126-DRI-11-006
SAFETY COMPLIANCE TESTING FOR FMVSS 126
Electronic Stability Control Systems

Chrysler Group LLC
2012 Fiat 500
NHTSA No. CC0501

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

12 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
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Prepared By: Brian K. Kebschull

Approved By:

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16. Abstract A test was conducted on a 2012 Fiat 500 , NHTSA No. CC0501, in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP-126-02 for the determination of FMVSS 126 compliance. Test failures identified were as follows: None			
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1.0 PURPOSE OF COMPLIANCE TEST

The purpose of this test is to determine if the test vehicle, a 2012 Fiat 500, meets the minimum equipment and performance requirements stated in Federal Motor Vehicle Safety Standard (FMVSS) 126, "Electronic Stability Control Systems."

2.0 TEST PROCEDURE AND DISCUSSION OF RESULTS

Testing of the 2012 Fiat 500 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: *2012 Fiat 500*

NHTSA No. *CC0501* VIN: *3C3CFFAR2CT120020*

Vehicle Type: *Passenger Car* Manufacture Date: *5/11*

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: *2012 Fiat 500*

NHTSA No. *CC0501* Data Sheet Completion Date: *7/5/2011*

VIN *3C3CFFAR2CT120020* Manufacture Date: *5/11*

GVWR (kg): *1497* Front GAWR (kg): *850* Rear GAWR (kg): *810*

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

Odometer reading at time of inspection: *44 miles (70.4 km)*

DESIGNATED TIRE SIZE(S) FROM VEHICLE LABELING:

Front axle: *185/55R15* Rear axle: *185/55R15*

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

		Front Axle	Rear Axle
	Tire Manufacturer:	*Firestone*	*Firestone*
	Tire Model:	*Firehawk GT*	*Firehawk GT*
	Tire Size:	*185/55R15*	*185/55R15*
TIN	Left Front:	*V68X FHT 1411*	Right Front: *V68X FHT 1811*
	Left Rear:	*V68X FHT 1811*	Right Rear: *V68X FHT 1811*

Are installed tire sizes same as labeled tire sizes? *Yes*

If no, contact COTR for further guidance

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

[X] Two Wheel Drive (2WD) [X] Front Wheel Drive [ ] Rear Wheel Drive

[ ] All Wheel Drive (AWD)

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

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

[ ] Four Wheel Drive Low Gear (4WD Low)

[ ] Other (Describe)

3.0 TEST DATA (CONTD)

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

DRIVE CONFIGURATIONS AND MODES: (ex. default, performance, off)

(For each of the vehicle's drive configurations identify available operating modes)

Drive Configuration: *FWD*
Mode: *Default - ESC on*
Drive Configuration: *FWD*
Mode: *ESC Off (Partial)*
Drive Configuration:
Mode:

VEHICLE STABILITY SYSTEMS (Check applicable technologies):

List other systems:

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

REMARKS:

RECORDED BY: *P Broen* DATE RECORDED: *7/5/2011*
APPROVED BY: *J Lenkeit* DATE APPROVED: *7/6/2011*

3.0 TEST DATA (CONTD)

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

Vehicle: *2012 Fiat 500*

NHTSA No *CC0501* Data Sheet Completion Date: *6/28/2011*

ESC SYSTEM IDENTIFICATION

Manufacturer/Model *Bosch System 8*

ESC SYSTEM HARDWARE (Check applicable hardware)

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

List other Components: _____

ESC OPERATIONAL CHARACTERISTICS

System is capable of generating brake torque at each wheel — X Yes (Pass) / ___ No (Fail)
Brief explanation: *Hydraulic modulator controls brake torque at each wheel individually*

System is capable of determining yaw rate — X Yes (Pass) / ___ No (Fail)
Brief explanation: *Yaw rate is measured directly using yaw rate sensor*

System is capable of monitoring driver steering input — X Yes (Pass) / ___ No (Fail)
Brief explanation: *Steering angle is measured directly*

System is capable of estimating side slip or side slip derivative — X Yes (Pass) / ___ No (Fail)
Brief explanation: *Estimates side slip from measured yaw rate and Ackerman yaw rate (steering angle and speed)*

3.0 TEST DATA (CONTD)

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

ESC OPERATIONAL CHARACTERISTICS (continued)

System is capable of modifying engine torque during ESC activation. Method used to modify torque: *Engine management ECU controls engine torque*

X Yes (Pass)
___ No (Fail)

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

Speed system becomes active: *14 km/h*

X Yes (Pass)
___ No (Fail)

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

X Yes (Pass)
___ No (Fail)

Driving phases during which ESC is capable of activation:
All phases of driving

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: *P Broen* DATE RECORDED: *6/28/2011*
APPROVED BY: *B Kebschull* DATE APPROVED: *8/17/2011*

3.0 TEST DATA (CONTD)

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

Vehicle: *2012 Fiat 500*

NHTSA No. *CC0501* Data Sheet completion date: *7/7/2011*

ESC Malfunction Telltale

Vehicle is equipped with malfunction telltale? *Yes*

Telltale Location: *Right side of the instrument cluster*

Telltale Color: *Yellow*

Telltale symbol or abbreviation used

or **ESC**

[ ] Vehicle uses this symbol

[X] Vehicle uses this abbreviation

[ ] Neither symbol or abbreviation is used

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

Is telltale part of a common space? *No*

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

If yes explain telltale operation during ESC activation:

Telltale flashes on and off during ESC activation

3.0 TEST DATA (CONTD)

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

"ESC OFF" Telltale (if provided)

Vehicle is equipped with "ESC OFF" telltale? *Yes*

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

Telltale Location: *Right side of the instrument cluster*

Telltale Color: *Yellow*

Telltale symbol or abbreviation used

or **ESC OFF**

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

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

Is telltale part of a common space? *No*

DATA INDICATES COMPLIANCE ***Yes***

(Vehicle is compliant if equipped with a malfunction telltale)

Remarks: *Turning ESC off only partially disables ESC Functionality.*

RECORDED BY: *P Broen* DATE RECORDED: *7/7/2011*

APPROVED BY: *J Lenkeit* DATE APPROVED: *7/8/2011*

3.0 TEST DATA (CONTD)

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

Vehicle: *2012 Fiat 500*

NHTSA No. *CC0501* Data Sheet completion date: *7/8/2011*

"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)

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

Identify each control location, labeling and selectable modes.

First Control: Location *To the right of the gear shift lever*
Labeling *ESC Off*
Modes *ESC off (partial deactivation)*

Second Control: Location ____
Labeling ____
Modes ____

Identify standard or default drive configuration *FWD*

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

N/A

3.0 TEST DATA (CONTD)

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

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

Control Mode	"ESC Off" telltale illuminates upon activation of control? (Yes/No)	"ESC Off" telltale extinguishes upon cycling ignition? (Yes/No)
NA		

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

__X__ NA ____ Yes ____ No

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

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

Ancillary Control: System *NA*

Control Description _____

Labeling _____

Ancillary Control: System _____

Control Description _____

Labeling _____

Ancillary Control: System _____

Control Description _____

Labeling _____

3.0 TEST DATA (CONTD)

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

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

Ancillary Control	Control Activates "ESC Off" Telltale? (Yes/No)	Warnings or Messages Provided
NA		

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)
NA	

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

___ Yes ___ No (Fail) X NA

DATA INDICATES COMPLIANCE: PASS

Remarks:

RECORDED BY: *P Broen* DATE RECORDED: *7/8/2011*
APPROVED BY: *B Kebschull* DATE APPROVED: *7/7/2011*

3.0 TEST DATA (CONTD)

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

Vehicle: *2012 Fiat 500*

NHTSA No. *CC0501* Data Sheet completion date: *7/7/2011*

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

Peak Friction Coefficient (at least 0.9) *0.934*

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 *230* kPa Rear Axle *210* kPa

Actual; LF *230* kPa RF *230* kPa

LR *210* kPa RR *210* kPa

Vehicle Dimensions: Front Track Width *141.6* cm Wheelbase *230.1* cm

Rear Track Width *140.3* cm

Vehicle Weight Ratings: GAWR Front *850* kg GAWR Rear *810* kg

Unloaded Vehicle Weight (UVW):

Front Axle *725.3* kg Left Front *376.0* kg Right Front *349.3* kg

Rear Axle *386.0* kg Left Rear *191.9* kg Right Rear *194.1* kg

Total UVW *1111.3* kg

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

Calculated baseline weight (UVW + 73kg) *1184.3* kg

Outrigger size required ("Standard" or "Heavy") *None*

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 *NA* kg Left front *NA* kg Right front *NA* kg

Rear axle *NA* kg Left rear *NA* kg Right rear *NA* kg

Total UVW with outriggers *NA* kg

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

Front axle *792.0* kg Left front *414.6* kg Right front *377.4* kg

Rear axle *461.4* kg Left rear *240.0* kg Right rear *221.4* kg

Vehicle Weight *1253.4* kg

Ballast Required =	[Total UVW with Outriggers (if applicable)]		+ *168*	kg	- [Loaded Weight w/Driver and Instrumentation)]	
=	*1111.3*	kg	+ *168*	kg	- 1253.4	kg

= *25.9* kg

Total Loaded Vehicle Weight w/Driver and Instrumentation and Ballast

Front axle *799.7* kg Left front *415.5* kg Right front *384.2* kg

Rear axle *479.4* kg Left rear *244.9* kg Right rear *234.5* kg

Total UVW *1279.1* kg

3.0 TEST DATA (CONTD)

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

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

x-distance (longitudinal)	Point of reference is the front axle centerline. (Positive from front axle toward rear of vehicle.)
y-distance (lateral)	Point of reference is the vehicle centerline. (Positive from the center toward the right.)
z-distance (vertical)	Point of reference is the ground plane. (Positive from the ground up.)

Locations:

	Center of Gravity				Inertial Sensing System			
x-distance	*34.0*	in	*86.2*	cm	*60.7*	in	*154.2*	cm
y-distance	*-0.9*	in	*-2.3*	cm	*0.0*	in	*0.1*	cm
z-distance	*22.3*	in	*56.7*	cm	*16.9*	in	*42.9*	cm
Roof Height					*58.8*	in	*149.3*	cm
Distance between ultrasonic sensors					*77.5*	in	*196.9*	cm

Remarks:

RECORDED BY: *P Broen* DATE RECORDED: *7/7/2011*
APPROVED BY: *J Lenkeit* DATE APPROVED: *7/8/2011*

3.0 TEST DATA (CONTD)

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

Vehicle: *2012 Fiat 500*

NHTSA No. *CC0501*

Measured tire pressure: LF *247* kPa RF *241* kPa

LR *220* kPa RR *217* kPa

Wind Speed *2* 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)) *30.4* °C

Brake Conditioning Time: *10:18:00 AM* Date: *7/7/2011*

56 km/h (35 mph) Brake Stops

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

Observed deceleration range (0.5g target) *0.5 - 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 *0.9-1.0* g

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

Duration of cool down period (5 minutes min.) *5* Minutes

3.0 TEST DATA (CONTD)

Data Sheet 6 (Page 2 of 3)
BRAKE AND TIRE CONDITIONING

Tire Conditioning series No. 1 Time: *10:40:00 AM* Date: *7/7/2011*

Measured cold tire pressure LF *255* kPa RF *256* kPa

LR *232* kPa RR *222* kPa

Wind Speed *2.5* m/s (10 m/sec (22 mph) max for passenger cars; 5m/sec (11 mph) max for MPVs and trucks)

Ambient Temperature (7°C (45°F) - 40°C (104°F)) *32*°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	3	56 ± 2 (35 ± 1)	*60*	0.5 - 0.6	*0.45*
2	4	56 ± 2 (35 ± 1)	*70*	0.5 - 0.6	*0.5*
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:
70 **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	*5-7*	56 ± 2 (35 ± 1)	*70* (cycles 1-10)	0.5 - 0.6	*0.5*
4	*8*	56 ± 2 (35 ± 1)	*70* (cycles 1-9)	0.5 - 0.6	*0.5*
			140 (cycle10)*	NA	*0.8*

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

3.0 TEST DATA (CONTD)

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

Tire Conditioning series No. 2 Time: *1:28:00 PM* Date: *7/7/2011*

Measured cold tire pressure LF *253* kPa RF *258* kPa

LR *232* kPa RR *222* kPa

Wind Speed *1.3* 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)) *36* °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:

70 **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	*18-20*	56 ± 2 (35 ± 1)	*70* (cycles 1-10)	0.5 - 0.6	*0.5*
4	*21*	56 ± 2 (35 ± 1)	*70* (cycles 1-9)	0.5 - 0.6	*0.5*
			140 (cycle 10)*	NA	*0.8*

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

Remarks:

RECORDED BY: *P Broen* DATE RECORDED: *7/7/2011*

APPROVED BY: *J Lenkeit* DATE APPROVED: *7/11/2011*

3.0 TEST DATA (CONTD)

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

Vehicle: *2012 Fiat 500*

NHTSA No. *CC0501*

Measured tire pressure: LF *246* kPa RF *246* kPa

LR *231* kPa RR *216* kPa

Wind Speed *5* 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 *FWD*

Selected Mode: *Default - ESC on*

Preliminary Left Steer Maneuver:

Lateral Acceleration measured at 30 degrees steering wheel angle

$a_{y,30degrees}$ = *0.4* 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} = *41.2* degrees (@.55g)

δ_{sis} = *40* degrees (rounded)

Steering Wheel Angle at Corrected 0.3g Lateral Acceleration:

Maneuver	Initial Steer Direction	Time Clock (5 min max between runs)	Steering Wheel Angle to nearest 0.1° (degrees)	Data Run	Good/NG
1	Left	*12:55*		*11*	*NG*
2	Left	*12:59*	*-26.8*	*12*	*Good*
3	Left	*13:02*	*-25.7*	*13*	*Good*
4	Left	*13:06*	*-26.4*	*14*	*Good*
5	Left				
1	Right	*13:08*	*24.5*	*15*	*Good*
2	Right	*13:12*	*24.2*	*16*	*Good*
3	Right	*13:13*	*24.2*	*17*	*Good*
4	Right				
5	Right				

3.0 TEST DATA (CONTD)

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

Average Overall Steering Wheel Angle:

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

$\delta_{0.3\ g,\ overall}$ = *25.3* degrees

[to nearest 0.1 degree]

Remarks:

RECORDED BY: *P Broen* DATE RECORDED: *7/7/2011*
APPROVED BY: *J Lenkeit* DATE APPROVED: *7/11/2011*

3.0 TEST DATA (CONTD)

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

Vehicle: *2012 Fiat 500*

NHTSA No. *CC0501* Data sheet completion date: *7/7/2011*

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: *FWD*

Selected Mode: *Default - ESC on*

Overall steering wheel angle ($\delta_{0.3\ g,\ overall}$) *25.3* 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
24	15:10	1.5	38	13.01	-0.19	-0.04	-1.45	PASS	-0.32	PASS
25	15:15	2.0	51	16.89	-0.25	-0.21	-1.50	PASS	-1.26	PASS
26	15:20	2.5	63	20.22	-0.38	-0.27	-1.90	PASS	-1.34	PASS
27	15:24	3.0	76	23.60	-0.36	-0.16	-1.52	PASS	-0.66	PASS
28	15:28	3.5	89	27.56	-0.10	-0.02	-0.38	PASS	-0.06	PASS
29	15:31	4.0	101	31.66	0.04	-0.09	0.13	PASS	-0.27	PASS
30	15:35	4.5	114	36.20	-0.09	-0.05	-0.25	PASS	-0.12	PASS
31	15:39	5.0	127	36.81	-0.38	-0.26	-1.04	PASS	-0.69	PASS
32	15:43	5.5	139	40.69	-0.25	-0.21	-0.62	PASS	-0.52	PASS
33	15:47	6.0	152	26.27	-0.08	-0.11	-0.32	PASS	-0.42	PASS
34	15:51	6.5	164	29.52	-0.25	-0.25	-0.84	PASS	-0.83	PASS
35	15:55	7.0	177	41.29	-0.29	-0.17	-0.70	PASS	-0.41	PASS
36	16:00	7.5	190	36.55	-0.15	0.05	-0.42	PASS	0.14	PASS
37	16:04	8.0	202	43.35	-0.28	-0.14	-0.64	PASS	-0.33	PASS
38	16:08	8.5	215	44.67	-0.12	-0.13	-0.27	PASS	-0.29	PASS
39	16:13	9.0	228	47.56	0.18	0.13	0.38	PASS	0.27	PASS
40	16:18	9.5	240	46.24	0.18	0.17	0.38	PASS	0.38	PASS
41	16:22	10.0	253	46.01	-0.16	-0.21	-0.35	PASS	-0.46	PASS
42	16:27	10.5	266	41.57	0.32	0.27	0.76	PASS	0.65	PASS
43	16:31	-	270	42.17	0.11	0.01	0.27	PASS	0.03	PASS

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

3.0 TEST DATA (CONTD)

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

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

Maneuver #	Clock Time (1.5 – 5.0 min max between runs)	Commanded Steering Wheel Angle[1]		Yaw Rates (degrees/sec)			YRR at 1.0 sec after COS [< 35%]		YRR at 1.75 sec after COS [< 20%]	
		Scalar (* $\delta_{0.3\,g}$)	Angle (degrees)	$\dot{\psi}_{Peak}$	$\dot{\psi}_{1.0sec}$	$\dot{\psi}_{1.75sec}$	%	Pass/Fail	%	Pass/Fail
44	16:36	1.5	38	-12.87	0.20	0.19	-1.57	*PASS*	-1.45	*PASS*
45	16:41	2.0	51	-17.63	0.19	0.03	-1.09	*PASS*	-0.15	*PASS*
46	16:43	2.5	63	-21.00	0.38	0.20	-1.79	*PASS*	-0.97	*PASS*
47	16:46	3.0	76	-25.69	0.29	0.22	-1.13	*PASS*	-0.87	*PASS*
48	16:48	3.5	89	-29.72	0.22	0.03	-0.73	*PASS*	-0.09	*PASS*
49	16:51	4.0	101	-33.49	0.18	0.09	-0.53	*PASS*	-0.25	*PASS*
50	16:54	4.5	114	-38.34	0.29	0.07	-0.77	*PASS*	-0.19	*PASS*
51	16:57	5.0	127	-22.96	0.12	-0.09	-0.52	*PASS*	0.37	*PASS*
52	17:00	5.5	139	-42.41	0.32	0.31	-0.75	*PASS*	-0.74	*PASS*
53	17:02	6.0	152	-43.21	0.43	0.33	-1.00	*PASS*	-0.75	*PASS*
54	17:05	6.5	164	-32.10	0.49	0.41	-1.53	*PASS*	-1.29	*PASS*
55	17:08	7.0	177	-34.72	0.40	0.33	-1.15	*PASS*	-0.95	*PASS*
56	17:10	7.5	190	-36.14	0.16	0.18	-0.44	*PASS*	-0.49	*PASS*
57	17:13	8.0	202	-40.65	-0.13	-0.11	0.33	*PASS*	0.26	*PASS*
58	17:15	8.5	215	-38.12	0.30	0.23	-0.78	*PASS*	-0.60	*PASS*
59	17:18	9.0	228	-40.80	-0.11	-0.09	0.27	*PASS*	0.22	*PASS*
60	17:21	9.5	240	-42.64	0.01	0.02	-0.02	*PASS*	-0.04	*PASS*
61	17:24	10.0	253	-46.96	-0.07	-0.13	0.14	*PASS*	0.28	*PASS*
62	17:26	10.5	266	-46.21	-0.12	-0.15	0.26	*PASS*	0.32	*PASS*
63	17:30	-	270	-44.81	-0.16	-0.26	0.35	*PASS*	0.58	*PASS*

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

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

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

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

3.0 TEST DATA (CONTD)

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

Responsiveness – Lateral Displacement

Maneuver #	Initial Steer Direction	Commanded Steering Wheel Angle (5.0*$\delta_{0.3\ g,\ overall}$ or greater)		Calculated Lateral Displacement[1]	
		Scalar *$\delta_{0.3\ g}$	Angle (degrees)	Distance (m)	Pass/Fail
31	Counter Clockwise	5.0	127	-3.1	*PASS*
32	Counter Clockwise	5.5	139	-3.2	*PASS*
33	Counter Clockwise	6.0	152	-3.2	*PASS*
34	Counter Clockwise	6.5	164	-3.3	*PASS*
35	Counter Clockwise	7.0	177	-3.2	*PASS*
36	Counter Clockwise	7.5	190	-3.3	*PASS*
37	Counter Clockwise	8.0	202	-3.3	*PASS*
38	Counter Clockwise	8.5	215	-3.2	*PASS*
39	Counter Clockwise	9.0	228	-3.3	*PASS*
40	Counter Clockwise	9.5	240	-3.5	*PASS*
41	Counter Clockwise	10.0	253	-3.4	*PASS*
42	Counter Clockwise	10.5	266	-3.3	*PASS*
43	Counter Clockwise	-	270	-3.2	*PASS*
51	Clockwise	5.0	127	2.9	*PASS*
52	Clockwise	5.5	139	3.0	*PASS*
53	Clockwise	6.0	152	3.1	*PASS*
54	Clockwise	6.5	164	3.1	*PASS*
55	Clockwise	7.0	177	3.2	*PASS*
56	Clockwise	7.5	190	3.1	*PASS*
57	Clockwise	8.0	202	3.2	*PASS*
58	Clockwise	8.5	215	3.2	*PASS*
59	Clockwise	9.0	228	3.2	*PASS*
60	Clockwise	9.5	240	3.2	*PASS*
61	Clockwise	10.0	253	3.3	*PASS*
62	Clockwise	10.5	266	3.3	*PASS*
63	Clockwise	-	270	3.2	*PASS*

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

DATA INDICATES COMPLIANCE: ☑ PASS ☐ FAIL

Remarks:

RECORDED BY: *P Broen* DATE RECORDED: *7/7/2011*

APPROVED BY: *B Kebschull* DATE APPROVED: *7/7/2011*

3.0 TEST DATA (CONTD)

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

Vehicle: *2012 Fiat 500*
NHTSA No. *CC0501* Data Sheet Completion Date: *7/7/2011*

TEST 1

MALFUNCTION SIMULATION: Describe method of malfunction simulation

Removed pump supply 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 1 DATA INDICATES COMPLIANCE: ***PASS***

Remarks: *Telltale illuminated immediately after ignition following removal of fuse. Yellow "ABS" and red "BRAKE" telltales also illuminated. Central (common area) display indicated, "EBD Failure", "ESC Unavailable", "ABS Unavailable", and "Hill Start Unavailable" in sequential messages. Upon re-installing the fuse and following ignition, the ESC malfunction telltale did not immediately extinguish. However, it did extinguish when the vehicle was accelerated to approximately 10 mph. (The other aforementioned telltales also extinguished).*

RECORDED BY: *B Kebschull* DATE RECORDED: *7/7/2011*

APPROVED BY: *J Lenkeit* DATE APPROVED *7/11/2011*

3.0 TEST DATA (CONTD)

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

Vehicle: *2012 Fiat 500*

NHTSA No. *CC0501* Data Sheet Completion Date: *7/7/2011*

TEST 2

MALFUNCTION SIMULATION: Describe method of malfunction simulation

Removed 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 2 DATA INDICATES COMPLIANCE: FAIL

Remarks: *Telltale did not illuminate immediately after ignition following disconnection of sensorconnector. However, it illuminated when the vehicle was accelerated to approximately 10 mph. Yellow "ABS" telltale also illuminated. Central (common area) display indicated "ESC Unavailable" and "ABS Unavailable" in sequential messages. Upon reconnecting the sensor and following ignition, the ESC malfunction telltale did not immediately extinguish. However, it did extinguish when it was accelerated to approximately 10 mph. (The "ABS telltale also extinguished).*

RECORDED BY: *B Kebschull* DATE RECORDED: *7/7/2011*

APPROVED BY: *J Lenkeit* DATE APPROVED *7/11/2011*

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)

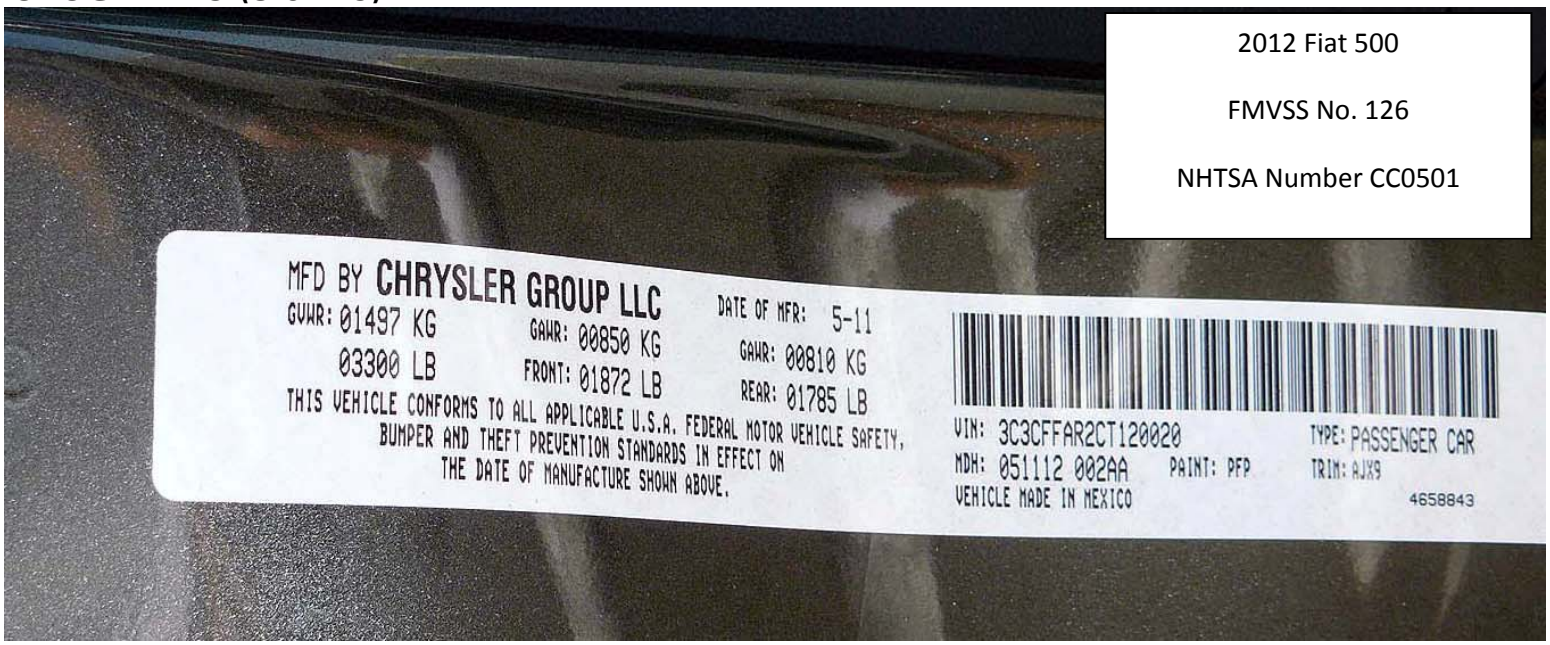


Figure 5.3. Vehicle Certification Label

5.0 PHOTOGRAPHS (4 of 15)

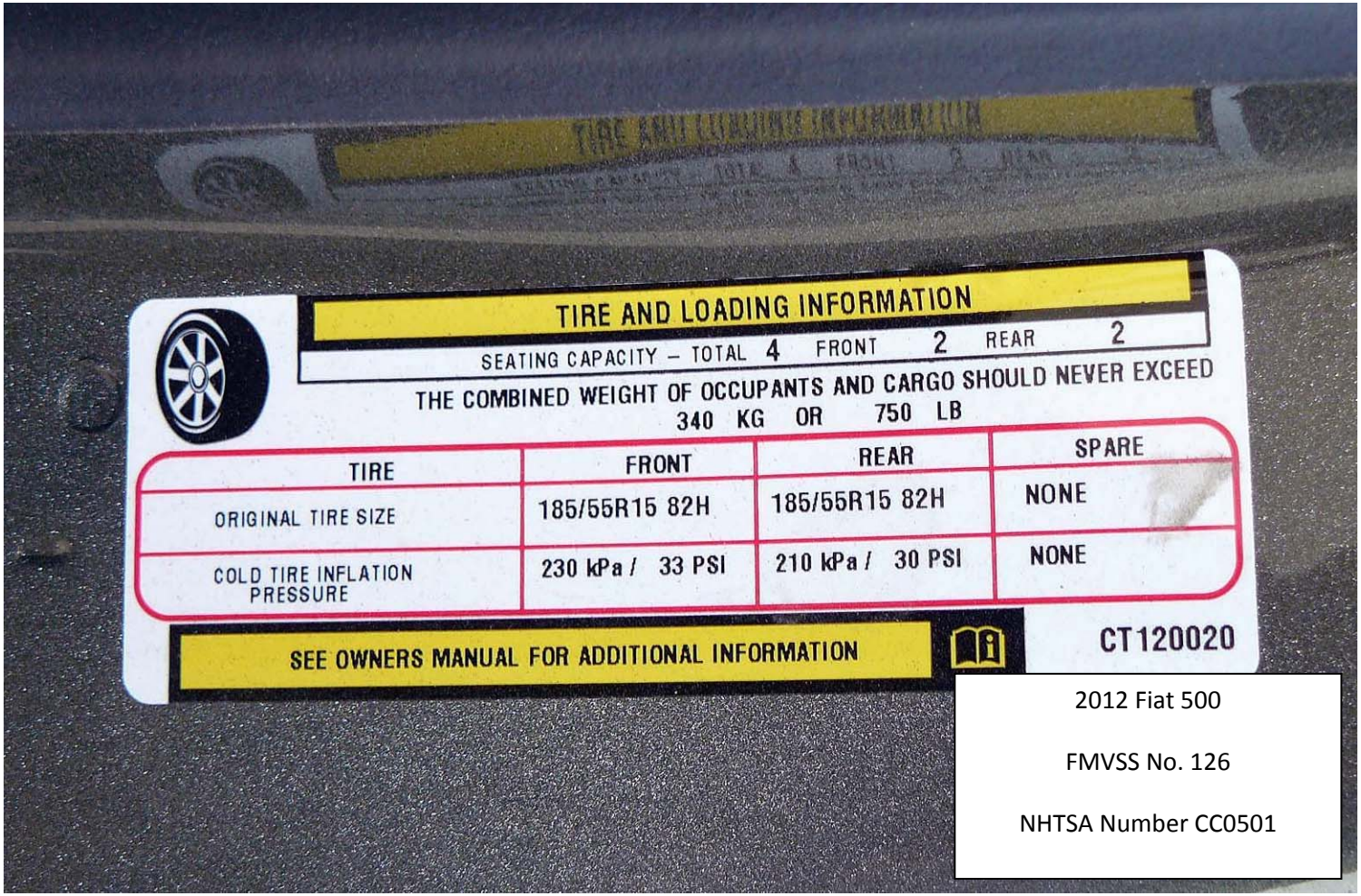


Figure 5.4. Vehicle Placard

5.0 PHOTOGRAPHS (5 of 15)

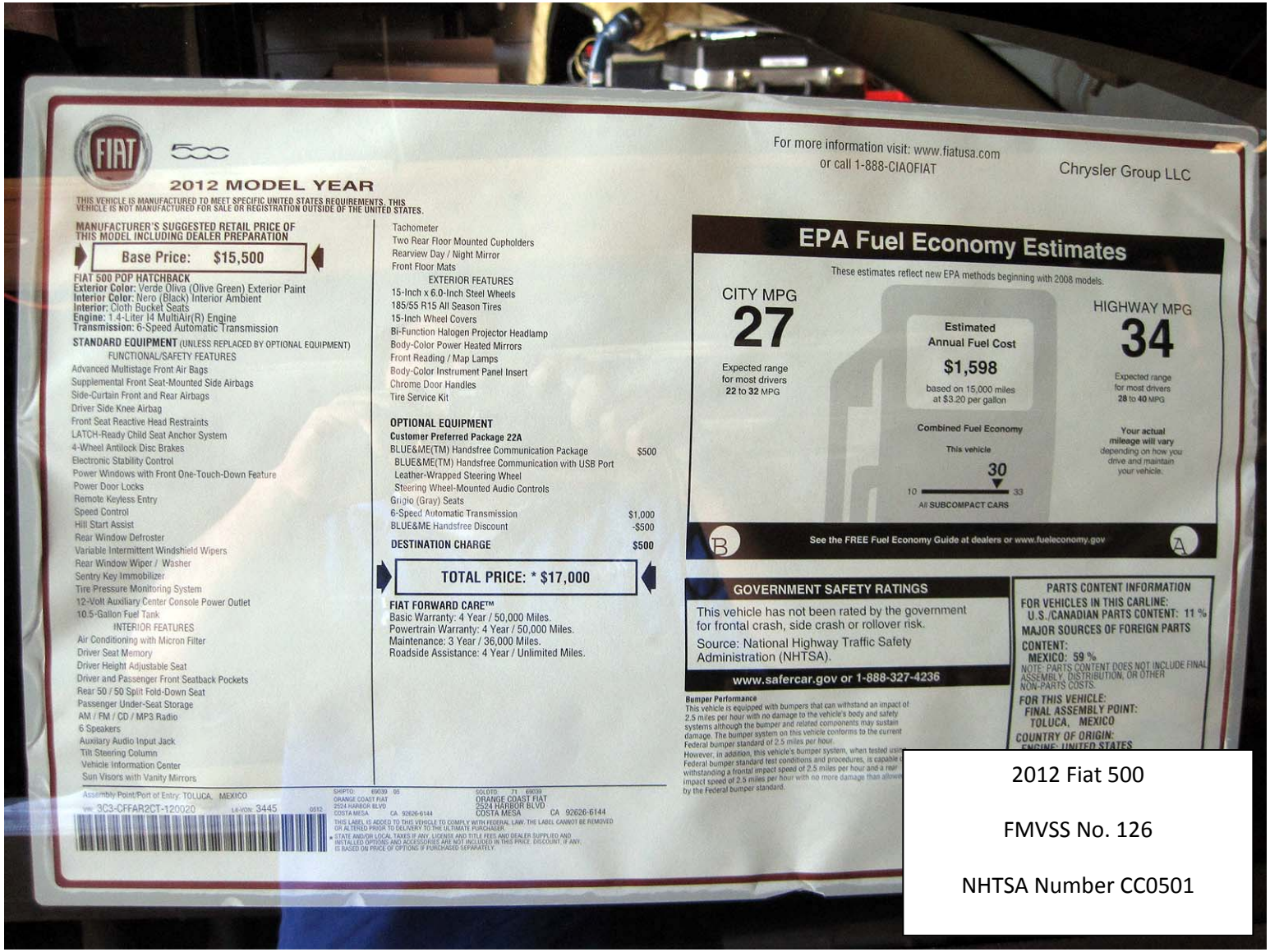


Figure 5.5. Window Sticker (Monroney Label)

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)

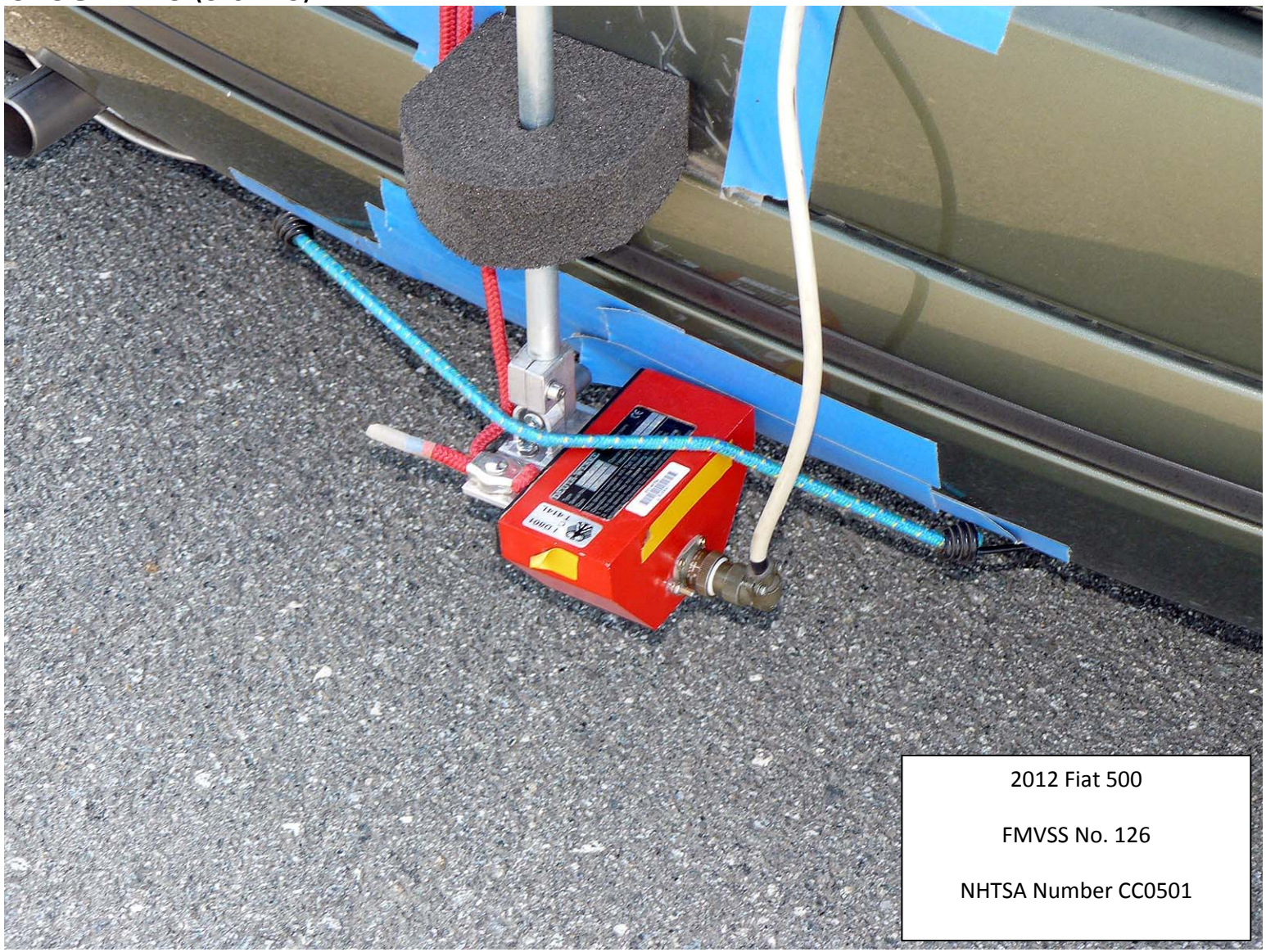


Figure 5.9. Rear Mounted Speed Sensor

5.0 PHOTOGRAPHS (10 of 15)

Figure 5.10. Steering Controller and Data Acquisition Computer

5.0 PHOTOGRAPHS (11 of 15)

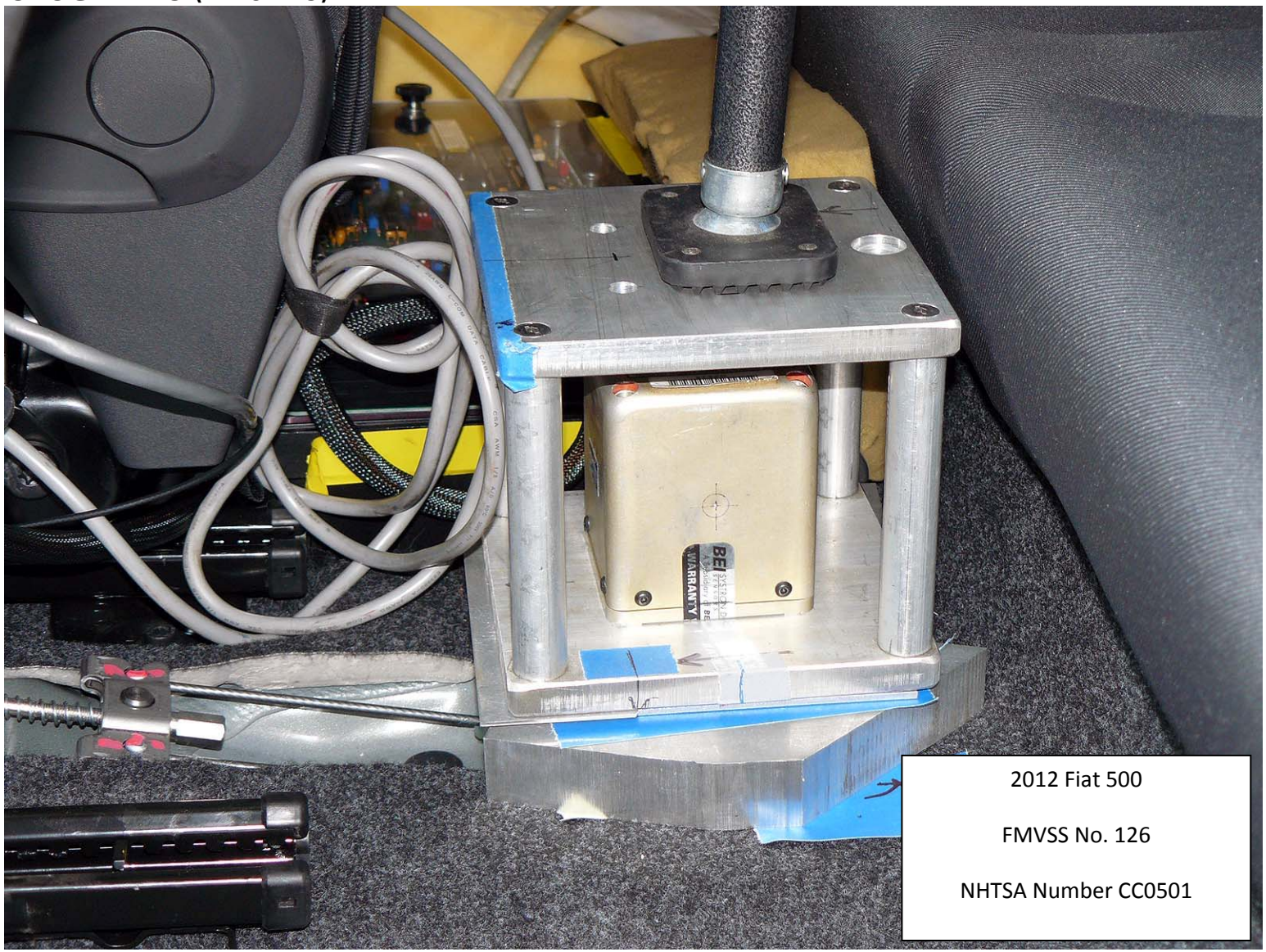


Figure 5.11. Inertial Measurement Unit Mounted in Vehicle

5.0 PHOTOGRAPHS (12 of 15)

Figure 5.12. Brake Pedal Load Cell

5.0 PHOTOGRAPHS (13 of 15)

Figure 5.13. Telltale for ESC Malfunction and ESC Activation

5.0 PHOTOGRAPHS (14 of 15)

Figure 5.14. Telltale for ESC Off

5.0 PHOTOGRAPHS (15 of 15)

Figure 5.15. ESC Off Control Switch

6.0 DATA PLOTS (1 of 4)

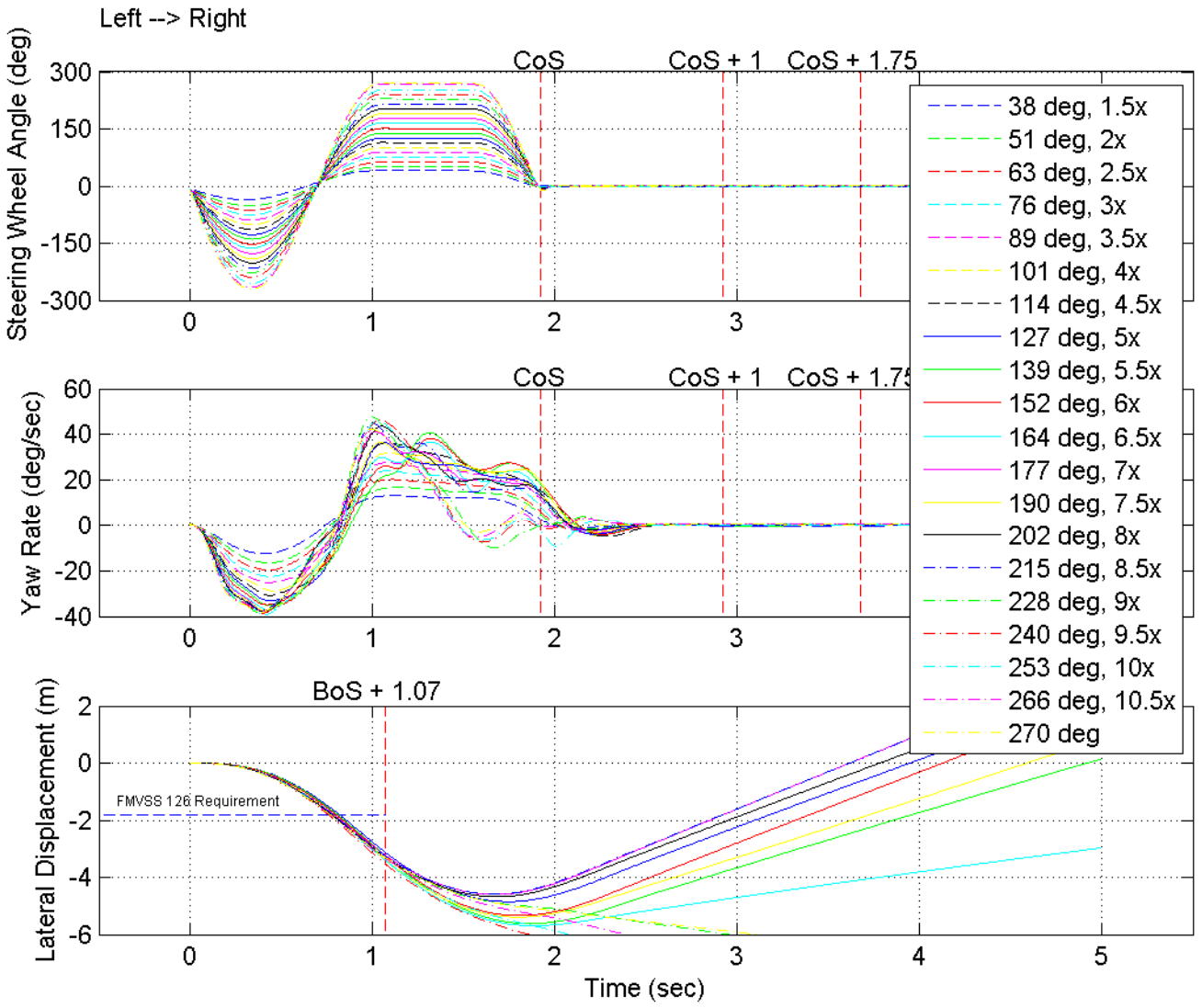


Figure 6.1. Steering Wheel Angle, Yaw Rate and Lateral Displacement for L-R Series

6.0 DATA PLOTS (2 of 4)

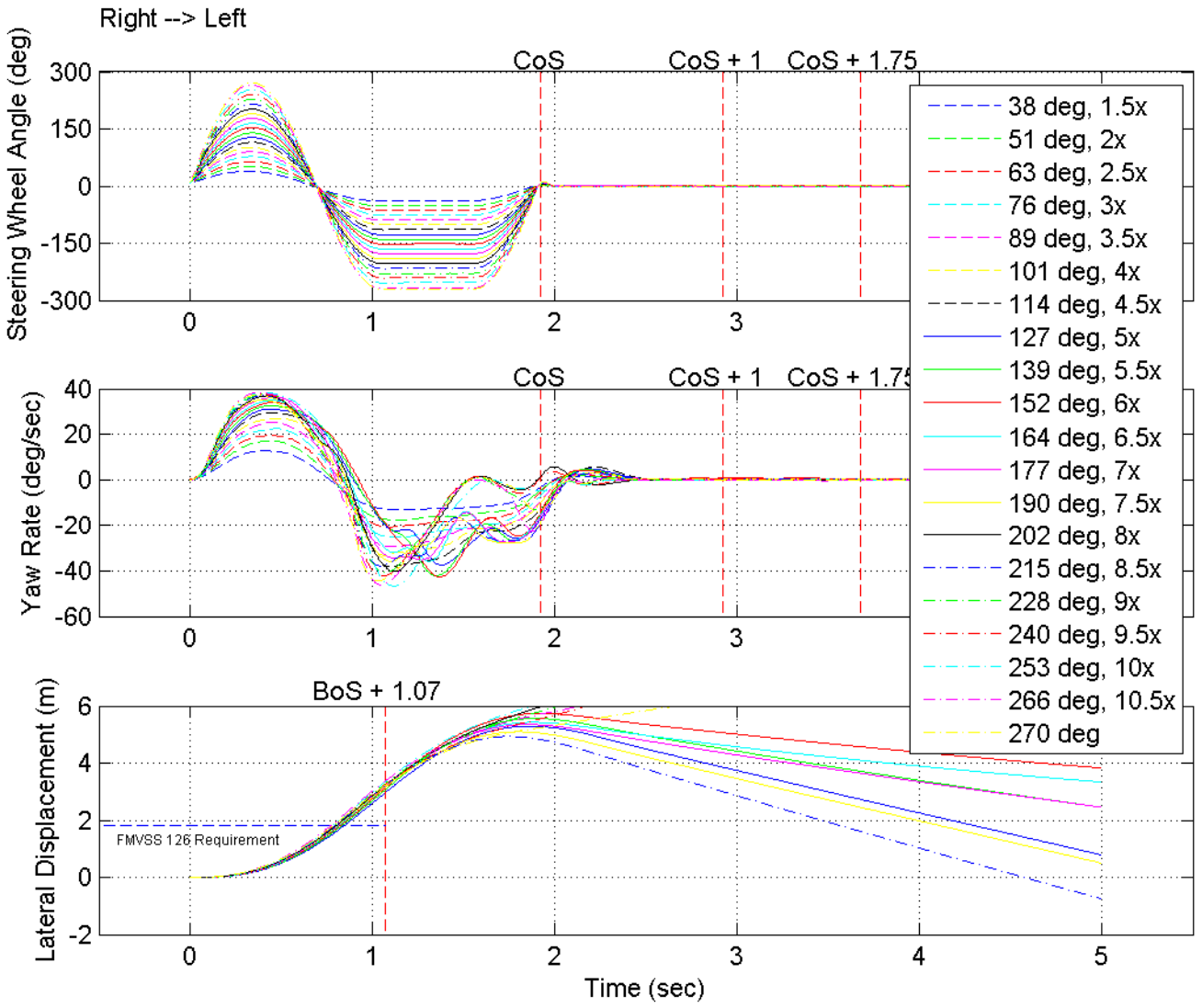


Figure 6.2. Steering Wheel Angle, Yaw Rate and Lateral Displacement for R-L Series

6.0 DATA PLOTS (3 of 4)

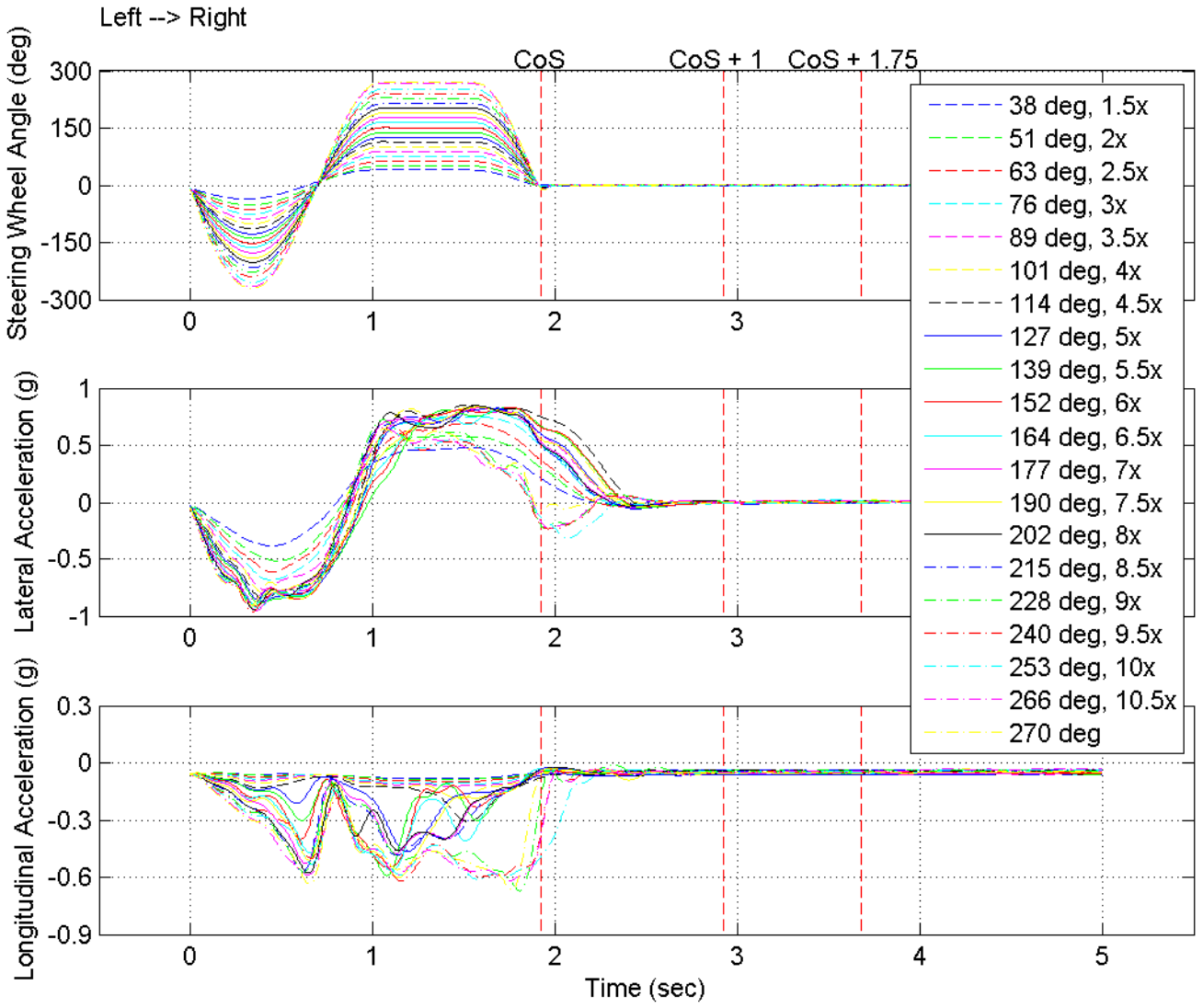


Figure 6.3. Steering Wheel Angle, Lateral Acceleration and Longitudinal Acceleration for L-R Series

6.0 DATA PLOTS (4 of 4)

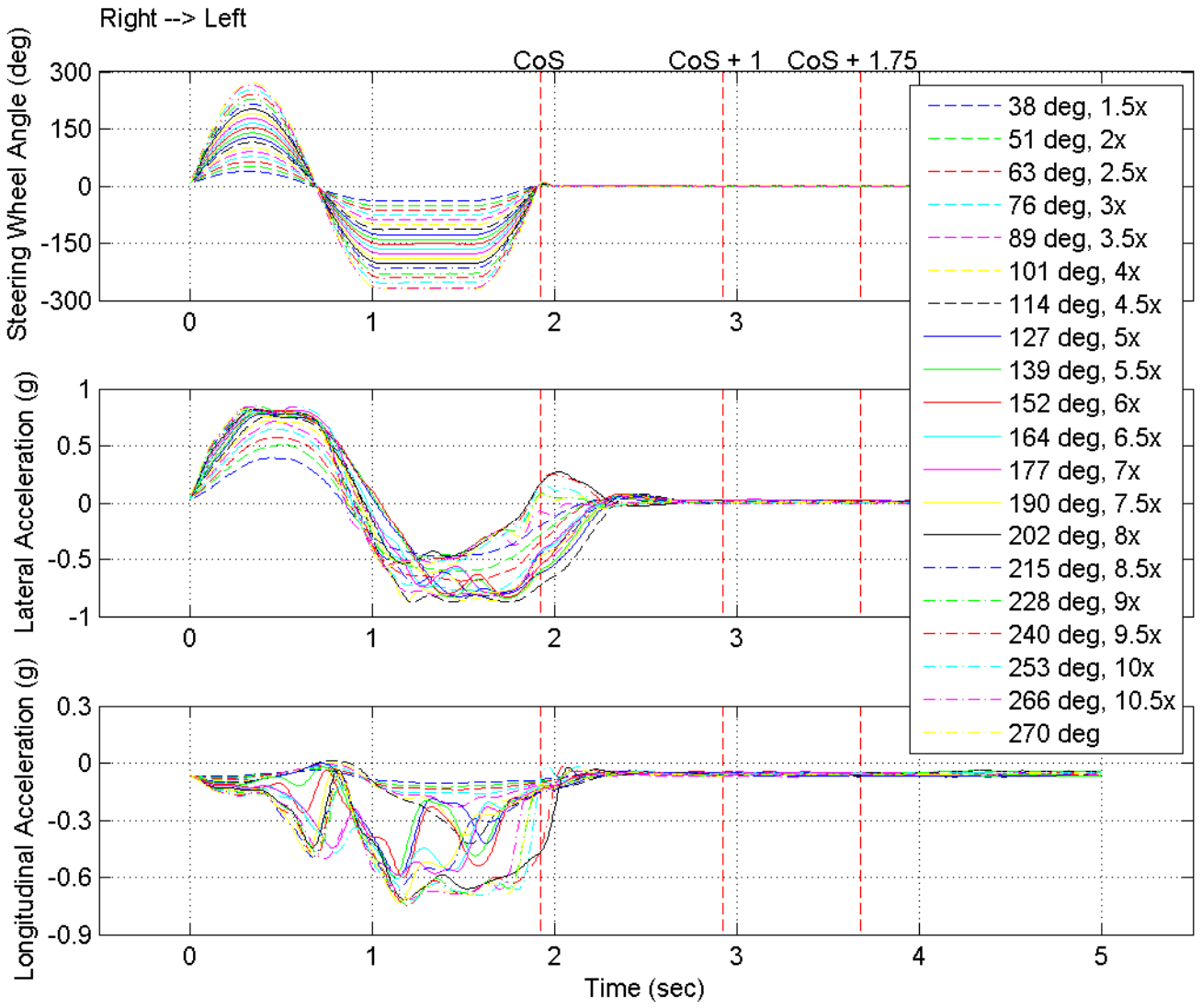


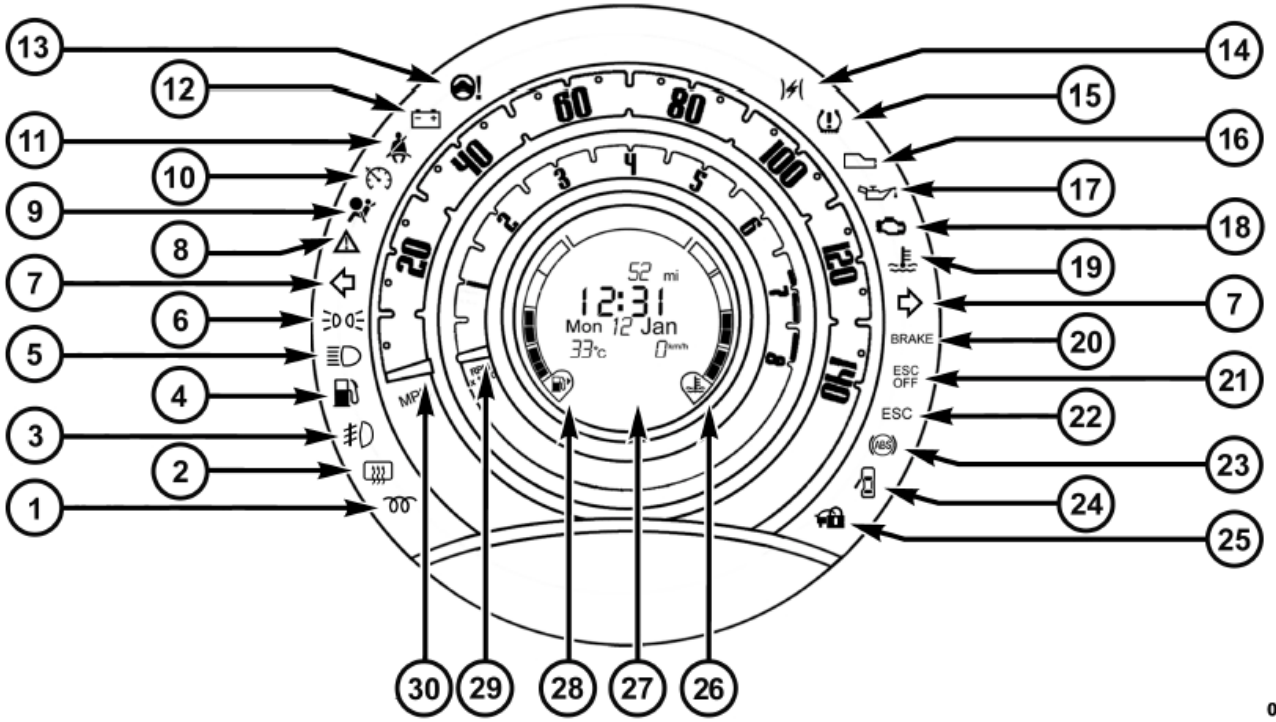
Figure 6.4. Steering Wheel Angle, Lateral Acceleration and Longitudinal Acceleration for R-L Series

7.0 OTHER DOCUMENTATION

7.1 OWNER'S MANUAL PAGES
7.2 VEHICLE ARRIVAL CONDITION REPORT
7.3 VEHICLE COMPLETION CONDITION REPORT
7.4 SINE WITH DWELL TEST RESULTS
7.5 SLOWLY INCREASING STEER TEST RESULTS
7.6 INERTIAL SENSING SYSTEM LOCATION COORDINATES

7.1 OWNER'S MANUAL PAGES

INSTRUMENT CLUSTER



21. Electronic Stability Control OFF (ESC OFF) Indicator Light

ESC OFF This light indicates the Electronic Stability Control system (ESC) has been turned off by the driver.

22. Electronic Stability Control (ESC) Activation / Malfunction Indicator Light

ESC The ESC Activation/Malfunction Indicator Light in the instrument cluster will come on for four seconds when the ignition switch is turned to the ON/RUN position. If the ESC Activation/Malfunction Indicator Light comes on continuously with the engine running, a malfunction has been detected in the ESC system. If this light remains on, see your authorized dealer as soon as possible to have the problem diagnosed and corrected.

NOTE:

- The ESC Off Indicator Light and the ESC Activation/ Malfunction Indicator Light come on momentarily each time the ignition switch is turned to ON/RUN.
- Each time the ignition is turned to ON/RUN, the ESC system will be on, even if it was turned off previously.

23. Anti-Lock Brake (ABS) Light

This light monitors the Anti-Lock Brake System (ABS). The light will turn on when the ignition switch is turned to the ON/RUN position and may stay on for as long as four seconds.

If the ABS light remains on or turns on while driving, it indicates that the Anti-Lock portion of the brake system is not functioning and that service is required. However, the conventional brake system will continue to operate normally if the BRAKE warning light is not on.

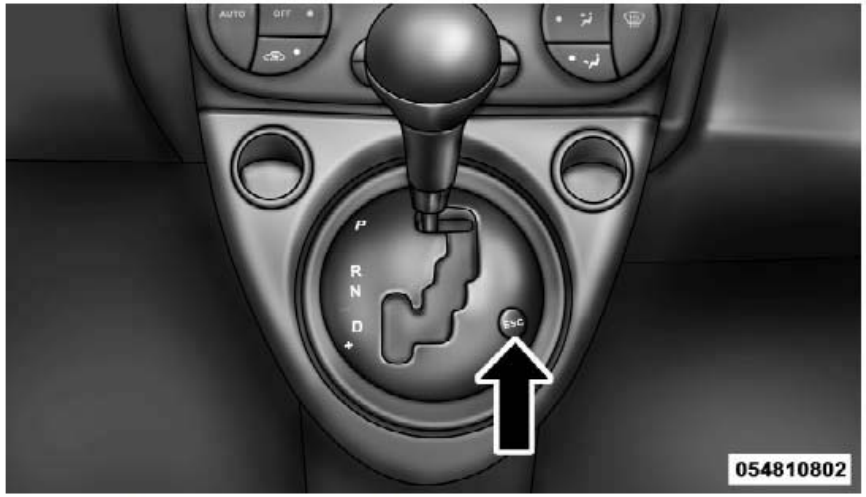
If the ABS light is on, the brake system should be serviced as soon as possible to restore the benefits of Anti-Lock brakes. If the ABS light does not turn on when the ignition switch is turned to the ON/RUN position, have the light inspected by an authorized dealer.

Electronic Stability Control (ESC)

This system enhances directional control and stability of the vehicle under various driving conditions. ESC corrects for oversteering or understeering of the vehicle by applying the brake of the appropriate wheel to assist in counteracting the oversteering or understeering condition. Engine power may also be reduced to help the vehicle maintain the desired path. ESC uses sensors in the vehicle to determine the vehicle path intended by the driver and compares it to the actual path of the vehicle. When the actual path does not match the intended path, ESC applies the brake of the appropriate wheel to assist in counteracting the oversteer or understeer condition.

- Oversteer - when the vehicle is turning more than appropriate for the steering wheel position.
- Understeer - when the vehicle is turning less than appropriate for the steering wheel position.

ESC Off Switch (Manual Transmission)



ESC Off Switch (Automatic Transmission)

ESC Operating Modes

The ESC system has two available operating modes.

Full On

This is the normal operating mode for ESC. Whenever the vehicle is started, the ESC system will be in On mode. This mode should be used for most driving situations. ESC should only be turned to Partial Off for specific reasons as noted below.

Partial Off

This mode is entered by momentarily pressing the ESC Off switch. This mode is intended to be used if the vehicle is in deep snow, sand or gravel conditions and more wheel spin than ESC would normally allow is required to gain traction.

To turn ESC on again, momentarily press the switch again. This will restore the normal ESC On mode of operation.

NOTE: To improve the vehicle's traction when driving with snow chains, or starting off in deep snow, sand or gravel, it may be desirable to switch to the Partial Off mode by pressing the switch. Once the situation requiring ESC to be switched to the Partial Off mode is overcome, turn ESC back on by momentarily pressing the switch. This may be done while the vehicle is in motion.

WARNING!

The Electronic Stability Control (ESC) cannot prevent the natural laws of physics from acting on the vehicle, nor can it increase the traction afforded by prevailing road conditions. ESC cannot prevent accidents, including those resulting from excessive speed in turns, driving on very slippery surfaces, or hydroplaning. Only a safe, attentive, and skillful driver can prevent accidents. The capabilities of an ESC equipped vehicle must never be exploited in a reckless or dangerous manner which could jeopardize the user's safety or the safety of others.

ESC Activation/Malfunction Indicator Light And ESC OFF Indicator Light

ESC

The ESC Activation/Malfunction Indicator Light in the instrument cluster will come on when the ignition switch is turned to the MAR (ACC/ON/RUN) position for four seconds. If the ESC Activation/Malfunction Indicator Light comes on continuously with the engine running, a malfunction has been detected in the ESC system. If this light remains on after several ignition cycles, and the vehicle has been driven several miles (kilometers) at speeds greater than 30 mph (48 km/h), see your authorized dealer as soon as possible to have the problem diagnosed and corrected.

The ESC Activation/Malfunction Indicator Light (located in the instrument cluster) starts to flash as soon as the tires lose traction and the ESC system becomes active. The ESC Activation/Malfunction Indicator Light also flashes when TCS is active. If the ESC Activation/Malfunction Indicator Light begins to flash during acceleration, ease up on the accelerator and apply as little throttle as possible. Be sure to adapt your speed and driving to the prevailing road conditions.

NOTE:

- The ESC Activation/Malfunction Indicator Light and the ESC OFF Indicator Light come on momentarily each time the ignition switch is turned ON.
- Each time the ignition is turned ON, the ESC system will be ON even if it was turned off previously.

ESC OFF The ESC OFF Indicator Light indicates the Electronic Stability Control (ESC) is off.

7.2 VEHICLE ARRIVAL CONDITION REPORT

CONTRACT NO.: *DTNH22-08-D-00098*
DATE: *7/5/11*

From: *Automotive Allies*

To: *Dynamic Research, Inc*

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

Vehicle VIN: *3C3CFFAR2CT120020* NHTSA NO.: *CC0501*
Model Year: *2012* Odometer Reading: *44* Miles
Make *Fiat* Body Style: *Passenger Car*
Model: *500* Body Color: *Green*
Manufacture Date: *5/11* Dealer: *Automotive Allies*
GVWR (kg/lb) *1497/3300* 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: *7/5/2011*

APPROVED BY: *B Kebschull* DATE APPROVED: *8/17/2011*

7.3 VEHICLE COMPLETION CONDITION REPORT

CONTRACT NO.: *DTNH22-08-D-00098*
DATE: *7/27/2011*

Vehicle VIN: *3C3CFFAR2CT120020* NHTSA NO.: *CC0501*
Model Year: *2012* Odometer Reading: *111* Miles
Make: *Fiat* Body Style: *Passenger Car*
Model: *500* Body Color: *Green*
Manufacture Date: *5/11* Dealer: *Automotive Allies*
GVWR (kg/lb) *1497 (3300)* Price: *Leased*

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

☒ THERE ARE NO DENTS OR OTHER INTERIOR OR EXTERIOR FLAWS

☒ THE VEHICLE HAS BEEN PROPERLY MAINTAINED AND IS IN RUNNING CONDITION

☒ THE GLOVE BOX CONTAINS AN OWNER'S MANUAL, WARRANTY DOCUMENT, CONSUMER INFORMATION, AND EXTRA SET OF KEYS

☒ PROPER FUEL FILLER CAP IS SUPPLIED ON THE TEST VEHICLE

REMARKS:

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

Explanation for equipment removal:

Test Vehicle Condition:

As delivered, like new

RECORDED BY: *J Lenkeit* DATE RECORDED: *7/27/2011*

APPROVED BY: *B Kebschull* DATE APPROVED: *7/29/2011*

7.4 SINE WITH DWELL TEST RESULTS

2012 Fiat 500
NHTSA No.: *CC0501*
Date of Test : *7/7/2011*
Date Created: *7/7/2011*

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	YRR175 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)
24	711	49.50	3.550	1091	5.448	847	4.228	-1.45	-0.19	1291	-0.32	-0.04	1441	13.01	937	-3.96	0.37	37.92	776	38.00
25	710	50.17	3.541	1091	5.447	847	4.227	-1.50	-0.25	1291	-1.26	-0.21	1441	16.89	939	-5.28	0.44	50.91	775	50.97
26	709	49.73	3.536	1091	5.446	847	4.226	-1.90	-0.38	1291	-1.34	-0.27	1441	20.22	932	-6.28	0.51	62.86	775	62.90
27	708	49.72	3.532	1090	5.445	847	4.226	-1.52	-0.36	1290	-0.66	-0.16	1440	23.60	925	-7.33	0.57	75.86	775	75.91
28	707	49.78	3.530	1090	5.445	847	4.226	-0.38	-0.10	1290	-0.06	-0.02	1440	27.56	924	-8.18	0.61	88.82	775	88.90
29	707	50.15	3.528	1090	5.445	846	4.225	0.13	0.04	1290	-0.27	-0.09	1440	31.66	926	-8.92	0.62	100.73	775	100.74
30	707	50.05	3.526	1090	5.445	846	4.225	-0.25	-0.09	1290	-0.12	-0.05	1440	36.20	925	-9.65	0.61	113.74	775	113.82
31	707	49.91	3.526	1091	5.446	847	4.226	-1.04	-0.38	1291	-0.69	-0.26	1441	36.81	918	-10.14	0.59	126.96	775	126.89
32	706	49.87	3.525	1091	5.446	847	4.226	-0.62	-0.25	1291	-0.52	-0.21	1441	40.69	970	-10.53	0.20	138.94	775	138.72
33	706	49.92	3.524	1090	5.445	846	4.225	-0.32	-0.08	1290	-0.42	-0.11	1440	26.27	921	-10.54	0.28	152.03	775	151.64
34	706	50.11	3.524	1091	5.446	847	4.226	-0.84	-0.25	1291	-0.83	-0.25	1441	29.52	918	-10.94	0.32	163.93	775	163.69
35	706	49.75	3.523	1090	5.445	847	4.226	-0.70	-0.29	1290	-0.41	-0.17	1440	41.29	911	-10.45	0.70	177.17	775	176.66
36	706	49.83	3.524	1090	5.445	847	4.227	-0.42	-0.15	1290	0.14	0.05	1440	36.55	916	-10.94	0.45	190.27	776	189.49
37	706	50.43	3.524	1090	5.445	847	4.227	-0.64	-0.28	1290	-0.33	-0.14	1440	43.35	917	-10.68	0.74	202.23	775	201.36
38	706	50.43	3.524	1090	5.444	847	4.227	-0.27	-0.12	1290	-0.29	-0.13	1440	44.67	908	-10.54	0.67	215.54	776	214.31
39	706	50.53	3.524	1090	5.444	847	4.227	0.38	0.18	1290	0.27	0.13	1440	47.56	907	-10.71	0.72	228.64	775	227.48
40	706	50.58	3.524	1090	5.443	847	4.227	0.38	0.18	1290	0.38	0.17	1440	46.24	916	-11.37	0.59	240.72	775	239.39
41	706	50.60	3.524	1090	5.443	847	4.227	-0.35	-0.16	1290	-0.46	-0.21	1440	46.01	913	-11.03	0.60	253.86	775	252.30
42	706	50.40	3.524	1090	5.442	847	4.227	0.76	0.32	1290	0.65	0.27	1440	41.57	908	-10.77	0.65	266.87	775	265.32
43	706	50.40	3.525	1090	5.443	847	4.227	0.27	0.11	1290	0.03	0.01	1440	42.17	907	-10.64	0.64	270.71	776	269.32

7.4 SINE WITH DWELL TEST RESULTS

2012 Fiat 500
NHTSA No.: *CC0501*
Date of Test : *7/7/2011*
Date Created: *7/7/2011*

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	YRR175 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)
44	711	50.07	3.548	1091	5.450	847	4.228	-1.57	0.20	1291	-1.45	0.19	1441	-12.87	940	4.24	-0.36	38.77	776	38.53
45	710	50.41	3.541	1091	5.448	847	4.228	-1.09	0.19	1291	-0.15	0.03	1441	-17.63	938	5.29	-0.45	51.79	776	51.56
46	708	50.58	3.535	1091	5.446	847	4.227	-1.79	0.38	1291	-0.97	0.20	1441	-21.00	928	6.25	-0.52	63.84	775	63.41
47	708	50.32	3.532	1091	5.446	847	4.227	-1.13	0.29	1291	-0.87	0.22	1441	-25.69	936	7.07	-0.55	76.74	775	76.48
48	707	50.44	3.529	1090	5.444	847	4.226	-0.73	0.22	1290	-0.09	0.03	1440	-29.72	926	7.81	-0.57	89.83	775	89.44
49	707	50.68	3.528	1090	5.444	847	4.227	-0.53	0.18	1290	-0.25	0.09	1440	-33.49	921	8.46	-0.56	101.61	775	101.35
50	706	50.20	3.525	1090	5.444	847	4.227	-0.77	0.29	1290	-0.19	0.07	1440	-38.34	927	9.06	-0.56	114.70	775	114.28
51	706	50.32	3.524	1090	5.444	847	4.227	-0.52	0.12	1290	0.37	-0.09	1440	-22.96	933	9.60	-0.12	127.63	775	127.42
52	706	50.43	3.523	1090	5.445	847	4.227	-0.75	0.32	1290	-0.74	0.31	1440	-42.41	977	9.90	-0.08	139.69	775	139.34
53	706	50.30	3.523	1090	5.445	847	4.227	-1.00	0.43	1290	-0.75	0.33	1440	-43.21	981	10.12	-0.06	152.68	775	152.24
54	706	50.44	3.523	1090	5.445	847	4.227	-1.53	0.49	1290	-1.29	0.41	1440	-32.10	930	10.23	-0.27	164.68	775	164.31
55	706	50.42	3.522	1090	5.445	847	4.227	-1.15	0.40	1290	-0.95	0.33	1440	-34.72	931	10.34	-0.31	177.62	775	177.28
56	706	50.32	3.522	1090	5.443	847	4.226	-0.44	0.16	1290	-0.49	0.18	1440	-36.14	927	10.20	-0.43	190.45	775	190.34
57	706	50.20	3.522	1090	5.444	847	4.227	0.33	-0.13	1290	0.26	-0.11	1440	-40.65	931	10.42	-0.37	202.44	775	202.19
58	706	50.42	3.522	1090	5.443	847	4.227	-0.78	0.30	1290	-0.60	0.23	1440	-38.12	916	10.42	-0.49	215.51	775	215.17
59	706	50.50	3.523	1090	5.443	847	4.227	0.27	-0.11	1290	0.22	-0.09	1440	-40.80	922	10.61	-0.47	228.82	776	228.26
60	706	50.34	3.523	1090	5.443	847	4.227	-0.02	0.01	1290	-0.04	0.02	1440	-42.64	919	10.52	-0.55	240.95	776	240.09
61	706	50.34	3.523	1090	5.442	847	4.227	0.14	-0.07	1290	0.28	-0.13	1440	-46.96	931	10.85	-0.35	254.07	776	253.12
62	706	50.28	3.523	1090	5.442	847	4.227	0.26	-0.12	1290	0.32	-0.15	1440	-46.21	917	10.83	-0.55	267.15	776	265.91
63	706	50.30	3.523	1090	5.442	847	4.227	0.35	-0.16	1290	0.58	-0.26	1440	-44.81	912	10.46	-0.59	271.24	776	269.96

7.5 SLOWLY INCREASING STEER TEST RESULTS

2012 Fiat 500
NHTSA No.: *CC0501*
Date of Test: *7/7/2011*
Date Created: *7/7/2011*

File	EventPt	DOS	MES (mph)	Mean SPD (mph)	AYcount_3	THETAENCF_3 (deg)	AYCG_CD2_3 (g)	r_squared	ZeroBegin	ZeroEnd
12	700	1	49.410	49.624	1106	-26.849	-0.313	0.965	500	700
13	700	1	50.430	50.336	1090	-25.717	-0.312	0.941	500	700
14	700	1	49.510	49.373	1100	-26.417	-0.300	0.950	500	700
15	700	0	50.303	50.174	1065	24.472	0.295	0.942	500	700
16	681	0	50.469	50.416	1062	24.239	0.294	0.958	481	681
17	700	0	49.665	49.707	1062	24.243	0.295	0.945	500	700
				Averages		25.300	0.302			

Scalars	Steering Angles (deg)
1.5	38
2.0	51
2.5	63
3.0	76
3.5	89
4.0	101
4.5	114
5.0	127

Scalars	Steering Angles (deg)
5.5	139
6.0	152
6.5	164
7.0	177
7.5	190
8.0	202
8.5	215
9.0	228

Scalars	Steering Angles (deg)
9.5	240
10	253
10.5	266
10.7	270

7.6 INERTIAL SENSING SYSTEM LOCATION COORDINATES

Vehicle:	**2012 Fiat 500**	NHTSA No.:	CC0501
Wheelbase:	90.6 Inches	Faro Arm S/N:	U08-05-08-06636
Measurement date:	7/5/2011	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	2.442		0.000
M_Point_48_Ref	0.000	0.000	-
M_CIRCLE001_I_Left_Rear_Wheel_Axle	-26.631	16.647	-10.959
M_Point_IMU_side	3.266	46.494	-16.888
M_Point_ROOF	-	-	-58.781
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	3.266	48.019	-16.888

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	**60.703**	**0.019**	**16.888**

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).