

REPORT NUMBER: NCAPCHILD-MGA-2004-003

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

**Evenflo Vanguard 5
Cosco Alpha Omega**

NHTSA NUMBER: F40200

**PREPARED BY:
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BURLINGTON, WI 53105**



Test Date: November 12, 2003

Report Date: December 16, 2003

FINAL REPORT

**PREPARED FOR:
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NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
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Manager, New Car Assessment Program

Date of Acceptance

COTR, NCAP Frontal Impact Program

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Technical Report Documentation Page

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16. Abstract The subjects CRS Evenflo Vanguard 5 and Cosco Alpha Omega were 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 November 12, 2003, in conjunction with frontal NCAP. <table border="1" style="margin: 10px auto; width: 80%; border-collapse: collapse;"> <tr> <th style="text-align: left;">Measurement Description</th> <th style="text-align: center;">Units</th> <th style="text-align: center;">Pos. 3 ATD</th> <th style="text-align: center;">Pos. 4 ATD</th> </tr> <tr> <td>Head Injury Criteria (HIC36)</td> <td style="text-align: center;">N/A</td> <td style="text-align: center;">607</td> <td style="text-align: center;">593</td> </tr> <tr> <td>Head Injury Criteria (HIC15)</td> <td style="text-align: center;">N/A</td> <td style="text-align: center;">272</td> <td style="text-align: center;">351</td> </tr> <tr> <td>Max. Thorax Accel. (3msec Clip)</td> <td style="text-align: center;">G's</td> <td style="text-align: center;">38</td> <td style="text-align: center;">49</td> </tr> </table>				Measurement Description	Units	Pos. 3 ATD	Pos. 4 ATD	Head Injury Criteria (HIC36)	N/A	607	593	Head Injury Criteria (HIC15)	N/A	272	351	Max. Thorax Accel. (3msec Clip)	G's	38	49
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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 56.6 kph 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

Both child dummies were instrumented with head, chest, and pelvic triaxial accelerometers. In addition, both dummies had six upper axial neck force and moment sensors.

The right rear (Position 3) child dummy (S/N 40) and left rear (Position 4) child dummy (S/N 42) were calibrated previous to this test. Child dummy certification information is found in Appendix C.

The right rear child dummy's HIC36 was 607; maximum chest deceleration over 3 msec was 38 g's. The left rear child dummy's HIC36 was 593. The maximum chest deceleration over 3 msec was 49 g's. Positions 3 and 4 were forward facing and used the vehicle LATCH and top tether for attachment.

**SECTION 2
DATA SHEET NO. 1
CRASH TEST SUMMARY**

TEST DUMMY INFORMATION

Description	Position 3 CRS	Position 4 CRS
Dummy Type / Serial No.	HIII 3 Year Old / 40	HIII 3 Year Old / 42
Number of Data Channels	22	22
Restraint System	Evenflo Vanguard 5 (Forward Facing)	Cosco Alpha Omega (Forward Facing)

CAMERA COVERAGE

High Speed	16
Real Time	1
Total	17

POST TEST DOOR OPENING

Description	Front	Rear
Left Side Doors	Door remained closed and latched; Door opened without tools	Door remained closed and latched; Door opened without tools
Right Side Doors	Door remained closed and latched; Door opened without tools	Door remained closed and latched; Door opened without tools
Hatch/Other Door	None	None

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
P4 (Left Rear)	0	None

VISIBLE DUMMY CONTACT POINTS

Description	Position 3 CRS (S/N 40)	Position 4 CRS (S/N 42)
Head Contact	None	None
Upper Torso Contact	None	None
Lower Torso Contact	None	None
Left Foot Contact	Passenger Seat Back	Back of Drivers seat
Right Foot Contact	Passenger Seat Back	Back of Drivers seat

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

Child Restraint System (Position 3)	Evenflo Vanguard 5
Child Restraint System (Position 4)	Cosco Alpha Omega
NHTSA No.	F40200

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value
Total Delivered Weight (UVW)	kg	1965.0
Weight of 2 P572E ATDs	kg	156.0
Rated Cargo/Luggage Weight (RCLW)	kg	68.0
Calculated Vehicle Target Weight (TVTW)	kg	2189.0

TEST VEHICLE WEIGHTS

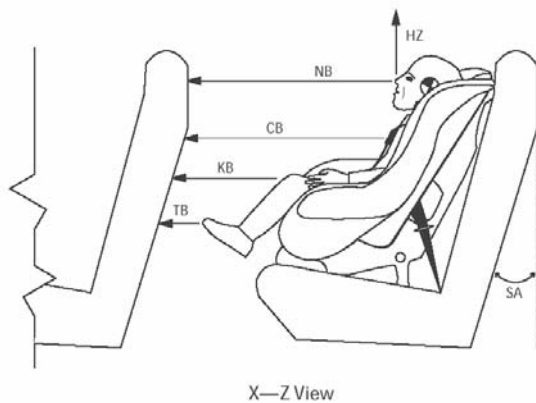
	Units	As Tested (ATW) (Axle)		
		Front	Rear	Total
Left	kg	644.6	463.1	
Right	kg	612.4	464.5	
Ratio	%	57.5	42.5	
Totals	kg	1257.0	927.6	2184.6

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

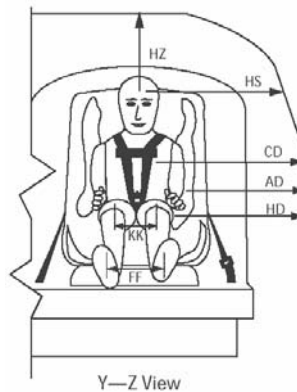
SECTION 2... (continued)
DATA SHEET NO. 3
CHILD DUMMY POSITIONING IN VEHICLE

Child Restraint System (Position 3)	Evenflo Vanguard 5 (Forward Facing)
NHTSA No.	F40200

Dummy Measurements for CRS Passengers



X—Z View



Y—Z View

X—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

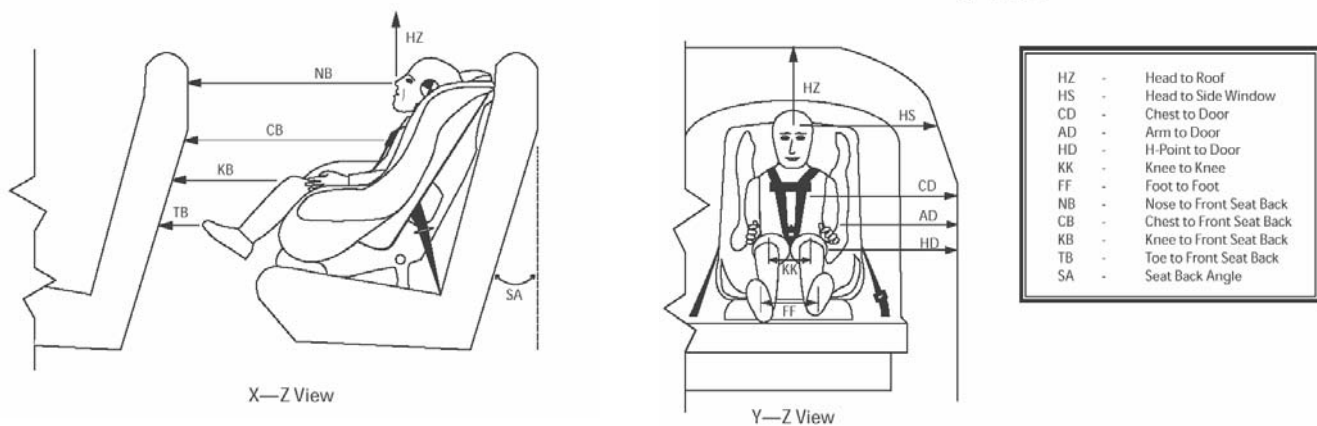
Measurement	Pre-Test (mm)	Post-Test (mm)
	P3 CRS (40)	P3 CRS (40)
SA (deg)	4.7°	4.7°
HS	528	514
CD	524	514
AD	373	358
HD	432	428
HZ	413	400
NB	564	562
CB	559	595
KK	156	170
FF	178	240
KB - LEFT	372	408
KB - RIGHT	376	390
TB - LEFT	94	175
TB - RIGHT	97	100

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

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

Child Restraint System (Position 4)	Cosco Alpha Omega (Forward Facing)
NHTSA No.	F40200

Dummy Measurements for CRS Passengers



Measurement	Pre-Test (mm)	Post-Test (mm)
	P4 CRS (42)	P4 CRS (42)
SA (deg)	4.7°	4.7°
HS	548	574
CD	543	539
AD	394	390
HD	448	448
HZ	405	410
NB	522	528
CB	524	547
KK	147	172
FF	153	205
KB - LEFT	335	338
KB - RIGHT	333	367
TB - LEFT	56	57
TB - RIGHT	50	60

All dimensions in mm (unless noted)
P4 – Left Rear Passenger (Forward facing)

SECTION 2... (continued)

DATA SHEET NO. 4 CHILD DUMMY INJURY CRITERIA VALUES

Child Restraint System (Position 3)	Evenflo Vanguard 5
Child Restraint System (Position 4)	Cosco Alpha Omega
NHTSA No.	F40200

HEAD PEAK ACCELERATIONS

Location	Axis	Units	Position 3				Position 4			
			Max	Time	Min	Time	Max	Time	Min	Time
Head CG	X	G's	20.3	200	-40.6	109	5.1	32	-37.2	103
Head CG	Y	G's	2.9	72	-30.7	109	22.6	113	-18.5	103
Head CG	Z	G's	48.7	90	-6.2	45	59.9	82	-7.9	47
Resultant	N/A	G's	65.9	109			61.6	83		

UPPER NECK PEAK FORCES AND MOMENTS

Location	Axis	Units	Position 3				Position 4			
			Max	Time	Min	Time	Max	Time	Min	Time
Neck Force	X	N	4	15	-679	123	7	20	-203	122
Neck Force	Y	N	13	160	-158	107	19	103	-22	77
Neck Force	Z	N	1732	89	-164	46	2554	88	-242	49
Resultant	N/A	N	1816	89			2557	88		
Neck Moment	X	N•m	2.2	164	-11.8	109	2.9	117	-1.0	85
Neck Moment	Y	N•m	4.6	81	-8.8	63	4.4	82	-5.9	60
Neck Moment	Z	N•m	2.7	88	-3.6	52	1.4	85	-1.5	111
Resultant	N/A	N•m	14.4	109			6.0	60		

CHEST PRIMARY PEAK ACCELERATIONS

Location	Axis	Units	Position 3				Position 4			
			Max	Time	Min	Time	Max	Time	Min	Time
Chest CG	X	G's	2.8	180	-31.2	97	3.3	167	-30.4	87
Chest CG	Y	G's	2.8	38	-11.5	95	3.0	106	-6.4	116
Chest CG	Z	G's	17.1	93	-29.2	65	28.1	90	-41.9	63
Resultant	N/A	G's	38.5	65			51.1	63		

CHEST PEAK DISPLACEMENTS

Location	Axis	Units	Position 3				Position 4			
			Max	Time	Min	Time	Max	Time	Min	Time
Chest CG	X	mm			-17.6	124			-19.1	125

SECTION 2... (continued)

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

Child Restraint System (Position 3)	Evenflo Vanguard 5
Child Restraint System (Position 4)	Cosco Alpha Omega
NHTSA No.	F40200

TETHER FORCE

Location	Axis	Units	Position 3				Position 4			
			Max	Time	Min	Time	Max	Time	Min	Time
Tether Force	N/A	N	722	105			616	66		

PELVIC PEAK ACCELERATIONS

Location	Axis	Units	Position 3				Position 4			
			Max	Time	Min	Time	Max	Time	Min	Time
Pelvis	X	G's	7.0	149	-34.2	64	10.4	162	-38.1	63
Pelvis	Y	G's	1.9	195	-12.3	79	10.8	70	-10.4	62
Pelvis	Z	G's	6.4	200	-30.9	63	13.1	93	-45.2	61
Resultant	N/A	G's	45.7	63			59.7	61		

HEAD PEAK REDUNDANT ACCELERATIONS

Location	Axis	Units	Position 3				Position 4			
			Max	Time	Min	Time	Max	Time	Min	Time
Head CG	X	G's	18.7	200	-41.8	109	1.2	22	-36.8	103
Head CG	Y	G's	0.5	160	-30.7	109	23.0	113	-18.4	103
Head CG	Z	G's	48.4	89	-5.8	45	60.0	82	-5.9	49
Resultant	N/A	G's	65.7	109			62.1	82		

CHEST PEAK REDUNDANT ACCELERATIONS

Location	Axis	Units	Position 3				Position 4			
			Max	Time	Min	Time	Max	Time	Min	Time
Chest CG	X	G's	2.9	180	-30.8	98	3.3	167	-30.8	87
Chest CG	Y	G's	3.0	37	-11.3	98	4.1	106	-4.4	116
Chest CG	Z	G's	17.5	92	-29.7	65	28.0	90	-42.8	63
Resultant	N/A	G's	39.5	65			52.0	63		

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

Child Restraint System (Position 3)	Evenflo Vanguard 5
Child Restraint System (Position 4)	Cosco Alpha Omega
NHTSA No.	F40200

HEAD INJURY CRITERIA (HIC36)

Location	HIC	T ¹ (msec)	T ² (msec)	Average Acceleration (G's)
Position 3 - Right	607	75.0	111.0	49.1
Position 4 – Left	593	71.8	107.8	48.6

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	272	80.6	95.6	50.5
Position 4 – Left	351	76.5	91.5	55.9

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	38	63.3	66.3
Position 4 – Left	49	61.3	64.3

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

POSITION 3 NECK INJURY SUMMARIES

Nij V10	Nij
Ntf	0.7
Nte	0.8
Ncf	0
Nce	0.2

POSITION 4 NECK INJURY SUMMARIES

Nij V10	Nij
Ntf	1.1
Nte	0.8
Ncf	0
Nce	0.2

SECTION 2... (continued)

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

Child Restraint System (Position 3)	Evenflo Vanguard 5
Child Restraint System (Position 4)	Cosco Alpha Omega
NHTSA No.	F40200

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	

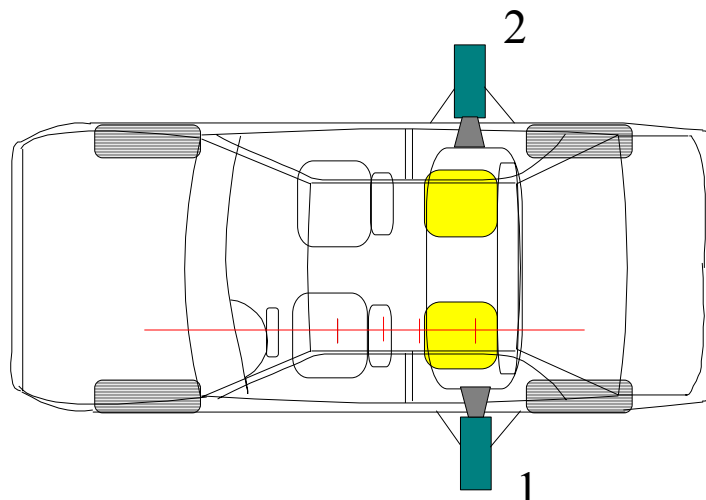
POSITION 4 CRS POST-TEST INSPECTION

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 Vanguard 5
Child Restraint System (Position 4)	Cosco Alpha Omega
NHTSA No.	F40200



No.	Camera View	Location (mm) *			Angle (deg)	Lens (mm)	Speed (fps)
		X	Y	Z			
1	Left Side CRS Lateral View					13	510
2	Right Side CRS Lateral View					13	526

*COORDINATES:

+X = film plane rearward of barrier

+Y = film plane to right of monorail centerline

+Z = film plane above ground level

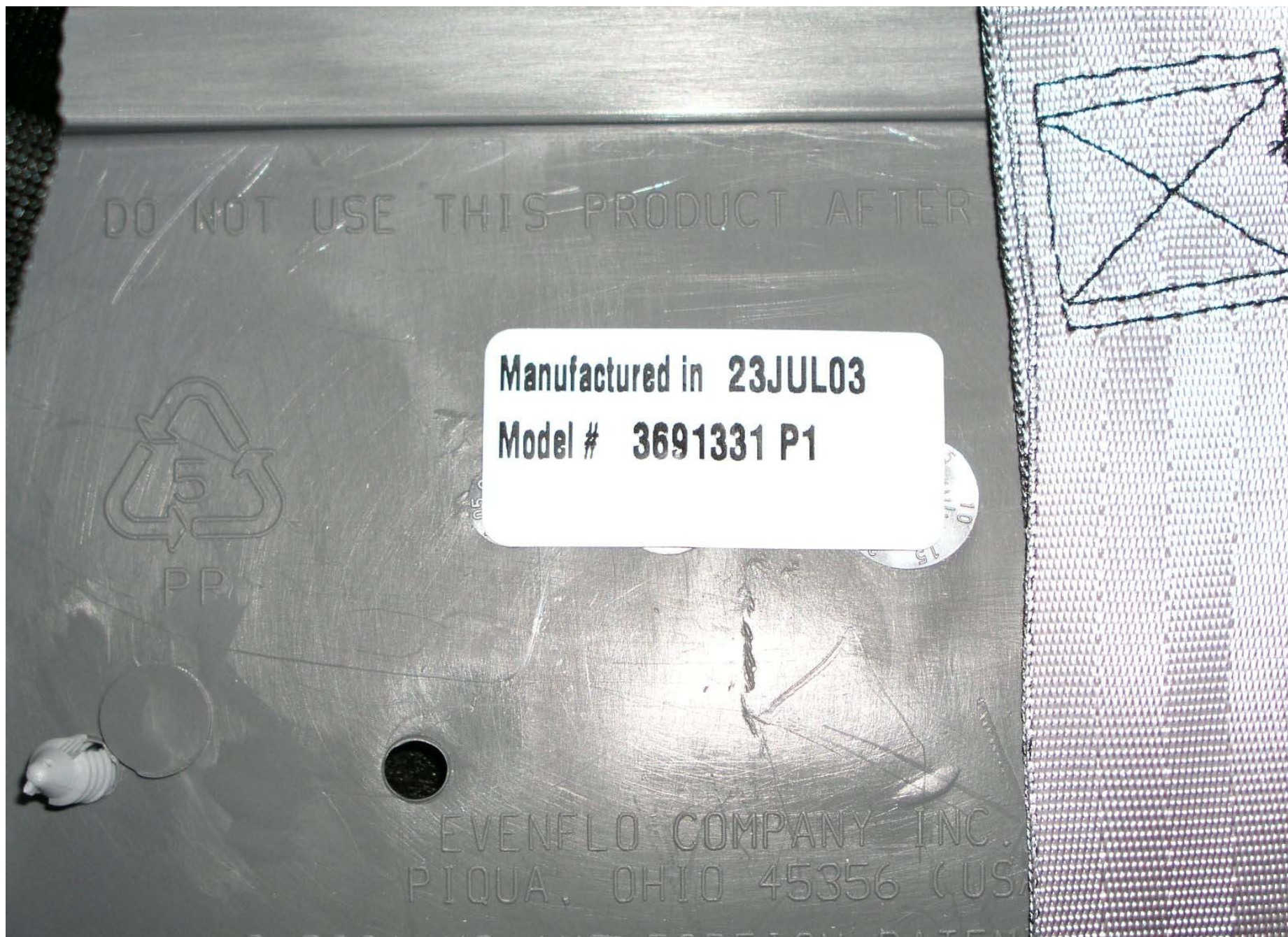
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A-1.



Close-up View of Position 3 CRS Label

A-2.



Pre-Test Frontal View of Position 3 CRS



Post-Test Front View of Position 3 CRS



Pre-Test Rear View of Position 3 CRS



Post-Test Rear View of Position 3 CRS



Pre-Test Left Side View of Position 3 CRS



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



Close-up View of Position 4 CRS Label

A-11.



Pre-Test Frontal View of Position 4 CRS



Post-Test Front View of Position 4 CRS

A-13.



Pre-Test Rear View of Position 4 CRS

A-14.



Post-Test Rear View of Position 4 CRS



Pre-Test Left Side View of Position 4 CRS



Post-Test Left Side View of Position 4 CRS



Pre-Test Right Side View of Position 4 CRS



Post-Test Right Side View of Position 4 CRS



Pre-Test Position 3 Left Side View



Post-Test Position 3 Left Side View



Pre-Test Position 4 Left Side View



Post-Test Position 4 Left Side View



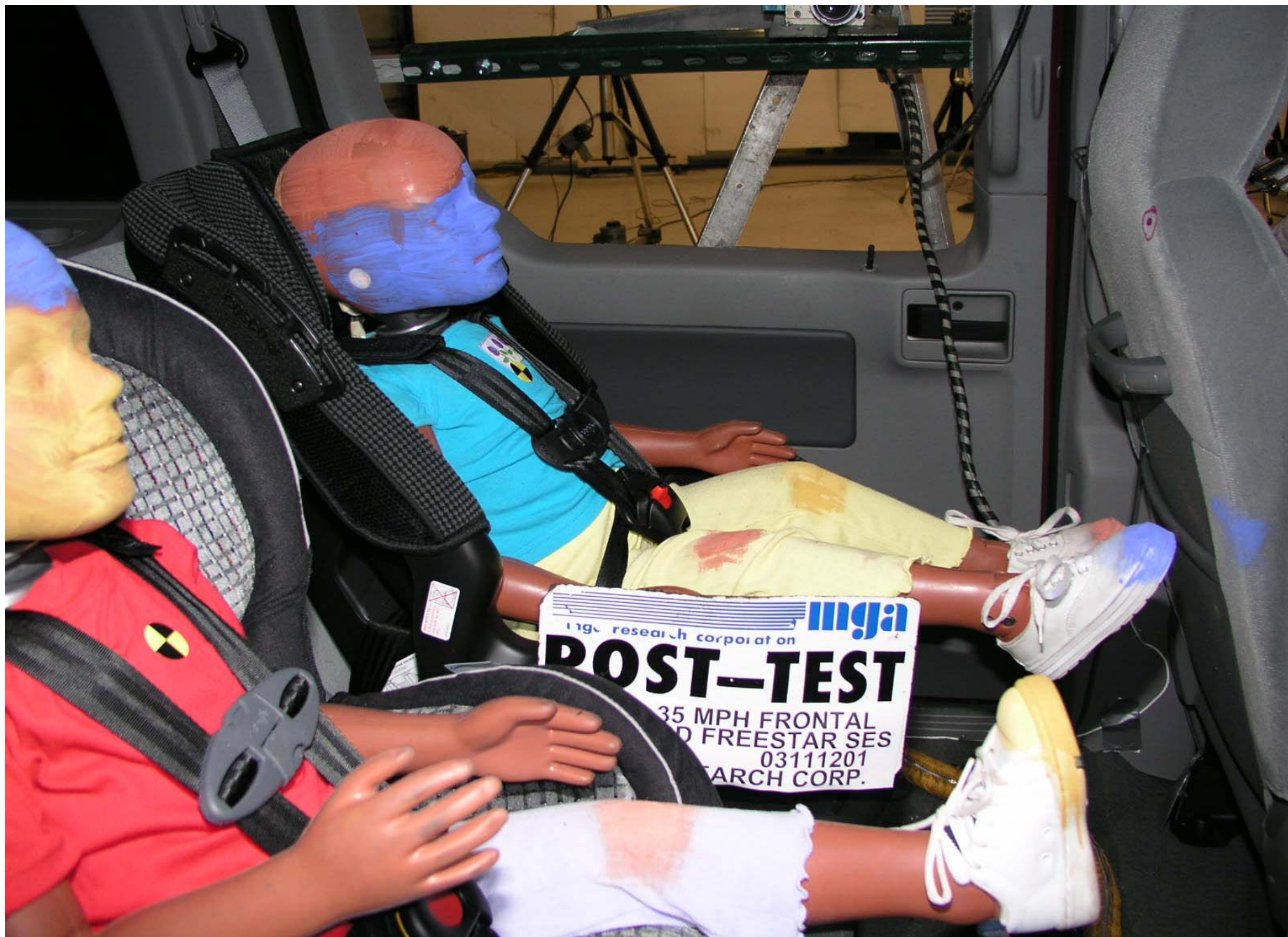
Pre-Test Position 3 Right Side View



Post-Test Position 3 Right Side View



Pre-Test Position 4 Right Side View



Post-Test Position 4 Right Side View



Pre-Test Position 3 Rear View



Post-Test Position 3 Rear View



Pre-Test Position 4 Rear View



Post-Test Position 4 Rear View



Post-Test Position 3 Foot Contact



Post-Test Position 4 Foot Contact

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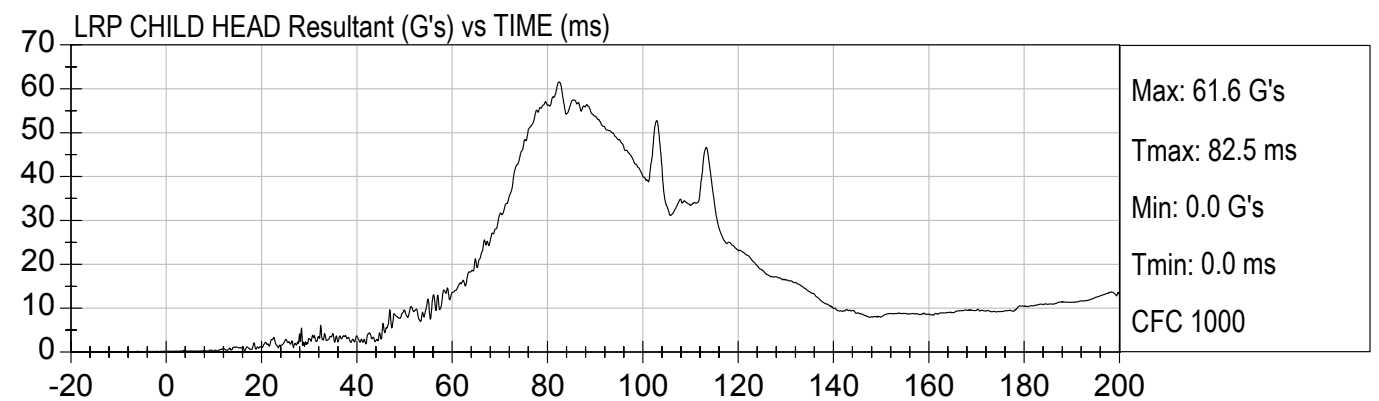
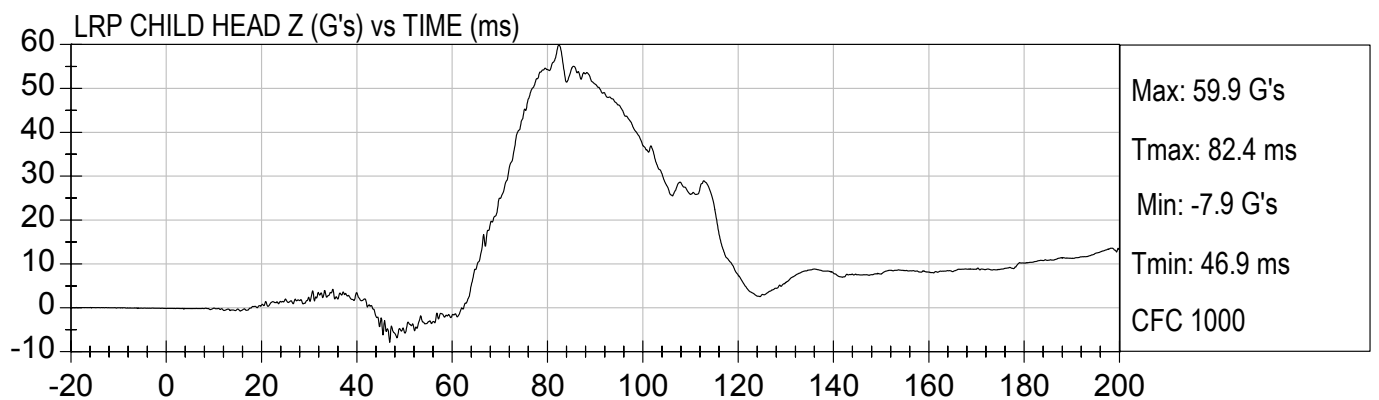
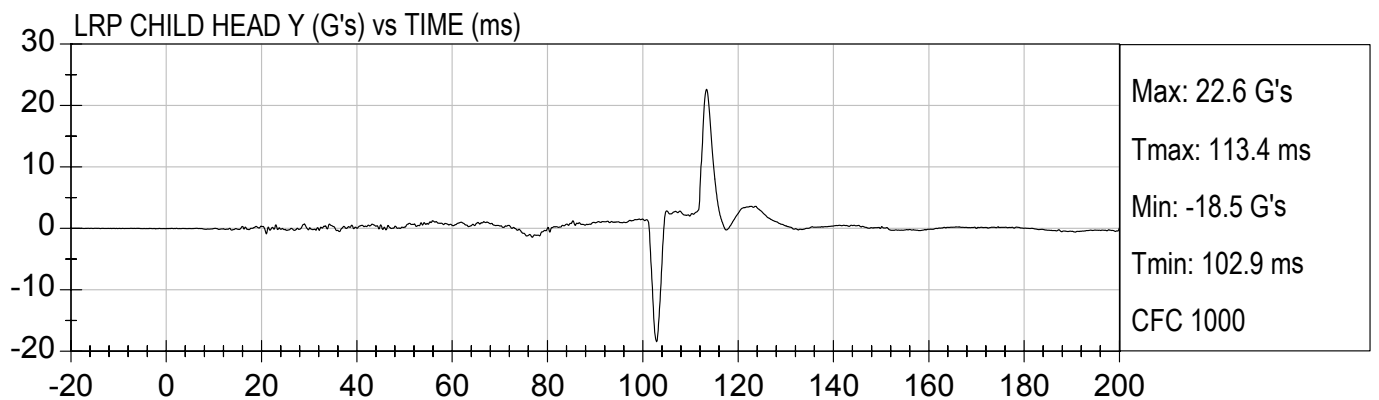
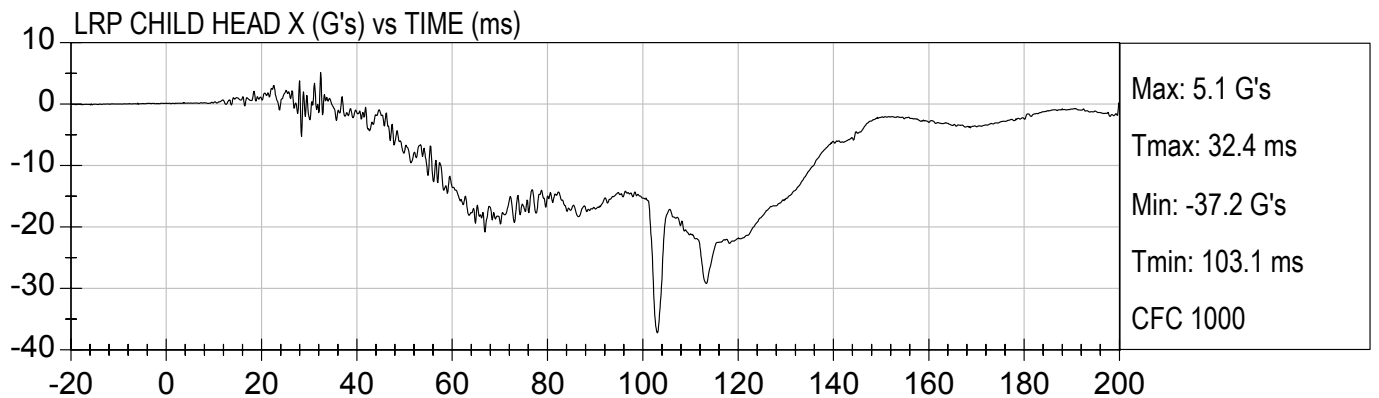
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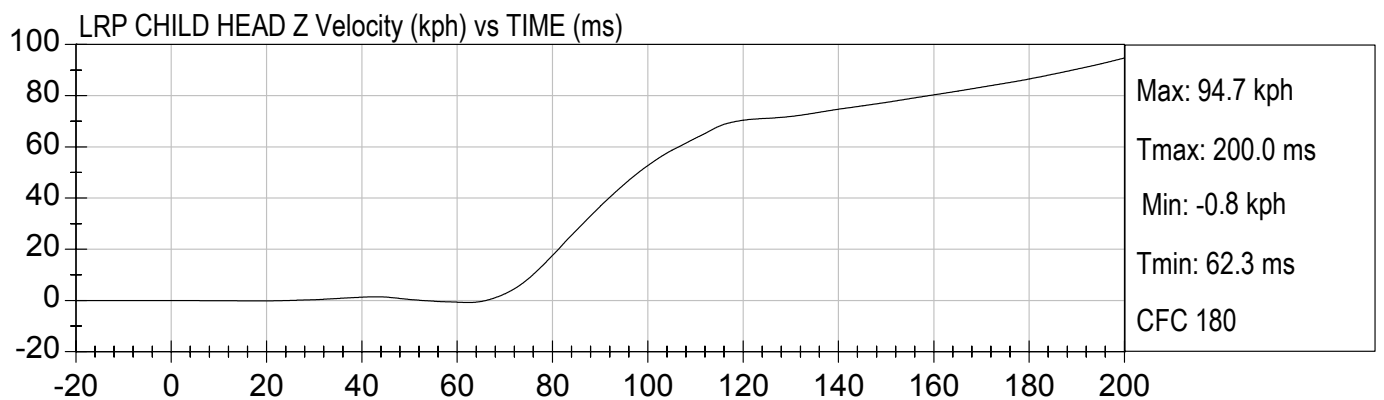
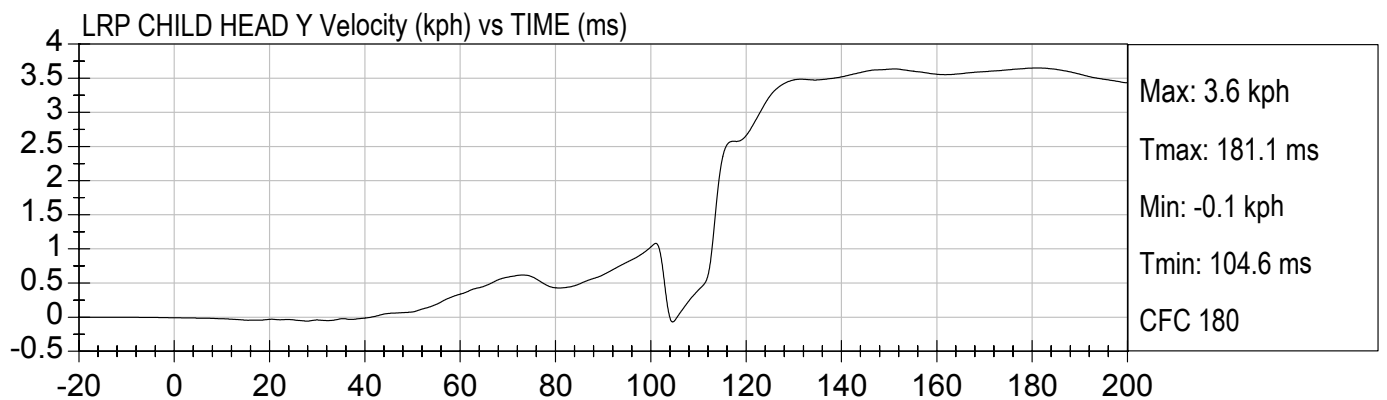
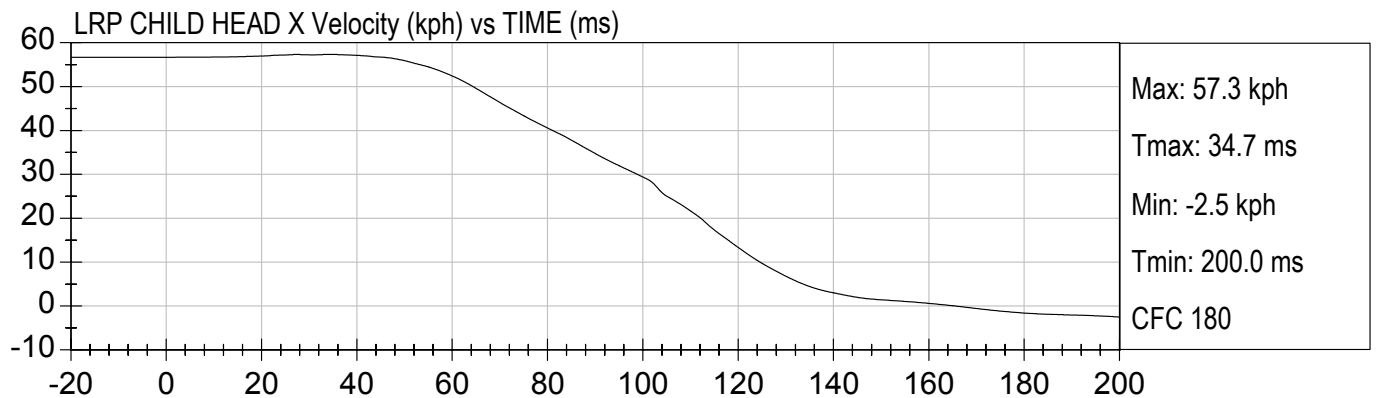
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35MPH NCAP FRONTAL
2004 FORD FREESTAR

Test Date: 11/12/2003
Speed: 35.2 mph (56.6 km/h)

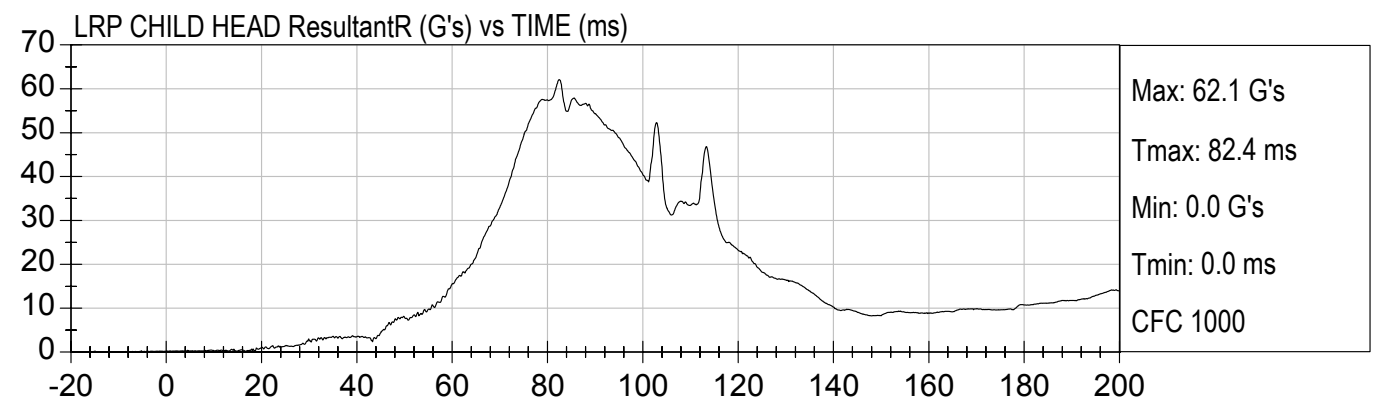
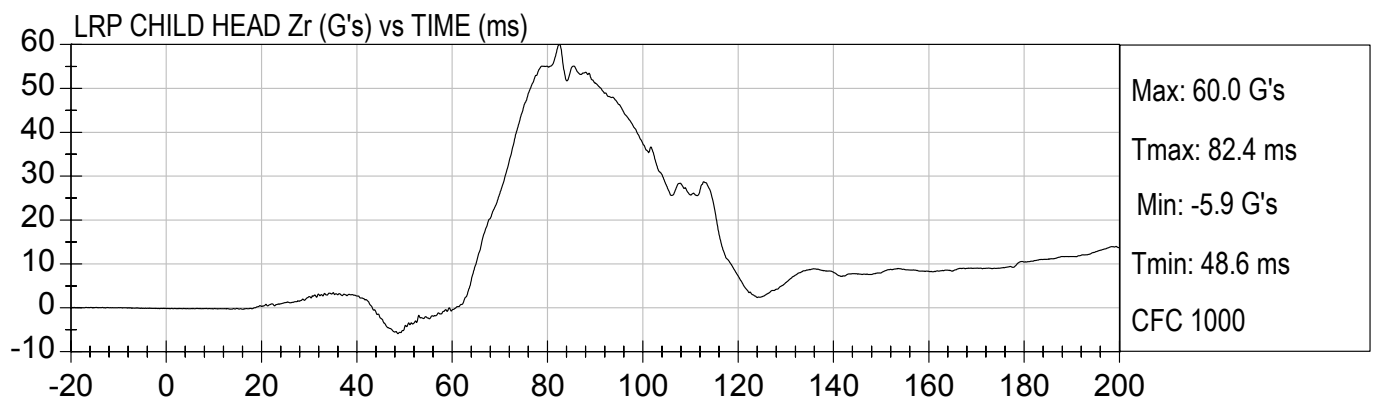
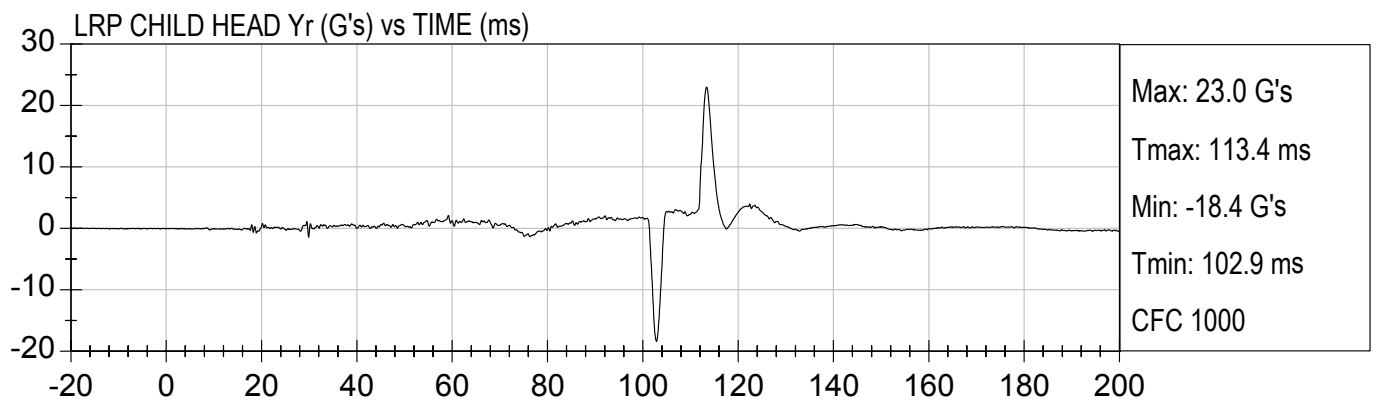
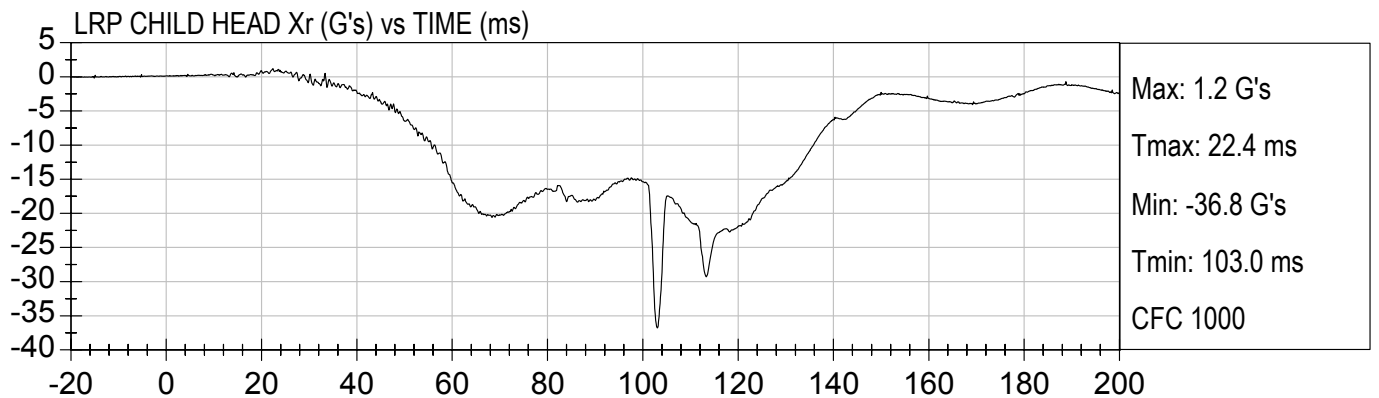


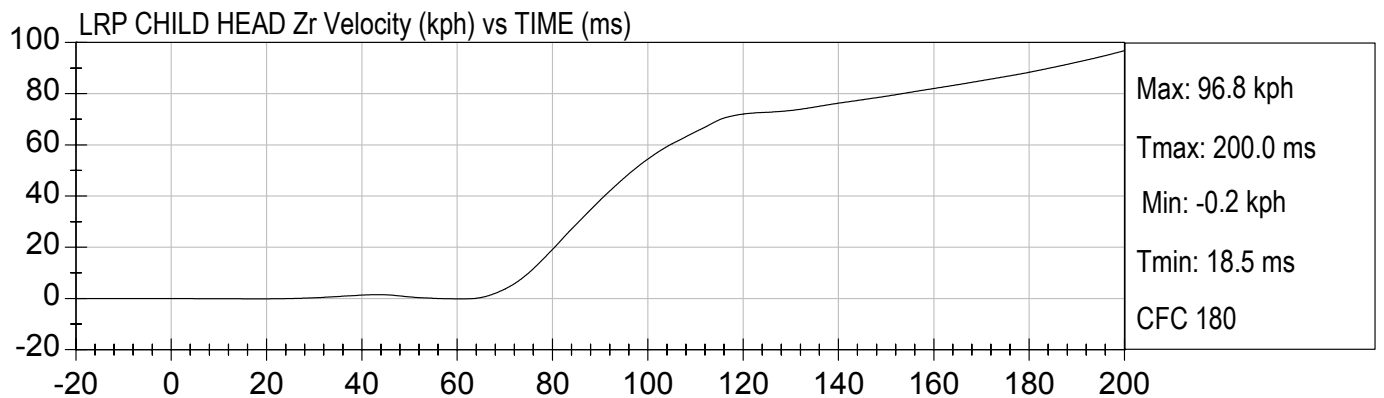
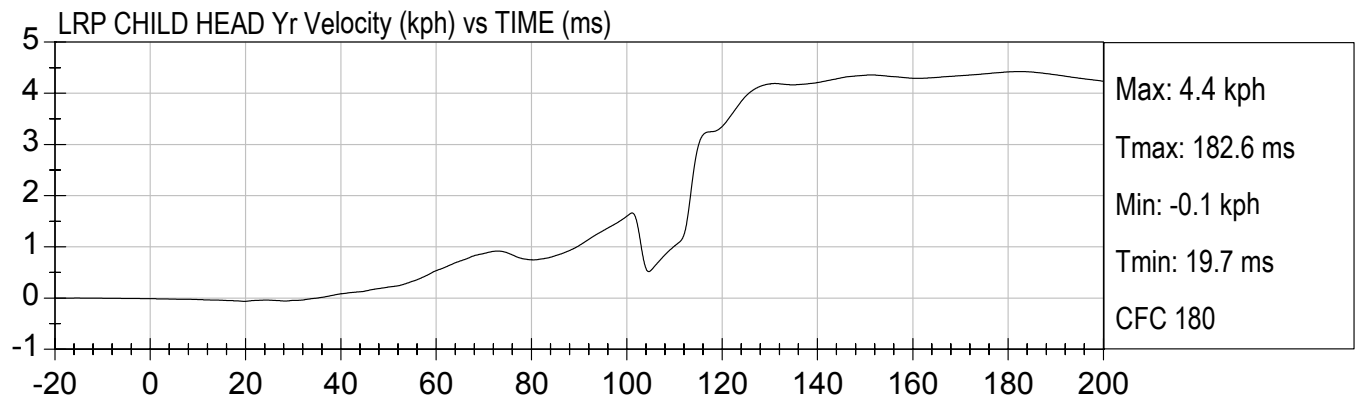
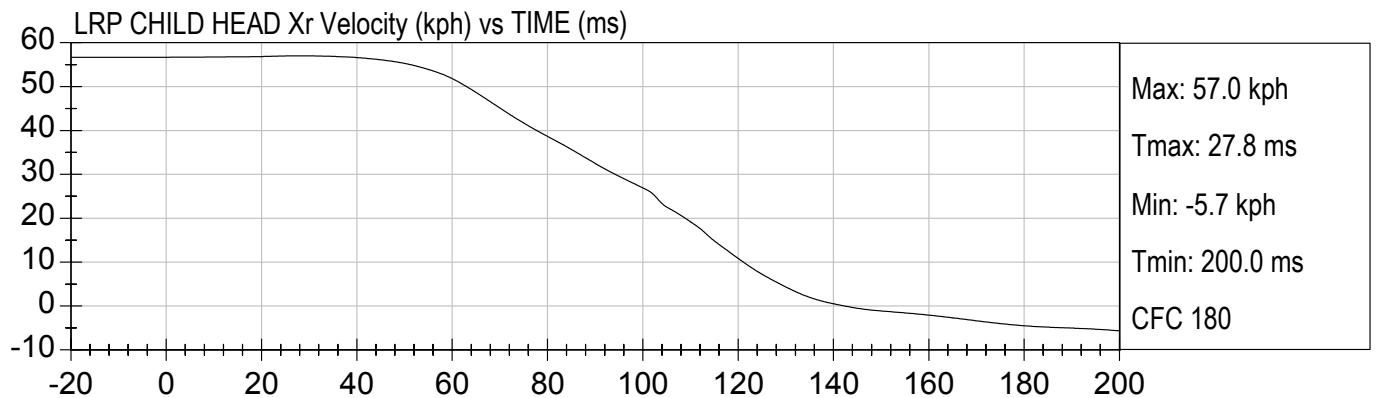




35MPH NCAP FRONTAL
2004 FORD FREESTAR

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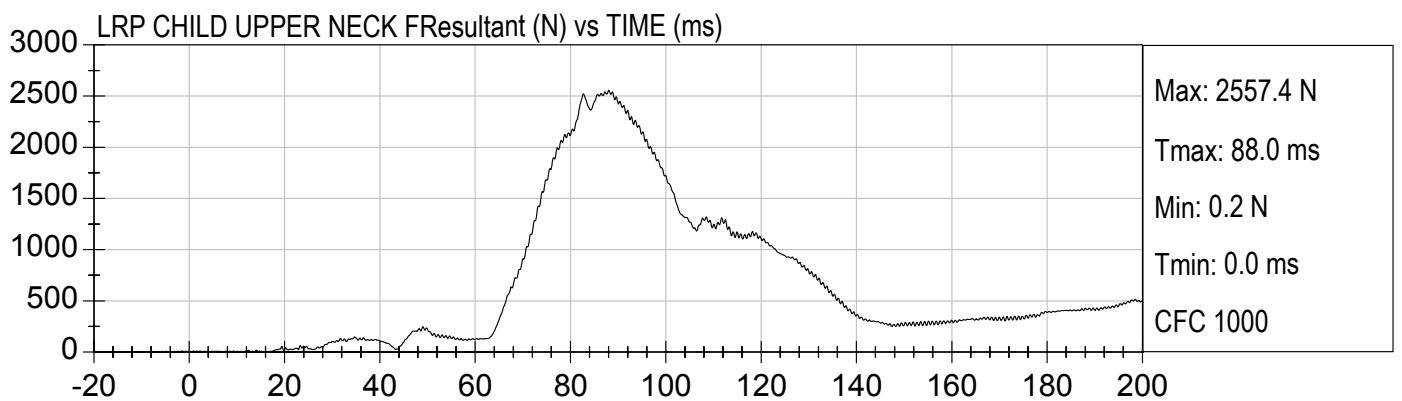
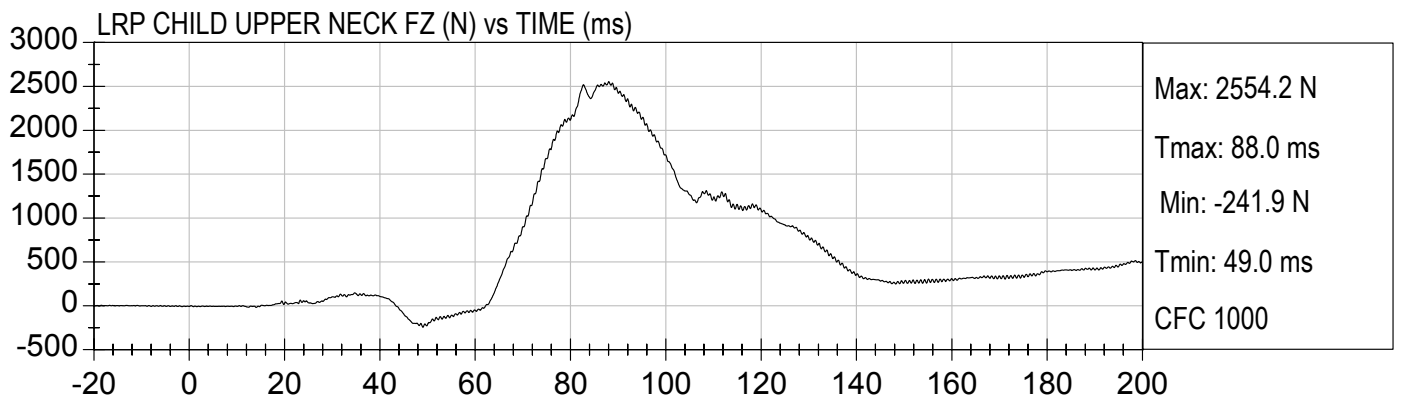
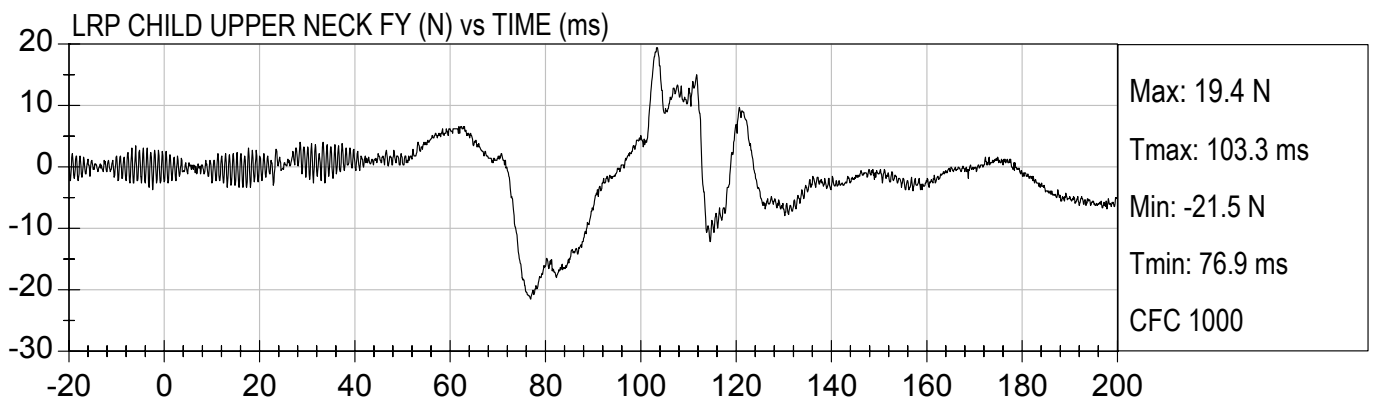
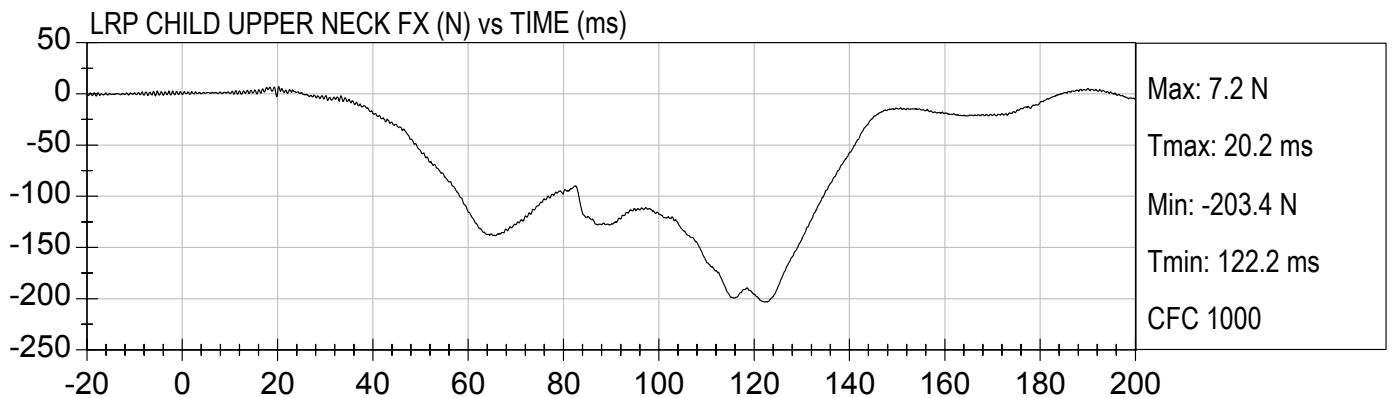






35MPH NCAP FRONTAL
2004 FORD FREESTAR

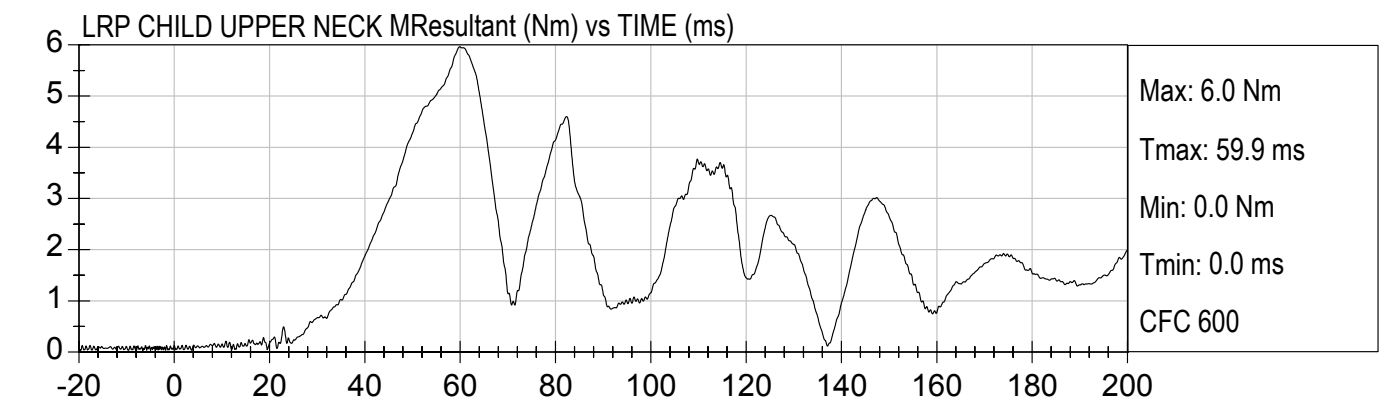
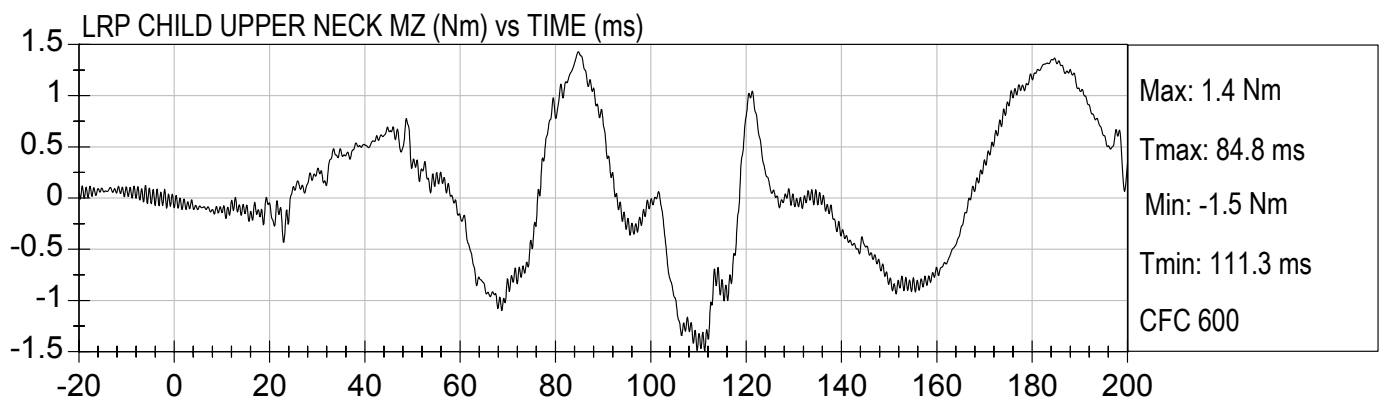
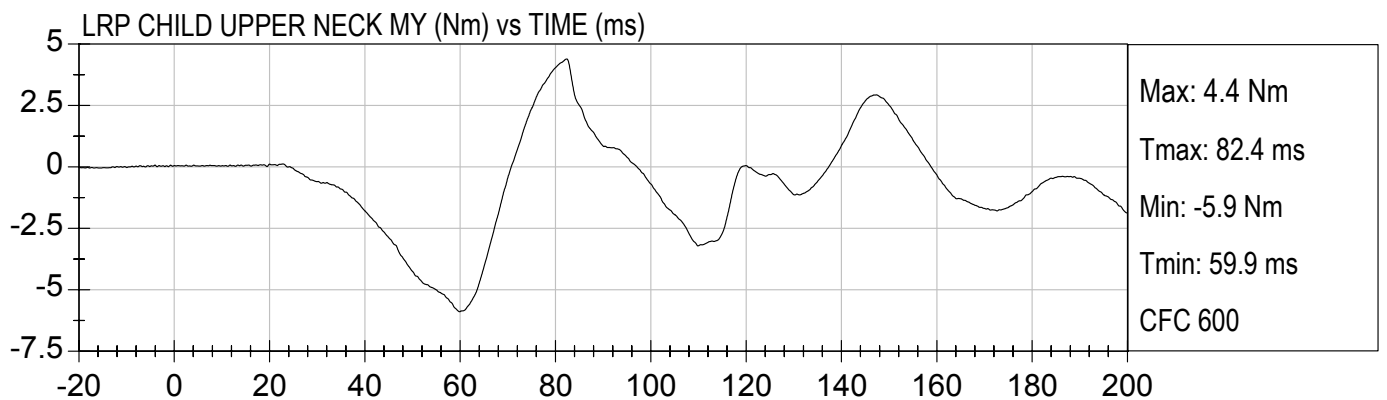
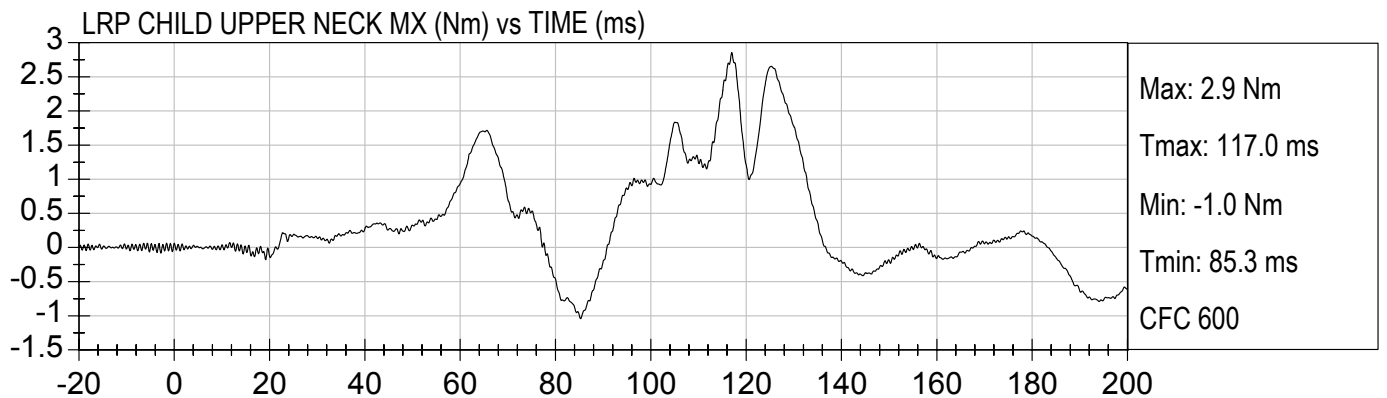
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Speed: 35.2 mph (56.6 km/h)





35MPH NCAP FRONTAL
2004 FORD FREESTAR

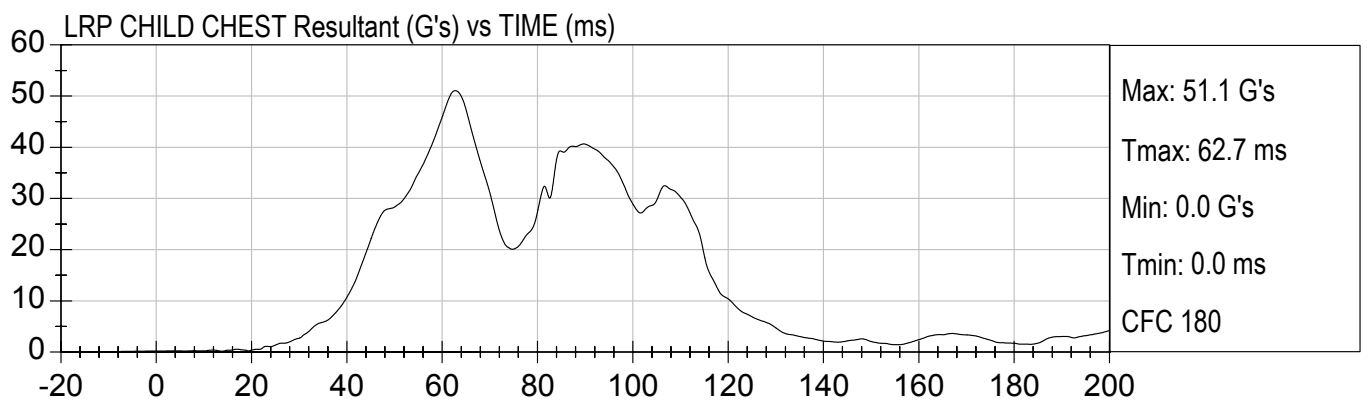
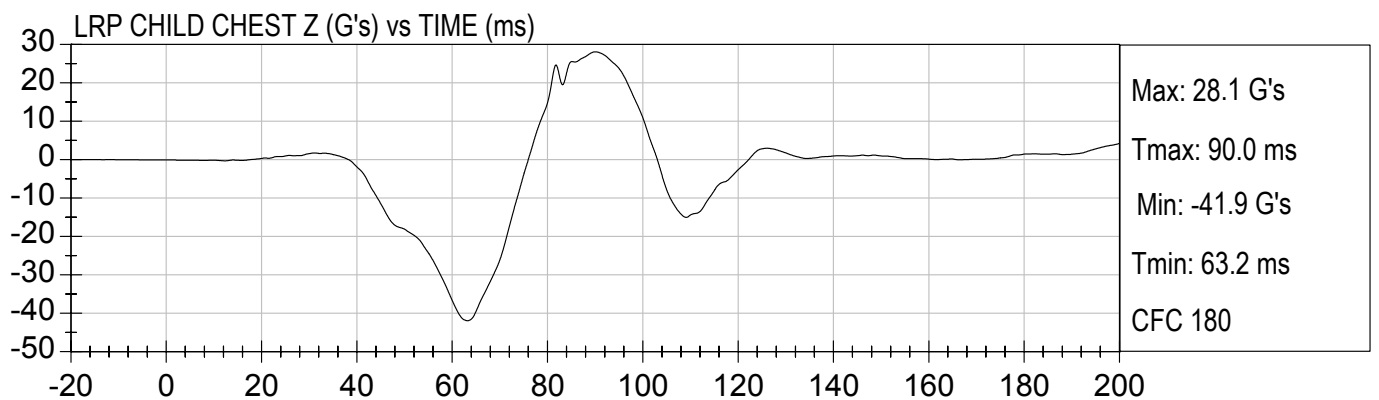
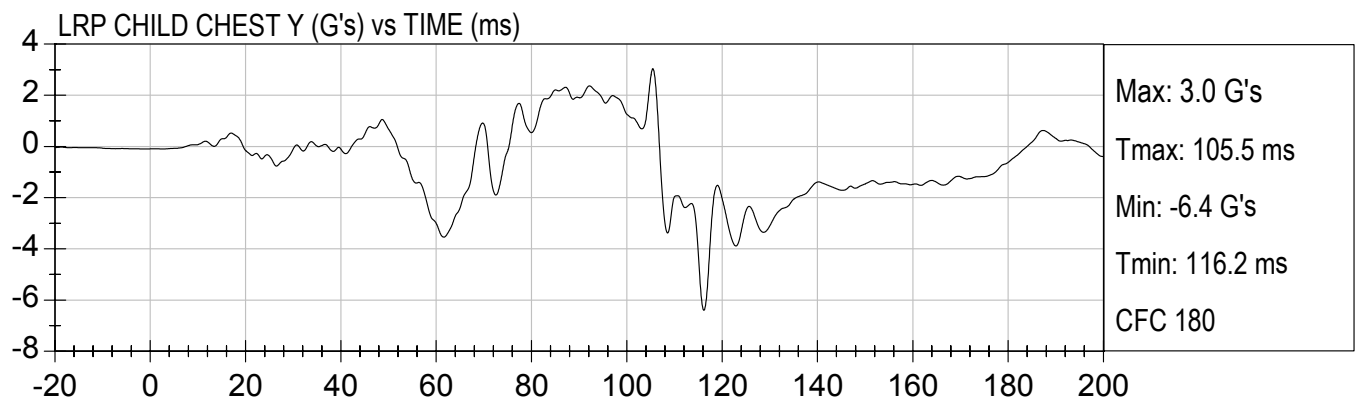
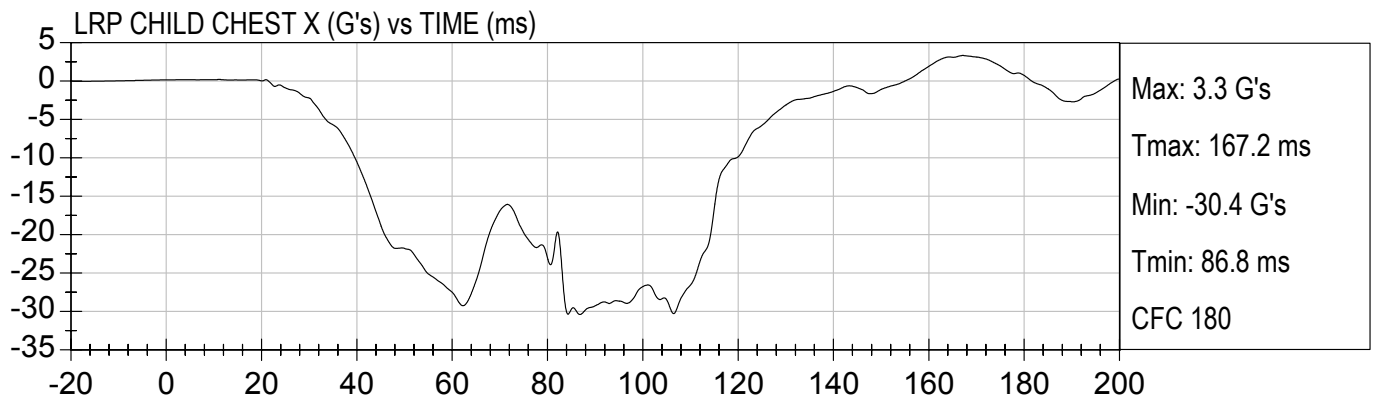
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35MPH NCAP FRONTAL
2004 FORD FREESTAR

Test Date: 11/12/2003
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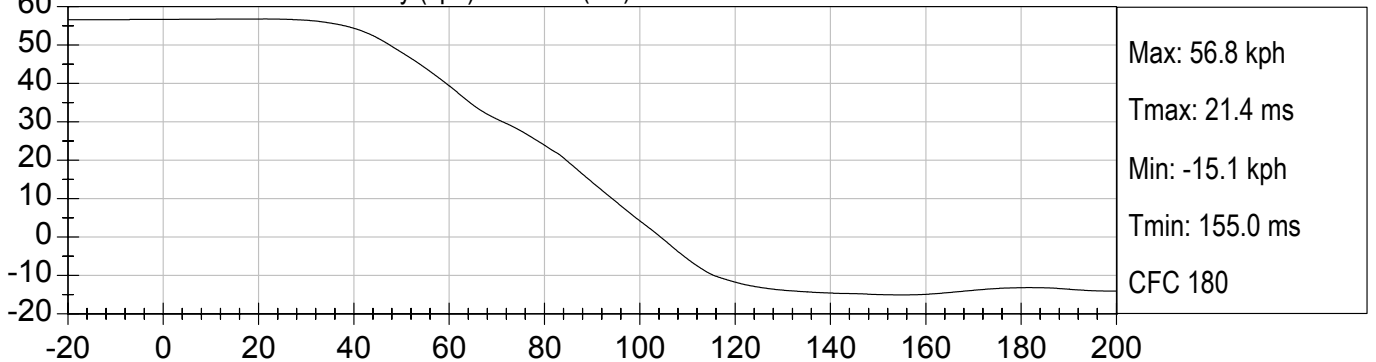




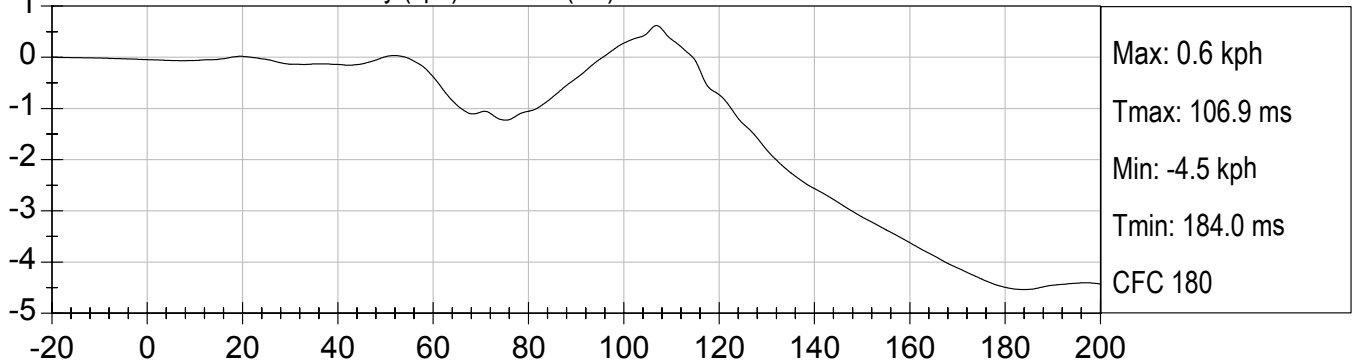
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2004 FORD FREESTAR

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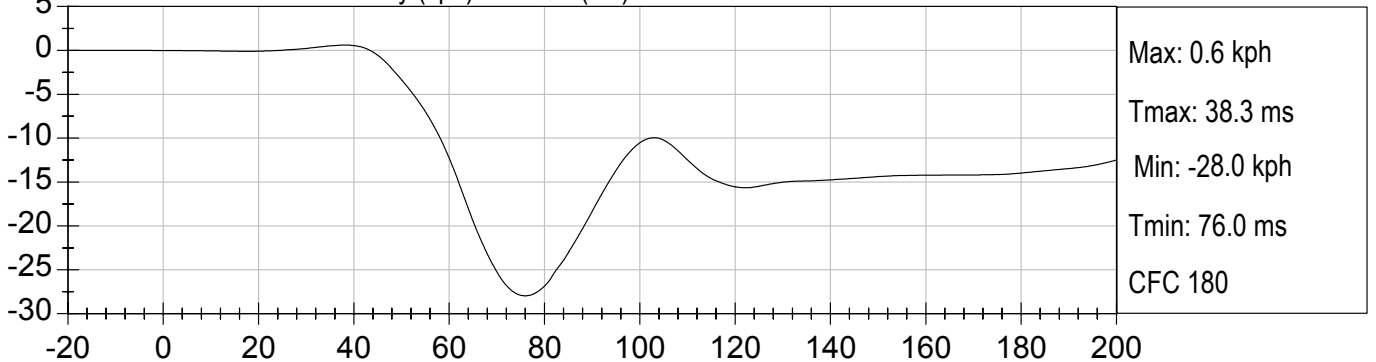
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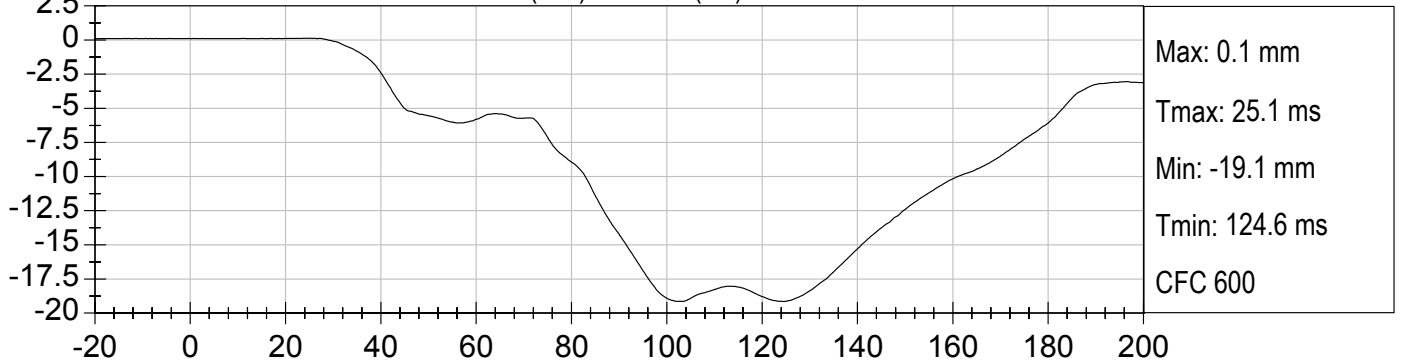
LRP CHILD CHEST Y Velocity (kph) vs TIME (ms)



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



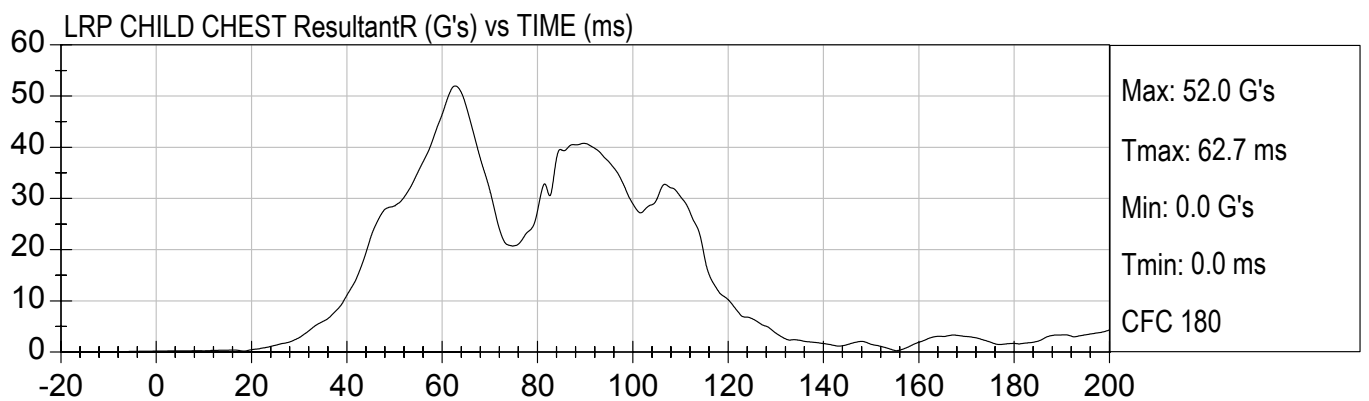
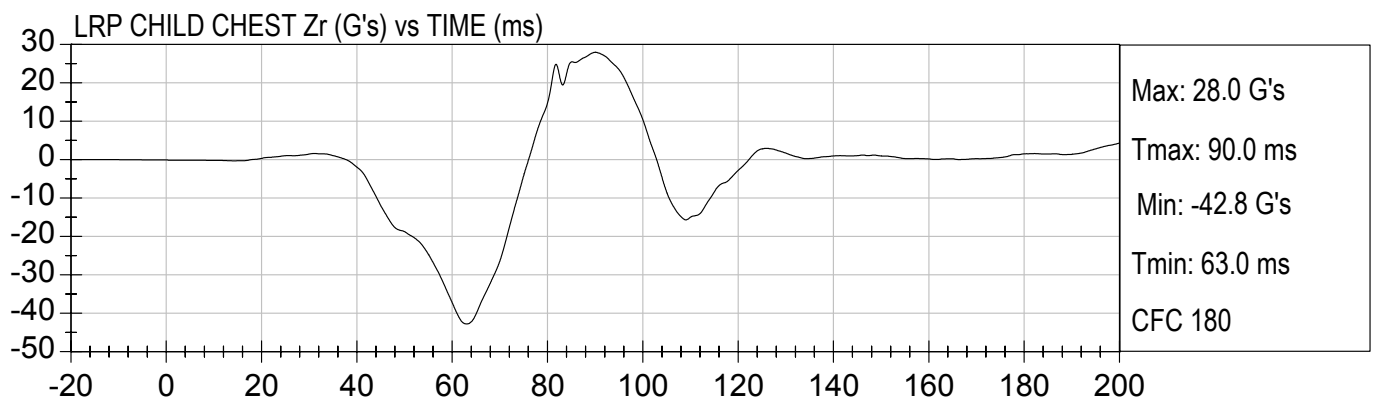
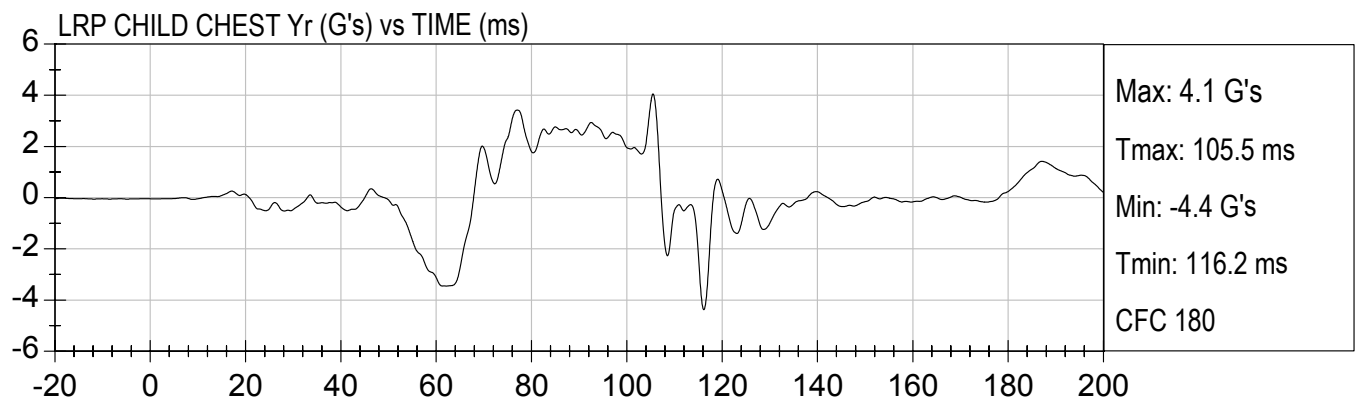
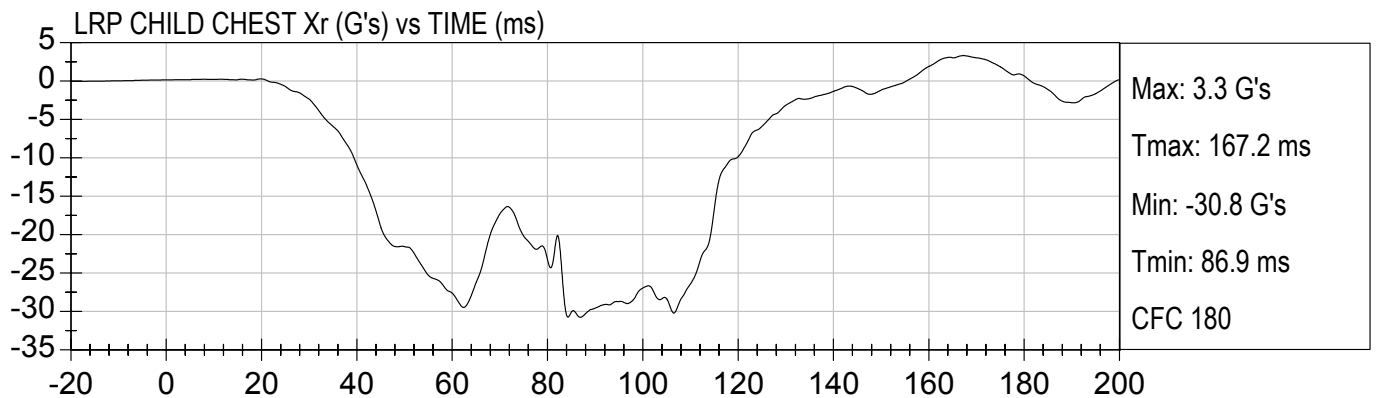
LRP CHILD CHEST DISPLACEMENT (mm) vs TIME (ms)

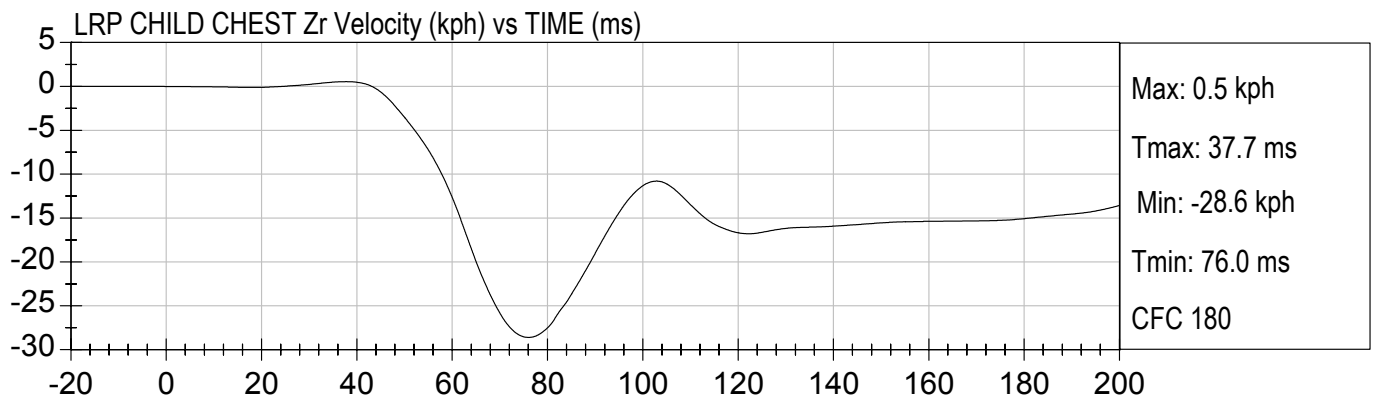
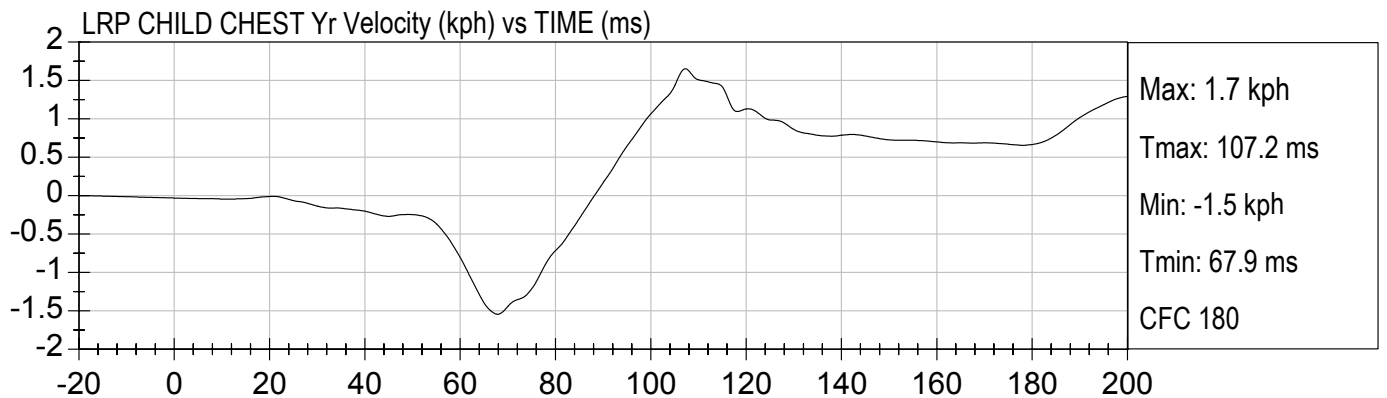
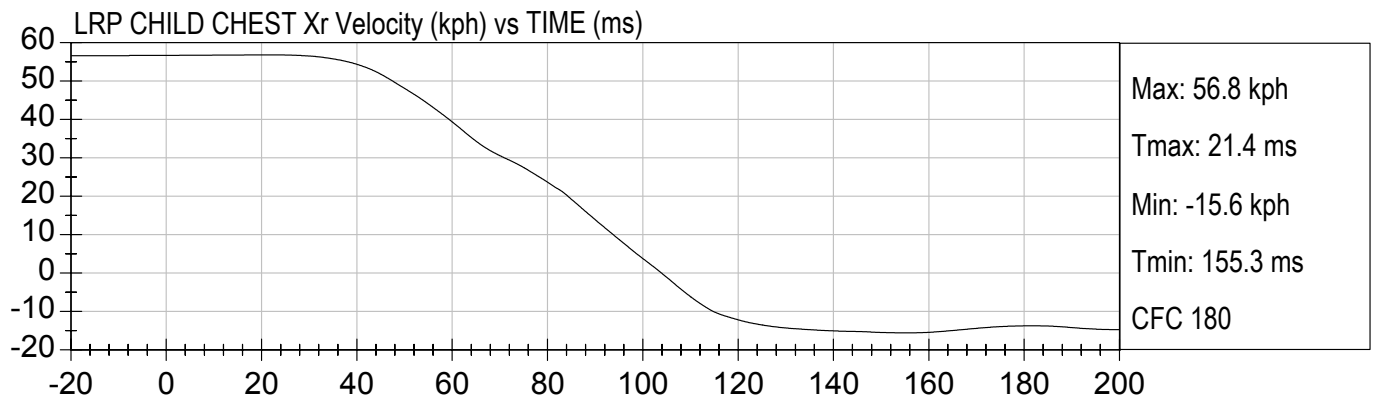




35MPH NCAP FRONTAL
2004 FORD FREESTAR

Test Date: 11/12/2003
Speed: 35.2 mph (56.6 km/h)

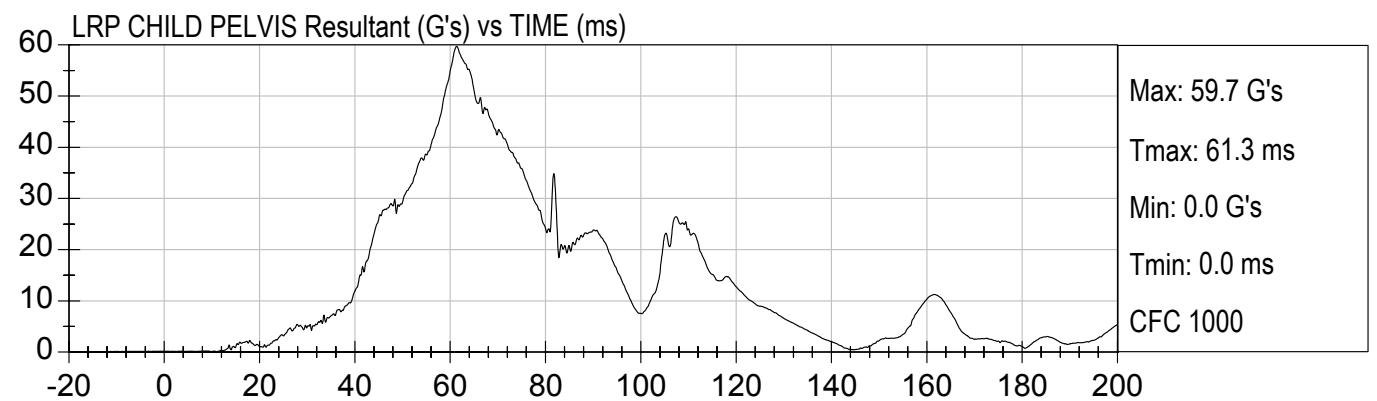
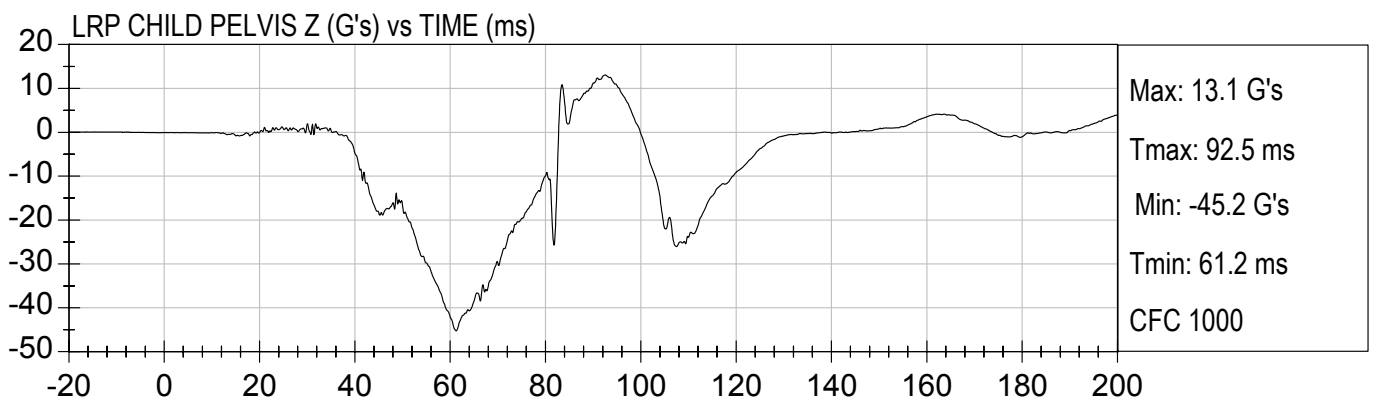
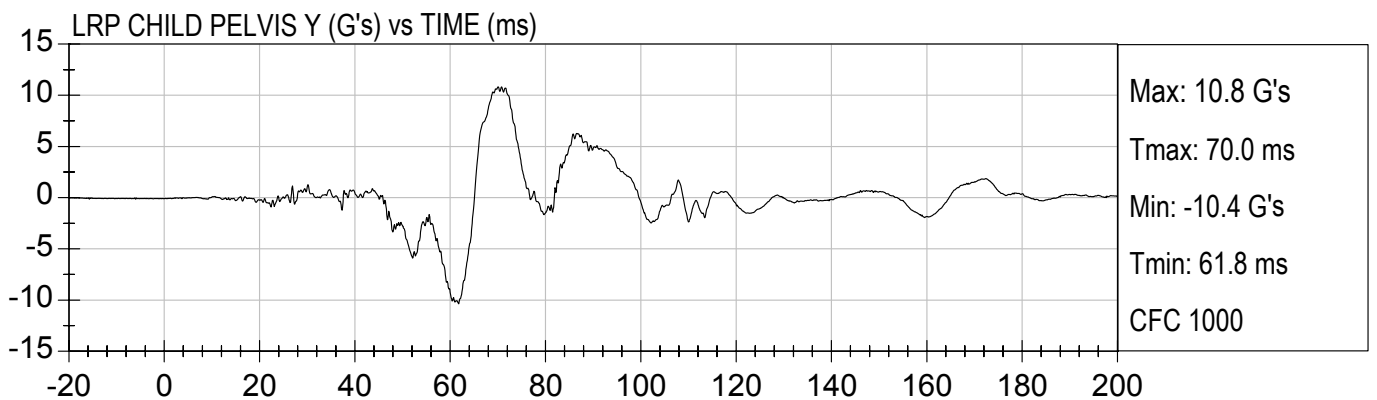
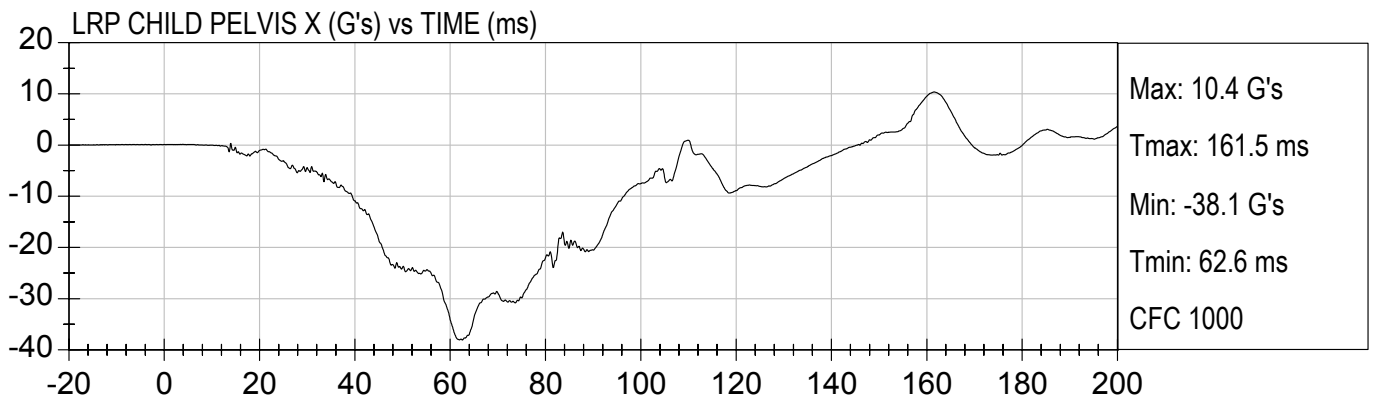






35MPH NCAP FRONTAL
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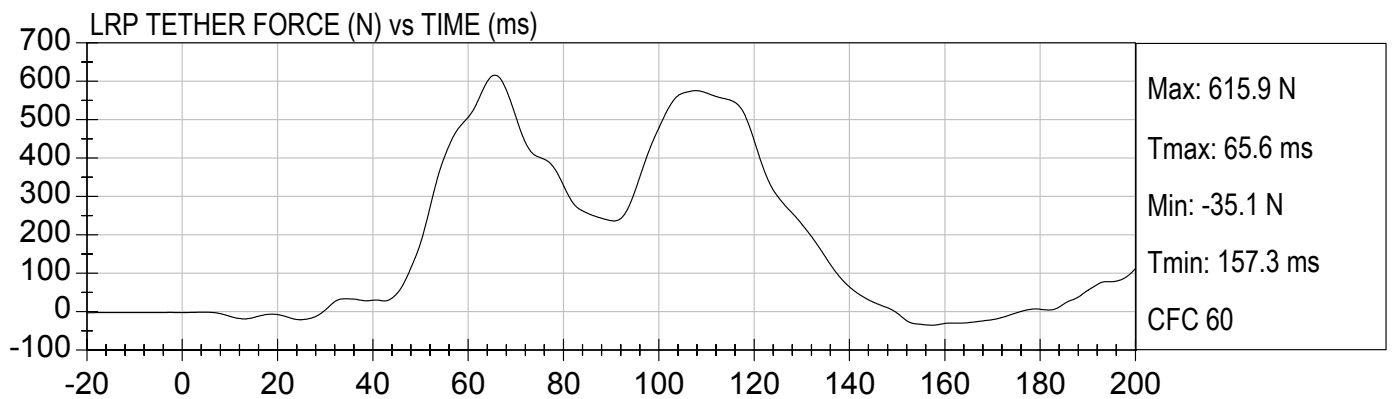
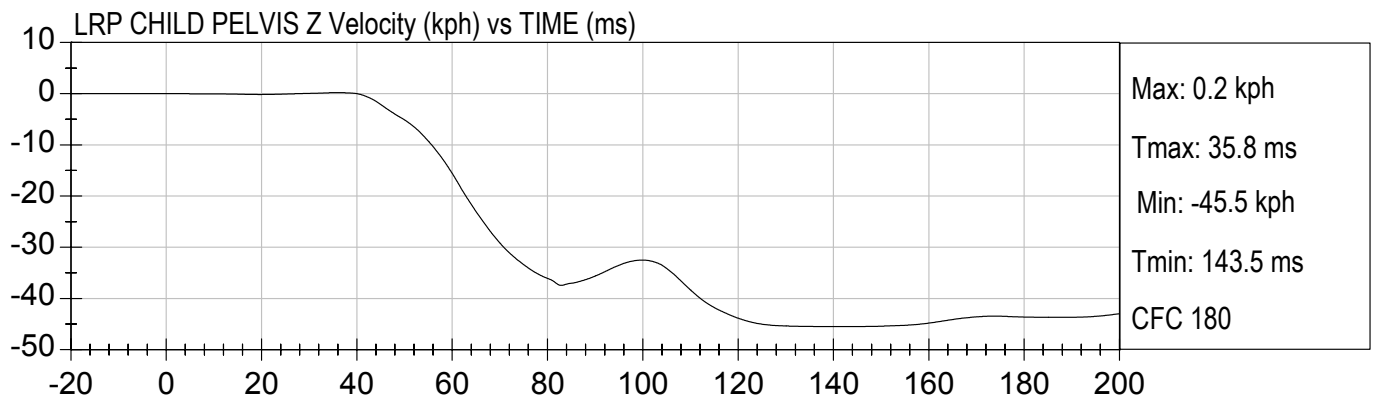
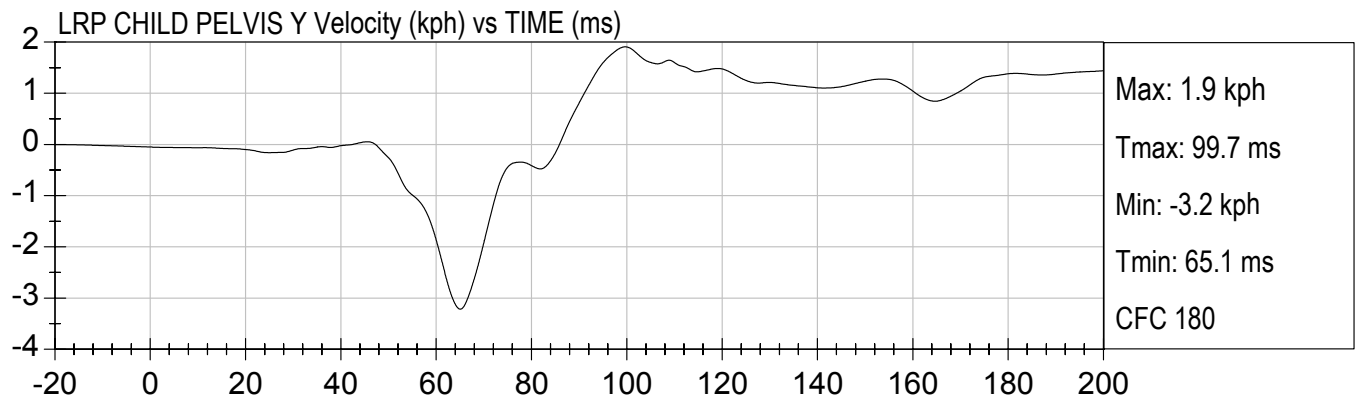
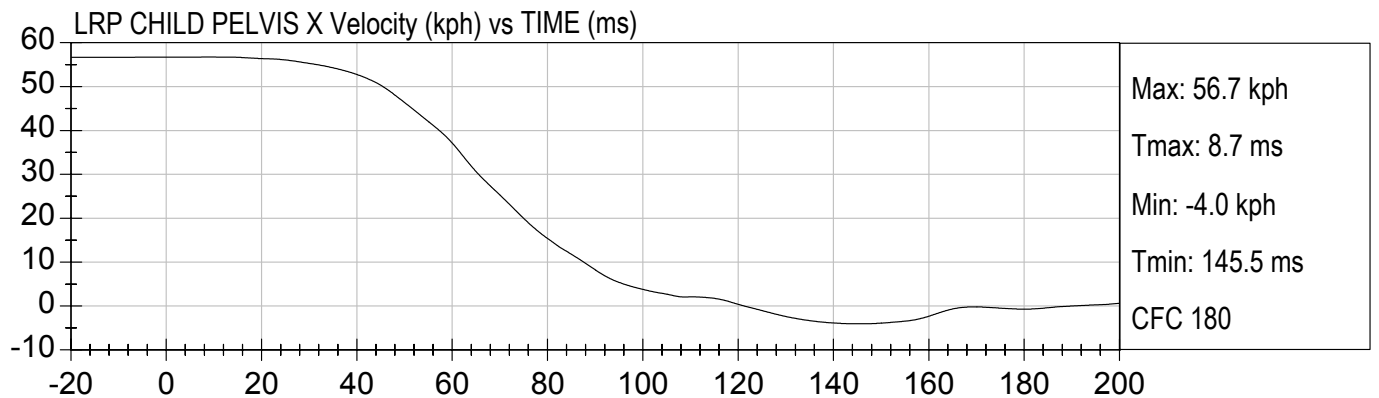
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35MPH NCAP FRONTAL
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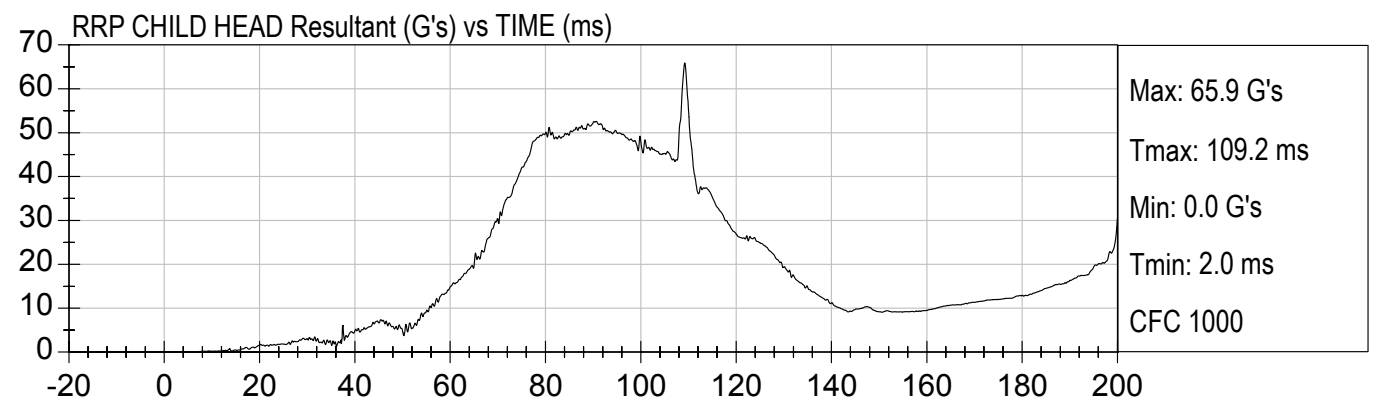
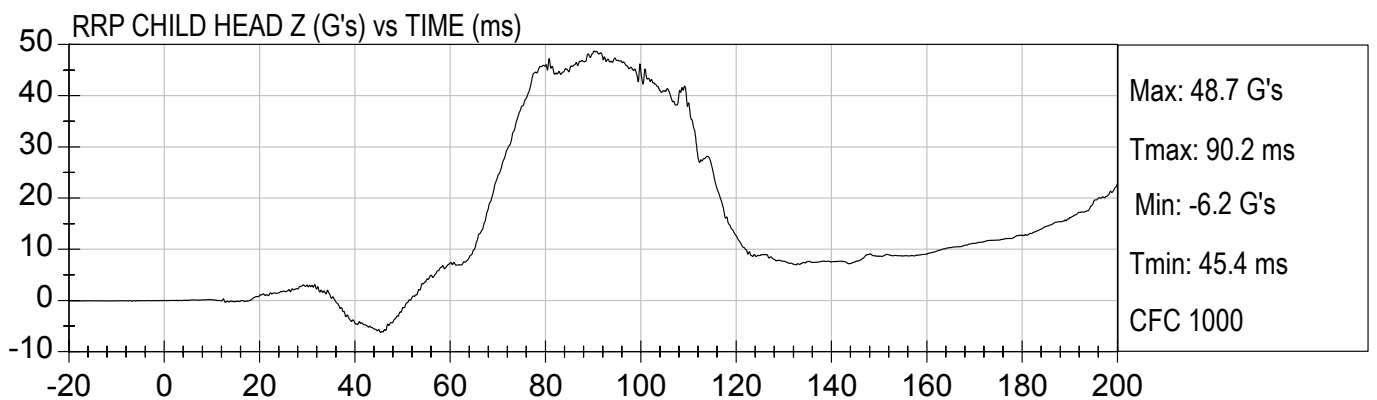
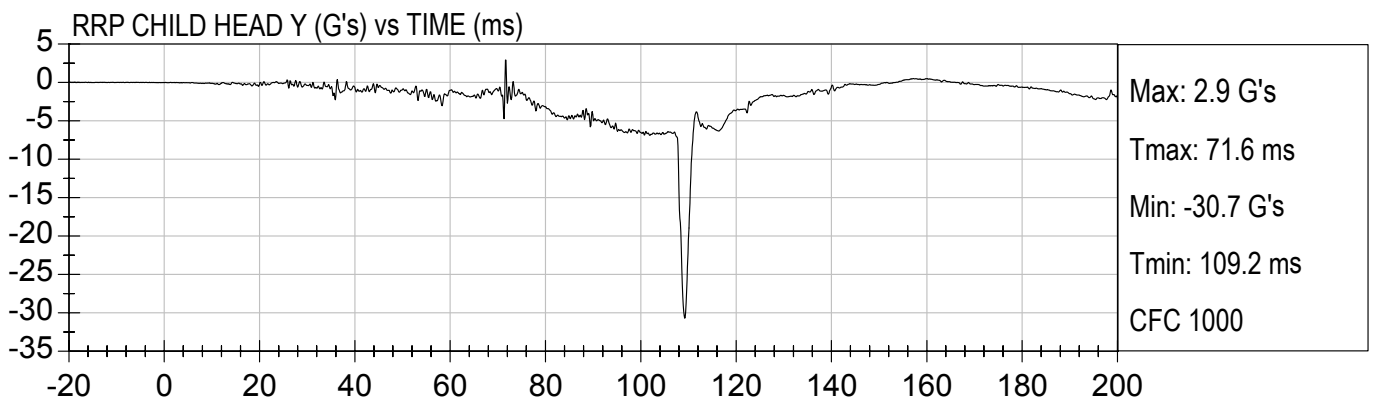
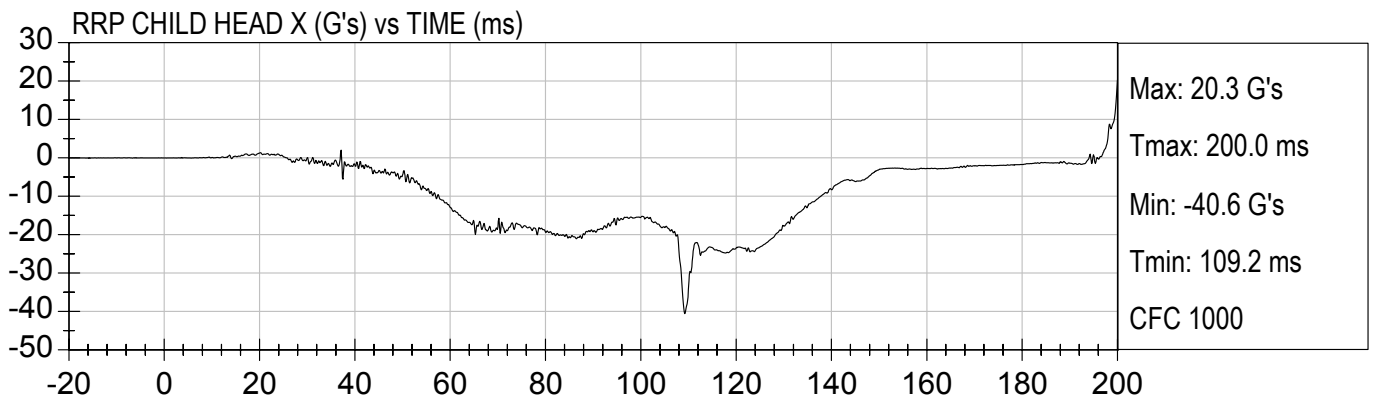
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35MPH NCAP FRONTAL
2004 FORD FREESTAR

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Speed: 35.2 mph (56.6 km/h)

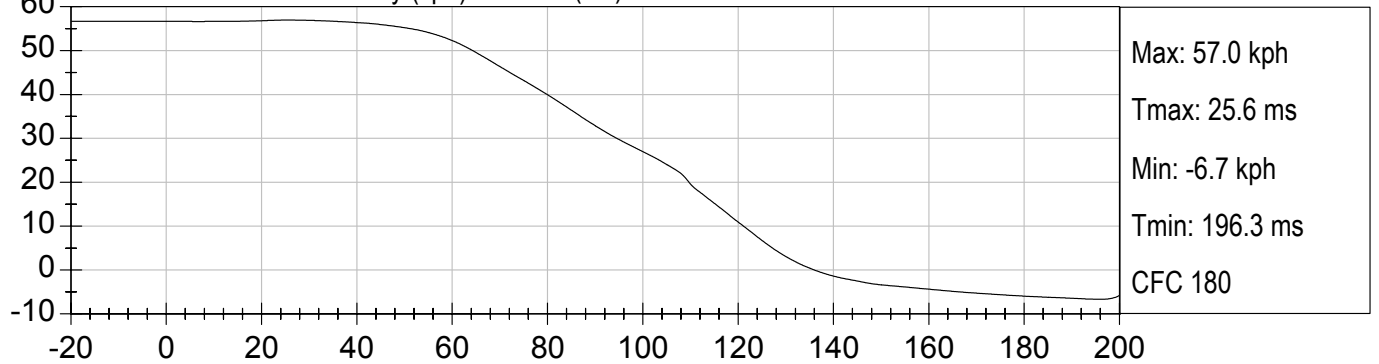




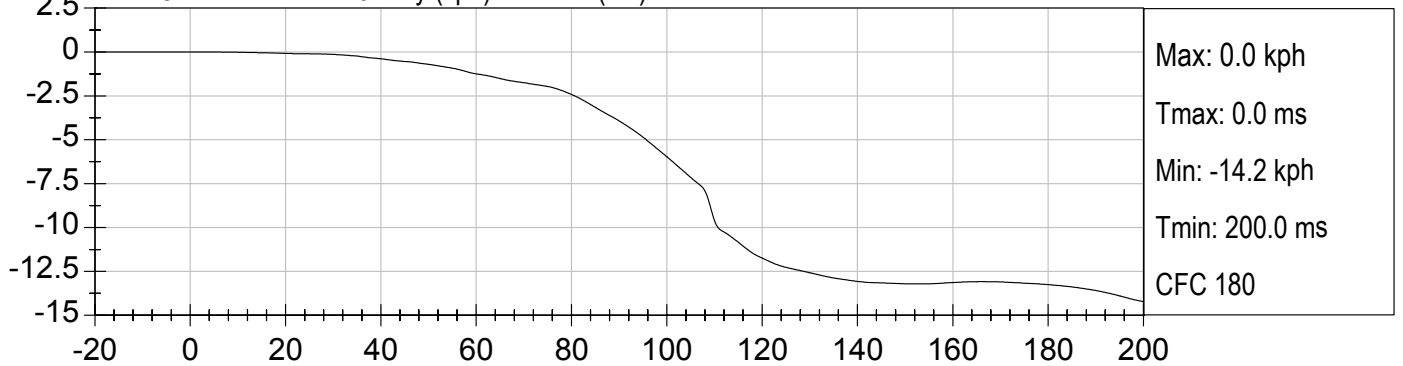
35MPH NCAP FRONTAL
2004 FORD FREESTAR

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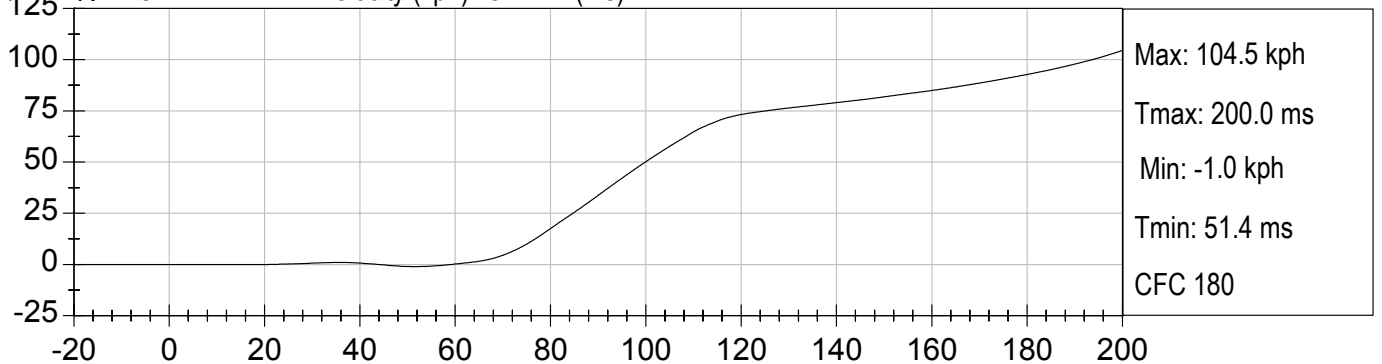
RRP CHILD HEAD X Velocity (kph) vs TIME (ms)



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



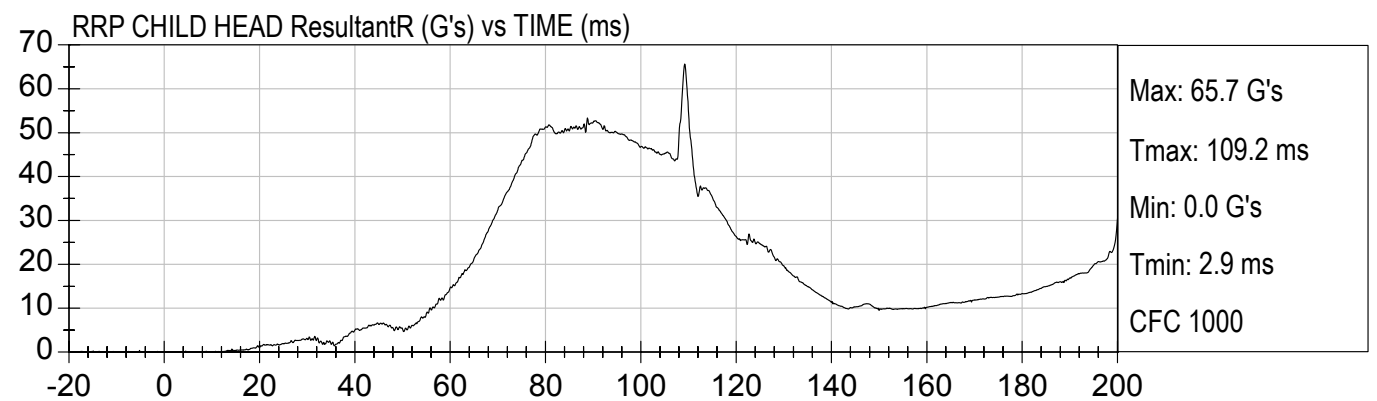
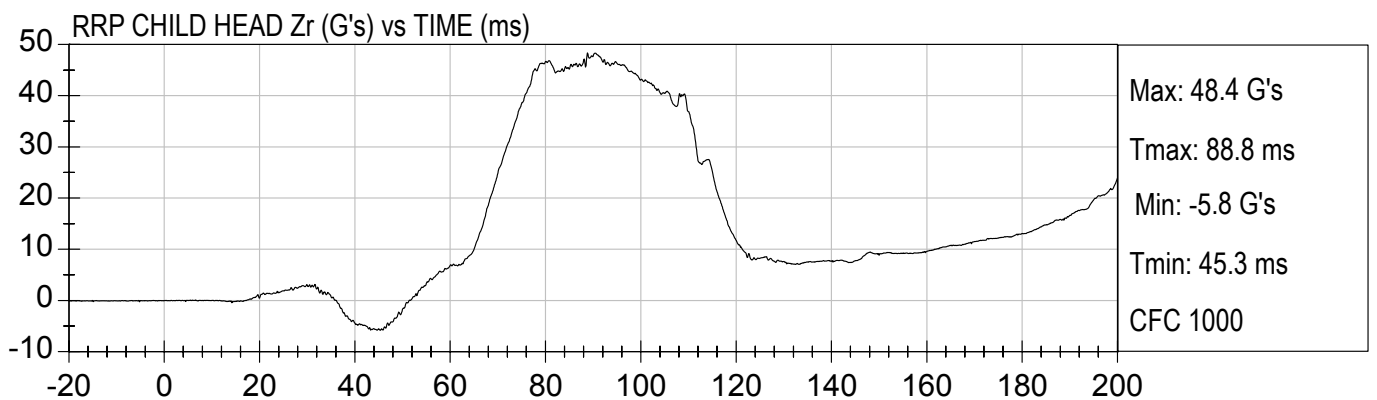
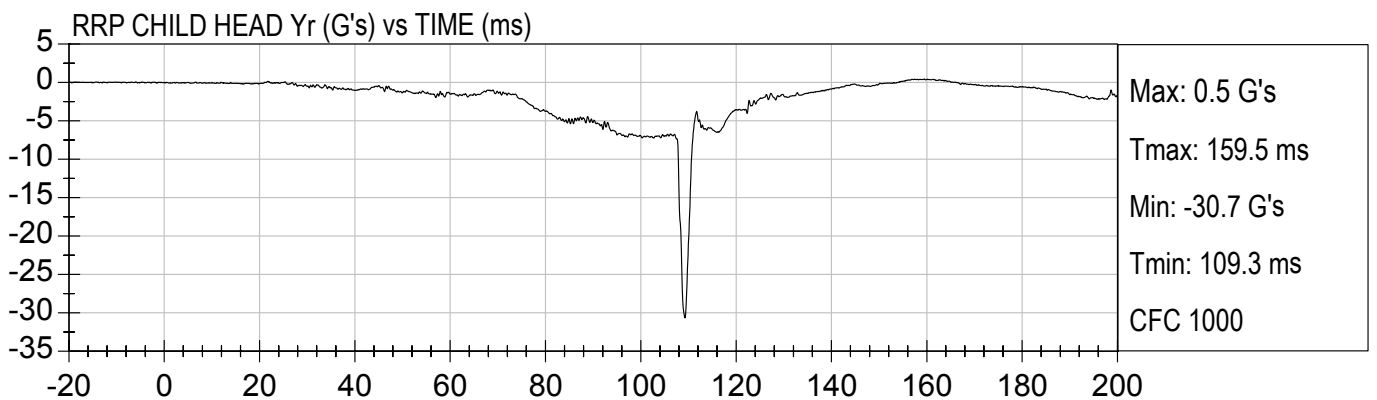
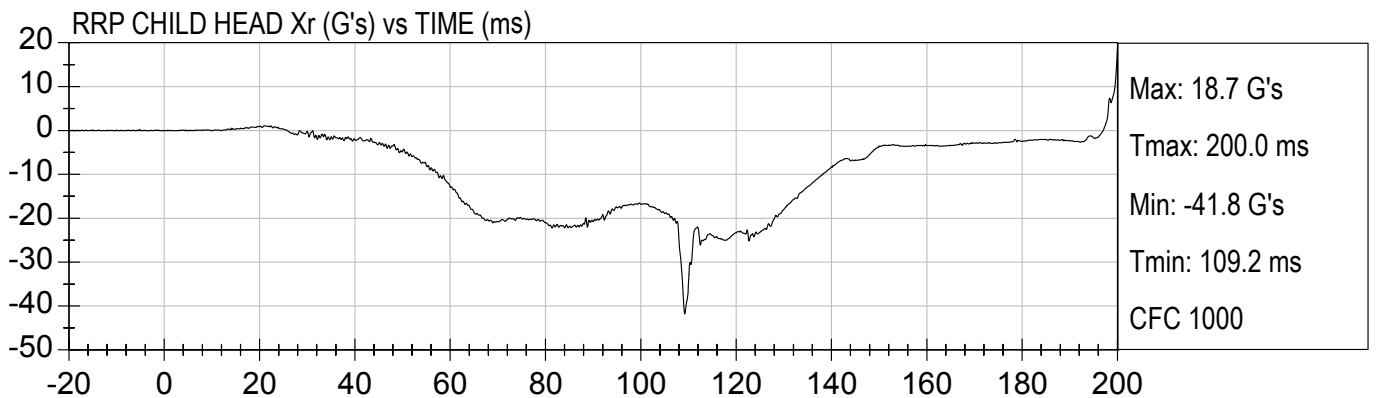
RRP CHILD HEAD Z Velocity (kph) vs TIME (ms)





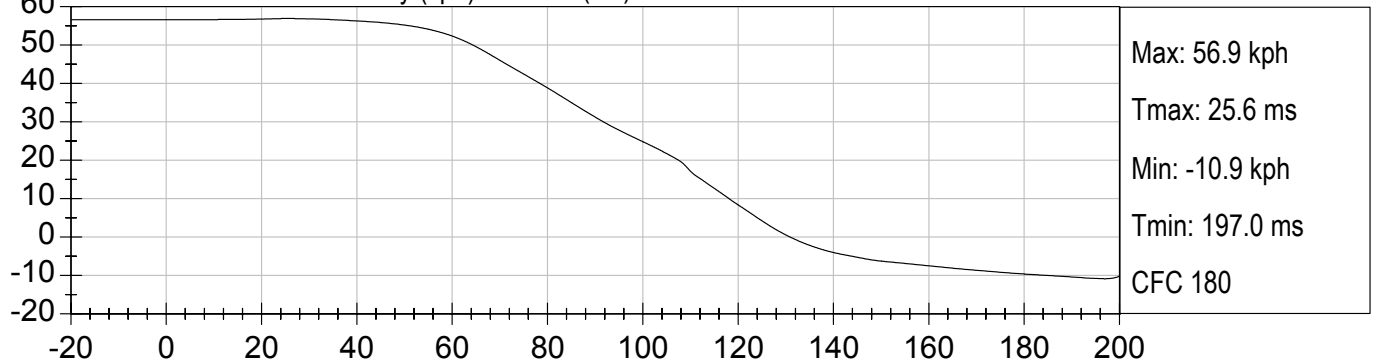
35MPH NCAP FRONTAL
2004 FORD FREESTAR

Test Date: 11/12/2003
Speed: 35.2 mph (56.6 km/h)

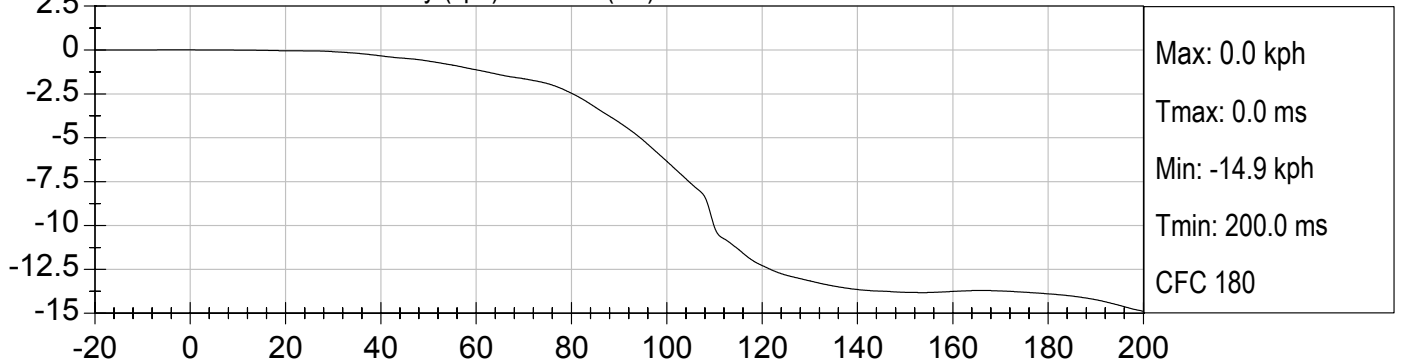




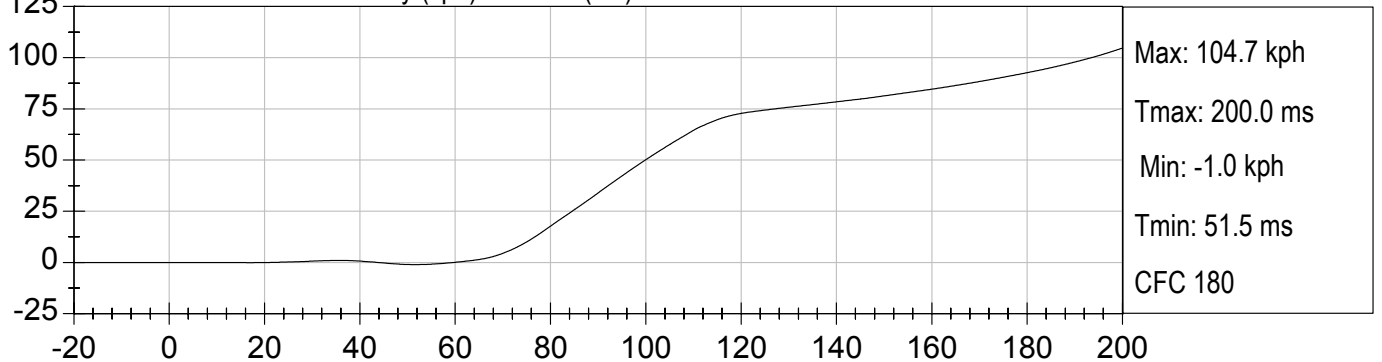
RRP CHILD HEAD Xr Velocity (kph) vs TIME (ms)



RRP CHILD HEAD Yr Velocity (kph) vs TIME (ms)



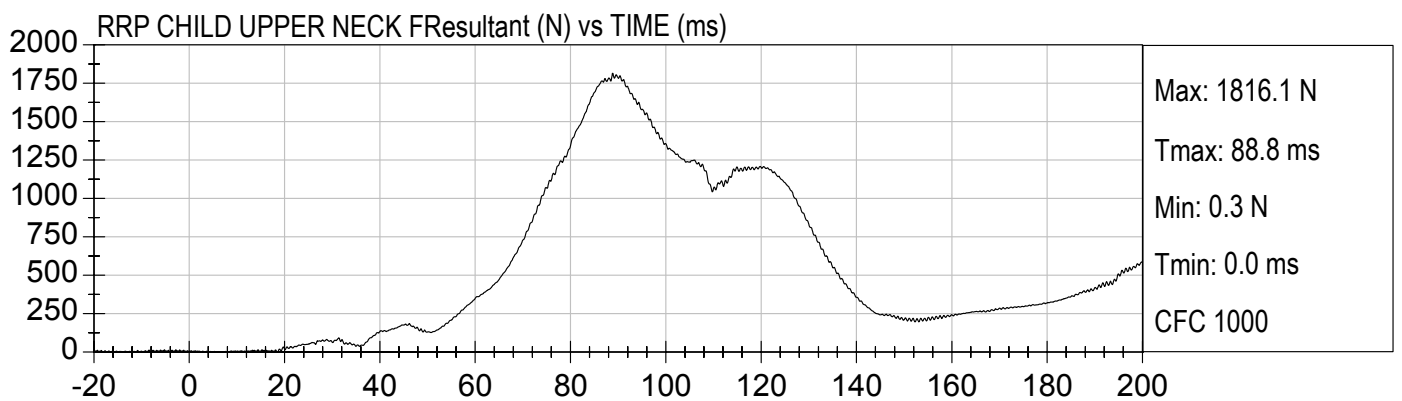
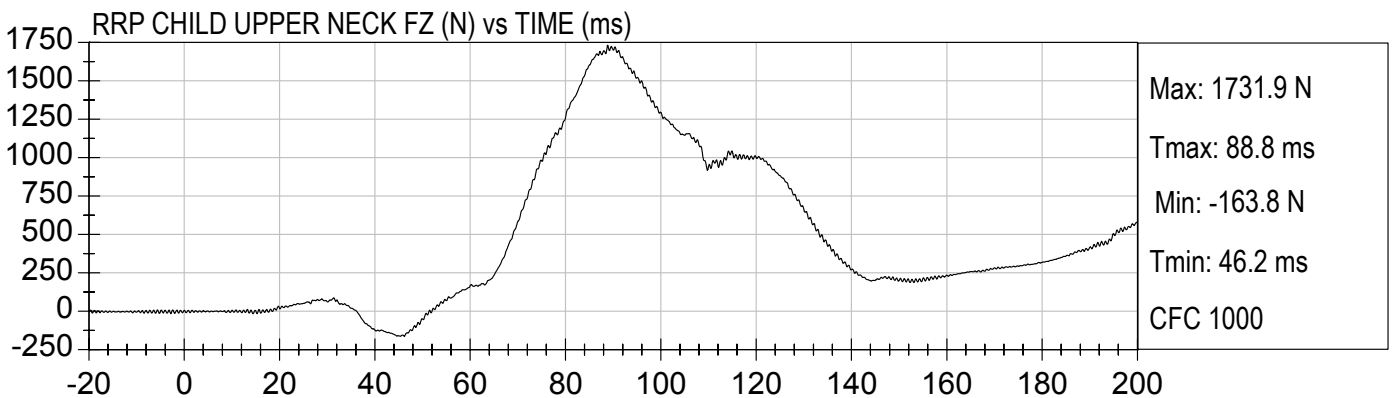
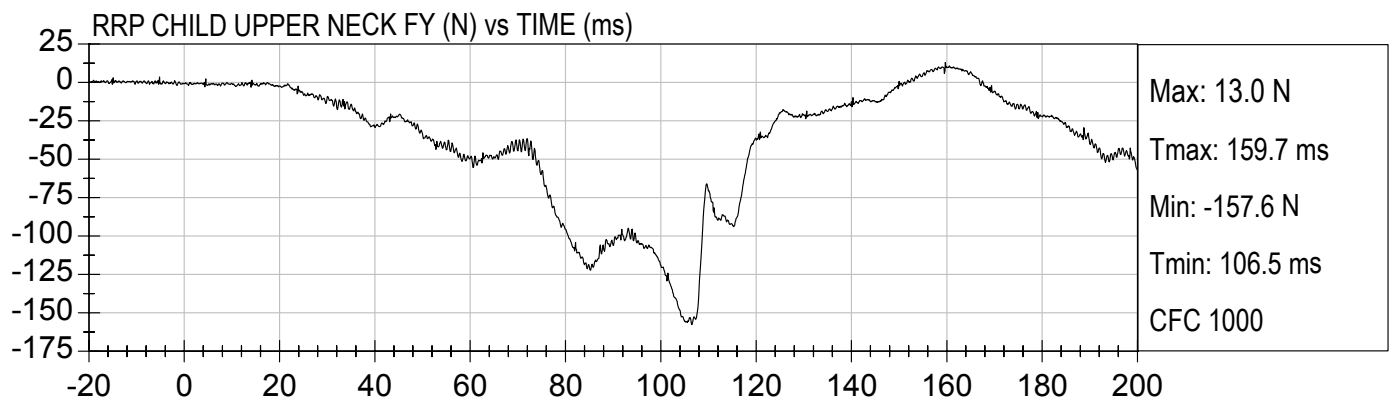
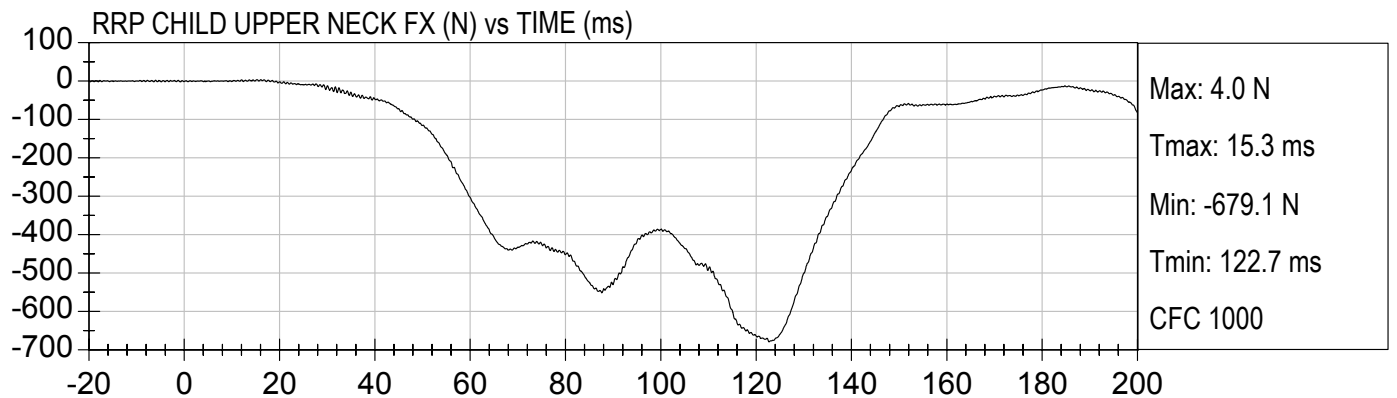
RRP CHILD HEAD Zr Velocity (kph) vs TIME (ms)





35MPH NCAP FRONTAL
2004 FORD FREESTAR

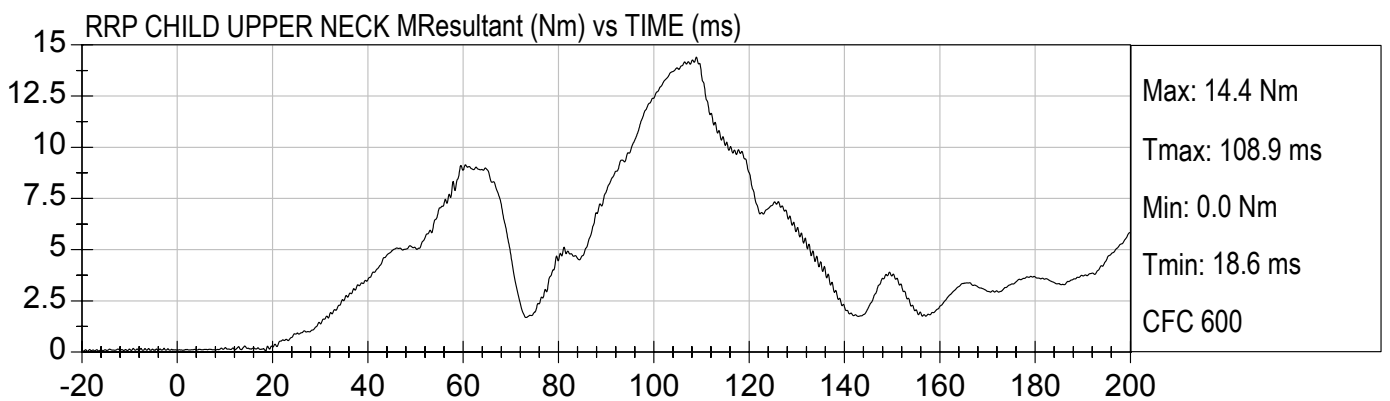
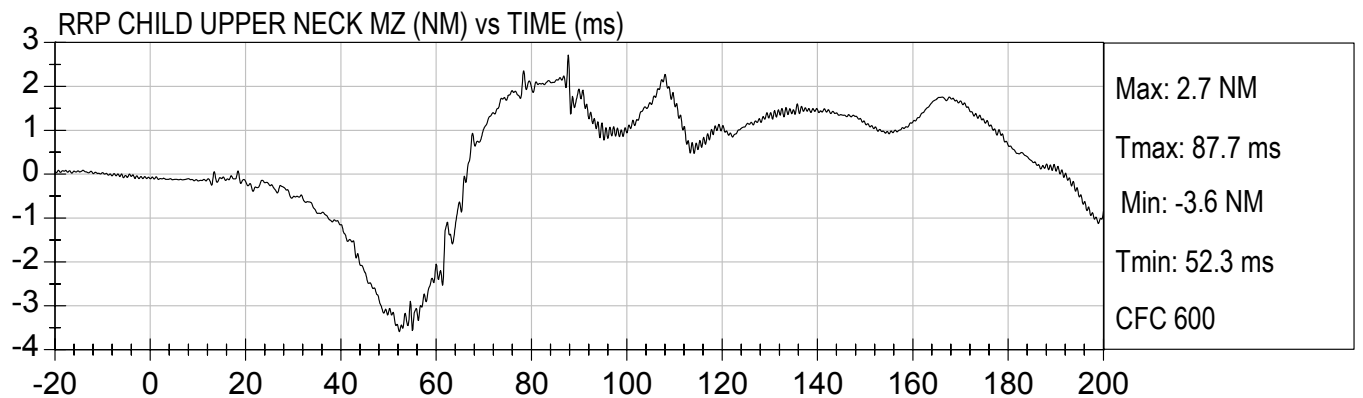
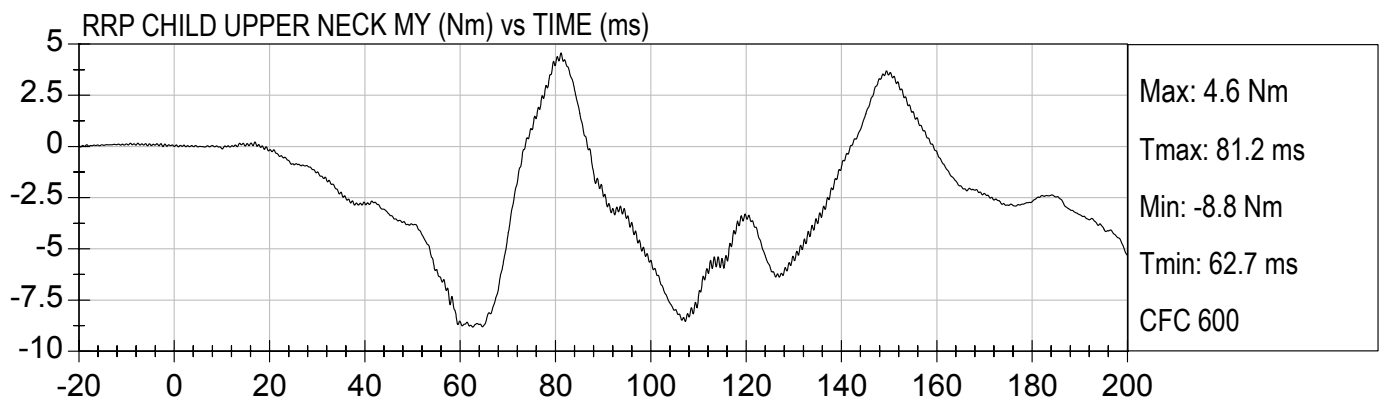
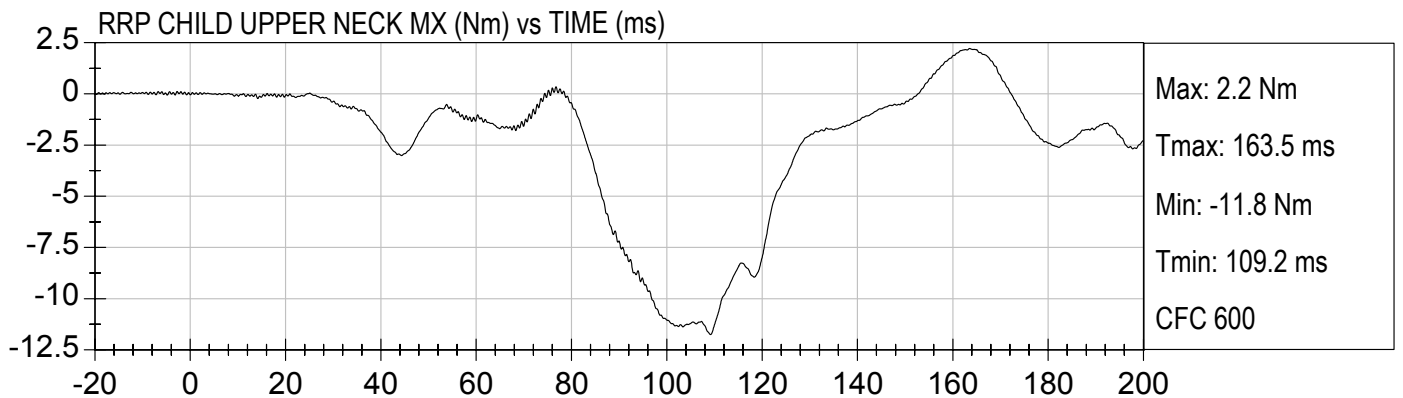
Test Date: 11/12/2003
Speed: 35.2 mph (56.6 km/h)





35MPH NCAP FRONTAL
2004 FORD FREESTAR

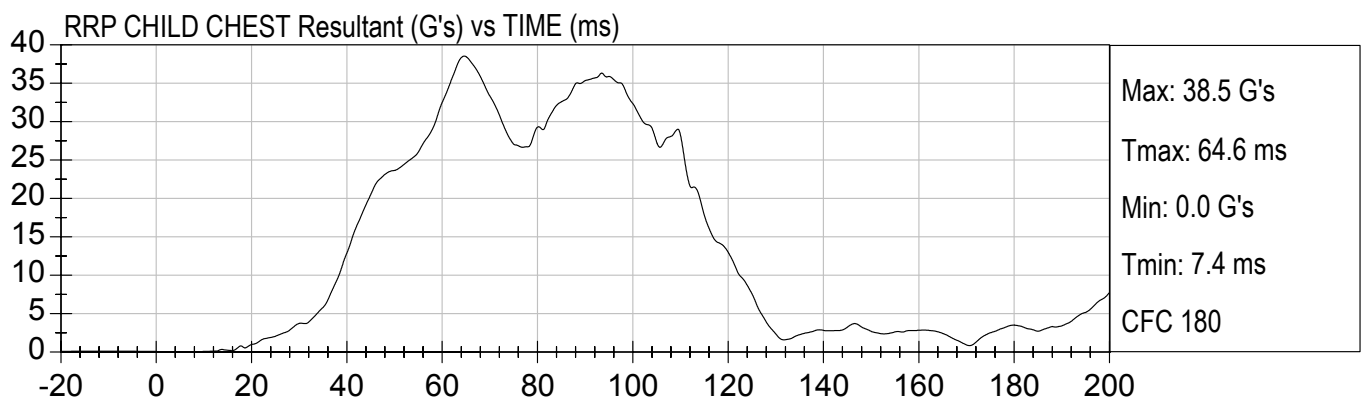
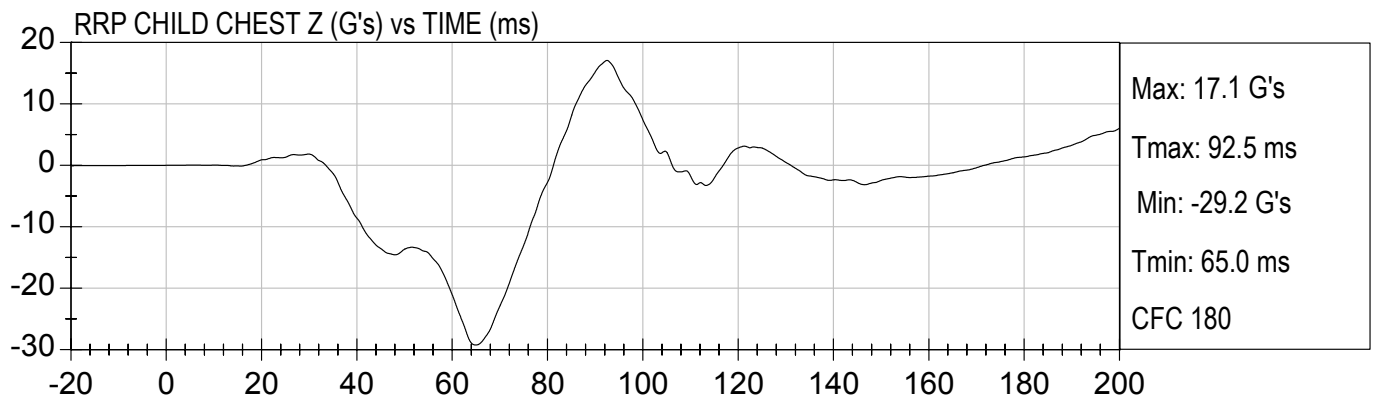
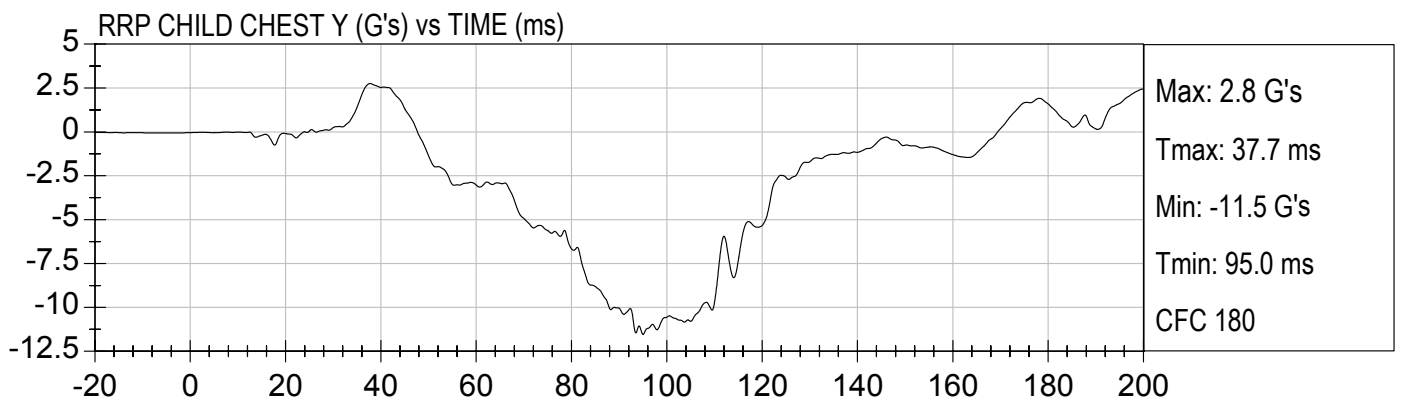
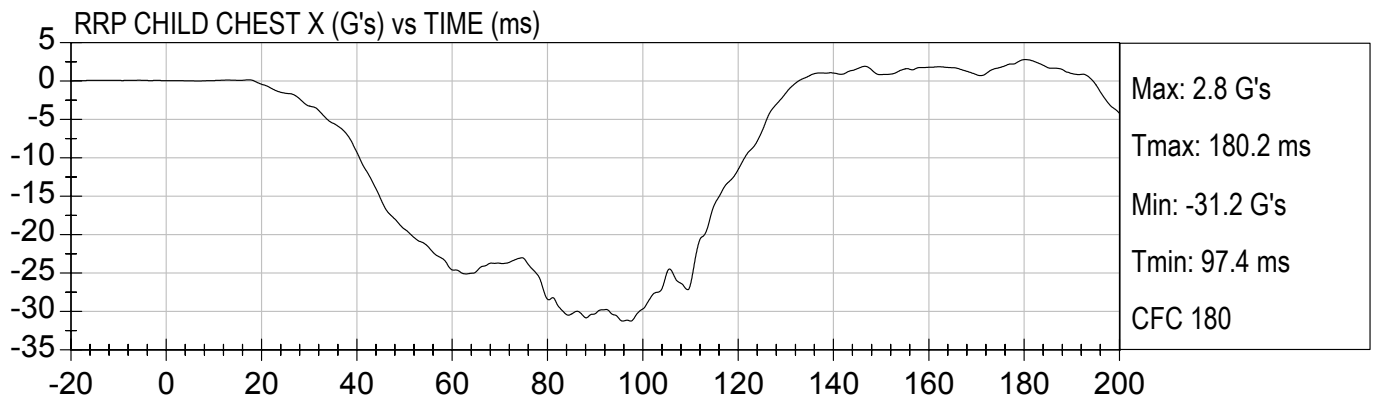
Test Date: 11/12/2003
Speed: 35.2 mph (56.6 km/h)





35MPH NCAP FRONTAL
2004 FORD FREESTAR

Test Date: 11/12/2003
Speed: 35.2 mph (56.6 km/h)

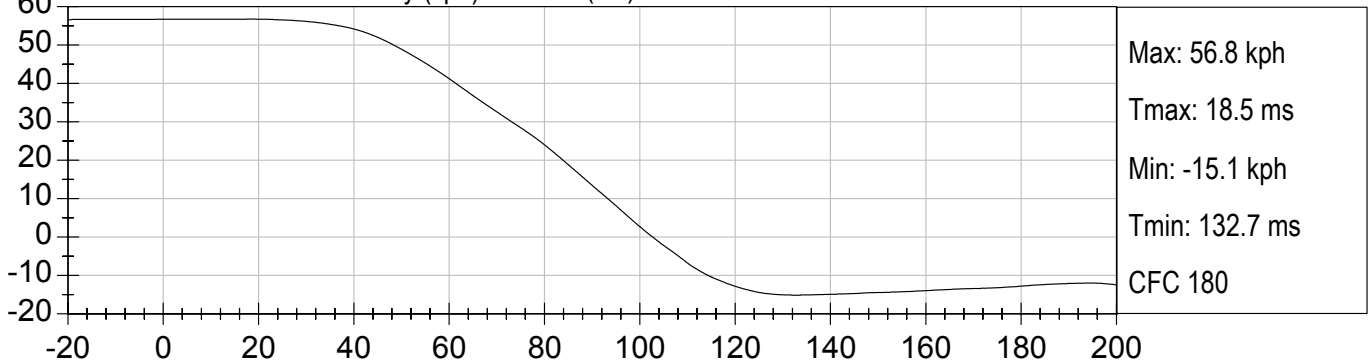




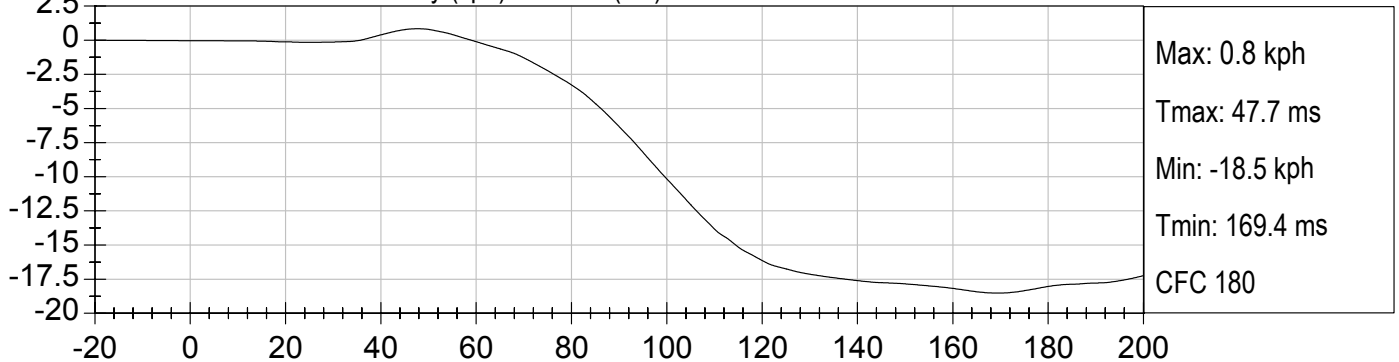
35MPH NCAP FRONTAL
2004 FORD FREESTAR

Test Date: 11/12/2003
Speed: 35.2 mph (56.6 km/h)

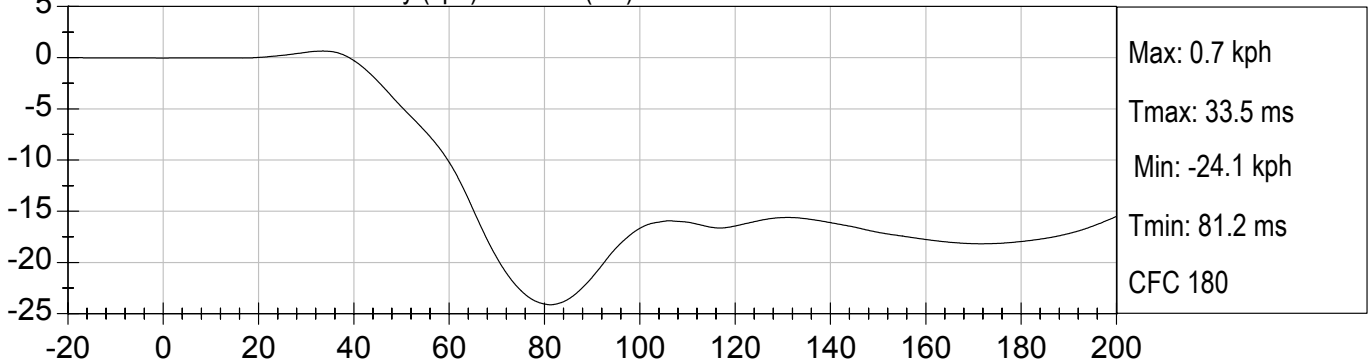
RRP CHILD CHEST X Velocity (kph) vs TIME (ms)



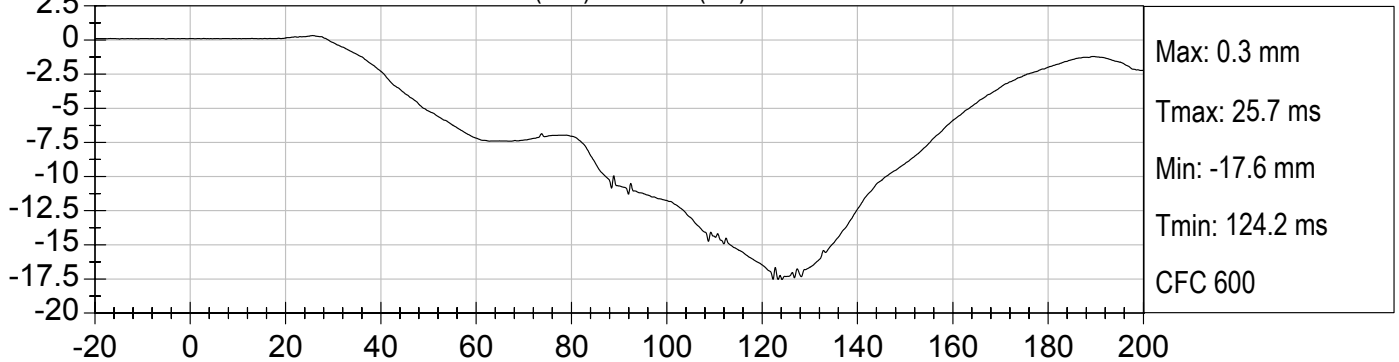
RRP CHILD CHEST Y Velocity (kph) vs TIME (ms)



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



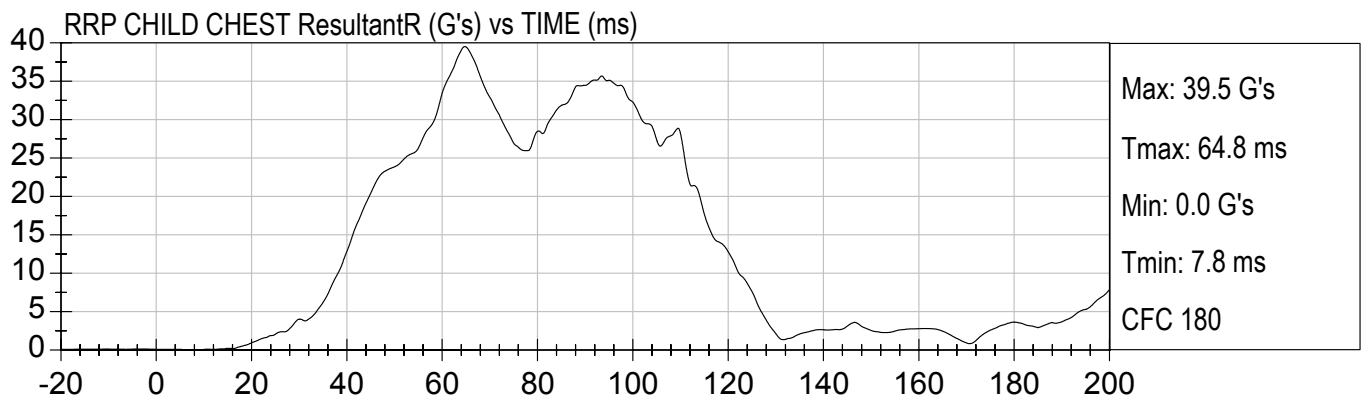
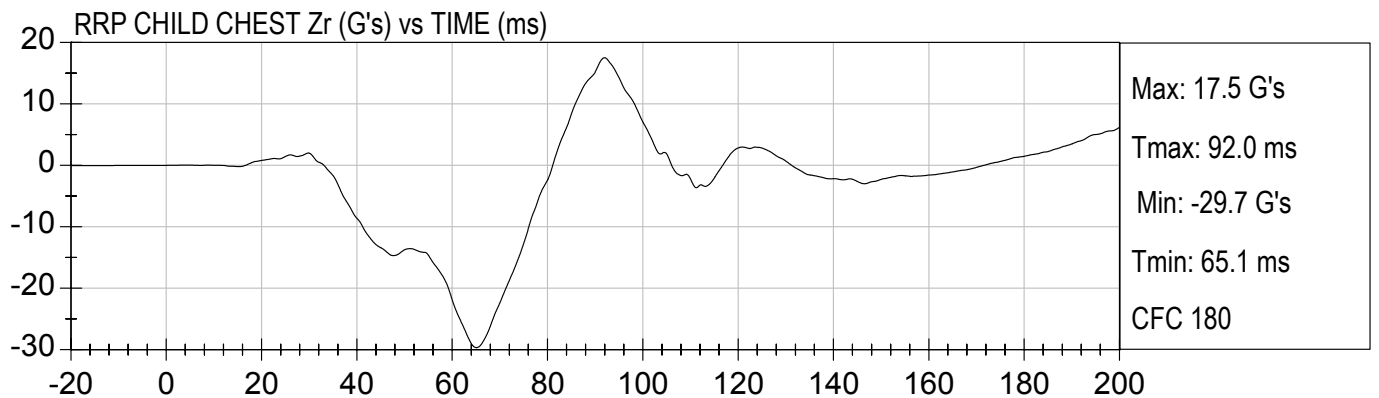
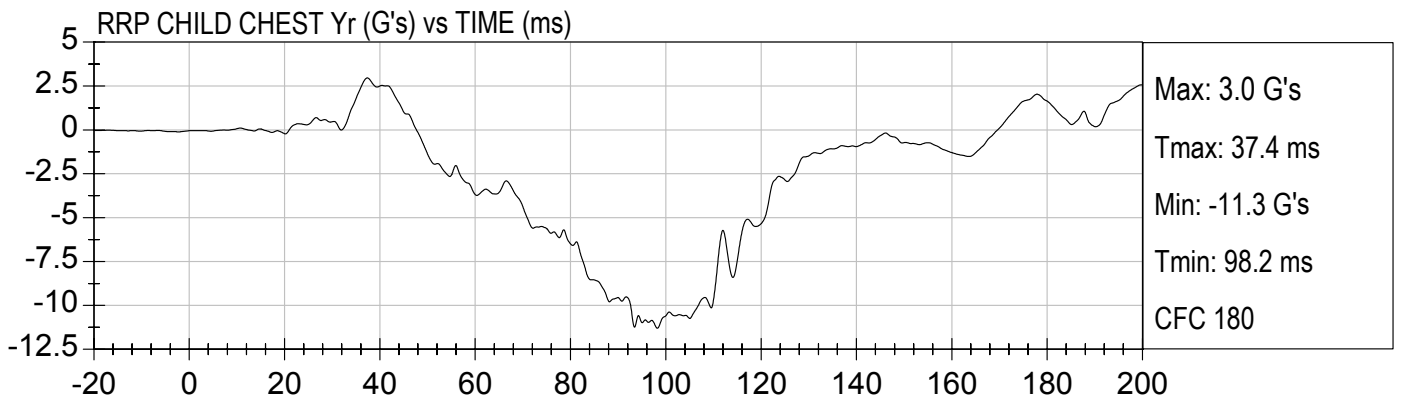
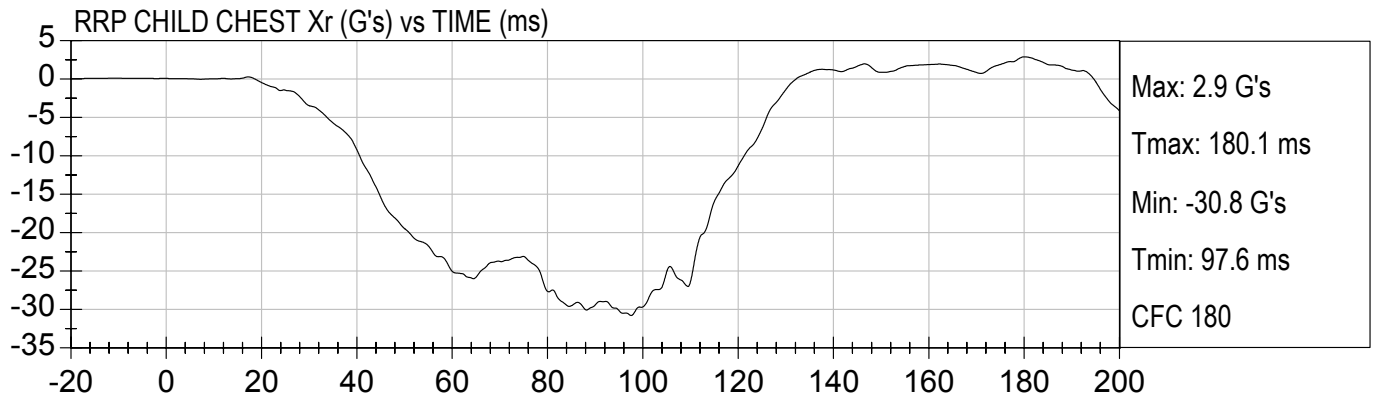
RRP CHILD CHEST DISPLACEMENT (mm) vs TIME (ms)





35MPH NCAP FRONTAL
2004 FORD FREESTAR

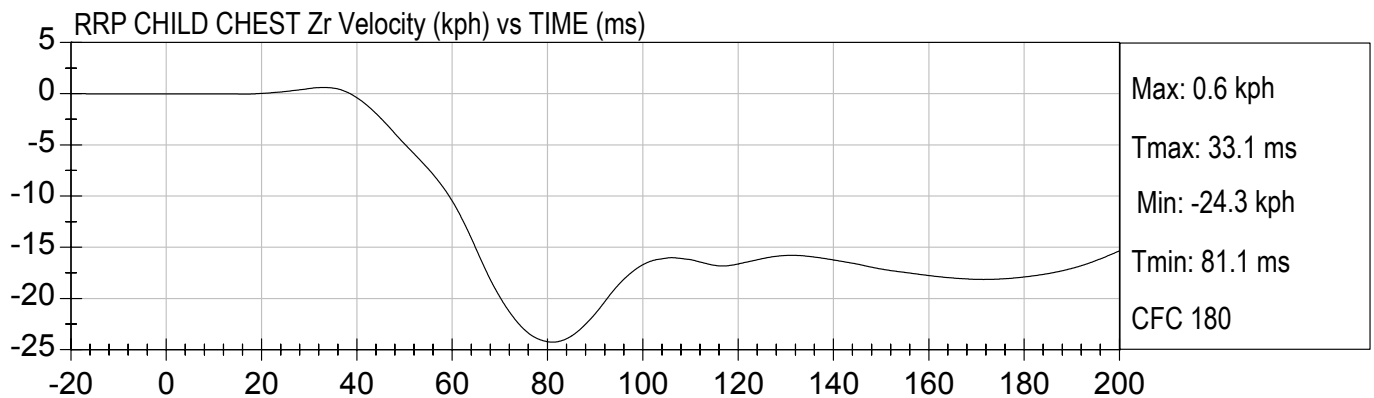
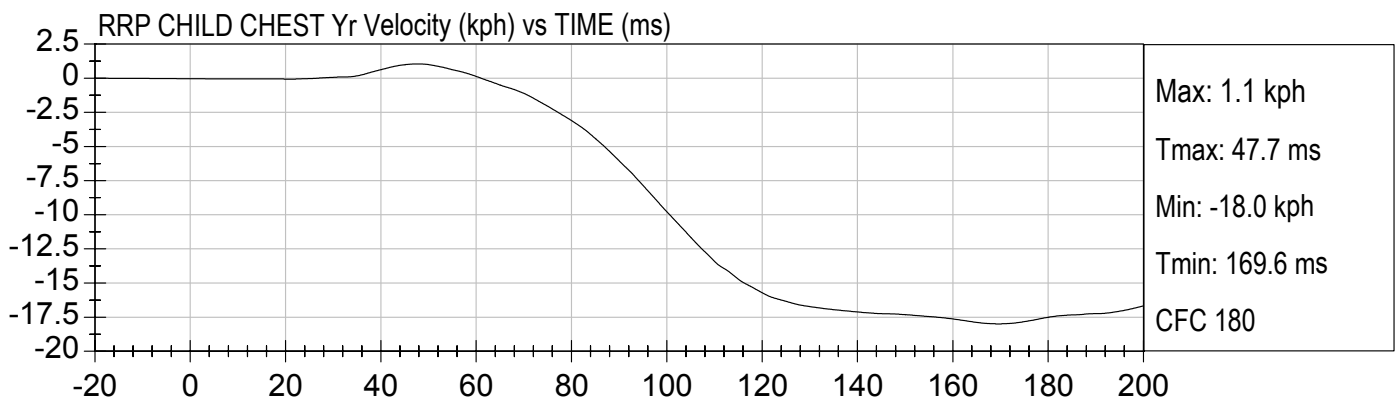
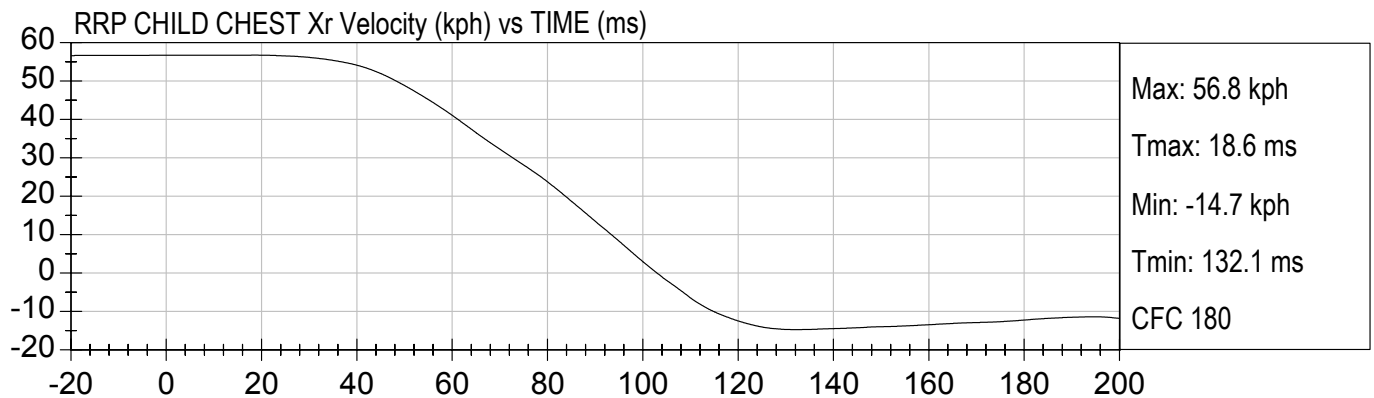
Test Date: 11/12/2003
Speed: 35.2 mph (56.6 km/h)





35MPH NCAP FRONTAL
2004 FORD FREESTAR

Test Date: 11/12/2003
Speed: 35.2 mph (56.6 km/h)

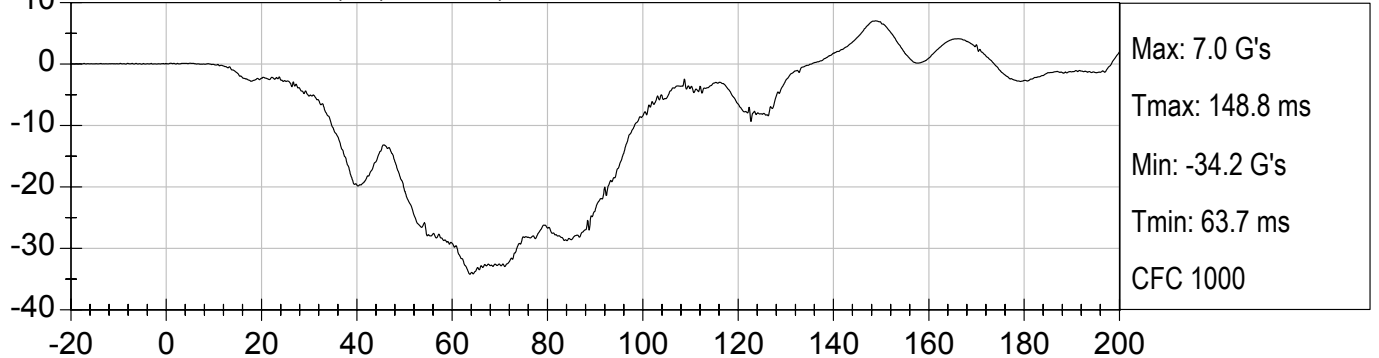




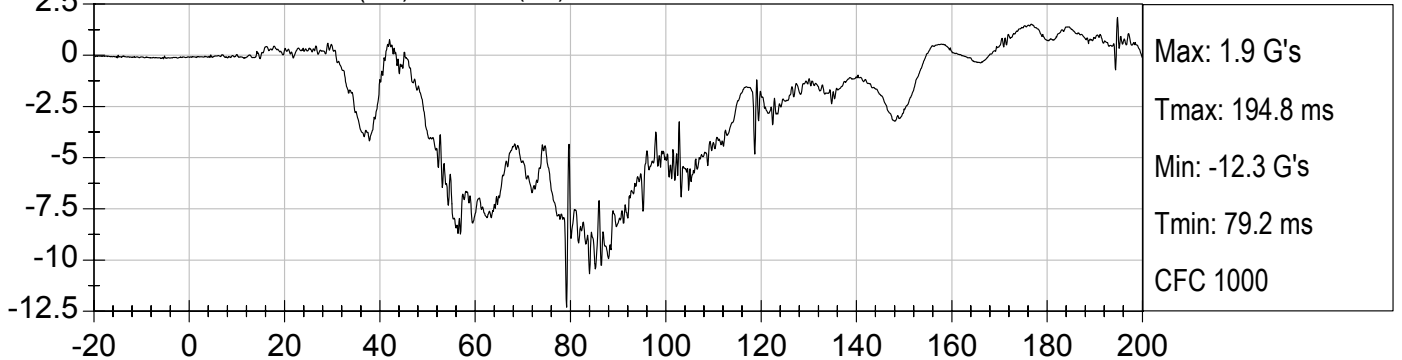
35MPH NCAP FRONTAL
2004 FORD FREESTAR

Test Date: 11/12/2003
Speed: 35.2 mph (56.6 km/h)

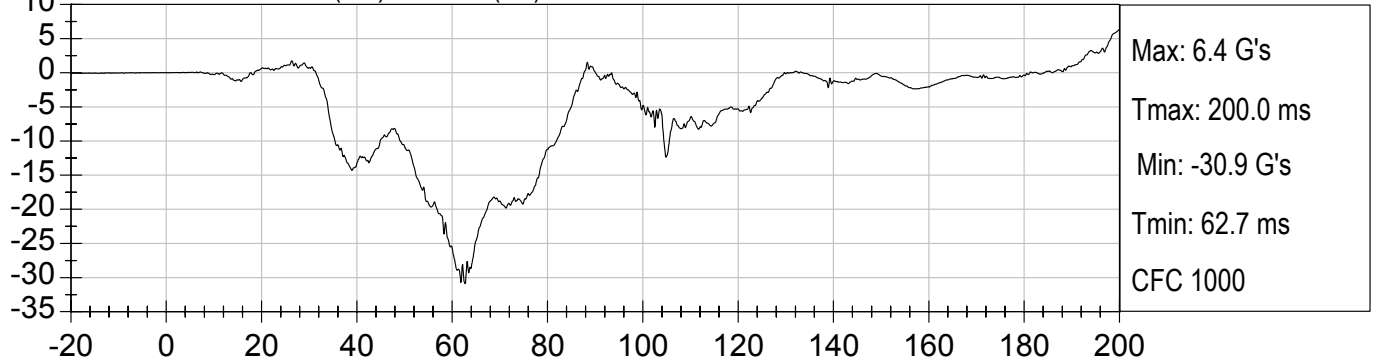
RRP CHILD PELVIS X (G's) vs TIME (ms)



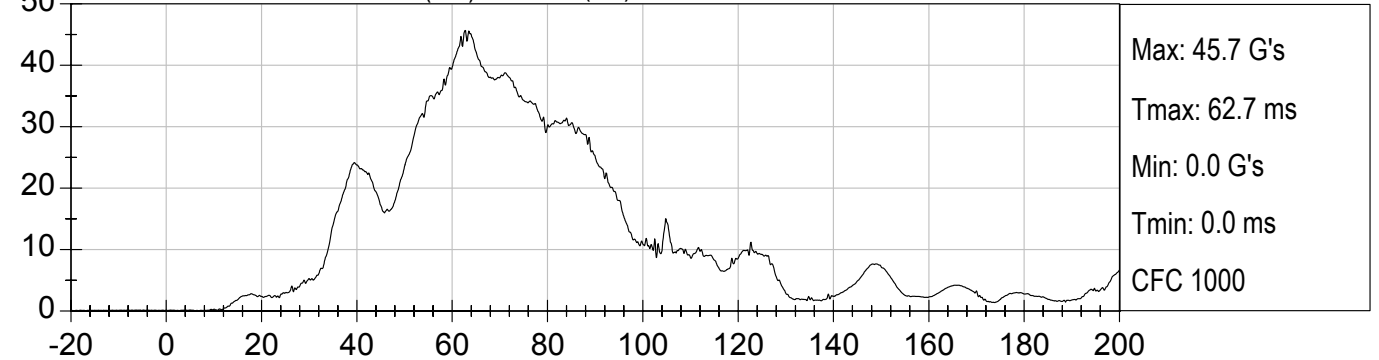
RRP CHILD PELVIS Y (G's) vs TIME (ms)



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



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

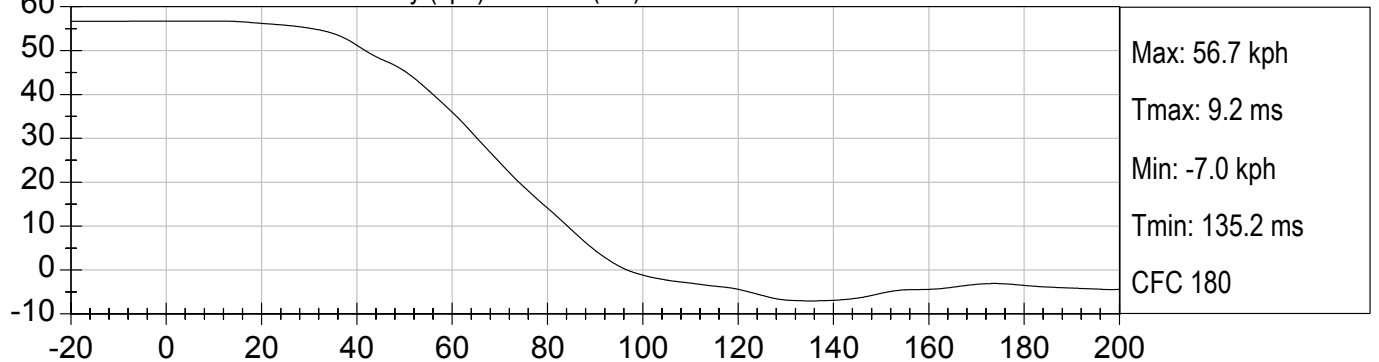




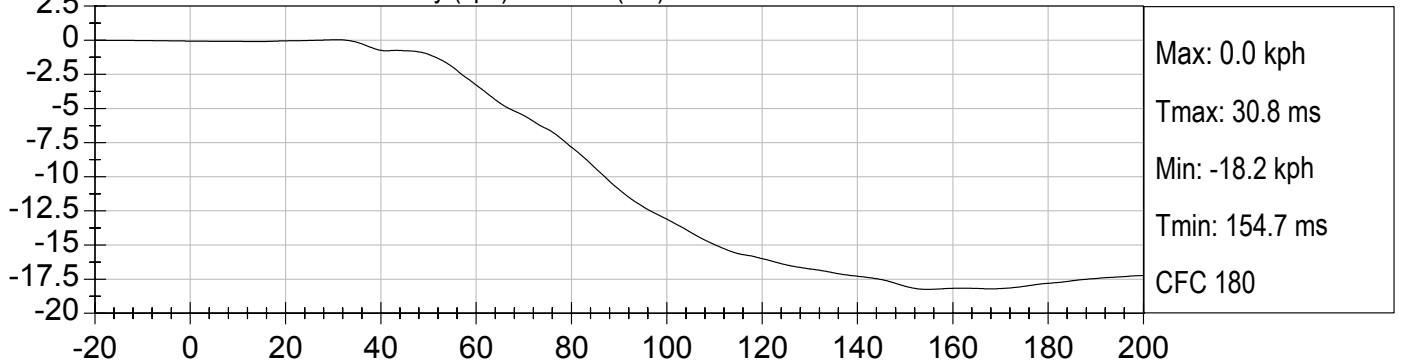
35MPH NCAP FRONTAL
2004 FORD FREESTAR

Test Date: 11/12/2003
Speed: 35.2 mph (56.6 km/h)

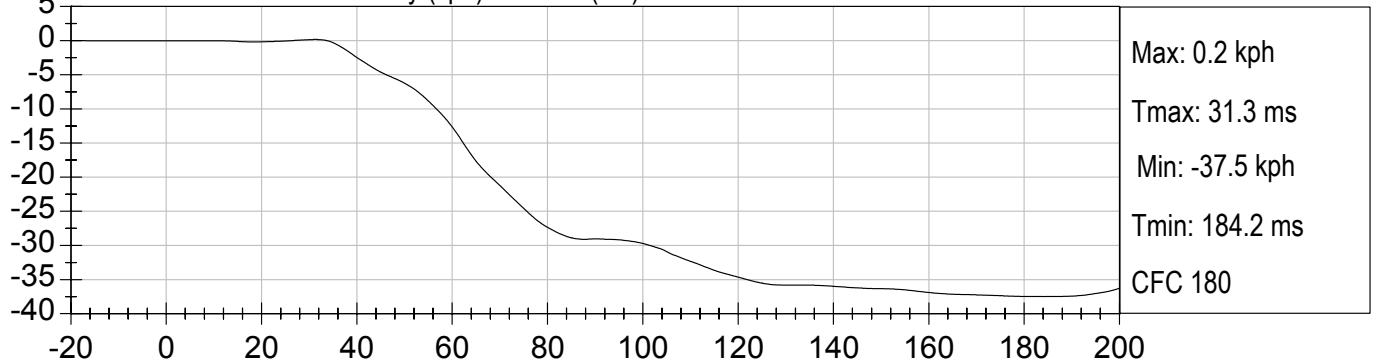
RRP CHILD PELVIS X Velocity (kph) vs TIME (ms)



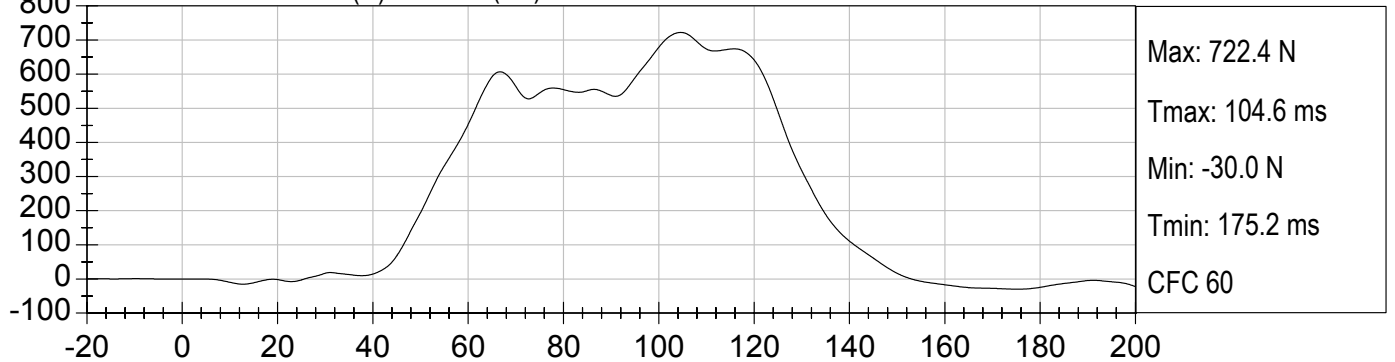
RRP CHILD PELVIS Y Velocity (kph) vs TIME (ms)



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



RRP TETHER FORCE (N) vs TIME (ms)



APPENDIX C
CHILD DUMMY CALIBRATION INFORMATION

**Transportation Research Center
Inc.**

ATD Calibration Report

for

VRTC

**HIII 3 Year Old Serial No. 040
Calibration No. 02**



Transportation Research Center Inc.
P.O. Box B-67
10820 St. Rt. 347
East Liberty, OH 43319-0367

Transportation Research Center Inc.
572P HIII 3 Year Old Dummy
External Dimensions
Serial No. 040 Calibration No. 02

Test Parameter	Dimension	Specification	Results	Pass
Total Sitting Height	A	538.5 - 553.7 mm	550 mm	Yes
Shoulder Pivot Height	B	307.3 - 322.6 mm	315 mm	Yes
Hip Pivot Height	C	33.0 - 43.2 mm	40 mm	Yes
Hip Pivot from Backline	D	56.9 - 67.1 mm	60 mm	Yes
Shoulder Pivot from Backline	E	58.4 - 68.6 mm	64 mm	Yes
Thigh Clearance	F	81.0 - 91.2 mm	86 mm	Yes
Back of Elbow to Wrist Pivot	G	247.4 - 262.6 mm	251 mm	Yes
Head Back to Backline	H	48.3 - 58.4 mm	55 mm	Yes
Shoulder to Elbow Length	I	185.0 - 200.7 mm	196 mm	Yes
Elbow Rest Height	J	133.6 - 148.8 mm	139 mm	Yes
Buttock to Knee Length	K	287.3 - 302.5 mm	297 mm	Yes
Popliteal Height	L	221.0 - 236.2 mm	229 mm	Yes
Knee to Floor Height	M	241.6 - 256.8 mm	254 mm	Yes
Buttock Popliteal Height	N	217.9 - 233.2 mm	225 mm	Yes
Chest Depth without Jacket	O	134.6 - 149.9 mm	145 mm	Yes
Foot Length	P	137.7 - 147.8 mm	140 mm	Yes
Stature	Q	932.2 - 957.6 mm	950 mm	Yes
Buttock to Knee Pivot Length	R	251.5 - 261.6 mm	254 mm	Yes
Head Breadth	S	128.3 - 143.5 mm	138 mm	Yes
Head Depth	T	167.4 - 182.6 mm	178 mm	Yes
Hip Breadth	U	200.7 - 215.9 mm	204 mm	Yes
Shoulder Breadth	V	236.5 - 251.7 mm	239 mm	Yes
Foot Breadth	W	53.6 - 63.8 mm	57 mm	Yes
Head Circumference	X	500.4 - 515.6 mm	503 mm	Yes
Chest Circumference with Jacket	Y	527.1 - 552.5 mm	531 mm	Yes
Waist Circumference	Z	527.1 - 552.5 mm	540 mm	Yes
Reference Location for Chest Circumference	AA	248.9 - 259.1 mm	254 mm	Yes
Reference Location for Waist Circumference	BB	160.0 - 170.2 mm	165 mm	Yes

Technician



Approved




Transportation Research Center Inc.

572P Head Drop Test

HIII 3 Year Old Serial No. 040 Calibration No. 02 - 1

Test Date 10/09/2003

Test Parameter	Specification	Test Results	Pass
Temperature	18.9 - 25.6 °C	21.1 °C	Yes
Relative Humidity	10 - 70 %	47 %	Yes
Peak Resultant Acceleration	250 - 280 g	262.1 g	Yes
Peak Lateral Acceleration	15 g Max	-4.5 g	Yes
Is Acceleration Curve Unimodal?	Yes	Yes	Yes

Comments:

Technician



Approved



10.09.2003 09:57:28 607

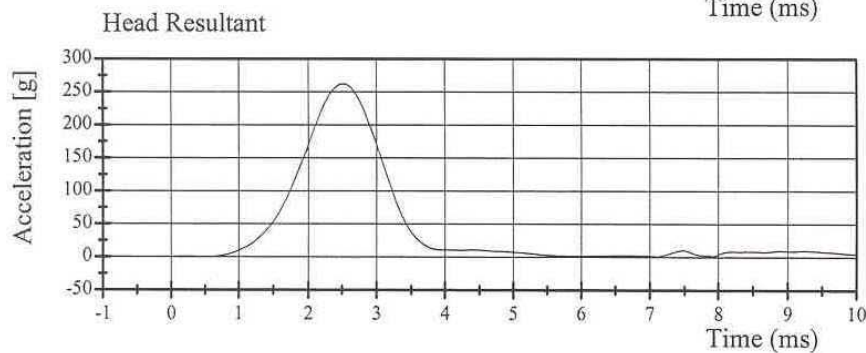
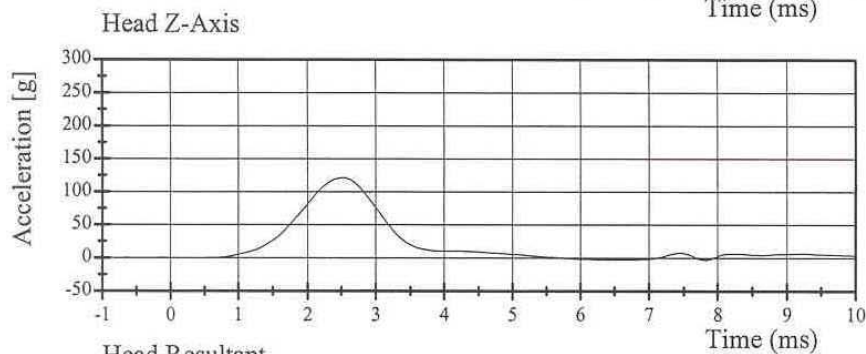
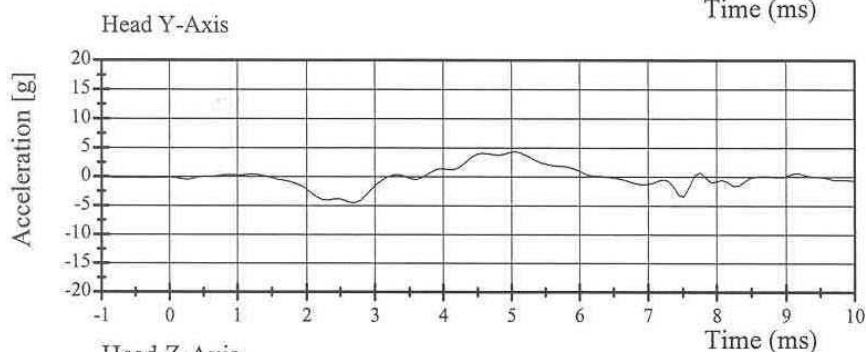
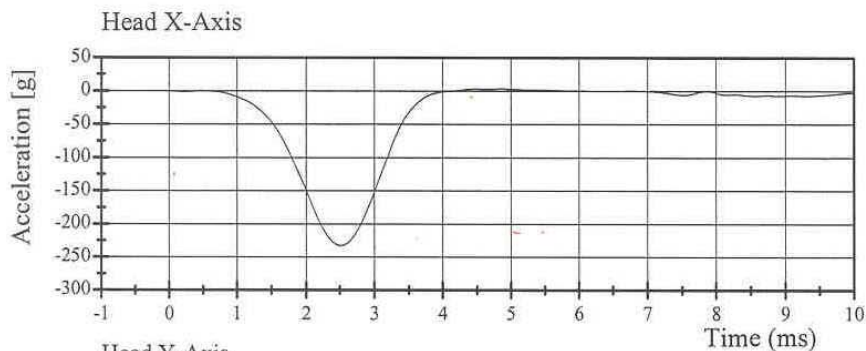


Transportation Research Center Inc.

572P Head Drop Test

HIII 3 Year Old Serial No. 040 Calibration No. 02 - 1

Test Date 10/09/2003



10.09.2003 09:57:30 607



Transportation Research Center Inc.

572P Neck Flexion Test - 6 Channel Transducer

HIII 3 Year Old Serial No. 040 Calibration No. 02 - 3

Test Date 10/09/2003

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	21.1 °C	Yes
Relative Humidity	10 - 70 %	44 %	Yes
Impact Velocity	5.40 - 5.60 m/s	5.58 m/s	Yes
Integrated Pendulum Velocity			
10 ms	2.00 - 2.70 m/s	2.60 m/s	Yes
15 ms	3.00 - 4.00 m/s	3.71 m/s	Yes
20 ms	4.00 - 5.10 m/s	5.03 m/s	Yes
Peak D Plane Rotation	70 - 82 °	71.8 °	Yes
Peak Moment About Occipital Condyles (During time interval rotation is within specified corridors)	42.0 - 53.0 N·m	46.29 N·m	Yes
Positive Moment Decay Time To 10 N·m	60 - 80 ms	69.12 ms	Yes

Comments:

Technician



Approved



10.09.2003 08:57:58 637



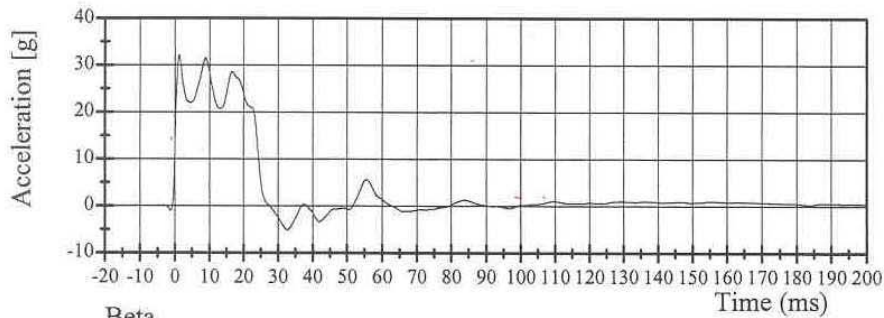
Transportation Research Center Inc.

572P Neck Flexion Test

HIII 3 Year Old Serial No. 040 Calibration No. 02 - 3

Test Date 10/09/2003

Pendulum Deceleration

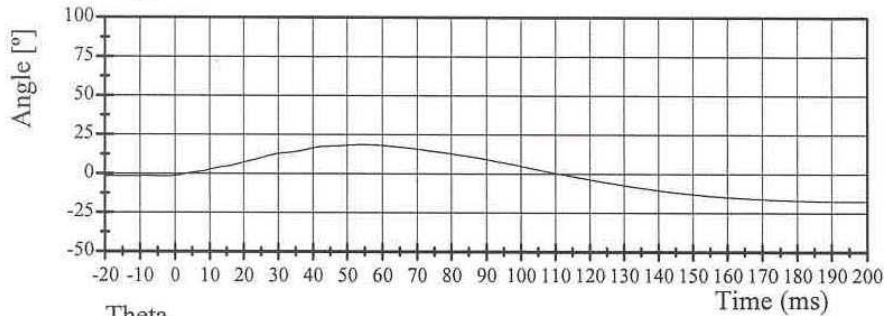


Filter Class: 180

Max: 32.1 g at 1.3 ms

Min: -5.1 g at 32.7 ms

Beta

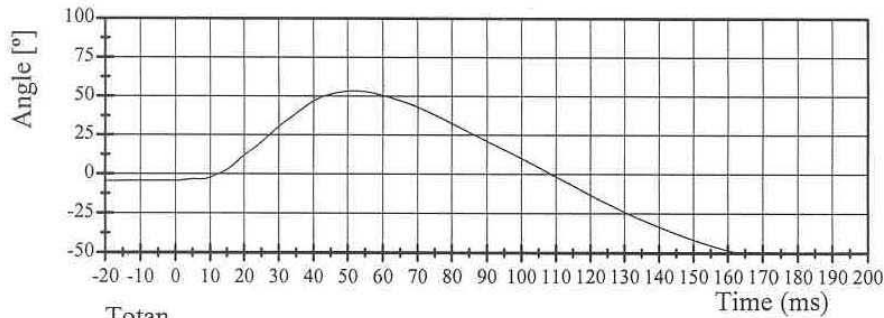


Filter Class: 60

Max: 18.5 ° at 55.1 ms

Min: -17.6 ° at 201.9 ms

Theta

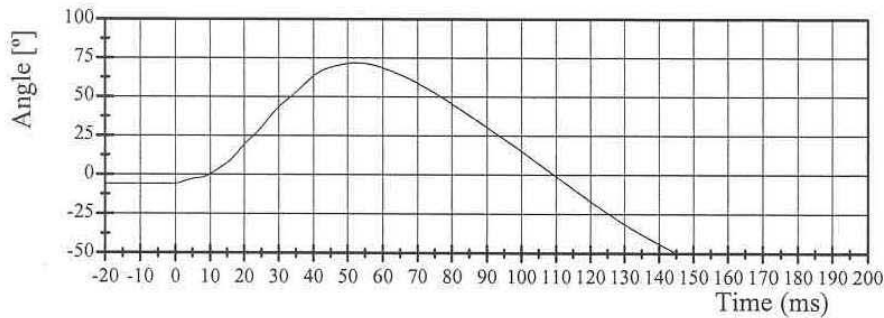


Filter Class: 60

Max: 53.4 ° at 51.7 ms

Min: -57.3 ° at 192.6 ms

Totan



Filter Class: 60

Max: 71.8 ° at 52.6 ms

Min: -74.9 ° at 192.9 ms

10.09.2003 08:57:59 637

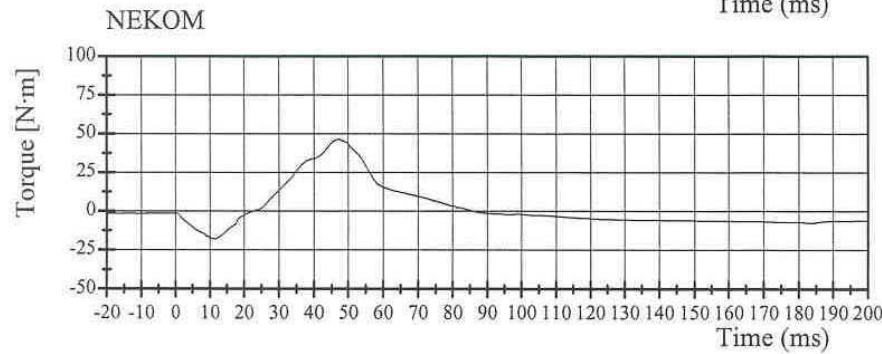
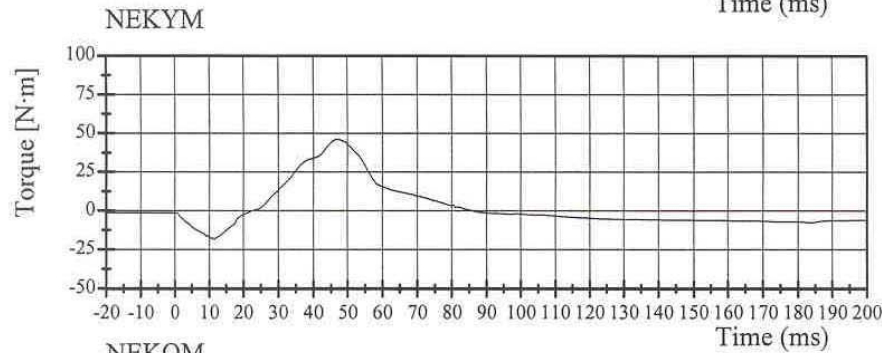
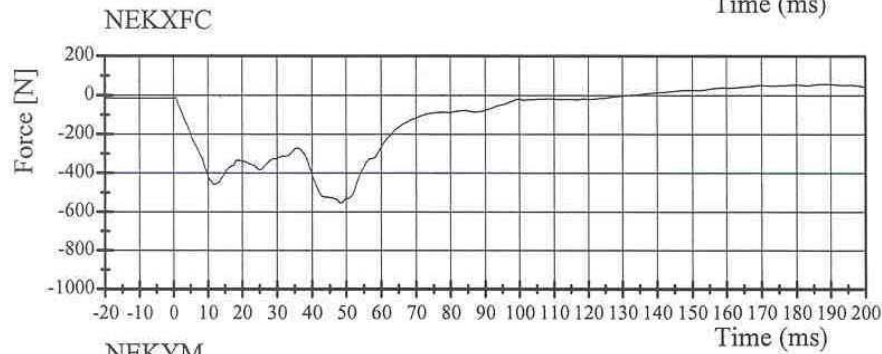
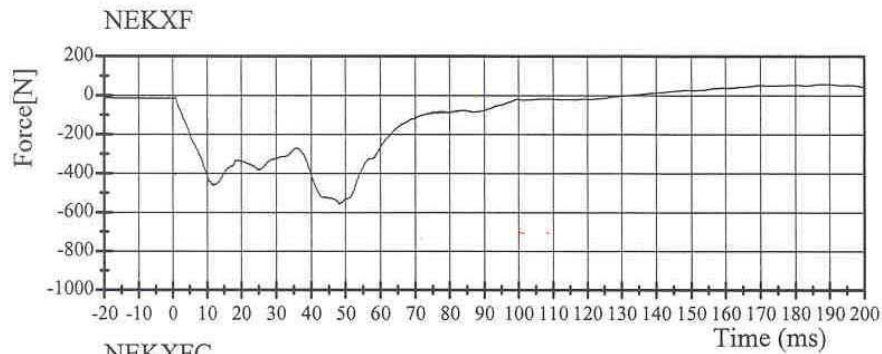


Transportation Research Center Inc.

572P Neck Flexion Test

HIII 3 Year Old Serial No. 040 Calibration No. 02 - 3

Test Date 10/09/2003



10.09.2003 08:58:00 637



Transportation Research Center Inc.

572P Neck Extension Test - 6 Channel Transducer

HIII 3 Year Old Serial No. 040 Calibration No. 02 - 2

Test Date 10/09/2003

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	21.1 °C	Yes
Relative Humidity	10 - 70 %	47 %	Yes
Impact Velocity	3.55 - 3.75 m/s	3.71 m/s	Yes
Integrated Pendulum Velocity			
10 ms	1.00 - 1.40 m/s	1.38 m/s	Yes
15 ms	1.90 - 2.50 m/s	2.44 m/s	Yes
20 ms	2.80 - 3.50 m/s	3.32 m/s	Yes
Peak D Plane Rotation	83 - 93 °	86.8 °	Yes
Peak Moment About Occipital Condyles (During time interval rotation is within specified corridors)	-53.3 - (-43.7) N·m	-46.33 N·m	Yes
Positive Moment Decay Time To -10 N·m	60 - 80 ms	66.16 ms	Yes

Comments:

Technician



Approved



10.09.2003 09:53:50 953



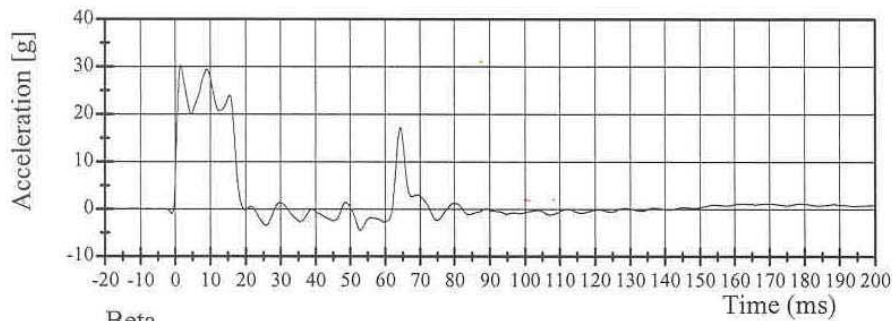
Transportation Research Center Inc.

572P Neck Extension Test

HIII 3 Year Old Serial No. 040 Calibration No. 02 - 2

Test Date 10/09/2003

Pendulum Deceleration

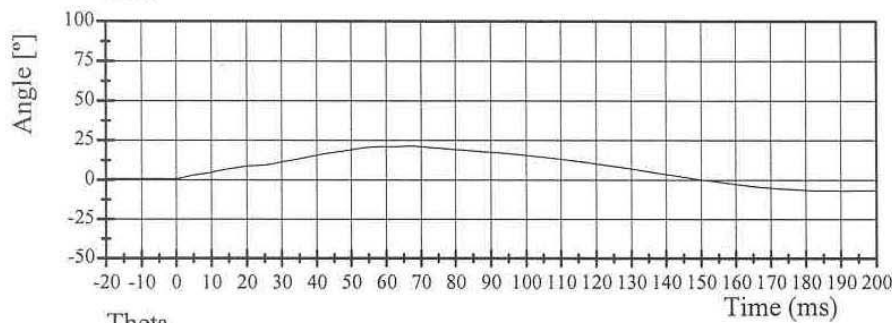


Filter Class: 180

Max: 30.2 g at 1.7 ms

Min: -4.5 g at 52.8 ms

Beta

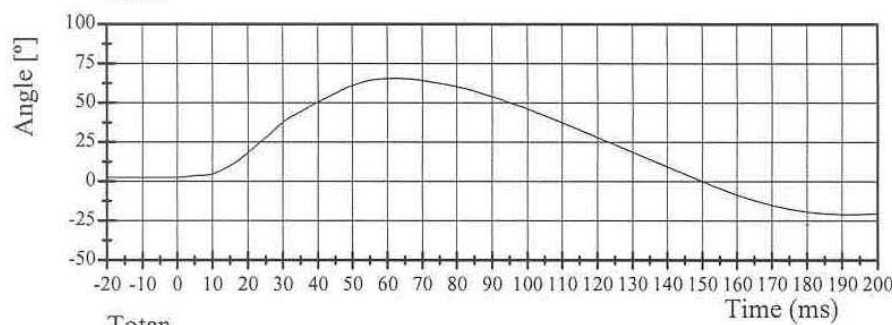


Filter Class: 60

Max: 21.4 ° at 67.0 ms

Min: -6.8 ° at 190.8 ms

Theta

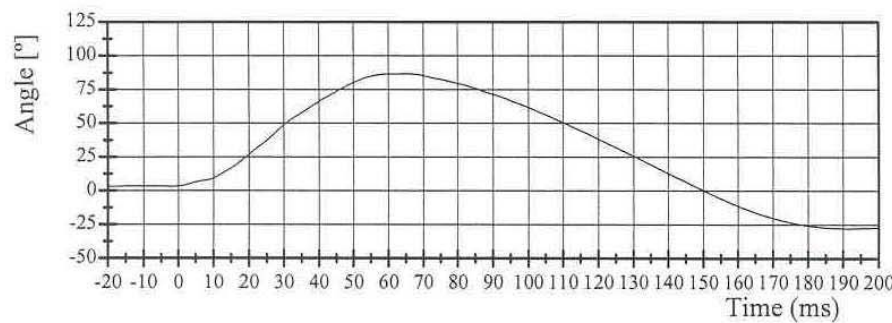


Filter Class: 60

Max: 65.5 ° at 62.4 ms

Min: -20.9 ° at 191.8 ms

Totan



Filter Class: 60

Max: 86.8 ° at 65.4 ms

Min: -27.8 ° at 191.6 ms

10.09.2003 09:53:51 953

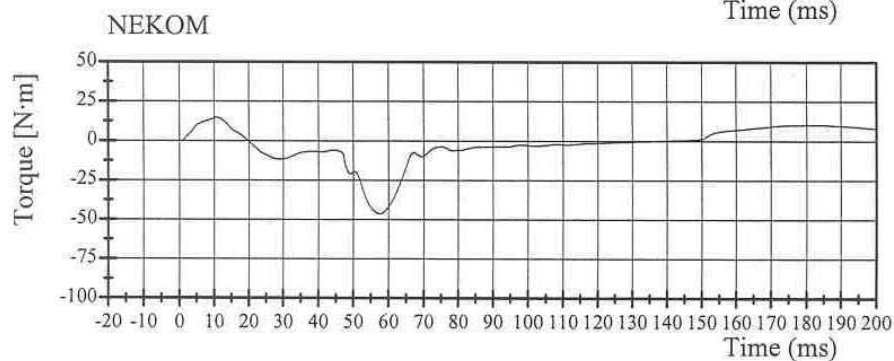
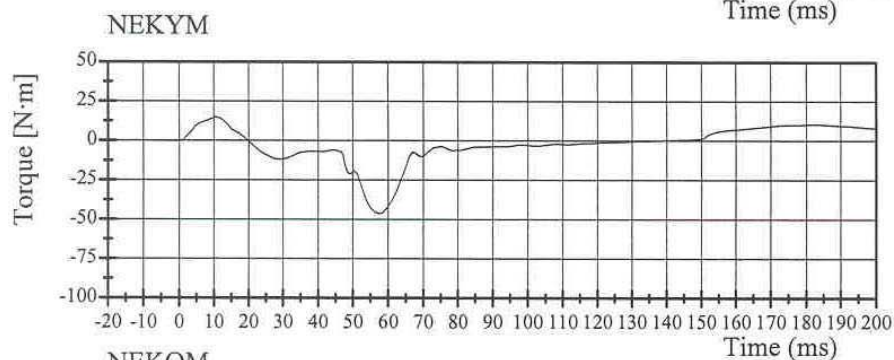
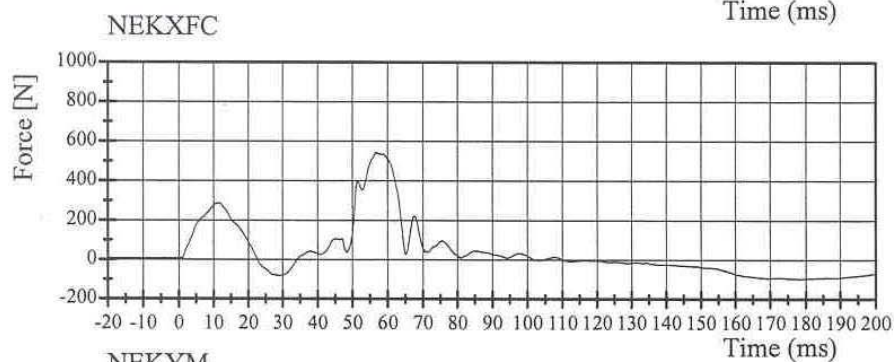
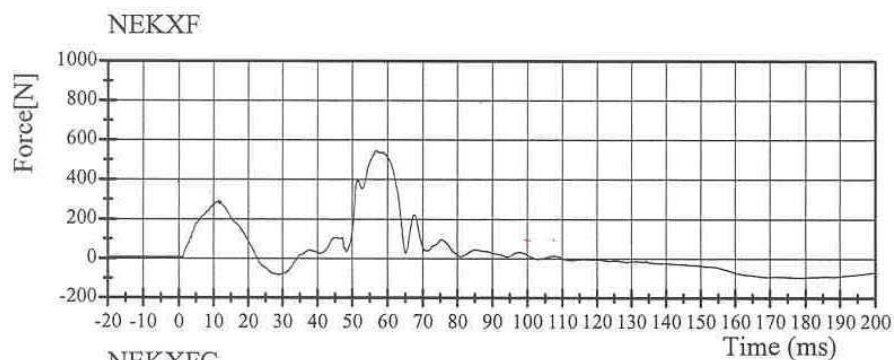


Transportation Research Center Inc.

572P Neck Extension Test

HIII 3 Year Old Serial No. 040 Calibration No. 02 - 2

Test Date 10/09/2003



10.09.2003 09:53:52 953



Transportation Research Center Inc.

572P Thorax Test

HIII 3 Year Old Serial No. 040 Calibration No. 02 - 3

Test Date 10/10/2003

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	21.1 °C	Yes
Relative Humidity	10 - 70 %	62 %	Yes
Pendulum Velocity	5.90 - 6.10 m/s	6.05 m/s	Yes
Maximum Chest Deflection	-38.0 - (-32.0) mm	-32.5 mm	Yes
Peak Impact Probe Force Within Compression Corridor	680 - 810 N	715 N	Yes
Internal Hysteresis	65 - 85 %	71 %	Yes
Maximum Force Between 12.5 mm & 32 mm Of Deflection	<= 910	778	Yes

Comments:

Technician



Approved



10.10.2003 09:47:24 998



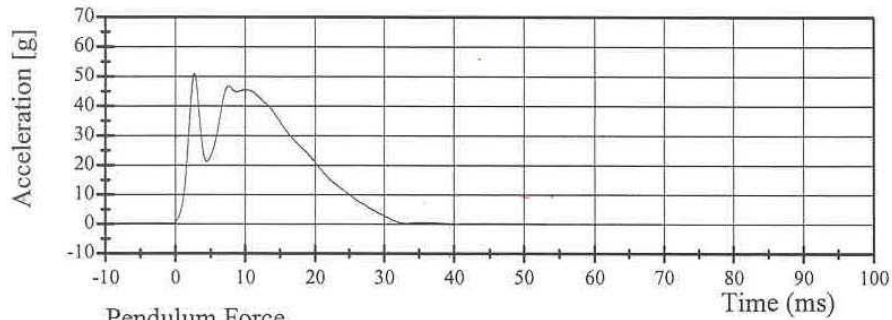
Transportation Research Center Inc.

572P Thorax Test

HIII 3 Year Old Serial No. 040 Calibration No. 02 - 3

Test Date 10/10/2003

Pendulum Deceleration

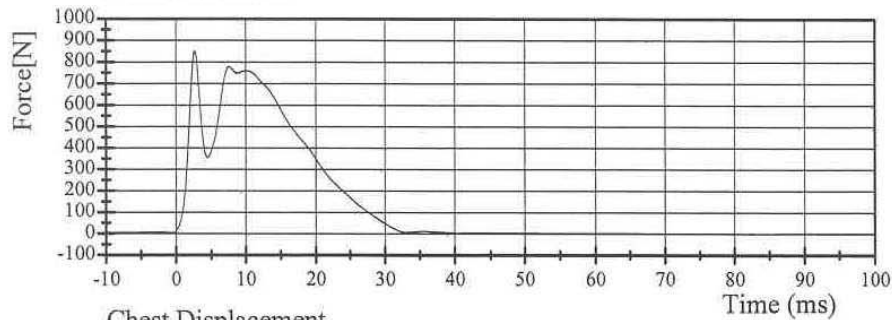


Filter Class: 180

Max: 51.0 g at 2.6 ms

Min: -0.4 g at 433.0 ms

Pendulum Force

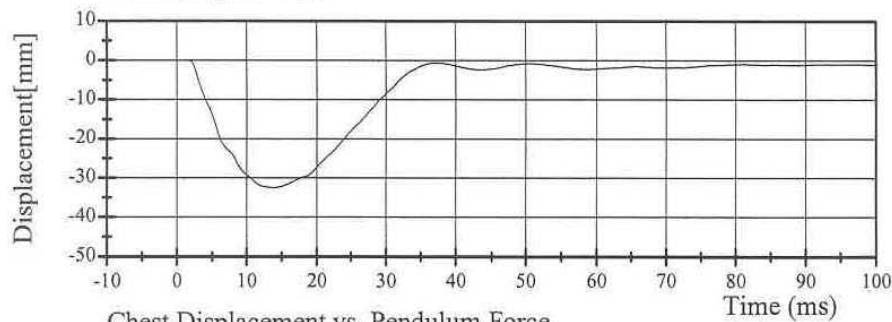


Filter Class: 180

Max: 850.3 N at 2.6 ms

Min: -7.0 N at 433.0 ms

Chest Displacement

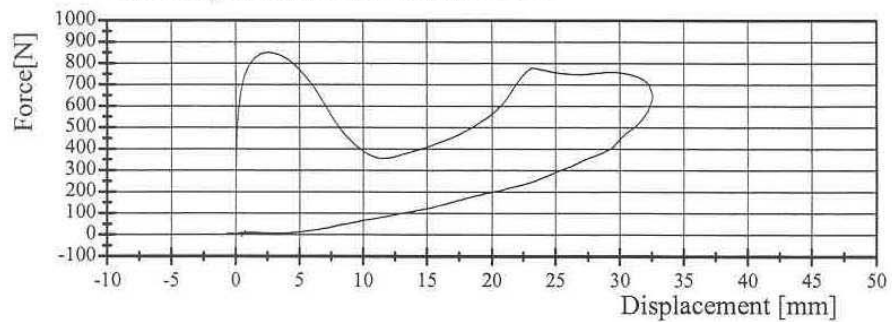


Filter Class: 600

Max: 0.7 mm at 725.3 ms

Min: -32.5 mm at 13.9 ms

Chest Displacement vs. Pendulum Force



10.10.2003 09:47:25 998



TRANSPORTATION RESEARCH CENTER INC.

TORSO FLEXION TEST

HYBRID III THREE-YEAR-OLD

CAL DATE: 09-Oct-03

TRC, INC. TEST NO: 040C02TF1 572 P SN 040 TORSO FLEX CAL 02

TEST PARAMETER	SPECIFICATION	TEST RESULTS
TEMPERATURE	18.9 – 25.6 DEG. C	21.7 DEG. C
RELATIVE HUMIDITY	10 – 70 %	44 %
INITIAL ANGLE OF UNSUPPORTRED DUMMY	≤ 15 DEG. REFERENCED TO VERTICAL	9.2 DEG.
MAXIMUM FORCE AT 45 DEG. DURING 10 SECOND PERIOD	130 – 180 N	152.6 N
RETURN ANGLE		14.8 °
DIFFERENCE BETWEEN RETURN ANGLE & INTIAL ANGLE	+/- 8 ° OF INTIAL ANGLE	5.6 °
RATE	0.5° - 1.5°/sec	1.0 °/sec

TEST MEETS SPECIFICATIONS

TECHNICIAN



**Transportation Research Center
Inc.**

ATD Calibration Report

for

VRTC

**HIII 3 Year Old Serial No. 042
Calibration No. 02**



Transportation Research Center Inc.
P.O. Box B-67
10820 St. Rt. 347
East Liberty, OH 43319-0367

Transportation Research Center Inc.
572P HIII 3 Year Old Dummy
External Dimensions
Serial No. 042 Calibration No. 02

Test Parameter	Dimension	Specification	Results	Pass
Total Sitting Height	A	538.5 - 553.7 mm	546 mm	Yes
Shoulder Pivot Height	B	307.3 - 322.6 mm	313 mm	Yes
Hip Pivot Height	C	33.0 - 43.2 mm	37 mm	Yes
Hip Pivot from Backline	D	56.9 - 67.1 mm	59 mm	Yes
Shoulder Pivot from Backline	E	58.4 - 68.6 mm	63 mm	Yes
Thigh Clearance	F	81.0 - 91.2 mm	87 mm	Yes
Back of Elbow to Wrist Pivot	G	247.4 - 262.6 mm	253 mm	Yes
Head Back to Backline	H	48.3 - 58.4 mm	49 mm	Yes
Shoulder to Elbow Length	I	185.0 - 200.7 mm	193 mm	Yes
Elbow Rest Height	J	133.6 - 148.8 mm	136 mm	Yes
Buttock to Knee Length	K	287.3 - 302.5 mm	293 mm	Yes
Popliteal Height	L	221.0 - 236.2 mm	228 mm	Yes
Knee to Floor Height	M	241.6 - 256.8 mm	249 mm	Yes
Buttock Popliteal Height	N	217.9 - 233.2 mm	229 mm	Yes
Chest Depth without Jacket	O	134.6 - 149.9 mm	137 mm	Yes
Foot Length	P	137.7 - 147.8 mm	141 mm	Yes
Stature	Q	932.2 - 957.6 mm	936 mm	Yes
Buttock to Knee Pivot Length	R	251.5 - 261.6 mm	258 mm	Yes
Head Breadth	S	128.3 - 143.5 mm	136 mm	Yes
Head Depth	T	167.4 - 182.6 mm	176 mm	Yes
Hip Breadth	U	200.7 - 215.9 mm	209 mm	Yes
Shoulder Breadth	V	236.5 - 251.7 mm	243 mm	Yes
Foot Breadth	W	53.6 - 63.8 mm	57 mm	Yes
Head Circumference	X	500.4 - 515.6 mm	510 mm	Yes
Chest Circumference with Jacket	Y	527.1 - 552.5 mm	536 mm	Yes
Waist Circumference	Z	527.1 - 552.5 mm	543 mm	Yes
Reference Location for Chest Circumference	AA	248.9 - 259.1 mm	254 mm	Yes
Reference Location for Waist Circumference	BB	160.0 - 170.2 mm	165 mm	Yes

Technician



Approved




Transportation Research Center Inc.

572P Head Drop Test

HIII 3 Year Old Serial No. 042 Calibration No. 02 - 1

Test Date 10/15/2003

Test Parameter	Specification	Test Results	Pass
Temperature	18.9 - 25.6 °C	21.1 °C	Yes
Relative Humidity	10 - 70 %	32 %	Yes
Peak Resultant Acceleration	250 - 280 g	259.5 g	Yes
Peak Lateral Acceleration	15 g Max	-8.0 g	Yes
Is Acceleration Curve Unimodal?	Yes	Yes	Yes

Comments:

Technician



Approved



10.15.2003 14:25:05 611

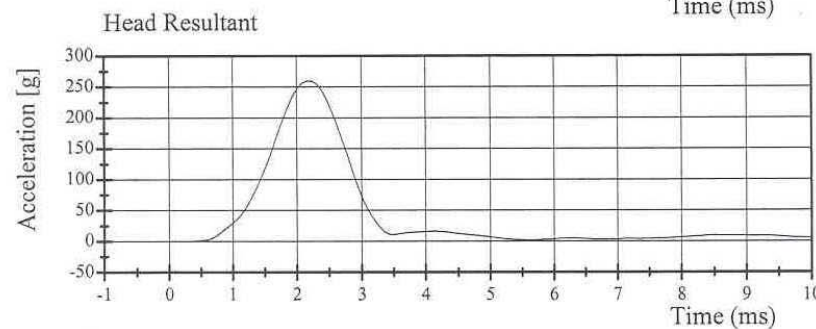
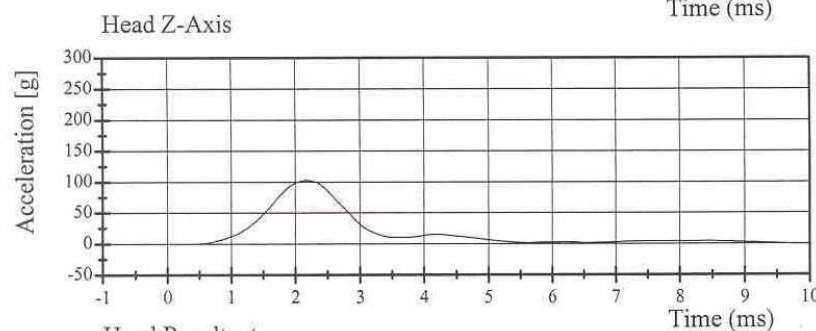
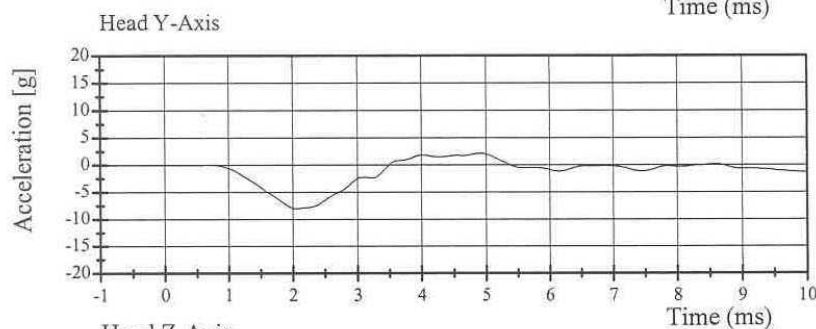
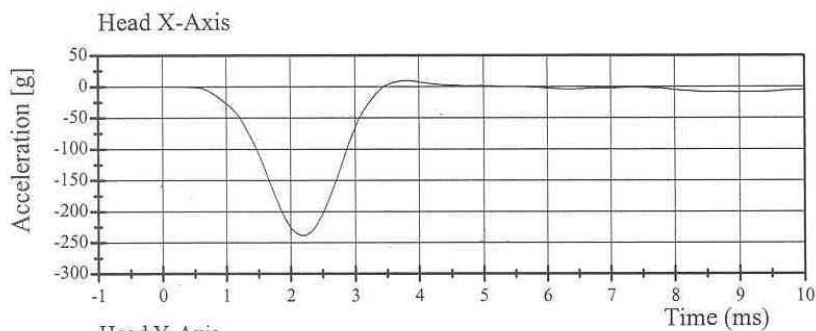


Transportation Research Center Inc.

572P Head Drop Test

HIII 3 Year Old Serial No. 042 Calibration No. 02 - 1

Test Date 10/15/2003



10.15.2003 14:25:05 611



Transportation Research Center Inc.

572P Neck Flexion Test - 6 Channel Transducer

HIII 3 Year Old Serial No. 042 Calibration No. 02 - 2

Test Date 10/15/2003

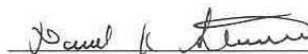
Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	21.1 °C	Yes
Relative Humidity	10 - 70 %	31 %	Yes
Impact Velocity	5.40 - 5.60 m/s	5.47 m/s	Yes
Integrated Pendulum Velocity			
10 ms	2.00 - 2.70 m/s	2.36 m/s	Yes
15 ms	3.00 - 4.00 m/s	3.41 m/s	Yes
20 ms	4.00 - 5.10 m/s	4.62 m/s	Yes
Peak D Plane Rotation	70 - 82 °	73.7 °	Yes
Peak Moment About Occipital Condyles (During time interval rotation is within specified corridors)	42.0 - 53.0 N·m	42.46 N·m	Yes
Positive Moment Decay Time To 10 N·m	60 - 80 ms	71.36 ms	Yes

Comments:

Technician



Approved



10.15.2003 15:21:00 640

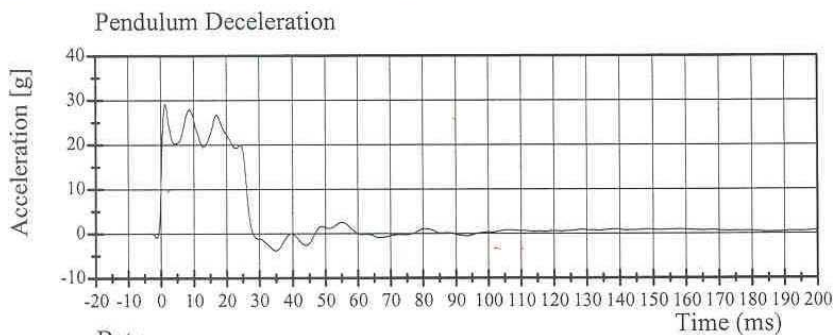


Transportation Research Center Inc.

572P Neck Flexion Test

HIII 3 Year Old Serial No. 042 Calibration No. 02 - 2

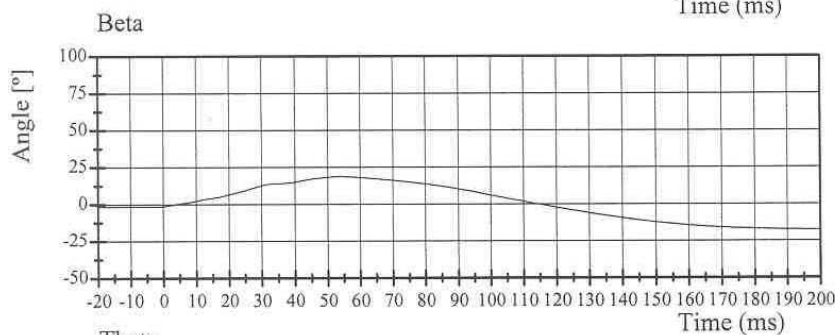
Test Date 10/15/2003



Filter Class: 180

Max: 29.2 g at 1.4 ms

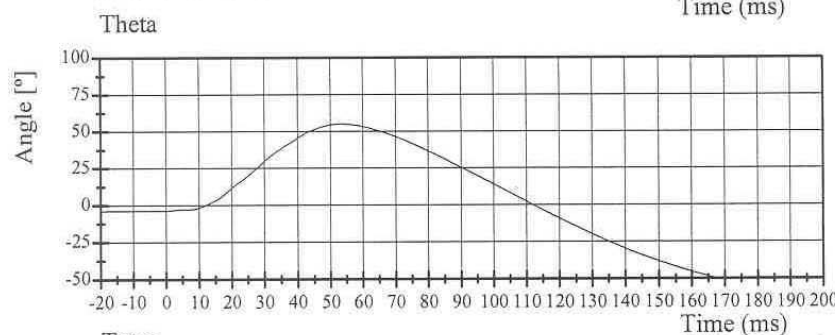
Min: -3.8 g at 35.0 ms



Filter Class: 60

Max: 18.7 ° at 53.9 ms

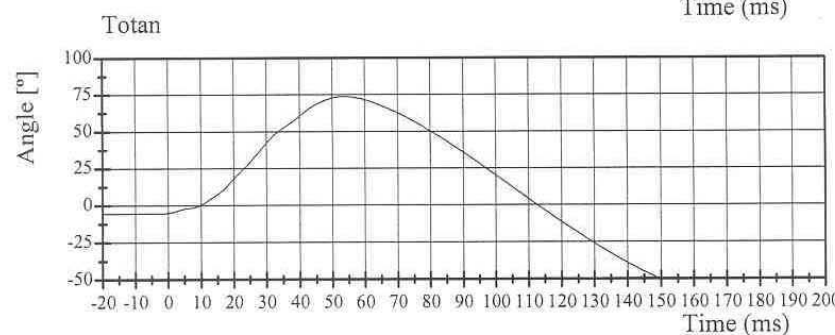
Min: -17.6 ° at 214.3 ms



Filter Class: 60

Max: 55.0 ° at 53.4 ms

Min: -56.8 ° at 200.0 ms



Filter Class: 60

Max: 73.7 ° at 53.6 ms

Min: -74.4 ° at 201.8 ms

10.15.2003 15:21:01 640

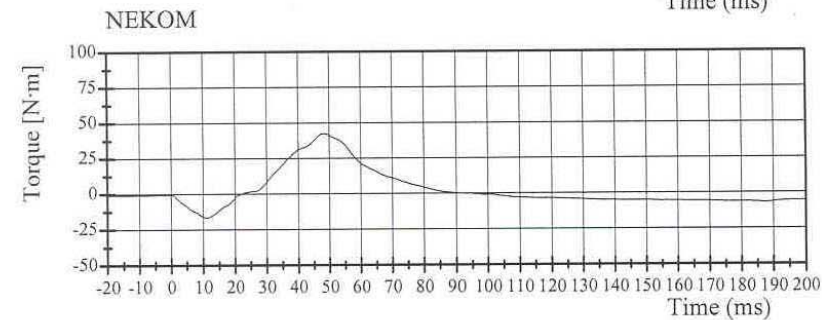
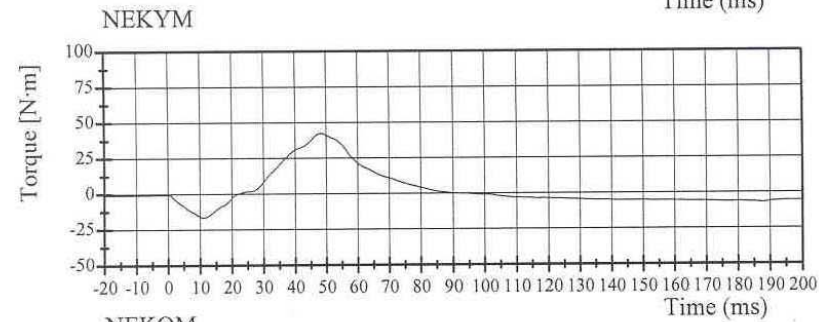
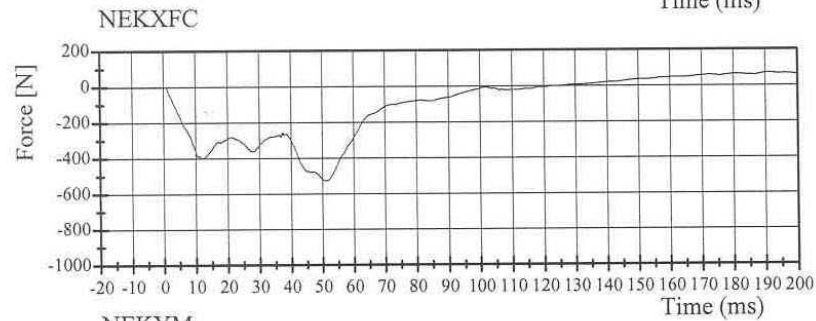
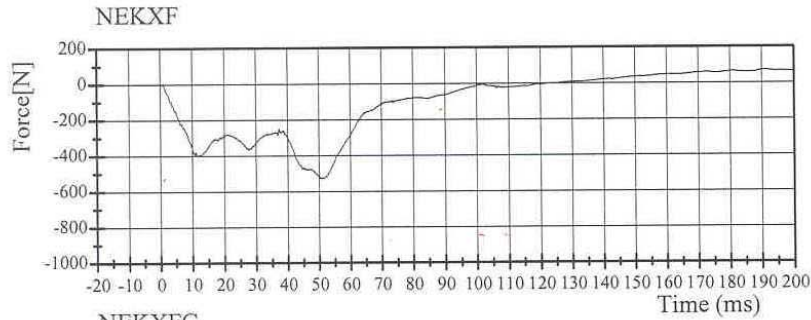


Transportation Research Center Inc.

572P Neck Flexion Test

HIII 3 Year Old Serial No. 042 Calibration No. 02 - 2

Test Date 10/15/2003



10.15.2003 15:21:02 640



Transportation Research Center Inc.

572P Neck Extension Test - 6 Channel Transducer

HIII 3 Year Old Serial No. 042 Calibration No. 02 - 3

Test Date 10/16/2003

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	21.1 °C	Yes
Relative Humidity	10 - 70 %	32 %	Yes
Impact Velocity	3.55 - 3.75 m/s	3.72 m/s	Yes
Integrated Pendulum Velocity			
10 ms	1.00 - 1.40 m/s	1.37 m/s	Yes
15 ms	1.90 - 2.50 m/s	2.44 m/s	Yes
20 ms	2.80 - 3.50 m/s	3.29 m/s	Yes
Peak D Plane Rotation	83 - 93 °	87.0 °	Yes
Peak Moment About Occipital Condyles (During time interval rotation is within specified corridors)	-53.3 - (-43.7) N·m	-47.07 N·m	Yes
Positive Moment Decay Time To -10 N·m	60 - 80 ms	72.08 ms	Yes

Comments:

Technician



Approved



10.16.2003 08:30:06 942



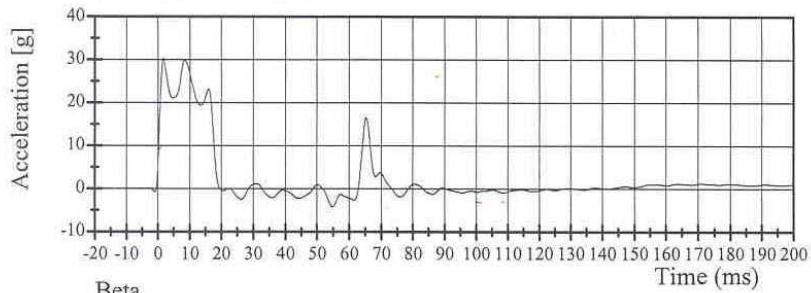
Transportation Research Center Inc.

572P Neck Extension Test

HIII 3 Year Old Serial No. 042 Calibration No. 02 - 3

Test Date 10/16/2003

Pendulum Deceleration

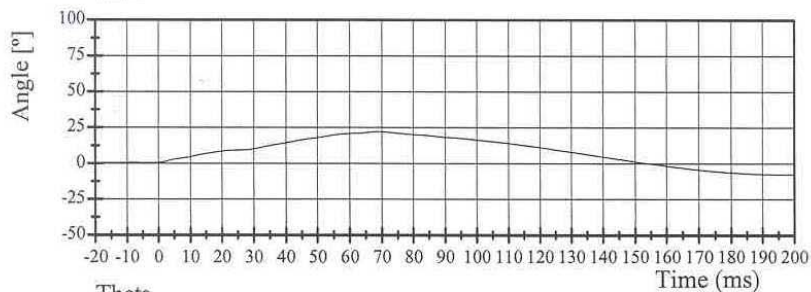


Filter Class: 180

Max: 30.4 g at 1.7 ms

Min: -4.2 g at 54.8 ms

Beta

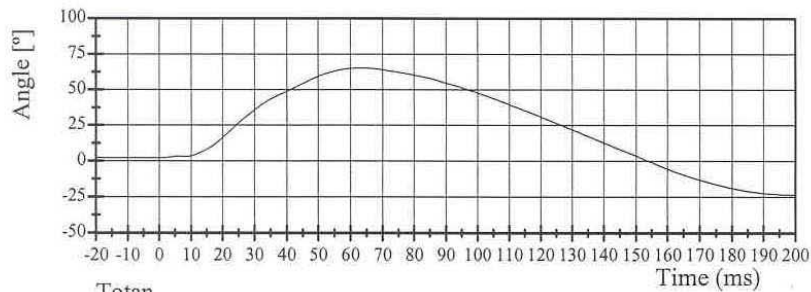


Filter Class: 60

Max: 22.2 ° at 68.8 ms

Min: -7.6 ° at 200.0 ms

Theta

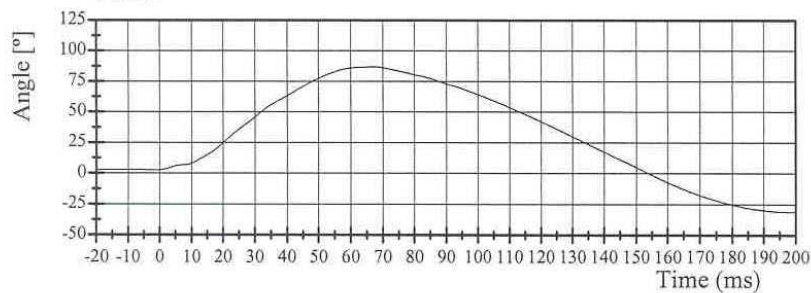


Filter Class: 60

Max: 65.3 ° at 63.4 ms

Min: -23.5 ° at 199.6 ms

Totan



Filter Class: 60

Max: 87.0 ° at 67.0 ms

Min: -31.1 ° at 199.6 ms

10.16.2003 08:30:07 942

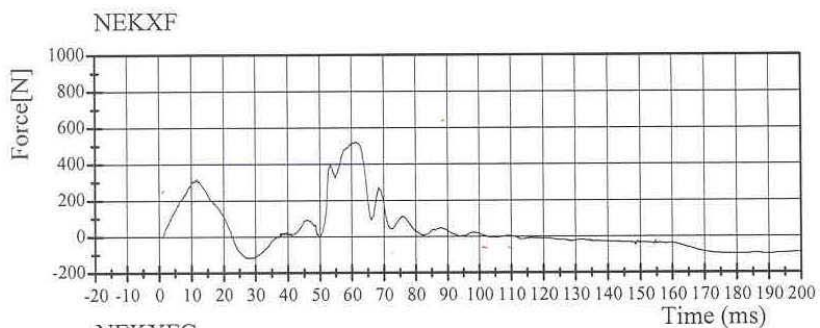


Transportation Research Center Inc.

572P Neck Extension Test

HIII 3 Year Old Serial No. 042 Calibration No. 02 - 3

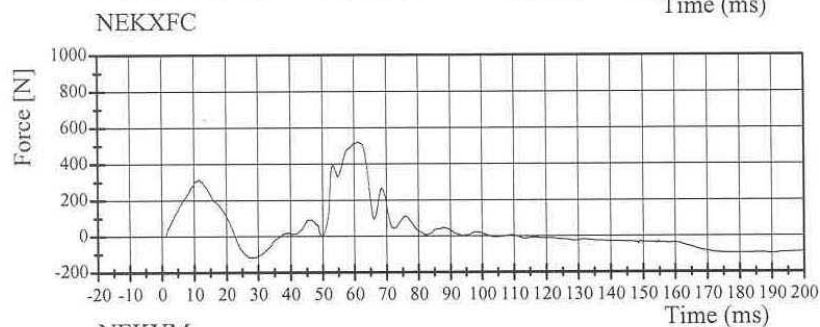
Test Date 10/16/2003



Filter Class: 1000

Max: 521.6 N at 61.4 ms

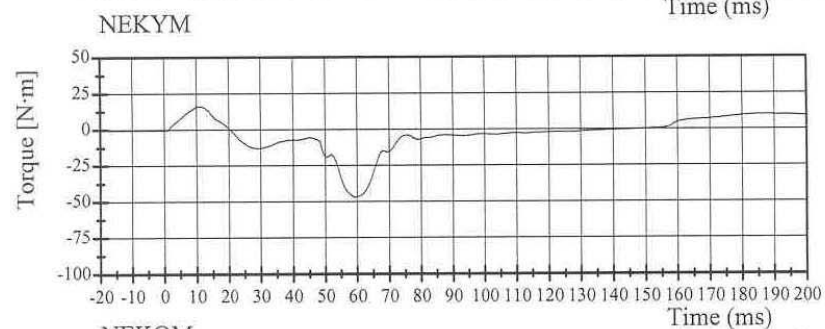
Min: -119.7 N at 28.4 ms



Filter Class: 600

Max: 520.8 N at 61.3 ms

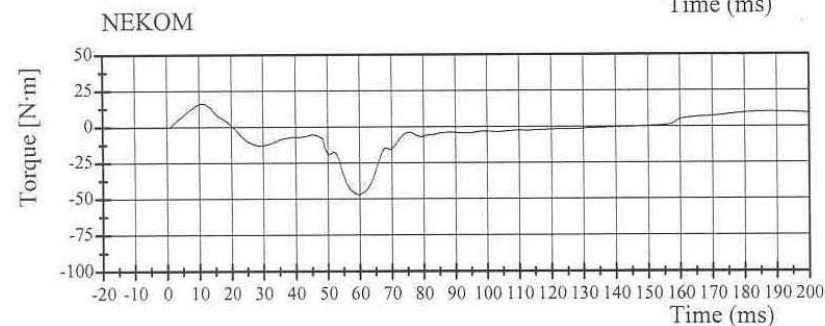
Min: -119.0 N at 28.3 ms



Filter Class: 600

Max: 16.2 N·m at 11.3 ms

Min: -47.1 N·m at 59.7 ms



Filter Class: 600

Max: 16.2 N·m at 11.3 ms

Min: -47.1 N·m at 59.7 ms

10.16.2003 08:30:08 942



Transportation Research Center Inc.

572P Thorax Test

HIII 3 Year Old Serial No. 042 Calibration No. 02 - 1

Test Date 10/17/2003

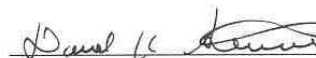
Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	21.7 °C	Yes
Relative Humidity	10 - 70 %	30 %	Yes
Pendulum Velocity	5.90 - 6.10 m/s	6.05 m/s	Yes
Maximum Chest Deflection	-38.0 - (-32.0) mm	-35.0 mm	Yes
Peak Impact Probe Force Within Compression Corridor	680 - 810 N	746 N	Yes
Internal Hysteresis	65 - 85 %	71 %	Yes
Maximum Force Between 12.5 mm & 32 mm Of Deflection	<= 910	795	Yes

Comments:

Technician



Approved



10.17.2003 13:12:32 991



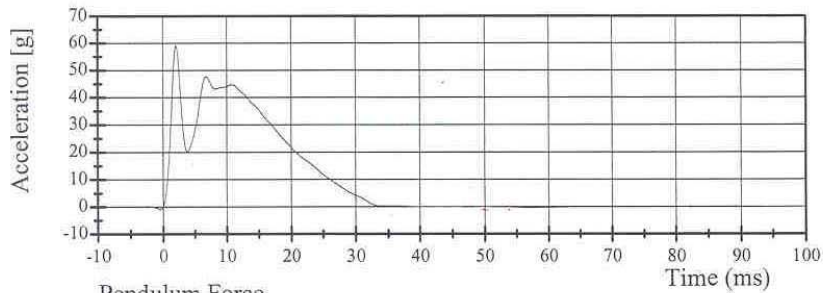
Transportation Research Center Inc.

572P Thorax Test

HIII 3 Year Old Serial No. 042 Calibration No. 02 - 1

Test Date 10/17/2003

Pendulum Deceleration

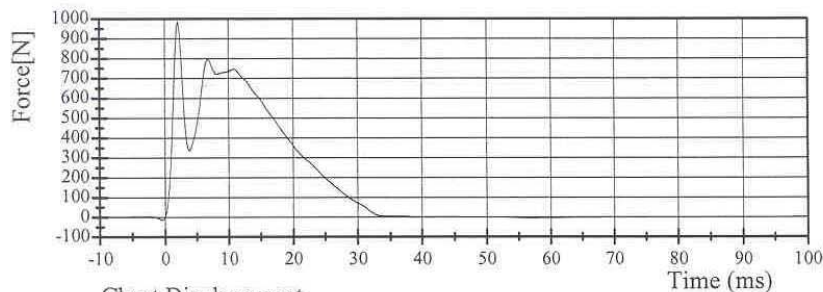


Filter Class: 180

Max: 59.1 g at 2.1 ms

Min: -0.9 g at -0.4 ms

Pendulum Force

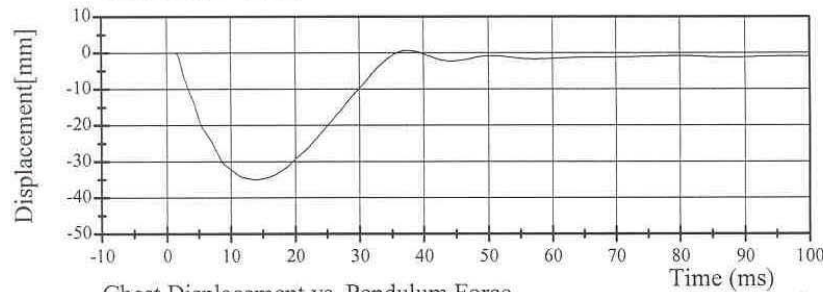


Filter Class: 180

Max: 984.8 N at 2.1 ms

Min: -15.2 N at -0.4 ms

Chest Displacement

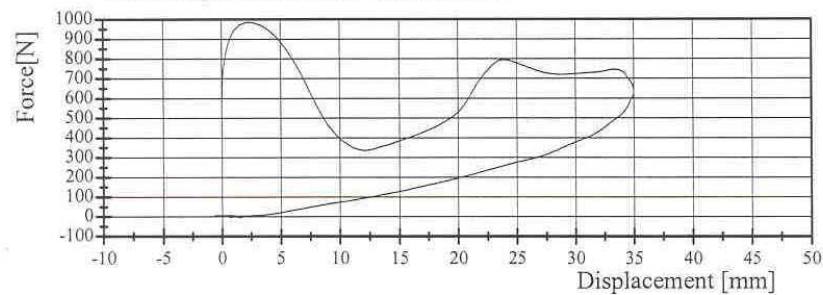


Filter Class: 600

Max: 0.7 mm at 37.3 ms

Min: -35.0 mm at 14.0 ms

Chest Displacement vs. Pendulum Force



10.17.2003 13:12:33 991



TRANSPORTATION RESEARCH CENTER INC.

TORSO FLEXION TEST

HYBRID III THREE-YEAR-OLD

CAL DATE: 16-Oct-03

TRC, INC. TEST NO: 042C02TF1 572 P SN 042 TORSO FLEX CAL 02

TEST PARAMETER	SPECIFICATION	TEST RESULTS
TEMPERATURE	18.9 – 25.6 DEG. C	21.7 DEG. C
RELATIVE HUMIDITY	10 – 70 %	36 %
INITIAL ANGLE OF UNSUPPORTRED DUMMY	<= 15 DEG. REFERENCED TO VERTICAL	4.9 DEG.
MAXIMUM FORCE AT 45 DEG. DURING 10 SECOND PERIOD	130 – 180 N	179.8 N
RETURN ANGLE		2.5 DEG.
DIFFERENCE BETWEEN RETURN ANGLE & INTIAL ANGLE	+/- 10° OF INTIAL ANGLE	7.4 °
RATE	0.5° - 1.5°/sec	1.0 °/sec

TEST MEETS SPECIFICATIONS

TECHNICIAN 

APPENDIX D

TEST EQUIPMENT LIST AND CALIBRATION INFORMATION

INSTRUMENTS FOR RRP CHILD DUMMY S/N: 040

	SERIAL NO.	MANUFACTURER	CALIBRATION DATE
Head X	AP1Y1	Endevco	8/7/03
Head Y	ACC81	Endevco	8/7/03
Head Z	AHY71	Endevco	8/7/03
Head X Redundant	P22190	Endevco	9/4/03
Head Y Redundant	P22180	Endevco	9/4/03
Head Z Redundant	P22805	Endevco	9/4/03
Upper Neck Load Cell	210	Denton	8/25/03
Chest X	J13649	Endevco	10/6/03
Chest Y	ANBP7	Endevco	9/4/03
Chest Z	J13422	Entran	10/6/03
Chest X Redundant	J13653	Endevco	10/6/03
Chest Y Redundant	AP1C6	Endevco	9/4/03
Chest Z Redundant	J13713	Endevco	10/6/03
Chest Deflection Gauge	040	Servo	10/14/03
Pelvis X	AMTG3	Endevco	8/6/03
Pelvis Y	AMTL6	Endevco	8/6/03
Pelvis Z	ALC37	Endevco	8/6/03
Tether Force	161	FTSS	9/18/03

INSTRUMENTS FOR LRP CHILD DUMMY S/N: 042

	SERIAL NO.	MANUFACTURER	CALIBRATION DATE
Head X	AKAH1	Entran	8/6/03
Head Y	J17709	Entran	8/6/03
Head Z	AJ412	Endevco	8/6/03
Head X Redundant	J18260	Endevco	8/6/03
Head Y Redundant	J20298	Endevco	8/6/03
Head Z Redundant	J20473	Endevco	8/6/03
Upper Neck Load Cell	94	FTSS	9/2/03
Chest X	J12449	Endevco	8/7/03
Chest Y	J12425	Endevco	8/7/03
Chest Z	J12462	Endevco	8/7/03
Chest X Redundant	P27029	Endevco	5/20/03
Chest Y Redundant	P23012	Endevco	9/4/03
Chest Z Redundant	P10148	Endevco	5/23/03
Chest Deflection Gauge	042	Servo	10/23/03
Pelvis X	AGTT3	Endevco	8/7/03
Pelvis Y	AC913	Endevco	8/7/03
Pelvis Z	J11630	Entran	8/7/03
Tether Force	192	Denton	9/4/03