

REPORT NUMBER: NCAP-CAL-19-006

**NEW CAR ASSESSMENT PROGRAM (NCAP)
FRONTAL BARRIER IMPACT TEST**

**FCA US LLC
2019 Jeep Wrangler Unlimited
Four Door SUV**

NHTSA No: M20190309

**PREPARED BY:
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June 5, 2019


FINAL REPORT

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

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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: _____

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16. Abstract A 56.30 km/h (35 mph), NCAP Frontal Impact Test was conducted on a 2019 Jeep Wrangler Unlimited four door SUV in accordance with the specifications of the Office of Crashworthiness Standards Frontal NCAP Laboratory Test Procedure. This test was conducted to obtain data indicant of FMVSS 208, 212, 219 (partial), 301, and foot well intrusion performance. The test was conducted at Calspan Corporation's Transportation Test Operations facility in Buffalo, New York on March 12, 2019. The impact velocity of the vehicle was 56.31 km/h, and the ambient temperature at the barrier face at the time of impact was 21°C. The target vehicle's maximum post-test static crush was 448 mm to the right side of the front bumper. The test vehicle's occupant performance data is as follows:																																																									
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SECTION 1

PURPOSE AND SUMMARY OF TEST

PURPOSE

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

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

SUMMARY

A ridged fixed barrier was impacted by a 2019 Jeep Wrangler Unlimited four door SUV at a velocity of 56.31 km/h. The test was performed at Calspan Corporation's Transportation Test Operations facility in Buffalo, New York on March 12, 2019. Pre- and post-test photographs of the vehicle and dummies to document the test can be found in Appendix A. One real-time camera and 14 high-speed cameras were used to document the frontal barrier impact event. Camera locations and other pertinent camera information can be found in Data Sheet 6 of this report.

One Part 572E, 50th percentile male anthropomorphic test device (ATD), was placed in the driver seating position and one Part 572O 5th percentile female ATD was placed in the right-front passenger seating position according to dummy placement instructions specified in the Frontal NCAP Laboratory Test Procedure. Both ATDs were fully instrumented with head, chest and pelvis tri-axial accelerometers, chest displacement potentiometers, upper neck transducers, right / left femur load cells, and lower leg instrumentation. The driver (position 1) ATD (Serial No. 142) and the right-front passenger (position 2) ATD (Serial No. 140) were calibrated previous to this test. Certification details, along with instrumentation calibration data, can be found in Appendix C of this report.

The 136 channels of data were recorded on an on-board data acquisition system. Please refer to Appendix B for the dummy response data traces.

There was 100 percent windshield retention and no intrusion into the protected zone of the windshield during the event. There was a total of 0.0 grams of stoddard solvent leakage after the event and including all phases of the static rollover. The maximum static crush of the test vehicle was 438 mm at C4 to the right side of front bumper. During and after the impact event, the driver's and passenger's side doors were closed and operational.

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

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

The occupant data is summarized below.

ATD Position	HIC ₁₅	Nij	Neck Tension (N)	Neck Comp. (N)	3ms Chest Clip (Gs)	Chest Disp. (mm)	Left Femur (N)	Right Femur (N)
Driver (50 th)	137.221	0.329	1628.593	-99.976	50.329	-30.448	-4228.714	-2914.398
Passenger (5 th)	206.533	0.350	938.415	-230.911	37.092	-18.036	-1813.211	-2304.614

GENERAL COMMENTS:

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

Data Anomalies:

- Driver Head CG Redundant Y Acceleration, Questionable data after 7ms
- Barrier Load Cell B7 Fx, Questionable data after 93ms
- Barrier Load Cell C3 Fx, Questionable data after 84.3ms
- Barrier Load Cell C7 Fx, Questionable data after 84.3ms

SECTION 2

OCCUPANT AND VEHICLE INFORMATION / DATA SHEETS

This section contains information reporting for the following Data Sheets:

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

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

Data Sheet No. 3 – Dummy Longitudinal Clearance Dimensions

Data Sheet No. 4 – Dummy Lateral Clearance Dimensions

Data Sheet No. 5 – Seat Belt Positioning Data

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

Data Sheet No. 7 – Vehicle Accelerometer Locations

Data Sheet No. 8 – Photographic Reference Target Locations

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

Data Sheet No. 10 – Test Vehicle Summary of Results

Data Sheet No. 11 – Post-Test Observations

Data Sheet No. 12 – Vehicle Profile Measurements

Data Sheet No. 13 – Accident Investigation Division Data

Data Sheet No. 14 – Vehicle Intrusion Measurements

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

Data Sheet No. 16 – FMVSS 301 Static Rollover Results

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

**DATA SHEET NO. 1
GENERAL TEST AND VEHICLE PARAMETER DATA**

Test Vehicle: 2019 Jeep Wrangler Unlimited four door SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20190309
 Test Date: 3/12/2019

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA No.	M20190309
Model Year	2019
Make	Jeep
Model	Wrangler
Body Style	Four Door SUV
VIN	1C4HJXDG7KW505887
Body Color	Red
Odometer Reading (km /mi)	101 mi
Engine Displacement (L)	3.6
Type / No. Cylinders	V6
Engine Placement	Inline
Transmission Type	Automatic
Transmission Speeds	8
Overdrive	Yes
Final Drive	4WD
Roof Rack	No
Sunroof / T-Top	Yes
Running Boards	No
Tilt Steering Wheel	Yes
Power Seats	No
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	No
Driver Head/Torso Airbag	Yes
Driver Torso Airbag	No
Driver Torso/Pelvis Airbag	No
Driver Pelvis Airbag	No
Driver Knee Airbag	No
Front Pass. Frontal Airbag	Yes
Front Pass. Curtain Airbag	No
Front Pass. Head/Torso Airbag	Yes
Front Pass. Torso Airbag	No
Front Pass. Torso/Pelvis Airbag	No
Front Pass. Pelvis Airbag	No
Front Pass. Knee Airbag	No
Driver Pretensioner	Yes
Driver Load Limiter	Yes
Front Pass. Pretensioner	Yes
Front Pass. Load Limiter	Yes
Other	No

Does owner's manual provide instructions to turn off automatic door locks?

Yes

DATA FROM CERTIFICATION LABEL

Manufactured By	FCA US LLC
Date of Manufacture	11-18

GVWR (kg)	2405
GAWR Front (kg)	1225
GAWR Rear (kg)	1361

VEHICLE SEATING AND WEIGHT CAPACITY DATA

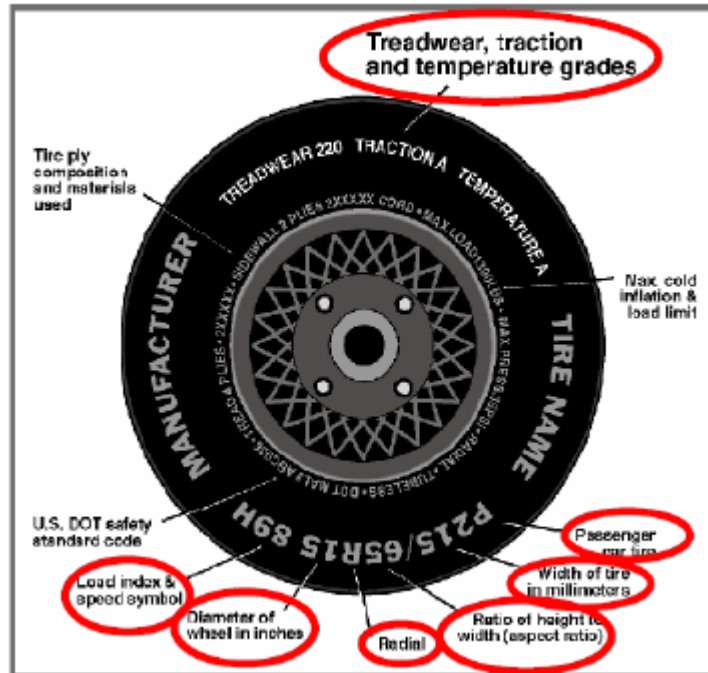
Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Bench	-	
Number of Occupants	2	3	-	5
Capacity Wt. (VCW) (kg)				385
Cargo Wt. (RCLW) (kg)				44.8

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

Test Vehicle: 2019 Jeep Wrangler Unlimited four door SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20190309
 Test Date: 3/12/2019

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



VEHICLE TIRE INFORMATION

Measured Parameter	Front	Rear
Maximum Tire Pressure (kPa)	300	300
Cold Pressure (kPa)	250	250
Recommended Tire Size	245/75R17 112T	245/75R17 112T
Tire Size on Vehicle	245/75R17	245/75R17
Tire Manufacturer	Bridgestone	Bridgestone
Tire Model	Dueler H/T	Dueler H/T
Treadwear	520	520
Traction	B	B
Temperature Grades	B	B
Tire Plies Sidewall	2 Polyester	2 Polyester
Tire Plies Body	2 Polyester, 2 Steel, 1 Polyamide	2 Polyester, 2 Steel, 1 Polyamide
Load Index / Speed Symbol	112T	112T
Tire Material	Rubber	Rubber
DOT Safety Code Left	9BM1 DHT 3918	9BM1 DHT 3918
DOT Safety Code Right	9BM1 DHT 3918	9BM1 DHT 3918

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

Test Vehicle: 2019 Jeep Wrangler Unlimited four door SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20190309
 Test Date: 3/12/2019

TEST VEHICLE WEIGHTS

	Units	As Delivered Weights (UVW)			As Tested Weights (ATW)		
		Front Axle	Rear Axle	Total	Front Axle	Rear Axle	Total
Left	kg	485	451		535.5	508.5	
Right	kg	531	462		554.5	508.5	
Ratio	%	53	47		52	48	
Totals	kg	1016	913	1929	1090	1017	2107

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value	
Total Delivered Weight (UVW)	kg	1929	(A)
Weight of 1 P572E ATD & 1 P572O ATD	kg	142	(B)
Rated Cargo / Luggage Weight (RCLW)	kg	44.8	(C)
Calculated Vehicle Target Weight (TVTW)	kg	2115.8	(A+B+C)

TEST VEHICLE ATTITUDES AND CG

Condition	Units	LF	RF	LR	RR	CG (aft of front axle)
As Delivered	mm	1026	1025	1051	1041	1423
As Tested	mm	985	984	1012	1010	1451
Post-Test	mm	1025	1070	1015	1045	

GENERAL TEST VEHICLE DATA

Measurement Description	Units	Value
Total Vehicle Wheel Base	mm	3006
Total Vehicle Length at Left Side	mm	4533
Total Vehicle Length at Centerline	mm	4602
Total Vehicle Length at Right Side	mm	4533
Weight of Ballast in Cargo Area	kg	5
Weight of Vehicle Components Removed	kg	52
Amount of Stoddard Solvent in Fuel Tank	L	75.6

LIST OF COMPONENTS REMOVED TO MEET TEST WEIGHT:

Trunk carpeting, Spare Tire, Jack, Tail light, Canvas Cover

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

Test Vehicle: 2019 Jeep Wrangler Unlimited four door SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20190309
 Test Date: 3/12/2019

TARGET VEHICLE STRUCTURAL MEASUREMENT

No.	Description	Pre-Test
1	Total Length	4602
2	Total Width	1669
3*	Bumper Top Height	671
4*	Bumper Bottom Height	498
5*	Longitudinal Member Top Height	649
6	Distance Between Longitudinal Members	844
7	Longitudinal Member Width	73
8*	Engine Top Height	1154
9*	Engine Bottom Height	358
10	Engine and Gearbox Width	578
11	Front Bumper-Engine Distance	799
12*	Front Shock Absorber Fixing Height	844
13*	Bonnet Leading Edge Height	1106
14	Front Shock Absorber Fixing Width	989
15	Front Bumper – Front Axle Distance	720
16	Front Axle – A Pillar Distance	944
17	A-Pillar – B-Pillar Distance	947
18	B-Pillar – Rear Axle Distance	1115
19	B-Pillar – C-Pillar Distance	786
20*	Roof Sill Bottom Height	1689
21*	Roof Sill Top Height	1771
22*	Floor Sill Bottom Height	509
23*	Floor Sill Top Height	599

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

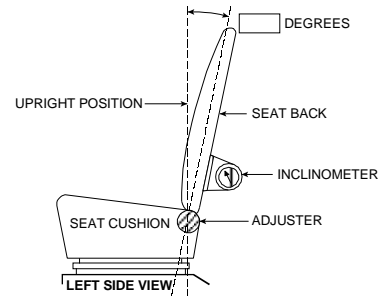
DATA SHEET NO. 2
SEAT ADJUSTMENT, FUEL SYSTEM, AND STEERING WHEEL DATA

Test Vehicle: 2019 Jeep Wrangler Unlimited four door SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20190309
 Test Date: 3/12/2019

NOMINAL DESIGN RIDING POSITION

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



FRONT SEAT ASSEMBLY

Seating Position	Degrees
Driver Seat Back Angle	5.3
Passenger Seat Back Angle	-2.9

SEAT FORE / AFT POSITIONS

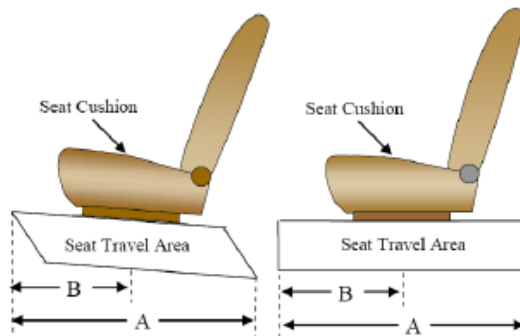
The driver's seat was positioned at the mid-point of fore/aft travel at its lowest position. The passenger's seat was positioned at the most forward position of fore/aft travel. Zero is defined as the forward most position.

Seating Position	Total Fore / Aft Travel	Placed in Position #
Driver Seat	31 (0-30)	12
Passenger Seat	29 (0-28)	0

SEAT BELT UPPER ANCHORAGE

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

Seating Position	Total # of Positions	Placed in Position #
Driver Seat	5	0
Passenger Seat	5	0



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

Test Vehicle: 2019 Jeep Wrangler Unlimited four door SUV
 Test Program: NCAP Frontal Barrier Impact Test

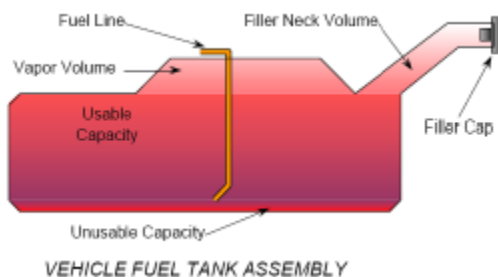
NHTSA No.: M20190309
 Test Date: 3/12/2019

FUEL TANK CAPACITY

Description	Liters
Usable Capacity of "Standard Tank"	81.3
Usable Capacity of "Optional Tank"	N/A
92%-94% of Usable Capacity	74.8 – 76.4
Actual Amount of Solvent Used	75.6
1/3 of Usable Capacity	26.8

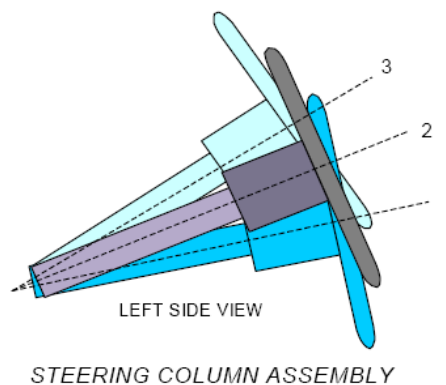
FUEL PUMP

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.



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.



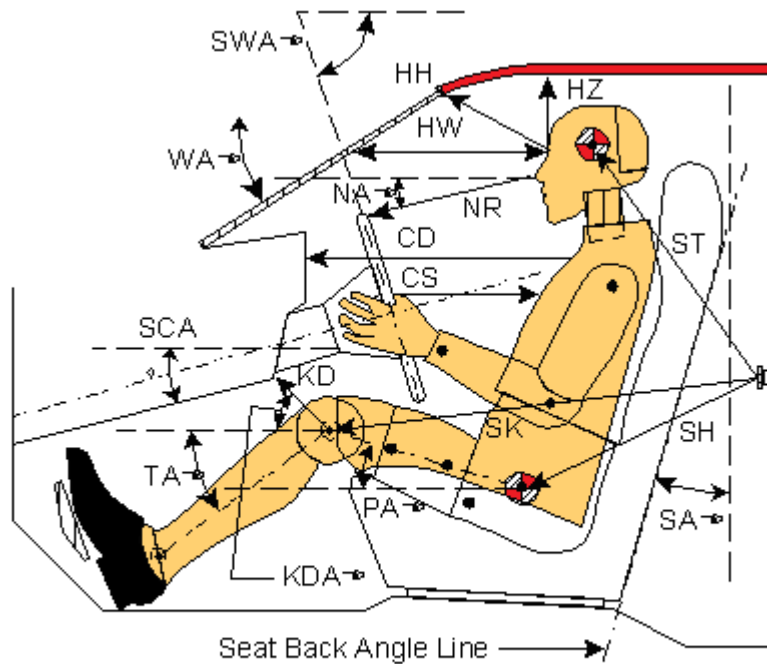
STEERING COLUMN POSITIONS

Description	Degrees	Fore / Aft Position (mm)
Lowermost position No. 1	18	
Geometric center position No. 2	21.1	
Uppermost position No. 3	23.5	
Telescoping Steering Wheel Travel		25
Test Position	21.7	12.5

DATA SHEET NO. 3
DUMMY LONGITUDINAL CLEARANCE DIMENSIONS

Test Vehicle: 2019 Jeep Wrangler Unlimited four door SUV
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20190309
Test Date: 3/12/2019



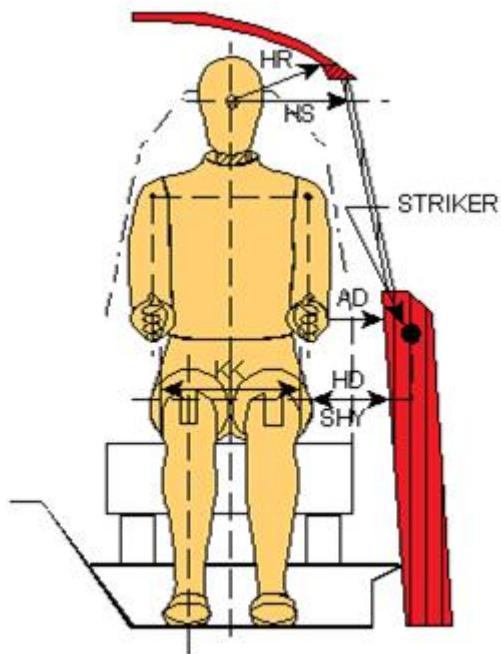
Left Side View

Code	Measurement Description	Driver (SN: 141)		Passenger (SN: 140)	
		Length (mm)	Angle (°)	Length (mm)	Angle (°)
WA°	Windshield Angle		53.9		
SWA°	Steering Wheel Angle		68.9		
SCA°	Steering Column Angle		21.1		
SA°	Seat Back Angle (on headrest post)		5.3		-2.9
HZ	Head to Roof (Z)	255	90	323	90
HH	Head to Header	490	17.3	426	33.3
HW	Head to Windshield	602	0	550	0
NR	Nose to Rim	383	11.4	425	35.8
CD	Chest to Dash	507		334	
CS	Chest to Steering Hub	290	7.8		
RA	Rim to Abdomen	150	16.6		
KDL	Left Knee to Dash	133	26.2	96	27.8
KDR	Right Knee to Dash	125	12.2	95	22.8
PA°	Pelvic Angle		22.8		20.3
TA°	Tibia Angle		36.9		57.2
SK	Striker to Knee	650	2.2	698	5.2
ST	Striker to Head	601	80.2	565	71.3
SH	Striker to H-Point	238	10.8	385	-4.4

DATA SHEET NO. 4
DUMMY LATERAL CLEARANCE DIMENSIONS

Test Vehicle: 2019 Jeep Wrangler Unlimited four door SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20190309
 Test Date: 3/12/2019



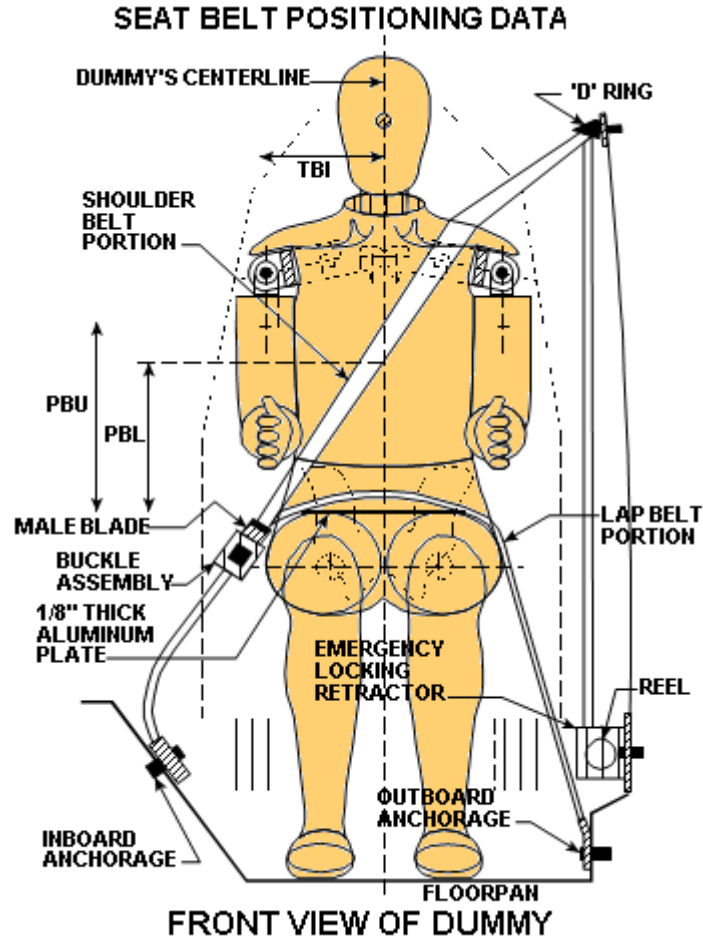
Front View

Code	Description	Driver (mm)	Passenger (mm)
AD	Arm to Door	76	46
HD	H-Point to Door	122	152
HR	Head to Side Header	240	285
HS	Head to Side Window	347	362
KK	Knee to Knee	280	165
SHY	Striker to H-Point (Y Direction)	180	250
AA	Ankle to Ankle	235	165

**DATA SHEET NO. 5
SEAT BELT POSITIONING DATA**

Test Vehicle: 2019 Jeep Wrangler Unlimited four door SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20190309
 Test Date: 3/12/2019



SEAT BELT POSITIONING MEASUREMENTS

Measurement Description	Units	Driver	Passenger
PBU — Top surface of reference to belt upper edge	mm	380	290
PBL — Top surface of reference to belt lower edge	mm	305	215

BELT LENGTH DATA

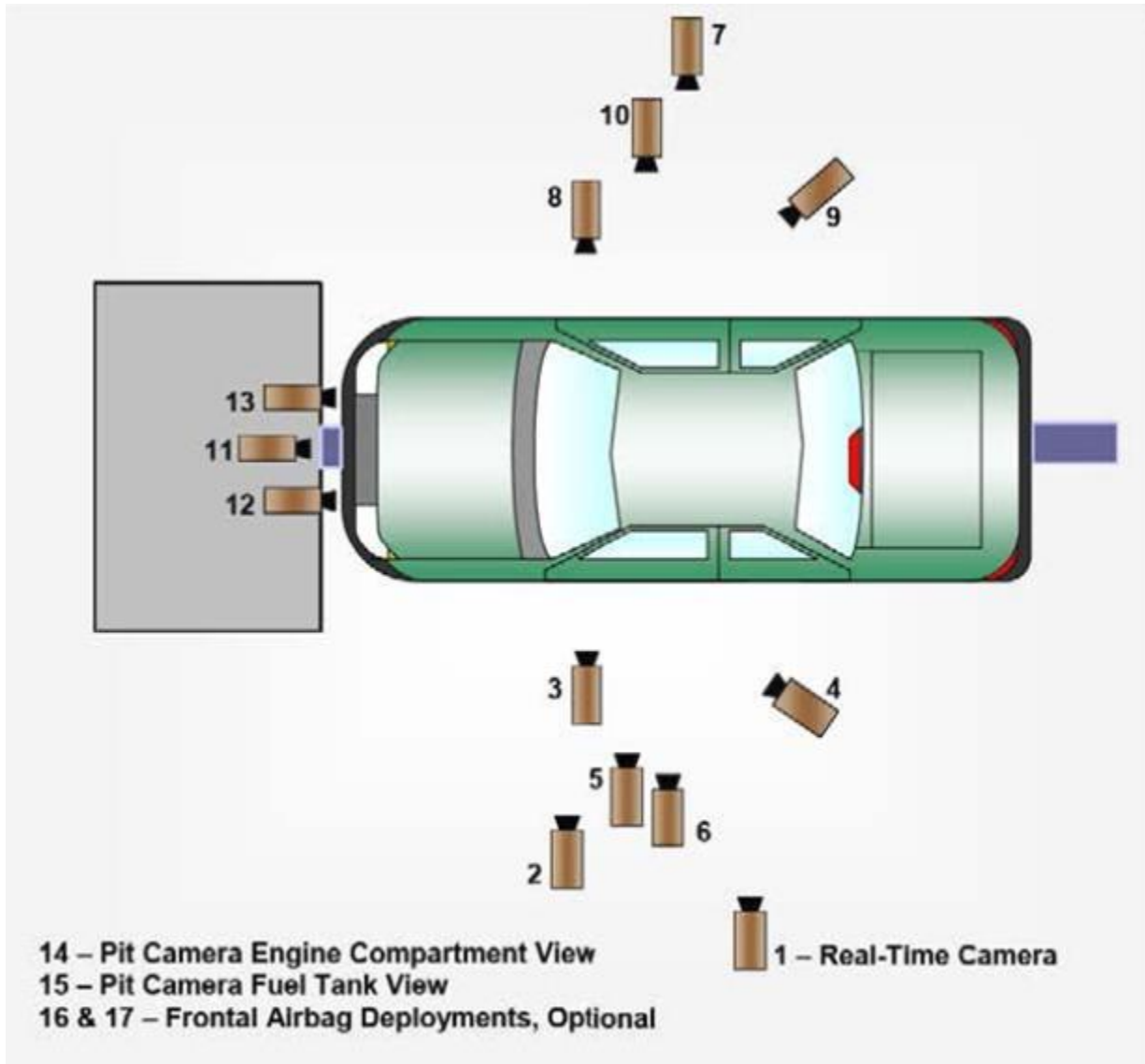
Measurement Description	Units	Driver	Passenger
Shoulder belt length as measured on ATD	mm	805	835
Lap Belt Length as measured on ATD	mm	675	690
Remainder of belt on reel	mm	950	995
Total belt length for continuous webbing systems	mm	2430	2520

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

Test Vehicle: 2019 Jeep Wrangler Unlimited four door SUV
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20190309
Test Date: 3/12/2019

CAMERA POSITIONS FOR FRONTAL IMPACTS



Top View

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

Test Vehicle: 2019 Jeep Wrangler Unlimited four door SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20190309
 Test Date: 3/12/2019

CAMERA LOCATIONS

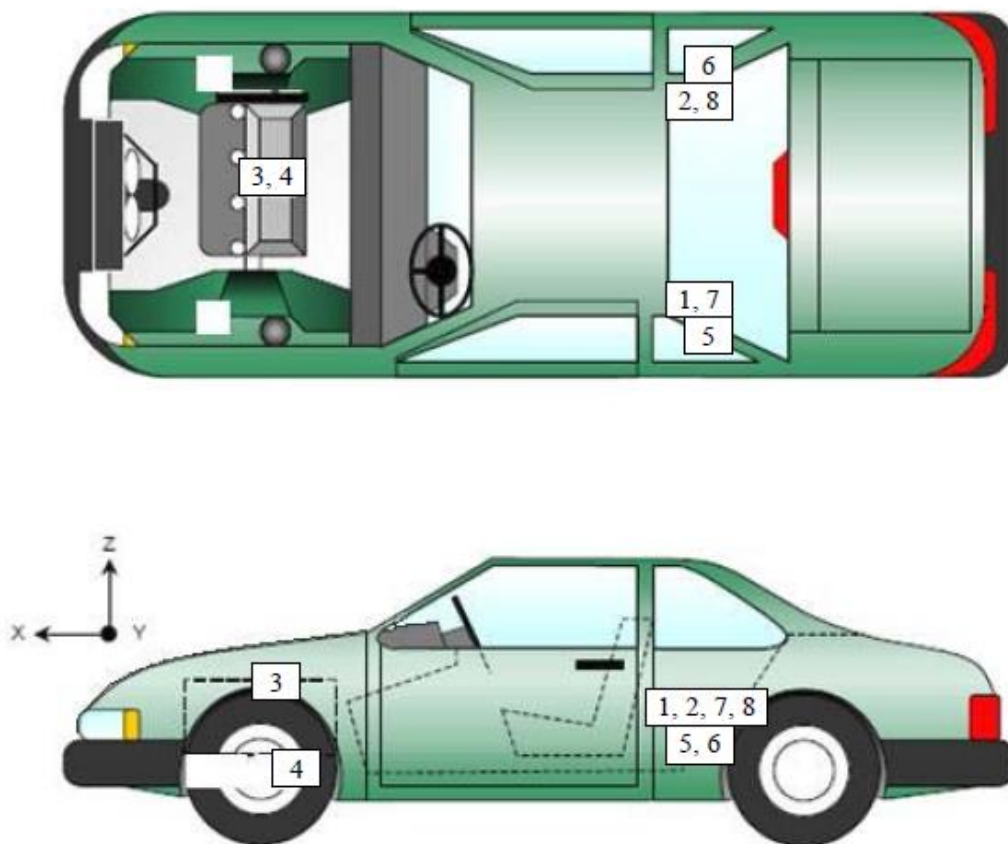
No.	Camera View	Location (mm)			Lens (mm)	Speed (fps)
		X	Y	Z		
1	Real-Time Left Overall	-	-	-		60
2	Driver Close-Up	-1859	-6941	-1425	50	1000
3	Left Front Half	-1180	-5929	-1166	28	1000
4	Left Angle	-4621	-4872	-2193	50	1000
5	Steering Column - Top					
6	Steering Column - Bottom					
7	Right Overall	-2123	7500	-1245	24	1000
8	Passenger Close-Up	-1755	7315	-1430	50	1000
9	Right Front Half	-1058	6030	-1248	28	1000
10	Right Angle	-4863	4479	2234	50	1000
11	Windshield	890	0	-3471	20	1000
12	Driver Windshield	-394	-258	-2112	12.5	1000
13	Passenger Windshield	-394	258	-2112	12.5	1000
14	Pit Front	-1050	0	2500	12.5	1000
15	Pit Rear	-2467	0	2500	12.5	1000
16	Onboard Driver Airbag (Optional)				8	1000
17	Onboard Passenger Airbag (Optional)				8	1000

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

**DATA SHEET NO. 7
VEHICLE ACCELEROMETER LOCATIONS**

Test Vehicle: 2019 Jeep Wrangler Unlimited four door SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20190309
 Test Date: 3/12/2019



VEHICLE ACCELEROMETER PRE-TEST LOCATIONS

No.	Accelerometer Location	Measurements (mm)		
		X	Y	Z
1	Left Rear Accelerometer – X Direction	1546	-396	-5
2	Right Rear Accelerometer – X Direction	1557	327	-4
3	Engine Top X	3766	-12	-416
4	Engine Bottom X	3577	80	212
5	Left Rear Accelerometer – Z Direction	1546	-396	-5
6	Right Rear Accelerometer – Z Direction	1557	327	-4
7	Left Rear Accelerometer – X Direction Redundant	1545	-376	-5
8	Right Rear Accelerometer – X Direction Redundant	1557	347	-4

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

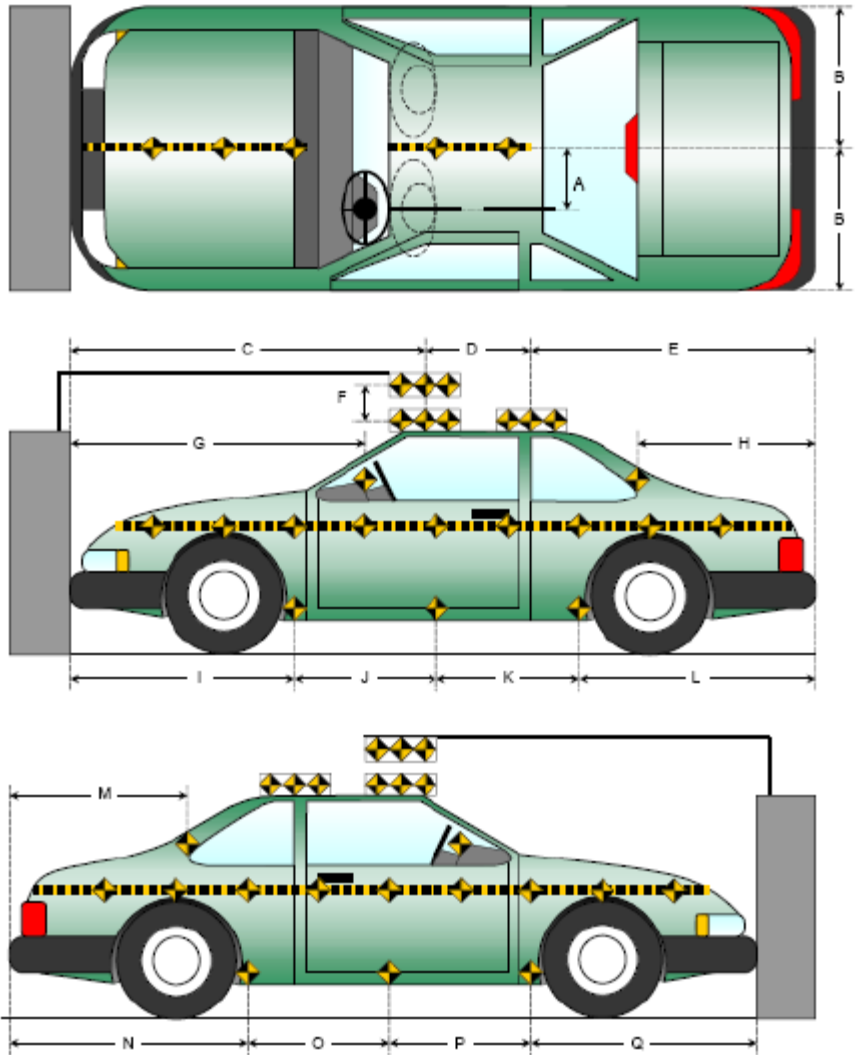
DATA SHEET NO. 8
PHOTOGRAPHIC REFERENCE TARGET LOCATIONS

Test Vehicle: 2019 Jeep Wrangler Unlimited four door SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20190309
 Test Date: 3/12/2019

Item	Value
A	390
B	834
C	2575
D	611
E	1415
F	288
G	1863
H	1212
I	1653
J	757
K	752
L	1440
M	1212
N	1445
O	751
P	761
Q	1645

All units in millimeters



DATA SHEET NO. 9
LOAD CELL LOCATIONS ON FIXED BARRIER

Test Vehicle: 2019 Jeep Wrangler Unlimited four door SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20190309
 Test Date: 3/12/2019

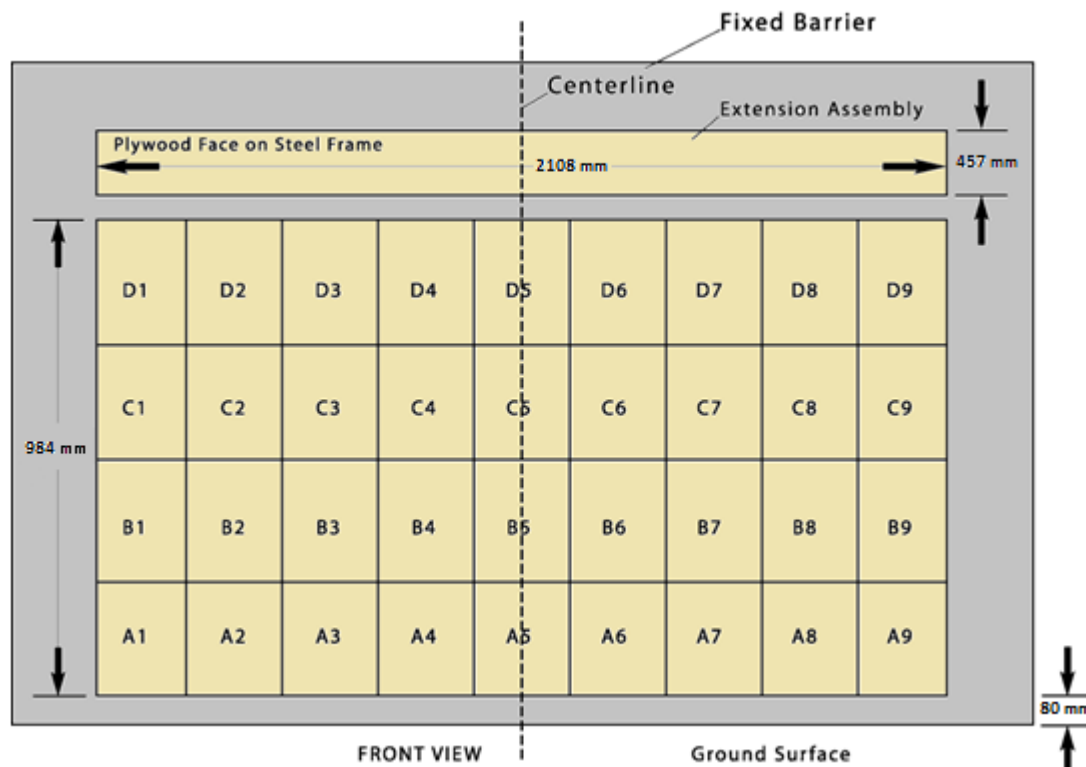


Figure 1 - Load Cell Locations on a 36-Load Cell Barrier with Plywood Height Extension*

DATA SHEET NO. 10
TEST VEHICLE SUMMARY OF RESULTS

Test Vehicle: 2019 Jeep Wrangler Unlimited four door SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20190309
 Test Date: 3/12/2019

INSTRUMENTATION

Instrumentation	Number of Channels Collected
Driver Dummy Accelerometers	46
Passenger Dummy Accelerometers	46
Vehicle Structure Accelerometers	8
Load Cell Barrier	36
Total	136

CAMERA COVERAGE

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

**DATA SHEET NO. 11
POST-TEST OBSERVATIONS**

Test Vehicle: 2019 Jeep Wrangler Unlimited four door SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20190309
 Test Date: 3/12/2019

TEST DUMMY INFORMATION AND CONTACT LOCATIONS

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

DOOR OPENING AND SEAT TRACK INFORMATION

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

POST-TEST STRUCTURAL OBSERVATIONS

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

VEHICLE REBOUND FROM BARRIER

Measured Parameter	Units	Value
Left Side	mm	1268
Center	mm	1250
Right Side	mm	1248
Average	mm	1255

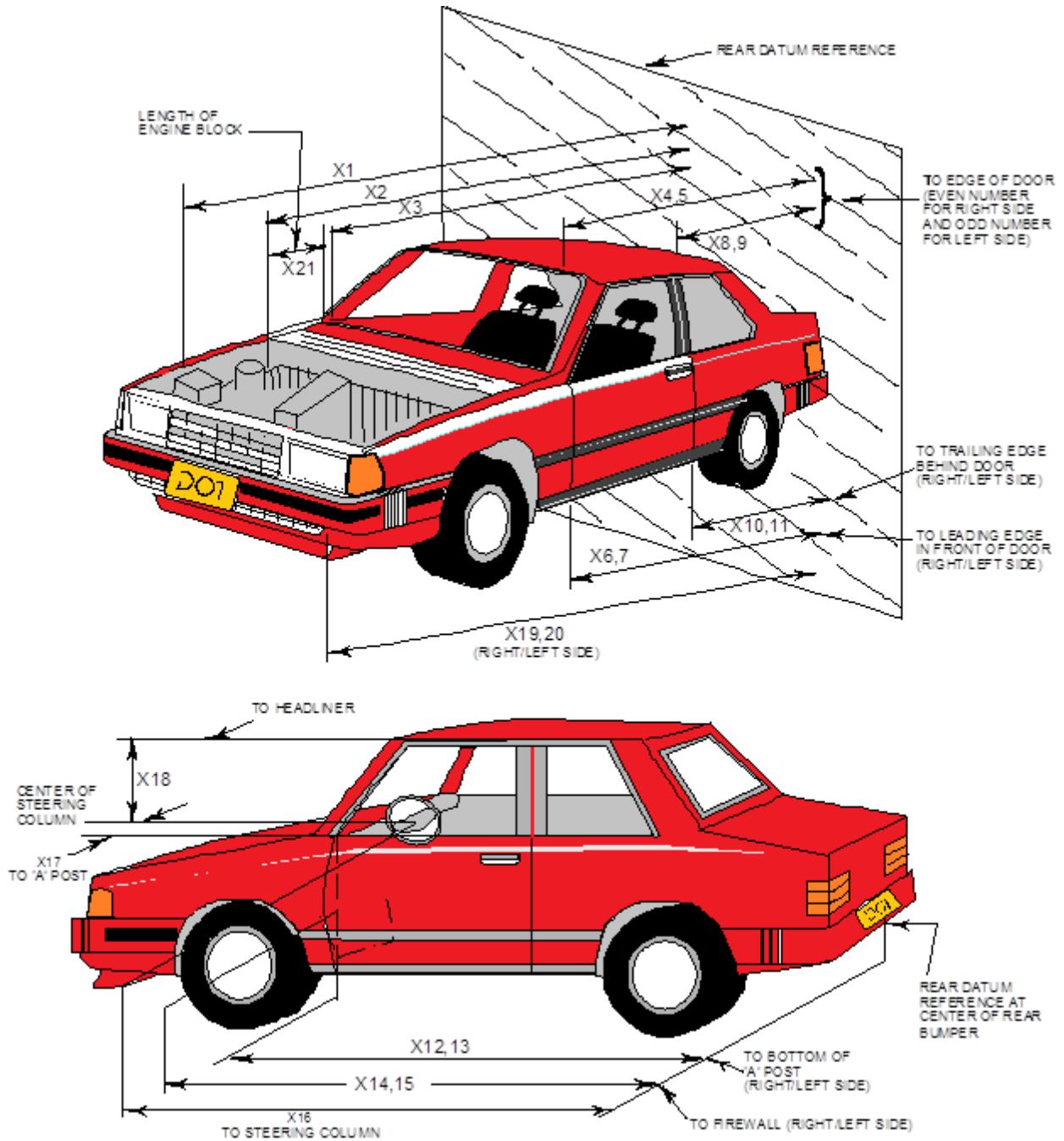
SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

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

DATA SHEET NO. 12
VEHICLE PROFILE MEASUREMENTS

Test Vehicle: 2019 Jeep Wrangler Unlimited four door SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20190309
 Test Date: 3/12/2019



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

Test Vehicle: 2019 Jeep Wrangler Unlimited four door SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20190309
 Test Date: 3/12/2019

No.	Measurement Description	Pre-Test	Post-Test	Difference
1	Total Length of Vehicle at Centerline	4602	4161	-441
2	Rear Surface of Vehicle (RSOV) to Front of Engine	3803	3709	-94
3	RSOV to Firewall	3328	3241	-87
4	RSOV to Upper Leading Edge of Right Door	2945	2933	-12
5	RSOV to Upper Leading Edge of Left Door	2944	2929	-15
6	RSOV to Lower Leading Edge of Right Door	2939	2933	-6
7	RSOV to Lower Leading Edge of Left Door	2923	2912	-11
8	RSOV to Upper Trailing Edge of Right Door	2012	2002	-10
9	RSOV to Upper Trailing Edge of Left Door	2010	1995	-15
10	RSOV to Lower Trailing Edge of Right Door	2139	2135	-4
11	RSOV to Lower Trailing Edge of Left Door	2125	2115	-10
12	RSOV to Bottom of "A" Post of Right Side	3014	3006	-8
13	RSOV to Bottom of "A" Post of Left Side	3007	2998	-9
14	RSOV to Firewall, Right Side	3335	3319	-16
15	RSOV to Firewall, Left Side	3335	3306	-29
16	RSOV to Steering Column	2583	2643	60
17	Center of Steering Column to "A" Post	280	278	-2
18	Center of Steering Column to Headliner	428	451	23
19	RSOV to Right Side of Front Bumper	4592	4144	-448
20	RSOV to Left Side of Front Bumper	4594	4153	-441
21	Length of Engine Block	435	435	0
RD	RSOV to Right Side of Dash Panel	2779	2768	-11
CD	RSOV to Center of Dash Panel	2717	2709	-8
LD	RSOV to Left Side of Dash Panel	2761	2745	-16

*UR= Unrecoverable data point
 All Dimensions in mm

DATA SHEET NO. 13
ACCIDENT INVESTIGATION DIVISION DATA

Test Vehicle: 2019 Jeep Wrangler Unlimited four door SUV
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20190309
Test Date: 3/12/2019

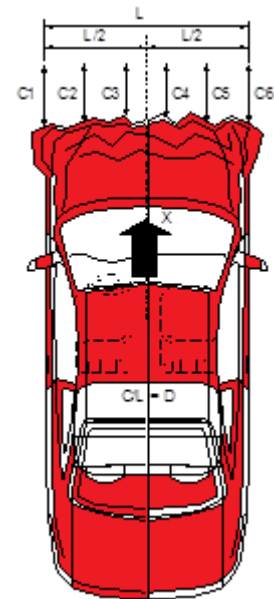
VEHICLE INFORMATION

VIN: 1C4HJXDG7KW505887
Vehicle Size Category: MPV

Wheelbase (mm): 3006
Test Weight (kg): 2107

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): 56.31
Velocity Change (km/h): 65.84
Time of Separation (ms): 132



CRUSH PROFILE

Collision Deformation Classification: 12FDEW2
Midpoint of Damage: C4
Damage Region Length (mm): 1446
Impact Mode: Frontal

No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
C1	Crush Zone 1 at Left Side	mm	4504	4163	341
C2	Crush Zone 2 at Left Side	mm	4628	4201	427
C3	Crush Zone 3 at Left Side	mm	4591	4161	430
C4	Crush Zone 4 at Right Side	mm	4592	4154	438
C5	Crush Zone 5 at Right Side	mm	4630	4194	436
C6	Crush Zone 6 at Right Side	mm	4505	4132	373
L	C1 to C6	mm	1446	1429	18

DATA SHEET NO. 14
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2019 Jeep Wrangler Unlimited four door SUV
 Test Program: NCAP Frontal Barrier Impact Test

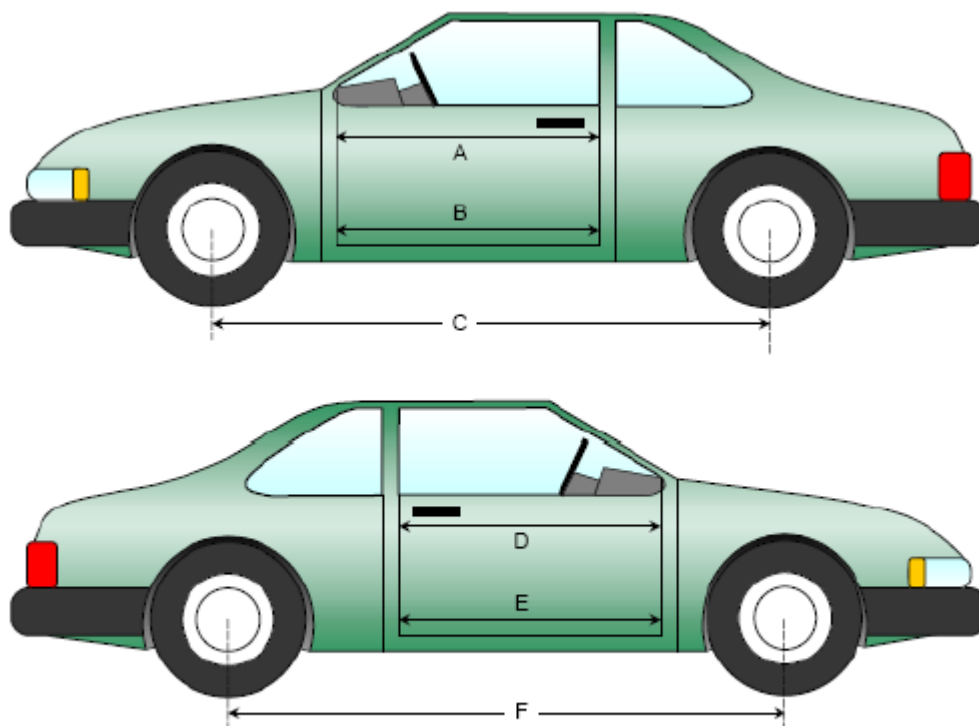
NHTSA No.: M20190309
 Test Date: 3/12/2019

DOOR OPENING WIDTH

Item	Description	Units	Pre-Test	Post-Test	Difference
A	Left Side Upper	mm	903	890	-13
B	Left Side Lower	mm	827	823	-4
D	Right Side Upper	mm	907	897	-10
E	Right Side Lower	mm	825	823	-2

WHEELBASE MEASUREMENTS

Item	Description	Units	Pre-Test	Post-Test	Difference
C	Left Side Wheelbase	mm	3006	2941	-65
F	Right Side Wheelbase	mm	3006	2946	-60



Left & Right Side Views

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

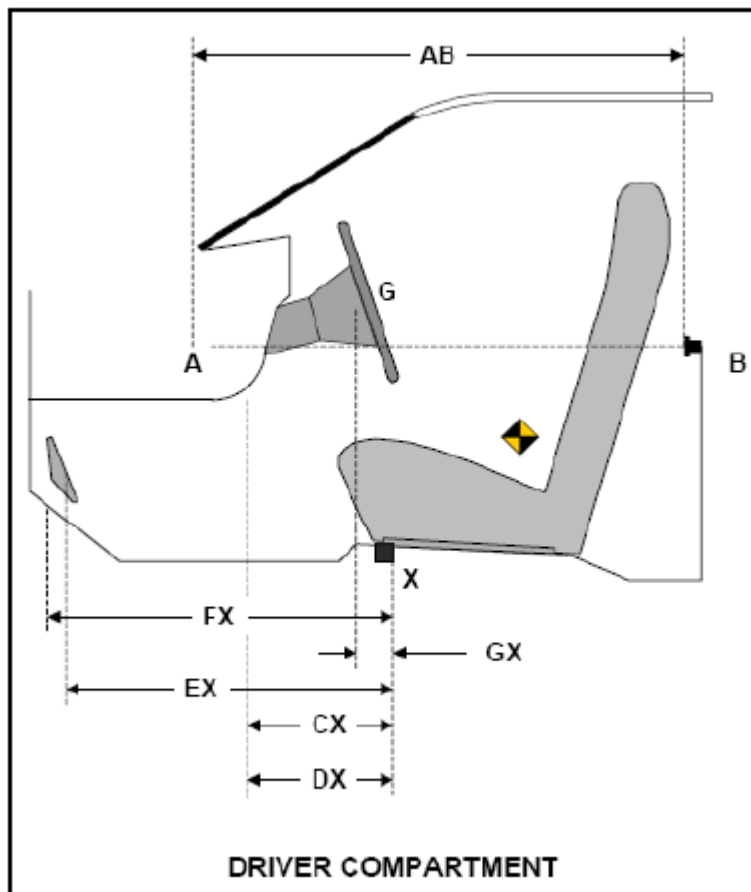
Test Vehicle: 2019 Jeep Wrangler Unlimited four door SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20190309
 Test Date: 3/12/2019

DRIVER COMPARTMENT INTRUSION

Item	Description	Units	Pre-Test	Post-Test	Difference
AB	Door Opening (Inside Window Jam)	mm	655	656	1
CX	Left Knee Bolster to X	mm	254	259	5
DX	Right Knee Bolster to X	mm	247	250	3
EX	Brake Pedal to X	mm	494	492	-2
FX	Foot Rest to X	mm	592	589	-3
GX	Center of Steering Column Wheel Hub to X	mm	-4	58	62

X = Front of Seat Track (Stationary)



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

Test Vehicle: 2019 Jeep Wrangler Unlimited four door SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20190309
 Test Date: 3/12/2019

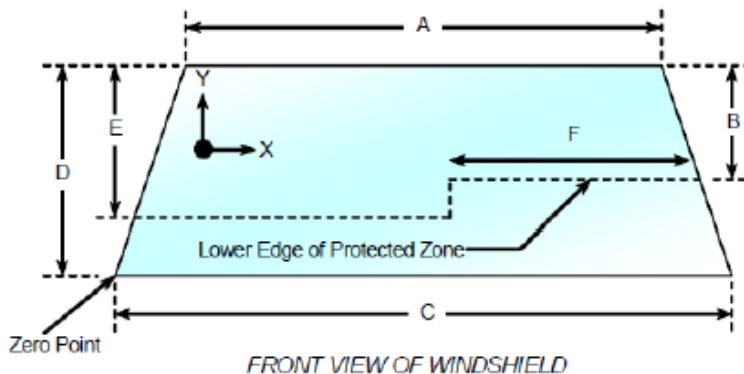
Windshield Mounting Details: A 0.8 mm trim surrounds the top and side of windshield while a plastic shroud is on the bottom.

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

Temperature of windshield molding during test: 21° C

WINDSHIELD PERIPHERY MEASUREMENTS

Measurement	Pre-Test (mm)	Post-Test (mm)	% Retention
Left Side	1809	1809	100
Right Side	1809	1809	100
Total	3618	3618	100



Item	Units	Value
A	mm	1306
B	mm	242
C	mm	1400
D	mm	456
E	mm	244
F	mm	502

AREAS OF PROTECTED ZONE FAILURES

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

X	Y

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

X	Y

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

Test Vehicle: 2019 Jeep Wrangler Unlimited four door SUV
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20190309
Test Date: 3/12/2019

FMVSS 301 FUEL SYSTEM INTEGRITY POST IMPACT DATA

Temperature at Time of Impact: 21 ° C

Test Time: 10:15 AM

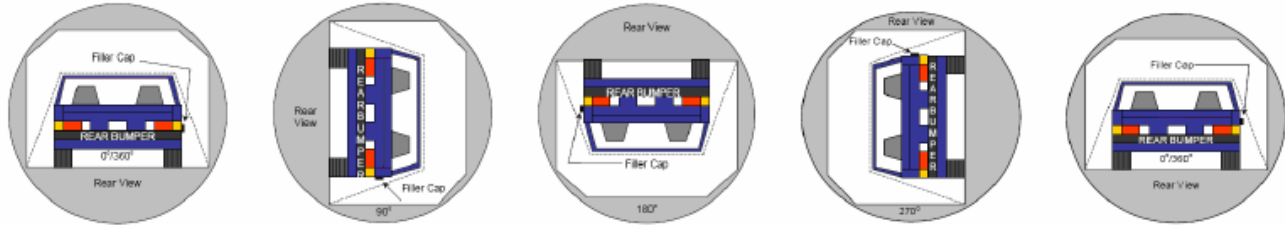
STODDARD SOLVENT SPILLAGE MEASUREMENTS

- A. From impact until vehicle motion ceases: 0 oz.
(Maximum allowable is 1 oz.)
- B. For the 5-minute period after motion ceases: 0 oz.
(Maximum allowable is 5 oz.)
- C. For the following 25 minutes: 0 oz.
(Maximum allowable is 1 oz./minute)
- D. Spillage: No Spillage Occurred

**DATA SHEET NO. 16
FMVSS 301 STATIC ROLLOVER RESULTS**

Test Vehicle: 2019 Jeep Wrangler Unlimited four door SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20190309
 Test Date: 3/12/2019



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

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

SOLVENT COLLECTION TIME TABLE IN SECONDS

Test Phase	Rotation Time	Hold Time	Total Time
0° to 90°	72	300	372
90° to 180°	60	300	360
180° to 270°	66	300	366
270° to 360°	81	300	381

FMVSS 301 SPILLAGE TABLE

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

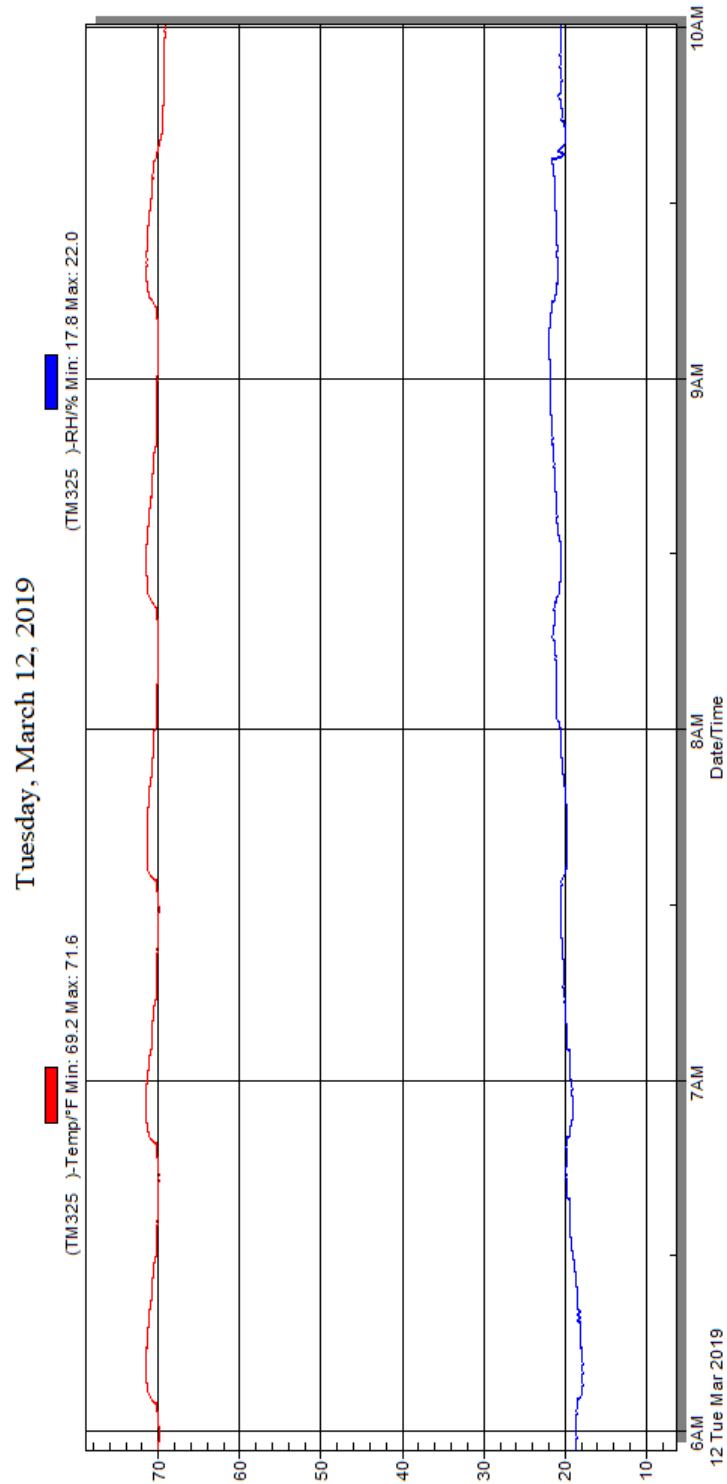
SOLVENT SPILLAGE LOCATION TABLE

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

DATA SHEET NO. 17
DUMMY / VEHICLE TEMPERATURE STABILIZATION CHART

Test Vehicle: 2019 Jeep Wrangler Unlimited four door SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20190309
 Test Date: 3/12/2019



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

APPENDIX A
PHOTOGRAPHS

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Fig.	Description	Page
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45	Post-Test Driver's Side Floorpan	A-27
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55	Pre-Test Passenger Dummy and Vehicle Interior View	A-32
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Fig.	Description	Page
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74	Vehicle at 90° on Static Rollover Device	A-41
75	Vehicle at 180° on Static Rollover Device	A-42
76	Vehicle at 270° on Static Rollover Device	A-42
77	Vehicle at 360° on Static Rollover Device	A-43
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79	Monroney Label Photograph	A-44

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

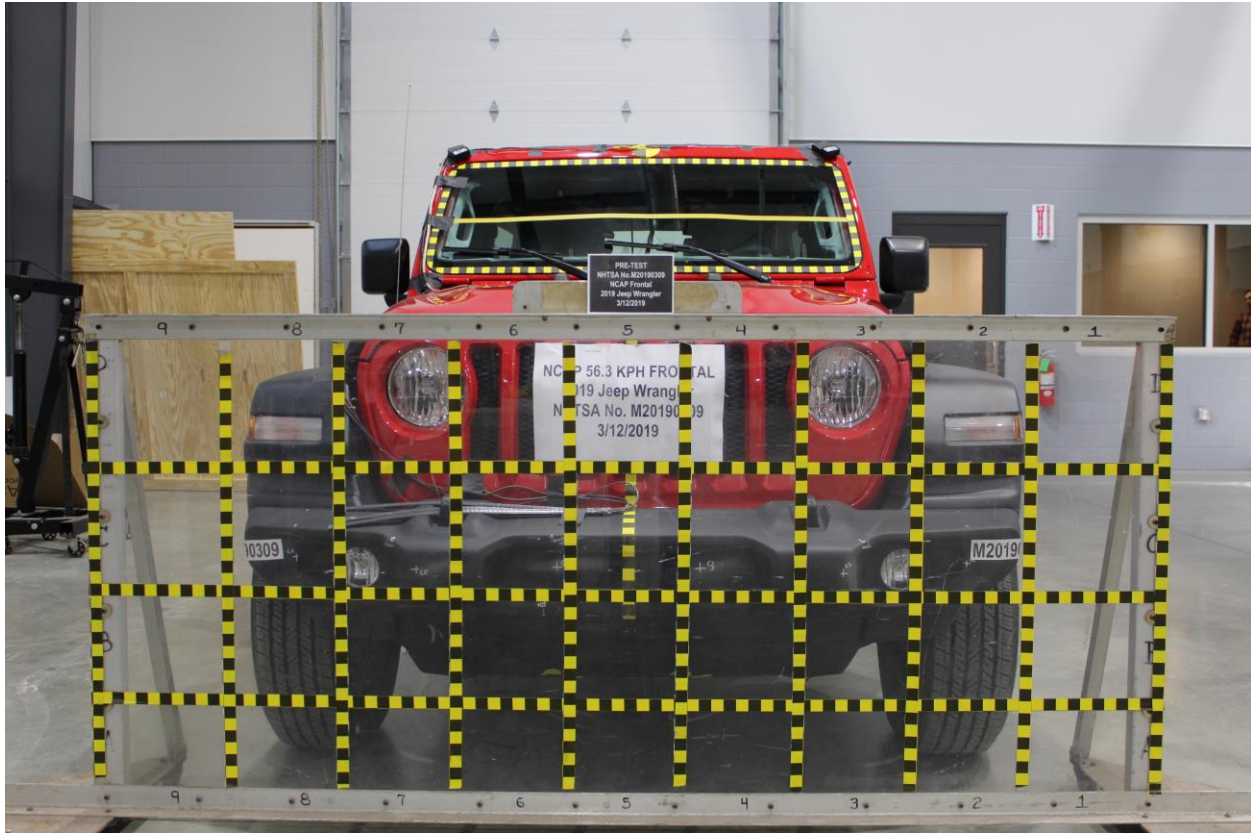


Figure A-1: Load Cell Location



Figure A-2: Pre-Test Load Cell Wall



Figure A-3: Post-Test Load Cell Wall



Figure A-4: Manufacturer's Label

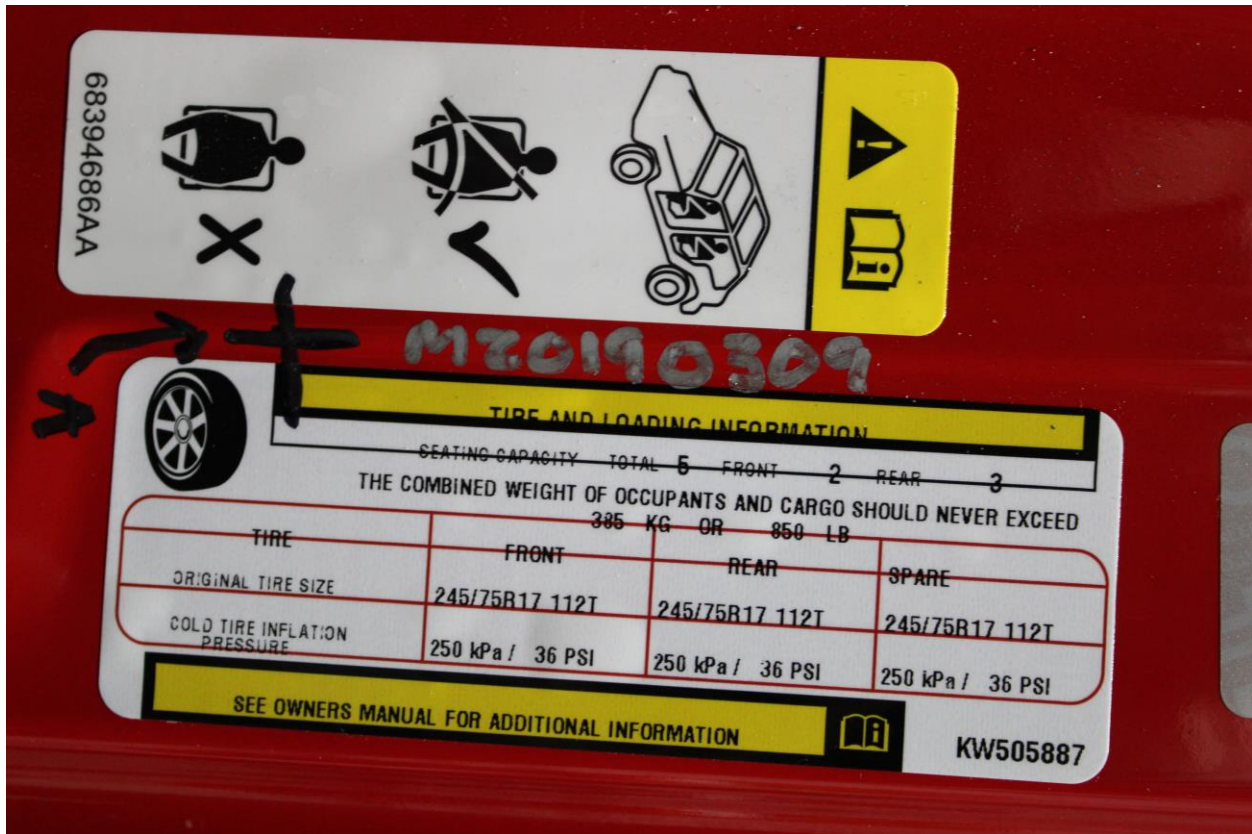


Figure A-5: Tire Placard



Figure A-6: 2019 Jeep Wrangler Unlimited Frontal As Delivered



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



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



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



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



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



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



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



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



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



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



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



Figure A-18: Pre-Test Windshield View



Figure A-19: Post-Test Windshield View



Figure A-20: Pre-Test Engine Compartment View



Figure A-21: Post-Test Engine Compartment View



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



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



Figure A-24: Pre-Test Front Underbody View



Figure A-25: Post-Test Front Underbody View



Figure A-26: Pre-Test Rear Underbody View



Figure A-27: Post-Test Rear Underbody View

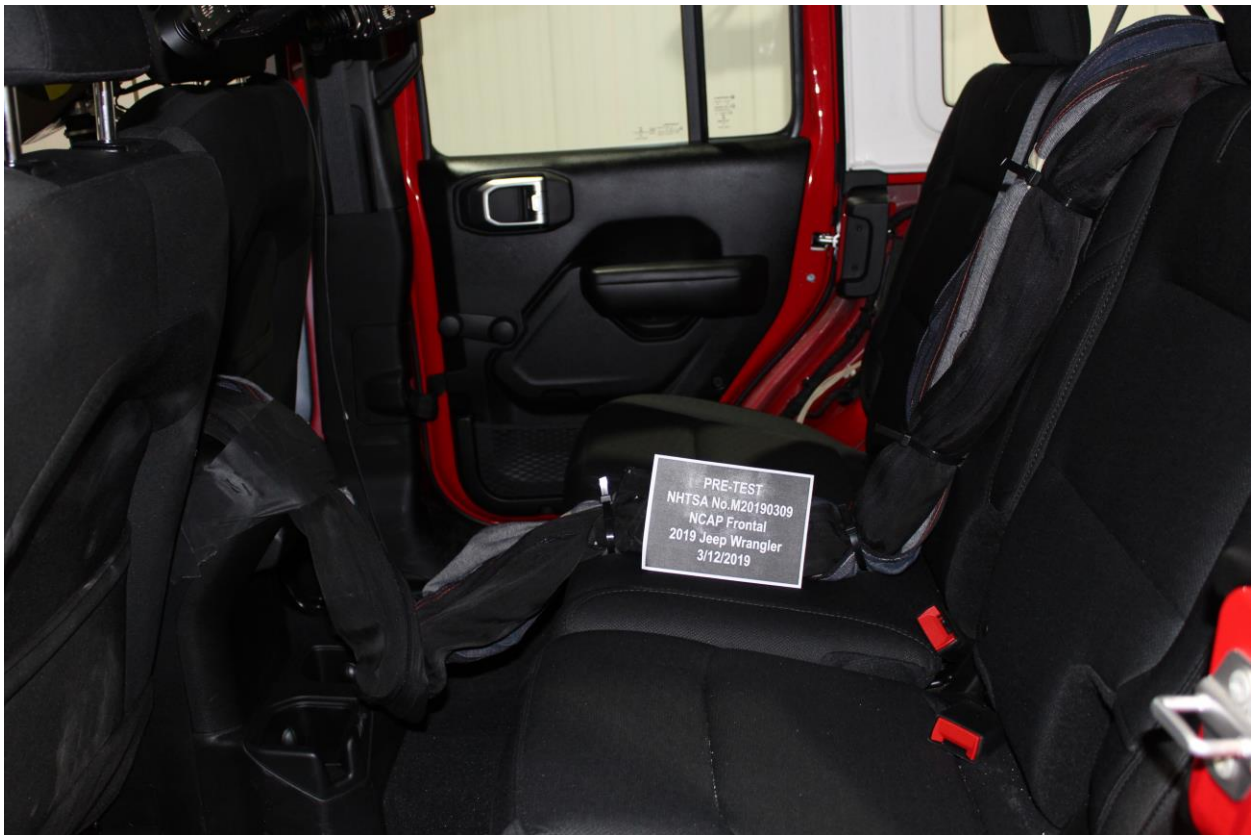


Figure A-28: Pre-Test Dummy Cable Routing

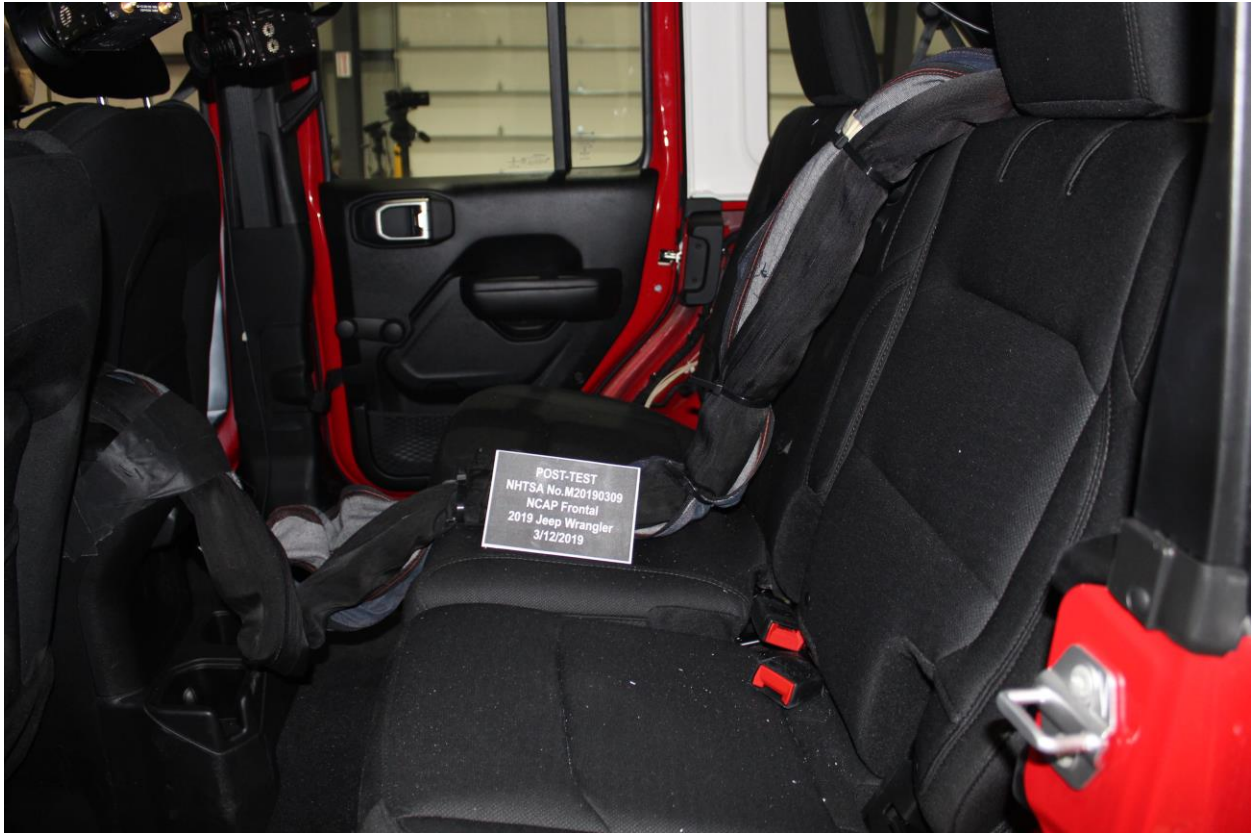


Figure A-29: Post-Test Dummy Cable Routing

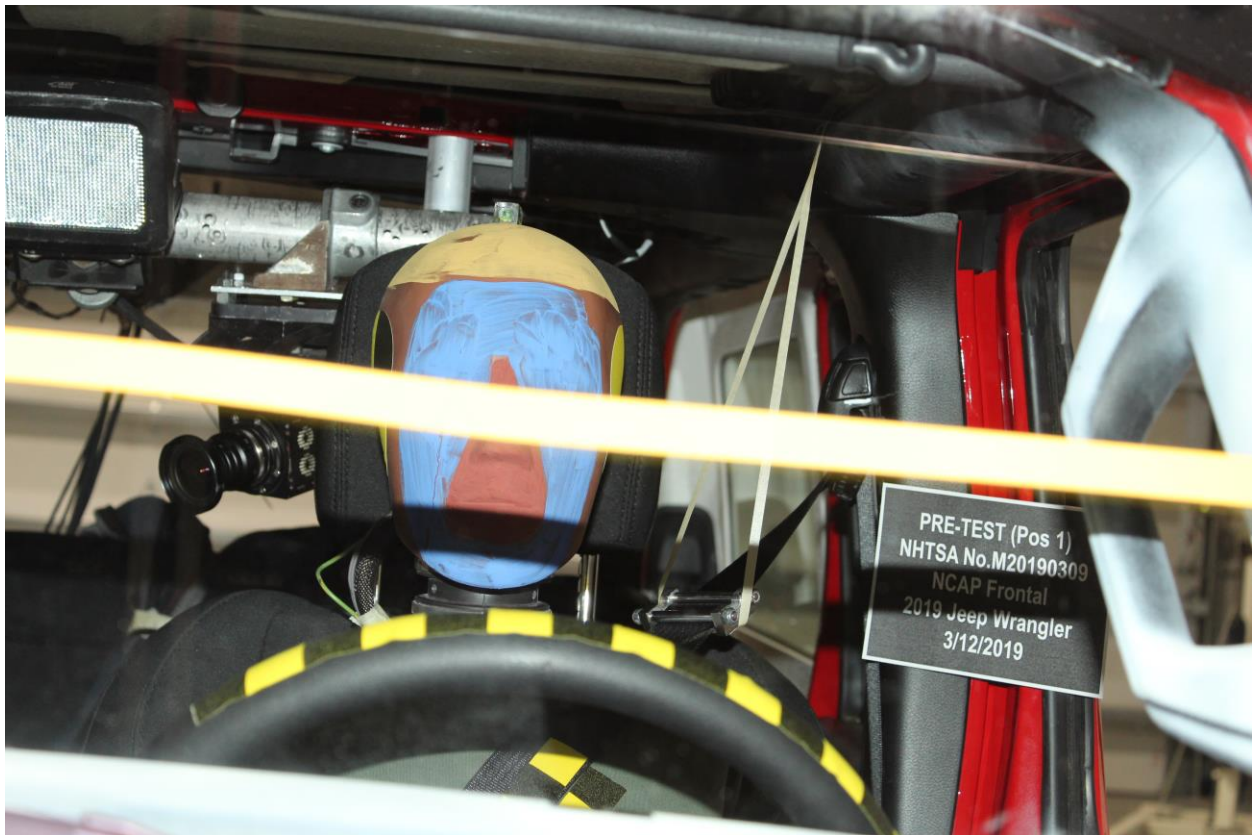


Figure A-30: Pre-Test Driver Dummy Front View

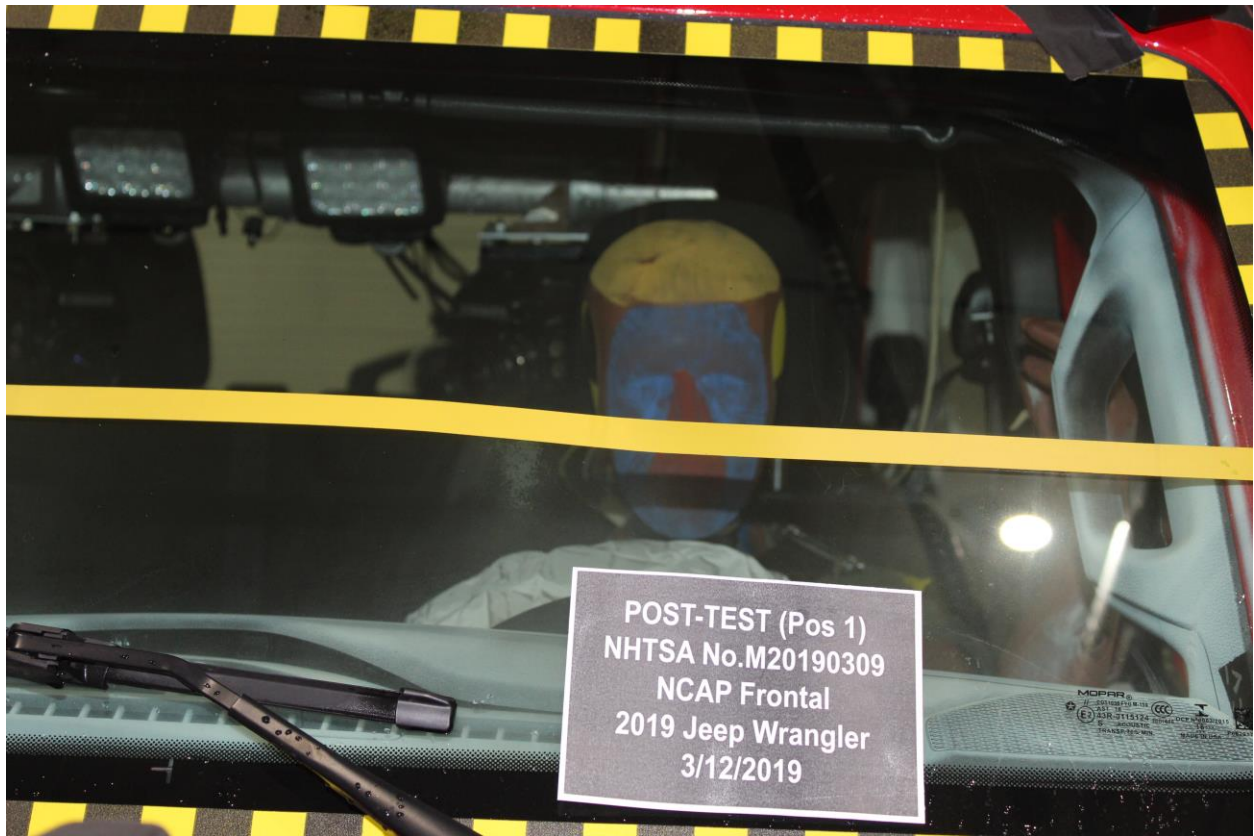


Figure A-31: Post-Test Driver Dummy Front View



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



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



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



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



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



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



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



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



Figure A-40: Pre-Test Driver Dummy Feet



Figure A-41: Post-Test Driver Dummy Feet



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



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



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



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

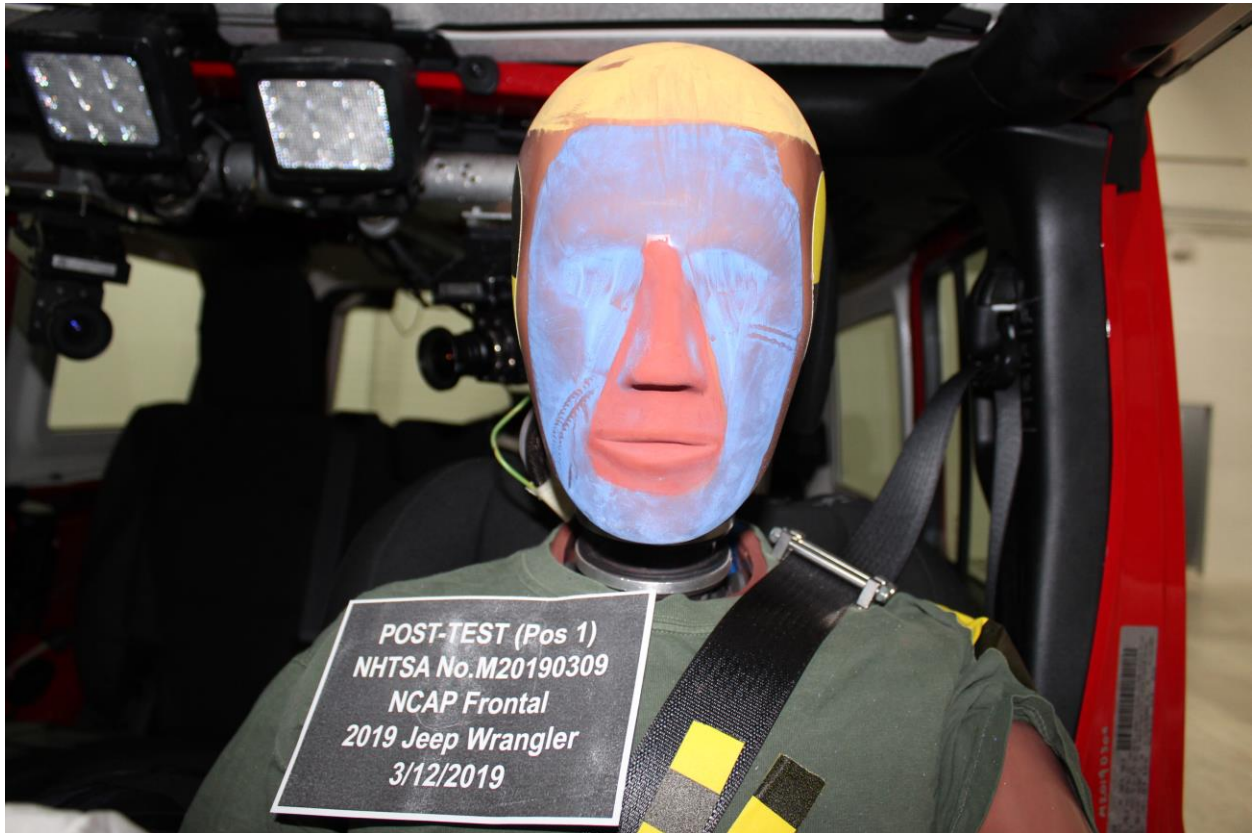


Figure A-46: Post-Test Driver Dummy Face

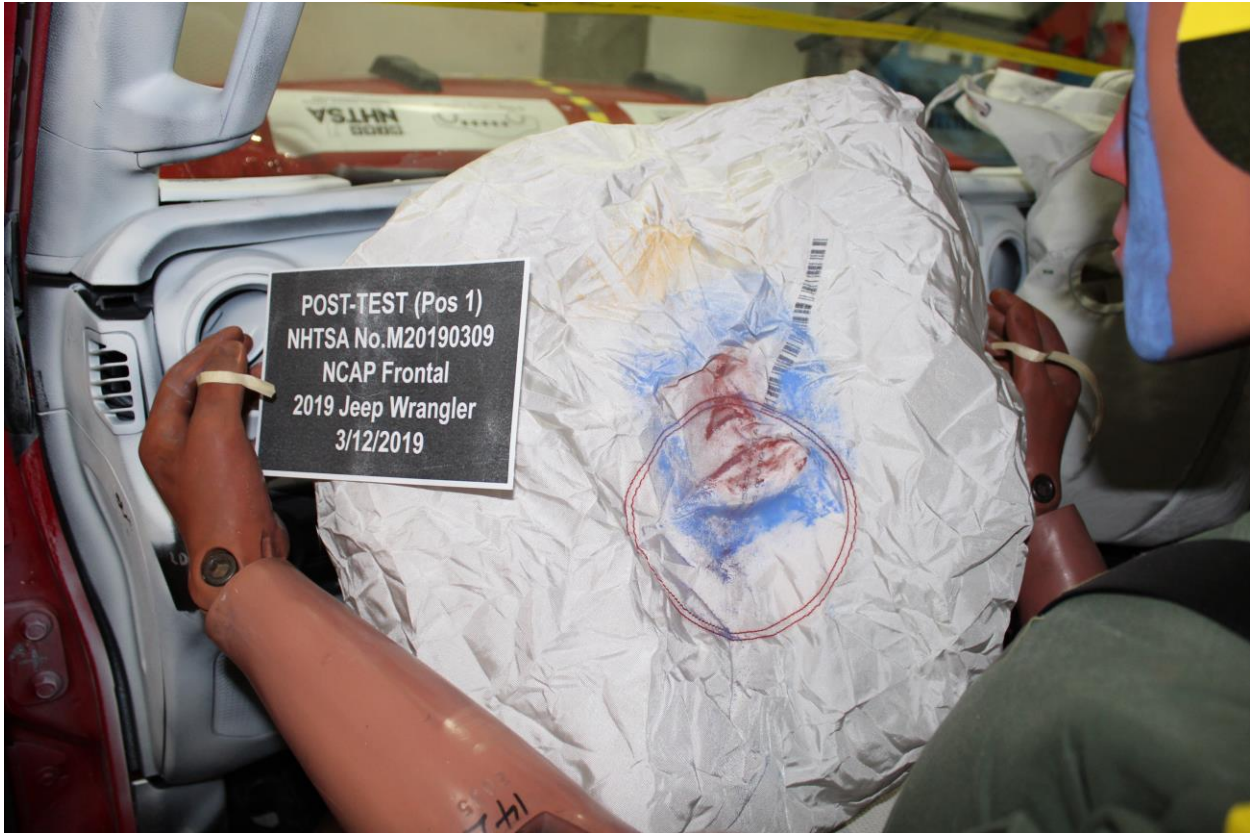


Figure A-47: Post-Test Driver Dummy Contact With Airbag



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



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



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

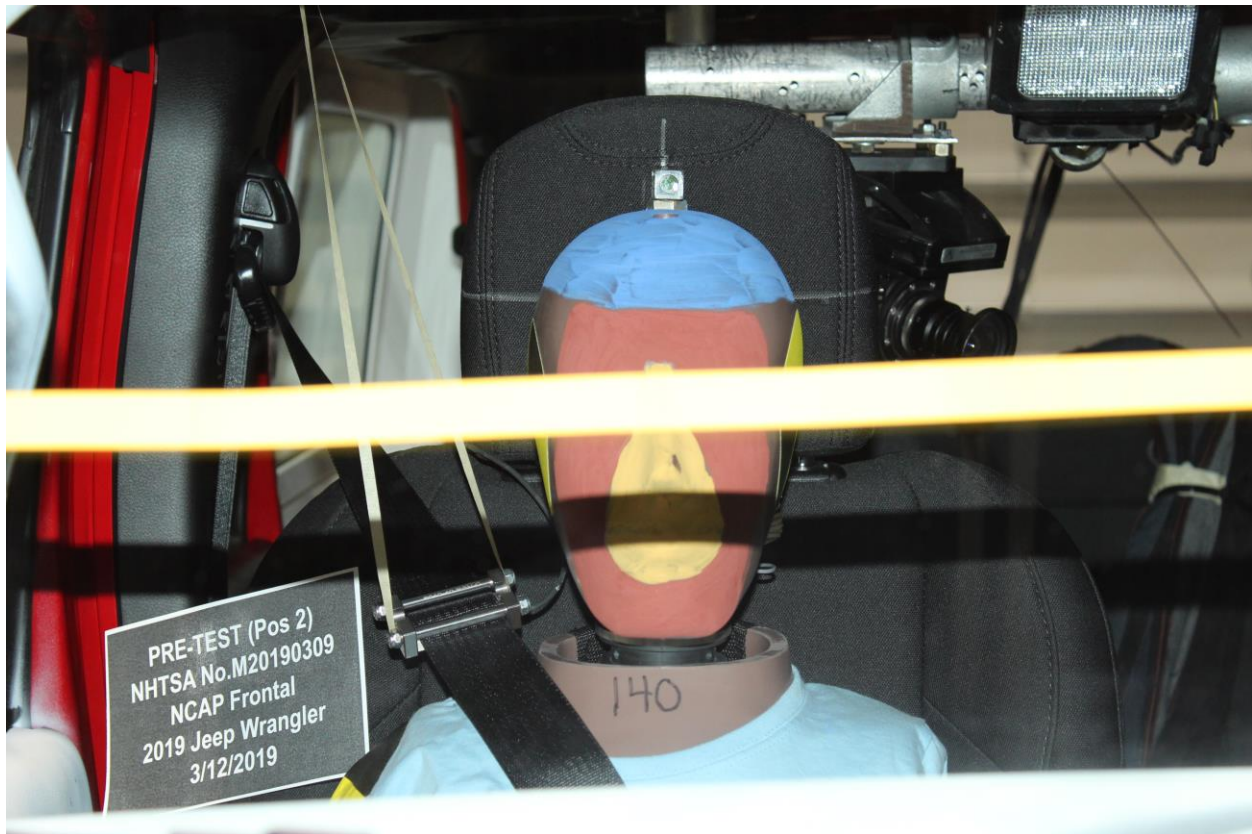


Figure A-51: Pre-Test Passenger Dummy Front View



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



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



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



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



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



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



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



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



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



Figure A-61: Pre-Test Passenger Dummy Feet



Figure A-62: Post-Test Passenger Dummy Feet



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



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



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



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



Figure A-67: Post-Test Passenger Dummy Face



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



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

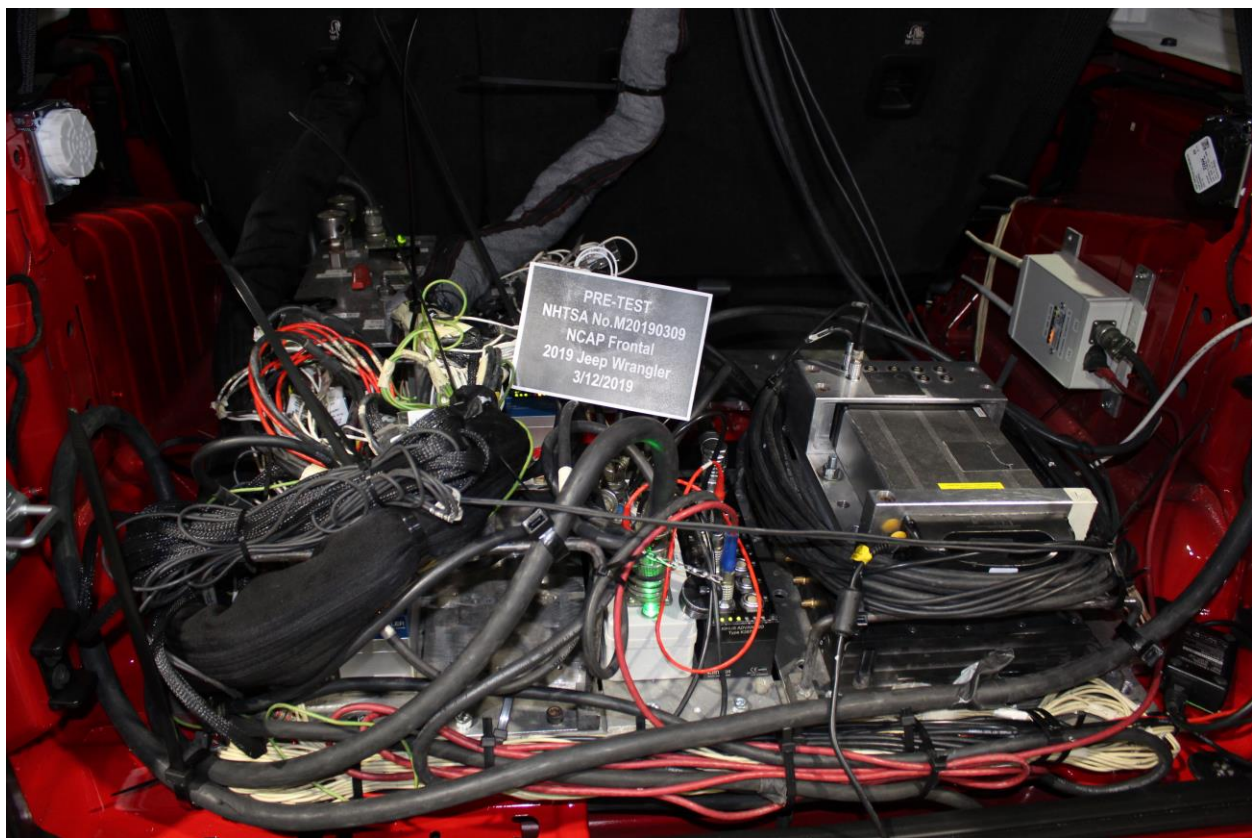


Figure A-70: Photograph of Ballast Installed in Vehicle

Photo Not Applicable

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



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



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



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



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

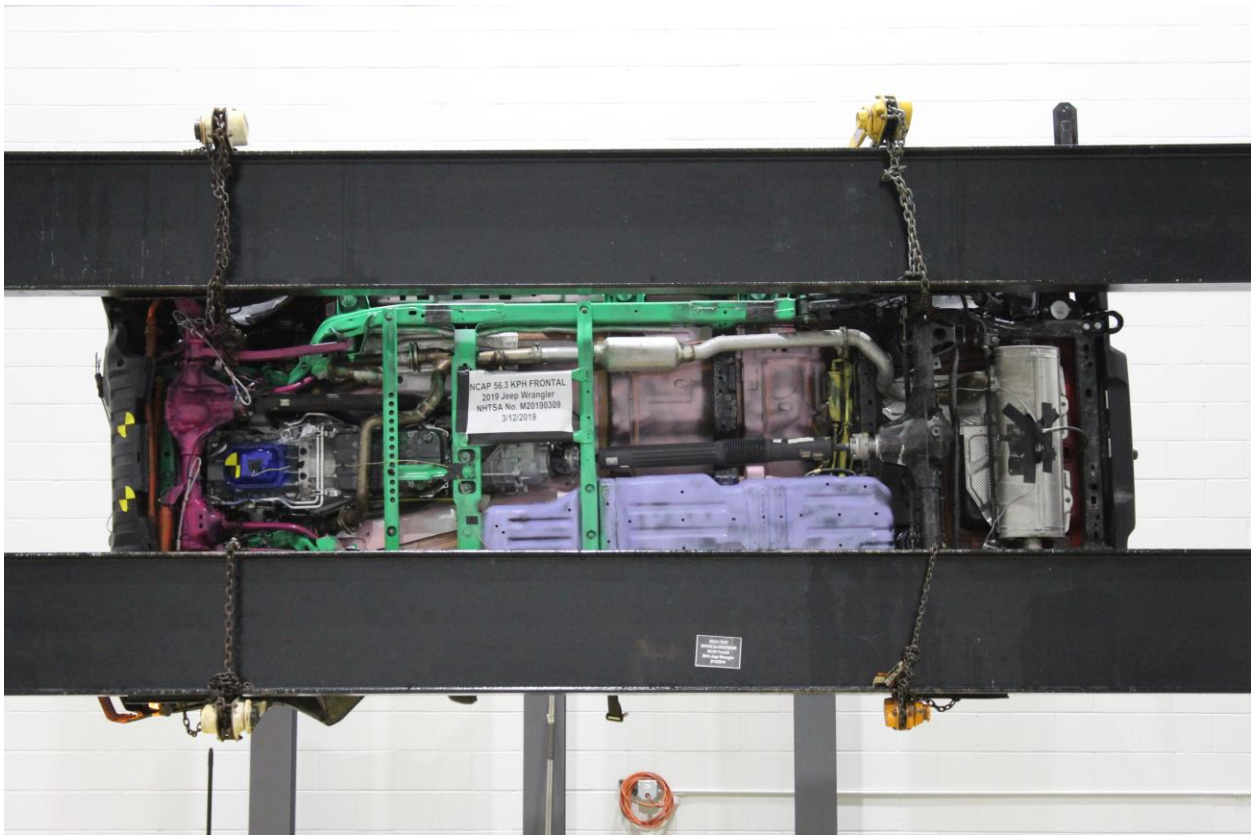


Figure A-76: Vehicle at 270° on Static Rollover Device



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



Figure A-78: 2019 Jeep Wrangler Unlimited Frontal Impact Event

Jeep 2019 MODEL YEAR
WRANGLER UNLIMITED SPORT 4X4

For more information visit: www.jeep.com
or call 1-877-IAM-JEEP

FCA US LLC

THIS VEHICLE IS MANUFACTURED TO MEET SPECIFIC UNITED STATES REQUIREMENTS. THIS VEHICLE IS NOT MANUFACTURED FOR SALE OR REGISTRATION OUTSIDE OF THE UNITED STATES.

MANUFACTURER'S SUGGESTED RETAIL PRICE OF THIS MODEL INCLUDING DEALER PREPARATION

Base Price: \$31,545

JEEP WRANGLER UNLIMITED SPORT
Exterior Color: Firecracker Red Clear-Coat Exterior Paint
Interior Color: Black Interior Color
Interior: 3-inch Seats with Adjustable Head Restraints
Engine: 3.6L V6 24V VVT Engine Upg 1 w/ESS
Transmission: 3-Speed Automatic Transmission

STANDARD EQUIPMENT (UNLESS REPLACED BY OPTIONAL EQUIPMENT)
FUNCTIONAL/SAFETY FEATURES

Advanced Multistage Front Air Bags
Supplemental Front Side Air Bags
ParkView® Rear Back-Up Camera
Command-Trac Part-Time 4WD System
3.45 Axle Gear Ratio
3rd Generation Dana® 44 HD Rear Axle
Fuel Tank Skid Plate Shield
Transfer Case Skid Plate Shield
Transmission Skid Plate
Jeep® Trail Rated
4-Wheel Disc Anti-Lock Brakes
Electronic Stability Control
Electronic Roll Mitigation
Trailer Sway Dampening
Hill Start Assist
Keyless Go™
Sentry Key® Theft Deterrent System
Tire Pressure Monitoring Display

INTERIOR FEATURES
Uconnect® 3 with 5-inch Display
Cluster 3.5-inch TFT 6.5W Display
Vehicle Information Center
8 Speakers
Media Hub (USB, Aux)
Integrated Voice Command with Bluetooth®
12-V Auxiliary Power Outlet
Air Conditioning
Tilt / Telescope Steering Column
Steering Wheel Mounted Audio Controls
Rear 60 / 40 Folding Seat
Manual 2-Way Adjustable Lumbar Driver Seat
Passenger Assist Handles
Manual Door Locks
Front and Rear Floor Mats

Rear Compartment Storage Tray
EXTERIOR FEATURES
17-inch x 7.5-inch Black Steel Styled Wheels
245/75R17 All-Season Tires
Full Size Spare Tire
Matching Spare Wheel
Black Sunrider® Soft Top (NA w/Sky 1-Touch Part Top)
Trail Rated Badge
Full Doors with Roll-up Windows
Halogen Headlamps
Front Fog Lamps
Incandescent Tail Lamps
2-Front and 1-Rear Tow Hooks

OPTIONAL EQUIPMENT (May Replace Standard Equipment)

Customer Preferred Package 248
All-Weather Floor Mats \$150
8-Speed Automatic Transmission \$2,000
3rd Generation Dana® Solid Rear Axle
Hill Descent Control
Tip Start
Black Freedom Top® 3-Piece Hard Top \$1,195
Diaper Soft Top
Rear Window Wiper / Washer
Rear Window Defroster
Freedom Panel Storage Bag
245/75R17 All-Season Tires

DESTINATION CHARGE \$1,495

TOTAL PRICE: * \$36,385

WARRANTY COVERAGE
5-year or 60,000-mile Powertrain Limited Warranty,
3-year or 36,000-mile Basic Limited Warranty.
Ask Dealer for a copy of the limited warranties or see your owner's manual for details.

5 YEAR / 60,000 MILE POWERTRAIN WARRANTY

EPA DOT Fuel Economy and Environment Gasoline Vehicle

Fuel Economy These estimates reflect new EPA methods beginning with 2017 models. Small SUV 4WD range from 18 to 37 MPG. The best vehicle rates 136 MPG.

20 MPG combined city/hwy
18 MPG city
23 MPG highway

You spend \$2,500 more in fuel costs over 5 years compared to the average new vehicle.

Annual fuel Cost \$1,900

Fuel Economy & Greenhouse Gas Rating (tailpipe only) 4 (Best)

Smog Rating (tailpipe only) 5 (Best)

This vehicle emits 443 grams CO2 per mile. The best emits 0 grams per mile (tailpipe only). Producing and distributing fuel also causes emissions. Learn more at fuelconomy.gov.

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 cost \$7,000 to fuel over 5 years. Cost estimates are based on 15,000 miles per year at \$2.25 per gallon. MPGe is miles per gasoline gallon equivalent. Vehicle emissions are a significant cause of climate change and smog.

fuelconomy.gov
Calculate personalized estimates and compare vehicles

GOVERNMENT 5-STAR SAFETY RATINGS

This vehicle has not been rated by the government for frontal crash, side crash or rollover risk.

Source: National Highway Traffic Safety Administration (NHTSA)
www.safercar.gov or 1-888-327-4236

PARTS CONTENT INFORMATION
FOR VEHICLES IN THIS COUNTRY:
U.S./CANADIAN PARTS CONTENT: 62%
MAJOR SOURCES OF FOREIGN PARTS CONTENT:
MEXICO: 21%
NOTE: PARTS CONTENT DOES NOT INCLUDE FINAL ASSEMBLY, DISTRIBUTION, OR OTHER NON-PARTS COSTS.
FOR THIS VEHICLE:
FINAL ASSEMBLY POINT:
TOLEDO, OHIO, U.S.A.
COUNTRY OF ORIGIN:
ENGINE: MEXICO
TRANSMISSION: UNITED STATES



Assembly Point/Port of Entry: TOLEDO, OHIO, U.S.A.
VIN: 1C4HJDDG7KW-505887

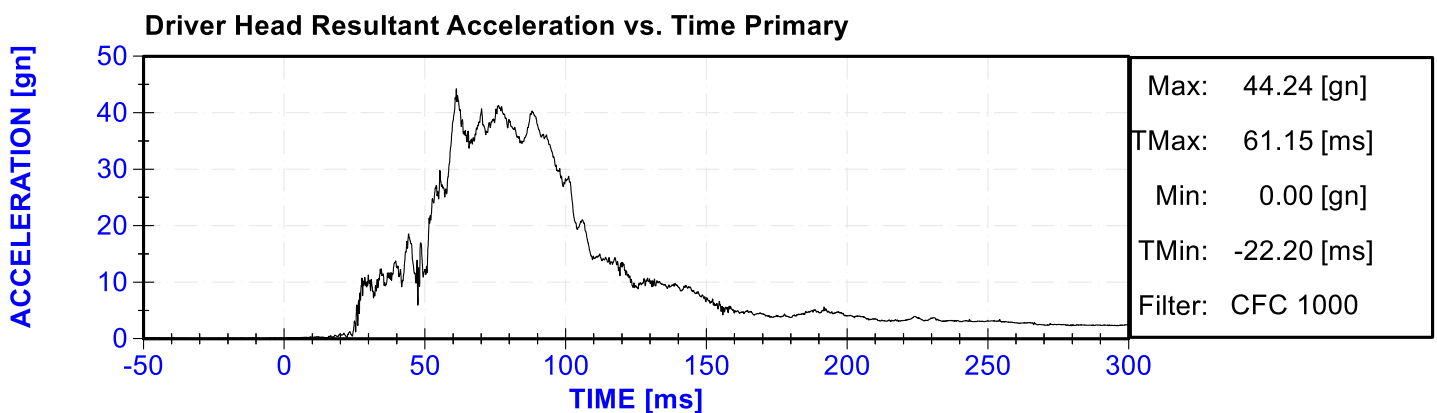
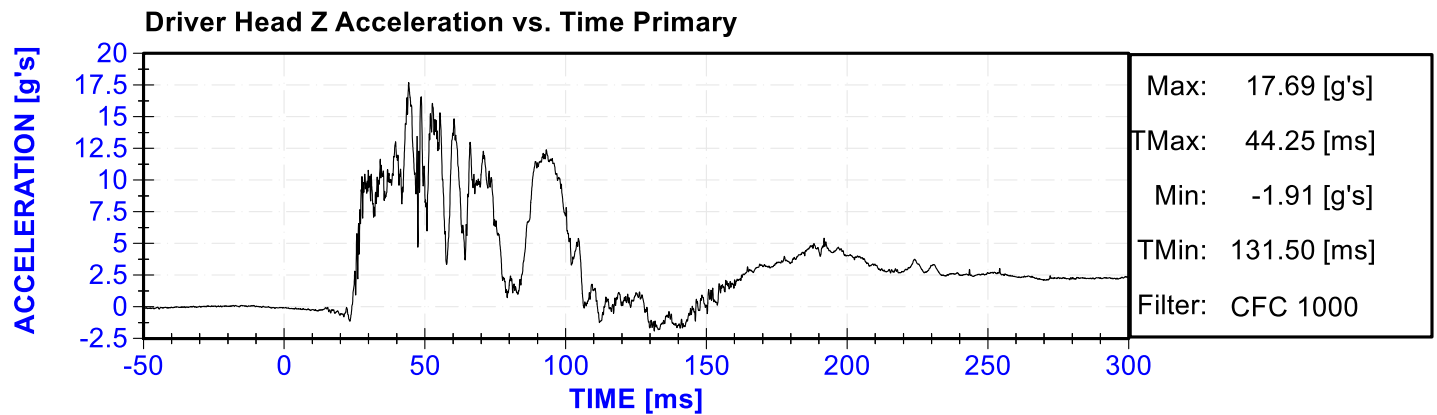
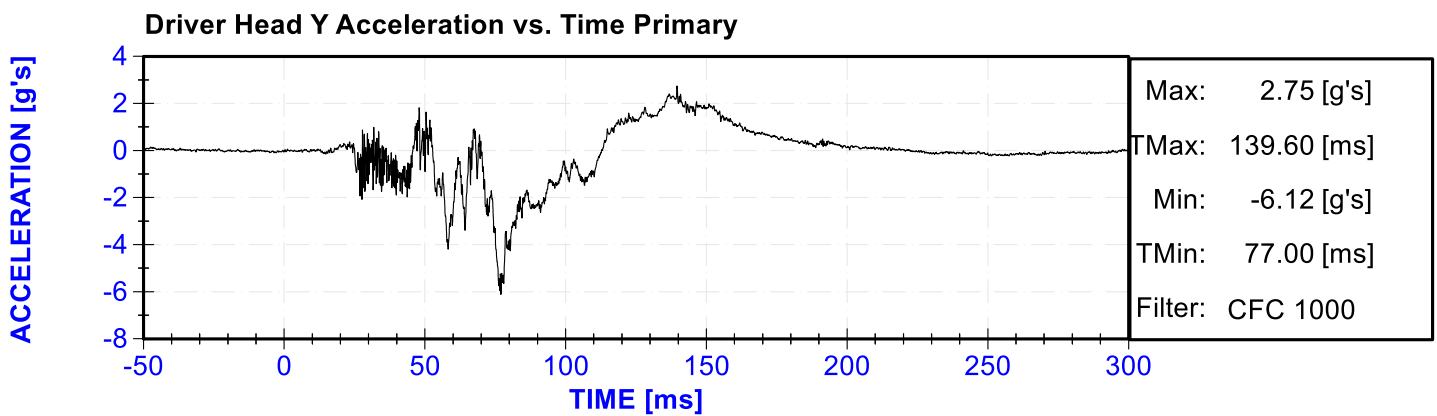
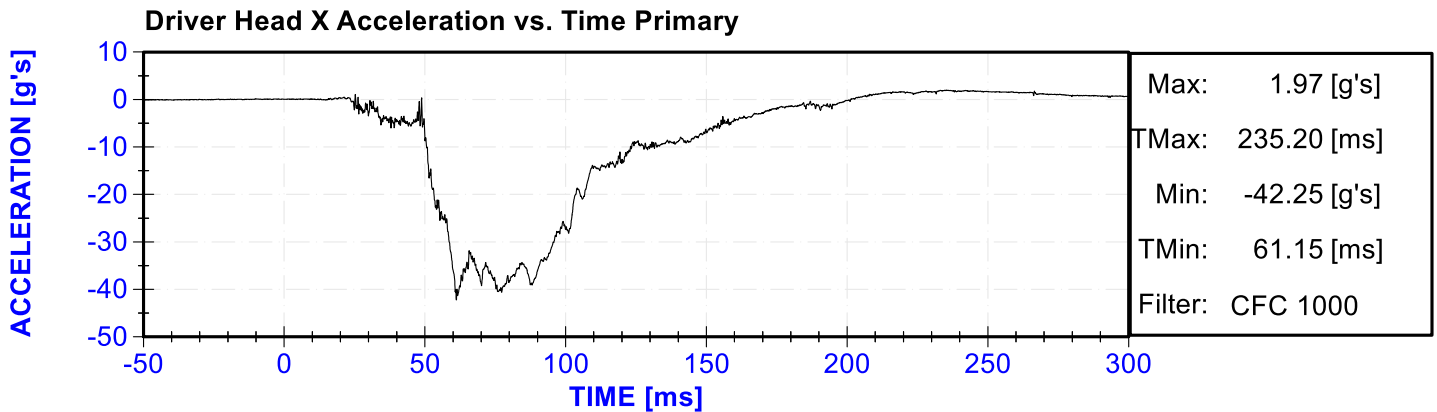
SAFARI 3601 11
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MILWAUKEE, WI 53212
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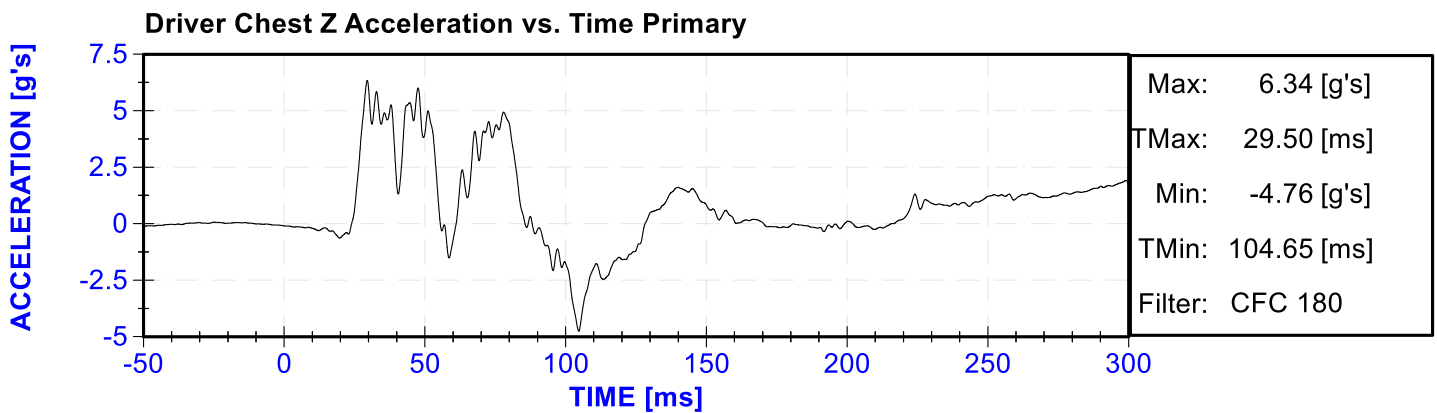
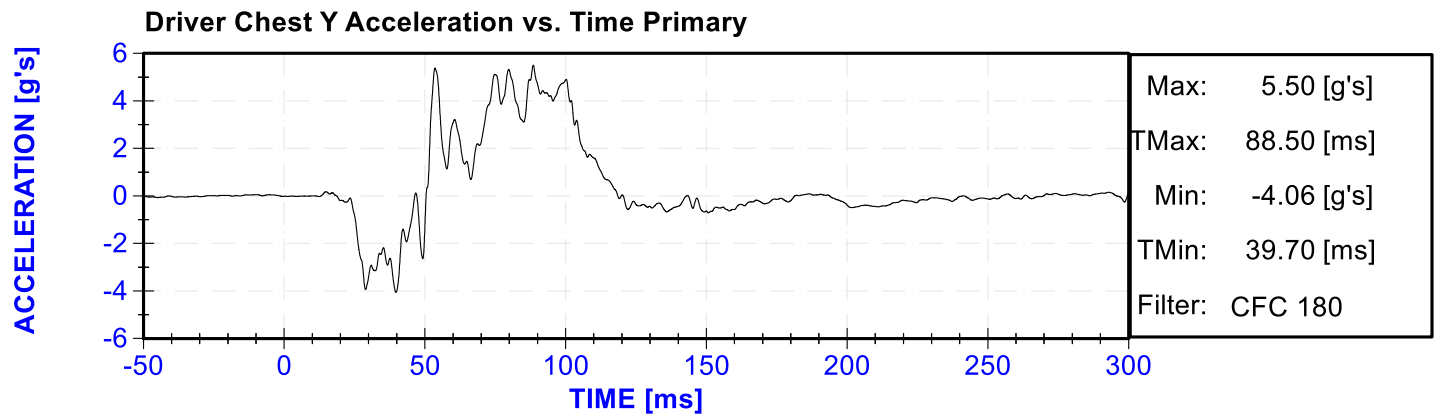
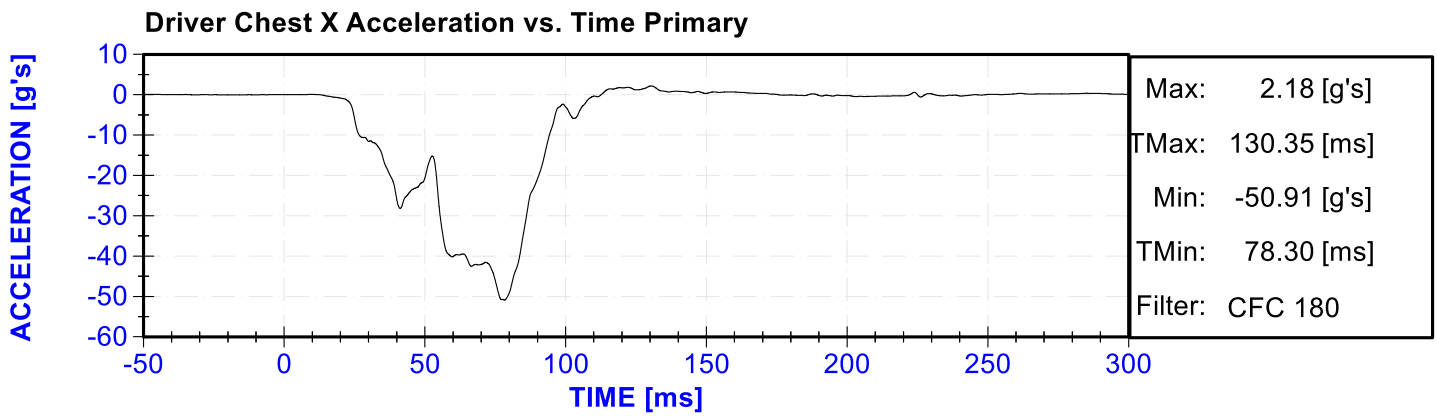
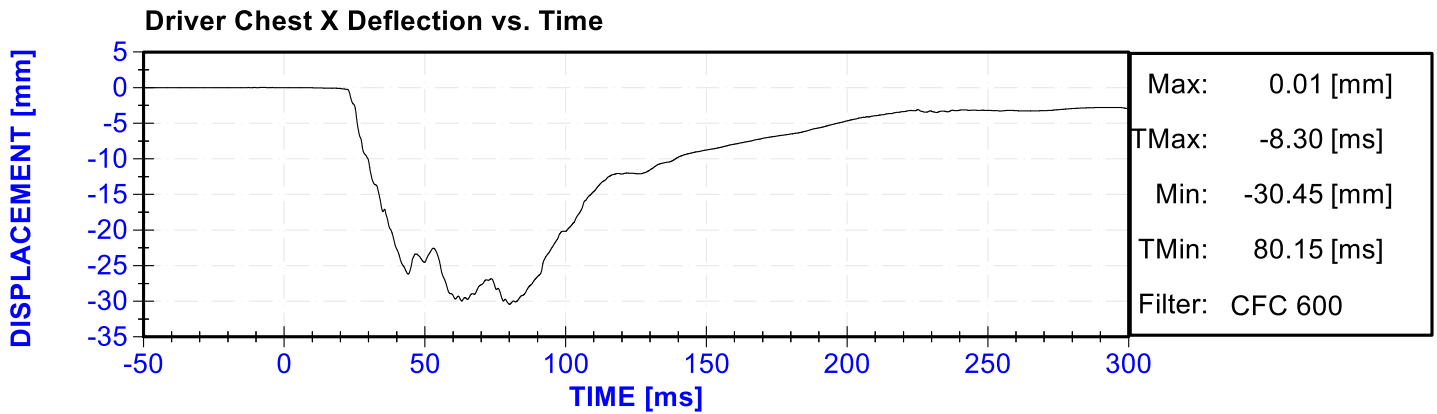
Figure A-79: Monroney Label Photograph

APPENDIX B
VEHICLE & DUMMY RESPONSE DATA TRACES

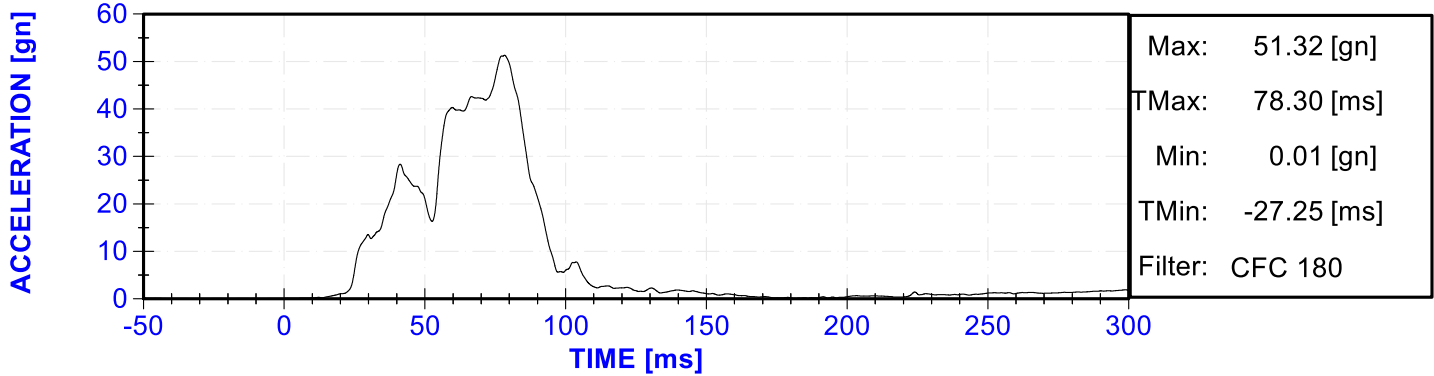
Table of Data Plots

No.	Description	Page
Plot 1	Driver Head X Acceleration vs. Time Primary	B-3
Plot 2	Driver Head Y Acceleration vs. Time Primary	B-3
Plot 3	Driver Head Z Acceleration vs. Time Primary	B-3
Plot 4	Driver Head Resultant Acceleration vs. Time Primary	B-3
Plot 5	Driver Chest X Deflection vs. Time	B-4
Plot 6	Driver Chest X Acceleration vs. Time Primary	B-4
Plot 7	Driver Chest Y Acceleration vs. Time Primary	B-4
Plot 8	Driver Chest Z Acceleration vs. Time Primary	B-4
Plot 9	Driver Chest Resultant Acceleration vs. Time Primary	B-5
Plot 10	Driver Upper Neck Force X vs. Time Primary	B-5
Plot 11	Driver Upper Neck Force Z vs. Time Primary	B-5
Plot 12	Driver Upper Neck Moment Y vs. Time Primary	B-5
Plot 13	Driver Nij vs. Time Primary	B-6
Plot 14	Driver Left Femur Force vs. Time	B-6
Plot 15	Driver Right Femur Force vs. Time	B-6
Plot 16	Passenger Head X Acceleration vs. Time Primary	B-6
Plot 17	Passenger Head Y Acceleration vs. Time Primary	B-7
Plot 18	Passenger Head Z Acceleration vs. Time Primary	B-7
Plot 19	Passenger Head Resultant Acceleration vs. Time Primary	B-7
Plot 20	Passenger Chest X Deflection vs. Time	B-7
Plot 21	Passenger Chest X Acceleration vs. Time Primary	B-8
Plot 22	Passenger Chest Y Acceleration vs. Time Primary	B-8
Plot 23	Passenger Chest Z Acceleration vs. Time Primary	B-8
Plot 24	Passenger Chest Resultant Acceleration vs. Time Primary	B-8
Plot 25	Passenger Upper Neck Force X vs. Time Primary	B-9
Plot 26	Passenger Upper Neck Force Z vs. Time Primary	B-9
Plot 27	Passenger Upper Neck Moment Y vs. Time Primary	B-9
Plot 28	Passenger Nij vs. Time Primary	B-9
Plot 29	Passenger Left Femur Force vs. Time	B-10
Plot 30	Passenger Right Femur Force vs. Time	B-10

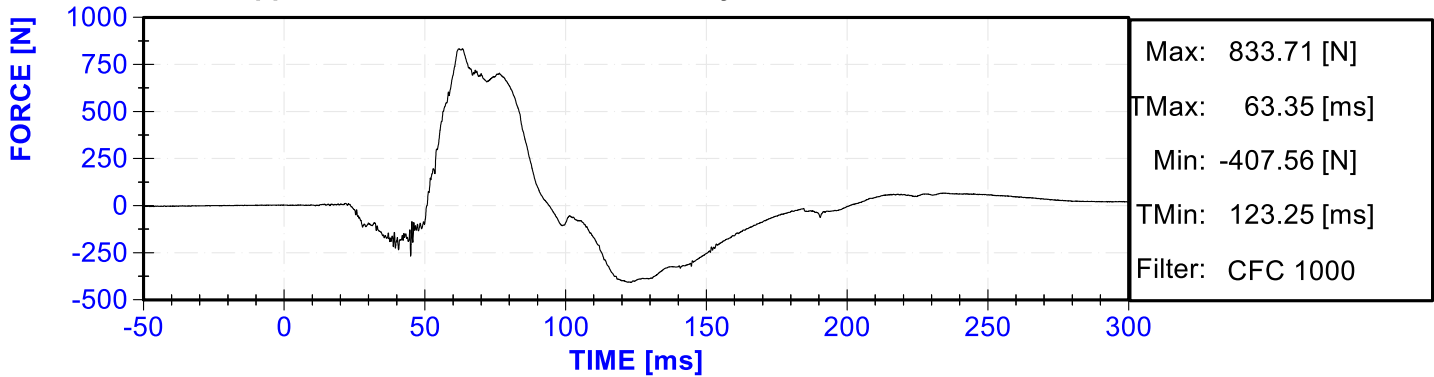




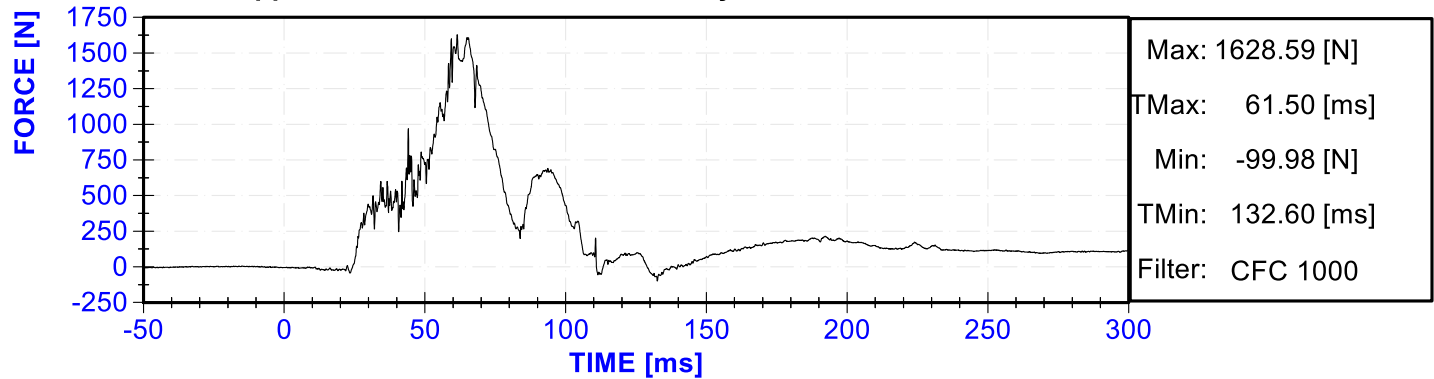
Driver Chest Resultant Acceleration vs. Time Primary



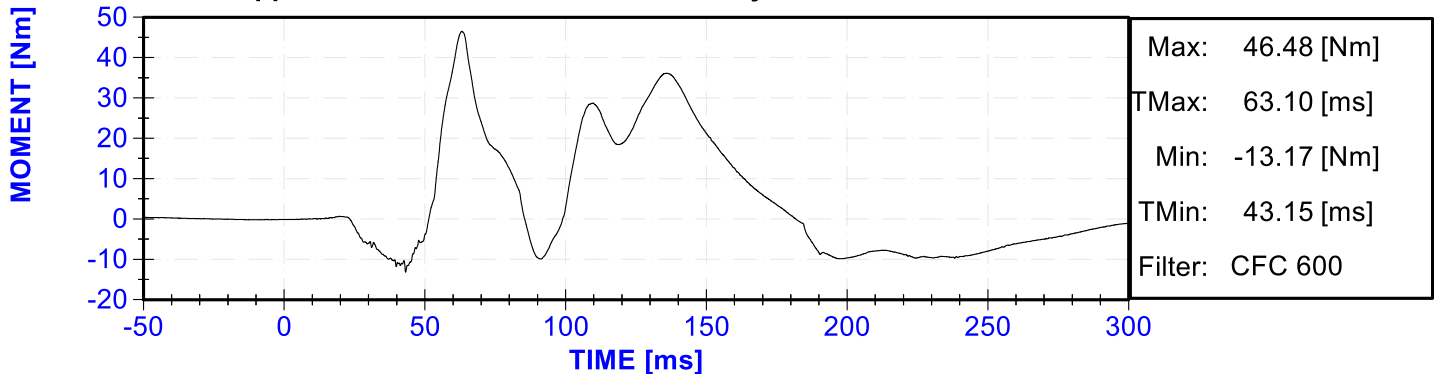
Driver Upper Neck Force X vs. Time Primary

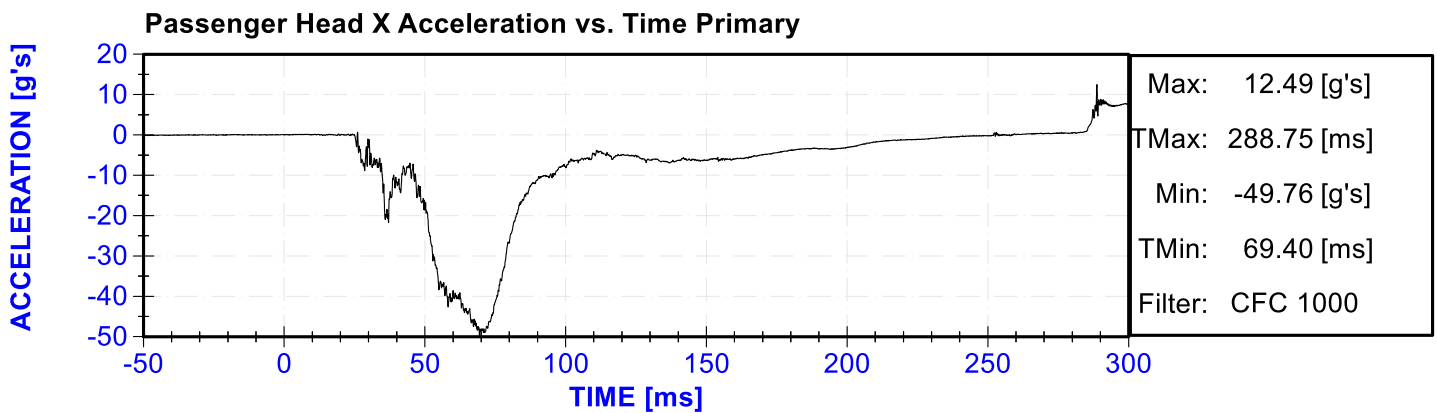
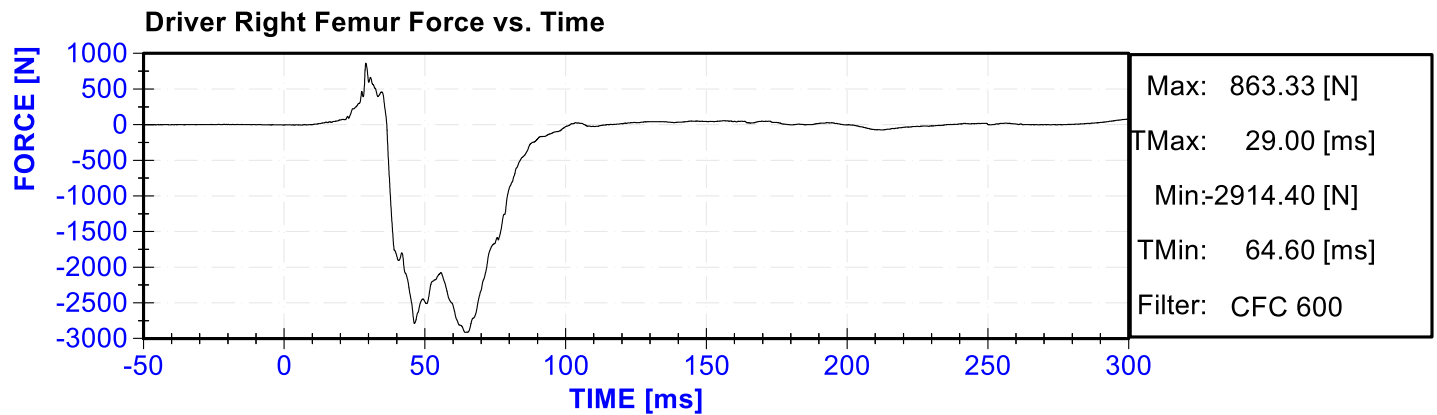
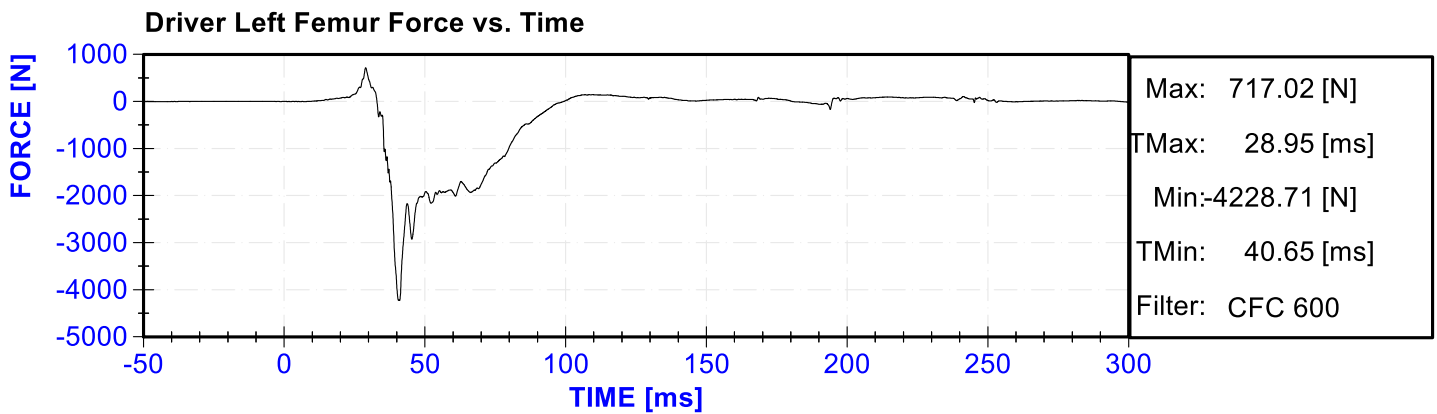
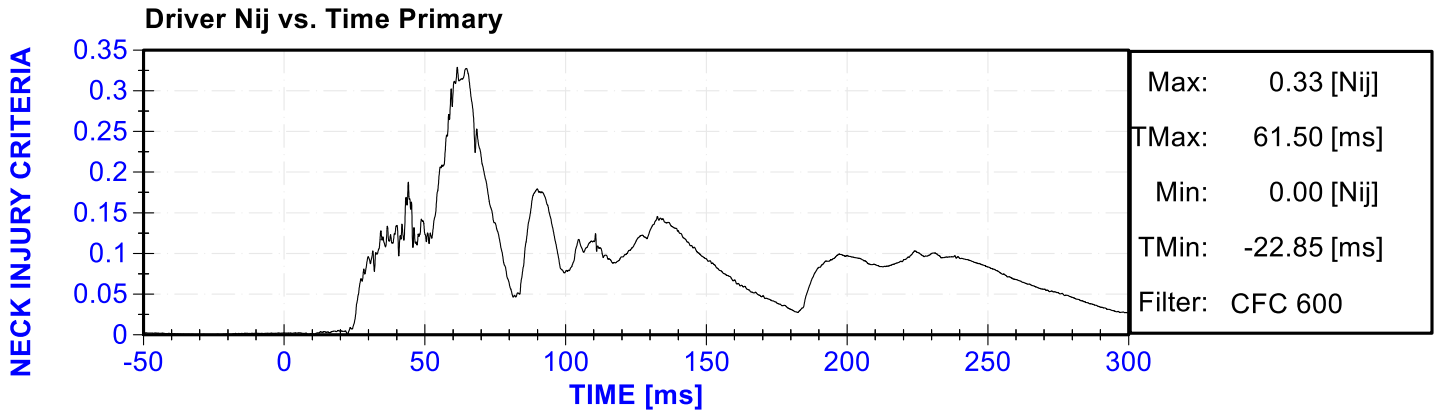


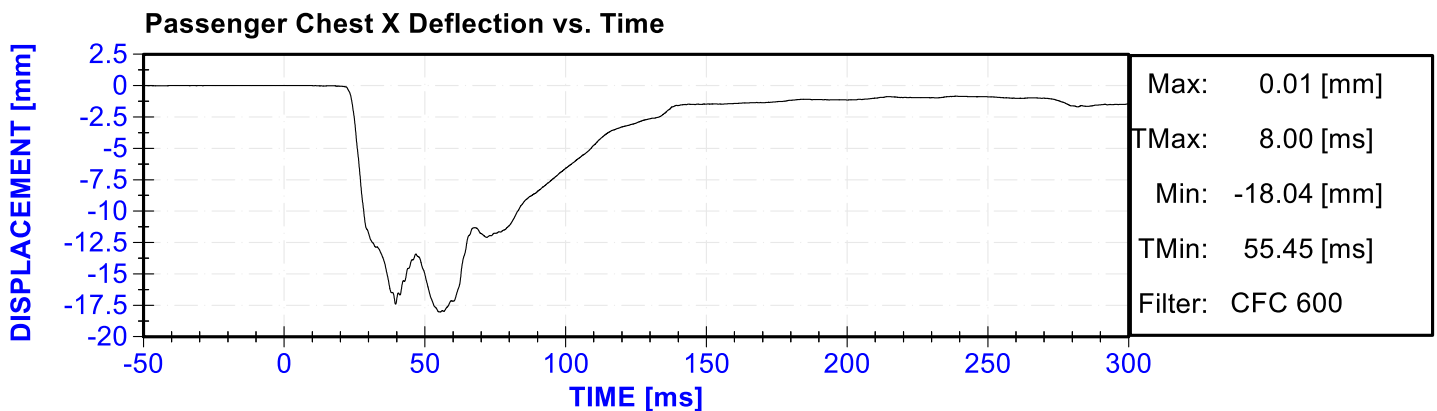
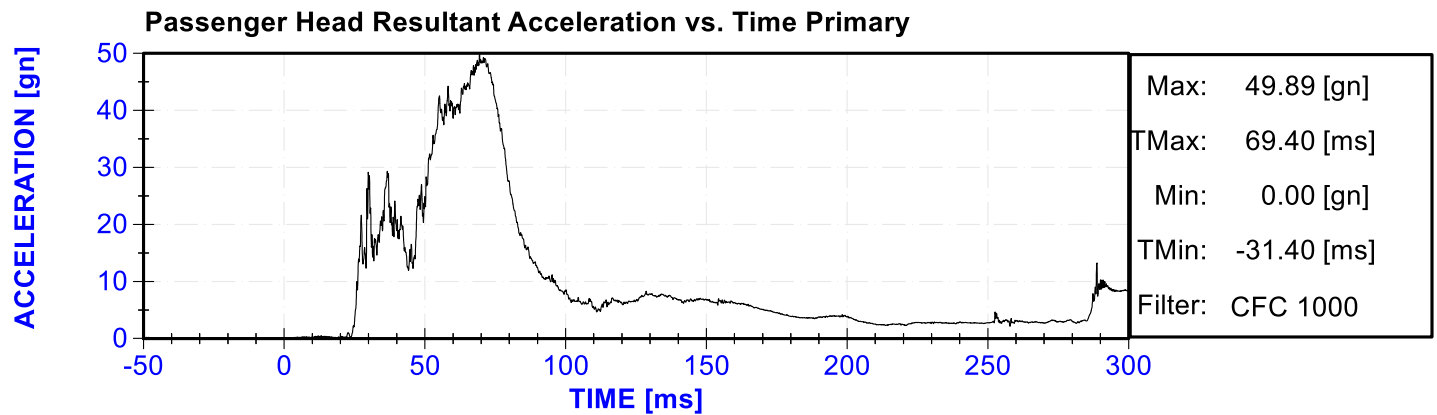
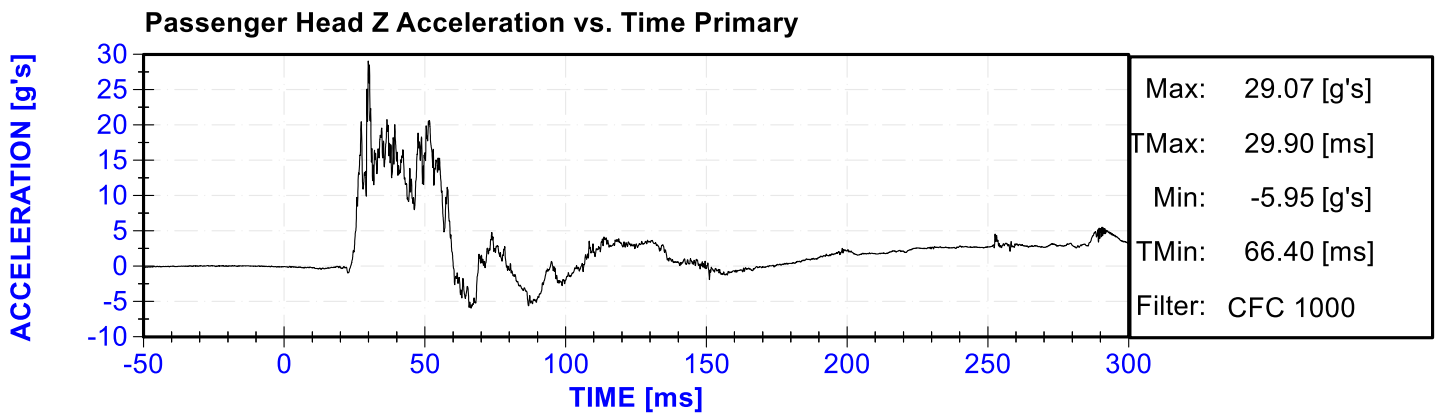
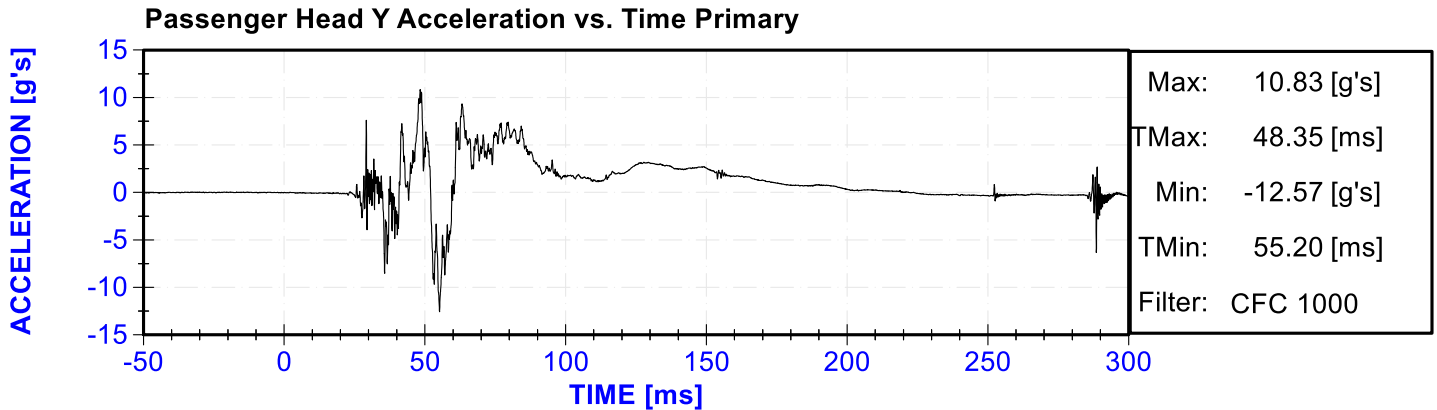
Driver Upper Neck Force Z vs. Time Primary

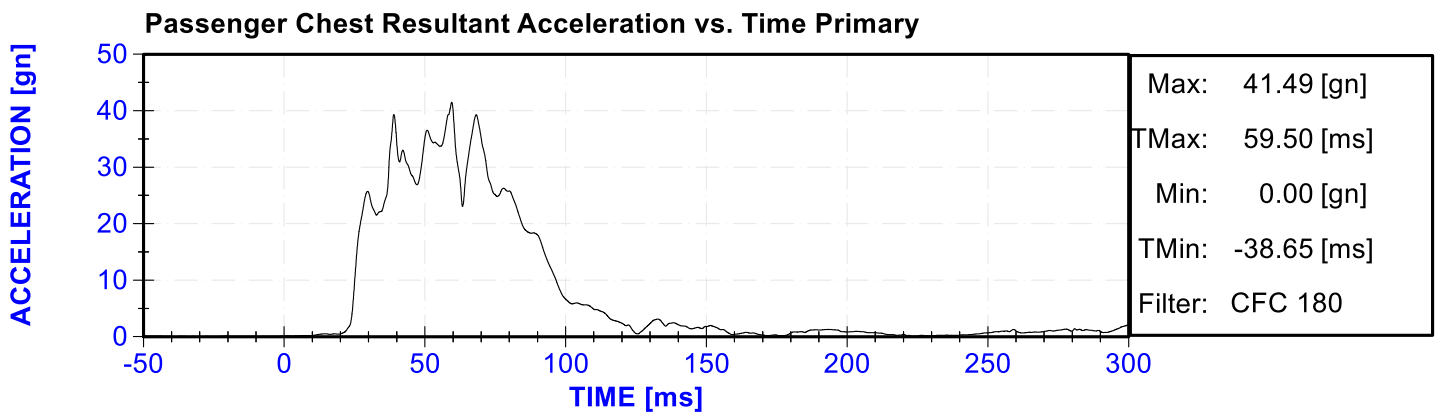
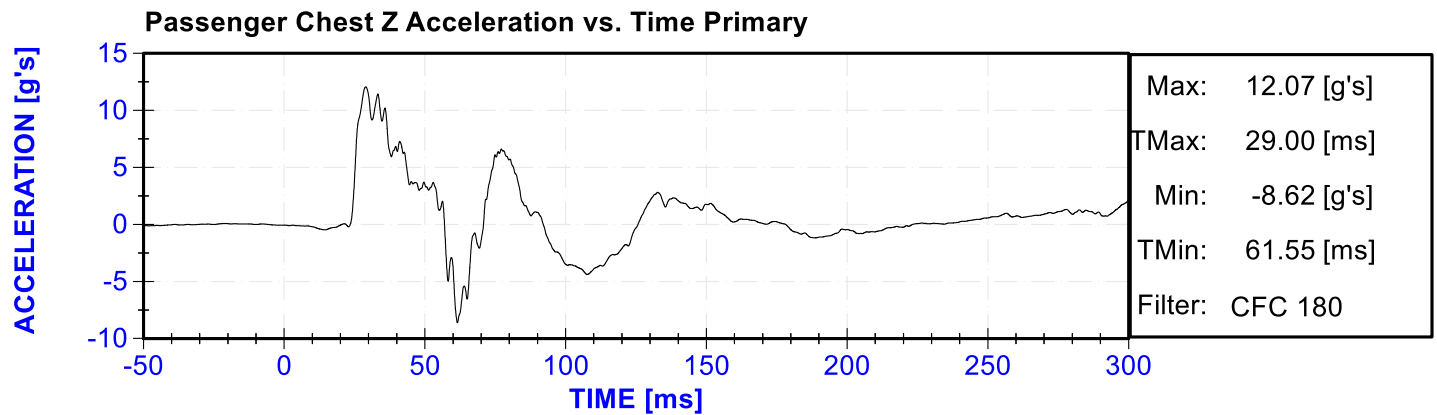
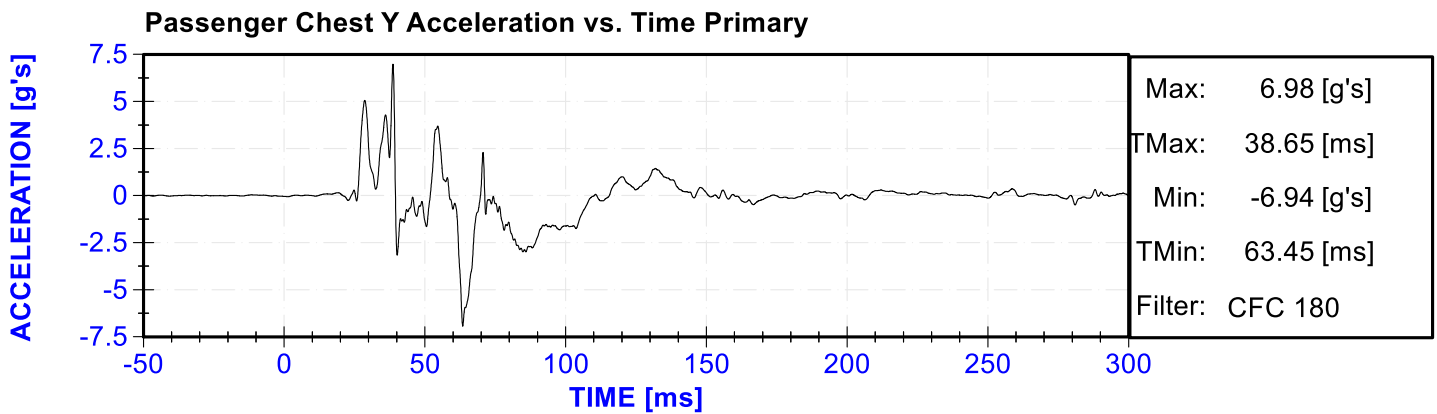
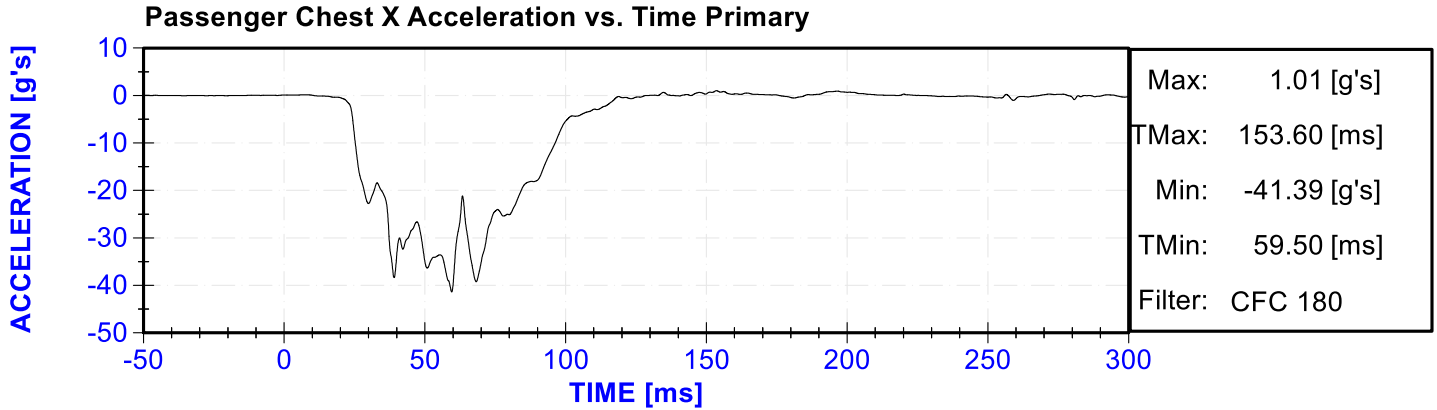


Driver Upper Neck Moment Y vs. Time Primary

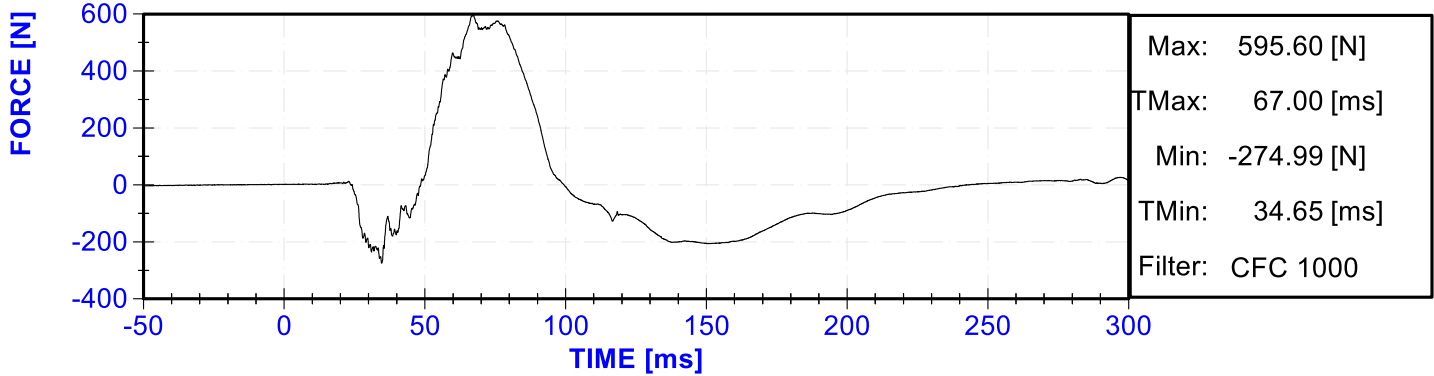




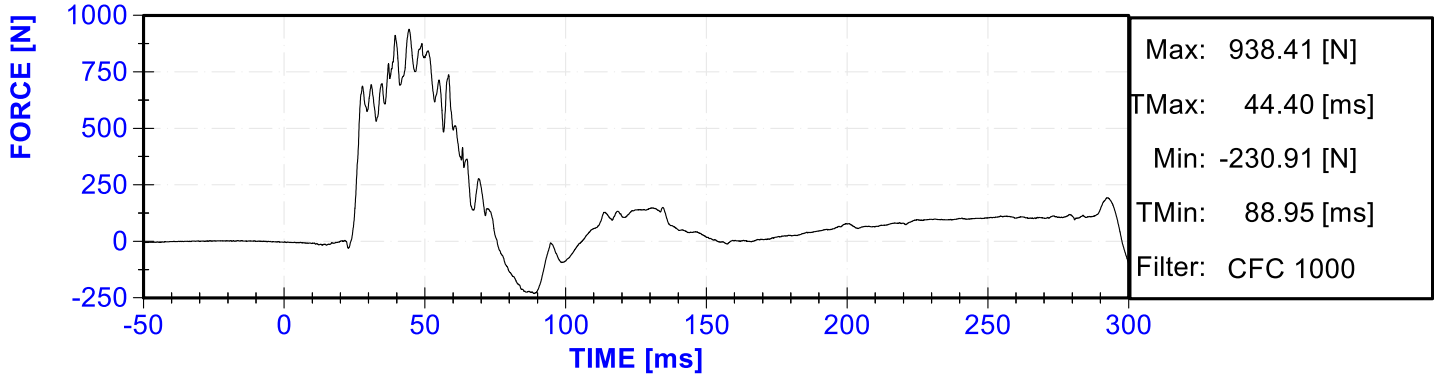




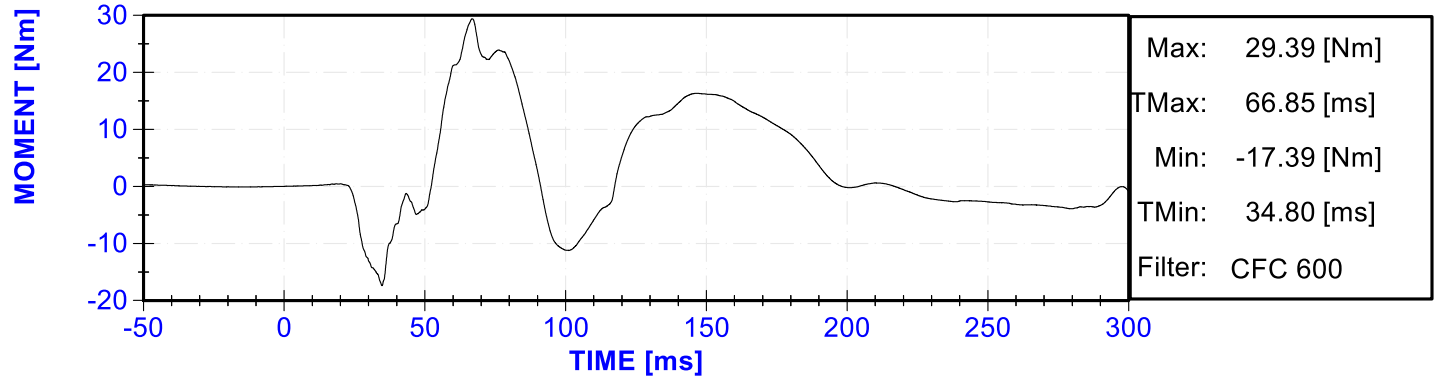
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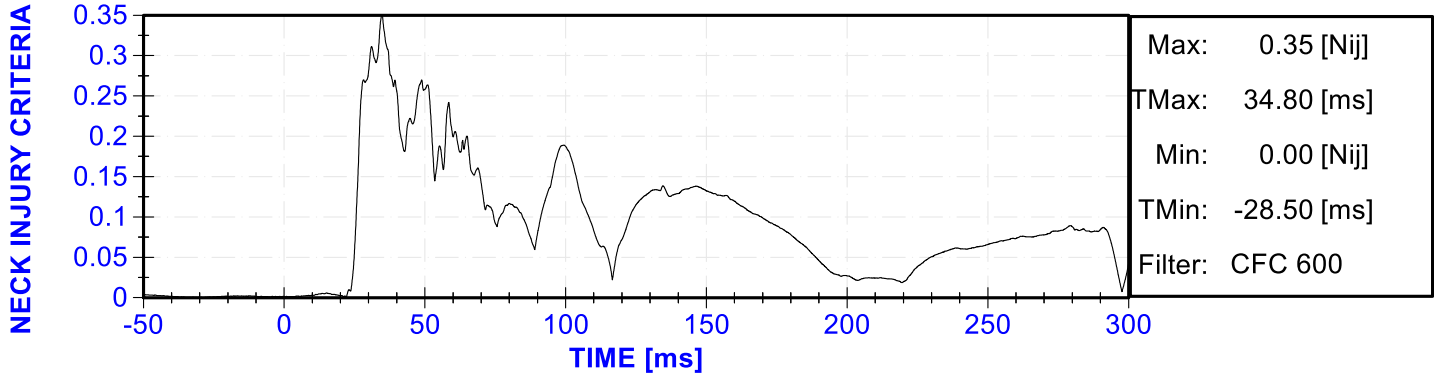
Passenger Upper Neck Force Z vs. Time Primary

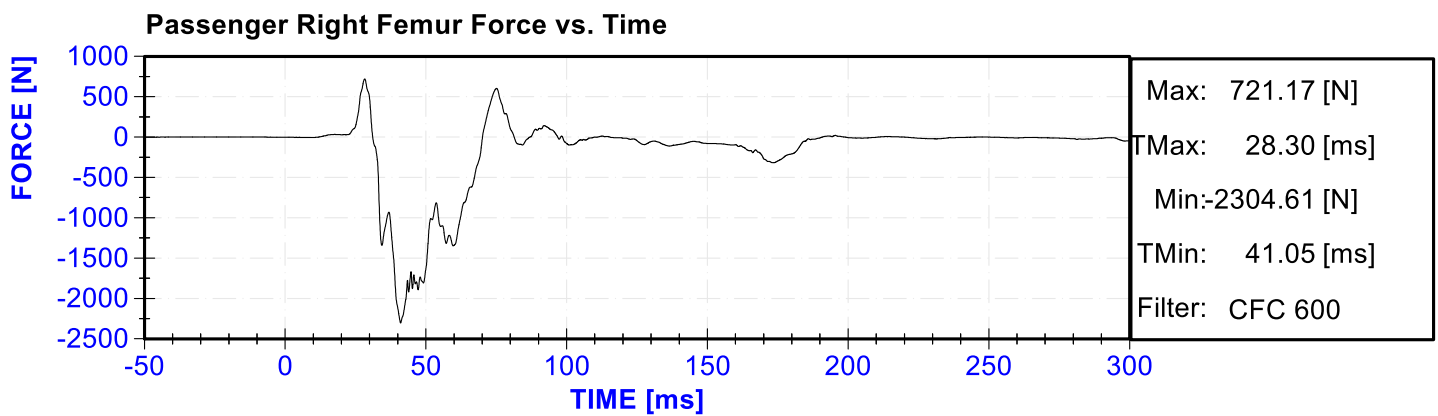
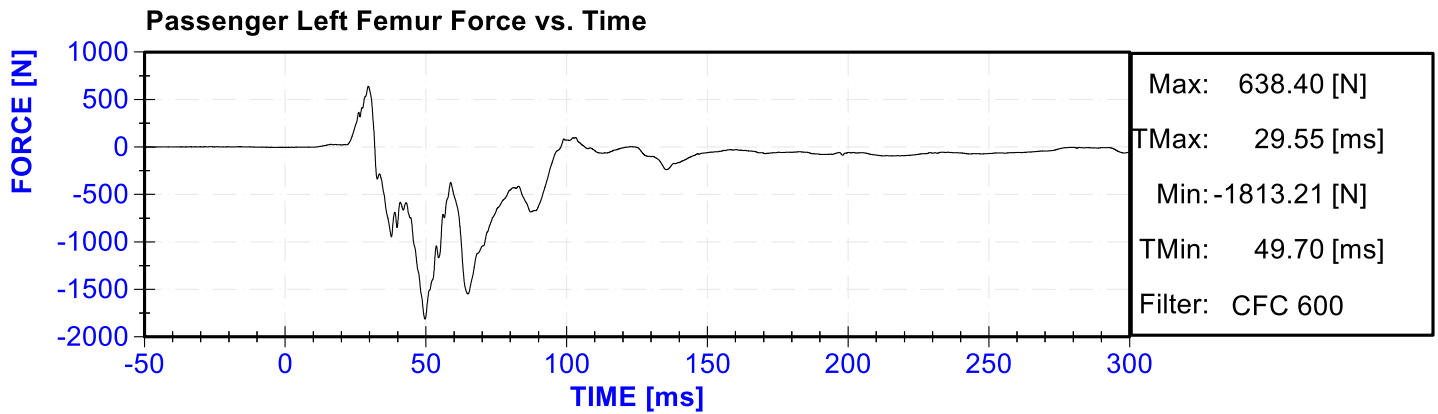


Passenger Upper Neck Moment Y vs. Time Primary



Passenger Nij vs. Time Primary





APPENDIX C

DUMMY CALIBRATION AND PERFORMANCE VERIFICATION DATA

CALIBRATION TEST RESULTS

PRE-TEST

HYBRID III 50TH PERCENTILE MALE - DRIVER ATD

SERIAL NO: 142

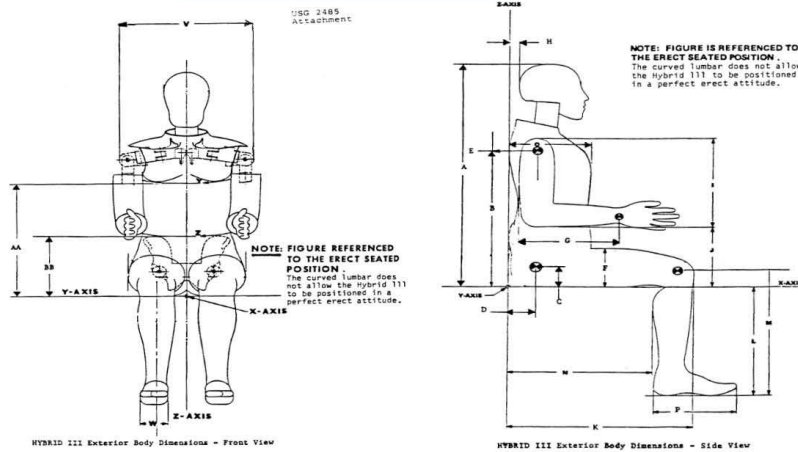


External Measurements - Hybrid 3 - 50th Male

Technician: K. Dutton

Date: 03/06/2019

Dummy Serial Number: 142



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	20.4	Pass
C	H-Point Height	3.3	3.5	3.4	Pass
D	H-Point from Backline	5.3	5.5	5.4	Pass
E	Shoulder Pivot from Backline	3.3	3.7	3.5	Pass
F	Thigh Clearance	5.5	6.1	5.8	Pass
G	Back of Elbow to Wrist Pivot	11.4	12.0	11.9	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	23.1	Pass
L	Popliteal Height	16.9	17.9	17.3	Pass
M	Knee Pivot Height	19.1	19.7	19.4	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	16.7	Pass
W	Foot Breadth	3.6	4.2	3.9	Pass
Y	Chest Circumference with Jacket	38.2	39.4	38.9	Pass
Z	Waist Circumference	32.9	34.1	33.7	Pass
AA	Reference Location (Chest Circumference)	16.9	17.1	17.0	Pass
BB	Reference Location (Waist Circumference)	8.9	9.1	9.0	Pass

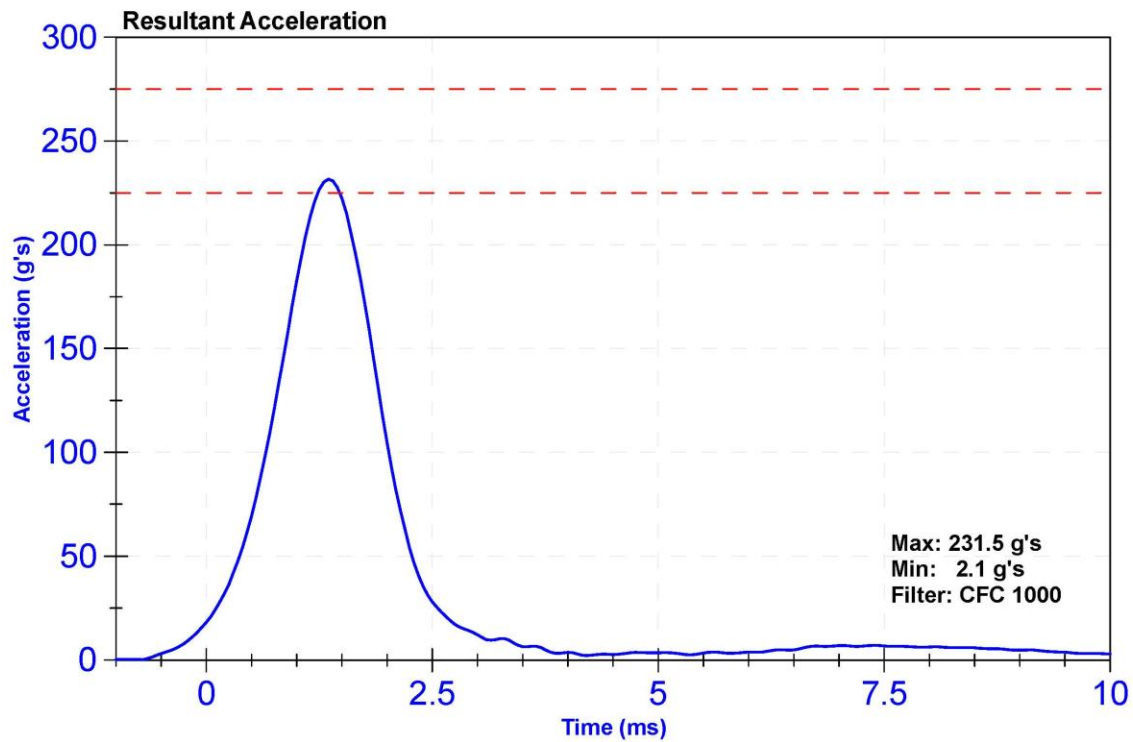
ATD Manufacturer	Humanetics	Test Technician	K. Dutton
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

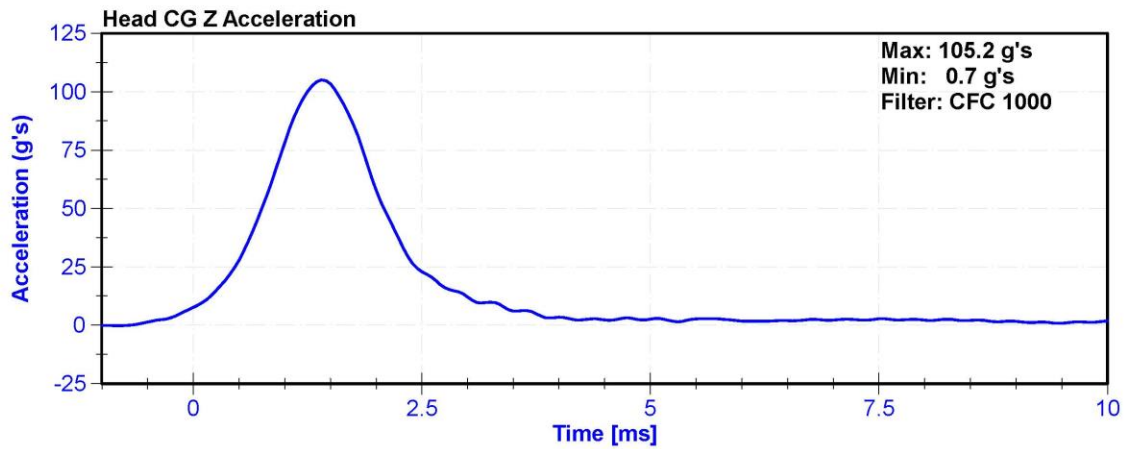
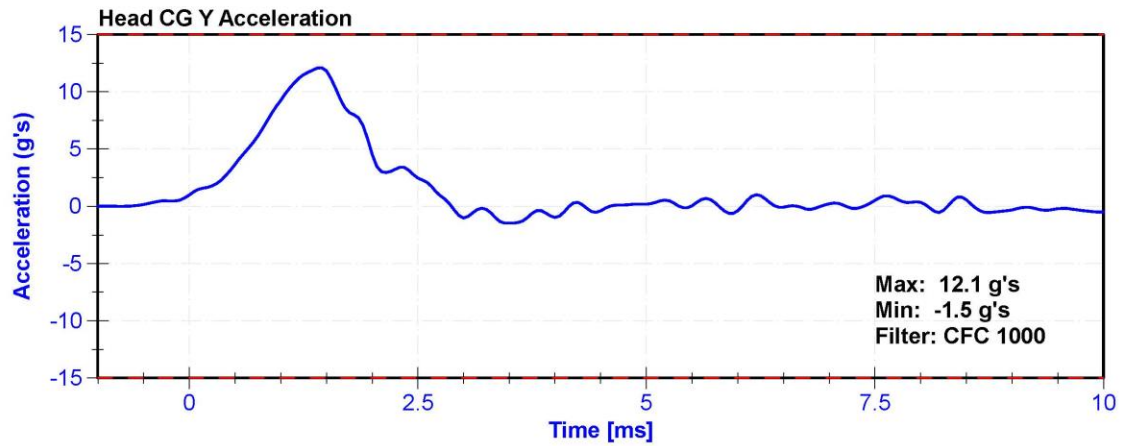
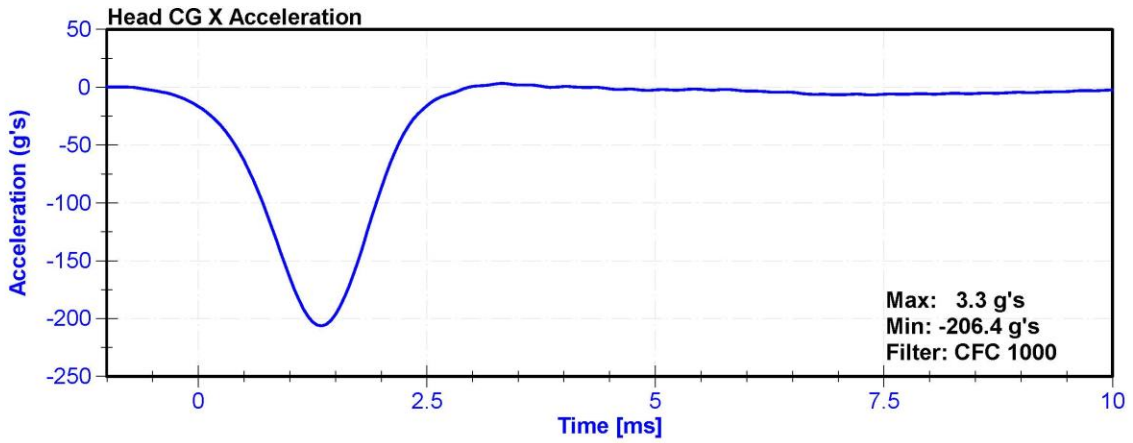
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	22.0	Pass
Humidity	10	70	%	14.5	Pass
Resultant Acceleration	225	275	g's	231.5	Pass
Oscillation	0	10	%	4.4	Pass
Lateral Acceleration	-15	15	g's	12.1	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	ENDEVCO 7264CT	AC-P58998	10/5/2018	4/5/2019
Y Accelerometer	ENDEVCO 7264CT	AC-P58912	10/6/2018	4/6/2019
Z Accelerometer	ENDEVCO 7264CT	AC-P58997	10/6/2018	4/6/2019





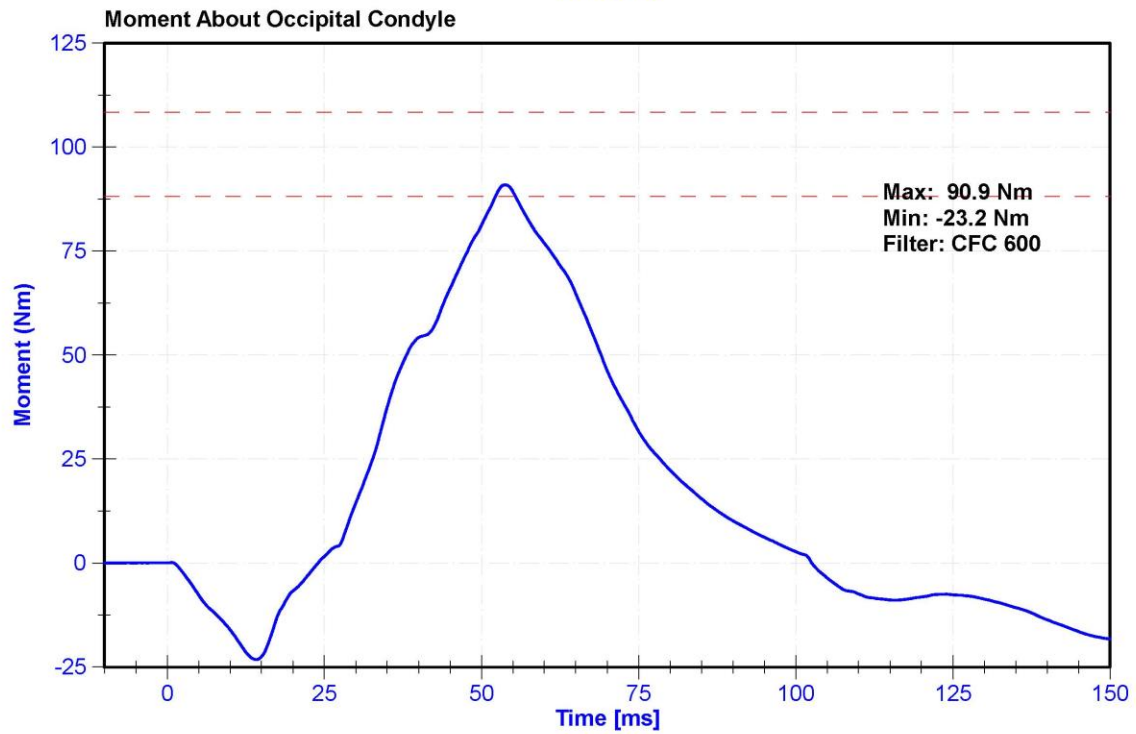
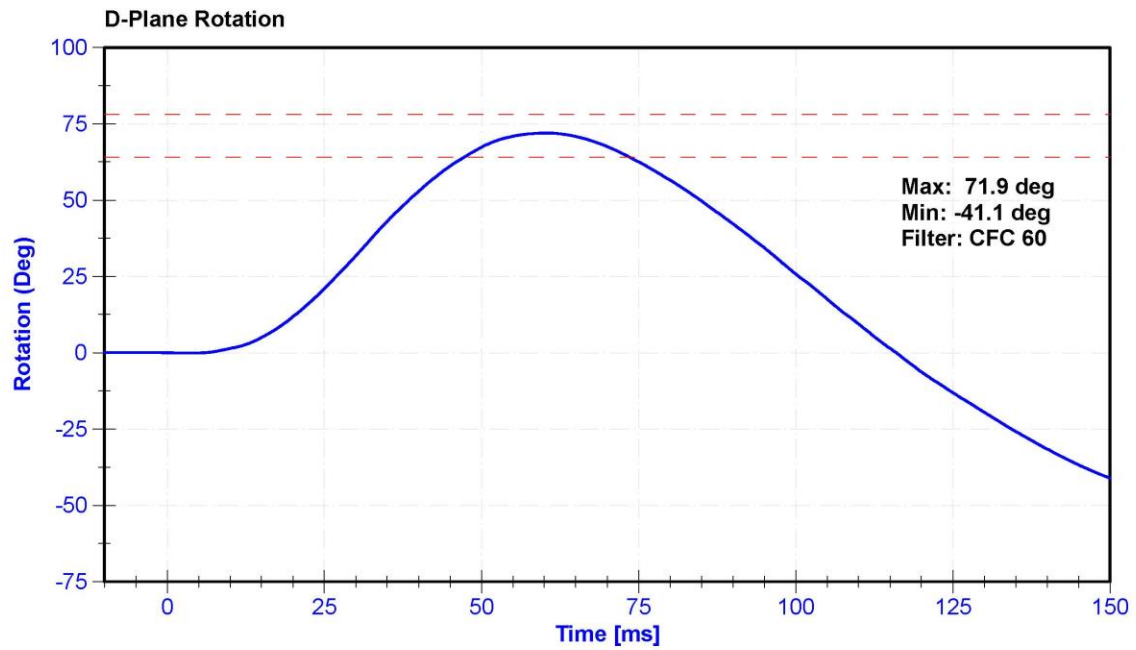
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ATD Serial Number	142	Laboratory Supervisor	K. Brogan

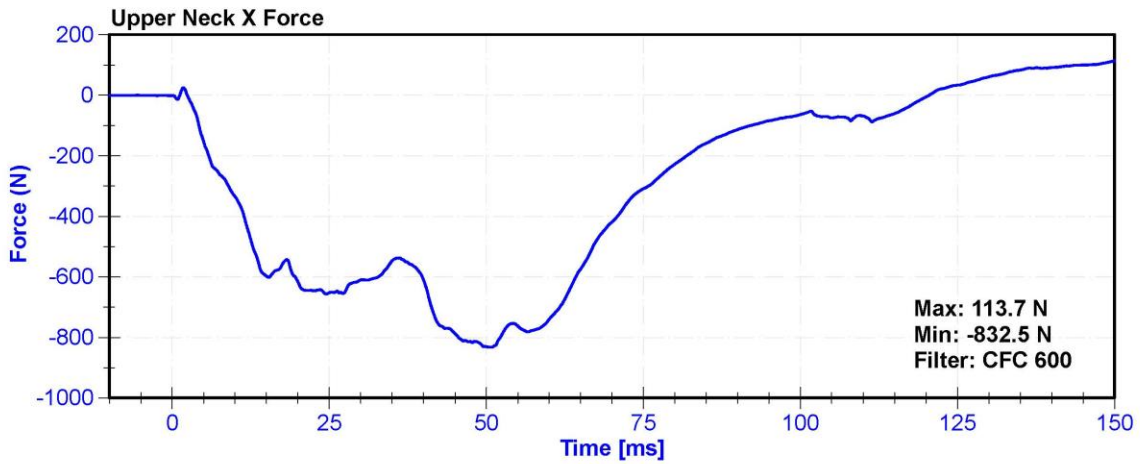
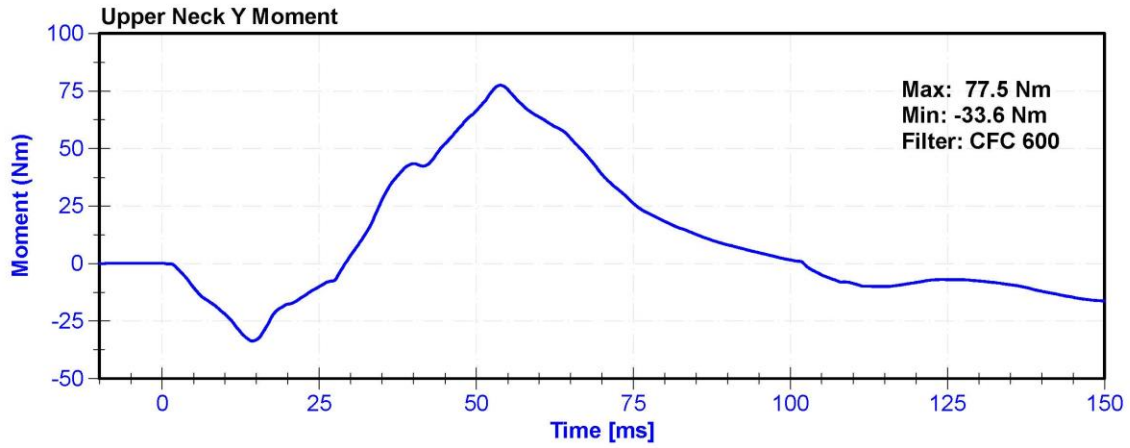
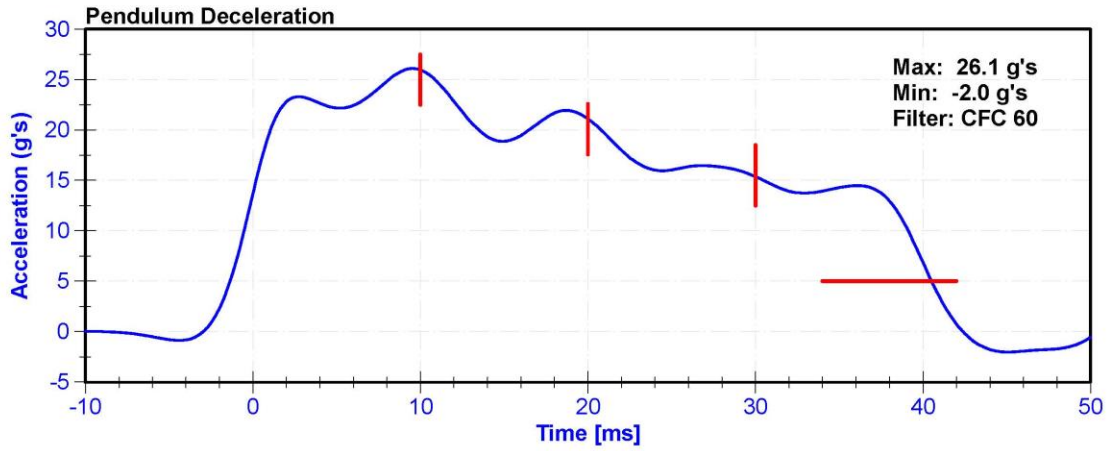
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	22.0	Pass
Humidity	10	70	%	13.6	Pass
Velocity	6.89	7.13	m/s	6.903	Pass
Pendulum Deceleration at 10ms	22.5	27.5	g's	25.96	Pass
Pendulum Deceleration at 20ms	17.6	22.6	g's	21.12	Pass
Pendulum Deceleration at 30ms	12.5	18.5	g's	15.38	Pass
Max. Pendulum Deceleration After 30ms	0	29	g's	26.1	Pass
Pendulum Deceleration Time to 5 g's	34	42	ms	40.5	Pass
Maximum D Plane Rotation	64	78	deg	71.9	Pass
Time to Maximum Rotation	57	64	ms	60.3	Pass
Rotation Decay to Zero	113	127	ms	116.0	Pass
Moment About Occipital Condyle	88.1	108.4	Nm	90.93	Pass
Time to Maximum Moment	47	58	ms	53.7	Pass
Moment Decay to Zero	97	107	ms	102.6	Pass

Transducer Calibrations

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





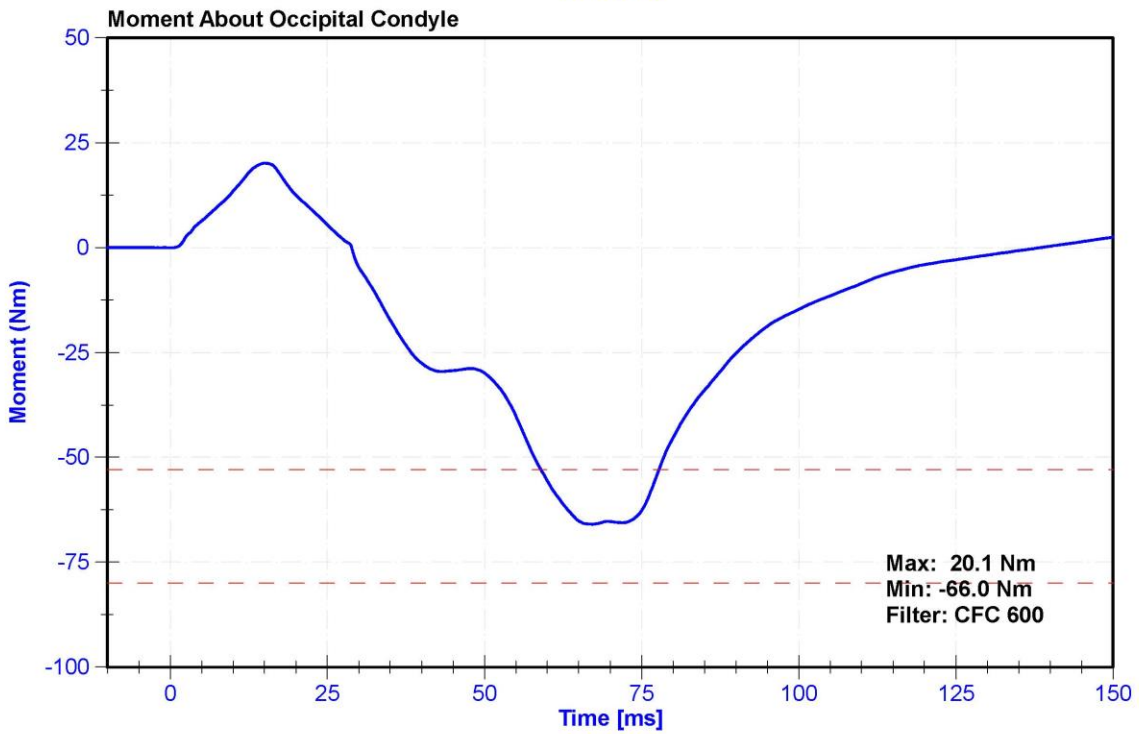
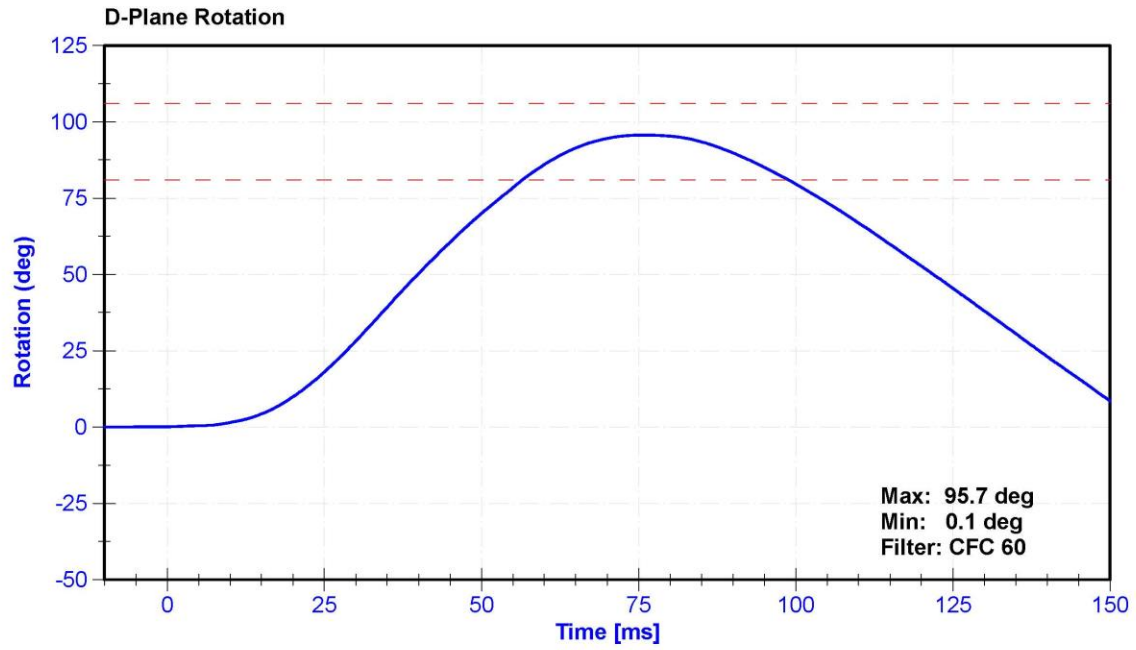
ATD Manufacturer	Humanetics	Test Technician	C. Mantell
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

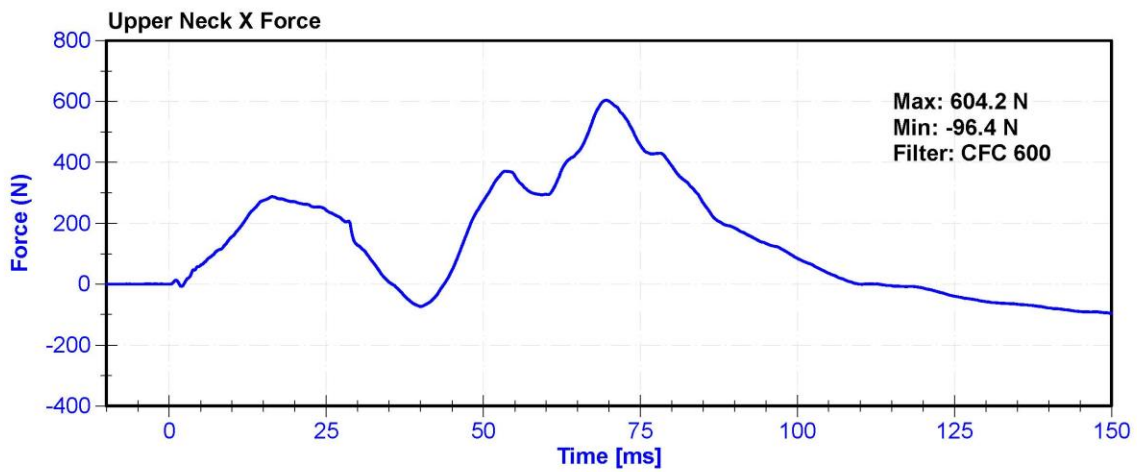
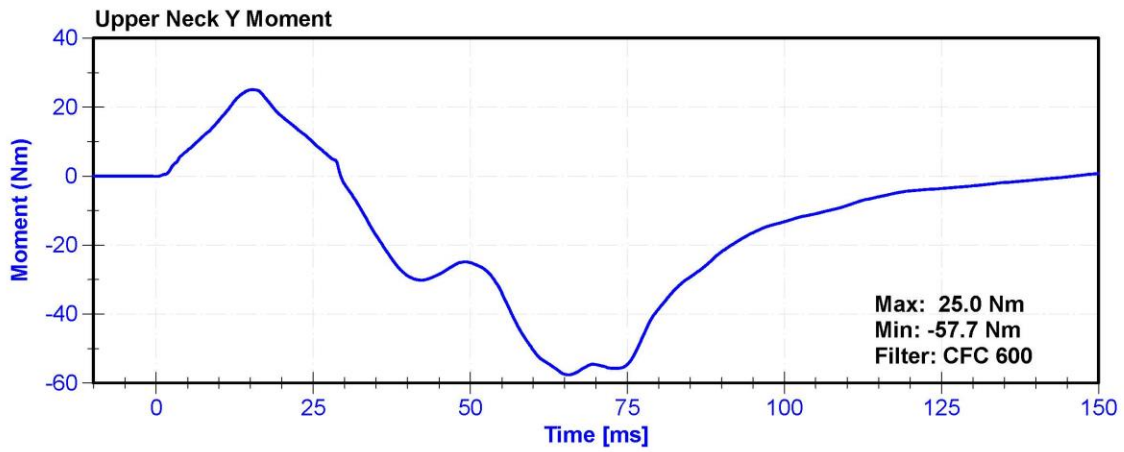
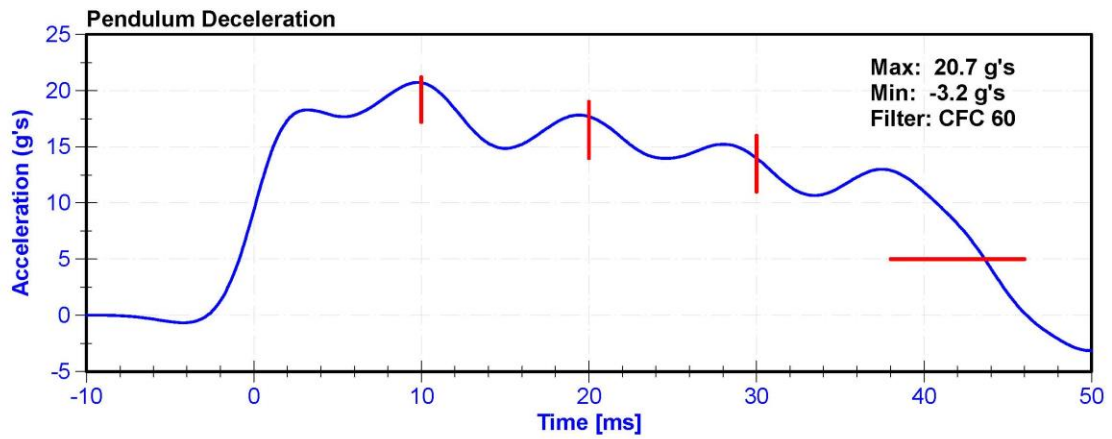
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	22	Pass
Humidity	10	70	%	18.1	Pass
Velocity	5.94	6.19	m/s	5.964	Pass
Pendulum Deceleration at 10ms	17.2	21.2	g's	20.70	Pass
Pendulum Deceleration at 20ms	14	19	g's	17.7	Pass
Pendulum Deceleration at 30ms	11	16	g's	14.0	Pass
Max. Pendulum Deceleration After 30ms	0	22	g's	20.7	Pass
Pendulum Deceleration Time to 5 g's	38	46	ms	43.6	Pass
Maximum D Plane Rotation	81	106	deg	95.7	Pass
Time to Maximum Rotation	72	82	ms	75.9	Pass
Rotation Decay to Zero	147	174	ms	155.4	Pass
Minimum Moment About OC	-80	-52.9	Nm	-65.99	Pass
Time to Minimum Moment	65	79	ms	67.2	Pass
Moment Decay to Zero	120	148	ms	138.6	Pass

Transducer Calibrations

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





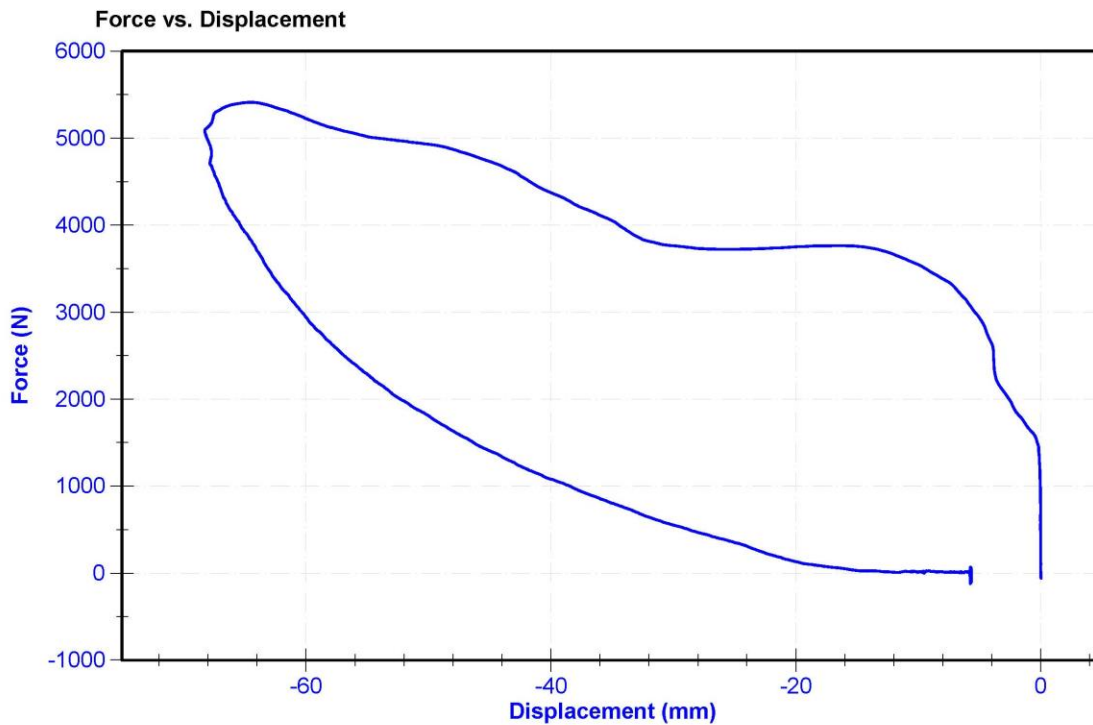
ATD Manufacturer	Humanetics	Test Technician	D.Reinhard
ATD Serial Number	142	Laboratory Supervisor	K.Brogan

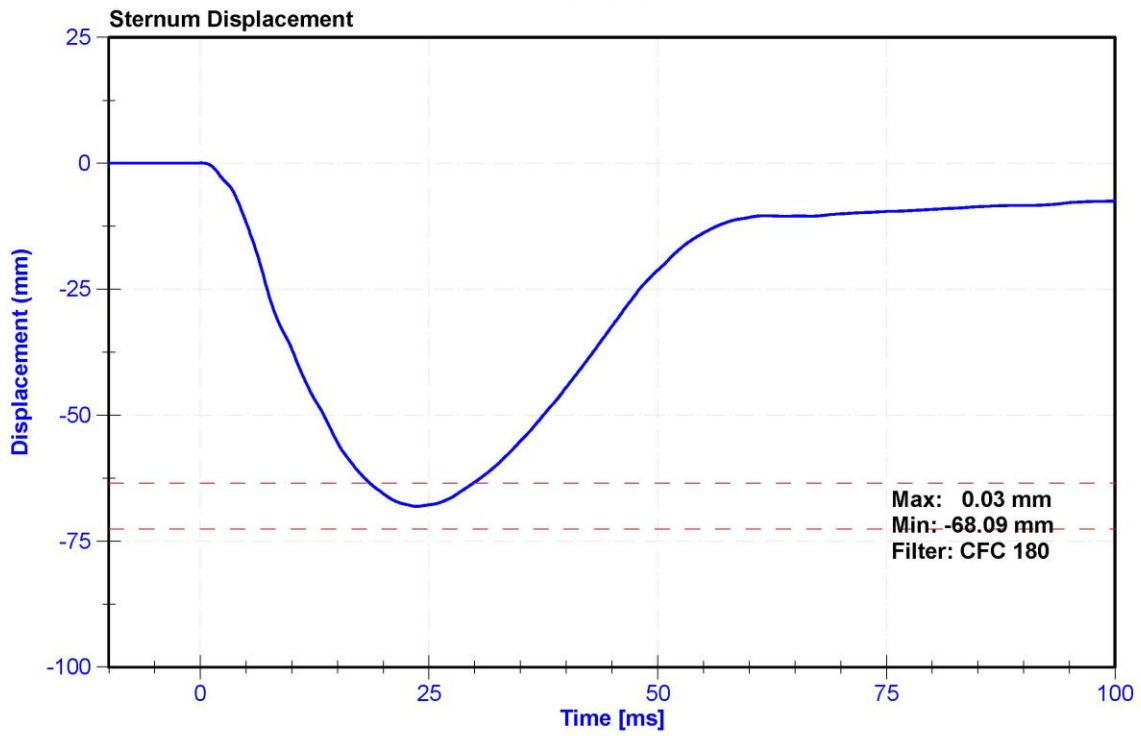
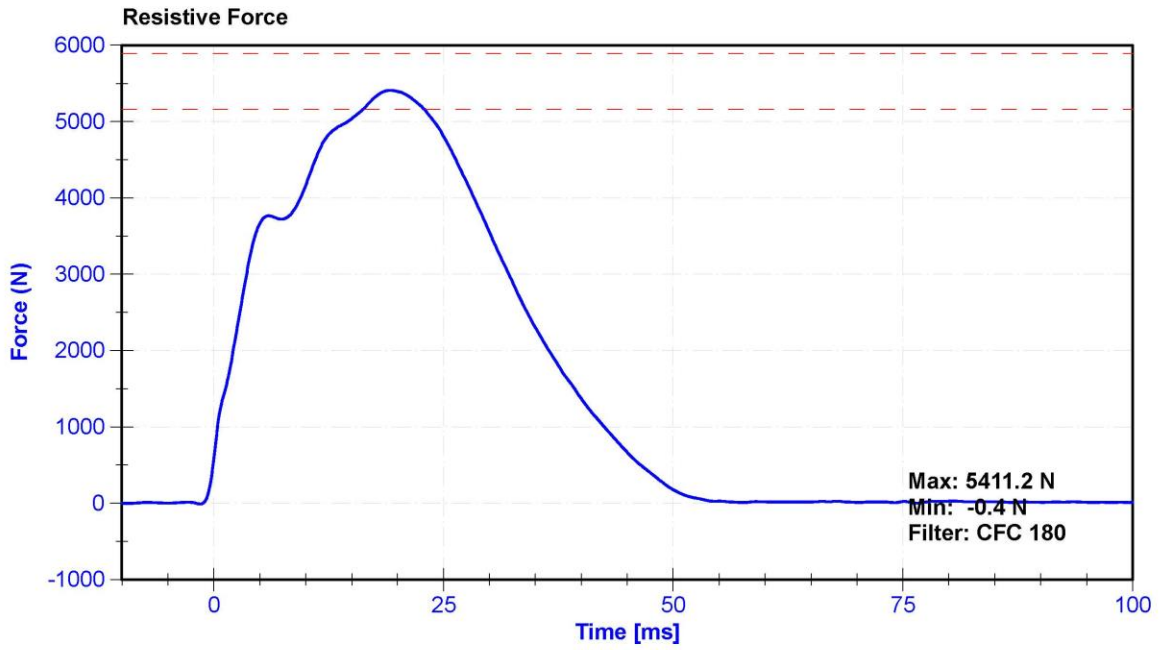
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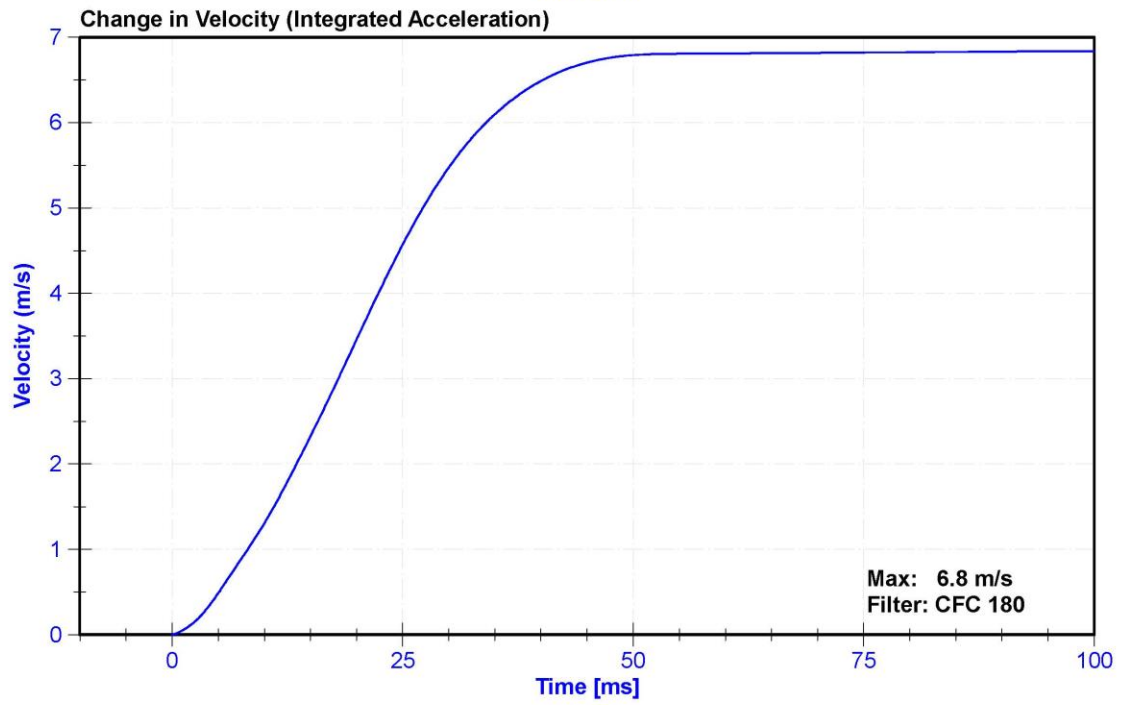
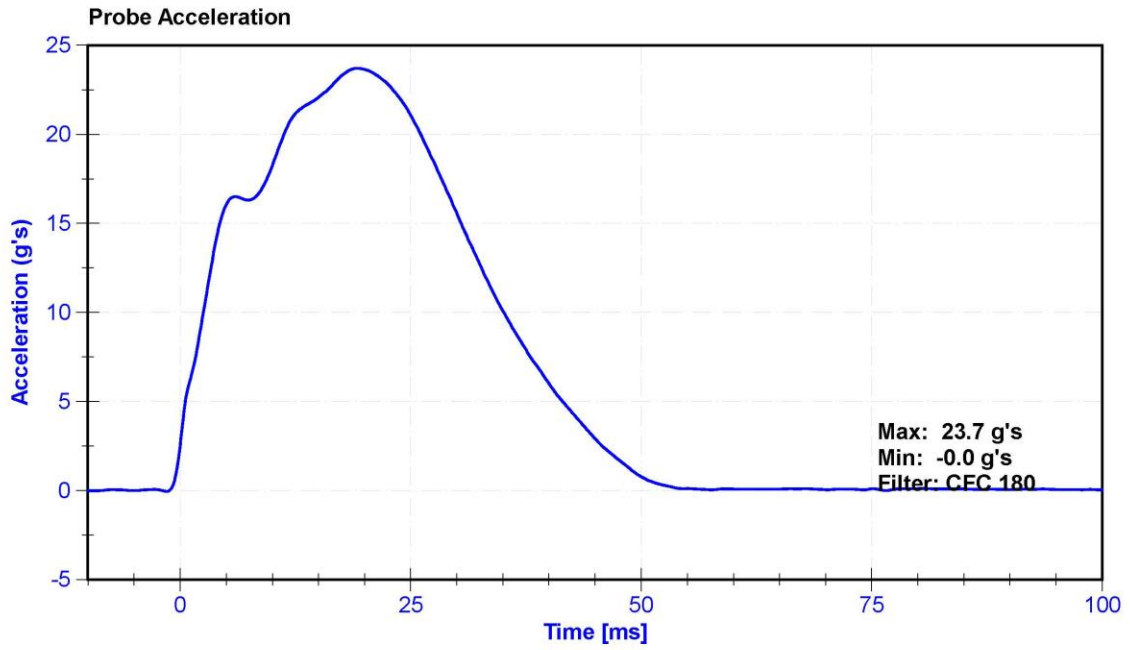
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	22	Pass
Humidity	10	70	%	18.5	Pass
Velocity	6.59	6.83	m/s	6.597	Pass
Chest Displacement	-72.6	-63.5	mm	-68.09	Pass
Resistive Force	5160	5894	N	5411.2	Pass
Hysteresis	65	85	%	71.8	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7264CT	AC-P23904	11/1/2018	5/2/2019
Chest Potentiometer	JDK 6209-2038	DS-142	10/22/2018	10/22/2019







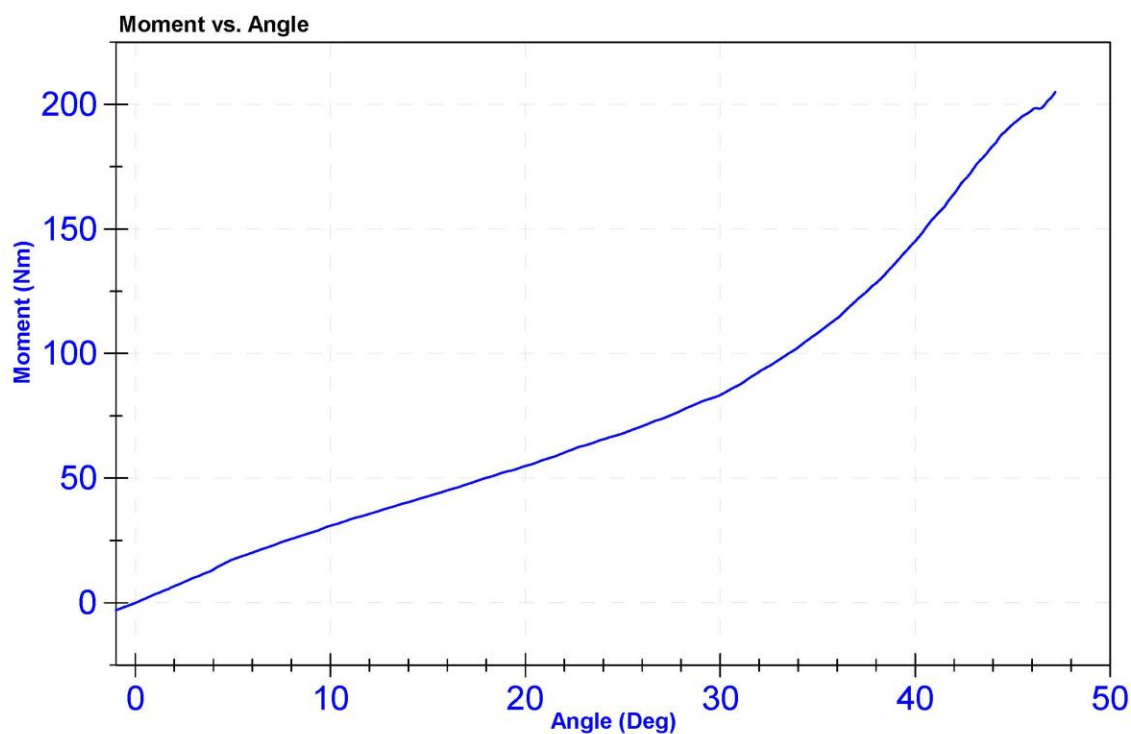
ATD Manufacturer	Humanetics	Test Technician	K. Dutton
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	22.0	Pass
Humidity	10	70	%	16.4	Pass
Average Velocity	5	10	deg/s	7.1	Pass
Angle at 203Nm	40	50	deg	47.0	Pass
Moment at 30 degrees	0	94.9	Nm	83.4	Pass

Transducer Calibrations

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



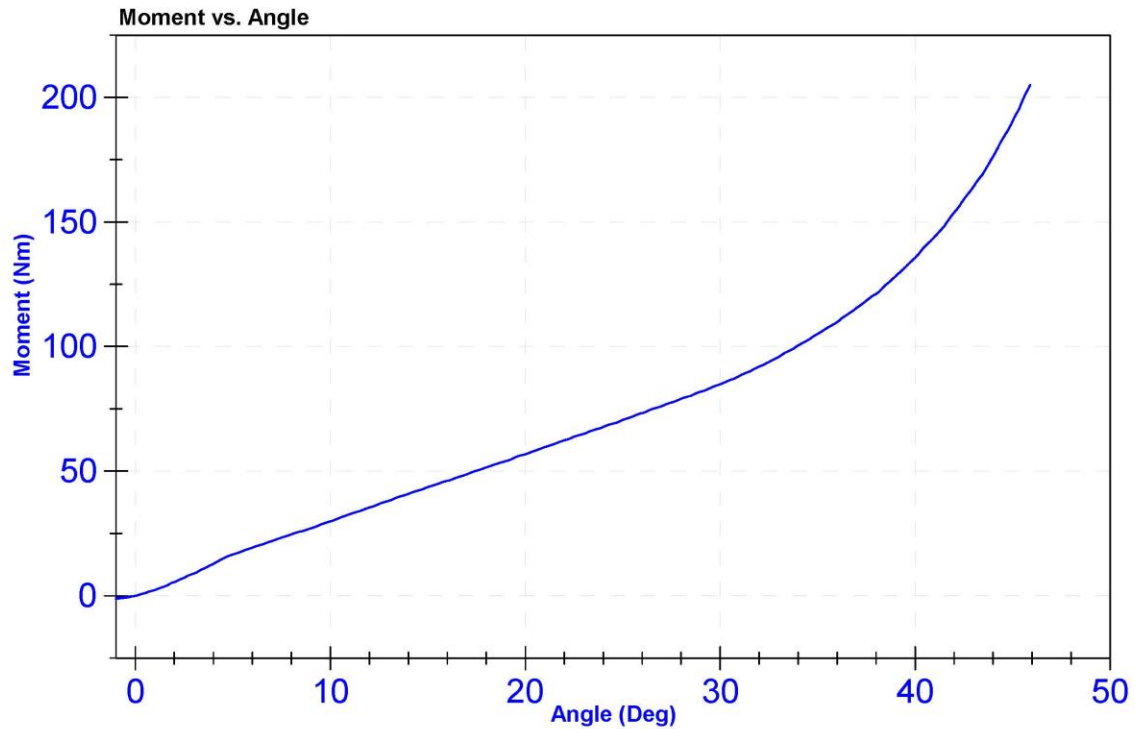
ATD Manufacturer	Humanetics	Test Technician	K. Dutton
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	22.0	Pass
Humidity	10	70	%	15.5	Pass
Average Velocity	5	10	deg/s	7.2	Pass
Angle at 203Nm	40	50	deg	45.8	Pass
Moment at 30 degrees	0	94.9	Nm	84.9	Pass

Transducer Calibrations

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



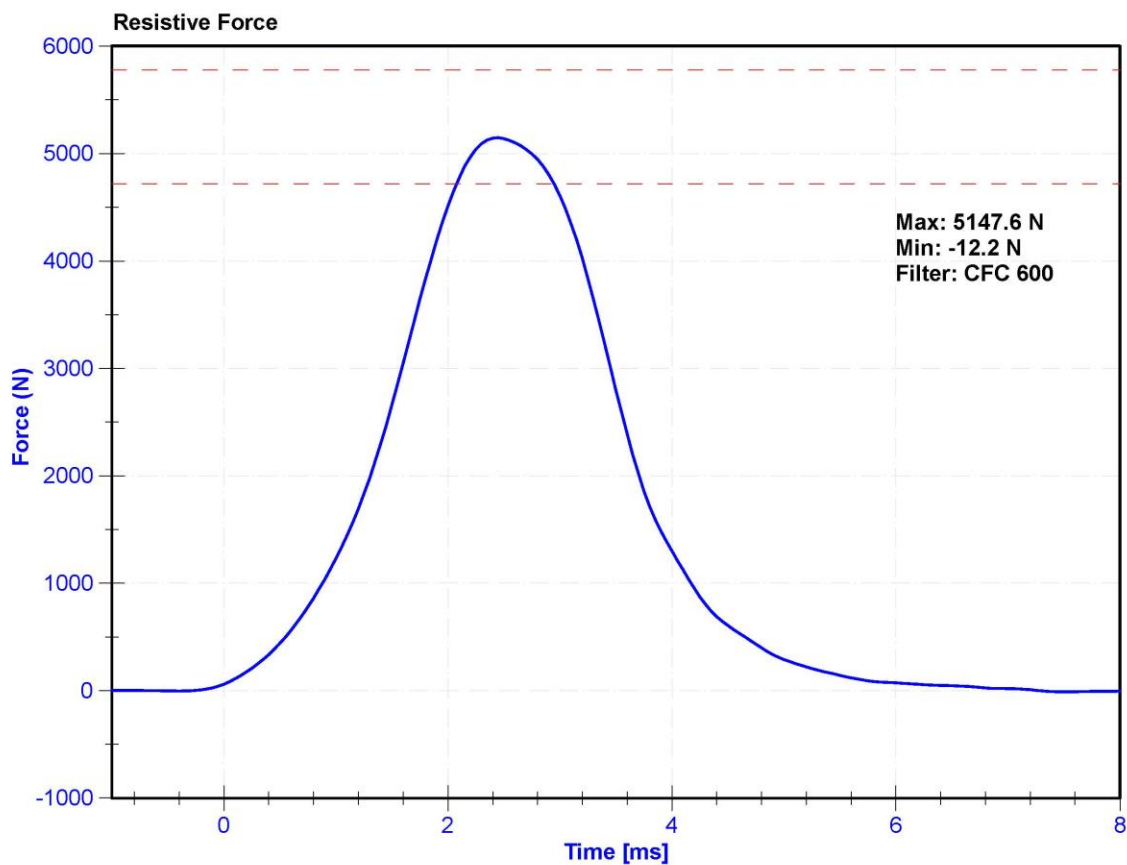
ATD Manufacturer	Humanetics	Test Technician	K. Dutton
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

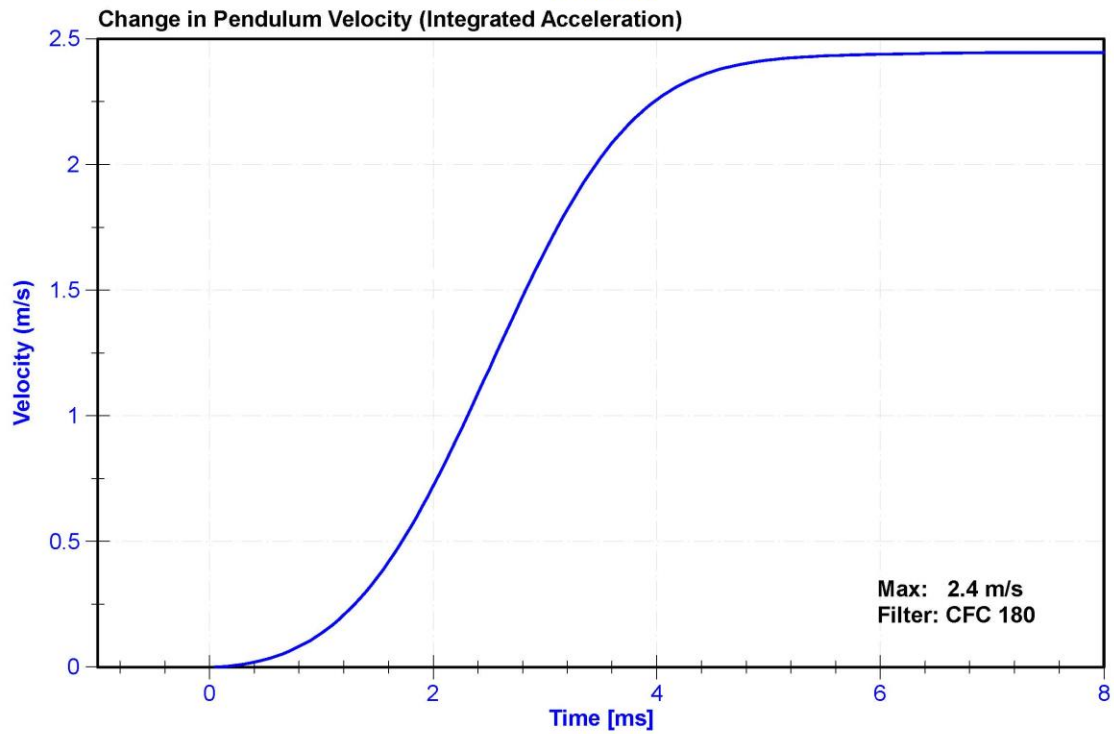
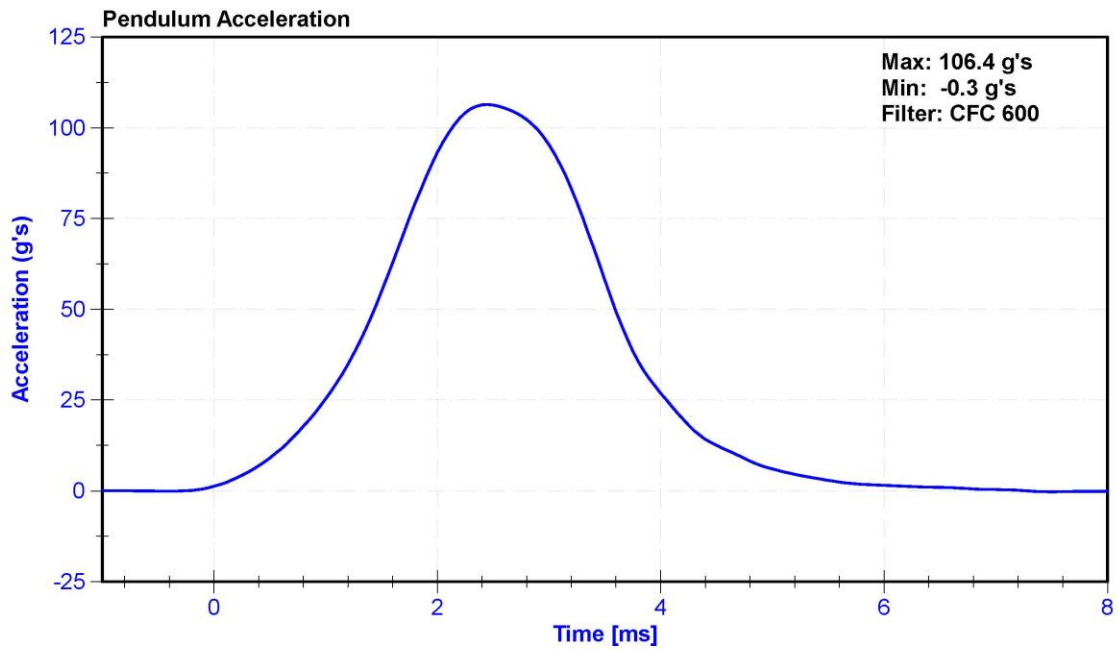
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	22	Pass
Humidity	10	70	%	18.5	Pass
Velocity	2.07	2.13	m/s	2.121	Pass
Maximum Resistive Force	4720	5780	N	5147.6	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7264CT	AC-P23904	11/1/2018	5/2/2019





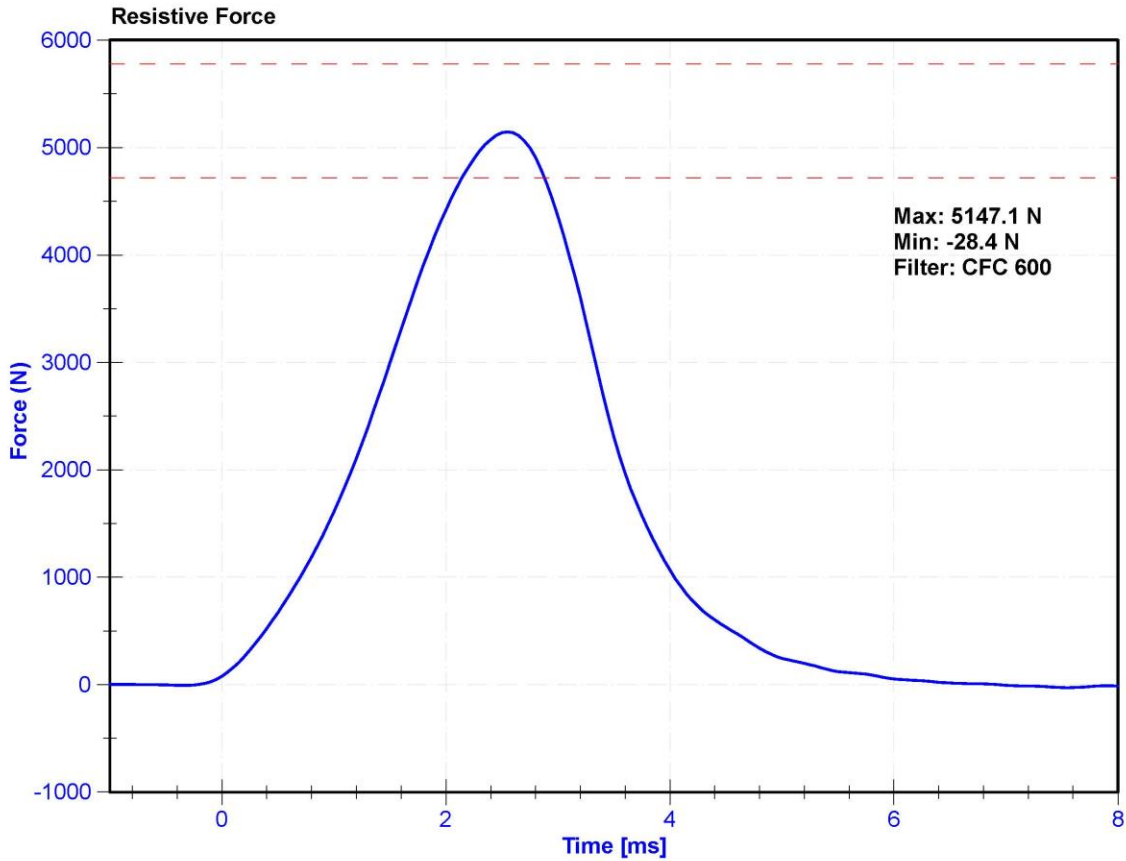
ATD Manufacturer	Humanetics	Test Technician	D.Reinhard
ATD Serial Number	142	Laboratory Supervisor	K.Brogan

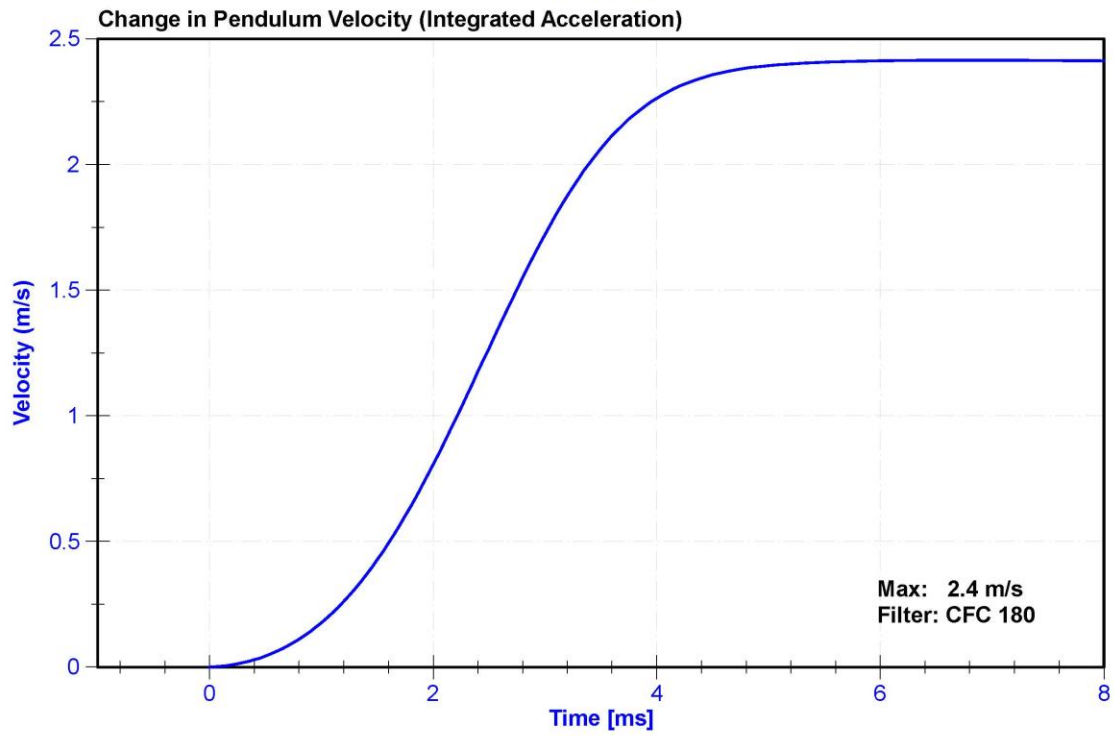
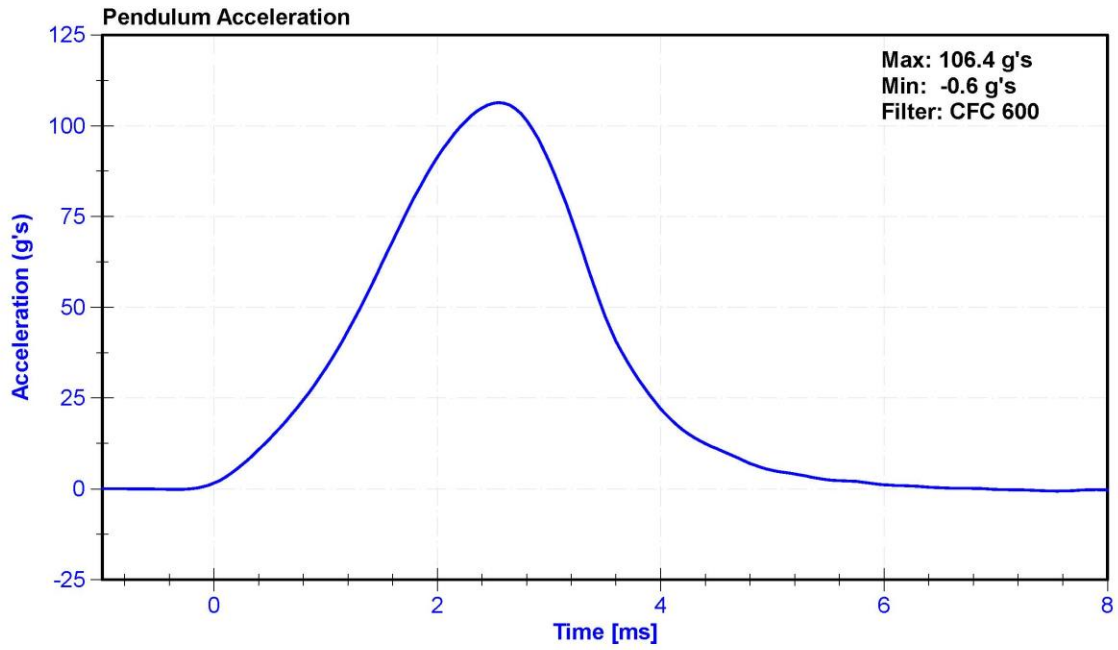
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	22	Pass
Humidity	10	70	%	18.7	Pass
Velocity	2.07	2.13	m/s	2.128	Pass
Maximum Resistive Force	4720	5780	N	5147.1	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7264CT	AC-P23904	11/1/2018	5/2/2019





CALIBRATION TEST RESULTS

PRE-TEST

HYBRID III 5TH PERCENTILE - PASSENGER ATD

SERIAL NO: 140

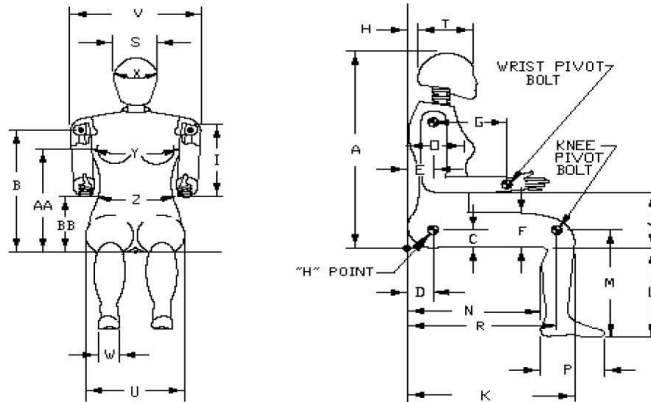


External Measurements - Hybrid 3 - 5th Female

Technician: K. Brogan

Date: 02/15/2019

Dummy Serial Number: 140



Symbol	Description	Specification (mm)		Result (mm)	Pass/Fail
A	Sitting Height	775	800	793	Pass
B	Shoulder Pivot Height	432	457	440	Pass
C	H-Point Height	81	86	83	Pass
D	H-Point from Backline	145	150	148	Pass
E	Shoulder Pivot from Backline	69	84	74	Pass
F	Thigh Clearance	119	135	127	Pass
G	Back of Elbow to Wrist Pivot	244	259	250	Pass
H	Head Back to Backline	43	48	46	Pass
I	Shoulder to Elbow Length	277	297	288	Pass
J	Elbow Rest Height	183	203	191	Pass
K	Buttock to Knee Length	521	546	535	Pass
L	Popliteal Height	356	376	368	Pass
M	Knee Pivot Height	394	419	405	Pass
N	Buttock Popliteal Length	414	439	428	Pass
O	Chest Depth without Jacket	175	191	182	Pass
P	Foot Length (right)	219	234	230	Pass
R	Buttock To Knee Pivot Length	457	483	466	Pass
S	Head Breadth	137	147	142	Pass
T	Head Depth	178	188	185	Pass
U	Hip Breadth	300	315	310	Pass
V	Shoulder Breadth	351	366	360	Pass
W	Foot Breadth	79	94	85	Pass
X	Head Circumference	528	549	534	Pass
Y	Chest Circumference with Jacket	851	881	872	Pass
Z	Waist Circumference	460	490	463	Pass
AA	Reference Location (Chest Circumference)	333	358	345	Pass
BB	Reference Location (Waist Circumference)	160	170	165	Pass

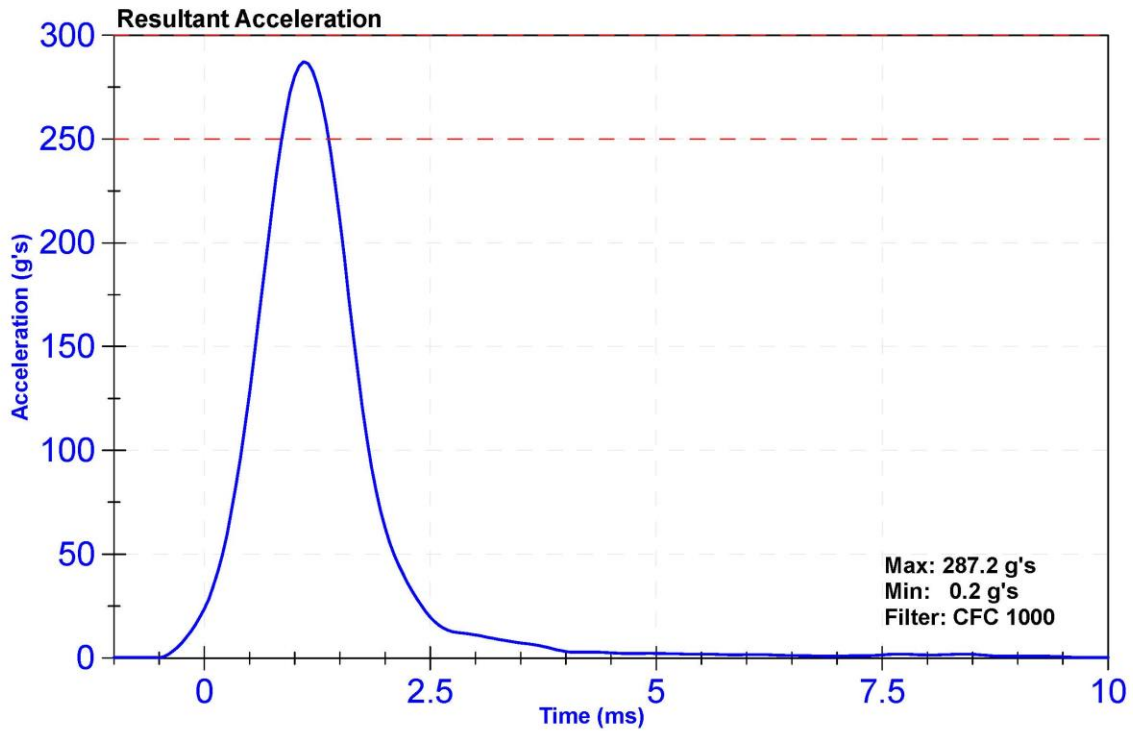
ATD Manufacturer	Humanetics	Test Technician	K. Dutton
ATD Serial Number	140	Laboratory Supervisor	K. Brogan

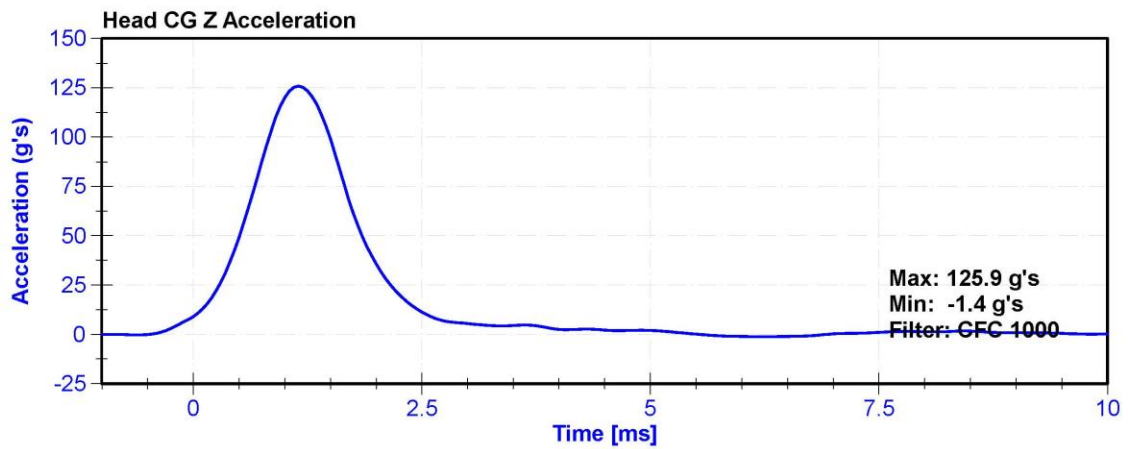
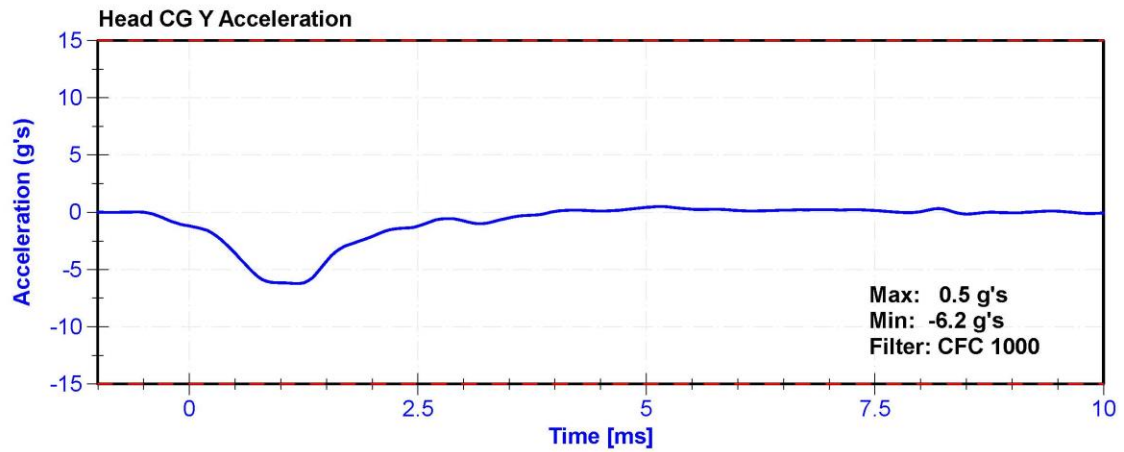
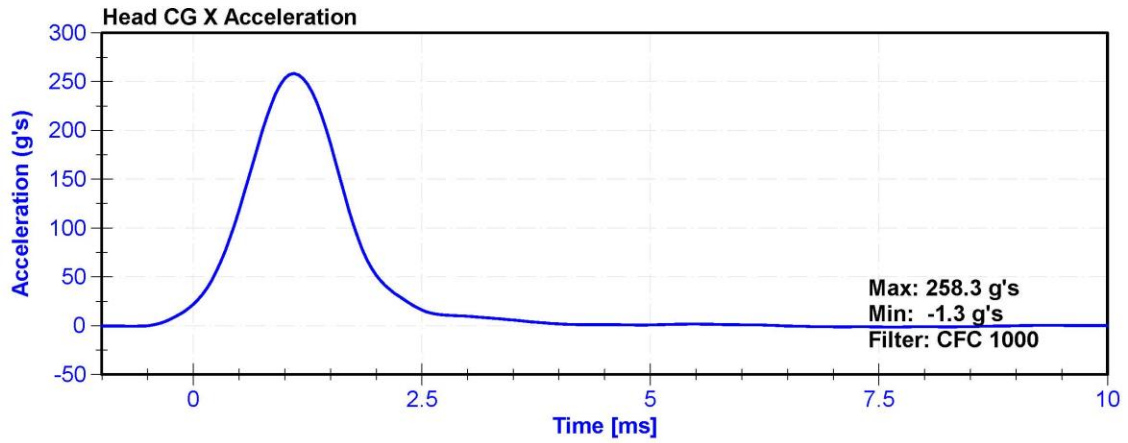
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	22	Pass
Humidity	10	70	%	19.9	Pass
Resultant Acceleration	250	300	g's	287.2	Pass
Oscillation	0	10	%	1.0	Pass
Lateral Acceleration	-15	15	g's	-6.2	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	ENDEVCO 7264CT	AC-P58871	10/26/2018	4/26/2019
Y Accelerometer	ENDEVCO 7264	AC-P12359	10/26/2018	4/26/2019
Z Accelerometer	ENDEVCO 7264CT	AC-P58880	10/26/2018	4/26/2019





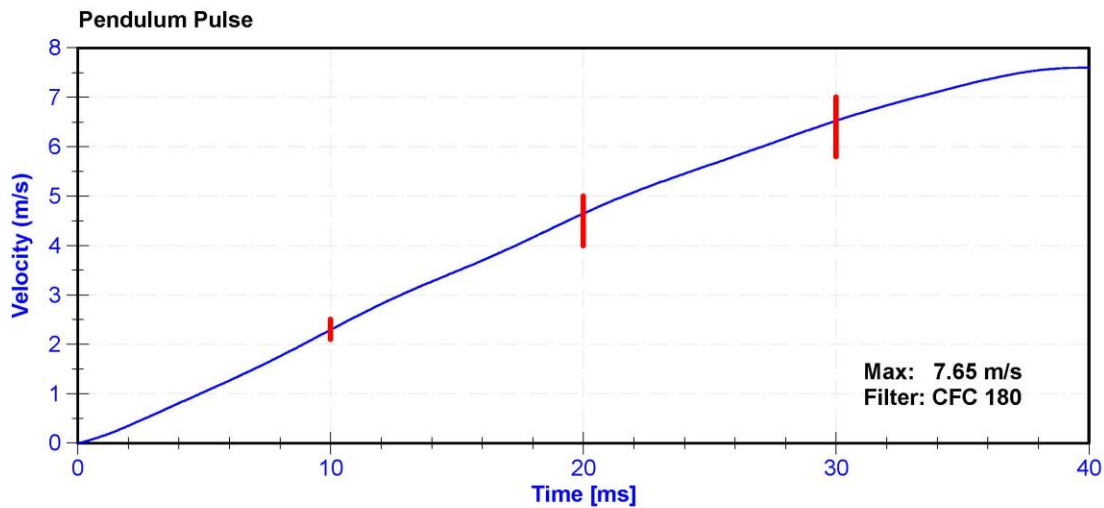
ATD Manufacturer	Humanetics	Test Technician	C. Mantell
ATD Serial Number	140	Laboratory Supervisor	K.Brogan

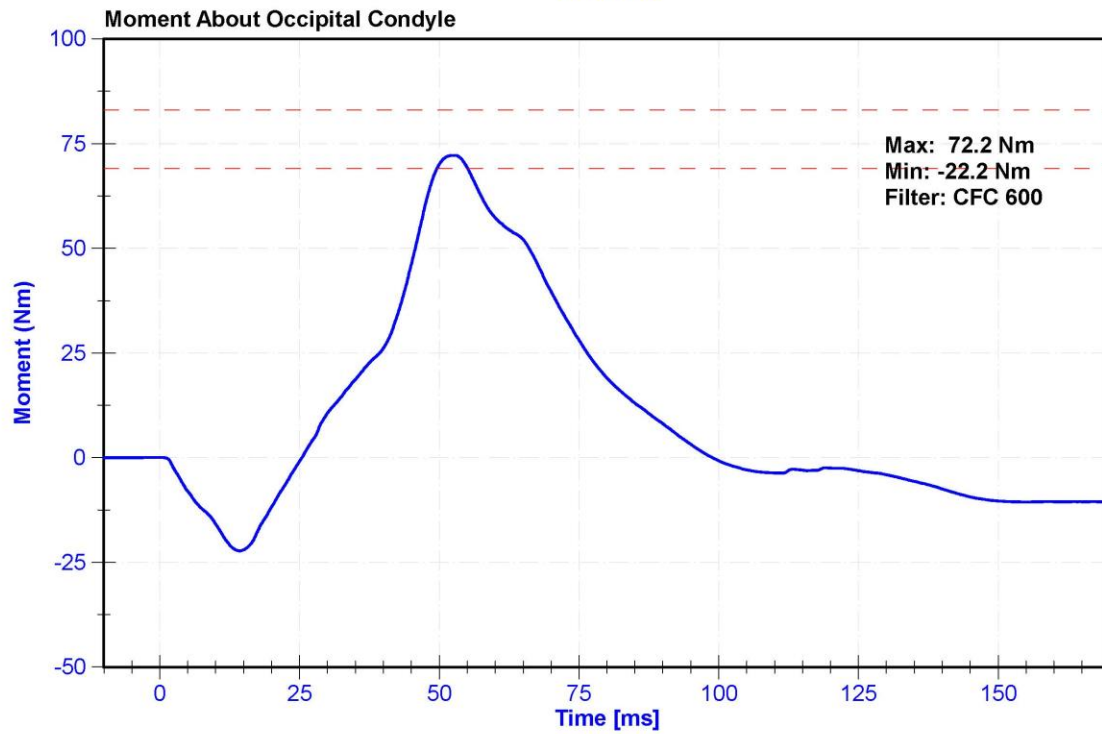
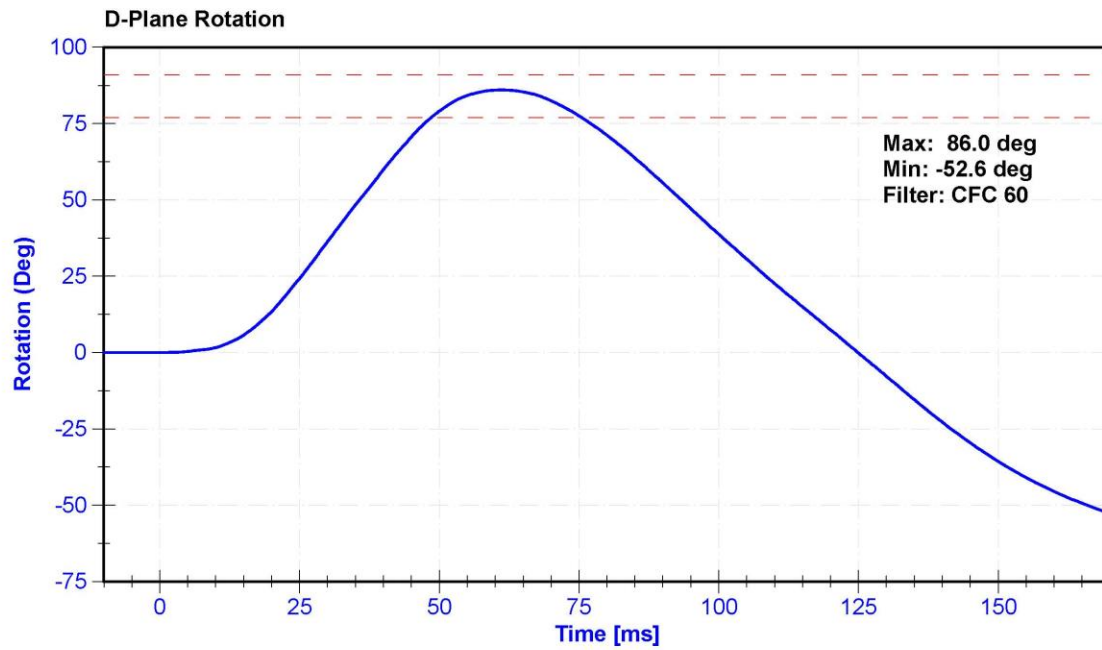
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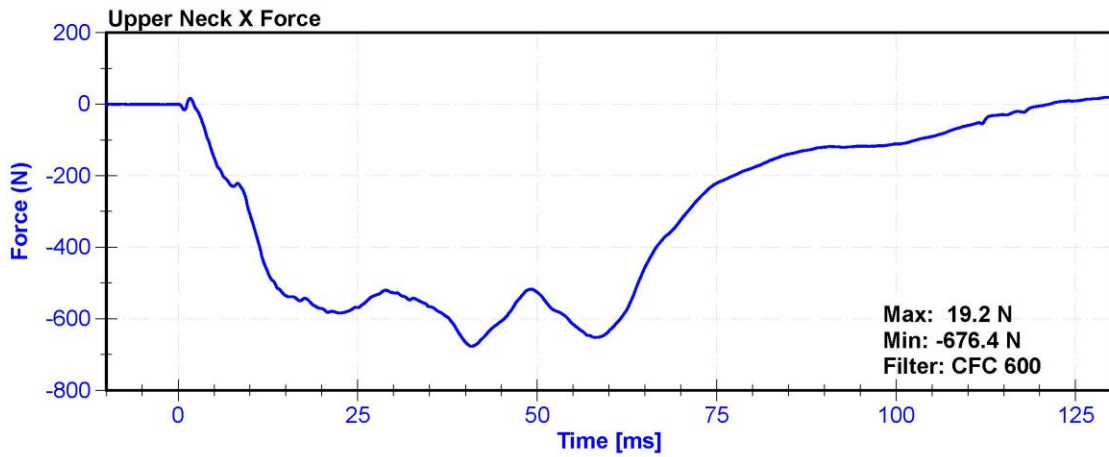
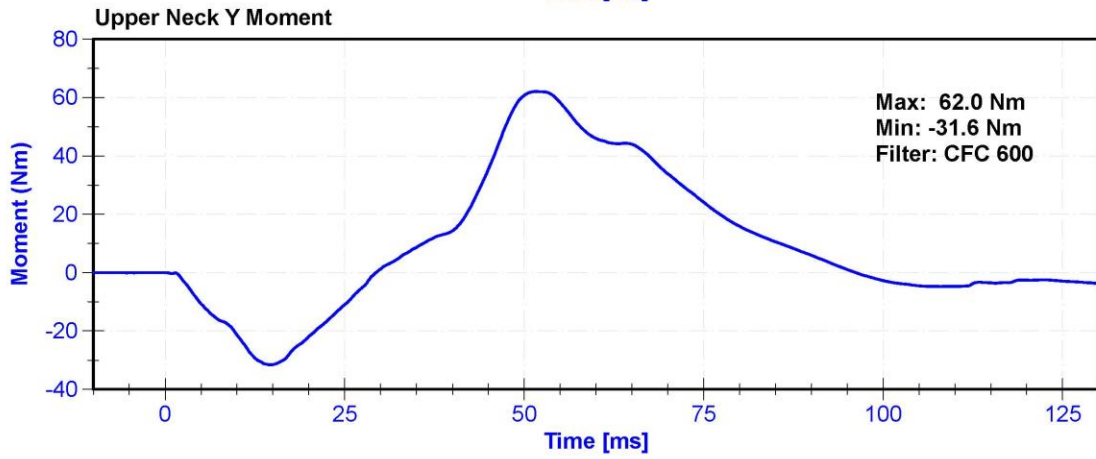
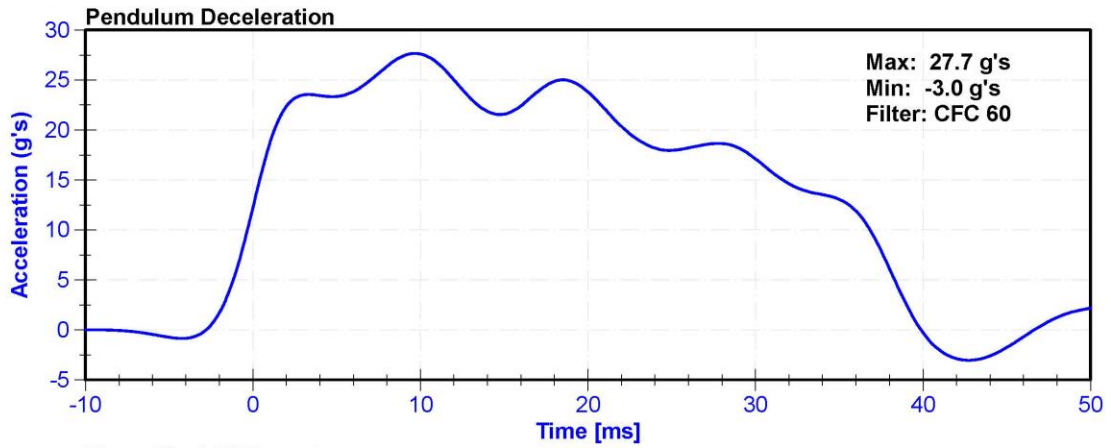
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.2	Pass
Humidity	10	70	%	22.8	Pass
Velocity	6.89	7.13	m/s	7.127	Pass
Pendulum Impulse at 10ms	2.1	2.5	m/s	2.29	Pass
Pendulum Impulse at 20ms	4.0	5.0	m/s	4.65	Pass
Pendulum Impulse at 30ms	5.8	7.0	m/s	6.53	Pass
Max D Plane Rotation	77	91	deg	86.0	Pass
Max Moment During Rotation Interval	69	83	Nm	72.2	Pass
Moment Decay to 10.0 Nm	80	100	ms	88.1	Pass

Transducer Calibrations

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







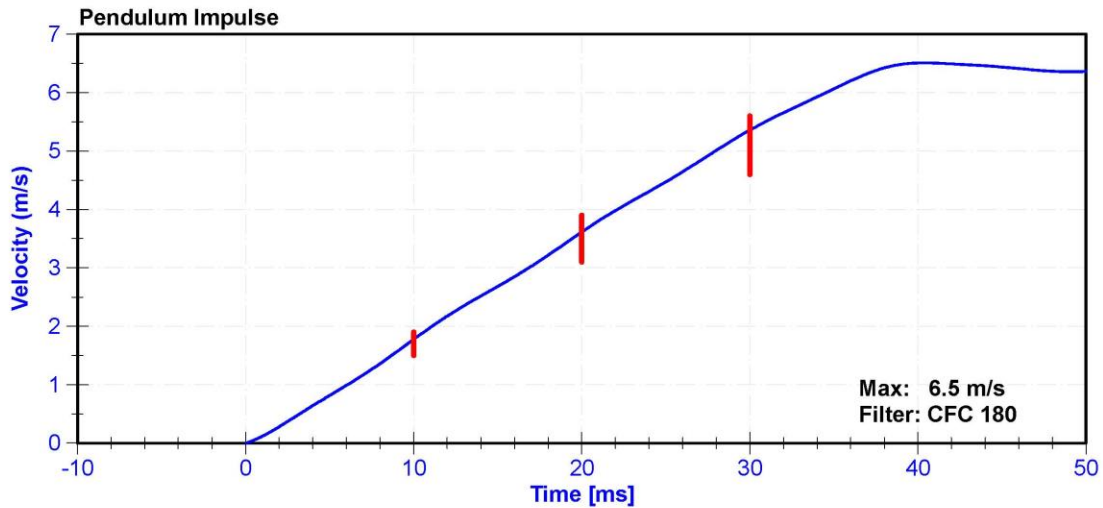
ATD Manufacturer	Humanetics	Test Technician	C. Mantell
ATD Serial Number	140	Laboratory Supervisor	K.Brogan

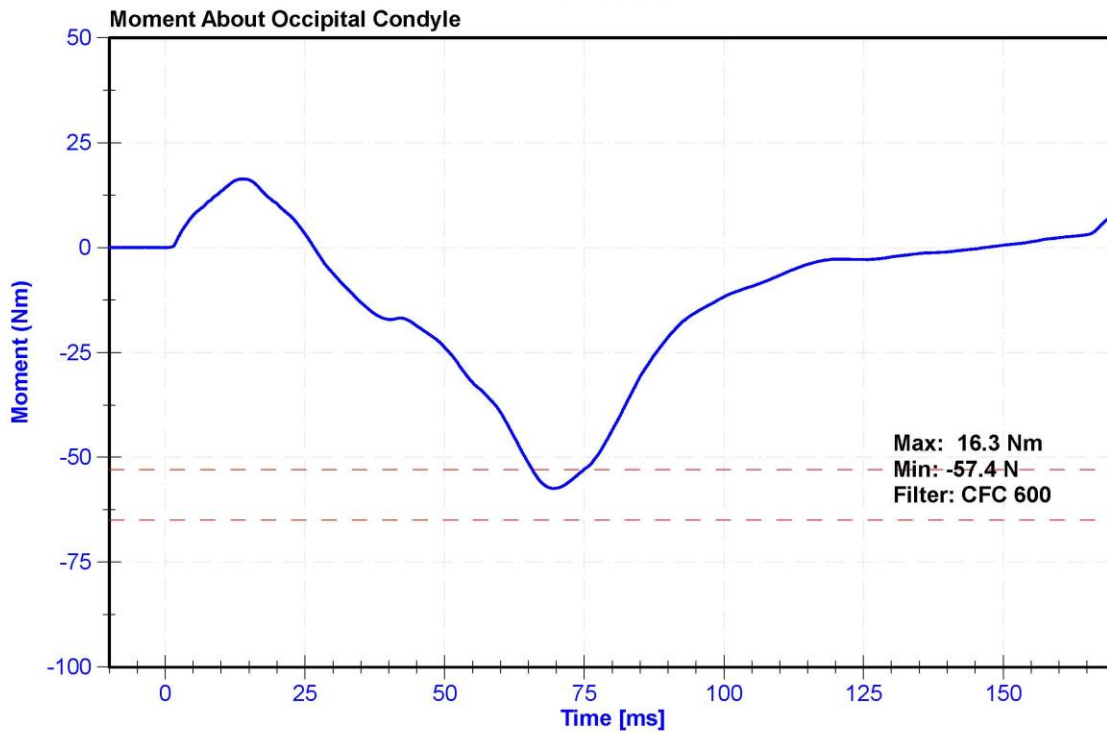
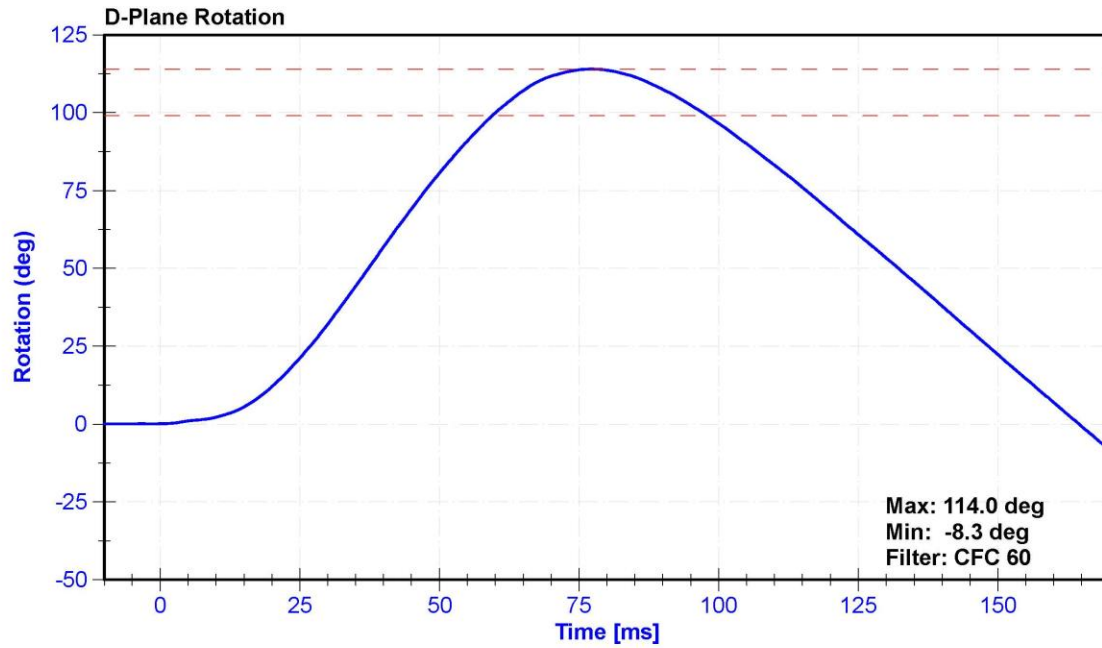
Results

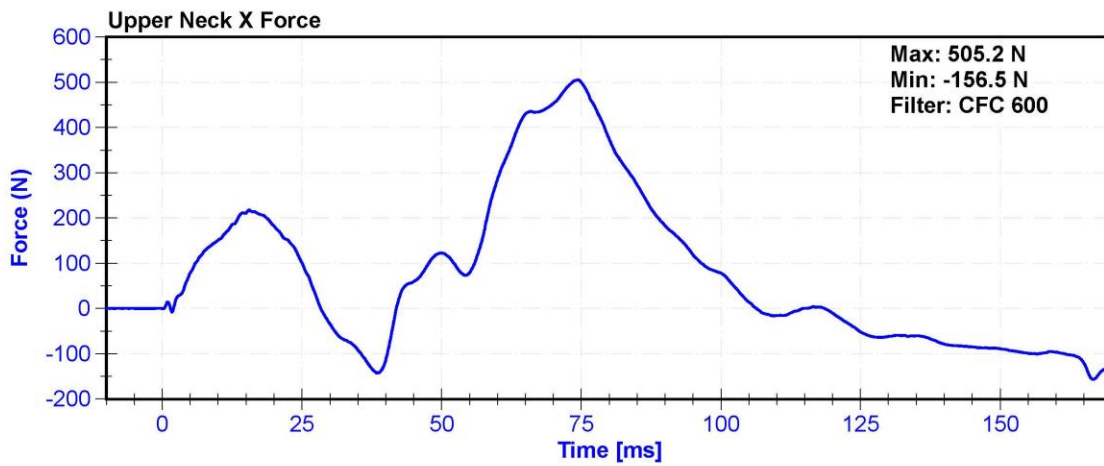
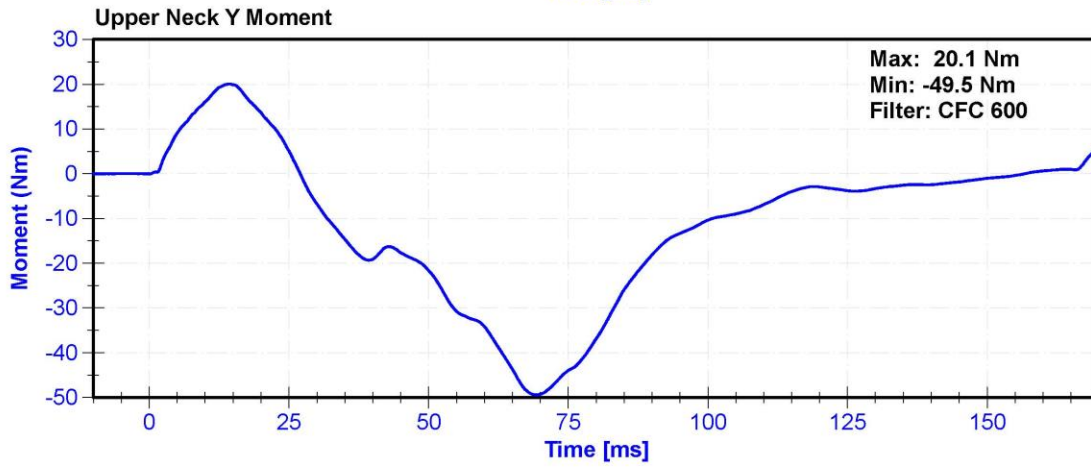
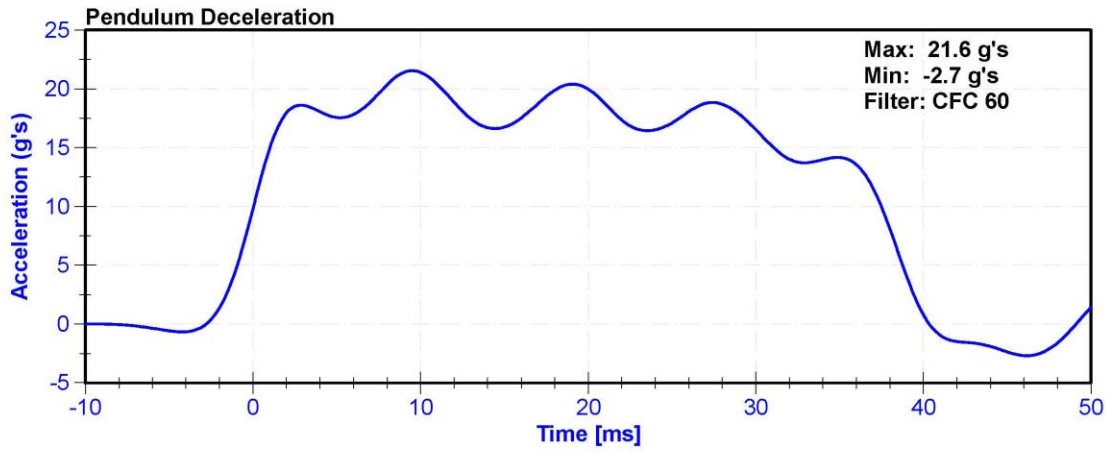
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.7	Pass
Humidity	10	70	%	32.0	Pass
Velocity	5.95	6.19	m/s	6.046	Pass
Pendulum Impulse at 10ms	1.5	1.9	m/s	1.78	Pass
Pendulum Impulse at 20ms	3.1	3.9	m/s	3.61	Pass
Pendulum Impulse at 30ms	4.6	5.6	m/s	5.36	Pass
D Plane Rotation	99	114	deg	114.0	Pass
Moment During Rotation Interval	-65	-53	Nm	-57.4	Pass
Moment Decay to -10Nm	94	114	ms	103.3	Pass

Transducer Calibrations

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







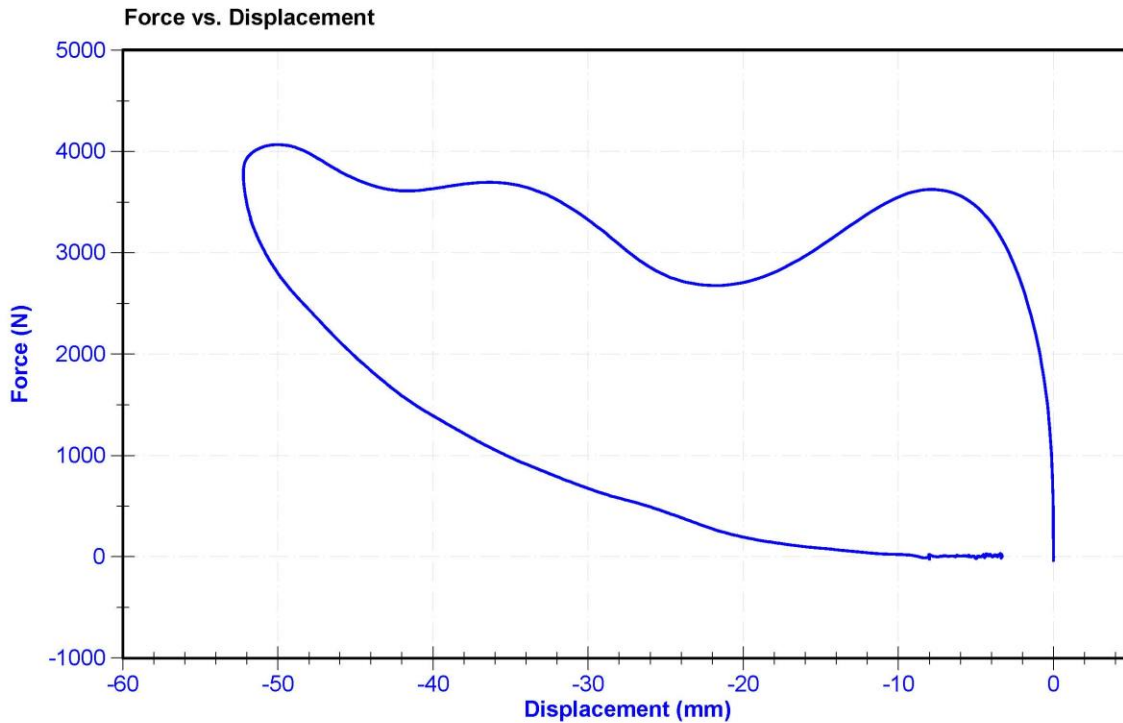
ATD Manufacturer	Humanetics	Test Technician	C. Mantell
ATD Serial Number	140	Laboratory Supervisor	K. Brogan

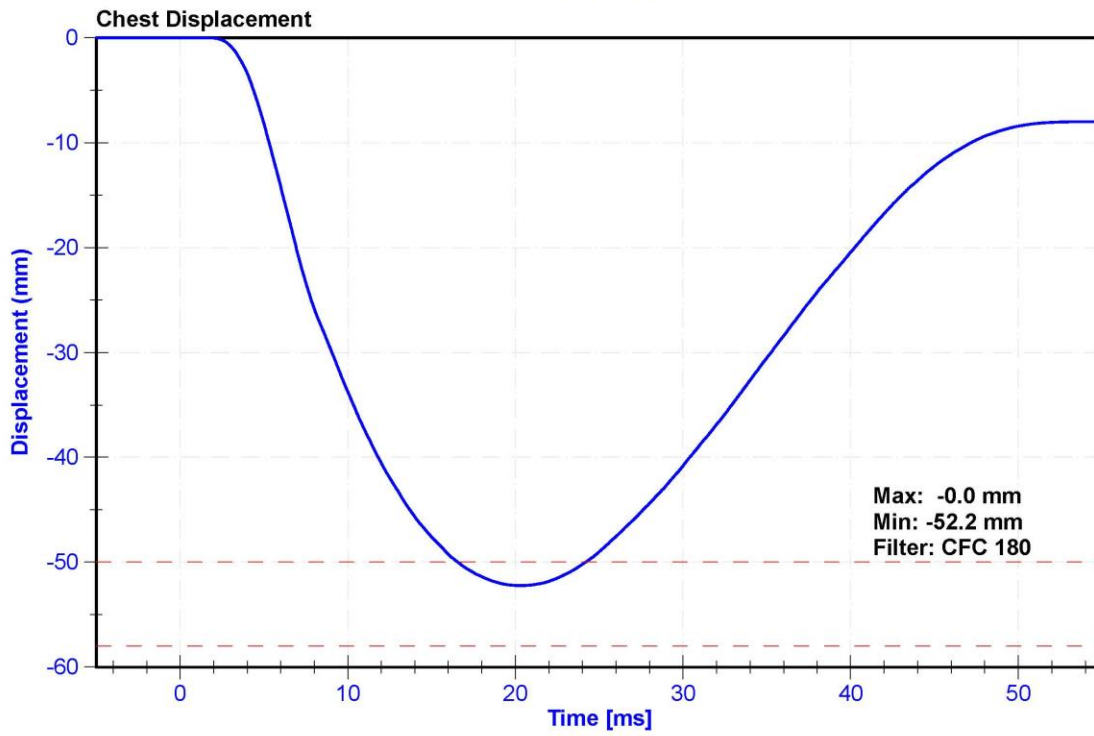
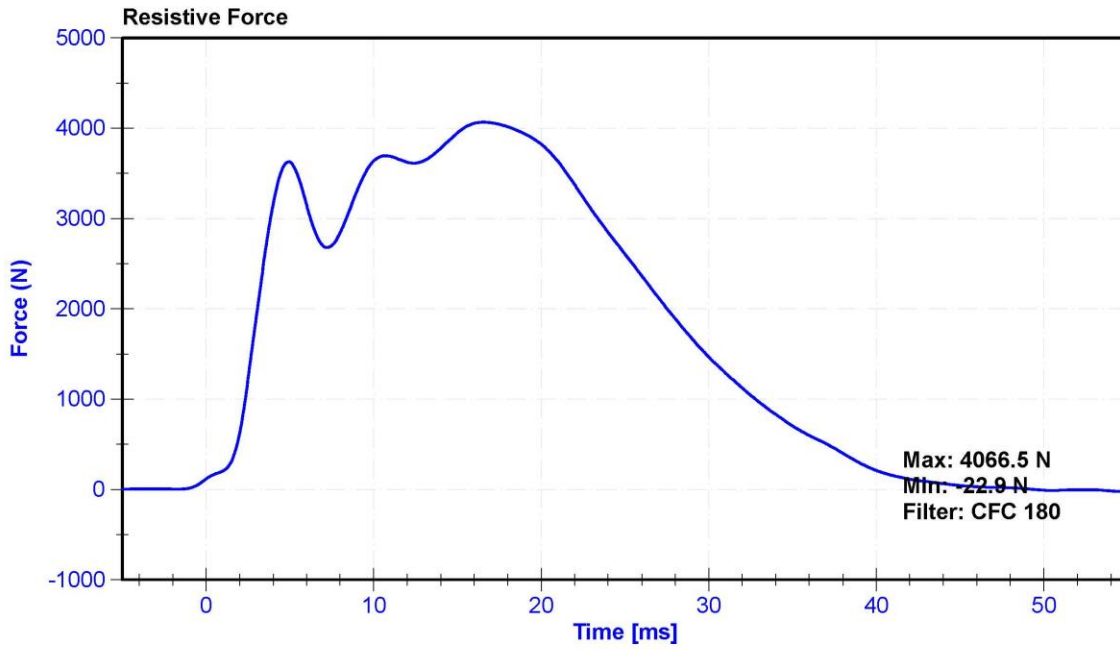
Results

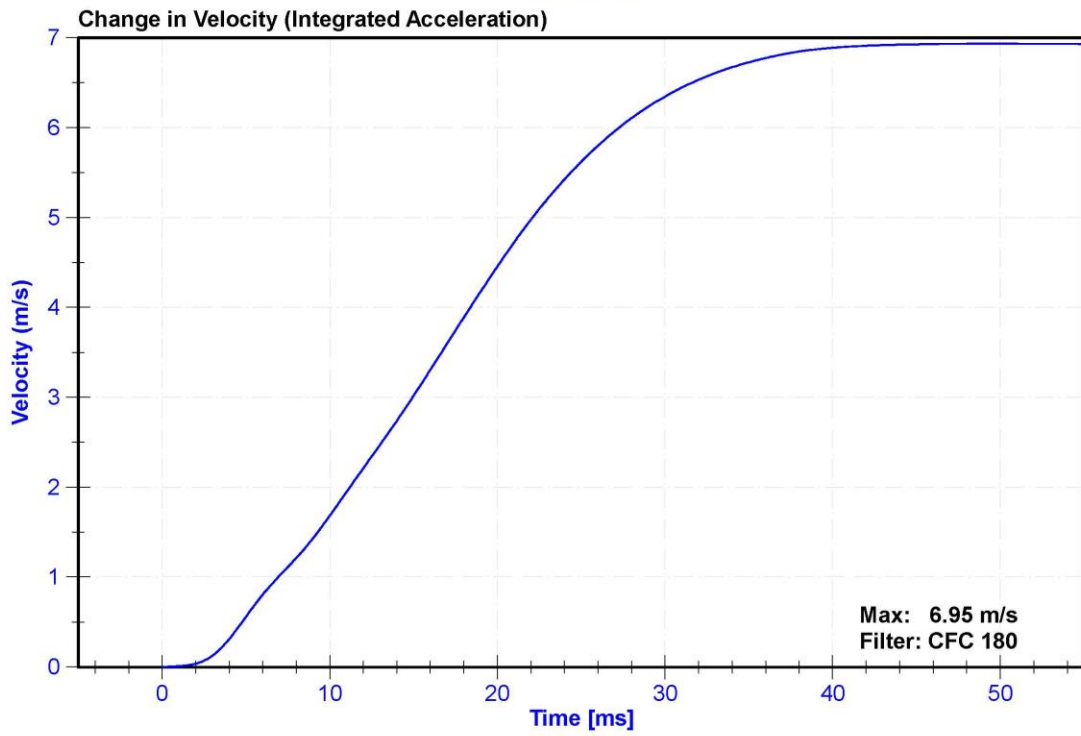
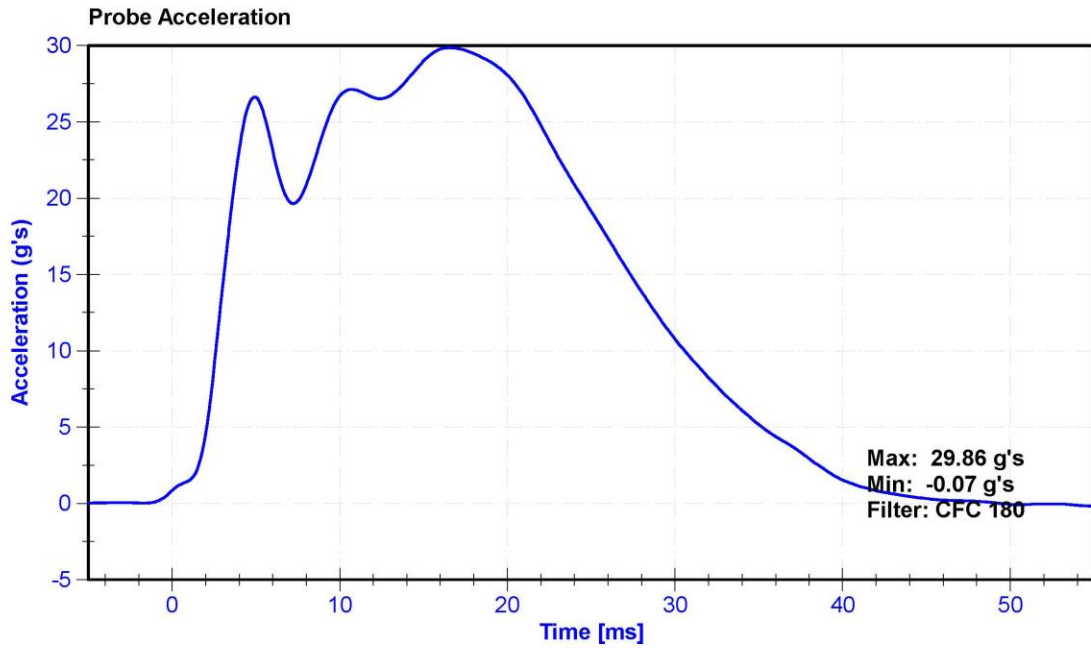
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	22	Pass
Humidity	10	70	%	25.8	Pass
Velocity	6.59	6.83	m/s	6.773	Pass
Chest Deflection	-58	-50	mm	-52.2	Pass
Maximum Resistive Force (50 to 58mm)	3900	4400	N	4066.5	Pass
Maximum Resistive Force (18 to 50mm)	0	4600	N	4066.5	Pass
Hysteresis	69	85	%	75.6	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco 7264C	AC-P94667	11/1/2018	11/1/2019
Chest Potentiometer	SERVO 14CBI-3615	DS-140GFE	11/7/2018	11/7/2019







ATD Manufacturer	Humanetics	Test Technician	C. Mantell
ATD Serial Number	140	Laboratory Supervisor	K. Brogan

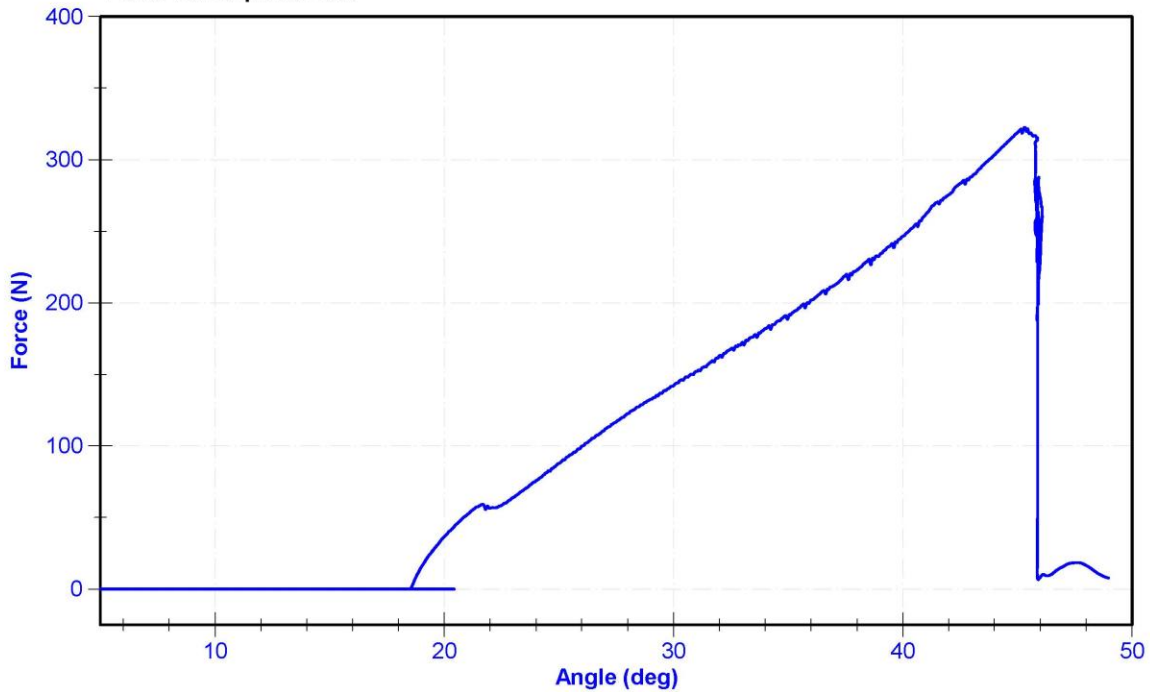
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.6	25.6	°C	21.3	Pass
Humidity	10	70	%	32.2	Pass
Initial Angle	0	20	deg	18.5	Pass
Force at 45 Degrees	320	390	N	322.7	Pass
Return Angle Relative to Initial	0	8	deg	5.2	Pass

Transducer Calibrations

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

Force vs. Displacement



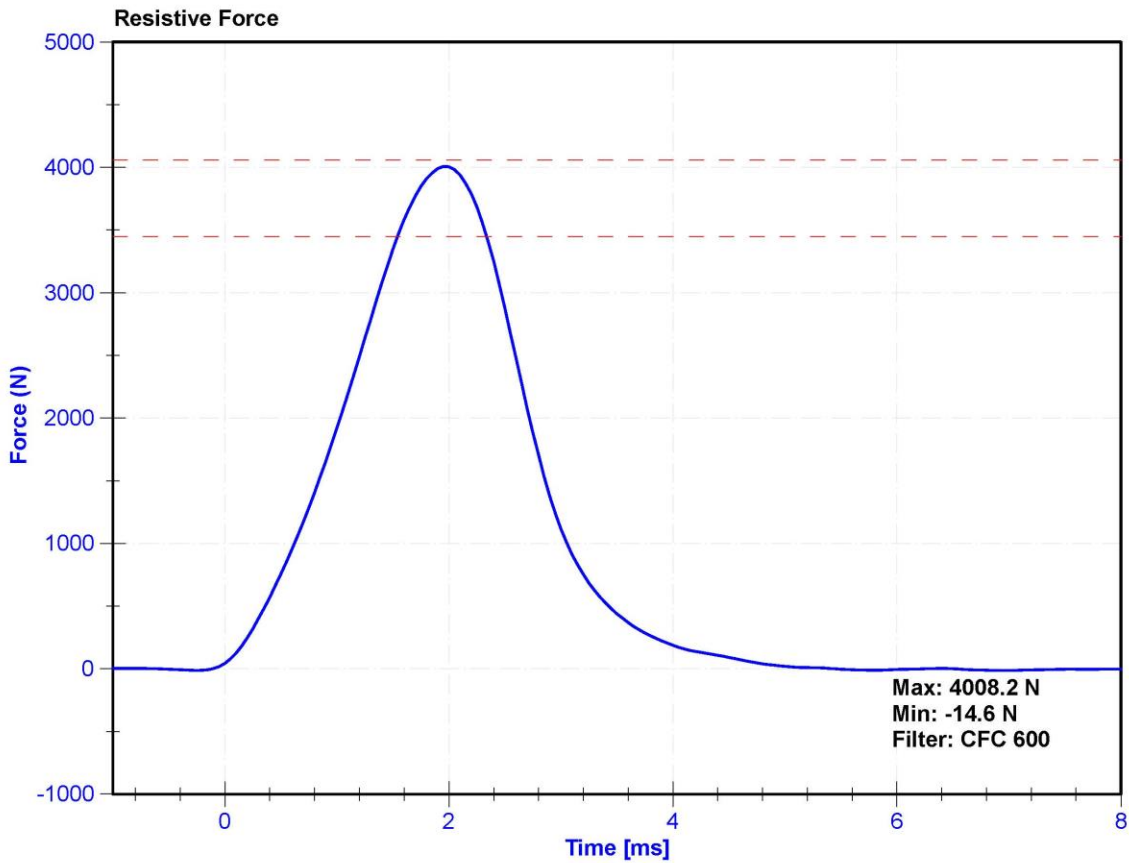
ATD Manufacturer	Humanetics	Test Technician	K. Dutton
ATD Serial Number	140	Laboratory Supervisor	K. Brogan

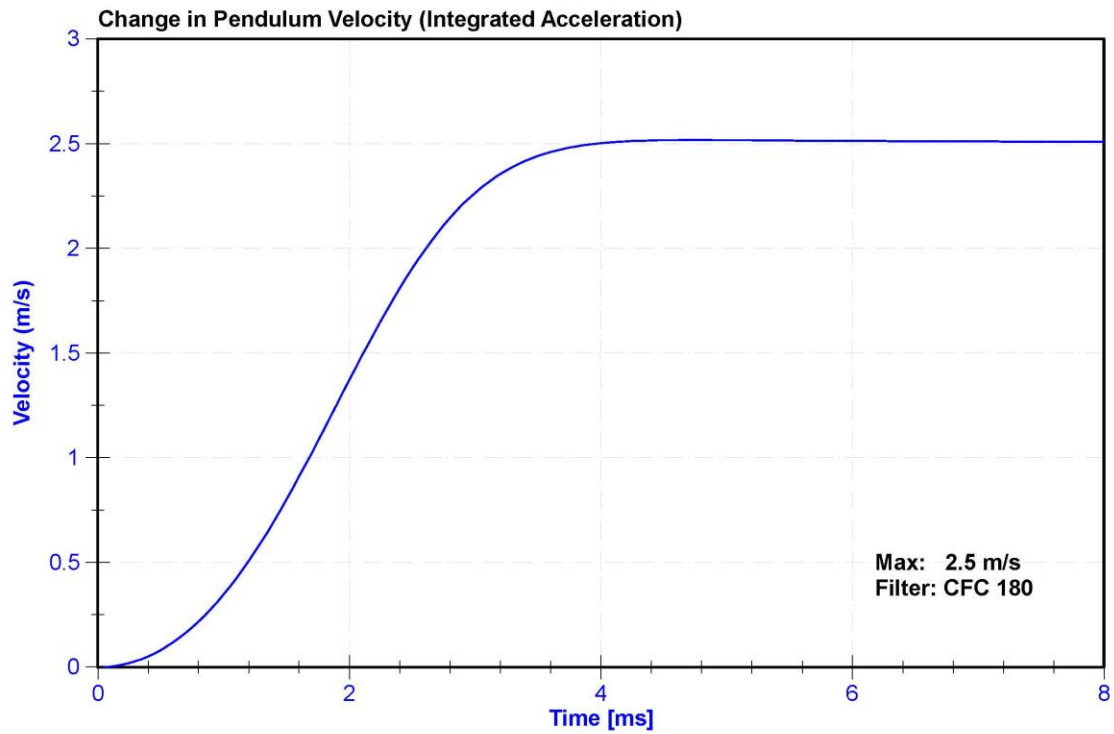
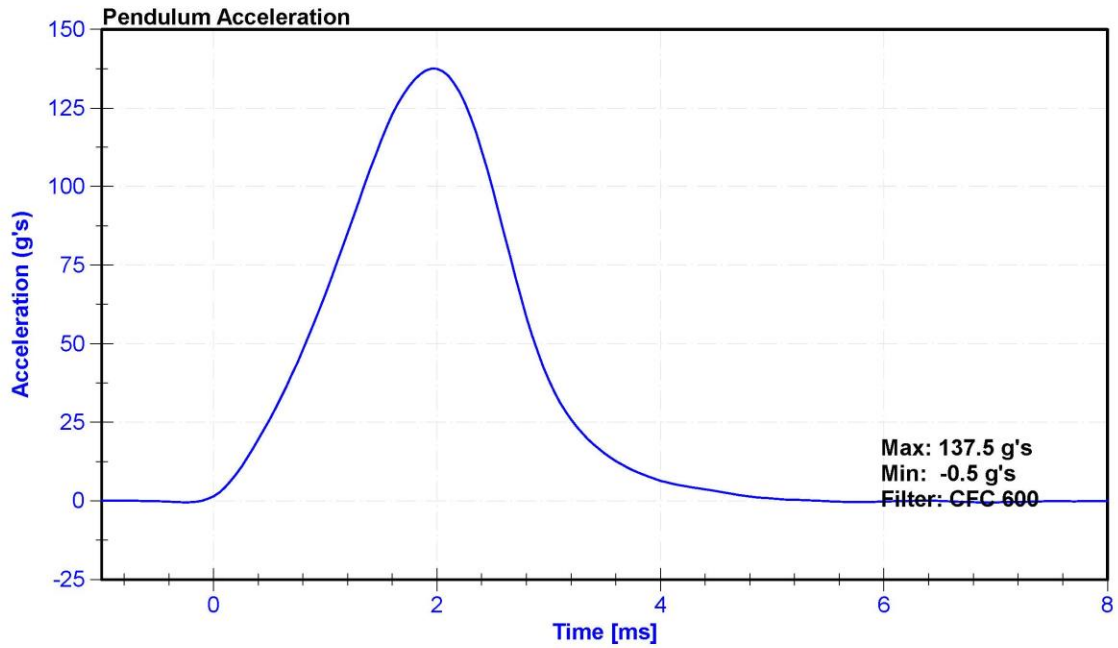
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	21.4	Pass
Humidity	10	70	%	31.7	Pass
Velocity	2.07	2.13	m/s	2.111	Pass
Resistive Force	3450	4060	N	4008.2	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7264CT	AC-P23904	11/1/2018	5/2/2019





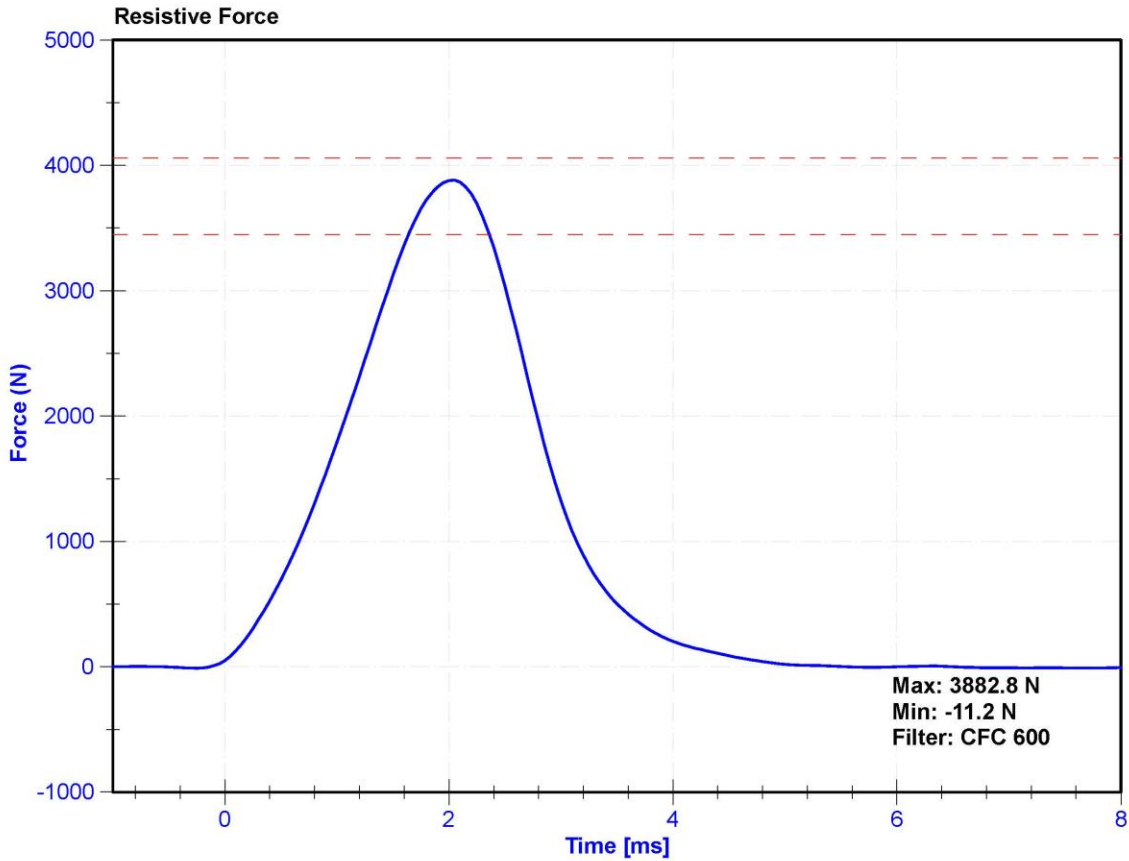
ATD Manufacturer	Humanetics	Test Technician	K. Dutton
ATD Serial Number	140	Laboratory Supervisor	K. Brogan

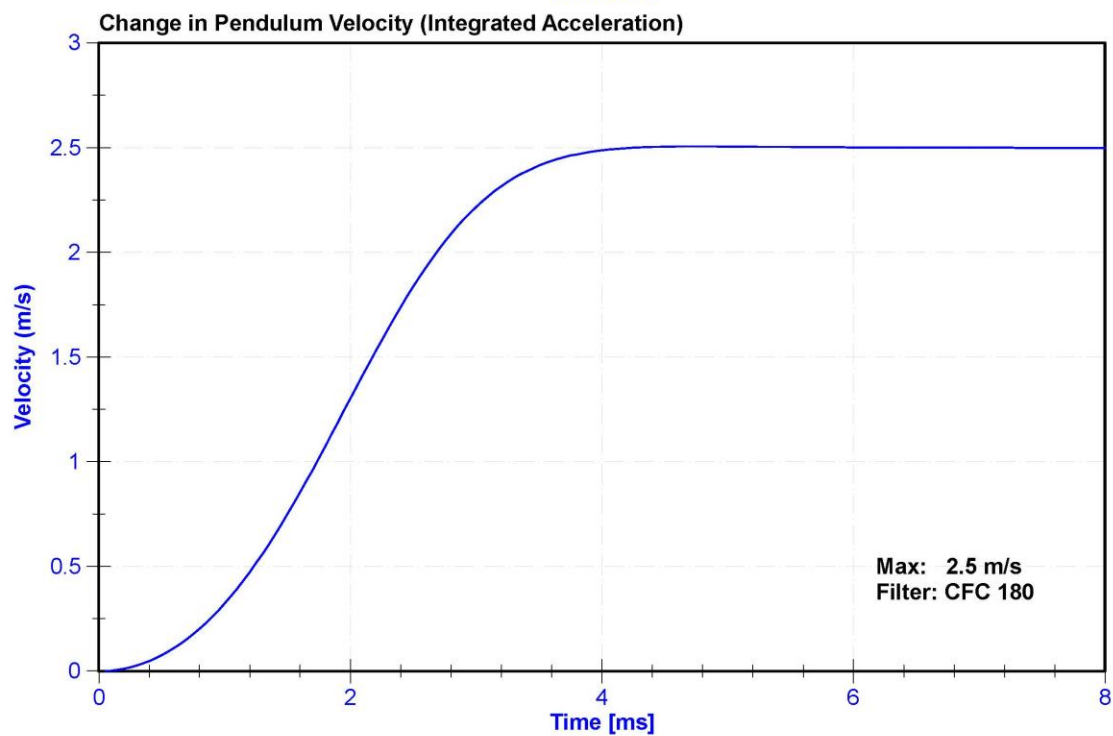
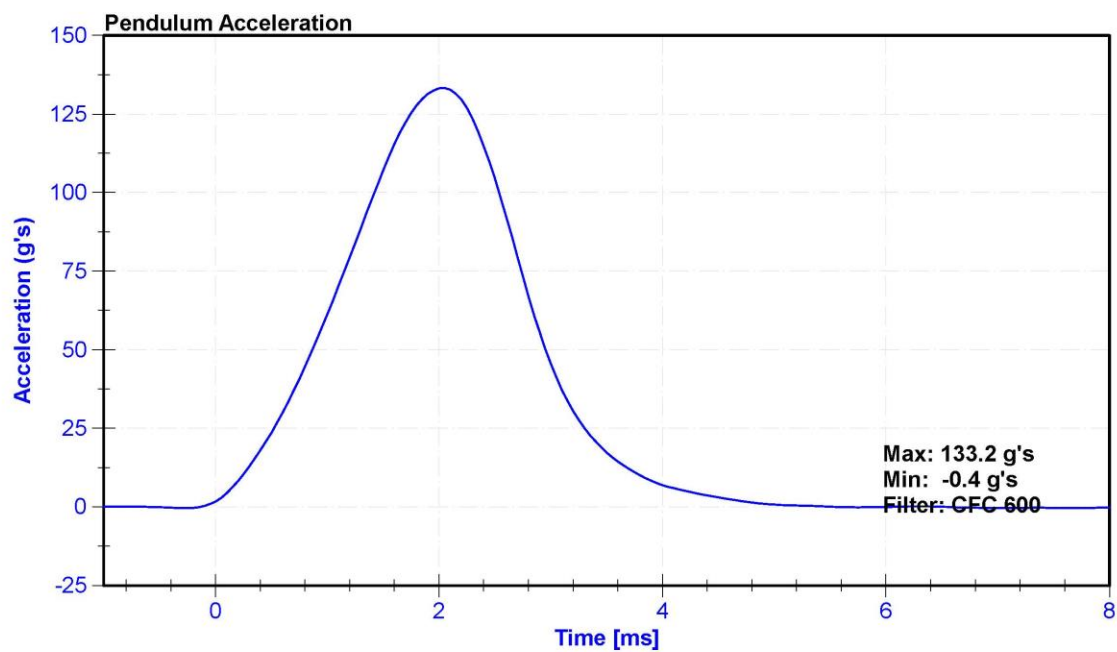
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	21.0	Pass
Humidity	10	70	%	32.5	Pass
Velocity	2.07	2.13	m/s	2.096	Pass
Resistive Force	3450	4060	N	3882.8	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7264CT	AC-P23904	11/1/2018	5/2/2019





CALIBRATION TEST RESULTS

POST-TEST

HYBRID III 50TH PERCENTILE MALE - DRIVER ATD

SERIAL NO: 142

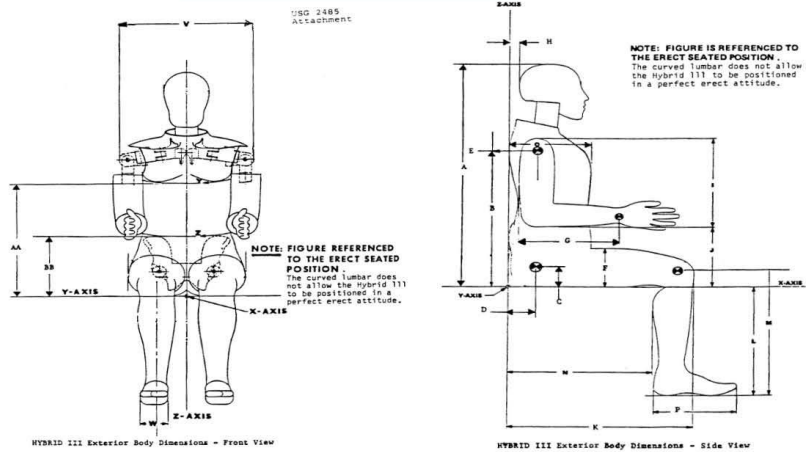


External Measurements - Hybrid 3 - 50th Male

Technician: K. Dutton

Date: 03/12/2019

Dummy Serial Number: 142



Symbol	Description	Specification (in)		Result (in)	Pass/Fail
A	Sitting Height	34.6	35.0	34.8	Pass
B	Shoulder Pivot Height	19.9	20.5	20.2	Pass
C	H-Point Height	3.3	3.5	3.4	Pass
D	H-Point from Backline	5.3	5.5	5.4	Pass
E	Shoulder Pivot from Backline	3.3	3.7	3.5	Pass
F	Thigh Clearance	5.5	6.1	5.8	Pass
G	Back of Elbow to Wrist Pivot	11.4	12.0	11.8	Pass
H	Head Back to Backline	1.6	1.8	1.7	Pass
I	Shoulder to Elbow Length	13.0	13.6	13.4	Pass
J	Elbow Rest Height	7.5	8.3	8.0	Pass
K	Buttock to Knee Length	22.8	23.8	23.1	Pass
L	Popliteal Height	16.9	17.9	17.3	Pass
M	Knee Pivot Height	19.1	19.7	19.4	Pass
N	Buttock Popliteal Length	17.8	18.8	18.4	Pass
O	Chest Depth without Jacket	8.4	9.0	8.7	Pass
P	Foot Length (right)	9.9	10.5	10.3	Pass
V	Shoulder Breadth	16.3	17.2	16.7	Pass
W	Foot Breadth	3.6	4.2	3.9	Pass
Y	Chest Circumference with Jacket	38.2	39.4	38.9	Pass
Z	Waist Circumference	32.9	34.1	33.7	Pass
AA	Reference Location (Chest Circumference)	16.9	17.1	17.0	Pass
BB	Reference Location (Waist Circumference)	8.9	9.1	9.0	Pass

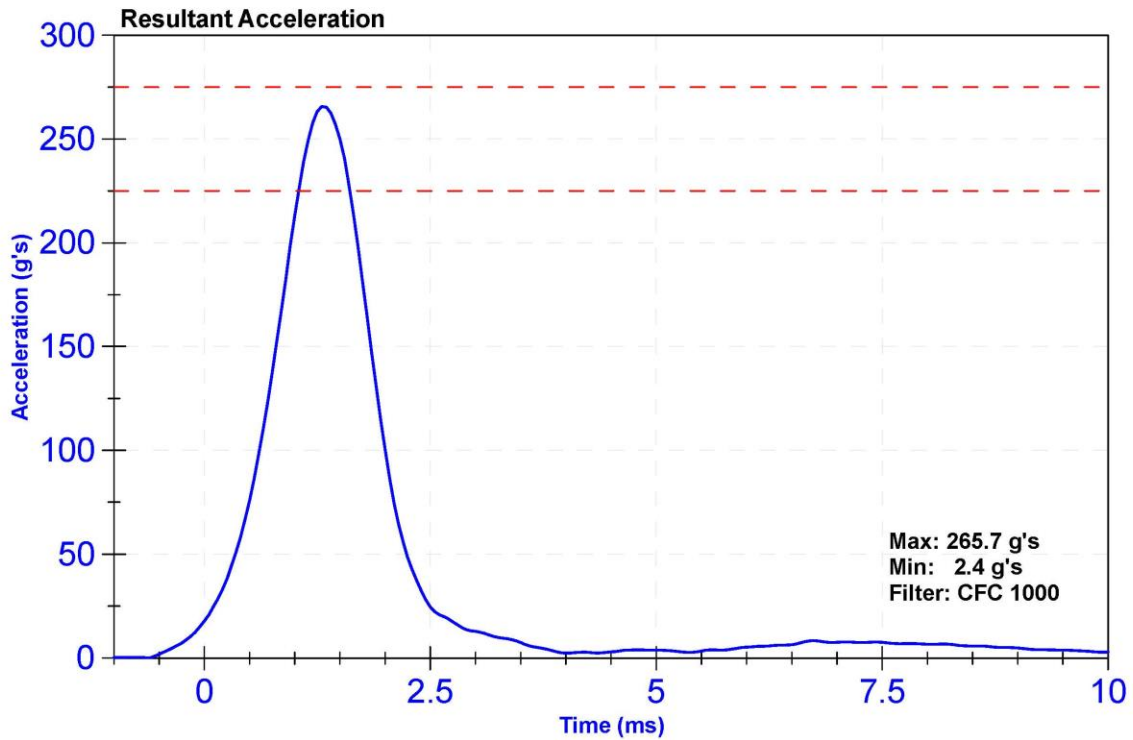
ATD Manufacturer	Humanetics	Test Technician	K. Dutton
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

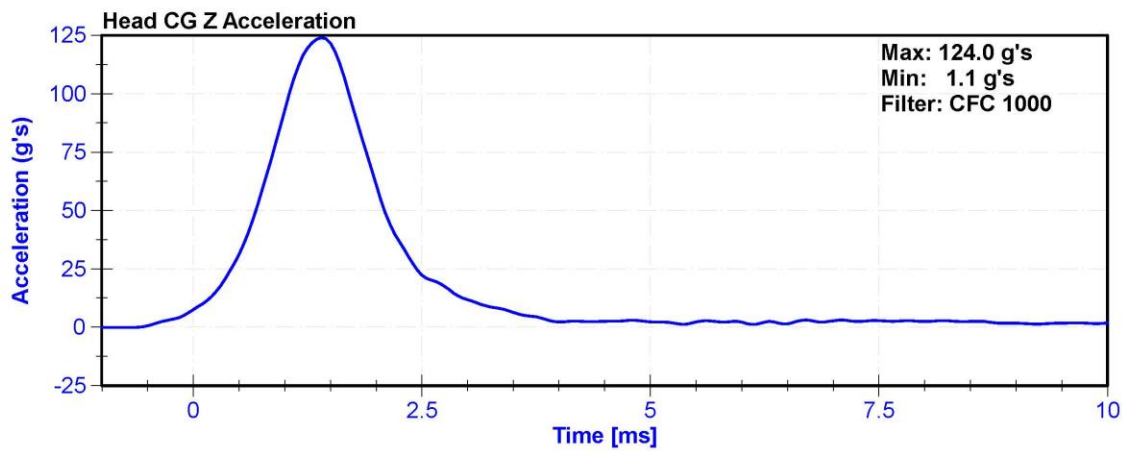
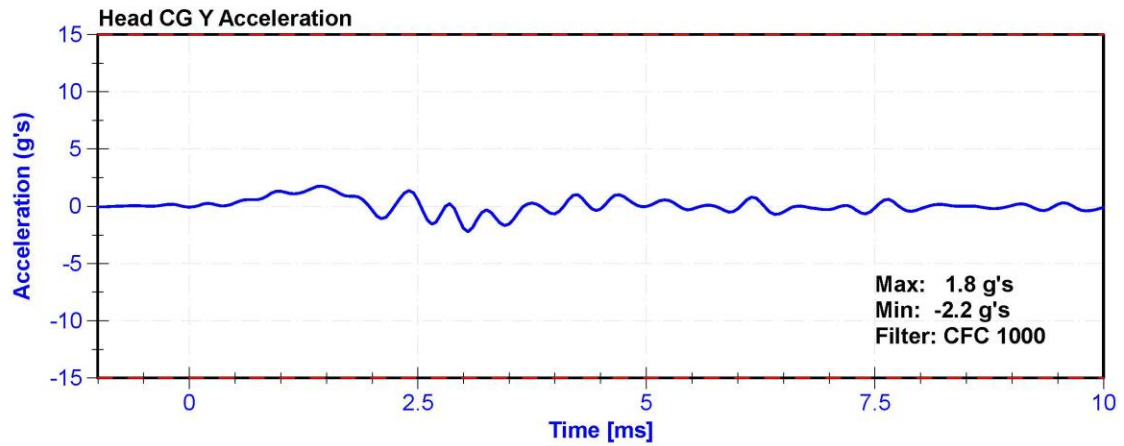
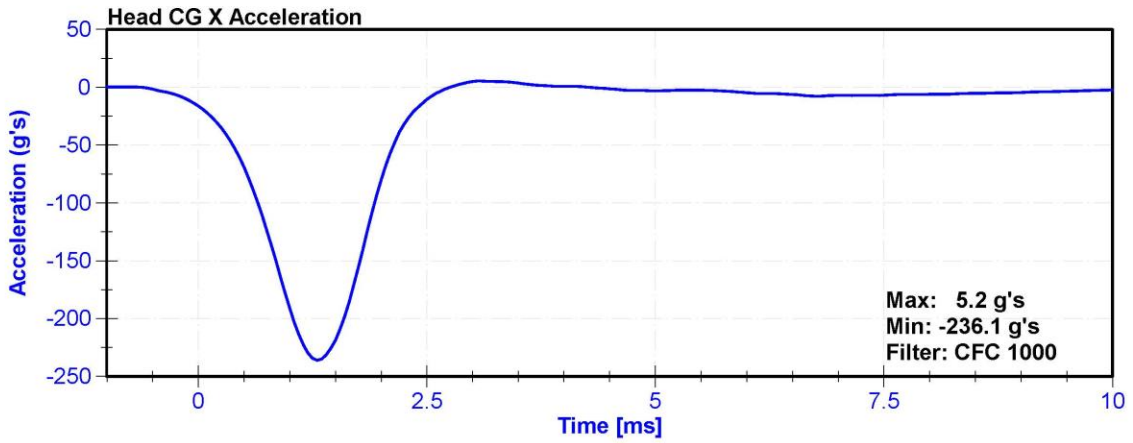
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	22.0	Pass
Humidity	10	70	%	37.0	Pass
Resultant Acceleration	225	275	g's	265.7	Pass
Oscillation	0	10	%	3.1	Pass
Lateral Acceleration	-15	15	g's	-2.9	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	ENDEVCO 7264CT	AC-P58998	10/5/2018	4/5/2019
Y Accelerometer	ENDEVCO 7264CT	AC-P51722	10/25/2018	4/25/2019
Z Accelerometer	ENDEVCO 7264CT	AC-P58997	10/6/2018	4/6/2019





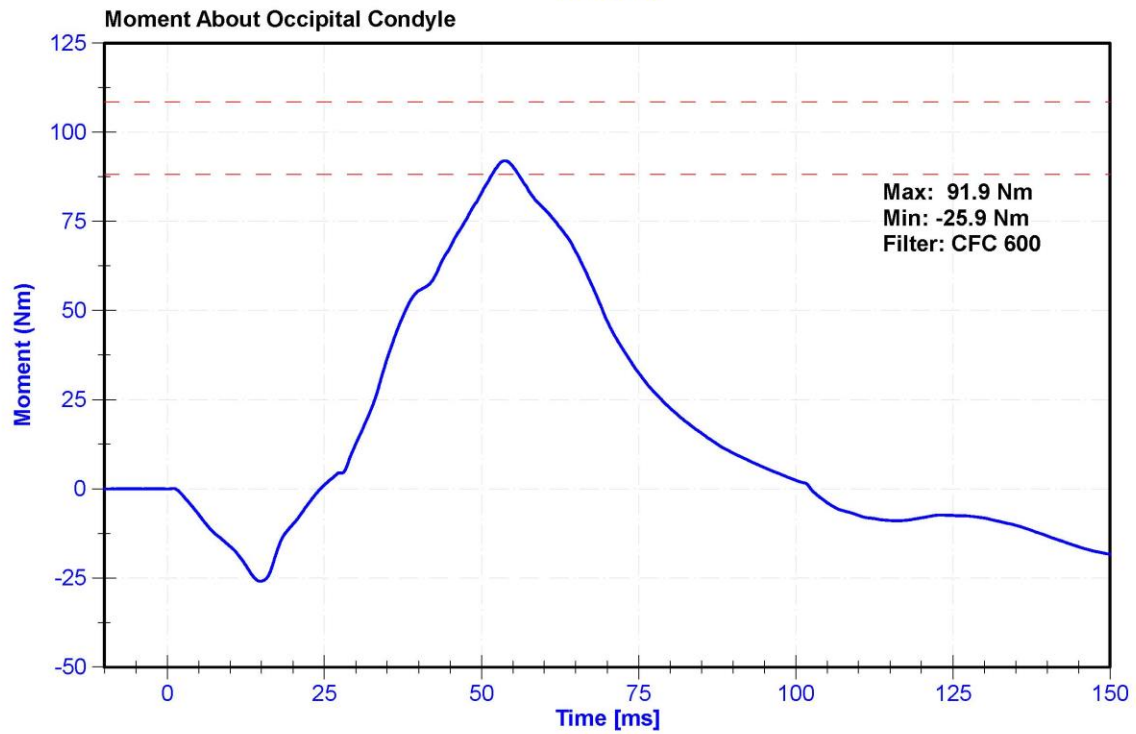
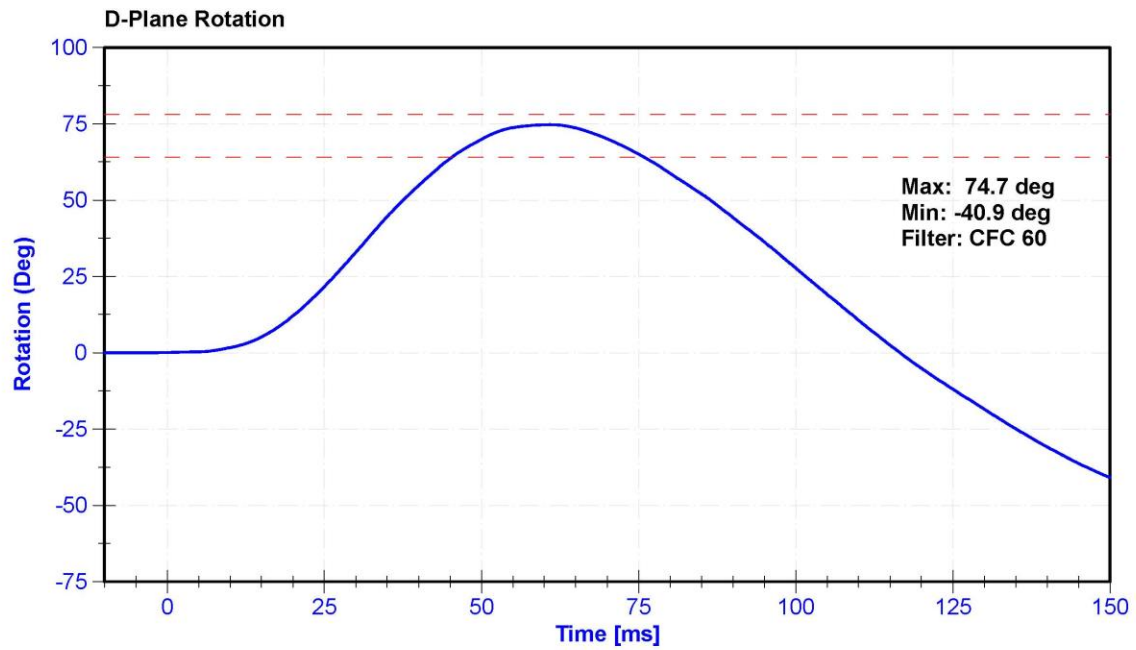
ATD Manufacturer	Humanetics	Test Technician	C. Mantell
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

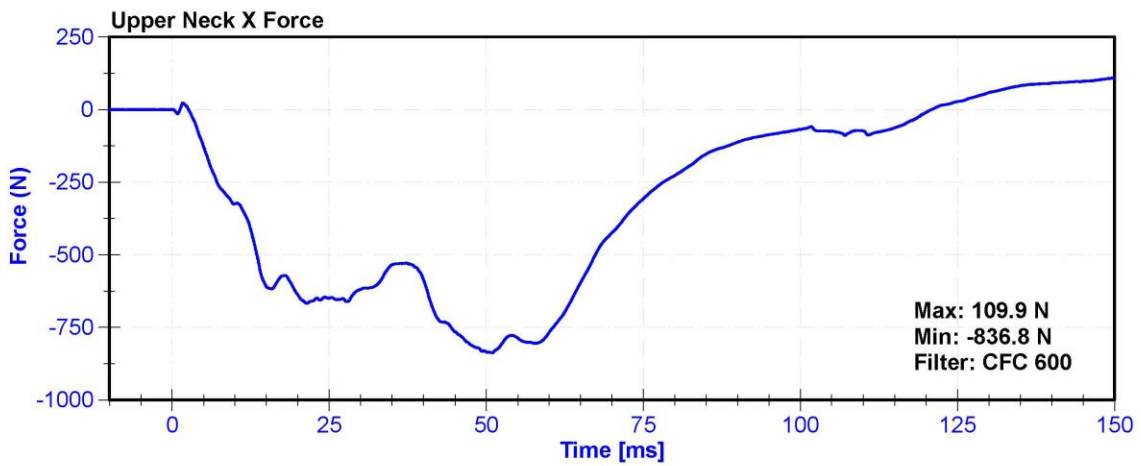
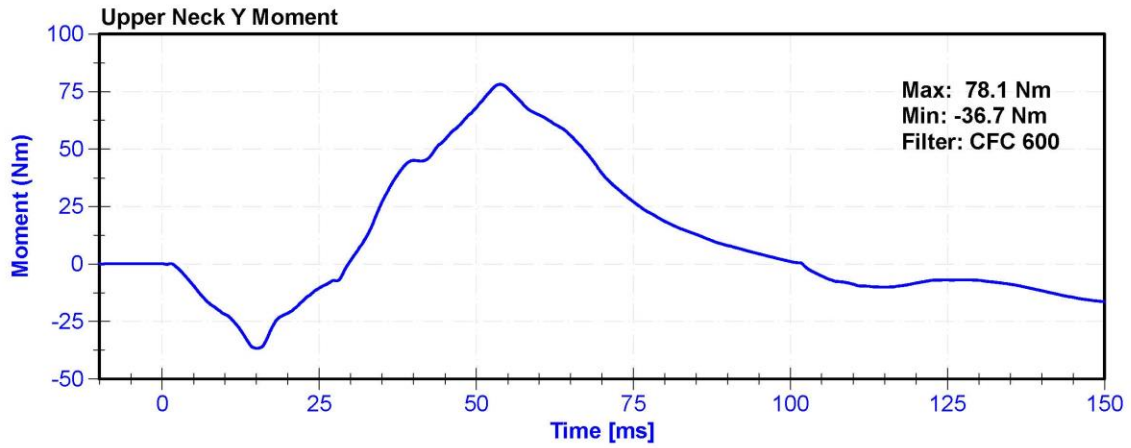
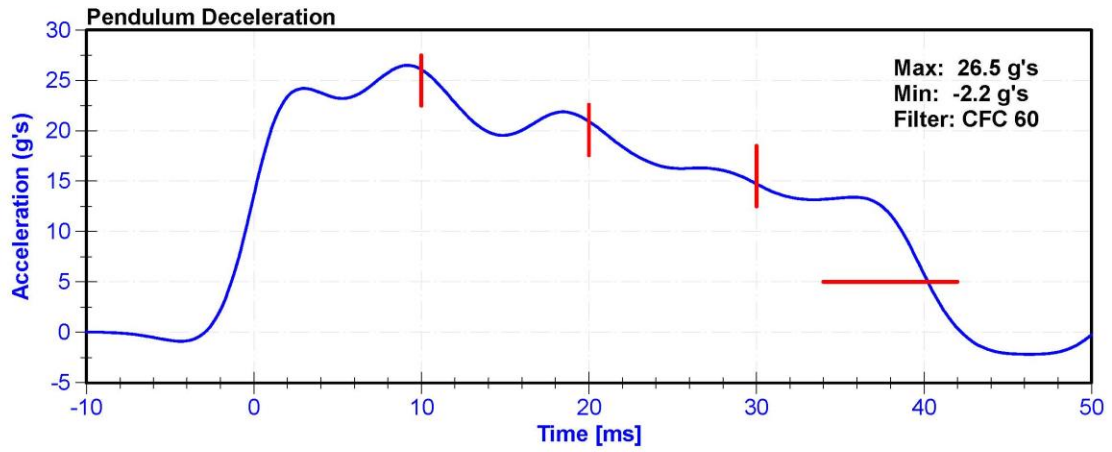
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	22.0	Pass
Humidity	10	70	%	25.6	Pass
Velocity	6.89	7.13	m/s	6.903	Pass
Pendulum Deceleration at 10ms	22.5	27.5	g's	26.08	Pass
Pendulum Deceleration at 20ms	17.6	22.6	g's	20.94	Pass
Pendulum Deceleration at 30ms	12.5	18.5	g's	14.74	Pass
Max. Pendulum Deceleration After 30ms	0	29	g's	26.5	Pass
Pendulum Deceleration Time to 5 g's	34	42	ms	40.3	Pass
Maximum D Plane Rotation	64	78	deg	74.7	Pass
Time to Maximum Rotation	57	64	ms	60.9	Pass
Rotation Decay to Zero	113	127	ms	116.6	Pass
Moment About Occipital Condyle	88.1	108.4	Nm	91.95	Pass
Time to Maximum Moment	47	58	ms	53.8	Pass
Moment Decay to Zero	97	107	ms	102.4	Pass

Transducer Calibrations

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





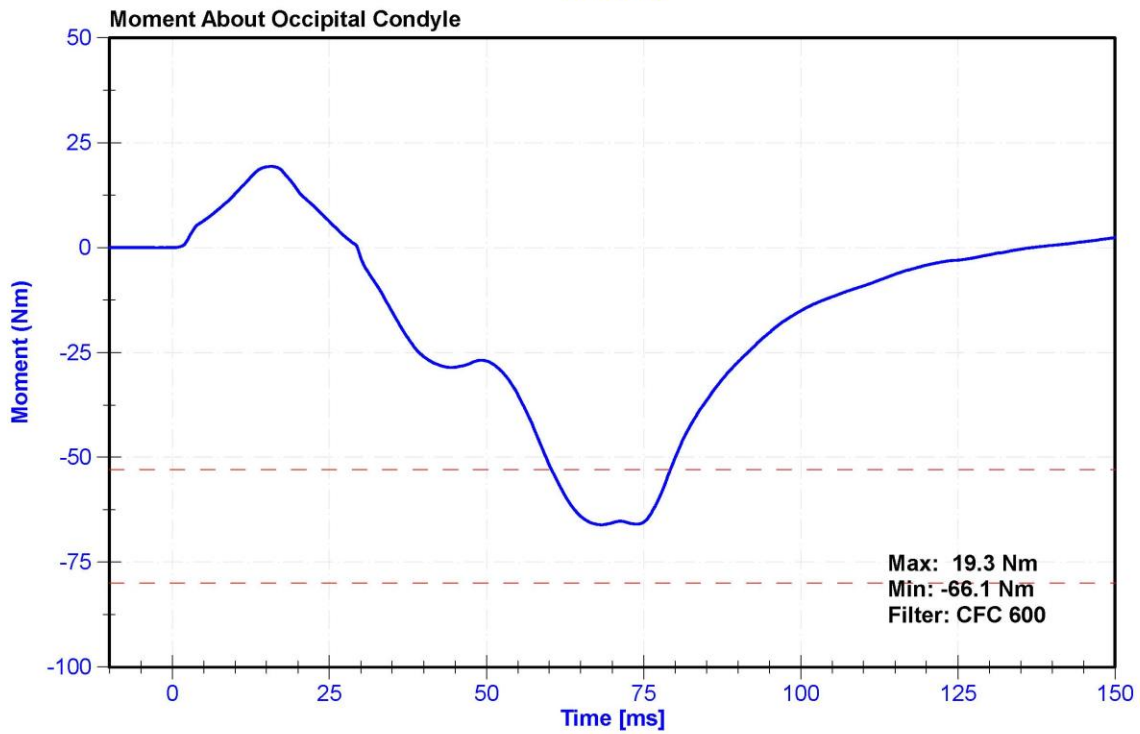
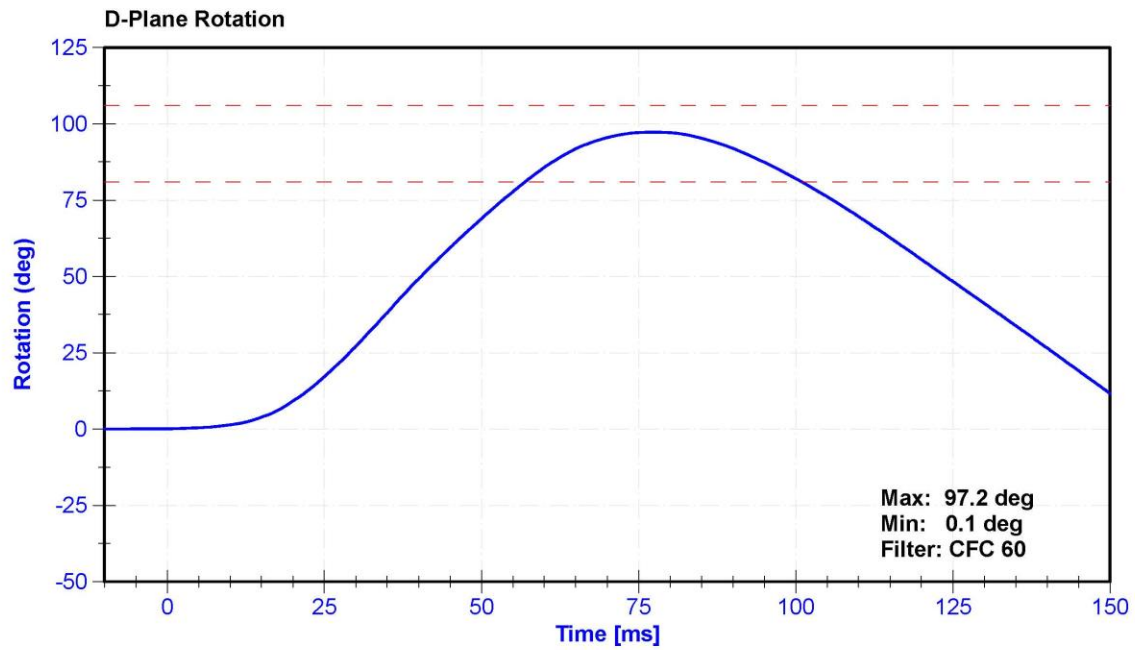
ATD Manufacturer	Humanetics	Test Technician	C. Mantell
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

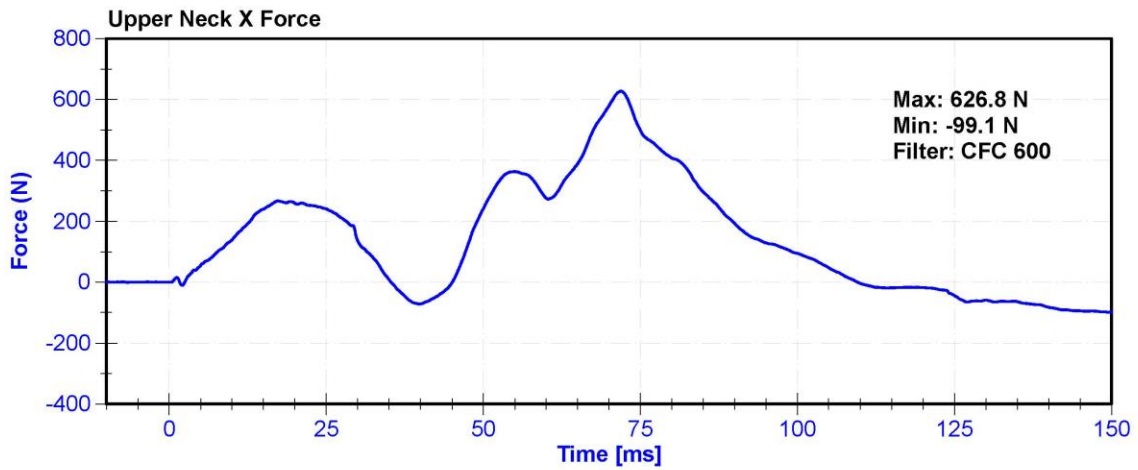
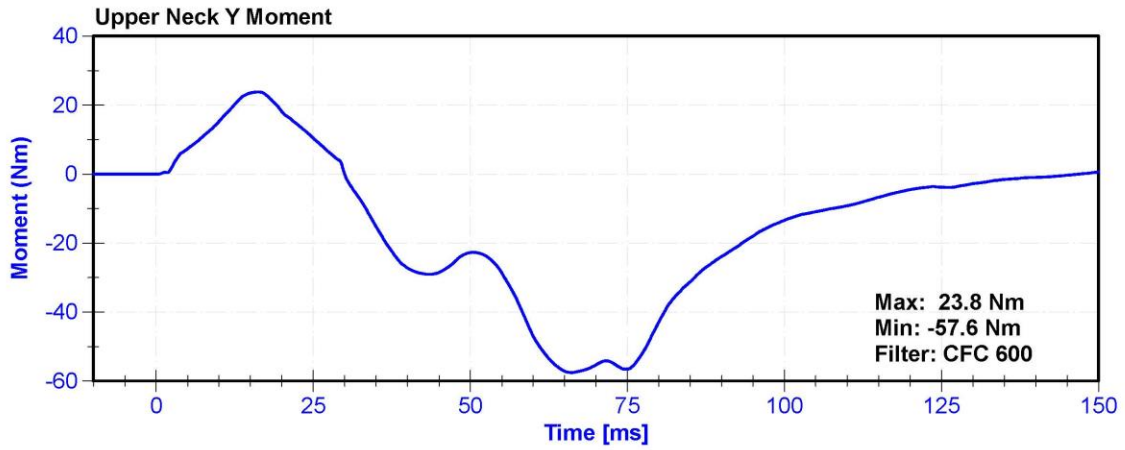
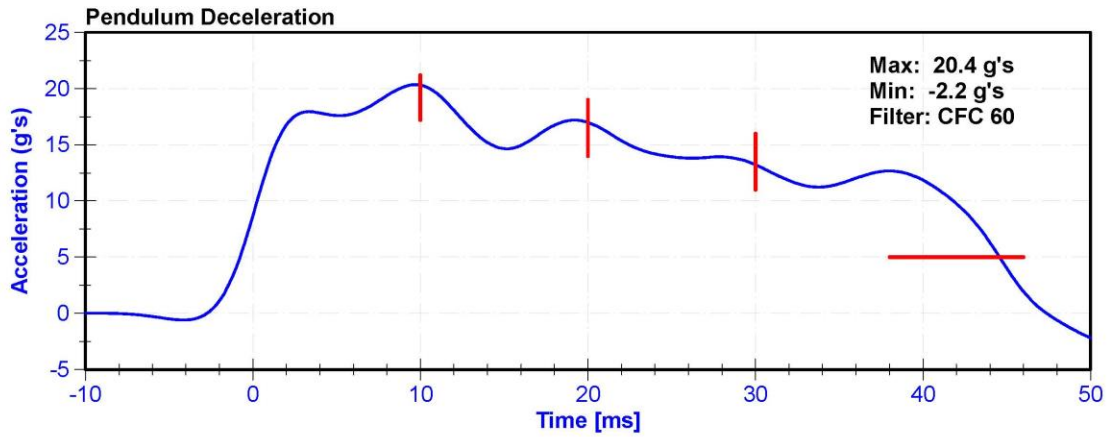
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	22	Pass
Humidity	10	70	%	21.7	Pass
Velocity	5.94	6.19	m/s	5.964	Pass
Pendulum Deceleration at 10ms	17.2	21.2	g's	20.32	Pass
Pendulum Deceleration at 20ms	14	19	g's	17.0	Pass
Pendulum Deceleration at 30ms	11	16	g's	13.2	Pass
Max. Pendulum Deceleration After 30ms	0	22	g's	20.4	Pass
Pendulum Deceleration Time to 5 g's	38	46	ms	44.6	Pass
Maximum D Plane Rotation	81	106	deg	97.2	Pass
Time to Maximum Rotation	72	82	ms	77.3	Pass
Rotation Decay to Zero	147	174	ms	157.9	Pass
Minimum Moment About OC	-80	-52.9	Nm	-66.11	Pass
Time to Minimum Moment	65	79	ms	68.3	Pass
Moment Decay to Zero	120	148	ms	137.0	Pass

Transducer Calibrations

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





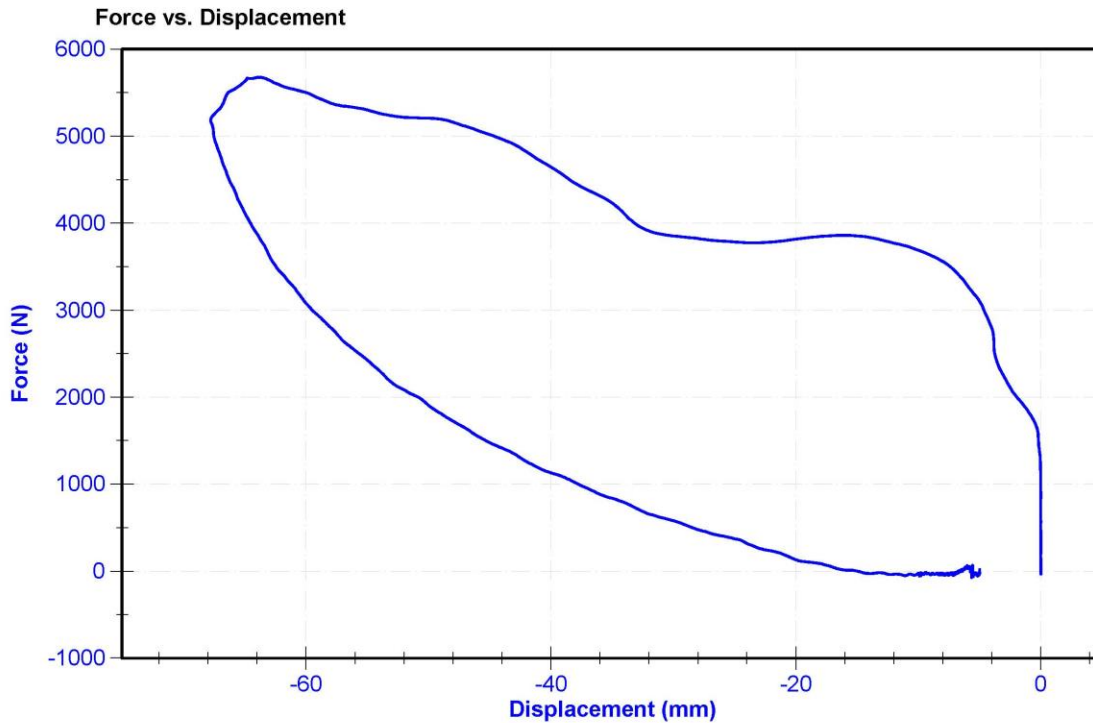
ATD Manufacturer	Humanetics	Test Technician	C. Mantell
ATD Serial Number	142	Laboratory Supervisor	K.Brogan

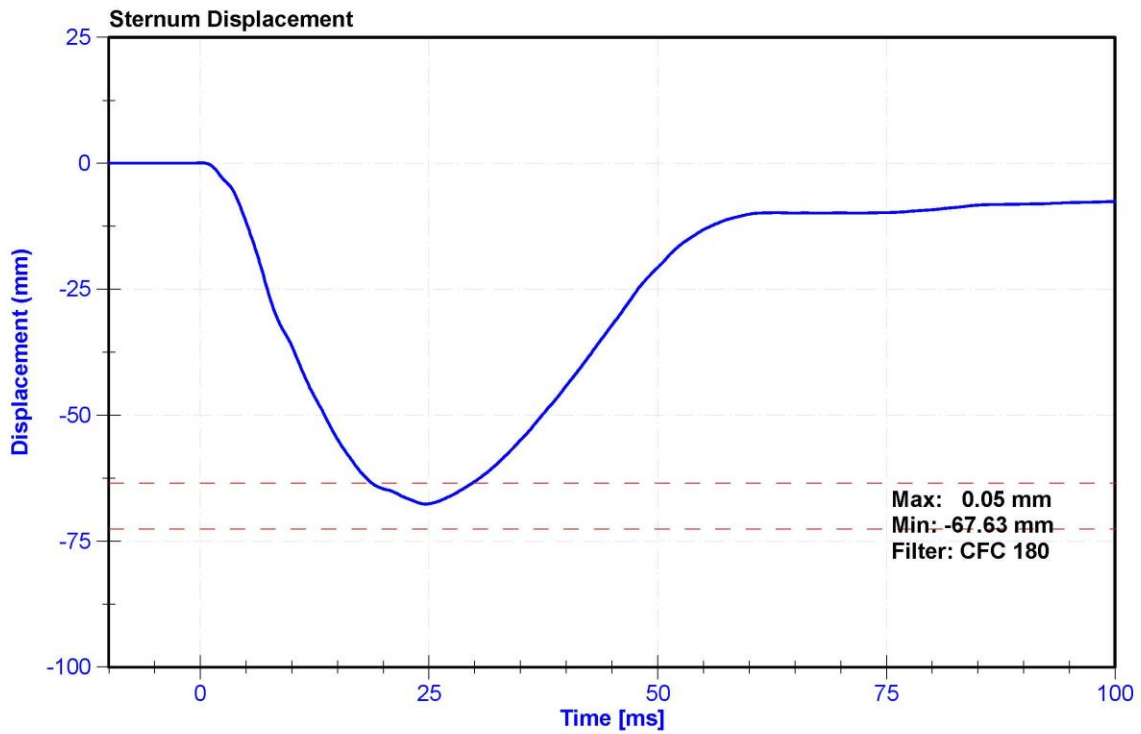
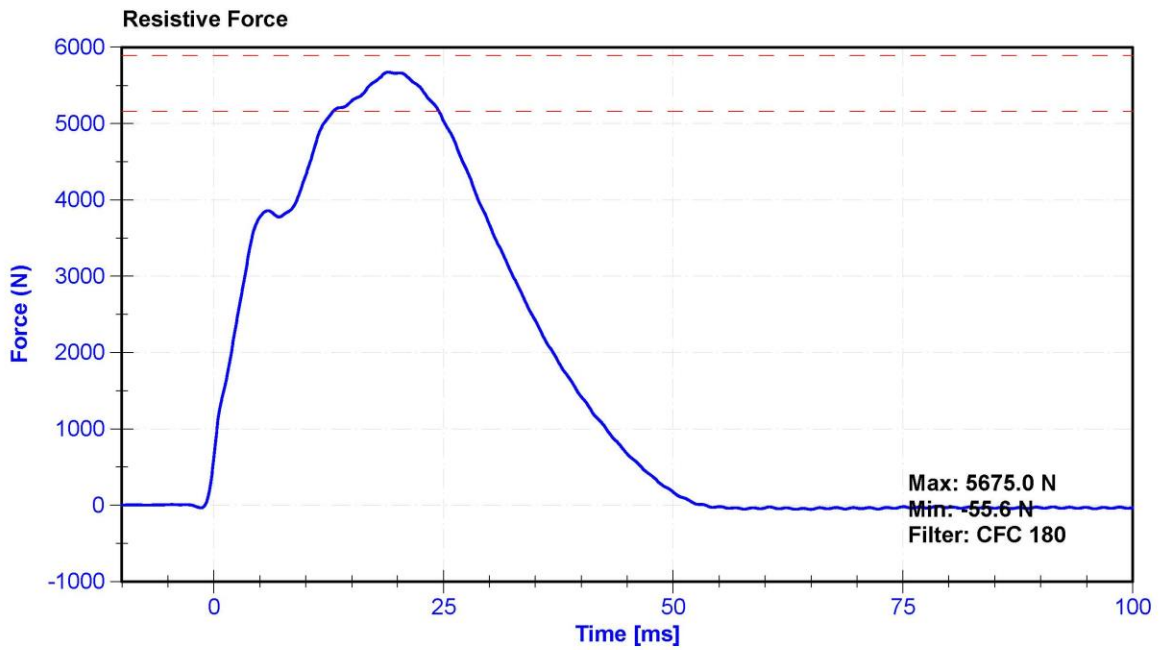
Results

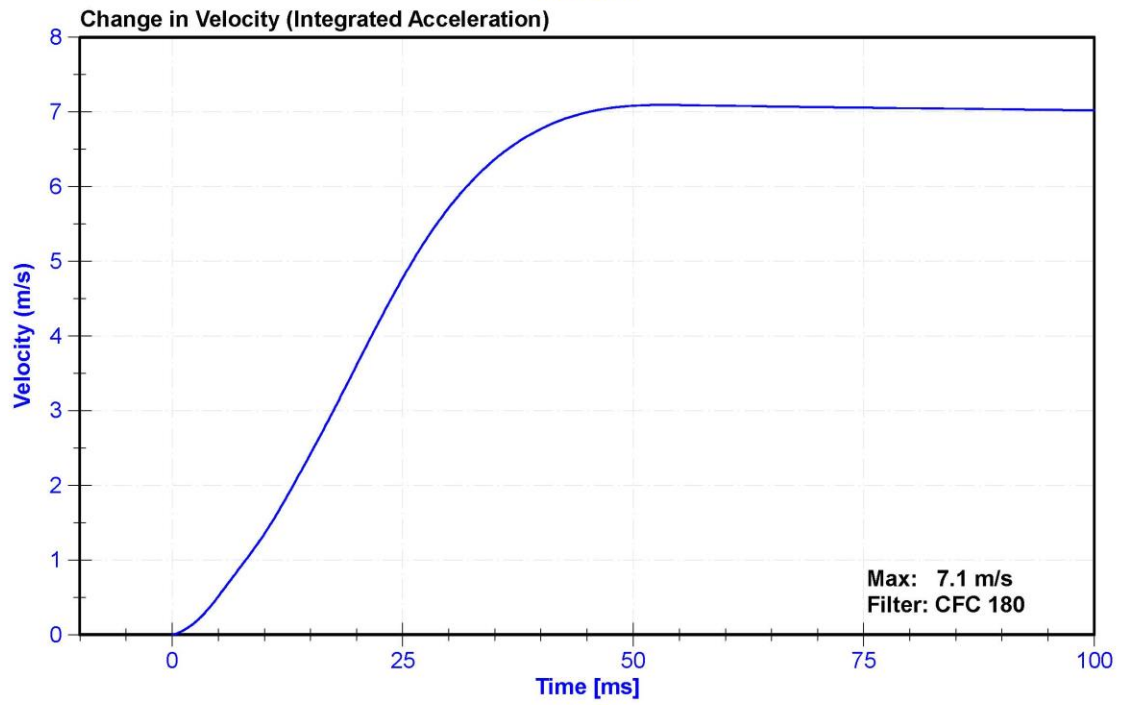
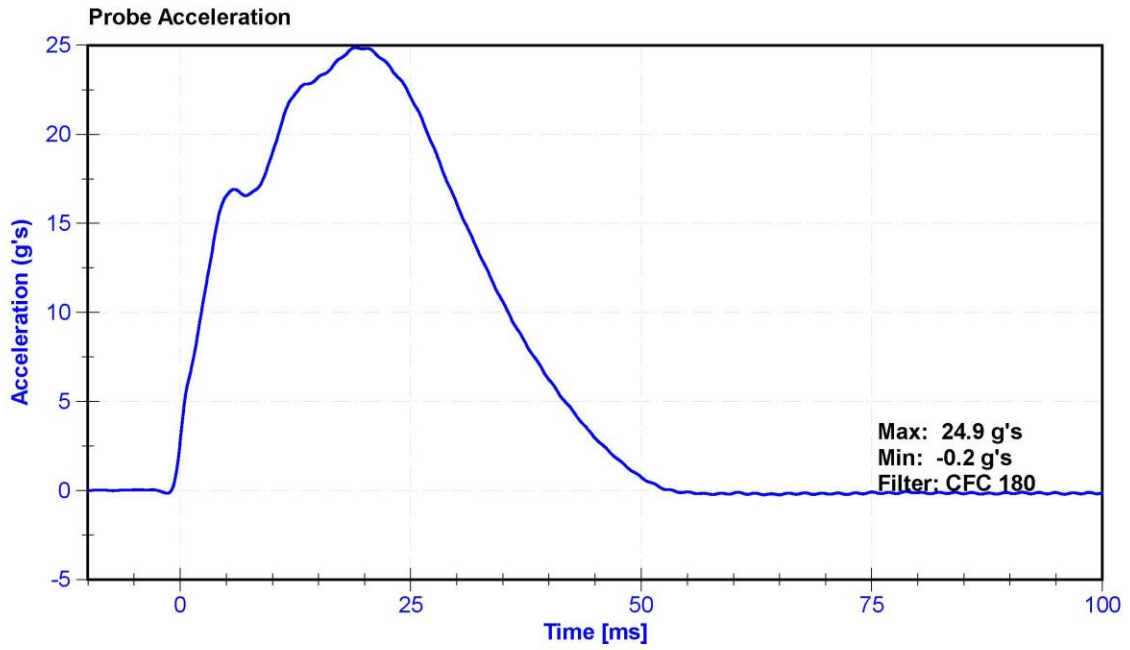
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.6	Pass
Humidity	10	70	%	22.5	Pass
Velocity	6.59	6.83	m/s	6.714	Pass
Chest Displacement	-72.6	-63.5	mm	-67.63	Pass
Resistive Force	5160	5894	N	5675.0	Pass
Hysteresis	65	85	%	72.1	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco 7264C	AC-P94667	11/1/2018	11/1/2019
Chest Potentiometer	JDK 6209-2038	DS-142	10/22/2018	10/22/2019







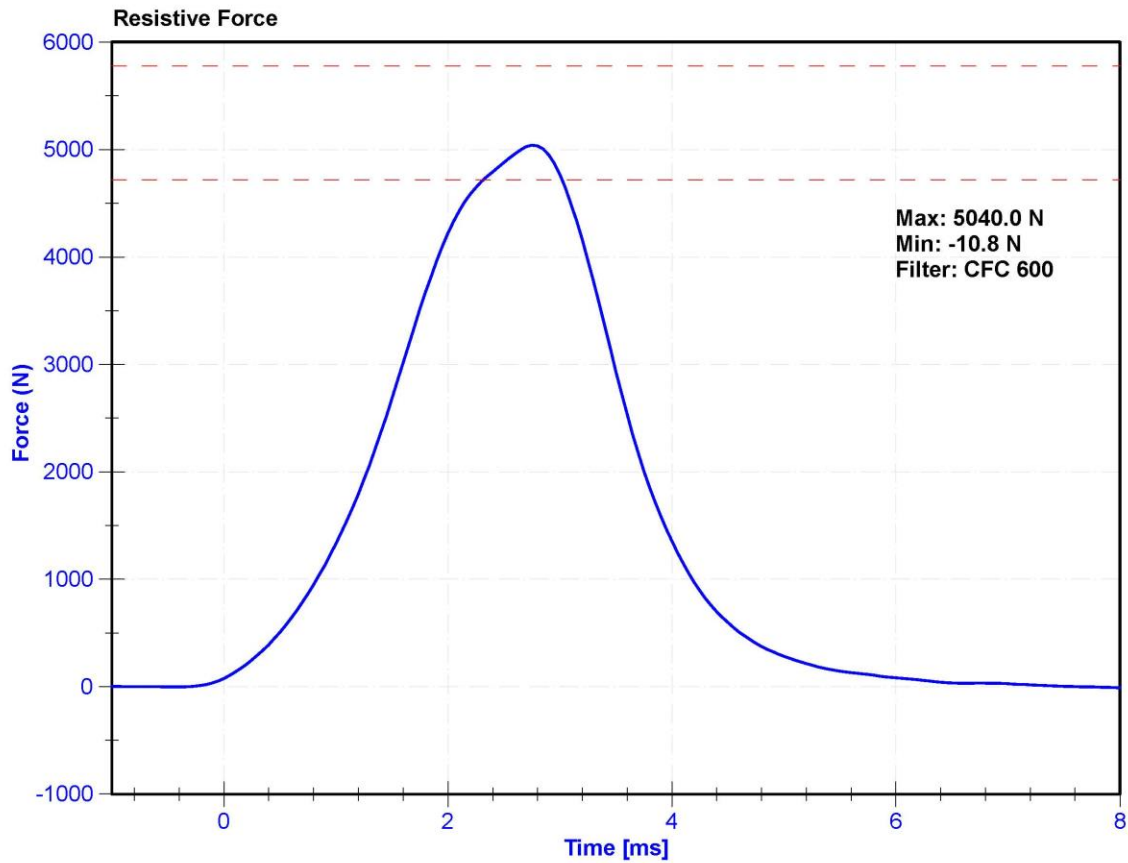
ATD Manufacturer	Humanetics	Test Technician	D.Reinhard
ATD Serial Number	142	Laboratory Supervisor	K.Brogan

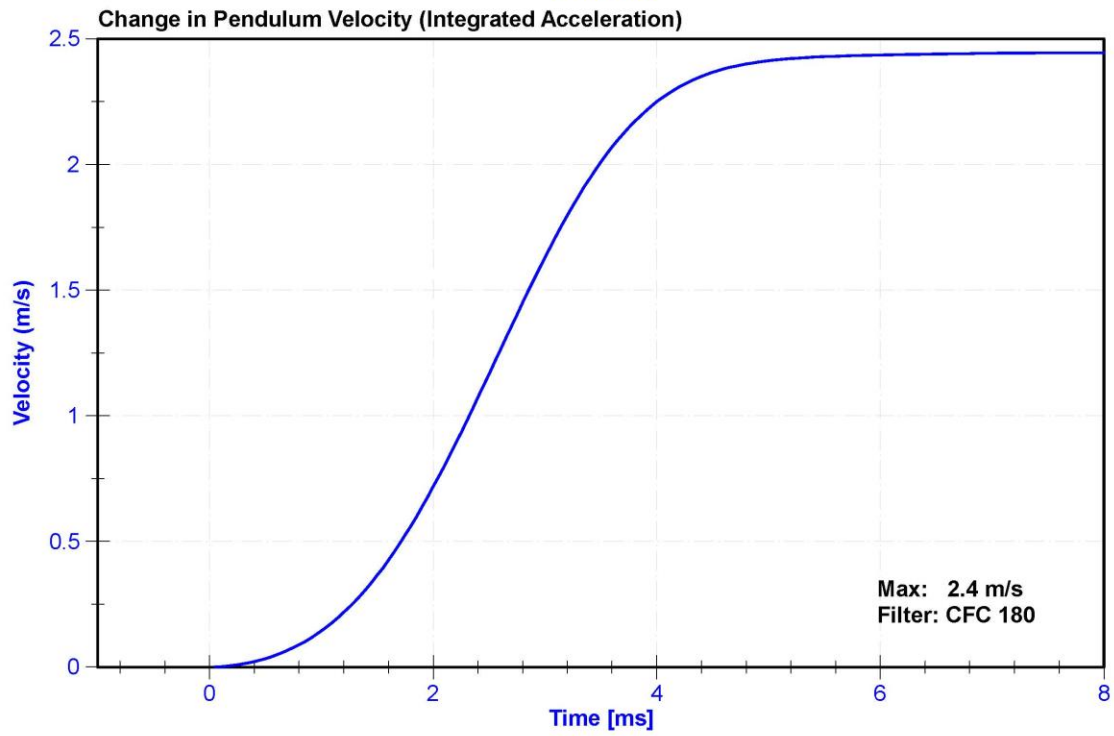
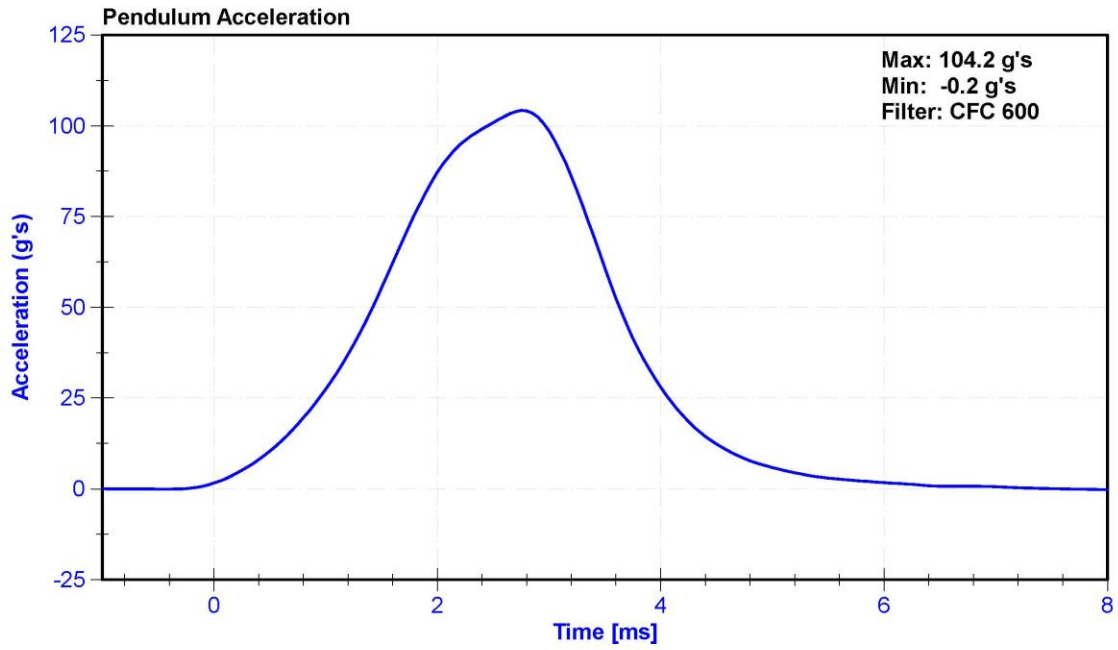
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	22	Pass
Humidity	10	70	%	22.6	Pass
Velocity	2.07	2.13	m/s	2.127	Pass
Maximum Resistive Force	4720	5780	N	5040.0	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7264CT	AC-P23904	11/1/2018	5/2/2019





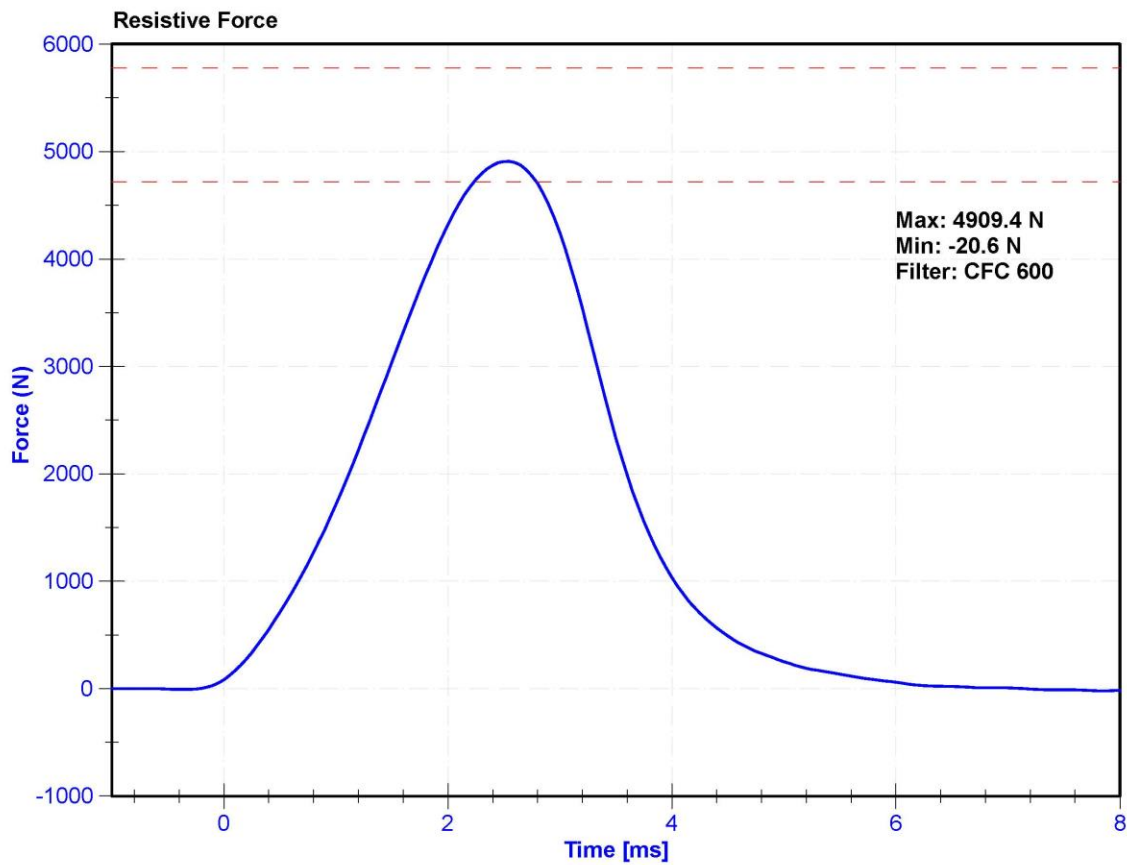
ATD Manufacturer	Humanetics	Test Technician	D.Reinhard
ATD Serial Number	142	Laboratory Supervisor	K.Brogan

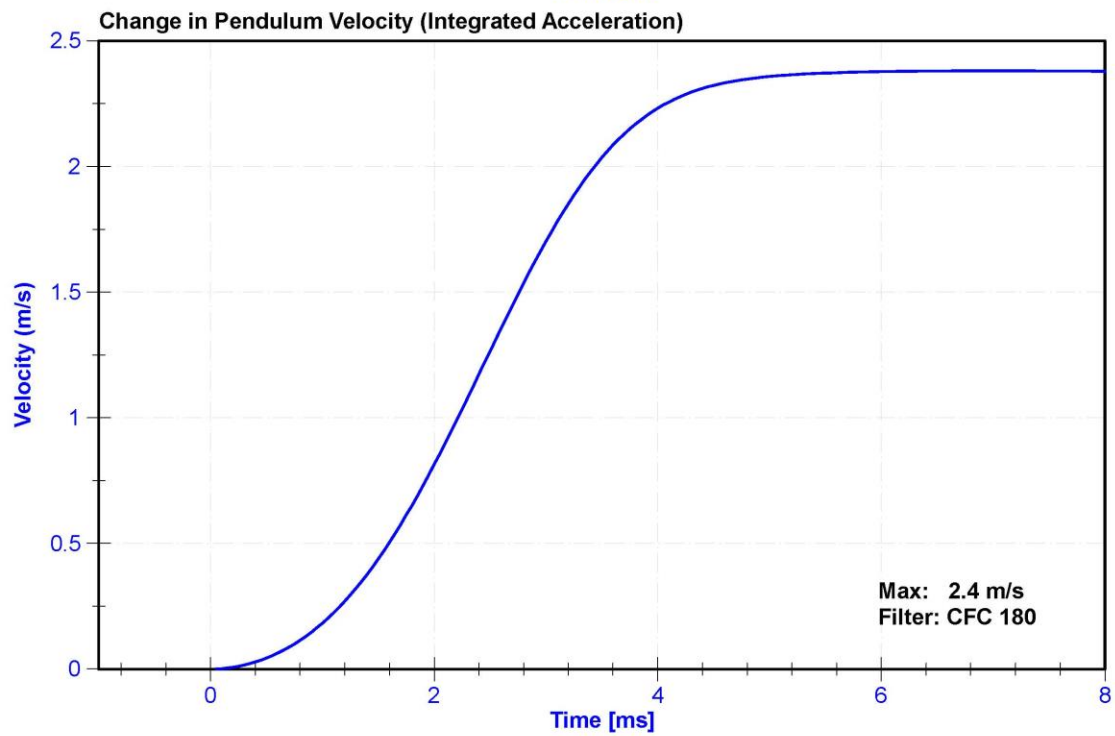
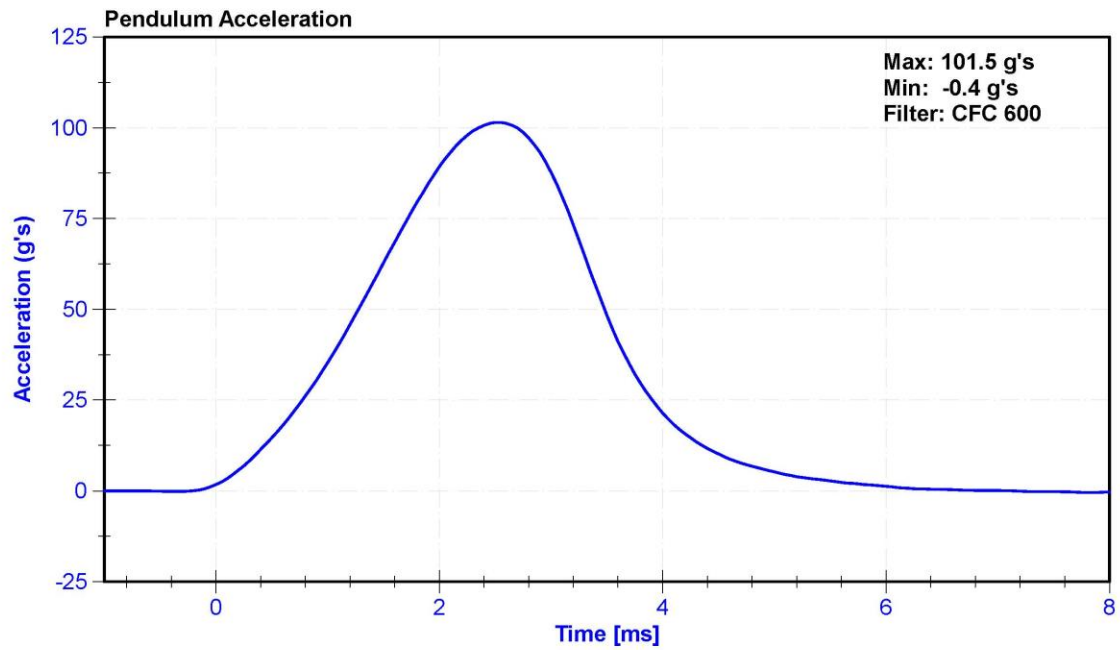
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	22	Pass
Humidity	10	70	%	22.7	Pass
Velocity	2.07	2.13	m/s	2.127	Pass
Maximum Resistive Force	4720	5780	N	4909.4	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7264CT	AC-P23904	11/1/2018	5/2/2019





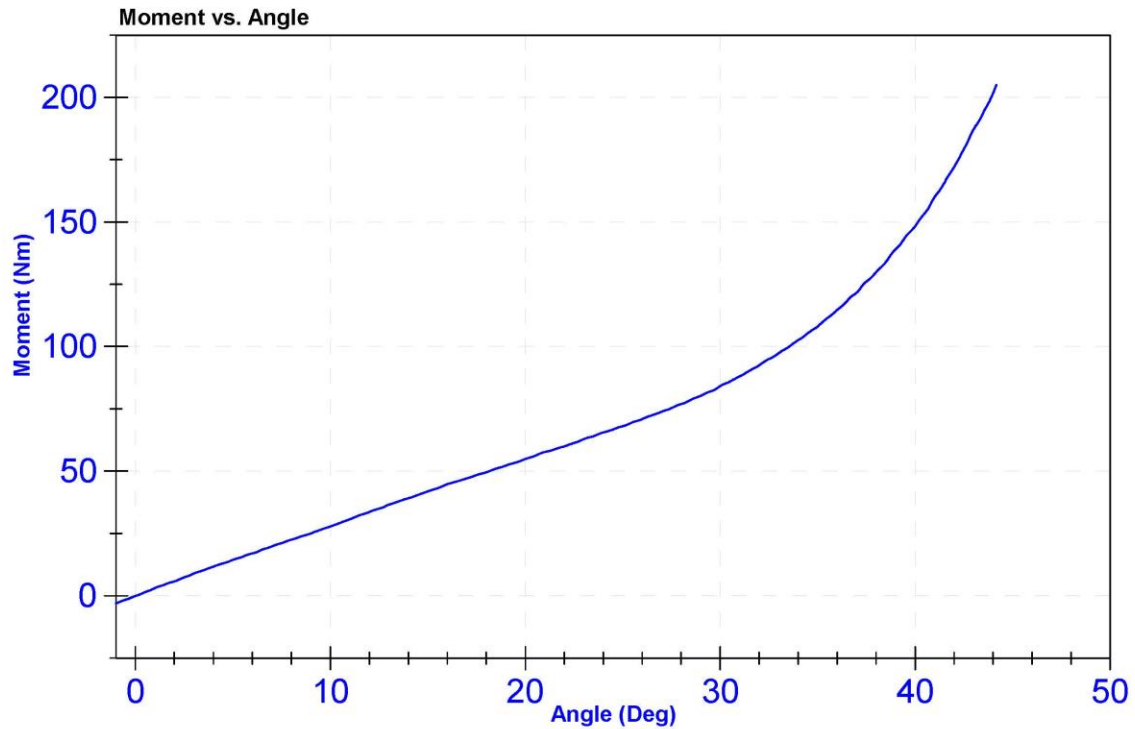
ATD Manufacturer	Humanetics	Test Technician	K. Dutton
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	22.0	Pass
Humidity	10	70	%	20.7	Pass
Average Velocity	5	10	deg/s	7.5	Pass
Angle at 203Nm	40	50	deg	44.1	Pass
Moment at 30 degrees	0	94.9	Nm	84.1	Pass

Transducer Calibrations

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



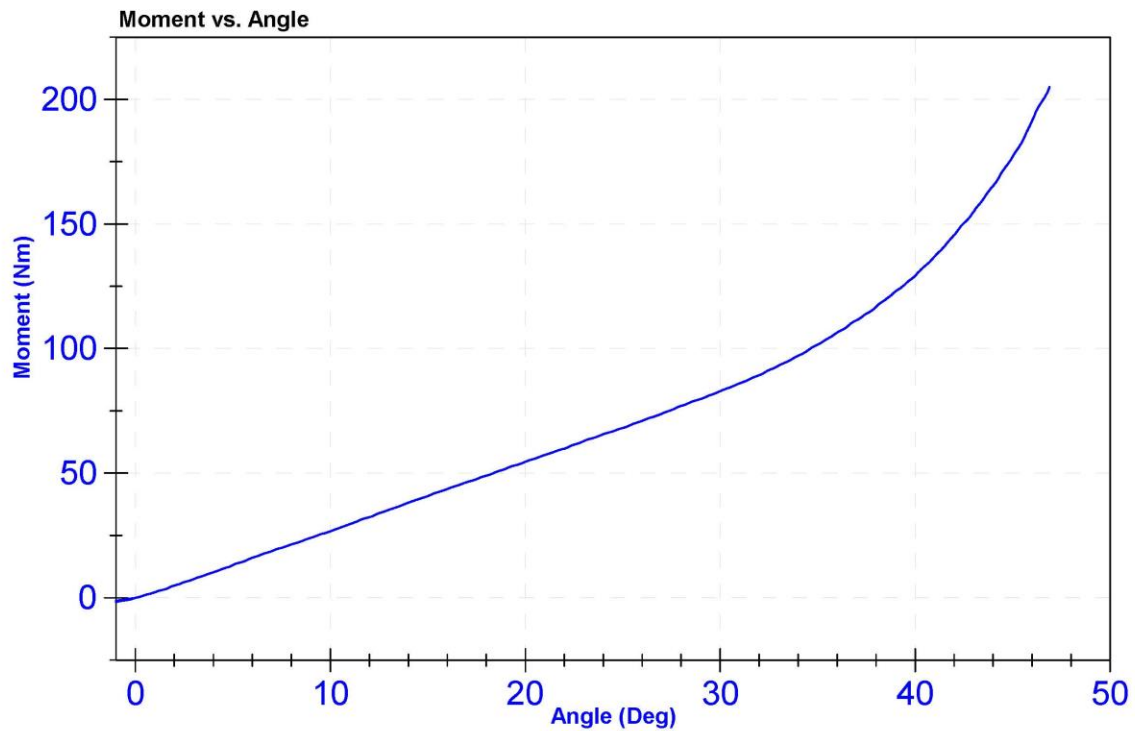
ATD Manufacturer	Humanetics	Test Technician	K. Dutton
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	21.8	Pass
Humidity	10	70	%	21.6	Pass
Average Velocity	5	10	deg/s	7.5	Pass
Angle at 203Nm	40	50	deg	46.8	Pass
Moment at 30 degrees	0	94.9	Nm	82.9	Pass

Transducer Calibrations

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



CALIBRATION TEST RESULTS

POST-TEST

HYBRID III 5TH PERCENTILE FEMALE - PASSENGER ATD

SERIAL NO: 140

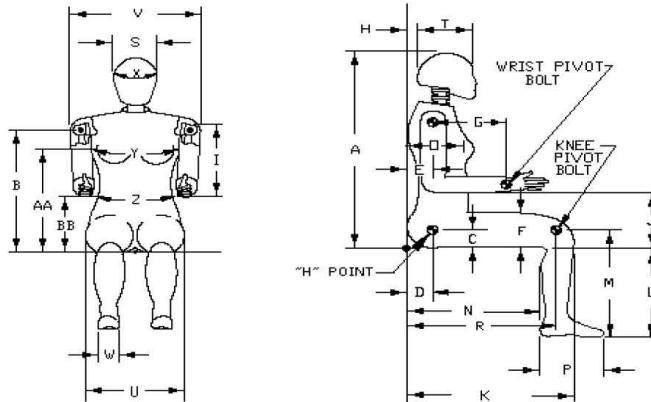


External Measurements - Hybrid 3 - 5th Female

Technician: K. Brogan

Date: 03/12/2019

Dummy Serial Number: 140



Symbol	Description	Specification (mm)		Result (mm)	Pass/Fail
A	Sitting Height	775	800	790	Pass
B	Shoulder Pivot Height	432	457	442	Pass
C	H-Point Height	81	86	83	Pass
D	H-Point from Backline	145	150	148	Pass
E	Shoulder Pivot from Backline	69	84	75	Pass
F	Thigh Clearance	119	135	128	Pass
G	Back of Elbow to Wrist Pivot	244	259	250	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	191	Pass
K	Buttock to Knee Length	521	546	535	Pass
L	Popliteal Height	356	376	368	Pass
M	Knee Pivot Height	394	419	407	Pass
N	Buttock Popliteal Length	414	439	428	Pass
O	Chest Depth without Jacket	175	191	182	Pass
P	Foot Length (right)	219	234	230	Pass
R	Buttock To Knee Pivot Length	457	483	466	Pass
S	Head Breadth	137	147	142	Pass
T	Head Depth	178	188	185	Pass
U	Hip Breadth	300	315	311	Pass
V	Shoulder Breadth	351	366	360	Pass
W	Foot Breadth	79	94	85	Pass
X	Head Circumference	528	549	534	Pass
Y	Chest Circumference with Jacket	851	881	872	Pass
Z	Waist Circumference	460	790	630	Pass
AA	Reference Location (Chest Circumference)	333	358	345	Pass
BB	Reference Location (Waist Circumference)	160	170	165	Pass

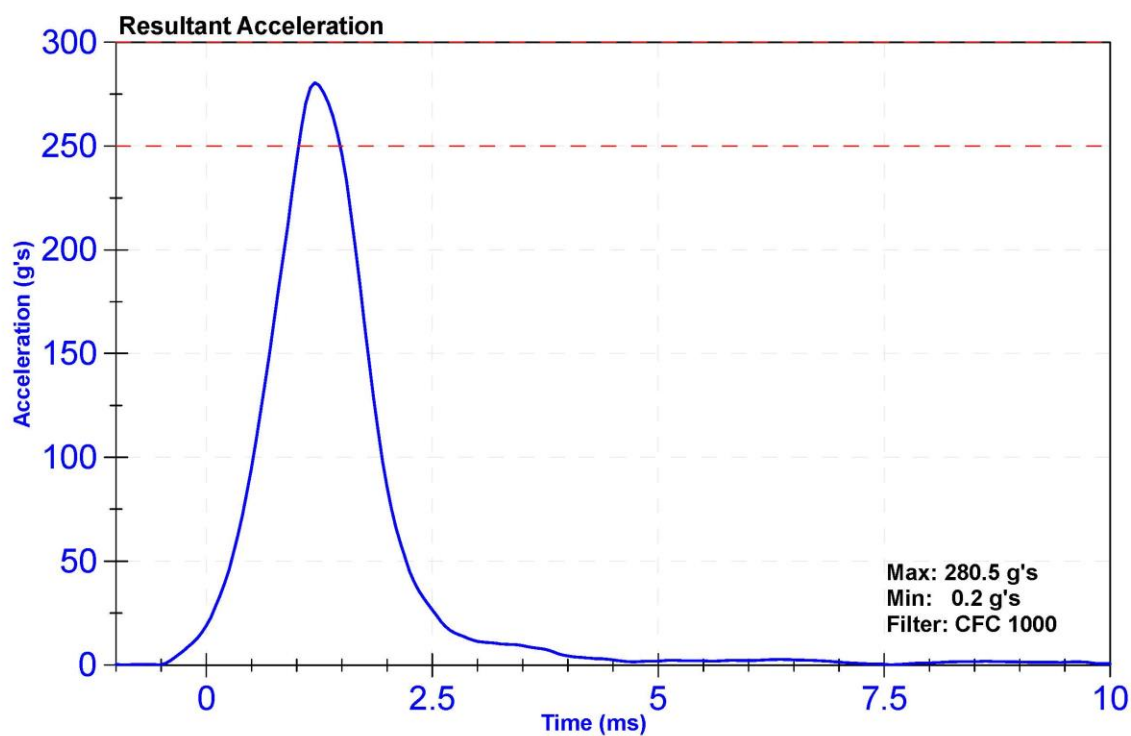
ATD Manufacturer	Humanetics	Test Technician	K. Dutton
ATD Serial Number	140	Laboratory Supervisor	K. Brogan

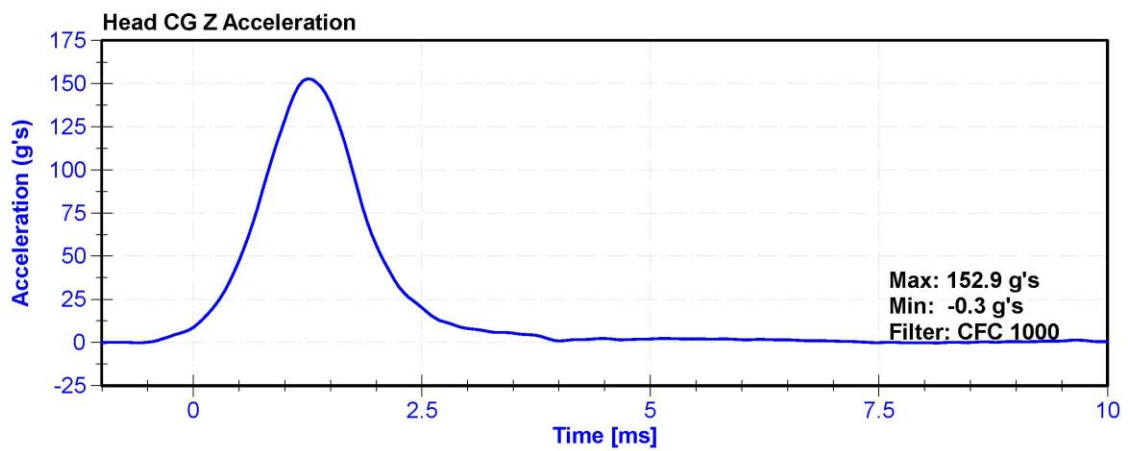
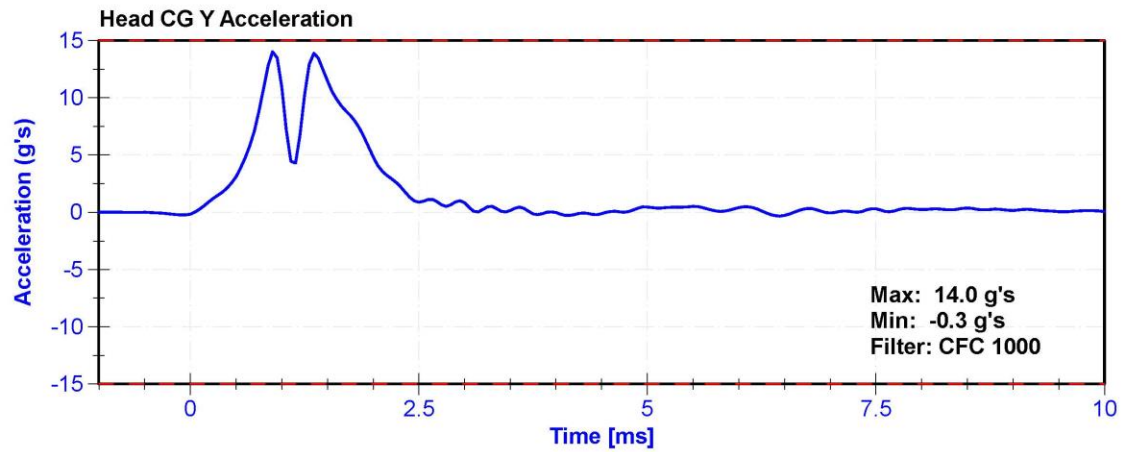
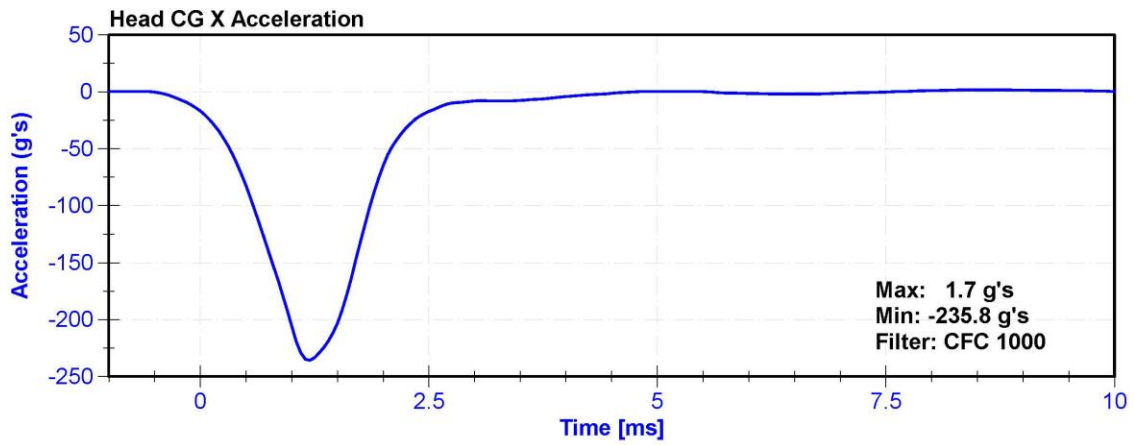
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	21.4	Pass
Humidity	10	70	%	20.8	Pass
Resultant Acceleration	250	300	g's	280.5	Pass
Oscillation	0	10	%	0.9	Pass
Lateral Acceleration	-15	15	g's	14.0	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	ENDEVCO 7264CT	AC-P58871	10/26/2018	4/26/2019
Y Accelerometer	ENDEVCO 7264	AC-P12359	10/26/2018	4/26/2019
Z Accelerometer	ENDEVCO 7264CT	AC-P58880	10/26/2018	4/26/2019





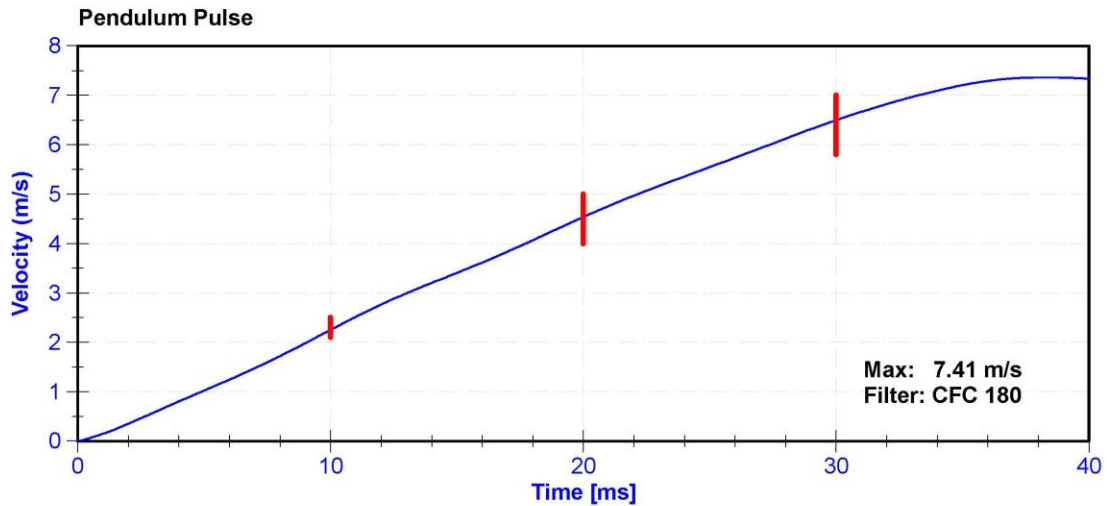
ATD Manufacturer	Humanetics	Test Technician	C. Mantell
ATD Serial Number	140	Laboratory Supervisor	K.Brogan

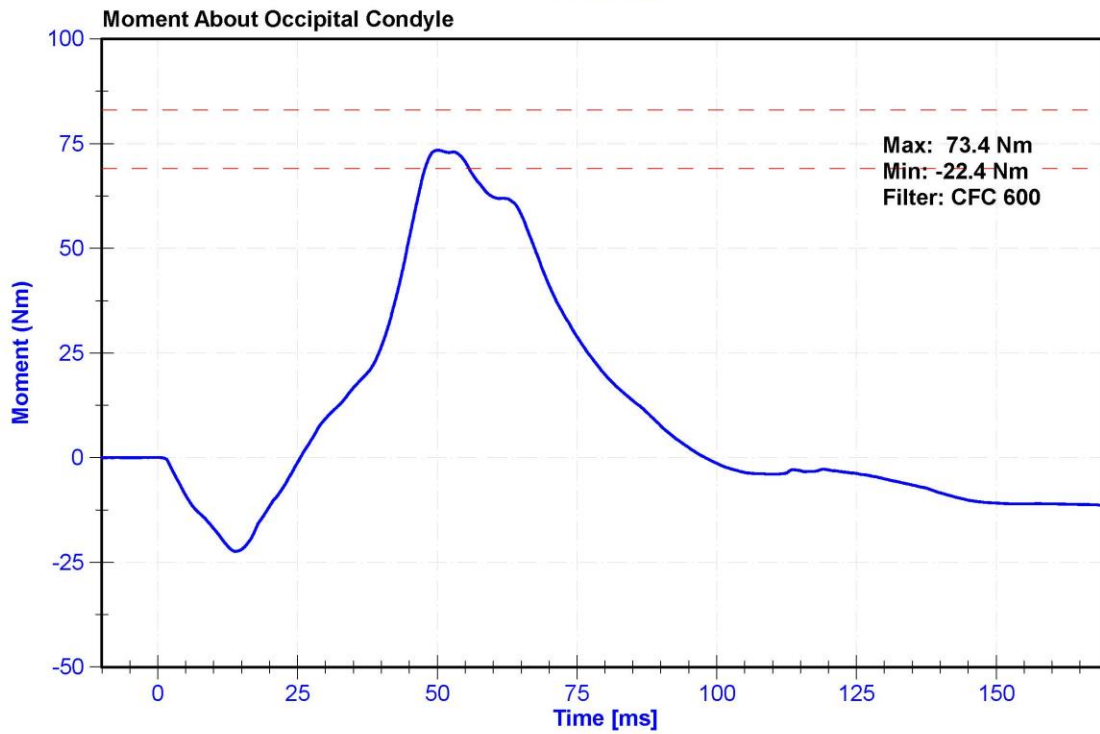
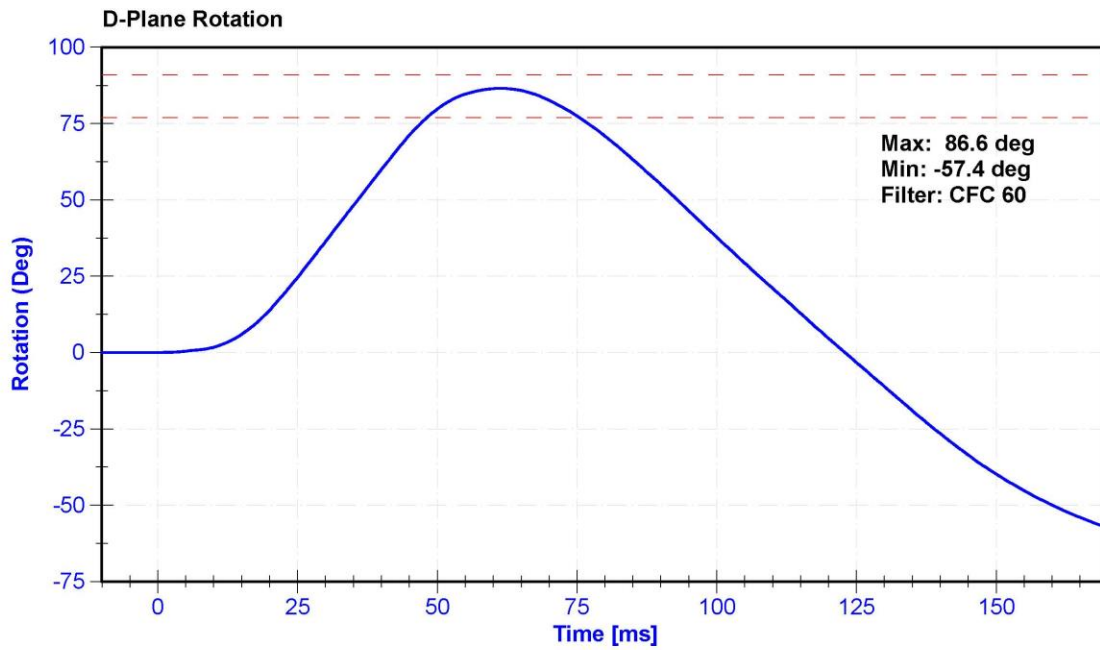
Results

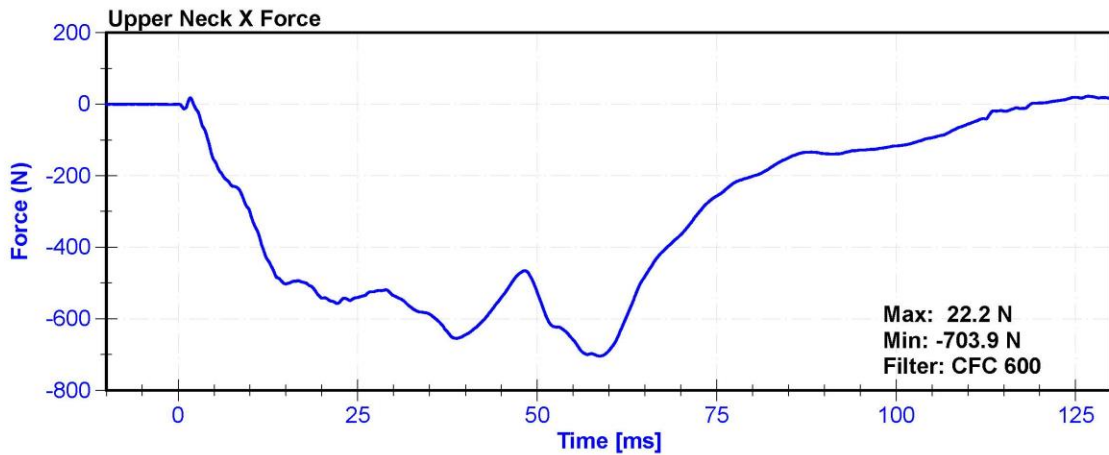
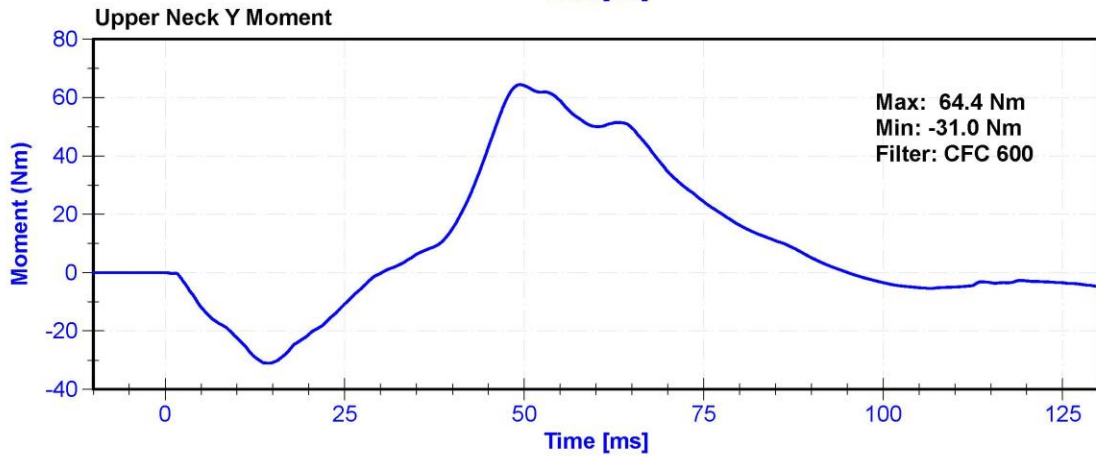
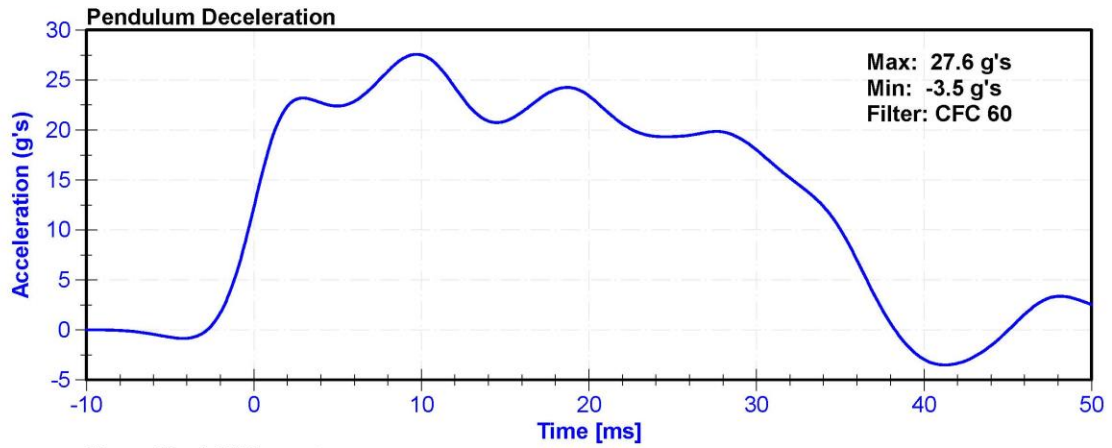
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	22.0	Pass
Humidity	10	70	%	20.8	Pass
Velocity	6.89	7.13	m/s	6.903	Pass
Pendulum Impulse at 10ms	2.1	2.5	m/s	2.25	Pass
Pendulum Impulse at 20ms	4.0	5.0	m/s	4.54	Pass
Pendulum Impulse at 30ms	5.8	7.0	m/s	6.50	Pass
Max D Plane Rotation	77	91	deg	86.6	Pass
Max Moment During Rotation Interval	69	83	Nm	73.4	Pass
Moment Decay to 10.0 Nm	80	100	ms	88.1	Pass

Transducer Calibrations

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







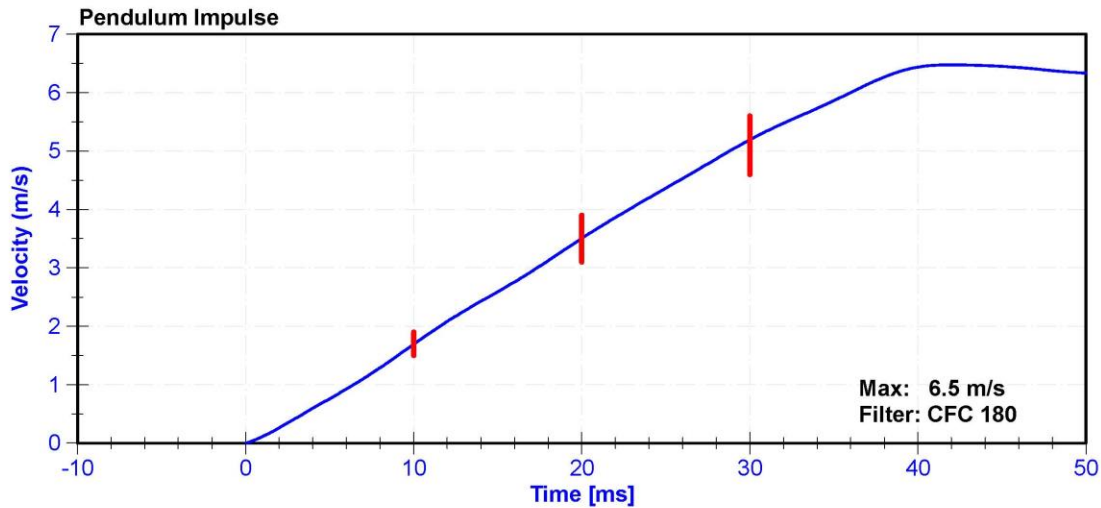
ATD Manufacturer	Humanetics	Test Technician	C. Mantell
ATD Serial Number	140	Laboratory Supervisor	K.Brogan

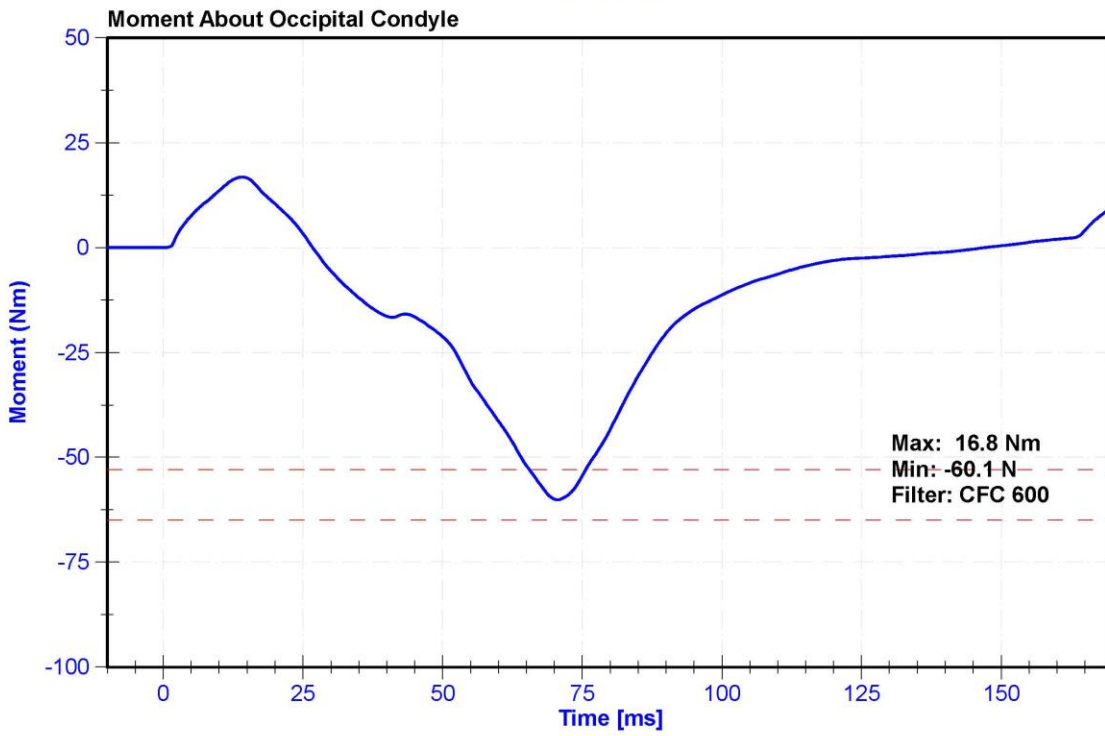
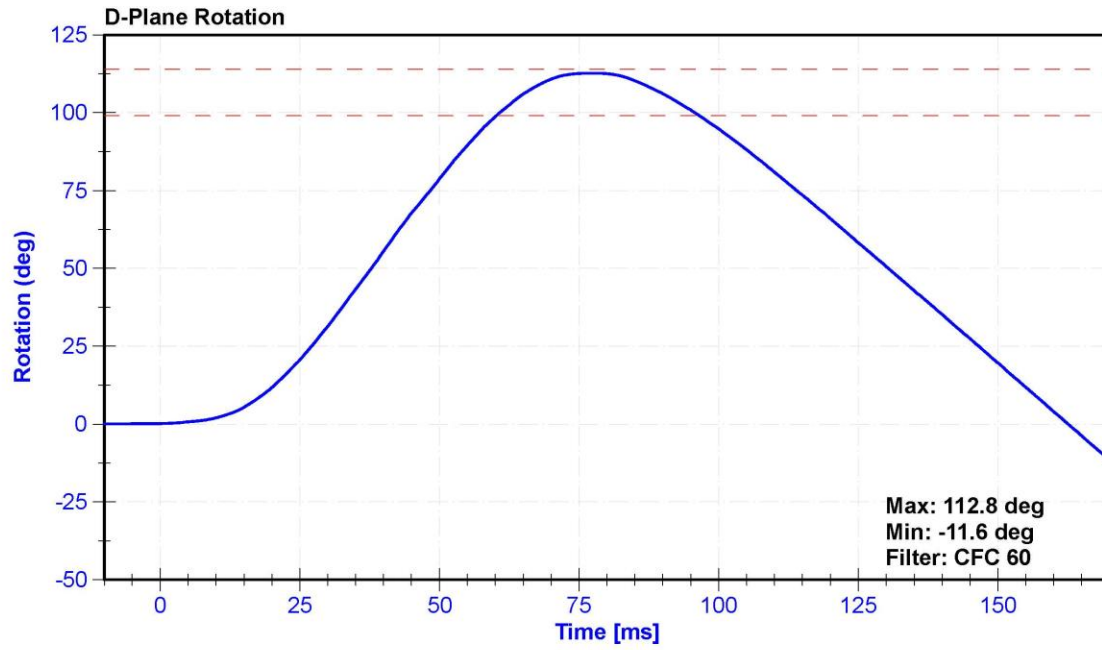
Results

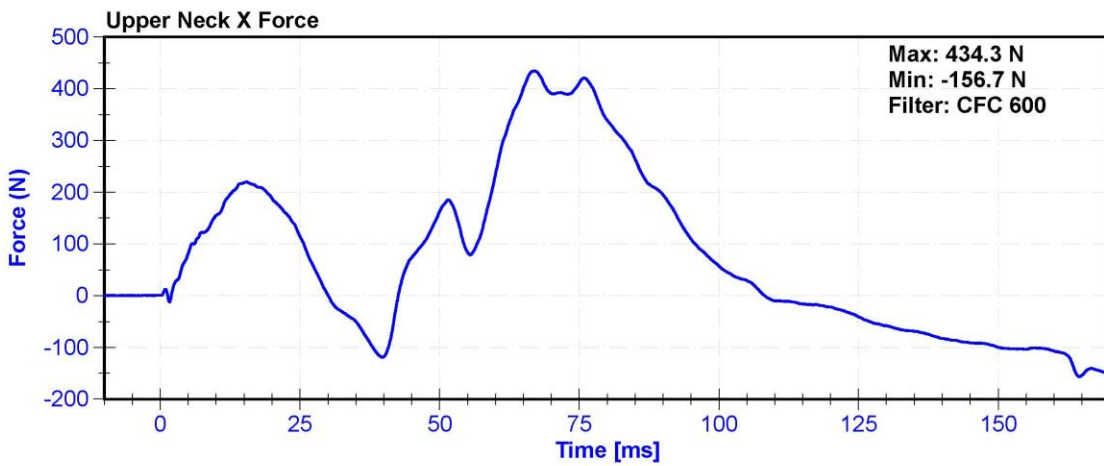
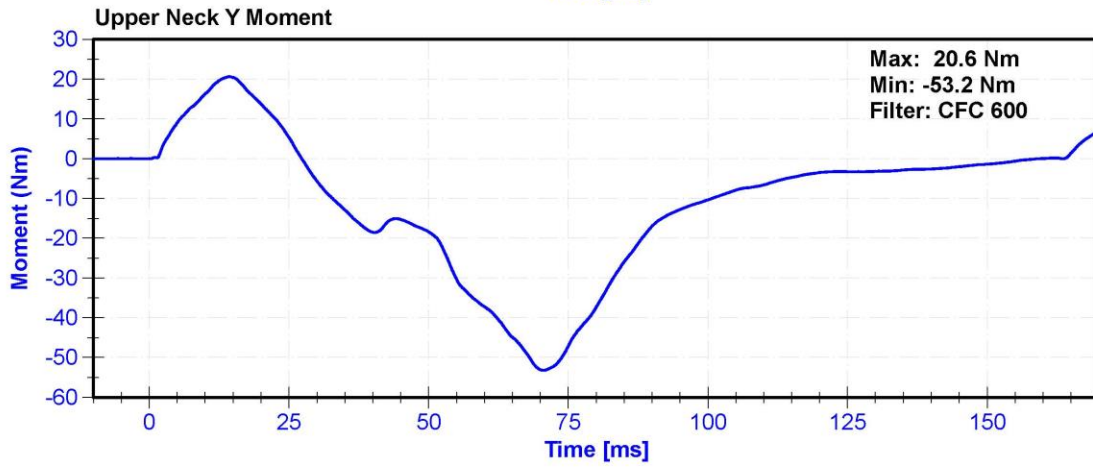
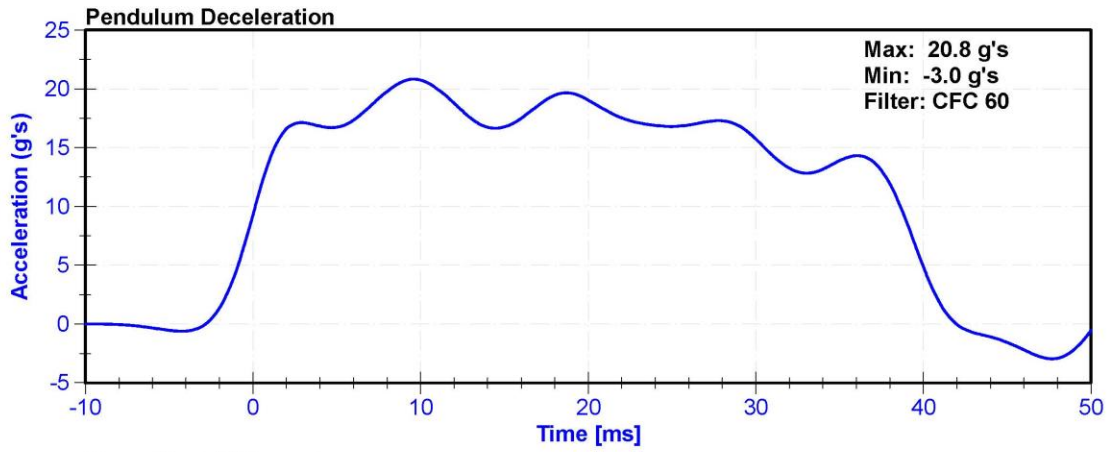
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.9	Pass
Humidity	10	70	%	21.5	Pass
Velocity	5.95	6.19	m/s	6.046	Pass
Pendulum Impulse at 10ms	1.5	1.9	m/s	1.69	Pass
Pendulum Impulse at 20ms	3.1	3.9	m/s	3.50	Pass
Pendulum Impulse at 30ms	4.6	5.6	m/s	5.19	Pass
D Plane Rotation	99	114	deg	112.8	Pass
Moment During Rotation Interval	-65	-53	Nm	-60.1	Pass
Moment Decay to -10Nm	94	114	ms	102.1	Pass

Transducer Calibrations

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







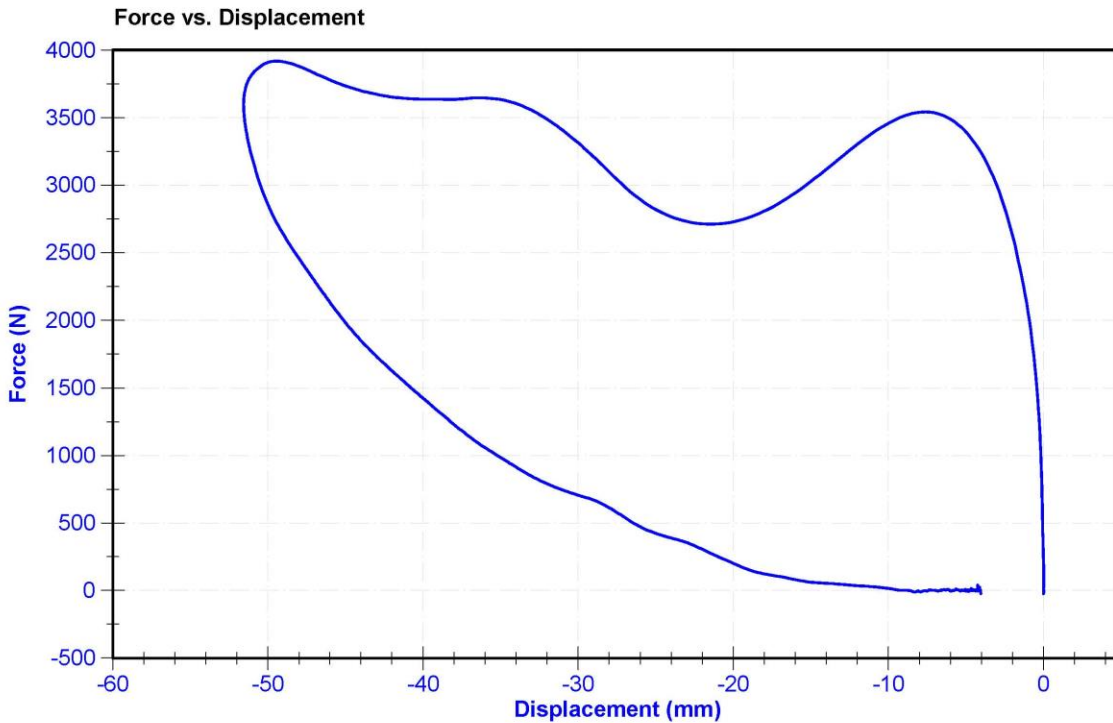
ATD Manufacturer	Humanetics	Test Technician	D.Reinhard
ATD Serial Number	140	Laboratory Supervisor	K. Brogan

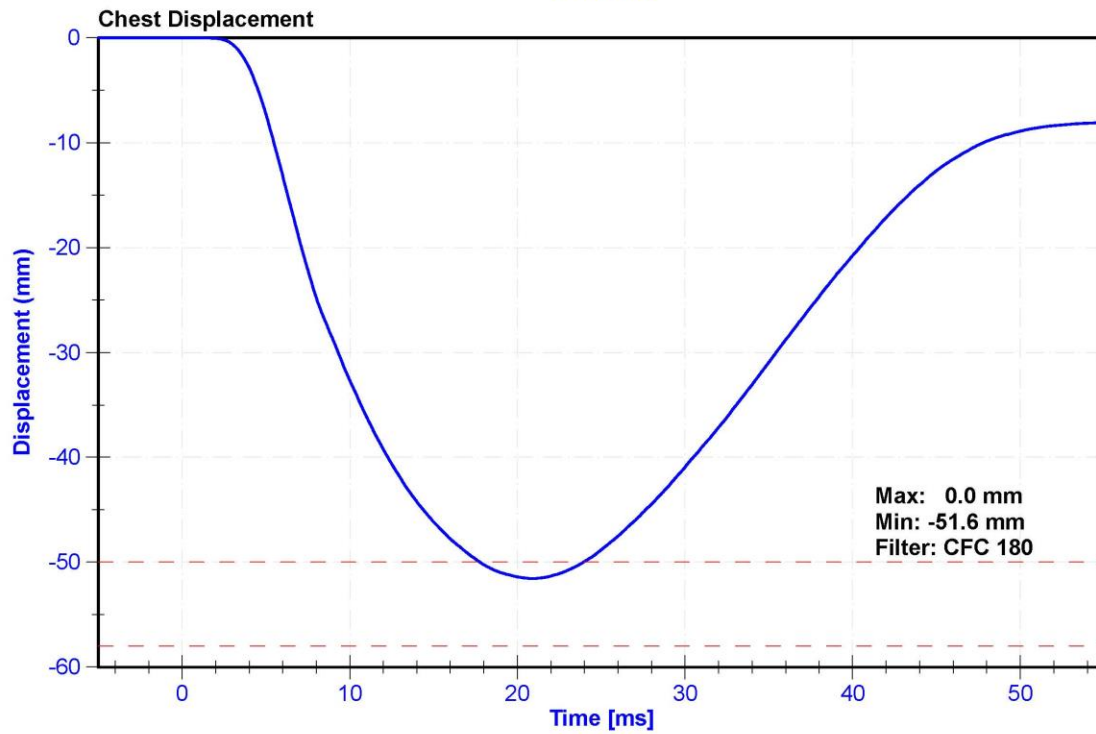
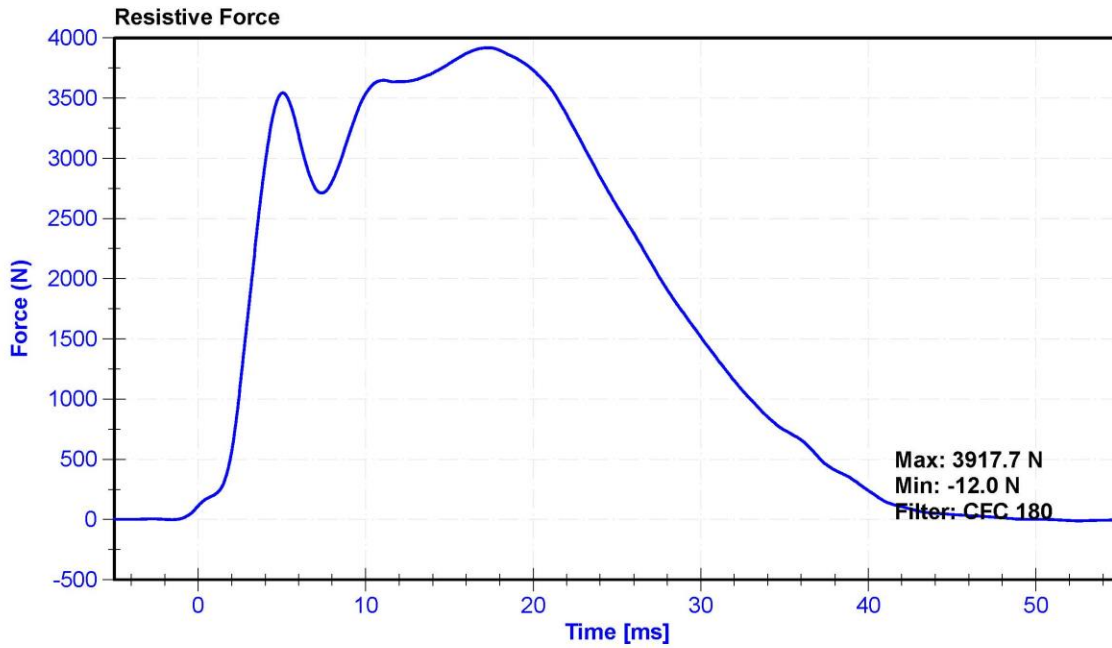
Results

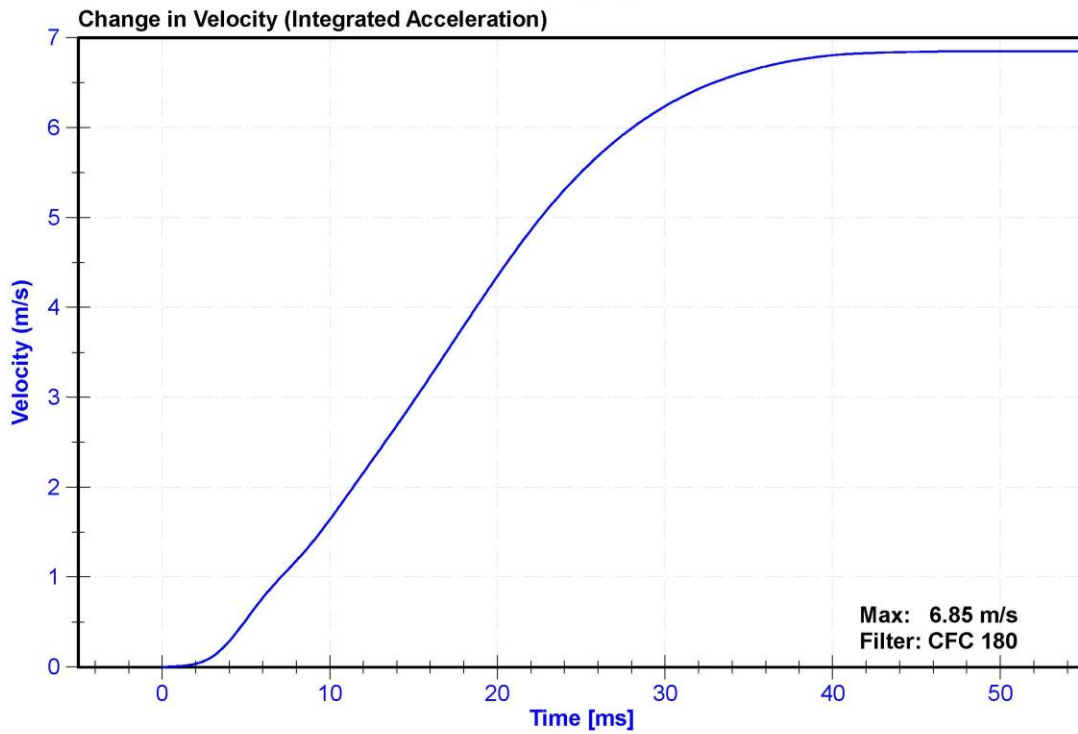
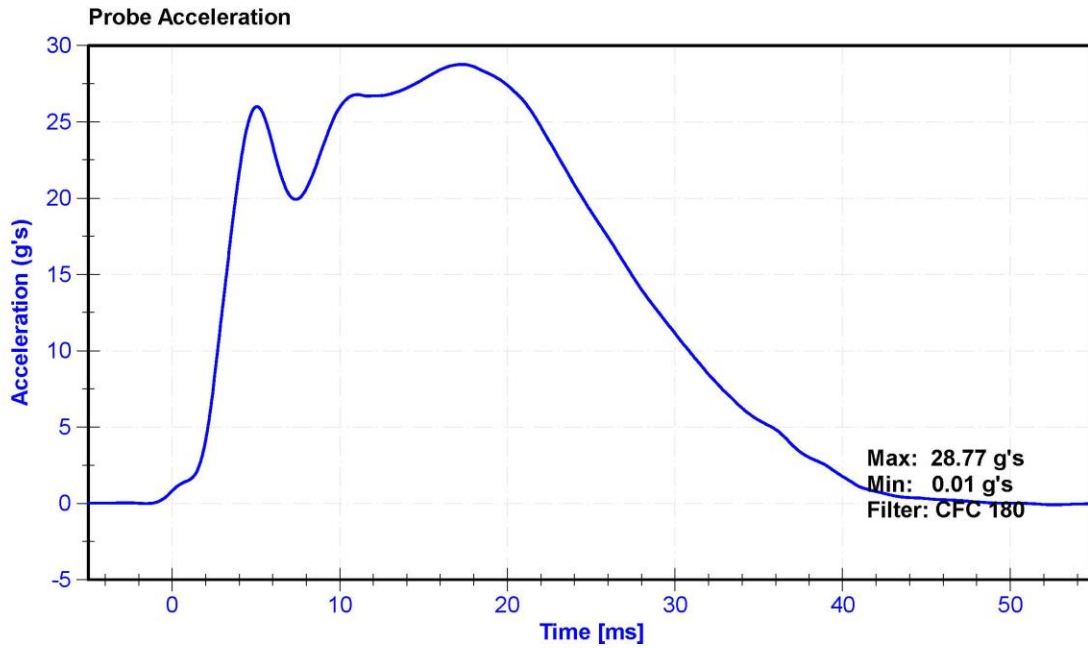
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.6	Pass
Humidity	10	70	%	24.7	Pass
Velocity	6.59	6.83	m/s	6.699	Pass
Chest Deflection	-58	-50	mm	-51.6	Pass
Maximum Resistive Force (50 to 58mm)	3900	4400	N	3909.2	Pass
Maximum Resistive Force (18 to 50mm)	0	4600	N	3917.7	Pass
Hysteresis	69	85	%	76.0	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco 7264C	AC-P94667	11/1/2018	11/1/2019
Chest Potentiometer	SERVO 14CBI-3615	DS-140GFE	11/7/2018	11/7/2019







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

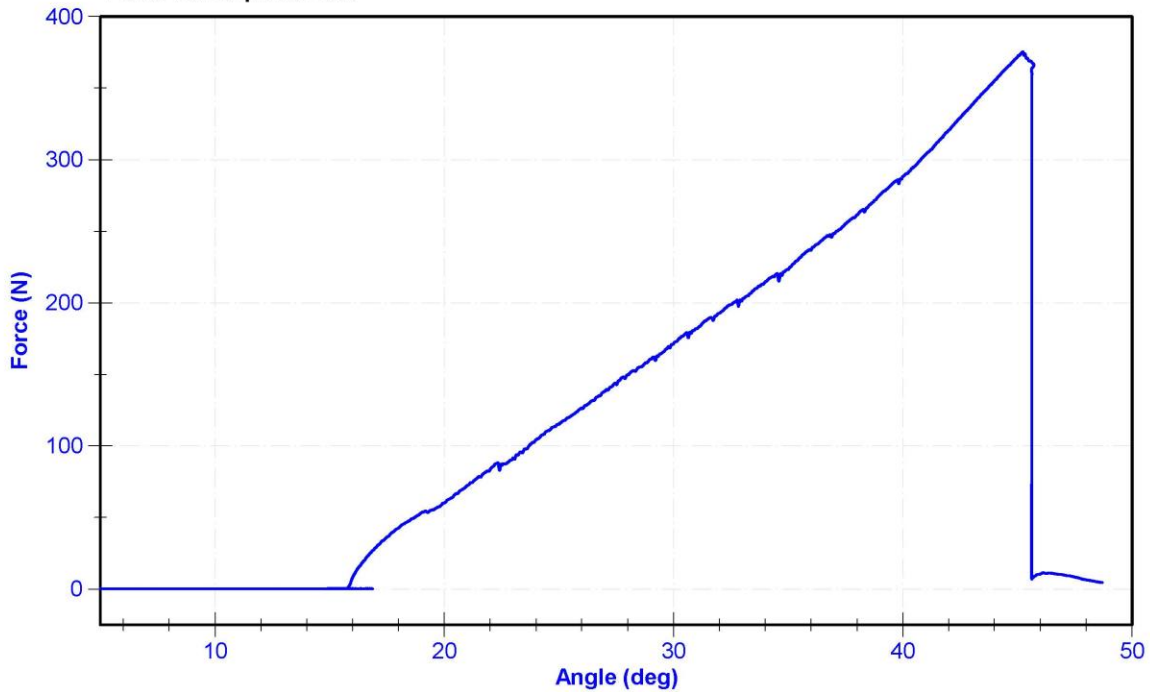
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.6	25.6	°C	22	Pass
Humidity	10	70	%	31.4	Pass
Initial Angle	0	20	deg	15.6	Pass
Force at 45 Degrees	320	390	N	375.4	Pass
Return Angle Relative to Initial	0	8	deg	6.1	Pass

Transducer Calibrations

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

Force vs. Displacement



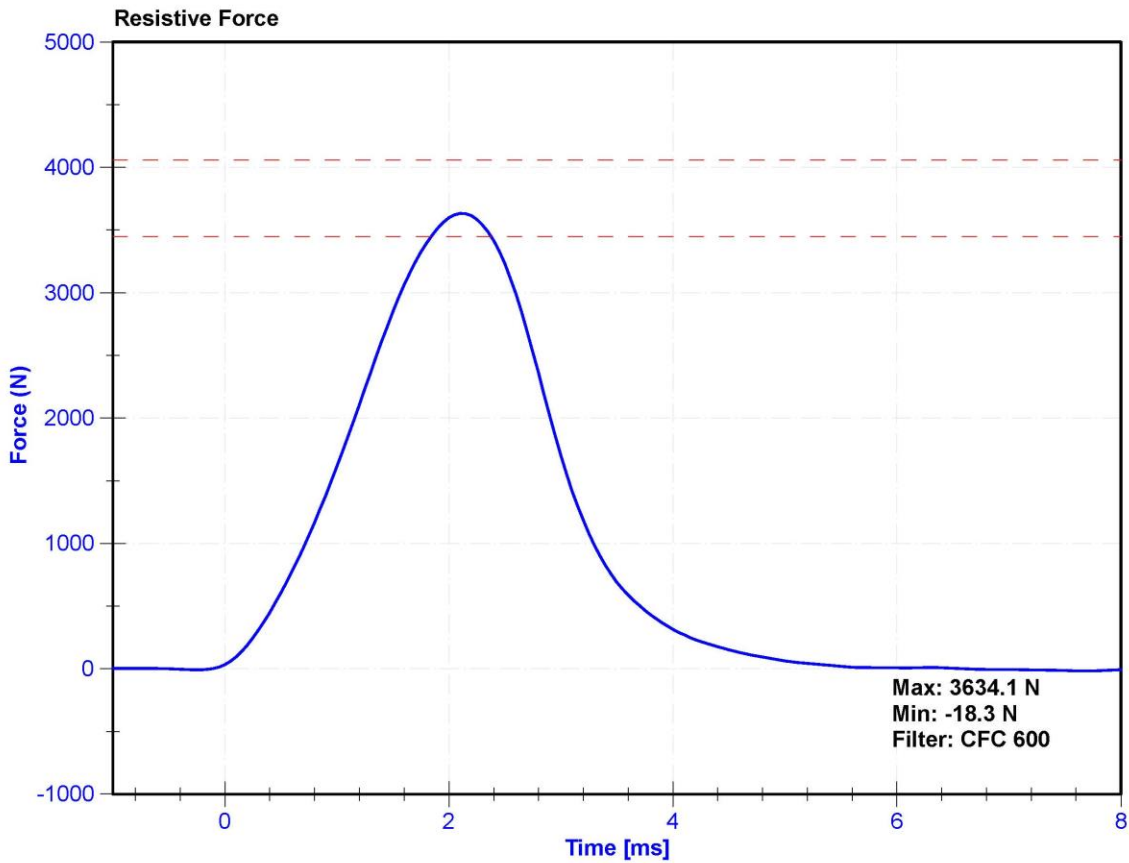
ATD Manufacturer	Humanetics	Test Technician	D.Reinhard
ATD Serial Number	140	Laboratory Supervisor	K.Brogan

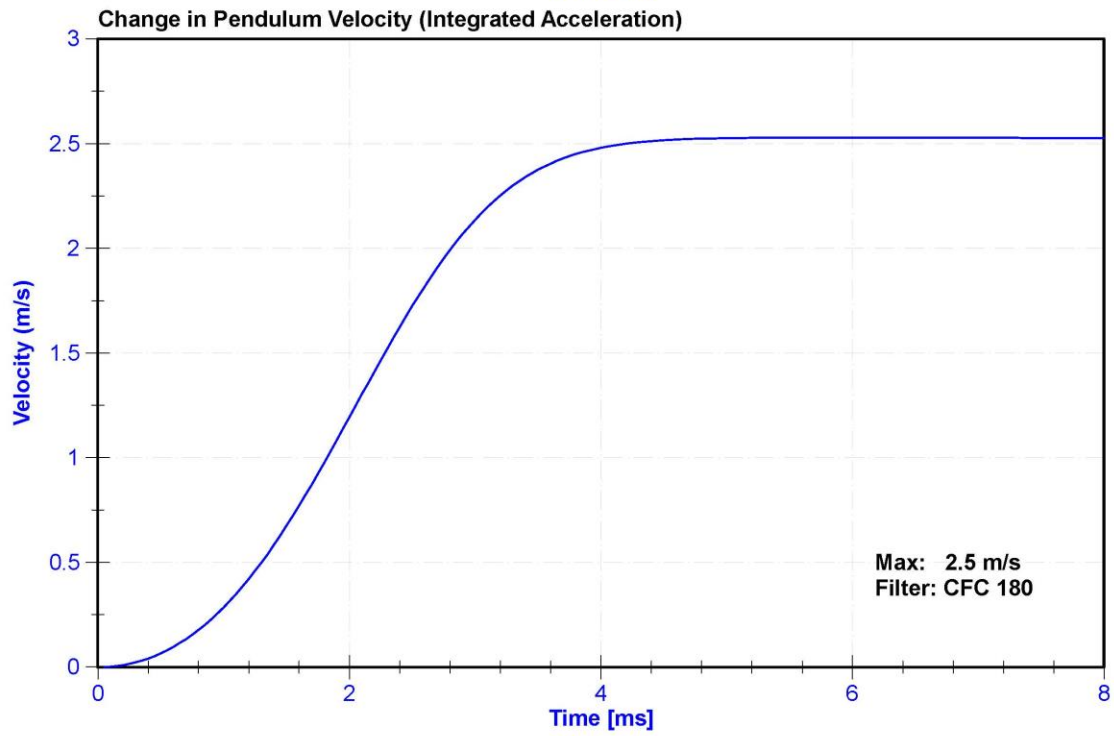
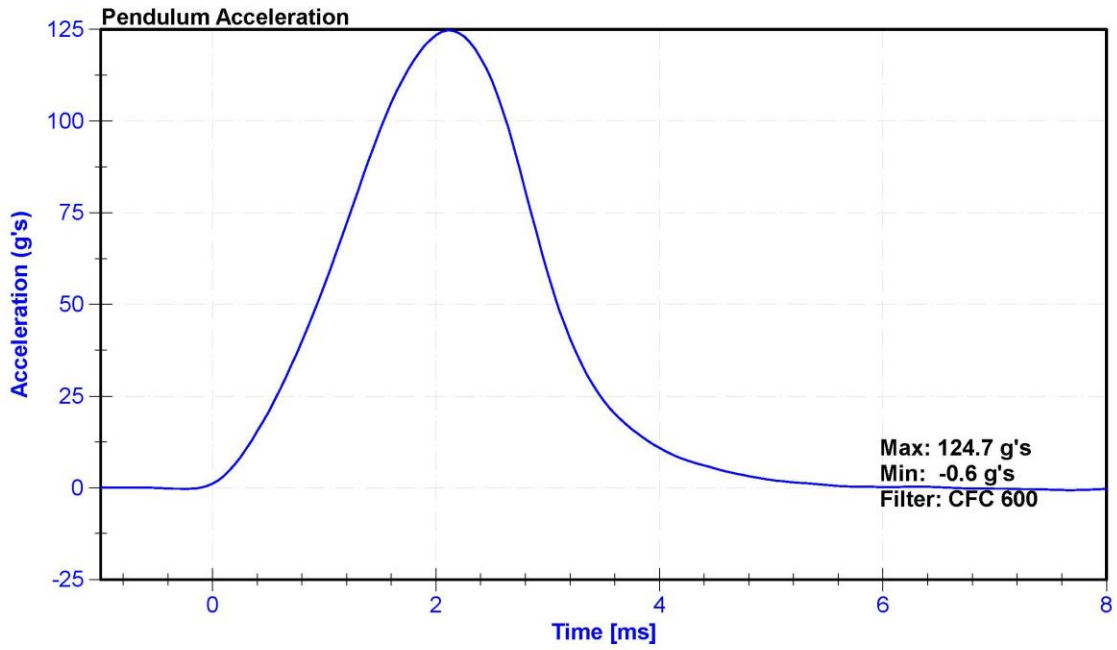
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	22.0	Pass
Humidity	10	70	%	24.1	Pass
Velocity	2.07	2.13	m/s	2.123	Pass
Resistive Force	3450	4060	N	3634.1	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7264CT	AC-P23904	11/1/2018	5/2/2019





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

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	22.0	Pass
Humidity	10	70	%	20.5	Pass
Velocity	2.07	2.13	m/s	2.117	Pass
Resistive Force	3450	4060	N	3877.8	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7264CT	AC-P23904	11/1/2018	5/2/2019

