REPORT NUMBER: NCAP-CAL-19-009

NEW CAR ASSESSMENT PROGRAM (NCAP)
FRONTAL BARRIER IMPACT TEST

General Motors LLC
2019 Chevrolet Silverado 2500 Crew Cab Truck

NHTSA No: M20190114

PREPARED BY:
CALSPAN CORPORATION
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September 27, 2019

FINAL REPORT

PREPARED FOR:
U. S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
OFFICE OF CRASHWORTHINESS STANDARDS
1200 NEW JERSEY AVE SE, ROOM W43-410
WASHINGTON, D.C. 20590

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Prepared by: _____ Date: September 27, 2019
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Vanessa Hansen, Operations Manager

FINAL REPORT ACCEPTANCE BY OCWS:

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

Date: _____

_____
COTR, New Car Assessment Program
NHTSA, Office of Crashworthiness Standards

Date: _____

TECHNICAL REPORT DOCUMENTATION PAGE

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9. Performing Organization Name and Address Calspan Corporation Transportation Test Operations P.O. Box 400 Buffalo, New York 104625		***10. Work Unit No.*** ***11. Contract or Grant No.*** DTNH22-12-D-00260
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15. Supplementary Notes		

16. Abstract

A 56.30 km/h (35 mph), NCAP Frontal Impact Test was conducted on a 2019 Chevrolet Silverado 2500 Crew Cab Truck in accordance with the specifications of the Office of Crashworthiness Standards Frontal NCAP Laboratory Test Procedure. This test was conducted to obtain data indicant of FMVSS 208, 212, 219 (partial), 301, and foot well intrusion performance. The test was conducted at Calspan Corporation's Transportation Test Operations facility in Buffalo, New York on July 18, 2019.

The impact velocity of the vehicle was 56.34 km/h, and the ambient temperature at the barrier face at the time of impact was 21°C. The target vehicle's maximum post-test static crush was 675 mm at the vehicles centerline of the front bumper. The test vehicle's occupant performance data is as follows:

Measurement Description	Units	Driver ATD (Serial No. 142)		Passenger ATD (Serial No. 288)	
		Threshold	Result	Threshold	Result
Head Injury Criteria (HIC_{15})		700	424.881	700	495.256
Maximum Chest Compression	mm	63	-25.551	52	-15.695
Nij		1	0.259	1	0.461
Neck Tension	N	4,170	1640.199	2,620	848.885
Neck Compression	N	4,000	-603.050	2,520	-685.788
Left Femur Force	N	10,008	-1674.484	6,805	-1286.794
Right Femur Force	N	10,008	-2495.485	6,805	-2097.458

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Form DOT F1700.7 (8-69)

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SECTION 1

PURPOSE AND SUMMARY OF TEST

PURPOSE

This 56.3 km/h frontal barrier impact test is part of the Vehicle Barrier Impact Testing Program sponsored by the National Highway Traffic Safety Administration (NHTSA) under Contract No. DTNH22-12-D-00260. The purpose of this test was to obtain vehicle crashworthiness and occupant restraint system performance data for consumer information purposes.

The 56.3 km/h frontal barrier impact test was conducted in accordance with the Office of Crashworthiness Standards Frontal NCAP Laboratory Test procedure, dated October 2015.

SUMMARY

A ridged fixed barrier was impacted by a 2019 Chevrolet Silverado 2500 Crew Cab Truck at a velocity of 56.34 km/h. The test was performed at Calspan Corporation's Transportation Test Operations facility in Buffalo, New York on July 18, 2019. Pre- and post-test photographs of the vehicle and dummies to document the test can be found in Appendix A. One real-time camera and 14 high-speed cameras were used to document the frontal barrier impact event. Camera locations and other pertinent camera information can be found in Data Sheet 6 of this report.

One Part 572E, 50th percentile male anthropomorphic test device (ATD), was placed in the driver seating position and one Part 572O 5th percentile female ATD was placed in the right-front passenger seating position according to dummy placement instructions specified in the Frontal NCAP Laboratory Test Procedure. Both ATDs were fully instrumented with head, chest and pelvis tri-axial accelerometers, chest displacement potentiometers, upper neck transducers, right / left femur load cells, and lower leg instrumentation. The driver (position 1) ATD (Serial No. 142) and the right-front passenger (position 2) ATD (Serial No. 288) were calibrated previous to this test. Certification details, along with instrumentation calibration data, can be found in Appendix C of this report.

The 100 channels of data were recorded on an on-board data acquisition system. Please refer to Appendix B for the dummy response data traces.

There was 100 percent windshield retention and no intrusion into the protected zone of the windshield during the event. There was a total of 0.0 grams of stoddard solvent leakage after the event and including all phases of the static rollover. The maximum static crush of the test vehicle was 675 mm at the vehicles centerline. During and after the impact event, the driver's and passenger's side doors were closed and operational.

The driver's visible contact points were as follows: The driver's head contacted the frontal airbag and then the head restraint. The upper torso contacted the frontal airbag. Both knees contacted the knee bolster.

The passenger's visible contact points were as follows: The passenger's head contacted the frontal airbag and then the head restraint. The upper torso contacted the frontal airbag. Both knees contacted the glove box.

The occupant data is summarized below.

ATD Position	HIC_{15}	Nij	Neck Tension (N)	Neck Comp. (N)	3ms Chest Clip (Gs)	Chest Disp. (mm)	Left Femur (N)	Right Femur (N)
Driver (50^{th})	424.881	0.259	1640.199	-603.050	42.932	-25.551	-1674.484	-2495.485
Passenger (5^{th})	495.256	0.461	848.885	-685.788	38.849	-15.695	-1286.794	-2097.458

GENERAL COMMENTS:

1. P1 (Driver) serial number - 142
2. P2 (Passenger) serial number - 288

Data Anomalies:

- Driver Right Lower Tibia Z Force, Questionable data after 13.8ms
- Driver Right Lower Tibia X Moment, Questionable data after 13.8ms
- Driver Right Lower Tibia Y Moment, Questionable data after 13.8ms

SECTION 2

OCCUPANT AND VEHICLE INFORMATION / DATA SHEETS

This section contains information reporting for the following Data Sheets:

Data Sheet No. 1 – General Test and Vehicle Parameter Data

Data Sheet No. 2 – Seat Adjustment, Fuel System, and Steering Wheel Data

Data Sheet No. 3 – Dummy Longitudinal Clearance Dimensions

Data Sheet No. 4 – Dummy Lateral Clearance Dimensions

Data Sheet No. 5 – Seat Belt Positioning Data

Data Sheet No. 6 – High-Speed Camera Locations and Data

Data Sheet No. 7 – Vehicle Accelerometer Locations

Data Sheet No. 8 – Photographic Reference Target Locations

Data Sheet No. 9 – Load Cell Locations on Fixed Barrier

Data Sheet No. 10 – Test Vehicle Summary of Results

Data Sheet No. 11 – Post-Test Observations

Data Sheet No. 12 – Vehicle Profile Measurements

Data Sheet No. 13 – Accident Investigation Division Data

Data Sheet No. 14 – Vehicle Intrusion Measurements

Data Sheet No. 15 – Summary of FMVSS 212, 219 (Partial), and 301 Data

Data Sheet No. 16 – FMVSS 301 Static Rollover Results

Data Sheet No. 17 – Dummy/Vehicle Temperature Stabilization Chart

DATA SHEET NO. 1
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2019 Chevrolet Silverado 2500 Crew Cab Truck
NHTSA No.: M20190114
Test Program: NCAP Frontal Barrier Impact Test
Test Date: 7/18/2019

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA No.	M20190114
Model Year	2019
Make	Chevrolet
Model	Silverado 2500
Body Style	Crew Cab Truck
VIN	1GC1KSEG3KF272168
Body Color	Silver
Odometer Reading (km /mi)	84 miles
Engine Displacement (L)	6.0
Type / No. Cylinders	V8
Engine Placement	Inline
Transmission Type	Automatic
Transmission Speeds	6-Speed
Overdrive	Yes
Final Drive	4x4
Roof Rack	No
Sunroof / T-Top	No
Running Boards	Yes
Tilt Steering Wheel	Yes
Power Seats	Yes
Anti-Lock Brakes (ABS)	Yes
Automatic Door Locks (ADLs)	Yes

Traction Control System (TCS)	Yes
Power Steering	Yes
Power Window Auto-Reverse	No
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	No
Front Pass. Frontal Airbag	Yes
Front Pass. Curtain Airbag	Yes
Front Pass. Head/Torso Airbag	No
Front Pass. Torso Airbag	No
Front Pass. Torso/Pelvis Airbag	Yes
Front Pass. Pelvis Airbag	No
Front Pass. Knee Airbag	No
Driver Pretensioner	Yes
Driver Load Limiter	Yes
Front Pass. Pretensioner	Yes
Front Pass. Load Limiter	Yes
Other	No

Does owner's manual provide instructions to turn off automatic door locks?	No

DATA FROM CERTIFICATION LABEL

Manufactured By	General Motors LLC
Date of Manufacture	04/19

GVWR (kg)	4491
GAWR Front (kg)	2540
GAWR Rear (kg)	2812

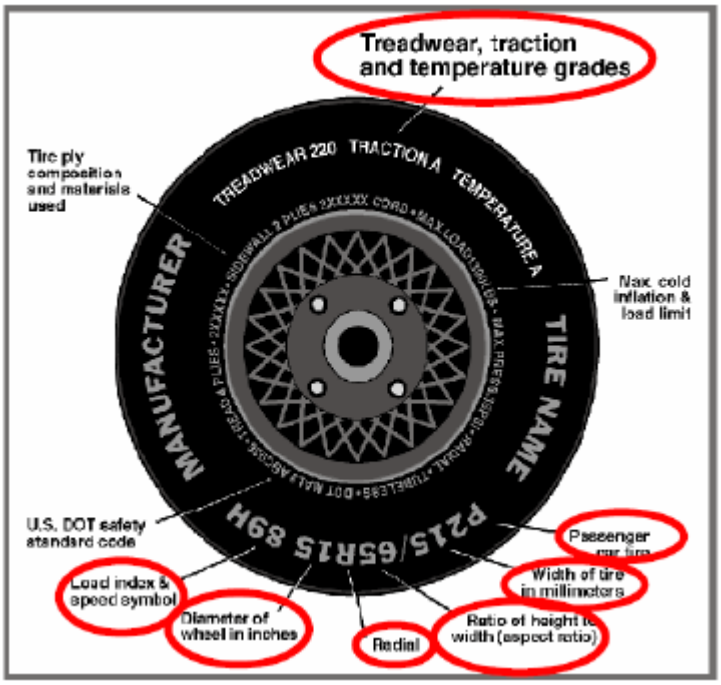
VEHICLE SEATING AND WEIGHT CAPACITY DATA

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Bench	N/A	
Number of Occupants	3	3	N/A	6
Capacity Wt. (VCW) (kg)				1319
Cargo Wt. (RCLW) (kg)				136

DATA SHEET NO. 1 … (CONTINUED)
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle:	2019 Chevrolet Silverado 2500 Crew Cab Truck	NHTSA No.:	M20190114
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	7/18/2019

Collect items circled in red, tire manufacturer, and tire name.



VEHICLE TIRE INFORMATION

Measured Parameter	Front	Rear
Maximum Tire Pressure (kPa)	550	550
Cold Pressure (kPa)	420	480
Recommended Tire Size	LT265/70R18ER	LT265/70R18ER
Tire Size on Vehicle	LT265/70R18	LT265/70R18
Tire Manufacturer	Michelin	Michelin
Tire Model	LTX	LTX
Treadwear	N/A	N/A
Traction	N/A	N/A
Temperature Grades	N/A	N/A
Tire Plies Sidewall	2 Polyester	2 Polyester
Tire Plies Body	2 Polyester, 1 Polyamide, 2 Steel	2 Polyester, 1 Polyamide, 2 Steel
Load Index / Speed Symbol	124/121R	LT265/70R18
Tire Material	Rubber	Rubber
DOT Safety Code Left	B3AC00JX1319	B3AC00JX1519
DOT Safety Code Right	B3AC00JX1319	B3AC00JX1519

DATA SHEET NO. 1 … (CONTINUED)
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2019 Chevrolet Silverado 2500 Crew Cab Truck NHTSA No.: M20190114
Test Program: NCAP Frontal Barrier Impact Test Test Date: 7/18/2019

TEST VEHICLE WEIGHTS

	Units	As Delivered Weights (UVW)			As Tested Weights (ATW)		
		Front Axle	Rear Axle	Total	Front Axle	Rear Axle	Total
Left	kg	932	659		994	729	
Right	kg	876	676		943	748	
Ratio	%	57.5	42.5		57	43	
Totals	kg	1808	1335	3143	1937	1477	3414

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value	
Total Delivered Weight (UVW)	kg	3143	(A)
Weight of 1 P572E ATD & 1 P572O ATD	kg	142	(B)
Rated Cargo / Luggage Weight (RCLW)	kg	136	(C)
Calculated Vehicle Target Weight (TVTW)	kg	3421	(A+B+C)

TEST VEHICLE ATTITUDES AND CG

Condition	Units	LF	RF	LR	RR	CG (aft of front axle)
As Delivered	mm	1031	1029	1111	1106	1812
As Tested	mm	1024	1021	1100	1090	1845
Post-Test	mm	990	1025	1088	1115	

GENERAL TEST VEHICLE DATA

Measurement Description	Units	Value
Total Vehicle Wheel Base	mm	4265
Total Vehicle Length at Left Side	mm	6517
Total Vehicle Length at Centerline	mm	6552
Total Vehicle Length at Right Side	mm	6517
Weight of Ballast in Cargo Area	kg	63
Weight of Vehicle Components Removed	kg	0
Amount of Stoddard Solvent in Fuel Tank	L	126.8

LIST OF COMPONENTS REMOVED TO MEET TEST WEIGHT:

None

DATA SHEET NO.1 … (CONTINUED)
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2019 Chevrolet Silverado 2500 Crew Cab Truck NHTSA No.: M20190114
Test Program: NCAP Frontal Barrier Impact Test Test Date: 7/18/2019

TARGET VEHICLE STRUCTURAL MEASUREMENT

No.	Description	Pre-Test
1	Total Length	6552
2	Total Width	2001
3*	Bumper Top Height	803
4*	Bumper Bottom Height	533
5*	Longitudinal Member Top Height	677
6	Distance Between Longitudinal Members	932
7	Longitudinal Member Width	60
8*	Engine Top Height	1193
9*	Engine Bottom Height	365
10	Engine and Gearbox Width	511
11	Front Bumper-Engine Distance	885
12*	Front Shock Absorber Fixing Height	795
13*	Bonnet Leading Edge Height	1270
14	Front Shock Absorber Fixing Width	997
15	Front Bumper – Front Axle Distance	991
16	Front Axle – A Pillar Distance	581
17	A-Pillar – B-Pillar Distance	1140
18	B-Pillar – Rear Axle Distance	2543
19	B-Pillar – C-Pillar Distance	1007
20*	Roof Sill Bottom Height	1839
21*	Roof Sill Top Height	1912
22*	Floor Sill Bottom Height	650
23*	Floor Sill Top Height	656

*Height Measurements are taken from the ground
Note: All measurements are in millimeters

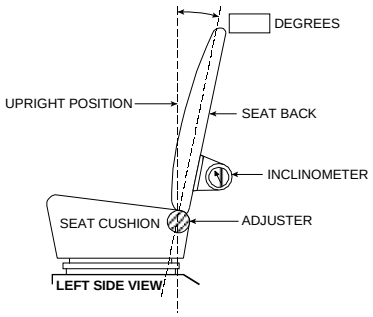
DATA SHEET NO. 2
SEAT ADJUSTMENT, FUEL SYSTEM, AND STEERING WHEEL DATA

Test Vehicle:	2019 Chevrolet Silverado 2500 Crew Cab Truck	NHTSA No.:	M20190114
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	7/18/2019

NOMINAL DESIGN RIDING POSITION

The driver's seat back was set to the manufacturer's designated angle. The passenger's seat back was positioned in a similar manner as the driver's seat back. Seat back angles are measured at the headrest post bezel using a digital inclinometer.

Seating Position	Degrees
Driver Seat Back Angle	4.0
Passenger Seat Back Angle	5.5



FRONT SEAT ASSEMBLY

SEAT FORE / AFT POSITIONS

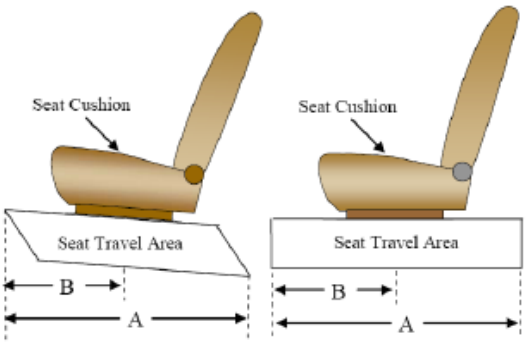
The driver's seat was positioned at the mid-point of fore/aft travel at its lowest position. The passenger's seat was positioned at the most forward position of fore/aft travel. Zero is defined as the forward most position.

Seating Position	Total Fore / Aft Travel	Placed in Position #
Driver Seat	338	169
Passenger Seat	22 (0-21)	0

SEAT BELT UPPER ANCHORAGE

The driver's seat belt anchorage was positioned according to the manufacturer's designated positioning for a 50th percentile adult male ATD. The passenger's seat belt anchorage was positioned according to the manufacturer's designated positioning for a 5th percentile adult female ATD. For this test zero is defined as the uppermost position.

Seating Position	Total # of Positions	Placed in Position #
Driver Seat	5	Uppermost
Passenger Seat	5	Uppermost



DATA SHEET NO. 2 … (CONTINUED)
SEAT ADJUSTMENT, FUEL SYSTEM, AND STEERING WHEEL DATA

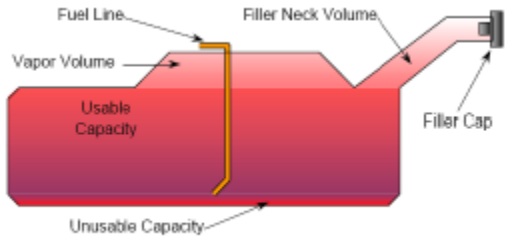
Test Vehicle: 2019 Chevrolet Silverado 2500 Crew Cab Truck
NHTSA No.: M20190114
Test Program: NCAP Frontal Barrier Impact Test
Test Date: 7/18/2019

FUEL TANK CAPACITY

Description	Liters
Usable Capacity of "Standard Tank"	136.3
Usable Capacity of "Optional Tank"	N/A
92%-94% of Usable Capacity	125.4 – 128.1
Actual Amount of Solvent Used	126.8
1/3 of Usable Capacity	45.4

FUEL PUMP

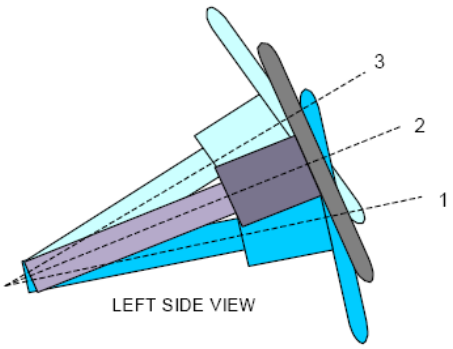
The vehicle is equipped with an electric fuel pump. The fuel filler neck is on the left side of the vehicle. The pump creates positive pressure in the fuel lines, pushing the gasoline to the engine. See form 1 for more information.



VEHICLE FUEL TANK ASSEMBLY

STEERING COLUMN ADJUSTMENT

Steering wheel and column adjustments are made so that the steering wheel hub is at the geometric center of the locus it describes when moved through its full range of motion. For angular measurements, a digital inclinometer was used to measure a plate which was placed across the steering wheel rim. A tape measure was used to measure the telescoping steering wheel travel.



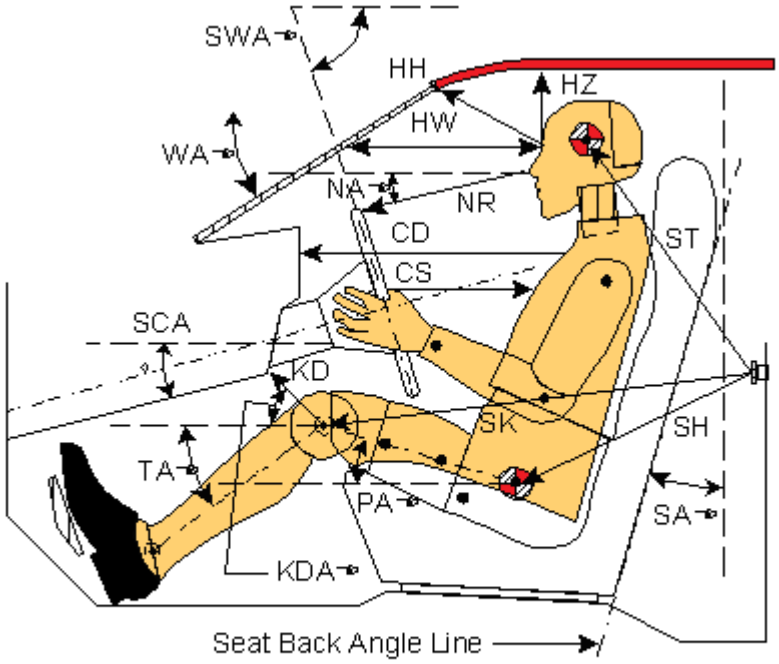
STEERING COLUMN ASSEMBLY

STEERING COLUMN POSITIONS

Description	Degrees	Fore / Aft Position (mm)
Lowermost position No. 1	11.0	
Geometric center position No. 2	20.8	
Uppermost position No. 3	33.4	
Telescoping Steering Wheel Travel		42
Test Position	20.8	21

DATA SHEET NO. 3
DUMMY LONGITUDINAL CLEARANCE DIMENSIONS

Test Vehicle: 2019 Chevrolet Silverado 2500 Crew Cab Truck
NHTSA No.: M20190114
Test Program: NCAP Frontal Barrier Impact Test
Test Date: 7/18/2019

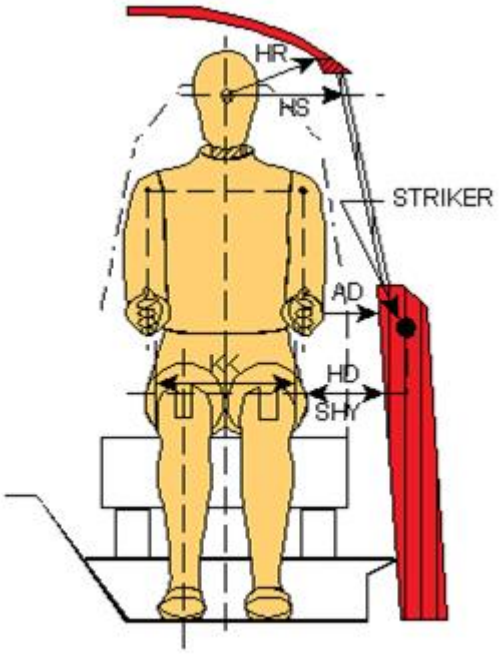


Left Side View

Code	Measurement Description	Driver (SN: 142)		Passenger (SN: 288)	
		Length (mm)	Angle (°)	Length (mm)	Angle (°)
WA°	Windshield Angle		33.9		
SWA°	Steering Wheel Angle		21.9		
SCA°	Steering Column Angle		68.1		
SA°	Seat Back Angle (on headrest post)		4.0		5.5
HZ	Head to Roof (Z)	310	90	352	90
HH	Head to Header	495	22.8	466	31.7
HW	Head to Windshield	816	0	778	0
NR	Nose to Rim	397	2.3	493	22.3
CD	Chest to Dash	572		445	
CS	Chest to Steering Hub	320	4.2		
RA	Rim to Abdomen	215	8.2		
KDL	Left Knee to Dash	185	20.9	152	34.6
KDR	Right Knee to Dash	187	24.3	150	34.8
PA°	Pelvic Angle		22.8		19.9
TA°	Tibia Angle		30.6		54.2
SK	Striker to Knee	584	5.0	642	2.0
ST	Striker to Head	581	78.3	492	73.7
SH	Striker to H-Point	257	4.3	322	2.7

DATA SHEET NO. 4
DUMMY LATERAL CLEARANCE DIMENSIONS

Test Vehicle:	2019 Chevrolet Silverado 2500 Crew Cab Truck	NHTSA No.:	M20190114
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	7/18/2019

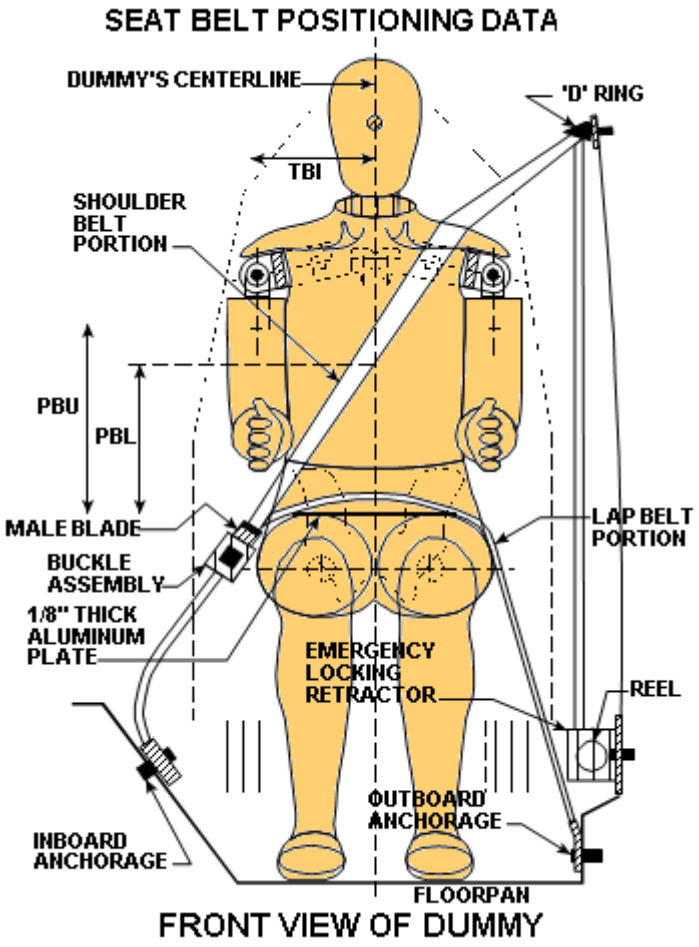


Front View

Code	Description	Driver (mm)	Passenger (mm)
AD	Arm to Door	80	89
HD	H-Point to Door	154	162
HR	Head to Side Header	292	348
HS	Head to Side Window	347	360
KK	Knee to Knee	375	232
SHY	Striker to H-Point (Y Direction)	245	287
AA	Ankle to Ankle	365	163

DATA SHEET NO. 5
SEAT BELT POSITIONING DATA

Test Vehicle:	2019 Chevrolet Silverado 2500 Crew Cab Truck	NHTSA No.:	M20190114
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	7/18/2019



SEAT BELT POSITIONING MEASUREMENTS

Measurement Description	Units	Driver	Passenger
PBU — Top surface of reference to belt upper edge	mm	308	261
PBL — Top surface of reference to belt lower edge	mm	205	156

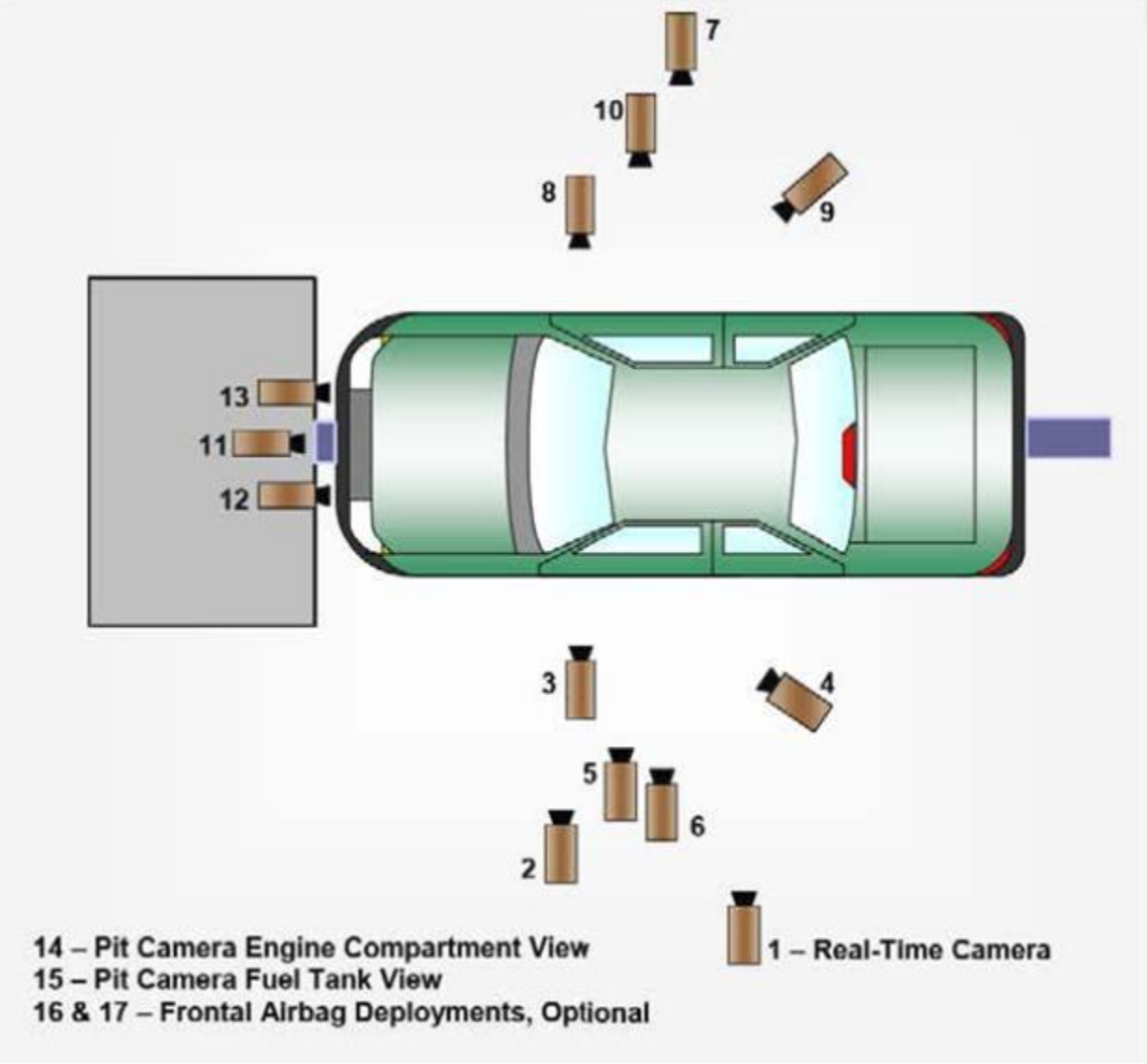
BELT LENGTH DATA

Measurement Description	Units	Driver	Passenger
Shoulder belt length as measured on ATD	mm	840	837
Lap Belt Length as measured on ATD	mm	538	515
Remainder of belt on reel	mm	1022	1088
Total belt length for continuous webbing systems	mm	2400	2440

DATA SHEET NO. 6
HIGH-SPEED CAMERA LOCATIONS AND DATA

Test Vehicle:	2019 Chevrolet Silverado 2500 Crew Cab Truck	NHTSA No.:	M20190114
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	7/18/2019

CAMERA POSITIONS FOR FRONTAL IMPACTS



Top View

DATA SHEET NO. 6 … (CONTINUED)
HIGH-SPEED CAMERA LOCATIONS AND DATA

Test Vehicle: 2019 Chevrolet Silverado 2500 Crew Cab Truck NHTSA No.: M20190114
Test Program: NCAP Frontal Barrier Impact Test Test Date: 7/18/2019

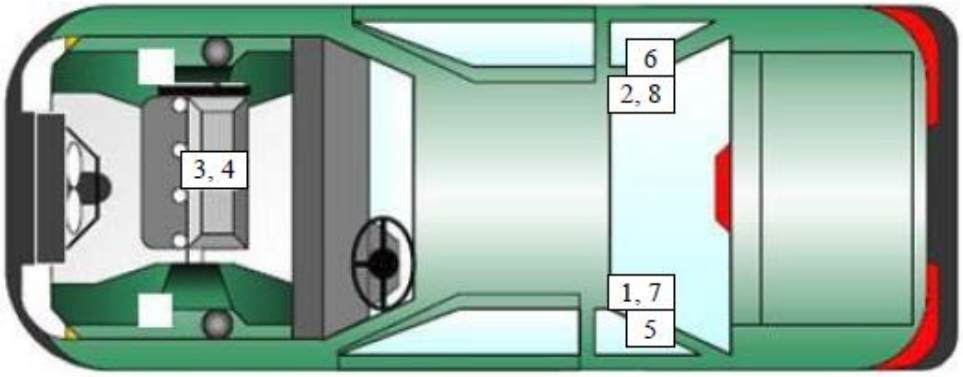
CAMERA LOCATIONS

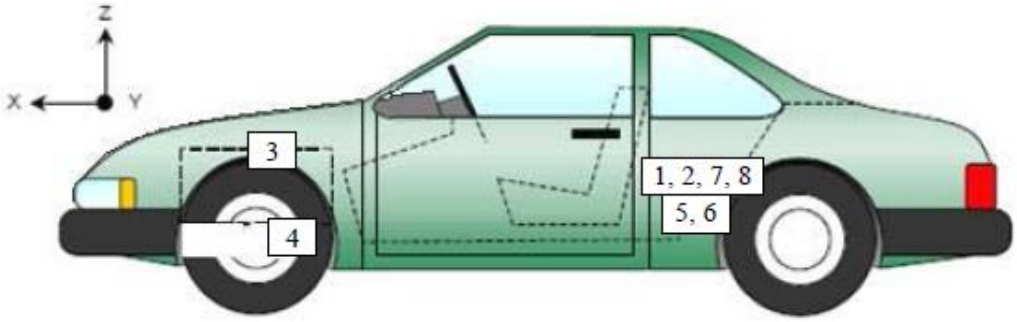
No.	Camera View	Location (mm)			Lens (mm)	Speed (fps)
		X	Y	Z		
1	Real-Time Left Overall	-	-	-		60
2	Driver Close-Up	-1901	-7103	-1562	50	1000
3	Left Front Half	-1535	-7131	-1331	28	1000
4	Left Angle	-3738	-4814	-2179	28	1000
5	Steering Column - Top					
6	Steering Column - Bottom					
7	Right Overall	-3116	9442	-1233	24	1000
8	Passenger Close-Up	-2046	7333	-1559	50	1000
9	Right Front Half	-1483	7342	-1411	28	1000
10	Right Angle	-3595	4740	-2228	28	1000
11	Windshield	200	0	-3471	12.5	1000
12	Driver Windshield	-250	-370	-2236	12.5	1000
13	Passenger Windshield	-250	370	-2236	12.5	1000
14	Pit Front	-1119	0	2473	12.5	1000
15	Pit Rear	-3594	0	2393	12.5	1000
16	Onboard Driver Airbag (Optional)				8	1000
17	Onboard Passenger Airbag (Optional)				8	1000

** COORDINATES:* *+X = forward of impact plane*
+Y = right of monorail center
+Z = into ground

DATA SHEET NO. 7
VEHICLE ACCELEROMETER LOCATIONS

Test Vehicle: 2019 Chevrolet Silverado 2500 Crew Cab Truck
NHTSA No.: M20190114
Test Program: NCAP Frontal Barrier Impact Test
Test Date: 7/18/2019





VEHICLE ACCELEROMETER PRE-TEST LOCATIONS

No.	Accelerometer Location	Measurements (mm)		
		X	Y	Z
1	Left Rear Accelerometer – X Direction	3441	-428	-55
2	Right Rear Accelerometer – X Direction	3418	393	-53
3	Engine Top X	5697	64	-528
4	Engine Bottom X	5668	47	125
5	Left Rear Accelerometer – Z Direction	3441	-428	-55
6	Right Rear Accelerometer – Z Direction	3418	393	-53
7	Left Rear Accelerometer – X Direction Redundant	3432	-427	-55
8	Right Rear Accelerometer – X Direction Redundant	3417	383	-53

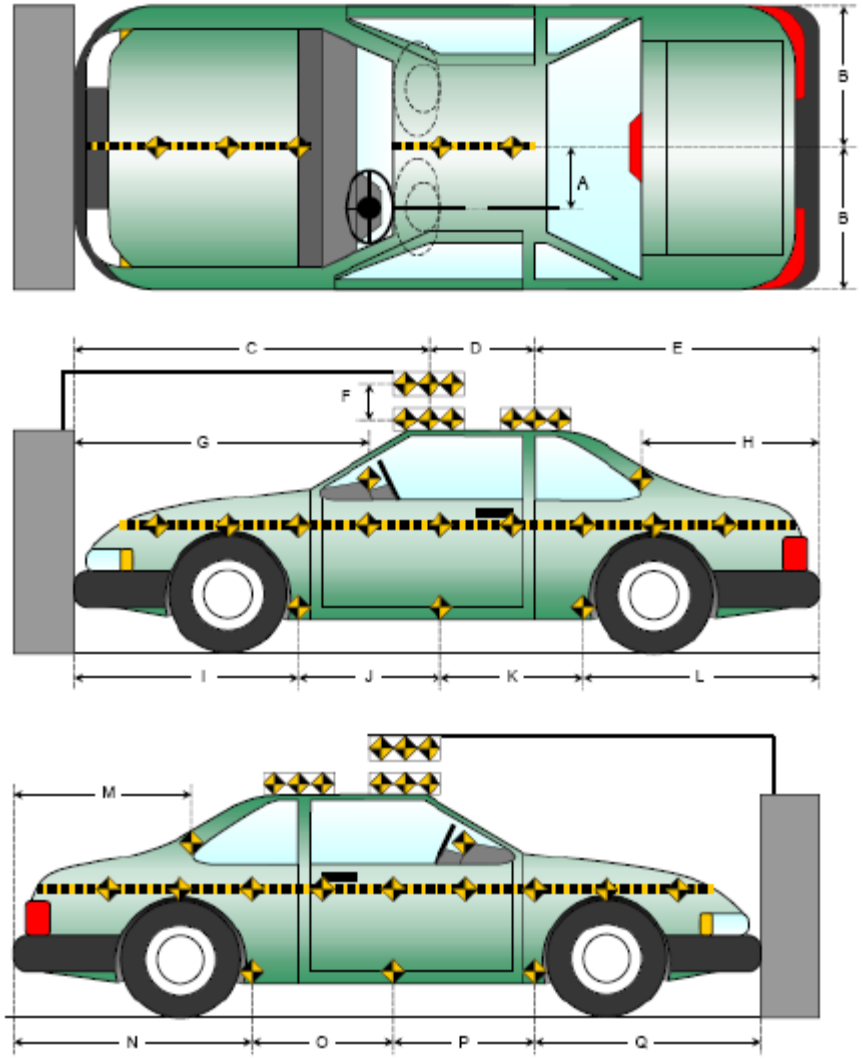
Reference Points: *X – Rear Surface of Vehicle (+ forward)*
Y – Vehicle Centerline (+ to right)
Z – Ground Plane (+ down)

DATA SHEET NO. 8
PHOTOGRAPHIC REFERENCE TARGET LOCATIONS

Test Vehicle: 2019 Chevrolet Silverado 2500 Crew Cab Truck
Test Program: NCAP Frontal Barrier Impact Test
NHTSA No.: M20190114
Test Date: 7/18/2019

Item	Value
A	453
B	1001
C	2850
D	611
E	3091
F	199
G	1888
H	2846
I	1566
J	1055
K	1063
L	2868
M	2847
N	2856
O	1066
P	1066
Q	1564

All units in millimeters



DATA SHEET NO. 9
LOAD CELL LOCATIONS ON FIXED BARRIER

Test Vehicle:	2019 Chevrolet Silverado 2500 Crew Cab Truck	NHTSA No.:	M20190114
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	7/18/2019

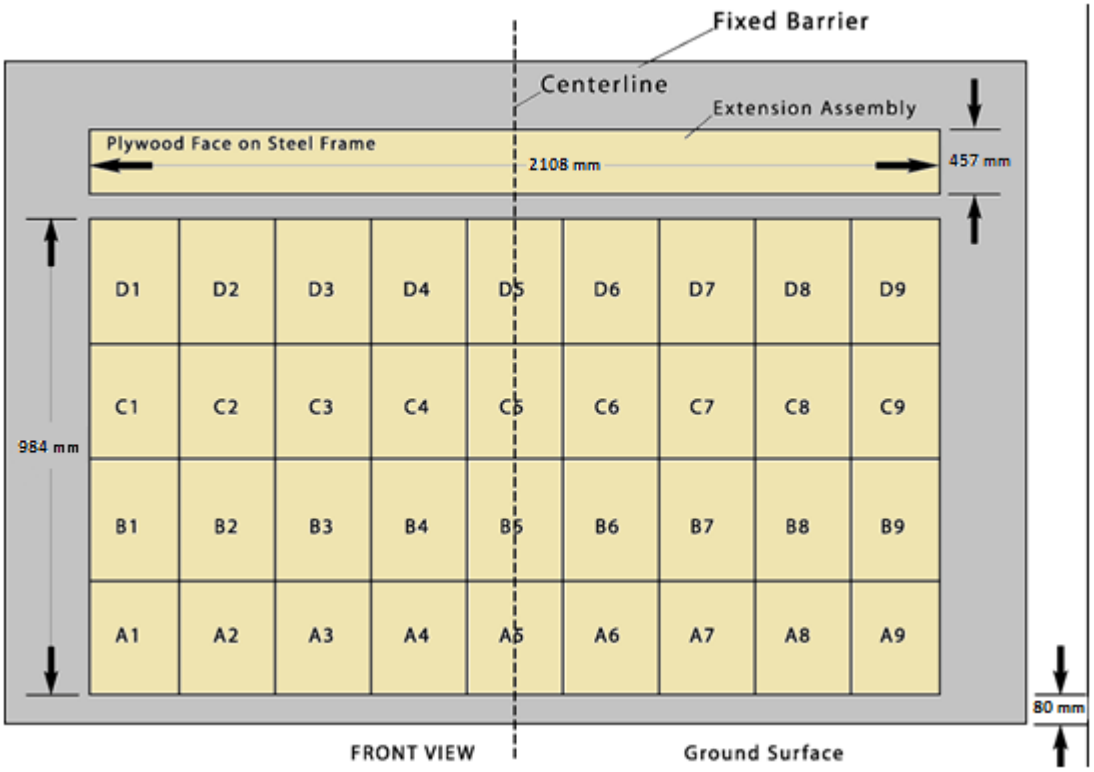


Figure 1 - * Load Cell Wall Not Used For Test

DATA SHEET NO. 10
TEST VEHICLE SUMMARY OF RESULTS

Test Vehicle: 2019 Chevrolet Silverado 2500 Crew Cab Truck NHTSA No.: M20190114
Test Program: NCAP Frontal Barrier Impact Test Test Date: 7/18/2019

INSTRUMENTATION

Instrumentation	Number of Channels Collected
Driver Dummy Accelerometers	46
Passenger Dummy Accelerometers	46
Vehicle Structure Accelerometers	8
Barrier	0
Total	100

CAMERA COVERAGE

Type of Camera	Number Used in this Test
High-Speed Vehicle Onboard	2
High-Speed Offboard	12
Real-Time Panning	1
Total	15

DATA SHEET NO. 11
POST-TEST OBSERVATIONS

Test Vehicle: 2019 Chevrolet Silverado 2500 Crew Cab Truck
NHTSA No.: M20190114
Test Program: NCAP Frontal Barrier Impact Test
Test Date: 7/18/2019

TEST DUMMY INFORMATION AND CONTACT LOCATIONS

Description	Driver	Passenger
Dummy Type / Serial No.	P572E 50th Male / 142	P5720 5th Female / 288
Head Contact	Front Airbag & Headrest	Front Airbag & Headrest
Upper Torso Contact	Front Airbag	Front Airbag
Lower Torso Contact	None	None
Left Knee Contact	Knee Bolster	Glove Box
Right Knee Contact	Knee Bolster	Glove Box

DOOR OPENING AND SEAT TRACK INFORMATION

Description	Driver	Passenger
Locked / Unlocked Doors	Unlocked	Unlocked
Front Door Opening	Closed & Operational	Closed & Operational
Rear Door Opening	Closed & Operational	Closed & Operational
Seat Track Shift (mm)	0	0
Seat Back Failure	No	No
Glazing Damage	None	None

POST-TEST STRUCTURAL OBSERVATIONS

Critical Areas of Performance	Observations and Conclusions
Windshield Damage	None
Window Damage	None
Other Notable Effects	None

VEHICLE REBOUND FROM BARRIER

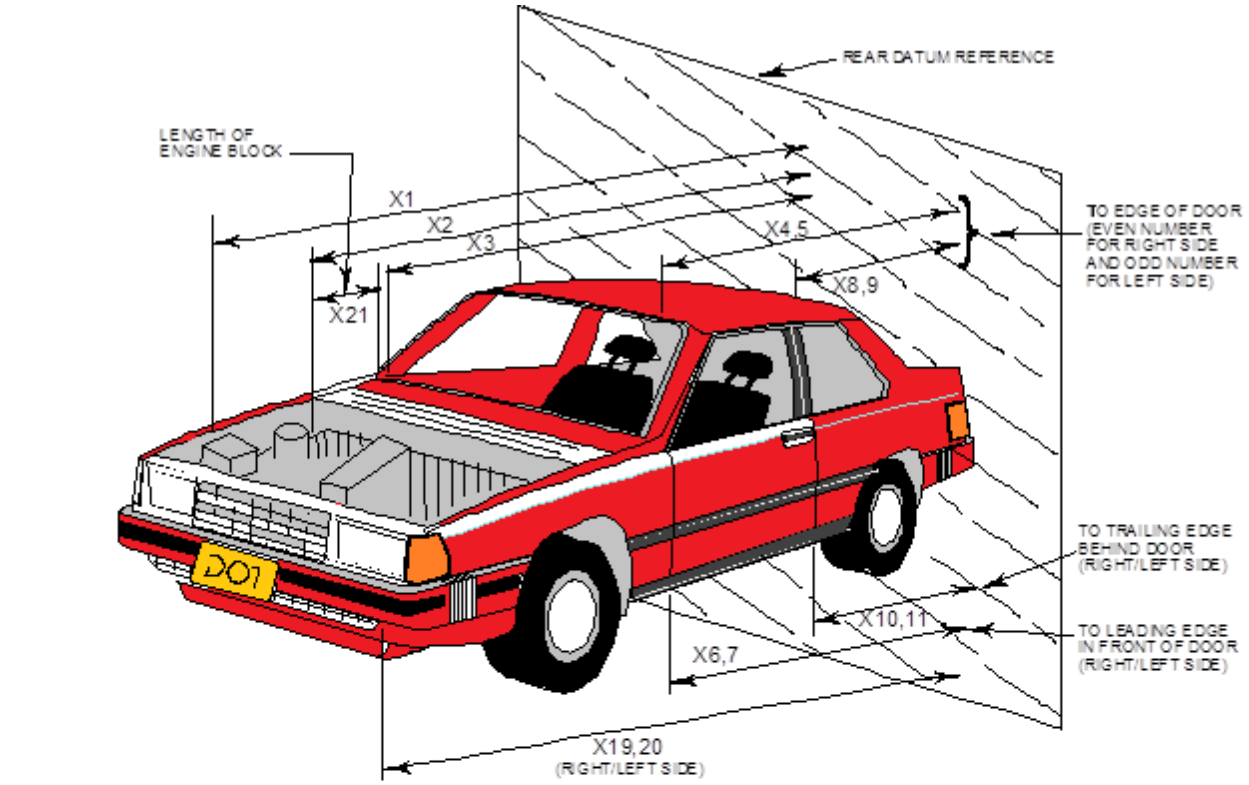
Measured Parameter	Units	Value
Left Side	mm	495
Center	mm	496
Right Side	mm	488
Average	mm	493

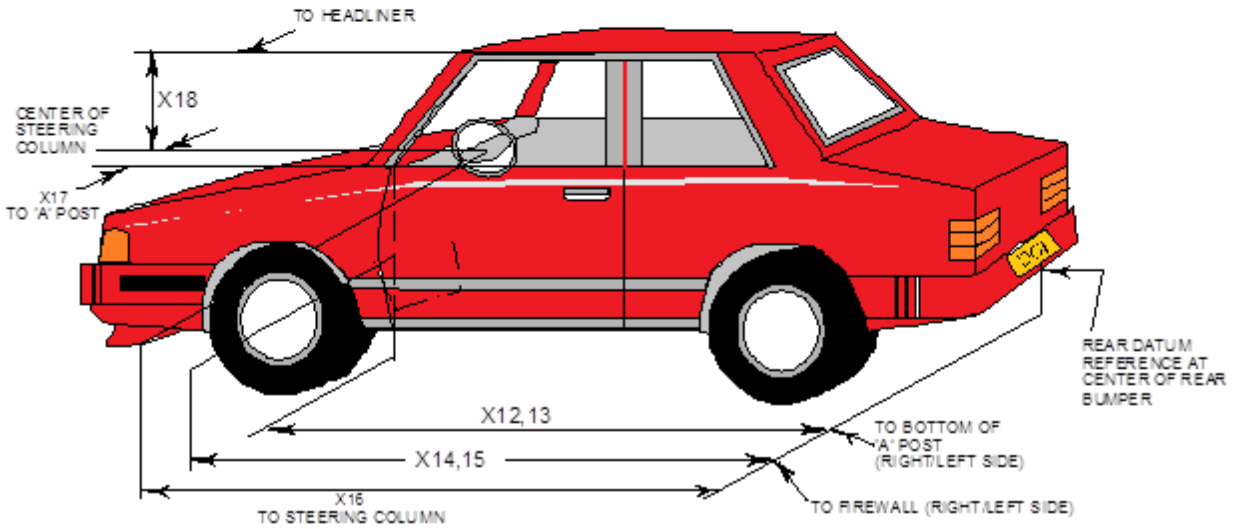
SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

Restraint Type	Driver		Passenger	
	Installed	Deployed	Installed	Deployed
Front Airbag	Yes	Yes	Yes	Yes
Side Airbag 1 - Curtain	Yes	Yes	Yes	Yes
Side Airbag 2 - Torso/Pelvis Airbag	Yes	No	Yes	No
Knee Airbag	No	N/A	No	N/A
Seat Belt Pretensioner	Yes	Yes	Yes	Yes
Seat Belt Load Limiter	Yes	Yes	Yes	Yes
Other				

DATA SHEET NO. 12
VEHICLE PROFILE MEASUREMENTS

Test Vehicle:	2019 Chevrolet Silverado 2500 Crew Cab Truck	NHTSA No.:	M20190114
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	7/18/2019





DATA SHEET NO. 12 … (CONTINUED)
VEHICLE PROFILE MEASUREMENTS

Test Vehicle: 2019 Chevrolet Silverado 2500 Crew Cab Truck NHTSA No.: M20190114
Test Program: NCAP Frontal Barrier Impact Test Test Date: 7/18/2019

No.	Measurement Description	Pre-Test	Post-Test	Difference
1	Total Length of Vehicle at Centerline	6552	5877	-675
2	Rear Surface of Vehicle (RSOV) to Front of Engine	5667	5511	-156
3	RSOV to Firewall	5352	5304	-48
4	RSOV to Upper Leading Edge of Right Door	4990	4964	-26
5	RSOV to Upper Leading Edge of Left Door	4989	4961	-28
6	RSOV to Lower Leading Edge of Right Door	4924	4908	-16
7	RSOV to Lower Leading Edge of Left Door	4922	4896	-26
8	RSOV to Upper Trailing Edge of Right Door	3841	3814	-27
9	RSOV to Upper Trailing Edge of Left Door	3842	3813	-29
10	RSOV to Lower Trailing Edge of Right Door	3810	3804	-6
11	RSOV to Lower Trailing Edge of Left Door	3811	3797	-14
12	RSOV to Bottom of “A” Post of Right Side	5043	5021	-22
13	RSOV to Bottom of “A” Post of Left Side	5041	5014	-27
14	RSOV to Firewall, Right Side	5307	5251	-56
15	RSOV to Firewall, Left Side	5303	5267	-36
16	RSOV to Steering Column	4460	4450	-10
17	Center of Steering Column to “A” Post	301	302	1
18	Center of Steering Column to Headliner	437	461	24
19	RSOV to Right Side of Front Bumper	6505	5924	-581
20	RSOV to Left Side of Front Bumper	6506	5915	-591
21	Length of Engine Block	371	371	0
RD	RSOV to Right Side of Dash Panel	4630	4607	-23
CD	RSOV to Center of Dash Panel	4619	4588	-31
LD	RSOV to Left Side of Dash Panel	4630	4607	-23

*UR= Unrecoverable data point
All Dimensions in mm

DATA SHEET NO. 13
ACCIDENT INVESTIGATION DIVISION DATA

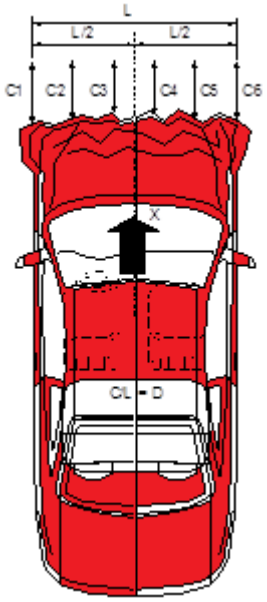
Test Vehicle:	2019 Chevrolet Silverado 2500 Crew Cab Truck	NHTSA No.:	M20190114
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	7/18/2019

VEHICLE INFORMATION

VIN:	1GC1KSEG3KF272168	Wheelbase (mm):	4,265
Vehicle Size Category:	Truck	Test Weight (kg):	3,414

ACCELEROMETER DATA

Accelerometer Locations:	Please See Data Sheet No. 7
Cal. Procedure / Interval:	Calspan Procedure / 6 month
Integration Algorithm:	Trapezoidal
Linearity:	> 99%
Impact Velocity (km/h):	56.34
Velocity Change (km/h):	64.43
Time of Separation (ms):	169



CRUSH PROFILE

Collision Deformation Classification:	12FDEW3
Midpoint of Damage:	C3
Damage Region Length (mm):	1611
Impact Mode:	Frontal

No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
C1	Crush Zone 1 at Left Side	mm	6413	5895	518
C2	Crush Zone 2 at Left Side	mm	6507	5915	592
C3	Crush Zone 3 at Left Side	mm	6542	5897	645
C4	Crush Zone 4 at Right Side	mm	6543	5900	643
C5	Crush Zone 5 at Right Side	mm	6508	5922	586
C6	Crush Zone 6 at Right Side	mm	6412	5909	503
L	C1 to C6	mm	1611	1625	-14

DATA SHEET NO. 14
VEHICLE INTRUSION MEASUREMENTS

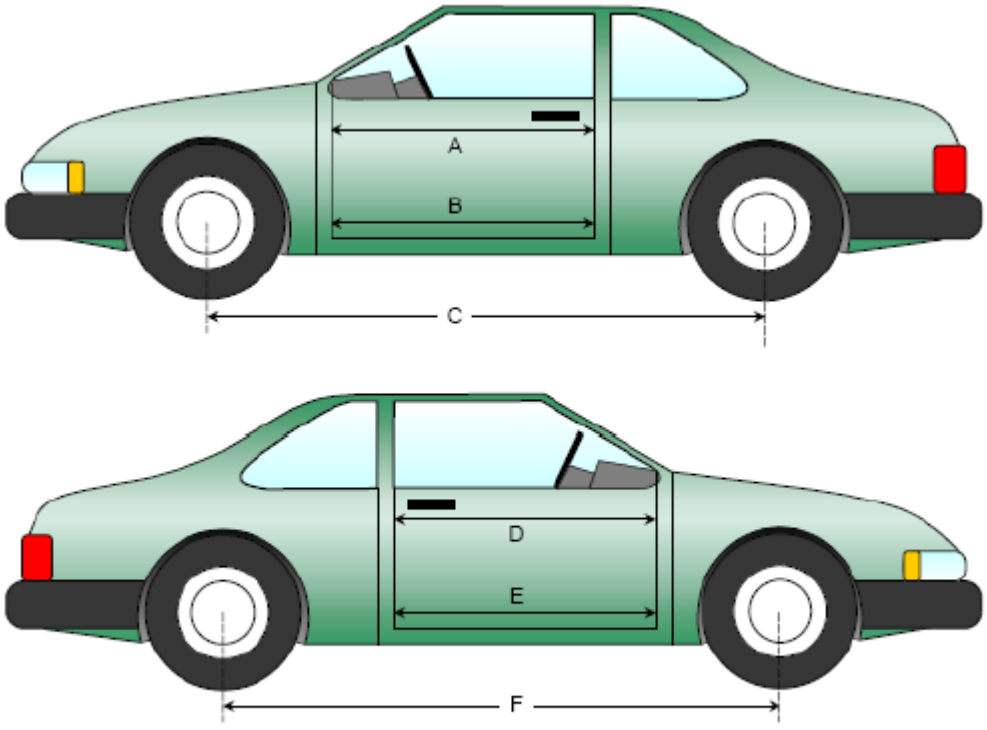
Test Vehicle: 2019 Chevrolet Silverado 2500 Crew Cab Truck
NHTSA No.: M20190114
Test Program: NCAP Frontal Barrier Impact Test
Test Date: 7/18/2019

DOOR OPENING WIDTH

Item	Description	Units	Pre-Test	Post-Test	Difference
A	Left Side Upper	mm	1034	1033	-1
B	Left Side Lower	mm	948	947	-1
D	Right Side Upper	mm	1035	1034	-1
E	Right Side Lower	mm	951	951	0

WHEELBASE MEASUREMENTS

Item	Description	Units	Pre-Test	Post-Test	Difference
C	Left Side Wheelbase	mm	4265	4129	-136
F	Right Side Wheelbase	mm	4265	4142	-123



Left & Right Side Views

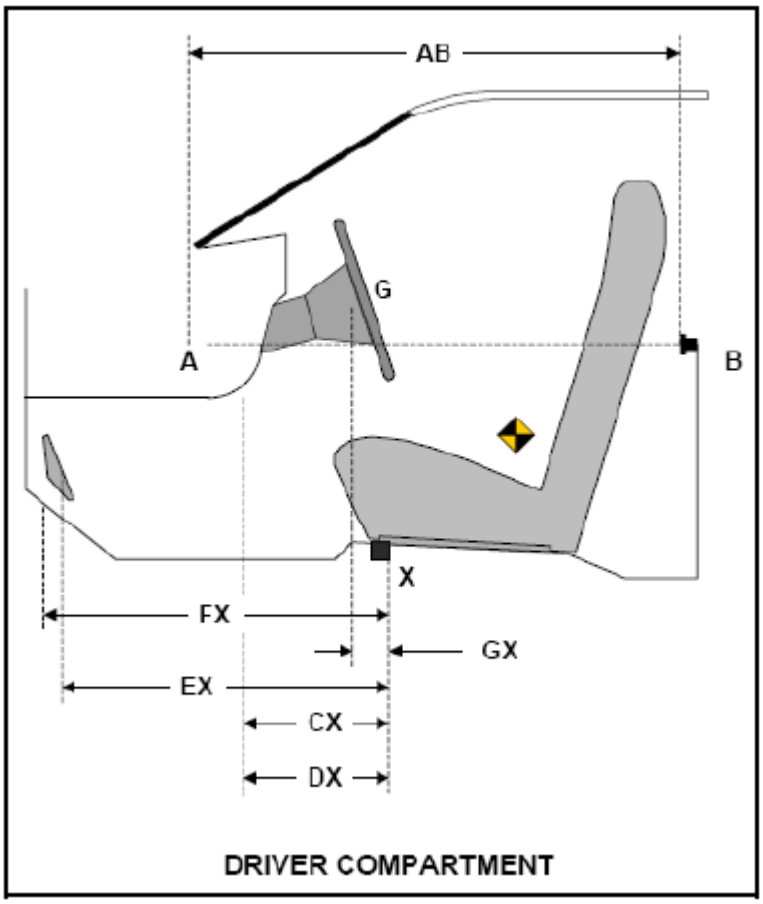
DATA SHEET NO.14 … (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2019 Chevrolet Silverado 2500 Crew Cab Truck
NHTSA No.: M20190114
Test Program: NCAP Frontal Barrier Impact Test
Test Date: 7/18/2019

DRIVER COMPARTMENT INTRUSION

Item	Description	Units	Pre-Test	Post-Test	Difference
AB	Door Opening (Inside Window Jam)	mm	734	735	1
CX	Left Knee Bolster to X	mm	334	284	-50
DX	Right Knee Bolster to X	mm	333	268	-65
EX	Brake Pedal to X	mm	551	584	33
FX	Foot Rest to X	mm	545	507	-38
GX	Center of Steering Column Wheel Hub to X	mm	82	51	-31

X = Front of Seat Track (Stationary)



DATA SHEET NO. 15
SUMMARY OF FMVSS 212, 219 (PARTIAL), AND 301 DATA

Test Vehicle:	2019 Chevrolet Silverado 2500 Crew Cab Truck	NHTSA No.:	M20190114
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	7/18/2019

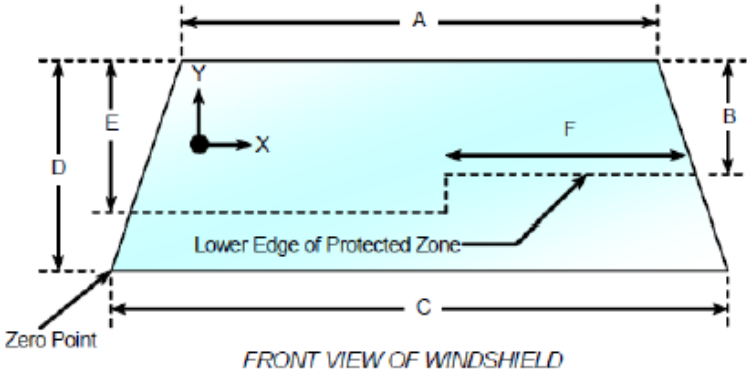
Windshield Mounting Details: A 0.8 mm trim surrounds the top and side of windshield while a plastic shroud is on the bottom.

The standard requires that the post-test retention measurement be a minimum of 75% of the pre-test total periphery measurement for vehicles not equipped with occupant passive restraints and 50% for each side of the windshield for vehicles which are equipped with occupant passive restraints.

Temperature of windshield molding during test: 21 ° C

WINDSHIELD PERIPHERY MEASUREMENTS

Measurement	Pre-Test (mm)	Post-Test (mm)	% Retention
Left Side	2272	2272	100
Right Side	2272	2272	100
Total	4544	4544	100



FRONT VIEW OF WINDSHIELD

Item	Units	Value
A	mm	1382
B	mm	385
C	mm	1635
D	mm	765
E	mm	415
F	mm	645

AREAS OF PROTECTED ZONE FAILURES

A. *Provide coordinates of the area that the protected zone was penetrated more than .25 inches by a vehicle component other than one that is normally in contact with the windshield.*
- No Penetration

X	Y

B. *Provide coordinates of the area beneath the protected zone that the inner surface of the windshield was penetrated by a vehicle component.*
- No Penetration

X	Y

DATA SHEET NO. 15 … (CONTINUED)
SUMMARY OF FMVSS 212, 219 (PARTIAL), AND 301 DATA

Test Vehicle:	2019 Chevrolet Silverado 2500 Crew Cab Truck	NHTSA No.:	M20190114
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	7/18/2019

FMVSS 301 FUEL SYSTEM INTEGRITY POST IMPACT DATA

Temperature at Time of Impact: 21 ° C Test Time: 11:40 AM

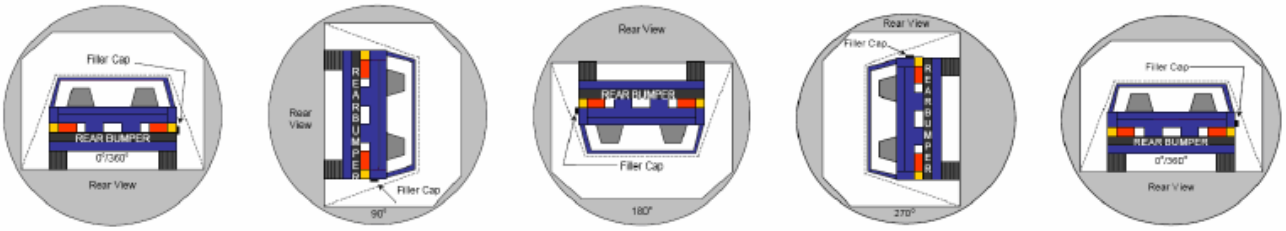
STODDARD SOLVENT SPILLAGE MEASUREMENTS

A. From impact until vehicle motion ceases: (Maximum allowable is 1 oz.)	0	oz.
B. For the 5-minute period after motion ceases: (Maximum allowable is 5 oz.)	0	oz.
C. For the following 25 minutes: (Maximum allowable is 1 oz./minute)	0	oz.

D. Spillage: No Spillage Occurred

DATA SHEET NO. 16
FMVSS 301 STATIC ROLLOVER RESULTS

Test Vehicle: 2019 Chevrolet Silverado 2500 Crew Cab Truck
NHTSA No.: M20190114
Test Program: NCAP Frontal Barrier Impact Test
Test Date: 7/18/2019



0° TO 90° 90° TO 180° 180° TO 270° 270° TO 360°

1. The specified fixture rollover rate for each 90°of rotation is 60 to 180 seconds.
2. The position hold time at each position is 300 seconds (minimum).
3. Details of Stoddard Solvent Spillage: No Spillage Occurred

SOLVENT COLLECTION TIME TABLE IN SECONDS

Test Phase	Rotation Time	Hold Time	Total Time
0° to 90°	68	300	368
90° to 180°	63	300	363
180° to 270°	66	300	366
270° to 360°	66	300	366

FMVSS 301 SPILLAGE TABLE

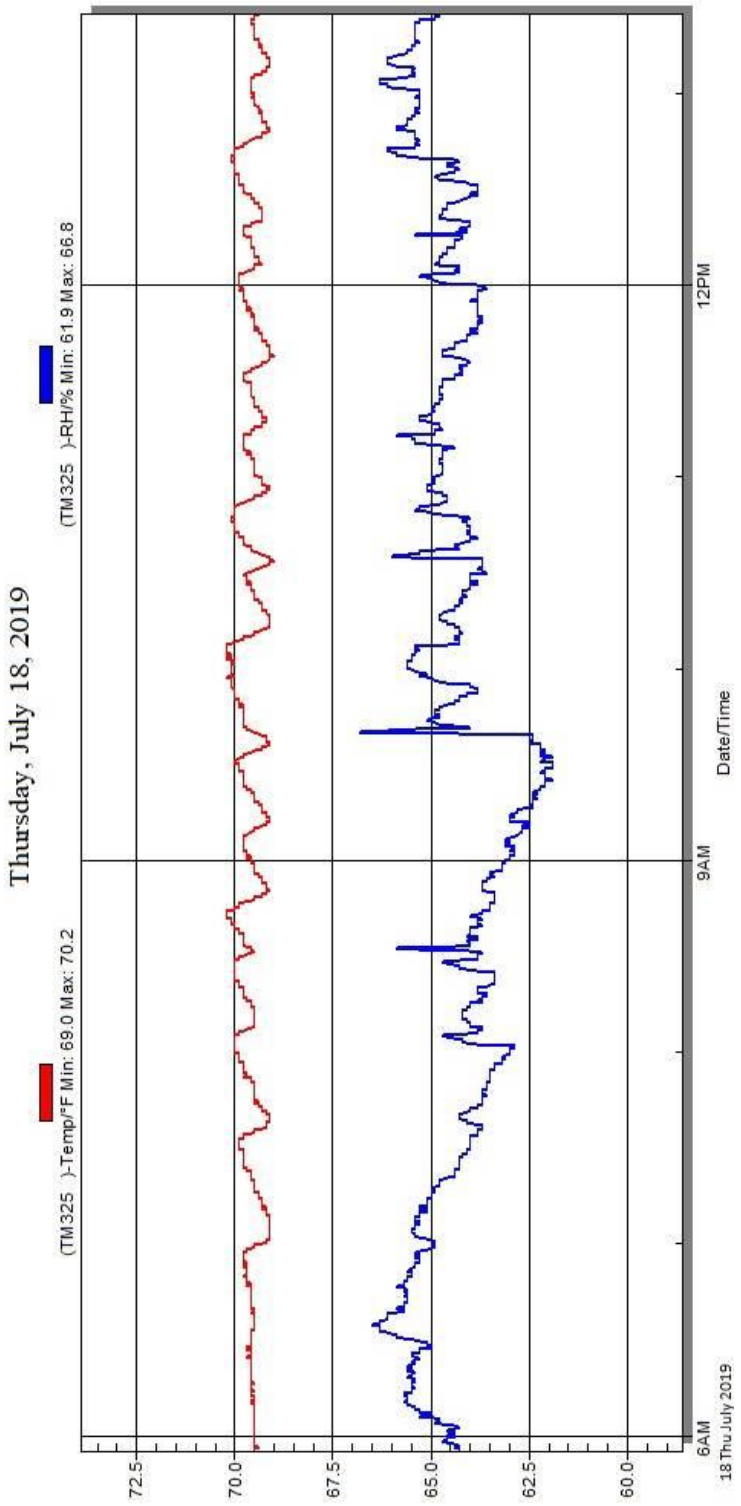
Test Phase	First 5 Minutes	Sixth Minute	Seventh Minute	Eighth Minute
0° to 90°	0	0	0	
90° to 180°	0	0	0	
180° to 270°	0	0	0	
270° to 360°	0	0	0	

SOLVENT SPILLAGE LOCATION TABLE

Test Phase	Spillage Location
0° to 90°	None
90° to 180°	None
180° to 270°	None
270° to 360°	None

DATA SHEET NO. 17
DUMMY / VEHICLE TEMPERATURE STABILIZATION CHART

Test Vehicle:	2019 Chevrolet Silverado 2500 Crew Cab Truck	NHTSA No.:	M20190114
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	7/18/2019



Temperature and Humidity Stabilization Chart/Data for Dummies and Test Vehicle

APPENDIX A

PHOTOGRAPHS

TABLE OF PHOTOGRAPHS

[1]**NOTE**: *The underbody views should include the following vehicle components: fuel pump, fuel lines, sender unit, fuel tank filler pipe and any other visible system components.*

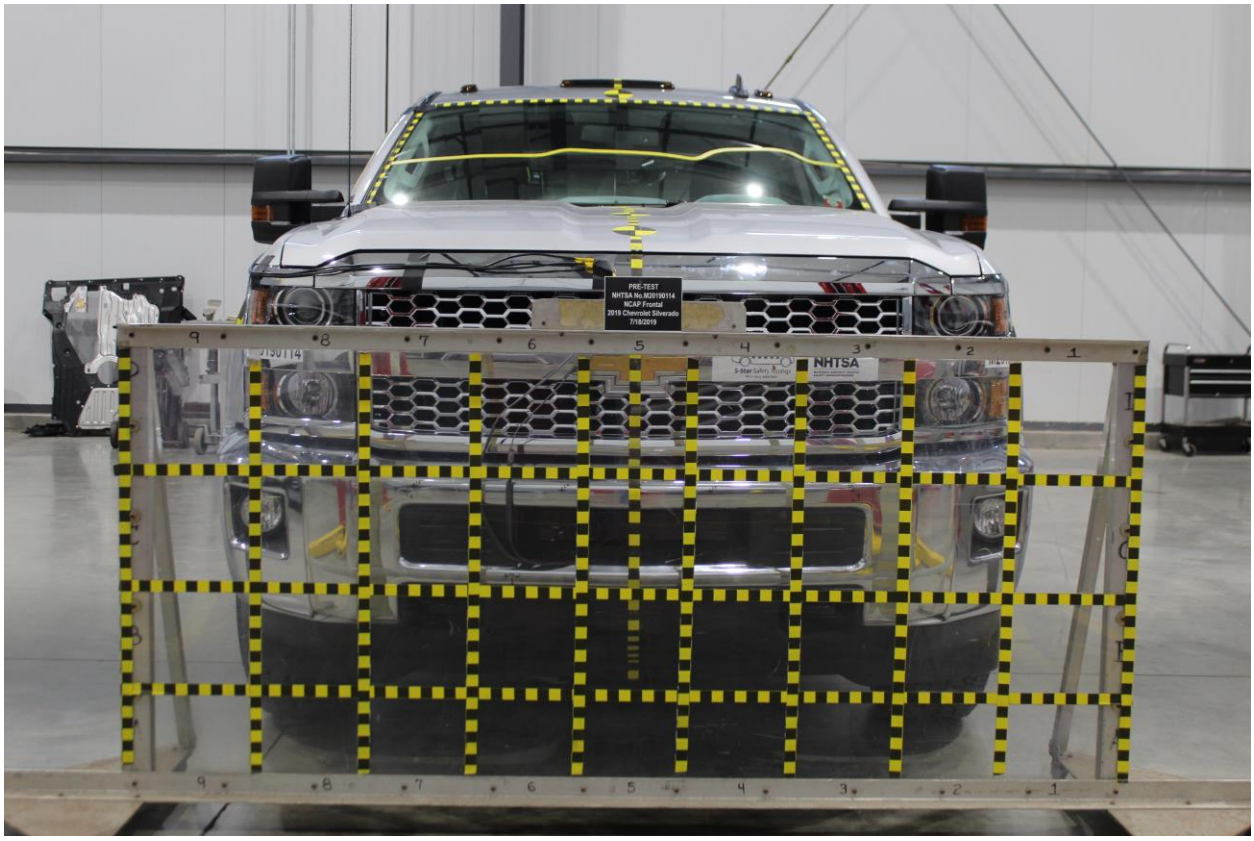


Figure A-1: Load Cell Location

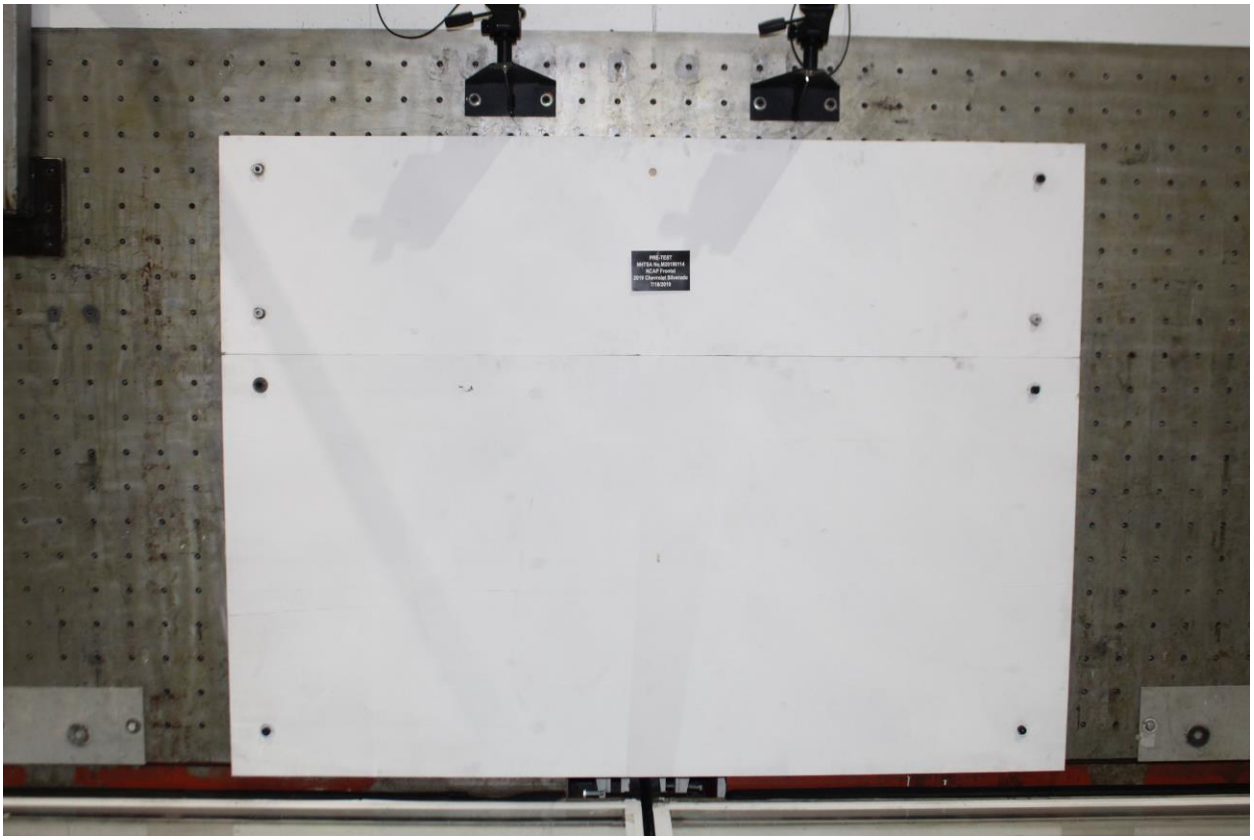


Figure A-2: Pre-Test Load Cell Wall

Figure A-3: Post-Test Load Cell Wall

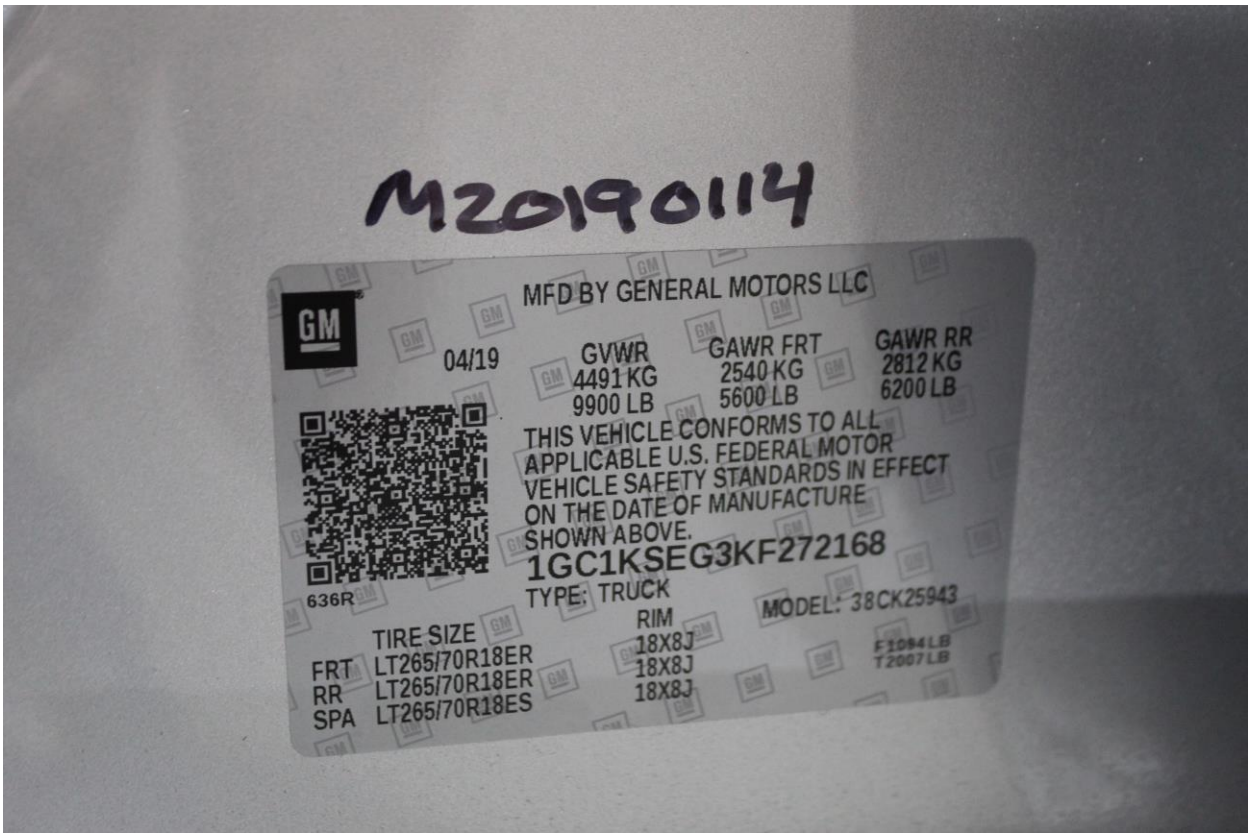


Figure A-4: Manufacturer's Label

Figure A-5: Tire Placard

Figure A-6: 2019 Chevrolet Silverado 2500 Frontal As Delivered

Figure A-7: Left Rear 3-4 View, As Received

Figure A-8: Pre-Test Front View of Test Vehicle

Figure A-9: Post-Test Front View of Test Vehicle

Figure A-10: Pre-Test Left View of Test Vehicle

Figure A-11: Post-Test Left View of Test Vehicle

Figure A-12: Pre-Test Right View of Test Vehicle

Figure A-13: Post-Test Right View of Test Vehicle

Figure A-14: Pre-Test Right Front 3-4 View

Figure A-15: Post-Test Right Front 3-4 View

Figure A-16: Pre-Test Left Rear 3-4 View

Figure A-17: Post-Test Left Rear 3-4 View

Figure A-18: Pre-Test Windshield View

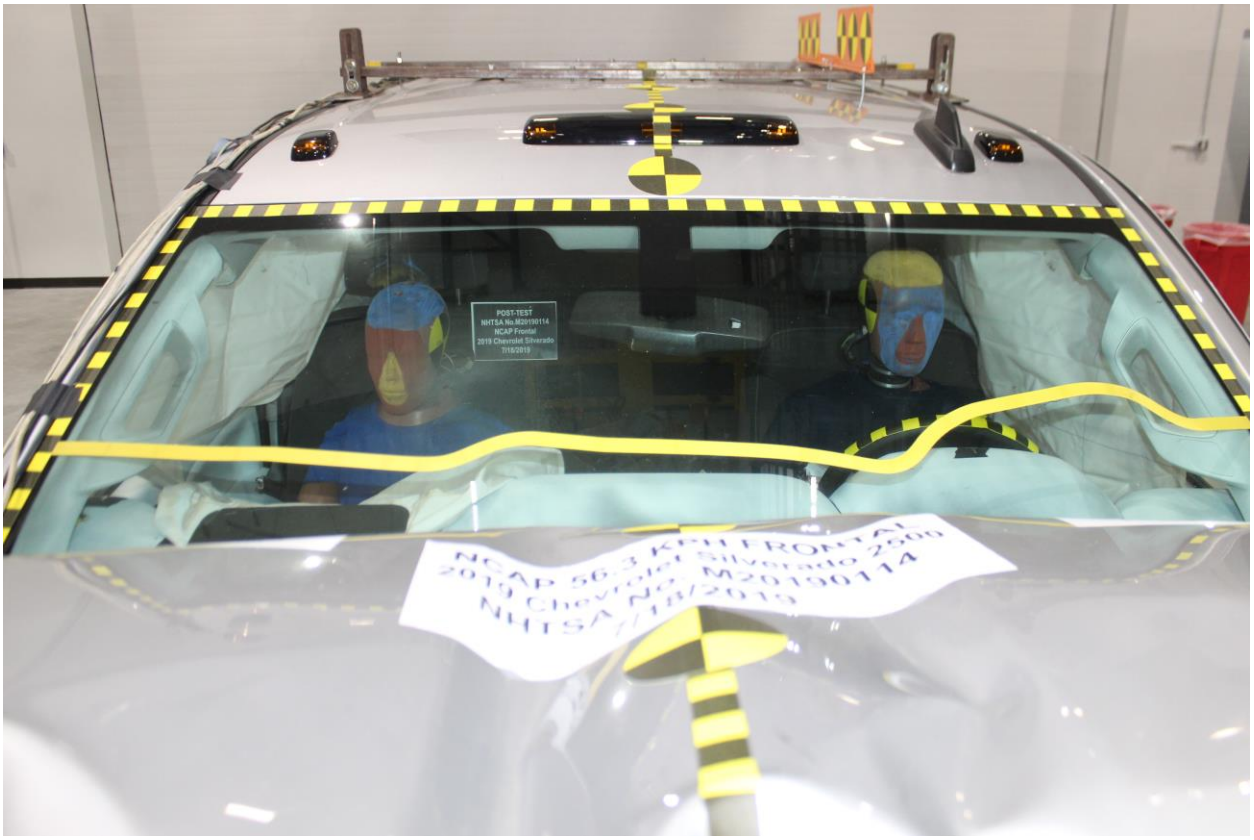


Figure A-19: Post-Test Windshield View

Figure A-20: Pre-Test Engine Compartment View

Figure A-21: Post-Test Engine Compartment View

Figure A-22: Pre-Test Fuel Filler Cap View

Figure A-23: Post-Test Fuel Filler Cap View

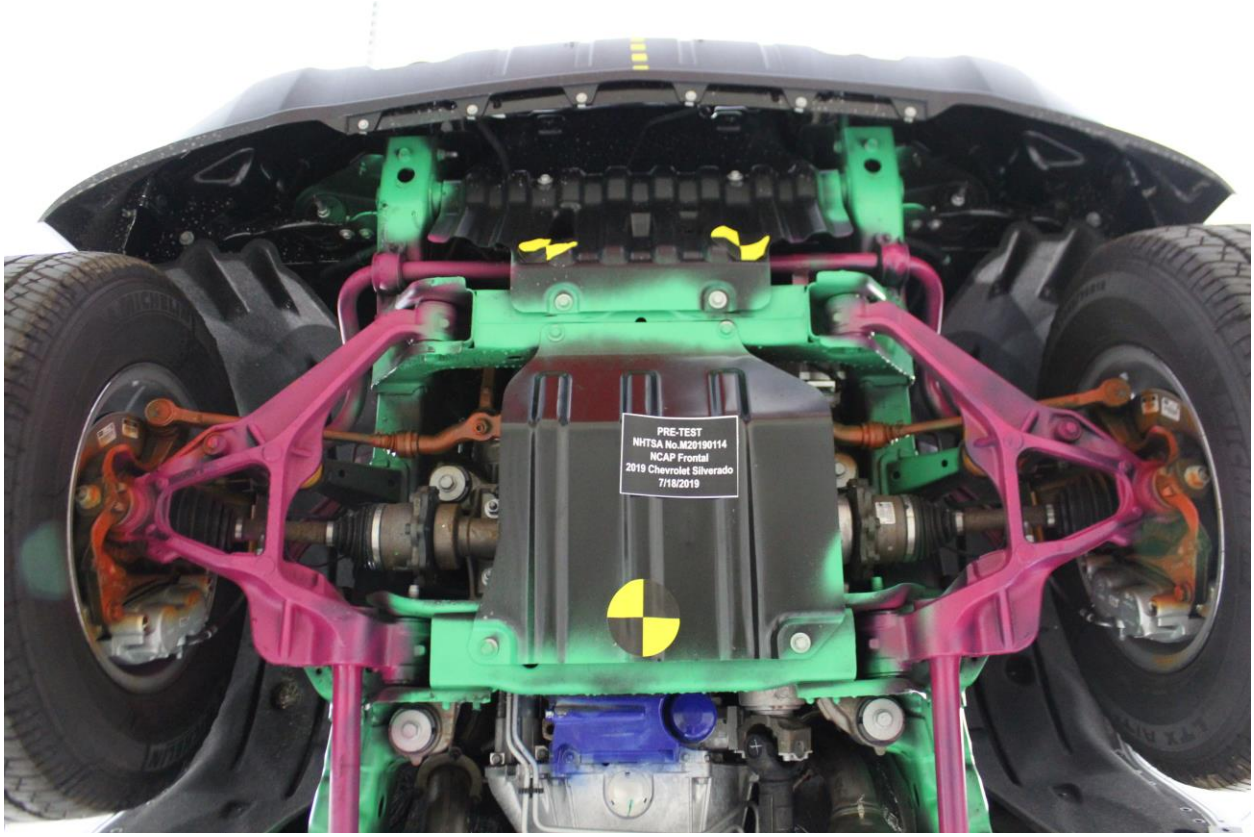


Figure A-24: Pre-Test Front Underbody View

Figure A-25: Post-Test Front Underbody View

Figure A-26: Pre-Test Rear Underbody View

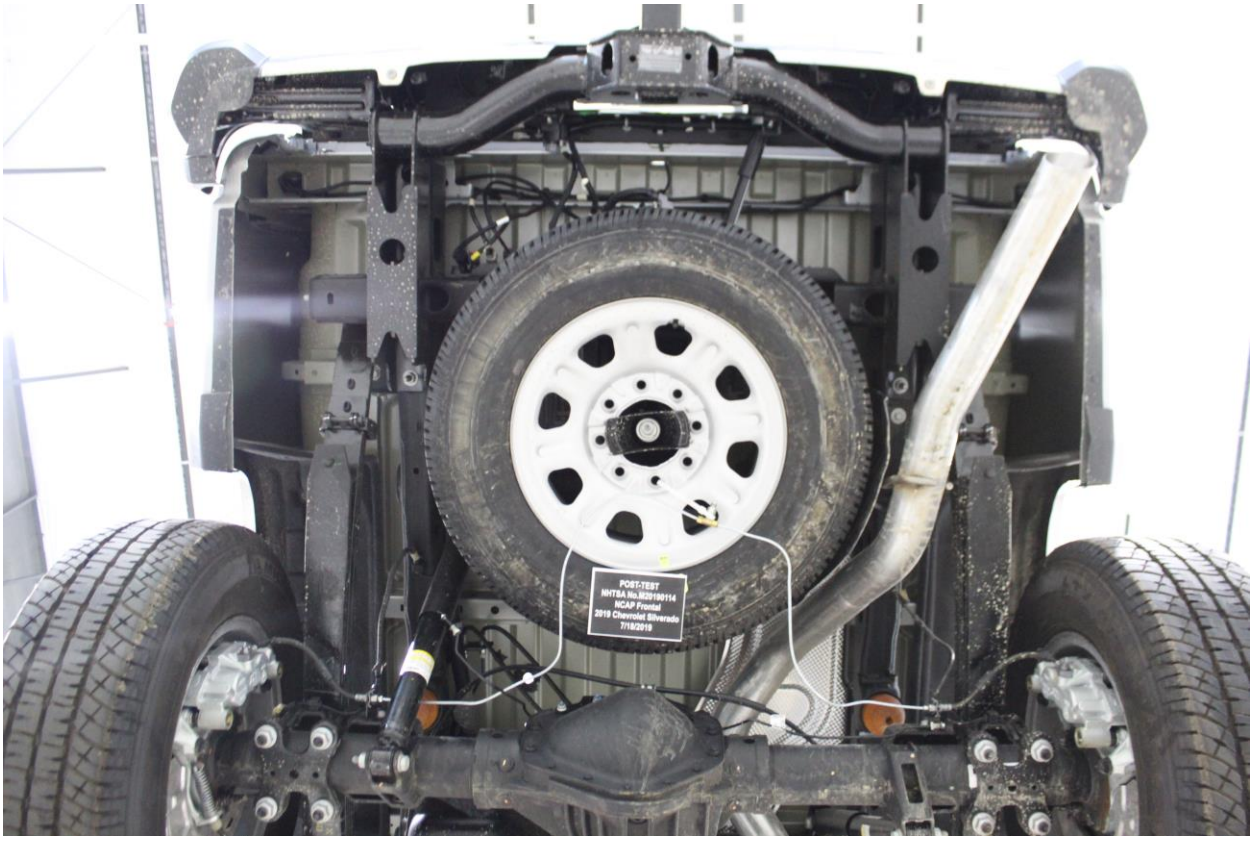


Figure A-27: Post-Test Rear Underbody View

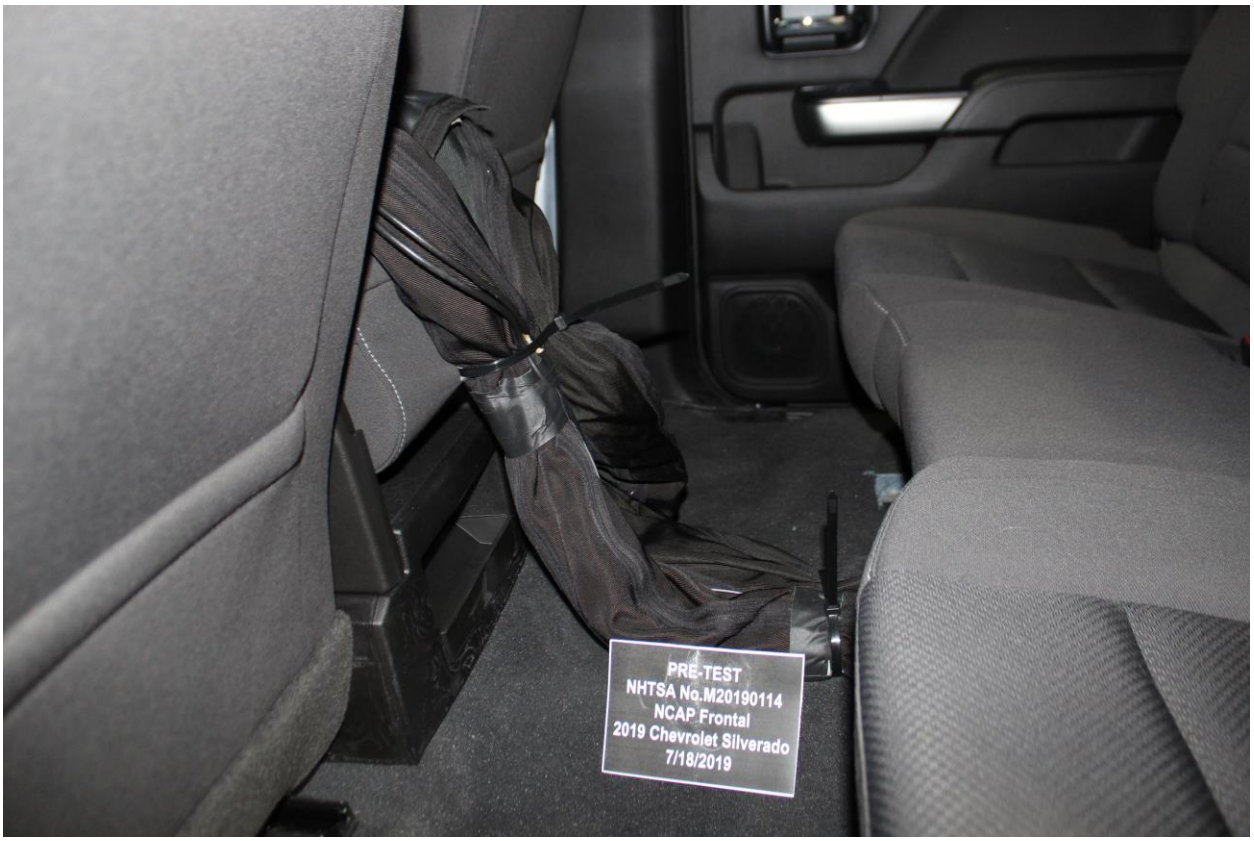


Figure A-28: Pre-Test Dummy Cable Routing

Figure A-29: Post-Test Dummy Cable Routing

Figure A-30: Pre-Test Driver Dummy Front View

Figure A-31: Post-Test Driver Dummy Front View

Figure A-32: Pre-Test Driver Dummy Window View

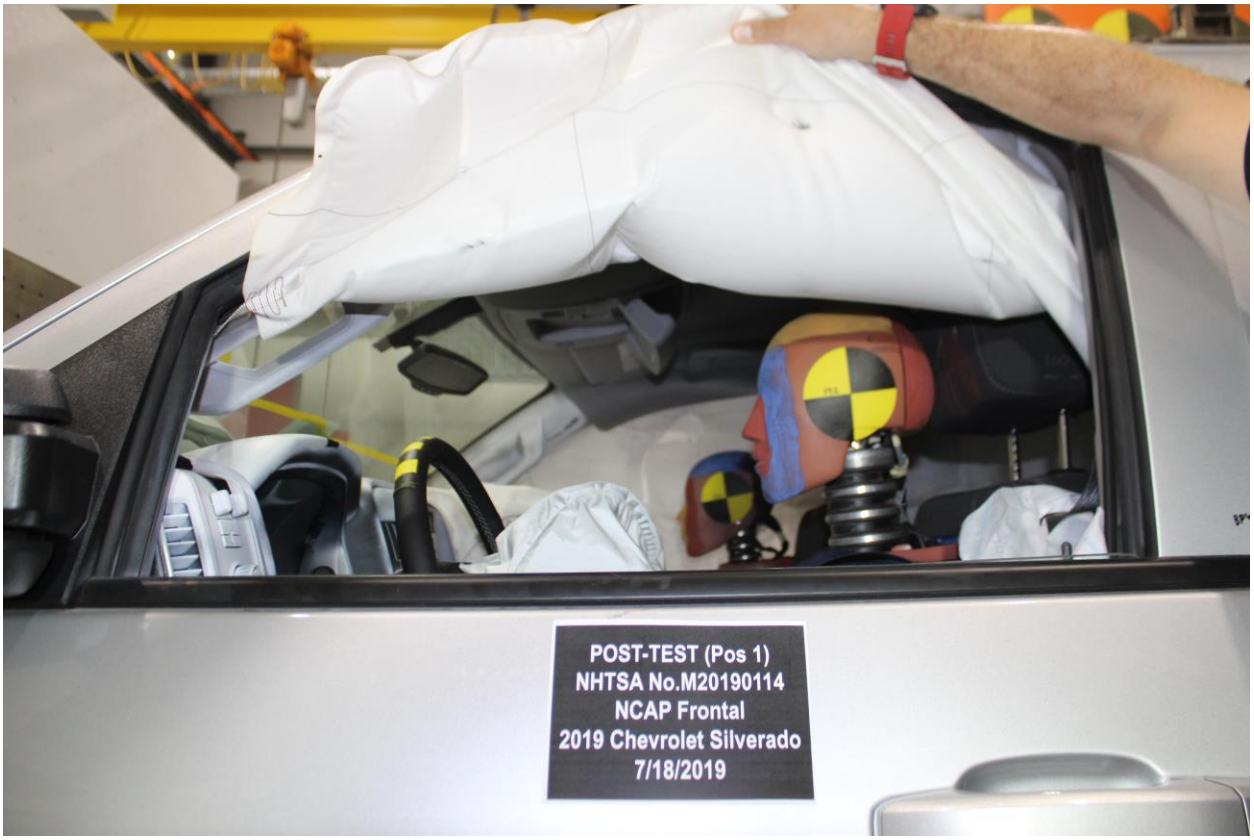


Figure A-33: Post-Test Driver Dummy Window View

Figure A-34: Pre-Test Driver Dummy and Vehicle Interior View

Figure A-35: Post-Test Driver Dummy and Vehicle Interior View

Figure A-36: Pre-Test Driver's Seat Fore-Aft Markings

Figure A-37: Post-Test Driver's Seat Fore-Aft Markings

Figure A-38: Pre-Test View of Belt Anchorage for Driver Dummy

Figure A-39: Post-Test View of Belt Anchorage for Driver Dummy

Figure A-40: Pre-Test Driver Dummy Feet

Figure A-41: Post-Test Driver Dummy Feet

Figure A-42: Pre-Test Driver's Side Knee Bolster

Figure A-43: Post-Test Driver's Side Knee Bolster

Figure A-44: Pre-Test Driver's Side Floorpan

Figure A-45: Post-Test Driver's Side Floorpan

Figure A-46: Post-Test Driver Dummy Face

Figure A-47: Post-Test Driver Dummy Contact With Airbag

Figure A-48: Post-Test Driver Dummy Contact With Headrest

Figure A-49: Pre-Test View of the Steering Wheel

Figure A-50: Post-Test View of the Steering Wheel

Figure A-51: Pre-Test Passenger Dummy Front View

Figure A-52: Post-Test Passenger Dummy Front View

Figure A-53: Pre-Test Passenger Dummy Window View

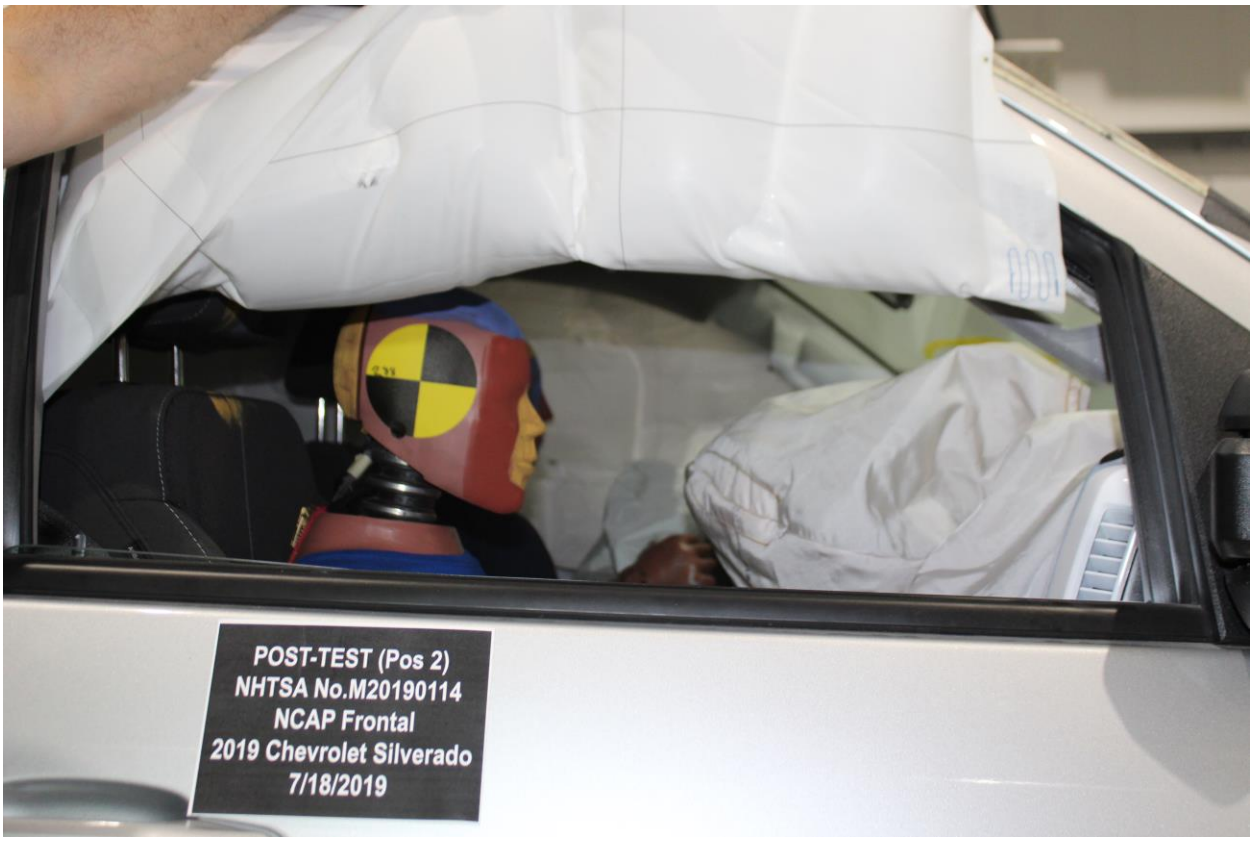


Figure A-54: Post-Test Passenger Dummy Window View

Figure A-55: Pre-Test Passenger Dummy and Vehicle Interior View

Figure A-56: Post-Test Passenger Dummy and Vehicle Interior View

Figure A-57: Pre-Test Passenger's Seat Fore-Aft Markings

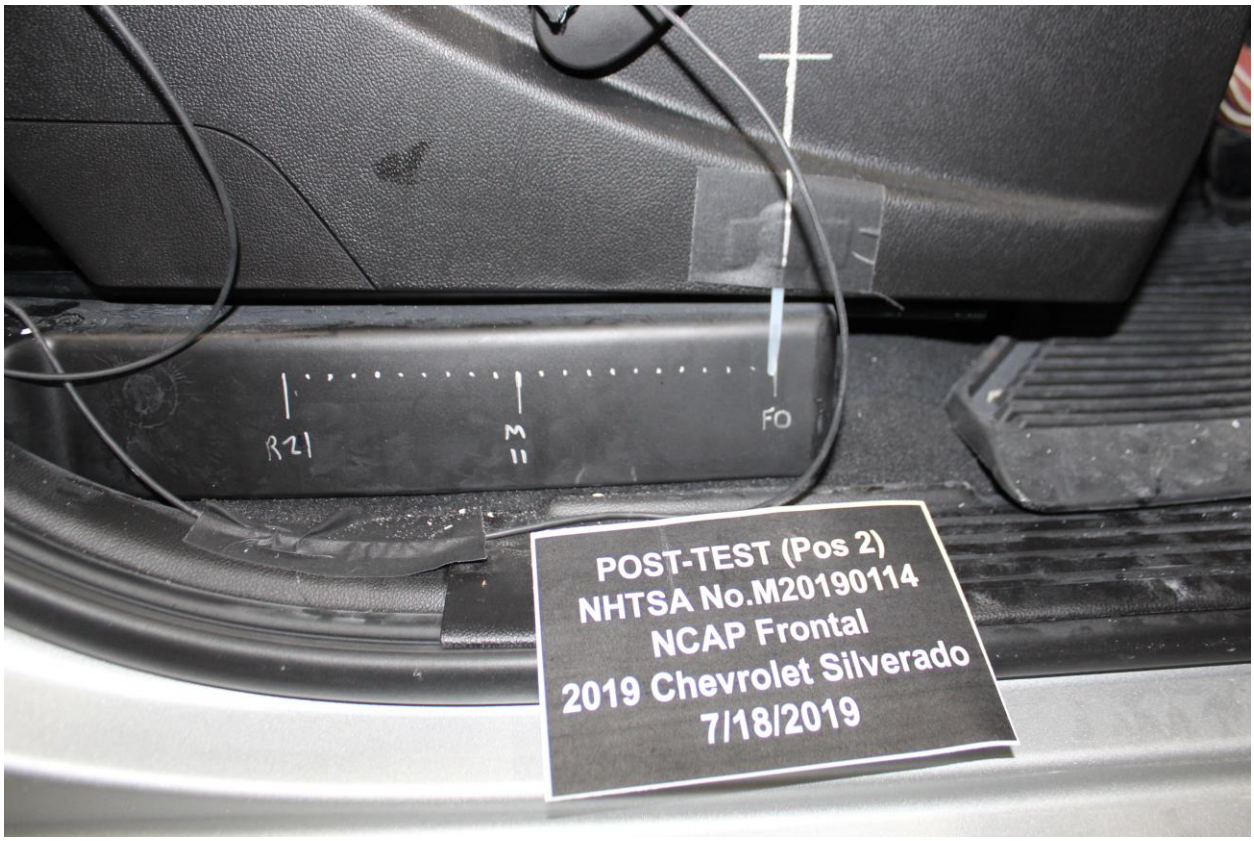


Figure A-58: Post-Test Passenger's Seat Fore-Aft Markings

Figure A-59: Pre-Test View of Belt Anchorage for Passenger Dummy

Figure A-60: Post-Test View of Belt Anchorage for Passenger Dummy

Figure A-61: Pre-Test Passenger Dummy Feet

Figure A-62: Post-Test Passenger Dummy Feet

Figure A-63: Pre-Test Passenger's Side Knee Bolster

Figure A-64: Post-Test Passenger's Side Knee Bolster

Figure A-65: Pre-Test Passenger's Side Floorpan

Figure A-66: Post-Test Passenger's Side Floorpan

Figure A-67: Post-Test Passenger Dummy Face

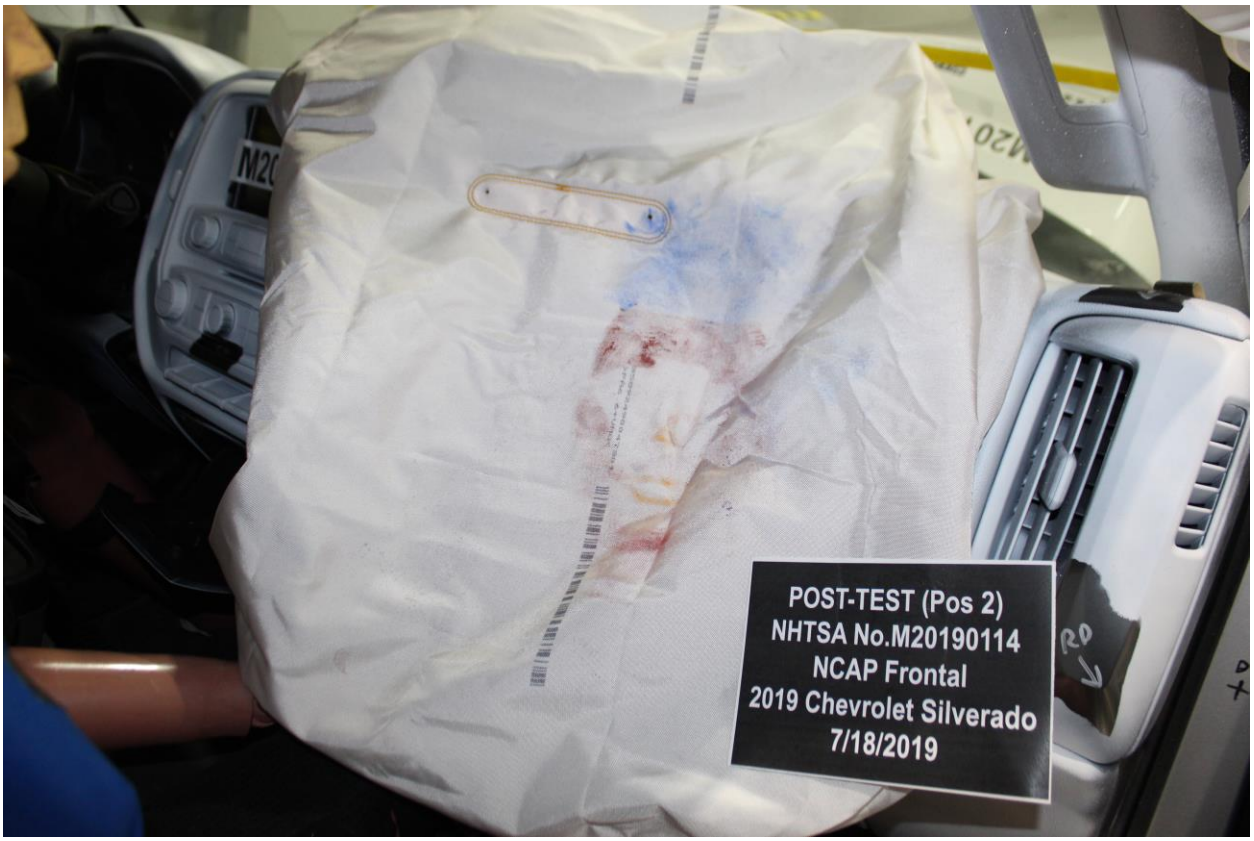


Figure A-68: Post-Test Passenger Dummy Contact With Airbag

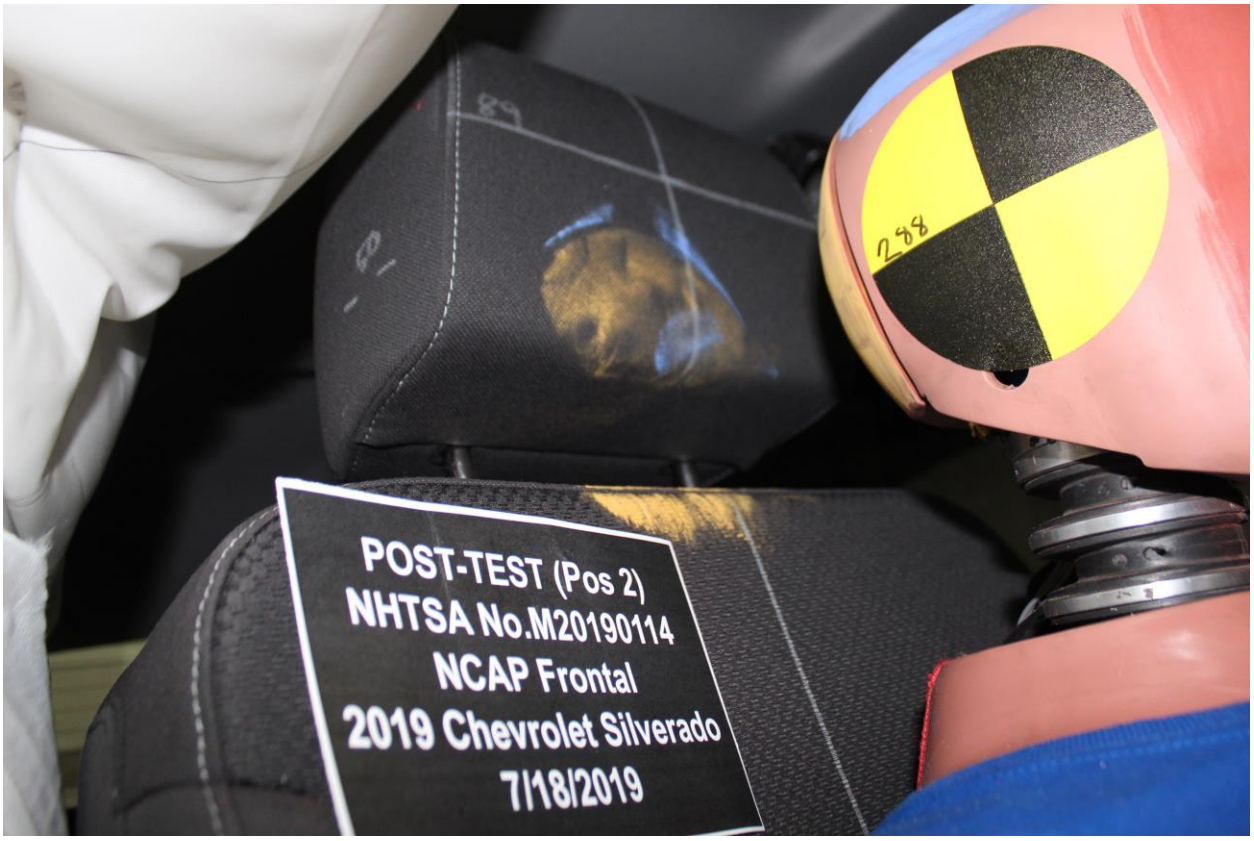


Figure A-69: Post-Test Passenger Dummy Contact With Headrest

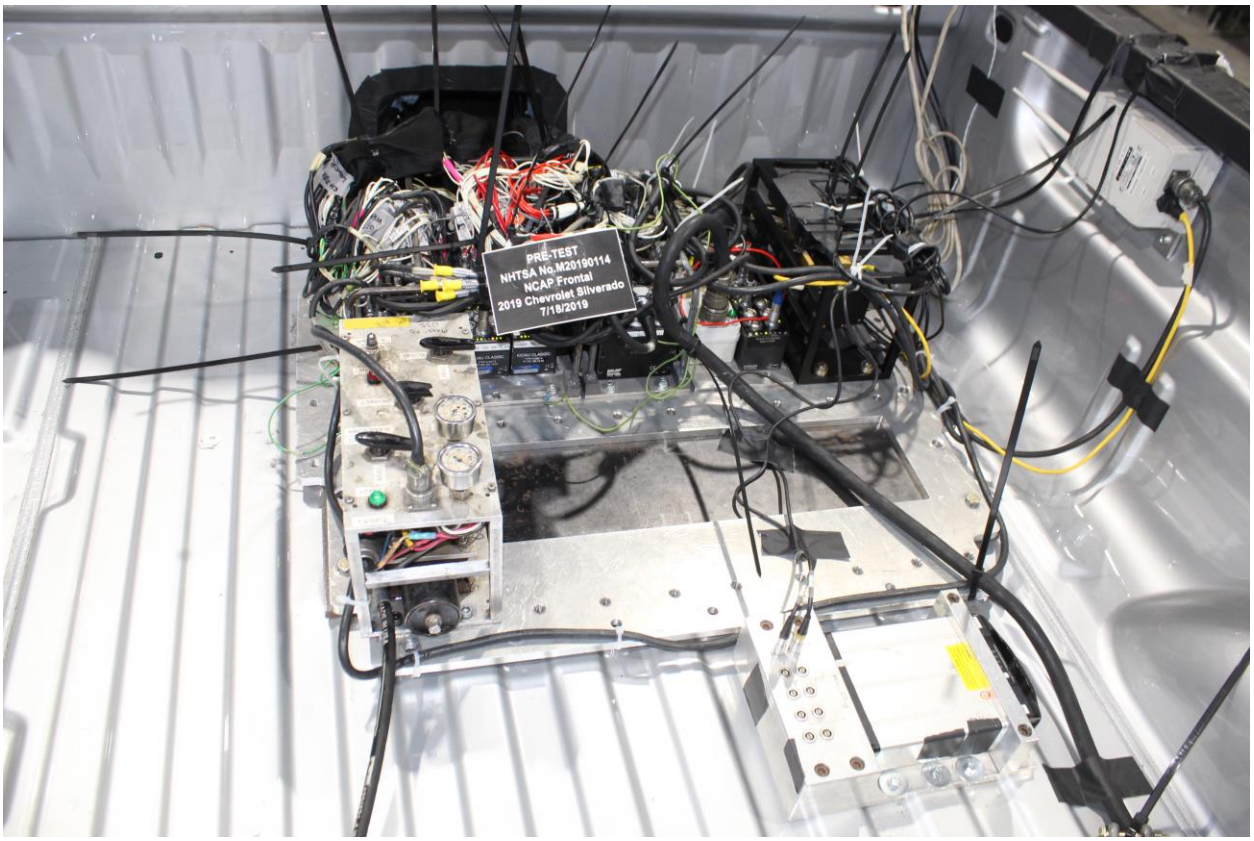


Figure A-70: Photograph of Ballast Installed in Vehicle

Photo Not Applicable

Figure A-71: Post-Test Stoddard Solvent Spillage Location View, If Required

Figure A-72: Post-Test Speed Trap Read-Out

Figure A-73: Vehicle at 0º on Static Rollover Device

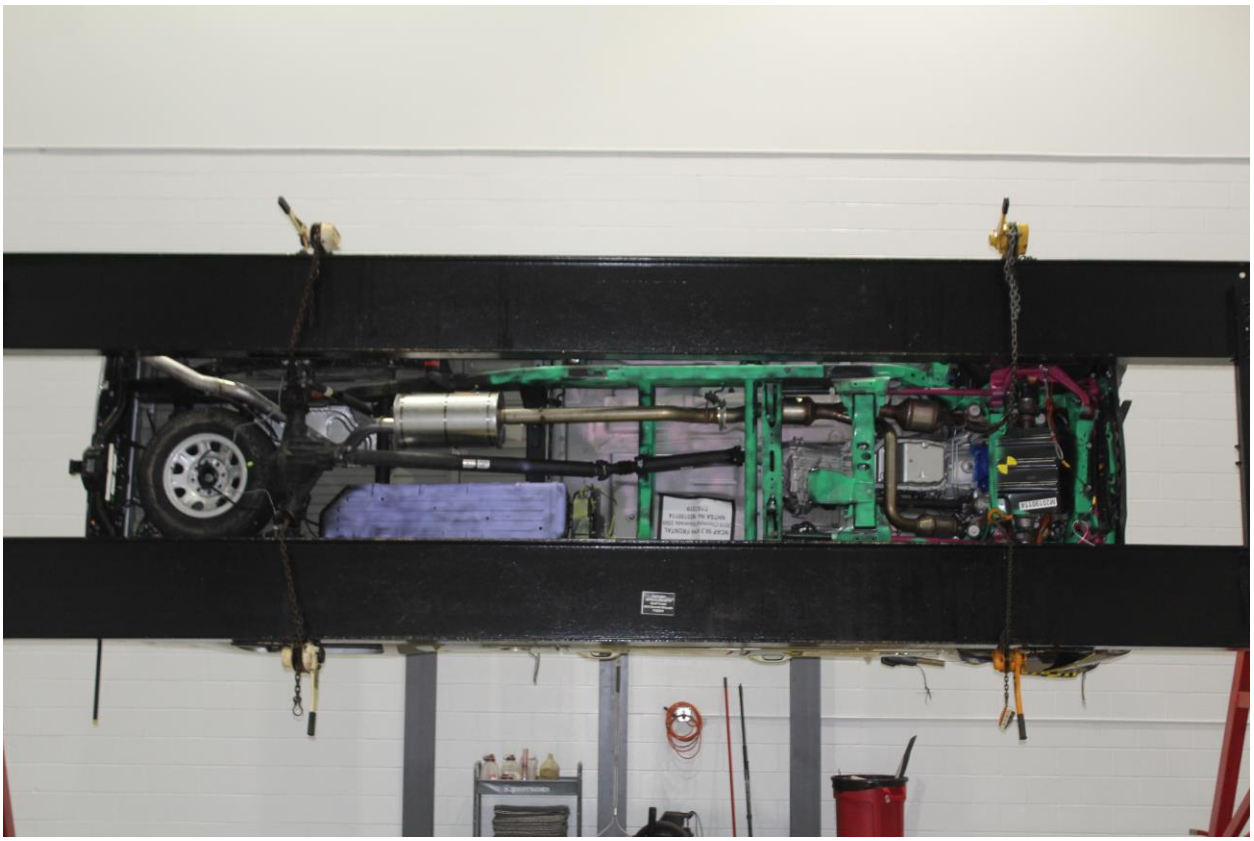


Figure A-74: Vehicle at 90º on Static Rollover Device

Figure A-75: Vehicle at 180º on Static Rollover Device

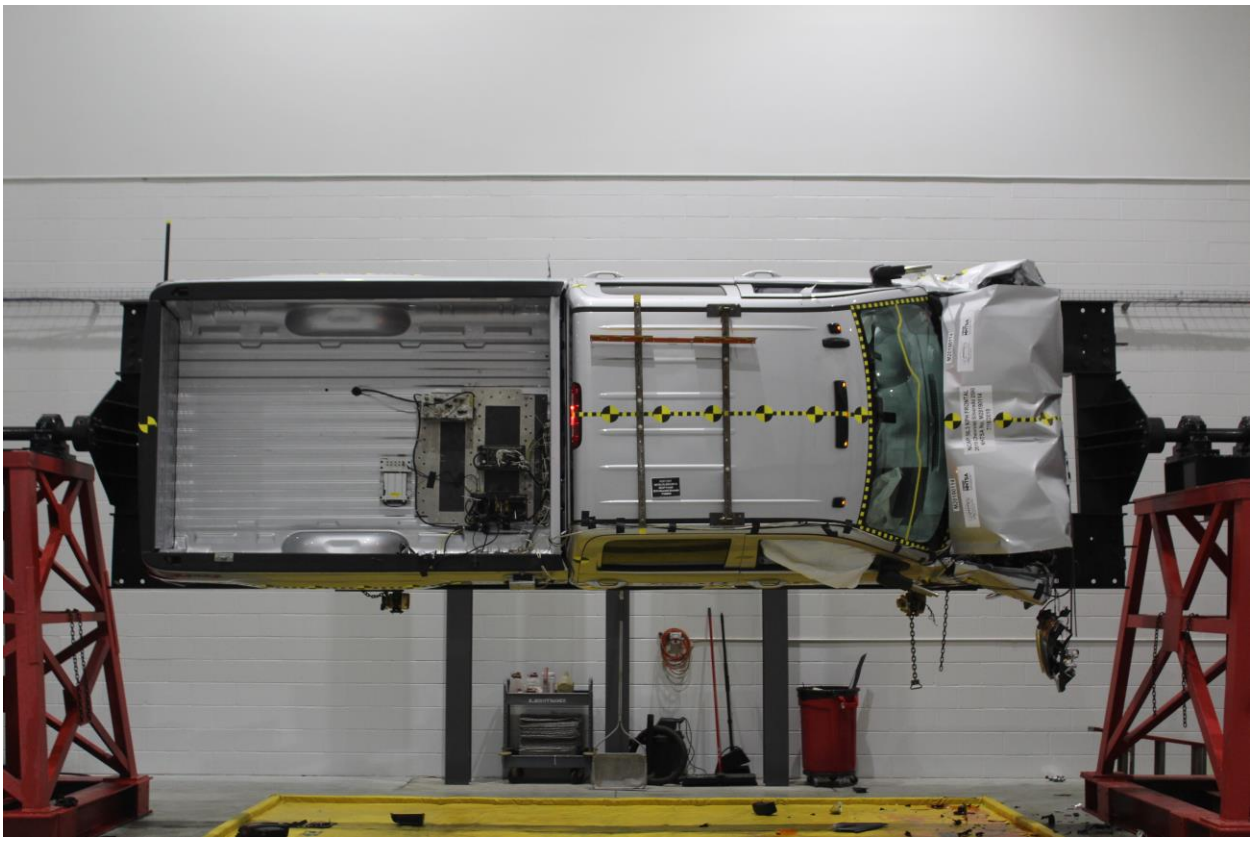


Figure A-76: Vehicle at 270º on Static Rollover Device

Figure A-77: Vehicle at 360º on Static Rollover Device

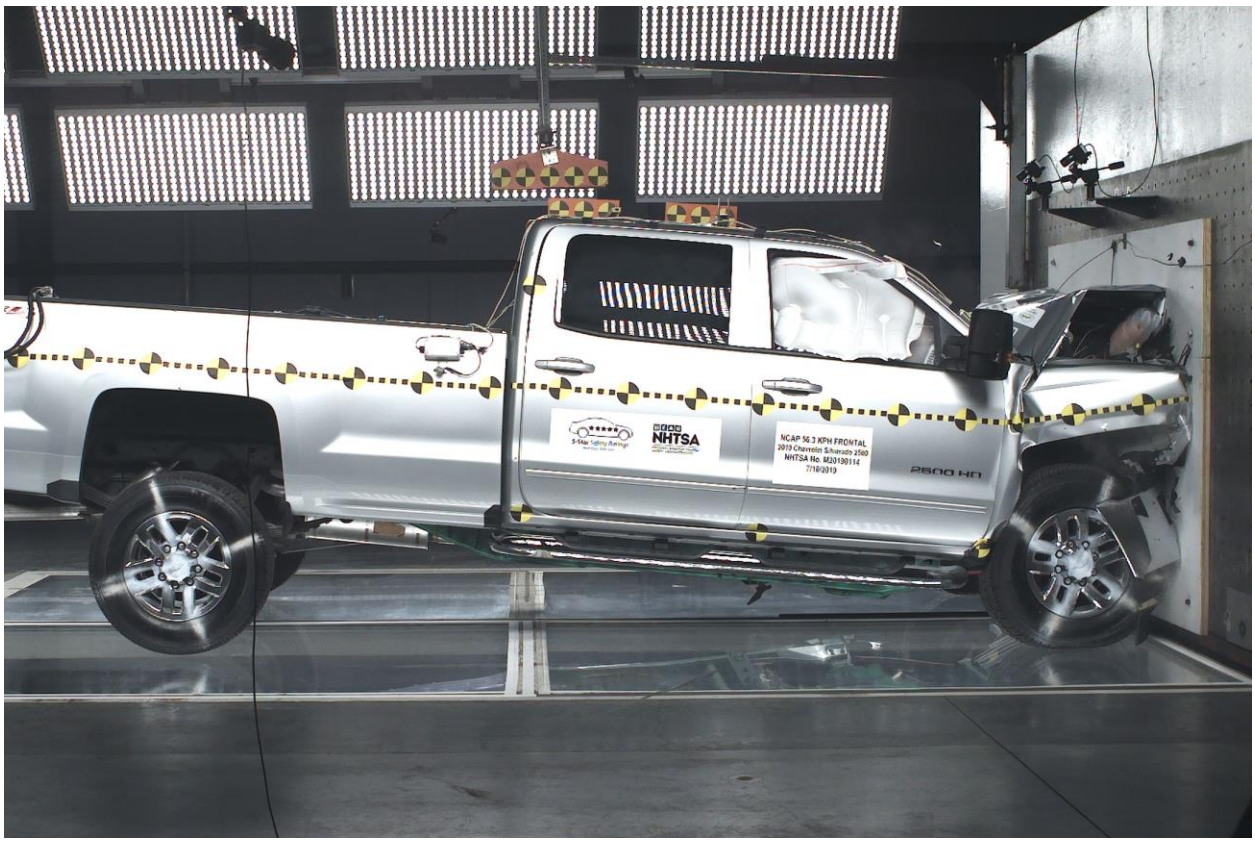


Figure A-78: 2019 Chevrolet Silverado 2500 Frontal Impact Event

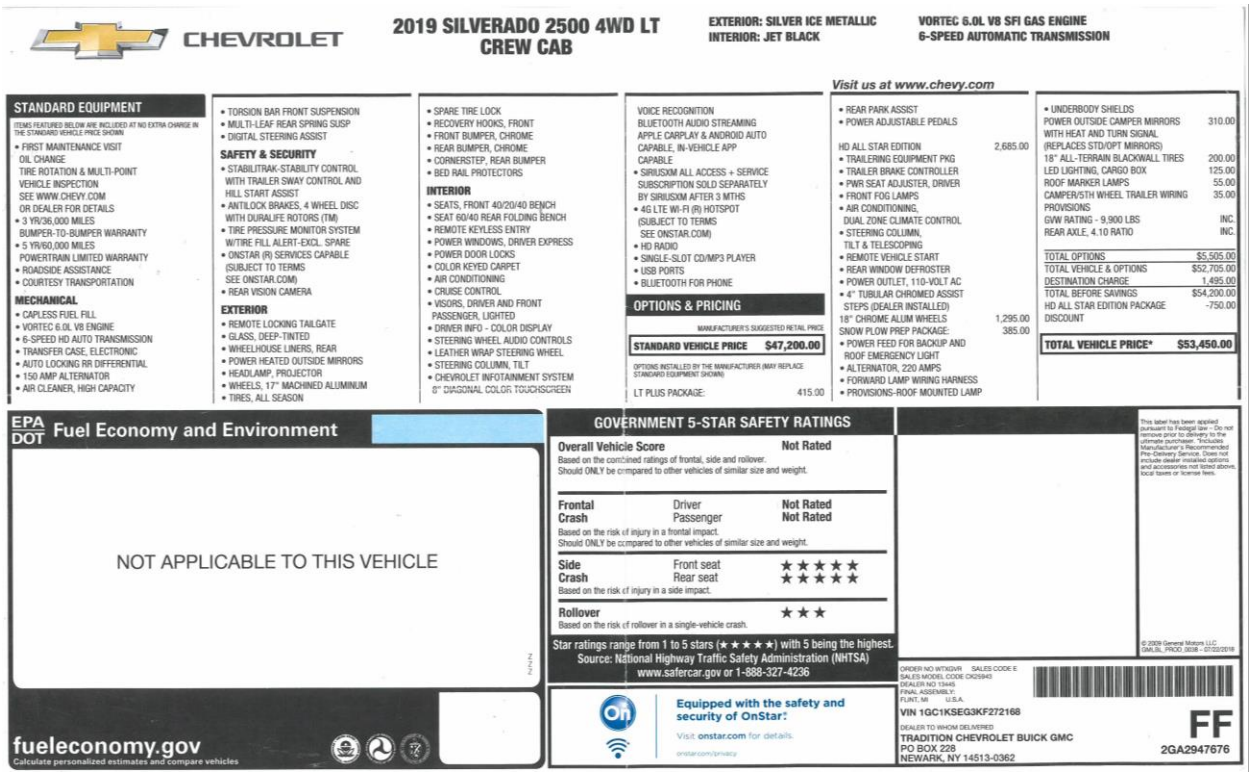
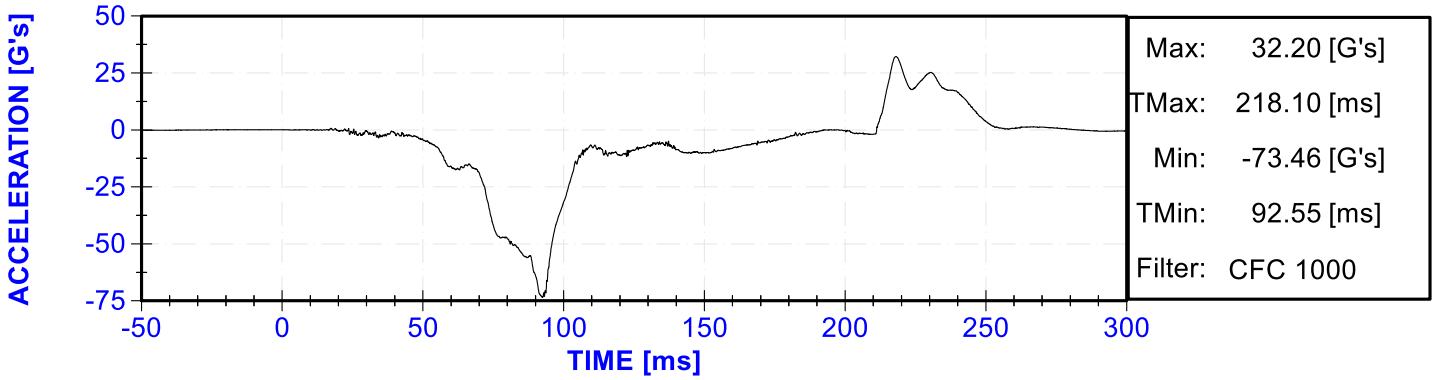


Figure A-79: Monroney Label Photograph

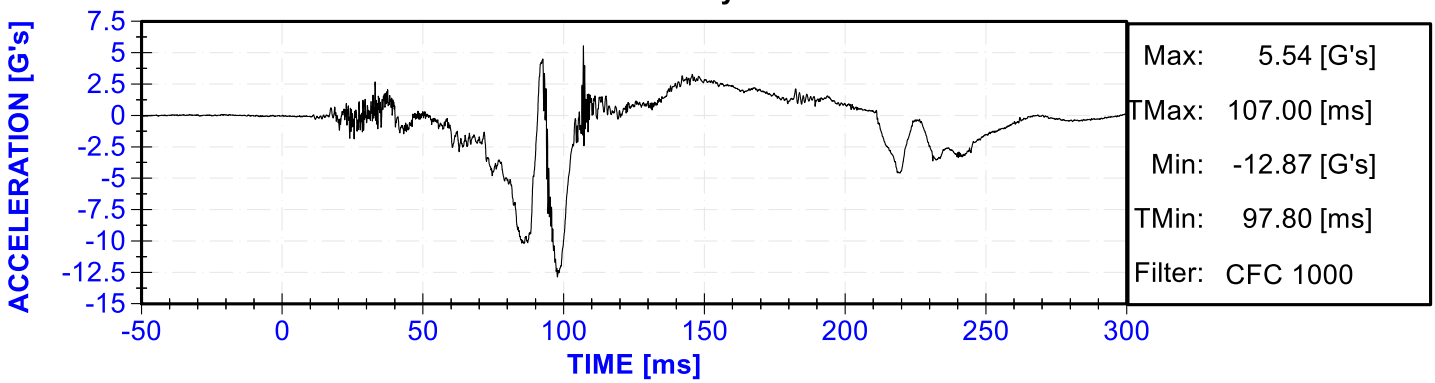
APPENDIX B
VEHICLE & DUMMY RESPONSE DATA TRACES

Table of Data Plots

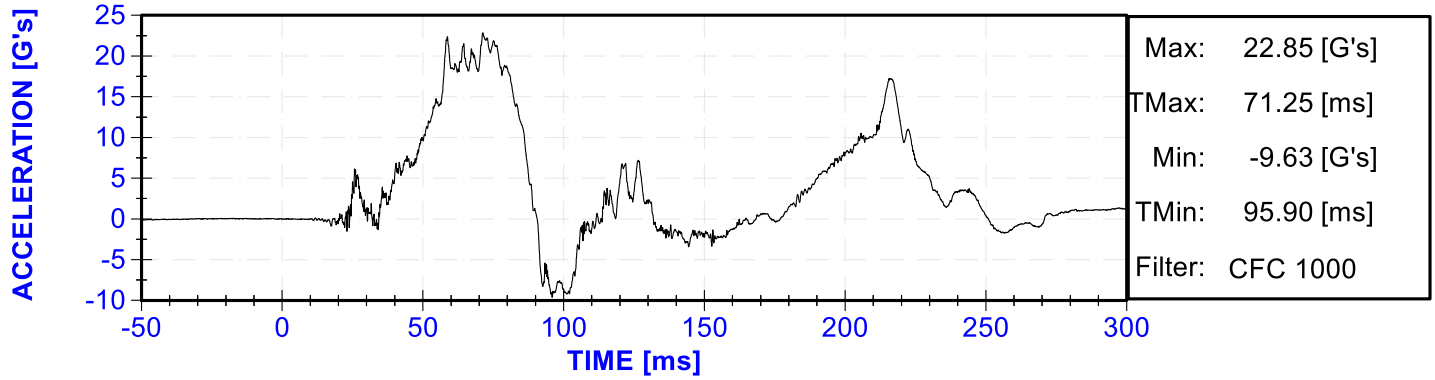
Driver Head X Acceleration vs. Time Primary



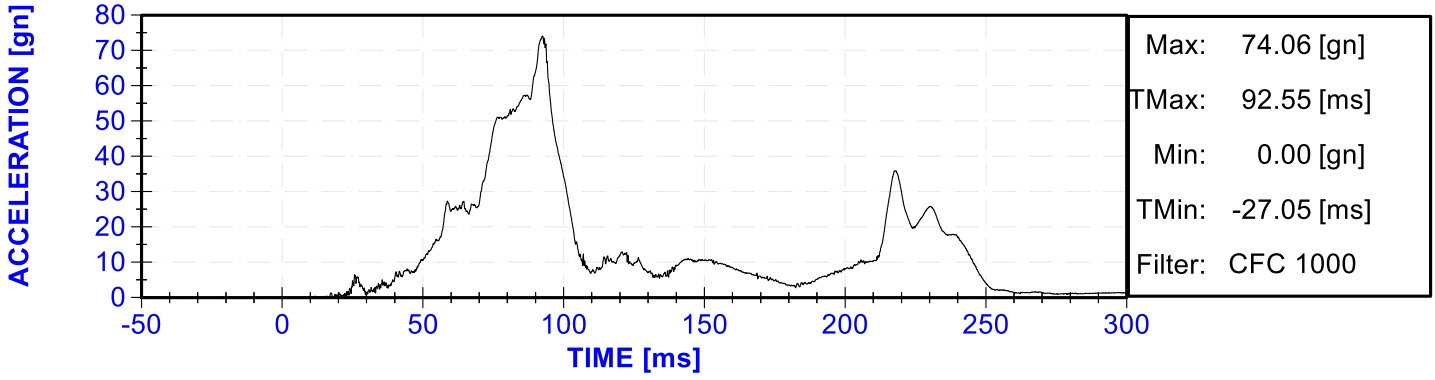
Driver Head Y Acceleration vs. Time Primary



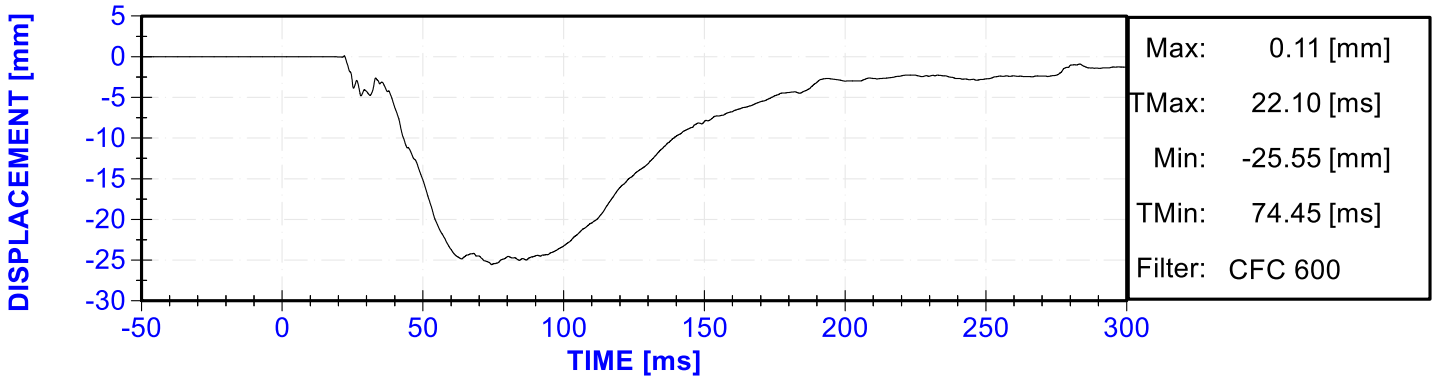
Driver Head Z Acceleration vs. Time Primary



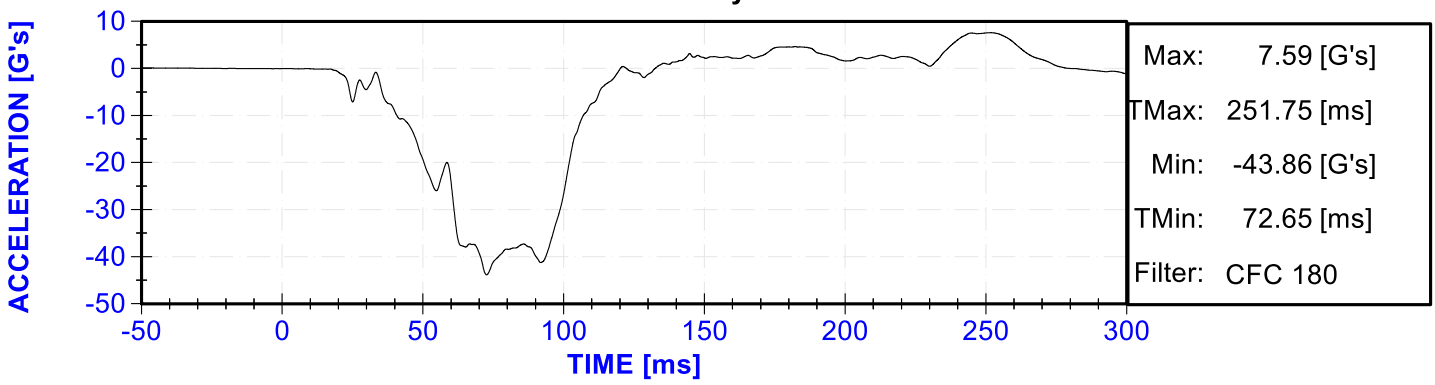
Driver Head Resultant Acceleration vs. Time Primary



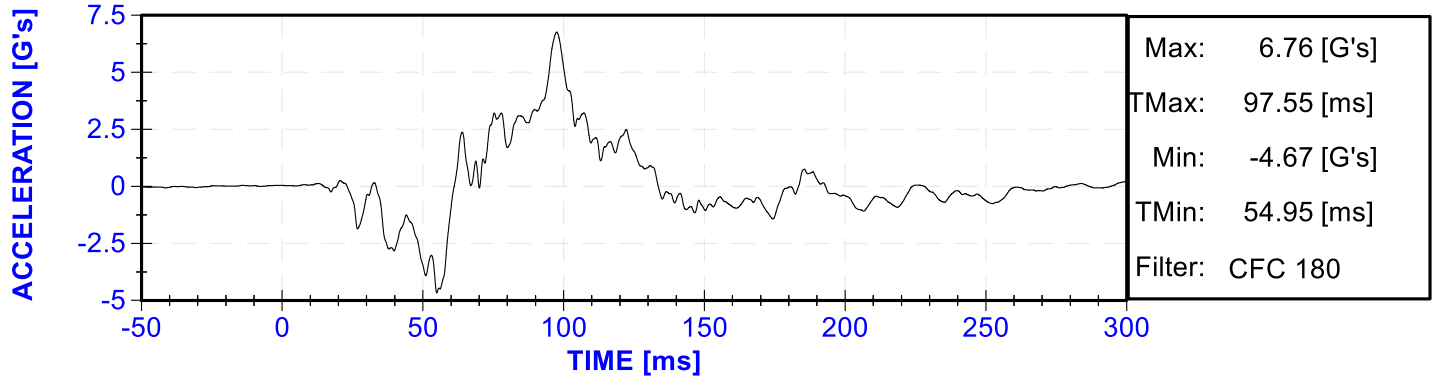
Driver Chest X Deflection vs. Time



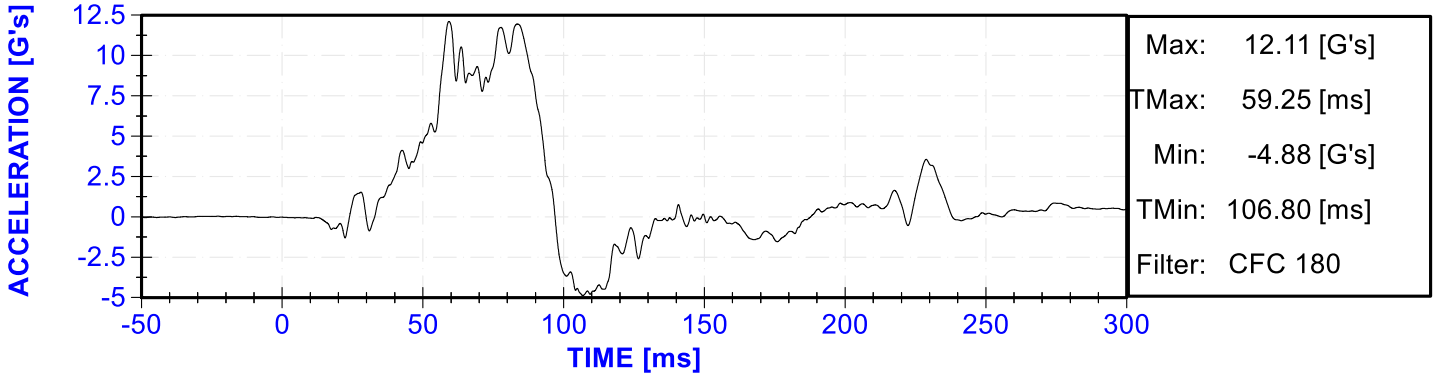
Driver Chest X Acceleration vs. Time Primary



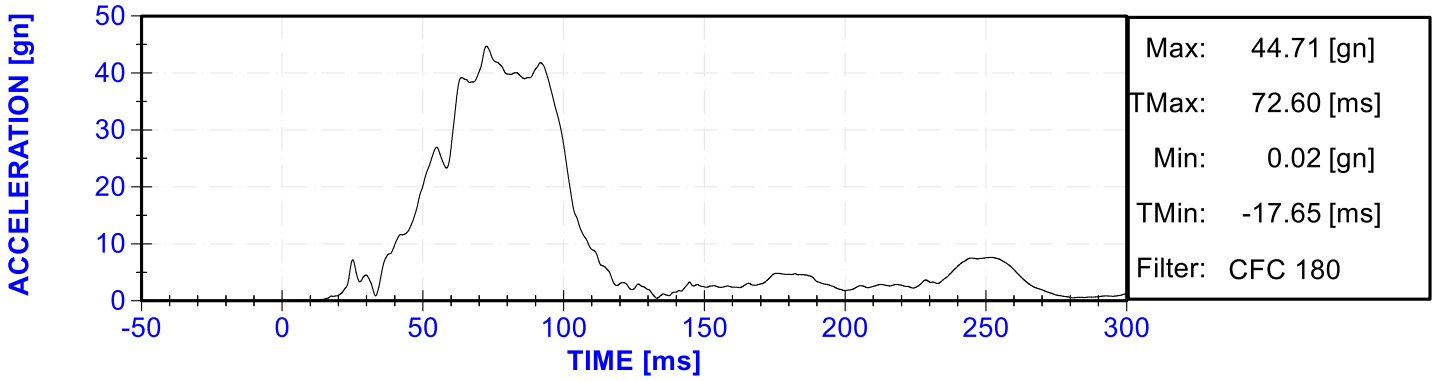
Driver Chest Y Acceleration vs. Time Primary



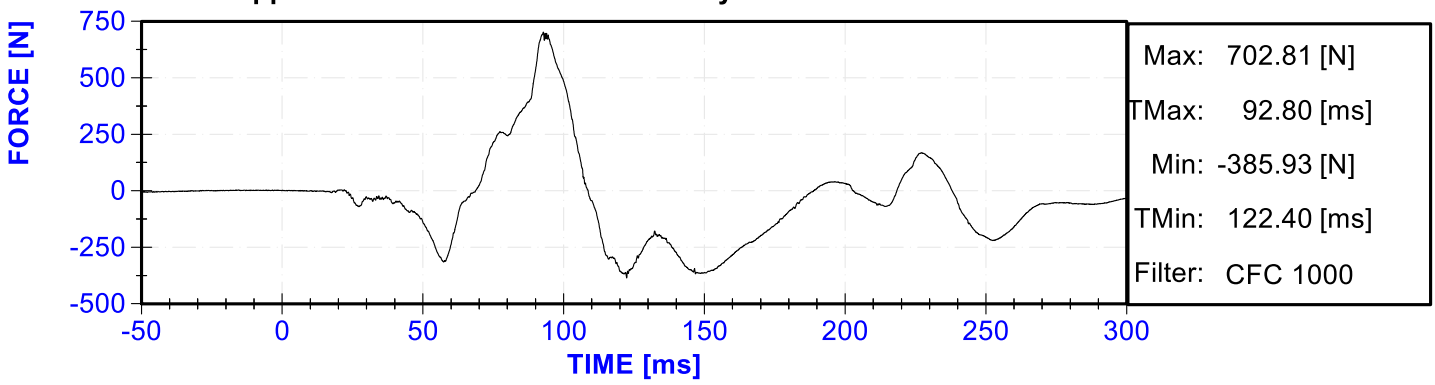
Driver Chest Z Acceleration vs. Time Primary



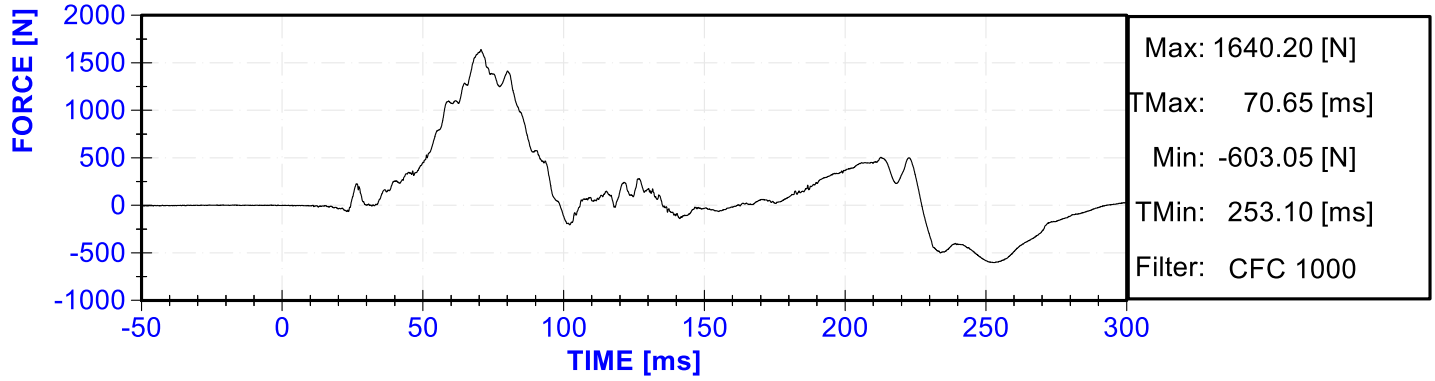
Driver Chest Resultant Acceleration vs. Time Primary



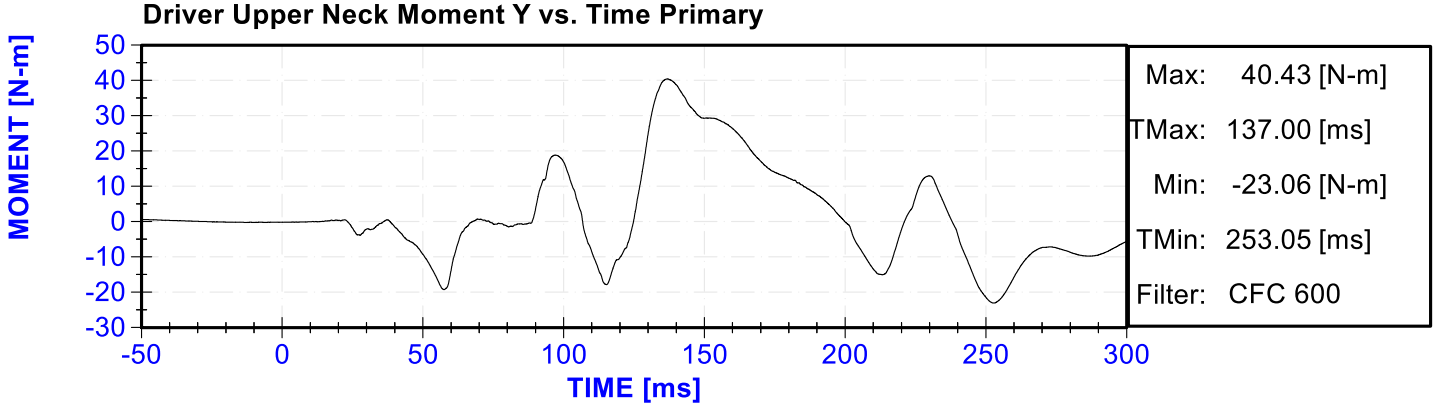
Driver Upper Neck Force X vs. Time Primary



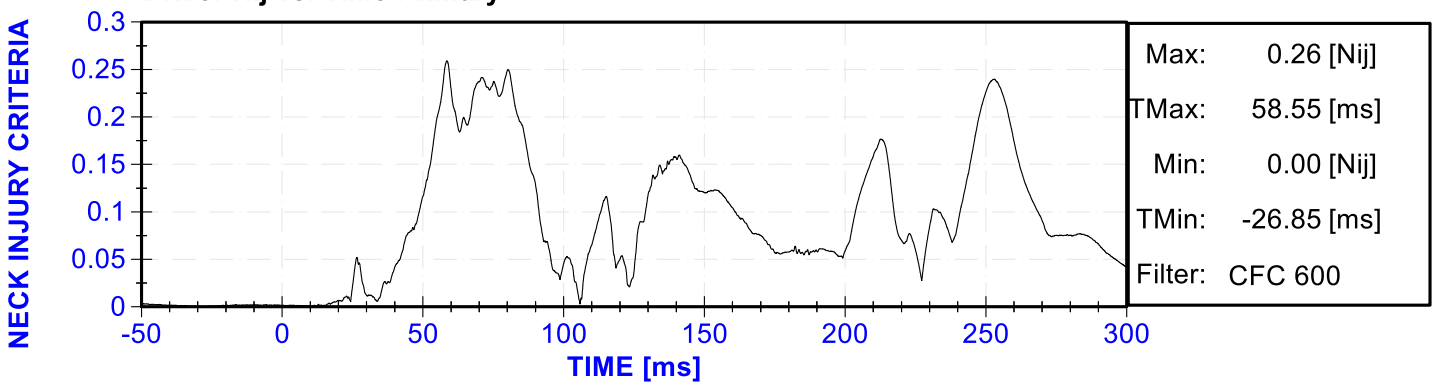
Driver Upper Neck Force Z vs. Time Primary



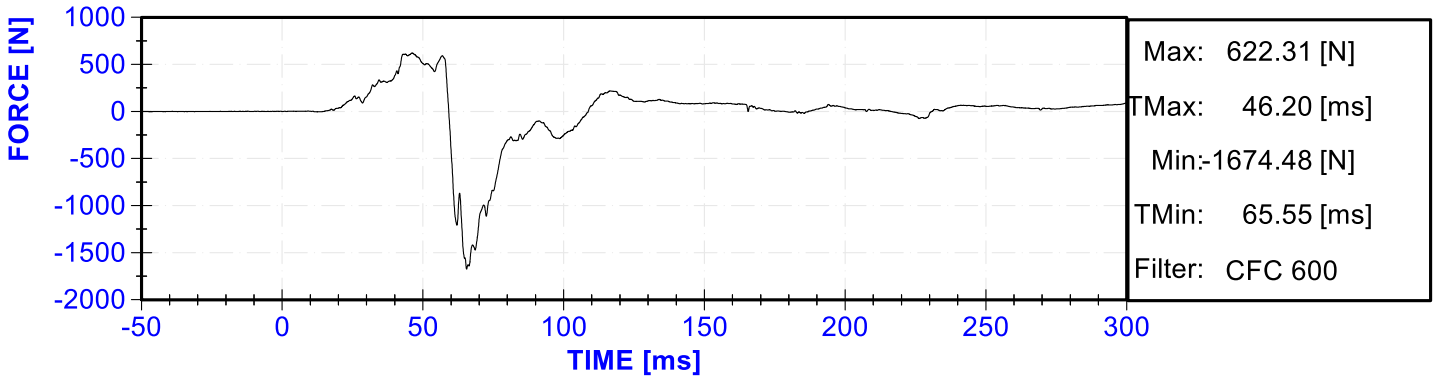
Driver Upper Neck Moment Y vs. Time Primary



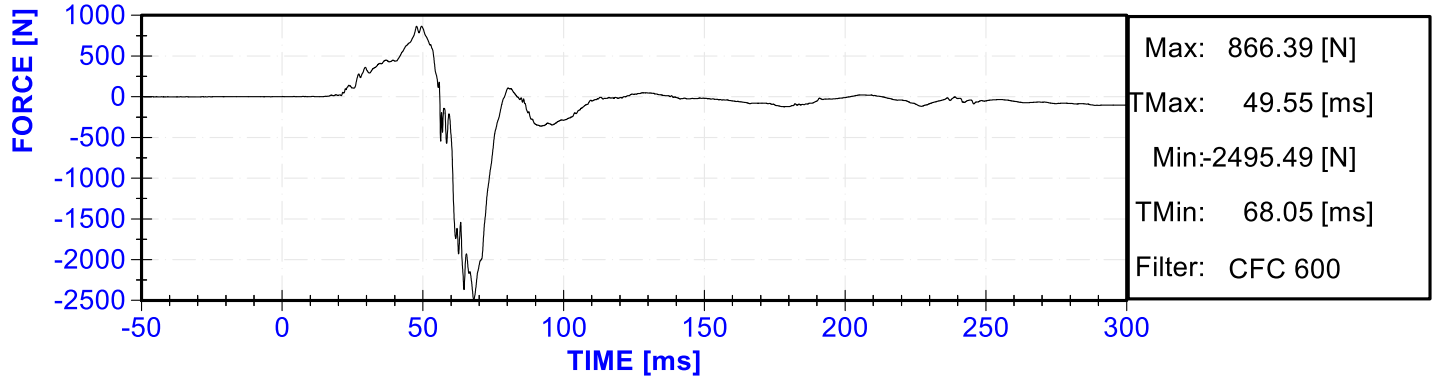
Driver Nij vs. Time Primary



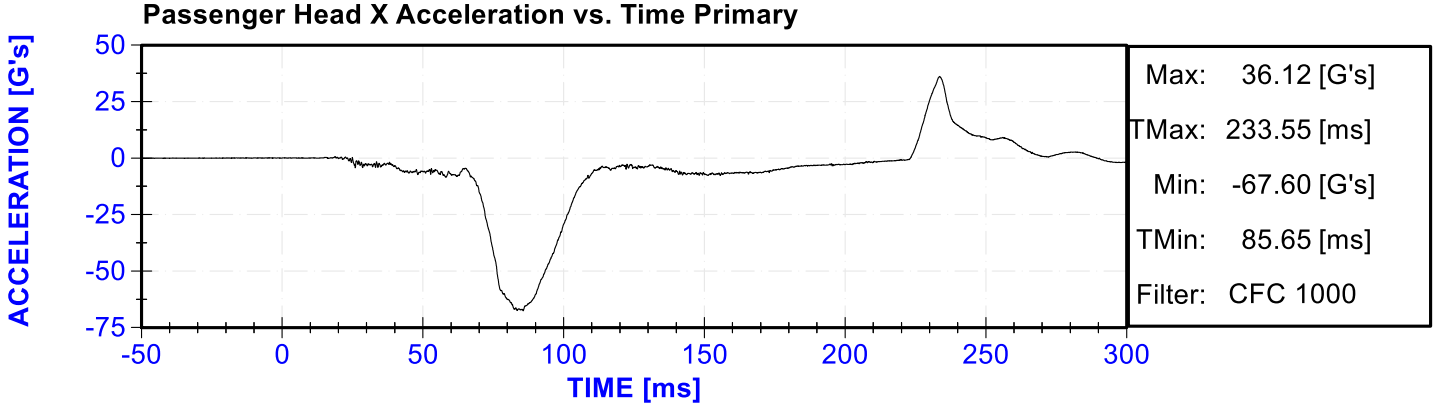
Driver Left Femur Force vs. Time



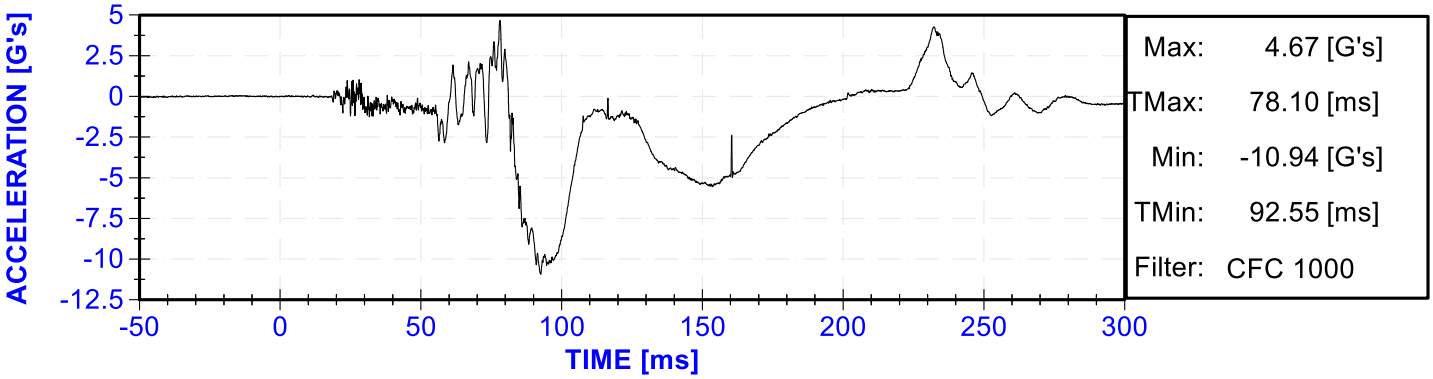
Driver Right Femur Force vs. Time



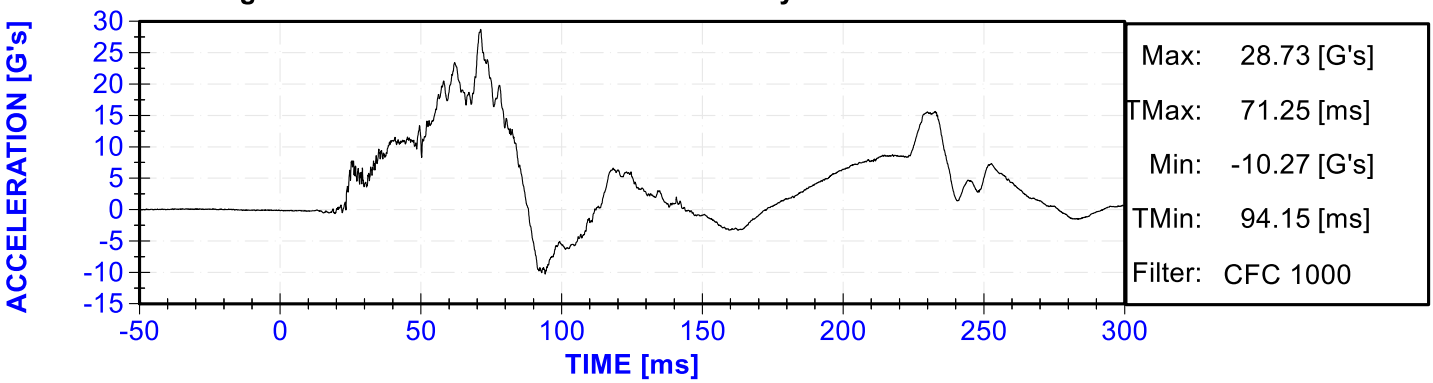
Passenger Head X Acceleration vs. Time Primary



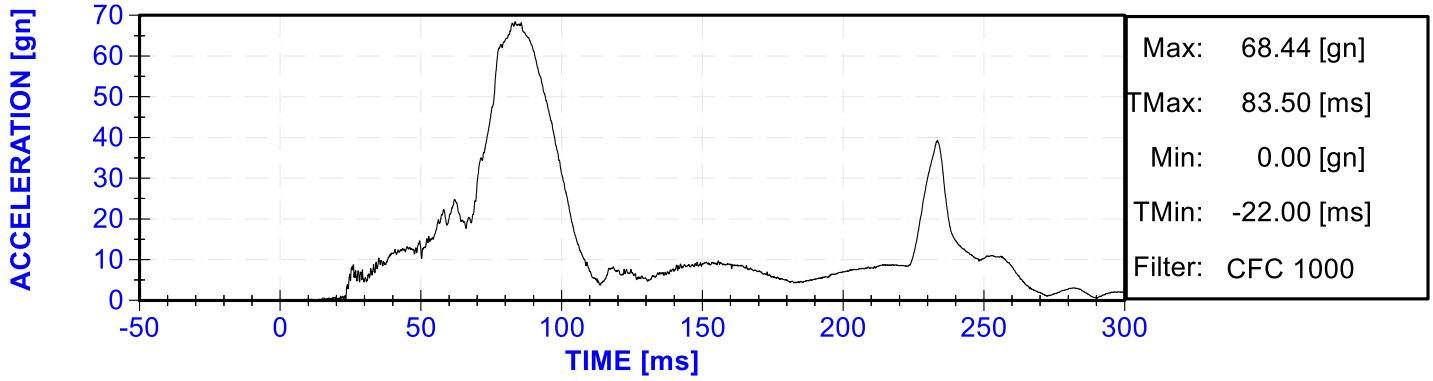
Passenger Head Y Acceleration vs. Time Primary



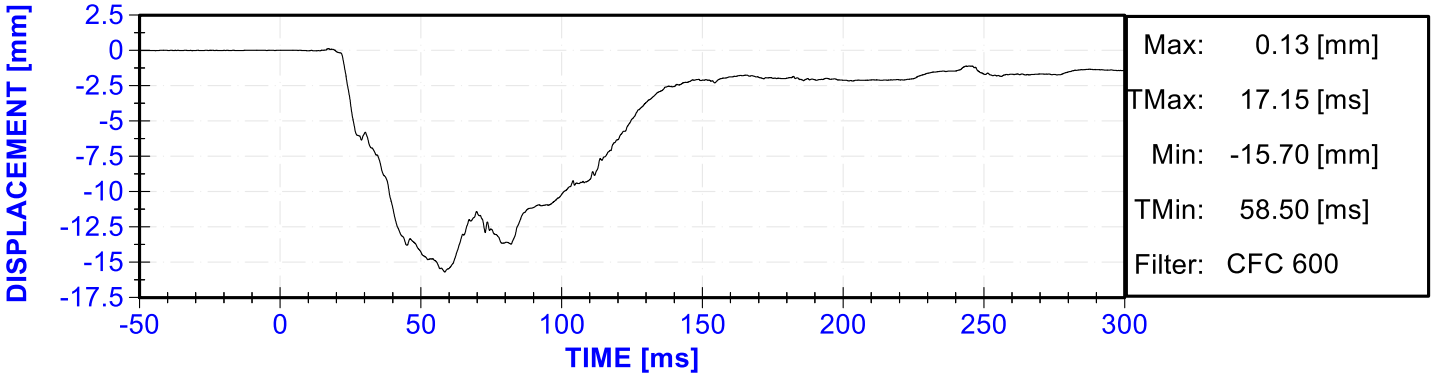
Passenger Head Z Acceleration vs. Time Primary



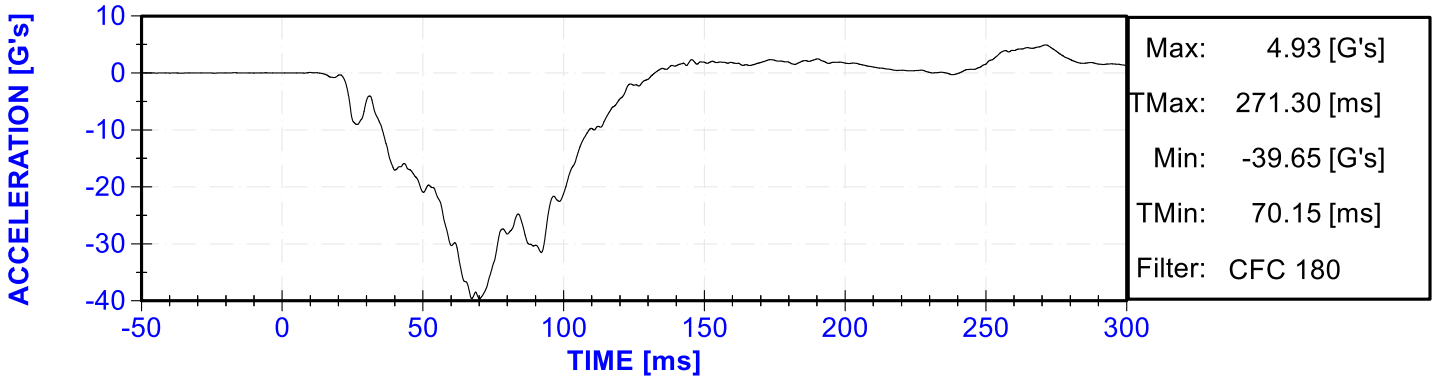
Passenger Head Resultant Acceleration vs. Time Primary



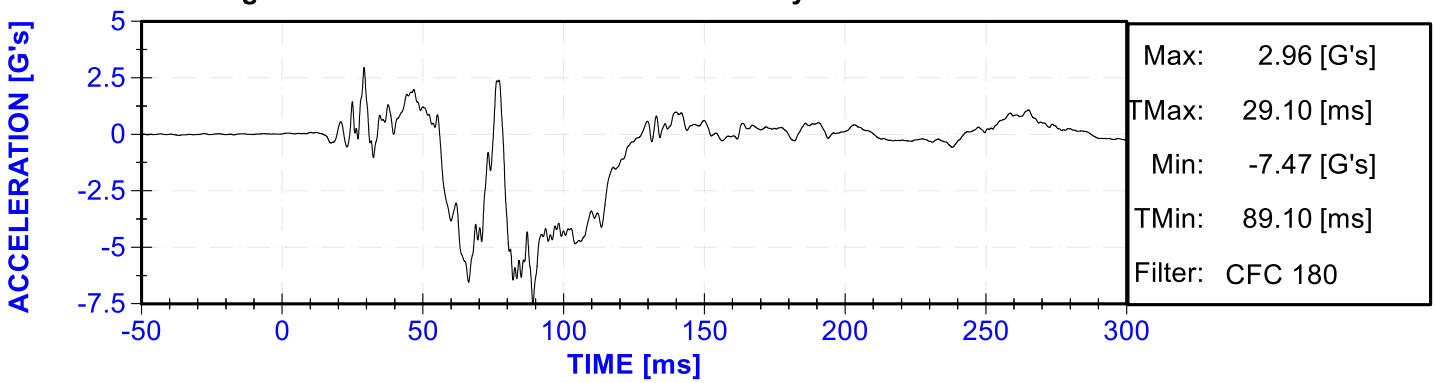
Passenger Chest X Deflection vs. Time



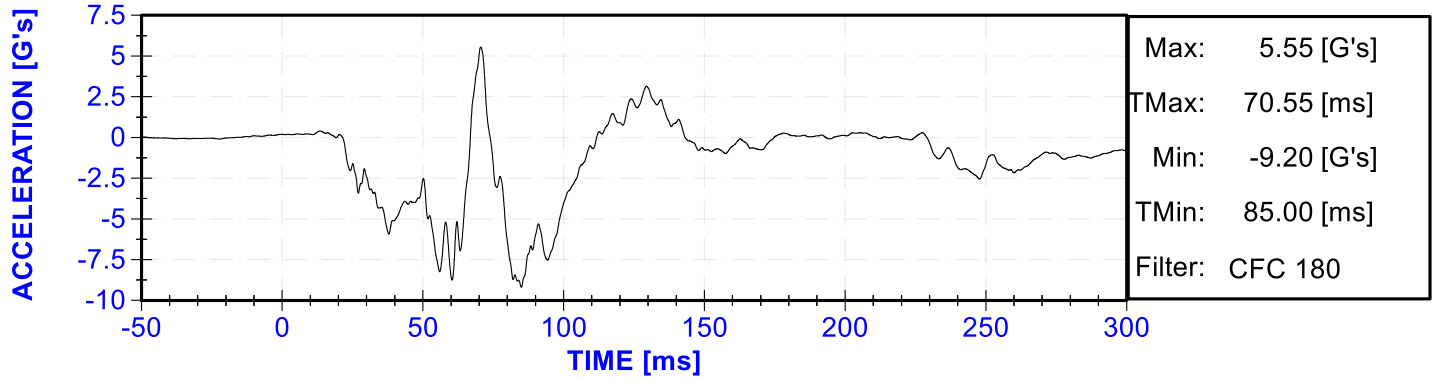
Passenger Chest X Acceleration vs. Time Primary



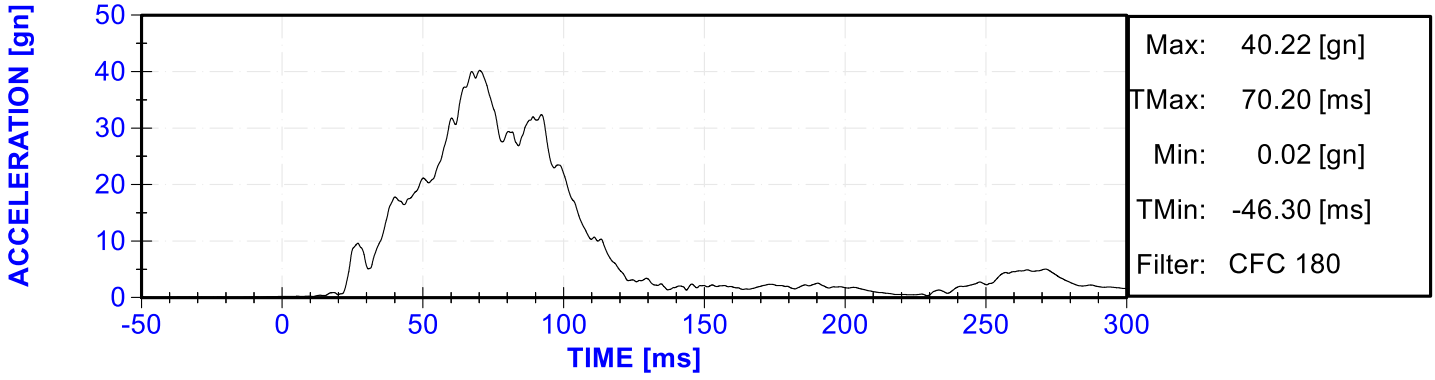
Passenger Chest Y Acceleration vs. Time Primary



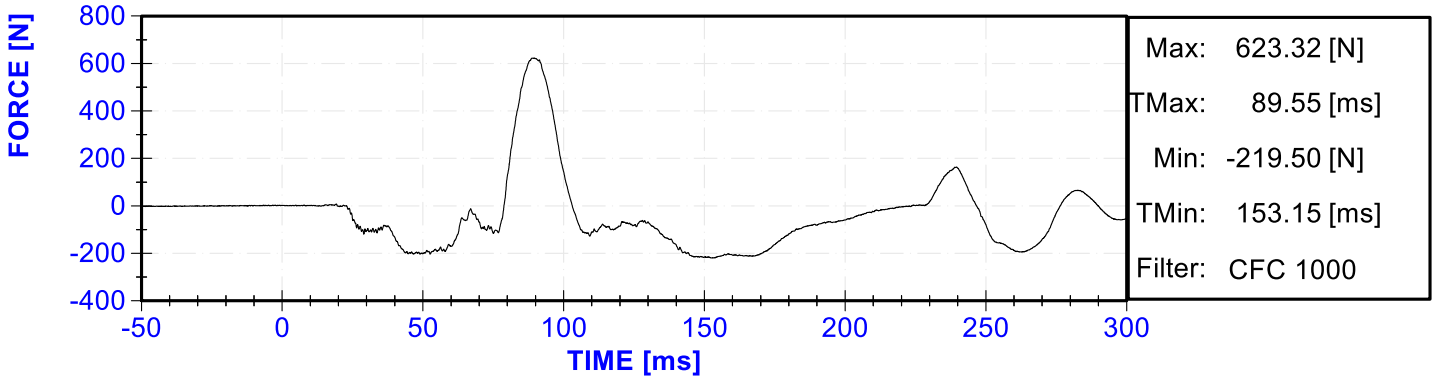
Passenger Chest Z Acceleration vs. Time Primary



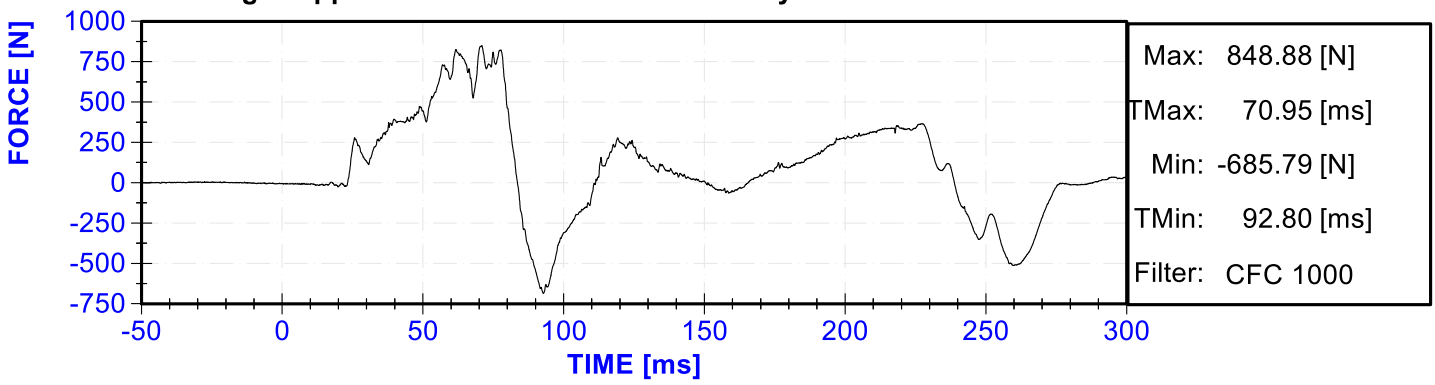
Passenger Chest Resultant Acceleration vs. Time Primary



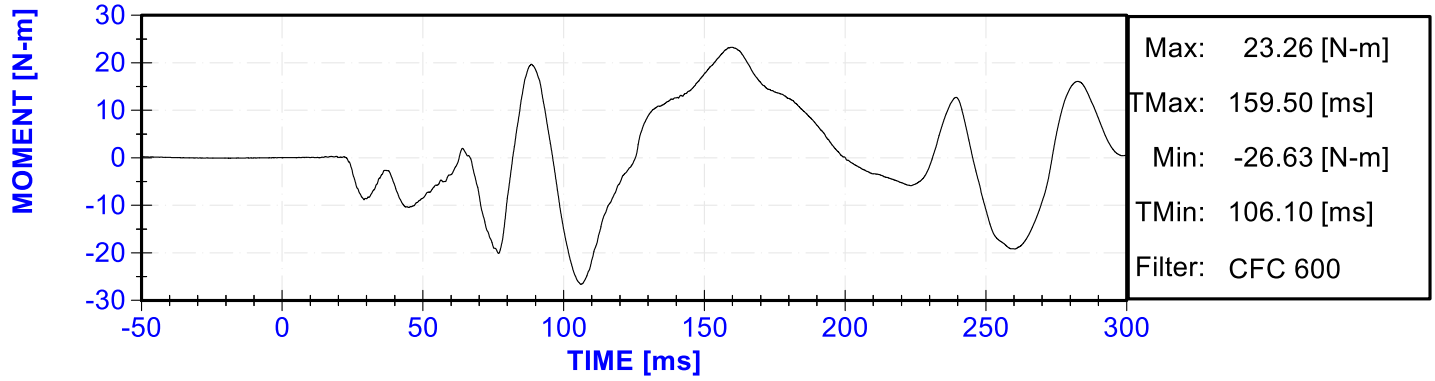
Passenger Upper Neck Force X vs. Time Primary



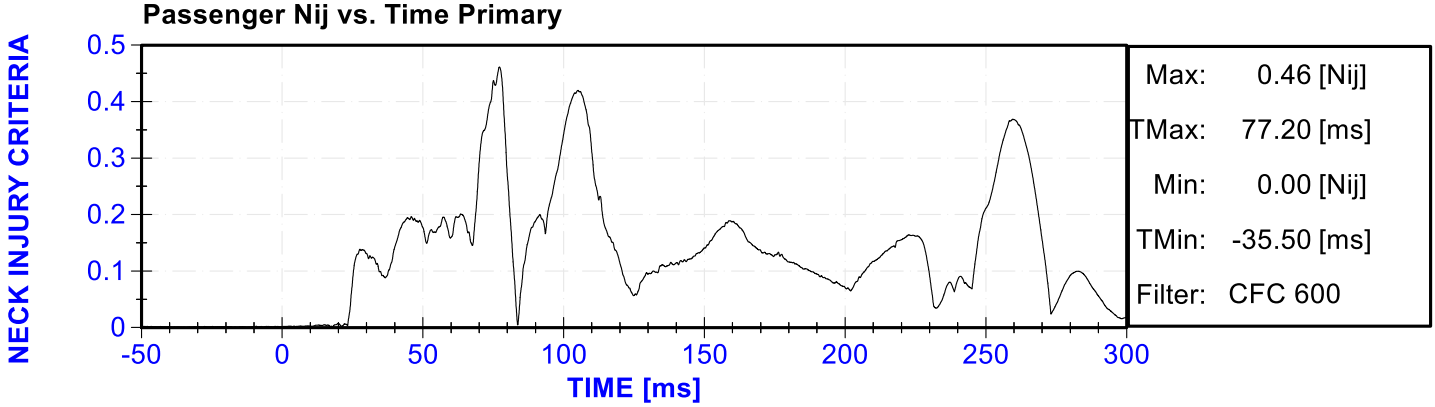
Passenger Upper Neck Force Z vs. Time Primary



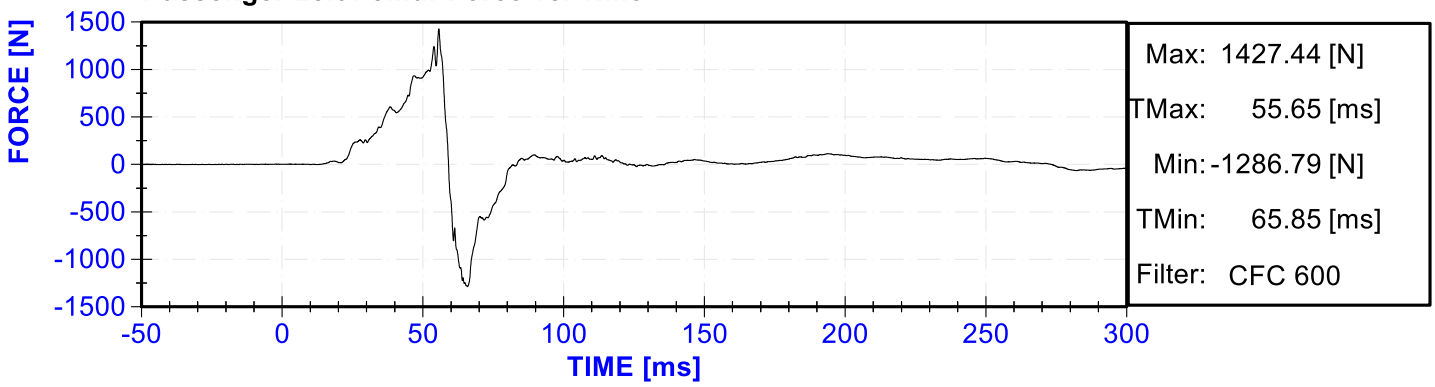
Passenger Upper Neck Moment Y vs. Time Primary



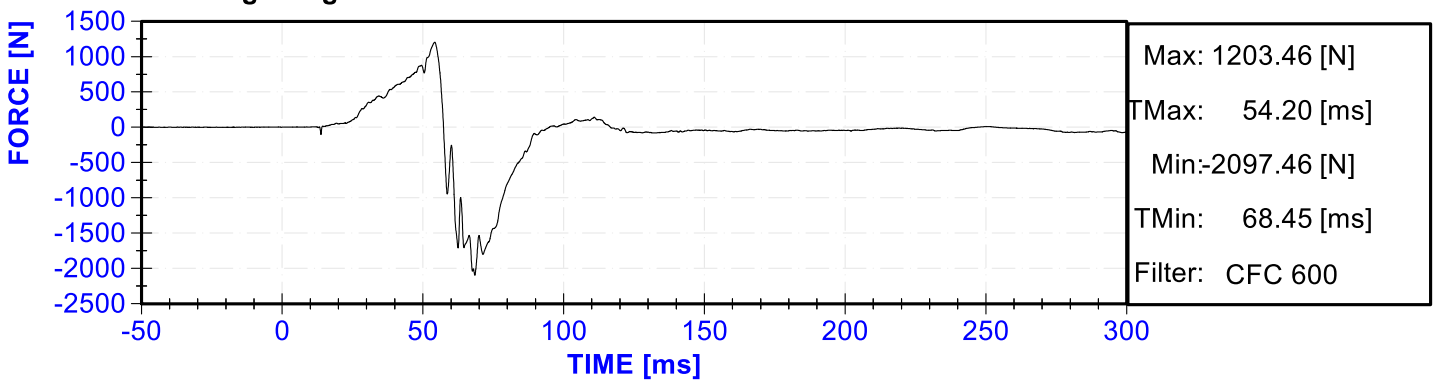
Passenger Nij vs. Time Primary



Passenger Left Femur Force vs. Time



Passenger Right Femur Force vs. Time



APPENDIX C

DUMMY CALIBRATION AND PERFORMANCE VERIFICATION DATA

CALIBRATION TEST RESULTS

PRE-TEST

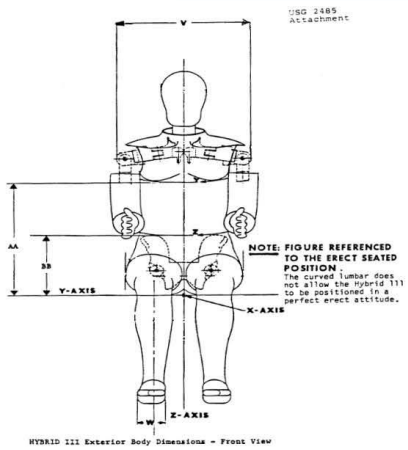
HYBRID III 50TH PERCENTILE MALE - DRIVER ATD

SERIAL NO: 142

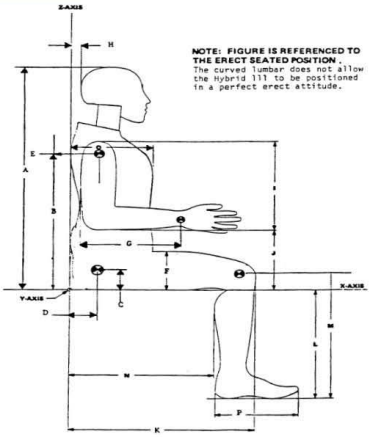
External Measurements - Hybrid 3 - 50th Male

Technician: K. Dutton Date: 07/11/2019

Dummy Serial Number: 142



HYBRID III Exterior Body Dimensions - Front View



HYBRID III Exterior Body Dimensions - Side View

Symbol	Description	Specification (in)		Result (in)	Pass/Fail
A	Sitting Height	34.6	35.0	34.8	Pass
B	Shoulder Pivot Height	19.9	20.5	20.3	Pass
C	H-Point Height	3.3	3.5	3.4	Pass
D	H-Point from Backline	5.3	5.5	5.4	Pass
E	Shoulder Pivot from Backline	3.3	3.7	3.5	Pass
F	Thigh Clearance	5.5	6.1	5.8	Pass
G	Back of Elbow to Wrist Pivot	11.4	12.0	11.6	Pass
H	Head Back to Backline	1.6	1.8	1.7	Pass
I	Shoulder to Elbow Length	13.0	13.6	13.4	Pass
J	Elbow Rest Height	7.5	8.3	8.0	Pass
K	Buttock to Knee Length	22.8	23.8	23.4	Pass
L	Popliteal Height	16.9	17.9	17.4	Pass
M	Knee Pivot Height	19.1	19.7	19.4	Pass
N	Buttock Popliteal Length	17.8	18.8	18.4	Pass
O	Chest Depth without Jacket	8.4	9.0	8.7	Pass
P	Foot Length (right)	9.9	10.5	10.3	Pass
V	Shoulder Breadth	16.3	17.2	16.7	Pass
W	Foot Breadth	3.6	4.2	3.9	Pass
Y	Chest Circumference with Jacket	38.2	39.4	38.9	Pass
Z	Waist Circumference	32.9	34.1	33.7	Pass
AA	Reference Location (Chest Circumference)	16.9	17.1	17.0	Pass
BB	Reference Location (Waist Circumference)	8.9	9.1	9.0	Pass

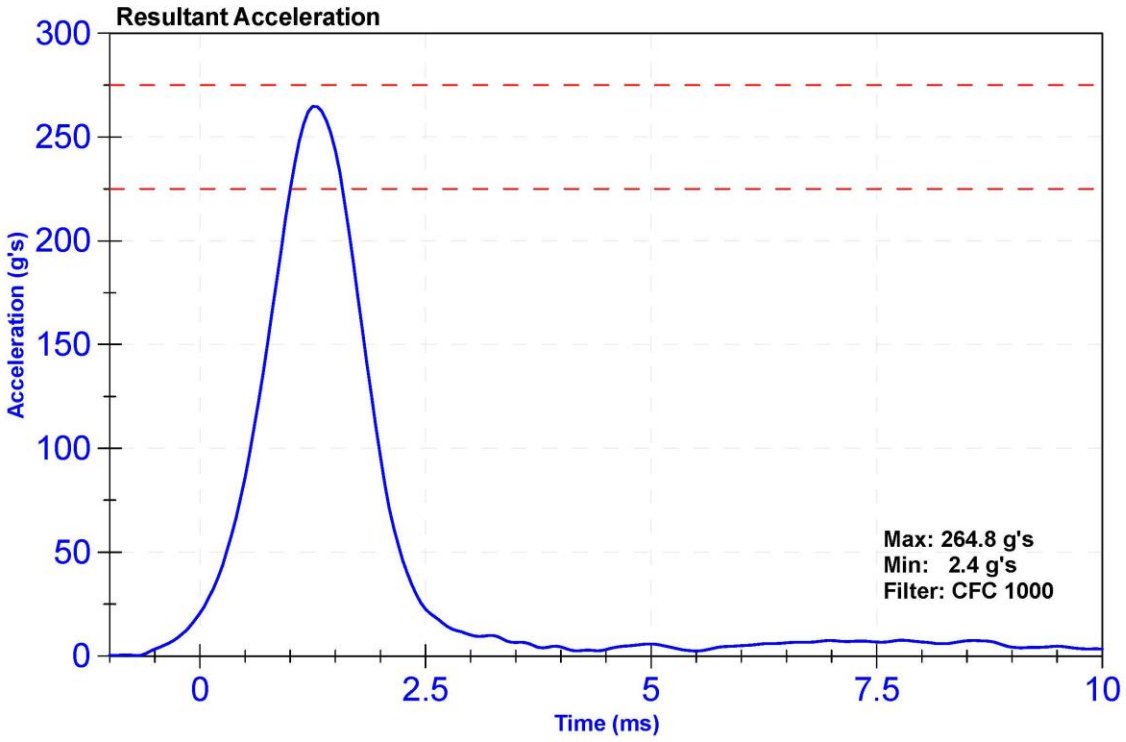
ATD Manufacturer	Humanetics	Test Technician	D.Reinhard
ATD Serial Number	142	Laboratory Supervisor	K.Brogan

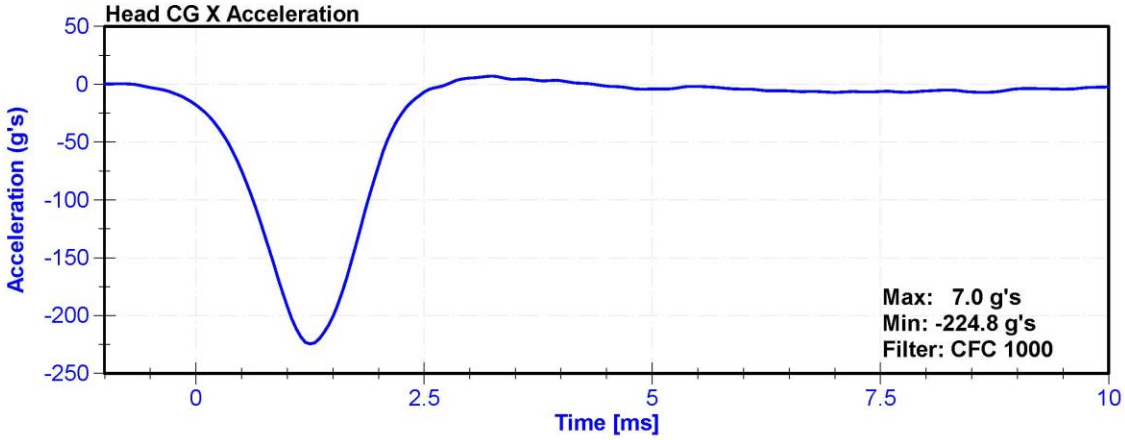
Results

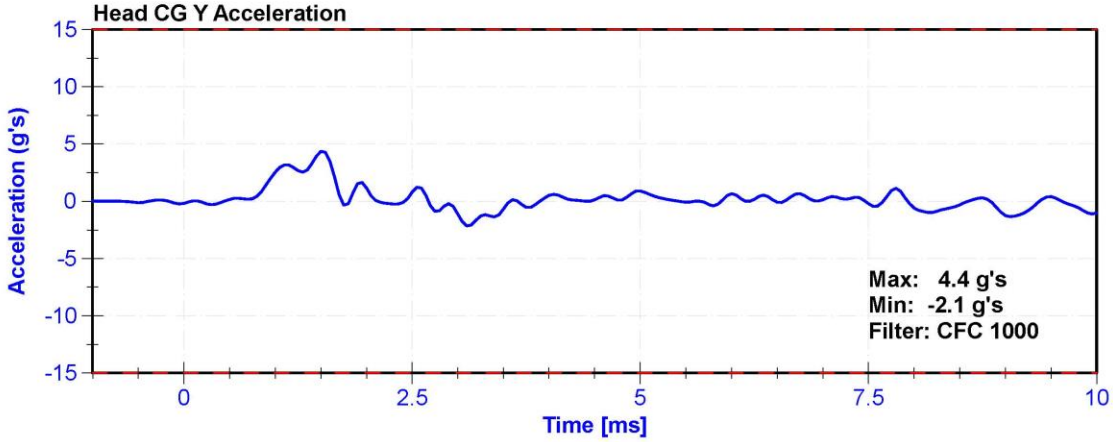
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.0	Pass
Humidity	10	70	%	57.0	Pass
Resultant Acceleration	225	275	g's	264.8	Pass
Oscillation	0	10	%	3.7	Pass
Lateral Acceleration	-15	15	g's	4.4	Pass

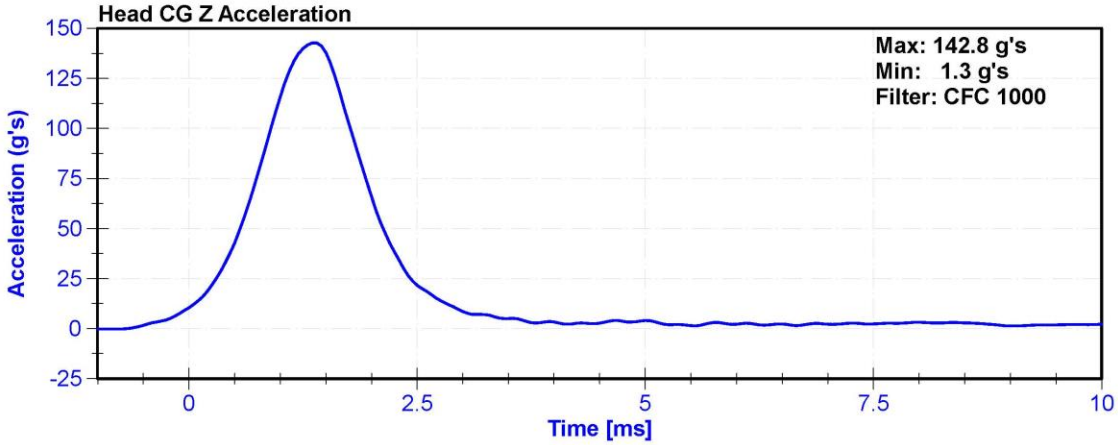
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	ENDEVCO 7264CT	AC-P58998	4/19/2019	10/18/2019
Y Accelerometer	ENDEVCO 7264CT	AC-P51722	4/19/2019	10/18/2019
Z Accelerometer	ENDEVCO 7264CT	AC-P58997	4/19/2019	10/18/2019




Head CG X Acceleration
Acceleration (g's)
50
0
-50
-100
-150
-200
-250
0
2.5
5
7.5
10
Time [ms]
Max: 7.0 g's
Min: -224.8 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: 4.4 g's
Min: -2.1 g's
Filter: CFC 1000


Head CG Z Acceleration
Acceleration (g's)
150
125
100
75
50
25
0
-25
0
2.5
5
7.5
10
Time [ms]
Max: 142.8 g's
Min: 1.3 g's
Filter: CFC 1000

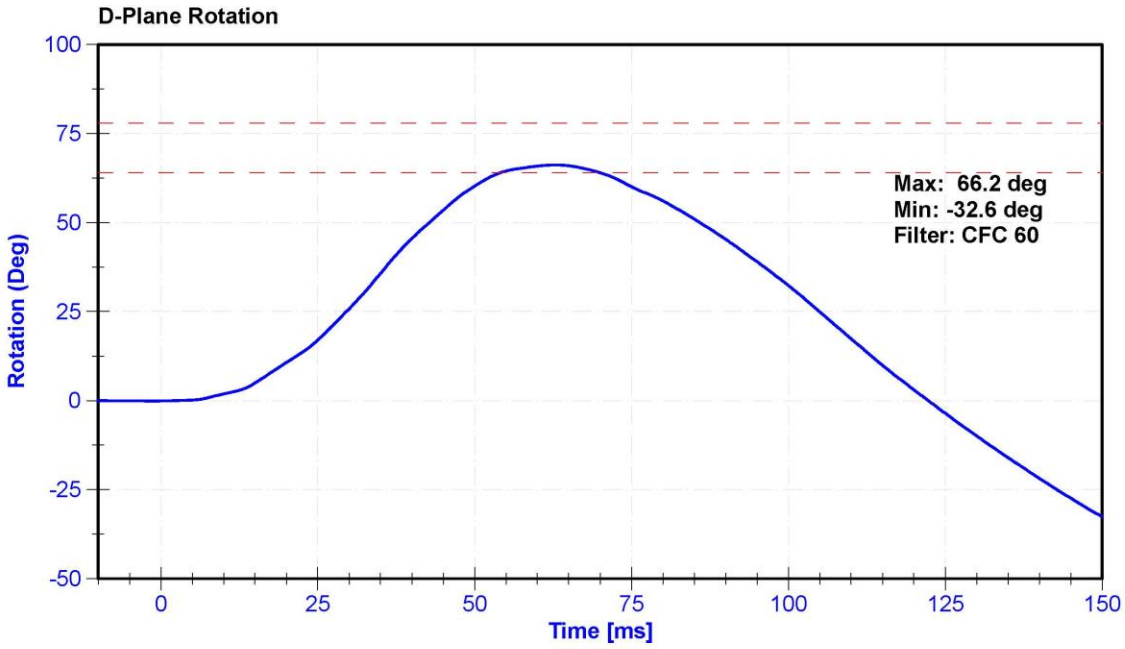
ATD Manufacturer	Humanetics	Test Technician	D.Reinhard
ATD Serial Number	142	Laboratory Supervisor	K.Brogan

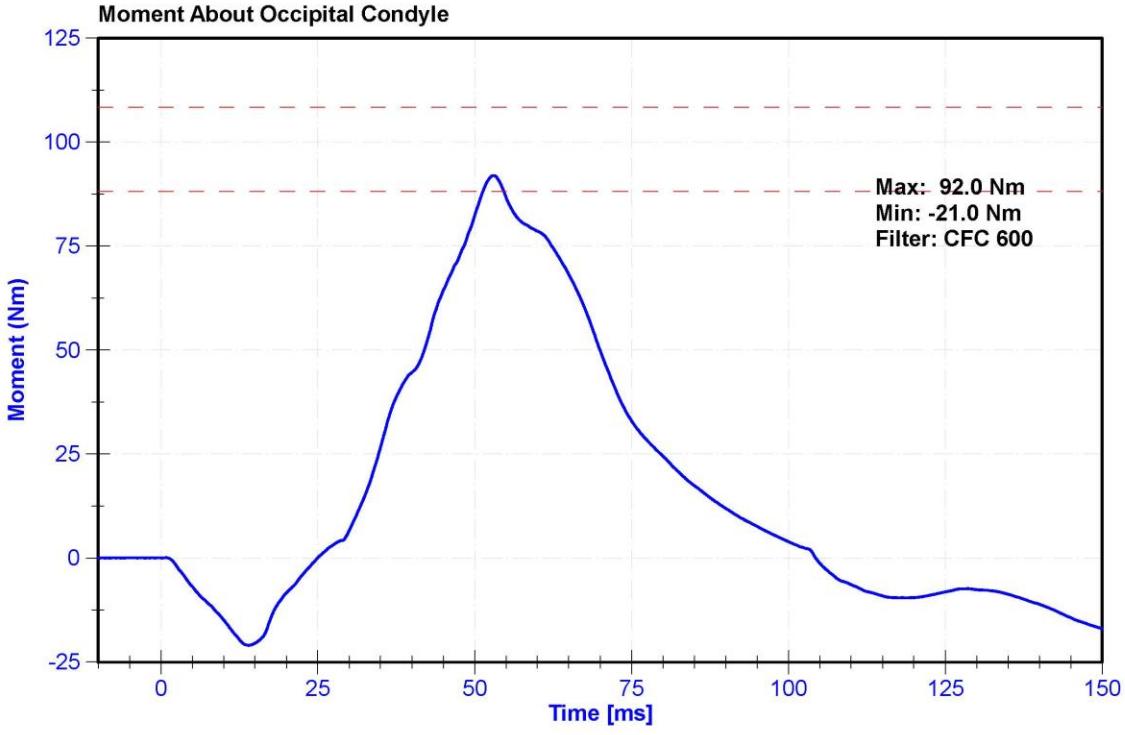
Results

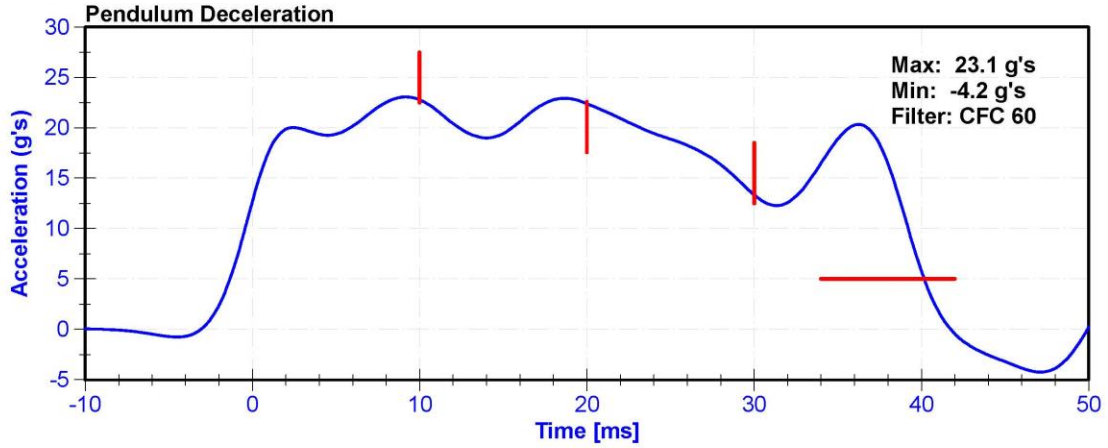
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.8	Pass
Humidity	10	70	%	57.0	Pass
Velocity	6.89	7.13	m/s	6.903	Pass
Pendulum Deceleration at 10ms	22.5	27.5	g's	22.79	Pass
Pendulum Deceleration at 20ms	17.6	22.6	g's	22.40	Pass
Pendulum Deceleration at 30ms	12.5	18.5	g's	13.35	Pass
Max. Pendulum Deceleration After 30ms	0	29	g's	23.1	Pass
Pendulum Deceleration Time to 5 g's	34	42	ms	40.2	Pass
Maximum D Plane Rotation	64	78	deg	66.2	Pass
Time to Maximum Rotation	57	64	ms	62.9	Pass
Rotation Decay to Zero	113	127	ms	122.3	Pass
Moment About Occipital Condyle	88.1	108.4	Nm	91.95	Pass
Time to Maximum Moment	47	58	ms	53.0	Pass
Moment Decay to Zero	97	107	ms	104.3	Pass

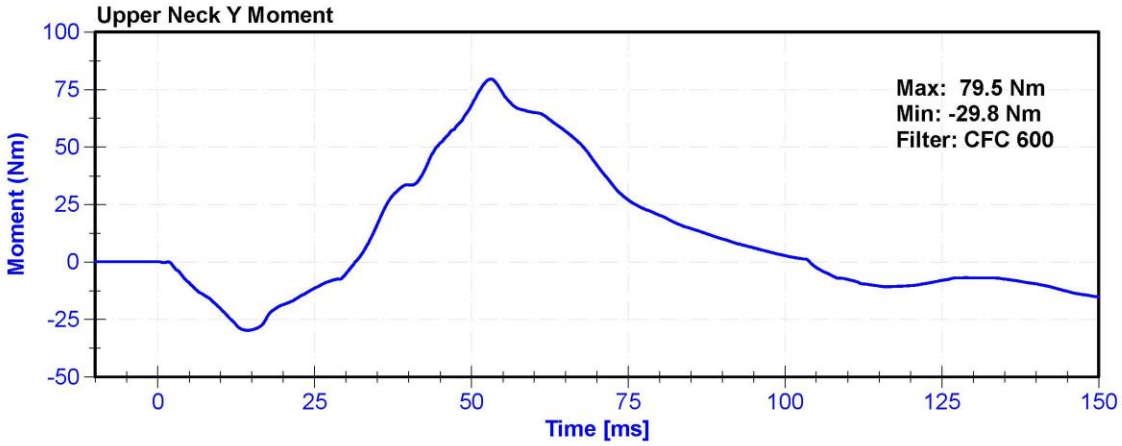
Transducer Calibrations

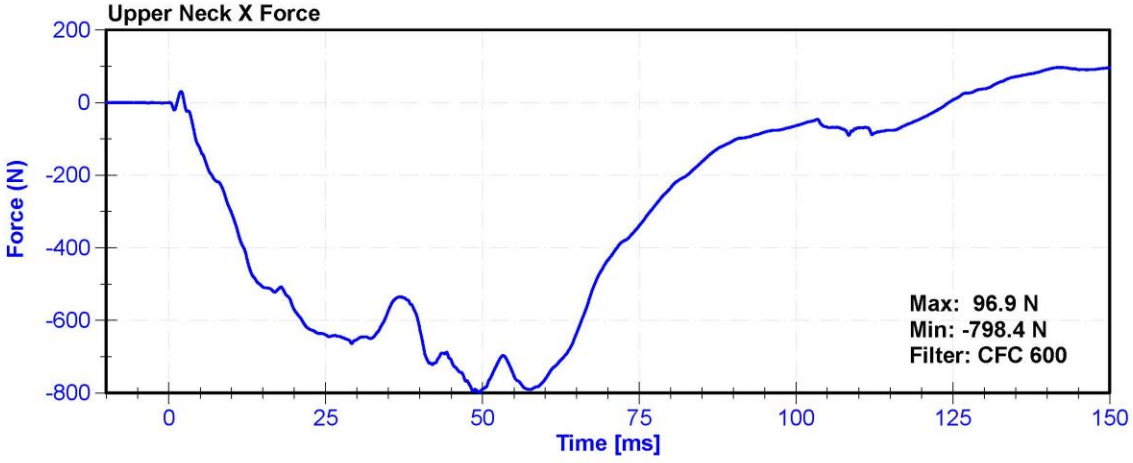
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-AH5M9 Pend	1/29/2019	1/29/2020
Pendulum Potentiometer	ETI SP22G	DS-LABPOT1	11/15/2018	11/15/2019
Condyle Potentiometer	ETI SP22G	DS-LABPOT2	11/15/2018	11/15/2019
Upper Neck Load Cell	FTSS IF-205	LC-161Fx	9/28/2018	9/28/2019


D-Plane Rotation
Rotation (Deg)
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]
Max: 66.2 deg
Min: -32.6 deg
Filter: CFC 60


Moment About Occipital Condyle
Moment (Nm)
125
100
75
50
25
0
-25
0
25
50
75
100
125
150
Time [ms]
Max: 92.0 Nm
Min: -21.0 Nm
Filter: CFC 600


Pendulum Deceleration
Acceleration (g's)
Time [ms]
Max: 23.1 g's
Min: -4.2 g's
Filter: CFC 60


Upper Neck Y Moment
Moment (Nm)
Time [ms]
Max: 79.5 Nm
Min: -29.8 Nm
Filter: CFC 600


Upper Neck X Force
Force (N)
Time [ms]
Max: 96.9 N
Min: -798.4 N
Filter: CFC 600

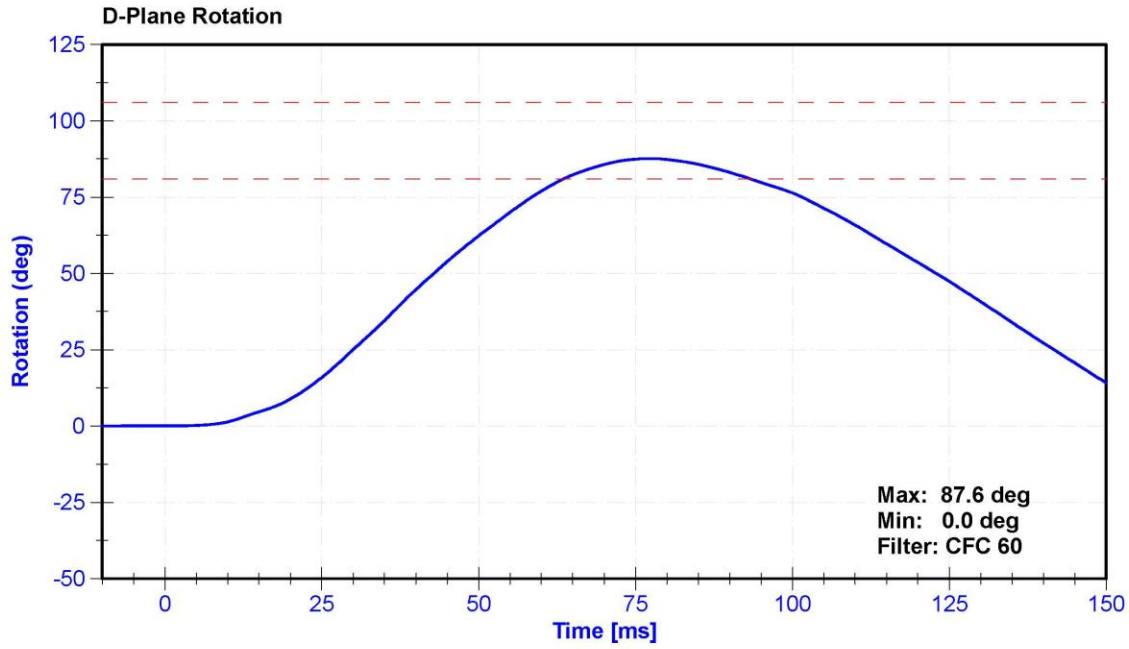
ATD Manufacturer	Humanetics	Test Technician	D.Reinhard
ATD Serial Number	142	Laboratory Supervisor	K.Brogan

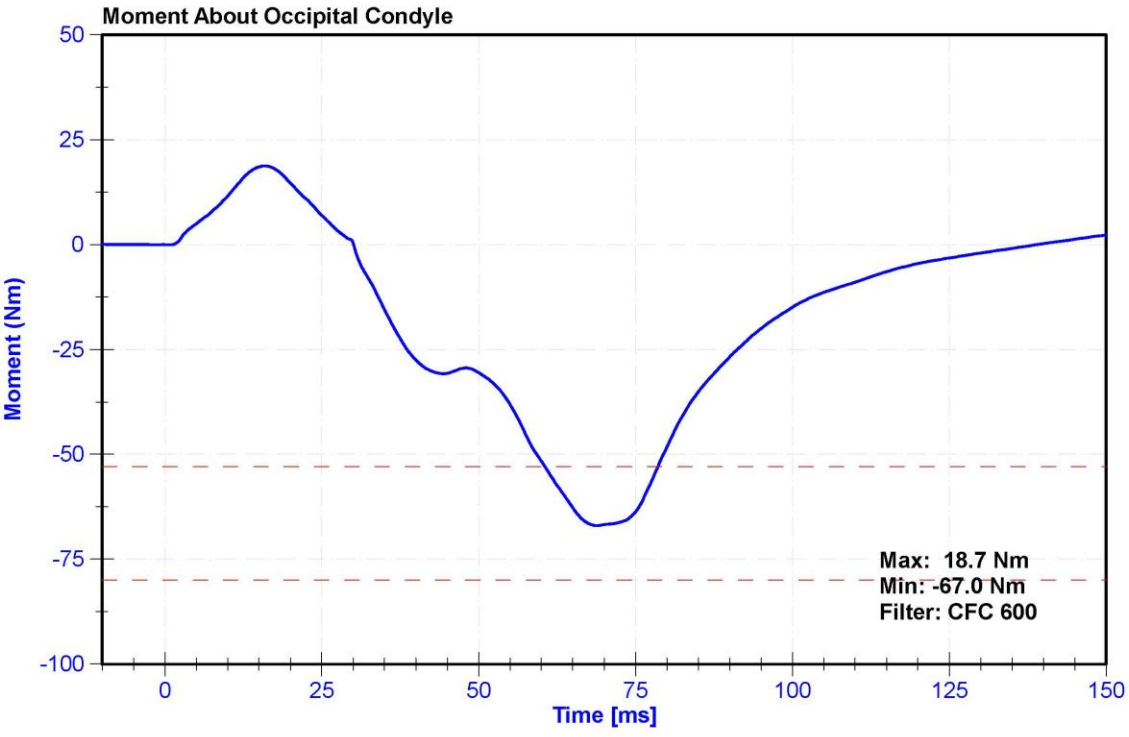
Results

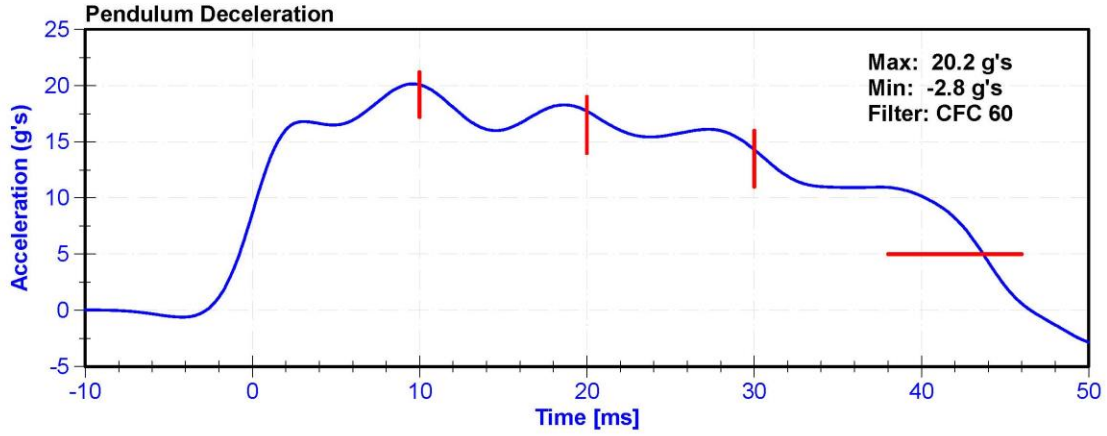
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.2	Pass
Humidity	10	70	%	50	Pass
Velocity	5.94	6.19	m/s	5.964	Pass
Pendulum Deceleration at 10ms	17.2	21.2	g's	20.09	Pass
Pendulum Deceleration at 20ms	14	19	g's	17.7	Pass
Pendulum Deceleration at 30ms	11	16	g's	14.3	Pass
Max. Pendulum Deceleration After 30ms	0	22	g's	20.2	Pass
Pendulum Deceleration Time to 5 g's	38	46	ms	43.7	Pass
Maximum D Plane Rotation	81	106	deg	87.6	Pass
Time to Maximum Rotation	72	82	ms	77.4	Pass
Rotation Decay to Zero	147	174	ms	160.3	Pass
Minimum Moment About OC	-80	-52.9	Nm	-67.01	Pass
Time to Minimum Moment	65	79	ms	68.9	Pass
Moment Decay to Zero	120	148	ms	139.0	Pass

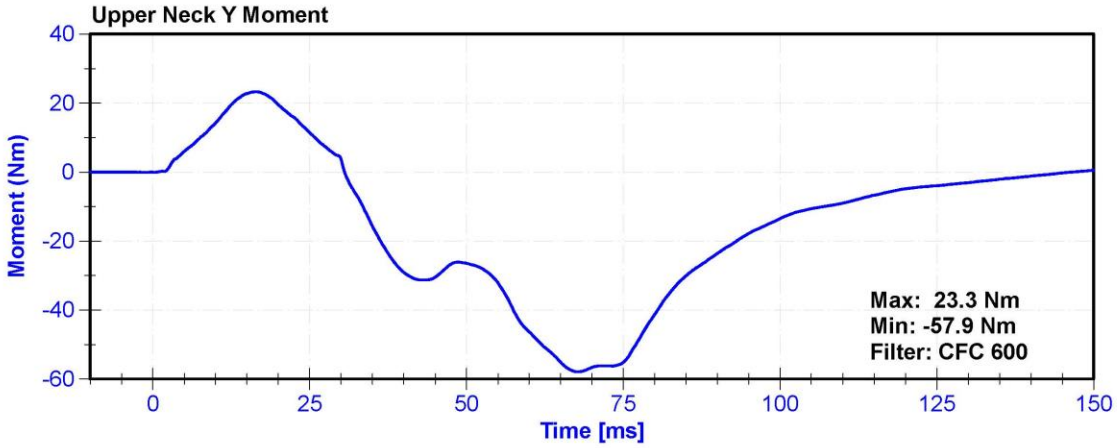
Transducer Calibrations

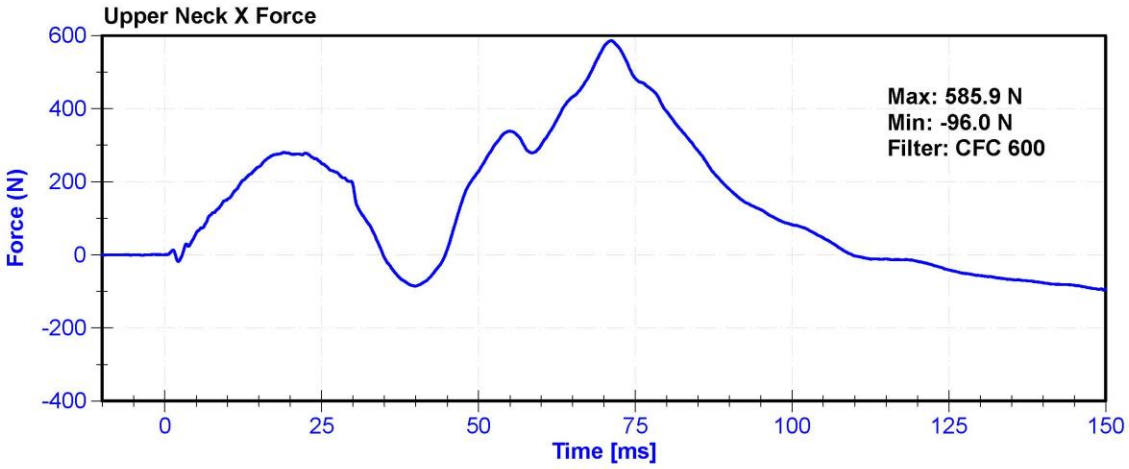
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-AH5M9 Pend	1/29/2019	1/29/2020
Pendulum Potentiometer	ETI SP22G	DS-LABPOT1	11/15/2018	11/15/2019
Condyle Potentiometer	ETI SP22G	DS-LABPOT2	11/15/2018	11/15/2019
Upper Neck Load Cell	FTSS IF-205	LC-161Fx	9/28/2018	9/28/2019


D-Plane Rotation
Rotation (deg)
125
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]
Max: 87.6 deg
Min: 0.0 deg
Filter: CFC 60


Moment About Occipital Condyle
Moment (Nm)
50
25
0
-25
-50
-75
-100
0
25
50
75
100
125
150
Time [ms]
Max: 18.7 Nm
Min: -67.0 Nm
Filter: CFC 600


Pendulum Deceleration
Max: 20.2 g's
Min: -2.8 g's
Filter: CFC 60
Acceleration (g's)
Time [ms]


Upper Neck Y Moment
Max: 23.3 Nm
Min: -57.9 Nm
Filter: CFC 600
Moment (Nm)
Time [ms]


Upper Neck X Force
Max: 585.9 N
Min: -96.0 N
Filter: CFC 600
Force (N)
Time [ms]

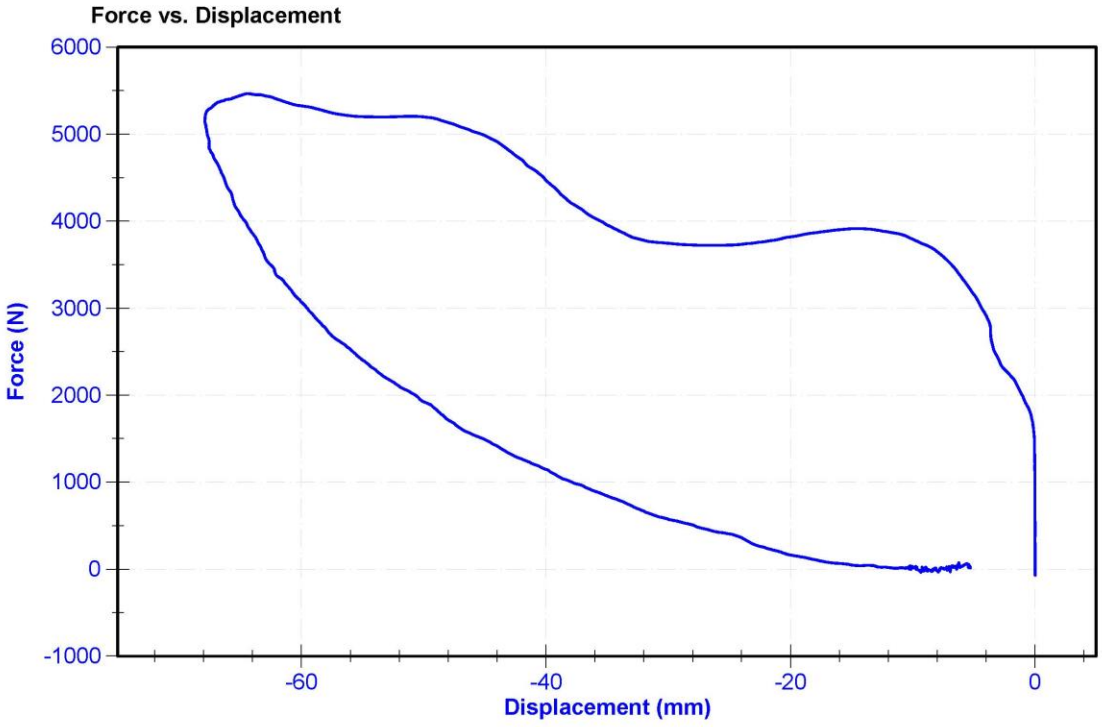
ATD Manufacturer	Humanetics	Test Technician	D.Reinhard
ATD Serial Number	142	Laboratory Supervisor	K.Brogan

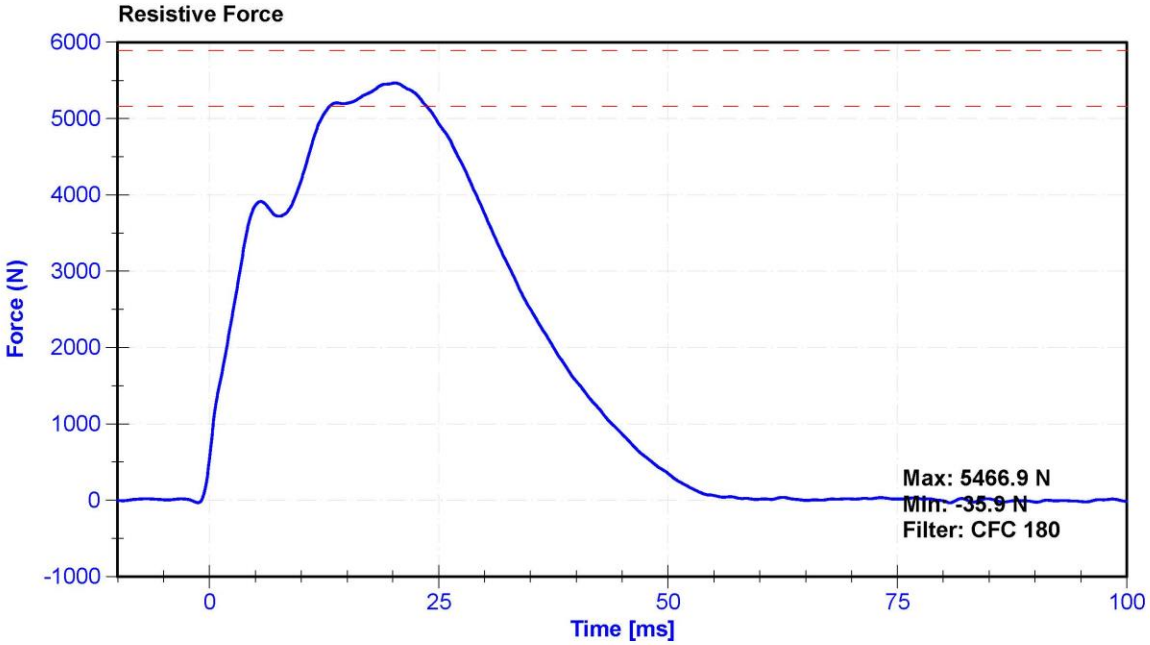
Results

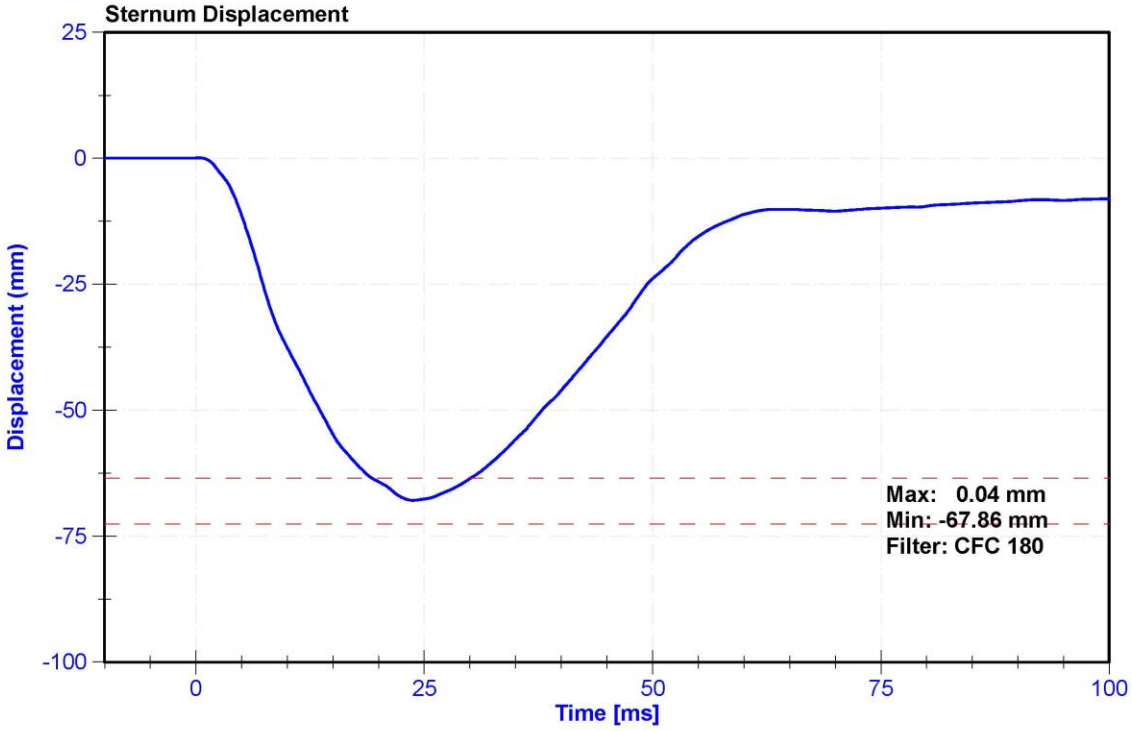
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.9	Pass
Humidity	10	70	%	59	Pass
Velocity	6.59	6.83	m/s	6.597	Pass
Chest Displacement	-72.6	-63.5	mm	-67.86	Pass
Resistive Force	5160	5894	N	5466.9	Pass
Hysteresis	65	85	%	71.4	Pass

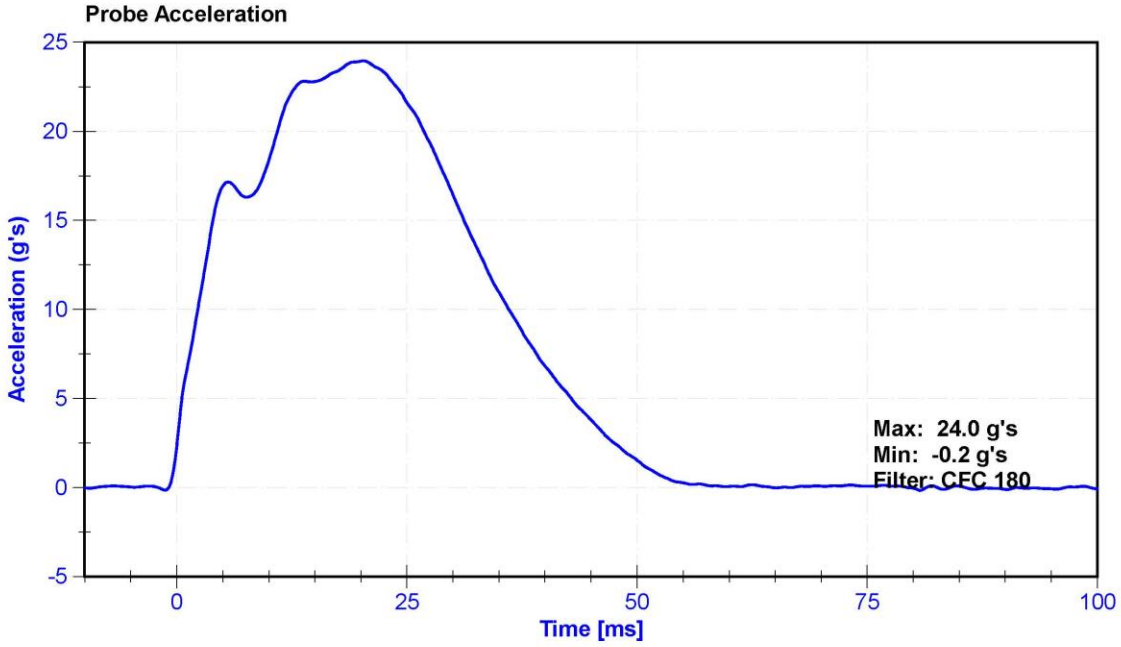
Transducer Calibrations

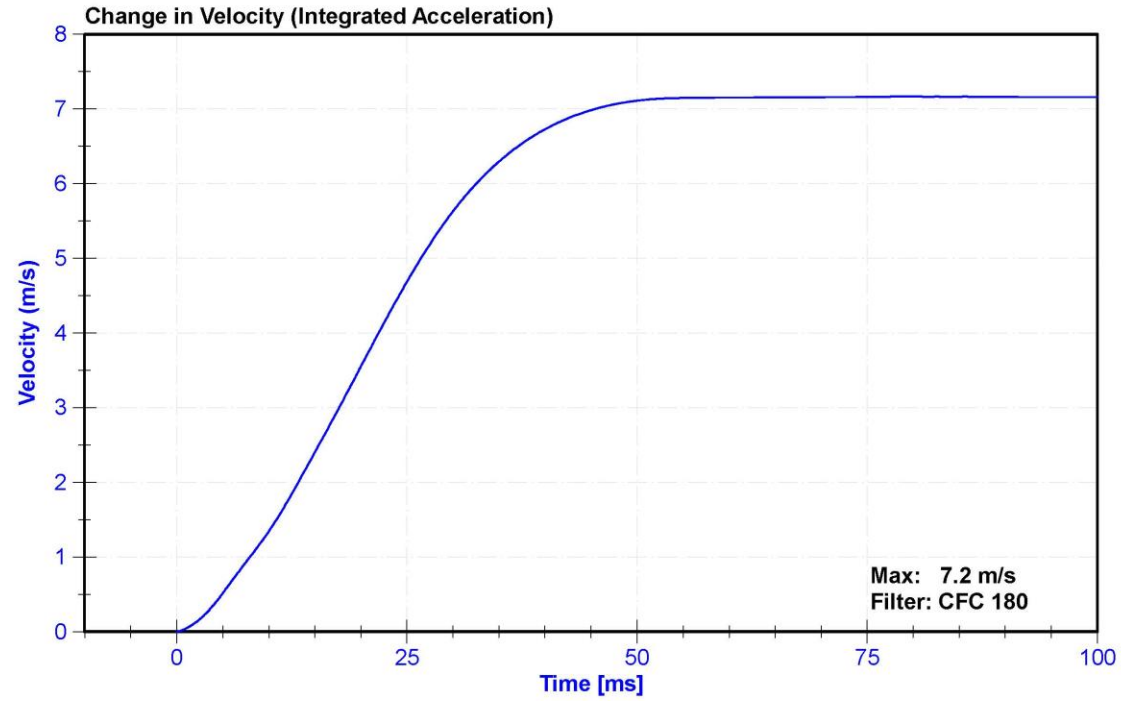
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7264CT	AC-P71278	12/14/2018	12/14/2019
Chest Potentiometer	JDK 6209-2038	DS-142	10/22/2018	10/22/2019




Resistive Force
Force (N)
6000
5000
4000
3000
2000
1000
0
-1000
0
25
50
75
100
Time [ms]
Max: 5466.9 N
Min: -35.9 N
Filter: CFC 180


Sternum Displacement
Displacement (mm)
25
0
-25
-50
-75
-100
0
25
50
75
100
Time [ms]
Max: 0.04 mm
Min: -67.86 mm
Filter: CFC 180


Probe Acceleration
Acceleration (g's)
25
20
15
10
5
0
-5
0
25
50
75
100
Time [ms]
Max: 24.0 g's
Min: -0.2 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: 7.2 m/s
Filter: CFC 180

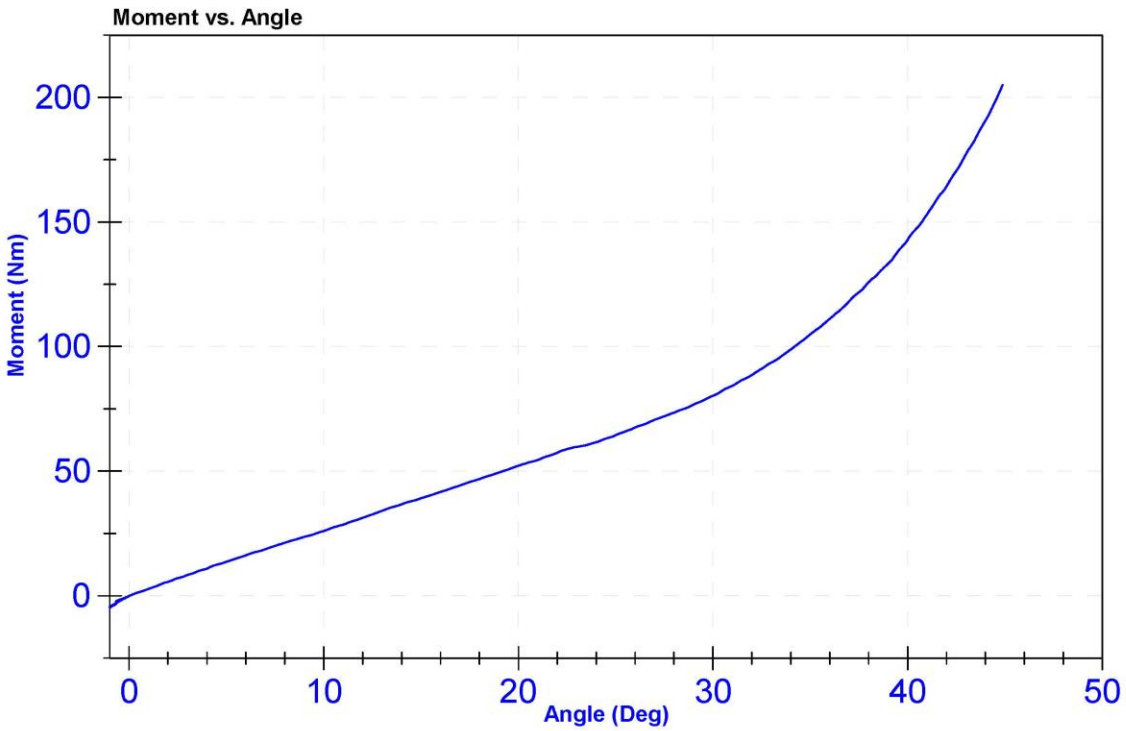
ATD Manufacturer	Humanetics	Test Technician	D.Reinhard
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	22.1	Pass
Humidity	10	70	%	58.0	Pass
Average Velocity	5	10	deg/s	7.5	Pass
Angle at 203Nm	40	50	deg	44.8	Pass
Moment at 30 degrees	0	94.9	Nm	80.3	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	ETI SP22	DS-0008	2018-09-18	2019-09-18
Load Cell	Key Trans 2301-02	LC-115 My	2018-09-06	2019-09-06



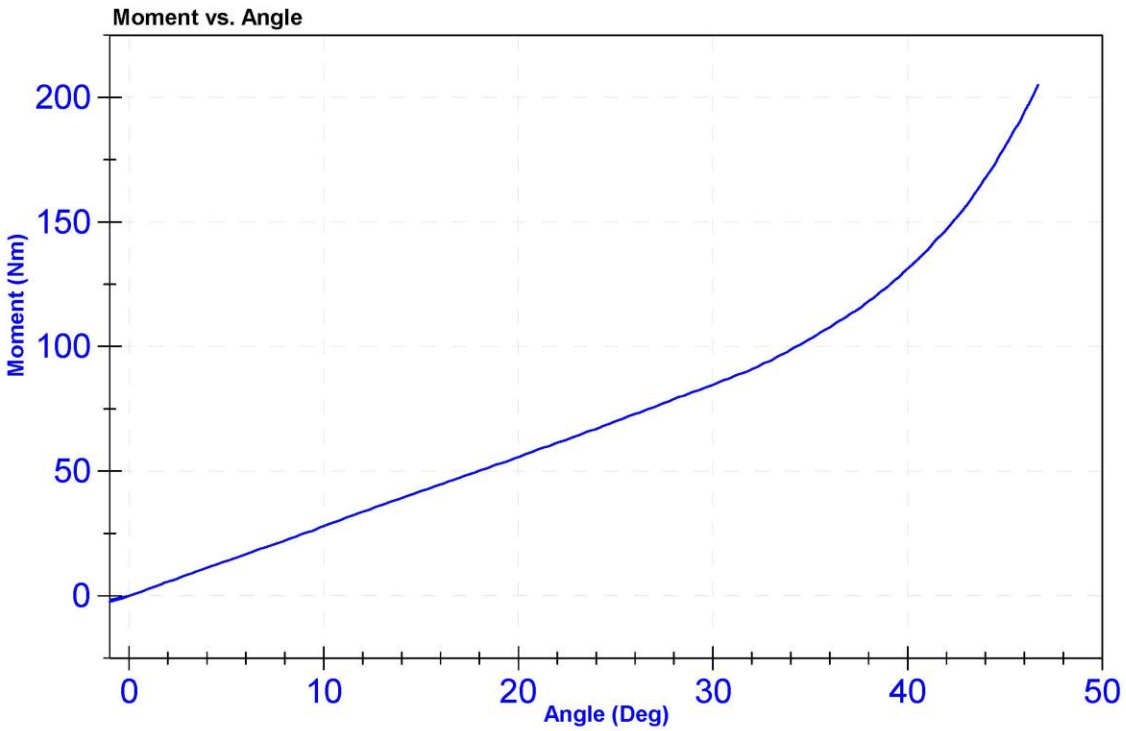
ATD Manufacturer	Humanetics	Test Technician	D.Reinhard
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.6	Pass
Humidity	10	70	%	58.0	Pass
Average Velocity	5	10	deg/s	7.4	Pass
Angle at 203Nm	40	50	deg	46.6	Pass
Moment at 30 degrees	0	94.9	Nm	84.6	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	ETI SP22	DS-0008	2018-09-18	2019-09-18
Load Cell	Key Trans 2301-02	LC-115 My	2018-09-06	2019-09-06



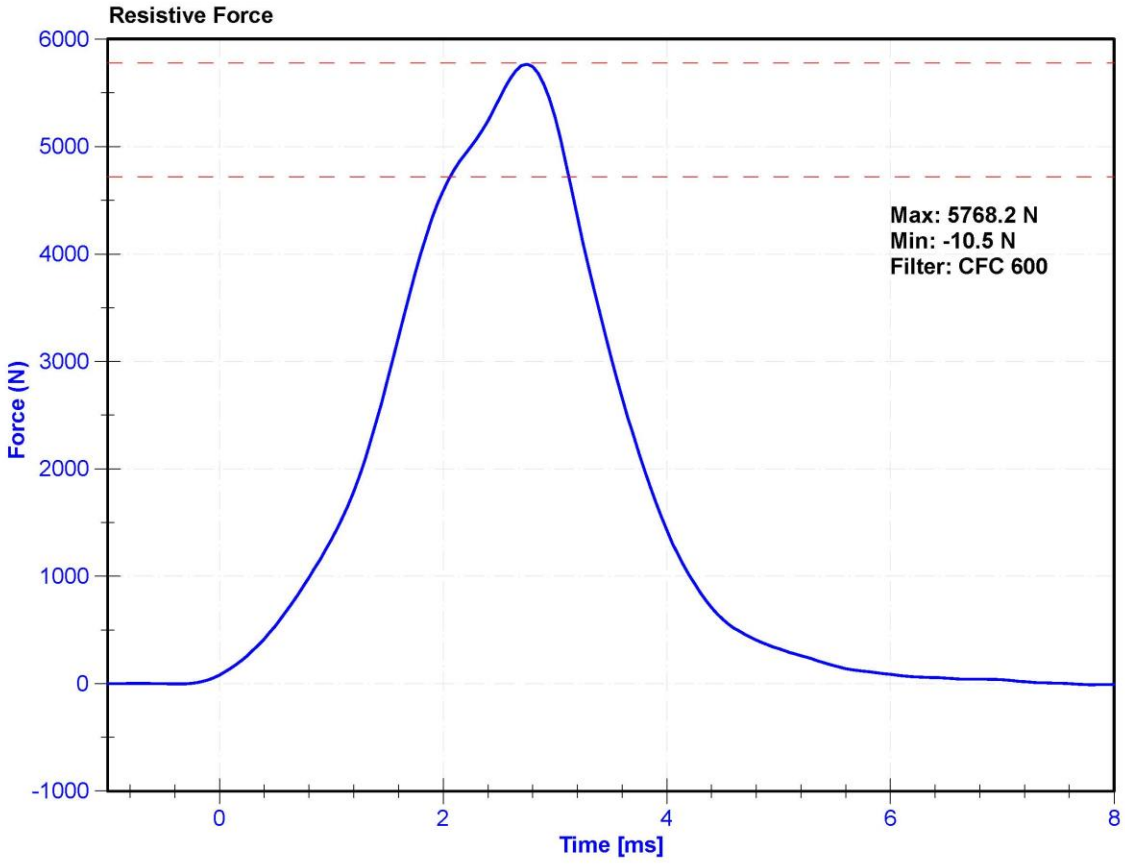
ATD Manufacturer	Humanetics	Test Technician	D.Reinhard
ATD Serial Number	142	Laboratory Supervisor	K.Brogan

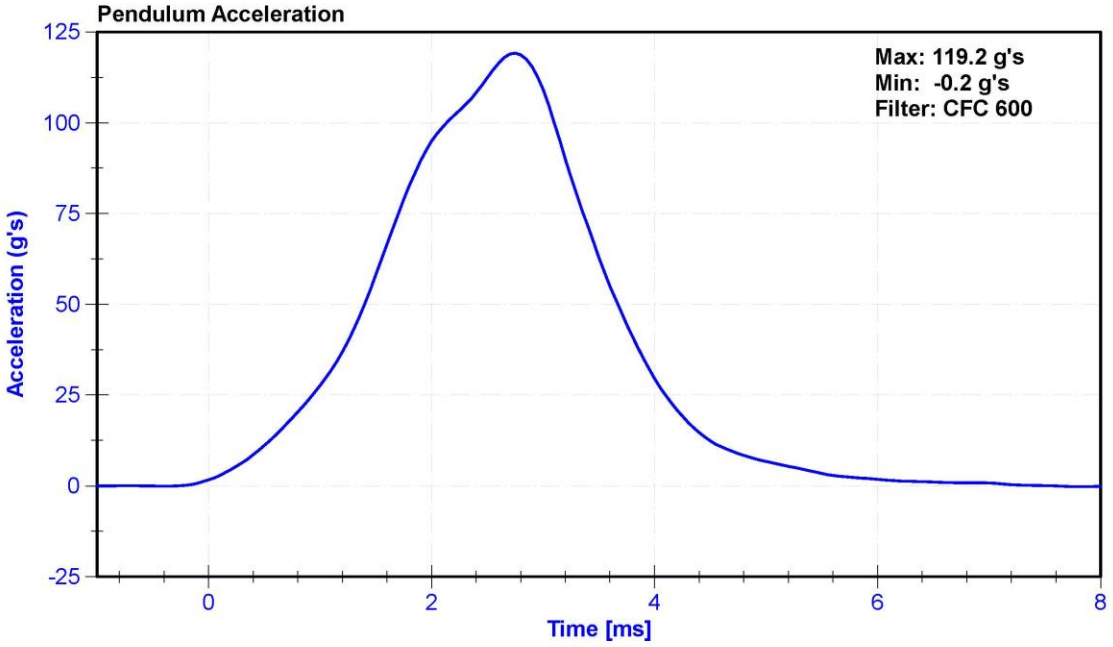
Results

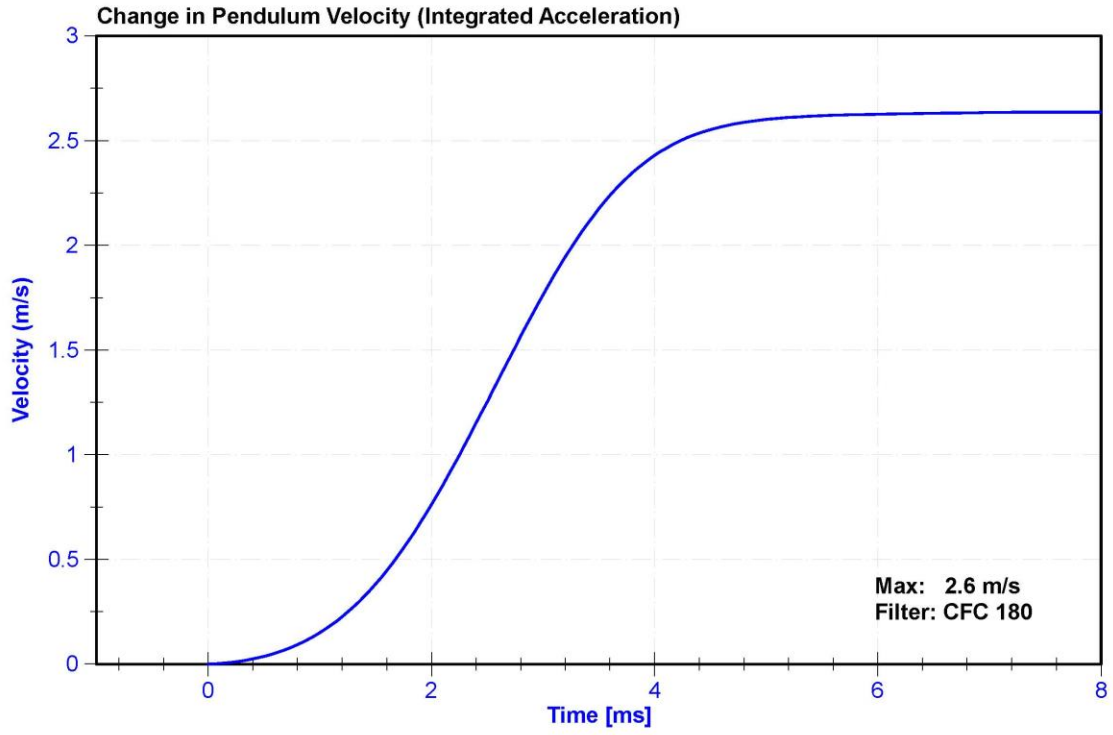
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	20.8	Pass
Humidity	10	70	%	60	Pass
Velocity	2.07	2.13	m/s	2.121	Pass
Maximum Resistive Force	4720	5780	N	5768.2	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A260487	2/21/2019	8/22/2019




Pendulum Acceleration
Max: 119.2 g's
Min: -0.2 g's
Filter: CFC 600
Acceleration (g's)
125
100
75
50
25
0
-25
0
2
4
6
8
Time [ms]


Change in Pendulum Velocity (Integrated Acceleration)
Max: 2.6 m/s
Filter: CFC 180
Velocity (m/s)
3
2.5
2
1.5
1
0.5
0
0
2
4
6
8
Time [ms]

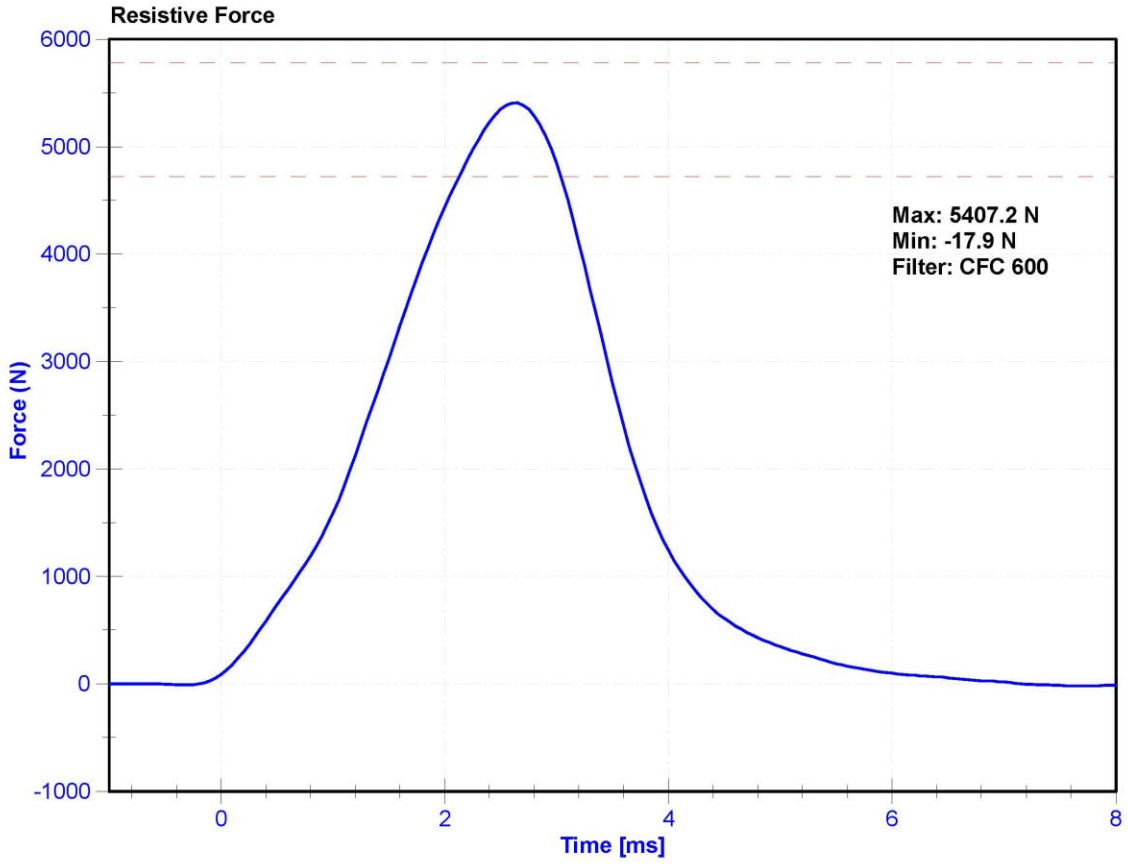
ATD Manufacturer	Humanetics	Test Technician	C. Mantell
ATD Serial Number	142	Laboratory Supervisor	K.Brogan

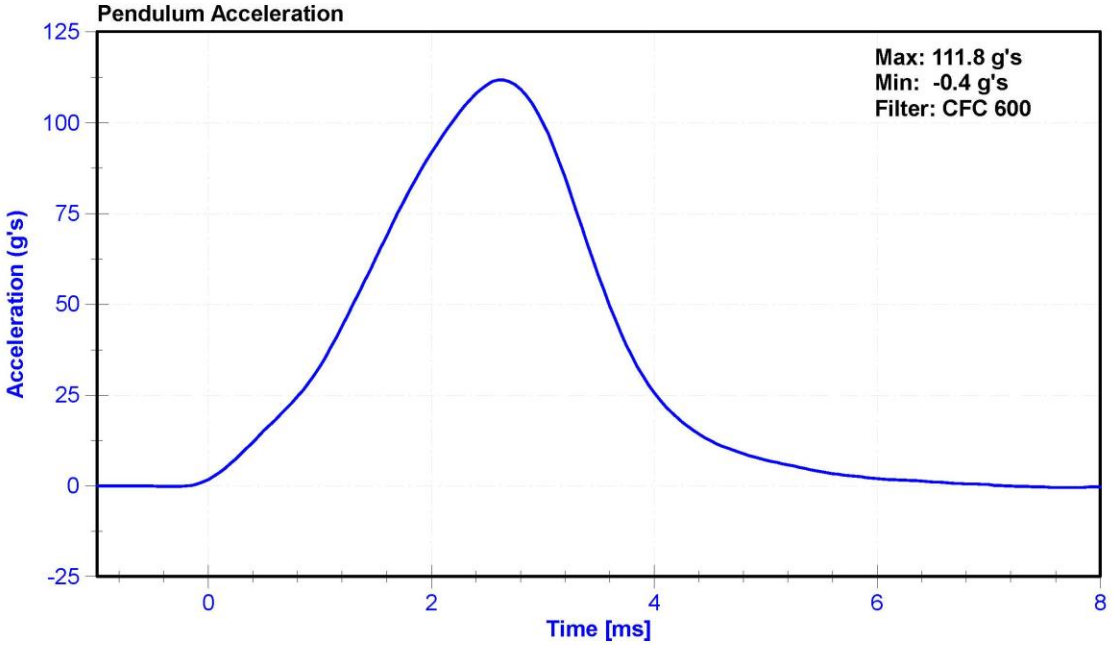
Results

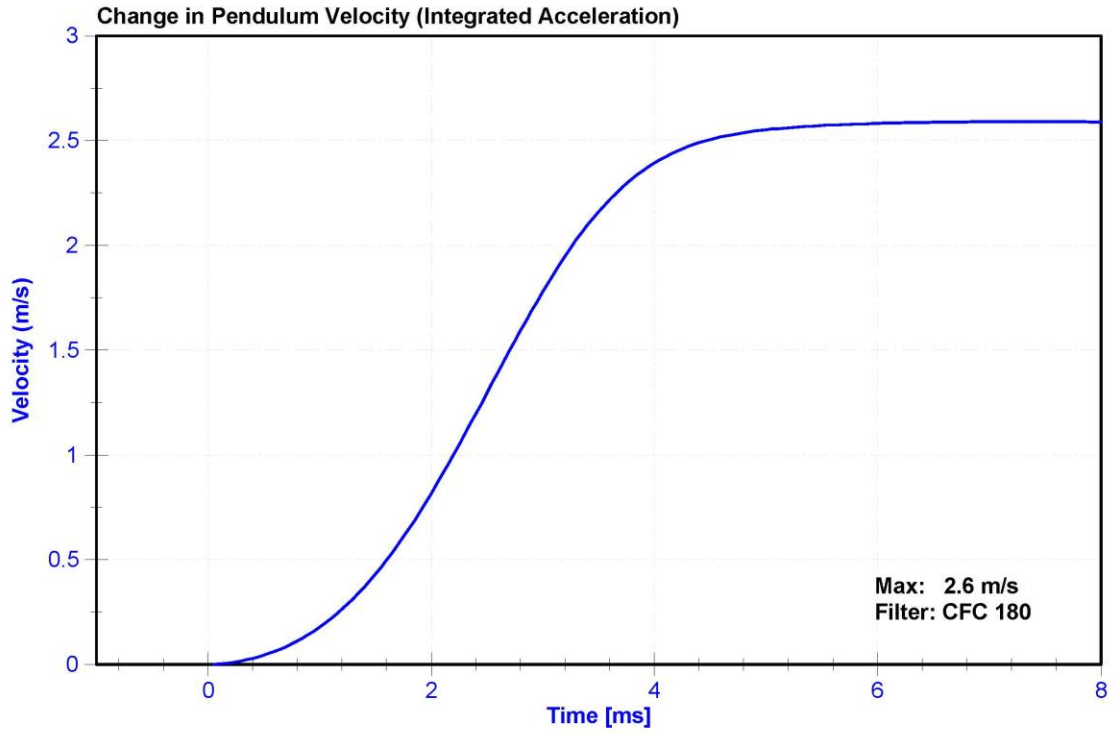
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	20.8	Pass
Humidity	10	70	%	50	Pass
Velocity	2.07	2.13	m/s	2.121	Pass
Maximum Resistive Force	4720	5780	N	5407.2	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A260487	2/21/2019	8/22/2019




Pendulum Acceleration
Max: 111.8 g's
Min: -0.4 g's
Filter: CFC 600
Acceleration (g's)
125
100
75
50
25
0
-25
0
2
4
6
8
Time [ms]


Change in Pendulum Velocity (Integrated Acceleration)
Velocity (m/s)
3
2.5
2
1.5
1
0.5
0
Max: 2.6 m/s
Filter: CFC 180
0
2
4
6
8
Time [ms]

CALIBRATION TEST RESULTS

PRE-TEST

HYBRID III 5TH PERCENTILE - PASSENGER ATD

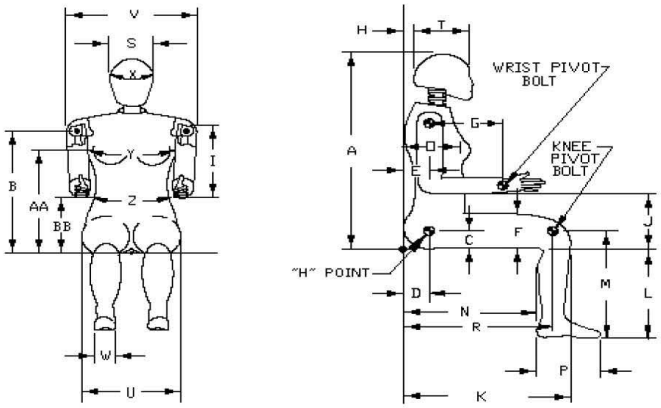
SERIAL NO: 288

Calspan

External Measurements - Hybrid 3 - 5th Female

Technician: K. Dutton Date: 07/09/2019

Dummy Serial Number: 288



Symbol	Description	Specification (mm)		Result (mm)	Pass/Fail
A	Sitting Height	775	800	787	Pass
B	Shoulder Pivot Height	432	457	450	Pass
C	H-Point Height	81	86	84	Pass
D	H-Point from Backline	145	150	147	Pass
E	Shoulder Pivot from Backline	69	84	77	Pass
F	Thigh Clearance	119	135	126	Pass
G	Back of Elbow to Wrist Pivot	244	259	255	Pass
H	Head Back to Backline	43	48	45	Pass
I	Shoulder to Elbow Length	277	297	284	Pass
J	Elbow Rest Height	183	203	190	Pass
K	Buttock to Knee Length	521	546	538	Pass
L	Popliteal Height	356	376	365	Pass
M	Knee Pivot Height	394	419	405	Pass
N	Buttock Popliteal Length	414	439	430	Pass
O	Chest Depth without Jacket	175	191	180	Pass
P	Foot Length (right)	219	234	221	Pass
R	Buttock To Knee Pivot Length	457	483	465	Pass
S	Head Breadth	137	147	142	Pass
T	Head Depth	178	188	183	Pass
U	Hip Breadth	300	315	310	Pass
V	Shoulder Breadth	351	366	361	Pass
W	Foot Breadth	79	94	85	Pass
X	Head Circumference	528	549	537	Pass
Y	Chest Circumference with Jacket	851	881	865	Pass
Z	Waist Circumference	460	790	777	Pass
AA	Reference Location (Chest Circumference)	333	358	345	Pass
BB	Reference Location (Waist Circumference)	160	170	164	Pass

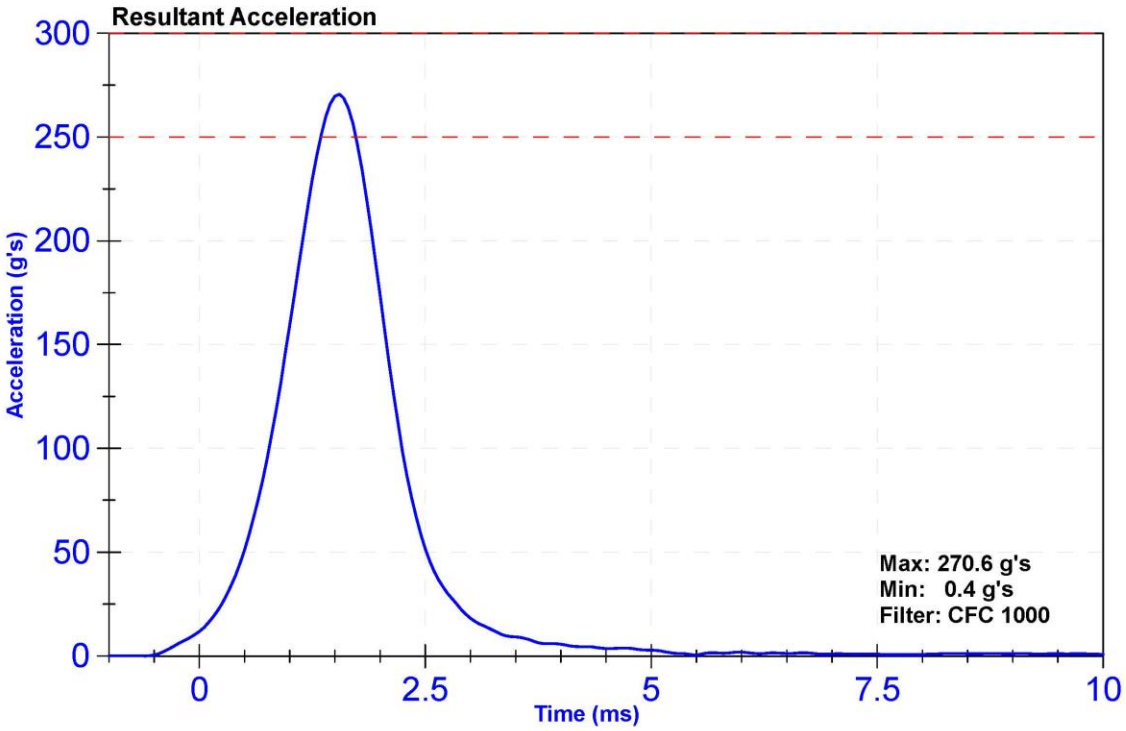
ATD Manufacturer	FTSS	Test Technician	D.Reinhard
ATD Serial Number	288	Laboratory Supervisor	K. Brogan

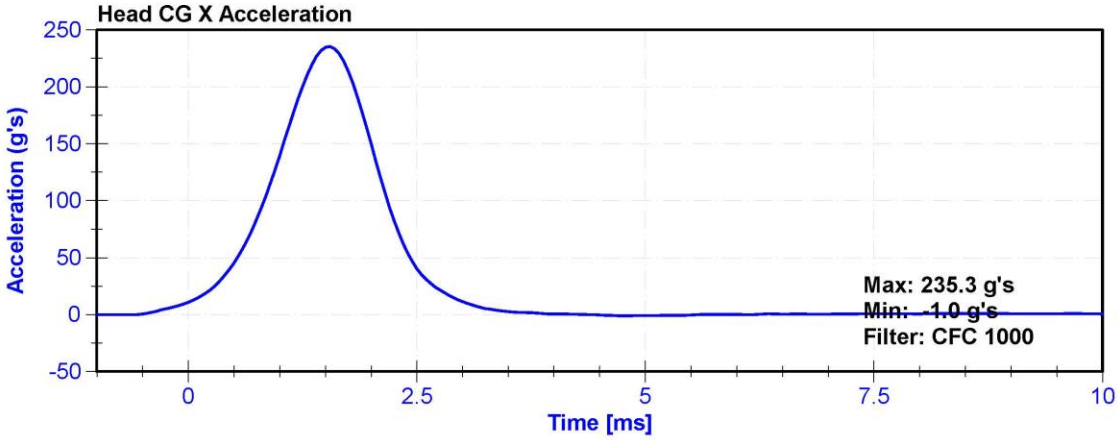
Results

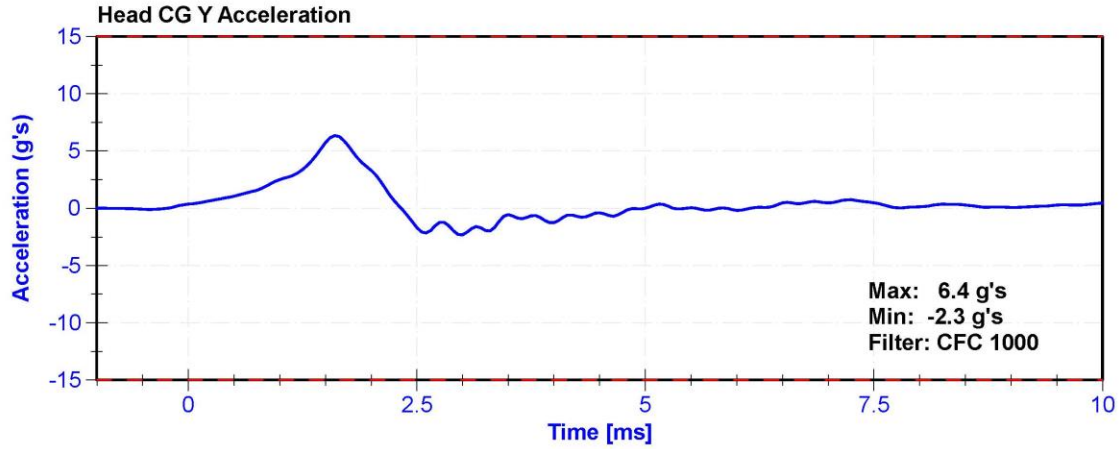
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.8	Pass
Humidity	10	70	%	56	Pass
Resultant Acceleration	250	300	g's	270.6	Pass
Oscillation	0	10	%	2.2	Pass
Lateral Acceleration	-15	15	g's	6.4	Pass

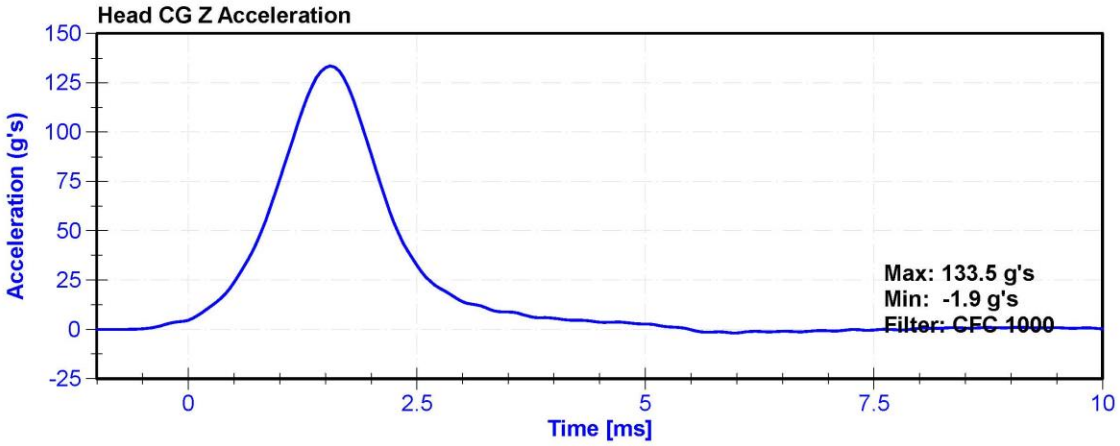
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	ENDEVCO 7264CT	AC-P52133	4/9/2019	10/8/2019
Y Accelerometer	ENDEVCO 7264	AC-P12359	4/9/2019	10/8/2019
Z Accelerometer	ENDEVCO 7264CT	AC-P58871	4/9/2019	10/8/2019




Head CG X Acceleration
Acceleration (g's)
250
200
150
100
50
0
-50
0
2.5
5
7.5
10
Time [ms]
Max: 235.3 g's
Min: -1.0 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: 6.4 g's
Min: -2.3 g's
Filter: CFC 1000


Head CG Z Acceleration
Acceleration (g's)
150
125
100
75
50
25
0
-25
0
2.5
5
7.5
10
Time [ms]
Max: 133.5 g's
Min: -1.9 g's
Filter: CFC 1000

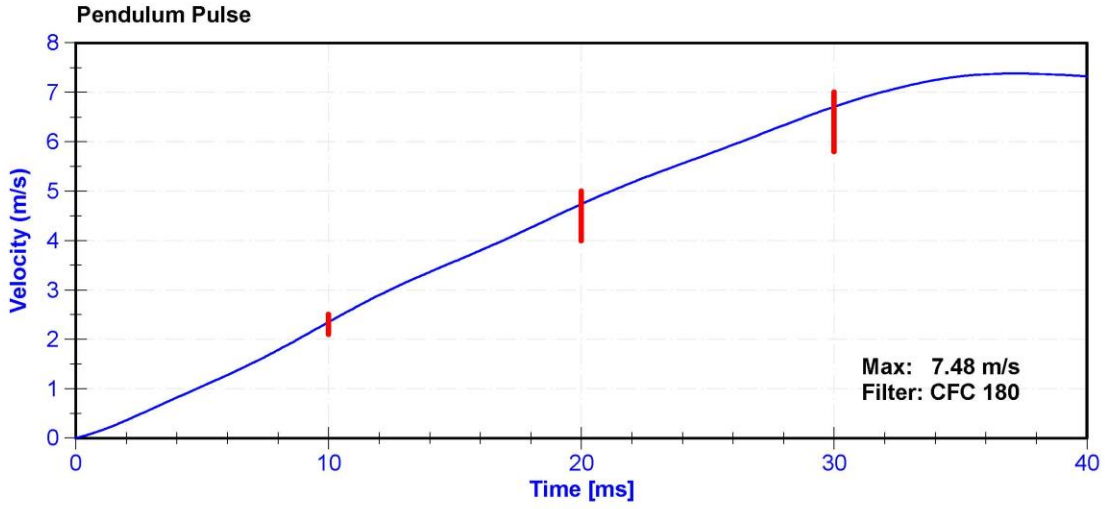
ATD Manufacturer	FTSS	Test Technician	C. Mantell
ATD Serial Number	288	Laboratory Supervisor	K. Brogan

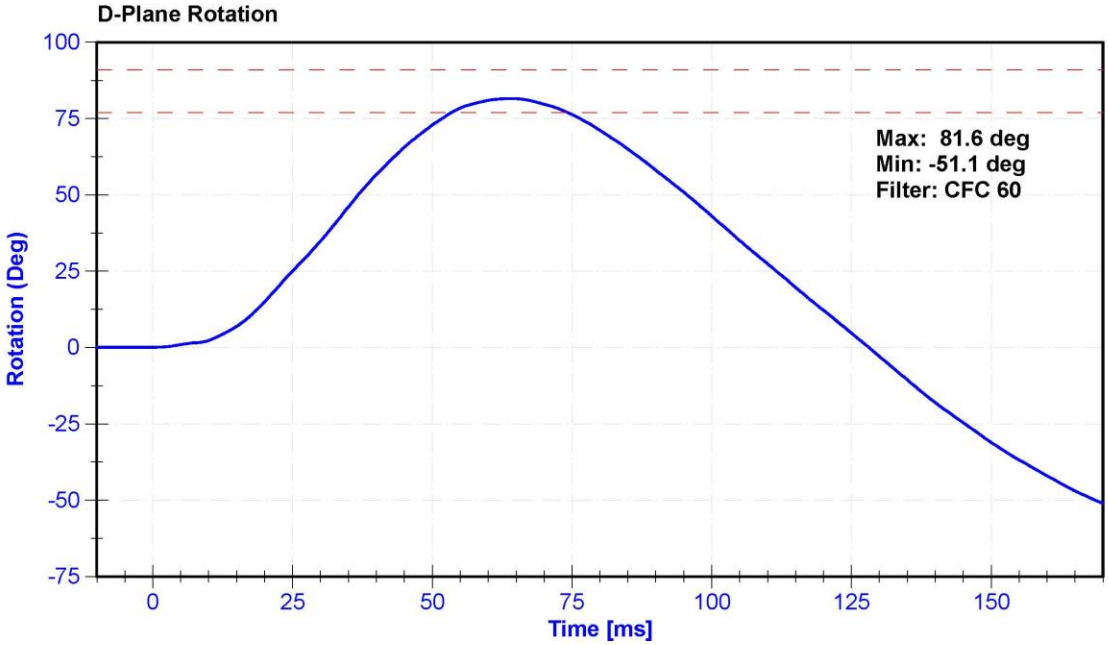
Results

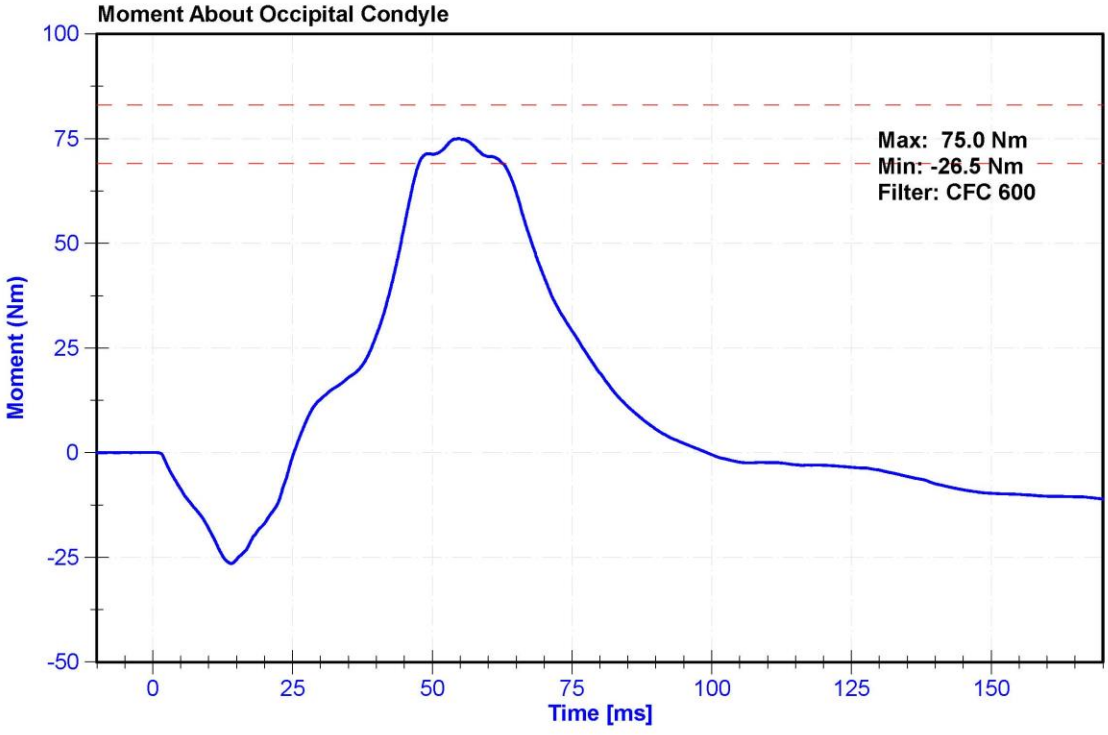
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.8	Pass
Humidity	10	70	%	48.5	Pass
Velocity	6.89	7.13	m/s	6.903	Pass
Pendulum Impulse at 10ms	2.1	2.5	m/s	2.35	Pass
Pendulum Impulse at 20ms	4.0	5.0	m/s	4.74	Pass
Pendulum Impulse at 30ms	5.8	7.0	m/s	6.71	Pass
Max D Plane Rotation	77	91	deg	81.6	Pass
Max Moment During Rotation Interval	69	83	Nm	75.0	Pass
Moment Decay to 10.0 Nm	80	100	ms	85.9	Pass

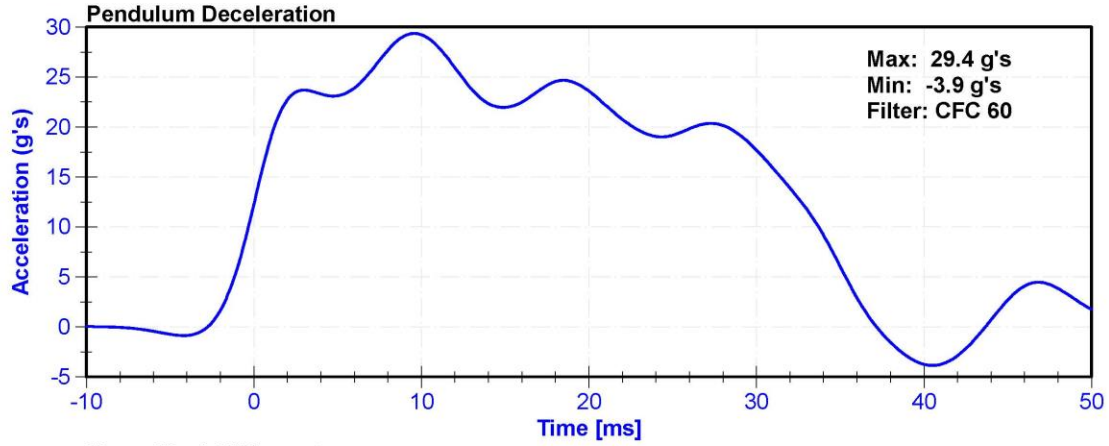
Transducer Calibrations

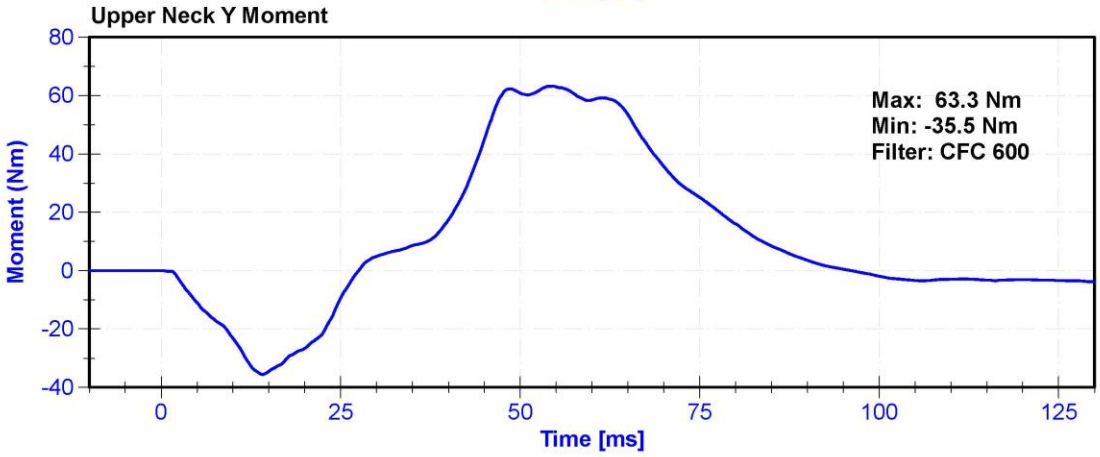
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-AH5M9 Pend	1/29/2019	1/29/2020
Pendulum Potentiometer	ETI SP22G	DS-LABPOT1	11/15/2018	11/15/2019
Condyle Potentiometer	ETI SP22G	DS-LABPOT2	11/15/2018	11/15/2019
Upper Neck Load Cell	DENTON 1716A	LC-1591Fx	9/28/2018	9/28/2019

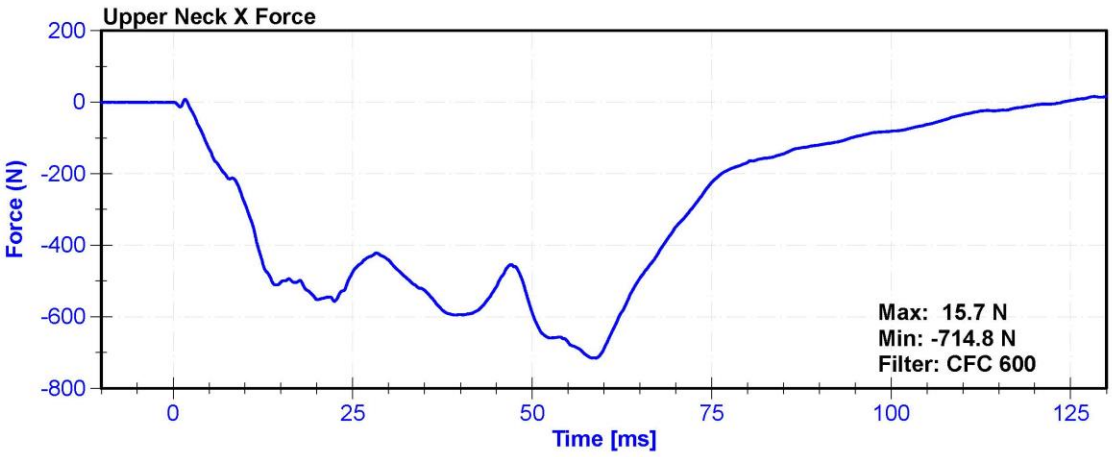



D-Plane Rotation
Max: 81.6 deg
Min: -51.1 deg
Filter: CFC 60
Rotation (Deg)
Time [ms]
100
75
50
25
0
-25
-50
-75
0
25
50
75
100
125
150


Moment About Occipital Condyle
Max: 75.0 Nm
Min: -26.5 Nm
Filter: CFC 600
Moment (Nm)
Time [ms]
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150


Pendulum Deceleration
Max: 29.4 g's
Min: -3.9 g's
Filter: CFC 60
Acceleration (g's)
Time [ms]


Upper Neck Y Moment
Max: 63.3 Nm
Min: -35.5 Nm
Filter: CFC 600
Moment (Nm)
Time [ms]


Upper Neck X Force
Max: 15.7 N
Min: -714.8 N
Filter: CFC 600
Force (N)
Time [ms]

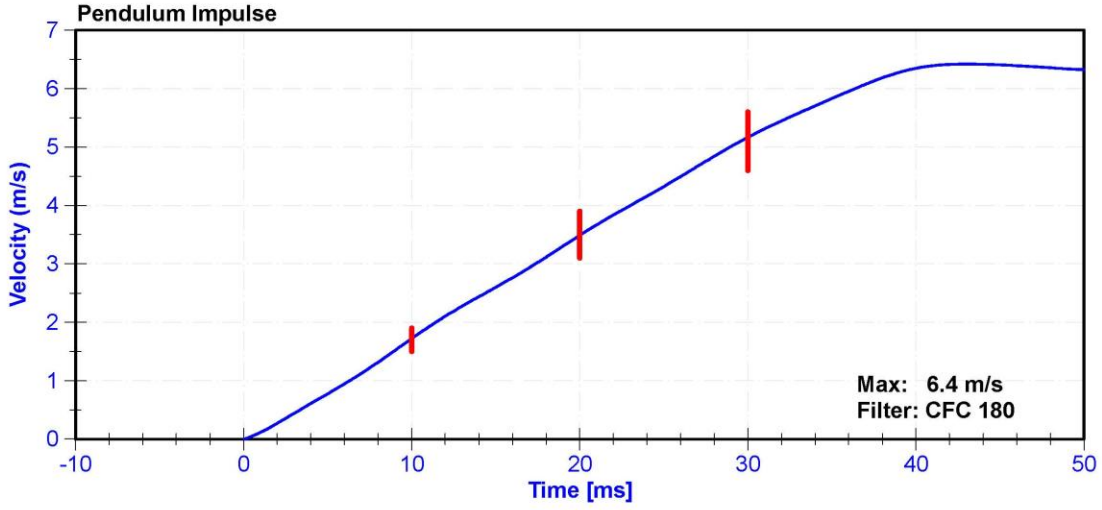
ATD Manufacturer	FTSS	Test Technician	C. Mantell
ATD Serial Number	288	Laboratory Supervisor	K. Brogan

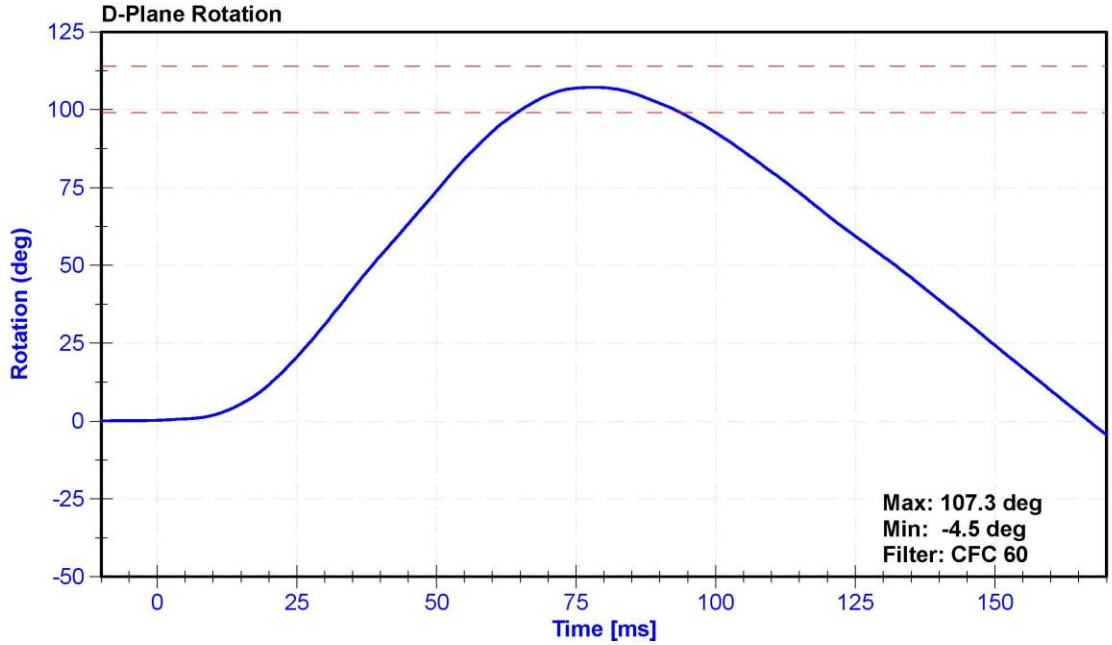
Results

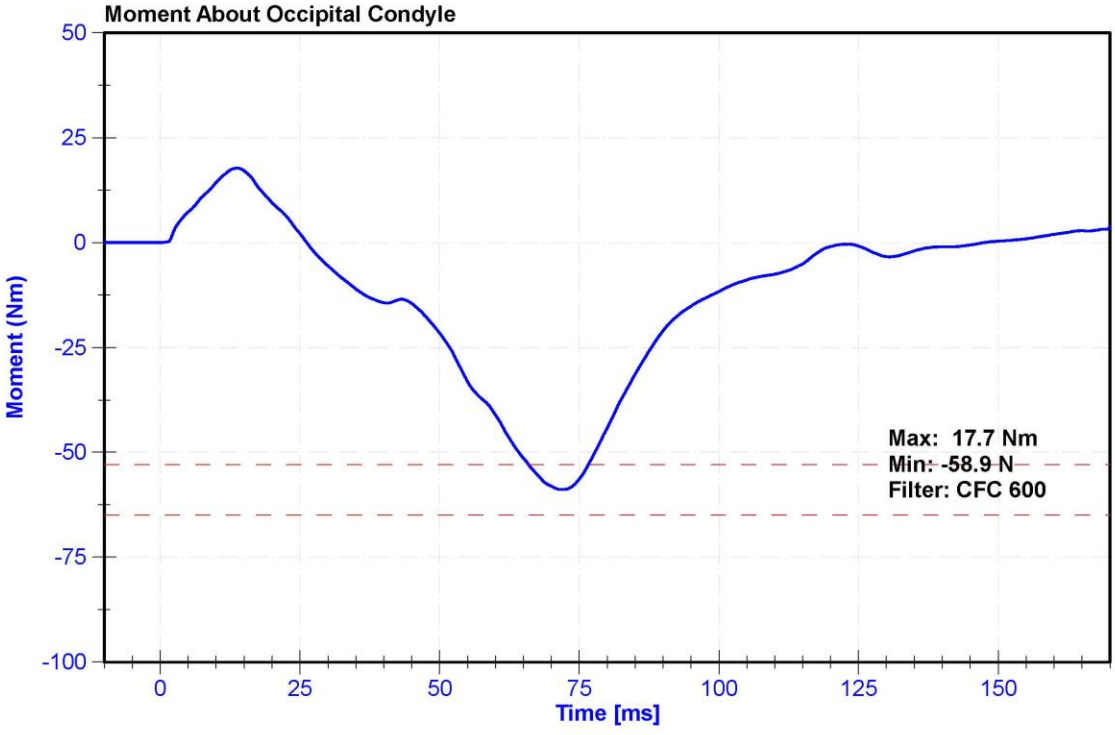
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.9	Pass
Humidity	10	70	%	54.8	Pass
Velocity	5.95	6.19	m/s	6.046	Pass
Pendulum Impulse at 10ms	1.5	1.9	m/s	1.72	Pass
Pendulum Impulse at 20ms	3.1	3.9	m/s	3.49	Pass
Pendulum Impulse at 30ms	4.6	5.6	m/s	5.17	Pass
D Plane Rotation	99	114	deg	107.3	Pass
Moment During Rotation Interval	-65	-53	Nm	-58.9	Pass
Moment Decay to -10Nm	94	114	ms	102.6	Pass

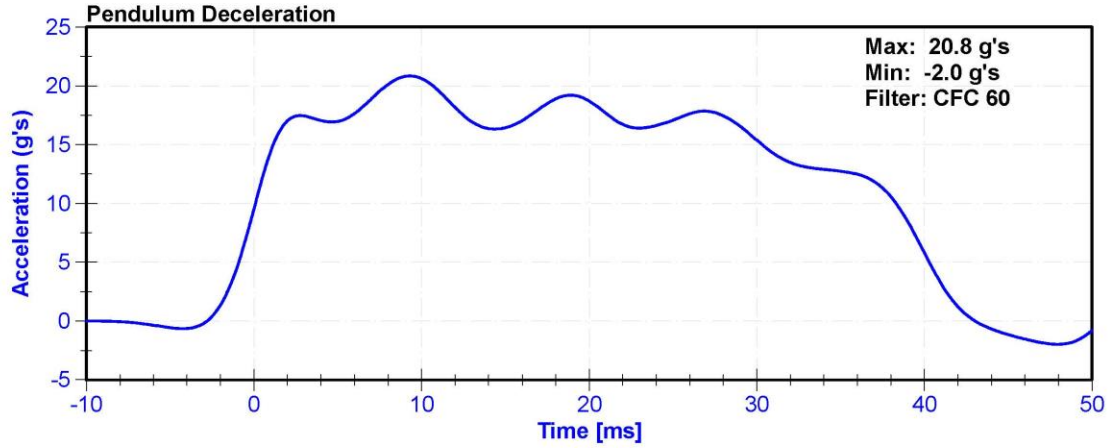
Transducer Calibrations

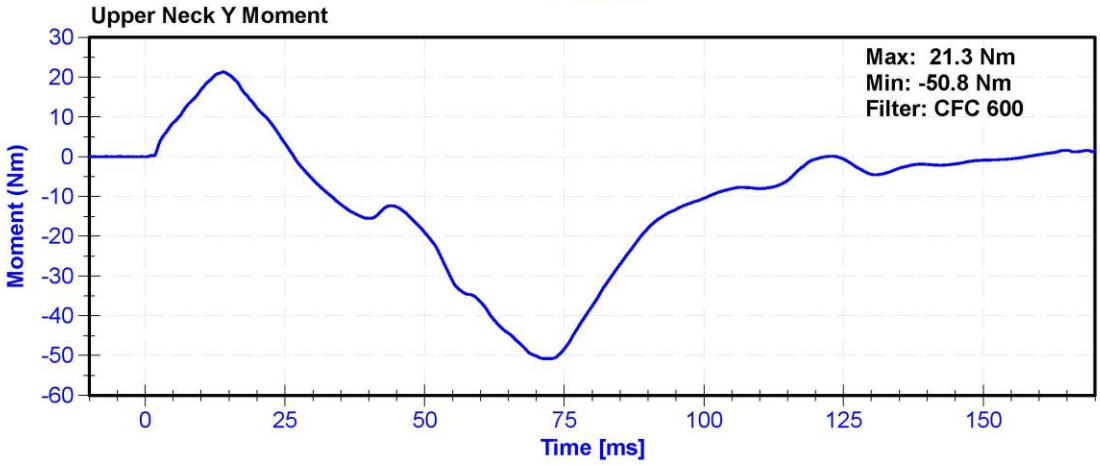
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-AH5M9 Pend	1/29/2019	1/29/2020
Pendulum Potentiometer	ETI SP22G	DS-LABPOT1	11/15/2018	11/15/2019
Condyle Potentiometer	ETI SP22G	DS-LABPOT2	11/15/2018	11/15/2019
Upper Neck Load Cell	DENTON 1716A	LC-1591Fx	9/28/2018	9/28/2019

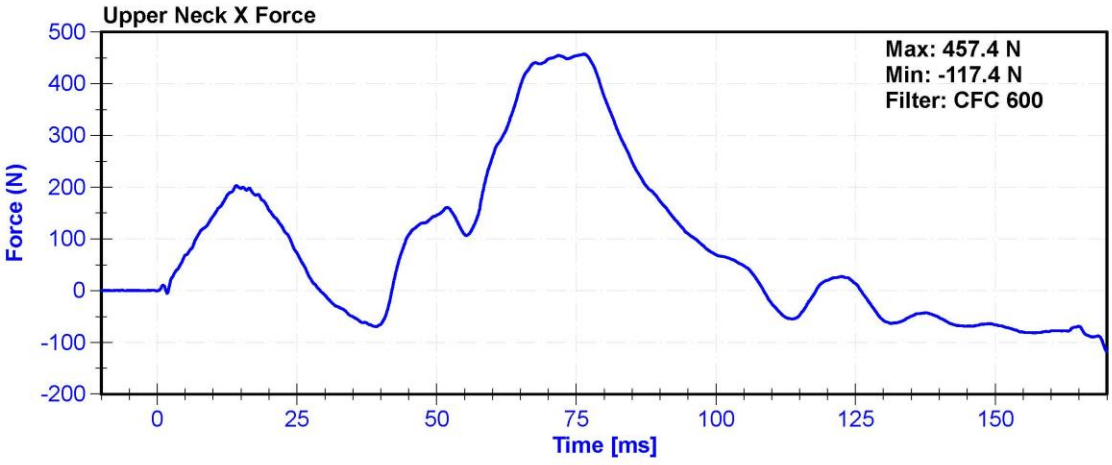



D-Plane Rotation
Rotation (deg)
125
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]
Max: 107.3 deg
Min: -4.5 deg
Filter: CFC 60


Moment About Occipital Condyle
Moment (Nm)
50
25
0
-25
-50
-75
-100
0
25
50
75
100
125
150
Time [ms]
Max: 17.7 Nm
Min: -58.9 N
Filter: CFC 600


Pendulum Deceleration
Max: 20.8 g's
Min: -2.0 g's
Filter: CFC 60
Acceleration (g's)
Time [ms]


Upper Neck Y Moment
Max: 21.3 Nm
Min: -50.8 Nm
Filter: CFC 600
Moment (Nm)
Time [ms]


Upper Neck X Force
Max: 457.4 N
Min: -117.4 N
Filter: CFC 600
Force (N)
Time [ms]

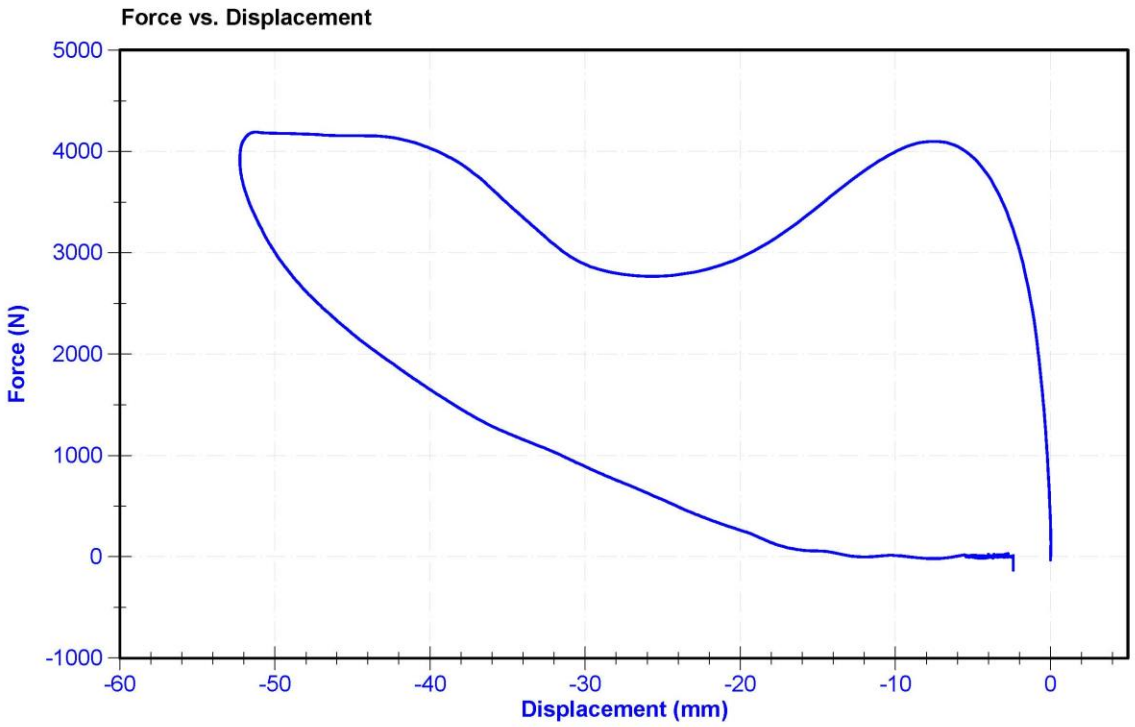
ATD Manufacturer	FTSS	Test Technician	K. Dutton
ATD Serial Number	288	Laboratory Supervisor	K. Brogan

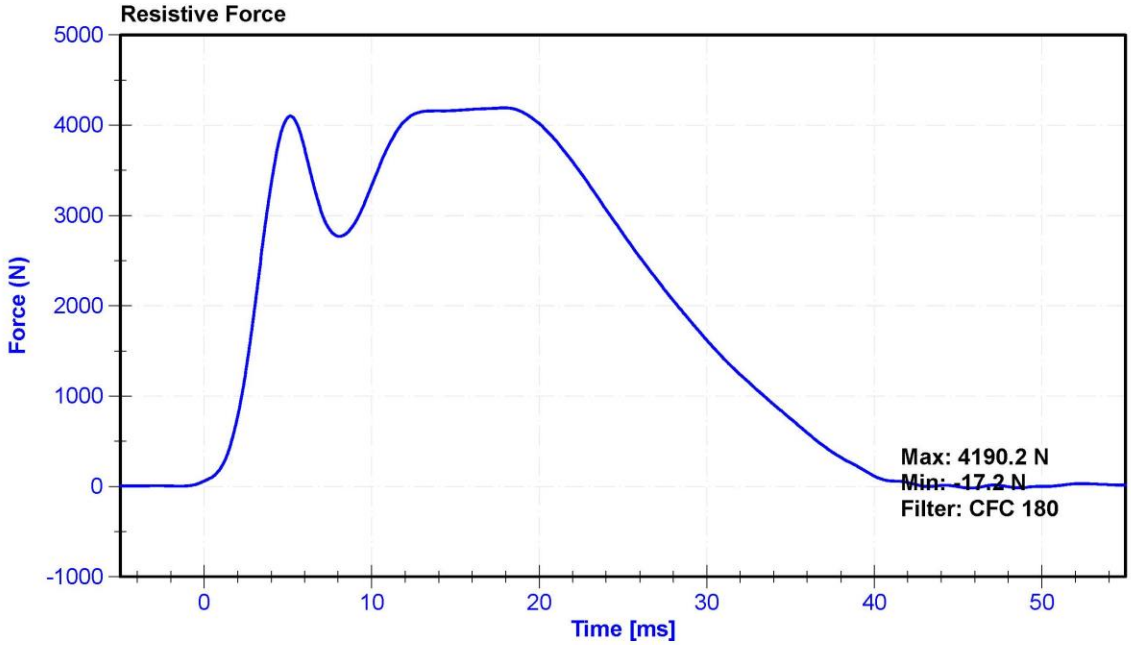
Results

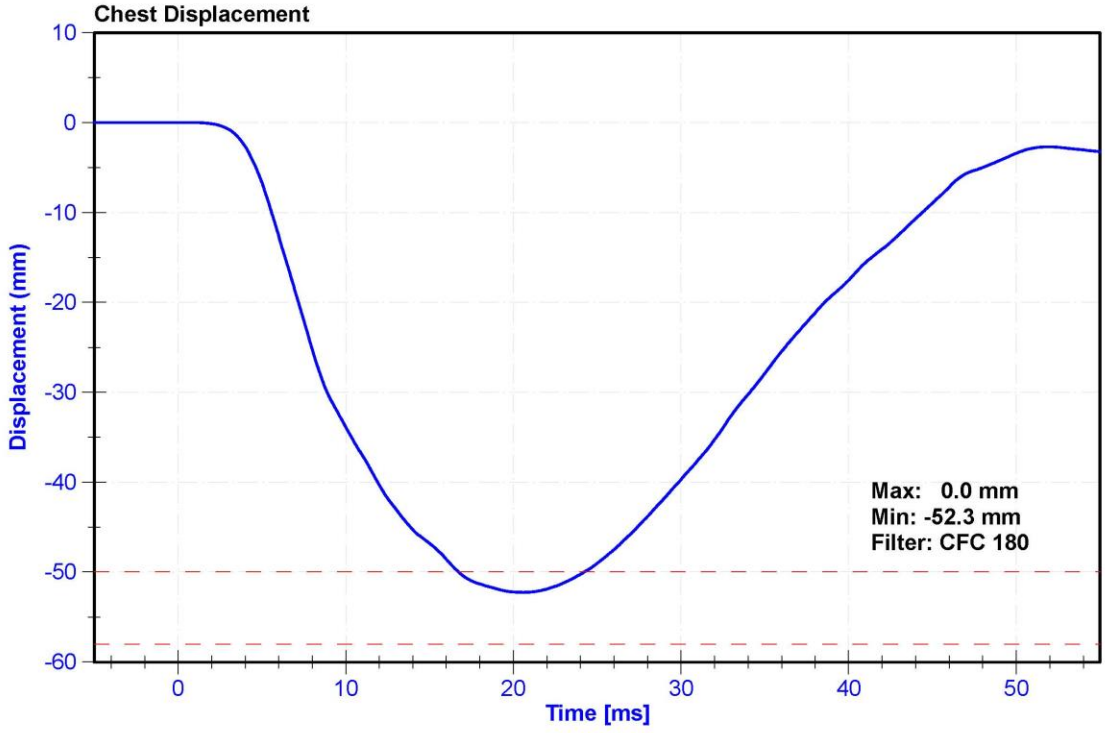
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.6	Pass
Humidity	10	70	%	58	Pass
Velocity	6.59	6.83	m/s	6.655	Pass
Chest Deflection	-58	-50	mm	-52.3	Pass
Maximum Resistive Force (50 to 58mm)	3900	4400	N	4190.2	Pass
Maximum Resistive Force (18 to 50mm)	0	4600	N	4179.3	Pass
Hysteresis	69	85	%	73.5	Pass

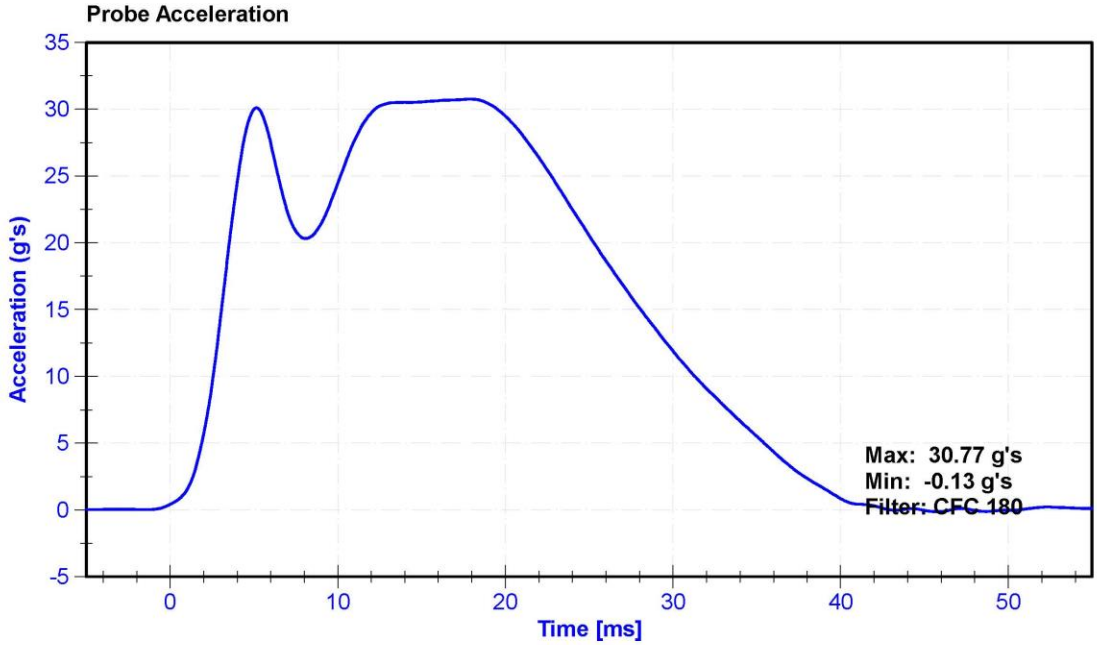
Transducer Calibrations

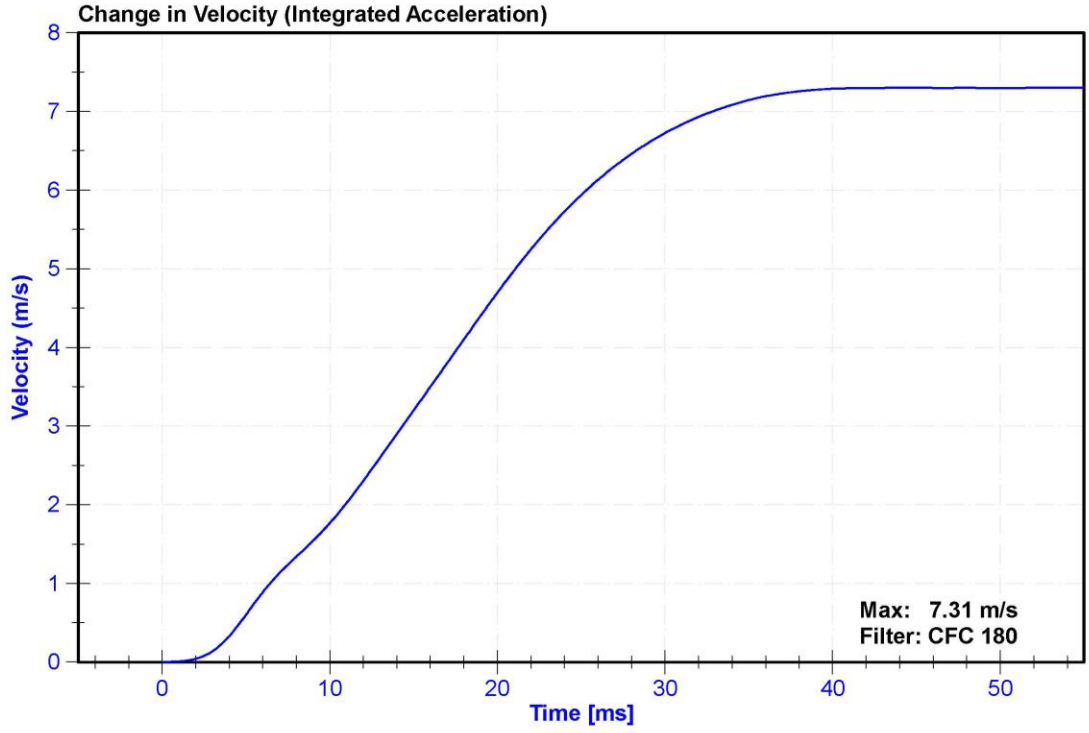
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7264CT	AC-P71278	12/14/2018	12/14/2019
Chest Potentiometer	SERVO 14CBI-3615	DS-140GFE	6/21/2019	6/20/2020




Resistive Force
5000
4000
3000
2000
1000
0
-1000
Force (N)
0
10
20
30
40
50
Time [ms]
Max: 4190.2 N
Min: -17.2 N
Filter: CFC 180


Chest Displacement
10
0
-10
-20
-30
-40
-50
-60
Displacement (mm)
0
10
20
30
40
50
Time [ms]
Max: 0.0 mm
Min: -52.3 mm
Filter: CFC 180


Probe Acceleration
Acceleration (g's)
35
30
25
20
15
10
5
0
-5
0
10
20
30
40
50
Time [ms]
Max: 30.77 g's
Min: -0.13 g's
Filter: CFC 180


Change in Velocity (Integrated Acceleration)
Velocity (m/s)
8
7
6
5
4
3
2
1
0
0
10
20
30
40
50
Time [ms]
Max: 7.31 m/s
Filter: CFC 180

ATD Manufacturer	FTSS	Test Technician	D.Reinhard
ATD Serial Number	288	Laboratory Supervisor	K. Brogan

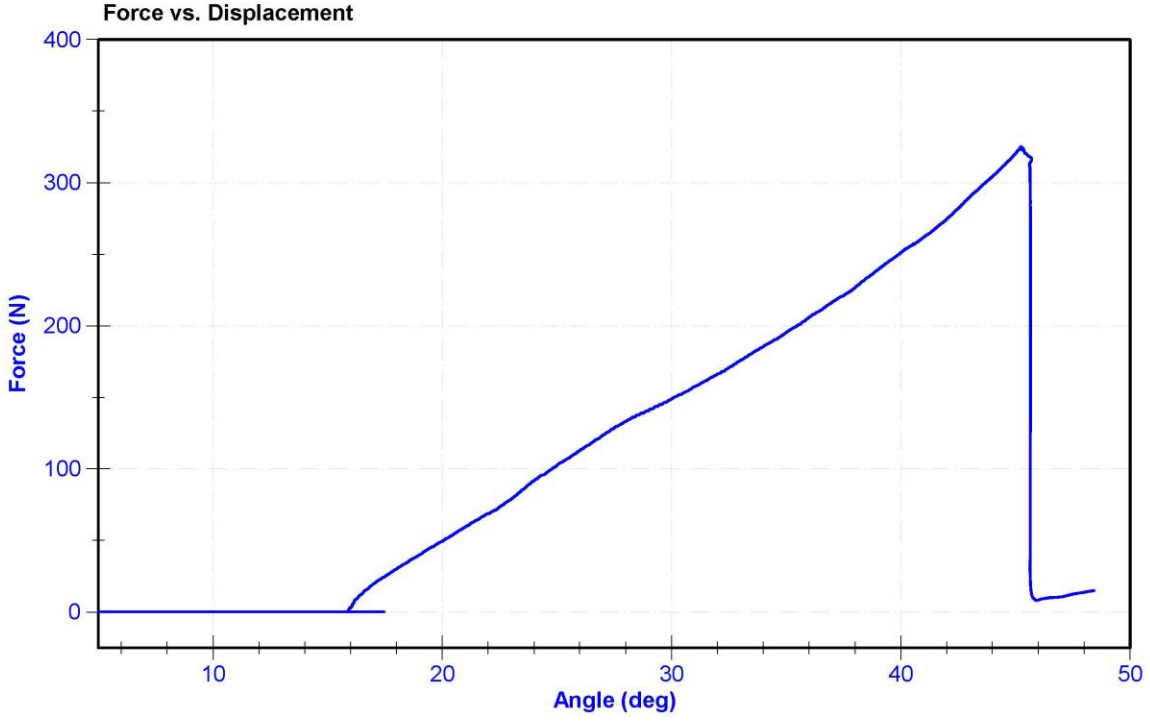
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.6	25.6	ºC	21.5	Pass
Humidity	10	70	%	56	Pass
Initial Angle	0	20	deg	15.8	Pass
Force at 45 Degrees	320	390	N	325.2	Pass
Return Angle Relative to Initial	0	8	deg	2.9	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	Rieker N4C-1	DS-13051548	2018-10-25	2019-10-25
Load Cell	Interface SML-200	LC-493319	2018-10-25	2019-10-25

Force vs. Displacement



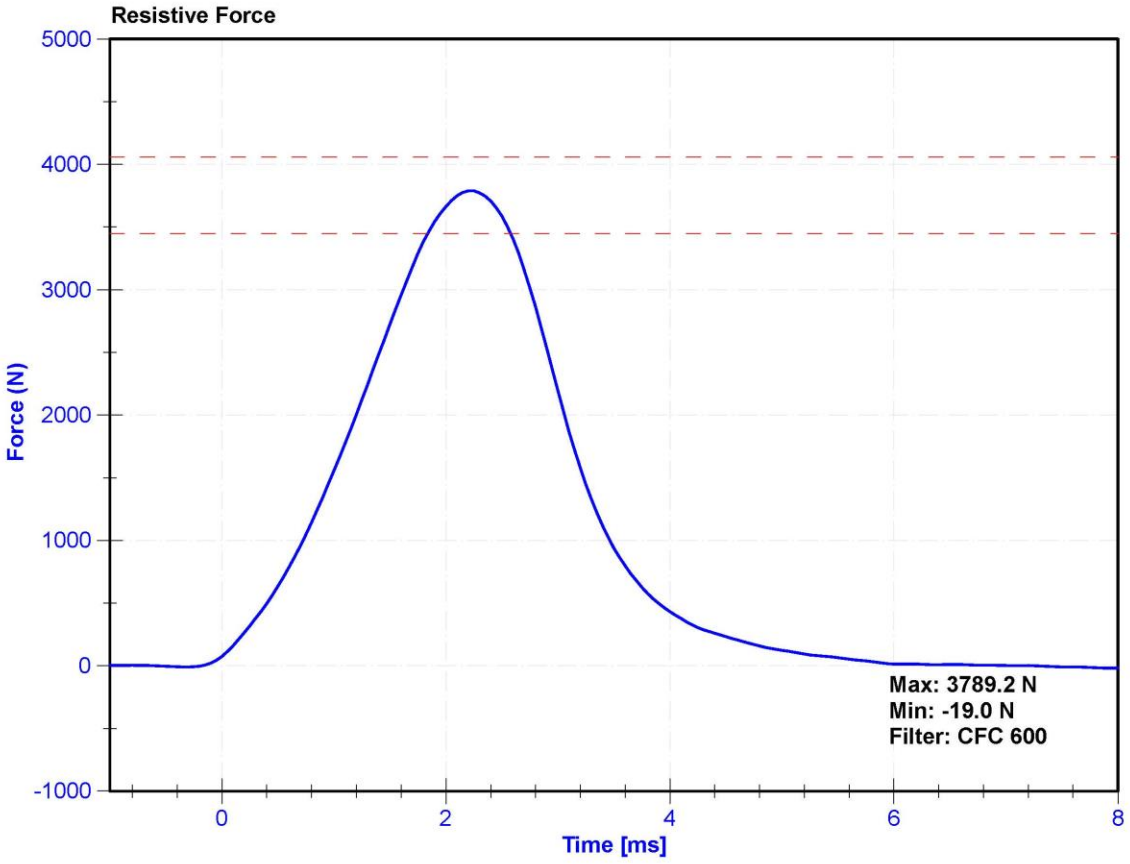
ATD Manufacturer	FTSS	Test Technician	D.Reinhard
ATD Serial Number	288	Laboratory Supervisor	K.Brogan

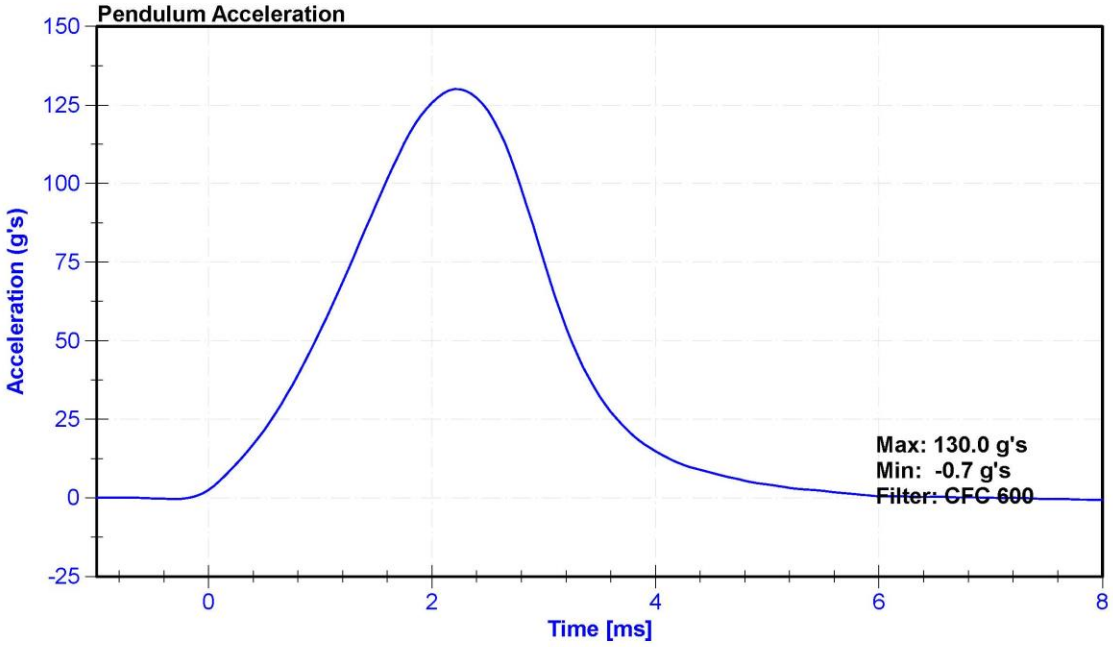
Results

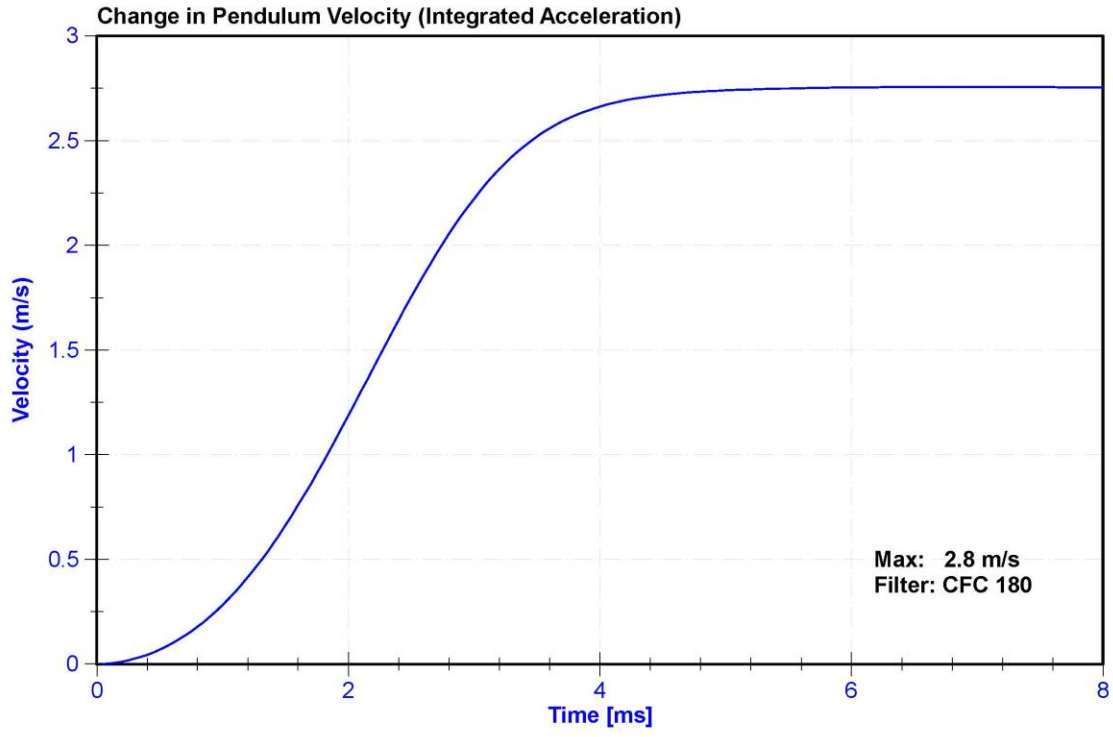
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.5	Pass
Humidity	10	70	%	54.0	Pass
Velocity	2.07	2.13	m/s	2.101	Pass
Resistive Force	3450	4060	N	3789.2	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A260487	2/21/2019	8/22/2019




Pendulum Acceleration
Acceleration (g's)
150
125
100
75
50
25
0
-25
0
2
4
6
8
Time [ms]
Max: 130.0 g's
Min: -0.7 g's
Filter: CFC 600


Change in Pendulum Velocity (Integrated Acceleration)
Velocity (m/s)
3
2.5
2
1.5
1
0.5
0
0
2
4
6
8
Time [ms]
Max: 2.8 m/s
Filter: CFC 180

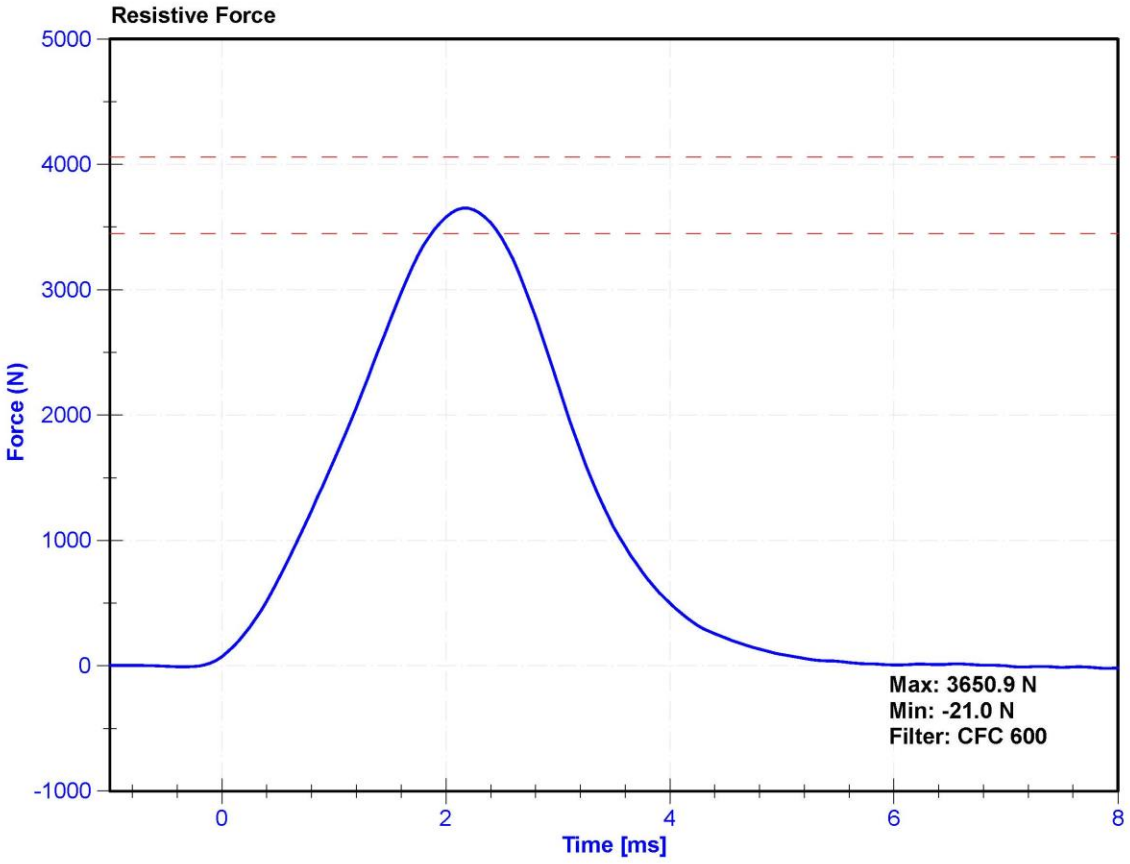
ATD Manufacturer	FTSS	Test Technician	D.Reinhard
ATD Serial Number	288	Laboratory Supervisor	K.Brogan

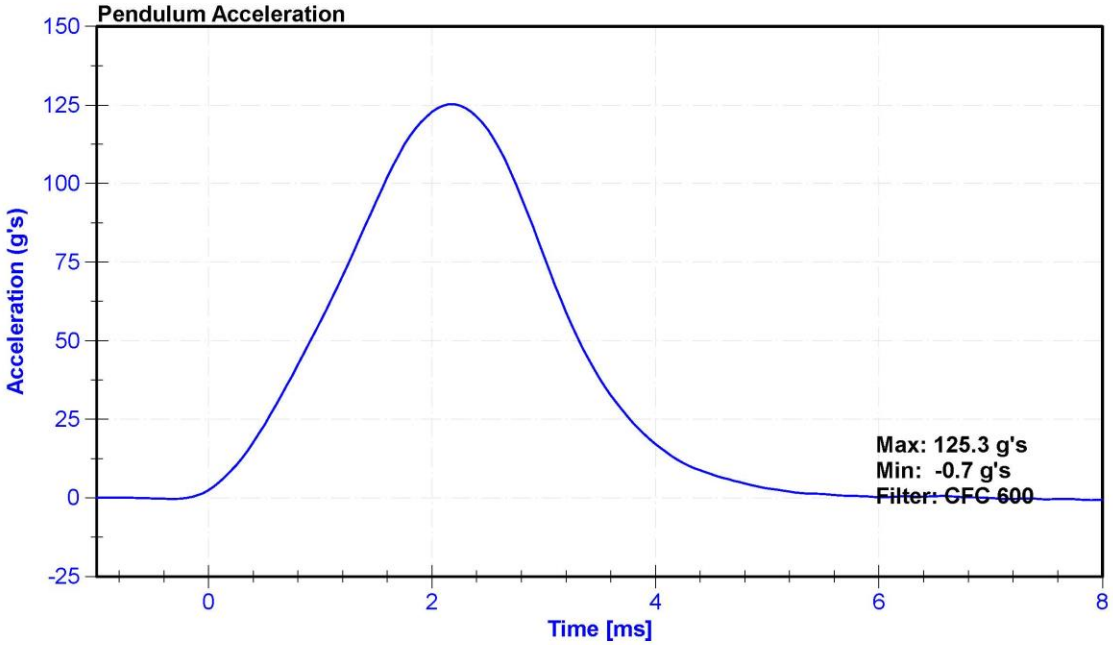
Results

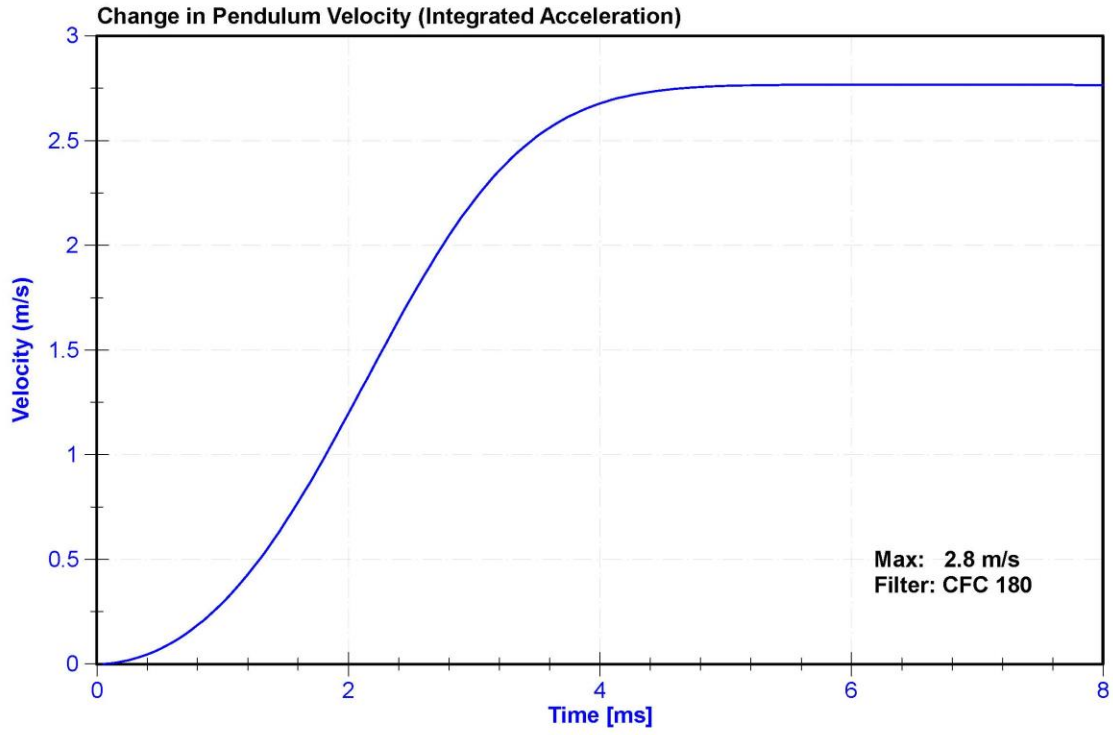
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.1	Pass
Humidity	10	70	%	56.0	Pass
Velocity	2.07	2.13	m/s	2.099	Pass
Resistive Force	3450	4060	N	3650.9	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A260487	2/21/2019	8/22/2019




Pendulum Acceleration
Acceleration (g's)
150
125
100
75
50
25
0
-25
0
2
4
6
8
Time [ms]
Max: 125.3 g's
Min: -0.7 g's
Filter: CFC 600


Change in Pendulum Velocity (Integrated Acceleration)
Velocity (m/s)
3
2.5
2
1.5
1
0.5
0
0
2
4
6
8
Time [ms]
Max: 2.8 m/s
Filter: CFC 180

CALIBRATION TEST RESULTS

POST-TEST

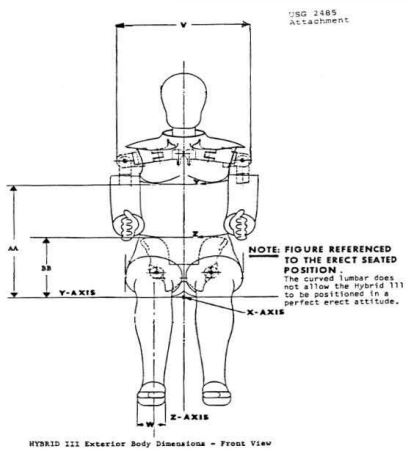
HYBRID III 50TH PERCENTILE MALE - DRIVER ATD

SERIAL NO: 142

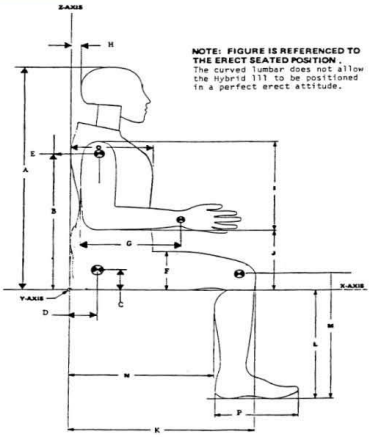
External Measurements - Hybrid 3 - 50th Male

Technician: K. Dutton Date: 07/19/2019

Dummy Serial Number: 142



HYBRID III Exterior Body Dimensions - Front View



HYBRID III Exterior Body Dimensions - Side View

Symbol	Description	Specification (in)		Result (in)	Pass/Fail
A	Sitting Height	34.6	35.0	34.8	Pass
B	Shoulder Pivot Height	19.9	20.5	20.2	Pass
C	H-Point Height	3.3	3.5	3.4	Pass
D	H-Point from Backline	5.3	5.5	5.4	Pass
E	Shoulder Pivot from Backline	3.3	3.7	3.5	Pass
F	Thigh Clearance	5.5	6.1	5.8	Pass
G	Back of Elbow to Wrist Pivot	11.4	12.0	11.6	Pass
H	Head Back to Backline	1.6	1.8	1.7	Pass
I	Shoulder to Elbow Length	13.0	13.6	13.5	Pass
J	Elbow Rest Height	7.5	8.3	8.1	Pass
K	Buttock to Knee Length	22.8	23.8	23.4	Pass
L	Popliteal Height	16.9	17.9	17.4	Pass
M	Knee Pivot Height	19.1	19.7	19.4	Pass
N	Buttock Popliteal Length	17.8	18.8	18.4	Pass
O	Chest Depth without Jacket	8.4	9.0	8.7	Pass
P	Foot Length (right)	9.9	10.5	10.3	Pass
V	Shoulder Breadth	16.3	17.2	16.8	Pass
W	Foot Breadth	3.6	4.2	3.9	Pass
Y	Chest Circumference with Jacket	38.2	39.4	38.9	Pass
Z	Waist Circumference	32.9	34.1	33.7	Pass
AA	Reference Location (Chest Circumference)	16.9	17.1	17.0	Pass
BB	Reference Location (Waist Circumference)	8.9	9.1	9.0	Pass

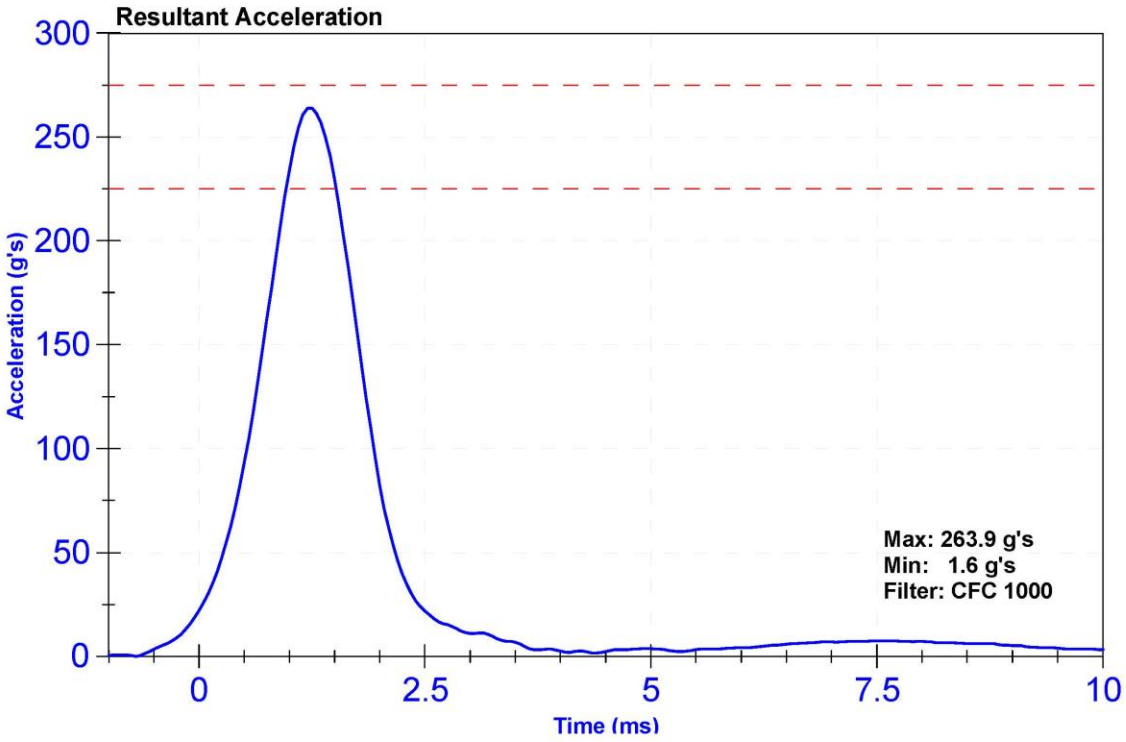
ATD Manufacturer	Humanetics	Test Technician	E. Helenbrook
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

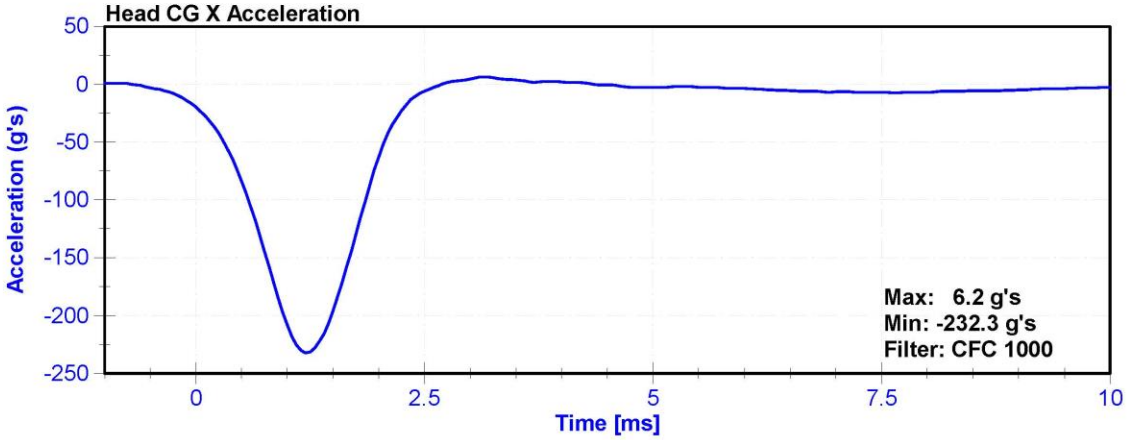
Results

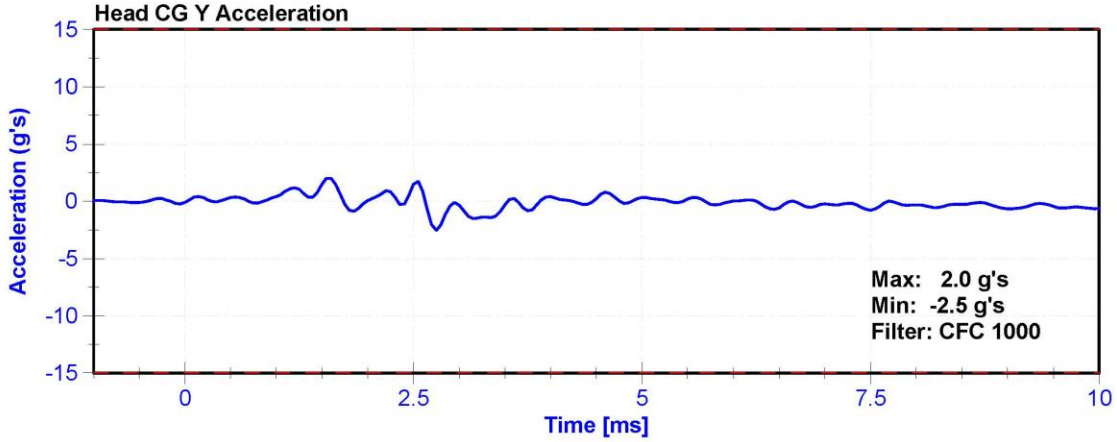
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.4	Pass
Humidity	10	70	%	56.8	Pass
Resultant Acceleration	225	275	g's	263.9	Pass
Oscillation	0	10	%	4.2	Pass
Lateral Acceleration	-15	15	g's	-2.5	Pass

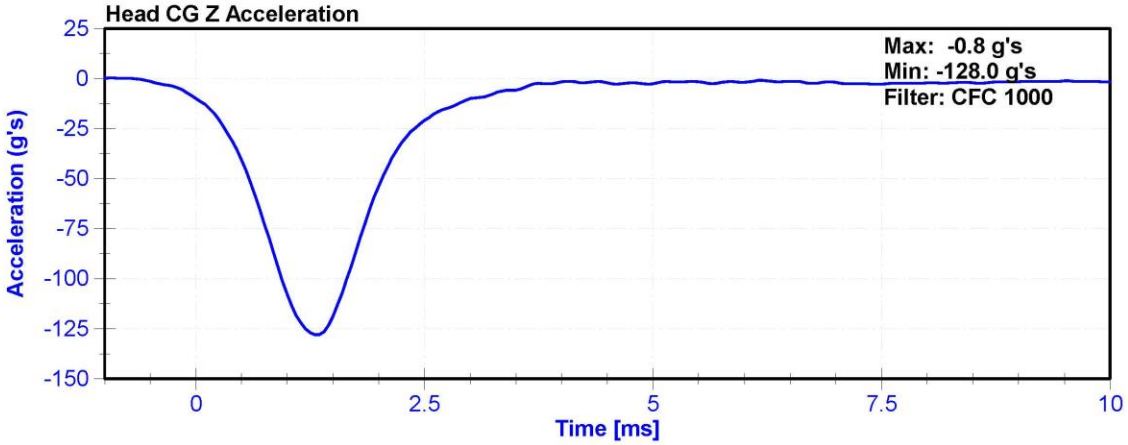
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	ENDEVCO 7264CT	P58998	4/19/2019	4/18/2020
Y Accelerometer	ENDEVCO 7264CT	P51722	4/19/2019	4/18/2020
Z Accelerometer	ENDEVCO 7264CT	P58997	4/19/2019	4/18/2020




Head CG X Acceleration
Acceleration (g's)
50
0
-50
-100
-150
-200
-250
0
2.5
5
7.5
10
Time [ms]
Max: 6.2 g's
Min: -232.3 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: 2.0 g's
Min: -2.5 g's
Filter: CFC 1000


Head CG Z Acceleration
Acceleration (g's)
25
0
-25
-50
-75
-100
-125
-150
0
2.5
5
7.5
10
Time [ms]
Max: -0.8 g's
Min: -128.0 g's
Filter: CFC 1000

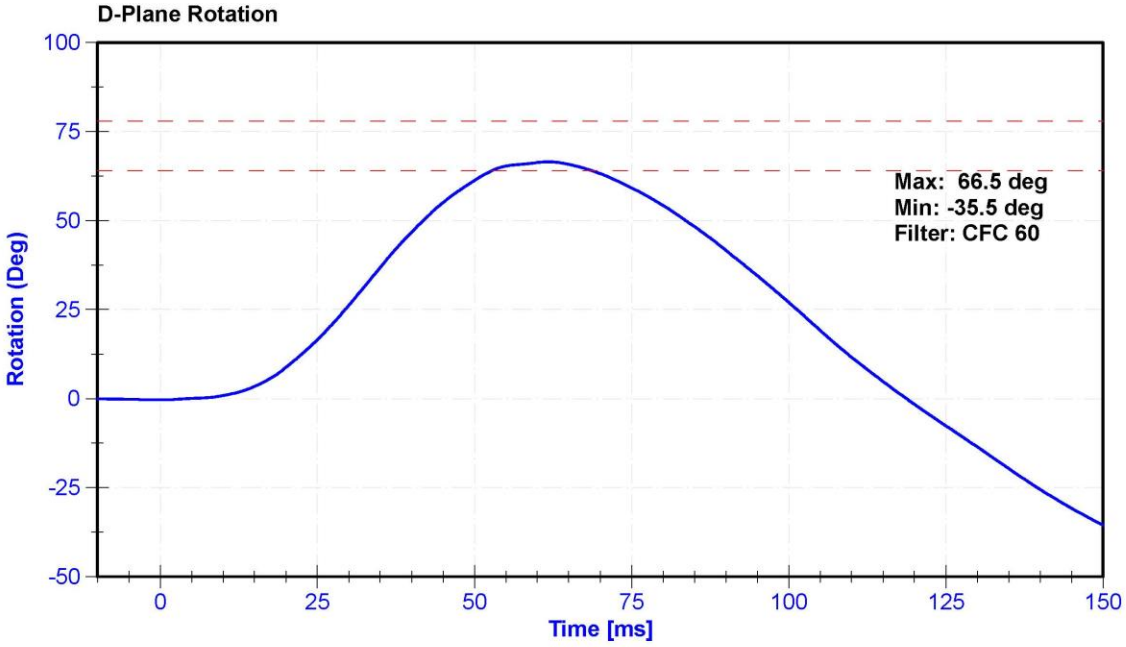
ATD Manufacturer	Humanetics	Test Technician	D.Reinhard
ATD Serial Number	142	Laboratory Supervisor	K.Brogan

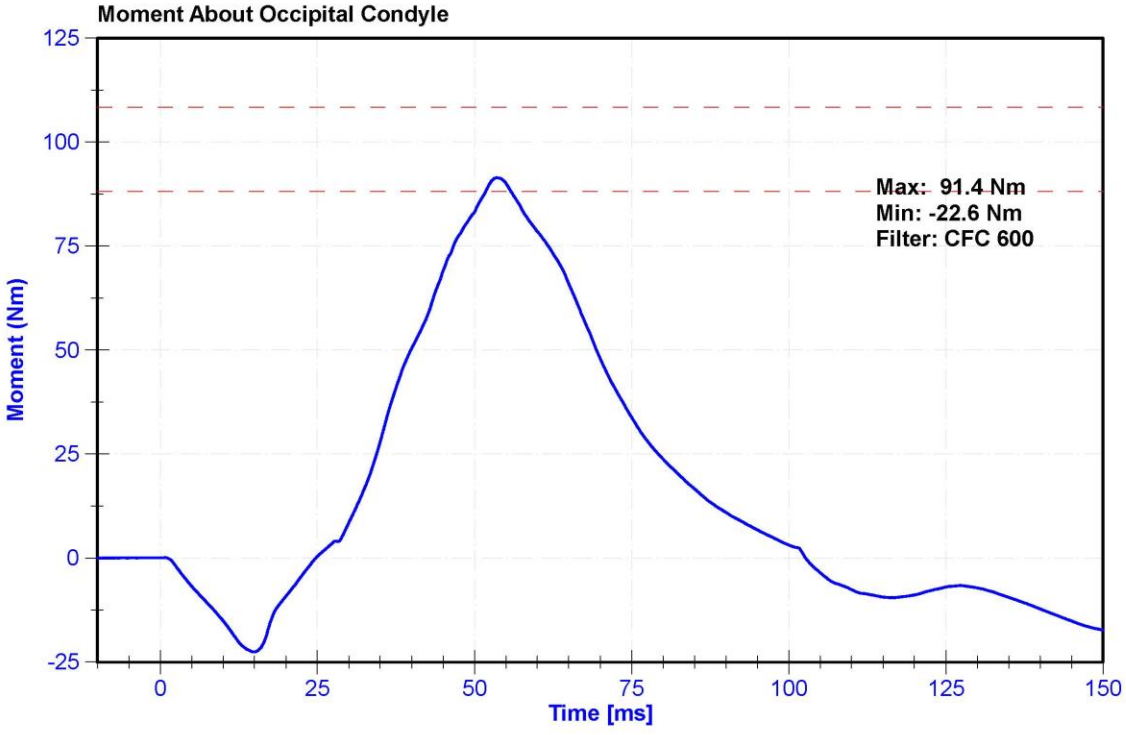
Results

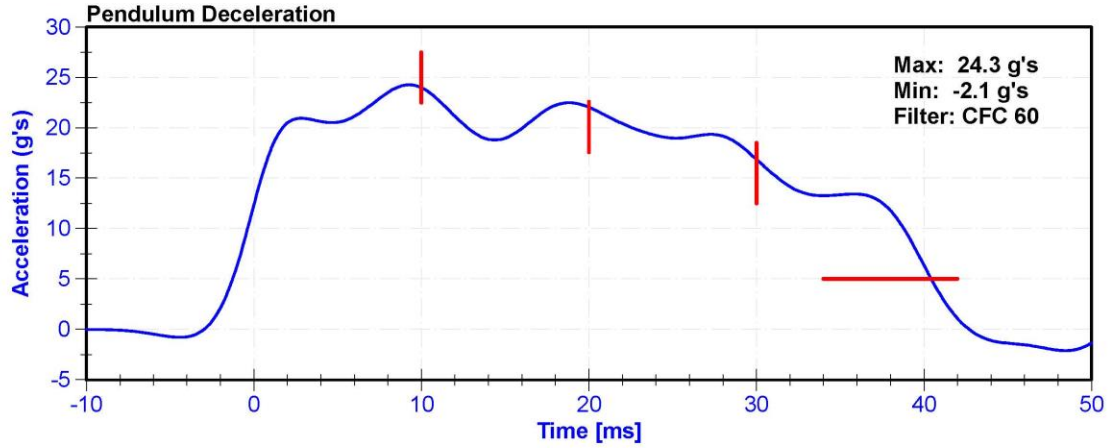
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.8	Pass
Humidity	10	70	%	49.8	Pass
Velocity	6.89	7.13	m/s	6.903	Pass
Pendulum Deceleration at 10ms	22.5	27.5	g's	23.99	Pass
Pendulum Deceleration at 20ms	17.6	22.6	g's	22.04	Pass
Pendulum Deceleration at 30ms	12.5	18.5	g's	16.87	Pass
Max. Pendulum Deceleration After 30ms	0	29	g's	24.3	Pass
Pendulum Deceleration Time to 5 g's	34	42	ms	40.4	Pass
Maximum D Plane Rotation	64	78	deg	66.5	Pass
Time to Maximum Rotation	57	64	ms	61.7	Pass
Rotation Decay to Zero	113	127	ms	118.7	Pass
Moment About Occipital Condyle	88.1	108.4	Nm	91.41	Pass
Time to Maximum Moment	47	58	ms	53.5	Pass
Moment Decay to Zero	97	107	ms	102.7	Pass

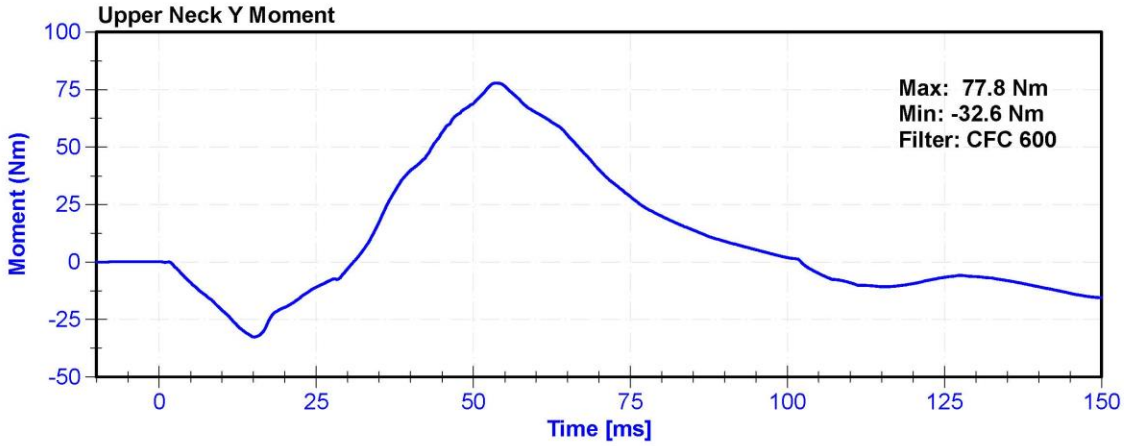
Transducer Calibrations

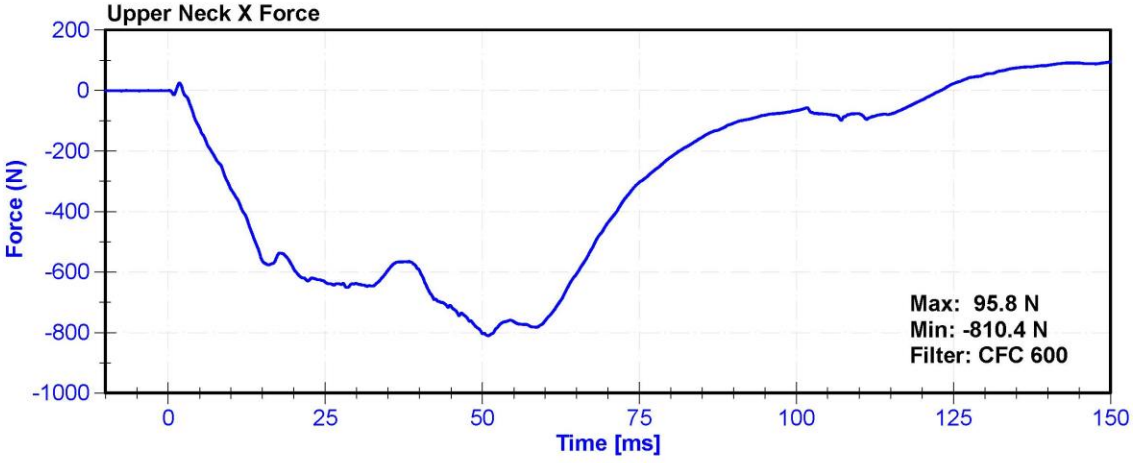
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-AH5M9 Pend	1/29/2019	1/29/2020
Pendulum Potentiometer	ETI SP22G	DS-LABPOT1	11/15/2018	11/15/2019
Condyle Potentiometer	ETI SP22G	DS-LABPOT2	11/15/2018	11/15/2019
Upper Neck Load Cell	FTSS IF-205	LC-161Fx	9/28/2018	9/28/2019


D-Plane Rotation
Rotation (Deg)
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]
Max: 66.5 deg
Min: -35.5 deg
Filter: CFC 60


Moment About Occipital Condyle
Moment (Nm)
125
100
75
50
25
0
-25
0
25
50
75
100
125
150
Time [ms]
Max: 91.4 Nm
Min: -22.6 Nm
Filter: CFC 600


Pendulum Deceleration
Max: 24.3 g's
Min: -2.1 g's
Filter: CFC 60
Acceleration (g's)
Time [ms]


Upper Neck Y Moment
Max: 77.8 Nm
Min: -32.6 Nm
Filter: CFC 600
Moment (Nm)
Time [ms]


Upper Neck X Force
Max: 95.8 N
Min: -810.4 N
Filter: CFC 600
Force (N)
Time [ms]

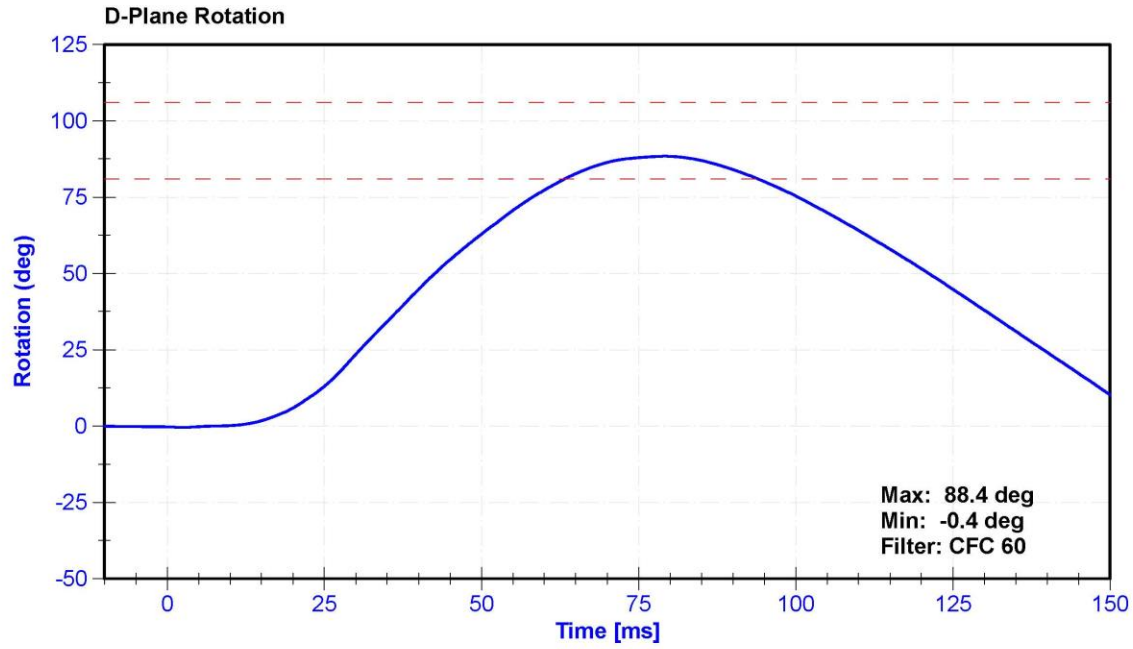
ATD Manufacturer	Humanetics	Test Technician	D.Reinhard
ATD Serial Number	142	Laboratory Supervisor	K.Brogan

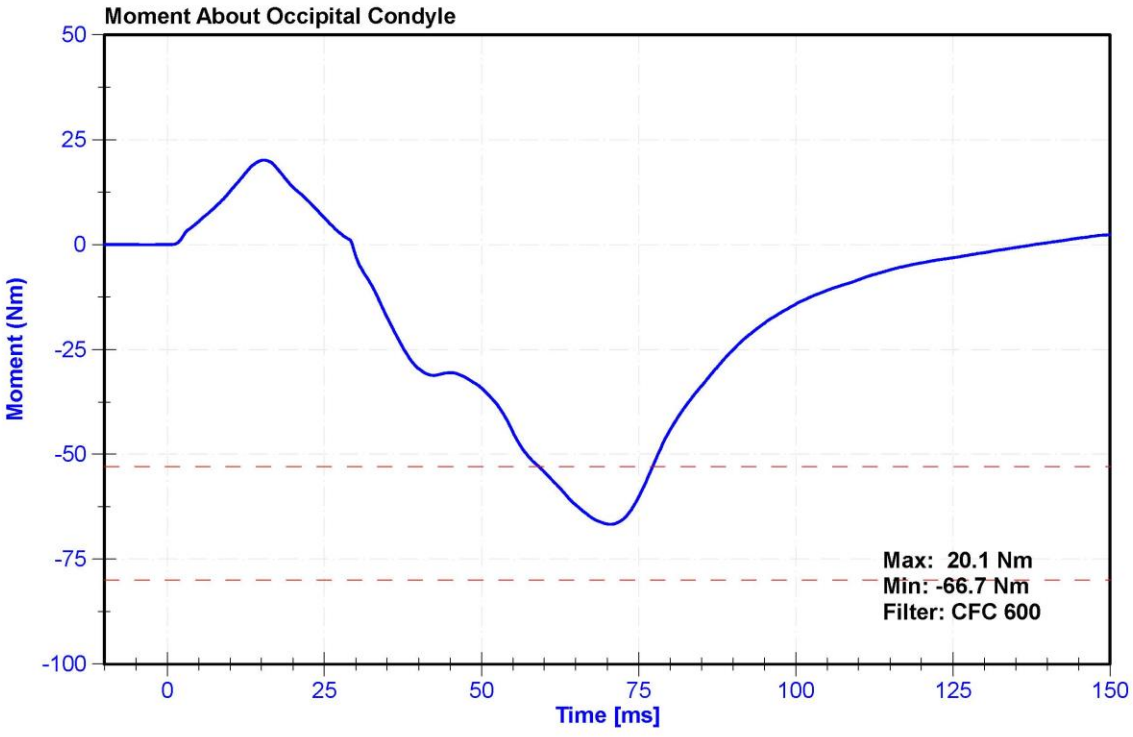
Results

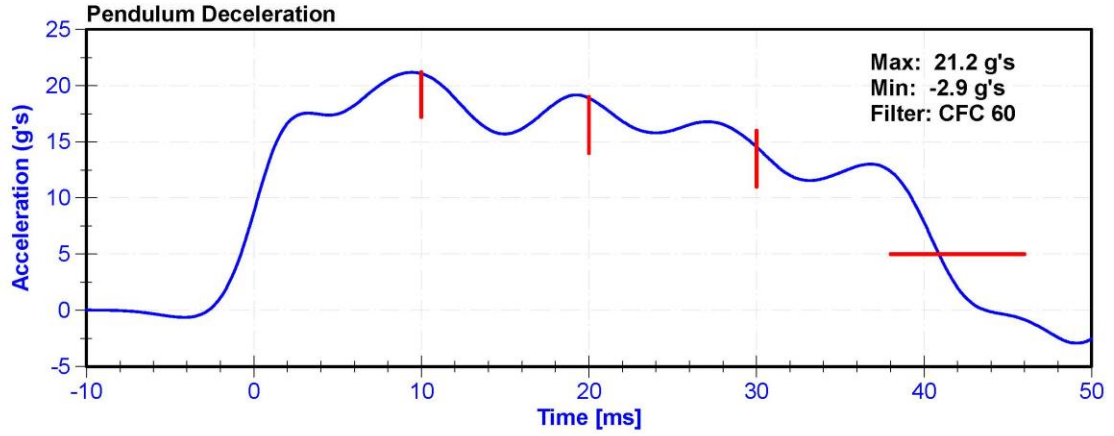
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	22	Pass
Humidity	10	70	%	50.8	Pass
Velocity	5.94	6.19	m/s	5.964	Pass
Pendulum Deceleration at 10ms	17.2	21.2	g's	21.06	Pass
Pendulum Deceleration at 20ms	14	19	g's	18.9	Pass
Pendulum Deceleration at 30ms	11	16	g's	14.6	Pass
Max. Pendulum Deceleration After 30ms	0	22	g's	21.2	Pass
Pendulum Deceleration Time to 5 g's	38	46	ms	40.9	Pass
Maximum D Plane Rotation	81	106	deg	88.4	Pass
Time to Maximum Rotation	72	82	ms	79.2	Pass
Rotation Decay to Zero	147	174	ms	157.1	Pass
Minimum Moment About OC	-80	-52.9	Nm	-66.71	Pass
Time to Minimum Moment	65	79	ms	70.4	Pass
Moment Decay to Zero	120	148	ms	138.0	Pass

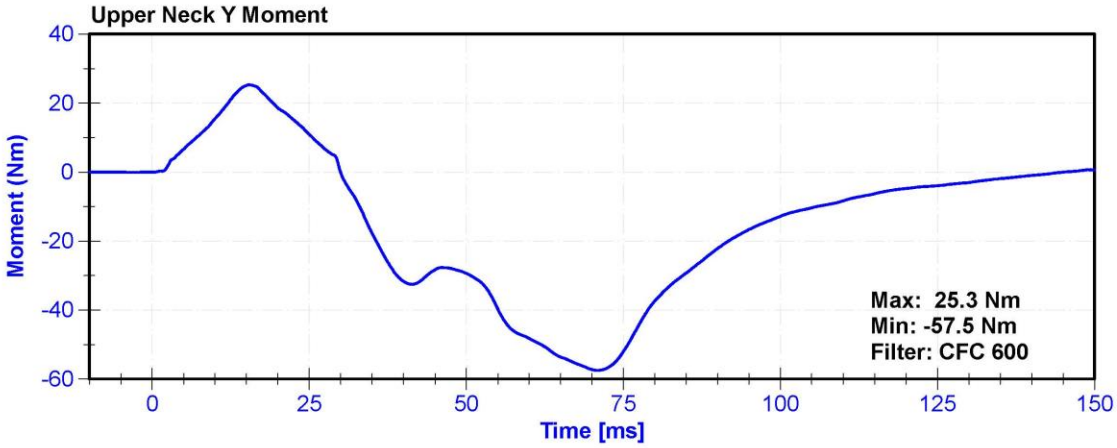
Transducer Calibrations

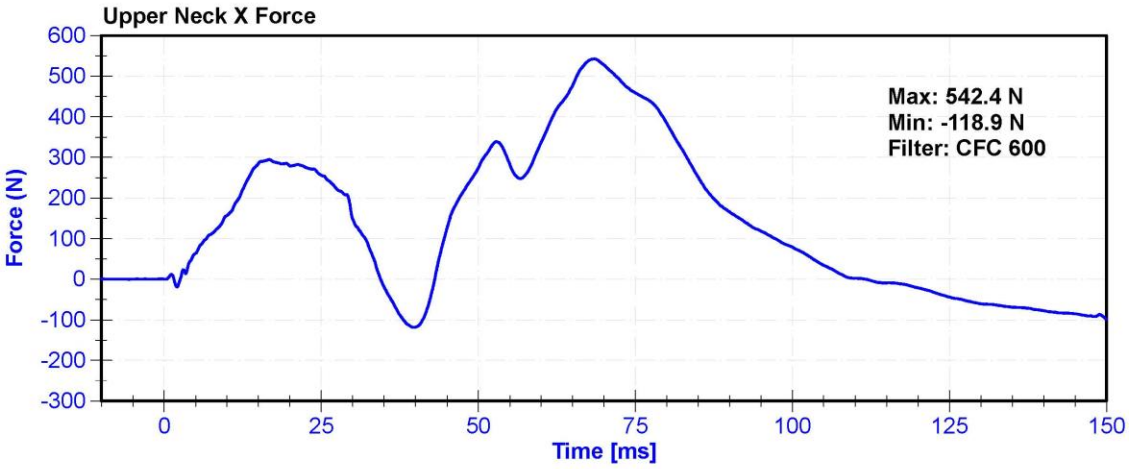
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-AH5M9 Pend	1/29/2019	1/29/2020
Pendulum Potentiometer	ETI SP22G	DS-LABPOT1	11/15/2018	11/15/2019
Condyle Potentiometer	ETI SP22G	DS-LABPOT2	11/15/2018	11/15/2019
Upper Neck Load Cell	FTSS IF-205	LC-161Fx	9/28/2018	9/28/2019


D-Plane Rotation
Rotation (deg)
125
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]
Max: 88.4 deg
Min: -0.4 deg
Filter: CFC 60


Moment About Occipital Condyle
Moment (Nm)
50
25
0
-25
-50
-75
-100
0
25
50
75
100
125
150
Time [ms]
Max: 20.1 Nm
Min: -66.7 Nm
Filter: CFC 600


Pendulum Deceleration
Max: 21.2 g's
Min: -2.9 g's
Filter: CFC 60
Acceleration (g's)
Time [ms]


Upper Neck Y Moment
Max: 25.3 Nm
Min: -57.5 Nm
Filter: CFC 600
Moment (Nm)
Time [ms]


Upper Neck X Force
Max: 542.4 N
Min: -118.9 N
Filter: CFC 600
Force (N)
Time [ms]

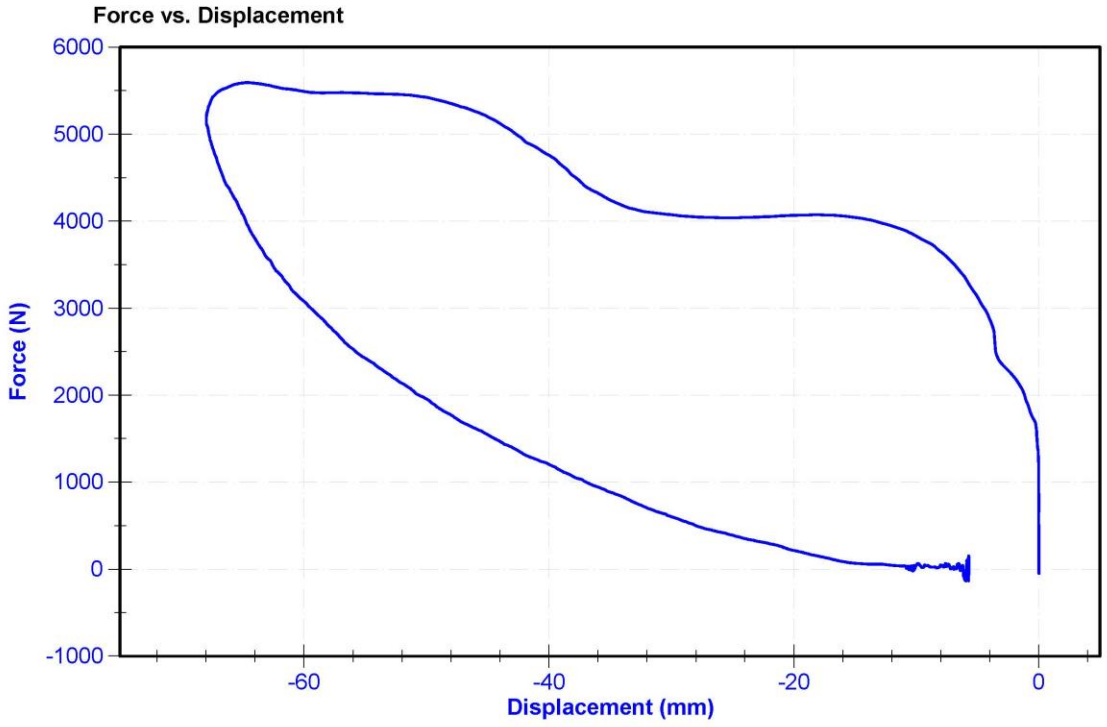
ATD Manufacturer	Humanetics	Test Technician	D.Reinhard
ATD Serial Number	142	Laboratory Supervisor	K.Brogan

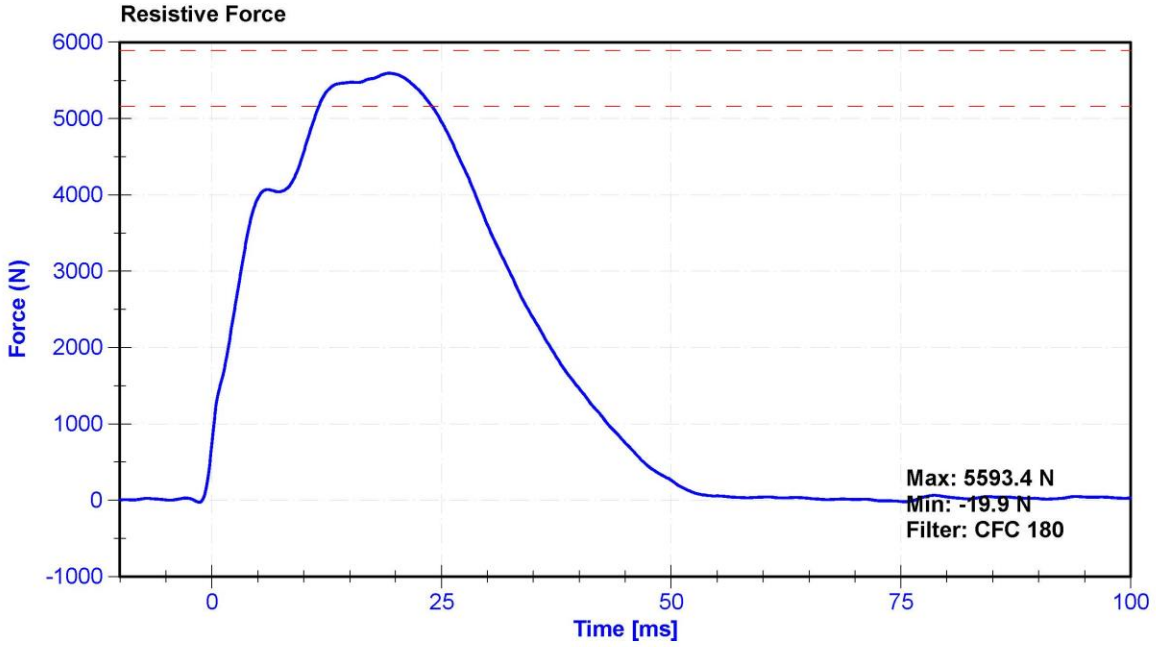
Results

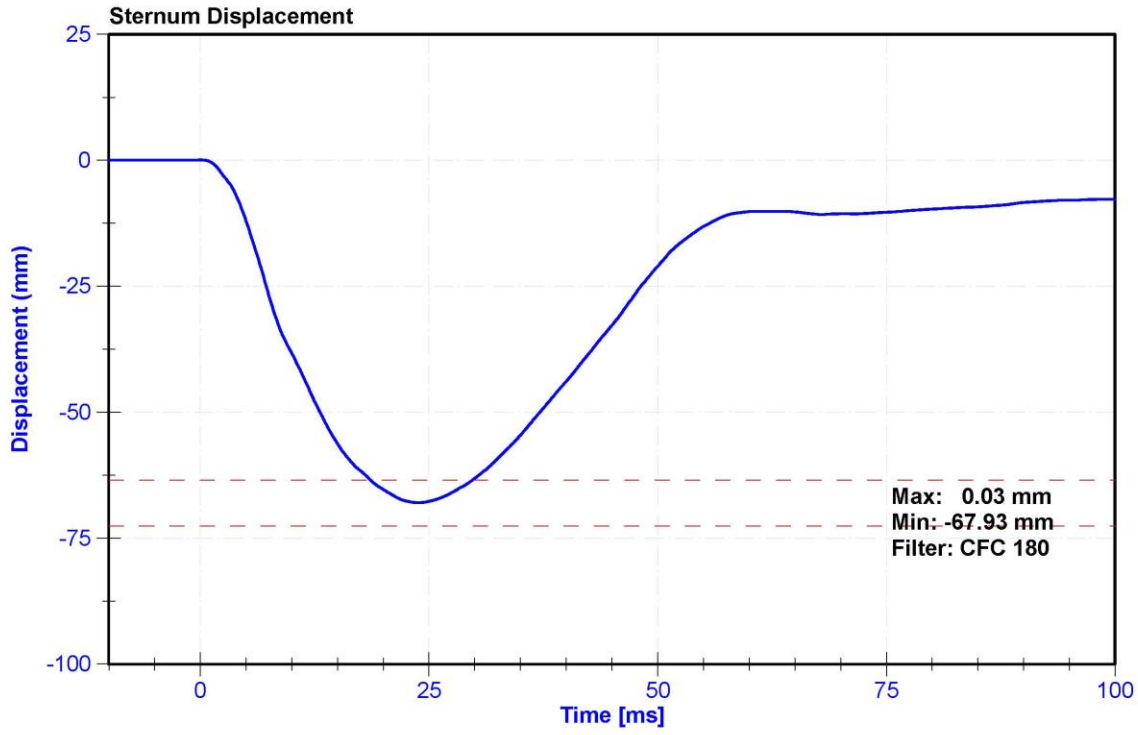
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	22	Pass
Humidity	10	70	%	59	Pass
Velocity	6.59	6.83	m/s	6.612	Pass
Chest Displacement	-72.6	-63.5	mm	-67.93	Pass
Resistive Force	5160	5894	N	5593.4	Pass
Hysteresis	65	85	%	72.0	Pass

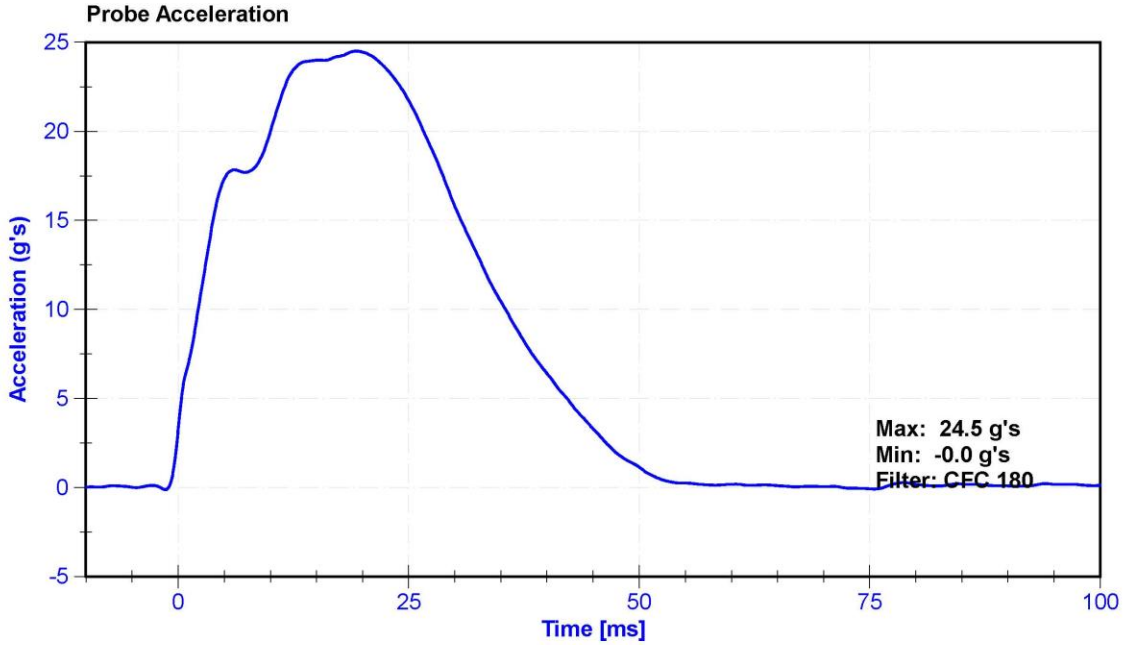
Transducer Calibrations

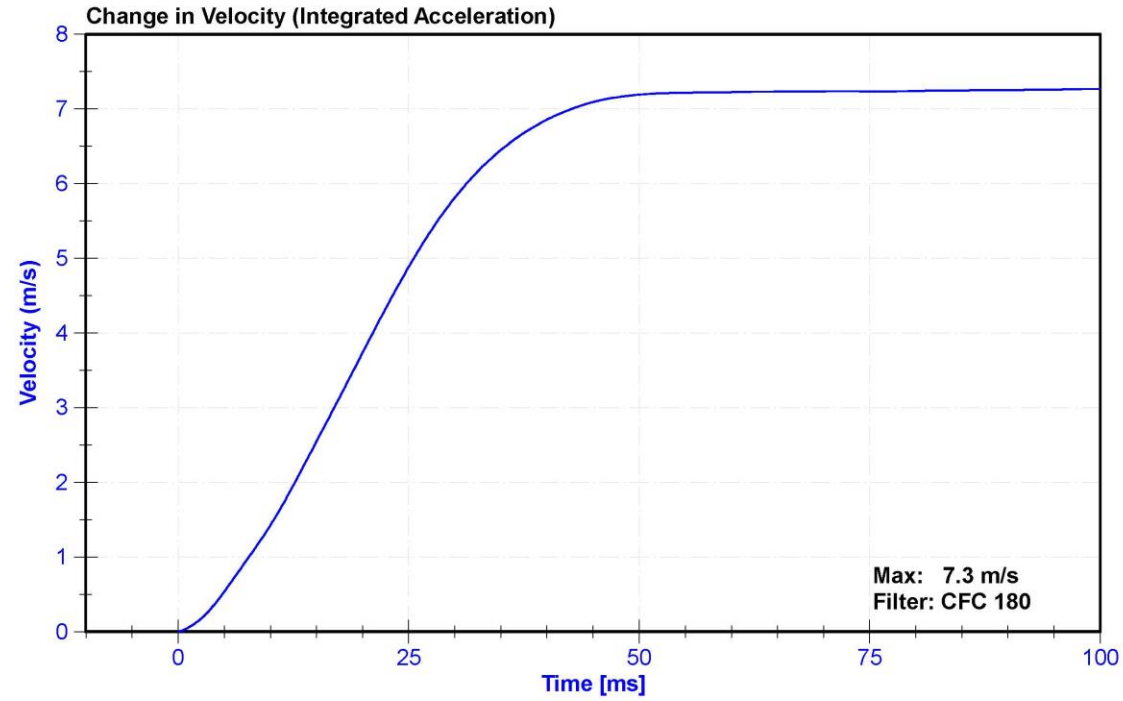
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7264CT	AC-P71278	12/14/2018	12/14/2019
Chest Potentiometer	JDK 6209-2038	DS-142	10/22/2018	10/22/2019




Resistive Force
6000
5000
4000
3000
2000
1000
0
-1000
Force (N)
0
25
50
75
100
Time [ms]
Max: 5593.4 N
Min: -19.9 N
Filter: CFC 180


Sternum Displacement
25
0
-25
-50
-75
-100
Displacement (mm)
0
25
50
75
100
Time [ms]
Max: 0.03 mm
Min: -67.93 mm
Filter: CFC 180


Probe Acceleration
Acceleration (g's)
25
20
15
10
5
0
-5
0
25
50
75
100
Time [ms]
Max: 24.5 g's
Min: -0.0 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: 7.3 m/s
Filter: CFC 180

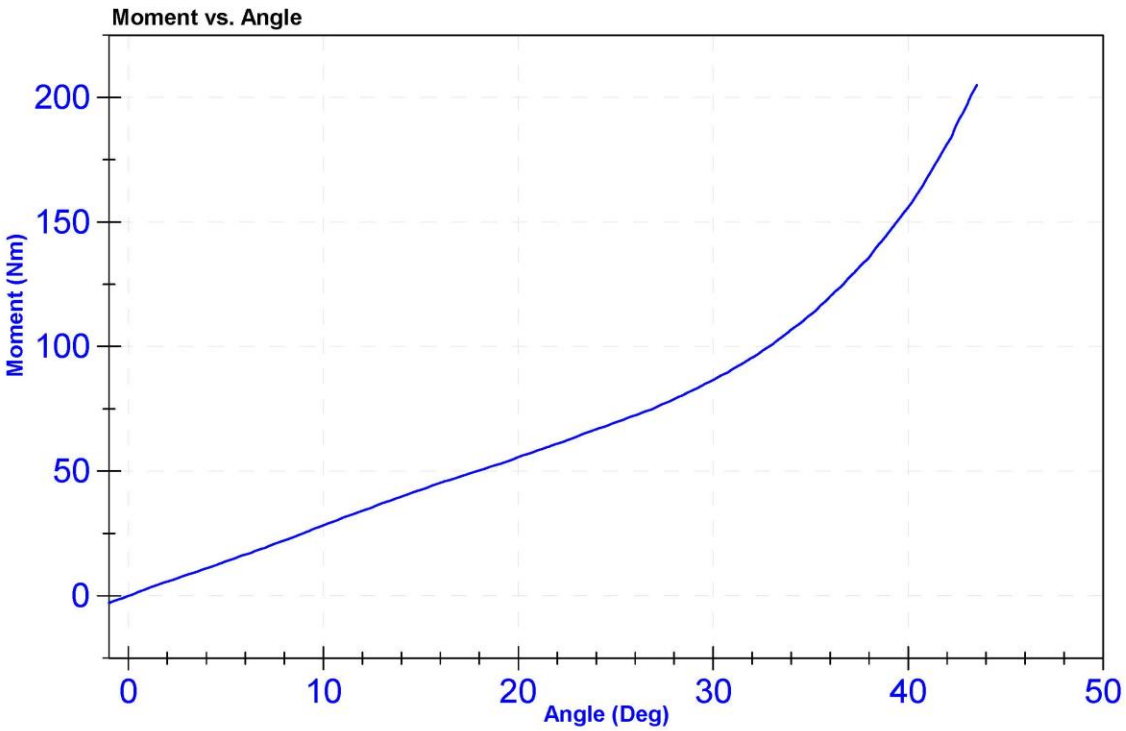
ATD Manufacturer	Humanetics	Test Technician	K. Dutton
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	20.9	Pass
Humidity	10	70	%	45.9	Pass
Average Velocity	5	10	deg/s	7.4	Pass
Angle at 203Nm	40	50	deg	43.4	Pass
Moment at 30 degrees	0	94.9	Nm	86.6	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	ETI SP22	DS-0008	9/18/2018	9/18/2019
Load Cell	Key Trans 2301-02	LC-115 My	9/6/2018	9/6/2019



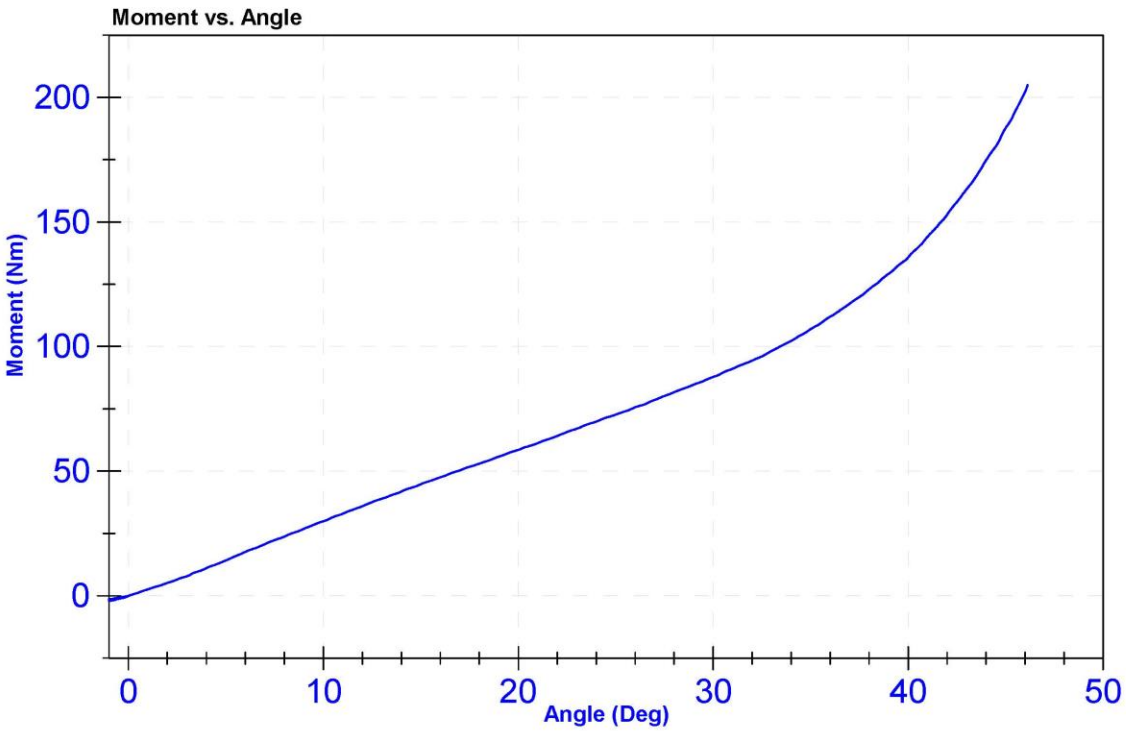
ATD Manufacturer	Humanetics	Test Technician	K. Dutton
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.0	Pass
Humidity	10	70	%	43.9	Pass
Average Velocity	5	10	deg/s	7.5	Pass
Angle at 203Nm	40	50	deg	46.0	Pass
Moment at 30 degrees	0	94.9	Nm	87.9	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	ETI SP22	DS-0008	9/18/2018	9/18/2019
Load Cell	Key Trans 2301-02	LC-115 My	9/6/2018	9/6/2019



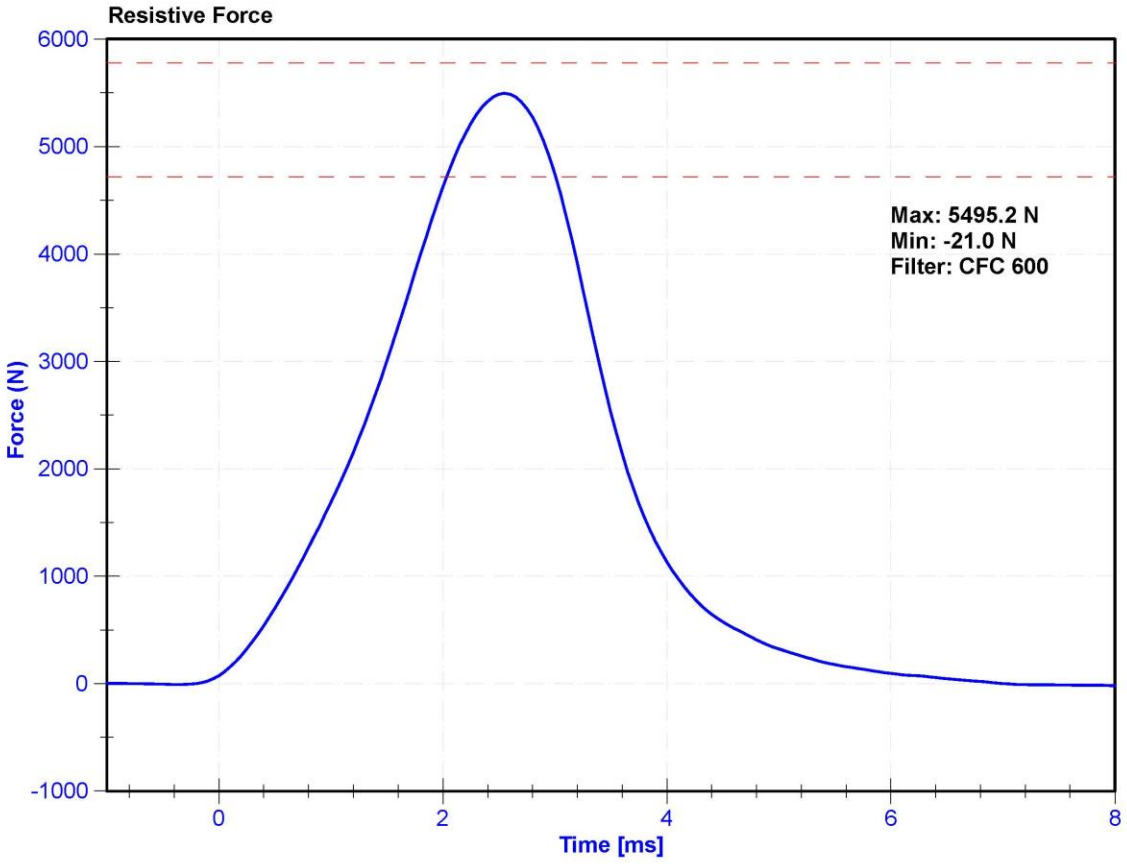
ATD Manufacturer	Humanetics	Test Technician	D.Reinhard
ATD Serial Number	142	Laboratory Supervisor	K.Brogan

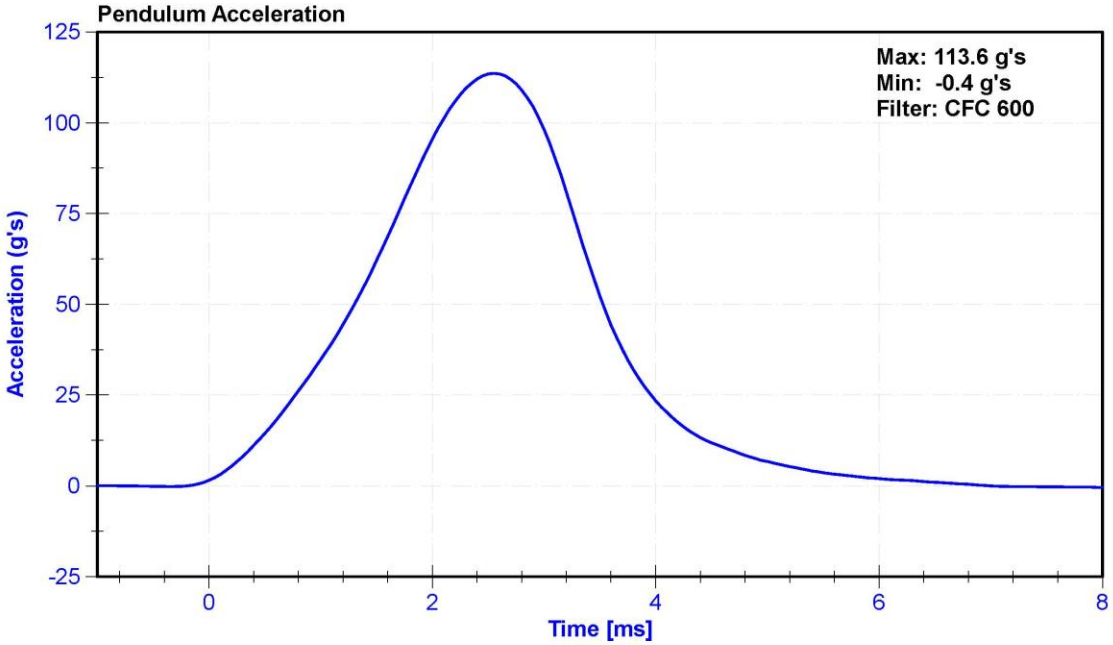
Results

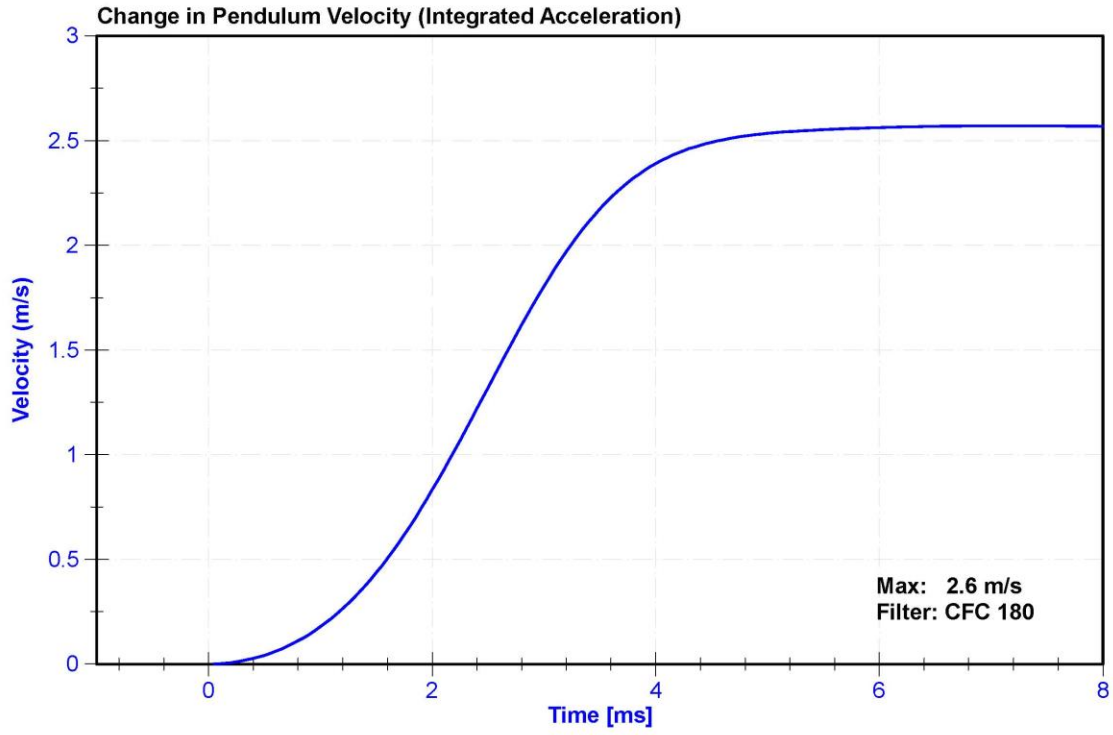
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.1	Pass
Humidity	10	70	%	61	Pass
Velocity	2.07	2.13	m/s	2.102	Pass
Maximum Resistive Force	4720	5780	N	5495.2	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A260487	2/21/2019	8/22/2019




Pendulum Acceleration
Max: 113.6 g's
Min: -0.4 g's
Filter: CFC 600
Acceleration (g's)
125
100
75
50
25
0
-25
0
2
4
6
8
Time [ms]


Change in Pendulum Velocity (Integrated Acceleration)
Velocity (m/s)
3
2.5
2
1.5
1
0.5
0
Max: 2.6 m/s
Filter: CFC 180
0
2
4
6
8
Time [ms]

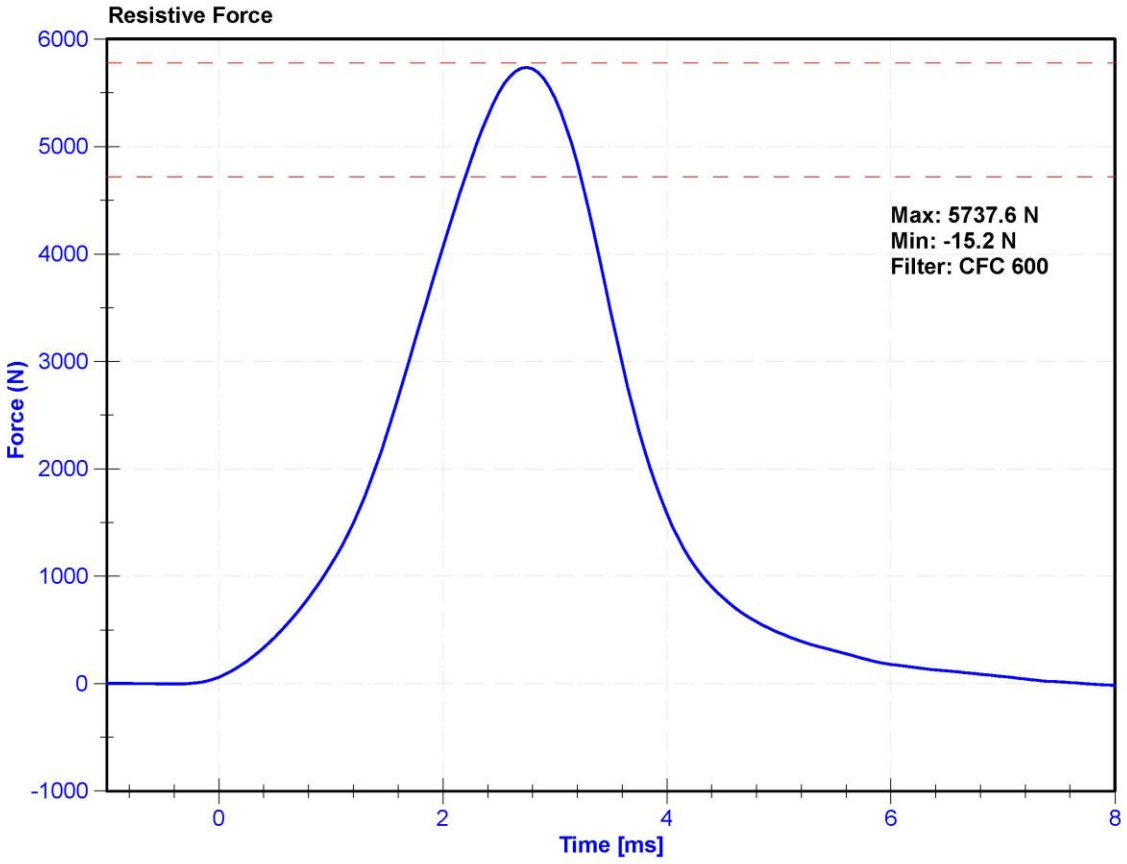
ATD Manufacturer	Humanetics	Test Technician	D.Reinhard
ATD Serial Number	142	Laboratory Supervisor	K.Brogan

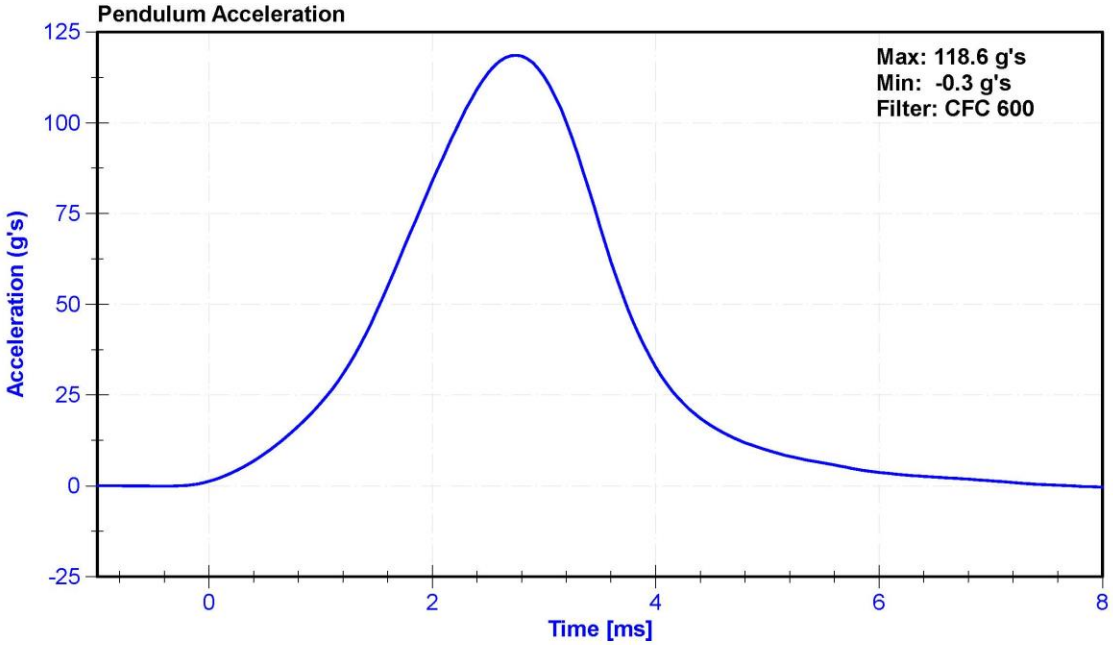
Results

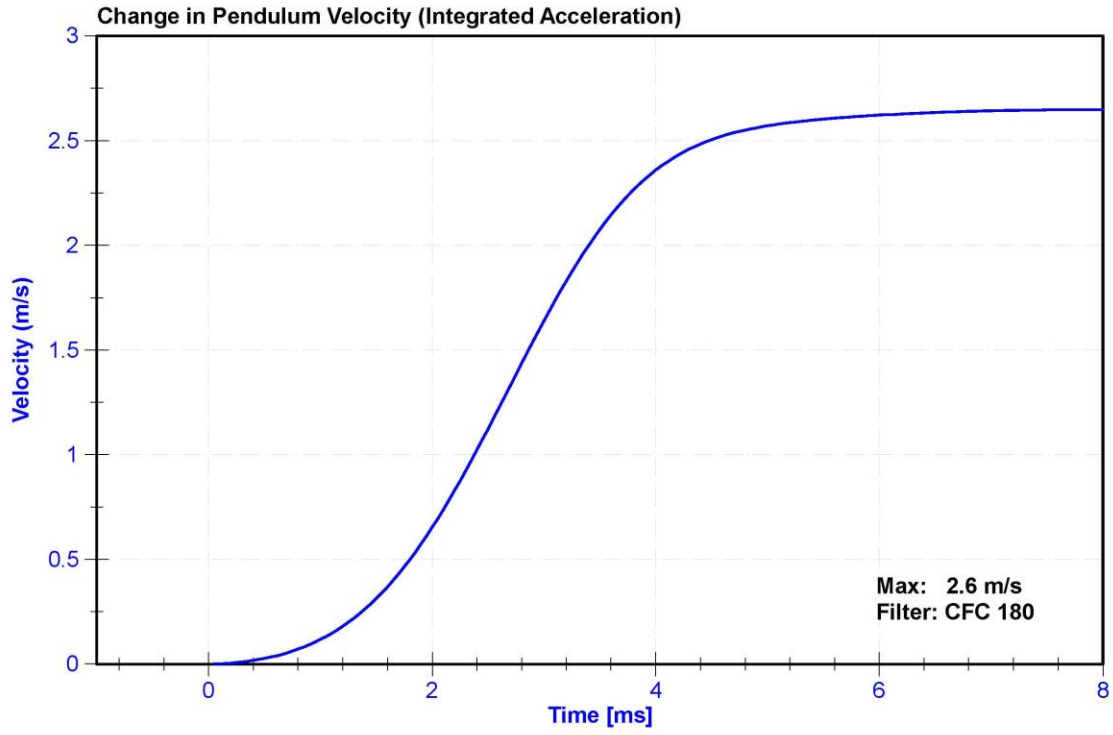
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.1	Pass
Humidity	10	70	%	57.5	Pass
Velocity	2.07	2.13	m/s	2.102	Pass
Maximum Resistive Force	4720	5780	N	5737.6	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A260487	2/21/2019	8/22/2019




Pendulum Acceleration
Max: 118.6 g's
Min: -0.3 g's
Filter: CFC 600
Acceleration (g's)
125
100
75
50
25
0
-25
0
2
4
6
8
Time [ms]


Change in Pendulum Velocity (Integrated Acceleration)
Velocity (m/s)
3
2.5
2
1.5
1
0.5
0
Max: 2.6 m/s
Filter: CFC 180
0
2
4
6
8
Time [ms]

CALIBRATION TEST RESULTS

POST-TEST

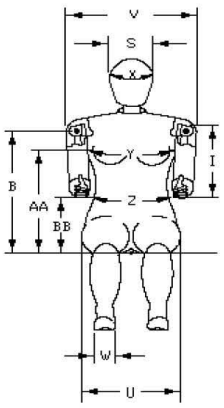
HYBRID III 5TH PERCENTILE FEMALE - PASSENGER ATD

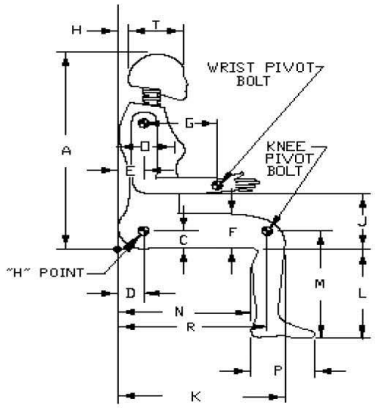
SERIAL NO: 288

External Measurements - Hybrid 3 - 5th Female

Technician: K. Dutton Date: 07/19/2019

Dummy Serial Number: 288





Symbol	Description	Specification (mm)		Result (mm)	Pass/Fail
A	Sitting Height	775	800	787	Pass
B	Shoulder Pivot Height	432	457	450	Pass
C	H-Point Height	81	86	84	Pass
D	H-Point from Backline	145	150	148	Pass
E	Shoulder Pivot from Backline	69	84	77	Pass
F	Thigh Clearance	119	135	126	Pass
G	Back of Elbow to Wrist Pivot	244	259	256	Pass
H	Head Back to Backline	43	48	45	Pass
I	Shoulder to Elbow Length	277	297	284	Pass
J	Elbow Rest Height	183	203	192	Pass
K	Buttock to Knee Length	521	546	538	Pass
L	Popliteal Height	356	376	365	Pass
M	Knee Pivot Height	394	419	407	Pass
N	Buttock Popliteal Length	414	439	429	Pass
O	Chest Depth without Jacket	175	191	180	Pass
P	Foot Length (right)	219	234	221	Pass
R	Buttock To Knee Pivot Length	457	483	465	Pass
S	Head Breadth	137	147	142	Pass
T	Head Depth	178	188	183	Pass
U	Hip Breadth	300	315	310	Pass
V	Shoulder Breadth	351	366	361	Pass
W	Foot Breadth	79	94	85	Pass
X	Head Circumference	528	549	537	Pass
Y	Chest Circumference with Jacket	851	881	865	Pass
Z	Waist Circumference	460	790	777	Pass
AA	Reference Location (Chest Circumference)	333	358	345	Pass
BB	Reference Location (Waist Circumference)	160	170	164	Pass

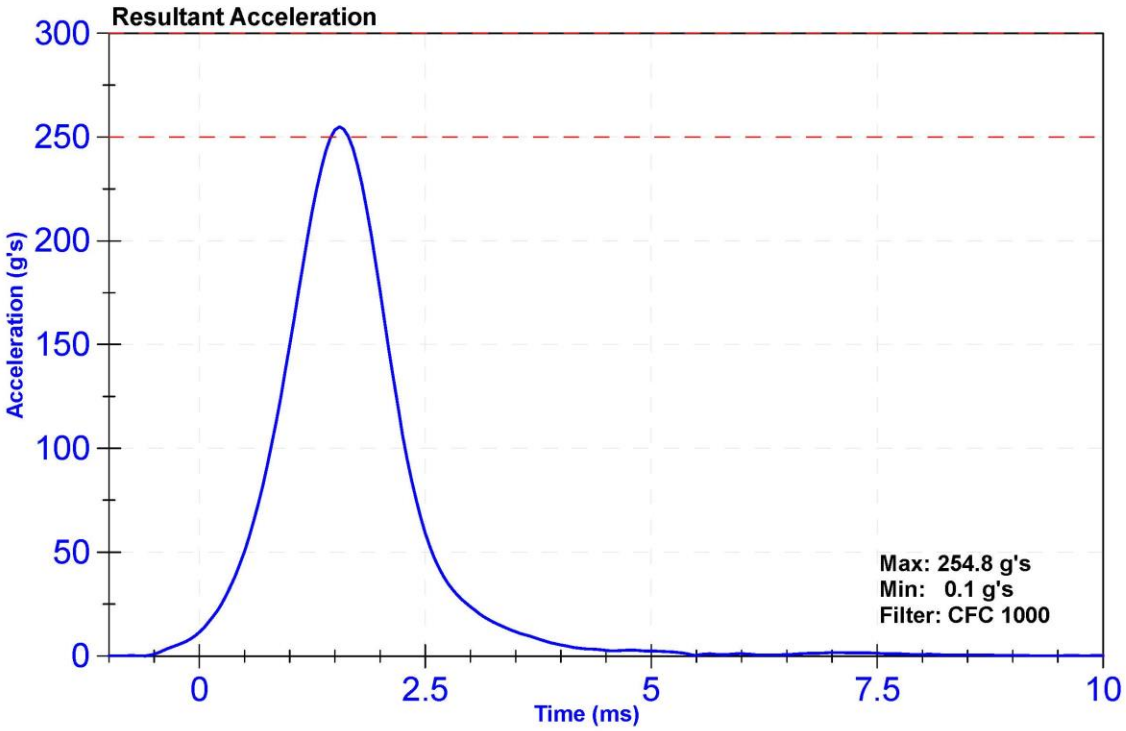
ATD Manufacturer	FTSS	Test Technician	K. Dutton
ATD Serial Number	288	Laboratory Supervisor	K. Brogan

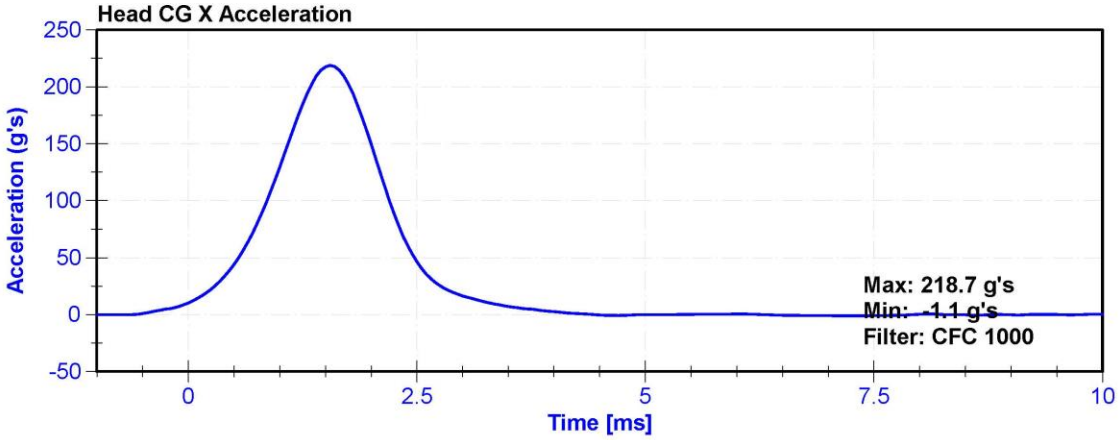
Results

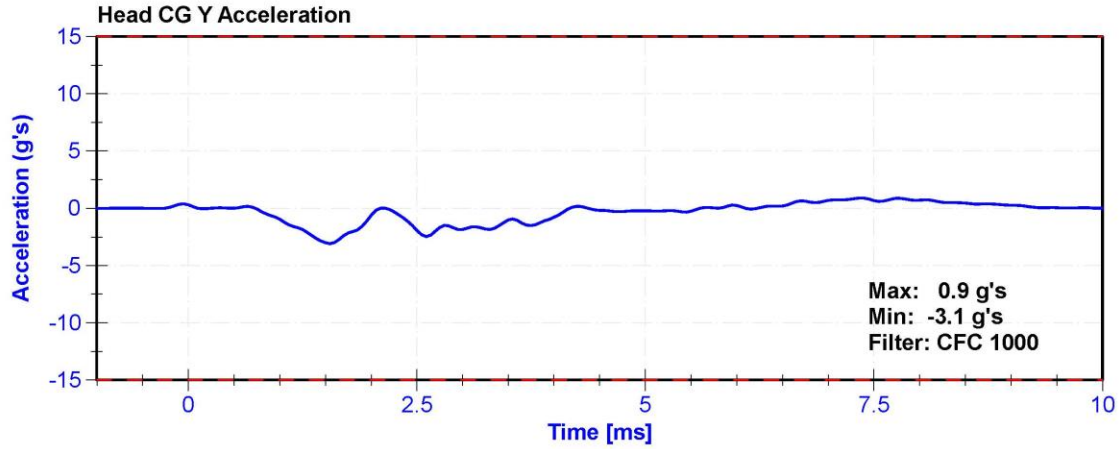
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	20.9	Pass
Humidity	10	70	%	50.5	Pass
Resultant Acceleration	250	300	g's	254.8	Pass
Oscillation	0	10	%	1.1	Pass
Lateral Acceleration	-15	15	g's	-3.1	Pass

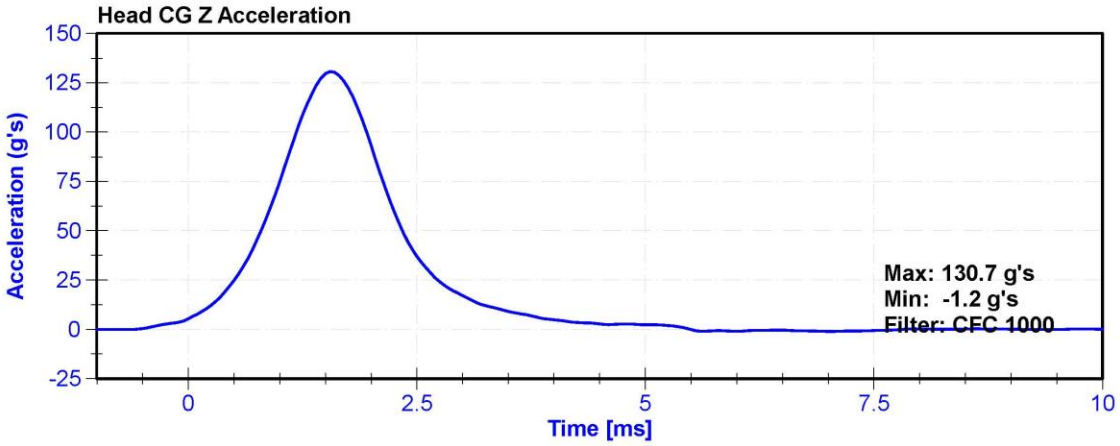
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	ENDEVCO 7264CT	AC-P52133	4/9/2019	10/8/2019
Y Accelerometer	ENDEVCO 7264	AC-P12359	4/9/2019	10/8/2019
Z Accelerometer	ENDEVCO 7264CT	AC-P58871	4/9/2019	10/8/2019




Head CG X Acceleration
Acceleration (g's)
250
200
150
100
50
0
-50
0
2.5
5
7.5
10
Time [ms]
Max: 218.7 g's
Min: -1.1 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: 0.9 g's
Min: -3.1 g's
Filter: CFC 1000


Head CG Z Acceleration
Acceleration (g's)
150
125
100
75
50
25
0
-25
0
2.5
5
7.5
10
Time [ms]
Max: 130.7 g's
Min: -1.2 g's
Filter: CFC 1000

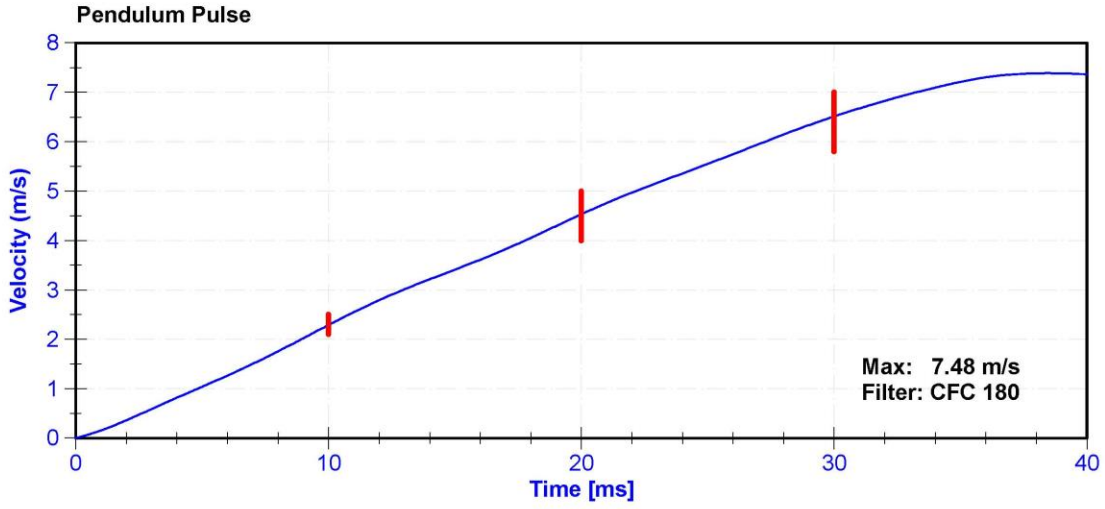
ATD Manufacturer	FTSS	Test Technician	C. Mantell
ATD Serial Number	288	Laboratory Supervisor	K. Brogan

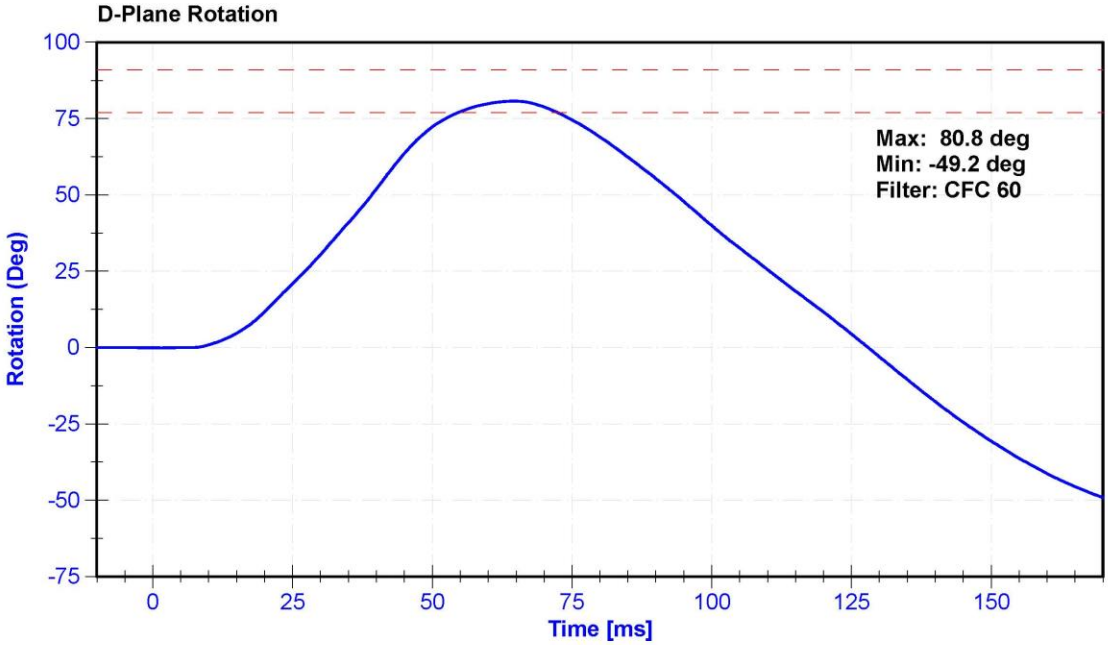
Results

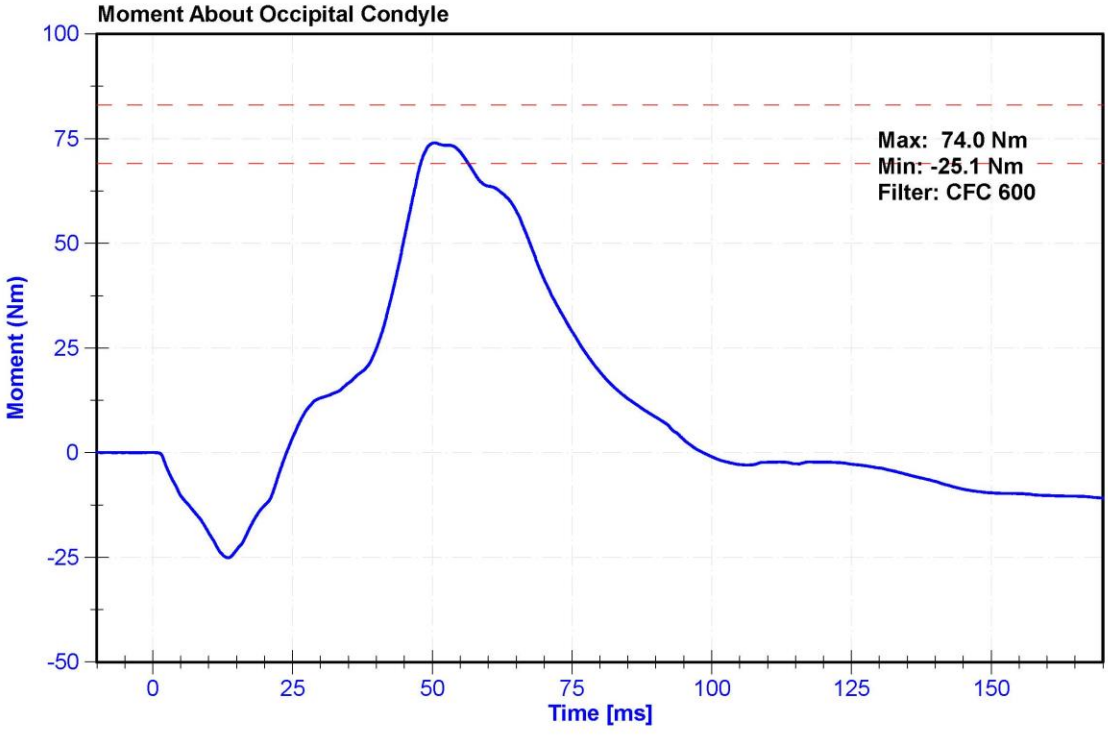
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.8	Pass
Humidity	10	70	%	48.5	Pass
Velocity	6.89	7.13	m/s	6.958	Pass
Pendulum Impulse at 10ms	2.1	2.5	m/s	2.29	Pass
Pendulum Impulse at 20ms	4.0	5.0	m/s	4.53	Pass
Pendulum Impulse at 30ms	5.8	7.0	m/s	6.51	Pass
Max D Plane Rotation	77	91	deg	80.8	Pass
Max Moment During Rotation Interval	69	83	Nm	74.0	Pass
Moment Decay to 10.0 Nm	80	100	ms	88.2	Pass

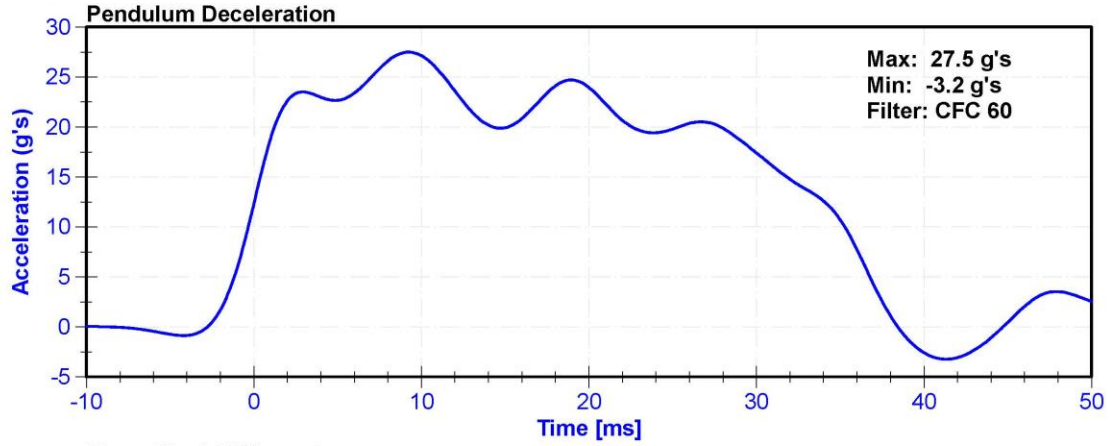
Transducer Calibrations

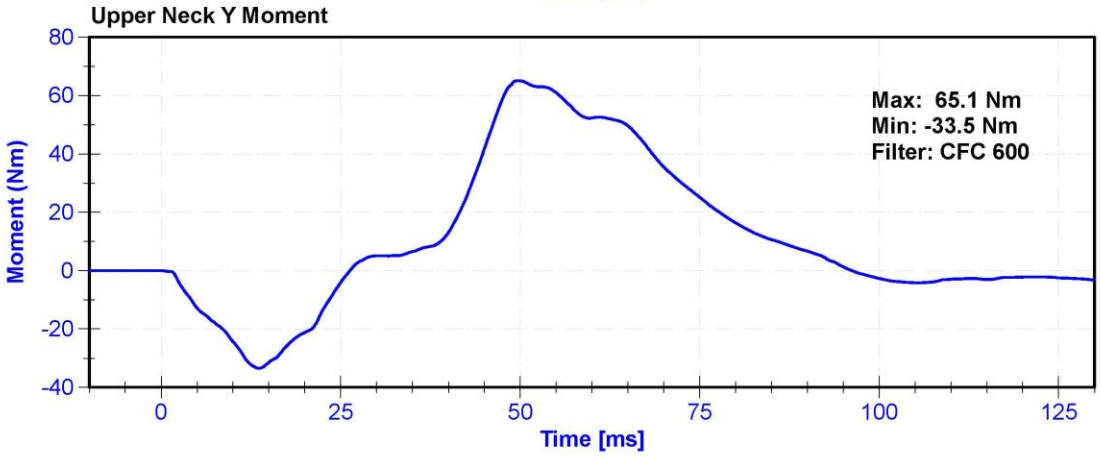
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-AH5M9 Pend	1/29/2019	1/29/2020
Pendulum Potentiometer	ETI SP22G	DS-LABPOT1	11/15/2018	11/15/2019
Condyle Potentiometer	ETI SP22G	DS-LABPOT2	11/15/2018	11/15/2019
Upper Neck Load Cell	DENTON 1716A	LC-1591Fx	9/28/2018	9/28/2019

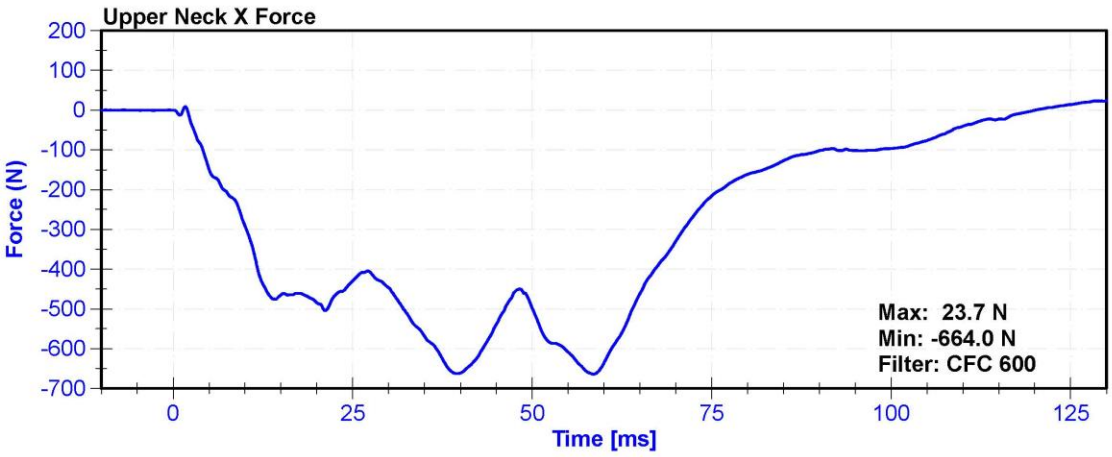



D-Plane Rotation
Max: 80.8 deg
Min: -49.2 deg
Filter: CFC 60
Rotation (Deg)
Time [ms]
100
75
50
25
0
-25
-50
-75
0
25
50
75
100
125
150


Moment About Occipital Condyle
Max: 74.0 Nm
Min: -25.1 Nm
Filter: CFC 600
Moment (Nm)
Time [ms]
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150


Pendulum Deceleration
Max: 27.5 g's
Min: -3.2 g's
Filter: CFC 60
Acceleration (g's)
Time [ms]


Upper Neck Y Moment
Max: 65.1 Nm
Min: -33.5 Nm
Filter: CFC 600
Moment (Nm)
Time [ms]


Upper Neck X Force
Max: 23.7 N
Min: -664.0 N
Filter: CFC 600
Force (N)
Time [ms]

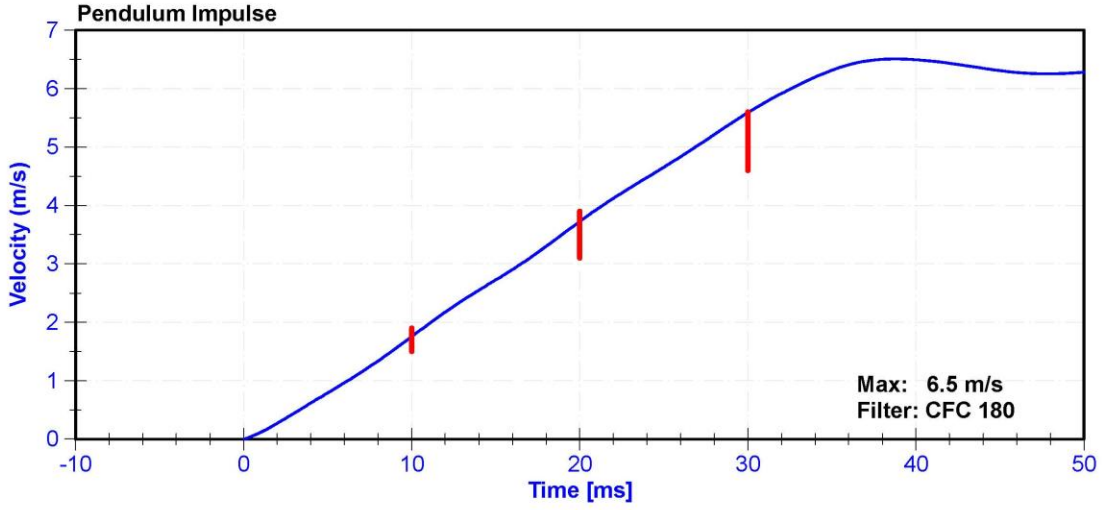
ATD Manufacturer	FTSS	Test Technician	D.Reinhard
ATD Serial Number	288	Laboratory Supervisor	K. Brogan

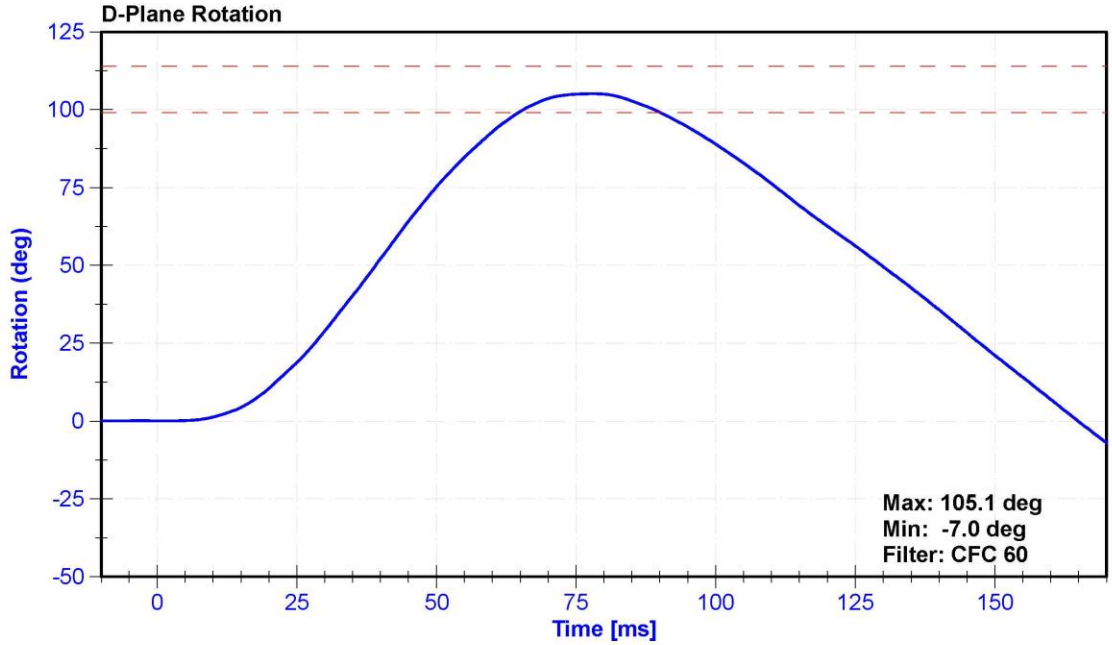
Results

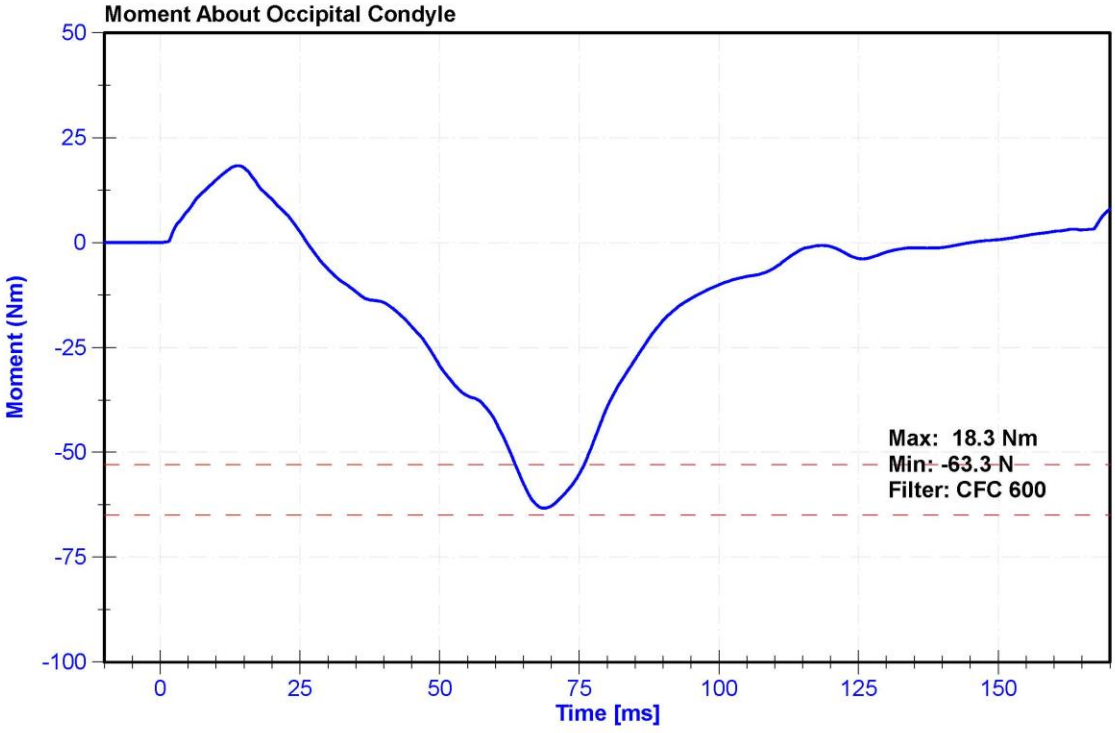
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.2	Pass
Humidity	10	70	%	62.9	Pass
Velocity	5.95	6.19	m/s	6.005	Pass
Pendulum Impulse at 10ms	1.5	1.9	m/s	1.75	Pass
Pendulum Impulse at 20ms	3.1	3.9	m/s	3.73	Pass
Pendulum Impulse at 30ms	4.6	5.6	m/s	5.59	Pass
D Plane Rotation	99	114	deg	105.1	Pass
Moment During Rotation Interval	-65	-53	Nm	-63.3	Pass
Moment Decay to -10Nm	94	114	ms	100.2	Pass

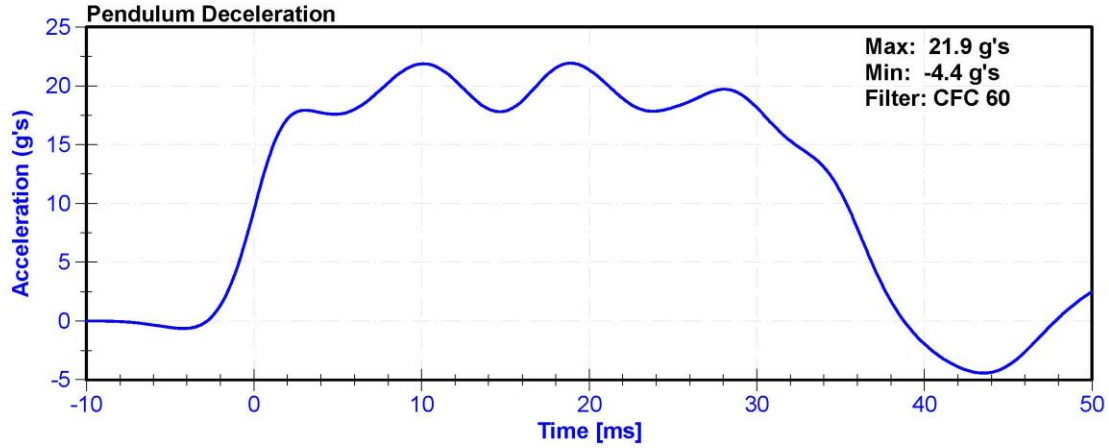
Transducer Calibrations

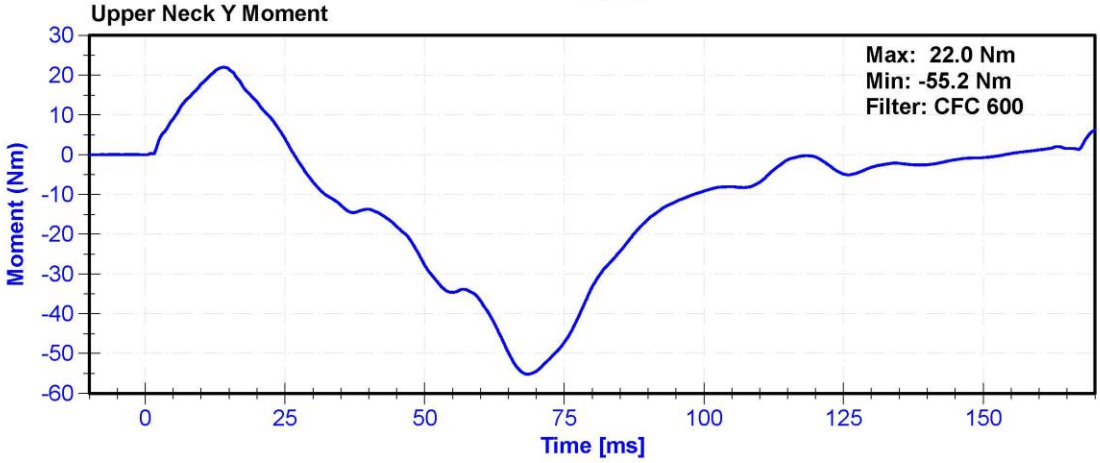
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-AH5M9 Pend	1/29/2019	1/29/2020
Pendulum Potentiometer	ETI SP22G	DS-LABPOT1	11/15/2018	11/15/2019
Condyle Potentiometer	ETI SP22G	DS-LABPOT2	11/15/2018	11/15/2019
Upper Neck Load Cell	DENTON 1716A	LC-1591Fx	9/28/2018	9/28/2019

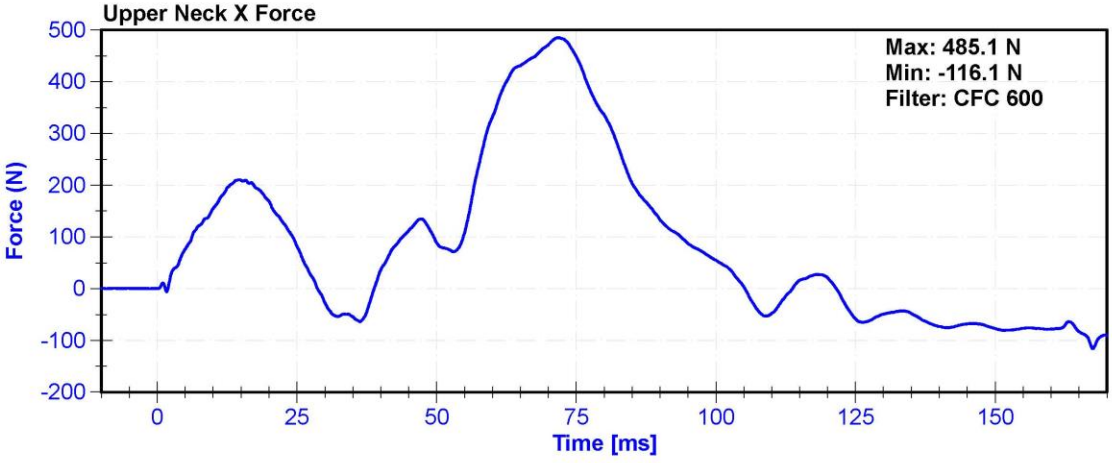



D-Plane Rotation
Rotation (deg)
125
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]
Max: 105.1 deg
Min: -7.0 deg
Filter: CFC 60


Moment About Occipital Condyle
Moment (Nm)
50
25
0
-25
-50
-75
-100
0
25
50
75
100
125
150
Time [ms]
Max: 18.3 Nm
Min: -63.3 N
Filter: CFC 600


Pendulum Deceleration
Max: 21.9 g's
Min: -4.4 g's
Filter: CFC 60
Acceleration (g's)
Time [ms]


Upper Neck Y Moment
Max: 22.0 Nm
Min: -55.2 Nm
Filter: CFC 600
Moment (Nm)
Time [ms]


Upper Neck X Force
Max: 485.1 N
Min: -116.1 N
Filter: CFC 600
Force (N)
Time [ms]

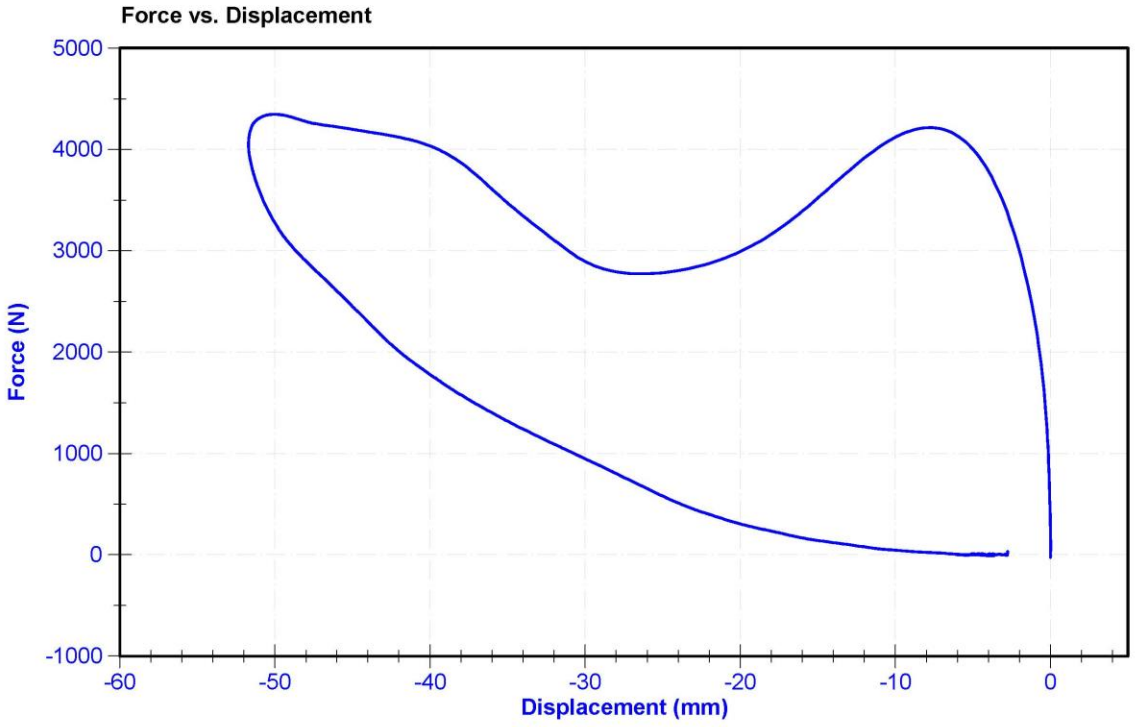
ATD Manufacturer	FTSS	Test Technician	K. Dutton
ATD Serial Number	288	Laboratory Supervisor	K. Brogan

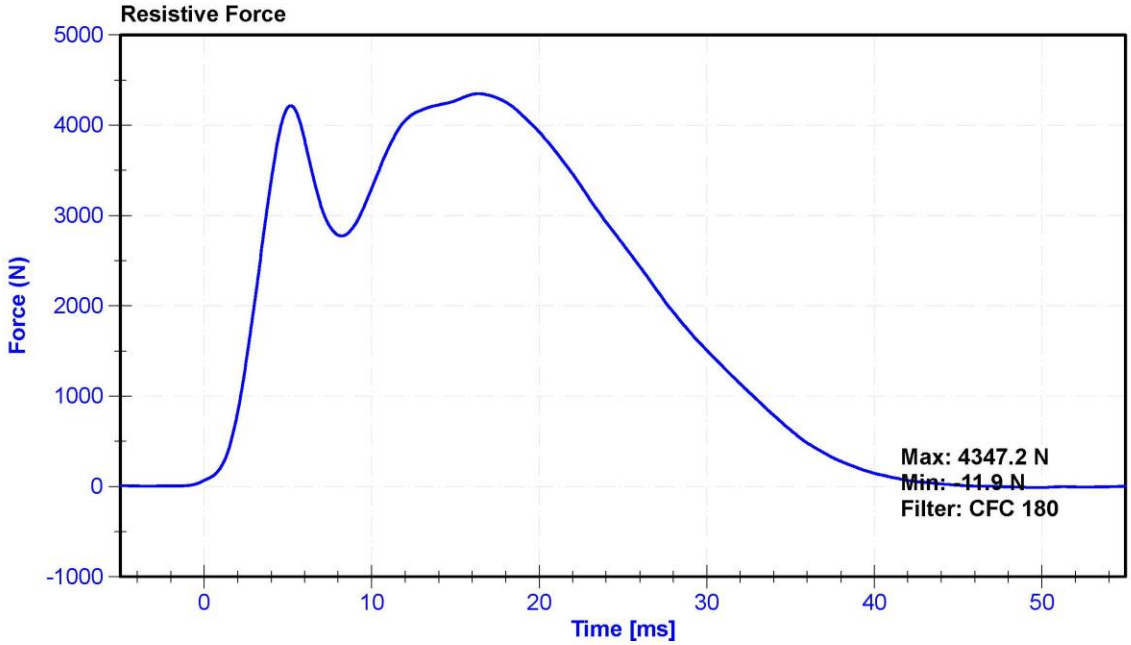
Results

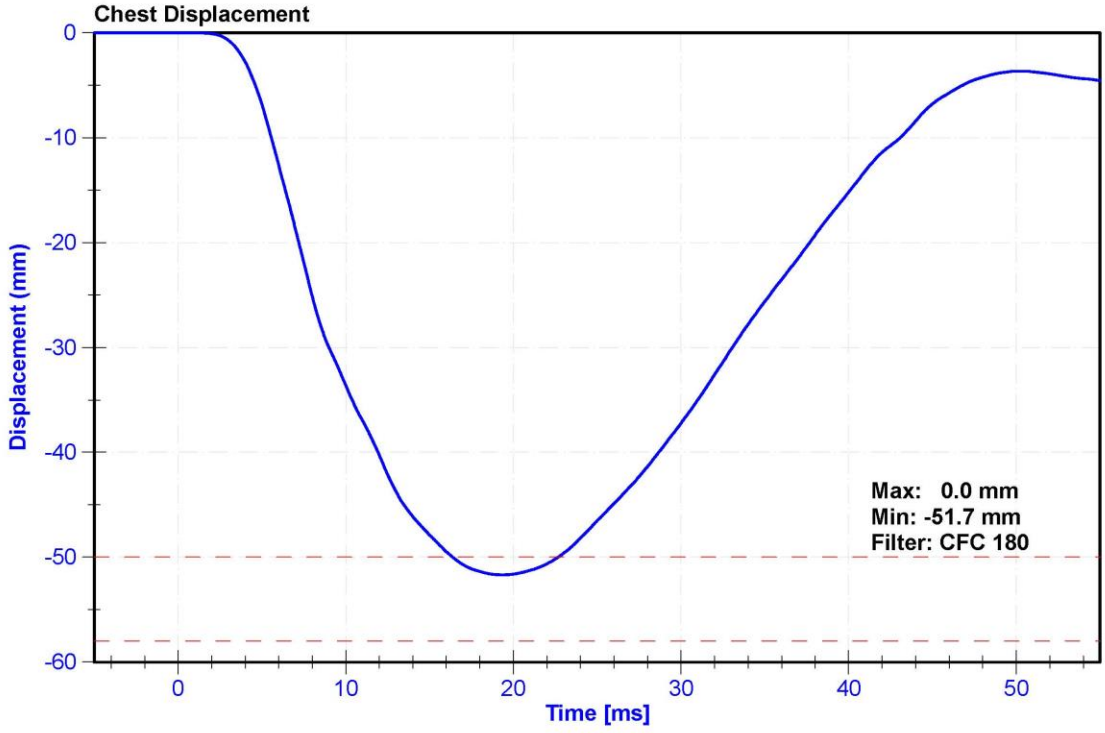
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.3	Pass
Humidity	10	70	%	64.3	Pass
Velocity	6.59	6.83	m/s	6.626	Pass
Chest Deflection	-58	-50	mm	-51.7	Pass
Maximum Resistive Force (50 to 58mm)	3900	4400	N	4347.2	Pass
Maximum Resistive Force (18 to 50mm)	0	4600	N	4347.2	Pass
Hysteresis	69	85	%	71.9	Pass

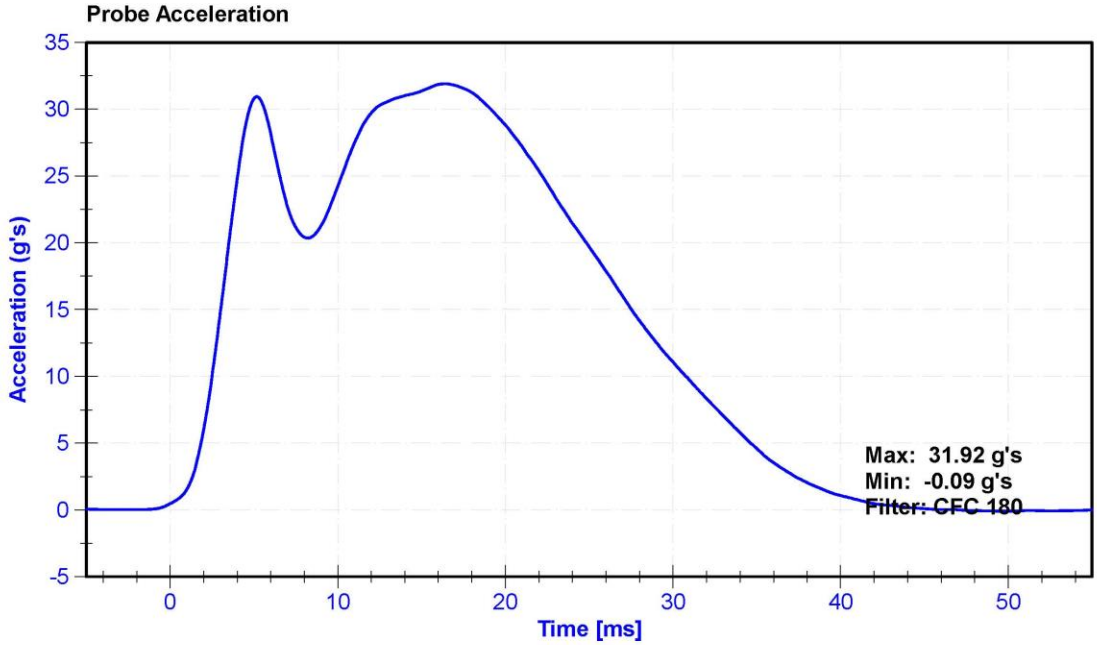
Transducer Calibrations

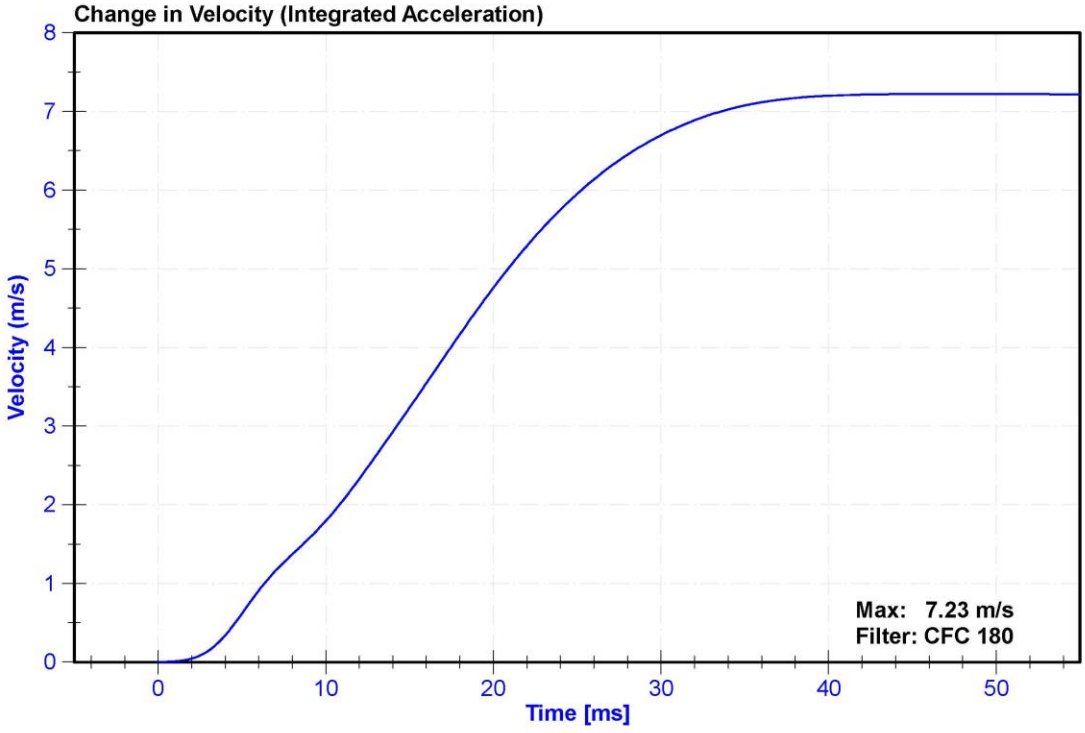
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A260487	2/21/2019	8/22/2019
Chest Potentiometer	SERVO 14CBI-3615	DS-140GFE	6/21/2019	6/20/2020




Resistive Force
Force (N)
5000
4000
3000
2000
1000
0
-1000
0
10
20
30
40
50
Time [ms]
Max: 4347.2 N
Min: -11.9 N
Filter: CFC 180


Chest Displacement
Displacement (mm)
0
-10
-20
-30
-40
-50
-60
0
10
20
30
40
50
Time [ms]
Max: 0.0 mm
Min: -51.7 mm
Filter: CFC 180


Probe Acceleration
Acceleration (g's)
35
30
25
20
15
10
5
0
-5
0
10
20
30
40
50
Time [ms]
Max: 31.92 g's
Min: -0.09 g's
Filter: CFC 180


Change in Velocity (Integrated Acceleration)
Velocity (m/s)
8
7
6
5
4
3
2
1
0
0
10
20
30
40
50
Time [ms]
Max: 7.23 m/s
Filter: CFC 180

ATD Manufacturer	FTSS	Test Technician	K. Dutton
ATD Serial Number	288	Laboratory Supervisor	K. Brogan

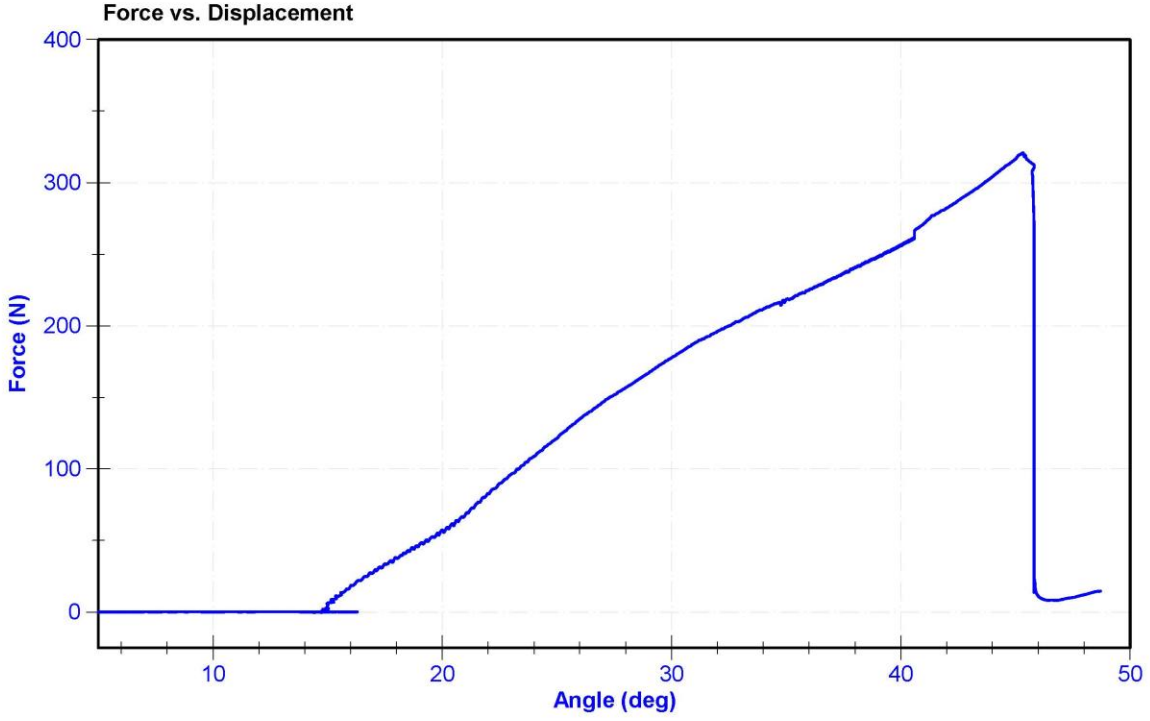
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.6	25.6	ºC	20.9	Pass
Humidity	10	70	%	59.9	Pass
Initial Angle	0	20	deg	14.7	Pass
Force at 45 Degrees	320	390	N	320.9	Pass
Return Angle Relative to Initial	0	8	deg	2.6	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	Rieker N4C-1	DS-13051548	10/25/2018	10/25/2019
Load Cell	Interface SML-200	LC-493319	10/25/2018	10/25/2019

Force vs. Displacement



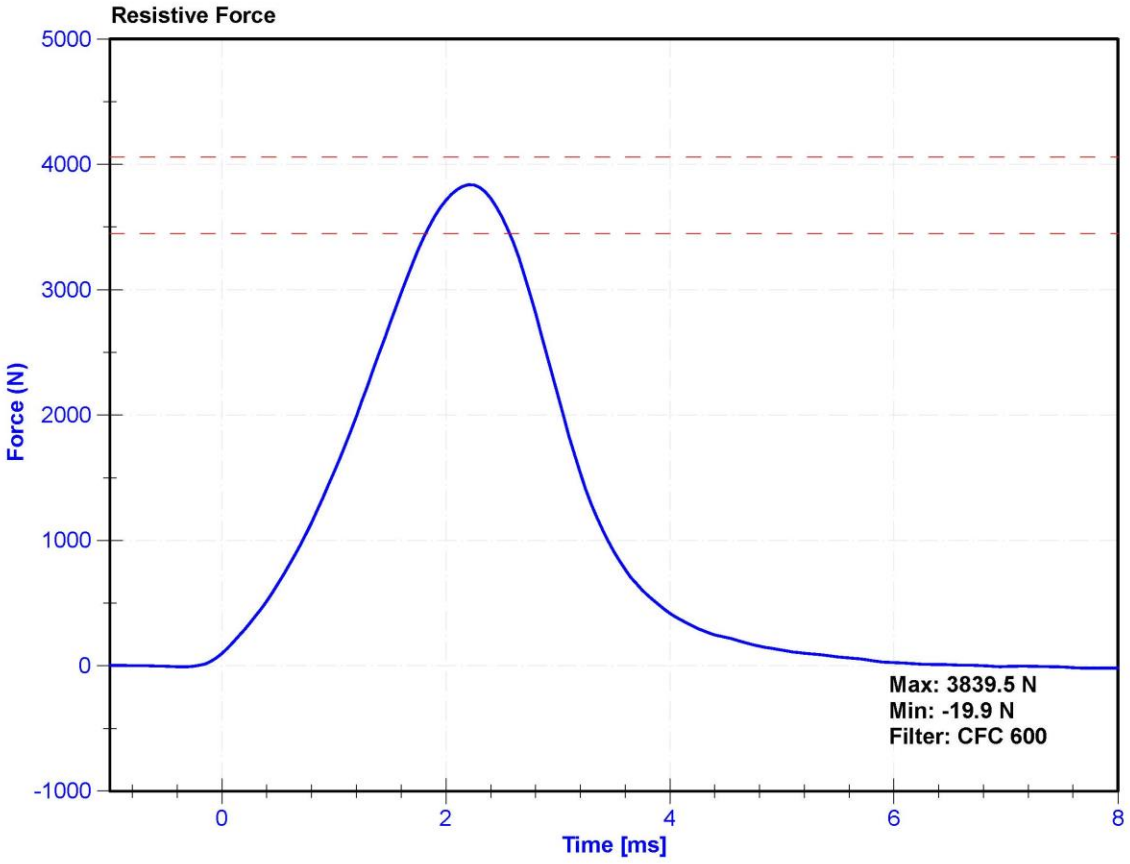
ATD Manufacturer	FTSS	Test Technician	D.Reinhard
ATD Serial Number	288	Laboratory Supervisor	K.Brogan

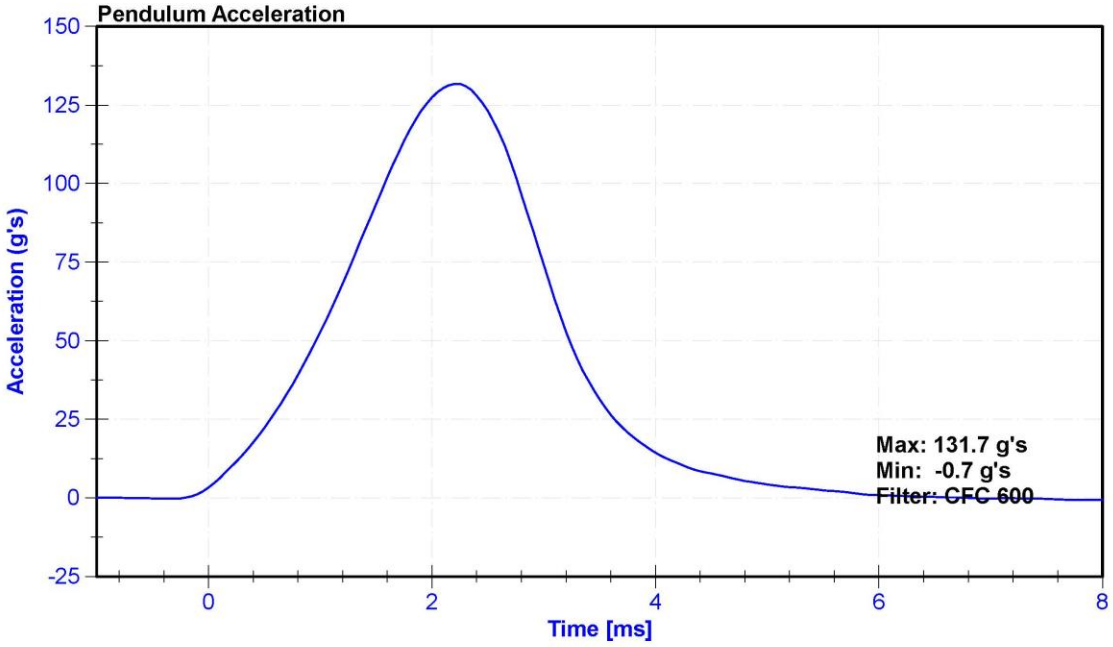
Results

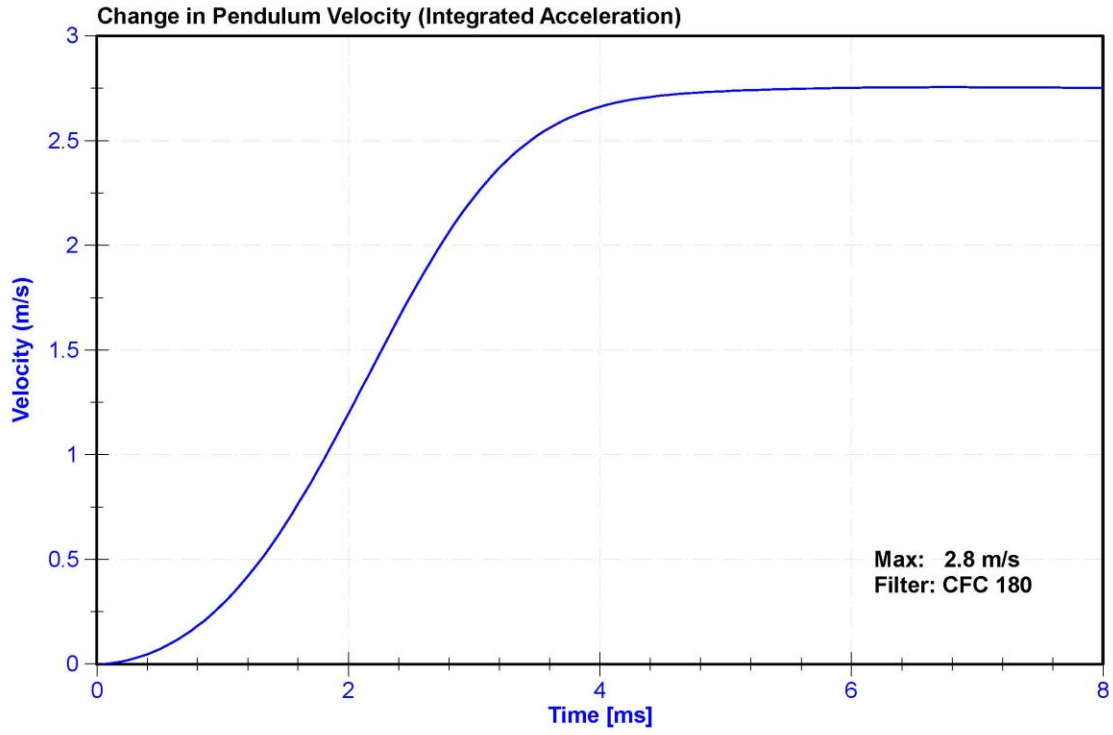
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.2	Pass
Humidity	10	70	%	51.1	Pass
Velocity	2.07	2.13	m/s	2.096	Pass
Resistive Force	3450	4060	N	3839.5	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A260487	2/21/2019	8/22/2019




Pendulum Acceleration
Acceleration (g's)
150
125
100
75
50
25
0
-25
0
2
4
6
8
Time [ms]
Max: 131.7 g's
Min: -0.7 g's
Filter: CFC 600


Change in Pendulum Velocity (Integrated Acceleration)
Velocity (m/s)
3
2.5
2
1.5
1
0.5
0
0
2
4
6
8
Time [ms]
Max: 2.8 m/s
Filter: CFC 180

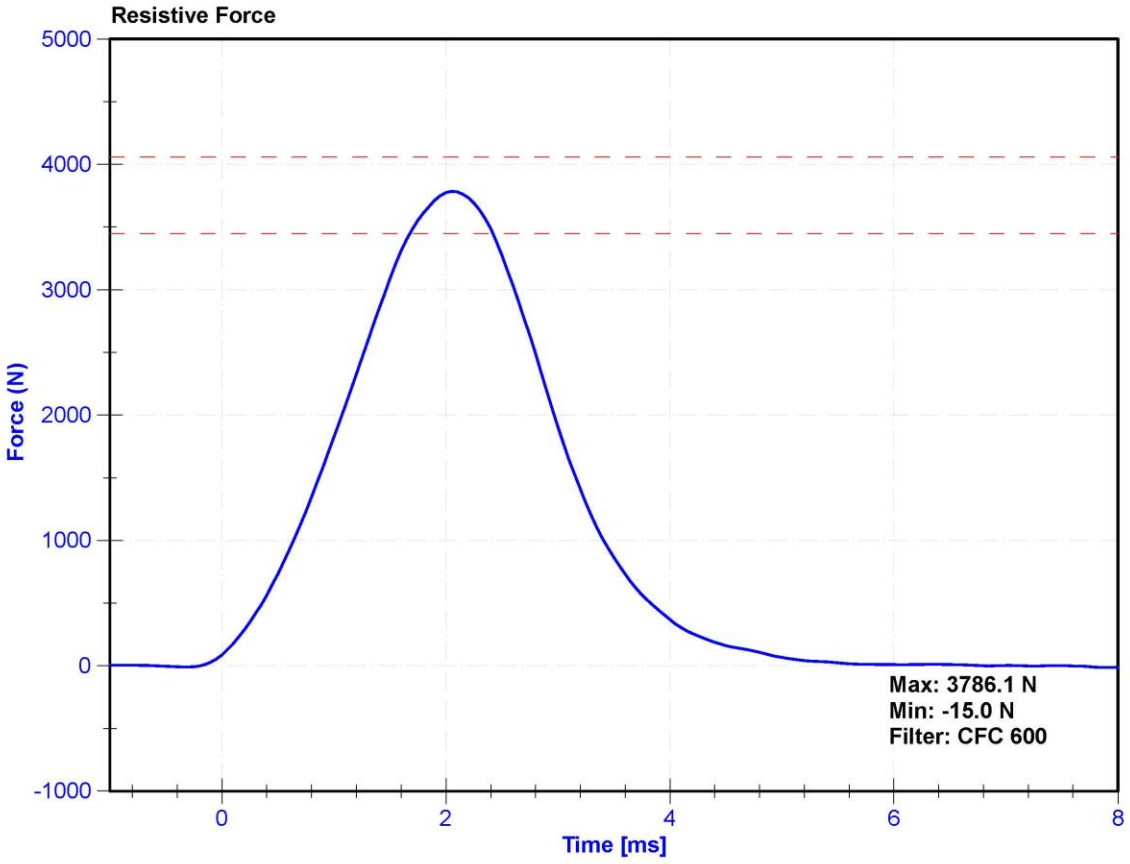
ATD Manufacturer	FTSS	Test Technician	D.Reinhard
ATD Serial Number	288	Laboratory Supervisor	K.Brogan

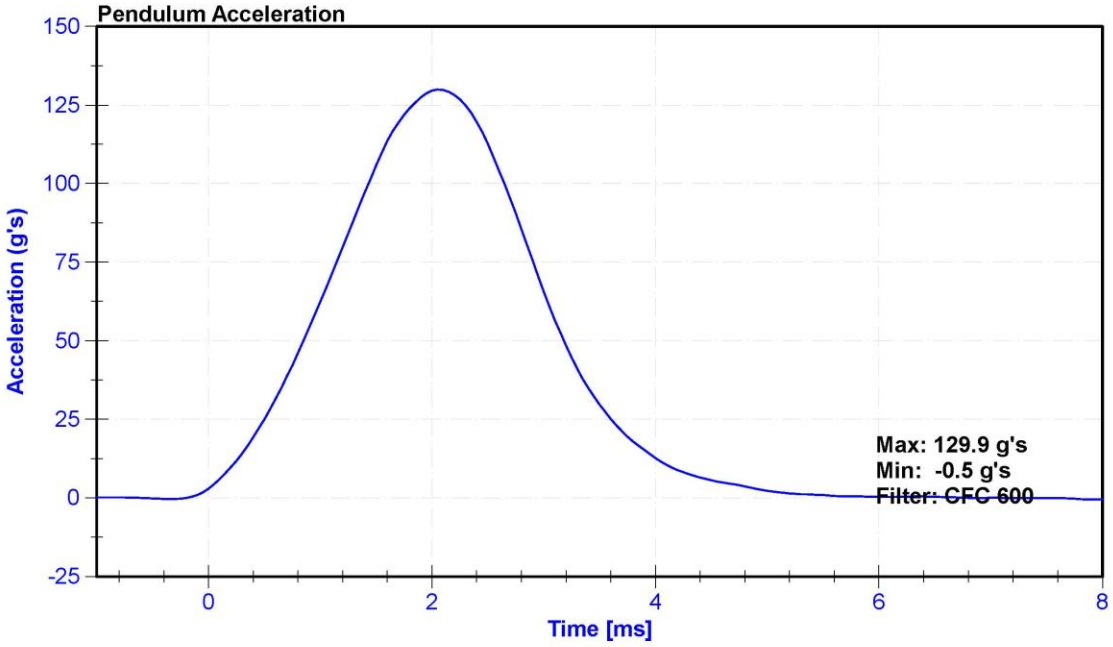
Results

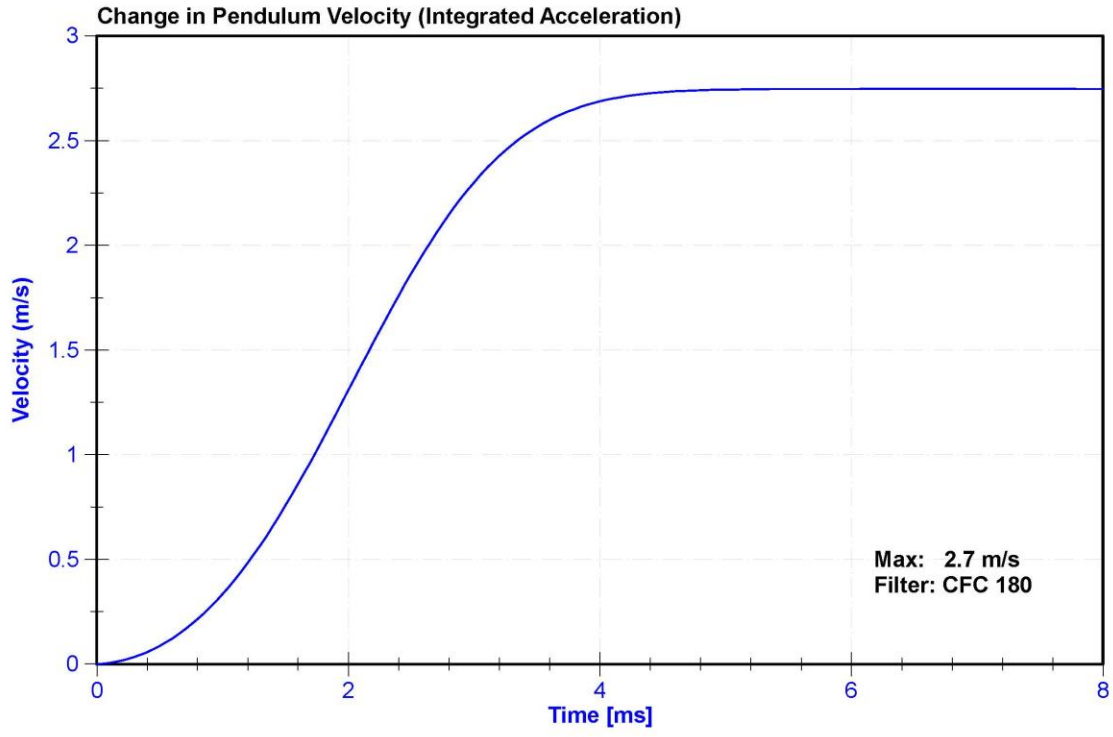
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	20.8	Pass
Humidity	10	70	%	58.9	Pass
Velocity	2.07	2.13	m/s	2.093	Pass
Resistive Force	3450	4060	N	3786.1	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A260487	2/21/2019	8/22/2019




Pendulum Acceleration
Acceleration (g's)
150
125
100
75
50
25
0
-25
0
2
4
6
8
Time [ms]
Max: 129.9 g's
Min: -0.5 g's
Filter: CFC 600


Change in Pendulum Velocity (Integrated Acceleration)
Velocity (m/s)
3
2.5
2
1.5
1
0.5
0
0
2
4
6
8
Time [ms]
Max: 2.7 m/s
Filter: CFC 180