126-TRC-11-007

SAFETY COMPLIANCE TESTING FOR FMVSS 126
Electronic Stability Control Systems

Mazda Motor Corporation
2011 Mazda2
NHTSA No. CB5402

TRANSPORTATION RESEARCH CENTER INC.
10820 State Route 347
East Liberty, Ohio 43319

September 14, 2011

FINAL REPORT

Prepared Under Contract No.: DTNH22-08-D-00097

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

Prepared for the Department of Transportation, National Highway Traffic Safety Administration, under Contract No. DTNH22-08-D-00097.

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16. Abstract A test was conducted on a 2011 Mazda2, NHTSA No. CB5402, 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 MY 2011 Mazda2 meets the minimum equipment and performance requirements stated in Federal Motor Vehicle Safety Standard (FMVSS) 126, "Electronic Stability Control Systems."

This standard establishes performance and equipment requirements for Electronic Stability Control (ESC) Systems installed in passenger cars, multipurpose passenger vehicles, trucks, and buses with a gross vehicle weight rating of 4,536 kilograms or less.

2.0 TEST PROCEDURE AND DISCUSSION OF RESULTS

Testing of the MY 2011 Mazda 2 was conducted at Transportation Research Center Inc. (TRC Inc.) 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 20km/h (12.4mph), when being driven in reverse, or during system initialization).

The vehicle was subjected to a 0.7Hz Sine with Dwell (SWD) 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).
- At 1.75 seconds after completion of a required sine with dwell steering input, the yaw rate of the vehicle must not exceed 20 percent of the first peak value of yaw rate recorded after the steering wheel angle changes sign (between first and second peaks during the same test run).
- The lateral displacement of the vehicle center of gravity with respect to its initial

straight path must be at least 1.83 m (6 feet) (for vehicles with a GVWR of 3,500kg (7,716 lb) or less) when computed 1.07 seconds after the Beginning of Steer (BOS) at the specified steering wheel angles.

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

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

2.0 TEST PROCEDURE AND DISCUSSION OF RESULTS …continued

DATA SUMMARY (Sheet 1 of 2)

VEHICLE MAKE/MODEL/BODY STYLE: Mazda / 2 / Passenger Car

VEHICLE NHTSA NO.: CB5402 VIN: JM1DE1HY3B0106366

VEHICLE TYPE: Passenger Car DATE OF MANUFACTURE: 07/10

LABORATORY: Transportation Research Center 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)	
The 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)	
The 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 …continued

DATA SUMMARY (Sheet 2 of 2)

REQUIREMENTS	PASS/FAIL
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
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 lbs.) or less, and 1.52 m (5 feet) for vehicles with a GVWR greater than 3,500 kg (7,716 lbs.). (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

REMARKS

3.0 TEST DATA

DATA SHEET 1 (Sheet 1 of 2)
TEST VEHICLE INSPECTION AND TEST PREPARATION

VEHICLE MAKE/MODEL/BODY STYLE: Mazda / 2 / Passenger Car

NHTSA No.: CB5402 TEST DATE: 8-16-11

VIN: JM1DE1HY3B0106366 MANUFACTURE DATE: 07/10

GVWR: 1,502 KG FRONT GAWR: 799 KG REAR GAWR 703 KG

SEATING POSITIONS: FRONT 2 REAR 3

ODOMETER READING AT START OF TEST: 21 (34) Miles (Kilometers)

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
Manufacturer and Model	Yokohama Avid S34	Yokohama Avid S34
Tire Size Designation	185 / 55R 15 82V	185 / 55R 15 82V

Are installed tire sizes same as labeled tire sizes? X Yes _____ No
If no, contact COTR for further guidance.

DRIVE CONFIGURATIONS (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 not locked full time (4WD Automatic)
_____ Four Wheel Drive High Gear Unlocked Center Differential
_____ Four Wheel Drive High Gear Locked Center Differential
_____ Four Wheel Drive Low Gear Unlocked Center Differential
_____ Four Wheel Drive Low Gear Locked Center Differential
_____ Other (define _____)

3.0 TEST DATA….continued

DATA SHEET 1 (Sheet 2 of 2)
TEST VEHICLE INSPECTION AND TEST PREPARATION

DRIVE CONFIGURATIONS AND MODES: (ex. default, performance, off)
(For each of the vehicle's drive configurations identify available operating modes)

Drive Configuration 2WD
Mode(s) default

Drive Configuration _____
Mode(s) _____

Drive Configuration _____
Mode(s) _____

VEHICLE STABILITY SYSTEMS (Check applicable technologies):

X ESC X Traction Control _____ Roll Stability Control

_____ Active Suspension X Electronic Throttle Control _____ Active Steering

X ABS

List other systems; _____

_____

REMARKS:

RECORDED BY: Alan Ida DATE: 8-16-11
APPROVED BY: Ken Webster DATE: 8-22-11

3.0 TEST DATA….continued

DATA SHEET 2 (Sheet 1 of 2)
ESC SYSTEM HARDWARE AND OPERATIONAL CHARACTERISTICS

VEHICLE MAKE/MODEL/BODY STYLE: Mazda / 2 / Passenger Car

NHTSA No.: CB5402 TEST DATE: 8-16-11

ESC SYSTEM IDENTIFICATION:

Manufacturer / Model Continental Automotive Systems / MK60

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; Engine Management interface, Brake Actuation

ESC SYSTEM OPERATIONAL CHARACTERISTICS:

System is capable of generating brake torques at each wheel X Yes (PASS)
_____ No (FAIL)

List and describe component(s): Hydraulic Control Unit with Integrated Control Unit

System is capable of determining yaw rate X Yes (PASS)
_____ No (FAIL)

List and describe component(s): Yaw Rate Sensor that resides in the Restrain Control Module (RCM)

System is capable of monitoring driver steering input X Yes (PASS)
_____ No (FAIL)

List and describe component(s): Steering wheel angle sensor (built in the EPAS system)

System is capable of estimating side slip or side slip derivation X Yes (PASS)
_____ No (FAIL)

List and describe component(s): The Hydraulic Control Unit estimates the side slip angle by calculating vehicle behavior based on the following inputs: wheel speed, steering wheel angle, yaw rate, and lateral acceleration signal inputs. The side slip derivative is calculated by the hydraulic control unit.

3.0 TEST DATA….continued

DATA SHEET 2 (Sheet 2 of 2)
ESC SYSTEM HARDWARE AND OPERATIONAL CHARACTERISTICS

ESC SYSTEM OPERATIONAL CHARACTERISTICS (continued):

System is capable of modifying engine torque during ESC activation. ___X___ Yes (PASS)
_____ No (FAIL)

Method used to modify engine torque: Controlling throttle by electronic throttle control and/or reducing the engine spark and cutting fuel.

System is capable of activation at speeds of 20 km/h (12.4 mph) and higher. ___X___ Yes (PASS)
_____ No (FAIL)

Speed system becomes active. 14.4 km/h (8.9 mph)

System is capable of activation during the following driving phases (acceleration, deceleration, coasting, and during activation of ABS or traction control). ___X___ Yes (PASS)
_____ No (FAIL)

Driving phases that the system is capable of activation. Acceleration, deceleration, coasting, and during activation of ABS or traction control

Vehicle manufacturer submitted documentation explaining how the ESC system mitigates understeer? ___X___ Yes (PASS)
_____ No (FAIL)

DATA INDICATES COMPLIANCE PASS/FAIL PASS

RECORDED BY: Alan Ida DATE: 8-19-11
APPROVED BY: Ken Webster DATE: 8-22-11

3.0 TEST DATA….continued

DATA SHEET 3 (Sheet 1 of 2)
ESC MALFUNCTION AND OFF TELLTALES

VEHICLE MAKE/MODEL/BODY STYLE: Mazda / 2 / Passenger Car

VEHICLE NHTSA NO. CB5402 TEST DATE: 8-19-11

ESC Malfunction Telltale

Vehicle is equipped with malfunction telltale? X Yes (Pass) ____ No (Fail)

Telltale Location Instrument cluster, left side, inside the tachometer

Telltale Color Amber

Telltale symbol or abbreviation used.

Or **ESC**

X Vehicle uses this symbol
____ Vehicles 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? ____ Yes X No

Is telltale also used to indicate activation of the ESC system? X Yes ____ No

If yes, explain telltale operation during ESC activation: During ESC Activation, the ESC telltale flashes.

DATA SHEET 3 (Sheet 2 of 2)
ESC MALFUNCTION AND OFF TELLTALES

"ESC OFF" Telltale (if provided)

Vehicle is equipped with "ESC Off" telltale? __X__ Yes _____ No

Is "ESC OFF" telltale combined with "ESC Malfunction" telltale utilizing a two part telltale?

_____ Yes __X__ No

Telltale Location Instrument cluster, center, inside the speedometer

Telltale Color Amber

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.
The ESC Off telltale is not proportionally sized. The dimension of the height is shorter than the width.

Is telltale part of a common space? _____ Yes __X__ No

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

REMARKS:

RECORDED BY: Alan Ida DATE: 8-19-11
APPROVED BY: Ken Webster DATE: 8-22-11

3.0 TEST DATA….continued

DATA SHEET 4 (Sheet 1 of 3)
ESC AND ANCILLARY SYSTEM CONTROLS

"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 Instrument panel, left of the steering column and below the driver side vent
Labeling Skidding car symbol with "Off" underneath
Modes Traction Control and DSC Off
Traction Control and DSC On

Identify standard or default drive configuration Default – 2WD

Verify standard or default drive configuration selected. __X__ Yes _____ No

Does the "ESC Off" telltale illuminate upon activation of the dedicated ESC off control or selection of the "ESC Off" mode on the multi-function control?

__X__ Yes _____ No (fail)

Does the "ESC Off" telltale extinguish when the ignition is cycled from "On" ("Run") to "Lock" or "Off" and then back again to the "On" ("Run") position?

__X__ Yes _____ No (fail)

If no, describe how the off control functions:

3.0 TEST DATA….continued

DATA SHEET 4 (Sheet 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 Modes	"ESC Off" telltale illuminates upon activation of control? (Yes/No)	"ESC Off" telltale extinguishes upon cycling ignition? (Yes/No)
N/A		

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?

_____ Yes _____ No (fail)

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

List and describe each control (i.e. alternate drive configuration selection controls):

Ancillary Control: System N/A
Control Description _____
Labeling _____

Ancillary Control: System N/A
Control Description _____
Labeling _____

3.0 TEST DATA….continued

DATA SHEET 4 (Sheet 3 of 3)
ESC AND ANCILLARY SYSTEM CONTROLS

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

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

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)
N/A	

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

_____ Yes _____ No (fail)

DATA INDICATES COMPLIANCE: PASS/FAIL PASS

REMARKS:

RECORDED BY: Alan Ida DATE: 8-19-11
APPROVED BY: Ken Webster DATE: 8-22-11

3.0 TEST DATA….continued

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

VEHICLE MAKE/MODEL/BODY STYLE: Mazda / 2 / Passenger Car

NHTSA No.: CB5402 TEST DATE: 8-18-11

Test Track Requirements: Test Surface Slope (0-1 %) 1 %

Peak Friction Coefficient (at least 0.9) 0.97

Full Fluid Levels: Fuel X Coolant X Other Fluids Washer (specify)

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: Track Width 147.3 cm Wheelbase 249.2 cm

Roof Height 145.5 cm

Vehicle weight ratings: GAWR Front 799 KG GAWR Rear 703 KG

Unloaded Vehicle Weight (UVW)

Front Axle 663.8 KG Left Front 334.8 KG Right Front 329.0 KG

Rear Axle 398.6 KG Left Rear 209.6 KG Right Rear 189.0 KG

Total UVW 1,062.4 KG

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

Calculated Baseline Weight (UVW+ 73 kg) 1,135.4 KG

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

Standard - Baseline weight under 2,722 kg (6,000 lbs.)
Heavy - Baseline weight equal to or greater than 2,722 kg (6,000 lbs.)

3.0 TEST DATA….continued

DATA SHEET 5 (Sheet 2 of 3)
VEHICLE AND TEST TRACK DATA

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

Front Axle 737.8 KG Left Front 377.6 KG Right Front 360.2 KG

Rear Axle 459.8 KG Left Rear 244.6 KG Right Rear 215.2 KG

Total Loaded Vehicle Weight 1,197.6 KG

Ballast Required = [**Total Unloaded Vehicle Weight** + 168 KG] - **Total Loaded Weight w/ Driver and Instrumentation**

= [1,062.4 KG + 168 KG] - 1,197.6 KG

= 32.8 KG

Total Loaded Vehicle Weight

Front Axle 751.2 KG Left Front 379.8 KG Right Front 371.4 KG

Rear Axle 479.2 KG Left Rear 250.4 KG Right Rear 228.8 KG

Total Loaded Vehicle Weight 1,230.4 KG

3.0 TEST DATA….continued

DATA SHEET 5 (Sheet 3 of 3)
VEHICLE AND TEST TRACK 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	97.1 cm	149.1 cm
y-distance	-1.8 cm	-0.4 cm
z-distance	55.3 cm	82.4 cm

Distance Between Ultrasonic Sensors: 176.1 cm

TEST TRACK DATA MEETS REQUIREMENTS: YES/NO YES
If no, explain: _____

REMARKS:

RECORDED BY: Alan Ida DATE: 8-18-11
APPROVED BY: Ken Webster DATE: 8-22-11

3.0 TEST DATA….continued

DATA SHEET 6 (Sheet 1 of 3)
BRAKE AND TIRE CONDITIONING

VEHICLE MAKE/MODEL/BODY STYLE: Mazda / 2 / Passenger Car

VEHICLE NHTSA No.: CB5402

Measured Cold Tire Pressures: LF 220 kPa RF 220 kPa

LR 210 kPa RR 210 kPa

Wind Speed 0.4 m/sec
(10m/sec (22mph) max for passenger cars; 5m/s (11mph) max. for MPVs and Trucks)

Ambient Temperature (7°C (45°F) - 40°C (104°F)) 21.7 °C

Brake Conditioning Time; 8:27 AM Date; 8-19-11

56 km/h (35 mph) Brake Stops

Number of stops executed (10 required) 10 stops

Observed deceleration rate range (.5g target) 0.50 – 0.55 g

72 km/h (45 mph) Brake Stops

Number of stops executed (3 required) 3 stops

Number of stops ABS activated (3 required) 3 stops

Observed deceleration rate range 1.00 – 1.20 g

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

Duration of cool down period (5 minutes min.) 5:17 minutes

3.0 TEST DATA….continued

DATA SHEET 6 (Sheet 2 of 3)
BRAKE AND TIRE CONDITIONING

Tire Conditioning Series No. 1 Time: 8:45 AM Date: 8-19-11

Measured Tire Pressures: LF 241 kPa RF 239 kPa

LR 219 kPa RR 221 kPa

Wind Speed 1.8 m/sec
(10m/sec (22mph) max for passenger cars; 5m/s (11mph) max. for MPVs and Trucks)

Ambient Temperature (7°C (45°F) - 40°C (104°F)) 23.3 °C

30 meter (100 ft) Diameter Circle Maneuver				
Test Runs	Steering Direction	Target Lateral Acceleration (g)	Observed Lateral Acceleration (g)	Observed Vehicle Speed (km/h)
1-3	Clockwise	0.5-0.6	0.55	32.5
4-6	Counterclockwise	0.5-0.6	0.55	32.5

1 Hz 5 Cycle Sinusoidal Steering Maneuver to Determine Steering Wheel Angle For 0.5-0.6g Lateral Acceleration				
Test Runs	Vehicle Speed Km/h(mph)	Steering Wheel Angle (degrees)	Target Peak Lateral Acceleration (g)	Observed Peak Lateral Acceleration (g)
1	56±2 (35±1)	30	0.5-0.6	0.38
2	56±2 (35±1)	40	0.5-0.6	0.48
3	56±2 (35±1)	50	0.5-0.6	0.58
4	56±2 (35±1)		0.5-0.6	

Steering wheel angle that corresponds to a peak 0.5–0.6g lateral acceleration; 50 degrees

1 Hz 10 Cycle Sinusoidal Steering Maneuver				
Test Runs	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)	50 (cycles 1-10)	0.5-0.6	0.56
4	56±2 (35±1)	50 (cycles 1-9)	0.5-0.6	0.56
		100 (cycle 10)*	N/A	0.80

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

3.0 TEST DATA….continued

DATA SHEET 6 (Sheet 3 of 3)
BRAKE AND TIRE CONDITIONING

Tire Conditioning Series No. 2 Time: 10:20 AM Date: 8-19-11

Measured Tire Pressures: LF 245 kPa RF 241 kPa

LR 221 kPa RR 222 kPa

Wind Speed 1.3 m/sec
(10m/sec (22mph) max for passenger cars; 5m/s (11mph) max. for MPVs and Trucks)

Ambient Temperature (7°C (45°F) - 40°C (104°F)) 25.6 °C

30 meter (100 ft) Diameter Circle Maneuver				
Test Runs	Steering Direction	Target Lateral Acceleration (g)	Observed Lateral Acceleration (g)	Observed Vehicle Speed (km/h)
1-3	clockwise	0.5-0.6	0.55	32.5
4-6	counterclockwise	0.5-0.6	0.55	32.5

1 Hz 5 Cycle Sinusoidal Steering Maneuver to Determine Steering Wheel Angle For 0.5-0.6g Lateral Acceleration				
Test Runs	Vehicle Speed Km/h (mph)	Steering Wheel Angle (degrees)	Target Peak Lateral Acceleration (g)	Observed Peak Lateral Acceleration (g)
1	56±2 (35±1)	N/A	0.5-0.6	N/A
2	56±2 (35±1)		0.5-0.6	
3	56±2 (35±1)		0.5-0.6	
4	56±2 (35±1)		0.5-0.6	

Steering wheel angle that corresponds to a peak 0.5–0.6g lateral acceleration; 50 degrees

1 Hz 10 Cycle Sinusoidal Steering Maneuver				
Test Runs	Vehicle Speed (mph)	Steering Wheel Angle (degrees)	Target Peak Lateral Acceleration (g)	Observed Peak Lateral Acceleration (g)
1 - 3	56±2 (35±1)	50 (cycles 1-10)	0.5-0.6	0.58
4	56±2 (35±1)	50 (cycles 1-9)	0.5-0.6	0.58
		100 (cycle 10)*	N/A	0.85

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

REMARKS:

RECORDED BY: Alan Ida DATE: 8-19-11
APPROVED BY: Ken Webster DATE: 8-22-11

3.0 TEST DATA….continued

DATA SHEET 7 (1 of 2)
SLOWLY INCREASING STEER (SIS) MANEUVER

VEHICLE MAKE/MODEL/BODY STYLE: Mazda / 2 / Passenger Car

VEHICLE NHTSA No.: CB5402 TEST DATE: 8-19-11

Wind Speed 1.8 m/sec
(10m/sec (22mph) max for passenger cars; 5m/s (11mph) max. for MPVs and Trucks)

Ambient Temperature (7°C (45°F) - 40°C (104°F)) 24.4 °C

Static Data File Number: 0011

Selected Drive Configuration: 2WD

Selected Mode: default

Preliminary Left Steer Maneuver:

Lateral Acceleration measured at 30 degrees steering wheel angle ($a_{y,30\ degrees}$)

$a_{y,30\ degrees}$ = 0.46 g

Assuming a linear relationship the following ratio should be used to calculate the steering wheel angle at .55g.

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

δ_{SIS} = 35.9 degrees @ 0.55g

δ_{SIS} = 40 degrees (rounded)

Steering Wheel Angle at Corrected 0.3 g Lateral Acceleration:

Maneuver #	Initial Steer Direction	Time Clock (5 min max between runs)	Steering Wheel Angle to nearest 0.1 degree (degrees)	All Conditions Met?
0013	Left	9:31 am	-24.6	Yes
0014	Left	9:34 am	-24.7	Yes
0015	Left	9:38 am	-24.4	Yes
0016	Right	9:41 am	24.7	Yes
0018	Right	9:47 am	25.0	Yes
0019	Right	9:50 am	25.3	Yes

3.0 TEST DATA….continued

DATA SHEET 7 (2 of 2)
SLOWLY INCREASING STEER (SIS) MANEUVER

Average Overall Steering Wheel Angle:

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

$\delta_{0.3\ g,\ overall}$ = 24.8 degrees
[to nearest 0.1 degree]

REMARKS:

File 0017 was omitted due to lateral acceleration exceeding the permitted limit. Therefore, the time clock indicates more than 5 minutes between maneuvers 0016 and 0018.

RECORDED BY: Alan Ida DATE: 8-19-11
APPROVED BY: Ken Webster DATE: 8-22-11

3.0 TEST DATA….continued

DATA SHEET 8 (1 of 3)
VEHICLE LATERAL STABILITY AND RESPONSIVENESS

VEHICLE MAKE/MODEL/BODY STYLE: Mazda / 2 / Passenger Car

VEHICLE NHTSA No.: CB5402 TEST DATE: 8-19-11

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

Selected Drive Configuration: 2WD
Selected Mode: default

Overall steering wheel angle ($\delta_{0.3\ g,\ overall}$) 24.8 degrees

Static Data File Number 0024

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

Maneuver #	Clock Time (1.5 – 5 min between each test run)	Commanded Steering Wheel Angle[1] (degrees)		Yaw Rates (degrees/sec)			YRR at 1.0 sec after COS [≤ 35%]		YRR at 1.75 sec after COS [≤ 20%]	
		Scalar	Angle	$\dot{\psi}_{Peak}$	$\dot{\psi}_{1.0sec}$	$\dot{\psi}_{1.75sec}$	%	Pass/ Fail	%	Pass/ Fail
0025	10:55 am	1.5* $\delta_{0.3\ g}$	37	10.99	-0.17	-0.20	-1.59	Pass	-1.82	Pass
0026	10:58 am	2.0* $\delta_{0.3\ g}$	50	15.15	0.27	0.09	1.76	Pass	0.58	Pass
0027	11:01 am	2.5* $\delta_{0.3\ g}$	62	18.63	-0.06	-0.16	-0.30	Pass	-0.89	Pass
0028	11:04 am	3.0* $\delta_{0.3\ g}$	74	21.92	-0.02	-0.06	-0.11	Pass	-0.28	Pass
0029	11:07 am	3.5* $\delta_{0.3\ g}$	87	25.24	-0.32	-0.15	-1.25	Pass	-0.58	Pass
0030	11:10 am	4.0* $\delta_{0.3\ g}$	99	30.61	-0.53	0.15	-1.74	Pass	0.48	Pass
0031	11:13 am	4.5* $\delta_{0.3\ g}$	112	37.60	1.41	0.04	3.76	Pass	0.11	Pass
0032	11:15 am	5.0* $\delta_{0.3\ g}$	124	40.51	2.08	-0.03	5.14	Pass	-0.07	Pass
0033	11:18 am	5.5* $\delta_{0.3\ g}$	136	44.35	1.76	0.07	3.98	Pass	0.16	Pass
0034	11:21 am	6.0* $\delta_{0.3\ g}$	149	48.78	1.79	-0.05	3.67	Pass	-0.11	Pass
0035	11:24 am	6.5* $\delta_{0.3\ g}$	161	52.43	-0.50	0.12	-0.95	Pass	0.23	Pass
0036	11:27 am	7.0* $\delta_{0.3\ g}$	174	54.90	-0.65	0.07	-1.19	Pass	0.12	Pass
0037	11:32 am	7.5* $\delta_{0.3\ g}$	186	57.31	-0.04	-0.09	-0.07	Pass	-0.15	Pass
0038	11:37 am	8.0* $\delta_{0.3\ g}$	198	58.55	0.61	-0.01	1.03	Pass	-0.02	Pass
0039	11:40 am	8.5* $\delta_{0.3\ g}$	211	61.18	1.77	-0.02	2.89	Pass	-0.04	Pass
0040	11:43 am	9.0* $\delta_{0.3\ g}$	223	62.79	2.12	0.21	3.38	Pass	0.33	Pass
0041	11:46 am	9.5* $\delta_{0.3\ g}$	236	62.58	0.86	0.08	1.38	Pass	0.12	Pass
0042	11:51 am	10.0* $\delta_{0.3\ g}$	248	62.24	1.51	0.02	2.42	Pass	0.04	Pass
0043	11:56 am	10.5* $\delta_{0.3\ g}$	260	65.57	-3.02	0.04	-4.60	Pass	0.06	Pass
0044	12:01 pm	10.9* $\delta_{0.3\ g}$	270	63.14	-6.15	-0.15	-9.74	Pass	-0.24	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….continued

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 min between each test run)	Commanded Steering Wheel Angle[1] (degrees)		Yaw Rates (degrees/sec)			YRR at 1.0 sec after COS [≤ 35%]		YRR at 1.75 sec after COS [≤ 20%]	
		Scalar	Angle	$\dot{\psi}_{Peak}$	$\dot{\psi}_{1.0\text{sec}}$	$\dot{\psi}_{1.75\text{sec}}$	%	Pass/ Fail	%	Pass/ Fail
0045	12:06 pm	1.5* $\delta_{0.3\ g}$	37	-11.51	-0.07	0.03	0.62	Pass	-0.28	Pass
0046	12:09 pm	2.0* $\delta_{0.3\ g}$	50	-15.20	-0.10	0.06	0.66	Pass	-0.38	Pass
0047	12:12 pm	2.5* $\delta_{0.3\ g}$	62	-18.72	0.04	-0.07	-0.22	Pass	0.38	Pass
0048	12:15 pm	3.0* $\delta_{0.3\ g}$	74	-22.61	-0.14	-0.01	0.63	Pass	0.05	Pass
0049	12:18 pm	3.5* $\delta_{0.3\ g}$	87	-24.77	0.03	0.03	-0.12	Pass	-0.13	Pass
0050	12:21 pm	4.0* $\delta_{0.3\ g}$	99	-30.63	0.47	0.00	-1.52	Pass	0.01	Pass
0051	12:24 pm	4.5* $\delta_{0.3\ g}$	112	-37.73	-0.57	-0.22	1.52	Pass	0.59	Pass
0052	12:27 pm	5.0* $\delta_{0.3\ g}$	124	-43.31	-0.21	0.04	0.49	Pass	-0.10	Pass
0053	12:30 pm	5.5* $\delta_{0.3\ g}$	136	-47.84	0.25	-0.11	-0.53	Pass	0.24	Pass
0054	12:33 pm	6.0* $\delta_{0.3\ g}$	149	-52.90	0.27	-0.07	-0.51	Pass	0.13	Pass
0055	12:36 pm	6.5* $\delta_{0.3\ g}$	161	-56.38	0.39	0.06	-0.70	Pass	-0.11	Pass
0056	12:38 pm	7.0* $\delta_{0.3\ g}$	174	-60.87	0.22	-0.04	-0.37	Pass	0.06	Pass
0057	12:41 pm	7.5* $\delta_{0.3\ g}$	186	-62.68	0.44	-0.02	-0.71	Pass	0.03	Pass
0058	12:44 pm	8.0* $\delta_{0.3\ g}$	198	-66.22	0.81	0.08	-1.22	Pass	-0.12	Pass
0059	12:47 pm	8.5* $\delta_{0.3\ g}$	211	-68.03	-0.33	0.09	0.49	Pass	-0.13	Pass
0060	12:50 pm	9.0* $\delta_{0.3\ g}$	223	-71.06	-2.05	0.03	2.89	Pass	-0.04	Pass
0061	12:53 pm	9.5* $\delta_{0.3\ g}$	236	-72.19	-2.05	0.02	2.84	Pass	-0.02	Pass
0062	12:56 pm	10.0* $\delta_{0.3\ g}$	248	-73.12	2.89	-0.20	-3.95	Pass	0.27	Pass
0063	12:58 pm	10.5* $\delta_{0.3\ g}$	260	-77.16	-1.27	0.21	1.64	Pass	-0.28	Pass
0064	1:01 pm	10.9* $\delta_{0.3\ g}$	270	-75.78	-6.77	0.48	8.94	Pass	-0.63	Pass

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

During execution of the sine with dwell maneuvers were any of the following events observed?

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

If "Yes" explain the event and consult with the COTR. The Mazda2 experienced momentary wheel lift at the right rear for counterclockwise initial steer tests Scalar 5.5 through 10.9. For clockwise initial steer tests, the vehicle experienced momentary wheel lift at the right rear for Scalar 7.0 through 10.9 and wheel lift at the left rear for Scalar 6.0 through 10.9.

3.0 TEST DATA….continued

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	Angle (degrees)	Distance (m)	Pass/Fail
0032	Counter Clockwise	5.0* $\delta_{0.3\ g}$	124	3.29	Pass
0033	Counter Clockwise	5.5* $\delta_{0.3\ g}$	136	3.40	Pass
0034	Counter Clockwise	6.0* $\delta_{0.3\ g}$	149	3.43	Pass
0035	Counter Clockwise	6.5* $\delta_{0.3\ g}$	161	3.51	Pass
0036	Counter Clockwise	7.0* $\delta_{0.3\ g}$	174	3.53	Pass
0037	Counter Clockwise	7.5* $\delta_{0.3\ g}$	186	3.57	Pass
0038	Counter Clockwise	8.0* $\delta_{0.3\ g}$	198	3.55	Pass
0039	Counter Clockwise	8.5* $\delta_{0.3\ g}$	211	3.54	Pass
0040	Counter Clockwise	9.0* $\delta_{0.3\ g}$	223	3.57	Pass
0041	Counter Clockwise	9.5* $\delta_{0.3\ g}$	236	3.54	Pass
0042	Counter Clockwise	10.0* $\delta_{0.3\ g}$	248	3.50	Pass
0043	Counter Clockwise	10.5* $\delta_{0.3\ g}$	260	3.50	Pass
0044	Counter Clockwise	10.9* $\delta_{0.3\ g}$	270	3.45	Pass
0052	Clockwise	5.0* $\delta_{0.3\ g}$	124	3.32	Pass
0053	Clockwise	5.5* $\delta_{0.3\ g}$	136	3.42	Pass
0054	Clockwise	6.0* $\delta_{0.3\ g}$	149	3.53	Pass
0055	Clockwise	6.5* $\delta_{0.3\ g}$	161	3.62	Pass
0056	Clockwise	7.0* $\delta_{0.3\ g}$	174	3.66	Pass
0057	Clockwise	7.5* $\delta_{0.3\ g}$	186	3.65	Pass
0058	Clockwise	8.0* $\delta_{0.3\ g}$	198	3.70	Pass
0059	Clockwise	8.5* $\delta_{0.3\ g}$	211	3.65	Pass
0060	Clockwise	9.0* $\delta_{0.3\ g}$	223	3.68	Pass
0061	Clockwise	9.5* $\delta_{0.3\ g}$	236	3.65	Pass
0062	Clockwise	10.0* $\delta_{0.3\ g}$	248	3.69	Pass
0063	Clockwise	10.5* $\delta_{0.3\ g}$	260	3.74	Pass
0064	Clockwise	10.9* $\delta_{0.3\ g}$	270	3.61	Pass

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

DATA INDICATES COMPLIANCE: PASS/FAIL PASS

REMARKS:

RECORDED BY: Alan Ida DATE: 8-19-11
APPROVED BY: Ken Webster DATE: 8-22-11

3.0 TEST DATA….continued

DATA SHEET 9 (Sheet 1 of 2)
MALFUNCTION WARNING TEST

VEHICLE MAKE/MODEL/BODY STYLE: Mazda / 2 / Passenger Car

VEHICLE NHTSA No.: CB5402 TEST DATE: 8-22-11

METHOD OF MALFUNCTION SIMULATION:
Describe method of malfunction simulation: Disconnect the Right Front wheel speed sensor 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.
0 Seconds (must be within 2 minutes) X Pass ____ Fail

ESC SYSTEM RESTORATION:
Telltale extinguishes after ignition locking system is activated and if necessary the vehicle is driven at least 2 minutes.

X Yes ____ No

Time for telltale to extinguish after ignition system is activated and vehicle speed of 48± 8 km/h (30± 5mph) is reached.
0 Seconds (must be within 2 minutes) X Pass ____ Fail

DATA INDICATES COMPLIANCE: PASS/FAIL PASS

REMARKS:
The vehicle did not require driving to illuminate the malfunction telltales. When the wheel speed sensor was disconnected, the ESC and ABS malfunction telltales illuminated. After the wheel speed sensor connector was restored, the vehicle required driving in the forward direction to extinguish the telltales. After driving at approximately 9 mph, the ESC and ABS malfunction telltales extinguished.

RECORDED BY: Alan Ida DATE: 8-22-11
APPROVED BY: Ken Webster DATE: 8-22-11

3.0 TEST DATA….continued

DATA SHEET 9 (Sheet 2 of 2)
MALFUNCTION WARNING TEST

VEHICLE MAKE/MODEL/BODY STYLE: Mazda / 2 / Passenger Car

VEHICLE NHTSA No.: CB5402 TEST DATE: 8-22-11

METHOD OF MALFUNCTION SIMULATION:
Describe method of malfunction simulation: Remove the 30-amp DSC-P fuse from the fuse box.

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.
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.
0 Seconds (must be within 2 minutes) X Pass ____ Fail

DATA INDICATES COMPLIANCE: PASS/FAIL PASS

REMARKS:
The vehicle did not require driving to illuminate the malfunction telltales. When the 30-amp DSC-P fuse was removed, the ESC and ABS malfunction telltales illuminated. After the 30-amp DSC-P fuse was restored, the vehicle required driving in the forward direction to extinguish the telltales. After driving at approximately 9 mph, the ESC and ABS malfunction telltales extinguished.

RECORDED BY: Alan Ida DATE: 8-22-11
APPROVED BY: Ken Webster DATE: 8-22-11

4.0 TEST EQUIPMENT LIST AND CALIBRATION INFORMATION

Type	Output	Range	Resolution	Accuracy	Specifics	Serial Number	Calibration
Tire Pressure Gauge	Vehicle Tire Pressure	0-60psi	0.5 psi	±0.5% of applied pressure	Moroso Model: 89562 0-60psi	N/A	By: TRC Date: 6-14-11 Due: 9-12-11
Platform Scales	Vehicle Total, Wheel, and Axle Load	0-2500 lb per each of four pads	0.5 lb	±1.0% of applied load	Mettler Toledo Model: JXGA1000	5225831-5JC	By: Mettler Toledo Date: 8-1111 Due: 11-11-11
Automated Steering Machine with Steering Angle Encoder	Handwheel Angle	±800 deg	0.25 deg	±0.25 deg	Heitz Automotive Testing Model: Sprint 3	60303	By: ATI-Heitz Date: 2-18-11 Due: 2-18-12
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	0768	By: BEI Tech. Date: 1-10-11 Due: 1-10-12
Radar Speed Sensor and Dashboard Display	Vehicle Speed	0-125 mph	0.009 mph	±0.25% of full scale	A-DAT Corp. Radar Model: DRS-6 Display Model: RD-2	1400603	By: B+S Multidata Date: 2-14-11 Due: 2-14-12
Ultrasonic Distance Measuring System	Left and Right Side Vehicle Height	5-24 inches	0.01 inches	±0.25% of maximum distance	Massa Products Corporation Model: M-5000/220	104619 & 104613	By: Consumers Energy Laboratory Services Date: 1-20-11 Due: 1-20-12
Data Acquisition System [Amplify, Anti-Alias, and Digitize]	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	Dewetron Sidehand DAS Model: DA-121-16 Digitizer Model: Dewe-Orion-1616-100 Amplifier/AntiAliasing: MDAQ-FILT-10-S	12060 1105	By: Dewetron Date: 12-02-10 Due: 12-02-11
Load Cell	Vehicle Brake Pedal Force	0-300 lb	1 lb	±0.05% of full scale	DATRON Model: DTM-LPA	4970-1103	By: TRC Date: per test Due: per test
Coordinate Measurement Machine	Inertial Sensing System Location	0-10 feet	0.001 inch	±0.003% of full scale	FARO International Model: Faro Arm N10	U12-05-08-07116*	By: FARO Date: 12-27-10 Due: 12-27-11
Outriggers	No output. Safety Item.	N/A	N/A	N/A	NHTSA Titanium Outriggers Model: Docket 2007-27662-11	N/A	N/A

*Note: TRC Inc.'s FARO Arm was sent out for calibration at the time of the test, therefore, GFP was utilized from VRTC.

5.0 PHOTOGRAPHS

5.1 ¾ FRONT VIEW FROM LEFT SIDE OF VEHICLE
5.2 ¾ REAR VIEW FROM RIGHT SIDE OF VEHICLE
5.3 VEHICLE CERTIFICATION LABEL
5.4 TIRE AND LOADING INFORMATION LABEL
5.5 WINDOW STICKER (MONRONEY LABEL)
5.6 ESC OFF TELLTALE
5.7 ESC MALFUNCTION TELLTALE
5.8 ESC OFF CONTROL
5.9 ¾ FRONT VIEW - TEST VEHICLE INSTRUMENTED
5.10 ¾ REAR VIEW – TEST VEHICLE INSTRUMENTED
5.11 STEERING WHEEL CONTROLLER AND DATA ACQUISITION SYSTEM
5.12 STEERING CONTROLLER BATTERY BOX
5.13 INERTIA MEASUREMENT UNIT
5.14 VEHICLE SPEED SENSOR
5.15 BODY ROLL SENSOR (DRIVER SIDE)
5.16 BODY ROLL SENSOR (PASSENGER SIDE)
5.17 BRAKE PEDAL FORCE TRANSDUCER

5.1 ¾ FRONT VIEW FROM LEFT SIDE OF VEHICLE

5.2 ¾ REAR VIEW FROM RIGHT SIDE OF VEHICLE

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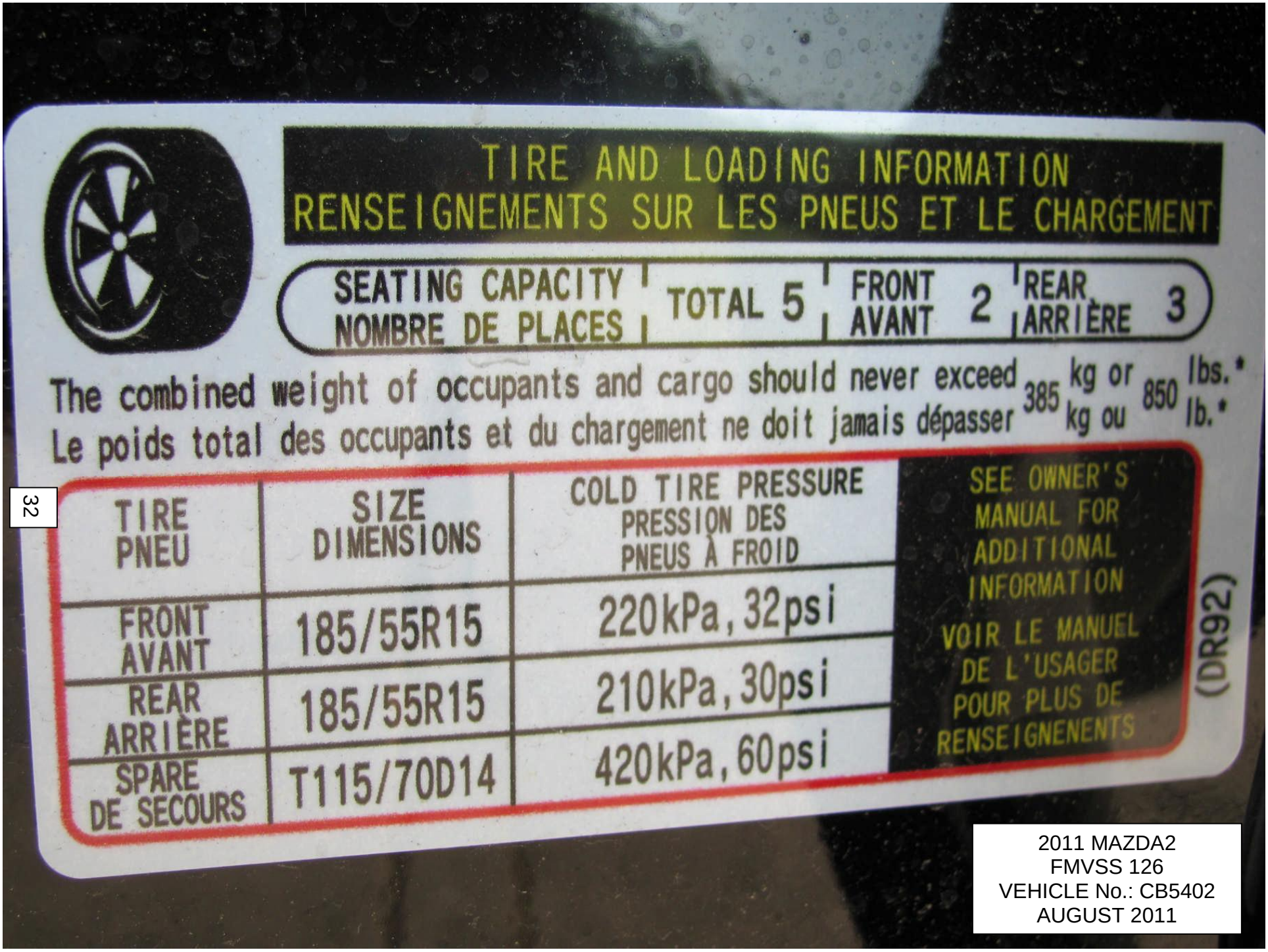
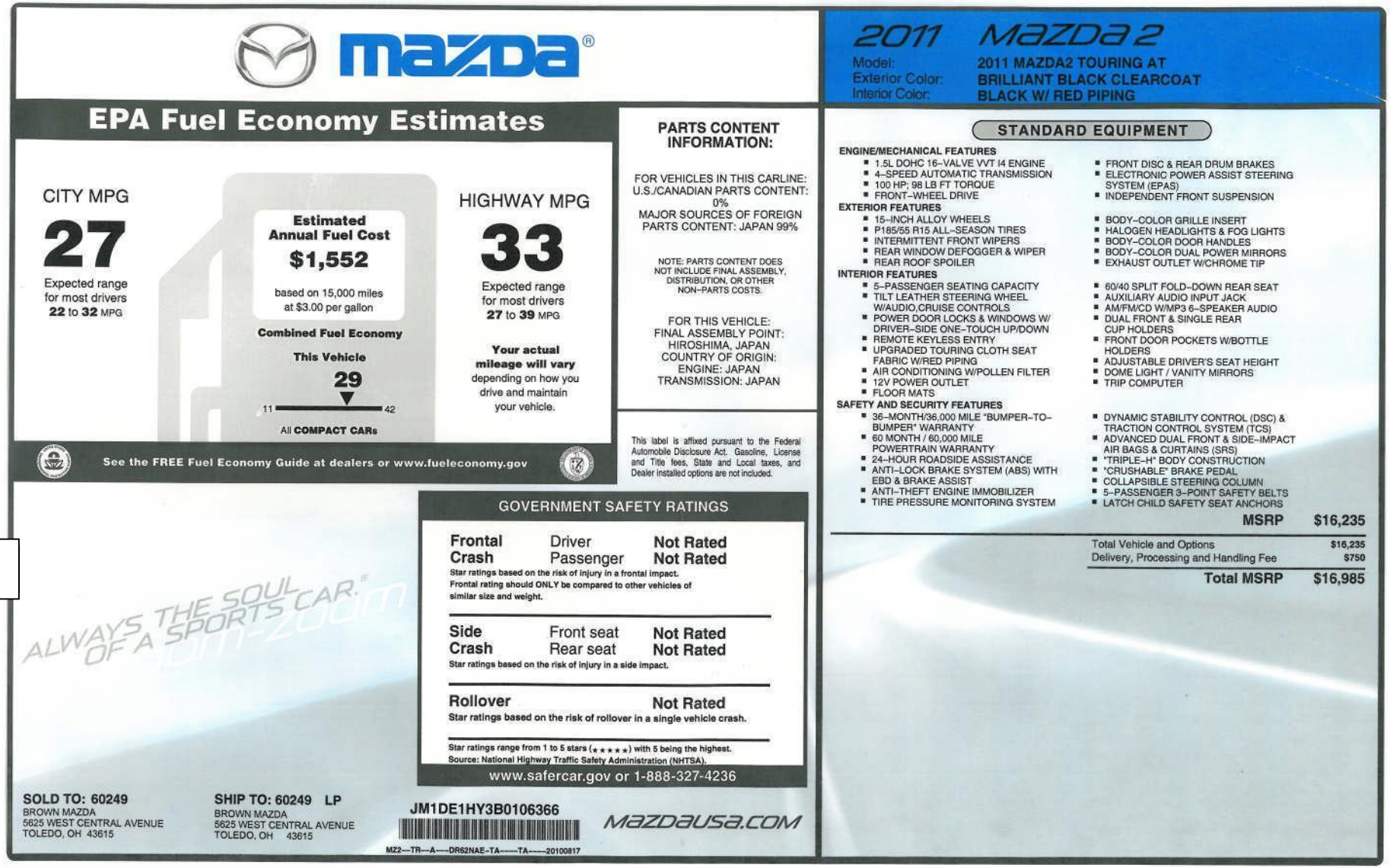
5.3 VEHICLE CERTIFICATION LABEL



5.4 TIRE AND LOADING INFORMATION LABEL



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5.5 WINDOW STICKER - MONRONEY LABEL

5.6 ESC OFF TELLTALE

5.7 ESC MALFUNCTION TELLTALE

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FMVSS 126
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5.8 ESC OFF CONTROL

5.9 ¾ FRONT VIEW - TEST VEHICLE INSTRUMENTED

5.10 ¾ REAR VIEW - TEST VEHICLE INSTRUMENTED

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VEHICLE No.: CB5402
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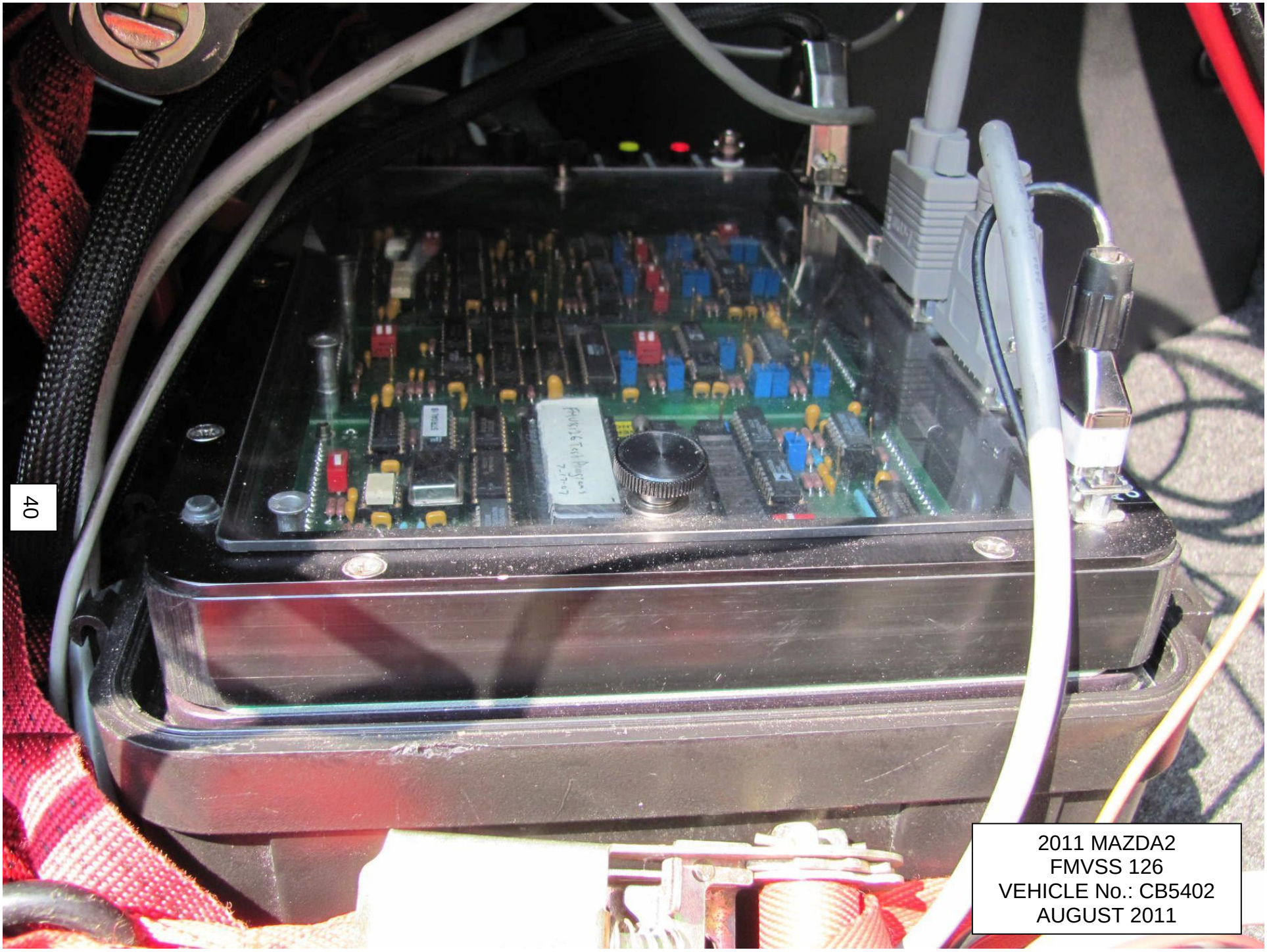
5.11 STEERING WHEEL CONTROLLER AND DATA ACQUISITION SYSTEM



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5.12 STEERING CONTROLLER BATTERY BOX

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5.13 INERTIA MEASUREMENT UNIT

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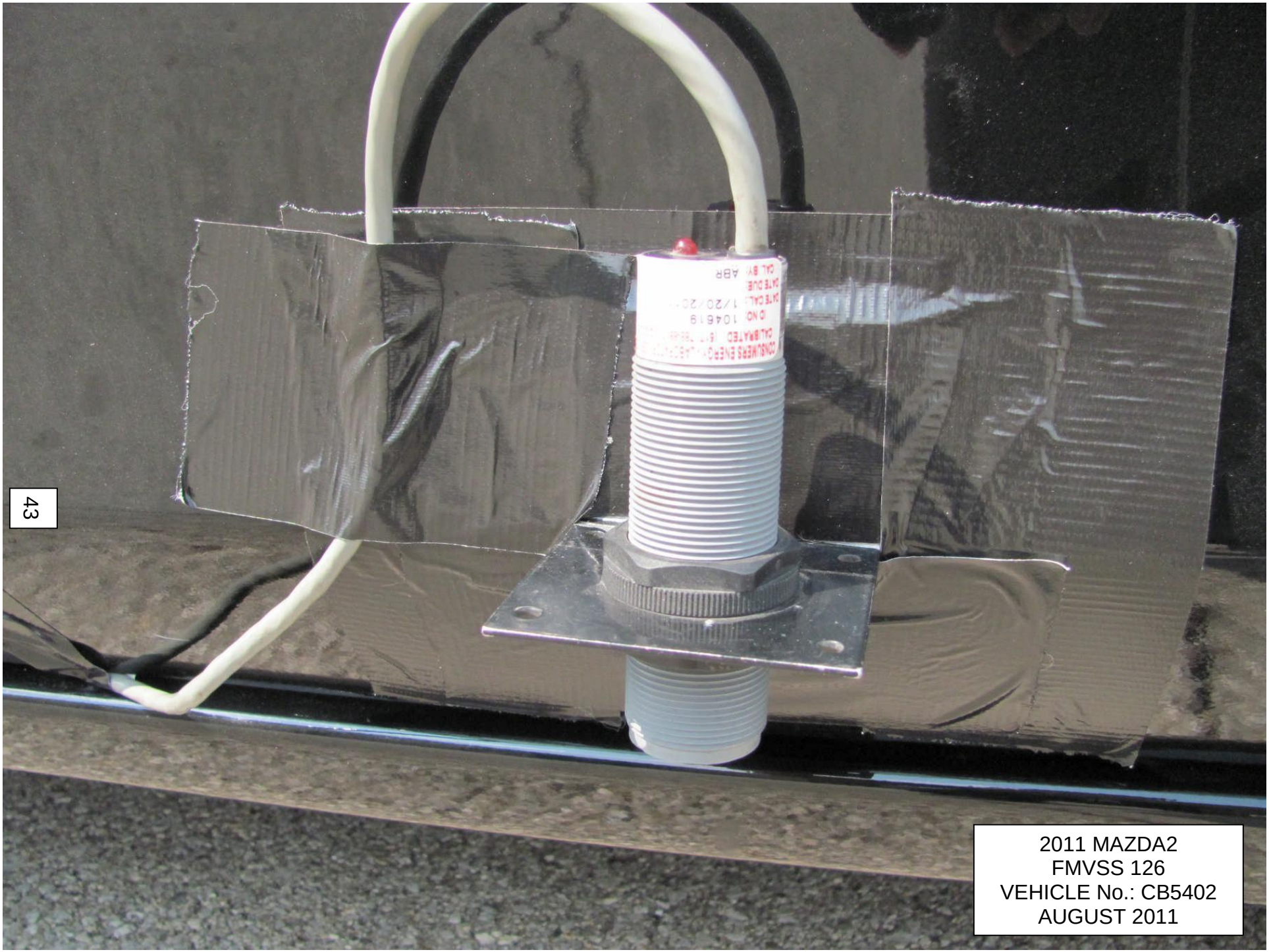
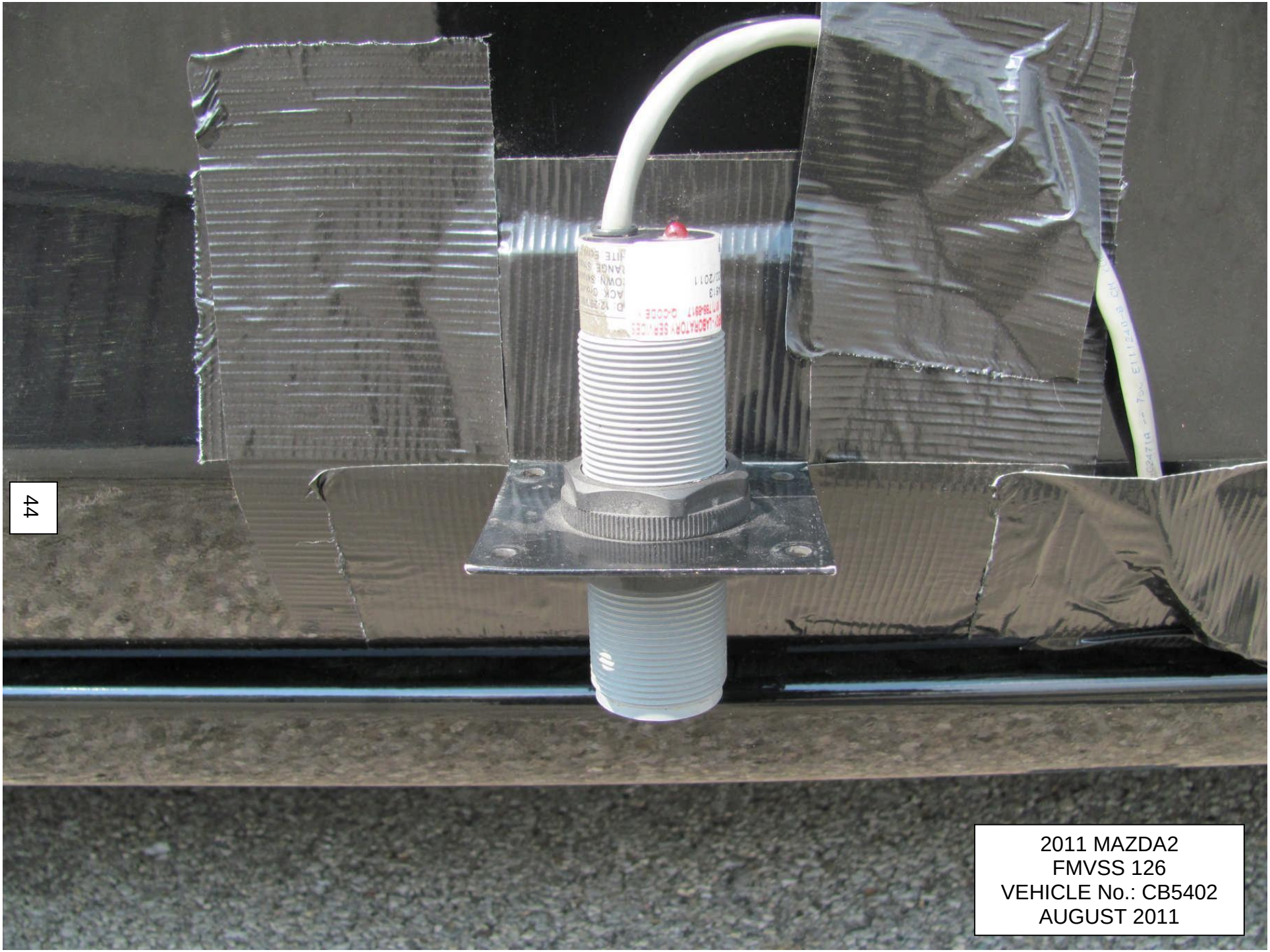
VEHICLE No.: CB5402
AUGUST 2011

5.14 VEHICLE SPEED SENSOR



2011 MAZDA2
FMVSS 126
VEHICLE No.: CB5402
AUGUST 2011

5.15 BODY ROLL SENSOR (DRIVER SIDE)



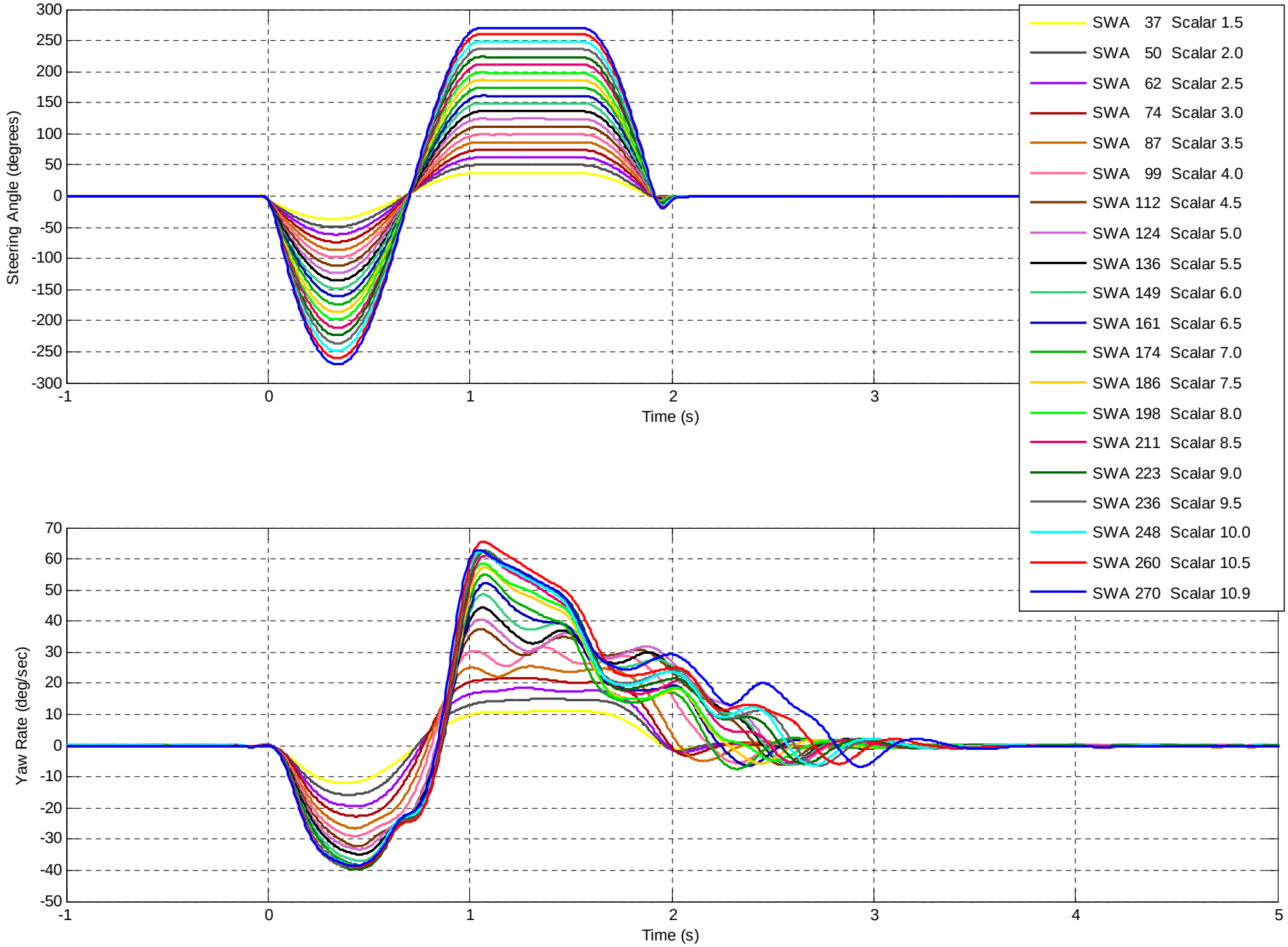
5.16 BODY ROLL SENSOR (PASSENGER SIDE)

5.17 BRAKE PEDAL FORCE TRANSDUCER

6.0 DATA PLOTS

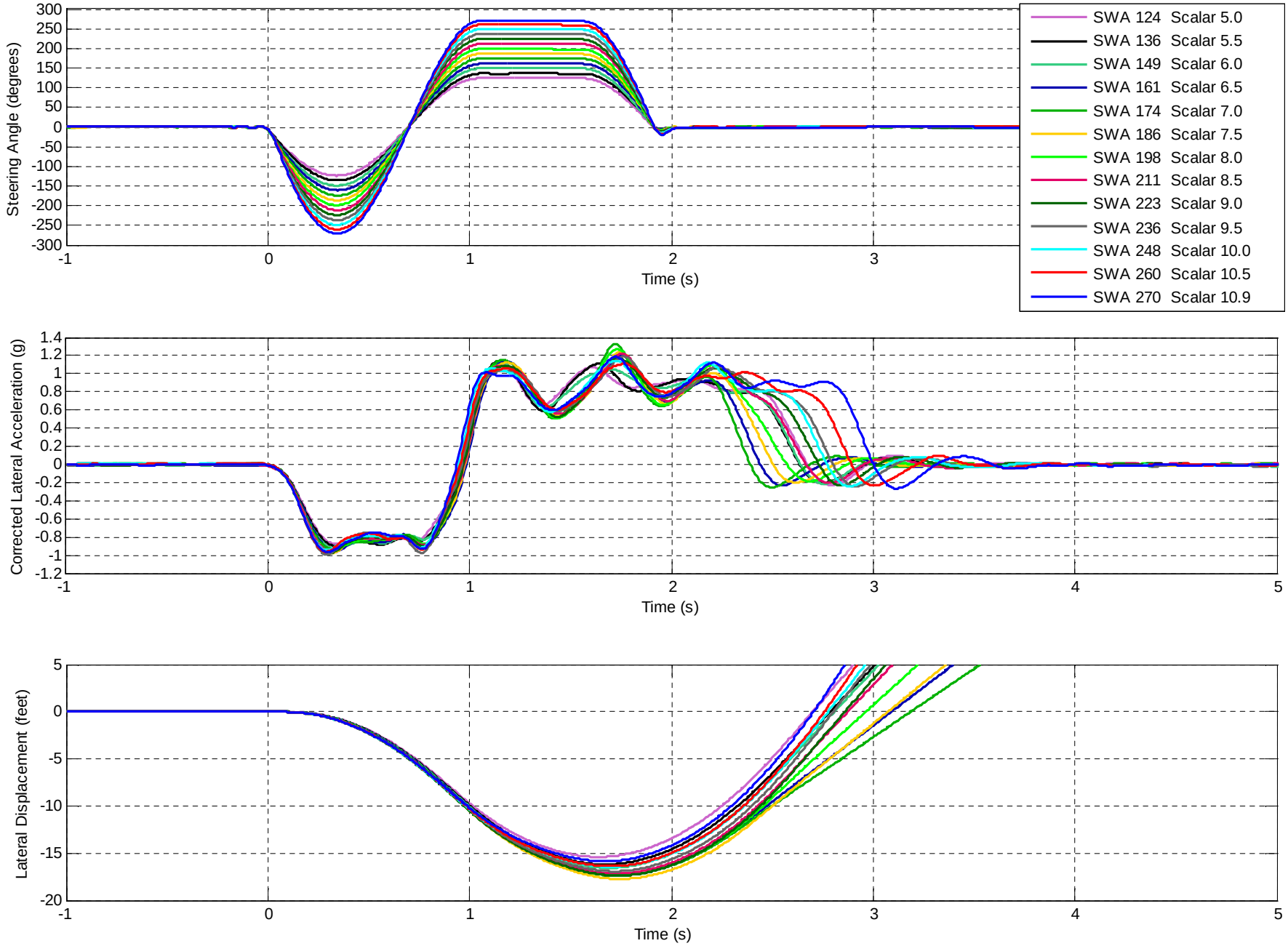
6.0 2011 Mazda2 DATA PLOTS

Figure 1. Steering Angle and Yaw Rate Time History, Counter-Clockwise Initial Steer Tests



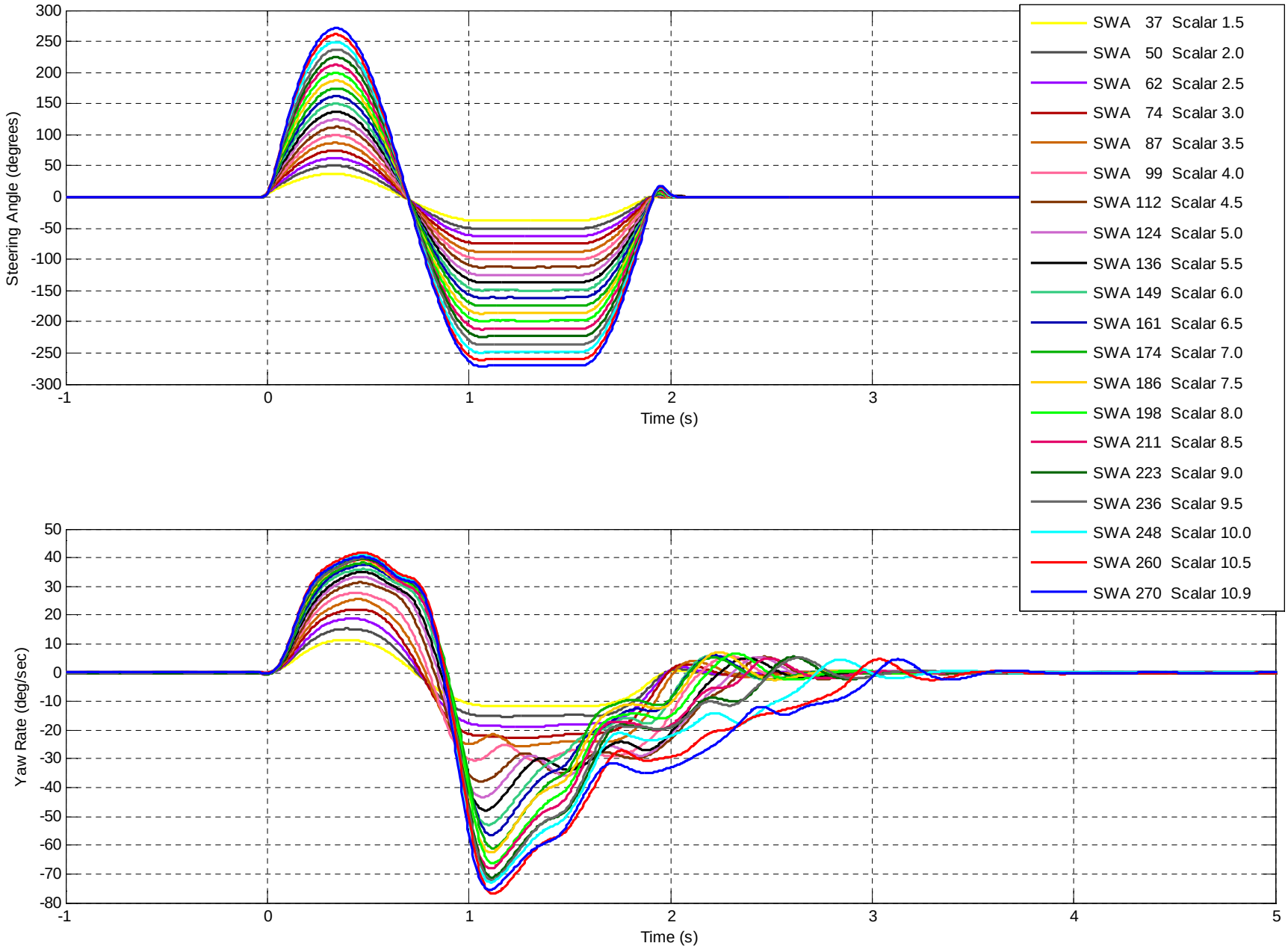
6.0 2011 Mazda2 DATA PLOTS…continued

Figure 2. Steering Angle, Lateral Acceleration, and Lateral Displacement Time History, Counter-Clockwise Initial Steer Tests



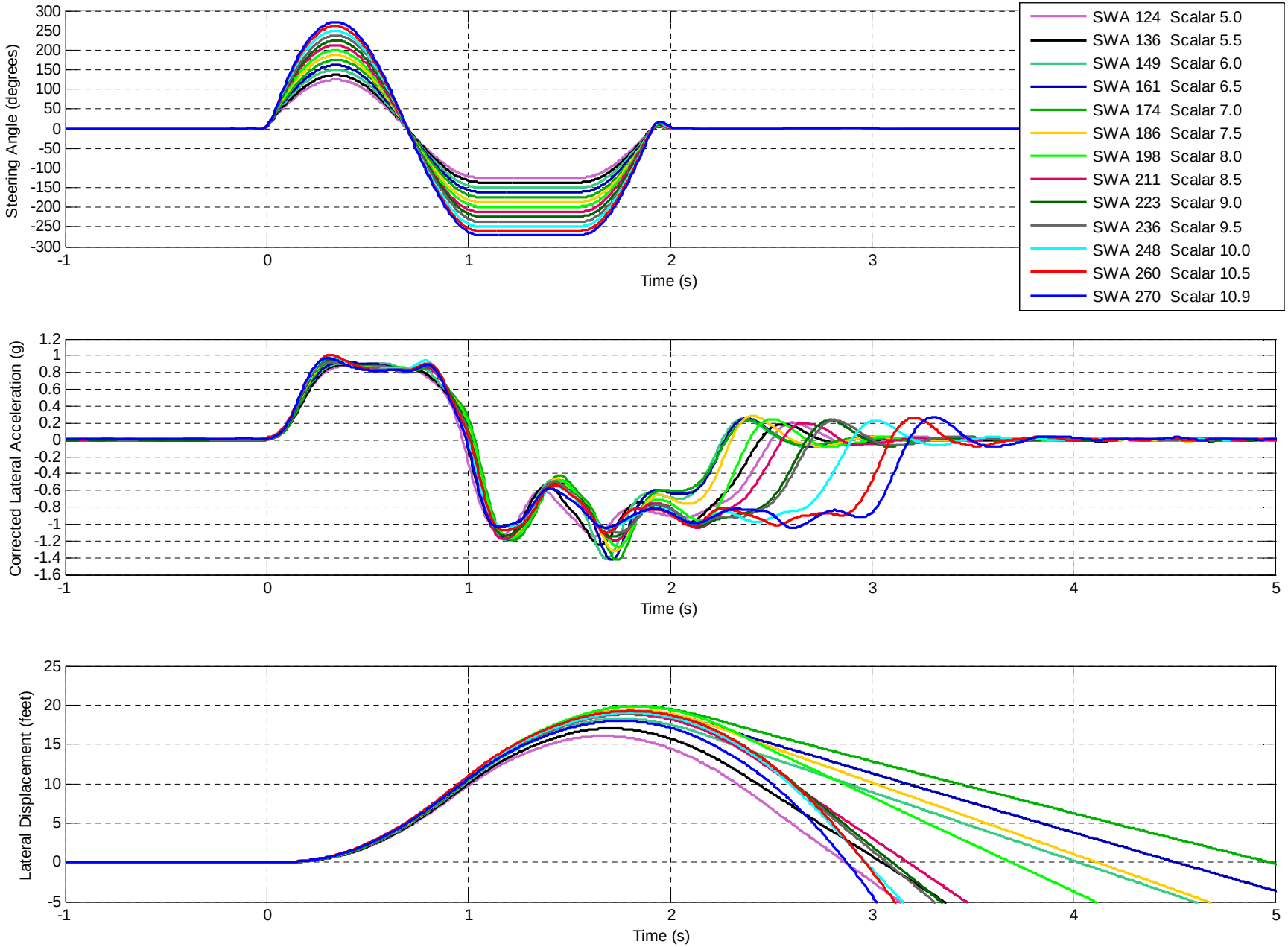
6.0 2011 Mazda2 DATA PLOTS…continued

Figure 3. Steering Angle and Yaw Rate Time History, Clockwise Initial Steer Tests



6.0 2011 Mazda2 DATA PLOTS…continued

Figure 4. Steering Angle, Lateral Acceleration, and Lateral Displacement Time History, Clockwise Initial Steer Tests



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

Traction Control System (TCS)

The Traction Control System (TCS) enhances traction and safety by controlling engine torque and braking. When the TCS detects driving wheel slippage, it lowers engine torque and operates the brakes to prevent loss of traction.

This means that on a slick surface, the engine adjusts automatically to provide optimum power to the drive wheels, limiting wheel spin and loss of traction.

⚠ WARNING

Do not rely on the traction control system as a substitute for safe driving:

The traction control system (TCS) cannot compensate for unsafe and reckless driving, excessive speed, tailgating (following another vehicle too closely), and hydroplaning (reduced tire friction and road contact because of water on the road surface). You can still have an accident.

Use snow tires or tire chains and drive at reduced speeds when roads are covered with ice and/or snow:

Driving without proper traction devices on snow and/or ice-covered roads is dangerous. The traction control system (TCS) alone cannot provide adequate traction and you could still have an accident.

NOTE

To turn off the TCS, press the DSC OFF switch (page 5-22).

▼TCS/DSC Indicator Light

This indicator light stays on for a few seconds when the ignition is switched ON. If the TCS or DSC is operating, the indicator light flashes.

If the light stays on, the TCS or DSC may have a malfunction and they may not operate correctly. Take your vehicle to an Authorized Mazda Dealer.

NOTE

- *In addition to the indicator light flashing, a slight lugging sound will come from the engine. This indicates that the TCS is operating properly.*
- *On slippery surfaces, such as fresh snow, it will be impossible to achieve high rpm when the TCS is on.*

Dynamic Stability Control (DSC)

The Dynamic Stability Control (DSC) automatically controls braking and engine torque in conjunction with systems such as ABS and TCS to help control side slip when driving on slippery surfaces, or during sudden or evasive maneuvering, enhancing vehicle safety.

Refer to ABS (page 5-8) and TCS (page 5-20).

DSC operation is possible at speeds greater than 20 km/h (12 mph).

⚠ WARNING

Do not rely on the dynamic stability control as a substitute for safe driving:

The dynamic stability control (DSC) cannot compensate for unsafe and reckless driving, excessive speed, tailgating (following another vehicle too closely), and hydroplaning (reduced tire friction and road contact because of water on the road surface). You can still have an accident.

⚠ CAUTION

- *The DSC may not operate correctly unless the following are observed:*
  - *Use tires of the correct size specified for your Mazda on all four wheels.*
  - *Use tires of the same manufacturer, brand and tread pattern on all four wheels.*
  - *Do not mix worn tires.*
- *The DSC may not operate correctly when tire chains are used or a temporary spare tire is installed because the tire diameter changes.*

NOTE

After switching the ignition ON, a clicking sound may be heard behind the dashboard. This sound is the result of the DSC system self-check operation and does not indicate an abnormality.

▼TCS/DSC Indicator Light

This indicator light stays on for a few seconds when the ignition is switched ON. If the TCS or DSC is operating, the indicator light flashes.

If the light stays on, the TCS or DSC may have a malfunction and they may not operate correctly. Take your vehicle to an Authorized Mazda Dealer.

2011 MAZDA2
FMVSS 126
VEHICLE No.: CB5402
AUGUST 2011

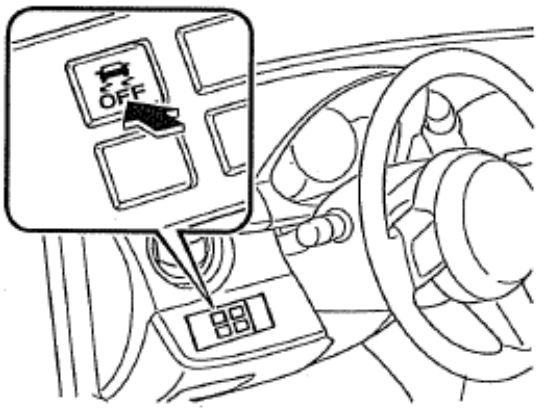
▼DSC OFF Indicator Light

This indicator light stays on for a few seconds when the ignition is switched ON.
It also illuminates when the DSC OFF switch is pressed and TCS/DSC is switched off (page 5-22).

If the light stays on when the TCS/DSC is not switched off, take your vehicle to an Authorized Mazda Dealer. The dynamic stability control may have a malfunction.

▼DSC OFF Switch

Press the DSC OFF switch to turn off the TCS/DSC. The DSC OFF indicator light will illuminate.



Press the switch again to turn the TCS/DSC back on. The DSC OFF indicator light will go out.

NOTE

- *When DSC is on and you attempt to free the vehicle when it is stuck, or drive it out of freshly fallen snow, the TCS (part of the DSC system) will activate. Depressing the accelerator will not increase engine power and freeing the vehicle may be difficult. When this happens, turn off the TCS/DSC.*
- *If the TCS/DSC is off when the engine is turned off, it automatically activates when the ignition is switched ON.*
- *Leaving the TCS/DSC on will provide the best stability.*

2011 MAZDA2
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VEHICLE No.: CB5402
AUGUST 2011

7.2 VEHICLE ARRIVAL CONDITION REPORT

CONTRACT NO. DTNH22-08-D-00097 DATE: 6/24/11

FROM: Automotive Allies

TO: TRC

PURPOSE: (X) Initial Receipt ( ) Received via Transfer ( ) Present vehicle condition

MODEL YEAR/MAKE/MODEL/BODY STYLE: 2011 / Mazda / 2 / Passenger Car

MANUFACTURE DATE: 07/10 NHTSA NO.: CB5402

BODY COLOR: Black VIN: JM1DE1HY3B0106366

ODOMETER READING: 21 miles GVWR: 1,502 KG

PURCHASE PRICE: $ rented / leased DEALER'S NAME: Automotive Allies, 209 W. Alameda Avenue, Suite 101, Burbank, CA 91502

X ALL OPTIONS LISTED ON "WINDOW STICKER" ARE PRESENT ON THE TEST VEHICLE

X TIRES AND WHEEL RIMS ARE NEW AND THE SAME AS LISTED

X THERE ARE NO DENTS OR OTHER INTERIOR OR EXTERIOR FLAWS

X THE VEHICLE HAS BEEN PROPERLY PREPARED AND IS IN RUNNING CONDITION

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

X PROPER FUEL FILLER CAP IS SUPPLIED ON THE TEST VEHICLE

X PLACE VEHICLE IN STORAGE AREA

X 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

RECORDED BY: Alan Ida DATE: 8-12-11
APPROVED BY: Ken Webster DATE: 8-22-11

7.3 VEHICLE COMPLETION CONDITION REPORT

CONTRACT NO. DTNH22-08-D-00097 DATE: 8/22/11

MODEL YEAR/MAKE/MODEL/BODY STYLE: 2011 / Mazda / 2 / Passenger Car

MANUFACTURE DATE: 07/10 NHTSA NO.: CB5402

BODY COLOR: Black VIN: JM1DE1HY3B0106366

ODOMETER READING: 86 miles GVWR: 1,502 KG

LIST OF FMVSS TESTS PERFORMED BY THIS LAB: 126, 135

X THERE ARE NO DENTS OR OTHER INTERIOR OR EXTERIOR FLAWS

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

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

X PROPER FUEL FILLER CAP IS SUPPLIED ON THE TEST VEHICLE

REMARKS:

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

None.

Explanation for equipment removal:

N/A

Test Vehicle Condition:

Like new.

RECORDED BY: Alan Ida DATE: 8-22-11
APPROVED BY: Ken Webster DATE: 8-22-11

7.4 SINE WITH DWELL TEST RESULTS
2011 Mazda2
NHTSA No.: CB5402

Date Created 19-Aug-11

LEFT-TO-RIGHT (INITIAL COUNTER-CLOCKWISE STEER)

File	SWA @ 5deg Ct	MES	Time@5deg	COS	Time@COS	MOS	Time@MOS	YRR1(%)	YR1 (deg/sec)	YRR1 Ct	YRR175(%)	YR175 (deg/sec)
0025	620	50.237	3.090	999	4.989	755	3.769	-1.589	-0.175	1199	-1.820	-0.200
0026	619	50.187	3.085	1000	4.991	756	3.771	1.764	0.267	1200	0.581	0.088
0027	617	50.175	3.079	999	4.988	755	3.768	-0.299	-0.056	1199	-0.888	-0.165
0028	616	50.212	3.074	999	4.986	755	3.767	-0.107	-0.023	1199	-0.276	-0.060
0029	616	50.166	3.074	999	4.988	755	3.769	-1.253	-0.316	1199	-0.575	-0.145
0030	615	50.248	3.068	998	4.983	755	3.766	-1.740	-0.533	1198	0.479	0.147
0031	615	50.230	3.067	998	4.983	755	3.766	3.757	1.413	1198	0.107	0.040
0032	616	50.197	3.071	999	4.988	755	3.769	5.140	2.082	1199	-0.071	-0.029
0033	615	50.462	3.069	999	4.987	755	3.768	3.975	1.763	1199	0.164	0.073
0034	615	50.264	3.065	998	4.983	755	3.766	3.668	1.789	1198	-0.108	-0.053
0035	615	50.244	3.069	999	4.987	755	3.770	-0.950	-0.498	1199	0.233	0.122
0036	615	50.114	3.070	999	4.987	755	3.770	-1.188	-0.652	1199	0.123	0.067
0037	615	50.265	3.066	998	4.983	755	3.766	-0.070	-0.040	1198	-0.154	-0.088
0038	616	50.270	3.070	999	4.988	756	3.772	1.035	0.606	1199	-0.021	-0.013
0039	615	50.347	3.070	999	4.987	756	3.771	2.887	1.766	1199	-0.035	-0.022
0040	615	50.337	3.066	998	4.983	755	3.767	3.380	2.122	1198	0.331	0.208
0041	615	50.338	3.069	999	4.985	755	3.769	1.375	0.861	1199	0.121	0.076
0042	615	50.247	3.068	998	4.984	755	3.769	2.425	1.509	1198	0.035	0.022
0043	615	50.089	3.069	998	4.985	755	3.770	-4.604	-3.019	1198	0.058	0.038
0044	615	50.295	3.069	999	4.986	756	3.770	-9.736	-6.148	1199	-0.238	-0.151

RIGHT-TO-LEFT (INITIAL CLOCKWISE STEER)

0045	619	50.242	3.090	999	4.988	755	3.769	0.622	-0.072	1199	-0.281	0.032
0046	618	50.175	3.081	999	4.986	755	3.768	0.659	-0.100	1199	-0.384	0.058
0047	617	50.107	3.080	999	4.989	755	3.770	-0.222	0.041	1199	0.384	-0.072
0048	617	50.121	3.076	999	4.988	755	3.768	0.629	-0.142	1199	0.049	-0.011
0049	617	50.240	3.075	999	4.989	756	3.771	-0.117	0.029	1199	-0.134	0.033
0050	616	50.267	3.072	999	4.986	755	3.770	-1.520	0.465	1199	0.006	-0.002
0051	615	50.292	3.069	998	4.985	755	3.768	1.520	-0.573	1198	0.592	-0.223
0052	615	50.303	3.066	998	4.983	754	3.765	0.492	-0.213	1198	-0.097	0.042
0053	615	50.060	3.067	998	4.984	755	3.766	-0.528	0.253	1198	0.238	-0.114
0054	615	50.146	3.065	998	4.984	755	3.766	-0.511	0.271	1198	0.129	-0.069
0055	615	50.355	3.067	998	4.985	755	3.767	-0.697	0.393	1198	-0.109	0.061
0056	615	50.097	3.069	999	4.986	755	3.769	-0.369	0.225	1199	0.058	-0.035
0057	616	50.212	3.070	999	4.987	756	3.770	-0.706	0.442	1199	0.034	-0.022
0058	615	50.140	3.065	998	4.983	755	3.766	-1.219	0.808	1198	-0.121	0.080
0059	616	50.247	3.070	999	4.987	756	3.771	0.489	-0.333	1199	-0.130	0.089
0060	615	50.268	3.069	999	4.985	755	3.769	2.889	-2.053	1199	-0.041	0.029
0061	615	50.317	3.070	999	4.986	756	3.770	2.842	-2.051	1199	-0.025	0.018
0062	616	50.143	3.071	999	4.987	756	3.771	-3.954	2.891	1199	0.272	-0.199
0063	616	50.334	3.071	999	4.987	756	3.771	1.643	-1.268	1199	-0.276	0.213
0064	615	50.235	3.067	998	4.983	755	3.767	8.940	-6.774	1198	-0.629	0.476

7.4 SINE WITH DWELL TEST RESULTS
2011 Mazda2
NHTSA No.: CB5402

Date Created 19-Aug-11

LEFT-TO-RIGHT (INITIAL COUNTER-CLOCKWISE STEER)

File	YRR175 Ct	2nd Yaw Peak(deg/sec)	2nd Yaw Peak Ct	Lat Disp (ft)	Lat. Acc. 1.07s (g)	1st SWA Peak(deg)	1st SWA Peak Ct	2nd SWA Mean(deg)
0025	1349	10.993	848	-4.176	0.426	37.041	684	36.831
0026	1350	15.152	895	-5.545	0.556	49.889	684	49.905
0027	1349	18.626	871	-6.843	0.633	61.721	684	61.823
0028	1349	21.915	861	-7.817	0.723	73.745	684	73.676
0029	1349	25.244	818	-8.957	0.774	86.574	684	86.819
0030	1348	30.607	820	-9.763	0.757	98.540	683	98.682
0031	1348	37.604	825	-10.466	0.789	111.850	683	111.980
0032	1349	40.509	826	-10.802	0.790	123.791	684	124.077
0033	1349	44.349	827	-11.147	0.820	135.733	684	136.169
0034	1348	48.778	828	-11.250	0.826	148.912	683	149.130
0035	1349	52.433	831	-11.525	0.808	160.861	684	161.033
0036	1349	54.898	830	-11.586	0.829	173.996	684	174.153
0037	1348	57.306	830	-11.726	0.821	186.129	684	186.099
0038	1349	58.552	829	-11.658	0.861	198.350	684	197.967
0039	1349	61.175	831	-11.625	0.860	211.543	684	211.257
0040	1348	62.786	830	-11.705	0.851	223.706	683	223.126
0041	1349	62.585	829	-11.605	0.861	236.720	684	236.084
0042	1348	62.238	826	-11.491	0.912	248.693	683	247.991
0043	1348	65.568	829	-11.467	0.908	260.698	684	259.834
0044	1349	63.141	824	-11.324	0.920	270.652	684	269.583

RIGHT-TO-LEFT (INITIAL CLOCKWISE STEER)

0045	1349	-11.508	842	4.060	-0.444	37.458	684	37.369
0046	1349	-15.198	857	5.390	-0.561	50.488	684	50.175
0047	1349	-18.716	879	6.498	-0.661	62.394	684	62.254
0048	1349	-22.610	868	7.584	-0.733	74.233	684	74.271
0049	1349	-24.766	818	8.508	-0.751	87.174	684	87.283
0050	1349	-30.630	822	9.370	-0.779	99.203	684	99.169
0051	1348	-37.729	827	10.409	-0.769	112.497	684	112.361
0052	1348	-43.306	829	10.891	-0.758	124.507	683	124.527
0053	1348	-47.842	831	11.212	-0.759	136.629	683	136.394
0054	1348	-52.900	834	11.573	-0.730	149.831	683	149.499
0055	1348	-56.376	837	11.864	-0.636	161.726	684	161.363
0056	1349	-60.874	839	11.999	-0.608	174.787	684	174.528
0057	1349	-62.677	838	11.973	-0.667	186.923	684	186.429
0058	1348	-66.220	839	12.125	-0.605	199.068	683	198.323
0059	1349	-68.031	837	11.961	-0.736	212.230	684	211.513
0060	1349	-71.064	838	12.063	-0.698	224.339	684	223.500
0061	1349	-72.189	838	11.989	-0.713	237.223	684	236.490
0062	1349	-73.124	838	12.099	-0.713	249.162	684	248.471
0063	1349	-77.165	840	12.267	-0.679	261.056	684	260.339
0064	1348	-75.776	836	11.857	-0.793	270.997	683	270.207

7.5 SLOWLY INCREASING STEER TEST RESULTS
2011 Mazda2
NHTSA No.: CB5402

Date Created 19-Aug-11

File	Vehicle	EventPt	DOS	MES [mph]	Mean SPD [mph]	AYcount_3	THETAENCF_3 [degree]	AYCG_CD2_3 [g]	r_squared	ZeroBegin	ZeroEnd
0013	2011 Mazda2	703	1	49.872	50.022	1065	-24.555	-0.296	0.999	503	703
0014	2011 Mazda2	704	1	49.898	49.549	1069	-24.701	-0.303	0.999	504	704
0015	2011 Mazda2	707	1	50.312	50.368	1066	-24.397	-0.300	0.998	507	707
0016	2011 Mazda2	704	0	49.682	49.955	1065	24.735	0.303	0.998	504	704
0018	2011 Mazda2	625	0	50.055	50.175	1070	25.042	0.297	0.998	425	625
0019	2011 Mazda2	695	0	49.918	49.982	1074	25.337	0.300	0.998	495	695
	Averages						24.8	0.300			

Scalars	Steering Angles (deg)
1.5	37
2	50
2.5	62
3	74
3.5	87
4	99
4.5	112
5	124
5.5	136
6	149
6.5	161
7	174
7.5	186
8	198
8.5	211
9	223
9.5	236
10	248
10.5	260
10.9	270

7.6 INERTIA SENSOR MEASUREMENTS
2011 Mazda2
NHTSA No.: CB5402

Device : U12-05-08-07116
device version : 2.24
device certification date : 12/27/10
today is : 8/18/2011
units : Millimeters

Label	ActualX	ActualY	ActualZ
C_DEVICEPOS001			
M_PLANE001	561.756	-713.030	-276.700
M_LINE001	820.764	136.350	-81.358
M_ORIGIN_FRT_AXLE_CENTER	0.000	0.000	0.000
C_COORDSYS001	0.000	0.000	0.000
M_TIRE_TREAD_CENTER	253.705	75.366	-154.424
M_INERTIA_PACK	1491.469	808.285	593.286
M_ROOF	1635.593	777.454	1180.309
M_GROUND	1635.110	49.602	-274.976
Track Width		1473.200	
Roof Height (relative to ground)			1455.285
Motion Pak - x-distance (mm)	1491.469		
Motion Pak - y-distance (mm)		-3.681	
Motion Pak - z-distance (mm)			823.812
Motion Pak - x-distance (inches)	58.719		
Motion Pak - y-distance (inches)		-0.145	
Motion Pak - z-distance (inches)			32.433

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.)