

REPORT NUMBER: TR-P36147-05-NC

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

**TOYOTA MOTOR CORPORATION
2016 LEXUS ES 350
4-DOOR SEDAN**

NHTSA NUMBER: M20165102TWG2

**PREPARED BY:
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JUNE 7, 2016

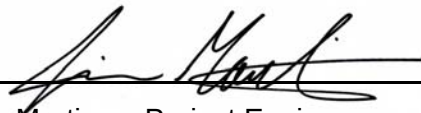
FINAL REPORT

**PREPARED FOR:
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This final test report was prepared for the U.S. Department of Transportation, Alpha Technology Associate, Inc., in response to Contract Number DTNH22-14-D-00355.

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Date of Acceptance

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SECTION 1

PURPOSE AND SUMMARY OF TEST

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 Alpha Technology Associate, Inc. under Contract No. DTNH22-14-D-00355. The purpose of this test was to obtain occupant injury data for a side airbag deployment.

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

SUMMARY

The effects of a roof mounted curtain airbag and a seat mounted torso/pelvis airbag deployment in a 2016 Lexus ES 350 4-door sedan with an out-of-position Hybrid III 6-year old crash test dummy were evaluated. The test was performed at KARCO Engineering, LLC. on May 31, 2016. Pre- and post-test photographs of the vehicle and dummy can be found in Appendix A.

Three (3) high-speed digital cameras and one (1) real time camera were used to document the deployment of the airbags. Camera locations and other pertinent camera information can be found on Data Sheet No.1 and Data Sheet No.6.

A 6-year old anthropomorphic test device (ATD) was placed in the right front passenger seating position facing inboard according to the dummy placement instructions (3.3.5.1) in the July 2003 Revision of the Technical Working Group's 'Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags'.

The 6-year old ATD was instrumented with head tri-axial accelerometers, and upper and lower neck force transducers.

The airbags were deployed and fifteen (15) channels of data were recorded using a data acquisition system. Appendix B contains dummy response data traces. Appendix C contains the instrumentation data channel assignments. Appendix D contains ATD calibration sheets.

Orientation of the 6-year old dummy was with the dummy facing toward the center of the vehicle with its arm against the seatback. The seat track is adjusted forward to minimize the vertical distance between the dummy's head and the roof-rail module and to maximize the airbag to head interaction. The dummy's pelvis is slid outboard until the dummy's back contacts the door trim panel or armrest and the CG of the head is centered in the deployment trajectory of the airbag. This orientation complies with section 3.3.5.1 of the Technical Working Group (TWG) recommendation in the Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags.

The passenger side door remained closed during the test, and was operable after the airbag deployed.

The 6-year old dummy's visible contact points were as follows: The ATD's head contacted the curtain airbag, window, and door panel. The ATD's abdomen contacted the torso/pelvis airbag. The ATD's pelvis contacted the torso/pelvis airbag, and seat. The ATD's left knee contacted the seat.

The occupant data is summarized below:

Measurement Description	Units	Passenger ATD (HIII 6YO)	
		IARV	Result
Head Injury Criteria (HC15)	N/A	723	28.5
Upper Neck Nij	N/A	1	0.77
Upper Neck Peak Tension	Newtons (N)	1490	1518.3
Upper Neck Peak Compression	Newtons (N)	1820	-1452.6

The upper neck peak tension value exceeded its IARV; however, this peak load was an artifact for this test.

SECTION 2

OCCUPANT AND VEHICLE INFORMATION / DATA SHEETS

Test Vehicle: 2016 Lexus ES 350 4-Door Sedan NHTSA No.: M20165102TWG2
Test Program: TWG 3.3.5.1 Test Date: 05/31/16

CONVERSION FACTORS

Quantity	Typical Application	Std Units	Metric Unit	Multiply By
Mass	Vehicle Weight	lb	kg	0.4536
Linear Velocity	Impact Velocity	miles/hr	km/hr	1.609344
Length or Distance	Measurements	in	mm	25.4
Volume	Fuel Systems	gal	liter	3.785
Volume	Small Fluids	oz	mL	29.574
Pressure	Tire Pressures	lb/in ²	kPa	6.895
Temperature	General Use	°F	°C	$=(T_f - 32)/1.8$
Force	Dynamic Forces	lbf	N	4.448
Moment	Torque	lbf-ft	N•m	1.355

DATA SHEET NO. 1**TEST SUMMARY**

Test Vehicle: 2016 Lexus ES 350 4-Door Sedan NHTSA No.: M20165102TWG2
Test Program: TWG 3.3.5.1 Test Date: 05/31/16

TEST DUMMY INFORMATION

Description	Passenger Seat
Dummy Type / Serial No.	6-year old / 186
Head Contact	Curtain Airbag, Window, Door Panel
Chest Contact	None
Abdomen Contact	Torso/Pelvis Airbag
Pelvis Contact	Torso/Pelvis Airbag, Seatback
Left Knee Contact	Seatback
Right Knee Contact	None

VIDEO COVERAGE

Description	Quantity
High Speed Digital	3
Real Time	1
Total	4

DATA CHANNELS

Description	Quantity
Head Accelerometers	3
Upper Neck Transducers	6
Lower Neck Transducers	6
Total	15

DATA SHEET NO. 2

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2016 Lexus ES 350 4-Door Sedan NHTSA No.: M20165102TWG2
 Test Program: TWG 3.3.5.1 Test Date: 05/31/16

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA Number	M20165102
Model Year	2016
Make	Lexus
Model	ES 350
Body Style	4-Door Sedan
VIN	JTHBK1GGXG2211196
Body Color	Silver Lining Met
Odometer Reading (km / mi)	48 / 30
Engine Displacement (L)	3.5
Type / No. of Cylinders	V6
Engine Placement	Transverse
Transmission Type	Automatic
Transmission Speeds	6
Overdrive	Yes
Final Drive	Front
Roof Rack	No
Sunroof / T-Top	Yes
Running Boards	No
Tilt Steering Wheel	Yes
Power Seats	Yes
Anti-Lock Brakes (ABS)	Yes

Traction Control System (TCS)	Yes
Auto-Leveling System	No
Automatic Door Locks	Yes
Power Window Auto-Reverse	Yes
Other Optional Feature	Yes
Driver Front 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
Rear Pass. Curtain Airbag	Yes
Rear Pass. Head/Torso Airbag	No
Rear Pass. Torso Airbag	No
Rear Pass. Torso/Pelvis Airbag	Yes
Rear Pass. Pelvis Airbag	No
Driver Seat Belt Pretensioner	Yes
Rear Pass. Seat Belt Pretensioner	No
Driver Load Limiter	Yes
Rear Pass. Load Limiter	No
Other Safety Restraint	No

Does Owner's Manual provide instructions to turn off automatic door locks?

Yes

DATA FROM CERTIFICATION LABEL

Manufactured By	Toyota Motor Corporation
Date of Manufacture	Jul-15
Vehicle Type	Passenger Car

GVWR (kg)	2132
GAWR Front (kg)	1190
GAWR Rear (kg)	1152

VEHICLE SEATING AND CAPACITY WEIGHT INFORMATION

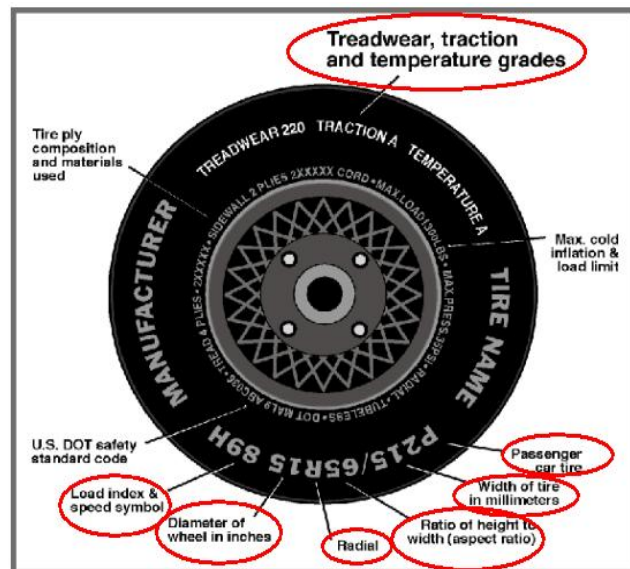
Measured Parameter	Front	Rear	Third	Total	
Type of Seats	Bucket	Bench			
Designated Seating Capacity	2	3		5	
Capacity Weight (VCW) (kg)				410.0	A
DSC x 68.04 (kg)				340.2	B
Cargo Weight (RCLW) (kg)				69.8	A-B

*Vehicle underwent New Car Assessment Program Side MDB Impact Testing on November 10, 2015.

DATA SHEET NO. 2 ... (CONTINUED)

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2016 Lexus ES 350 4-Door Sedan NHTSA No.: M20165102TWG2
 Test Program: TWG 3.3.5.1 Test Date: 05/31/16



VEHICLE TIRE INFORMATION

Measured Parameter	Front	Rear
Max. Tire Pressure (kpa)	350	350
Cold Pressure (kPa)	230	230
Recommended Tire Size	P215/55R17	P215/55R17
Tire Size on Vehicle	P215/55R17	P215/55R17
Tire Manufacturer	Michelin	Michelin
Tire Model	Primacy MXV4	Primacy MXV4
Treadware	500	500
Traction Grade	A	A
Temperature Grade	A	A
Tire Plies Sidewall	1 Polyester	1 Polyester
Tire Plies Body	1 Polyester, 1 Polyamide, 2 Steel	1 Polyester, 1 Polyamide, 2 Steel
Load Index/Speed Symbol	93V	93V
Tire Material	Polyester, Polyamide, Steel	Polyester, Polyamide, Steel
DOT Safety Code Left	M33F 009X 0215	M33F 009X 1115
DOT Safety Code Right	M33F 009X 0215	M33F 009X 1115

DATA SHEET NO. 3

SEAT ADJUSTMENTS

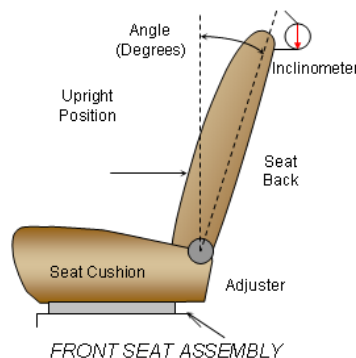
Test Vehicle: 2016 Lexus ES 350 4-Door Sedan NHTSA No.: M20165102TWG2
 Test Program: TWG 3.3.5.1 Test Date: 05/31/16

SEAT BACK ANGLE

The passenger seat back is positioned per section 3.3.5.1 of the TWG recommendation in the Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags.

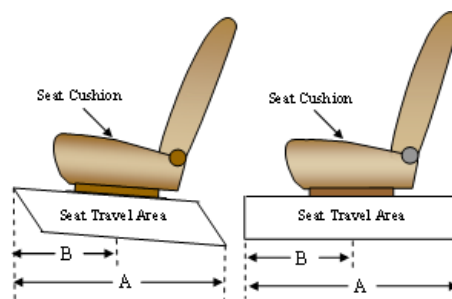
Seat back angle is measured on the head rest post.

Seating Position	Angle
Passenger Seat	5.0



SEAT FORE / AFT POSITIONING

The passenger seat track travel is set per section 3.3.5.1 of the TWG recommendation in the Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags.



Seating Position	Total Fore-Aft Travel		Placed in Position	
	mm	Detents	mm	Detents
Passenger Seat	260		0	

SEAT BELT UPPER ANCHORAGE

The seat belt upper anchorage is positioned to the uppermost position. Position "H" is the uppermost position, followed by position "M1". Position "L" is the lowermost position.

Seating Position	Total No. of Positions	Placed in Position
Passenger Seat	4	H

DATA SHEET NO. 4

DUMMY POSITIONING AND AIRBAG DIMENSIONS

Test Vehicle: 2016 Lexus ES 350 4-Door Sedan NHTSA No.: M20165102TWG2
 Test Program: TWG 3.3.5.1 Test Date: 05/31/16

DUMMY POSITIONING

Code	Measurement Description	Passenger	
		Length (mm)	Angle (°)
SA	Seat Back Angle		5.0
AN	Top of Airbag Module to Head/Neck Junction	265	
HD	Head CG to Door Panel/ Window	125	0.0
HSC	Head to Seat Back Centerline	266	0.0
HB	Head to B-Pillar	362	0.0
HZ	Head to Roof (Z)	164	90.0
HHD	Head to Side Header	222	90.0
ND	Nose to Dash	464	29.3
NS	Nose to Seat Back	329	0.0
NR	Nose to Header	229	57.9
CD	Chest to Dash	375	11.3
CS	Chest to Seat Back	242	0.0
RACL	Right Arm to Seat Back Centerline	240	0.0
LACL	Left Arm to Seat Back Centerline	240	0.0
RA	Right Arm to Door Panel	137	0.0
LA	Left Arm to Door Panel	147	0.0
KK	Knee to Knee	100	0.0
TT	Toe to Toe	86	0.0
KSCR	Right Knee to Seat Cushion Centerline	105	0.0
KSCL	Left Knee to Seat Cushion Centerline	105	0.0
	Head Level (X Direction)		4.4
	Head Level (Y Direction)		2.1

AIRBAG DIMENSIONS

Code	Measurement Description	Airbag
		Length (mm)
AMW	Curtain Airbag Module Diameter	30
AML	Curtain Airbag Module Length	360
ABW	Curtain Airbag Width	545
ABL	Curtain Airbag Length	1829
AMW	Torso/Pelvis Airbag Module Diameter	25
AML	Torso/Pelvis Airbag Module Length	183
ABW	Torso/Pelvis Airbag Width	240
ABL	Torso/Pelvis Airbag Length	575

DATA SHEET NO. 5

DUMMY INJURY CRITERIA AND PERFORMANCE DATA

Test Vehicle: 2016 Lexus ES 350 4-Door Sedan NHTSA No.: M20165102TWG2
 Test Program: TWG 3.3.5.1 Test Date: 05/31/16

HEAD PEAK ACCELERATIONS

Location	Axis	Units	6 Yr. Old			
			Max	Time	Min	Time
Head CG	X	g	28.2	78.2	-13.1	10.0
Head CG	Y	g	13.3	21.1	-10.6	53.6
Head CG	Z	g	37.2	10.0	-20.0	80.3
Head CG Resultant	N/A	g	40.5	10.0		

UPPER NECK PEAK FORCES AND MOMENTS

Location	Axis	Units	6 Yr. Old			
			Max	Time	Min	Time
Neck Force	X	N	527.1	78.4	-100.3	42.4
Neck Force	Y	N	160.4	41.0	-115.5	29.4
Neck Force	Z	N	1518.3	77.9	-1452.6	41.7
Neck Force Resultant	N/A	N	1604.0	77.9		
Neck Moment	X	Nm	22.1	30.7	-12.7	82.4
Neck Moment	Y	Nm	40.4	79.2	-1.1	6.7
Neck Moment	Z	Nm	8.6	58.7	-1.9	121.4
Neck Moment Resultant	N/A	Nm	42.6	82.7		

LOWER NECK PEAK FORCES AND MOMENTS

Location	Axis	Units	6 Yr. Old			
			Max	Time	Min	Time
Neck Force	X	N	150.0	17.1	-329.8	76.2
Neck Force	Y	N	210.0	78.6	-156.8	52.1
Neck Force	Z	N	1279.4	77.8	-1192.7	41.4
Neck Force Resultant	N/A	N	1314.5	77.8		
Neck Moment	X	Nm	15.1	77.2	-5.5	97.6
Neck Moment	Y	Nm	46.3	42.1	-44.7	78.4
Neck Moment	Z	Nm	10.5	77.4	-5.1	30.8
Neck Moment Resultant	N/A	Nm	48.2	78.4		

HEAD INJURY CRITERIA (HIC 15)

Location	6 Yr. Old			
	HIC15	T1	T2	Avg G
Head CG	28.5	73.8	87.5	21.2

UPPER NECK NIJ VALUES

Location	6 Yr. Old			
	Ntf	Nte	Ncf	Nce
Upper Neck	0.84	0.00	0.77	0.06

DATA SHEET NO. 6**HIGH SPEED CAMERA LOCATIONS AND DATA**Test Vehicle: 2016 Lexus ES 350 4-Door Sedan NHTSA No.: M20165102TWG2Test Program: TWG 3.3.5.1 Test Date: 05/31/16**CAMERA LOCATIONS**

No.	Camera View	Location (mm)			Angle (Deg.)	Lens (mm)	Speed (fps)
		X	Y	Z			
1	High Speed Side View	0	-2716	-860	-0.2	24	1000
2	High Speed 3/4 View	1940	-1645	-1430	9.5	50	1000
3	High Speed Front View	2255	-461	-1435	7.1	50	1000
4	Real Time	0	-2740	-935	-0.2	Zoom	30

Coordinates: +X = forward of vehicle relative to dummy's head CG

+Y = right of vehicle relative to dummy's head CG

+Z = into ground

APPENDIX A
PHOTOGRAPHS

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FIGURE 1. Right Front ¾ View, As Received



FIGURE 2. Vehicle Certification Label



FIGURE 3. Post-Test Left Front 3/4 View of NCAP Side MDB Impact Test



FIGURE 4. Post-Test Left Side View of NCAP Side MDB Impact Test



FIGURE 5. Post-Test Left Rear ¾ View of NCAP Side MDB Impact Test



FIGURE 6. Post-Test Right Side View of NCAP Side MDB Impact Test



FIGURE 7. Pre-Test Dummy Position, Left View



FIGURE 8. Post-Test Dummy Position, Left View



FIGURE 9. Pre-Test Dummy Position, $\frac{3}{4}$ View



FIGURE 10. Post-Test Dummy Position, $\frac{3}{4}$ View



FIGURE 11. Pre-Test Dummy Position, Front View



FIGURE 12. Post-Test Dummy Position, Front View



FIGURE 13. Pre-Test Dummy Position, Close-Up Front View



FIGURE 14. Post-Test Dummy Position, Close-Up Front View



FIGURE 15. Pre-Test Dummy Position, Close-Up Rear View



FIGURE 16. Post-Test Dummy Position, Close-Up Rear View



FIGURE 17. Post-Test Airbags, Left Side View



FIGURE 18. Post-Test Airbags, Left Front $\frac{3}{4}$ View

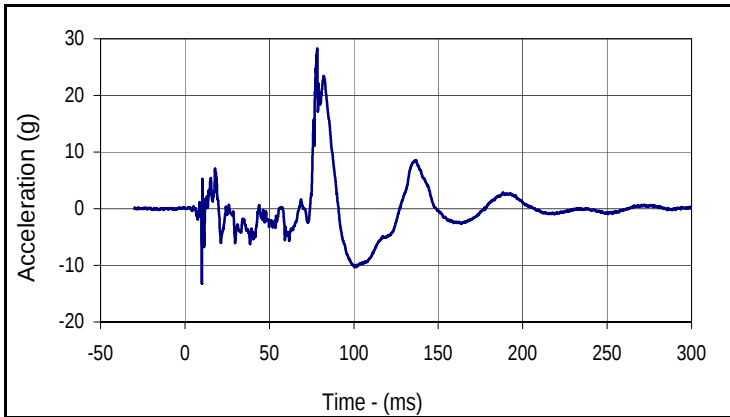
APPENDIX B
DUMMY RESPONSE DATA TRACES

TABLE OF DATA PLOTS

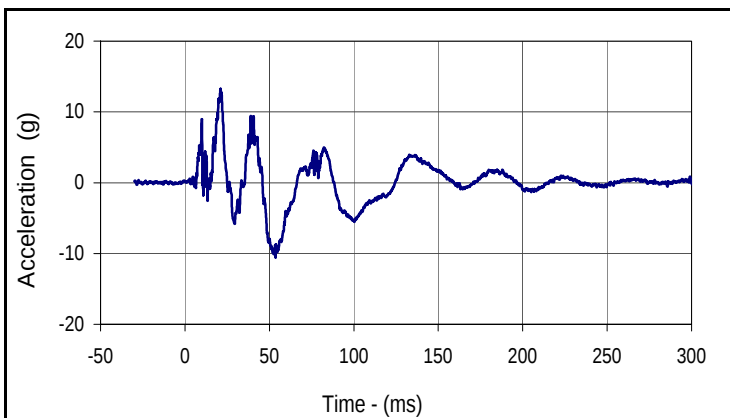
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1	6 Yr. Old Head Acceleration X Primary	B-1
2	6 Yr. Old Head Acceleration Y Primary	B-1
3	6 Yr. Old Head Acceleration Z Primary	B-1
4	6 Yr. Old Head Acceleration Primary Resultant	B-1
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Test Vehicle: 2016 Lexus ES 350 4-Door Sedan
 Test Program: TWG 3.3.5.1

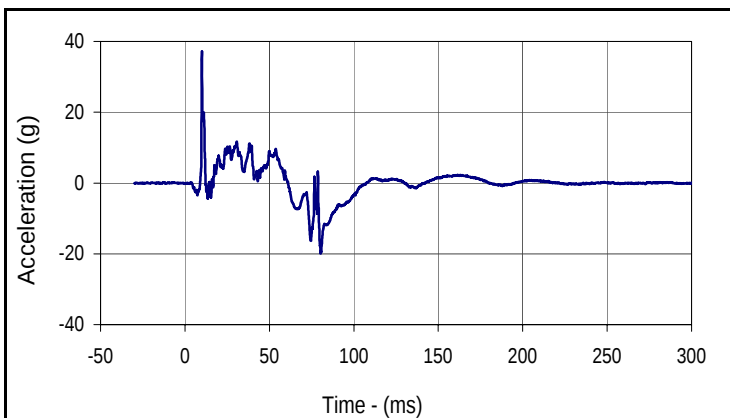
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 NHTSA No.: M20165102TWG2



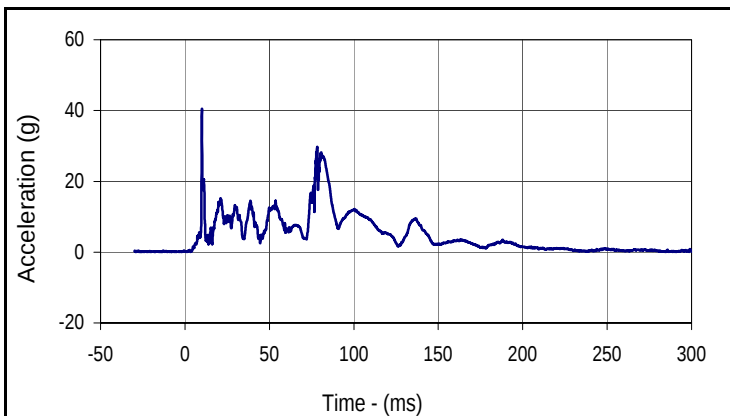
Curve Description			
6 Yr. Old Head Acceleration X			
Plot No.	Type	SAE Class	Units
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Max	Time	Min	Time
28.2	78.2	-13.1	10.0



Curve Description			
6 Yr. Old Head Acceleration Y			
Plot No.	Type	SAE Class	Units
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Max	Time	Min	Time
13.3	21.1	-10.6	53.6



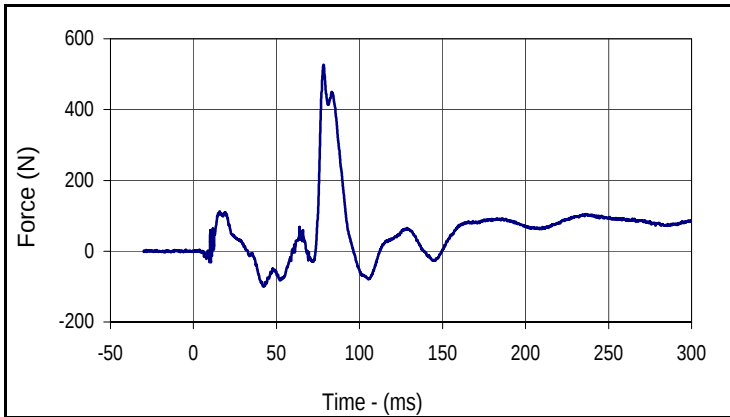
Curve Description			
6 Yr. Old Head Acceleration Z			
Plot No.	Type	SAE Class	Units
003	FIL	1000	g
Max	Time	Min	Time
37.2	10.0	-20.0	80.3



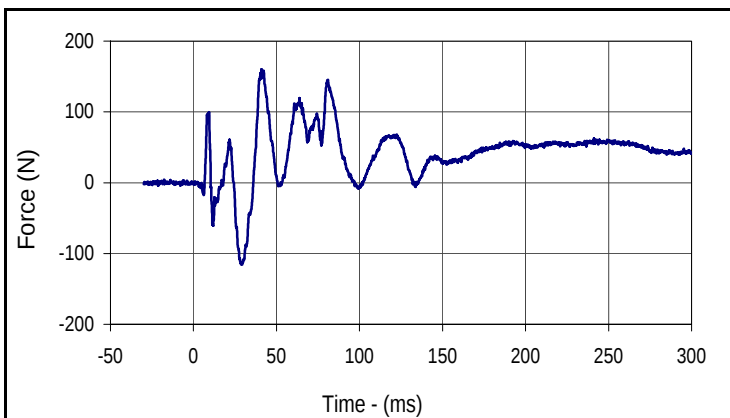
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6 Yr. Old Head Acceleration Resultant			
Plot No.	Type	SAE Class	Units
004	RES	1000	g
Max	Time	Min	Time
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Test Vehicle: 2016 Lexus ES 350 4-Door Sedan
 Test Program: TWG 3.3.5.1

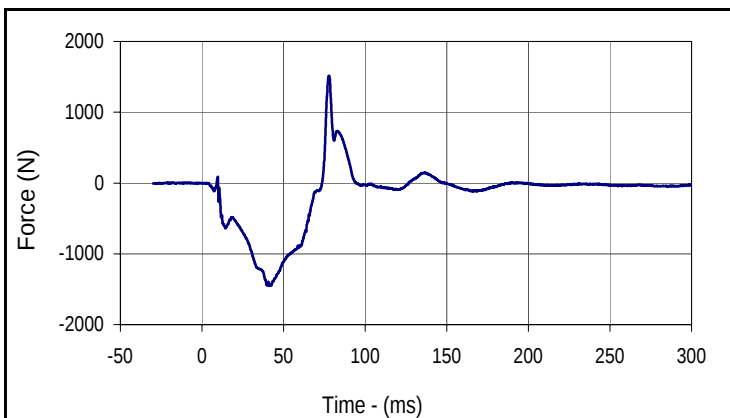
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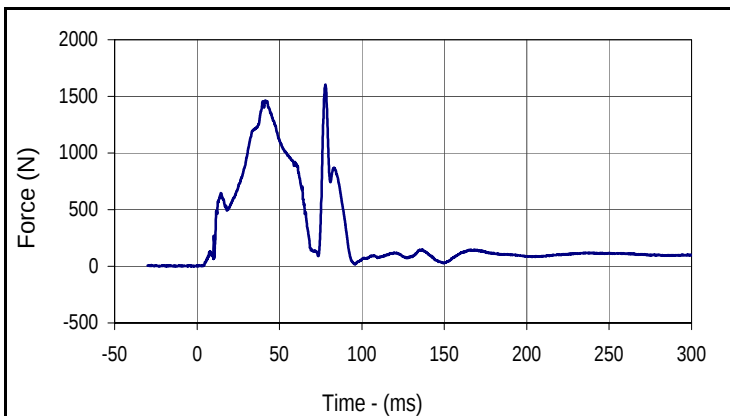
Curve Description			
6 Yr. Old Upper Neck Force X			
Plot No.	Type	SAE Class	Units
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Max	Time	Min	Time
527.1	78.4	-100.3	42.4



Curve Description			
6 Yr. Old Upper Neck Force Y			
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Max	Time	Min	Time
160.4	41.0	-115.5	29.4



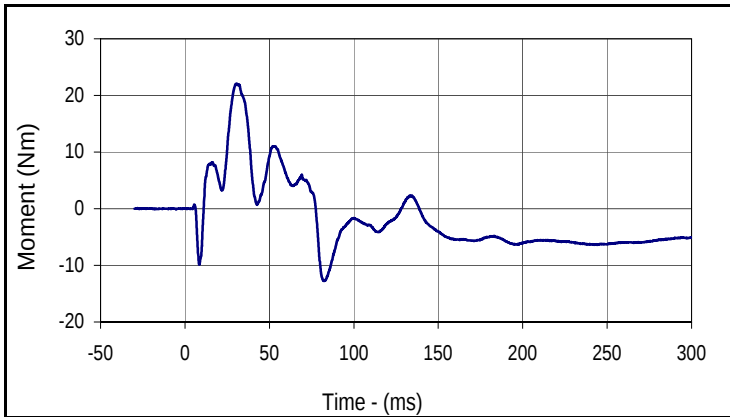
Curve Description			
6 Yr. Old Upper Neck Force Z			
Plot No.	Type	SAE Class	Units
007	FIL	1000	N
Max	Time	Min	Time
1518.3	77.9	-1452.6	41.7



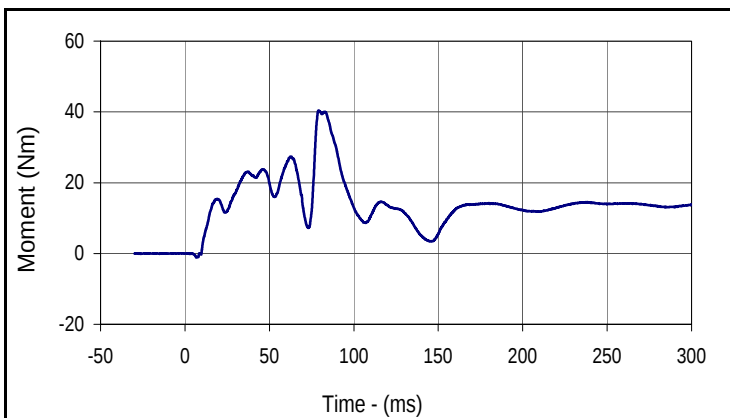
Curve Description			
6 Yr. Old Upper Neck Force Resultant			
Plot No.	Type	SAE Class	Units
008	RES	1000	N
Max	Time	Min	Time
1604.0	77.9	0.8	2.9

Test Vehicle: 2016 Lexus ES 350 4-Door Sedan
 Test Program: TWG 3.3.5.1

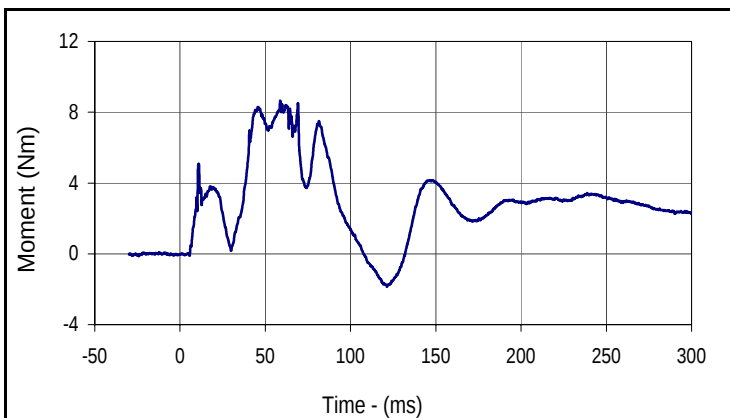
Test Date: 5/31/16
 NHTSA No.: M20165102TWG2



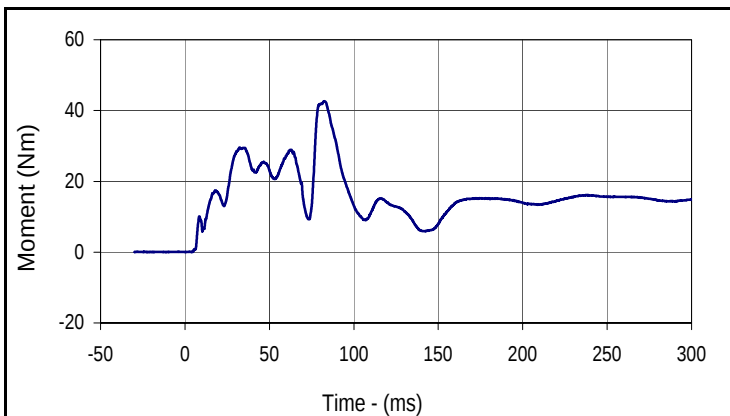
Curve Description			
6 Yr. Old Upper Neck Moment X			
Plot No.	Type	SAE Class	Units
009	FIL	600	Nm
Max	Time	Min	Time
22.1	30.7	-12.7	82.4



Curve Description			
6 Yr. Old Upper Neck Moment Y			
Plot No.	Type	SAE Class	Units
010	FIL	600	Nm
Max	Time	Min	Time
40.4	79.2	-1.1	6.7



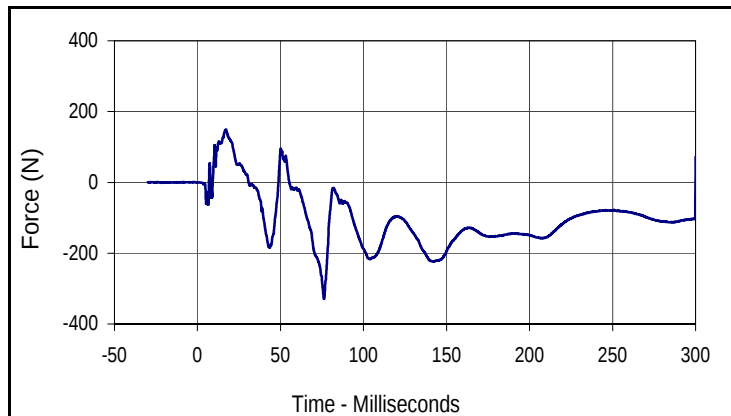
Curve Description			
6 Yr. Old Upper Neck Moment Z			
Plot No.	Type	SAE Class	Units
011	FIL	600	Nm
Max	Time	Min	Time
8.6	58.7	-1.9	121.4



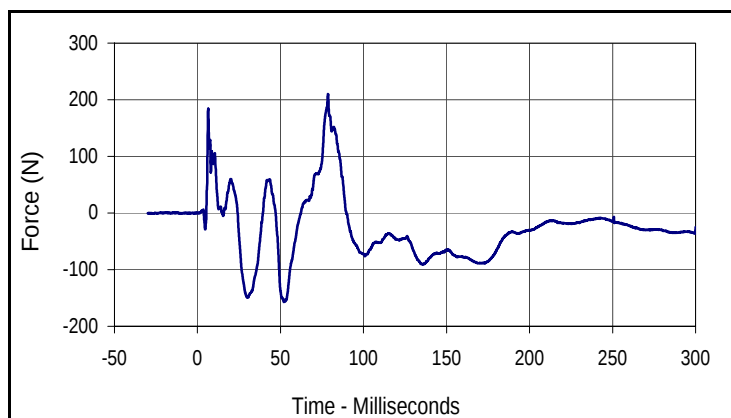
Curve Description			
6 Yr. Old Upper Neck Moment Resultant			
Plot No.	Type	SAE Class	Units
012	RES	600	Nm
Max	Time	Min	Time
42.6	82.7	0.0	4.1

Test Vehicle: 2016 Lexus ES 350 4-Door Sedan
 Test Program: TWG 3.3.5.1

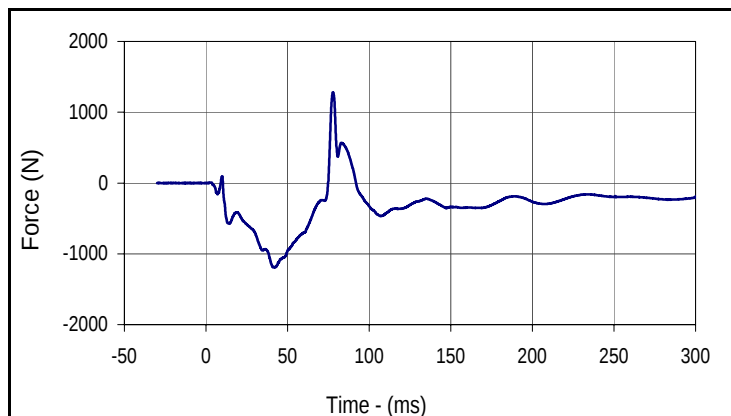
Test Date: 5/31/16
 NHTSA No.: M20165102TWG2



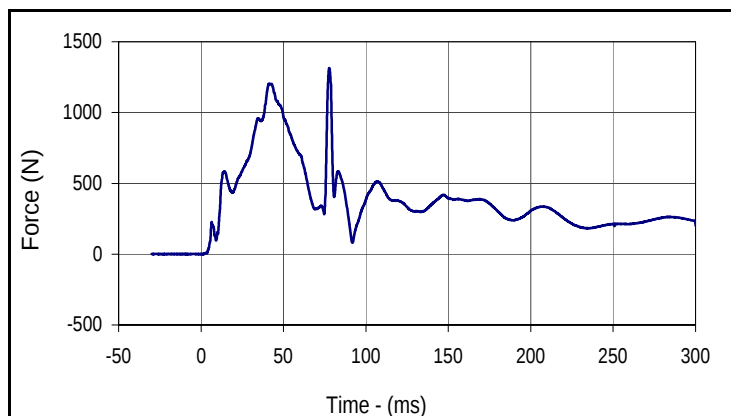
Curve Description			
6 Yr. Old Lower Neck Force X			
Plot No.	Type	SAE Class	Units
013	FIL	1000	N
Max	Time	Min	Time
150.0	17.1	-329.8	76.2



Curve Description			
6 Yr. Old Lower Neck Force Y			
Plot No.	Type	SAE Class	Units
014	FIL	1000	N
Max	Time	Min	Time
210.0	78.6	-156.8	52.1



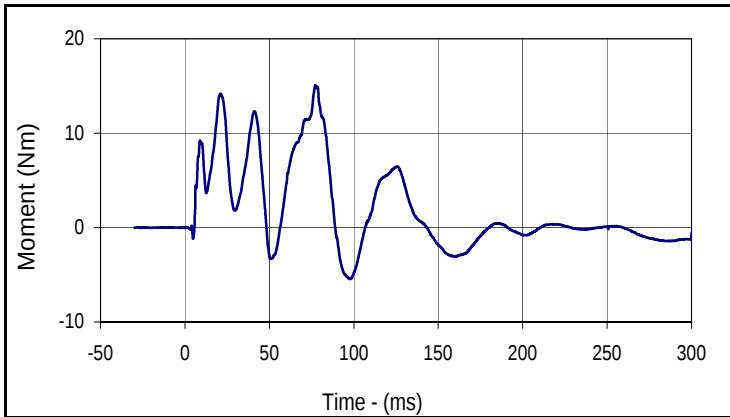
Curve Description			
6 Yr. Old Lower Neck Force Z			
Plot No.	Type	SAE Class	Units
015	FIL	1000	N
Max	Time	Min	Time
1279.4	77.8	-1192.7	41.4



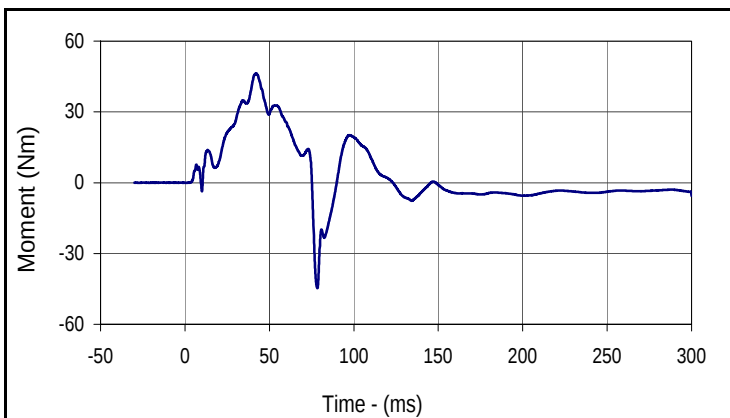
Curve Description			
6 Yr. Old Lower Neck Force Resultant			
Plot No.	Type	SAE Class	Units
016	RES	1000	N
Max	Time	Min	Time
1314.5	77.8	0.3	0.3

Test Vehicle: 2016 Lexus ES 350 4-Door Sedan
 Test Program: TWG 3.3.5.1

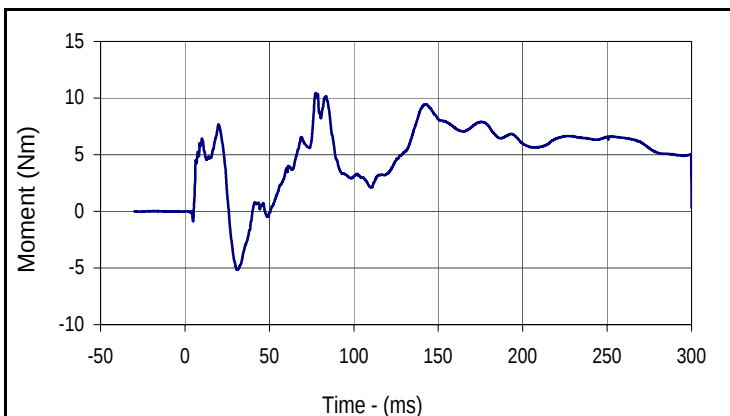
Test Date: 5/31/16
 NHTSA No.: M20165102TWG2



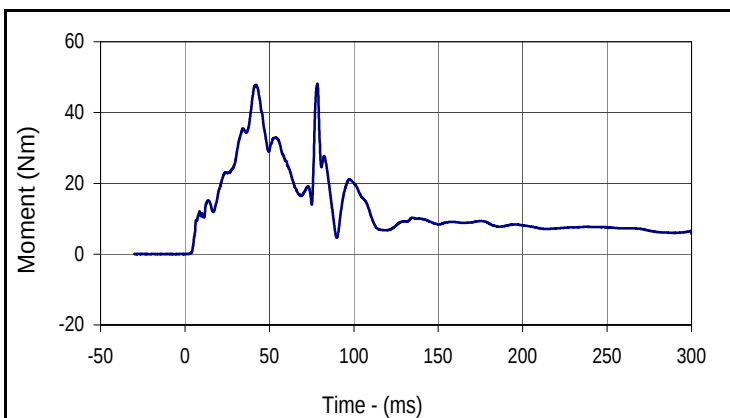
Curve Description			
6 Yr. Old Lower Neck Moment X			
Plot No.	Type	SAE Class	Units
017	FIL	600	Nm
Max	Time	Min	Time
15.1	77.2	-5.5	97.6



Curve Description			
6 Yr. Old Lower Neck Moment Y			
Plot No.	Type	SAE Class	Units
018	FIL	600	Nm
Max	Time	Min	Time
46.3	42.1	-44.7	78.4



Curve Description			
6 Yr. Old Lower Neck Moment Z			
Plot No.	Type	SAE Class	Units
019	FIL	600	Nm
Max	Time	Min	Time
10.5	77.4	-5.1	30.8



Curve Description			
6 Yr. Old Lower Neck Moment Resultant			
Plot No.	Type	SAE Class	Units
020	RES	600	Nm
Max	Time	Min	Time
48.2	78.4	0.0	1.6

APPENDIX C
INSTRUMENTATION DATA CHANNEL ASSIGNMENTS

TWG 3.3.5.1
Instrumentation Data Channel Assignments
A.T.D. Serial Number 186
5/31/16
2016 Lexus ES 350 4-Door Sedan

CH.	LOCATION	AXIS	IDENT. NO.	DESCRIPTION	MFR	MODEL	UNITS
1	HEAD	X	J34330	Accel.,full bridge	Endevco	7264-2000	G
2	HEAD	Y	P15334	Accel.,full bridge	Endevco	7264C-2000	G
3	HEAD	Z	ACCW9	Accel.,full bridge	Endevco	7264-2000	G
4	UPPER NECK FORCE	X	2189	Load cell, six axis neck	R. A. Denton	1716A	N
5	UPPER NECK FORCE	Y	2189	Load cell, six axis neck	R. A. Denton	1716A	N
6	UPPER NECK FORCE	Z	2189	Load cell, six axis neck	R. A. Denton	1716A	N
7	UPPER NECK MOMENT	X	2189	Load cell, six axis neck	R. A. Denton	1716A	Nm
8	UPPER NECK MOMENT	Y	2189	Load cell, six axis neck	R. A. Denton	1716A	Nm
9	UPPER NECK MOMENT	Z	2189	Load cell, six axis neck	R. A. Denton	1716A	Nm
10	LOWER NECK FORCE	X	180	Load cell, six axis neck	R. A. Denton	2430	N
11	LOWER NECK FORCE	Y	180	Load cell, six axis neck	R. A. Denton	2430	N
12	LOWER NECK FORCE	Z	180	Load cell, six axis neck	R. A. Denton	2430	N
13	LOWER NECK MOMENT	X	180	Load cell, six axis neck	R. A. Denton	2430	Nm
14	LOWER NECK MOMENT	Y	180	Load cell, six axis neck	R. A. Denton	2430	Nm
15	LOWER NECK MOMENT	Z	180	Load cell, six axis neck	R. A. Denton	2430	Nm

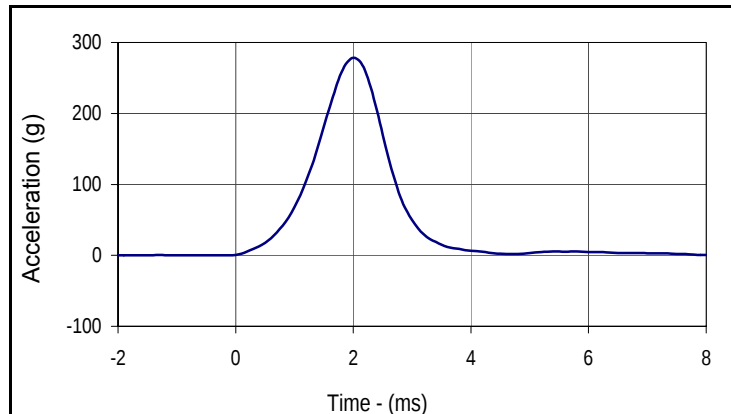
APPENDIX D
PRE-TEST / HIII CONFIGURATION AND PERFORMANCE VERIFICATION DATA

Test Program: Hybrid III 6 Yr Old Head Drop Test
 ATD Serial No.: 186

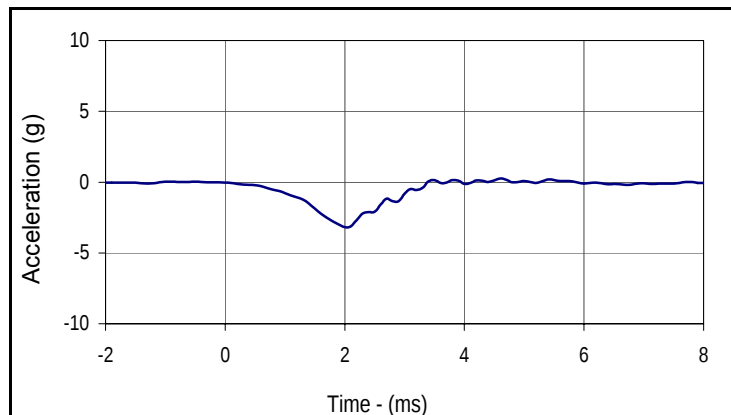
Test Date: 5/17/16
 Test I.D.: HDM20165102TWG2



Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	°C	18.9 to 25.6	21.5	Pass
Laboratory Relative Humidity	%	10 to 70	30	Pass
Peak Resultant Acceleration	g	245.0 to 300.0	278.2	Pass
Peak Lateral Acceleration	g	≤15.0	3.2	Pass
Is Acceleration Unimodal?	Yes/No	Yes	Yes	Pass
Overall Test Results				Pass



Curve Description			
Head Resultant			
CURNO	Type	SAE Class	Units
001	RES	1000	g
Max	Time	Min	Time
278.2	2.0	0.1	-0.5



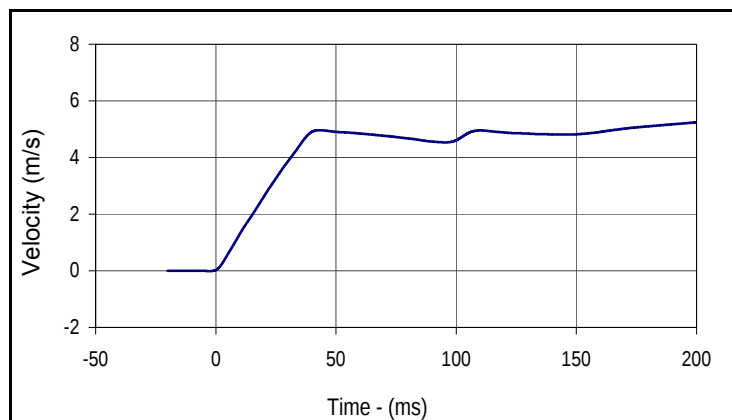
Curve Description			
Head Y			
CURNO	Type	SAE Class	Units
002	FIL	1000	g
Max	Time	Min	Time
0.3	4.6	-3.2	2.0

Test Program: Hybrid III 6 Yr Old Neck Flexion Test
 ATD Serial No.: 186

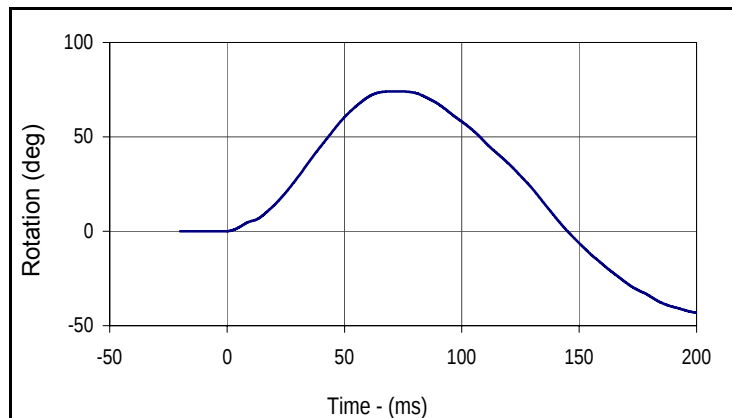
Test Date: 5/17/16
 Test I.D.: NFM20165102TWG2



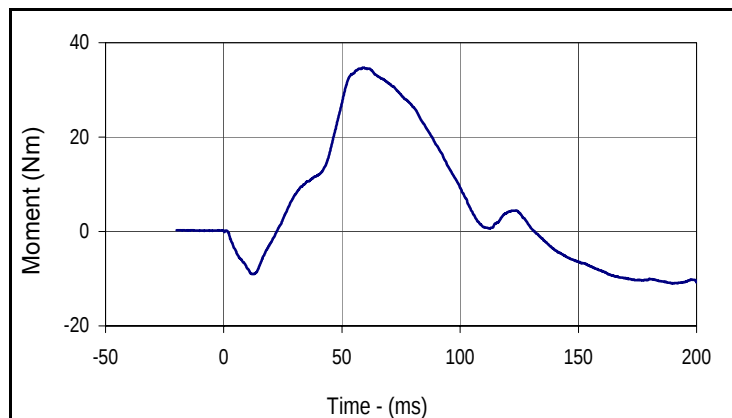
Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		°C	20.6 to 22.2	21.3	Pass
Laboratory Relative Humidity		%	10 to 70	31	Pass
Pendulum Velocity		m/s	4.83 to 5.07	4.85	Pass
Pendulum Deceleration	10 Msec.	m/s	1.2 to 1.6	1.3	Pass
	20 Msec.	m/s	2.4 to 3.4	2.6	Pass
	30 Msec.	m/s	3.8 to 5.0	3.9	Pass
"D" Plane Rotation	Max	deg	74.0 to 92.0	74.1	Pass
Peak Moment in Rotation	Max	Nm	27.0 to 33.0	32.1	Pass
Positive Moment Decay, Time To 5 Nm		ms	103.0 to 123.0	104.3	Pass
			Overall Test Results		Pass



Curve Description			
Pendulum Velocity			
CURNO	Type	SAE Class	Units
001	FIL	180	m/s
Max	Time	Min	Time
5.2	199.9	0.0	-2.3



Curve Description			
"D" Plane Rotation			
CURNO	Type	SAE Class	Units
002	FIL	60	deg
Max	Time	Min	Time
74.1	73.0	-43.1	199.9



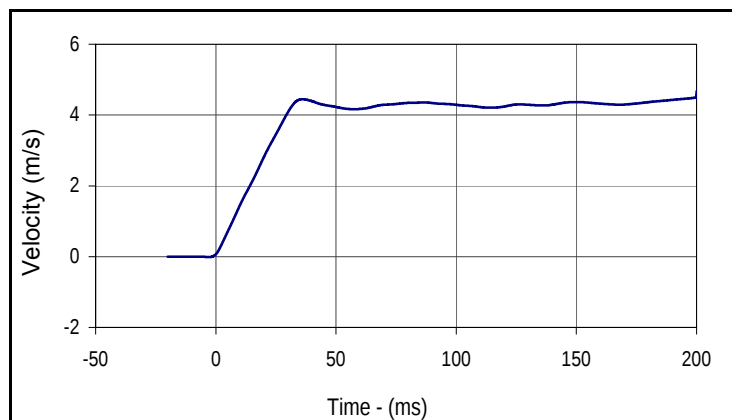
Curve Description			
Moment About Occipital Condyle			
CURNO	Type	SAE Class	Units
003	FIL	600	Nm
Max	Time	Min	Time
34.7	58.9	-11.0	190.2

Test Program: Hybrid III 6 Yr Old Neck Extension Test
 ATD Serial No.: 186

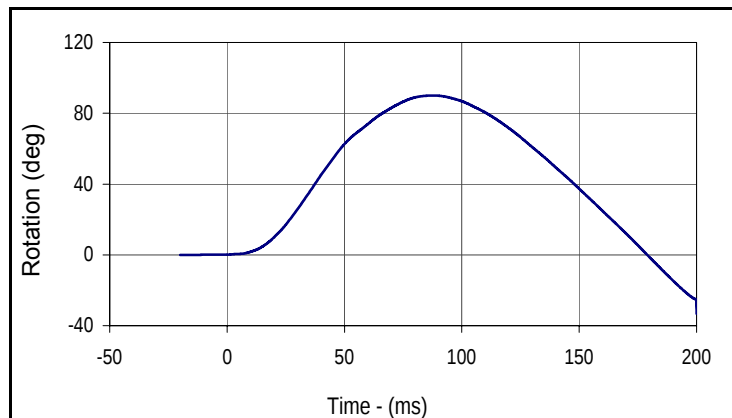
Test Date: 5/17/16
 Test I.D.: NEM20165102TWG2



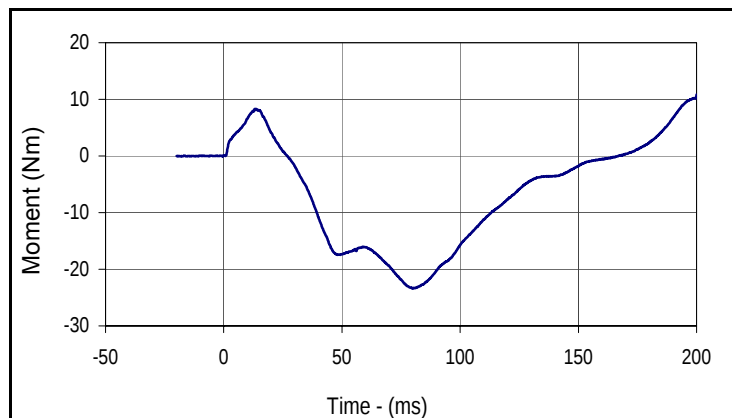
Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		°C	20.6 to 22.2	21.3	Pass
Laboratory Relative Humidity		%	10 to 70	29	Pass
Pendulum Velocity		m/s	4.18 to 4.42	4.32	Pass
Pendulum Deceleration	10 Msec.	m/s	1.0 to 1.4	1.4	Pass
	20 Msec.	m/s	2.2 to 3.0	2.8	Pass
	30 Msec.	m/s	3.2 to 4.2	4.1	Pass
"D" Plane Rotation	Max	deg	85.0 to 103.0	90.0	Pass
Peak Moment in Rotation	Max	Nm	-24.0 to -19.0	-23.4	Pass
Positive Moment Decay, Time To -5 Nm		ms	123.0 to 147.0	127.2	Pass
			Overall Test Results		Pass



Curve Description			
Pendulum Velocity			
CURNO	Type	SAE Class	Units
001	FIL	180	m/s
Max	Time	Min	Time
4.7	200.0	0.0	-2.8



Curve Description			
"D" Plane Rotation			
CURNO	Type	SAE Class	Units
002	FIL	60	deg
Max	Time	Min	Time
90.0	87.8	-33.3	200.0



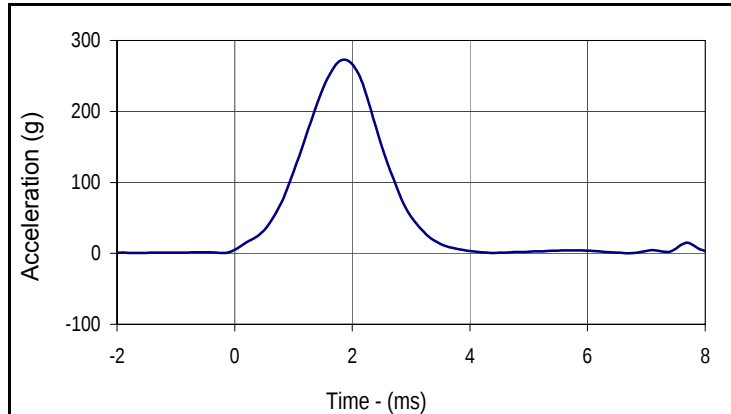
Curve Description			
Moment About Occipital Condyle			
CURNO	Type	SAE Class	Units
003	FIL	600	Nm
Max	Time	Min	Time
10.8	200.0	-23.4	80.0

Test Program: Hybrid III 6 Yr Old Head Drop Test
 ATD Serial No.: 186

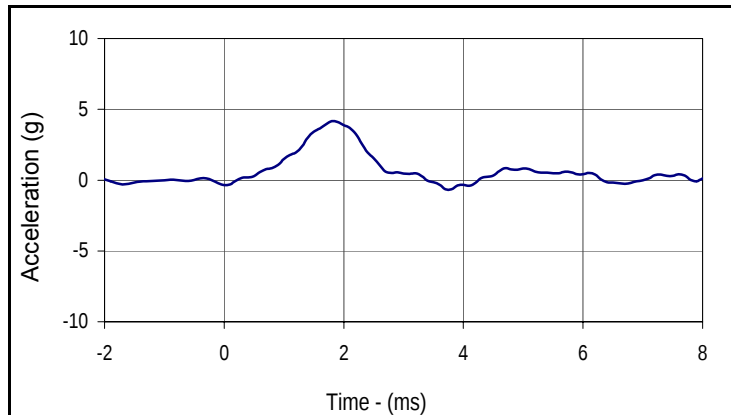
Test Date: 6/7/16
 Test I.D.: HDM20165102TWG2-02



Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	°C	18.9 to 25.6	21.2	Pass
Laboratory Relative Humidity	%	10 to 70	29	Pass
Peak Resultant Acceleration	g	245.0 to 300.0	272.5	Pass
Peak Lateral Acceleration	g	≤15.0	4.2	Pass
Is Acceleration Unimodal?	Yes/No	Yes	Yes	Pass
Overall Test Results				Pass



Curve Description			
Head Resultant			
CURNO	Type	SAE Class	Units
001	RES	1000	g
Max	Time	Min	Time
272.5	1.9	0.4	-0.2



Curve Description			
Head Y			
CURNO	Type	SAE Class	Units
002	FIL	1000	g
Max	Time	Min	Time
4.2	1.8	-0.6	3.8

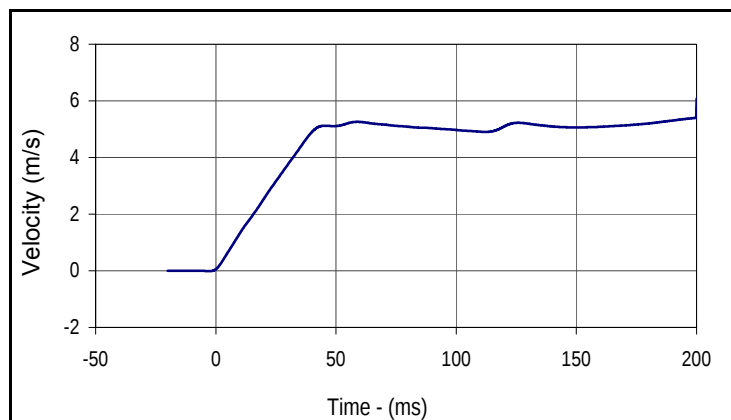
APPENDIX D
POST-TEST / HIII CONFIGURATION AND PERFORMANCE VERIFICATION DATA

Test Program: Hybrid III 6 Yr Old Neck Flexion Test
 ATD Serial No.: 186

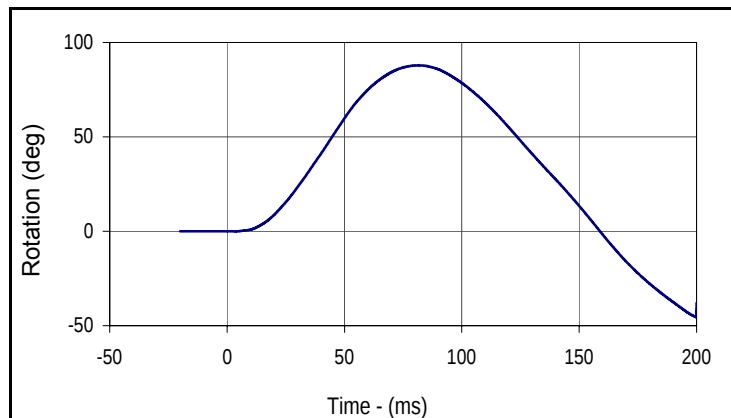
Test Date: 6/7/16
 Test I.D.: NFM20165102TWG2-02



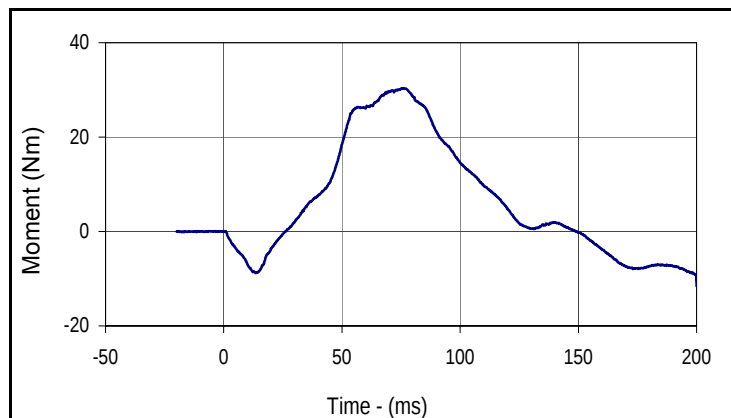
Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		°C	20.6 to 22.2	21.2	Pass
Laboratory Relative Humidity		%	10 to 70	28	Pass
Pendulum Velocity		m/s	4.83 to 5.07	4.86	Pass
Pendulum Deceleration	10 Msec.	m/s	1.2 to 1.6	1.3	Pass
	20 Msec.	m/s	2.4 to 3.4	2.5	Pass
	30 Msec.	m/s	3.8 to 5.0	3.8	Pass
"D" Plane Rotation	Max	deg	74.0 to 92.0	87.9	Pass
Peak Moment in Rotation	Max	Nm	27.0 to 33.0	30.3	Pass
Positive Moment Decay, Time To 5 Nm		ms	103.0 to 123.0	119.8	Pass
			Overall Test Results		Pass



Curve Description			
Pendulum Velocity			
CURNO	Type	SAE Class	Units
001	FIL	180	m/s
Max	Time	Min	Time
6.1	200.0	0.0	-2.7



Curve Description			
"D" Plane Rotation			
CURNO	Type	SAE Class	Units
002	FIL	60	deg
Max	Time	Min	Time
87.9	81.8	-45.5	199.9



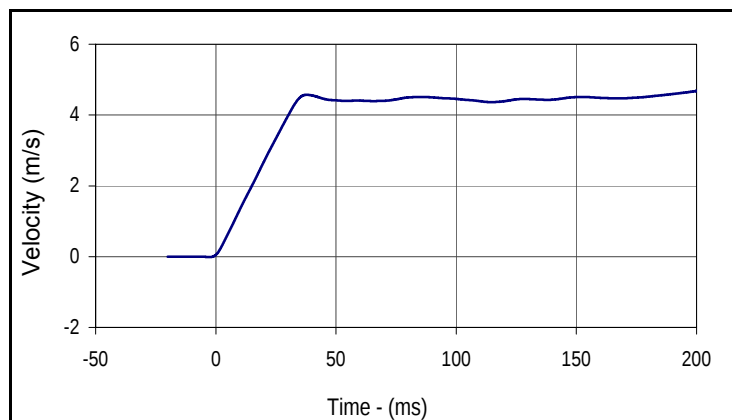
Curve Description			
Moment About Occipital Condyle			
CURNO	Type	SAE Class	Units
003	FIL	600	Nm
Max	Time	Min	Time
30.3	75.5	-11.6	200.0

Test Program: Hybrid III 6 Yr Old Neck Extension Test
 ATD Serial No.: 186

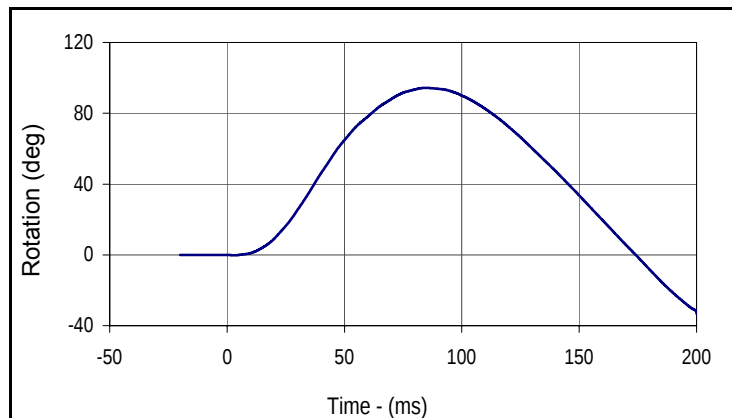
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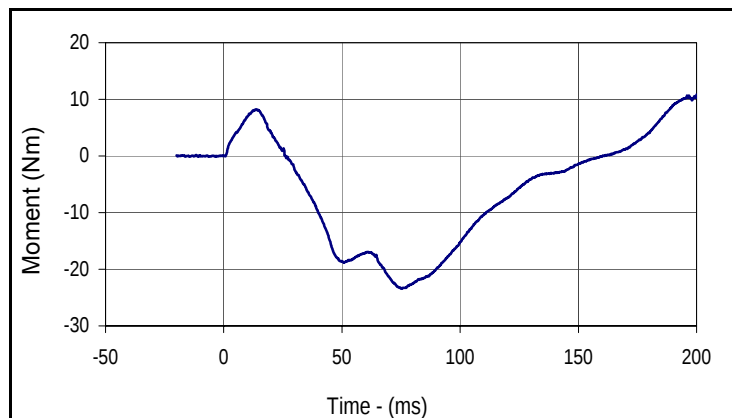
Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		°C	20.6 to 22.2	21.2	Pass
Laboratory Relative Humidity		%	10 to 70	29	Pass
Pendulum Velocity		m/s	4.18 to 4.42	4.32	Pass
Pendulum Deceleration	10 Msec.	m/s	1.0 to 1.4	1.3	Pass
	20 Msec.	m/s	2.2 to 3.0	2.7	Pass
	30 Msec.	m/s	3.2 to 4.2	4.0	Pass
"D" Plane Rotation	Max	deg	85.0 to 103.0	94.3	Pass
Peak Moment in Rotation	Max	Nm	-24.0 to -19.0	-23.4	Pass
Positive Moment Decay, Time To -5 Nm		ms	123.0 to 147.0	126.9	Pass
			Overall Test Results		Pass



Curve Description			
Pendulum Velocity			
CURNO	Type	SAE Class	Units
001	FIL	180	m/s
Max	Time	Min	Time
4.7	199.9	0.0	-2.6



Curve Description			
"D" Plane Rotation			
CURNO	Type	SAE Class	Units
002	FIL	60	deg
Max	Time	Min	Time
94.3	84.5	-33.3	200.0



Curve Description			
Moment About Occipital Condyle			
CURNO	Type	SAE Class	Units
003	FIL	600	Nm
Max	Time	Min	Time
10.8	200.0	-23.4	75.3