REPORT NUMBER: NCAPCHILD-MGA-2003-004

NEW CAR ASSESSMENT PROGRAM
FRONTAL BARRIER IMPACT TEST

Evenflo Vanguard 5

NHTSA NUMBER: M30200

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

Test Date: January 21, 2003

Report Date: February 5, 2003

FINAL REPORT

PREPARED FOR:
U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
RULEMAKING
OFFICE OF CRASHWORTHINESS STANDARDS
400 SEVENTH STREET, SW, ROOM 5313
WASHINGTON, D.C. 20590

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Reviewed by: David Winkelbauer Date: February 5, 2003
David Winkelbauer, Facility Director

FINAL REPORT ACCEPTED BY:

_____
Manager, New Car Assessment Program

_____
Date of Acceptance

_____
COTR, NCAP Frontal Impact Program

_____
Date of Acceptance

Technical Report Documentation Page

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16. Abstract

A CRS test was performed in conjunction with a New CAR Assessment Program (NCAP) load cell barrier test. his test was conducted a MGA Research Corporation in Burlington, Wisconsin on January 21, 2003.

Measurement Description	Units	Threshold / Pos. 3 ATD		Threshold / Pos. 4 ATD	
Head Injury Criteria (HIC36)	N/A	N/A	507	N/A	298
Head Injury Criteria (HIC15)	N/A	570	281	390	190
Max. Thorax Accel. (3msec Clip)	G's	55	36	50	40

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TABLE OF CONTENTS

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 56.8 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, head rear Z acceleration and upper and lower six axial neck force and moment sensors were utilized for the right rear (Position 3) child dummy. There were upper six axial neck force and moment sensors for the left rear (Position 4) child dummy.

The right rear (Position 3) child dummy (S/N 42) and left rear (Position 4) child dummy (S/N 074) were calibrated previous to this test. Child dummy certification information is found in Appendix C.

The right rear child dummy's HIC36 was 506.9; maximum chest deceleration over 3 msec was 35.6 g's. The left rear child dummy's HIC36 was 297.6. The maximum chest deceleration over 3 msec was 39.6 g's. Position 3 was forward facing and used the vehicle LATCH and top tether for attachment. Position 4 was rear facing and used the vehicle LATCH attachment without the top tether.

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 / 42	12 month old CRABI / 074
Number of Data Channels	22	15
Restraint System	Evenflo Vanguard 5 (front facing)	Evenflo Vanguard 5 (rear facing)

CAMERA COVERAGE

High Speed	17
Real Time	1
Total	18

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	N/A	N/A

POST TEST SEAT DATA

Location	Seat Movement (mm)	Seat Back Failure
P1 (Left Front)	8	None
P2 (Right Front)	5	None
P3 (Right Rear)	0	None
P4 (Left Rear)	0	None

VISIBLE DUMMY CONTACT POINTS

Description	Position 3 CRS (S/N 42)	Position 4 CRS (S/N 074)
Head Contact	Back of head to CRS	Back of head to CRS
Upper Torso Contact	None	None
Lower Torso Contact	None	None
Left Foot Contact	Foot to back of front seat	None
Right Foot Contact	Foot to back of front seat	None

SECTION 2… (continued)

DATA SHEET NO. 2
CRS PARAMETER DATA

Child Restraint System (Position 3)	Evenflo Vanguard 5 (front facing with 3 Year Old)
Child Restraint System (Position 4)	Evenflo Vanguard 5 (rear facing with CRABI)
NHTSA No.	M30200

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value
Total Delivered Weight (UVW)	kg	1885.5
Weight of 2 P572E ATDs	kg	156.0
Rated Cargo/Luggage Weight (RCLW)	kg	91.0
Calculated Vehicle Target Weight (TVTW)	kg	2132.5

TEST VEHICLE WEIGHTS

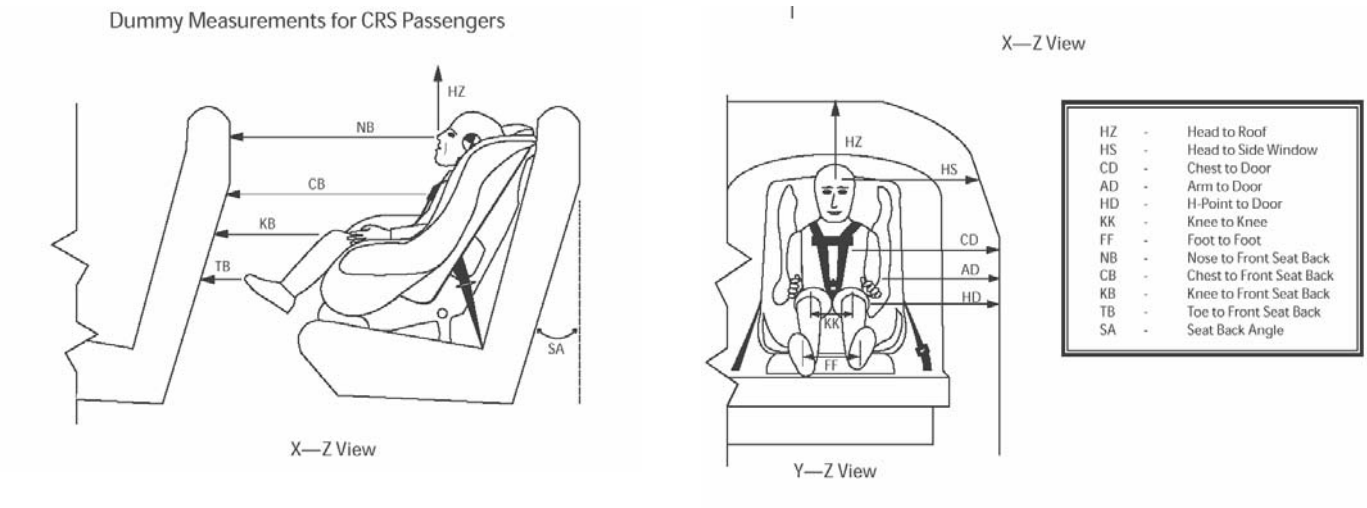
	Units	As Tested (ATW) (Axle)		
		Front	Rear	Total
Left	kg	572.9	497.6	
Right	kg	567.9	489.4	
Ratio	%	53.6	46.4	
Totals	kg	1140.8	987.0	2127.8

As tested weight of vehicle includes two ATDs, one 3 year old with CRS, one 12 month old CRABI 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 (front facing with 3 Year Old)
NHTSA No.	M30200



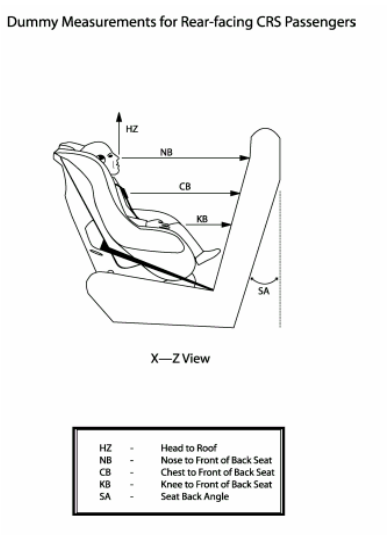
Measurement	Pre-Test (mm)	Post-Test (mm)
	P3 CRS (42)	P3 CRS (42)
SA (deg)	17.3	17.3
HS	408	401
CD	377	356
AD	226	210
HD	261	270
HZ	342	337
NB	575	610
CB	563	601
KK	155	160
FF	153	160
KB - LEFT	381	411
KB – RIGHT	378	390
TB - LEFT	116	131
TB - RIGHT	107	120

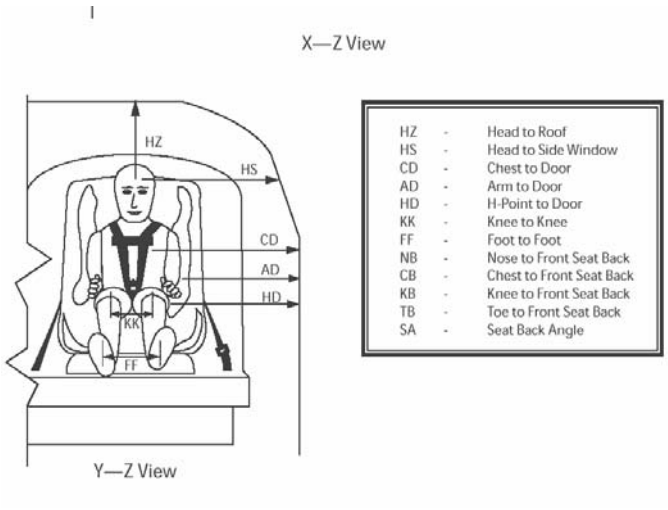
All dimensions in mm (unless noted)
P3 – Right Rear Passenger

SECTION 2… (continued)

DATA SHEET NO. 3
CHILD DUMMY POSITIONING IN VEHICLE

Child Restraint System (Position 4)	Evenflo Vanguard 5 (rear facing with CRABI)
NHTSA No.	M30200





Measurement	Pre-Test (mm)	Post-Test (mm)
	P4 CRS (74)	P4 CRS (74)
SA (deg)	17.3	17.3
HS	401	424
CD	370	351
AD	224	224
HD	277	295
HZ	406	447
NB	528	578
CB	441	493
KK	102	108
FF	106	91
KB - LEFT	230	260
KB – RIGHT	217	255
TB - LEFT	112	189
TB - RIGHT	105	200

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

SECTION 2… (continued)

DATA SHEET NO. 4
CHILD DUMMY INJURY CRITERIA VALUES

Child Restraint System (Position 3)	Evenflo Vanguard 5 (front facing with 3 Year Old)
Child Restraint System (Position 4)	Evenflo Vanguard 5 (rear facing with CRABI)
NHTSA No.	M30200

HEAD PEAK ACCELERATIONS

Location	Axis	Units	Position 3				Position 4			
			Max	Time	Min	Time	Max	Time	Min	Time
Head CG	X	G's	0.4	30	-43.1	112	36.9	102	-6.5	140
Head CG	Y	G's	1.7	70	-18.1	112	1.6	47	-20.5	118
Head CG	Z	G's	49.3	94	-11.1	50	38.6	64	-12.9	117
Resultant	N/A	G's	54.4	94			50.2	65		
Head Rear	Z	G's	56.1	94	-22.1	52				

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	1.5	-14	-756.7	127	87.3	105	-209.1	134
Neck Force	Y	N	40.0	61	-80.4	180	31.0	47	-199.0	132
Neck Force	Z	N	1586.9	95	-288.6	50	1448.6	188	-123.8	114
Resultant	N/A	N	1664.5	95			1448.6	188		
Neck Moment	X	N•m	2.9	65	-9.3	122	8.0	118	-2.7	146
Neck Moment	Y	N•m	13.1	75	-11.0	127	5.5	109	-5.6	55
Neck Moment	Z	N•m	1.6	161	-2.2	192	0.5	64	-6.5	136
Resultant	N/A	N•m	13.7	121			9.7	118		

LOWER NECK PEAK FORCES AND MOMENTS

Location	Axis	Units	Position 3				Position 4			
			Max	Time	Min	Time	Max	Time	Min	Time
Neck Force	X	N	75.7	74	-469.2	126				
Neck Force	Y	N	53.9	51	-131.9	180				
Neck Force	Z	N	1024.3	94	-447.8	50				
Resultant	N/A	N	1110.6	94						
Neck Moment	X	N•m	7.3	68	-13.7	180				
Neck Moment	Y	N•m	85.0	127	-6.1	200				
Neck Moment	Z	N•m	2.4	81	-9.1	119				
Resultant	N/A	N•m	85.4	126						

SECTION 2… (continued)

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

Child Restraint System (Position 3)	Evenflo Vanguard 5 (front facing with 3 Year Old)
Child Restraint System (Position 4)	Evenflo Vanguard 5 (rear facing with CRABI)
NHTSA No.	M30200

CHEST PRIMARY PEAK ACCELERATIONS

Location	Axis	Units	Position 3				Position 4			
			Max	Time	Min	Time	Max	Time	Min	Time
Chest CG	X	G's	1.7	141	-36.6	89	33.0	78	-1.6	177
Chest CG	Y	G's	2.7	186	-4.6	122	2.4	134	-15.2	114
Chest CG	Z	G's	8.8	185	-19.9	67	25.8	68	-13.0	118
Resultant	N/A	G's	36.8	89			40.6	77		

TETHER FORCE

Location	Axis	Units	Position 3				Position 4			
			Max	Time	Min	Time	Max	Time	Min	Time
Tether Force	N/A	N	**	**	**	**	**	**	**	**

** Not recorded because the load cell would not fit between the tether anchor and the CRS

PELVIC PEAK ACCELERATIONS

Location	Axis	Units	Position 3				Position 4			
			Max	Time	Min	Time	Max	Time	Min	Time
Pelvis	X	G's	7.5	121	-44.9	74	23.8	94	-3.3	180
Pelvis	Y	G's	4.6	74	-5.7	112	3.5	148	-8.9	119
Pelvis	Z	G's	21.9	77	-7.6	185	33.5	53	-5.4	118
Resultant	N/A	G's	47.7	74			37.0	47		

SECTION 2… (continued)

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

Child Restraint System (Position 3)	Evenflo Vanguard 5 (front facing with 3 Year Old)
Child Restraint System (Position 4)	Evenflo Vanguard 5 (rear facing with CRABI)
NHTSA No.	M30200

HEAD INJURY CRITERIA (HIC36)

Location	HIC	T^1 (msec)	T^2 (msec)	Average Acceleration (G's)
Position 3 - Right	506.9	79.3	115.3	45.6
Position 4 – Left	297.6	56.1	92.1	36.9

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	280.6	85.9	100.9	51.1
Position 4 – Left	190.4	60.9	75.9	43.8

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	35.6	87.8	90.8
Position 4 – Left	39.6	53.5	56.5

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	0.45
Nte	0.9
Ncf	0
Nce	0.35

POSITION 4 NECK INJURY SUMMARIES

Nij V10	Nij
Ntf	0.4
Nte	0.95
Ncf	0.18
Nce	0

SECTION 2… (continued)

DATA SHEET NO. 5
CRS PERFORMANCE DATA

Child Restraint System (Position 3)	Evenflo Vanguard 5 (front facing with 3 Year Old)
Child Restraint System (Position 4)	Evenflo Vanguard 5 (rear facing with CRABI)
NHTSA No.	M30200

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	

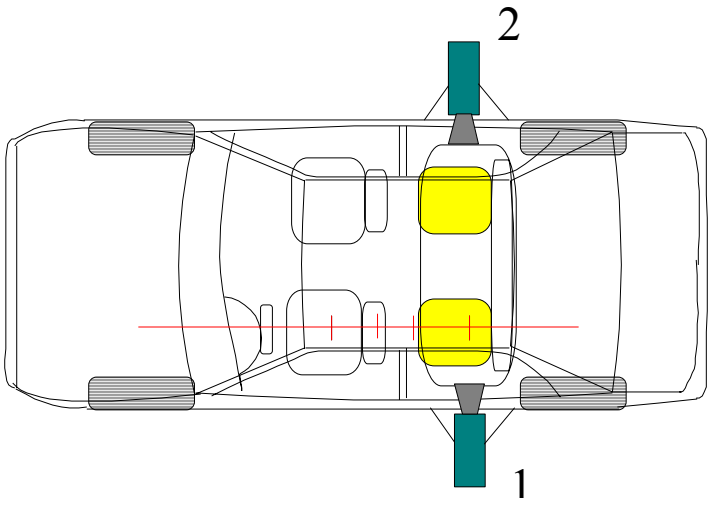
POSITION 4 CRS POST-TEST INSPECTION

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 (front facing with 3 Year Old)
Child Restraint System (Position 4)	Evenflo Vanguard 5 (rear facing with CRABI)
NHTSA No.	M30200



No.	Camera View	Location (mm) *			Angle (deg)	Lens (mm)	Speed (fps)
		X	Y	Z			
1	Left Side CRS Lateral View					13	518
2	Right Side CRS Lateral View					13	524

*COORDINATES:

+X = film plane rearward of barrier

+Y = film plane to right of monorail centerline

+Z = film plane above ground level

APPENDIX A

PHOTOGRAPHS

TABLE OF PHOTOGRAPHS

Close-up View of Position 3 CRS Label

Pre-Test Front 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

Pre-Test Right Side View of Position 3 CRS

Post-Test Right Side View of Position 3 CRS

Close-up View of Position 4 CRS Label

Pre-Test Front View of Position 4 CRS

Post-Test Front View of Position 4 CRS

Pre-Test Rear View of Position 4 CRS

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 Right Side View

Post-Test Position 3 Right Side View

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 4 Right Side View

Post-Test Position 4 Right Side View

Post-Test Position 3 Feet Contact

Post-Test Position 4 Feet Contact

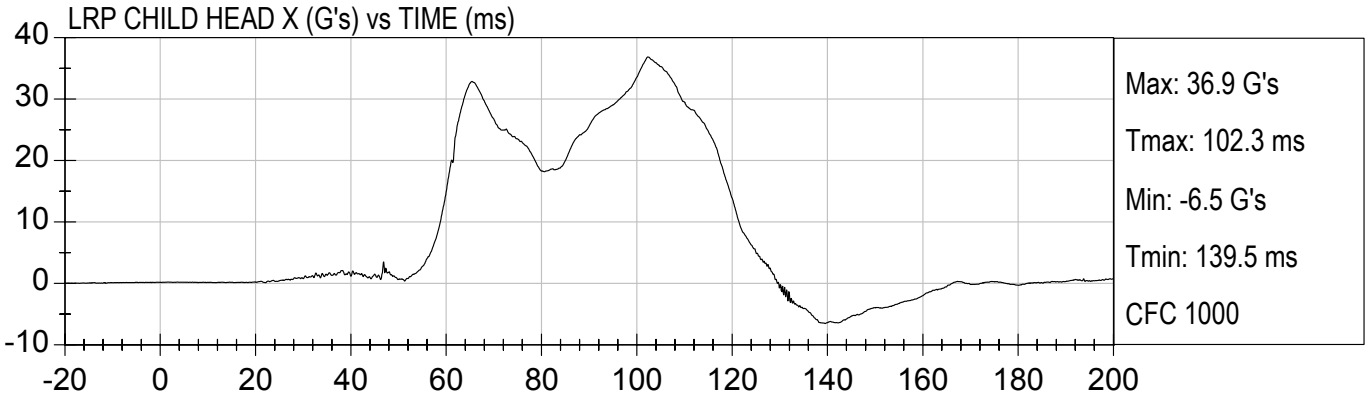
APPENDIX B

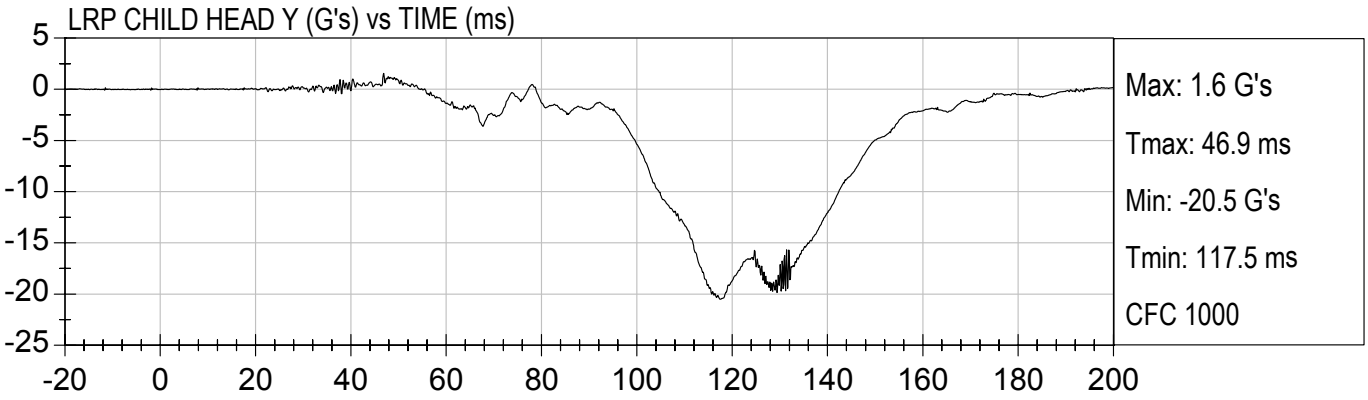
CHILD DUMMY RESPONSE DATA TRACES

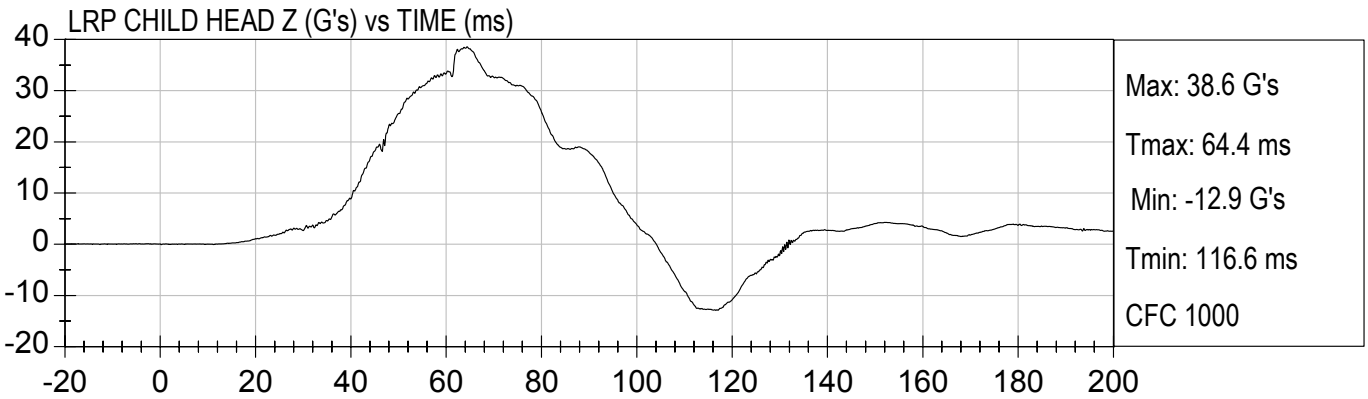
TABLE OF DATA PLOTS

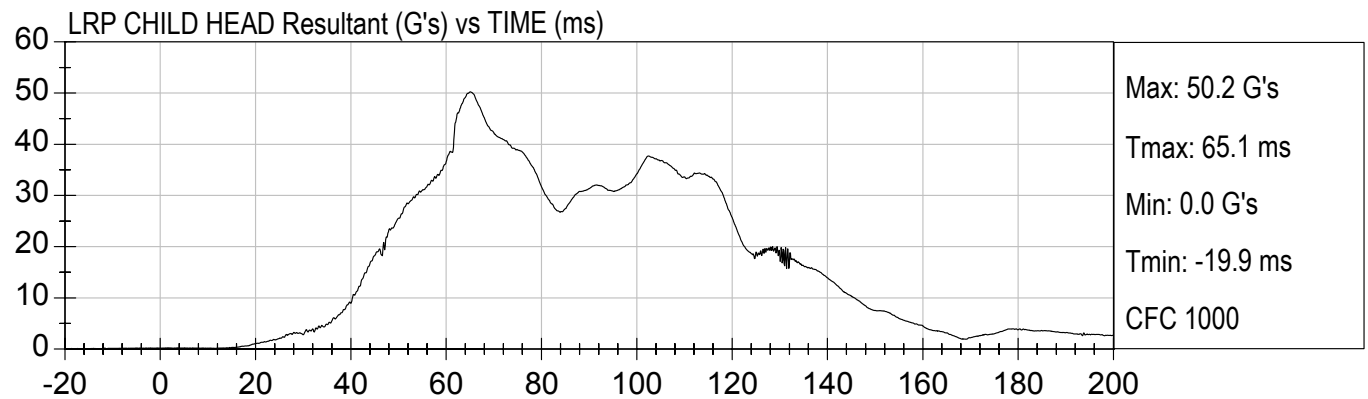
35MPH FRONTAL NCAP
2003 FORD CROWN VICTORIA

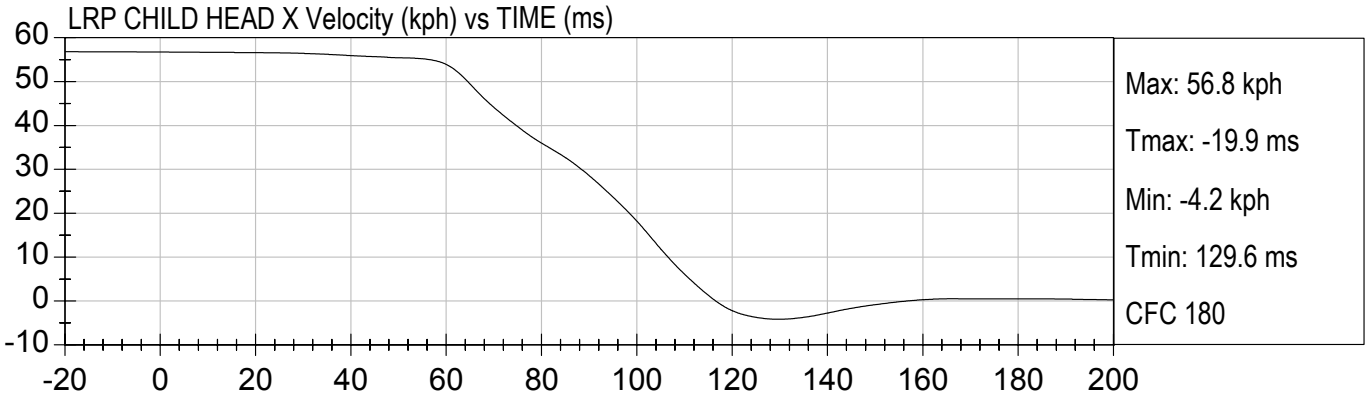
Test Date: 1/21/2003
Speed: 35.3 mph (56.8 km/h)

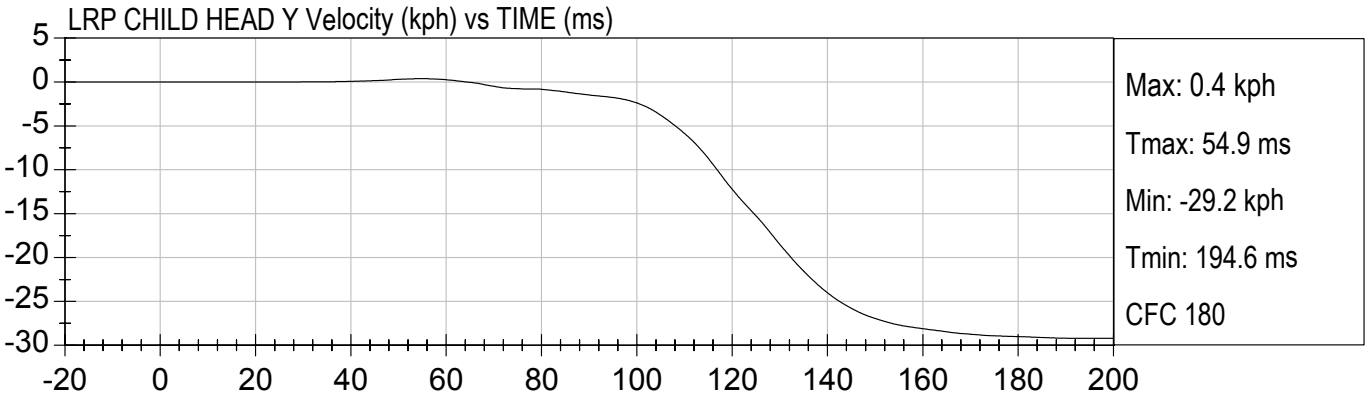


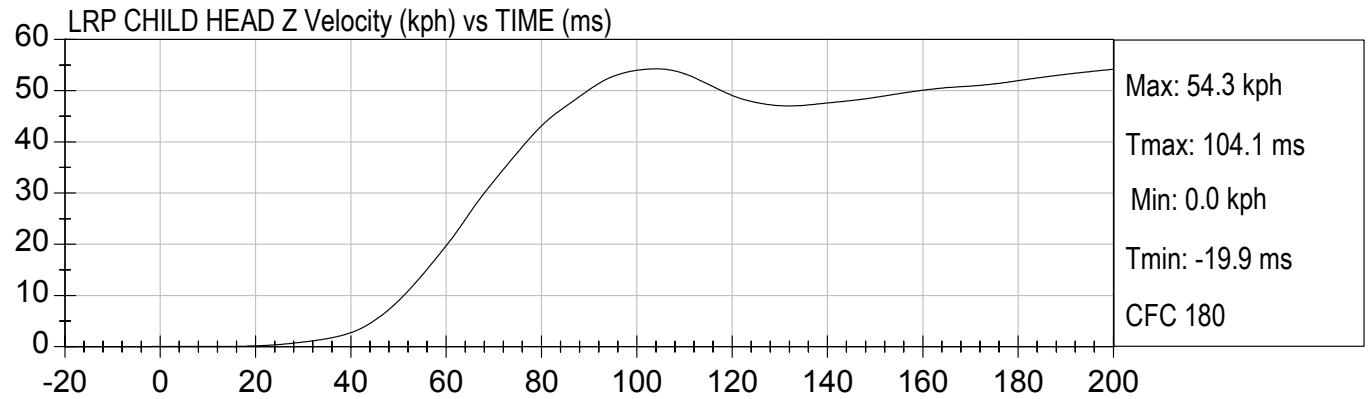






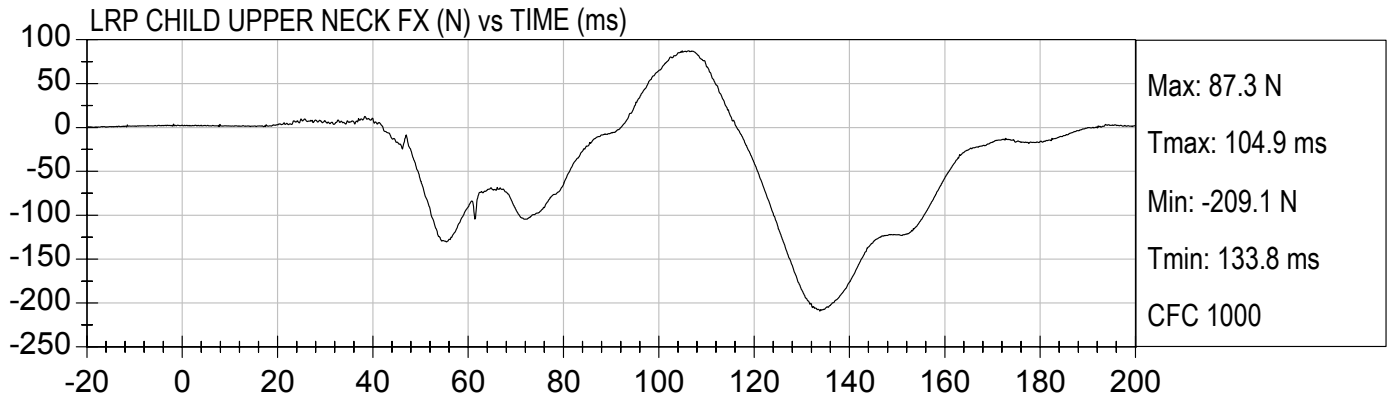

LRP CHILD HEAD X Velocity (kph) vs TIME (ms)
60
50
40
30
20
10
0
-10
-20 0 20 40 60 80 100 120 140 160 180 200
Max: 56.8 kph
Tmax: -19.9 ms
Min: -4.2 kph
Tmin: 129.6 ms
CFC 180

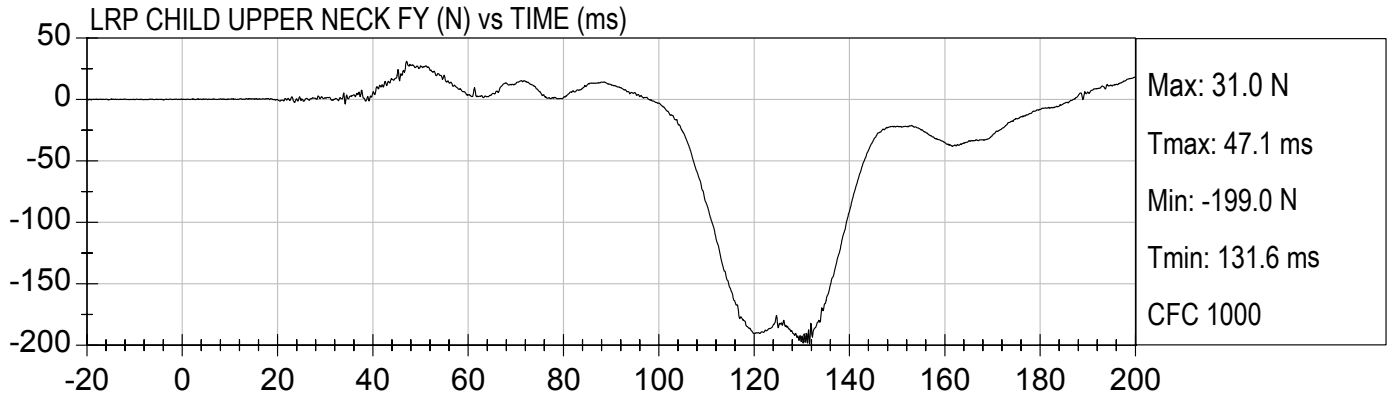

LRP CHILD HEAD Y Velocity (kph) vs TIME (ms)
5
0
-5
-10
-15
-20
-25
-30
-20 0 20 40 60 80 100 120 140 160 180 200
Max: 0.4 kph
Tmax: 54.9 ms
Min: -29.2 kph
Tmin: 194.6 ms
CFC 180

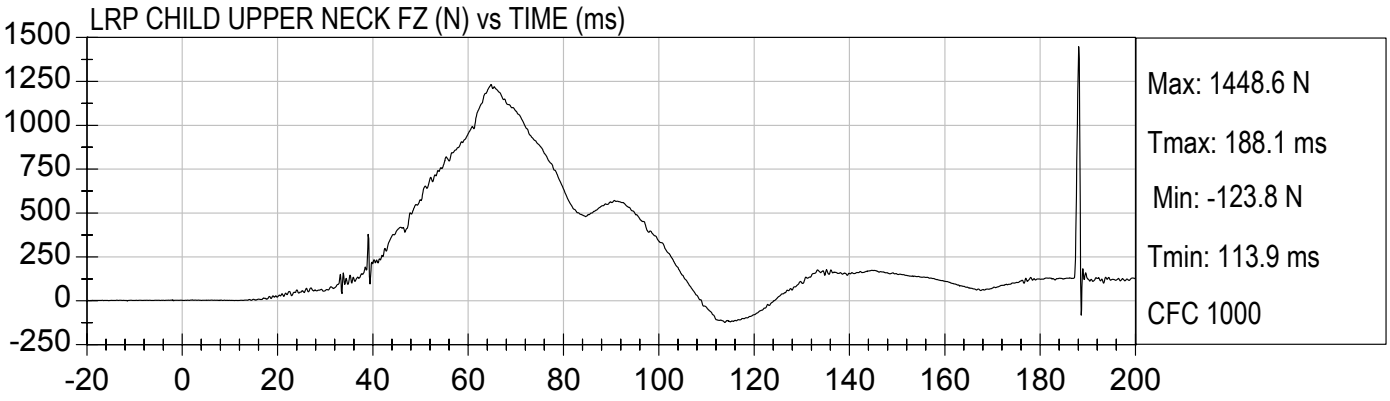

LRP CHILD HEAD Z Velocity (kph) vs TIME (ms)
60
50
40
30
20
10
0
-20 0 20 40 60 80 100 120 140 160 180 200
Max: 54.3 kph
Tmax: 104.1 ms
Min: 0.0 kph
Tmin: -19.9 ms
CFC 180

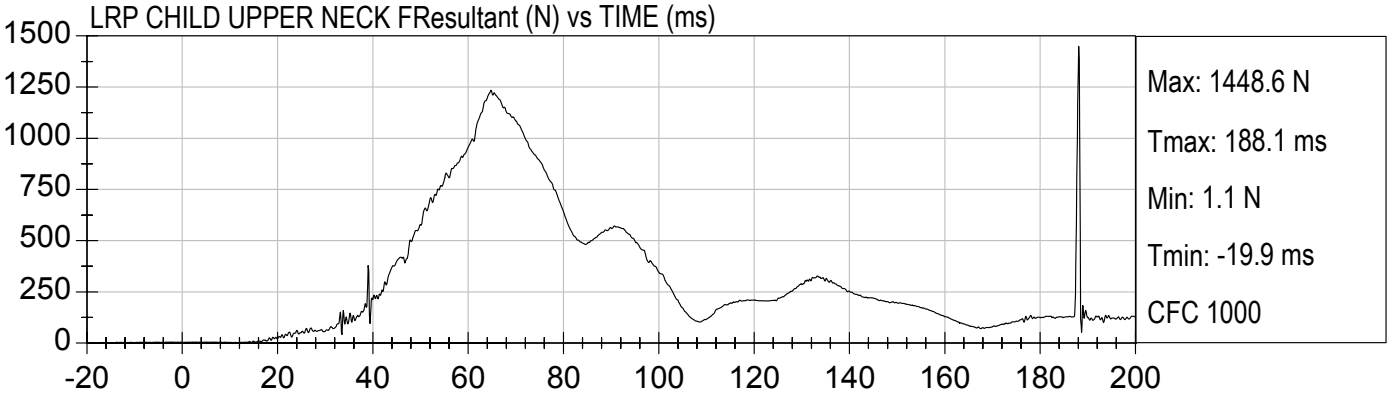
35MPH FRONTAL NCAP
2003 FORD CROWN VICTORIA

Test Date: 1/21/2003
Speed: 35.3 mph (56.8 km/h)









35MPH FRONTAL NCAP
2003 FORD CROWN VICTORIA

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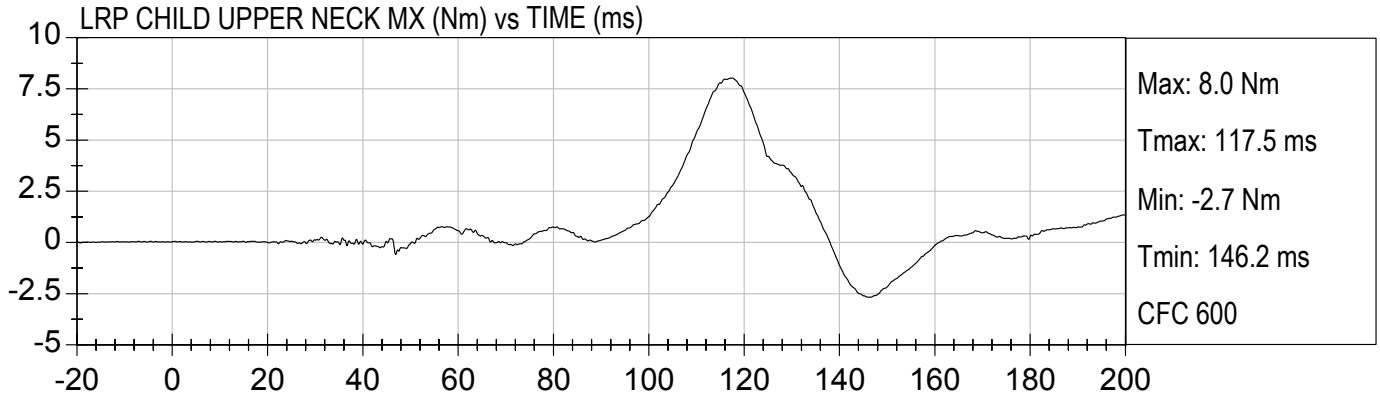
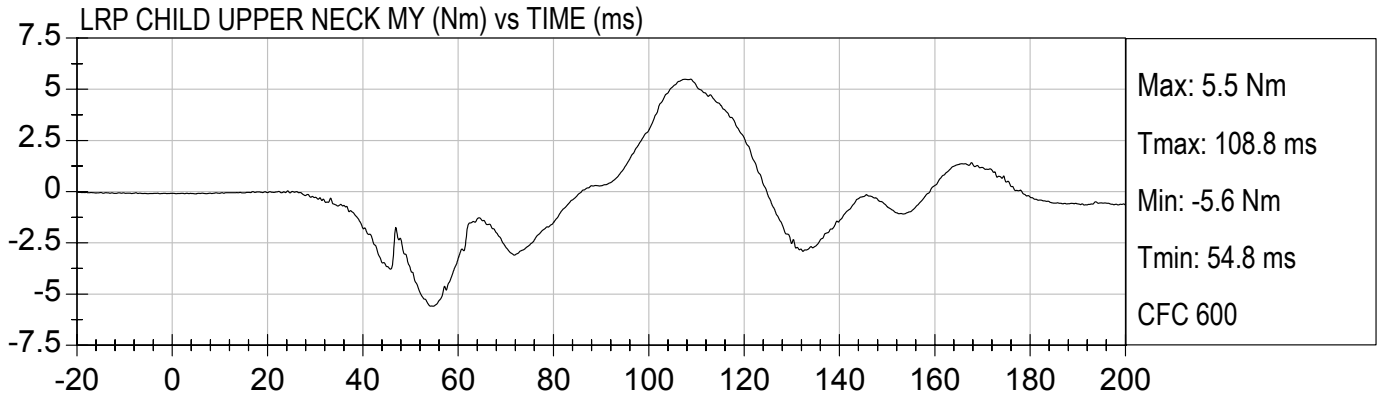
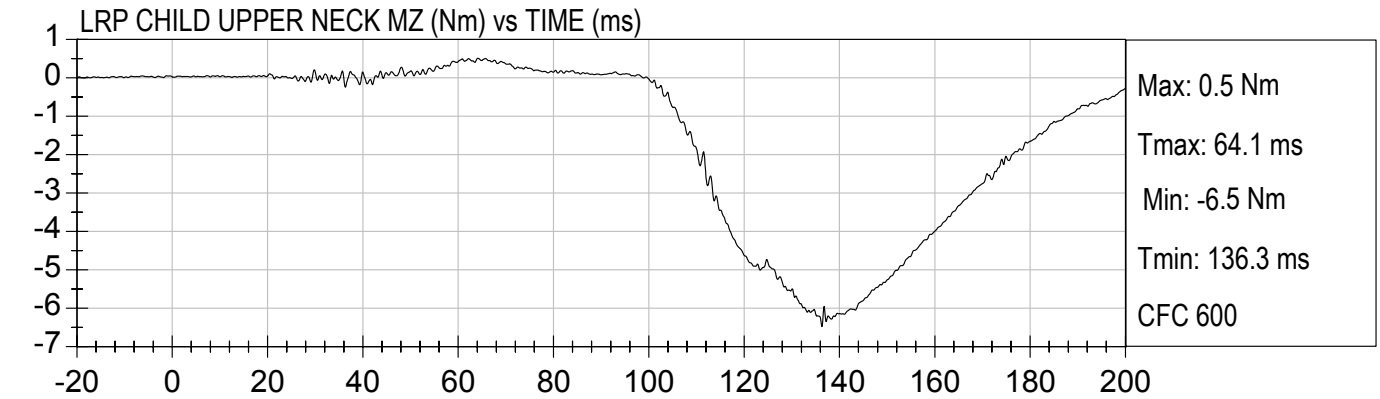
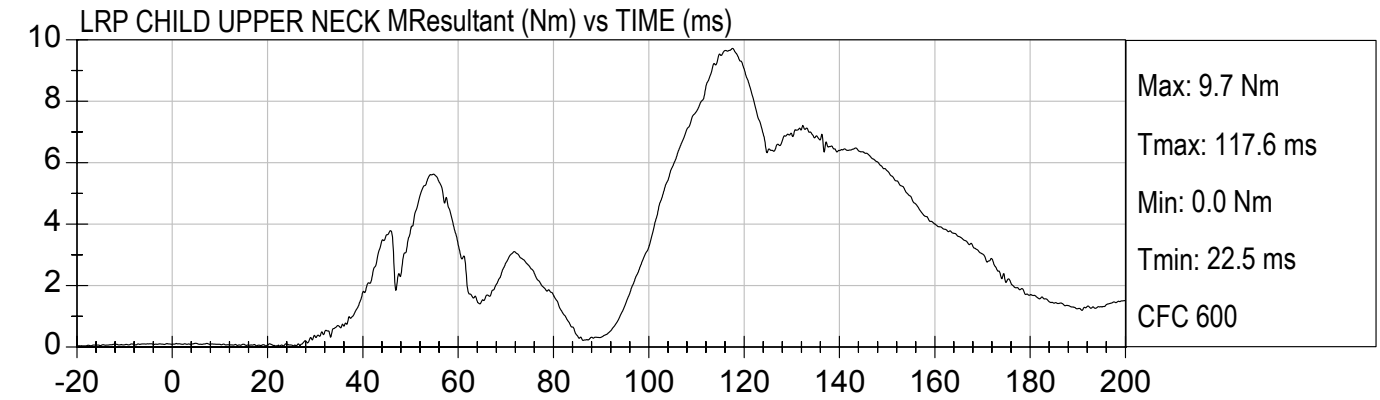


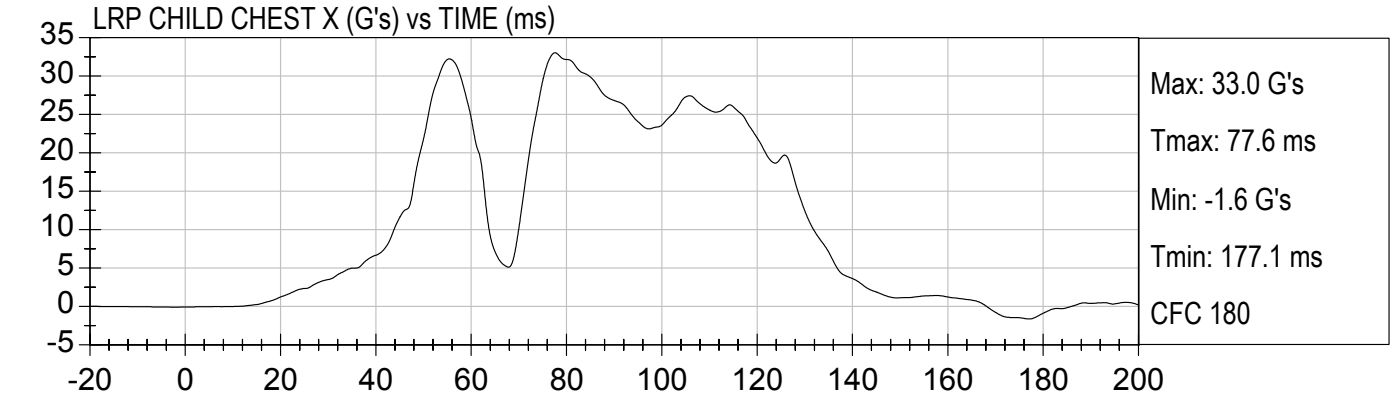


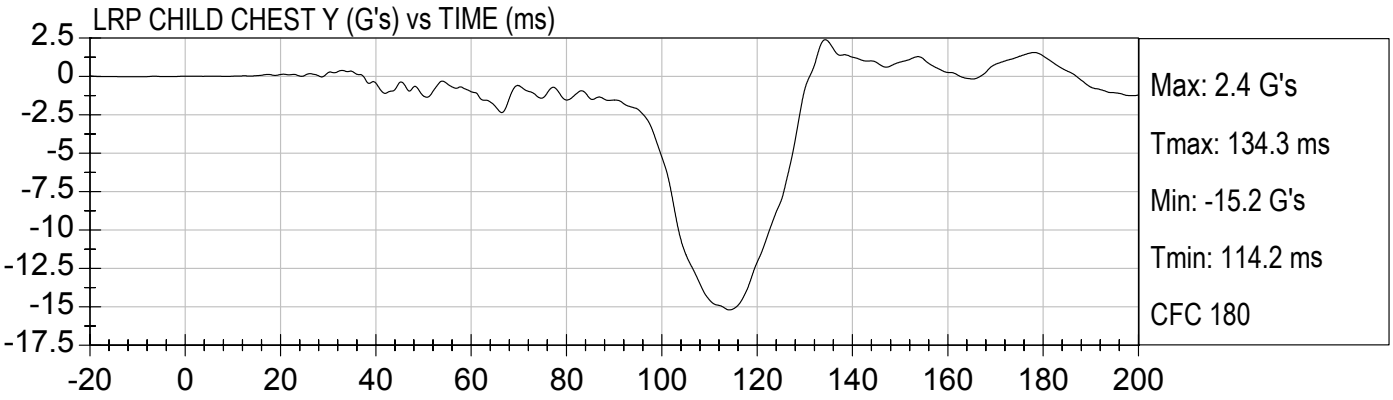


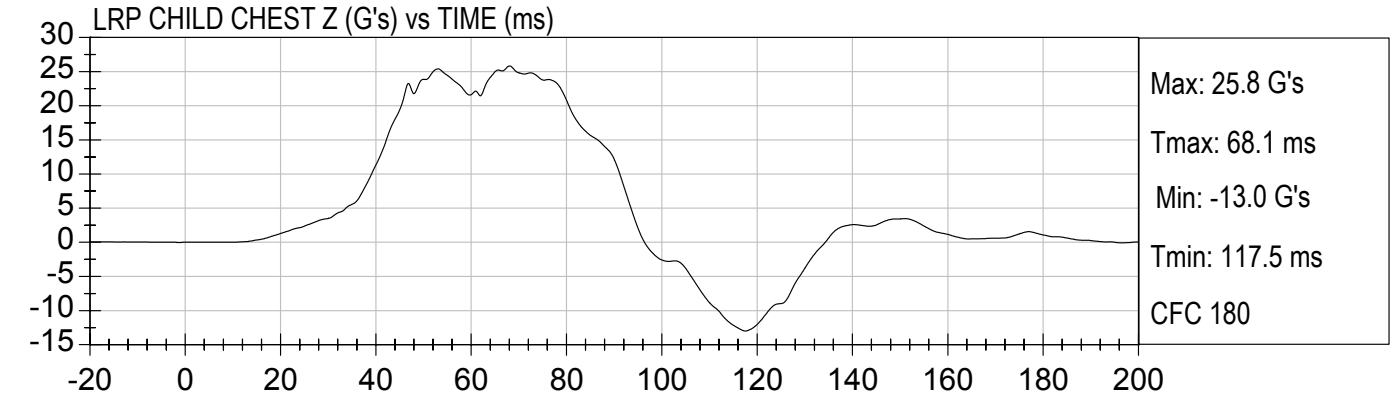


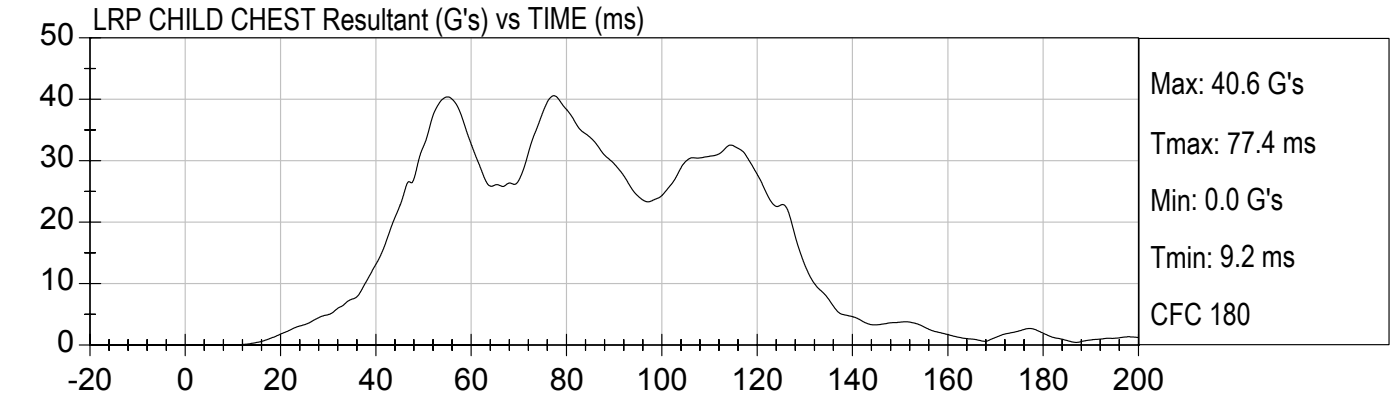
35MPH FRONTAL NCAP
2003 FORD CROWN VICTORIA

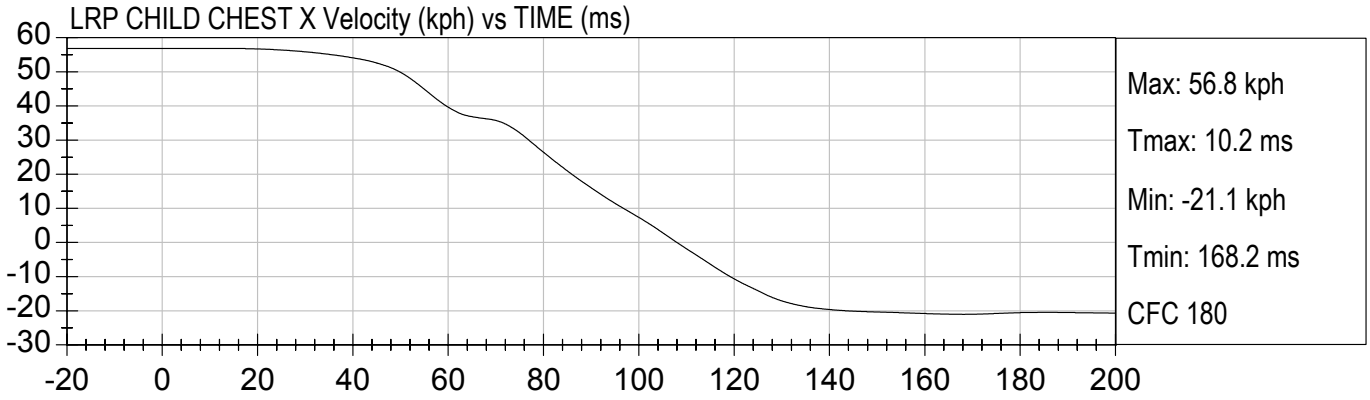
Test Date: 1/21/2003
Speed: 35.3 mph (56.8 km/h)

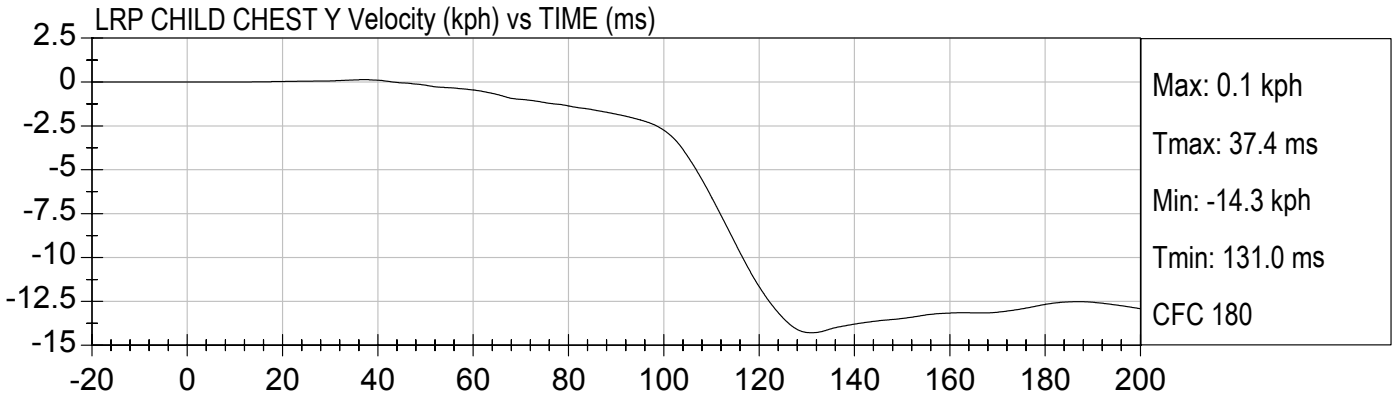


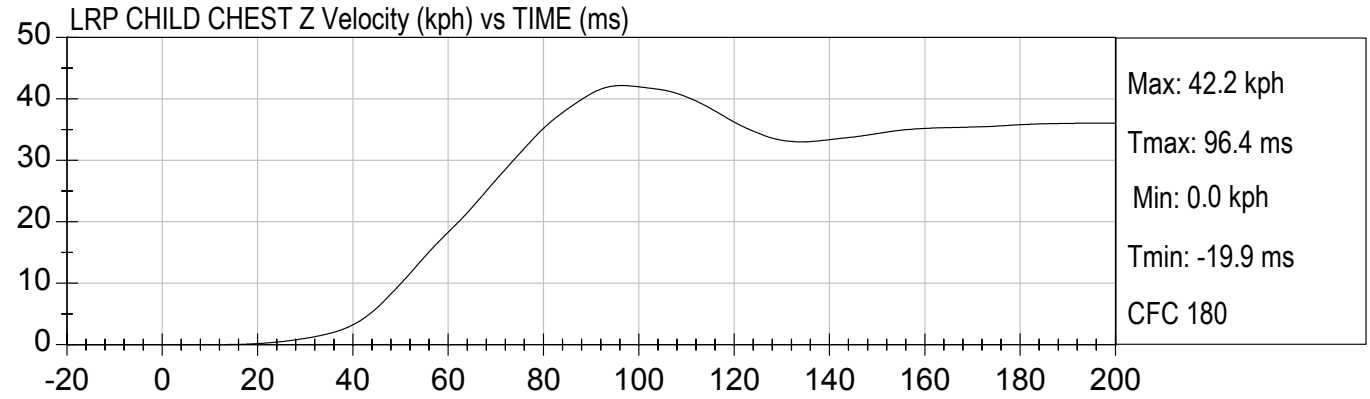






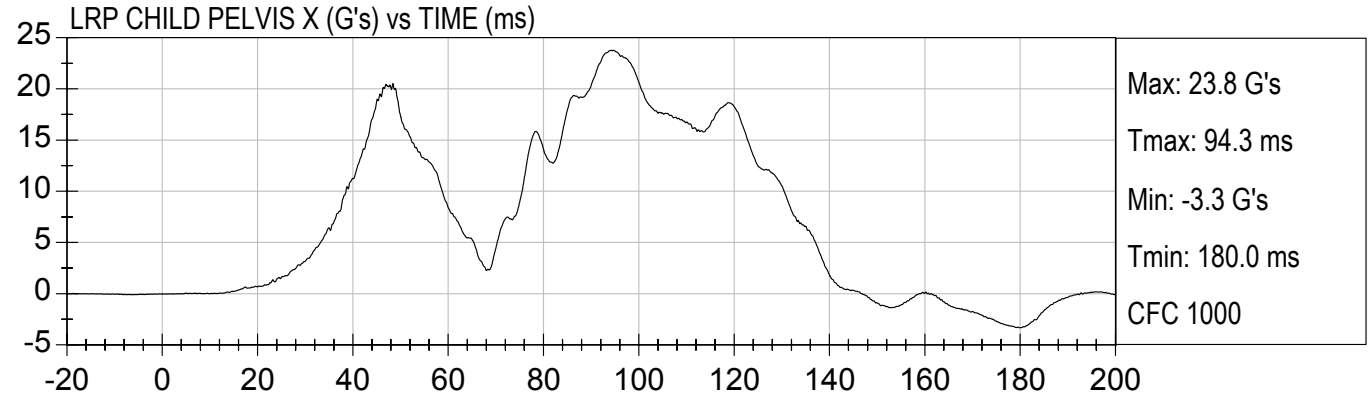

LRP CHILD CHEST X Velocity (kph) vs TIME (ms)
60
50
40
30
20
10
0
-10
-20
-30
-20 0 20 40 60 80 100 120 140 160 180 200
Max: 56.8 kph
Tmax: 10.2 ms
Min: -21.1 kph
Tmin: 168.2 ms
CFC 180

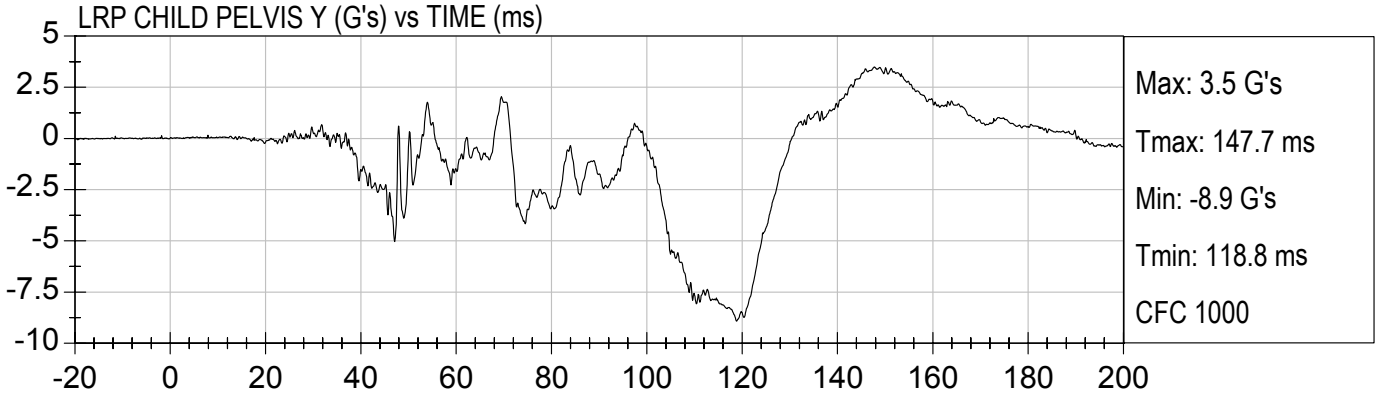

LRP CHILD CHEST Y Velocity (kph) vs TIME (ms)
2.5
0
-2.5
-5
-7.5
-10
-12.5
-15
-20 0 20 40 60 80 100 120 140 160 180 200
Max: 0.1 kph
Tmax: 37.4 ms
Min: -14.3 kph
Tmin: 131.0 ms
CFC 180

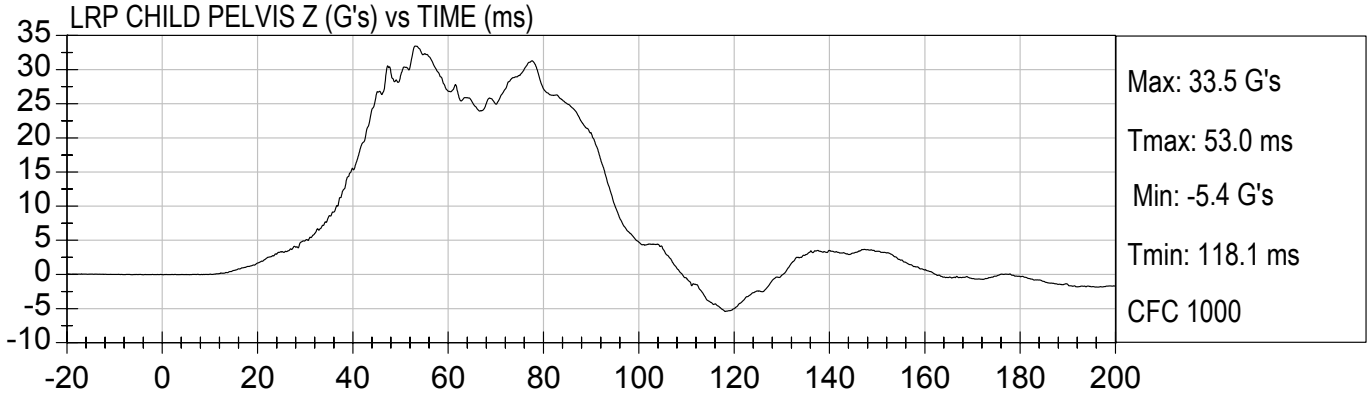

LRP CHILD CHEST Z Velocity (kph) vs TIME (ms)
50
40
30
20
10
0
-20 0 20 40 60 80 100 120 140 160 180 200
Max: 42.2 kph
Tmax: 96.4 ms
Min: 0.0 kph
Tmin: -19.9 ms
CFC 180

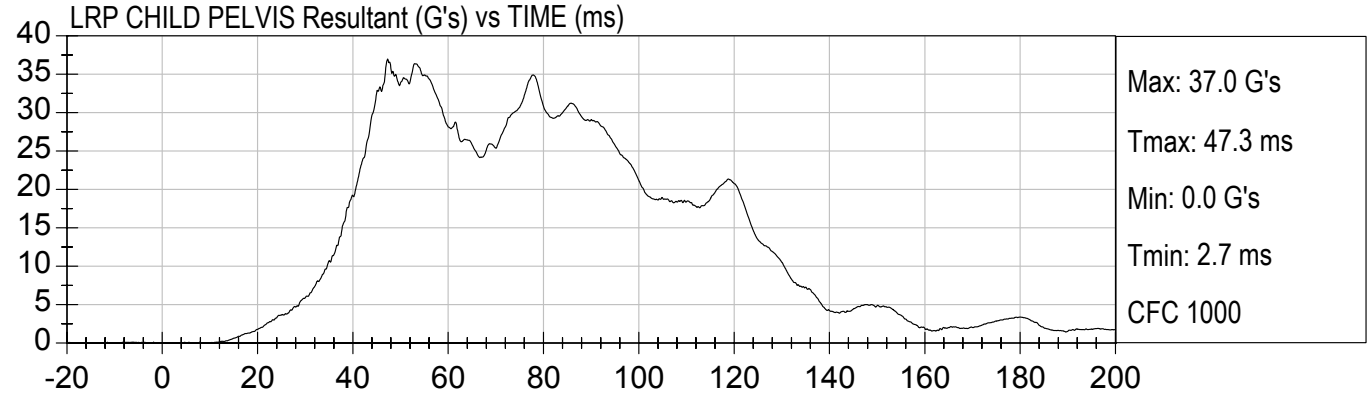
35MPH FRONTAL NCAP
2003 FORD CROWN VICTORIA

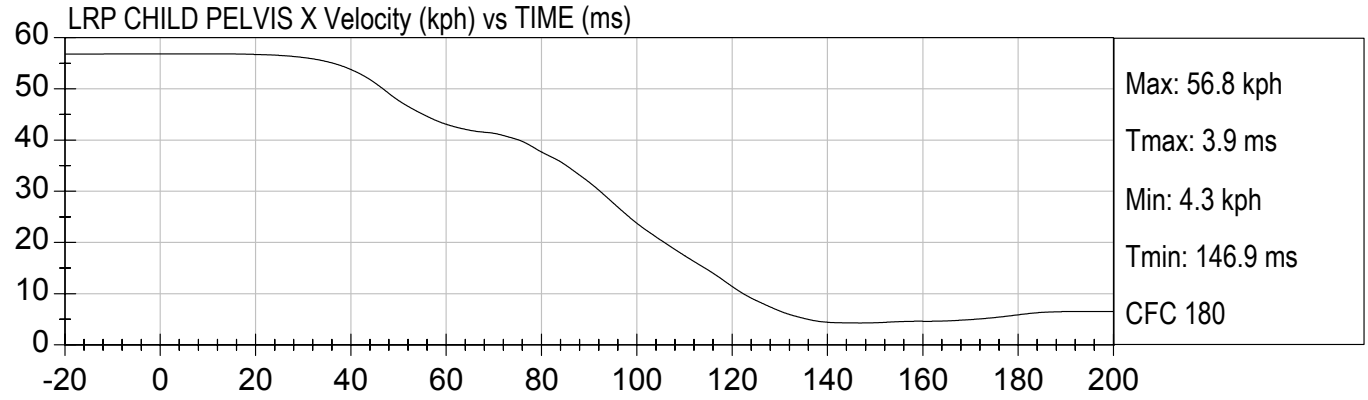
Test Date: 1/21/2003
Speed: 35.3 mph (56.8 km/h)

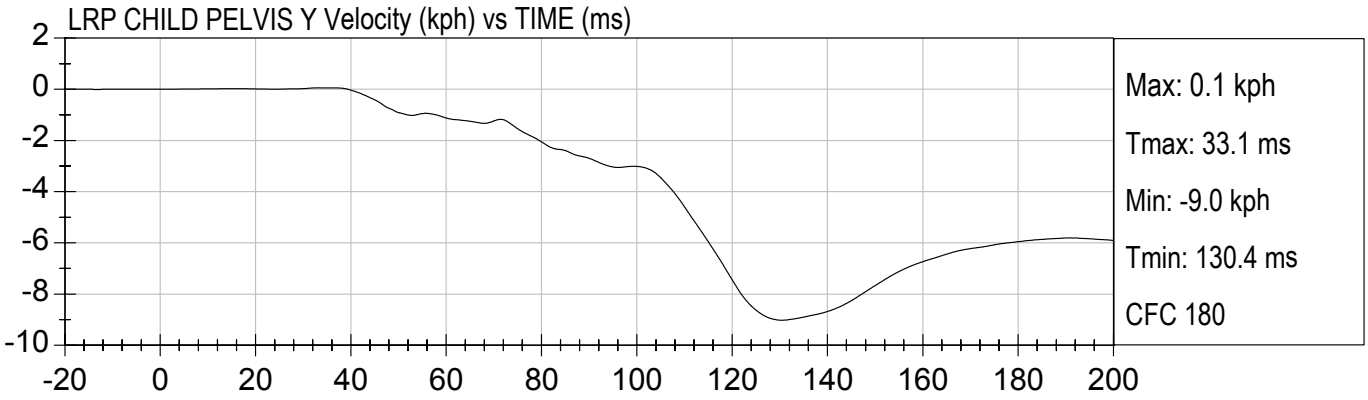


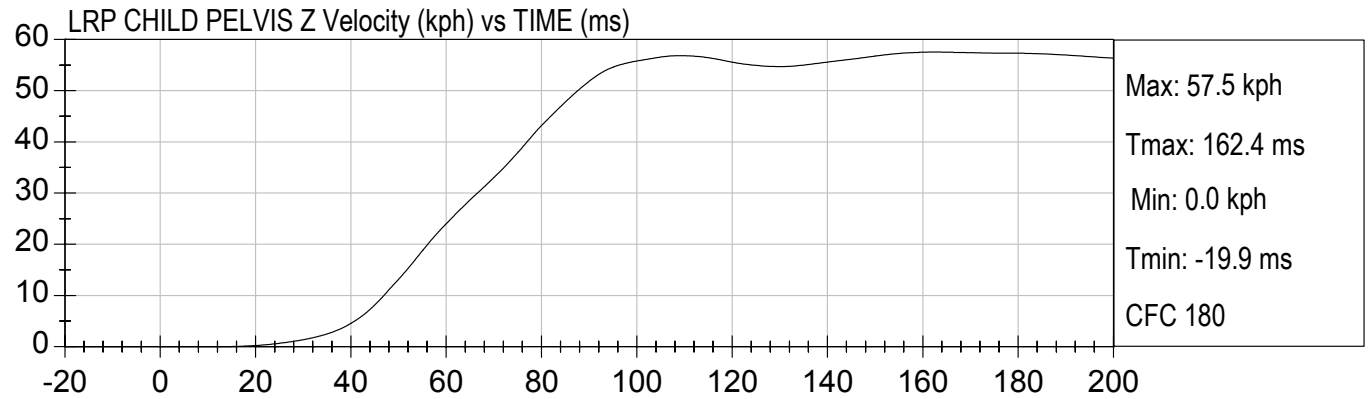






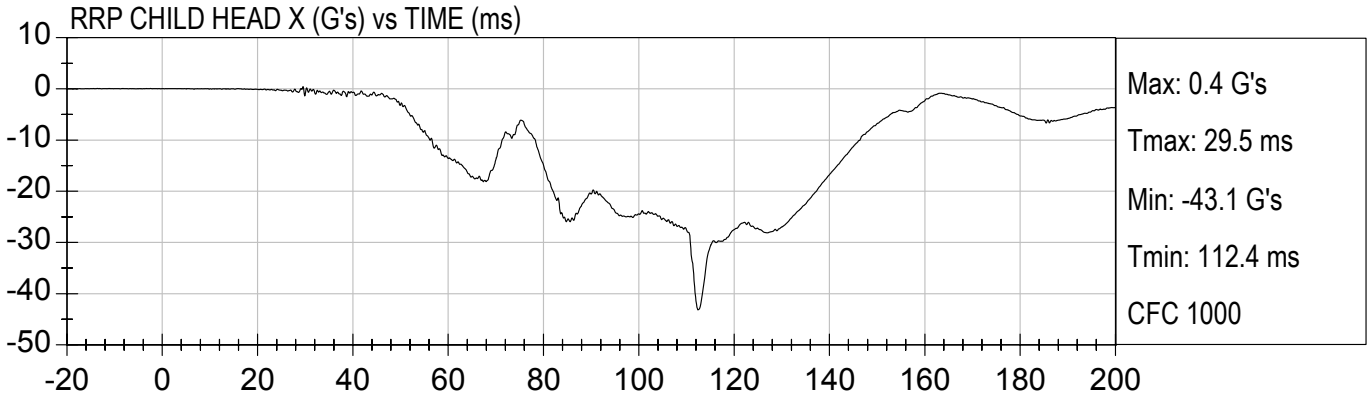

LRP CHILD PELVIS X Velocity (kph) vs TIME (ms)
60
50
40
30
20
10
0
-20
0
20
40
60
80
100
120
140
160
180
200
Max: 56.8 kph
Tmax: 3.9 ms
Min: 4.3 kph
Tmin: 146.9 ms
CFC 180

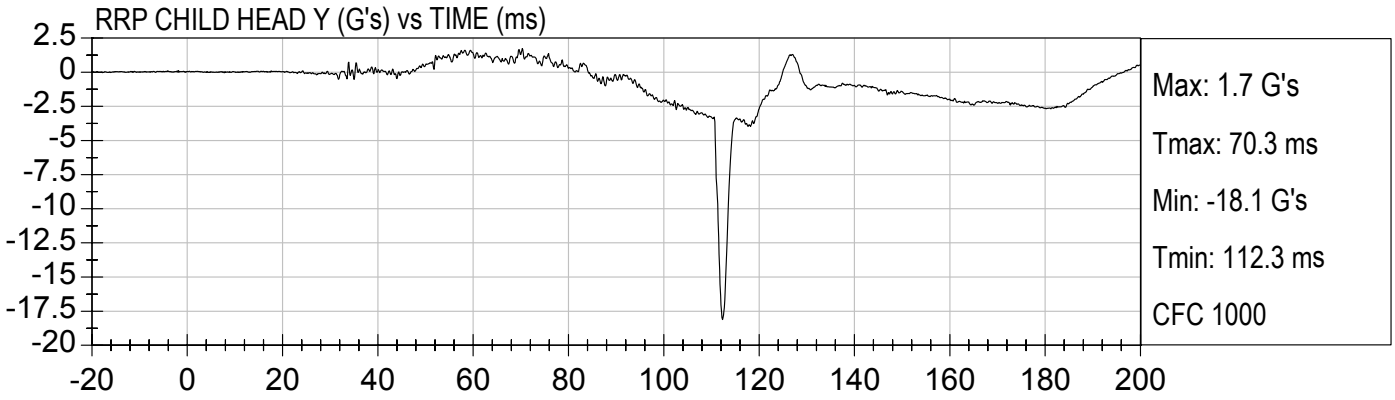

LRP CHILD PELVIS Y Velocity (kph) vs TIME (ms)
2
0
-2
-4
-6
-8
-10
-20
0
20
40
60
80
100
120
140
160
180
200
Max: 0.1 kph
Tmax: 33.1 ms
Min: -9.0 kph
Tmin: 130.4 ms
CFC 180

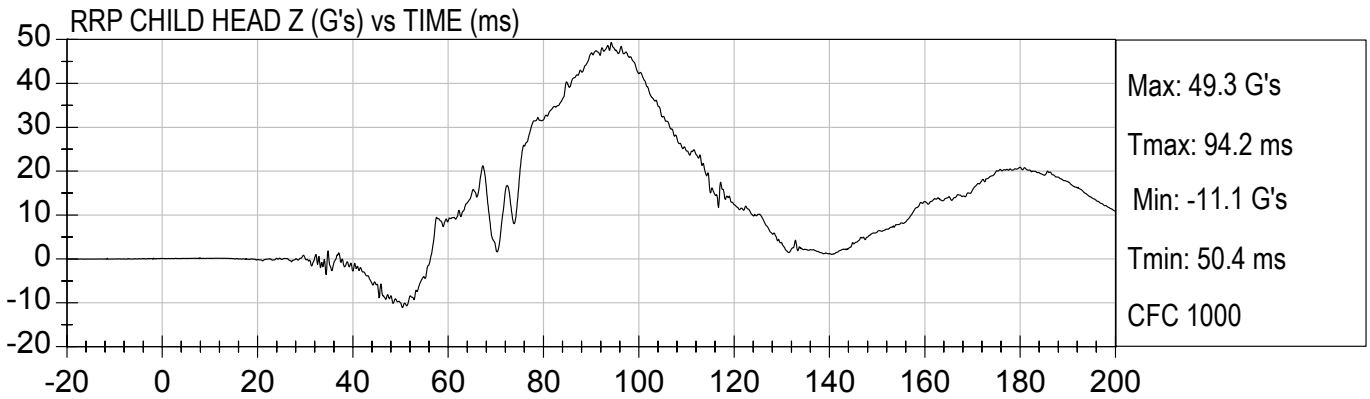

LRP CHILD PELVIS Z Velocity (kph) vs TIME (ms)
60
50
40
30
20
10
0
-20
0
20
40
60
80
100
120
140
160
180
200
Max: 57.5 kph
Tmax: 162.4 ms
Min: 0.0 kph
Tmin: -19.9 ms
CFC 180

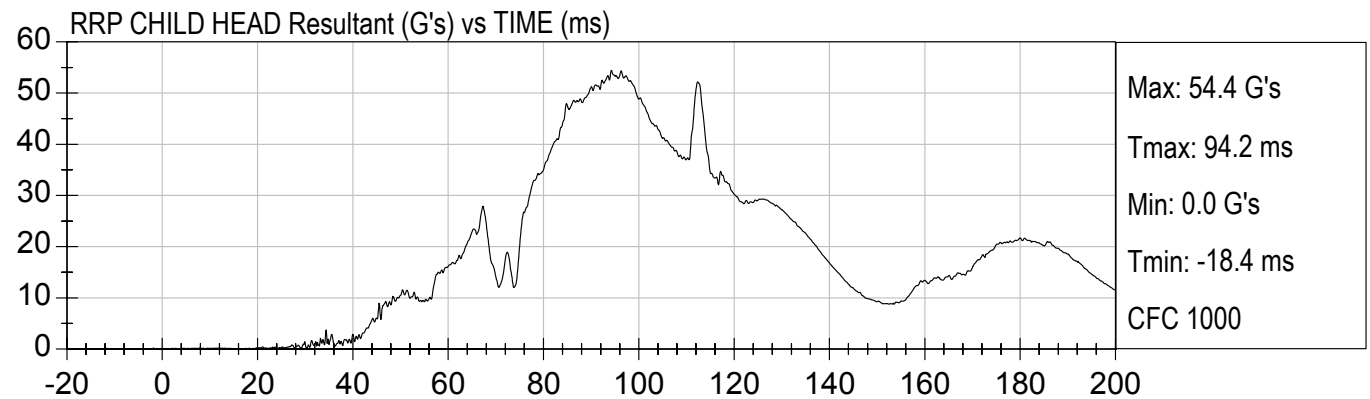
35MPH FRONTAL NCAP
2003 FORD CROWN VICTORIA

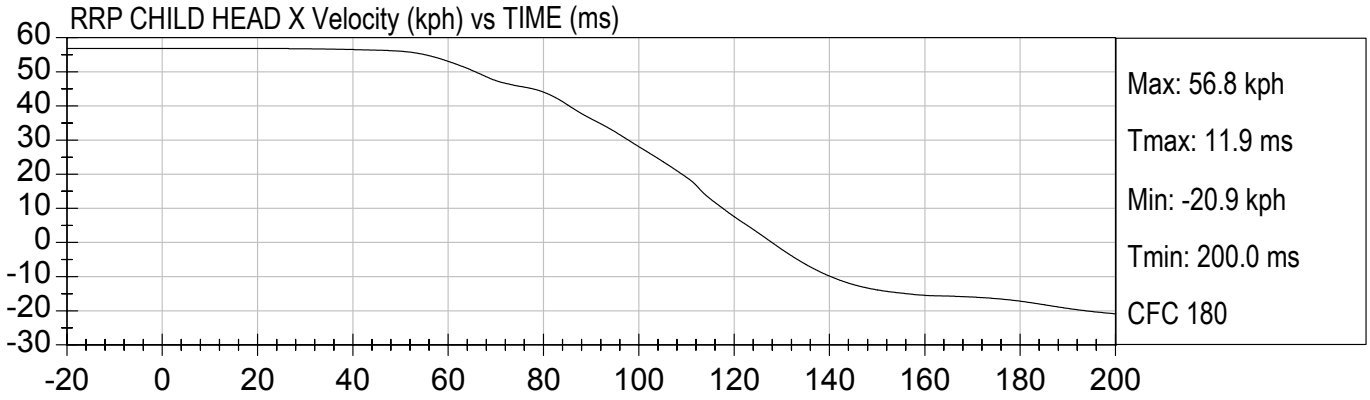
Test Date: 1/21/2003
Speed: 35.3 mph (56.8 km/h)

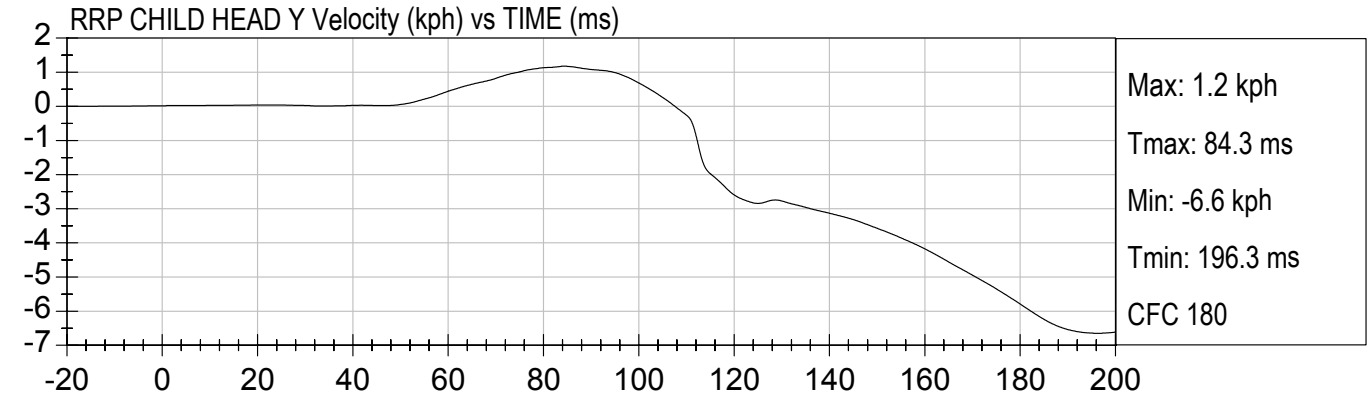


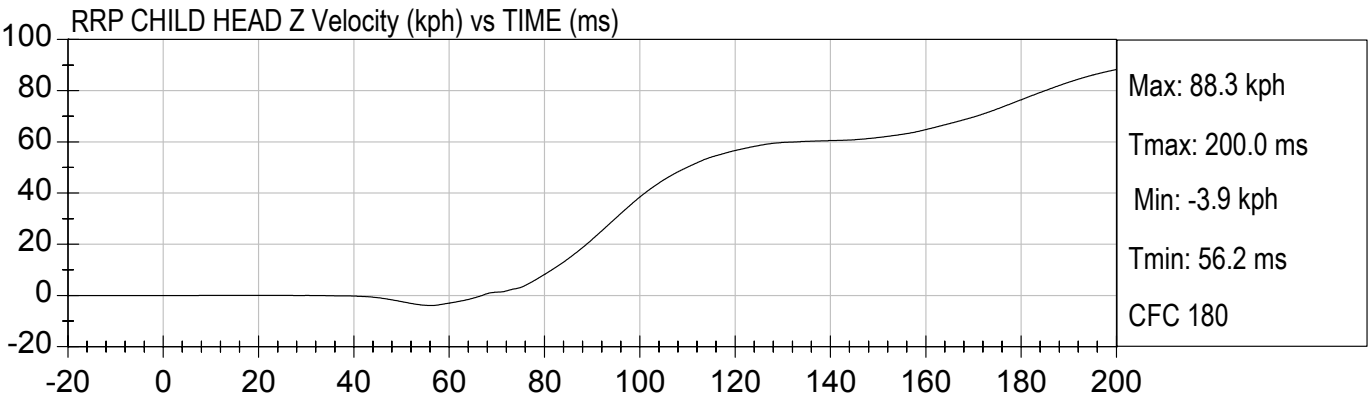






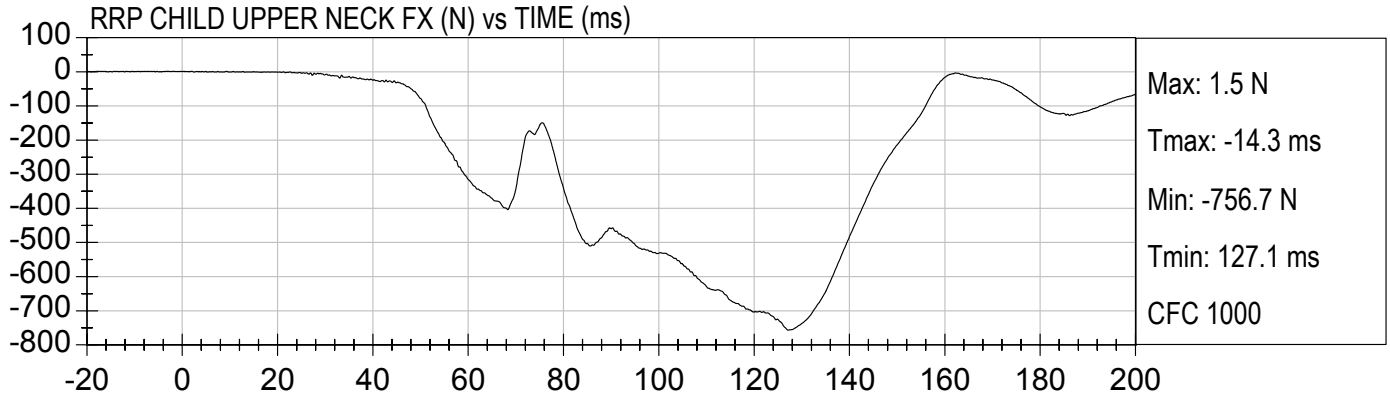

RRP CHILD HEAD X Velocity (kph) vs TIME (ms)
60
50
40
30
20
10
0
-10
-20
-30
-20 0 20 40 60 80 100 120 140 160 180 200
Max: 56.8 kph
Tmax: 11.9 ms
Min: -20.9 kph
Tmin: 200.0 ms
CFC 180

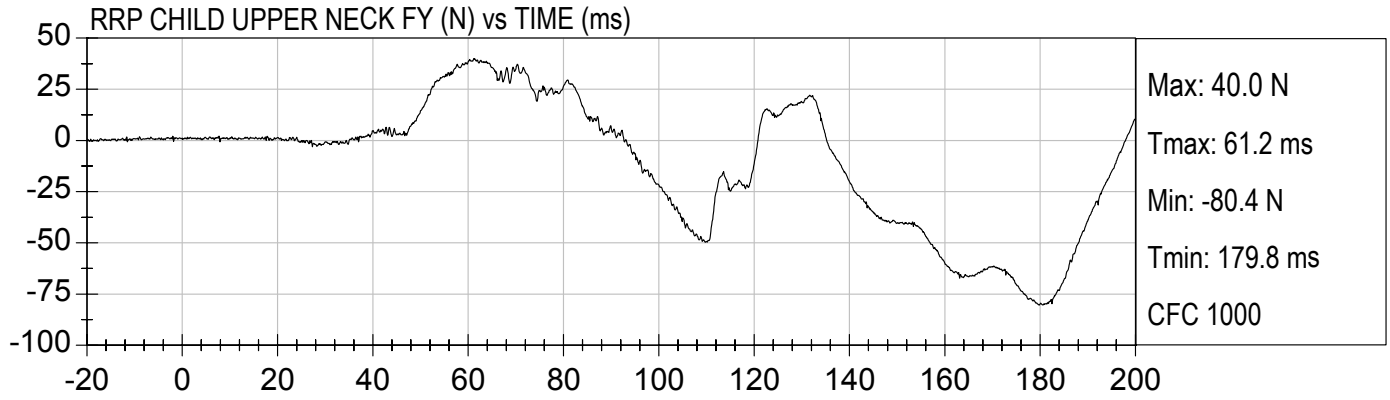

RRP CHILD HEAD Y Velocity (kph) vs TIME (ms)
2
1
0
-1
-2
-3
-4
-5
-6
-7
-20 0 20 40 60 80 100 120 140 160 180 200
Max: 1.2 kph
Tmax: 84.3 ms
Min: -6.6 kph
Tmin: 196.3 ms
CFC 180

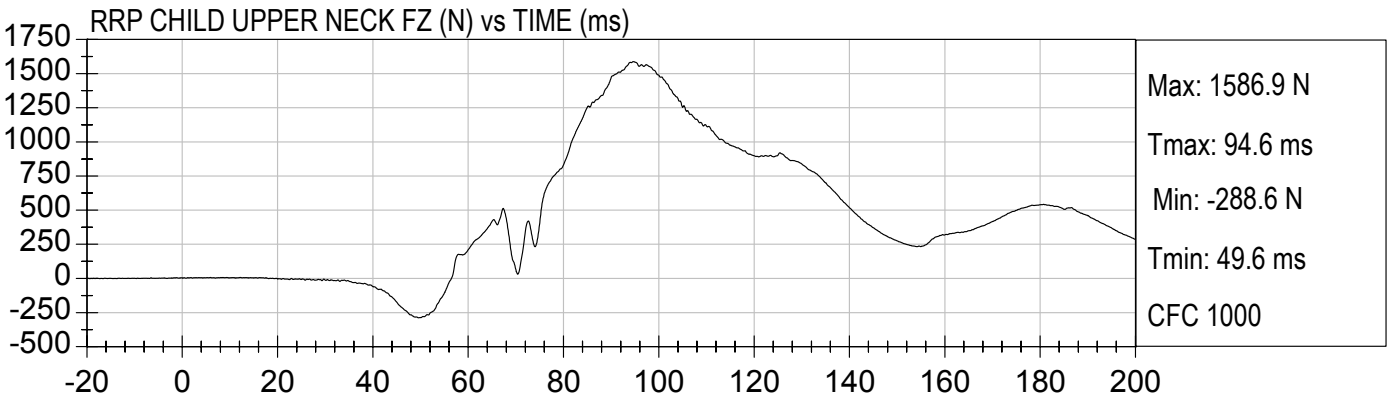

RRP CHILD HEAD Z Velocity (kph) vs TIME (ms)
100
80
60
40
20
0
-20
-20 0 20 40 60 80 100 120 140 160 180 200
Max: 88.3 kph
Tmax: 200.0 ms
Min: -3.9 kph
Tmin: 56.2 ms
CFC 180

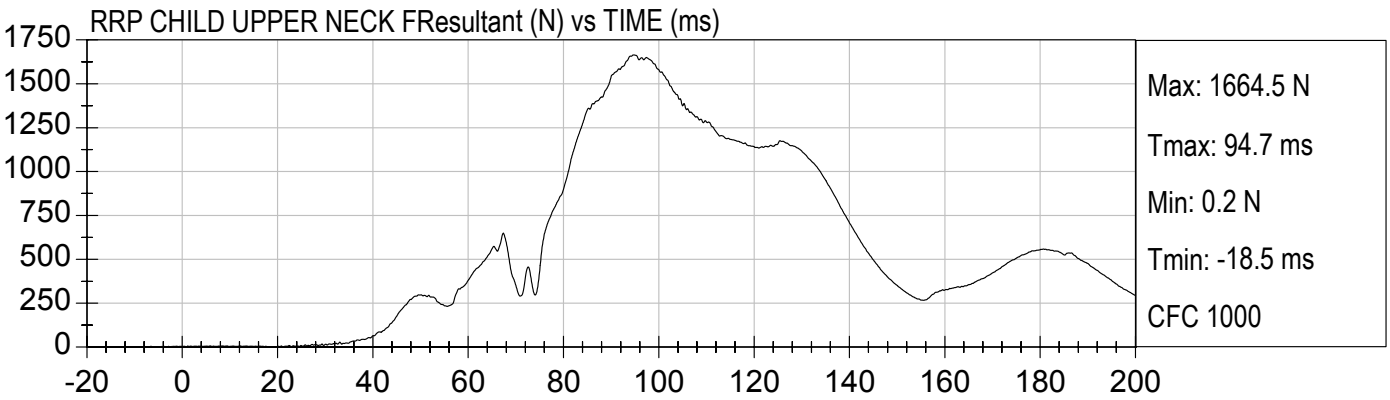
35MPH FRONTAL NCAP
2003 FORD CROWN VICTORIA

Test Date: 1/21/2003
Speed: 35.3 mph (56.8 km/h)



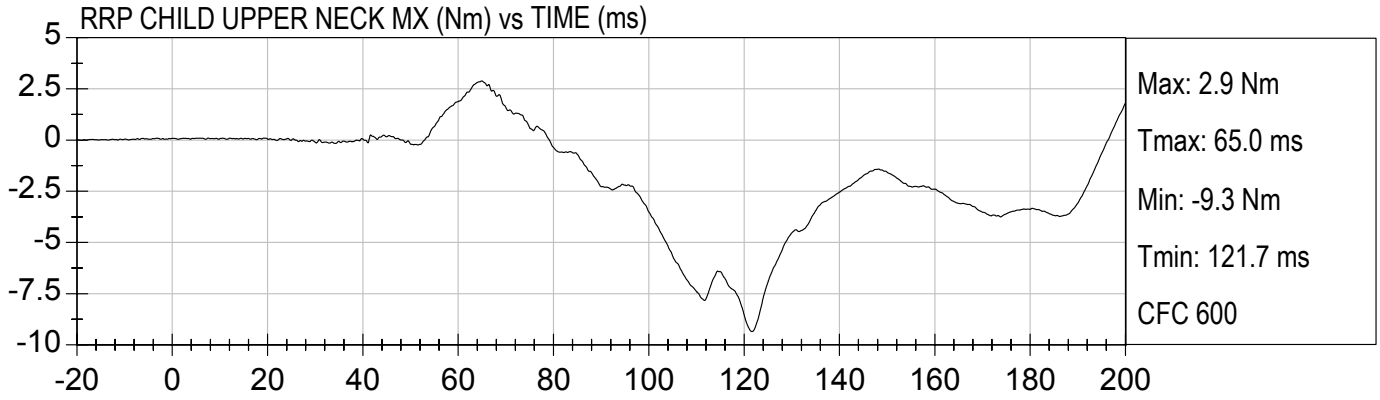


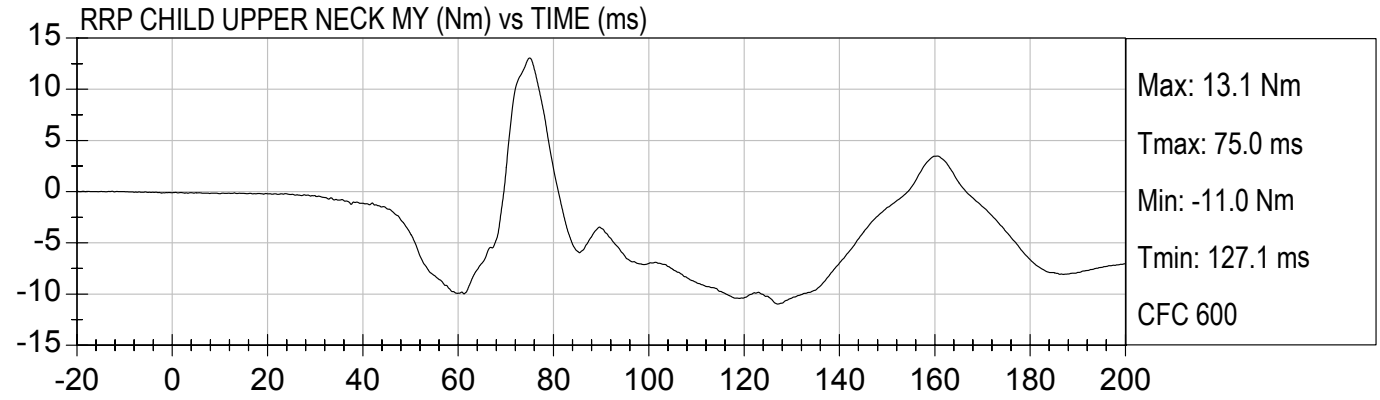


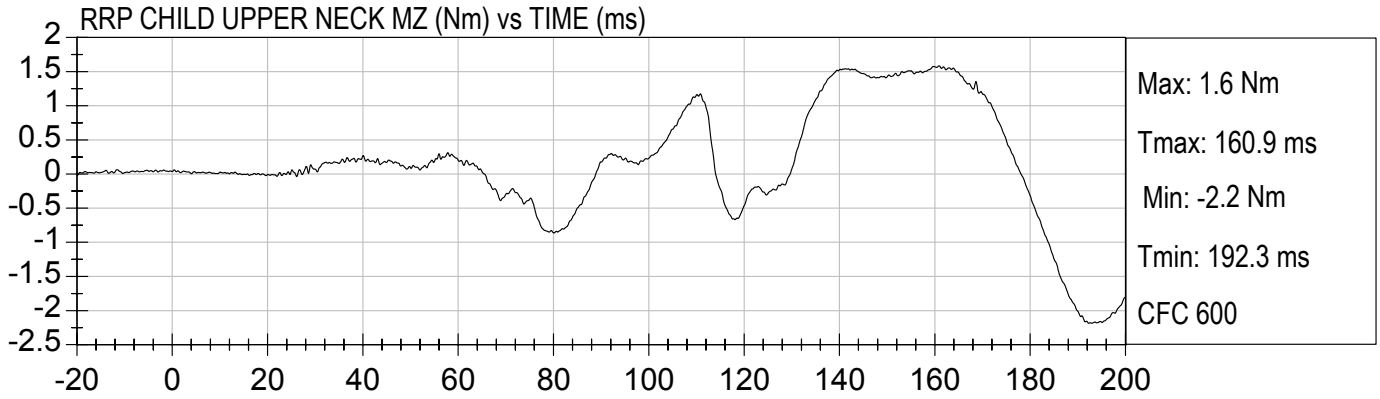


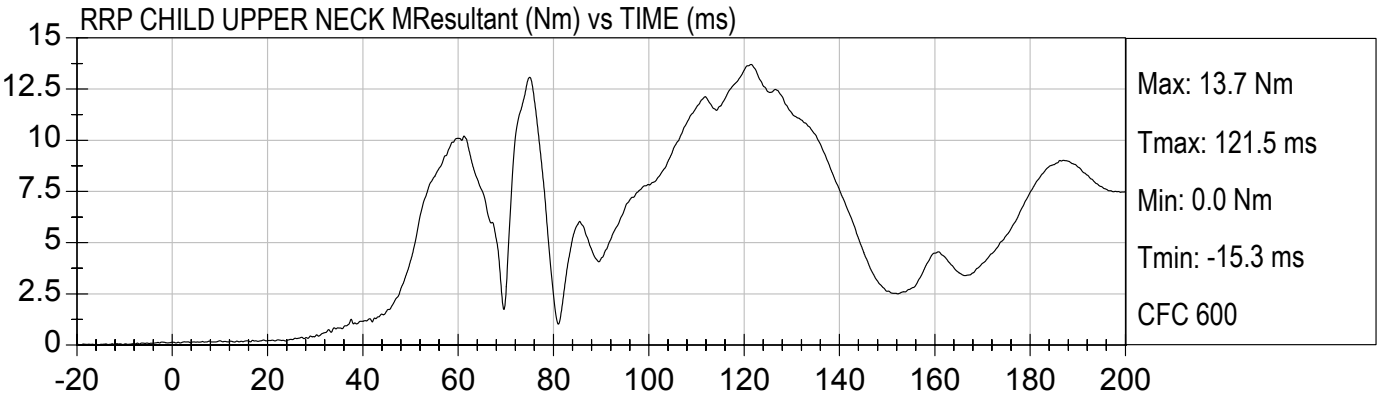
35MPH FRONTAL NCAP
2003 FORD CROWN VICTORIA

Test Date: 1/21/2003
Speed: 35.3 mph (56.8 km/h)



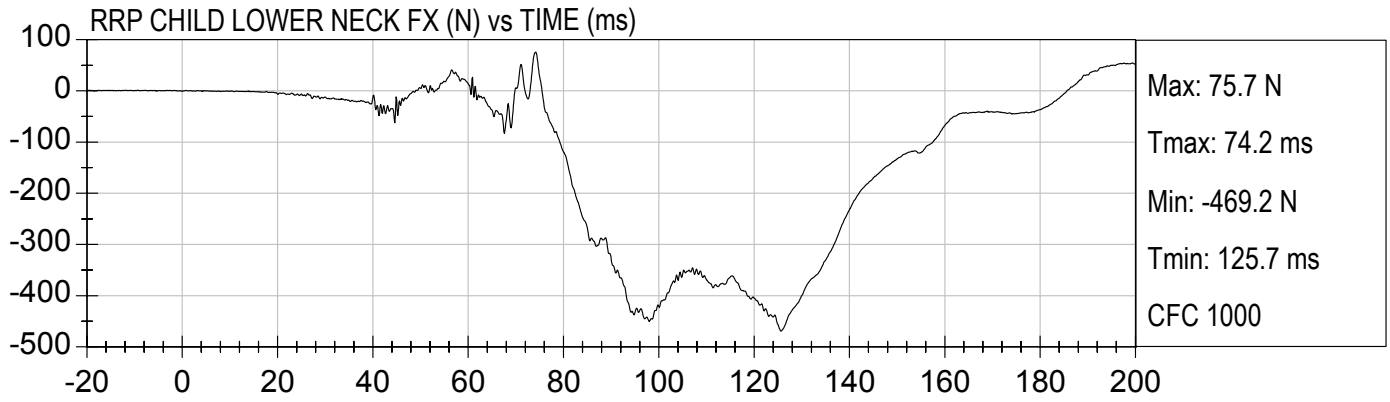


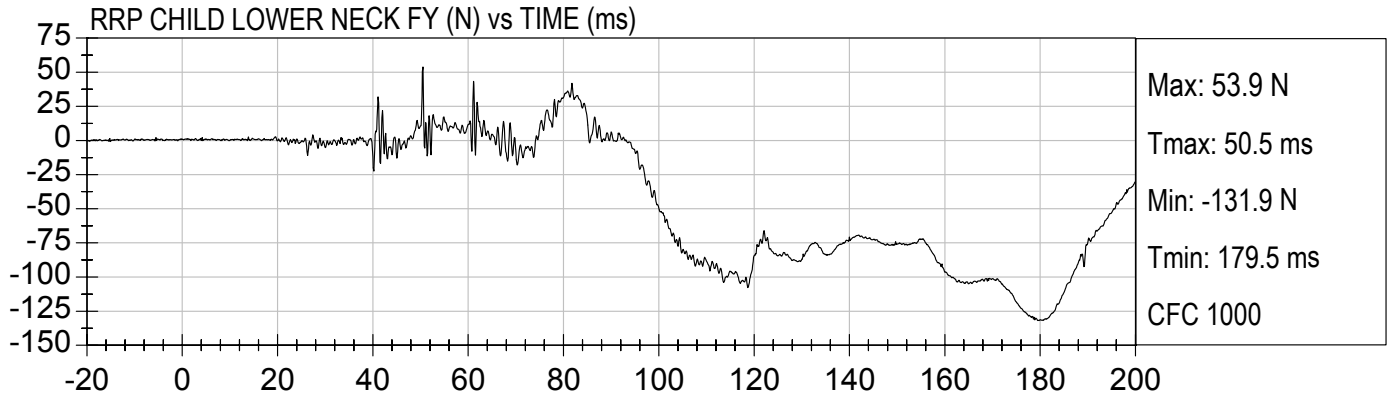


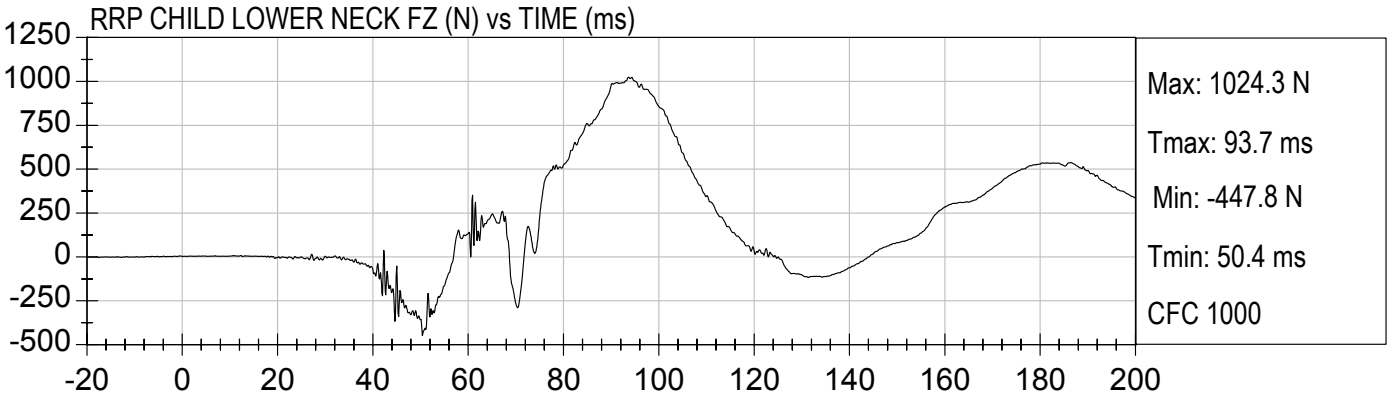


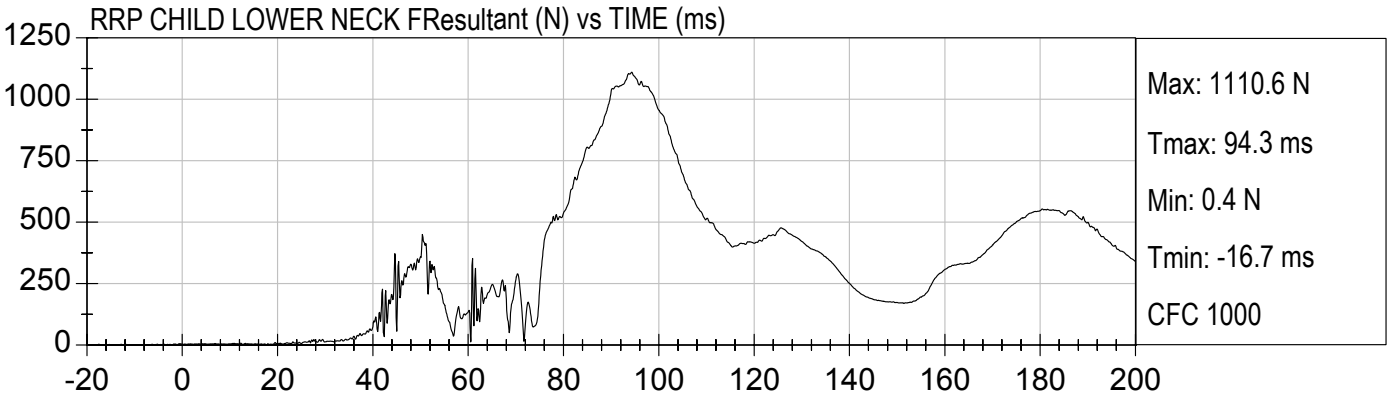
35MPH FRONTAL NCAP
2003 FORD CROWN VICTORIA

Test Date: 1/21/2003
Speed: 35.3 mph (56.8 km/h)



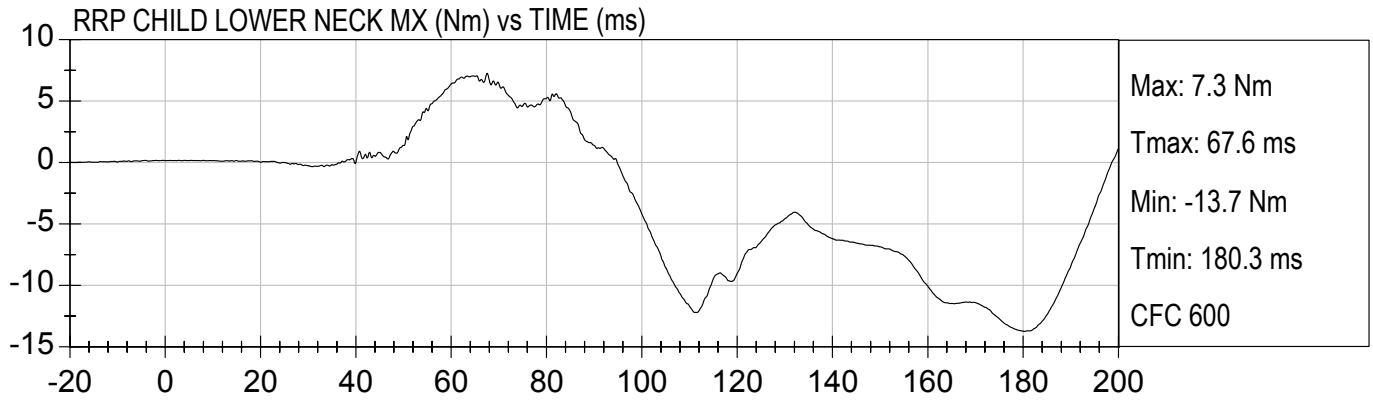


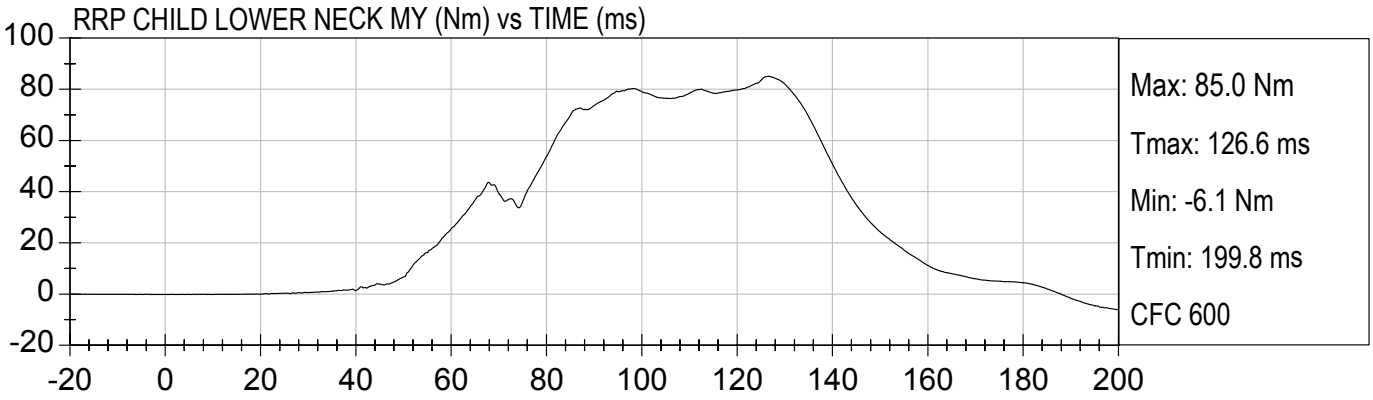


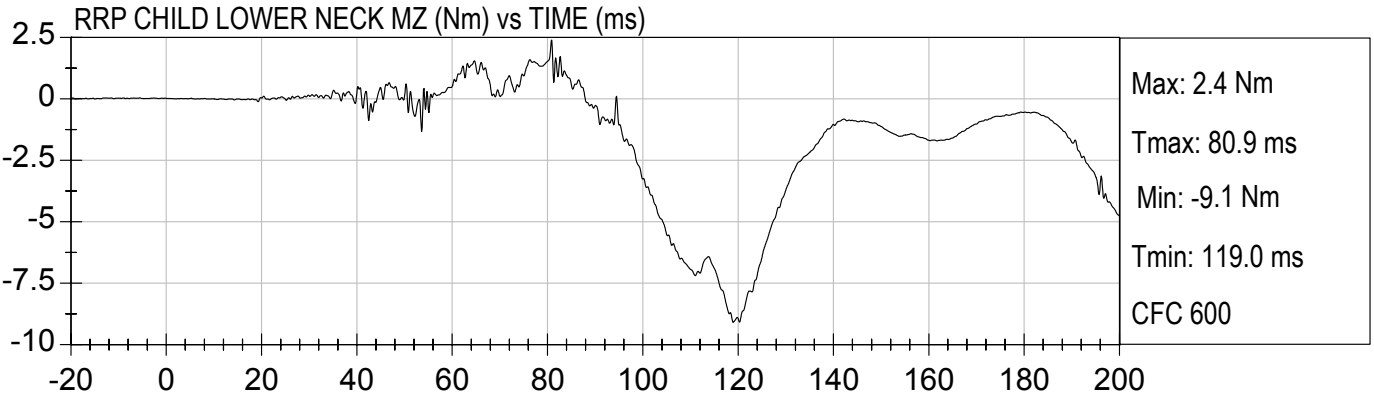


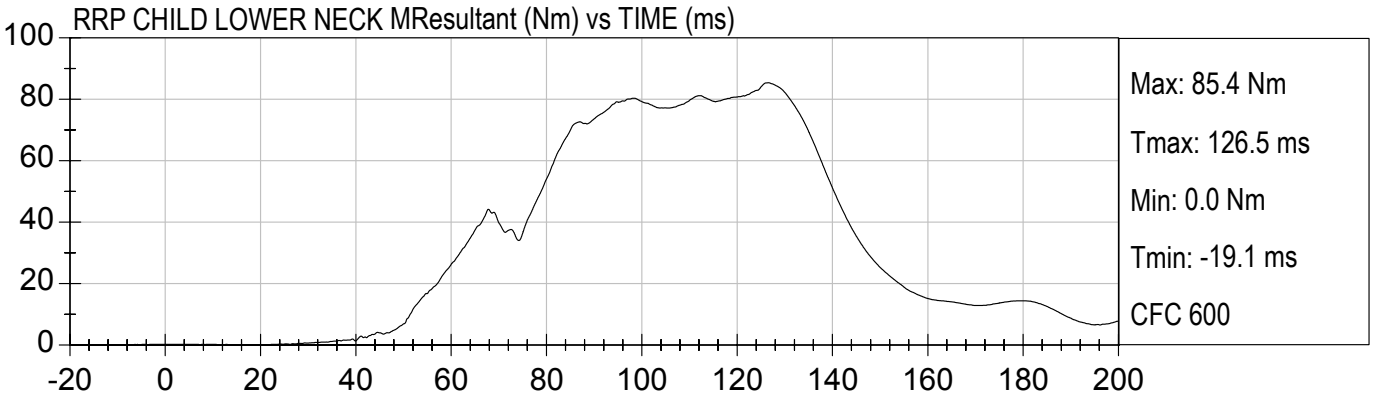
35MPH FRONTAL NCAP
2003 FORD CROWN VICTORIA

Test Date: 1/21/2003
Speed: 35.3 mph (56.8 km/h)



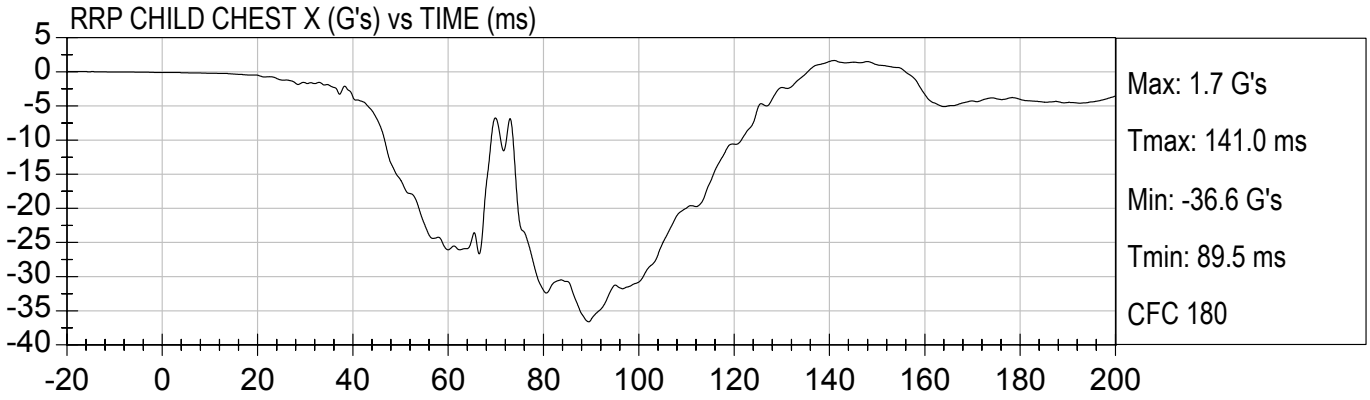


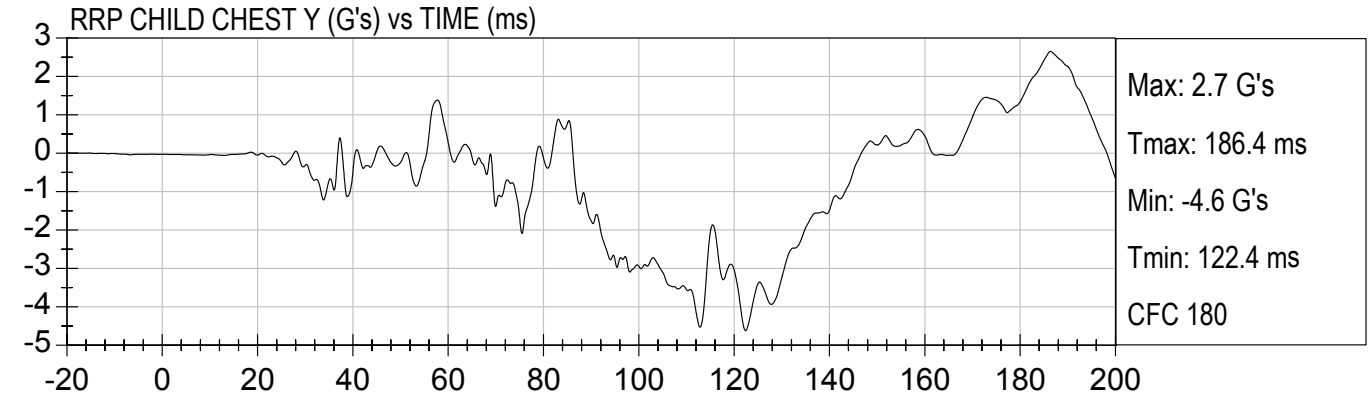


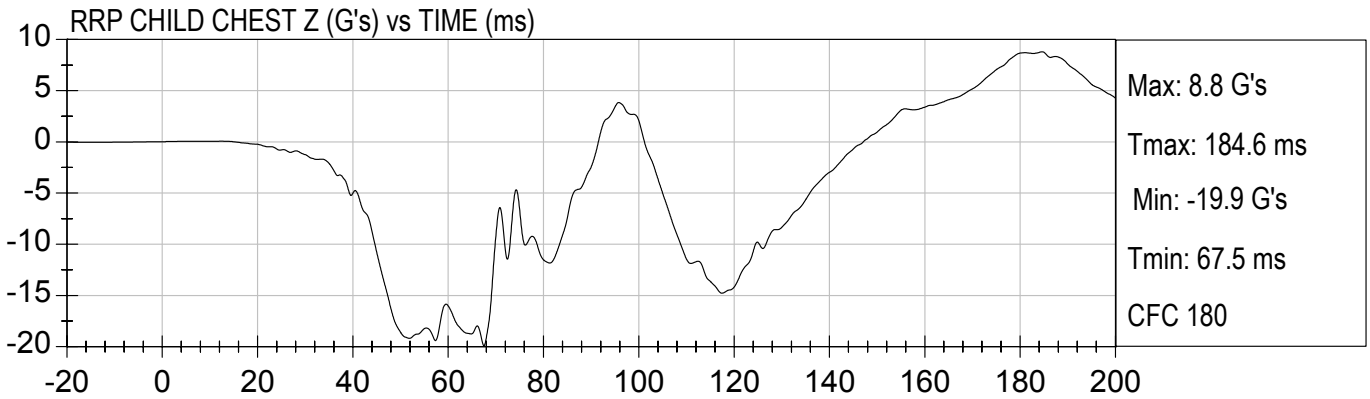


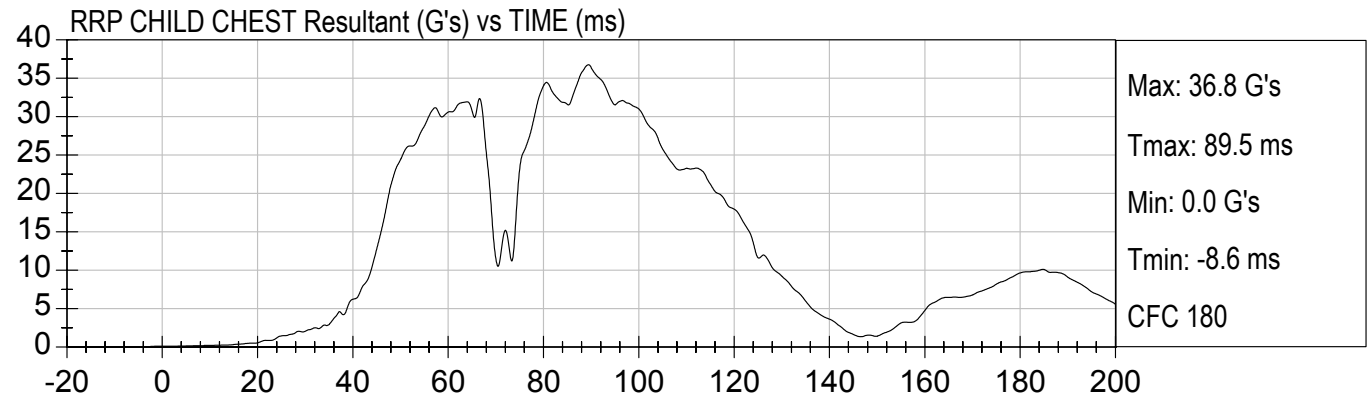
35MPH FRONTAL NCAP
2003 FORD CROWN VICTORIA

Test Date: 1/21/2003
Speed: 35.3 mph (56.8 km/h)



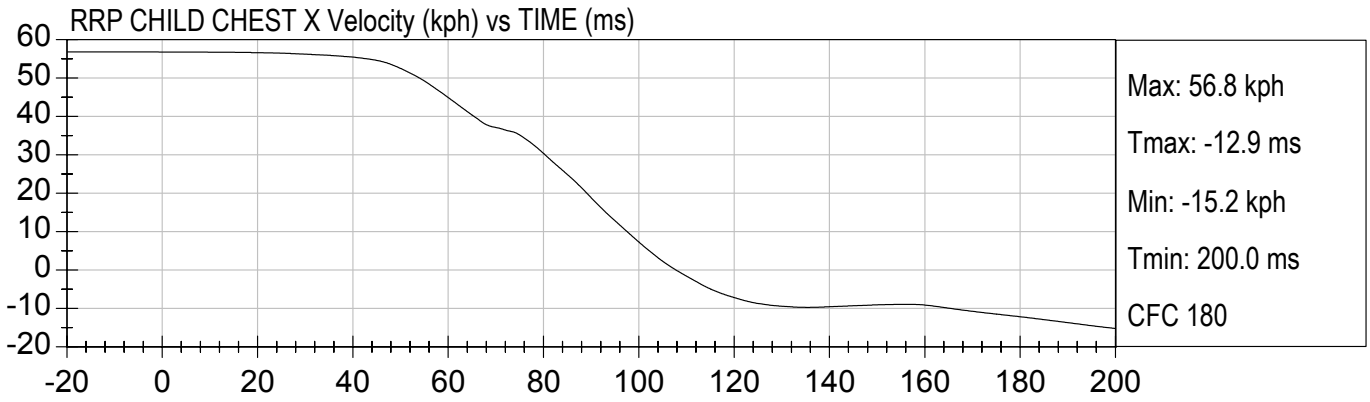


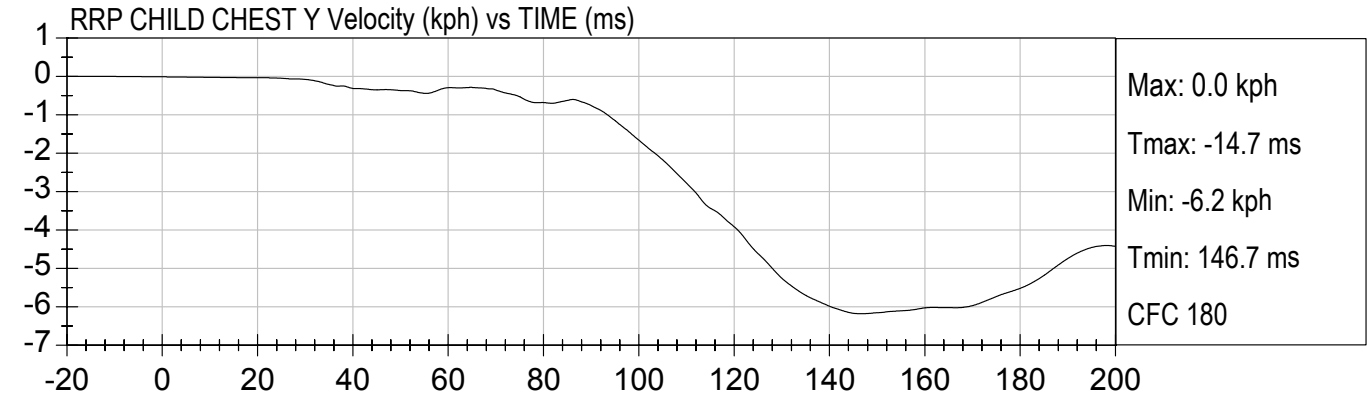


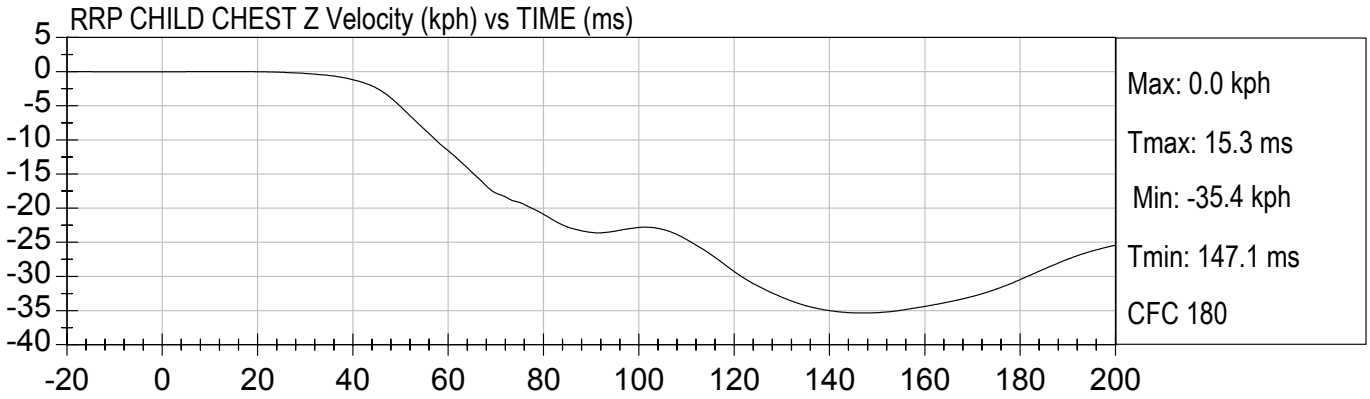


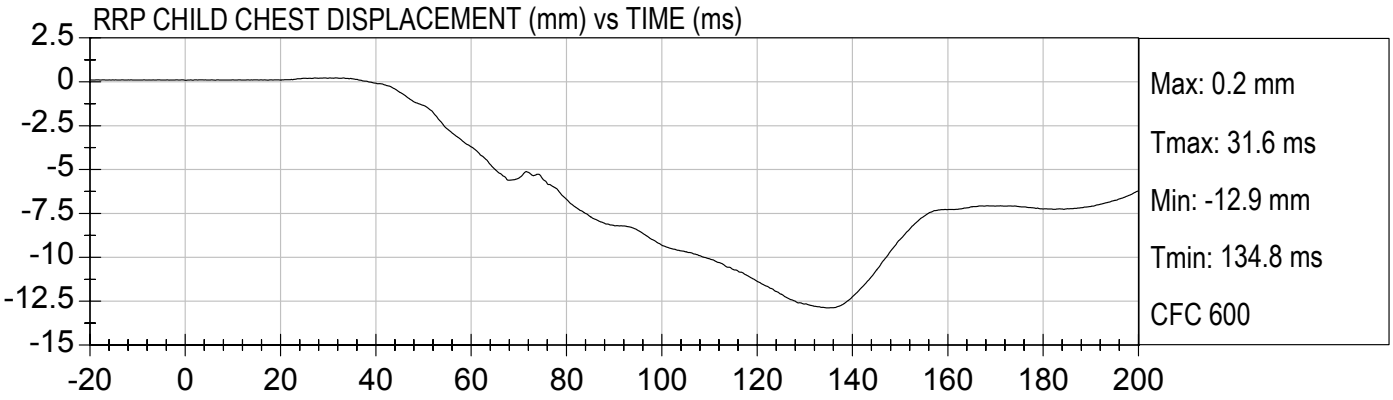
35MPH FRONTAL NCAP
2003 FORD CROWN VICTORIA

Test Date: 1/21/2003
Speed: 35.3 mph (56.8 km/h)



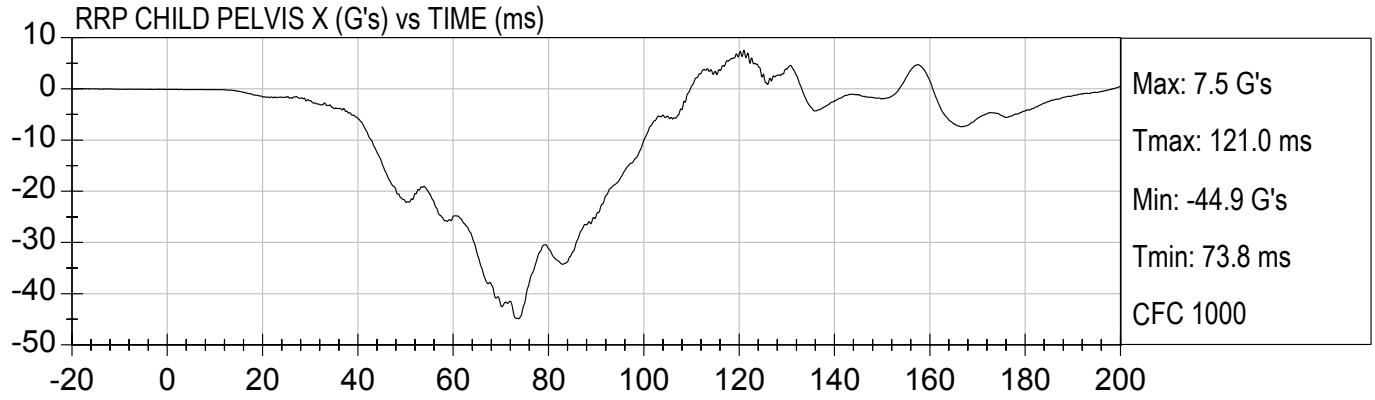


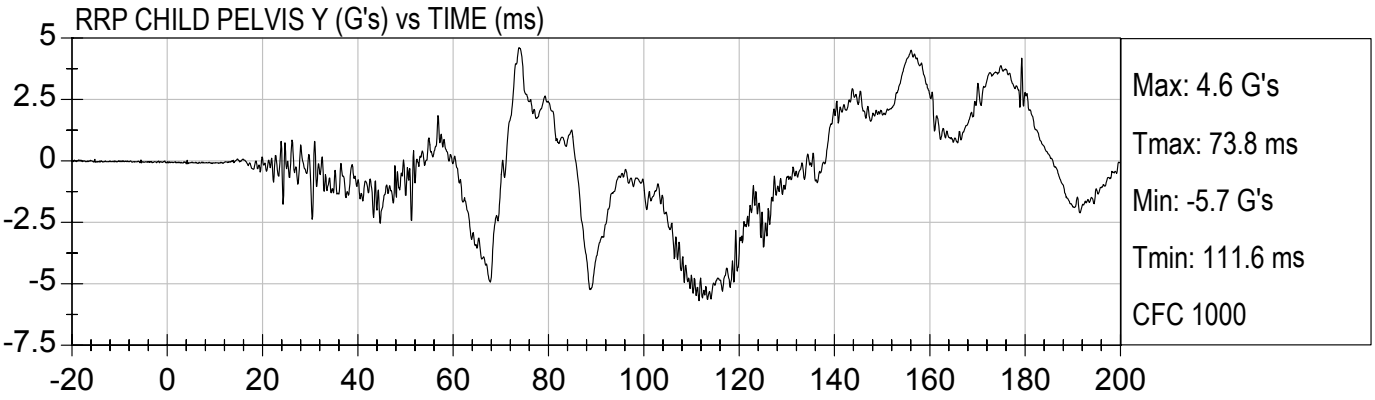


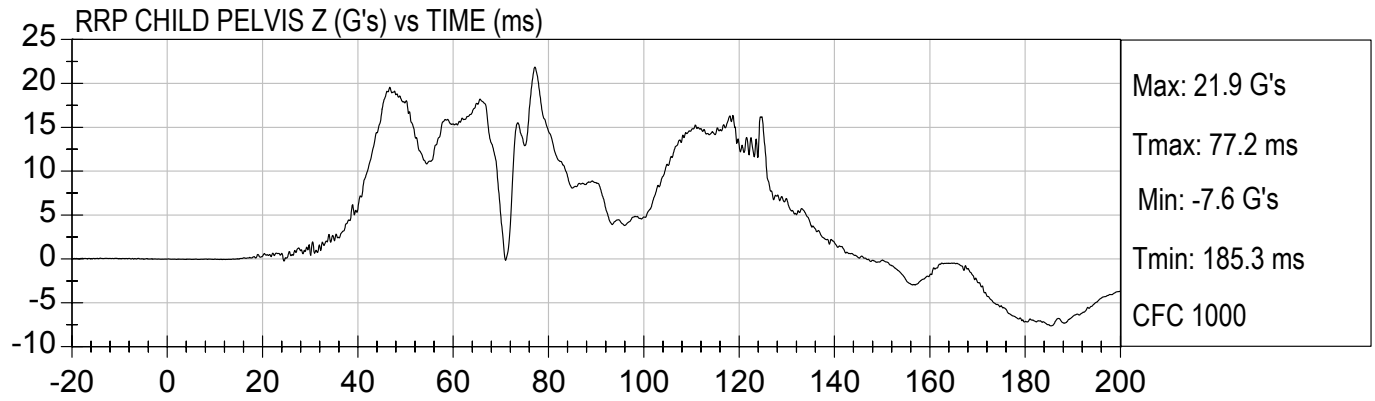


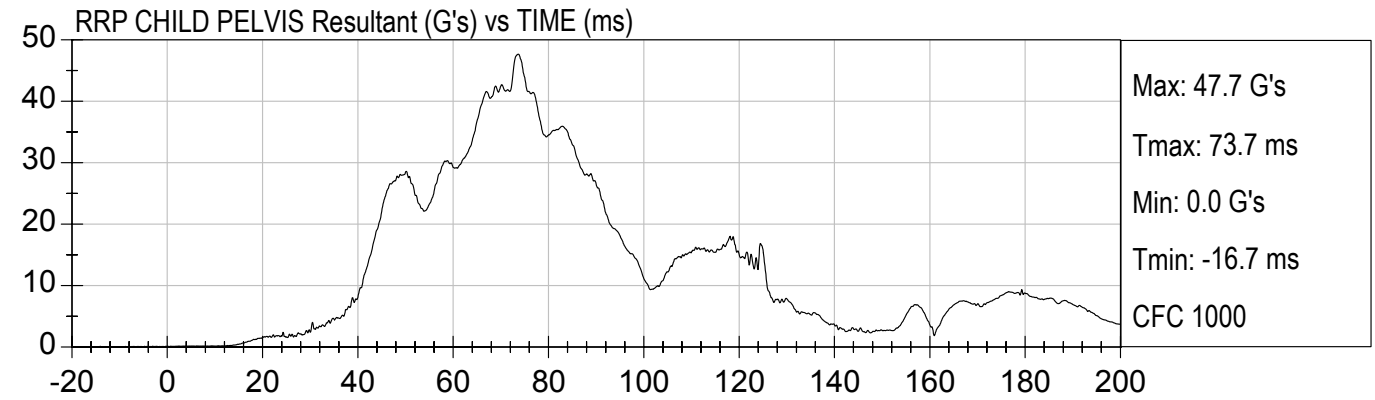
35MPH FRONTAL NCAP
2003 FORD CROWN VICTORIA

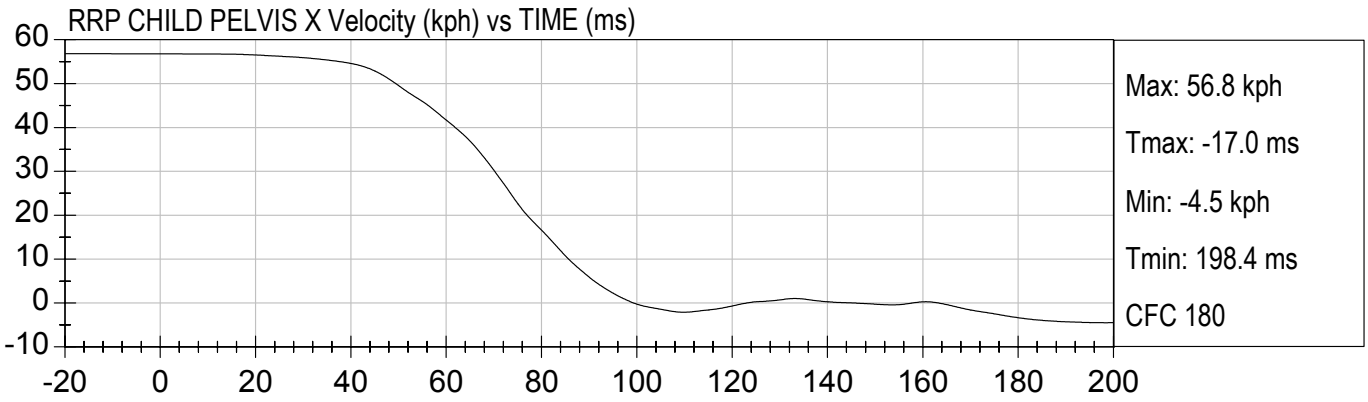
Test Date: 1/21/2003
Speed: 35.3 mph (56.8 km/h)

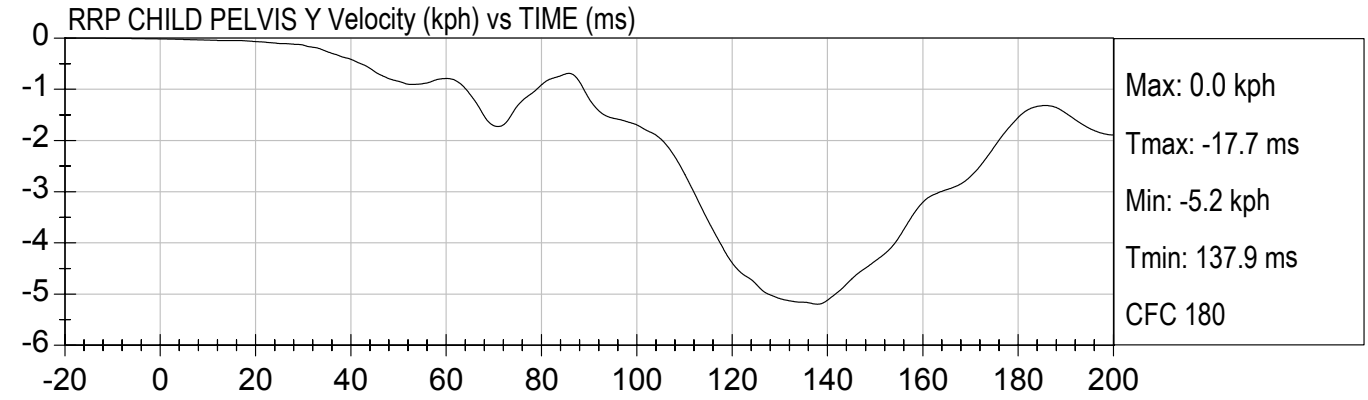


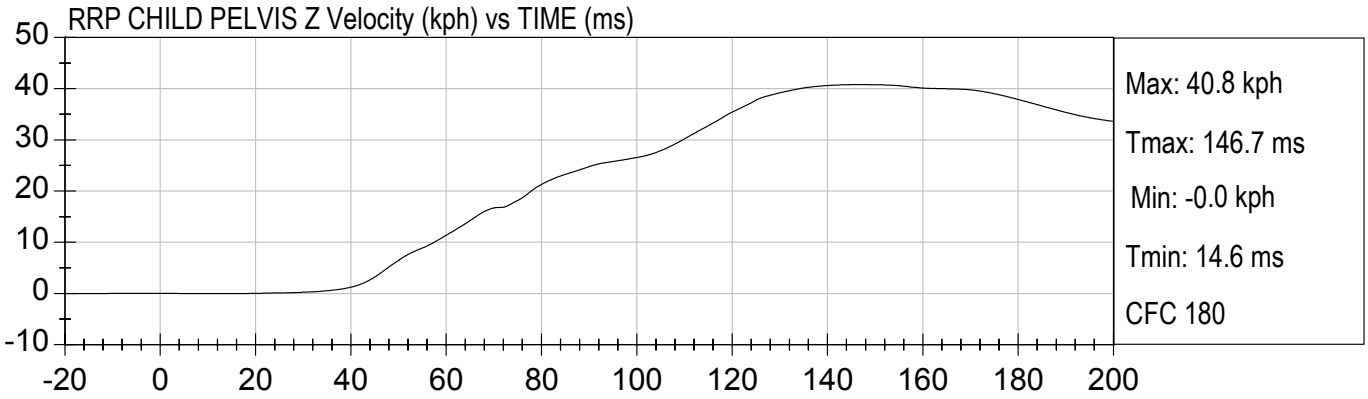


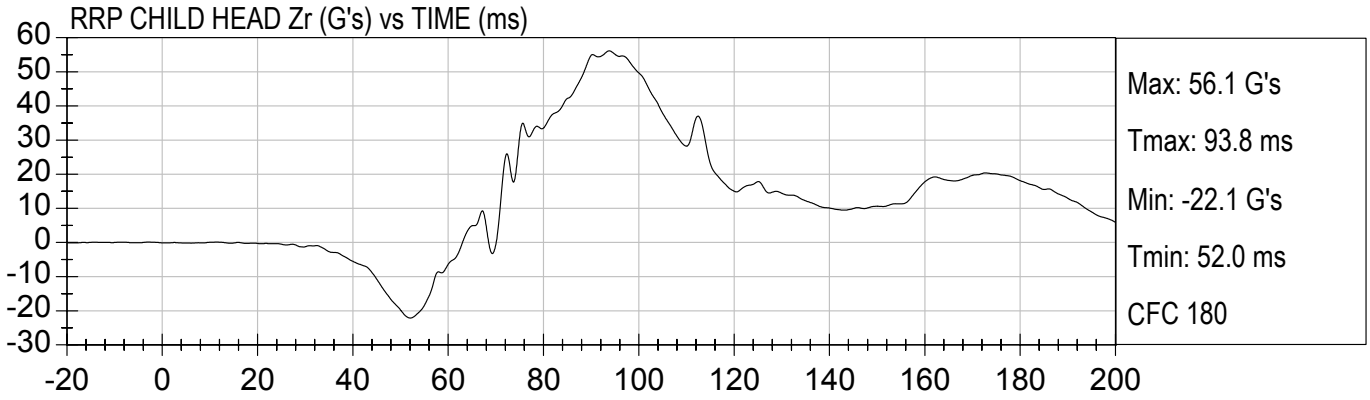


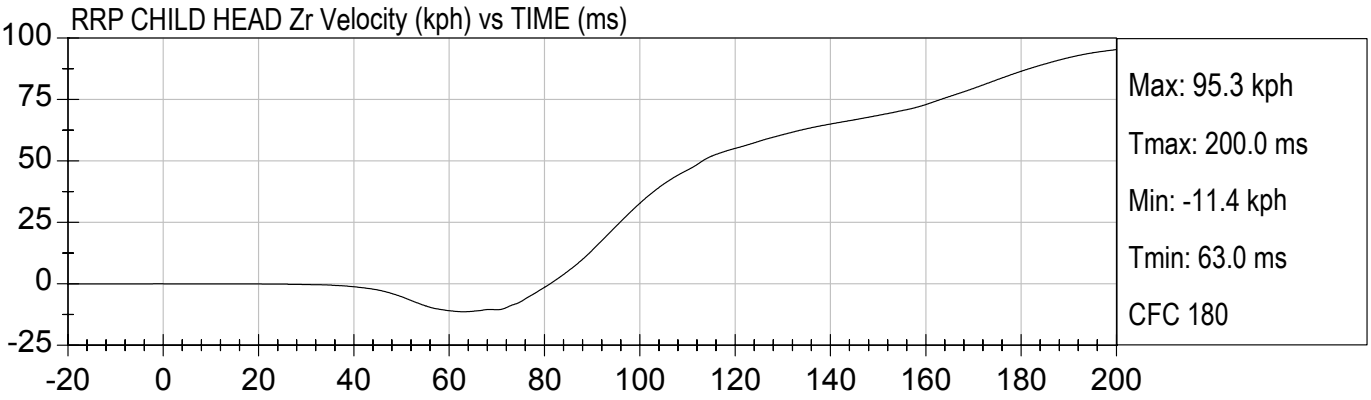



RRP CHILD PELVIS X Velocity (kph) vs TIME (ms)
60
50
40
30
20
10
0
-10
-20
0
20
40
60
80
100
120
140
160
180
200
Max: 56.8 kph
Tmax: -17.0 ms
Min: -4.5 kph
Tmin: 198.4 ms
CFC 180


RRP CHILD PELVIS Y Velocity (kph) vs TIME (ms)
0
-1
-2
-3
-4
-5
-6
-20
0
20
40
60
80
100
120
140
160
180
200
Max: 0.0 kph
Tmax: -17.7 ms
Min: -5.2 kph
Tmin: 137.9 ms
CFC 180


RRP CHILD PELVIS Z Velocity (kph) vs TIME (ms)
50
40
30
20
10
0
-10
-20
0
20
40
60
80
100
120
140
160
180
200
Max: 40.8 kph
Tmax: 146.7 ms
Min: -0.0 kph
Tmin: 14.6 ms
CFC 180


RRP CHILD HEAD Zr (G's) vs TIME (ms)
60
50
40
30
20
10
0
-10
-20
-30
-20
0
20
40
60
80
100
120
140
160
180
200
Max: 56.1 G's
Tmax: 93.8 ms
Min: -22.1 G's
Tmin: 52.0 ms
CFC 180


RRP CHILD HEAD Zr Velocity (kph) vs TIME (ms)
100
75
50
25
0
-25
-20
0
20
40
60
80
100
120
140
160
180
200
Max: 95.3 kph
Tmax: 200.0 ms
Min: -11.4 kph
Tmin: 63.0 ms
CFC 180

APPENDIX C

CHILD DUMMY CALIBRATION INFORMATION

Hybrid III Calibration Data Sheet

3 Year Old

Head Drop Calibration

ATD Serial No: 042 **Test I.D:** D021461

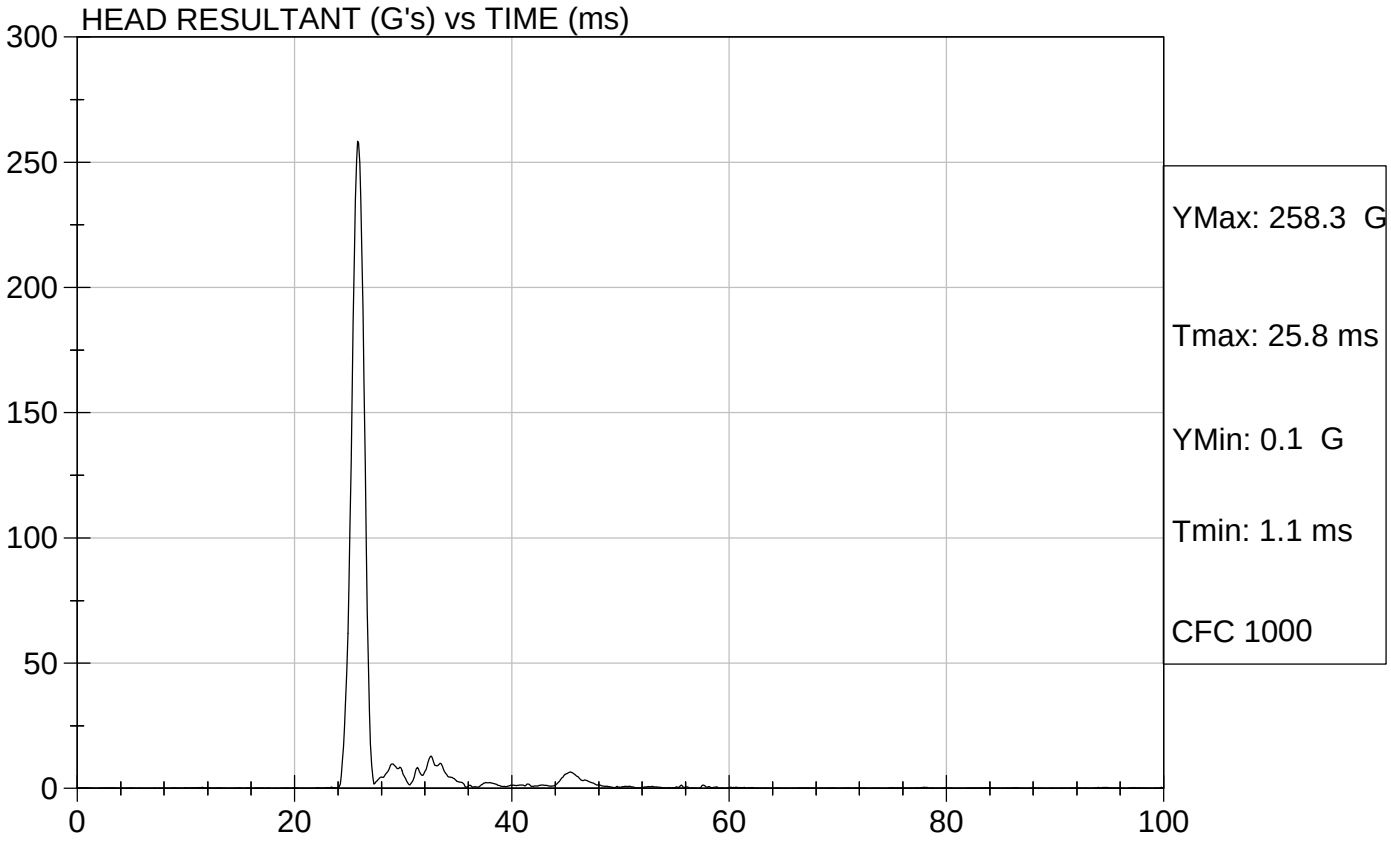
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	22.1	Pass
Laboratory Relative Humidity	%	10 to 70	29	Pass
Peak Resultant Acceleration	G's	250.0 to 280.0	258.3	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	9.9	Pass
Is Acceleration Unimodal?	Yes/No	< 10% Peak	Yes	Pass
		Overall Test Results		Pass

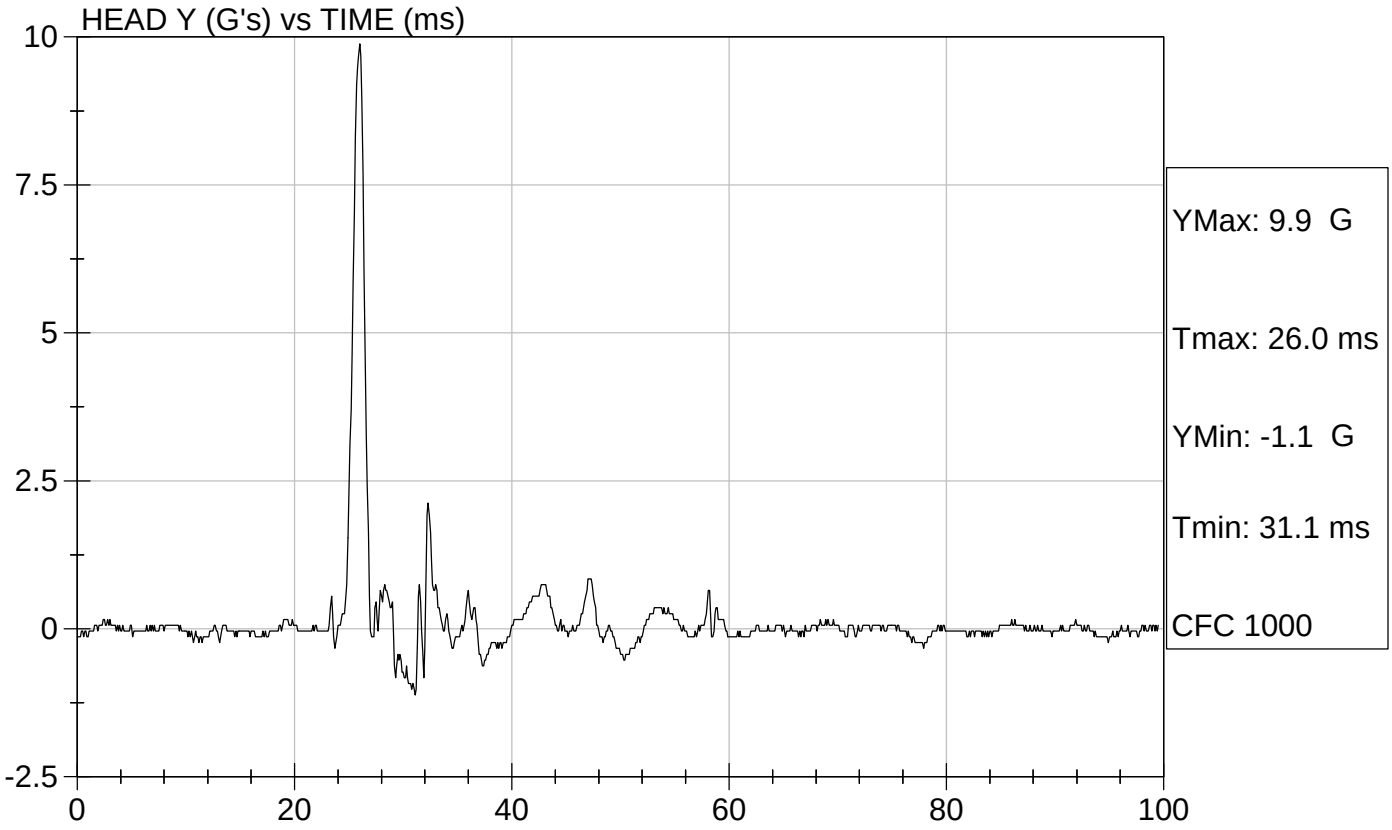
Laboratory Technician

11/13/2002
Test Date

Approved By

	Test Description: Head Drop	Test Date: 11/13/2002
	Component: D021461	Speed: 0 ft/s, 0.00 m/s





Hybrid III Calibration Data Sheet

3 Year Old

Neck Flexion Test

ATD Serial No: 042 **Test I.D:** D021462

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.6	Pass
Laboratory Relative Humidity		%	10 to 70	31	Pass
Pendulum Speed		m/s	5.4 to 5.6	5.53	Pass
Pendulum Deceleration	10 msec	m/s	2.0 - 2.7	2.3	Pass
	15 msec	m/s	3.0 - 4.0	3.4	Pass
	20 msec	m/s	4.0 - 5.1	4.5	Pass
D Plane Rotation		deg	70 - 82	81.0	Pass
Peak Moment within Deflection Corridor		Nm	42.0 - 53.0	45.1	Pass
Positive Moment - Time Curve Decay to 10 Nm		msec	60.0 - 80.0	72.0	Pass
			Overall Test Results		Pass

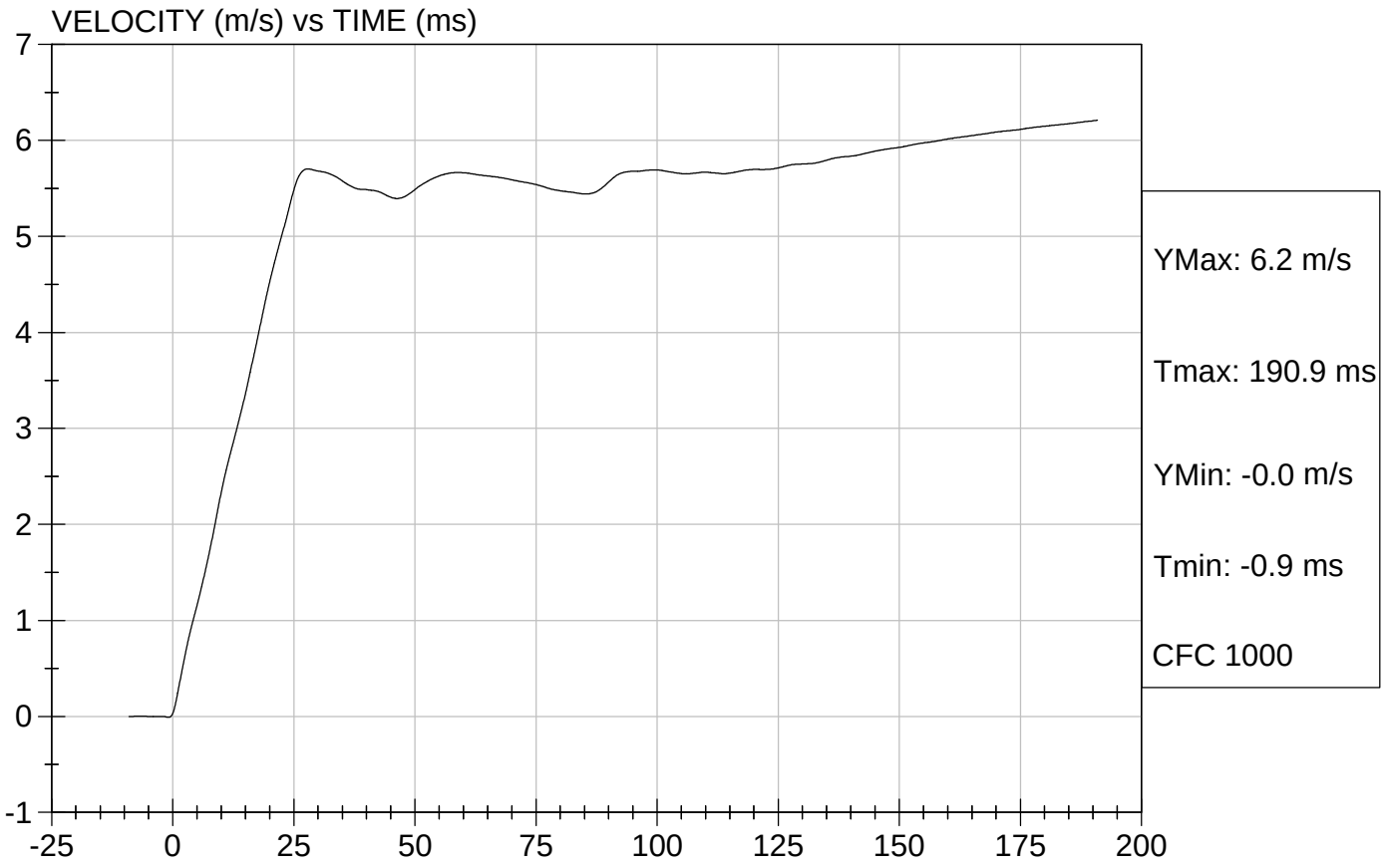
Laboratory Technician

11/14/2002
Test Date

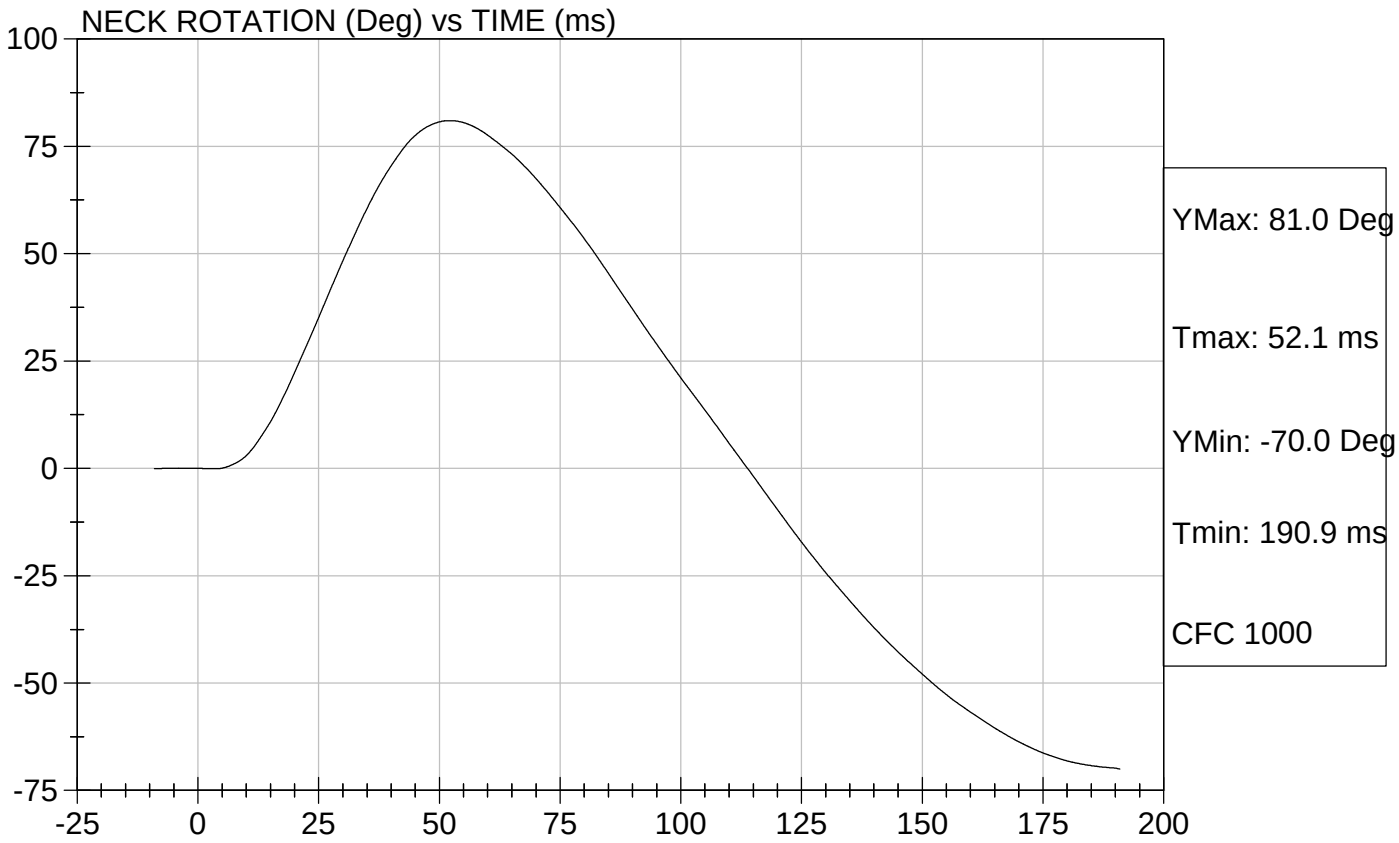
Approved By

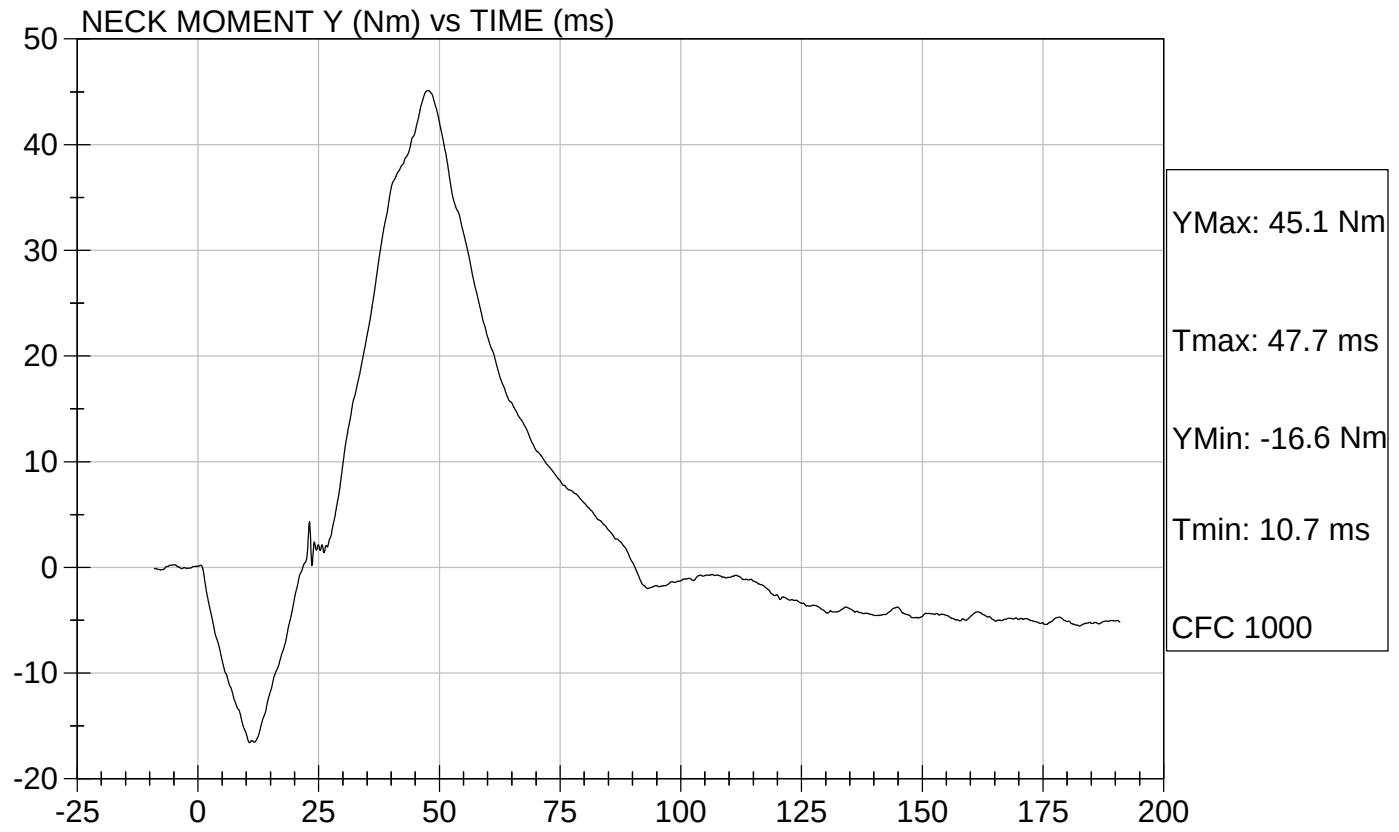
Test Description: Neck Flexion | Test Date: 11/14/2002

Component: D021462 | Speed: 18.15 ft/sec, 5.53 m/sec



	Test Description: Neck Flexion	Test Date: 11/14/2002
	Component: D021462	Speed: 18.15 ft/s, 5.53 m/s





Hybrid III Calibration Data Sheet

3 Year Old

Neck Extension Test

ATD Serial No: 042 **Test I.D:** D021463

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.5	Pass
Laboratory Relative Humidity		%	10 to 70	31	Pass
Pendulum Speed		m/s	3.55 to 3.75	3.73	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	3.0	Pass
D Plane Rotation		deg	83 - 93	85.8	Pass
Peak Moment within Deflection Corridor		Nm	-53.3 - -43.7	-44.5	Pass
Negative Moment - Time Curve Decay to -10 Nm		msec	60.0 - 80.0	69.9	Pass
			Overall Test Results		Pass

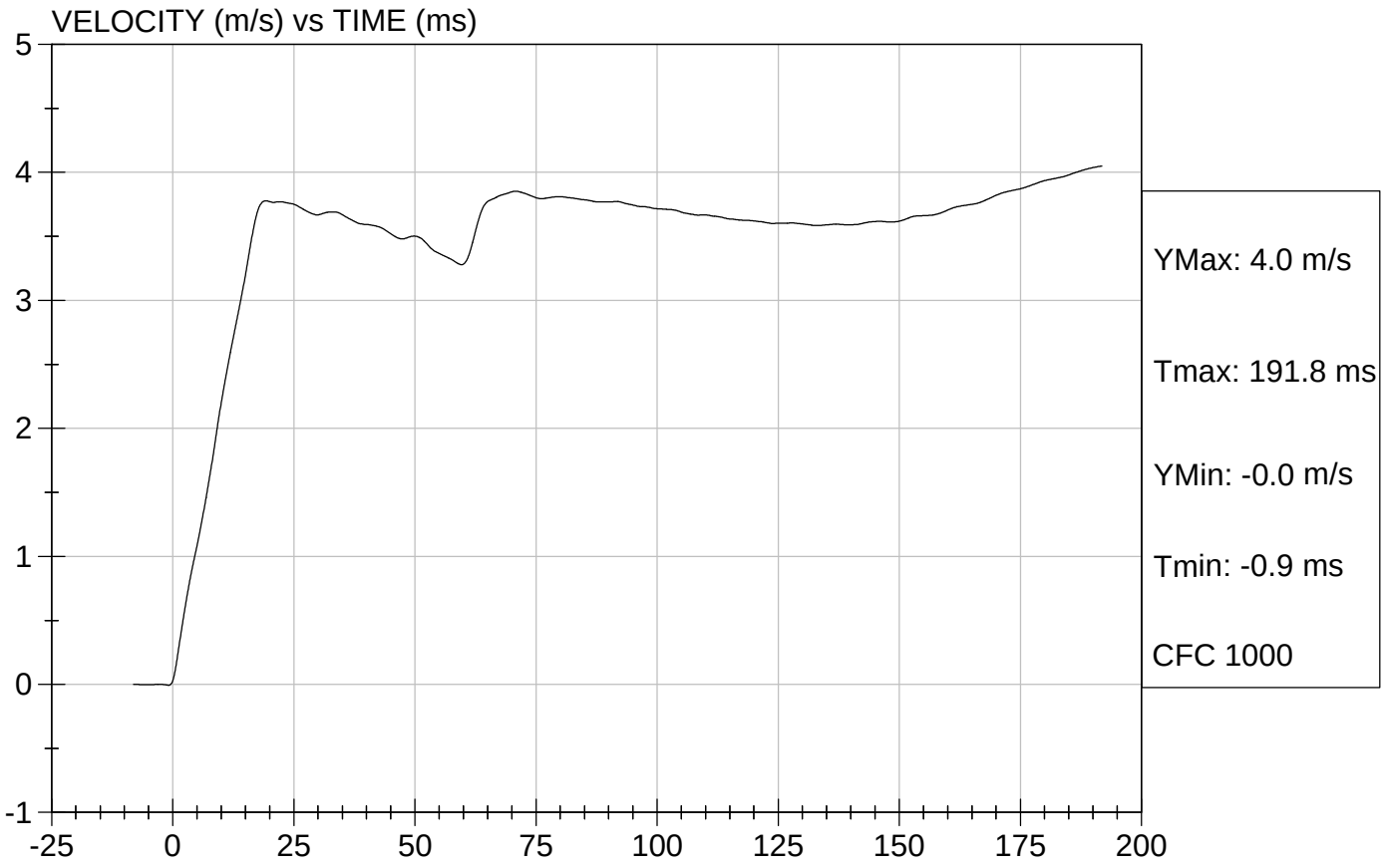
Laboratory Technician

11/14/2002
Test Date

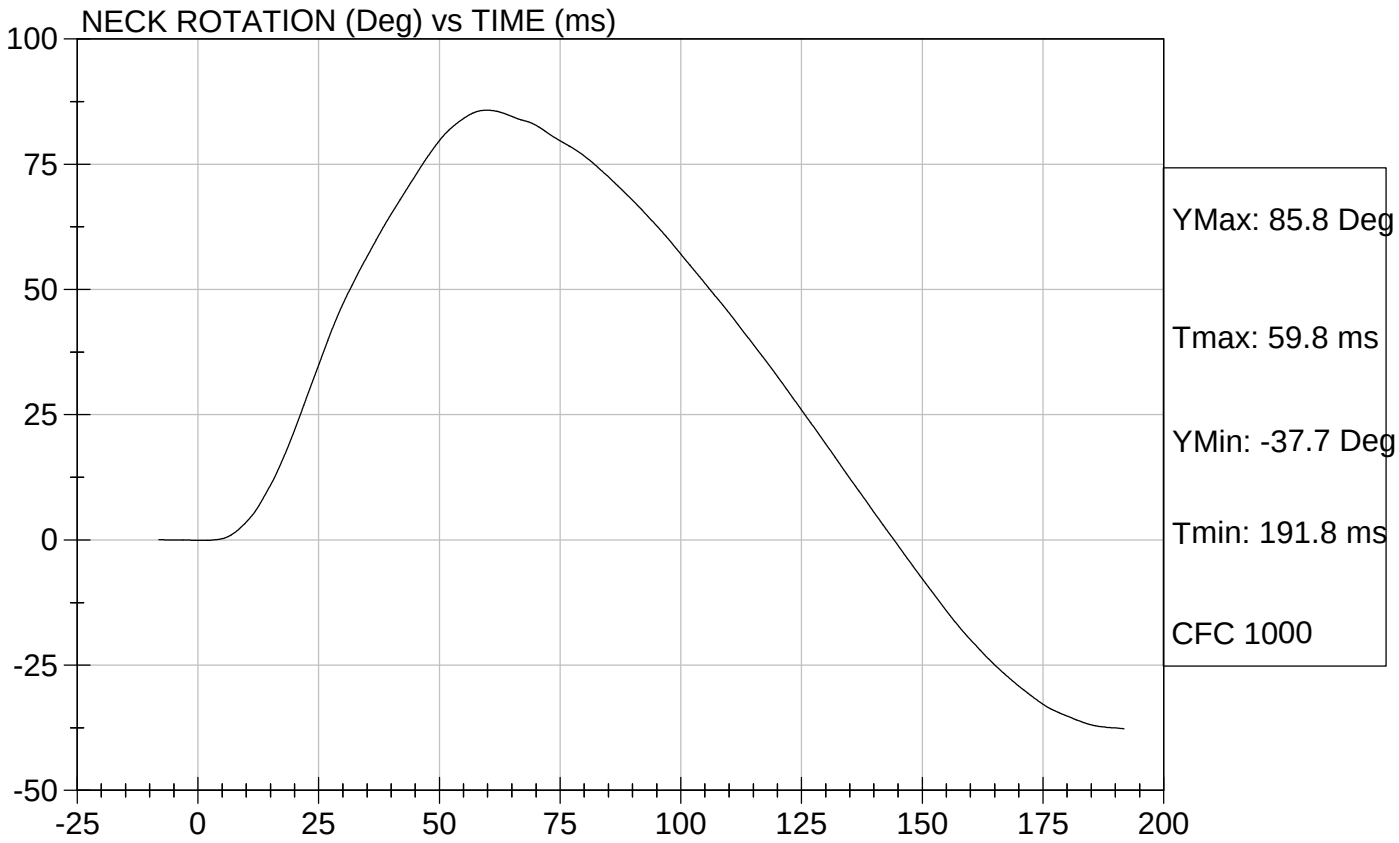
Approved By

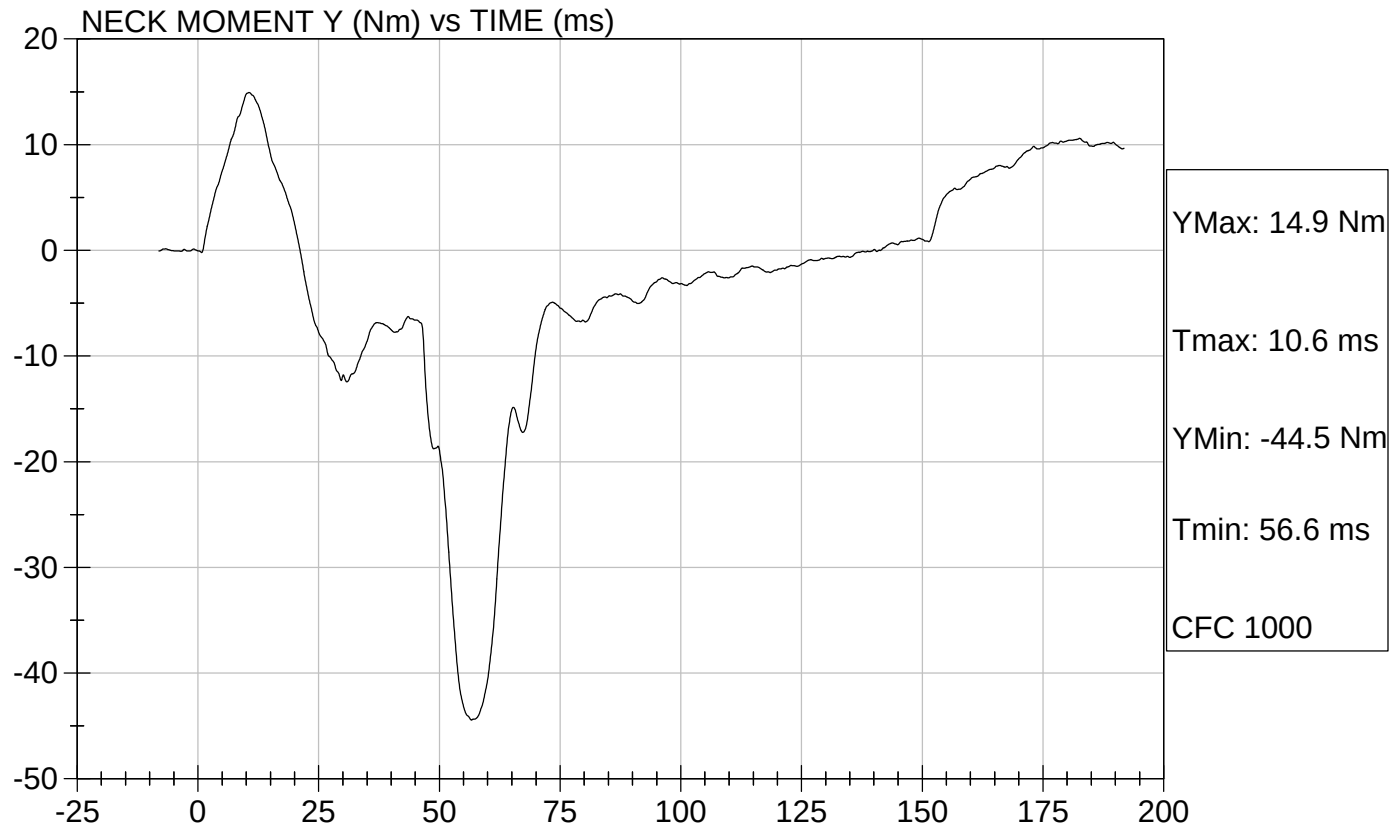
Test Description: Neck Extension Test Date: 11/14/2002

Component: D021463 Speed: 12.23 ft/sec, 3.73 m/sec



	Test Description: Neck Extension	Test Date: 11/14/2002
	Component: D021463	Speed: 12.23 ft/s, 3.73 m/s





Hybrid III Calibration Data Sheet

3 Year Old

Thorax Impact Test

ATD Serial No: 042 **Test I.D:** D021464

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	20.8	Pass
Laboratory Relative Humidity	%	10 to 70	26	Pass
Probe Velocity	m/s	5.9 to 6.1	6.00	Pass
Peak Deflection	mm	32 - 38	33	Pass
Peak Resistive Force w/in Deflection Corridor	kN	0.68 - 0.81	0.72	Pass
Internal Hysteresis	%	65 to 85	72	Pass
Max Force 12.5 mm - 32 mm Deflection	kN	Max 0.86	0.80	Pass
		Overall Test Results		Pass

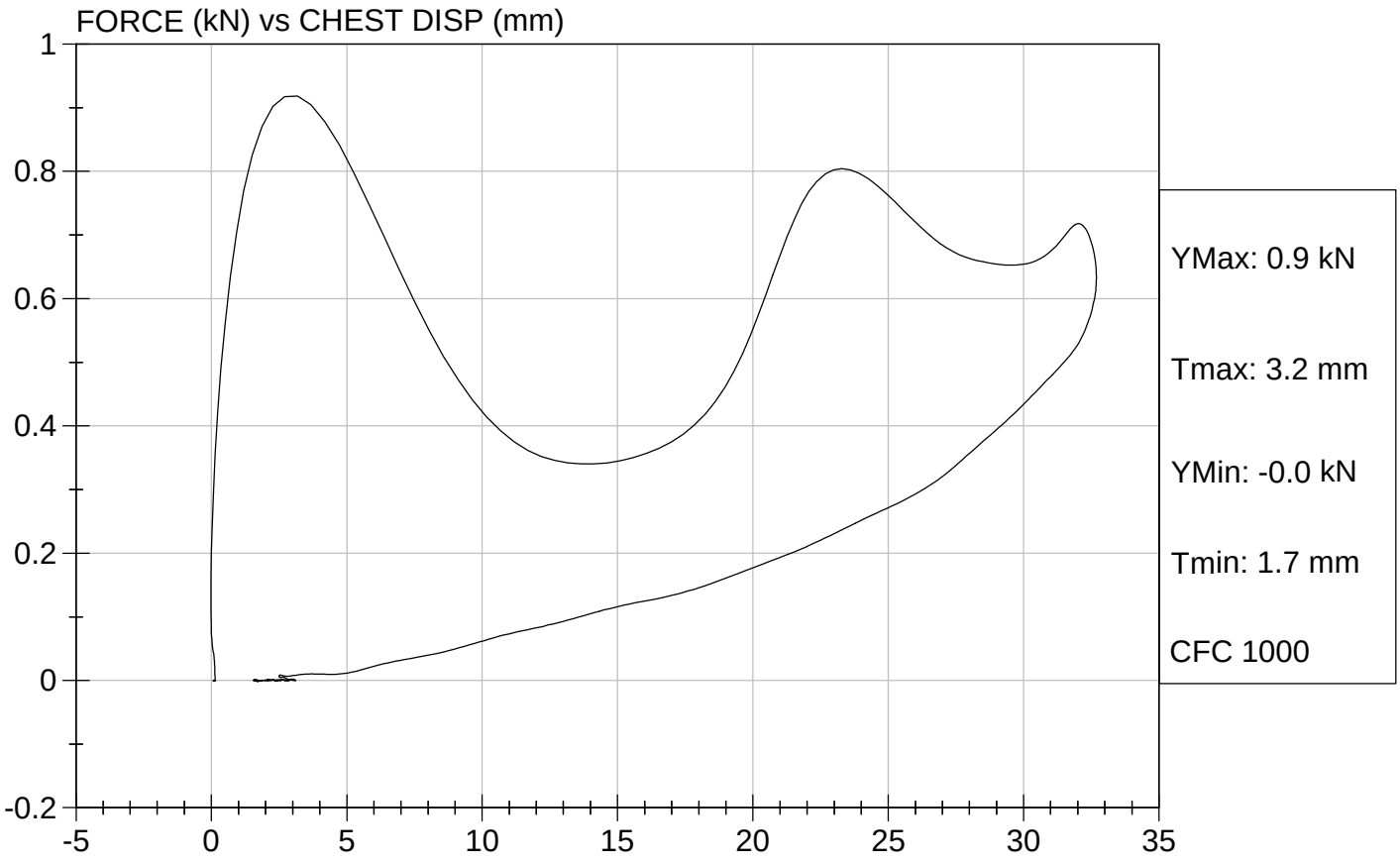
Laboratory Technician

11/15/2002
Test Date

Approved By

Test Description: Thorax Impact Test Date: 11/15/2002

Component: D021464 Speed: 19.67 ft/sec, 6.00 m/sec



Hybrid III Calibration Data Sheet

3 Year Old

Torso Lumbar Flexion

ATD Serial No: 042 **Test I.D:** D021465

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.8	Pass
Laboratory Relative Humidity	%	10 to 70	28	Pass
Force At 45 deg.	N	130 - 180	157	Pass
Initial Angle	deg	0 - 15	8	Pass
Return Angle	deg	0 - 10	6	Pass
		Overall Test Results		Pass

Laboratory Technician

11/19/02
Test Date

Approved By

Transportation Research Center Inc.

ATD Calibration Report

for

VRTC

12 Month Old CRABI Serial No. 074 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.

572R Frontal Head Drop Test

12 Month Old CRABI Serial No. 074 Calibration No. 02 - 1

Test Date 12/19/2002

Test Parameter	Specification	Test Results	Pass
Temperature	18.9 - 25.6 °C	21.7 °C	Yes
Relative Humidity	10 - 70 %	38 %	Yes
Peak Resultant Acceleration	100 - 120 g	113.9 g	Yes
Peak Lateral Acceleration	15 g Max	3.7 g	Yes
Is Acceleration Curve Unimodal?	Yes	Yes	Yes

Comments:

Technician

Approved

12.19.2002 12:34:41 598

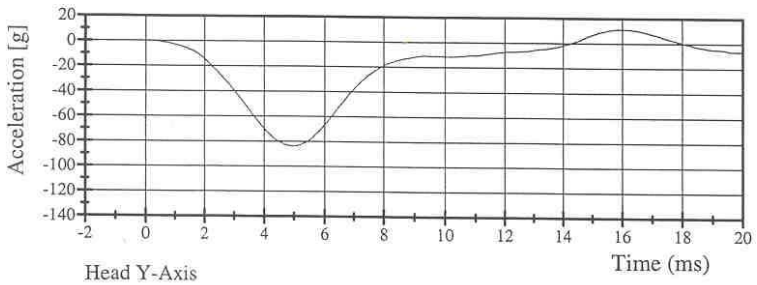
Transportation Research Center Inc.

572R Frontal Head Drop Test

12 Month Old CRABI Serial No. 074 Calibration No. 02 - 1

Test Date 12/19/2002

Head X-Axis

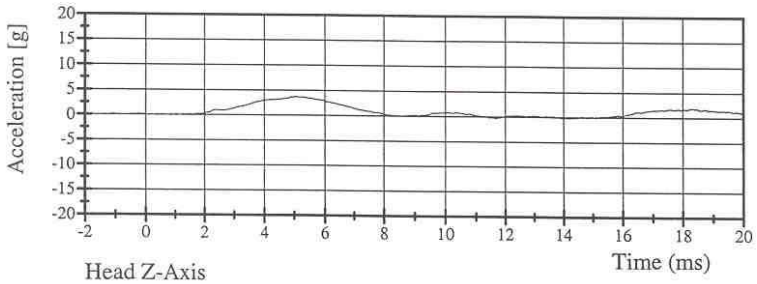


Filter Class: 1000

Max: 0.1 g at 0.1 ms

Min: -83.6 g at 5.0 ms

Head Y-Axis

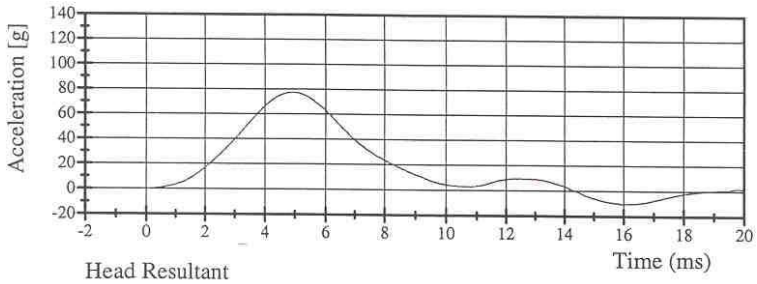


Filter Class: 1000

Max: 3.7 g at 5.0 ms

Min: -0.1 g at 0.4 ms

Head Z-Axis

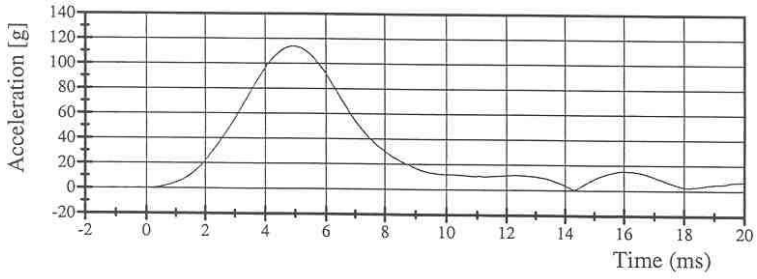


Filter Class: 1000

Max: 77.4 g at 5.0 ms

Min: -0.1 g at 0.1 ms

Head Resultant



Filter Class: 1000

Max: 113.9 g at 5.0 ms

Min: 0.0 g at 0.0 ms

12.19.2002 12:34:42 598

Transportation Research Center Inc.

572R Rear Head Drop Test

12 Month Old CRABI Serial No. 074 Calibration No. 02 - 1

Test Date 12/19/2002

Test Parameter	Specification	Test Results	Pass
Temperature	18.9 - 25.6 °C	21.7 °C	Yes
Relative Humidity	10 - 70 %	40 %	Yes
Peak Resultant Acceleration	55 - 71 g	65.7 g	Yes
Peak Lateral Acceleration	15 g Max	2.6 g	Yes
Is Acceleration Curve Unimodal?	Yes	Yes	Yes

Comments:

Technician

Approved

12.19.2002 14:21:46 596

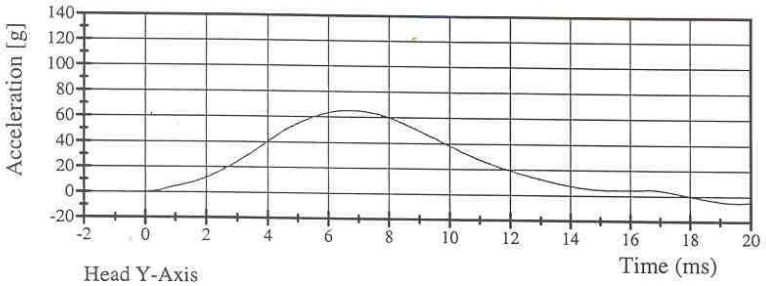
Transportation Research Center Inc.

572R Rear Head Drop Test

12 Month Old CRABI Serial No. 074 Calibration No. 02 - 1

Test Date 12/19/2002

Head X-Axis

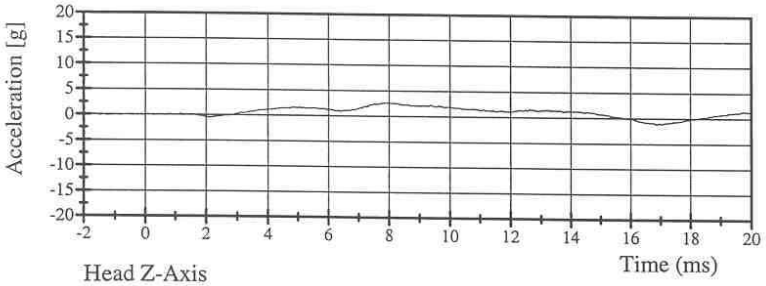


Filter Class: 1000

Max: 65.1 g at 6.6 ms

Min: 0.2 g at 0.0 ms

Head Y-Axis

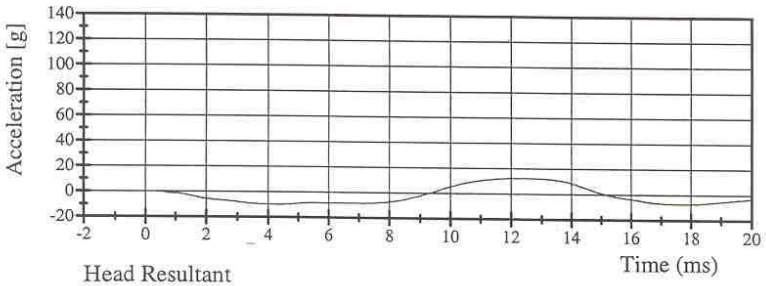


Filter Class: 1000

Max: 2.6 g at 7.9 ms

Min: -0.5 g at 2.2 ms

Head Z-Axis

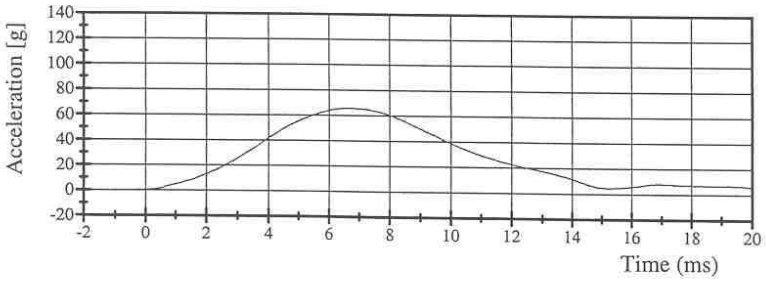


Filter Class: 1000

Max: 5.2 g at 10.0 ms

Min: -9.9 g at 4.3 ms

Head Resultant



Filter Class: 1000

Max: 65.7 g at 6.7 ms

Min: 0.0 g at 0.8 ms

12.19.2002 14:21:47 596

Transportation Research Center Inc.

572R Neck Flexion Test - 6 Channel Transducer

12 Month Old CRABI Serial No. 074 Calibration No. 02 - 3

Test Date 12/20/2002

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	21.7 °C	Yes
Relative Humidity	10 - 70 %	21 %	Yes
Impact Velocity	5.10 - 5.30 m/s	5.22 m/s	Yes
Integrated Pendulum Velocity			
10 ms	1.60 - 2.30 m/s	1.97 m/s	Yes
20 ms	3.40 - 4.20 m/s	3.83 m/s	Yes
25 ms	4.30 - 5.20 m/s	4.68 m/s	Yes
Peak D Plane Rotation	75 - 86 °	75.4 °	Yes
Peak Moment About Occipital Condyles (During time interval rotation is within specified corridors)	36.0 - 45.0 N·m	41.78 N·m	Yes
Positive Moment Decay Time To 5 N·m	60 - 80 ms	71.76 ms	Yes

Comments:

Technician

Approved

12.20.2002 14:29:15 665

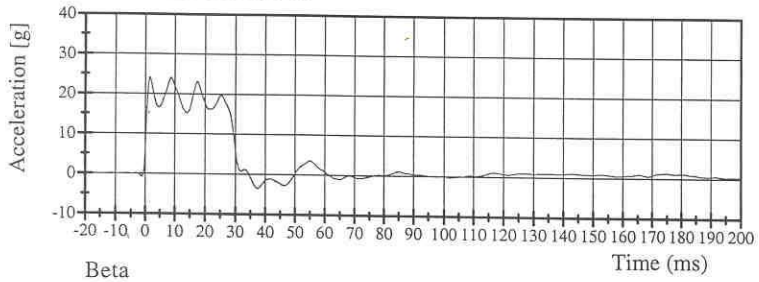
Transportation Research Center Inc.

572R Neck Flexion Test

12 Month Old CRABI Serial No. 074 Calibration No. 02 - 3

Test Date 12/20/2002

Pendulum Deceleration

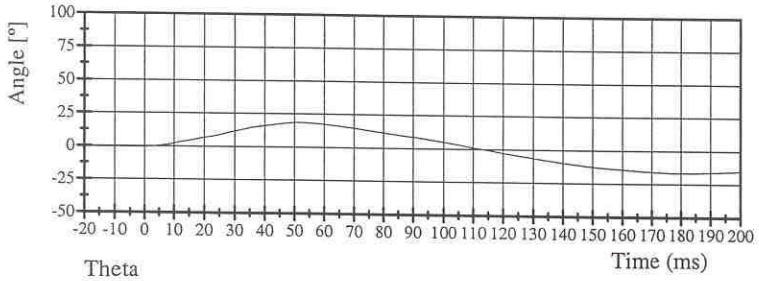


Filter Class: 180

Max: 24.1 g at 1.5 ms

Min: -3.5 g at 37.4 ms

Beta

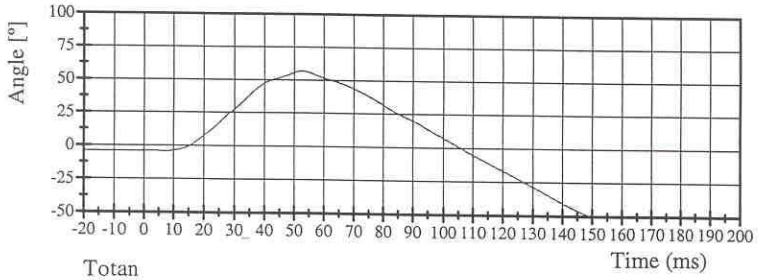


Filter Class: 60

Max: 18.6 ° at 51.8 ms

Min: -16.7 ° at 180.3 ms

Theta

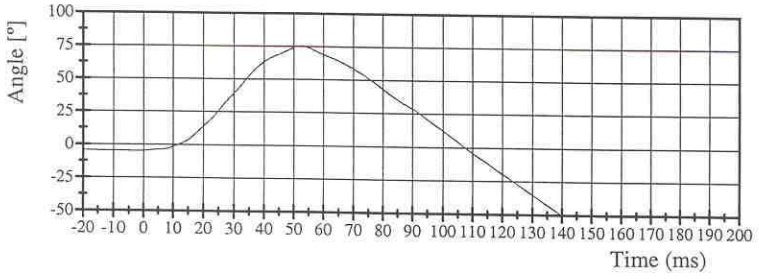


Filter Class: 60

Max: 56.8 ° at 52.6 ms

Min: -66.0 ° at 180.2 ms

Totan



Filter Class: 60

Max: 75.4 ° at 52.5 ms

Min: -82.6 ° at 180.2 ms

12.20.2002 14:29:17 665

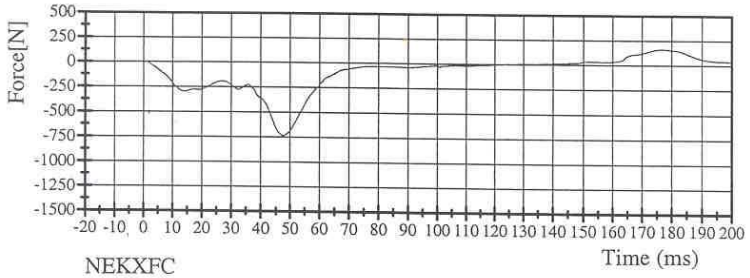
Transportation Research Center Inc.

572R Neck Flexion Test

12 Month Old CRABI Serial No. 074 Calibration No. 02 - 3

Test Date 12/20/2002

NEKXF

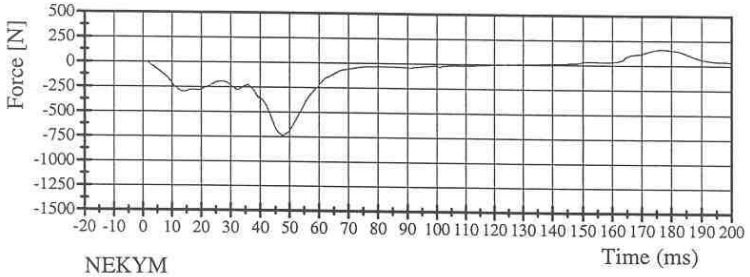


Filter Class: 1000

Max: 161.8 N at 176.9 ms

Min: -732.7 N at 47.6 ms

NEKXFC

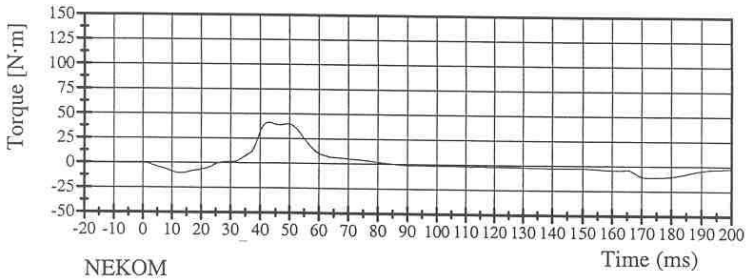


Filter Class: 600

Max: 161.8 N at 176.8 ms

Min: -732.6 N at 47.6 ms

NEKYM

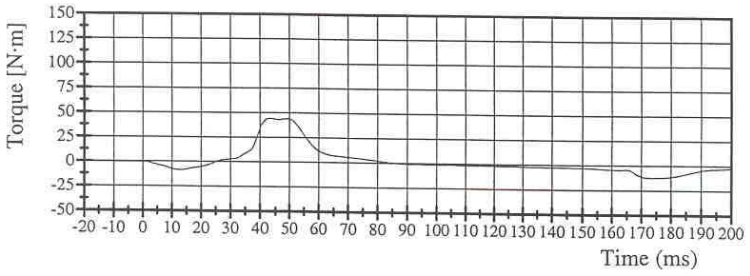


Filter Class: 600

Max: 41.3 N·m at 43.0 ms

Min: -11.3 N·m at 172.6 ms

NEKOM



Filter Class: 600

Max: 44.4 N·m at 43.3 ms

Min: -12.2 N·m at 173.3 ms

12.20.2002 14:29:20 665

Transportation Research Center Inc.

572R Neck Extension Test - 6 Channel Transducer

12 Month Old CRABI Serial No. 074 Calibration No. 02 - 1

Test Date 12/20/2002

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	21.7 °C	Yes
Relative Humidity	10 - 70 %	23 %	Yes
Impact Velocity	2.40 - 2.60 m/s	2.53 m/s	Yes
Integrated Pendulum Velocity			
6 ms	0.80 - 1.20 m/s	0.99 m/s	Yes
10 ms	1.50 - 2.10 m/s	1.76 m/s	Yes
14 ms	2.20 - 2.90 m/s	2.37 m/s	Yes
Peak D Plane Rotation	80 - 92 °	81.7 °	Yes
Peak Moment About Occipital Condyles (During time interval rotation is within specified corridors)	-23.0 - (-12.0) N·m	-18.85 N·m	Yes
Positive Moment Decay Time To -5 N·m	76 - 90 ms	78.96 ms	Yes

Comments:

Technician

Approved

12.20.2002 15:05:51 1405

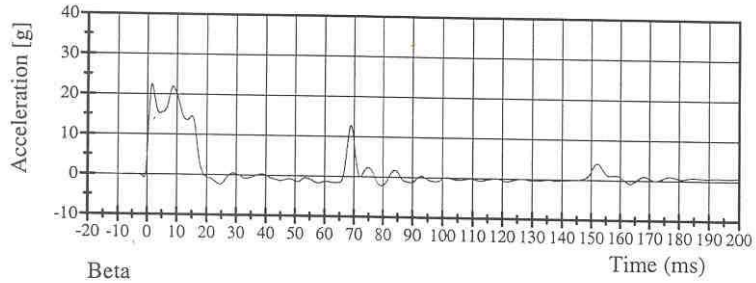
Transportation Research Center Inc.

572R Neck Extension Test

12 Month Old CRABI Serial No. 074 Calibration No. 02 - 1

Test Date 12/20/2002

Pendulum Deceleration

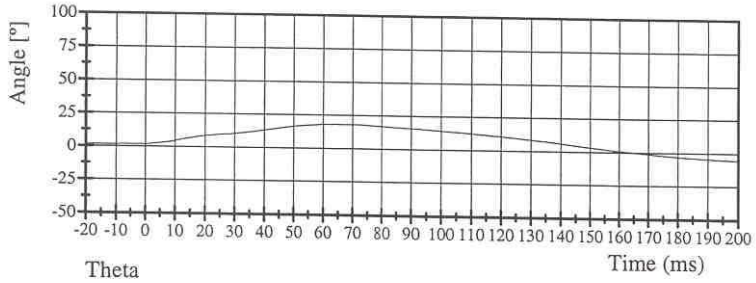


Filter Class: 180

Max: 22.4 g at 1.6 ms

Min: -2.4 g at 24.6 ms

Beta

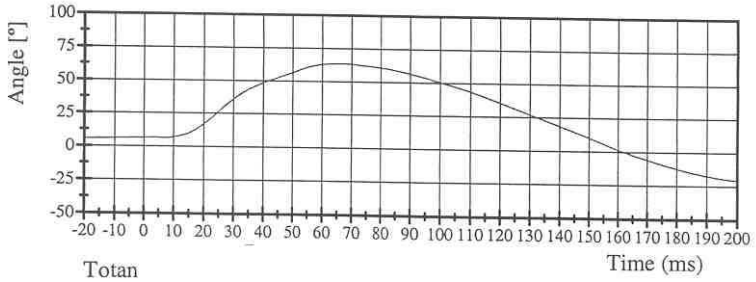


Filter Class: 60

Max: 18.2 ° at 64.5 ms

Min: -5.6 ° at 210.9 ms

Theta

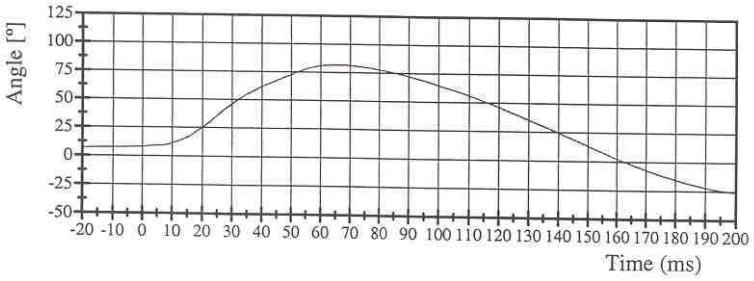


Filter Class: 60

Max: 63.6 ° at 66.2 ms

Min: -21.5 ° at 210.6 ms

Totan



Filter Class: 60

Max: 81.7 ° at 65.6 ms

Min: -27.1 ° at 210.6 ms

12.20.2002 15:05:52 1405

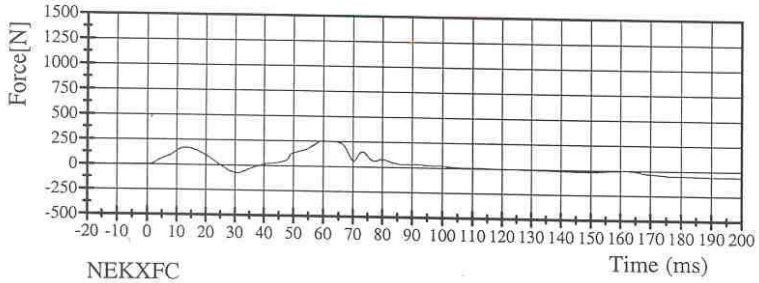
Transportation Research Center Inc.

572R Neck Extension Test

12 Month Old CRABI Serial No. 074 Calibration No. 02 - 1

Test Date 12/20/2002

NEKXF

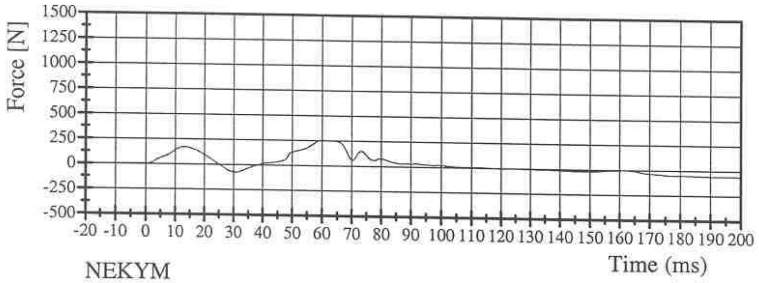


Filter Class: 1000

Max: 255.9 N at 60.2 ms

Min: -77.6 N at 31.1 ms

NEKXFC

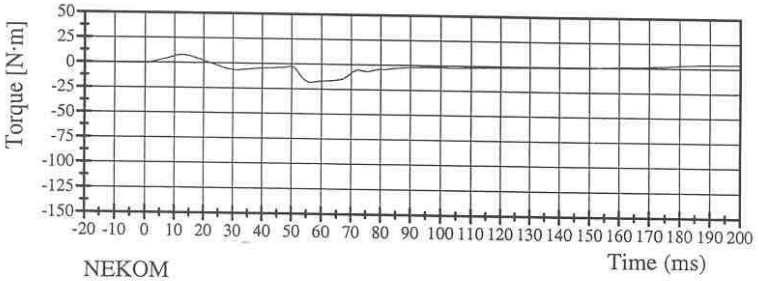


Filter Class: 600

Max: 255.8 N at 60.2 ms

Min: -77.5 N at 31.0 ms

NEKYM

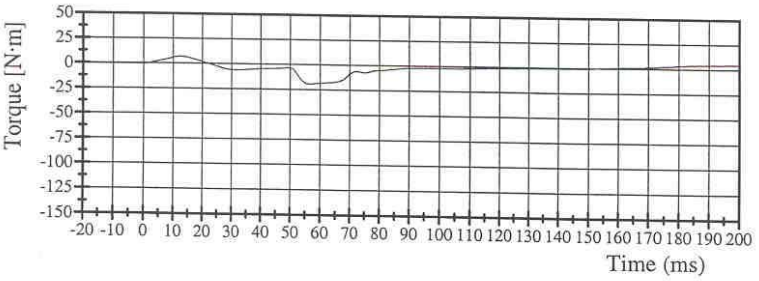


Filter Class: 600

Max: 8.0 N·m at 12.5 ms

Min: -18.2 N·m at 56.6 ms

NEKOM



Filter Class: 600

Max: 7.0 N·m at 12.5 ms

Min: -19.4 N·m at 56.7 ms

12.20.2002 15:05:53 1405

Transportation Research Center Inc.

572R Thorax Test

12 Month Old CRABI Serial No. 074 Calibration No. 02 - 1

Test Date 12/23/2002

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	21.1 °C	Yes
Relative Humidity	10 - 70 %	21 %	Yes
Pendulum Velocity	4.90 - 5.10 m/s	5.04 m/s	Yes
Peak Impact Probe Force	1514 - 1796 N	1672 N	Yes

Comments:

Technician

Approved

12.23.2002 14:25:44 1125

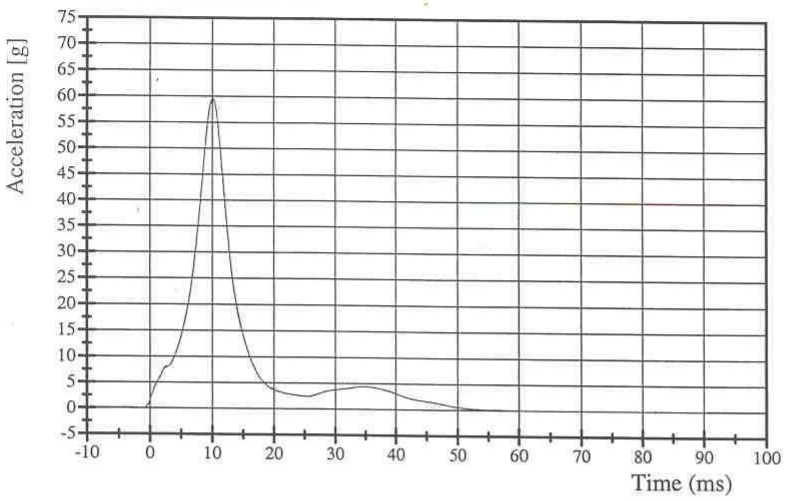
Transportation Research Center Inc.

572R Thorax Test

12 Month Old CRABI Serial No. 074 Calibration No. 02 - 1

Test Date 12/23/2002

Pendulum Deceleration

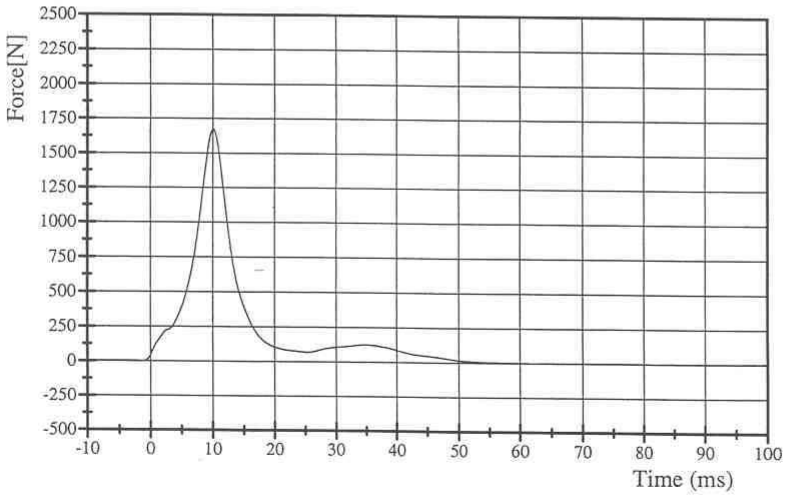


Filter Class: 180

Max: 59.6 g at 10.1 ms

Min: -0.1 g at 540.4 ms

Pendulum Force



Filter Class: 180

Max: 1672.1 N at 10.1 ms

Min: -3.8 N at 540.4 ms

12.23.2002 14:25:45 1125

APPENDIX D

TEST EQUIPMENT LIST AND CALIBRATION INFORMATION

INSTRUMENTS FOR LRP CHILD DUMMY S/N: 074

	SERIAL NO.	MANUFACTURER	CALIBRATION DATE
Head X	I10-N16	Endevco	11/14/02
Head Y	I05-F23	Endevco	11/14/02
Head Z	I05-F22	Endevco	11/14/02
Upper Neck Load Cell	279	Denton	12/16/03
Chest X	I10-N14	Endevco	11/14/02
Chest Y	I10-N22	Endevco	11/14/02
Chest Z	I16-A15	Entran	11/14/02
Pelvis X	I05-F09	Endevco	11/14/02
Pelvis Y	I10-N24	Endevco	11/14/02
Pelvis Z	I10-N12	Endevco	11/13/02

INSTRUMENTS FOR RRP CHILD DUMMY S/N: 42

	SERIAL NO.	MANUFACTURER	CALIBRATION DATE
Head X	H10-F10	Entran	11/13/02
Head Y	H10-F12	Entran	11/13/02
Head Z	AJ4L1	Endevco	11/13/02
Head Z-Rear	ADAT0	Endevco	11/13/02
Upper Neck Load Cell	121	FTSS	10/4/02
Lower Neck Load Cell	120	FTSS	10/4/02
Chest X	J19547	Endevco	11/13/02
Chest Y	CC92H	Endevco	11/13/02
Chest Z	J26976	Endevco	11/13/02
Chest Deflection Gauge	42	Servo	11/15/02
Pelvis X	BE95J	Endevco	11/13/02
Pelvis Y	DE54J	Endevco	11/13/02
Pelvis Z	H12-F30	Entran	11/13/02