126-DRI-11-007
SAFETY COMPLIANCE TESTING FOR FMVSS 126
Electronic Stability Control Systems

Fuji Heavy Industries Ltd
2011 Subaru Forester
NHTSA No. CB5503

DYNAMIC RESEARCH, INC.
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10 November 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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16. Abstract A test was conducted on a 2011 Subaru Forester , NHTSA No. CB5503, 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 2011 Subaru Forester, meets the minimum equipment and performance requirements stated in Federal Motor Vehicle Safety Standard (FMVSS) 126, "Electronic Stability Control Systems."

2.0 TEST PROCEDURE AND DISCUSSION OF RESULTS

Testing of the 2011 Subaru Forester 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 Subaru Forester*

NHTSA No. *CB5503* VIN: *JF2SHAGC3BH758458*

Vehicle Type: *MPV* Manufacture Date: *3/11*

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 Subaru Forester*

NHTSA No. *CB5503* Data Sheet Completion Date: *7/13/2011*

VIN *JF2SHAGC3BH758458* Manufacture Date: *3/11*

GVWR (kg): *2035* Front GAWR (kg): *1050* Rear GAWR (kg): *1095*

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

Odometer reading at time of inspection: *11 miles (17.6 km)*

DESIGNATED TIRE SIZE(S) FROM VEHICLE LABELING:

Front axle: *P225/55R17* Rear axle: *P225/55R17*

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

		Front Axle	Rear Axle
	Tire Manufacturer:	*Yokohama*	*Yokohama*
	Tire Model:	*Geolander G95*	*Geolander G95*
	Tire Size:	*P225/55R17*	*P225/55R17*
TIN	Left Front:	*FDUP N2U 1211*	Right Front: *FDUP N2U 1211*
	Left Rear:	*FDUP N2U 1211*	Right Rear: *FDUP N2U 1211*

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

If no, contact COTR for further guidance

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

- [ ] Two Wheel Drive (2WD) [ ] Front Wheel Drive [ ] Rear Wheel Drive
- [X] 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: *AWD*
Mode: *Default, ESC on*
Drive Configuration: *AWD*
Mode: *ESC off*
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: *7/13/2011*
APPROVED BY: *B Kebschull* DATE APPROVED: *7/26/2011*

3.0 TEST DATA (CONTD)

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

Vehicle: *2011 Subaru Forester*

NHTSA No *CB5503* Data Sheet Completion Date: *6/28/2011*

ESC SYSTEM IDENTIFICATION

Manufacturer/Model *Bosch Corporation / VDC8*

ESC SYSTEM HARDWARE (Check applicable hardware)

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

List other Components: _____

ESC OPERATIONAL CHARACTERISTICS

System is capable of generating brake torque at each wheel — [X] Yes (Pass) [ ] No (Fail)
Brief explanation: *The manufacturer provided a schematic of the brake system that indicates brake torques can be applied at each wheel*

System is capable of determining yaw rate — [X] Yes (Pass) [ ] No (Fail)
Brief explanation: *System measures yaw rate using yaw rate sensor*

System is capable of monitoring driver steering input — [X] Yes (Pass) [ ] No (Fail)
Brief explanation: *Steer angle sensor measures the driver steering input.*

System is capable of estimating side slip or side slip derivative — [X] Yes (Pass) [ ] No (Fail)
Brief explanation: *Based on signal values from the major feedback loop including the wheel sensors, brake pressure sensor, steering wheel angle and yaw rate sensors, engine output signals via CAN in addition to several other variables estimated in the minor feedback loop a first nominal value for the yaw rate derived from the Ackermann equation can be calculated. The outputs of this block are the nominal values of the yaw rate and the vehicle slip angle.*

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 torque is reduced by closing the throttle*

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: *7.2 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 except backwards driving,or driving less than 7.2 km/h

Vehicle manufacturer submitted documentation explaining how the ESC mitigates understeer

X Yes (Pass)
___ No (Fail)

DATA INDICATES COMPLIANCE: **X** Yes (Pass)
___ No (Fail)

REMARKS:

RECORDED BY: *P Broen* DATE RECORDED: *6/28/2011*
APPROVED BY: *B Kebschull* DATE APPROVED: *7/26/2011*

3.0 TEST DATA (CONTD)

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

Vehicle: *2011 Subaru Forester*

NHTSA No. *CB5503* Data Sheet completion date: *6/28/2011*

ESC Malfunction Telltale

Vehicle is equipped with malfunction telltale? *Yes*

Telltale Location: *Upper left side of instrument panel*

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.

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 telltale flashes during activation of Vehicle Dynamics Control (ESC) or TCS

3.0 TEST DATA (CONTD)

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

"ESC OFF" Telltale (if provided)

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

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

Telltale Location: *Lower center of instrument panel, just left of speedometer*

Telltale Color: *Yellow*

Telltale symbol or abbreviation used

or **ESC OFF**

[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.

Is telltale part of a common space? *No*

DATA INDICATES COMPLIANCE ***Yes***

(Vehicle is compliant if equipped with a malfunction telltale)

Remarks:

RECORDED BY:	*P Broen*	DATE RECORDED:	*6/28/2011*
APPROVED BY:	*B Kebschull*	DATE APPROVED:	*7/26/2011*

3.0 TEST DATA (CONTD)

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

Vehicle: *2011 Subaru Forester*

NHTSA No. *CB5503* Data Sheet completion date: *7/21/2011*

"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 *Lower panel left of the instrument cluster*
Labeling *Sliding car symbol with "off" label adjacent*
Modes *Vehicle Dynamics Control (ESC)/TCS On/off*

Second Control: Location ____
Labeling ____
Modes ____

Identify standard or default drive configuration *All Wheel Drive*

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

Momentary button is depressed to disable ESC. The button is depressed again to re-enable ESC

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: *B Kebschull* DATE RECORDED: *7/21/2011*
APPROVED BY: *J Lenkeit* DATE APPROVED: *7/26/2011*

3.0 TEST DATA (CONTD)

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

Vehicle: *2011 Subaru Forester*

NHTSA No. *CB5503* Data Sheet completion date: *7/21/2011*

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

Peak Friction Coefficient (at least 0.9) *0.95*

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 *220* kPa Rear Axle *210* kPa

Actual; LF *220* kPa RF *220* kPa

LR *210* kPa RR *210* kPa

Vehicle Dimensions: Front Track Width *153.0* cm Wheelbase *261.6* cm

Rear Track Width *153.0* cm

Vehicle Weight Ratings: GAWR Front *1050* kg GAWR Rear *1095* kg

Unloaded Vehicle Weight (UVW):

Front Axle *846.4* kg Left Front *432.3* kg Right Front *414.1* kg

Rear Axle *685.8* kg Left Rear *347.9* kg Right Rear *337.9* kg

Total UVW *1532.2* kg

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

Calculated baseline weight (UVW + 73kg) *1605.2* 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 *877.7* kg Left front *448.1* kg Right front *429.6* kg

Rear axle *725.7* kg Left rear *367.4* kg Right rear *358.3* kg

Total UVW with outriggers *1603.4* kg

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

Front axle *958.9* kg Left front *493.1* kg Right front *465.8* kg

Rear axle *809.6* kg Left rear *421.8* kg Right rear *387.8* kg

Vehicle Weight *1768.5* kg

Ballast Required =

[Total UVW with Outriggers (if applicable)]		+ *168*	kg	- [Loaded Weight w/Driver and Instrumentation)]	
= *1603.4*	kg	+ *168*	kg	- 1768.5	kg

= *2.9* kg

Total Loaded Vehicle Weight w/Driver and Instrumentation and Ballast

Front axle *959.4* kg Left front *493.1* kg Right front *466.3* kg

Rear axle *811.9* kg Left rear *422.3* kg Right rear *389.6* kg

Total UVW *1771.3* 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	*47.2*	in	*119.9*	cm	*68.3*	in	*173.6*	cm
y-distance	*-1.0*	in	*-2.6*	cm	*-0.1*	in	*-0.3*	cm
z-distance	*24.5*	in	*62.2*	cm	*20.5*	in	*52.1*	cm
Roof Height	*64.456*	in			*163.7*	cm		
Distance between ultrasonic sensors	*81.3*	in			*206.4*	cm		

Remarks:

RECORDED BY: *B Kebschull* DATE RECORDED: *7/21/2011*
APPROVED BY: *J Lenkeit* DATE APPROVED: *7/26/2011*

3.0 TEST DATA (CONTD)

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

Vehicle: *2011 Subaru Forester*

NHTSA No. *CB5503*

Measured tire pressure: LF *222* kPa RF *225* kPa

LR *211* kPa RR *220* kPa

Wind Speed *1.1* m/s (10 m/sec (22 mph) max for passenger cars; 5m/sec (11 mph) max for MPVs and trucks)

Ambient Temperature (7°C (45°F) - 40°C (104°F)) *29* °C

Brake Conditioning Time: *10:02:00 AM* Date: *7/21/2011*

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 *0.9-1.0* 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: *10:16:00 AM* Date: *7/21/2011*

Measured cold tire pressure LF *237* kPa RF *240* kPa

LR *224* kPa RR *226* kPa

Wind Speed *1.4* m/s (10 m/sec (22 mph) max for passenger cars; 5m/sec (11 mph) max for MPVs and trucks)

Ambient Temperature (7°C (45°F) - 40°C (104°F)) *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*	*31.2 - 32.8*
4-6	Counterclockwise	0.5 – 0.6	*0.5 - 0.6*	*31.2 - 32.8*

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	*0.39*
2	3	56 ± 2 (35 ± 1)	*80*	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:
80 **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)	*80* (cycles 1-10)	0.5 - 0.6	*0.51*
4	*7*	56 ± 2 (35 ± 1)	*80* (cycles 1-9)	0.5 - 0.6	*0.51*
			160 (cycle10)*	NA	*0.76*

* 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: *11:17:00 AM* Date: *7/21/2011*

Measured cold tire pressure LF *240* kPa RF *241* kPa

LR *226* kPa RR *226* kPa

Wind Speed *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)) *31* °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*	*31.2 - 32.8*
4-6	Counterclockwise	0.5 - 0.6	*0.5- 0.6*	*31.2 - 32.8*

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

80 **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	*17-19*	56 ± 2 (35 ± 1)	*80* (cycles 1-10)	0.5 - 0.6	*0.51*
4	*20*	56 ± 2 (35 ± 1)	*80* (cycles 1-9)	0.5 - 0.6	*0.51*
			160 (cycle 10)*	NA	*0.76*

* 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: *7/21/2011*

APPROVED BY: *J Lenkeit* DATE APPROVED: *7/26/2011*

3.0 TEST DATA (CONTD)

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

Vehicle: *2011 Subaru Forester*

NHTSA No. *CB5503*

Measured tire pressure: LF *238* kPa RF *240* kPa

LR *225* kPa RR *227* kPa

Wind Speed *2.7* 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)) *30* °C

Selected drive configuration *AWD*

Selected Mode: *Default, ESC on*

Preliminary Left Steer Maneuver:

Lateral Acceleration measured at 30 degrees steering wheel angle

$a_{y,30degrees}$ = *0.36* 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} = *45.8* degrees (@.55g)

δ_{sis} = *50* 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	*10:45*	*-28.8*	*10*	*Good*
2	Left	*10:48*	*-28.8*	*11*	*Good*
3	Left	*10:52*	*-28.6*	*12*	*Good*
4	Left				
5	Left				
1	Right	*10:55*		*13*	*NG*
2	Right	*10:59*	*28.0*	*14*	*Good*
3	Right	*11:02*	*28.0*	*15*	*Good*
4	Right	*11:05*	*28.2*	*16*	*Good*
5	Right				

3.0 TEST DATA (CONTD)

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

Average Overall Steering Wheel Angle:

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

$\delta_{0.3\ g,\ overall}$ = *28.4* degrees

[to nearest 0.1 degree]

Remarks:

RECORDED BY: *B Kebschull* DATE RECORDED: *7/21/2011*
APPROVED BY: *J Lenkeit* DATE APPROVED: *7/26/2011*

3.0 TEST DATA (CONTD)

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

Vehicle: *2011 Subaru Forester*

NHTSA No. *CB5503* Data sheet completion date: *7/22/2011*

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: *AWD*

Selected Mode: *Default, ESC on*

Overall steering wheel angle ($\delta_{0.3\ g,\ overall}$) *28.4* 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
23	11:42	1.5	43	13.44	0.09	0.04	0.70	PASS	0.30	PASS
24	11:45	2.0	57	17.52	-0.07	-0.14	-0.39	PASS	-0.78	PASS
25	11:48	2.5	71	21.80	0.08	-0.04	0.35	PASS	-0.21	PASS
26	11:51	3.0	85	25.66	0.57	-0.12	2.22	PASS	-0.46	PASS
27	11:54	3.5	99	30.28	0.36	-0.16	1.18	PASS	-0.52	PASS
28	11:58	4.0	114	37.39	0.04	-0.08	0.11	PASS	-0.22	PASS
29	12:01	4.5	128	40.05	0.12	-0.22	0.29	PASS	-0.56	PASS
30	12:04	5.0	142	40.14	0.02	0.10	0.05	PASS	0.26	PASS
31	12:06	5.5	156	36.50	-0.20	-0.12	-0.56	PASS	-0.33	PASS
32	12:09	6.0	170	41.75	-0.14	-0.15	-0.34	PASS	-0.37	PASS
34	12:15	6.5	185	41.95	-0.03	-0.04	-0.08	PASS	-0.09	PASS
35	12:18	7.0	199	44.07	0.00	0.10	0.01	PASS	0.22	PASS
36	12:21	7.5	213	45.44	0.02	0.05	0.04	PASS	0.11	PASS
37	12:24	8.0	227	48.52	0.15	0.20	0.31	PASS	0.40	PASS
38	12:27	8.5	241	49.08	-0.59	-0.57	-1.21	PASS	-1.15	PASS
39	12:30	9.0	256	48.82	-0.05	-0.02	-0.10	PASS	-0.05	PASS
40	12:33	9.5	270	49.83	0.16	0.29	0.31	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 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
42	12:39	1.5	43	-13.64	-0.11	-0.08	0.78	*PASS*	0.55	*PASS*
43	12:42	2.0	57	-17.99	0.01	-0.04	-0.07	*PASS*	0.21	*PASS*
44	12:45	2.5	71	-21.91	-0.02	0.09	0.08	*PASS*	-0.42	*PASS*
45	12:47	3.0	85	-26.62	-0.30	0.00	1.14	*PASS*	0.01	*PASS*
46	12:50	3.5	99	-30.20	-1.12	0.08	3.72	*PASS*	-0.26	*PASS*
47	12:53	4.0	114	-35.98	-0.04	-0.07	0.11	*PASS*	0.21	*PASS*
48	12:56	4.5	128	-41.38	0.29	0.27	-0.69	*PASS*	-0.64	*PASS*
49	12:59	5.0	142	-43.81	0.11	0.00	-0.26	*PASS*	0.00	*PASS*
50	13:02	5.5	156	-39.98	0.00	-0.02	-0.01	*PASS*	0.05	*PASS*
51	13:05	6.0	170	-42.52	-0.07	0.03	0.17	*PASS*	-0.08	*PASS*
52	13:08	6.5	185	-41.49	-0.15	-0.16	0.36	*PASS*	0.38	*PASS*
53	13:10	7.0	199	-42.72	-0.08	0.01	0.20	*PASS*	-0.02	*PASS*
54	13:13	7.5	213	-42.59	-0.13	-0.09	0.30	*PASS*	0.21	*PASS*
55	13:16	8.0	227	-45.03	-0.10	0.10	0.22	*PASS*	-0.22	*PASS*
56	13:19	8.5	241	-44.92	-0.11	-0.10	0.24	*PASS*	0.22	*PASS*
57	13:22	9.0	256	-47.20	-0.15	-0.07	0.31	*PASS*	0.15	*PASS*
58	13:25	9.5	270	-50.53	-0.06	0.03	0.12	*PASS*	-0.06	*PASS*

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

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

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

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

3.0 TEST DATA (CONTD)

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

Responsiveness – Lateral Displacement

Maneuver #	Initial Steer Direction	Commanded Steering Wheel Angle (5.0*$\delta_{0.3\ g,\ overall}$ or greater)		Calculated Lateral Displacement[1]	
		Scalar *$\delta_{0.3\ g}$	Angle (degrees)	Distance (m)	Pass/Fail
30	Counter Clockwise	5.0	142	-3.0	*PASS*
31	Counter Clockwise	5.5	156	-3.0	*PASS*
32	Counter Clockwise	6.0	170	-3.1	*PASS*
34	Counter Clockwise	6.5	185	-3.1	*PASS*
35	Counter Clockwise	7.0	199	-3.1	*PASS*
36	Counter Clockwise	7.5	213	-3.1	*PASS*
37	Counter Clockwise	8.0	227	-3.2	*PASS*
38	Counter Clockwise	8.5	241	-3.2	*PASS*
39	Counter Clockwise	9.0	256	-3.2	*PASS*
40	Counter Clockwise	9.5	270	-3.3	*PASS*
49	Clockwise	5.0	142	2.8	*PASS*
50	Clockwise	5.5	156	2.8	*PASS*
51	Clockwise	6.0	170	2.8	*PASS*
52	Clockwise	6.5	185	2.9	*PASS*
53	Clockwise	7.0	199	2.9	*PASS*
54	Clockwise	7.5	213	3.0	*PASS*
55	Clockwise	8.0	227	3.0	*PASS*
56	Clockwise	8.5	241	3.0	*PASS*
57	Clockwise	9.0	256	3.0	*PASS*
58	Clockwise	9.5	270	3.0	*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: *Run 33 NG*

RECORDED BY: *B Kebschull* DATE RECORDED: *7/22/2011*
APPROVED BY: *J Lenkeit* DATE APPROVED: *7/26/2011*

3.0 TEST DATA (CONTD)

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

Vehicle: *2011 Subaru Forester*

NHTSA No. *CB5503* Data Sheet Completion Date: *7/21/2011*

TEST 1

MALFUNCTION SIMULATION: Describe method of malfunction simulation

ABS pump motor fuse removed

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 the malfunction was caused. Other telltales that also illuminated included Brake and ABS. After fuse was re-installed, the ESC Telltale extinguished immediately upon ignition. The Brake and ABS telltales also extinguished. No driving was necessary.*

RECORDED BY: *B Kebschull* DATE RECORDED: *7/21/2011*

APPROVED BY: *J Lenkeit* DATE APPROVED *7/26/2011*

3.0 TEST DATA (CONTD)

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

Vehicle: *2011 Subaru Forester*

NHTSA No. *CB5503* Data Sheet Completion Date: *7/21/2011*

TEST 2

MALFUNCTION SIMULATION: Describe method of malfunction simulation

Disconnect left front wheel speed sensor at the connector

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 the malfunction was caused. Other telltales that also illuminated included ABS and Check Engine. All of those telltales extinguished immediately upon ignition after the LF wheel speed sensor was reconnected and 3 cycles of the following procedure had been completed. First, the vehicle was started. It was then driven higher than 20 km/h. It was then stopped, and the ignition was shut off. (As per manufacturer instructions the ignition had to be cycled three times to restore the system to normal after a failure). No driving was necessary after the 4th ignition.*

RECORDED BY: *B Kebschull* DATE RECORDED: *7/21/2011*

APPROVED BY: *J.Lenkeit* DATE APPROVED *7/26/2011*

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)

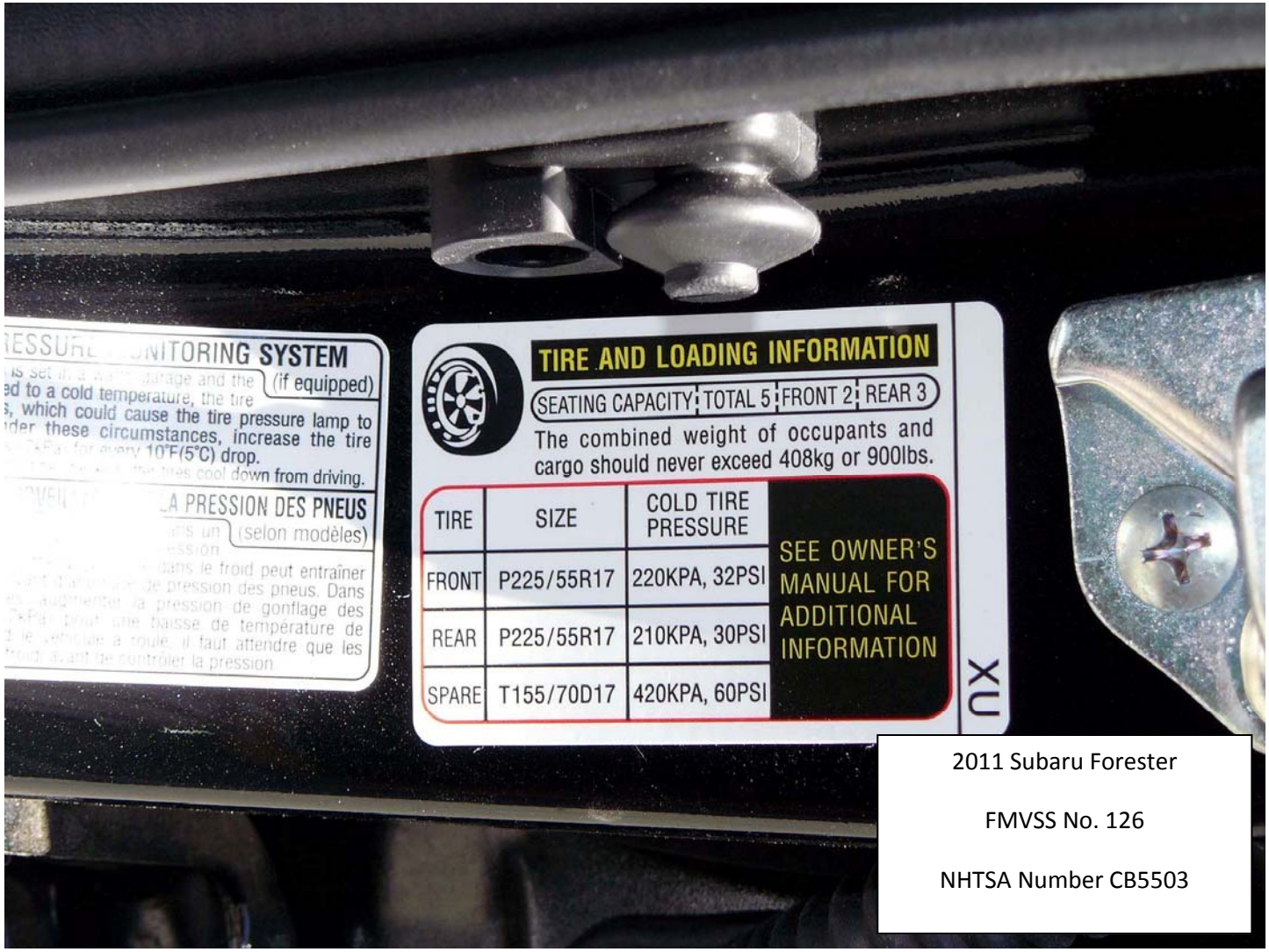


Figure 5.4. Vehicle Placard

5.0 PHOTOGRAPHS (5 of 15)

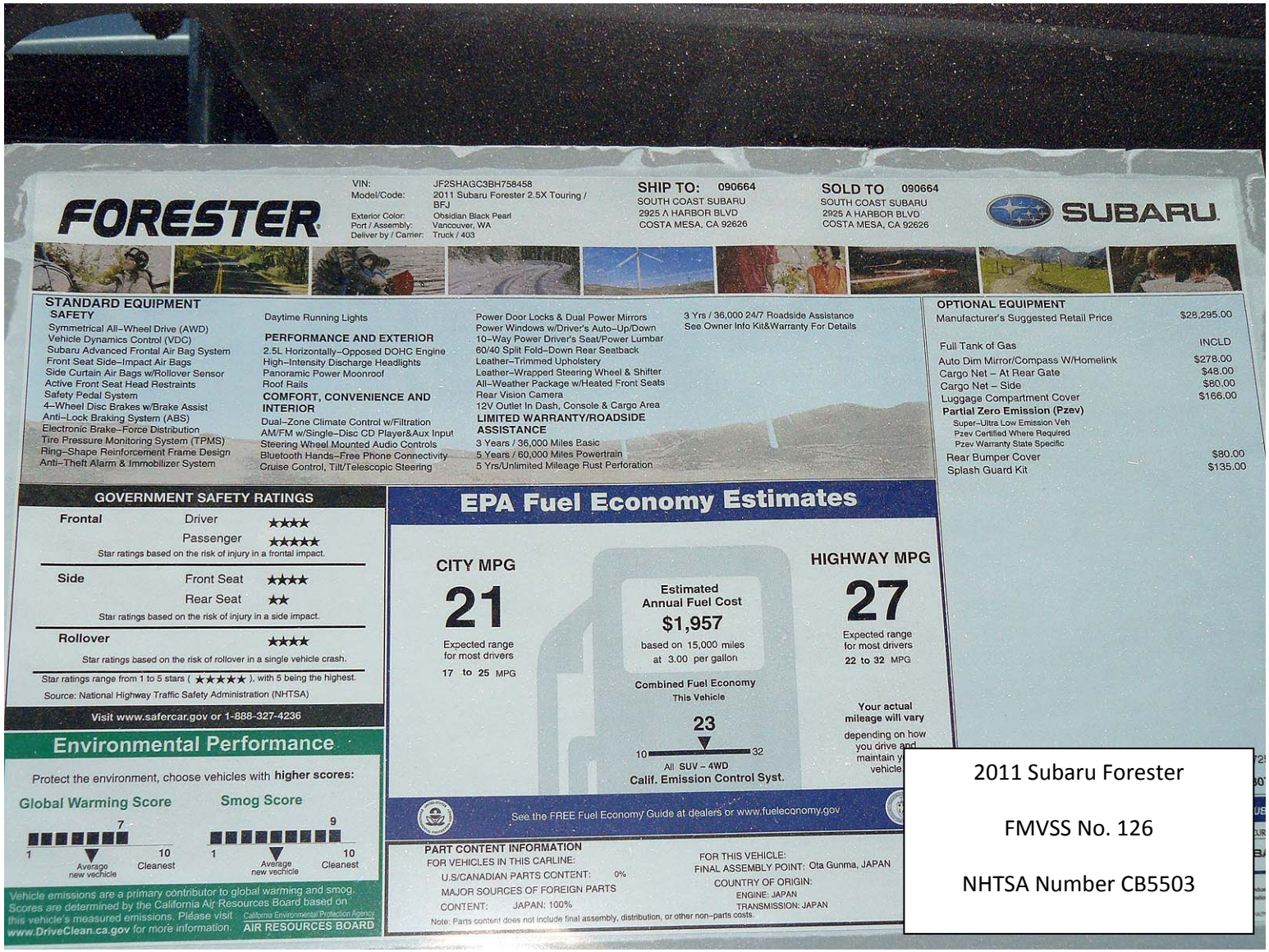


Figure 5.5. Window Sticker (Monroney Label)

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)

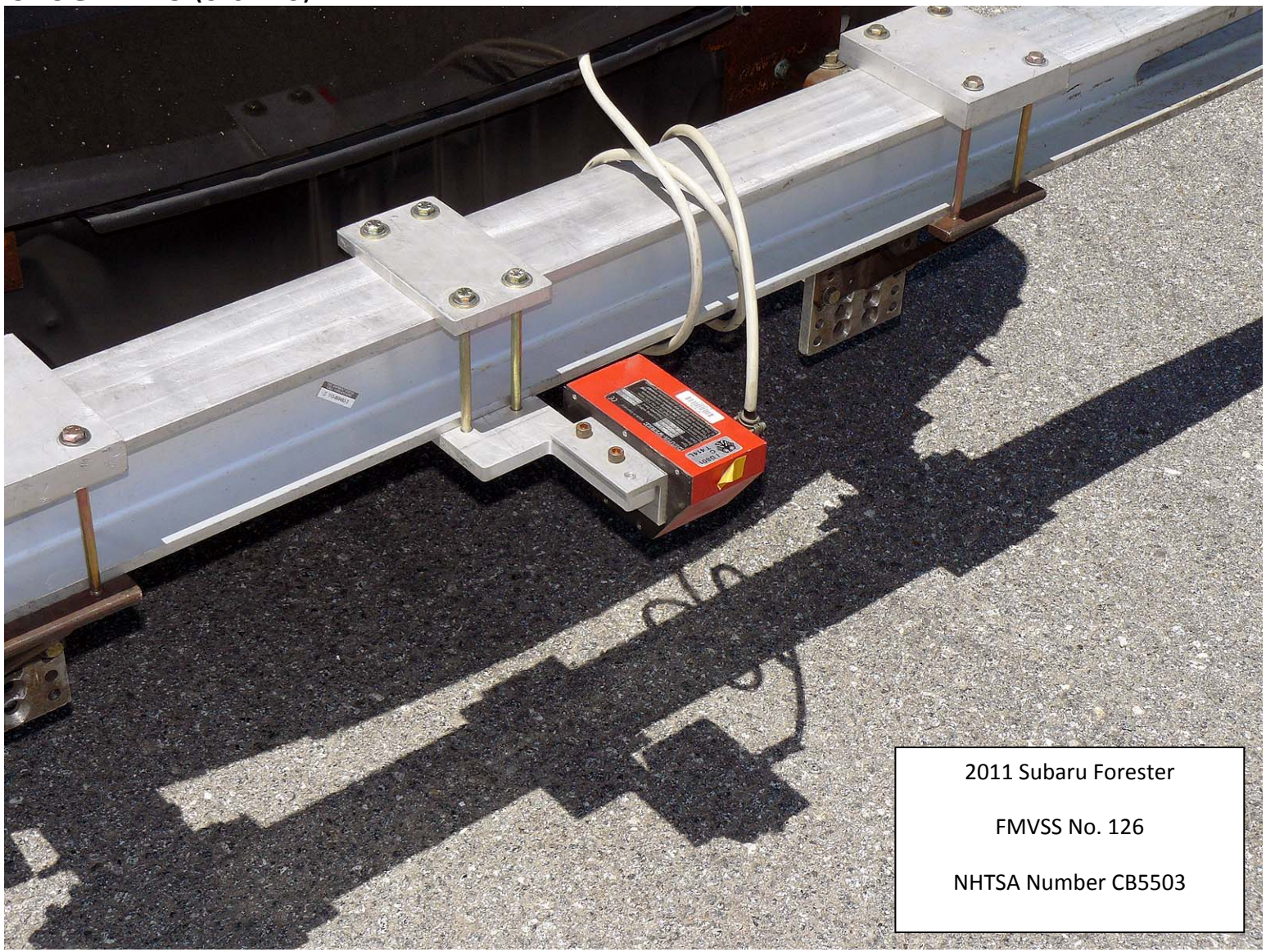


Figure 5.9. Rear Mounted Speed Sensor

5.0 PHOTOGRAPHS (10 of 15)

Figure 5.10. Steering Controller and Data Acquisition Computer

5.0 PHOTOGRAPHS (11 of 15)

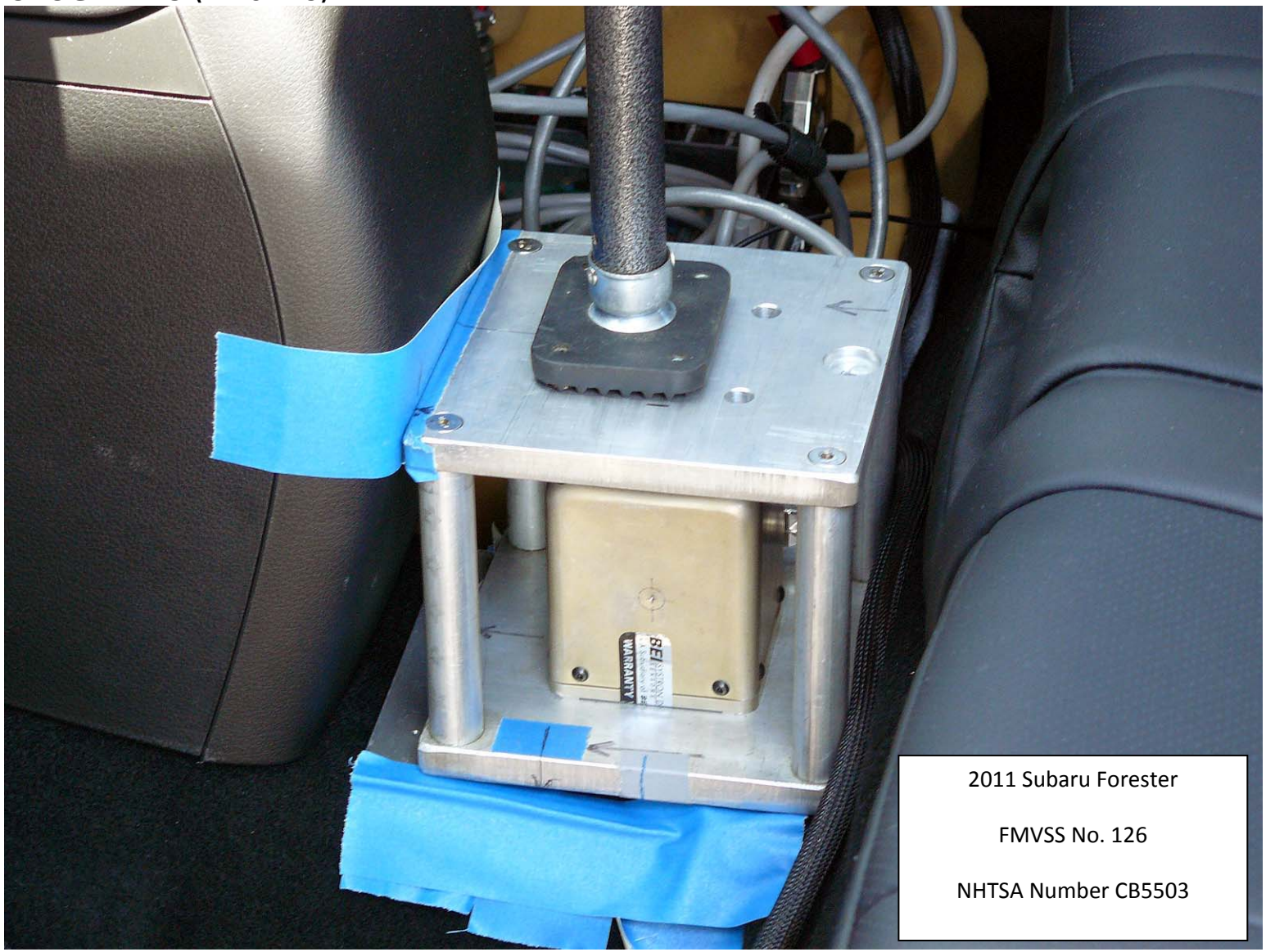


Figure 5.11. Inertial Measurement Unit Mounted in Vehicle

5.0 PHOTOGRAPHS (12 of 15)

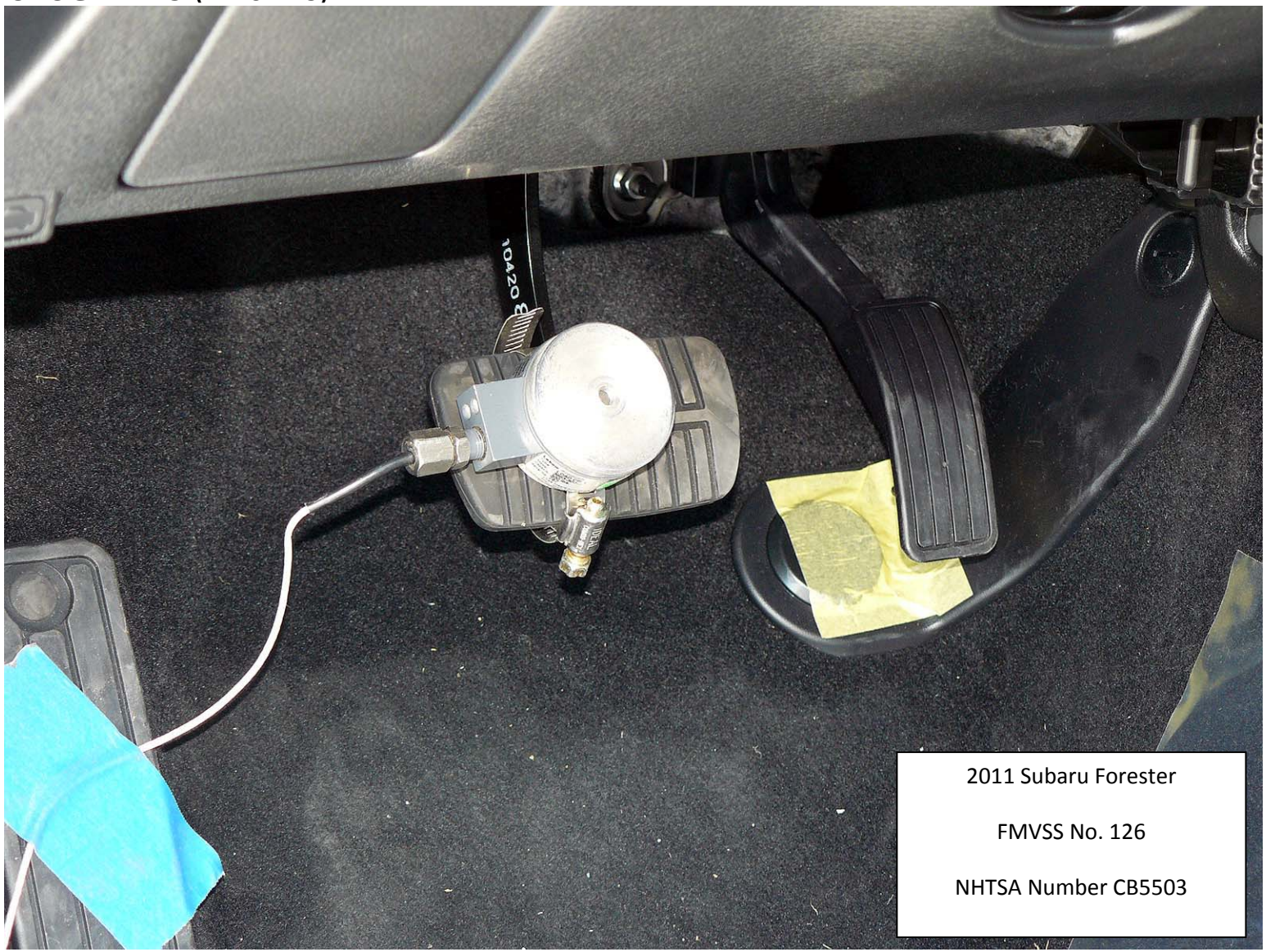


Figure 5.12. Brake Pedal Load Cell

5.0 PHOTOGRAPHS (13 of 15)

Figure 5.13. Telltale for ESC Malfunction and ESC Activation

5.0 PHOTOGRAPHS (14 of 15)

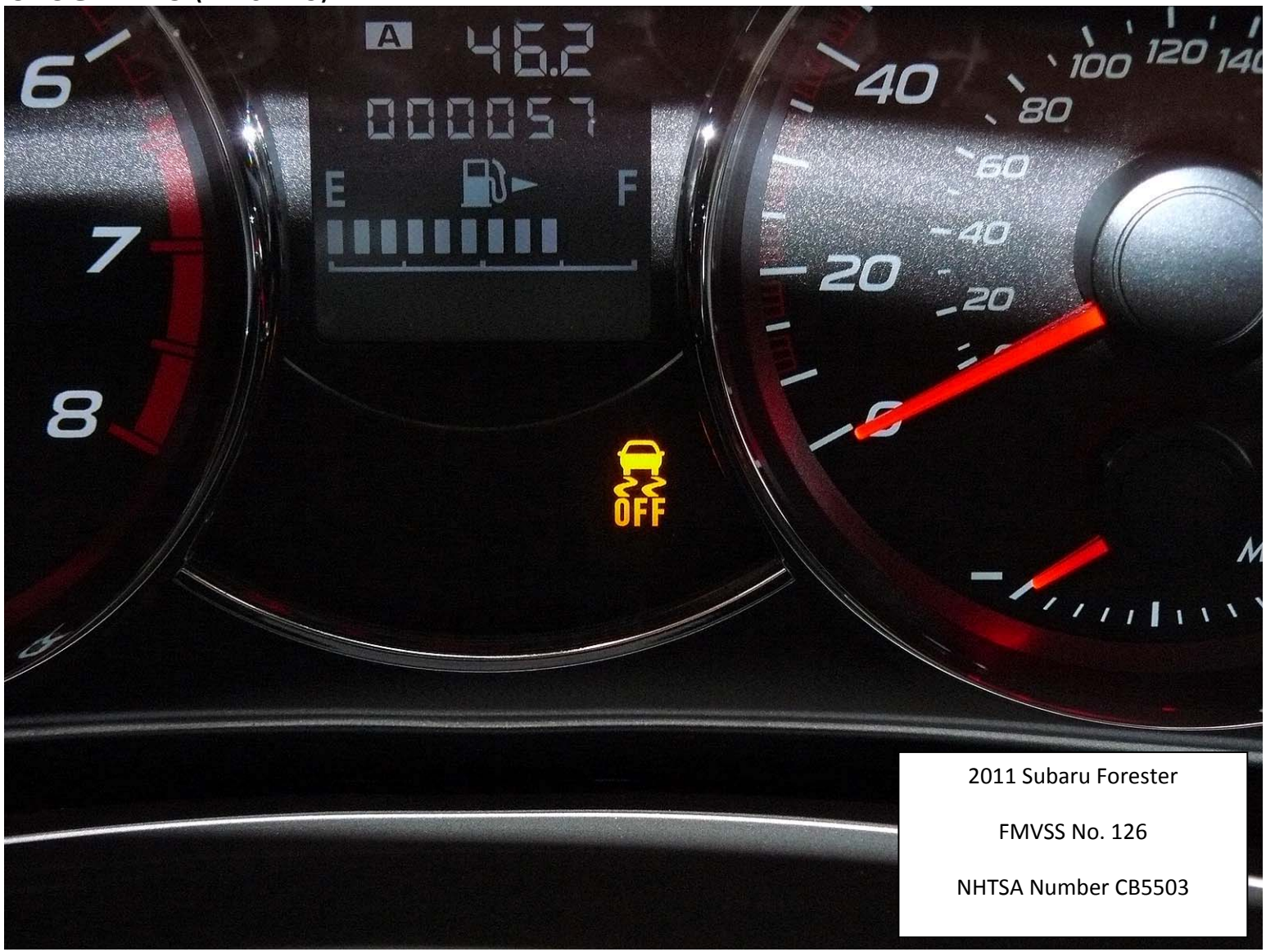


Figure 5.14. Telltale for ESC Off

5.0 PHOTOGRAPHS (15 of 15)

Figure 5.15. ESC Off Control Switch

6.0 DATA PLOTS (1 of 4)

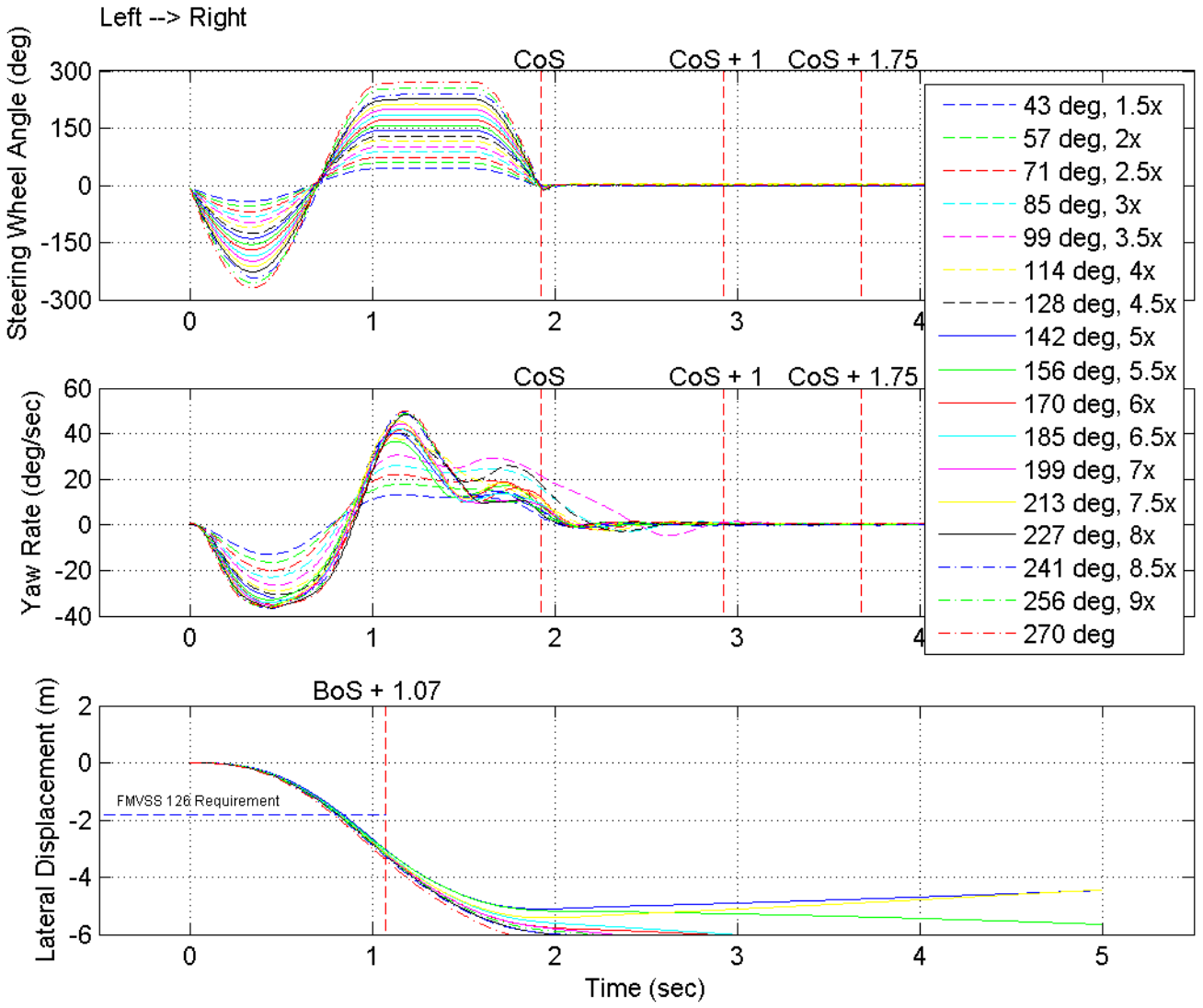


Figure 6.1. Steering Wheel Angle, Yaw Rate and Lateral Displacement for L-R Series

6.0 DATA PLOTS (2 of 4)

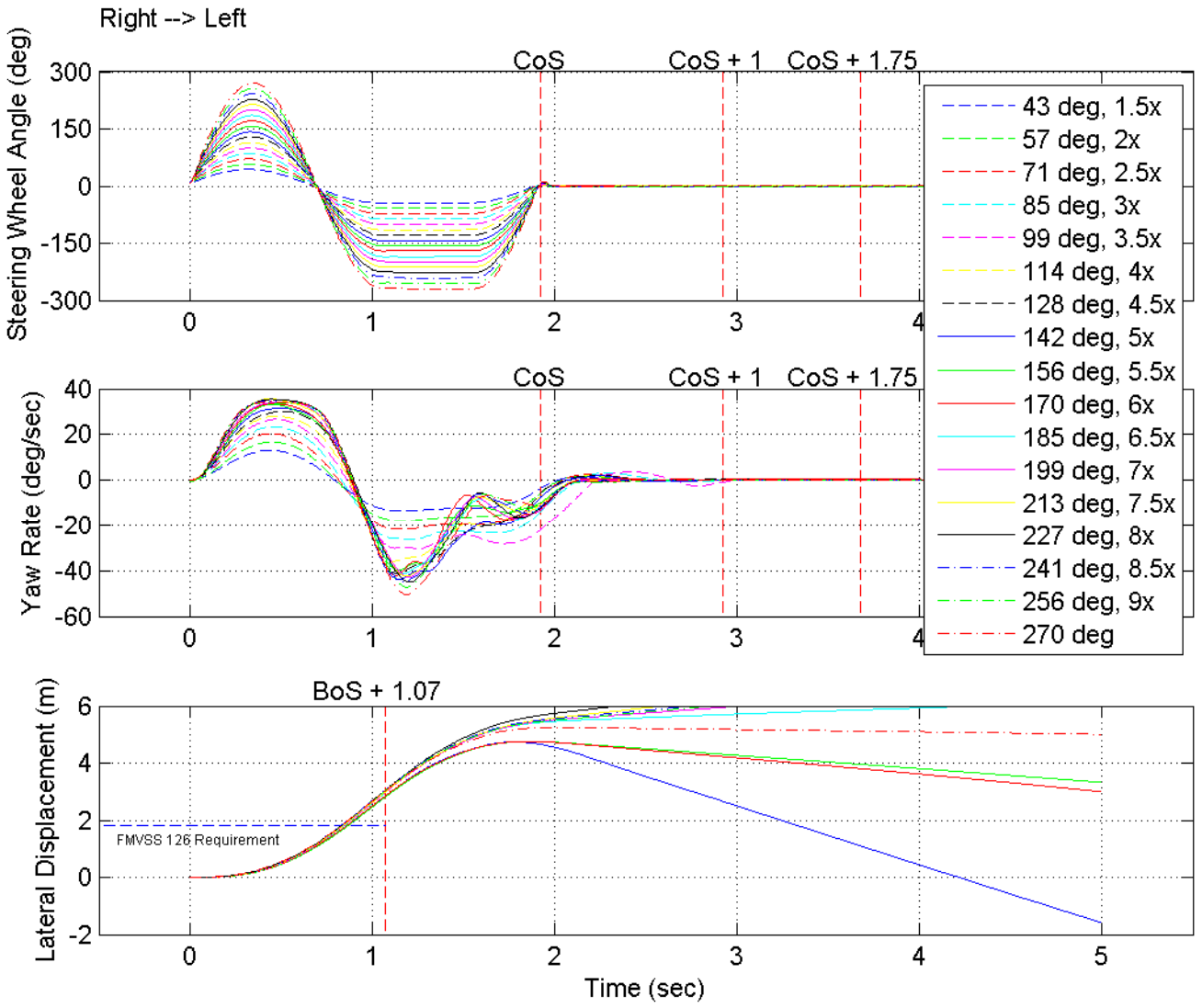


Figure 6.2. Steering Wheel Angle, Yaw Rate and Lateral Displacement for R-L Series

6.0 DATA PLOTS (3 of 4)

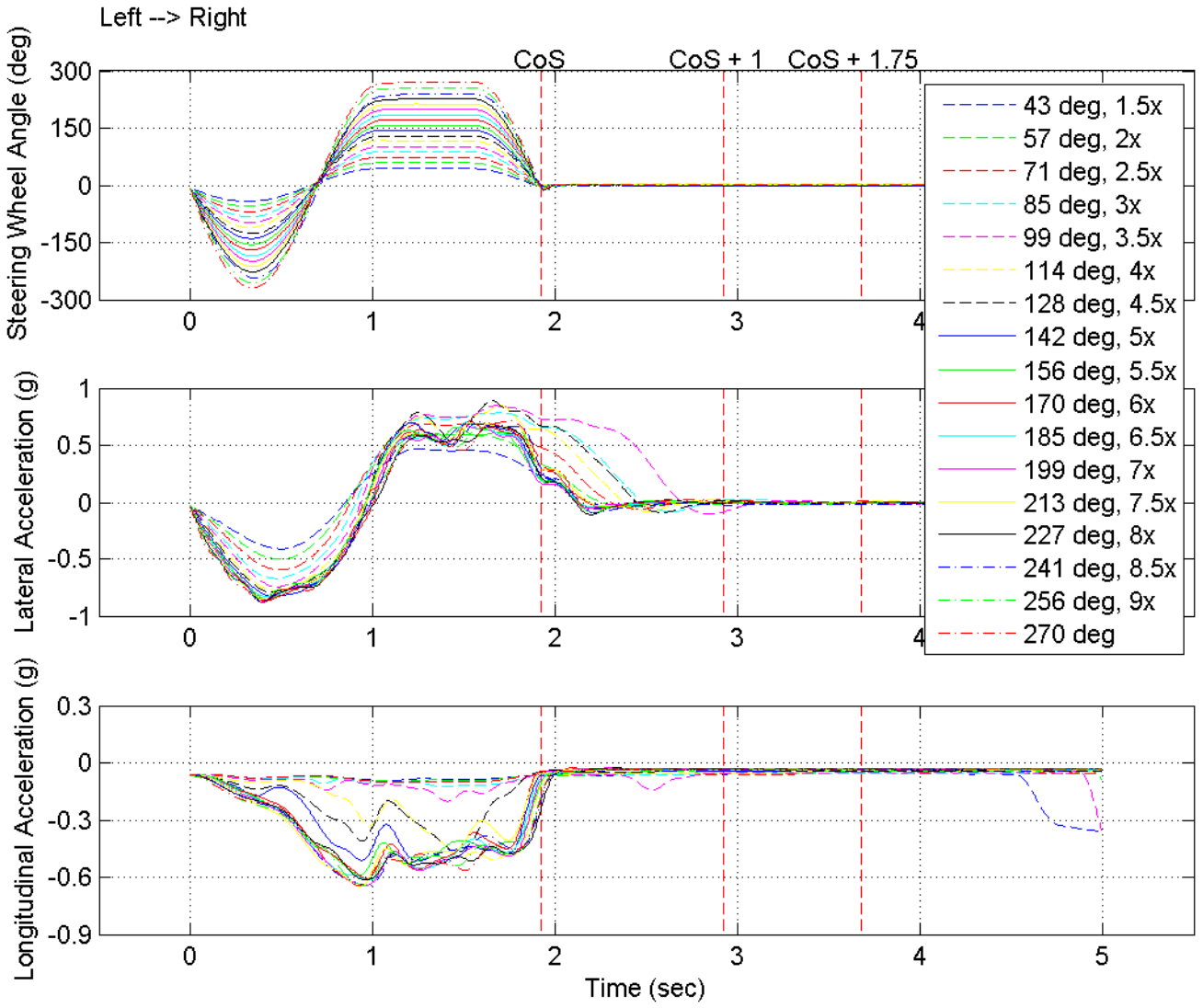


Figure 6.3. Steering Wheel Angle, Lateral Acceleration and Longitudinal Acceleration for L-R Series

6.0 DATA PLOTS (4 of 4)

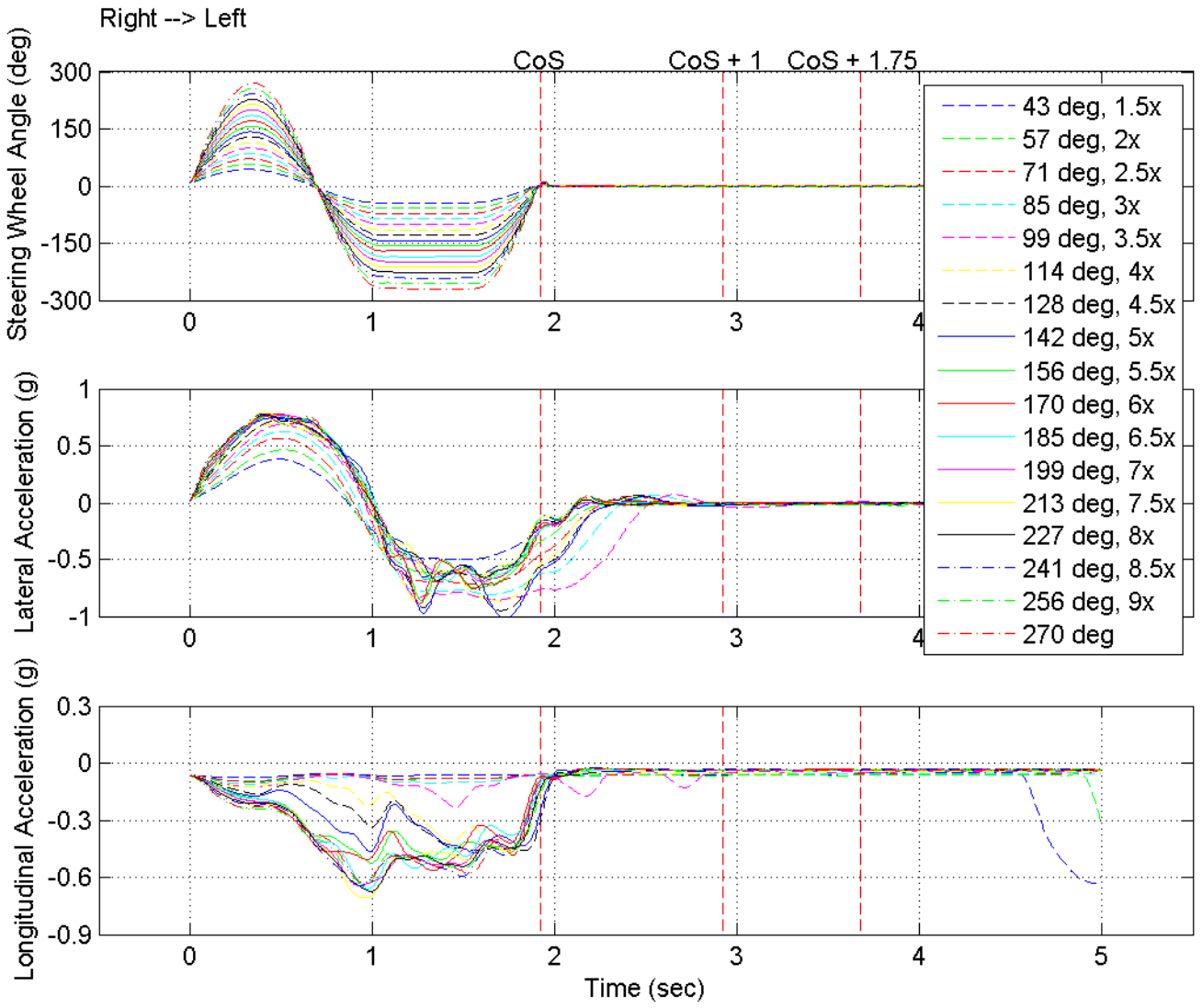


Figure 6.4. Steering Wheel Angle, Lateral Acceleration and Longitudinal Acceleration for R-L Series

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

■ Abbreviation list

You will find several abbreviations in this manual. The meanings of the abbreviations are shown in the following list.

Abbreviation	Meaning
A/C	Air conditioner
A/ELR	Automatic/Emergency locking retractor
ABS	Anti-lock brake system
AKI	Anti knock index
ALR	Automatic locking retractor
AT	Automatic transmission
ATF	Automatic transmission fluid
AWD	All-wheel drive
DRL	Daytime running light
EBD	Electronic brake force distribution
ELR	Emergency locking retractor
FWD	Front-wheel drive
GAW	Gross axle weight
GAWR	Gross axle weight rating
GVW	Gross vehicle weight
GVWR	Gross vehicle weight rating
HID	High intensity discharge
INT	Intermittent
LATCH	Lower anchors and tethers for children
LED	Light emitting diode
LSD	Limited slip differential
MIL	Malfunction indicator lamp
MMT	Methylcyclopentadienyl manganese tricarbonyl
MT	Manual transmission
OBD	On-board diagnostics
RON	Research octane number
SRS	Supplemental restraint system
TIN	Tire identification number
TPMS	Tire pressure monitoring system
VDC	Vehicle dynamics control

Vehicle symbols

There are some of the symbols you may see on your vehicle.

For warning and indicator lights, refer to "Warning and indicator lights" ☞21.

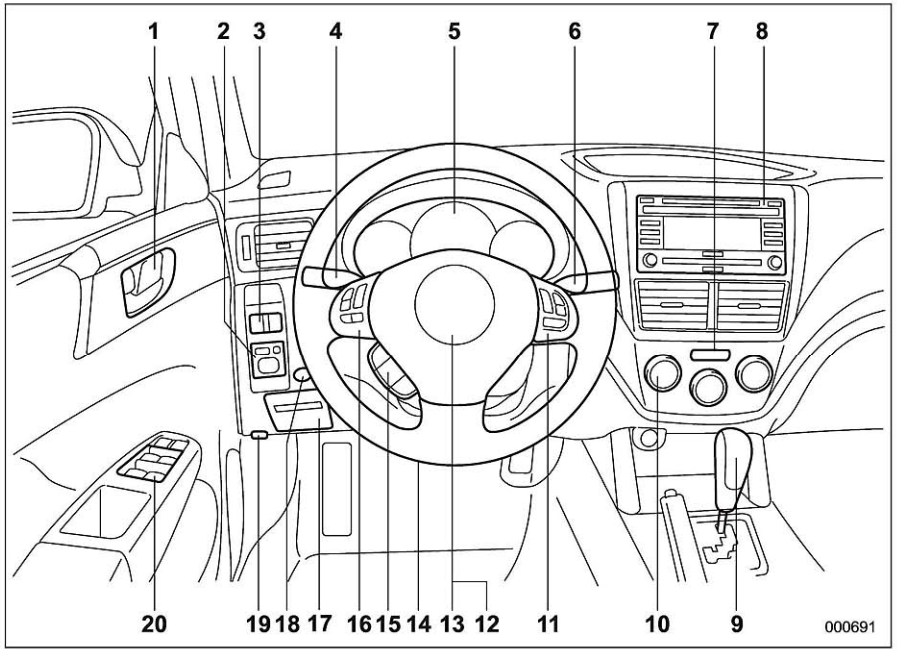
Mark	Name
	WARNING
	CAUTION
	Power door lock
	Power door unlock
	Power window with automatic open (all models) and close (if equipped) function
	Passengers' windows lock and unlock
	Fuel
	Front fog lights

– CONTINUED –

7.1 OWNER'S MANUAL PAGES

16

■ Instrument panel



1) Door locks (page 2-4)
2) Outside mirror switch (page 3-44)
3) Illumination brightness control (page 3-32)
4) Light control lever (page 3-29)
5) Combination meter (page 3-6)
6) Wiper control lever (page 3-33)
7) Hazard warning flasher switch (page 3-5)
8) Audio (page 5-1)
9) Shift lever (MT) (page 7-13)/ Select lever (AT) (page 7-15)
10) Climate control (page 4-1)
11) Cruise control (page 7-32)
12) Horn (page 3-47)
13) SRS airbag (page 1-33)
14) Tilt/telescopic steering (page 3-47)
15) Hands-free switches (page 5-43)
16) Audio control buttons (page 5-38)
17) Fuse box (page 11-45)
18) Vehicle Dynamics Control OFF switch (page 7-27)
19) Hood lock release knob (page 11-5)
20) Power windows (page 2-20)

7.1 OWNER'S MANUAL PAGES

■ Warning and indicator lights

Mark	Name	Page
	Seatbelt warning light	3-13
	Front passenger's seat-belt warning light	3-13
AIR BAG	SRS airbag system warning light	3-15
ON / 	Front passenger's frontal airbag ON indicator	3-15
OFF / 	Front passenger's frontal airbag OFF indicator	3-15
CHECK ENGINE	CHECK ENGINE warning light/Malfunction indicator lamp	3-16
	Coolant temperature low indicator light (if equipped)/Coolant temperature high warning light (if equipped)	3-16
	Charge warning light	3-17
	Oil pressure warning light	3-17
AT OIL TEMP	AT OIL TEMP warning light (AT models)	3-18

Mark	Name	Page
ABS / 	ABS warning light	3-19
BRAKE /	Brake system warning light	3-20
	Door open warning light	3-21
AWD	AWD warning light (AT models)	3-21
	Hill start assist warning light (MT models)	3-21
	Vehicle Dynamics Control warning light/Vehicle Dynamics Control operation indicator light	3-22
	Vehicle Dynamics Control OFF indicator light	3-23
	Turn signal indicator lights	3-25
	High beam indicator light	3-25
	Automatic headlight beam leveler warning light (models with HID headlights)	3-22

Mark	Name	Page
	Front fog light indicator light (if equipped)	3-25
	Security indicator light	3-23
	Headlight indicator light	3-25
CRUISE	Cruise control indicator light	3-25
SET/ 	Cruise control set indicator light	3-25
	Low fuel warning light	3-21
	Low tire pressure warning light (U.S.-spec. models)	3-18
SPORT	SPORT mode indicator light (AT models)	3-24

: Coolant temperature high warning light (if equipped)

: Charge warning light

: Oil pressure warning light

AT OIL TEMP: AT OIL TEMP warning light (AT models)

: Low tire pressure warning light (U.S.- spec. models)

ABS / : ABS warning light

BRAKE / : Brake system warning light

: Low fuel warning light

: Hill start assist warning light (MT models)

: Door open warning light

AWD: AWD warning light (AT models)

: Vehicle Dynamics Control warning light/Vehicle Dynamics Control operation indicator light

: Vehicle Dynamics Control OFF indicator light

SPORT: SPORT mode indicator light (AT models)

CRUISE: Cruise control indicator light

SET/SET: Cruise control set indicator light

: Automatic headlight beam leveler warning light (models with HID headlights)

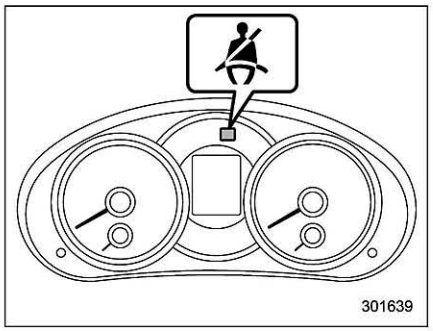
If any lights fail to illuminate, it indicates a burned-out bulb or a malfunction of the corresponding system.

Consult your authorized SUBARU dealer for repair.

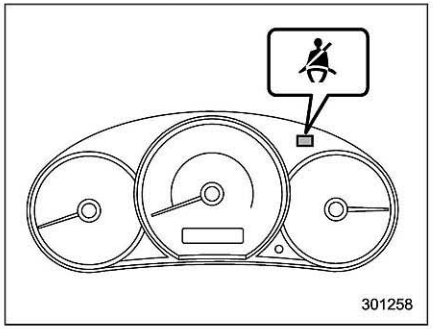
■ Seatbelt warning light and chime

Your vehicle is equipped with a seatbelt warning device at the driver's and front passenger's seat, as required by current safety standards.

With the ignition switch turned to the "ON" position, this device reminds the driver and front passenger to fasten their seatbelts by illuminating the warning lights in the locations indicated in the following illustration and sounding a chime.



Driver's warning light (type A)



Driver's warning light (type B)

– CONTINUED –

or with an excessively low air pressure in any of the tires.

⚠ CAUTION

Continuing to drive with the AWD warning light flashing can damage the powertrain. If the AWD warning light starts to flash, promptly park in a safe place and check whether the tires have differing diameters and whether any of the tires has an excessively low inflation pressure.

■ Automatic headlight beam leveler warning light (models with HID headlights)

This light illuminates when the automatic headlight beam leveler does not operate normally.

If this light illuminates while driving or does not turn off approximately 3 seconds after turning the ignition switch to the "ON" position, have your vehicle inspected at your SUBARU dealer.

■ Vehicle Dynamics Control warning light/ Vehicle Dynamics Control operation indicator light

▼ **Vehicle Dynamics Control warning light**

⚠ CAUTION

The Vehicle Dynamics Control system provides its ABS control through the electrical circuit of the ABS system. Accordingly, if the ABS is inoperative, the Vehicle Dynamics Control system becomes unable to provide ABS control. As a result, the Vehicle Dynamics Control system also becomes inoperative, causing the warning light to illuminate. Though both the Vehicle Dynamics Control and ABS systems are inoperative in this case, the ordinary functions of the brake system are still available. You will be safe while driving with this condition, but drive carefully and have your vehicle checked at a SUBARU dealer as soon as possible.

NOTE

- **If the electrical circuit of the Vehicle Dynamics Control system itself malfunctions, only this particular warning light illuminates. Under these circumstances, the ABS (Anti-lock Brake System) remains fully operational.**
- **The warning light illuminates when the electronic control system of the ABS/Vehicle Dynamics Control system malfunctions.**

The Vehicle Dynamics Control system is probably inoperative under any of the following conditions. Have your vehicle checked at a SUBARU dealer immediately.

- The warning light does not illuminate when the ignition switch is turned to the "ON" position.
- The warning light illuminates while the vehicle is running.

NOTE

If the warning light behavior is as described in the following examples, the Vehicle Dynamics Control system may be considered to be operating normally.

- **The warning light illuminates right after the engine is started but turns off immediately, remaining off.**
- **The warning light illuminates after**

the engine has started and turns off while the vehicle is subsequently being driven.

- **The warning light illuminates during driving, but it turns off immediately and remains off.**

▼ **Vehicle Dynamics Control operation indicator light**

The indicator light flashes during activation of the skid suppression function and during activation of the traction control function.

NOTE

- **The light may remain illuminated for a short period of time after the engine has been started, especially in cold weather. This does not indicate the existence of a problem. The light should turn off as soon as the engine has warmed up.**
- **The indicator light illuminates when the engine has developed a problem and the CHECK ENGINE warning light/ malfunction indicator lamp is on.**

The Vehicle Dynamics Control system is probably malfunctioning under the following condition. Have your vehicle checked at a SUBARU dealer as soon as possible.

- The light does not turn off even after the lapse of several minutes (the engine has warmed up) after the engine has started.

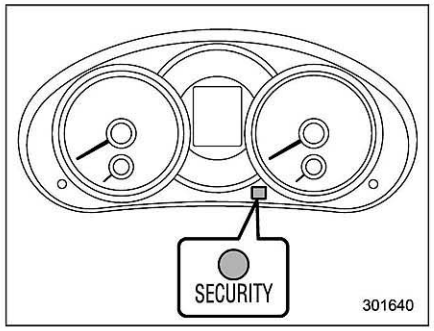
■ Vehicle Dynamics Control OFF indicator light

The light illuminates when the Vehicle Dynamics Control OFF switch is pressed to deactivate the Vehicle Dynamics Control system.

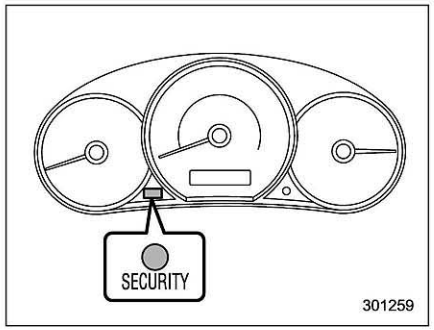
The Vehicle Dynamics Control system is probably malfunctioning under any of the following conditions. Have your vehicle checked at a SUBARU dealer immediately.

- The light does not illuminate when the ignition switch is turned to the "ON" position.
- The light does not turn off even after a period of approximately 2 seconds after the ignition switch has been turned to the "ON" position.

■ Security indicator light



Type A



Type B

The security indicator light deters potential thieves by indicating that the vehicle is

– CONTINUED –

7.1 OWNER'S MANUAL PAGES

5. If the brake fluid level is not below the "MIN" mark, the EBD system may be malfunctioning. Drive carefully to the nearest SUBARU dealer and have the system inspected.
6. If the brake fluid level is below the "MIN" mark, DO NOT drive the vehicle. Instead, have the vehicle towed to the nearest SUBARU dealer for repair.

⚠ WARNING

- **Driving with the brake system warning light illuminated is dangerous. This indicates your brake system may not be working properly. If the light remains on, have the brakes inspected by a SUBARU dealer immediately.**
- **If at all in doubt about whether the brakes are operating properly, do not drive the vehicle. Have your vehicle towed to the nearest SUBARU dealer for repair.**

Vehicle Dynamics Control system

⚠ WARNING

Always use the utmost care in driving – overconfidence because you are driving a vehicle with the Vehicle Dynamics Control system could easily lead to a serious accident.

⚠ CAUTION

- **Even if your vehicle is equipped with Vehicle Dynamics Control system, winter tires should be used when driving on snow-covered or icy roads; in addition, vehicle speed should be reduced considerably. Simply having a Vehicle Dynamics Control system does not guarantee that the vehicle will be able to avoid accidents in any situation.**
- **Activation of the Vehicle Dynamics Control system is an indication that the road being travelled on has a slippery surface; since having Vehicle Dynamics Control is no guarantee that full vehicle control will be maintained at all times and under all conditions, its activation should be seen as a sign that the speed of the vehicle should be reduced considerably.**
- **Whenever suspension components, steering components, or an axle are removed from a vehicle equipped with the Vehicle Dynamics Control system, have an inspection of that system performed by an authorized SUBARU dealer.**
- **The following precautions should be observed in order to ensure that the Vehicle Dynamics Control system is operating properly:**
  - **All four wheels should be fitted with tires of the same size, type, and brand. Furthermore, the amount of wear should be the same for all four tires.**
  - **Keep the tire pressure at the proper level as shown on the vehicle placard attached to the driver's side door pillar.**
  - **Use only the specified temporary spare tire to replace a flat tire. With a temporary**

– CONTINUED –

7.1 OWNER'S MANUAL PAGES

spare tire, the effectiveness of the Vehicle Dynamics Control system is reduced and this should be taken into account when driving the vehicle in such a condition.

In the event of wheelspin and/or skidding on a slippery road surface and/or during cornering and/or an evasive maneuver, the Vehicle Dynamics Control system adjusts the engine's output and the wheels' respective braking forces to help maintain traction and directional control.

- **Traction Control Function**

The traction control function is designed to prevent spinning of the driving wheels on slippery road surfaces, thereby helping to maintain traction and directional control. Activation of this function is shown by steady illumination of the Vehicle Dynamics Control operation indicator light.

- **Skid Suppression Function**

The skid suppression function is designed to help maintain directional stability by suppressing the wheels' tendency to slide sideways during steering operations. Activation of this function is shown by flashing of the Vehicle Dynamics Control operation indicator light.

NOTE

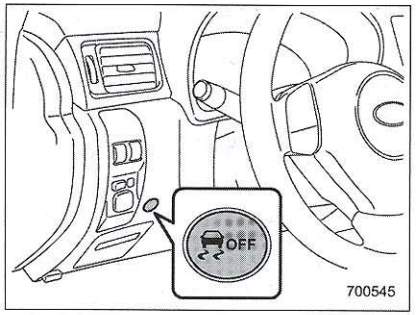
- **Slight twitching of the brake pedal may be felt when the Vehicle Dynamics Control system operates; a small degree of vehicle or steering wheel shaking may also be noticed in this situation. These are normal characteristics of Vehicle Dynamics Control operation and are no cause for alarm.**
- **When driving off immediately after starting the engine, a short-lived operation noise may be noticed coming from the engine compartment. This noise is generated as a result of a check being performed on the Vehicle Dynamics Control system and is normal.**
- **Depending on the timing of activation of the brakes, the brake pedal may seem to jolt when you drive off after starting the engine. This is a consequence of the Vehicle Dynamics Control operational check and is normal.**
- **In the circumstances listed in the following, the vehicle may be more unstable than it feels to the driver. The Vehicle Dynamics Control System may therefore operate. Such operation does not indicate a system malfunction.**
  - **– on gravel-covered or rutted roads**
  - **– on unfinished roads**
  - **– when the vehicle is fitted with snow tires or winter tires**
- **Activation of the Vehicle Dynamics Control system will cause operation of the steering wheel to feel slightly different compared to that for normal conditions.**
- **Even if the vehicle is equipped with a Vehicle Dynamics Control system, it is important that winter tires be used when driving on snow-covered or icy roads. (All four wheels should be fitted with tires of the same size and brand.)**
- **It is always important to reduce speed when approaching a corner, even if the vehicle is equipped with Vehicle Dynamics Control.**
- **All four wheels should be fitted with tires of the same size, type, and brand; furthermore, the amount of wear should be the same for all four tires. If these precautions are not observed and non-matching tires are used, it is quite possible that the Vehicle Dynamics Control system will be unable to operate correctly as intended.**
- **Always turn off the engine before replacing a tire. Failure to do so may render the Vehicle Dynamics Control system unable to operate correctly.**

7.1 OWNER'S MANUAL PAGES

■ Vehicle Dynamics Control system monitor

Refer to "Vehicle Dynamics Control warning light/Vehicle Dynamics Control operation indicator light" ☞3-22 and "Vehicle Dynamics Control OFF indicator light" ☞3-23.

■ Vehicle Dynamics Control OFF switch



Pressing the switch to deactivate the Vehicle Dynamics Control system can facilitate the following operations:

- a standing start on a steeply sloping road with a snowy, gravel-covered, or otherwise slippery surface
- extrication of the vehicle when its wheels are stuck in mud or deep snow

When the switch is pressed during engine operation, the Vehicle Dynamics Control OFF indicator light on the combination meter illuminates. The Vehicle Dynamics Control system will be deactivated and the vehicle will behave like a model not equipped with the Vehicle Dynamics Control system. When the switch is pressed again to reactivate the Vehicle Dynamics Control system, the Vehicle Dynamics Control OFF indicator light turns off.

With the Vehicle Dynamics Control system deactivated, traction and stability enhancement offered by Vehicle Dynamics Control system is unavailable. Therefore you should not deactivate the Vehicle Dynamics Control system except under above-mentioned situations.

NOTE

• When the switch has been pressed to deactivate the Vehicle Dynamics Control system, the Vehicle Dynamics Control system automatically reactivates itself the next time the ignition switch is turned to the "LOCK" position and the engine is restarted.

• If the switch is held down for 10 seconds or longer, the indicator light turns off, the Vehicle Dynamics Control system is activated, and the system ignores any further pressing of the switch. To make the switch usable again, turn the ignition switch to the "LOCK" position and restart the engine.

• When the switch is pressed to deactivate the Vehicle Dynamics Control system, the vehicle's running performance is comparable with that of a vehicle that does not have a Vehicle Dynamics Control system. Do not deactivate the Vehicle Dynamics Control system except when absolutely necessary.

• Even when the Vehicle Dynamics Control system is deactivated, components of the brake control system may still activate. When the brake control system is activated, the Vehicle Dynamics Control operation indicator light illuminates.

7.2 VEHICLE ARRIVAL CONDITION REPORT

CONTRACT NO.: *DTNH22-08-D-00098*
DATE: *6/30/2011*

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

Vehicle VIN: *JF2SHAGC3BH758458* NHTSA NO.: *CB5503*
Model Year: *2011* Odometer Reading: *11* Miles
Make *Subaru* Body Style: *MPV*
Model: *Forester* Body Color: *Black*
Manufacture Date: *3/11* Dealer: *Automotive Allies*
GVWR (kg/lb) *2035/4480* 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: *6/30/2011*

APPROVED BY: *B Kebschull* DATE APPROVED: *7/26/2011*

7.3 VEHICLE COMPLETION CONDITION REPORT

CONTRACT NO.: *DTNH22-08-D-00098*
DATE: *7/29/2011*

Vehicle VIN: *JF2SHAGC3BH758458* NHTSA NO.: *CB5503*
Model Year: *2011* Odometer Reading: *58* Miles
Make: *Subaru* Body Style: *MPV*
Model: *Forester* Body Color: *Black*
Manufacture Date: *3/11* Dealer: *Automotive Allies*
GVWR (kg/lb) *2035 (4480)* 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: *7/29/2011*

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

7.4 SINE WITH DWELL TEST RESULTS

2011 Subaru Forester
NHTSA No.: CB5503
Date of Test : *7/21/2011*
Date Created: *7/21/2011*

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)
23	710	50.14	3.545	1090	5.444	846	4.225	0.70	0.09	1290	0.30	0.04	1440	13.44	941	-3.96	0.34	43.12	775	42.93
24	709	50.09	3.539	1090	5.443	846	4.225	-0.39	-0.07	1290	-0.78	-0.14	1440	17.52	944	-5.22	0.39	57.30	775	56.85
25	708	50.08	3.534	1090	5.443	846	4.225	0.35	0.08	1290	-0.21	-0.04	1440	21.80	938	-6.27	0.44	71.23	775	70.84
26	708	50.75	3.531	1090	5.442	846	4.225	2.22	0.57	1290	-0.46	-0.12	1440	25.66	936	-7.42	0.47	85.22	775	84.83
27	707	50.39	3.529	1090	5.442	846	4.225	1.18	0.36	1290	-0.52	-0.16	1440	30.28	936	-8.21	0.49	99.20	775	98.82
28	707	50.62	3.527	1090	5.442	846	4.225	0.11	0.04	1290	-0.22	-0.08	1440	37.39	934	-8.94	0.45	114.06	775	113.57
29	707	50.12	3.526	1090	5.442	846	4.225	0.29	0.12	1290	-0.56	-0.22	1440	40.05	936	-9.28	0.47	128.29	775	127.81
30	706	50.37	3.524	1090	5.443	846	4.224	0.05	0.02	1290	0.26	0.10	1440	40.14	933	-9.72	0.43	142.18	775	141.91
31	706	50.15	3.525	1090	5.443	846	4.225	-0.56	-0.20	1290	-0.33	-0.12	1440	36.50	934	-9.81	0.40	156.17	775	155.90
32	706	50.40	3.525	1092	5.451	848	4.233	-0.34	-0.14	1292	-0.37	-0.15	1442	41.75	941	-10.18	0.26	170.19	775	169.93
34	706	50.35	3.524	1090	5.443	846	4.225	-0.08	-0.03	1290	-0.09	-0.04	1440	41.95	937	-10.10	0.34	185.20	775	184.87
35	706	50.18	3.524	1090	5.442	846	4.225	0.01	0.00	1290	0.22	0.10	1440	44.07	939	-10.33	0.34	199.12	775	198.99
36	706	50.53	3.524	1090	5.441	846	4.225	0.04	0.02	1290	0.11	0.05	1440	45.44	936	-10.23	0.38	213.12	775	212.89
37	706	50.34	3.525	1090	5.441	847	4.226	0.31	0.15	1290	0.40	0.20	1440	48.52	944	-10.44	0.18	227.17	775	227.01
38	706	50.18	3.525	1092	5.451	850	4.241	-1.21	-0.59	1292	-1.15	-0.57	1442	49.08	940	-10.63	0.26	243.33	778	238.68
39	706	50.37	3.525	1090	5.441	847	4.226	-0.10	-0.05	1290	-0.05	-0.02	1440	48.82	944	-10.46	0.23	255.91	776	255.80
40	707	50.36	3.526	1091	5.449	847	4.227	0.31	0.16	1291	0.58	0.29	1441	49.83	944	-10.93	0.18	269.58	776	271.14

7.4 SINE WITH DWELL TEST RESULTS

2011 Subaru Forester
NHTSA No.: CB5503
Date of Test : *7/21/2011*
Date Created: *7/21/2011*

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)
42	710	50.35	3.544	1090	5.444	847	4.226	0.78	-0.11	1290	0.55	-0.08	1440	-13.64	944	4.01	-0.33	43.89	775	43.54
43	709	50.08	3.538	1090	5.443	846	4.225	-0.07	0.01	1290	0.21	-0.04	1440	-17.99	945	5.05	-0.39	57.95	775	57.60
44	708	50.03	3.534	1090	5.442	846	4.225	0.08	-0.02	1290	-0.42	0.09	1440	-21.91	944	6.00	-0.43	71.96	775	71.52
45	707	50.33	3.530	1090	5.441	846	4.225	1.14	-0.30	1290	0.01	0.00	1440	-26.62	953	6.93	-0.44	86.01	775	85.46
46	707	50.18	3.527	1091	5.448	846	4.225	3.72	-1.12	1291	-0.26	0.08	1441	-30.20	933	7.76	-0.41	99.95	775	99.39
47	707	50.41	3.526	1090	5.443	846	4.225	0.11	-0.04	1290	0.21	-0.07	1440	-35.98	931	8.24	-0.42	114.89	775	114.28
48	706	50.27	3.524	1090	5.441	846	4.224	-0.69	0.29	1290	-0.64	0.27	1440	-41.38	934	8.60	-0.37	129.01	775	128.41
49	706	50.60	3.524	1091	5.450	848	4.232	-0.26	0.11	1291	0.00	0.00	1441	-43.81	937	9.11	-0.28	143.03	775	142.86
50	706	50.22	3.523	1090	5.445	846	4.225	-0.01	0.00	1290	0.05	-0.02	1440	-39.98	936	9.08	-0.29	156.95	775	156.35
51	706	50.13	3.523	1091	5.450	846	4.225	0.17	-0.07	1291	-0.08	0.03	1441	-42.52	933	9.22	-0.37	171.05	775	170.27
52	706	50.28	3.523	1090	5.442	846	4.225	0.36	-0.15	1290	0.38	-0.16	1440	-41.49	940	9.60	-0.20	186.01	775	185.28
53	706	50.54	3.524	1090	5.444	847	4.226	0.20	-0.08	1290	-0.02	0.01	1440	-42.72	948	9.62	-0.17	200.10	775	199.23
54	706	50.22	3.524	1090	5.443	847	4.226	0.30	-0.13	1290	0.21	-0.09	1440	-42.59	943	9.69	-0.20	214.07	775	213.17
55	706	50.29	3.524	1090	5.442	847	4.226	0.22	-0.10	1290	-0.22	0.10	1440	-45.03	948	9.88	-0.20	228.13	775	227.28
56	706	50.28	3.524	1090	5.443	847	4.226	0.24	-0.11	1290	0.22	-0.10	1440	-44.92	941	9.89	-0.23	242.18	775	241.17
57	706	50.25	3.524	1090	5.442	847	4.226	0.31	-0.15	1290	0.15	-0.07	1440	-47.20	945	9.84	-0.23	256.85	775	256.09
58	706	50.39	3.525	1090	5.442	847	4.226	0.12	-0.06	1290	-0.06	0.03	1440	-50.53	945	9.82	-0.26	270.75	776	269.95

7.5 SLOWLY INCREASING STEER TEST RESULTS

2011 Subaru Forester
NHTSA No.: *CB5503*
Date of Test: *7/21/2011*
Date Created: *7/21/2011*

File	EventPt	DOS	MES (mph)	Mean SPD (mph)	AYcount_3	THETAENCF_3 (deg)	AYCG_CD2_3 (g)	r_squared	ZeroBegin	ZeroEnd
10	717	1	50.267	50.153	1133	-28.804	-0.308	0.990	517	717
11	716	1	50.134	50.370	1132	-28.815	-0.308	0.990	516	716
12	707	1	49.825	50.102	1130	-28.635	-0.293	0.995	507	707
14	719	0	49.825	50.238	1119	27.998	0.296	0.994	519	719
15	700	0	49.930	49.993	1118	27.961	0.299	0.996	500	700
16	718	0	50.176	50.363	1121	28.211	0.295	0.996	518	718
				Averages		28.4	0.300			

Scalars	Steering Angles (deg)
1.5	43
2.0	57
2.5	71
3.0	85
3.5	99
4.0	114
4.5	128
5.0	142

Scalars	Steering Angles (deg)
5.5	156
6.0	170
6.5	185
7.0	199
7.5	213
8.0	227
8.5	241
9.0	256

Scalars	Steering Angles (deg)
9.5	270

7.6 INERTIAL SENSING SYSTEM LOCATION COORDINATES

Vehicle:	**2011 Subaru Forester**	NHTSA No.:	CB5503
Wheelbase:	103 Inches	Faro Arm S/N:	U08-05-08-06636
Measurement date:	7/14/2011	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	2.501		0.000
M_Point_48_Ref	0.000	0.000	-
M_CIRCLE001_I_Left_Rear_Wheel_Axle	-24.350	13.498	-12.459
M_Point_IMU_side	10.305	46.374	-20.520
M_Point_ROOF	-	-	-64.456
Motion Pak reference point taken from mid height of unit left side			
Motion Pak Width = 3.05" ==> 1/2 W = 1.525			
Motion_PAK_Location	10.305	47.899	-20.520

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	**68.345**	**-0.101**	**20.520**

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).