REPORT NO. 135-TRC-11-007

COMPLIANCE TESTING FOR FMVSS 135
Light Vehicle Brake Systems

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Mazda
2011 Mazda 2, 4-Door Sedan
NHTSA No. CB5402

TRANSPORTATION RESEARCH CENTER INC.
10820 State Route 347, P.O. Box B-67
East Liberty, Ohio 43319

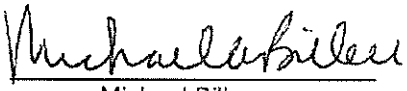
September 9, 2011

FINAL REPORT

PREPARED FOR:

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

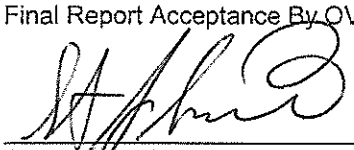
Prepared for the Department of Transportation, National Highway Traffic Safety Administration, under Contract No. DTNH22-06-C-00033.

Prepared By 
Michael Bilbee

Approved By 
Ken Webster

Approval Date: 9/9/11

Final Report Acceptance By OVSC:


Contract Technical Manager, Office of Vehicle Safety Compliance

9/13/11
Acceptance Date

1. REPORT NUMBER: 135-TRC-11-007	2. GOVERNMENT ACCESSION NO.:	3. RECIPIENTS CATALOG NO.:
4. TITLE AND SUBTITLE: Final report of FMVSS 135 Compliance Testing of a 2011 Mazda 2, 4-door Sedan, NHTSA No. CB5402		5. REPORT DATE: September 9, 2011
		6. PERFORMING ORGANIZATION CODE: TRC 20060110/4015
7. AUTHOR(S): Project Manager: ALAN IDA Project Engineer: MICHAEL BILBEE		8. PERFORMING ORGANIZATION REPORT NO.: TRC-DOT-135-112
9. PERFORMING ORGANIZATION NAME AND ADDRESS: Transportation Research Center Inc. 10820 State Route 347, P.O. Box B-67 East Liberty, Ohio 43319		10. WORK UNIT NUMBER:
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12. SPONSORING AGENCY NAME AND ADDRESS: U.S. Department of Transportation National Highway Traffic Safety Administration Enforcement Office of Vehicle Safety Compliance (NVS-221) 1200 New Jersey Avenue S.E. West Wing 4th Floor Washington, DC 20590		13. TYPE OF REPORT AND PERIOD COVERED: Final test report 8/22/11 to 8/31/11
		14. SPONSORING AGENCY CODE: NVS-221
15. SUPPLEMENTARY NOTES:		
16. ABSTRACT: Compliance tests were conducted on the subject 2011 Mazda 2, 4-door Sedan in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP-135-01 for the determination of FMVSS 135 compliance. Test failures identified were as follows: None.		
17. KEY WORDS: Compliance Testing Safety Engineering FMVSS 135		18. DISTRIBUTION STATEMENT: Copies of this report are available from: NHTSA Technical Information Services NPO-411 1200 New Jersey Ave, S.E. Washington, DC 20590 Email: tis@nhtsa.dot.gov FAX: 202-493-2833

19. SECURITY CLASSIF. (OF THIS REPORT): Unclassified	20. SECURITY CLASSIF. (OF THIS PAGE). Unclassified	21. NO. OF PAGES: 65	22. PRICE:

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1.0 INTRODUCTION

Tests were conducted on a 2011 Mazda 2, 4-Door Sedan, Passenger Car, manufactured by Mazda Motor Company, to determine compliance with FMVSS 135 "Light Vehicle Brake Systems." All tests were conducted in accordance with the U.S. D.O.T., NHTSA Laboratory Procedure TP 135-01 and/or the corresponding TRC Inc. Test Procedure that was submitted to NHTSA for their approval. The Test Procedure was clearly described in the submitted document and has not been repeated in this report.

All stops were performed manually.

All tests were conducted by TRC Inc. personnel using the following TRC facilities:

7.5-Mile Test Track
Vehicle Maximum Speed
Heating Snubs and Hot Performance Stops
Brake Cooling and Recovery Stops

Skid Pad
Burnish
Cold Effectiveness Stops
High Speed Effectiveness Stops
Stops with Engine Off
Failed ABS
Failed Variable Proportioning Valve (if applicable)
Failed Hydraulic Circuits
Brake Power Assist Unit Failures
RBS Failure (if applicable)
EMF (Battery) Failure (if applicable)

Brake Slope
Parking Brake

Average PFC during the test period was 0.97 (Skid Pad) and 0.98 (Test Track) utilizing the ASTM E1337 w/E1136 tire method.

The test vehicle was ABS-equipped; therefore, the Wheel Lock Sequence and Adhesion Utilization Tests were not performed.

This vehicle appears to meet the requirements of FMVSS 135.

2.0 SUMMARY OF RESULTS

VEHICLE: 2011 Mazda 2 NHTSA NO.: CB5402 DATE: 9/9/11

		Specification and Limit				TEST RESULTS (In compliance if one stop meets requirement)		
TEST	Loading Condition	Speed (km/h)	Min. Pedal Force (N)	Max. Pedal Force (N)	Stopping Distance Requirement (m)	Shortest Stop Max. Pedal Force Newtons (Average – N)	Shortest Stop Stopping Distance (m) (Corrected)	Pass / Fail
Equipment Requirements					Specified Equipment	Vehicle contains specified equipment		Pass
Vehicle Maximum Speed	LLVW	NA				157.1 km/h avg.		NA
Burnish	GVWR	80				200, 80-0 km/h stops @3.0mpsps		NA
Wheel Lockup Sequence w/o ABS	GVWR				Lockup of front wheels prior to rear	ABS equipped – not required.		NA
Wheel Lockup Sequence w/o ABS	LLVW					ABS equipped – not required.		NA
Adhesion Utilization w/o ABS	LLVW				Rear axle adhesion utilization curve below specified value	ABS equipped – not required.		NA
Adhesion Utilization w/o ABS	GVWR					ABS equipped – not required.		NA
Cold Effectiveness	GVWR	100	65	500	70	492.0	51.8	Pass
High Speed Effectiveness	GVWR	126	65	500	spd. depend. – 118.0	476.2	75.3	Pass
Stops with Engine Off	GVWR	100	65	500	70	443.1	49.9	Pass
Cold Effectiveness	LLVW	100	65	500	70	473.8	49.0	Pass
High Speed Effectiveness	LLVW	126	65	500	spd. depend. – 118.0	419.8	73.6	Pass
Failed Antilock	LLVW	100	65	500	85	184.4	54.8	Pass
Failed Proportioning Valve	LLVW	100	65	500	110	NA	NA	NA
Failed Hydraulic Circuit #1	LLVW	100	65	500	168	473.2	94.2	Pass
Failed Hydraulic Circuit #2	LLVW	100	65	500	168	479.0	93.7	Pass
Failed Hydraulic Circuit #1	GVWR	100	65	500	168	494.1	101.1	Pass
Failed Hydraulic Circuit #2	GVWR	100	65	500	168	492.3	106.3	Pass
Failed Antilock	GVWR	100	65	500	85	212.0	54.9	Pass
Failed Proportioning Valve	GVWR	100	65	500	110	NA	NA	NA
Regenerative Brake System (RBS) Failure	GVWR	100	65	500	168	NA	NA	NA
Electromotive Force (EMF) – Battery Failure	GVWR	100	65	500	70	NA	NA	NA
Power Brake Unit Failure	GVWR	100	65	500	168	488.8	140.8	Pass
Parking Brake - Uphill	GVWR	-	-	500	Hold for 5 min.?	355.4 P-Brake	Yes-Holds	Pass
Parking Brake - Downhill	GVWR	-	-	500	Hold for 5 min.?	330.6 P-Brake	Yes-Holds	Pass
Heating Snubs	GVWR	120-60	NA	NA	15 Snubs- 3.0 mpsps	63 Vis. Avg.	NA	NA
Hot Performance Stop #1	GVWR	100	65	397 **avg**	79.7	343.7 (245.0)	59.4	Pass
Hot Performance Stop #2	GVWR	100	65	500	89	395.1 (316.4)	58.0	Pass
Brake Cooling	GVWR	50	NA	NA	4 Stops - 3.0 mpsps	46 Vis. Avg.	NA	NA
Recovery Performance Stop #1	GVWR	100	65	397 **avg**	One of the two stops between 37.9 and 69.8 meters.	329.1 (245.4)	50.8	Pass
Recovery Performance Stop #2	GVWR	100	65	397 **avg**		381.0 (302.2)	50.2	
Final Inspection-Brake Integrity	Check components for detachment, fracture or lubricants.					No detachments or fractures-normal appear. & color		Pass
Final Inspection- Reservoirs/Warning Indicators	Master cylinder or brake power reservoir shall meet the volume and label requirements of S5.4.2 and S5.4.3.					Brake system has sufficient capacity and indicators are in compliance.		Pass

3.0 TEST VEHICLE INFORMATION AND DATA SHEETS

The compliance data sheets associated with the FMVSS 135 Brake for NHTSA Vehicle No. CB5402 follow:

Project Number: 20060110-4015
NHTSA Unit Number: CB5402

Test Number: 7
Manufacturer: Mazda Motor Corporation
Make: Mazda
Model: 2
Body Style: Passenger Car
Front Cold Tire Pressure: 220.0 kPa
Rear Cold Tire Pressure: 210.0 kPa

Transportation Research Center Inc. TRC

Vehicle Specifications

Year: 2011
Manufacturer: Mazda Motor Corporation
Make: Mazda
Model: 2
Body Style: Passenger Car
Manufacture Date: 7/1/2010
VIN: JM1DE1HY3B0106366
Transmission Type: 4-Speed Automatic
Engine Type: Gasoline, DOHC,16 valve, VVT, inline 4 cyl., SFI
Displacement: 1.5 Liter
Engine Horsepower: 100
Idle Speed (rpm): 750
No. of Axles: 2

Test Number: 7
GVWR (kg): 1502
GAWR Front (kg): 799
GAWR Rear (kg): 703
Wheelbase (mm): 2489.2
Odometer Start (mi): 86 mi.
Odometer End (mi): 526 mi.

BUSES ONLY

Chassis Mfg.: N/A
Serial Number: N/A
No. of Seats: N/A
Mfg. Date: N/A

TIRES

Size: 185/55R15 82V
Type: Avid S34, tubeless, radial, M+S
Manufacturer: Yokohama
Front GVWR Tire Pressure: 220.0 kPa
Rear GVWR Tire Pressure: 210.0 kPa

Brake Application System

Series: Front: Disc Rear: Drum
Actuation: Diagonal
Foundation: Hydraulic
Parking Mechanism: Yes
Type of Parking Unit: Automatic transmission with park detent.

Master Cylinder Dia. (mm): 20.61
Pedal Ratio: 2.4:1
Anti-Skid Device: Yes
Anti-Skid Unit Mfg.: Conti-Teves

Power Unit: Vacuum
Power Assist Unit: Yes
Power Unit with Accumulator: N/A
Power Asst/Power Unit with Backup: N/A
Variable Proportioning System: N/A

Brake Component Materials and Construction

Brake Type Front: Disc
Construction: Integral Cast Vented
Rotor Diameter (mm): 257.74
Rotor Thickness (mm): 23
Lining Construction: Bonded
Material: Cast Iron
Hydraulic Piston Dia. (mm): 53.78

Inboard (Leading)
Width (mm): 42.2
Length (mm): 97.65
Thickness (mm): 8.65
Lining Code/Color: JB NF80 FF B

Outboard (Leading)
Width (mm): 42.1
Length (mm): 97.65
Thickness (mm): 8.37
Lining Code/Color: JB NF80 FF B

Brake Type Rear: Drum
Construction: Cast
Drum Diameter (mm): 200.12
Rotor Thickness (mm): N/A
Lining Construction: Bonded
Material: Cast Iron
Hydraulic Piston Dia. (mm): 17.61

Inboard (Leading)
Width (mm): 30.19
Length (mm): 188.91
Thickness (mm): 3.92
Lining Code/Color: Textar 14191 FF

Outboard (Leading)
Width (mm): 30.19
Length (mm): 190.51
Thickness (mm): 4.03
Lining Code/Color: Textar 14191 FF

Other Component Information

Friction-type Park Brake: Hand Operated
Non-Service Brake Type: N/A N/A

Technician:_____ Date: _____

Quality Assurance:_____

Project Number: 20060110-4015
NHTSA Unit Number: CB5402

Test Number: 7
Manufacturer: Mazda Motor Corporation
Make: Mazda
Model: 2
Body Style: Passenger Car
Front Cold Tire Pressure: 220.0 kPa
Rear Cold Tire Pressure: 210.0 kPa

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Vehicle Weight

Odometer Start (mi): 86 mi. Odometer End (mi): 526 mi. Scales Used: Building 70 Mettler Scales

GVWR/GAWR Information
(From Vehicle Certification Label)

GVWR (kg): 1502
GAWR Front (kg): 799
GAWR Rear (kg): 703

NOTE: GVWR, LLVW and axle weights to measure within +0% and -1%

Unloaded Vehicle Weight
UVW (kg)

	Left	Right	Total Axle	Total Weight
Front	333.6	328.4	662.0	1,060.0
Rear	208.8	189.2	398.0	

Target Light Loaded Vehicle Weight
LLVW (kg)

	Left	Right	Total Axle	Total Weight
Front	377.4	372.4	749.8	1,241.2
Rear	255.2	236.2	491.4	

Actual Light Loaded Vehicle Weight
LLVW (kg)

	Left	Right	Total Axle	Total Weight
Front	382.8	367.2	750.0	1,242.0
Rear	260.6	231.4	492.0	

Load: Driver/Observer 91.0 (kg) + Instrumentation 18.0 (kg) + Ballast 72.0 (kg) = 181.0(kg)

NOTE 1: LLVW = UVW +181.4 kg

NOTE 2: Weight distributed in front passenger seat area.

NOTE 3: Neither axle load at LLVW less than at UVW; ballast as required.

Fully Loaded Vehicle Weight
GVWR (kg)

	Left	Right	Total Axle	Total Weight
Front	401.4	397.8	799.2	1,502.0
Rear	362.0	340.8	702.8	

Load: Driver/Observer 91.0 (kg) + Instrumentation 18.0 (kg) + Ballast 333.0 (kg) = 442.0(kg)

NOTE 1: Vehicle loaded so axle loadds proportional to GAWR shown previously.

NOTE 2: But no axle weight to be less than at LLVW.

NOTE 3: If weight on any axle at LLVW exceeds the axle's proportional share of the GVWR, the load required to reach GVWR is placed so that the weight on the axle remains the same as at LLVW.

Technician:_____ Date: _____

Quality Assurance:_____

Service Brake System (S5.1)

Vehicle equipped with a service brake acting on all wheels?	Yes

Wear Adjustment (S5.1.1)

Service brakes are compensated for wear by means of a system of automatic adjustment?	Yes

Description: Front: Disc, Automatic clearance take-up. Rear: Automatic adjusters

Wear Status (S5.1.2)

Wear status of service brakes is indicated by:

(A) Acoustic or optical device?	Yes

Description: Metal tab emits high frequency squeal when worn.

or

(B) Visual check outside or under vehicle?	Yes

Description: Front: Look through the caliper. Rear: Pull plug in dust cover to view.

Regenerative Braking System (S5.1.3)

EV with RBS, RBS is a part of the service brake system if automatically activated, there is no means to deactivate, and functions in all transmission positions?	N/A
If equipped with ABS and RBS that is part of the service brake system, ABS controls RBS?	N/A

Parking Brake System (S5.2)

Vehicle equipped with a parking brake system of friction type with solely mechanical means to retain engagement?	Yes

Controls (S5.3)

(A) Service brakes activated by means of a foot control?	Yes
(B) Parking brake control is independent of the service brake control?	Yes
(C) Parking Brake control is hand or foot operated?	Yes
(D) ABS, if equipped, cannot be manually disabled?	
Data Indicates Compliance	Yes

Comments:

Technician:_____ Date: _____

Quality Assurance:_____

Project Number: 20060110-4015
NHTSA Unit Number: CB5402

Test Number: 7
Manufacturer: Mazda Motor Corporation
Make: Mazda
Model: 2
Body Style: Passenger Car
Front Cold Tire Pressure: 220.0 kPa
Rear Cold Tire Pressure: 210.0 kPa

Transportation Research Center Inc. TRC

Date Tested: 08/23/2011

S4 Max. Speed at LLVW

Weather Conditions: 75ºF Wind: 6 mph at 224º

Start Odometer: 106 End Odometer: 122

Schedule:

LLVW, accelerate from 0 kph to Max.
speed attainable in 3.2 km on a level surface.

Performance Requirements:

None.

Stop #	Max. Speed (kph)	Left Front IBT (ºC)	Right Front IBT (ºC)	Left Rear IBT (ºC)	Right Rear IBT (ºC)	Time 0-100 km/h (s)
1	*156.8*	78.7	86.8	48.4	42.7	13.5
2	*157.4*	86.6	96.2	57.3	51.0	14.0

Average Speed = 157.1 kph

Stop #	Direction of Run
1	South
2	North

Driver: Derek Bevis
Recorded Data Processed by: Derek Bevis
Approving Laboratory Official: Mike Bilbee

Observer: None
Date:8/31/2011

Project Number: 20060110-4015
NHTSA Unit Number: CB5402

Test Number: 7
Manufacturer: Mazda Motor Corporation
Make: Mazda
Model: 2
Body Style: Passenger Car
Front Cold Tire Pressure: 220.0 kPa
Rear Cold Tire Pressure: 210.0 kPa

Transportation Research Center Inc. TRC

Date Tested: 08/23/2011

S7.1 Burnish at GVWR

Weather Conditions: 87ºF Wind: 14 mph at 160º

Start Odometer: 125 End Odometer: 365

Schedule:

Initial Brake Temperature less than 100ºC
Initial Speed 80 kph to zero
200 stops with transmission in gear

Performance Requirements:

Interval between runs: Time necessary to reduce IBT to 100ºC or 2 km distance, whichever occurs first.
constant decel rate: 3.0 m/s/s
Ped. Force ajusted to maintain constant decel
No lock up allowed longer than 0.1 sec above 15 kph
Vehicle must stay in lane of 3.5m

Stop #	Initial Speed (kph)	Left Front IBT (ºC)	Right Front IBT (ºC)	Left Rear IBT (ºC)	Right Rear IBT (ºC)	Max. Ped. Force (N)	Avg. Ped. Force (N)	Avg. Decel (m/s²)
1	81.0	47.1	49.8	35.8	35.4	81.0	53.6	2.9
10	80.4	104.9	106.8	79.0	88.6	61.2	46.0	3.1
20	80.4	108.8	107.3	90.7	98.3	56.2	42.9	2.9
30	80.4	105.8	108.6	91.6	93.0	64.3	47.1	3.0
40	80.9	106.5	106.0	87.3	86.1	72.0	46.1	3.1
50	80.4	109.1	112.2	89.1	86.0	56.4	41.9	3.0
60	80.6	106.7	107.2	85.7	82.9	65.8	43.0	3.1
70	80.6	118.6	119.3	90.0	86.5	60.4	45.3	3.0
80	80.3	105.1	105.2	72.5	70.3	63.6	47.5	2.8
90	80.5	105.8	106.9	82.9	78.8	70.2	48.1	3.0
100	80.4	104.8	104.8	81.7	79.0	70.1	46.2	2.9
110	80.3	105.8	106.2	83.1	80.5	85.6	51.3	3.1
120	80.8	103.8	105.9	82.4	79.5	82.3	57.3	3.2
130	80.5	107.8	109.1	85.2	81.2	77.9	54.2	3.1
140	80.2	115.1	118.4	87.9	83.7	68.7	51.1	2.7
150	80.5	113.7	111.3	86.4	82.9	72.9	51.5	2.9
160	80.6	106.7	112.0	67.3	66.1	68.1	46.3	3.0
170	80.6	115.7	114.3	85.7	83.7	68.6	47.0	3.1
180	80.4	111.0	111.5	87.8	85.7	62.9	47.7	3.0
190	80.5	117.8	115.5	87.0	85.9	70.1	47.3	3.0
200	80.9	110.0	112.6	86.7	82.6	76.0	46.9	3.1

Brake Adjustment Schedule: Adjust service brakes; record procedure and amount adjusted.

Left Front : None
Right Front: None
Left Rear : None
Right Rear : None
Comments: None
Data Indicates Compliance: Yes

Driver: Derek Bevis
Observer: None
Recorded Data Processed by: Derek Bevis
Date:8/31/2011
Approving Laboratory Official: Mike Bilbee

Project Number: 20060110-4015
NHTSA Unit Number: CB5402

Test Number: 7
Manufacturer: Mazda Motor Corporation
Make: Mazda
Model: 2
Body Style: Passenger Car
Front Cold Tire Pressure: 220.0 kPa
Rear Cold Tire Pressure: 210.0 kPa

Transportation Research Center Inc. TRC

Date Tested: 08/25/2011

S7.5 Cold Effectiveness at GVWR

Weather Conditions: 73ºF Wind: 9 mph at 313º

Start Odometer: 378 End Odometer: 383

Schedule:

Initial Brake Temperature 65 -100 ºC
Initial Speed 100 kph to zero
6 stops with transmission in neutral

Performance Requirements:

One stop with:
Stopping distance less than or equal to 70m
Ped. Force between 65N and 500N
No lock up allowed longer than 0.1 sec above 15 kph
Vehicle must stay in lane of 3.5m

Stop #	Initial Speed (kph)	Left Front IBT (ºC)	Right Front IBT (ºC)	Left Rear IBT (ºC)	Right Rear IBT (ºC)	Actual Distance (m)	Corrected Distance SAE J299 (m)	Max. Ped. Force (N)	Avg. Ped. Force (N)	Max. Decel (m/s²)	Avg. Decel (m/s²)
1	99.5	95	96	54	51	53.6	54.1	476.9	331.0	10.8	6.1
2	100.7	90	89	61	56	53.6	52.8	488.2	332.8	11.0	5.8
3	100.5	94	93	63	62	53.4	52.8	487.4	388.3	10.9	7.1
4	100.4	95	94	59	60	52.4	52.0	484.9	361.5	11.4	6.8
5	100.4	96	94	57	58	52.7	52.3	487.5	354.8	11.3	6.4
6	100.3	95	94	58	59	52.1	51.8	492.0	398.4	11.2	7.4

Stop #	Wheel Lock Up	Direction of Stop	Stay In Lane
1	No	South	Yes
2	No	South	Yes
3	No	South	Yes
4	No	South	Yes
5	No	South	Yes
6	No	South	Yes

Corrected Distances are used to determine shortest stopping distance.
Comments:

Data Indicates Compliance: Yes

Driver: Derek Bevis
Observer: None
Recorded Data Processed by: Derek Bevis
Date:8/31/2011
Approving Laboratory Official: Mike Bilbee

Project Number: 20060110-4015
NHTSA Unit Number: CB5402

Test Number: 7
Manufacturer: Mazda Motor Corporation
Make: Mazda
Model: 2
Body Style: Passenger Car
Front Cold Tire Pressure: 220.0 kPa
Rear Cold Tire Pressure: 210.0 kPa

Transportation Research Center Inc.

Date Tested: 08/25/2011

S7.6 High Speed Effectiveness at GVWR

Weather Conditions: 74ºF Wind: 10 mph at 280º

Start Odometer: 383 End Odometer: 393

Schedule:

Initial Brake Temperature 65 -100 ºC
Initial Speed 126 kph to zero
6 stops with transmission in gear

Performance Requirements:

One stop with:
Stopping distance less than or equal to 118m
Ped. Force between 65N and 500N
No lock up allowed longer than 0.1 sec above 15 kph
Vehicle must stay in lane of 3.5m

Stop #	Initial Speed (kph)	Left Front IBT (ºC)	Right Front IBT (ºC)	Left Rear IBT (ºC)	Right Rear IBT (ºC)	Actual Distance (m)	Corrected Distance SAE J299 (m)	Max. Ped. Force (N)	Avg. Ped. Force (N)	Max. Decel (m/s²)	Avg. Decel (m/s²)
1	125.1	96	93	56	55	75.6	76.2	474.7	381.6	11.0	7.6
2	126.0	92	91	59	58	75.8	75.3	476.2	359.2	11.0	7.4
3	124.9	91	90	58	58	75.1	76.0	503.3	407.2	11.4	7.8
4	125.0	92	89	61	61	78.0	78.8	493.7	352.3	10.7	6.9
5	125.1	93	91	60	61	78.5	79.1	442.1	323.5	10.8	7.8
6	126.7	91	90	60	61	78.9	77.6	465.4	376.8	11.2	7.7

Stop #	Wheel Lock Up	Direction of Stop	Stay In Lane
1	No	South	Yes
2	No	South	Yes
3	No	South	Yes
4	No	South	Yes
5	No	South	Yes
6	No	South	Yes

Corrected Distances are used to determine shortest stopping distance.
Comments:

Data Indicates Compliance: Yes

Driver: Derek Bevis
Observer: None
Recorded Data Processed by: Derek Bevis
Date:8/31/2011
Approving Laboratory Official: Mike Bilbee

Project Number: 20060110-4015
NHTSA Unit Number: CB5402

Test Number: 7
Manufacturer: Mazda Motor Corporation
Make: Mazda
Model: 2
Body Style: Passenger Car
Front Cold Tire Pressure: 220.0 kPa
Rear Cold Tire Pressure: 210.0 kPa

Transportation Research Center Inc. TRC

Date Tested: 08/25/2011

S7.7 Stops with Engine Off at GVWR

Weather Conditions: 75ºF Wind: 7 mph at 311º

Start Odometer: 393 End Odometer: 401

Schedule:

Initial Brake Temperature 65 -100 ºC
Initial Speed 100 kph to zero
6 stops with transmission in neutral

Performance Requirements:

One stop with:
Stopping distance less than or equal to 70m
Ped. Force between 65N and 500N
No lock up allowed longer than 0.1 sec above 15 kph
Vehicle must stay in lane of 3.5m

Stop #	Initial Speed (kph)	Left Front IBT (ºC)	Right Front IBT (ºC)	Left Rear IBT (ºC)	Right Rear IBT (ºC)	Actual Distance (m)	Corrected Distance SAE J299 (m)	Max. Ped. Force (N)	Avg. Ped. Force (N)	Max. Decel (m/s²)	Avg. Decel (m/s²)
1	99.9	96	95	62	63	52.3	52.3	476.0	352.6	10.6	6.6
2	100.9	94	94	58	60	52.0	51.1	468.6	373.5	10.9	7.1
3	100.6	94	91	58	61	50.9	50.3	493.9	358.7	11.4	7.2
4	100.7	92	82	51	46	50.6	49.9	443.1	318.0	11.3	7.6
5	100.6	96	88	57	55	52.6	52.0	491.6	309.4	11.4	6.5
6	100.0	91	87	56	57	51.8	51.8	479.1	373.9	11.1	7.3

Stop #	Wheel Lock Up	Direction of Stop	Stay In Lane
1	No	South	Yes
2	No	South	Yes
3	No	South	Yes
4	No	South	Yes
5	No	South	Yes
6	No	South	Yes

Corrected Distances are used to determine shortest stopping distance.

Comments:

Data Indicates Compliance: Yes

Driver: Derek Bevis
Observer: None
Recorded Data Processed by: Derek Bevis
Date:8/31/2011
Approving Laboratory Official: Mike Bilbee

Project Number: 20060110-4015
NHTSA Unit Number: CB5402

Test Number: 7
Manufacturer: Mazda Motor Corporation
Make: Mazda
Model: 2
Body Style: Passenger Car
Front Cold Tire Pressure: 220.0 kPa
Rear Cold Tire Pressure: 210.0 kPa

Transportation Research Center Inc.

Date Tested: 08/25/2011

S7.5 Cold Effectiveness at LLVW

Weather Conditions: 76ºF Wind: 7 mph at 298º

Start Odometer: 406 End Odometer: 413

Schedule:

Initial Brake Temperature 65 -100 ºC
Initial Speed 100 kph to zero
6 stops with transmission in neutral

Performance Requirements:

One stop with:
Stopping distance less than or equal to 70m
Ped. Force between 65N and 500N
No lock up allowed longer than 0.1 sec above 15 kph
Vehicle must stay in lane of 3.5m

Stop #	Initial Speed (kph)	Left Front IBT (ºC)	Right Front IBT (ºC)	Left Rear IBT (ºC)	Right Rear IBT (ºC)	Actual Distance (m)	Corrected Distance SAE J299 (m)	Max. Ped. Force (N)	Avg. Ped. Force (N)	Max. Decel (m/s²)	Avg. Decel (m/s²)
1	100.4	93	97	52	50	49.9	49.5	475.3	341.7	11.7	7.0
2	100.8	90	92	52	51	49.8	49.0	473.8	357.7	11.9	7.3
3	100.0	89	92	51	51	50.8	50.8	463.9	334.5	13.0	7.3
4	99.0	94	97	52	52	50.2	51.2	466.5	327.9	12.7	6.8
5	100.8	97	97	52	49	51.4	50.6	503.1	326.4	11.7	6.3
6	99.4	98	98	52	51	49.2	49.8	503.4	343.1	12.6	6.9

Stop #	Wheel Lock Up	Direction of Stop	Stay In Lane
1	No	South	Yes
2	No	South	Yes
3	No	South	Yes
4	No	South	Yes
5	No	South	Yes
6	No	South	Yes

Corrected Distances are used to determine shortest stopping distance.
Comments:

Data Indicates Compliance: Yes

Driver: Derek Bevis
Observer: None
Recorded Data Processed by: Derek Bevis
Date:8/31/2011
Approving Laboratory Official: Mike Bilbee

Project Number: 20060110-4015
NHTSA Unit Number: CB5402

Test Number: 7
Manufacturer: Mazda Motor Corporation
Make: Mazda
Model: 2
Body Style: Passenger Car
Front Cold Tire Pressure: 220.0 kPa
Rear Cold Tire Pressure: 210.0 kPa

Transportation Research Center Inc.

Date Tested: 08/25/2011

S7.6 High Speed Effectiveness at LLVW

Weather Conditions: 64ºF Wind: 2 mph at 311º

Start Odometer: 413 End Odometer: 431

Schedule:

Initial Brake Temperature 65 -100 ºC
Initial Speed 126 kph to zero
6 stops with transmission in gear

Performance Requirements:

One stop with:
Stopping distance less than or equal to 118m
Ped. Force between 65N and 500N
No lock up allowed longer than 0.1 sec above 15 kph
Vehicle must stay in lane of 3.5m

Stop #	Initial Speed (kph)	Left Front IBT (ºC)	Right Front IBT (ºC)	Left Rear IBT (ºC)	Right Rear IBT (ºC)	Actual Distance (m)	Corrected Distance SAE J299 (m)	Max. Ped. Force (N)	Avg. Ped. Force (N)	Max. Decel (m/s²)	Avg. Decel (m/s²)
1	126.5	93	95	53	53	77.8	76.8	481.1	319.7	11.7	7.8
2	125.8	91	94	51	52	76.1	76.0	495.5	362.9	11.9	7.8
3	126.5	91	92	51	52	76.2	75.2	468.0	350.8	12.1	8.1
4	126.2	77	83	43	41	74.2	73.6	498.5	329.4	12.1	7.5
5	124.7	88	92	47	45	72.5	73.6	419.8	338.6	11.9	8.6
6	124.9	89	91	48	46	73.0	74.0	476.3	346.9	12.6	7.6

Stop #	Wheel Lock Up	Direction of Stop	Stay In Lane
1	No	South	Yes
2	No	South	Yes
3	No	South	Yes
4	No	South	Yes
5	No	South	Yes
6	No	South	Yes

Corrected Distances are used to determine shortest stopping distance.

Comments:

Data Indicates Compliance: Yes

Driver: Derek Bevis
Observer: None
Recorded Data Processed by: Derek Bevis
Date:8/31/2011
Approving Laboratory Official: Mike Bilbee

Project Number: 20060110-4015
NHTSA Unit Number: CB5402

Test Number: 7
Manufacturer: Mazda Motor Corporation
Make: Mazda
Model: 2
Body Style: Passenger Car
Front Cold Tire Pressure: 220.0 kPa
Rear Cold Tire Pressure: 210.0 kPa

Transportation Research Center Inc.

Date Tested: 08/26/2011

S7.8 Antilock Failure at LLVW

Weather Conditions: 67ºF Wind: 3 mph at 92º

Start Odometer: 431 End Odometer: 439

Schedule:

Initial Brake Temperature 65 -100 ºC
Initial Speed 100 kph to zero
6 stops with transmission in neutral

Performance Requirements:

One stop with:
Stopping distance less than or equal to 85m
Ped. Force between 65N and 500N
No lock up allowed longer than 0.1 sec above 15 kph
Vehicle must stay in lane of 3.5m

Stop #	Initial Speed (kph)	Left Front IBT (ºC)	Right Front IBT (ºC)	Left Rear IBT (ºC)	Right Rear IBT (ºC)	Actual Distance (m)	Corrected Distance SAE J299 (m)	Max. Ped. Force (N)	Avg. Ped. Force (N)	Max. Decel (m/s²)	Avg. Decel (m/s²)
1	101.2	94	96	49	47	57.9	56.6	150.4	120.2	9.4	6.9
2	100.4	90	93	52	50	56.4	56.0	177.4	125.5	9.8	7.0
3	100.4	92	97	54	53	60.7	60.2	139.2	118.2	9.6	6.7
4	99.7	92	96	56	55	55.9	56.3	168.4	118.4	10.0	6.2
5	100.1	90	94	56	54	58.1	57.9	158.9	117.5	9.3	6.6
6	100.4	89	94	56	55	55.3	54.8	184.4	140.5	10.3	6.6

Stop #	Wheel Lock Up	Direction of Stop	Stay In Lane
1	No	South	Yes
2	No	South	Yes
3	No	South	Yes
4	No	South	Yes
5	No	South	Yes
6	No	South	Yes

Corrected Distances are used to determine shortest stopping distance.
Comments: Disconnected LR wheel speed sensor to induce ABS failure.

Data Indicates Compliance: Yes

Driver: Derek Bevis
Observer: None
Recorded Data Processed by: Derek Bevis
Date:8/31/2011
Approving Laboratory Official: Mike Bilbee

Project Number: 20060110-4015
NHTSA Unit Number: CB5402

Test Number: 7
Manufacturer: Mazda Motor Corporation
Make: Mazda
Model: 2
Body Style: Passenger Car
Front Cold Tire Pressure: 220.0 kPa
Rear Cold Tire Pressure: 210.0 kPa

Transportation Research Center Inc. TRC

Date Tested: 08/26/2011

S7.10 Hydraulic Circuit Failure #1 at LLVW

Weather Conditions: 72ºF Wind: 3 mph at 42º

Start Odometer: 443 End Odometer: 447

Schedule:

Initial Brake Temperature 65 -100 ºC
Initial Speed 100 kph to zero
6 stops with transmission in neutral

Performance Requirements:

One stop with:
Stopping distance less than or equal to 168m
Ped. Force between 65N and 500N
No lock up allowed longer than 0.1 sec above 15 kph
Vehicle must stay in lane of 3.5m

Stop #	Initial Speed (kph)	Left Front IBT (ºC)	Right Front IBT (ºC)	Left Rear IBT (ºC)	Right Rear IBT (ºC)	Actual Distance (m)	Corrected Distance SAE J299 (m)	Max. Ped. Force (N)	Avg. Ped. Force (N)	Max. Decel (m/s²)	Avg. Decel (m/s²)
1	100.3	37	84	49	29	96.1	95.5	476.3	398.3	5.9	4.3
2	99.8	35	94	59	29	98.7	99.1	470.3	362.8	6.3	4.4
3	100.1	34	96	60	30	98.2	98.1	456.1	368.8	6.3	4.4
4	99.9	33	91	55	30	94.0	94.2	473.2	412.6	6.2	4.8

Stop #	Wheel Lock Up	Direction of Stop	Stay In Lane
1	No	South	Yes
2	No	South	Yes
3	No	South	Yes
4	No	South	Yes

Corrected Distances are used to determine shortest stopping distance.
Comments: Subsystem #1 failed, LF & RR brakes failed.
142 ml removed to activate the brake lamp.
Data Indicates Compliance: Yes

Driver: Derek Bevis
Observer: None
Recorded Data Processed by: Derek Bevis
Date:8/31/2011
Approving Laboratory Official: Mike Bilbee

Project Number: 20060110-4015
NHTSA Unit Number: CB5402

Test Number: 7
Manufacturer: Mazda Motor Corporation
Make: Mazda
Model: 2
Body Style: Passenger Car
Front Cold Tire Pressure: 220.0 kPa
Rear Cold Tire Pressure: 210.0 kPa

Transportation Research Center Inc.

Date Tested: 08/26/2011

S7.10 Redundant Hydraulic Circuit Fail #2 at LLVW

Weather Conditions: 76ºF Wind: 3 mph at 346º

Start Odometer: 452 End Odometer: 456

Schedule:

Initial Brake Temperature 65 -100 ºC
Initial Speed 100 kph to zero
6 stops with transmission in neutral

Performance Requirements:

One stop with:
Stopping distance less than or equal to 168m
Ped. Force between 65N and 500N
No lock up allowed longer than 0.1 sec above 15 kph
Vehicle must stay in lane of 3.5m

Stop #	Initial Speed (kph)	Left Front IBT (ºC)	Right Front IBT (ºC)	Left Rear IBT (ºC)	Right Rear IBT (ºC)	Actual Distance (m)	Corrected Distance SAE J299 (m)	Max. Ped. Force (N)	Avg. Ped. Force (N)	Max. Decel (m/s²)	Avg. Decel (m/s²)
1	100.3	95	34	26	50	98.3	97.7	485.7	407.4	6.0	4.2
2	101.7	96	37	28	61	97.6	94.4	522.8	395.8	6.3	4.3
3	100.4	94	39	28	63	97.4	96.6	485.1	425.3	6.7	4.3
4	99.6	90	41	30	64	92.8	93.7	479.0	398.9	6.5	4.2

Stop #	Wheel Lock Up	Direction of Stop	Stay In Lane
1	No	South	Yes
2	No	South	Yes
3	No	South	Yes
4	No	South	Yes

Corrected Distances are used to determine shortest stopping distance.
Comments: Subsystem #2 failed, RF & LR brakes failed.

Data Indicates Compliance: Yes

Driver: Derek Bevis
Observer: None
Recorded Data Processed by: Derek Bevis
Date:8/31/2011
Approving Laboratory Official: Mike Bilbee

Project Number: 20060110-4015
NHTSA Unit Number: CB5402

Test Number: 7
Manufacturer: Mazda Motor Corporation
Make: Mazda
Model: 2
Body Style: Passenger Car
Front Cold Tire Pressure: 220.0 kPa
Rear Cold Tire Pressure: 210.0 kPa

Transportation Research Center Inc.

Date Tested: 08/29/2011

S7.10 Hydraulic Circuit Failure #1 at GVWR

Weather Conditions: 61ºF Wind: 3 mph at 337º

Start Odometer: 468 End Odometer: 471

Schedule:

Initial Brake Temperature 65 -100 ºC
Initial Speed 100 kph to zero
6 stops with transmission in neutral

Performance Requirements:

One stop with:
Stopping distance less than or equal to 168m
Ped. Force between 65N and 500N
No lock up allowed longer than 0.1 sec above 15 kph
Vehicle must stay in lane of 3.5m

Stop #	Initial Speed (kph)	Left Front IBT (ºC)	Right Front IBT (ºC)	Left Rear IBT (ºC)	Right Rear IBT (ºC)	Actual Distance (m)	Corrected Distance SAE J299 (m)	Max. Ped. Force (N)	Avg. Ped. Force (N)	Max. Decel (m/s²)	Avg. Decel (m/s²)
1	101.0	24	95	55	20	105.7	103.6	503.7	381.8	5.5	4.0
2	99.8	25	92	57	21	100.8	101.1	494.1	421.4	5.5	3.8
3	100.1	27	95	64	22	102.6	102.4	491.8	416.3	5.8	3.8
4	99.5	30	98	68	23	101.5	102.5	475.8	424.1	5.2	3.8

Stop #	Wheel Lock Up	Direction of Stop	Stay In Lane
1	No	South	Yes
2	No	South	Yes
3	No	South	Yes
4	No	South	Yes

Corrected Distances are used to determine shortest stopping distance.

Comments: Subsystem #1 failed, LF & RR brakes failed.

Data Indicates Compliance: Yes

Driver: Derek Bevis
Observer: None
Recorded Data Processed by: Derek Bevis
Date:8/31/2011
Approving Laboratory Official: Mike Bilbee

Project Number: 20060110-4015
NHTSA Unit Number: CB5402

Test Number: 7
Manufacturer: Mazda Motor Corporation
Make: Mazda
Model: 2
Body Style: Passenger Car
Front Cold Tire Pressure: 220.0 kPa
Rear Cold Tire Pressure: 210.0 kPa

Transportation Research Center Inc. TRC

Date Tested: 08/26/2011

S7.10 Redundant Hydraulic Circuit Fail #2 at GVWR

Weather Conditions: 76ºF Wind: 3 mph at 5º

Start Odometer: 459 End Odometer: 462

Schedule:

Initial Brake Temperature 65 -100 ºC
Initial Speed 100 kph to zero
6 stops with transmission in neutral

Performance Requirements:

One stop with:
Stopping distance less than or equal to 168m
Ped. Force between 65N and 500N
No lock up allowed longer than 0.1 sec above 15 kph
Vehicle must stay in lane of 3.5m

Stop #	Initial Speed (kph)	Left Front IBT (ºC)	Right Front IBT (ºC)	Left Rear IBT (ºC)	Right Rear IBT (ºC)	Actual Distance (m)	Corrected Distance SAE J299 (m)	Max. Ped. Force (N)	Avg. Ped. Force (N)	Max. Decel (m/s²)	Avg. Decel (m/s²)
1	101.0	95	41	32	60	108.4	106.4	484.0	427.7	5.2	3.7
2	99.1	95	43	31	67	107.3	109.2	504.4	433.3	5.3	3.6
3	102.6	99	45	32	74	111.9	106.3	492.3	409.0	5.1	3.6
4	101.1	95	46	31	73	112.2	109.8	494.7	425.9	5.4	3.4

Stop #	Wheel Lock Up	Direction of Stop	Stay In Lane
1	No	South	Yes
2	No	South	Yes
3	No	South	Yes
4	No	South	Yes

Corrected Distances are used to determine shortest stopping distance.
Comments: Subsystem #2 failed, RF & LR brakes failed.

Data Indicates Compliance: Yes

Driver: Derek Bevis
Observer: None
Recorded Data Processed by: Derek Bevis
Date:8/31/2011
Approving Laboratory Official: Mike Bilbee

Project Number: 20060110-4015
NHTSA Unit Number: CB5402

Test Number: 7
Manufacturer: Mazda Motor Corporation
Make: Mazda
Model: 2
Body Style: Passenger Car
Front Cold Tire Pressure: 220.0 kPa
Rear Cold Tire Pressure: 210.0 kPa

Transportation Research Center Inc. TRC

Date Tested: 08/29/2011

S7.8 Antilock Failure at GVWR

Weather Conditions: 67ºF Wind: 7 mph at 360º

Start Odometer: 478 End Odometer: 483

Schedule:

Initial Brake Temperature 65 -100 ºC
Initial Speed 100 kph to zero
6 stops with transmission in neutral

Performance Requirements:

One stop with:
Stopping distance less than or equal to 85m
Ped. Force between 65N and 500N
No lock up allowed longer than 0.1 sec above 15 kph
Vehicle must stay in lane of 3.5m

Stop #	Initial Speed (kph)	Left Front IBT (ºC)	Right Front IBT (ºC)	Left Rear IBT (ºC)	Right Rear IBT (ºC)	Actual Distance (m)	Corrected Distance SAE J299 (m)	Max. Ped. Force (N)	Avg. Ped. Force (N)	Max. Decel (m/s²)	Avg. Decel (m/s²)
1	99.5	80	90	51	45	61.1	61.8	255.5	199.6	8.6	6.2
2	101.1	76	88	54	51	57.3	56.0	296.5	176.1	9.1	5.6
3	101.3	85	97	59	56	57.7	56.2	272.5	198.1	9.9	6.3
4	99.8	83	95	56	56	55.2	55.4	246.4	217.0	9.5	7.4
5	100.8	81	93	54	55	59.3	58.3	248.4	199.8	8.9	6.2
6	102.4	86	95	57	58	57.6	54.9	212.0	163.6	9.7	6.4

Stop #	Wheel Lock Up	Direction of Stop	Stay In Lane
1	No	South	Yes
2	No	South	Yes
3	No	South	Yes
4	No	South	Yes
5	No	South	Yes
6	No	South	Yes

Corrected Distances are used to determine shortest stopping distance.
Comments: Disconnected LR wheel speed sensor to induce ABS failure.

Data Indicates Compliance: Yes

Driver: Derek Bevis
Observer: None
Recorded Data Processed by: Derek Bevis
Date:8/31/2011
Approving Laboratory Official: Mike Bilbee

Project Number: 20060110-4015
NHTSA Unit Number: CB5402

Test Number: 7
Manufacturer: Mazda Motor Corporation
Make: Mazda
Model: 2
Body Style: Passenger Car
Front Cold Tire Pressure: 220.0 kPa
Rear Cold Tire Pressure: 210.0 kPa

Transportation Research Center Inc.

Date Tested: 08/29/2011

S7.11 Power Brake Unit Failure at GVWR

Weather Conditions: 69ºF Wind: 10 mph at 58º

Start Odometer: 484 End Odometer: 491

Schedule:

Initial Brake Temperature 65 -100 ºC
Initial Speed 100 kph to zero
6 stops with transmission in neutral

Performance Requirements:

One stop with:
Stopping distance less than or equal to 168m
Ped. Force between 65N and 500N
No lock up allowed longer than 0.1 sec above 15 kph
Vehicle must stay in lane of 3.5m

Stop #	Initial Speed (kph)	Left Front IBT (ºC)	Right Front IBT (ºC)	Left Rear IBT (ºC)	Right Rear IBT (ºC)	Actual Distance (m)	Corrected Distance SAE J299 (m)	Max. Ped. Force (N)	Avg. Ped. Force (N)	Max. Decel (m/s²)	Avg. Decel (m/s²)
1	99.9	85	91	53	52	158.1	158.2	487.7	450.8	3.3	2.7
2	99.6	90	95	56	55	143.1	144.1	485.2	459.4	3.5	2.9
3	99.8	91	94	57	55	133.9	134.5	523.8	452.8	3.8	3.0
4	100.3	92	94	55	55	150.0	149.1	487.4	449.1	3.5	2.8
5	101.3	94	95	53	54	144.5	140.8	488.8	455.1	3.6	2.9
6	100.0	92	95	54	53	146.9	146.9	493.1	446.1	3.6	2.9

Stop #	Wheel Lock Up	Direction of Stop	Stay In Lane
1	No	South	Yes
2	No	South	Yes
3	No	South	Yes
4	No	South	Yes
5	No	South	Yes
6	No	South	Yes

Corrected Distances are used to determine shortest stopping distance.
Comments: Removed and blocked vacuum line to brake booster. Performed 10 firm applications of the service pedal to deplete the system.
Data Indicates Compliance: Yes

Driver: Derek Bevis
Observer: None
Recorded Data Processed by: Derek Bevis
Date:8/31/2011
Approving Laboratory Official: Mike Bilbee

Project Number: 20060110-4015
NHTSA Unit Number: CB5402

Test Number: 7
Manufacturer: Mazda Motor Corporation
Make: Mazda
Model: 2
Body Style: Passenger Car
Front Cold Tire Pressure: 220.0 kPa
Rear Cold Tire Pressure: 210.0 kPa

Transportation Research Center Inc.

Date Tested: 08/29/2011

S7.12 Parking Brake Static at GVWR

Weather Conditions: 70ºF Wind: 6 mph at 50º

Start Odometer: 494 End Odometer: 494

Schedule:

Initial Brake Temperature ≤100 ºC
or Ambient Temp. if non-service brake type materials
Loaded to GVWR with transmission in Neutral
Drive onto 20% slope in forward and reverse directions.

Performance Requirements:

Up to three Applies in each direction:
Parking brake must hold the vehicle stationary
in both directions for 5 miutes each
Ped. Force: Hand Control: <400N
Ped. Force: Foot Control: <500N

Stop #	Left Front IBT (ºC)	Right Front IBT (ºC)	Left Rear IBT (ºC)	Right Rear IBT (ºC)	Max. Ped. Force (N)	Max. P-Brake Force (N)
1	60	60	35	35	89.4	355.4
2	56	55	35	34	89.7	330.6

Stationary time: 5 minutes
Comments: Stop #1 was uphill, Stop #2 was downhill
Park brake indicator operated each time the parking brake was applied.

Data Indicates Compliance: Yes

Driver: Derek Bevis
Observer: None
Recorded Data Processed by: Derek Bevis
Date:8/31/2011
Approving Laboratory Official: Mike Bilbee

Project Number: 20060110-4015
NHTSA Unit Number: CB5402

Test Number: 7
Manufacturer: Mazda Motor Corporation
Make: Mazda
Model: 2
Body Style: Passenger Car
Front Cold Tire Pressure: 220.0 kPa
Rear Cold Tire Pressure: 210.0 kPa

Transportation Research Center Inc. TRC

Date Tested: 08/29/2011

S7.13 Heating Snubs at GVWR

Weather Conditions: 71ºF Wind: 7 mph at 49º

Start Odometer: 495 End Odometer: 507

Schedule:

Initial Brake Temperature 55 -65 ºC
Initial Speed 120 kph to 60
15 snubs with transmission in gear

Performance Requirements:

Maintain a constant Decel rate of 3.0 m/s^2
Attain the specified Decel within one second
and maintain it for the remainder of the snub.
Maintain a time interval of 45s between the start of snubs.
Accelerate as rapidly as possible to the initial test speed
immediately after each snub.

Stop #	Avg. Decel (m/s^2)	Time Between Snubs (s)	Avg. Ped. Force (N)	Left Front IBT (ºC)	Right Front IBT (ºC)	Left Rear IBT (ºC)	Right Rear IBT (ºC)	Initial Speed (kph)
1	3.0	0.0	61.3	54	62	35	37	121.0
2	3.0	45.8	66.5	95	102	48	48	120.4
3	3.1	43.8	59.4	135	139	61	60	120.5
4	3.1	46.2	57.0	171	172	74	71	120.8
5	3.1	45.0	63.9	201	200	87	82	120.4
6	2.9	45.0	64.8	224	221	99	92	120.8
7	3.0	45.0	61.5	244	240	112	101	120.6
8	2.9	45.1	64.1	257	254	123	110	121.0
9	3.0	45.0	58.9	262	261	133	117	120.3
10	2.9	45.3	64.9	267	271	143	123	121.3
11	2.9	44.7	67.1	270	276	151	129	120.7
12	3.1	45.9	62.5	271	276	158	134	121.0
13	3.0	44.1	58.0	278	282	166	139	121.3
14	3.1	45.2	68.9	282	285	172	144	120.8
15	3.0	45.7	71.2	283	286	177	148	121.1

Stop #	Wheel Lock Up	Direction of Stop	Stay In Lane
1	No	North	Yes
2	No	East	Yes
3	No	South	Yes
4	No	South	Yes
5	No	South	Yes
6	No	South	Yes
7	No	West	Yes
8	No	North	Yes
9	No	North	Yes
10	No	North	Yes
11	No	East	Yes
12	No	South	Yes
13	No	South	Yes
14	No	South	Yes
15	No	South	Yes

Comments:

Data Indicates Compliance: Yes

Driver: Derek Bevis
Observer: None
Recorded Data Processed by: Derek Bevis
Date:8/31/2011
Approving Laboratory Official: Mike Bilbee

Project Number: 20060110-4015
NHTSA Unit Number: CB5402

Test Number: 7
Manufacturer: Mazda Motor Corporation
Make: Mazda
Model: 2
Body Style: Passenger Car
Front Cold Tire Pressure: 220.0 kPa
Rear Cold Tire Pressure: 210.0 kPa

Transportation Research Center Inc. TRC

Date Tested: 08/29/2011

S7.14 Hot Performance at GVWR

Weather Conditions: 71ºF Wind: 7 mph at 49º

Start Odometer: 507 End Odometer: 507

Schedule:

Initial Speed 100 kph to zero
2 runs with transmission in neutral

Performance Requirements:

Run 1: Maintain an Avg. Ped. Force <= 397 N
Run 1: Stopping distance less than or equal to79.7 m
Run 2: Maintain an Avg. Ped. Force <= 500 N
Run 2: Stopping distance less than or equal to 89m
Based on shortest GVWR Cold Effectiveness stop # 6

Stop #	Initial Speed (kph)	Left Front IBT (ºC)	Right Front IBT (ºC)	Left Rear IBT (ºC)	Right Rear IBT (ºC)	Actual Distance (m)	Corrected Distance SAE J299 (m)	Max. Ped. Force (N)	Avg. Ped. Force (N)	Max. Decel (m/s²)	Avg. Decel (m/s²)
1	100.4	302	303	186	154	59.8	59.4	343.7	245.0	9.1	6.3
2	100.5	324	326	193	163	58.6	58.0	395.1	316.4	10.3	6.3

Stop #	Wheel Lock Up	Direction of Stop	Stay In Lane
1	No	West	Yes
2	No	West	Yes

Corrected Distances are used to determine shortest stopping distance.

Comments:

Data Indicates Compliance: Yes

Driver: Derek Bevis
Observer: None
Recorded Data Processed by: Derek Bevis
Date:8/31/2011
Approving Laboratory Official: Mike Bilbee

Project Number: 20060110-4015
NHTSA Unit Number: CB5402

Test Number: 7
Manufacturer: Mazda Motor Corporation
Make: Mazda
Model: 2
Body Style: Passenger Car
Front Cold Tire Pressure: 220.0 kPa
Rear Cold Tire Pressure: 210.0 kPa

Transportation Research Center Inc. TRC

Date Tested: 08/29/2011

S7.15 Brake Cooling Stops at GVWR

Weather Conditions: 71ºF Wind: 7 mph at 49º

Start Odometer: 507 End Odometer: 511

Schedule:

Initial Speed 50 kph to zero
4 stops with transmission in gear
After each stop, immediately accelerate at the
Max. rate to 50 kph
Maintain that speed until beginning the next stop
at a distance of 1.5 km from the beginning of the previous stop

Performance Requirements:

Ped. Force adjust as necessary
Maintain a constant Decel rate of 3.0 m/s^2
No lock up allowed longer than 0.1 sec above 15 kph

Stop #	Initial Speed (kph)	Left Front IBT (ºC)	Right Front IBT (ºC)	Left Rear IBT (ºC)	Right Rear IBT (ºC)	Actual Distance (m)	Corrected Distance SAE J299 (m)	Max. Ped. Force (N)	Avg. Ped. Force (N)	Max. Decel (m/s^2)	Avg. Decel (m/s^2)
1	51.3	275	281	189	166	37.7	35.8	74.1	48.2	3.5	2.7
2	50.9	222	233	171	149	35.7	34.5	71.8	41.6	3.9	2.9
3	51.1	179	193	152	130	35.7	34.2	68.2	48.4	4.0	3.0
4	51.0	147	162	135	113	34.2	32.8	72.4	46.8	4.3	3.0

Stop #	Wheel Lock Up	Direction of Stop	Stay In Lane
1	No	North	Yes
2	No	North	Yes
3	No	North	Yes
4	No	East	Yes

Corrected Distances are used to determine shortest stopping distance.
Comments:

Data Indicates Compliance: Yes

Driver: Derek Bevis
Observer: None
Recorded Data Processed by: Derek Bevis
Date:8/31/2011
Approving Laboratory Official: Mike Bilbee

Project Number: 20060110-4015
NHTSA Unit Number: CB5402

Test Number: 7
Manufacturer: Mazda Motor Corporation
Make: Mazda
Model: 2
Body Style: Passenger Car
Front Cold Tire Pressure: 220.0 kPa
Rear Cold Tire Pressure: 210.0 kPa

Transportation Research Center Inc.

Date Tested: 08/29/2011

S7.16 Recovery Performance at GVWR

Weather Conditions: 71ºF Wind: 7 mph at 49º

Start Odometer: 511 End Odometer: 513

Schedule:

Initial Speed 100 kph to zero
2 runs with transmission in neutral

Performance Requirements:

Maintain an Avg. Ped. Force <= 397 N
Stopping distance of at least one stop
within 37.9m to 69.8m
No lock up allowed longer than 0.1 sec above 15 kph
Based on shortest GVWR Cold Effectiveness stop # 6

Stop #	Initial Speed (kph)	Left Front IBT (ºC)	Right Front IBT (ºC)	Left Rear IBT (ºC)	Right Rear IBT (ºC)	Actual Distance (m)	Corrected Distance SAE J299 (m)	Max. Ped. Force (N)	Avg. Ped. Force (N)	Max. Decel (m/s²)	Avg. Decel (m/s²)
1	100.2	134	150	126	105	51.0	50.8	329.1	245.4	11.2	7.3
2	99.7	168	185	134	113	49.9	50.2	381.0	302.2	11.2	7.4

Stop #	Wheel Lock Up	Direction of Stop	Stay In Lane
1	No	South	Yes
2	No	South	Yes

Corrected Distances are used to determine shortest stopping distance.
Comments:

Data Indicates Compliance: Yes

Driver: Derek Bevis
Observer: None
Recorded Data Processed by: Derek Bevis
Date:8/31/2011
Approving Laboratory Official: Mike Bilbee

Test Completion Inspection (7.17)

VEHICLE: 2011 Mazda 2 NHTSA NO.: CB5402 ODO.: 635 mi. DATE: 8/30/11

System Integrity (S5.6)

Each vehicle shall meet the complete performance requirements of this standard without:
(a) Detachment or fracture of any component of the braking system such as brake springs and brake shoes or disc pad facings, other than minor cracks, that do not impair attachment of the friction facings. All mechanical components of the braking system shall be intact and functional. Friction facing tearout (complete detachment of lining) shall not exceed 10 percent of the lining on any single frictional element.
(b) Any visible brake fluid or lubricant on the friction surface of the brake or leakage at the master cylinder or brake power unit reservoir cover, seal, and filler openings.

Friction Material Condition: Primary/Inner		**Friction Material Condition: Secondary/Outer**	
LF	Normal Appearance & Color	LF	Normal Appearance & Color
RF	Normal Appearance & Color	RF	Normal Appearance & Color
LR	Normal Appearance & Color	LF	Normal Appearance & Color
RR	Normal Appearance & Color	RR	Normal Appearance & Color
Drum (or Rotor) Condition:		**Brake Fluid/Lubricant Inside Brakes:**	
LF	Normal Appearance & Color	LF	None
RF	Normal Appearance & Color	RF	None
LR	Normal Appearance & Color	LR	None
RR	Normal Appearance & Color	RR	None
Hydraulic Component Condition:		**Mechanical Component Condition:**	
LF	Good	Brk/Pedal	Good
RF	Good	Power Brk	Good
LR	Good	Stop/Lamp	Good
RR	Good	Linkage	Good
M/Cyl	Good	Other	NA

COMPLIANCE: Yes_X__ No____
Comments: None.

Technician: Derek Bevis

TEST COMPLETION INSPECTION (S7.17)

VEHICLE: 2011 Mazda 2; NHTSA NO.: CB5402 GVWR: 1910 kg
MASTER CYLINDER RESERVOIR:

DATE		Requirements	Pass	Fail
Reservoir Compartments (S5.4.1)				
(1) Does master cylinder have a reservoir compartment for each brake subsystem?	***Yes***	Master cylinder shall have a reservoir compartment for each subsystem.	X	
	No			
(2) Does loss of fluid in one compartment result in complete loss from another compartment?	Yes	Loss of fluid from one compartment shall not cause complete loss from another compartment.	X	
	No			
Reservoir Capacity (S5.4.2)				
Shall conform to requirements (1) or (2), state units: (1) For reservoirs having completely separate compartments for each subsystem (two separate, independent reservoirs):				
Subsystem 1 Subsystem reservoir capacity		Each compartment (reservoir) shall have a minimum capacity equivalent to the fluid displacement resulting when all wheel cylinders or caliper pistons serviced by that independent compartment/reservoir moves from a new lining, fully retracted position to a fully worn, properly adjusted, fully applied position. (Use CALCULATION OF MINIMUM RESERVOIR VOLUME REQUIREMENTS Data Sheet)	NA	NA
Subsystem 1 Fluid displaced from new to worn lining				
Subsystem 2 Subsystem reservoir capacity			NA	NA
Subsystem 2 Fluid displaced from new to worn lining				
2) For reservoirs utilizing a portion of the reservoir for a common supply to two or more subsystems:				
Total minimum capacity for the entire master cylinder reservoir (includes individual compartment reservoirs)	217 ml	Shall have total minimum capacity for entire reservoir for displacement resulting from all subsystem wheel cylinders or caliper positions moving from new lining to full worn condition as above.	X	
Fluid displaced from new to worn linings (ALL linings) *Value calculated from CALCULATION OF MINIMUM RESERVOIR VOLUME REQUIREMENTS Data Sheet	84 ml*			

Comments: None.

Technician: Derek Bevis

TEST COMPLETION INSPECTION (S7.18)

VEHICLE: 2011 Mazda 2; NHTSA NO.: CB5402 GVWR: 1502 kg

MASTER CYLINDER RESERVOIR:

DATE		Requirements	Pass	Fail
Master Cylinder Piston Displacement(S5.4.2) [If Common Reservoir Supply – continued from previous page]				
Fluid displaced by three strokes of master cylinder piston for Subsystem No. 1.	21.0 ml	Individual partial compartments of reservoir shall **each** have a minimum of fluid equal to at least the volume displaced by the master cylinder piston servicing the subsystem during a full stroke of the piston. **NOTE:** Procedure uses three strokes to ensure an accurate measurement.		
Fluid displaced by three strokes of master cylinder piston for Secondary (Subsystem No. 2)	21.0 ml			
Fluid displaced per stroke, Subsystem No. 1.	7.0 ml			
Fluid displaced per stroke, Subsystem No. 2.	7.0 ml			
Fluid available in partial compartment Subsystem No. 1	26 ml		X	
Fluid available in partial compartment Subsystem No. 2	26 ml		X	
Brake Power Unit Reservoir (S5.4.2)				
Volume displaced in charging system piston or accumulator to normal operating pressure plus wheel cylinder or caliper piston displacement.		Shall have a capacity at least equal to fluid displacement required to charge the system pistons on accumulators to normal operating pressure plus displacement when wheel cylinders or caliper pistons move from new lining to full worn condition as above.	NA	
Reservoir Labeling (S5.4.3)				
Exact copy of reservoir label: On top of master cylinder reservoir: WARNING CLEAN FILLER CAP BEFORE REMOVING. USE ONLY DOT3 BRAKE FLUID FROM A SEALED CONTAINER.		Label shall read: "Warning, clean filler cap before removing; use only * fluid from a sealed container". * Fluid type specified in 49 CFR 571.116	X	
Measure letter height	4.0 mm	Letters shall be at least 3.2 mm/ 0.125" high	X	
Describe label attachment method and location. Letters are embossed on the master cylinder reservoir filler cap.		Lettering shall be permanently affixed, engraved or embossed and located so as to be visible by direct view either on or within 100 mm/3.94 inches of the brake fluid reservoir filler plug or cap.	X	
Does the lettering contrast with the background?	***Yes*** No	If label is not engraved or embossed, letters shall be of a color that contrasts with the background	X	

Comments: None.

Technician: Derek Bevis

TEST COMPLETION INSPECTION (S7.18)

VEHICLE: 2011 Mazda 2 ; NHTSA NO.: CB5402 DATE: 8/30/11

BRAKE SYSTEM WARNING INDICATOR (S5.5)

CONDITION	ANSWER	REQUIREMENTS	PASS	FAIL
Brake Systems Indicator Lamp Function Check (S5.5.2) (Bulb and systems check)				
Describe location of brake indicator lamp: Lower left of Speedometer in the Instrument cluster.	NA	Shall be in front, and in clear view, of driver.	X	
Does lamp light with ignition (start) switch at ON/RUN?	Yes	Automatic activation when ignition switch is "on" when engine **not running**, or ignition between "on" and "start" if is manufacturer check position- OR -single manual action by driver	X	
Does lamp light with ignition between ON and Start?	Yes			
Brake check description in owner's manual?	Yes	Manufacturer shall explain the brake check function test procedure in the owner's manual.	X	
Brake System Warning Indicator ACTIVATION (S5.5.1) DURATION (S5.5.3) FUNCTION (S5.5.4)				
CONDITION	**Light ON?**	**REQUIREMENT**	**PASS**	**FAIL**
A. In event of hydraulic leak (1) On or before appearance of pressure differential of 218 psi (split system)	NA	When ignition (Start) switch is **ON**, lamp must light whenever (A), (B), (C), or (D) occurs. In addition, if service brake system is not a split system, audible warning must be activated when any condition in (A) exists. Visual warning indicator for non-split systems must be flashing.	X	
(2) If any reservoir falls below either "safe" level or 25% of capacity, whichever is greater. Values: 75 **ml** or cc remaining = 35%	Yes			
(3) On or before supply pressure to brake power unit falls to 50%	NA			
B. Electrical functional failure in an antilock or variable brake proportioning system.	Yes		X	
C. Application of the parking brake.	Yes			
D. Brake lining wear-out if optical warning.	Yes			
E. *For a vehicle with electrically-actuated service brakes, failure of the source of electric power to the brakes or diminution of state of charge of the batteries.*	NA			
F. *For a vehicle with electric transmission of the service brake control signal, failure to a brake control circuit.*	NA			
G. *For an EV with RBS that is part of the service brake system failure of RBS.*	NA			
Must have Audible alarm if not split system and a condition in (a) above exists?	NA			
If condition (A) (2) above does not exist, then fluid reservoir must be **transparent** for fluid check without the need for reservoir to be opened? (S5.4.4)	NA			
Indicator lamps remain activated as long as condition exists - ignition "on", and engine on or off? _____ (S5.5.3 DURATION))	Yes			
Visual warning – continuous or flashing? Audible warning –continuous or flashing?	Yes- Visual Cont.			

Comments: **None.**

Technician: Derek Bevis

TEST COMPLETION INSPECTION (S7.18)

VEHICLE: 2011 Mazda 2 NHTSA NO.: CB5402 DATE: 8/30/11

BRAKE SYSTEM WARNING INDICATOR LABELING (S5.5.5)

CONDITION AND REQUIREMENT	ANSWER NOTE: Standard requires that the answer to questions be YES	PASS	FAIL
Are visual indicators legible to driver in daylight and nighttime conditions when activated?	Yes	X	
Are visual indicator words 3.2 mm (.125") high minimum? Record Height: "Brake" – 3.2 mm; "ABS" – 3.2 mm.	Yes	X	
Visual indicator words and background contrasting colors, one of which is red. Record colors Letters –Red, Lens – Black	Yes	X	
If split system, is there one brake indicator? If yes, does it say the word "Brake"? (With one symbol adjacent.)	Yes	X	
If not split system; is there a separate indicator for loss of fluid or fluid pressure? Does this indicator say "Stop-Brake Failure"? Are the letters block and not less than 6.4 mm (.25") in height? Record letter height_____	NA		
If separate indicator for: 1. Low brake fluid per S5.5.1(a)(1), does indicator say "Brake Fluid"? NOTE: not required for mineral oil system Record wording: "Brake" 2. Gross pressure loss per S5.5.1(a)(2), does indicator say "Brake Pressure"? Record wording ___NA_____ 3. Electrical functional failure in antilock or variable proportioning system per S5.5.1(b), letters and background contrasting colors one of which is yellow? Record colors__Lens – Black, Letters – Yellow. Does indicator say "Antilock" or "ABS" or "Brake Proportioning"? Record wording: _"ABS". 4. Parking brake per S5.5.1(c), does indicator say "Park" or "Parking Brake"? Record wording: ___NA_____. 5. Brake lining wear-out per S5.5.1(d), does indicator say "Brake Wear"? Record wording -___NA_____. 6. *If separate indicator for RBS, the letters and background shall be of contrasting colors, one of which is yellow. The indicator shall be labeled "RBS". RBS failure in a system which is part of the service brake system may also be indicated by a yellow lamp that also indicates "ABS" failure and displays the symbol "ABS/RBS." Record wording:*_ 7. For any other function? If yes, Record_____NA_____	NA NA Yes NA NA NA NA	X	

DATA INDICATES COMPLIANCE: YES__X___ NO_____

Comments: None.

Technician: Derek Bevis

CALCULATION OF MINIMUM RESERVOIR VOLUME REQUIREMENTS

VEHICLE: 2011 Mazda 2 NHTSA NO.: CB5402 DATE: 8/30/11

BRAKE		LINING		
LOCATION	**TYPE**	**DESCRIPTION**	**MINIMUM THICKNESS**	**THICKNESS TO FULLY WORN (1) mm***
Left Front	Drum	Leading	Pre-test 8.65 mm	
		Primary	Post Test 8.25 mm	
		Inboard X	Δ 0.40 mm	
	Disc X	Trailing	Pre-test 8.37 mm	
		Secondary	Post Test 8.01 mm	
		Outboard X	Δ 0.36 mm	
LINING CLEARANCE:	Diametrical (2): N/A	Inboard – app 0 mm.	Outboard – app 0 mm.	
WHEEL CYLINDER DIAMETER (3) N/A		CALIPER PISTON DIAMETER (3): 53.78 mm		
SHOE CAGE DIAMETER (4) N/A ; CENTER POINT OF BRAKE ASSY TO CENTER POINT OF W.C. N/A				
Right Rear	Drum X	Leading X	Pre-test 3.92 mm	
		Primary	Post Test 3.91 mm	
		Inboard	Δ 0.01 mm	
	Disc	Trailing X	Pre-test 4.03 mm	
		Secondary	Post Test 4.02 mm	
		Outboard	Δ 0.01 mm	
LINING CLEARANCE:	Diametrical (2) .35 mm	Inboard – app 0 mm	Outboard – app 0 mm	
WHEEL CYLINDER DIAMETER (3): 17.61 mm		CALIPER PISTON DIAMETER (3): NA mm		
SHOE CAGE DIAMETER (4): 199.72 mm		CENTER POINT OF BRAKE ASSY TO CENTER PT. OF W.C.: 76.68 mm		
CIRCUIT #1 CONSISTS OF:	LF – X	LR	RF – X	RR
CIRCUIT #2 CONSISTS OF:	LF	LR – X	RF	RR – X
(1) MFRS. RECOMMENDATIONS – FRONT and REAR: NA				
(2) DRUM BRAKES, MEASURED AT HORIZONTAL CENTERLINE: 102.23 mm				
(3) MFRS. DATA: FRONT – NA (4) RESET POSITION: - 0.35 mm				

Comments: None.

Technician: Derek Bevis

Vehicle: 2011 Mazda 2; NHTSA No.: CB5402; Date: 8/11/11

Determination of Master Cylinder Volume Requirement
Determining the minimum volume requirements. The measured data is taken from the previous page, and the manufacturer's data is taken from Appendix E (when made available).

DISC BRAKES

Volume Required, $V_r = (\Delta t_i + t_{ic} + \Delta t_o + t_{oc}) \times [\pi (D^2)]/4$, where

V_r	= Volume required per wheel
Δt	= Change in thickness (average)
i	= Inboard
o	= Outboard
D	= Caliper cylinder diameter
c	= Average clearance

DRUM BRAKES

Volume Required, $V_r = ((2C + \Delta t_s + t_p)/ \cos \alpha) \times \pi r^2$, $\alpha = \sin^{-1}(2 Y/D)$, where

V_r	= Volume required per wheel
C	= Manufacturer's recommended drum-to-lining clearance
Δt_p	= Change in thickness of primary lining
Δt_s	= Change in thickness of secondary lining
Y	= Center point of wheel cylinder to center point of brake assembly
r	= Radius of wheel cylinder bore
D	= Cage diameter

Using the above equations, the volume requirements for Subsystem No. 1 and Subsystem No. 2 were calculated utilizing measured and manufacturer's provided data to create the greatest displacement, as shown on next page:

Front
Disc Brake: $V_r = (\Delta t_i + t_{ic} + \Delta t_o + t_{oc}) \times \frac{\pi D^2}{4}$

Δt_i	8.65 mm
Δt_o	8.37 mm
t_{ic}	0.0 mm
t_{oc}	0.0 mm
D	53.78 mm

$V_r = (8.65 + 0.0 + 8.37 + 0.0) \frac{\pi (53.78)^2}{4}$

$= 17.02 (2270)$

$= 38635 \text{ mm}^3 = 38.6 \text{ ml (x 1 Piston)} = 38.6 \text{ ml}$

(Rear)

Drum Brake: $V_r = ((2C + \Delta t_s + t_p)/ \cos \alpha) \times \pi r^2$, $\alpha = \sin^{-1}(2 Y/D)$

C	0.35 mm
Δt_s	3.92 mm
Δt_p	4.03 mm
r	8.81 mm
Y	76.68 mm
D	199.72 mm
α	50.2 degrees

$V_r = (((0.35 \times 2) + 3.92 + 4.03)/ \cos 50.2) \times \pi (8.81)^2$

$= (8.65/\cos 50.2) \times 243.71 = 3293 \text{ mm}^3 = 3.29 \text{ ml}$

Subsystem 1	LF	RR	Totals
	38.6 ml	3.29 ml	41.9 ml
Subsystem 2	LR	RF	
	3.29 ml	38.6 ml	41.9 ml

*TOTAL VOLUME REQUIRED = $V_t = V_{r1} + V_{r2} = 41.9 + 41.9 =$ **83.8 ml**

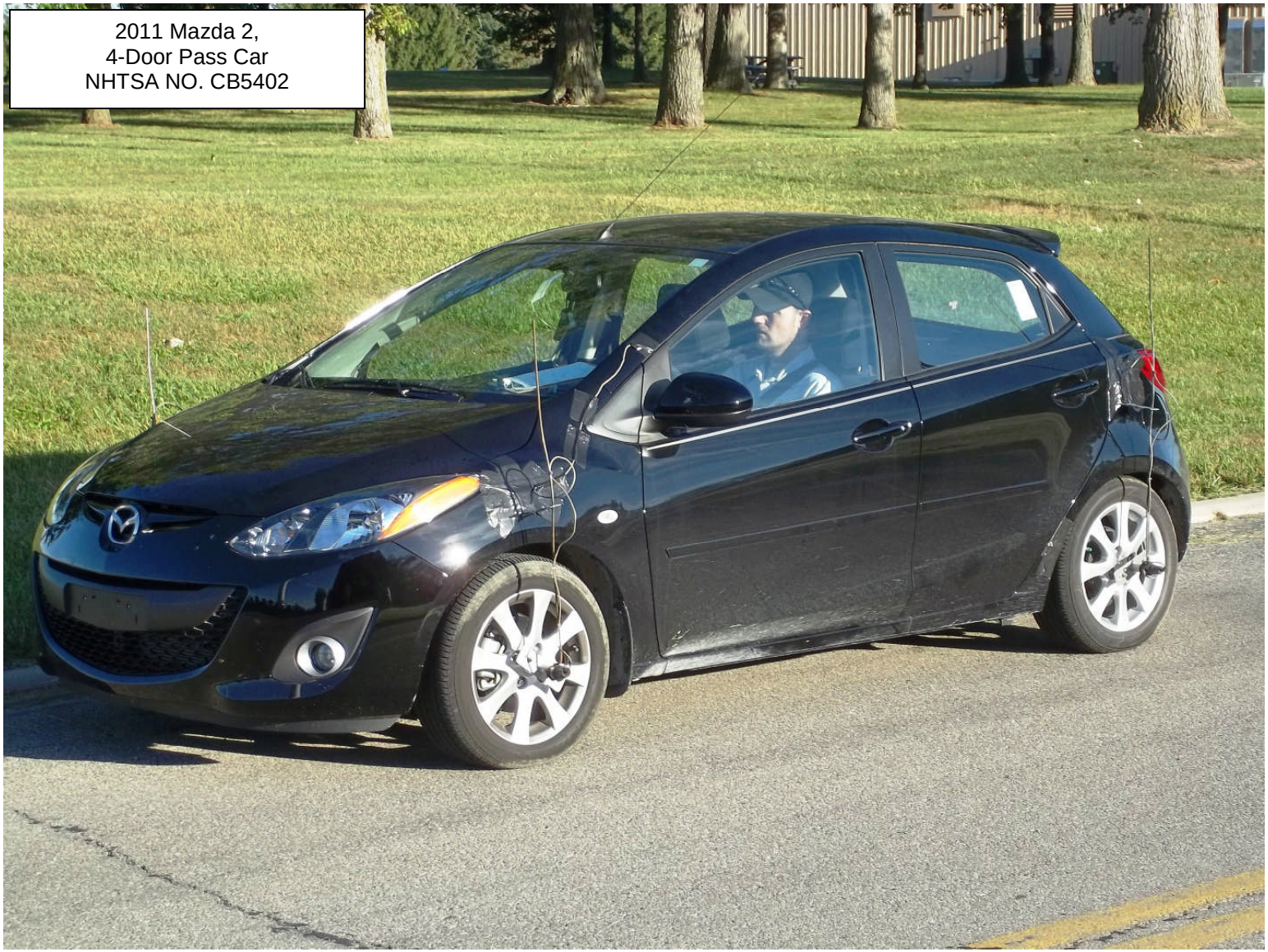
4.0 NOTICE OF POSSIBLE NON-COMPLIANCE

This vehicle (CB5402) appears to meet the requirements of the FMVSS 135 Standard.

5.0 PHOTOGRAPHS

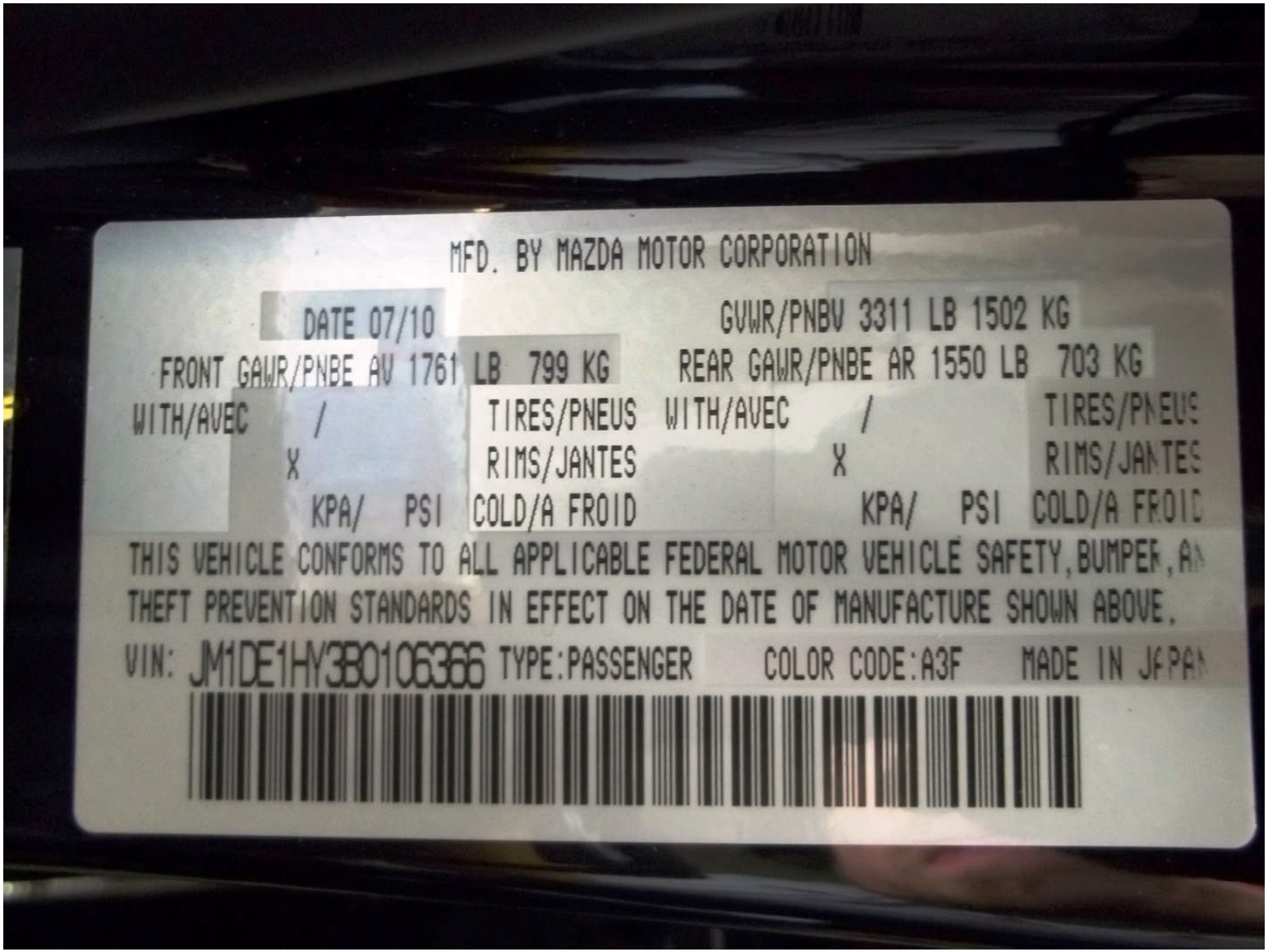
Photographs to document the vehicle, the instrumentation and ballast used, plus any other pertinent information are included in this report.

2011 Mazda 2,
4-Door Pass Car
NHTSA NO. CB5402

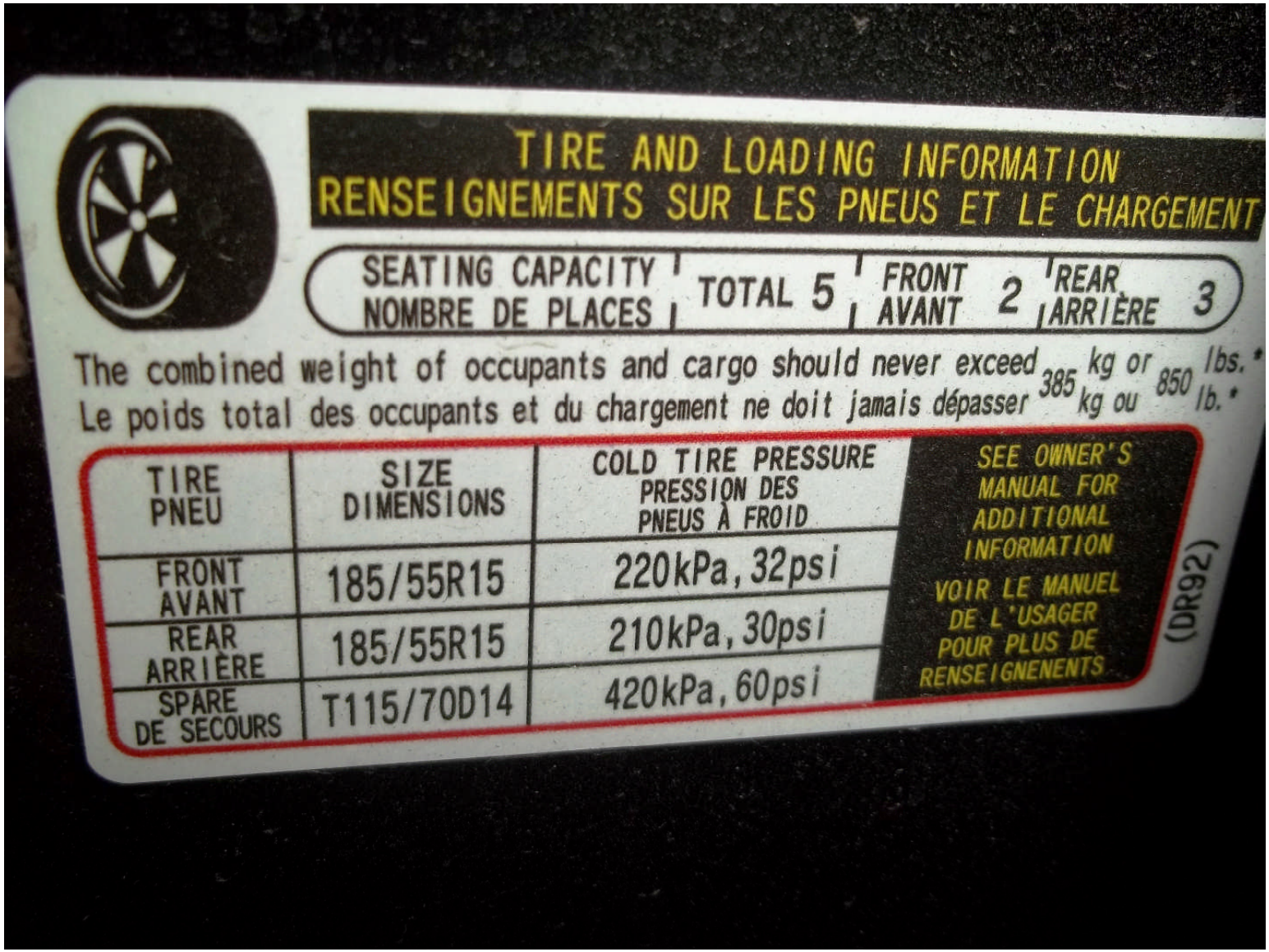


Left Front ¾ View

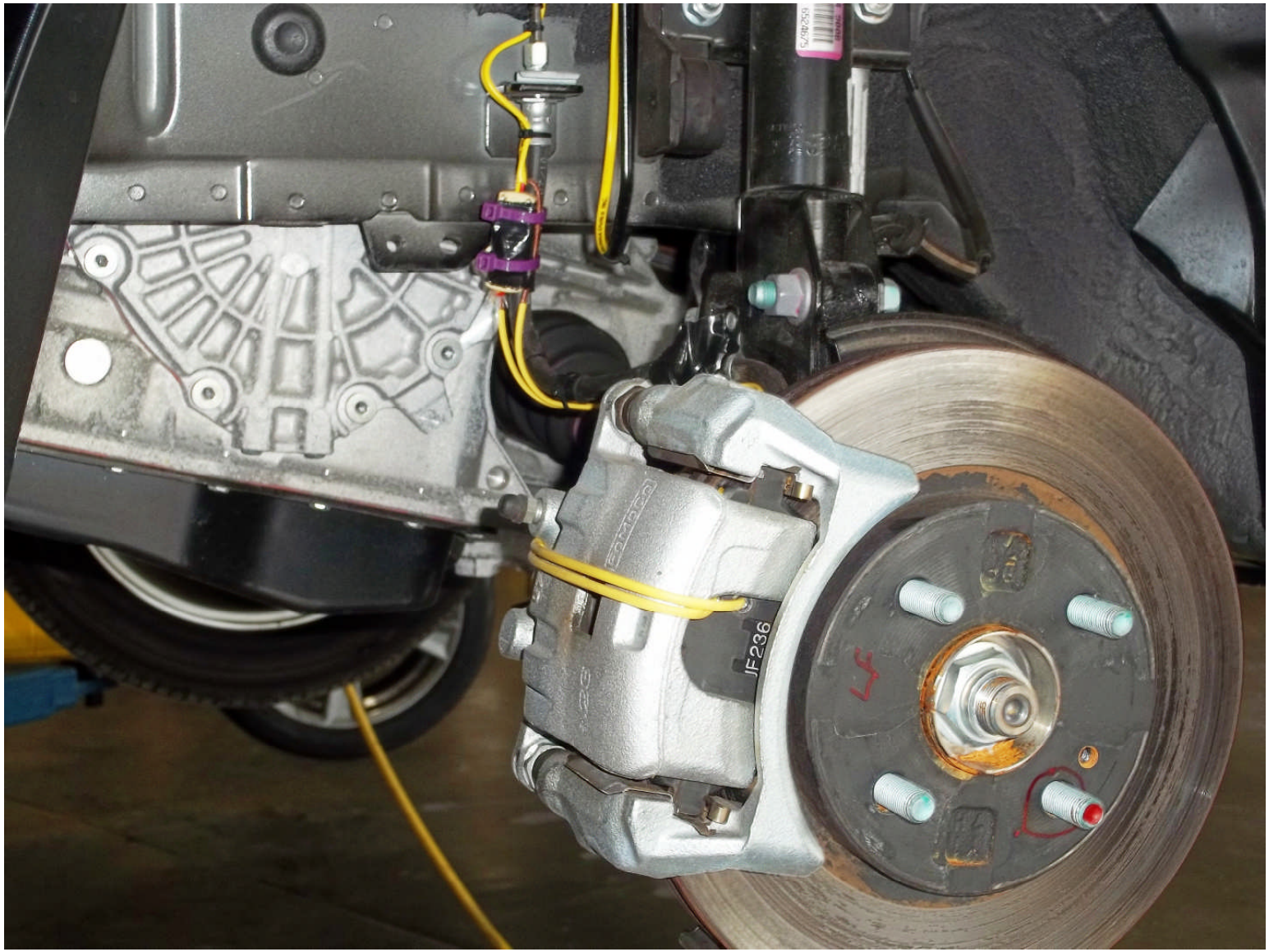
Right Rear ¾ View



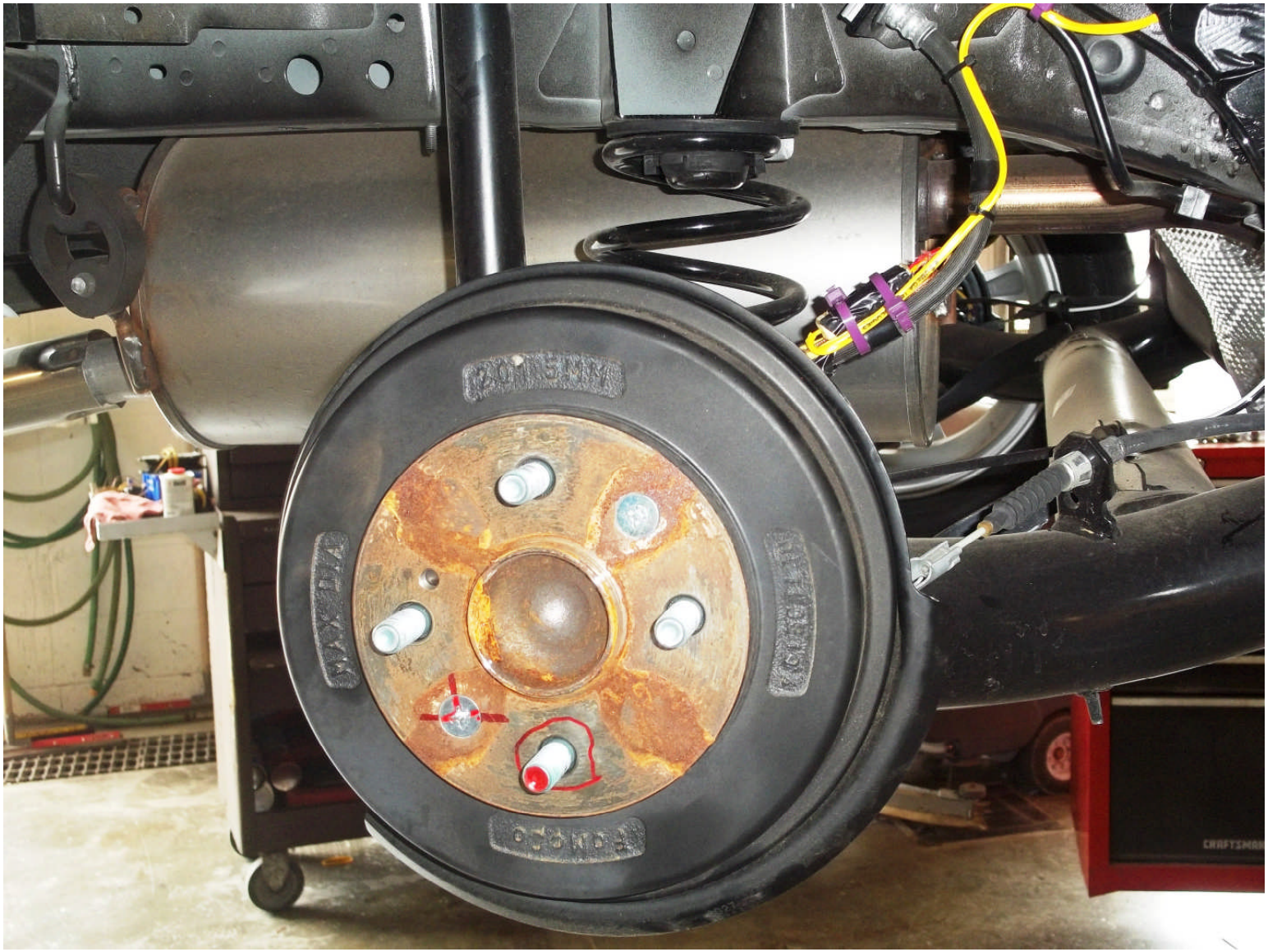
Vehicle Certification Placard



Tire Information Label



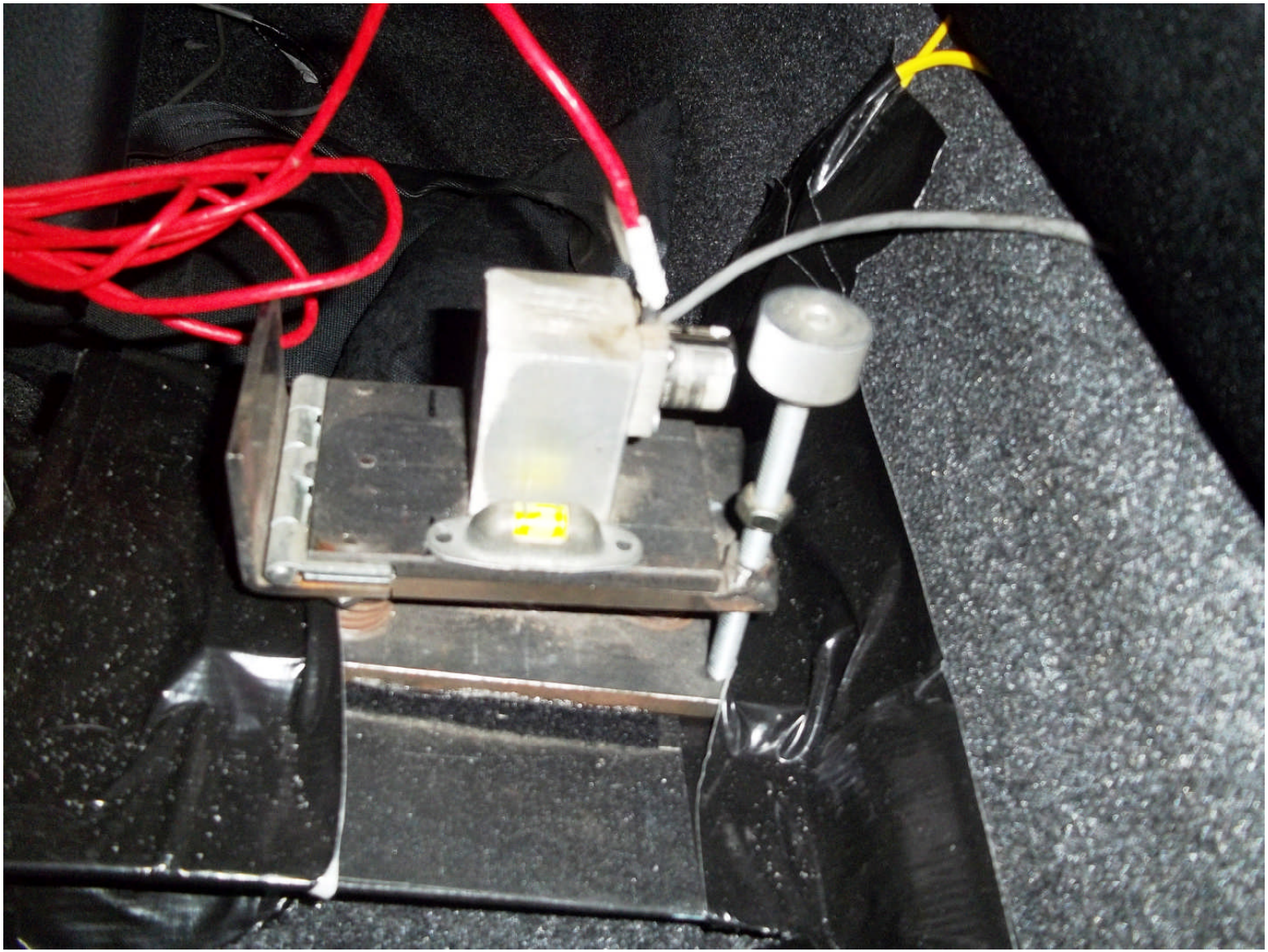
Left Front Thermocouple Installation



Right Rear Thermocouple Installation

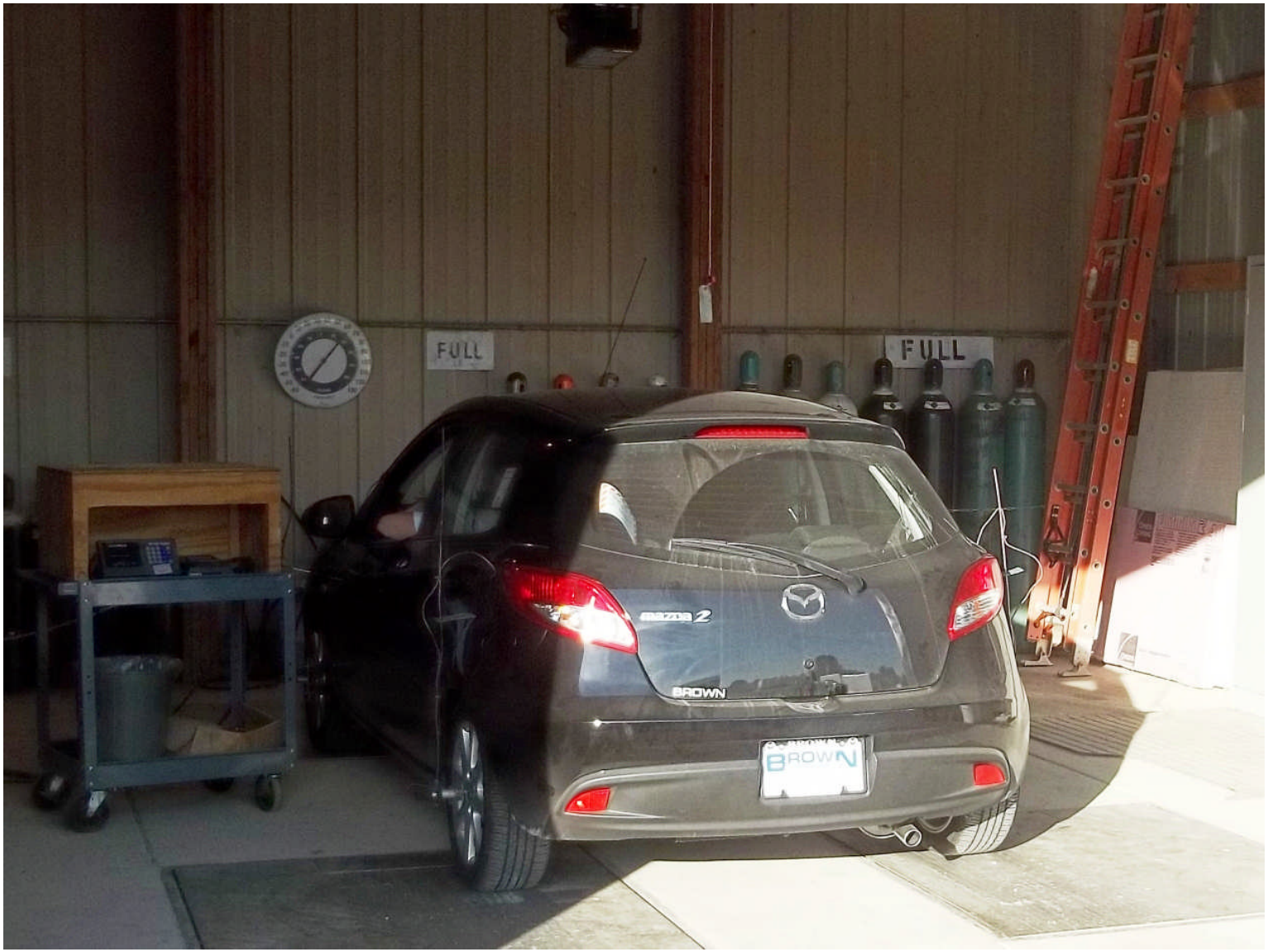
Test Instrumentation in Vehicle

Test Instrumentation in Vehicle



Test Instrumentation in Vehicle

Test Instrumentation in Vehicle



Vehicle Being Weighed

Ballast in Vehicle

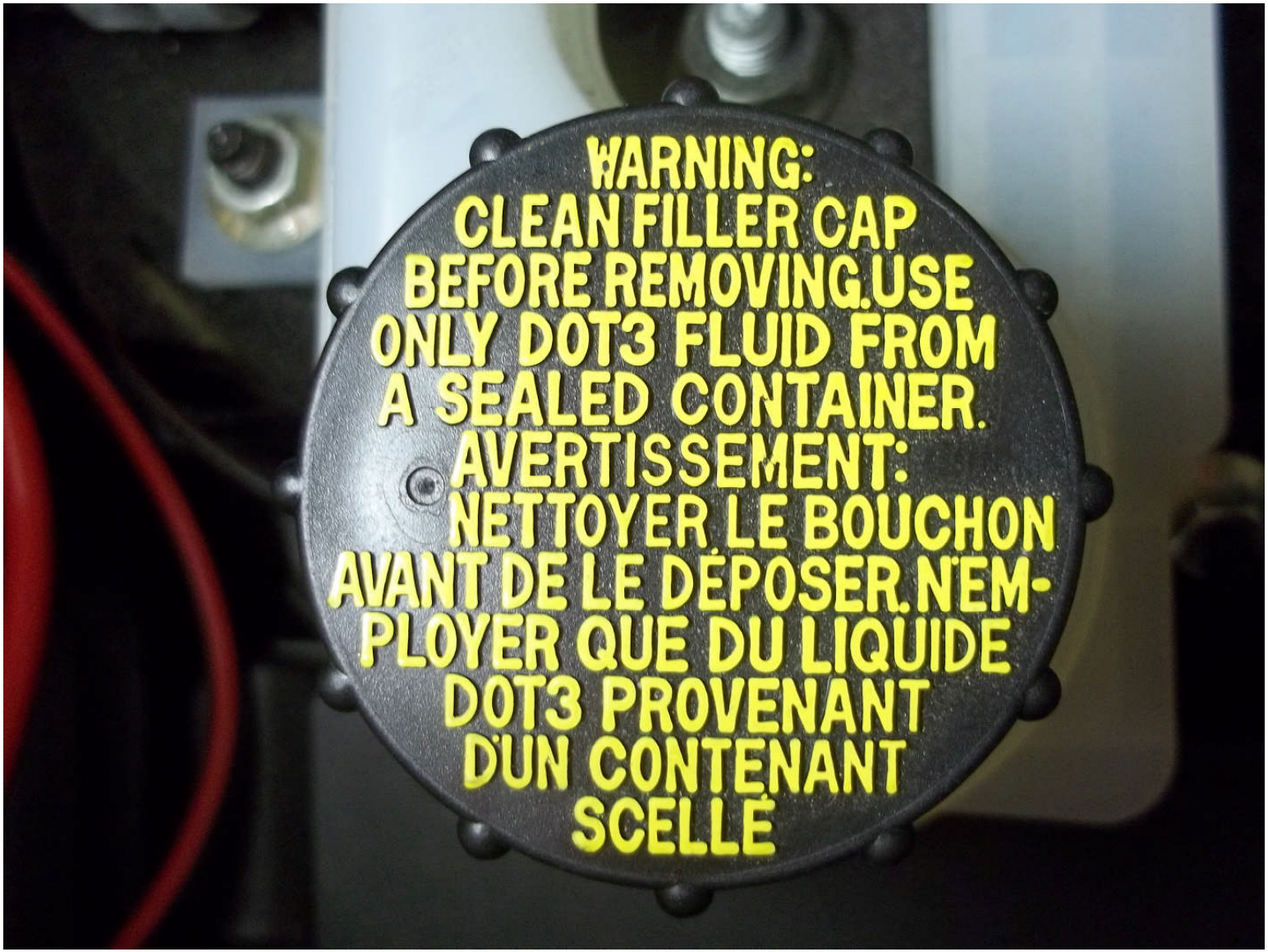
Ballast in Vehicle

Ballast in Vehicle

Ballast in Vehicle

ABS Indicator (Warning) Lamp

Brake Indicator (Warning) Lamp



Brake System (Master Cylinder) Reservoir Warning (Top of Cap)

6.0 TEST EQUIPMENT LIST AND CALIBRATION INFORMATION

A calibration report is included here that documents the instrumentation used on this test and the calibration dates.

Project Number: 20060110-4015
NHTSA Unit Number: CB5402

Test Number: 7
Manufacturer: Mazda Motor Corporation
Make: Mazda
Model: 2
Body Style: Passenger Car
Front Cold Tire Pressure: 220.0 kPa
Rear Cold Tire Pressure: 210.0 kPa

Transportation Research Center Inc. TRC

Manufacturer	Model	Serial	Calibration Date	Calibration Due
National Instruments	NI cDAQ-9172	DAS-13FBEE4	4/25/2011	4/25/2012
Transduct	Park Brake Transducer	157	Each Test	Each Test
Fisher Scientific	Stopwatch	SW-90841662	4/20/2011	4/20/2012
Fisher Scientific	Stopwatch	SW-97216633	8/9/2011	8/9/2012
McDaniel Controls	Tire Pressure Gauge	AG-019	6/14/2011	9/12/2011
GSE	Pedal Force Transducer	4351-120	Each Test	Each Test
Ohaus	Asst. Pipe-Handle Steel Weights	LB-0001	5/19/2011	5/19/2012
Setra	NOVALUE	A-1055763	Each Test	Each Test
ADAT	DSR-06/1aa	140.0135	Each Test	Each Test
Davis	6410	50608N22	5/10/2011	5/10/2012
Davis	6152	50608N02	5/10/2011	5/10/2012
Temprel/NI	LF Brake Thermocouple	T52-0B-24K	Ea. Test w/NI	Ea. Test w/NI
Temprel/NI	RF Brake Thermocouple	T52-0B-24K	Ea. Test w/NI	Ea. Test w/NI
Temprel/NI	LR Brake Thermocouple	T52-0B-24K	Ea. Test w/NI	Ea. Test w/NI
Temprel/NI	RR Brake Thermocouple	T52-0B-24K	Ea. Test w/NI	Ea. Test w/NI
Toledo/Mettler Scales	JAGXTREME 3000000	SN 5225831-5JC	8/16/2011	11/16/2011

Driver: Derek Bevis
Observer: None
Recorded Data Processed by: Derek Bevis
Date:8/31/2011
Approving Laboratory Official: Mike Bilbee

Instrumentation Calibration (1 of 3)

Year	2011
Make & Model	Mazda 2
Unit Number	CB5402

Accelerometer (Decel)

Pre-Test Linearity Check

Date	8/23/2011
Actual (m/s/s)	Rec. (m/s/s)
0.0	0.0
3.0	3.0
6.1	6.1
9.8	9.8

Daily Calibration Check
Level to zero, then tilt 90 degrees for full scale
Desired full scale value is: 9.81 m/s/s
Allowed deviation is: +/- 0.15 m/s/s

Date	Time	Zero	Cal	
8/23/2011	11:18 AM	0.00	9.80	Pre-Test
8/24/2011	9:27 AM	0.00	9.80	
8/25/2011	9:10 AM	0.00	9.80	
8/25/2011	3:30 PM	0.00	9.80	
8/26/2011	8:19:00	0.00	9.80	
8/29/2011	8:08:00	0.00	9.80	
8/29/2011	14:47:00	0.00	9.80	Post-Test

Post-Test Linearity Check

Date	8/29/2011
Actual (m/s/s)	Rec. (m/s/s)
0.0	0.0
3.0	3.0
6.1	6.1
9.8	9.8

Service Brake Pedal Force

Pre-Test Linearity Check

Date	8/23/2011
Actual	Recorded
Force (N)	Force (N)
0	0
222	222
445	445
498	480

Post-Test Linearity Check

Date	8/29/2011
Actual	Recorded
Force (N)	Force (N)
0	0
222	220
445	444
498	495

Instrumentation Calibration (2 of 3)

Year	2011
Make & Model	Mazda
Unit Number	CB5402

Distance

Drive on a measured kilometer
Desired full scale value is: 1000 m
Allowed deviation is: 3 m

Date	Time	Distance	
8/23/2011	11:11 AM	1000.57	Pre-Test
8/24/2011	9:28 AM	999.23	
8/25/2011	9:11 AM	1002.00	
8/25/2011	3:31 PM	999.00	
8/26/2011	8:20 AM	998.59	
8/29/2011	8:09:00	1000.7	
8/29/2011	14:49:00	999.1	Post-Test

Speed Sensor Drive vehicle at a steady 100 km/h through a kilometer.
Desired time value is: 36 seconds
Allowed deviation is: +/- 0.5 seconds

Date	Time	Time (sec.)	
8/23/2011	11:16:00	36.11	Pre-Test
8/24/2011	9:30:00	35.99	
8/25/2011	9:19:00	36.27	
8/25/2011	15:34:00	36.16	
8/26/2011	8:26:00	36.08	
8/29/2011	8:12:00	36.08	
8/29/2011	14:53:00	36.02	Post-Test

Instrumentation Calibration (3 of 3)

Year	2011
Make & Model	Mazda
Unit Number	CB5402

Wheel Speed While stopped, verify all wheel speeds read "0".
Then travel at approximatley 15 km/h and assure wheel speeds match vehicle speed.

		Zero				Match Vehicle Speed?				
Date	Time	LF	RF	LR	RR	LF	RF	LR	RR	
8/25/2011	10:08:00	Y	Y	Y	Y	Y	Y	Y	Y	Pre-Test
8/25/2011	15:29:00	Y	Y	Y	Y	Y	Y	Y	Y	
8/26/2011	8:29:00	Y	Y	Y	Y	Y	Y	Y	Y	
8/29/2011	8:14:00	Y	Y	Y	Y	Y	Y	Y	Y	
8/29/2011	14:56:00	Y	Y	Y	Y	Y	Y	Y	Y	Post-Test

Park Brake Force

Pedal	N/A
Lever	Yes

Pre-Test

Date	8/29/2011
Actual Force (N)	Recorded Force (N)
0	0
222	222
445	445
498	N/A

Note: 498 only used for Pedal

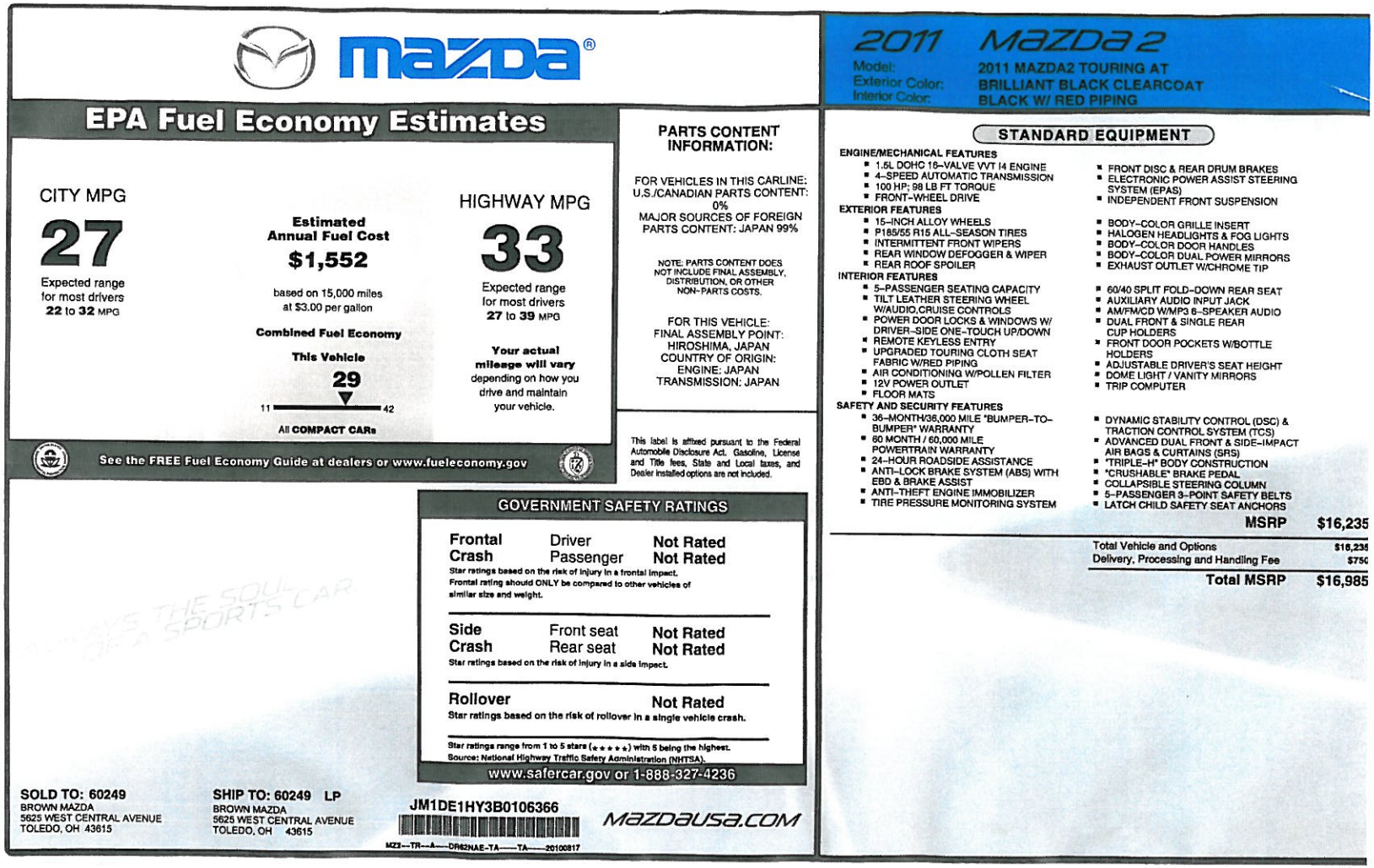
Post-Test

Date	8/29/2011
Actual Force (N)	Recorded Force (N)
0	0
222	222
445	445
498	N/A

Note: 498 only used for Pedal

APPENDIX A

Copy of Manufacturer's Sticker



mazda®

EPA Fuel Economy Estimates

CITY MPG

27

Expected range for most drivers **22** to **32** MPG

Estimated Annual Fuel Cost

$1,552

based on 15,000 miles at $3.00 per gallon

Combined Fuel Economy

This Vehicle

29

11 — 42

All **COMPACT CARs**

HIGHWAY MPG

33

Expected range for most drivers **27** to **39** MPG

Your actual mileage will vary depending on how you drive and maintain your vehicle.

See the FREE Fuel Economy Guide at dealers or www.fueleconomy.gov

PARTS CONTENT INFORMATION:

FOR VEHICLES IN THIS CARLINE:
U.S./CANADIAN PARTS CONTENT: 0%
MAJOR SOURCES OF FOREIGN PARTS CONTENT: JAPAN 99%

NOTE: PARTS CONTENT DOES NOT INCLUDE FINAL ASSEMBLY, DISTRIBUTION, OR OTHER NON-PARTS COSTS.

FOR THIS VEHICLE:
FINAL ASSEMBLY POINT: HIROSHIMA, JAPAN
COUNTRY OF ORIGIN:
ENGINE: JAPAN
TRANSMISSION: JAPAN

This label is affixed pursuant to the Federal Automobile Disclosure Act. Gasoline, License and Title fees, State and Local taxes, and Dealer installed options are not included.

GOVERNMENT SAFETY RATINGS

Frontal Crash	Driver	Not Rated
	Passenger	Not Rated

Star ratings based on the risk of injury in a frontal impact. Frontal rating should ONLY be compared to other vehicles of similar size and weight.

Side Crash	Front seat	Not Rated
	Rear seat	Not Rated

Star ratings based on the risk of injury in a side impact.

Rollover — **Not Rated**

Star ratings based on the risk of rollover in a single vehicle crash.

Star ratings range from 1 to 5 stars (★★★★★) with 5 being the highest.
Source: National Highway Traffic Safety Administration (NHTSA).

www.safercar.gov or 1-888-327-4236

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JM1DE1HY3B0106366

MZ3---TR---A----DR62NAE-TA----TA----20100817

MazdaUSA.com

2011 MAZDA2

Model: 2011 MAZDA2 TOURING AT
Exterior Color: BRILLIANT BLACK CLEARCOAT
Interior Color: BLACK W/ RED PIPING

STANDARD EQUIPMENT

ENGINE/MECHANICAL FEATURES
- 1.5L DOHC 16-VALVE VVT I4 ENGINE
- 4-SPEED AUTOMATIC TRANSMISSION
- 100 HP; 98 LB FT TORQUE
- FRONT-WHEEL DRIVE
- FRONT DISC & REAR DRUM BRAKES
- ELECTRONIC POWER ASSIST STEERING SYSTEM (EPAS)
- INDEPENDENT FRONT SUSPENSION

EXTERIOR FEATURES
- 15-INCH ALLOY WHEELS
- P185/55 R15 ALL-SEASON TIRES
- INTERMITTENT FRONT WIPERS
- REAR WINDOW DEFOGGER & WIPER
- REAR ROOF SPOILER
- BODY-COLOR GRILLE INSERT
- HALOGEN HEADLIGHTS & FOG LIGHTS
- BODY-COLOR DOOR HANDLES
- BODY-COLOR DUAL POWER MIRRORS
- EXHAUST OUTLET W/CHROME TIP

INTERIOR FEATURES
- 5-PASSENGER SEATING CAPACITY
- TILT LEATHER STEERING WHEEL W/AUDIO,CRUISE CONTROLS
- POWER DOOR LOCKS & WINDOWS W/ DRIVER-SIDE ONE-TOUCH UP/DOWN
- REMOTE KEYLESS ENTRY
- UPGRADED TOURING CLOTH SEAT FABRIC W/RED PIPING
- AIR CONDITIONING W/POLLEN FILTER
- 12V POWER OUTLET
- FLOOR MATS
- 60/40 SPLIT FOLD-DOWN REAR SEAT
- AUXILIARY AUDIO INPUT JACK
- AM/FM/CD W/MP3 6-SPEAKER AUDIO
- DUAL FRONT & SINGLE REAR CUP HOLDERS
- FRONT DOOR POCKETS W/BOTTLE HOLDERS
- ADJUSTABLE DRIVER'S SEAT HEIGHT
- DOME LIGHT / VANITY MIRRORS
- TRIP COMPUTER

SAFETY AND SECURITY FEATURES
- 36-MONTH/36,000 MILE "BUMPER-TO-BUMPER" WARRANTY
- 60 MONTH / 60,000 MILE POWERTRAIN WARRANTY
- 24-HOUR ROADSIDE ASSISTANCE
- ANTI-LOCK BRAKE SYSTEM (ABS) WITH EBD & BRAKE ASSIST
- ANTI-THEFT ENGINE IMMOBILIZER
- TIRE PRESSURE MONITORING SYSTEM
- DYNAMIC STABILITY CONTROL (DSC) & TRACTION CONTROL SYSTEM (TCS)
- ADVANCED DUAL FRONT & SIDE-IMPACT AIR BAGS & CURTAINS (SRS)
- "TRIPLE-H" BODY CONSTRUCTION
- "CRUSHABLE" BRAKE PEDAL
- COLLAPSIBLE STEERING COLUMN
- 5-PASSENGER 3-POINT SAFETY BELTS
- LATCH CHILD SAFETY SEAT ANCHORS

MSRP	**$16,235**
Total Vehicle and Options	$16,235
Delivery, Processing and Handling Fee	$750
Total MSRP	**$16,985**

APPENDIX B

Discussion on Data

DISCUSSION ON DATA

Symbols for Brake Components

4	-	4 Wheel	G	-	Groan	DL	-	Deceleration (State FPSPS)
X	-	Skid	SQ	-	Squeal	PF	-	Pedal on Floor
L	-	Left	SQK	-	Squeak	SCP	-	Shoe Scrape
R	-	Right	PO	-	Pinchout	RB	-	Rubber Banding
R	-	Rear	P	-	Pull	O	-	Odor
F	-	Front	R	-	Shudder	NOX	-	No Skid
B	-	Both	M	-	Momentary			

INT or INIT	-	Initial Part of Stop
MID	-	Middle of Stop
END	-	End of Stop

All stops were made manually.

APPENDIX C

Contractor's Comments
Procedure Modifications
and
Test Facility

Comments for vehicle CB5402.

For all recorded decelerations:

The recorded *average* deceleration values for the tests are slightly lower than that which is required or targeted for certain test sections. However, in all cases and in reality, the driver maintained the correct required/target deceleration values for the majority of time for each of those stops. The recorded deceleration is acquired from the moment the service brake pedal is moved until the vehicle reaches zero speed. Therefore, the time needed to achieve the target deceleration (rise time) and the time the vehicle goes from the target deceleration to zero (fall time) is included in the average deceleration calculation. The rise and fall times were added to the entire length of the stops. Hence, the recorded average deceleration values were generally and slightly less than the required/target deceleration values.

For Antilock Functional Failures, the “ABS” and “BRAKE” lamps all alighted. ABS failure was conducted by removing the wheel speed sensor on the LR wheel.

The Hydraulic Circuit Failure Tests were performed not to the lab procedure sequence to both save time and cause minimal disruption to the hydraulic brake system. Sequence: Circuit #1 @ LLVW; Circuit #2 @ LLVW: Circuit #2 @ GVWR and Circuit #1 @ GVWR.

7.5-MILE TEST TRACK

The 7.5-mile test track encloses a 1,600-acre area, one mile wide and 3.5 miles long.

The track has a downward grade, north to south, of 0.228 percent and a cross slope in the straight-aways of 3/16 inch per foot. The 1.88 mile long straight-aways flow into transition areas 2,300 feet in length and then into 5,275-foot long curves with a constant radius of 2,400 feet. The 36-foot wide straight-aways and the 42-foot wide curves provide three test lanes. Paved berms, 12 feet in width, border the straight-aways and the inside of the curves.

As a vehicle moves toward the outside of the track in the curves, it encounters a progressively steeper bank. The inside lane (or "slow" lane) has a bank of 10 degrees allowing a neutral speed of 80 mph with no side forces. In the center lane, the slope increases to 19 degrees resulting in a neutral speed of 110 mph. The outside lane's 28-degree bank allows a 140 mph neutral speed. Rimming the outer lane is a seven-foot safety lane culminating in a 36-degree slope at the guardrail.

The facility is paved with Portland cement concrete. It carries a maximum single axle load of 36,000 pounds and a maximum tandem axle load weight of 48,000 pounds. Special provisions can be made for heavier weight loads.

With 22.5 lane miles, our track will accommodate many vehicles simultaneously. Research which utilizes the track includes component performance and durability studies, brake tests, aerodynamic studies, fuel economy studies, drive line efficiency tests, and the determination of vehicular acceleration and cruise characteristics. In addition, it supports maximum speed determination, road load power, noise and emission measurements and tire durability test programs.

The 7.5-mile test track can be used in conjunction with other facilities at TRC. It provides an excellent area for pre-test conditioning of equipment such as brake burnishing, tire break-in, and vehicle warm-up.

TRC SKID PAD

The Skid Pad is a test facility which is utilized primarily for the evaluation of tire and brake systems.

The overall dimensions of the pad are 9,000 feet by 84 feet with loops on the north and south ends. Both turnaround loops have a 309-foot radius and are 16 feet wide with a 25 percent super elevation. They will accommodate speeds of 45 mph with zero side force and 60 mph with .5 g's lateral acceleration. The acceleration/deceleration lanes at each end are 3,280 feet in length.

A test area of 210,000 square feet is situated in the center of the skid pad containing several test pads with varying surface textures. Skid numbers in this area range from 30 (wet) to mid 80s (dry). Dry Peaks are in the mid 90's.

The skid pad is paved with Portland cement. The load capacity of the skid pad is 36,000 pounds maximum single axle weight and 48,000 pounds maximum tandem axle weight.

Varying surface textures in the main test area are ideal for testing tire and/or brake system performance on different surfaces as characterized by "skid numbers." The skid pad is also used for acceleration studies, aerodynamics, rolling resistance, noise testing, and vehicle top speed determination.

The subject test vehicle was rear wheel anti lock equipped. Rather than rapidly and fully applying the service brake control, the driver modulated the service brake control as necessary to control/prevent front wheel lock.