REPORT NUMBER: NCAP-CAL-21-004

NEW CAR ASSESSMENT PROGRAM (NCAP)
FRONTAL BARRIER IMPACT TEST

Hyundai Motor Company
2021 Genesis GV80
Five Door SUV

NHTSA No: O20214215

PREPARED BY:
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August 17, 2021

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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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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16. Abstract

A 56.30 km/h (35 mph), NCAP frontal rigid barrier impact test was conducted on a 2021 Genesis GV80 SUV in accordance with the specifications of the Office of Crashworthiness Standards Laboratory Procedure for NCAP Full Frontal Rigid Barrier Impact Testing. The test was conducted at Calspan Corporation's Transportation Test Operations facility in Buffalo, New York on February 12, 2021.

The impact velocity of the vehicle was 56.35 km/h, and the ambient temperature at the barrier face at the time of impact was 21°C. The target vehicle post-test maximum crush was 348 mm at vehicle centerline. The test vehicle's occupant performance data is as follows:

Measurement Description	Units	Driver ATD (Serial No. 142)		Passenger ATD (Serial No. 140)	
		Threshold	Result	Threshold	Result
Head Injury Criteria (HIC_{15})		700	327.673	700	262.983
Maximum Chest Compression	mm	63	-26.691	52	-15.476
Nij		1	0.241	1	0.340
Neck Tension	N	4,170	698.812	2,620	1012.333
Neck Compression	N	4,000	-112.678	2,520	-287.172
Left Femur Force	N	10,008	-1130.446	6,805	-1728.103
Right Femur Force	N	10,008	-1487.535	6,805	-2212.550

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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. 693JJ919D000005. 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 Laboratory Procedure for NCAP Full Frontal Rigid Barrier Impact Testing.

SUMMARY

A load cell barrier consisting of 128 load cells was impacted by a 2021 Genesis GV80 SUV at a velocity of 56.35 km/h. The test was performed at Calspan Corporation's Transportation Test Operations facility in Buffalo, New York on February 12, 2021. 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 16 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 Laboratory Procedure for NCAP Full Frontal Rigid Barrier Impact Testing. Both ATDs were fully instrumented with head, chest and pelvis tri-axial accelerometers, chest displacement potentiometers, upper neck transducers, femur load cells, and lower leg instrumentation. Seat belt load cells were installed on the driver's and passenger's shoulder belts to measure dummy torso and pelvic section loading. The driver (position 1) ATD (Serial No. 142) and the right-front passenger (position 2) ATD (Serial No. 140) were qualified prior to this test. Certification details, along with instrumentation calibration data, can be found in Appendix C of this report.

The 486 channels of data were recorded on an on-board data acquisition system. Appendix B contains the vehicle, load cell barrier and 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 or during any phase of the static rollover. The maximum static crush of the vehicle was 348 mm and both driver and passenger side doors remained closed during the impact event and were operable after the impact.

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 air bag.

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})	327.673	0.241	698.812	-112.678	49.236	-26.691	-1130.446	-1487.535
Passenger (5^{th})	262.983	0.340	1012.333	-287.172	52.063	-15.476	-1728.103	-2212.550

GENERAL COMMENTS:

1. P1 (Driver) serial number – 142
2. P2 (Passenger) serial number – 140

Data Anomalies:

- Bottom of Engine X, Exceeded calibration range at 36 ms 39.7 ms

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 Indicant FMVSS No. 212 and FMVSS No. 219 (Partial)

Data Sheet No. 16 – FMVSS 301 Barrier Impact and Static Rollover Results

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

DATA SHEET NO. 1
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2021 Genesis GV80 SUV NHTSA No.: O20214215
Test Program: NCAP Frontal Barrier Impact Test Test Date: 2/12/2021

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA No.	O20214215
Model Year	2021
Make	Genesis
Model	GV80
Body Style	SUV
VIN	KMUHCESC8MU031362
Body Color	Gray
Odometer Reading (km /mi)	73 miles
Engine Displacement (L)	3.5
Type / No. Cylinders	V6
Engine Placement	Inline
Transmission Type	Automatic
Transmission Speeds	8 – Speed
Overdrive	Yes
Final Drive	All Wheel Drive
Roof Rack	No
Sunroof / T-Top	Yes
Running Boards	No
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	Yes
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
Driver Inboard Seat Airbag	Yes

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

DATA FROM CERTIFICATION LABEL

Manufactured By	Hyundai Motor Company
Date of Manufacture	Sep/ 2020

GVWR (kg)	2770
GAWR Front (kg)	1390
GAWR Rear (kg)	1485

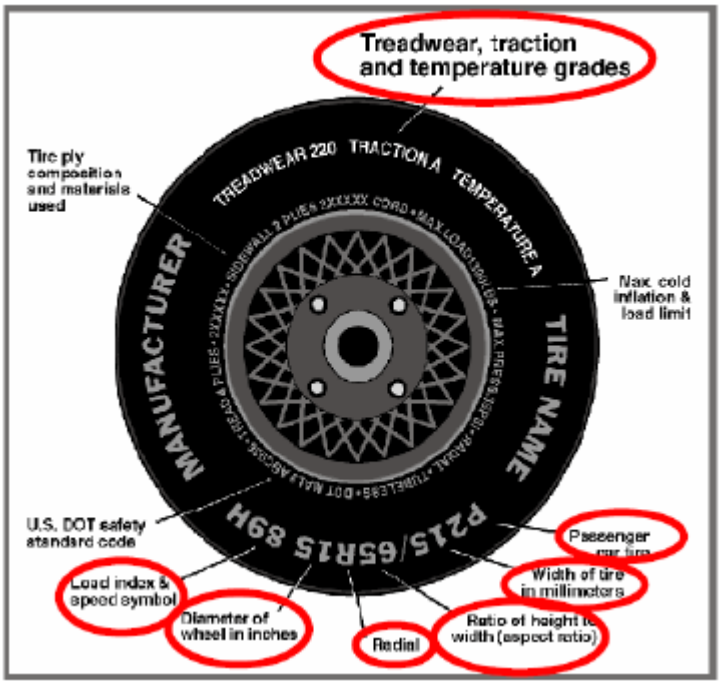
VEHICLE SEATING AND WEIGHT CAPACITY DATA

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Bench	N/A	
Number of Occupants	2	3	N/A	5
Capacity Wt. (VCW) (kg)				410
Cargo Wt. (RCLW) (kg)				69.8

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

Test Vehicle:	2021 Genesis GV80 SUV	NHTSA No.:	O20214215
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	2/12/2021

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



VEHICLE TIRE INFORMATION

Measured Parameter	Front	Rear
Maximum Tire Pressure (kPa)	340	340
Cold Pressure (kPa)	230	250
Recommended Tire Size	265/40R22	265/40R22
Tire Size on Vehicle	265/40R22	265/40R22
Tire Manufacturer	Michelin	Michelin
Tire Model	Primacy Tour A/S	Primacy Tour A/S
Treadwear	540	540
Traction	A	A
Temperature Grades	A	A
Tire Plies Sidewall	2 Polyester	2 Polyester
Tire Plies Body	2 Polyester, 2 Steel, 2 Polyamide	2 Polyester, 2 Steel, 2 Polyamide
Load Index / Speed Symbol	106W	106W
Tire Material	Rubber	Rubber
DOT Safety Code Left	61NB00LX2220	61NB00LX2220
DOT Safety Code Right	61NB00LX2220	61NB00LX2220

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

Test Vehicle: 2021 Genesis GV80 SUV NHTSA No.: O20214215
Test Program: NCAP Frontal Barrier Impact Test Test Date: 2/12/2021

TEST VEHICLE WEIGHTS

	Units	As Delivered Weights (UVW)			As Tested Weights (ATW)		
		Front Axle	Rear Axle	Total	Front Axle	Rear Axle	Total
Left	kg	584	563		626	638	
Right	kg	590	546		609	615	
Ratio	%	51.0	49.0		50.0	50.0	
Totals	kg	1174	1109	2283	1235	1253	2488

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value	
Total Delivered Weight (UVW)	kg	2283	(A)
Weight of 1 P572E ATD & 1 P572O ATD	kg	142	(B)
Rated Cargo / Luggage Weight (RCLW)	kg	69.8	(C)
Calculated Vehicle Target Weight (TVTW)	kg	2494.8	(A+B+C)

TEST VEHICLE ATTITUDES AND CG

Condition	Units	LF	RF	LR	RR	CG (aft of front axle)
As Delivered	mm	904	904	915	915	1435
As Tested	mm	895	897	890	891	1488
Post-Test	mm	921	937	880	894	

GENERAL TEST VEHICLE DATA

Measurement Description	Units	Value
Total Vehicle Wheel Base	mm	2955
Total Vehicle Length at Left Side	mm	4866
Total Vehicle Length at Centerline	mm	4942
Total Vehicle Length at Right Side	mm	4866
Weight of Ballast in Cargo Area	kg	50.3
Weight of Vehicle Components Removed	kg	30
Amount of Stoddard Solvent in Fuel Tank	L	74.4

LIST OF COMPONENTS REMOVED TO MEET TEST WEIGHT:

Trunk Carpeting, Jack, Tail Light

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

Test Vehicle: 2021 Genesis GV80 SUV NHTSA No.: O20214215
Test Program: NCAP Frontal Barrier Impact Test Test Date: 2/12/2021

TARGET VEHICLE STRUCTURAL MEASUREMENT

No.	Description	Pre-Test
1	Total Length	4942
2	Total Width	1931
3*	Bumper Top Height	613
4*	Bumper Bottom Height	516
5*	Longitudinal Member Top Height	627
6	Distance Between Longitudinal Members	876
7	Longitudinal Member Width	39
8*	Engine Top Height	904
9*	Engine Bottom Height	289
10	Engine and Gearbox Width	607
11	Front Bumper-Engine Distance	816
12*	Front Shock Absorber Fixing Height	988
13*	Bonnet Leading Edge Height	1024
14	Front Shock Absorber Fixing Width	921
15	Front Bumper – Front Axle Distance	876
16	Front Axle – A Pillar Distance	742
17	A-Pillar – B-Pillar Distance	1071
18	B-Pillar – Rear Axle Distance	1143
19	B-Pillar – C-Pillar Distance	1066
20*	Roof Sill Bottom Height	1637
21*	Roof Sill Top Height	1686
22*	Floor Sill Bottom Height	471
23*	Floor Sill Top Height	500

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

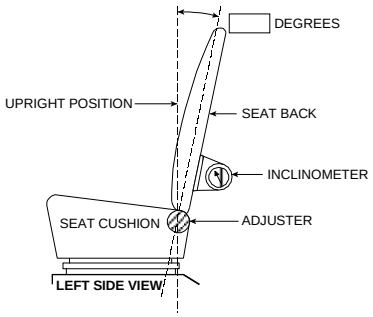
DATA SHEET NO. 2
SEAT ADJUSTMENT, FUEL SYSTEM, AND STEERING WHEEL DATA

Test Vehicle:	2021 Genesis GV80 SUV	NHTSA No.:	O20214215
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	2/12/2021

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	-1.5
Passenger Seat Back Angle	-2.0



FRONT SEAT ASSEMBLY

SEAT FORE / AFT POSITIONS

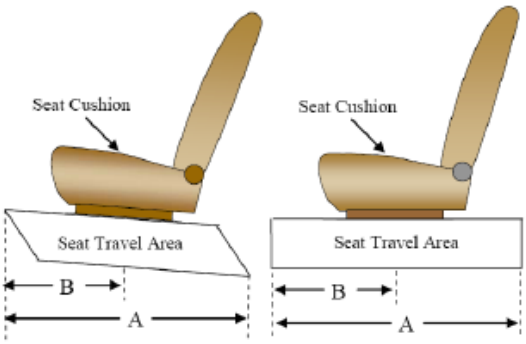
The driver's seat was positioned at the mid-point of fore/aft travel at its lowest position. The passenger's seat was positioned at the most forward position of fore/aft travel. Zero is defined as the forward most position.

Seating Position	Total Fore / Aft Travel	Placed in Position #
Driver Seat	325	163
Passenger Seat	245	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 (0-4)	0
Passenger Seat	5 (0-4)	0



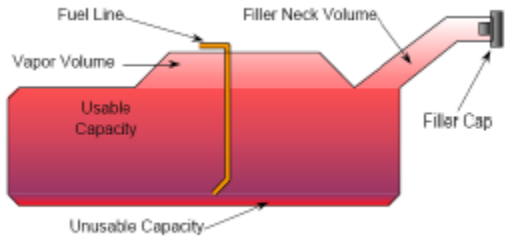
Test Vehicle: 2021 Genesis GV80 SUV NHTSA No.: O20214215
Test Program: NCAP Frontal Barrier Impact Test Test Date: 2/12/2021

FUEL TANK CAPACITY

Description	Liters
Usable Capacity of "Standard Tank"	80
Usable Capacity of "Optional Tank"	N/A
92%-94% of Usable Capacity	73.6 – 75.2
Actual Amount of Solvent Used	74.4
1/3 of Usable Capacity	26.7

FUEL PUMP

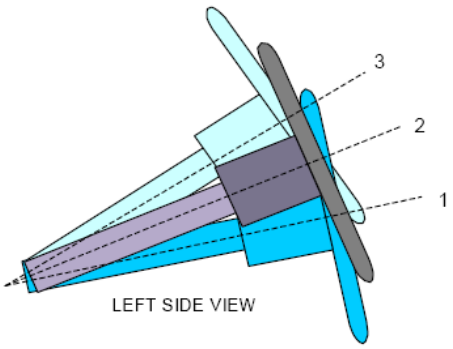
The vehicle is equipped with an electric fuel pump. The fuel filler neck is on the left side of the vehicle. The pump creates positive pressure in the fuel lines, pushing the gasoline to the engine. See form 1 for more information.



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.



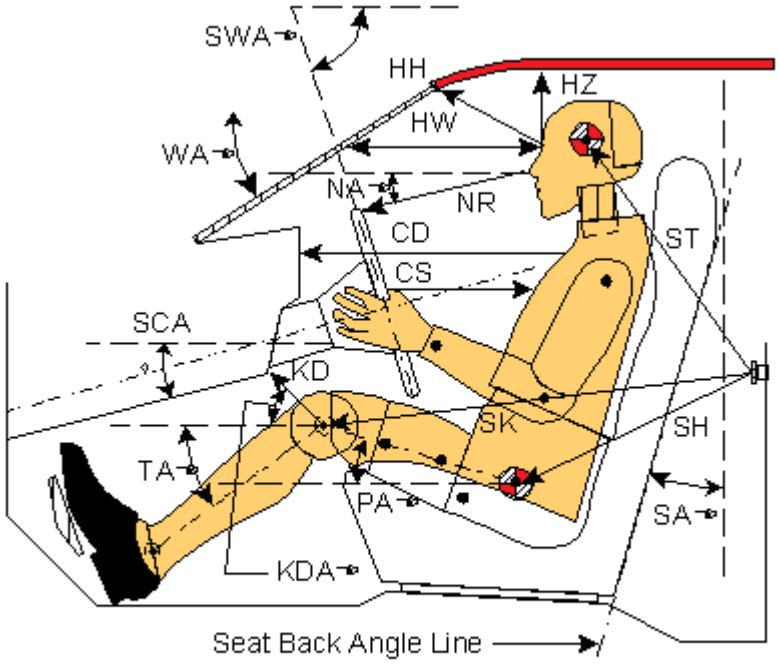
STEERING COLUMN ASSEMBLY

STEERING COLUMN POSITIONS

Description	Degrees	Fore / Aft Position (mm)
Lowermost position No. 1	22.5	
Geometric center position No. 2	24.5	
Uppermost position No. 3	26.7	
Telescoping Steering Wheel Travel		55
Test Position	24.5	27.5

DATA SHEET NO. 3
DUMMY LONGITUDINAL CLEARANCE DIMENSIONS

Test Vehicle:	2021 Genesis GV80 SUV	NHTSA No.:	O20214215
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	2/12/2021



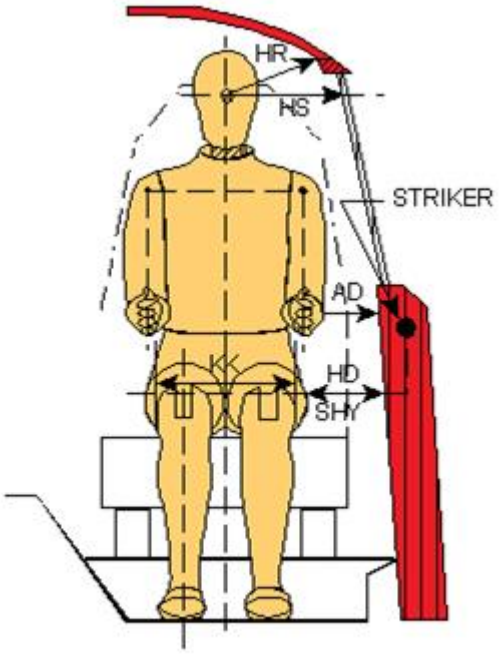
Left Side View

Code	Measurement Description	Driver (SN: 142)		Passenger (SN: 140)	
		Length (mm)	Angle (°)	Length (mm)	Angle (°)
WA°	Windshield Angle		31.2		
SWA°	Steering Wheel Angle		25.0		
SCA°	Steering Column Angle		65.0		
SA°	Seat Back Angle (on headrest post)		-1.5		-2.0
HZ	Head to Roof (Z)	184	90	198	90
HH	Head to Header	352	29.4	297	53.2
HW	Head to Windshield	585	0	561	0
NR	Nose to Rim / Dash	393	7.3	432	22.3
CD	Chest to Dash	528		392	
CS	Chest to Steering Hub	300	2.1		
RA	Rim to Abdomen	196	4.0		
KDL	Left Knee to Dash	191	26.9	115	33.8
KDR	Right Knee to Dash	184	29.0	111	37.2
PA°	Pelvic Angle		22.0		19.7
TA°	Tibia Angle		30.3		44.0
SK	Striker to Knee	572	8.4	642	7.3
ST	Striker to Head	506	80.5	464	62.1
SH	Striker to H-Point	257	49.2	345	26.9

DATA SHEET NO. 4
DUMMY LATERAL CLEARANCE DIMENSIONS

Test Vehicle: 2021 Genesis GV80 SUV
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20214215
Test Date: 2/12/2021

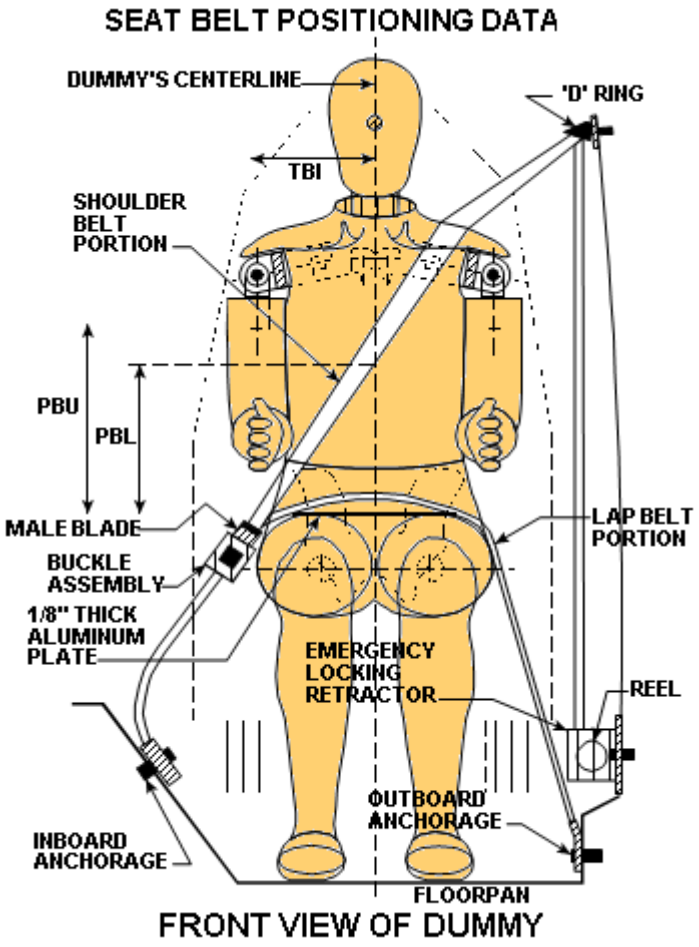


Front View

Code	Description	Driver (mm)	Passenger (mm)
AD	Arm to Door	149	84
HD	H-Point to Door	178	193
HR	Head to Side Header	232	262
HS	Head to Side Window	357	380
KK	Knee to Knee	345	167
SHY	Striker to H-Point (Y Direction)	265	310
AA	Ankle to Ankle	327	167

DATA SHEET NO. 5
SEAT BELT POSITIONING DATA

Test Vehicle:	2021 Genesis GV80 SUV	NHTSA No.:	O20214215
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	2/12/2021



SEAT BELT POSITIONING MEASUREMENTS

Measurement Description	Units	Driver	Passenger
PBU — Top surface of reference to belt upper edge	mm	340	310
PBL — Top surface of reference to belt lower edge	mm	255	220

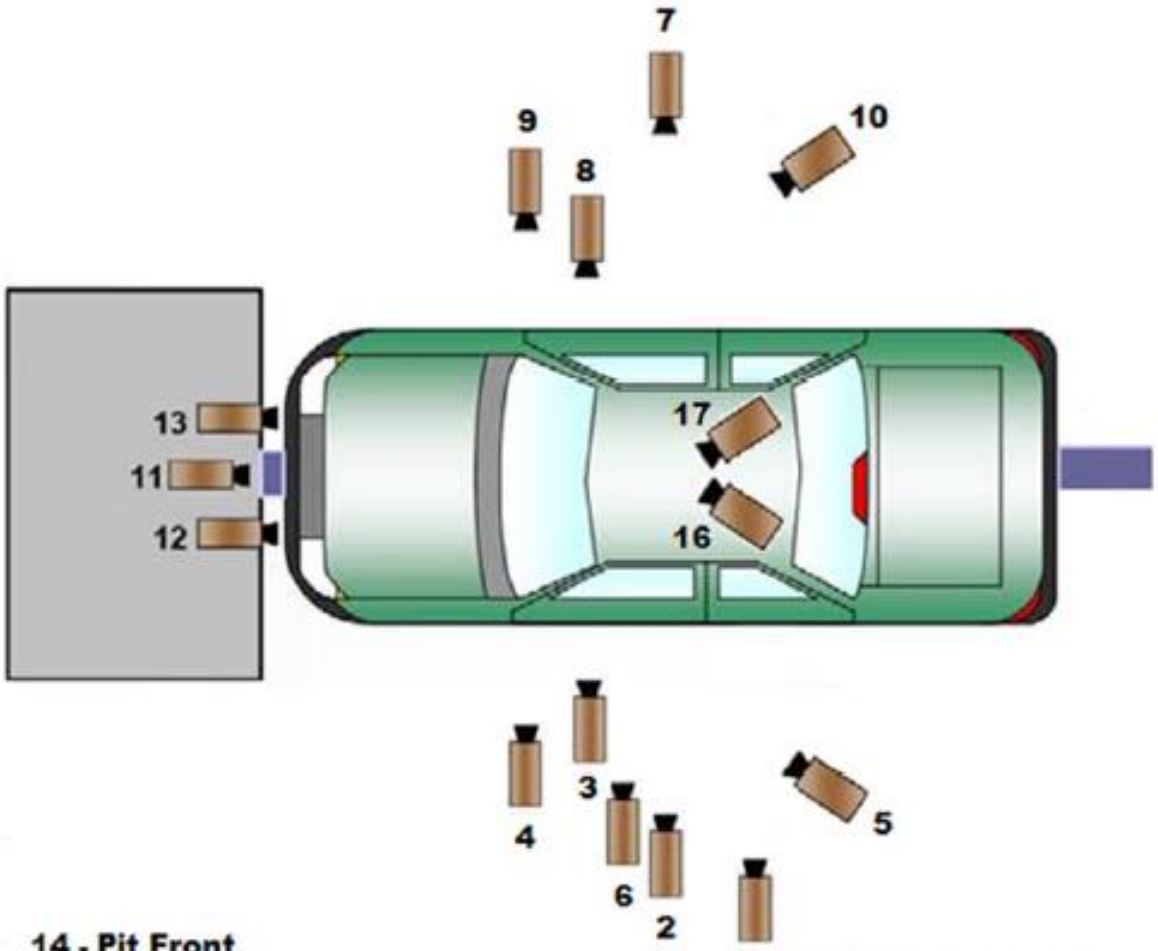
BELT LENGTH DATA

Measurement Description	Units	Driver	Passenger
Shoulder belt length as measured on ATD	mm	910	985
Lap Belt Length as measured on ATD	mm	415	465
Remainder of belt on reel	mm	1075	950
Total belt length for continuous webbing systems	mm	2400	2400

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

Test Vehicle:	2021 Genesis GV80 SUV	NHTSA No.:	O20214215
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	2/12/2021

CAMERA POSITIONS FOR FRONTAL IMPACTS



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

Test Vehicle: 2021 Genesis GV80 SUV NHTSA No.: O20214215
Test Program: NCAP Frontal Barrier Impact Test Test Date: 2/12/2021

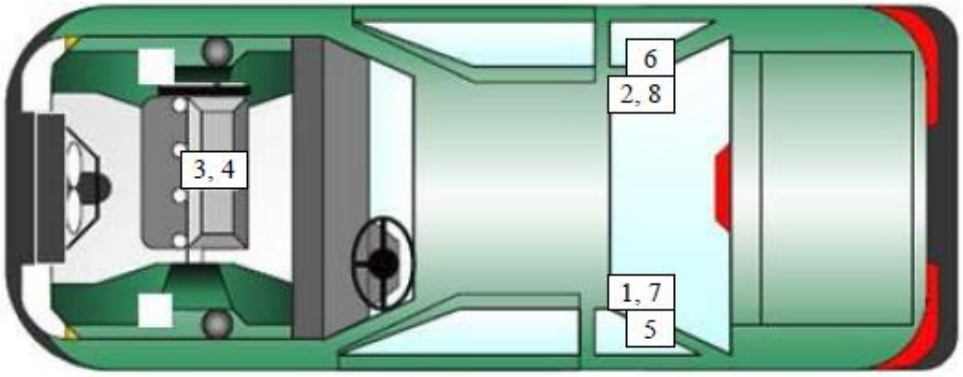
CAMERA LOCATIONS

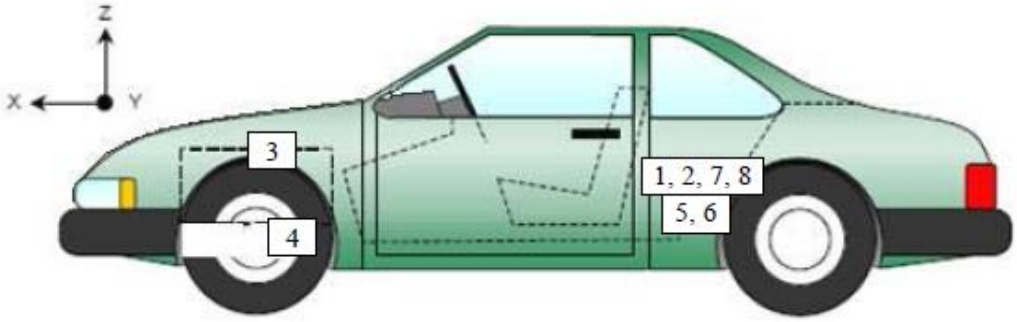
No.	Camera View	Location (mm)			Lens (mm)	Speed (fps)
		X	Y	Z		
1	Real-Time Left Overall	-	-	-		60
2	Left Overall	-2345	-8694	-1441	24	1000
3	Driver Close-Up	-1562	-6852	-1564	50	1000
4	Left Front Half	-1103	-7026	-1334	28	1000
5	Left Angle	-4330	-5266	-2629	50	1000
6	Steering Column	-1190	-8805	-2495	75	1000
7	Right Overall	-1527	8476	-1436	24	1000
8	Passenger Close-Up	-1805	9277	-2006	75	1000
9	Right Front Half	-1153	7183	-1384	28	1000
10	Right Angle	-4152	4936	-2635	50	1000
11	Windshield	1083	0	-3700	12.5	1000
12	Driver Windshield	785	-400	-2405	25	1000
13	Passenger Windshield	785	400	-2405	25	1000
14	Pit Front	-938	0	2315	12.5	1000
15	Pit Rear	-2754	0	2315	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: 2021 Genesis GV80 SUV NHTSA No.: O20214215
Test Program: NCAP Frontal Barrier Impact Test Test Date: 2/12/2021





VEHICLE ACCELEROMETER PRE-TEST LOCATIONS

No.	Accelerometer Location	Measurements (mm)		
		X	Y	Z
1	Left Rear Accelerometer – X Direction	1968	-379	-52
2	Right Rear Accelerometer – X Direction	1969	390	-44
3	Engine Top X	4147	124	-473
4	Engine Bottom X	4024	1	191
5	Left Rear Accelerometer – Z Direction	1968	-379	-52
6	Right Rear Accelerometer – Z Direction	1969	390	-44
7	Left Rear Accelerometer – X Direction Redundant	1968	-379	-52
8	Right Rear Accelerometer – X Direction Redundant	1969	390	-44

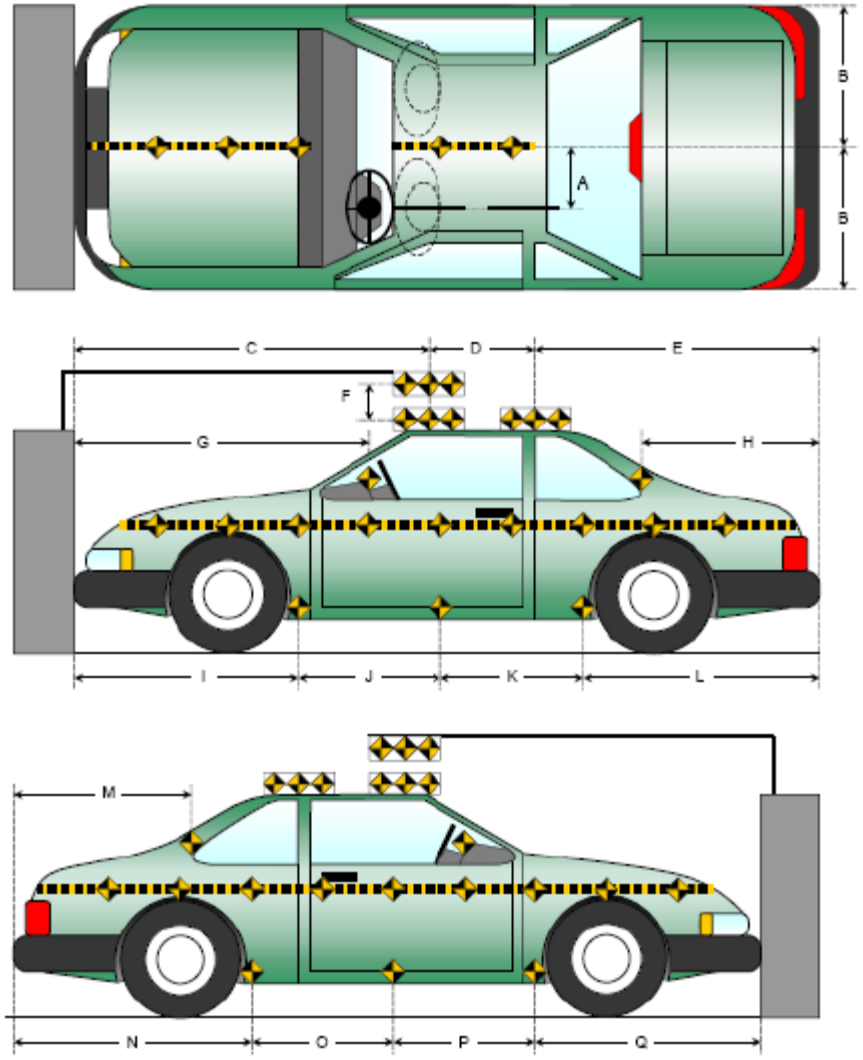
Reference Points: *X – Rear Surface of Vehicle (+ forward)*
Y – Vehicle Centerline (+ to right)
Z – Ground Plane (+ down)

DATA SHEET NO. 8
PHOTOGRAPHIC REFERENCE TARGET LOCATIONS

Test Vehicle: 2021 Genesis GV80 SUV
Test Program: NCAP Frontal Barrier Impact Test
NHTSA No.: O20214215
Test Date: 2/12/2021

Item	Value
A	390
B	966
C	2525
D	612
E	1805
F	244
G	1887
H	1223
I	1387
J	957
K	977
L	1621
M	1220
N	1620
O	954
P	977
Q	1391

All units in millimeters



DATA SHEET NO. 9
LOAD CELL LOCATIONS ON FIXED BARRIER

Test Vehicle:	2021 Genesis GV80 SUV	NHTSA No.:	O20214215
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	2/12/2021

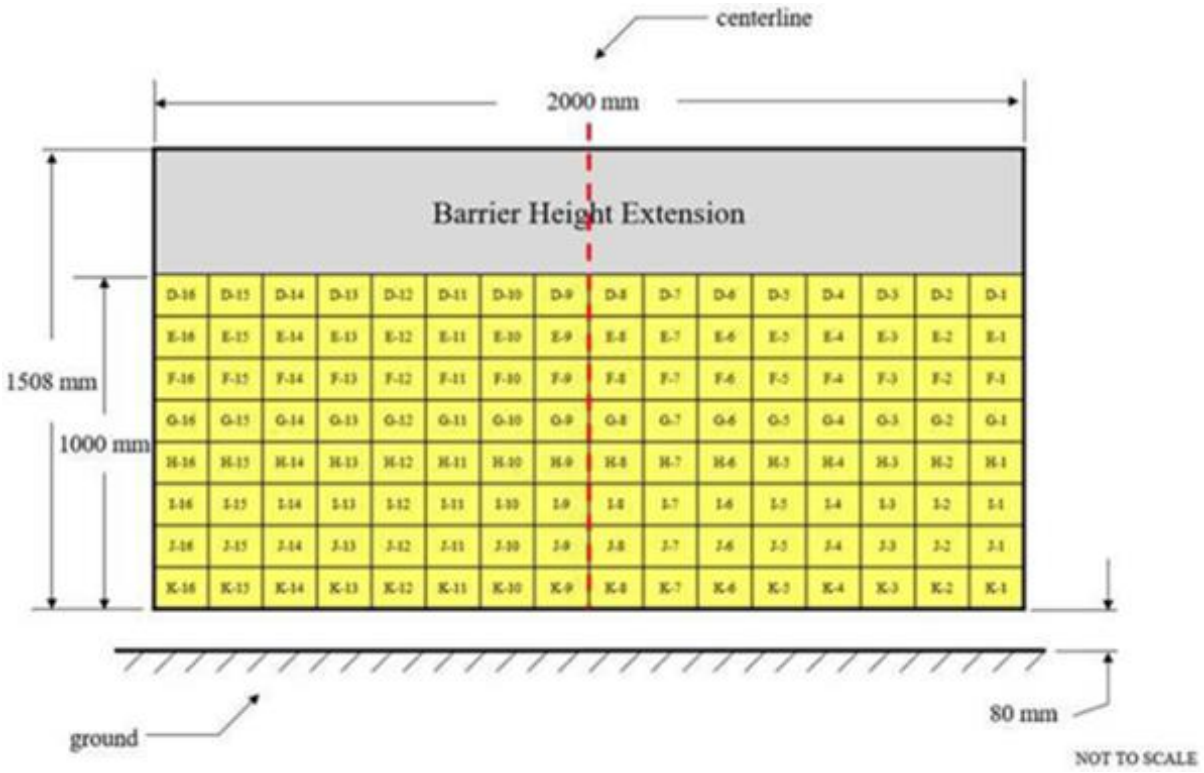


Figure 1 - Load Cell Locations on a 128-Load Cell Barrier with Plywood Height Extension*
Please note above diagram is not actual representation of load cell barrier used.

DATA SHEET NO. 10
TEST VEHICLE SUMMARY OF RESULTS

Test Vehicle: 2021 Genesis GV80 SUV NHTSA No.: O20214215
Test Program: NCAP Frontal Barrier Impact Test Test Date: 2/12/2021

INSTRUMENTATION

Instrumentation	Number of Channels Collected
Driver Dummy Accelerometers	47
Passenger Dummy Accelerometers	47
Vehicle Structure Accelerometers	8
Load Cell Barrier	384
Total	486

CAMERA COVERAGE

Type of Camera	Number Used in this Test
High-Speed Vehicle Onboard	2
High-Speed Offboard	14
Real-Time Panning	1
Total	17

DATA SHEET NO. 11
POST-TEST OBSERVATIONS

Test Vehicle: 2021 Genesis GV80 SUV NHTSA No.: O20214215
Test Program: NCAP Frontal Barrier Impact Test Test Date: 2/12/2021

TEST DUMMY INFORMATION AND CONTACT LOCATIONS

Description	Driver	Passenger
Dummy Type / Serial No.	P572E 50th Male / 142	P5720 5th Female / 140
Head Contact	Frontal Airbag & Headrest	Frontal Airbag & Headrest
Upper Torso Contact	Frontal Airbag	Frontal Airbag
Lower Torso Contact	None	None
Left Knee Contact	Knee Airbag	Glove Box
Right Knee Contact	Knee Airbag	Glove Box

DOOR OPENING AND SEAT TRACK INFORMATION

Description	Driver	Passenger	Other
Locked / Unlocked Doors	Unlocked	Unlocked	
Front Door Opening	Closed & Operational	Closed & Operational	
Rear Door Opening	Closed & Operational	Closed & Operational	
Trunk/Hatch/Tailgate Opening			Closed & Operational
Seat Track Shift (mm)	0	0	
Seat Back Movement from Initial Position	None	None	

POST-TEST STRUCTURAL OBSERVATIONS

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

VEHICLE REBOUND FROM BARRIER

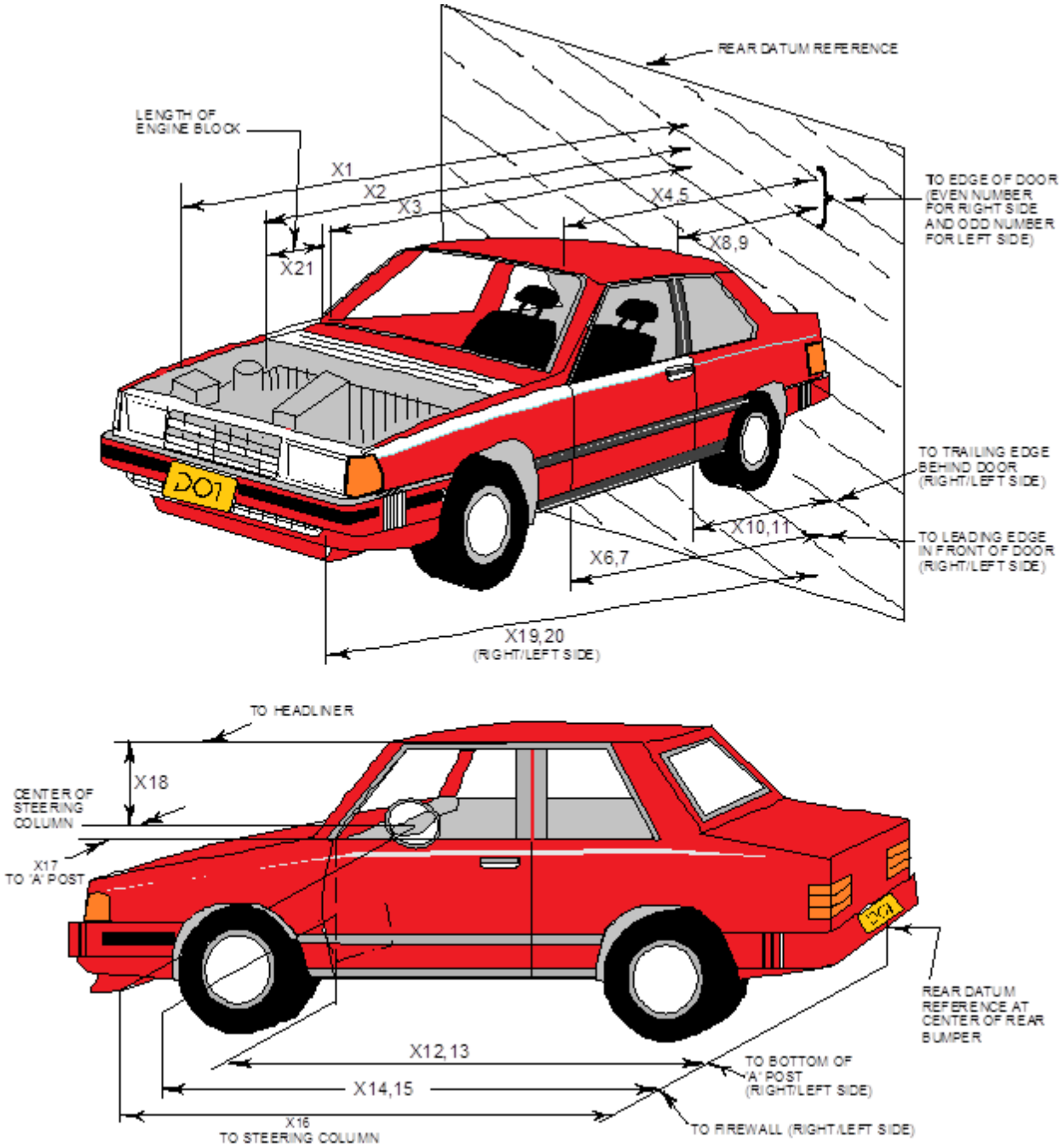
Measured Parameter	Units	Value
Left Side	mm	908
Center	mm	838
Right Side	mm	852
Average	mm	866

SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

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

DATA SHEET NO. 12
VEHICLE PROFILE MEASUREMENTS

Test Vehicle:	2021 Genesis GV80 SUV	NHTSA No.:	O20214215
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	2/12/2021



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

Test Vehicle: 2021 Genesis GV80 SUV NHTSA No.: O20214215
Test Program: NCAP Frontal Barrier Impact Test Test Date: 2/12/2021

No.	Measurement Description	Pre-Test	Post-Test	Difference
1	Total Length of Vehicle at Centerline	4942	4594	-348
2	Rear Surface of Vehicle (RSOV) to Front of Engine	4126	4046	-80
3	RSOV to Firewall	3768	3650	-118
4	RSOV to Upper Leading Edge of Right Door	3317	3318	1
5	RSOV to Upper Leading Edge of Left Door	3321	3320	-1
6	RSOV to Lower Leading Edge of Right Door	3368	3367	-1
7	RSOV to Lower Leading Edge of Left Door	3370	3371	1
8	RSOV to Upper Trailing Edge of Right Door	2259	2258	-1
9	RSOV to Upper Trailing Edge of Left Door	2259	2258	-1
10	RSOV to Lower Trailing Edge of Right Door	2316	2315	-1
11	RSOV to Lower Trailing Edge of Left Door	2318	2316	-2
12	RSOV to Bottom of “A” Post of Right Side	3539	3539	0
13	RSOV to Bottom of “A” Post of Left Side	3540	3540	0
14	RSOV to Firewall, Right Side	3791	3792	1
15	RSOV to Firewall, Left Side	3794	3795	1
16	RSOV to Steering Column	2871	2922	51
17	Center of Steering Column to “A” Post	299	297	-2
18	Center of Steering Column to Headliner	415	429	14
19	RSOV to Right Side of Front Bumper	4904	4578	-326
20	RSOV to Left Side of Front Bumper	4905	4544	-361
21	Length of Engine Block	375	375	0
RD	RSOV to Right Side of Dash Panel	3061	3063	2
CD	RSOV to Center of Dash Panel	3078	3079	1
LD	RSOV to Left Side of Dash Panel	3061	3062	1

*UR= Unrecoverable data point
All Dimensions in mm

DATA SHEET NO. 13
ACCIDENT INVESTIGATION DIVISION DATA

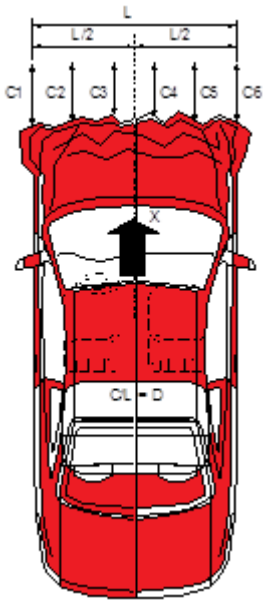
Test Vehicle:	2021 Genesis GV80 SUV	NHTSA No.:	O20214215
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	2/12/2021

VEHICLE INFORMATION

VIN:	KMUHCESC8MU031362	Wheelbase (mm):	2955
Vehicle Size Category:	MPV	Test Weight (kg):	2488

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):	56.35
Velocity Change (km/h):	65.63
Time of Separation (ms):	128



CRUSH PROFILE

Collision Deformation Classification:	12FDEW2
Midpoint of Damage:	C3
Damage Region Length (mm):	1563
Impact Mode:	Frontal

No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
C1	Crush Zone 1 at Left Side	mm	4711	4477	234
C2	Crush Zone 2 at Left Side	mm	4870	4547	323
C3	Crush Zone 3 at Left Side	mm	4932	4588	344
C4	Crush Zone 4 at Right Side	mm	4932	4606	326
C5	Crush Zone 5 at Right Side	mm	4867	4570	297
C6	Crush Zone 6 at Right Side	mm	4708	4493	215
L	C1 to C6	mm	1563	1636	-73

DATA SHEET NO. 14
VEHICLE INTRUSION MEASUREMENTS

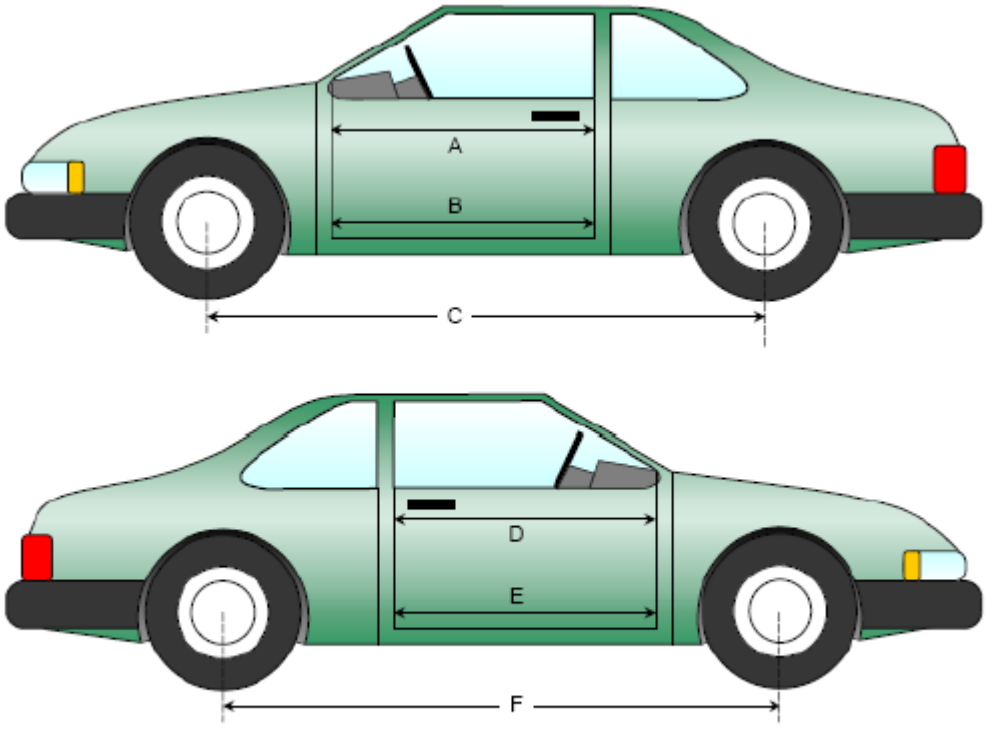
Test Vehicle: 2021 Genesis GV80 SUV
Test Program: NCAP Frontal Barrier Impact Test
NHTSA No.: O20214215
Test Date: 2/12/2021

DOOR OPENING WIDTH

Item	Description	Units	Pre-Test	Post-Test	Difference
A	Left Side Upper	mm	964	964	0
B	Left Side Lower	mm	873	872	-1
D	Right Side Upper	mm	966	965	-1
E	Right Side Lower	mm	873	873	0

WHEELBASE MEASUREMENTS

Item	Description	Units	Pre-Test	Post-Test	Difference
C	Left Side Wheelbase	mm	2955	2853	-102
F	Right Side Wheelbase	mm	2955	2858	-97



Left & Right Side Views

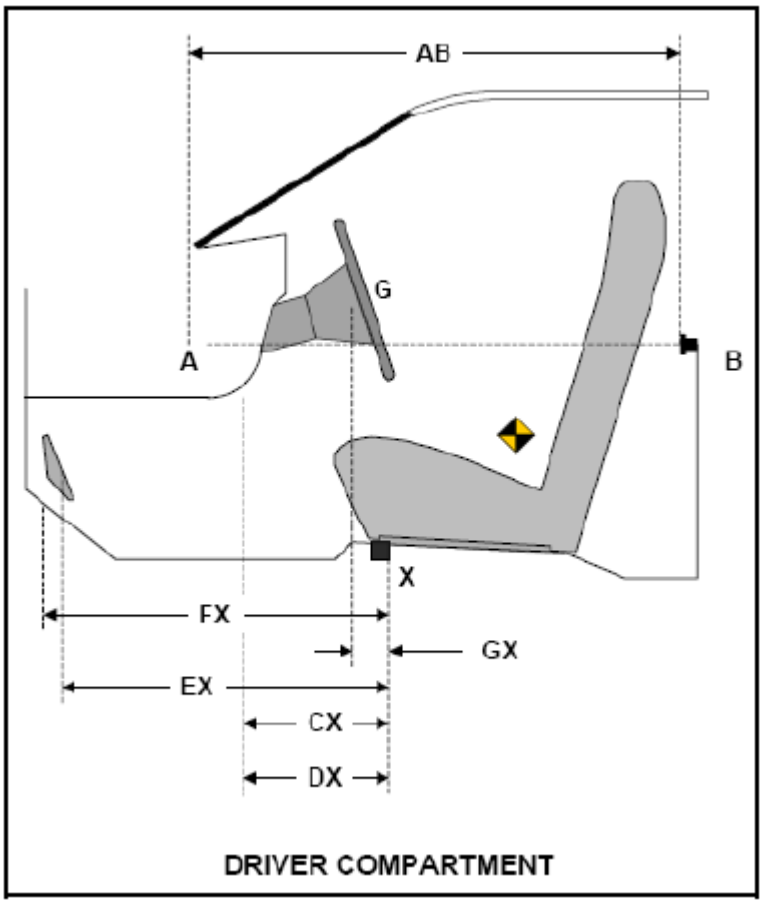
DATA SHEET NO.14 … (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2021 Genesis GV80 SUV NHTSA No.: O20214215
Test Program: NCAP Frontal Barrier Impact Test Test Date: 2/12/2021

DRIVER COMPARTMENT INTRUSION

Item	Description	Units	Pre-Test	Post-Test	Difference
AB	Door Opening (Inside Window Jam)	mm	675	671	-4
CX	Left Knee Bolster to X	mm	299	299	0
DX	Right Knee Bolster to X	mm	307	305	-2
EX	Brake Pedal to X	mm	573	558	-15
FX	Foot Rest to X	mm	578	574	-4
GX	Center of Steering Column Wheel Hub to X	mm	59	110	51

X = Front of Seat Track (Stationary)



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

Test Vehicle:	2021 Genesis GV80 SUV	NHTSA No.:	O20214215
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	2/12/2021

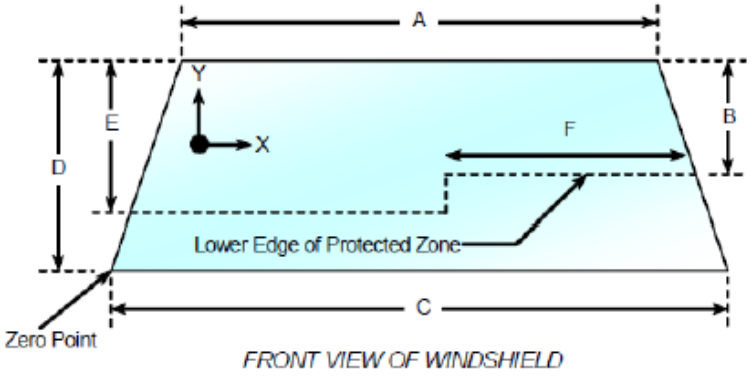
Windshield Mounting Details: A 0.8 mm trim surrounds the top and side of windshield while a plastic shroud is on the bottom.

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	2300.5	2300.5	100.00
Right Side	2300.5	2300.5	100.00
Total	4601	4601	4601



FRONT VIEW OF WINDSHIELD

Item	Units	Value
A	mm	1301
B	mm	454
C	mm	1570
D	mm	865
E	mm	527
F	mm	505

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:	2021 Genesis GV80 SUV	NHTSA No.:	O20214215
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	2/12/2021

FMVSS 301 FUEL SYSTEM INTEGRITY POST IMPACT DATA

Temperature at Time of Impact: 21 ° C Test Time: 12:30 PM

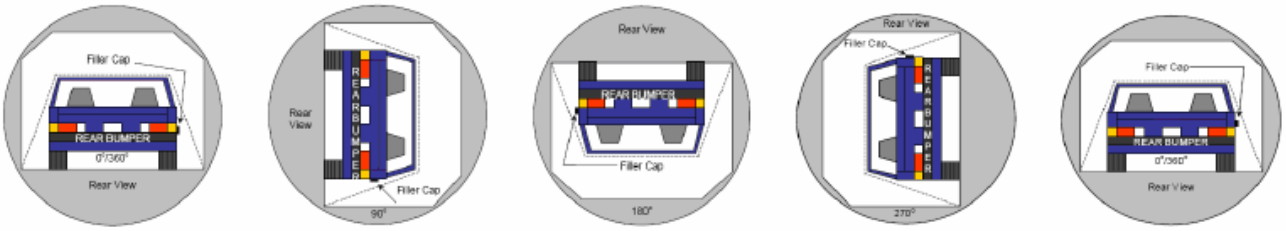
STODDARD SOLVENT SPILLAGE MEASUREMENTS

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: 2021 Genesis GV80 SUV NHTSA No.: O20214215
Test Program: NCAP Frontal Barrier Impact Test Test Date: 2/12/2021



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°	66	300	366
90° to 180°	67	300	367
180° to 270°	61	300	361
270° to 360°	66	300	366

FMVSS 301 SPILLAGE TABLE

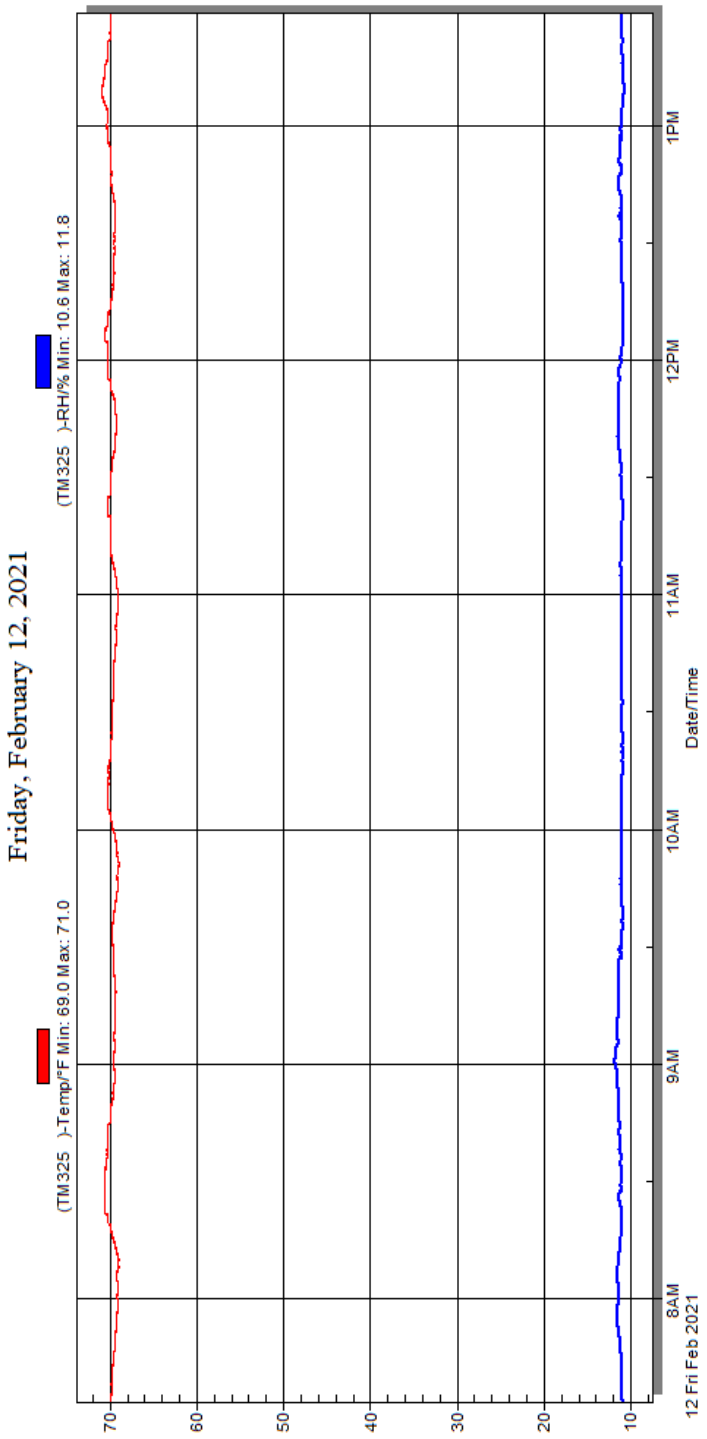
Test Phase	First 5 Minutes	Sixth Minute	Seventh Minute	Eighth Minute
0° to 90°	0	0	0	
90° to 180°	0	0	0	
180° to 270°	0	0	0	
270° to 360°	0	0	0	

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:	2021 Genesis GV80 SUV	NHTSA No.:	O20214215
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	2/12/2021



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.*

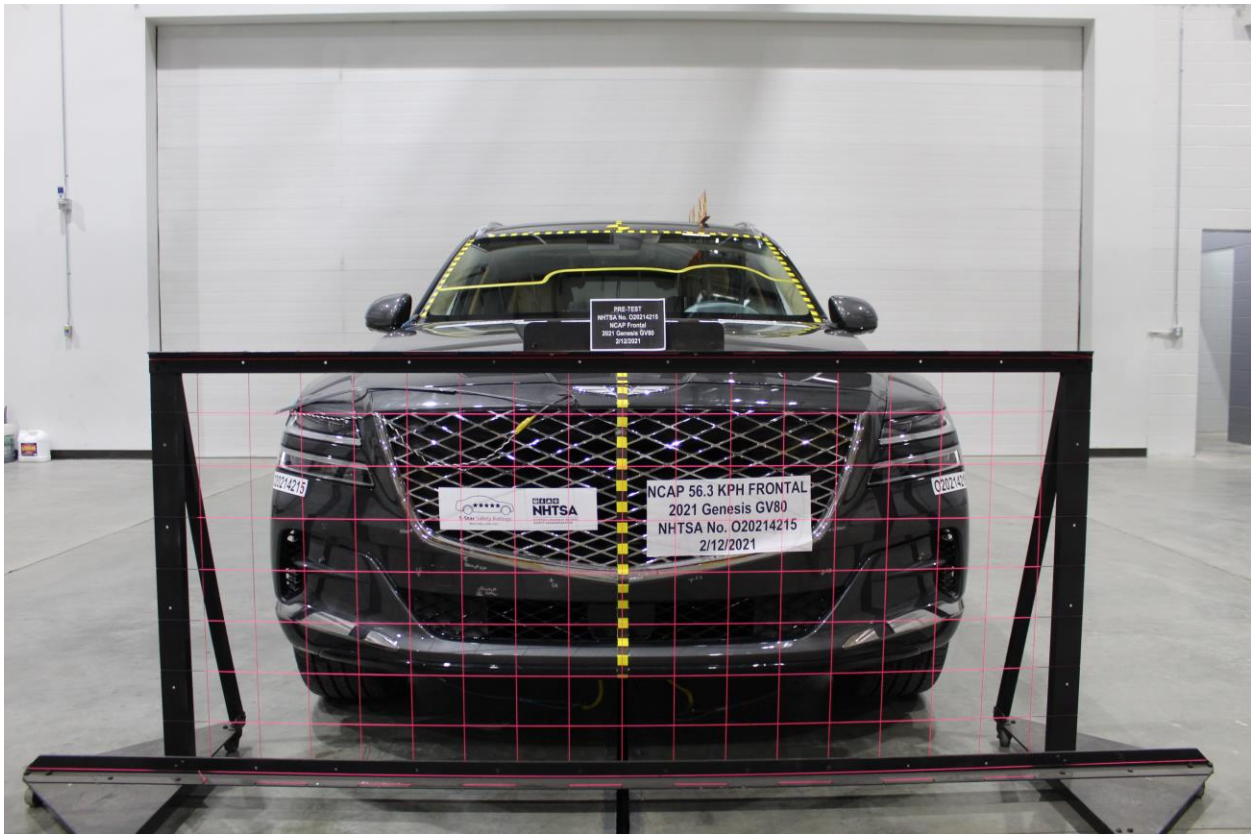


Figure A-1: Load Cell Location

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: 2021 Genesis GV80 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

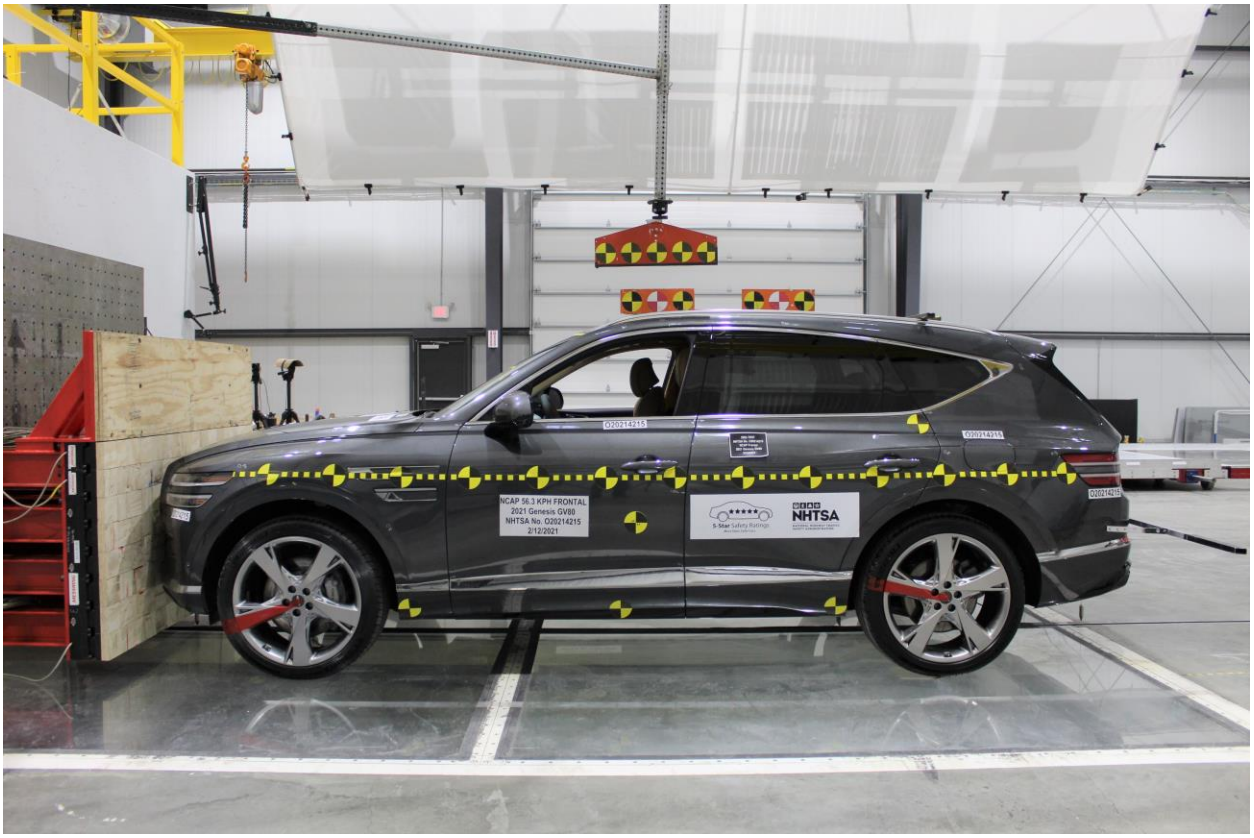


Figure A-10: Pre-Test Left View of Test Vehicle

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

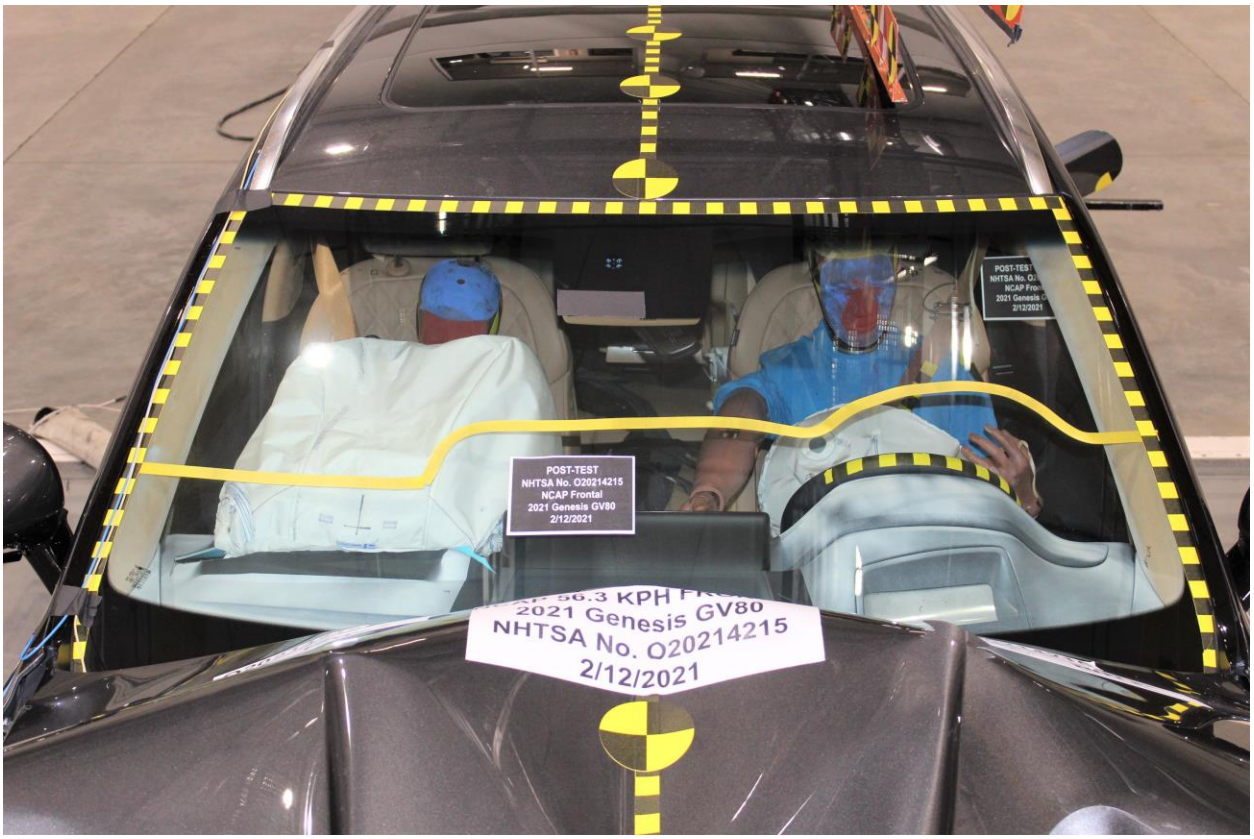


Figure A-19: Post-Test Windshield View

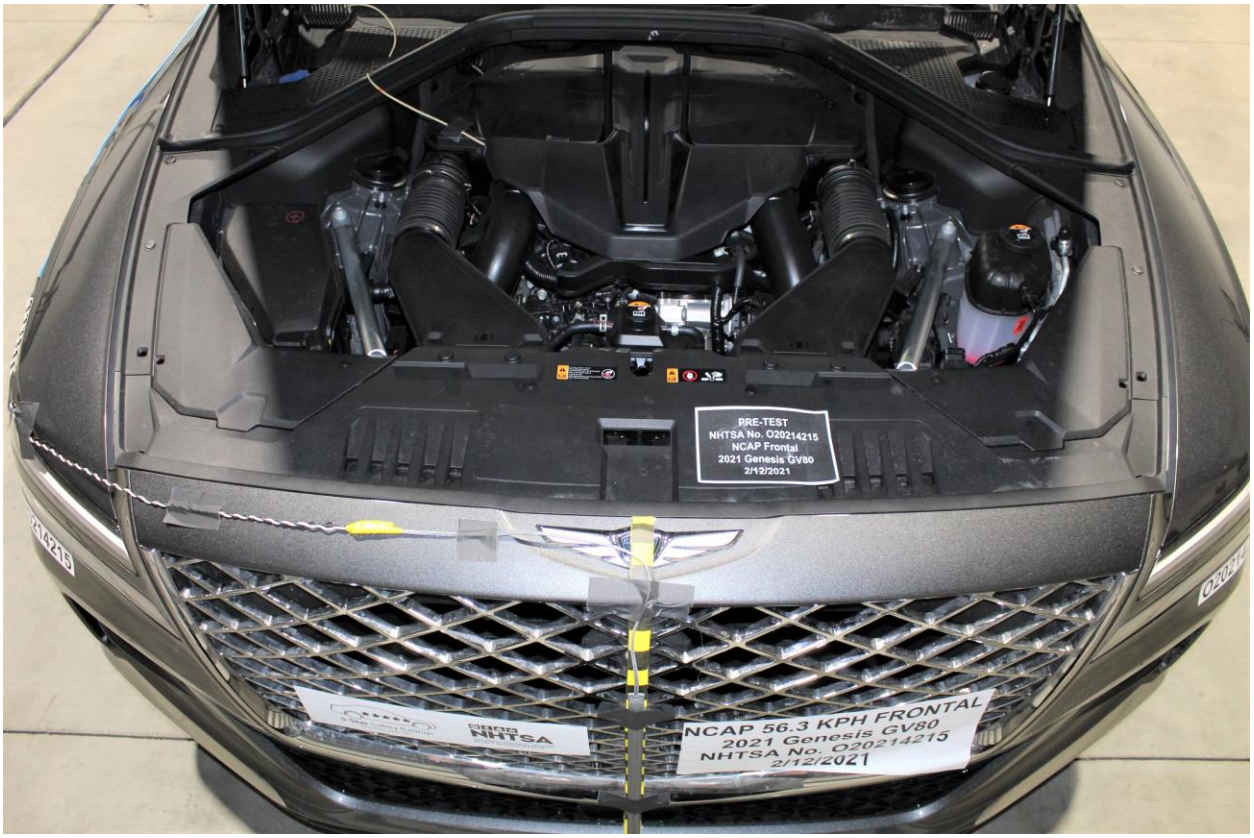


Figure A-20: Pre-Test Engine Compartment View

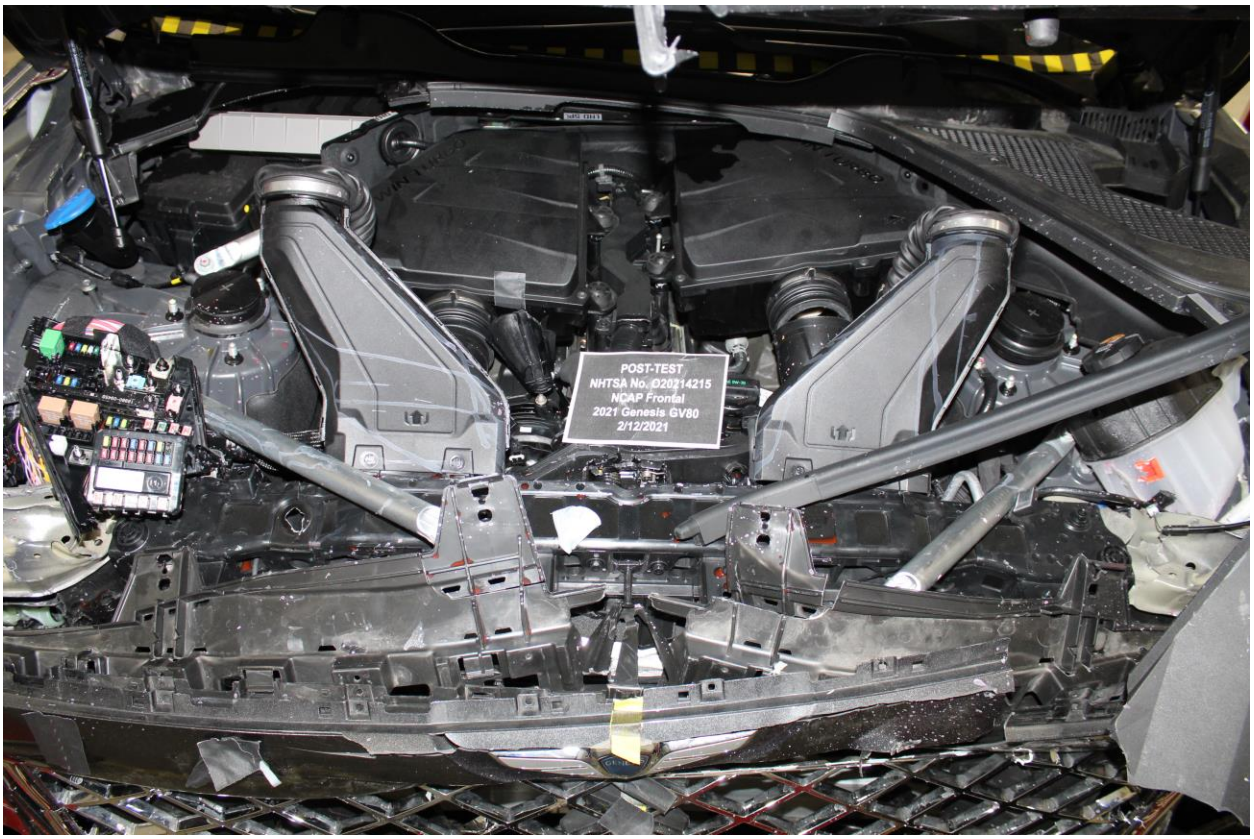


Figure A-21: Post-Test Engine Compartment View

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

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

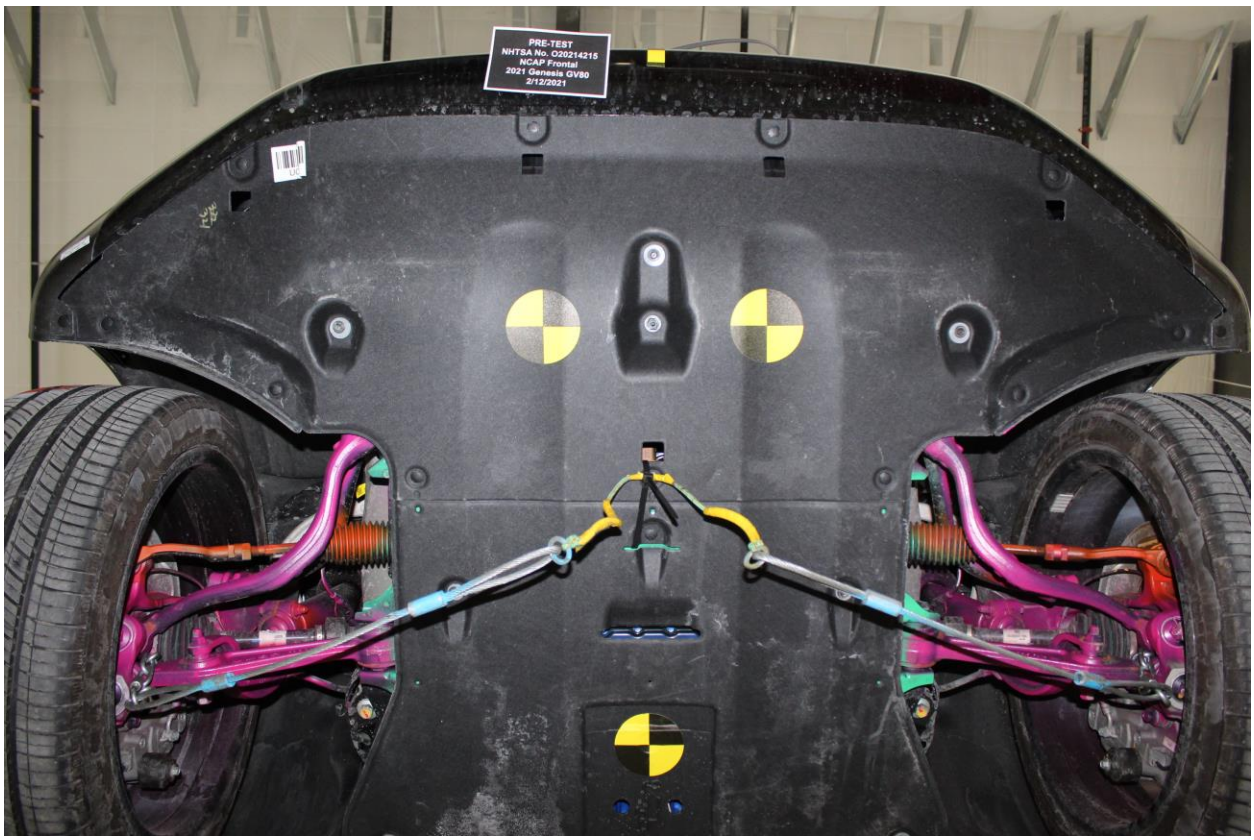


Figure A-24: Pre-Test Front Underbody View

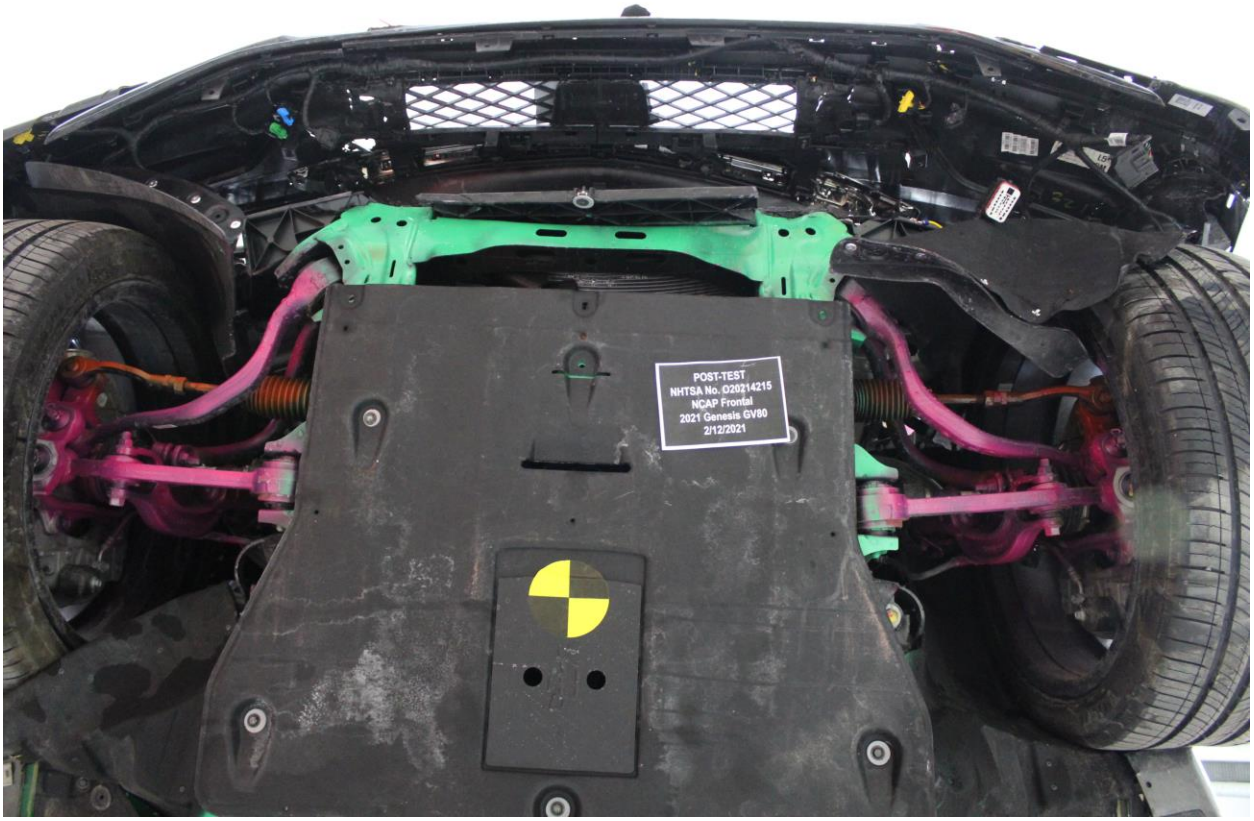


Figure A-25: Post-Test Front Underbody View

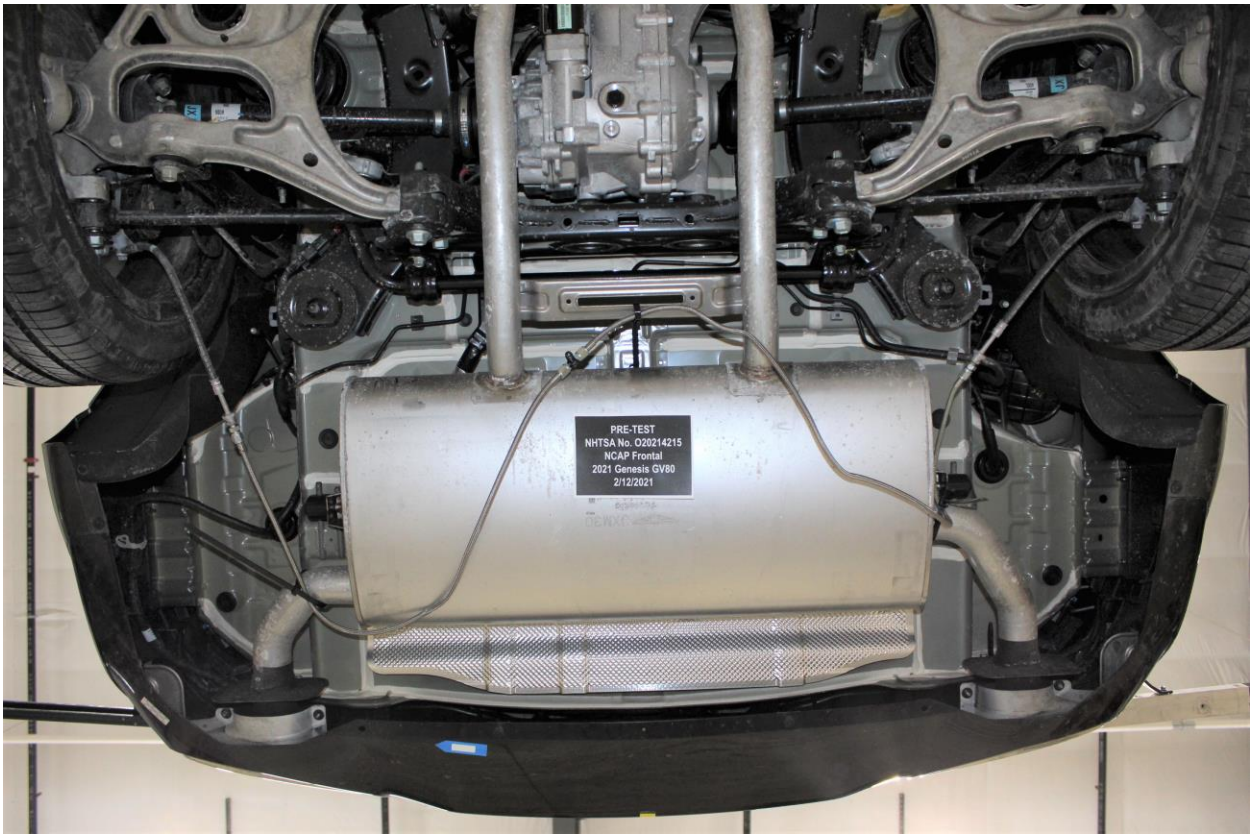


Figure A-26: Pre-Test Rear Underbody View

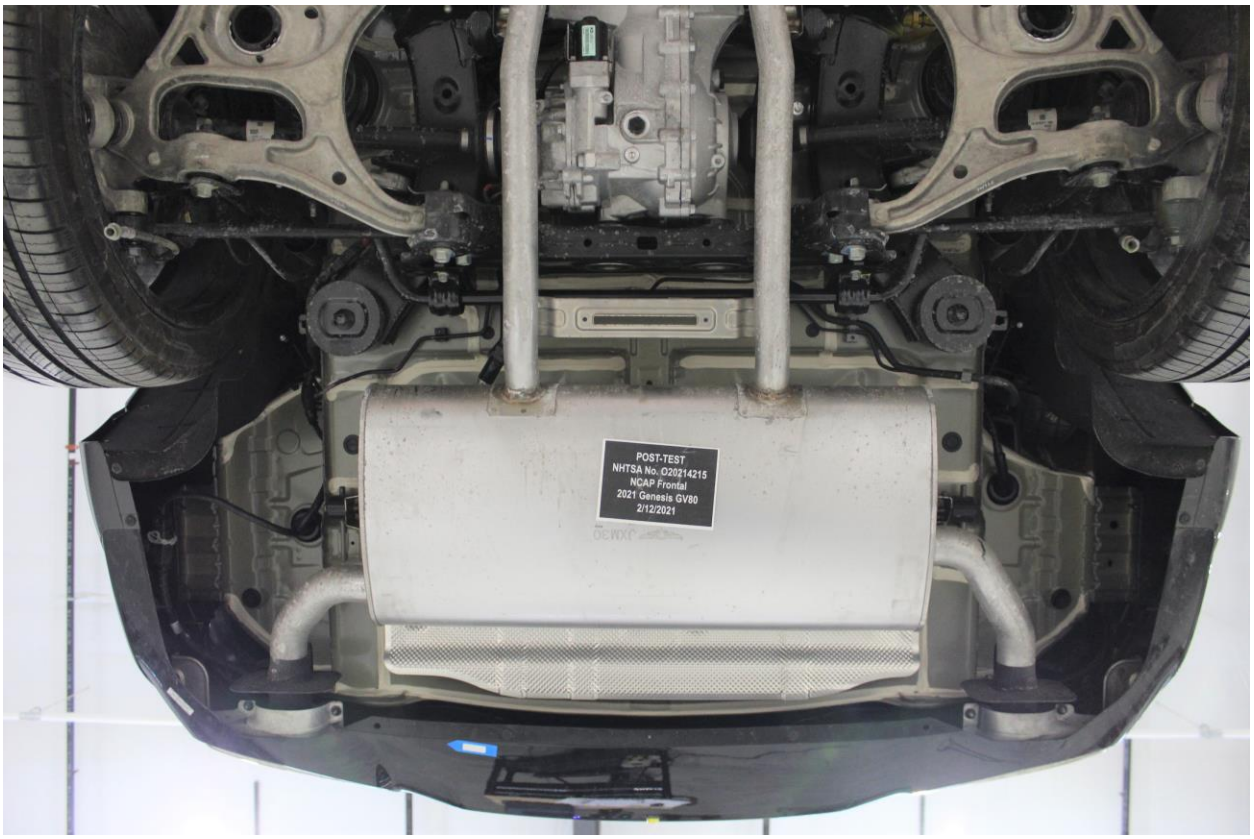


Figure A-27: Post-Test Rear Underbody View

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

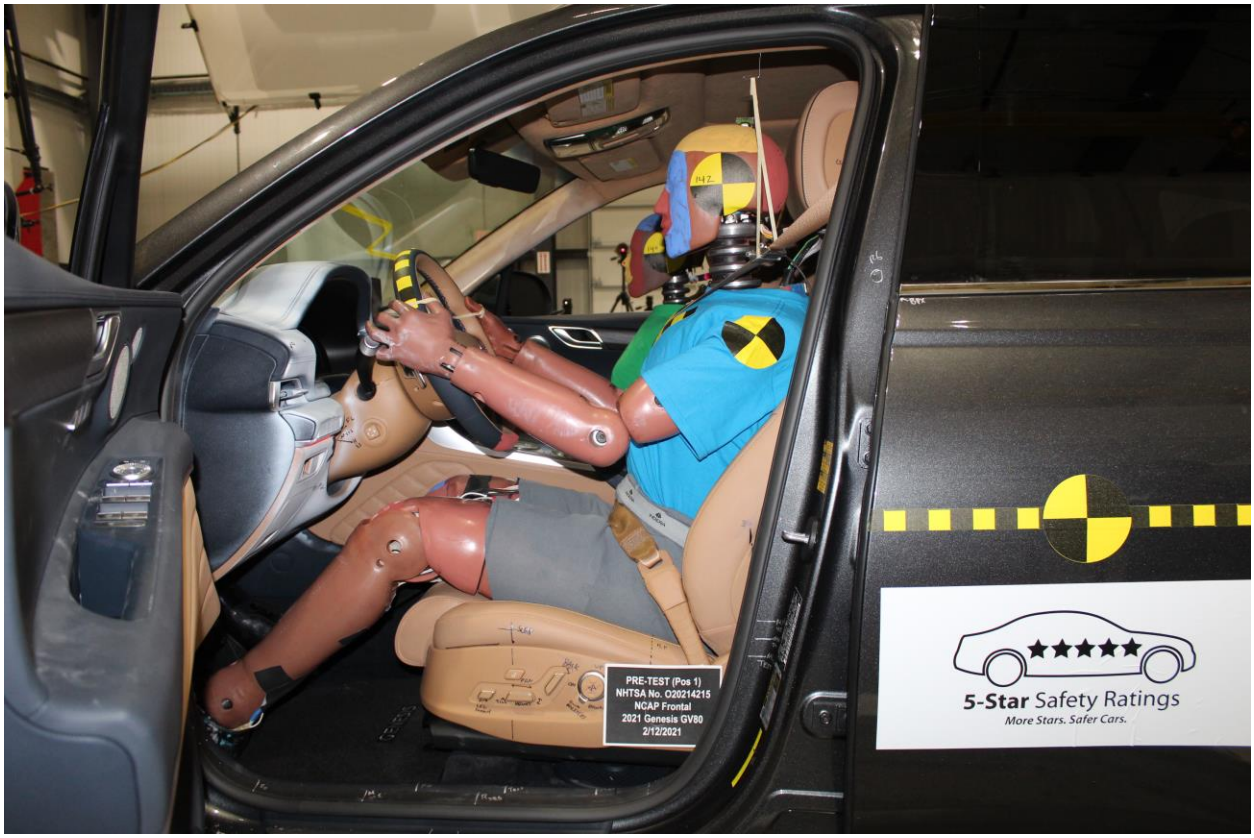


Figure A-34: Pre-Test Driver Dummy and Vehicle Interior View

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

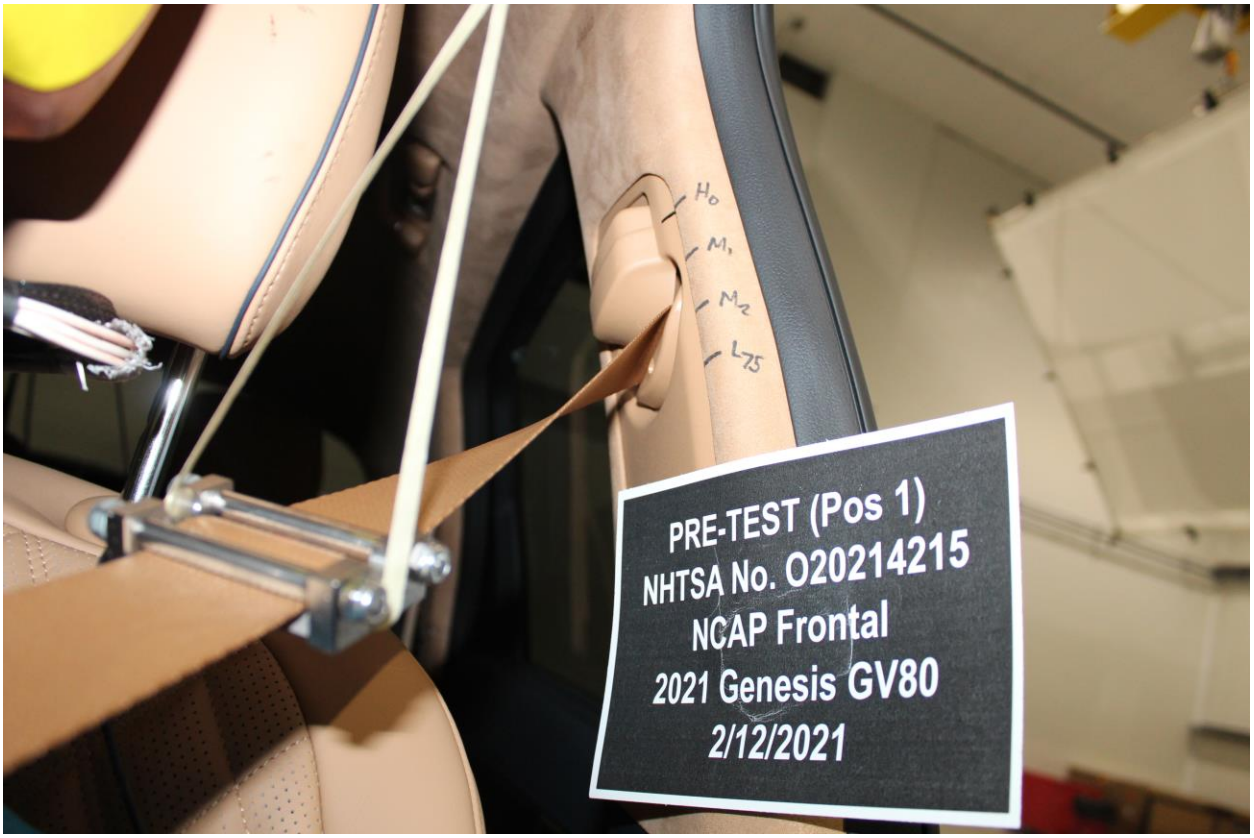


Figure A-38: Pre-Test View of Belt Anchorage for Driver Dummy

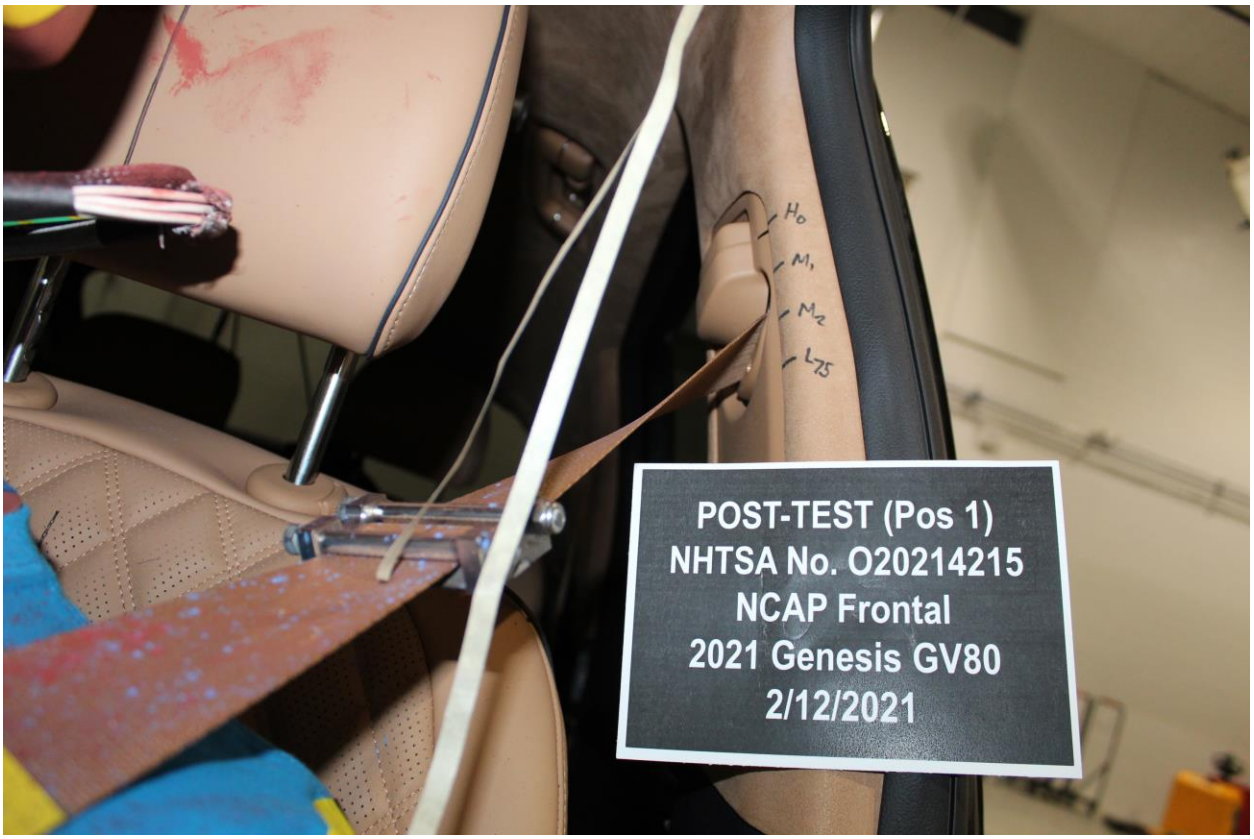


Figure A-39: Post-Test View of Belt Anchorage for Driver Dummy

Figure A-40: Pre-Test View of Belt Buckle and Latch Plate for Driver Dummy

Figure A-41: Post-Test View of Belt Buckle and Latch Plate for Driver Dummy

Figure A-42: Pre-Test Driver Dummy Feet

Figure A-43: Post-Test Driver Dummy Feet

Figure A-44: Pre-Test Driver's Side Knee Bolster

Figure A-45: Post-Test Driver's Side Knee Bolster

Figure A-46: Pre-Test Driver's Side Floorpan

Figure A-47: Post-Test Driver's Side Floorpan

Figure A-48: Post-Test Driver Dummy Face

Figure A-49: Post-Test Driver Dummy Contact With Airbag

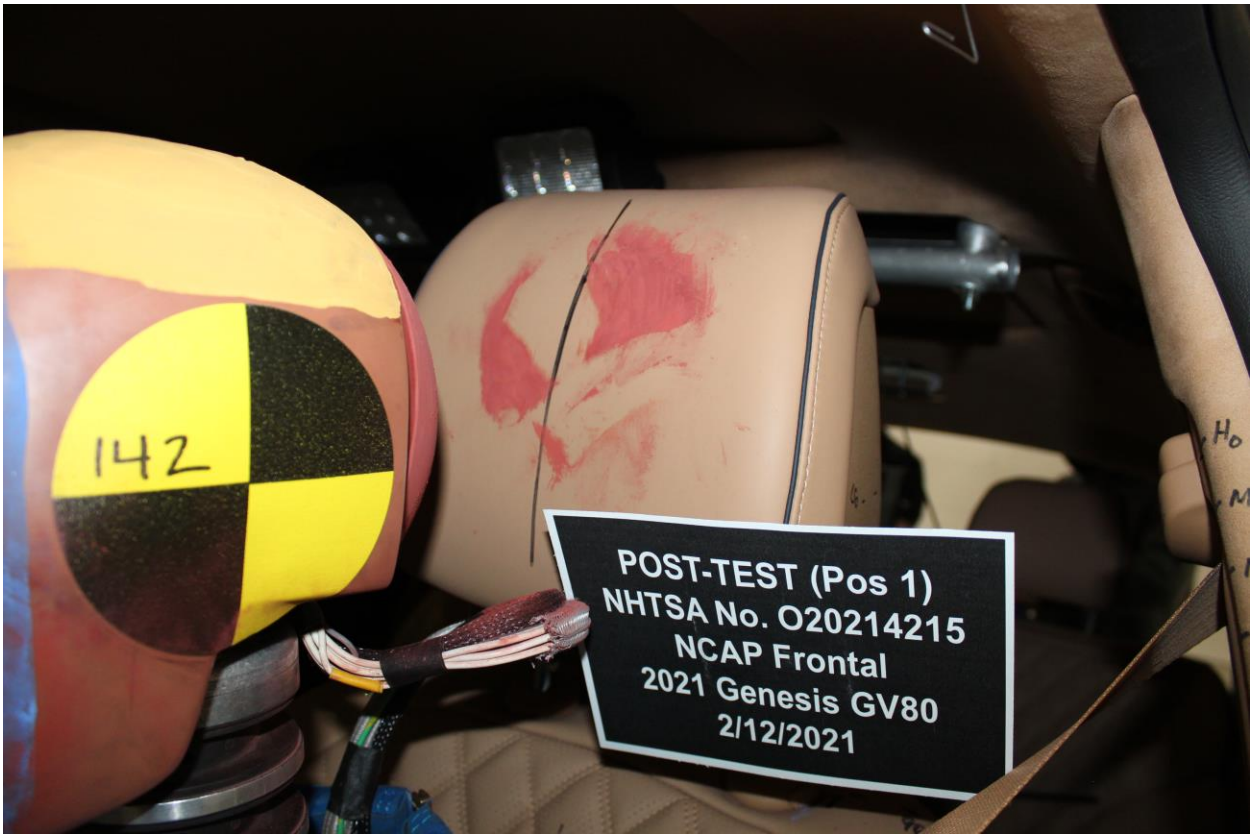


Figure A-50: Post-Test Driver Dummy Contact With Headrest

Figure A-51: Pre-Test View of the Steering Wheel

Figure A-52: Post-Test View of the Steering Wheel

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

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

Figure A-55: Pre-Test Passenger Dummy Window View

Figure A-56: Post-Test Passenger Dummy Window View

Figure A-57: Pre-Test Passenger Dummy and Vehicle Interior View

Figure A-58: Post-Test Passenger Dummy and Vehicle Interior View

Figure A-59: Pre-Test Passenger's Seat Fore-Aft Markings

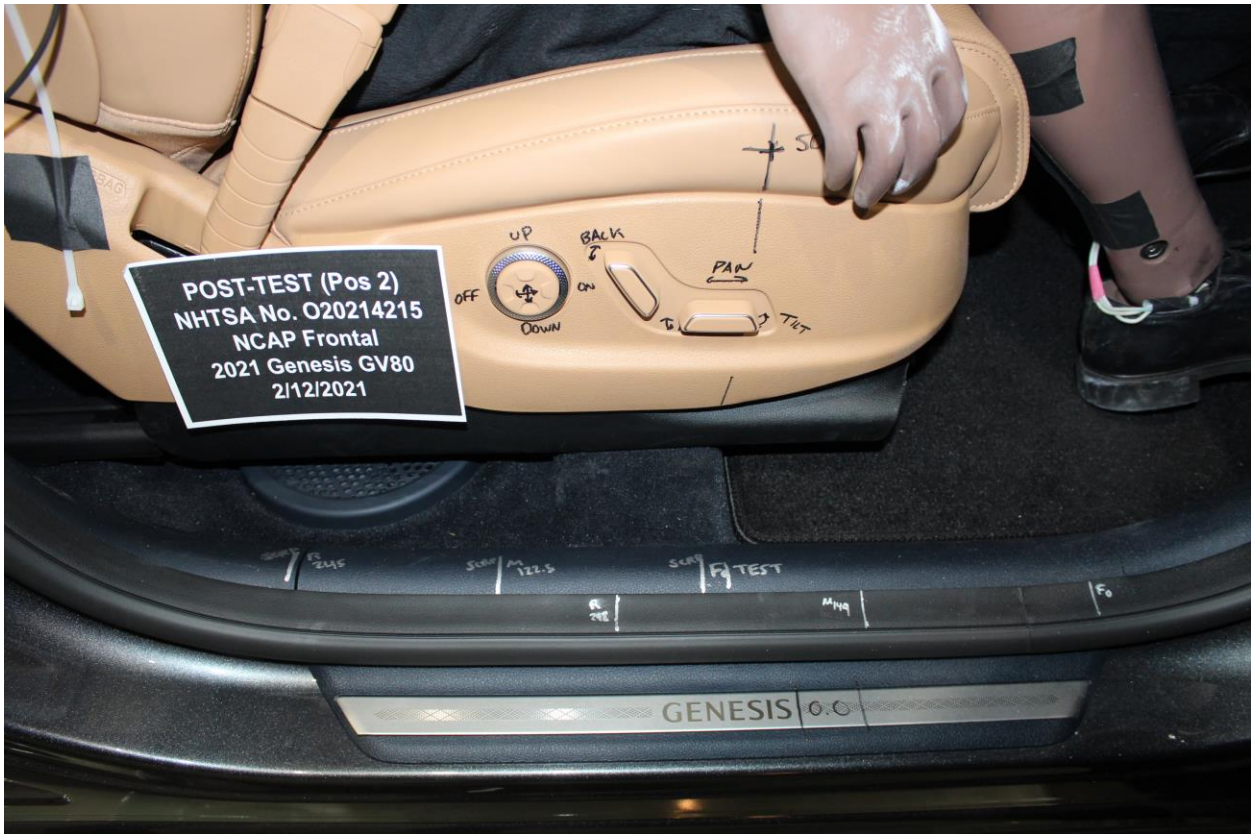


Figure A-60: Post-Test Passenger's Seat Fore-Aft Markings

Figure A-61: Pre-Test View of Belt Anchorage for Passenger Dummy

Figure A-62: Post-Test View of Belt Anchorage for Passenger Dummy

Figure A-63: Pre-Test View of Belt Buckle and Latch Plate for Passenger Dummy

Figure A-64: Post-Test View of Belt Buckle and Latch Plate for Passenger Dummy

Figure A-65: Pre-Test Passenger Dummy Feet

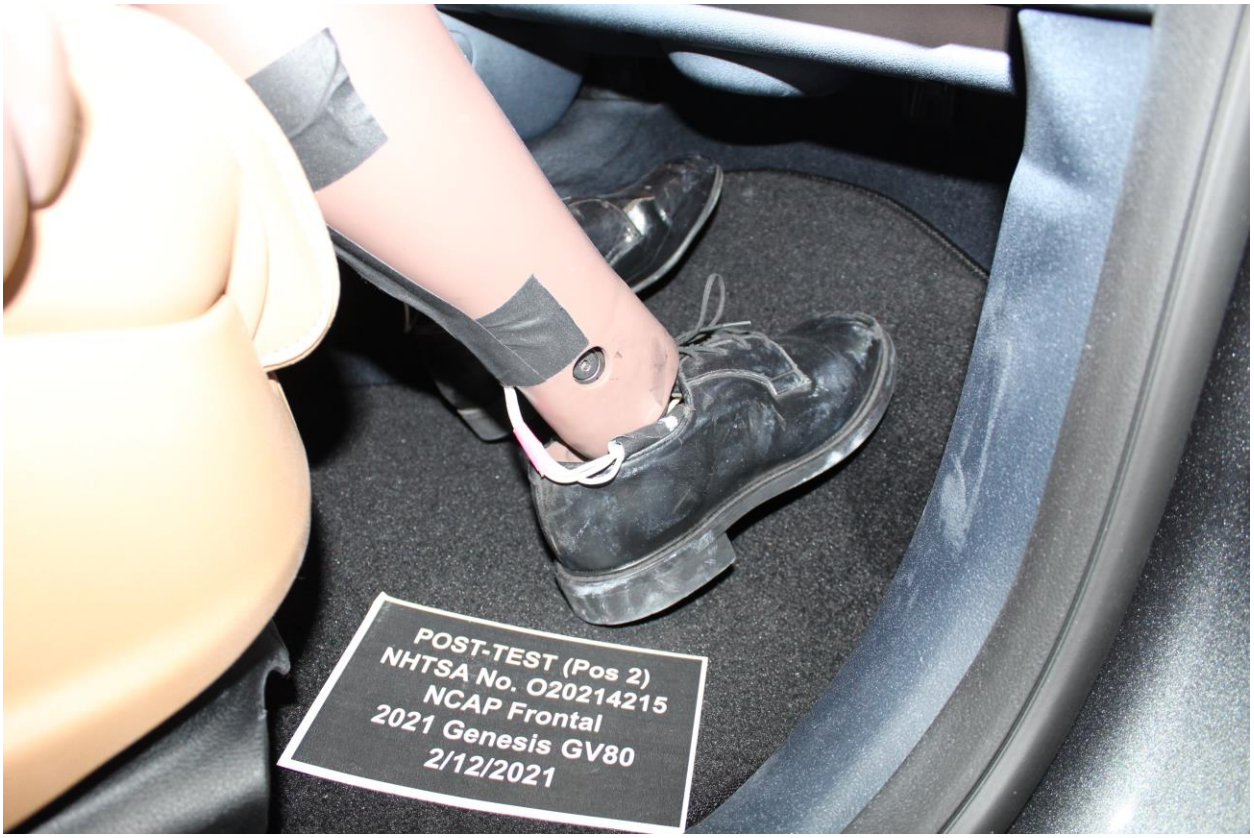


Figure A-66: Post-Test Passenger Dummy Feet

Figure A-67: Pre-Test Passenger's Side Knee Bolster

Figure A-68: Post-Test Passenger's Side Knee Bolster

Figure A-69: Pre-Test Passenger's Side Floorpan

Figure A-70: Post-Test Passenger's Side Floorpan

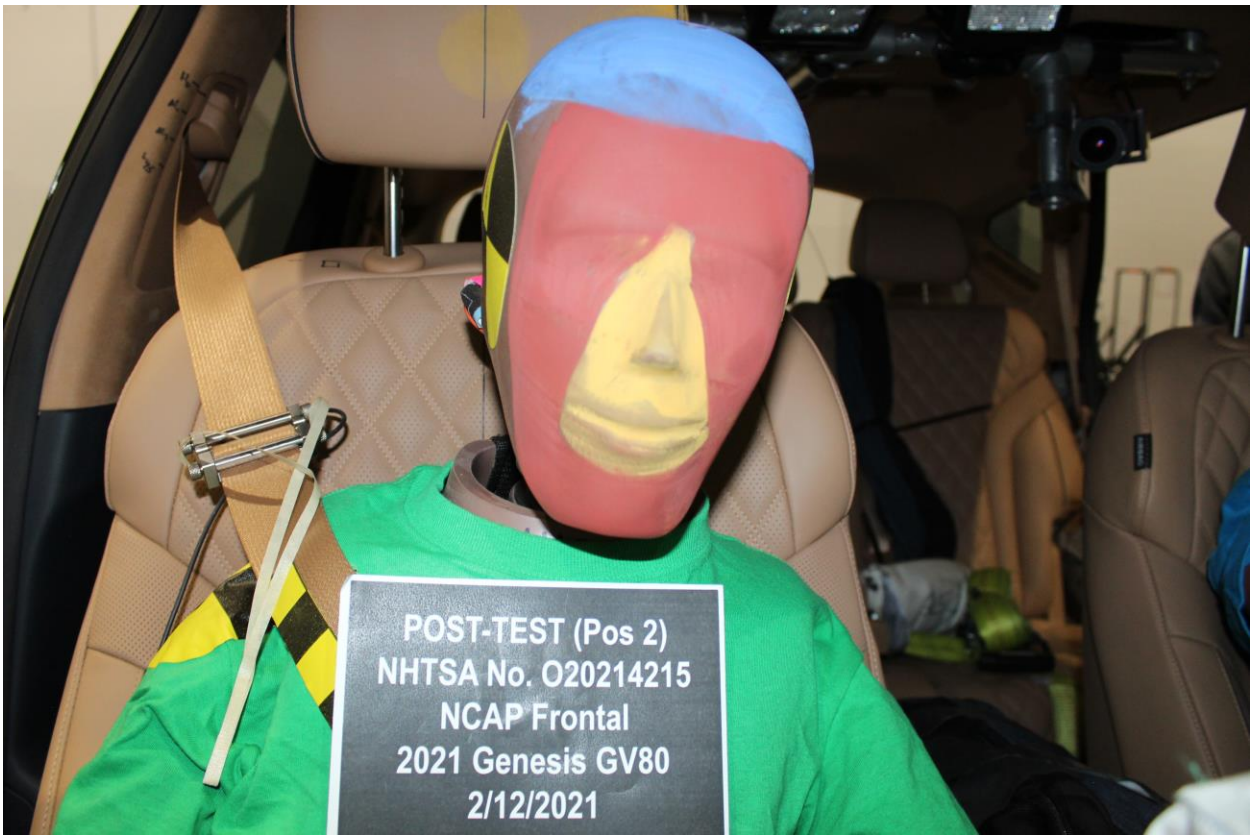


Figure A-71: Post-Test Passenger Dummy Face

Figure A-72: Post-Test Passenger Dummy Contact With Airbag

Figure A-73: Post-Test Passenger Dummy Contact With Headrest

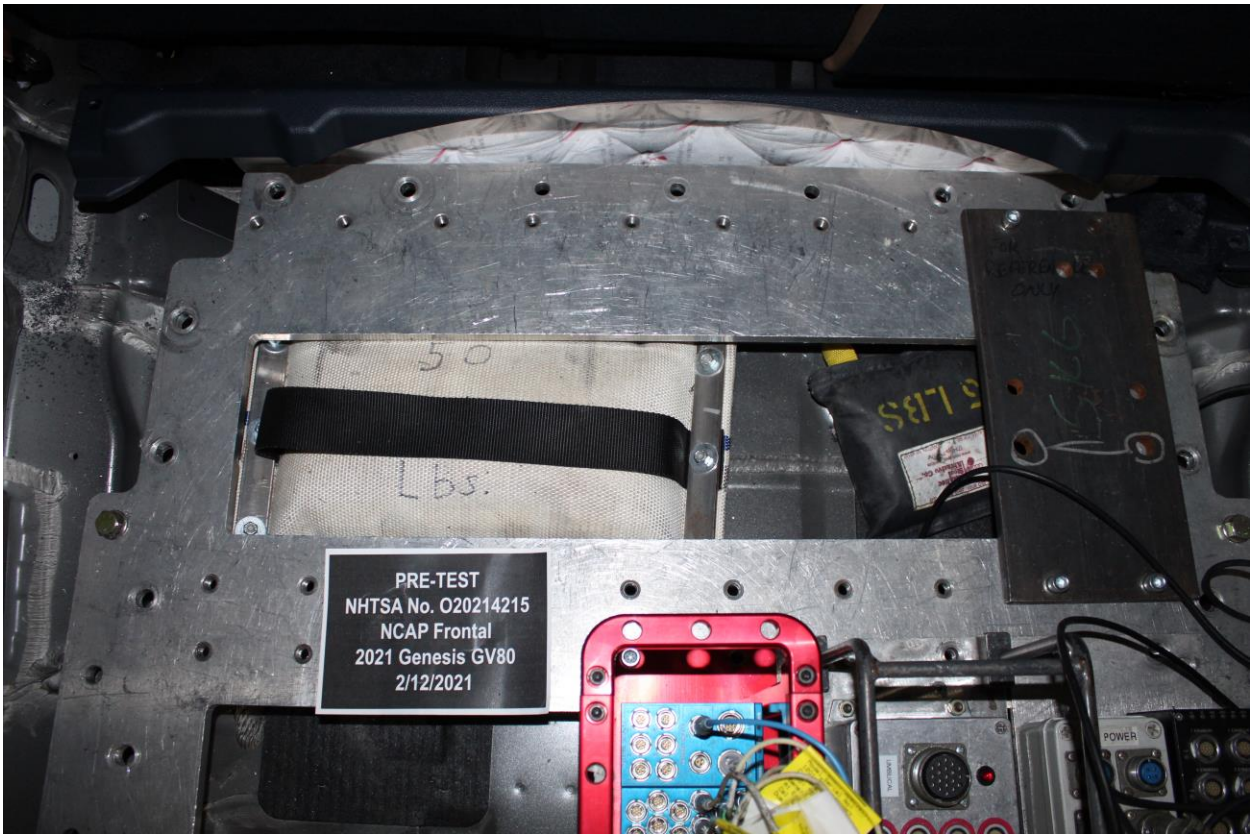


Figure A-74: Photograph of Ballast Installed in Vehicle

Photo Not Applicable

Figure A-75: Post-Test Stoddard Solvent Spillage Location View, If Required

Figure A-76: Post-Test Speed Trap Read-Out

Figure A-77: Vehicle at 0º on Static Rollover Device

Figure A-78: Vehicle at 90º on Static Rollover Device

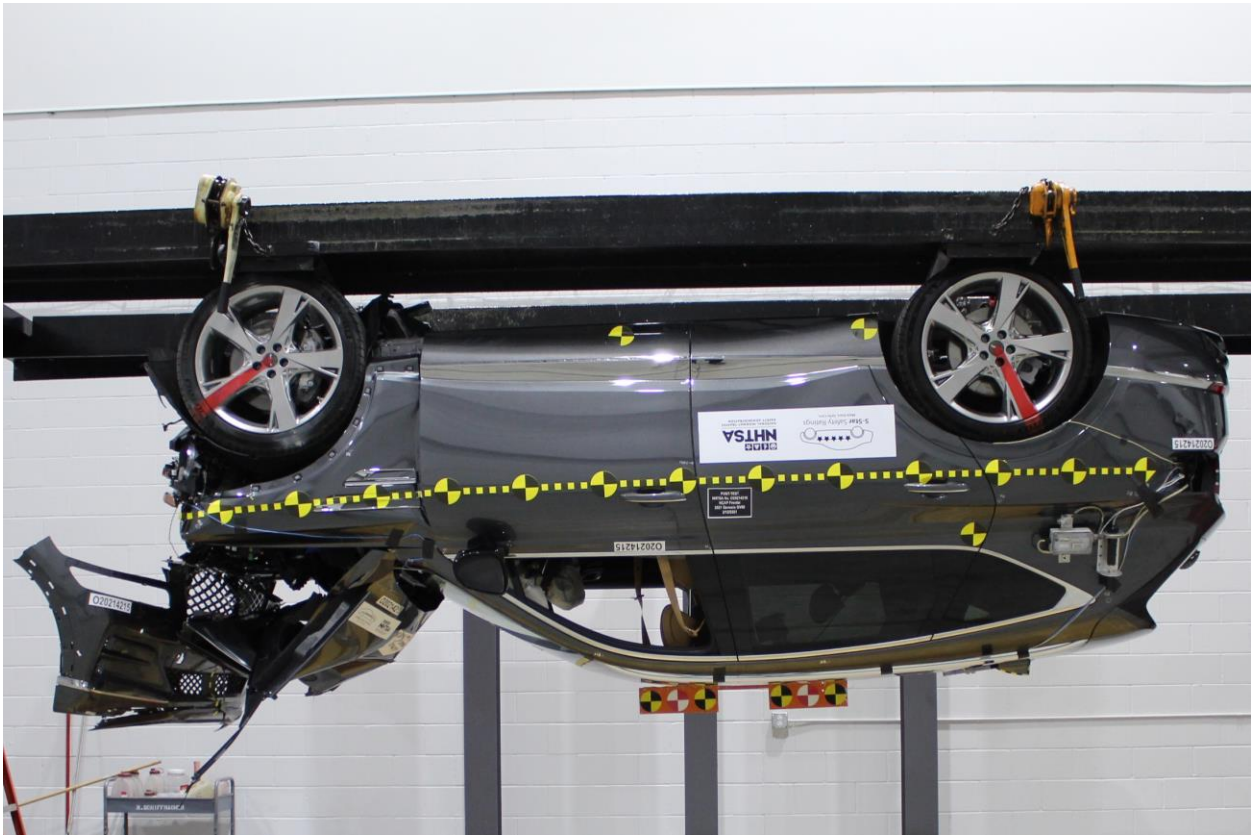


Figure A-79: Vehicle at 180º on Static Rollover Device

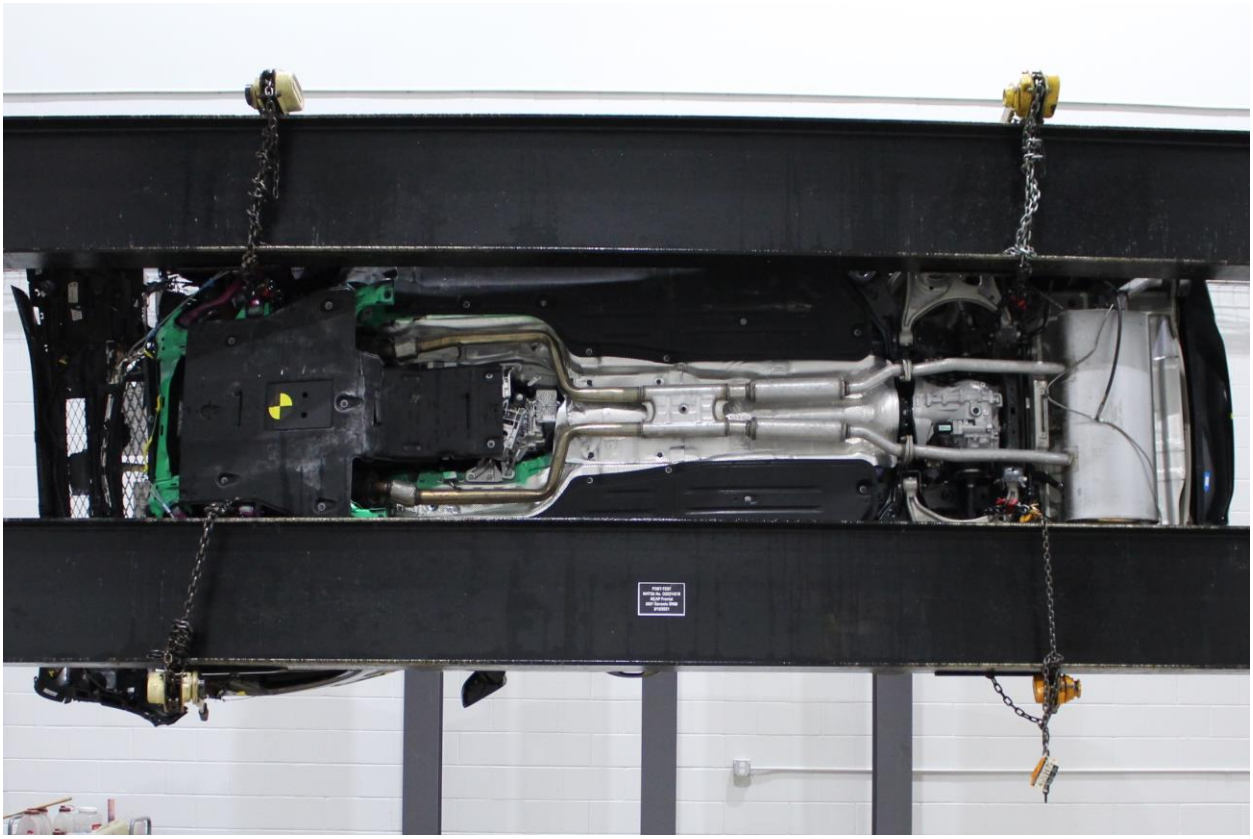


Figure A-80: Vehicle at 270º on Static Rollover Device

Figure A-81: Vehicle at 360º on Static Rollover Device

Figure A-82: 2021 Genesis GV80 Frontal Impact Event

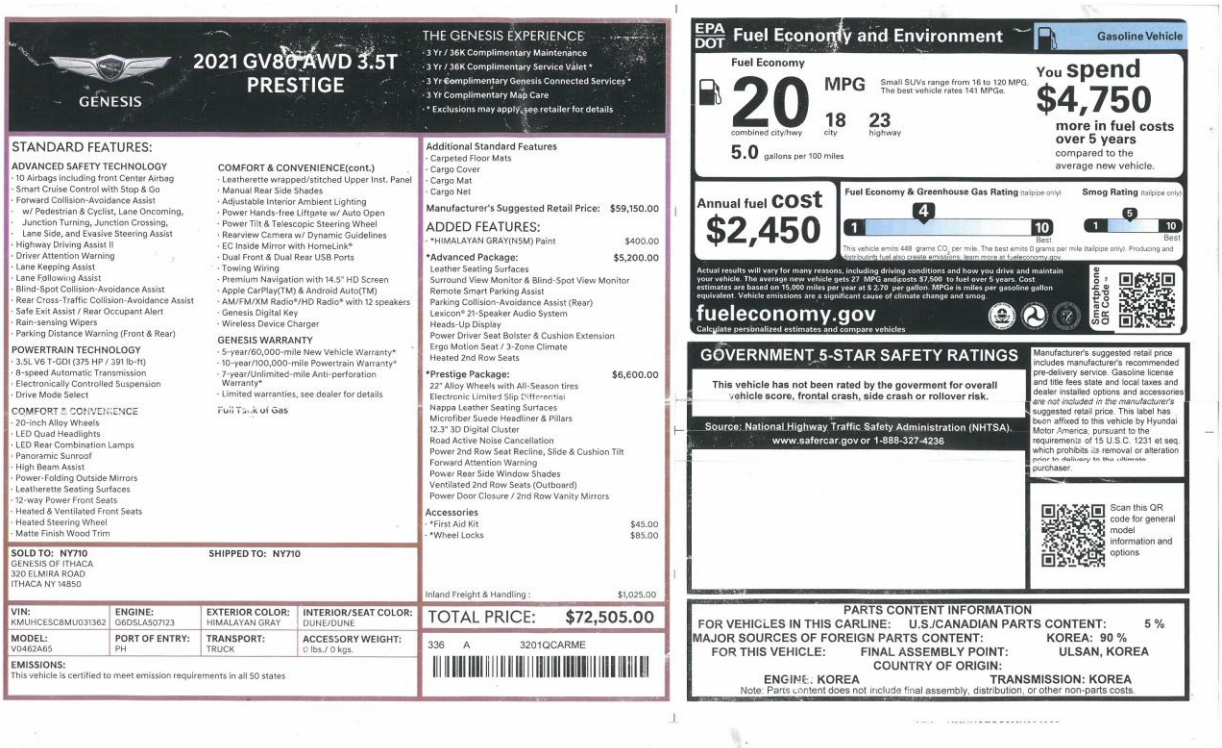


Figure A-83: Monroney Label Photograph

APPENDIX B
VEHICLE & DUMMY RESPONSE DATA TRACES

Table of Data Plots

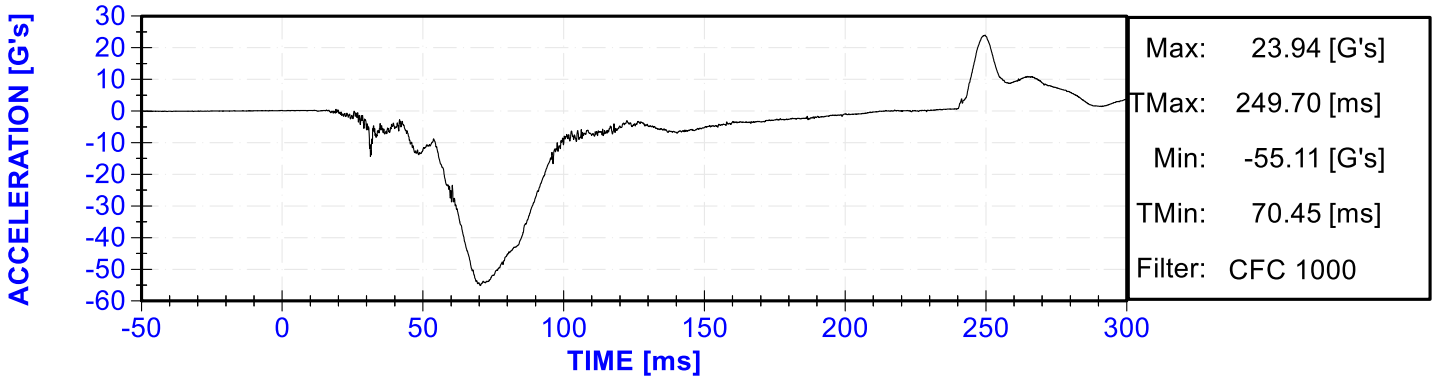
The following additional dummy and vehicle response data can be found in the R&D section of the NHTSA website at www.NHTSA.gov

Driver Head X Acceleration Redundant
Driver Head Y Acceleration Redundant
Driver Head Z Acceleration Redundant
Driver Upper Neck Force Y
Driver Upper Neck Moment X
Driver Upper Neck Moment Z
Driver Chest X Acceleration Redundant
Driver Chest Y Acceleration Redundant
Driver Chest Z Acceleration Redundant
Driver Pelvis X
Driver Pelvis Y
Driver Pelvis Z
Driver Left Femur Redundant
Driver Right Femur Redundant
Driver Left Upper Tibia Moment X
Driver Left Upper Tibia Moment Y

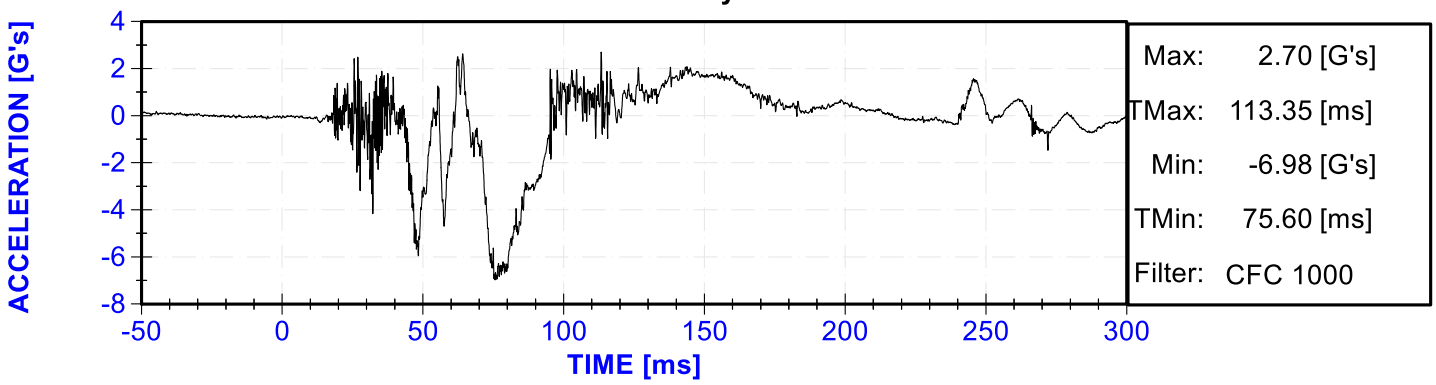
Driver Left Upper Tibia Force Z
Driver Left Lower Tibia Moment X
Driver Left Lower Tibia Moment Y
Driver Left Lower Tibia Force Z
Driver Right Upper Tibia Moment X
Driver Right Upper Tibia Moment Y
Driver Right Upper Tibia Force Z
Driver Right Lower Tibia Moment X
Driver Right Lower Tibia Moment Y
Driver Right Lower Tibia Force Z
Driver Left Foot Fore Z
Driver Left Foot Aft X
Driver Left Foot Aft Z
Driver Right Foot Fore Z
Driver Right Foot Aft X
Driver Right Foot Aft Z
Driver Shoulder Belt Force
Driver Lap Belt Force
Driver Head Angular Velocity X
Driver Head Angular Velocity Y
Driver Head Angular Velocity Z
Passenger Head X Acceleration Redundant
Passenger Head Y Acceleration Redundant
Passenger Head Z Acceleration Redundant
Passenger Upper Neck Force X
Passenger Upper Neck Force Z
Passenger Upper Neck Moment Y
Passenger Chest X Acceleration Redundant
Passenger Chest Y Acceleration Redundant
Passenger Chest Z Acceleration Redundant
Passenger Pelvis X
Passenger Pelvis Y
Passenger Pelvis Z
Passenger Left Femur Redundant
Passenger Right Femur Redundant
Passenger Left Upper Tibia Moment X
Passenger Left Upper Tibia Moment Y
Passenger Left Upper Tibia Force Z
Passenger Left Lower Tibia Moment X
Passenger Left Lower Tibia Moment Y
Passenger Left Lower Tibia Force Z
Passenger Right Upper Tibia Moment X
Passenger Right Upper Tibia Moment Y
Passenger Right Upper Tibia Force Z
Passenger Right Lower Tibia Moment X
Passenger Right Lower Tibia Moment Y
Passenger Right Lower Tibia Force Z
Passenger Left Foot Fore Z
Passenger Left Foot Aft X
Passenger Left Foot Aft Z

Passenger Right Food Fore Z
Passenger Right Foot Aft X
Passenger Right Foot Aft Z
Passenger Shoulder Belt Force
Passenger Lap Belt Force
Passenger Head Angular Velocity X
Passenger Head Angular Velocity Y
Passenger Head Angular Velocity Z
Left Rear Seat Crossmember X
Left Rear Seat Crossmember Z
Right Rear Seat Crossmember X
Right Rear Seat Crossmember Z
Left Rear Seat Crossmember X Redundant
Right Rear Seat Crossmember X Redundant
Vehicle Engine Top X
Vehicle Engine Bottom X
Load Cell Barrier Forces and Moments

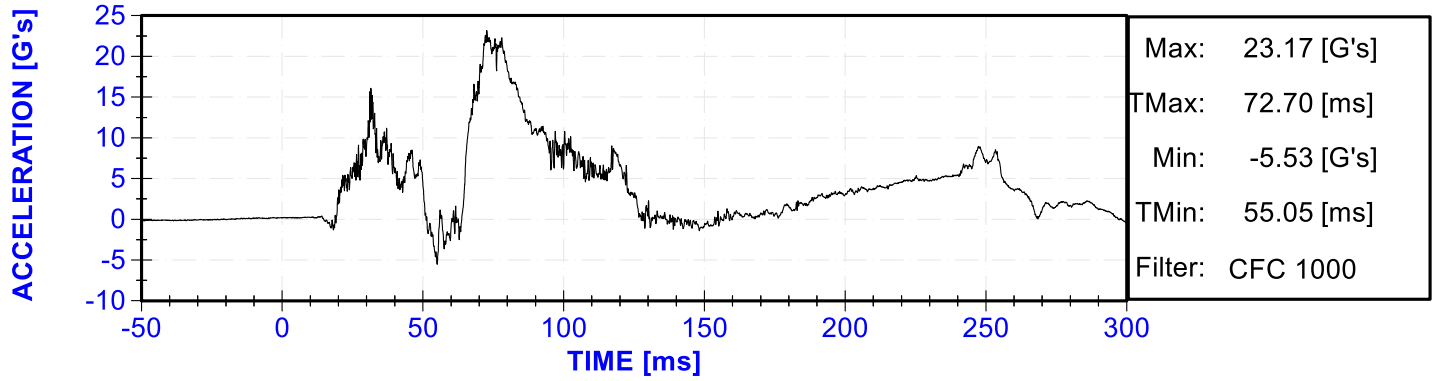
Driver Head X Acceleration vs. Time Primary



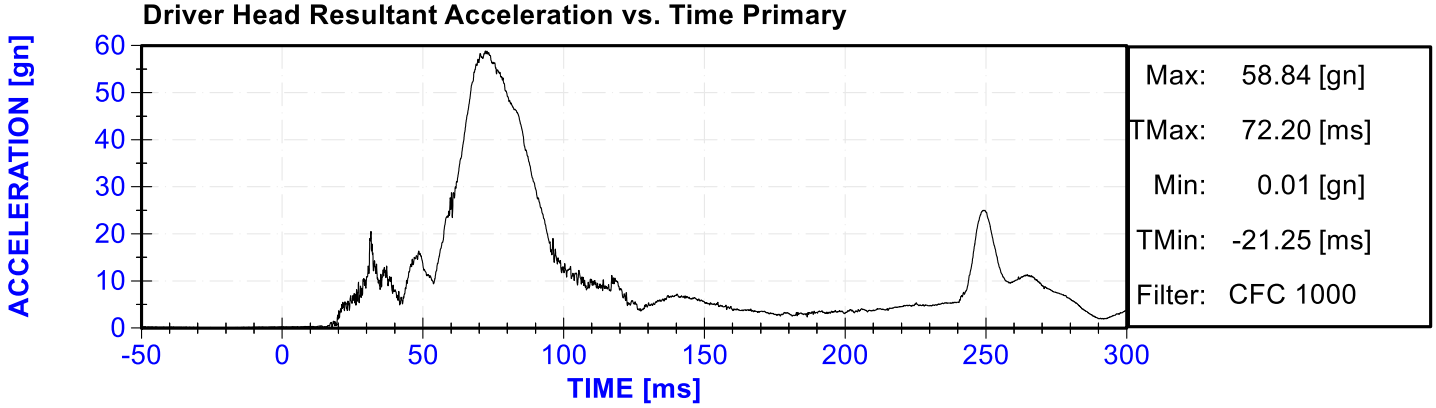
Driver Head Y Acceleration vs. Time Primary



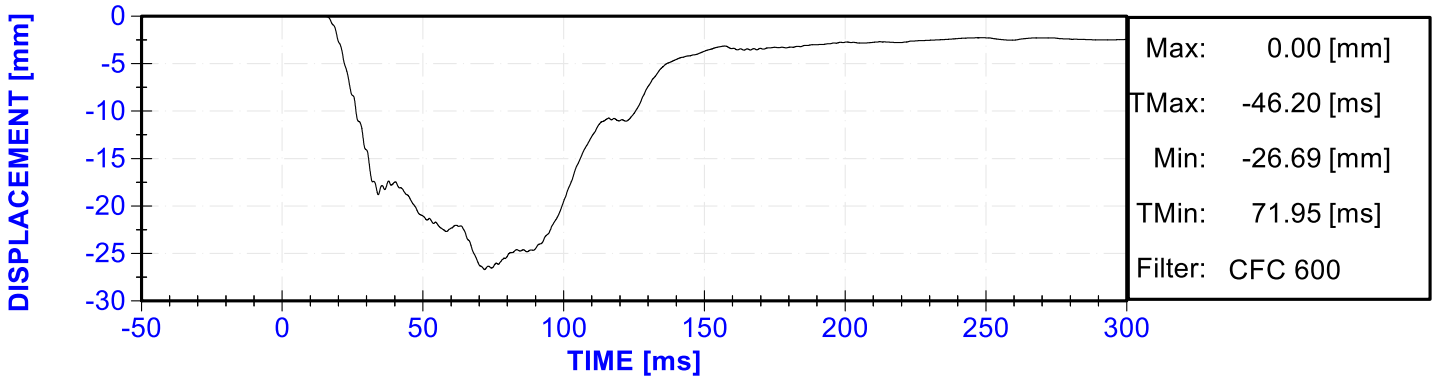
Driver Head Z Acceleration vs. Time Primary



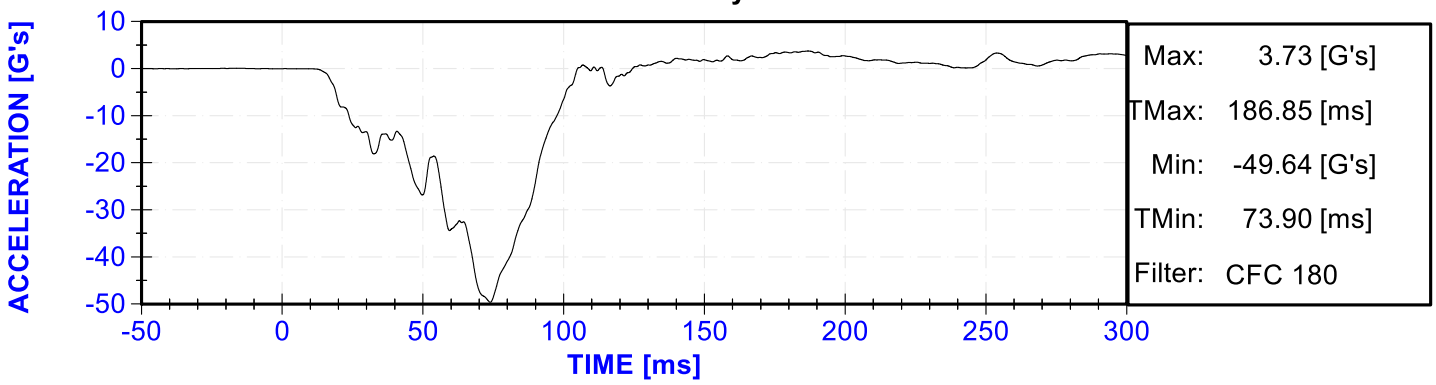
Driver Head Resultant Acceleration vs. Time Primary



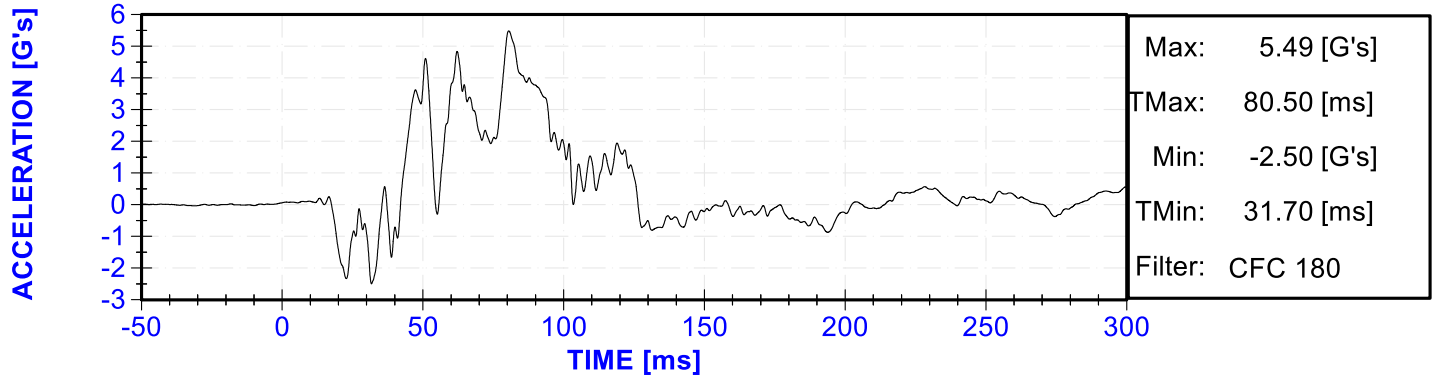
Driver Chest X Deflection vs. Time



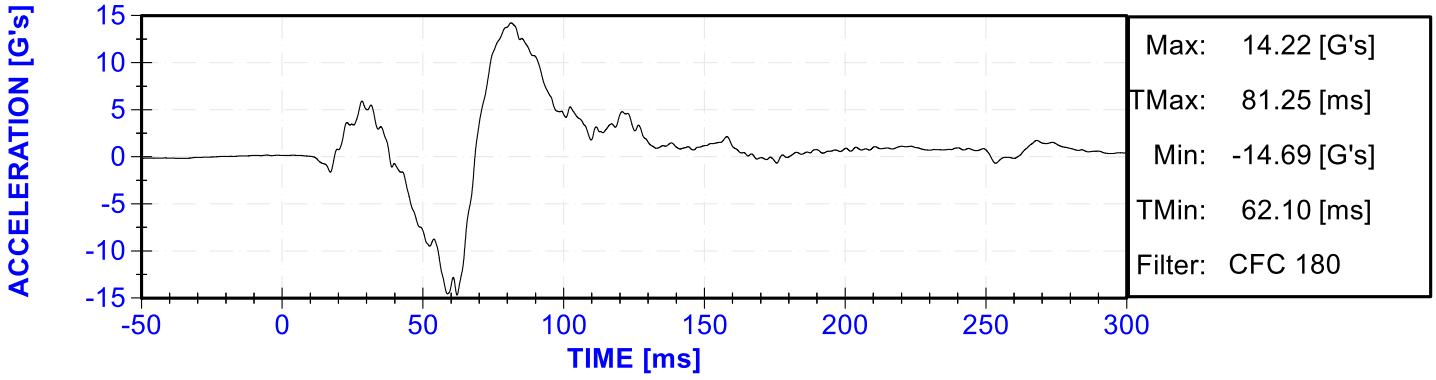
Driver Chest X Acceleration vs. Time Primary



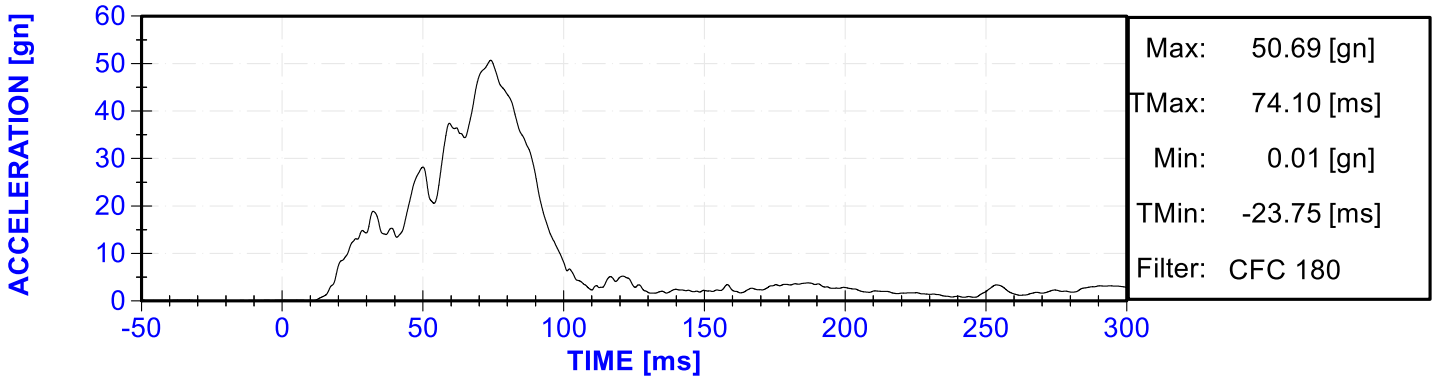
Driver Chest Y Acceleration vs. Time Primary



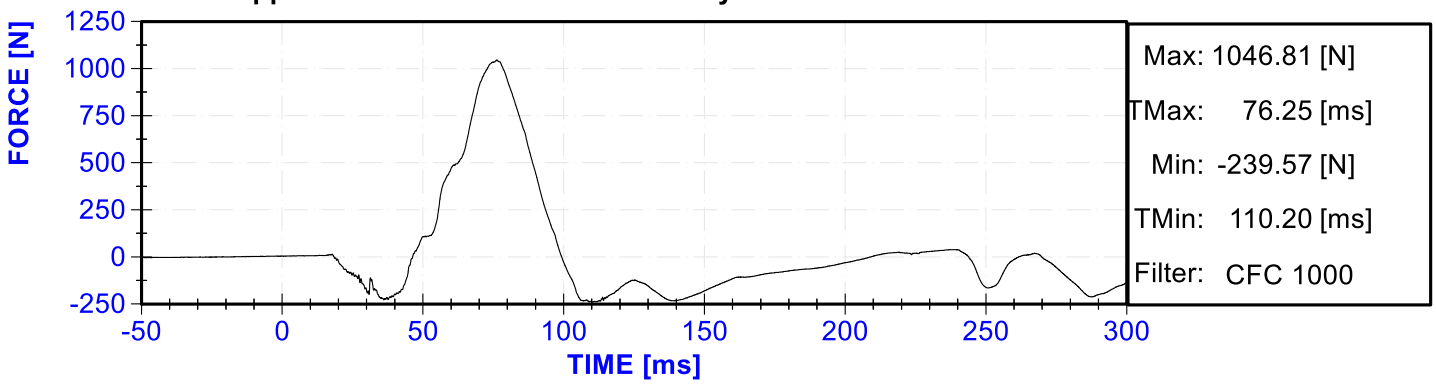
Driver Chest Z Acceleration vs. Time Primary



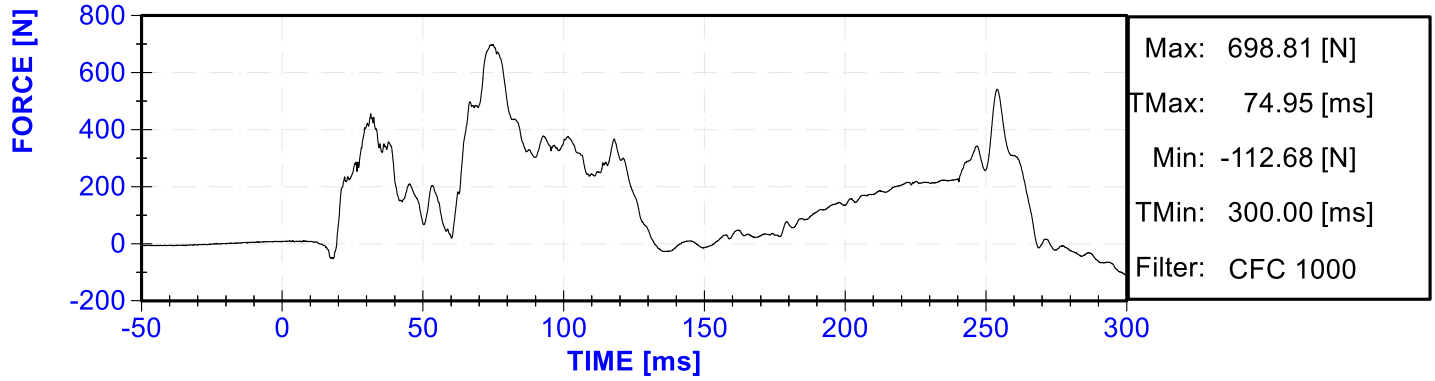
Driver Chest Resultant Acceleration vs. Time Primary



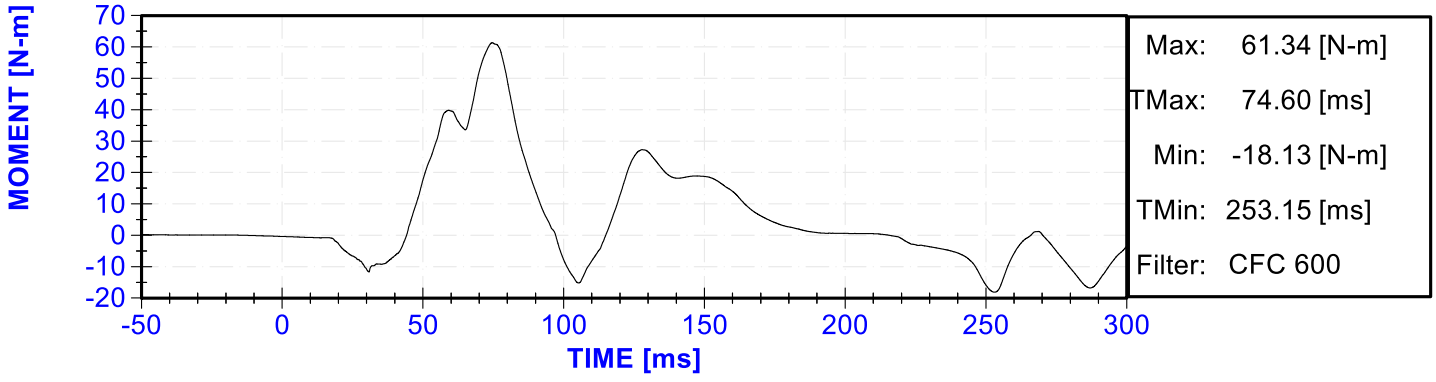
Driver Upper Neck Force X vs. Time Primary



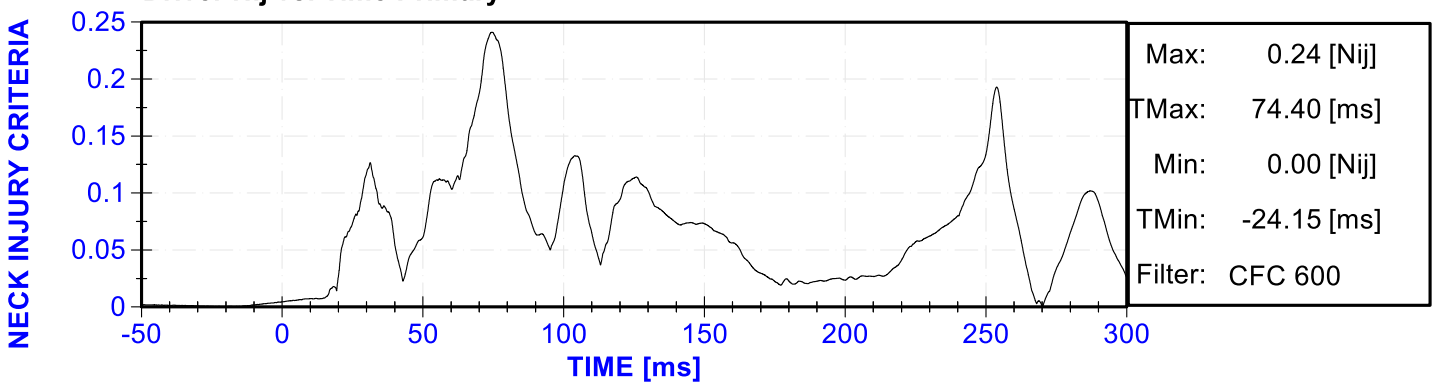
Driver Upper Neck Force Z vs. Time Primary



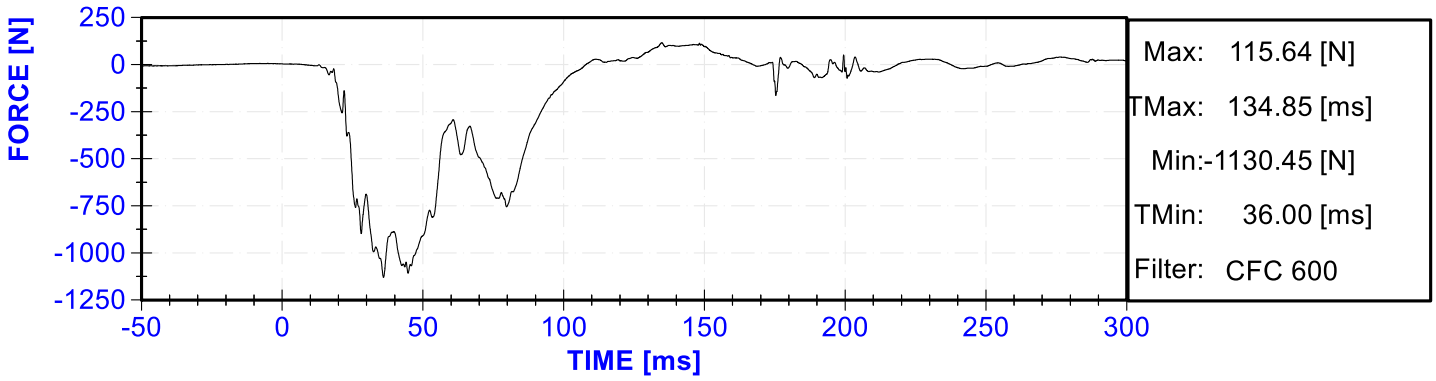
Driver Upper Neck Moment Y vs. Time Primary



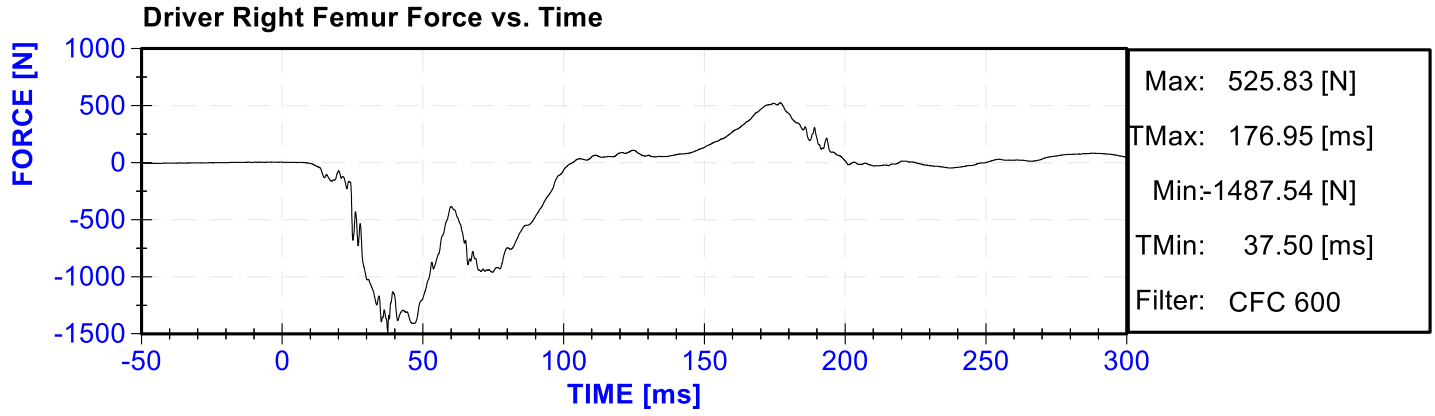
Driver Nij vs. Time Primary



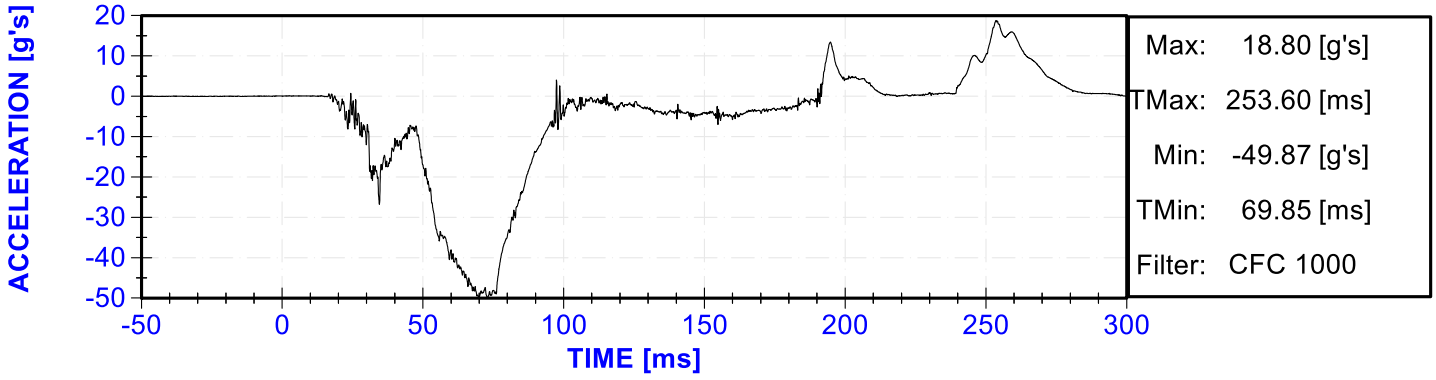
Driver Left Femur Force vs. Time



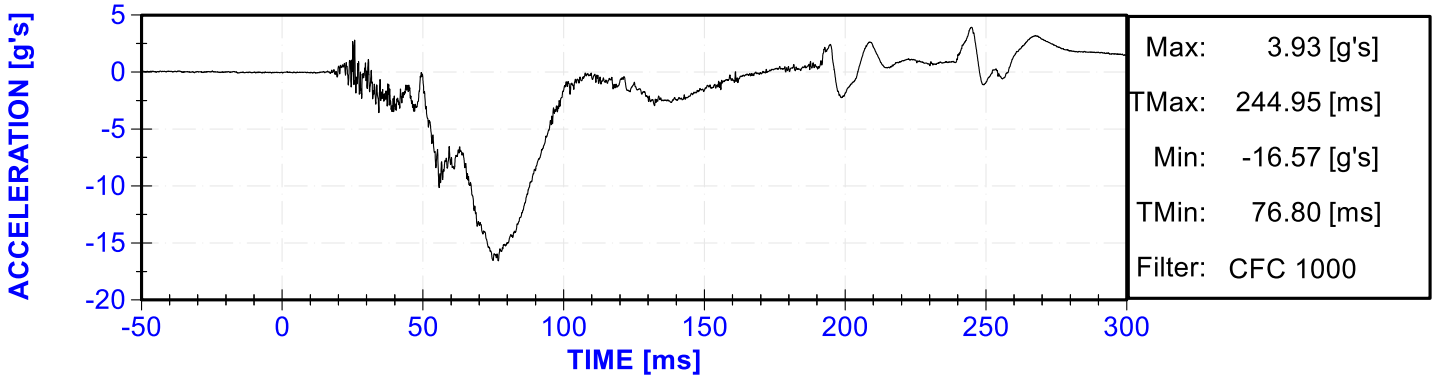
Driver Right Femur Force vs. Time



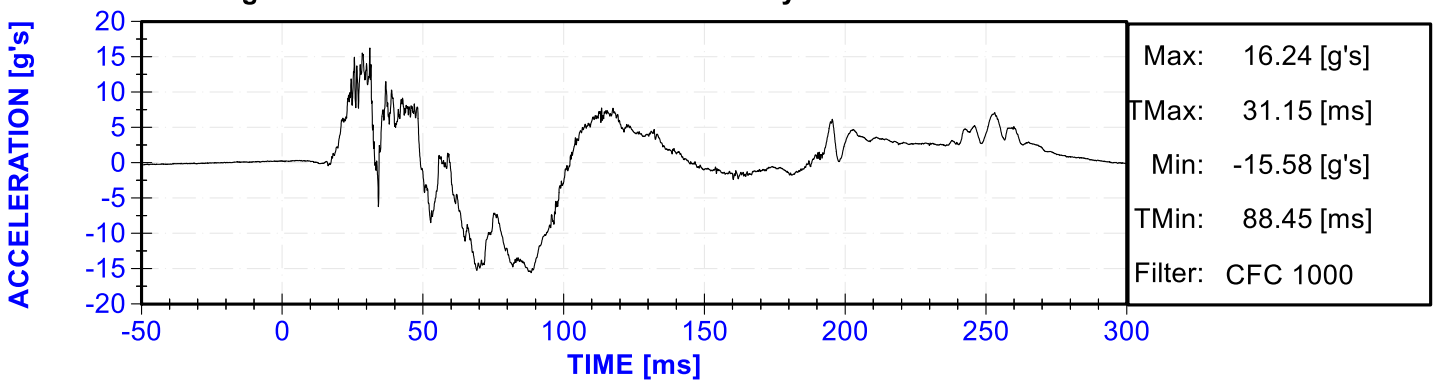
Passenger Head X Acceleration vs. Time Primary



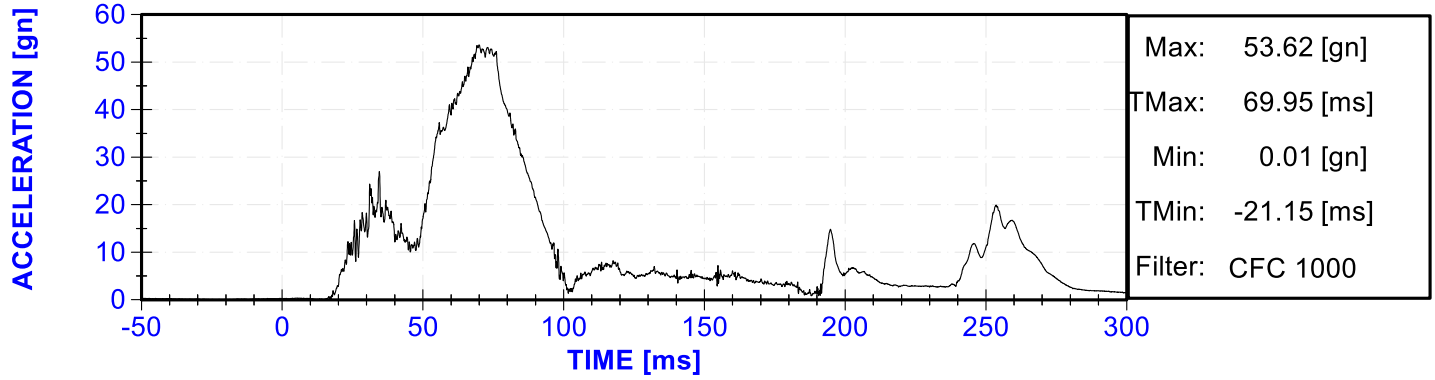
Passenger Head Y Acceleration vs. Time Primary



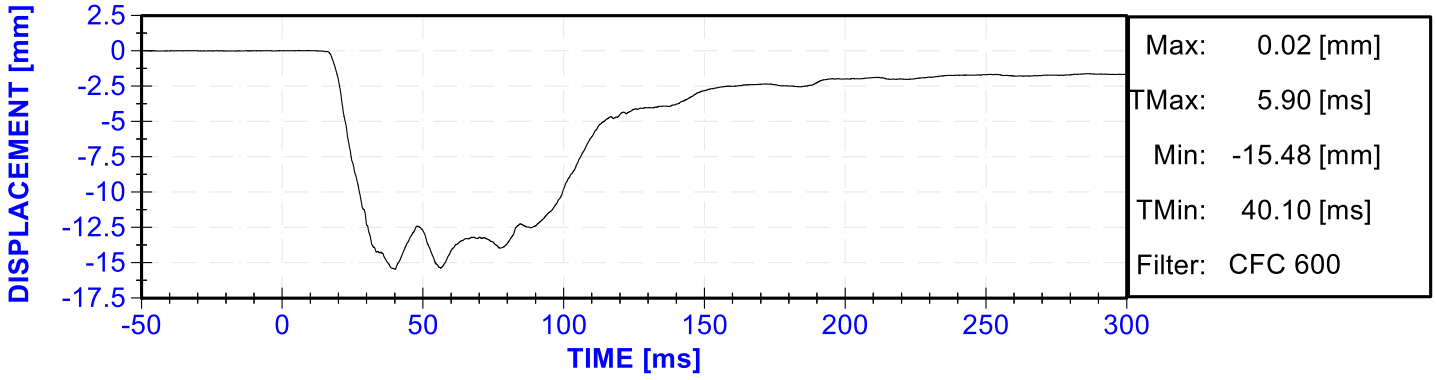
Passenger Head Z Acceleration vs. Time Primary



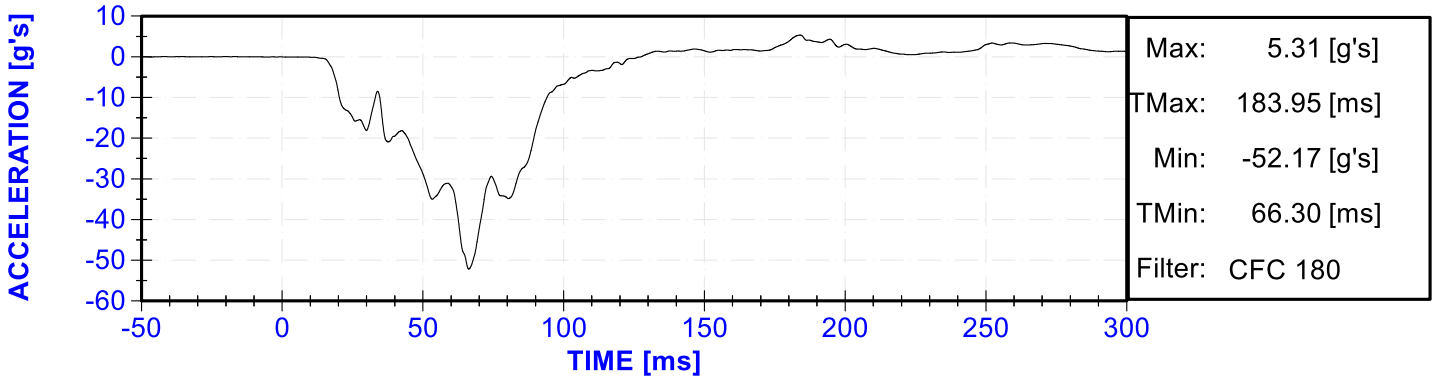
Passenger Head Resultant Acceleration vs. Time Primary



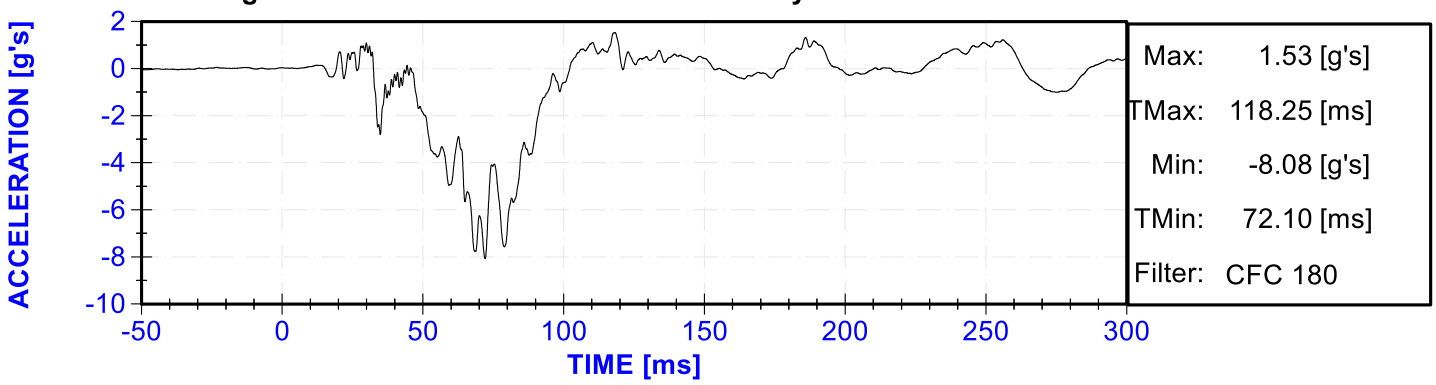
Passenger Chest X Deflection vs. Time



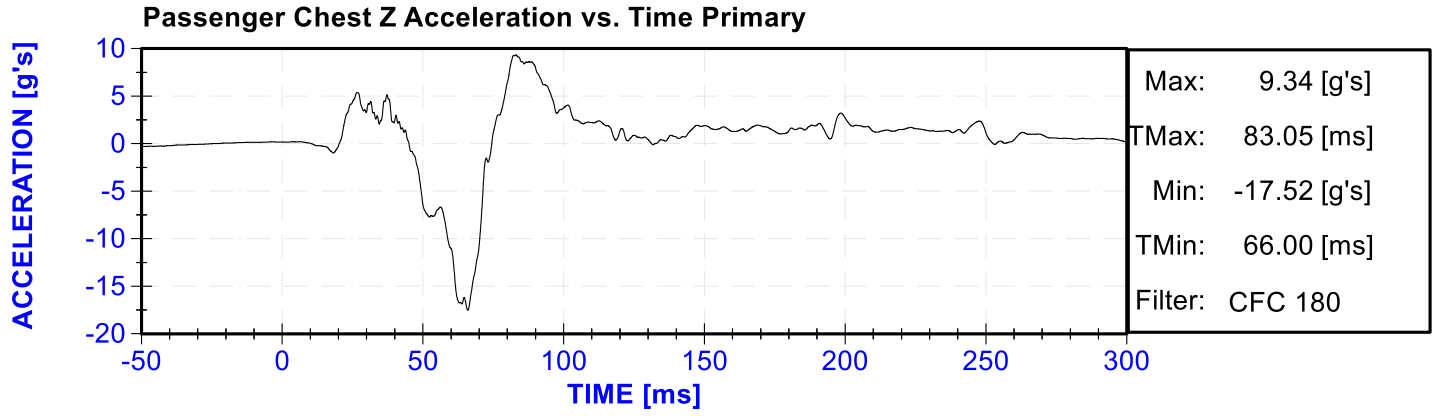
Passenger Chest X Acceleration vs. Time Primary



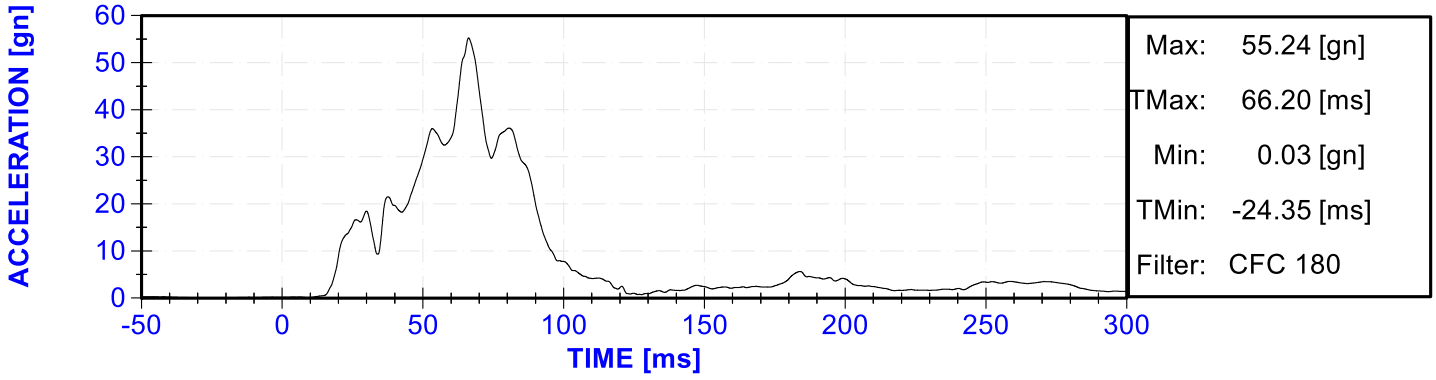
Passenger Chest Y Acceleration vs. Time Primary



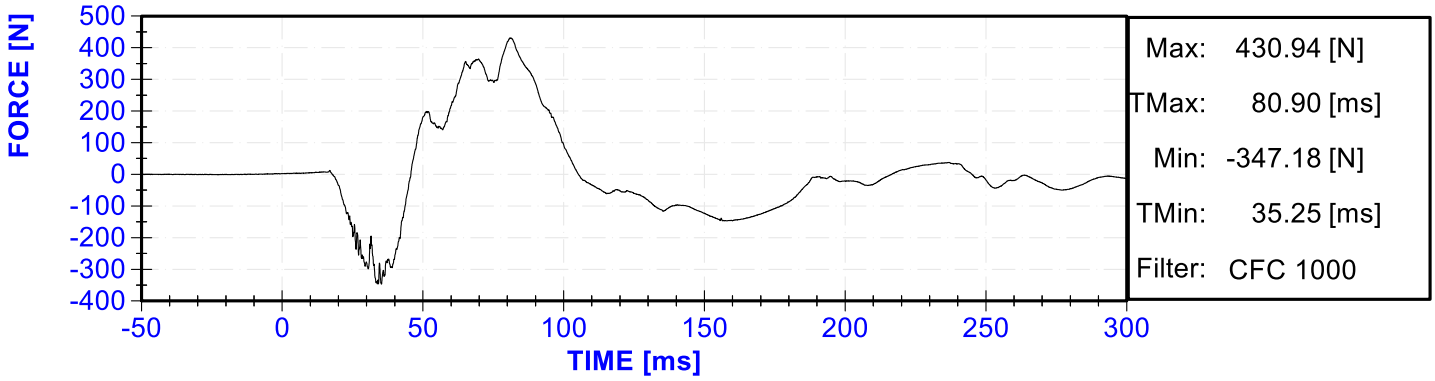
Passenger Chest Z Acceleration vs. Time Primary



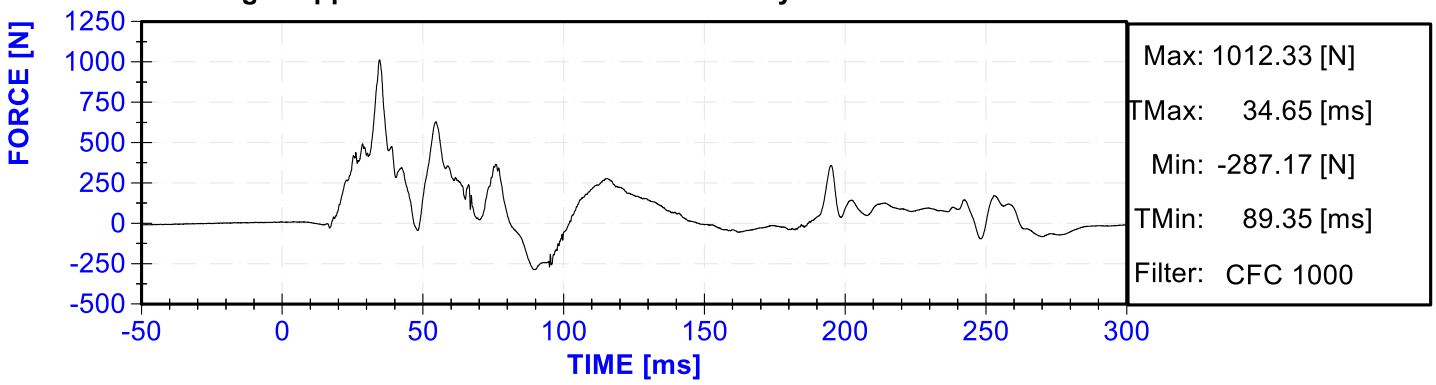
Passenger Chest Resultant Acceleration vs. Time Primary



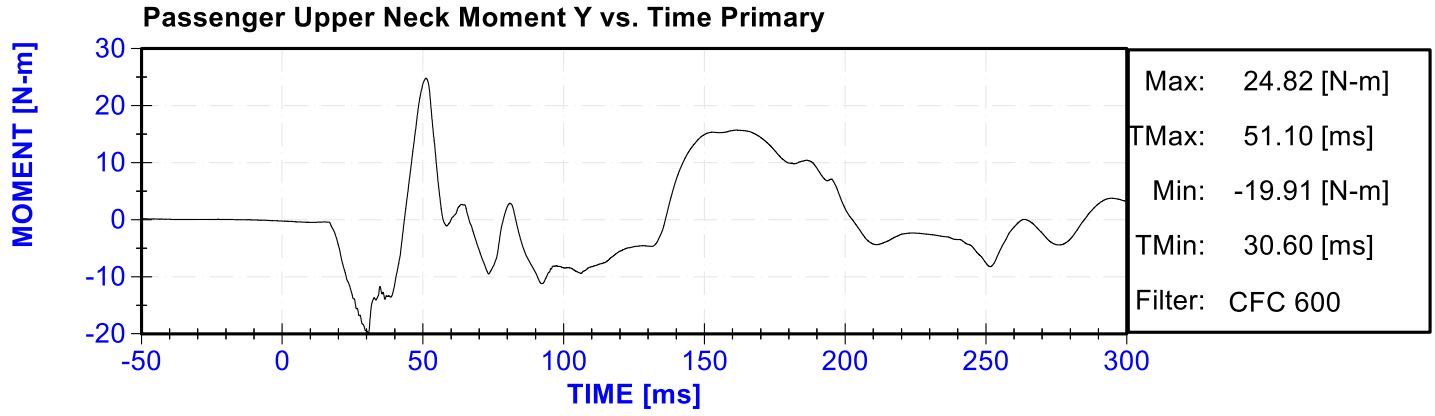
Passenger Upper Neck Force X vs. Time Primary



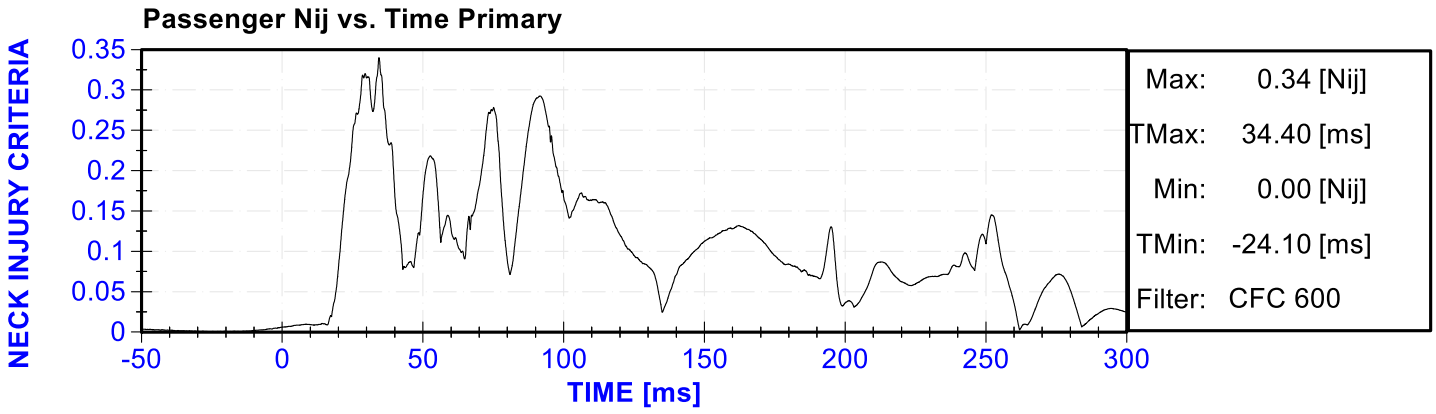
Passenger Upper Neck Force Z vs. Time Primary



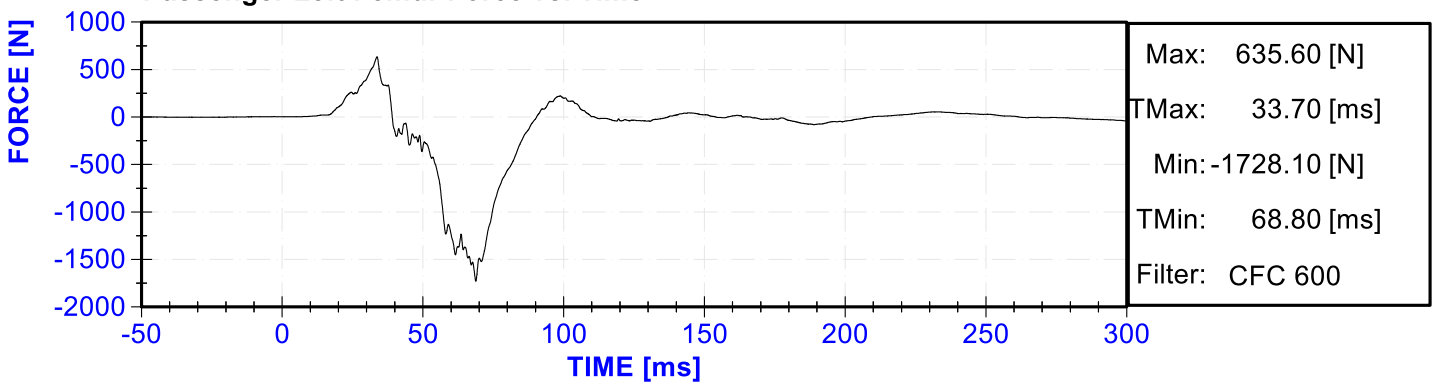
Passenger Upper Neck Moment Y vs. Time Primary



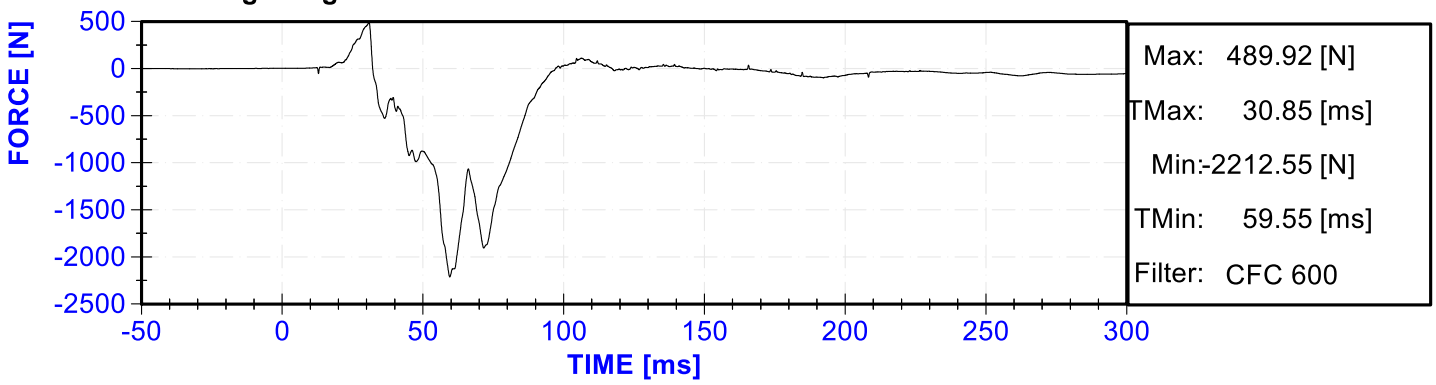
Passenger Nij vs. Time Primary



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

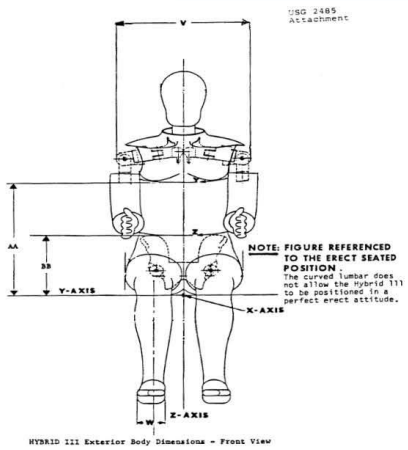
HYBRID III 50TH PERCENTILE MALE - DRIVER ATD

SERIAL NO: 142

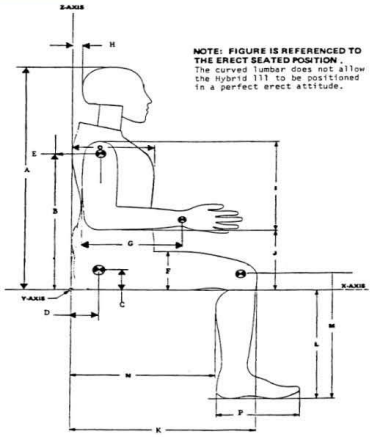
External Measurements - Hybrid 3 - 50th Male

Technician: K. Dutton Date: 01/05/2021

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	34.7	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	5.9	Pass
G	Back of Elbow to Wrist Pivot	11.4	12.0	11.7	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	8.1	Pass
K	Buttock to Knee Length	22.8	23.8	23.0	Pass
L	Popliteal Height	16.9	17.9	17.5	Pass
M	Knee Pivot Height	19.1	19.7	19.5	Pass
N	Buttock Popliteal Length	17.8	18.8	18.3	Pass
O	Chest Depth without Jacket	8.4	9.0	8.6	Pass
P	Foot Length (right)	9.9	10.5	10.1	Pass
V	Shoulder Breadth	16.3	17.2	16.8	Pass
W	Foot Breadth	3.6	4.2	3.8	Pass
Y	Chest Circumference with Jacket	38.2	39.4	38.8	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

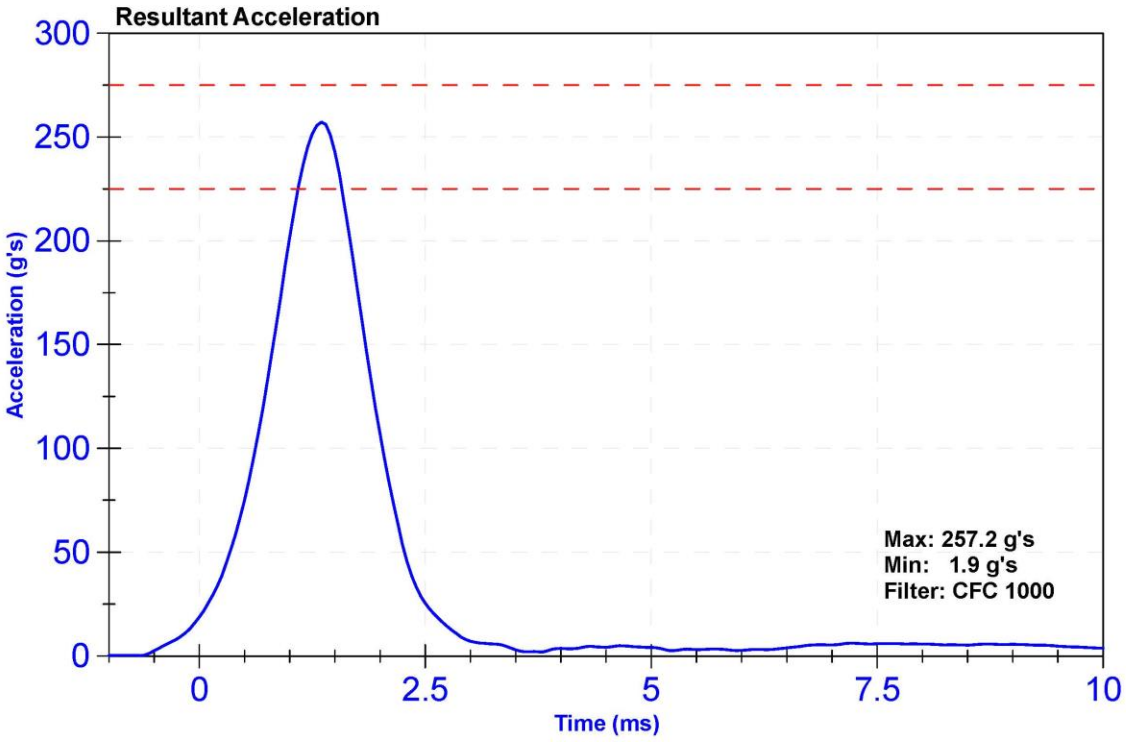
ATD Manufacturer	Humanetics	Test Technician	E. Helenbrook
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

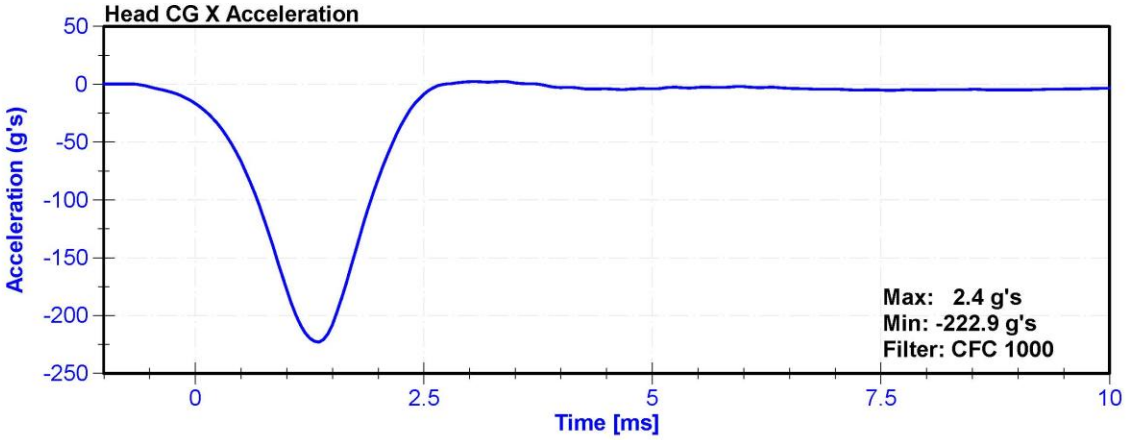
Results

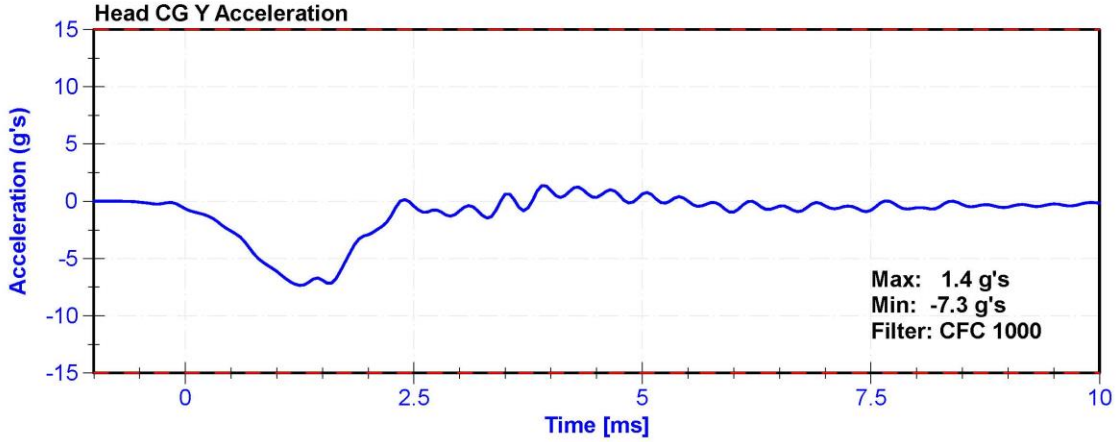
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.5	Pass
Humidity	10	70	%	23.2	Pass
Resultant Acceleration	225	275	g's	257.2	Pass
Oscillation	0	10	%	2.4	Pass
Lateral Acceleration	-15	15	g's	-7.3	Pass

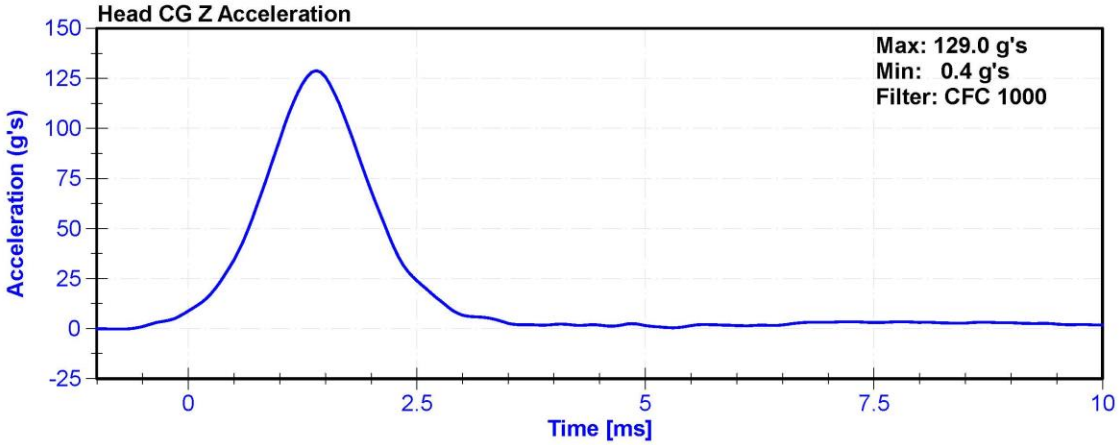
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	ENDEVCO 7264	P51681	11/3/2020	5/4/2021
Y Accelerometer	ENDEVCO 7264	P64151	11/3/2020	5/4/2021
Z Accelerometer	ENDEVCO 7264	P52114	11/3/2020	5/4/2021




Head CG X Acceleration
Acceleration (g's)
50
0
-50
-100
-150
-200
-250
0
2.5
5
7.5
10
Time [ms]
Max: 2.4 g's
Min: -222.9 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: 1.4 g's
Min: -7.3 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: 129.0 g's
Min: 0.4 g's
Filter: CFC 1000

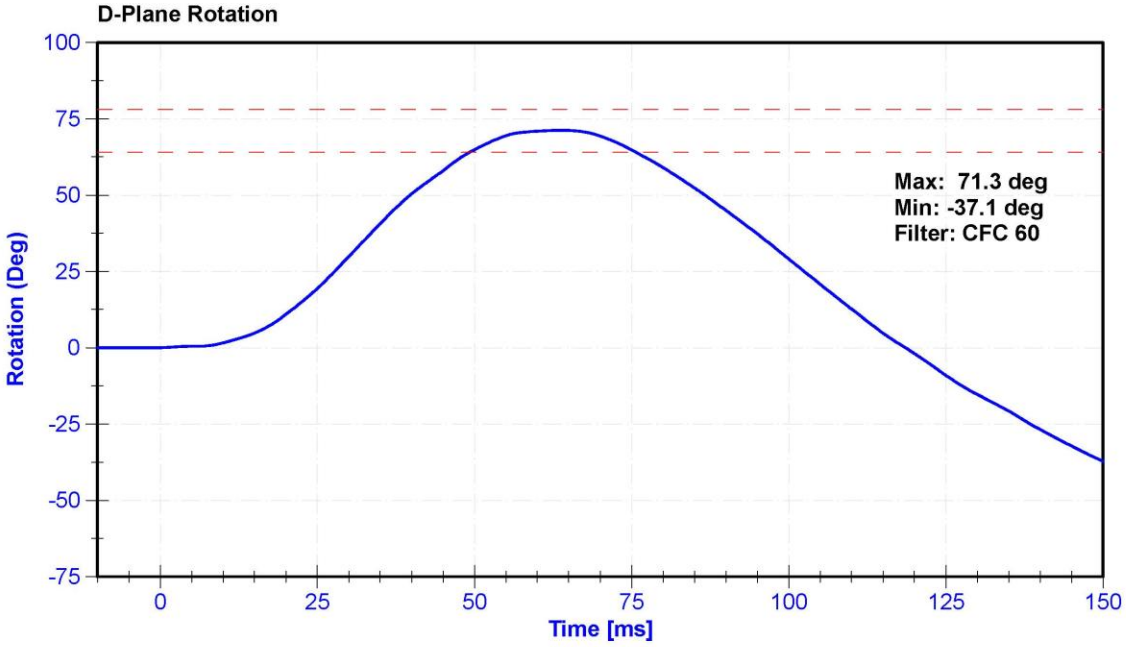
ATD Manufacturer	Humanetics	Test Technician	S. Vacanti
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

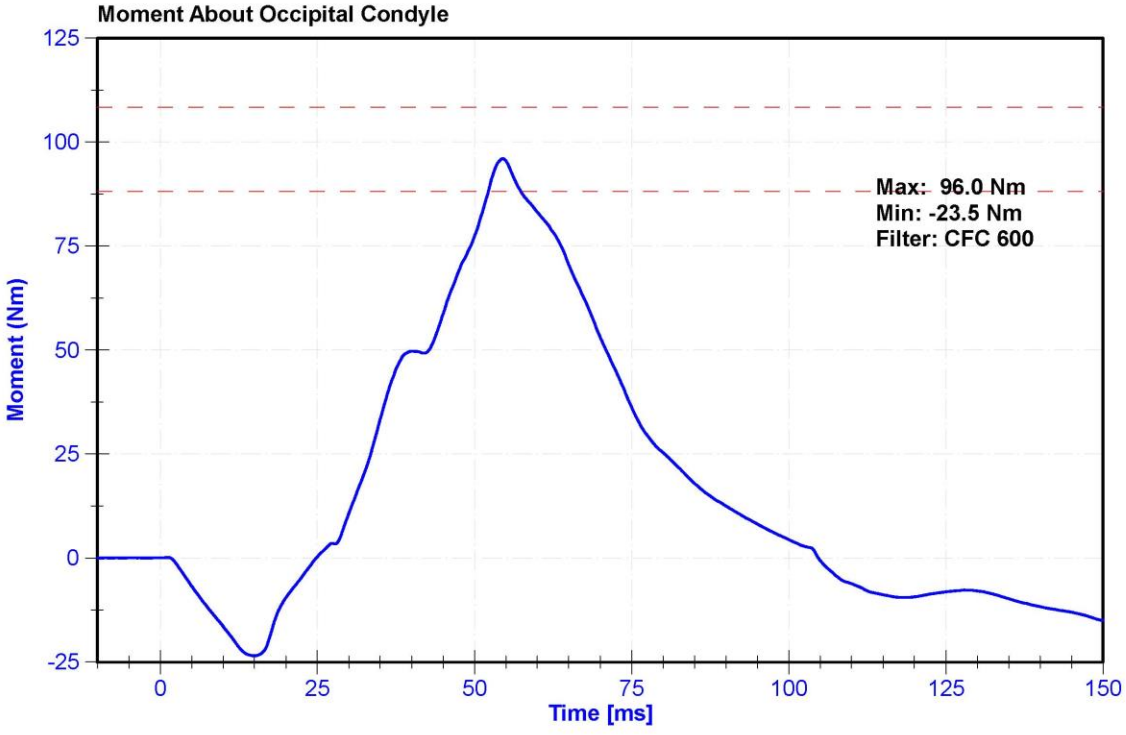
Results

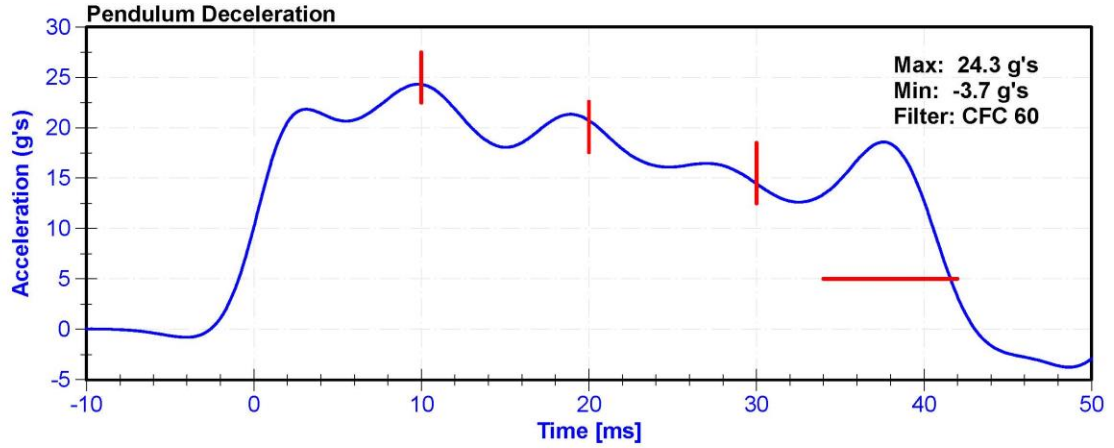
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.5	Pass
Humidity	10	70	%	34.0	Pass
Velocity	6.89	7.13	m/s	6.958	Pass
Pendulum Deceleration at 10ms	22.5	27.5	g's	24.32	Pass
Pendulum Deceleration at 20ms	17.6	22.6	g's	20.73	Pass
Pendulum Deceleration at 30ms	12.5	18.5	g's	14.46	Pass
Max. Pendulum Deceleration After 30ms	0	29	g's	24.3	Pass
Pendulum Deceleration Time to 5 g's	34	42	ms	41.6	Pass
Maximum D Plane Rotation	64	78	deg	71.3	Pass
Time to Maximum Rotation	57	64	ms	63.8	Pass
Rotation Decay to Zero	113	127	ms	118.6	Pass
Moment About Occipital Condyle	88.1	108.4	Nm	96.01	Pass
Time to Maximum Moment	47	58	ms	54.5	Pass
Moment Decay to Zero	97	107	ms	104.7	Pass

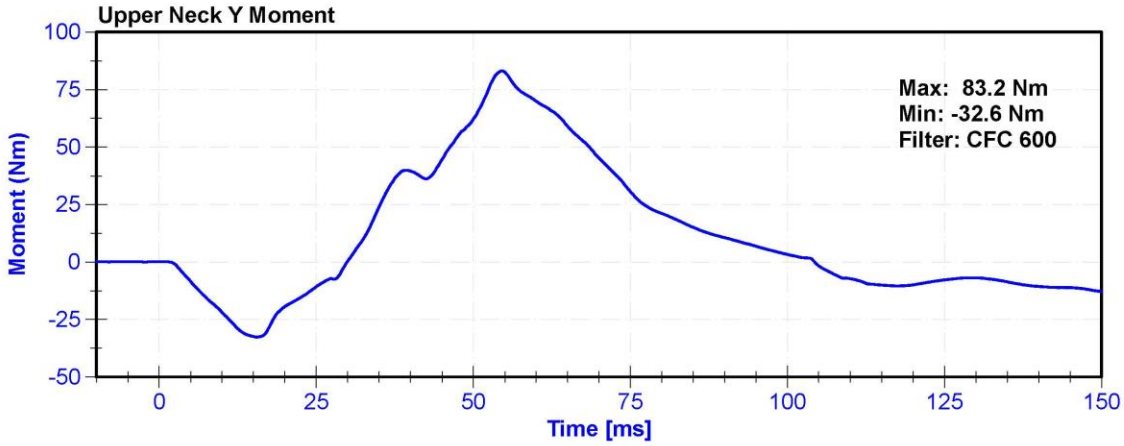
Transducer Calibrations

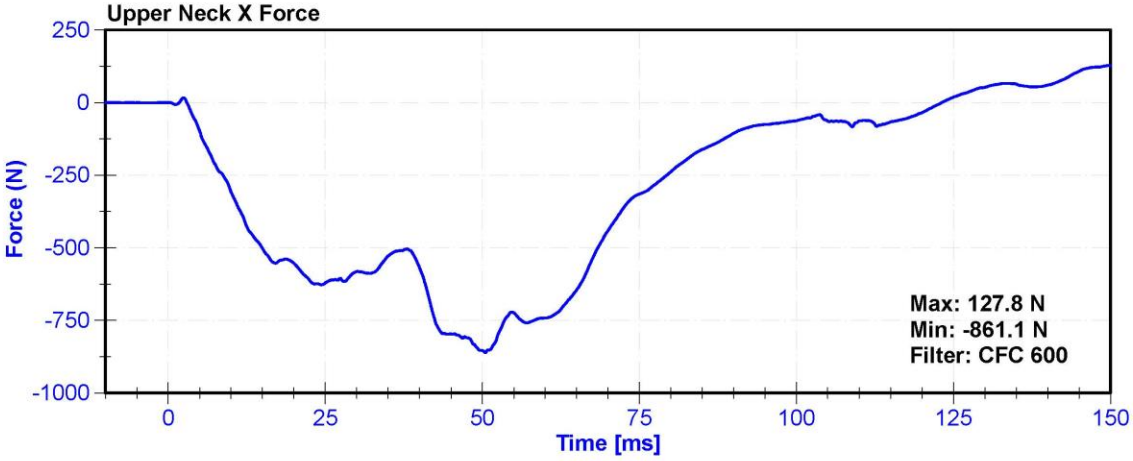
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-C16503 Striker	2/6/2020	2/5/2021
Pendulum Potentiometer	ETI SP22G	DS-LABPOT1	9/17/2020	9/17/2021
Condyle Potentiometer	ETI SP22G	DS-LABPOT2	9/17/2020	9/17/2021
Upper Neck Load Cell	DENTON 1716A	LC-2186Fx	11/10/2020	11/10/2021


D-Plane Rotation
Rotation (Deg)
100
75
50
25
0
-25
-50
-75
0
25
50
75
100
125
150
Time [ms]
Max: 71.3 deg
Min: -37.1 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: 96.0 Nm
Min: -23.5 Nm
Filter: CFC 600


Pendulum Deceleration
Max: 24.3 g's
Min: -3.7 g's
Filter: CFC 60
Acceleration (g's)
Time [ms]


Upper Neck Y Moment
Max: 83.2 Nm
Min: -32.6 Nm
Filter: CFC 600
Moment (Nm)
Time [ms]


Upper Neck X Force
Max: 127.8 N
Min: -861.1 N
Filter: CFC 600
Force (N)
Time [ms]

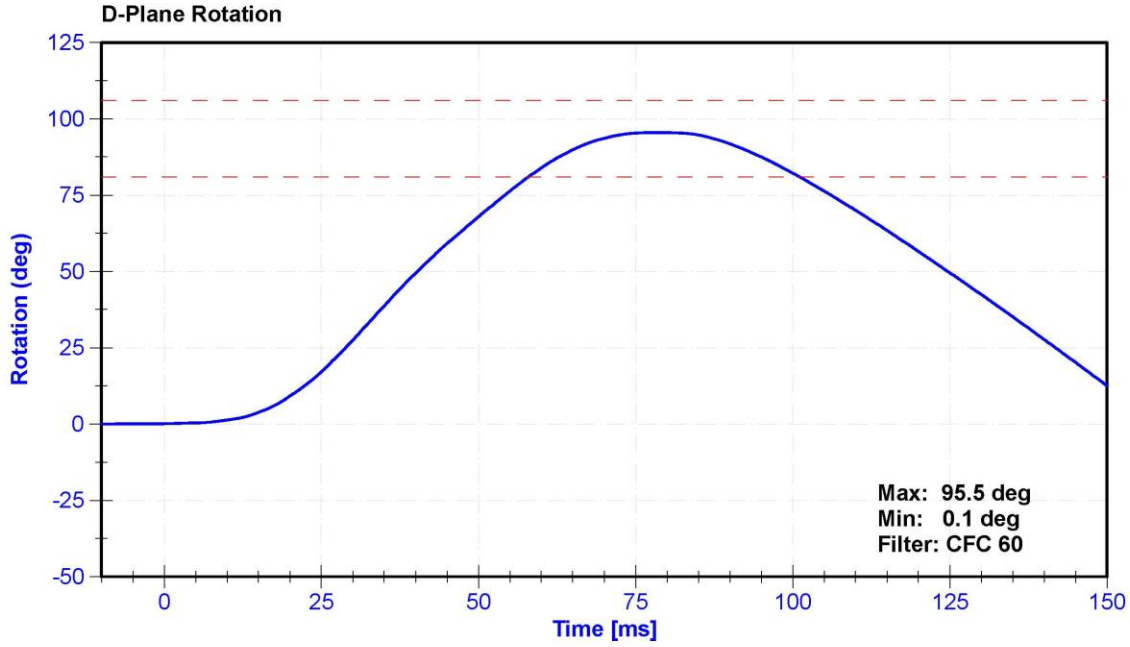
ATD Manufacturer	Humanetics	Test Technician	E. Helenbrook
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

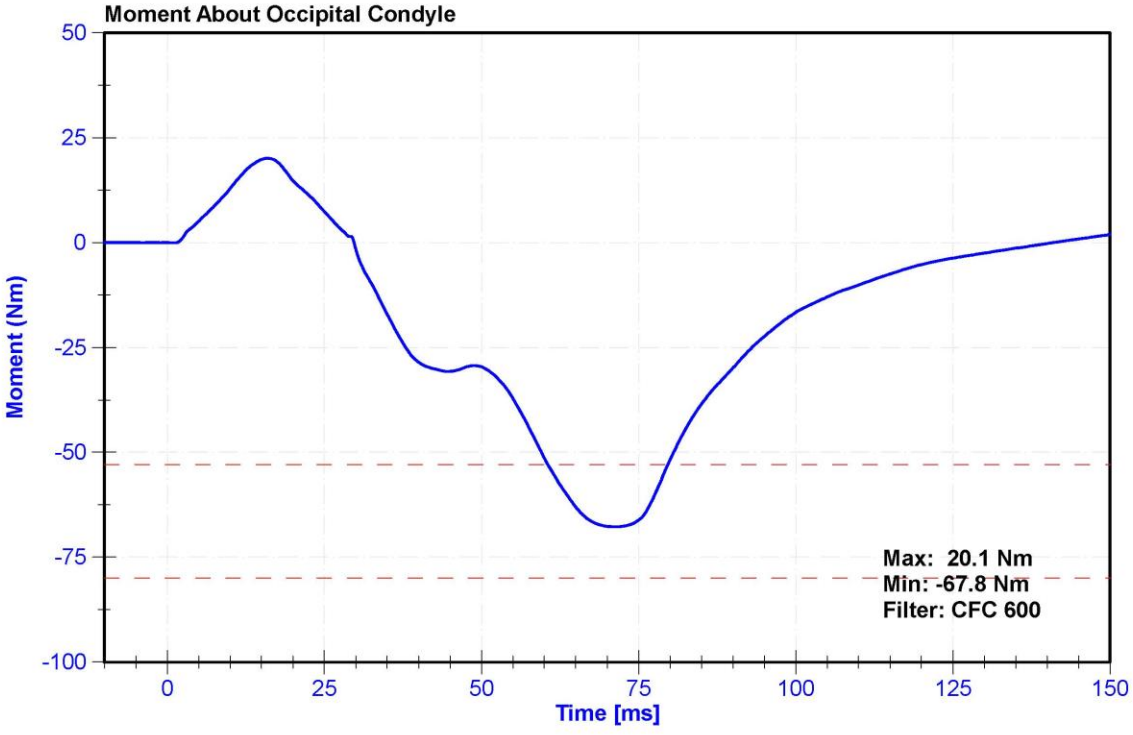
Results

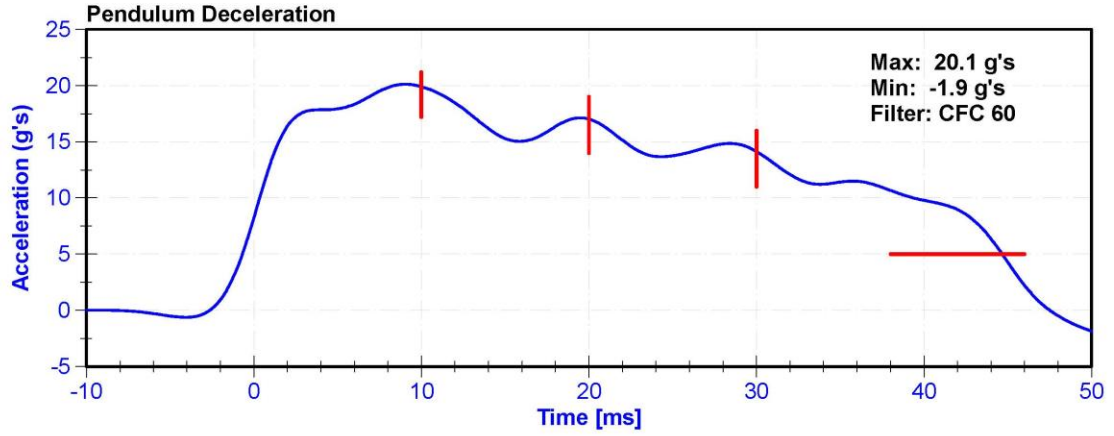
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.4	Pass
Humidity	10	70	%	22.3	Pass
Velocity	5.94	6.19	m/s	5.964	Pass
Pendulum Deceleration at 10ms	17.2	21.2	g's	19.91	Pass
Pendulum Deceleration at 20ms	14	19	g's	17.0	Pass
Pendulum Deceleration at 30ms	11	16	g's	14.1	Pass
Max. Pendulum Deceleration After 30ms	0	22	g's	20.1	Pass
Pendulum Deceleration Time to 5 g's	38	46	ms	44.7	Pass
Maximum D Plane Rotation	81	106	deg	95.5	Pass
Time to Maximum Rotation	72	82	ms	78.2	Pass
Rotation Decay to Zero	147	174	ms	158.3	Pass
Minimum Moment About OC	-80	-52.9	Nm	-67.76	Pass
Time to Minimum Moment	65	79	ms	71.5	Pass
Moment Decay to Zero	120	148	ms	141.0	Pass

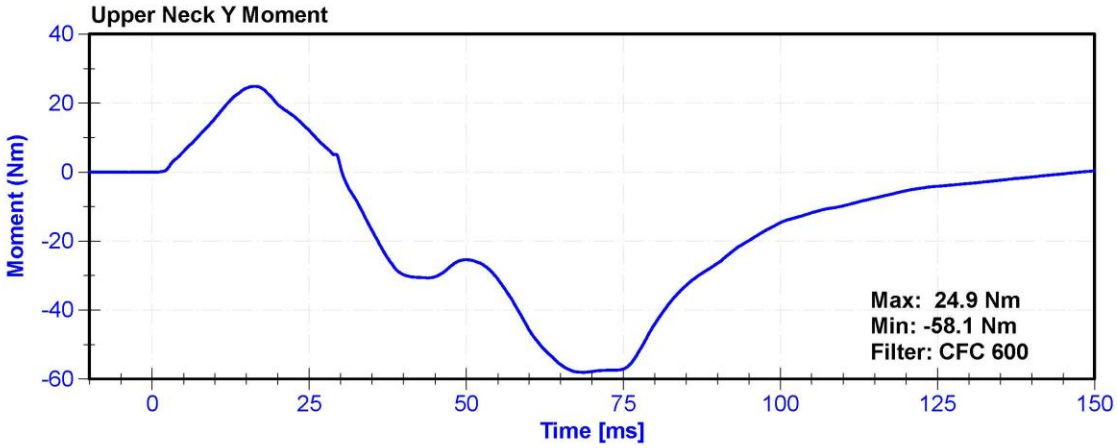
Transducer Calibrations

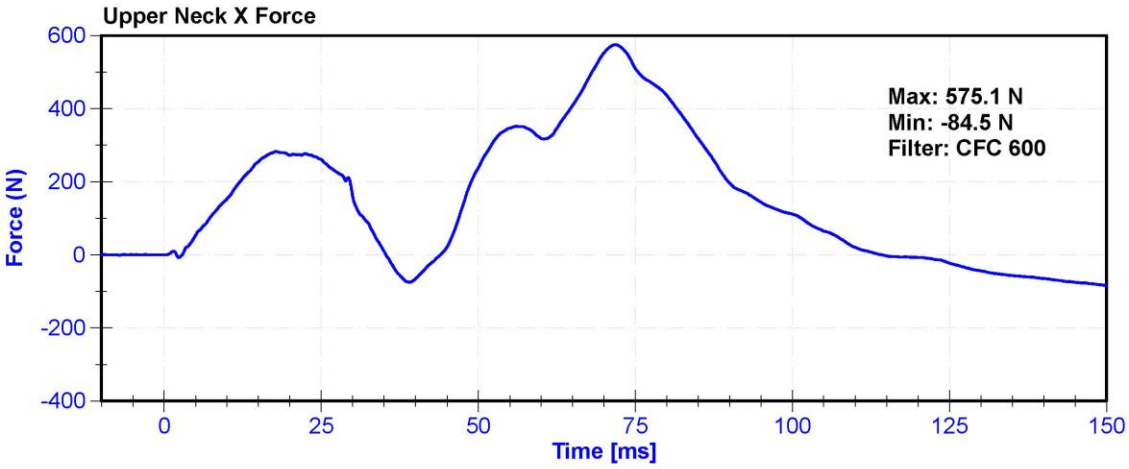
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-C16503 Striker	2/6/2020	2/5/2021
Pendulum Potentiometer	ETI SP22G	DS-LABPOT1	9/17/2020	9/17/2021
Condyle Potentiometer	ETI SP22G	DS-LABPOT2	9/17/2020	9/17/2021
Upper Neck Load Cell	DENTON 1716A	LC-2186Fx	11/10/2020	11/10/2021


D-Plane Rotation
Rotation (deg)
125
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]
Max: 95.5 deg
Min: 0.1 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: -67.8 Nm
Filter: CFC 600


Pendulum Deceleration
Max: 20.1 g's
Min: -1.9 g's
Filter: CFC 60
Acceleration (g's)
Time [ms]


Upper Neck Y Moment
Max: 24.9 Nm
Min: -58.1 Nm
Filter: CFC 600
Moment (Nm)
Time [ms]


Upper Neck X Force
Max: 575.1 N
Min: -84.5 N
Filter: CFC 600
Force (N)
Time [ms]

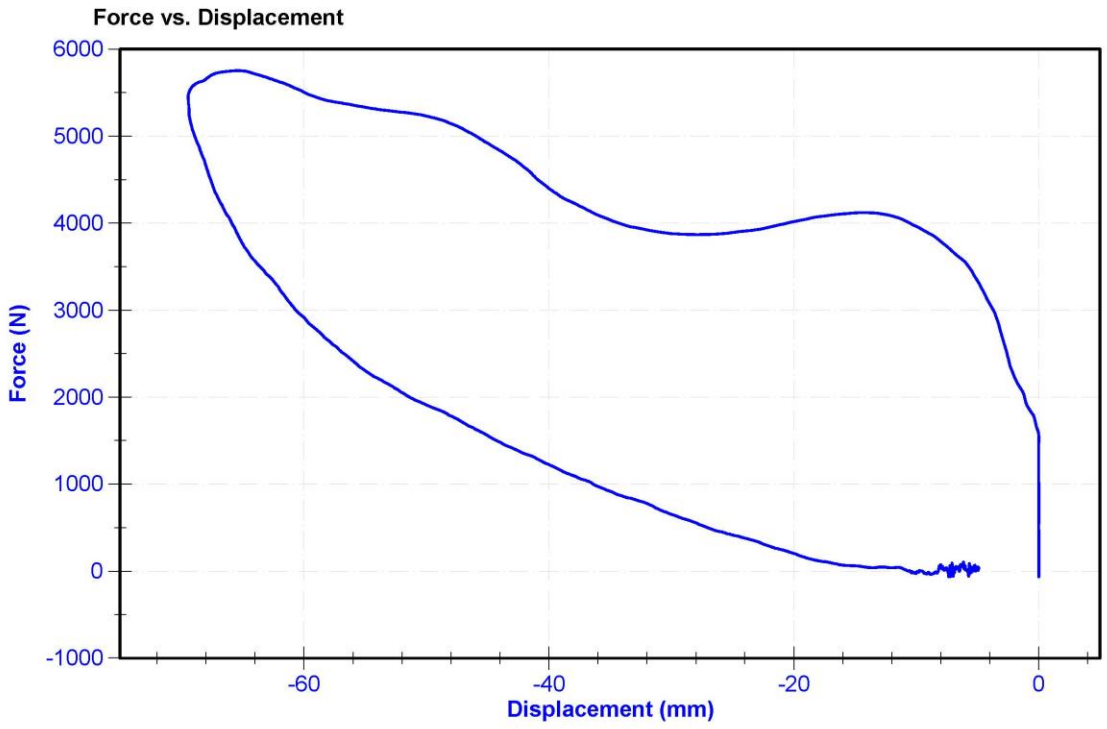
ATD Manufacturer	Humanetics	Test Technician	D.Reinhard
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

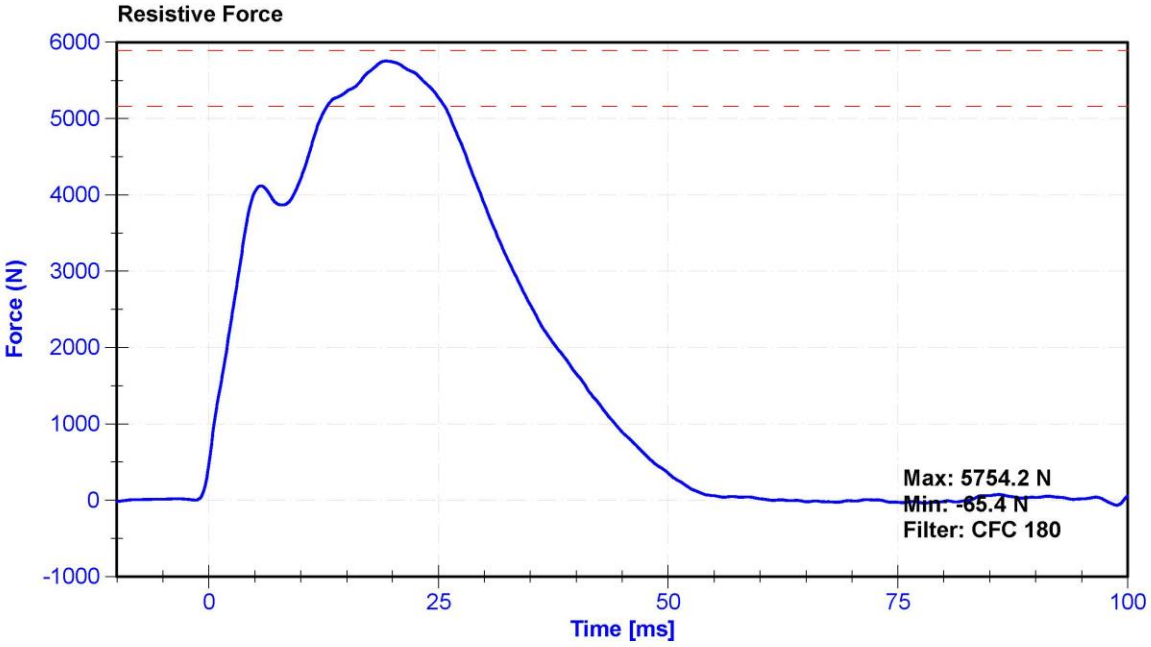
Results

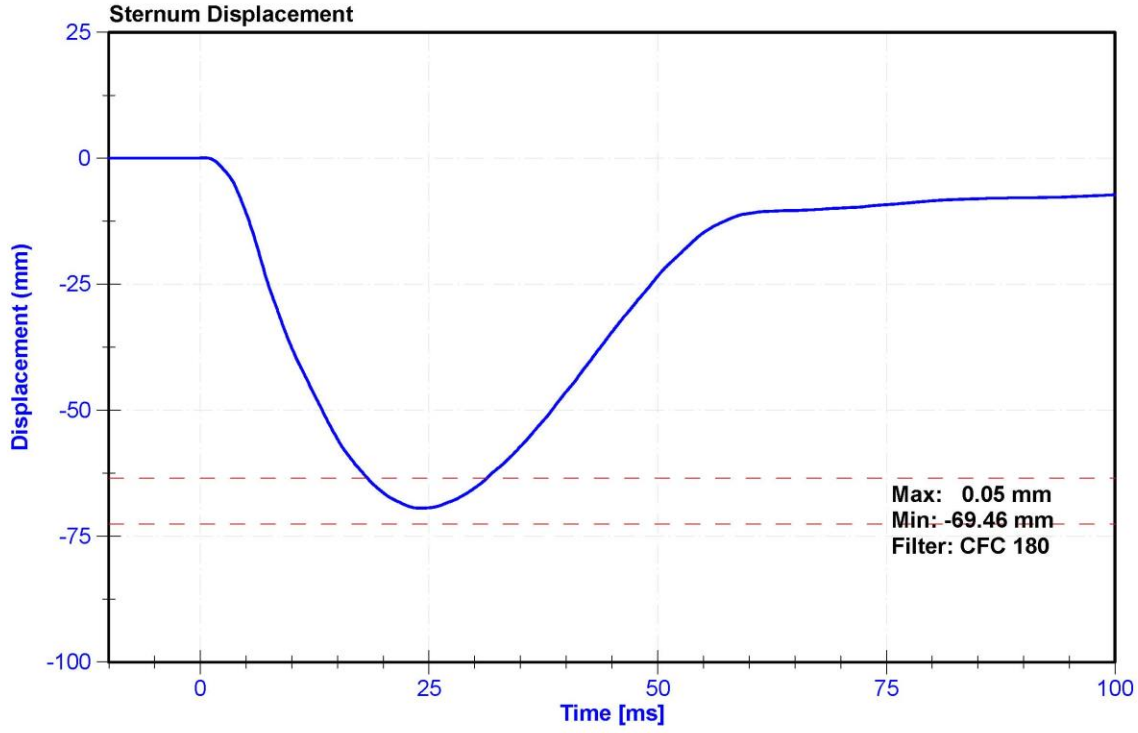
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.8	Pass
Humidity	10	70	%	27	Pass
Velocity	6.59	6.83	m/s	6.684	Pass
Chest Displacement	-72.6	-63.5	mm	-69.46	Pass
Resistive Force	5160	5894	N	5754.2	Pass
Hysteresis	65	85	%	70.8	Pass

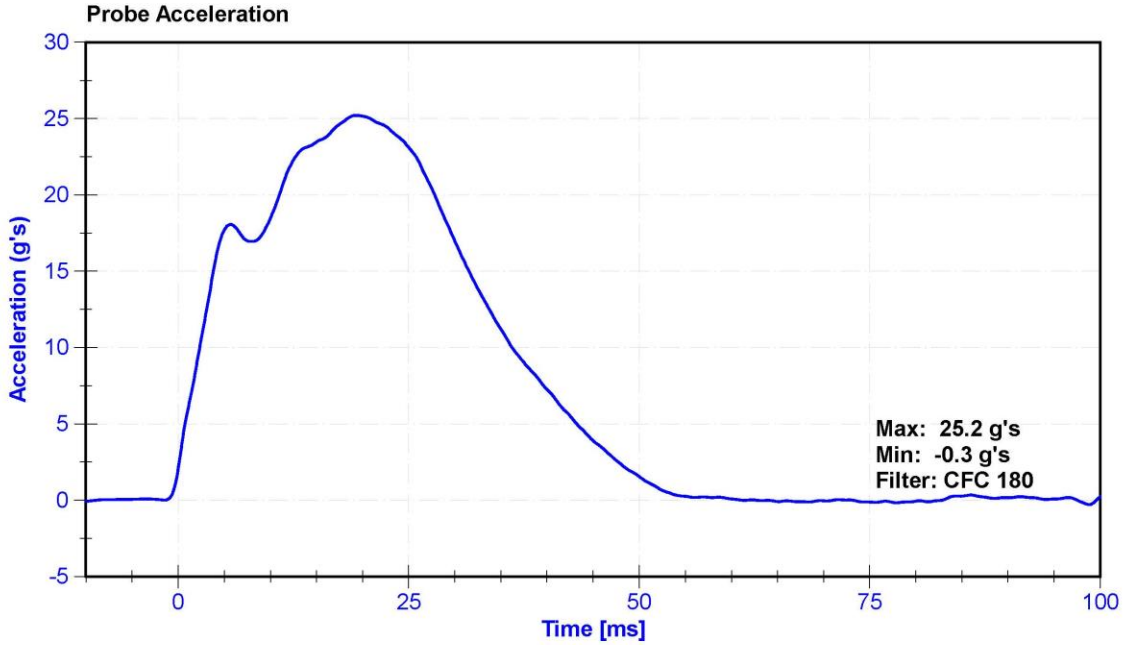
Transducer Calibrations

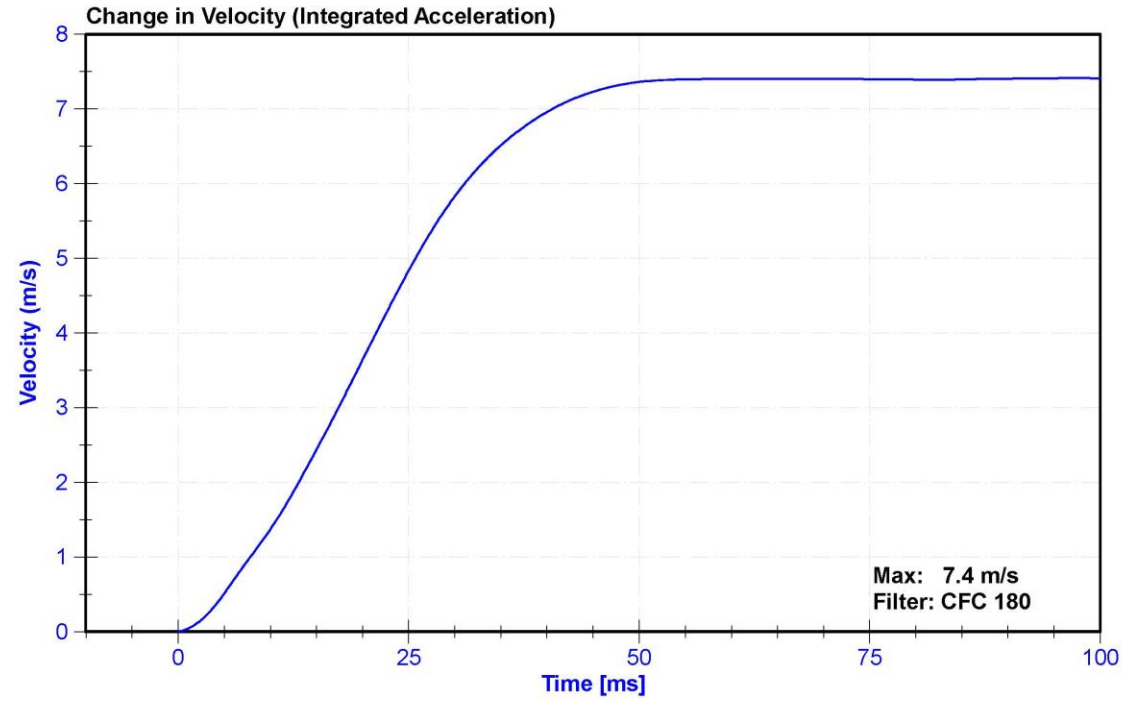
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A286228	1/29/2020	1/28/2021
Chest Potentiometer	Servo 6209-2038	DS-142	11/19/2020	5/20/2021




Resistive Force
Force (N)
6000
5000
4000
3000
2000
1000
0
-1000
0
25
50
75
100
Time [ms]
Max: 5754.2 N
Min: -65.4 N
Filter: CFC 180


Sternum Displacement
Displacement (mm)
25
0
-25
-50
-75
-100
0
25
50
75
100
Time [ms]
Max: 0.05 mm
Min: -69.46 mm
Filter: CFC 180


Probe Acceleration
Acceleration (g's)
30
25
20
15
10
5
0
-5
0
25
50
75
100
Time [ms]
Max: 25.2 g's
Min: -0.3 g's
Filter: CFC 180


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

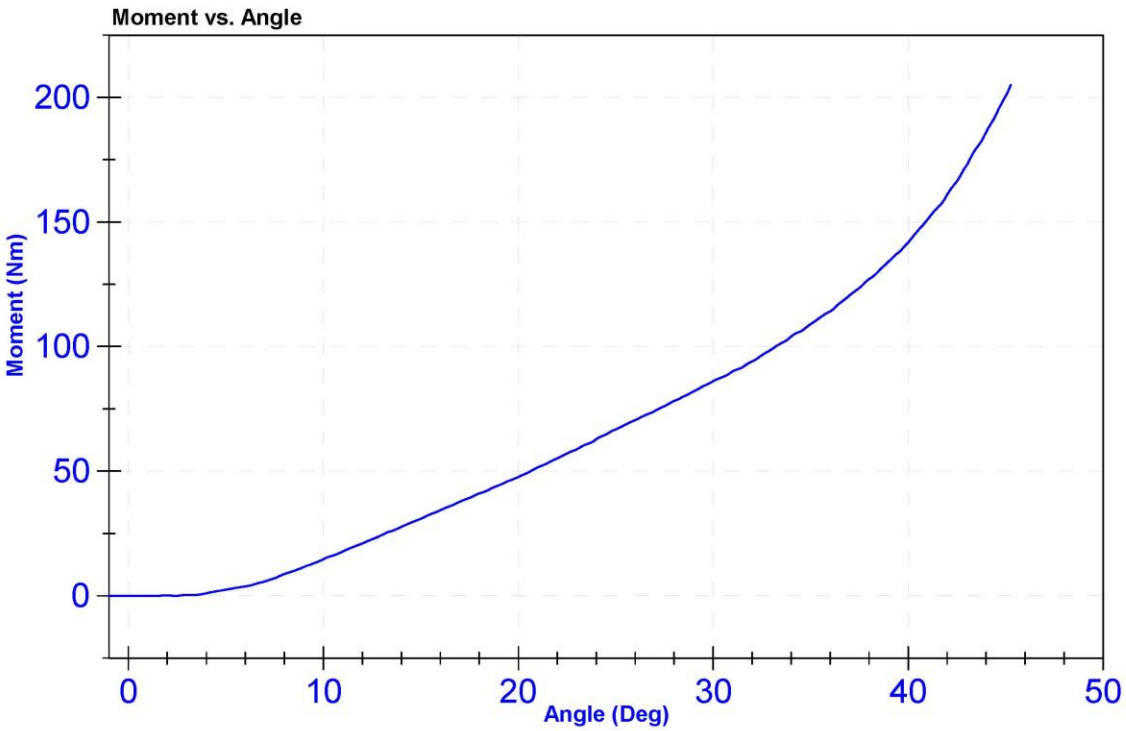
ATD Manufacturer	Humanetics	Test Technician	E. Helenbrook
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.5	Pass
Humidity	10	70	%	22.3	Pass
Average Velocity	5	10	deg/s	7.2	Pass
Angle at 203Nm	40	50	deg	45.2	Pass
Moment at 30 degrees	0	94.9	Nm	86.1	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	ETI SP22	DS-0008	9/18/2020	9/18/2021
Load Cell	Key Trans 2301-02	LC-115 My	9/12/2020	9/12/2021



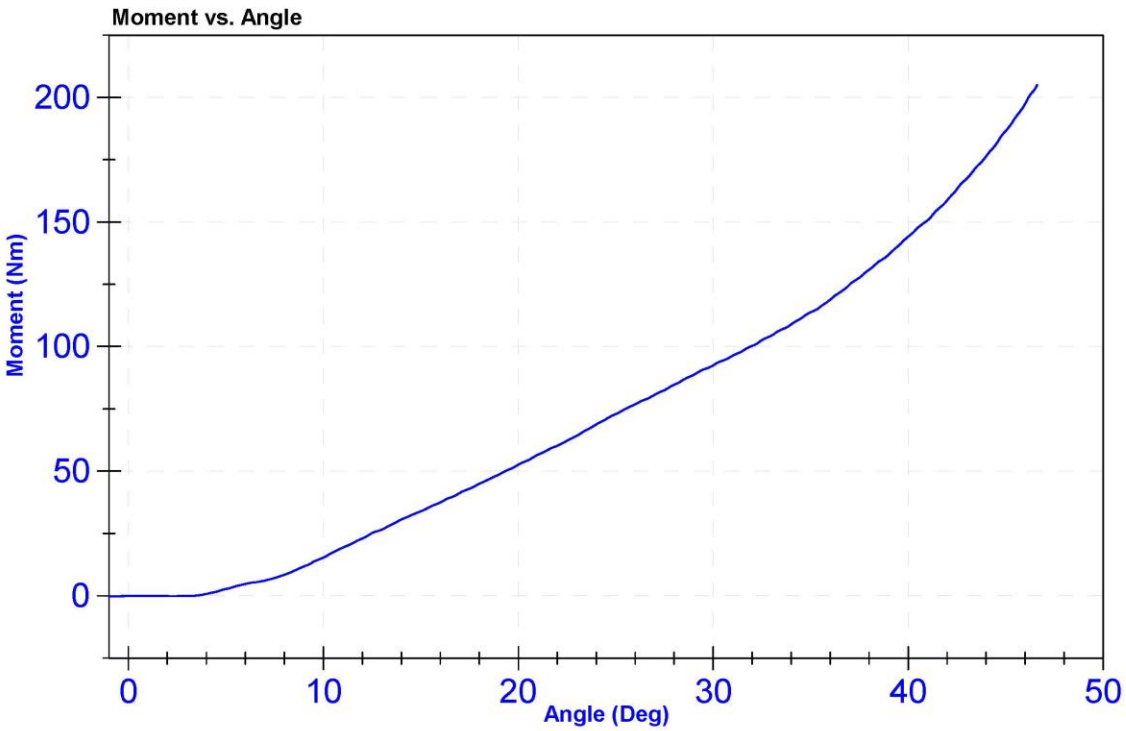
ATD Manufacturer	Humanetics	Test Technician	E. Helenbrook
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.5	Pass
Humidity	10	70	%	22.3	Pass
Average Velocity	5	10	deg/s	7.2	Pass
Angle at 203Nm	40	50	deg	46.5	Pass
Moment at 30 degrees	0	94.9	Nm	92.4	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	ETI SP22	DS-0008	9/18/2020	9/18/2021
Load Cell	Key Trans 2301-02	LC-115 My	9/12/2020	9/12/2021



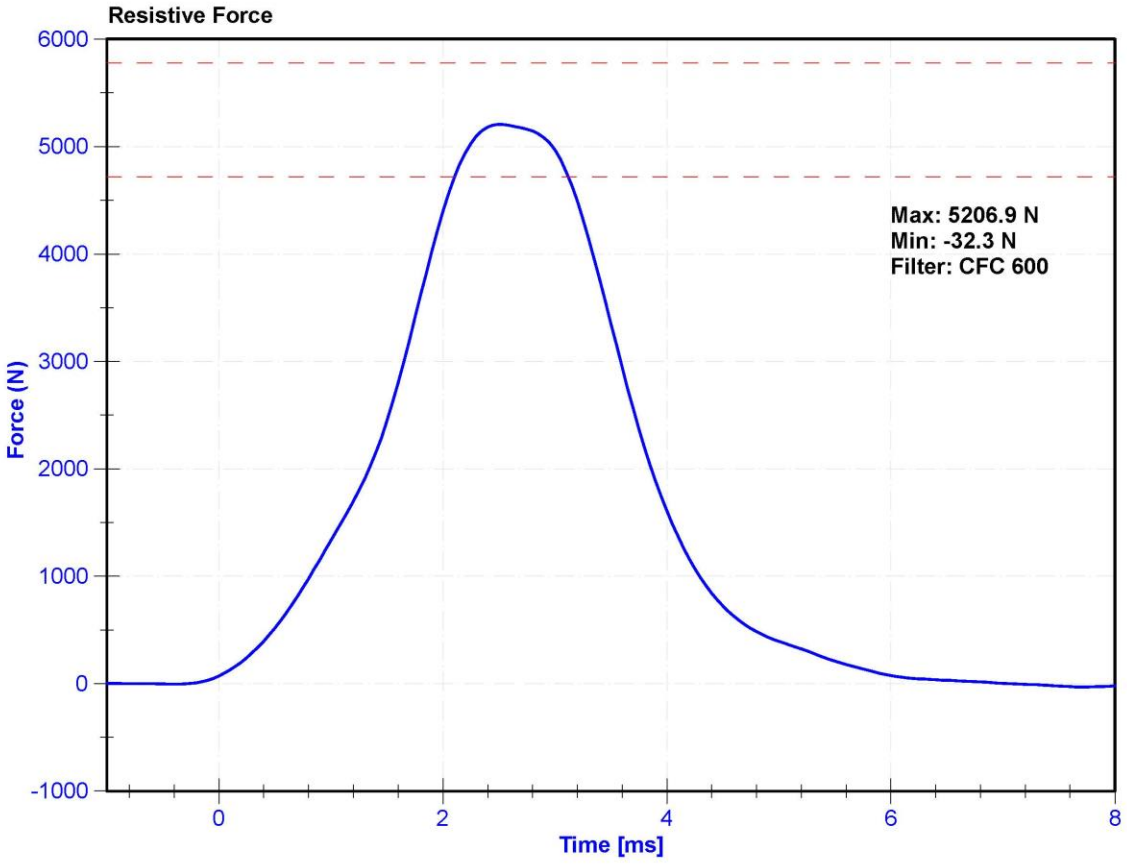
ATD Manufacturer	Humanetics	Test Technician	E. Helenbrook
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

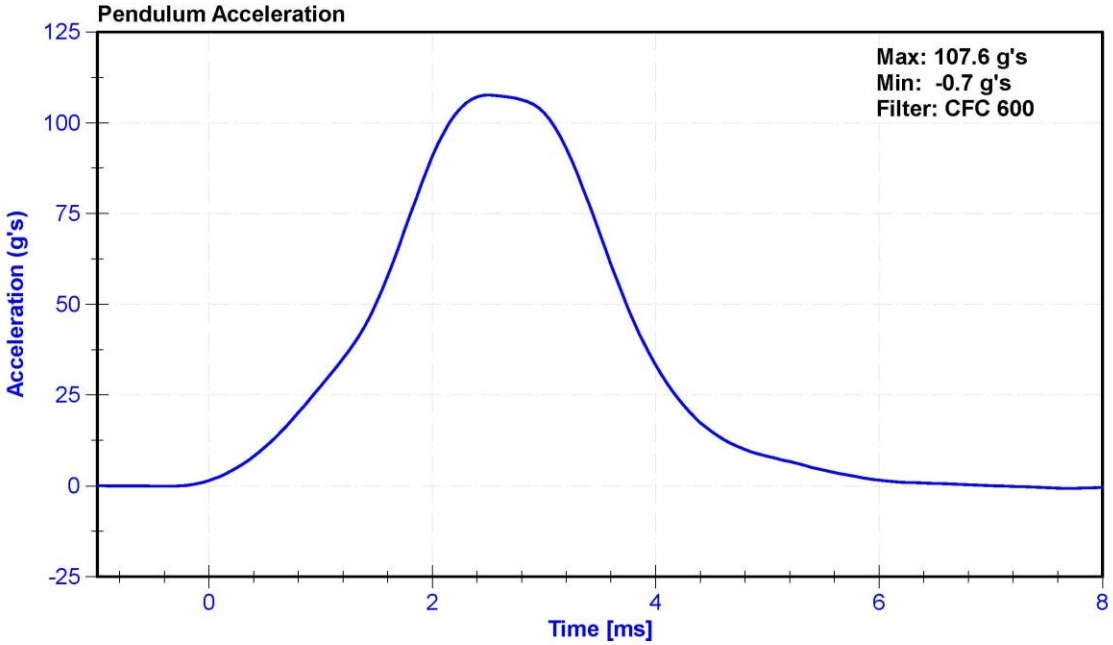
Results

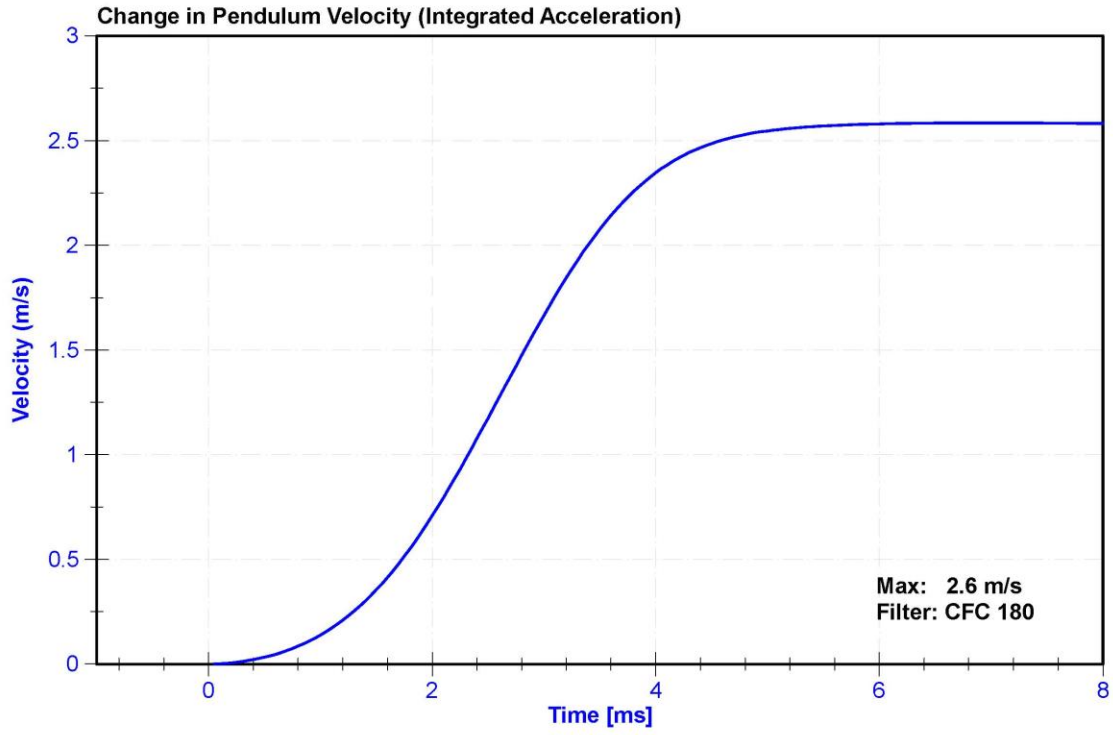
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.6	Pass
Humidity	10	70	%	22.3	Pass
Velocity	2.07	2.13	m/s	2.101	Pass
Maximum Resistive Force	4720	5780	N	5206.9	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A279031	5/8/2020	5/8/2021




Pendulum Acceleration
Max: 107.6 g's
Min: -0.7 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]

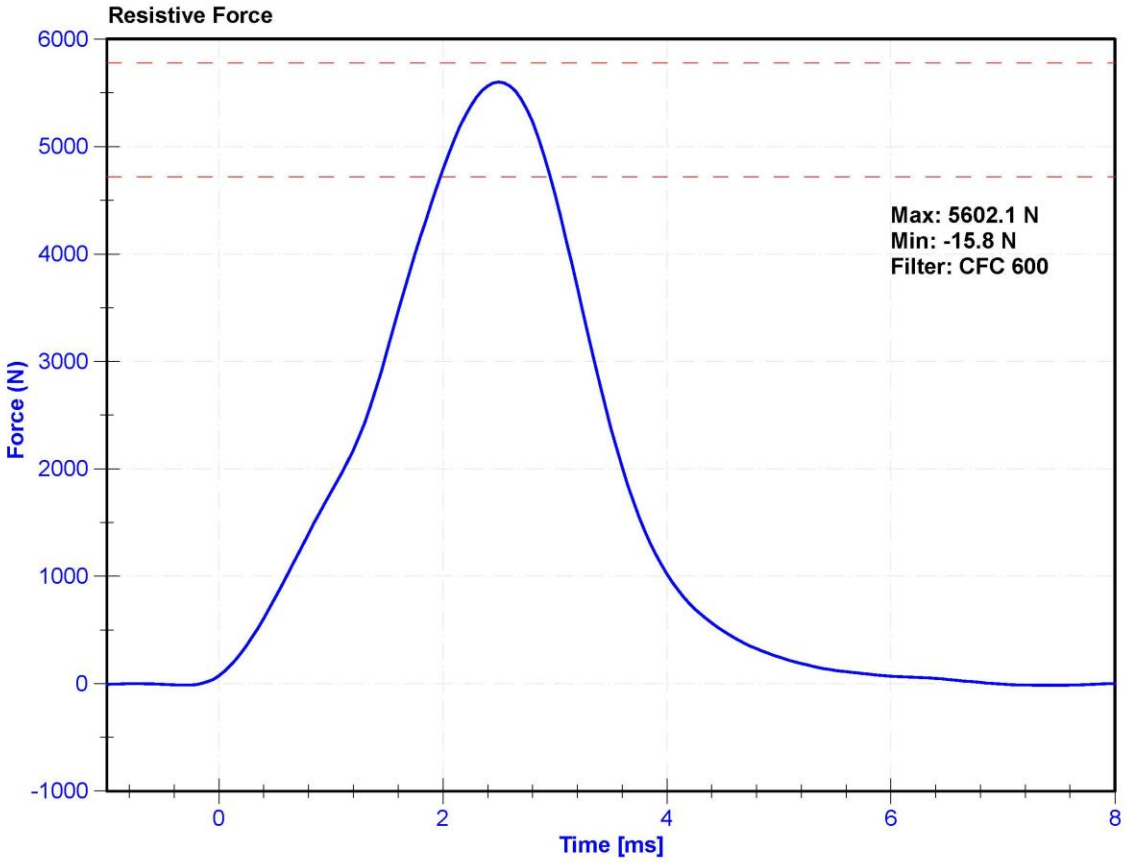
ATD Manufacturer	Humanetics	Test Technician	E. Helenbrook
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

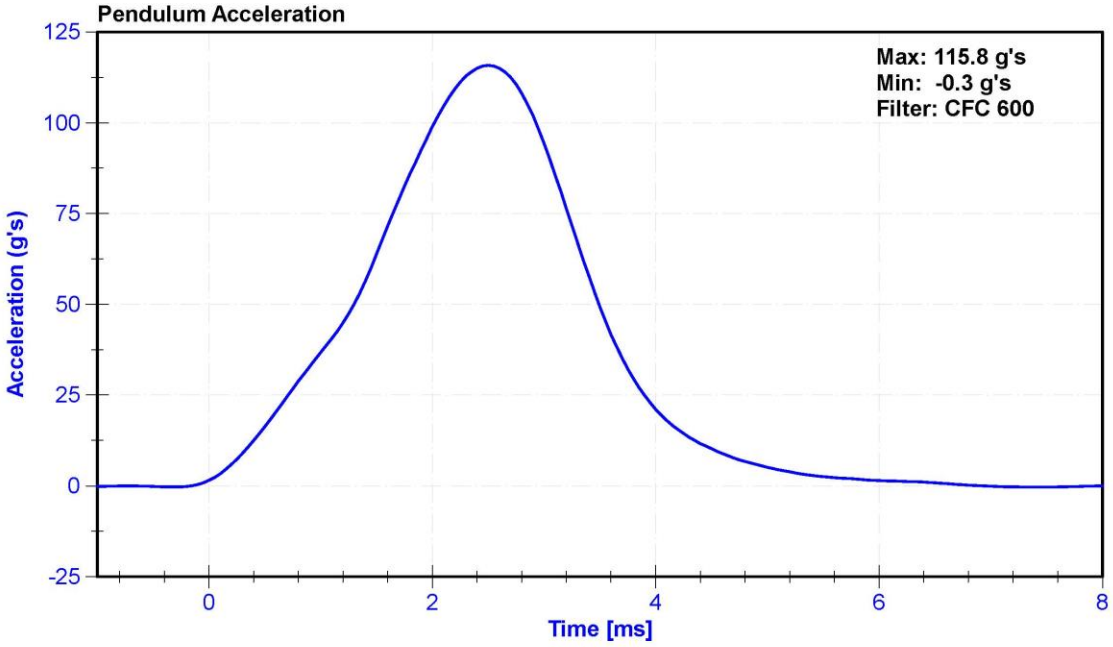
Results

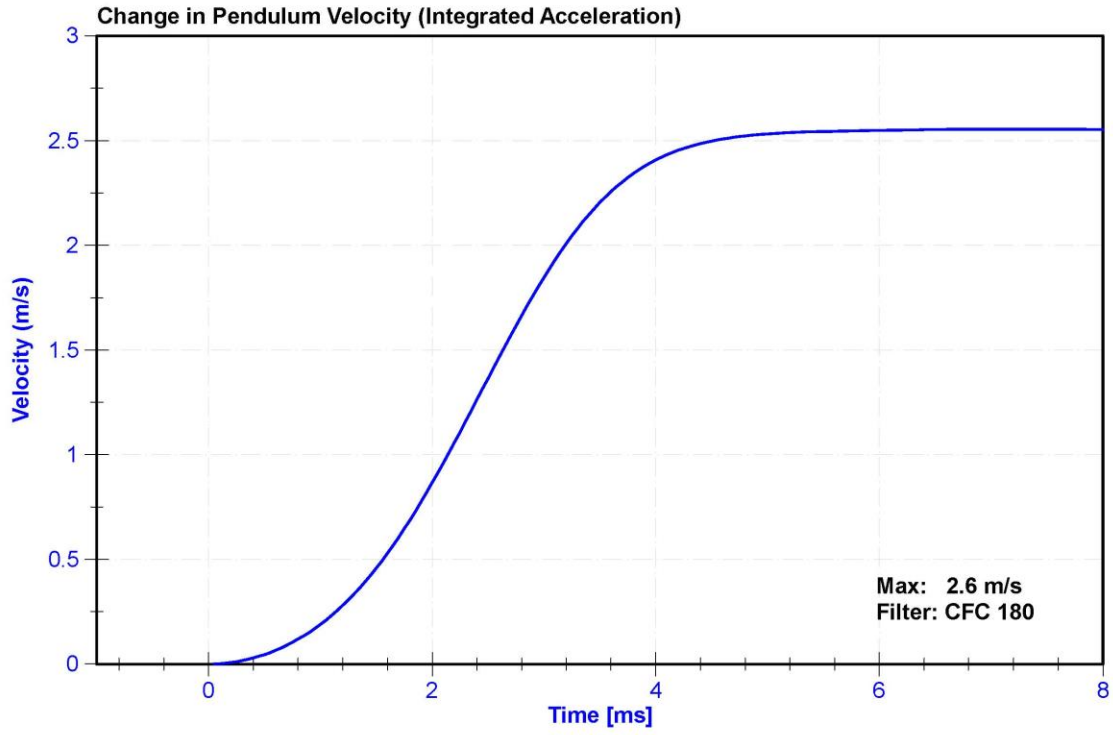
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.2	Pass
Humidity	10	70	%	23.2	Pass
Velocity	2.07	2.13	m/s	2.099	Pass
Maximum Resistive Force	4720	5780	N	5602.1	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A279031	5/8/2020	5/8/2021




Pendulum Acceleration
Max: 115.8 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

PRE-TEST

HYBRID III 5TH PERCENTILE - PASSENGER ATD

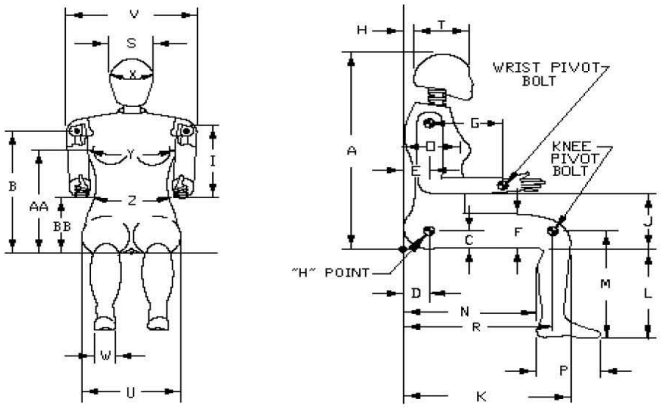
SERIAL NO: 140

Calspan

External Measurements - Hybrid 3 - 5th Female

Technician: K. Brogan Date: 1/6/2021

Dummy Serial Number: 140



Symbol	Description	Specification (mm)		Result (mm)	Pass/Fail
A	Sitting Height	775	800	790	Pass
B	Shoulder Pivot Height	432	457	442	Pass
C	H-Point Height	81	86	83	Pass
D	H-Point from Backline	145	150	146	Pass
E	Shoulder Pivot from Backline	69	84	78	Pass
F	Thigh Clearance	119	135	126	Pass
G	Back of Elbow to Wrist Pivot	244	259	252	Pass
H	Head Back to Backline	43	48	45	Pass
I	Shoulder to Elbow Length	277	297	291	Pass
J	Elbow Rest Height	183	203	197	Pass
K	Buttock to Knee Length	521	546	541	Pass
L	Popliteal Height	356	376	366	Pass
M	Knee Pivot Height	394	419	410	Pass
N	Buttock Popliteal Length	414	439	428	Pass
O	Chest Depth without Jacket	175	191	182	Pass
P	Foot Length (right)	219	234	229	Pass
R	Buttock To Knee Pivot Length	457	483	465	Pass
S	Head Breadth	137	147	142	Pass
T	Head Depth	178	188	180	Pass
U	Hip Breadth	300	315	313	Pass
V	Shoulder Breadth	351	366	361	Pass
W	Foot Breadth	79	94	83	Pass
X	Head Circumference	528	549	540	Pass
Y	Chest Circumference with Jacket	851	881	874	Pass
Z	Waist Circumference	460	790	624	Pass
AA	Reference Location (Chest Circumference)	333	358	345	Pass
BB	Reference Location (Waist Circumference)	160	170	165	Pass

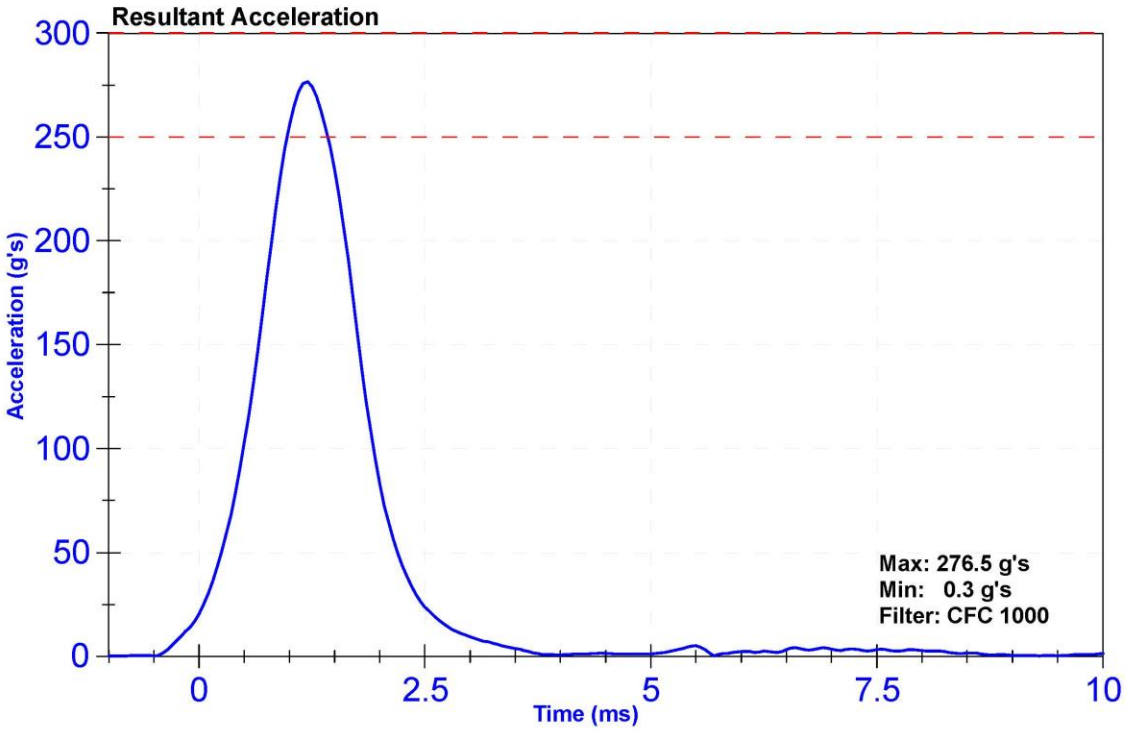
ATD Manufacturer	Humanetics	Test Technician	D.Reinhard
ATD Serial Number	140	Laboratory Supervisor	K. Brogan

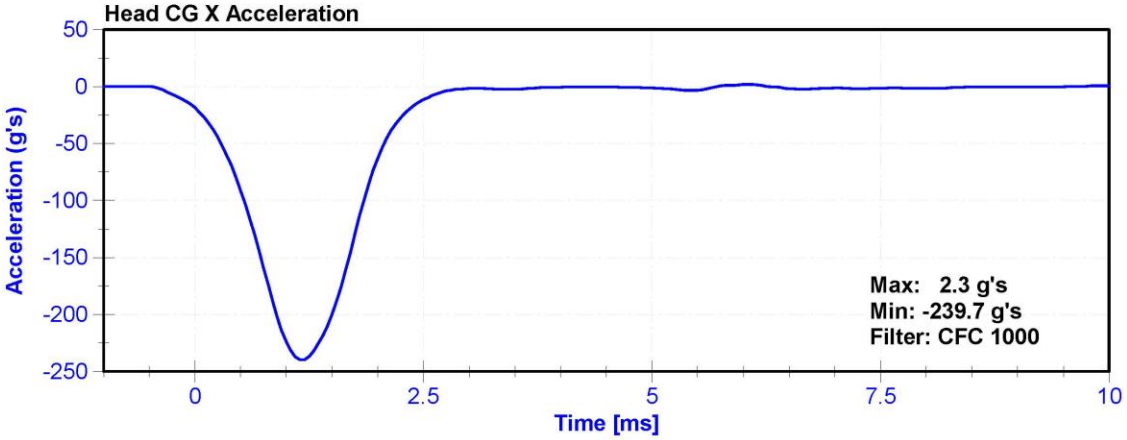
Results

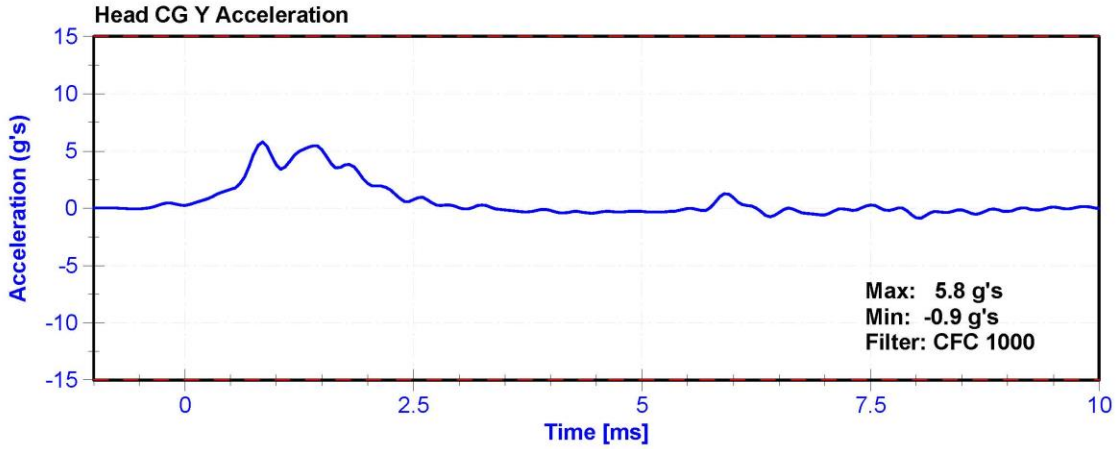
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	20.7	Pass
Humidity	10	70	%	27	Pass
Resultant Acceleration	250	300	g's	276.5	Pass
Oscillation	0	10	%	1.8	Pass
Lateral Acceleration	-15	15	g's	5.8	Pass

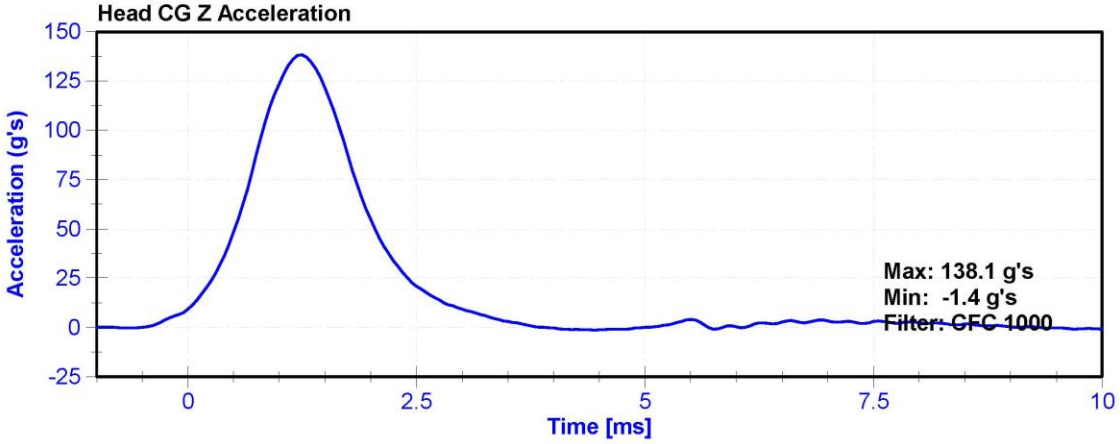
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	Endevco 7264C	P52008	9/22/2020	3/23/2021
Y Accelerometer	Endevco 7264C	P83335	9/22/2020	3/23/2021
Z Accelerometer	Endevco 7264C	T11252	9/22/2020	3/23/2021




Head CG X Acceleration
Acceleration (g's)
50
0
-50
-100
-150
-200
-250
0
2.5
5
7.5
10
Time [ms]
Max: 2.3 g's
Min: -239.7 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: 5.8 g's
Min: -0.9 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: 138.1 g's
Min: -1.4 g's
Filter: CFC 1000

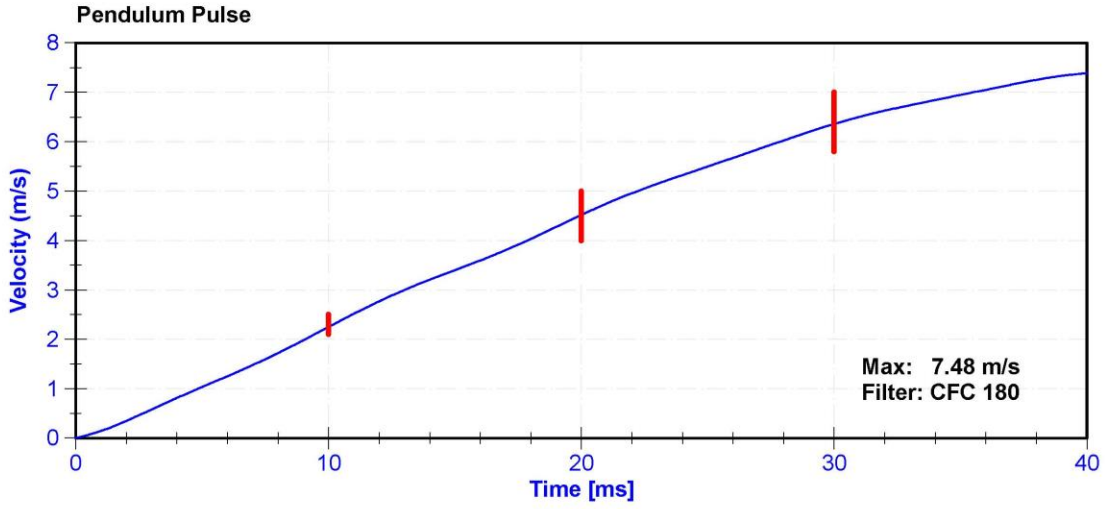
ATD Manufacturer	Humanetics	Test Technician	D.Reinhard
ATD Serial Number	140	Laboratory Supervisor	K. Brogan

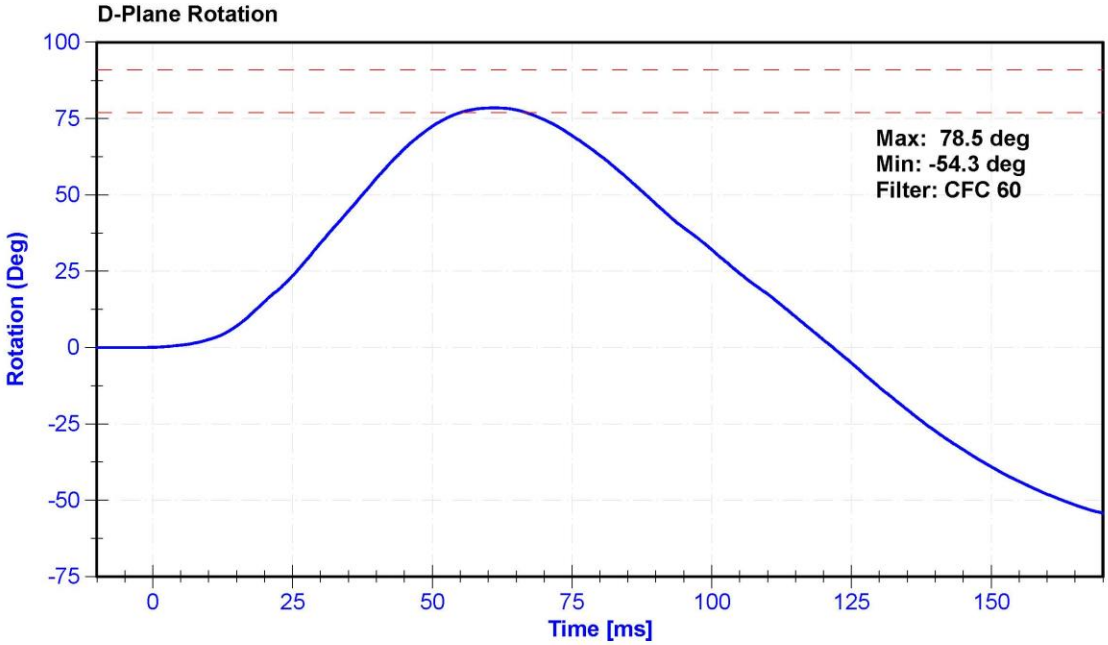
Results

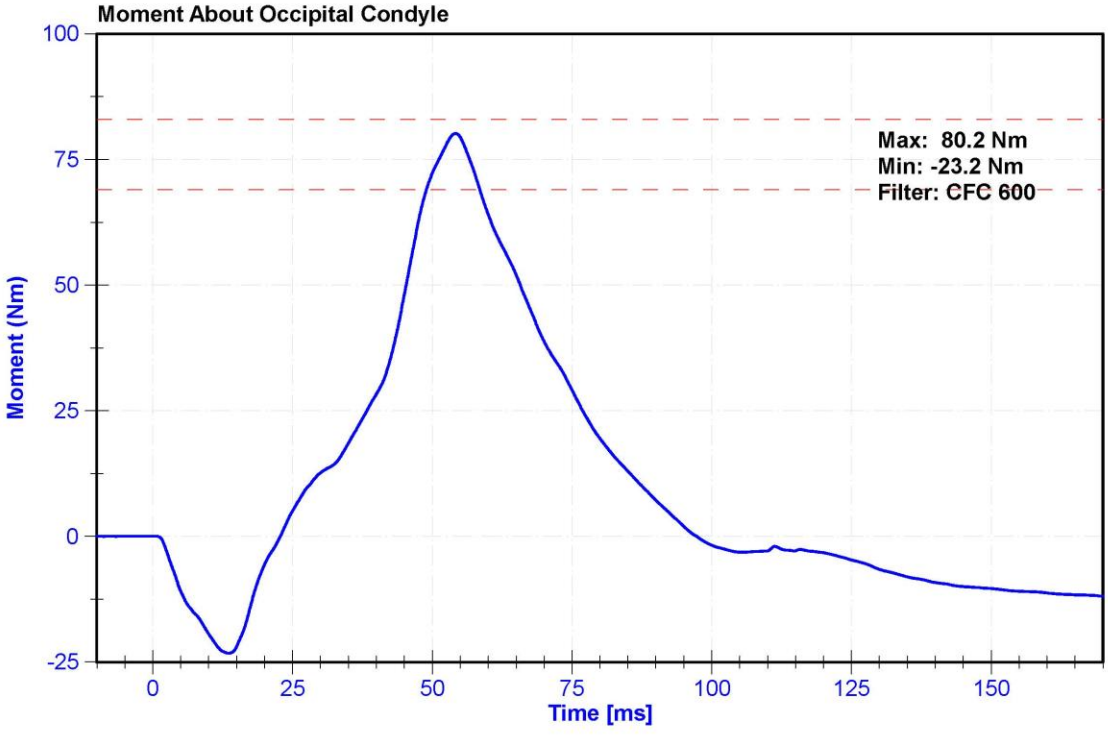
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.9	Pass
Humidity	10	70	%	29.0	Pass
Velocity	6.89	7.13	m/s	7.013	Pass
Pendulum Impulse at 10ms	2.1	2.5	m/s	2.25	Pass
Pendulum Impulse at 20ms	4.0	5.0	m/s	4.52	Pass
Pendulum Impulse at 30ms	5.8	7.0	m/s	6.36	Pass
Max D Plane Rotation	77	91	deg	78.5	Pass
Max Moment During Rotation Interval	69	83	Nm	80.2	Pass
Moment Decay to 10.0 Nm	80	100	ms	87.6	Pass

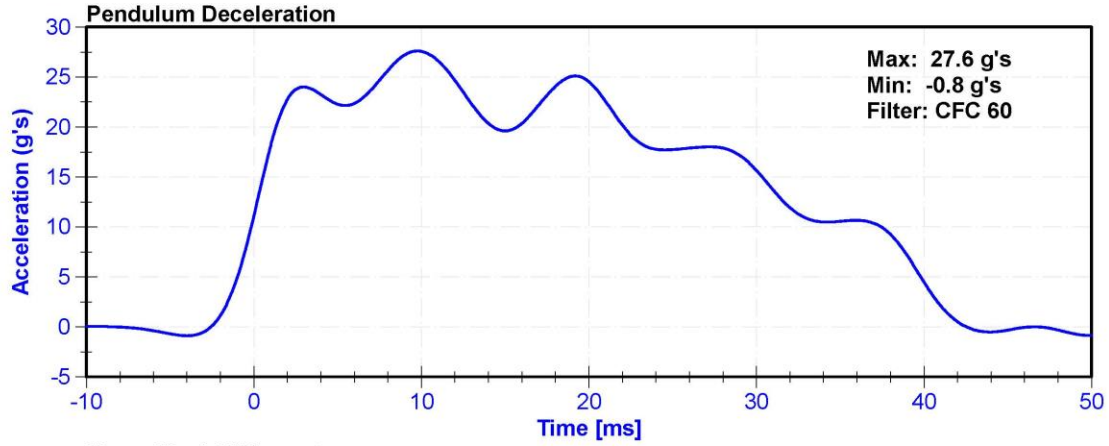
Transducer Calibrations

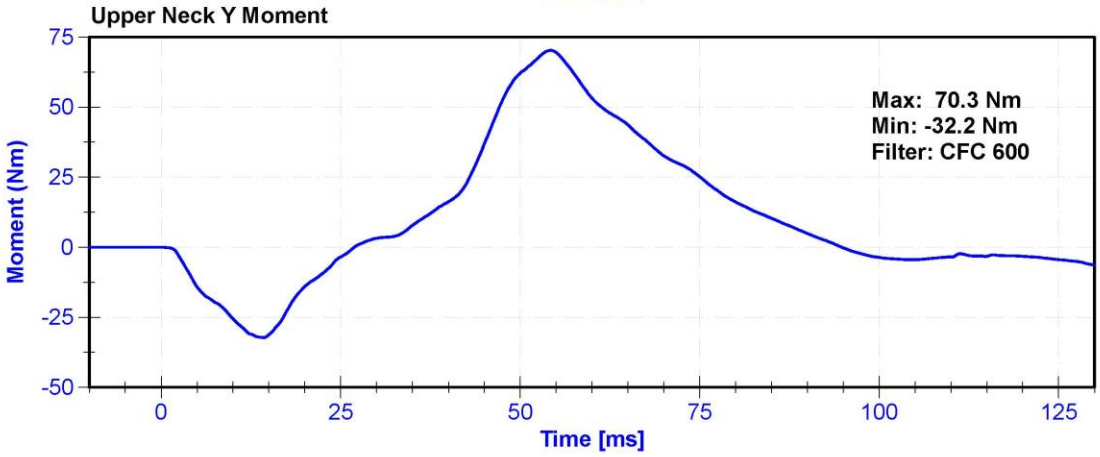
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-C16503 Striker	2/6/2020	2/5/2021
Pendulum Potentiometer	ETI SP22G	DS-LABPOT1	9/17/2020	9/17/2021
Condyle Potentiometer	ETI SP22G	DS-LABPOT2	9/17/2020	9/17/2021
Upper Neck Load Cell	Denton 1716A	LC-1916Fx	11/23/2020	11/23/2021

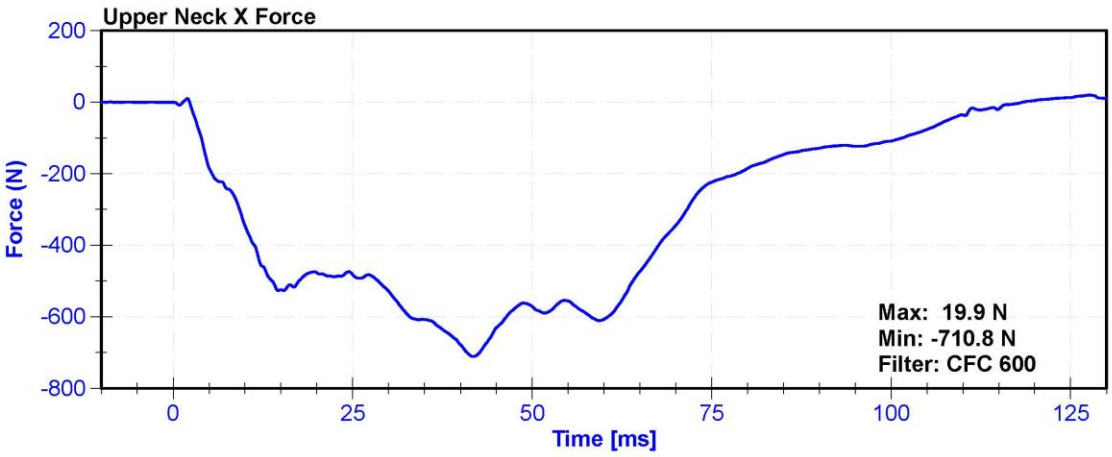



D-Plane Rotation
Max: 78.5 deg
Min: -54.3 deg
Filter: CFC 60
Rotation (Deg)
100
75
50
25
0
-25
-50
-75
0
25
50
75
100
125
150
Time [ms]


Moment About Occipital Condyle
Max: 80.2 Nm
Min: -23.2 Nm
Filter: CFC 600
Moment (Nm)
100
75
50
25
0
-25
0
25
50
75
100
125
150
Time [ms]


Pendulum Deceleration
Max: 27.6 g's
Min: -0.8 g's
Filter: CFC 60
Acceleration (g's)
Time [ms]


Upper Neck Y Moment
Max: 70.3 Nm
Min: -32.2 Nm
Filter: CFC 600
Moment (Nm)
Time [ms]


Upper Neck X Force
Max: 19.9 N
Min: -710.8 N
Filter: CFC 600
Force (N)
Time [ms]

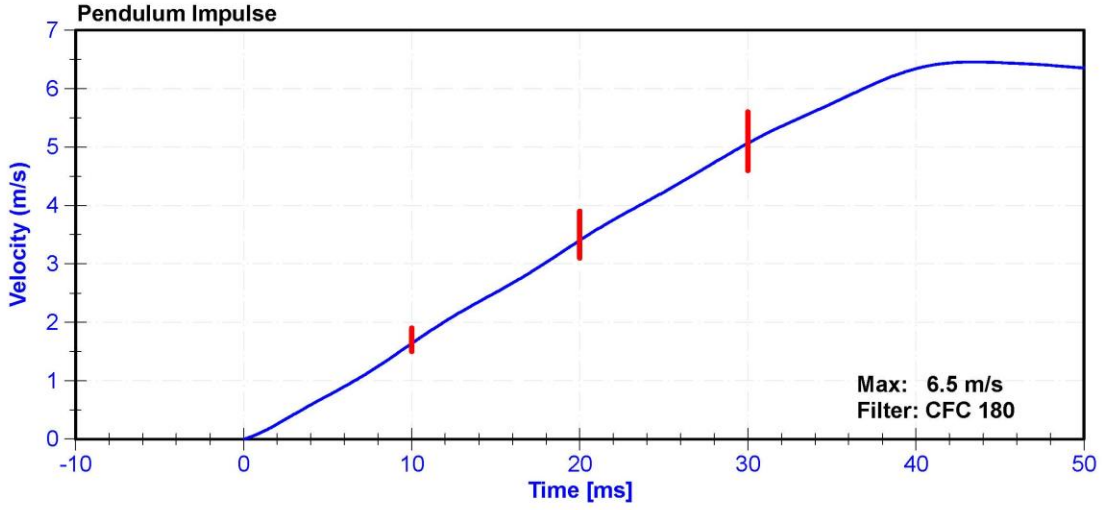
ATD Manufacturer	Humanetics	Test Technician	D.Reinhard
ATD Serial Number	140	Laboratory Supervisor	K. Brogan

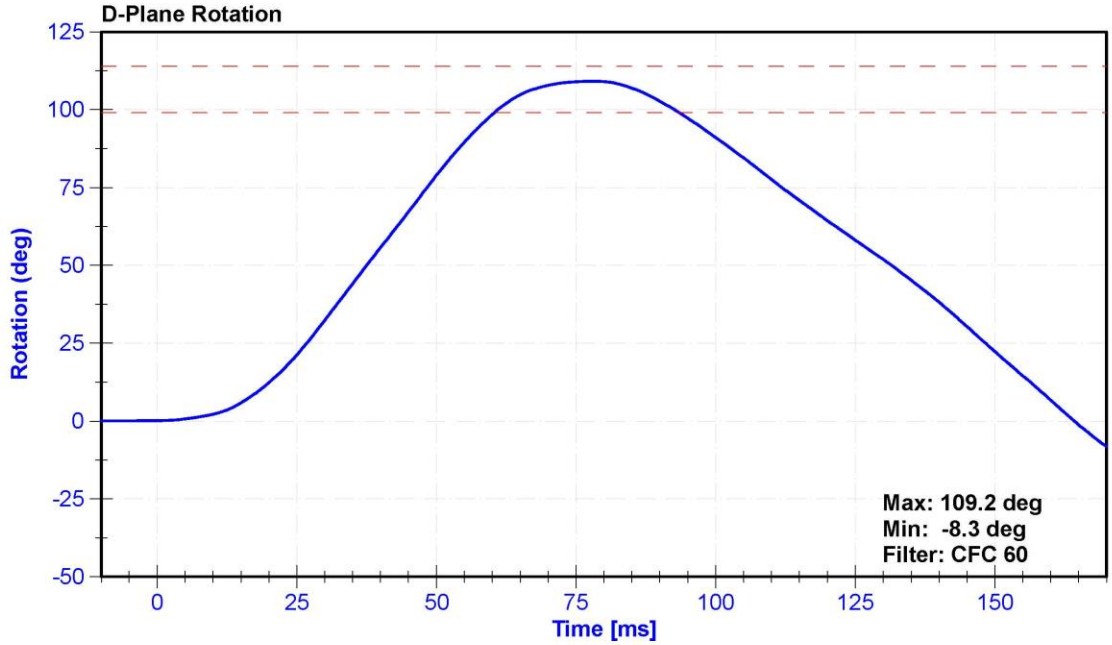
Results

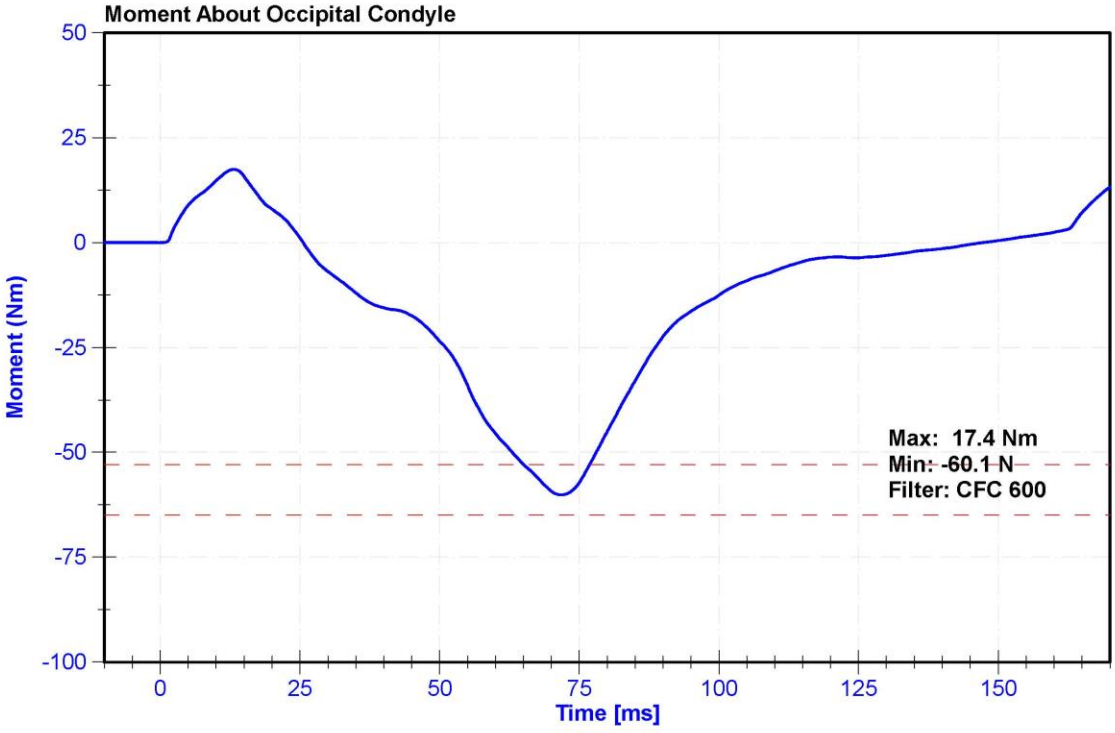
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.8	Pass
Humidity	10	70	%	29.0	Pass
Velocity	5.95	6.19	m/s	6.046	Pass
Pendulum Impulse at 10ms	1.5	1.9	m/s	1.64	Pass
Pendulum Impulse at 20ms	3.1	3.9	m/s	3.40	Pass
Pendulum Impulse at 30ms	4.6	5.6	m/s	5.07	Pass
D Plane Rotation	99	114	deg	109.2	Pass
Moment During Rotation Interval	-65	-53	Nm	-60.1	Pass
Moment Decay to -10Nm	94	114	ms	103.4	Pass

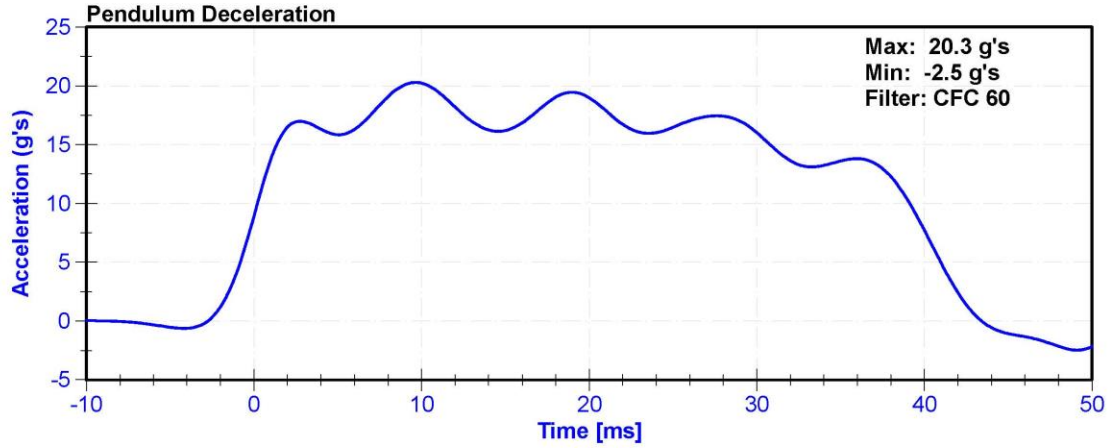
Transducer Calibrations

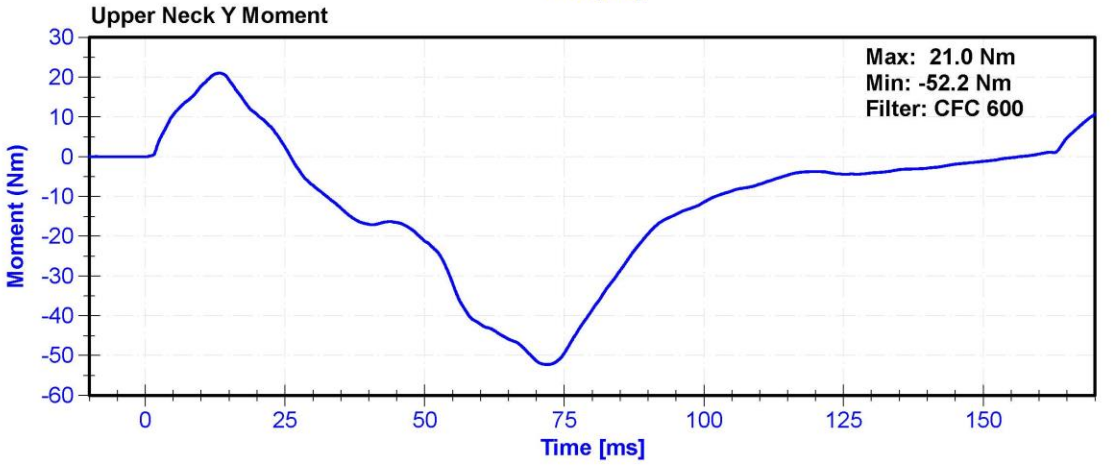
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-C16503 Striker	2/6/2020	2/5/2021
Pendulum Potentiometer	ETI SP22G	DS-LABPOT1	9/17/2020	9/17/2021
Condyle Potentiometer	ETI SP22G	DS-LABPOT2	9/17/2020	9/17/2021
Upper Neck Load Cell	Denton 1716A	LC-1916Fx	11/23/2020	11/23/2021

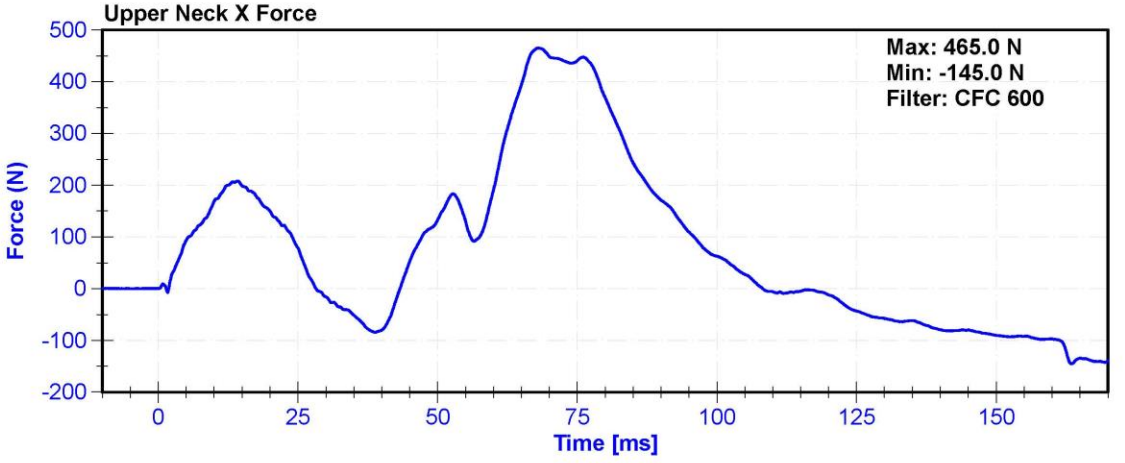



D-Plane Rotation
Rotation (deg)
125
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]
Max: 109.2 deg
Min: -8.3 deg
Filter: CFC 60


Moment About Occipital Condyle
Moment (Nm)
50
25
0
-25
-50
-75
-100
0
25
50
75
100
125
150
Time [ms]
Max: 17.4 Nm
Min: -60.1 N
Filter: CFC 600


Pendulum Deceleration
Max: 20.3 g's
Min: -2.5 g's
Filter: CFC 60
Acceleration (g's)
25
20
15
10
5
0
-5
-10
0
10
20
30
40
50
Time [ms]


Upper Neck Y Moment
Max: 21.0 Nm
Min: -52.2 Nm
Filter: CFC 600
Moment (Nm)
30
20
10
0
-10
-20
-30
-40
-50
-60
0
25
50
75
100
125
150
Time [ms]


Upper Neck X Force
Max: 465.0 N
Min: -145.0 N
Filter: CFC 600
Force (N)
500
400
300
200
100
0
-100
-200
0
25
50
75
100
125
150
Time [ms]

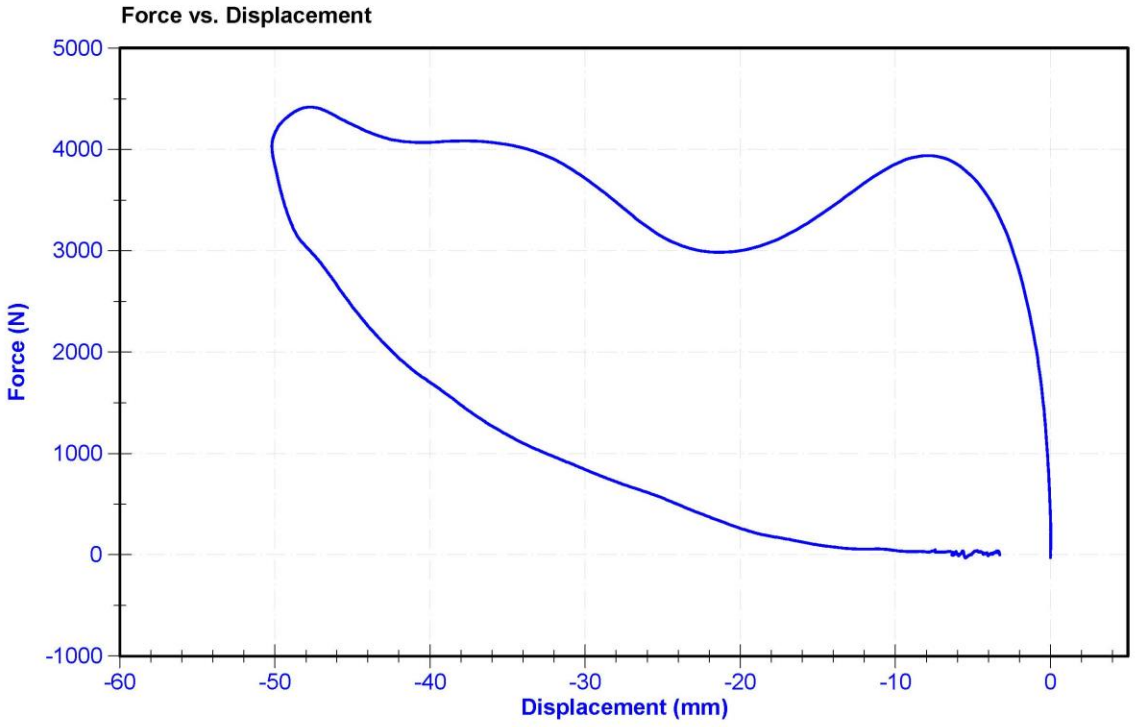
ATD Manufacturer	Humanetics	Test Technician	D.Reinhard
ATD Serial Number	140	Laboratory Supervisor	K. Brogan

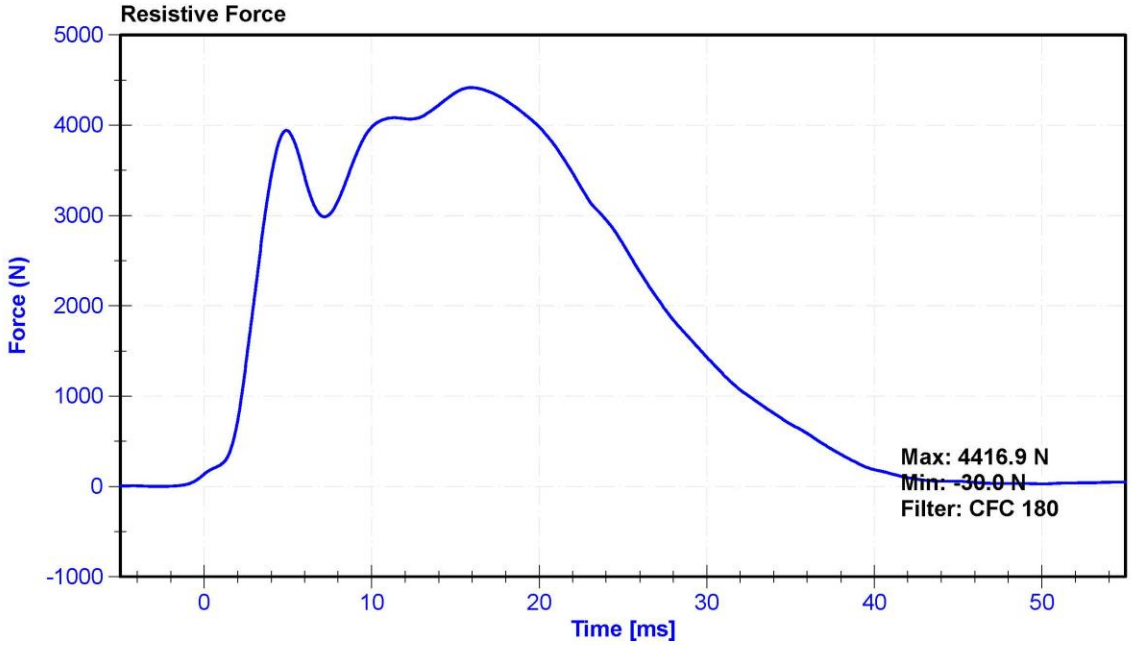
Results

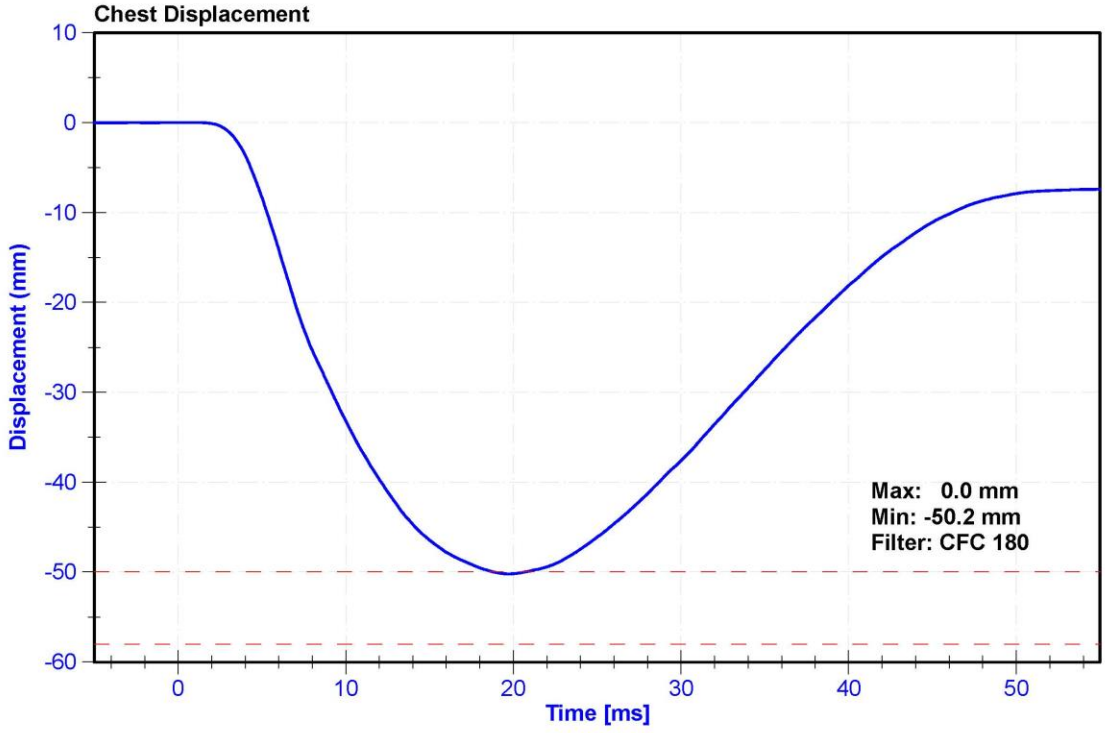
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.8	Pass
Humidity	10	70	%	27	Pass
Velocity	6.59	6.83	m/s	6.743	Pass
Chest Deflection	-58	-50	mm	-50.2	Pass
Maximum Resistive Force (50 to 58mm)	3900	4400	N	4169.1	Pass
Maximum Resistive Force (18 to 50mm)	0	4600	N	4416.9	Pass
Hysteresis	69	85	%	75.4	Pass

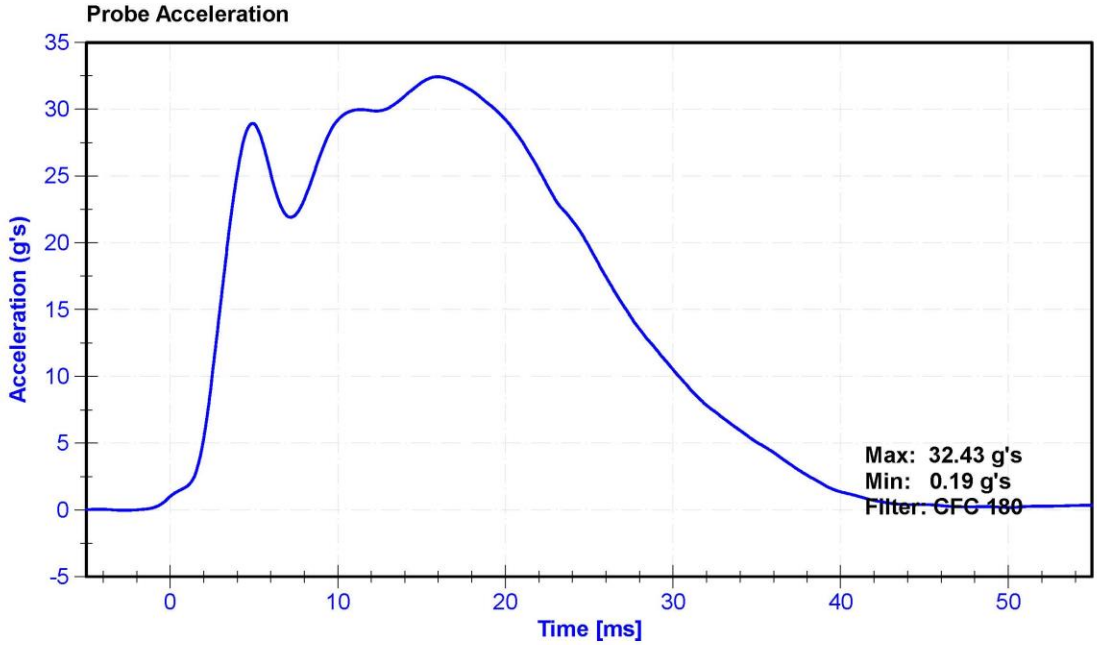
Transducer Calibrations

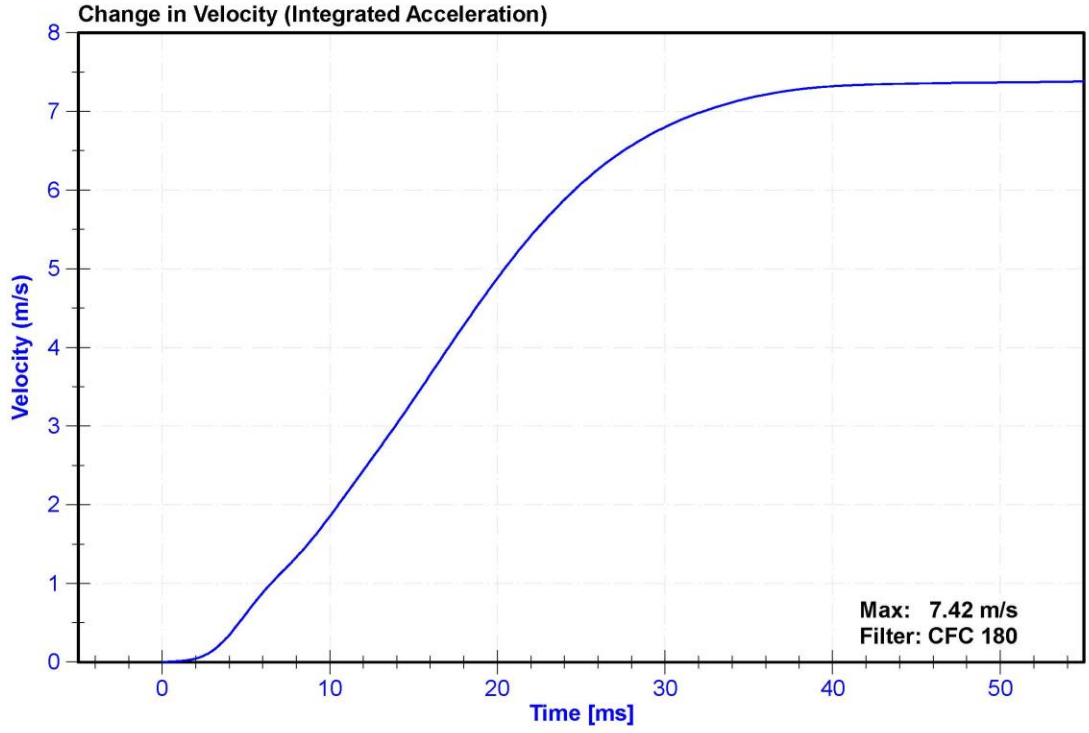
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A286228	1/29/2020	1/28/2021
Chest Potentiometer	SERVO 14CBI-3615	DS-140GFE	11/17/2020	5/18/2021




Resistive Force
Force (N)
5000
4000
3000
2000
1000
0
-1000
0
10
20
30
40
50
Time [ms]
Max: 4416.9 N
Min: -30.0 N
Filter: CFC 180


Chest Displacement
Displacement (mm)
10
0
-10
-20
-30
-40
-50
-60
0
10
20
30
40
50
Time [ms]
Max: 0.0 mm
Min: -50.2 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: 32.43 g's
Min: 0.19 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: 7.42 m/s
Filter: CFC 180

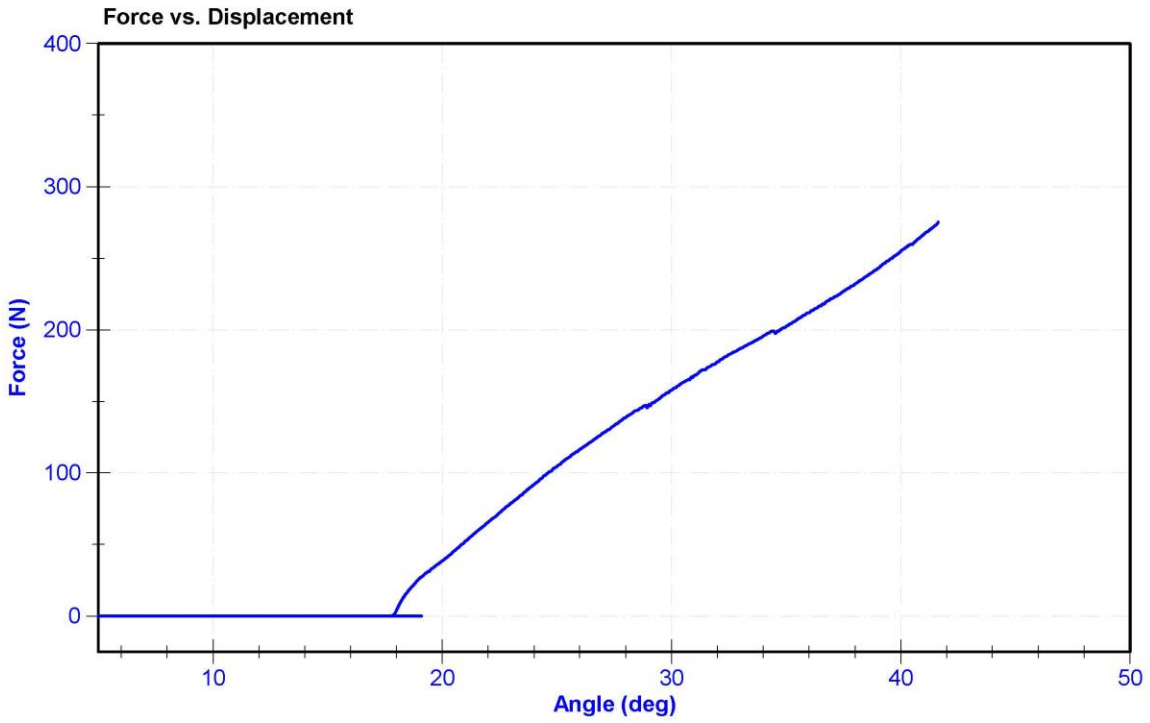
ATD Manufacturer	Humanetics	Test Technician	D. Reinhard
ATD Serial Number	140	Laboratory Supervisor	K. Brogan

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.6	25.6	ºC	20.8	Pass
Humidity	10	70	%	29	Pass
Initial Angle	0	20	deg	17.5	Pass
Force at 45 Degrees	320	390	N	321.8	Pass
Return Angle Relative to Initial	0	8	deg	5.3	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	Seika.de N4C-1	DS-13051548	10/12/2021	10/12/2022
Load Cell	Interface SML-200	LC-493319	10/8/2020	10/8/2021



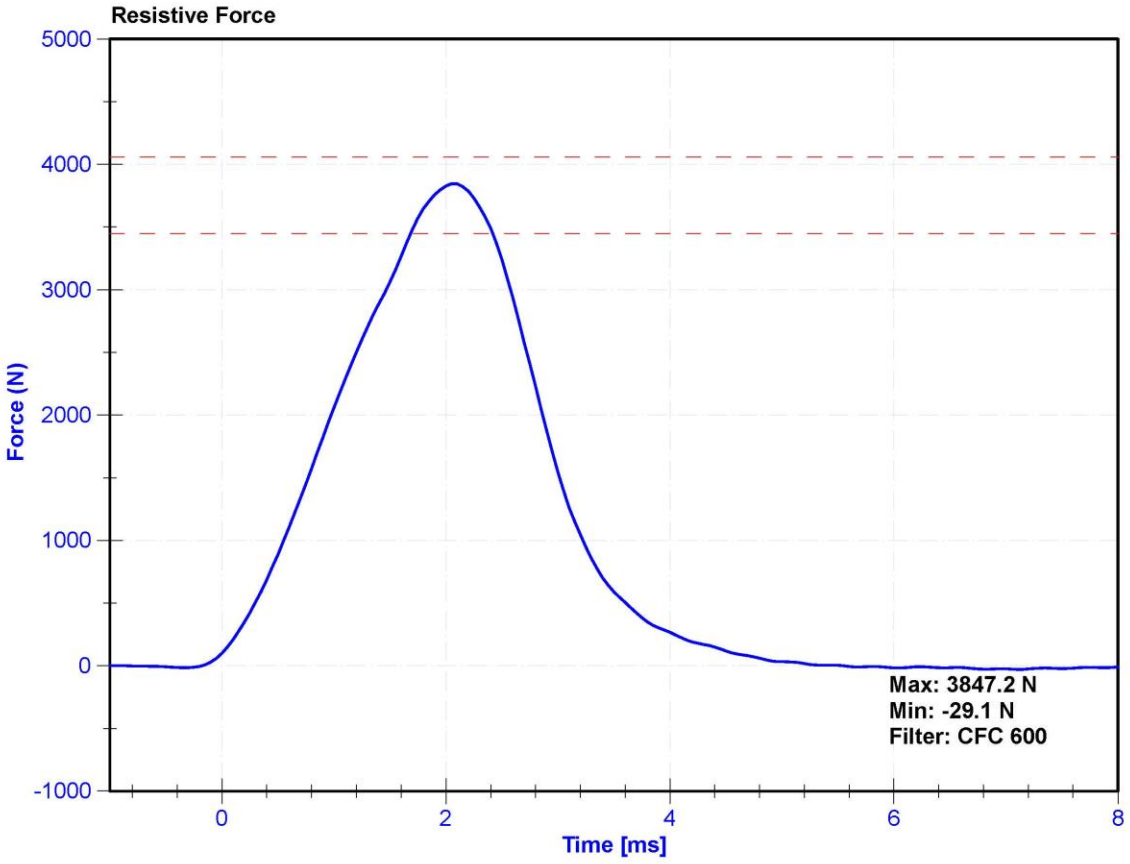
ATD Manufacturer	Denton	Test Technician	D.Reinhard
ATD Serial Number	140	Laboratory Supervisor	K. Brogan

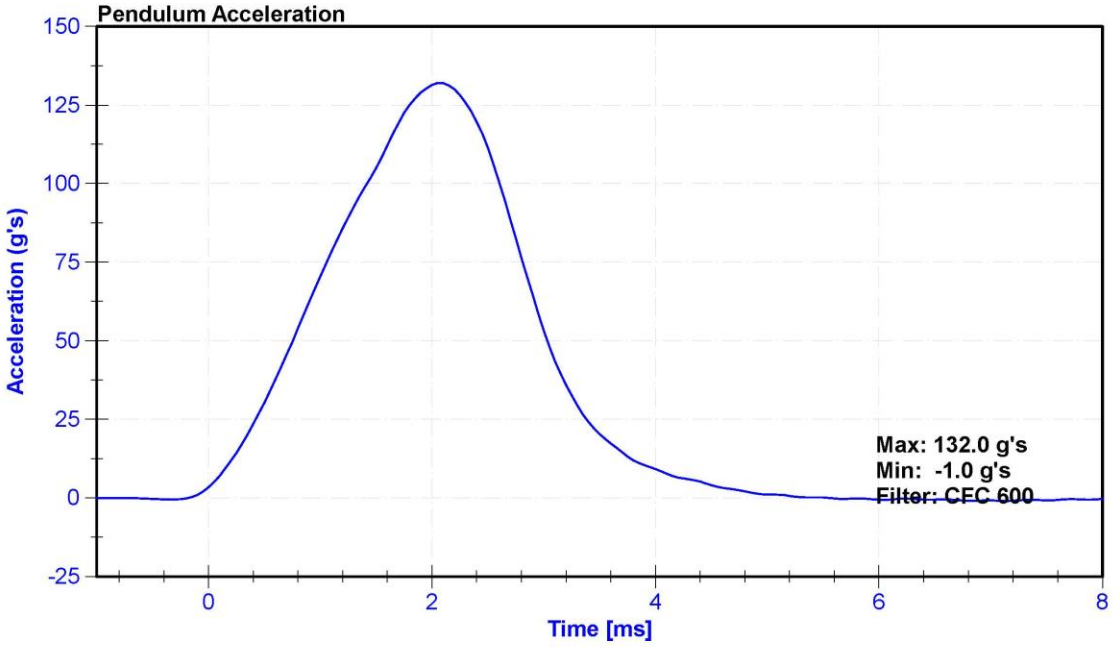
Results

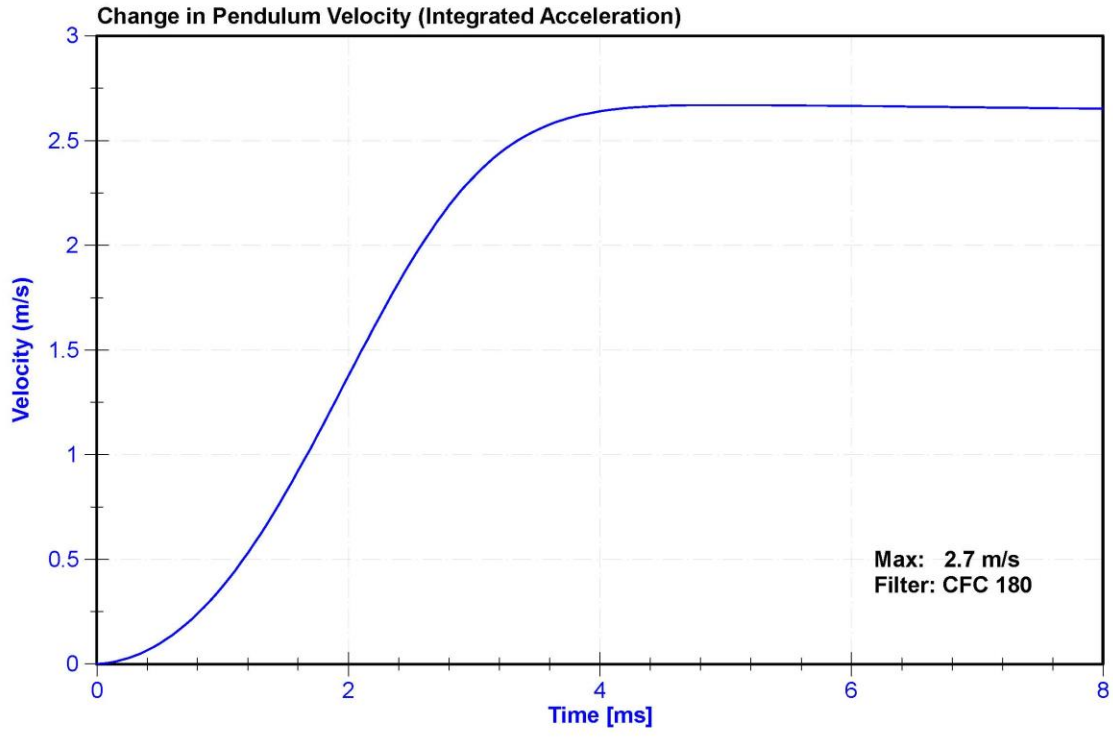
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	20.9	Pass
Humidity	10	70	%	29.0	Pass
Velocity	2.07	2.13	m/s	2.106	Pass
Resistive Force	3450	4060	N	3847.2	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A279031	5/8/2020	5/8/2021




Pendulum Acceleration
Acceleration (g's)
150
125
100
75
50
25
0
-25
0
2
4
6
8
Time [ms]
Max: 132.0 g's
Min: -1.0 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

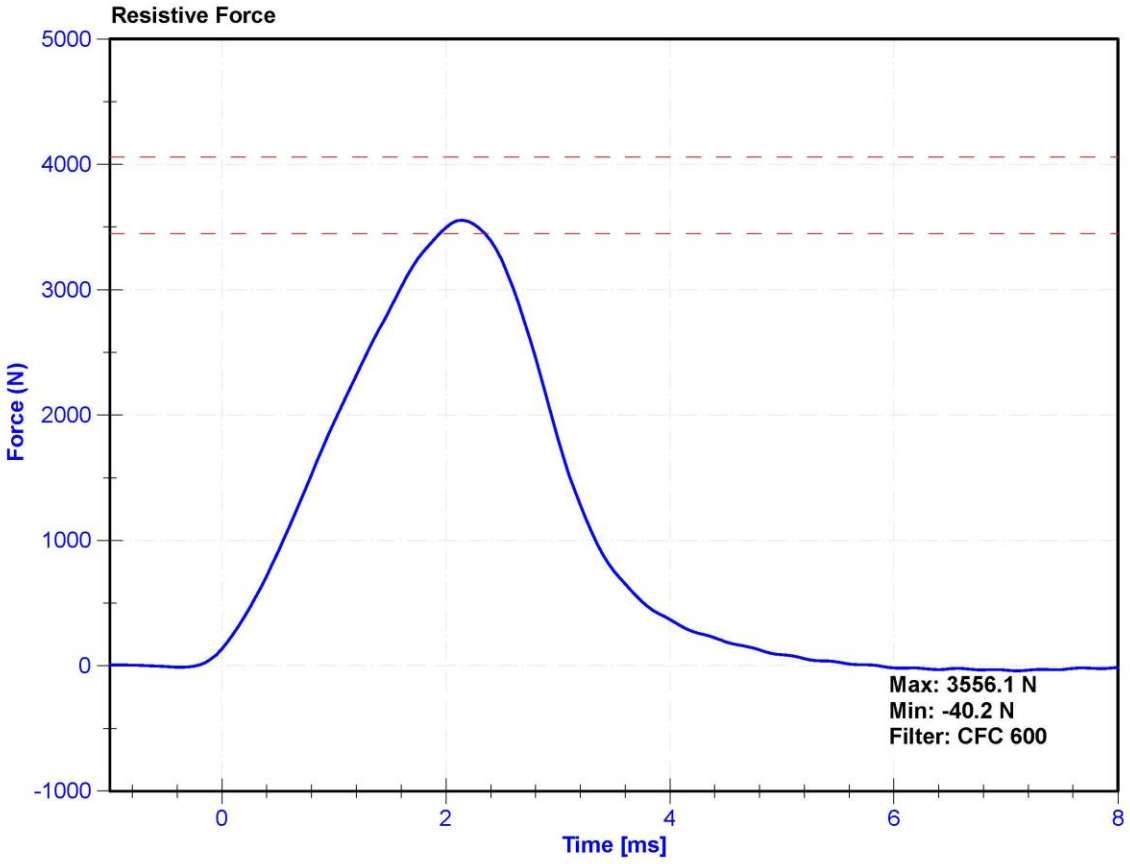
ATD Manufacturer	Denton	Test Technician	D.Reinhard
ATD Serial Number	140	Laboratory Supervisor	K. Brogan

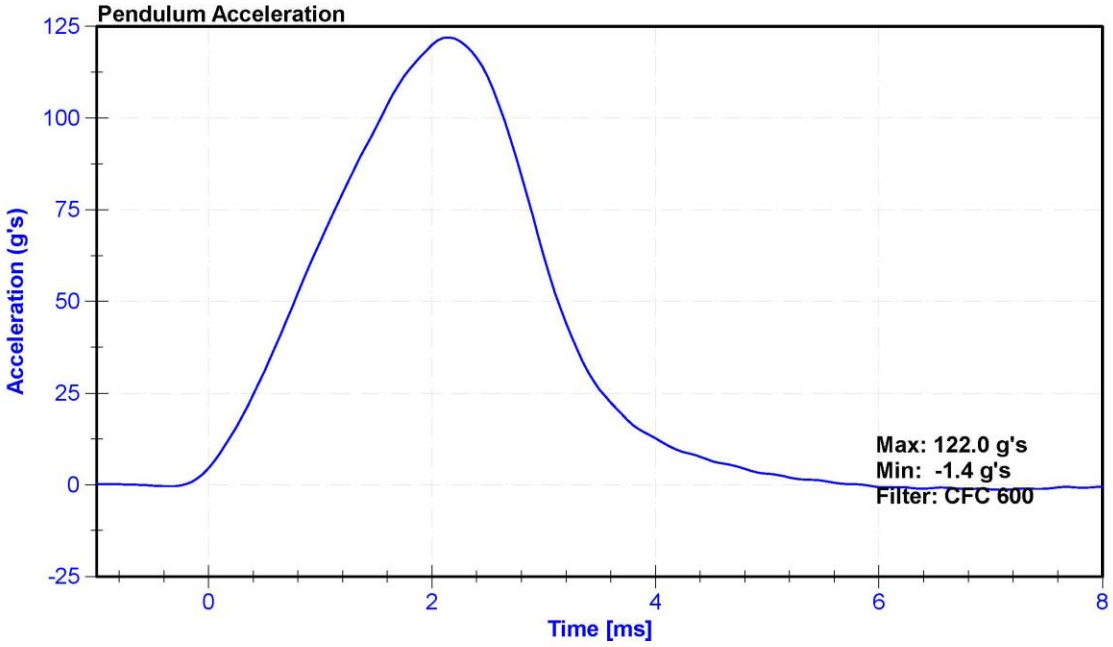
Results

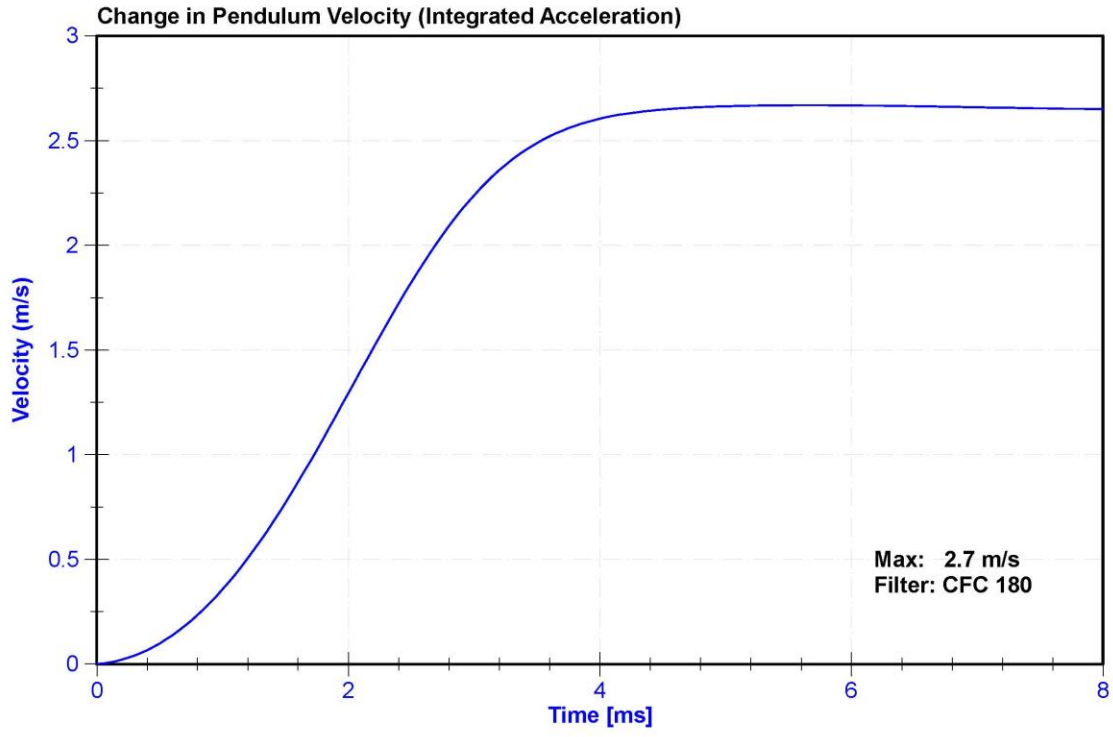
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	20.9	Pass
Humidity	10	70	%	29.0	Pass
Velocity	2.07	2.13	m/s	2.104	Pass
Resistive Force	3450	4060	N	3556.1	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A279031	5/8/2020	5/8/2021




Pendulum Acceleration
Acceleration (g's)
125
100
75
50
25
0
-25
0
2
4
6
8
Time [ms]
Max: 122.0 g's
Min: -1.4 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

CALIBRATION TEST RESULTS

POST-TEST

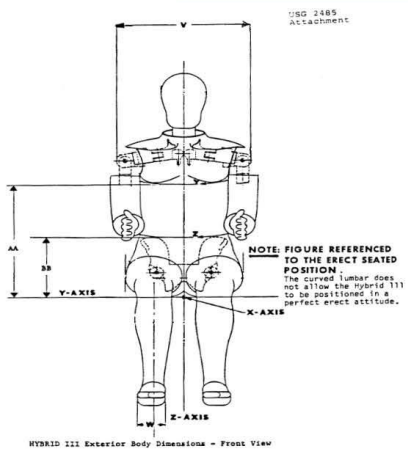
HYBRID III 50TH PERCENTILE MALE - DRIVER ATD

SERIAL NO: 142

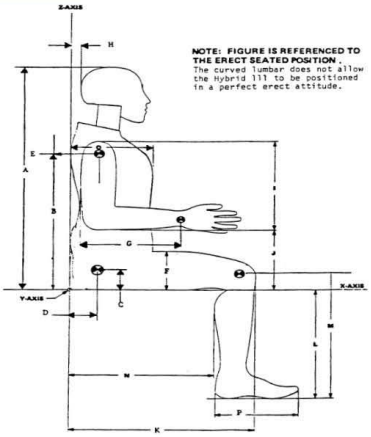
External Measurements - Hybrid 3 - 50th Male

Technician: K. Dutton Date: 02/15/2021

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	34.7	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	5.9	Pass
G	Back of Elbow to Wrist Pivot	11.4	12.0	11.8	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	8.1	Pass
K	Buttock to Knee Length	22.8	23.8	23.0	Pass
L	Popliteal Height	16.9	17.9	17.5	Pass
M	Knee Pivot Height	19.1	19.7	19.4	Pass
N	Buttock Popliteal Length	17.8	18.8	18.3	Pass
O	Chest Depth without Jacket	8.4	9.0	8.6	Pass
P	Foot Length (right)	9.9	10.5	10.1	Pass
V	Shoulder Breadth	16.3	17.2	16.8	Pass
W	Foot Breadth	3.6	4.2	3.8	Pass
Y	Chest Circumference with Jacket	38.2	39.4	38.8	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

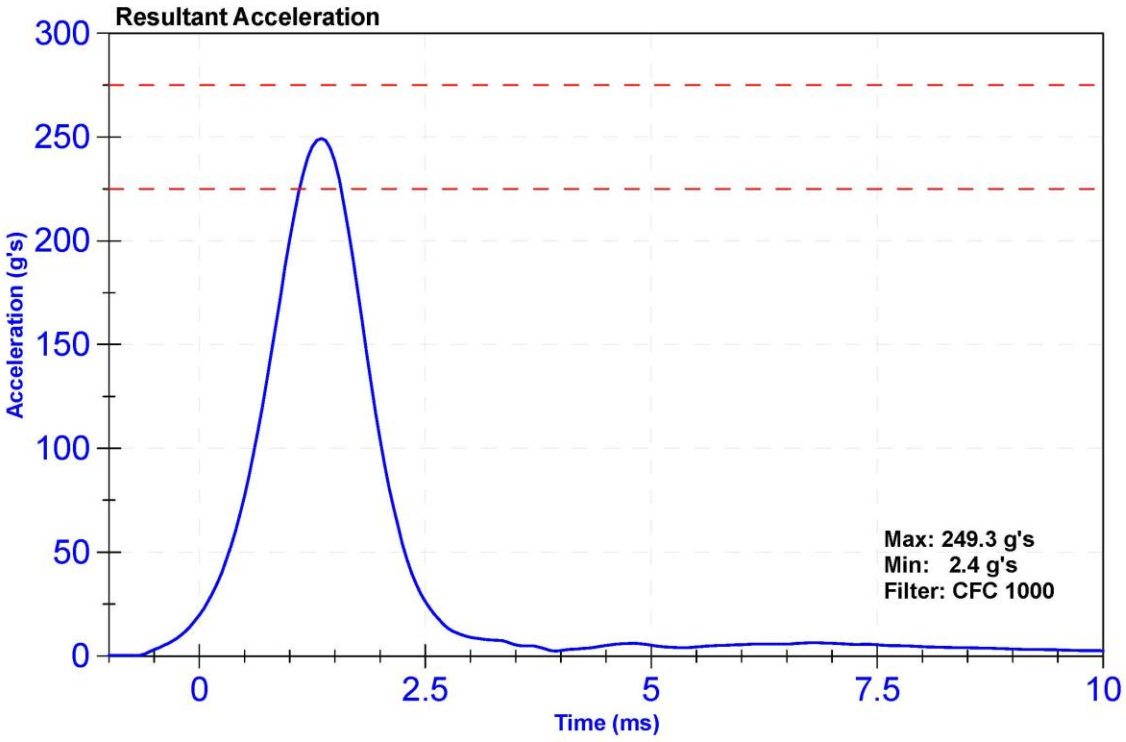
ATD Manufacturer	Humanetics	Test Technician	M. Dudek
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

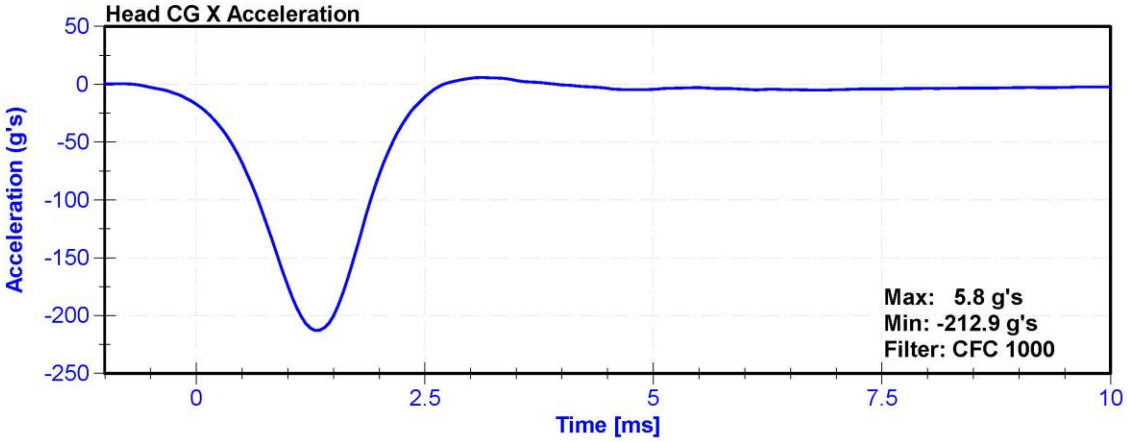
Results

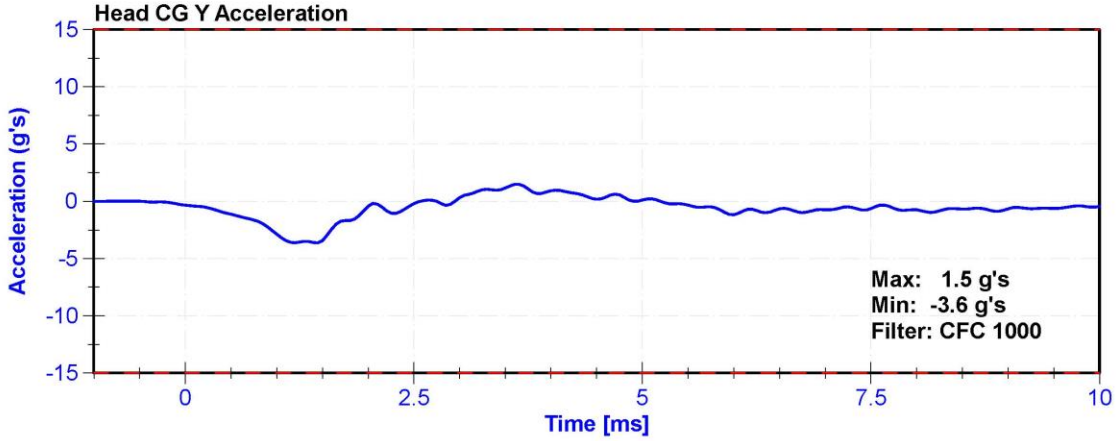
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21	Pass
Humidity	10	70	%	16.2	Pass
Resultant Acceleration	225	275	g's	249.3	Pass
Oscillation	0	10	%	2.5	Pass
Lateral Acceleration	-15	15	g's	-3.6	Pass

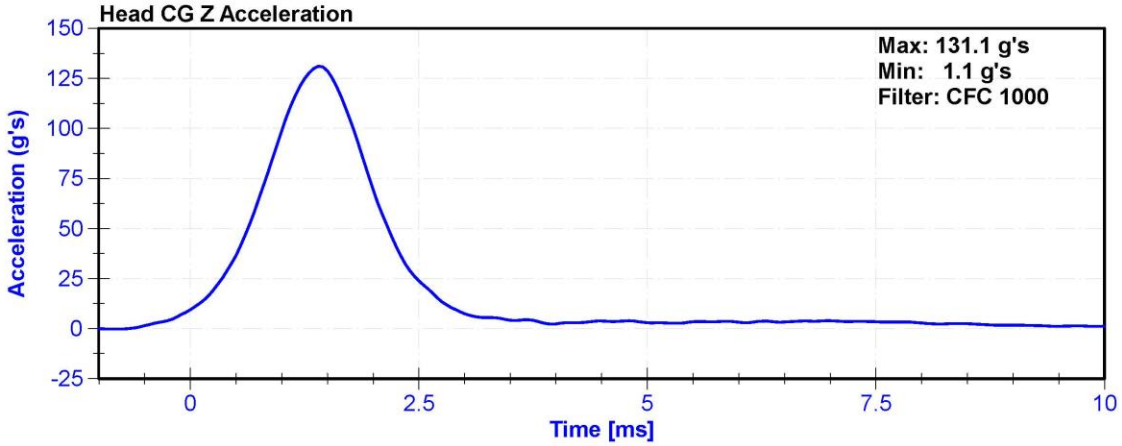
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	ENDEVCO 7264	P51681	11/3/2020	5/4/2021
Y Accelerometer	ENDEVCO 7264	P64151	11/3/2020	5/4/2021
Z Accelerometer	ENDEVCO 7264	P52114	11/3/2020	5/4/2021




Head CG X Acceleration
Acceleration (g's)
50
0
-50
-100
-150
-200
-250
0
2.5
5
7.5
10
Time [ms]
Max: 5.8 g's
Min: -212.9 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: 1.5 g's
Min: -3.6 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: 131.1 g's
Min: 1.1 g's
Filter: CFC 1000

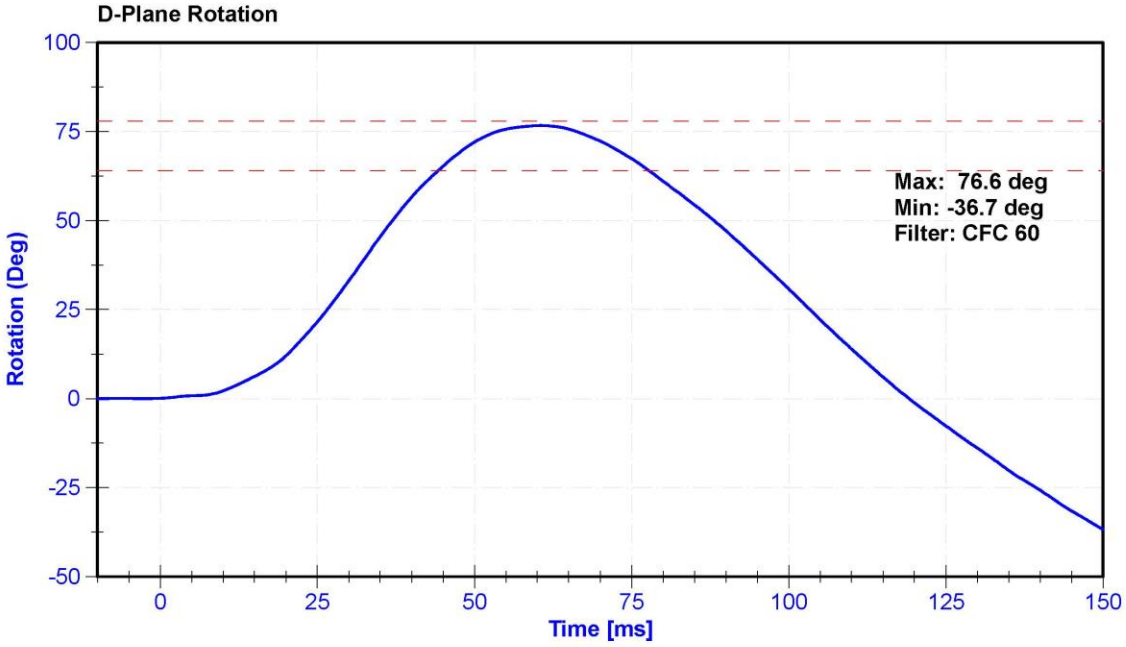
ATD Manufacturer	Humanetics	Test Technician	E. Helenbrook
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

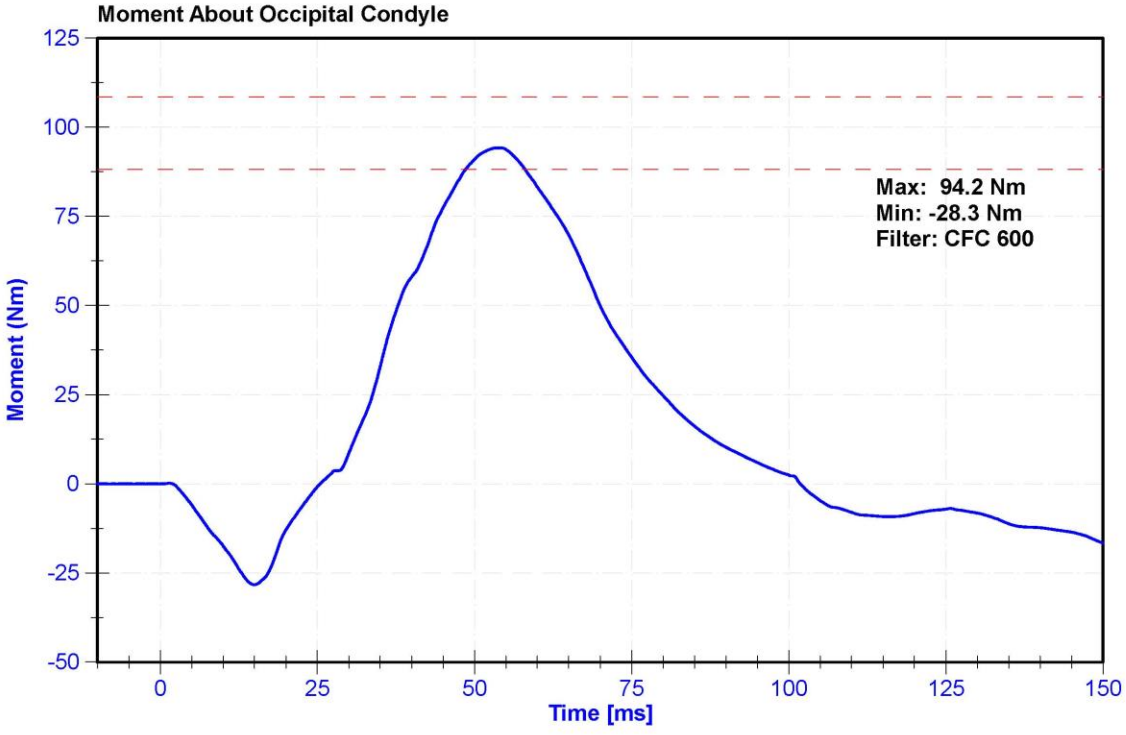
Results

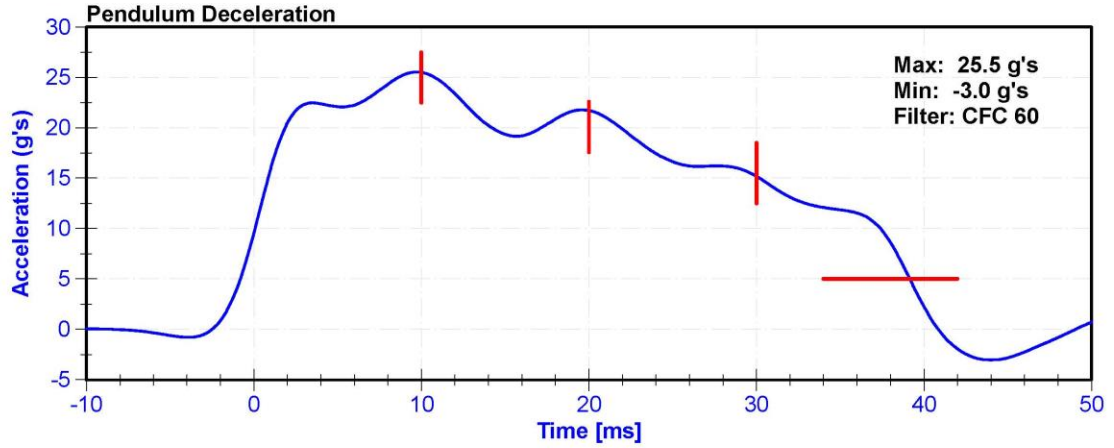
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.5	Pass
Humidity	10	70	%	19.5	Pass
Velocity	6.89	7.13	m/s	6.958	Pass
Pendulum Deceleration at 10ms	22.5	27.5	g's	25.49	Pass
Pendulum Deceleration at 20ms	17.6	22.6	g's	21.71	Pass
Pendulum Deceleration at 30ms	12.5	18.5	g's	15.19	Pass
Max. Pendulum Deceleration After 30ms	0	29	g's	25.5	Pass
Pendulum Deceleration Time to 5 g's	34	42	ms	39.2	Pass
Maximum D Plane Rotation	64	78	deg	76.6	Pass
Time to Maximum Rotation	57	64	ms	60.5	Pass
Rotation Decay to Zero	113	127	ms	119.2	Pass
Moment About Occipital Condyle	88.1	108.4	Nm	94.18	Pass
Time to Maximum Moment	47	58	ms	54.2	Pass
Moment Decay to Zero	97	107	ms	101.8	Pass

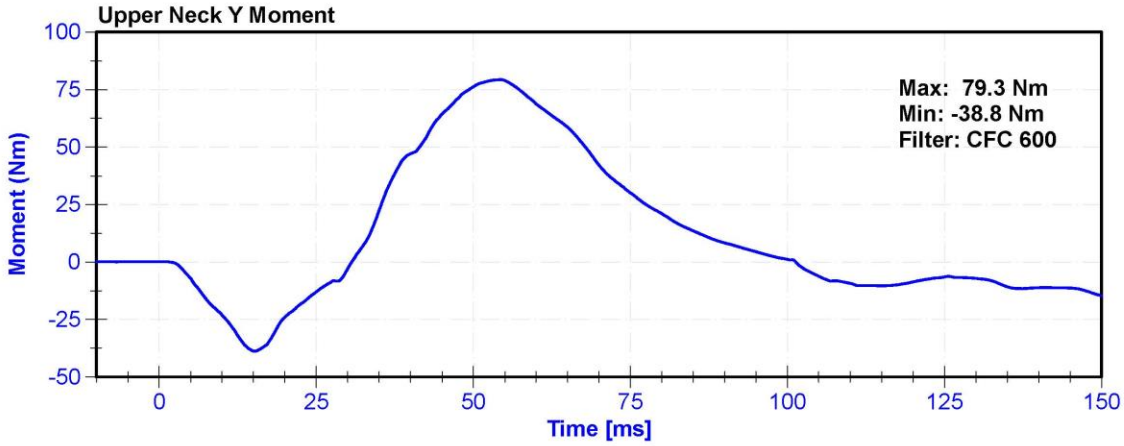
Transducer Calibrations

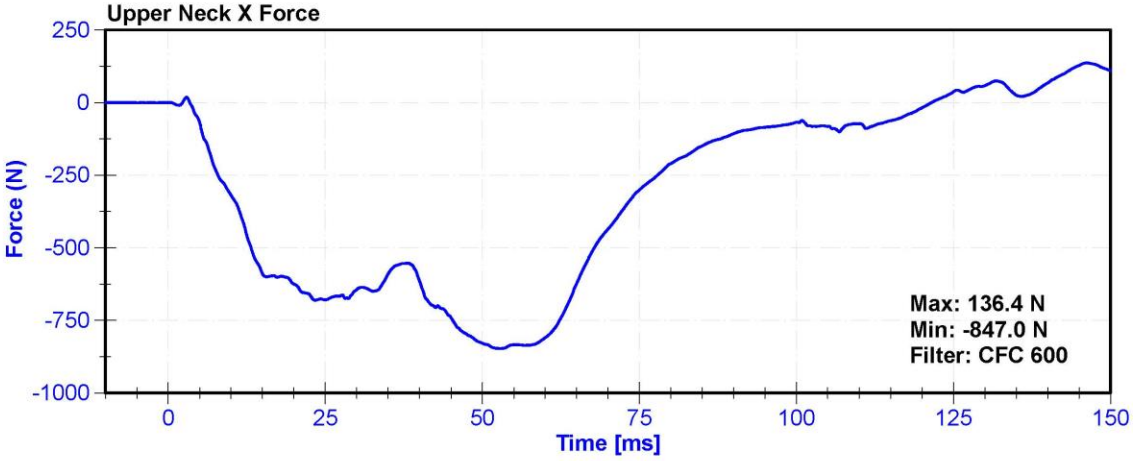
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-C16503	2/5/2021	2/5/2022
Pendulum Potentiometer	ETI SP22G	DS-LABPOT1	9/17/2020	9/17/2021
Condyle Potentiometer	ETI SP22G	DS-LABPOT2	9/17/2020	9/17/2021
Upper Neck Load Cell	DENTON 1716A	LC-2186Fx	11/10/2020	11/10/2021


D-Plane Rotation
Rotation (Deg)
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]
Max: 76.6 deg
Min: -36.7 deg
Filter: CFC 60


Moment About Occipital Condyle
Moment (Nm)
125
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]
Max: 94.2 Nm
Min: -28.3 Nm
Filter: CFC 600


Pendulum Deceleration
Max: 25.5 g's
Min: -3.0 g's
Filter: CFC 60
Acceleration (g's)
Time [ms]


Upper Neck Y Moment
Max: 79.3 Nm
Min: -38.8 Nm
Filter: CFC 600
Moment (Nm)
Time [ms]


Upper Neck X Force
Max: 136.4 N
Min: -847.0 N
Filter: CFC 600
Force (N)
Time [ms]

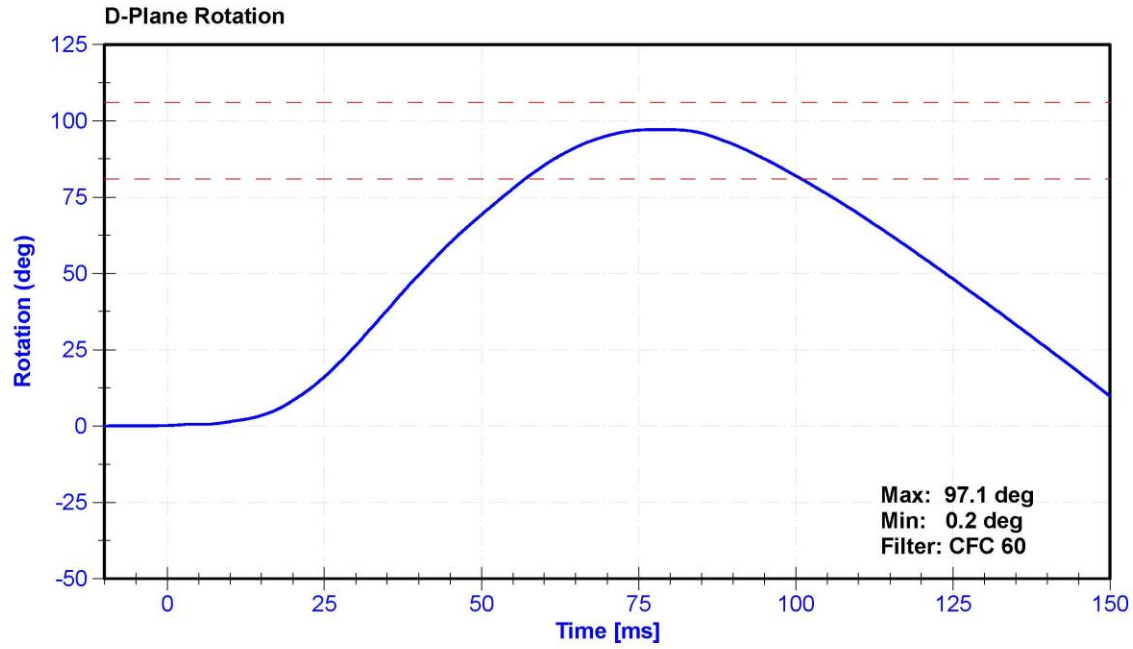
ATD Manufacturer	Humanetics	Test Technician	S. Vacanti
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

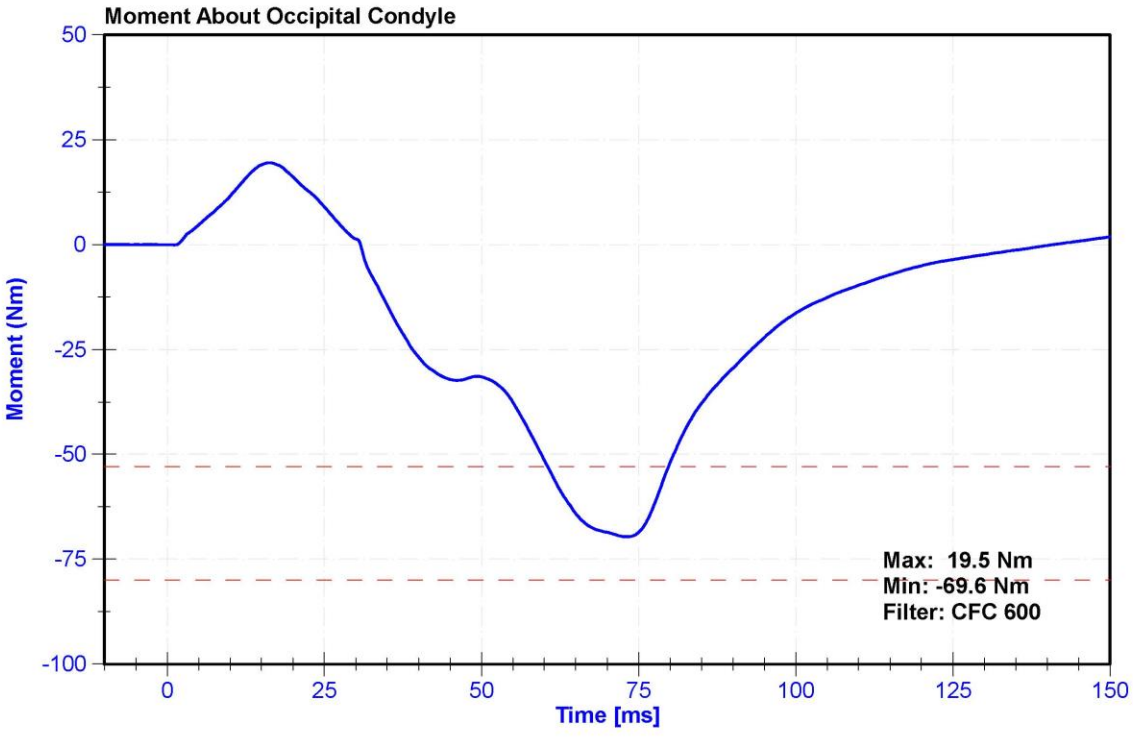
Results

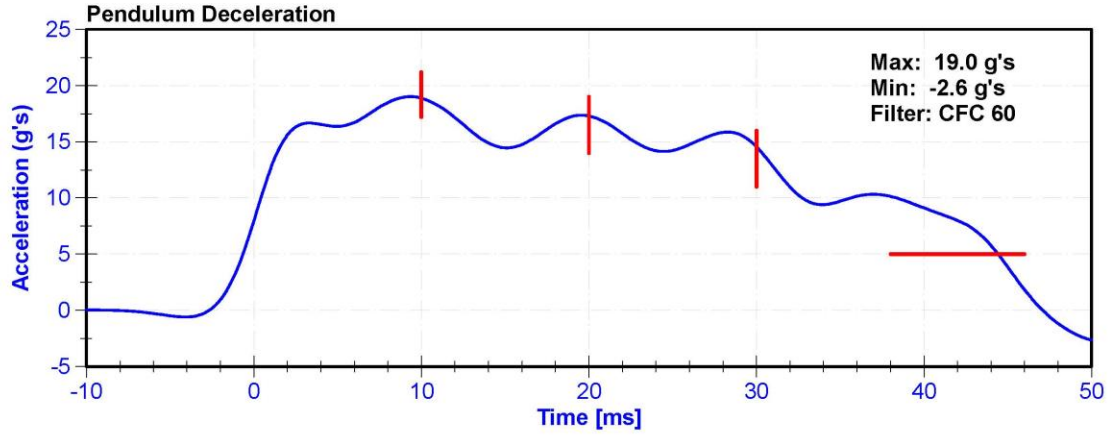
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.7	Pass
Humidity	10	70	%	24	Pass
Velocity	5.94	6.19	m/s	5.964	Pass
Pendulum Deceleration at 10ms	17.2	21.2	g's	18.88	Pass
Pendulum Deceleration at 20ms	14	19	g's	17.3	Pass
Pendulum Deceleration at 30ms	11	16	g's	14.6	Pass
Max. Pendulum Deceleration After 30ms	0	22	g's	19.0	Pass
Pendulum Deceleration Time to 5 g's	38	46	ms	44.4	Pass
Maximum D Plane Rotation	81	106	deg	97.1	Pass
Time to Maximum Rotation	72	82	ms	78.2	Pass
Rotation Decay to Zero	147	174	ms	156.6	Pass
Minimum Moment About OC	-80	-52.9	Nm	-69.60	Pass
Time to Minimum Moment	65	79	ms	73.1	Pass
Moment Decay to Zero	120	148	ms	141.1	Pass

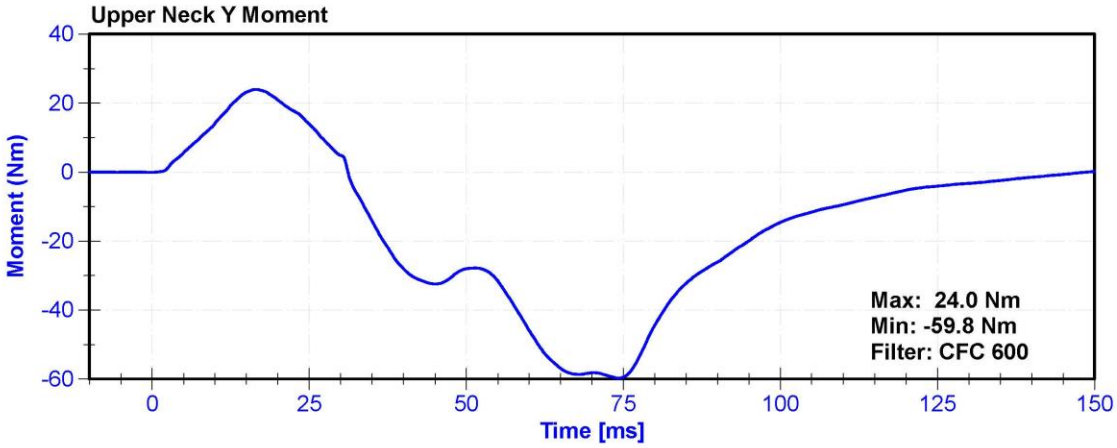
Transducer Calibrations

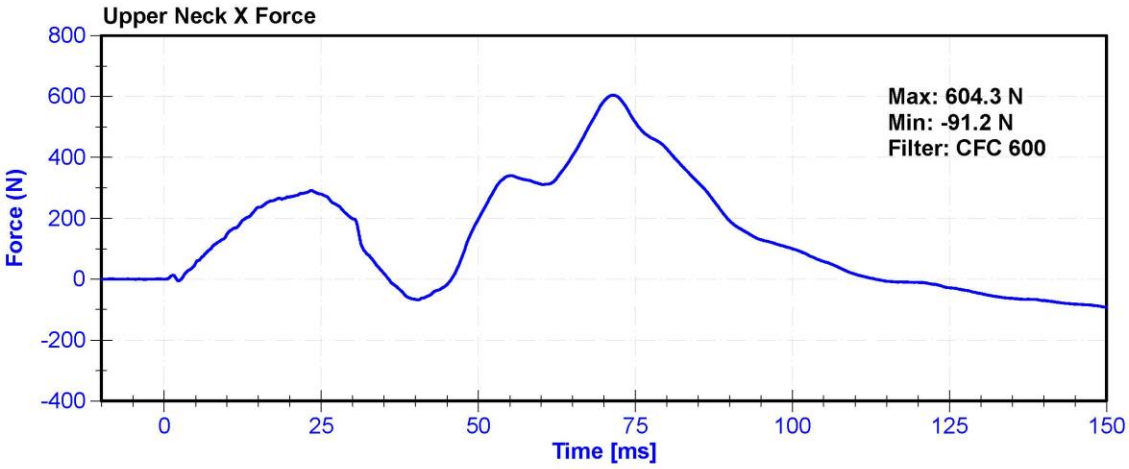
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-C16503 Striker	2/5/2021	2/5/2022
Pendulum Potentiometer	ETI SP22G	DS-LABPOT1	9/17/2020	9/17/2021
Condyle Potentiometer	ETI SP22G	DS-LABPOT2	9/17/2020	9/17/2021
Upper Neck Load Cell	DENTON 1716A	LC-2186Fx	11/10/2020	11/10/2021


D-Plane Rotation
Rotation (deg)
125
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]
Max: 97.1 deg
Min: 0.2 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: 19.5 Nm
Min: -69.6 Nm
Filter: CFC 600


Pendulum Deceleration
Max: 19.0 g's
Min: -2.6 g's
Filter: CFC 60
Acceleration (g's)
25
20
15
10
5
0
-5
-10
0
10
20
30
40
50
Time [ms]


Upper Neck Y Moment
Max: 24.0 Nm
Min: -59.8 Nm
Filter: CFC 600
Moment (Nm)
40
20
0
-20
-40
-60
0
25
50
75
100
125
150
Time [ms]


Upper Neck X Force
Max: 604.3 N
Min: -91.2 N
Filter: CFC 600
Force (N)
800
600
400
200
0
-200
-400
0
25
50
75
100
125
150
Time [ms]

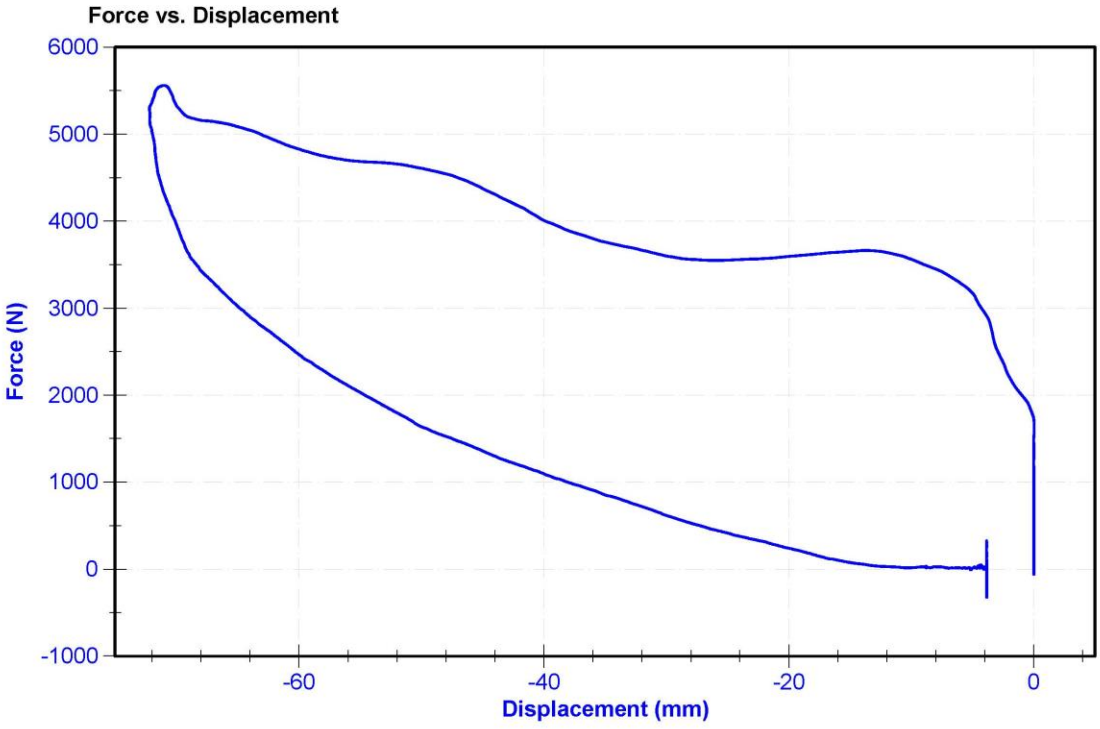
ATD Manufacturer	Humanetics	Test Technician	E. Helenbrook
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

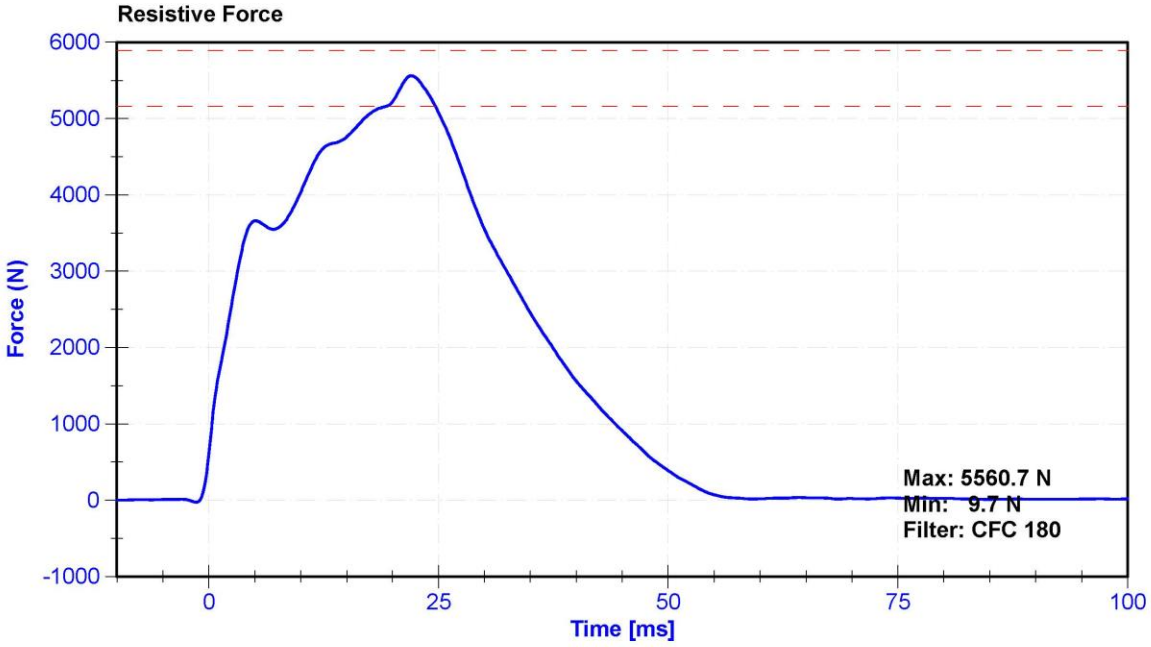
Results

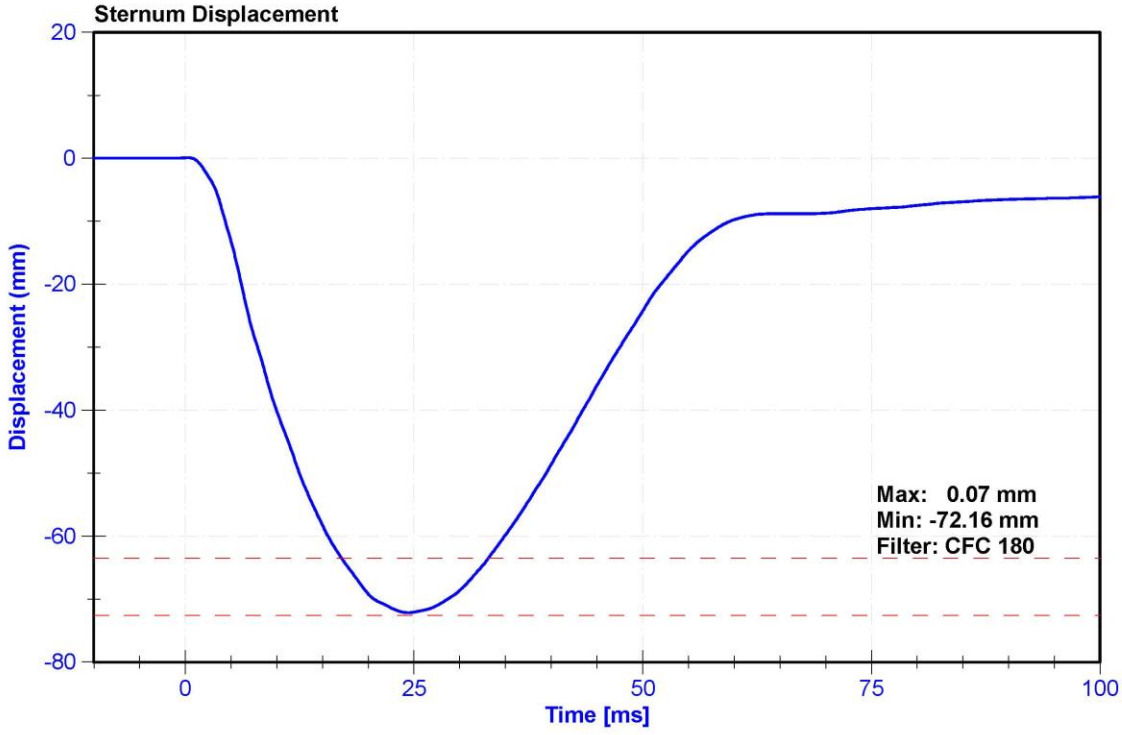
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.5	Pass
Humidity	10	70	%	19.5	Pass
Velocity	6.59	6.83	m/s	6.699	Pass
Chest Displacement	-72.6	-63.5	mm	-72.16	Pass
Resistive Force	5160	5894	N	5560.7	Pass
Hysteresis	65	85	%	69.8	Pass

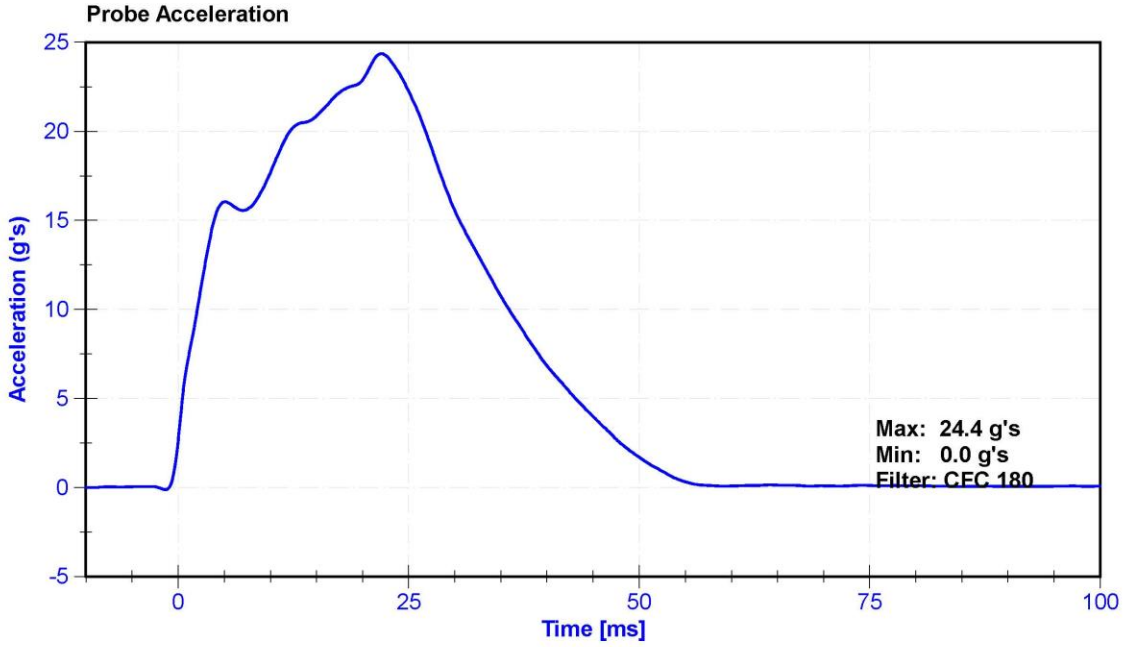
Transducer Calibrations

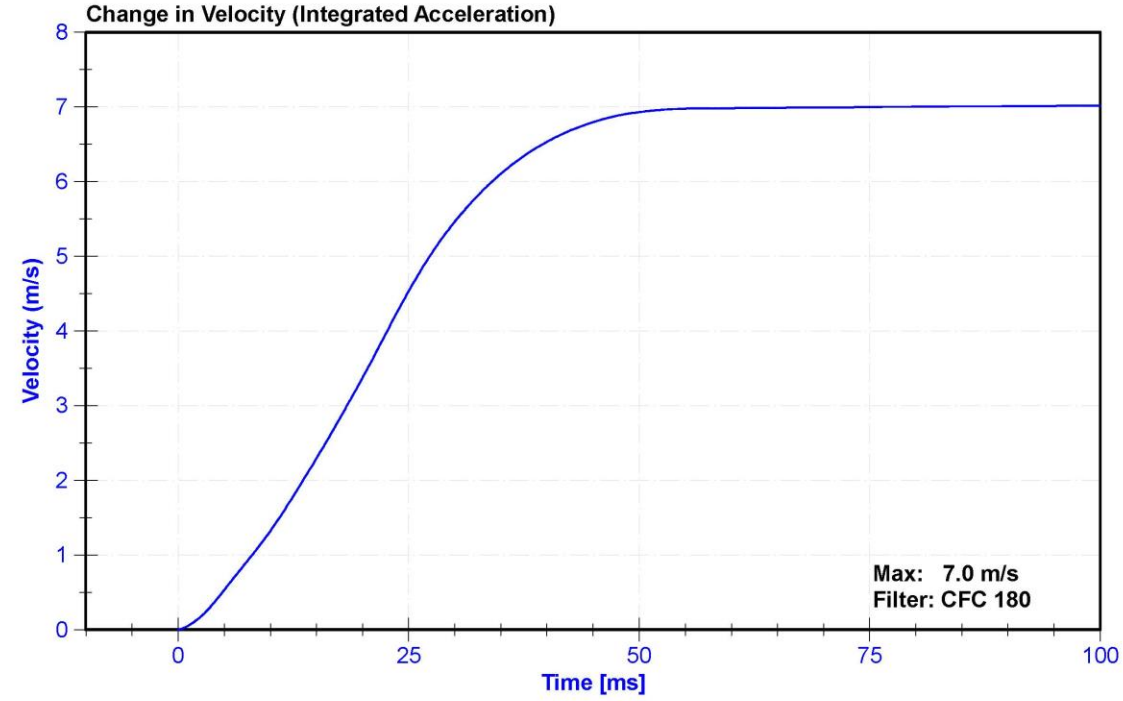
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7264C	T25885	2/2/2021	2/2/2022
Chest Potentiometer	Servo 6209-2038	DS-142	11/19/2020	5/20/2021




Resistive Force
Force (N)
6000
5000
4000
3000
2000
1000
0
-1000
0
25
50
75
100
Time [ms]
Max: 5560.7 N
Min: 9.7 N
Filter: CFC 180


Sternum Displacement
Displacement (mm)
20
0
-20
-40
-60
-80
0
25
50
75
100
Time [ms]
Max: 0.07 mm
Min: -72.16 mm
Filter: CFC 180


Probe Acceleration
Acceleration (g's)
25
20
15
10
5
0
-5
0
25
50
75
100
Time [ms]
Max: 24.4 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: 7.0 m/s
Filter: CFC 180

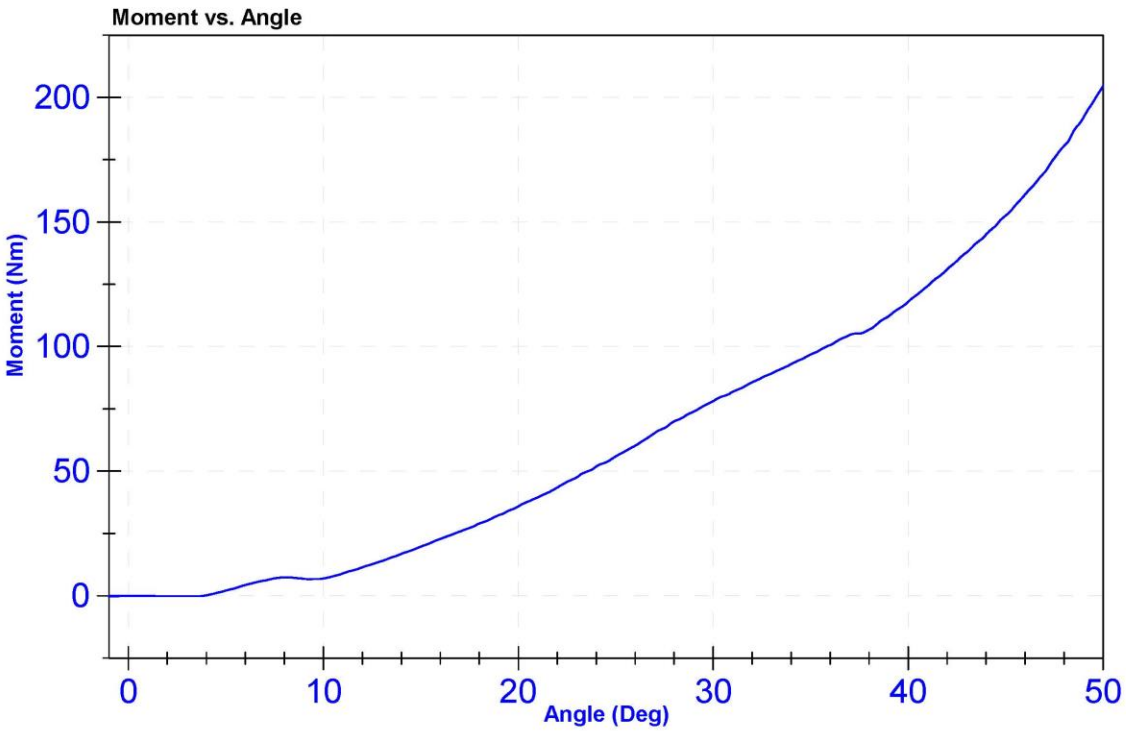
ATD Manufacturer	Humanetics	Test Technician	D.Reinhard
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	20.6	Pass
Humidity	10	70	%	27.0	Pass
Average Velocity	5	10	deg/s	7.2	Pass
Angle at 203Nm	40	50	deg	49.9	Pass
Moment at 30 degrees	0	94.9	Nm	78.1	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	ETI SP22	DS-0008	9/18/2020	9/18/2021
Load Cell	Key Trans 2301-02	LC-115 My	2020-09-12	2021-09-12



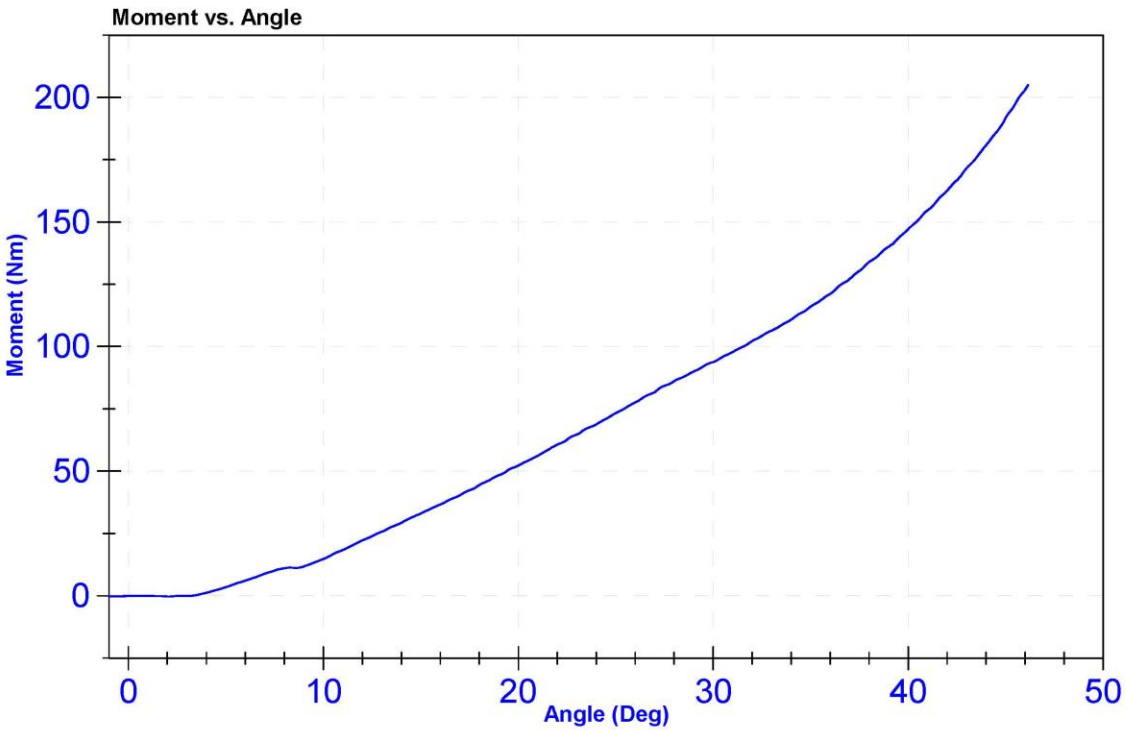
ATD Manufacturer	Humanetics	Test Technician	D.Reinhard
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	20.6	Pass
Humidity	10	70	%	26.0	Pass
Average Velocity	5	10	deg/s	7.2	Pass
Angle at 203Nm	40	50	deg	46.0	Pass
Moment at 30 degrees	0	94.9	Nm	93.8	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	ETI SP22	DS-0008	9/18/2020	9/18/2021
Load Cell	Key Trans 2301-02	LC-115 My	2020-09-12	2021-09-12



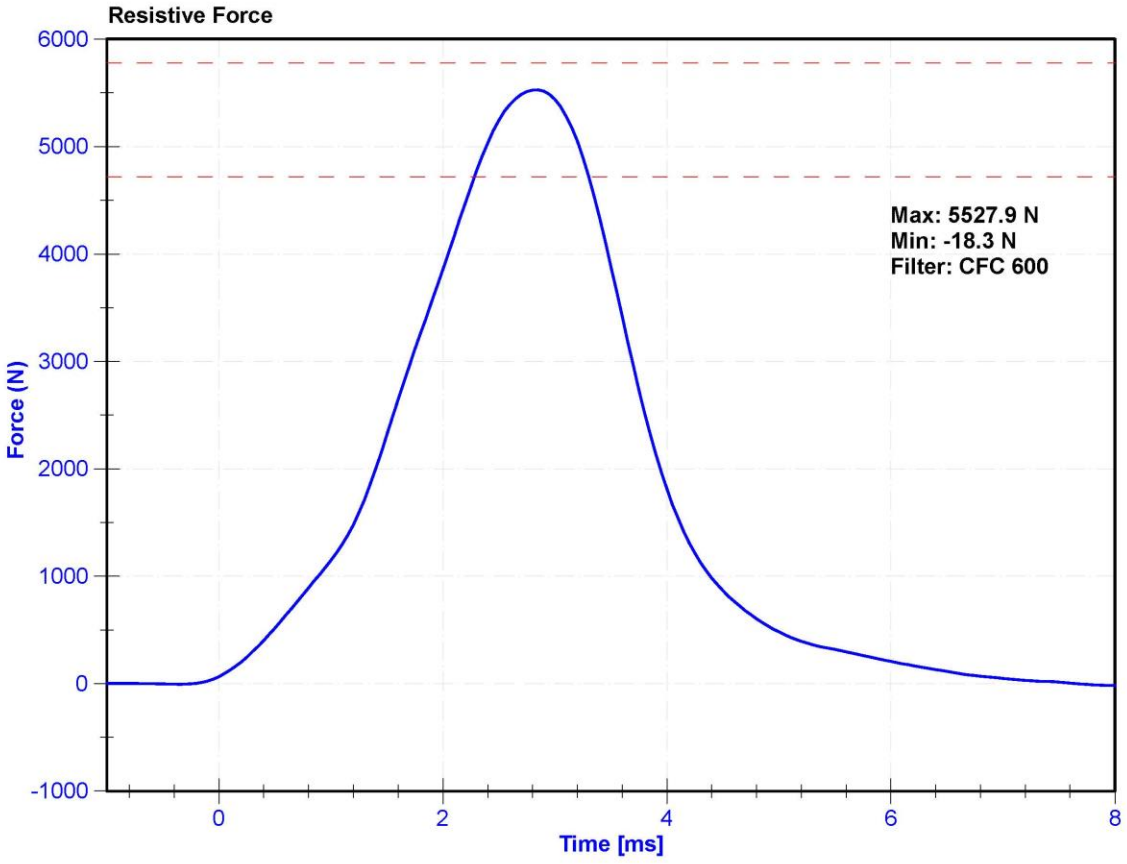
ATD Manufacturer	Humanetics	Test Technician	E. Helenbrook
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

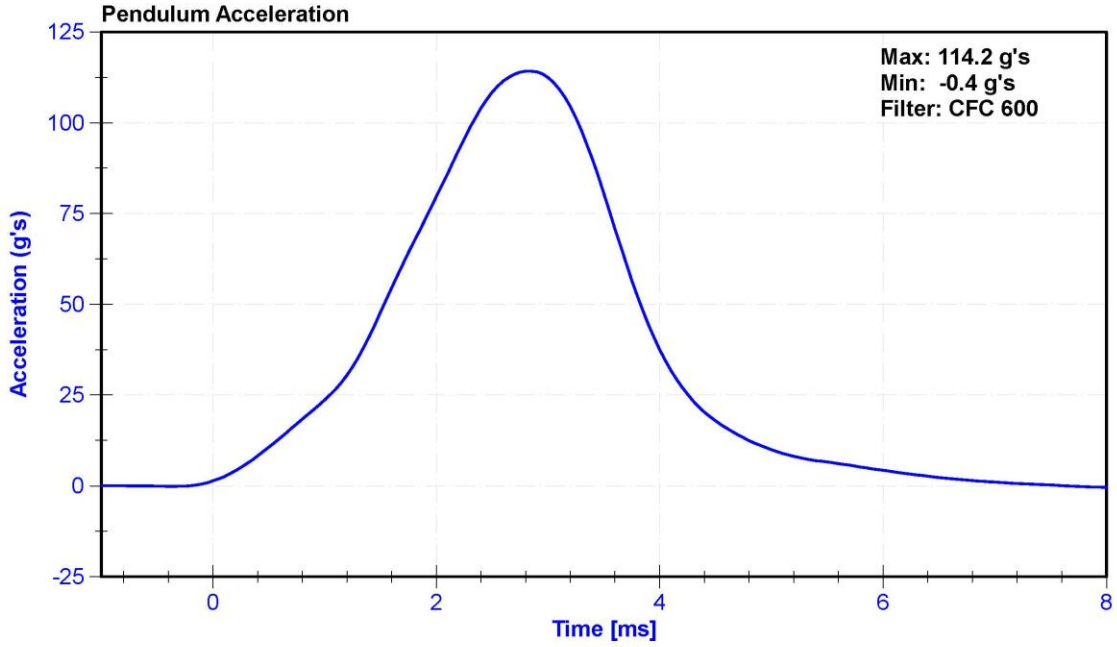
Results

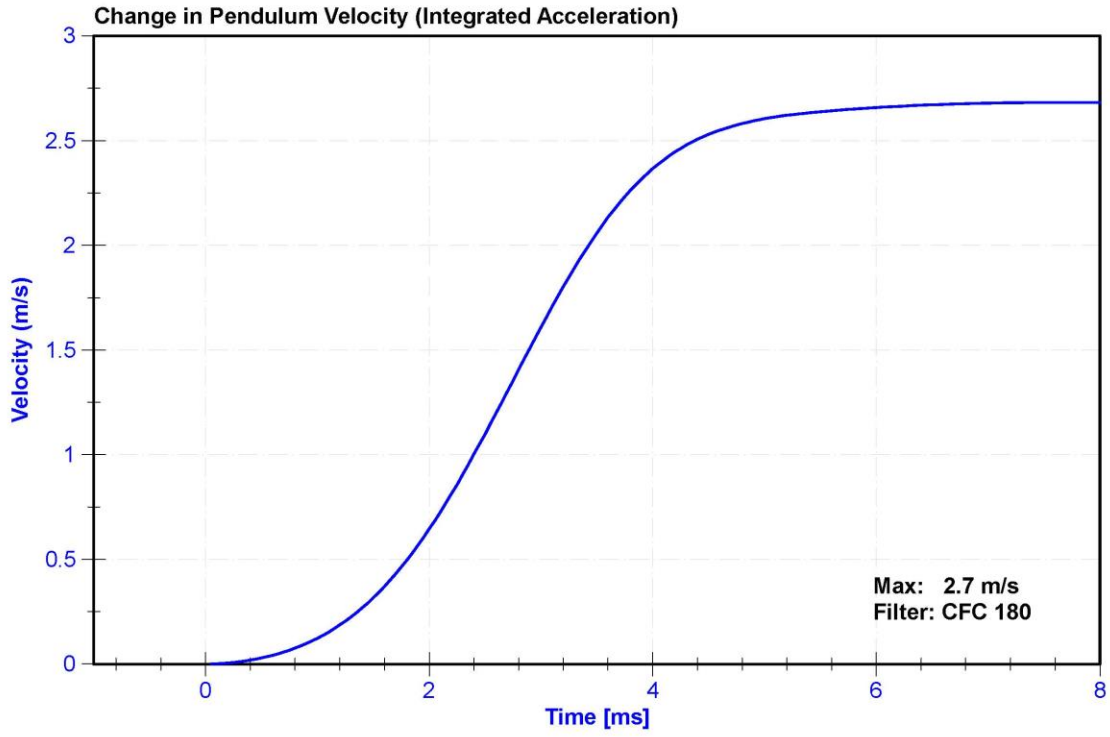
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.5	Pass
Humidity	10	70	%	19.5	Pass
Velocity	2.07	2.13	m/s	2.111	Pass
Maximum Resistive Force	4720	5780	N	5527.9	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A278994	12/3/2020	12/3/2021




Pendulum Acceleration
Max: 114.2 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: 2.7 m/s
Filter: CFC 180
0
2
4
6
8
Time [ms]

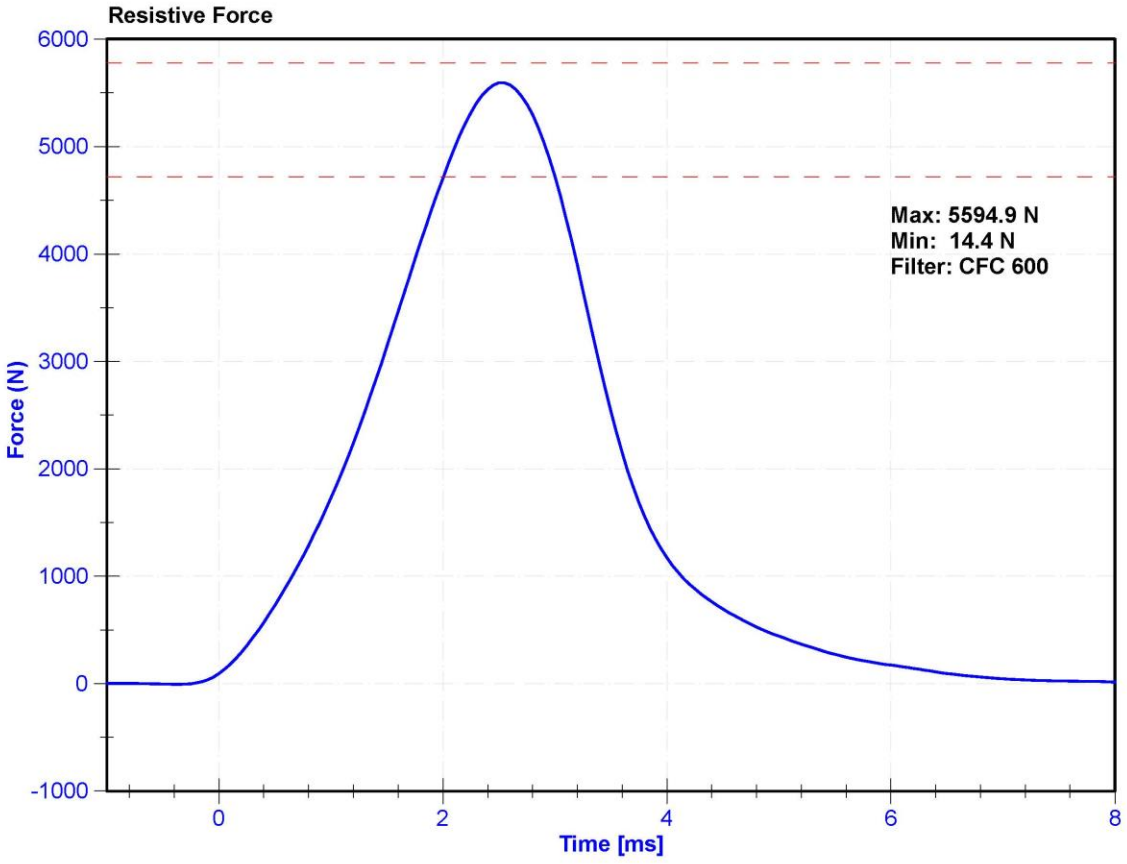
ATD Manufacturer	Humanetics	Test Technician	D.Reinhard
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

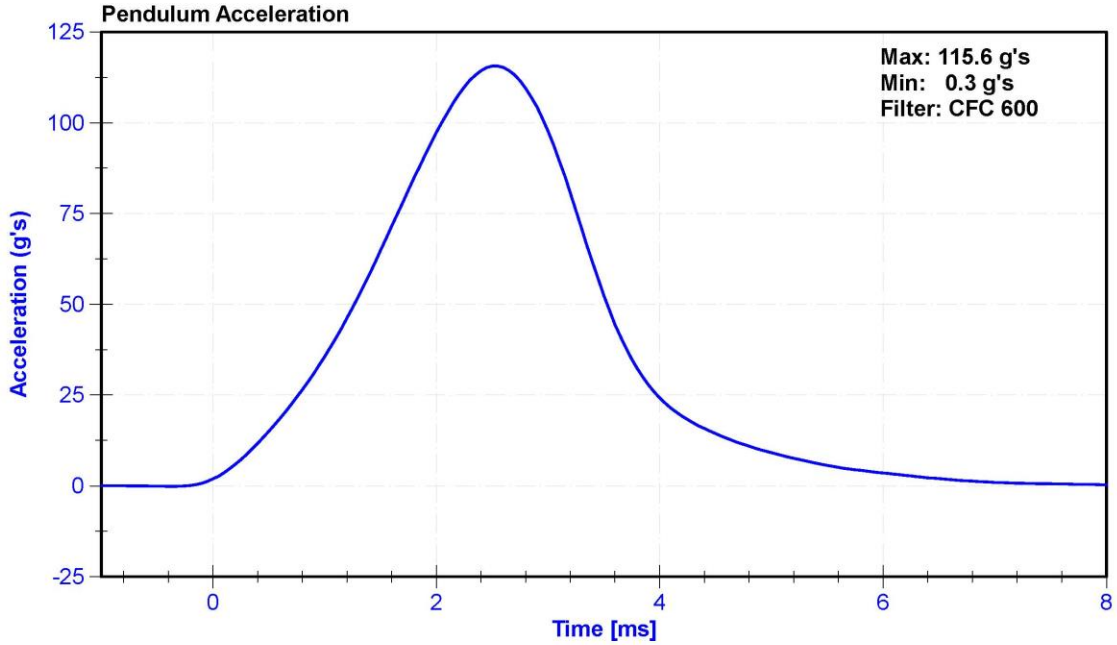
Results

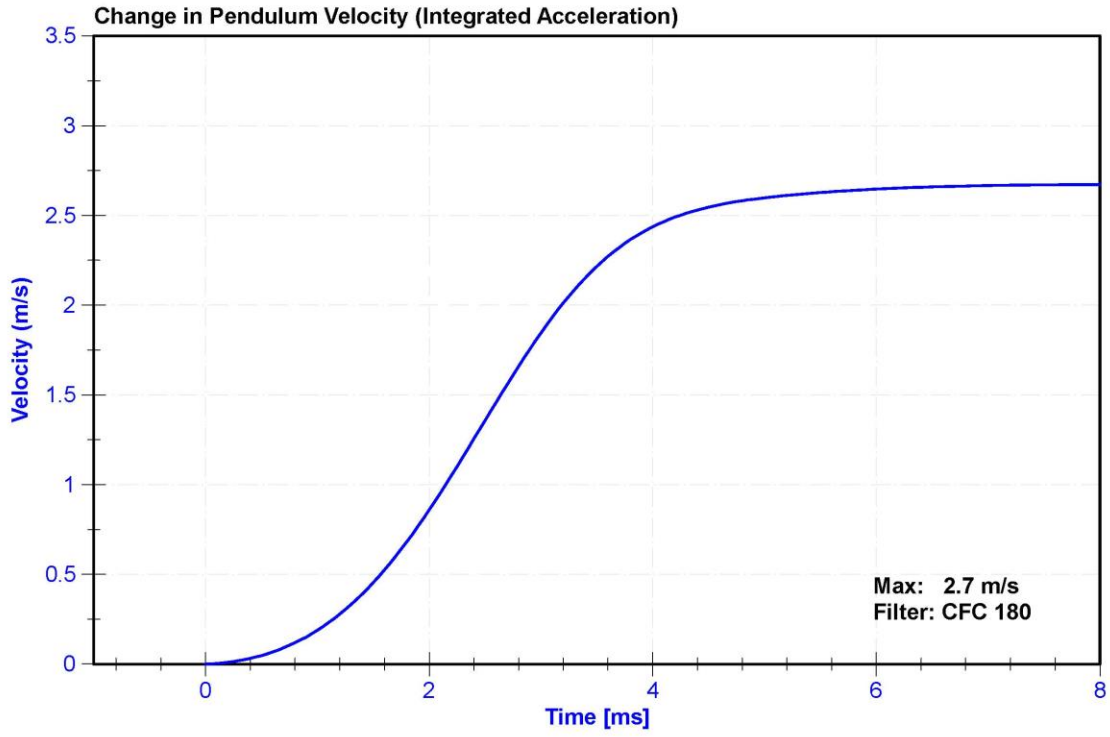
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	20.6	Pass
Humidity	10	70	%	27	Pass
Velocity	2.07	2.13	m/s	2.096	Pass
Maximum Resistive Force	4720	5780	N	5594.9	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A278994	12/3/2020	12/3/2021




Pendulum Acceleration
Max: 115.6 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)
Max: 2.7 m/s
Filter: CFC 180
Velocity (m/s)
3.5
3
2.5
2
1.5
1
0.5
0
0
2
4
6
8
Time [ms]

CALIBRATION TEST RESULTS

POST-TEST

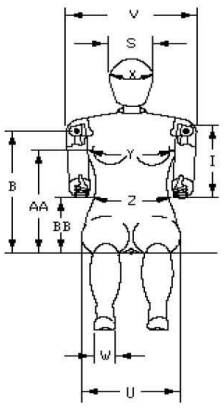
HYBRID III 5TH PERCENTILE FEMALE - PASSENGER ATD

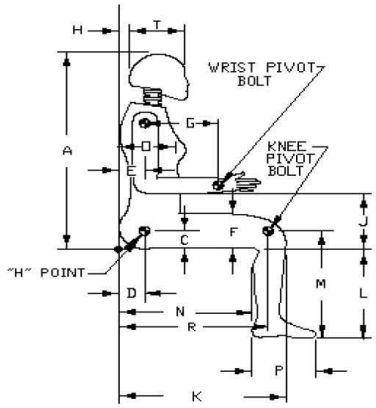
SERIAL NO: 140

External Measurements - Hybrid 3 - 5th Female

Technician: K. Brogan Date: 2/15/2021

Dummy Serial Number: 140





Symbol	Description	Specification (mm)		Result (mm)	Pass/Fail
A	Sitting Height	775	800	790	Pass
B	Shoulder Pivot Height	432	457	442	Pass
C	H-Point Height	81	86	83	Pass
D	H-Point from Backline	145	150	146	Pass
E	Shoulder Pivot from Backline	69	84	78	Pass
F	Thigh Clearance	119	135	127	Pass
G	Back of Elbow to Wrist Pivot	244	259	252	Pass
H	Head Back to Backline	43	48	45	Pass
I	Shoulder to Elbow Length	277	297	291	Pass
J	Elbow Rest Height	183	203	197	Pass
K	Buttock to Knee Length	521	546	541	Pass
L	Popliteal Height	356	376	366	Pass
M	Knee Pivot Height	394	419	410	Pass
N	Buttock Popliteal Length	414	439	428	Pass
O	Chest Depth without Jacket	175	191	182	Pass
P	Foot Length (right)	219	234	229	Pass
R	Buttock To Knee Pivot Length	457	483	465	Pass
S	Head Breadth	137	147	142	Pass
T	Head Depth	178	188	180	Pass
U	Hip Breadth	300	315	313	Pass
V	Shoulder Breadth	351	366	361	Pass
W	Foot Breadth	79	94	83	Pass
X	Head Circumference	528	549	540	Pass
Y	Chest Circumference with Jacket	851	881	874	Pass
Z	Waist Circumference	460	790	624	Pass
AA	Reference Location (Chest Circumference)	333	358	345	Pass
BB	Reference Location (Waist Circumference)	160	170	165	Pass

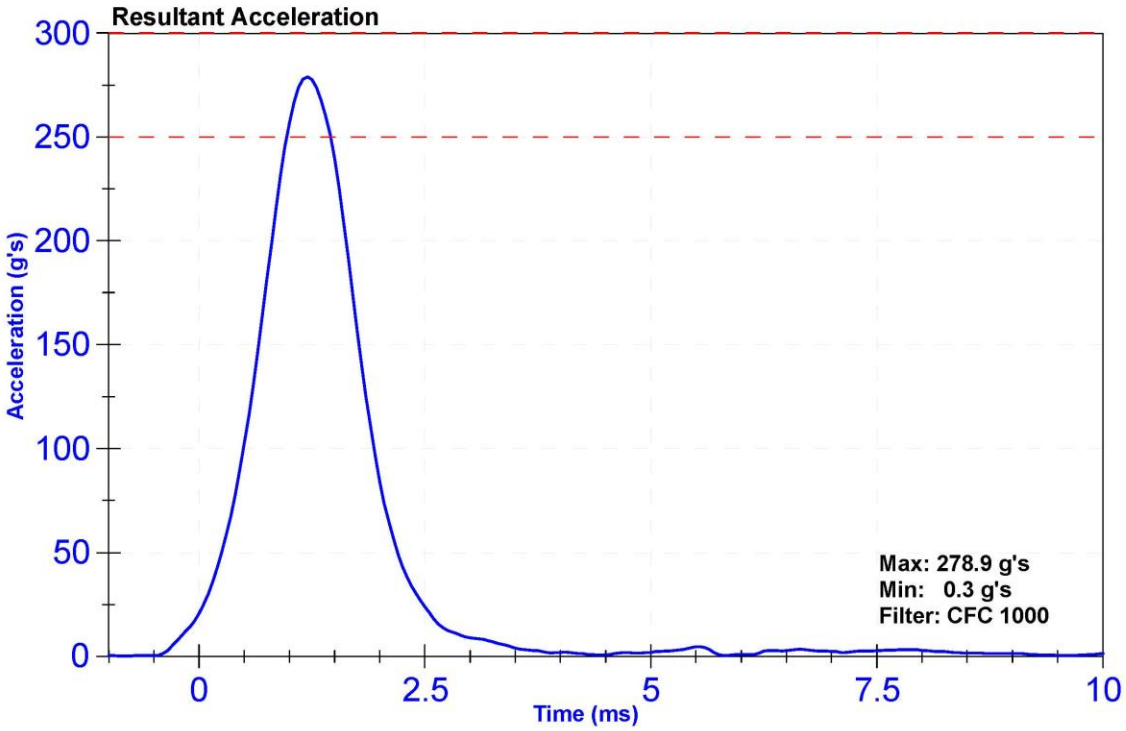
ATD Manufacturer	Humanetics	Test Technician	S. Vacanti
ATD Serial Number	140	Laboratory Supervisor	K. Brogan

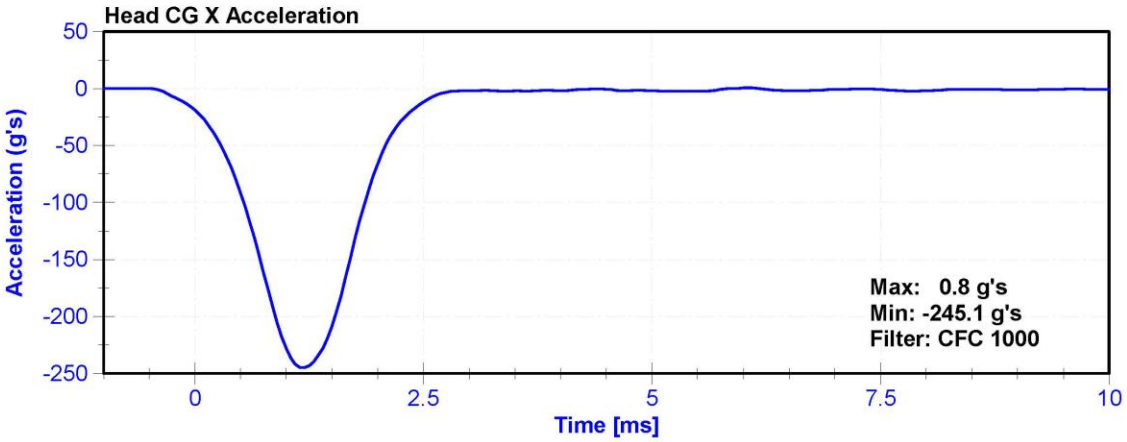
Results

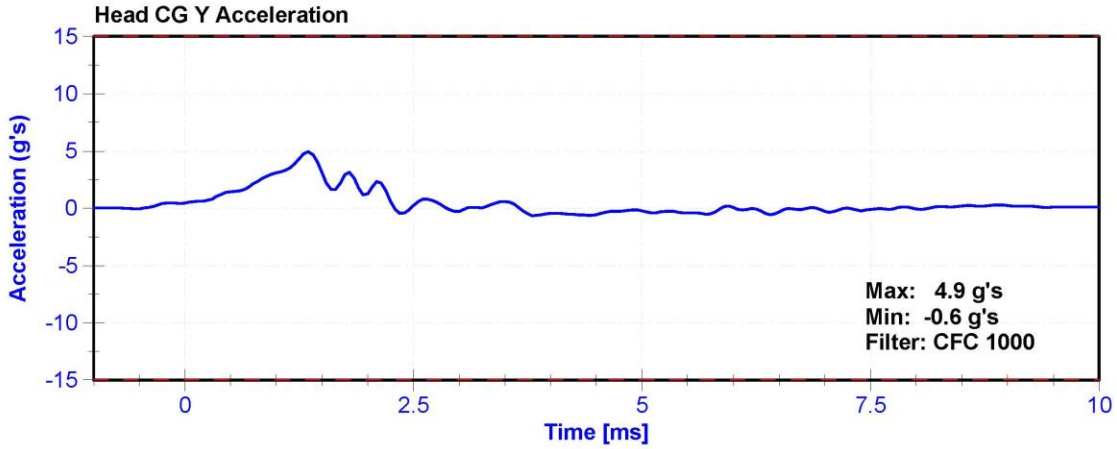
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	20.7	Pass
Humidity	10	70	%	23	Pass
Resultant Acceleration	250	300	g's	278.9	Pass
Oscillation	0	10	%	1.6	Pass
Lateral Acceleration	-15	15	g's	4.9	Pass

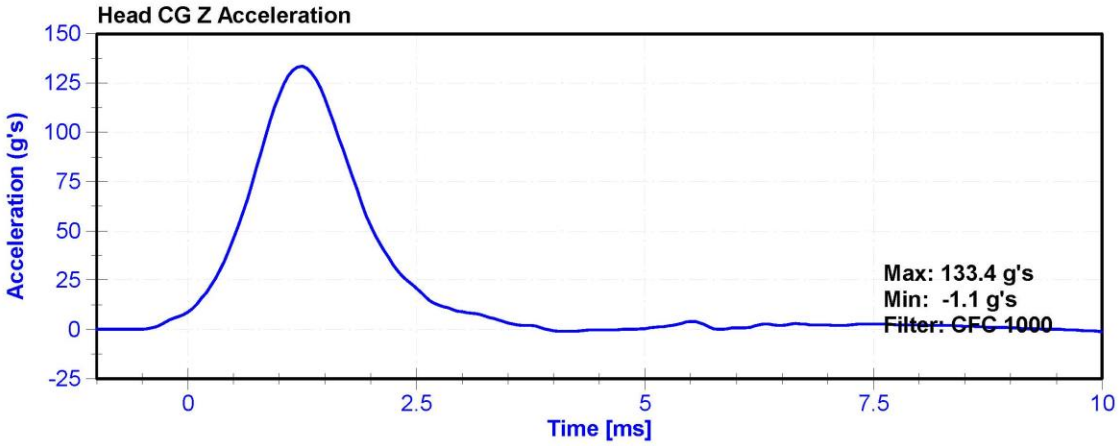
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	Endevco 7264C-2KTZ-2-240	P79417	9/22/2020	3/23/2021
Y Accelerometer	Endevco 7264C-2KTZ-2-240	P83335	9/22/2020	3/23/2021
Z Accelerometer	Endevco 7264C-2KTZ-2-240	T11252	9/22/2020	3/23/2021




Head CG X Acceleration
Acceleration (g's)
50
0
-50
-100
-150
-200
-250
0
2.5
5
7.5
10
Time [ms]
Max: 0.8 g's
Min: -245.1 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: 4.9 g's
Min: -0.6 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: 133.4 g's
Min: -1.1 g's
Filter: CFC 1000

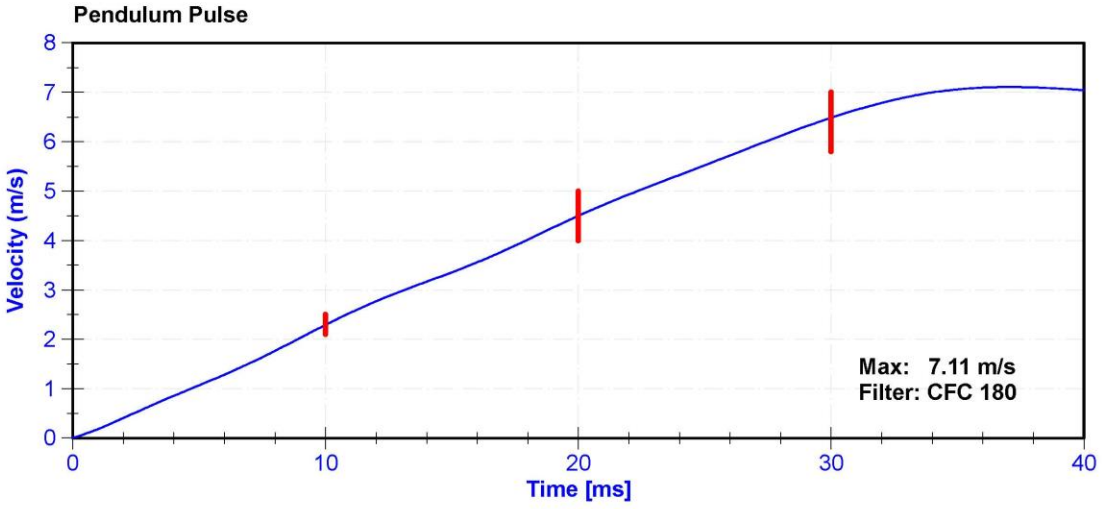
ATD Manufacturer	Humanetics	Test Technician	S. Vacanti
ATD Serial Number	140	Laboratory Supervisor	K. Brogan

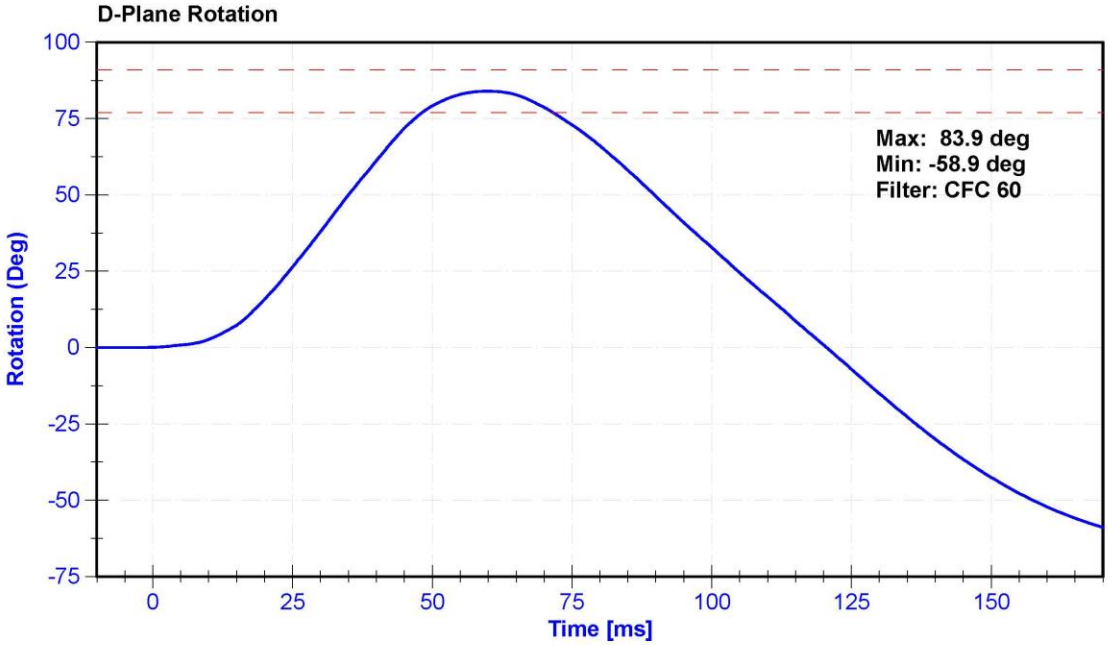
Results

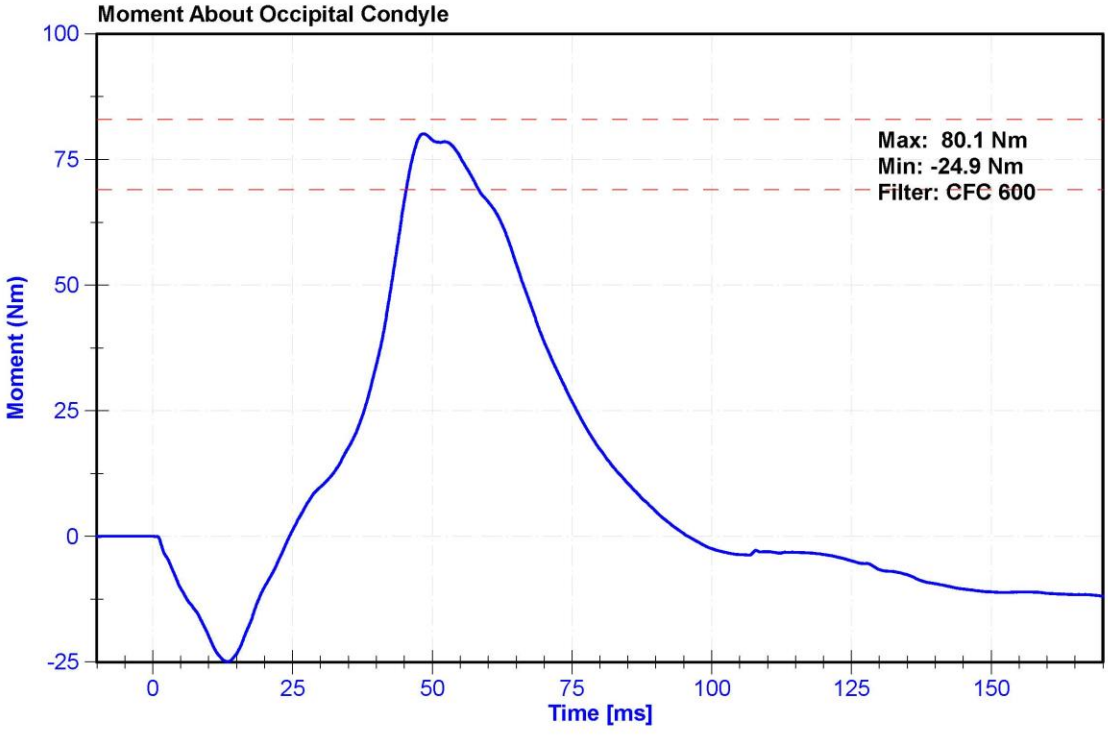
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.9	Pass
Humidity	10	70	%	29.0	Pass
Velocity	6.89	7.13	m/s	7.013	Pass
Pendulum Impulse at 10ms	2.1	2.5	m/s	2.29	Pass
Pendulum Impulse at 20ms	4.0	5.0	m/s	4.50	Pass
Pendulum Impulse at 30ms	5.8	7.0	m/s	6.49	Pass
Max D Plane Rotation	77	91	deg	83.9	Pass
Max Moment During Rotation Interval	69	83	Nm	80.1	Pass
Moment Decay to 10.0 Nm	80	100	ms	85.5	Pass

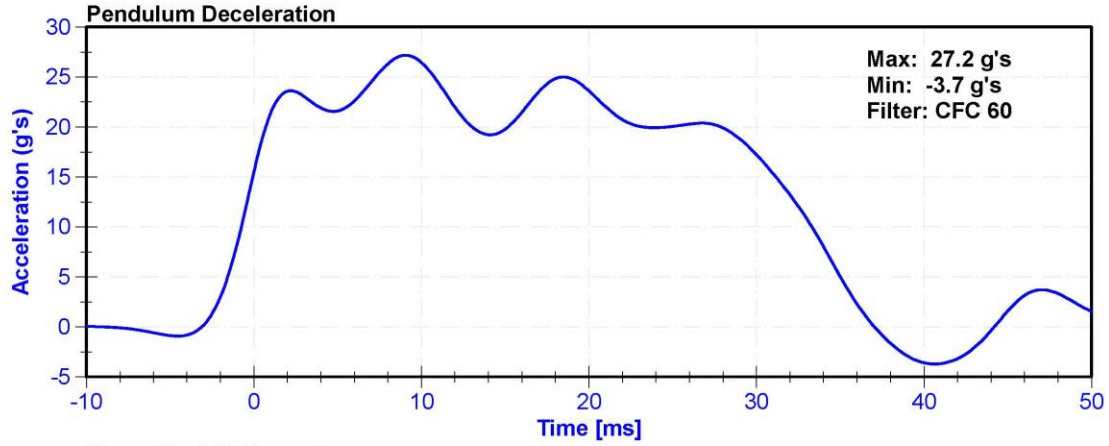
Transducer Calibrations

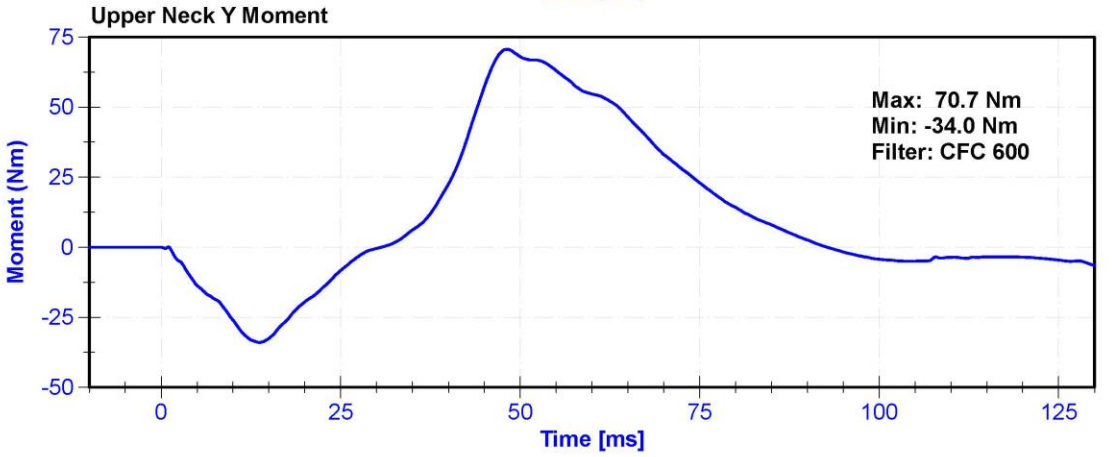
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-C16503 Striker	2/5/2021	2/5/2022
Pendulum Potentiometer	ETI SP22G	DS-LABPOT1	9/17/2020	9/17/2021
Condyle Potentiometer	ETI SP22G	DS-LABPOT2	9/17/2020	9/17/2021
Upper Neck Load Cell	Denton 1716A	LC-1916Fx	11/23/2020	11/23/2021

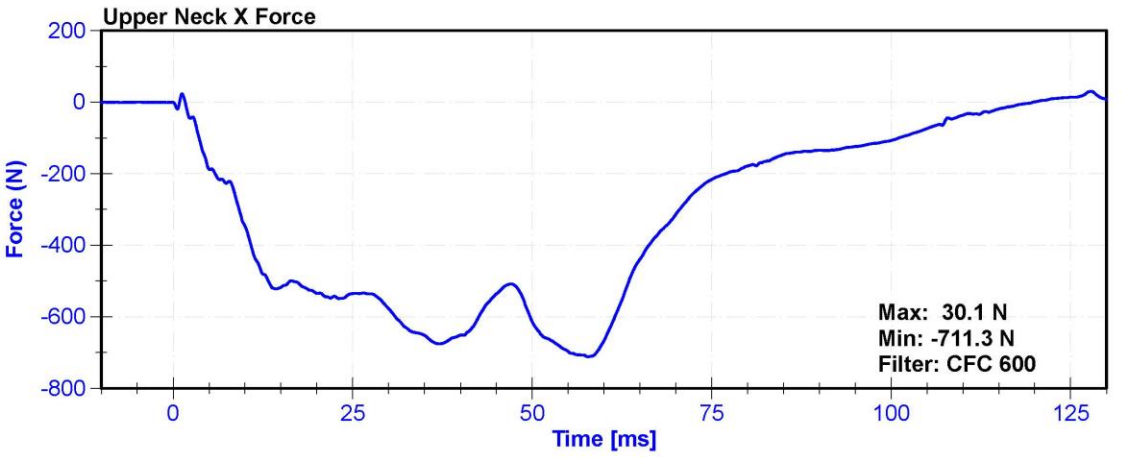



D-Plane Rotation
Rotation (Deg)
100
75
50
25
0
-25
-50
-75
0
25
50
75
100
125
150
Time [ms]
Max: 83.9 deg
Min: -58.9 deg
Filter: CFC 60


Moment About Occipital Condyle
Moment (Nm)
100
75
50
25
0
-25
0
25
50
75
100
125
150
Time [ms]
Max: 80.1 Nm
Min: -24.9 Nm
Filter: CFC 600


Pendulum Deceleration
Max: 27.2 g's
Min: -3.7 g's
Filter: CFC 60
Acceleration (g's)
30
25
20
15
10
5
0
-5
-10
0
10
20
30
40
50
Time [ms]


Upper Neck Y Moment
Max: 70.7 Nm
Min: -34.0 Nm
Filter: CFC 600
Moment (Nm)
75
50
25
0
-25
-50
0
25
50
75
100
125
Time [ms]


Upper Neck X Force
Max: 30.1 N
Min: -711.3 N
Filter: CFC 600
Force (N)
200
0
-200
-400
-600
-800
0
25
50
75
100
125
Time [ms]

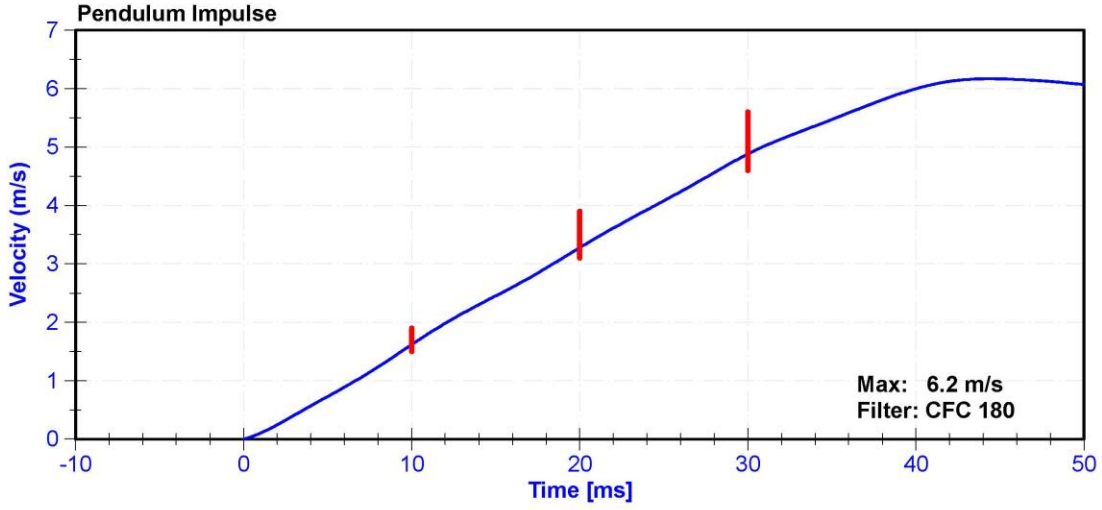
ATD Manufacturer	Humanetics	Test Technician	S. Vacanti
ATD Serial Number	140	Laboratory Supervisor	K. Brogan

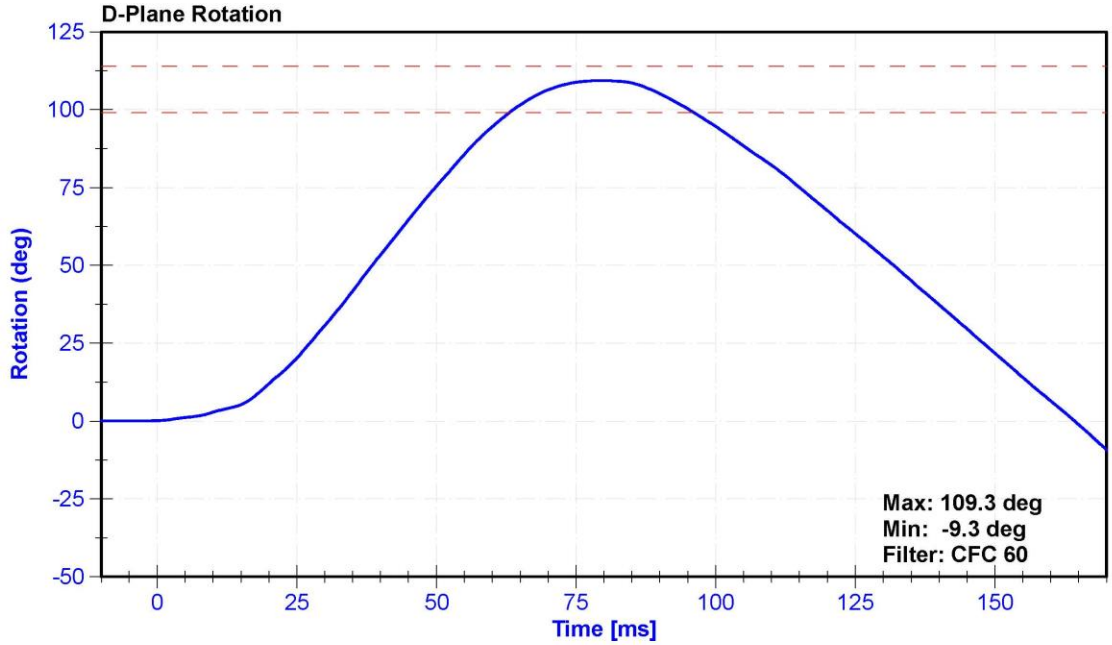
Results

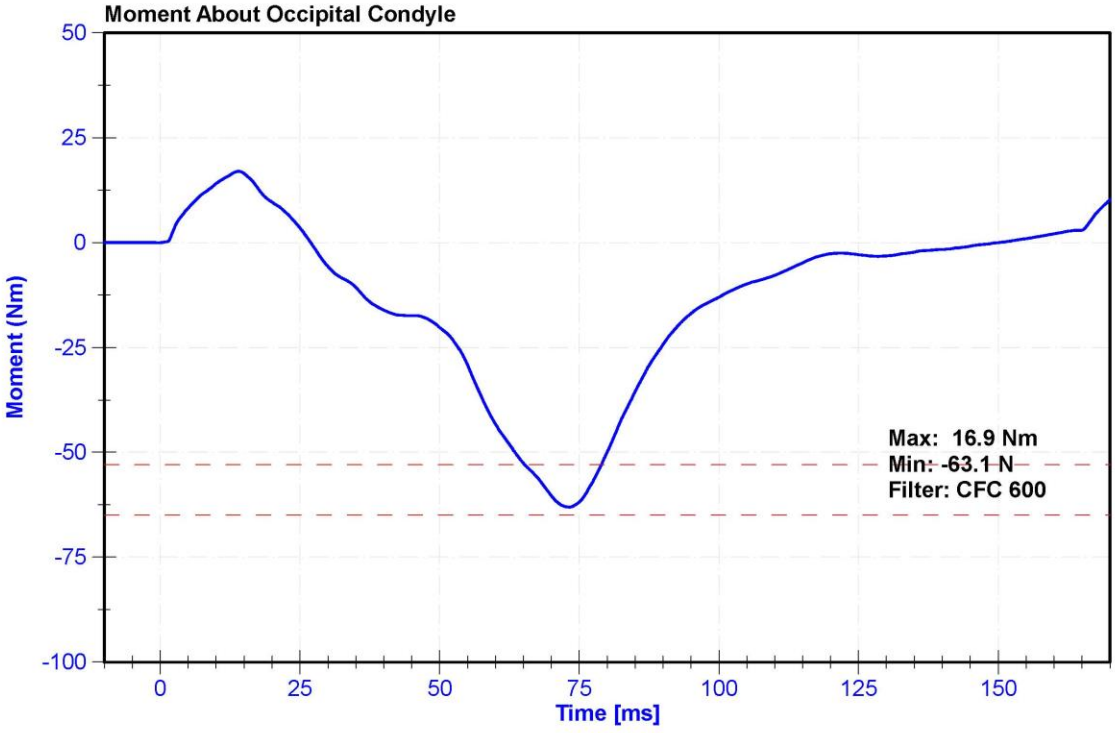
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.8	Pass
Humidity	10	70	%	29.0	Pass
Velocity	5.95	6.19	m/s	6.046	Pass
Pendulum Impulse at 10ms	1.5	1.9	m/s	1.62	Pass
Pendulum Impulse at 20ms	3.1	3.9	m/s	3.28	Pass
Pendulum Impulse at 30ms	4.6	5.6	m/s	4.88	Pass
D Plane Rotation	99	114	deg	109.3	Pass
Moment During Rotation Interval	-65	-53	Nm	-63.1	Pass
Moment Decay to -10Nm	94	114	ms	104.8	Pass

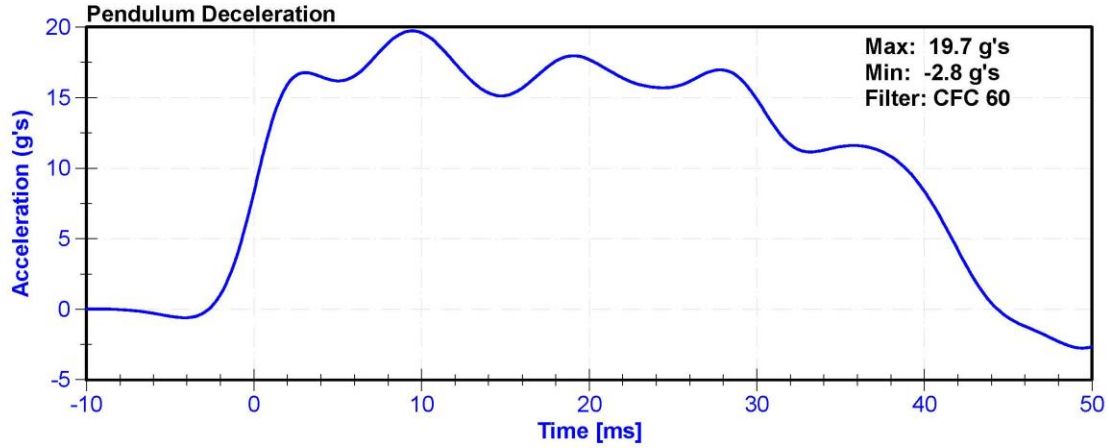
Transducer Calibrations

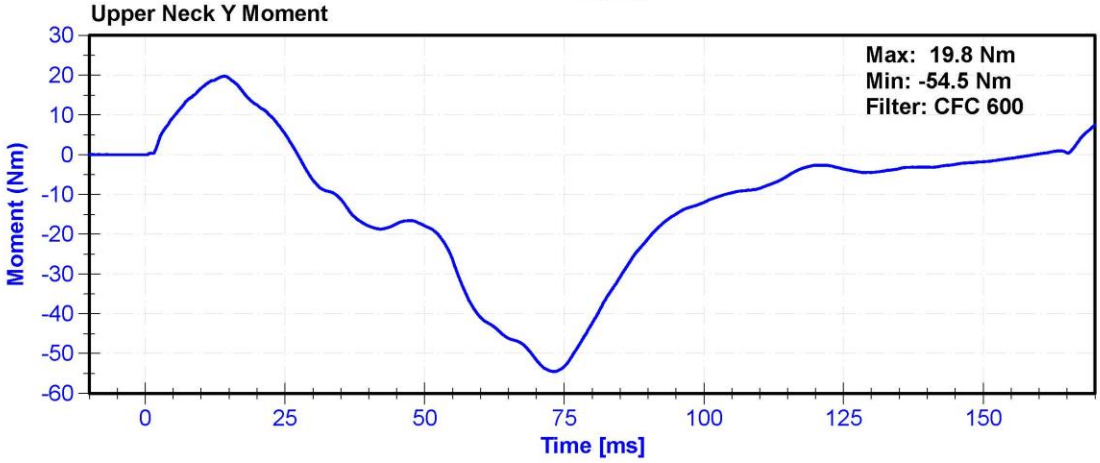
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-C16503 Striker	2/5/2021	2/5/2022
Pendulum Potentiometer	ETI SP22G	DS-LABPOT1	9/17/2020	9/17/2021
Condyle Potentiometer	ETI SP22G	DS-LABPOT2	9/17/2020	9/17/2021
Upper Neck Load Cell	Denton 1716A	LC-1916Fx	11/23/2020	11/23/2021

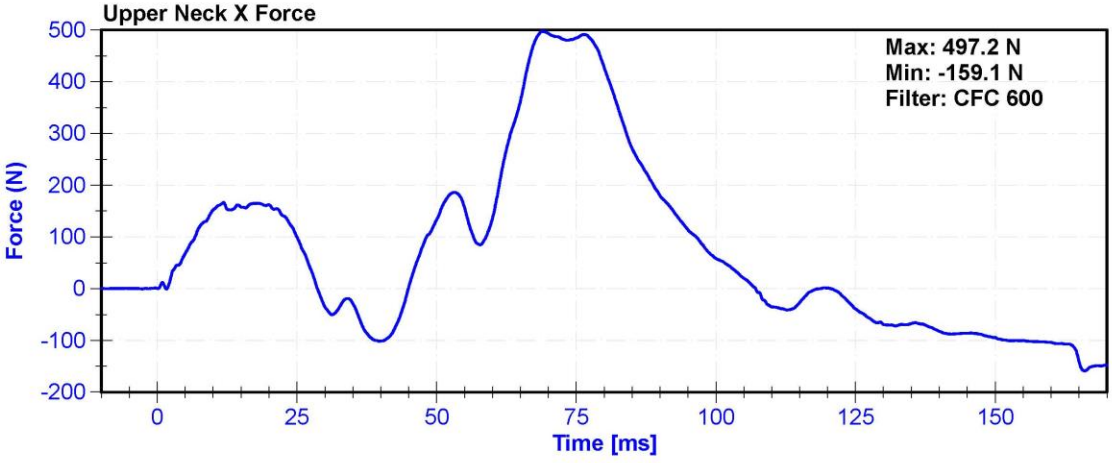



D-Plane Rotation
Rotation (deg)
125
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]
Max: 109.3 deg
Min: -9.3 deg
Filter: CFC 60


Moment About Occipital Condyle
Moment (Nm)
50
25
0
-25
-50
-75
-100
0
25
50
75
100
125
150
Time [ms]
Max: 16.9 Nm
Min: -63.1 N
Filter: CFC 600


Pendulum Deceleration
Max: 19.7 g's
Min: -2.8 g's
Filter: CFC 60
Acceleration (g's)
Time [ms]


Upper Neck Y Moment
Max: 19.8 Nm
Min: -54.5 Nm
Filter: CFC 600
Moment (Nm)
Time [ms]


Upper Neck X Force
Max: 497.2 N
Min: -159.1 N
Filter: CFC 600
Force (N)
Time [ms]

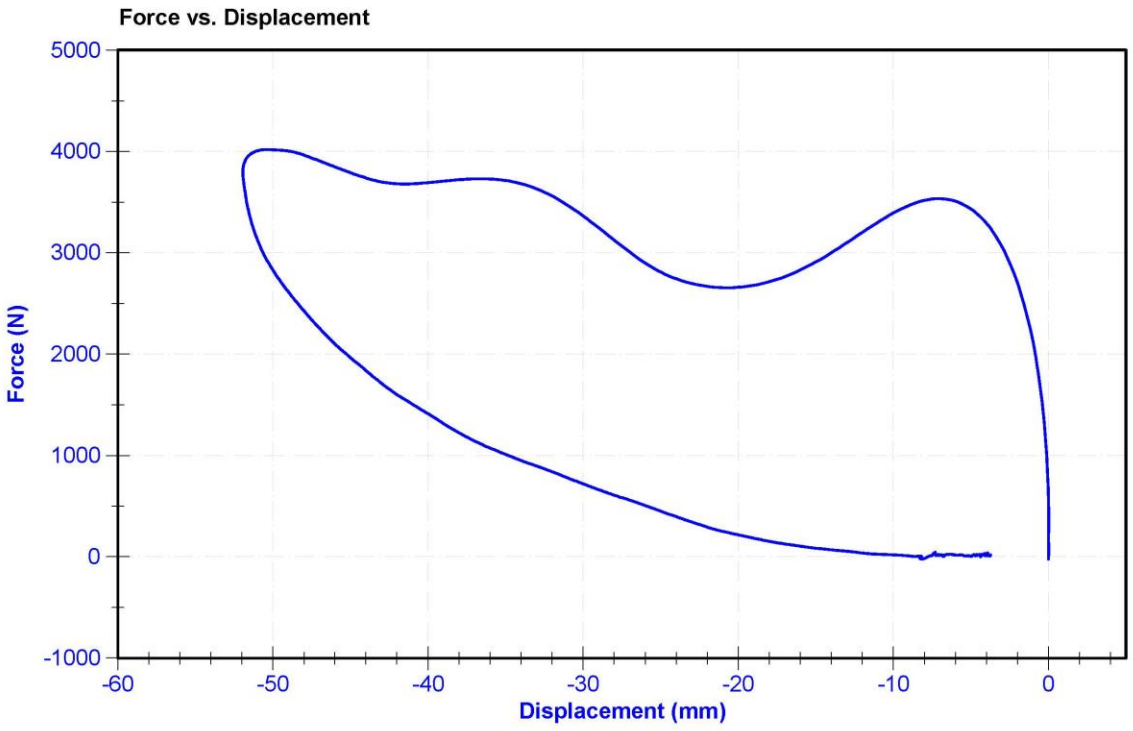
ATD Manufacturer	Humanetics	Test Technician	E. Helenbrook
ATD Serial Number	140	Laboratory Supervisor	K. Brogan

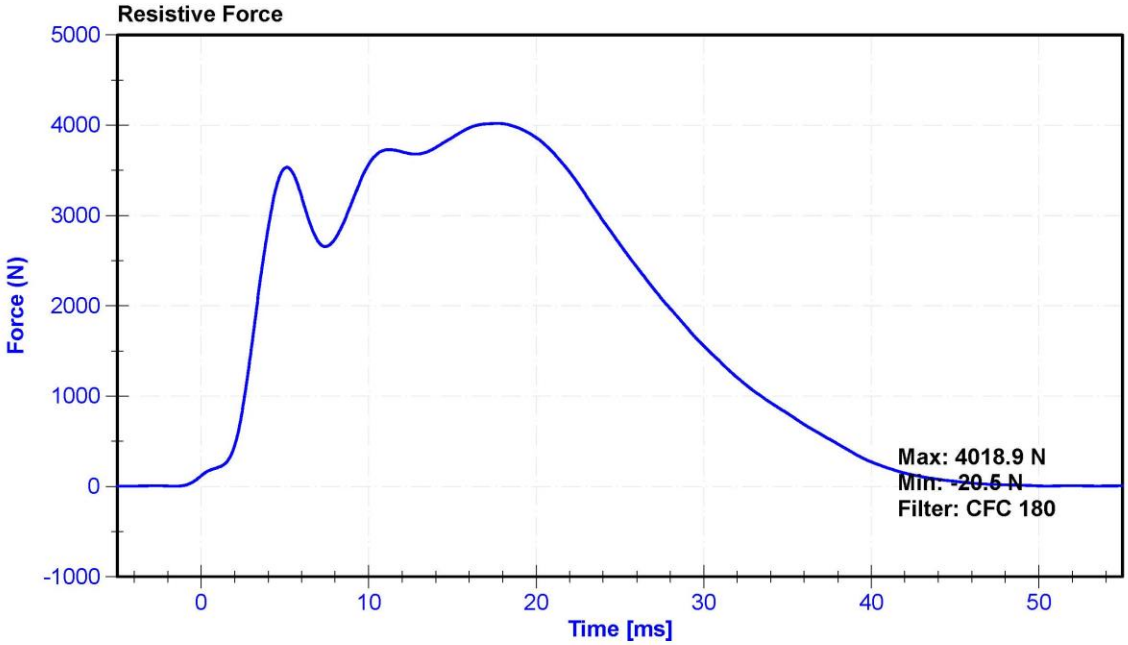
Results

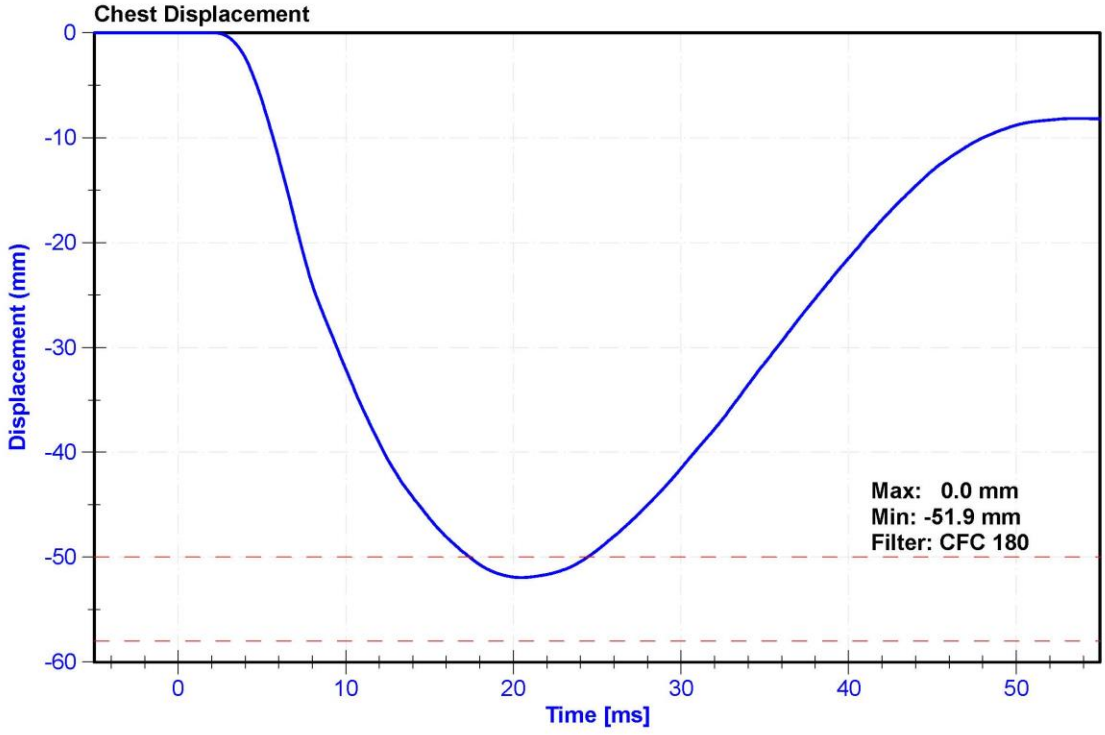
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.5	Pass
Humidity	10	70	%	19.4	Pass
Velocity	6.59	6.83	m/s	6.699	Pass
Chest Deflection	-58	-50	mm	-51.9	Pass
Maximum Resistive Force (50 to 58mm)	3900	4400	N	4018.9	Pass
Maximum Resistive Force (18 to 50mm)	0	4600	N	4016.4	Pass
Hysteresis	69	85	%	75.5	Pass

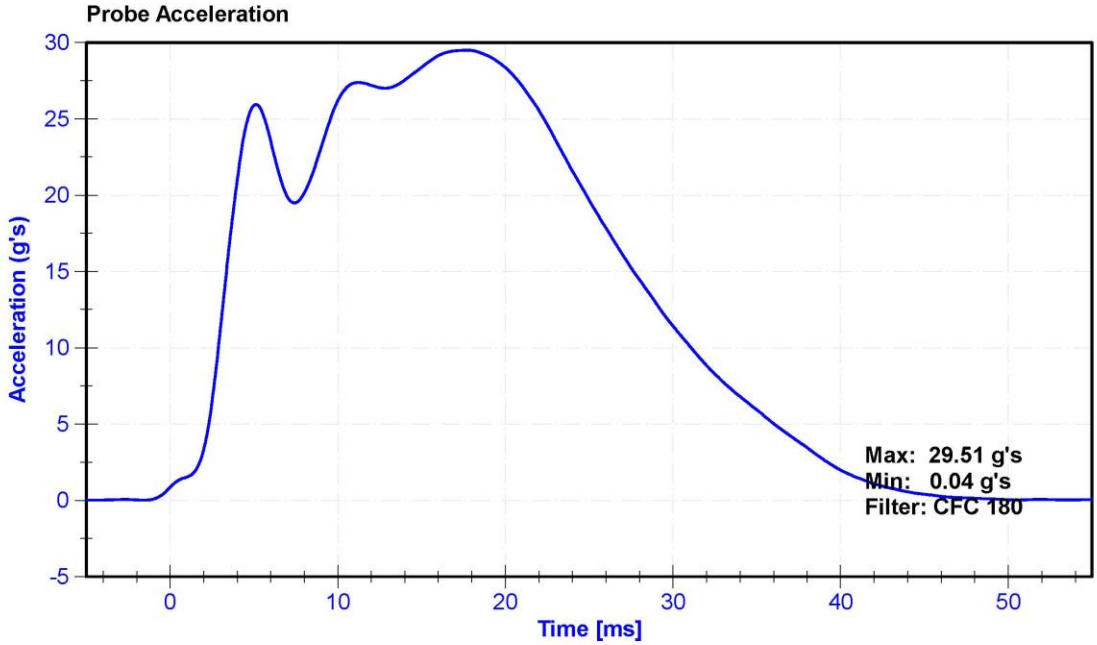
Transducer Calibrations

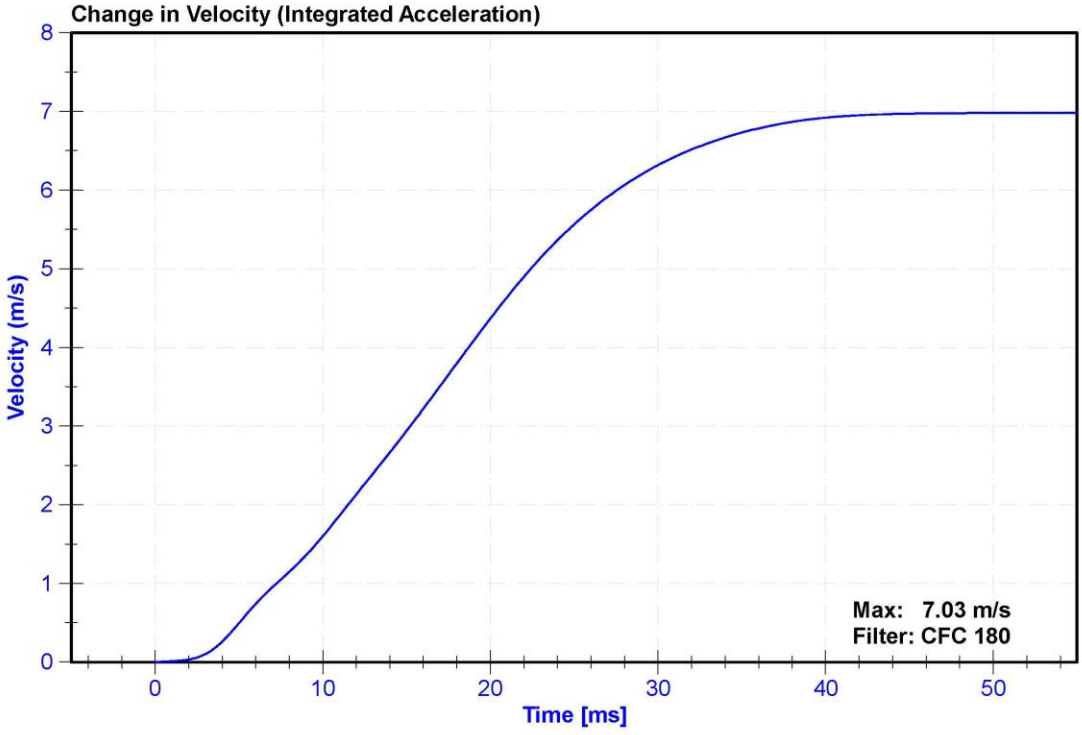
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7264C	T25885	2/2/2021	2/2/2022
Chest Potentiometer	SERVO 14CBI-3615	DS-140GFE	11/17/2020	5/18/2021




Resistive Force
Force (N)
5000
4000
3000
2000
1000
0
-1000
0
10
20
30
40
50
Time [ms]
Max: 4018.9 N
Min: -20.5 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: -51.9 mm
Filter: CFC 180


Probe Acceleration
Acceleration (g's)
30
25
20
15
10
5
0
-5
0
10
20
30
40
50
Time [ms]
Max: 29.51 g's
Min: 0.04 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: 7.03 m/s
Filter: CFC 180

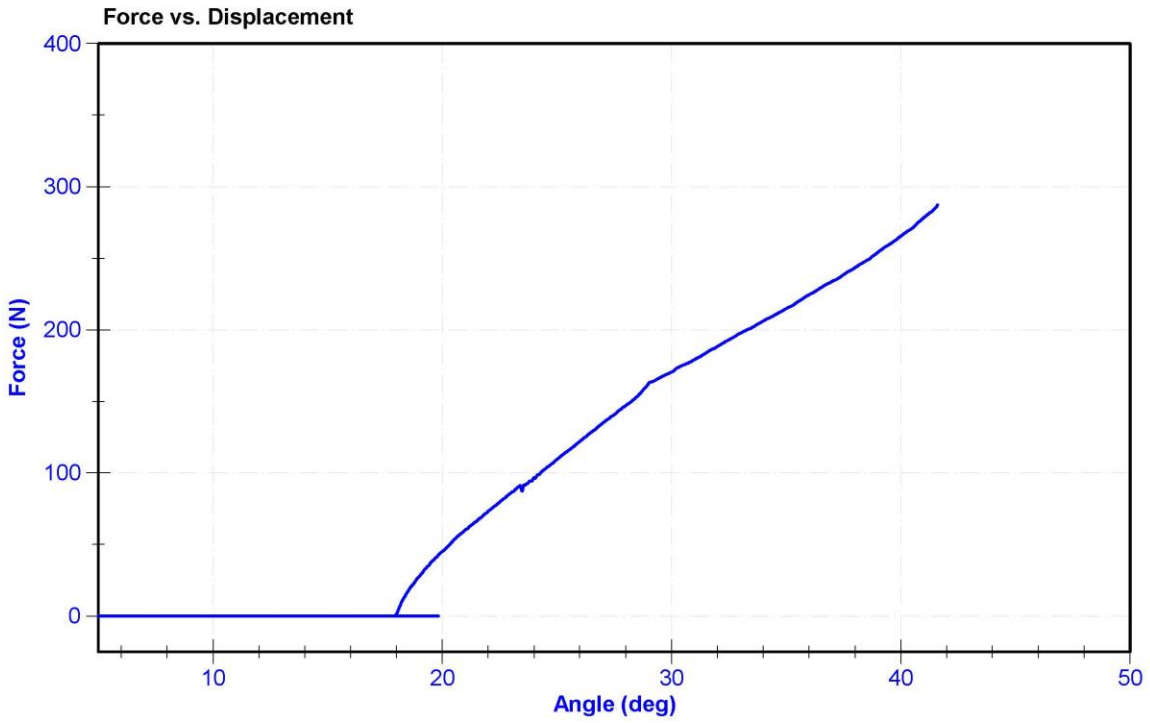
ATD Manufacturer	Humanetics	Test Technician	S. Vacanti
ATD Serial Number	140	Laboratory Supervisor	K. Brogan

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.6	25.6	ºC	20.8	Pass
Humidity	10	70	%	19.9	Pass
Initial Angle	0	20	deg	17.9	Pass
Force at 45 Degrees	320	390	N	342.5	Pass
Return Angle Relative to Initial	0	8	deg	7.8	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	Seika.de N4C-1	DS-1905226	10/12/2020	10/12/2021
Load Cell	Interface SML-200	LC-493319	10/8/2020	10/8/2021



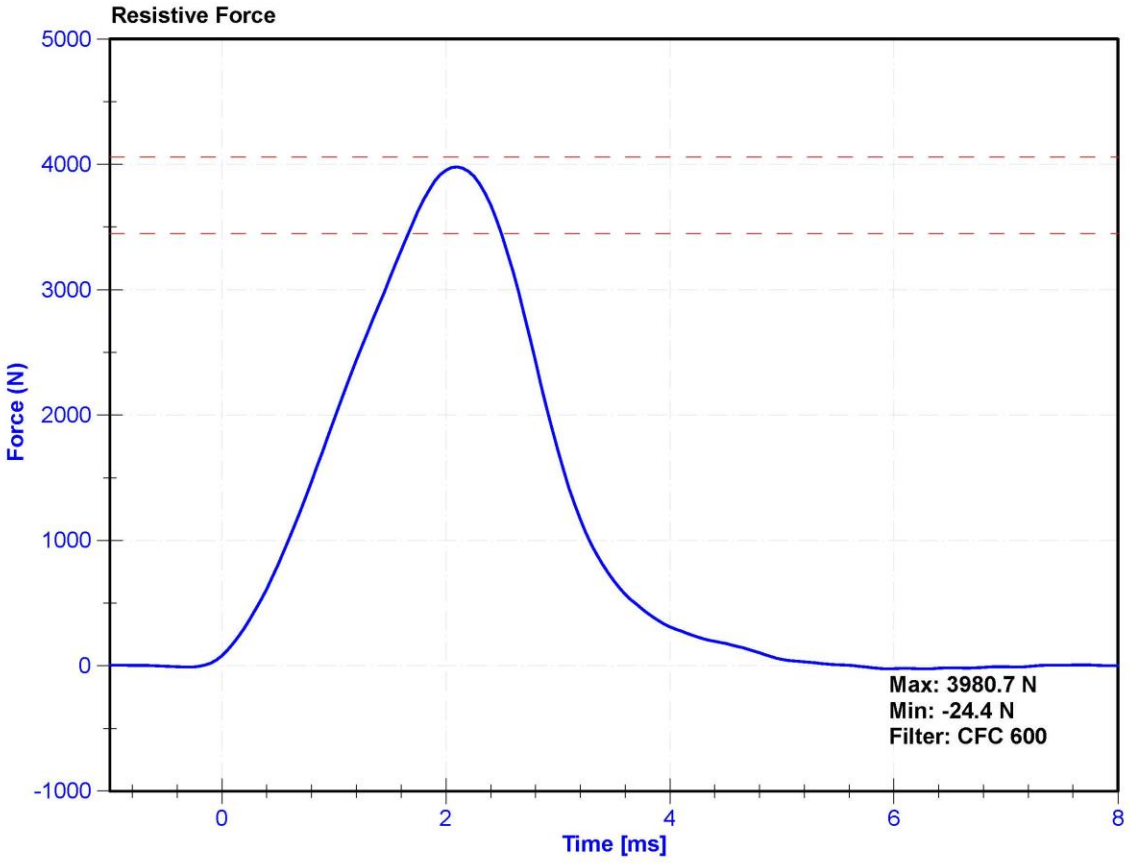
ATD Manufacturer	Humanetics	Test Technician	D.Reinhard
ATD Serial Number	140	Laboratory Supervisor	K. Brogan

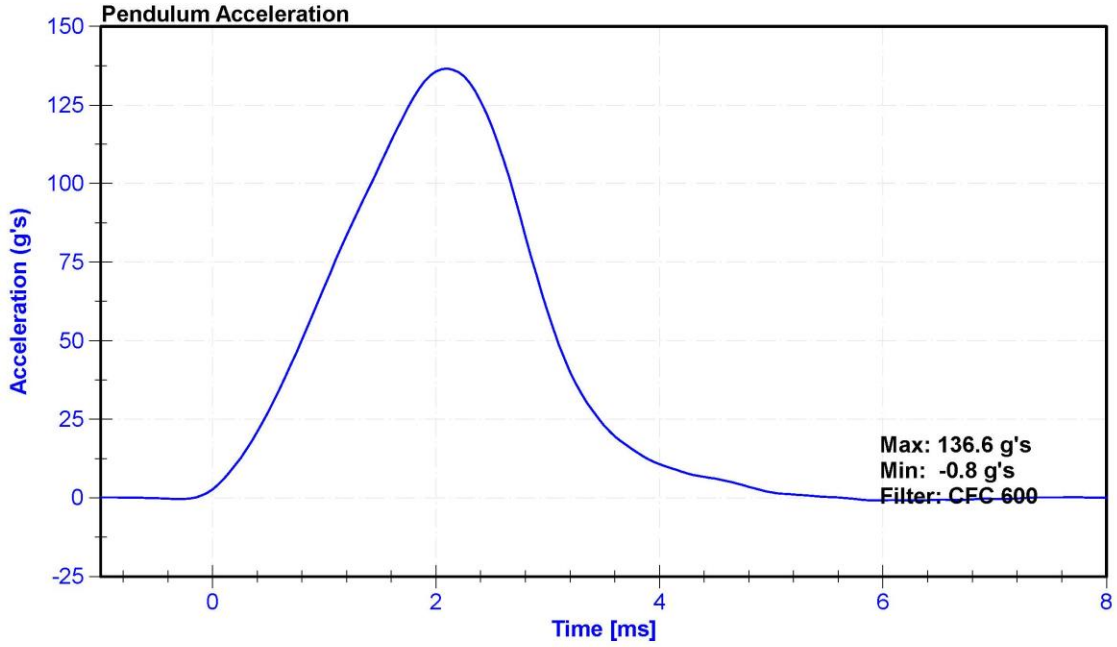
Results

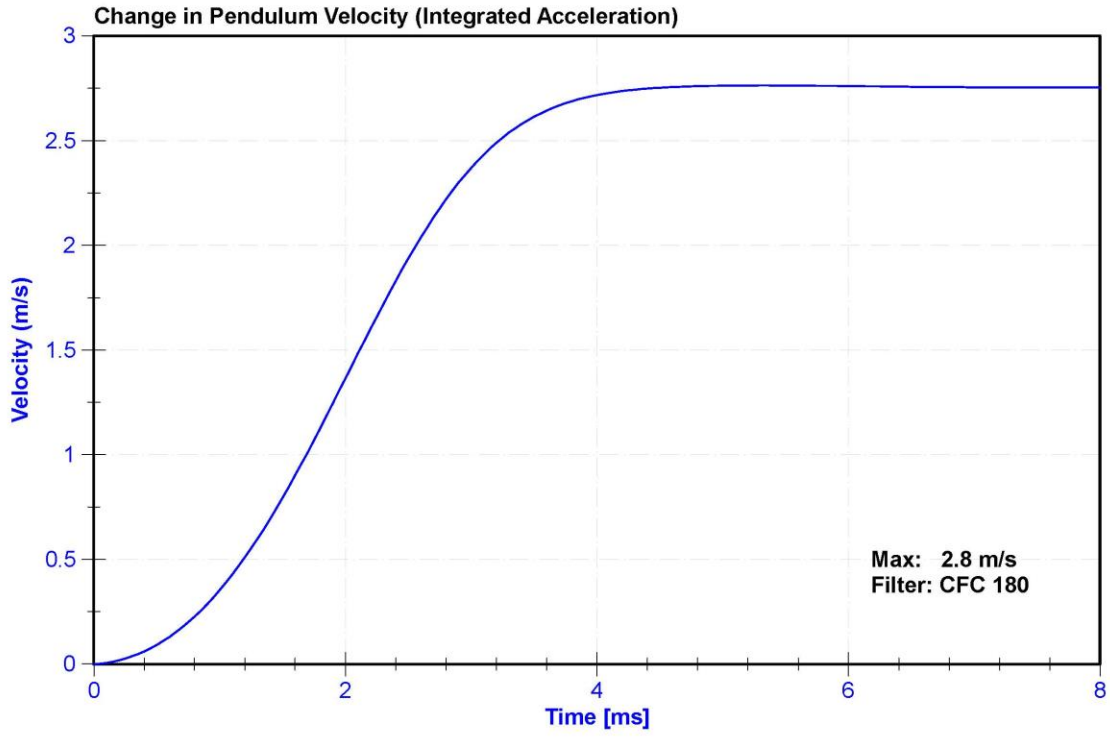
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	20.6	Pass
Humidity	10	70	%	26.0	Pass
Velocity	2.07	2.13	m/s	2.102	Pass
Resistive Force	3450	4060	N	3980.7	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A278994	12/3/2020	12/3/2021




Pendulum Acceleration
Acceleration (g's)
150
125
100
75
50
25
0
-25
0
2
4
6
8
Time [ms]
Max: 136.6 g's
Min: -0.8 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

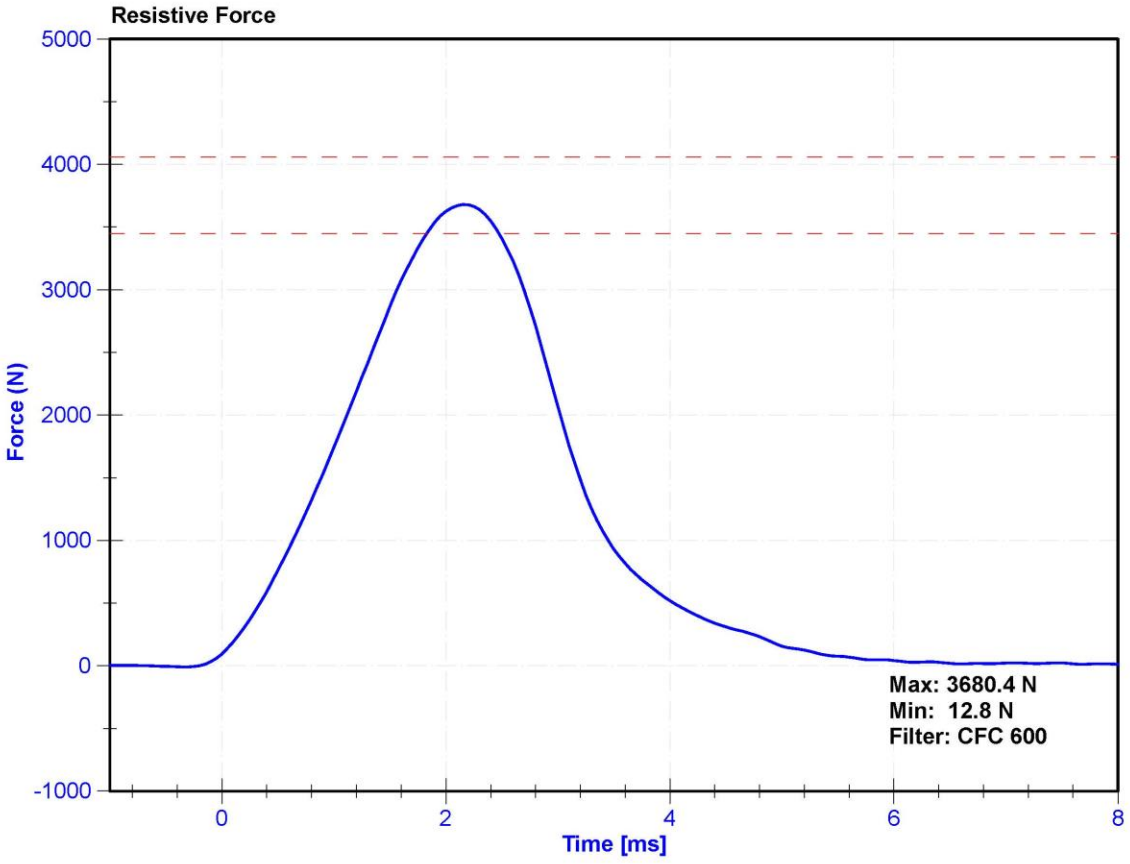
ATD Manufacturer	Humanetics	Test Technician	D.Reinhard
ATD Serial Number	140	Laboratory Supervisor	K. Brogan

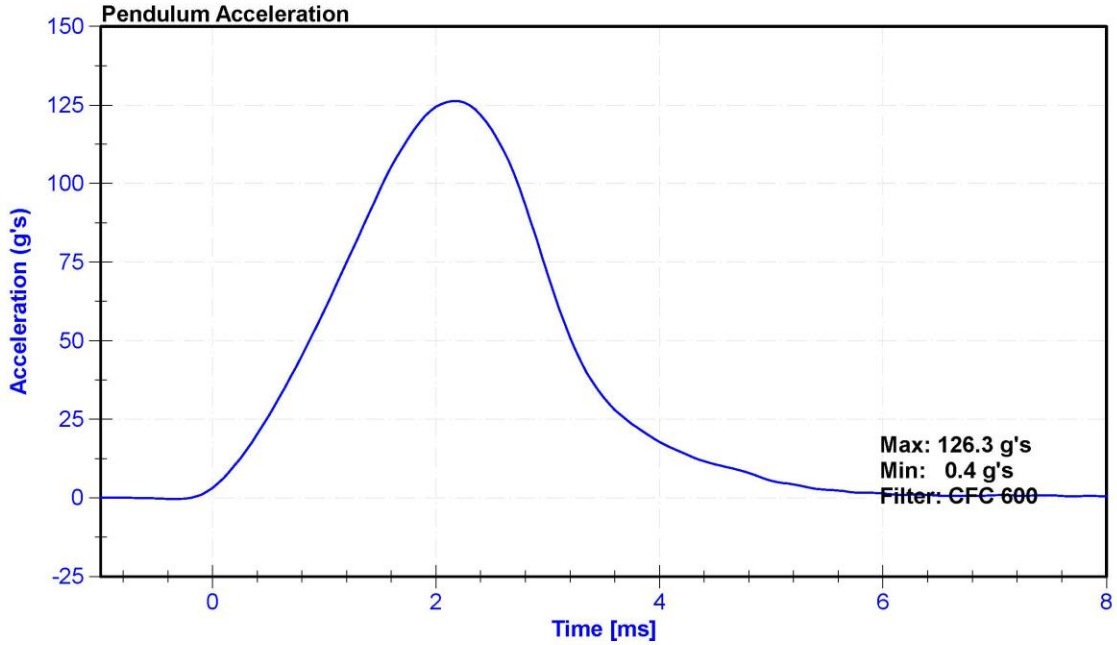
Results

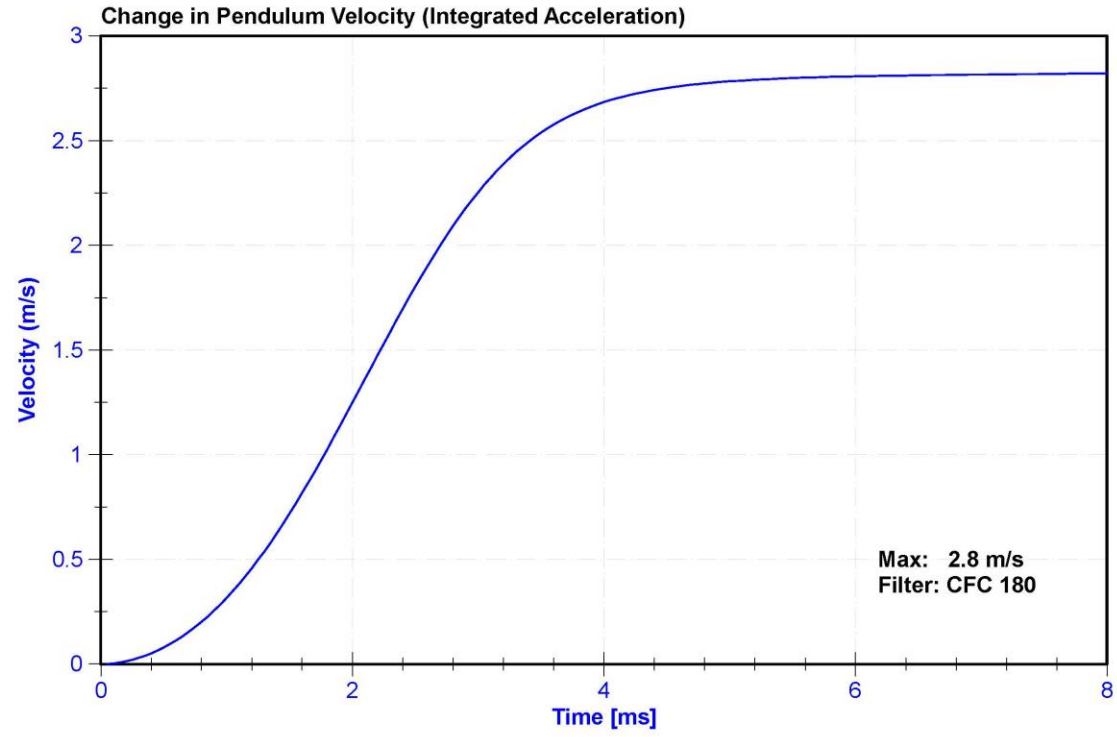
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	20.6	Pass
Humidity	10	70	%	26.0	Pass
Velocity	2.07	2.13	m/s	2.109	Pass
Resistive Force	3450	4060	N	3680.4	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A278994	12/3/2020	12/3/2021




Pendulum Acceleration
Acceleration (g's)
150
125
100
75
50
25
0
-25
0
2
4
6
8
Time [ms]
Max: 126.3 g's
Min: 0.4 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

APPENDIX D

DUMMY CALIBRATION AND PERFORMANCE VERIFICATION DATA

Table 1 – Driver Dummy Instrumentation

Instrumentation		Axis/Location	Hybrid III 50th S/N: 142		
			Serial Number	Manufacturer	Calibration Date
Head Accelerometers	Primary	X	P51681	Endevco	11/3/2020
		Y	P64151	Endevco	11/3/2020
		Z	P52114	Endevco	11/3/2020
	Redundant	X	P58833	Endevco	11/3/2020
		Y	P58905	Endevco	11/3/2020
		Z	P63996	Endevco	11/3/2020
Head Angular Rate Sensors		X	ARS-7603 GFE	DTS	8/4/2020
		Y	ARS-4718 GFE	DTS	8/4/2020
		Z	ARS-7521 GFE	DTS	8/4/2020
Upper Neck Load Cell		FX, Fy, Fz MX,MY, MZ	LC-2186Fx	Denton	11/10/2020
Chest Accelerometers	Primary	X	AC-P51994	Endevco	11/3/2020
		Y	AC-P51991	Endevco	11/3/2020
		Z	AC-P49185	Endevco	11/3/2020
	Redundant	X	AC-P51713	Endevco	11/3/2020
		Y	AC-P68059	Endevco	11/3/2020
		Z	AC-P78824	Endevco	11/3/2020
Chest Potentiometer		X	DS-142	Servo	11/19/2020
Pelvis Accelerometer		X	AC-P58800	Endevco	11/3/2020
		Y	AC-P52157	Endevco	11/3/2020
		Z	AC-P52156	Endevco	11/3/2020
Femur Load Cells - Left	Primary	Z	LC-136Fz1	Denton	11/10/2020
	Redundant	Z	LC-136Fz2	Denton	11/10/2020
Femur Load Cells - Right	Primary	Z	LC-DI4211FZ1	Denton	11/10/2020
	Redundant	Z	LC-DI4211FZ2	Denton	11/10/2020
Tibia Load Cells - Left	Upper	MX, MY, FZ	3643-93 Fz	Denton	11/20/2020
	Lower	MX, MY, FZ	36440495-FZ	Denton	11/20/2020
Tibia Load Cells – Right	Upper	MX, MY, FZ	36430362-FZ	Denton	11/20/2020
	Lower	MX, MY, FZ	LC-672 FZ	Denton	7/8/2020
Foot Accelerometers - Left	Rear	X	AC-P50084	Endevco	11/3/2020
	Front	Z	AC-P58779	Endevco	11/3/2020
Foot Accelerometers - Right	Rear	X	AC-P51872	Endevco	11/3/2020
	Front	Z	AC-P58893	Endevco	11/3/2020
Seat belt Load Cells	Lap		N/A	N/A	N/A
	Shoulder		IF-964-174-F0	FTSS	5/4/2019

Table 2 – Front Passenger Dummy Instrumentation

Instrumentation		Axis/Location	Hybrid III 5th S/N: 140		
			Serial Number	Manufacturer	Calibration Date
Head Accelerometers	Primary	X	P79417	Endevco	9/22/2020
		Y	P83335	Endevco	9/22/2020
		Z	T11252	Endevco	9/22/2020
	Redundant	X	P52008	Endevco	9/22/2020
		Y	P52045	Endevco	9/22/2020
		Z	P63845	Endevco	9/22/2020
Head Angular Rate Sensors		X	ARS-7553 GFE	DTS	2/21/2020
		Y	ARS-14909GFE	DTS	2/21/2020
		Z	ARS-14908GFE	DTS	2/21/2020
Upper Neck Load Cell		FX, Fy, Fz MX,MY, MZ	LC-1916Fx	Denton 1716A	11/23/2020
Chest Accelerometers	Primary	X	T21142	Endevco	9/22/2020
		Y	P83346	Endevco	9/22/2020
		Z	P49190	Endevco	9/22/2020
	Redundant	X	P58794	Endevco	9/22/2020
		Y	P58775	Endevco	9/22/2020
		Z	T11253	Endevco	9/22/2020
Chest Potentiometer		X	DS-140GFE	Servo	11/17/2020
Pelvis Accelerometer		X	P58735	Endevco	9/22/2020
		Y	P51285	Endevco	9/22/2020
		Z	P82756	Endevco	9/22/2020
Femur Load Cells - Left	Primary	Z	LC-140Fz1	Denton	7/9/2020
	Redundant	Z	LC-140Fz2	Denton	7/9/2020
Femur Load Cells - Right	Primary	Z	LC-124Fz1	Denton	11/23/2020
	Redundant	Z	LC-124Fz2	Denton	11/23/2020
Tibia Load Cells - Left	Upper	MX, MY, FZ	LC-404Fz	Denton	11/20/2020
	Lower	MX, MY, FZ	LC-398Fz	Denton	11/20/2020
Tibia Load Cells – Right	Upper	MX, MY, FZ	LC-364Fz	Denton	11/20/2020
	Lower	MX, MY, FZ	LC-396Fz	Denton	11/20/2020
Foot Accelerometers - Left	Rear	X	AC-P78959	Endevco	11/6/2020
	Front	Z	AC-P83418	Endevco	11/6/2020
Foot Accelerometers - Right	Rear	X	P83428	Endevco	11/20/2020
	Front	Z	AC-P80265	Endevco	11/6/2020
Seat belt Load Cells	Lap		N/A	N/A	N/A
	Shoulder		LC-292	GFE IF-964	5/12/2020

Table 3 – Vehicle Instrumentation

Instrumentation			Axis	Serial Number	Manufacturer	Calibration Date
Crossmember/Rear Seat Accelerometers	Left	Primary	X	1201-1000_A350957	Measurement Specialties	9/28/2020
			Z	1201-1000_A350998	Measurement Specialties	11/19/2020
		Redundant	X	1201-1000_A350964	Measurement Specialties	9/28/2020
	Right	Primary	X	1201-1000_A280394	Measurement Specialties	12/30/2020
			Z	1201-1000_A352399	Measurement Specialties	9/26/2020
		Redundant	X	1201-1000_A352383	Measurement Specialties	9/28/2020
Engine Accelerometers	Top		X	1201-1000_A315817	Measurement Specialties	11/19/2020
	Bottom		X	1201-1000_A280017	Measurement Specialties	9/18/2020