REPORT NUMBER: TWG-TRC-14-06

NEW CAR ASSESSMENT PROGRAM (NCAP)
SIDE AIRBAG OUT-OF-POSITION INJURY TESTING

Mazda Motor Corporation
2014 Mazda 3 4-Door Sedan

NHTSA NUMBER: M20145405TWG2
TRC TEST NUMBER: 140529-1

PREPARED BY:
TRANSPORTATION RESEARCH CENTER INC.
10820 State Route 347
P.O. BOX B-67
East Liberty, OH 43319

Test Date: May 29, 2014

FINAL REPORT

Alpha Technology Associate, Inc.
2810 Old Lee Highway, Suite 120
Fairfax, VA 22031

This Final Test Report was prepared for the U.S. Department of Transportation, National Highway Traffic Safety Administration, under Contract No. DTNH22-08-D-00088, Alpha Technology PO 10GT156. This document is disseminated under the sponsorship of the U.S. Department of Transportation in the interest of information exchange. The United States Government assumes no liability for its contents or use thereof.

Prepared By: ILO Projects Operations Group

Approved By: 

Jeffery W. Sankey
Manager, Project Operations

Approval Date: June 30, 2014

FINAL REPORT ACCEPTANCE BY:

Accepted By: _____

Acceptance Date: _____

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No. TWG-TRC-14-06	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle Final Report 2014 Mazda 3 4-Door Sedan TWG/Out-of-Position Test NHTSA No.: M20145405TWG2		5. Report Date June 30, 2014
		6. Performing Organization Code TRC
7. Author(s) Jeffery W. Sankey Manager, Project Operations		8. Performing Organization Report No. 140529-1
9. Performing Organization Name and Address Transportation Research Center Inc. 10820 State Route 347 East Liberty, OH 43319		10. Work Unit No.
		11. Contract or Grant No. DTNH22-08-D-00088
12. Sponsoring Agency Name and Address Alpha Technology Associate, Inc 2810 Old Lee Hwy, Suite 120 Fairfax, VA 22031		13. Type of Report and Period Covered Final Report, May 29, 2014 – June 30, 2014
		14. Sponsoring Agency Code NVS-111
15. Supplementary Notes		
16. Abstract This side impact Out-Of-Position test was performed in conjunction with a New Car Assessment Program (NCAP). This test was conducted at the TRC Test Facility in East Liberty, Ohio, on May 29, 2014.		

Injury Summary

HIC15	Maximum Chest Displacement (mm)	Maximum Chest Displacement Rate (m/s)	NIJ(NTF)	NIJ(NTE)	NIJ(NCF)	NIJ(NCE)
14	N/A	N/A	0.0103	0.0007	0.8949	0.1691

17. Key Words New Car Assessment Program (NCAP) Side Airbag Out-Of-Position	18. Distribution Statement Copies of this report are available from: Alpha Technology Associate, Inc 2810 Old Lee Hwy, Suite 120 Fairfax, VA 22031 Phone: (703) 876-0010 Fax: (703) 876-0120 Attn: Mai Lan Aram

19. Security Classification of Report UNCLASSIFIED	20. Security Classification of Page UNCLASSIFIED	21. No. of Pages 28	22. Price

TABLE OF CONTENTS

SECTION 1

TEST PURPOSE AND PROCEDURE

1.1 PURPOSE

The purpose of this test was to obtain data from a static out-of-position side impact using a vehicle that had undergone a New Car Assessment Program (NCAP) sponsored test requested by the National Highway Traffic Safety Administration (NHTSA). This test was performed following the technical requirements under NHTSA contract No. DTNH22-08-D-00088 and through Alpha Technology Associate, Inc.

1.2 SUMMARY

The effects of both a seat-mounted side airbag and a curtain airbag deployment in a 2014 Mazda 3 4-Door Sedan on an out-of-position SID-IIs 49CFR Part 572 Subpart V anthropomorphic test device (ATD) were evaluated. The test was performed by TRC on May 29, 2014. Pre- and post-test photographs of the vehicle and ATD can be found in Appendix A.

Three (3) high-speed digital cameras were used to document the front seat side airbag deployment event. Images were recorded at rates of 1000 frames per second. Cameras were placed relative to the right front seat and positioned to capture the deployment event from the side, front, and oblique views.

The SID-IIs ATD was placed in the right front (passenger) seat situated perpendicular to the centerline of the seat, facing inboard. This was placed following the ATD placement instructions specified in the Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags as prepared by the Side Airbag Out-of-Position Injury Technical Working Group (TWG). The specific test was section 3.3.5.3.

The SID-IIs ATD was instrumented with head x, y and z accelerometers, six upper neck axial force and moment load cell transducers, and six lower neck axial force and moment load cell transducers.

Twenty-two (22) channels of data were recorded using an on-board data acquisition system. Appendix A contains photographs. Appendix B contains ATD response data traces. Appendix C contains the Instrumentation Data Channel assignments.

The SID-IIs ATD was positioned in the seat dummy facing toward the center of the vehicle with its arm against the seatback. The arm was rotated horizontal in the forward direction with respect to the dummy. The seat was positioned to minimize the vertical distance between the dummy's head and the roof-rail module and to maximize the cushion to head interaction. The seat track test position measurements were not recorded. The head was in a neutral orientation and the pelvis was in contact with the door trim panel. The CG of the head was centered in the deployment trajectory of the airbag. A vertical plane through the centerline of the dummy's rib-stiffener and shoulder bolt was parallel to the centerline of the vehicle. This orientation complies with section 3.3.5.3 of the TWG Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags, First Revision dated July, 2003.

SECTION 2

DATA SHEET NO. 1
TEST SUMMARY

TEST CONFIGURATION INFORMATION:

Seating Position:	P2	Right Front Seating Position
Test:	3.3.5.3	Inboard Facing SID-IIs on Raised Seat (Driver and Passenger Positions with Roof-Rail-Mounted Airbags)
Airbag:	Seat	Seat mounted – outside seam
Airbag:	Side Rail	Side curtain airbag
Booster Block:	N/A	N/A
ATD Type/Serial No.:	297	SID-IIs

SEAT POSITION

Measurement	Value
Total Fore/Aft Travel (Detents)	---[1]
Placed in Position #	---[1]

Number of Data Channels:	22	
Number of Cameras:	0	Real Time
	3	High Speed Digital

VISIBLE DUMMY CONTACT POINTS

Head Contact:	Curtain Airbag
Upper Torso Contact:	None
Lower Torso Contact:	None
Left Knee Contact:	None
Right Knee Contact:	None

[1] Measurements were not recorded.

DATA SHEET NO. 2

GENERAL TEST AND VEHICLE PARAMETER DATA

TEST VEHICLE INFORMATION

NHTSA No.	M20145405
Model Year	2014
Make	Mazda
Model	3
Body Style	Sedan
VIN	JM1BM1T78E1125406
Body Color	Silver
Odometer Reading (km/mi)	5 mi
Engine Displacement (L)	2.0
Type/No. Cylinders	4
Engine Placement	Front/Transverse
Transmission Type	Manual
Transmission Speeds	6
Overdrive	Yes
Final Drive	FWD
Roof Rack	No
Sunroof/T-Top	No
Running Boards	No
Tilt Steering Wheel	Yes
Power Seats	No
Anti-Lock Brakes (ABS)	Yes
Automatic Door Locks (ADLs)	Yes

TEST VEHICLE OPTIONS

Traction Control System (TCS)	Yes
Power Steering	Yes
Power Window Auto-Reverse	Yes
Driver Frontal Airbag	Yes
Driver Curtain Airbag	Yes
Driver Head/Torso Airbag	No
Driver Torso Airbag	No
Driver Torso/Pelvis Airbag	Yes
Driver Pelvis Airbag	No
Driver Knee Airbag	Yes
Front Pass. Frontal Airbag	Yes
Front Pass. Curtain Airbag	Yes
Front Pass. Head/Torso Airbag	No
Front Pass. Torso Airbag	No
Front Pass. Torso/Pelvis Airbag	Yes
Front Pass. Pelvis Airbag	No
Front Pass. Knee Airbag	Yes
Driver Pretensioner	Yes
Driver Load Limiter	Yes
Front Pass. Pretensioner	Yes
Front Pass. Load Limiter	Yes
Other	No

Does owner's manual provide instructions to turn off automatic door locks? Yes

DATA FROM CERTIFICATION LABEL

Manufactured by	Mazda Motor Corporation
Date of Manufacture	10/13

GVWR (kg)	1772
GAWR Front (kg)	925
GAWR Rear (kg)	855

VEHICLE SEATING AND WEIGHT CAPACITY

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Bench		
Number of Occupants	2	3		5
Capacity Wt. (VCW) (kg)				385
Cargo Wt. (RCLW) (kg)				44.8

DATA SHEET NO. 3

DUMMY POSITIONING IN VEHICLE[1]

Measurement		Value
Total Range of Seat Travel Fore/Aft (detents)		N/A
Test Distance Rearward of Full-Forward (detents)		N/A
Seat Vertical Position		N/A
Placed in Position #		N/A
Seat Back Angle at Headrest Post	SA (^{o})	N/A
Top of Curtain Airbag Module to Head/Neck Junction	AN (mm)	N/A
Top of Seat Airbag Module to Head/Neck Junction	AN (mm)	N/A
Head CG to Door Panel/Window	HD (mm)	N/A
Head to Seat Back Centerline	HSC (mm)	N/A
Chest to Seat	CD (mm)	N/A
Chest to Seat Back	CS (mm)	N/A
Right Arm to Seat Back Centerline	RACL (mm)	N/A
Left Arm to Seat Back Centerline	LACL (mm)	N/A
Right Arm to Door Panel	RA (mm)	N/A
Left Arm to B-Post	LA (mm)	N/A
Knee to Knee	KK (mm)	N/A
Toe to Toe	TT (mm)	N/A
Right Knee to Seat Cushion Centerline	KSCR (mm)	N/A
Left Knee to Seat Cushion Centerline	KSCL (mm)	N/A
Right Toe to Seat Cushion Centerline	TSCR (mm)	N/A
Left Toe to Seat Cushion Centerline	TSCL (mm)	N/A
Nose to Seat	ND (mm)	N/A
Nose to Seat Back	NS (mm)	N/A
Top of Head to Headliner	HH (mm)	N/A

[1] Measurements were not recorded.

Test Vehicle: 2014 Mazda 3 4-Door Sedan NHTSA No.: M20145405TWG2
Test Program: Side Airbag O.O.P. Injury Testing Test Date: 5/29/14

DATA SHEET NO. 4
DUMMY INJURY CRITERIA VALUES

Channel	Max	Time (ms)	Min	Time (ms)
Head Ax [g , CFC_1000]	24.4	80.8	-24.7	15.4
Head Ay [g , CFC_1000]	17.2	19.4	-30.5	8.5
Head Az [g , CFC_1000]	50.6	8.3	-8.8	11.7
Upper Neck Fx [N , CFC_1000]	661.4	25.8	-98.8	111.6
Upper Neck Fy [N , CFC_1000]	413.8	19.4	-161.3	10.4
Upper Neck Fz [N , CFC_1000]	36.6	7.4	-1818.8	20.1
Upper Neck Mx [N-m , CFC_600]	16.9	11.4	-31.8	22.6
Upper Neck My [N-m , CFC_600]	86.9	25.8	-2.0	8.8
Upper Neck Mz [N-m , CFC_600]	10.8	54.6	-0.1	8.8
Lower Neck Fx [N , CFC_1000]	733.6	25.1	-69.2	10.0
Lower Neck Fy [N , CFC_1000]	224.1	22.4	-181.3	13.8
Lower Neck Fz [N , CFC_1000]	48.9	7.7	-1799.3	20.9
Lower Neck Mx [N-m , CFC_600]	34.6	22.6	-8.8	12.4
Lower Neck My [N-m , CFC_600]	63.9	12.2	-1.3	6.9
Lower Neck Mz [N-m , CFC_600]	16.6	22.4	-9.2	12.5
Airbag Event Passenger Side Curtain Voltage [V]	29.7	0.6		
Airbag Event Front Passenger Seat Voltage [V]	17.8	2.4		
Airbag Event Passenger Side Curtain Current [A]	3.3	0.5		
Airbag Event Front Passenger Seat Current [A]	3.1	1.8		

HEAD INJURY CRITERIA (HIC)

	HIC(15)	t_1 (msec)	t_2 (msec)	HIC(36)	t_1 (msec)	t_2 (msec)
Position #2 Right Front	14	7.76	20.24	16	7.68	29.04

Position 2 Neck Injury Summary (SID-IIs)

Nij V10	Nij	Time (ms)
Upper Neck NTF	0.0103	7.44
Upper Neck NTE	0.0007	-14.08
Upper Neck NCF	0.8949	27.12
Upper Neck NCE	0.1691	9.36

Peak Tension (CFC1000) **36.63 N** **Peak Compression (CFC1000)** **-1,818.81 N**

Critical Values

Nij Intercepts				Peak Limits	
Tension (CVt)	3880	Extension (mCVe)	61	Tension	1
Compression (CVc)	3880	Flexion (mCVf)	155	Compression	1

APPENDIX A

PHOTOGRAPHS

TABLE OF PHOTOGRAPHS

Figure A-1 Right ¾ Front View, as Received

Figure A-2 Vehicle Certification Label

Figure A-3 Pre-Crash Test Image From NCAP Vehicle

Figure A-4 Post-Crash Test Image From NCAP Vehicle

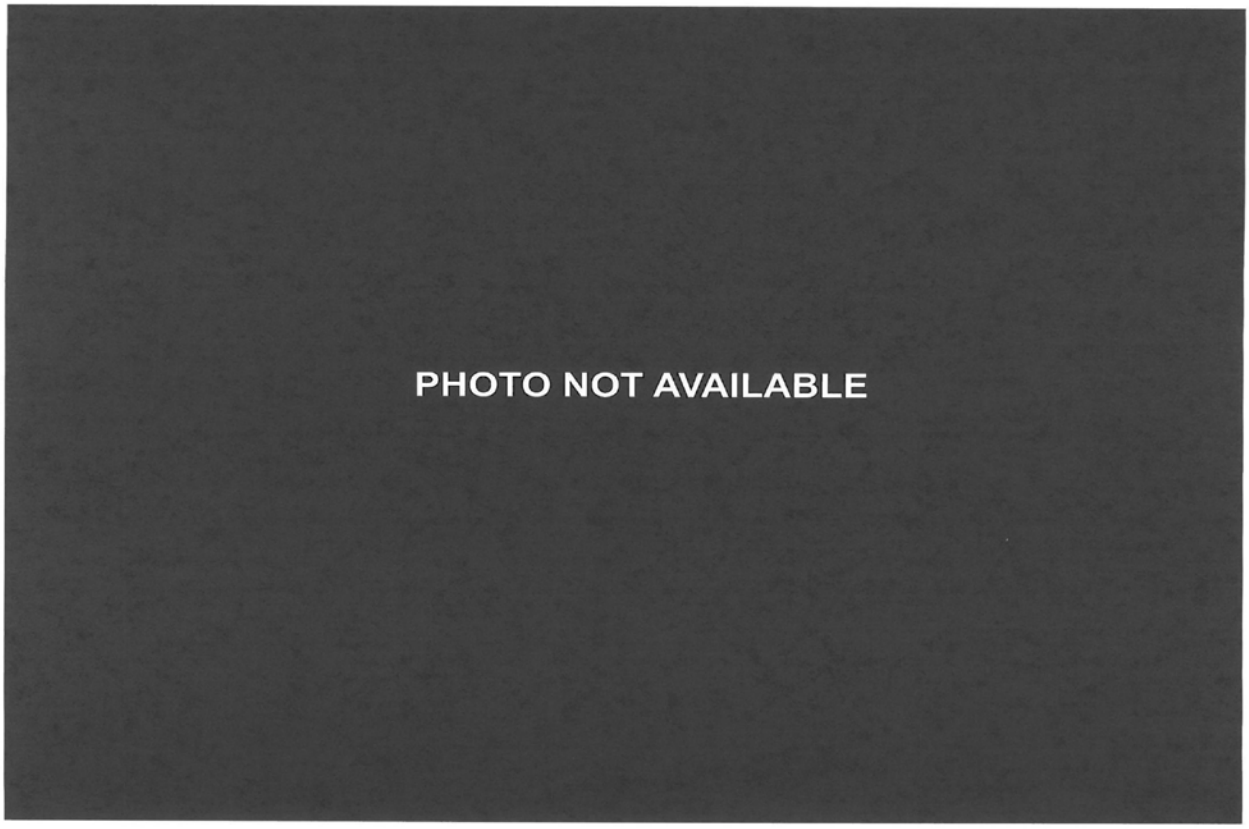


Figure A-5 Pre-Test Front Right Dummy Position – Right Side View

Figure A-6 Pre-Test Front Right Dummy Position – ¾ View

Figure A-7 Pre-Test Front Right Dummy Position – Front View

Figure A-8 Pre-Test Front Right Dummy Positioning – Left Side View

Figure A-9 Post-Test Front Right Dummy Position – Left Side View

Figure A-10 Post-Test Front Right Dummy Position – ¾ View

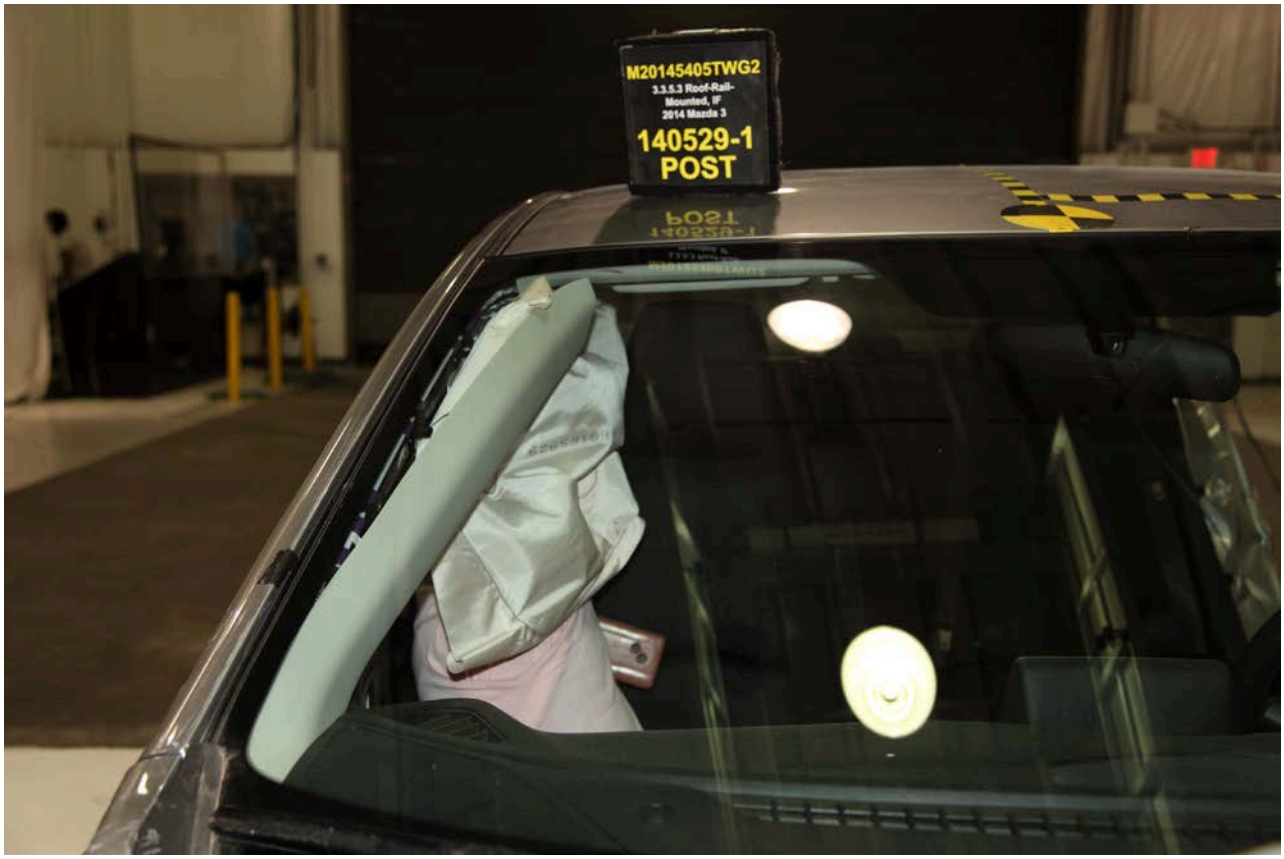


Figure A-11 Post-Test Front Right Dummy Position – Front View

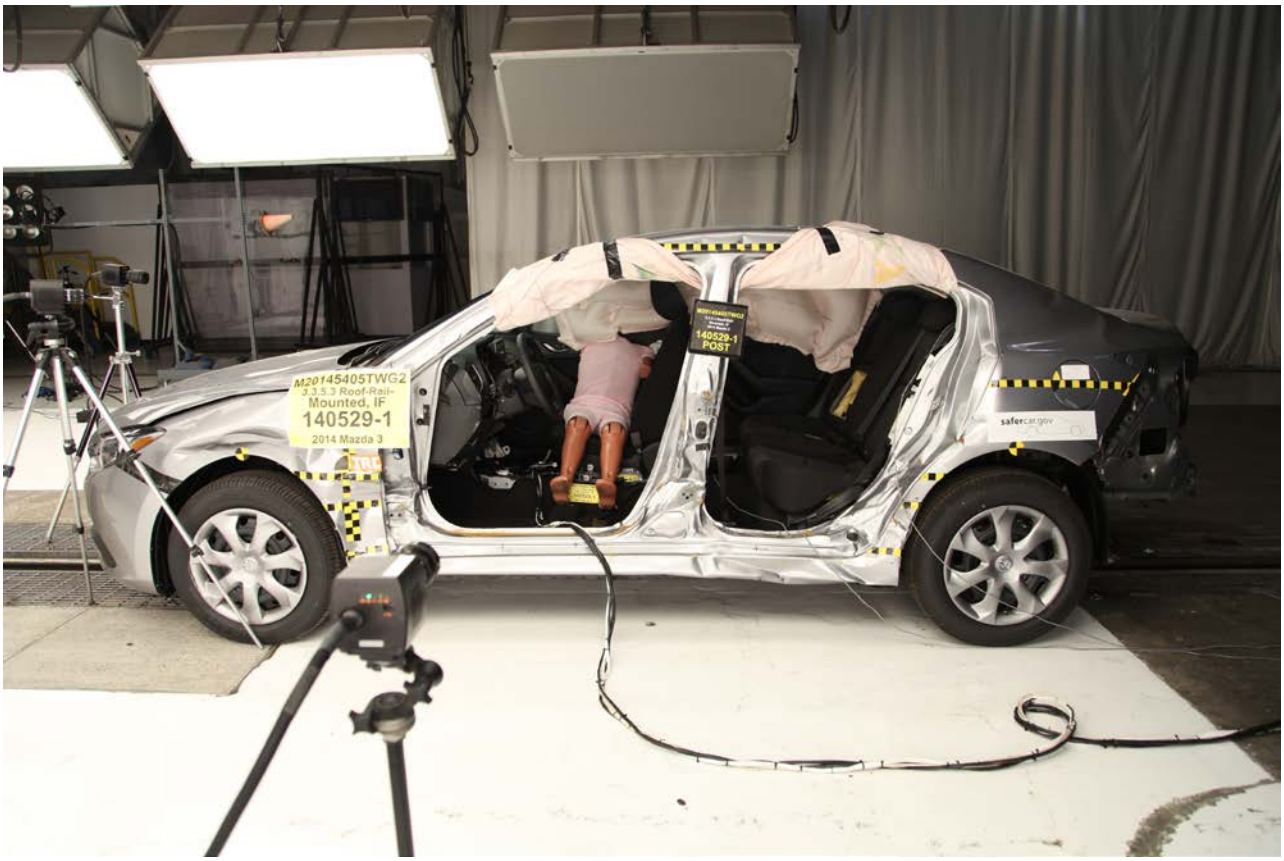


Figure A-12 Post-Test Front Passenger Airbags – Left Side View

Figure A-13 Post-Test Front Passenger Door – Window View

APPENDIX B

SID-IIs RESPONSE DATA TRACES

Table of Data Plots

Alpha Technology

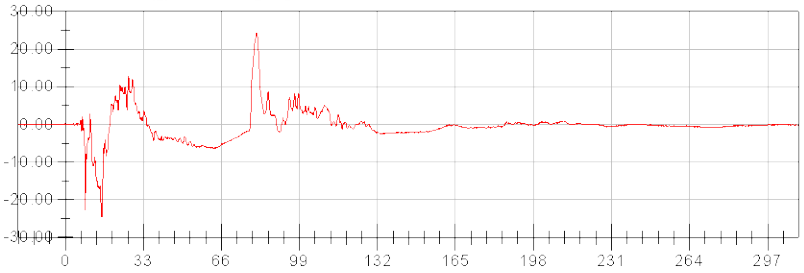
Test Date: 05/29/2014

Position #2 SID IIs Dummy (13S2)

Test Lab: CTF

Test Number: 140529-1 ()

Head Accel X (g) vs. Time [ms]



<Max>

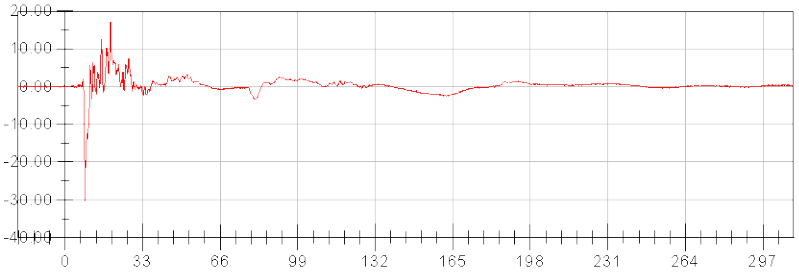
24.36 g at 80.80 ms

<Min>

-24.74 g at 15.44 ms

CFC_1000

Head Accel Y (g) vs. Time [ms]



<Max>

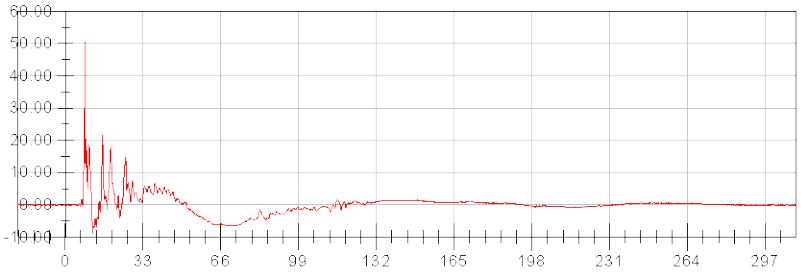
17.21 g at 19.36 ms

<Min>

-30.50 g at 8.48 ms

CFC_1000

Head Accel Z (g) vs. Time [ms]



<Max>

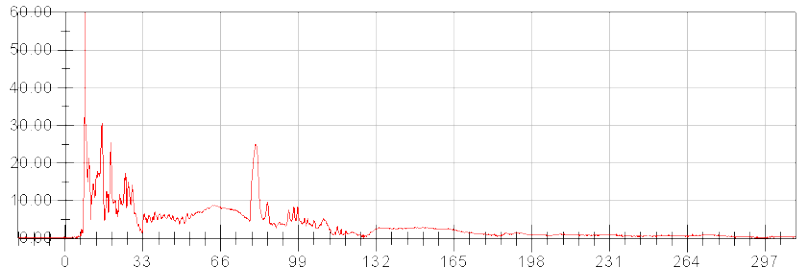
50.56 g at 8.32 ms

<Min>

-8.79 g at 11.68 ms

CFC_1000

Head Accel Resultant (g) vs. Time [ms]



<Max>

59.86 g at 8.40 ms

<Min>

0.03 g at -19.60 ms

CFC_1000

Alpha Technology

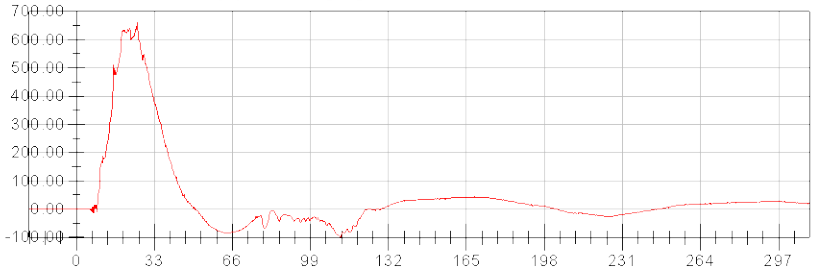
Test Date: 05/29/2014

Position #2 SID IIs Dummy (13S2)

Test Lab: CTF

Test Number: 140529-1 ()

Upper Neck Force X (N) vs. Time [ms]



<Max>

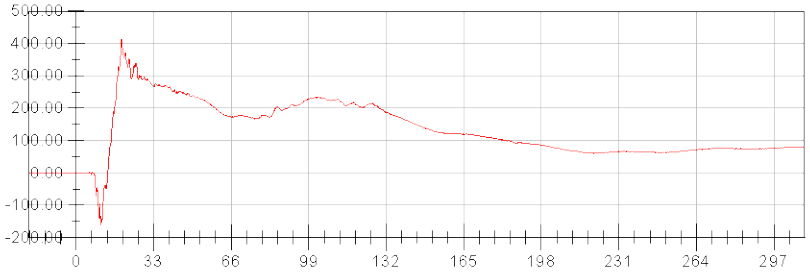
661.36 N at 25.76 ms

<Min>

-98.80 N at 111.60 ms

CFC_1000

Upper Neck Force Y (N) vs. Time [ms]



<Max>

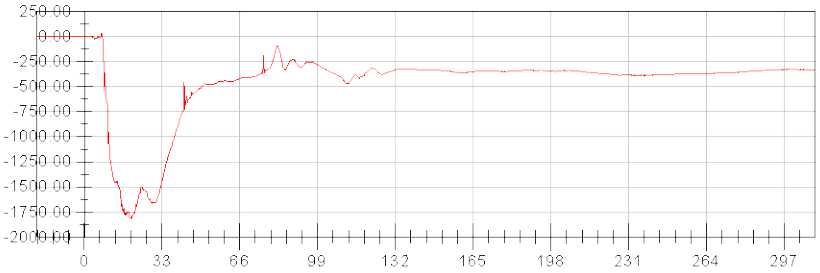
413.80 N at 19.44 ms

<Min>

-161.32 N at 10.40 ms

CFC_1000

Upper Neck Force Z (N) vs. Time [ms]



<Max>

36.63 N at 7.36 ms

<Min>

-1,818.81 N at 20.08 ms

CFC_1000

Alpha Technology

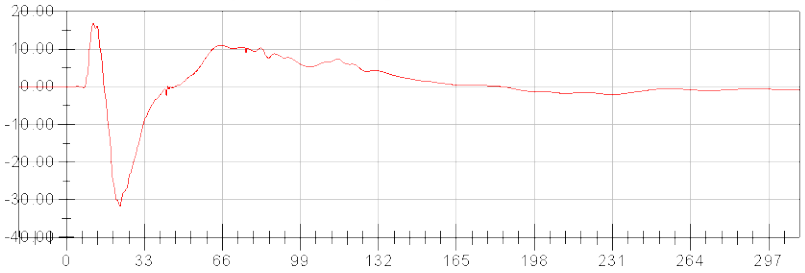
Test Date: 05/29/2014

Position #2 SID IIs Dummy (13S2)

Test Lab: CTF

Test Number: 140529-1 ()

Upper Neck Moment X (Nm) vs. Time [ms]



<Max>

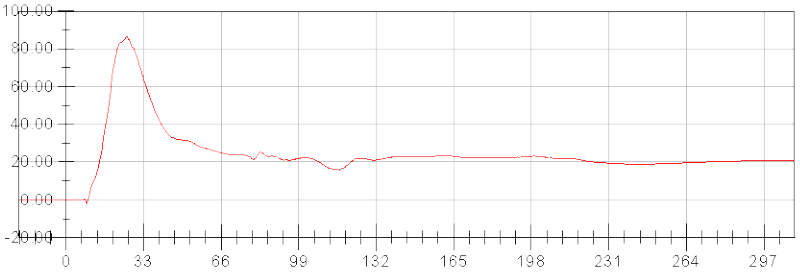
16.90 Nm at 11.44 ms

<Min>

-31.79 Nm at 22.64 ms

CFC_600

Upper Neck Moment Y (Nm) vs. Time [ms]



<Max>

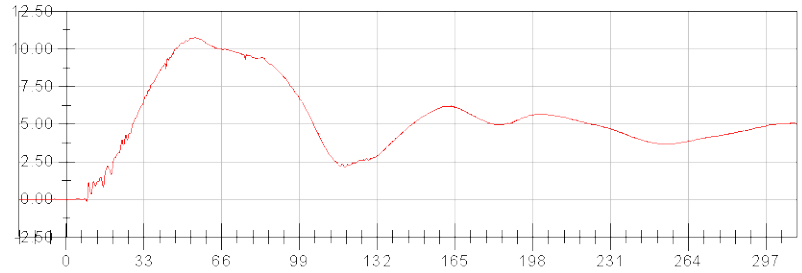
86.88 Nm at 25.76 ms

<Min>

-1.96 Nm at 8.80 ms

CFC_600

Upper Neck Moment Z (Nm) vs. Time [ms]



<Max>

10.77 Nm at 54.64 ms

<Min>

-0.15 Nm at 8.80 ms

CFC_600

Alpha Technology

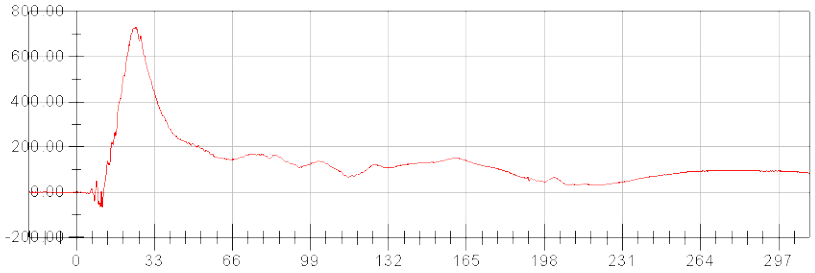
Test Date: 05/29/2014

Position #2 SID IIs Dummy (13S2)

Test Lab: CTF

Test Number: 140529-1 ()

Lower Neck Force X (N) vs. Time [ms]



<Max>

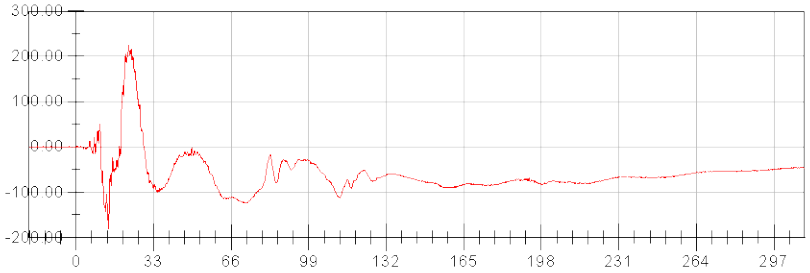
733.60 N at 25.12 ms

<Min>

-69.15 N at 10.00 ms

CFC_1000

Lower Neck Force Y (N) vs. Time [ms]



<Max>

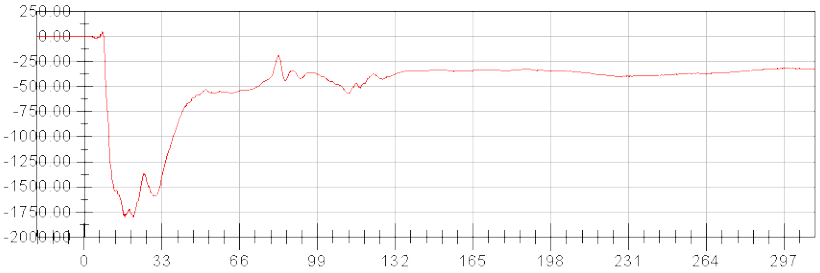
224.06 N at 22.40 ms

<Min>

-181.30 N at 13.76 ms

CFC_1000

Lower Neck Force Z (N) vs. Time [ms]



<Max>

48.92 N at 7.68 ms

<Min>

-1,799.32 N at 20.88 ms

CFC_1000

Alpha Technology

Test Date: 05/29/2014

Position #2 SID IIs Dummy (13S2)

Test Lab: CTF

Test Number: 140529-1 ()

Lower Neck Moment X (Nm) vs. Time [ms]

<Max>

34.60 Nm at 22.64 ms

<Min>

-8.78 Nm at 12.40 ms

CFC_600

Lower Neck Moment Y (Nm) vs. Time [ms]

<Max>

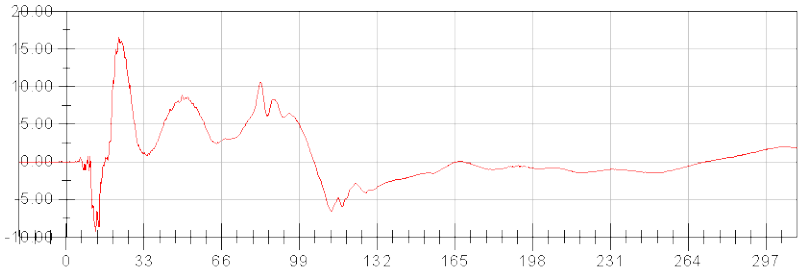
63.88 Nm at 12.16 ms

<Min>

-1.27 Nm at 6.88 ms

CFC_600

Lower Neck Moment Z (Nm) vs. Time [ms]



<Max>

16.57 Nm at 22.40 ms

<Min>

-9.22 Nm at 12.48 ms

CFC_600

Alpha Technology

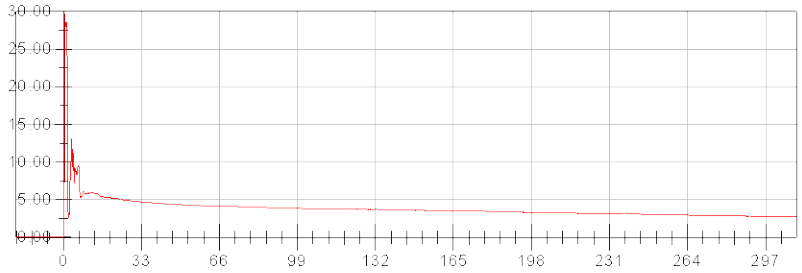
Test Date: 05/29/2014

Position #2 SID IIs Dummy (13S2)

Test Lab: CTF

Test Number: 140529-1 ()

Airbag Event Right Side Passenger Seat (V) vs. Time [ms]



<Max>

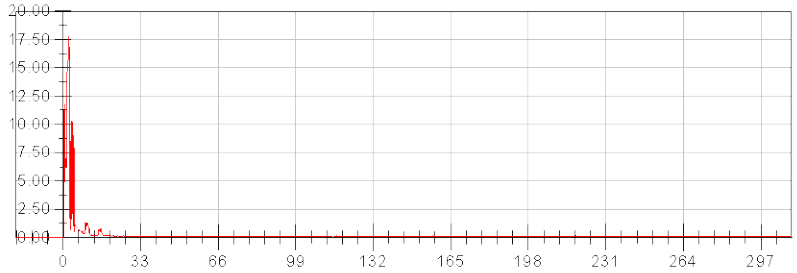
29.74 V at 0.64 ms

<Min>

0.00 V at -20.00 ms

Unfiltered

Airbag Event Right Side Passenger Curtain (V) vs. Time [ms]



<Max>

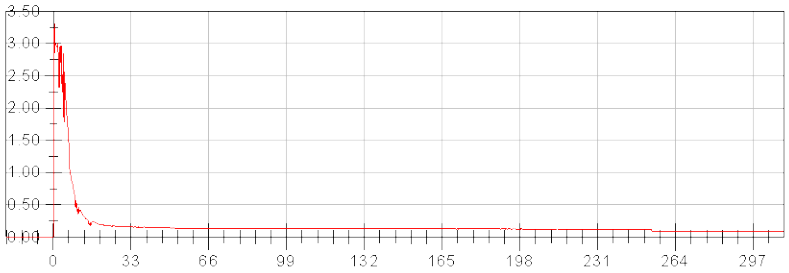
17.77 V at 2.40 ms

<Min>

0.00 V at -20.00 ms

Unfiltered

Airbag Event Right Side Passenger Curtain (A) vs. Time [ms]



<Max>

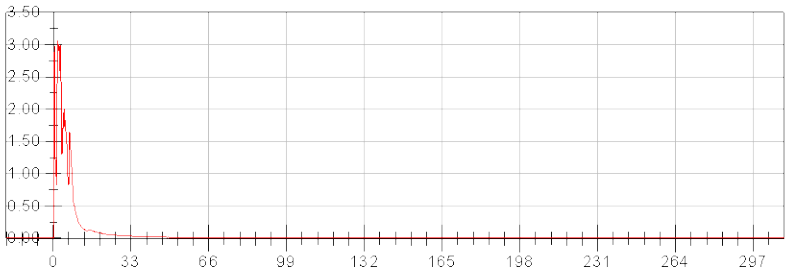
3.32 A at 0.48 ms

<Min>

0.00 A at -20.00 ms

Unfiltered

Airbag Event Right Side Passenger Seat (A) vs. Time [ms]



<Max>

3.06 A at 1.84 ms

<Min>

0.00 A at -20.00 ms

Unfiltered

APPENDIX C

TEST EQUIPMENT LIST AND CALIBRATION INFORMATION

Test Vehicle: 2014 Mazda 3 4-Door Sedan NHTSA No.: M20145405TWG2
Test Program: Side Airbag O.O.P. Injury Testing Test Date: 5/29/14

TEST EQUIPMENT LIST AND CALIBRATION INFORMATION

P572V INSTRUMENTATION

	POSITION #2 (RIGHT) SERIAL NO.: 297		
	SERIAL NUMBER	MANUFACTURER	CALIBRATION DATE
Head Accel X	P51292	Endevco	12-Mar-2014
Head Accel Y	P58999	Endevco	12-Mar-2014
Head Accel Z	P58797	Endevco	12-Mar-2014
Upper Neck Force X	1716A-1914-FX	Denton	11-Mar-2014
Upper Neck Force Y	1716A-1914-FY	Denton	11-Mar-2014
Upper Neck Force Z	1716A-1914-FZ	Denton	11-Mar-2014
Upper Neck Moment X	1716A-1914-MX	Denton	11-Mar-2014
Upper Neck Moment Y	1716A-1914-MY	Denton	11-Mar-2014
Upper Neck Moment Z	1716A-1914-MZ	Denton	11-Mar-2014
Lower Neck Force X	3166-150-FX	Denton	24-Mar-2014
Lower Neck Force Y	3166-150-FY	Denton	24-Mar-2014
Lower Neck Force Z	3166-150-FZ	Denton	24-Mar-2014
Lower Neck Moment X	3166-150-MX	Denton	24-Mar-2014
Lower Neck Moment Y	3166-150-MY	Denton	24-Mar-2014
Lower Neck Moment Z	3166-150-MZ	Denton	24-Mar-2014
Airbag Event Front Passenger Seat	K3789-223	KAYSER-THREDE	29-May-2014
Airbag Event Passenger Side Curtain	K3789-223	KAYSER-THREDE	29-May-2014
Airbag Event Front Passenger Seat	K3789-223	KAYSER-THREDE	29-May-2014
Airbag Event Passenger Side Curtain	K3789-223	KAYSER-THREDE	29-May-2014