REPORT NUMBER: TWG-TRC-19-02

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

NISSAN MOTOR CO., LTD.
2019 Infiniti QX50 SUV

NHTSA NUMBER: M20195215TWG2
TRC TEST NUMBER: 190710-1

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

Test Date: July 10, 2019

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 15GT153. 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: June 26, 2020

FINAL REPORT ACCEPTANCE BY:

Accepted By: _____

Acceptance Date: _____

TECHNICAL REPORT DOCUMENTATION PAGE

1. REPORT NO. TWG-TRC-19-02	2. GOVERNMENT ACCESSION NO.	3. RECIPIENT'S CATALOG NO.
4. TITLE AND SUBTITLE Final Report of New Car Assessment Program Side Air Bag Out-of-Position Testing of 2019 Infiniti QX50 SUV NHTSA No. M20195215TWG2		5. Report Date June 26, 2020 6. PERFORMING ORGANIZATION CODE TRC
7. AUTHOR(S) John Shultz, Project Manager		8. PERFORMING ORGANIZATION REPORT NO. 190710-1
9. PERFORMING ORGANIZATION NAME AND ADDRESS Transportation Research Center Inc. 10820 State Route 347 East Liberty, OH 43319		10. WORK UNIT NO. 11. CONTRACT OR GRANT NO. DTNH22-13-D-00311L
12. SPONSORING AGENCY NAME AND ADDRESS Alpha Technology Associate, Inc. 2810 Old Lee Hwy, Suite 120 Fairfax, VA 22031		13. TYPE OF REPORT AND PERIOD COVERED Final Test Report July 10, 2019 – June 26, 2020 14. SPONSORING AGENCY CODE NRM-110
15. SUPPLEMENTARY NOTES		

16. ABSTRACT

A side air bag out of position test was conducted on the subject 2019 Infiniti QX50 SUV 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 10, 2019.

The curtain and torso side air bags were deployed and responses were measured on a Hybrid III 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 21.4°C.

Section 3.3.3.2 – Hybrid III 3-Year-Old – Position 2

Measurement Description	Units	IARV	Result
Head Injury Criteria (HIC15)	N/A	570	43
Nij	N/A	1	1.73
Upper Neck Tension	Newton	1130	1165.2
Upper Neck Compression	Newton	1380	-50.1
Maximum Chest Compression	mm	36	-23.5
Maximum Chest Compression rate	m/sec	8.0	-4.0

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

19. SECURITY CLASSIFICATION OF REPORT Unclassified	20. SECURITY CLASSIFICATION OF PAGE Unclassified	21. NO. OF PAGES 57	22. PRICE

TABLE OF CONTENTS

SECTION 1 – TEST PURPOSE AND PROCEDURE

This side air bag out-of-position test is part of the MY19 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 2019 Infiniti QX50 SUV. 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 2019 Infiniti QX50 SUV on an out-of-position Hybrid III 3-Year-Old were evaluated. The test was performed by TRC on July 10, 2019. 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 Hybrid III 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 and a six-axis lower neck load cell, 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 upper neck tension and Nij NTE injury values exceeded during the test. The occupant data is summarized below:

Measurement Description	Units	Passenger ATD Hybrid III 3-Year-Old	
		IARV	Result
Head Injury Criteria (HIC15)	N/A	570	43
Nij	N/A	1	1.73
Upper Neck Tension	N	1130	1165.2
Upper Neck Compression	N	1380	-50.1
Thorax Compression	mm	36	-23.5
Thorax Compression rate	m/sec	8.0	-4.0

SECTION 3 DATA SHEET

DATA SHEET NO. 1
TEST SUMMARY

Test Vehicle:	2019 Infiniti QX50 SUV	NHTSA No.:	M20195215TWG2
Test Program:	Side Air Bag Out-of-Position Test	Test Date:	7/10/2019

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.:	Hybrid III 3-Year-Old	040
Vehicle	Infiniti	QX50
Previous Crash Test	MDB	3/21/2019 and M20195215

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:	2019 Infiniti QX50 SUV	NHTSA No.:	M20195215TWG2
Test Program:	Side Air Bag Out-of-Position Test	Test Date:	7/10/2019

TEST CONFIGURATION INFORMATION

NHTSA No.	M20195215
Model Year	2019
Make	Infiniti
Model	QX50
Body Style	MPV
VIN	3PCAJ5M13KF128478
Body Color	Liquid Platinum
Odometer Reading (km/mi)	149 mi.
Engine Displacement (L)	2.0
Type/No. Cylinders	Gas/4
Engine Placement	Front/Transverse
Transmission Type	Automatic
Transmission Speeds	CVT
Overdrive	Yes
Final Drive	FWD
Roof Rack	No
Sunroof/T-Top	No
Running Boards	No
Tilt Steering Wheel	Yes
Power Seats	Yes
Anti-Lock Brakes (ABS)	Yes

Traction Control System (TCS)	Yes
Auto-Leveling System	No
Automatic Door Locks (ADL)	Yes
Power Window Auto-Reverse	Yes
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	Yes
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	Yes
Driver Load Limiter	Yes
Rear Passenger Load Limiter	Yes
Other Safety Restraint	No

DATA FROM CERTIFICATION LABEL

Manufactured By	NISSAN MOTOR CO., LTD.
Date of Manufacture	11/18
Vehicle Type	MPV

GVWR (kg)	4916
GAWR Front (kg)	2822
GAWR Rear (kg)	2513

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)				390.0	(A)
DSC x 68.04 (kg)				340.2	(B)
Cargo Weight (RCLW) (kg)				49.8	(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	N/A	Yes	Yes	N/A	Yes	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: 2019 Infiniti QX50 SUV NHTSA No.: M20195215TWG2

Test Program: Side Air Bag Out-of-Position Test Test Date: 7/10/2019

VEHICLE SEAT FORE/AFT POSITION

Seat Location	Total Fore/Aft Travel		Test Position from Forwardmost Position	
	mm	# Detents	mm	# Detents
Front Right	260	N/A	183	N/A
Rear Right	N/A	N/A	N/A	N/A

Seat Fore/Aft Position Per TWG Guidelines	Tests are to be conducted with the seat in the rearmost adjustment
Reason for Deviation from TWG Guidelines	In order to align the vertical centerline of the dummy's sternum as close as possible with the leading edge of the seat back bolster, the seat track was moved forward 77 mm.

VEHICLE SEAT BACK ANGLE ADJUSTMENT

Seat Location	Total Seat Back Angle Range		Test Position from Most Upright (Vertical)	
	Degrees	# Detents	Degrees	# Detents
Front Right	78.3	N/A	0.6	N/A
Rear Right	N/A	N/A	N/A	N/A

OEM Back Angle Design Position	965 mm as measured from outboard headrest post to rear striker face
Method of Measuring Back Angle Position	As per OEM instruction
Seat Back Angle Position Per TWG Guidelines	Manufacturer design angle
Reason for Deviation from TWG Guidelines	No deviations

VEHICLE SEAT HEIGHT ADJUSTMENT

Seat Location	Total Height Adjustment Range		Test Position from Lowest Position	
	mm	# Detents	mm	# Detents
Front Right	69	N/A	0	N/A
Rear Right	N/A	N/A	N/A	N/A

Seat Height Adjustment Per TWG Guidelines	Tests are to be conducted with the seat in the lowest adjustment
Reason for Deviation from TWG Guidelines	No deviations

DATA SHEET NO. 4
DUMMY SETUP AND POSITIONING DATA

Test Vehicle:	2019 Infiniti QX50 SUV	NHTSA No.:	M20195215TWG2
Test Program:	Side Air Bag Out-of-Position Test	Test Date:	7/10/2019

DUMMY INFORMATION

ATD Type	Hybrid III 3 Year Old
Serial Number	040
Qualification Date	6/27/2019
Qualification Type	Partial
Clothing	Cotton shirt and pants
Other ATD Prep	Electrical tape on skull cap seam, baby power on head

DUMMY POSITIONING INFORMATION

TWG Setup Instructions	As specified in the 3.3.3.2 Test Procedure; Seat is adjusted to its highest position; ATD positioned to 3.3.3.2.1.
Actual Setup	The seat back angle is set to the manufacturer's specification. The seat is set to the full down position and was initially set to the full rear position. In order to align the vertical centerline of the dummy's sternum as close as possible with the leading edge of the seat back bolster, the seat track was moved forward 77mm. The dummy is placed along the outboard edge of the seat cushion, kneeling and facing rearward, with the sternum contacting the seat. The dummy's head is in between the seat bolster and pillar/side trim and is not forced into flexion or extension. The outboard leg is set at the outboard edge of the seat cushion bolster and parallel to the seat centerline. The outboard knee and lower leg are slid toward the seat bight to bring the top edge of the upper rib as close as possible with the top edge of the airbag module. The inboard leg is parallel to the centerline of the seat cushion. The inboard knee and lower leg are slid in towards the seat bight to achieve a line perpendicular to the vehicle centerline through both shoulder bolts. The inboard thumb is contacting the seat back. The outboard arm and hand are hanging down as close to vertical as possible.

DATA SHEET NO. 5
DUMMY INJURY CRITERIA DATA

Test Vehicle: 2019 Infiniti QX50 SUV
NHTSA No.: M20195215TWG2
Test Program: Side Air Bag Out-of-Position Test
Test Date: 7/10/2019

RECORDED DATA - MINIMUMS AND MAXIMUMS

Channel	Unit	CFC	Maximum	Time (ms)	Minimum	Time (ms)
Head X	G	1000	37.84	11.60	-28.36	15.28
Head Y	G	1000	29.16	11.92	-5.46	285.60
Head Z	G	1000	43.57	12.32	-13.36	21.04
Head Resultant	G	1000	47.88	11.92		
Head Red X	G	1000	37.46	11.60	-28.88	15.28
Head Red Y	G	1000	29.32	11.92	-5.40	285.20
Head Red Z	G	1000	41.75	12.32	-13.44	21.04
Head Red Resultant	G	1000	47.57	11.92		
Upper Neck X	N	1000	115.84	8.96	-812.82	16.56
Upper Neck Y	N	1000	54.78	50.48	-188.97	16.32
Upper Neck Z	N	1000	1165.17	15.92	-50.14	306.88
Upper Neck Resultant	N	1000	1415.17	16.00		
Upper Neck X	Nm	600	4.13	15.12	-17.66	24.80
Upper Neck Y	Nm	600	7.40	310.00	-33.01	16.64
Upper Neck Z	Nm	600	5.76	97.60	-12.26	23.28
Upper Neck Resultant	Nm	600	33.66	16.72		
Lower Neck X	N	1000	89.19	237.76	-712.46	19.76
Lower Neck Y	N	1000	676.65	16.32	-197.06	8.24
Lower Neck Z	N	1000	474.02	95.76	-787.57	19.68
Lower Neck Resultant	N	1000	1177.67	18.08		
Lower Neck X	Nm	600	8.86	10.64	-35.06	16.16
Lower Neck Y	Nm	600	1.31	310.00	-27.61	16.24
Lower Neck Z	Nm	600	18.17	15.68	-0.19	5.20
Lower Neck Resultant	Nm	600	47.88	16.16		
Dummy Chest Deflection X	MM	600	0.45	5.12	-23.52	15.20
Dummy Upper Sternum X	G	1000	301.25	11.28	-737.36	7.04
Dummy Lower Sternum X	G	1000	200.63	14.40	-236.12	4.96

HEAD INJURY SUMMARY

HIC15	T1 (ms)	T2 (ms)	HIC36	T1 (ms)	T2 (ms)
43	11.36	18.24	43	11.36	18.24

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

Test Vehicle:	2019 Infiniti QX50 SUV	NHTSA No.:	M20195215TWG2
Test Program:	Side Air Bag Out-of-Position Test	Test Date:	7/10/2019

NECK INJURY SUMMARY

Injury Criteria	Value	Time (ms)
Upper Neck NTF	0.16	8.40
Upper Neck NTE	1.73	16.08
Upper Neck NCF	0.13	309.28
Upper Neck NCE	0.01	5.12
Peak Tension	1165.2	15.92
Peak Compression	-50.1	306.88

CHEST INJURY SUMMARY

Injury Criteria	Value	Time (ms)
Chest Deflection	-23.5	15.20
Deflection Rate[1]	-4.0	11.20

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

RESEARCH INJURY SUMMARY

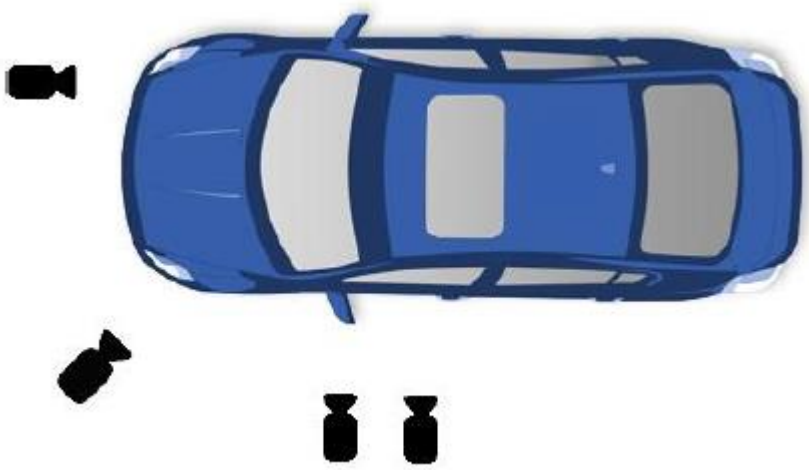
Research Injury Criteria[1]	Value	Time (ms)
Upper Neck Lateral Moment		
Upper Neck Twist Moment		
Lower Neck Flexion Moment		
Lower Neck Extension Moment		
Lower Neck Lateral Moment		
Lower Neck Twist Moment		
Lower Neck Tension		
Lower Neck Compression		
Spine Acceleration		

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

DATA SHEET NO. 6
CAMERA SETUP AND DESCRIPTION

Test Vehicle:	2019 Infiniti QX50 SUV	NHTSA No.:	M20195215TWG2
Test Program:	Side Air Bag Out-of-Position Test	Test Date:	7/10/2019

CAMERA SETUP DIAGRAM FOR SAB OOP TESTS



No.	Camera View	Location (mm)[1]			Lens (mm)	Speed (fps)
		X	Y	Z		
1	Left View	-403	-2480	-1252	20	1000
2	Oblique View	1776	-2642	-1488	28	1000
3	Front View	2724	208	-1648	50	1000
4	Real Time (optional)	596	-2506	-1153	Zoom	24

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

APPENDIX A

PHOTOGRAPHS

TABLE OF PHOTOGRAPHS

Figure A-1 Right Front ¾ View of Test Vehicle as Delivered

Figure A-2 Vehicle Certification Label

Figure A-3 Pre-Test Vehicle Left Side View

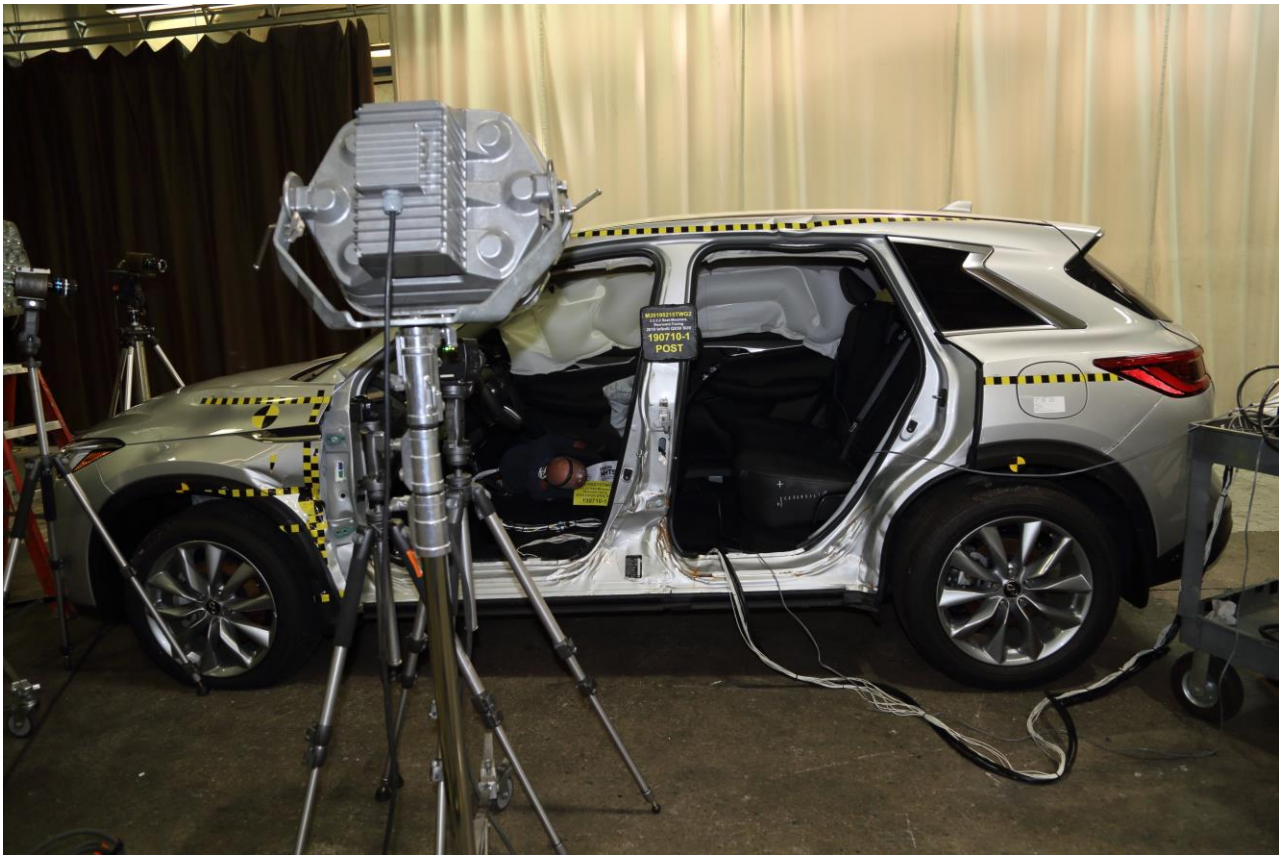


Figure A-4 Post-Test Vehicle Left Side View

Figure A-5 Pre-Test Vehicle Location of Air Bag 1

Figure A-6 Pre-Test Vehicle Location of Air Bag 2

Figure A-7 Pre-Test Vehicle Location of Air Bag 3

Figure A-8 Pre-Test Vehicle Seat Back Angle

Figure A-9 Pre-Test Dummy Left Side View

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

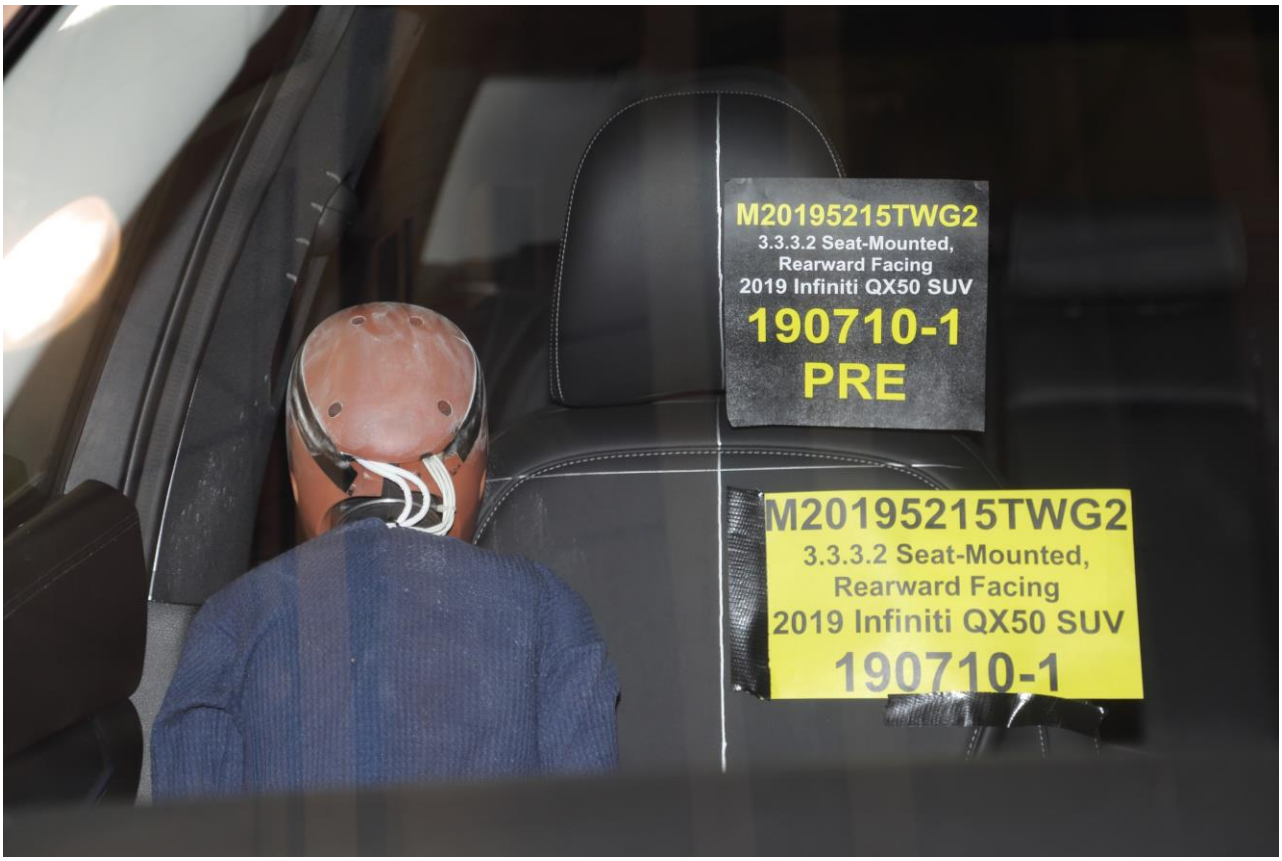


Figure A-19 Pre-Test Dummy Front Close-up View

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

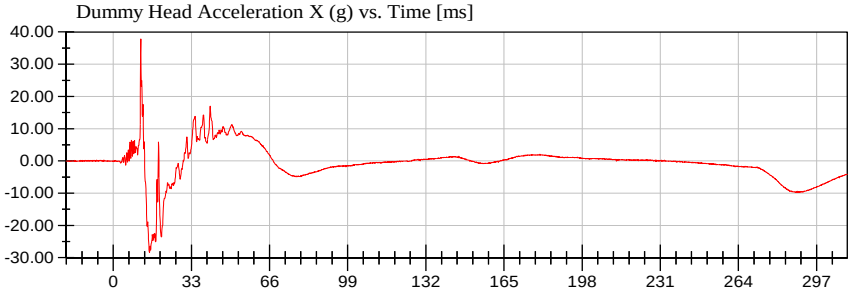
Test Date: 07/10/2019

Position #2 Hybrid III 3 year old Dummy (Part 572 P) (13Y6)

Test Lab: CTF

Test Number: 190710-1 (M20195215TWG2)

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



<Max>

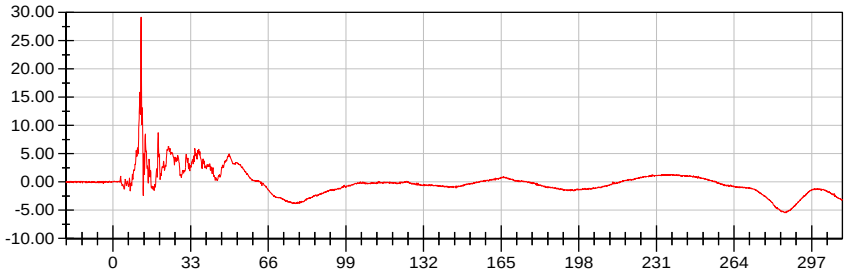
37.84 g at 11.60 ms

<Min>

-28.36 g at 15.28 ms

CFC_1000

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



<Max>

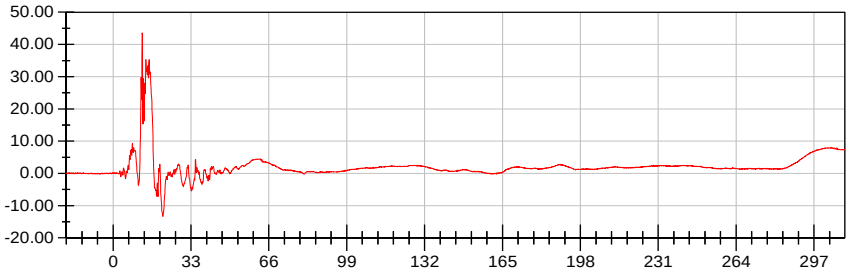
29.16 g at 11.92 ms

<Min>

-5.46 g at 285.60 ms

CFC_1000

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



<Max>

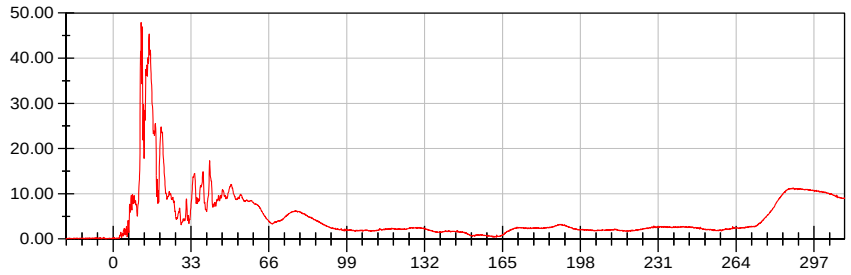
43.57 g at 12.32 ms

<Min>

-13.36 g at 21.04 ms

CFC_1000

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



<Max>

47.88 g at 11.92 ms

<Min>

0.03 g at -19.76 ms

CFC_1000

Alpha Technology

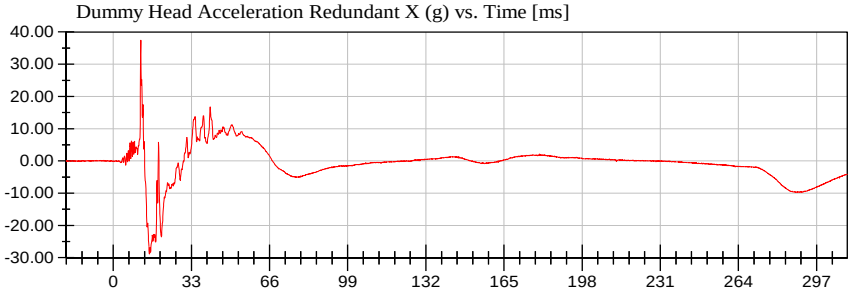
Test Date: 07/10/2019

Position #2 Hybrid III 3 year old Dummy (Part 572 P) (13Y6)

Test Lab: CTF

Test Number: 190710-1 (M20195215TWG2)

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



<Max>

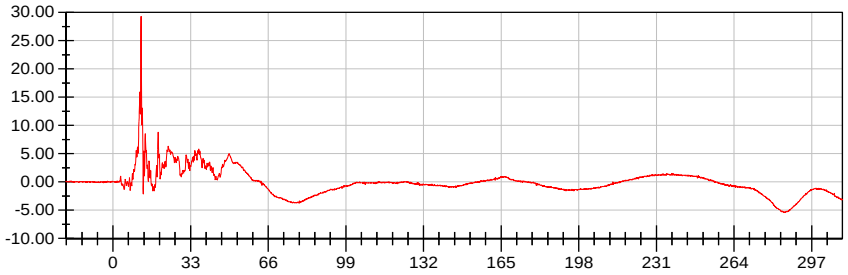
37.46 g at 11.60 ms

<Min>

-28.88 g at 15.28 ms

CFC_1000

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



<Max>

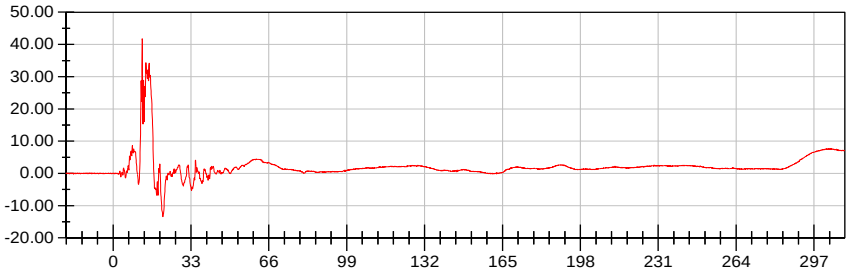
29.32 g at 11.92 ms

<Min>

-5.40 g at 285.20 ms

CFC_1000

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



<Max>

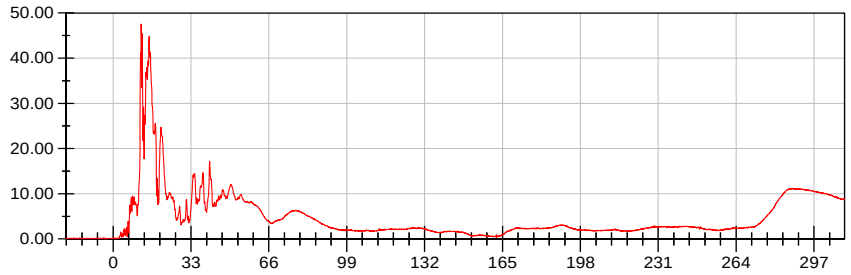
41.75 g at 12.32 ms

<Min>

-13.44 g at 21.04 ms

CFC_1000

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



<Max>

47.56 g at 11.92 ms

<Min>

0.03 g at -19.12 ms

CFC_1000

Alpha Technology

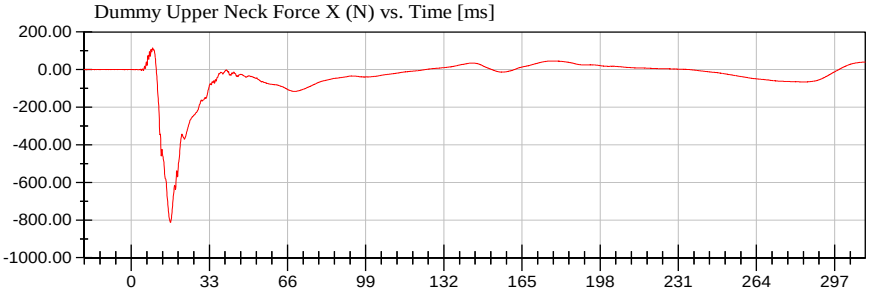
Test Date: 07/10/2019

Position #2 Hybrid III 3 year old Dummy (Part 572 P) (13Y6)

Test Lab: CTF

Test Number: 190710-1 (M20195215TWG2)

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



<Max>

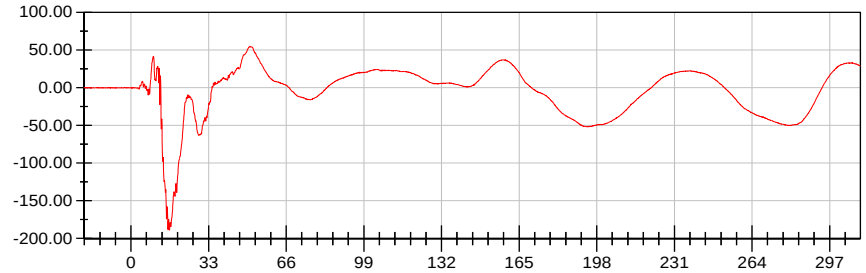
115.84 N at 8.96 ms

<Min>

-812.82 N at 16.56 ms

CFC_1000

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



<Max>

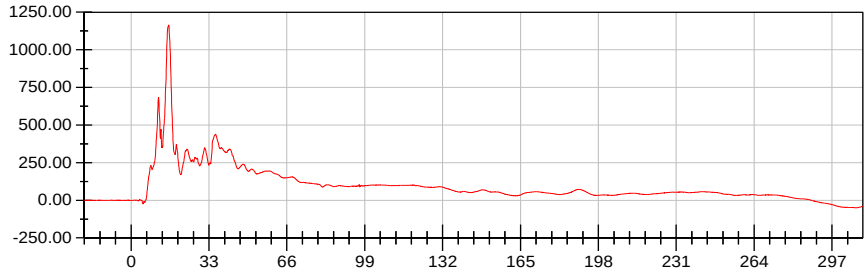
54.78 N at 50.48 ms

<Min>

-188.96 N at 16.32 ms

CFC_1000

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



<Max>

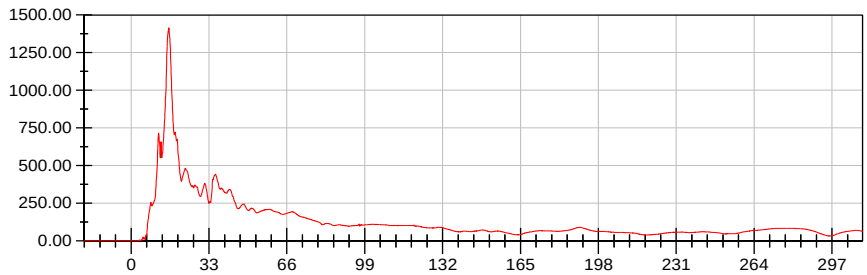
1,165.17 N at 15.92 ms

<Min>

-50.14 N at 306.88 ms

CFC_1000

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



<Max>

1,415.17 N at 16.00 ms

<Min>

0.06 N at -15.68 ms

CFC_1000

Alpha Technology

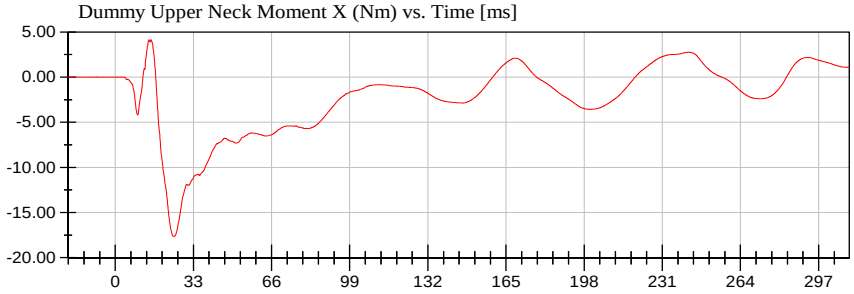
Test Date: 07/10/2019

Position #2 Hybrid III 3 year old Dummy (Part 572 P) (13Y6)

Test Lab: CTF

Test Number: 190710-1 (M20195215TWG2)

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



<Max>

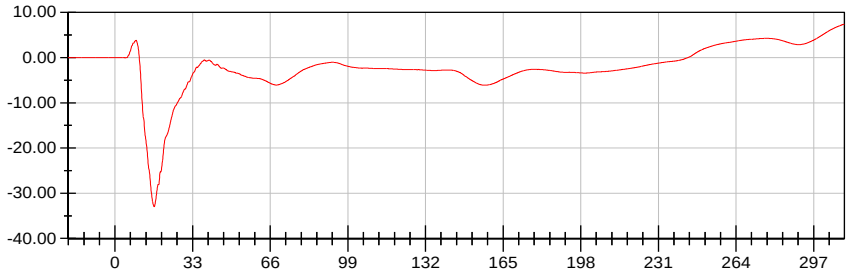
4.13 Nm at 15.12 ms

<Min>

-17.66 Nm at 24.80 ms

CFC_600

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



<Max>

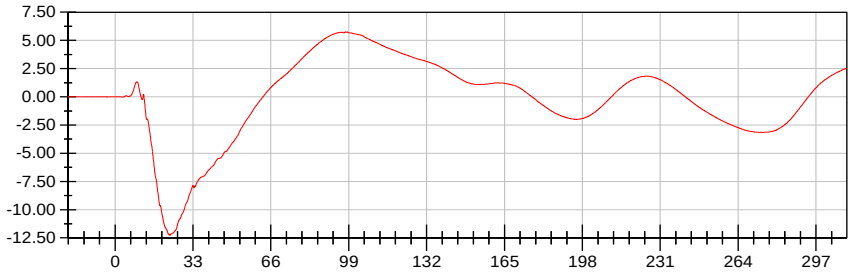
7.40 Nm at 310.00 ms

<Min>

-33.00 Nm at 16.64 ms

CFC_600

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



<Max>

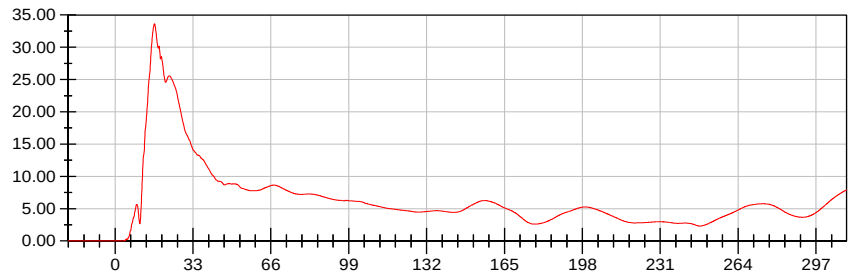
5.76 Nm at 97.60 ms

<Min>

-12.26 Nm at 23.28 ms

CFC_600

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



<Max>

33.66 Nm at 16.72 ms

<Min>

0.00 Nm at -10.88 ms

CFC_600

Alpha Technology

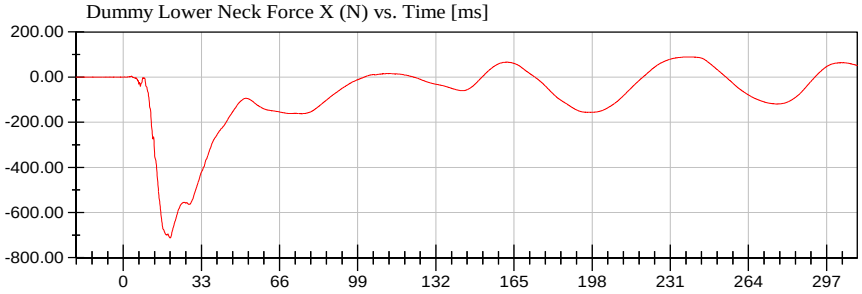
Test Date: 07/10/2019

Position #2 Hybrid III 3 year old Dummy (Part 572 P) (13Y6)

Test Lab: CTF

Test Number: 190710-1 (M20195215TWG2)

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



<Max>

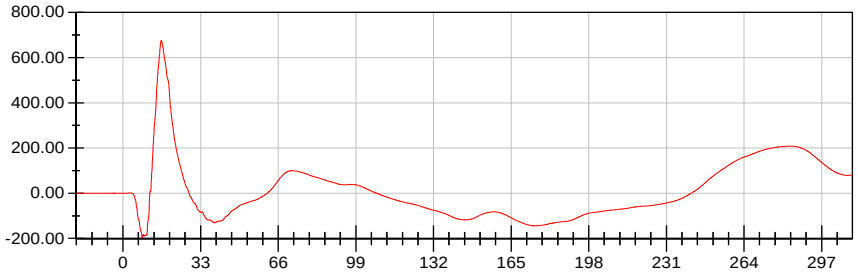
89.19 N at 237.76 ms

<Min>

-712.46 N at 19.76 ms

CFC_1000

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



<Max>

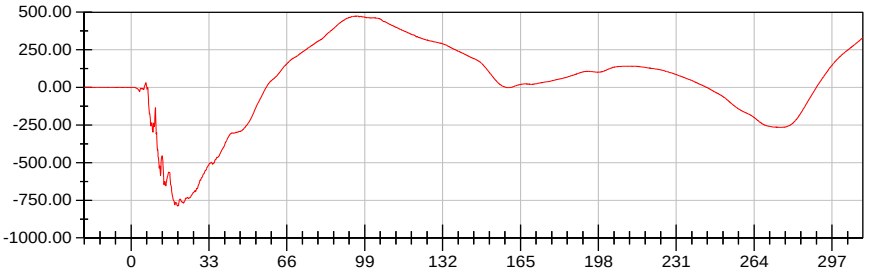
676.65 N at 16.32 ms

<Min>

-197.06 N at 8.24 ms

CFC_1000

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



<Max>

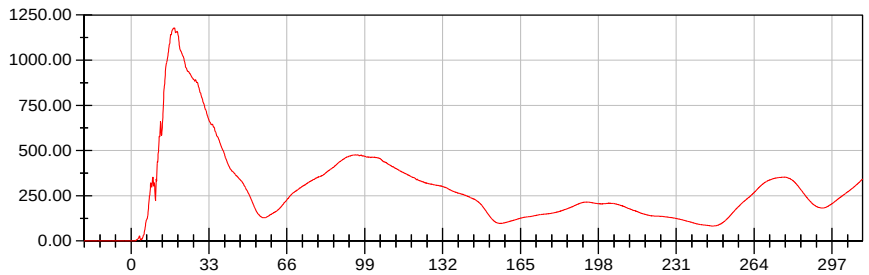
474.02 N at 95.76 ms

<Min>

-787.57 N at 19.68 ms

CFC_1000

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



<Max>

1,177.67 N at 18.08 ms

<Min>

0.12 N at -15.12 ms

CFC_1000

Alpha Technology

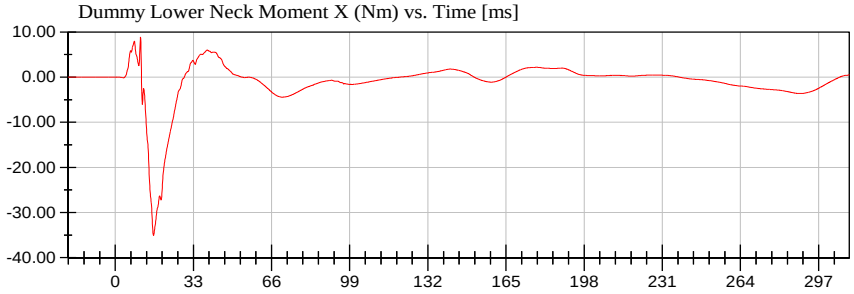
Test Date: 07/10/2019

Position #2 Hybrid III 3 year old Dummy (Part 572 P) (13Y6)

Test Lab: CTF

Test Number: 190710-1 (M20195215TWG2)

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



<Max>

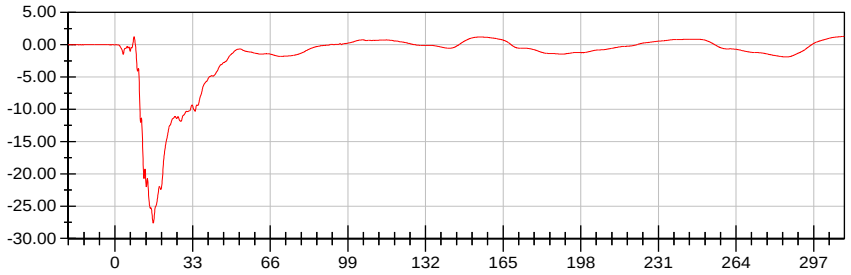
8.86 Nm at 10.64 ms

<Min>

-35.06 Nm at 16.16 ms

CFC_600

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



<Max>

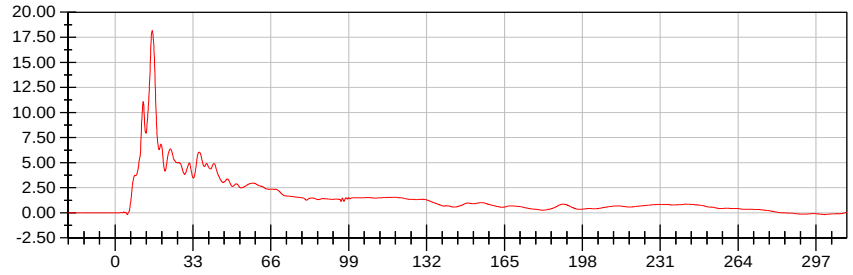
1.31 Nm at 310.00 ms

<Min>

-27.61 Nm at 16.24 ms

CFC_600

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



<Max>

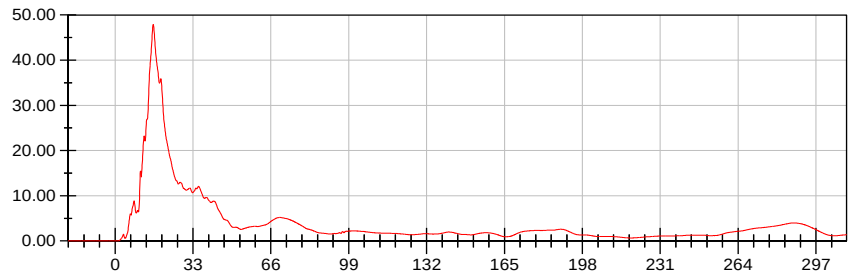
18.16 Nm at 15.68 ms

<Min>

-0.18 Nm at 5.20 ms

CFC_600

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



<Max>

47.88 Nm at 16.16 ms

<Min>

0.00 Nm at -3.20 ms

CFC_600

2019 Infiniti QX50 SUV TWG OOP Test 3.3.3.2

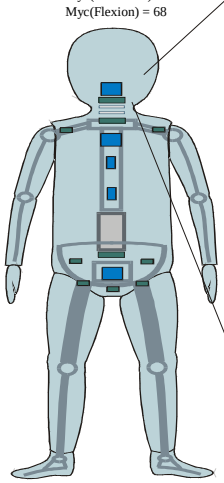
Neck Injury Predictor (NIJ)

Date: 07/10/2019
Time: 10:15

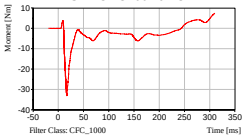
Customer: Alpha Technology
Test Number: M20195215TWG2

TRC Inc. Test Lab: CTF
Test Number: 190710-1

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

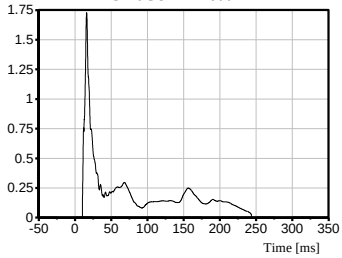


13TMONUP00Y6MOYX



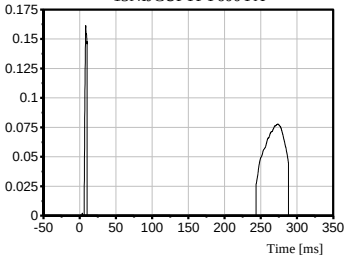
13NECKUP00Y6FOZA

13NIJCUPTEY600YX



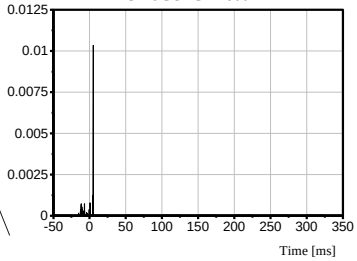
Max [NTE] 1.7265 at 16.08 ms

13NIJCUPTFY600YX



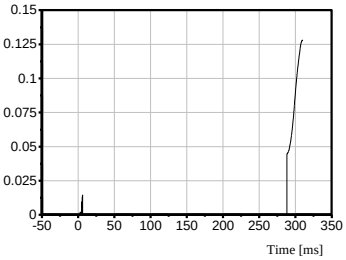
Max [NTF] 0.1612 at 8.40 ms

13NIJCUPCEY600YX



Max [NCE] 0.0104 at 5.12 ms

13NIJCUPCFY600YX



Max [NCF] 0.1281 at 309.28 ms

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

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

2019 Infiniti QX50 SUV TWG OOP Test 3.3.3.2

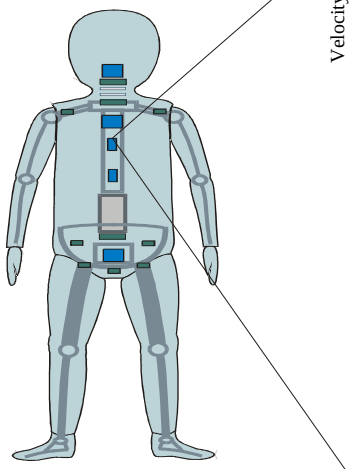
Chest Compression Speed

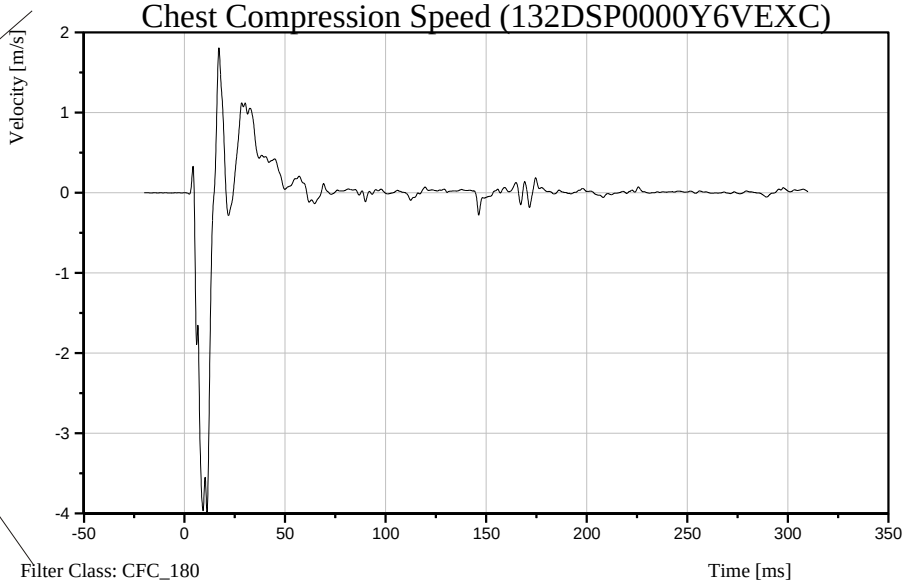
Date: 07/10/2019
Time: 10:15

Customer: Alpha Technology
Test Number: M20195215TWG2

TRC Inc. Test Lab: CTF
Test Number: 190710-1

Test Orientation = Frontal





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

[Max.] 1.81 m/s at 17.12 ms
[Min.] -3.99 m/s at 11.20 ms

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

Alpha Technology

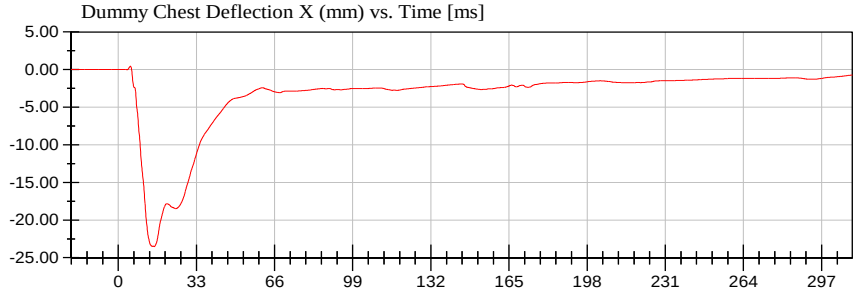
Test Date: 07/10/2019

Position #2 Hybrid III 3 year old Dummy (Part 572 P) (13Y6)

Test Lab: CTF

Test Number: 190710-1 (M20195215TWG2)

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



<Max>

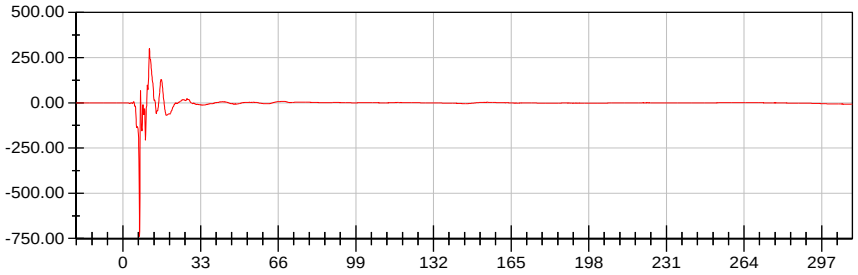
0.45 mm at 5.12 ms

<Min>

-23.52 mm at 15.20 ms

CFC_600

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



<Max>

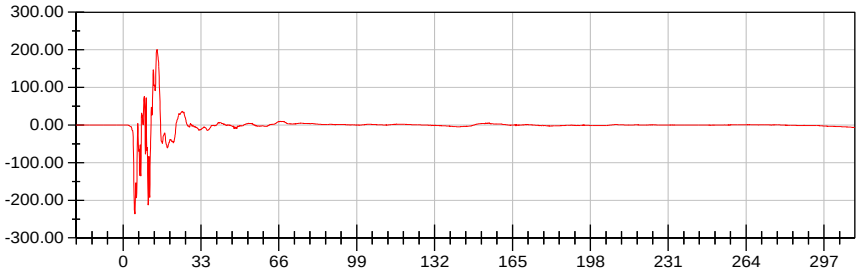
301.25 g at 11.28 ms

<Min>

-737.36 g at 7.04 ms

CFC_1000

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



<Max>

200.63 g at 14.40 ms

<Min>

-236.12 g at 4.96 ms

CFC_1000

Alpha Technology

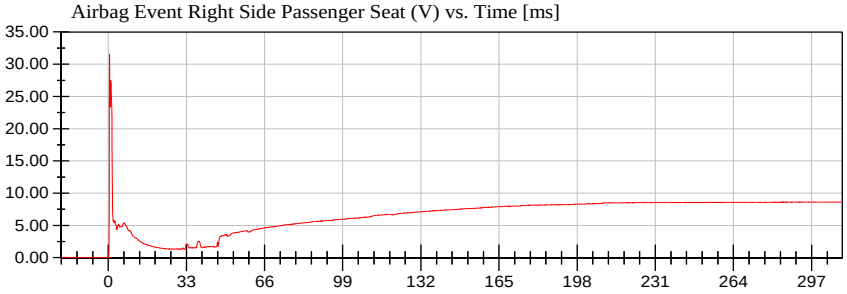
Test Date: 07/10/2019

Position #2 Hybrid III 3 year old Dummy (Part 572 P) (13Y6)

Test Lab: CTF

Test Number: 190710-1 (M20195215TWG2)

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



<Max>

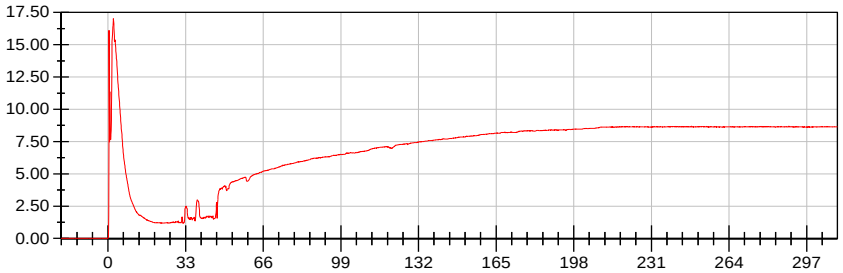
31.53 V at 0.56 ms

<Min>

0.00 V at -20.00 ms

Unfiltered

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



<Max>

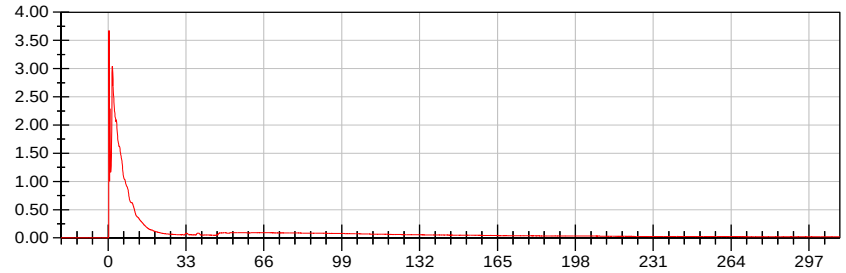
17.02 V at 2.32 ms

<Min>

0.00 V at -20.00 ms

Unfiltered

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



<Max>

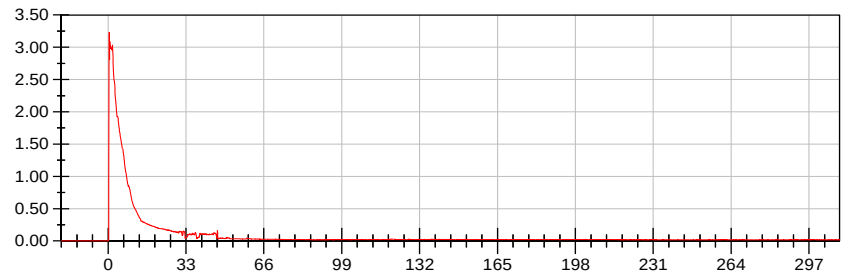
3.67 A at 0.40 ms

<Min>

0.00 A at -20.00 ms

Unfiltered

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



<Max>

3.23 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. 9-1
Test Date: 6/26/2019

Test Parameter	Specification	Test Results	Pass
Temperature	18.9 - 25.6 °C	21.0 °C	Yes
Relative Humidity	10 - 70 %	59 %	Yes
Peak Head Resultant Acceleration	250 - 280 g	277.0 g	Yes
Peak Head Lateral Acceleration	(-15) - 15 g	-9.6 g	Yes
Is Acceleration Curve Unimodal?	< 10 %	5.07 %	Yes

Test meets specifications.

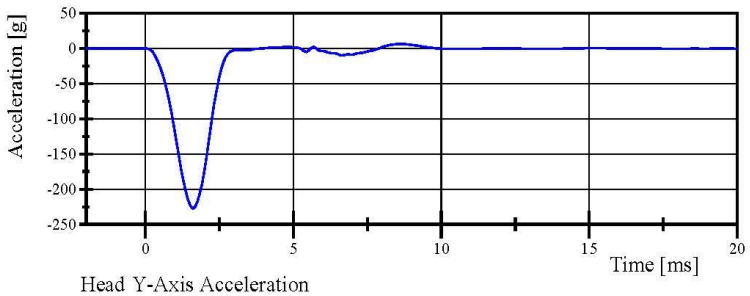
Condition: Used

Comments:
Head Skin S/N: N/A

Transportation Research Center Inc.

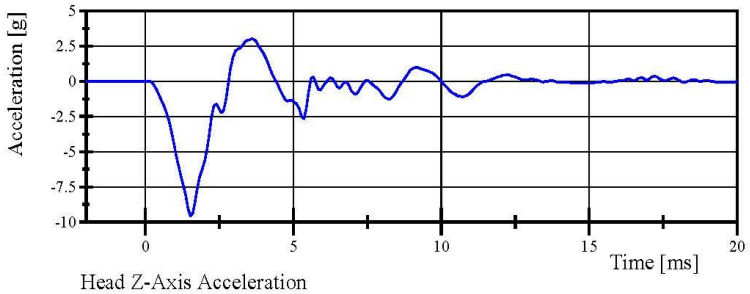
Front Head Drop
HIII 3YO Serial No. 040 Certification No. 9-1
Test Date: 6/26/2019

Head X-Axis Acceleration



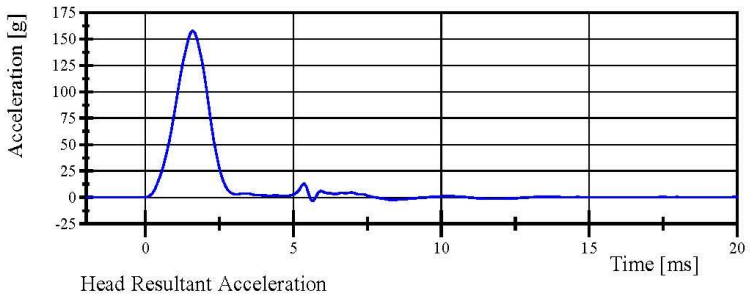
Filter Class: CFC_1000
Max: 6.6 g at 8.6 ms
Min: -227.3 g at 1.6 ms

Head Y-Axis Acceleration



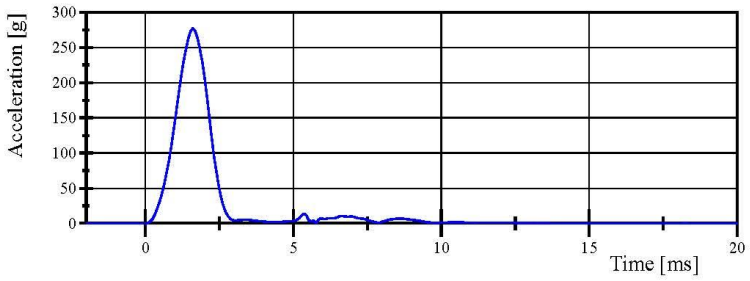
Filter Class: CFC_1000
Max: 3.0 g at 3.6 ms
Min: -9.6 g at 1.5 ms

Head Z-Axis Acceleration



Filter Class: CFC_1000
Max: 158.1 g at 1.6 ms
Min: -3.5 g at 5.7 ms

Head Resultant Acceleration



Filter Class: CFC_1000
Max: 277.0 g at 1.6 ms
Min: 0.0 g at -2.0 ms

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

06.26.2019 10:10:33 582

Transportation Research Center Inc.

Neck Flexion
HIII 3YO Serial No. 040 Certification No. 9-2
Test Date: 6/27/2019

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	20.8 °C	Yes
Relative Humidity	10 - 70 %	58 %	Yes
Pendulum Impact Velocity	5.40 - 5.60 m/s	5.599 m/s	Yes
Pendulum Integrated Velocity Change at 10 ms	(-2.0) - (-2.7) m/s	-2.42 m/s	Yes
Pendulum Integrated Velocity Change at 15 ms	(-3.0) - (-4.0) m/s	-3.49 m/s	Yes
Pendulum Integrated Velocity Change at 20 ms	(-4.0) - (-5.1) m/s	-4.68 m/s	Yes
Total Headform D-Plane Rotation	(-70) - (-82) °	-79.2 °	Yes
Peak Neck Occipital Condyles Moment	42 - 53 Nm	44.4 Nm	Yes
Neck Occipital Condyles Moment Decay to 10 Nm	60 - 80 ms	74.6 ms	Yes

Test meets specifications.

Condition: New

Comments:
Neck S/N: 160308

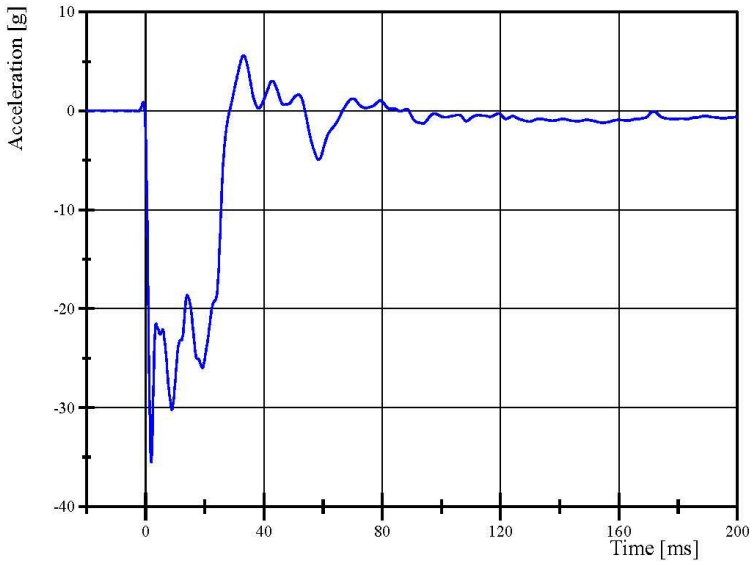
Specification Source: CFR49 Part 572 Subpart P
with Polarity in accordance with J211

06.27.2019 11:29:38 633

Transportation Research Center Inc.

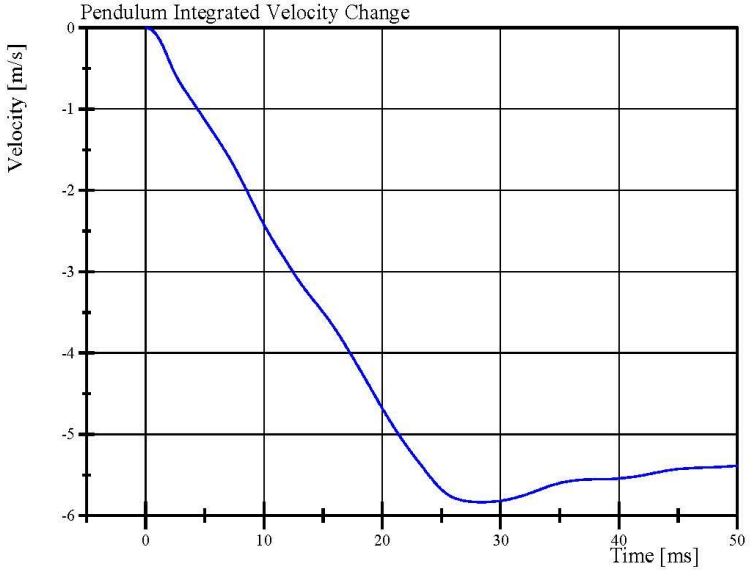
Neck Flexion
HIII 3YO Serial No. 040 Certification No. 9-2
Test Date: 6/27/2019

Pendulum Acceleration



Filter Class: CFC_180
Max: 5.6 g at 33.1 ms
Min: -35.5 g at 1.9 ms

Pendulum Integrated Velocity Change



Filter Class: CFC_180
Max: 0.0 m/s at 0.0 ms
Min: -5.8 m/s at 28.4 ms

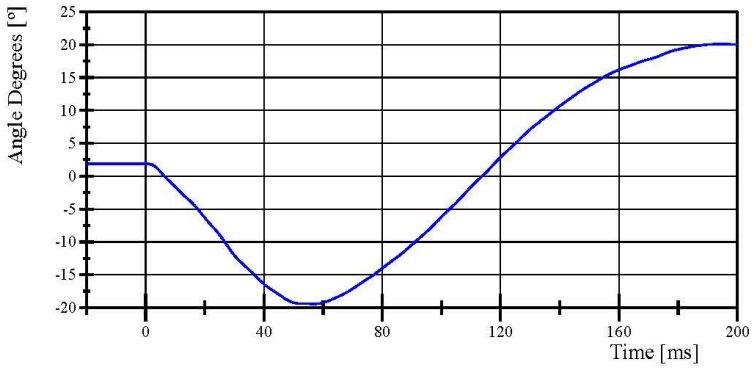
Specification Source: CFR49 Part 572 Subpart P
with Polarity in accordance with J211

06.27.2019 11:30:31 633

Transportation Research Center Inc.

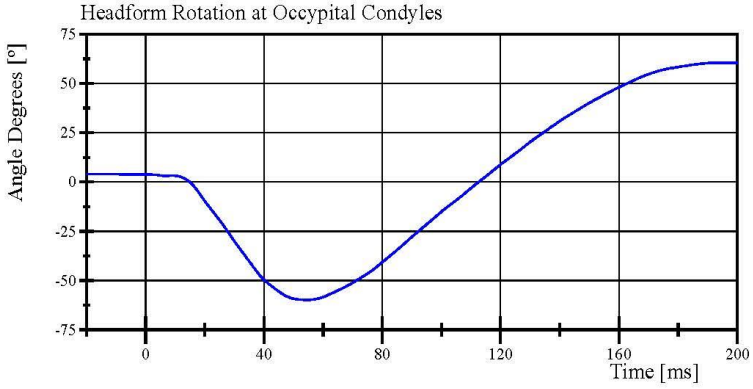
Neck Flexion
HIII 3YO Serial No. 040 Certification No. 9-2
Test Date: 6/27/2019

Pot Rotation at the Base of Neck



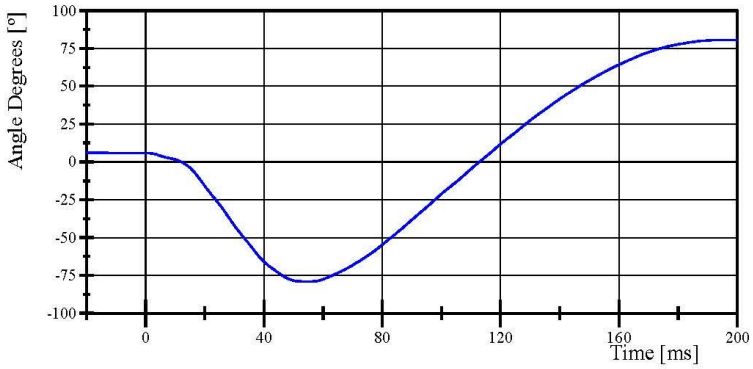
Filter Class: CFC_60
Max: 20.1 ° at 194.2 ms
Min: -19.5 ° at 56.7 ms

Headform Rotation at Occypital Condyles



Filter Class: CFC_60
Max: 60.5 ° at 197.1 ms
Min: -59.7 ° at 54.7 ms

Total Headform D-Plane Rotation



Filter Class: CFC_60
Max: 80.6 ° at 195.0 ms
Min: -79.2 ° at 55.0 ms

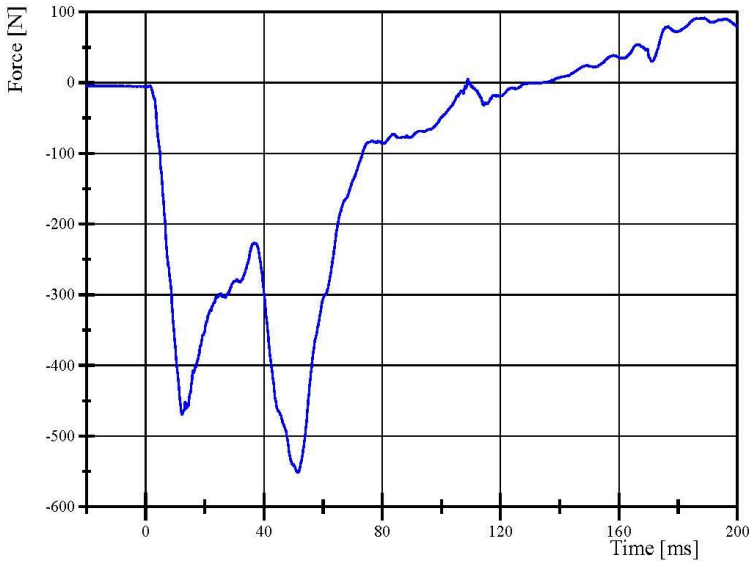
Specification Source: CFR49 Part 572 Subpart P
with Polarity in accordance with J211

06.27.2019 11:30:31 633

Transportation Research Center Inc.

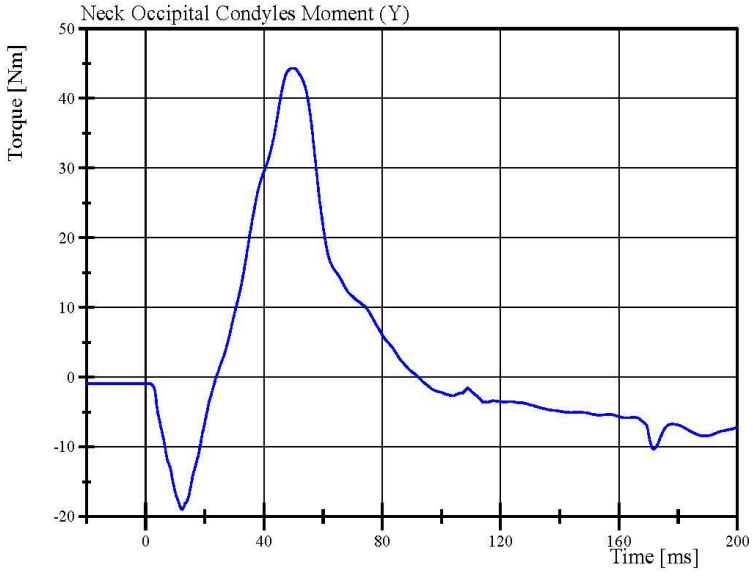
Neck Flexion
HIII 3YO Serial No. 040 Certification No. 9-2
Test Date: 6/27/2019

Neck Force (X)



Filter Class: CFC_1000
Max: 91.5 N at 188.8 ms
Min: -551.4 N at 51.4 ms

Neck Occipital Condyles Moment (Y)



Filter Class: CFC_600
Max: 44.4 Nm at 49.8 ms
Min: -19.0 Nm at 12.3 ms

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

06.27.2019 11:30:32 633

Transportation Research Center Inc.

Neck Extension
HIII 3YO Serial No. 040 Certification No. 9-1
Test Date: 6/27/2019

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	21.0 °C	Yes
Relative Humidity	10 - 70 %	60 %	Yes
Pendulum Impact Velocity	(-3.55) - (-3.75) m/s	-3.745 m/s	Yes
Pendulum Integrated Velocity Change at 6 ms	1.0 - 1.4 m/s	1.25 m/s	Yes
Pendulum Integrated Velocity Change at 10 ms	1.9 - 2.5 m/s	2.26 m/s	Yes
Pendulum Integrated Velocity Change at 14 ms	2.8 - 3.5 m/s	3.19 m/s	Yes
Total Headform D-Plane Rotation	83 - 93 °	88.6 °	Yes
Peak Neck Occipital Condyles Moment	(-43.7) - (-53.3) Nm	-45.39 Nm	Yes
Neck Occipital Condyles Moment Decay to 10 Nm	60 - 80 ms	70.2 ms	Yes

Test meets specifications.

Condition: New

Comments:
Neck S/N: 160308

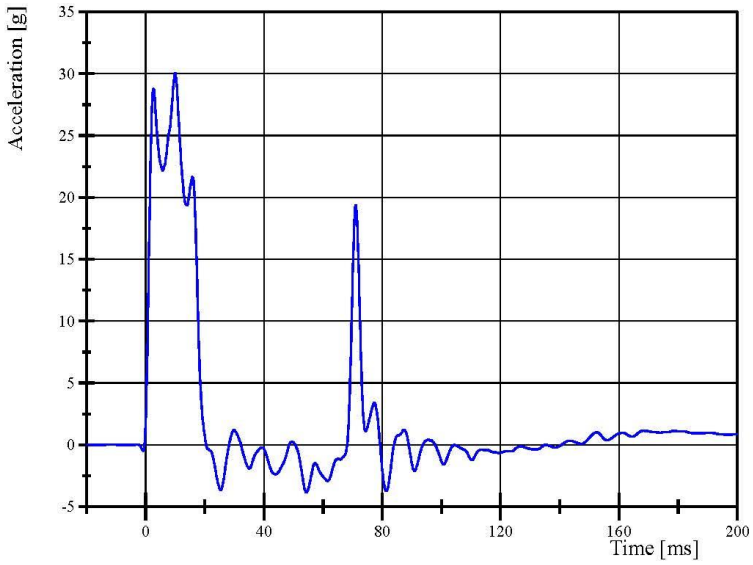
Specification Source: CFR49 Part 572 Subpart P with Polarity in accordance with J211

06.27.2019 12:49:38 935

Transportation Research Center Inc.

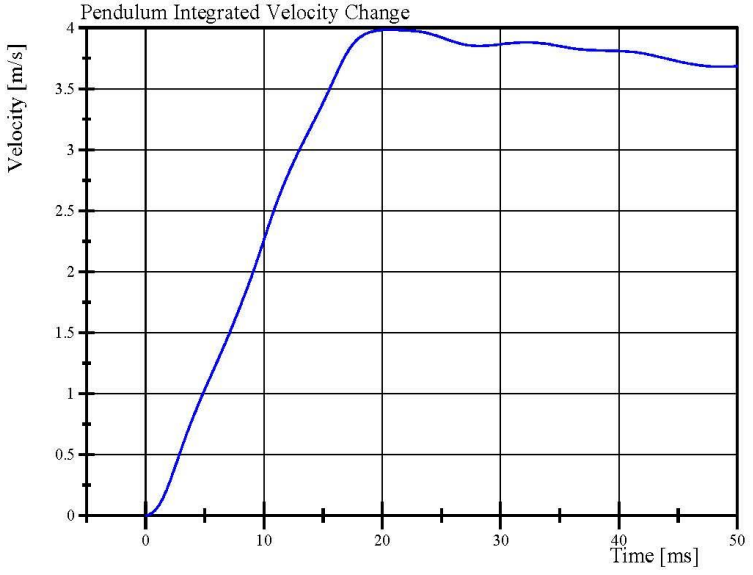
Neck Extension
HIII 3YO Serial No. 040 Certification No. 9-1
Test Date: 6/27/2019

Pendulum Acceleration



Filter Class: CFC_180
Max: 30.1 g at 10.0 ms
Min: -3.8 g at 54.3 ms

Pendulum Integrated Velocity Change



Filter Class: CFC_180
Max: 4.0 m/s at 20.5 ms
Min: 0.0 m/s at 0.0 ms

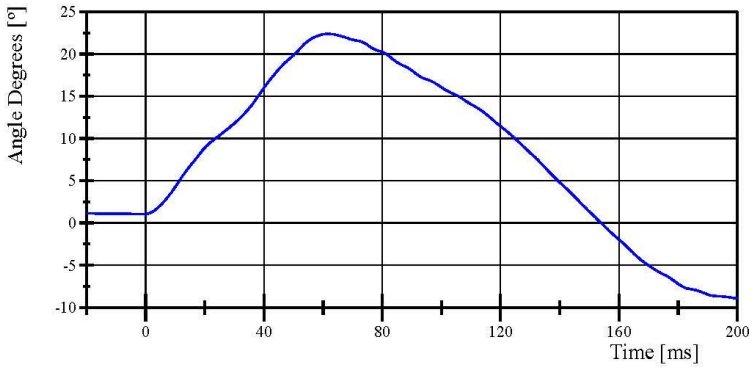
Specification Source: CFR49 Part 572 Subpart P
with Polarity in accordance with J211

06.27.2019 12:50:24 935

Transportation Research Center Inc.

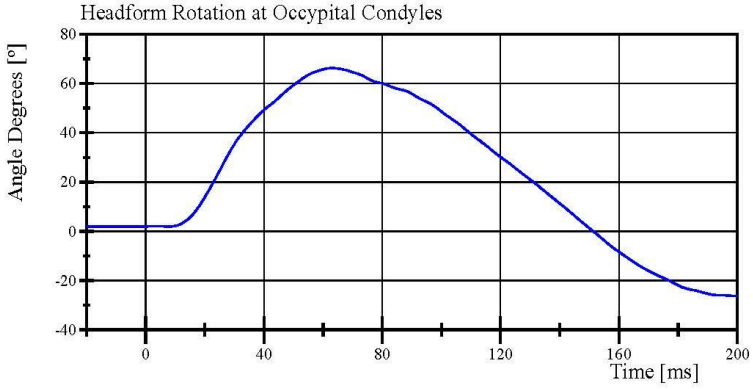
Neck Extension
HIII 3YO Serial No. 040 Certification No. 9-1
Test Date: 6/27/2019

Pot Rotation at the Base of Neck



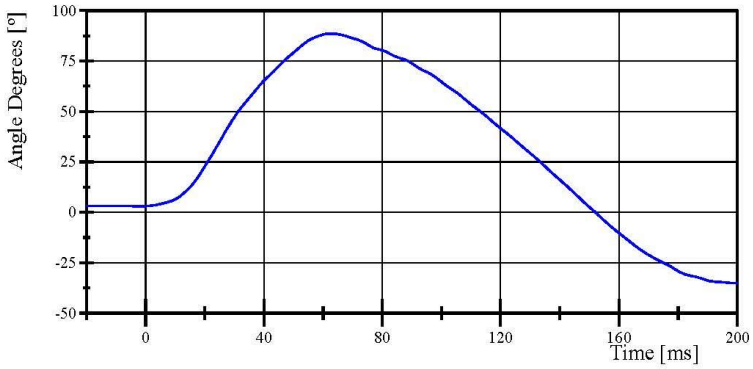
Filter Class: CFC_60
Max: 22.4 ° at 61.7 ms
Min: -8.9 ° at 200.0 ms

Headform Rotation at Occypital Condyles



Filter Class: CFC_60
Max: 66.2 ° at 63.0 ms
Min: -26.2 ° at 199.8 ms

Total Headform D-Plane Rotation



Filter Class: CFC_60
Max: 88.6 ° at 62.6 ms
Min: -35.1 ° at 200.0 ms

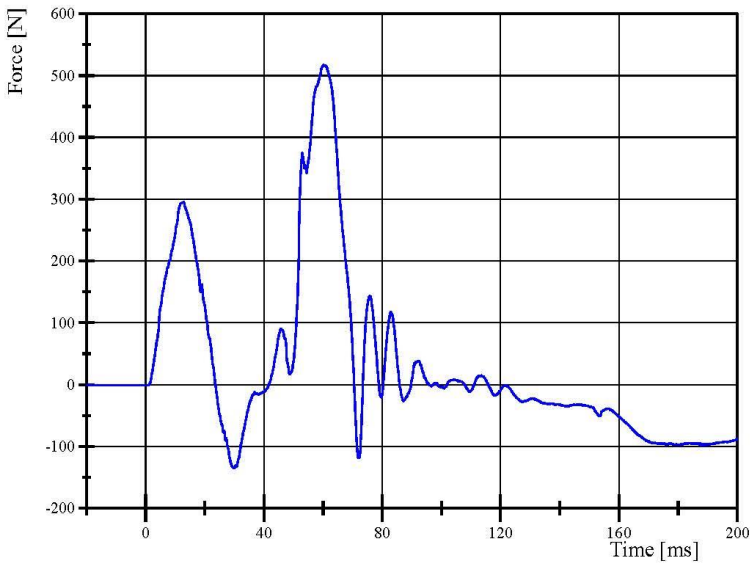
Specification Source: CFR49 Part 572 Subpart P
with Polarity in accordance with J211

06.27.2019 12:50:24 935

Transportation Research Center Inc.

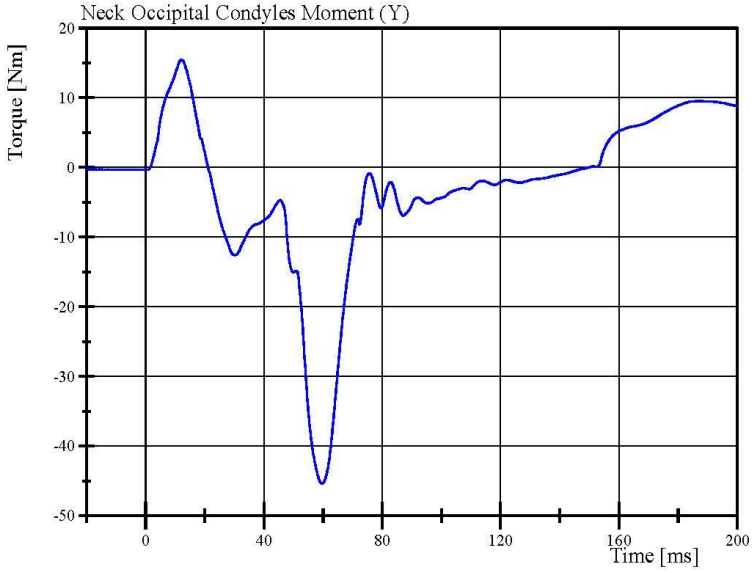
Neck Extension
HIII 3YO Serial No. 040 Certification No. 9-1
Test Date: 6/27/2019

Neck Force (X)



Filter Class: CFC_1000
Max: 516.7 N at 60.2 ms
Min: -134.7 N at 30.1 ms

Neck Occipital Condyles Moment (Y)



Filter Class: CFC_600
Max: 15.4 Nm at 12.0 ms
Min: -45.4 Nm at 59.7 ms

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

06.27.2019 12:50:25 935

Transportation Research Center Inc.

Front Thorax
HIII 3YO Serial No. 040 Certification No. 9-1
Test Date: 6/27/2019

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	21.4 °C	Yes
Relative Humidity	10 - 70 %	58 %	Yes
Probe Velocity	5.9 - 6.1 m/s	5.98 m/s	Yes
Probe Force Peak Between 32.0 mm and 38.0 mm Chest Deflection	(-680) - (-810) N	-743.3 N	Yes
Probe Force Peak Between 12.5 mm and 32.0 mm Chest Deflection	>= (-910) N	-738.7 N	Yes
Maximum Chest Compression	(-32) - (-38) mm	-34.7 mm	Yes
Internal Hysteresis	65 - 85 %	65.3 %	Yes

Test meets specifications.

Condition: Used

Comments:
Torso Flesh S/N: 16312
Rib Set S/N: 16030071

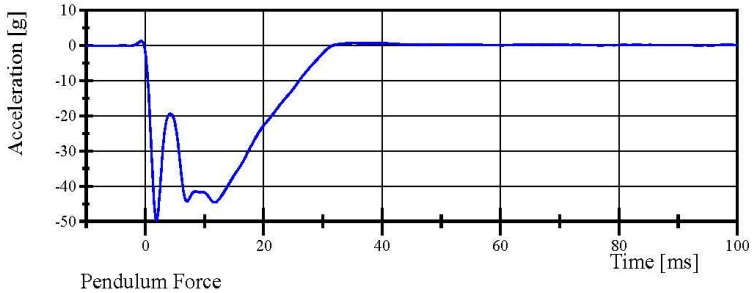
Specification Source: CFR49 Part 572 Subpart P with Polarity in accordance with J211

06.27.2019 15:18:53 416

Transportation Research Center Inc.

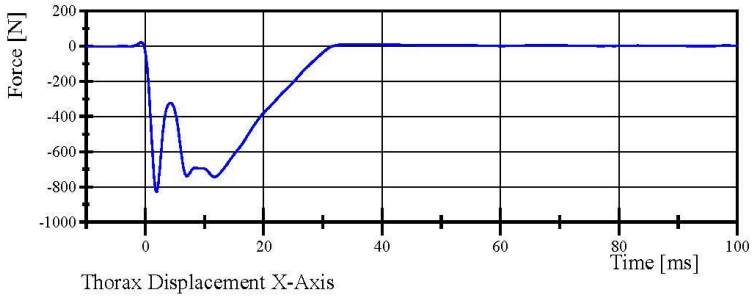
Front Thorax
HIII 3YO Serial No. 040 Certification No. 9-1
Test Date: 6/27/2019

Pendulum Acceleration



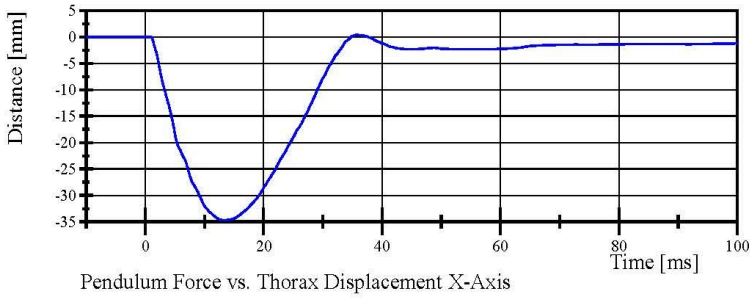
Filter Class: CFC_180
Max: 1.3 g at -0.7 ms
Min: -49.7 g at 1.9 ms

Pendulum Force



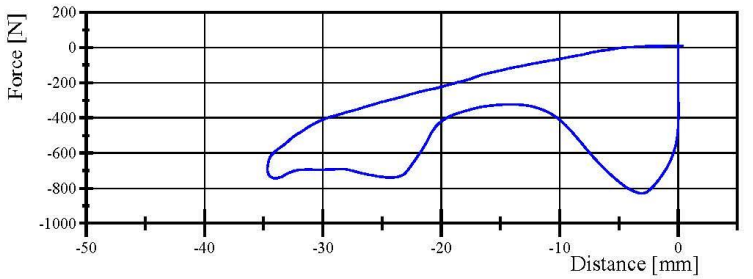
Filter Class: CFC_180
Max: 20.9 N at -0.7 ms
Min: -829.1 N at 1.9 ms

Thorax Displacement X-Axis



Filter Class: CFC_600
Max: 0.4 mm at 35.6 ms
Min: -34.7 mm at 13.4 ms

Pendulum Force vs. Thorax Displacement X-Axis



Filter Class: CFC_180
Max: 20.9 N at -0.0 mm
Min: -829.1 N at -3.2 mm

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

06.27.2019 15:19:56 416

APPENDIX D – TEST EQUIPMENT AND INSTRUMENTATION CALIBRATION

			Serial Number	Manufacturer and Model #	Calibration Date	Date Due
ATD		N/A	040	FTSS	27-Jun-2019	
Head Accelerometers	Primary	X	P97685	Endevco	26-Jun-2019	26-Dec-2019
		Y	P97528	Endevco	26-Jun-2019	26-Dec-2019
		Z	P97862	Endevco	27-Jun-2019	27-Dec-2019
	Redundant	X	P97696	Endevco	26-Jun-2019	27-Dec-2019
		Y	P97533	Endevco	26-Jun-2019	26-Dec-2019
		Z	P97531	Endevco	26-Jun-2019	26-Dec-2019
Upper Neck Load Cell		Fx, Fy, Fz, Mx, My, Mz	214	Denton	26-Jun-2019	25-Jun-2020
Lower Neck Load Cell		Fx, Fy, Fz, Mx, My, Mz	210	Denton	26-Jun-2019	25-Jun-2020
Chest Potentiometer		Dx	CST040	Servo	26-Jun-2019	25-Jun-2020
Sternum Accelerometer		X	P97686	Endevco	26-Jun-2019	26-Dec-2019
Spine Accelerometer		X	T11394	Endevco	26-Jun-2019	26-Dec-2019
Data System		N/A	223	Kayser-Threde	10-Jul-2019	
Inclinometer		N/A	DP-7	Mitutoyo Pro 360	19-Oct-2018	19-Oct-2019