

REPORT NUMBER: NCAPCHILD-MGA-2005-005

**NEW CAR ASSESSMENT PROGRAM
FRONTAL BARRIER IMPACT TEST**

Evenflo Titan 5

NHTSA NUMBER: M50206

**PREPARED BY:
MGA RESEARCH CORPORATION
5000 WARREN ROAD
BURLINGTON, WI 53105**



Test Date: December 1, 2004

Final Report Date: January 18, 2005

FINAL REPORT

**PREPARED FOR:
U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
RULEMAKING
OFFICE OF CRASHWORTHINESS STANDARDS
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WASHINGTON, D.C. 20590**

This final test report was prepared for the U.S. Department of Transportation, National Highway Traffic Safety Administration, in response to Contract Number DTNH22-01-D-12005.

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Technical Report Documentation Page

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16. Abstract The subject CRS Evenflo Titan 5 was tested in conjunction with a Frontal NCAP test in support of research in accordance with the specifications of the Office of Crashworthiness Standards Test Procedure for the determination of CRS crashworthiness. This test was conducted at MGA Research Corporation in Burlington, Wisconsin on December 1, 2004, in conjunction with frontal NCAP. <table border="1"> <tr> <td>Measurement Description</td> <td>Units</td> <td>Pos. 3 ATD</td> </tr> <tr> <td>Head Injury Criteria (HIC36)</td> <td>N/A</td> <td>569</td> </tr> <tr> <td>Head Injury Criteria (HIC15)</td> <td>N/A</td> <td>380</td> </tr> <tr> <td>Max. Thorax Accel. (3msec Clip)</td> <td>G's</td> <td>42</td> </tr> </table>						Measurement Description	Units	Pos. 3 ATD	Head Injury Criteria (HIC36)	N/A	569	Head Injury Criteria (HIC15)	N/A	380	Max. Thorax Accel. (3msec Clip)	G's	42
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SECTION 1

PURPOSE AND SUMMARY OF TEST

PURPOSE

The purpose of this test was to obtain CRS performance data in a frontal impact NCAP condition.

This 56.3 km/h frontal barrier impact test is part of the Vehicle Barrier Impact Testing Program sponsored by the National Highway Traffic Safety Administration (NHTSA) under contract number DTNH22-01-D-12005.

SUMMARY

The child dummy was instrumented with head, chest, and pelvic triaxial accelerometers. In addition, the dummy had six upper axial neck force and moment sensors.

The right rear (Position 3) child dummy (S/N 042) was calibrated previous to this test. Child dummy certification information is found in Appendix C.

The right rear child dummy's HIC36 was 569.3; maximum chest deceleration over 3 msec was 42.3 g's. Position 3 was forward facing and it used the vehicle LATCH and top tether for attachments.

TEST NOTES

There was no child dummy in the left rear (Position 4) seating position.

SECTION 2

DATA SHEET NO. 1 CRASH TEST SUMMARY

TEST DUMMY INFORMATION

Description	Position 3 CRS
Dummy Type / Serial No.	HIII 3 Year Old / 42
Number of Data Channels	22
Restraint System	Evenflo Titan 5 (Forward Facing)

16 MM CAMERA COVERAGE

High Speed	15
Real Time	1
Total	16

POST TEST DOOR OPENING

Description	Driver	Passenger
Locked/Unlocked Doors	Doors were unlocked	Doors were unlocked
Front Door Opening	Door remained closed and latched; Door opened without tools	Door remained closed and latched; Door opened without tools
Rear Door Opening		
Seat Track Shift (mm)	0	0
Seat Back Failure	None	None
Glazing Damage	The windshield cracked	

POST TEST SEAT DATA

Location	Seat Movement (mm)	Seat Back Failure
P1 (Left Front)	0	None
P2 (Right Front)	0	None
P3 (Right Rear)	0	None

VISIBLE DUMMY CONTACT POINTS

Description	Position 3 CRS (S/N 42)
Head Contact	Back of head to CRS
Upper Torso Contact	None
Lower Torso Contact	None
Left Foot Contact	Passenger seat back
Right Foot Contact	Passenger seat back

SECTION 2... (continued)**DATA SHEET NO. 2
CRS PARAMETER DATA**

Child Restraint System (Position 3)	Evenflo Titan 5 (Forward Facing)
NHTSA No.	M50206

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value
Total Delivered Weight (UVW)	kg	1531.4
Weight of 2 P572E ATDs	kg	156.0
Rated Cargo/Luggage Weight (RCLW)	kg	54.4
Calculated Vehicle Target Weight (TVTW)	kg	1741.8

TEST VEHICLE WEIGHTS

	Units	As Tested (ATW) (Axle)		
		Front	Rear	Total
Left	kg	453.1	418.2	
Right	kg	440.0	423.7	
Ratio	%	51.5	48.5	
Totals	kg	893.1	841.9	1735.0

As tested weight of vehicle includes two 50th percentile ATDs and one 3 year old with CRS, cargo, equipment and instrumentation.

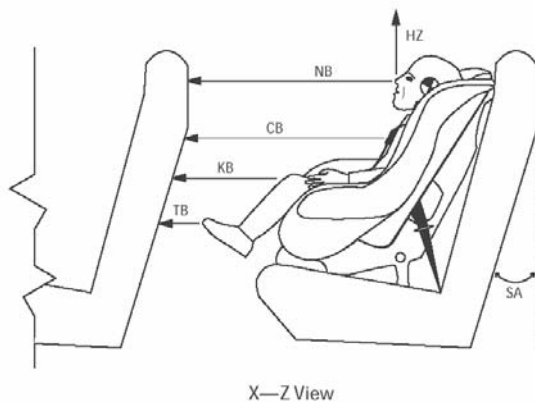
CHEST CLIP DISPLACEMENT

	Units	Left	Right
Right Child Dummy	mm	59	65

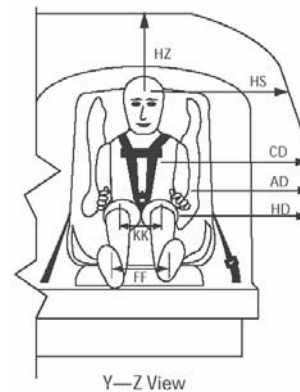
SECTION 2... (continued)
DATA SHEET NO. 3
CHILD DUMMY POSITIONING IN VEHICLE

Child Restraint System (Position 3)	Evenflo Titan 5 (Forward Facing)
NHTSA No.	M50206

Dummy Measurements for CRS Passengers



X—Z View



Y—Z View

HZ	-	Head to Roof
HS	-	Head to Side Window
CD	-	Chest to Door
AD	-	Arm to Door
HD	-	H-Point to Door
KK	-	Knee to Knee
FF	-	Foot to Foot
NB	-	Nose to Front Seat Back
CB	-	Chest to Front Seat Back
KB	-	Knee to Front Seat Back
TB	-	Toe to Front Seat Back
SA	-	Seat Back Angle

Measurement	Pre-Test (mm)	Post-Test (mm)
	P3 CRS (42)	P3 CRS (42)
SA (deg)	16.1	16.1
HS	464	482
CD	371	386
AD	240	265
HD	295	314
HZ	252	263
NB	455	490
CB	436	433
KK	125	151
FF	110	101
KB - LEFT	232	247
KB - RIGHT	233	252
TB - LEFT	0	0
TB - RIGHT	0	0

All dimensions in mm (unless noted)
P3 – Right Rear Passenger (Forward Facing)

SECTION 2... (continued)

DATA SHEET NO. 4 CHILD DUMMY INJURY CRITERIA VALUES

Child Restraint System (Position 3)	Evenflo Titan 5
NHTSA No.	M50206

HEAD PEAK ACCELERATIONS

Location	Axis	Units	Position 3			
			Max	Time	Min	Time
Head CG	X	G's	81.8	179	-35.6	74
Head CG	Y	G's	2.4	207	-10.0	180
Head CG	Z	G's	52.5	81	-2.6	34
Resultant	N/A	G's	85.3	179		

UPPER NECK PEAK FORCES AND MOMENTS

Location	Axis	Units	Position 3			
			Max	Time	Min	Time
Neck Force	X	N	86	209	-817	74
Neck Force	Y	N	97	183	-17	89
Neck Force	Z	N	2085	78	-417	182
Resultant	N/A	N	2215	78		
Neck Moment	X	N•m	4.0	214	-6.5	75
Neck Moment	Y	N•m	8.7	209	-24.4	184
Neck Moment	Z	N•m	2.1	85	-1.3	64
Resultant	N/A	N•m	24.5	184		

CHEST PRIMARY PEAK ACCELERATIONS

Location	Axis	Units	Position 3			
			Max	Time	Min	Time
Chest CG	X	G's	19.5	185	-38.7	86
Chest CG	Y	G's	4.8	90	-3.6	184
Chest CG	Z	G's	13.8	181	-37.4	59
Resultant	N/A	G's	42.8	59		

CHEST PEAK DISPLACEMENTS

Location	Axis	Units	Position 3			
			Max	Time	Min	Time
Chest	X	mm			-11.8	112

SECTION 2... (continued)

**DATA SHEET NO. 4... (continued)
CHILD DUMMY INJURY CRITERIA VALUES**

Child Restraint System (Position 3)	Evenflo Titan 5
NHTSA No.	M50206

TETHER FORCE

Location	Axis	Units	Position 3			
			Max	Time	Min	Time
Right Tether Force	N/A	N	2165	76		

PELVIC PEAK ACCELERATIONS

Location	Axis	Units	Position 3			
			Max	Time	Min	Time
Pelvis	X	G's	9.6	211	-36.3	55
Pelvis	Y	G's	8.9	84	-3.8	41
Pelvis	Z	G's	13.4	182	-37.9	54
Resultant	N/A	G's	52.3	54		

SECTION 2... (continued)
DATA SHEET NO. 4... (continued)
CHILD DUMMY INJURY CRITERIA VALUES

Child Restraint System (Position 3)	Evenflo Titan 5
NHTSA No.	M50206

HEAD INJURY CRITERIA (HIC36)

Location	HIC	T ¹ (msec)	T ² (msec)	Average Acceleration (G's)
Position 3 - Right	569.3	64.9	100.9	47.8

HIC is as defined in FMVSS 208. The maximum time interval from t1 to t2 is 36 milliseconds.

HEAD INJURY CRITERIA (HIC15)

Location	HIC	T ¹ (msec)	T ² (msec)	Average Acceleration (G's)
Position 3 - Right	380.2	172.5	183.5	65.4

HIC is as defined in FMVSS 208. The maximum time interval from t1 to t2 is 15 milliseconds.

CLIP SUMMARY

Location	CLIP	T ¹ (msec)	T ² (msec)
Position 3 - Right	42.3	57.6	60.6

The maximum chest resultant acceleration is defined as the maximum acceleration, which exceeds 0.003 seconds in duration.

SECTION 2... (continued)

**DATA SHEET NO. 5
CRS PERFORMANCE DATA**

Child Restraint System (Position 3)	Evenflo Titan 5 (Forward Facing)
NHTSA No.	M50206

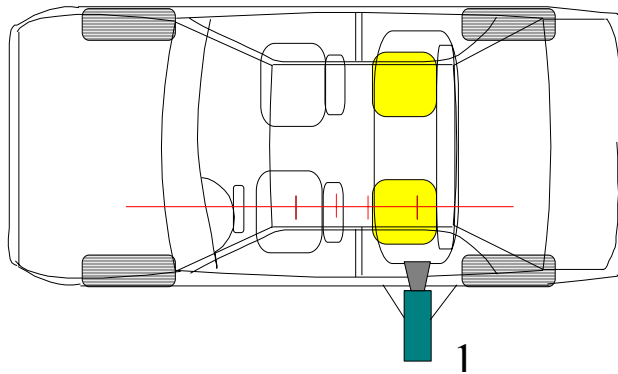
POSITION 3 CRS POST-TEST INSPECTION

Location	Damage	Remarks
Upper Tether Strap	None	
Upper Tether Buckle	None	
Upper Tether Hook	None	
Vehicle Upper Tether Anchor	None	
Lower Anchor Strap	None	
Lower Anchor Buckle	None	
Lower Anchor Hooks	None	
Vehicle Lower CRS Anchors	None	
Five Point Harness Connections	None	
Cracks on CRS	None	
Fabric Tears on CRS	None	
Vehicle Seat Structure	None	
Vehicle Seat Fabric Tears	None	
Child Dummy	None	

SECTION 2... (continued)

DATA SHEET NO. 6 CRS CAMERA DATA

Child Restraint System (Position 3)	Evenflo Titan 5 (Forward Facing)
NHTSA No.	M50206



No.	Camera View	Location (mm) *			Angle (deg)	Lens (mm)	Speed (fps)
		X	Y	Z			
1	Left Side CRS Lateral View					10	1000

*COORDINATES:

- +X = forward of impact plane
- +Y = right of monorail centerline
- +Z = above ground level

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PHOTOGRAPHS

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S PRODUCT AFTER DECEMBER 31 2010

Manufactured in 13OCT04

Model # 3671439 P1

INFLO COMPANY INC.
OHIO 45356 (USA)

Close-up View of Position 3 CRS Label

A-2.



Pre-Test Front View of Position 3 CRS

A-3.



Post-Test Front View of Position 3 CRS

A-4.



Pre-Test Rear View of Position 3 CRS

A-5.



Post-Test Rear View of Position 3 CRS

A-6.



Pre-Test Left Side View of Position 3 CRS

A-7.



Post-Test Left Side View of Position 3 CRS

A-8.



Pre-Test Right Side View of Position 3 CRS

A-9.



Post-Test Right Side View of Position 3 CRS

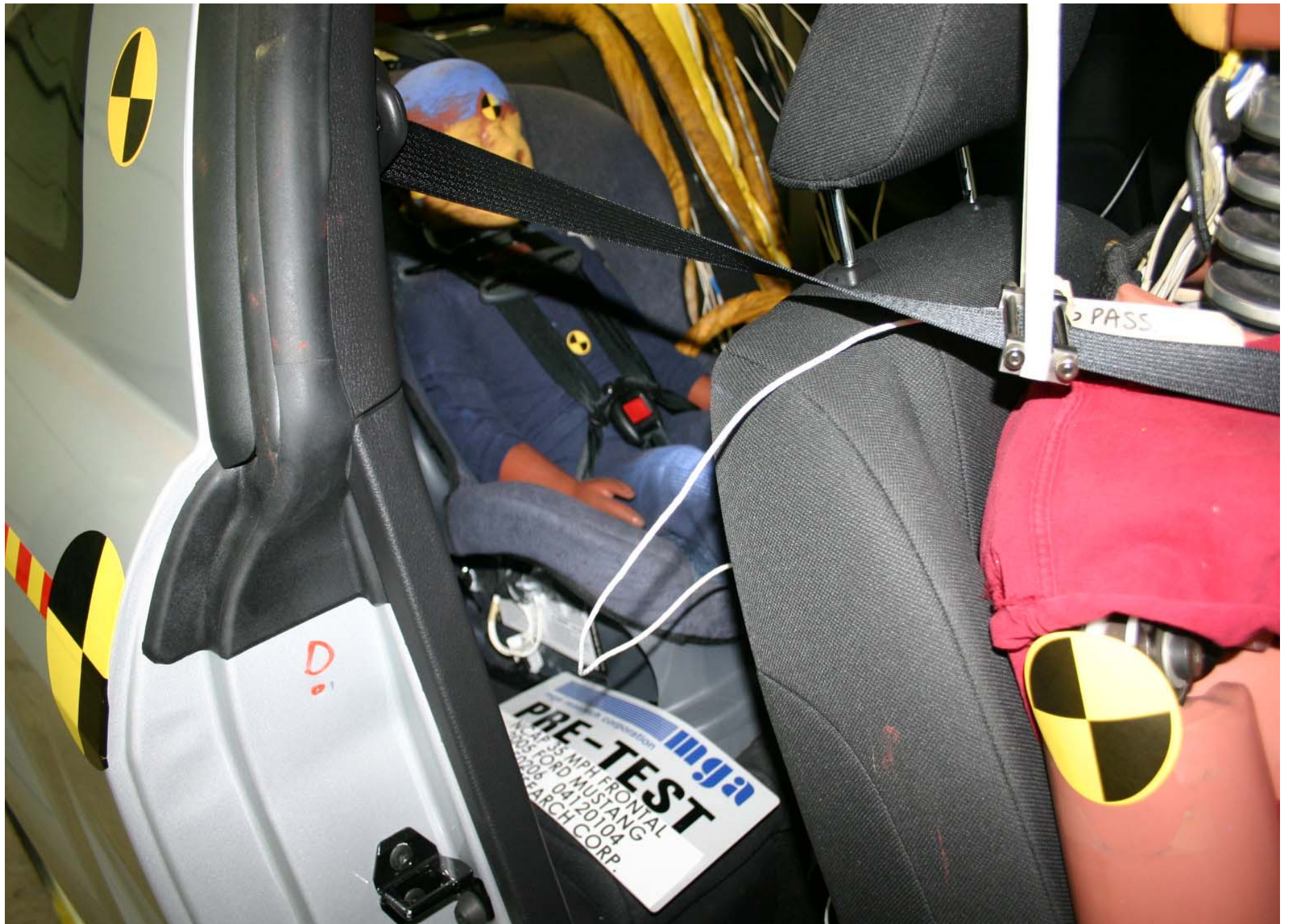


Pre-Test Position 3 Left Side View

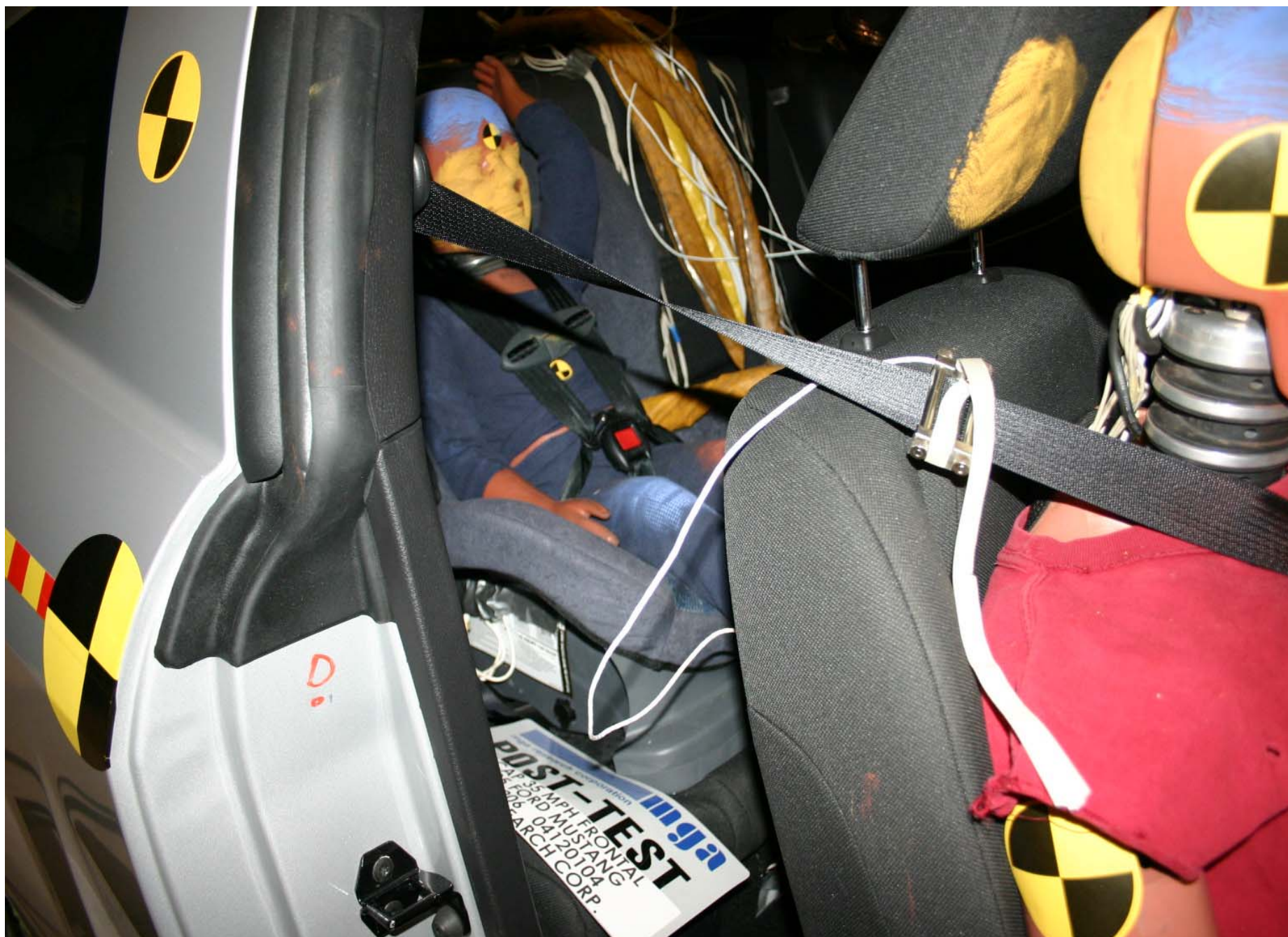
A-11.



Post-Test Position 3 Left Side View



Pre-Test Position 3 Right Side View



Post-Test Position 3 Right Side View



Pre-Test Position 3 Rear View



Post-Test Position 3 Rear View and Foot Contact



Post-Test Position 3 Three-Quarter Front View

APPENDIX B

CHILD DUMMY RESPONSE DATA TRACES

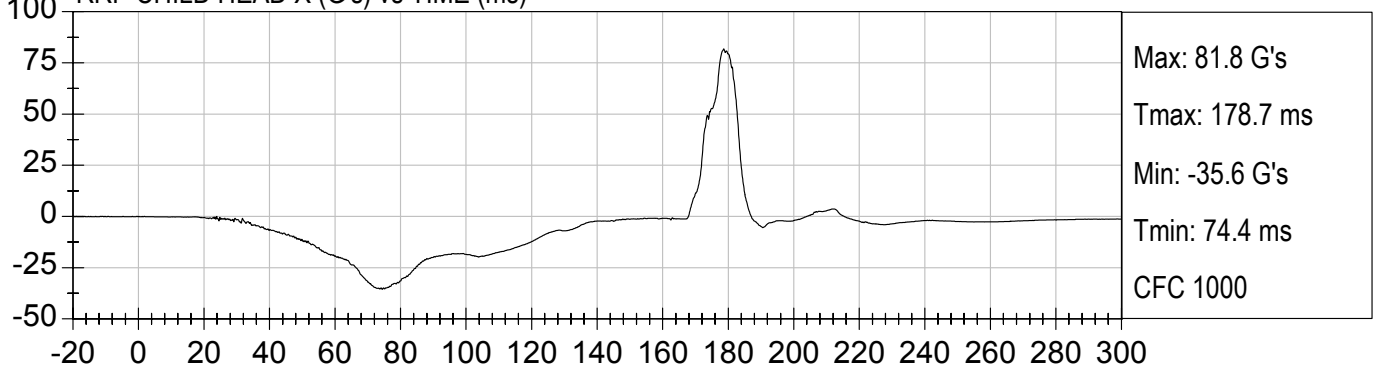
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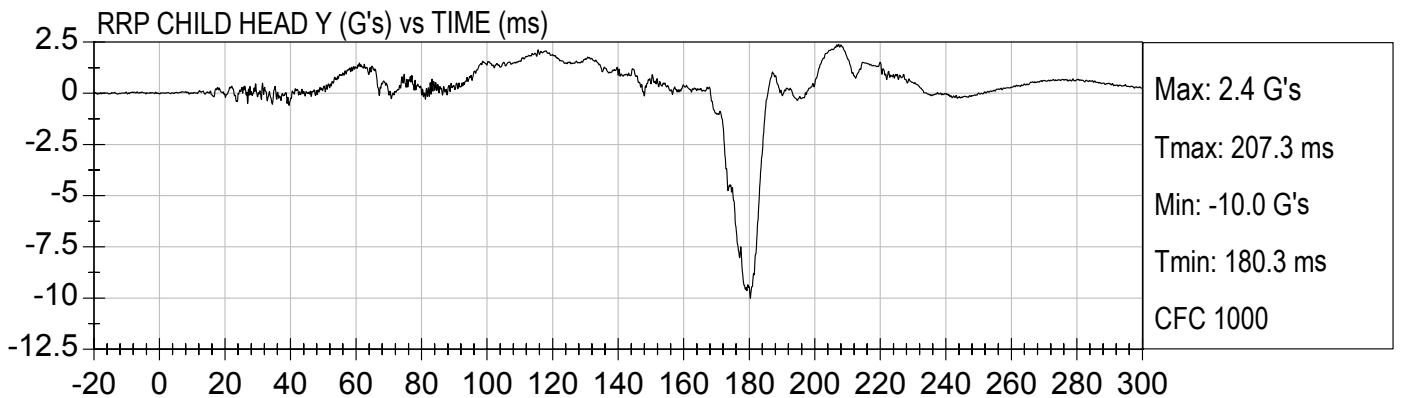
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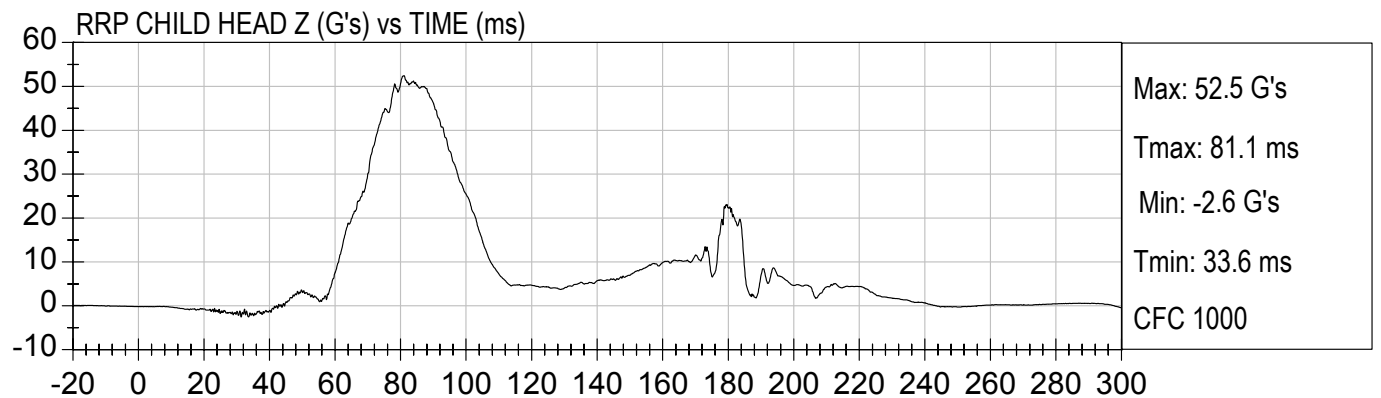
RRP CHILD HEAD X (G's) vs TIME (ms)



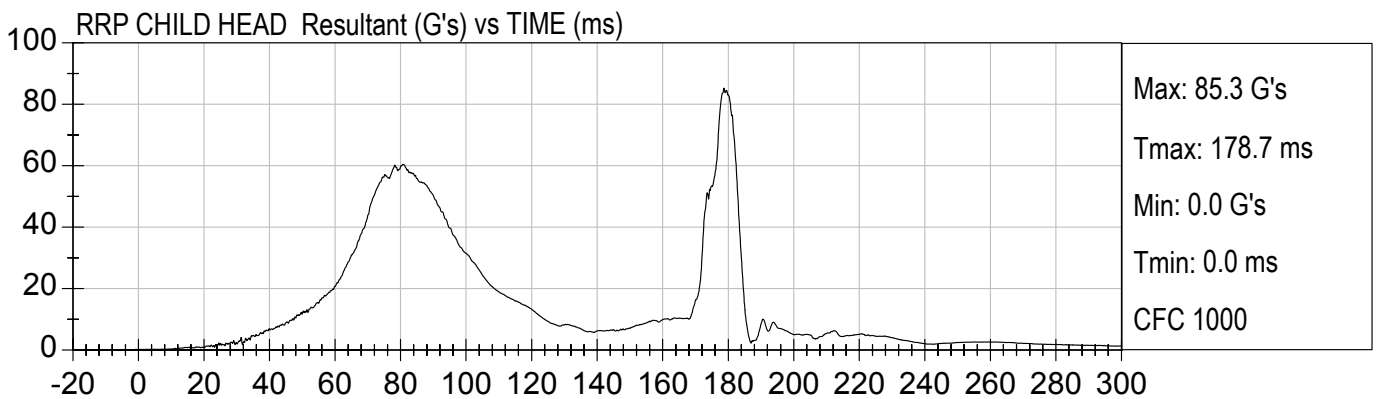
RRP CHILD HEAD Y (G's) vs TIME (ms)

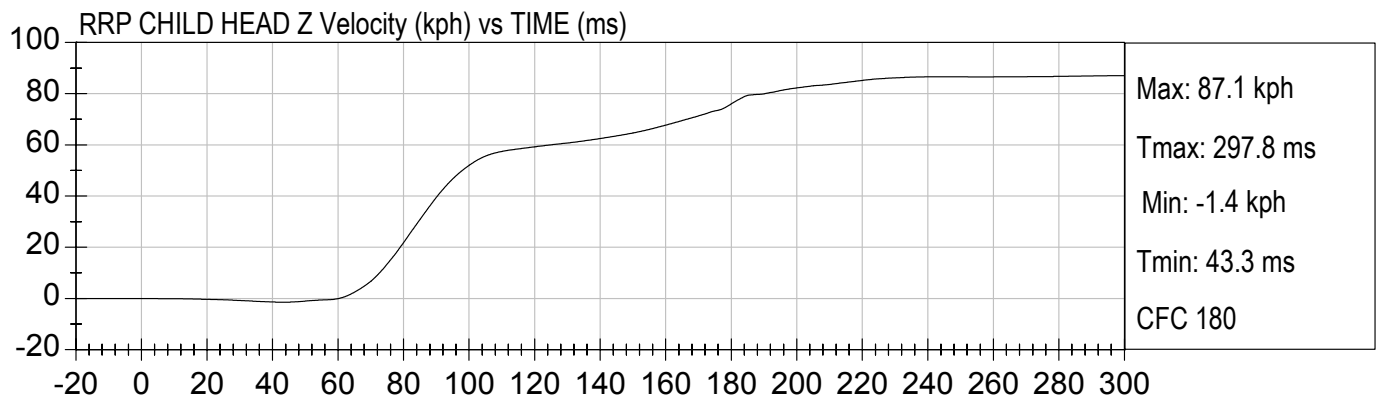
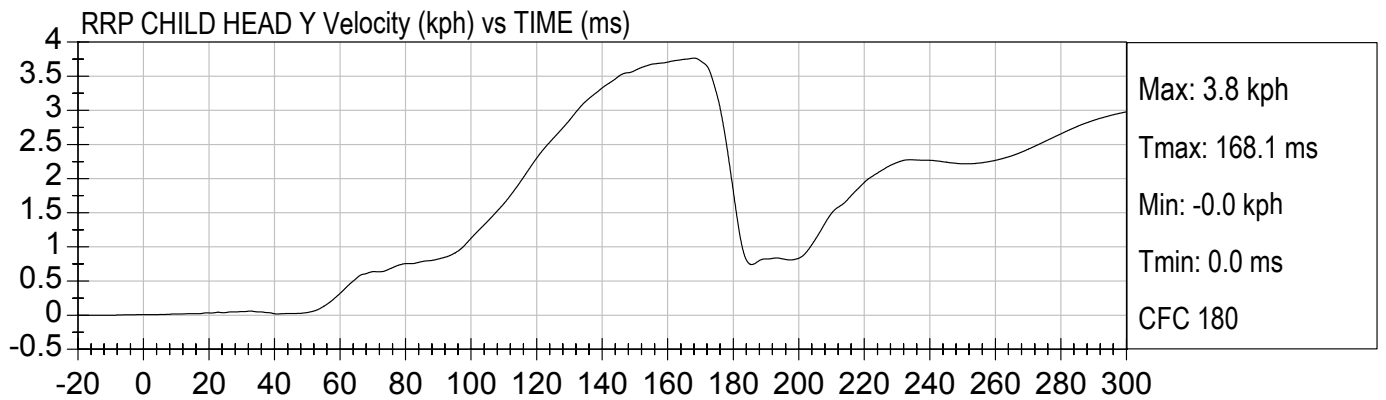
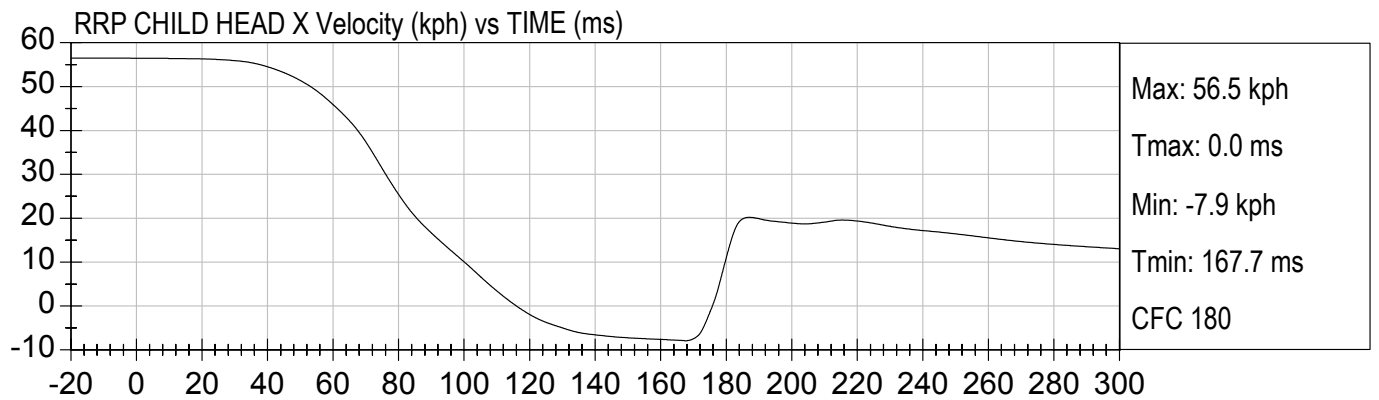


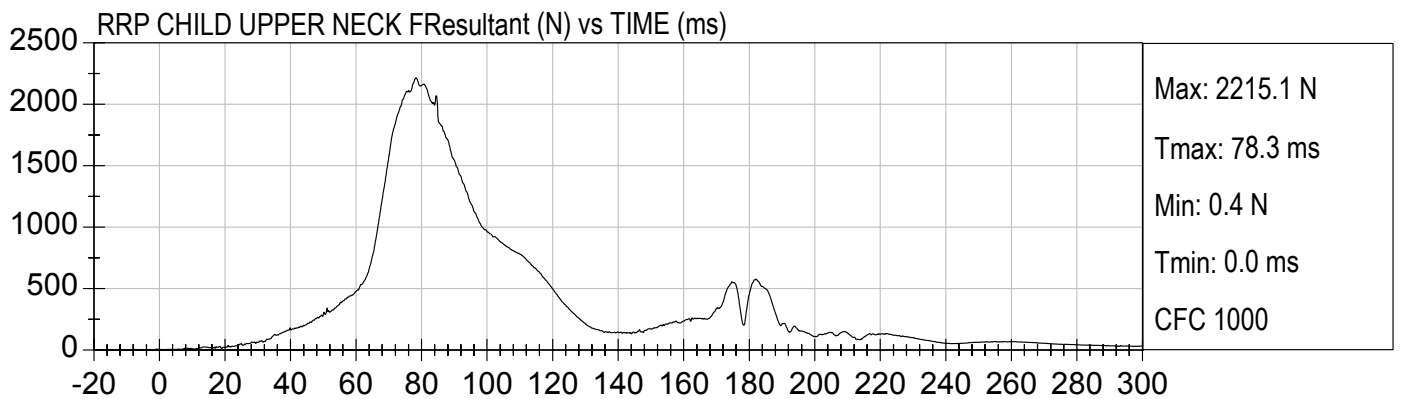
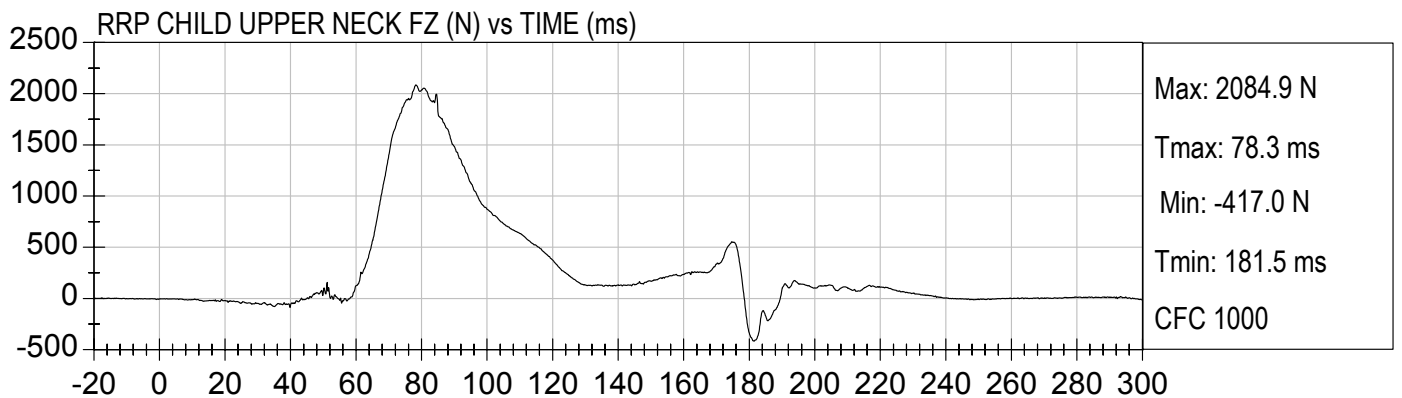
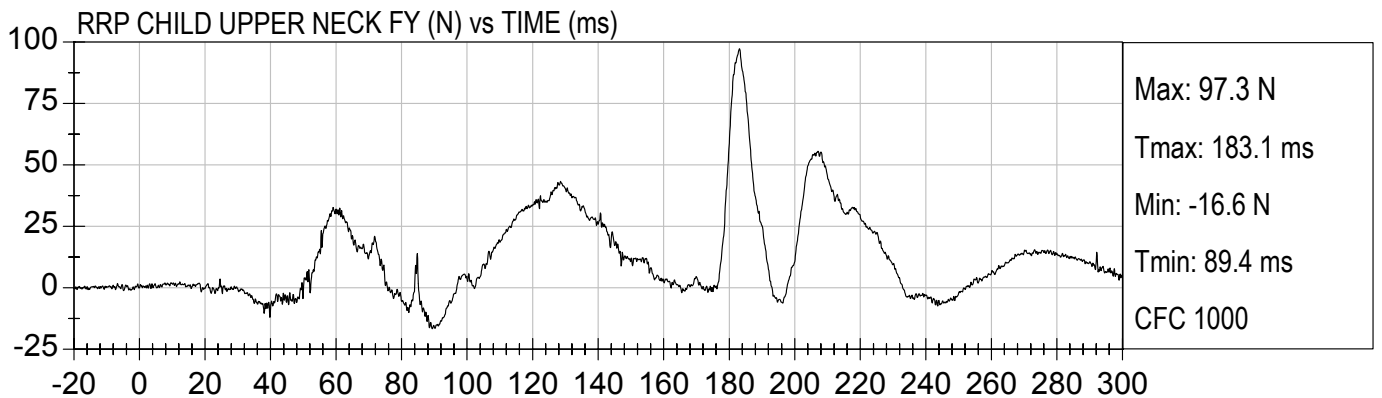
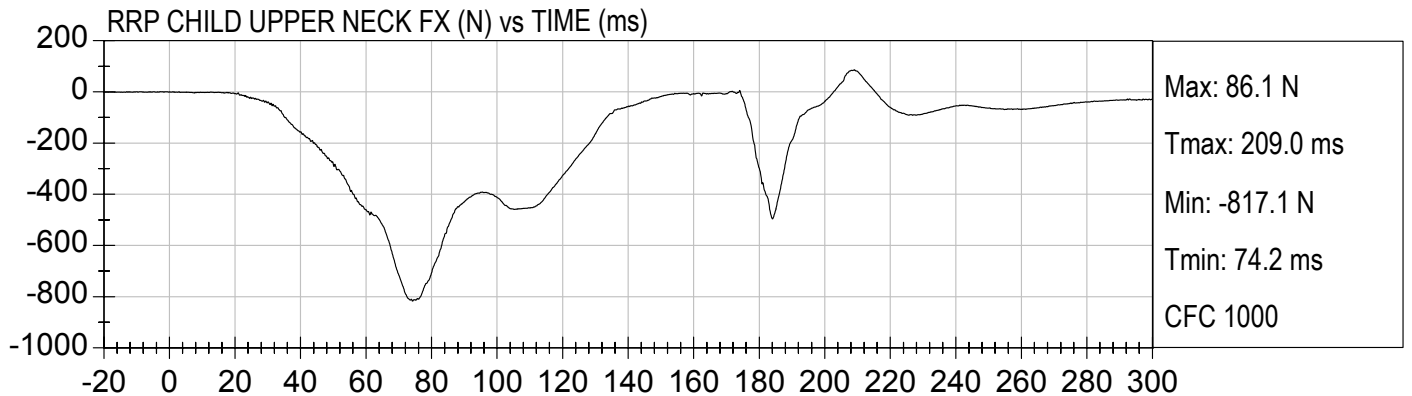
RRP CHILD HEAD Z (G's) vs TIME (ms)

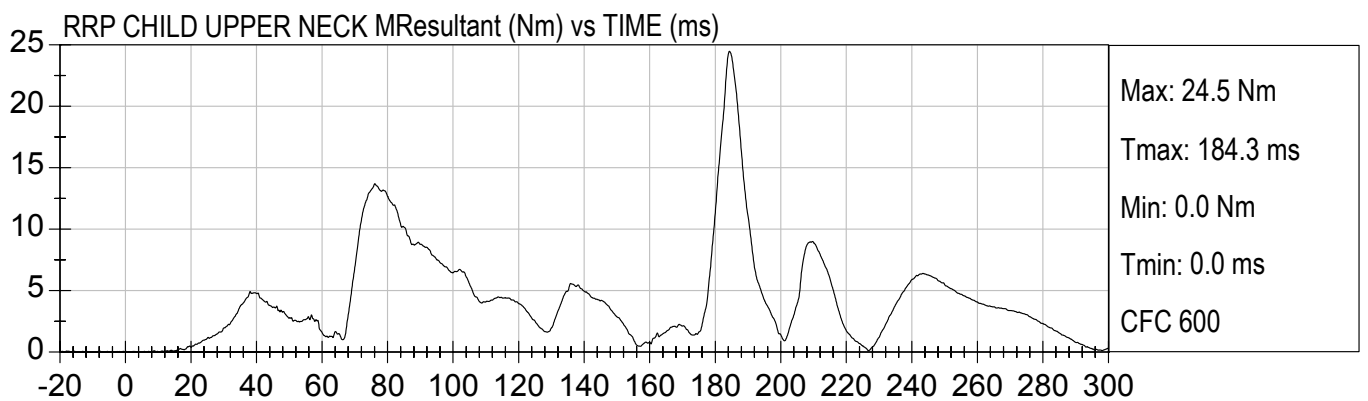
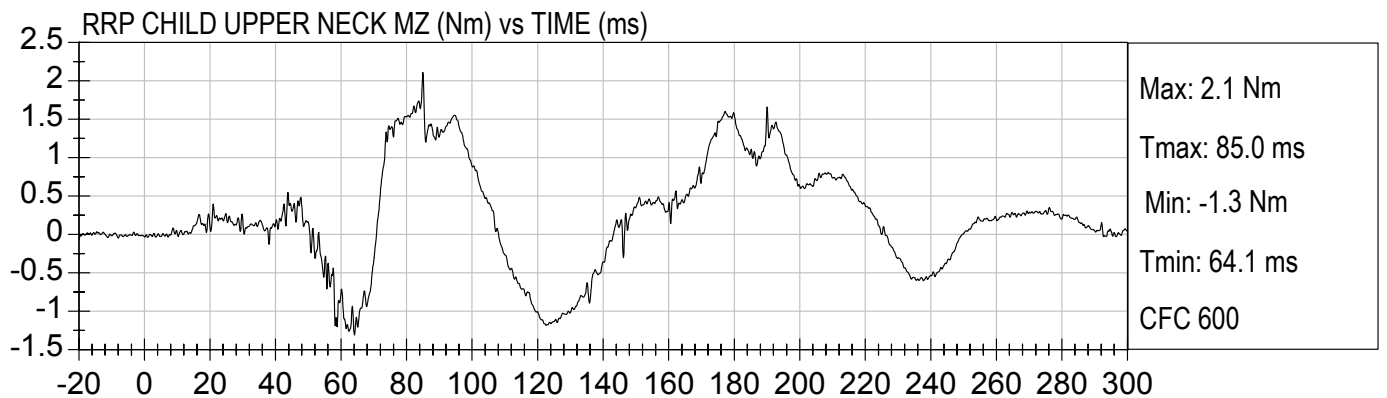
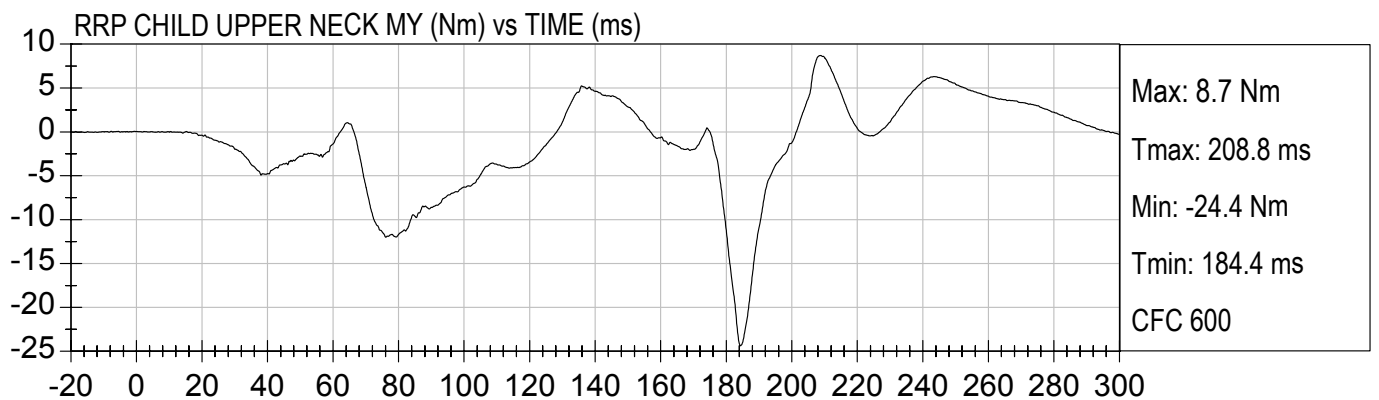
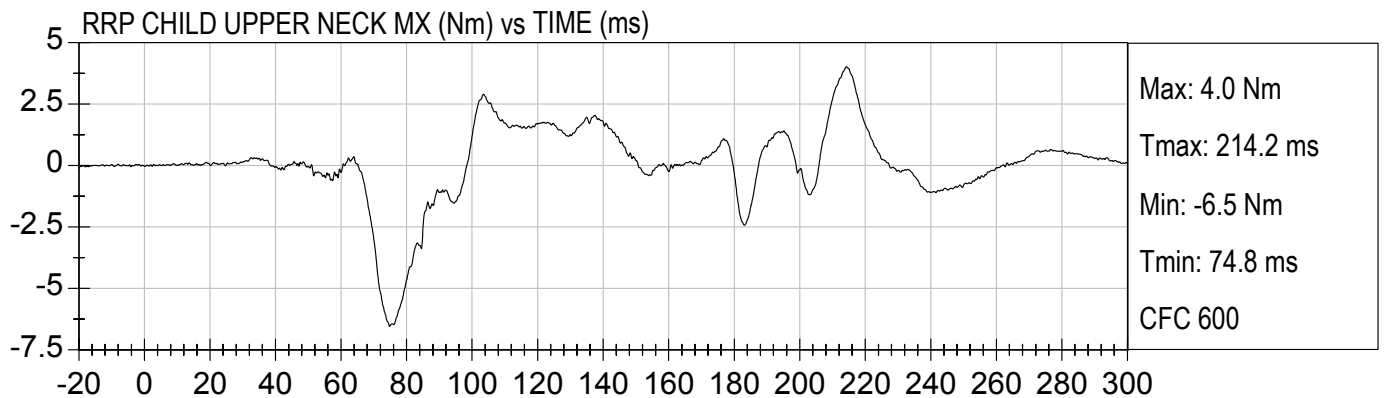


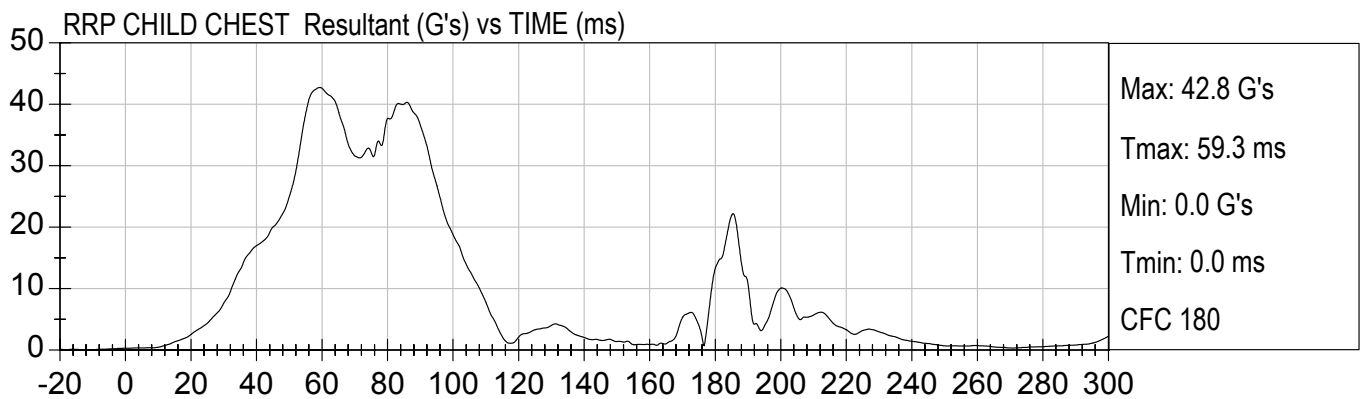
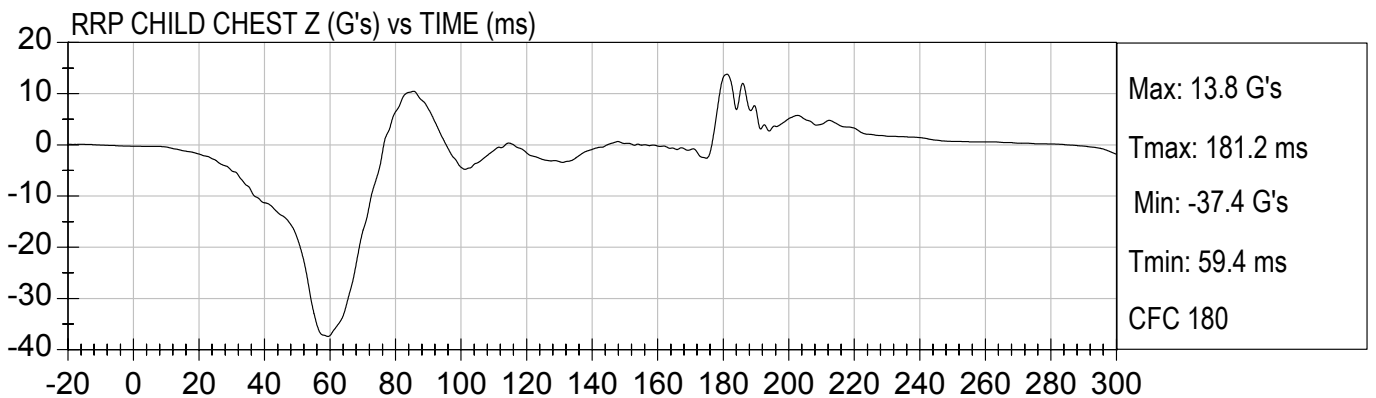
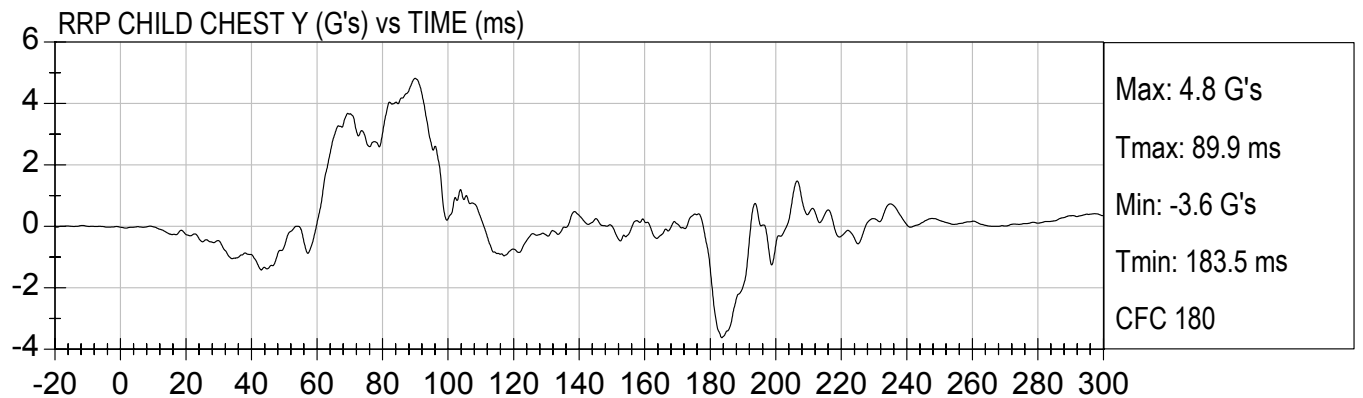
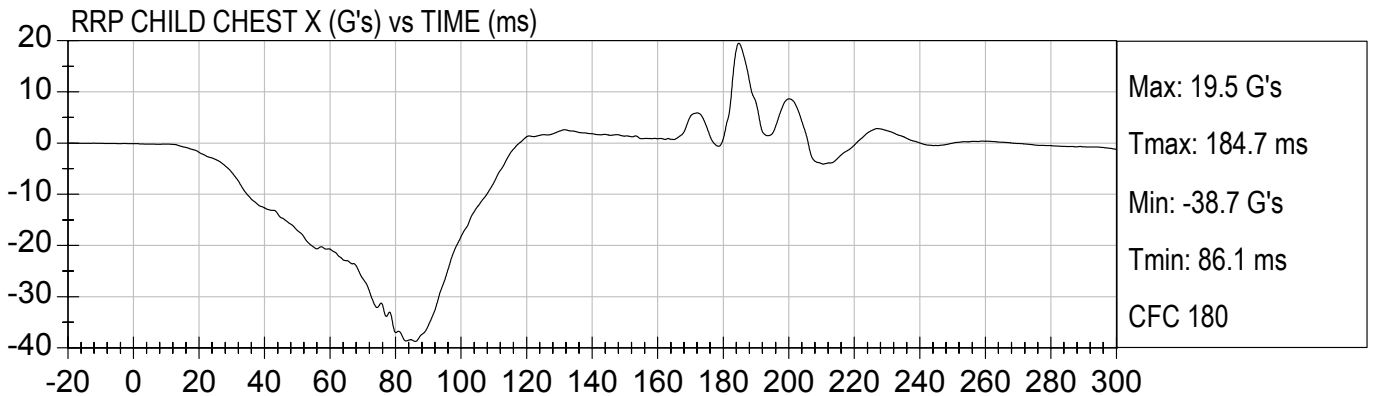
RRP CHILD HEAD Resultant (G's) vs TIME (ms)





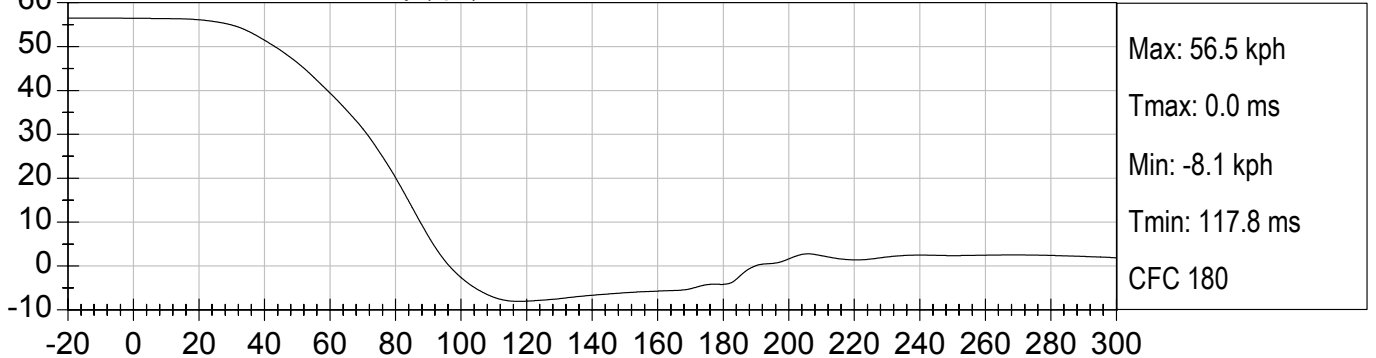




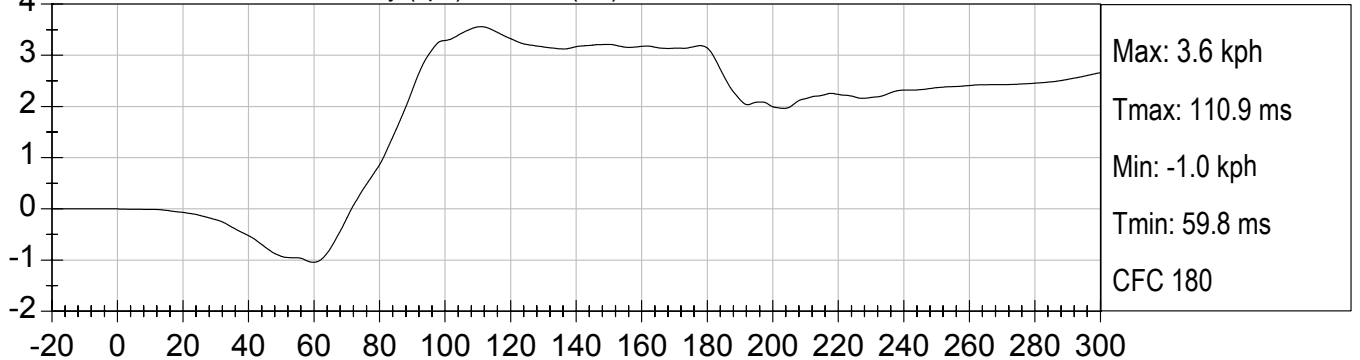




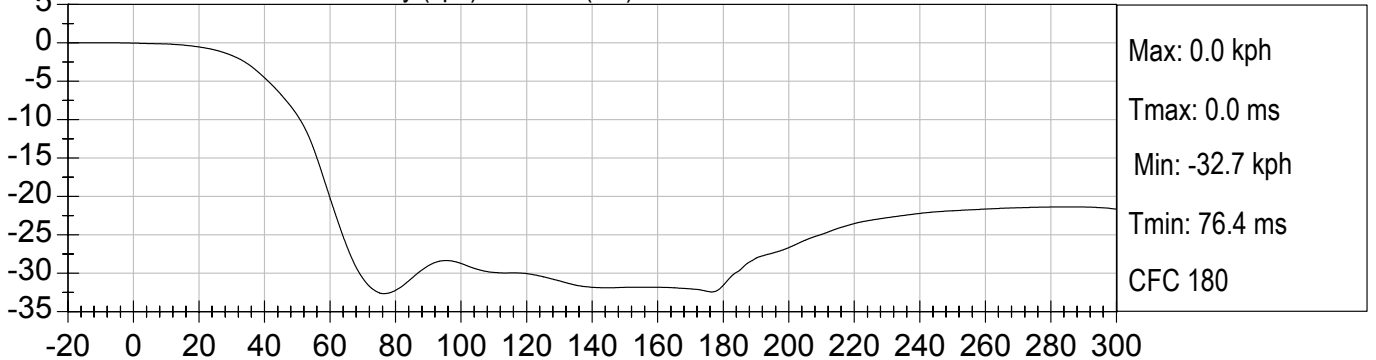
RRP CHILD CHEST X Velocity (kph) vs TIME (ms)



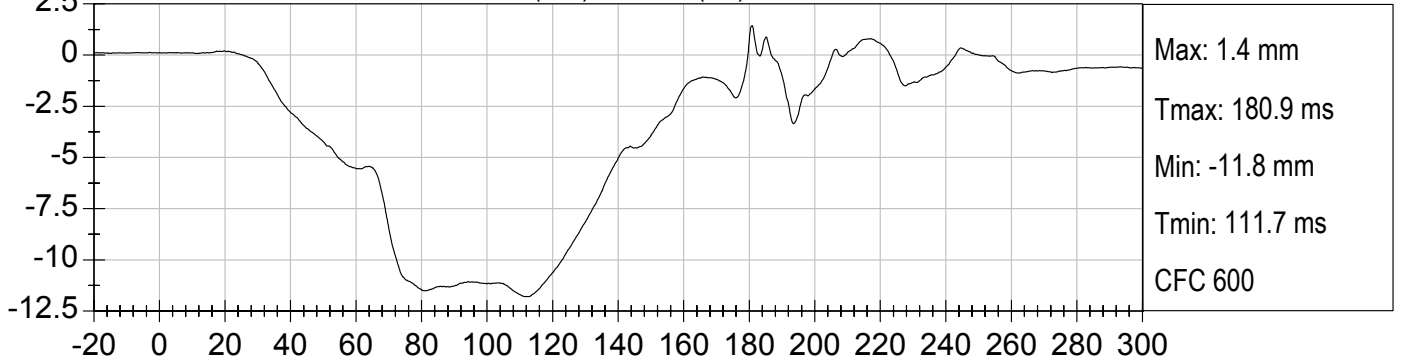
RRP CHILD CHEST Y Velocity (kph) vs TIME (ms)

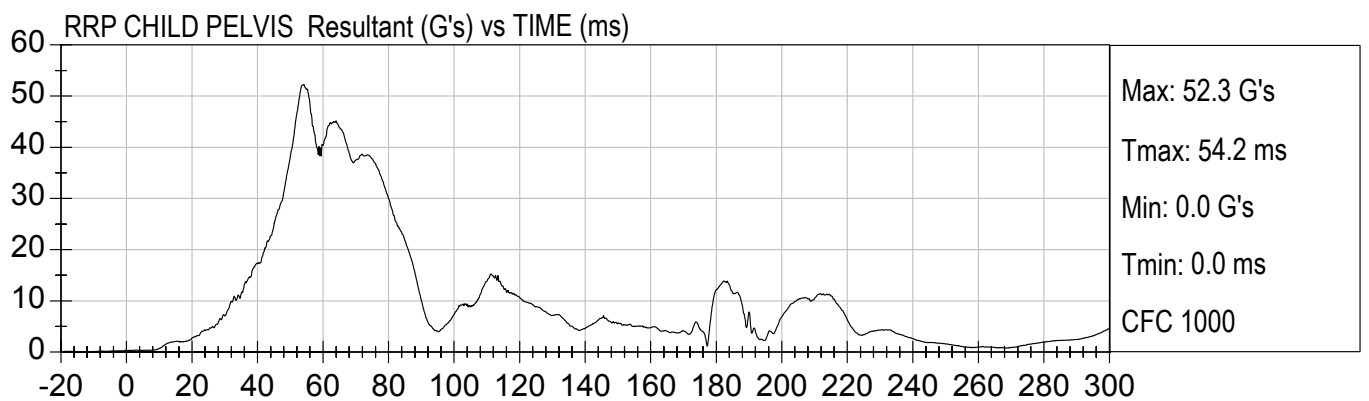
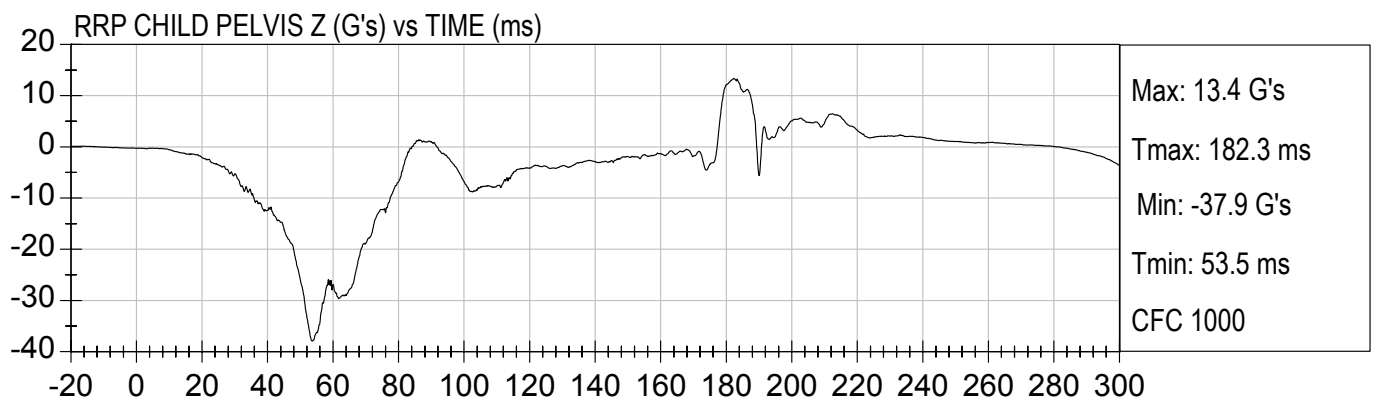
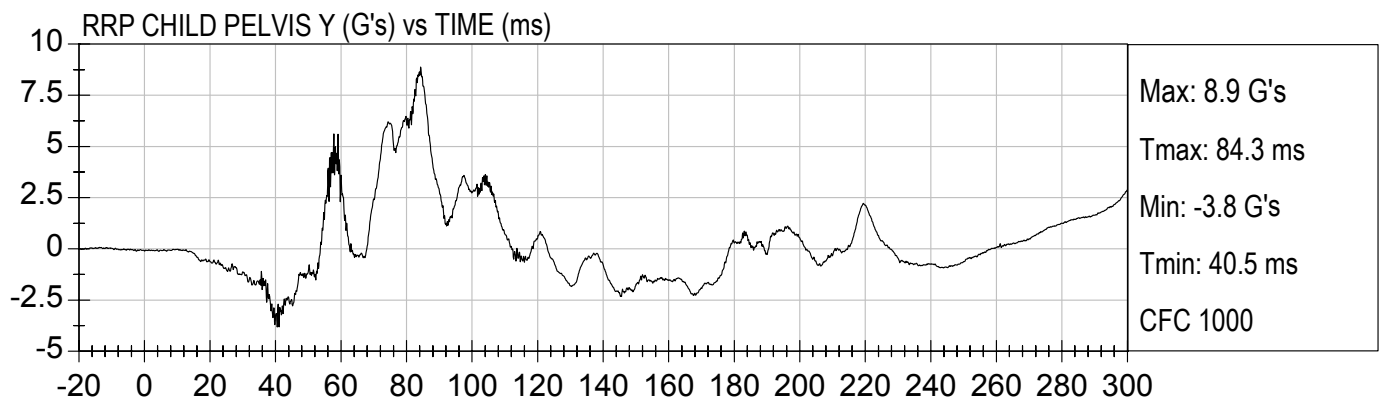
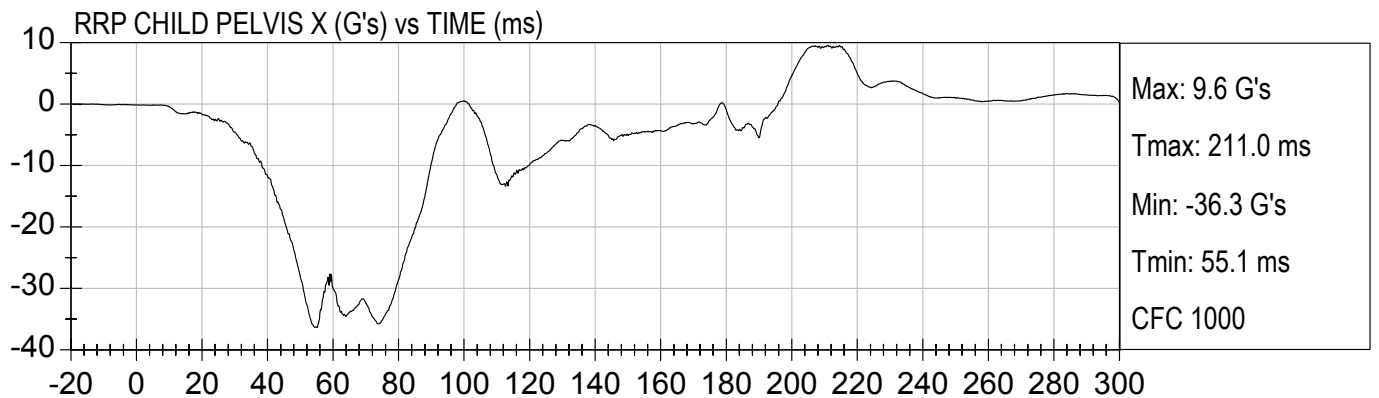


RRP CHILD CHEST Z Velocity (kph) vs TIME (ms)



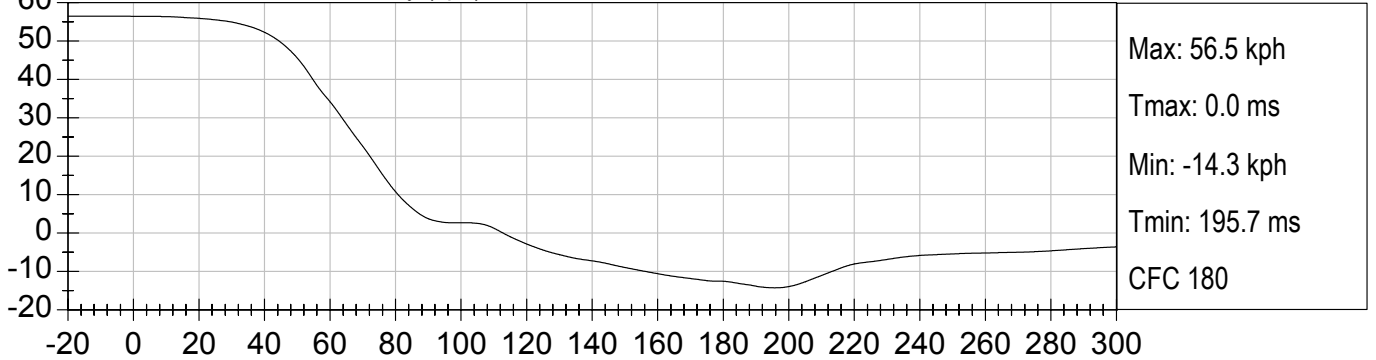
RRP CHILD CHEST DISPLACEMENT (mm) vs TIME (ms)



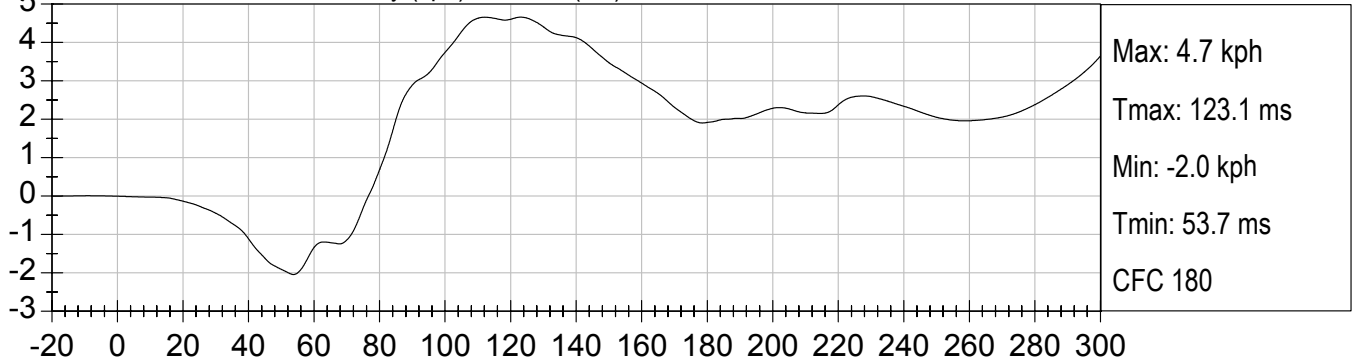




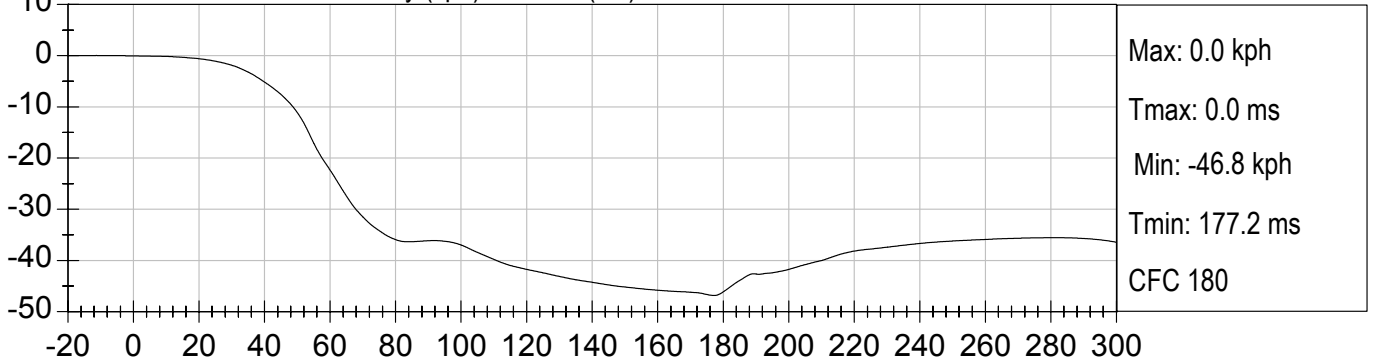
RRP CHILD PELVIS X Velocity (kph) vs TIME (ms)



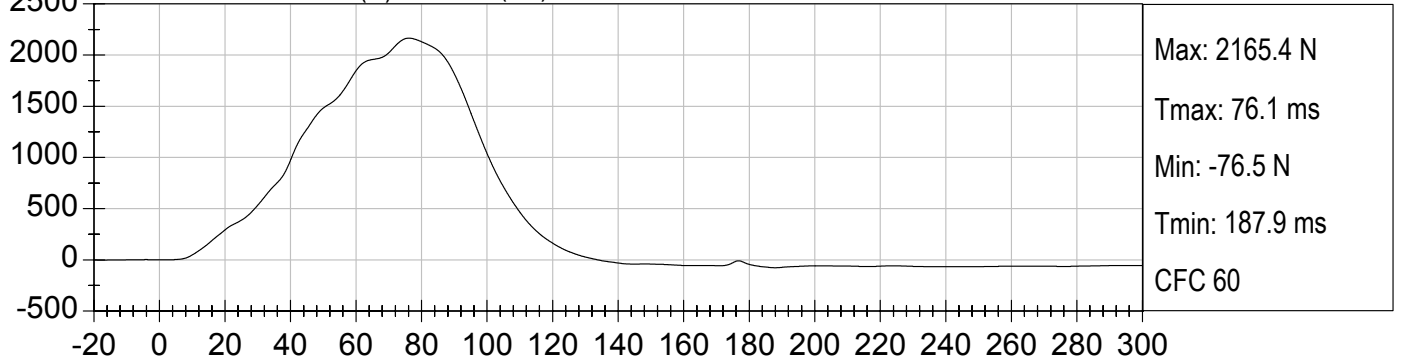
RRP CHILD PELVIS Y Velocity (kph) vs TIME (ms)

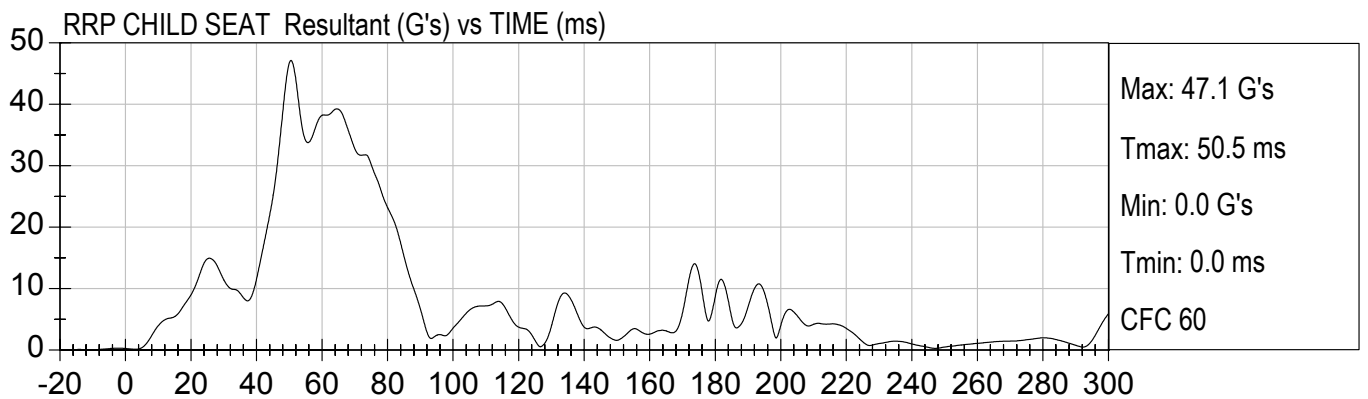
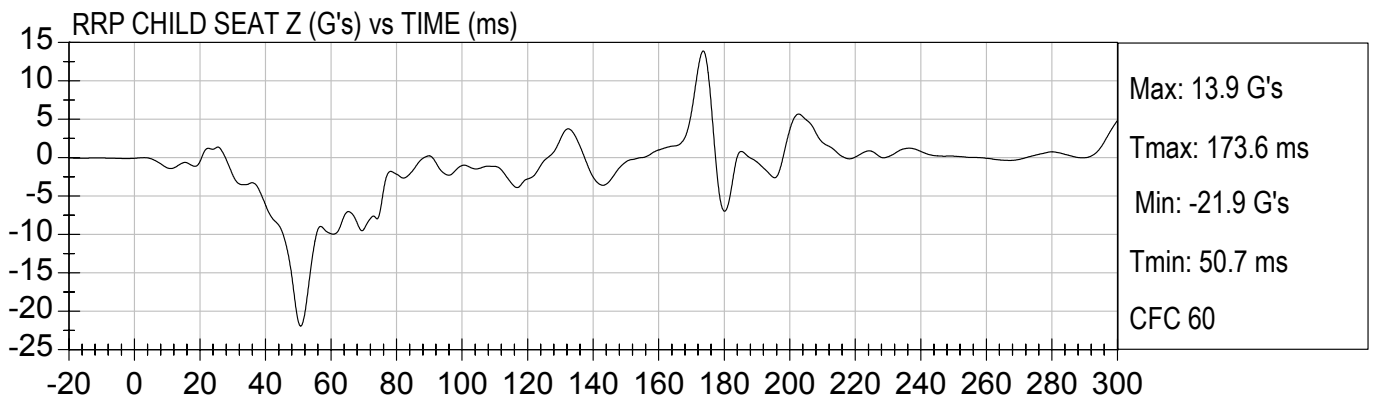
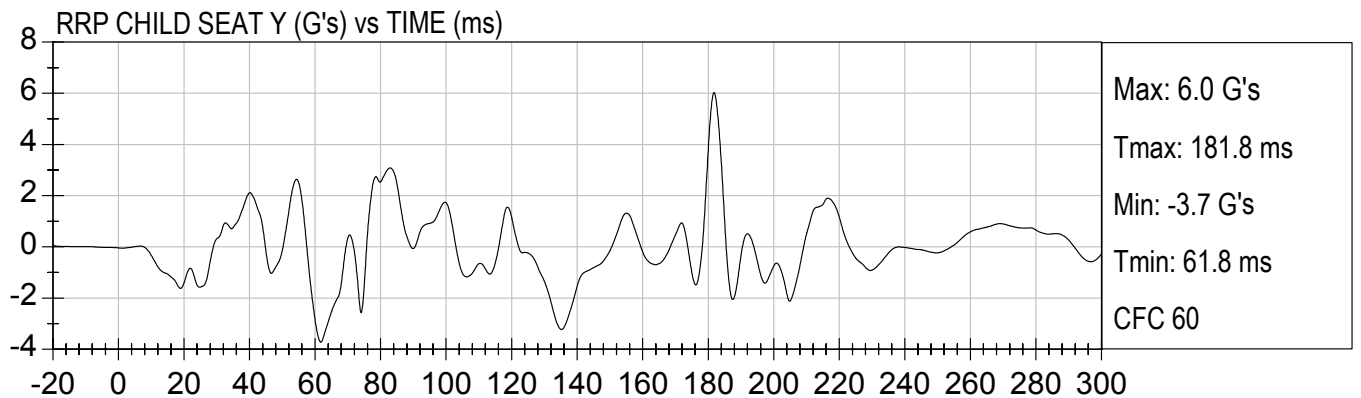
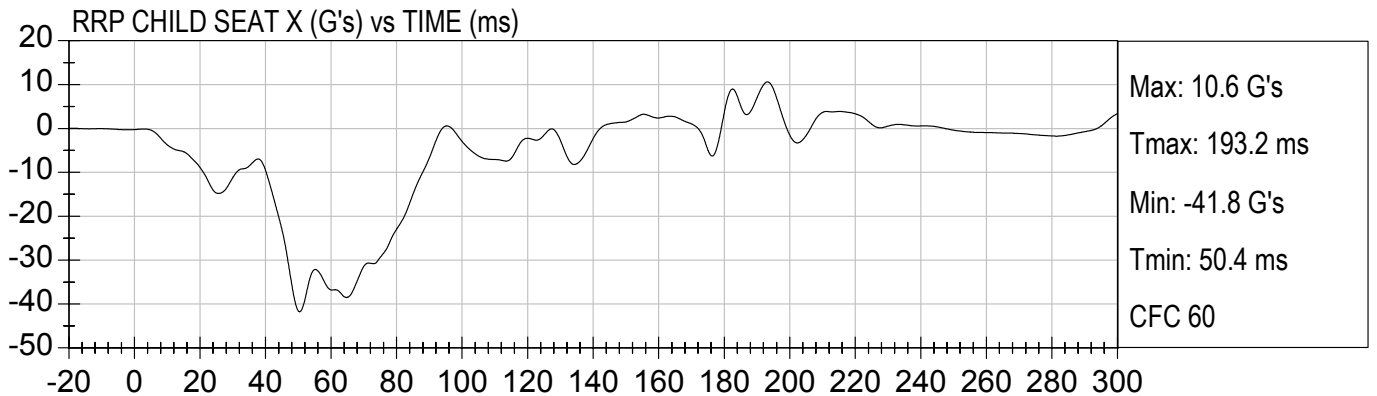


RRP CHILD PELVIS Z Velocity (kph) vs TIME (ms)



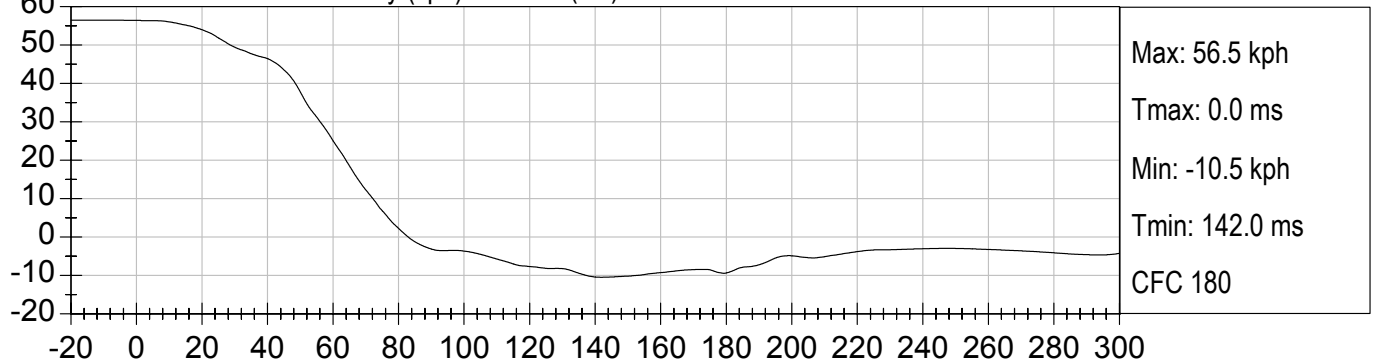
RRP TETHER FORCE (N) vs TIME (ms)



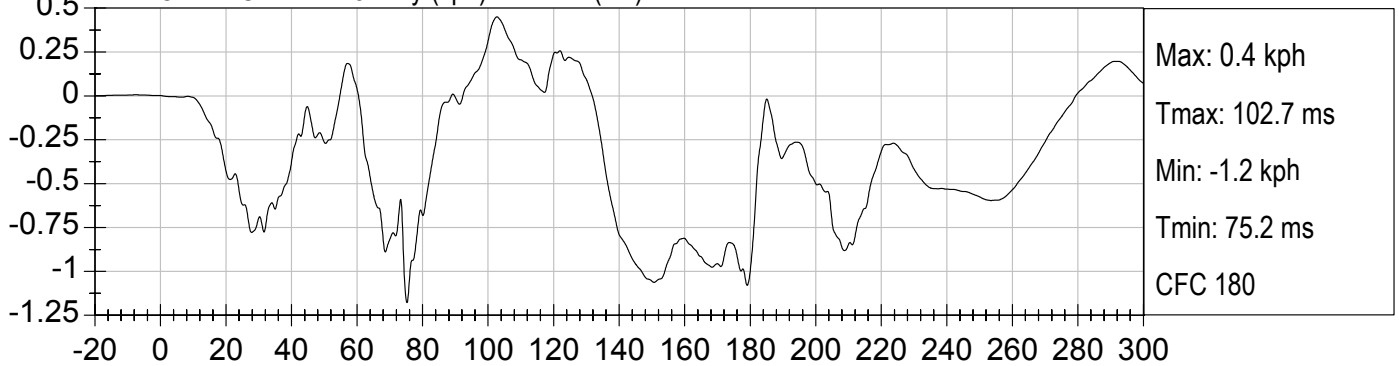




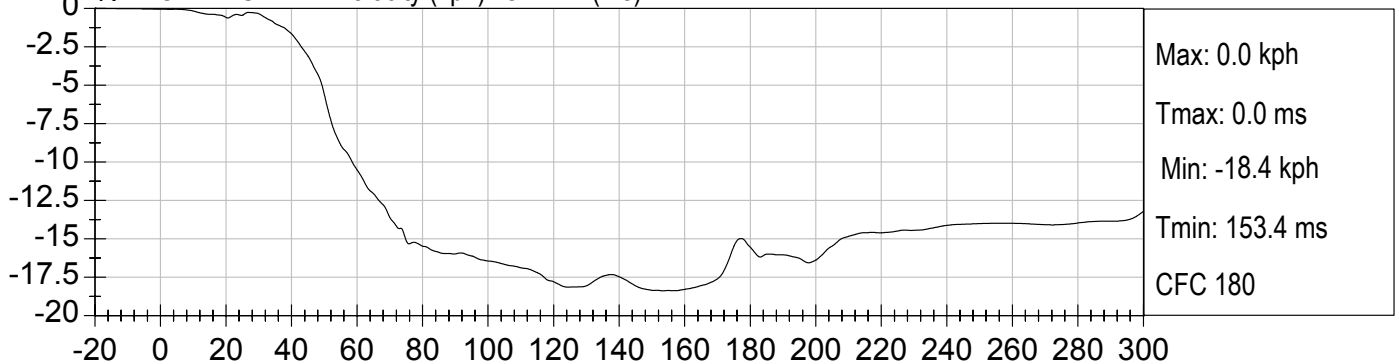
RRP CHILD SEAT X Velocity (kph) vs TIME (ms)

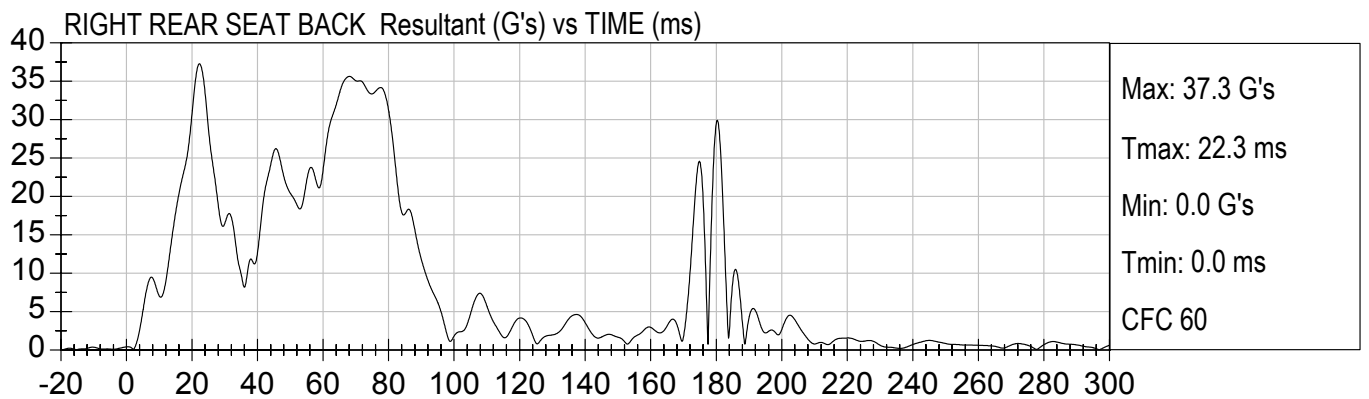
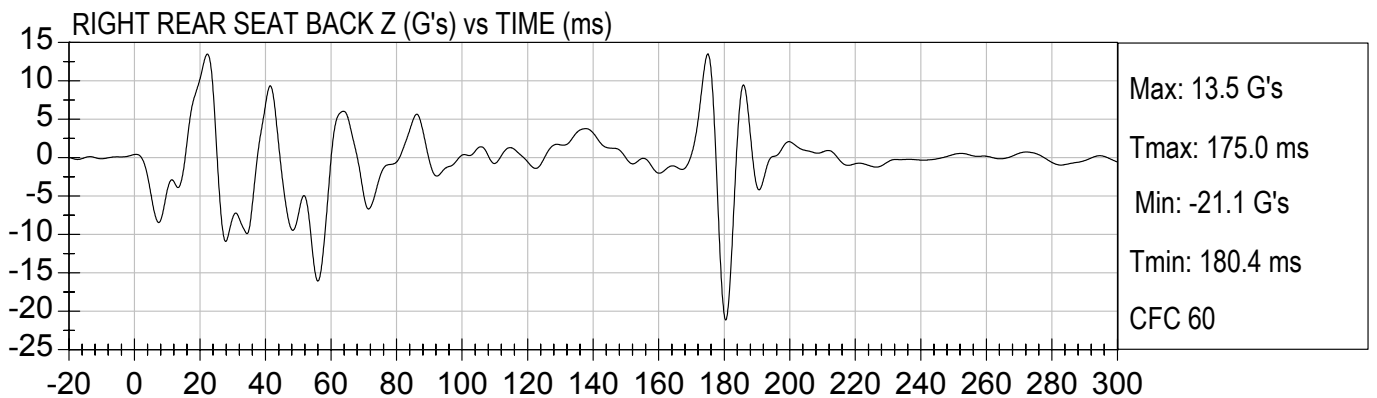
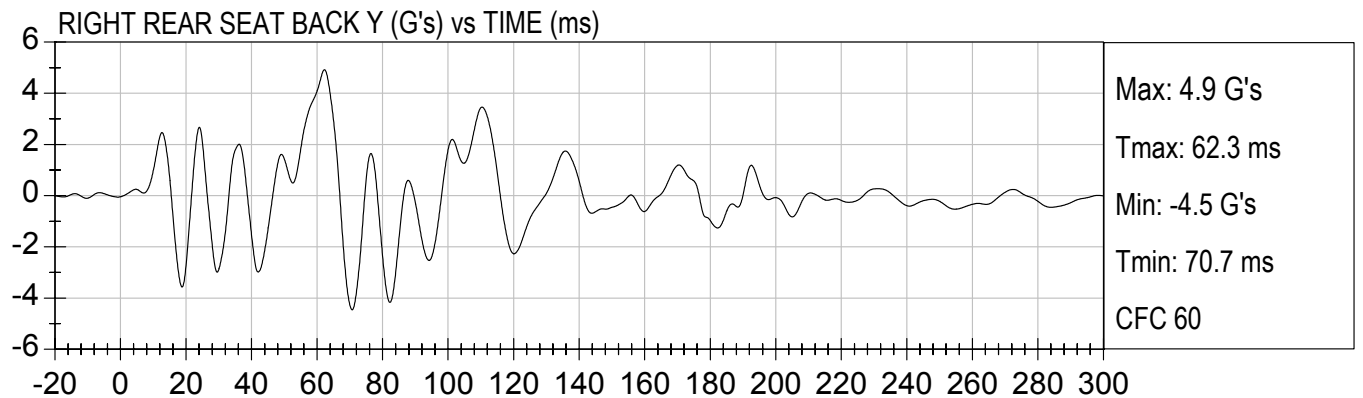
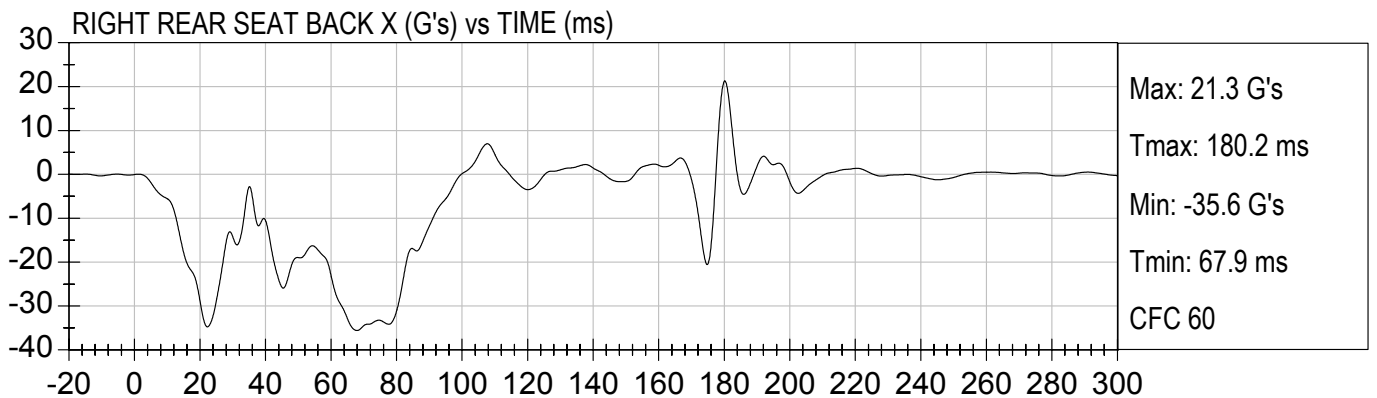


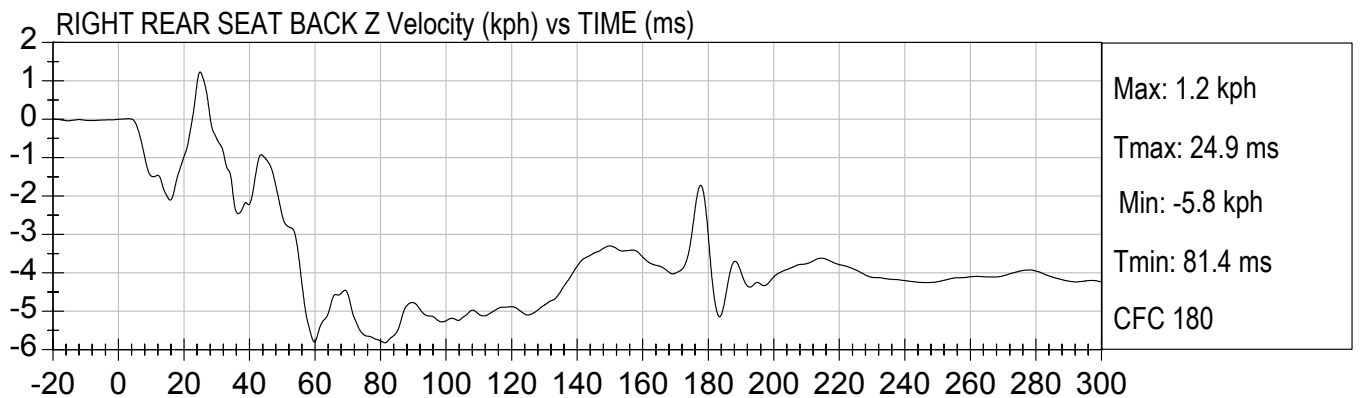
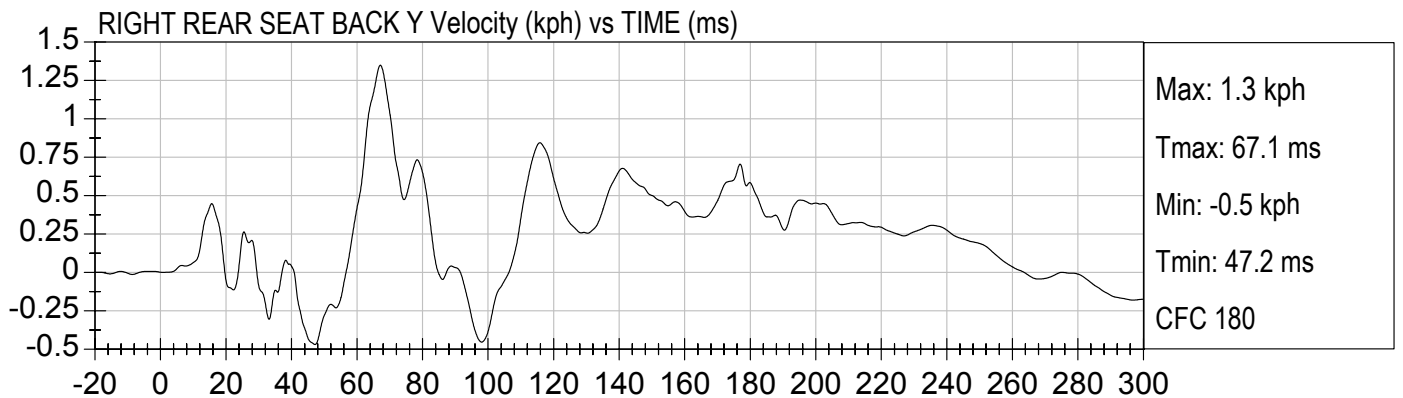
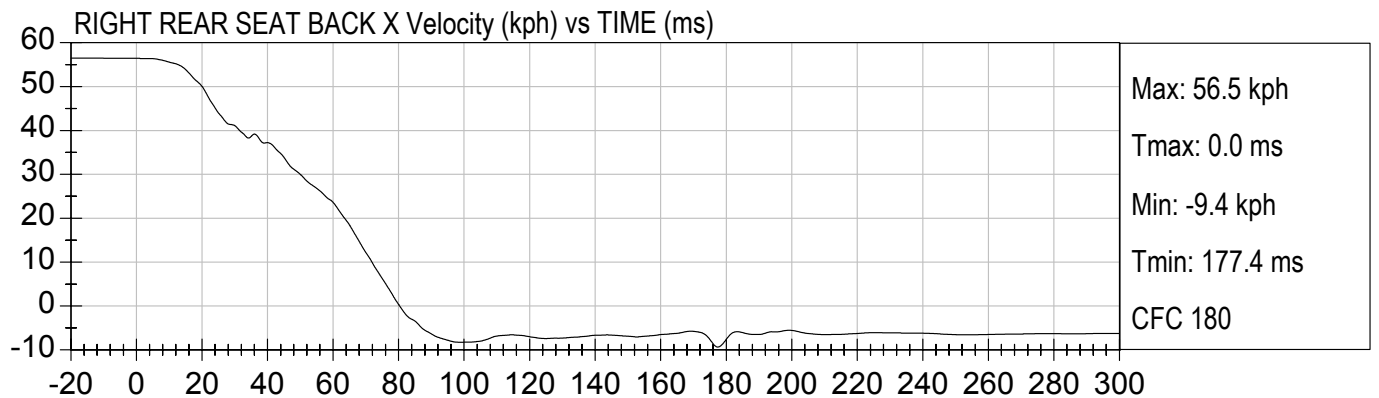
RRP CHILD SEAT Y Velocity (kph) vs TIME (ms)



RRP CHILD SEAT Z Velocity (kph) vs TIME (ms)







APPENDIX C
CHILD DUMMY CALIBRATION INFORMATION

Hybrid III Calibration Data Sheet
3 Year Old
Head Drop Calibration

ATD Serial No: 042

Test I.D: D041811

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	21.7	Pass
Laboratory Relative Humidity	%	10 to 70	46	Pass
Peak Resultant Acceleration	G's	250.0 to 280.0	268.4	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	-11.5	Pass
Is Acceleration Unimodal?	Yes/No	< 10% Peak	Yes	Pass
Overall Test Results				Pass


Laboratory Technician


Approved By

08/06/2004
Test Date



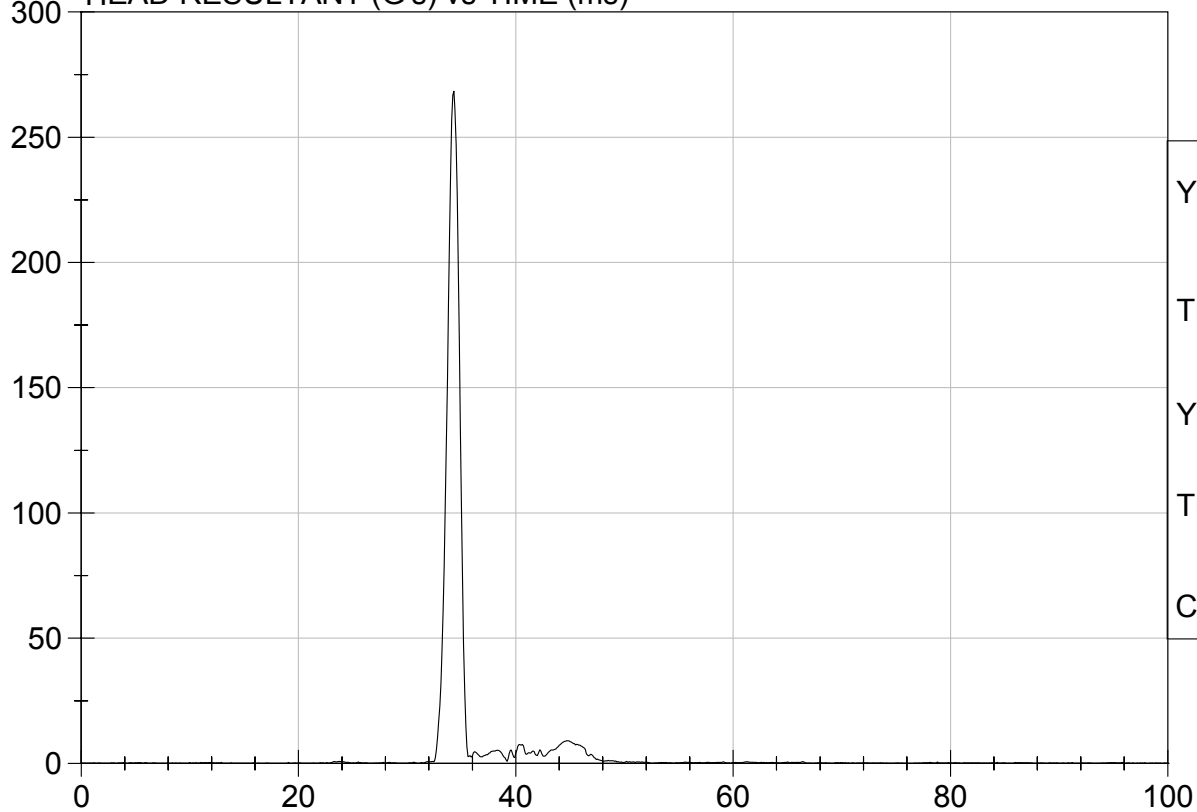
Test Description: Head Drop

Test Date: 08/06/2004

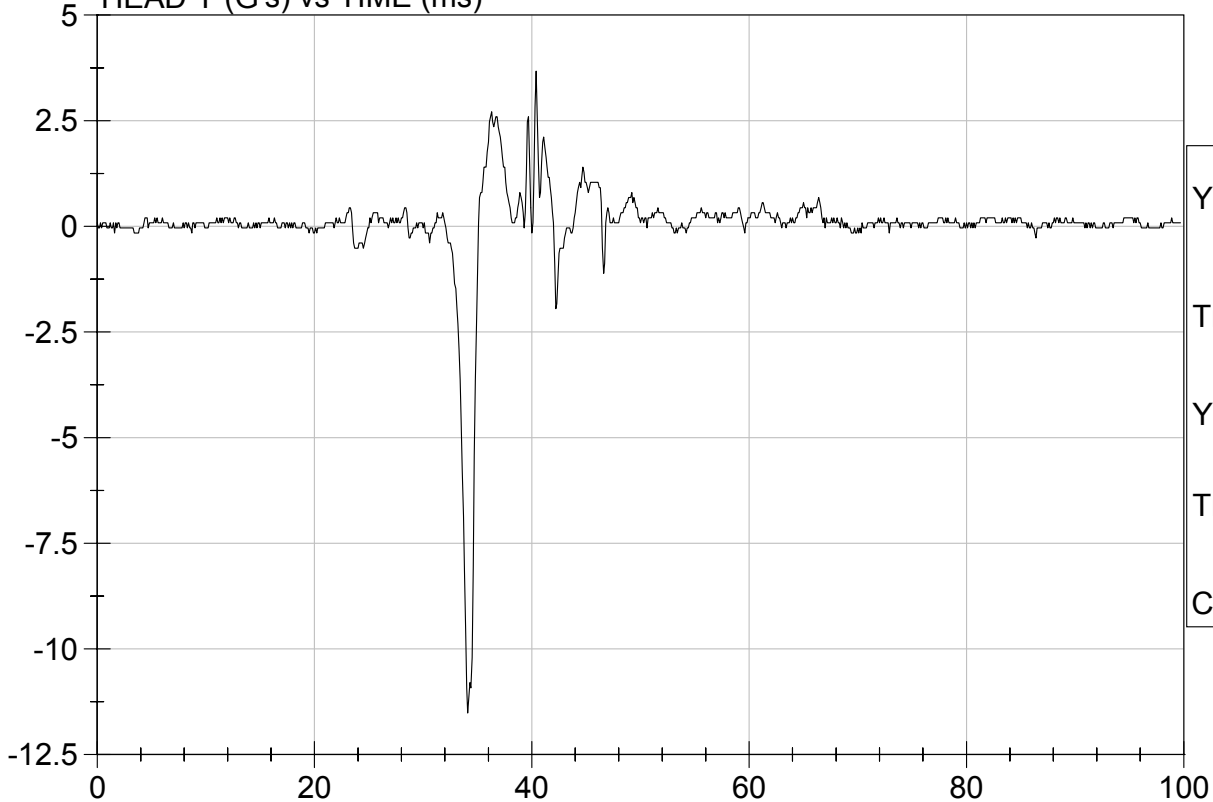
Component: D041811

Speed: 0 ft/s, 0.00 m/s

HEAD RESULTANT (G's) vs TIME (ms)



HEAD Y (G's) vs TIME (ms)



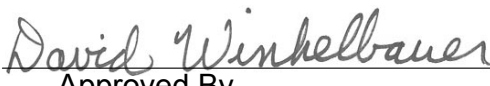
Hybrid III Calibration Data Sheet
3 Year Old
Neck Flexion Test

ATD Serial No: 042

Test I.D: D041812

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.8	Pass
Laboratory Relative Humidity		%	10 to 70	46	Pass
Pendulum Speed		m/s	5.4 to 5.6	5.5	Pass
Pendulum Deceleration	10 msec	m/s	2.0 - 2.7	2.3	Pass
	15 msec	m/s	3.0 - 4.0	3.3	Pass
	20 msec	m/s	4.0 - 5.1	4.5	Pass
D Plane Rotation		deg	70 - 82	81	Pass
Peak Moment within Deflection Corridor		Nm	42.0 - 53.0	43.8	Pass
Positive Moment - Time Curve Decay to 10 Nm		msec	60.0 - 80.0	71.5	Pass
Overall Test Results					Pass


 Laboratory Technician


 Approved By

08/06/2004

Test Date

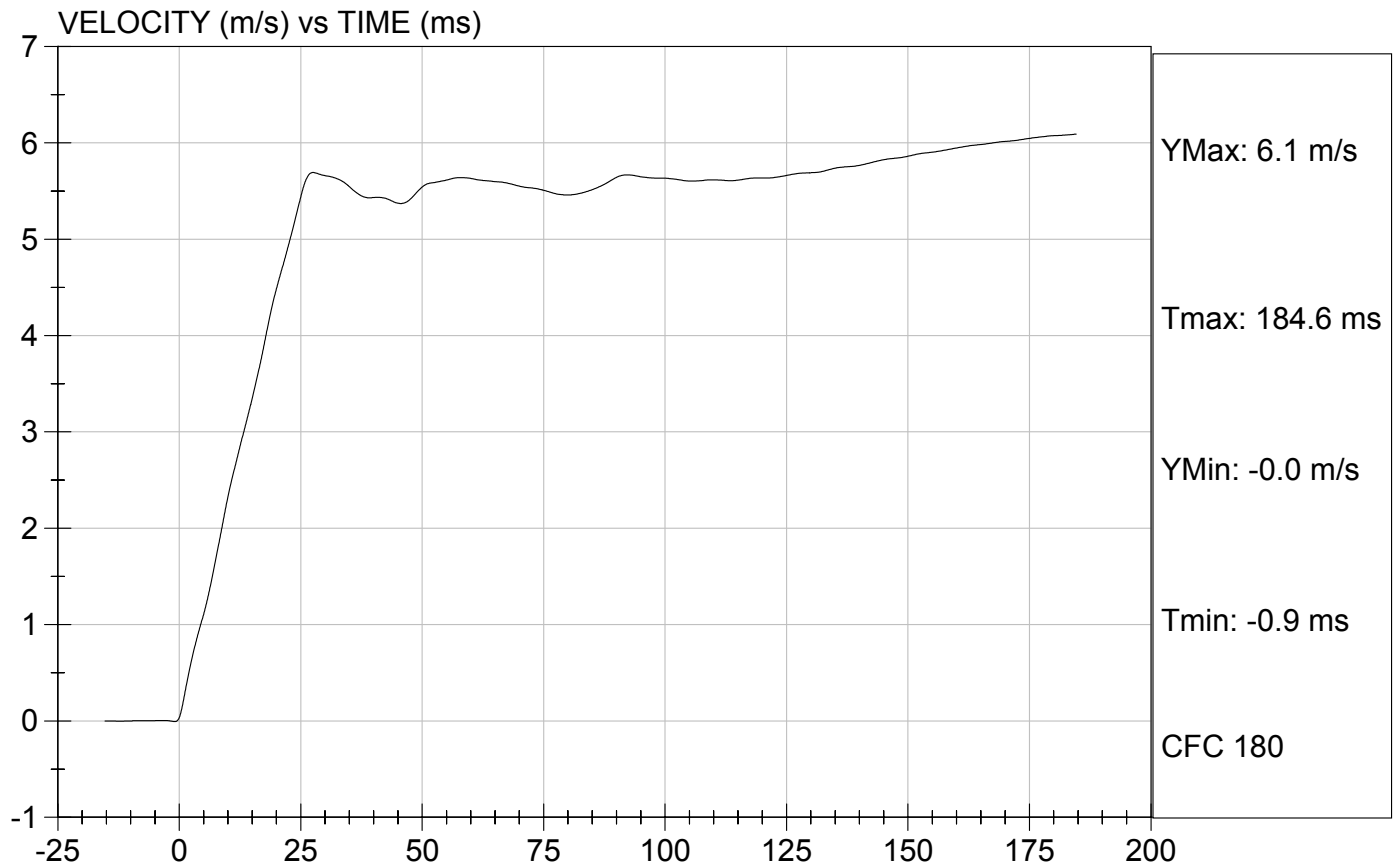


Test Description: Neck Flexion

Test Date: 08/06/2004

Component: D041812

Speed: 17.98 ft/sec, 5.48 m/sec





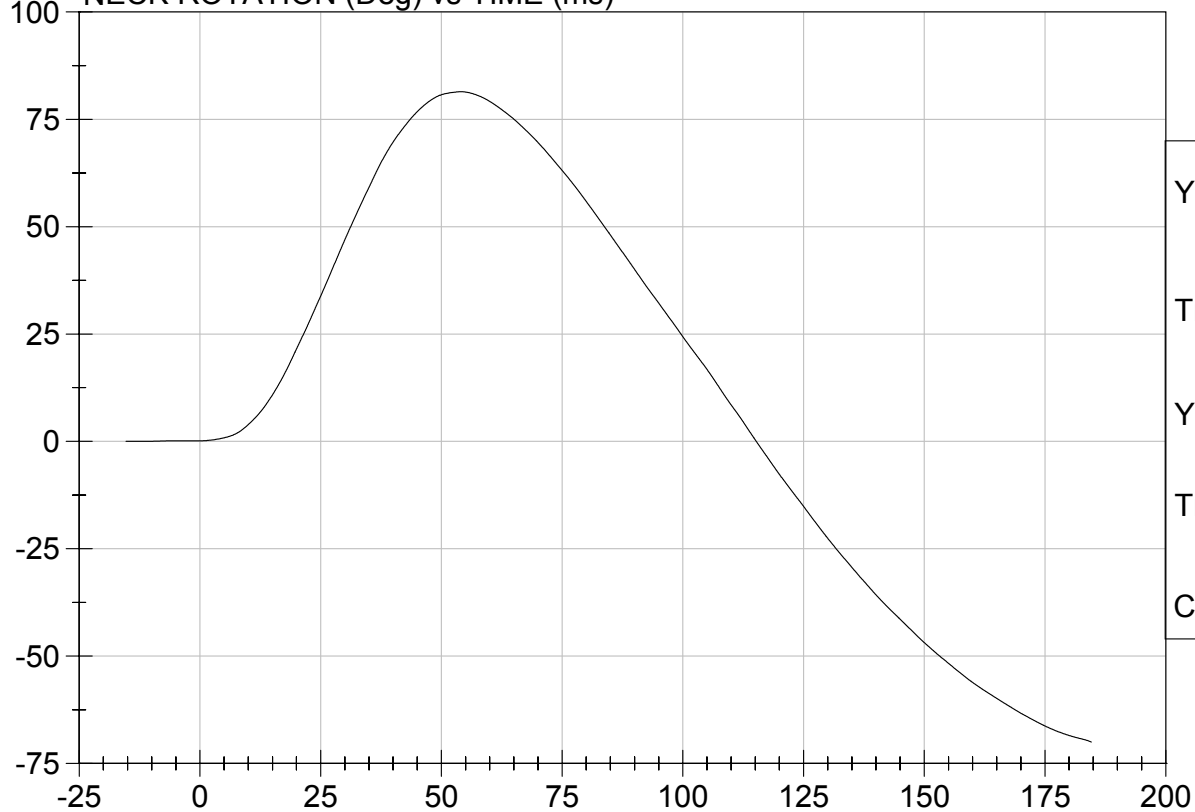
Test Description: Neck Flexion

Test Date: 08/06/2004

Component: D041812

Speed: 17.98 ft/s, 5.48 m/s

NECK ROTATION (Deg) vs TIME (ms)



YMax: 81.4 Deg

Tmax: 54.1 ms

YMin: -70.0 Deg

Tmin: 184.6 ms

CFC 60

NECK MOMENT Y (Nm) vs TIME (ms)



YMax: 43.8 Nm

Tmax: 47.5 ms

YMin: -16.0 Nm

Tmin: 11.4 ms

CFC 600

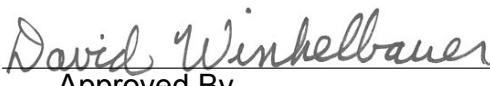
Hybrid III Calibration Data Sheet
3 Year Old
Neck Extension Test

ATD Serial No: 042

Test I.D: D041813

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.9	Pass
Laboratory Relative Humidity		%	10 to 70	44	Pass
Pendulum Speed		m/s	3.55 to 3.75	3.75	Pass
Pendulum Deceleration	6 msec	m/s	1.0 - 1.4	1.3	Pass
	10 msec	m/s	1.9 - 2.5	2.2	Pass
	14 msec	m/s	2.8 - 3.5	2.9	Pass
D Plane Rotation		deg	83 - 93	85	Pass
Peak Moment within Deflection Corridor		Nm	-53.3 - -43.7	-45.9	Pass
Negative Moment - Time Curve Decay to -10 Nm		msec	60.0 - 80.0	69.1	Pass
Overall Test Results					Pass


 Laboratory Technician


 Approved By

08/06/2004

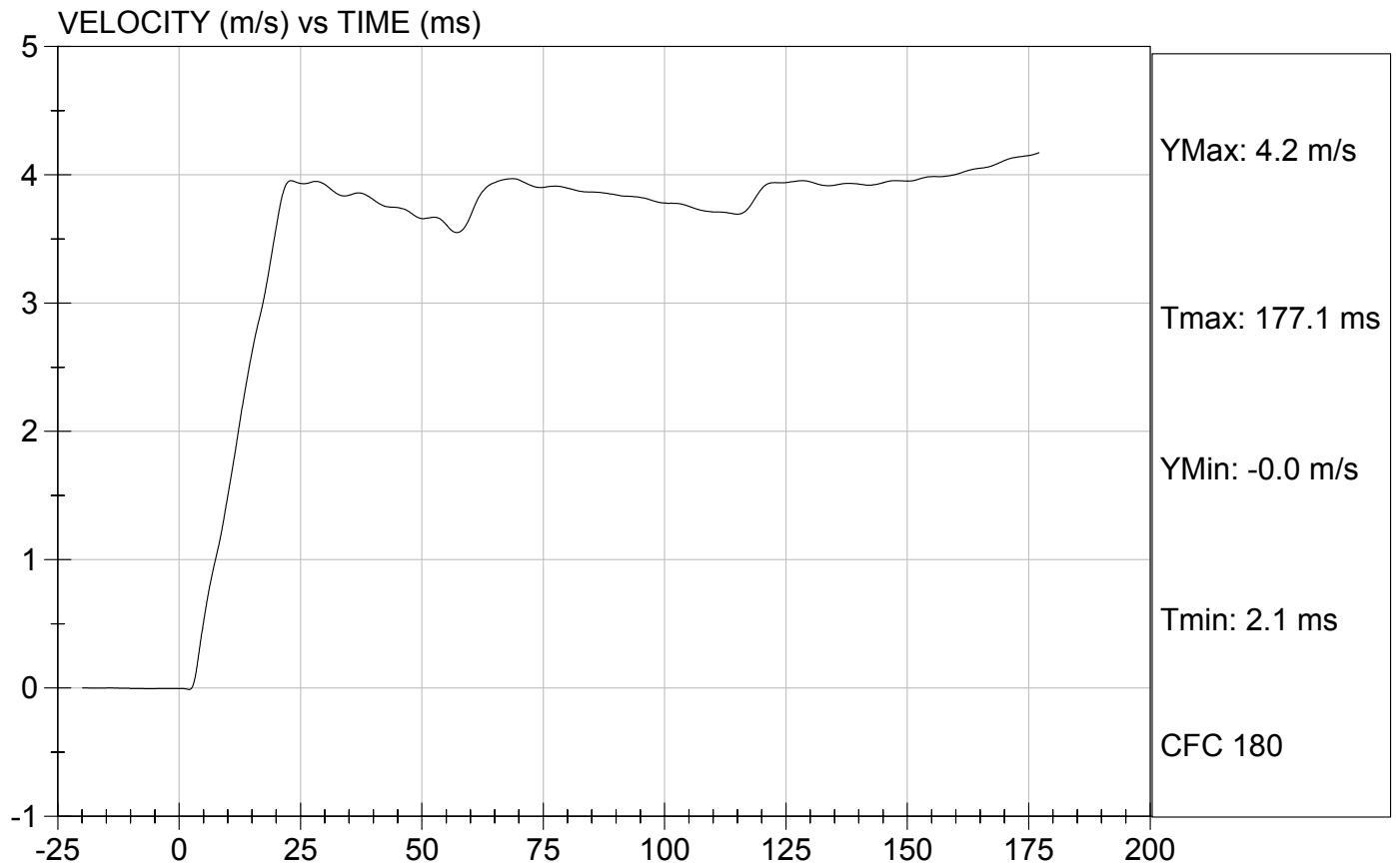
Test Date



Test Description: Neck Extension Test Date: 08/06/2004

Component: D041813

Speed: 12.29 ft/sec, 3.75 m/sec





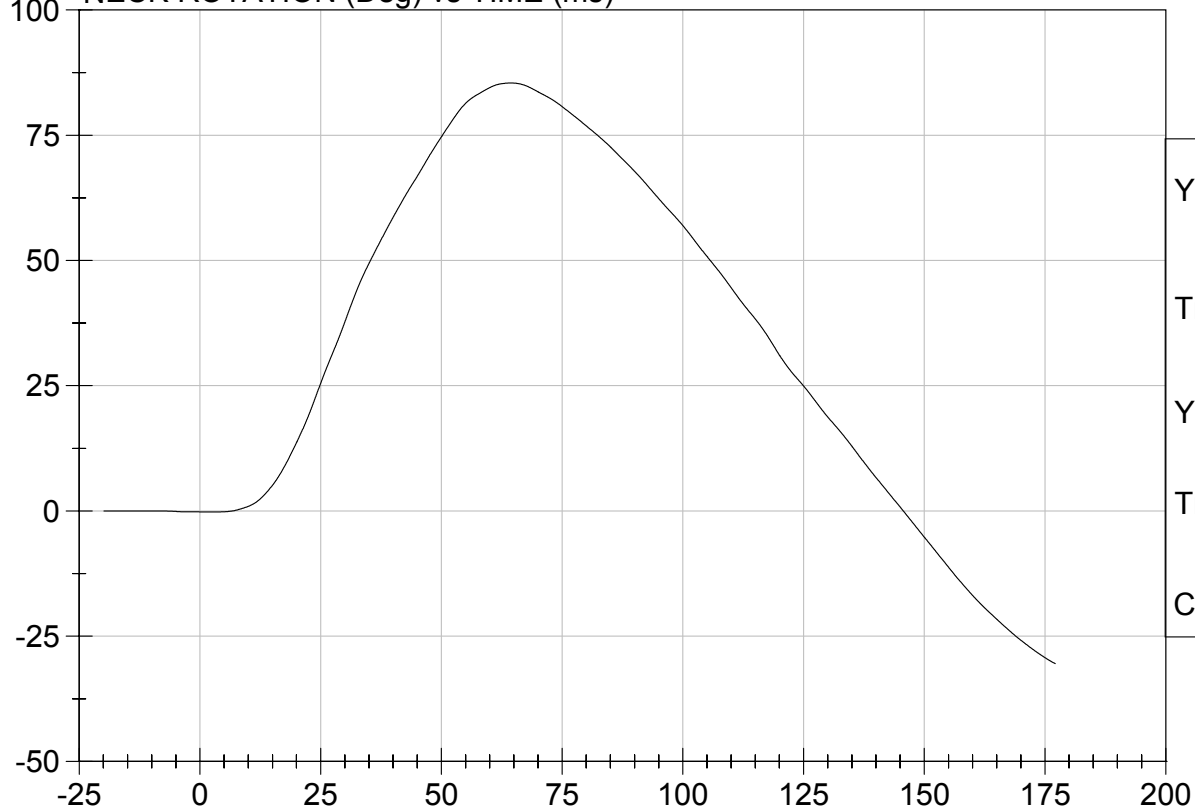
Test Description: Neck Extension

Test Date: 08/06/2004

Component: D041813

Speed: 12.29 ft/s, 3.75 m/s

NECK ROTATION (Deg) vs TIME (ms)



YMax: 85.4 Deg

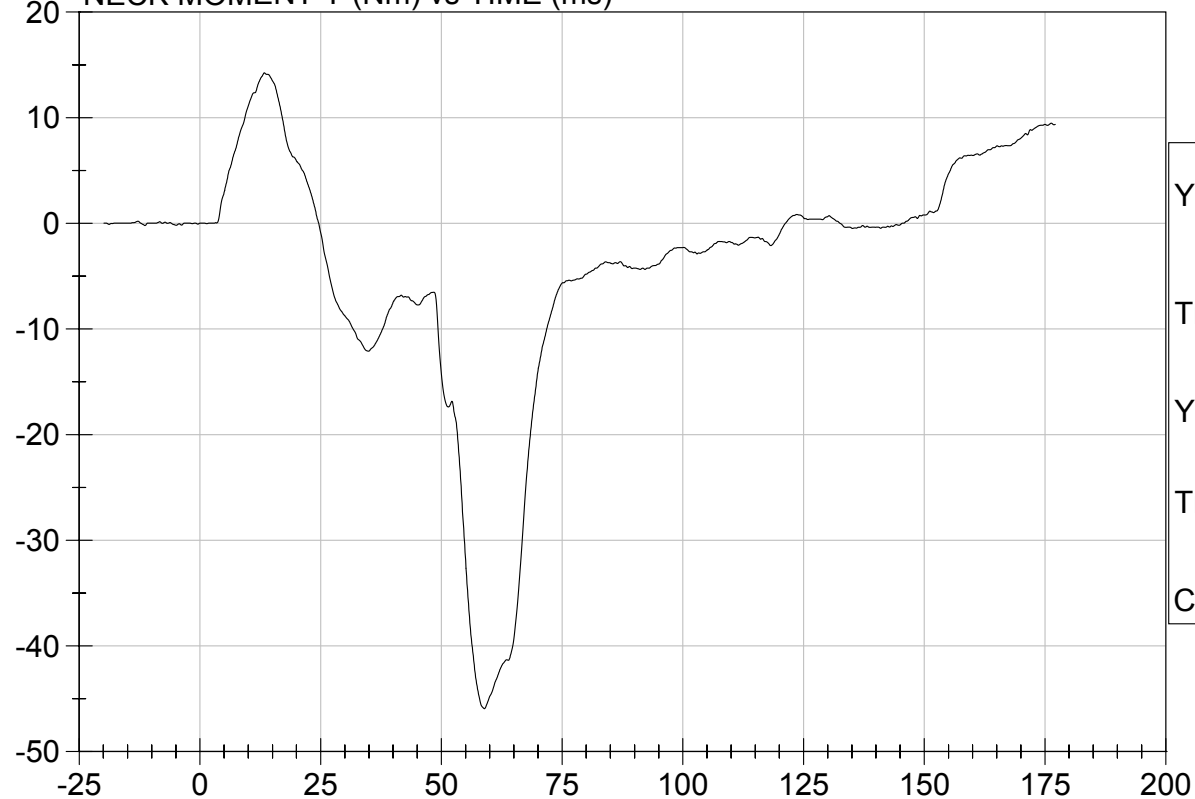
Tmax: 64.4 ms

YMin: -30.5 Deg

Tmin: 177.1 ms

CFC 60

NECK MOMENT Y (Nm) vs TIME (ms)



YMax: 14.2 Nm

Tmax: 13.3 ms

YMin: -45.9 Nm

Tmin: 58.9 ms

CFC 600

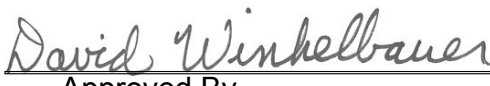
Hybrid III Calibration Data Sheet
3 Year Old
Thorax Impact Test

ATD Serial No: 042

Test I.D: D041814

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.1	Pass
Laboratory Relative Humidity	%	10 to 70	43	Pass
Probe Velocity	m/s	5.9 to 6.1	5.9	Pass
Peak Deflection	mm	32 - 38	37	Pass
Peak Force w/in Deflection Corridor	kN	0.68 - 0.81	0.74	Pass
Internal Hysteresis	%	65 to 85	69	Pass
Max Force 12.5 mm - 32 mm Deflection	kN	Max 0.86	0.48	Pass
Overall Test Results				Pass


Laboratory Technician


Approved By

08/06/2004

Test Date

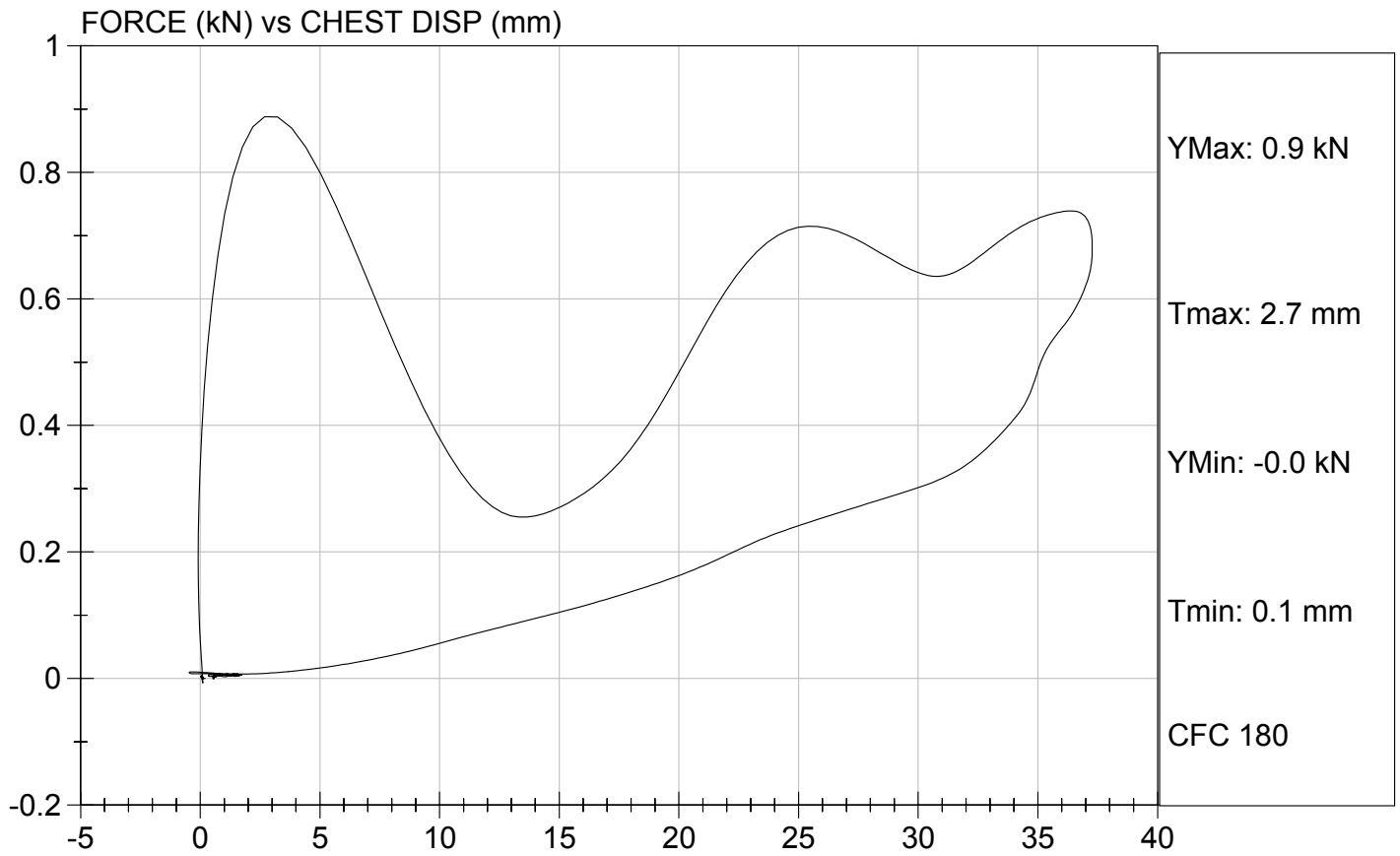


Test Description: Thorax Impact

Test Date: 08/06/2004

Component: D041814

Speed: 19.42 ft/sec, 5.92 m/sec



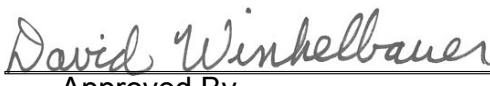
Hybrid III Calibration Data Sheet
3 Year Old
Torso Lumbar Flexion

ATD Serial No: 042

Test I.D: D041817

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.0	Pass
Laboratory Relative Humidity	%	10 to 70	42	Pass
Force At 45 deg.	N	130 - 180	172	Pass
Initial Angle	deg	0 - 15	4	Pass
Return Angle	deg	0 - 10	4	Pass
Overall Test Results				Pass


Laboratory Technician


Approved By

08/06/2004
Test Date

APPENDIX D

TEST EQUIPMENT LIST AND CALIBRATION INFORMATION

INSTRUMENTS FOR RRP CHILD DUMMY S/N: 042

	SERIAL NO.	MANUFACTURER	CALIBRATION DATE
Head X	B04-J12	Entran	9/15/04
Head Y	B05-J19	Entran	9/15/04
Head Z	A27-Z11	Entran	9/15/04
Upper Neck Load Cell	208	FTSS	5/13/04
Chest X	A27-Z23	Entran	9/15/04
Chest Y	A27-Z24	Entran	9/15/04
Chest Z	A27-Z13	Entran	9/15/04
Chest Deflection Gauge	042	Servo	8/06/04
Pelvis X	A27-Z19	Entran	9/15/04
Pelvis Y	A27-Z07	Entran	9/15/04
Pelvis Z	A27-Z16	Entran	9/15/04
RRP Tether Force	172	FTSS	8/18/04

INSTRUMENTS FOR VEHICLE AND CHILD SEAT

	SERIAL NO.	MANUFACTURER	CALIBRATION DATE
RRP Child Seat X	J07-M07	Entran	10/29/04
RRP Child Seat Y	J07-M03	Entran	10/29/04
RRP Child Seat Z	J07-M06	Entran	10/29/04
Right Rear Seat Back X	A29-J08	Entran	11/02/04
Right Rear Seat Back Y	A29-J01	Entran	11/02/04
Right Rear Seat Back Z	A29-F14	Entran	11/02/04