REPORT NUMBER: TWG-TRC-18-02

NEW CAR ASSESSMENT PROGRAM (NCAP)
Side Airbag Out-of-Position Test

NISSAN MOTOR CO., LTD.
2018 Nissan Versa Sedan

NHTSA NUMBER: M20185208TWG2
TRC TEST NUMBER: 180717-1

PREPARED BY:
TRANSPORTATION RESEARCH CENTER INC.
10820 State Route 347
P.O. BOX B-67
East Liberty, OH 43319

Test Date: July 17, 2018

FINAL REPORT

Alpha Technology Associate, Inc.
2810 Old Lee Highway, Suite 120
Fairfax, VA 22031

This Final Test Report was prepared for the U.S. Department of Transportation, National Highway Traffic Safety Administration, under Contract No. DTNH22-13-D-00311L, Alpha Technology PO 14GT150. This document is disseminated under the sponsorship of the U.S. Department of Transportation in the interest of information exchange. The United States Government assumes no liability for its contents or use thereof.

Prepared By: ILO Projects Operations Group

Approved By: 

John Shultz
Project Manager

Approval Date: November 6, 2018

FINAL REPORT ACCEPTANCE BY:

Accepted By: _____

Acceptance Date: _____

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16. ABSTRACT

A side air bag out of position test was conducted on the subject 2018 Nissan Versa Sedan in accordance with the specifications of the Office of Crashworthiness Standards SAB OOP NCAP Laboratory Test Procedure for the generation of consumer information on vehicle side air bag protection. The test was conducted at the by Transportation Research Center Inc. in East Liberty, Ohio, on July 17, 2018.

The curtain and torso side air bags were deployed and responses were measured on a 3-Year-Old. One real-time camera and three high speed cameras recorded the event. The ambient temperature at the time of air bag deployment was 21.2°C.

Section 3.3.3.2 – 3-Year-Old – Position 2

Measurement Description	Units	IARV	Result
Head Injury Criteria (HIC15)	N/A	570	44
Nij	N/A	1	1.10
Upper Neck Tension	Newton	1130	772.9
Upper Neck Compression	Newton	1380	-634.1
Maximum Chest Compression	mm	36	-23.2
Maximum Chest Compression rate	m/sec	8.0	-5.1

17. KEY WORDS New Car Assessment Program Side Air Bag Out-of-position (OOP) Technical Working Group (TWG)	18. DISTRIBUTION STATEMENT Copies of this report are available from the following: Alpha Technology Associate, Inc. 2810 Old Lee Hwy, Suite 120 Fairfax, VA 22031 Phone: (703) 876-0010 FAX: (703) 876-0120 Attn: Steven Kim

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SECTION 1 – TEST PURPOSE AND PROCEDURE

This side air bag out-of-position test is part of the MY18 New Car Assessment Program (NCAP), sponsored by the National Highway Traffic Safety Administration (NHTSA), under contract number DTNH22-13-D-00311L. The purpose of this test is to obtain data on the performance of side air bags with an out-of-position occupant in a 2018 Nissan Versa Sedan. The air bag test was conducted in accordance with the Office of Crashworthiness Standard's Laboratory Test Procedure, dated April 2018.

SECTION 2 – SUMMARY OF TEST RESULTS

The effects of both a seat-mounted side air bag and a curtain air bag deployment in a 2018 Nissan Versa Sedan on an out-of-position 3-Year-Old were evaluated. The test was performed by TRC on July 17, 2018. Pre and post-test photographs of the vehicle and ATD can be found in Appendix A.

The vehicle had previously undergone crash testing as part of the NCAP. After conducting the crash test and before conducting the air bag deployment test, the vehicle was inspected for damage. The vehicle was found to be in good condition to undergo the air bag deployment test.

One real-time camera and three high-speed cameras were used to record the air bag deployment event. High speed images were recorded at rates of 1,000 frames per second. Cameras were placed relative to the position 2 and were positioned to capture the deployment event from the side, the front, and the oblique views.

The 3-Year-Old was placed in the right front (passenger) seat situated rearward facing. This placement followed the ATD placement instructions in the NCAP Laboratory Test Procedure as well as the Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags as prepared by the Side Airbag Out-of-Position Injury Technical Working Group (TWG). The specific test section was section 3.3.3.2.

The 3-Year-Old was instrumented with head X, Y, and Z accelerometers, a six-axis upper neck load cell, a six-axis lower neck load cell, a chest deflection potentiometer, and thorax accelerometers. During the air bag deployment, a total of twenty-five channels of data were recorded using an on-board data acquisition system. Appendix B contains the ATD response data traces and Appendix C contains the instrumentation list and calibration information. Appendix D contains the dummy's pre-test qualification performance verification data.

The Nij NCE injury value exceeded during the test. The occupant data is summarized below:

Measurement Description	Units	Passenger ATD 3-Year-Old	
		IARV	Result
Head Injury Criteria (HIC15)	N/A	570	44
Nij	N/A	1	1.10
Upper Neck Tension	N	1130	772.9
Upper Neck Compression	N	1380	-634.1
Thorax Compression	mm	36	-23.2
Thorax Compression rate	m/sec	8.0	-5.1

SECTION 3 DATA SHEET

DATA SHEET NO. 1
TEST SUMMARY

Test Vehicle:	2018 Nissan Versa Sedan	NHTSA No.:	M20185208TWG2
Test Program:	Side Air Bag Out-of-Position Test	Test Date:	7/17/2018

TEST SUMMARY

TEST CONFIGURATION INFORMATION

Seating Position:	P2	Right Front Seating Position
Test Section:	3.3.3.2	Seat-Mounted, Rearward Facing
Airbag 1:	Seat	Seat mounted – outside seam
Airbag 2:	Side Rail	Side curtain airbag
Booster Block:	N/A	N/A
ATD Type/Serial No.:	3-Year-Old	040
Vehicle	Nissan	Versa
Previous Crash Test	MDB	12/7/2017 and M20185208

EQUIPMENT INFORMATION

Number of Data Channels	25
Number of High Speed Video Cameras	3
Number of Real Time Video Cameras	1

VISIBLE DUMMY CONTACT POINTS

Head	None Visible
Upper Torso	None Visible
Lower Torso	None Visible
Knee	None Visible

DATA SHEET NO. 2
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle:	2018 Nissan Versa Sedan	NHTSA No.:	M20185208TWG2
Test Program:	Side Air Bag Out-of-Position Test	Test Date:	7/17/2018

TEST CONFIGURATION INFORMATION

NHTSA No.	M20185208
Model Year	2018
Make	Nissan
Model	Versa S
Body Style	4-Door Sedan
VIN	3N1CN7AP9JL802900
Body Color	Gun Metallic
Odometer Reading (km/mi)	27 mi
Engine Displacement (L)	1.6
Type/No. Cylinders	Straight/4
Engine Placement	Front/Transverse
Transmission Type	Manual
Transmission Speeds	5
Overdrive	Yes
Final Drive	FWD
Roof Rack	No
Sunroof/T-Top	No
Running Boards	No
Tilt Steering Wheel	Yes
Power Seats	No
Anti-Lock Brakes (ABS)	Yes

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

DATA FROM CERTIFICATION LABEL

Manufactured By	NISSAN MOTOR CO., LTD.
Date of Manufacture	08/17
Vehicle Type	Passenger Car

GVWR (kg)	3389
GAWR Front (kg)	1750
GAWR Rear (kg)	1708

VEHICLE SEATING AND CAPACITY WEIGHT INFORMATION

Measured Parameter	Front	Rear	Third	Total	
Designated Seating Capacity DSC)	2	3	N/A	5	
Capacity Weight (VCW) (kg)				385	(A)
DSC x 68.04 (kg)				340.2	(B)
Cargo Weight (RCLW) (kg)				44.8	(A-B)

VEHICLE SEAT TYPE

Seating Location	Type of Seat Pan				Type of Seat Back		
	Bucket	Bench	Split Bench	Contoured	Fixed	Adjustable	
						w/ Lever	w/ Knob
Front Seat	Yes	N/A	N/A		N/A	Yes	N/A
Rear or Second Row Seat	N/A	Yes	N/A	Yes	Yes	N/A	N/A
Third Row Seat	N/A	N/A	N/A	N/A	N/A	N/A	N/A

DATA SHEET NO. 3

SEAT ADJUSTMENT DATA

Test Vehicle: 2018 Nissan Versa Sedan NHTSA No.: M20185208TWG2

Test Program: Side Air Bag Out-of-Position Test Test Date: 7/17/2018

VEHICLE SEAT FORE/AFT POSITION

Seat Location	Total Fore/Aft Travel		Test Position from Forwardmost Position	
	mm	# Detents	mm	# Detents
Front Right	237	25	237	25
Rear Right	Fixed	N/A	Fixed	N/A

Seat Fore/Aft Position Per TWG Guidelines	25th of 25; full rear
Reason for Deviation from TWG Guidelines	None

VEHICLE SEAT BACK ANGLE ADJUSTMENT

Seat Location	Total Seat Back Angle Range		Test Position from Most Upright (Vertical)	
	Degrees	# Detents	Degrees	# Detents
Front Right	57.1	30	3.2	4
Rear Right	Fixed	N/A	23.3	N/A

OEM Back Angle Design Position	4th notch from full forward
Method of Measuring Back Angle Position	Pointer on seat back side
Seat Back Angle Position Per TWG Guidelines	4th notch from full forward
Reason for Deviation from TWG Guidelines	None

VEHICLE SEAT HEIGHT ADJUSTMENT

Seat Location	Total Height Adjustment Range		Test Position from Lowest Position	
	mm	# Detents	mm	# Detents
Front Right	Fixed	N/A	N/A	N/A
Rear Right	Fixed	N/A	N/A	N/A

Seat Height Adjustment Per TWG Guidelines	No Feature
Reason for Deviation from TWG Guidelines	None

DATA SHEET NO. 4
DUMMY SETUP AND POSITIONING DATA

Test Vehicle:	2018 Nissan Versa Sedan	NHTSA No.:	M20185208TWG2
Test Program:	Side Air Bag Out-of-Position Test	Test Date:	7/17/2018

DUMMY INFORMATION

ATD Type	H-III 3 Year Old
Serial Number	040
Qualification Date	7/13/18
Qualification Type	Partial
Clothing	Shirt, pants, shoes
Other ATD Prep	Baby powder, electrical tape

DUMMY POSITIONING INFORMATION

TWG Setup Instructions	Seat positioned to specifications in 3.3.1; ATD positioned to 3.3.3.2.1
Actual Setup	As specified in the 3.3.3.2 Test Procedure; The vehicle seat is in the full rear position with the seat back angle set on the fourth notch, according to the design position called out in Form 1. The dummy's skull cap is powdered and the seam is taped. The dummy is facing rearward, kneeling along the outboard edge of the seat cushion. The dummy's sternum centerline is as close as possible to the seat back side bolster's leading edge. The dummy's head is neutral between the B-pillar and the seat back in order to maximize the contact between the seat and the sternum. The shoulder belt has been taped to the B-pillar. The outboard leg is aligned with the outboard edge of the seat cushion and positioned to align the top rib as close as possible to the top of the torso bag. The inboard leg is parallel to the vehicle's centerline. The dummy's shoulders are as close to perpendicular with the centerline of the vehicle as possible. The arms are placed according to the procedure.

DATA SHEET NO. 5
DUMMY INJURY CRITERIA DATA

Test Vehicle: 2018 Nissan Versa Sedan NHTSA No.: M20185208TWG2
Test Program: Side Air Bag Out-of-Position Test Test Date: 7/17/2018

RECORDED DATA - MINIMUMS AND MAXIMUMS

Channel	Unit	CFC	Maximum	Time (ms)	Minimum	Time (ms)
Head X	G	1000	78.51	15.76	-21.19	20.32
Head Y	G	1000	15.31	21.04	-36.19	16.32
Head Z	G	1000	76.27	15.84	-22.94	17.20
Head Resultant	G	1000	108.36	15.76		
Head Red X	G	1000	77.70	15.76	-21.94	20.24
Head Red Y	G	1000	15.75	21.04	-35.48	16.32
Head Red Z	G	1000	76.47	15.84	-23.09	17.20
Head Red Resultant	G	1000	108.18	15.76		
Upper Neck X	N	1000	78.33	6.56	-597.67	16.08
Upper Neck Y	N	1000	108.92	25.12	-426.76	14.08
Upper Neck Z	N	1000	772.89	13.36	-634.10	16.96
Upper Neck X	Nm	600	19.20	13.44	-7.68	19.44
Upper Neck Y	Nm	600	7.73	74.08	-23.34	17.60
Upper Neck Z	Nm	600	2.05	186.08	-17.54	21.76
Lower Neck X	N	1000	544.69	19.76	-49.94	5.84
Lower Neck Y	N	1000	603.21	12.72	-70.96	74.72
Lower Neck Z	N	1000	830.01	13.20	-623.57	17.20
Lower Neck X	Nm	600	21.46	31.76	-30.36	14.24
Lower Neck Y	Nm	600	32.42	19.28	-5.02	286.48
Lower Neck Z	Nm	600	5.51	75.68	-20.04	22.08
Dummy Chest Deflection X	MM	600	1.64	155.20	-23.20	11.76
Dummy Upper Sternum X	G	1000	216.79	12.24	-366.64	5.92
Dummy Lower Sternum X	G	1000	536.02	11.12	-397.76	5.28

HEAD INJURY SUMMARY

HIC15	T1 (ms)	T2 (ms)	HIC36	T1 (ms)	T2 (ms)
44	15.60	16.64	44	15.60	16.64

DATA SHEET NO. 5
DUMMY INJURY CRITERIA DATA (CONTINUED)

Test Vehicle: 2018 Nissan Versa Sedan NHTSA No.: M20185208TWG2
Test Program: Side Air Bag Out-of-Position Test Test Date: 7/17/2018

NECK INJURY SUMMARY

Injury Criteria	Value	Time (ms)
Upper Neck NTF	0.22	8.16
Upper Neck NTE	0.93	19.68
Upper Neck NCF	0.02	39.52
Upper Neck NCE	1.10	17.60
Peak Tension	772.9	13.36
Peak Compression	-634.1	16.96

CHEST INJURY SUMMARY

Injury Criteria	Value	Time (ms)
Chest Deflection	-23.2	11.76
Deflection Rate[1]	-5.1	8.16

[1] Deflection Rate was assessed by measuring compression from a rotary potentiometer

RESEARCH INJURY SUMMARY

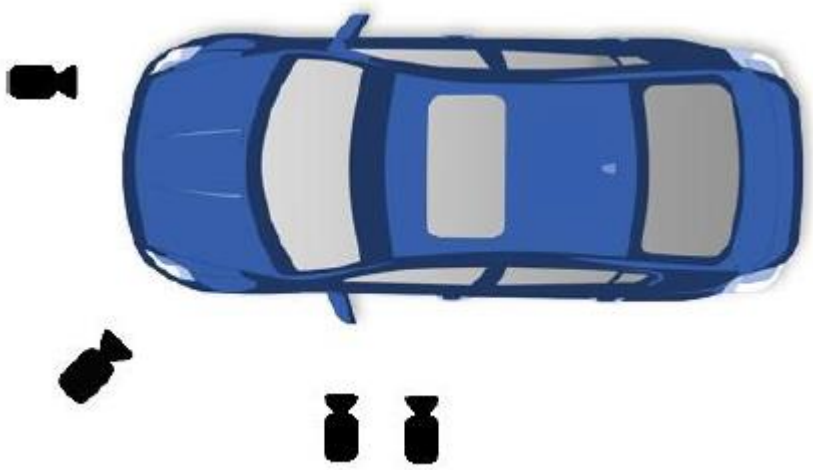
Research Injury Criteria[1]	Value	Time (ms)
Upper Neck Lateral Moment		
Upper Neck Twist Moment		
Lower Neck Flexion Moment		
Lower Neck Extension Moment		
Lower Neck Lateral Moment		
Lower Neck Twist Moment		
Lower Neck Tension		
Lower Neck Compression		
Spine Acceleration		

[1]These injury criteria are only monitored and not considered pass/fail

DATA SHEET NO. 6
CAMERA SETUP AND DESCRIPTION

Test Vehicle:	2018 Nissan Versa Sedan	NHTSA No.:	M20185208TWG2
Test Program:	Side Air Bag Out-of-Position Test	Test Date:	7/17/2018

CAMERA SETUP DIAGRAM FOR SAB OOP TESTS



No.	Camera View	Location (mm)[1]			Lens (mm)	Speed (fps)
		X	Y	Z		
1	Left View	328	-2427	-1078	50	1000
2	Oblique View	2401	-1129	-1512	50	1000
3	Front View	2499	0	-1371	50	1000
4	Real Time (optional)	0	-2474	-1119	Zoom	30

[1] +X forward of vehicle, +Y right of vehicle, +Z into ground

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Figure A-10 Post-Test Dummy Left Side View

Figure A-11 Pre-Test Dummy Left Side Close-up View

Figure A-12 Post-Test Dummy Left Side Close-up View

Figure A-13 Pre-Test Dummy Left ¾ Front View

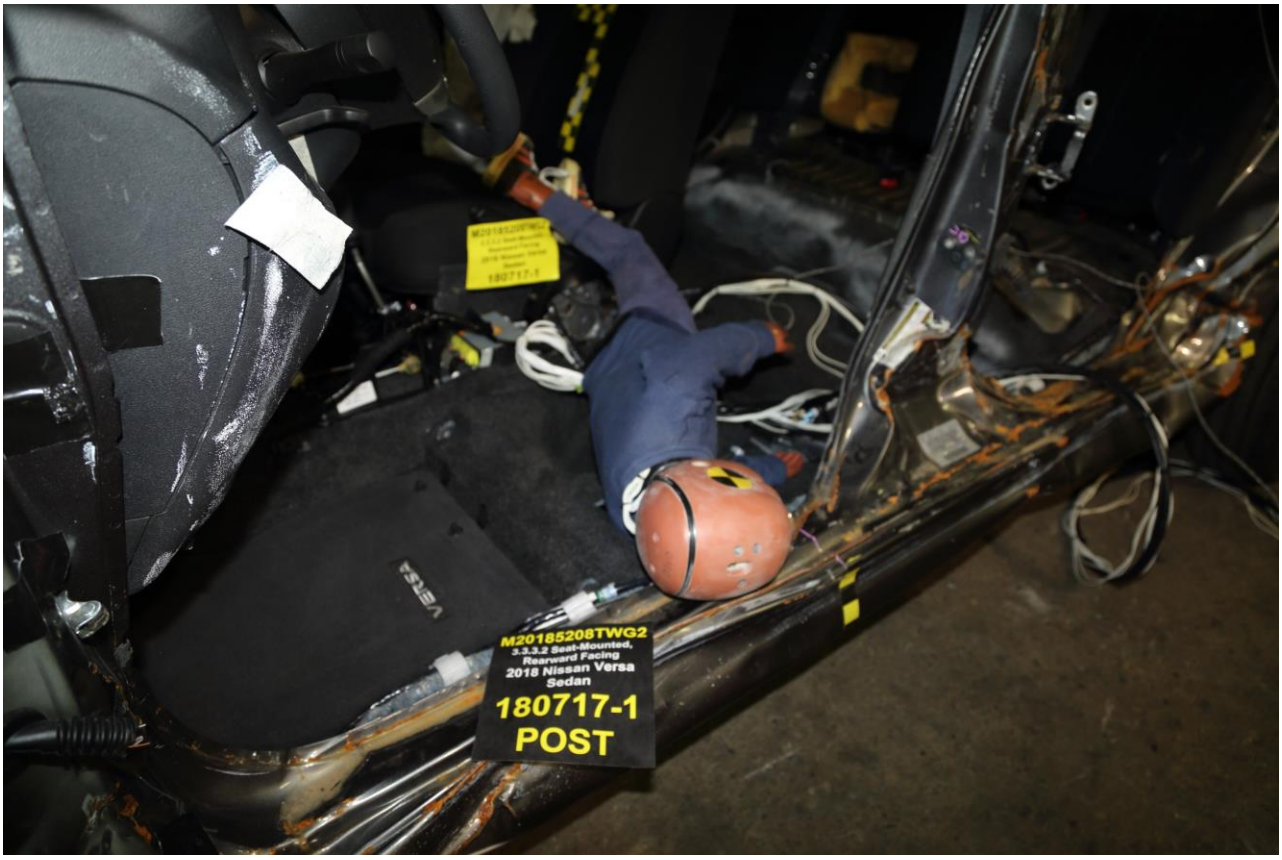


Figure A-14 Post-Test Dummy Left ¾ Front View

Figure A-15 Pre-Test Dummy Left ¾ Front Close-up View

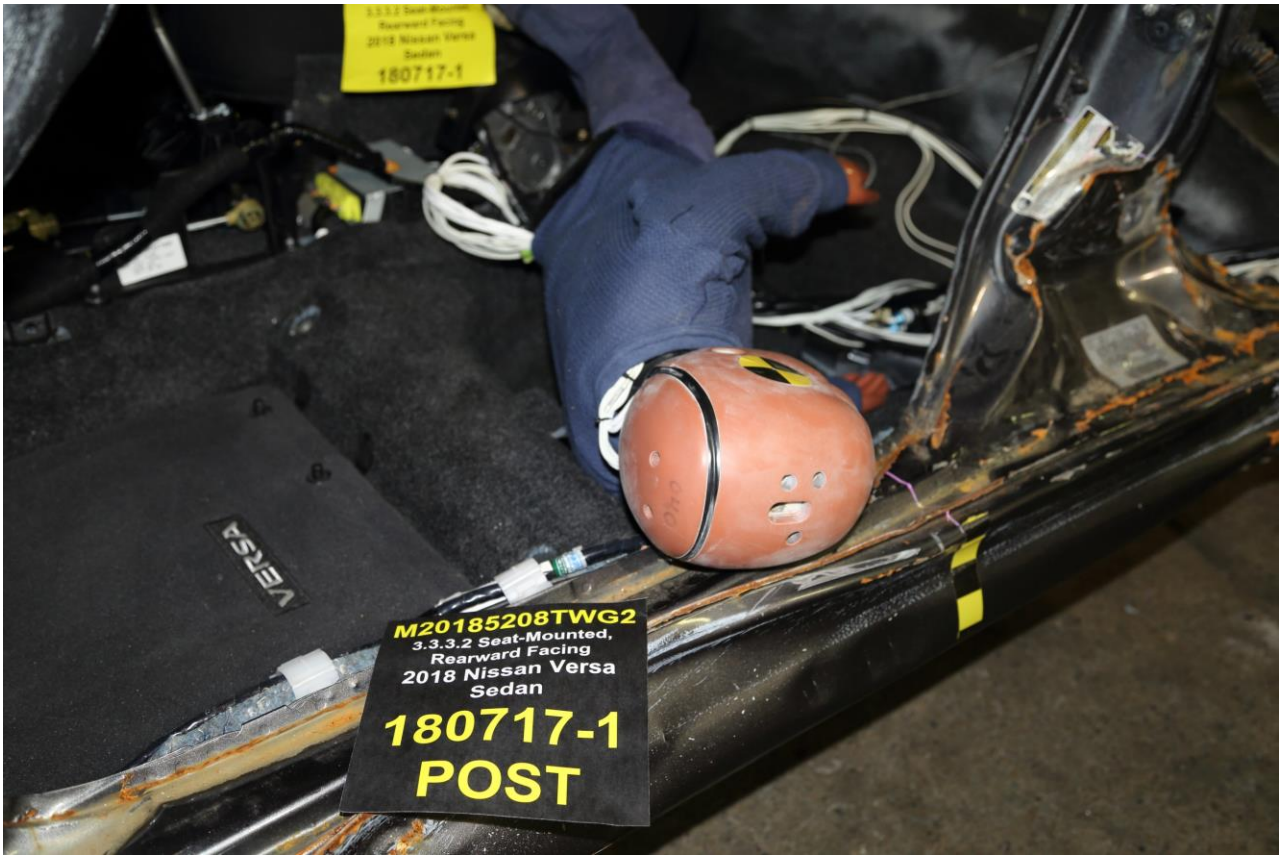


Figure A-16 Post-Test Dummy Left ¾ Front Close-up View

Figure A-17 Pre-Test Dummy Front View

Figure A-18 Post-Test Dummy Front View

Figure A-19 Pre-Test Dummy Front Close-up View

Figure A-20 Post-Test Dummy Front Close-up View

Figure A-21 Pre-Test Dummy Right ¾ Front View

Figure A-22 Post-Test Dummy Right ¾ Front View

Figure A-23 Pre-Test Dummy Right Side Front View

Figure A-24 Post-Test Dummy Right Side Front View

Figure A-25 Post-Test Dummy Right Side Front View

Figure A-26 Post-Test Curtain Air Bag Left Side View

Figure A-27 Post-Test Curtain Air Bag Left ¾ Front View

Figure A-28 Post-Test Curtain Air Bag Front View

Figure A-29 Post-Test Curtain Air Bag Right Side View

APPENDIX B

DUMMY RESPONSE DATA PLOTS

Alpha Technology

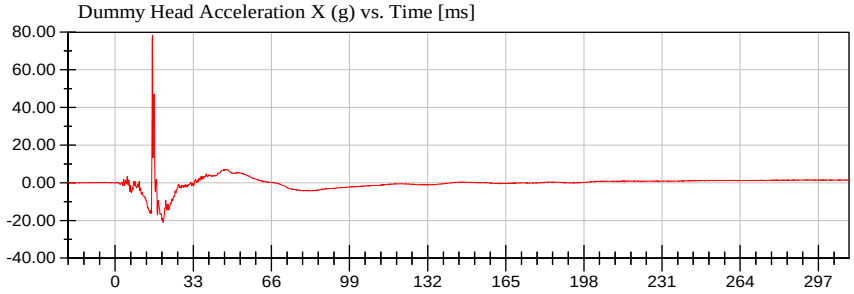
Test Date: 07/17/2018

Position #2 Hybrid III 3 year old Dummy (Part 572 P) (040)

Test Lab: CTF

Test Number: 180717-1 (M20185208TWG2)

Dummy Head Acceleration X (g) vs. Time [ms]



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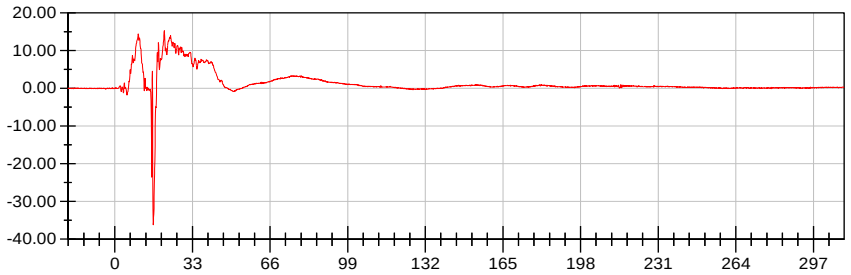
78.51 g at 15.76 ms

<Min>

-21.19 g at 20.32 ms

CFC_1000

Dummy Head Acceleration Y (g) vs. Time [ms]



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15.31 g at 21.04 ms

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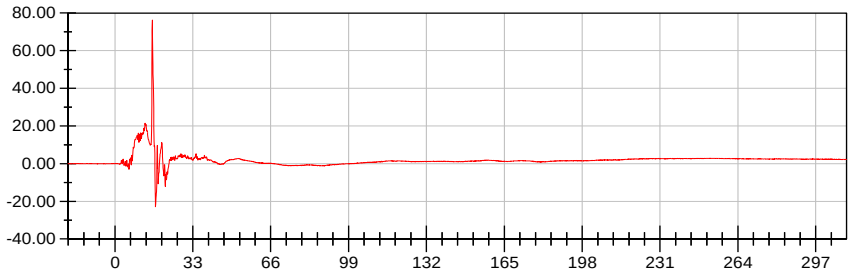
-36.19 g at 16.32 ms

CFC_1000

Dummy Head Acceleration Z (g) vs. Time [ms]



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76.27 g at 15.84 ms

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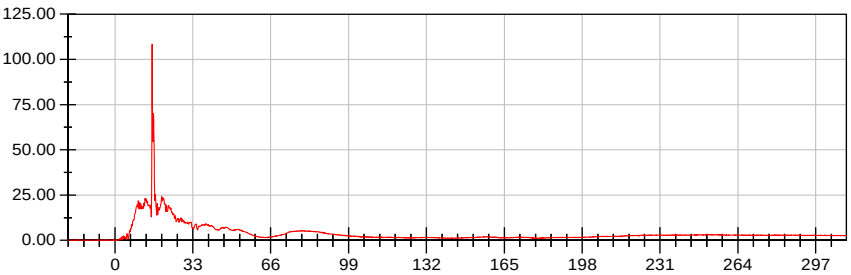
-22.93 g at 17.20 ms

CFC_1000

Dummy Head Acceleration Resultant (g) vs. Time [ms]



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108.36 g at 15.76 ms

<Min>

0.03 g at -19.12 ms

CFC_1000

Alpha Technology

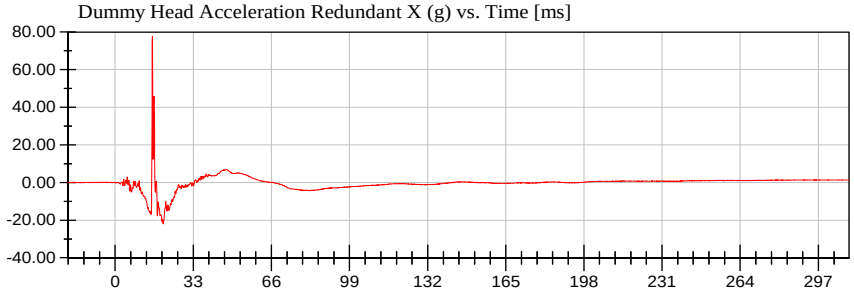
Test Date: 07/17/2018

Position #2 Hybrid III 3 year old Dummy (Part 572 P) (040)

Test Lab: CTF

Test Number: 180717-1 (M20185208TWG2)

Dummy Head Acceleration Redundant X (g) vs. Time [ms]



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77.70 g at 15.76 ms

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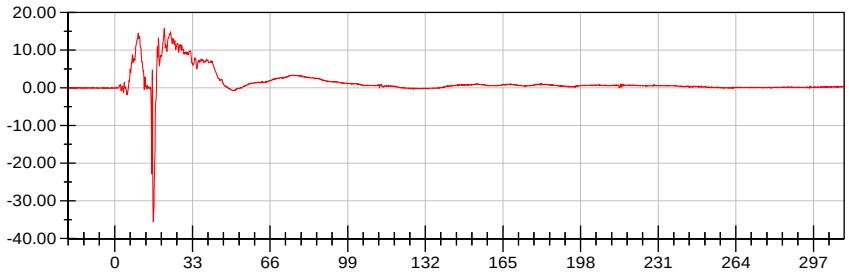
-21.94 g at 20.24 ms

CFC_1000

Dummy Head Acceleration Redundant Y (g) vs. Time [ms]



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15.75 g at 21.04 ms

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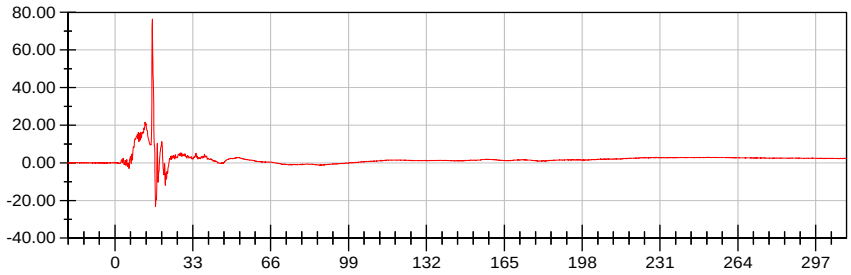
-35.48 g at 16.32 ms

CFC_1000

Dummy Head Acceleration Redundant Z (g) vs. Time [ms]



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76.46 g at 15.84 ms

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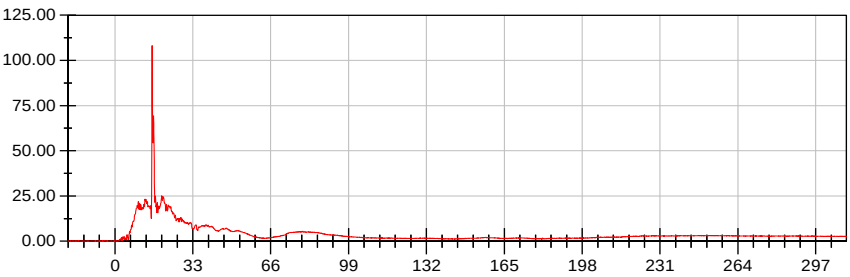
-23.09 g at 17.20 ms

CFC_1000

Dummy Head Acceleration Redundant Resultant (g) vs. Time [ms]



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108.18 g at 15.76 ms

<Min>

0.02 g at -18.56 ms

CFC_1000

Alpha Technology

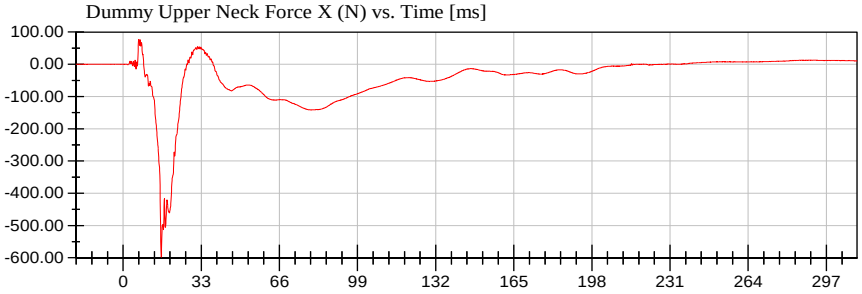
Test Date: 07/17/2018

Position #2 Hybrid III 3 year old Dummy (Part 572 P) (040)

Test Lab: CTF

Test Number: 180717-1 (M20185208TWG2)

Dummy Upper Neck Force X (N) vs. Time [ms]



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78.33 N at 6.56 ms

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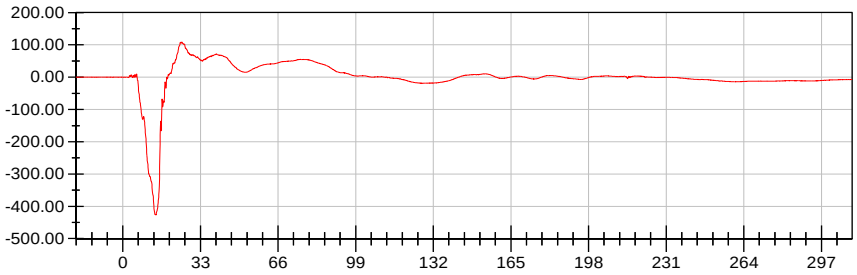
-597.67 N at 16.08 ms

CFC_1000

Dummy Upper Neck Force Y (N) vs. Time [ms]



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108.92 N at 25.12 ms

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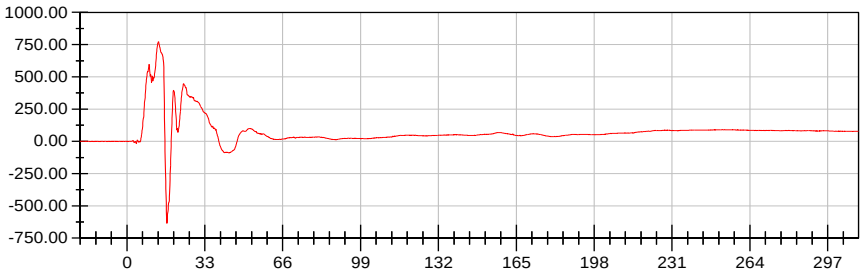
-426.76 N at 14.08 ms

CFC_1000

Dummy Upper Neck Force Z (N) vs. Time [ms]



<Max>

772.89 N at 13.36 ms

<Min>

-634.10 N at 16.96 ms

CFC_1000

Alpha Technology

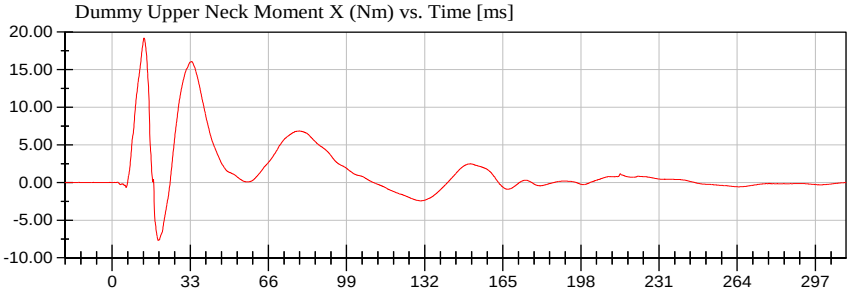
Test Date: 07/17/2018

Position #2 Hybrid III 3 year old Dummy (Part 572 P) (040)

Test Lab: CTF

Test Number: 180717-1 (M20185208TWG2)

Dummy Upper Neck Moment X (Nm) vs. Time [ms]



<Max>

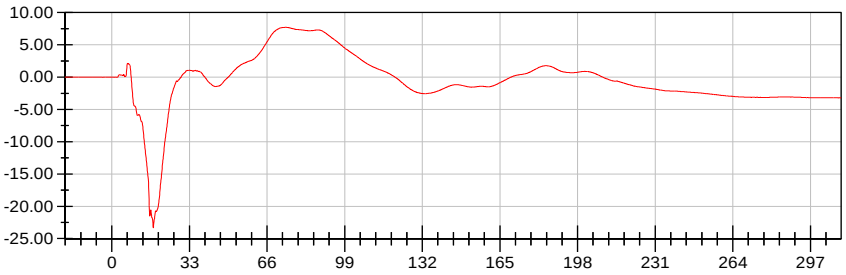
19.20 Nm at 13.44 ms

<Min>

-7.68 Nm at 19.44 ms

CFC_600

Dummy Upper Neck Moment Y (Nm) vs. Time [ms]



<Max>

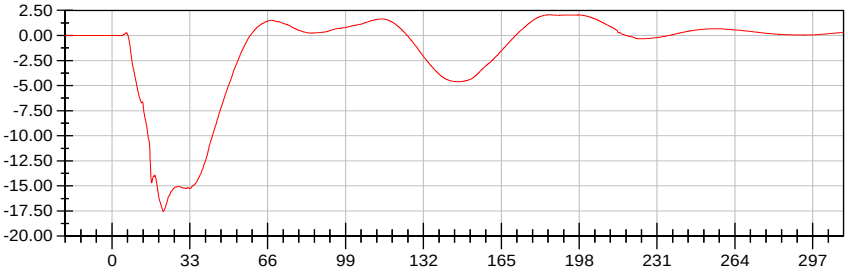
7.73 Nm at 74.08 ms

<Min>

-23.34 Nm at 17.60 ms

CFC_600

Dummy Upper Neck Moment Z (Nm) vs. Time [ms]



<Max>

2.05 Nm at 186.08 ms

<Min>

-17.54 Nm at 21.76 ms

CFC_600

Alpha Technology

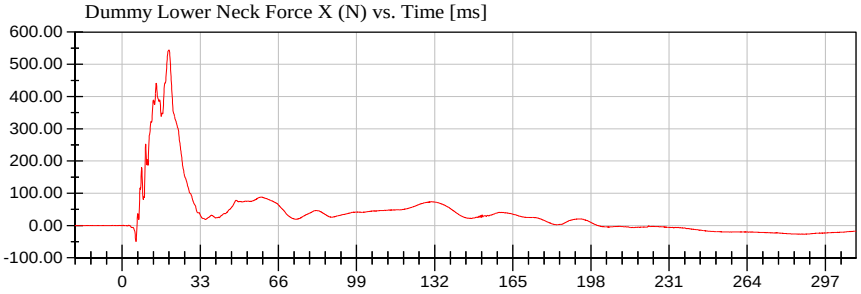
Test Date: 07/17/2018

Position #2 Hybrid III 3 year old Dummy (Part 572 P) (040)

Test Lab: CTF

Test Number: 180717-1 (M20185208TWG2)

Dummy Lower Neck Force X (N) vs. Time [ms]



<Max>

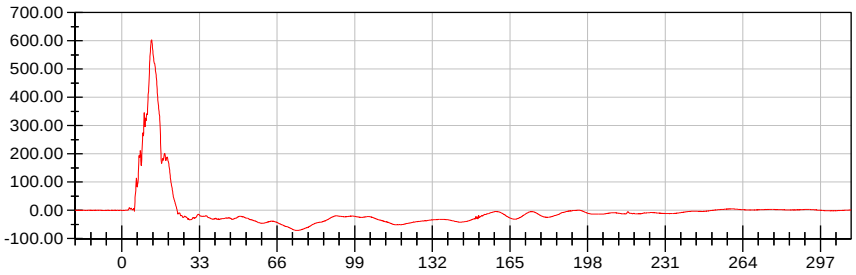
544.69 N at 19.76 ms

<Min>

-49.94 N at 5.84 ms

CFC_1000

Dummy Lower Neck Force Y (N) vs. Time [ms]



<Max>

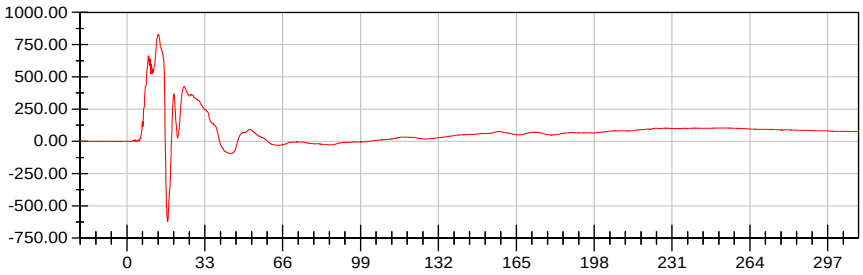
603.21 N at 12.72 ms

<Min>

-70.96 N at 74.72 ms

CFC_1000

Dummy Lower Neck Force Z (N) vs. Time [ms]



<Max>

830.01 N at 13.20 ms

<Min>

-623.57 N at 17.20 ms

CFC_1000

Alpha Technology

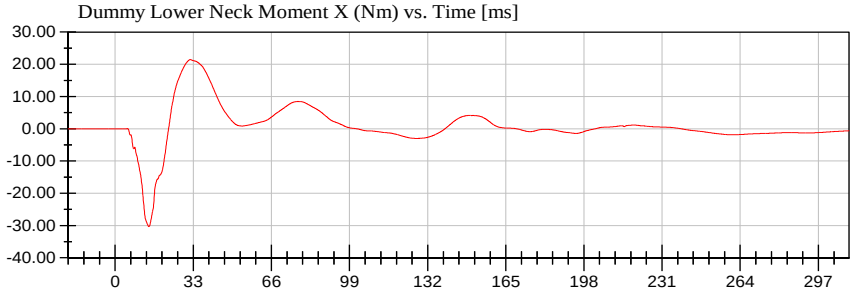
Test Date: 07/17/2018

Position #2 Hybrid III 3 year old Dummy (Part 572 P) (040)

Test Lab: CTF

Test Number: 180717-1 (M20185208TWG2)

Dummy Lower Neck Moment X (Nm) vs. Time [ms]



<Max>

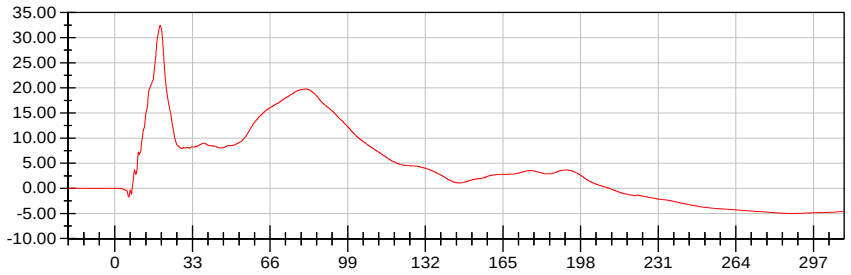
21.46 Nm at 31.76 ms

<Min>

-30.36 Nm at 14.24 ms

CFC_600

Dummy Lower Neck Moment Y (Nm) vs. Time [ms]



<Max>

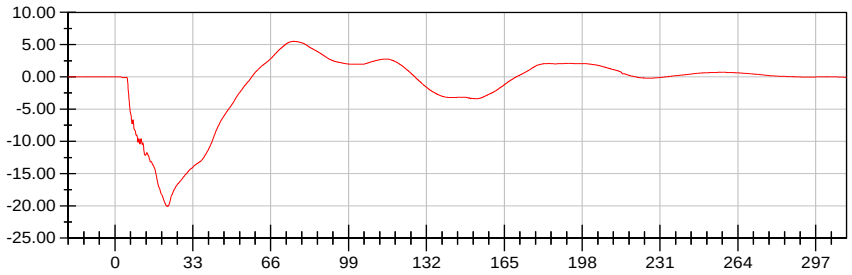
32.42 Nm at 19.28 ms

<Min>

-5.02 Nm at 286.48 ms

CFC_600

Dummy Lower Neck Moment Z (Nm) vs. Time [ms]



<Max>

5.51 Nm at 75.68 ms

<Min>

-20.04 Nm at 22.08 ms

CFC_600

2018 Nissan Versa Sedan TWG OOP Test 3.3.3.2

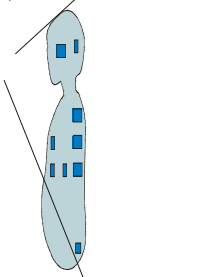
Neck Injury Predictor (NIJ)

Date: 07/17/2018
Time: 10:53

Customer: Alpha Technology
Test Number: M20185208TWG2

TRC Inc. Test Lab: CTF
Test Number: 180717-1

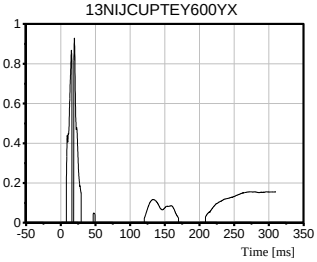
Test Orientation = Side
Fzc(Tension) = 2120
Fzc(Compression) = 2120
Myc(Extension) = 27
Myc(Flexion) = 68



13TMONUP00Y6MOYX

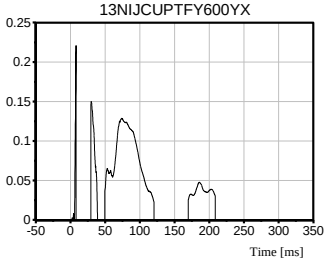
13NECKUP00Y6FOZA

13NIJCUPTEY600YX



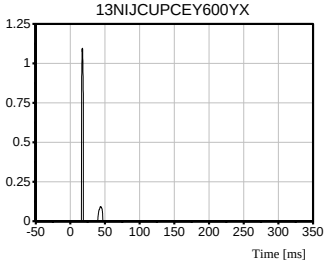
Max [NTE] 0.9294 at 19.68 ms

13NIJCUPTFY600YX



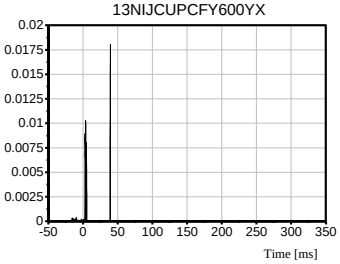
Max [NTF] 0.2204 at 8.16 ms

13NIJCUPCEY600YX



Max [NCE] 1.0973 at 17.60 ms

13NIJCUPCFY600YX



Max [NCF] 0.0180 at 39.52 ms

Dummy:HIII 3 Year Old
Seating Position:
Right Front Passenger

NIJ Source Code: (Fz/Fzc)+(My/Myc)

2018 Nissan Versa Sedan TWG OOP Test 3.3.3.2

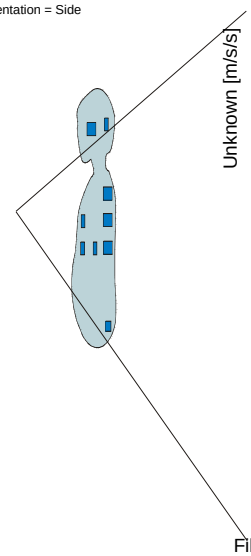
Chest Compression Speed

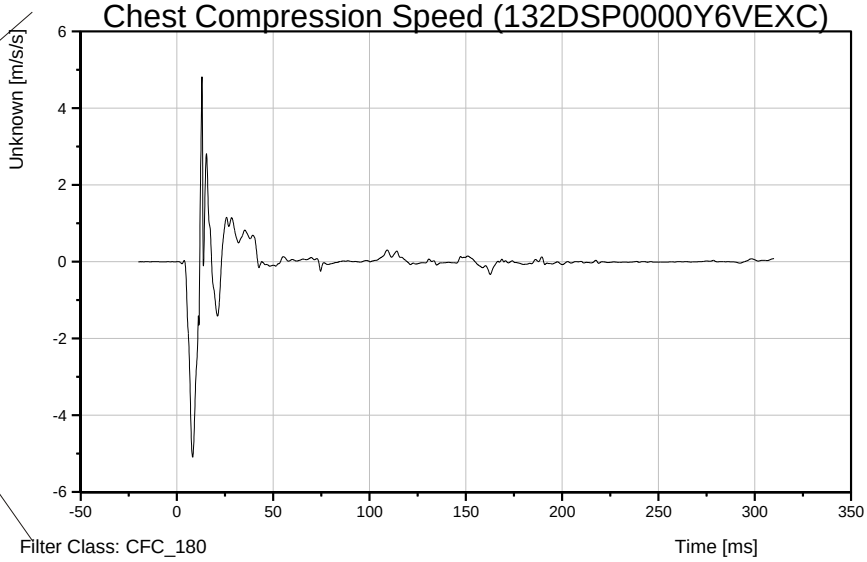
Date: 07/17/2018
Time: 10:53

Customer: Alpha Technology
Test Number: M20185208TWG2

TRC Inc. Test Lab: CTF
Test Number: 180717-1

Test Orientation = Side





Dummy:HIII 3 Year Old
Seating Position:
Right Front Passenger

[Max.] 4.82 m/s/s at 12.96 ms
[Min.] -5.09 m/s/s at 8.16 ms

Chest Compression Speed Source Code : Derivation of X-Axis Chest Displacement

Alpha Technology

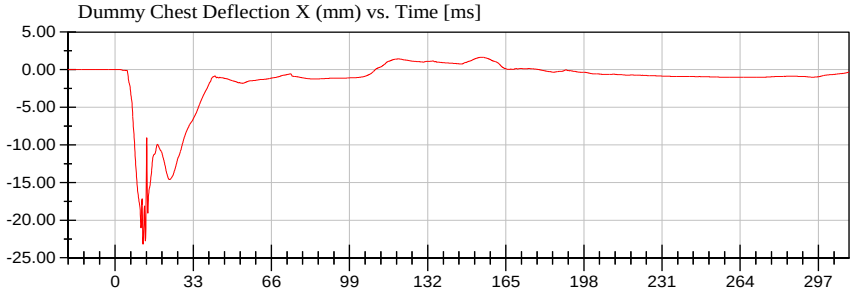
Test Date: 07/17/2018

Position #2 Hybrid III 3 year old Dummy (Part 572 P) (040)

Test Lab: CTF

Test Number: 180717-1 (M20185208TWG2)

Dummy Chest Deflection X (mm) vs. Time [ms]



<Max>

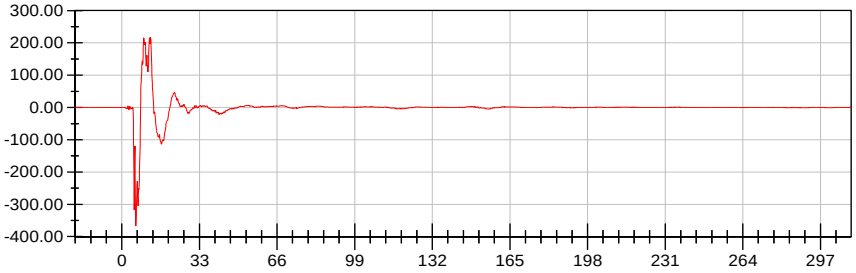
1.64 mm at 155.20 ms

<Min>

-23.20 mm at 11.76 ms

CFC_600

Dummy Upper Sternum Acceleration X (g) vs. Time [ms]



<Max>

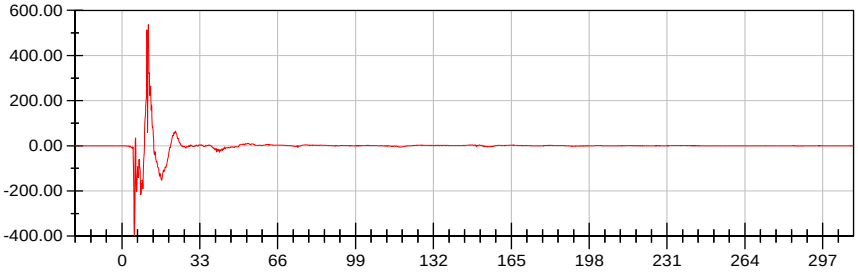
216.79 g at 12.24 ms

<Min>

-366.64 g at 5.92 ms

CFC_1000

Dummy Lower Sternum Acceleration X (g) vs. Time [ms]



<Max>

536.02 g at 11.12 ms

<Min>

-397.76 g at 5.28 ms

CFC_1000

Alpha Technology

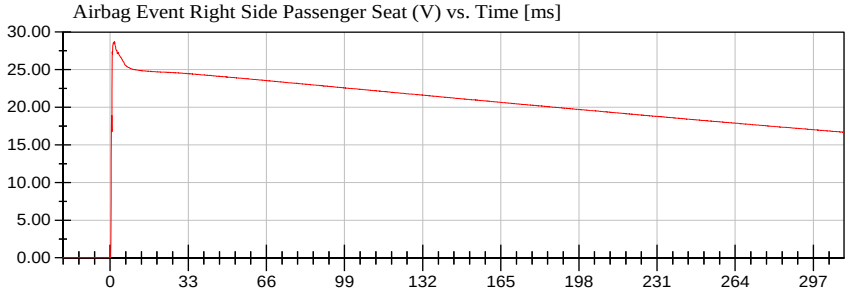
Test Date: 07/17/2018

Position #2 Hybrid III 3 year old Dummy (Part 572 P) (040)

Test Lab: CTF

Test Number: 180717-1 (M20185208TWG2)

Airbag Event Right Side Passenger Seat (V) vs. Time [ms]



<Max>

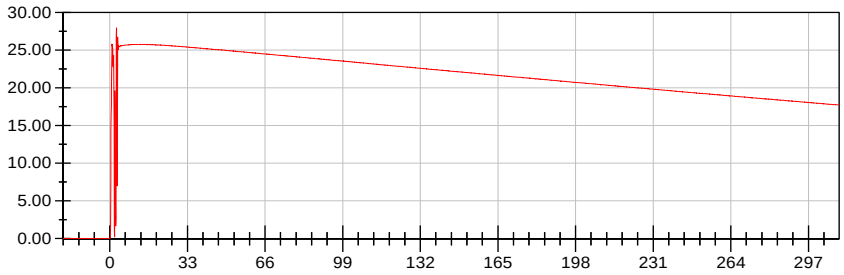
28.74 V at 1.76 ms

<Min>

0.00 V at -20.00 ms

Unfiltered

Airbag Event Right Side Passenger Curtain (V) vs. Time [ms]



<Max>

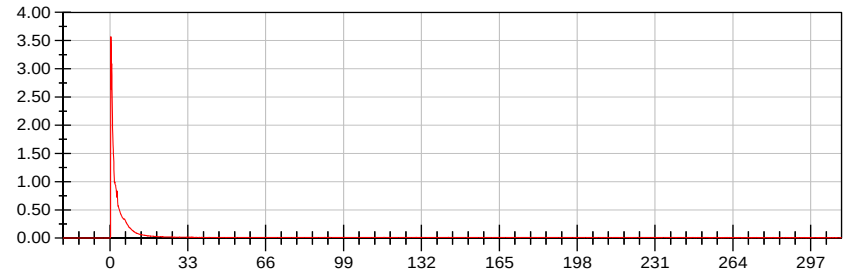
27.97 V at 2.88 ms

<Min>

0.00 V at -20.00 ms

Unfiltered

Airbag Event Right Side Passenger Seat (A) vs. Time [ms]



<Max>

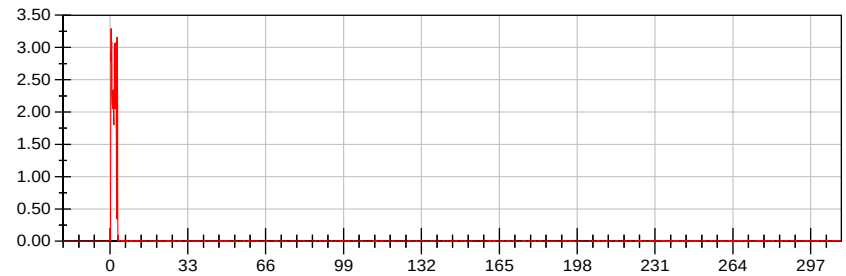
3.57 A at 0.40 ms

<Min>

0.00 A at -20.00 ms

Unfiltered

Airbag Event Right Side Passenger Curtain (A) vs. Time [ms]



<Max>

3.29 A at 0.48 ms

<Min>

0.00 A at -20.00 ms

Unfiltered

APPENDIX C

DUMMY QUALIFICATION DATA

Pre-Test Calibration Sheets
Passenger S/N 040

Transportation Research Center Inc.

Front Head Drop
HIII 3YO Serial No. 040 Certification No. 8-1
Test Date: 7/12/2018

Test Parameter	Specification	Test Results	Pass
Temperature	18.9 - 25.6 °C	20.8 °C	Yes
Relative Humidity	10 - 70 %	50 %	Yes
Peak Head Resultant Acceleration	250 - 280 g	258.3 g	Yes
Peak Head Lateral Acceleration	(-15) - 15 g	-8.5 g	Yes
Is Acceleration Curve Unimodal?	Yes	Yes	Yes

Test meets specifications.

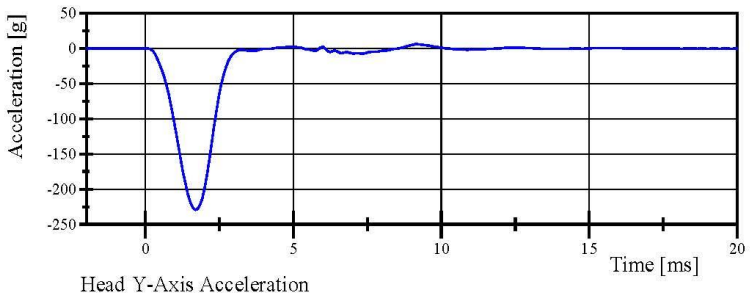
Condition: Used

Comments:
Head Skin S/N: N/A

Transportation Research Center Inc.

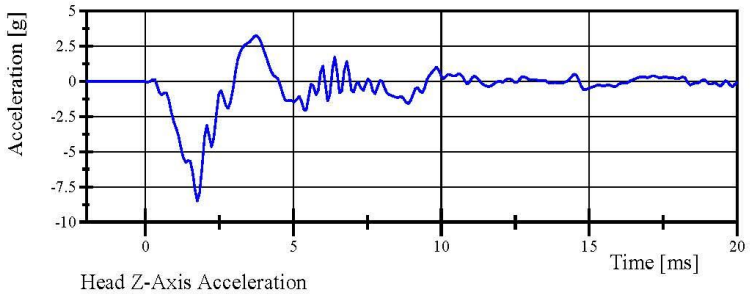
Front Head Drop
HIII 3YO Serial No. 040 Certification No. 8-1
Test Date: 7/12/2018

Head X-Axis Acceleration



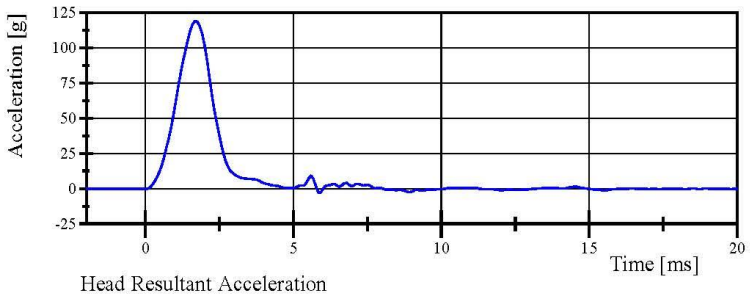
Filter Class: CFC_1000
Max: 5.9 g at 9.1 ms
Min: -229.1 g at 1.7 ms

Head Y-Axis Acceleration



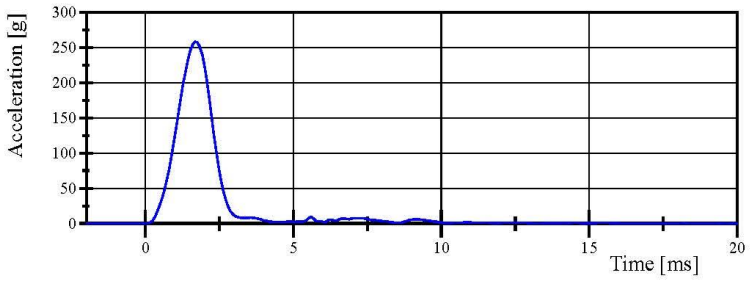
Filter Class: CFC_1000
Max: 3.3 g at 3.8 ms
Min: -8.5 g at 1.8 ms

Head Z-Axis Acceleration



Filter Class: CFC_1000
Max: 119.0 g at 1.7 ms
Min: -2.8 g at 5.9 ms

Head Resultant Acceleration



Filter Class: CFC_1000
Max: 258.3 g at 1.7 ms
Min: 0.0 g at -2.0 ms

Specification Source: CFR49 Part 572 Subpart P
with Polarity in accordance with J211

07.12.2018 08:24:41 581

Transportation Research Center Inc.

Neck Flexion
HIII 3YO Serial No. 040 Certification No. 8-2
Test Date: 7/12/2018

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	21.0 °C	Yes
Relative Humidity	10 - 70 %	49 %	Yes
Pendulum Impact Velocity	5.40 - 5.60 m/s	5.446 m/s	Yes
Pendulum Integrated Velocity Change at 10 ms	(-2.0) - (-2.7) m/s	-2.44 m/s	Yes
Pendulum Integrated Velocity Change at 15 ms	(-3.0) - (-4.0) m/s	-3.64 m/s	Yes
Pendulum Integrated Velocity Change at 20 ms	(-4.0) - (-5.1) m/s	-4.91 m/s	Yes
Total Headform D-Plane Rotation	(-70) - (-82) °	-77.4 °	Yes
Peak Neck Occipital Condyles Moment	42 - 53 Nm	50.4 Nm	Yes
Neck Occipital Condyles Moment Decay to 10 Nm	60 - 80 ms	66.6 ms	Yes

Test meets specifications.

Condition: Used
Comments:
Neck S/N: DG6492

Specification Source: CFR49 Part 572 Subpart P with Polarity in accordance with J211

07.12.2018 09:15:43 733

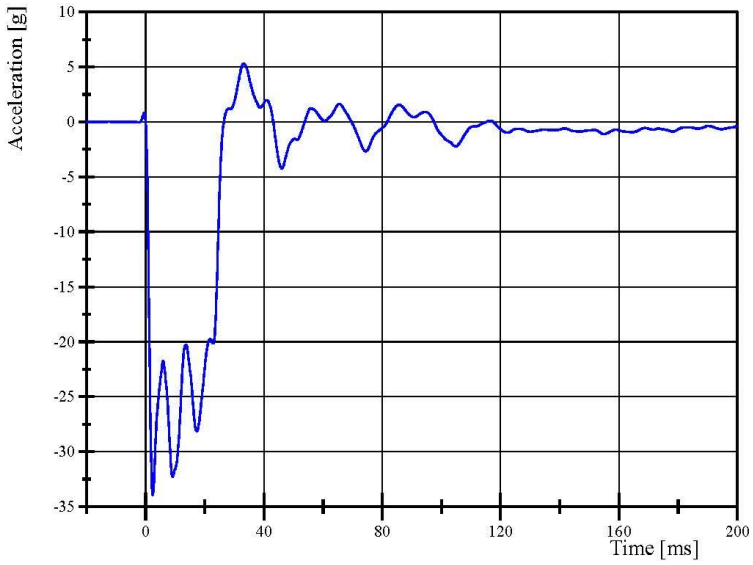
Transportation Research Center Inc.

Neck Flexion

HIII 3YO Serial No. 040 Certification No. 8-2

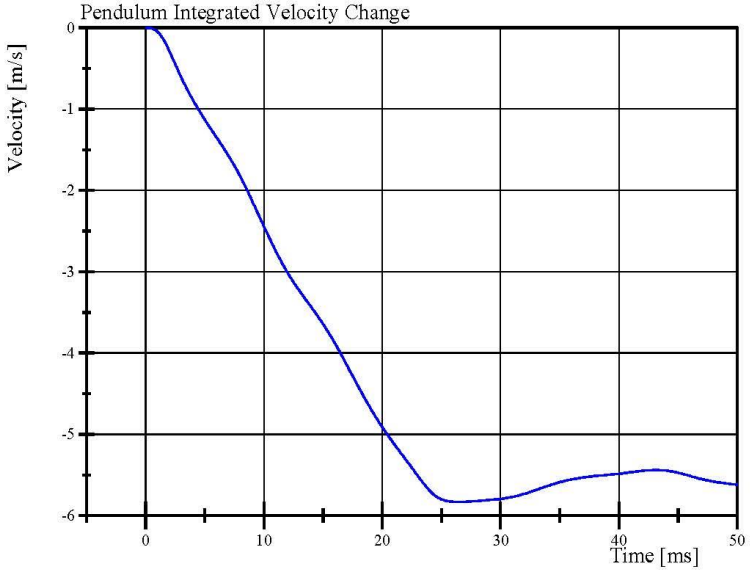
Test Date: 7/12/2018

Pendulum Acceleration



Filter Class: CFC_180
Max: 5.3 g at 33.2 ms
Min: -33.9 g at 2.4 ms

Pendulum Integrated Velocity Change



Filter Class: CFC_180
Max: 0.0 m/s at 0.0 ms
Min: -5.8 m/s at 26.4 ms

Specification Source: CFR49 Part 572 Subpart P
with Polarity in accordance with J211

07.12.2018 09:16:22 733

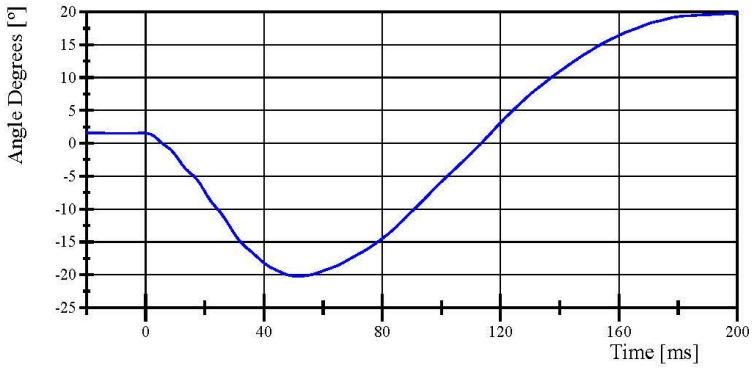
Transportation Research Center Inc.

Neck Flexion

HIII 3YO Serial No. 040 Certification No. 8-2

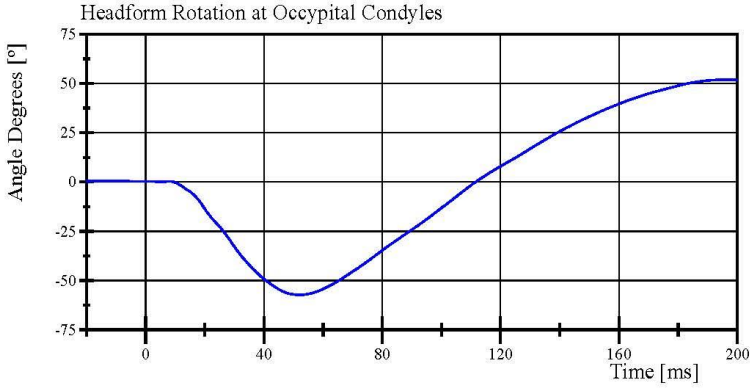
Test Date: 7/12/2018

Pot Rotation at the Base of Neck



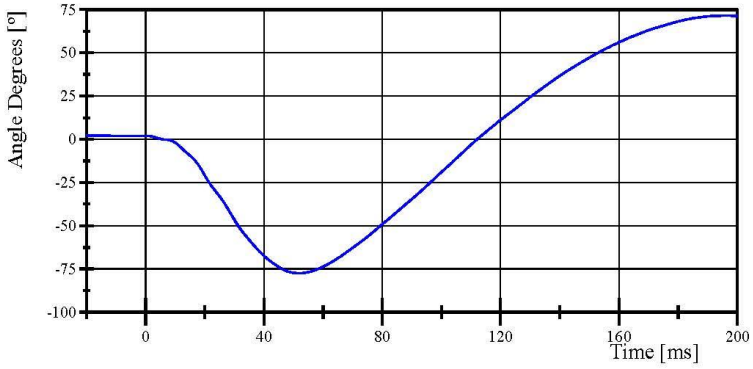
Filter Class: CFC_60
Max: 19.7 ° at 196.8 ms
Min: -20.2 ° at 51.3 ms

Headform Rotation at Occypital Condyles



Filter Class: CFC_60
Max: 51.9 ° at 195.9 ms
Min: -57.2 ° at 52.0 ms

Total Headform D-Plane Rotation



Filter Class: CFC_60
Max: 71.6 ° at 196.1 ms
Min: -77.4 ° at 51.9 ms

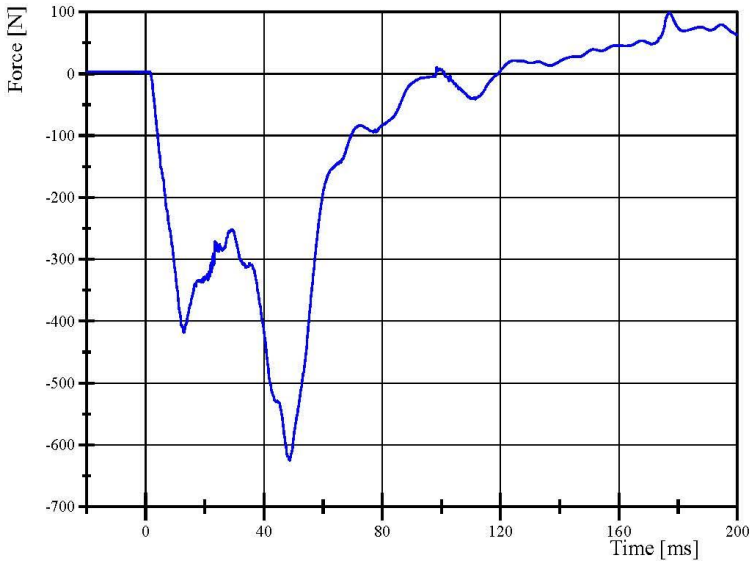
Specification Source: CFR49 Part 572 Subpart P
with Polarity in accordance with J211

07.12.2018 09:16:22 733

Transportation Research Center Inc.

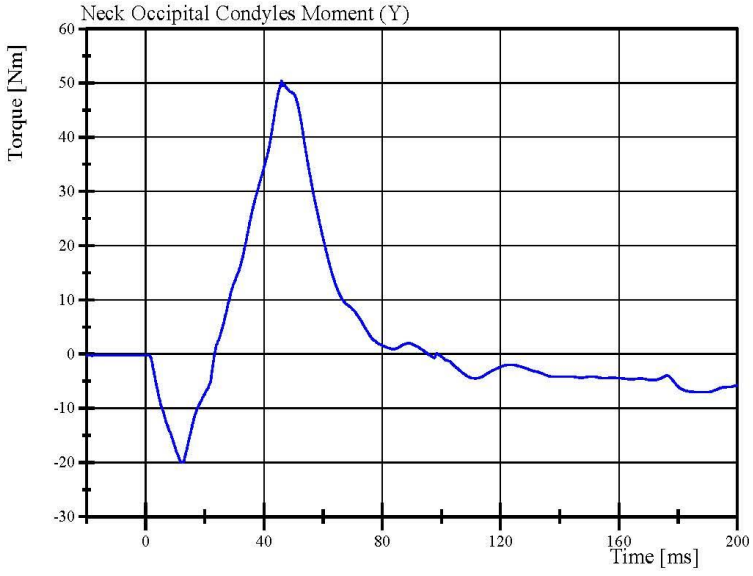
Neck Flexion
HIII 3YO Serial No. 040 Certification No. 8-2
Test Date: 7/12/2018

Neck Force (X)



Filter Class: CFC_1000
Max: 98.3 N at 177.0 ms
Min: -625.1 N at 48.7 ms

Neck Occipital Condyles Moment (Y)



Filter Class: CFC_600
Max: 50.4 Nm at 46.0 ms
Min: -20.0 Nm at 12.2 ms

Specification Source: CFR49 Part 572 Subpart P
with Polarity in accordance with J211

07.12.2018 09:16:23 733

Transportation Research Center Inc.

Neck Extension
HIII 3YO Serial No. 040 Certification No. 8-1
Test Date: 7/12/2018

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	21.1 °C	Yes
Relative Humidity	10 - 70 %	49 %	Yes
Pendulum Impact Velocity	(-3.55) - (-3.75) m/s	-3.556 m/s	Yes
Pendulum Integrated Velocity Change at 6 ms	1.0 - 1.4 m/s	1.29 m/s	Yes
Pendulum Integrated Velocity Change at 10 ms	1.9 - 2.5 m/s	2.34 m/s	Yes
Pendulum Integrated Velocity Change at 14 ms	2.8 - 3.5 m/s	3.27 m/s	Yes
Total Headform D-Plane Rotation	83 - 93 °	85.8 °	Yes
Peak Neck Occipital Condyles Moment	(-43.7) - (-53.3) Nm	-47.49 Nm	Yes
Neck Occipital Condyles Moment Decay to 10 Nm	60 - 80 ms	71.8 ms	Yes

Test meets specifications.

Condition: Used

Comments:
Neck S/N: DG6492

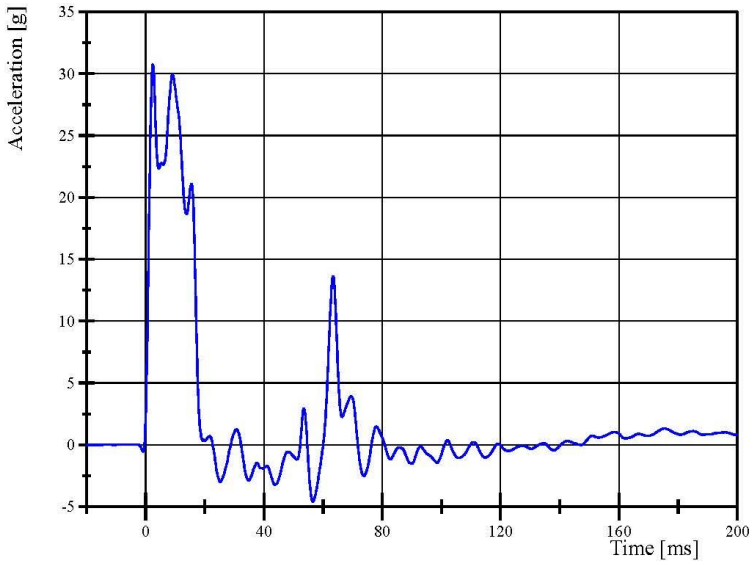
Specification Source: CFR49 Part 572 Subpart P with Polarity in accordance with J211

07.12.2018 10:03:40 1133

Transportation Research Center Inc.

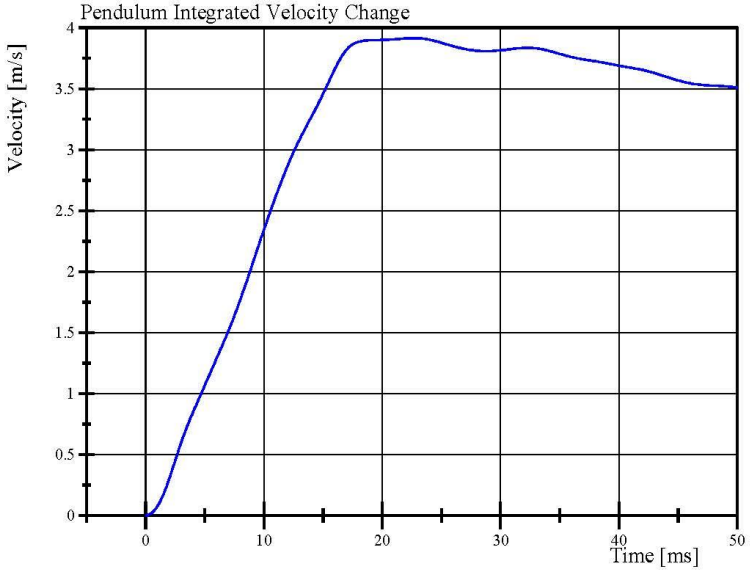
Neck Extension
HIII 3YO Serial No. 040 Certification No. 8-1
Test Date: 7/12/2018

Pendulum Acceleration



Filter Class: CFC_180
Max: 30.8 g at 2.5 ms
Min: -4.6 g at 56.6 ms

Pendulum Integrated Velocity Change



Filter Class: CFC_180
Max: 3.9 m/s at 22.6 ms
Min: 0.0 m/s at 0.0 ms

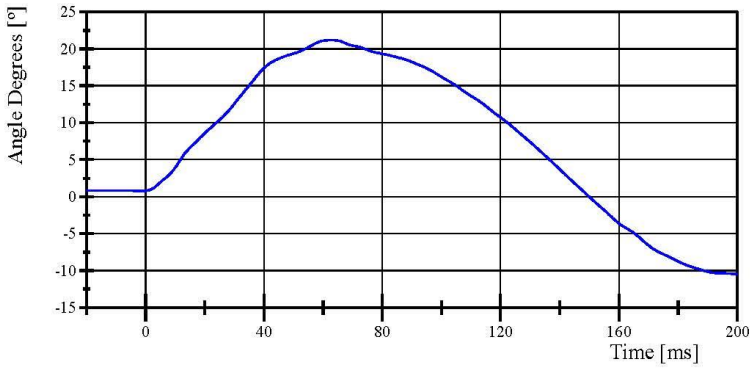
Specification Source: CFR49 Part 572 Subpart P
with Polarity in accordance with J211

07.12.2018 10:08:31 1133

Transportation Research Center Inc.

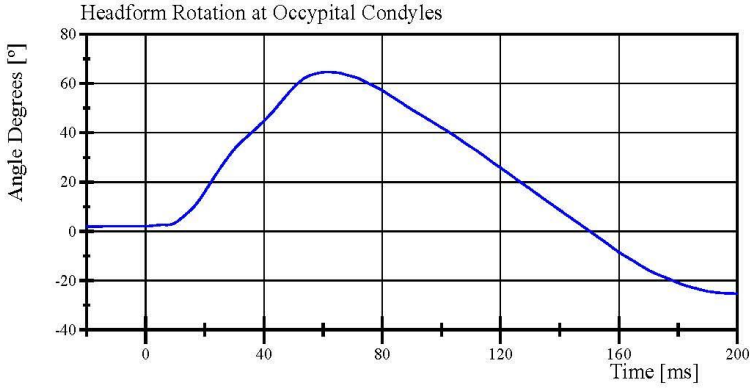
Neck Extension
HIII 3YO Serial No. 040 Certification No. 8-1
Test Date: 7/12/2018

Pot Rotation at the Base of Neck



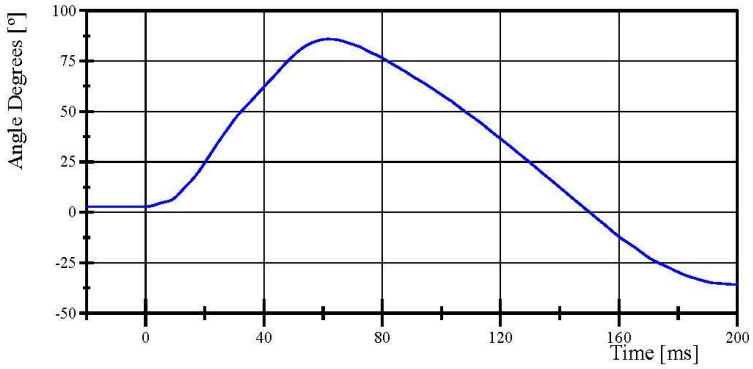
Filter Class: CFC_60
Max: 21.2 ° at 63.0 ms
Min: -10.5 ° at 200.0 ms

Headform Rotation at Occypital Condyles



Filter Class: CFC_60
Max: 64.6 ° at 61.4 ms
Min: -25.4 ° at 200.0 ms

Total Headform D-Plane Rotation



Filter Class: CFC_60
Max: 85.8 ° at 61.8 ms
Min: -35.8 ° at 200.0 ms

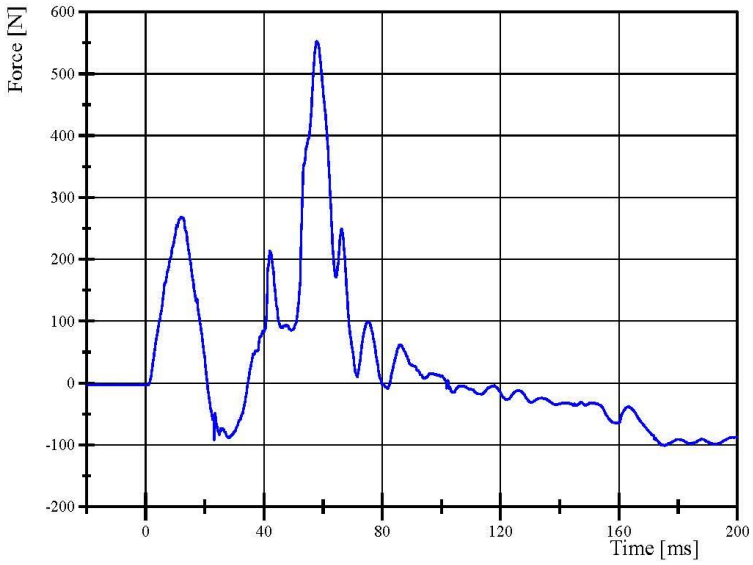
Specification Source: CFR49 Part 572 Subpart P
with Polarity in accordance with J211

07.12.2018 10:08:32 1133

Transportation Research Center Inc.

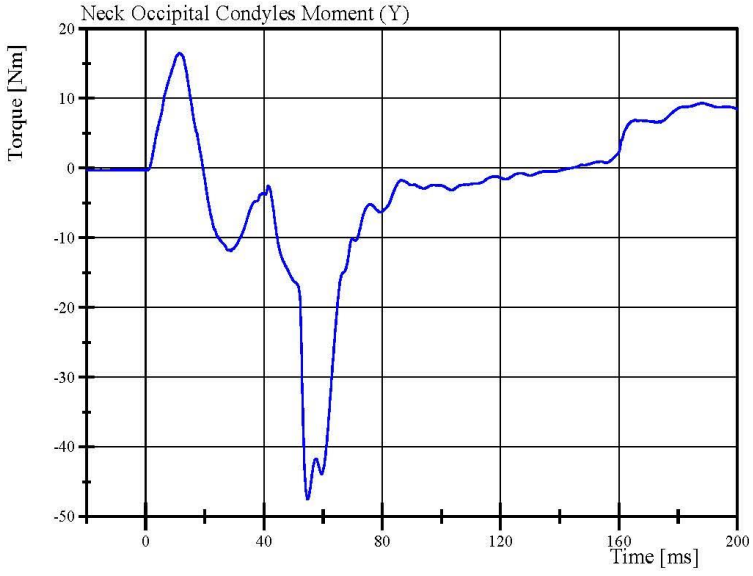
Neck Extension
HIII 3YO Serial No. 040 Certification No. 8-1
Test Date: 7/12/2018

Neck Force (X)



Filter Class: CFC_1000
Max: 552.4 N at 57.8 ms
Min: -101.0 N at 175.4 ms

Neck Occipital Condyles Moment (Y)



Filter Class: CFC_600
Max: 16.5 Nm at 11.4 ms
Min: -47.5 Nm at 54.7 ms

Specification Source: CFR49 Part 572 Subpart P
with Polarity in accordance with J211

07.12.2018 10:08:32 1133

Transportation Research Center Inc.

Front Thorax
HIII 3YO Serial No. 040 Certification No. 8-1
Test Date: 7/12/2018

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	21.3 °C	Yes
Relative Humidity	10 - 70 %	49 %	Yes
Probe Velocity	5.9 - 6.1 m/s	5.97 m/s	Yes
Probe Force Peak Between 32.0 mm and 38.0 mm Chest Deflection	(-680) - (-810) N	-738.0 N	Yes
Probe Force Peak Between 12.5 mm and 32.0 mm Chest Deflection	>= (-910) N	-674.2 N	Yes
Maximum Chest Compression	(-32) - (-38) mm	-37.2 mm	Yes
Internal Hysteresis	65 - 85 %	67.4 %	Yes

Test meets specifications.

Condition: Used

Comments:
Torso Flesh S/N: 16533
Rib Set S/N: 16030071

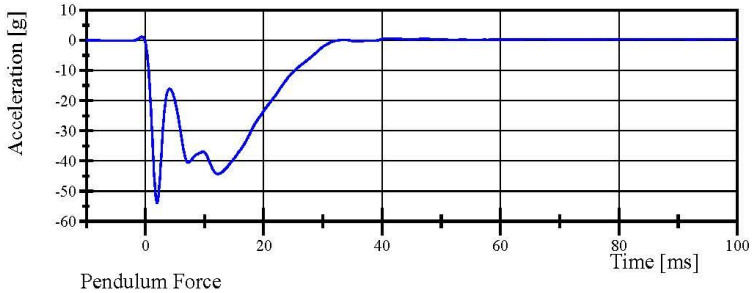
Specification Source: CFR49 Part 572 Subpart P
with Polarity in accordance with J211

07.12.2018 13:34:19 413

Transportation Research Center Inc.

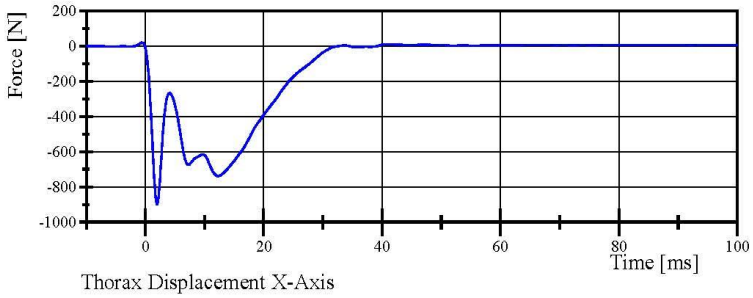
Front Thorax
HIII 3YO Serial No. 040 Certification No. 8-1
Test Date: 7/12/2018

Pendulum Acceleration



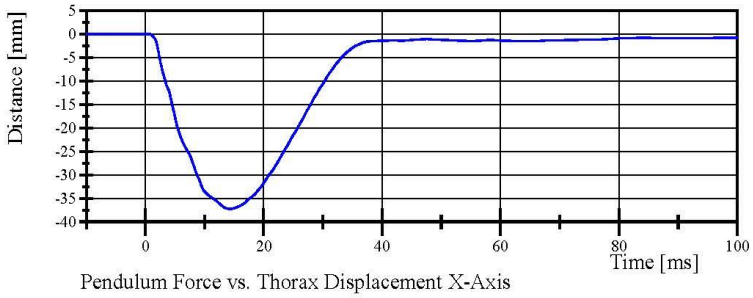
Filter Class: CFC_180
Max: 1.2 g at -0.6 ms
Min: -53.9 g at 2.0 ms

Pendulum Force



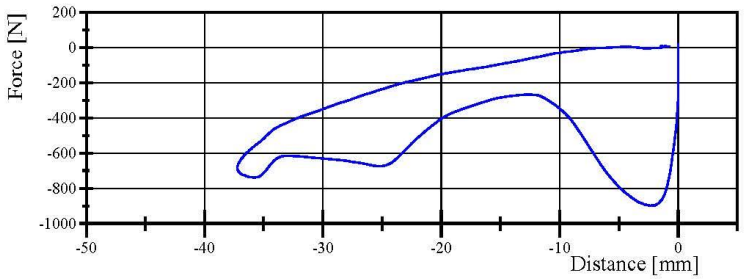
Filter Class: CFC_180
Max: 20.2 N at -0.6 ms
Min: -898.1 N at 2.0 ms

Thorax Displacement X-Axis



Filter Class: CFC_600
Max: 0.0 mm at 0.6 ms
Min: -37.2 mm at 14.2 ms

Pendulum Force vs. Thorax Displacement X-Axis



Filter Class: CFC_180
Max: 20.2 N at -0.0 mm
Min: -898.1 N at -2.4 mm

Specification Source: CFR49 Part 572 Subpart P
with Polarity in accordance with J211

07.12.2018 13:37:03 413

Post-Test Calibration Sheets
Passenger S/N 040

Transportation Research Center Inc.

Neck Flexion
HIII 3YO Serial No. 040 Certification No. 8-3
Test Date: 7/17/2018

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	21.1 °C	Yes
Relative Humidity	10 - 70 %	49 %	Yes
Pendulum Impact Velocity	5.40 - 5.60 m/s	5.443 m/s	Yes
Pendulum Integrated Velocity Change at 10 ms	(-2.0) - (-2.7) m/s	-2.15 m/s	Yes
Pendulum Integrated Velocity Change at 15 ms	(-3.0) - (-4.0) m/s	-3.26 m/s	Yes
Pendulum Integrated Velocity Change at 20 ms	(-4.0) - (-5.1) m/s	-4.45 m/s	Yes
Total Headform D-Plane Rotation	(-70) - (-82) °	-77.6 °	Yes
Peak Neck Occipital Condyles Moment	42 - 53 Nm	46.6 Nm	Yes
Neck Occipital Condyles Moment Decay to 10 Nm	60 - 80 ms	71.8 ms	Yes

Test meets specifications.

Condition: Used
Comments:
Neck S/N: DG6492

Specification Source: CFR49 Part 572 Subpart P with Polarity in accordance with J211

07.17.2018 12:00:37 729

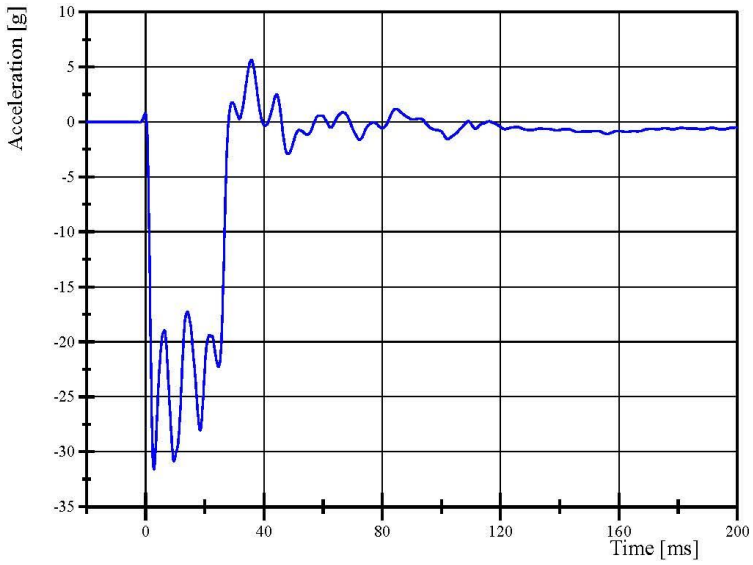
Transportation Research Center Inc.

Neck Flexion

HIII 3YO Serial No. 040 Certification No. 8-3

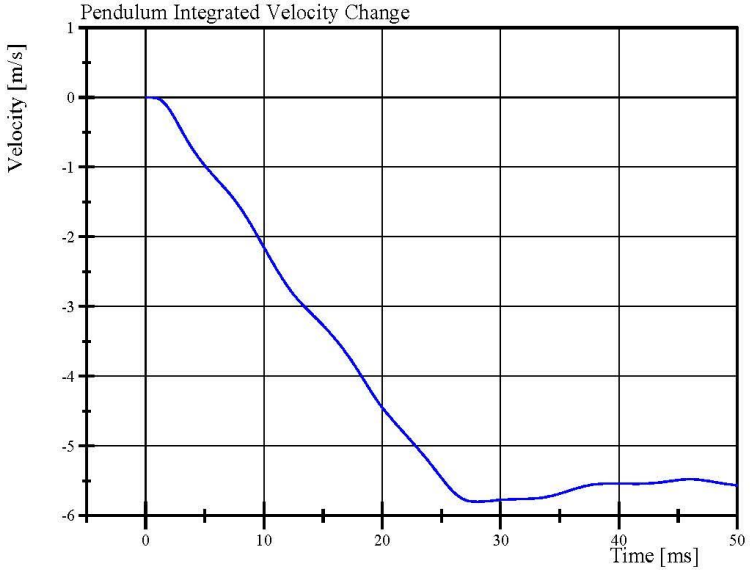
Test Date: 7/17/2018

Pendulum Acceleration



Filter Class: CFC_180
Max: 5.6 g at 35.8 ms
Min: -31.6 g at 2.8 ms

Pendulum Integrated Velocity Change



Filter Class: CFC_180
Max: 0.0 m/s at 0.3 ms
Min: -5.8 m/s at 28.0 ms

Specification Source: CFR49 Part 572 Subpart P
with Polarity in accordance with J211

07.17.2018 12:01:17 729

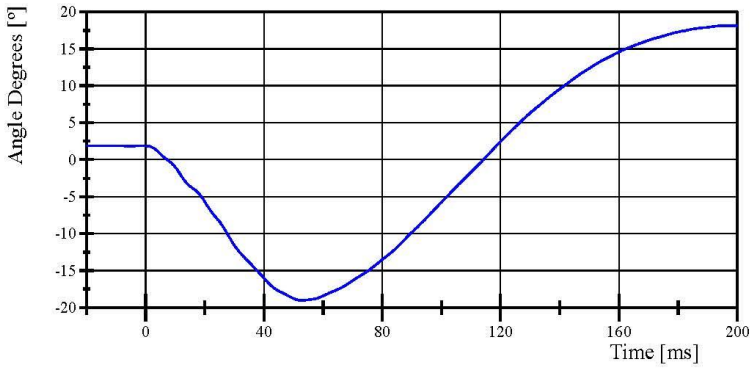
Transportation Research Center Inc.

Neck Flexion

HIII 3YO Serial No. 040 Certification No. 8-3

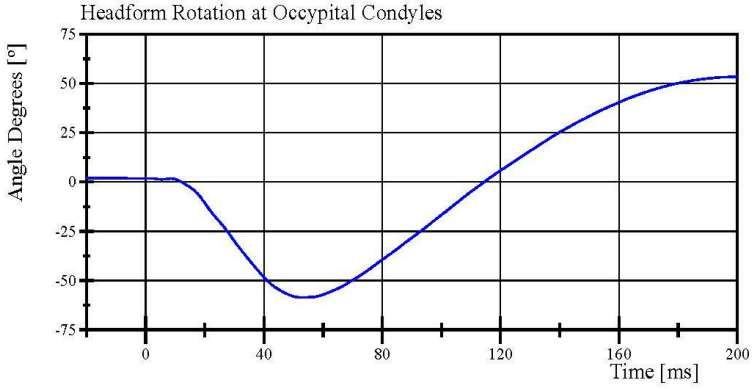
Test Date: 7/17/2018

Pot Rotation at the Base of Neck



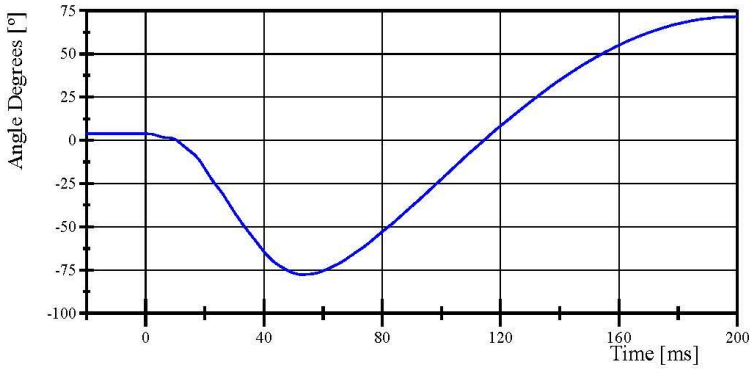
Filter Class: CFC_60
Max: 18.1 ° at 200.0 ms
Min: -19.0 ° at 52.6 ms

Headform Rotation at Occypital Condyles



Filter Class: CFC_60
Max: 53.4 ° at 200.0 ms
Min: -58.6 ° at 53.0 ms

Total Headform D-Plane Rotation



Filter Class: CFC_60
Max: 71.5 ° at 200.0 ms
Min: -77.6 ° at 52.9 ms

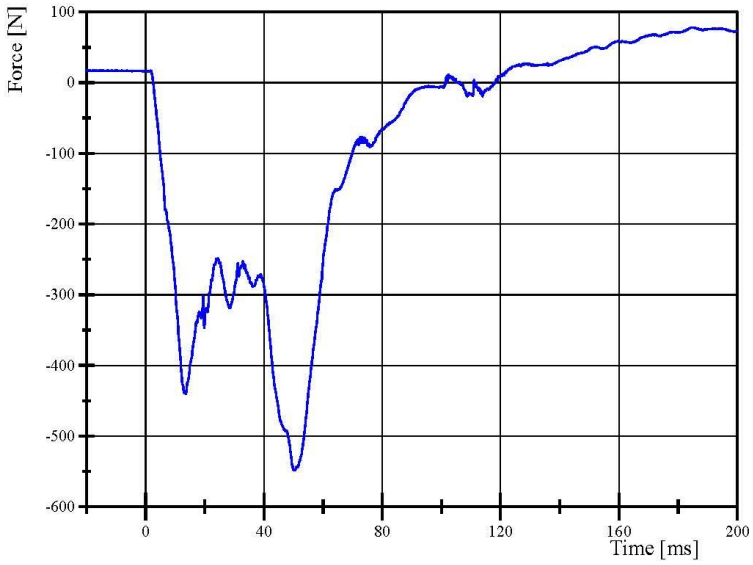
Specification Source: CFR49 Part 572 Subpart P
with Polarity in accordance with J211

07.17.2018 12:01:18 729

Transportation Research Center Inc.

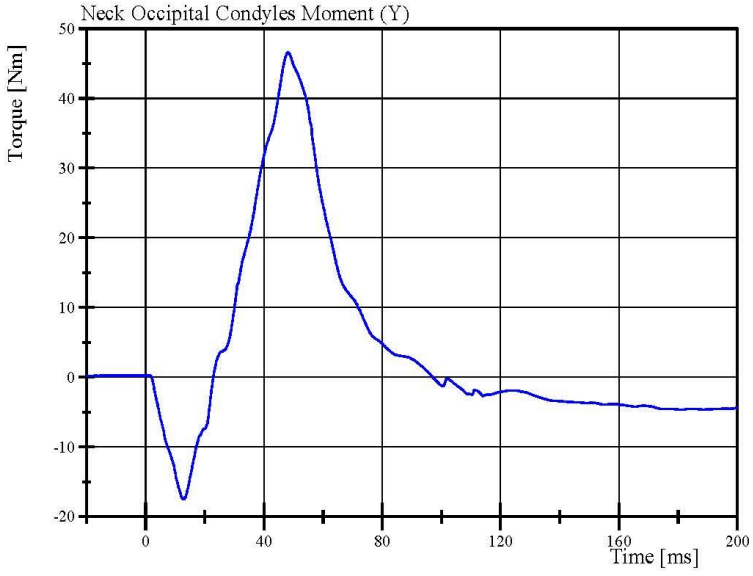
Neck Flexion
HIII 3YO Serial No. 040 Certification No. 8-3
Test Date: 7/17/2018

Neck Force (X)



Filter Class: CFC_1000
Max: 77.8 N at 184.8 ms
Min: -548.6 N at 50.3 ms

Neck Occipital Condyles Moment (Y)



Filter Class: CFC_600
Max: 46.6 Nm at 48.1 ms
Min: -17.5 Nm at 12.8 ms

Specification Source: CFR49 Part 572 Subpart P
with Polarity in accordance with J211

07.17.2018 12:01:18 729

Transportation Research Center Inc.

Neck Extension
HIII 3YO Serial No. 040 Certification No. 8-3
Test Date: 7/17/2018

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	21.1 °C	Yes
Relative Humidity	10 - 70 %	49 %	Yes
Pendulum Impact Velocity	(-3.55) - (-3.75) m/s	-3.630 m/s	Yes
Pendulum Integrated Velocity Change at 6 ms	1.0 - 1.4 m/s	1.14 m/s	Yes
Pendulum Integrated Velocity Change at 10 ms	1.9 - 2.5 m/s	2.11 m/s	Yes
Pendulum Integrated Velocity Change at 14 ms	2.8 - 3.5 m/s	2.93 m/s	Yes
Total Headform D-Plane Rotation	83 - 93 °	88.8 °	Yes
Peak Neck Occipital Condyles Moment	(-43.7) - (-53.3) Nm	-46.02 Nm	Yes
Neck Occipital Condyles Moment Decay to 10 Nm	60 - 80 ms	71.3 ms	Yes

Test meets specifications.

Condition: Used
Comments:
Neck S/N: DG6492

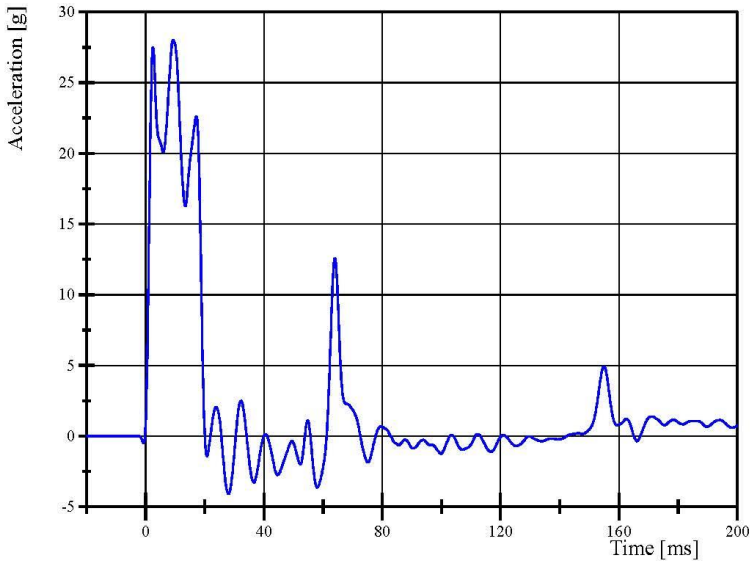
Specification Source: CFR49 Part 572 Subpart P with Polarity in accordance with J211

07.17.2018 13:22:59 1107

Transportation Research Center Inc.

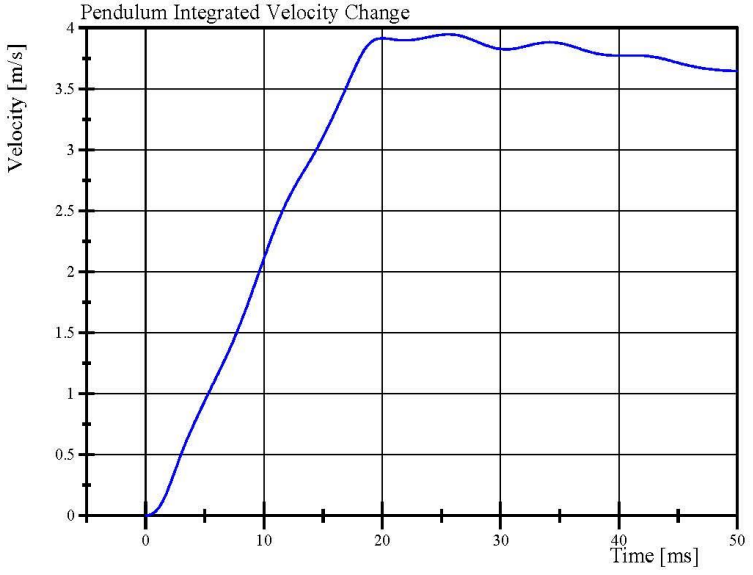
Neck Extension
HIII 3YO Serial No. 040 Certification No. 8-3
Test Date: 7/17/2018

Pendulum Acceleration



Filter Class: CFC_180
Max: 28.0 g at 9.3 ms
Min: -4.1 g at 28.1 ms

Pendulum Integrated Velocity Change



Filter Class: CFC_180
Max: 3.9 m/s at 25.6 ms
Min: 0.0 m/s at 0.0 ms

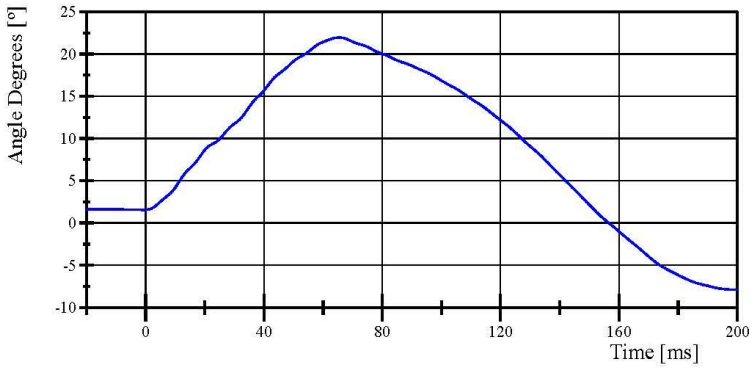
Specification Source: CFR49 Part 572 Subpart P
with Polarity in accordance with J211

07.17.2018 13:23:34 1107

Transportation Research Center Inc.

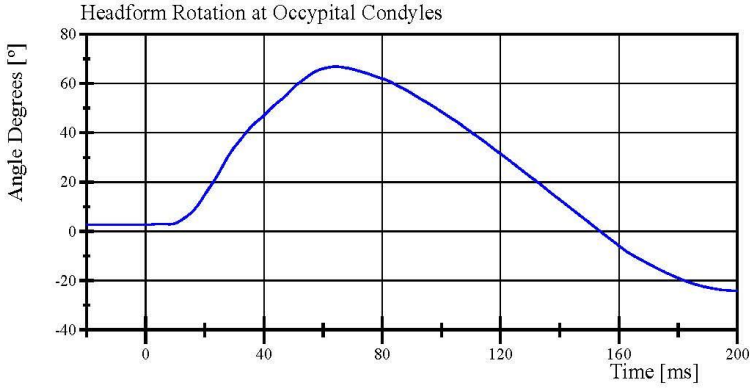
Neck Extension
HIII 3YO Serial No. 040 Certification No. 8-3
Test Date: 7/17/2018

Pot Rotation at the Base of Neck



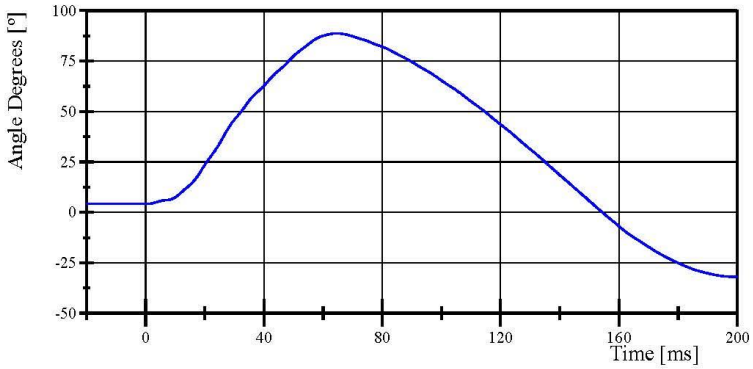
Filter Class: CFC_60
Max: 22.0 ° at 65.4 ms
Min: -7.9 ° at 200.0 ms

Headform Rotation at Occypital Condyles



Filter Class: CFC_60
Max: 66.8 ° at 64.3 ms
Min: -24.2 ° at 200.0 ms

Total Headform D-Plane Rotation



Filter Class: CFC_60
Max: 88.8 ° at 64.7 ms
Min: -32.1 ° at 200.0 ms

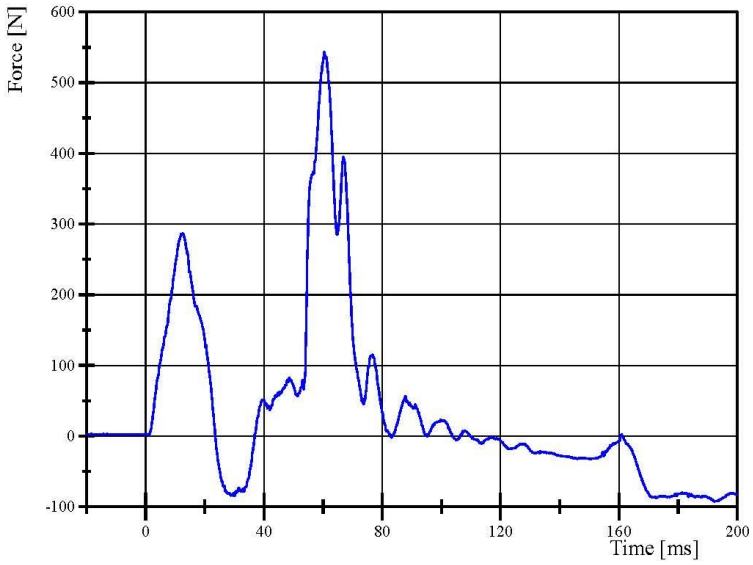
Specification Source: CFR49 Part 572 Subpart P
with Polarity in accordance with J211

07.17.2018 13:23:35 1107

Transportation Research Center Inc.

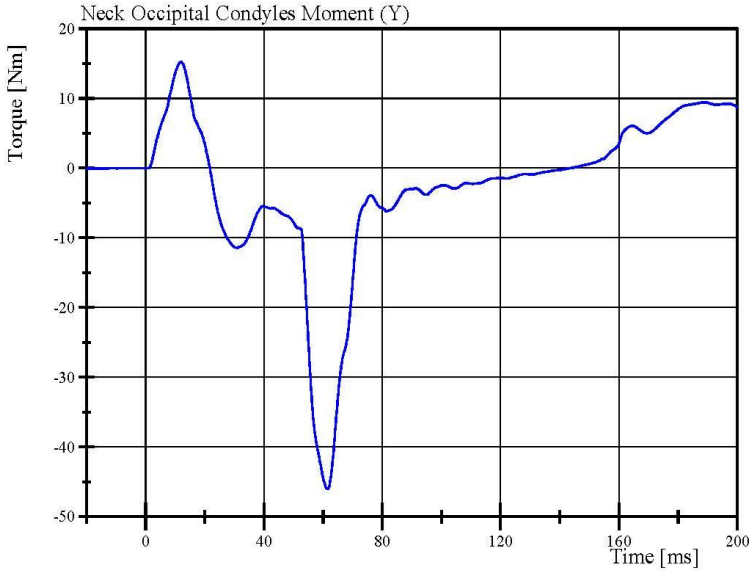
Neck Extension
HIII 3YO Serial No. 040 Certification No. 8-3
Test Date: 7/17/2018

Neck Force (X)



Filter Class: CFC_1000
Max: 543.1 N at 60.5 ms
Min: -92.4 N at 192.2 ms

Neck Occipital Condyles Moment (Y)



Filter Class: CFC_600
Max: 15.3 Nm at 11.9 ms
Min: -46.0 Nm at 61.6 ms

Specification Source: CFR49 Part 572 Subpart P
with Polarity in accordance with J211

07.17.2018 13:23:36 1107

APPENDIX D – TEST EQUIPMENT AND INSTRUMENTATION CALIBRATION

			Serial Number	Manufacturer and Model #	Calibration Date	Date Due
ATD		N/A	040	FTSS	13-Jul-2018	
Head Accelerometers	Primary	X	P97685	Endevco	11-Jul-2018	10-Jan-2019
		Y	P97528	Endevco	11-Jul-2018	10-Jan-2019
		Z	P97862	Endevco	11-Jul-2018	10-Jan-2019
	Redundant	X	P97696	Endevco	11-Jul-2018	11-Jan-2019
		Y	P97533	Endevco	11-Jul-2018	10-Jan-2019
		Z	P97846	Endevco	11-Jul-2018	10-Jan-2019
Upper Neck Load Cell		Fx, Fy, Fz, Mx, My, Mz	214	Denton	11-Jul-2018	11-Jul-2019
Lower Neck Load Cell		Fx, Fy, Fz, Mx, My, Mz	210	Denton	11-Jul-2018	11-Jul-2019
Chest Potentiometer		Dx	CST040	Servo	11-Jul-2018	11-Jul-2019
Sternum Accelerometer		X	P97686	Endevco	05-Jul-2018	04-Jan-2019
Spine Accelerometer		X	T11394	Endevco	05-Jul-2018	04-Jan-2019
Data System		N/A	223	Kayser-Threde	17-Jul-2018	
Inclinometer		N/A	DP-2	Mitutoyo Pro 360	11/20/2017	11/20/2018