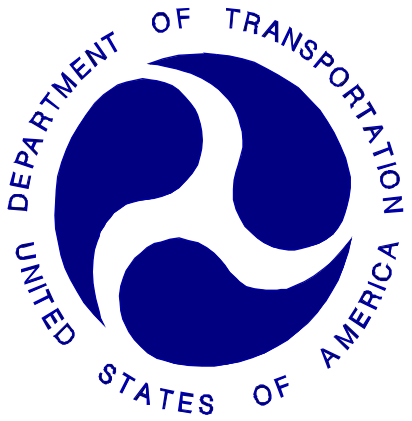
REPORT NUMBER: TWG-CAL-20-05

NEW CAR ASSESSMENT PROGRAM (NCAP)
SIDE AIRBAG OUT-OF-POSITION TEST

GM Korea Company
2020 Buick Encore GX
SUV

NHTSA NUMBER: M20200101TWG3

PREPARED BY:
CALSPAN CORPORATION
4455 Genesee St.
BUFFALO, NEW YORK 14225



July 8, 2021

FINAL REPORT

U.S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Office of Crashworthiness Standards
Mail Code: NRM-110
1200 New Jersey Ave, SE
Room W43-410
Washington, DC 20590

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Vanessa Hansen, Operations Program Manager

Approval Date: July 8, 2021

FINAL REPORT ACCEPTANCE BY OCWS:

Accepted By: _____

Division Chief, New Car Assessment Program
NHTSA, Office of Crashworthiness Standards

Date: _____

Accepted By: _____

COR, New Car Assessment Program
NHTSA, Office of Crashworthiness Standards

Date: _____

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7. Author(s) Matthew Pronko, Test Engineer Vanessa Hansen, Operations Program Manager		8. Performing Organization Report Number CAL-DOT-2020-005
9. Performing Organization Name and Address Calspan Corporation 4455 Genesee St. Buffalo, New York 14225		10. Work Unit No. 11. Contract or Grant No. 693JJ919F000146
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16. Abstract

A side air bag out of position test was conducted on the subject 2020 Buick Encore GX 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 Calspan Corporation Test Facility in Buffalo, New York, on August 7, 2020.

The curtain and torso side air bags were deployed and responses were measured on a Hybrid III 3-Year-Old. One high-speed camera recorded the event. The ambient temperature at the time of air bag deployment was 21 °C

Section 3.3.3.4 – Hybrid III 3-Year-Old – Right Rear Passenger Seat			
Measurement Description	**Units**	**IARV**	**Result**
Head Injury Criteria (HIC15)		570	11.21
Nij		1.0	0.466
Upper Neck Tension	N	1130	56.898
Upper Neck Compression	N	1380	-604.754
Maximum Chest Compression	mm	N/A	N/A
Maximum Chest Compression Rate	m/s	N/A	N/A

17. KEY Words: New Car Assessment Program (NCAP) Side Air Bag Out-of-Position (OOP) Technical Working Group (TWG)	18. Distribution Statement Copies of this report are available from the following: National Highway Traffic Safety Administration Technical Information Services 1200 New Jersey Ave, SE Washington, DC 20590 Email: tis@nhtsa.dot.gov FAX: 202-493-2833

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SECTION 1

PURPOSE AND PROCEDURE OF TEST:

1.1 PURPOSE

The purpose of this test was to obtain data from a static out-of-position side air bag deployment using a vehicle that had previously undergone a New Car Assessment Program (NCAP) sponsored side pole impact test requested by the National Highway Traffic Safety Administration (NHTSA). This test was performed under NHTSA contract No. 693JJ919F000146.

SECTION 2

SUMMARY OF TEST RESULTS

The effects of both a seat-mounted side airbag and a curtain airbag deployment in a 2020 Buick Encore GX SUV on an out-of-position Hybrid III 3-Year-Old ATD were evaluated. The test was performed by Calspan on August 7, 2020. Pre-and post-test photographs of the vehicle and ATD can be found in Appendix A.

The vehicle has previously undergone crash testing as part of the NCAP program. 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 high-speed digital camera was used to document the airbag deployment event. High-speed images were recorded at rates of 1000 frames per second. Cameras were placed perpendicular to the right-rear passenger seat centerline through the passenger window to capture the deployment event from various positions.

The Hybrid III 3-Year-Old anthropomorphic test device (ATD) was placed in the right rear passenger seat laying face up with head aligned with the vertical centerline of the seat-mounted airbag module. 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). This orientation complies with section 3.3.3.4 of the TWG Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags as defined by Lund, et al and the Technical Working Group First Revision dated July 2003.

The Hybrid III 3-Year-Old ATD was instrumented with head x, y and z accelerometers, a six-axis upper neck load cell, and a six-axis lower neck load cell. During the air bag deployment event, a total of 22 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.

No Injury Reference Values were exceeded during the test. The occupant data is summarized below:

Measurement Description	Units	Hybrid III 3-Year-Old	
		IARV	Result
Head Injury Criteria (HIC15)		570	11.21
Nij		1.0	0.466
Upper Neck Tension	N	1130	56.898
Upper Neck Compression	N	1380	-604.754

SECTION 3
DATA SHEETS

DATA SHEET NO. 1
TEST SUMMARY

Test Vehicle:	2020 Buick Encore GX SUV	NHTSA No.:	M20200101TWG3
Test Program:	TWG 3.3.3.4	Test Date:	8/7/2020

TEST CONFIGURATION INFORMATION

Seating Position:	P3	Right Rear Seating Position
Test:	3.3.3.4	Seat Mounted – Lying on Seat
Airbag: 1	Curtain	Roof Rail Mounted – Passenger Side
Airbag: 2	Seat/Torso	Rear Passenger Seat Mounted – Outside Seam
Booster Block:	N/A	N/A
Vehicle	Buick	Encore GX SUV
Previous Crash Test	SPNCAP	NCAP Side Pole – NHTSA No. M20200101

EQUIPMENT INFORMATION

Number of Data Channels	22
Number of High Speed Video Cameras	1
Number of Real Time Video Cameras	0

VISIBLE DUMMY CONTACT POINTS

Head Contact:	Torso/Pelvis Airbag
Upper Torso Contact:	Right Rear Passenger Seat Pan
Lower Torso Contact:	Right Rear Passenger Seat Pan
Knee Contact:	Center Rear Passenger Seat Pan
Foot Contact:	Left Rear Passenger Seat Pan

DATA SHEET NO. 2
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2020 Buick Encore GX SUV
NHTSA No.: M20200101TWG3
Test Program: TWG 3.3.3.4
Test Date: 8/7/2020

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA No.	M20200101TWG3
Model Year	2020
Make	Buick
Model	Encore GX
Body Style	SUV
VIN	KL4MMBS20LB070343
Body Color	Gray
Odometer Reading (km /mi)	165 miles
Engine Displacement (L)	1.2
Type / No. Cylinders	I3
Engine Placement	Transverse
Transmission Type	Automatic
Transmission Speeds	CVT
Overdrive	Yes
Final Drive	Front Wheel Drive
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 (ADLs)	Yes
Power Window Auto-Reverse	No
Other Optional Feature	-
Driver Frontal 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	Yes
Rear Pass. Pelvis Airbag	No
Driver Pretensioner	Yes
Rear Pass. Pretensioner	No
Driver Load Limiter	Yes
Rear Pass. Load Limiter	No
Other Safety Restraint	-

DATA FROM CERTIFICATION LABEL

Manufactured By	GM Korea Company
Date of Manufacture	11/19
Vehicle Type	MPV

GVWR (kg)	1910
GAWR Front (kg)	1060
GAWR Rear (kg)	1060

VEHICLE SEATING AND WEIGHT CAPACITY DATA

Measured Parameter	Front	Rear	Third	Total	
Designated Seating Capacity (DSC)	2	3	N/A	5	
Capacity Wt. (VCW) (kg)				428	(A)
DSC x 68.04 (kg)				340.2	(B)
Cargo Wt. (RCLW) (kg)				87.8	(A-B)

VEHICLE SEAT TYPE

Seating Location	Type of Seat Pan				Type of Seatback		
	Bucket	Bench	Split Bench	Contoured	Fixed	Adjustable w/lever	Adjustable w/knob
Front Seat	X					X	
Rear or Second Row			X		X		
Third Row							

DATA SHEET NO. 3
SEAT ADJUSTMENT DATA

Test Vehicle: 2020 Buick Encore GX SUV NHTSA No.: M20200101TWG3
Test Program: TWG 3.3.3.4 Test Date: 8/7/2020

VEHICLE SEAT FORE / AFT POSITION

Seat Location	Total Fore / Aft Travel		Test Position from Forwardmost Position	
	mm	Detents*	mm	Detent*
Front Right	260	27 (0-26)	0	0
Rear Right	FIXED	FIXED	FIXED	FIXED

TWG Seat Fore/Aft Guideline Reference	
Seat Fore/Aft Position Per TWG Guidelines	Tests are to be conducted with the seat in the rearmost position
Reason for Deviation from TWG Guidelines	No deviation from TWG Guidelines Front seat was positioned to Full Forward for conducted 3.3.5.2 TWG Testing

VEHICLE SEAT BACK ANGLE ADJUSTMENT

Seat Location	Total Seat Back Angle Range		Test Position from Most Upright (Vertical)	
	Degrees	Detents*	Degrees	Detents*
Front Right	N/A	N/A	-7.4	6
Rear Right	FIXED	FIXED	FIXED	FIXED

TWG Seat Back Guideline Reference	
OEM Seat Back Angle Design Position	12.7°
Method of Measuring Seat Back Angle Position	Headrest Post
Seat Back Angle Position Per TWG Guidelines	14.8° (Fixed)
Reason for Deviation from TWG Guidelines	No deviation from TWG Guidelines

VEHICLE SEAT HEIGHT ADJUSTMENT

Seat Location	Total Height Adjustment Range		Test Position from Lowermost Position	
	mm	Detents*	mm	Detent*
Front Right	N/A	N/A	N/A	N/A
Rear Right	FIXED	FIXED	FIXED	FIXED

TWG Seat Back Guideline Reference	
Seat Height Position Per TWG Guidelines	Tests are to be conducted with the seat in the rearmost adjustment.
Reason for Deviation from TWG Guidelines	No deviation from TWG Guidelines

DATA SHEET NO. 4
DUMMY SETUP AND POSITIONING DATA

Test Vehicle:	2020 Buick Encore GX SUV	NHTSA No.:	M20200101TWG3
Test Program:	TWG 3.3.3.4	Test Date:	8/7/2020

DUMMY INFORMATION

ATD Type:	Hybrid III 3-Year-Old
Serial Number:	139
Qualification Date:	July 28, 2020
Qualification Type:	Full Qualification
Clothing:	Cotton knit shirt and pants
Other ATD Prep:	The skullcap seam was taped with 4mm wide electrical tape and the ATD's head was cleaned with alcohol and dusted with baby powder.
ATD Temperature:	21° C

DUMMY POSITIONING INFORMATION

TWG Setup Instructions:	Place the dummy on the seat lying on its back with its arms at its sides so that its rearmost arm contacts the seatback. Slide the dummy outboard until the CG of the head is aligned with the vertical centerline of the airbag module. Should the door/side trim interfere with the placement of the head then adjust the seat to ensure that the test objective is met. If necessary, stabilize the dummy by placing a block of lightweight foam under the dummy's legs.
Actual Setup:	The dummy was placed on the seat lying on its back with its arms at its sides so that its rearmost arm contacted the seatback. The dummy was slid outboard until the top of the head could no longer be moved outboard due to interference with the right rear passenger interior door trim. As a result, the CG of the head was not directly aligned with the vertical centerline of the airbag module.

DATA SHEET NO. 5
DUMMY INJURY CRITERIA DATA

Test Vehicle: 2020 Buick Encore GX SUV NHTSA No.: M20200101TWG3
Test Program: TWG 3.3.3.4 Test Date: 8/7/2020

RECORDED DATA – MINIMUMS AND MAXIMUMS

Channel	Units	Max	Time (ms)	Min	Time (ms)
V1P3 Head x [CFC_1000]	g's	7.85	19.20	-45.80	8.55
V1P3 Head y [CFC_1000]	g's	12.80	17.80	-17.48	12.75
V1P3 Head z [CFC_1000]	g's	25.86	15.10	-13.03	8.90
V1P3 Headform Resultant [CFC_1000]	g's	47.98	8.55	0.00	-38.45
V1P3 Upper Neck Mocy [CFC_600]	Nm	14.20	17.15	-1.12	128.85
V1P3 Upper Neck Ntf [CFC_600]	-	0.05	67.05	0.00	-50.00
V1P3 Upper Neck Nte [CFC_600]	-	0.03	211.30	0.00	-50.00
V1P3 Upper Neck Ncf [CFC_600]	-	0.47	16.00	0.00	-50.00
V1P3 Upper Neck Nce [CFC_600]	-	0.10	9.15	0.00	-49.90
V1P3 Upper Neck Nij [CFC_600]	-	0.47	16.00	0.00	-16.50
V1P3 Upper Neck Fx [CFC_1000]	N	15.32	9.10	-286.53	14.85
V1P3 Upper neck Fy [CFC_1000]	N	57.30	8.55	-107.74	15.00
V1P3 Upper neck Fz [CFC_1000]	N	56.90	72.05	-604.75	15.65
V1P3 Neck Force Resultant [CFC_1000]	N	661.04	15.60	0.04	-30.05
V1P3 Upper Neck Mx [CFC_600]	Nm	2.08	10.10	-9.33	18.35
V1P3 Upper Neck My [CFC_600]	Nm	14.20	17.15	-1.12	128.85
V1P3 Upper Neck Mz [CFC_600]	Nm	0.46	8.55	-2.47	33.25
V1P3 Neck Moment Resultant [CFC_600]	Nm	16.71	17.15	0.00	-5.45
V1P3 Lower Neck Fx F [CFC_1000]	N	492.33	18.35	-37.43	130.90
V1P3 Lower Neck Fy F [CFC_1000]	N	255.60	15.85	-101.79	11.30
V1P3 Lower Neck Fz F [CFC_1000]	N	107.67	72.10	-1245.67	15.85
V1P3 Lower Neck Force Resultant [CFC_1000]	N	1326.99	15.85	0.08	-14.10
V1P3 Lower Neck Mx F [CFC_600]	Nm	3.81	49.25	-11.74	28.55
V1P3 Lower Neck My F [CFC_600]	Nm	0.86	46.30	-9.97	18.10
V1P3 Lower Neck Mz F [CFC_600]	Nm	0.50	11.10	-2.00	35.80
V1P3 Lower Neck Moment Resultant [CFC_600]	Nm	11.97	28.55	0.00	-9.45
Curtain Airbag Volts	V	15.73	9.50	-0.00	-10.00
Torso/Pelvis Airbag Volts	V	15.15	0.25	-0.12	40.25
Front Center Airbag Volts	V	-	-	-	-
Curtain Airbag Current	A	3.12	0.20	-0.04	36.75
Torso/Pelvis Airbag Current	A	21.82	0.80	-0.09	9.50
Front Center Airbag Current	A	-	-	-	-

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

Test Vehicle: 2020 Buick Encore GX SUV NHTSA No.: M20200101TWG3
Test Program: TWG 3.3.3.4 Test Date: 8/7/2020

HEAD INJURY SUMMARY

H15	T1 (ms)	T2 (ms)	HIC36	T1 (ms)	T2 (ms)
11.21	7.95	20.55	N/A	N/A	N/A

NECK INJURY SUMMARY

Injury Criteria	Units	Value	Time(ms)
Upper Neck NTF		0.047	67.050
Upper Neck NTE		0.027	211.300
Upper Neck NCF		0.466	16.000
Upper Neck NCE		0.103	9.150
Peak Tension	N	56.898	72.05
Peak Compression	N	-604.754	15.65

CHEST INJURY SUMMARY

Injury Criteria	Units	Value	Time(ms)
Chest/Rib Deflection	mm	N/A	N/A
Deflection Rate[1]	m/s	N/A	N/A

[1](Describe deflection rate calculation method)

RESEARCH INJURY SUMMARY

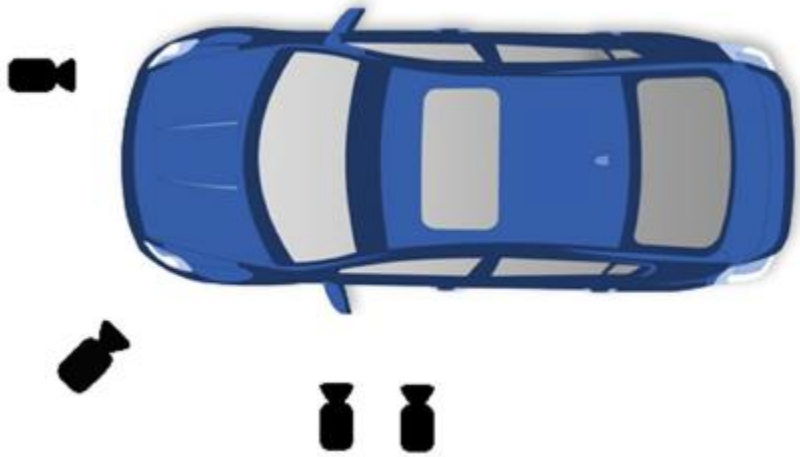
Research Injury Criteria	Units	Value	Time(ms)
Upper Neck Lateral Moment	Nm	-9.33	18.35
Upper Neck Twist Moment	Nm	-2.47	33.25
Lower Neck Flexion Moment	Nm	0.86	46.30
Lower Neck Extension Moment	Nm	-9.97	18.10
Lower Neck Lateral Moment	Nm	-11.74	28.55
Lower Neck Twist Moment	Nm	-2.00	35.80
Lower Neck Tension	N	107.67	72.10
Lower Neck Compression	N	-1245.67	15.85
Spine Acceleration	G	NA	NA

Note: These injury criteria are only monitored and not considered pass/fail

DATA SHEET NO. 6
CAMERA SETUP AND DESCRIPTION

Test Vehicle:	2020 Buick Encore GX SUV	NHTSA No.:	M20200101TWG3
Test Program:	TWG 3.3.3.4	Test Date:	8/7/2020

CAMERA SETUP DIAGRAM FOR SAB OOP TESTS



CAMERA LOCATIONS

No.	Camera View	Coordinates (mm)			Lens Length (mm)	Speed (fps)
		X	Y	Z		
1	Left View	-1963	-660	-1389	12.5	1000
2	Oblique View	0	-836	-1579	50	1000
3	Front View	624	0	-1658	50	1000
4	Real Time (Optional)	-3015	-660	-1446	12.5	1000

Reference:

+X = To Forward of vehicle
+Y = To Right of vehicle
+Z = Down 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

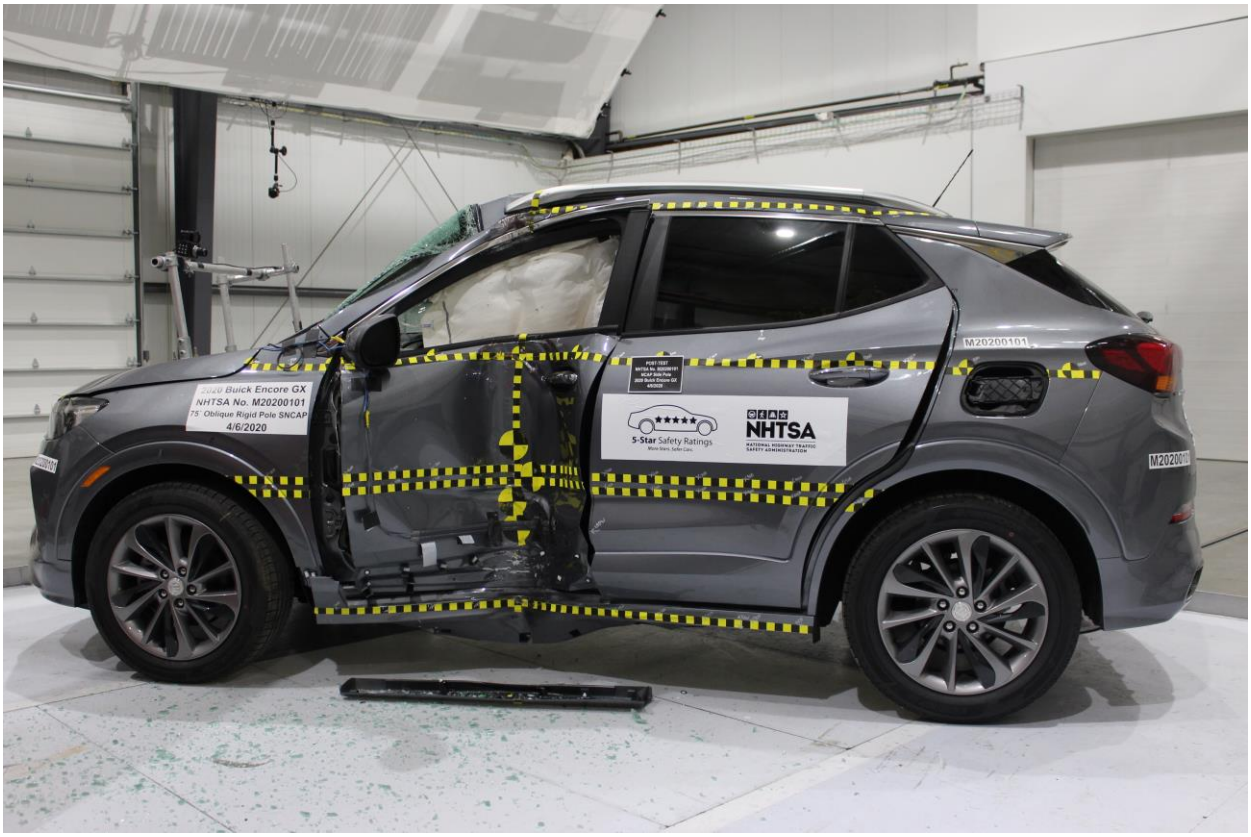


Figure A-4: Post-Test Vehicle Left Side View

Figure A-5: Pre-Test Vehicle Location of Airbag 1

Figure A-6: Pre-Test Vehicle Location of Airbag 2

Figure A-7: Pre-Test Vehicle Location of Airbag 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 View

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

Figure A-25: Post-Test Dummy Right Side View (Door Open)

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

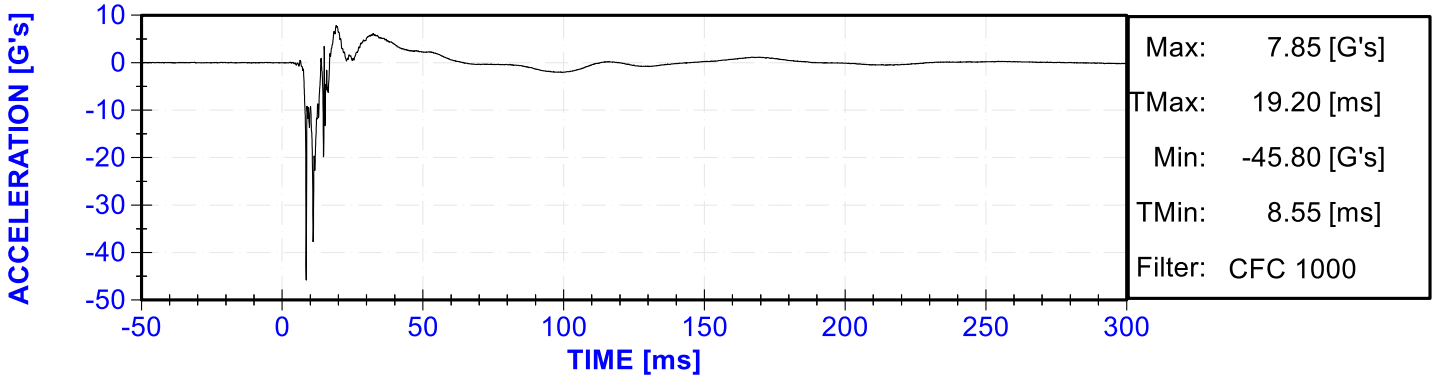
Figure A-29: Post-Test Curtain Air Bag Right Side View (Door Open)

APPENDIX B

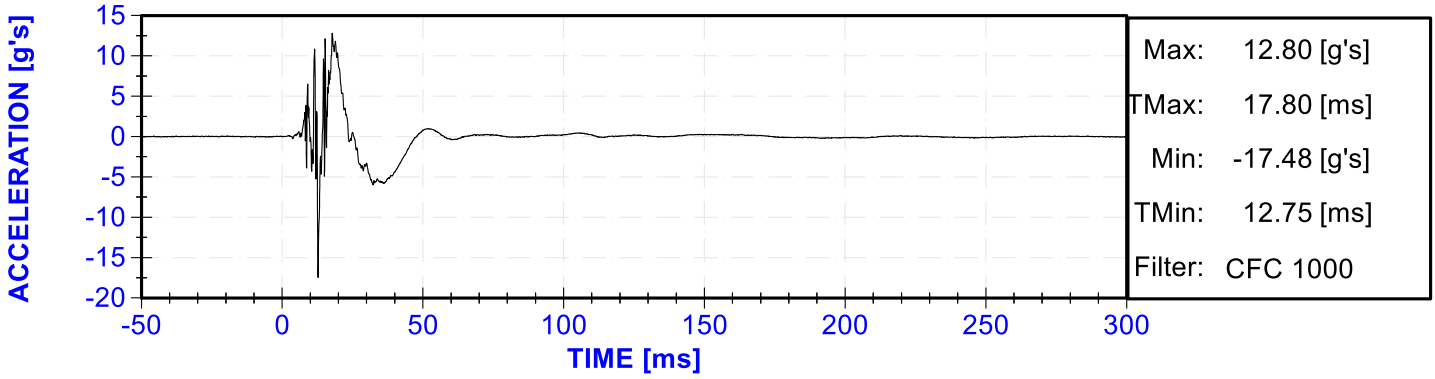
DUMMY RESPONSE DATA PLOTS

Table of Data Plots

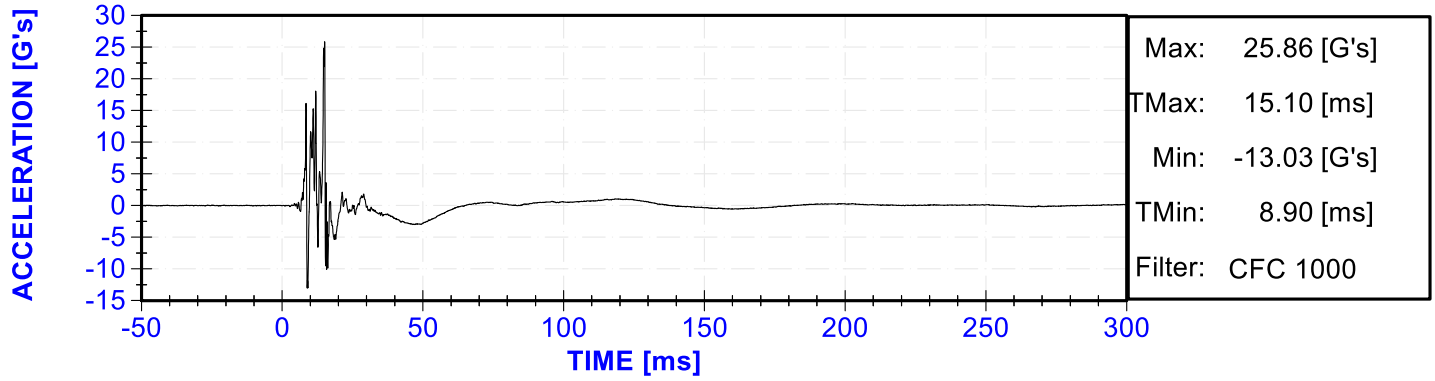
Head CG X Acceleration



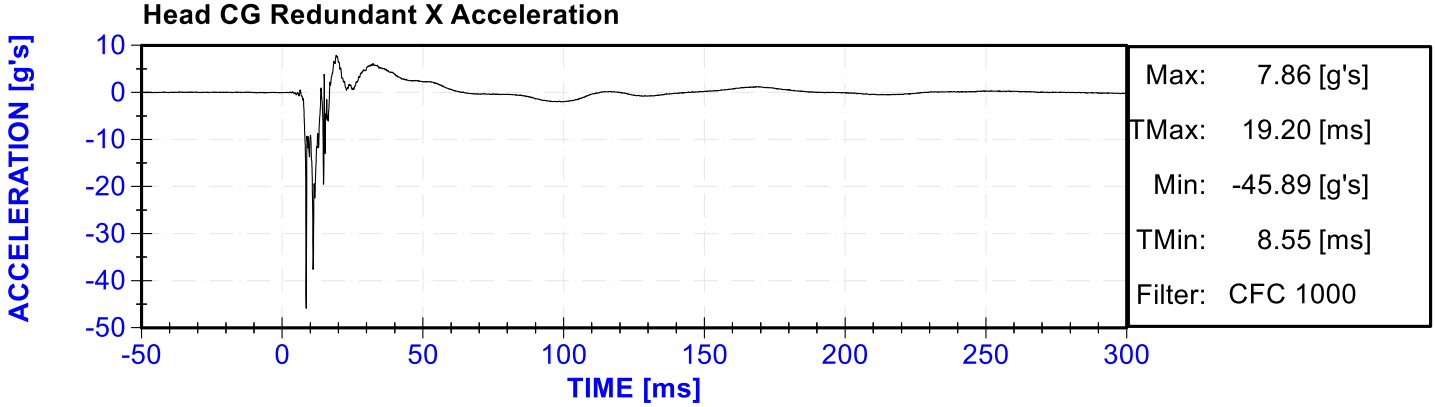
Head CG Y Acceleration



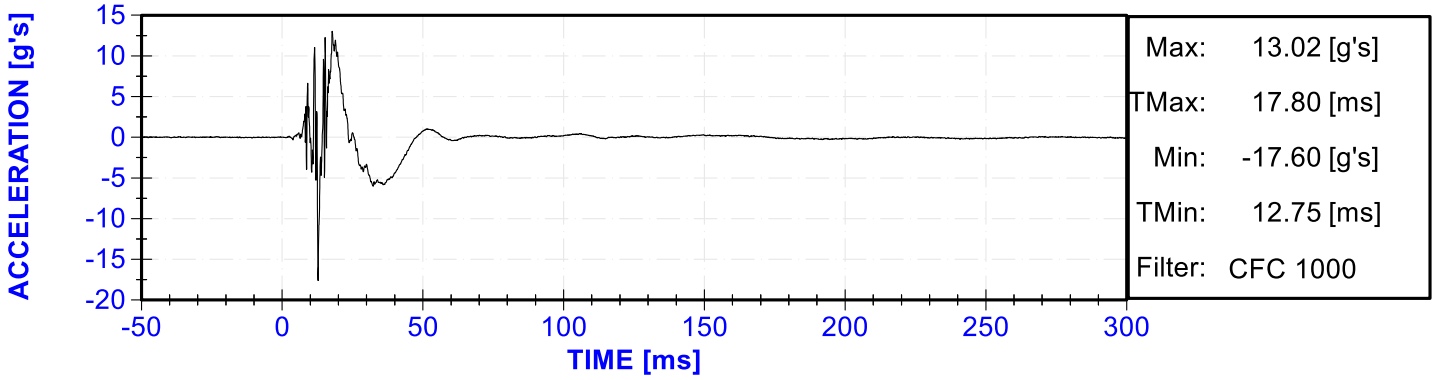
Head CG Z Acceleration



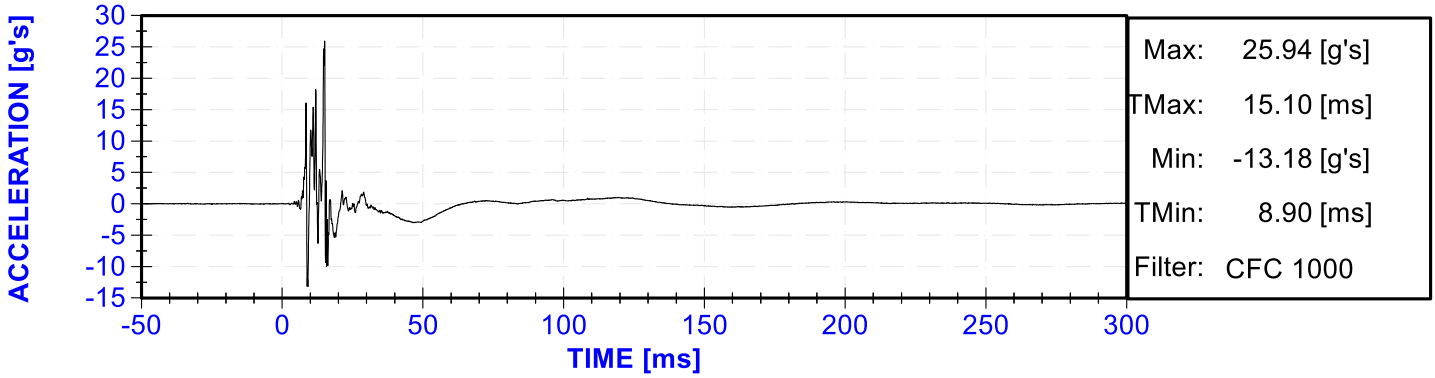
Head CG Redundant X Acceleration



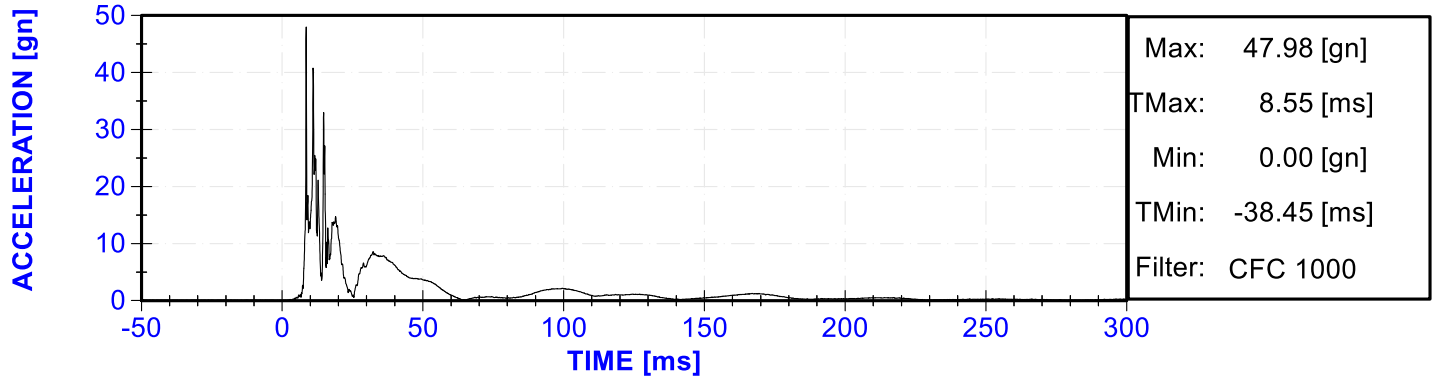
Head CG Redundant Y Acceleration



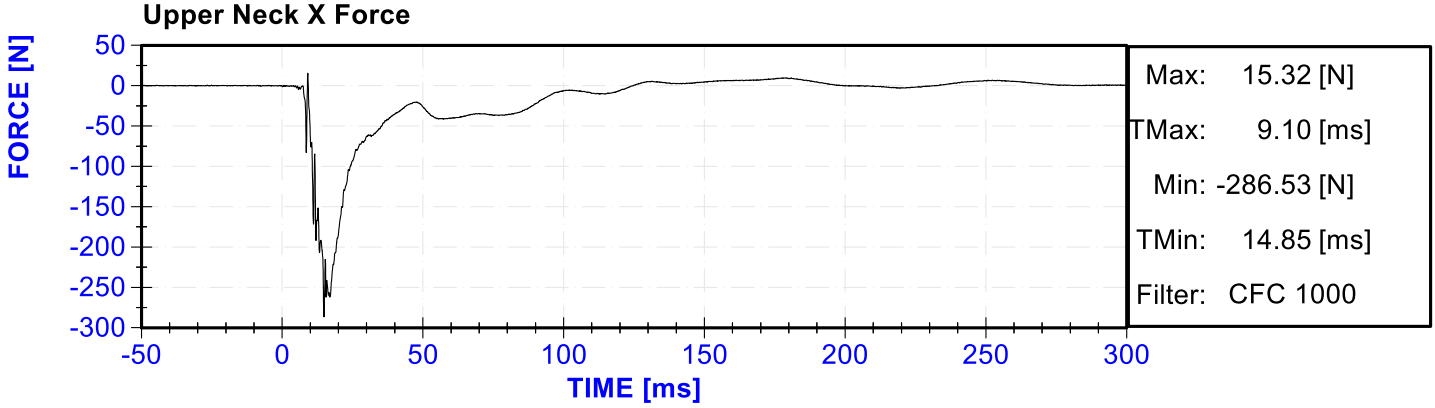
Head CG Redundant Z Acceleration



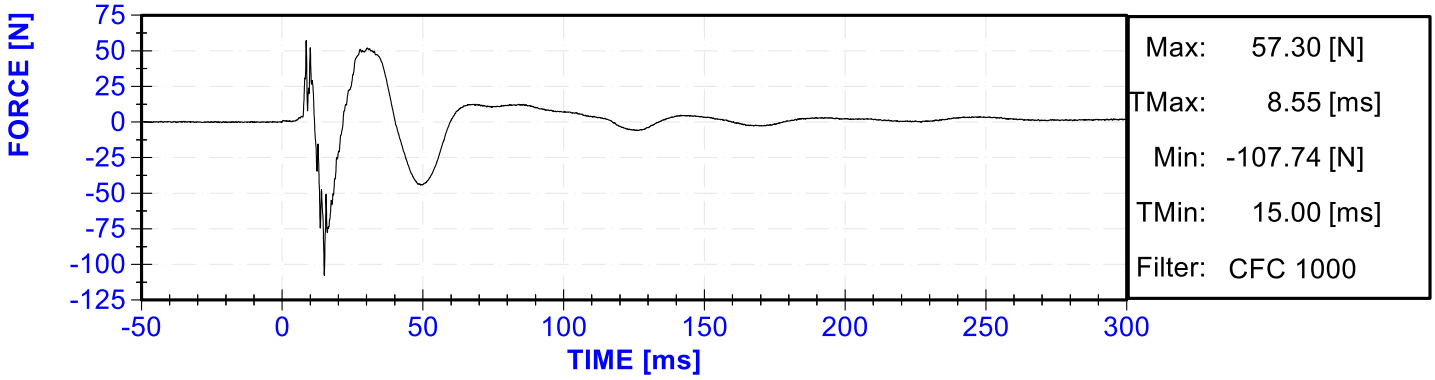
Head CG Acceleration Resultant



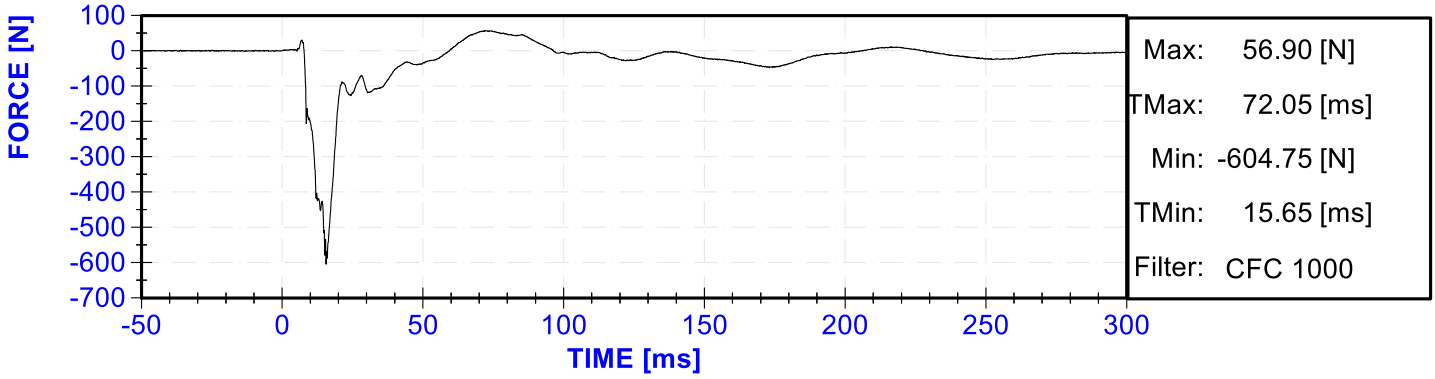
Upper Neck X Force



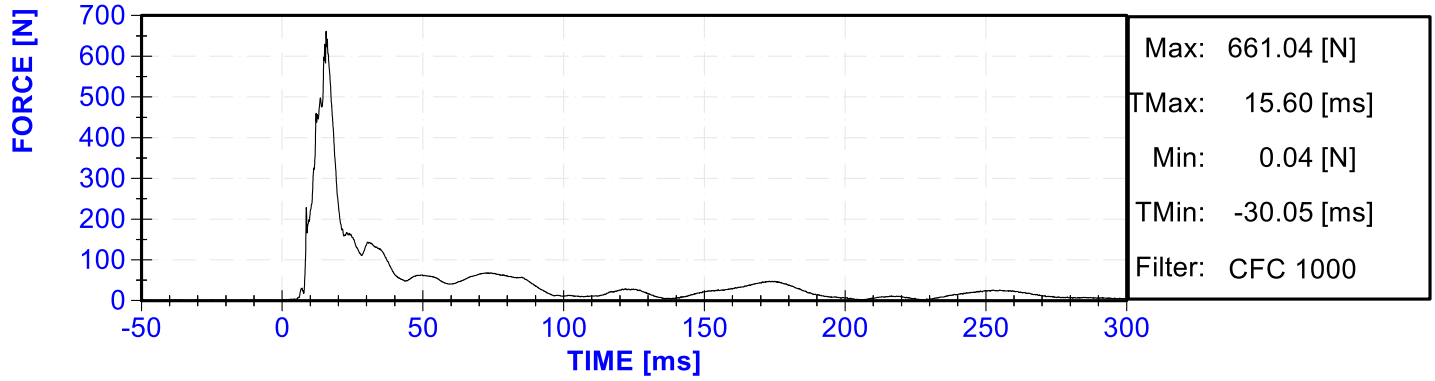
Upper Neck Y Force



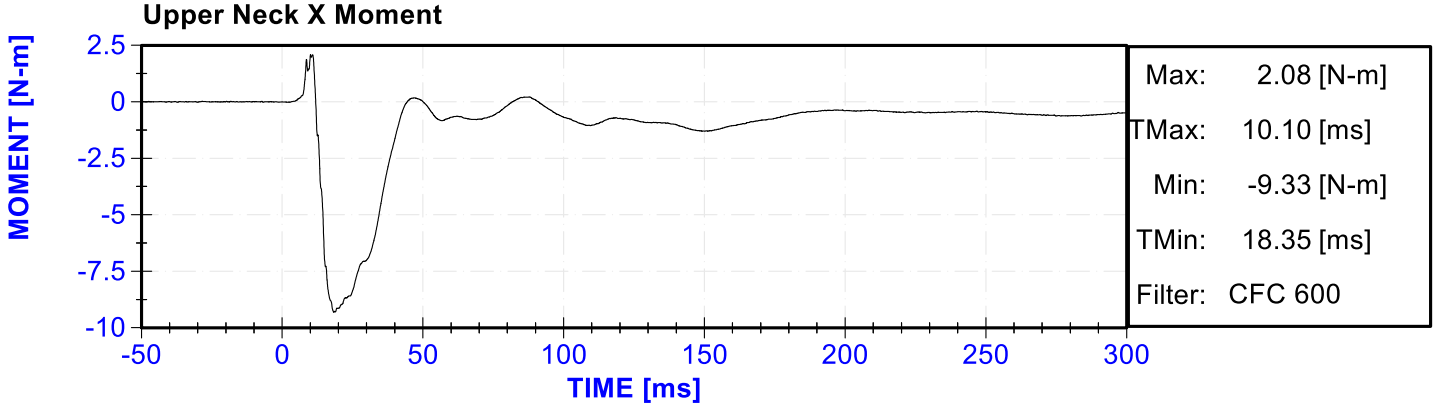
Upper Neck Z Force

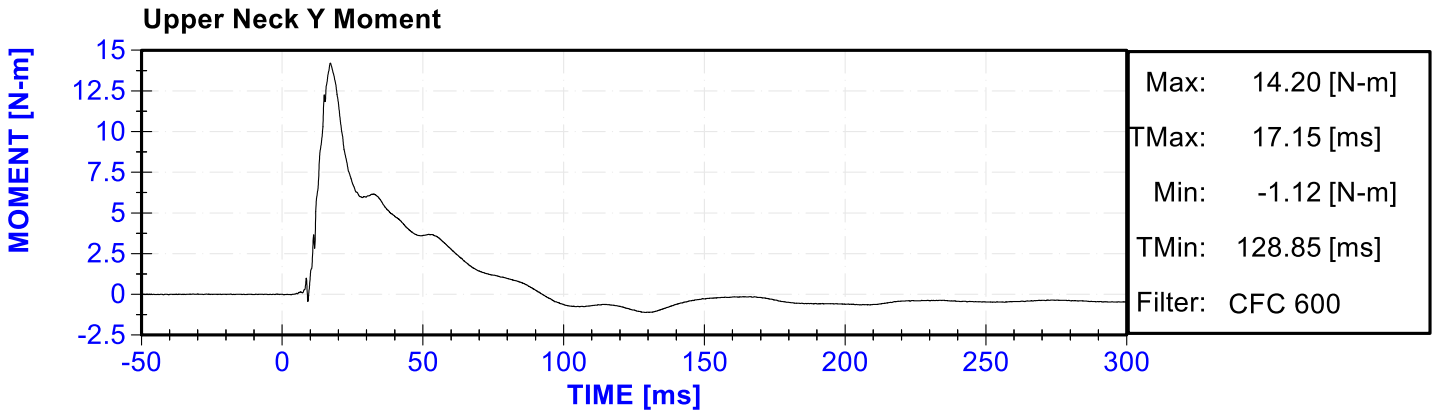


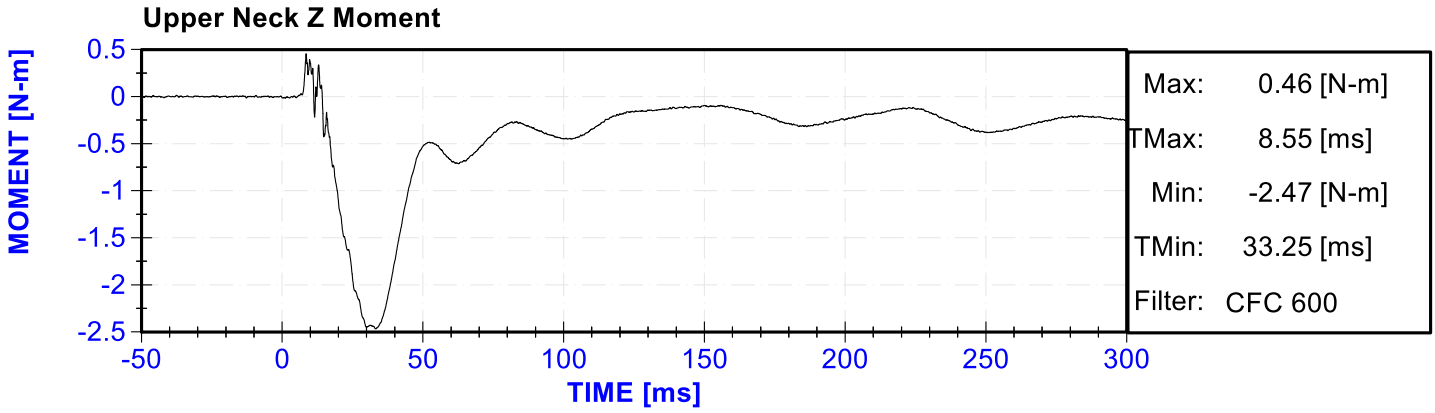
Upper Neck Force Resultant

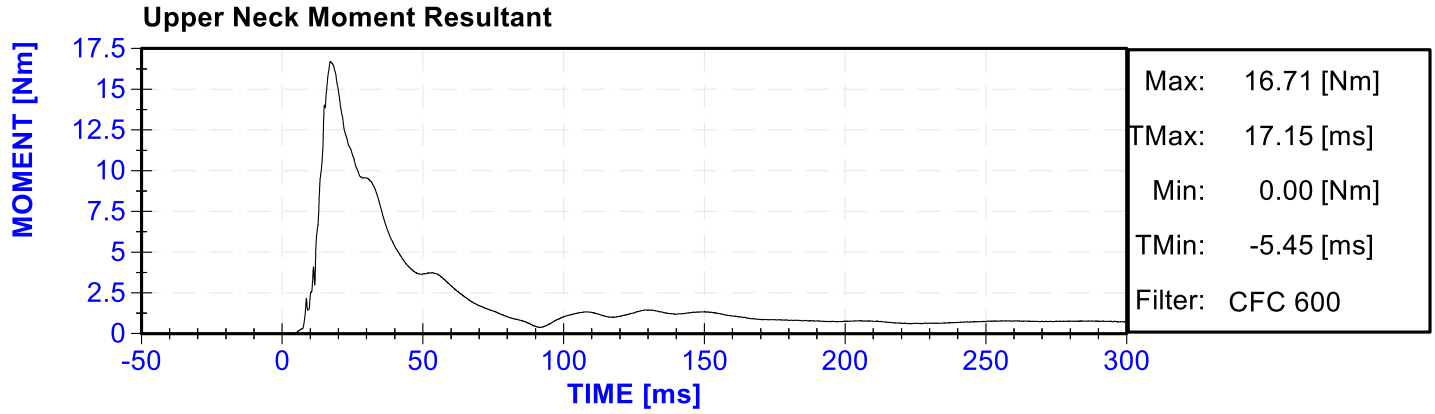


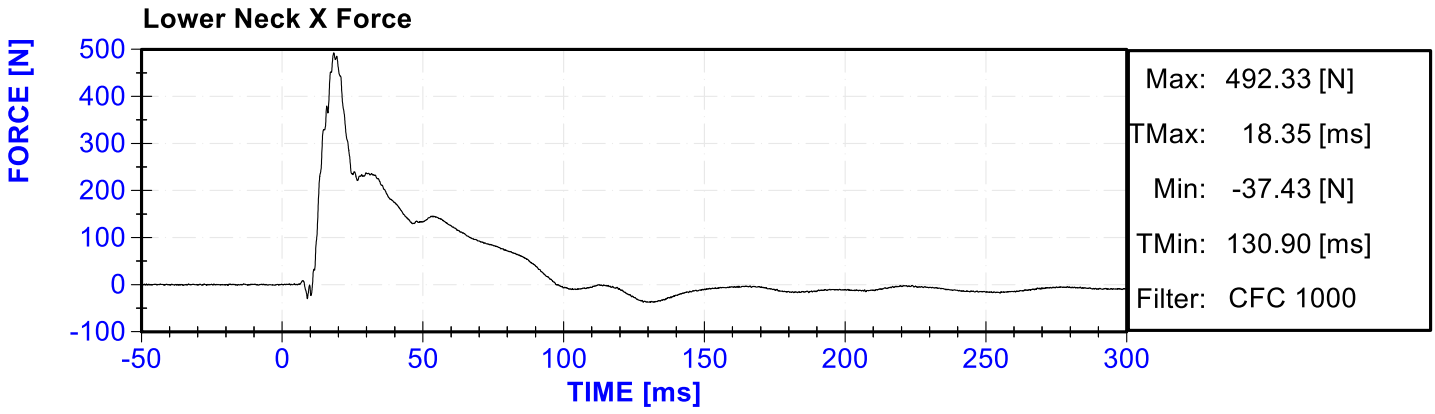
Upper Neck X Moment



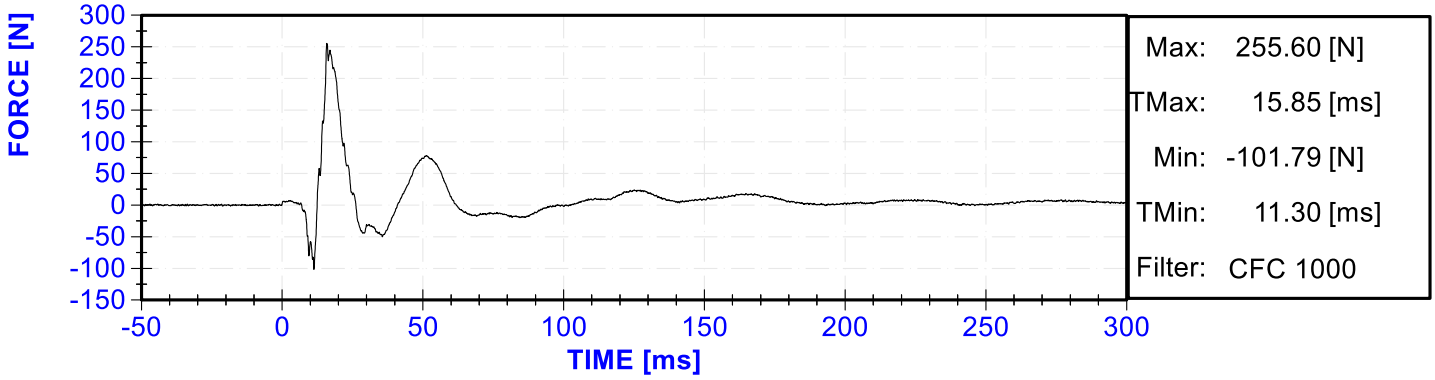

Upper Neck Y Moment
MOMENT [N-m]
15
12.5
10
7.5
5
2.5
0
-2.5
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 14.20 [N-m]
TMax: 17.15 [ms]
Min: -1.12 [N-m]
TMin: 128.85 [ms]
Filter: CFC 600


Upper Neck Z Moment
MOMENT [N-m]
0.5
0
-0.5
-1
-1.5
-2
-2.5
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 0.46 [N-m]
TMax: 8.55 [ms]
Min: -2.47 [N-m]
TMin: 33.25 [ms]
Filter: CFC 600

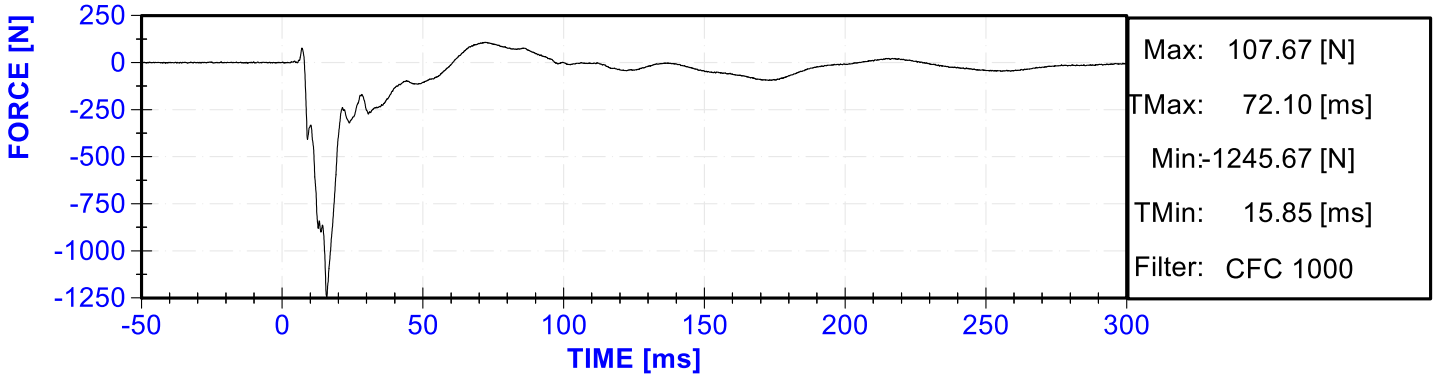

Upper Neck Moment Resultant
MOMENT [Nm]
17.5
15
12.5
10
7.5
5
2.5
0
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 16.71 [Nm]
TMax: 17.15 [ms]
Min: 0.00 [Nm]
TMin: -5.45 [ms]
Filter: CFC 600


Lower Neck X Force
FORCE [N]
500
400
300
200
100
0
-100
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 492.33 [N]
TMax: 18.35 [ms]
Min: -37.43 [N]
TMin: 130.90 [ms]
Filter: CFC 1000

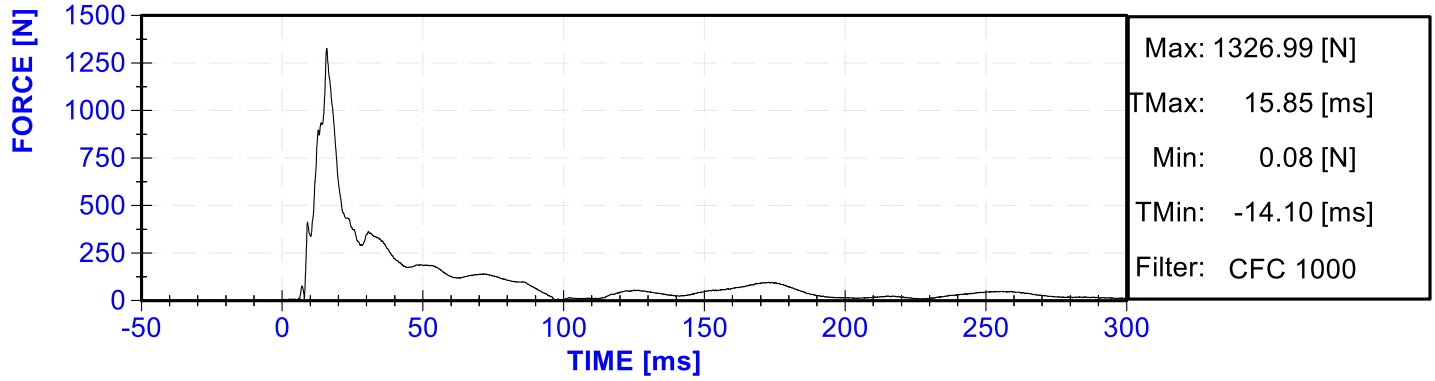
Lower Neck Y Force



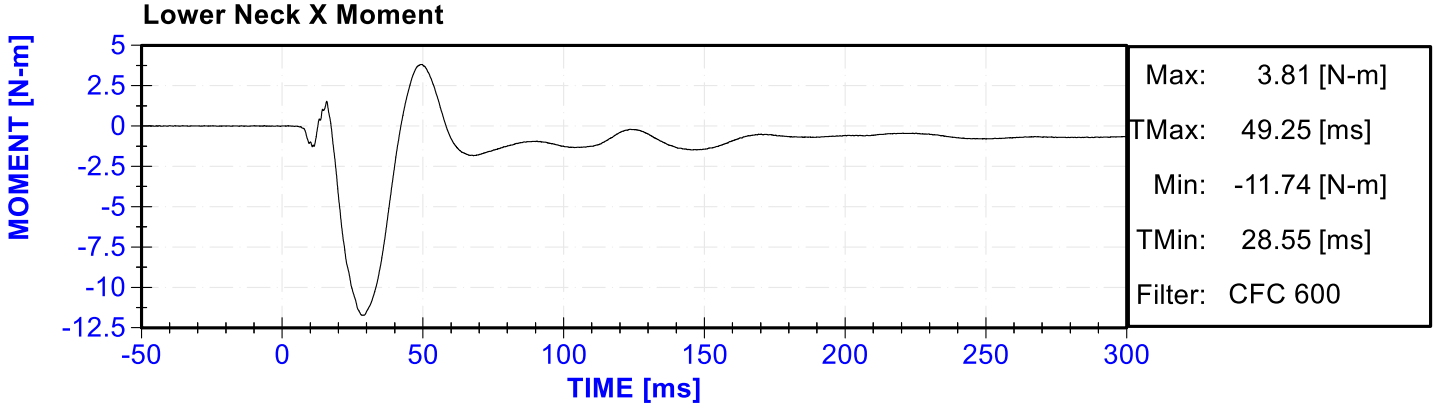
Lower Neck Z Force

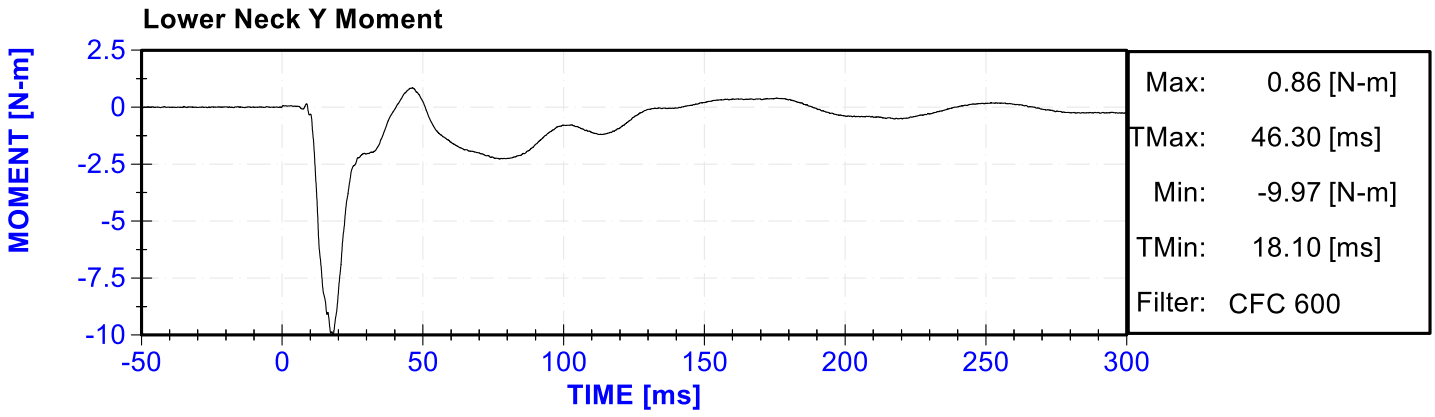


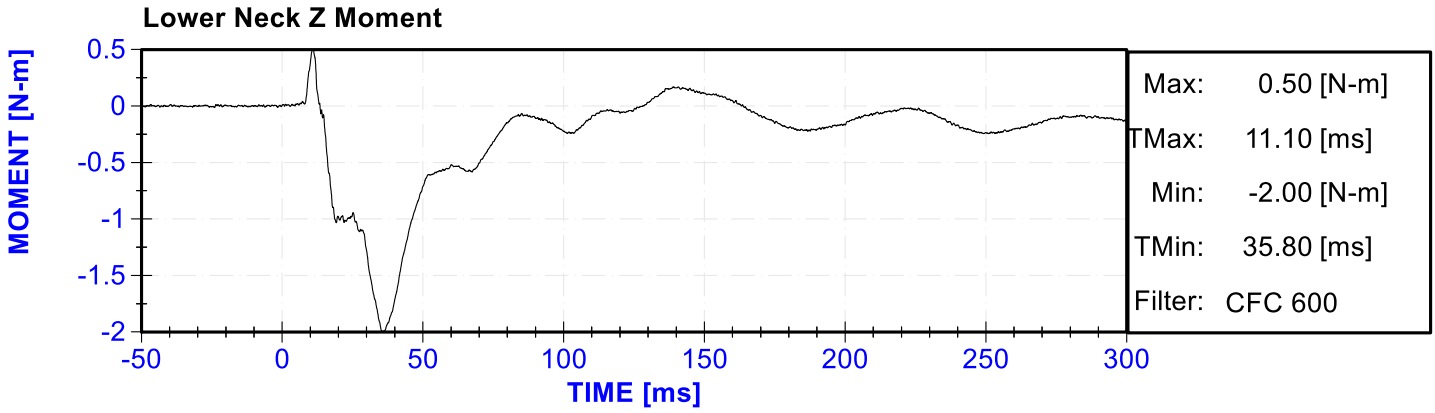
Lower Neck Force Resultant

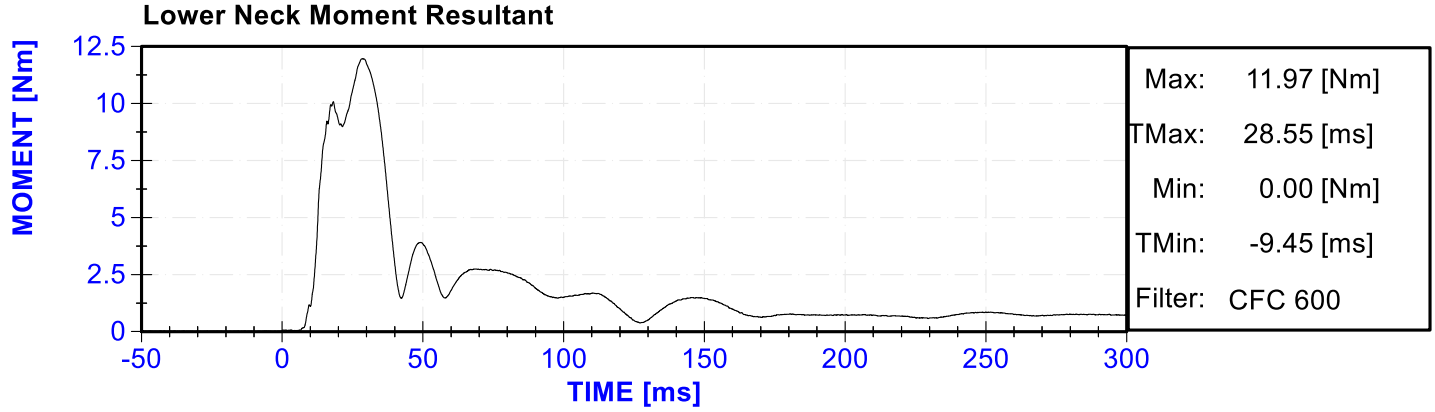


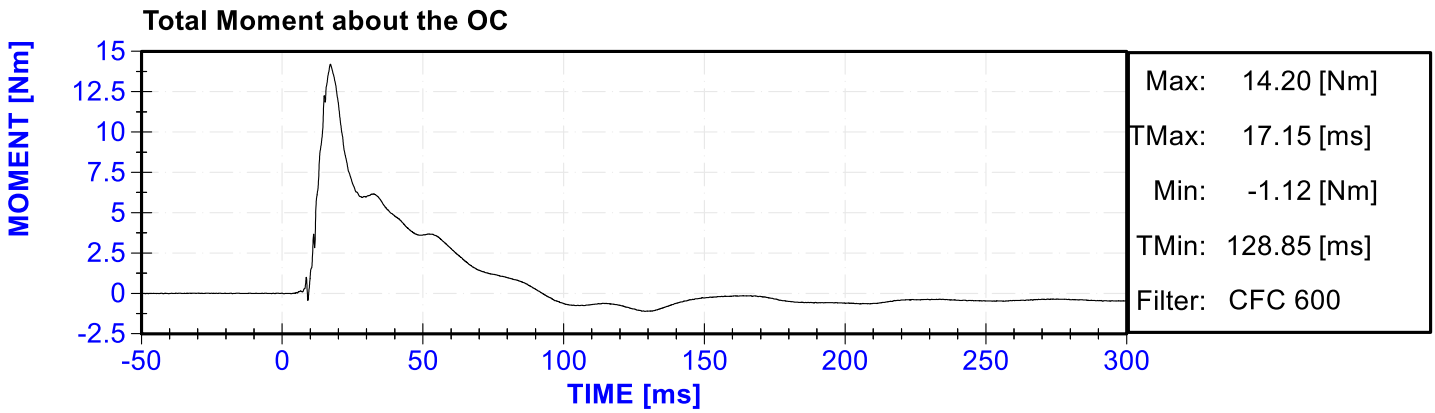
Lower Neck X Moment



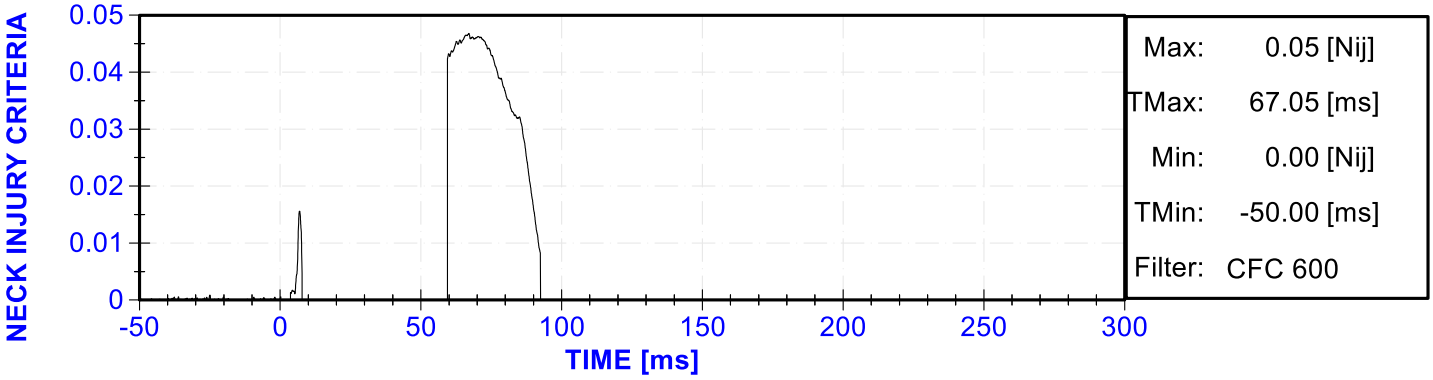

Lower Neck Y Moment
MOMENT [N-m]
2.5
0
-2.5
-5
-7.5
-10
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 0.86 [N-m]
TMax: 46.30 [ms]
Min: -9.97 [N-m]
TMin: 18.10 [ms]
Filter: CFC 600


Lower Neck Z Moment
MOMENT [N-m]
0.5
0
-0.5
-1
-1.5
-2
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 0.50 [N-m]
TMax: 11.10 [ms]
Min: -2.00 [N-m]
TMin: 35.80 [ms]
Filter: CFC 600

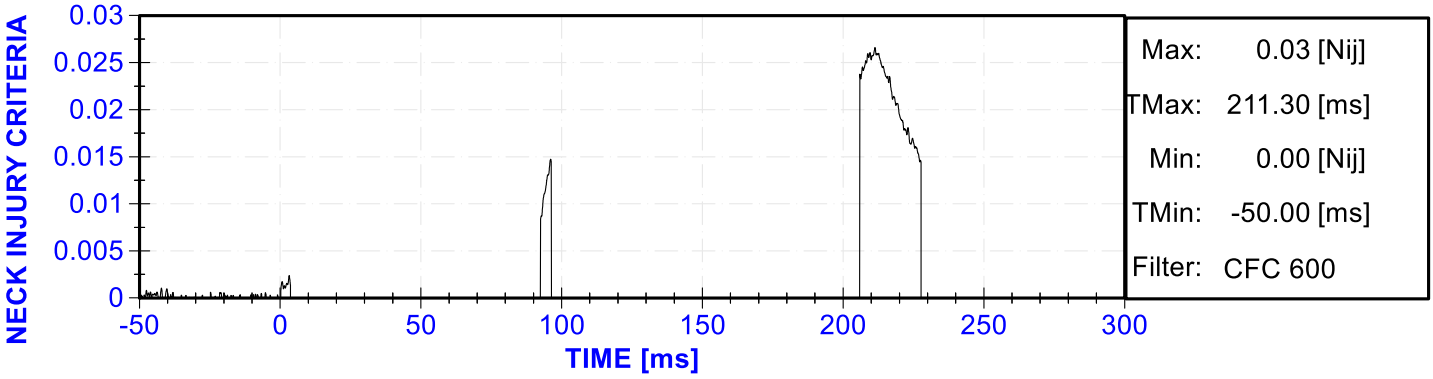

Lower Neck Moment Resultant
MOMENT [Nm]
12.5
10
7.5
5
2.5
0
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 11.97 [Nm]
TMax: 28.55 [ms]
Min: 0.00 [Nm]
TMin: -9.45 [ms]
Filter: CFC 600


Total Moment about the OC
MOMENT [Nm]
15
12.5
10
7.5
5
2.5
0
-2.5
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 14.20 [Nm]
TMax: 17.15 [ms]
Min: -1.12 [Nm]
TMin: 128.85 [ms]
Filter: CFC 600

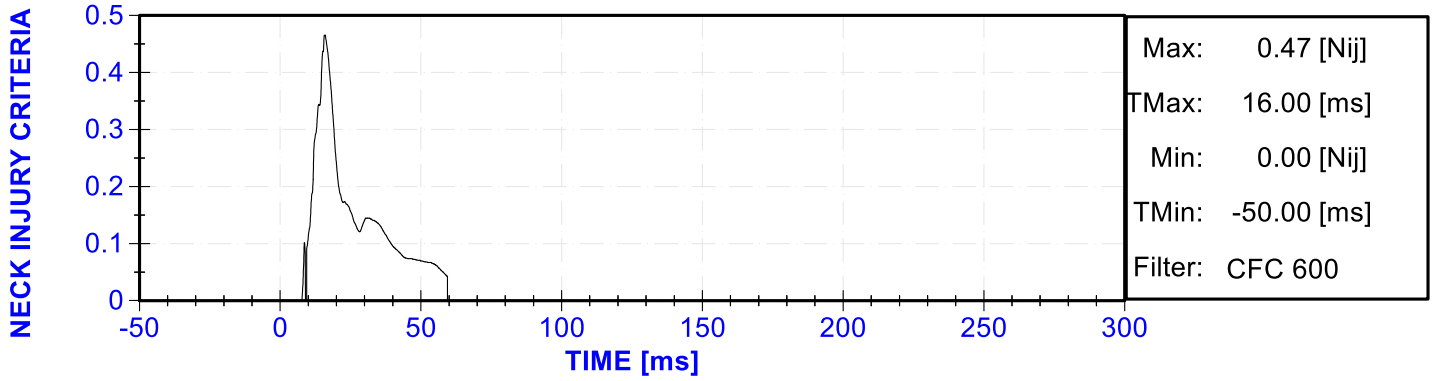
Neck Tension-Flexion Injury



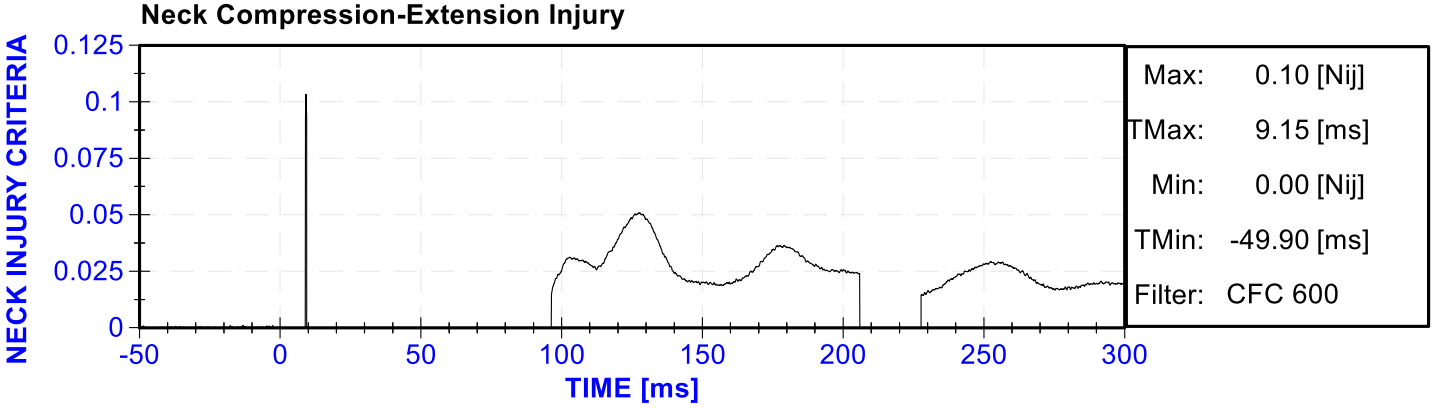
Neck Tension-Extension Injury



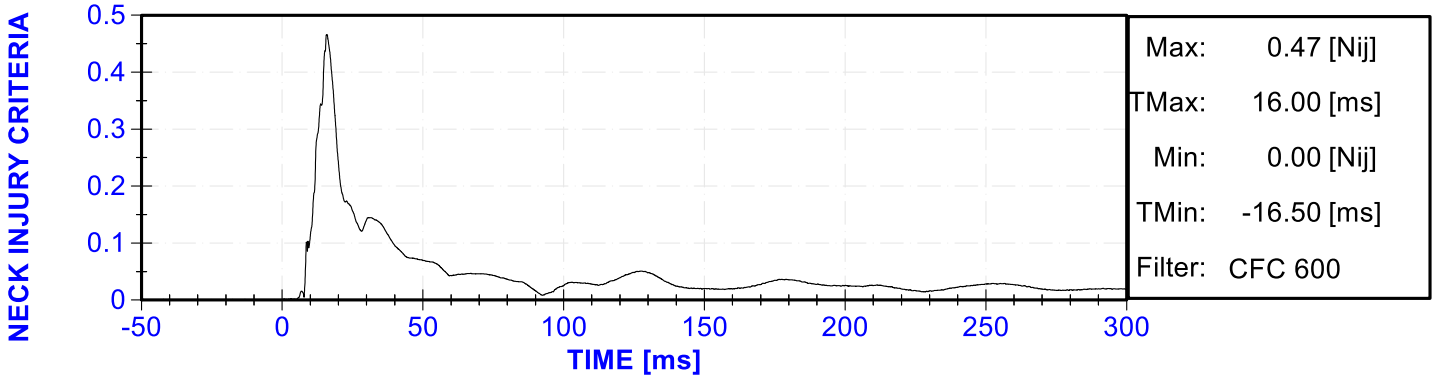
Neck Compression-Flexion Injury



Neck Compression-Extension Injury

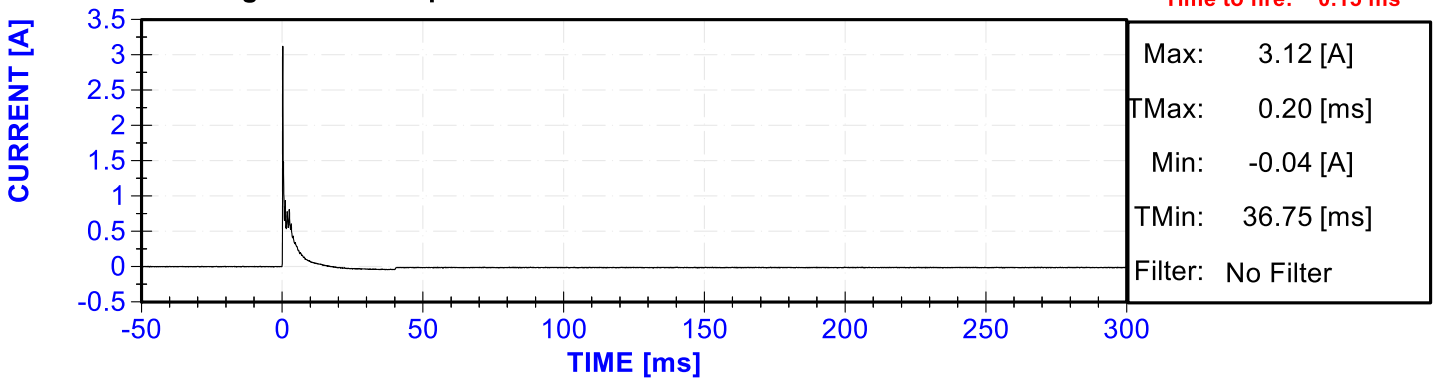


Total Neck Injury



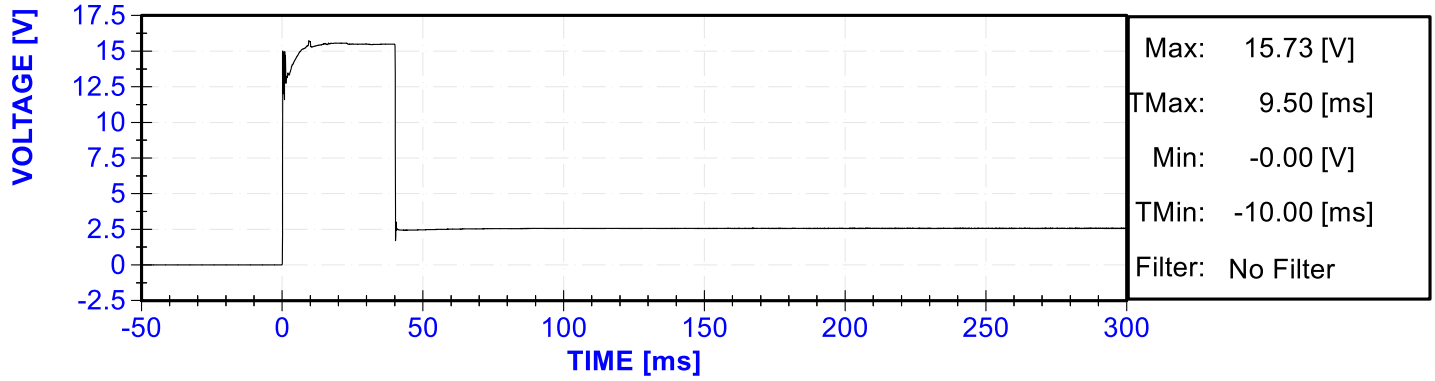
Passenger Curtain Squib Current

Time to fire: 0.15 ms



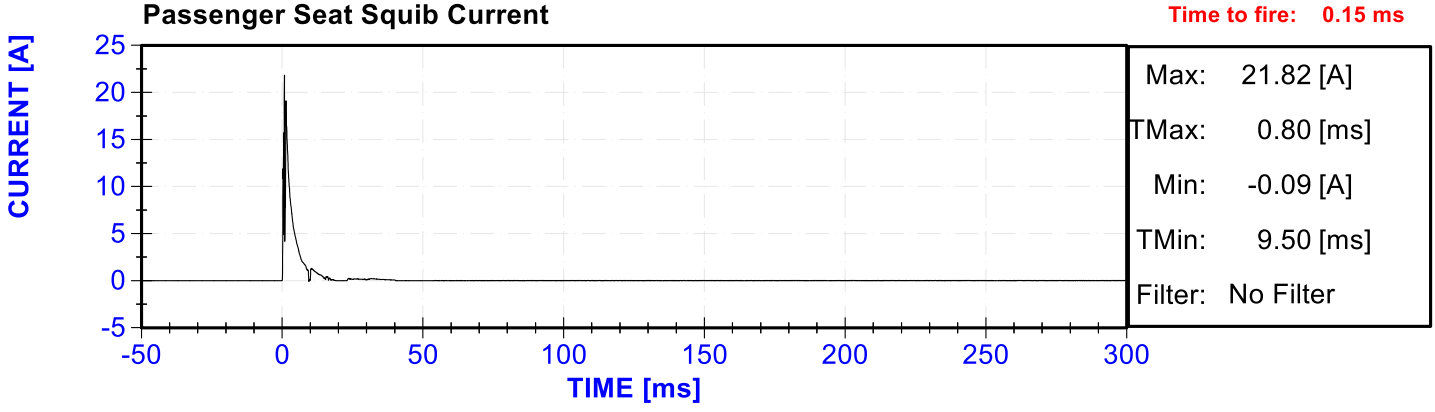
Passenger Curtain Squib Voltage

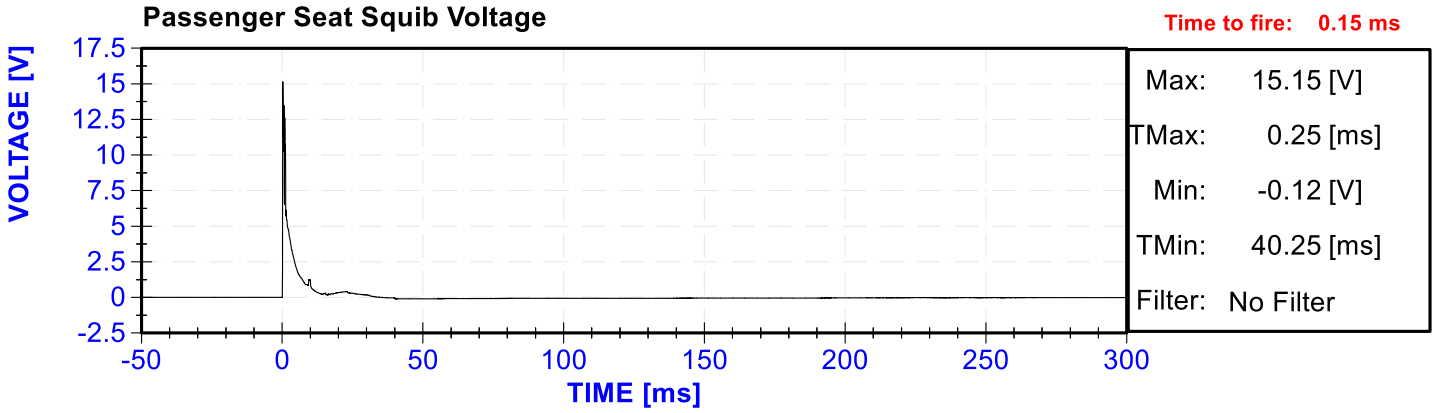
Time to fire: 0.15 ms



Passenger Seat Squib Current

Time to fire: 0.15 ms




Passenger Seat Squib Voltage
Time to fire: 0.15 ms
VOLTAGE [V]
17.5
15
12.5
10
7.5
5
2.5
0
-2.5
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 15.15 [V]
TMax: 0.25 [ms]
Min: -0.12 [V]
TMin: 40.25 [ms]
Filter: No Filter

APPENDIX C

TEST EQUIPMENT AND INSTRUMENTATION CALIBRATION DATA

Table 1 – Dummy Instrumentation

	POSITION #3 (Rear Right Passenger) SERIAL NO.: 139			
	SERIAL NUMBER	MANUFACTURER	CALIBRATION DATE	CALIBRATION DUE DATE
Head X Acceleration	AC-P64001	ENDEVCO 7264CT	7/17/2020	1/15/2021
Head Y Acceleration	P51687	Endevco 7264C-2KTZ-2-240	7/17/2020	1/15/2021
Head Z Acceleration	AC-P64008	ENDEVCO 7264CT	7/24/2020	1/22/2021
Head Redundant X Acceleration	T11245	Endevco 7264C-2KTZ-2-300	7/24/2020	1/22/2021
Head Redundant Y Acceleration	P58740	Endevco 7264C-2KTZ-2-300	7/24/2020	1/22/2021
Head Redundant Z Acceleration	T21213	Endevco 7264C-2KTZ-2-300	7/24/2020	1/22/2021
Upper Neck X Force	LC-125Fx	FTSS IF-234	7/17/2020	7/17/2021
Upper Neck Y Force	LC-125Fy	FTSS IF-234	7/17/2020	7/17/2021
Upper Neck Z Force	LC-125Fz	FTSS IF-234	7/17/2020	7/17/2021
Upper Neck X Moment	LC-125Mx	FTSS IF-234	7/17/2020	7/17/2021
Upper Neck Y Moment	LC-125My	FTSS IF-234	7/17/2020	7/17/2021
Upper Neck Z Moment	LC-125Mz	FTSS IF-234	7/17/2020	7/17/2021
Lower Neck X Force	LC-208 Fx	Humanetics 3303	7/17/2020	7/17/2021
Lower Neck Y Force	LC-208 Fy	Humanetics 3303	7/17/2020	7/17/2021
Lower Neck Z Force	LC-208 Fz	Humanetics 3303	7/17/2020	7/17/2021
Lower Neck X Moment	LC-208 Mx	Humanetics 3303	7/17/2020	7/17/2021
Lower Neck Y Moment	LC-208 My	Humanetics 3303	7/17/2020	7/17/2021
Lower Neck Z Moment	LC-208 Mz	Humanetics 3303	7/17/2020	7/17/2021
Curtain Bag Voltage	ABF017 (Voltage)	-	-	-
Curtain Bag Current	ABF017 (Current)	-	-	-
Seat/Torso Bag Voltage	ABF020 (Voltage)	-	-	-
Seat/Torso Bag Current	ABF020 (Current)	-	-	-

APPENDIX D

DUMMY QUALIFICATION DATA

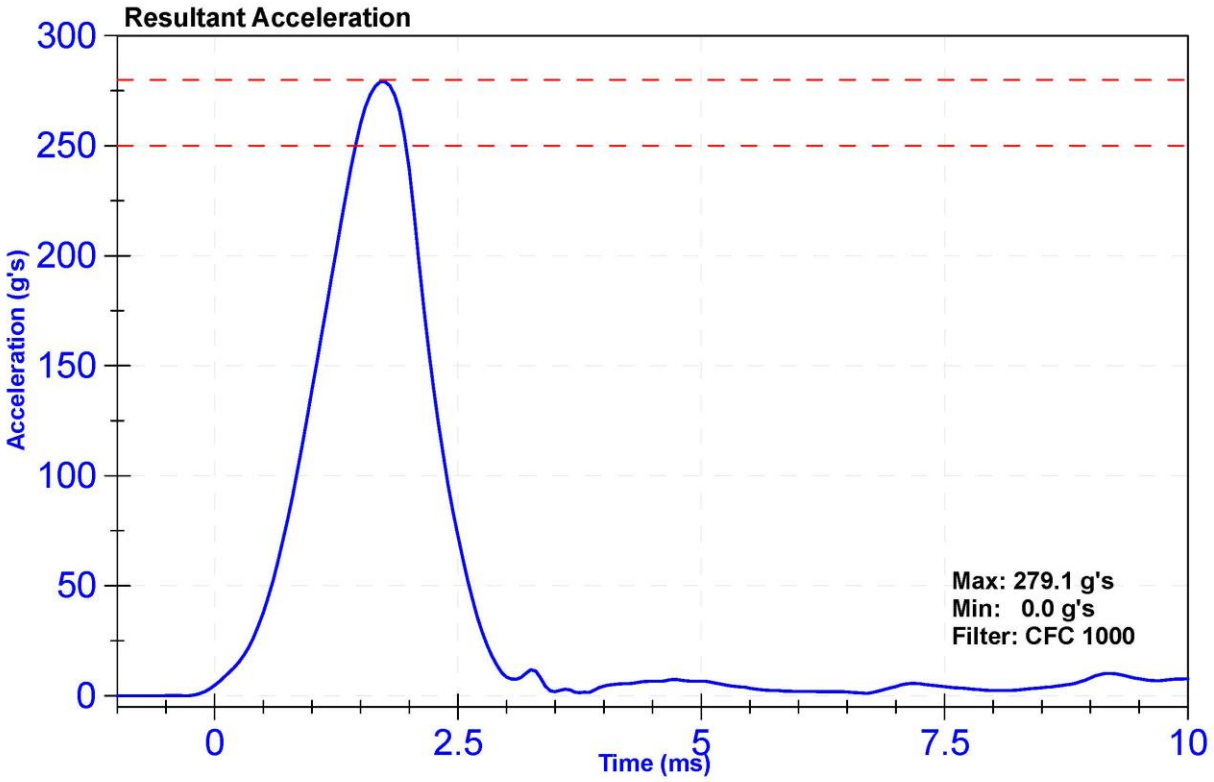
ATD Manufacturer	FTSS	Test Technician	M.Hartung
ATD Serial Number	139	Laboratory Supervisor	W.Horn

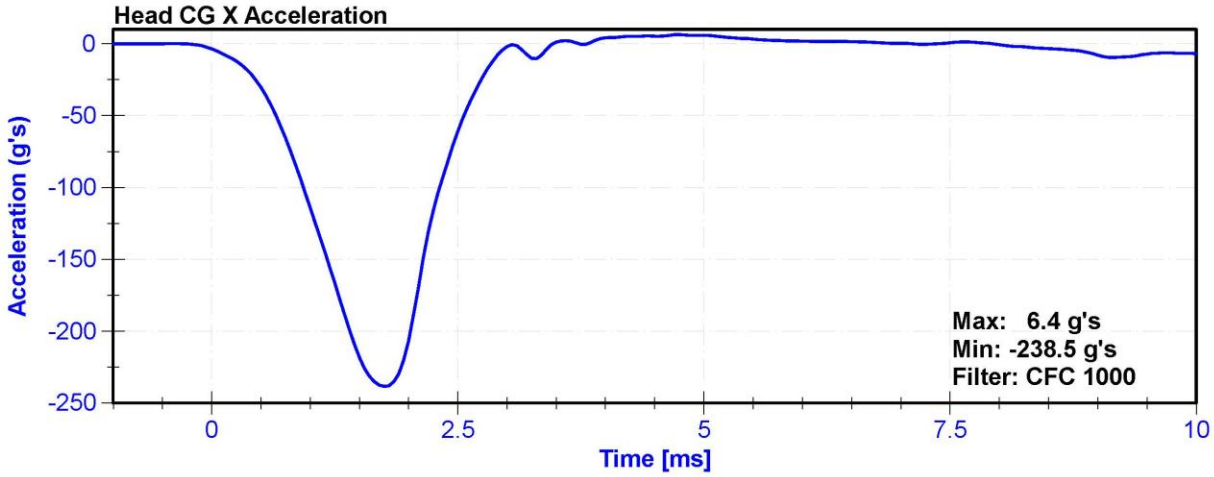
Results

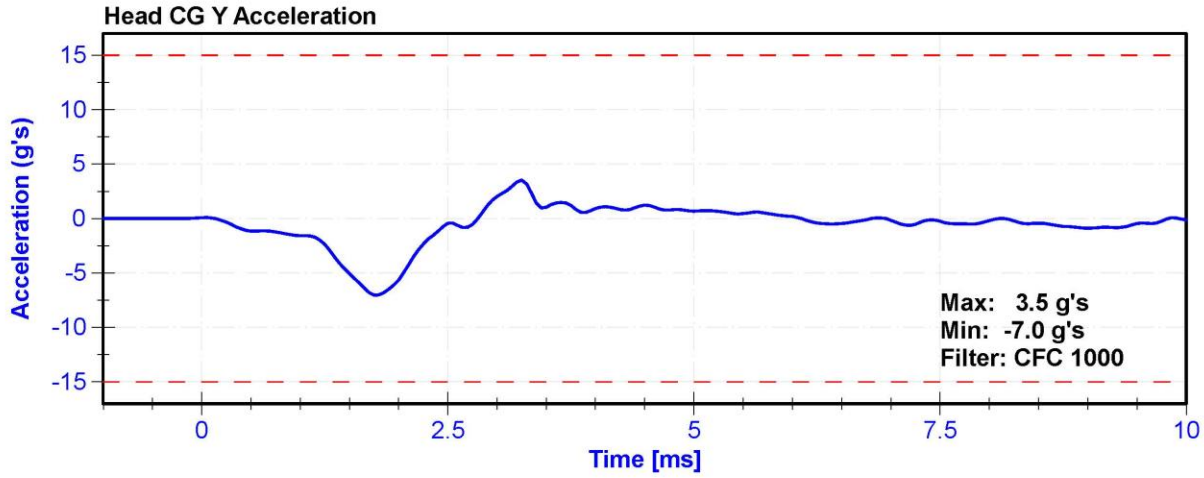
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	22.1	Pass
Humidity	10	70	%	57.2	Pass
Resultant Acceleration	250	280	g's	279.1	Pass
Oscillation	0	10	%	4.2	Pass
Lateral Acceleration	-15	15	g's	-7.0	Pass

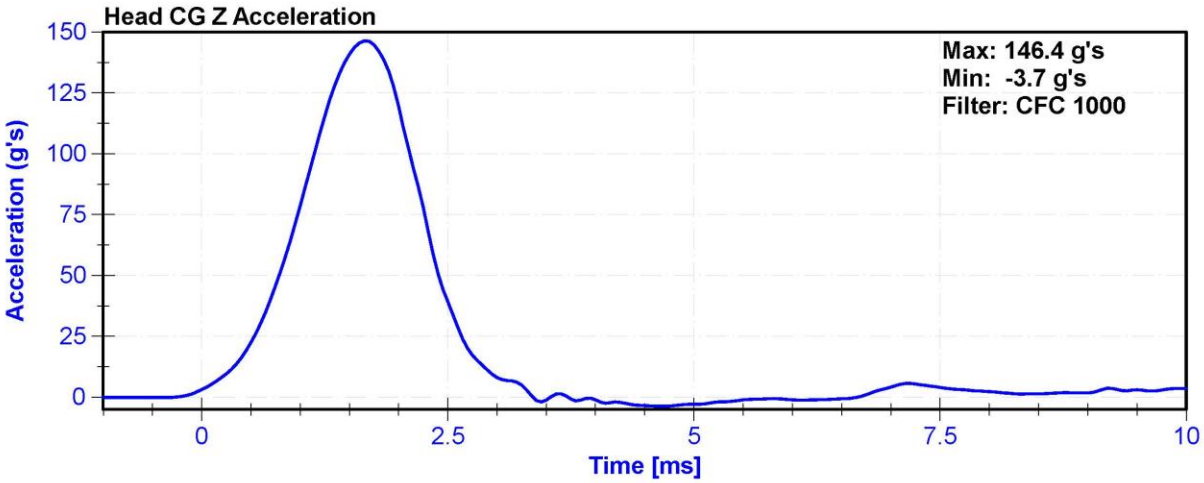
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	ENDEVCO 7264CT	AC-P64001	7/17/2020	1/15/2021
Y Accelerometer	ENDEVCO 7264C	P51687	7/17/2020	1/15/2021
Z Accelerometer	ENDEVCO 7264CT	AC-P64008	7/28/2020	1/26/2021




Head CG X Acceleration
Acceleration (g's)
0
-50
-100
-150
-200
-250
0
2.5
5
7.5
10
Time [ms]
Max: 6.4 g's
Min: -238.5 g's
Filter: CFC 1000


Head CG Y Acceleration
Acceleration (g's)
15
10
5
0
-5
-10
-15
0
2.5
5
7.5
10
Time [ms]
Max: 3.5 g's
Min: -7.0 g's
Filter: CFC 1000


Head CG Z Acceleration
Acceleration (g's)
150
125
100
75
50
25
0
0
2.5
5
7.5
10
Time [ms]
Max: 146.4 g's
Min: -3.7 g's
Filter: CFC 1000

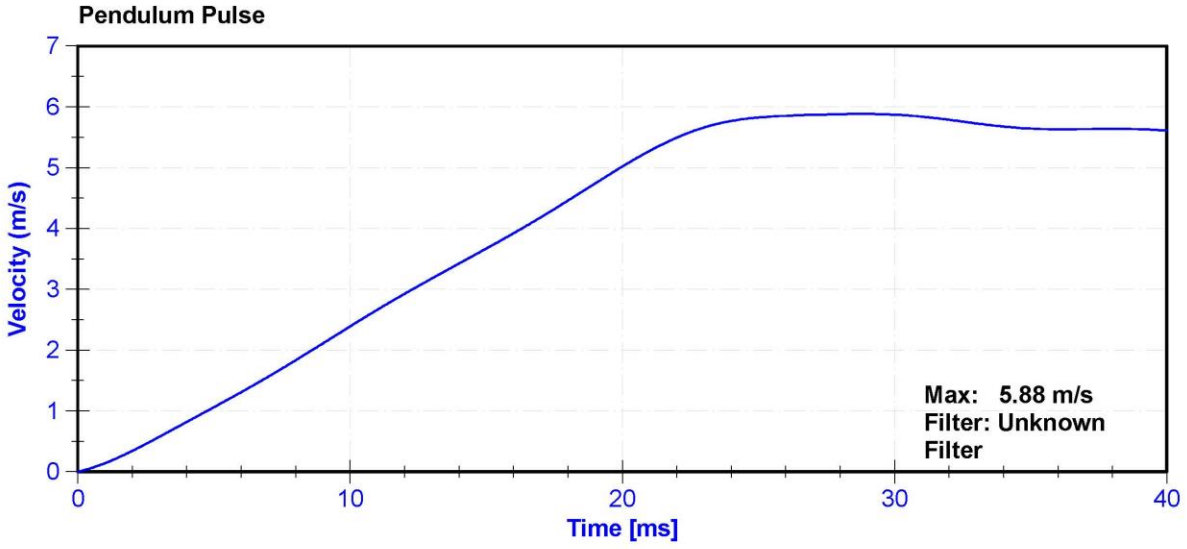
ATD Manufacturer	FTSS	Test Technician	MH
ATD Serial Number	139	Laboratory Supervisor	MB

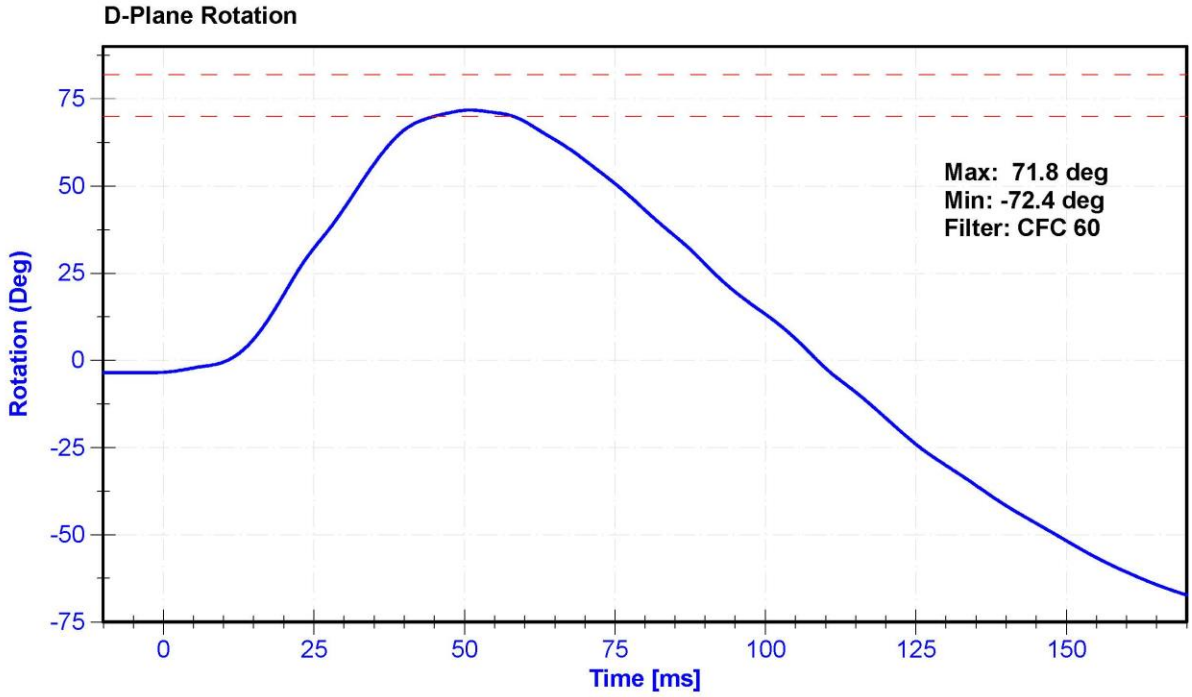
Results

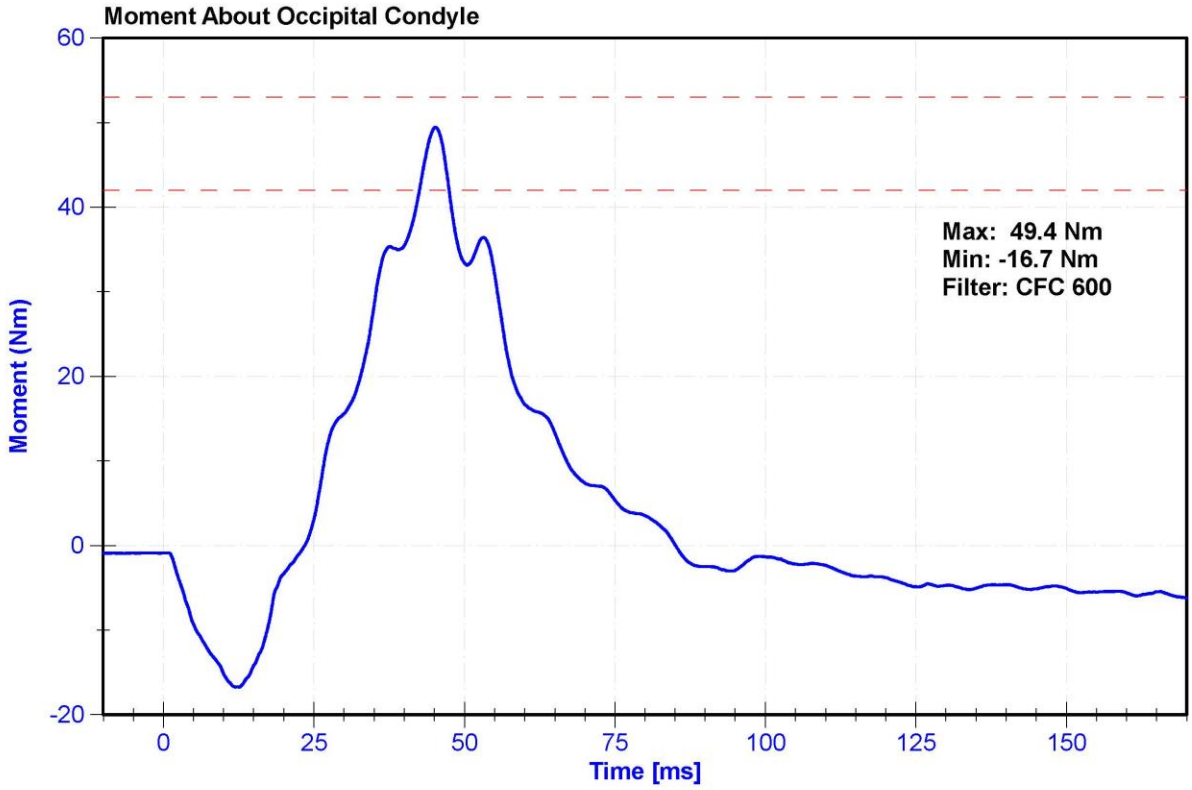
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.5	Pass
Humidity	10	70	%	61.1	Pass
Velocity	5.4	5.6	m/s	5.58	Pass
Pendulum Impulse at 10ms	2.0	2.7	m/s	2.39	Pass
Pendulum Impulse at 15ms	3.0	4.0	m/s	3.67	Pass
Pendulum Impulse at 20ms	4.0	5.1	m/s	5.02	Pass
D Plane Rotation	70	82	deg	71.8	Pass
Moment During Rotation Interval	42	53	Nm	49.4	Pass
Moment Decay to 10.0 Nm	60	80	ms	67.0	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	C16687	7/21/2020	7/21/2021
Pendulum Potentiometer	ETI SP22G	PENDPOT	10/24/2019	10/23/2020
Condyle Potentiometer	ETI SP22G	CONDPOT	10/24/2019	10/23/2020
Upper Neck Load Cell	FTSS IF-234	125	7/17/2020	7/17/2021




D-Plane Rotation
Max: 71.8 deg
Min: -72.4 deg
Filter: CFC 60
Rotation (Deg)
75
50
25
0
-25
-50
-75
0
25
50
75
100
125
150
Time [ms]


Moment About Occipital Condyle
Max: 49.4 Nm
Min: -16.7 Nm
Filter: CFC 600
Moment (Nm)
60
40
20
0
-20
0
25
50
75
100
125
150
Time [ms]

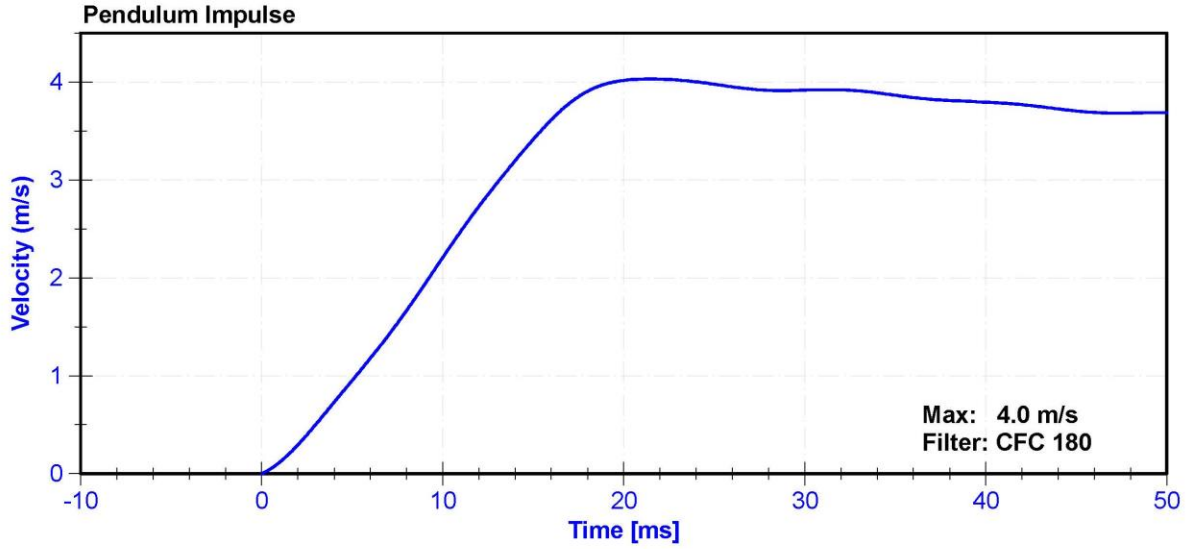
ATD Manufacturer	FTSS	Test Technician	MH
ATD Serial Number	139	Laboratory Supervisor	MB

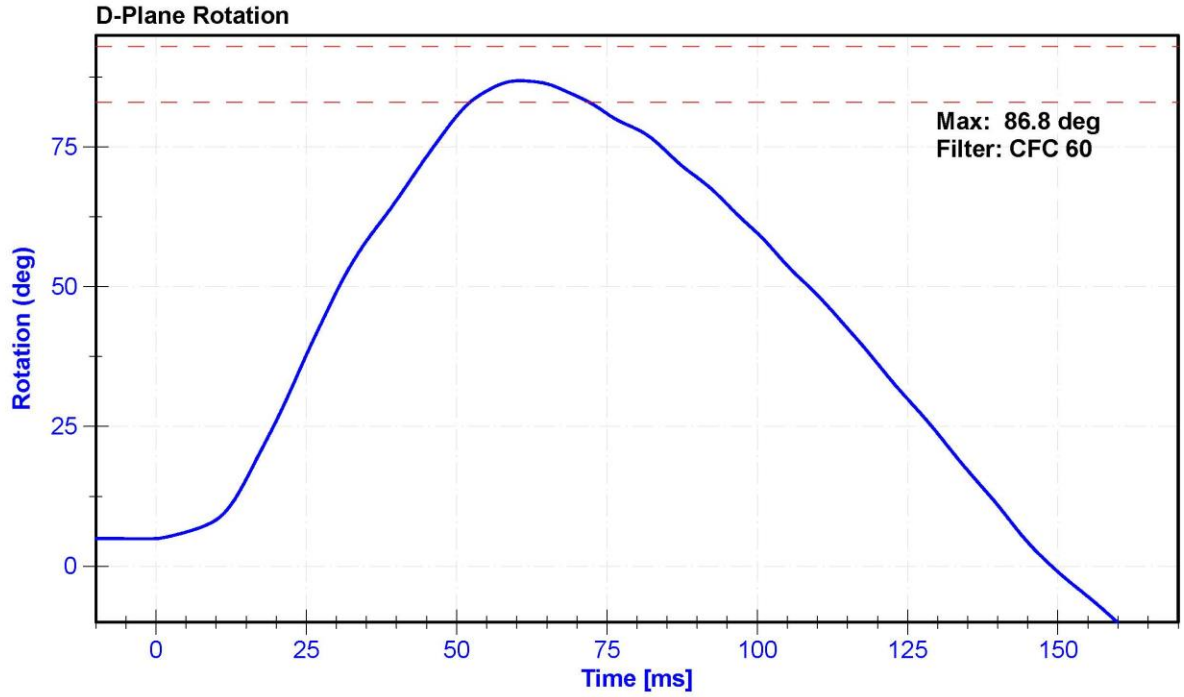
Results

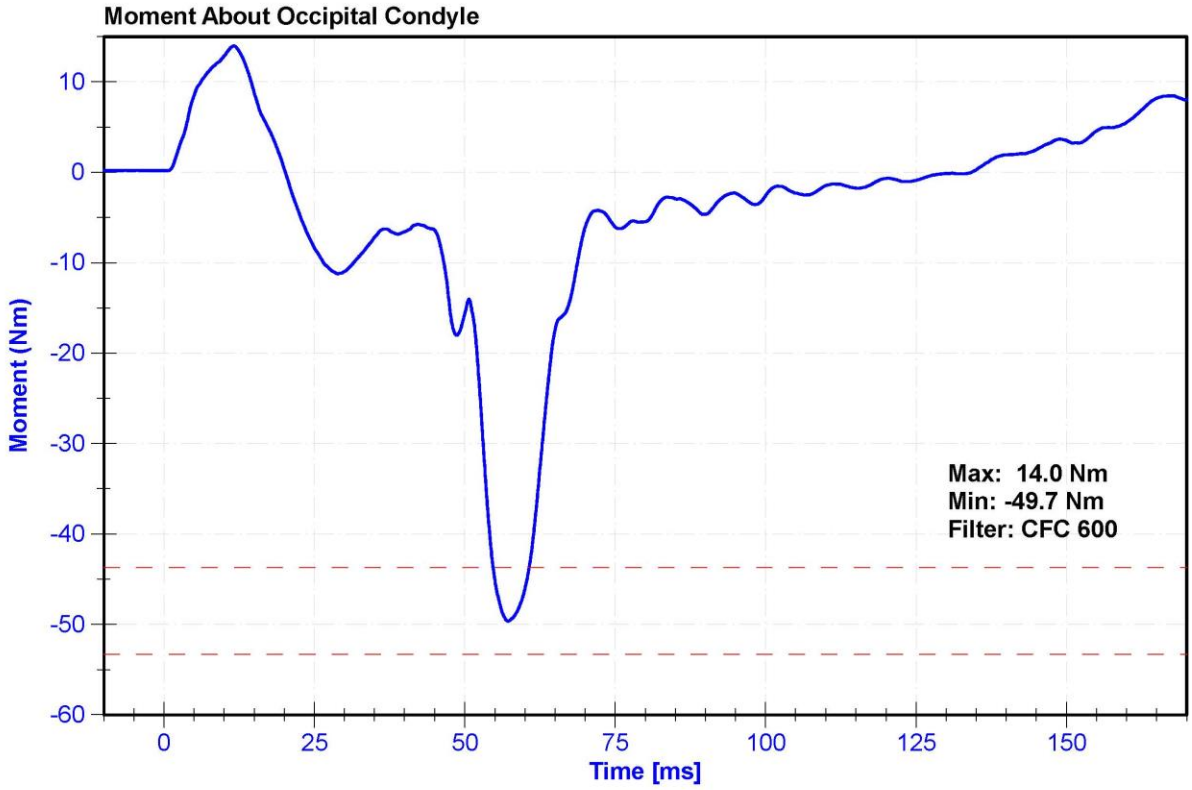
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.7	Pass
Humidity	10	70	%	58.4	Pass
Velocity	3.55	3.75	m/s	3.69	Pass
Pendulum Impulse at 6ms	1.0	1.4	m/s	1.18	Pass
Pendulum Impulse at 10ms	1.9	2.5	m/s	2.21	Pass
Pendulum Impulse at 14ms	2.8	3.5	m/s	3.20	Pass
D Plane Rotation	83	93	deg	86.8	Pass
Moment During Rotation Interval	-53.3	-43.7	Nm	-49.7	Pass
Moment Decay to -10Nm	60	80	ms	68.8	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	C16687	7/21/2020	7/21/2021
Pendulum Potentiometer	ETI SP22G	PENDPOT	10/24/2019	10/23/2020
Condyle Potentiometer	ETI SP22G	CONDPOT	10/24/2019	10/23/2020
Upper Neck Load Cell	FTSS IF-234	125	7/17/2020	7/17/2021




D-Plane Rotation
Max: 86.8 deg
Filter: CFC 60
Rotation (deg)
75
50
25
0
0
25
50
75
100
125
150
Time [ms]


Moment About Occipital Condyle
Max: 14.0 Nm
Min: -49.7 Nm
Filter: CFC 600
Moment (Nm)
10
0
-10
-20
-30
-40
-50
-60
0
25
50
75
100
125
150
Time [ms]

Calspan

TORSO FLEXION TEST – Hybrid III – 3 Year Old

Based on the Code of Federal Regulations (CFR) Title 49 Part 572

Dummy Serial Number 139 GPE

Technician SC Test Date 7/28/2020

Test attempt no. 1 Pass X Fail __

__X__ 1) It has been at least 30 minutes since the last torso flexion test.
__/__ N/A, ONLY one torso flexion test performed

__X__ 2) The test fixture conforms to the specifications in the CFR.

__/__ 3) The assembled dummy is used
__/__ with lower legs
__ without lower legs

__X__ 4) The dummy assembly soaked at a temperature between 18.9°C and 25.6°C and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to this test.
Record the temperature: 22.0
Record the humidity: 54.9

__X__ 5) Unzip the torso jacket and install the rigid pelvis attachment fixture so that that test material is rigidly affixed to the test fixture and the pelvic lumbar joining surface is horizontal ± 1°.

__X__ 6) Attach the loading adapter bracket to the upper spine box of the dummy as shown on the second page.

__/__ 7) Rezip the torso jacket as allowed by fixtures

__/__ 8) Flex the dummy forward and back 3 times such that the angle reference plane moves between 0° and 30° with respect to the vertical transverse plane.

__/__ 9) Support the dummy such that the angle reference plane is at or near 0° (vertical with respect to the vertical transverse plane).

__/__ 10) Wait at least 30 minutes before continuing.

__/__ 11) Remove all external support that was implemented in step 9 above and wait 2 minutes.

__/__ 12) Measure the initial orientation angle of the torso reference plane of the seated, unsupported dummy and record on the results chart.

__/__ 13) Apply a tension force in the midsagittal plane to the pull cable at any upper torso deflection rate between 0.5° and 1.5° per second, until the angle reference plane is at 45° ± 0.5° of flexion relative to the vertical transverse plane.

__X__ 14) Maintain angle reference plane at 45° ± 0.5° of flexion for 10 seconds

__/__ 15) Quickly release the force applied to the attachment bracket.

__X__ 16) Measure the reference plane angle between 3 and 4 minutes and record on the chart.

17) Process the data and complete the following table:

Torso Flexion Results

Parameter	Specification		Result	Pass	Fail
	Minimum	Maximum			
Initial Angle		15°	3.6°	X	
Force at 45°	130 N	180 N	154 N	X	
Final Angle	Initial -10°	Initial +10°	8.2°	X	

18) Select the outcome:

X All results passed and the report is saved on Calspan's server

__ Not all results passed

Variable to change for next test:

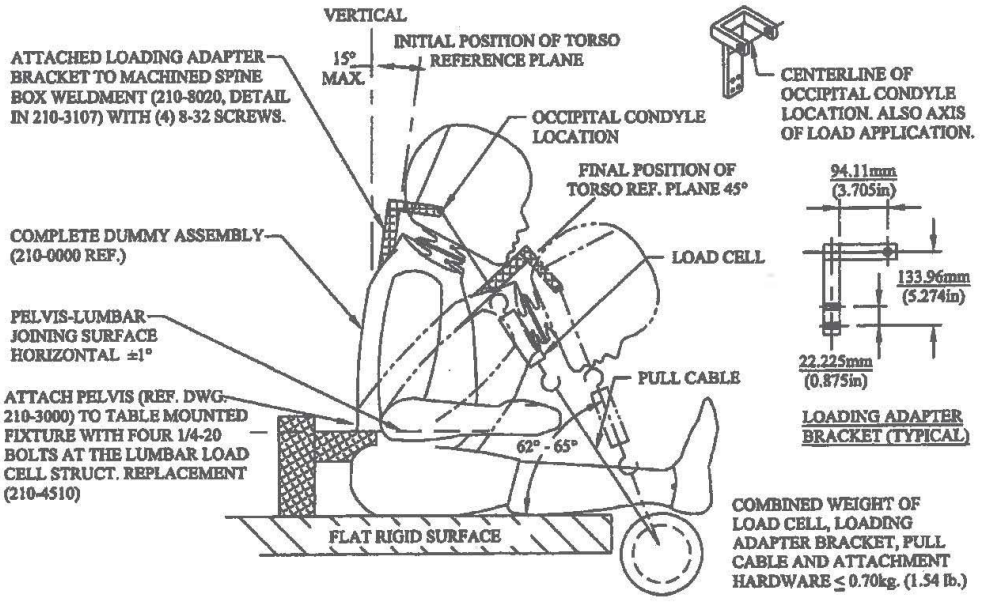
_____

_____

_____

_____

Signature 7/28/2020 Date



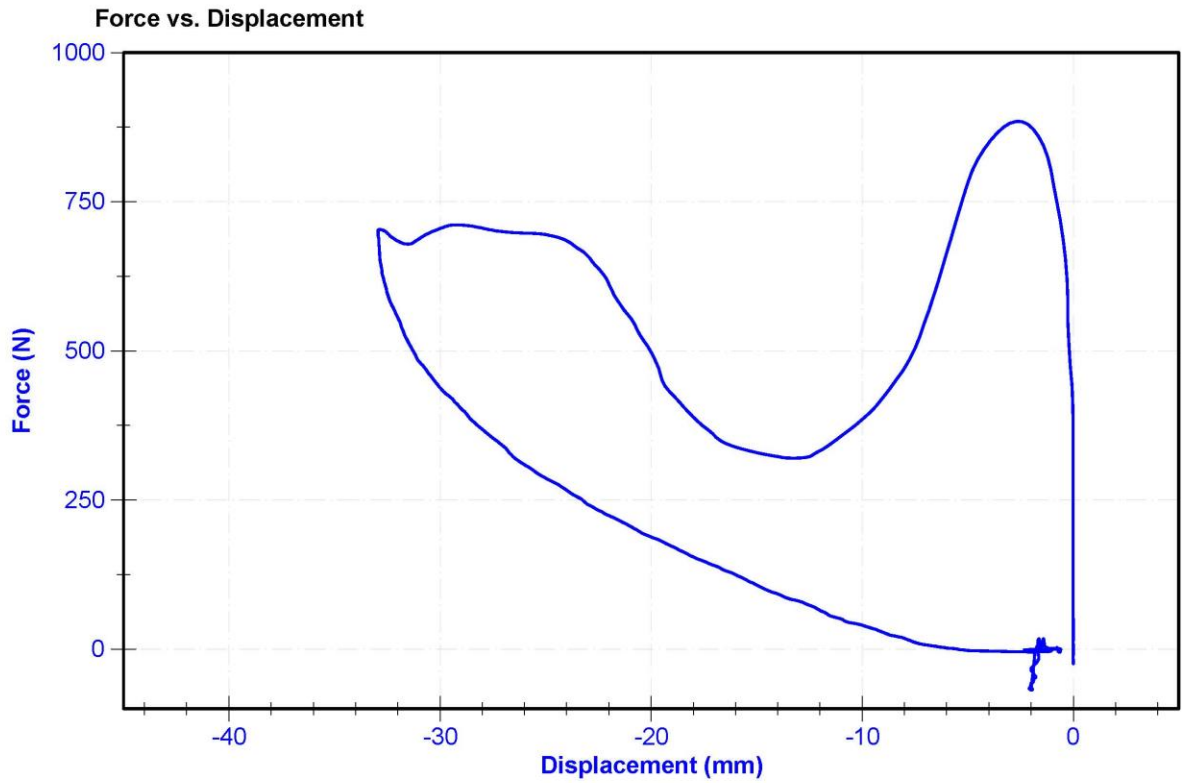
ATD Manufacturer	FTSS	Test Technician	J.Cowell
ATD Serial Number	139	Laboratory Supervisor	W.Horn

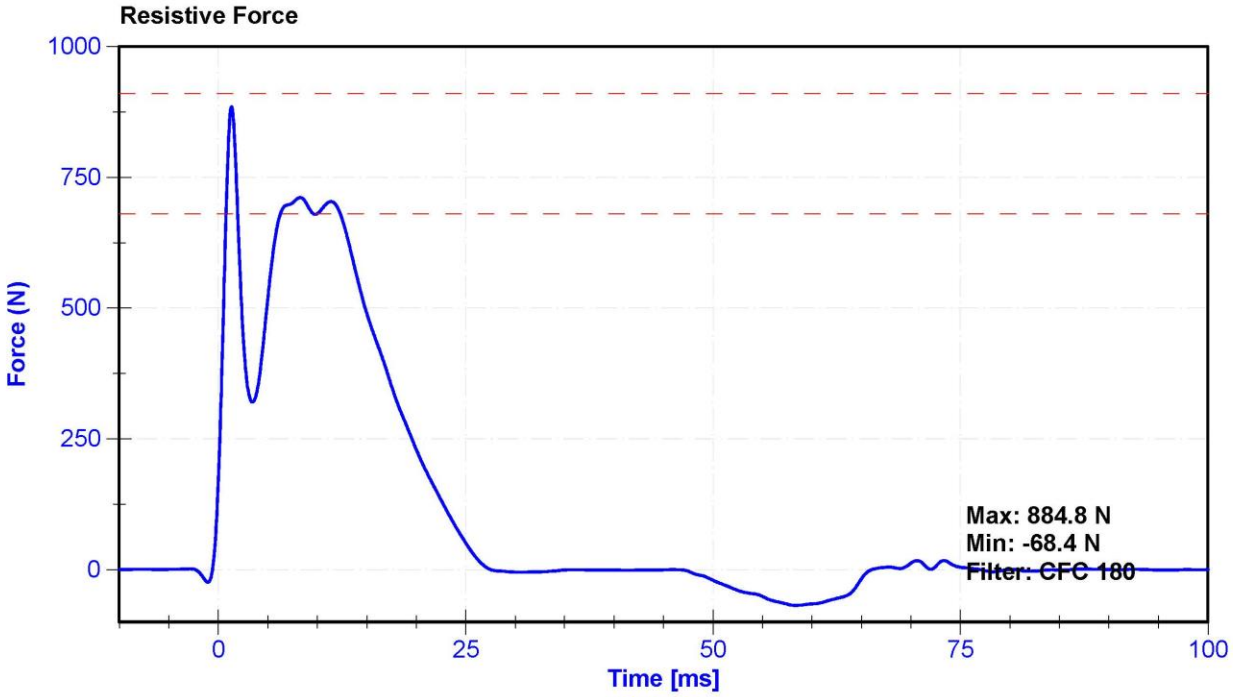
Results

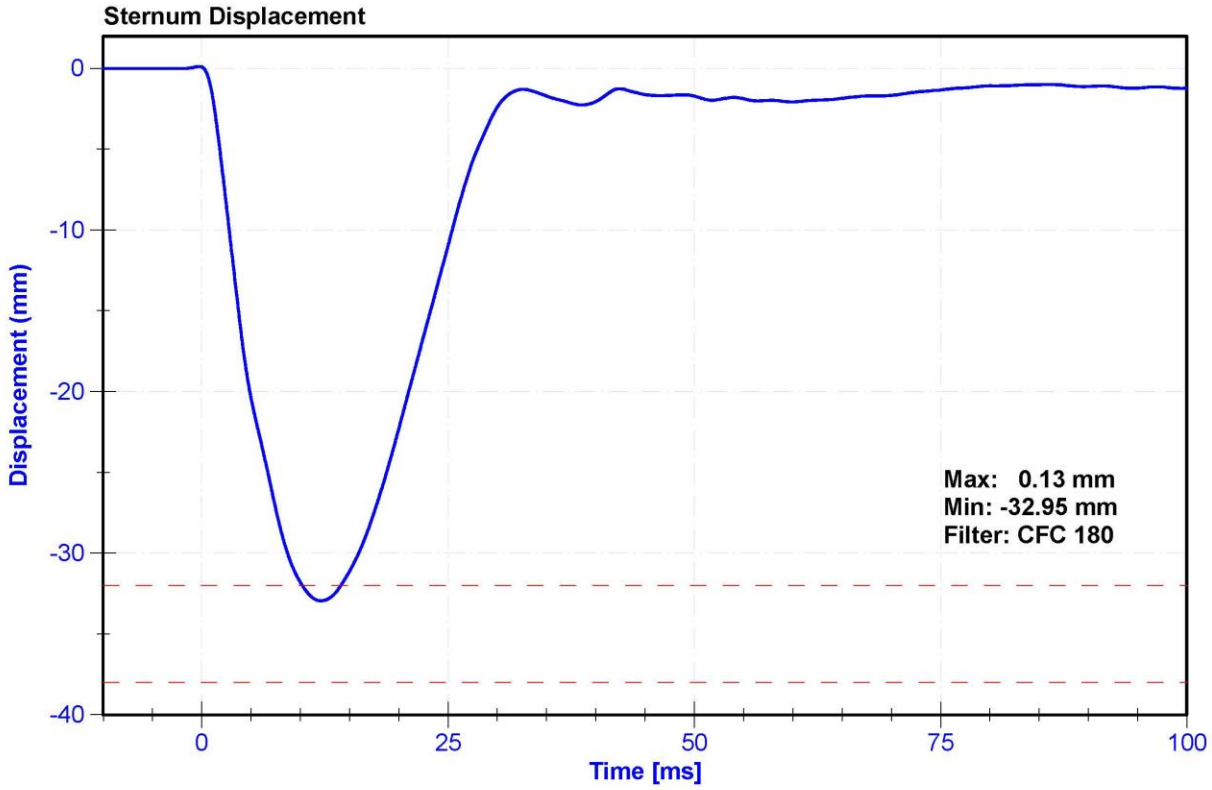
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	22	Pass
Humidity	10	70	%	54.8	Pass
Velocity	5.9	6.1	m/s	6.048	Pass
Chest Displacement	-38	-32	mm	-32.95	Pass
Max Force from -38 to -32 mm	680	810	N	703.6	Pass
Max Force from -32 to -12.5 mm	0	910	N	711.4	Pass
Hysteresis	65	85	%	69.9	Pass

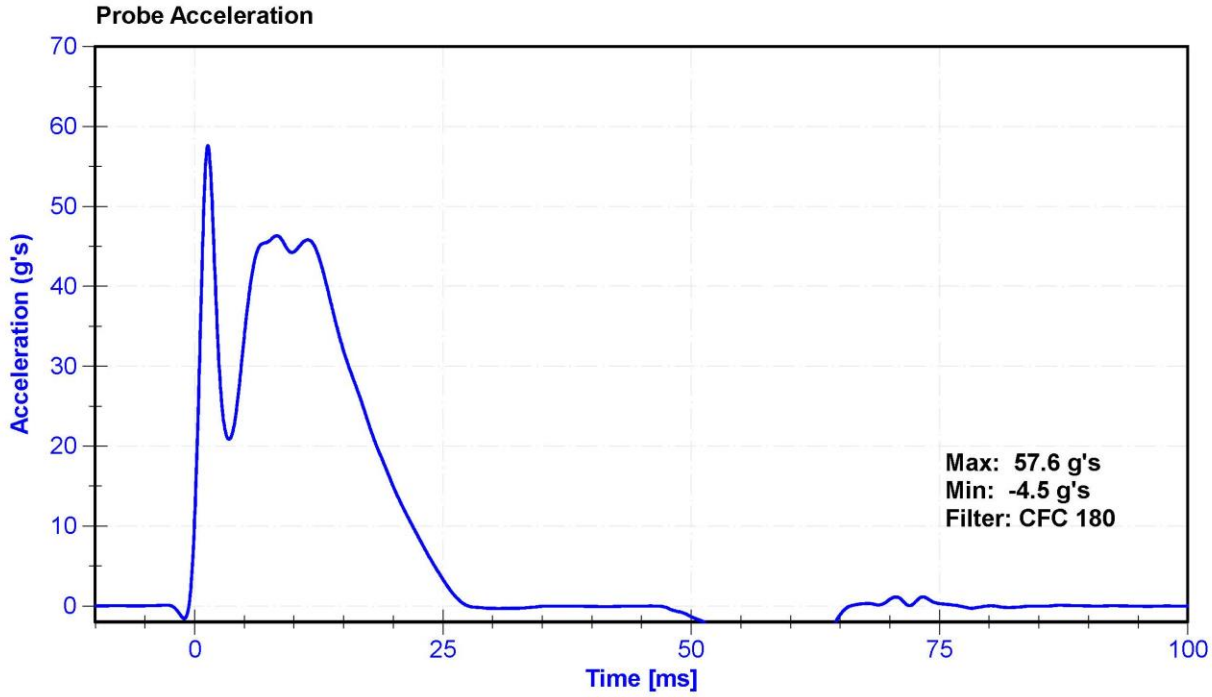
Transducer Calibrations

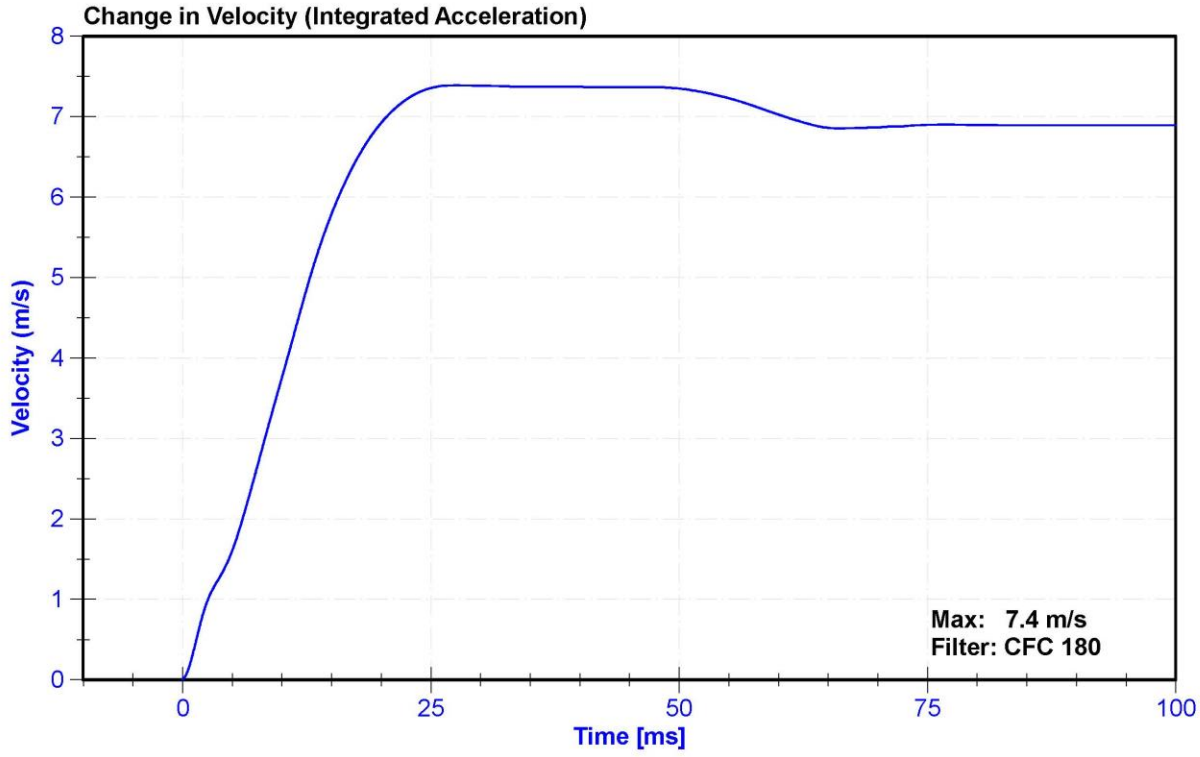
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7264CT	AC-P18743	3/18/2020	3/18/2021
Chest Potentiometer	Servo 14CBI-3615	DS-139GFE3YO	7/20/2020	1/18/2021




Resistive Force
1000
750
500
250
0
Force (N)
Max: 884.8 N
Min: -68.4 N
Filter: CFC 180
0
25
50
75
100
Time [ms]


Sternum Displacement
0
-10
-20
-30
-40
Displacement (mm)
Max: 0.13 mm
Min: -32.95 mm
Filter: CFC 180
0
25
50
75
100
Time [ms]


Probe Acceleration
Acceleration (g's)
70
60
50
40
30
20
10
0
0
25
50
75
100
Time [ms]
Max: 57.6 g's
Min: -4.5 g's
Filter: CFC 180


Change in Velocity (Integrated Acceleration)
Velocity (m/s)
8
7
6
5
4
3
2
1
0
0
25
50
75
100
Time [ms]
Max: 7.4 m/s
Filter: CFC 180