

REPORT NUMBER TR-P27082-07-NC

**SIDE AIRBAG OCCUPANT RISK PROGRAM
OCCUPANT OUT-OF-POSITION TESTS**

**TOYOTA MOTOR CORPORATION
2006 TOYOTA RAV4
5-DOOR MPV**

NHTSA NUMBER: M65110TWG2

**PREPARED BY:
KARCO ENGINEERING, LLC
9270 HOLLY ROAD
ADELANTO, CALIFORNIA 92301**



MAY 7, 2007

FINAL REPORT

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Date of Acceptance

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Date of Acceptance

Technical Report Documentation Page

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16. Abstract A static side airbag deployment was conducted on a 2006 Toyota Rav4 5-Door MPV at KARCO Engineering, LLC on 5/7/2007. This test was conducted to obtain data indicant of TWG Side Airbag Out-of-Position Injury criteria.			
Measurement Description	Units	Threshold	Hybrid III 6 Year Old ATD
Head Injury Criteria (HIC ₁₅)		700	14.3
17. Key Words TWG Occupant Out-of-Position Test Section 3.3.3.5 New Car Assessment Program (NCAP) 2006 Toyota Rav4 5-Door MPV NHTSA NO. M65110TWG2		18. Distribution Statement Copies of this report available from: NHTSA Technical Reference Division National Highway Traffic Safety Admin. 400 Seventh St., SW, Room 5111 Washington, D.C. 20590	
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SECTION 1

PURPOSE AND SUMMARY OF TEST M65110TWG2

1.1 PURPOSE

This occupant out-of-position static side airbag deployment test is part of the Technical Working Group Occupant Injury Risk from Deploying Side Airbags Testing Program sponsored by the National Highway Traffic Safety Administration (NHTSA) under Contract No. DTNH22-03-D-32005. The purpose of this test was to obtain occupant injury data for a side airbag deployment.

The occupant out-of-position side airbag test was conducted in accordance with the Technical Working Group Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags.

1.2 SUMMARY

The effects of a seat mounted torso airbag and a roof mounted curtain airbag deployment in a 2006 Toyota Rav4 5-Door MPV with an out-of-position Hybrid III 6 Year-Old Child dummy were evaluated. It should be noted that this test does not reflect the proper airbag deployment pattern found in this vehicle. In an actual event, the torso bag would be suppressed from deployment based on the occupant size. The test was performed at Karco Engineering, LLC on May 7, 2007. Pre- and post-test photographs of the vehicle and dummy can be found in Appendix A.

Two high-speed digital cameras were used to document the torso and curtain airbag deployment. Camera locations and other pertinent camera information can be found on Data Sheet No.1 and Data Sheet No.6.

One Part 572N, Hybrid III 6-Year old child anthropomorphic test device (ATD) was placed in the right front passenger seating position facing forward according to the dummy placement instructions (3.3.3.5) in the July 2003 Revision of the Technical Working Group's 'Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags'.

The Hybrid III 6-Year old ATD was instrumented with head tri-axial accelerometers, and upper neck transducers.

Nine (9) channels of data were recorded using an on-board data acquisition system. Appendix A contains Photographs. Appendix B contains dummy response data traces. Appendix C contains the Instrumentation Data Channel assignments.

The front passenger side door remained closed during the deployment and was operable after the deployment.

The Hybrid III 6-Year-Old Child Dummy's visible contact points were as follows: The torso airbag contacted the ATD's back. The curtain airbag contacted the ATD's head.

OUT OF POSITION OCCUPANT DATA SUMMARY

ATD Position	HIC ₁₅
Passenger	14.3

Orientation of the Hybrid III 6 Year-old Child Dummy was in the inboard facing position leaning against the front passenger door. The dummy's spine was aligned with the deploying trajectory of the torso airbag. The lower legs were extended. Synthetic foam was used to raise the dummy. This orientation complies with section 3.3.3.5 of the Technical Working Group (TWG) recommendation in the Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags.

SECTION 2

OCCUPANT AND VEHICLE INFORMATION/DATA SHEETS

Test Vehicle: 2006 Toyota Rav4 5-Door MPV NHTSA No.: M65110TWG2
Test Program: TWG 3.3.3.5. Test Date: 05/07/07

CONVERSION FACTORS USED IN THIS REPORT*

Quantity	Typical Application	Std Units	Metric Unit	Multiply By
Mass	Vehicle Weight	lb	kg	0.4536
Linear Velocity	Impact Velocity	mile/h	km/h	1.609
Length or Distance	Measurements	in	mm	25.4
Volume	Fuel Systems	gal	liter	3.785
Volume	Small Fluids	oz	mL	29.573
Pressure	Tire Pressures	lbf/in ²	kPa	7.0
Volume	Liquid	gal	liter	3.785
Temperature	General Use	°F	°C	$=(tf - 32)/1.8$
Force	Dynamic Forces	lbf	N	4.448
Moment	Torque	lbf/ft	Nm	1.355

* Based on the Recommended Practice in SAE J916, May 85

DATA SHEET NO. 1

TEST SUMMARY

Test Vehicle: 2006 Toyota Rav4 5-Door MPV NHTSA No.: M65110TWG2
Test Program: TWG 3.3.3.5. Test Date: 05/07/07

TEST DUMMY INFORMATION

Description	Passenger Seat Forward Facing
Dummy Type / Serial No.	Hybrid III 6 year old / 144
Head Contact	Yes
Chest Contact	None
Abdomen Contact	None
Pelvis	Yes
Left Knee Contact	None
Right Knee Contact	None

MOVIE COVERAGE

High Speed Digital	2
Total	2

DATA CHANNELS

Child ATD Sensors	9
Belt Assessment Sensors	0
Vehicle Structure Accelerometers	0
Total	9

DATA SHEET NO. 2**GENERAL TEST AND VEHICLE PARAMETER DATA**Test Vehicle: 2006 Toyota Rav4 5-Door MPV NHTSA No.: M65110TWG2Test Program: TWG 3.3.3.5. Test Date: 05/07/07**TEST VEHICLE INFORMATION**

Make	Toyota
Model	Rav4
Body Style	5-Door MPV
NHTSA No.	M65110TWG2
VIN	JTMZD33V665029275
Color	White
Delivery Date	July 28, 2006
Odometer Reading (mile)	22
Dealer	Valley-Hi Toyota
Transmission	Automatic
Final Drive	Front
Type/Number Cylinders	I4
Engine Displacement (L)	2.4
Engine Placement	Transverse

TEST VEHICLE OPTIONS

Driver Front Airbag	Yes
Driver Side Airbag	Yes
Driver Side Curtain Airbag	Yes
Pass. Front Airbag	Yes
Pass.Side Airbag	Yes
Pass. Curtain Airbag	Yes
Power Brakes	Yes
Power Steering	Yes
Disc Brakes, Front	Yes
Disc Brakes, Rear	Yes
Anti-lock Brakes	Yes
Tilt Steering Wheel	Yes
Power Windows	Yes
Power Seats	No

DATA FROM CERTIFICATION LABEL

Manufactured By	Toyota Motor Corporation	GVWR (kg)	2010
Date of Manufacture	Jul. 06	GAWR Front (kg)	1150
		GAWR Rear (kg)	1105

DATA FROM TIRE PLACARD

Measured Parameter	Front	Rear
Maximum Tire Pressure (kPa)	302	302
Cold Pressure (kPa)	220	220
Recommend Tire Size	P225/65R17	P225/65R17
Tire Size on Vehicle	P225/65R17	P225/65R17
Tire Manufacturer	Yokohama	Yokohama

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Bench		
Number of Occupants	2	3		5
Capacity Wt. (VCW) (kg)				375

* Vehicle had undergone Side Impact New Car Assessment Program Frontal Impact Testing on August 7, 2006

DATA SHEET NO. 3

TEST VEHICLE INFORMATION

Test Vehicle: 2006 Toyota Rav4 5-Door MPV NHTSA No.: M65110TWG2
Test Program: TWG 3.3.3.5. Test Date: 05/07/07

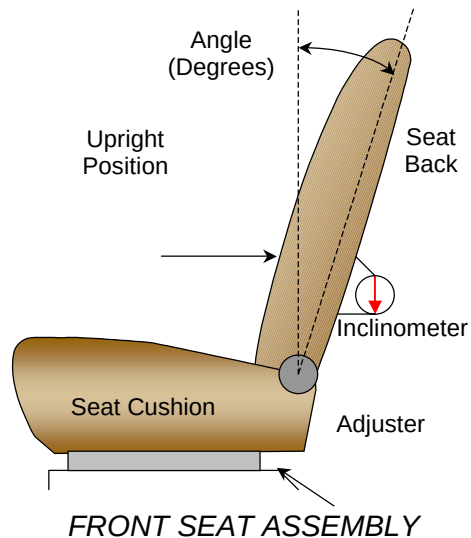
NOMINAL DESIGN RIDING POSITION

The passenger seat back is positioned to section 3.3.3.5. of the Technical Working Group (TWG) recommendation in the Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags.

SEAT BACK ANGLES

Position	Deg.
Passenger w/ Dummy	1.7*

*Measurement taken at headrest



SEAT FORE/AFT POSITIONS

The first or forward most position is counted as number one (1). The fore/aft position is set aft of the middle position for the passenger seat.

SEAT FORE/AFT POSITIONING

	Total Fore/Aft Travel	Placed in Position #
Passenger Seat	16	9

DATA SHEET NO. 4

DUMMY POSITIONING INFORMATION

Test Vehicle: 2006 Toyota Rav4 5-Door MPV NHTSA No.: M65110TWG2
 Test Program: TWG 3.3.3.5. Test Date: 05/07/07

TEST DUMMY POSITION MEASUREMENTS

Code	Measurement Description	Hybrid III 6-Year-Old Child Dummy	
		Length (mm)	Angle (°)
SA	Seat Back Angle		1.7
AMW	Side Airbag Module Width (Torso / Curtain)	75 / 50	
ABW	Side Airbag Width (Torso / Curtain)	360 / 630	
AML	Side Airbag Module Length (Torso / Curtain)	300 / 1900	
ABL	Side Airbag Length (Torso / Curtain)	380 / 1890	
AN	Top of Airbag Module to Head/Neck Junction (Curtain)	68	
HD	Head CG to Door Panel/ Window	98	
HSC	Head to Seat Back Centerline	174	
HB	Head to B-Pillar (first contact)	10	
HZ	Head to Roof (Z)	210	
HHD	Head to Header	493	
ND	Nose to Dash	722	
NS	Nose to Seat Back	250	
NR	Nose to Header	516	
CD	Chest to Dash	677	
CS	Chest to Seat Back	213	
RACL	Right Arm to Seat Back Centerline	360	
LACL	Left Arm to Seat Back Centerline	123	
RA	Right Arm to Door Panel	0	
LA	Left Arm to Door Panel	269	
KK	Knee to Knee	110	
TT	Toe to Toe	125	
KSCR	Right Knee to Seat Cushion Centerline	110	
KSCL	Left Knee to Seat Cushion Centerline	15	
TSCR	Right Toe to Seat Cushion Centerline	-75	
TSCL	Left Toe to Seat Cushion Centerline	-175	

DATA SHEET NO. 5
HYBRID III ATD INJURY CRITERIA AND SENSOR DATA

Test Vehicle: 2006 Toyota Rav4 5-Door MPV

NHTSA No.: M65110TWG2

Test Program: TWG 3.3.3.5

Test Date: 5/7/07

HEAD PEAK ACCELERATIONS

Location	Axis	Units	Pass. (6 Yr.)			
			Max	Time	Min	Time
Head CG	X	G's	11.7	12.0	-12.8	13.2
Head CG	Y	G's	17.1	11.7	-31.9	10.9
Head CG	Z	G's	45.1	11.4	-22.6	14.3
Head CG Resultant	N/A	G's	46.8	11.4		

UPPER NECK PEAK FORCES AND MOMENTS

Location	Axis	Units	Pass. (6 Yr.)			
			Max	Time	Min	Time
Neck Force	X	Newtons	210.5	9.8	-64.6	137.2
Neck Force	Y	Newtons	197.7	12.9	-27.6	331.1
Neck Force	Z	Newtons	106.1	212.3	-976.0	12.9
Neck Force Resultant	N/A	Newtons	998.1	12.9		
Neck Moment	X	Nm	7.8	74.4	-9.6	25.1
Neck Moment	Y	Nm	20.2	9.4	-16.7	30.1
Neck Moment	Z	Nm	8.0	300.6	-3.6	82.2
Neck Moment Resultant	N/A	Nm	20.3	9.4		

DATA SHEET NO. 5...(CONTINUED)Test Vehicle: 2006 Toyota Rav4 5-Door MPVNHTSA No.: M65110TWG2Test Program: TWG 3.3.3.5Test Date: 5/7/07**HEAD INJURY CRITERIA (HIC 15)**

Location	Pass. (6 Yr.)			
	HIC15	T ¹	T ²	Avg G
Head CG	14.3	10.8	15.3	14.4

UPPER NECK NIJ VALUES

Location	Pass. (6 Yr.)			
	Ntf	Nte	Ncf	Nce
Upper Neck	0.08	0.19	0.41	0.54

DATA SHEET NO. 6**CAMERA LOCATIONS**Test Vehicle: 2006 Toyota Rav4 5-Door MPV NHTSA No.: M65110TWG2Test Program: TWG 3.3.3.5. Test Date: 05/07/07

No.	Camera View	Location (mm)			Angle (Deg.)	Lens (mm)	Speed (fps)
		X	Y	Z			
1	High Speed Digital Side View	-200	-3740	-20	1.2	50	1000
2	High Speed Digital Front View	-2310	-562	-440	-13.6	50	1000

* Cameras aligned to the CG of dummy's head as reference.

APPENDIX A

PHOTOGRAPHS



Figure A-1: Right Front $\frac{3}{4}$ View, As Received

MFD. BY: TOYOTA MOTOR CORPORATION
GVWR: 2010KG (4430LB)
GAWR: FRT. 1150KG (2535LB) WITH 225/65R17 TIRES.
RR. 17X6 1/2J RIMS, AT 220KPA (32PSI) COLD.
1105KG (2435LB) WITH 225/65R17 TIRES.
17X6 1/2J RIMS, AT 220KPA (32PSI) COLD.

07/06

THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR VEHICLE SAFETY AND THEFT PREVENTION STANDARDS IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE.

JTMZD33V665029275 MPV



C/TR: 040/FC10
A/TM: -06A/U241E

ACA38L-ANPXKA
MADE IN JAPAN

074



Figure A-2: Vehicle Certification Label



Figure A-3: Post-Test Right Front $\frac{3}{4}$ View of Frontal NCAP Test



Figure A-4: Post-Test Right Side View of Frontal NCAP Test



Figure A-5: Pre-Test Dummy Position, Left Side View

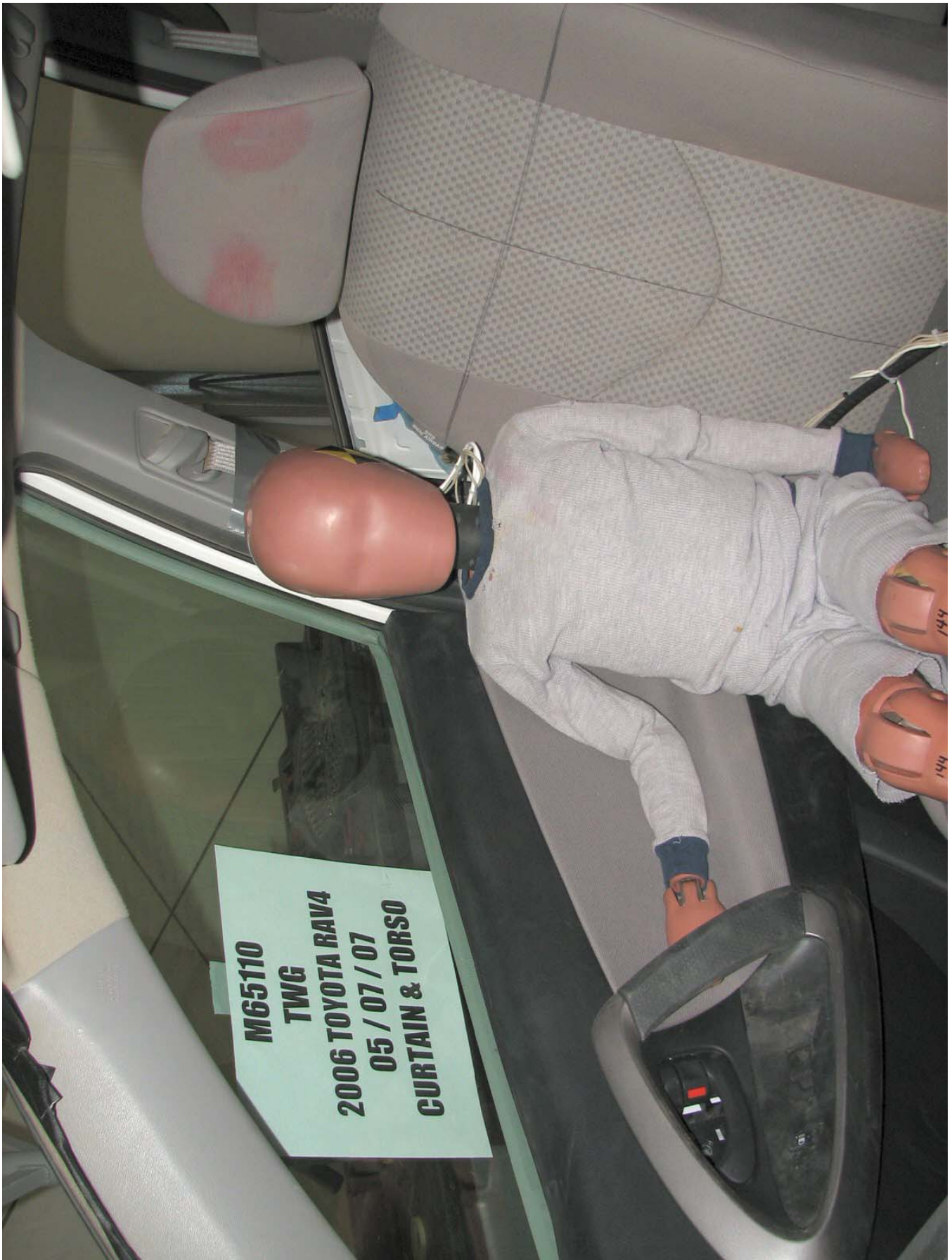


Figure A-6: Pre-Test Dummy Position, 3/4 View

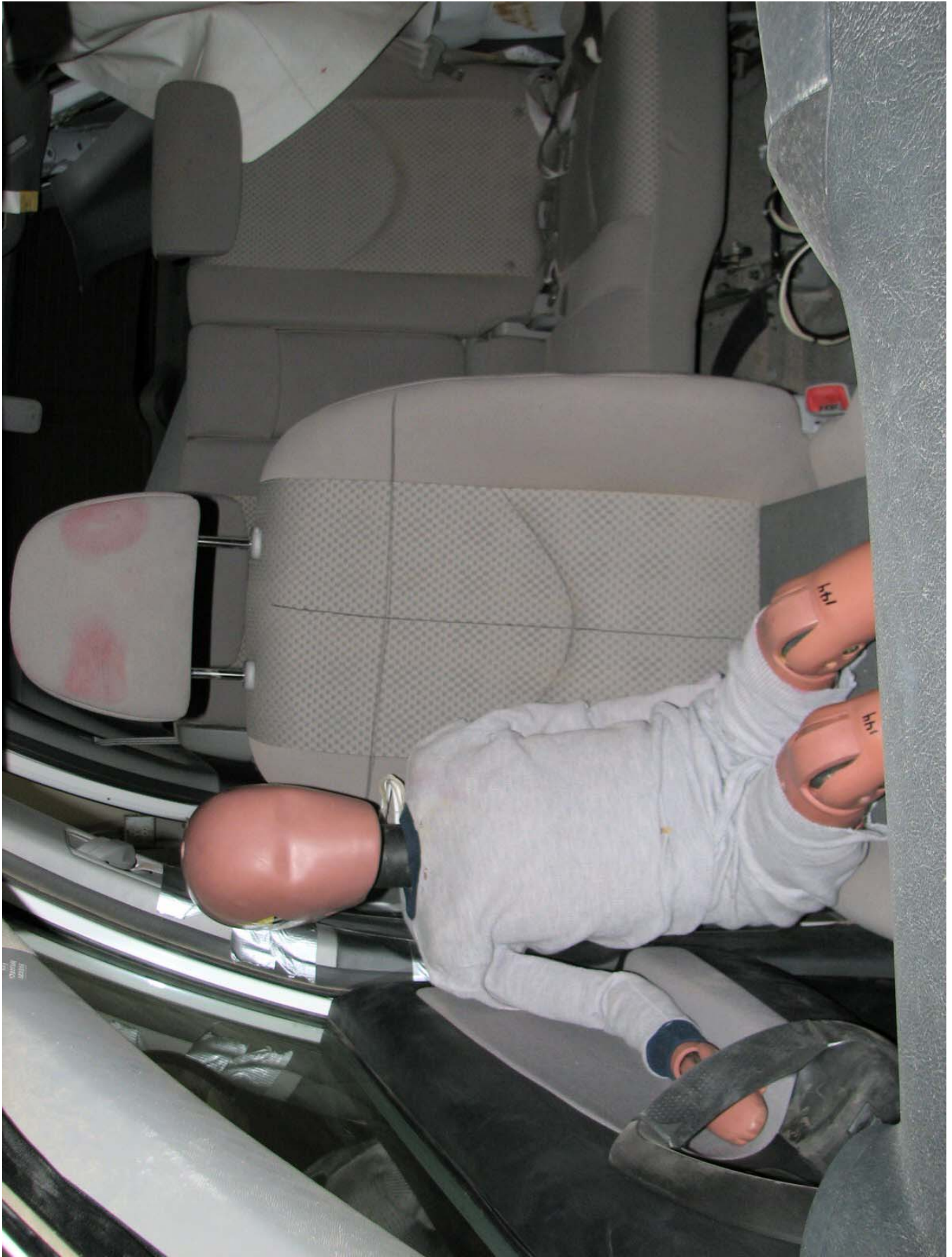


Figure A-7: Pre-Test Dummy Position, Front View



Figure A-8: Post-Test Dummy Position and Airbags, Left Side View

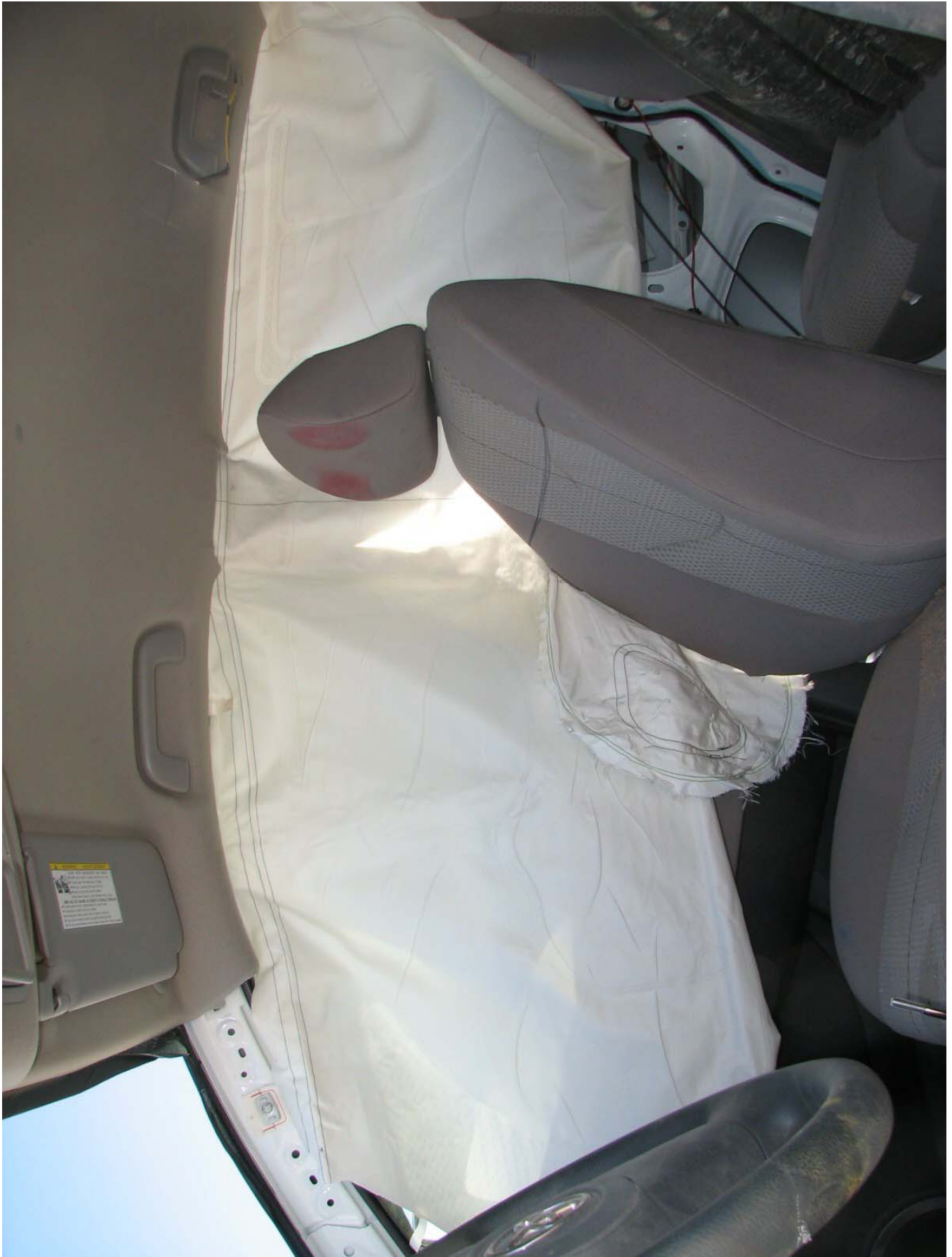


Figure A-9: Post-Test Airbags, Left Side View



Figure A-10: Post-Test Airbags, Close-up View

APPENDIX B

DATA PLOTS

DATA SHEET NO. 5
HYBRID III ATD INJURY CRITERIA AND SENSOR DATA

Test Vehicle: 2006 Toyota Rav4 5-Door MPV

NHTSA No.: M65110TWG2

Test Program: TWG 3.3.3.5

Test Date: 5/7/07

HEAD PEAK ACCELERATIONS

Location	Axis	Units	Pass. (6 Yr.)			
			Max	Time	Min	Time
Head CG	X	G's	11.7	12.0	-12.8	13.2
Head CG	Y	G's	17.1	11.7	-31.9	10.9
Head CG	Z	G's	45.1	11.4	-22.6	14.3
Head CG Resultant	N/A	G's	46.8	11.4		

UPPER NECK PEAK FORCES AND MOMENTS

Location	Axis	Units	Pass. (6 Yr.)			
			Max	Time	Min	Time
Neck Force	X	Newtons	210.5	9.8	-64.6	137.2
Neck Force	Y	Newtons	197.7	12.9	-27.6	331.1
Neck Force	Z	Newtons	106.1	212.3	-976.0	12.9
Neck Force Resultant	N/A	Newtons	998.1	12.9		
Neck Moment	X	Nm	7.8	74.4	-9.6	25.1
Neck Moment	Y	Nm	20.2	9.4	-16.7	30.1
Neck Moment	Z	Nm	8.0	300.6	-3.6	82.2
Neck Moment Resultant	N/A	Nm	20.3	9.4		

DATA SHEET NO. 5...(CONTINUED)Test Vehicle: 2006 Toyota Rav4 5-Door MPVNHTSA No.: M65110TWG2Test Program: TWG 3.3.3.5Test Date: 5/7/07**HEAD INJURY CRITERIA (HIC 15)**

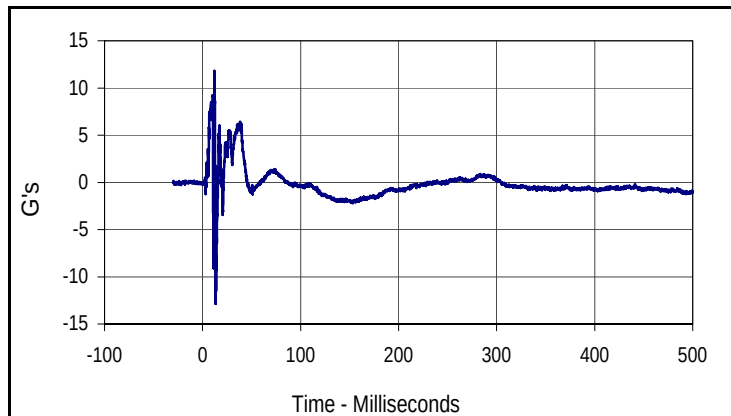
Location	Pass. (6 Yr.)			
	HIC15	T ¹	T ²	Avg G
Head CG	14.3	10.8	15.3	14.4

UPPER NECK NIJ VALUES

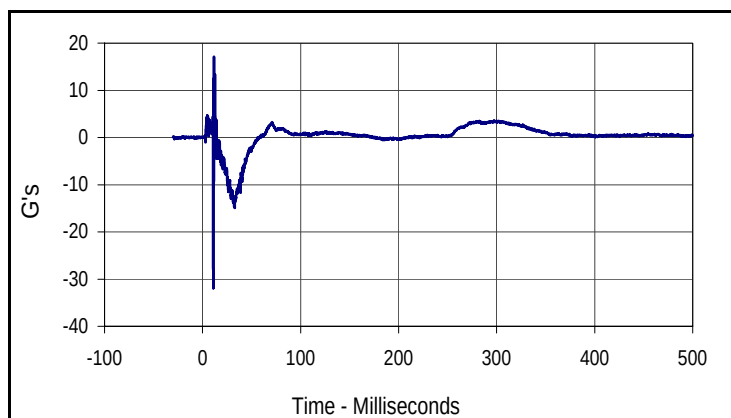
Location	Pass. (6 Yr.)			
	Ntf	Nte	Ncf	Nce
Upper Neck	0.08	0.19	0.41	0.54

Test Vehicle: 2006 Toyota Rav4 5-Door MPV
 Test Program: TWG 3.3.3.5

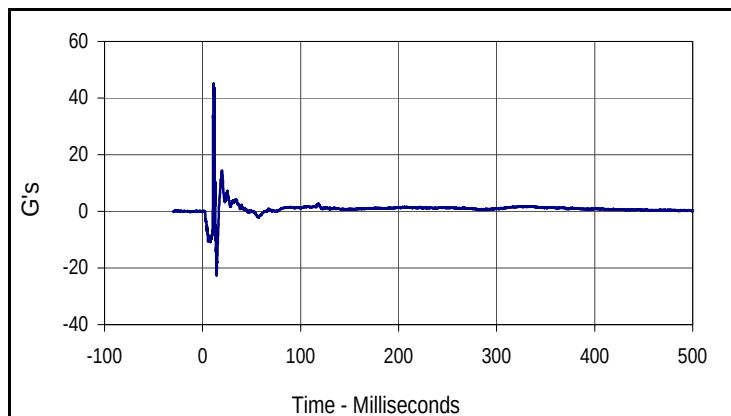
Test Date: 5/7/07
 NHTSA No.: M65110TWG2



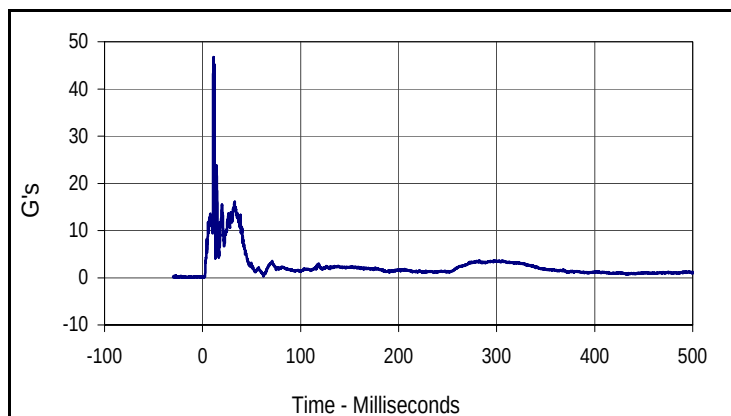
Curve Description			
Pass. (6 Yr.) Head X			
CURNO	Type	SAE Class	Units
001	FIL	1000	G's
Max	Time	Min	Time
11.7	12.0	-12.8	13.2



Curve Description			
Pass. (6 Yr.) Head Y			
CURNO	Type	SAE Class	Units
002	FIL	1000	G's
Max	Time	Min	Time
17.1	11.7	-31.9	10.9



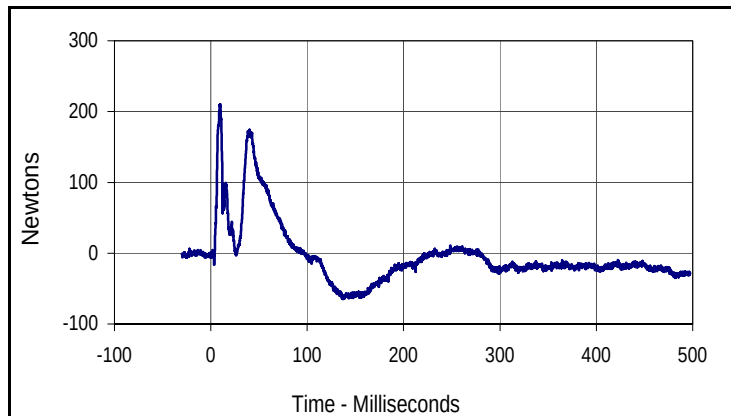
Curve Description			
Pass. (6 Yr.) Head Z			
CURNO	Type	SAE Class	Units
003	FIL	1000	G's
Max	Time	Min	Time
45.1	11.4	-22.6	14.3



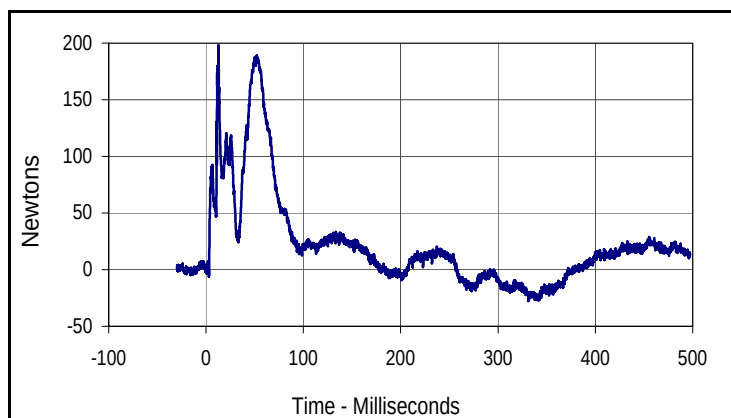
Curve Description			
Pass. (6 Yr.) Head Resultant			
CURNO	Type	SAE Class	Units
001	RES	1000	G's
Max	Time	Min	Time
46.8	11.4	0.1	1.4

Test Vehicle: 2006 Toyota Rav4 5-Door MPV
 Test Program: TWG 3.3.3.5

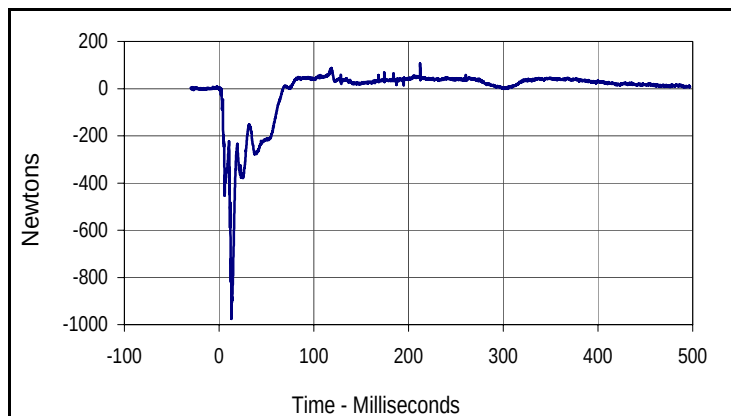
Test Date: 5/7/07
 NHTSA No.: M65110TWG2



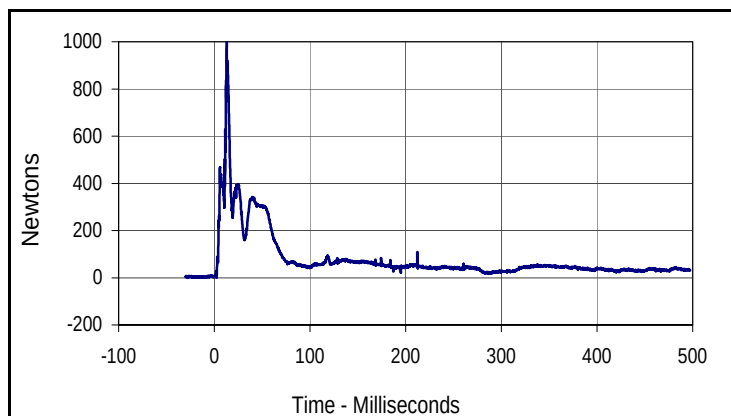
Curve Description			
Pass. (6 Yr.) Upper Neck Force X			
CURNO	Type	SAE Class	Units
001	FIL	1000	Newtons
Max	Time	Min	Time
210.5	9.8	-64.6	137.2



Curve Description			
Pass. (6 Yr.) Upper Neck Force Y			
CURNO	Type	SAE Class	Units
002	FIL	1000	Newtons
Max	Time	Min	Time
197.7	12.9	-27.6	331.1



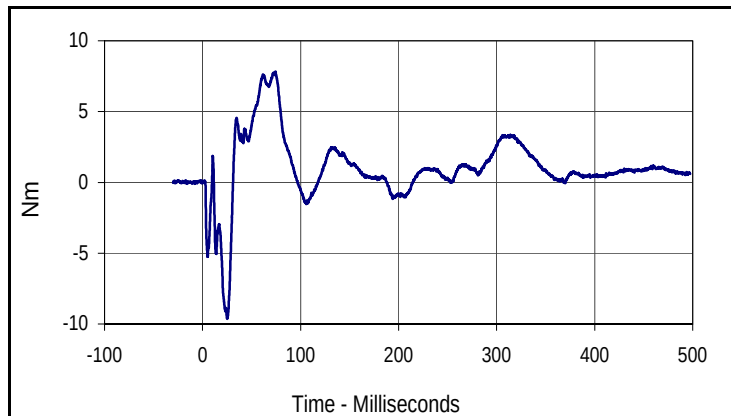
Curve Description			
Pass. (6 Yr.) Upper Neck Force Z			
CURNO	Type	SAE Class	Units
003	FIL	1000	Newtons
Max	Time	Min	Time
106.1	212.3	-976.0	12.9



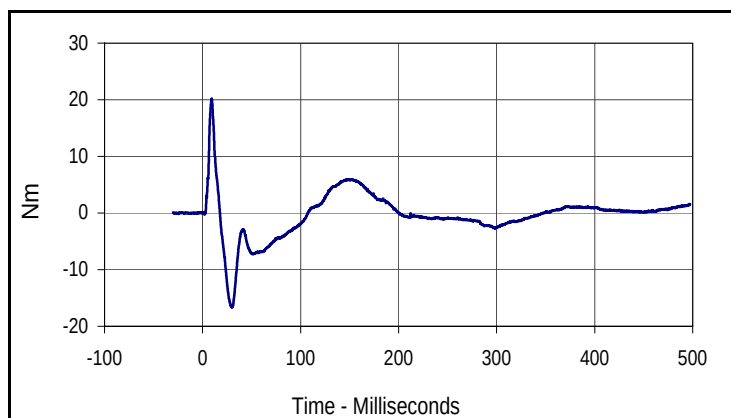
Curve Description			
Pass. (6 Yr.) Upper Neck Force Resultant			
CURNO	Type	SAE Class	Units
001	RES	1000	Newtons
Max	Time	Min	Time
998.1	12.9	0.3	2.4

Test Vehicle: 2006 Toyota Rav4 5-Door MPV
 Test Program: TWG 3.3.3.5

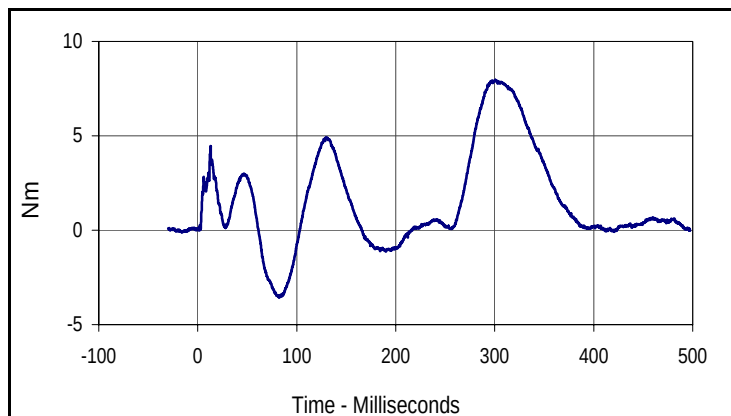
Test Date: 5/7/07
 NHTSA No.: M65110TWG2



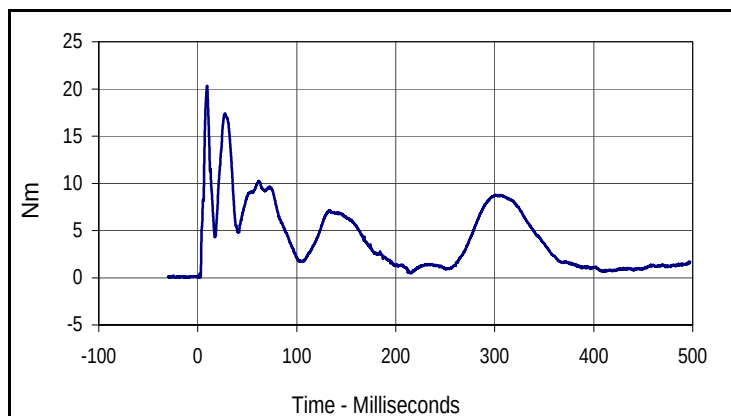
Curve Description			
Pass. (6 Yr.) Upper Neck Moment X			
CURNO	Type	SAE Class	Units
004	FIL	600	Nm
Max	Time	Min	Time
7.8	74.4	-9.6	25.1



Curve Description			
Pass. (6 Yr.) Upper Neck Moment Y			
CURNO	Type	SAE Class	Units
005	FIL	600	Nm
Max	Time	Min	Time
20.2	9.4	-16.7	30.1



Curve Description			
Pass. (6 Yr.) Upper Neck Moment Z			
CURNO	Type	SAE Class	Units
006	FIL	600	Nm
Max	Time	Min	Time
8.0	300.6	-3.6	82.2



Curve Description			
Pass. (6 Yr.) Upper Neck Moment Resultant			
CURNO	Type	SAE Class	Units
004	RES	600	Nm
Max	Time	Min	Time
20.3	9.4	0.0	1.5

APPENDIX C

INSTRUMENTATION DATA CHANNEL ASSIGNMENTS

TWG 3.3.3.5
Instrumentation Data Channel Assignments
A.T.D. Serial Number 144
5/7/07
2006 Toyota Rav4 5-Door MPV

CH.	LOCATION	AXIS	IDENT. NO.	DESCRIPTION	MFR	MODEL	UNITS
1	HEAD	X	J32884	Accel.,full bridge	ENDEVCO	7264-2000	G
2	HEAD	Y	J19925	Accel.,full bridge	ENDEVCO	7264-2000	G
3	HEAD	Z	J35560	Accel.,full bridge	ENDEVCO	7264-2000	G
4	UPPER NECK FORCE	X	810 FX	Load cell, six axis neck	R. A. Denton	IF-234	N
5	UPPER NECK FORCE	Y	810 FY	Load cell, six axis neck	R. A. Denton	IF-234	N
6	UPPER NECK FORCE	Z	810 FZ	Load cell, six axis neck	R. A. Denton	IF-234	N
7	UPPER NECK MOMENT	X	810 MX	Load cell, six axis neck	R. A. Denton	IF-234	Nm
8	UPPER NECK MOMENT	Y	810 MY	Load cell, six axis neck	R. A. Denton	IF-234	Nm
9	UPPER NECK MOMENT	Z	810 MZ	Load cell, six axis neck	R. A. Denton	IF-234	Nm