

REPORT NUMBER: TWG-TRC-14-03

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

Chrysler Group LLC
2014 Jeep Cherokee MPV

NHTSA NUMBER: M20140302TWG2
TRC TEST NUMBER: 140414

PREPARED BY:
TRANSPORTATION RESEARCH CENTER INC.
10820 State Route 347
P.O. BOX B-67
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Test Date: April 14, 2014

FINAL REPORT

Alpha Technology Associate, Inc.
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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 10GT154. 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.

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Approved By: 

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Approval Date: May 23, 2014

FINAL REPORT ACCEPTANCE BY:

Accepted By: _____

Acceptance Date: _____

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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 T R C Test Facility in East Liberty, O h i o , on April 14, 2014.						
Injury Summary						
HIC15	Maximum Chest Displacement (mm)	Maximum Chest Displacement Rate (m/s)	NIJ(NTF)	NIJ(NTE)	NIJ(NCF)	NIJ(NCE)
13.19	N/A	N/A	0.0025	0.3753	0.5891	0.2813
17. Key Words New Car Assessment Program (NCAP) Side Airbag Out-Of-Position				18. Distribution Statement <u>Copies of this report are available from:</u> 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		
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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 Jeep Cherokee MPV on an out-of-position SID-II's 49CFR Part 572 Subpart V anthropomorphic test device (ATD) were evaluated. The test was performed by TRC on May 23, 2014. Pre- and post-test photographs of the vehicle and ATD can be found in Appendix A.

Two (2) 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, and front views.

The SID-II's 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-II's 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-II's 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 was 2 detents rearward of full forward. 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)	50
Placed in Position #	2

Number of Data Channels:	22	
Number of Cameras:	0	<u>Real Time</u>
	2	<u>High Speed Digital</u>

VISIBLE DUMMY CONTACT POINTS

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

DATA SHEET NO. 2

GENERAL TEST AND VEHICLE PARAMETER DATA

TEST VEHICLE INFORMATION

NHTSA No.	M20140302
Model Year	2014
Make	Jeep
Model	Cherokee Sport
Body Style	MPV
VIN	1C4PJMAB0EW121635
Body Color	Red
Odometer Reading (km/mi)	15 mi
Engine Displacement (L)	2.4
Type/No. Cylinders	4
Engine Placement	Front/Transverse
Transmission Type	Automatic
Transmission Speeds	9
Overdrive	Yes
Final Drive	AWD
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	No
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	Chrysler Group LLC	GVWR (kg)	2495
Date of Manufacture	10/13	GAWR Front (kg)	1273
		GAWR Rear (kg)	1273

VEHICLE SEATING AND WEIGHT CAPACITY

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Split Bench	N/A	
Number of Occupants	2	3	N/A	5
Capacity Wt. (VCW) (kg)				453.0
Cargo Wt. (RCLW) (kg)				112.8

DATA SHEET NO. 3

DUMMY POSITIONING IN VEHICLE

Measurement		Value
Total Range of Seat Travel Fore/Aft (detents)		50
Test Distance Rearward of Full-Forward (detents)		2
Seat Vertical Position		Lowermost
Placed in Position #		2
Seat Back Angle at Headrest Post	SA (°)	0.6 fwd
Top of Curtain Airbag Module to Head/Neck Junction	AN (mm)	197
Top of Seat Airbag Module to Head/Neck Junction	AN (mm)	240
Head CG to Door Panel/Window	HD (mm)	132
Head to Seat Back Centerline	HSC (mm)	170
Chest to Seat	CD (mm)	N/A
Chest to Seat Back	CS (mm)	235
Right Arm to Seat Back Centerline	RACL (mm)	N/A
Left Arm to Seat Back Centerline	LACL (mm)	73
Right Arm to Door Panel	RA (mm)	N/A
Left Arm to B-Post	LA (mm)	245
Knee to Knee	KK (mm)	160
Toe to Toe	TT (mm)	120
Right Knee to Seat Cushion Centerline	KSCR (mm)	265
Left Knee to Seat Cushion Centerline	KSCL (mm)	255
Right Toe to Seat Cushion Centerline	TSCR (mm)	710
Left Toe to Seat Cushion Centerline	TSCL (mm)	740
Nose to Seat	ND (mm)	N/A
Nose to Seat Back	NS (mm)	240
Top of Head to Headliner	HH (mm)	94

**DATA SHEET NO. 4
 DUMMY INJURY CRITERIA VALUES**

Channel	Max	Time (ms)	Min	Time (ms)
Head Ax [g , CFC_1000]	15.775	17.60	-8.927	38.96
Head Ay [g , CFC_1000]	6.950	90.24	-34.246	7.28
Head Az [g , CFC_1000]	55.169	7.28	-9.990	10.72
Upper Neck Fx [N , CFC_1000]	391.729	23.60	-78.471	37.12
Upper Neck Fy [N , CFC_1000]	578.966	49.20	-5.407	0.88
Upper Neck Fz [N , CFC_1000]	900.414	90.88	-1,331.490	16.80
Upper Neck Mx [N-m , CFC_600]	23.849	85.84	-37.282	16.88
Upper Neck My [N-m , CFC_600]	59.951	23.52	-12.921	98.40
Upper Neck Mz [N-m , CFC_600]	18.618	41.44	-8.939	90.88
Lower Neck Fx [N , CFC_1000]	697.603	21.20	-230.284	222.56
Lower Neck Fy [N , CFC_1000]	482.900	16.00	-116.147	240.88
Lower Neck Fz [N , CFC_1000]	6.063	0.64	-1,376.14	17.76
Lower Neck Mx [N-m , CFC_600]	65.830	38.00	-0.492	8.48
Lower Neck My [N-m , CFC_600]	39.549	16.40	-31.506	85.20
Lower Neck Mz [N-m , CFC_600]	34.726	16.08	-32.481	94.48
Airbag Event Passenger Side Curtain Voltage [V]	23.499	1.68		
Airbag Event Front Passenger Seat Voltage [V]	30.933	0.56		
Airbag Event Passenger Side Curtain Current [A]	3.052	1.04		
Airbag Event Front Passenger Seat Current [A]	3.292	0.48		

HEAD INJURY CRITERIA (HIC)

	HIC(15)	t ₁ (msec)	t ₂ (msec)	HIC(36)	t ₁ (msec)	t ₂ (msec)
Position #2 Right Front	13.19	16.72	31.76	21.38	6.88	42.88

Position 2 Neck Injury Summary (SID-IIs)

Nij V10	Nij	Time (ms)
Upper Neck NTF	0.0025	0.40
Upper Neck NTE	0.3753	90.88
Upper Neck NCF	0.5891	21.28
Upper Neck NCE	0.2813	168.00

**Peak Tension (CFC1000) 900.41 N Peak Compression (CFC1000) -1331.49 N
 Critical Values**

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

Test Vehicle: 2014 Jeep Cherokee MPV
Test Program: Side Airbag O.O.P. Injury Testing

NHTSA No.: M20140302TWG2
Test Date: 4/14/14

APPENDIX A
PHOTOGRAPHS

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Test Vehicle: 2014 Jeep Cherokee MPV
Test Program: Side Airbag O.O.P. Injury Testing

NHTSA No.: M20140302TWG2
Test Date: 4/14/14

APPENDIX B

SID-IIs RESPONSE DATA TRACES

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Test Vehicle: 2014 Jeep Cherokee MPV
Test Program: Side Airbag O.O.P. Injury Testing

NHTSA No.: M20140302TWG2
Test Date: 4/14/14

APPENDIX C

TEST EQUIPMENT LIST AND CALIBRATION INFORMATION

Test Vehicle: 2014 Jeep Cherokee MPV
 Test Program: Side Airbag O.O.P. Injury Testing

NHTSA No.: M20140302TWG2
 Test Date: 4/14/14

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	04-Apr-2014
Upper Neck Moment Y	1716A-1914-MY	Denton	04-Apr-2014
Upper Neck Moment Z	1716A-1914-MZ	Denton	04-Apr-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	07-Apr-2014
Airbag Event Passenger Side Curtain	K3789-223	KAYSER-THREDE	07-Apr-2014
Airbag Event Front Passenger Seat	K3789-223	KAYSER-THREDE	07-Apr-2014
Airbag Event Passenger Side Curtain	K3789-223	KAYSER-THREDE	07-Apr-2014



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

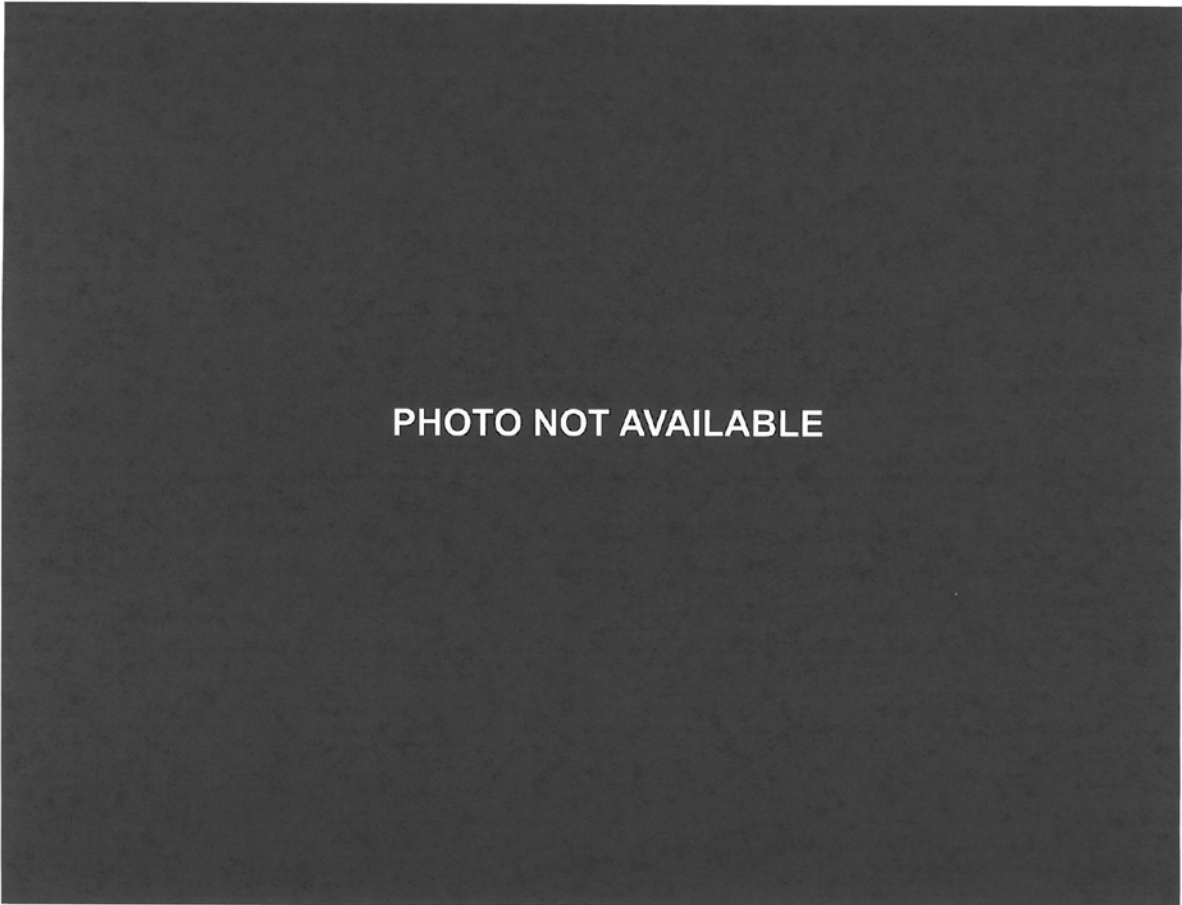


Figure A-5 Pre-Test Front Right Dummy Position – Right Side View



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

Test Vehicle: 2014 Jeep Cherokee MPV
Test Program: Side Airbag O.O.P. Injury Testing

NHTSA No.: M20140302TWG2
Test Date: 4/14/14

APPENDIX B

SID-IIs RESPONSE DATA TRACES

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19	Airbag Event Passenger Side Curtain (A) vs. Time	B-8
20	Airbag Event Front Passenger Seat (A) vs. Time	B-8

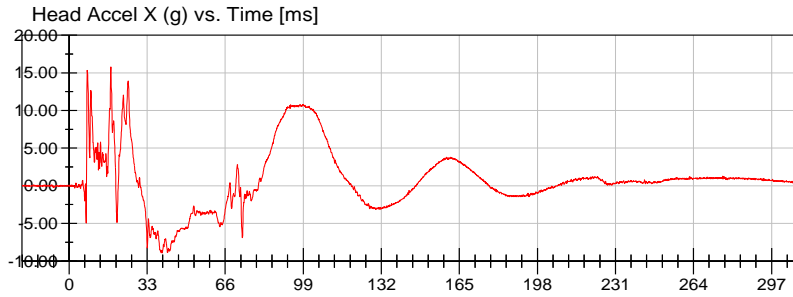
Alpha Technology

Position #2 SID IIs Dummy (13S2)

Test Date: 04/14/2014

Test Lab: CTF

Test Number: 140414 (M20140302TWG2)



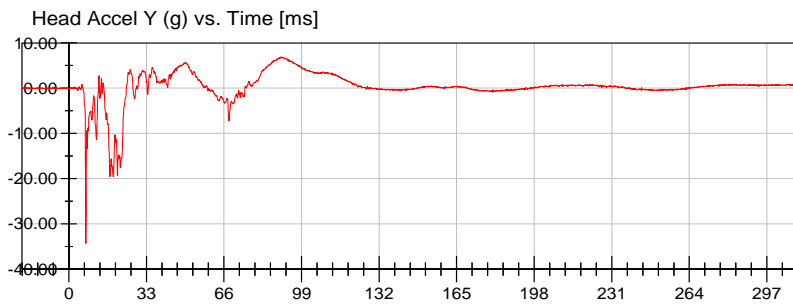
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15.77 g at 17.60 ms

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-8.93 g at 38.96 ms

CFC_1000



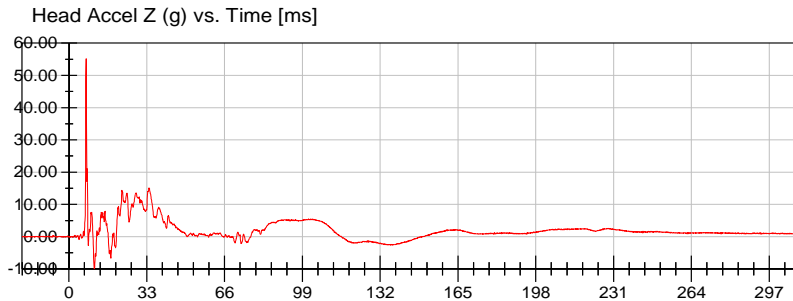
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-34.25 g at 7.28 ms

CFC_1000



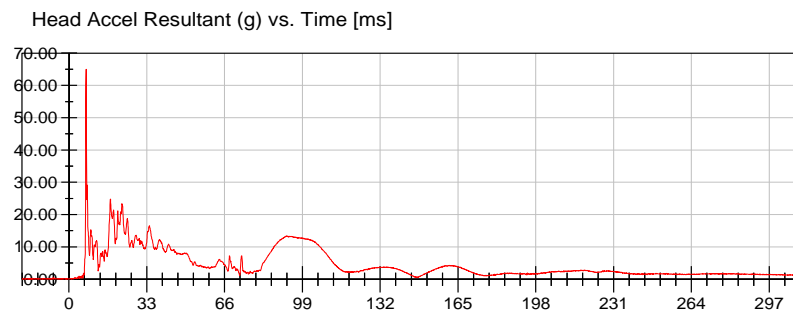
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55.17 g at 7.28 ms

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-9.99 g at 10.72 ms

CFC_1000



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65.02 g at 7.28 ms

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0.02 g at -19.84 ms

CFC_1000



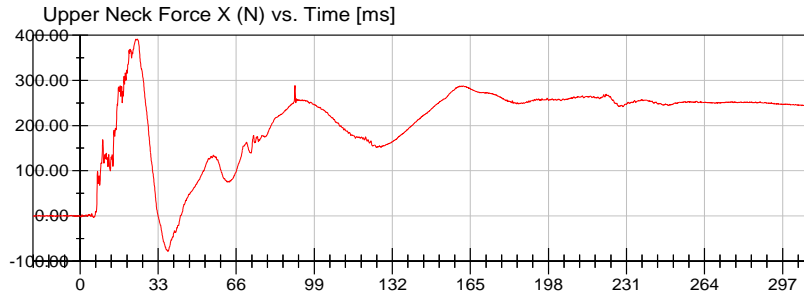
Alpha Technology

Position #2 SID IIs Dummy (13S2)

Test Date: 04/14/2014

Test Lab: CTF

Test Number: 140414 (M20140302TWG2)



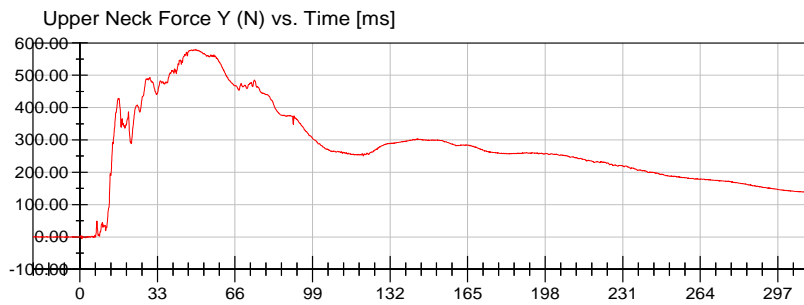
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-78.47 N at 37.12 ms

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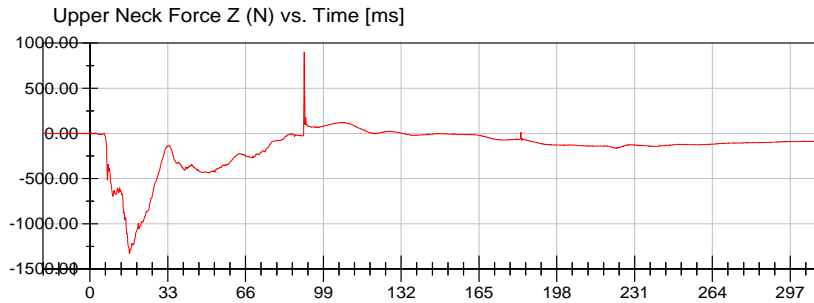
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CFC_1000



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-1,331.49 N at 16.80 ms

CFC_1000



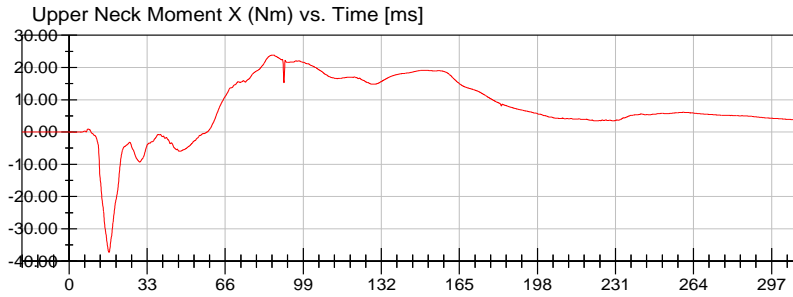
Alpha Technology

Position #2 SID IIs Dummy (13S2)

Test Date: 04/14/2014

Test Lab: CTF

Test Number: 140414 (M20140302TWG2)



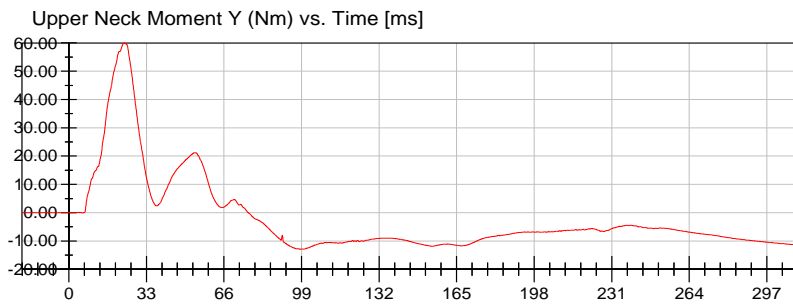
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-37.28 Nm at 16.88 ms

CFC_600



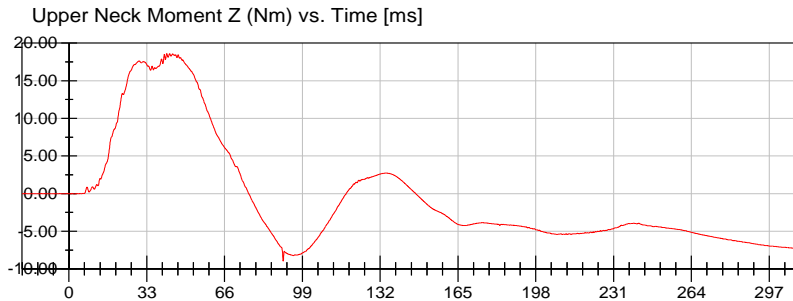
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59.95 Nm at 23.52 ms

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-12.92 Nm at 98.40 ms

CFC_600



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18.62 Nm at 41.44 ms

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-8.94 Nm at 90.88 ms

CFC_600



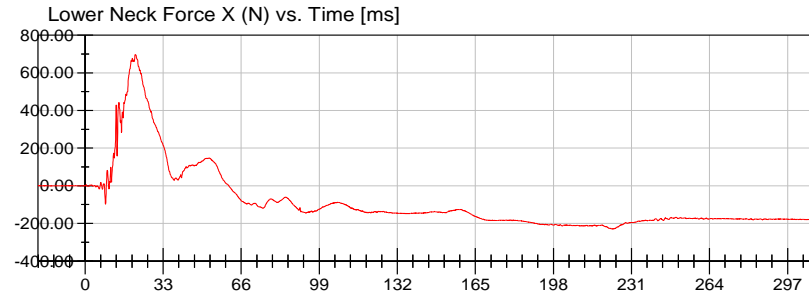
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Position #2 SID IIs Dummy (13S2)

Test Date: 04/14/2014

Test Lab: CTF

Test Number: 140414 (M20140302TWG2)



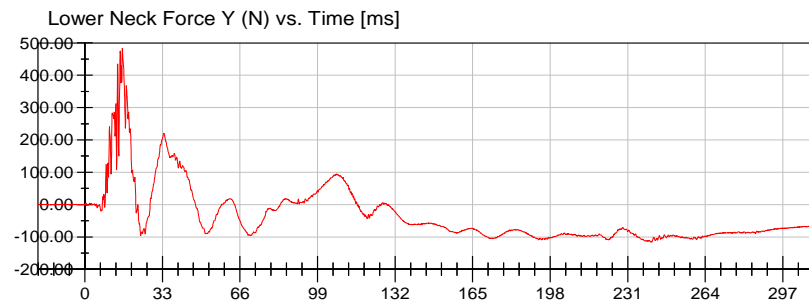
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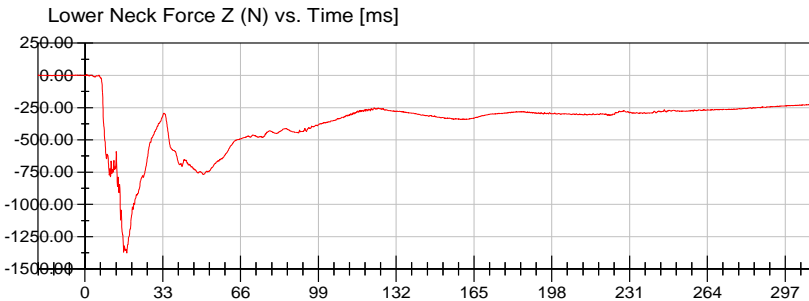
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CFC_1000



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6.06 N at 0.64 ms

<Min>

-1,376.14 N at 17.76 ms

CFC_1000



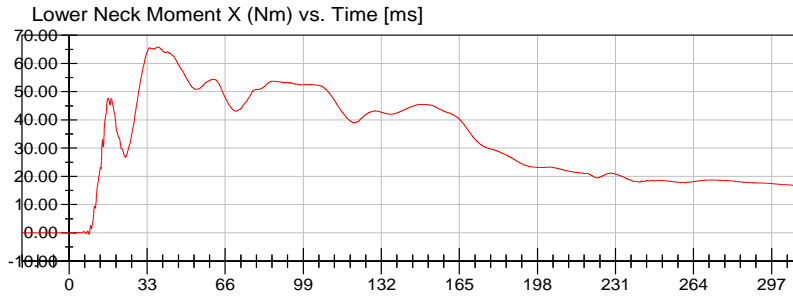
Alpha Technology

Position #2 SID IIs Dummy (13S2)

Test Date: 04/14/2014

Test Lab: CTF

Test Number: 140414 (M20140302TWG2)



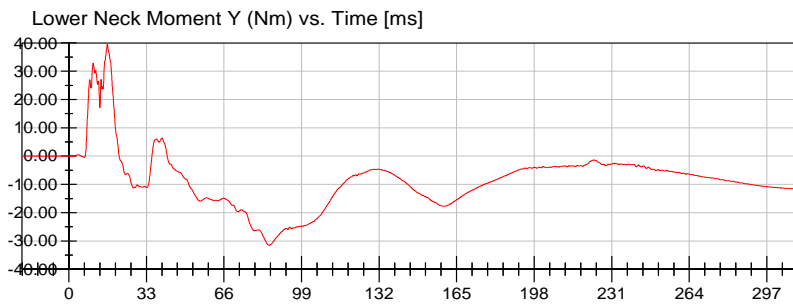
<Max>

65.83 Nm at 38.00 ms

<Min>

-0.49 Nm at 8.48 ms

CFC_600



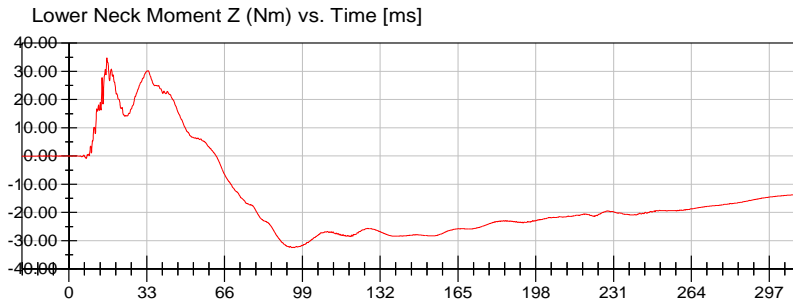
<Max>

39.55 Nm at 16.40 ms

<Min>

-31.51 Nm at 85.20 ms

CFC_600



<Max>

34.73 Nm at 16.08 ms

<Min>

-32.48 Nm at 94.48 ms

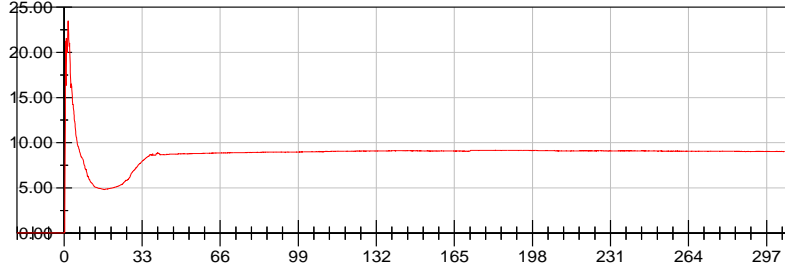
CFC_600



Test Lab: CTF

Test Number: 140414 (M20140302TWG2)

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



<Max>

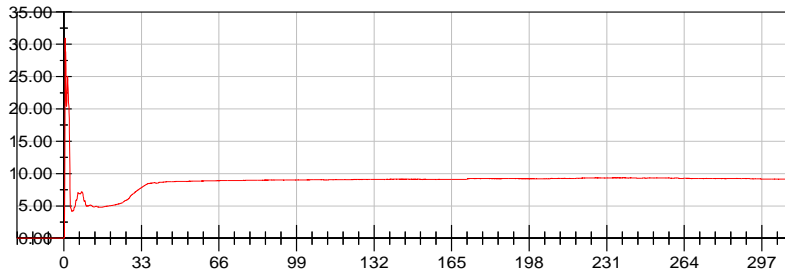
23.50 V at 1.68 ms

<Min>

0.00 V at -20.00 ms

Unfiltered

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



<Max>

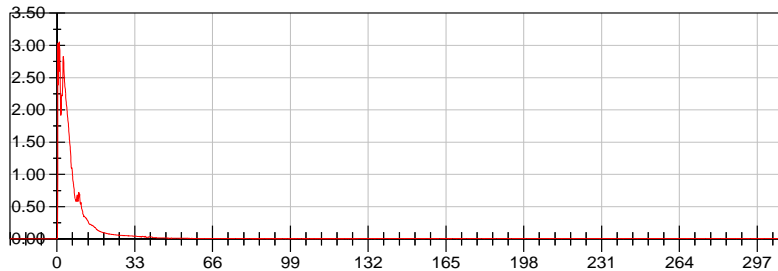
30.93 V at 0.56 ms

<Min>

0.00 V at -20.00 ms

Unfiltered

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



<Max>

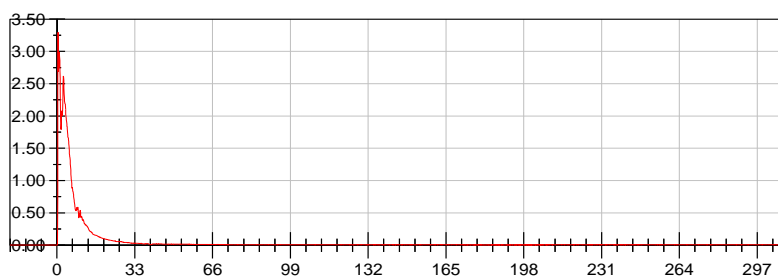
3.05 A at 1.04 ms

<Min>

0.00 A at -20.00 ms

Unfiltered

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



<Max>

3.29 A at 0.48 ms

<Min>

0.00 A at -20.00 ms

Unfiltered



Test Vehicle: 2014 Jeep Cherokee MPV
Test Program: Side Airbag O.O.P. Injury Testing

NHTSA No.: M20140302TWG2
Test Date: 4/14/14

APPENDIX C

TEST EQUIPMENT LIST AND CALIBRATION INFORMATION

Test Vehicle: 2014 Jeep Cherokee MPV
 Test Program: Side Airbag O.O.P. Injury Testing

NHTSA No.: M20140302TWG2
 Test Date: 4/14/14

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	04-Apr-2014
Upper Neck Moment Y	1716A-1914-MY	Denton	04-Apr-2014
Upper Neck Moment Z	1716A-1914-MZ	Denton	04-Apr-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	07-Apr-2014
Airbag Event Passenger Side Curtain	K3789-223	KAYSER-THREDE	07-Apr-2014
Airbag Event Front Passenger Seat	K3789-223	KAYSER-THREDE	07-Apr-2014
Airbag Event Passenger Side Curtain	K3789-223	KAYSER-THREDE	07-Apr-2014