REPORT NUMBER: NCAP-CAL-20-013

NEW CAR ASSESSMENT PROGRAM (NCAP)
FRONTAL BARRIER IMPACT TEST

KIA Motors Corporation
2020 KIA Stinger GT-Line
Four Door Sedan

NHTSA No: M20204215

PREPARED BY:
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June 16, 2020

FINAL REPORT

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

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Prepared by: Matthew Pronko Date: June 16, 2020
Matthew Pronko, Test Engineer

Approved by: Vanessa Hansen Date: June 16, 2020
Vanessa Hansen, Operations Manager

FINAL REPORT ACCEPTANCE BY OCWS:

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

Date: _____

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

Date: _____

TECHNICAL REPORT DOCUMENTATION PAGE

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9. Performing Organization Name and Address Calspan Corporation Transportation Test Operations P.O. Box 400 Buffalo, New York 104625		***10. Work Unit No.*** ***11. Contract or Grant No.*** 693JJ919D000005
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15. Supplementary Notes		

16. Abstract

A 56.30 km/h (35 mph), NCAP frontal rigid barrier impact test was conducted on a 2020 KIA Stinger GT-Line four door sedan in accordance with the specifications of the Office of Crashworthiness Standards Laboratory Procedure for NCAP Full Frontal Rigid Barrier Impact Testing. This test was conducted to obtain data related to FMVSS Nos. 208, 212, 219 (partial), 301, and 305 performance. The test was conducted at Calspan Corporation's Transportation Test Operations facility in Buffalo, New York on April 21, 2020.

The impact velocity of the vehicle was 56.26 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 583 mm at C3 to the left side of the front bumper. The test vehicle's occupant performance data is as follows:

Measurement Description	Units	Driver ATD (Serial No. 142)		Passenger ATD (Serial No. 139)	
		Threshold	Result	Threshold	Result
Head Injury Criteria (HIC_{15})		700	161.228	700	219.871
Maximum Chest Compression	mm	63	-25.450	52	-23.415
Nij		1	0.183	1	0.366
Neck Tension	N	4,170	608.859	2,620	769.876
Neck Compression	N	4,000	-277.376	2,520	-144.071
Left Femur Force	N	10,008	-431.661	6,805	-236.461
Right Femur Force	N	10,008	-1577.749	6,805	-113.217

17. Key Words 56.3 km/h (35 mph) Full Frontal Rigid Barrier Impact Test New Car Assessment Program (NCAP)	***18. Distribution Statement*** Copies of this report are available from: National Highway Traffic Safety Administration Technical Information Services Division 1200 New Jersey Ave, SE Washington, DC 20590

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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 2020 KIA Stinger GT-Line four door sedan at a velocity of 56.26 km/h. The test was performed at Calspan Corporation's Transportation Test Operations facility in Buffalo, New York on April 21, 2020. 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 shoulder belt to measure dummy torso section loading. The driver (position 1) ATD (Serial No. 142) and the right-front passenger (position 2) ATD (Serial No. 139) 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 583 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.

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})	161.228	0.183	608.859	-277.376	43.308	-25.450	-431.661	-1577.749
Passenger (5^{th})	219.871	0.366	769.876	-144.071	43.762	-23.415	-236.461	-113.217

GENERAL COMMENTS:

1. P1 (Driver) serial number - 142
2. P2 (Passenger) serial number – 139
3. No seatbelt load cells were placed on Passenger belt per OEM specification.
4. Driver lap belt load cell was not used per OEM specification
5. Vehicle body design is considered a four door sedan however the vehicle's rear compartment functions like a hatchback

Data Anomalies:

- None

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: 2020 KIA Stinger GT-Line four door sedan
NHTSA No.: M20204215
Test Program: NCAP Frontal Barrier Impact Test
Test Date: 4/21/2020

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA No.	M20204215
Model Year	2020
Make	KIA
Model	Stinger GT-Line
Body Style	Five Door Hatchback
VIN	KNAE15LA7L6074115
Body Color	Black
Odometer Reading (km /mi)	46 mi
Engine Displacement (L)	2.0
Type / No. Cylinders	I4
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
Other –	-

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

DATA FROM CERTIFICATION LABEL

Manufactured By	KIA Motors Corporation
Date of Manufacture	08/19

GVWR (kg)	2235
GAWR Front (kg)	1115
GAWR Rear (kg)	1230

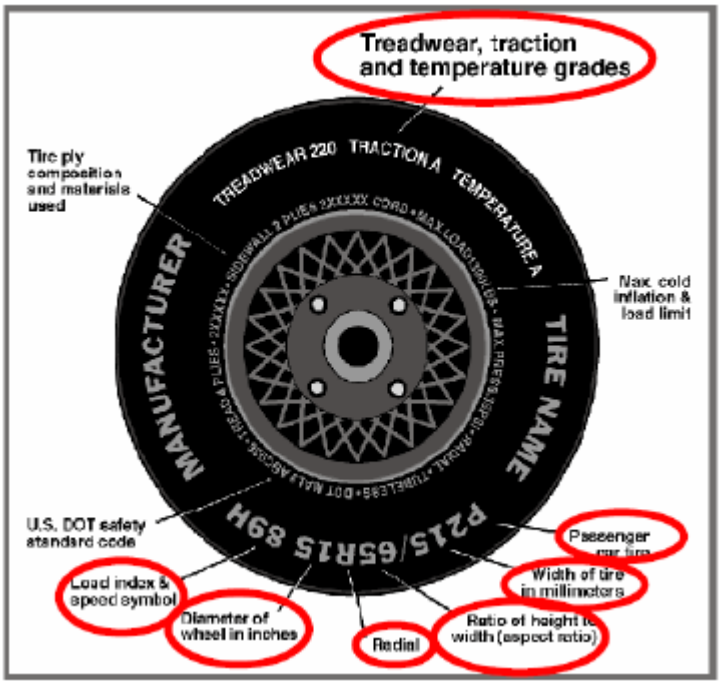
VEHICLE SEATING AND WEIGHT CAPACITY DATA

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:	2020 KIA Stinger GT-Line four door sedan	NHTSA No.:	M20204215
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	4/21/2020

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)	250	270
Recommended Tire Size	225/45R18	225/45R18
Tire Size on Vehicle	225/45R18	225/45R18
Tire Manufacturer	Bridgestone	Bridgestone
Tire Model	Potenza	Potenza
Treadwear	400	400
Traction	A	A
Temperature Grades	A	A
Tire Plies Sidewall	2 Polyester	2 Polyester
Tire Plies Body	1 Polyester, 2 Steel, 1 Nylon	1 Polyester, 2 Steel, 1 Nylon
Load Index / Speed Symbol	95V	95V
Tire Material	Rubber	Rubber
DOT Safety Code Left	EJJ7DAA4218	EJJ7DAA4318
DOT Safety Code Right	EJJ7DAA4318	EJJ7DAA4318

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

Test Vehicle: 2020 KIA Stinger GT-Line four door sedan
NHTSA No.: M20204215
Test Program: NCAP Frontal Barrier Impact Test
Test Date: 4/21/2020

TEST VEHICLE WEIGHTS

	Units	As Delivered Weights (UVW)			As Tested Weights (ATW)		
		Front Axle	Rear Axle	Total	Front Axle	Rear Axle	Total
Left	kg	459	427		494	504	
Right	kg	463	423		478	501	
Ratio	%	52	48		49.2	50.8	
Totals	kg	922	850	1772	972	1005	1977

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value	
Total Delivered Weight (UVW)	kg	1772	(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	1983.8	(A+B+C)

TEST VEHICLE ATTITUDES AND CG

Condition	Units	LF	RF	LR	RR	CG (aft of front axle)
As Delivered	mm	715	714	704	706	1394
As Tested	mm	704	706	684	686	1478
Post-Test	mm	742	741	689	687	

GENERAL TEST VEHICLE DATA

Measurement Description	Units	Value
Total Vehicle Wheel Base	mm	2907
Total Vehicle Length at Left Side	mm	4732
Total Vehicle Length at Centerline	mm	4830
Total Vehicle Length at Right Side	mm	4732
Weight of Ballast in Cargo Area	kg	40
Weight of Vehicle Components Removed	kg	30.5
Amount of Stoddard Solvent in Fuel Tank	L	55.8

LIST OF COMPONENTS REMOVED TO MEET TEST WEIGHT:

Trunk carpeting, spare tire, jack

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

Test Vehicle: 2020 KIA Stinger GT-Line four door sedan NHTSA No.: M20204215
Test Program: NCAP Frontal Barrier Impact Test Test Date: 4/21/2020

TARGET VEHICLE STRUCTURAL MEASUREMENT

No.	Description	Pre-Test
1	Total Length	4830
2	Total Width	1815
3*	Bumper Top Height	507
4*	Bumper Bottom Height	434
5*	Longitudinal Member Top Height	529
6	Distance Between Longitudinal Members	960
7	Longitudinal Member Width	85
8*	Engine Top Height	826
9*	Engine Bottom Height	166
10	Engine and Gearbox Width	352
11	Front Bumper-Engine Distance	651
12*	Front Shock Absorber Fixing Height	853
13*	Bonnet Leading Edge Height	741
14	Front Shock Absorber Fixing Width	1187
15	Front Bumper – Front Axle Distance	824
16	Front Axle – A Pillar Distance	810
17	A-Pillar – B-Pillar Distance	1008
18	B-Pillar – Rear Axle Distance	1088
19	B-Pillar – C-Pillar Distance	1100
20*	Roof Sill Bottom Height	1281
21*	Roof Sill Top Height	1361
22*	Floor Sill Bottom Height	275
23*	Floor Sill Top Height	372

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

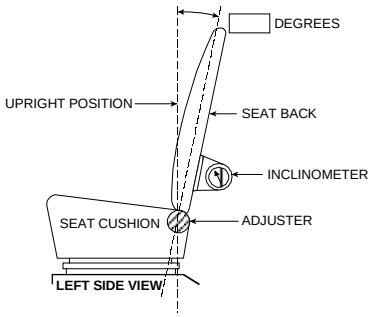
DATA SHEET NO. 2
SEAT ADJUSTMENT, FUEL SYSTEM, AND STEERING WHEEL DATA

Test Vehicle:	2020 KIA Stinger GT-Line four door sedan	NHTSA No.:	M20204215
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	4/21/2020

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	2.6
Passenger Seat Back Angle	0.7



FRONT SEAT ASSEMBLY

SEAT FORE / AFT POSITIONS

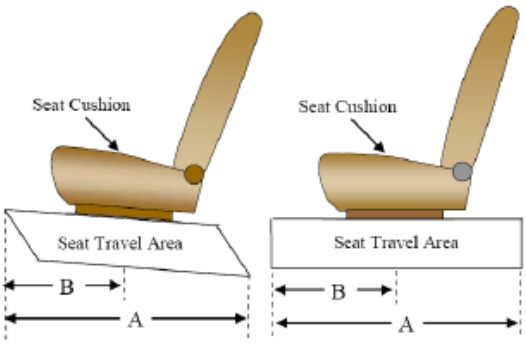
The driver's seat was positioned at the mid-point of fore/aft travel at its lowest position. The passenger's seat was positioned at the most forward position of fore/aft travel. Zero is defined as the forward most position.

Seating Position	Total Fore / Aft Travel	Placed in Position #
Driver Seat	290	145
Passenger Seat	240	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	4 (0-3)	0
Passenger Seat	4 (0-3)	0



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

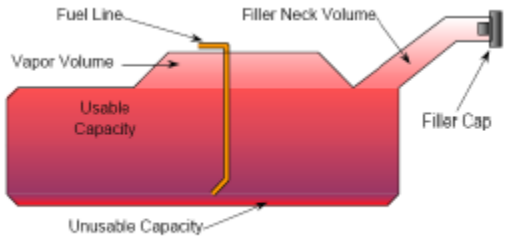
Test Vehicle:	2020 KIA Stinger GT-Line four door sedan	NHTSA No.:	M20204215
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	4/21/2020

FUEL TANK CAPACITY

Description	Liters
Usable Capacity of "Standard Tank"	60
Usable Capacity of "Optional Tank"	N/A
92%-94% of Usable Capacity	55.2 – 56.4
Actual Amount of Solvent Used	55.8
1/3 of Usable Capacity	20

FUEL PUMP

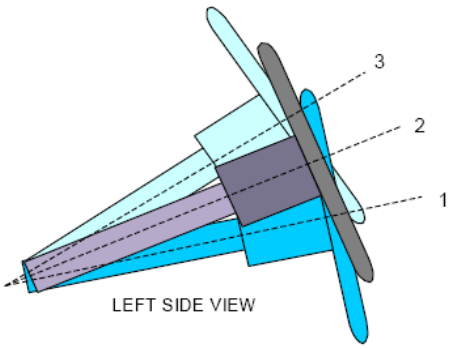
The vehicle is equipped with an electric fuel pump. The fuel filler neck is on the left side of the vehicle. The pump creates positive pressure in the fuel lines, pushing the gasoline to the engine. See form 1 for more information.



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.



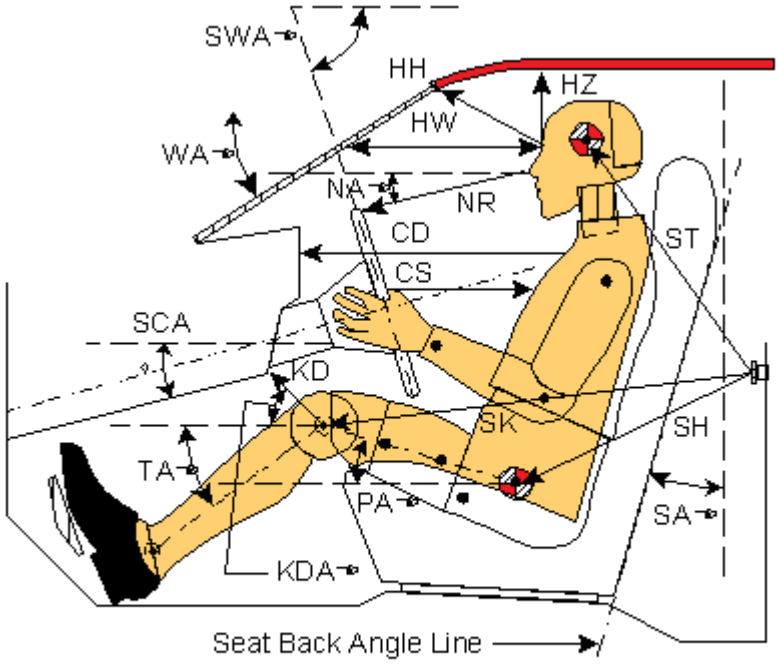
STEERING COLUMN ASSEMBLY

STEERING COLUMN POSITIONS

Description	Degrees	Fore / Aft Position (mm)
Lowermost position No. 1	17.0	
Geometric center position No. 2	19.4	
Uppermost position No. 3	22.2	
Telescoping Steering Wheel Travel		50
Test Position	19.4	25

DATA SHEET NO. 3
DUMMY LONGITUDINAL CLEARANCE DIMENSIONS

Test Vehicle: 2020 KIA Stinger GT-Line four door sedan
NHTSA No.: M20204215
Test Program: NCAP Frontal Barrier Impact Test
Test Date: 4/21/2020

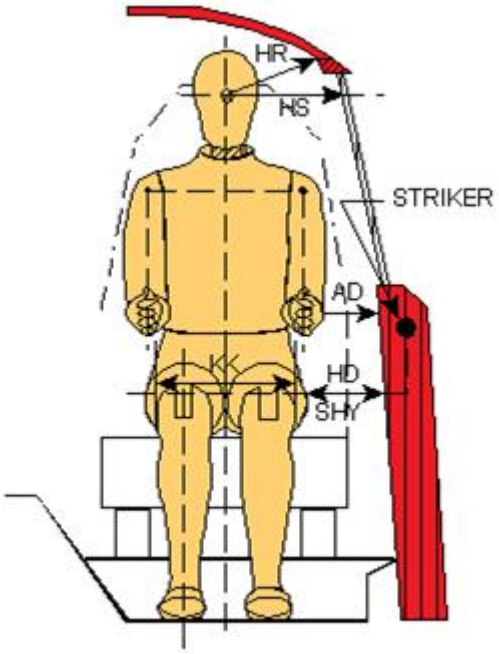


Left Side View

Code	Measurement Description	Driver (SN: 142)		Passenger (SN: 139)	
		Length (mm)	Angle (°)	Length (mm)	Angle (°)
WA°	Windshield Angle		27.1		
SWA°	Steering Wheel Angle		19.6		
SCA°	Steering Column Angle		70.4		
SA°	Seat Back Angle (on headrest post)		2.6		0.7
HZ	Head to Roof (Z)	155	90	182	90
HH	Head to Header	335	23.4	290	42.5
HW	Head to Windshield	608	0	621	0
NR	Nose to Rim / Dash	367	5.8	463	12.8
CD	Chest to Dash	511		416	
CS	Chest to Steering Hub	295	1.9		
RA	Rim to Abdomen	214	0		
KDL	Left Knee to Dash	230	29.9	140	32.5
KDR	Right Knee to Dash	218	28.8	149	33.7
PA°	Pelvic Angle		22.8		20.7
TA°	Tibia Angle		19.3		28.7
SK	Striker to Knee	574	18.7	672	14.7
ST	Striker to Head	383	78.5	378	60.2
SH	Striker to H-Point	332	57.6	423	34.4

DATA SHEET NO. 4
DUMMY LATERAL CLEARANCE DIMENSIONS

Test Vehicle: 2020 KIA Stinger GT-Line four door sedan
NHTSA No.: M20204215
Test Program: NCAP Frontal Barrier Impact Test
Test Date: 4/21/2020

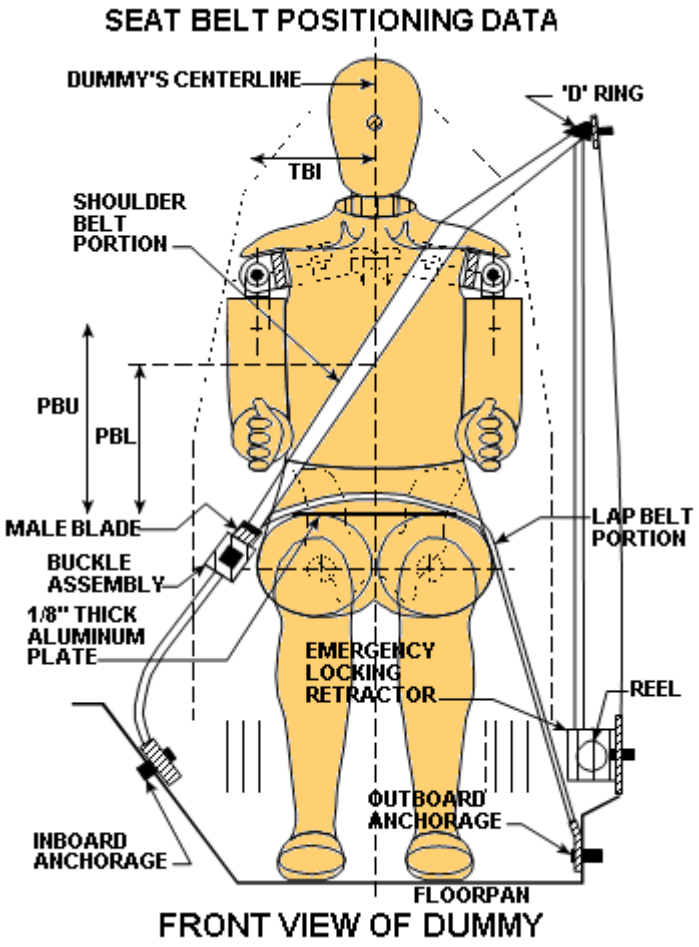


Front View

Code	Description	Driver (mm)	Passenger (mm)
AD	Arm to Door	131	78
HD	H-Point to Door	162	190
HR	Head to Side Header	188	224
HS	Head to Side Window	327	354
KK	Knee to Knee	330	210
SHY	Striker to H-Point (Y Direction)	240	245
AA	Ankle to Ankle	335	168

DATA SHEET NO. 5
SEAT BELT POSITIONING DATA

Test Vehicle:	2020 KIA Stinger GT-Line four door sedan	NHTSA No.:	M20204215
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	4/21/2020



SEAT BELT POSITIONING MEASUREMENTS

Measurement Description	Units	Driver	Passenger
PBU — Top surface of reference to belt upper edge	mm	395	295
PBL — Top surface of reference to belt lower edge	mm	320	220

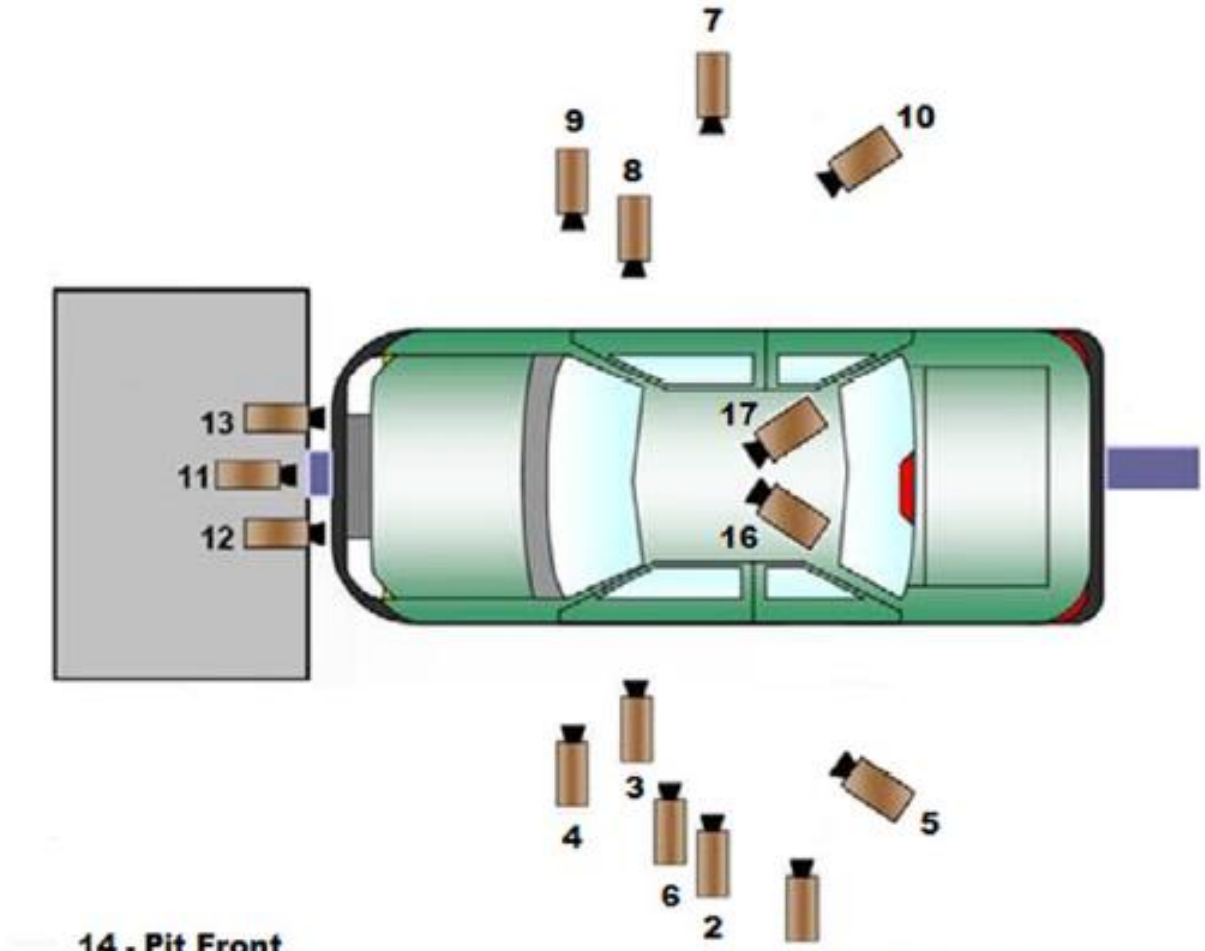
BELT LENGTH DATA

Measurement Description	Units	Driver	Passenger
Shoulder belt length as measured on ATD	mm	825	890
Lap Belt Length as measured on ATD	mm	585	675
Remainder of belt on reel	mm	990	835
Total belt length for continuous webbing systems	mm	2400	2400

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

Test Vehicle:	2020 KIA Stinger GT-Line four door sedan	NHTSA No.:	M20204215
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	4/21/2020

CAMERA POSITIONS FOR FRONTAL IMPACTS



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

Test Vehicle: 2020 KIA Stinger GT-Line four door sedan NHTSA No.: M20204215
Test Program: NCAP Frontal Barrier Impact Test Test Date: 4/21/2020

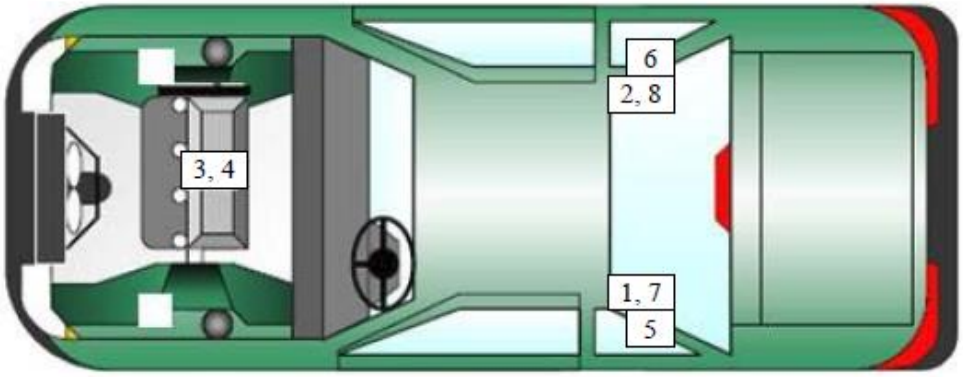
CAMERA LOCATIONS

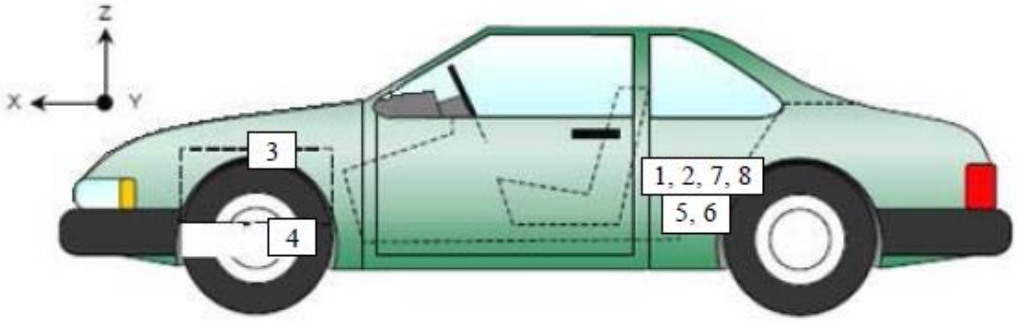
No.	Camera View	Location (mm)			Lens (mm)	Speed (fps)
		X	Y	Z		
1	Real-Time Left Overall	-	-	-		60
2	Left Overall	-2216	-7291	-1335	24	1000
3	Driver Close-Up	-1517	-6621	-1430	50	1000
4	Left Front Half	-852	-6178	-1284	28	1000
5	Left Angle	-4804	-5322	-2590	50	1000
6	Steering Column	-1520	-7432	-2153	50	1000
7	Right Overall	-2132	7211	-1286	24	1000
8	Passenger Close-Up	-1490	6931	-1443	50	1000
9	Right Front Half	-1176	6441	-1284	28	1000
10	Right Angle	-4632	4904	-2537	50	1000
11	Windshield	1163	0	-3471	25	1000
12	Driver Windshield	823	-400	-2340	25	1000
13	Passenger Windshield	823	400	-2340	25	1000
14	Pit Front	-1080	0	2247	12.5	1000
15	Pit Rear	-2485	0	2404	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: 2020 KIA Stinger GT-Line four door sedan NHTSA No.: M20204215
Test Program: NCAP Frontal Barrier Impact Test Test Date: 4/21/2020





VEHICLE ACCELEROMETER PRE-TEST LOCATIONS

No.	Accelerometer Location	Measurements (mm)		
		X	Y	Z
1	Left Rear Accelerometer – X Direction	1946	-382	118
2	Right Rear Accelerometer – X Direction	1945	329	115
3	Engine Top X	4031	68	-400
4	Engine Bottom X	3927	-20	310
5	Left Rear Accelerometer – Z Direction	1946	-382	118
6	Right Rear Accelerometer – Z Direction	1945	329	115
7	Left Rear Accelerometer – X Direction Redundant	1946	-385	119
8	Right Rear Accelerometer – X Direction Redundant	1945	329	118

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

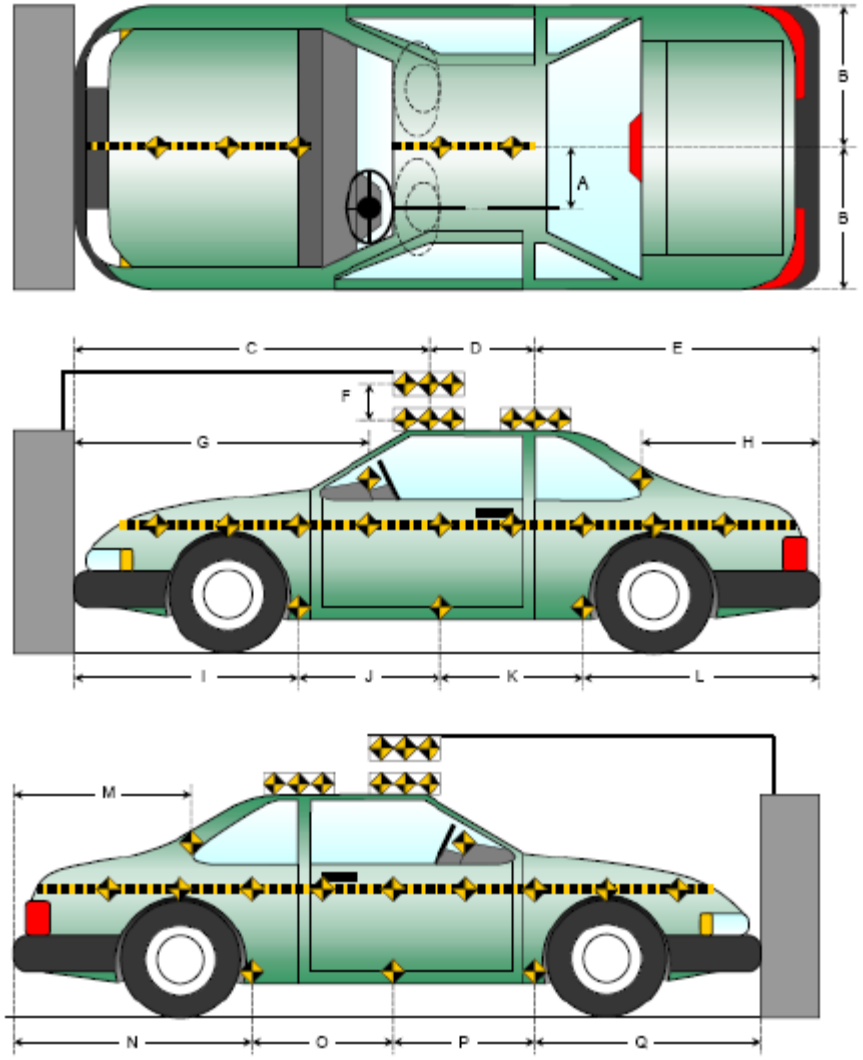
DATA SHEET NO. 8
PHOTOGRAPHIC REFERENCE TARGET LOCATIONS

Test Vehicle: 2020 KIA Stinger GT-Line four door sedan
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20204215
Test Date: 4/21/2020

Item	Value
A	378
B	908
C	2491
D	610
E	1729
F	180
G	1847
H	1109
I	1467
J	876
K	878
L	1609
M	1110
N	1612
O	877
P	874
Q	1467

All units in millimeters



DATA SHEET NO. 9
LOAD CELL LOCATIONS ON FIXED BARRIER

Test Vehicle:	2020 KIA Stinger GT-Line four door sedan	NHTSA No.:	M20204215
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	4/21/2020

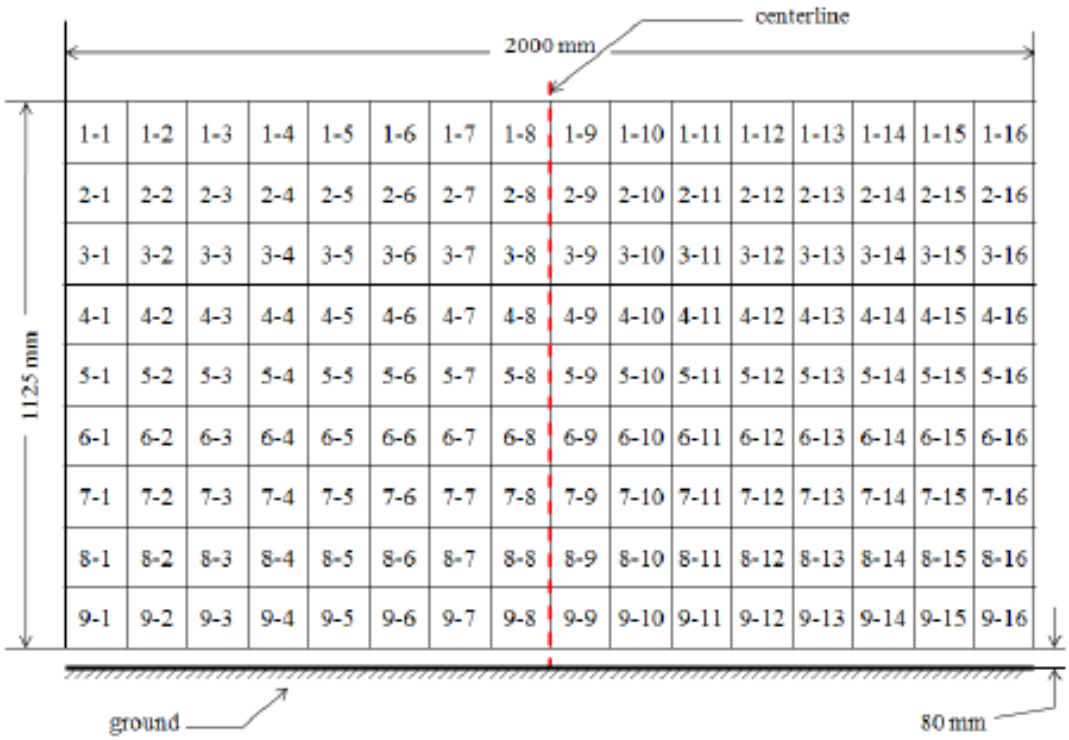


Figure 1 - Load Cell Locations on a 128-Load Cell Barrier with Plywood Height Extension*
Please note above diagram is not actual representation of load cell barrier used.

DATA SHEET NO. 10
TEST VEHICLE SUMMARY OF RESULTS

Test Vehicle: 2020 KIA Stinger GT-Line four door sedan NHTSA No.: M20204215
Test Program: NCAP Frontal Barrier Impact Test Test Date: 4/21/2020

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: 2020 KIA Stinger GT-Line four door sedan NHTSA No.: M20204215
Test Program: NCAP Frontal Barrier Impact Test Test Date: 4/21/2020

TEST DUMMY INFORMATION AND CONTACT LOCATIONS

Description	Driver	Passenger
Dummy Type / Serial No.	P572E 50th Male / 142	P5720 5th Female / 139
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	None
Right Knee Contact	Knee Airbag	None

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			Operational
Seat Track Shift (mm)	0	0	
Seat Back Movement from Initial Position	No	No	

POST-TEST STRUCTURAL OBSERVATIONS

Critical Areas of Performance	Observations and Conclusions
Windshield Damage	Minor cracks along passenger side
Window Damage	None
Other	None

VEHICLE REBOUND FROM BARRIER

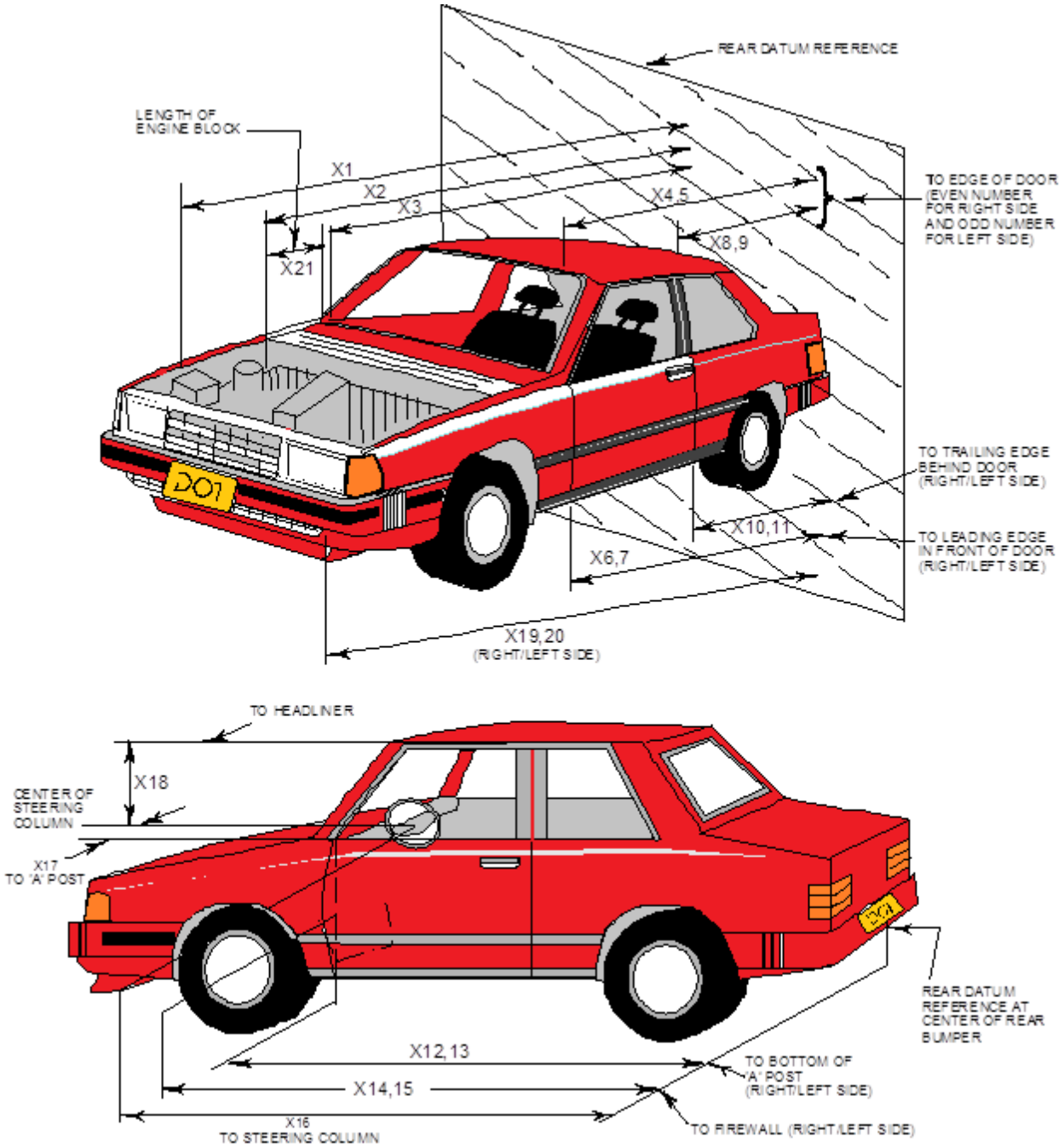
Measured Parameter	Units	Value
Left Side	mm	1005
Center	mm	980
Right Side	mm	1017
Average	mm	1001

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
Other				

DATA SHEET NO. 12
VEHICLE PROFILE MEASUREMENTS

Test Vehicle:	2020 KIA Stinger GT-Line four door sedan	NHTSA No.:	M20204215
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	4/21/2020



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

Test Vehicle: 2020 KIA Stinger GT-Line four door sedan NHTSA No.: M20204215
Test Program: NCAP Frontal Barrier Impact Test Test Date: 4/21/2020

No.	Measurement Description	Pre-Test	Post-Test	Difference
1	Total Length of Vehicle at Centerline	4830	4290	-540
2	Rear Surface of Vehicle (RSOV) to Front of Engine	4179	4098	-81
3	RSOV to Firewall	3672	3668	-4
4	RSOV to Upper Leading Edge of Right Door	3217	3217	0
5	RSOV to Upper Leading Edge of Left Door	3215	3214	-1
6	RSOV to Lower Leading Edge of Right Door	3310	3307	-3
7	RSOV to Lower Leading Edge of Left Door	3309	3305	-4
8	RSOV to Upper Trailing Edge of Right Door	2199	2200	1
9	RSOV to Upper Trailing Edge of Left Door	2198	2198	0
10	RSOV to Lower Trailing Edge of Right Door	2239	2239	0
11	RSOV to Lower Trailing Edge of Left Door	2238	2239	1
12	RSOV to Bottom of “A” Post of Right Side	3270	3269	-1
13	RSOV to Bottom of “A” Post of Left Side	3267	3265	-2
14	RSOV to Firewall, Right Side	3674	3676	2
15	RSOV to Firewall, Left Side	3677	3677	0
16	RSOV to Steering Column	2790	2826	36
17	Center of Steering Column to “A” Post	272	274	2
18	Center of Steering Column to Headliner	370	462	92
19	RSOV to Right Side of Front Bumper	4779	4246	-533
20	RSOV to Left Side of Front Bumper	4778	4257	-521
21	Length of Engine Block	412	412	0
RD	RSOV to Right Side of Dash Panel	2992	2991	-1
CD	RSOV to Center of Dash Panel	2934	2932	-2
LD	RSOV to Left Side of Dash Panel	3000	3001	1

All Dimensions in mm

DATA SHEET NO. 13
ACCIDENT INVESTIGATION DIVISION DATA

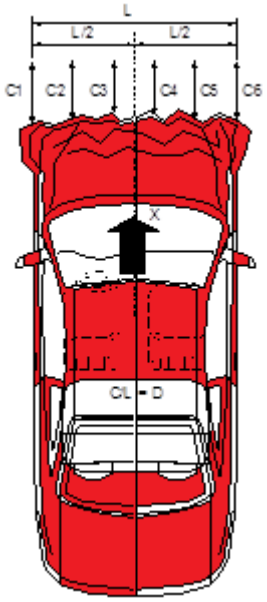
Test Vehicle:	2020 KIA Stinger GT-Line four door sedan	NHTSA No.:	M20204215
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	4/21/2020

VEHICLE INFORMATION

VIN:	KNAE15LA7L6074115	Wheelbase (mm):	2907
Vehicle Size Category:	Passenger Car	Test Weight (kg):	1,977

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):	56.26
Velocity Change (km/h):	65.55
Time of Separation (ms):	131



CRUSH PROFILE

Collision Deformation Classification:	12FDEW3
Midpoint of Damage:	C3
Damage Region Length (mm):	1436
Impact Mode:	Frontal

No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
C1	Crush Zone 1 at Left Side	mm	4584	4196	388
C2	Crush Zone 2 at Left Side	mm	4777	4247	530
C3	Crush Zone 3 at Left Side	mm	4825	4242	583
C4	Crush Zone 4 at Right Side	mm	4825	4245	580
C5	Crush Zone 5 at Right Side	mm	4780	4247	533
C6	Crush Zone 6 at Right Side	mm	4586	4245	341
L	C1 to C6	mm	1436	1280	156

DATA SHEET NO. 14
VEHICLE INTRUSION MEASUREMENTS

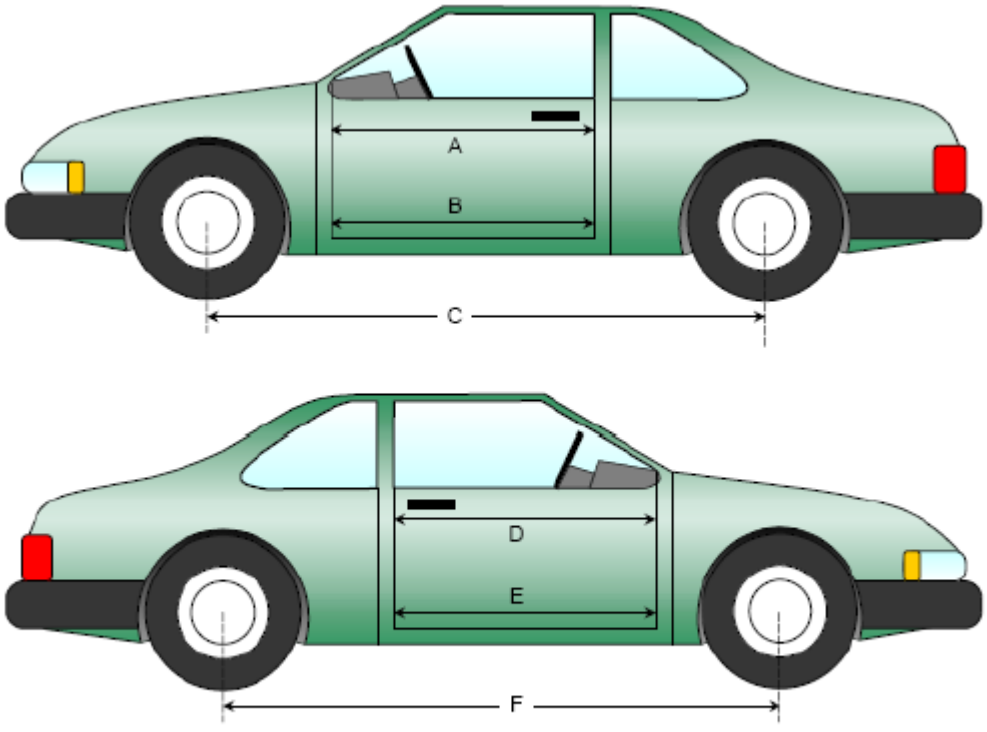
Test Vehicle: 2020 KIA Stinger GT-Line four door sedan
NHTSA No.: M20204215
Test Program: NCAP Frontal Barrier Impact Test
Test Date: 4/21/2020

DOOR OPENING WIDTH

Item	Description	Units	Pre-Test	Post-Test	Difference
A	Left Side Upper	mm	972	971	-1
B	Left Side Lower	mm	902	901	-1
D	Right Side Upper	mm	972	973	1
E	Right Side Lower	mm	904	904	0

WHEELBASE MEASUREMENTS

Item	Description	Units	Pre-Test	Post-Test	Difference
C	Left Side Wheelbase	mm	2907	2843	-64
F	Right Side Wheelbase	mm	2907	2856	-51



Left & Right Side Views

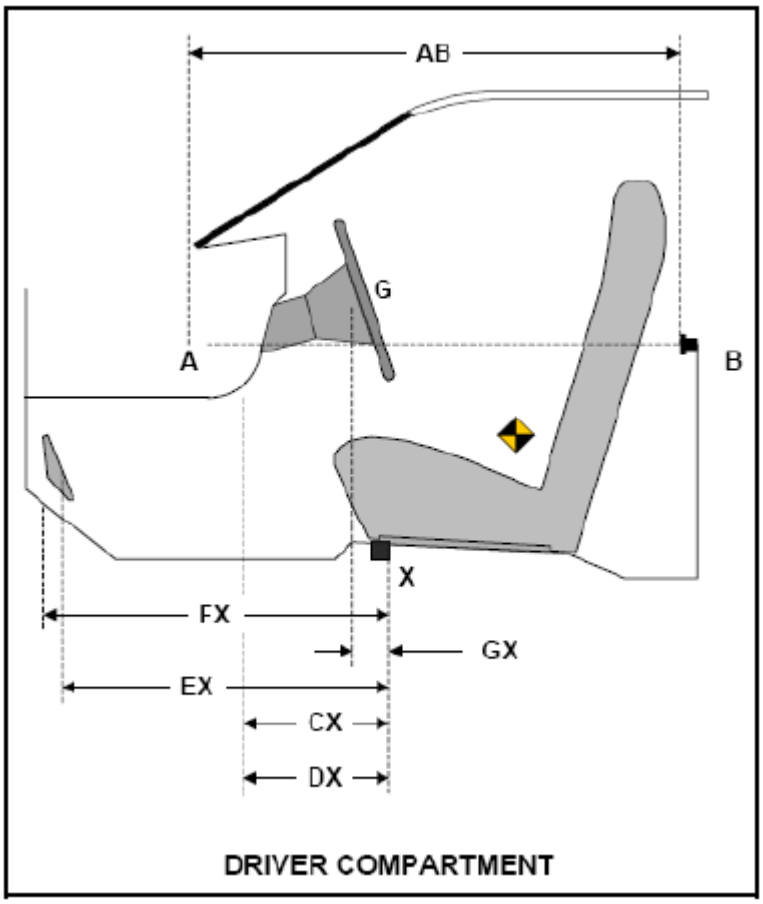
DATA SHEET NO.14 … (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2020 KIA Stinger GT-Line four door sedan NHTSA No.: M20204215
Test Program: NCAP Frontal Barrier Impact Test Test Date: 4/21/2020

DRIVER COMPARTMENT INTRUSION

Item	Description	Units	Pre-Test	Post-Test	Difference
AB	Door Opening (Inside Window Jam)	mm	717	715	-2
CX	Left Knee Bolster to X	mm	288	286	-2
DX	Right Knee Bolster to X	mm	272	270	-2
EX	Brake Pedal to X	mm	593	579	-14
FX	Foot Rest to X	mm	610	608	-2
GX	Center of Steering Column Wheel Hub to X	mm	39	77	38

X = Front of Seat Track (Stationary)



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

Test Vehicle: 2020 KIA Stinger GT-Line four door sedan NHTSA No.: M20204215
Test Program: NCAP Frontal Barrier Impact Test Test Date: 4/21/2020

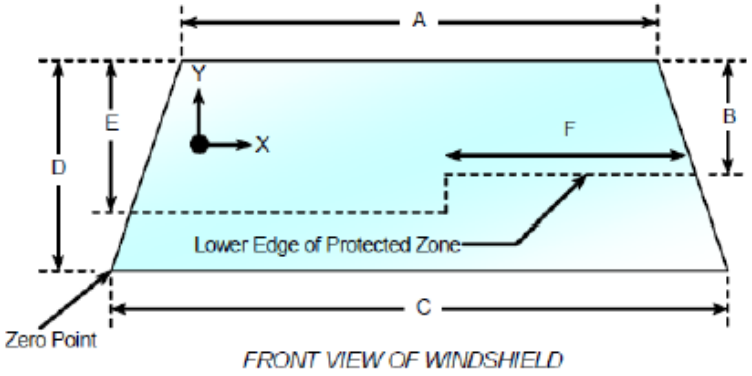
Windshield Mounting Details: A 0.8 mm trim surrounds the top and side of windshield while a plastic shroud is on the bottom.

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	2186.5	2186.5	100
Right Side	2186.5	2186.5	100
Total	4373	4373	100



FRONT VIEW OF WINDSHIELD

Item	Units	Value
A	mm	1233
B	mm	458
C	mm	1500
D	mm	820
E	mm	491
F	mm	545

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:	2020 KIA Stinger GT-Line four door sedan	NHTSA No.:	M20204215
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	4/21/2020

FMVSS 301 FUEL SYSTEM INTEGRITY POST IMPACT DATA

Temperature at Time of Impact: 21 ° C Test Time: 10:00 AM

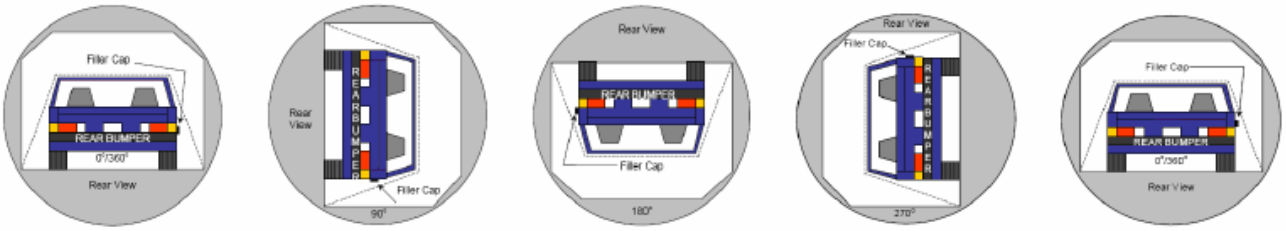
STODDARD SOLVENT SPILLAGE MEASUREMENTS

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

D. Spillage: No Spillage Occurred

DATA SHEET NO. 16
FMVSS 301 STATIC ROLLOVER RESULTS

Test Vehicle: 2020 KIA Stinger GT-Line four door sedan
NHTSA No.: M20204215
Test Program: NCAP Frontal Barrier Impact Test
Test Date: 4/21/2020



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°	69	300	369
90° to 180°	65	300	365
180° to 270°	63	300	363
270° to 360°	65	300	365

FMVSS 301 SPILLAGE TABLE

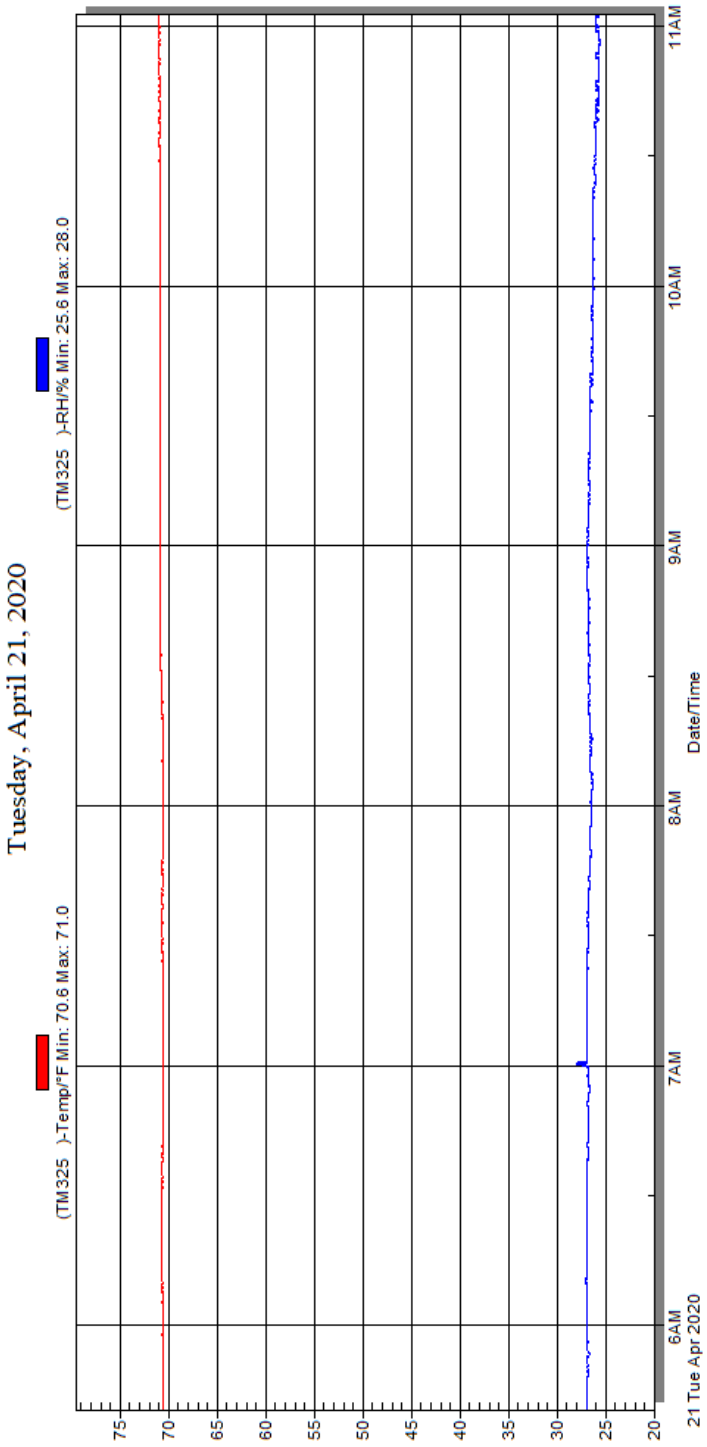
Test Phase	First 5 Minutes	Sixth Minute	Seventh Minute	Eighth Minute
0° to 90°	0	0	0	
90° to 180°	0	0	0	
180° to 270°	0	0	0	
270° to 360°	0	0	0	

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:	2020 KIA Stinger GT-Line four door sedan	NHTSA No.:	M20204215
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	4/21/2020



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.*

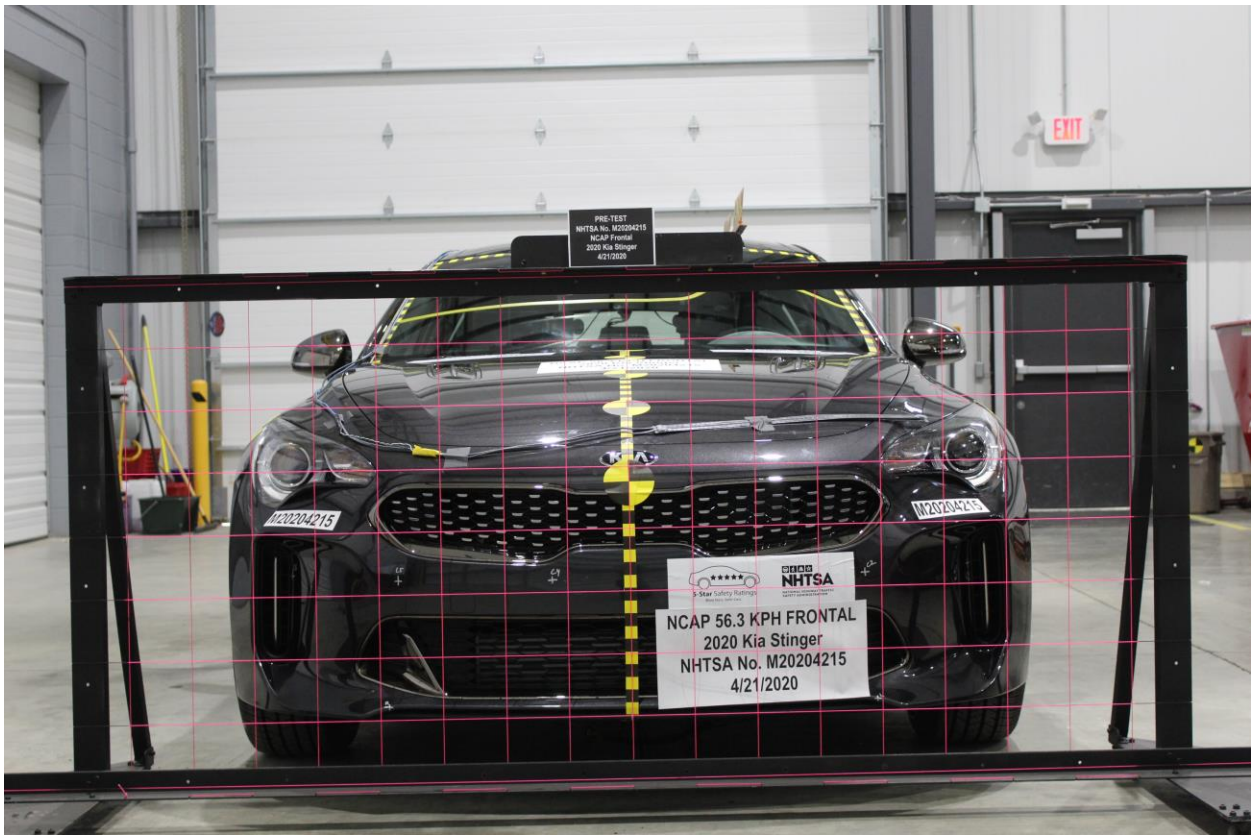


Figure A-1: Load Cell Location

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: 2020 KIA Stinger Frontal As Delivered

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

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

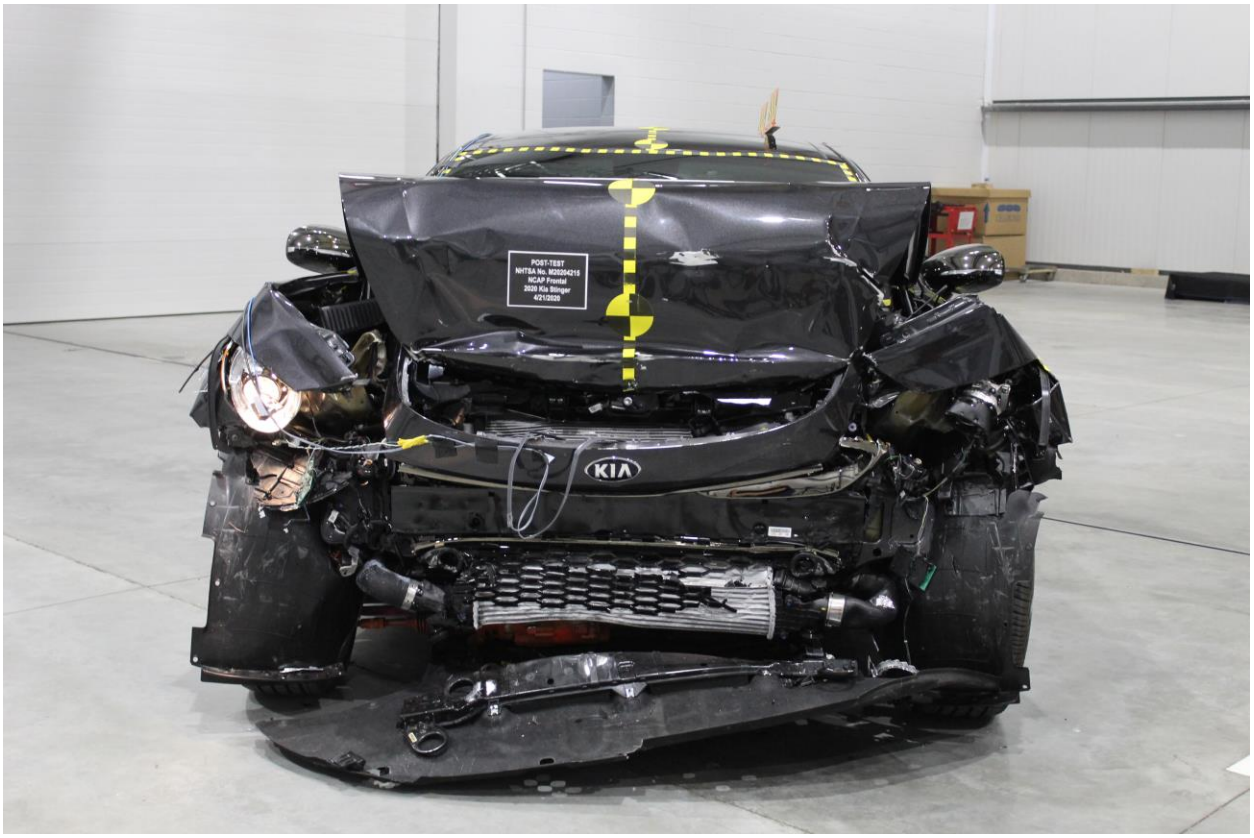


Figure A-9: Post-Test Front View of Test Vehicle

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

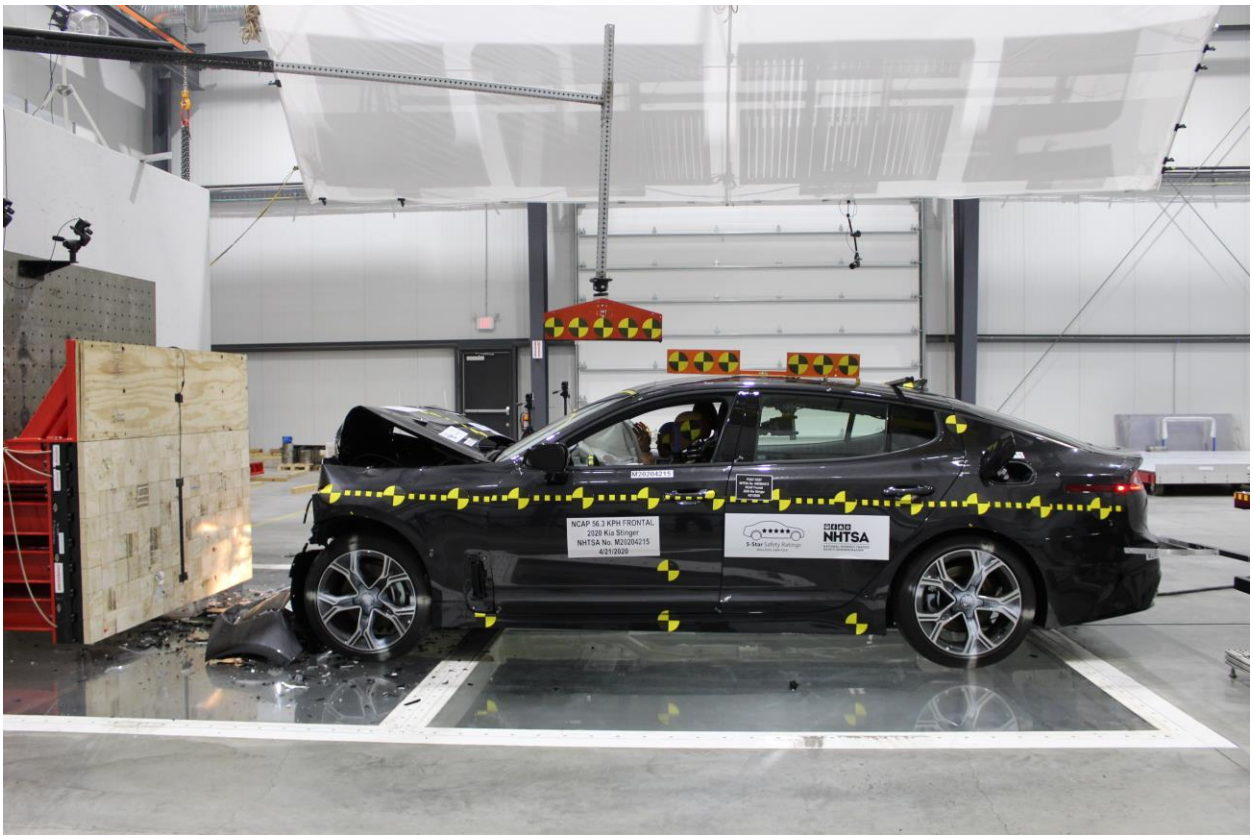


Figure A-11: Post-Test Left View of Test Vehicle

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

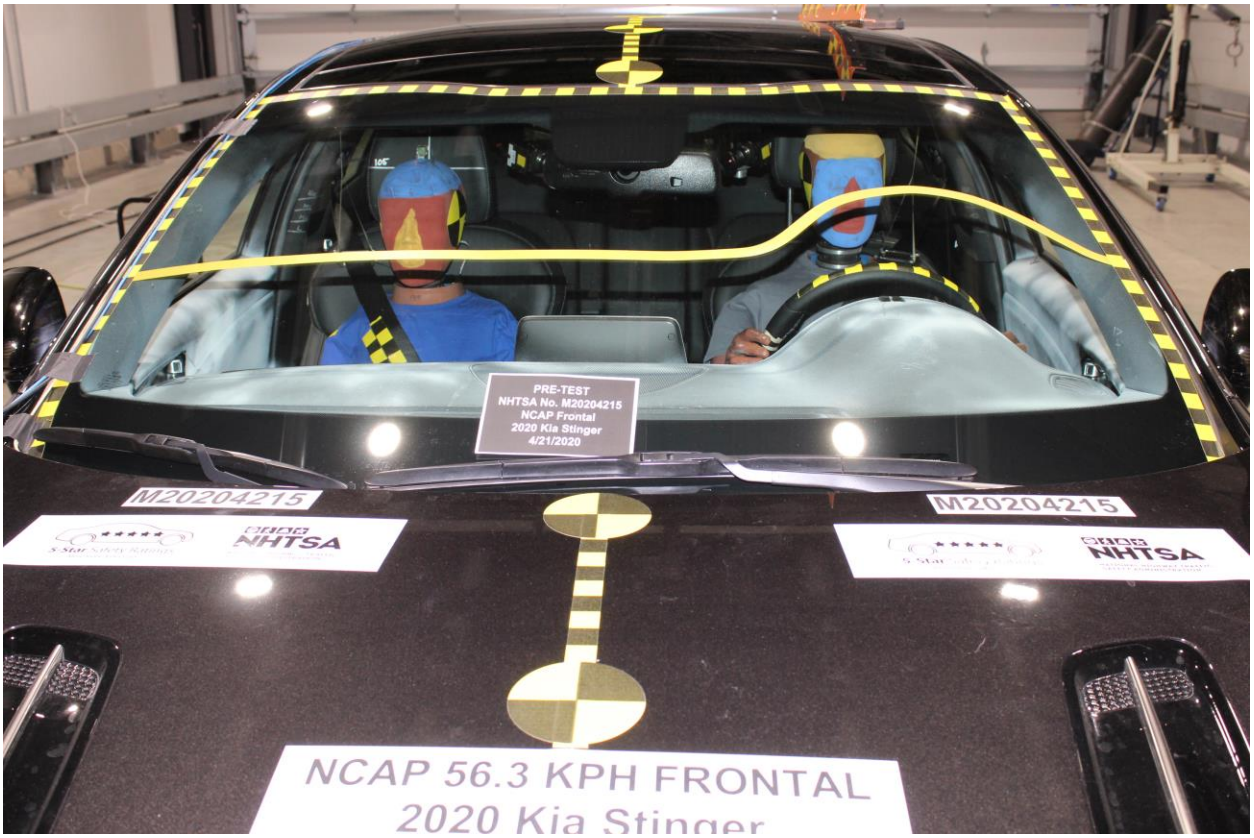


Figure A-18: Pre-Test Windshield View

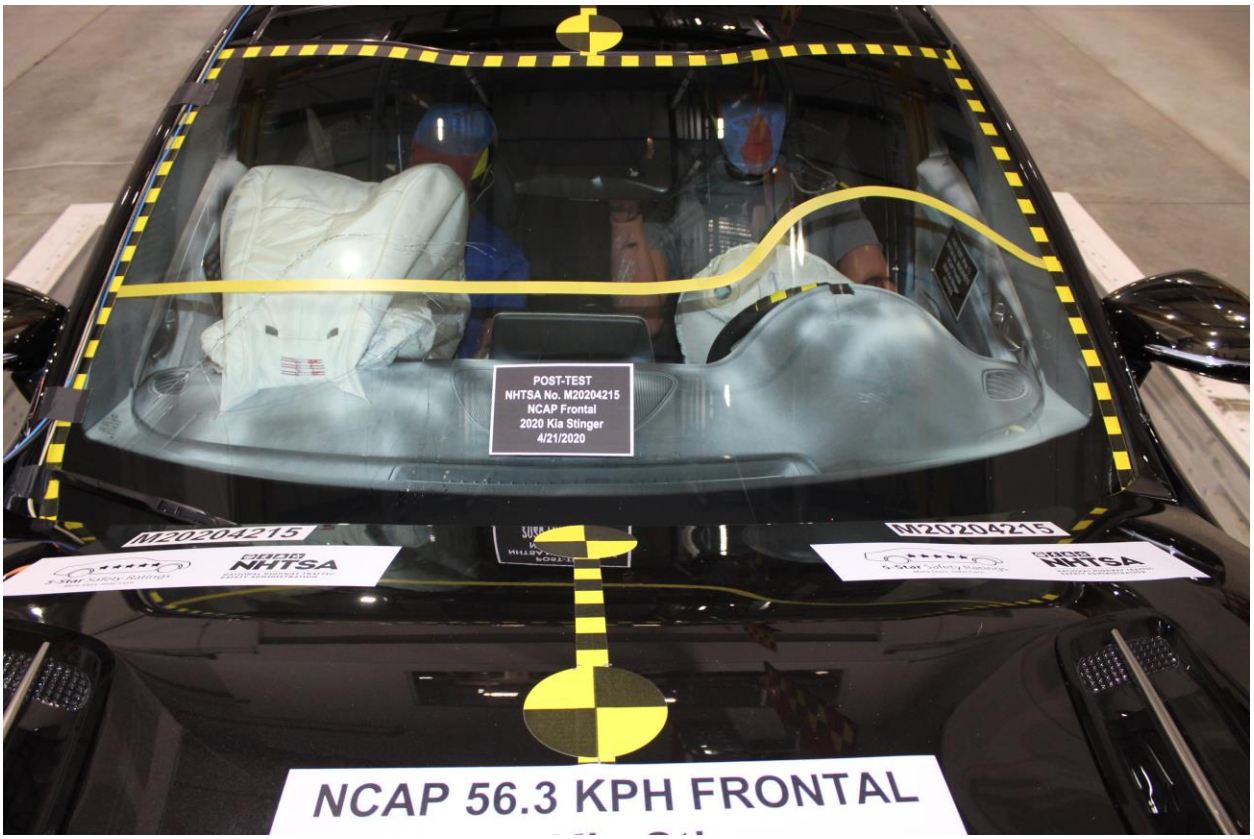


Figure A-19: Post-Test Windshield View

Figure A-20: Pre-Test Engine Compartment View

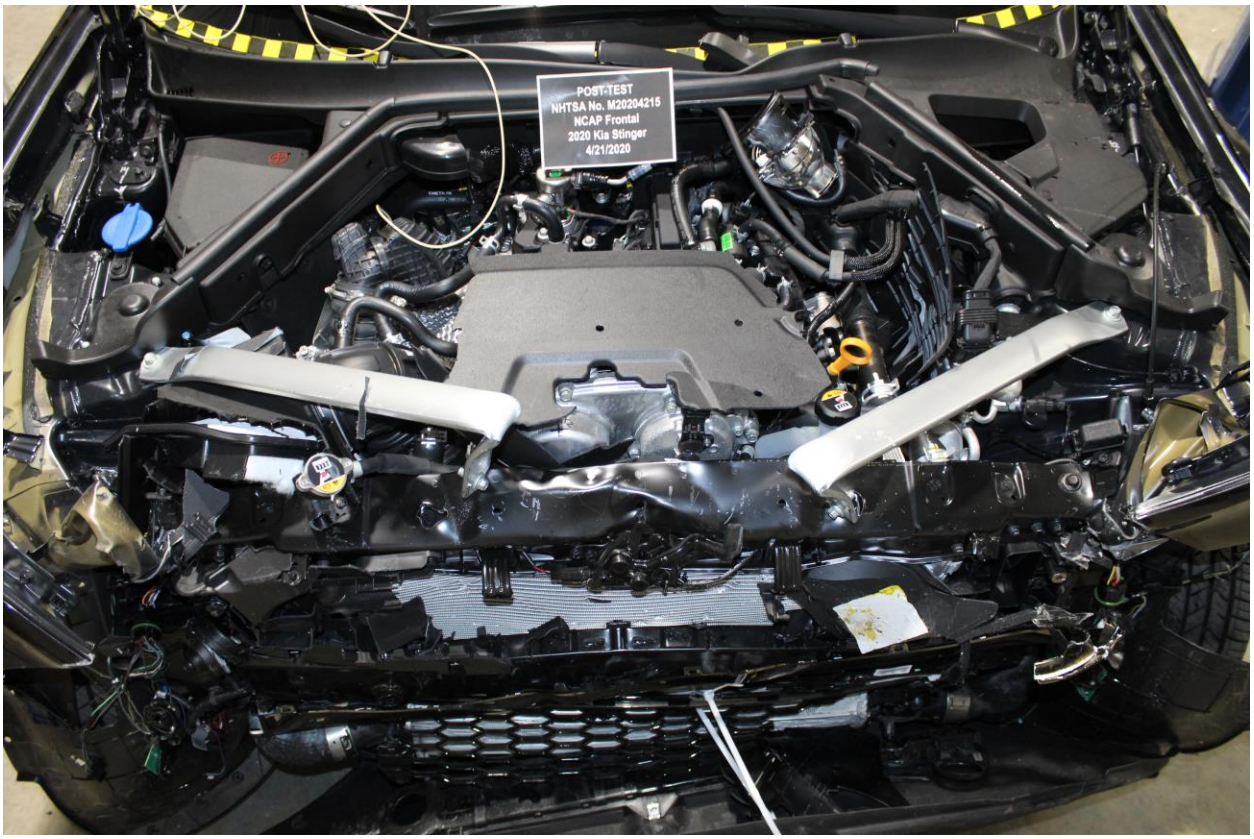


Figure A-21: Post-Test Engine Compartment View

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

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

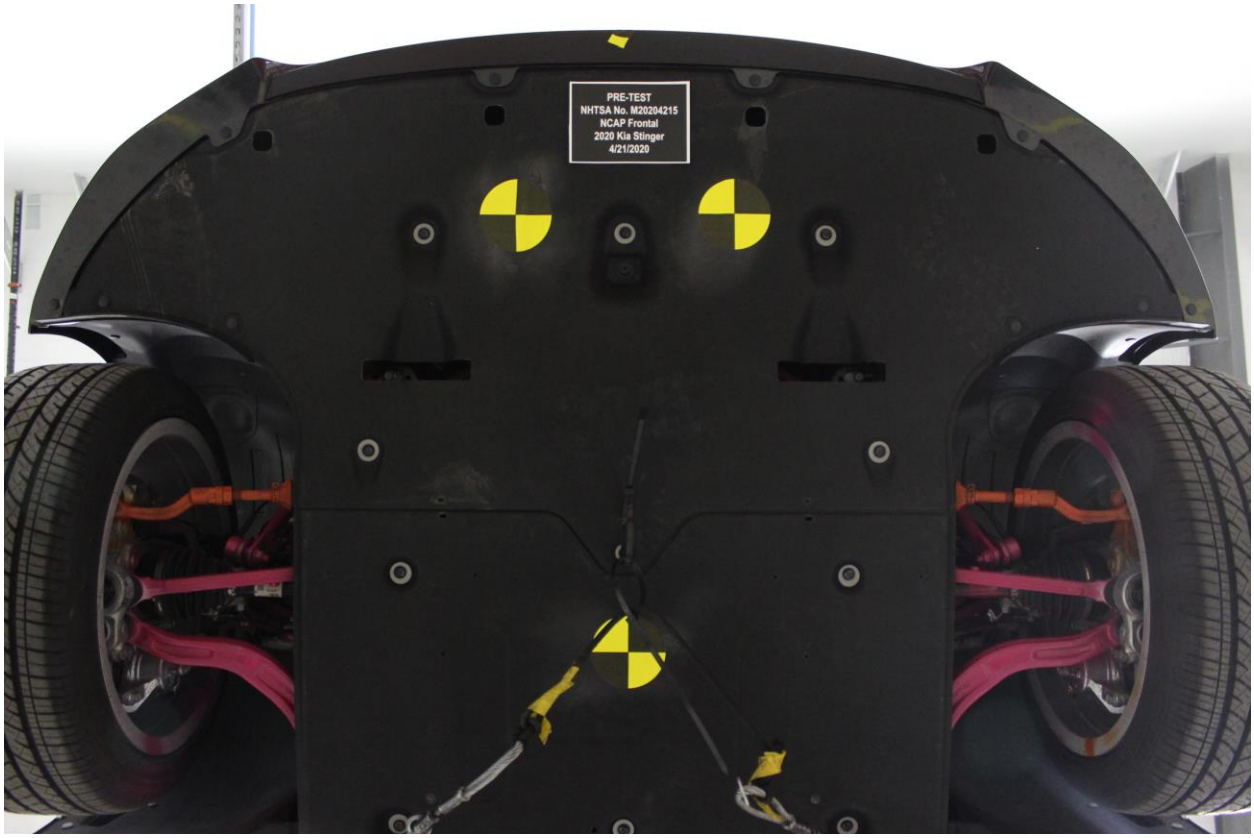


Figure A-24: Pre-Test Front Underbody View

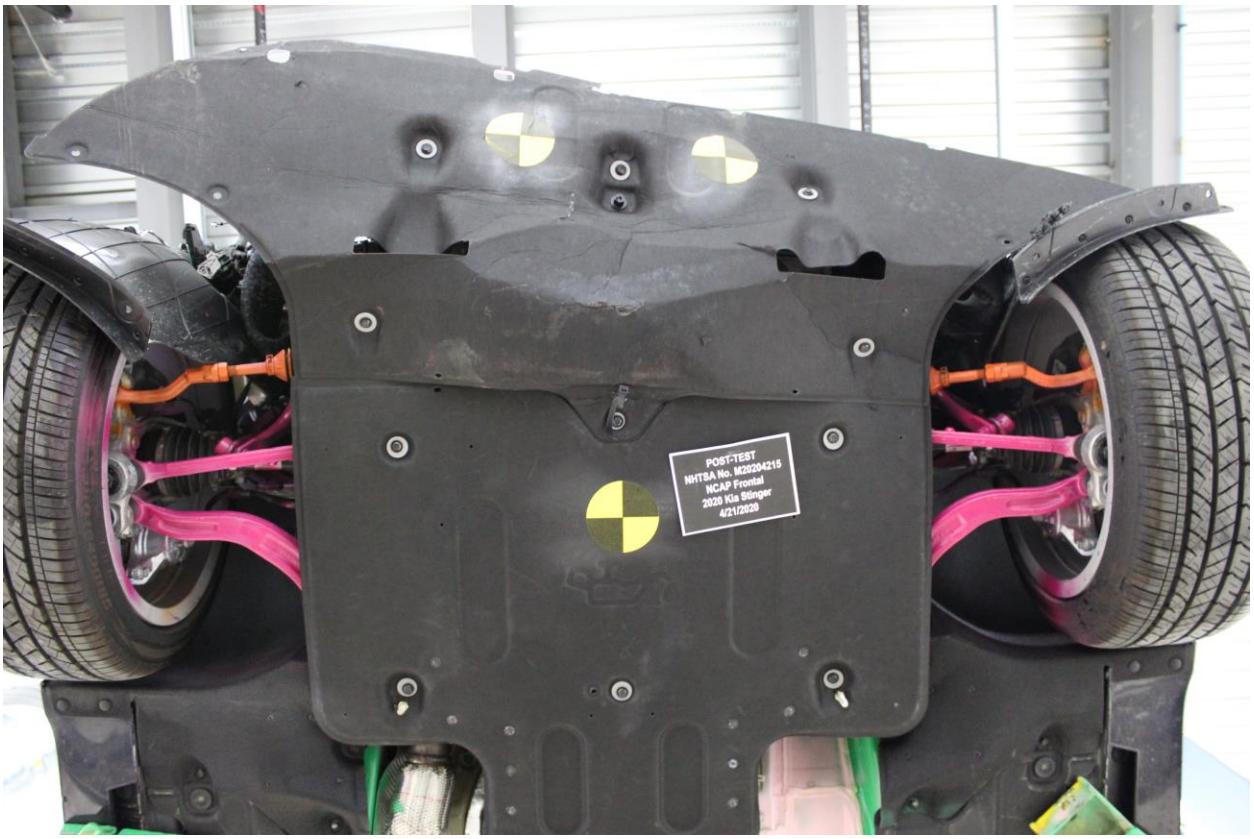


Figure A-25: Post-Test Front Underbody View

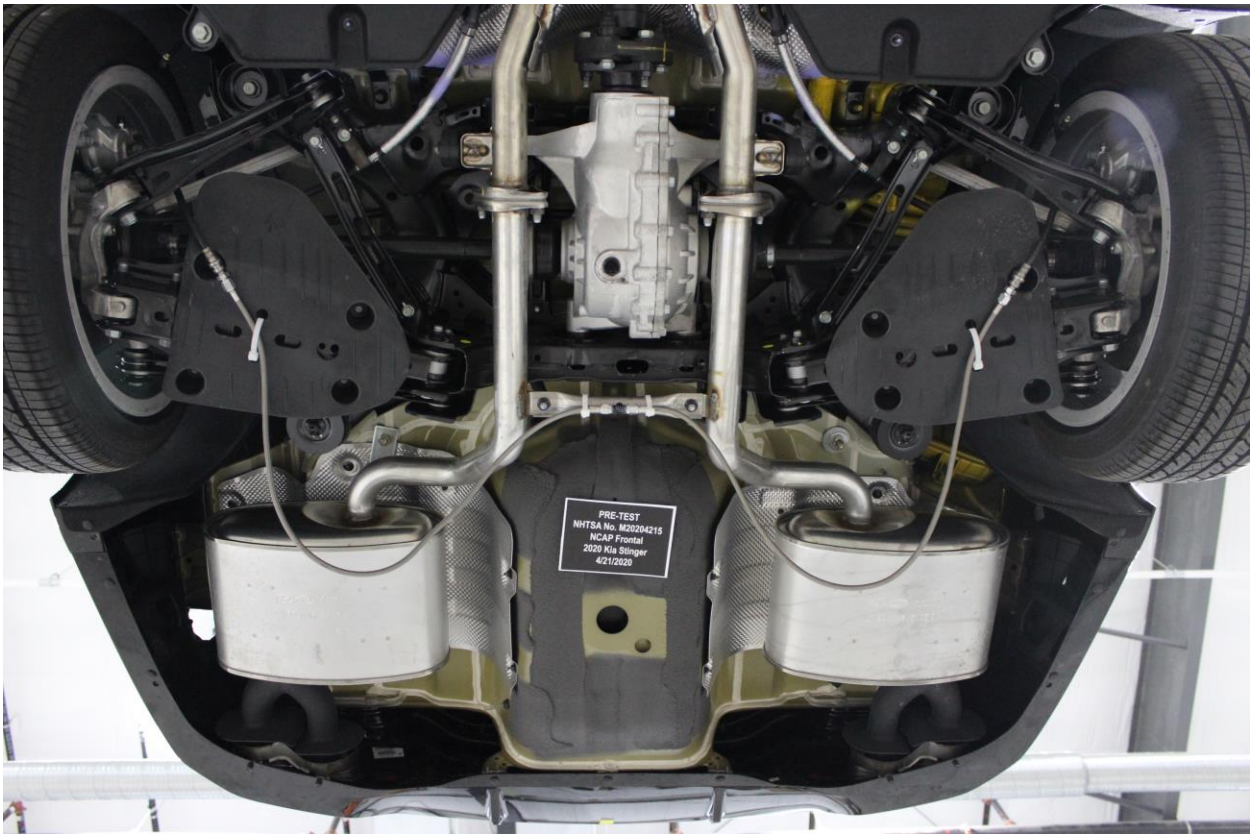


Figure A-26: Pre-Test Rear Underbody View

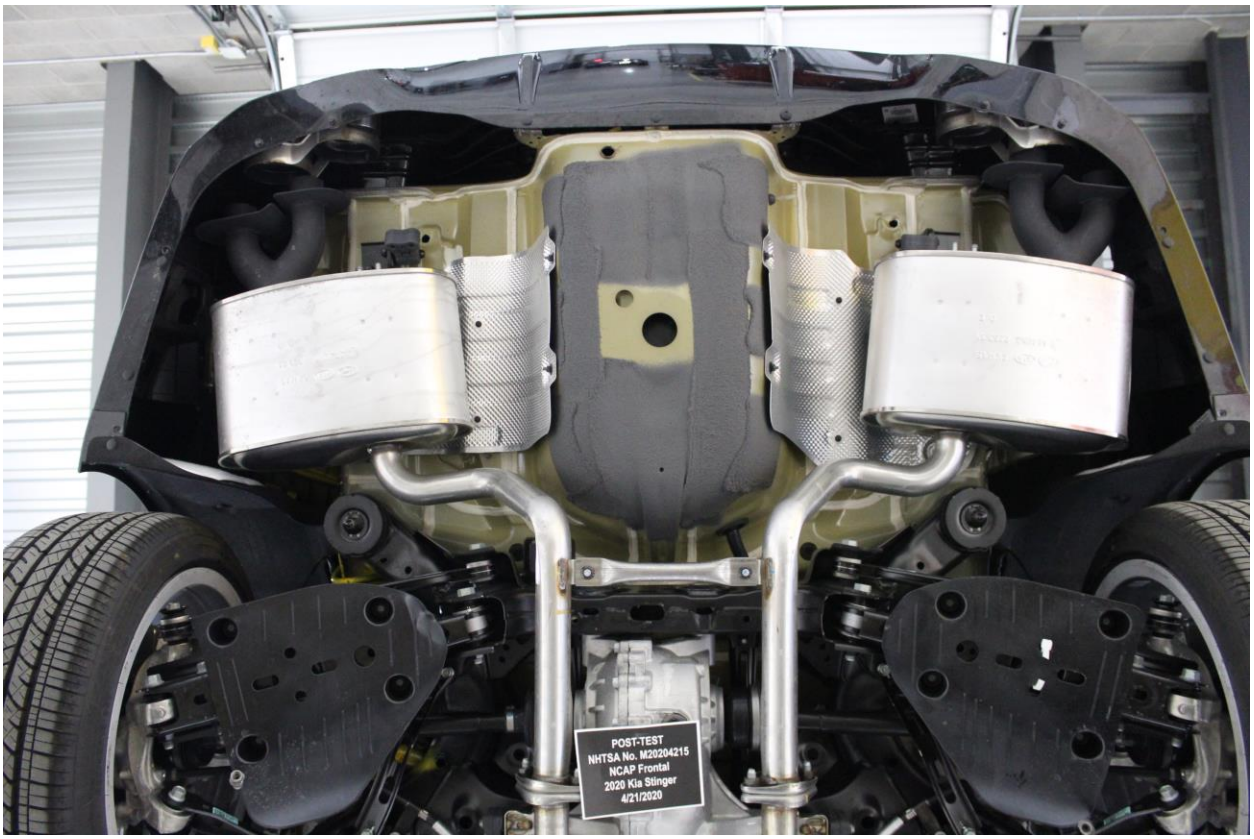


Figure A-27: Post-Test Rear Underbody View

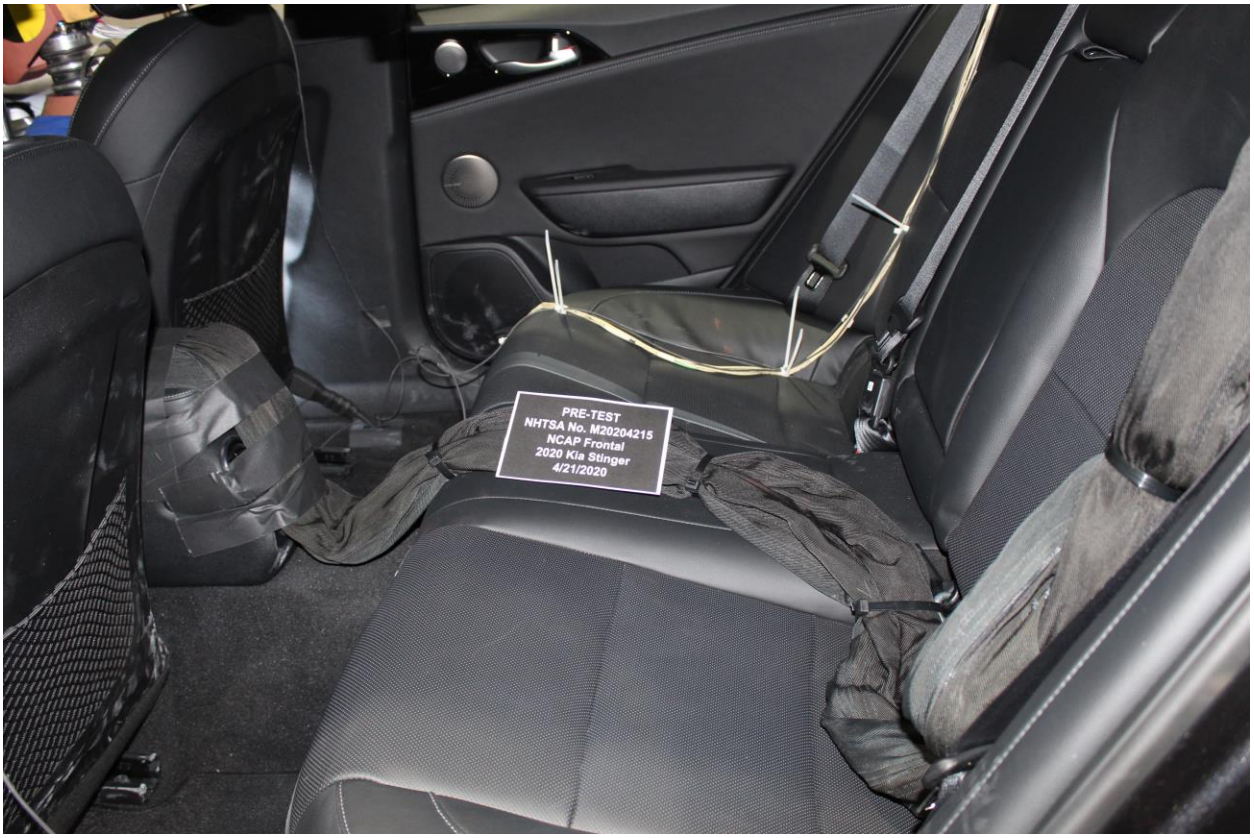


Figure A-28: Pre-Test Dummy Cable Routing

Figure A-29: Post-Test Dummy Cable Routing

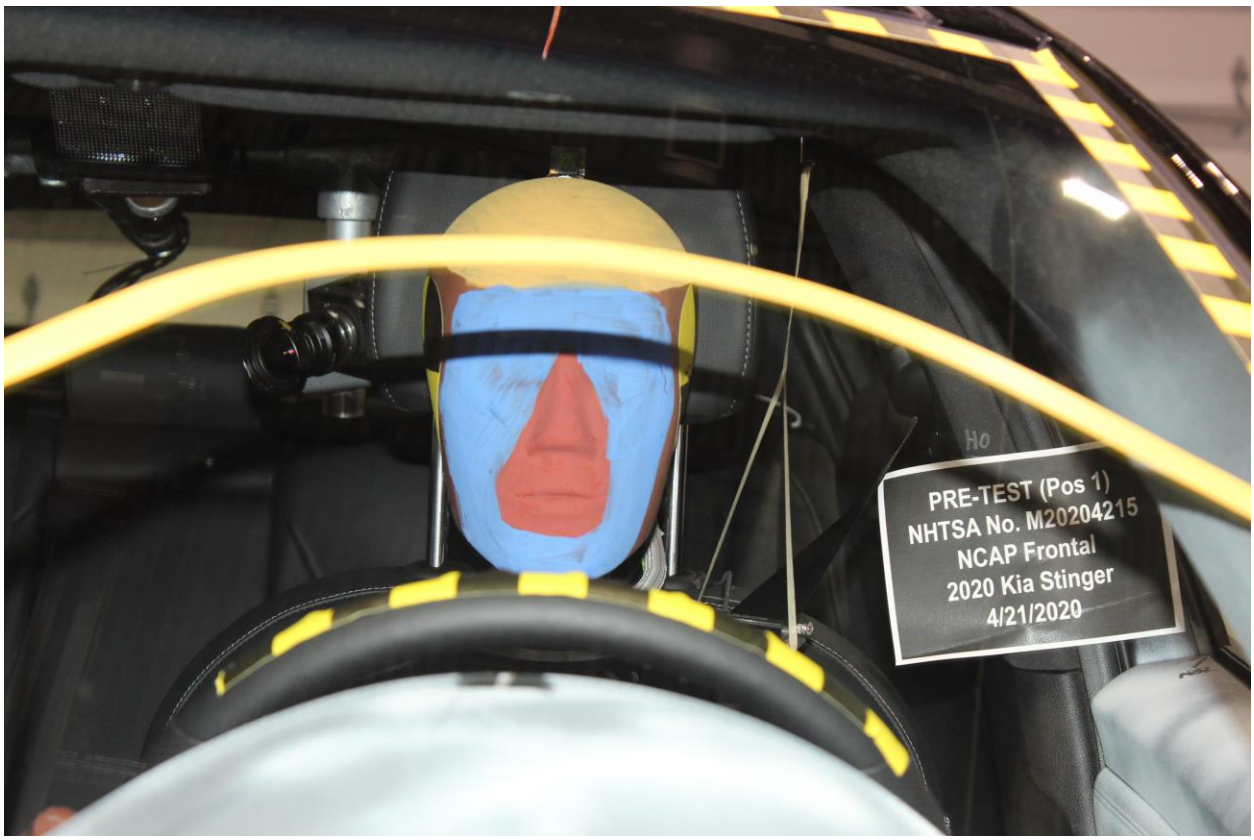


Figure A-30: Pre-Test Driver Dummy Front View

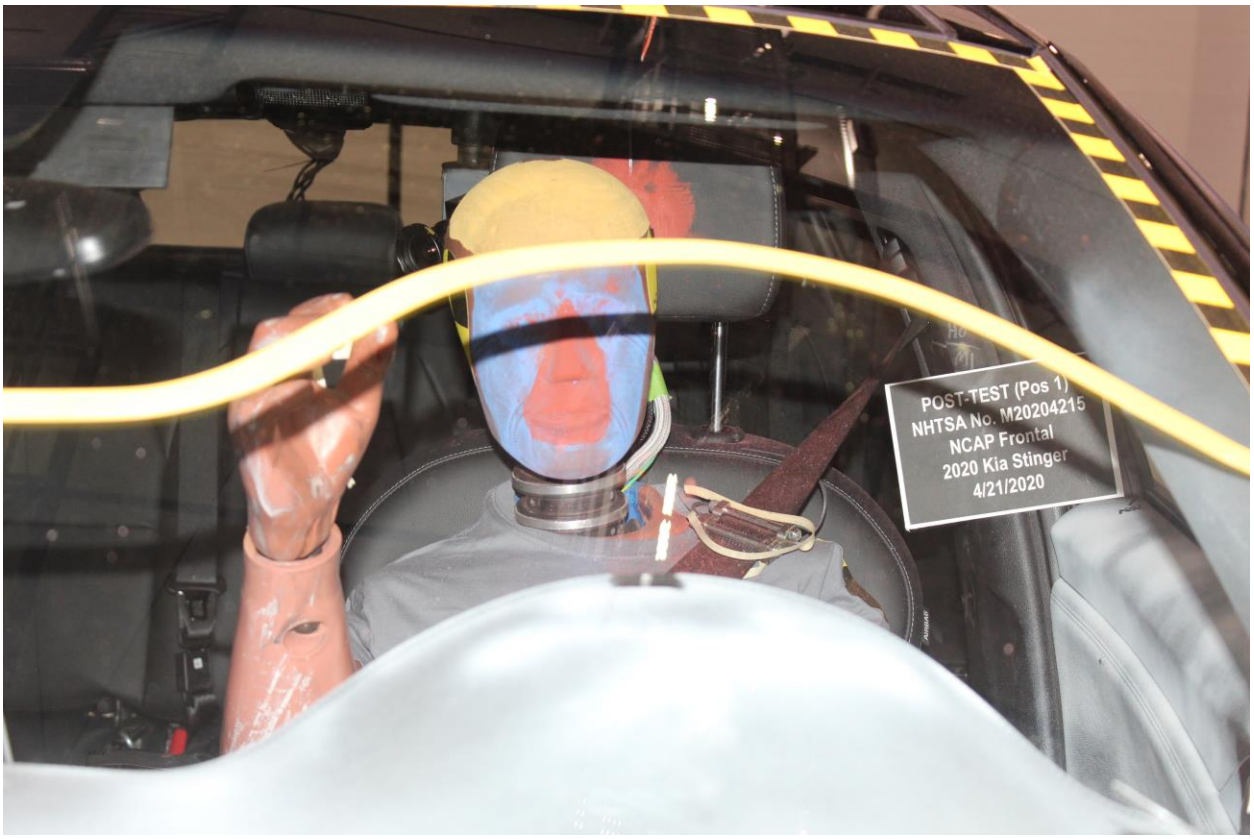


Figure A-31: Post-Test Driver Dummy Front View

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

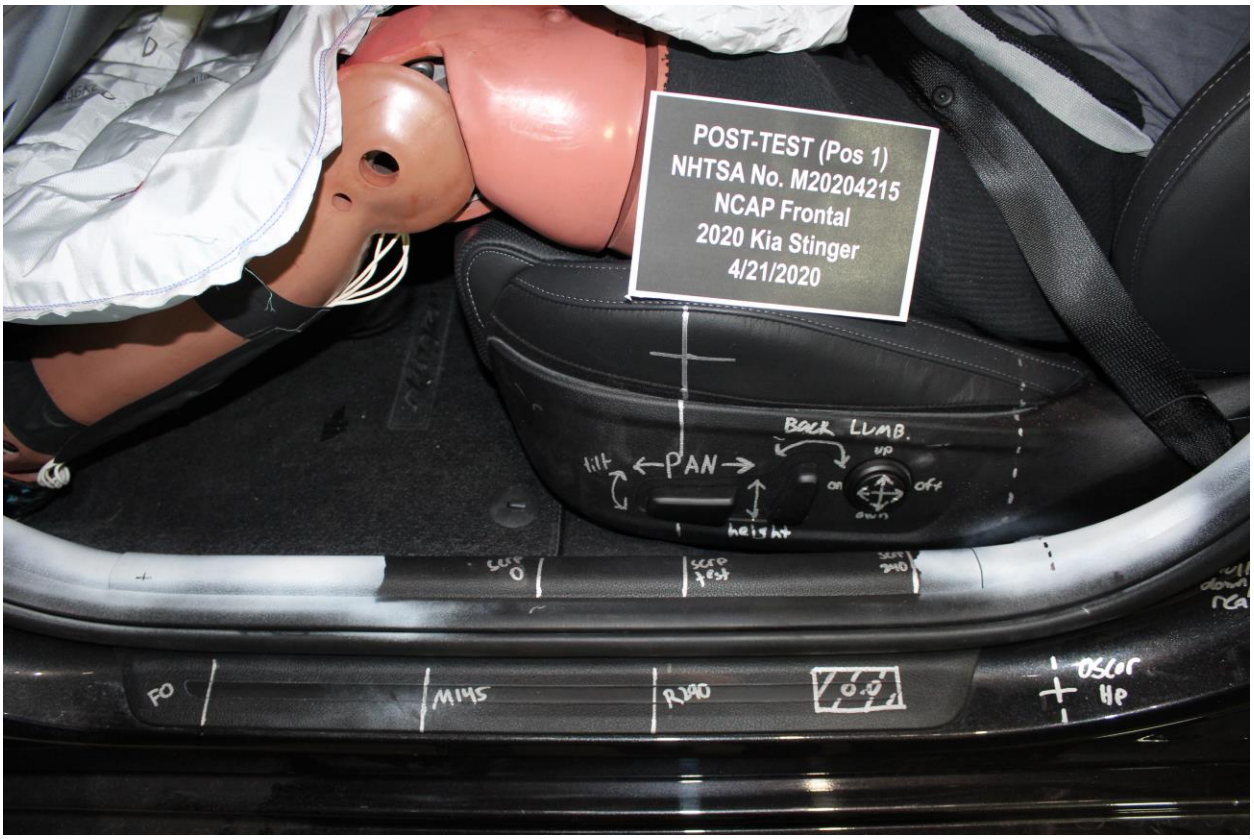


Figure A-37: Post-Test Driver's Seat Fore-Aft Markings

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

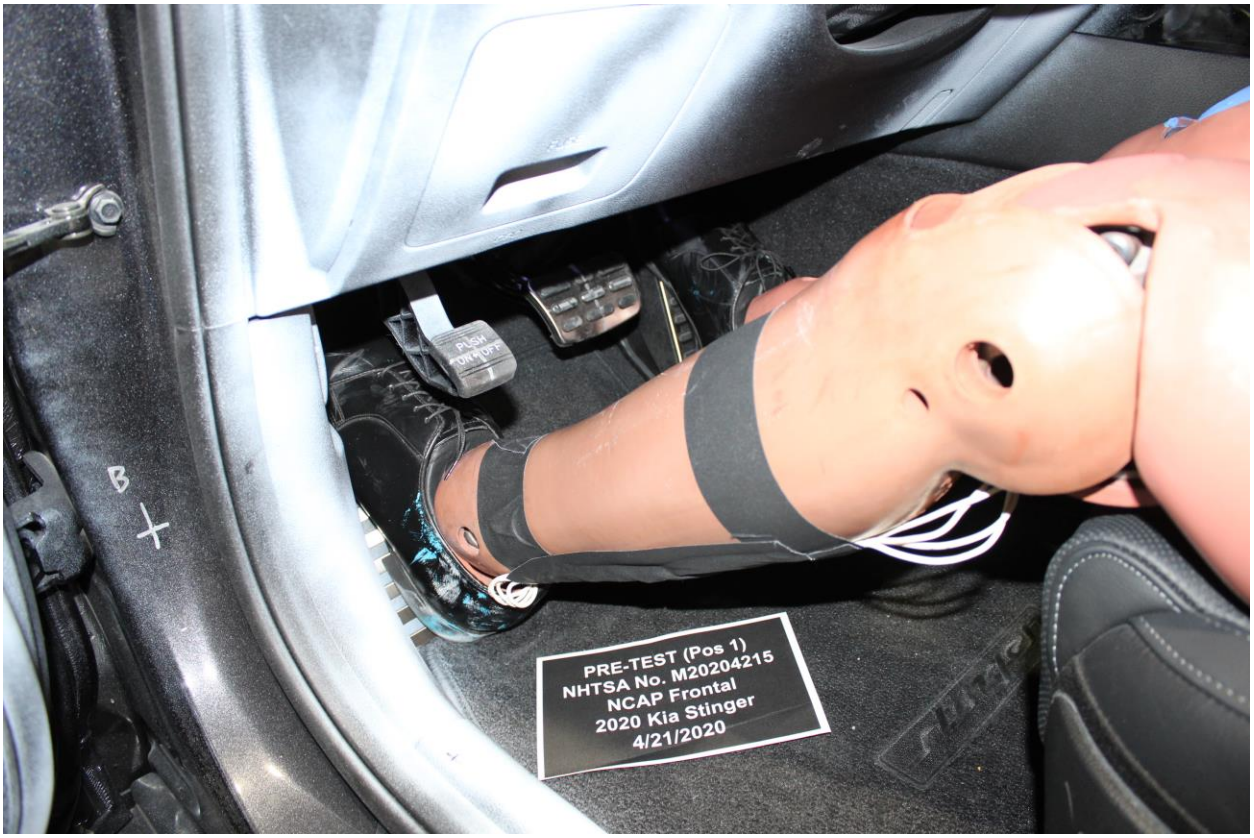


Figure A-42: Pre-Test Driver Dummy Feet

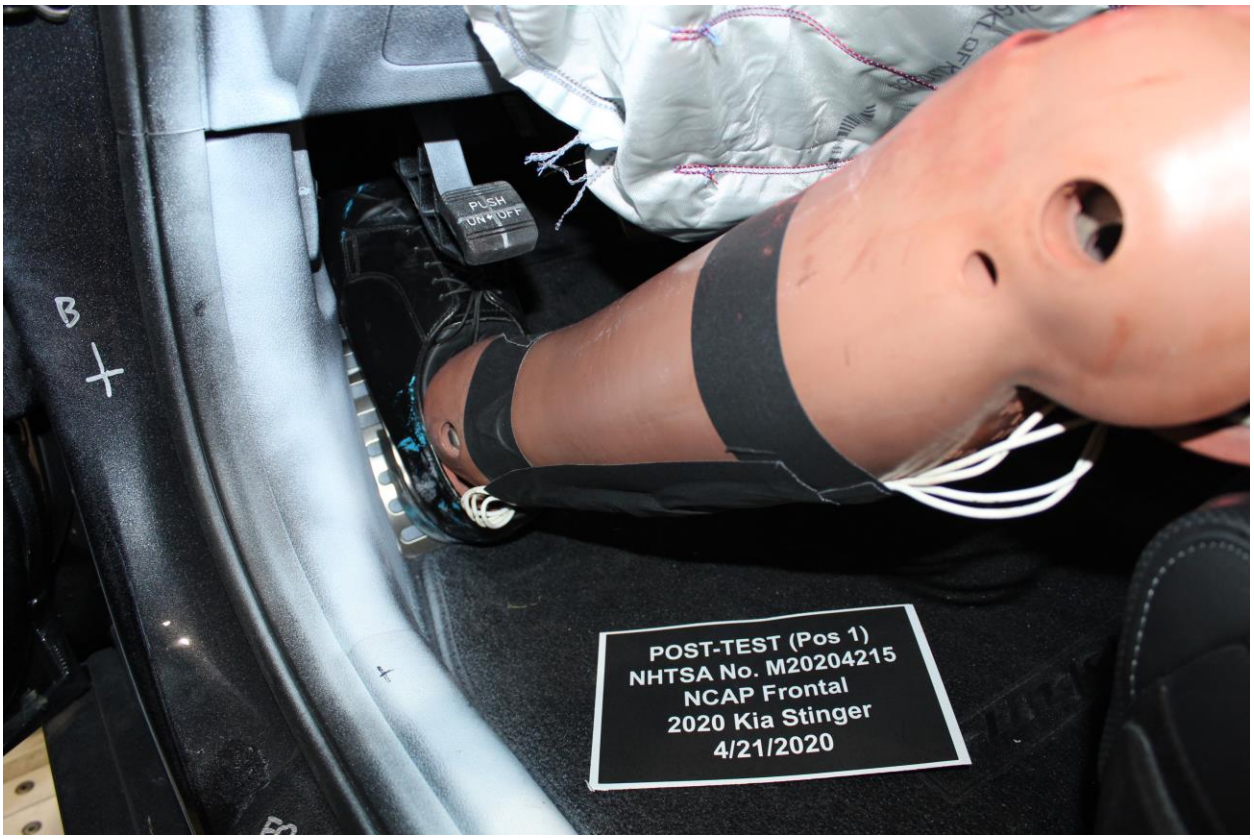


Figure A-43: Post-Test Driver Dummy Feet

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

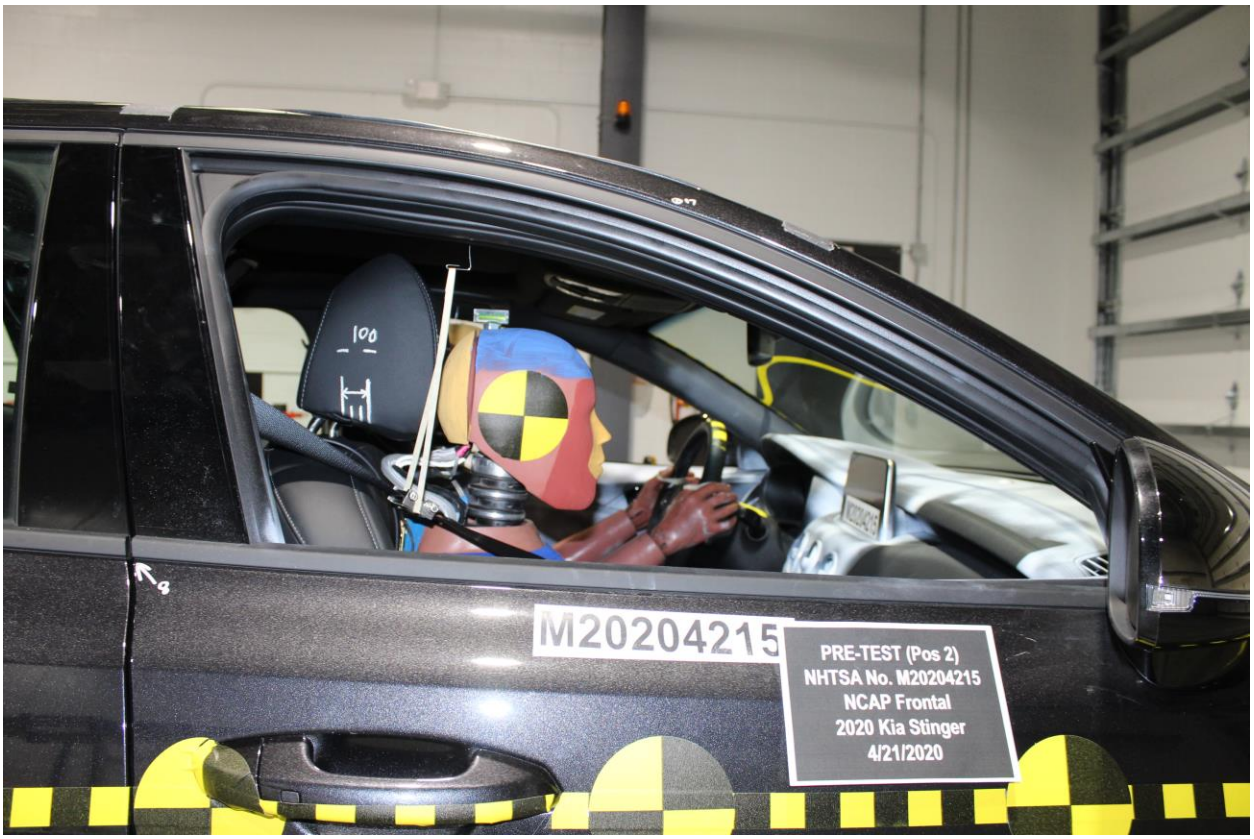


Figure A-55: Pre-Test Passenger Dummy Window View

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

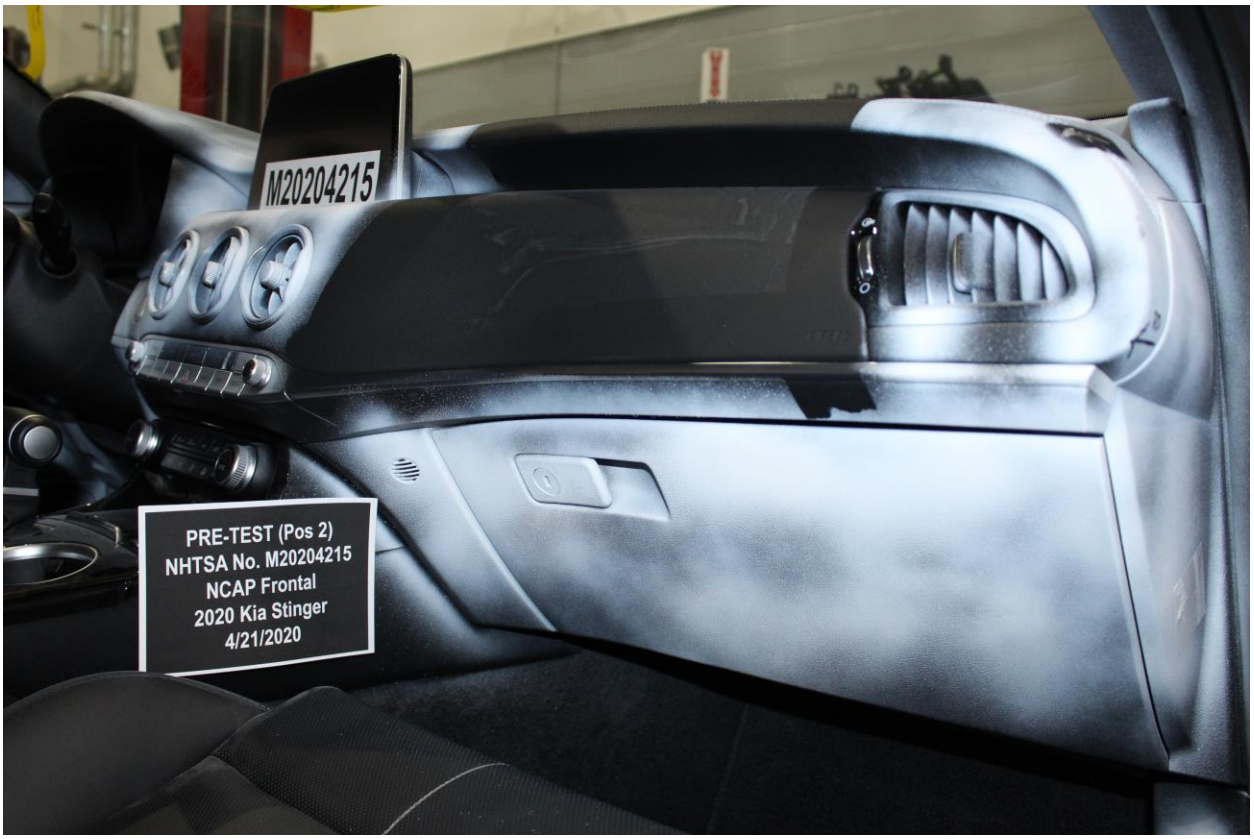


Figure A-67: Pre-Test Passenger's Side Knee Bolster

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

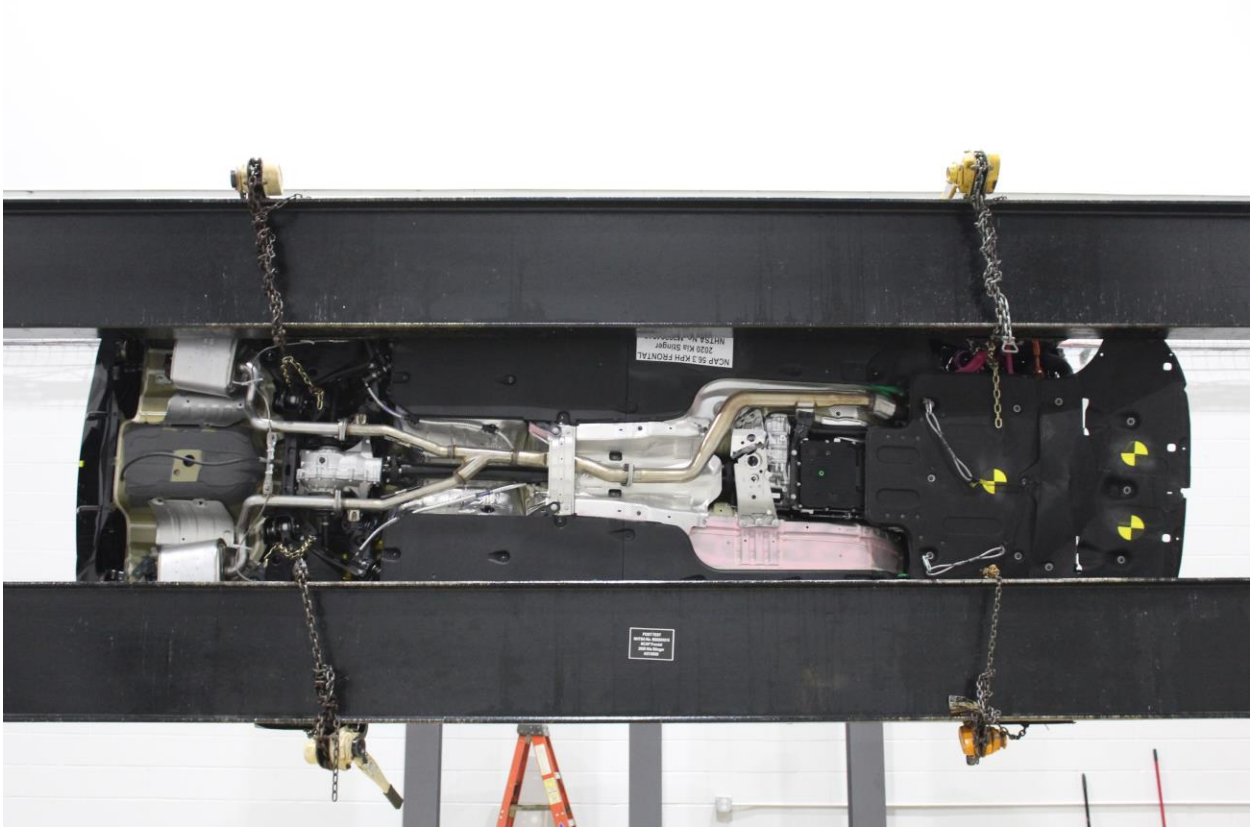


Figure A-78: Vehicle at 90º on Static Rollover Device

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

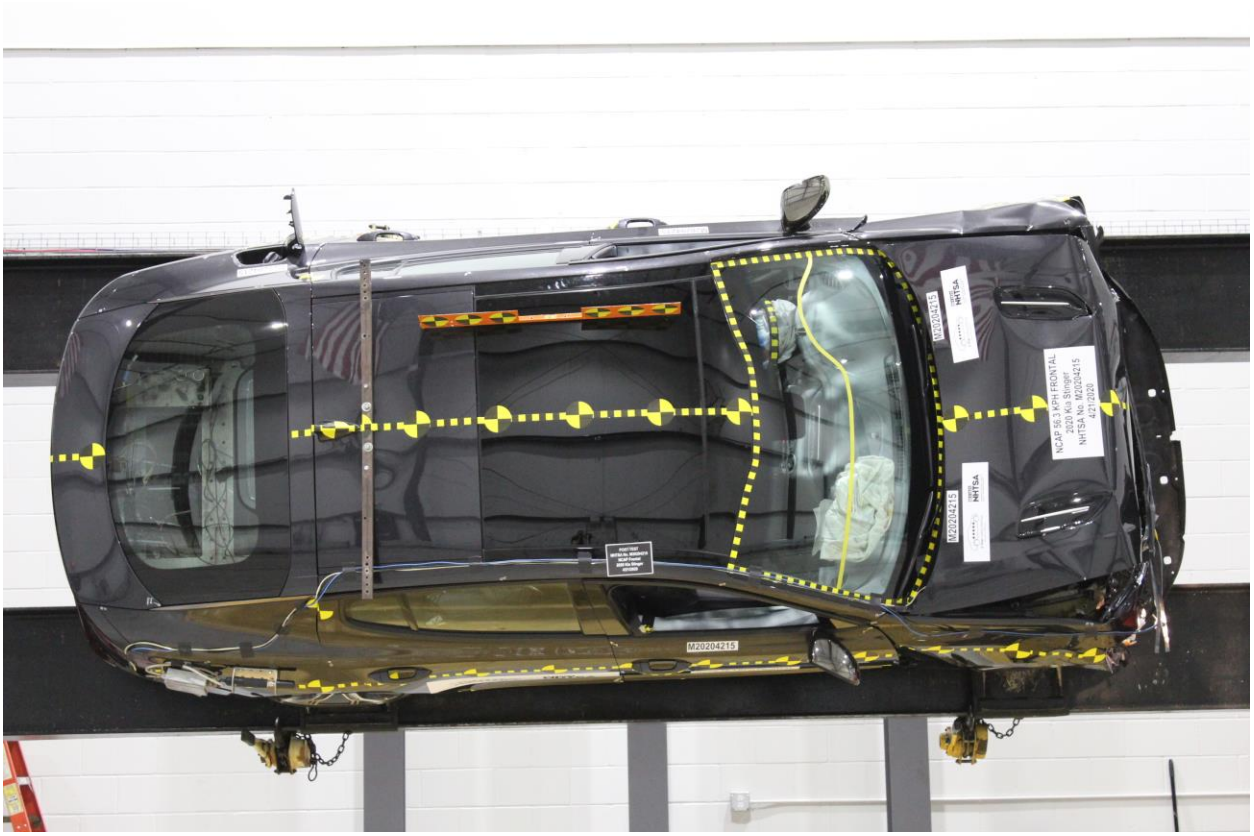
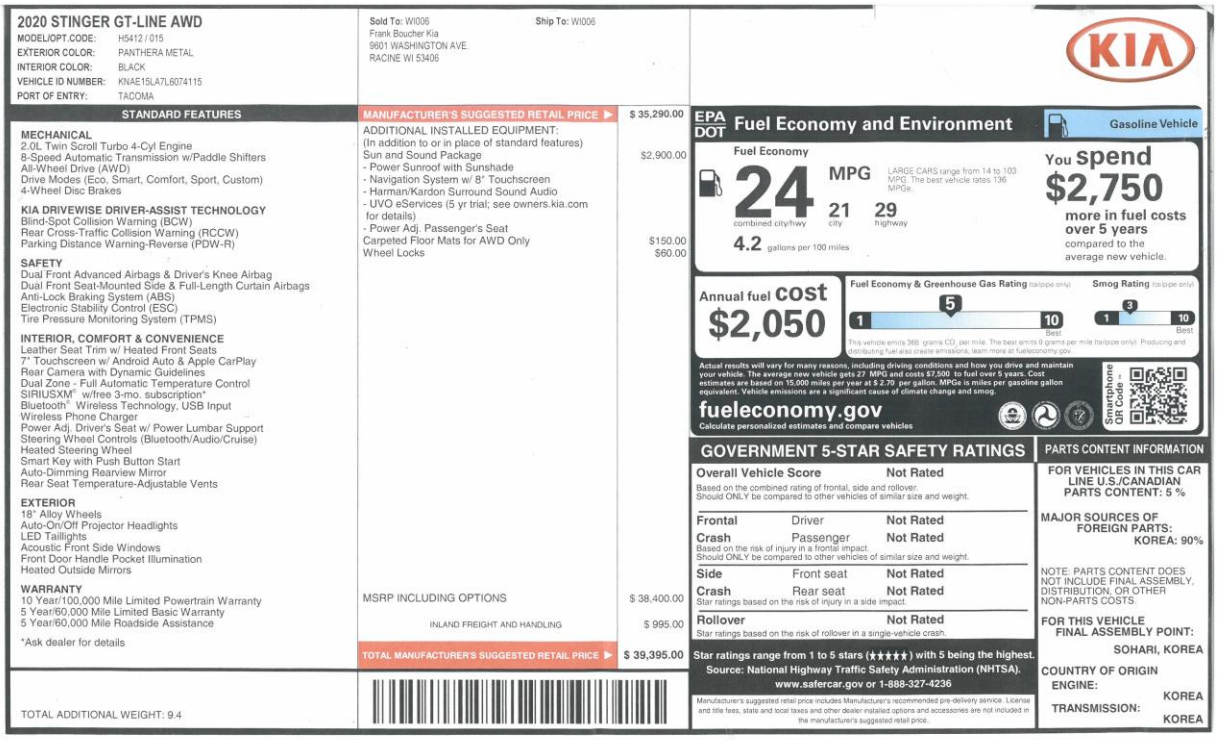


Figure A-80: Vehicle at 270º on Static Rollover Device

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

Figure A-82: 2020 KIA Stinger Frontal Impact Event



2020 STINGER GT-LINE AWD
MODEL/OPT.CODE: H5412 / 015
EXTERIOR COLOR: PANTHERA METAL
INTERIOR COLOR: BLACK
VEHICLE ID NUMBER: KNAE15LA7L6074115
PORT OF ENTRY: TACOMA

Sold To: WI006
Frank Boucher Kia
9601 WASHINGTON AVE.
RACINE WI 53406

Ship To: WI006

STANDARD FEATURES

MECHANICAL
2.0L Twin Scroll Turbo 4-Cyl Engine
8-Speed Automatic Transmission w/Paddle Shifters
All-Wheel Drive (AWD)
Drive Modes (Eco, Smart, Comfort, Sport, Custom)
4-Wheel Disc Brakes

KIA DRIVEWISE DRIVER-ASSIST TECHNOLOGY
Blind-Spot Collision Warning (BCW)
Rear Cross-Traffic Collision Warning (RCCW)
Parking Distance Warning-Reverse (PDW-R)

SAFETY
Dual Front Advanced Airbags & Driver's Knee Airbag
Dual Front Seat-Mounted Side & Full-Length Curtain Airbags
Anti-Lock Braking System (ABS)
Electronic Stability Control (ESC)
Tire Pressure Monitoring System (TPMS)

INTERIOR, COMFORT & CONVENIENCE
Leather Seat Trim w/ Heated Front Seats
7" Touchscreen w/ Android Auto & Apple CarPlay
Rear Camera with Dynamic Guidelines
Dual Zone - Full Automatic Temperature Control
SIRIUSXM® w/free 3-mo. subscription*
Bluetooth® Wireless Technology, USB Input
Wireless Phone Charger
Power Adj. Driver's Seat w/ Power Lumbar Support
Steering Wheel Controls (Bluetooth/Audio/Cruise)
Heated Steering Wheel
Smart Key with Push Button Start
Auto-Dimming Rearview Mirror
Rear Seat Temperature-Adjustable Vents

EXTERIOR
18" Alloy Wheels
Auto-On/Off Projector Headlights
LED Taillights
Acoustic Front Side Windows
Front Door Handle Pocket Illumination
Heated Outside Mirrors

WARRANTY
10 Year/100,000 Mile Limited Powertrain Warranty
5 Year/60,000 Mile Limited Basic Warranty
5 Year/60,000 Mile Roadside Assistance
*Ask dealer for details

TOTAL ADDITIONAL WEIGHT: 9.4

MANUFACTURER'S SUGGESTED RETAIL PRICE ▶	$ 35,290.00
ADDITIONAL INSTALLED EQUIPMENT: (In addition to or in place of standard features)	
Sun and Sound Package	$2,900.00
- Power Sunroof with Sunshade	
- Navigation System w/ 8" Touchscreen	
- Harman/Kardon Surround Sound Audio	
- UVO eServices (5 yr trial; see owners.kia.com for details)	
- Power Adj. Passenger's Seat	
Carpeted Floor Mats for AWD Only	$150.00
Wheel Locks	$60.00
MSRP INCLUDING OPTIONS	$ 38,400.00
INLAND FREIGHT AND HANDLING	$ 995.00
TOTAL MANUFACTURER'S SUGGESTED RETAIL PRICE ▶	$ 39,395.00

EPA DOT Fuel Economy and Environment — Gasoline Vehicle

Fuel Economy
24 MPG combined city/hwy
21 city
29 highway
4.2 gallons per 100 miles
LARGE CARS range from 14 to 103 MPG. The best vehicle rates 136 MPGe.

You spend $2,750 more in fuel costs over 5 years compared to the average new vehicle.

Annual fuel cost $2,050

Fuel Economy & Greenhouse Gas Rating (tailpipe only): 5 (1 – 10, Best)
This vehicle emits 368 grams CO2 per mile. The best emits 0 grams per mile (tailpipe only). Producing and distributing fuel also creates emissions; learn more at fueleconomy.gov.

Smog Rating (tailpipe only): 3 (1 – 10, Best)

Actual results will vary for many reasons, including driving conditions and how you drive and maintain your vehicle. The average new vehicle gets 27 MPG and costs $7,500 to fuel over 5 years. Cost estimates are based on 15,000 miles per year at $ 2.70 per gallon. MPGe is miles per gasoline gallon equivalent. Vehicle emissions are a significant cause of climate change and smog.

fueleconomy.gov
Calculate personalized estimates and compare vehicles

Smartphone QR Code

GOVERNMENT 5-STAR SAFETY RATINGS

Overall Vehicle Score: Not Rated
Based on the combined rating of frontal, side and rollover. Should ONLY be compared to other vehicles of similar size and weight.

Frontal Crash — Driver: Not Rated; Passenger: Not Rated
Based on the risk of injury in a frontal impact. Should ONLY be compared to other vehicles of similar size and weight.

Side Crash — Front seat: Not Rated; Rear seat: Not Rated
Star ratings based on the risk of injury in a side impact.

Rollover: Not Rated
Star ratings based on the risk of rollover in a single-vehicle crash.

Star ratings range from 1 to 5 stars (★★★★★) with 5 being the highest.
Source: National Highway Traffic Safety Administration (NHTSA).
www.safercar.gov or 1-888-327-4236

Manufacturer's suggested retail price includes Manufacturer's recommended pre-delivery service. License and title fees, state and local taxes and other dealer installed options and accessories are not included in the manufacturer's suggested retail price.

PARTS CONTENT INFORMATION

FOR VEHICLES IN THIS CAR LINE U.S./CANADIAN PARTS CONTENT: 5 %

MAJOR SOURCES OF FOREIGN PARTS: KOREA: 90%

NOTE: PARTS CONTENT DOES NOT INCLUDE FINAL ASSEMBLY, DISTRIBUTION, OR OTHER NON-PARTS COSTS.

FOR THIS VEHICLE FINAL ASSEMBLY POINT: SOHARI, KOREA

COUNTRY OF ORIGIN
ENGINE: KOREA
TRANSMISSION: KOREA

Figure A-83: Monroney Label Photograph

APPENDIX B
VEHICLE & DUMMY RESPONSE DATA TRACES

Table of Data Plots

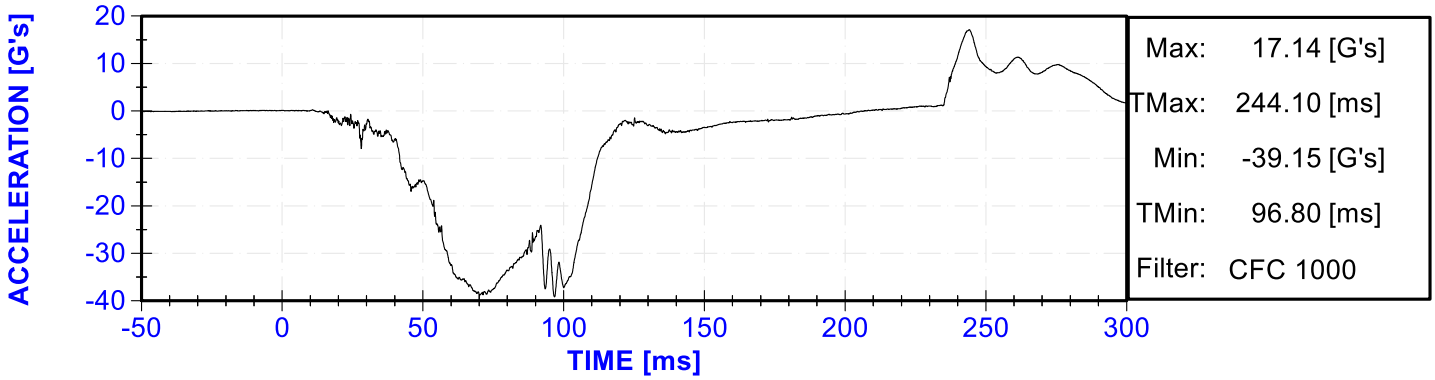
The following additional dummy and vehicle response data can be found in the R&D section of the NHTSA website at www.NHTSA.gov

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

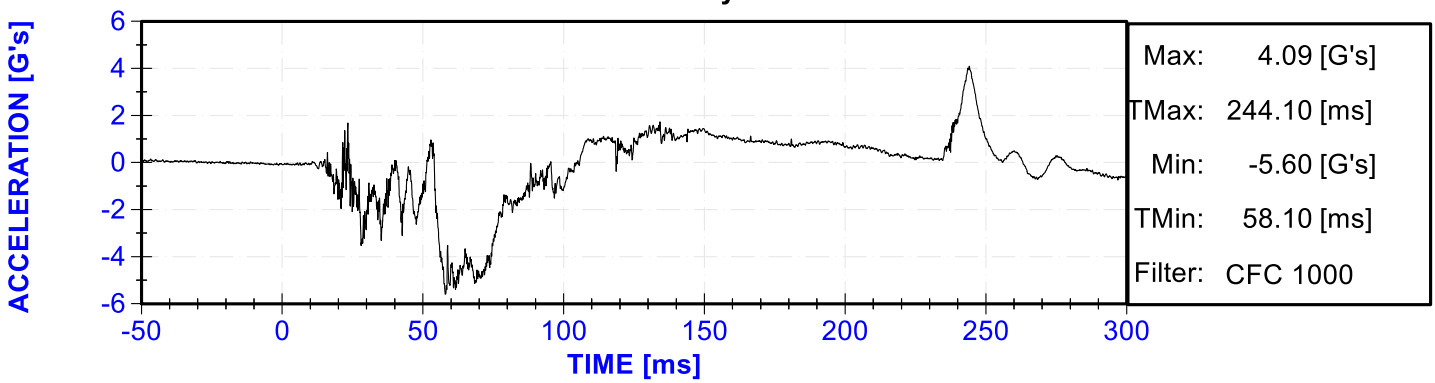
Driver Left Upper Tibia Force Z
Driver Left Lower Tibia Moment X
Driver Left Lower Tibia Moment Y
Driver Left Lower Tibia Force Z
Driver Right Upper Tibia Moment X
Driver Right Upper Tibia Moment Y
Driver Right Upper Tibia Force Z
Driver Right Lower Tibia Moment X
Driver Right Lower Tibia Moment Y
Driver 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

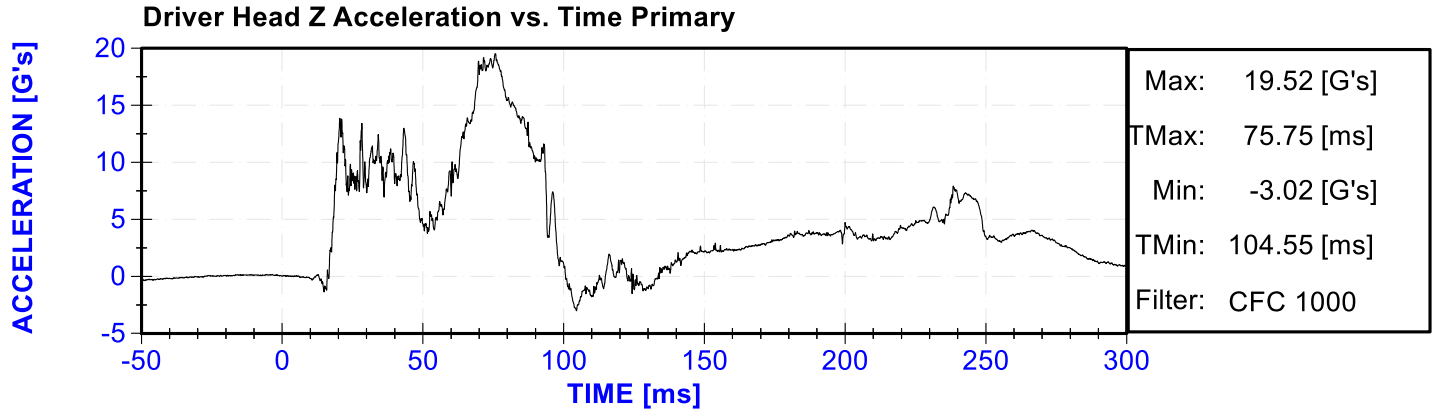
Driver Head X Acceleration vs. Time Primary



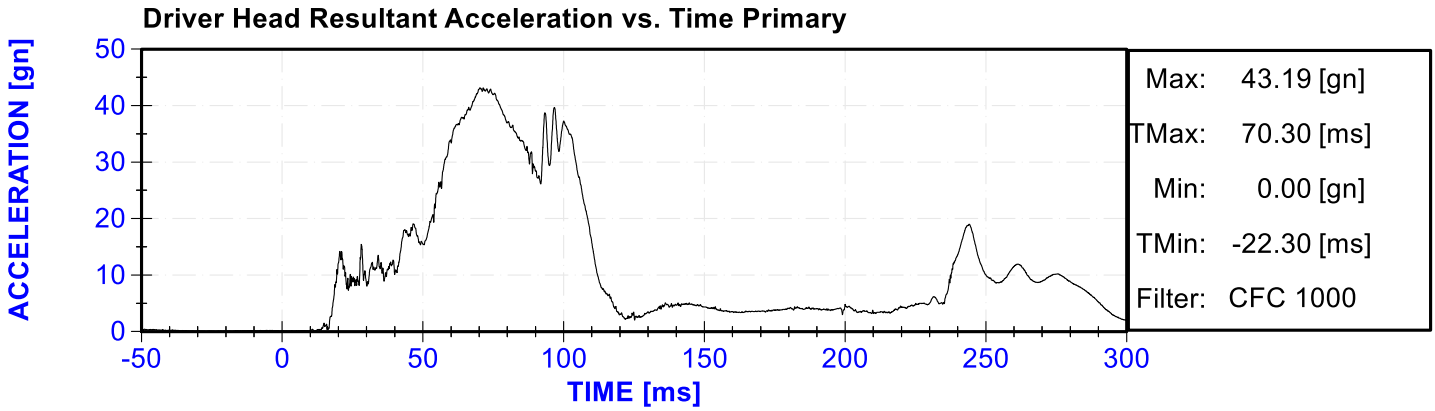
Driver Head Y Acceleration vs. Time Primary



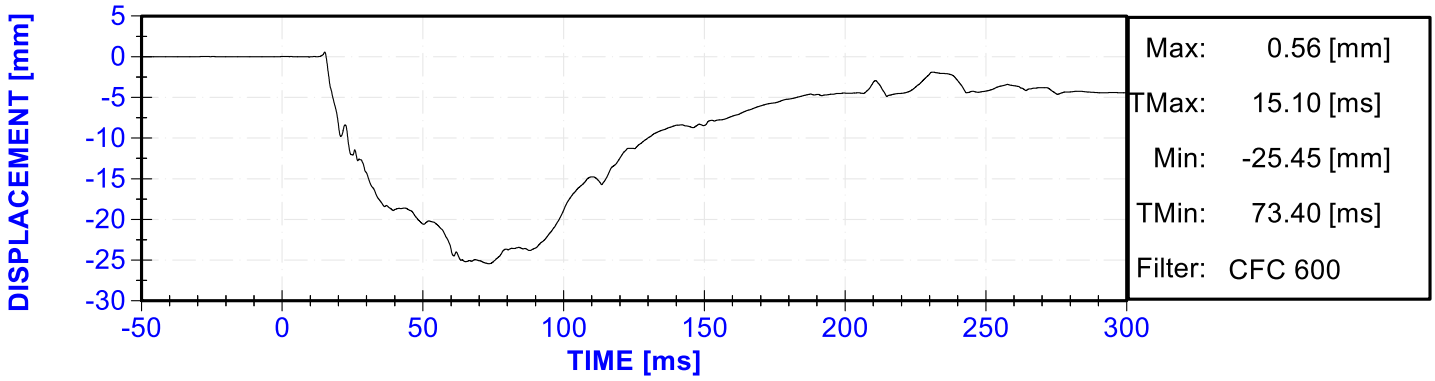
Driver Head Z Acceleration vs. Time Primary



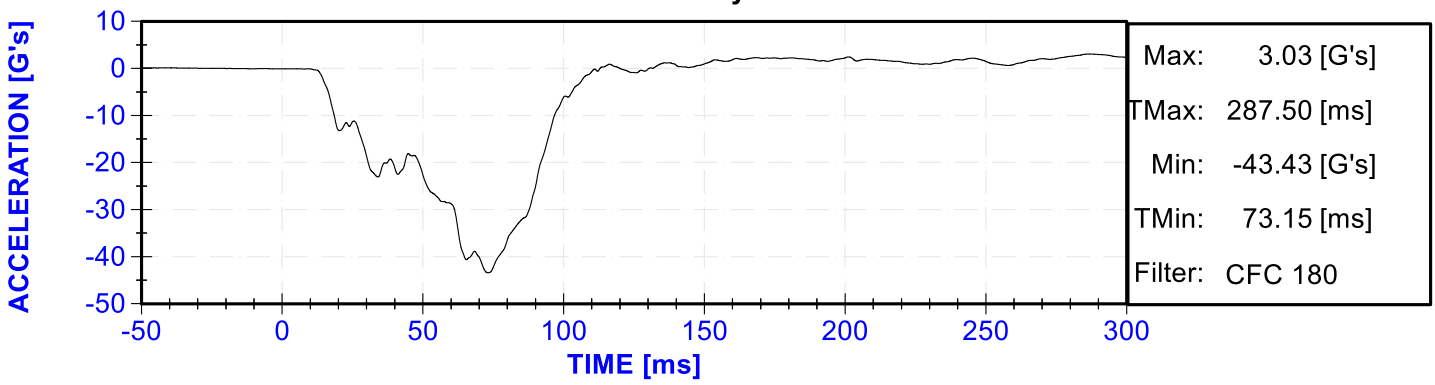
Driver Head Resultant Acceleration vs. Time Primary



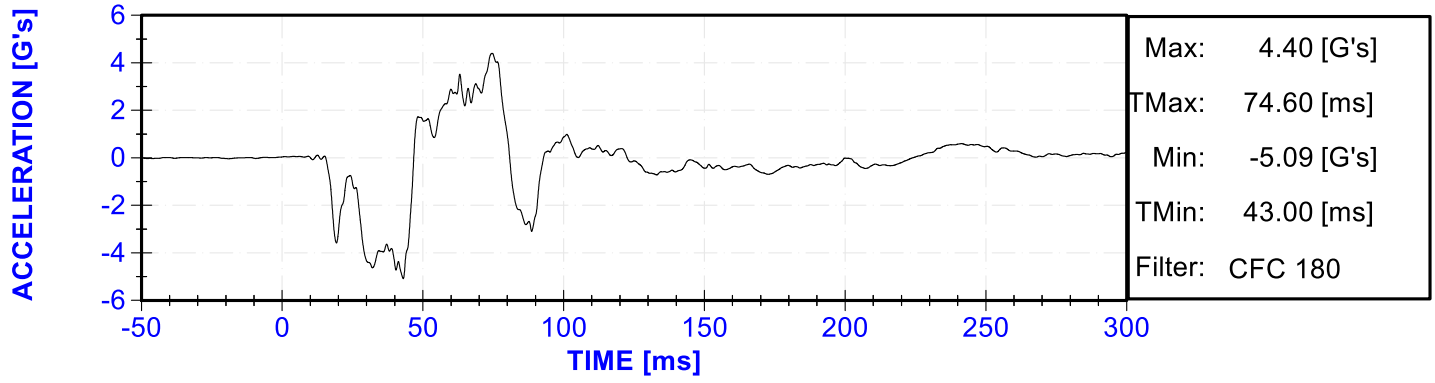
Driver Chest X Deflection vs. Time



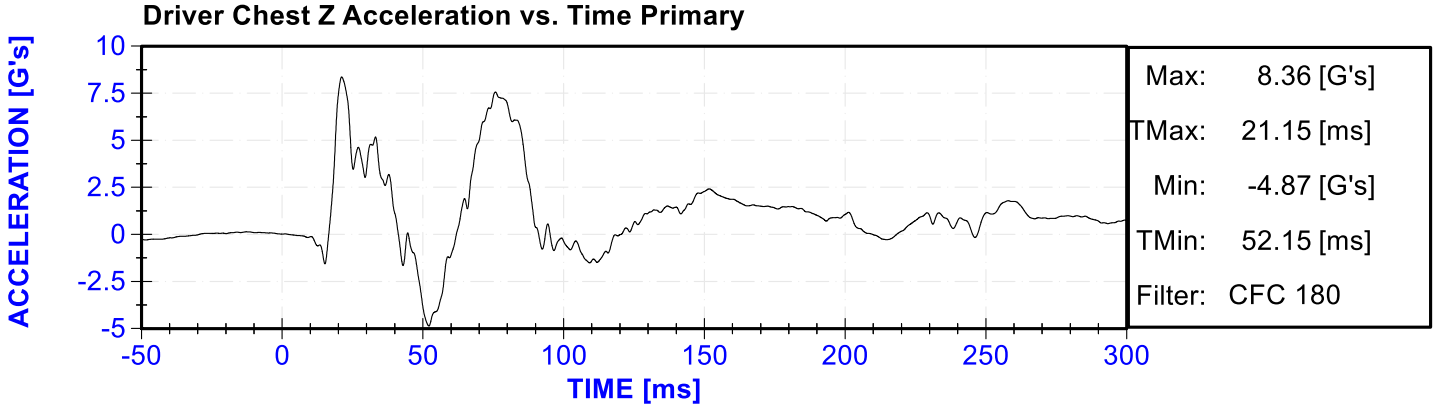
Driver Chest X Acceleration vs. Time Primary



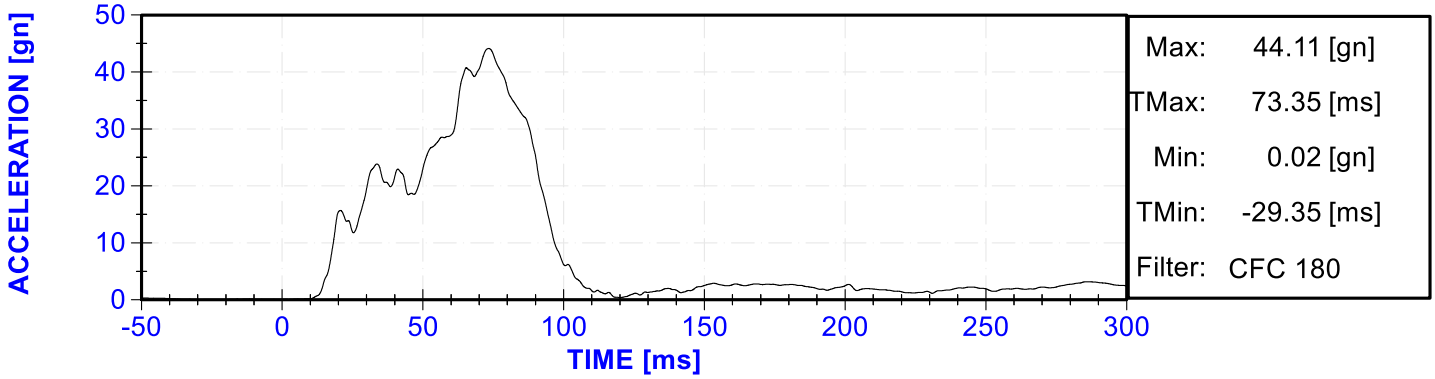
Driver Chest Y Acceleration vs. Time Primary



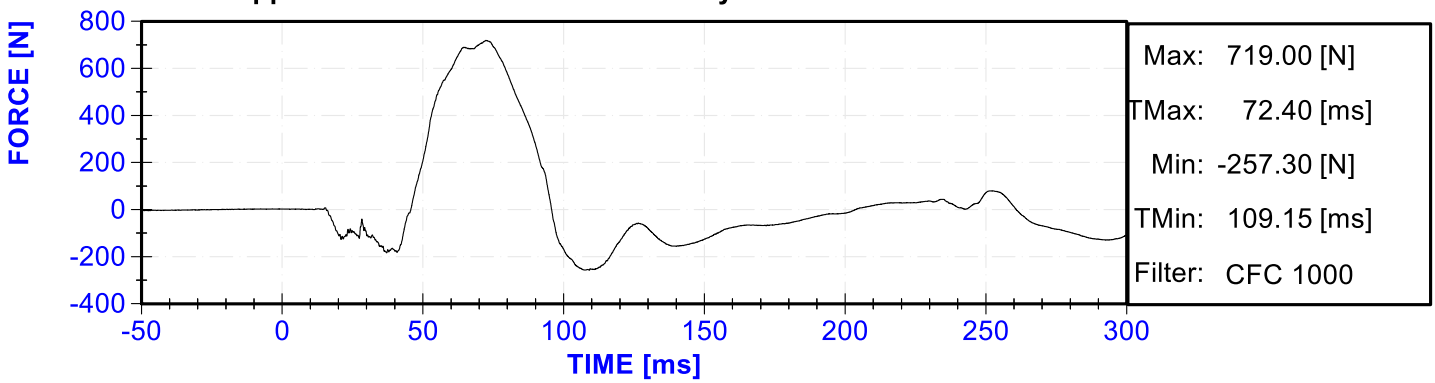
Driver Chest Z Acceleration vs. Time Primary



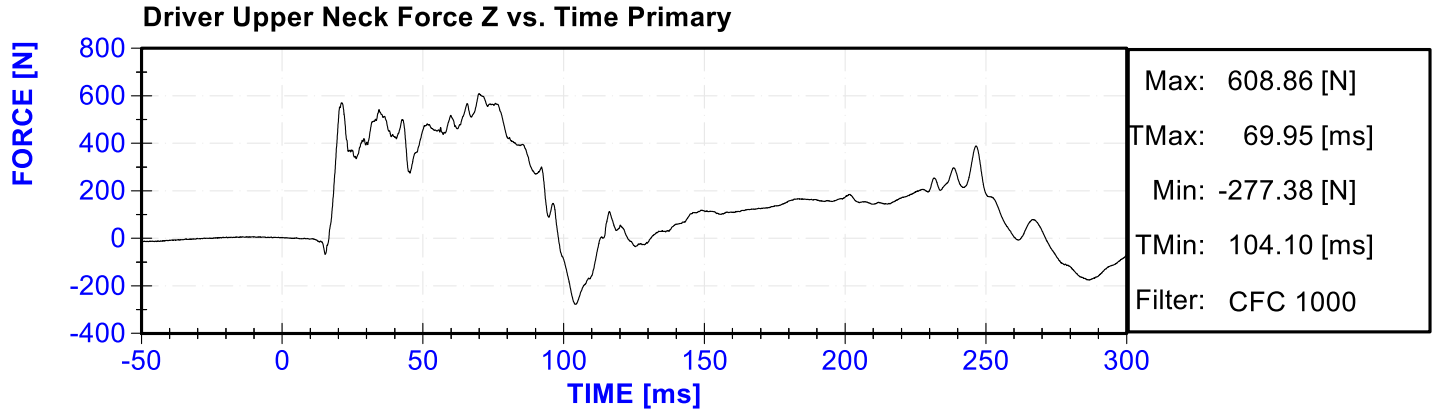
Driver Chest Resultant Acceleration vs. Time Primary



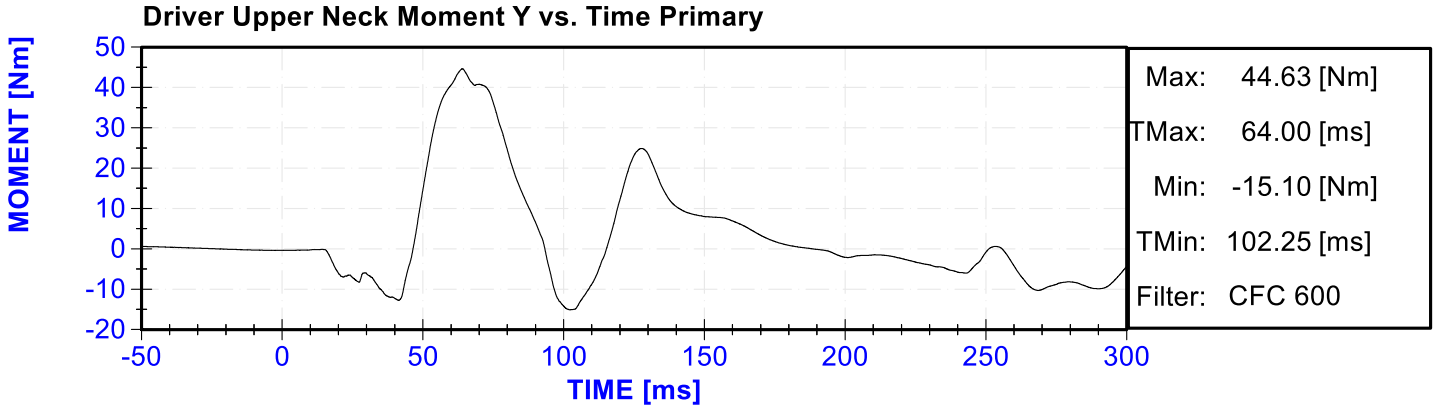
Driver Upper Neck Force X vs. Time Primary



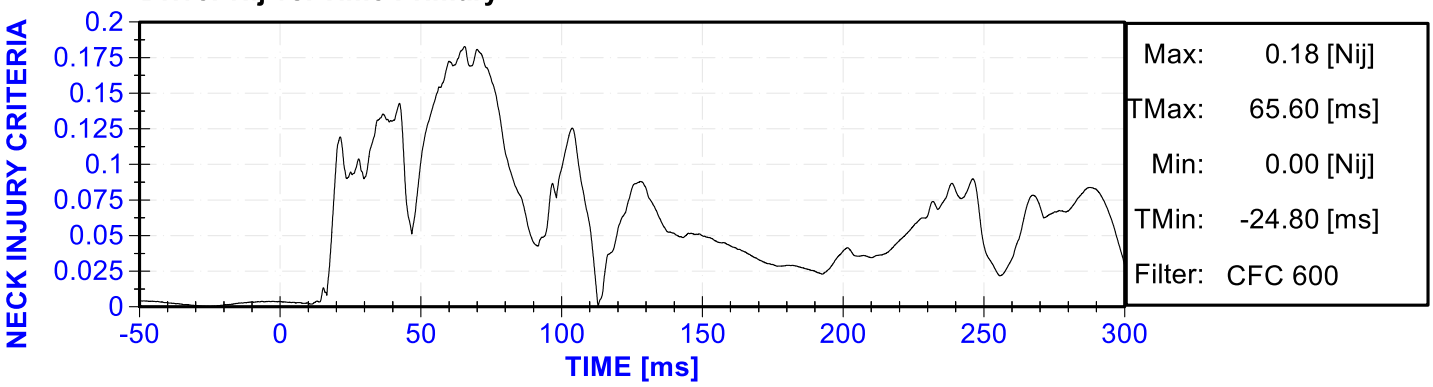
Driver Upper Neck Force Z vs. Time Primary



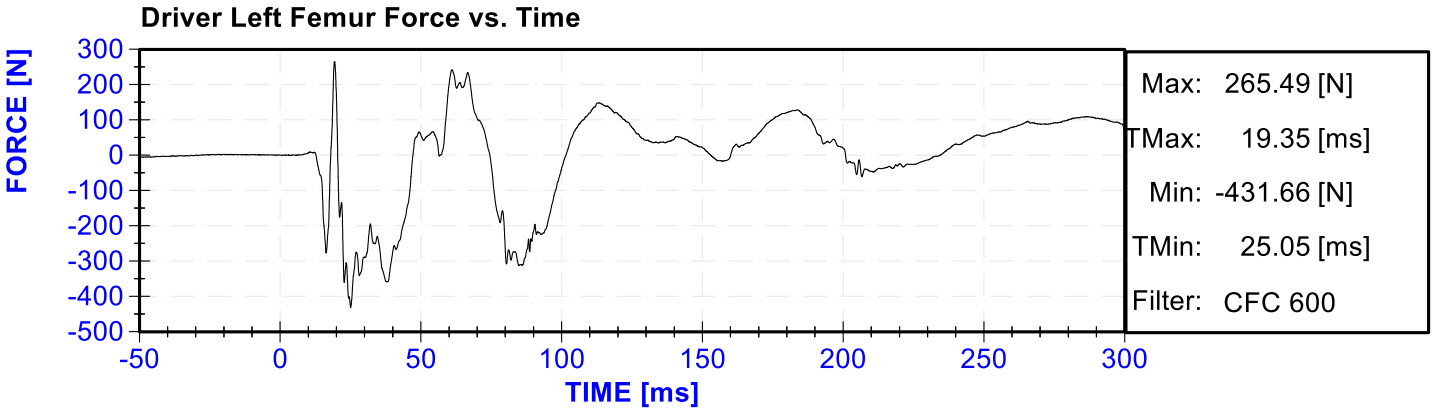
Driver Upper Neck Moment Y vs. Time Primary



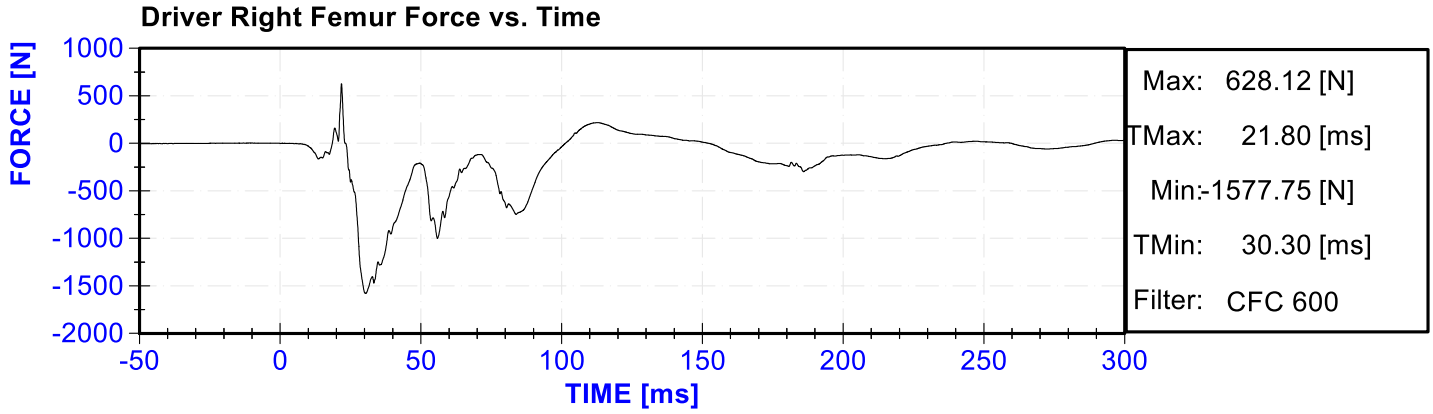
Driver Nij vs. Time Primary



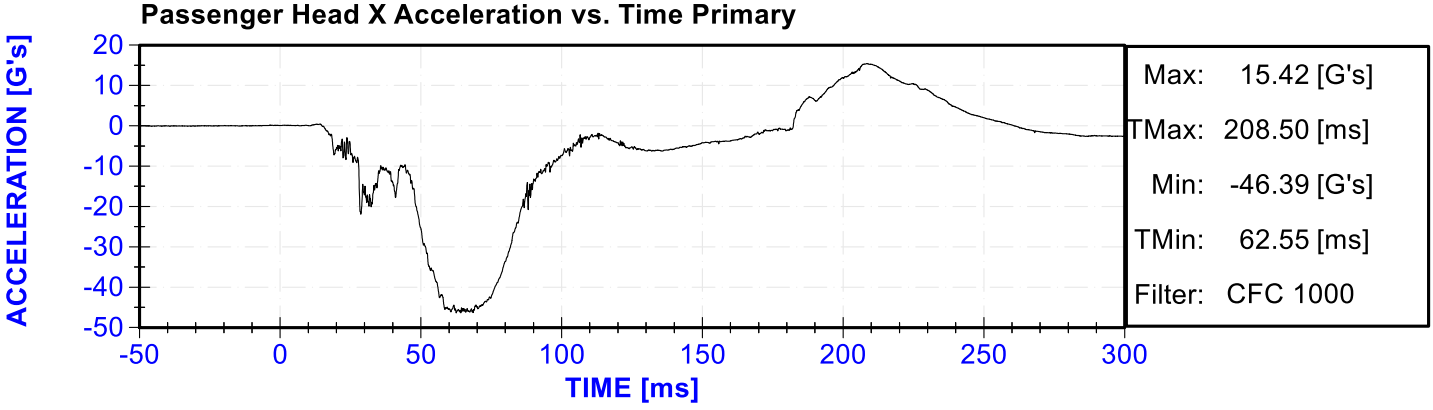
Driver Left Femur Force vs. Time



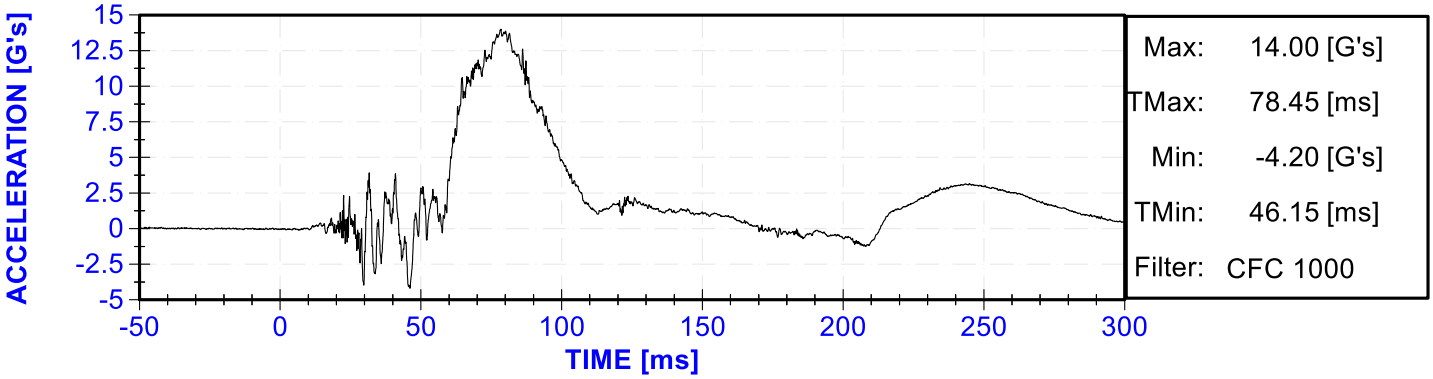
Driver Right Femur Force vs. Time



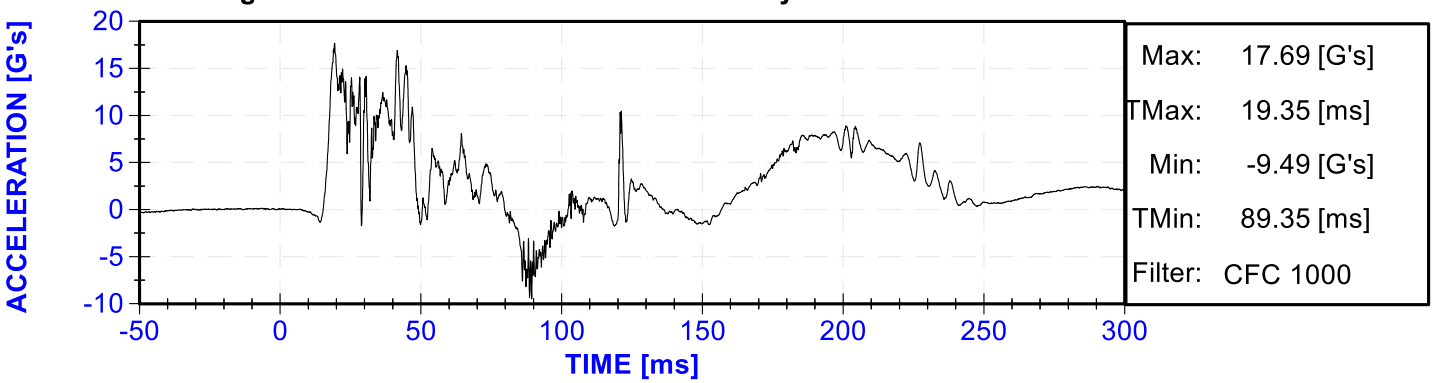
Passenger Head X Acceleration vs. Time Primary



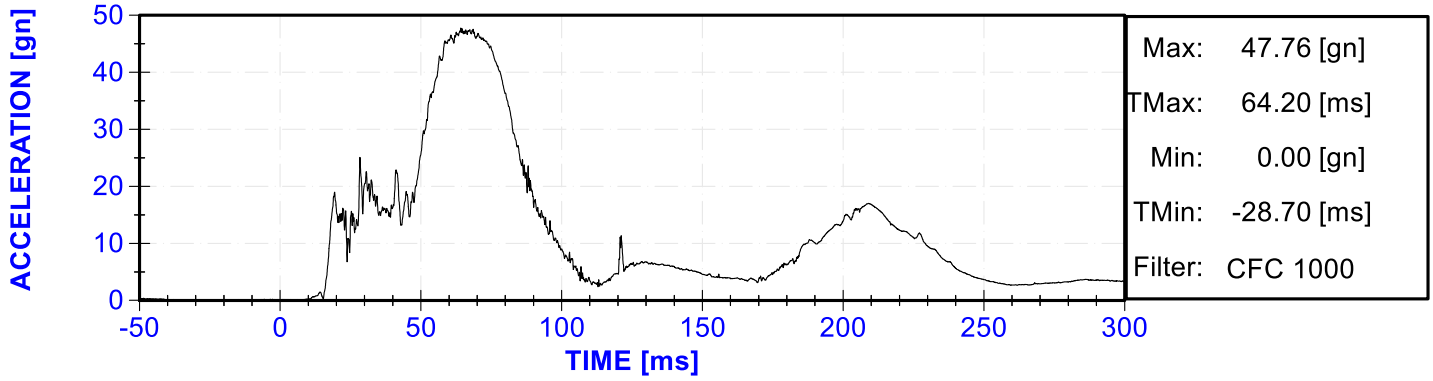
Passenger Head Y Acceleration vs. Time Primary



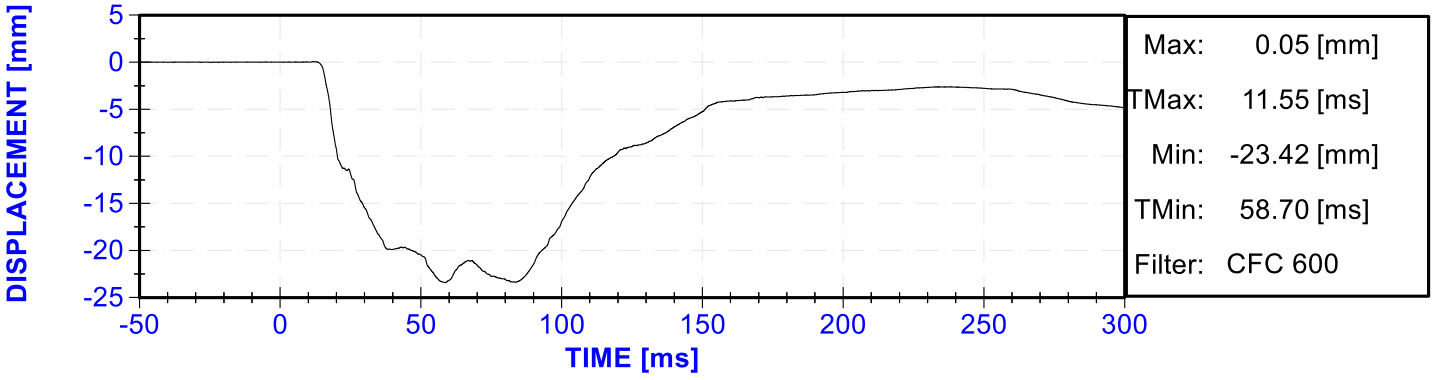
Passenger Head Z Acceleration vs. Time Primary



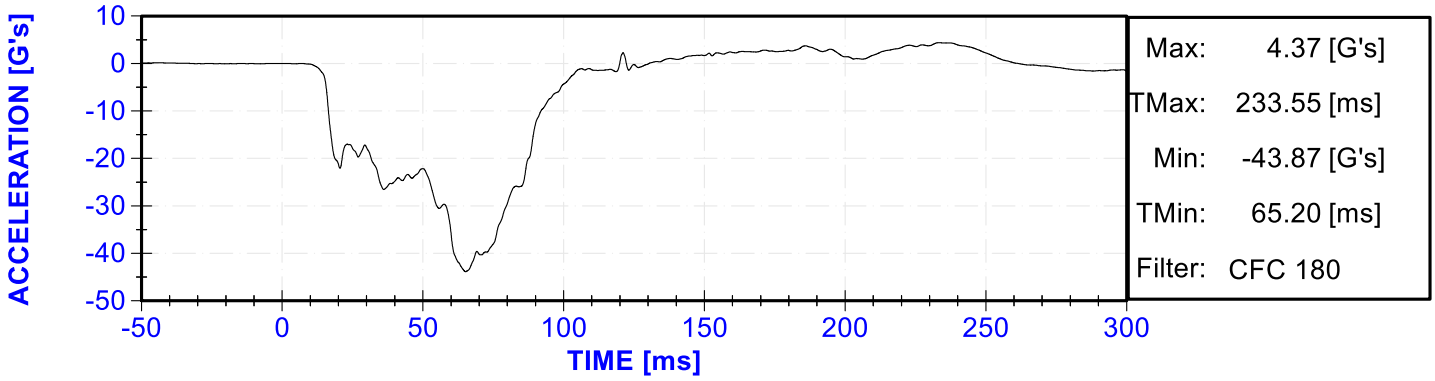
Passenger Head Resultant Acceleration vs. Time Primary



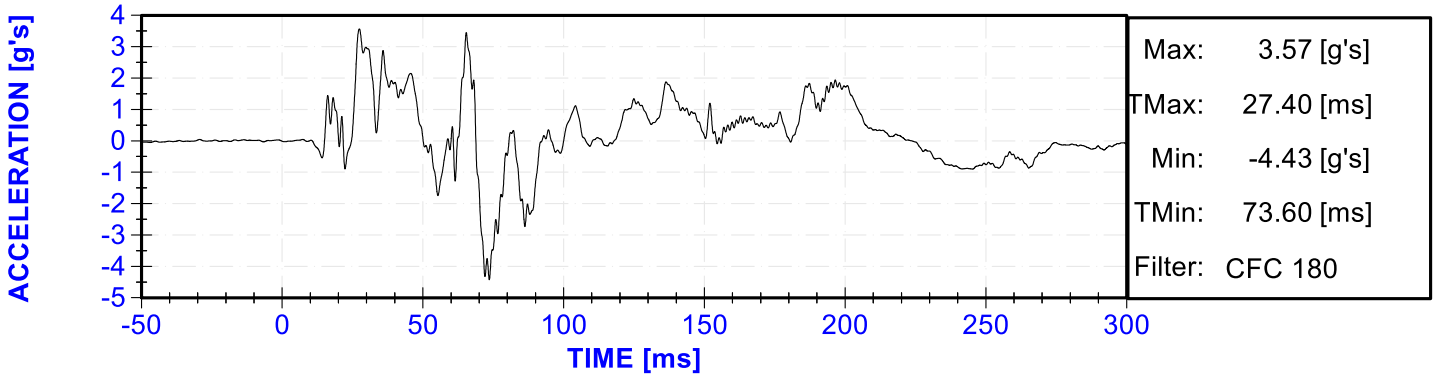
Passenger Chest X Deflection vs. Time



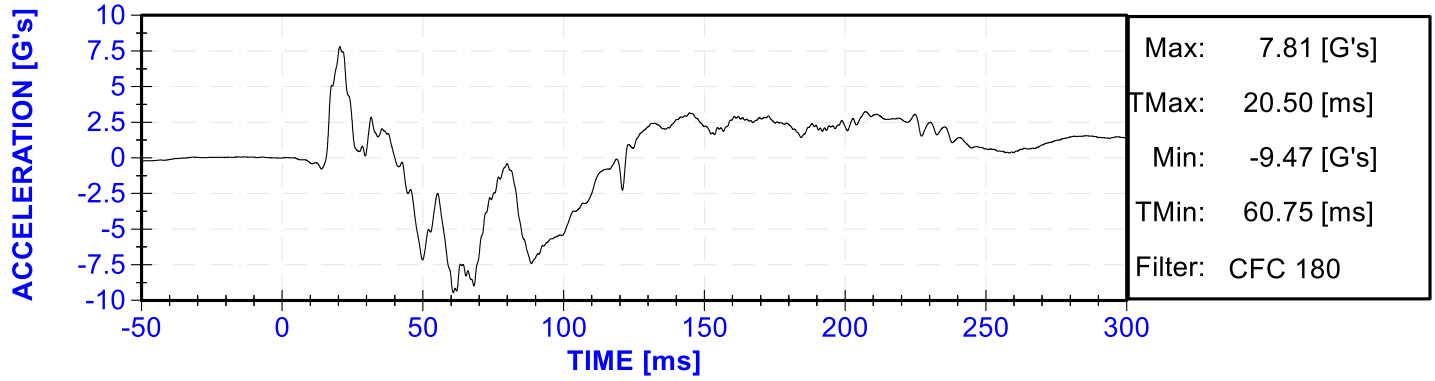
Passenger Chest X Acceleration vs. Time Primary



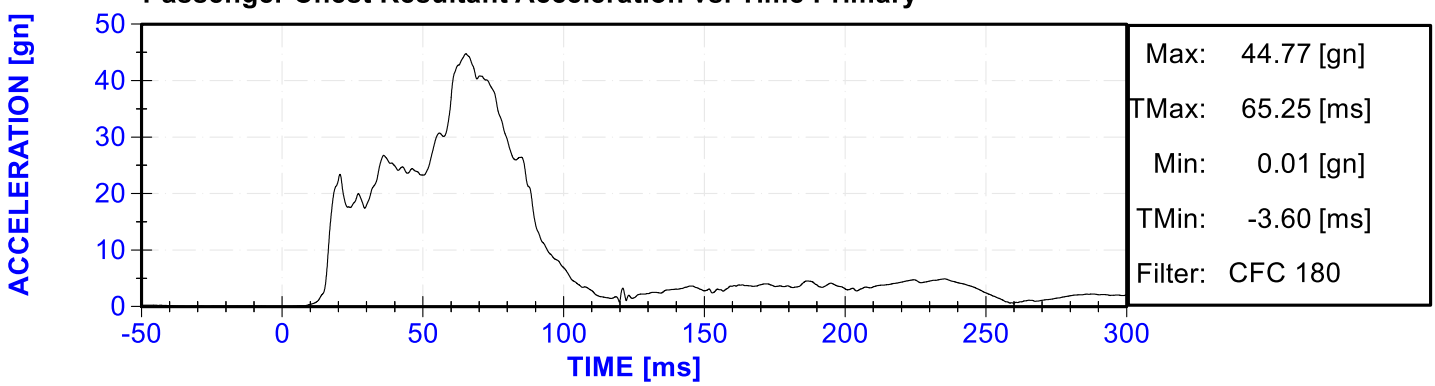
Passenger Chest Y Acceleration vs. Time Primary



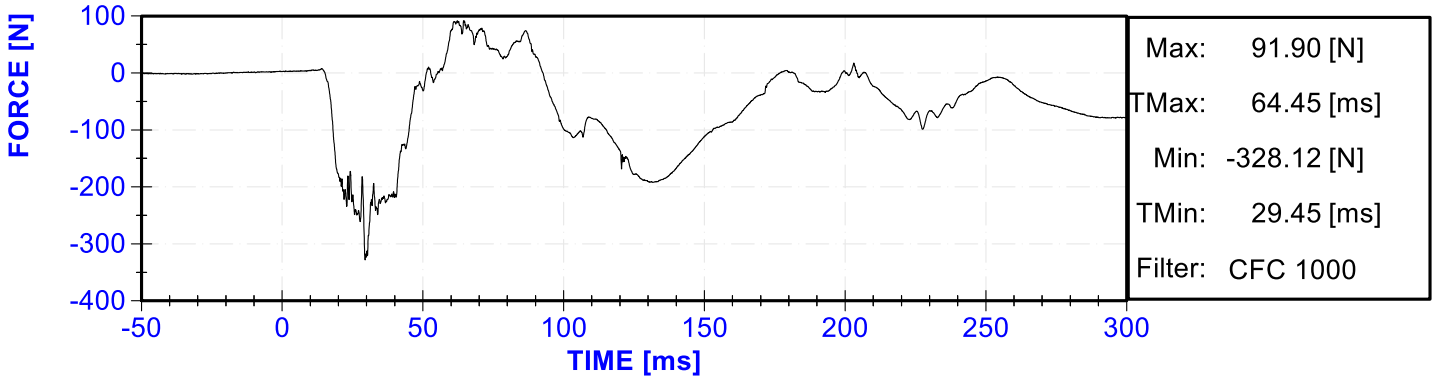
Passenger Chest Z Acceleration vs. Time Primary



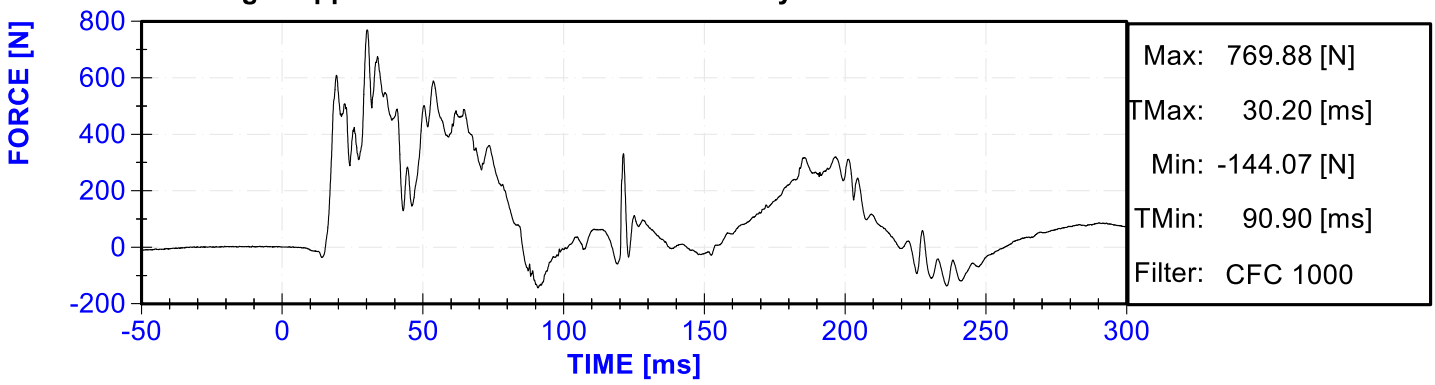
Passenger Chest Resultant Acceleration vs. Time Primary



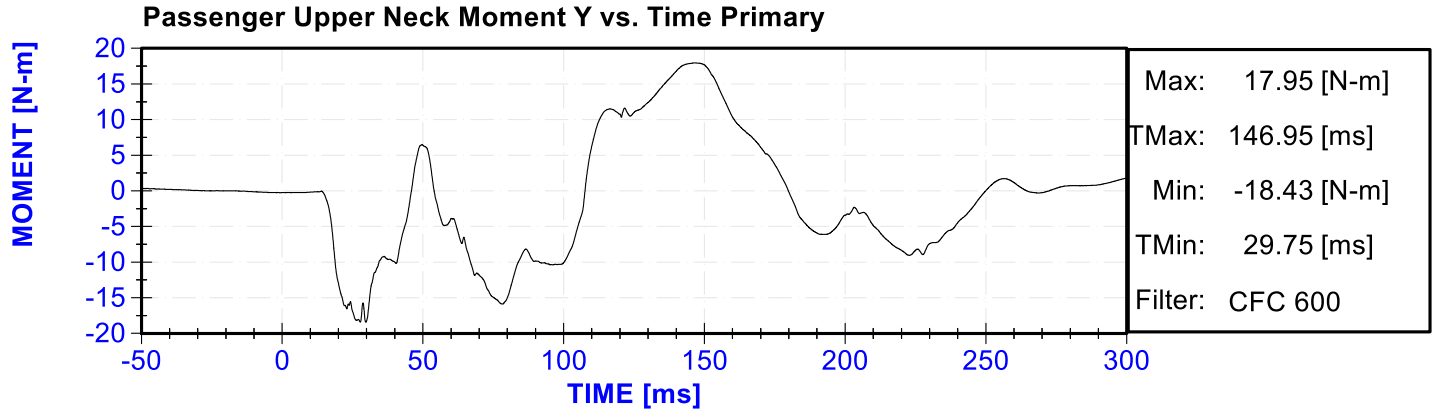
Passenger Upper Neck Force X vs. Time Primary



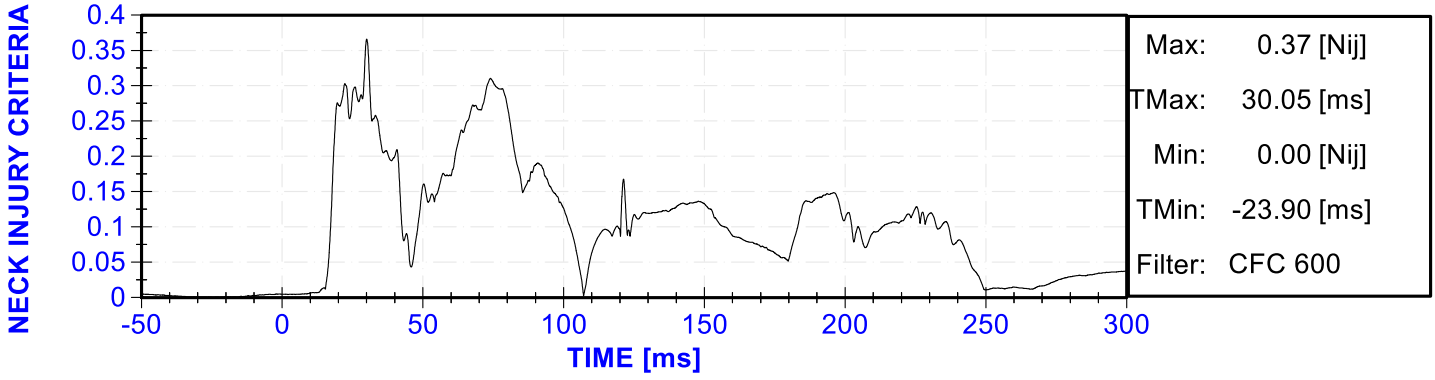
Passenger Upper Neck Force Z vs. Time Primary

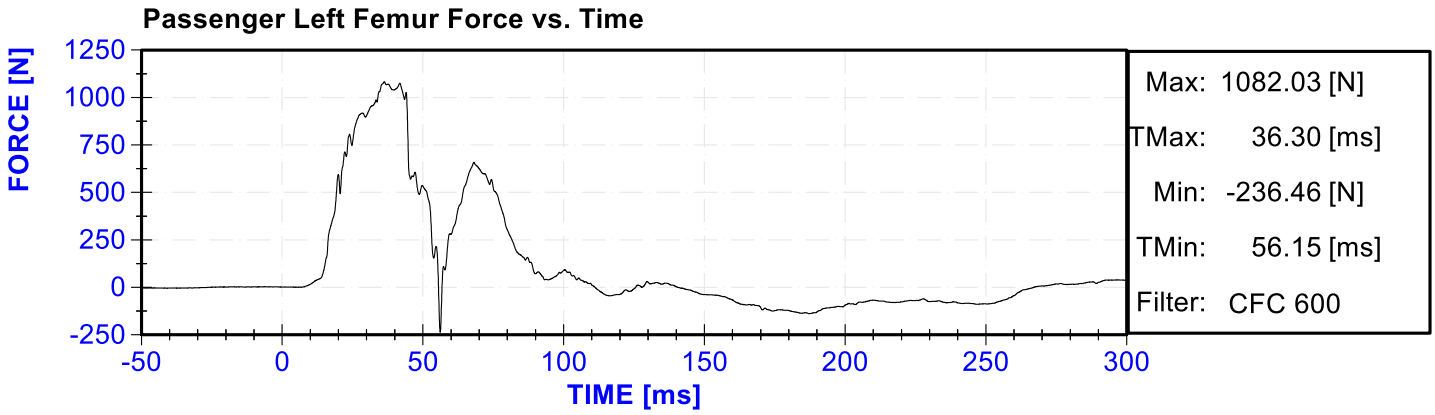


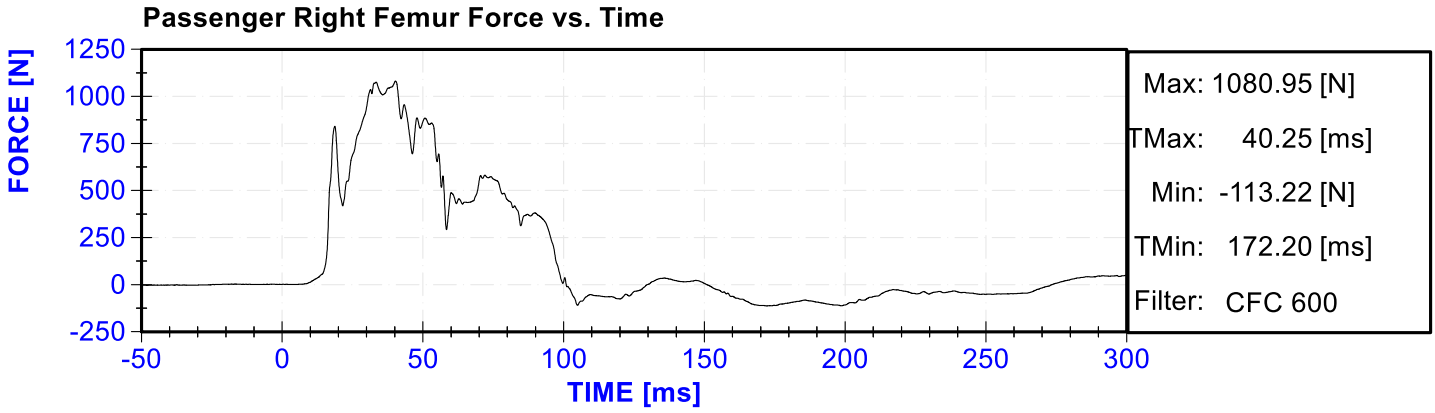
Passenger Upper Neck Moment Y vs. Time Primary



Passenger Nij vs. Time Primary




Passenger Left Femur Force vs. Time
FORCE [N]
1250
1000
750
500
250
0
-250
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 1082.03 [N]
TMax: 36.30 [ms]
Min: -236.46 [N]
TMin: 56.15 [ms]
Filter: CFC 600


Passenger Right Femur Force vs. Time
FORCE [N]
1250
1000
750
500
250
0
-250
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 1080.95 [N]
TMax: 40.25 [ms]
Min: -113.22 [N]
TMin: 172.20 [ms]
Filter: CFC 600

APPENDIX C

DUMMY CALIBRATION AND PERFORMANCE VERIFICATION DATA

CALIBRATION TEST RESULTS

PRE-TEST

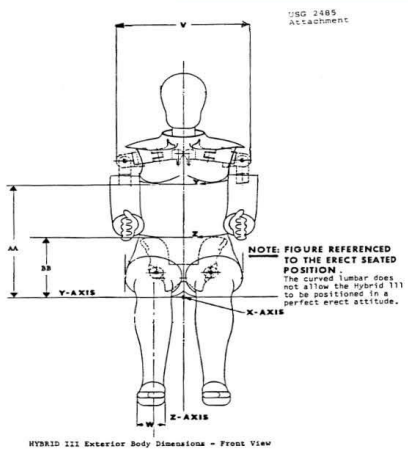
HYBRID III 50TH PERCENTILE MALE - DRIVER ATD

SERIAL NO: 142

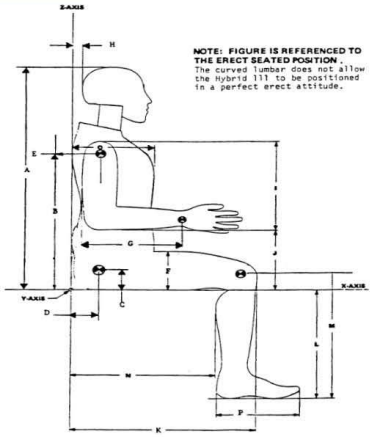
External Measurements - Hybrid 3 - 50th Male

Technician: K. Dutton Date: 04/09/2020

Dummy Serial Number: 142



HYBRID III Exterior Body Dimensions - Front View



HYBRID III Exterior Body Dimensions - Side View

Symbol	Description	Specification (in)		Result (in)	Pass/Fail
A	Sitting Height	34.6	35.0	34.8	Pass
B	Shoulder Pivot Height	19.9	20.5	20.2	Pass
C	H-Point Height	3.3	3.5	3.4	Pass
D	H-Point from Backline	5.3	5.5	5.4	Pass
E	Shoulder Pivot from Backline	3.3	3.7	3.6	Pass
F	Thigh Clearance	5.5	6.1	5.9	Pass
G	Back of Elbow to Wrist Pivot	11.4	12.0	11.6	Pass
H	Head Back to Backline	1.6	1.8	1.7	Pass
I	Shoulder to Elbow Length	13.0	13.6	13.4	Pass
J	Elbow Rest Height	7.5	8.3	8.0	Pass
K	Buttock to Knee Length	22.8	23.8	23.5	Pass
L	Popliteal Height	16.9	17.9	17.4	Pass
M	Knee Pivot Height	19.1	19.7	19.6	Pass
N	Buttock Popliteal Length	17.8	18.8	18.5	Pass
O	Chest Depth without Jacket	8.4	9.0	8.7	Pass
P	Foot Length (right)	9.9	10.5	10.3	Pass
V	Shoulder Breadth	16.3	17.2	16.9	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

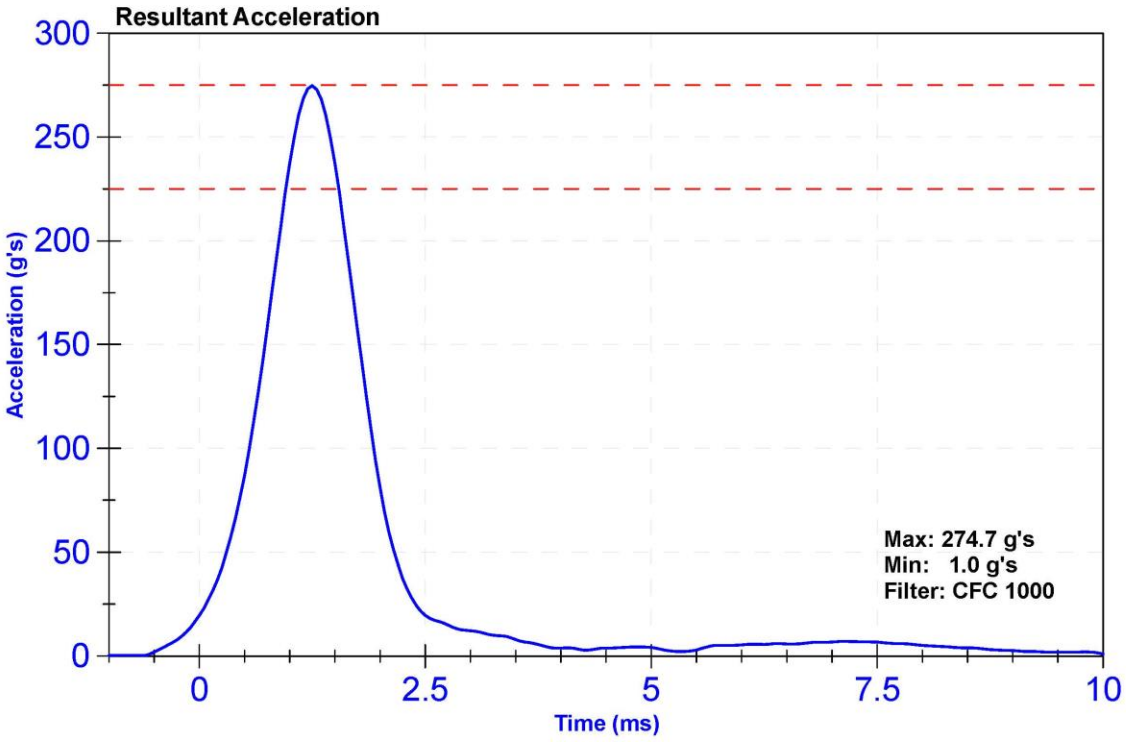
ATD Manufacturer	Humanetics	Test Technician	M. Dudek
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

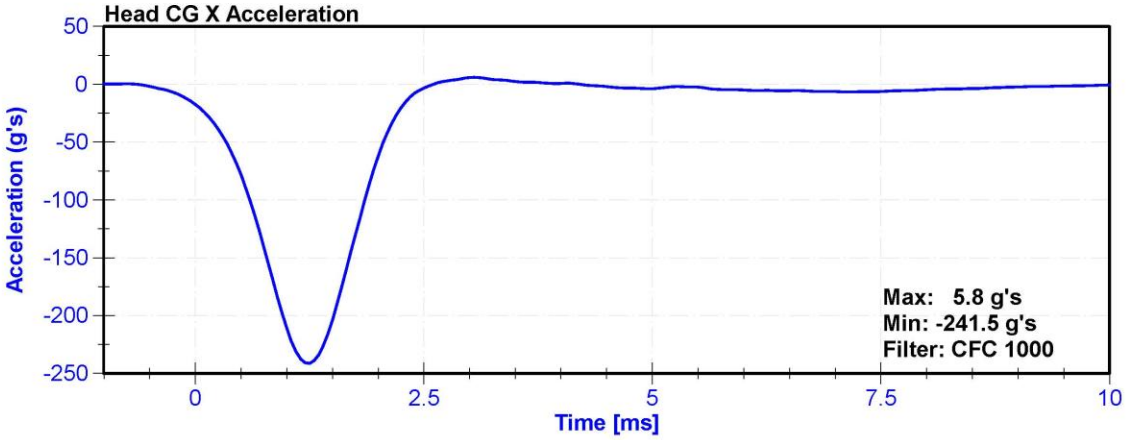
Results

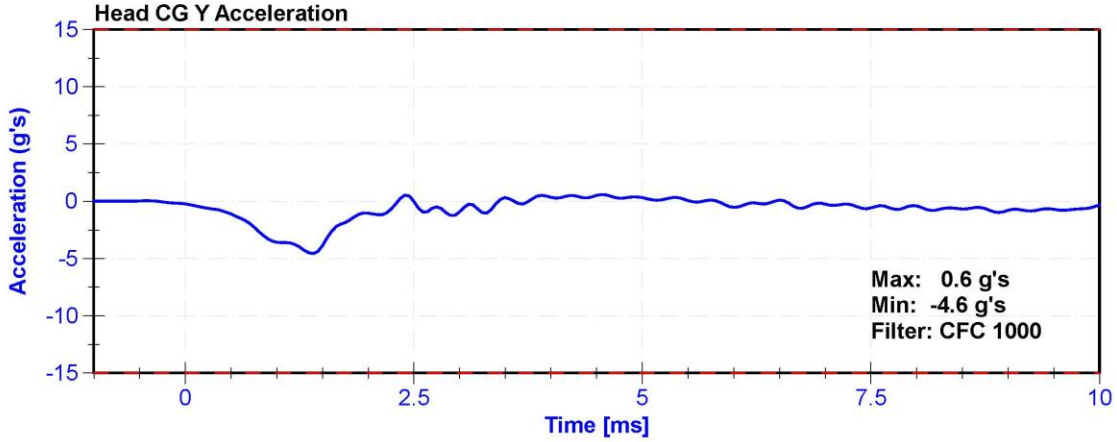
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	20.6	Pass
Humidity	10	70	%	24.9	Pass
Resultant Acceleration	225	275	g's	274.7	Pass
Oscillation	0	10	%	2.5	Pass
Lateral Acceleration	-15	15	g's	-4.6	Pass

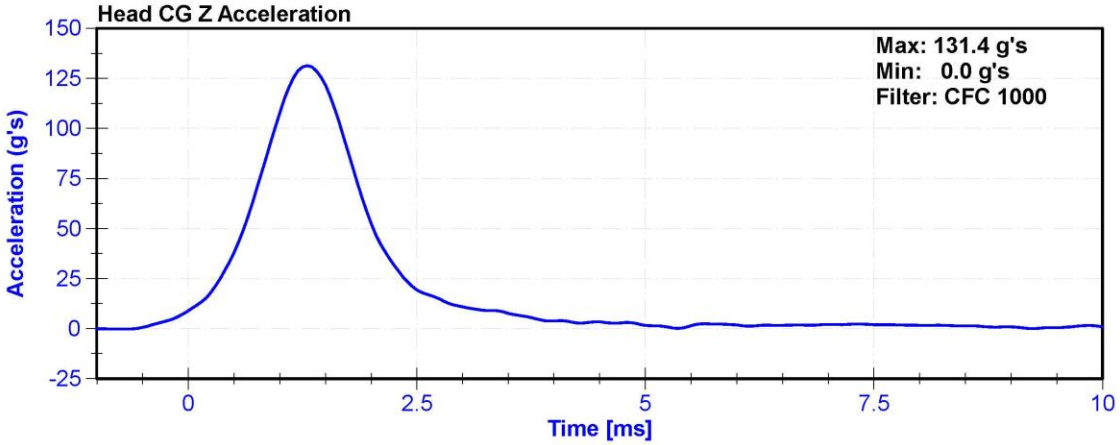
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	ENDEVCO 7264	P51681	4/16/2020	10/15/2020
Y Accelerometer	ENDEVCO 7264	P64151	4/16/2020	10/15/2020
Z Accelerometer	ENDEVCO 7264	P52114	4/16/2020	10/15/2020




Head CG X Acceleration
Acceleration (g's)
50
0
-50
-100
-150
-200
-250
0
2.5
5
7.5
10
Time [ms]
Max: 5.8 g's
Min: -241.5 g's
Filter: CFC 1000


Head CG Y Acceleration
Acceleration (g's)
15
10
5
0
-5
-10
-15
0
2.5
5
7.5
10
Time [ms]
Max: 0.6 g's
Min: -4.6 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: 131.4 g's
Min: 0.0 g's
Filter: CFC 1000

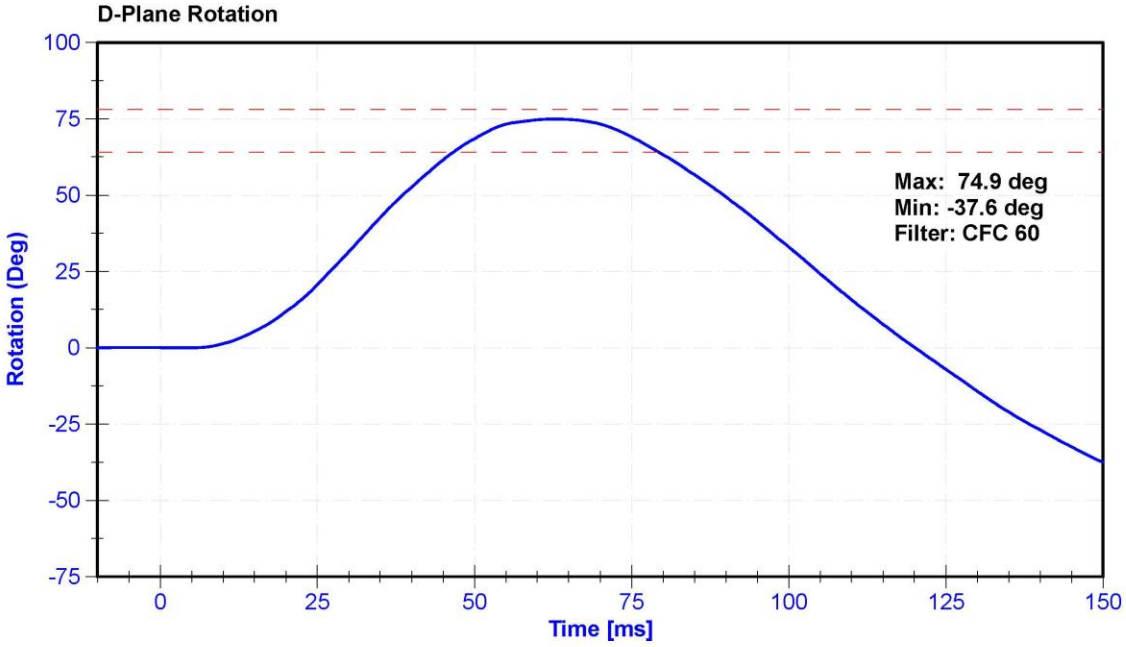
ATD Manufacturer	Humanetics	Test Technician	M. Dudek
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

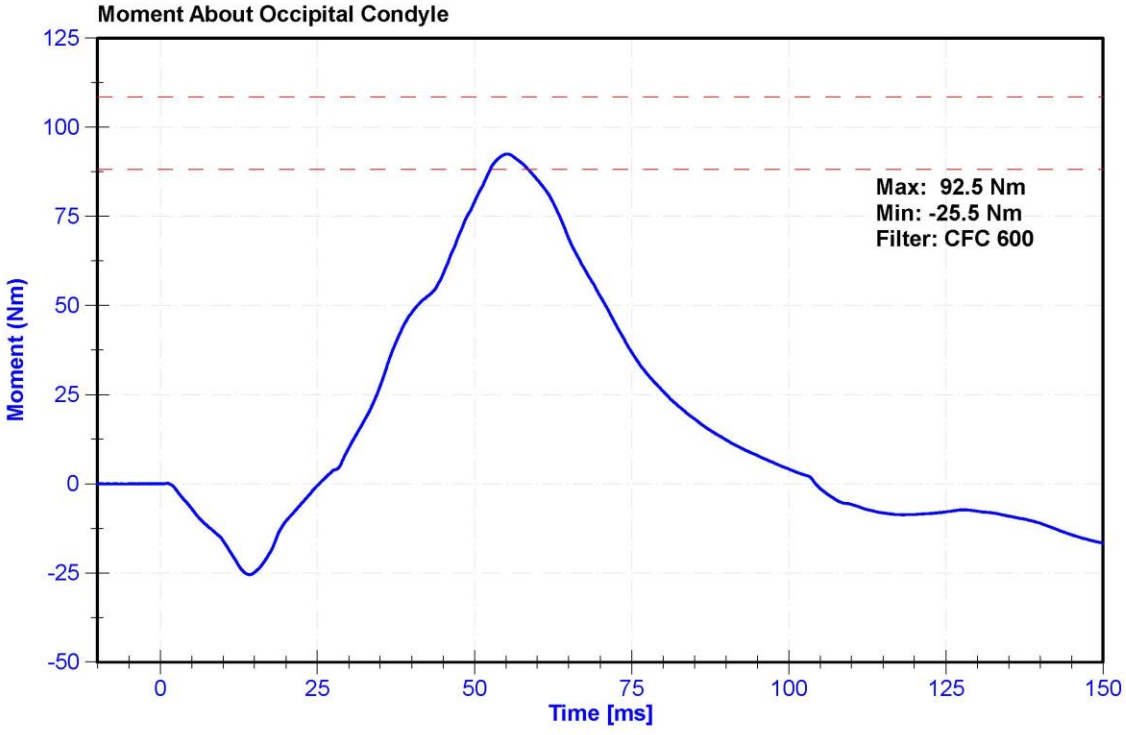
Results

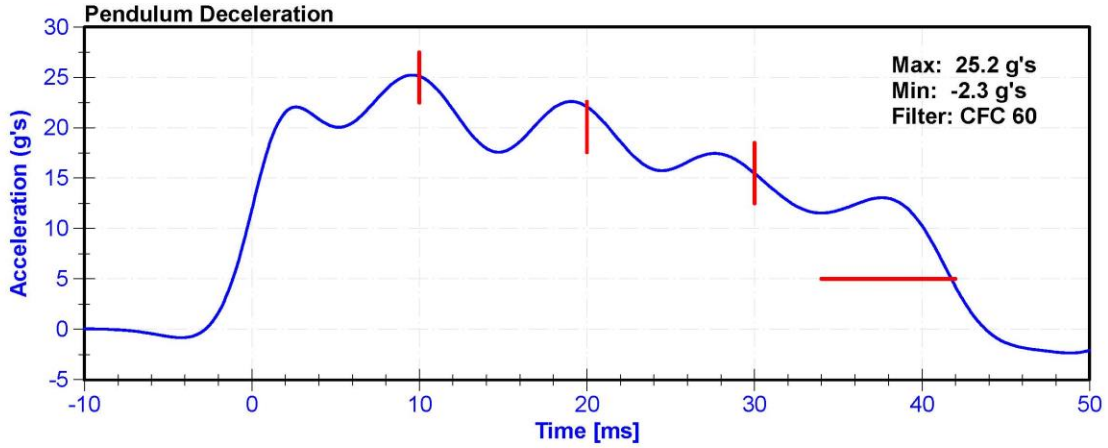
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.2	Pass
Humidity	10	70	%	46.5	Pass
Velocity	6.89	7.13	m/s	6.958	Pass
Pendulum Deceleration at 10ms	22.5	27.5	g's	25.12	Pass
Pendulum Deceleration at 20ms	17.6	22.6	g's	22.09	Pass
Pendulum Deceleration at 30ms	12.5	18.5	g's	15.48	Pass
Max. Pendulum Deceleration After 30ms	0	29	g's	25.2	Pass
Pendulum Deceleration Time to 5 g's	34	42	ms	41.8	Pass
Maximum D Plane Rotation	64	78	deg	74.9	Pass
Time to Maximum Rotation	57	64	ms	62.7	Pass
Rotation Decay to Zero	113	127	ms	120.2	Pass
Moment About Occipital Condyle	88.1	108.4	Nm	92.46	Pass
Time to Maximum Moment	47	58	ms	55.2	Pass
Moment Decay to Zero	97	107	ms	104.3	Pass

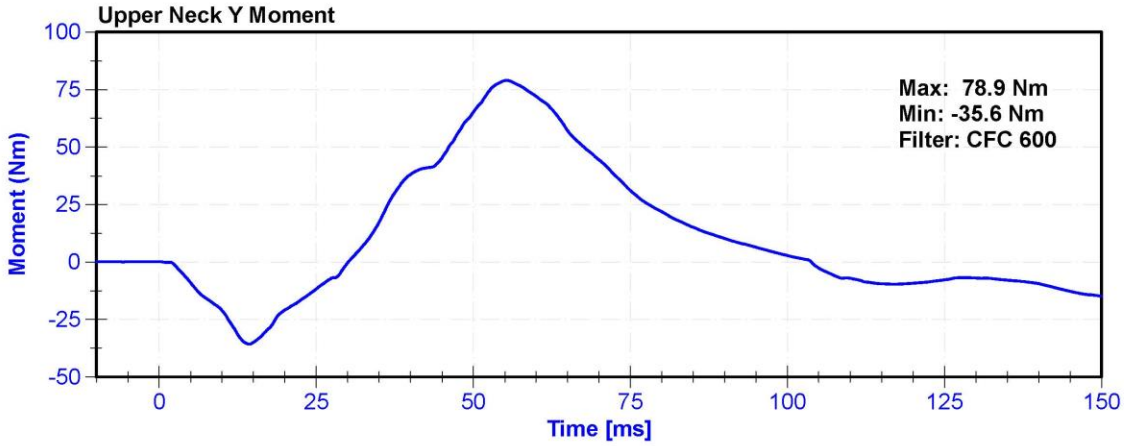
Transducer Calibrations

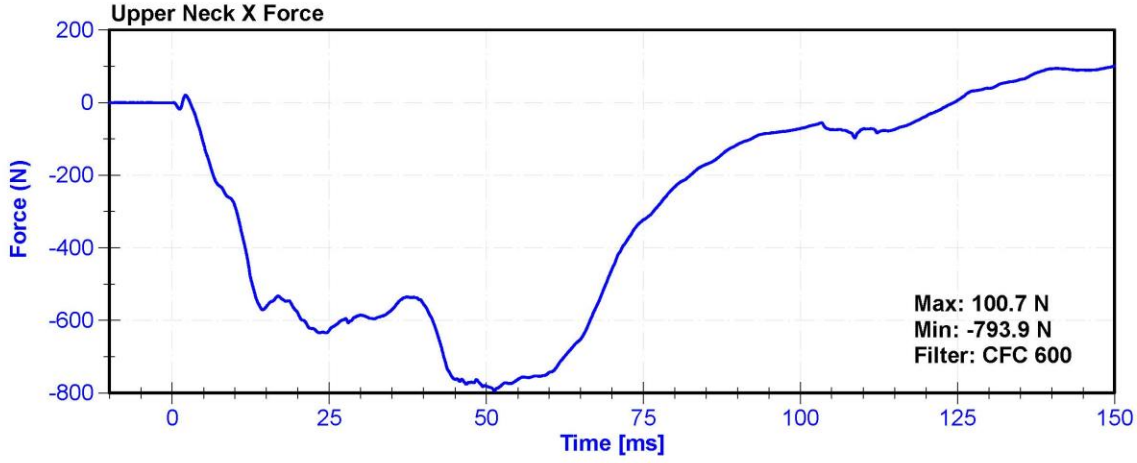
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-C16503 Striker	2/6/2020	2/5/2021
Pendulum Potentiometer	ETI SP22G	DS-LABPOT1	9/13/2019	9/12/2020
Condyle Potentiometer	ETI SP22G	DS-LABPOT2	9/13/2019	9/12/2020
Upper Neck Load Cell	Denton IF-205	LC-280FxGFE	10/3/2019	10/2/2020


D-Plane Rotation
Rotation (Deg)
100
75
50
25
0
-25
-50
-75
0
25
50
75
100
125
150
Time [ms]
Max: 74.9 deg
Min: -37.6 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: 92.5 Nm
Min: -25.5 Nm
Filter: CFC 600


Pendulum Deceleration
Acceleration (g's)
Time [ms]
Max: 25.2 g's
Min: -2.3 g's
Filter: CFC 60


Upper Neck Y Moment
Moment (Nm)
Time [ms]
Max: 78.9 Nm
Min: -35.6 Nm
Filter: CFC 600


Upper Neck X Force
Force (N)
Time [ms]
Max: 100.7 N
Min: -793.9 N
Filter: CFC 600

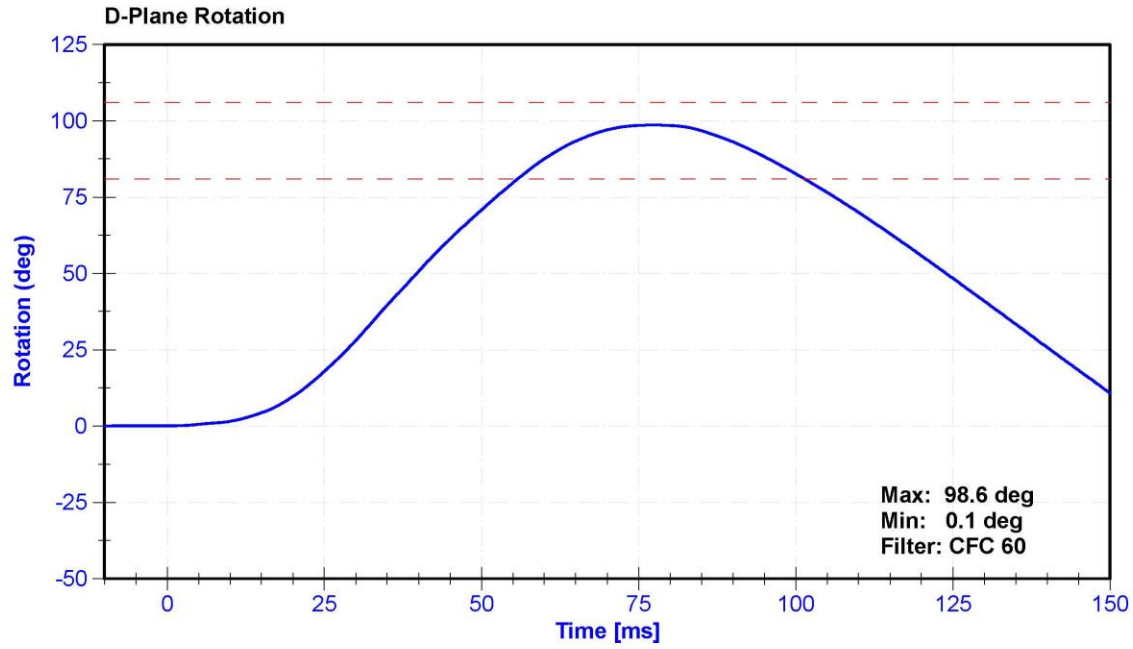
ATD Manufacturer	Humanetics	Test Technician	M. Dudek
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

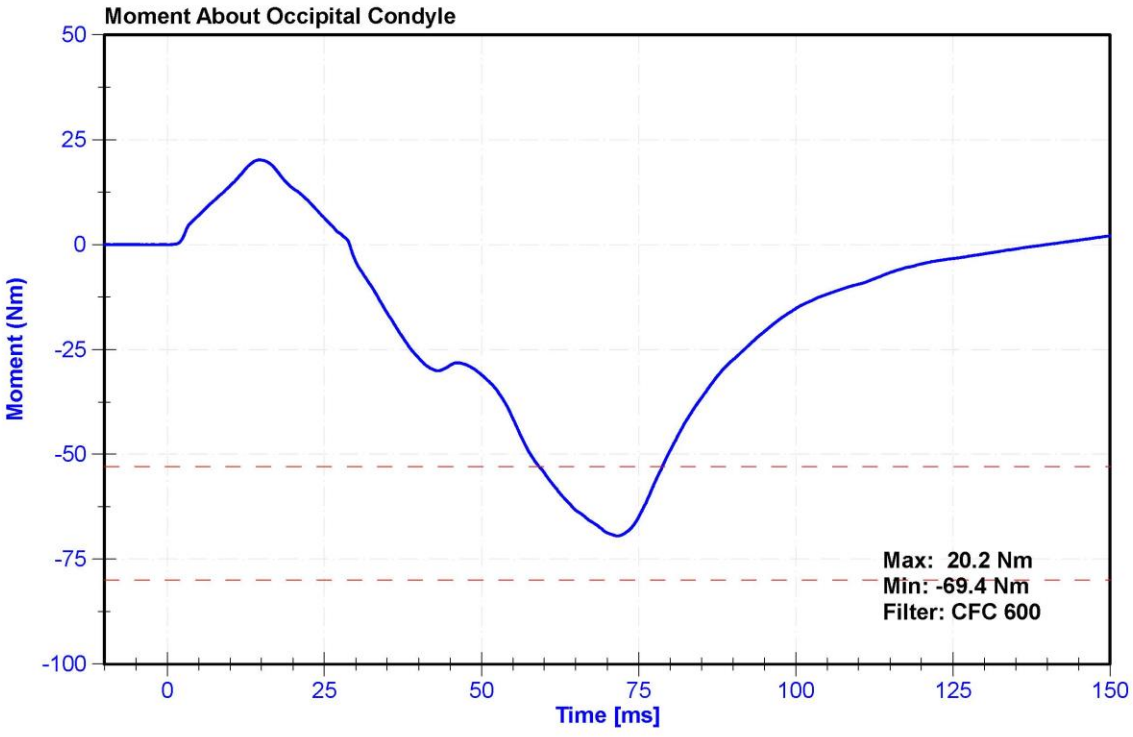
Results

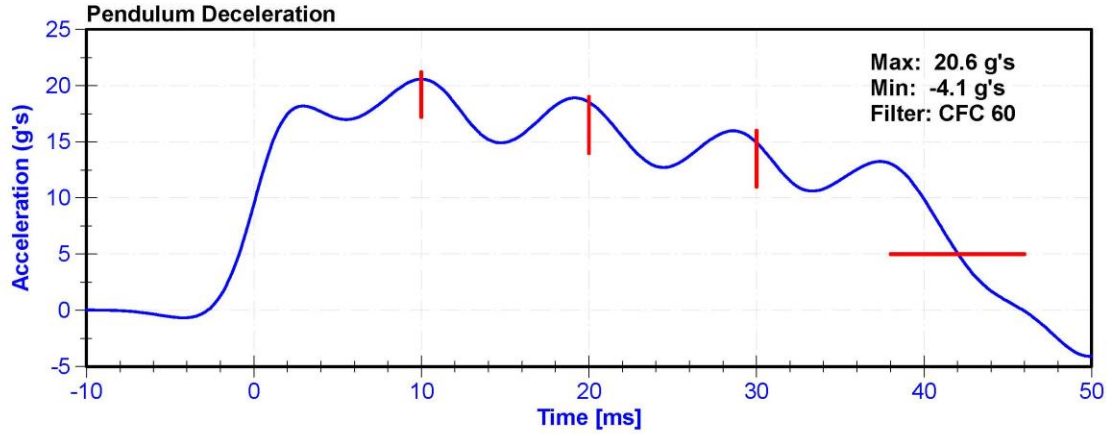
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.2	Pass
Humidity	10	70	%	46.5	Pass
Velocity	5.94	6.19	m/s	6.005	Pass
Pendulum Deceleration at 10ms	17.2	21.2	g's	20.58	Pass
Pendulum Deceleration at 20ms	14	19	g's	18.5	Pass
Pendulum Deceleration at 30ms	11	16	g's	14.9	Pass
Max. Pendulum Deceleration After 30ms	0	22	g's	20.6	Pass
Pendulum Deceleration Time to 5 g's	38	46	ms	42.0	Pass
Maximum D Plane Rotation	81	106	deg	98.6	Pass
Time to Maximum Rotation	72	82	ms	77.2	Pass
Rotation Decay to Zero	147	174	ms	157.3	Pass
Minimum Moment About OC	-80	-52.9	Nm	-69.41	Pass
Time to Minimum Moment	65	79	ms	71.5	Pass
Moment Decay to Zero	120	148	ms	140.0	Pass

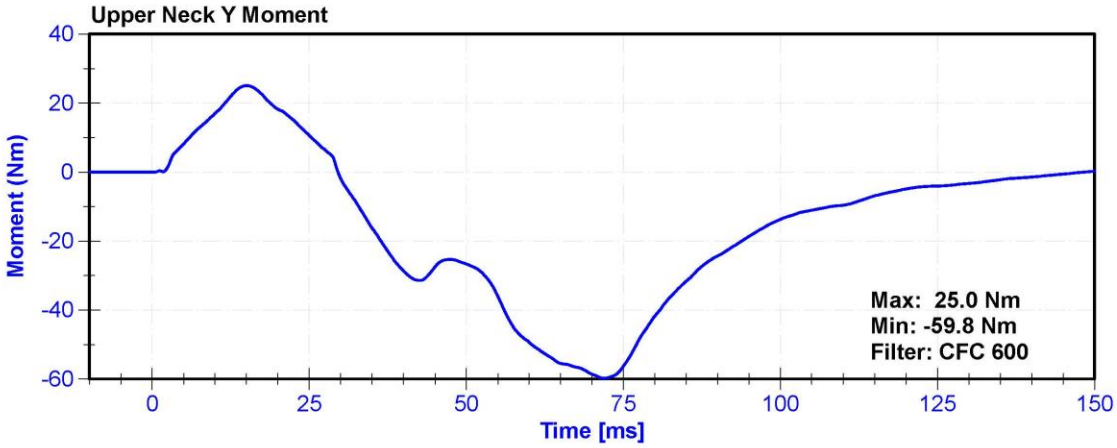
Transducer Calibrations

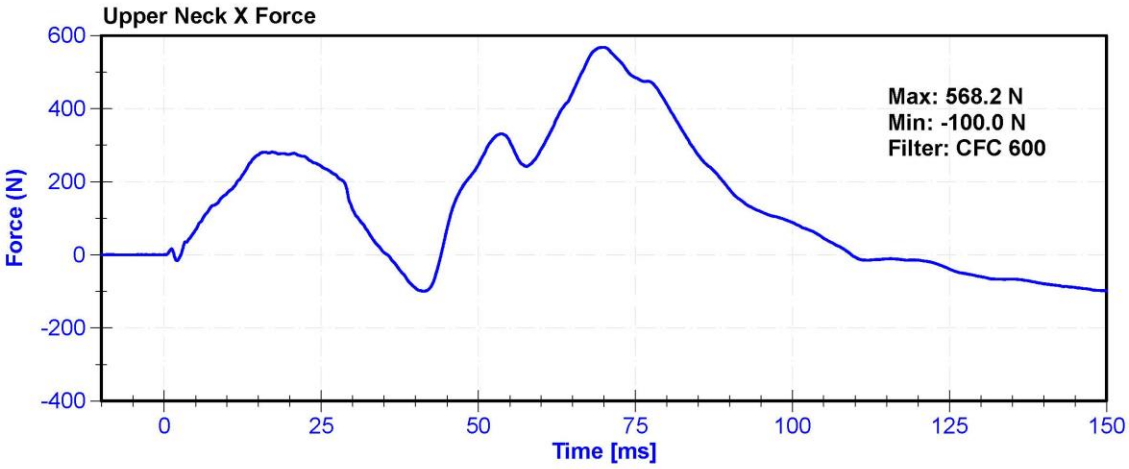
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-C16503 Striker	2/6/2020	2/5/2021
Pendulum Potentiometer	ETI SP22G	DS-LABPOT1	9/13/2019	9/12/2020
Condyle Potentiometer	ETI SP22G	DS-LABPOT2	9/13/2019	9/12/2020
Upper Neck Load Cell	Denton IF-205	LC-280FxGFE	10/3/2019	10/2/2020


D-Plane Rotation
Rotation (deg)
125
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]
Max: 98.6 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: 20.2 Nm
Min: -69.4 Nm
Filter: CFC 600


Pendulum Deceleration
Max: 20.6 g's
Min: -4.1 g's
Filter: CFC 60
Acceleration (g's)
Time [ms]


Upper Neck Y Moment
Max: 25.0 Nm
Min: -59.8 Nm
Filter: CFC 600
Moment (Nm)
Time [ms]


Upper Neck X Force
Max: 568.2 N
Min: -100.0 N
Filter: CFC 600
Force (N)
Time [ms]

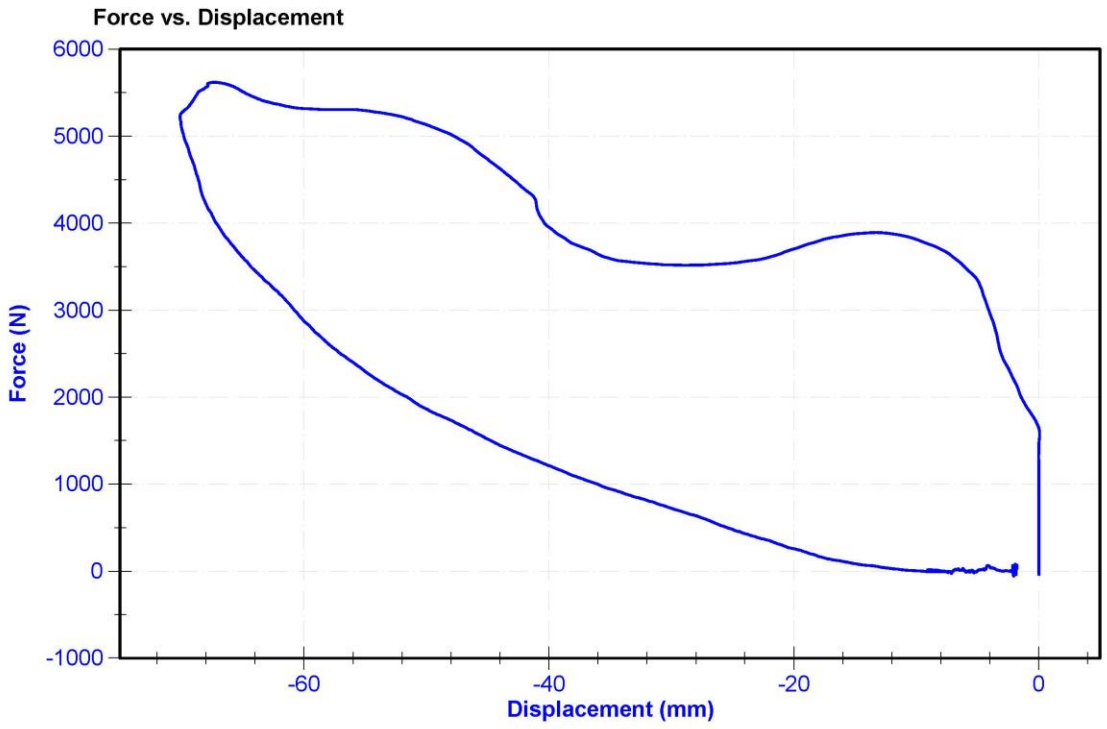
ATD Manufacturer	Humanetics	Test Technician	D.Reinhard
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

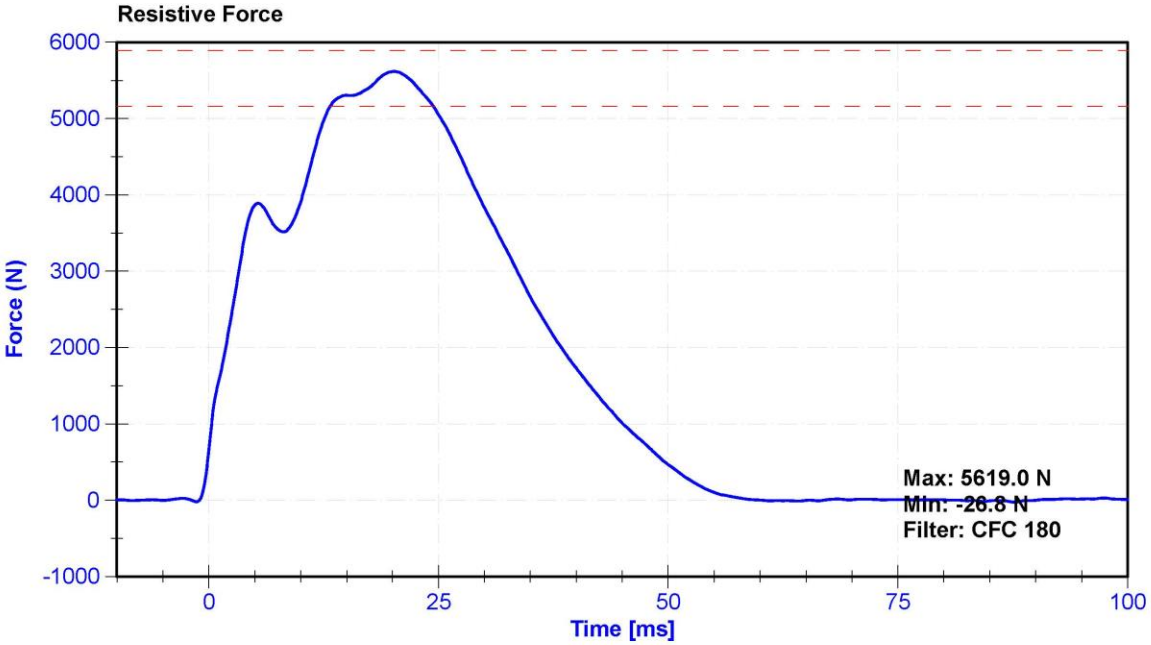
Results

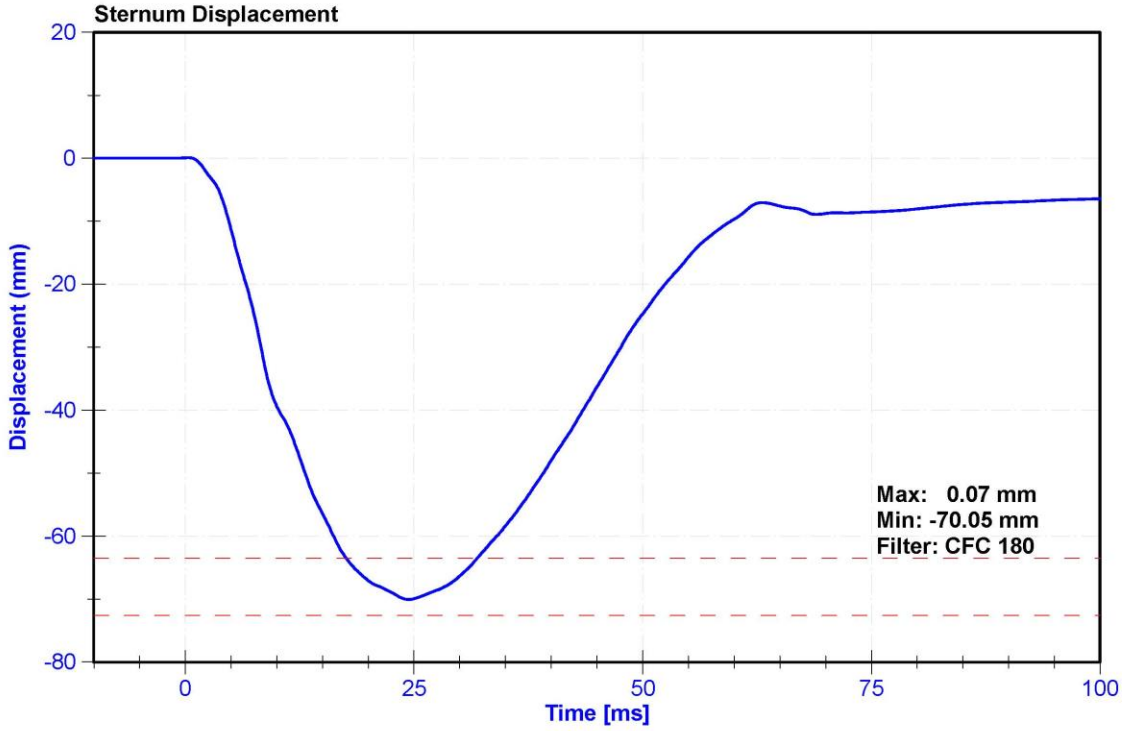
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.6	Pass
Humidity	10	70	%	46.6	Pass
Velocity	6.59	6.83	m/s	6.597	Pass
Chest Displacement	-72.6	-63.5	mm	-70.05	Pass
Resistive Force	5160	5894	N	5619.0	Pass
Hysteresis	65	85	%	69.0	Pass

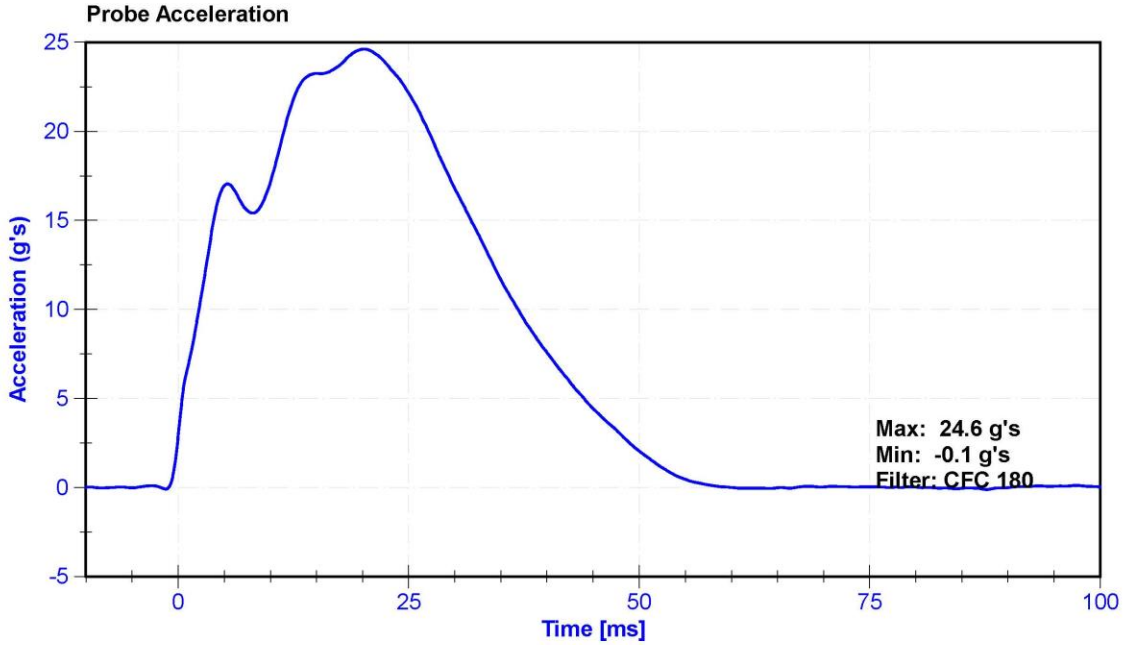
Transducer Calibrations

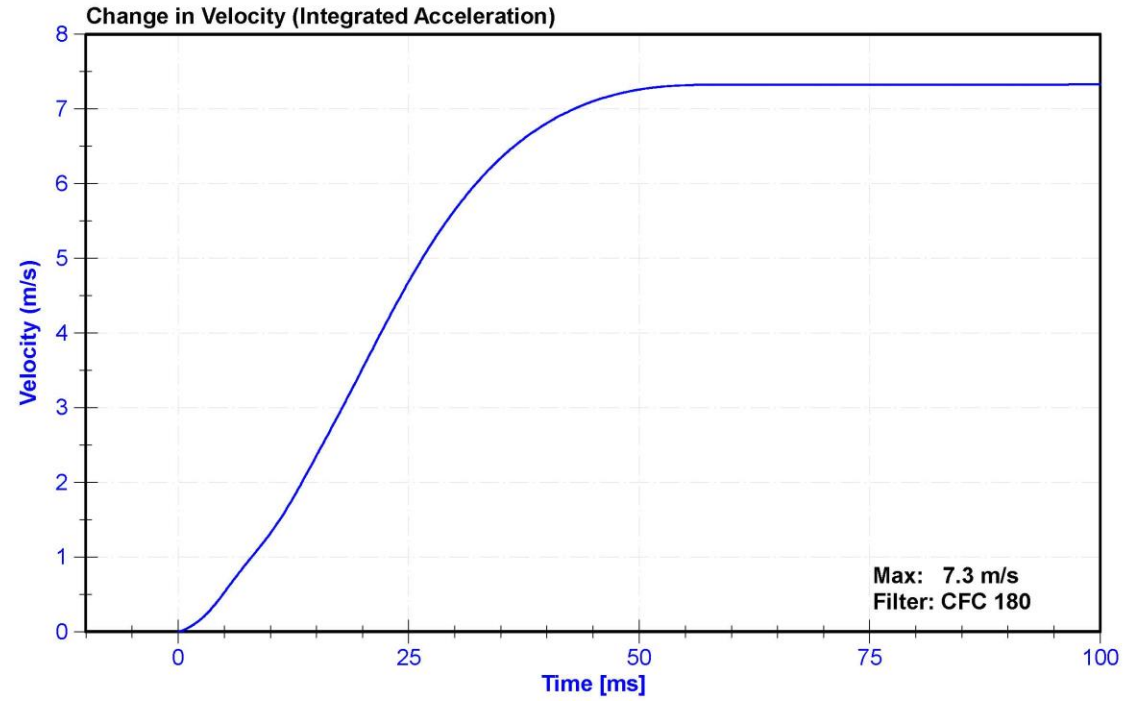
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A260568	1/29/2020	7/29/2020
Chest Potentiometer	Servo 6209-2038	DS-142	3/27/2020	9/25/2020




Resistive Force
Force (N)
6000
5000
4000
3000
2000
1000
0
-1000
0
25
50
75
100
Time [ms]
Max: 5619.0 N
Min: -26.8 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: -70.05 mm
Filter: CFC 180


Probe Acceleration
Acceleration (g's)
25
20
15
10
5
0
-5
0
25
50
75
100
Time [ms]
Max: 24.6 g's
Min: -0.1 g's
Filter: CFC 180


Change in Velocity (Integrated Acceleration)
Velocity (m/s)
8
7
6
5
4
3
2
1
0
0
25
50
75
100
Time [ms]
Max: 7.3 m/s
Filter: CFC 180

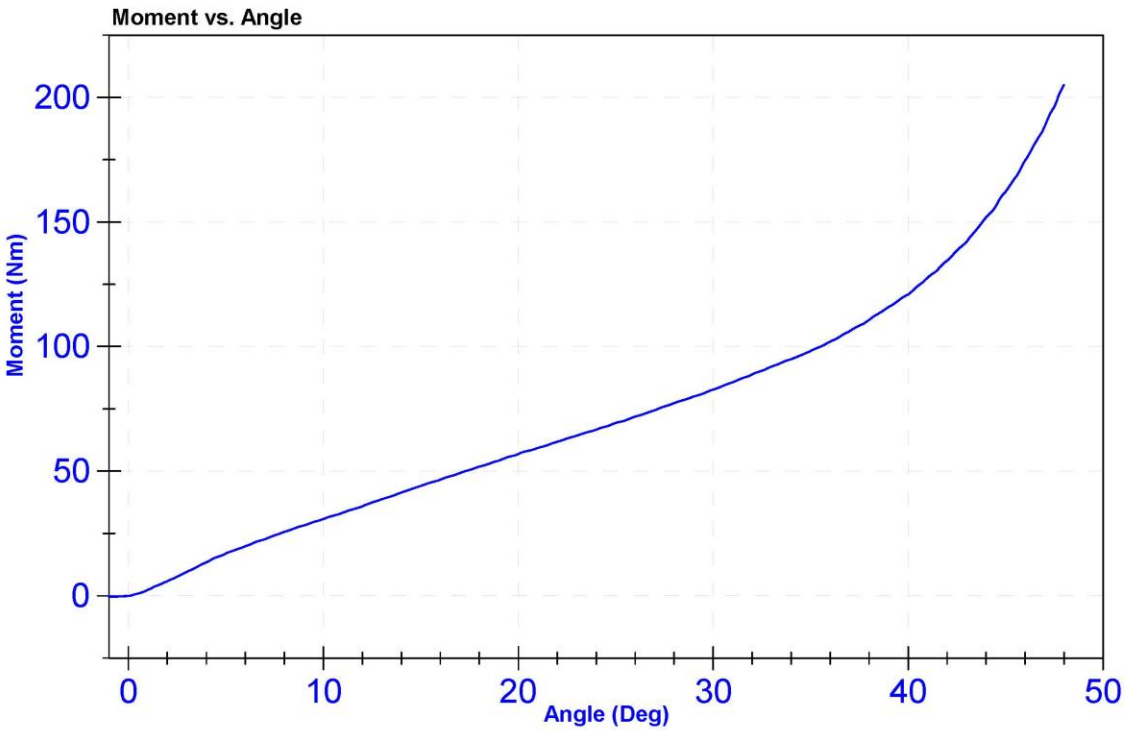
ATD Manufacturer	Humanetics	Test Technician	M. Dudek
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	20.4	Pass
Humidity	10	70	%	29.2	Pass
Average Velocity	5	10	deg/s	7.0	Pass
Angle at 203Nm	40	50	deg	47.9	Pass
Moment at 30 degrees	0	94.9	Nm	82.8	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	ETI SP22	DS-0008	9/18/2019	9/17/2020
Load Cell	Key Trans 2301-02	LC-115 My	9/12/2019	9/11/2020



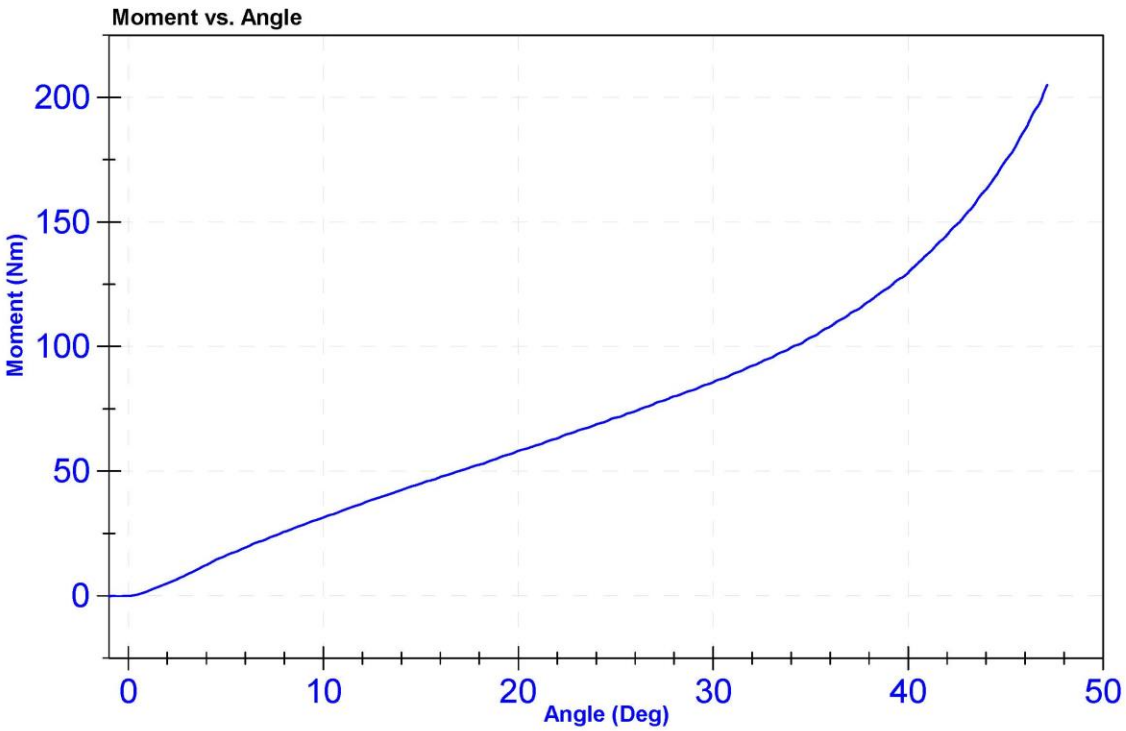
ATD Manufacturer	Humanetics	Test Technician	M. Dudek
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	20.4	Pass
Humidity	10	70	%	29.2	Pass
Average Velocity	5	10	deg/s	7.0	Pass
Angle at 203Nm	40	50	deg	47.0	Pass
Moment at 30 degrees	0	94.9	Nm	85.7	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	ETI SP22	DS-0008	9/18/2019	9/17/2020
Load Cell	Key Trans 2301-02	LC-115 My	9/12/2019	9/11/2020



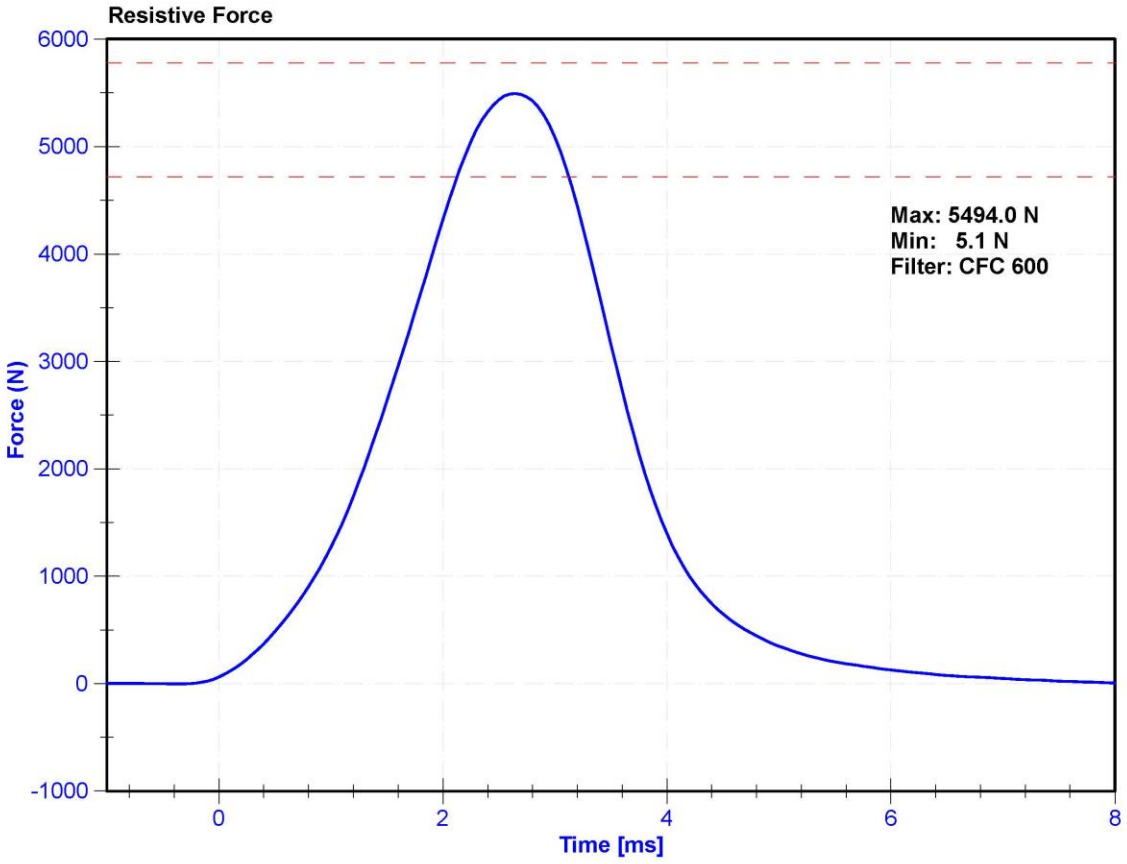
ATD Manufacturer	Humanetics	Test Technician	M. Dudek
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

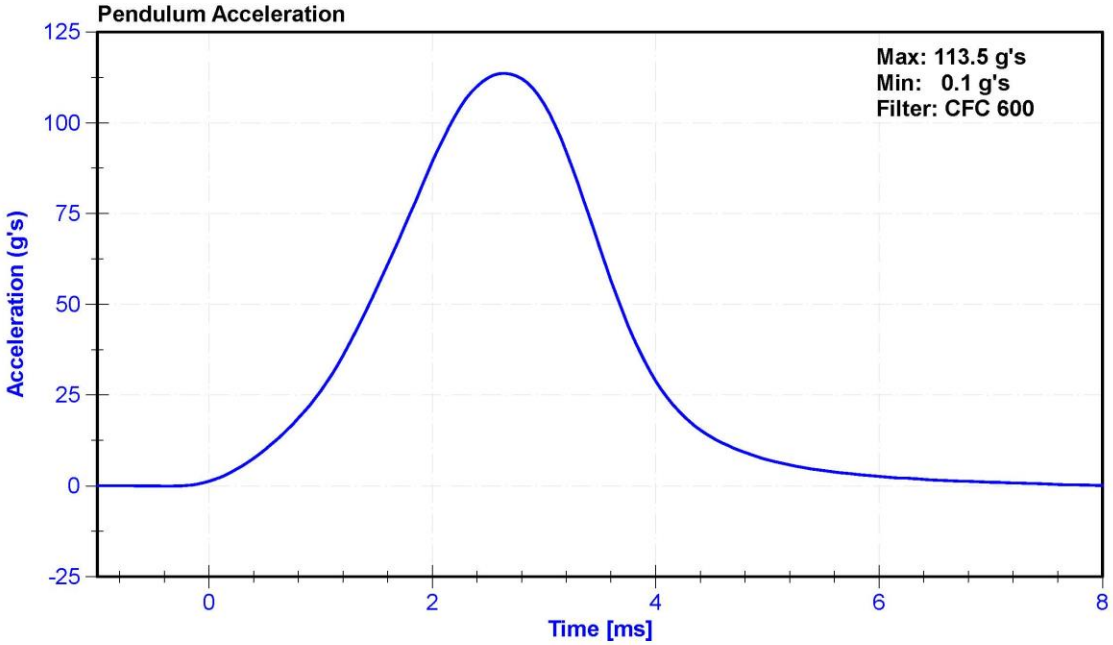
Results

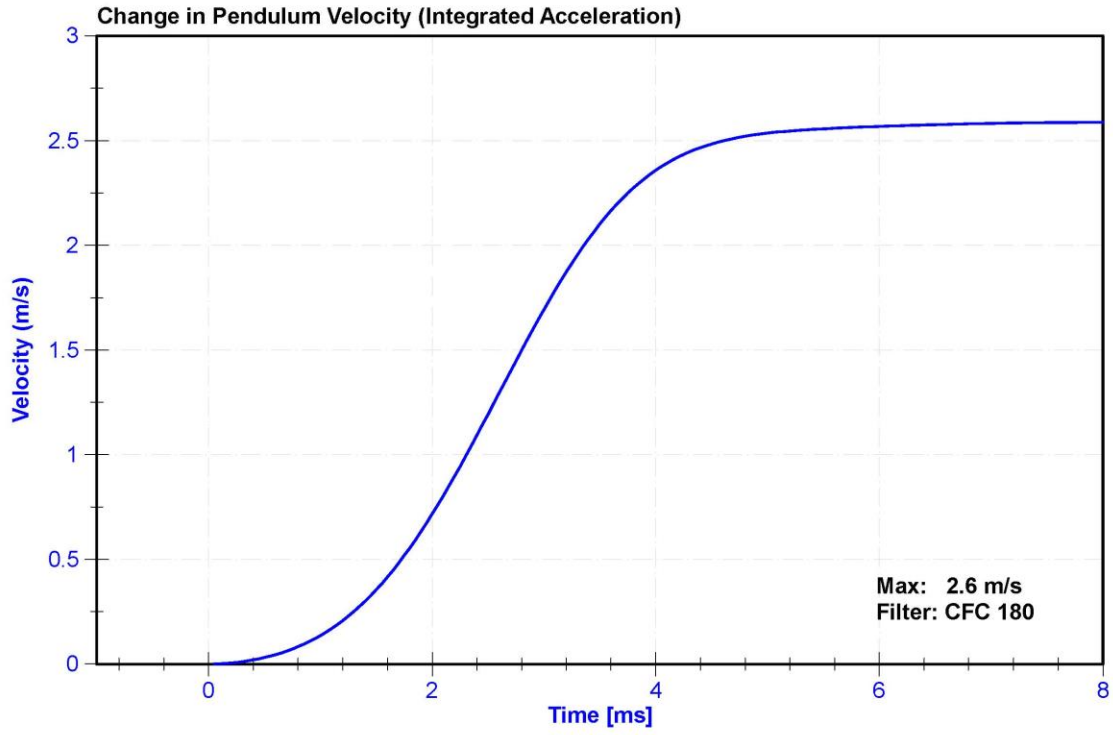
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	20.2	Pass
Humidity	10	70	%	31.3	Pass
Velocity	2.07	2.13	m/s	2.081	Pass
Maximum Resistive Force	4720	5780	N	5494.0	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A260568	1/29/2020	7/29/2020




Pendulum Acceleration
Max: 113.5 g's
Min: 0.1 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]

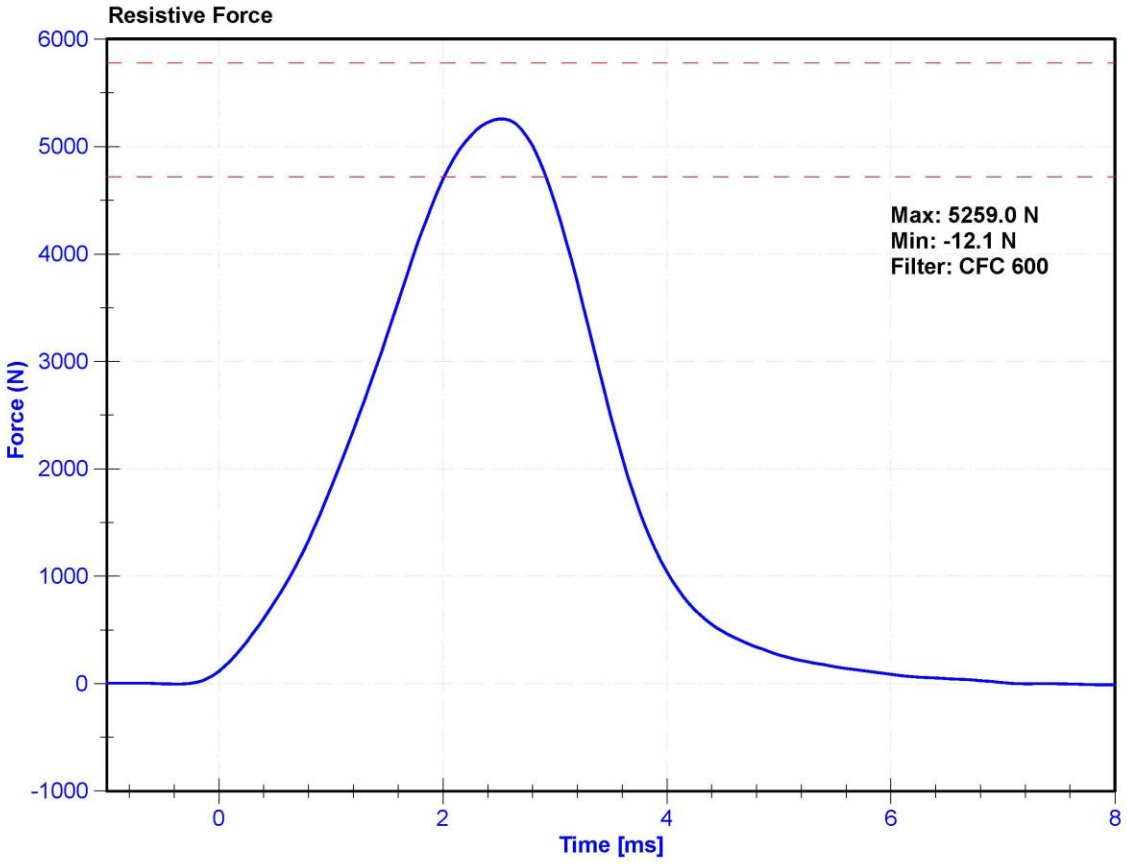
ATD Manufacturer	Humanetics	Test Technician	M. Dudek
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

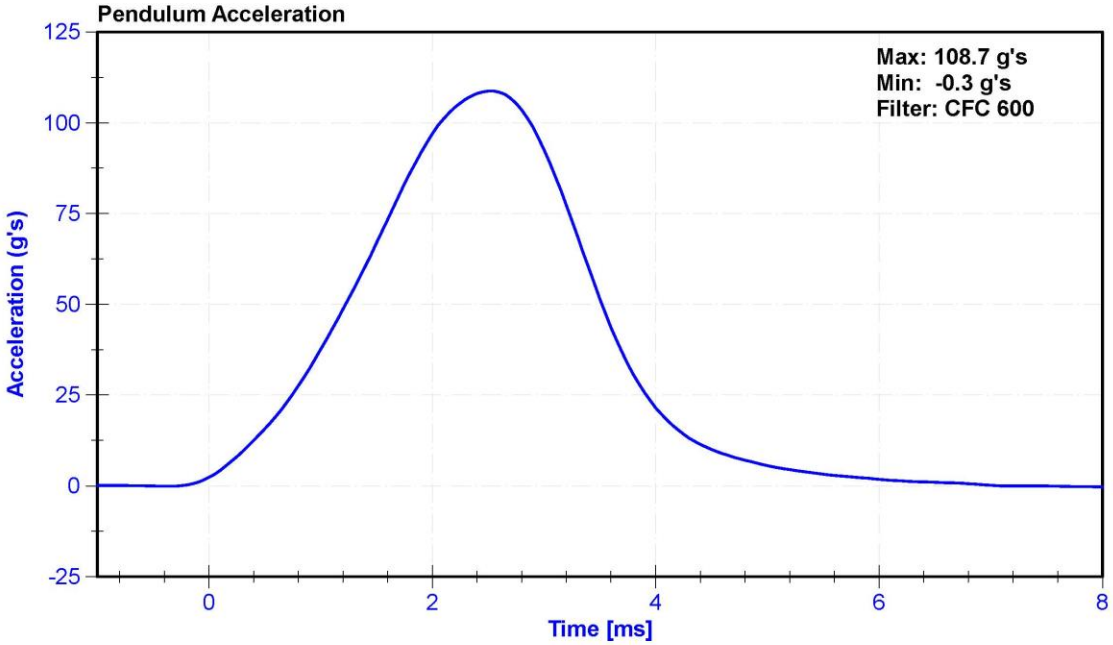
Results

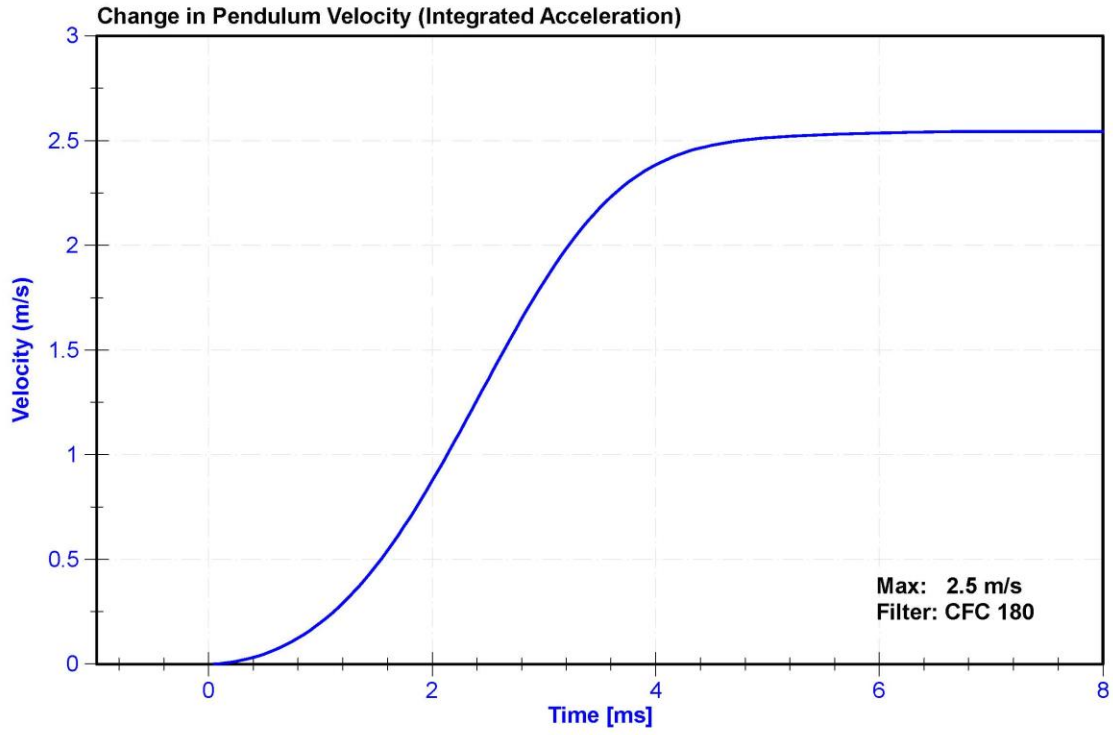
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	20.1	Pass
Humidity	10	70	%	31.3	Pass
Velocity	2.07	2.13	m/s	2.078	Pass
Maximum Resistive Force	4720	5780	N	5259.0	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A260568	1/29/2020	7/29/2020




Pendulum Acceleration
Max: 108.7 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: 2.5 m/s
Filter: CFC 180
0
2
4
6
8
Time [ms]

CALIBRATION TEST RESULTS

PRE-TEST

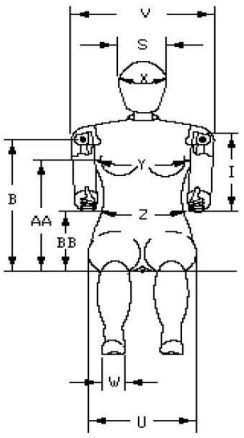
HYBRID III 5TH PERCENTILE - PASSENGER ATD

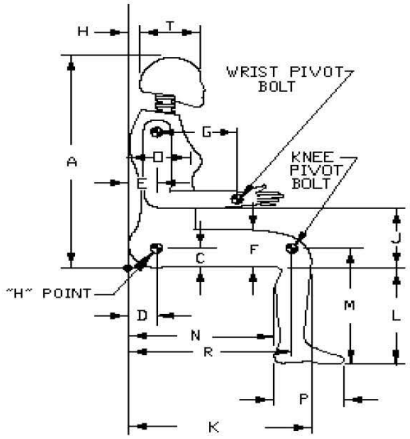
SERIAL NO: 139

External Measurements - Hybrid 3 - 5th Female

Technician: K. Brogan Date: 04/17/2020

Dummy Serial Number: 139





Symbol	Description	Specification (mm)		Result (mm)	Pass/Fail
A	Sitting Height	775	800	791	Pass
B	Shoulder Pivot Height	432	457	447	Pass
C	H-Point Height	81	86	84	Pass
D	H-Point from Backline	145	150	146	Pass
E	Shoulder Pivot from Backline	69	84	78	Pass
F	Thigh Clearance	119	135	125	Pass
G	Back of Elbow to Wrist Pivot	244	259	254	Pass
H	Head Back to Backline	43	48	45	Pass
I	Shoulder to Elbow Length	277	297	289	Pass
J	Elbow Rest Height	183	203	190	Pass
K	Buttock to Knee Length	521	546	541	Pass
L	Popliteal Height	356	376	363	Pass
M	Knee Pivot Height	394	419	402	Pass
N	Buttock Popliteal Length	414	439	426	Pass
O	Chest Depth without Jacket	175	191	185	Pass
P	Foot Length (right)	219	234	225	Pass
R	Buttock To Knee Pivot Length	457	483	473	Pass
S	Head Breadth	137	147	143	Pass
T	Head Depth	178	188	182	Pass
U	Hip Breadth	300	315	310	Pass
V	Shoulder Breadth	351	366	362	Pass
W	Foot Breadth	79	94	87	Pass
X	Head Circumference	528	549	535	Pass
Y	Chest Circumference with Jacket	851	881	861	Pass
Z	Waist Circumference	460	790	773	Pass
AA	Reference Location (Chest Circumference)	333	358	345	Pass
BB	Reference Location (Waist Circumference)	160	170	165	Pass

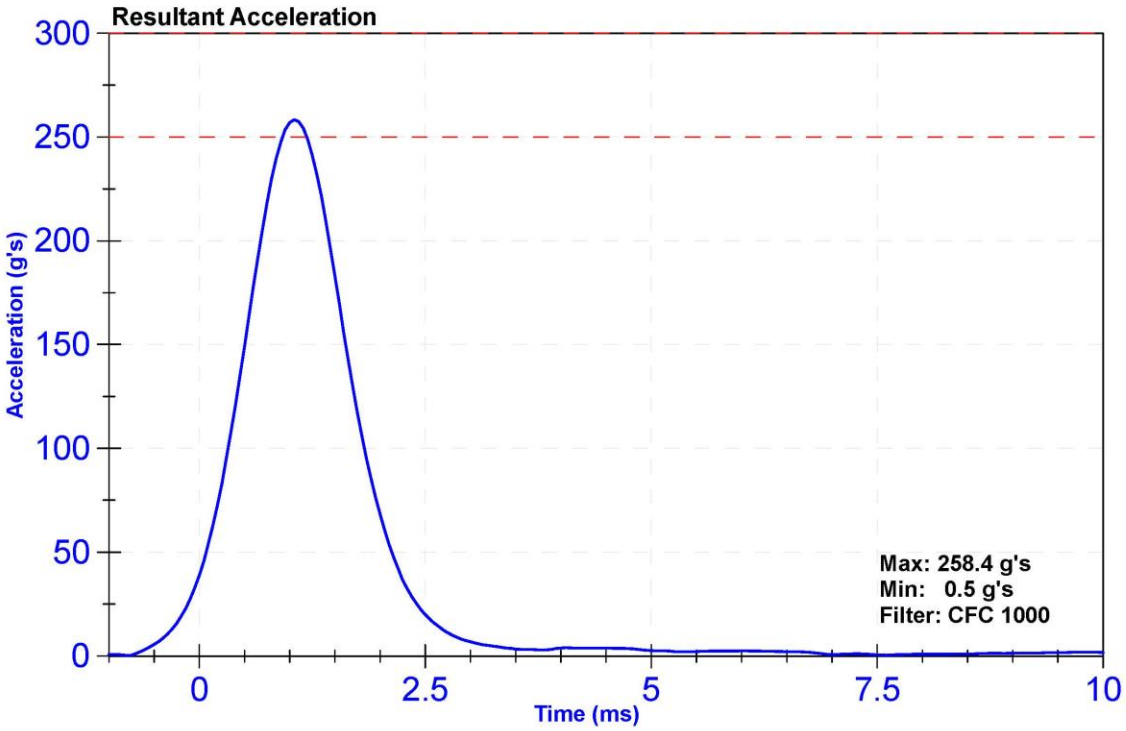
ATD Manufacturer	Denton	Test Technician	M. Dudek
ATD Serial Number	139	Laboratory Supervisor	K. Brogan

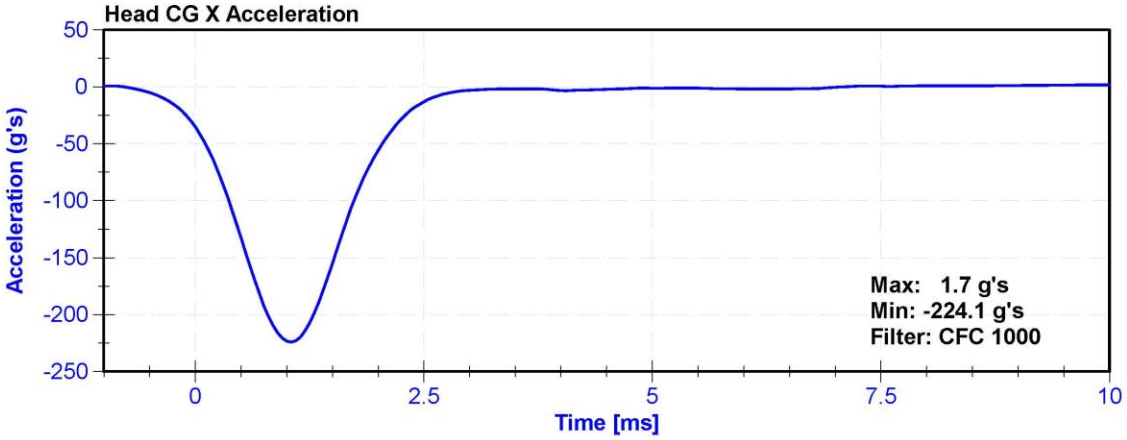
Results

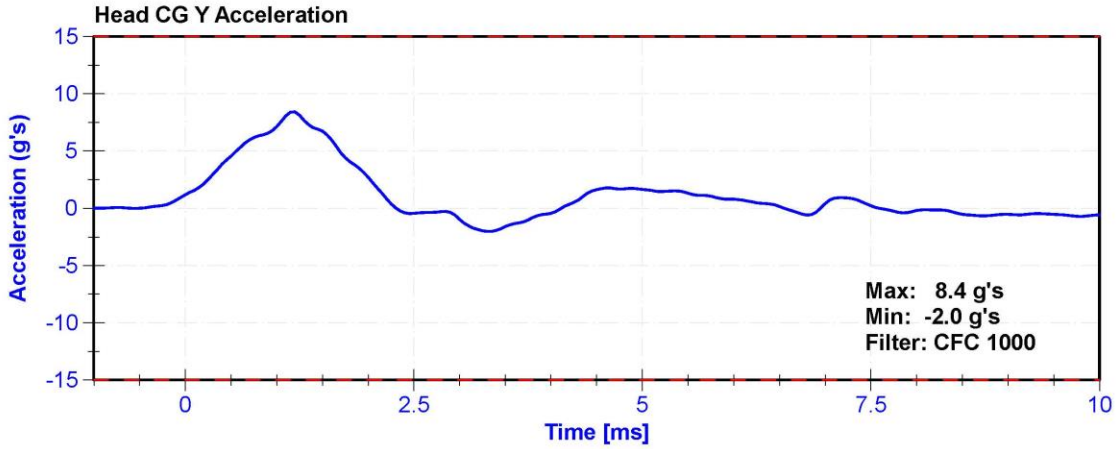
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	20.6	Pass
Humidity	10	70	%	23.8	Pass
Resultant Acceleration	250	300	g's	258.4	Pass
Oscillation	0	10	%	2.7	Pass
Lateral Acceleration	-15	15	g's	8.4	Pass

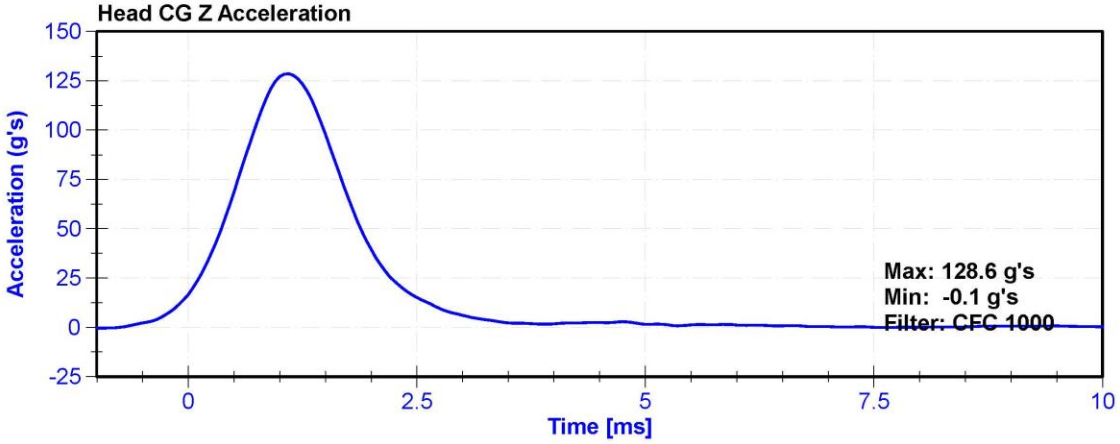
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	ENDEVCO 7264CT	AC-P58998	4/17/2020	10/16/2020
Y Accelerometer	ENDEVCO 7264	AC-P83320	4/17/2020	10/16/2020
Z Accelerometer	ENDEVCO 7264CT	AC-P58997	4/17/2020	10/16/2020




Head CG X Acceleration
Acceleration (g's)
50
0
-50
-100
-150
-200
-250
0
2.5
5
7.5
10
Time [ms]
Max: 1.7 g's
Min: -224.1 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: 8.4 g's
Min: -2.0 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: 128.6 g's
Min: -0.1 g's
Filter: CFC 1000

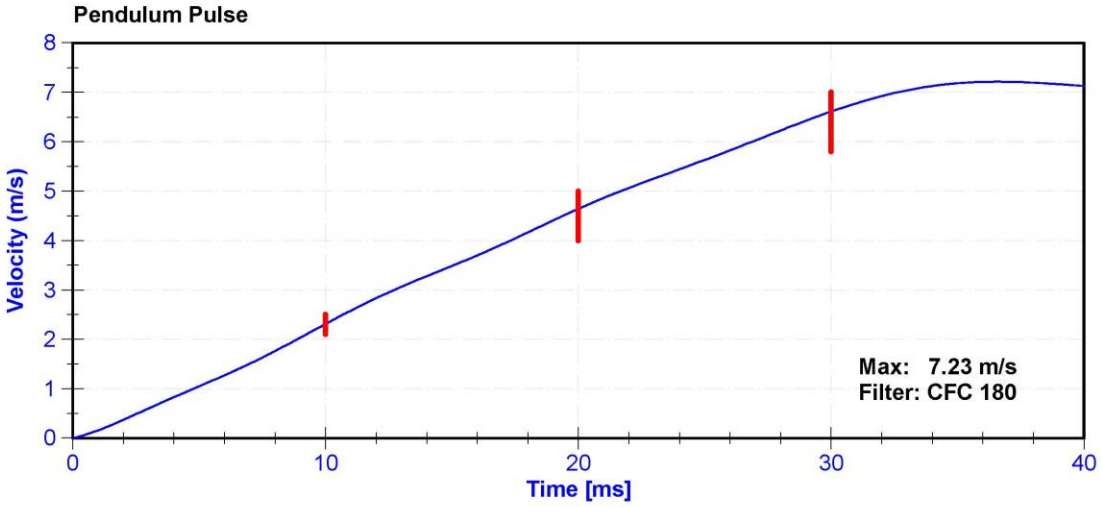
ATD Manufacturer	Denton	Test Technician	C. Mantell
ATD Serial Number	139	Laboratory Supervisor	K. Brogan

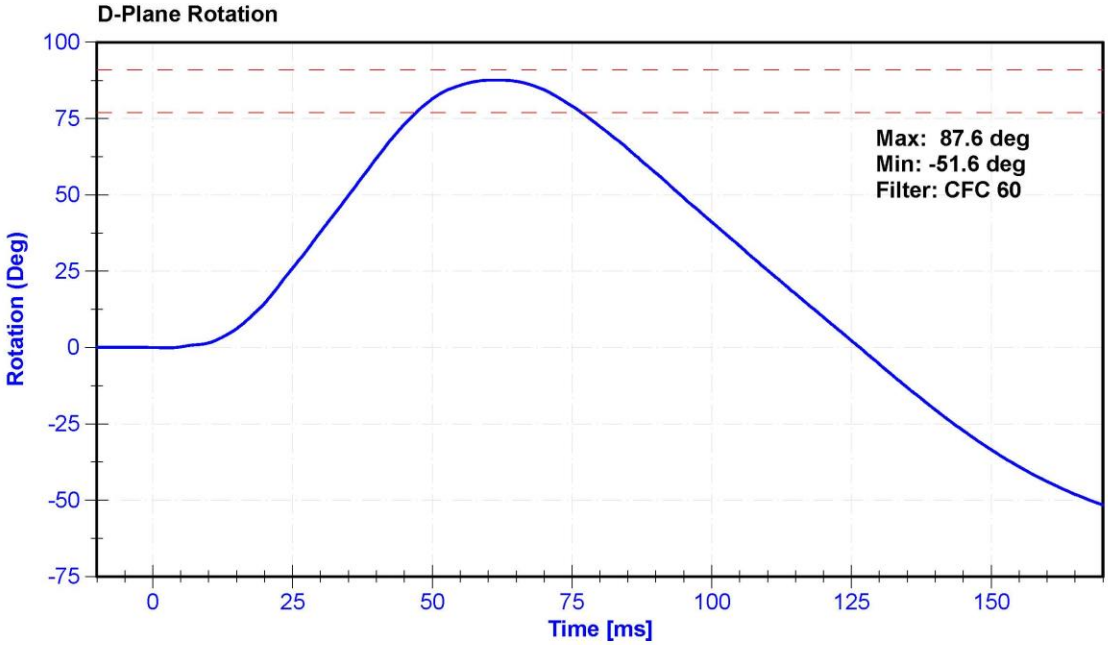
Results

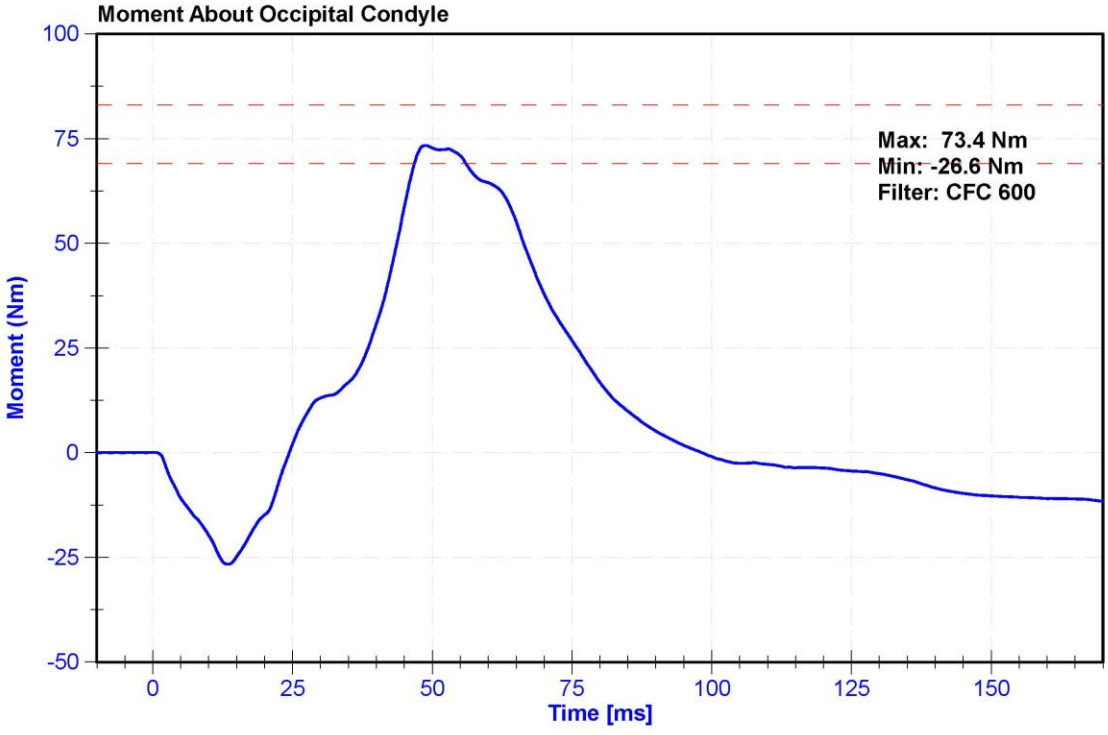
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	22.0	Pass
Humidity	10	70	%	33.0	Pass
Velocity	6.89	7.13	m/s	6.903	Pass
Pendulum Impulse at 10ms	2.1	2.5	m/s	2.31	Pass
Pendulum Impulse at 20ms	4.0	5.0	m/s	4.64	Pass
Pendulum Impulse at 30ms	5.8	7.0	m/s	6.61	Pass
Max D Plane Rotation	77	91	deg	87.6	Pass
Max Moment During Rotation Interval	69	83	Nm	73.4	Pass
Moment Decay to 10.0 Nm	80	100	ms	84.9	Pass

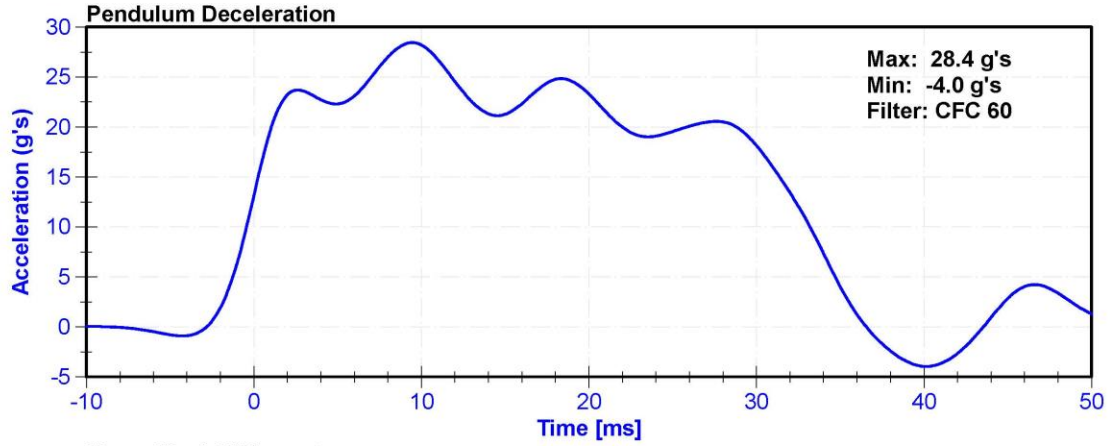
Transducer Calibrations

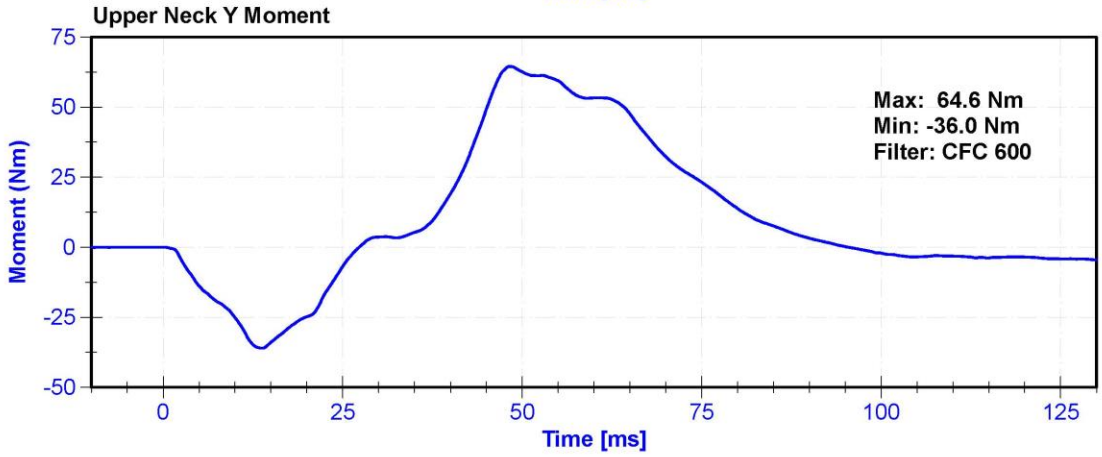
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-AH5M9 Pend	1/30/2020	1/29/2021
Pendulum Potentiometer	ETI SP22G	DS-LABPOT1	9/13/2019	9/12/2020
Condyle Potentiometer	ETI SP22G	DS-LABPOT2	9/13/2019	9/12/2020
Upper Neck Load Cell	Denton 1716A	LC-1916Fx	10/3/2019	10/2/2020

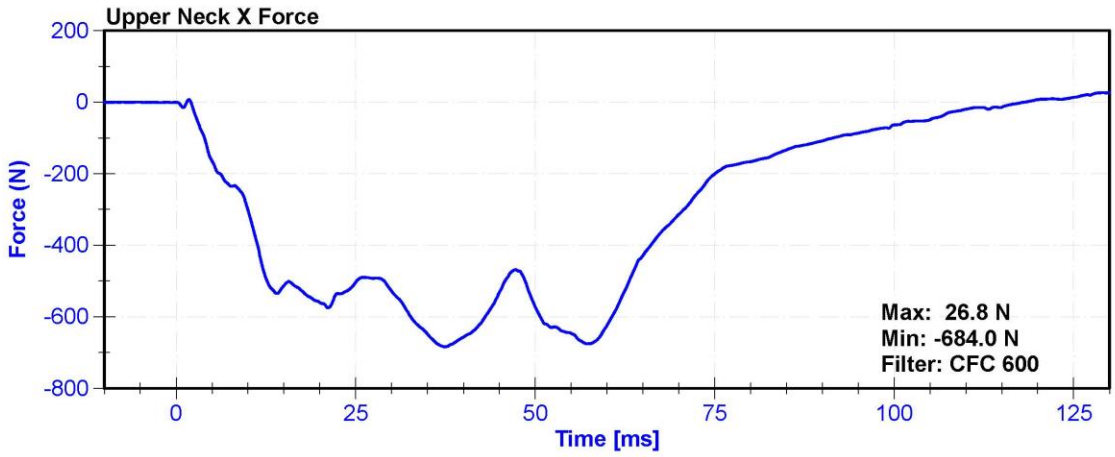



D-Plane Rotation
Max: 87.6 deg
Min: -51.6 deg
Filter: CFC 60
Rotation (Deg)
100
75
50
25
0
-25
-50
-75
0
25
50
75
100
125
150
Time [ms]


Moment About Occipital Condyle
Max: 73.4 Nm
Min: -26.6 Nm
Filter: CFC 600
Moment (Nm)
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]


Pendulum Deceleration
Max: 28.4 g's
Min: -4.0 g's
Filter: CFC 60
Acceleration (g's)
Time [ms]


Upper Neck Y Moment
Max: 64.6 Nm
Min: -36.0 Nm
Filter: CFC 600
Moment (Nm)
Time [ms]


Upper Neck X Force
Max: 26.8 N
Min: -684.0 N
Filter: CFC 600
Force (N)
Time [ms]

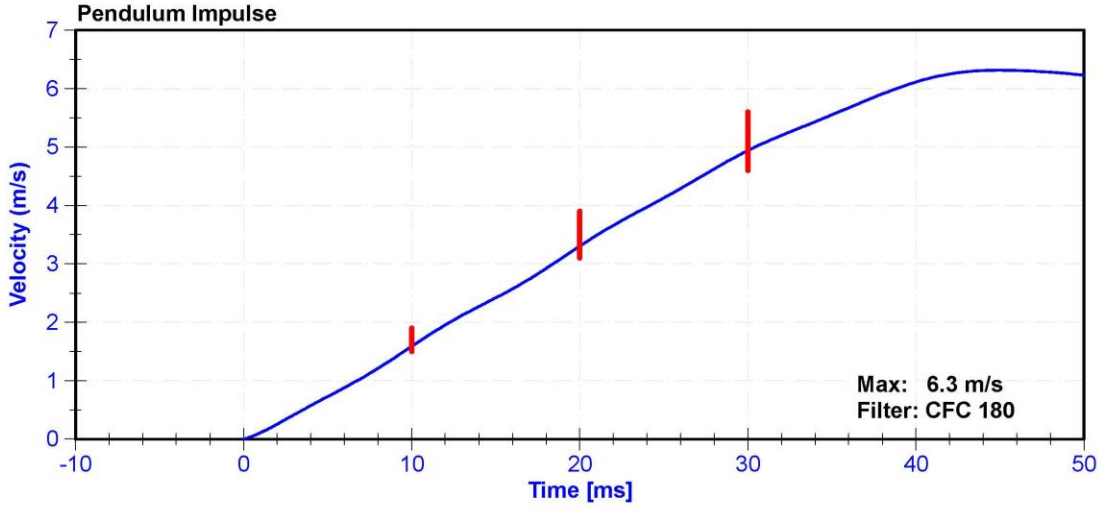
ATD Manufacturer	Denton	Test Technician	C. Mantell
ATD Serial Number	139	Laboratory Supervisor	K. Brogan

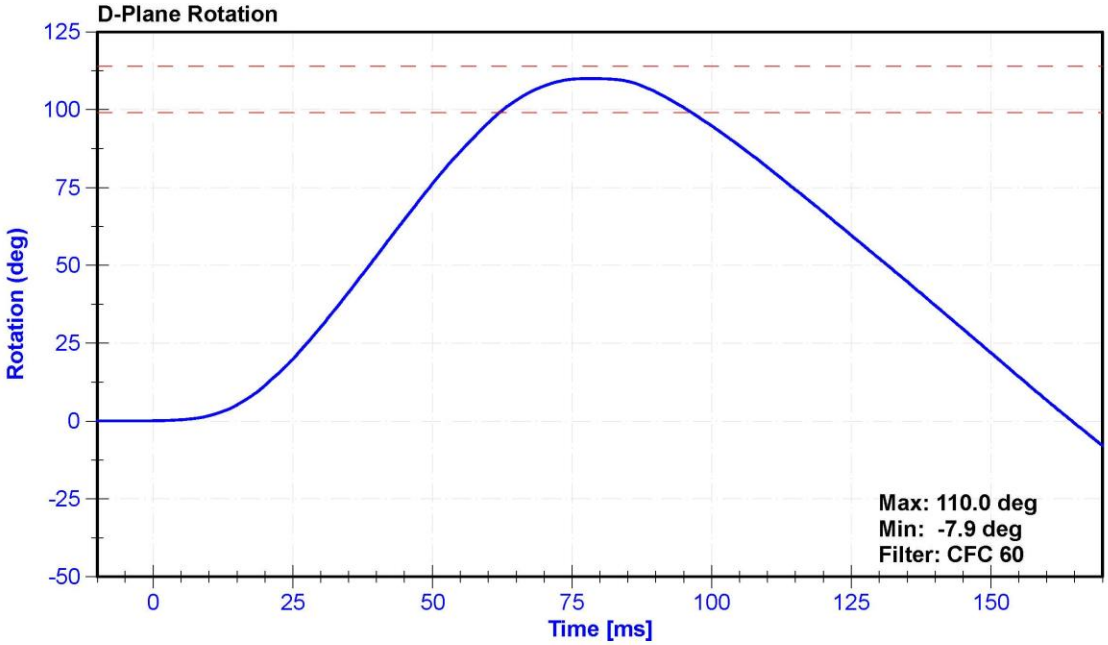
Results

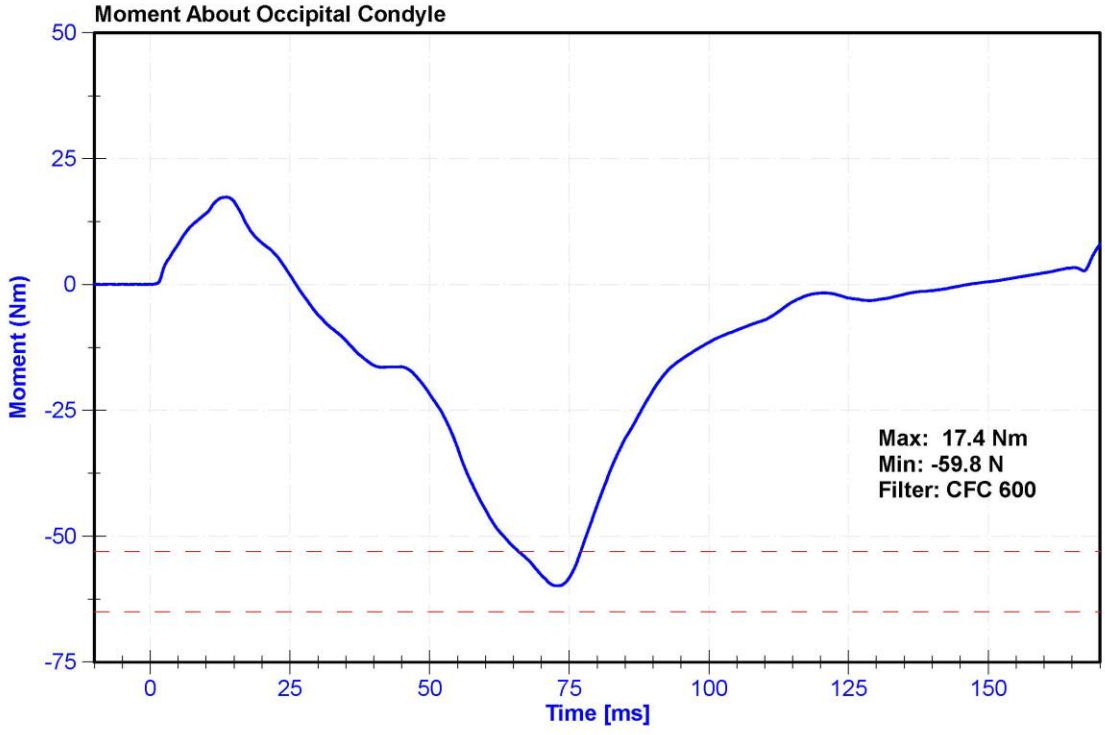
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.9	Pass
Humidity	10	70	%	32.8	Pass
Velocity	5.95	6.19	m/s	6.046	Pass
Pendulum Impulse at 10ms	1.5	1.9	m/s	1.59	Pass
Pendulum Impulse at 20ms	3.1	3.9	m/s	3.30	Pass
Pendulum Impulse at 30ms	4.6	5.6	m/s	4.94	Pass
D Plane Rotation	99	114	deg	110.0	Pass
Moment During Rotation Interval	-65	-53	Nm	-59.8	Pass
Moment Decay to -10Nm	94	114	ms	102.9	Pass

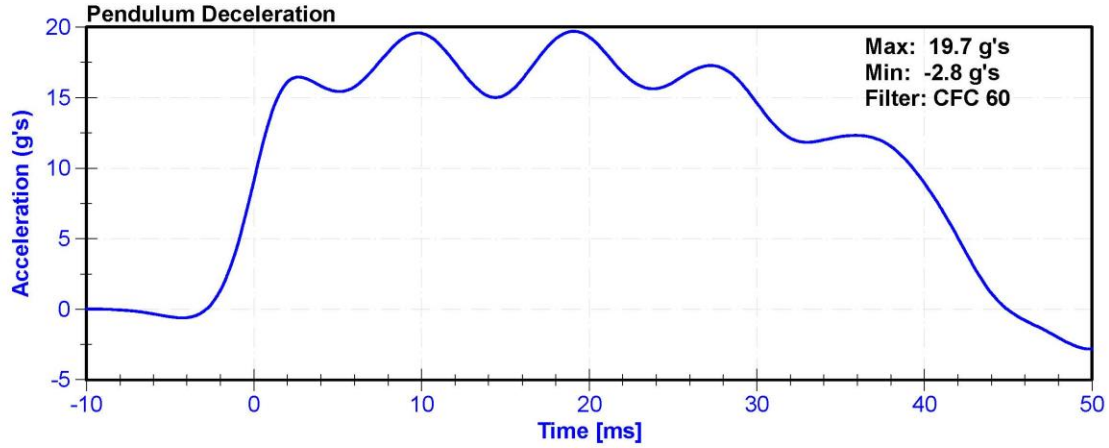
Transducer Calibrations

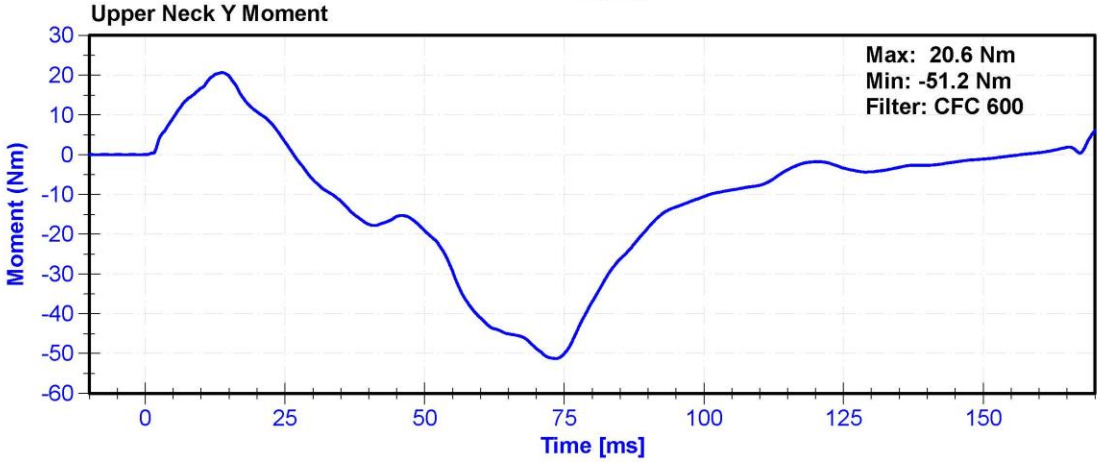
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-AH5M9 Pend	1/30/2020	1/29/2021
Pendulum Potentiometer	ETI SP22G	DS-LABPOT1	9/13/2019	9/12/2020
Condyle Potentiometer	ETI SP22G	DS-LABPOT2	9/13/2019	9/12/2020
Upper Neck Load Cell	Denton 1716A	LC-1916Fx	10/3/2019	10/2/2020

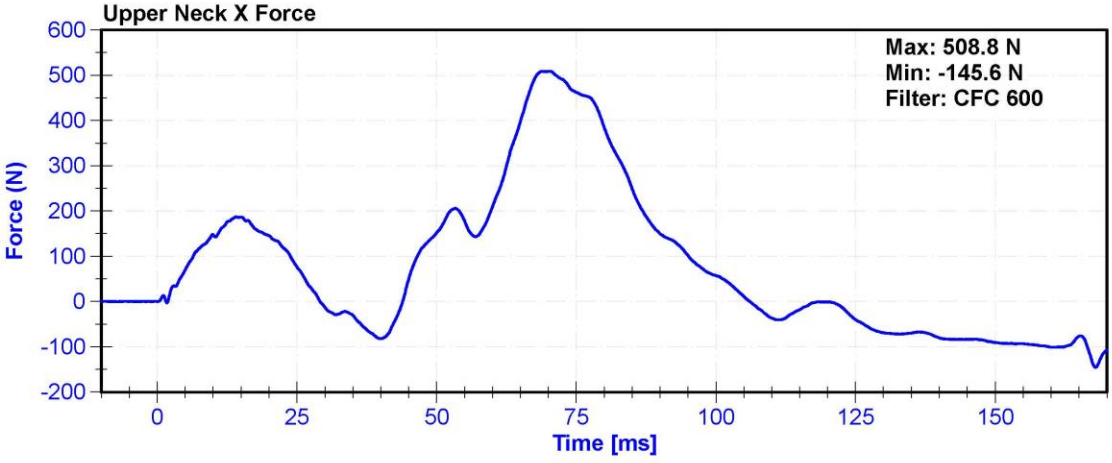



D-Plane Rotation
Rotation (deg)
125
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]
Max: 110.0 deg
Min: -7.9 deg
Filter: CFC 60


Moment About Occipital Condyle
Moment (Nm)
50
25
0
-25
-50
-75
0
25
50
75
100
125
150
Time [ms]
Max: 17.4 Nm
Min: -59.8 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: 20.6 Nm
Min: -51.2 Nm
Filter: CFC 600
Moment (Nm)
Time [ms]


Upper Neck X Force
Max: 508.8 N
Min: -145.6 N
Filter: CFC 600
Force (N)
Time [ms]

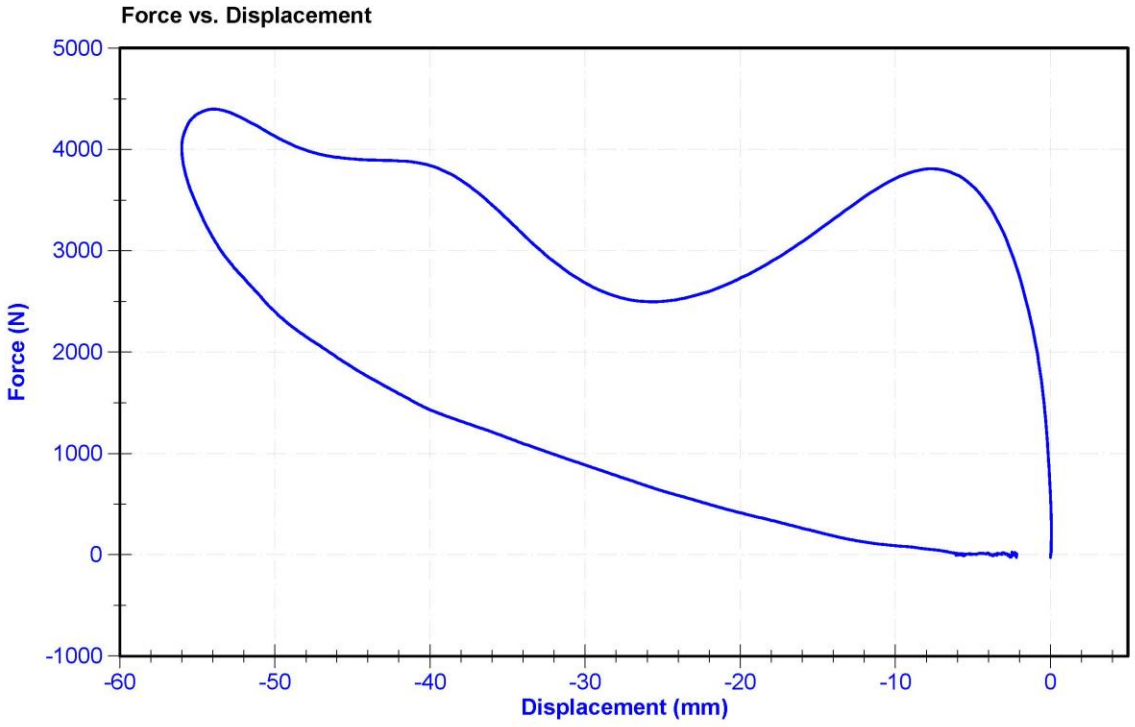
ATD Manufacturer	Denton	Test Technician	D.Reinhard
ATD Serial Number	139	Laboratory Supervisor	K. Brogan

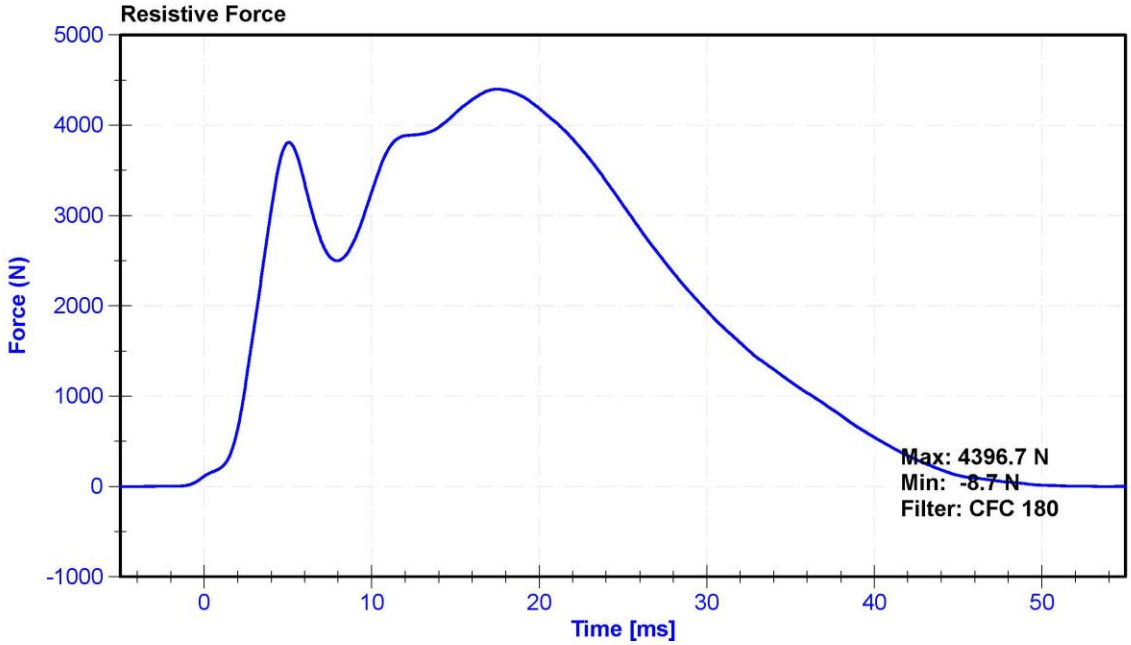
Results

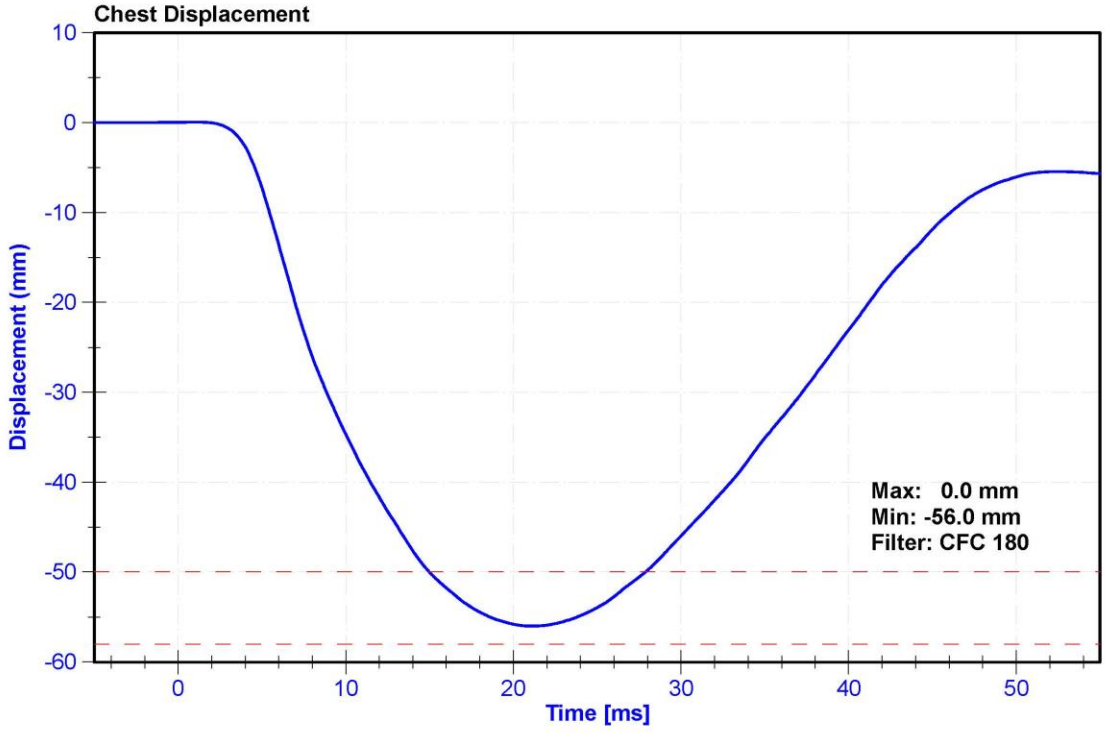
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.8	Pass
Humidity	10	70	%	28.2	Pass
Velocity	6.59	6.83	m/s	6.804	Pass
Chest Deflection	-58	-50	mm	-56.0	Pass
Maximum Resistive Force (50 to 58mm)	3900	4400	N	4396.7	Pass
Maximum Resistive Force (18 to 50mm)	0	4600	N	4124.1	Pass
Hysteresis	69	85	%	69.7	Pass

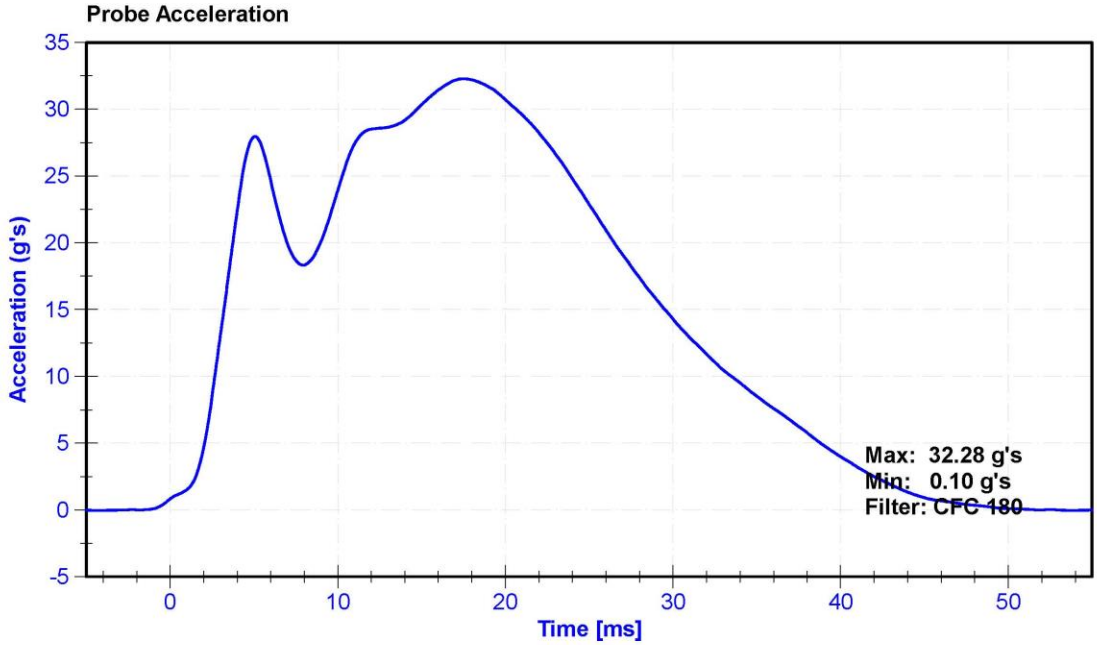
Transducer Calibrations

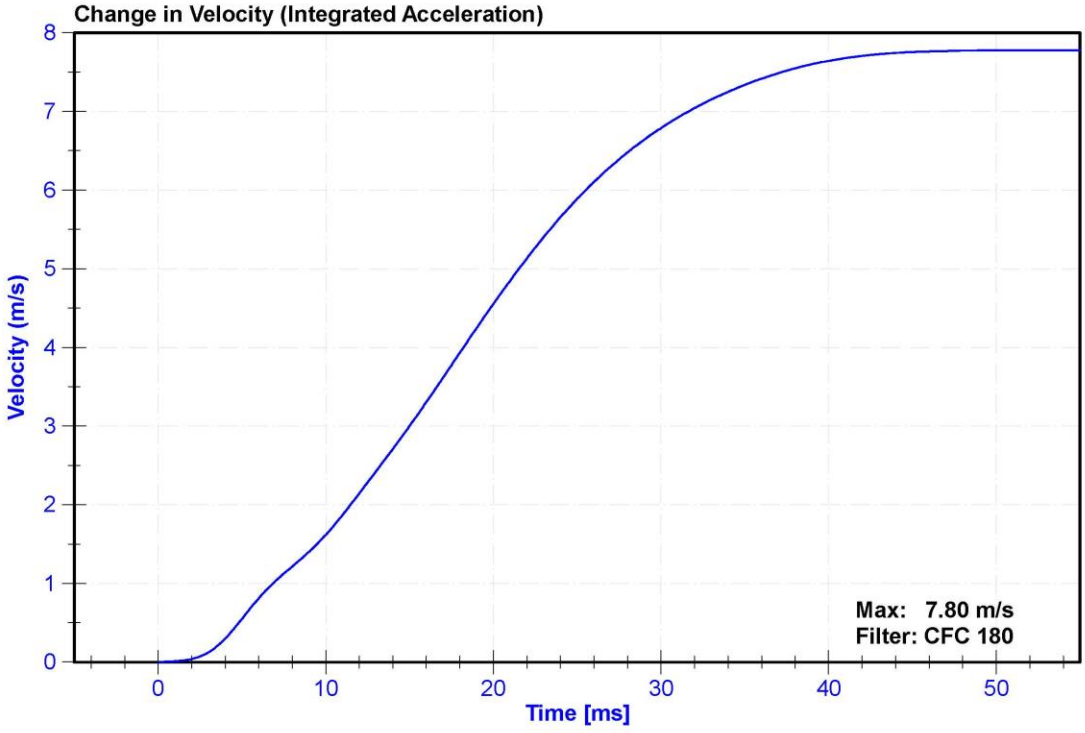
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A260568	1/29/2020	7/29/2020
Chest Potentiometer	SERVO 14CB1-2897	DS-288GFE	4/17/2020	10/16/2020




Resistive Force
Force (N)
5000
4000
3000
2000
1000
0
-1000
0
10
20
30
40
50
Time [ms]
Max: 4396.7 N
Min: -8.7 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: -56.0 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: 32.28 g's
Min: 0.10 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: 7.80 m/s
Filter: CFC 180

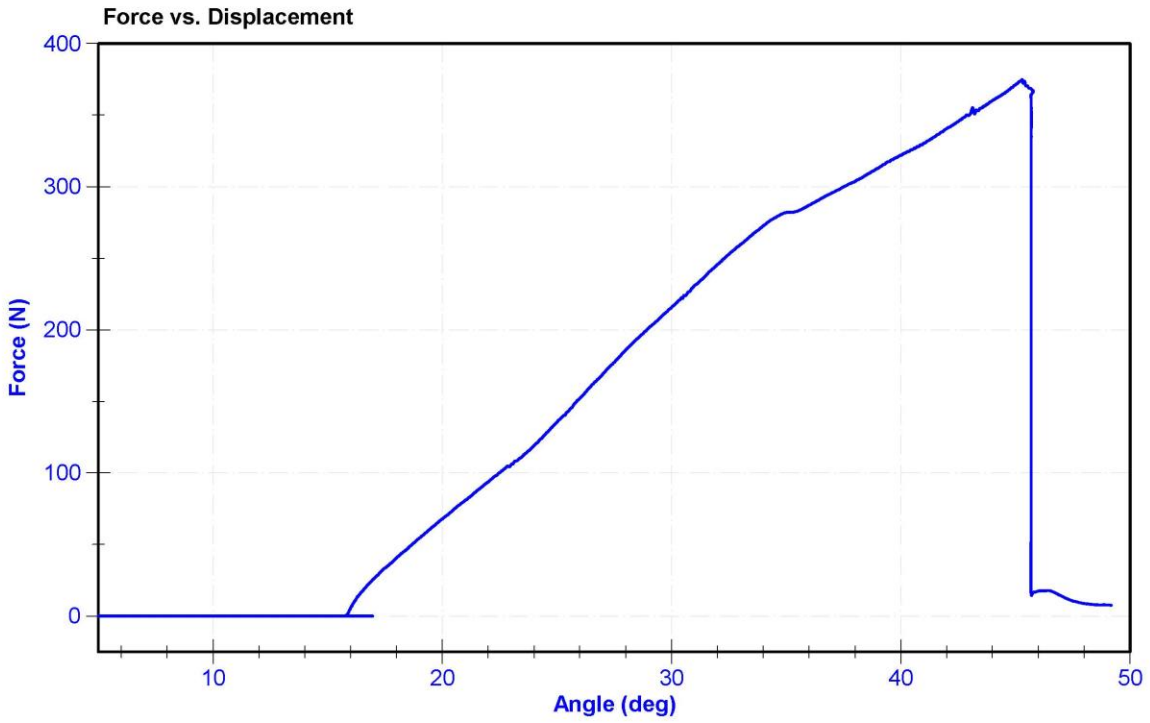
ATD Manufacturer	Denton	Test Technician	D.Reinhard
ATD Serial Number	139	Laboratory Supervisor	K. Brogan

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.6	25.6	ºC	21	Pass
Humidity	10	70	%	23	Pass
Initial Angle	0	20	deg	15.6	Pass
Force at 45 Degrees	320	390	N	374.8	Pass
Return Angle Relative to Initial	0	8	deg	0.9	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	Rieker N4C-1	DS-13051548	2019-12-09	2020-12-08
Load Cell	Interface SML-200	LC-493319	2020-01-10	2021-01-09



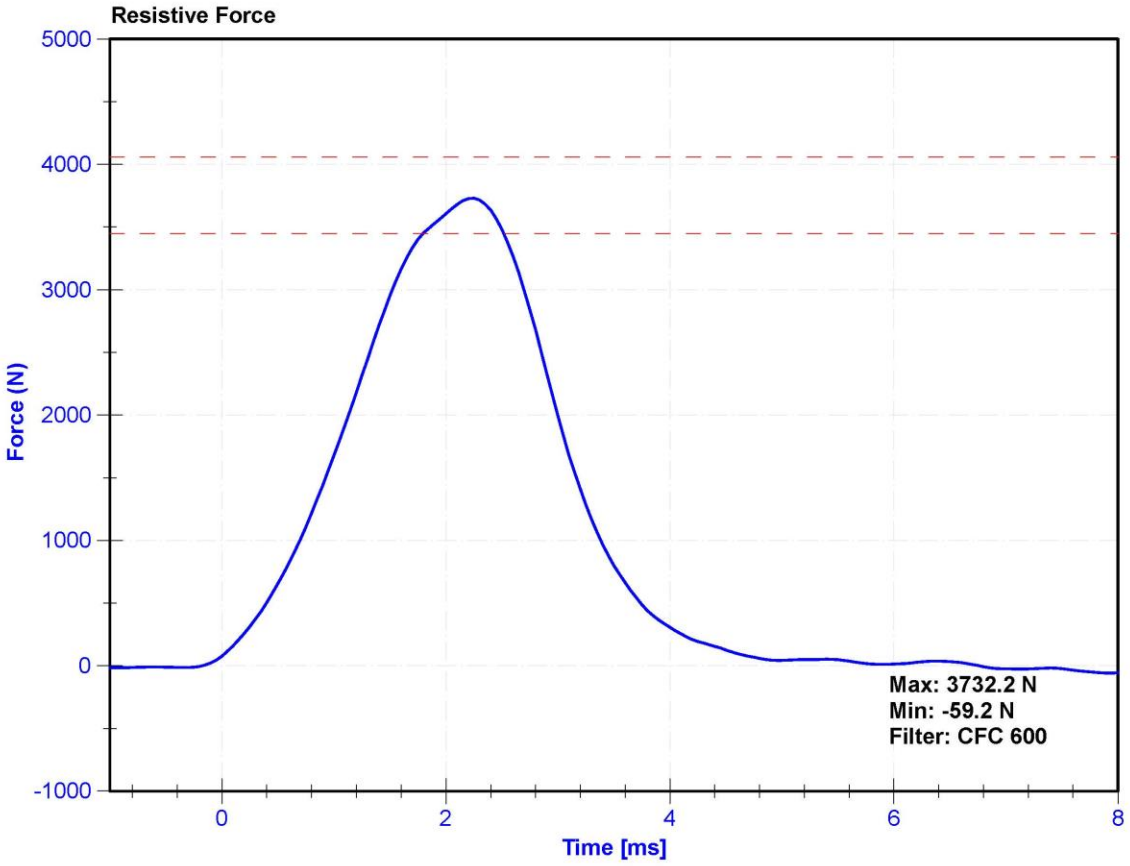
ATD Manufacturer	Denton	Test Technician	E. Helenbrook
ATD Serial Number	139	Laboratory Supervisor	K. Brogan

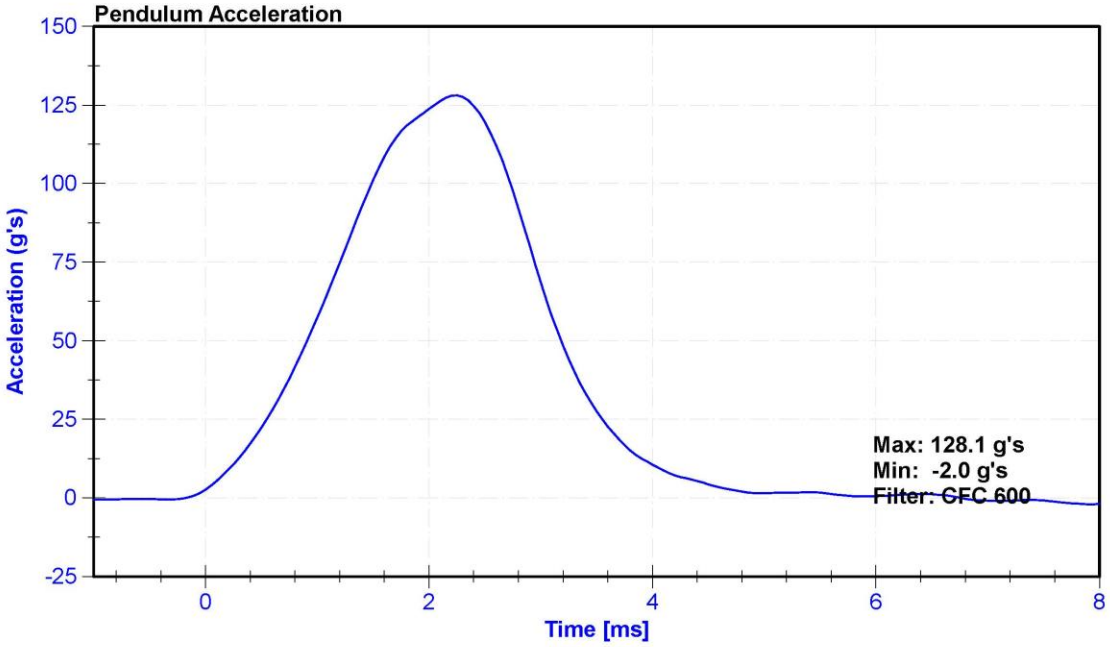
Results

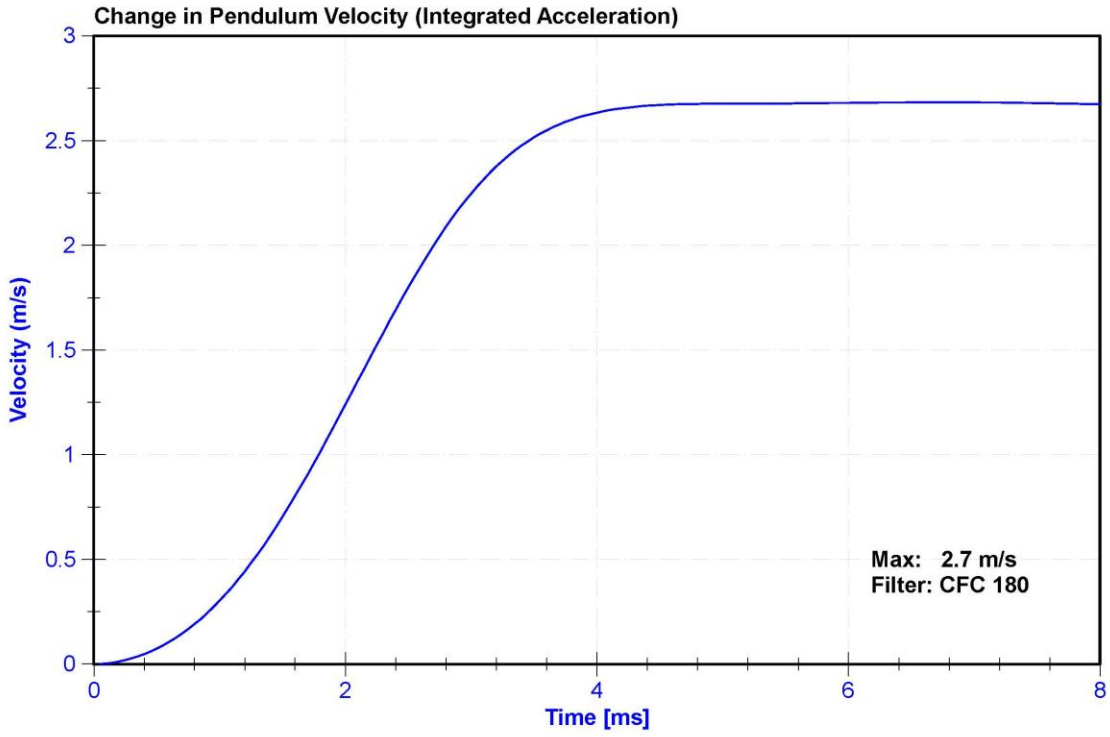
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.3	Pass
Humidity	10	70	%	32.2	Pass
Velocity	2.07	2.13	m/s	2.109	Pass
Resistive Force	3450	4060	N	3732.2	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A260568	1/29/2020	1/28/2021




Pendulum Acceleration
Acceleration (g's)
150
125
100
75
50
25
0
-25
0
2
4
6
8
Time [ms]
Max: 128.1 g's
Min: -2.0 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

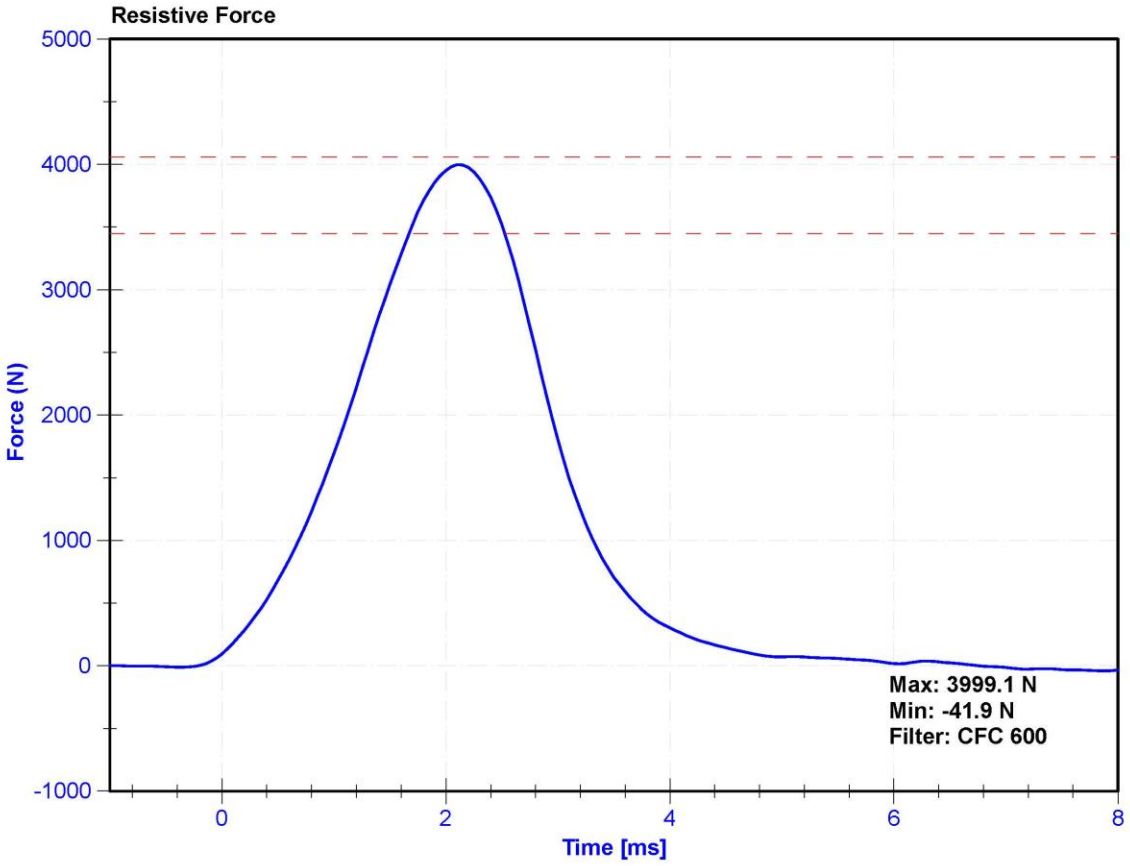
ATD Manufacturer	Denton	Test Technician	E. Helenbrook
ATD Serial Number	139	Laboratory Supervisor	K. Brogan

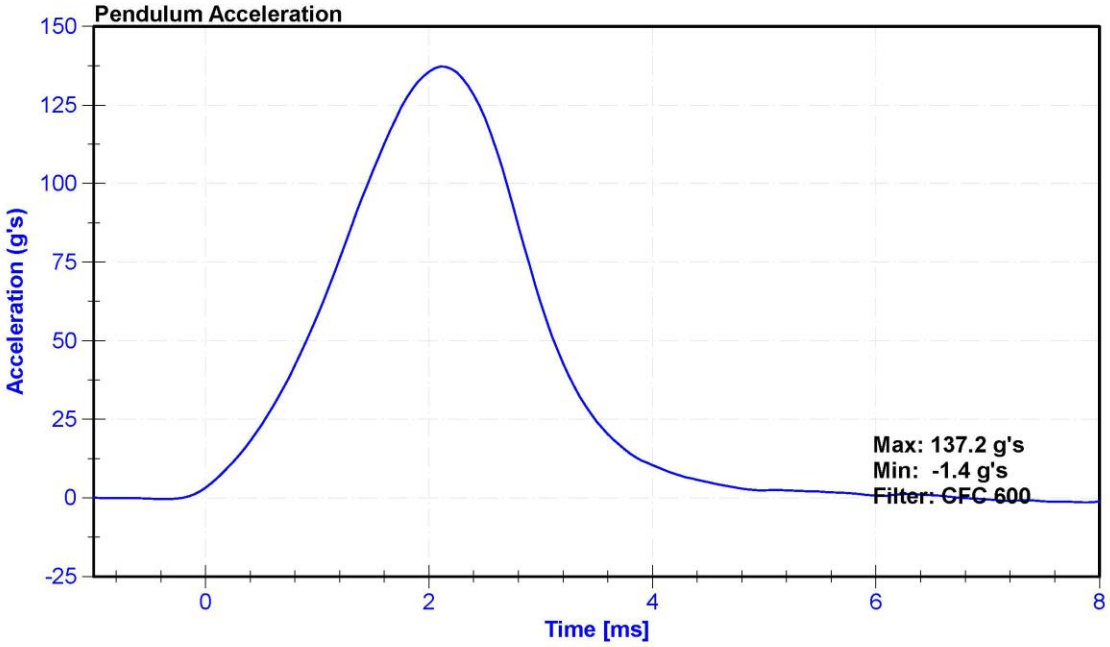
Results

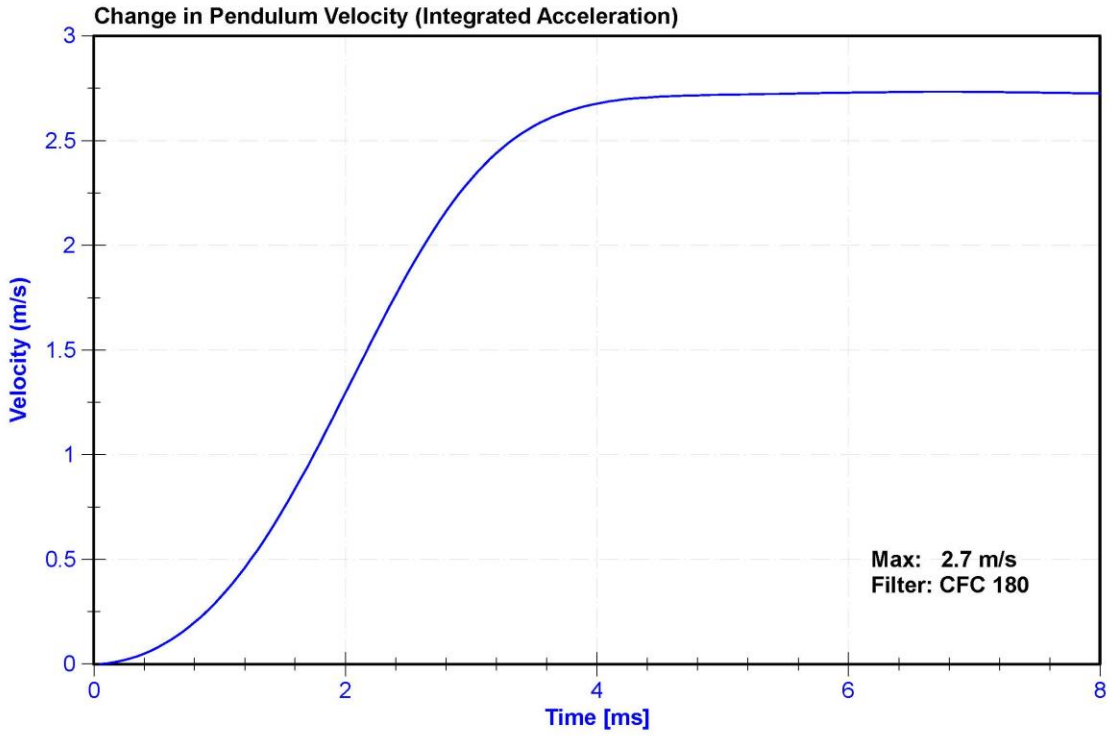
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.3	Pass
Humidity	10	70	%	32.3	Pass
Velocity	2.07	2.13	m/s	2.105	Pass
Resistive Force	3450	4060	N	3999.1	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A260568	1/29/2020	1/28/2021




Pendulum Acceleration
Acceleration (g's)
150
125
100
75
50
25
0
-25
0
2
4
6
8
Time [ms]
Max: 137.2 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

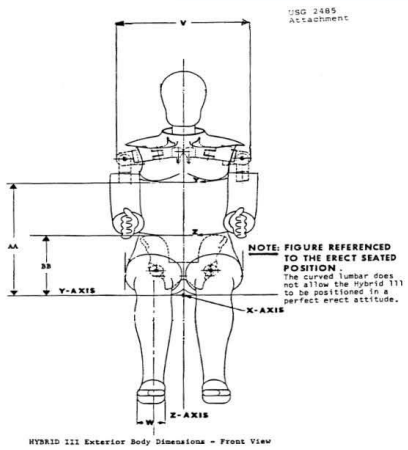
HYBRID III 50TH PERCENTILE MALE - DRIVER ATD

SERIAL NO: 142

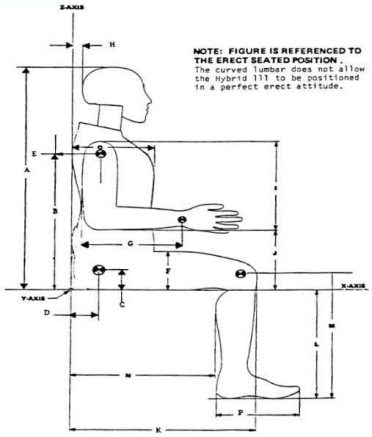
External Measurements - Hybrid 3 - 50th Male

Technician: K. Dutton Date: 04/22/2020

Dummy Serial Number: 142



HYBRID III Exterior Body Dimensions - Front View



HYBRID III Exterior Body Dimensions - Side View

Symbol	Description	Specification (in)		Result (in)	Pass/Fail
A	Sitting Height	34.6	35.0	34.8	Pass
B	Shoulder Pivot Height	19.9	20.5	20.2	Pass
C	H-Point Height	3.3	3.5	3.4	Pass
D	H-Point from Backline	5.3	5.5	5.4	Pass
E	Shoulder Pivot from Backline	3.3	3.7	3.6	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	8.0	Pass
K	Buttock to Knee Length	22.8	23.8	23.3	Pass
L	Popliteal Height	16.9	17.9	17.4	Pass
M	Knee Pivot Height	19.1	19.7	19.6	Pass
N	Buttock Popliteal Length	17.8	18.8	18.5	Pass
O	Chest Depth without Jacket	8.4	9.0	8.7	Pass
P	Foot Length (right)	9.9	10.5	10.3	Pass
V	Shoulder Breadth	16.3	17.2	16.9	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

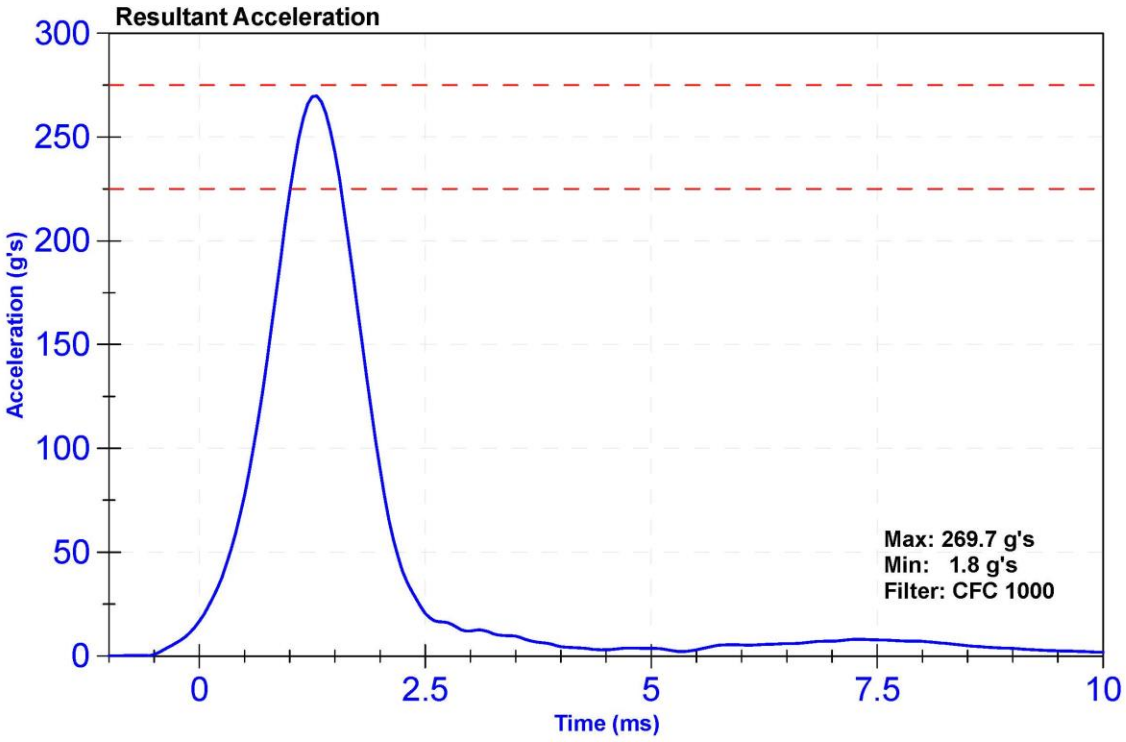
ATD Manufacturer	Humanetics	Test Technician	M. Dudek
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

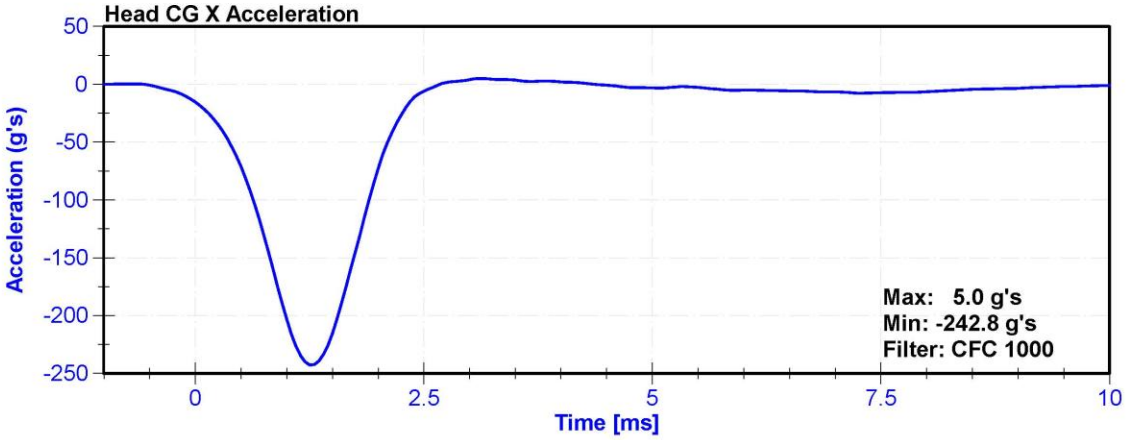
Results

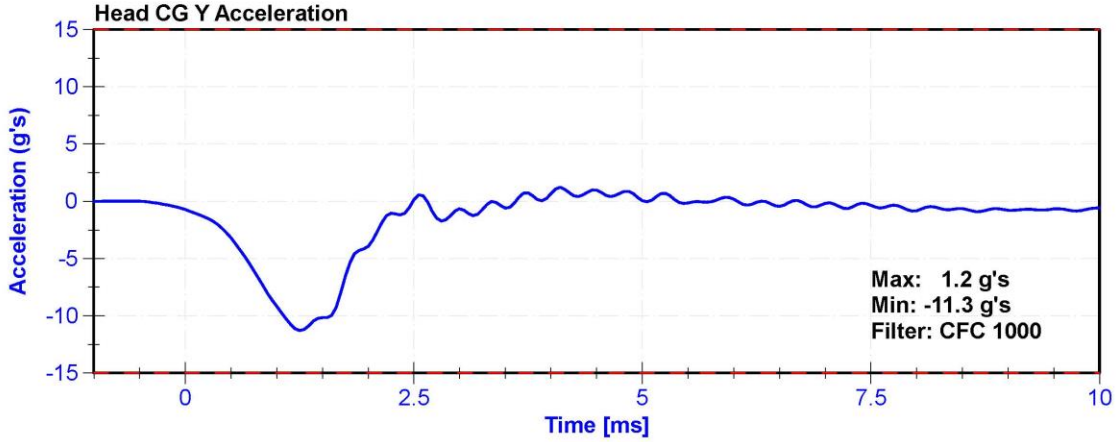
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.2	Pass
Humidity	10	70	%	23.8	Pass
Resultant Acceleration	225	275	g's	269.7	Pass
Oscillation	0	10	%	4.7	Pass
Lateral Acceleration	-15	15	g's	-11.3	Pass

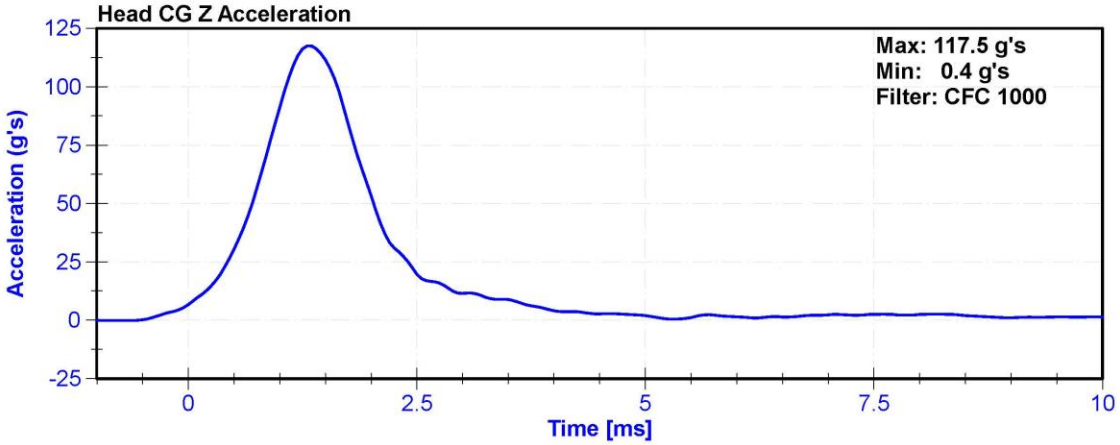
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	ENDEVCO 7264	P51681	4/17/2020	10/16/2020
Y Accelerometer	ENDEVCO 7264	P64151	4/17/2020	10/16/2020
Z Accelerometer	ENDEVCO 7264	P52114	4/17/2020	10/16/2020




Head CG X Acceleration
Acceleration (g's)
50
0
-50
-100
-150
-200
-250
0
2.5
5
7.5
10
Time [ms]
Max: 5.0 g's
Min: -242.8 g's
Filter: CFC 1000


Head CG Y Acceleration
Acceleration (g's)
15
10
5
0
-5
-10
-15
0
2.5
5
7.5
10
Time [ms]
Max: 1.2 g's
Min: -11.3 g's
Filter: CFC 1000


Head CG Z Acceleration
Acceleration (g's)
125
100
75
50
25
0
-25
0
2.5
5
7.5
10
Time [ms]
Max: 117.5 g's
Min: 0.4 g's
Filter: CFC 1000

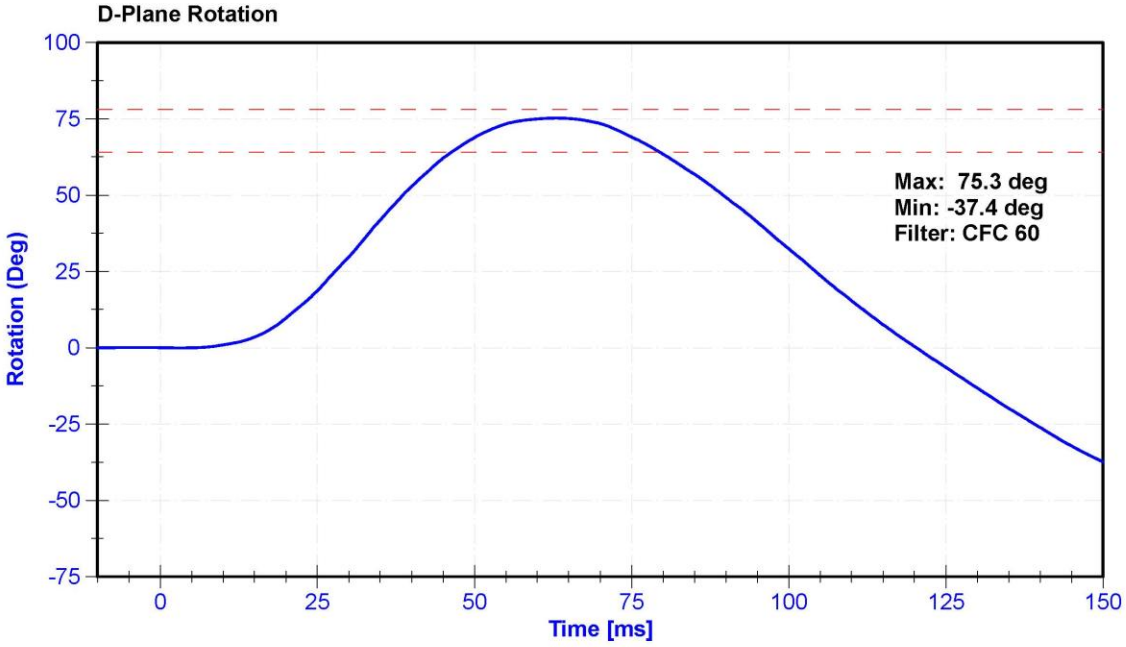
ATD Manufacturer	Humanetics	Test Technician	M. Dudek
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

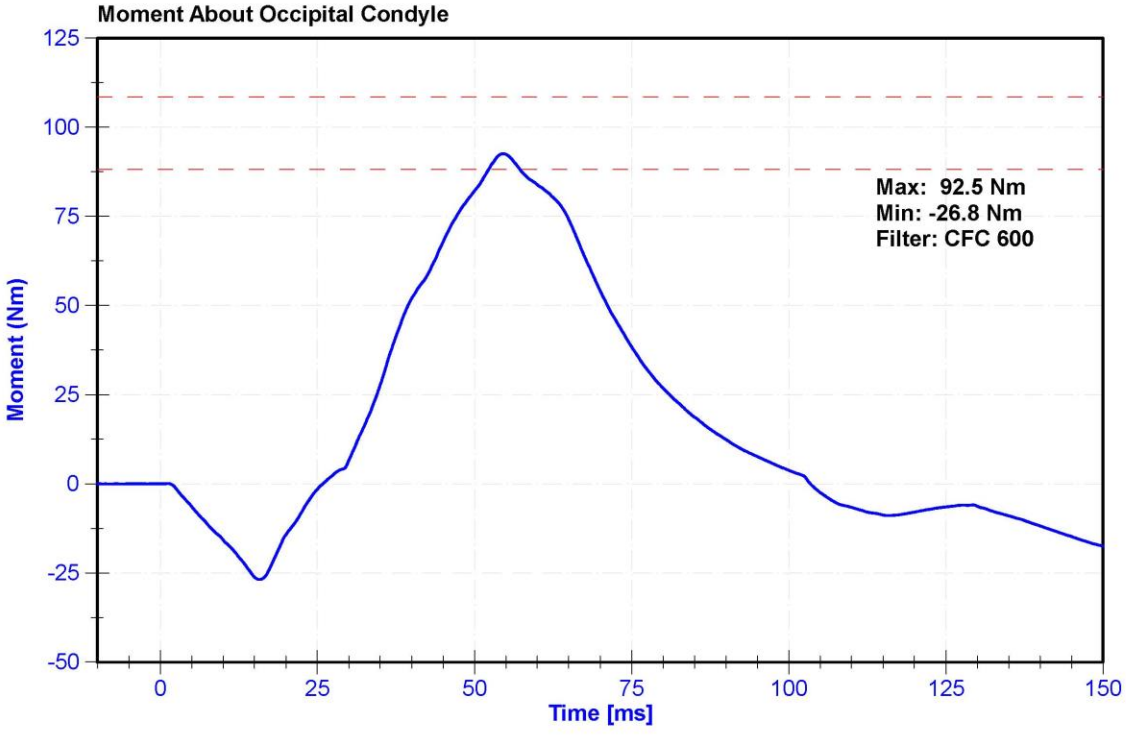
Results

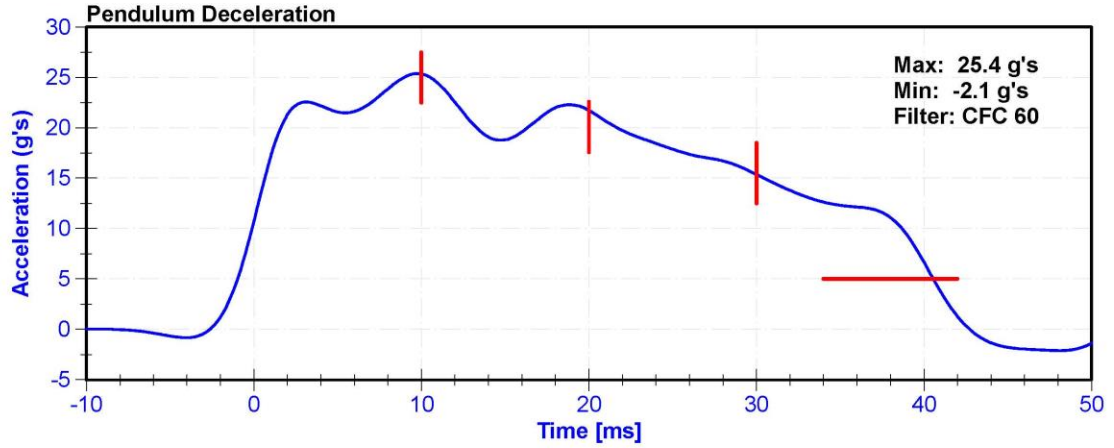
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.6	Pass
Humidity	10	70	%	22.7	Pass
Velocity	6.89	7.13	m/s	6.903	Pass
Pendulum Deceleration at 10ms	22.5	27.5	g's	25.35	Pass
Pendulum Deceleration at 20ms	17.6	22.6	g's	21.73	Pass
Pendulum Deceleration at 30ms	12.5	18.5	g's	15.37	Pass
Max. Pendulum Deceleration After 30ms	0	29	g's	25.4	Pass
Pendulum Deceleration Time to 5 g's	34	42	ms	40.6	Pass
Maximum D Plane Rotation	64	78	deg	75.3	Pass
Time to Maximum Rotation	57	64	ms	63.0	Pass
Rotation Decay to Zero	113	127	ms	120.3	Pass
Moment About Occipital Condyle	88.1	108.4	Nm	92.54	Pass
Time to Maximum Moment	47	58	ms	54.5	Pass
Moment Decay to Zero	97	107	ms	103.4	Pass

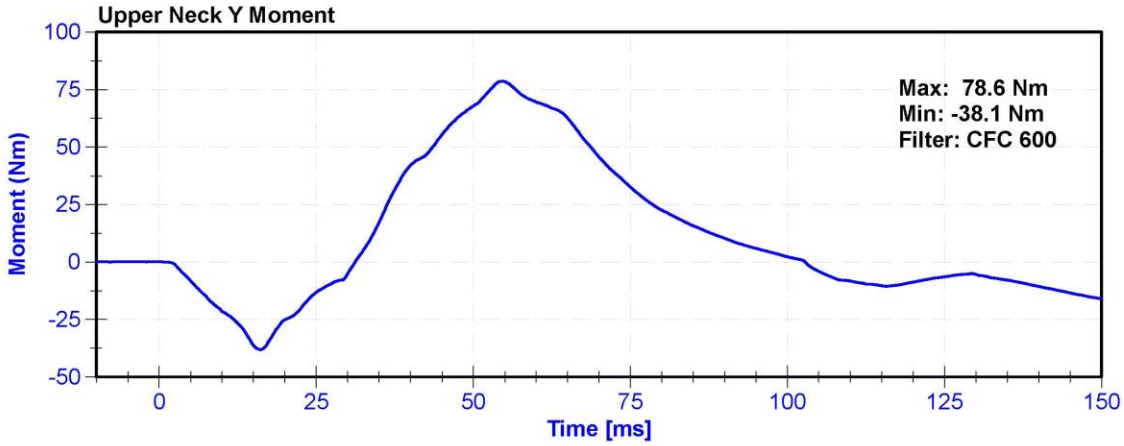
Transducer Calibrations

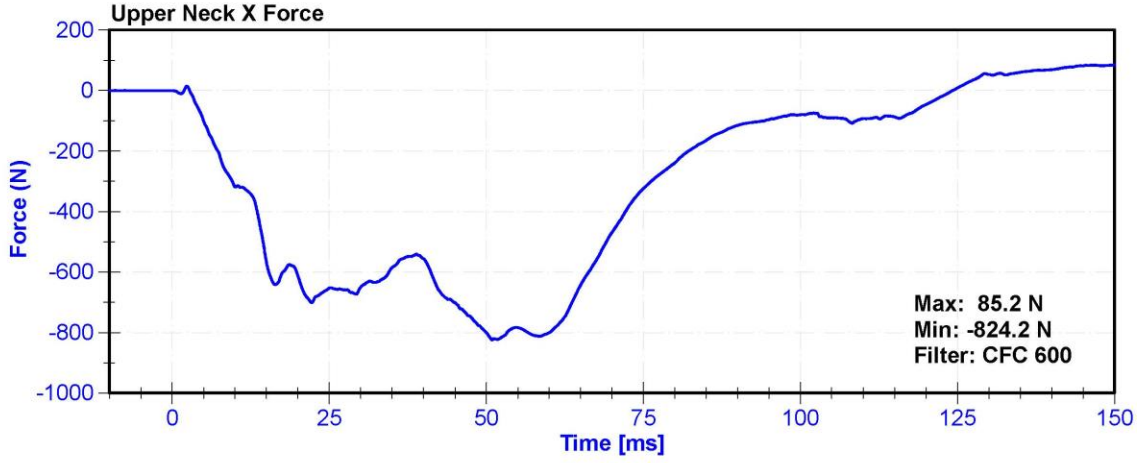
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-AH5M9 Pend	1/30/2020	1/29/2021
Pendulum Potentiometer	ETI SP22G	DS-LABPOT1	9/13/2019	9/12/2020
Condyle Potentiometer	ETI SP22G	DS-LABPOT2	9/13/2019	9/12/2020
Upper Neck Load Cell	Denton IF-205	LC-280FxGFE	10/3/2019	10/2/2020


D-Plane Rotation
Rotation (Deg)
100
75
50
25
0
-25
-50
-75
0
25
50
75
100
125
150
Time [ms]
Max: 75.3 deg
Min: -37.4 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: 92.5 Nm
Min: -26.8 Nm
Filter: CFC 600


Pendulum Deceleration
Max: 25.4 g's
Min: -2.1 g's
Filter: CFC 60
Acceleration (g's)
Time [ms]


Upper Neck Y Moment
Max: 78.6 Nm
Min: -38.1 Nm
Filter: CFC 600
Moment (Nm)
Time [ms]


Upper Neck X Force
Max: 85.2 N
Min: -824.2 N
Filter: CFC 600
Force (N)
Time [ms]

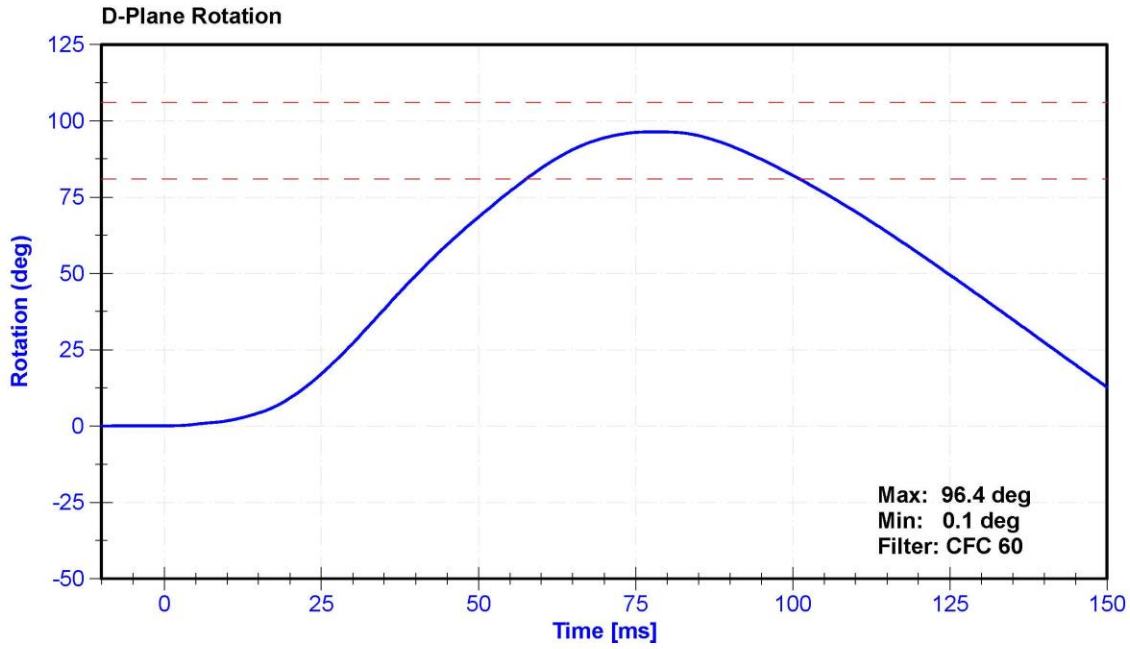
ATD Manufacturer	Humanetics	Test Technician	M. Dudek
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

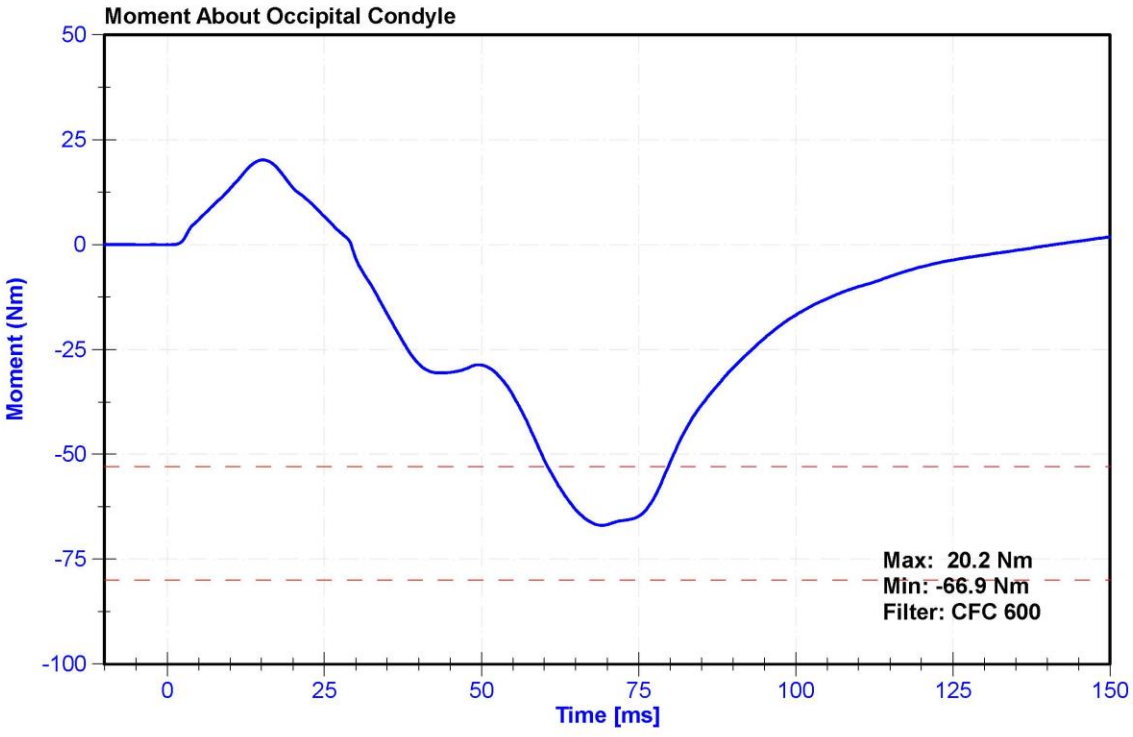
Results

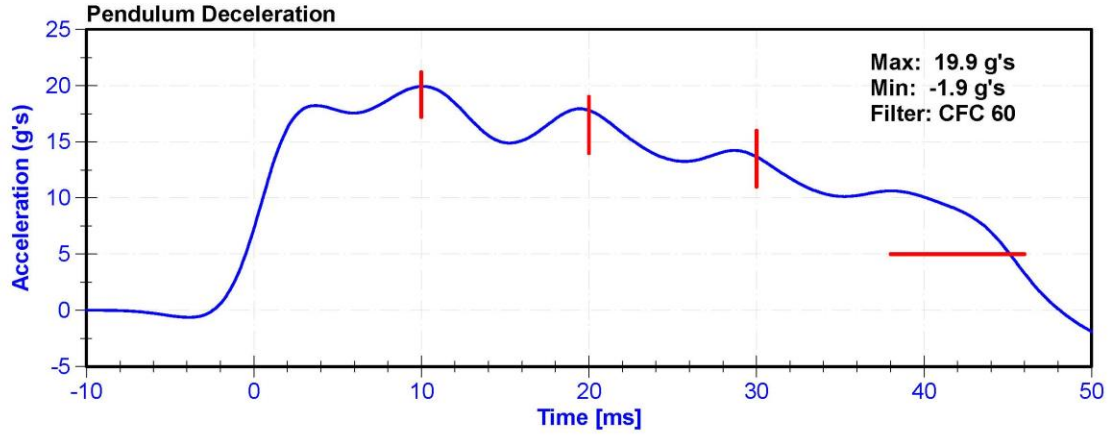
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.6	Pass
Humidity	10	70	%	23.8	Pass
Velocity	5.94	6.19	m/s	5.964	Pass
Pendulum Deceleration at 10ms	17.2	21.2	g's	19.94	Pass
Pendulum Deceleration at 20ms	14	19	g's	17.8	Pass
Pendulum Deceleration at 30ms	11	16	g's	13.7	Pass
Max. Pendulum Deceleration After 30ms	0	22	g's	19.9	Pass
Pendulum Deceleration Time to 5 g's	38	46	ms	45.2	Pass
Maximum D Plane Rotation	81	106	deg	96.4	Pass
Time to Maximum Rotation	72	82	ms	78.1	Pass
Rotation Decay to Zero	147	174	ms	158.8	Pass
Minimum Moment About OC	-80	-52.9	Nm	-66.94	Pass
Time to Minimum Moment	65	79	ms	69.2	Pass
Moment Decay to Zero	120	148	ms	141.3	Pass

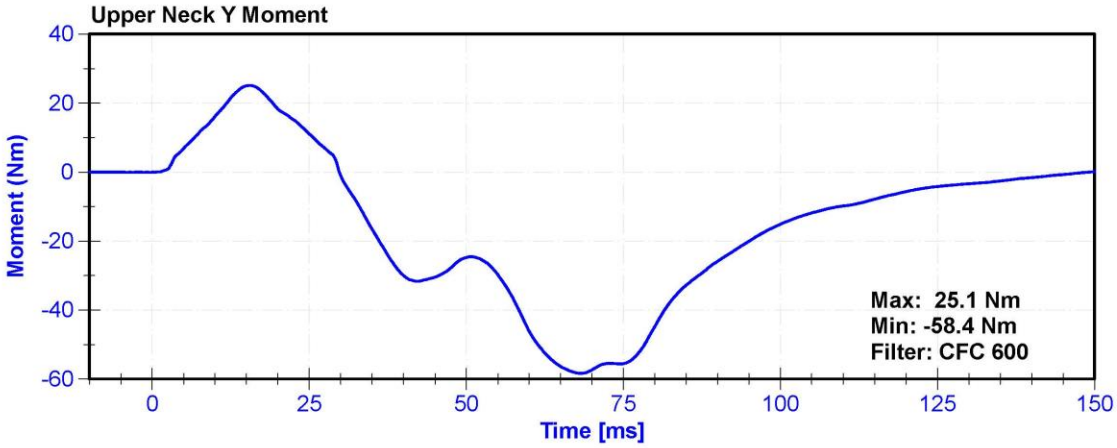
Transducer Calibrations

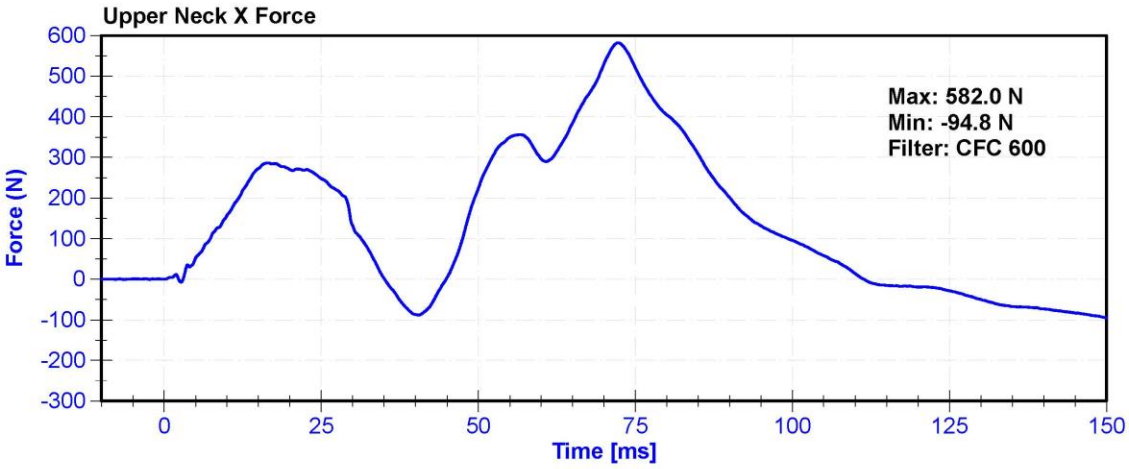
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-AH5M9 Pend	1/30/2020	1/29/2021
Pendulum Potentiometer	ETI SP22G	DS-LABPOT1	9/13/2019	9/12/2020
Condyle Potentiometer	ETI SP22G	DS-LABPOT2	9/13/2019	9/12/2020
Upper Neck Load Cell	Denton IF-205	LC-280FxGFE	10/3/2019	10/2/2020


D-Plane Rotation
Rotation (deg)
125
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]
Max: 96.4 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: 20.2 Nm
Min: -66.9 Nm
Filter: CFC 600


Pendulum Deceleration
Max: 19.9 g's
Min: -1.9 g's
Filter: CFC 60
Acceleration (g's)
Time [ms]


Upper Neck Y Moment
Max: 25.1 Nm
Min: -58.4 Nm
Filter: CFC 600
Moment (Nm)
Time [ms]


Upper Neck X Force
Max: 582.0 N
Min: -94.8 N
Filter: CFC 600
Force (N)
Time [ms]

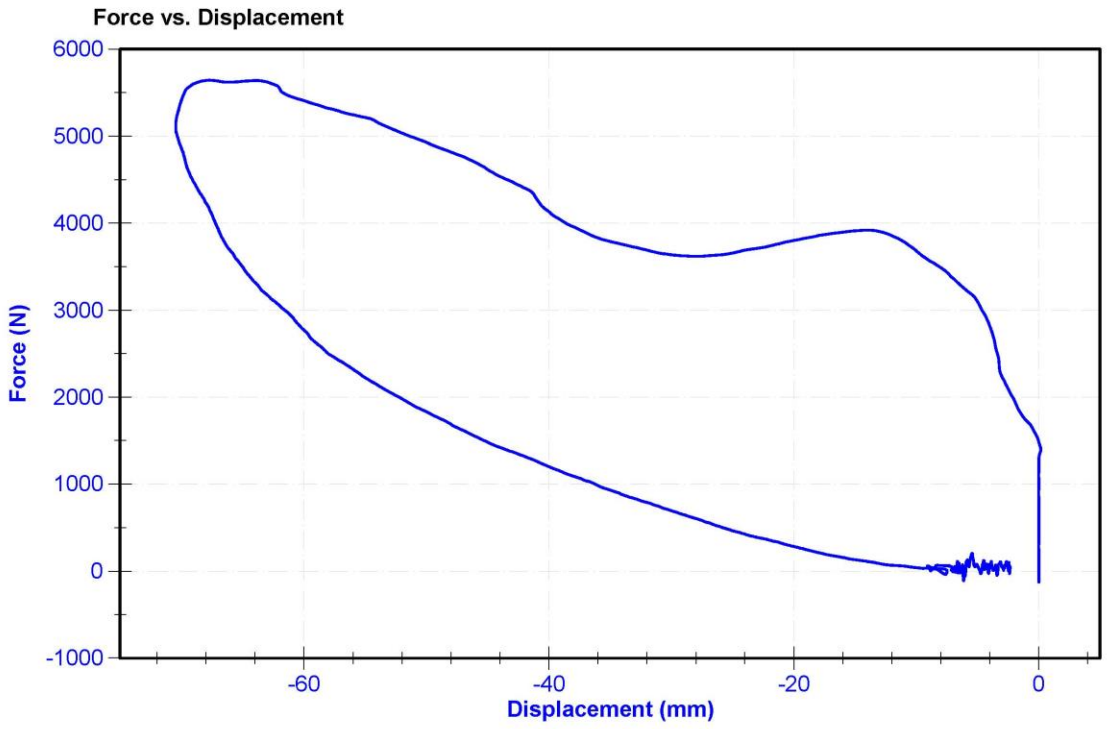
ATD Manufacturer	Humanetics	Test Technician	M. Dudek
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

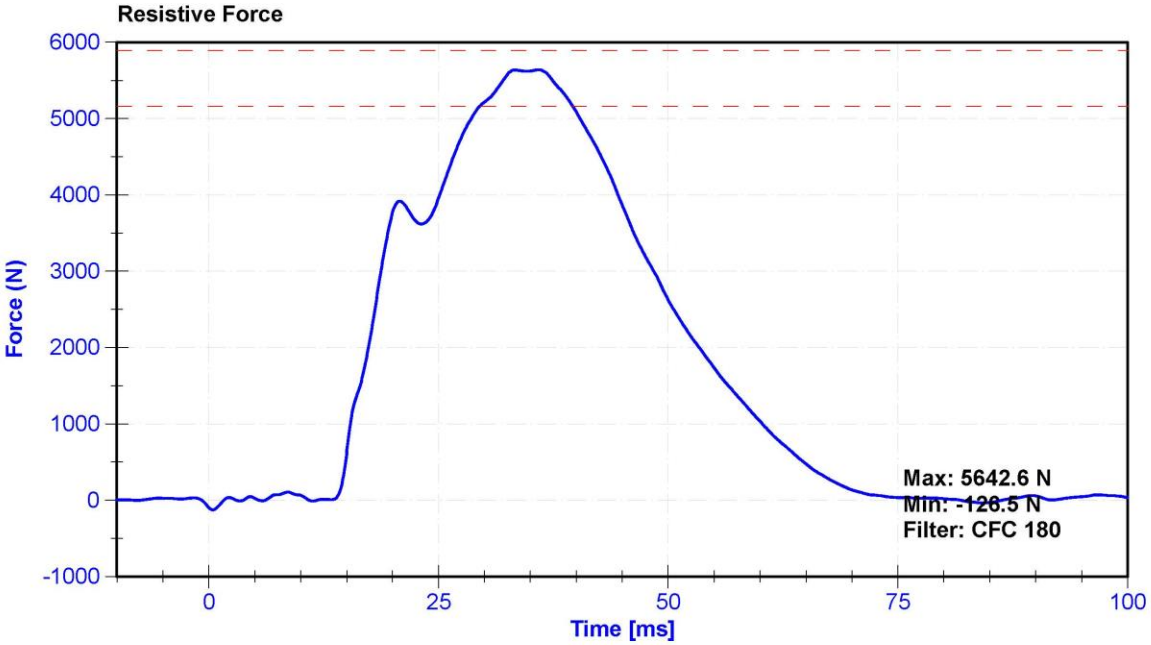
Results

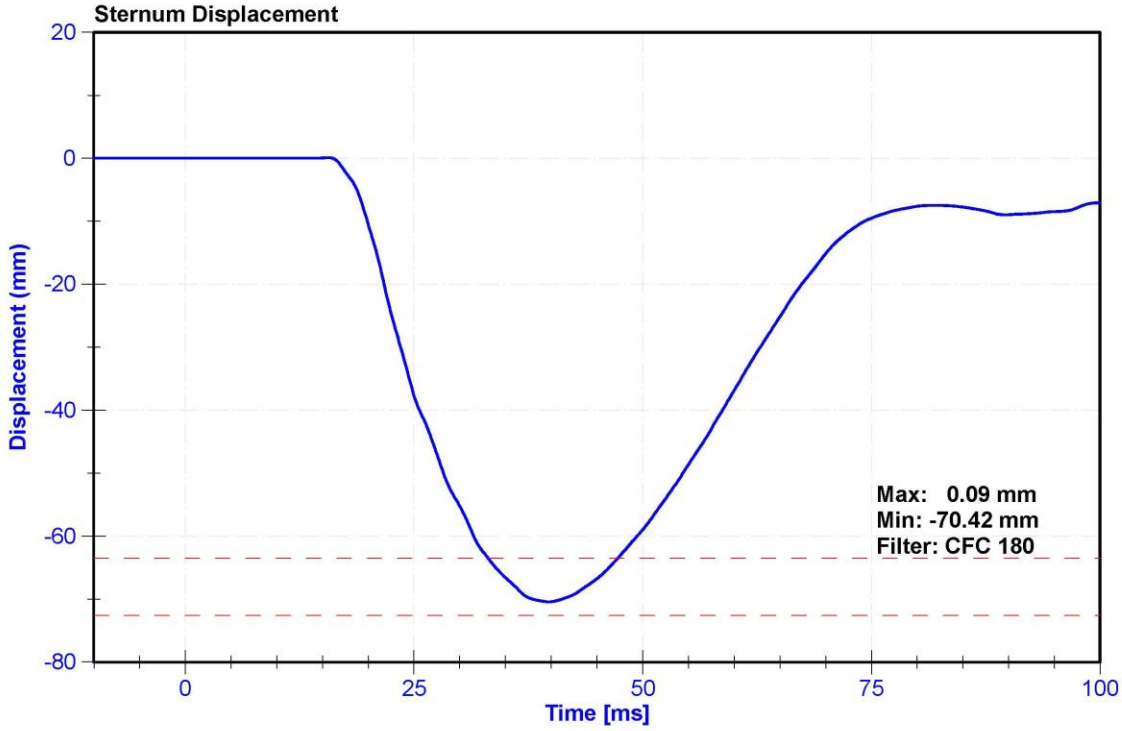
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.2	Pass
Humidity	10	70	%	35.2	Pass
Velocity	6.59	6.83	m/s	6.597	Pass
Chest Displacement	-72.6	-63.5	mm	-70.42	Pass
Resistive Force	5160	5894	N	5642.6	Pass
Hysteresis	65	85	%	69.3	Pass

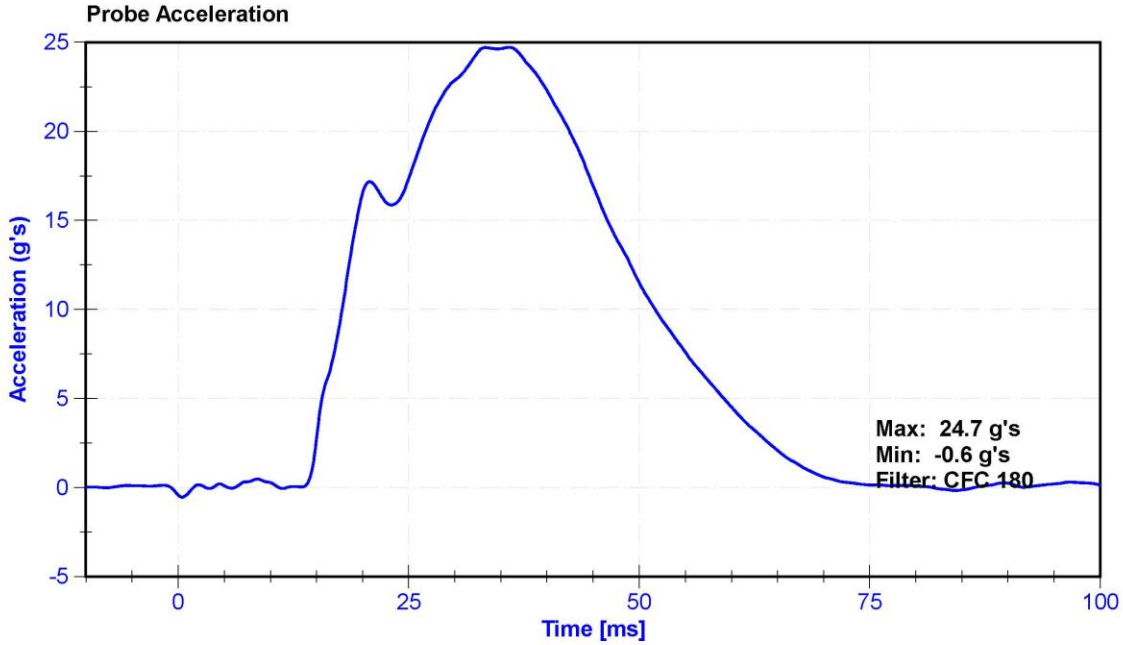
Transducer Calibrations

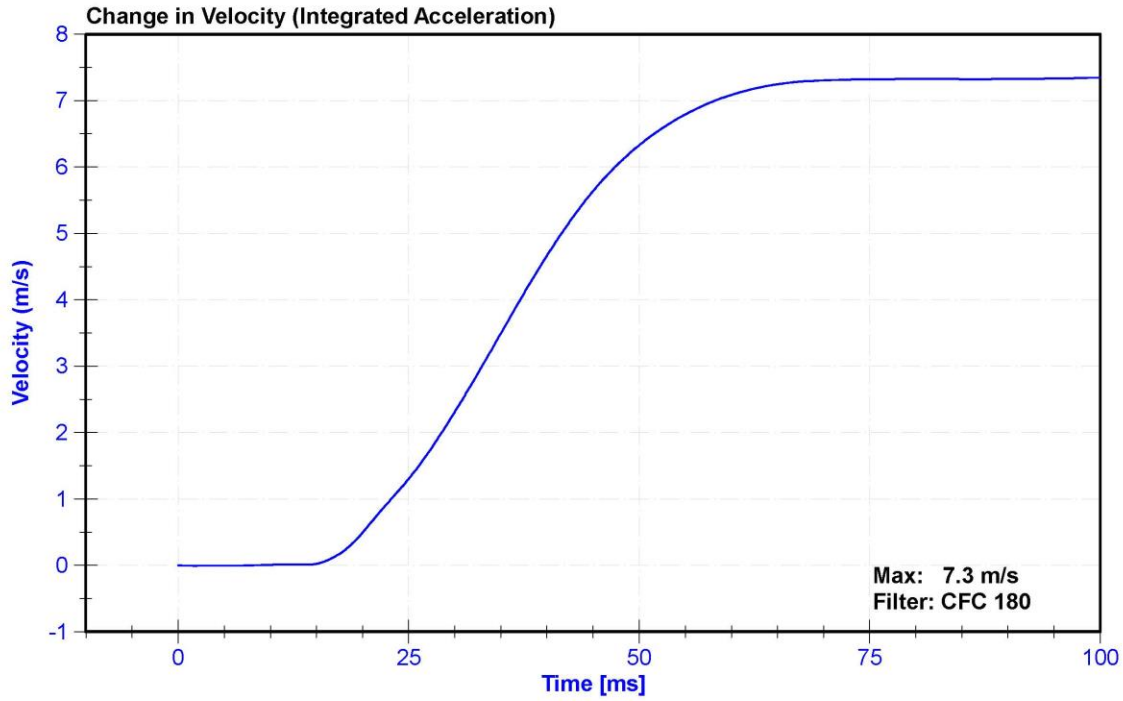
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A286228	1/29/2020	7/29/2020
Chest Potentiometer	Servo 6209-2038	DS-142	3/27/2020	9/25/2020




Resistive Force
Force (N)
6000
5000
4000
3000
2000
1000
0
-1000
0
25
50
75
100
Time [ms]
Max: 5642.6 N
Min: -126.5 N
Filter: CFC 180


Sternum Displacement
Displacement (mm)
20
0
-20
-40
-60
-80
0
25
50
75
100
Time [ms]
Max: 0.09 mm
Min: -70.42 mm
Filter: CFC 180


Probe Acceleration
Acceleration (g's)
25
20
15
10
5
0
-5
0
25
50
75
100
Time [ms]
Max: 24.7 g's
Min: -0.6 g's
Filter: CFC 180


Change in Velocity (Integrated Acceleration)
Velocity (m/s)
8
7
6
5
4
3
2
1
0
-1
0
25
50
75
100
Time [ms]
Max: 7.3 m/s
Filter: CFC 180

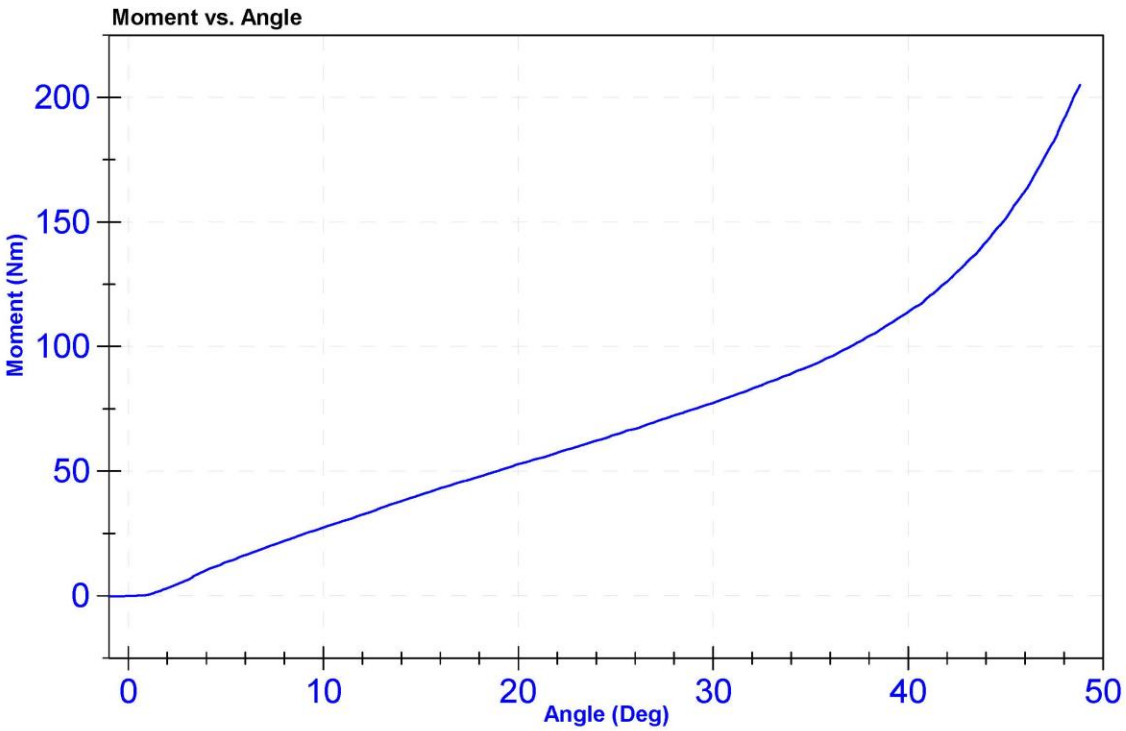
ATD Manufacturer	Humanetics	Test Technician	M. Dudek
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	20.8	Pass
Humidity	10	70	%	24.4	Pass
Average Velocity	5	10	deg/s	7.0	Pass
Angle at 203Nm	40	50	deg	48.7	Pass
Moment at 30 degrees	0	94.9	Nm	77.4	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	ETI SP22	DS-0008	9/18/2019	9/17/2020
Load Cell	Key Trans 2301-02	LC-115 My	2019-09-12	2020-09-11



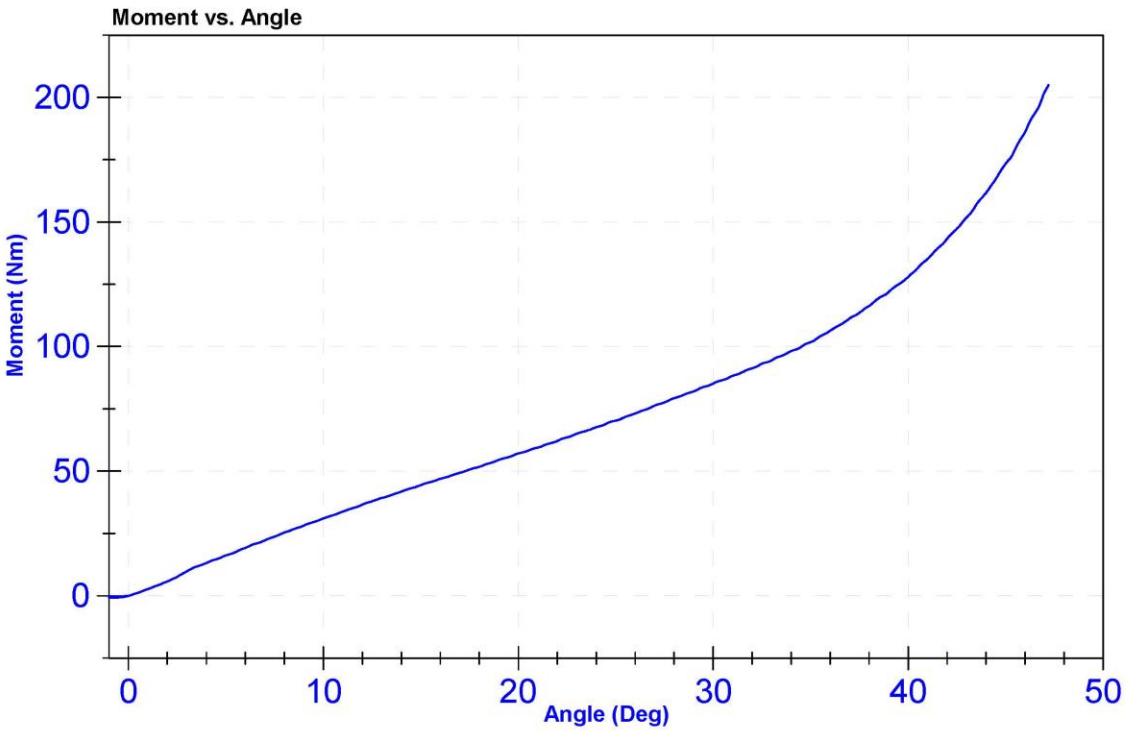
ATD Manufacturer	Humanetics	Test Technician	M. Dudek
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	20.8	Pass
Humidity	10	70	%	24.4	Pass
Average Velocity	5	10	deg/s	7.0	Pass
Angle at 203Nm	40	50	deg	47.1	Pass
Moment at 30 degrees	0	94.9	Nm	85.2	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	ETI SP22	DS-0008	9/18/2019	9/17/2020
Load Cell	Key Trans 2301-02	LC-115 My	2019-09-12	2020-09-11



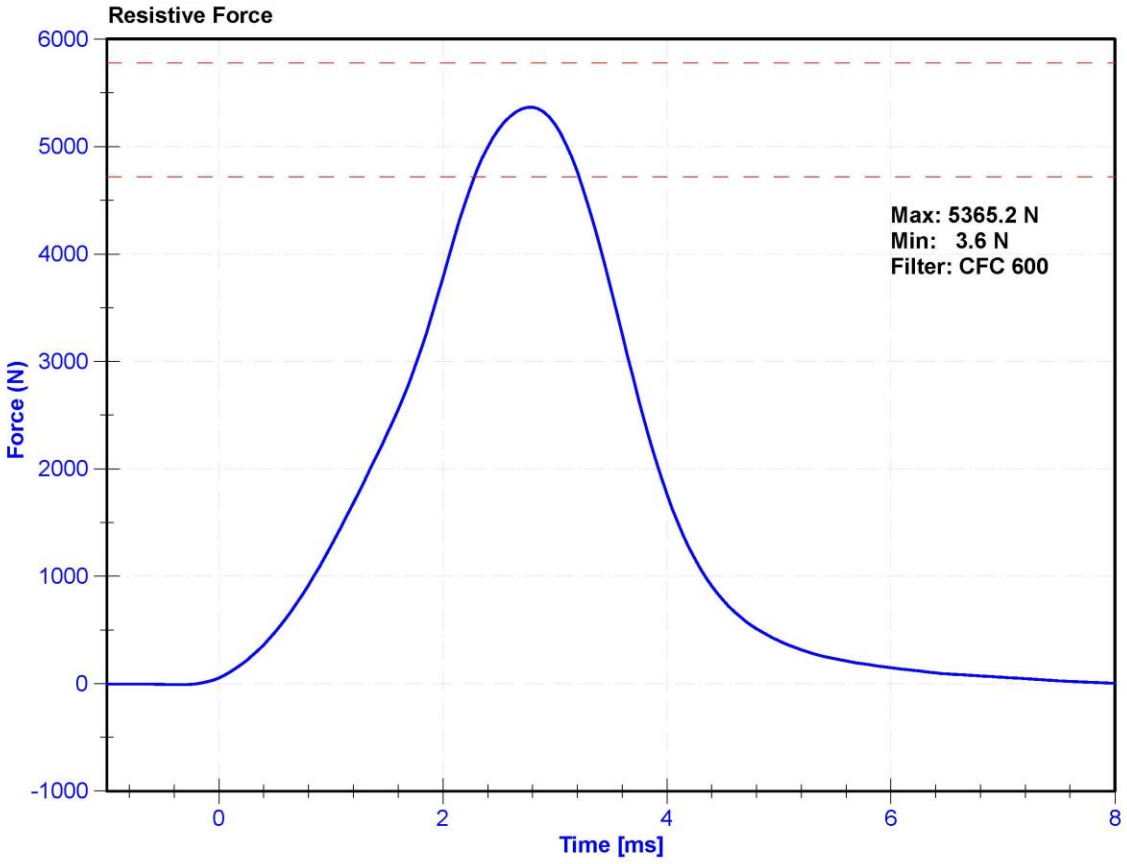
ATD Manufacturer	Humanetics	Test Technician	D.Reinhard
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

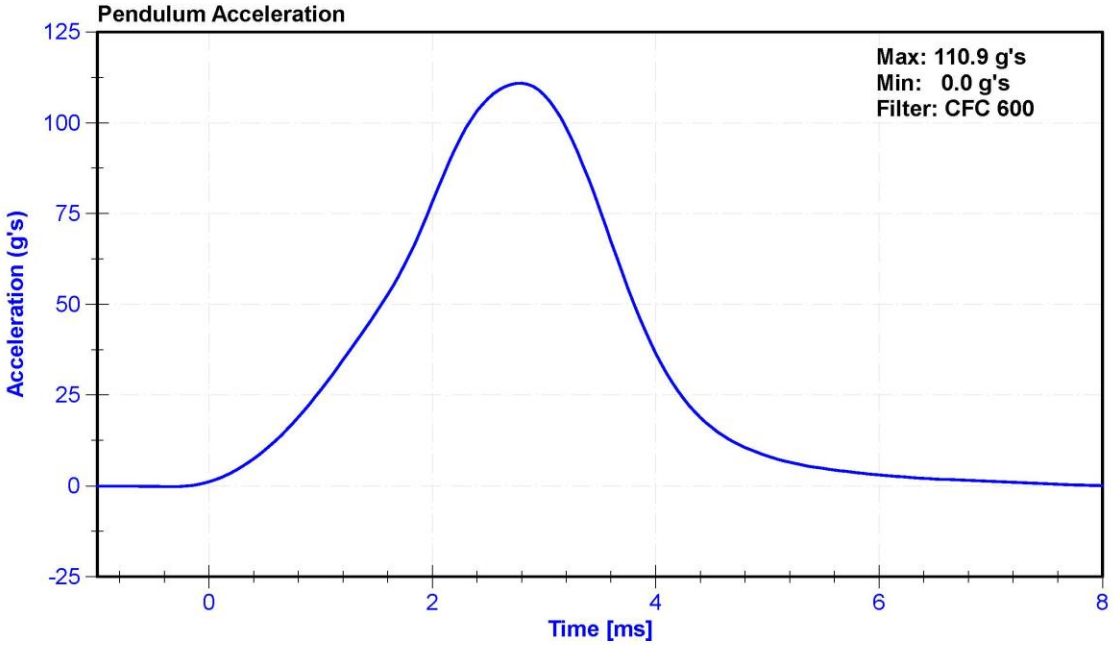
Results

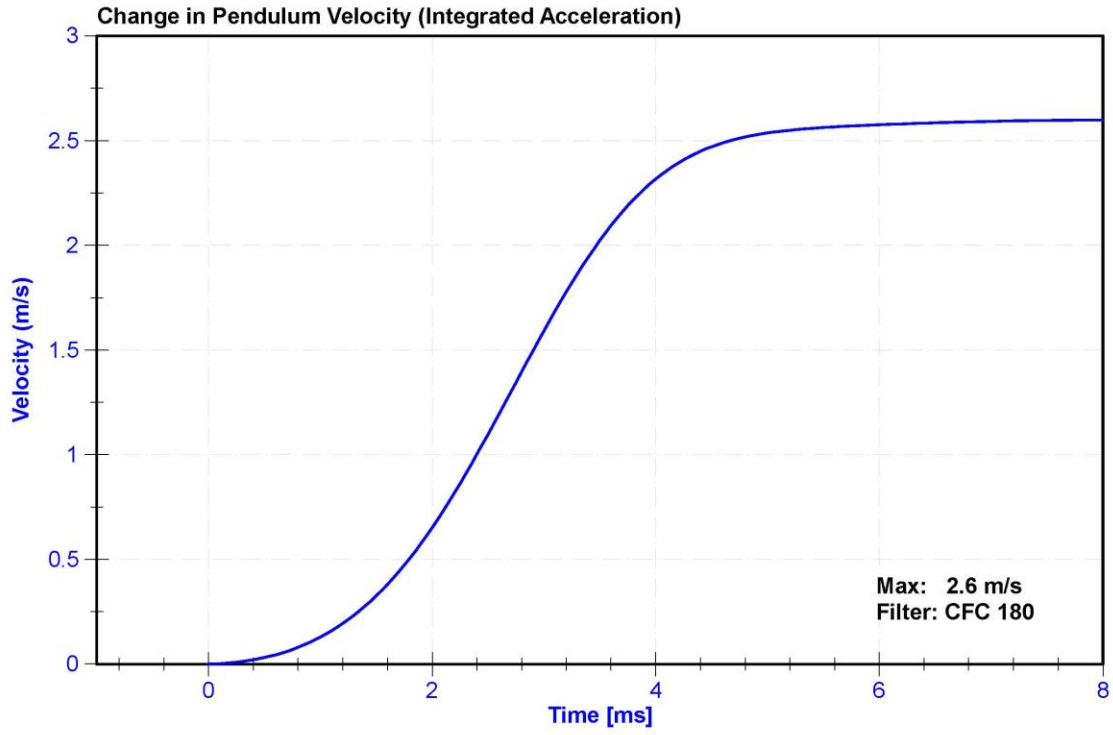
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21	Pass
Humidity	10	70	%	19.6	Pass
Velocity	2.07	2.13	m/s	2.104	Pass
Maximum Resistive Force	4720	5780	N	5365.2	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A260568	1/29/2020	7/29/2020




Pendulum Acceleration
Max: 110.9 g's
Min: 0.0 g's
Filter: CFC 600
Acceleration (g's)
125
100
75
50
25
0
-25
0
2
4
6
8
Time [ms]


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

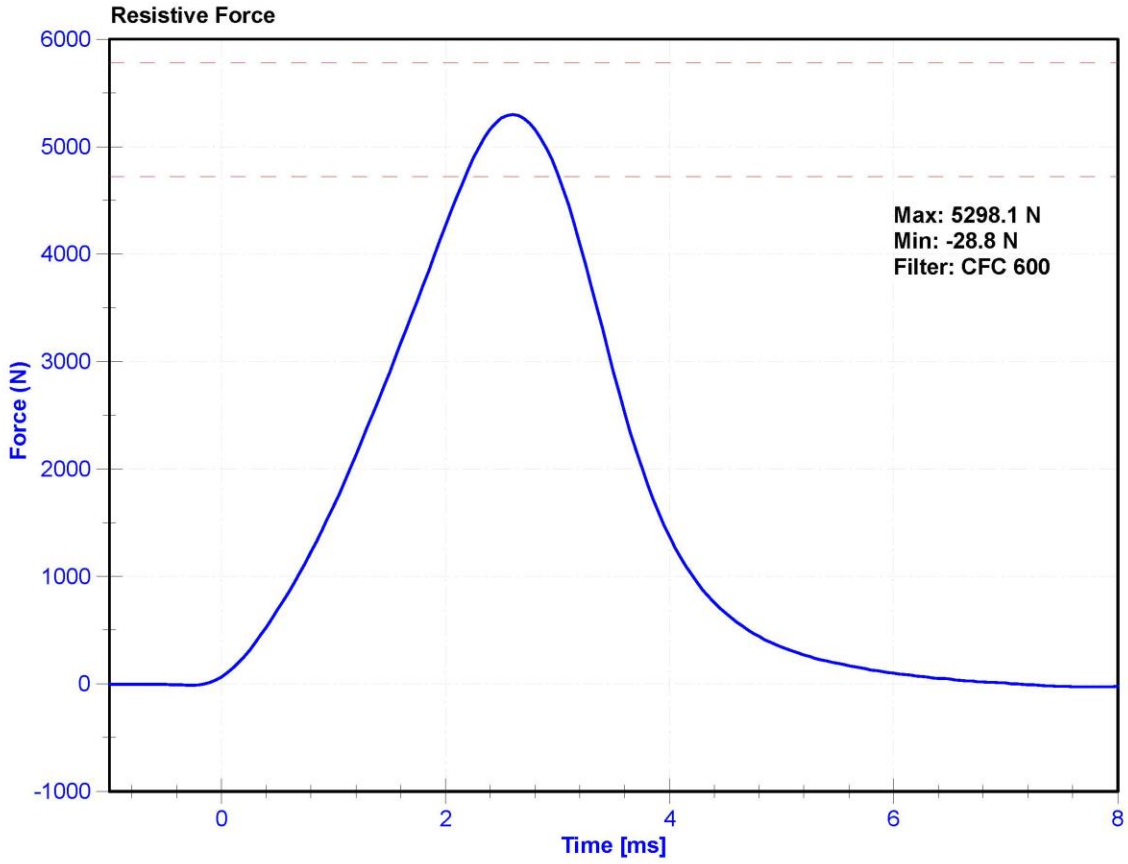
ATD Manufacturer	Humanetics	Test Technician	D.Reinhard
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

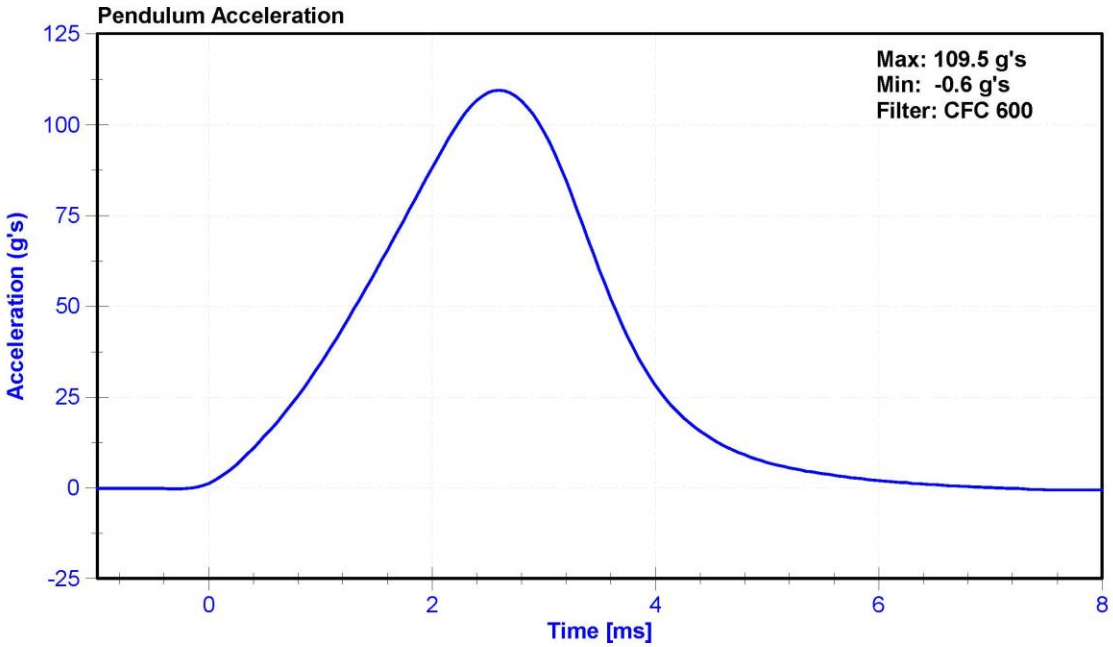
Results

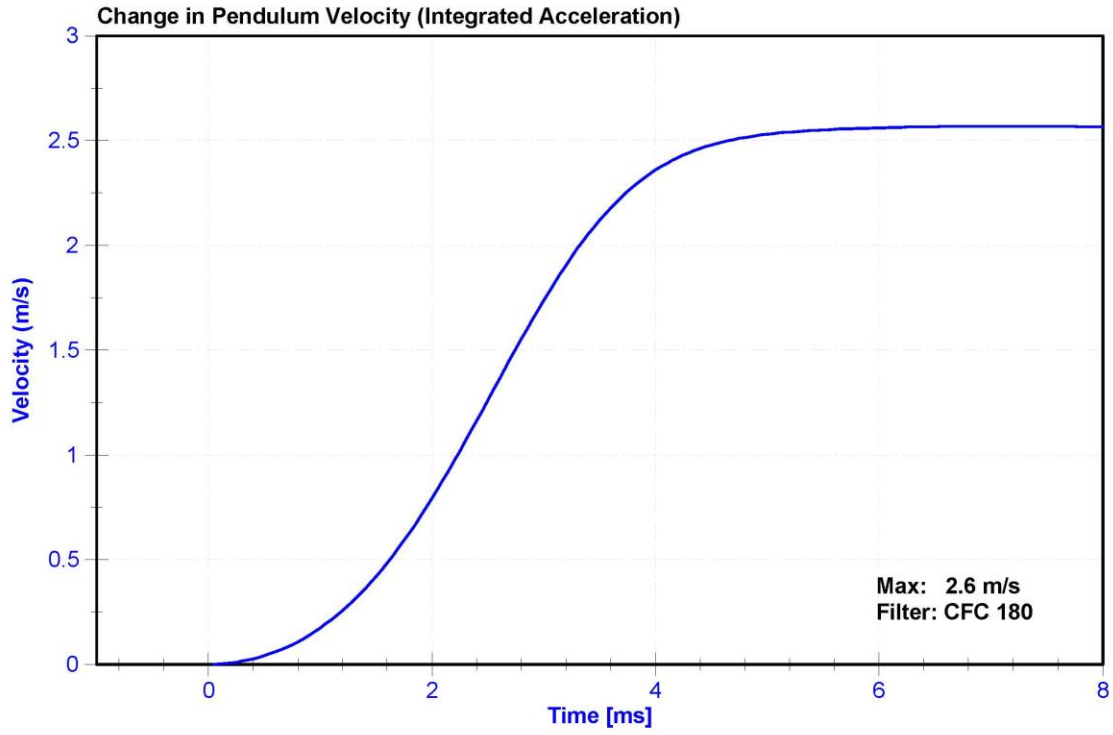
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	20.7	Pass
Humidity	10	70	%	23.8	Pass
Velocity	2.07	2.13	m/s	2.108	Pass
Maximum Resistive Force	4720	5780	N	5298.1	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A260568	1/29/2020	7/29/2020




Pendulum Acceleration
Max: 109.5 g's
Min: -0.6 g's
Filter: CFC 600
Acceleration (g's)
125
100
75
50
25
0
-25
0
2
4
6
8
Time [ms]


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

CALIBRATION TEST RESULTS

POST-TEST

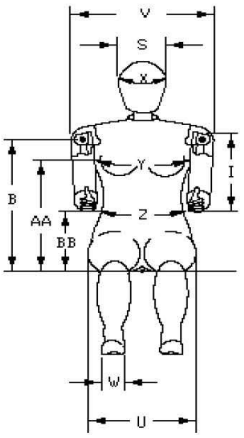
HYBRID III 5TH PERCENTILE FEMALE - PASSENGER ATD

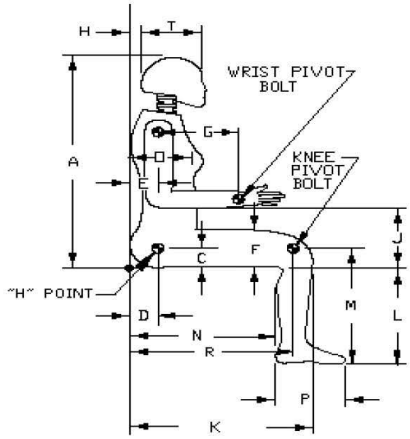
SERIAL NO: 139

External Measurements - Hybrid 3 - 5th Female

Technician: K. Brogan Date: 04/22/2020

Dummy Serial Number: 139





Symbol	Description	Specification (mm)		Result (mm)	Pass/Fail
A	Sitting Height	775	800	791	Pass
B	Shoulder Pivot Height	432	457	447	Pass
C	H-Point Height	81	86	84	Pass
D	H-Point from Backline	145	150	146	Pass
E	Shoulder Pivot from Backline	69	84	78	Pass
F	Thigh Clearance	119	135	125	Pass
G	Back of Elbow to Wrist Pivot	244	259	254	Pass
H	Head Back to Backline	43	48	45	Pass
I	Shoulder to Elbow Length	277	297	289	Pass
J	Elbow Rest Height	183	203	194	Pass
K	Buttock to Knee Length	521	546	541	Pass
L	Popliteal Height	356	376	363	Pass
M	Knee Pivot Height	394	419	402	Pass
N	Buttock Popliteal Length	414	439	426	Pass
O	Chest Depth without Jacket	175	191	185	Pass
P	Foot Length (right)	219	234	225	Pass
R	Buttock To Knee Pivot Length	457	483	473	Pass
S	Head Breadth	137	147	143	Pass
T	Head Depth	178	188	182	Pass
U	Hip Breadth	300	315	310	Pass
V	Shoulder Breadth	351	366	362	Pass
W	Foot Breadth	79	94	87	Pass
X	Head Circumference	528	549	535	Pass
Y	Chest Circumference with Jacket	851	881	861	Pass
Z	Waist Circumference	460	790	773	Pass
AA	Reference Location (Chest Circumference)	333	358	345	Pass
BB	Reference Location (Waist Circumference)	160	170	165	Pass

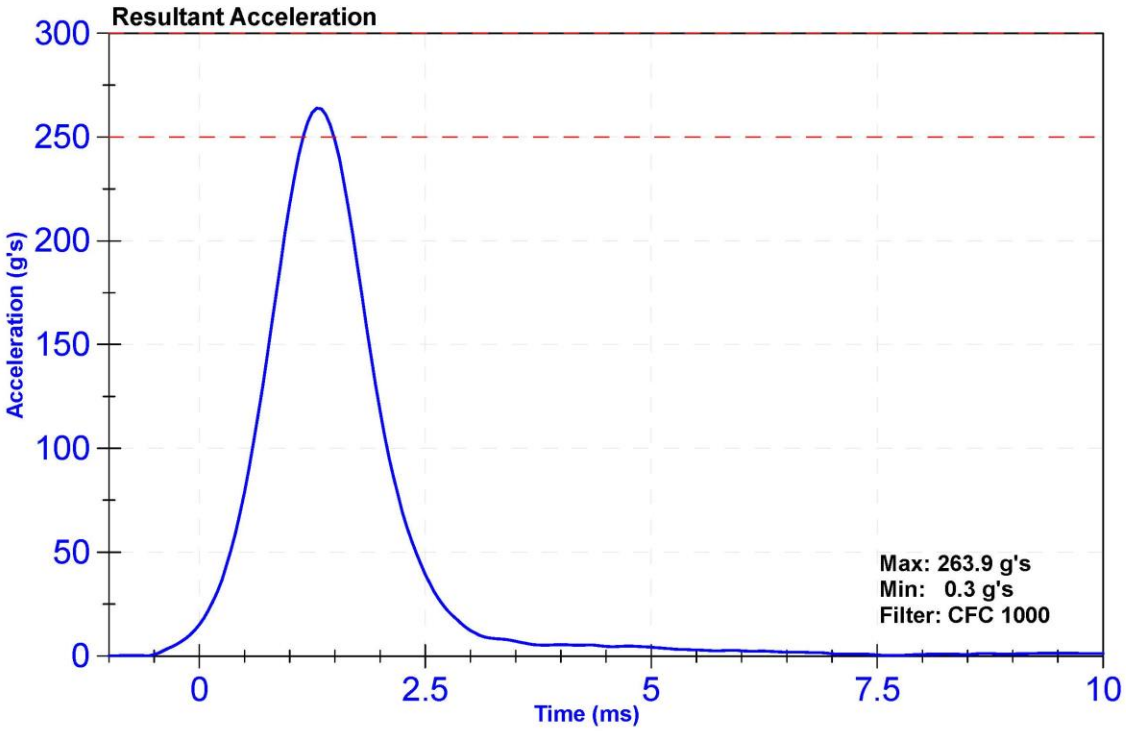
ATD Manufacturer	Denton	Test Technician	M. Dudek
ATD Serial Number	139	Laboratory Supervisor	K. Brogan

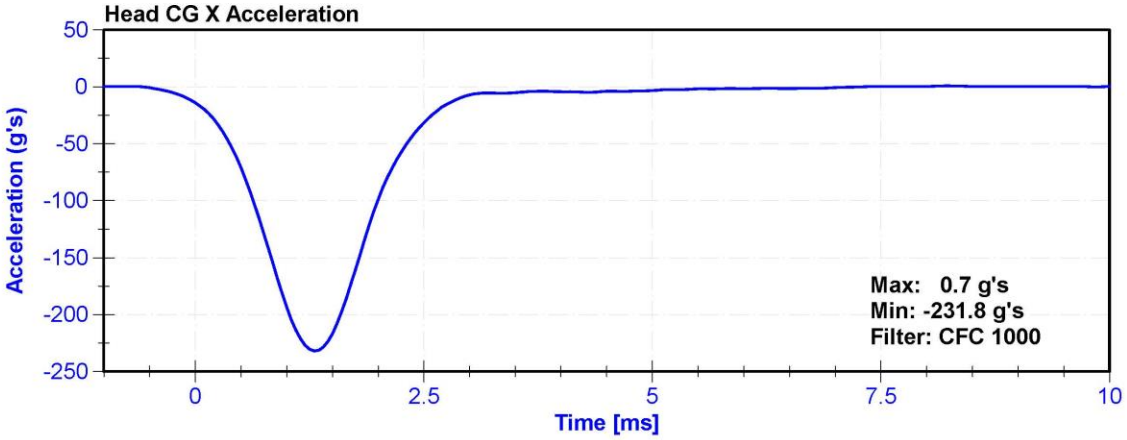
Results

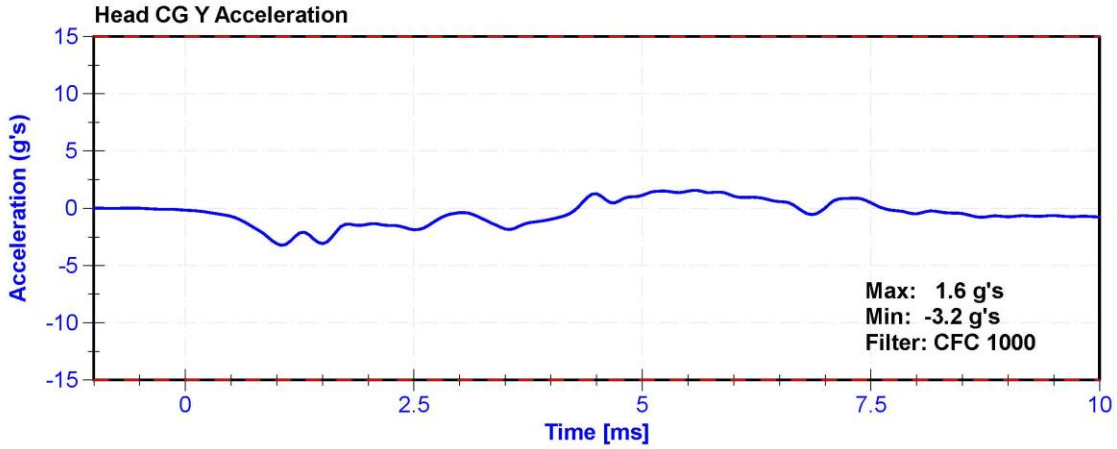
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	20.7	Pass
Humidity	10	70	%	23.8	Pass
Resultant Acceleration	250	300	g's	263.9	Pass
Oscillation	0	10	%	2.1	Pass
Lateral Acceleration	-15	15	g's	-3.2	Pass

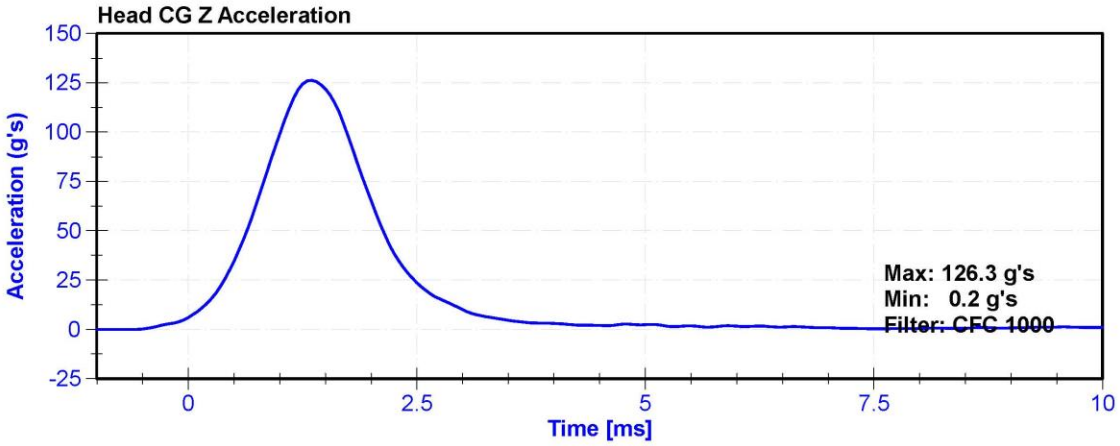
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	ENDEVCO 7264CT	AC-P58998	4/17/2020	10/16/2020
Y Accelerometer	ENDEVCO 7264	AC-P83320	4/17/2020	10/16/2020
Z Accelerometer	ENDEVCO 7264CT	AC-P58997	4/17/2020	10/16/2020




Head CG X Acceleration
Acceleration (g's)
50
0
-50
-100
-150
-200
-250
0
2.5
5
7.5
10
Time [ms]
Max: 0.7 g's
Min: -231.8 g's
Filter: CFC 1000


Head CG Y Acceleration
Acceleration (g's)
15
10
5
0
-5
-10
-15
0
2.5
5
7.5
10
Time [ms]
Max: 1.6 g's
Min: -3.2 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: 126.3 g's
Min: 0.2 g's
Filter: CFC 1000

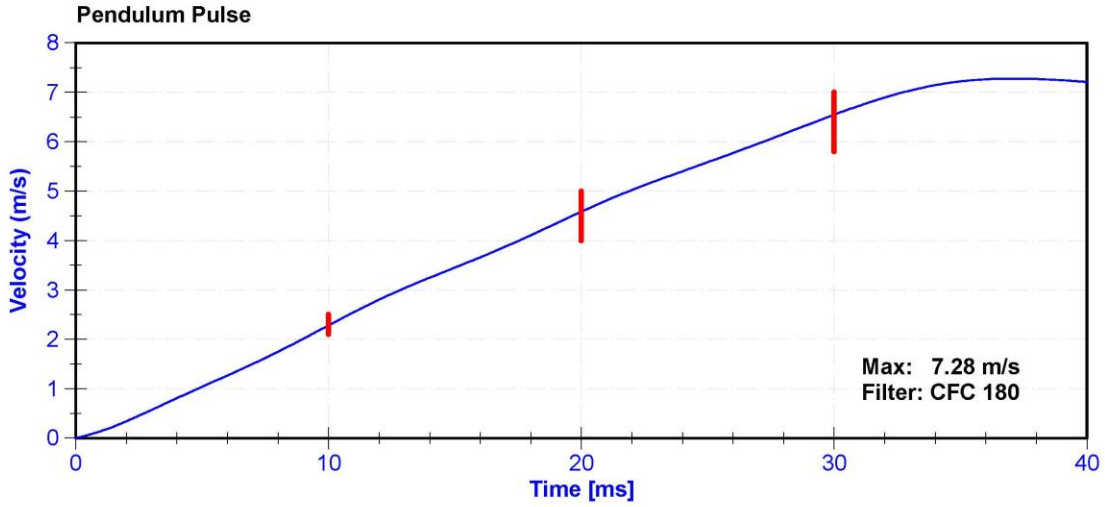
ATD Manufacturer	Denton	Test Technician	M. Dudek
ATD Serial Number	139	Laboratory Supervisor	K. Brogan

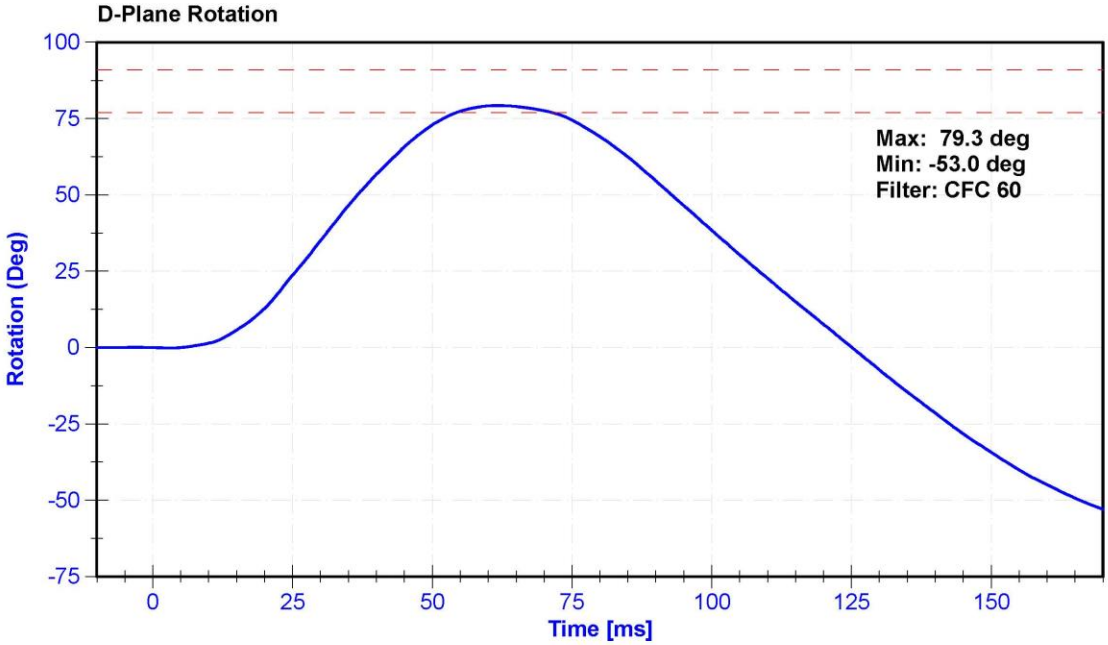
Results

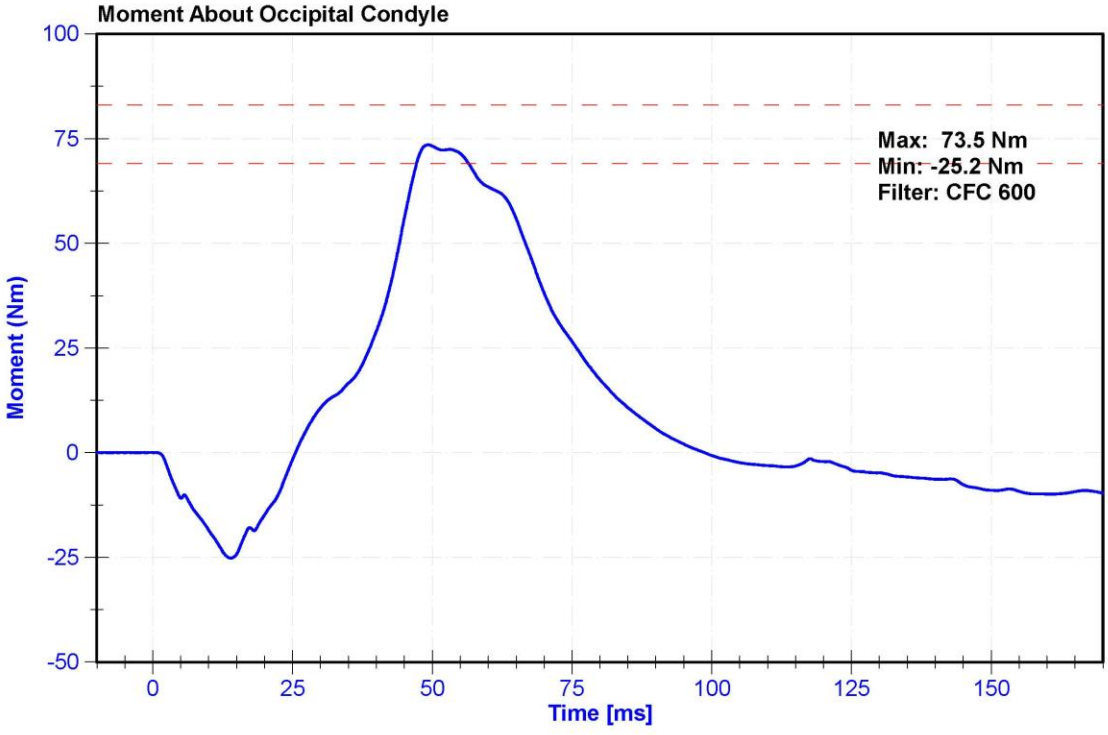
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.6	Pass
Humidity	10	70	%	23.8	Pass
Velocity	6.89	7.13	m/s	6.903	Pass
Pendulum Impulse at 10ms	2.1	2.5	m/s	2.28	Pass
Pendulum Impulse at 20ms	4.0	5.0	m/s	4.58	Pass
Pendulum Impulse at 30ms	5.8	7.0	m/s	6.55	Pass
Max D Plane Rotation	77	91	deg	79.3	Pass
Max Moment During Rotation Interval	69	83	Nm	73.5	Pass
Moment Decay to 10.0 Nm	80	100	ms	85.8	Pass

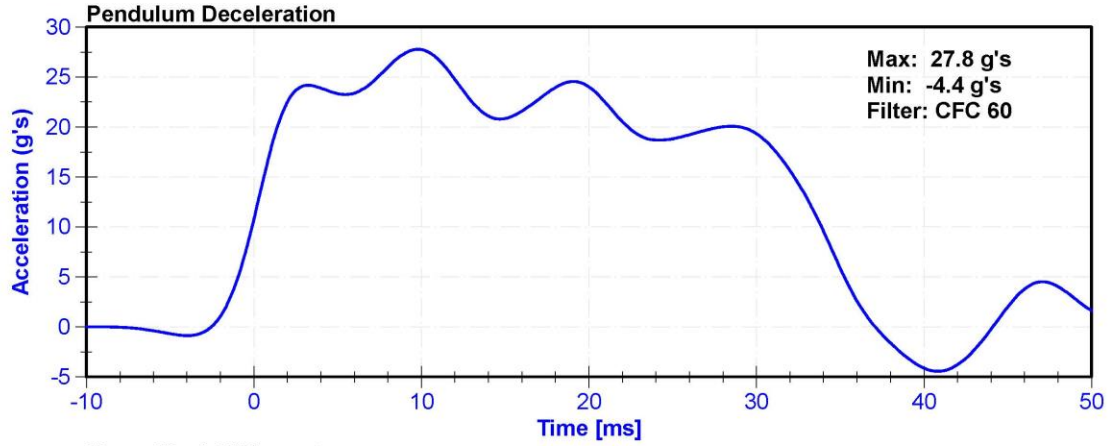
Transducer Calibrations

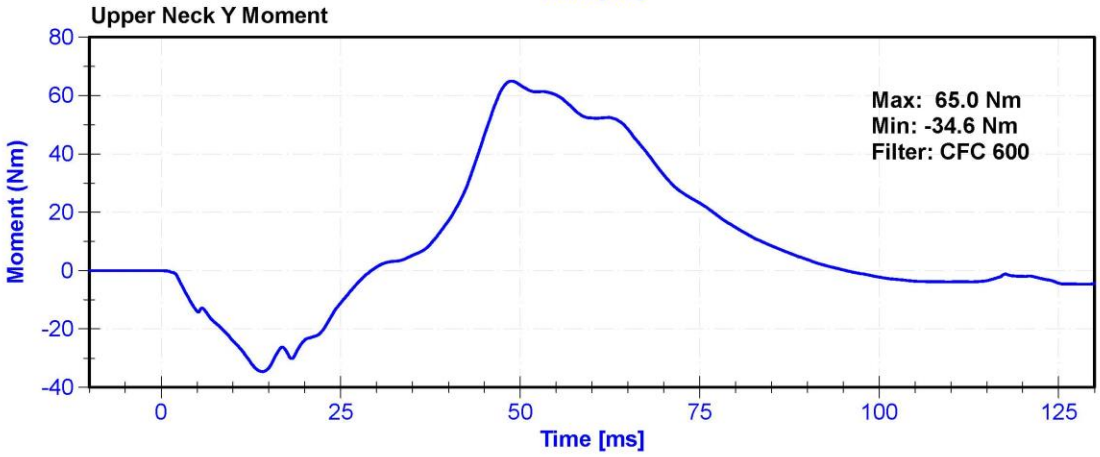
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-AH5M9 Pend	1/30/2020	1/29/2021
Pendulum Potentiometer	ETI SP22G	DS-LABPOT1	9/13/2019	9/12/2020
Condyle Potentiometer	ETI SP22G	DS-LABPOT2	9/13/2019	9/12/2020
Upper Neck Load Cell	Denton 1716A	LC-1916Fx	10/3/2019	10/2/2020

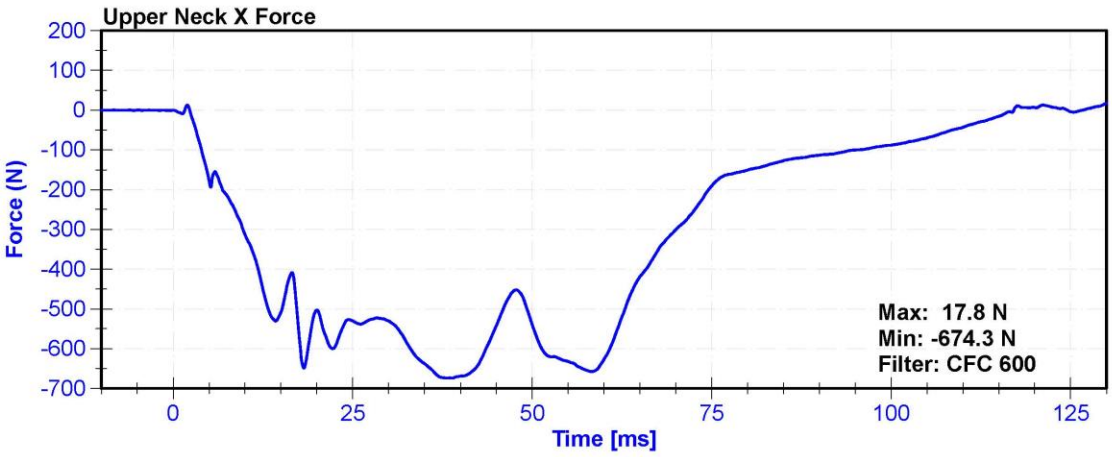



D-Plane Rotation
Max: 79.3 deg
Min: -53.0 deg
Filter: CFC 60
Rotation (Deg)
100
75
50
25
0
-25
-50
-75
0
25
50
75
100
125
150
Time [ms]


Moment About Occipital Condyle
Max: 73.5 Nm
Min: -25.2 Nm
Filter: CFC 600
Moment (Nm)
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]


Pendulum Deceleration
Max: 27.8 g's
Min: -4.4 g's
Filter: CFC 60
Acceleration (g's)
Time [ms]


Upper Neck Y Moment
Max: 65.0 Nm
Min: -34.6 Nm
Filter: CFC 600
Moment (Nm)
Time [ms]


Upper Neck X Force
Max: 17.8 N
Min: -674.3 N
Filter: CFC 600
Force (N)
Time [ms]

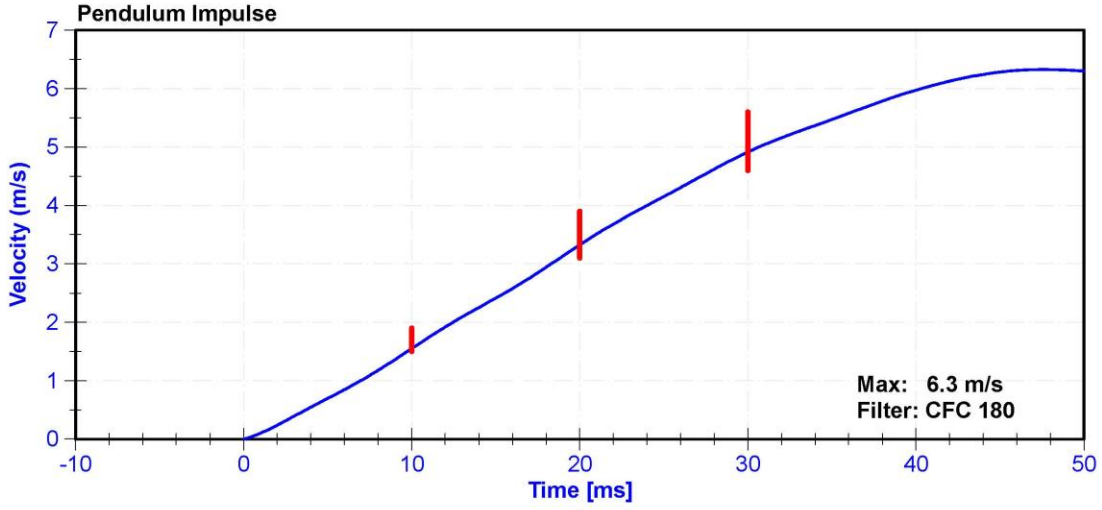
ATD Manufacturer	Denton	Test Technician	M. Dudek
ATD Serial Number	139	Laboratory Supervisor	K. Brogan

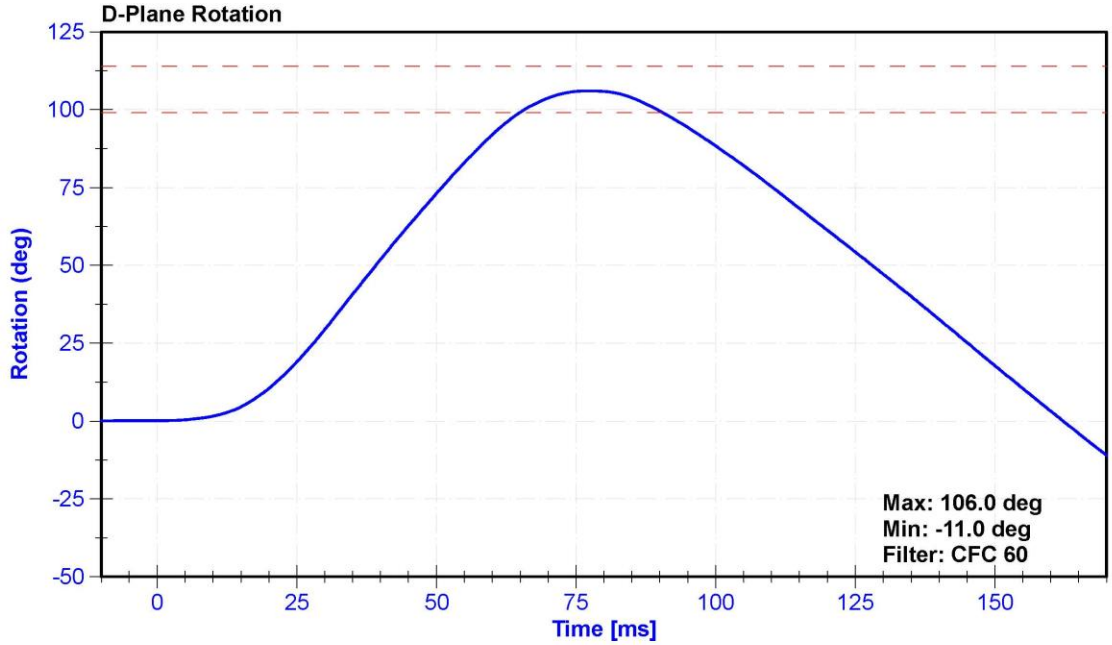
Results

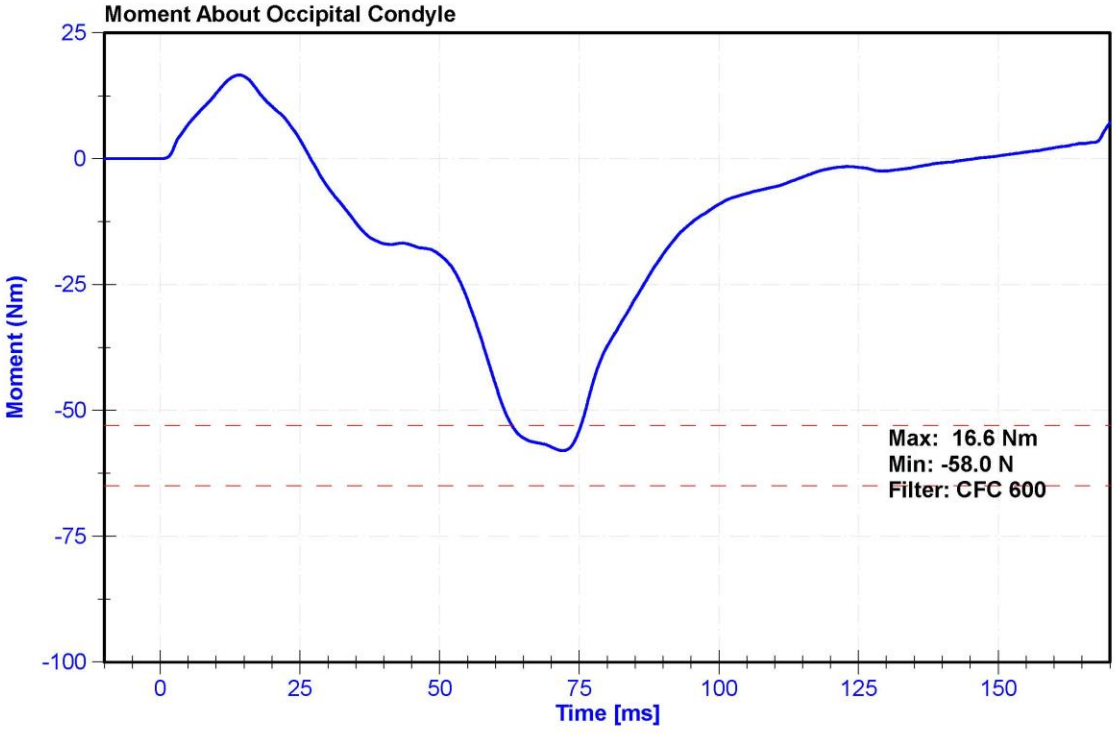
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.6	Pass
Humidity	10	70	%	22.7	Pass
Velocity	5.95	6.19	m/s	6.005	Pass
Pendulum Impulse at 10ms	1.5	1.9	m/s	1.55	Pass
Pendulum Impulse at 20ms	3.1	3.9	m/s	3.33	Pass
Pendulum Impulse at 30ms	4.6	5.6	m/s	4.91	Pass
D Plane Rotation	99	114	deg	106.0	Pass
Moment During Rotation Interval	-65	-53	Nm	-58.0	Pass
Moment Decay to -10Nm	94	114	ms	98.7	Pass

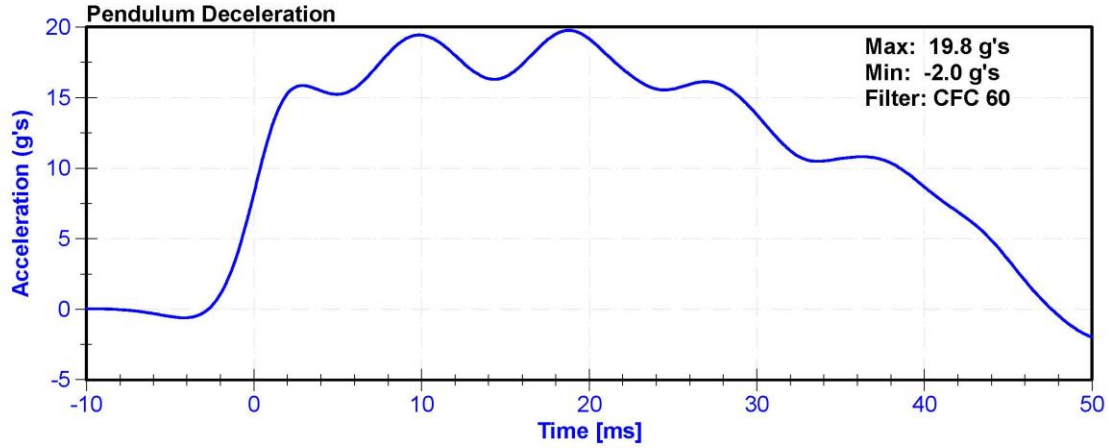
Transducer Calibrations

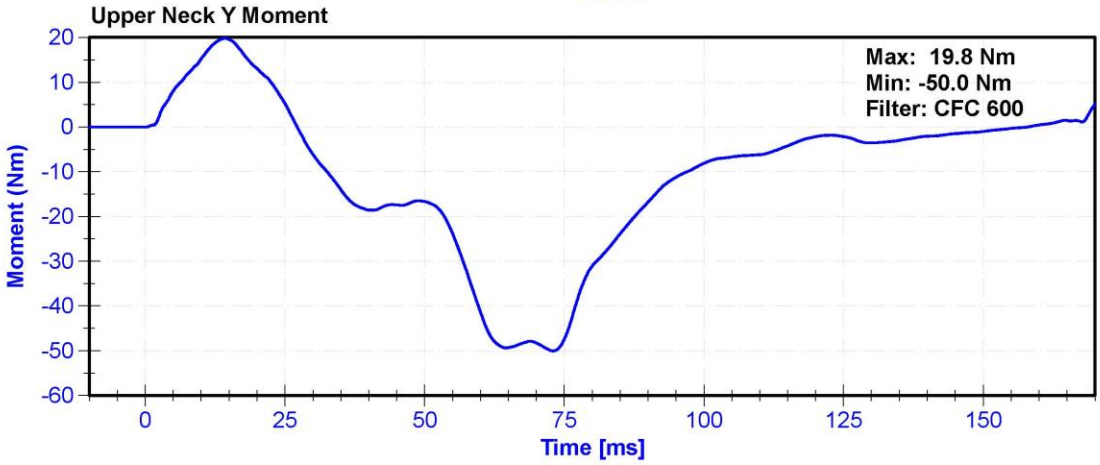
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-AH5M9 Pend	1/30/2020	1/29/2021
Pendulum Potentiometer	ETI SP22G	DS-LABPOT1	9/13/2019	9/12/2020
Condyle Potentiometer	ETI SP22G	DS-LABPOT2	9/13/2019	9/12/2020
Upper Neck Load Cell	Denton 1716A	LC-1916Fx	10/3/2019	10/2/2020

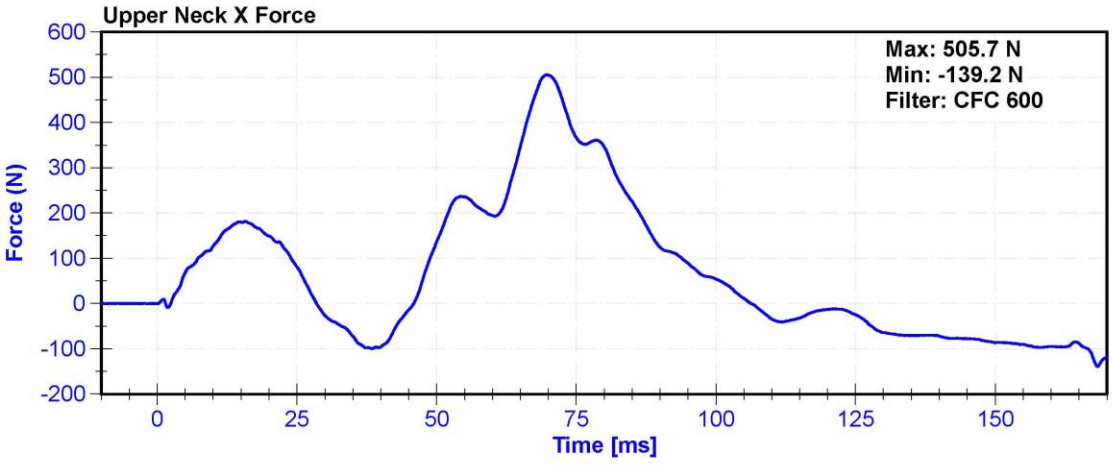



D-Plane Rotation
Rotation (deg)
125
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]
Max: 106.0 deg
Min: -11.0 deg
Filter: CFC 60


Moment About Occipital Condyle
Moment (Nm)
25
0
-25
-50
-75
-100
0
25
50
75
100
125
150
Time [ms]
Max: 16.6 Nm
Min: -58.0 N
Filter: CFC 600


Pendulum Deceleration
Max: 19.8 g's
Min: -2.0 g's
Filter: CFC 60
Acceleration (g's)
Time [ms]


Upper Neck Y Moment
Max: 19.8 Nm
Min: -50.0 Nm
Filter: CFC 600
Moment (Nm)
Time [ms]


Upper Neck X Force
Max: 505.7 N
Min: -139.2 N
Filter: CFC 600
Force (N)
Time [ms]

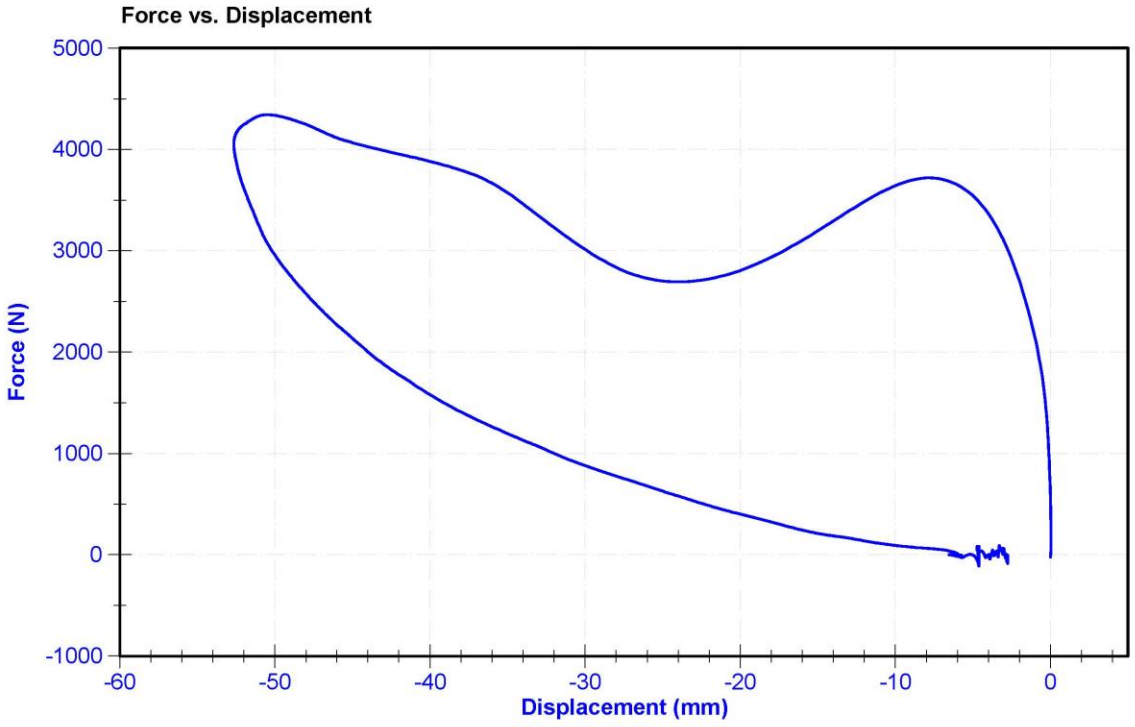
ATD Manufacturer	Denton	Test Technician	E. Helenbrook
ATD Serial Number	139	Laboratory Supervisor	K. Brogan

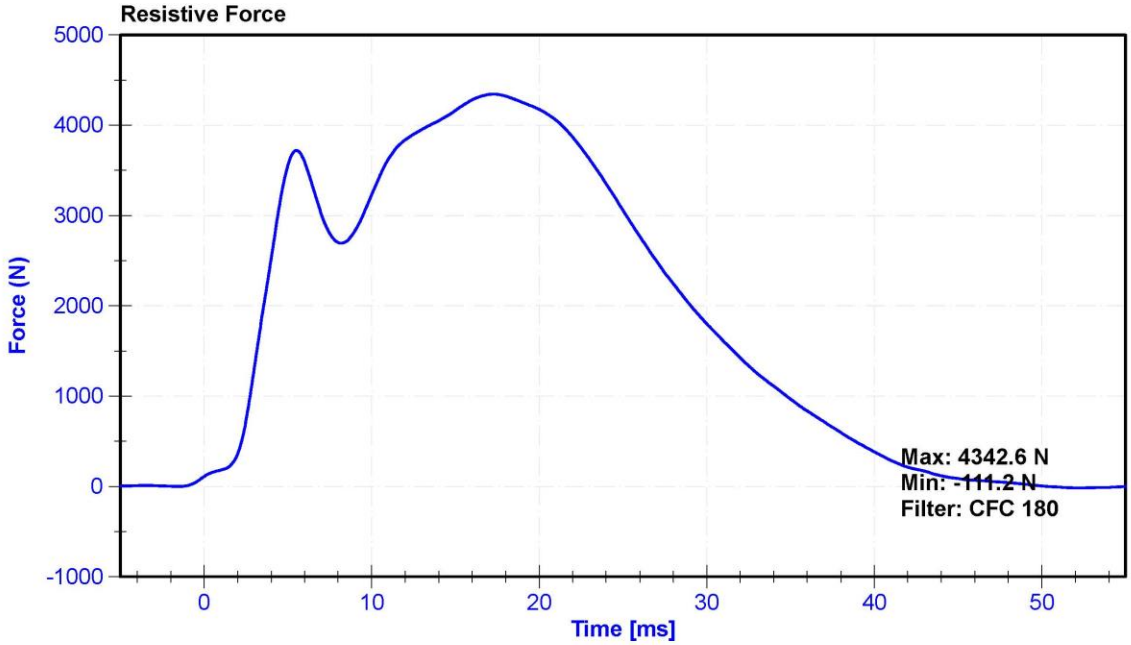
Results

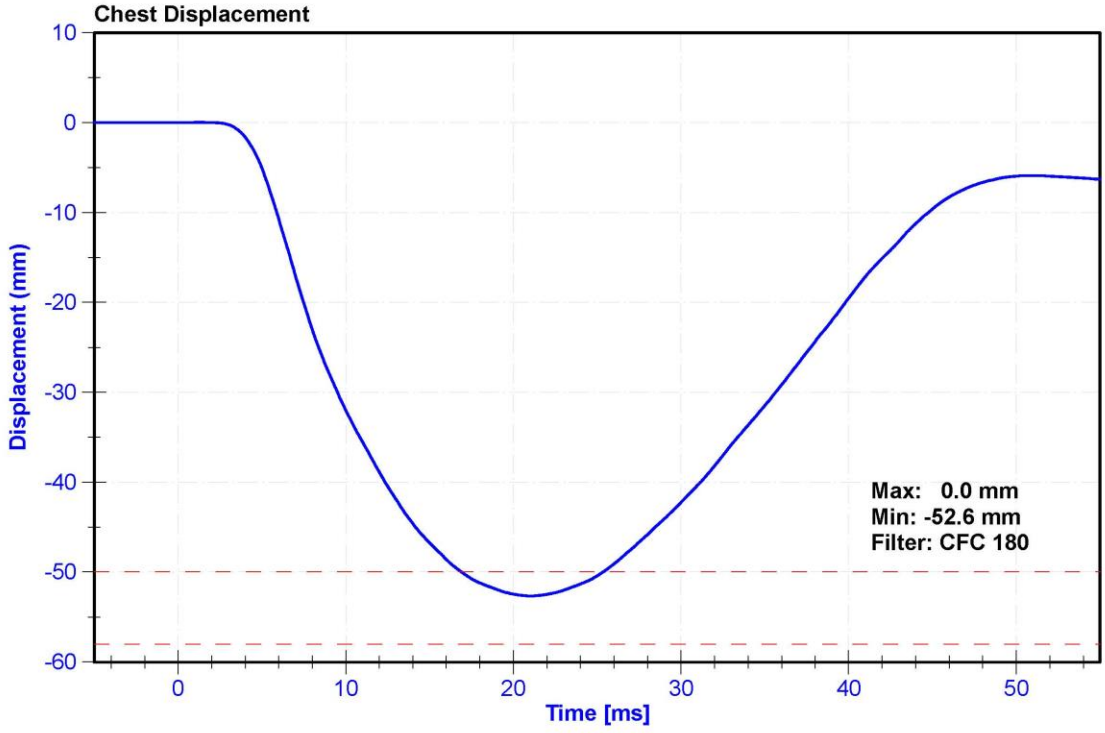
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.4	Pass
Humidity	10	70	%	36.4	Pass
Velocity	6.59	6.83	m/s	6.655	Pass
Chest Deflection	-58	-50	mm	-52.6	Pass
Maximum Resistive Force (50 to 58mm)	3900	4400	N	4342.6	Pass
Maximum Resistive Force (18 to 50mm)	0	4600	N	4335.7	Pass
Hysteresis	69	85	%	71.2	Pass

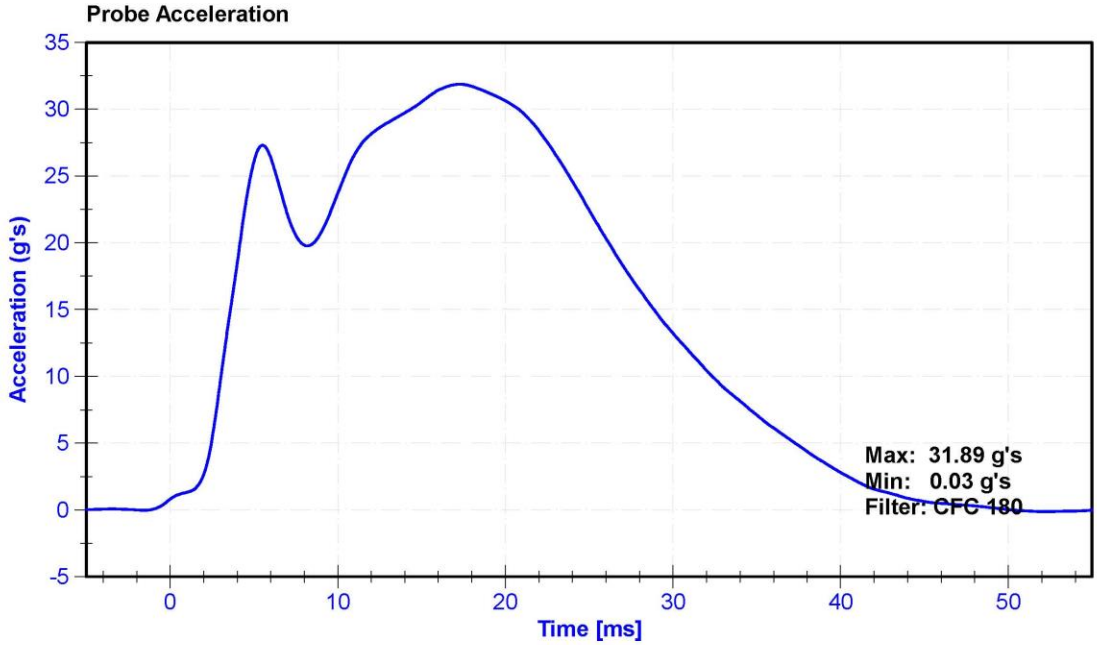
Transducer Calibrations

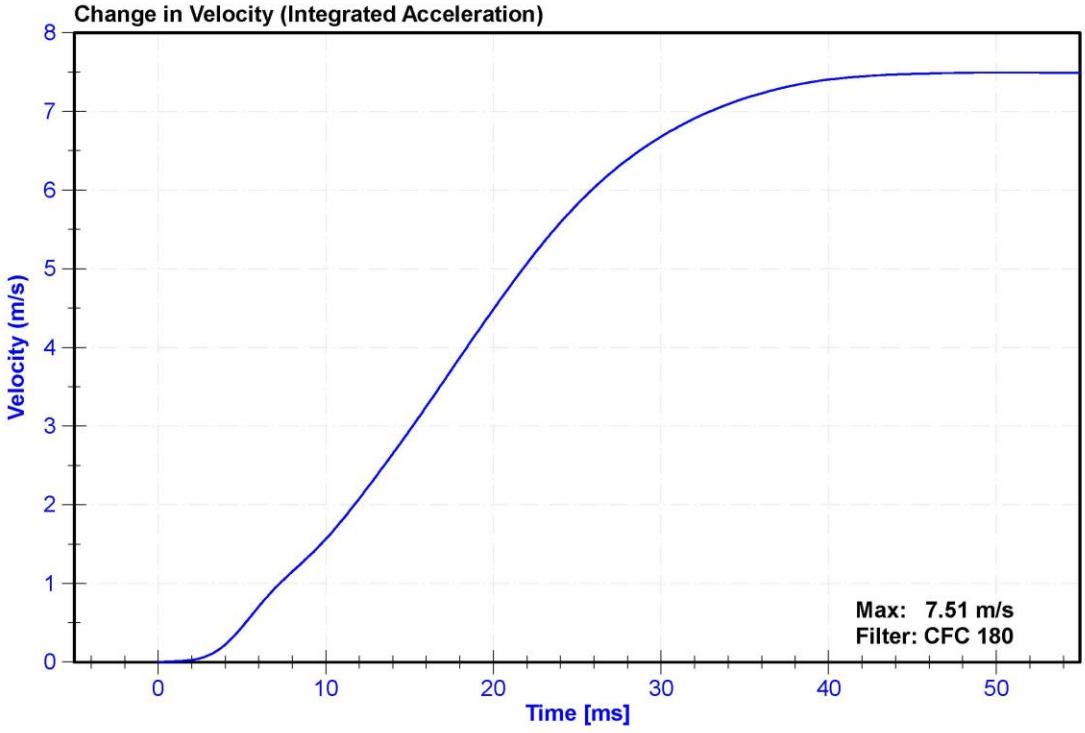
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A286228	1/29/2020	7/29/2020
Chest Potentiometer	SERVO 14CB1-2897	DS-288GFE	4/17/2020	10/16/2020




Resistive Force
Force (N)
5000
4000
3000
2000
1000
0
-1000
0
10
20
30
40
50
Time [ms]
Max: 4342.6 N
Min: -111.2 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: -52.6 mm
Filter: CFC 180


Probe Acceleration
Acceleration (g's)
35
30
25
20
15
10
5
0
-5
0
10
20
30
40
50
Time [ms]
Max: 31.89 g's
Min: 0.03 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: 7.51 m/s
Filter: CFC 180

ATD Manufacturer	Denton	Test Technician	E. Helenbrook
ATD Serial Number	139	Laboratory Supervisor	K. Brogan

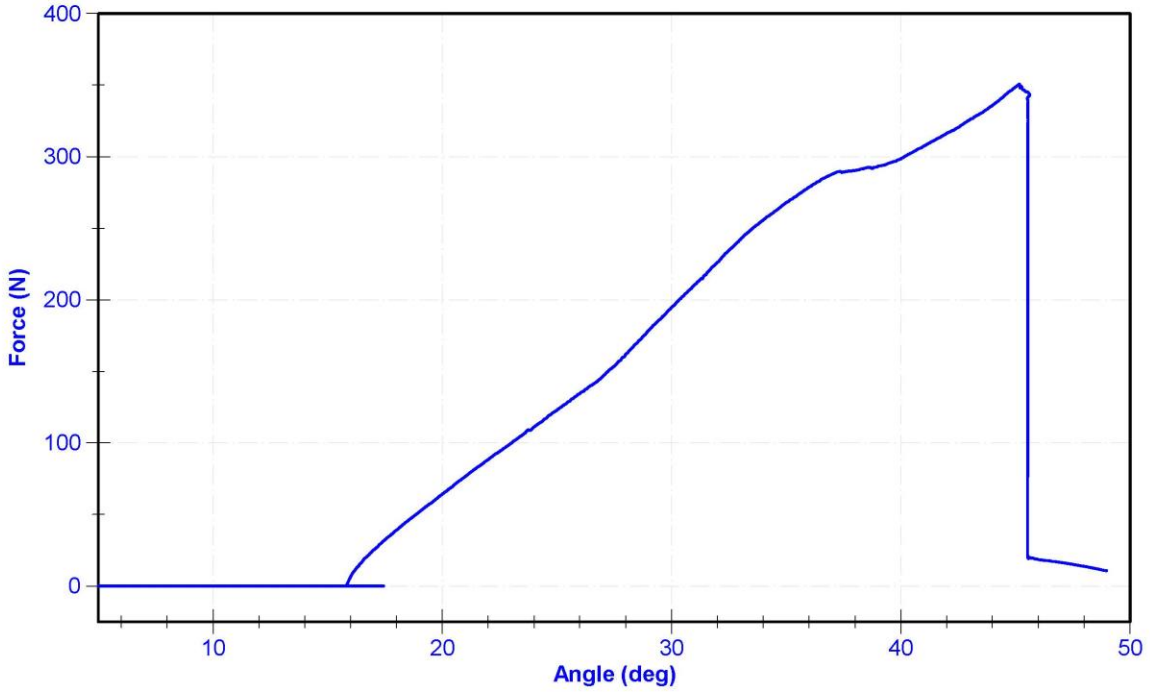
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.6	25.6	ºC	21.1	Pass
Humidity	10	70	%	35.7	Pass
Initial Angle	0	20	deg	15.8	Pass
Force at 45 Degrees	320	390	N	350.7	Pass
Return Angle Relative to Initial	0	8	deg	3.7	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	Rieker N4C-1	DS-13051548	12/9/2019	12/8/2020
Load Cell	Interface SML-200	LC-493319	1/10/2020	1/9/2021

Force vs. Displacement



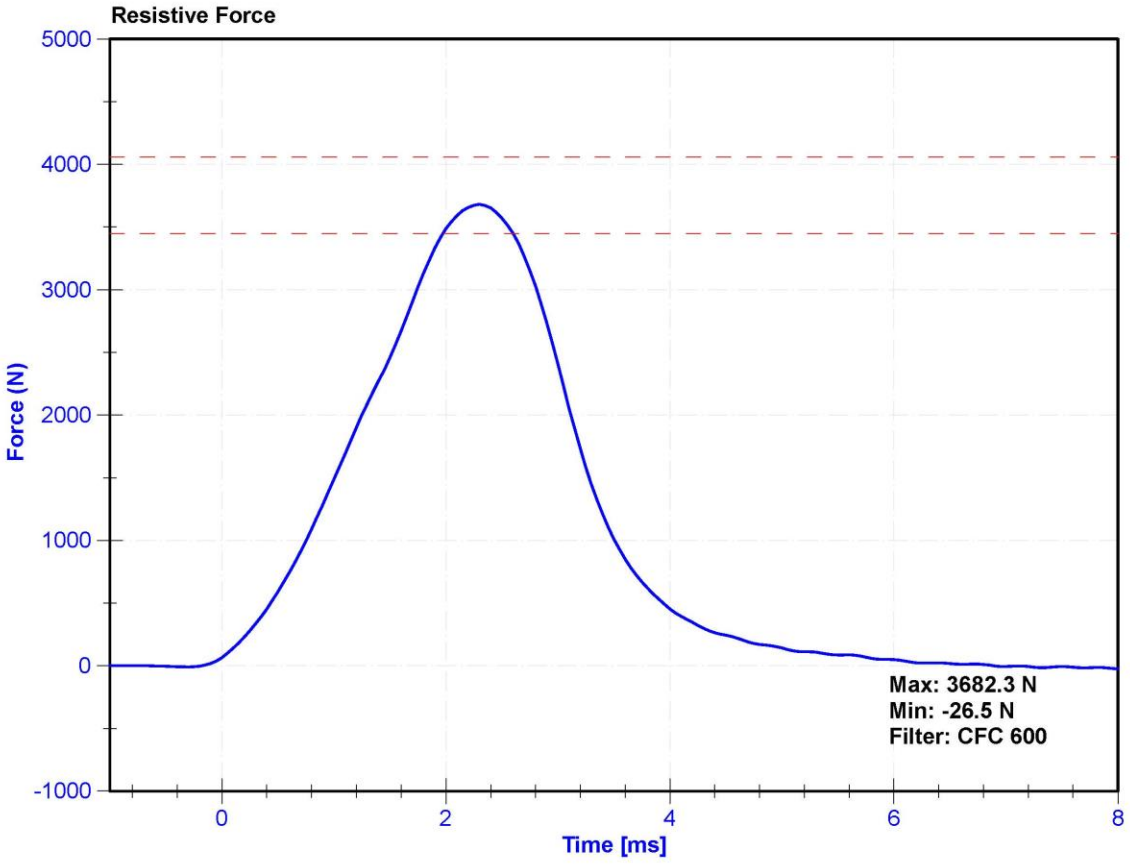
ATD Manufacturer	Denton	Test Technician	D.Reinhard
ATD Serial Number	139	Laboratory Supervisor	K.Brogan

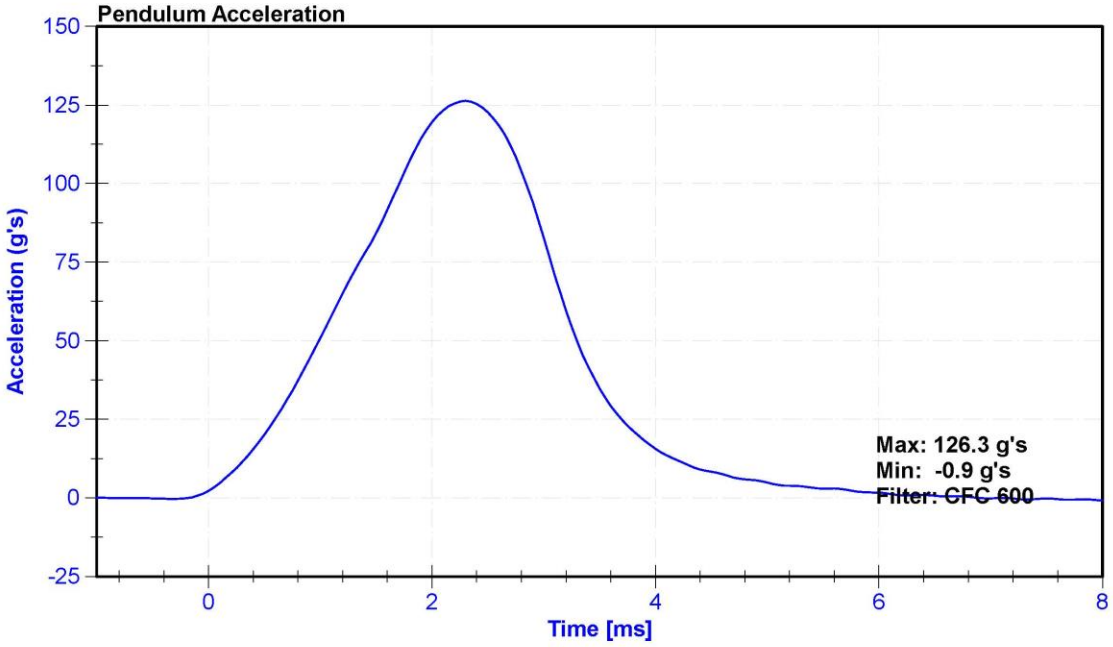
Results

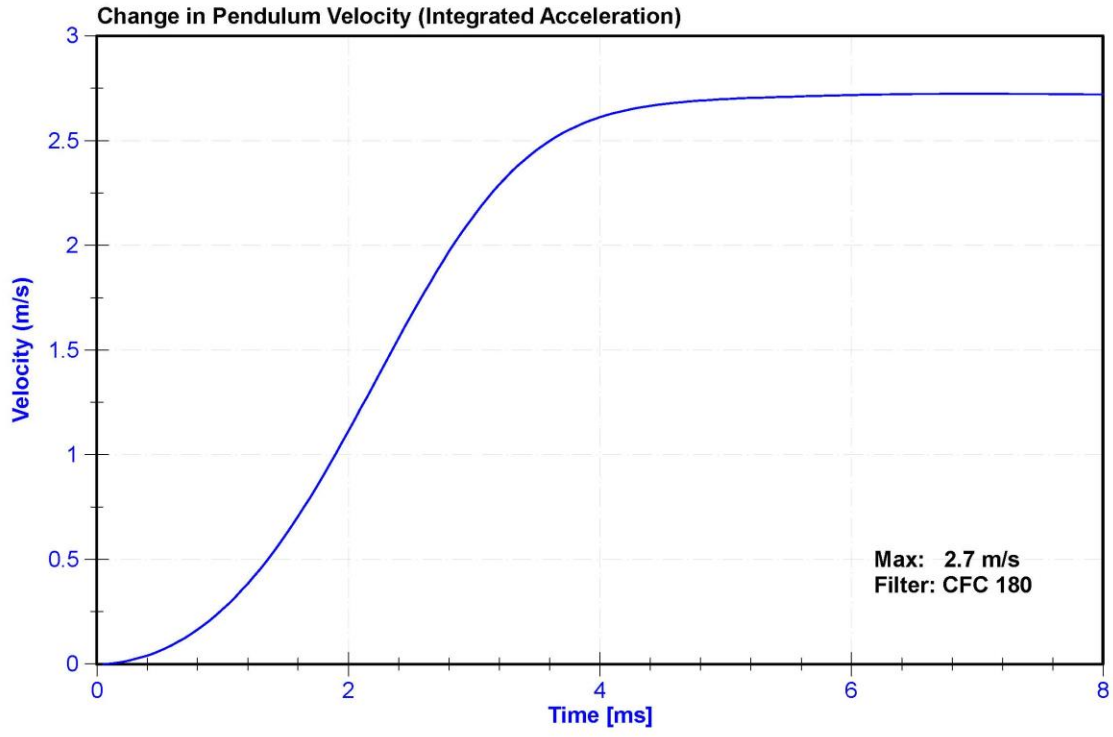
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.4	Pass
Humidity	10	70	%	21.0	Pass
Velocity	2.07	2.13	m/s	2.130	Pass
Resistive Force	3450	4060	N	3682.3	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A260568	1/29/2020	7/29/2020




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: -0.9 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

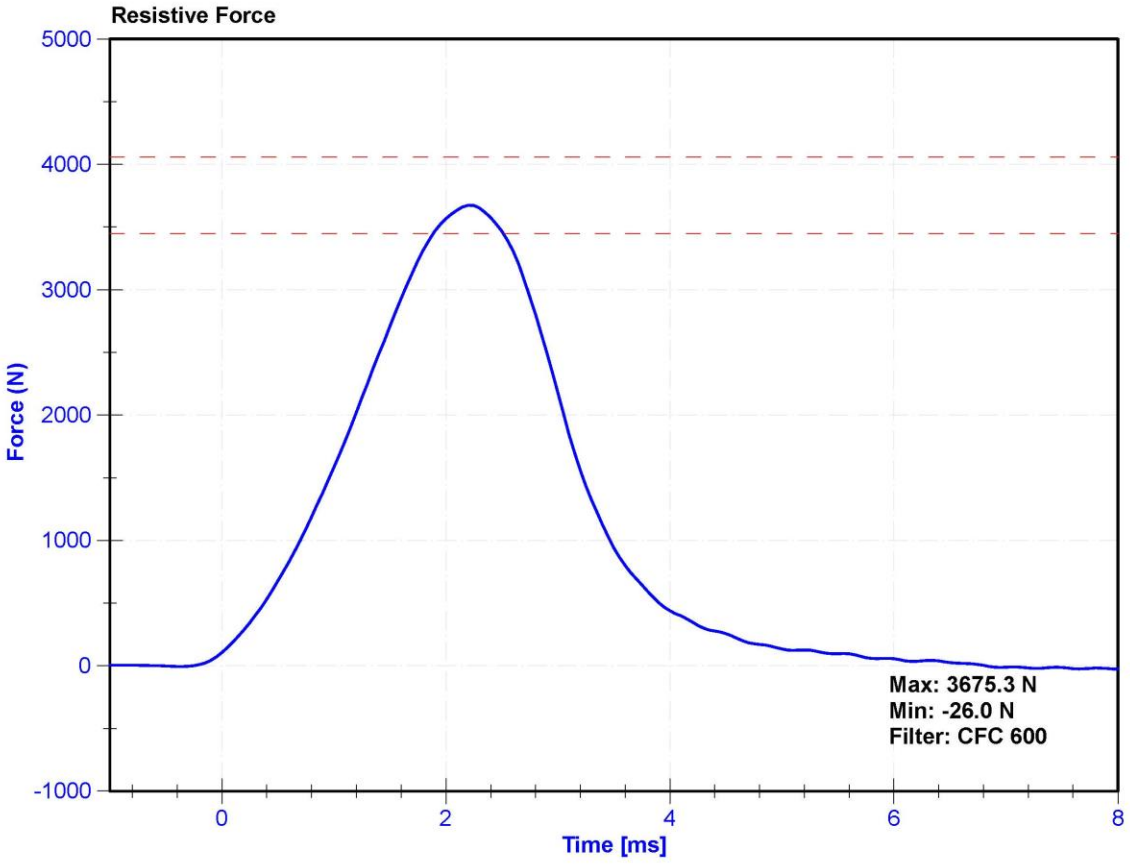
ATD Manufacturer	Denton	Test Technician	D.Reinhard
ATD Serial Number	139	Laboratory Supervisor	K.Brogan

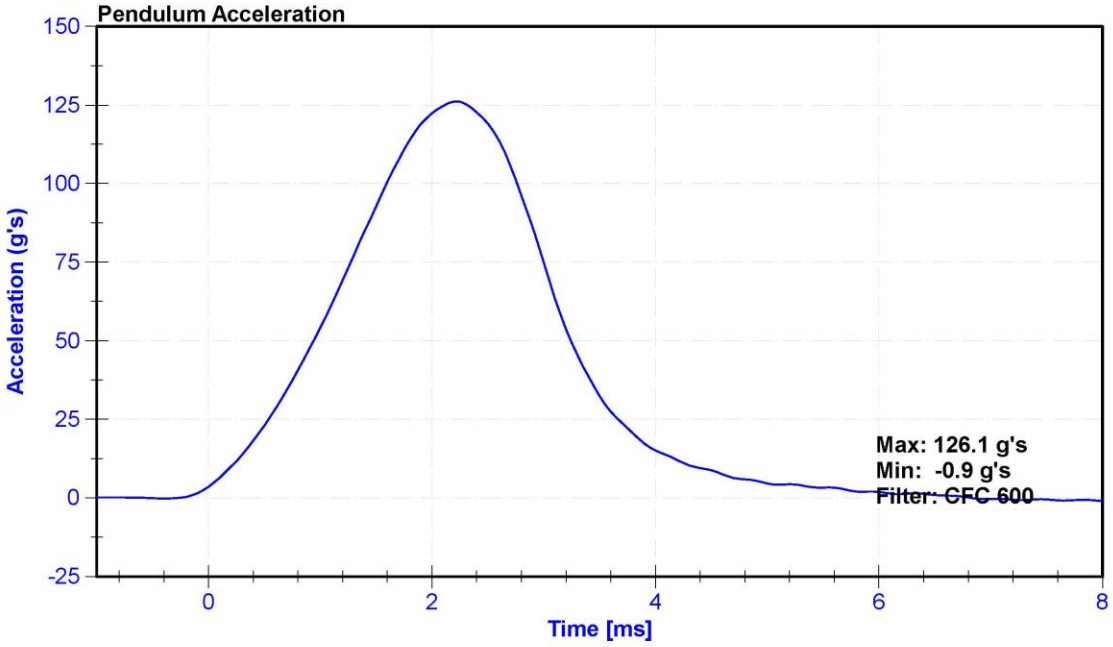
Results

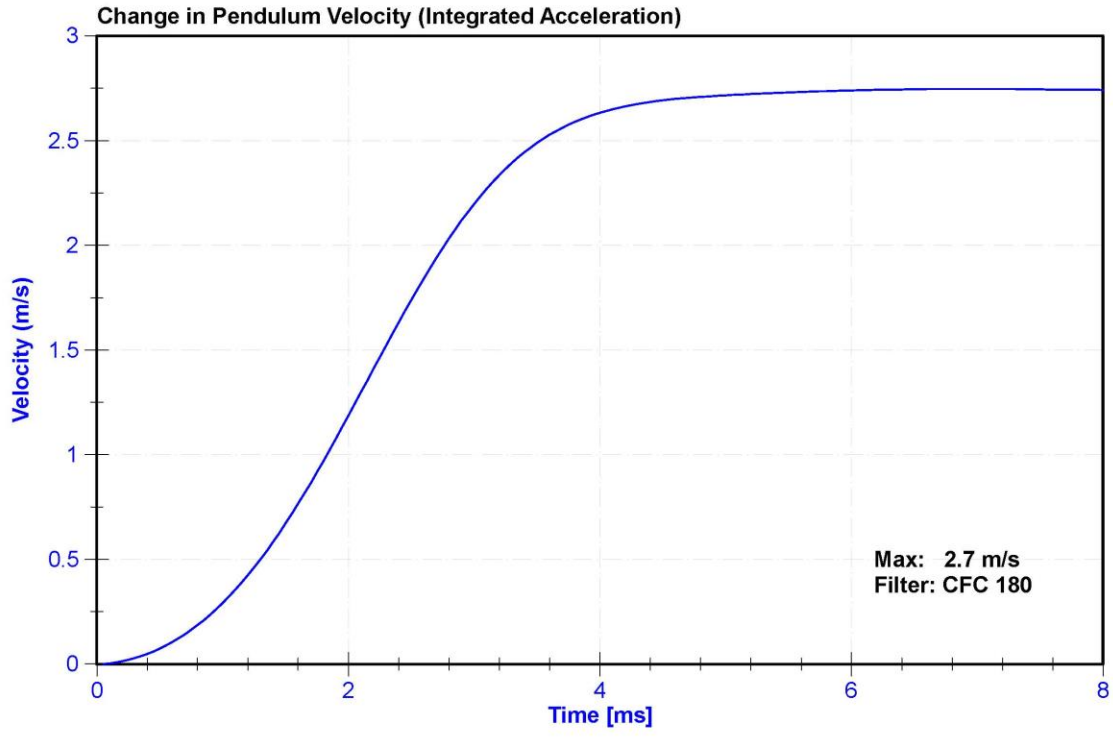
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.5	Pass
Humidity	10	70	%	22.0	Pass
Velocity	2.07	2.13	m/s	2.128	Pass
Resistive Force	3450	4060	N	3675.3	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A260568	1/29/2020	7/29/2020




Pendulum Acceleration
Acceleration (g's)
150
125
100
75
50
25
0
-25
0
2
4
6
8
Time [ms]
Max: 126.1 g's
Min: -0.9 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

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	4/17/2020
		Y	P64151	ENDEVCO	4/17/2020
		Z	P52114	ENDEVCO	4/17/2020
	Redundant	X	P58833	ENDEVCO	4/17/2020
		Y	P58905	ENDEVCO	4/17/2020
		Z	P63996	ENDEVCO	4/17/2020
Head Angular Rate Sensors		X	ARS-5941 GFE	DTS ARS PRO-18K	7/8/2019
		Y	ARS-6014 GFE	DTS ARS PRO-18K	7/8/2019
		Z	ARS-5990	DTS ARS PRO-18k	7/8/2019
Upper Neck Load Cell		FX, Fy, Fz MX,MY, MZ	LC-280FxGFE	Denton	10/3/2019
Chest Accelerometers	Primary	X	AC-P51994	ENDEVCO	4/17/2020
		Y	AC-P51991	ENDEVCO	4/17/2020
		Z	AC-P49185	ENDEVCO	4/17/2020
	Redundant	X	AC-P51713	ENDEVCO	4/17/2020
		Y	AC-P68059	ENDEVCO	4/17/2020
		Z	AC-P78824	ENDEVCO	4/17/2020
Chest Potentiometer		X	DS-142	Servo	3/27/2020
Pelvis Accelerometer		X	AC-P58800	ENDEVCO	4/17/2020
		Y	AC-P52157	ENDEVCO	4/17/2020
		Z	AC-P52156	ENDEVCO	4/17/2020
Femur Load Cells - Left	Primary	Z	LC-115-1 Fz	Denton	10/3/2019
	Redundant	Z	LC-115-2 Fz	Denton	10/3/2019
Femur Load Cells - Right	Primary	Z	LC-DI4210FZ1	Denton	10/3/2019
	Redundant	Z	LC-DI4210FZ2	Denton	10/3/2019
Tibia Load Cells - Left	Upper	MX, MY, FZ	LC-404Fx	Denton	9/25/2019
	Lower	MX, MY, FZ	LC-396Fz	Denton	9/25/2019
Tibia Load Cells – Right	Upper	MX, MY, FZ	LC-364Fz	Denton	10/3/2019
	Lower	MX, MY, FZ	36440364 FZ	Denton	9/25/2019
Foot Accelerometers - Left	Rear	X	AC-P50084	ENDEVCO	4/20/2020
	Front	Z	AC-P58779	ENDEVCO	4/20/2020
Foot Accelerometers - Right	Rear	X	AC-P51872	ENDEVCO	4/20/2020
	Front	Z	AC-P58893	ENDEVCO	4/20/2020
Seat belt Load Cells	Lap		NA	NA	11/2/2019
	Shoulder		LC-174	FTSS IF-964	5/4/2019

Table 2 – Front Passenger Dummy Instrumentation

Instrumentation		Axis/Location	Hybrid III 5th S/N:139		
			Serial Number	Manufacturer	Calibration Date
Head Accelerometers	Primary	X	AC-P58780	ENDEVCO	4/17/2020
		Y	AC-P83320	ENDEVCO	4/17/2020
		Z	AC-P58997	ENDEVCO	4/17/2020
	Redundant	X	AC-P58998	ENDEVCO	4/17/2020
		Y	AC-P58749	ENDEVCO	4/17/2020
		Z	AC-P71292	ENDEVCO	4/17/2020
Head Angular Rate Sensors		X	ARS16992	DTS ARS	5/28/2019
		Y	ARS-4712 GFE	DTS ARS	7/8/2019
		Z	ARS11293	DTS ARS	5/28/2019
Upper Neck Load Cell		FX, Fy, Fz MX,MY, MZ	LC-1916Fx	Denton	10/3/2019
Chest Accelerometers	Primary	X	AC-P51965	ENDEVCO	4/15/2020
		Y	AC-P23904	ENDEVCO	4/15/2020
		Z	AC-P50062	ENDEVCO	4/15/2020
	Redundant	X	AC-P52007	ENDEVCO	4/15/2020
		Y	AC-P51259	ENDEVCO	4/15/2020
		Z	AC-P58981	ENDEVCO	4/14/2020
Chest Potentiometer		X	DS-288GFE	SERVO	4/17/2020
Pelvis Accelerometer		X	AC-P49182	ENDEVCO	4/14/2020
		Y	AC-P51220	ENDEVCO	4/14/2020
		Z	AC-P82759	ENDEVCO	4/14/2020
Femur Load Cells - Left	Primary	Z	LC-118Fz1	Denton	10/3/2019
	Redundant	Z	LC-118Fz2	Denton	10/3/2019
Femur Load Cells - Right	Primary	Z	LC-117Fz1	Denton	10/3/2019
	Redundant	Z	LC-117Fz2	Denton	10/3/2019
Tibia Load Cells - Left	Upper	MX, MY, FZ	36430362-FZ	Denton	10/3/2019
	Lower	MX, MY, FZ	36440674-FZ	Denton	10/3/2019
Tibia Load Cells – Right	Upper	MX, MY, FZ	36430486-FX	Denton	10/3/2019
	Lower	MX, MY, FZ	36440495-FZ	Denton	10/3/2019
Foot Accelerometers - Left	Rear	X	AC-P64005	ENDEVCO	4/15/2020
	Front	Z	AC-P64006	ENDEVCO	4/15/2020
Foot Accelerometers - Right	Rear	X	AC-P78669	ENDEVCO	4/15/2020
	Front	Z	AC-P52054	ENDEVCO	4/15/2020
Seat belt Load Cells	Lap		NA	NA	NA
	Shoulder		NA	NA	NA

Table 3 – Vehicle Instrumentation

Instrumentation			Axis	Serial Number	Manufacturer	Calibration Date
Crossmember/Rear Seat Accelerometers	Left	Primary	X	AC-A280325	MSI 1201-1000	1/13/2020
			Z	A284319	MSI 1201-1000	1/13/2020
		Redundant	X	AC-A280900	MSI 1201-1000	1/13/2020
	Right	Primary	X	AC-A280018	MSI 1201-1000	12/18/2019
			Z	AC-A281033	MSI 1201-1000	1/14/2020
		Redundant	X	AC-A280326	MSI 1201-1000	12/2/2019
Engine Accelerometers	Top		X	AC-A280198	MSI 1201-1000	2/18/2020
	Bottom		X	A315784	MSI 1201-1000	2/4/2020