

REPORT NUMBER: NCAP-CAL-19-004

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

**KIA Motors Mexico S.A. de C.V
2019 KIA Forte
Four Door Sedan**

NHTSA No: M20194206

**PREPARED BY:
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May 9, 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 KIA Forte four door sedan 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 February 20, 2019. The impact velocity of the vehicle was 56.21 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 421 mm at C3 to the left side of the front bumper. The test vehicle's occupant performance data is as follows: <table border="1"> <thead> <tr> <th rowspan="2">Measurement Description</th> <th rowspan="2">Units</th> <th colspan="2">Driver ATD (Serial No. 142)</th> <th colspan="2">Passenger ATD (Serial No. 139)</th> </tr> <tr> <th>Threshold</th> <th>Result</th> <th>Threshold</th> <th>Result</th> </tr> </thead> <tbody> <tr> <td>Head Injury Criteria (HIC₁₅)</td> <td></td> <td>700</td> <td>245.485</td> <td>700</td> <td>325.398</td> </tr> <tr> <td>Maximum Chest Compression</td> <td>mm</td> <td>63</td> <td>-28.541</td> <td>52</td> <td>-27.756</td> </tr> <tr> <td>Nij</td> <td></td> <td>1</td> <td>0.242</td> <td>1</td> <td>0.491</td> </tr> <tr> <td>Neck Tension</td> <td>N</td> <td>4,170</td> <td>927.639</td> <td>2,620</td> <td>661.917</td> </tr> <tr> <td>Neck Compression</td> <td>N</td> <td>4,000</td> <td>-221.678</td> <td>2,520</td> <td>-438.808</td> </tr> <tr> <td>Left Femur Force</td> <td>N</td> <td>10,008</td> <td>-327.993</td> <td>6,805</td> <td>-771.571</td> </tr> <tr> <td>Right Femur Force</td> <td>N</td> <td>10,008</td> <td>-587.916</td> <td>6,805</td> <td>-449.239</td> </tr> </tbody> </table>						Measurement Description	Units	Driver ATD (Serial No. 142)		Passenger ATD (Serial No. 139)		Threshold	Result	Threshold	Result	Head Injury Criteria (HIC ₁₅)		700	245.485	700	325.398	Maximum Chest Compression	mm	63	-28.541	52	-27.756	Nij		1	0.242	1	0.491	Neck Tension	N	4,170	927.639	2,620	661.917	Neck Compression	N	4,000	-221.678	2,520	-438.808	Left Femur Force	N	10,008	-327.993	6,805	-771.571	Right Femur Force	N	10,008	-587.916	6,805	-449.239
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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 KIA Forte four door sedan at a velocity of 56.21 km/h. The test was performed at Calspan Corporation's Transportation Test Operations facility in Buffalo, New York on February 20, 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. 139) 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 421 mm at C3 to the left 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. The right side knee contacted the driver side steering column.

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 door.

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)	245.485	0.242	927.639	-221.678	44.802	-28.541	-327.993	-587.916
Passenger (5 th)	325.398	0.491	661.917	-438.808	47.406	-27.756	-771.571	-449.239

GENERAL COMMENTS:

1. P1 (Driver) serial number - 142
2. P2 (Passenger) serial number - 139

Data Anomalies:

None.

SECTION 2

OCCUPANT AND VEHICLE INFORMATION / DATA SHEETS

This section contains information reporting for the following Data Sheets:

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

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

Data Sheet No. 3 – Dummy Longitudinal Clearance Dimensions

Data Sheet No. 4 – Dummy Lateral Clearance Dimensions

Data Sheet No. 5 – Seat Belt Positioning Data

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

Data Sheet No. 7 – Vehicle Accelerometer Locations

Data Sheet No. 8 – Photographic Reference Target Locations

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

Data Sheet No. 10 – Test Vehicle Summary of Results

Data Sheet No. 11 – Post-Test Observations

Data Sheet No. 12 – Vehicle Profile Measurements

Data Sheet No. 13 – Accident Investigation Division Data

Data Sheet No. 14 – Vehicle Intrusion Measurements

Data Sheet No. 15 – Summary of 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 KIA Forte four door sedan
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20194206
Test Date: 2/20/2019

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA No.	M20194206	Traction Control System (TCS)	Yes
Model Year	2019	Power Steering	Yes
Make	KIA	Power Window Auto-Reverse	No
Model	Forte	Driver Frontal Airbag	Yes
Body Style	Four Door Sedan	Driver Curtain Airbag	Yes
VIN	3KPF24AD7KE032256	Driver Head/Torso Airbag	No
Body Color	Red	Driver Torso Airbag	No
Odometer Reading (km /mi)	160 miles	Driver Torso/Pelvis Airbag	Yes
Engine Displacement (L)	2.0	Driver Pelvis Airbag	No
Type / No. Cylinders	I4	Driver Knee Airbag	No
Engine Placement	Transverse	Front Pass. Frontal Airbag	Yes
Transmission Type	Automatic	Front Pass. Curtain Airbag	Yes
Transmission Speeds	IVT	Front Pass. Head/Torso Airbag	No
Overdrive	Yes	Front Pass. Torso Airbag	No
Final Drive	Front Wheel Drive	Front Pass. Torso/Pelvis Airbag	Yes
Roof Rack	No	Front Pass. Pelvis Airbag	No
Sunroof / T-Top	No	Front Pass. Knee Airbag	No
Running Boards	No	Driver Pretensioner	Yes
Tilt Steering Wheel	Yes	Driver Load Limiter	Yes
Power Seats	No	Front Pass. Pretensioner	Yes
Anti-Lock Brakes (ABS)	Yes	Front Pass. Load Limiter	Yes
Automatic Door Locks (ADLs)	Yes	Other	No

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

No

DATA FROM CERTIFICATION LABEL

Manufactured By	KIA Motors Mexico S.A. de C.V	GVWR (kg)	1720
Date of Manufacture	09/18	GAWR Front (kg)	990
		GAWR Rear (kg)	950

VEHICLE SEATING AND WEIGHT CAPACITY DATA

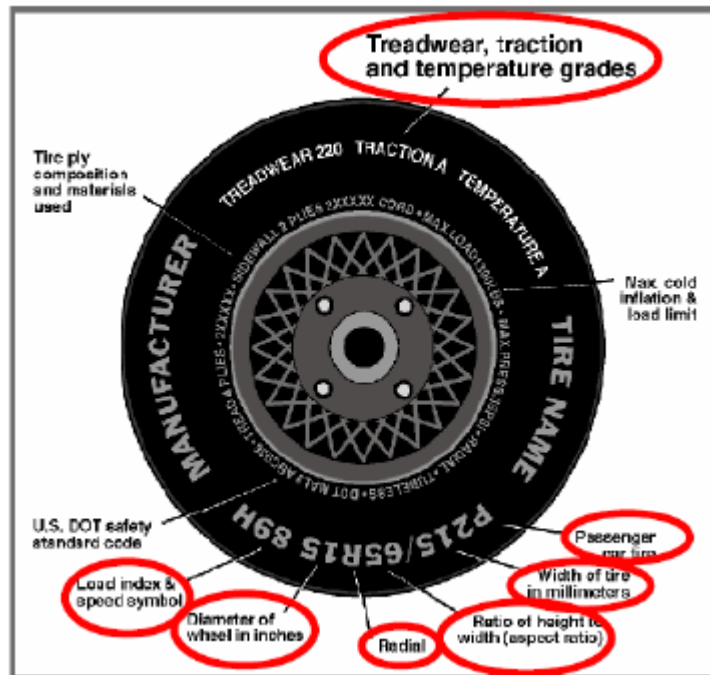
Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Bench	N/A	
Number of Occupants	2	3	-	5
Capacity Wt. (VCW) (kg)				385
Cargo Wt. (RCLW) (kg)				44.8

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

Test Vehicle: 2019 KIA Forte four door sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20194206
 Test Date: 2/20/2019

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)	230	230
Recommended Tire Size	205/55R16	205/55R16
Tire Size on Vehicle	205/55R16	205/55R16
Tire Manufacturer	Kumho	Kumho
Tire Model	Solus	Solus
Treadwear	500	500
Traction	A	A
Temperature Grades	A	A
Tire Plies Sidewall	2 Polyester	2 Polyester
Tire Plies Body	2 Steel, 1 Polyester, 1 Nylon	2 Steel, 1 Polyester, 1 Nylon
Load Index / Speed Symbol	91H	91H
Tire Material	Rubber	Rubber
DOT Safety Code Left	000 LMYAY1 3518	000 LMYAY1 3618
DOT Safety Code Right	000 LMYAY1 3518	000 LMYAY1

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

Test Vehicle: 2019 KIA Forte four door sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20194206
 Test Date: 2/20/2019

TEST VEHICLE WEIGHTS

	Units	As Delivered Weights (UVW)			As Tested Weights (ATW)		
		Front Axle	Rear Axle	Total	Front Axle	Rear Axle	Total
Left	kg	398.5	248		431	318	
Right	kg	395.5	233		428	278	
Ratio	%	62	48		59	41	
Totals	kg	794	481	1275	859	596	1455

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value	
Total Delivered Weight (UVW)	kg	1275	(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	1461.8	(A+B+C)

TEST VEHICLE ATTITUDES AND CG

Condition	Units	LF	RF	LR	RR	CG (aft of front axle)
As Delivered	mm	675	675	685	686	1019
As Tested	mm	663	668	654	657	1106
Post-Test	mm	675	710	657	635	

GENERAL TEST VEHICLE DATA

Measurement Description	Units	Value
Total Vehicle Wheel Base	mm	2701
Total Vehicle Length at Left Side	mm	4548
Total Vehicle Length at Centerline	mm	4635
Total Vehicle Length at Right Side	mm	4548
Weight of Ballast in Cargo Area	kg	0
Weight of Vehicle Components Removed	kg	36
Amount of Stoddard Solvent in Fuel Tank	L	49.2

LIST OF COMPONENTS REMOVED TO MEET TEST WEIGHT:

Rear bumper cover and beam, rear door internals and windows

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

Test Vehicle: 2019 KIA Forte four door sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20194206
 Test Date: 2/20/2019

TARGET VEHICLE STRUCTURAL MEASUREMENT

No.	Description	Pre-Test
1	Total Length	4635
2	Total Width	1768
3*	Bumper Top Height	513
4*	Bumper Bottom Height	409
5*	Longitudinal Member Top Height	519
6	Distance Between Longitudinal Members	1041
7	Longitudinal Member Width	66
8*	Engine Top Height	813
9*	Engine Bottom Height	187
10	Engine and Gearbox Width	497
11	Front Bumper-Engine Distance	625
12*	Front Shock Absorber Fixing Height	843
13*	Bonnet Leading Edge Height	765
14	Front Shock Absorber Fixing Width	1170
15	Front Bumper – Front Axle Distance	897
16	Front Axle – A Pillar Distance	450
17	A-Pillar – B-Pillar Distance	1143
18	B-Pillar – Rear Axle Distance	1108
19	B-Pillar – C-Pillar Distance	960
20*	Roof Sill Bottom Height	1275
21*	Roof Sill Top Height	1344
22*	Floor Sill Bottom Height	251
23*	Floor Sill Top Height	348

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

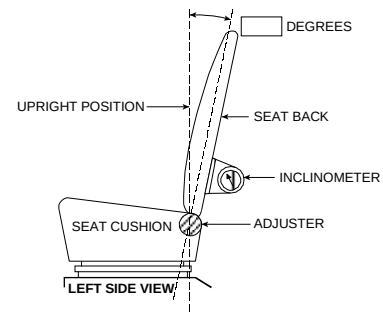
DATA SHEET NO. 2 SEAT ADJUSTMENT, FUEL SYSTEM, AND STEERING WHEEL DATA

Test Vehicle: 2019 KIA Forte four door sedan
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20194206
Test Date: 2/20/2019

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

SEAT FORE / AFT POSITIONS

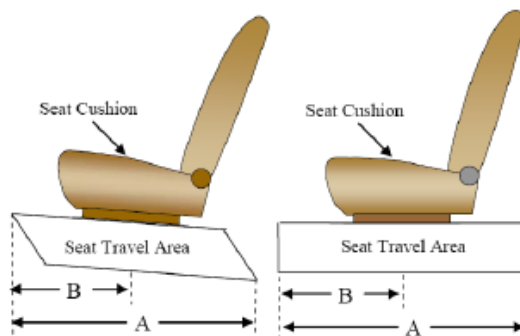
The driver's seat was positioned at the mid-point of fore/aft travel at its lowest position. The passenger's seat was positioned at the most forward position of fore/aft travel. Zero is defined as the forward most position.

Seating Position	Total Fore / Aft Travel	Placed in Position #
Driver Seat	38 (0-37)	14
Passenger Seat	38 (0-37)	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	3	0
Passenger Seat	3	0



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

Test Vehicle: 2019 KIA Forte four door sedan
 Test Program: NCAP Frontal Barrier Impact Test

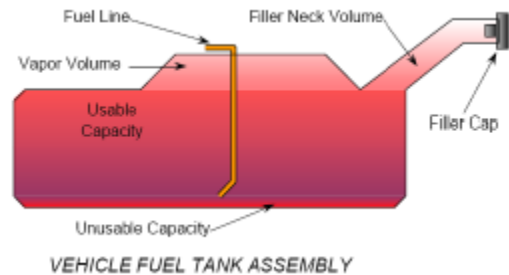
NHTSA No.: M20194206
 Test Date: 2/20/2019

FUEL TANK CAPACITY

Description	Liters
Usable Capacity of "Standard Tank"	53
Usable Capacity of "Optional Tank"	N/A
92%-94% of Usable Capacity	48.76 – 49.82
Actual Amount of Solvent Used	49.2
1/3 of Usable Capacity	17.6

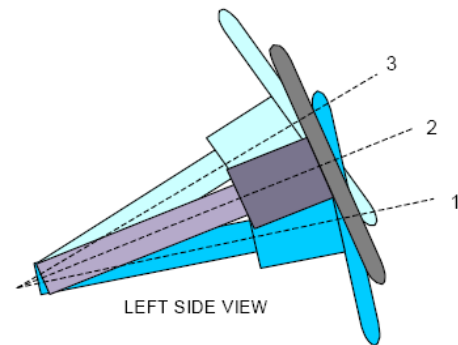
FUEL PUMP

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 ASSEMBLY

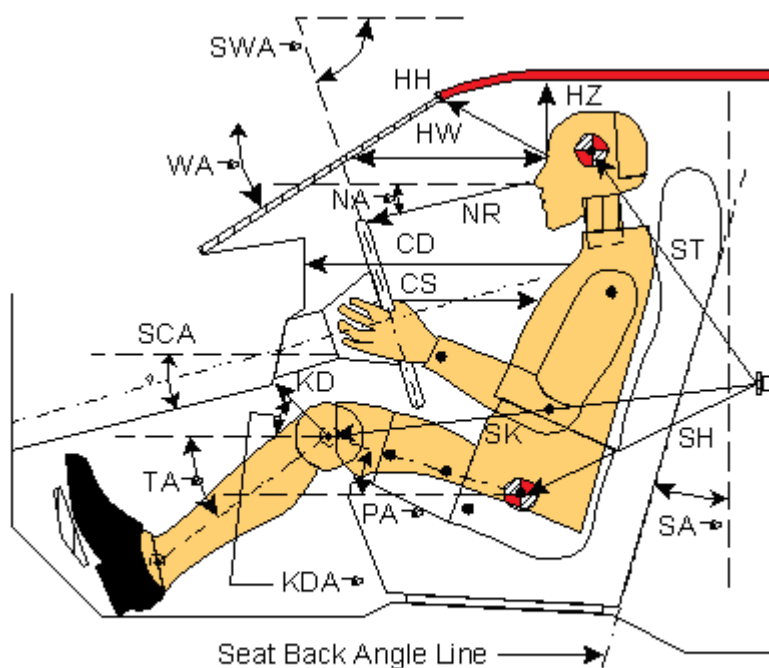
STEERING COLUMN POSITIONS

Description	Degrees	Fore / Aft Position (mm)
Lowermost position No. 1	20.8	
Geometric center position No. 2	22.8	
Uppermost position No. 3	25.8	
Telescoping Steering Wheel Travel		50
Test Position	22.8	25

DATA SHEET NO. 3 DUMMY LONGITUDINAL CLEARANCE DIMENSIONS

Test Vehicle: 2019 KIA Forte four door sedan
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20194206
Test Date: 2/20/2019



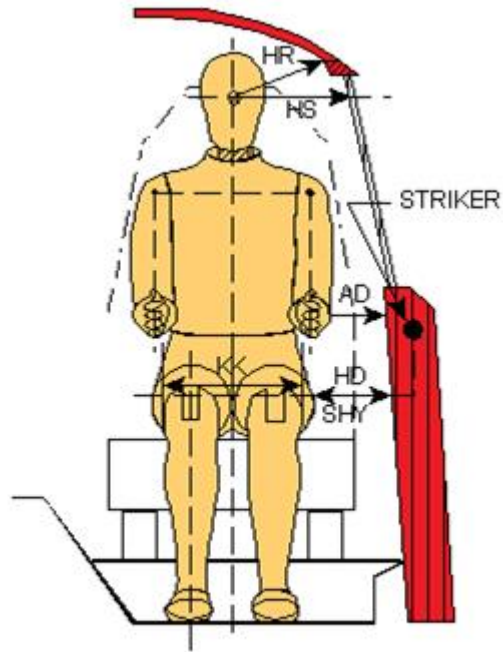
Left Side View

Code	Measurement Description	Driver (SN: 142)		Passenger (SN: 139)	
		Length (mm)	Angle (°)	Length (mm)	Angle (°)
WA°	Windshield Angle		26.4		
SWA°	Steering Wheel Angle		67.5		
SCA°	Steering Column Angle		22.5		
SA°	Seat Back Angle (on headrest post)		1.6		1.4
HZ	Head to Roof (Z)	187	90	192	90
HH	Head to Header	357	18.2	282	46.5
HW	Head to Windshield	698	0	687	0
NR	Nose to Rim	394	7.4	456	29.5
CD	Chest to Dash	528		408	
CS	Chest to Steering Hub	305	3.5		
RA	Rim to Abdomen	207	0		
KDL	Left Knee to Dash	205	36.2	121	40.2
KDR	Right Knee to Dash	175	35.4	137	37.9
PA°	Pelvic Angle		23.5		18.9
TA°	Tibia Angle		26.9		35.8
SK	Striker to Knee	585	-18.9	695	-17.5
ST	Striker to Head	355	76.9	363	37.1
SH	Striker to H-Point	345	35.2	415	45.8

DATA SHEET NO. 4
DUMMY LATERAL CLEARANCE DIMENSIONS

Test Vehicle: 2019 KIA Forte four door sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20194206
 Test Date: 2/20/2019



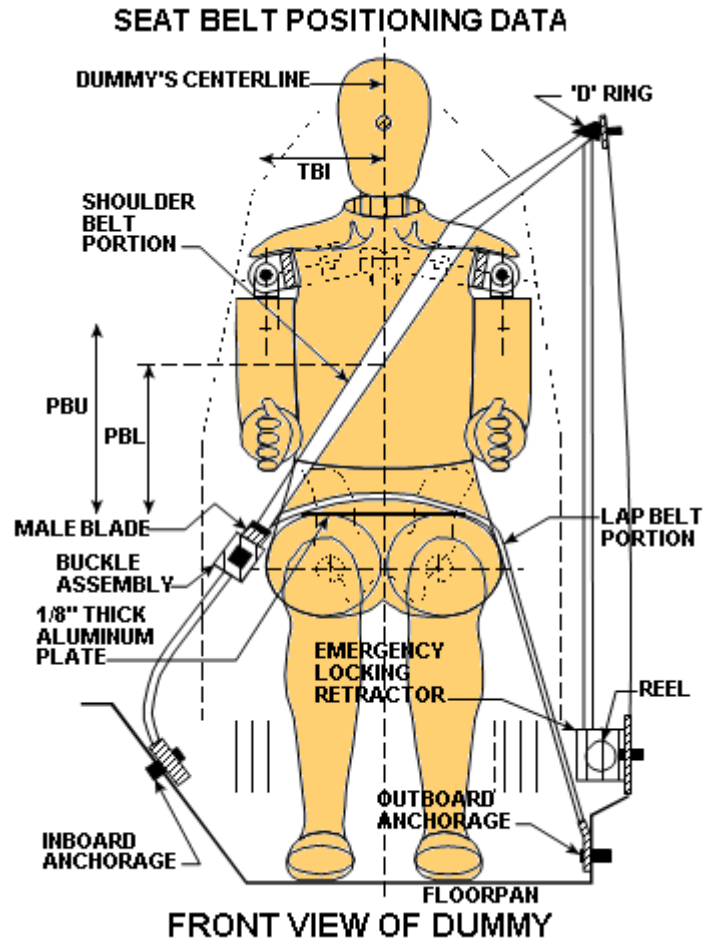
Front View

Code	Description	Driver (mm)	Passenger (mm)
AD	Arm to Door	117	113
HD	H-Point to Door	160	191
HR	Head to Side Header	214	240
HS	Head to Side Window	349	358
KK	Knee to Knee	365	245
SHY	Striker to H-Point (Y Direction)	235	275
AA	Ankle to Ankle	397	180

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

Test Vehicle: 2019 KIA Forte four door sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20194206
 Test Date: 2/20/2019



SEAT BELT POSITIONING MEASUREMENTS

Measurement Description	Units	Driver	Passenger
PBU — Top surface of reference to belt upper edge	mm	325	295
PBL — Top surface of reference to belt lower edge	mm	250	210

BELT LENGTH DATA

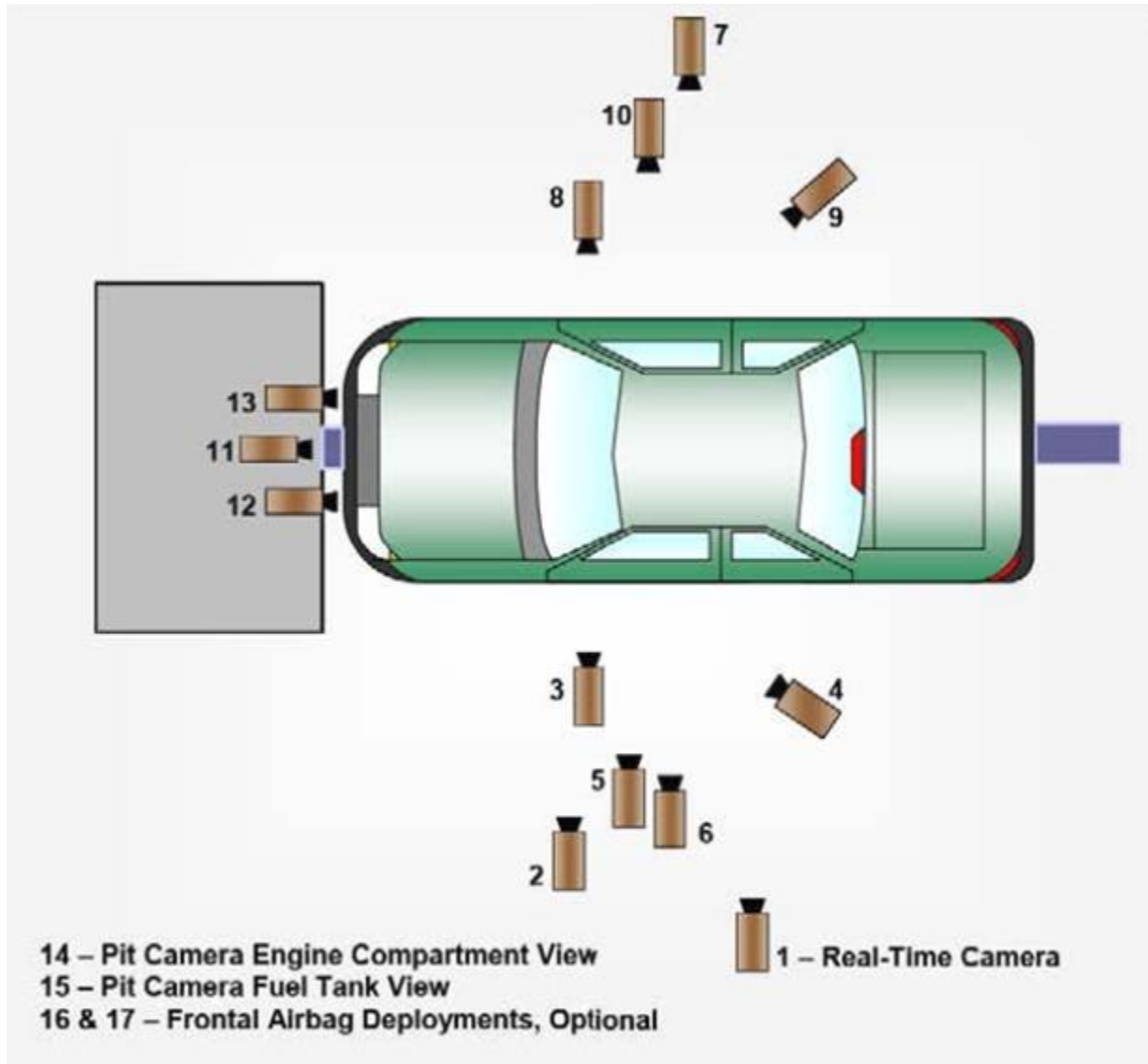
Measurement Description	Units	Driver	Passenger
Shoulder belt length as measured on ATD	mm	875	920
Lap Belt Length as measured on ATD	mm	815	935
Remainder of belt on reel	mm	660	595
Total belt length for continuous webbing systems	mm	2350	2450

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

Test Vehicle: 2019 KIA Forte four door sedan
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20194206
Test Date: 2/20/2019

CAMERA POSITIONS FOR FRONTAL IMPACTS



Top View

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

Test Vehicle: 2019 KIA Forte four door sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20194206
 Test Date: 2/20/2019

CAMERA LOCATIONS

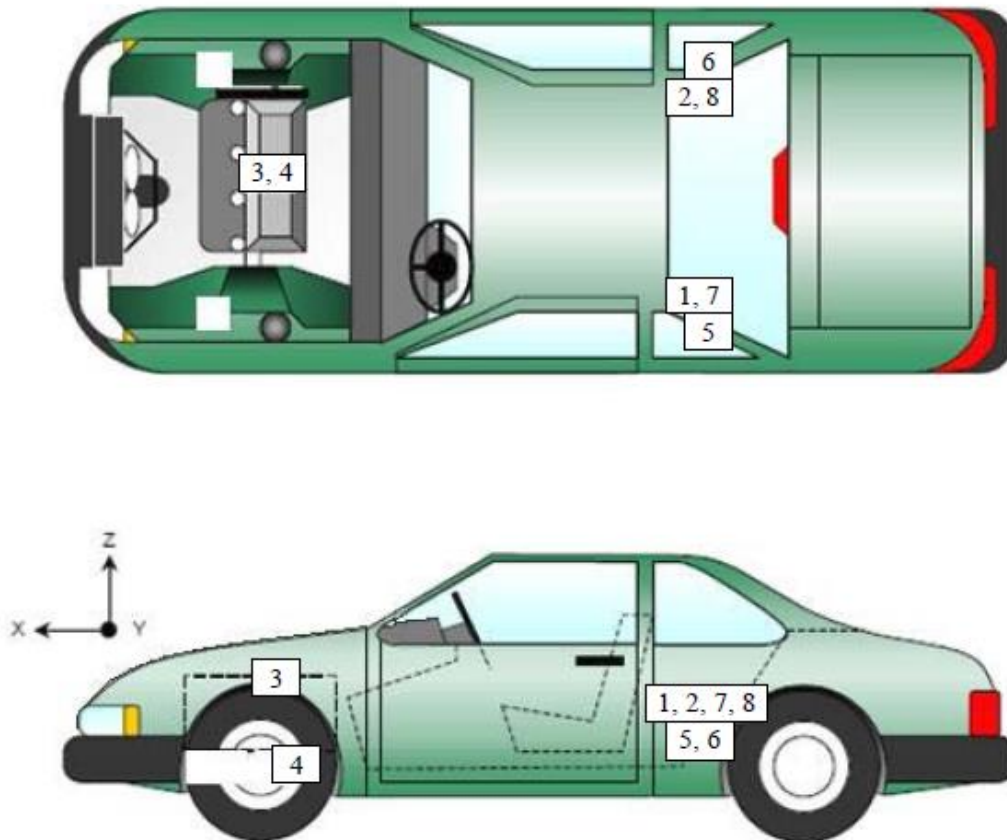
No.	Camera View	Location (mm)			Lens (mm)	Speed (fps)
		X	Y	Z		
1	Real-Time Left Overall	-	-	-		60
2	Driver Close-Up	-1625	-6747	-1419	50	1000
3	Left Front Half	-1151	-5247	-1148	28	1000
4	Left Angle	-4359	-4925	-2386	50	1000
5	Steering Column - Top					
6	Steering Column - Bottom					
7	Right Overall	-1789	6947	-1264	24	1000
8	Passenger Close-Up	-1428	6872	-1458	50	1000
9	Right Front Half	-1046	5331	-1135	28	1000
10	Right Angle	-4348	5118	-2437	50	1000
11	Windshield	1200	0	-3471	20	1000
12	Driver Windshield	400	400	-2175	12.5	1000
13	Passenger Windshield	400	400	-2175	12.5	1000
14	Pit Front	-1127	0	2469	12.5	1000
15	Pit Rear	-2592	0	2469	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 KIA Forte four door sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20194206
 Test Date: 2/20/2019



VEHICLE ACCELEROMETER PRE-TEST LOCATIONS

No.	Accelerometer Location	Measurements (mm)		
		X	Y	Z
1	Left Rear Accelerometer – X Direction	1874	-327	353
2	Right Rear Accelerometer – X Direction	1874	317	355
3	Engine Top X	3916	207	-205
4	Engine Bottom X	4249	-135	444
5	Left Rear Accelerometer – Z Direction	1874	-327	353
6	Right Rear Accelerometer – Z Direction	1874	317	355
7	Left Rear Accelerometer – X Direction Redundant	1874	-344	353
8	Right Rear Accelerometer – X Direction Redundant	1874	317	355

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

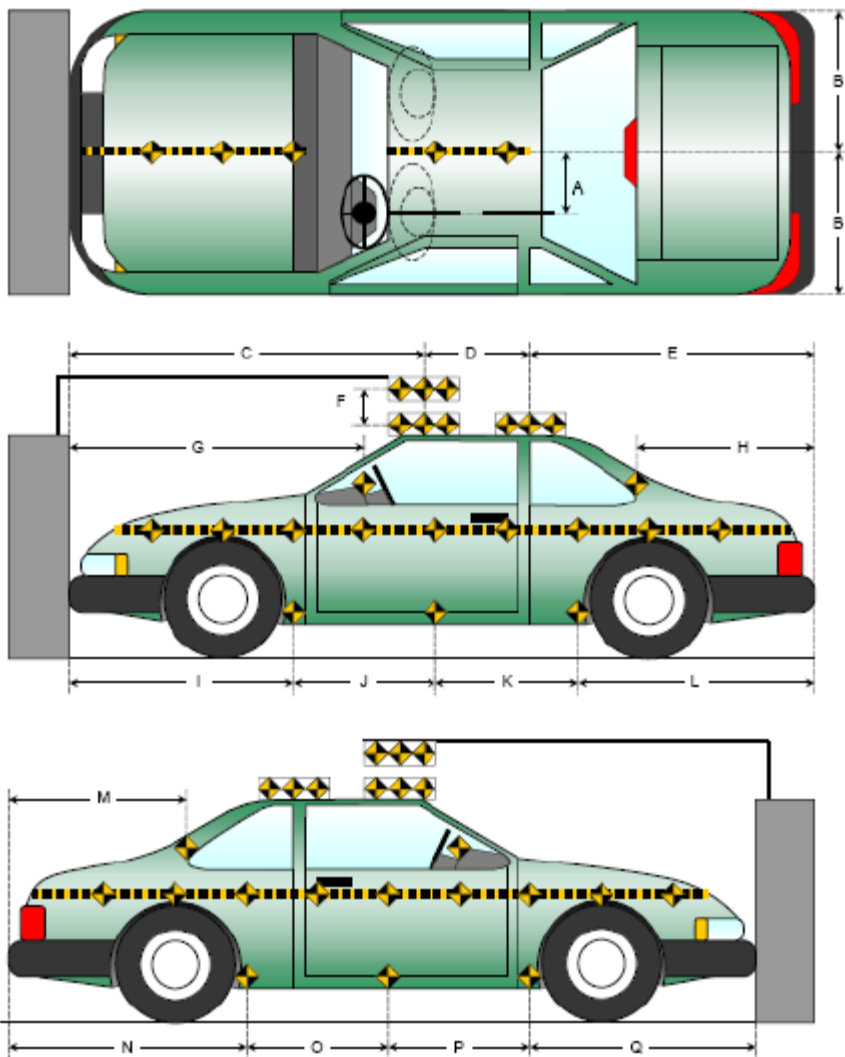
DATA SHEET NO. 8
PHOTOGRAPHIC REFERENCE TARGET LOCATIONS

Test Vehicle: 2019 KIA Forte four door sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20194206
 Test Date: 2/20/2019

Item	Value
A	332
B	884
C	2705
D	611
E	1319
F	290
G	1721
H	1242
I	1321
J	929
K	917
L	1468
M	1260
N	1462
O	923
P	923
Q	1327

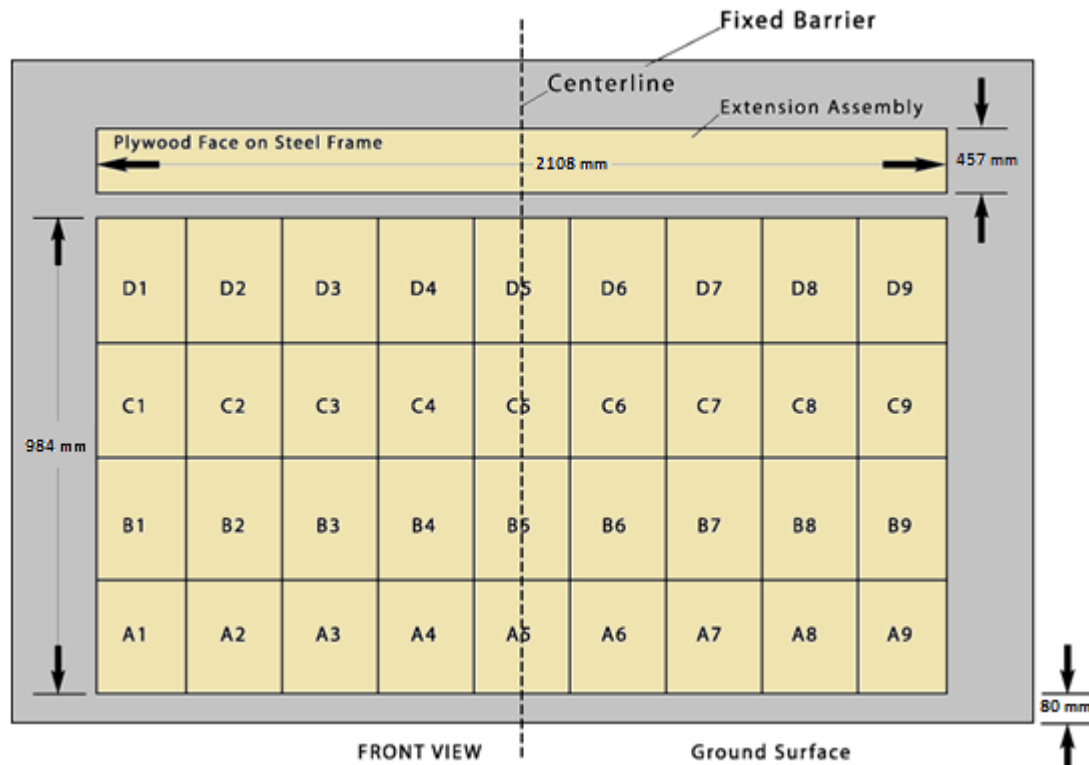
All units in millimeters



DATA SHEET NO. 9
LOAD CELL LOCATIONS ON FIXED BARRIER

Test Vehicle: 2019 KIA Forte four door sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20194206
 Test Date: 2/20/2019



*** Load cell Barrier was not used**

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 KIA Forte four door sedan
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20194206
Test Date: 2/20/2019

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 KIA Forte four door sedan
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20194206
Test Date: 2/20/2019

TEST DUMMY INFORMATION AND CONTACT LOCATIONS

Description	Driver	Passenger
Dummy Type / Serial No.	P572E 50 th Male / 142	P5720 5 th Female / 139
Head Contact	Frontal Air bag & Head Restraint	Frontal Air bag & Head Restraint
Upper Torso Contact	Frontal Air bag	Frontal Air bag
Lower Torso Contact	None	None
Left Knee Contact	None	Glove Box Door
Right Knee Contact	Dash Panel/Steering Column	Glove Box Door

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	Cracked from air bag deployment
Window Damage	None
Other Notable Effects	None

VEHICLE REBOUND FROM BARRIER

Measured Parameter	Units	Value
Left Side	mm	1121
Center	mm	1134
Right Side	mm	1096
Average	mm	1117

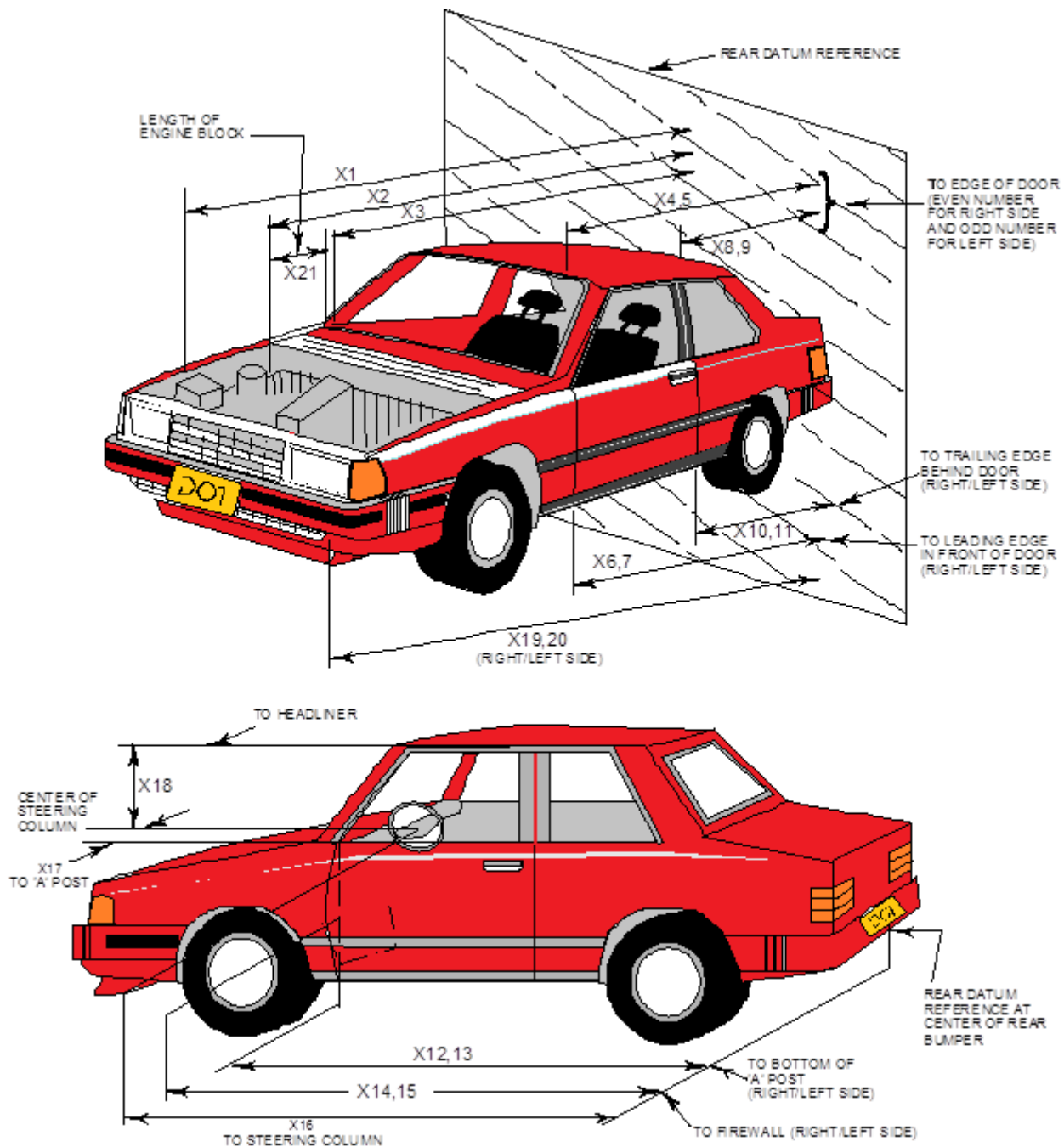
SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

Restraint Type	Driver		Passenger	
	Installed	Deployed	Installed	Deployed
Front Airbag	Yes	Yes	Yes	Yes
Side Airbag 1 - Curtain	Yes	No	Yes	No
Side Airbag 2 - Torso/Pelvis Airbag	Yes	No	Yes	No
Knee Airbag	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 KIA Forte four door sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20194206
 Test Date: 2/20/2019



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

Test Vehicle: 2019 KIA Forte four door sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20194206
 Test Date: 2/20/2019

No.	Measurement Description	Pre-Test	Post-Test	Difference
1	Total Length of Vehicle at Centerline	4635	4224	-411
2	Rear Surface of Vehicle (RSOV) to Front of Engine	4011	3796	-215
3	RSOV to Firewall	3674	3660	-14
4	RSOV to Upper Leading Edge of Right Door	3286	3291	5
5	RSOV to Upper Leading Edge of Left Door	3288	3284	-4
6	RSOV to Lower Leading Edge of Right Door	3276	3275	-1
7	RSOV to Lower Leading Edge of Left Door	3275	3273	-2
8	RSOV to Upper Trailing Edge of Right Door	2146	2151	5
9	RSOV to Upper Trailing Edge of Left Door	2146	2144	-2
10	RSOV to Lower Trailing Edge of Right Door	2166	2168	2
11	RSOV to Lower Trailing Edge of Left Door	2164	2162	-2
12	RSOV to Bottom of "A" Post of Right Side	3350	3355	5
13	RSOV to Bottom of "A" Post of Left Side	3351	3349	-2
14	RSOV to Firewall, Right Side	3695	3691	-4
15	RSOV to Firewall, Left Side	3693	3682	-11
16	RSOV to Steering Column	2753	2823	70
17	Center of Steering Column to "A" Post	277	282	5
18	Center of Steering Column to Headliner	397	421	24
19	RSOV to Right Side of Front Bumper	4588	4227	-361
20	RSOV to Left Side of Front Bumper	4589	4272	-317
21	Length of Engine Block	253	253	0
RD	RSOV to Right Side of Dash Panel	2966	2970	4
CD	RSOV to Center of Dash Panel	2935	2942	7
LD	RSOV to Left Side of Dash Panel	2967	2968	1

All Dimensions in mm

DATA SHEET NO. 13
ACCIDENT INVESTIGATION DIVISION DATA

Test Vehicle: 2019 KIA Forte four door sedan
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20194206
Test Date: 2/20/2019

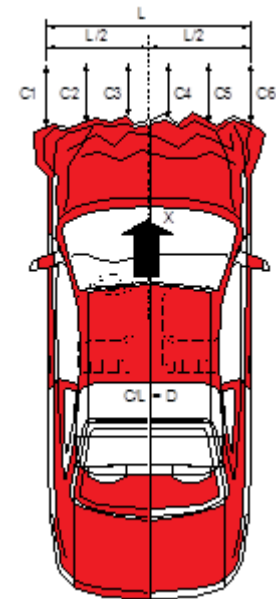
VEHICLE INFORMATION

VIN: 3KPF24AD7KE032256
Vehicle Size Category: Passenger Car

Wheelbase (mm): 2701
Test Weight (kg): 1455

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): 56.21
Velocity Change (km/h): 66.19
Time of Separation (ms): 125



CRUSH PROFILE

Collision Deformation Classification: 12FDEW2
Midpoint of Damage: C3
Damage Region Length (mm): 1404
Impact Mode: Frontal

No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
C1	Crush Zone 1 at Left Side	mm	4453	4120	333
C2	Crush Zone 2 at Left Side	mm	4584	4174	410
C3	Crush Zone 3 at Left Side	mm	4629	4208	421
C4	Crush Zone 4 at Right Side	mm	4628	4218	410
C5	Crush Zone 5 at Right Side	mm	4581	4229	352
C6	Crush Zone 6 at Right Side	mm	4450	4228	222
L	C1 to C6	mm	1404	1380	24

DATA SHEET NO. 14
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2019 KIA Forte four door sedan
Test Program: NCAP Frontal Barrier Impact Test

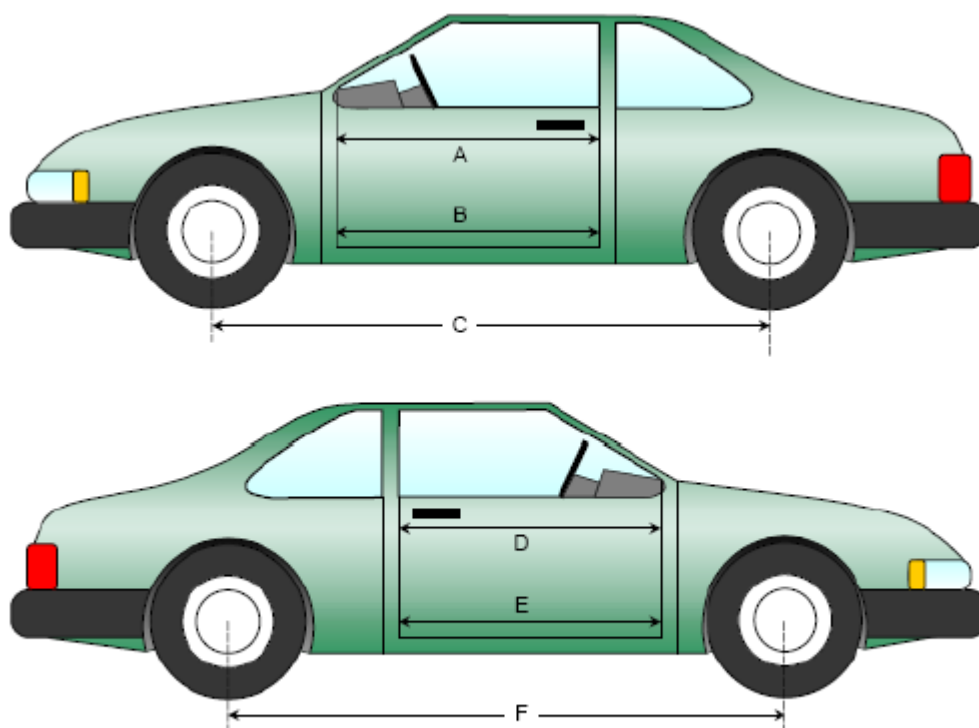
NHTSA No.: M20194206
Test Date: 2/20/2019

DOOR OPENING WIDTH

Item	Description	Units	Pre-Test	Post-Test	Difference
A	Left Side Upper	mm	1018	1017	-1
B	Left Side Lower	mm	907	906	-1
D	Right Side Upper	mm	1018	1018	0
E	Right Side Lower	mm	904	903	-1

WHEELBASE MEASUREMENTS

Item	Description	Units	Pre-Test	Post-Test	Difference
C	Left Side Wheelbase	mm	2701	2651	-50
F	Right Side Wheelbase	mm	2701	2669	-32



Left & Right Side Views

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

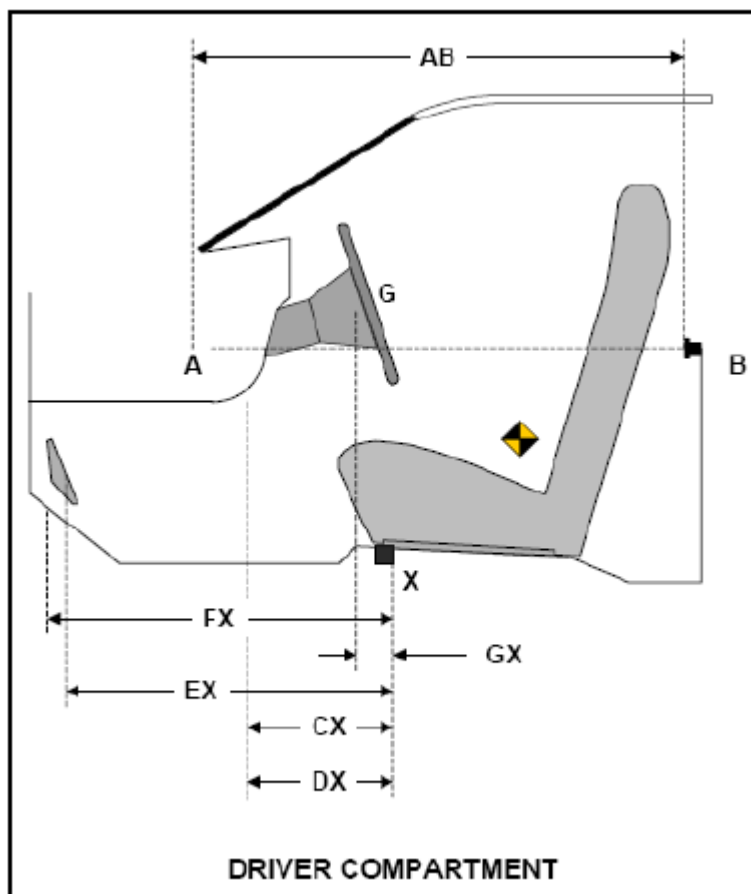
Test Vehicle: 2019 KIA Forte four door sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20194206
 Test Date: 2/20/2019

DRIVER COMPARTMENT INTRUSION

Item	Description	Units	Pre-Test	Post-Test	Difference
AB	Door Opening (Inside Window Jam)	mm	791	792	1
CX	Left Knee Bolster to X	mm	302	303	1
DX	Right Knee Bolster to X	mm	289	295	6
EX	Brake Pedal to X	mm	576	547	-29
FX	Foot Rest to X	mm	621	599	-22
GX	Center of Steering Column Wheel Hub to X	mm	63	132	69

X = Front of Seat Track (Stationary)



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

Test Vehicle: 2019 KIA Forte four door sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20194206
 Test Date: 2/20/2019

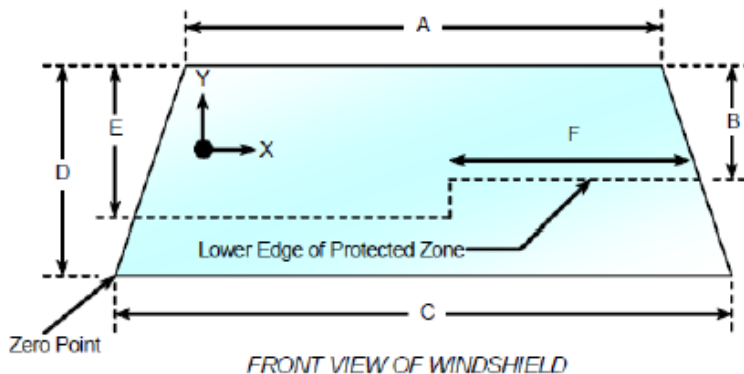
Windshield Mounting Details: A 0.8 mm trim surrounds the top and side of windshield while a plastic shroud is on the bottom.

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	2163	2163	100.0%
Right Side	2163	2163	100.0%
Total	4325	4325	100.0%



Item	Units	Value
A	mm	1175
B	mm	475
C	mm	1430
D	mm	860
E	mm	480
F	mm	510

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 KIA Forte four door sedan
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20194206
Test Date: 2/20/2019

FMVSS 301 FUEL SYSTEM INTEGRITY POST IMPACT DATA

Temperature at Time of Impact: 21 ° C

Test Time: 9:09 AM

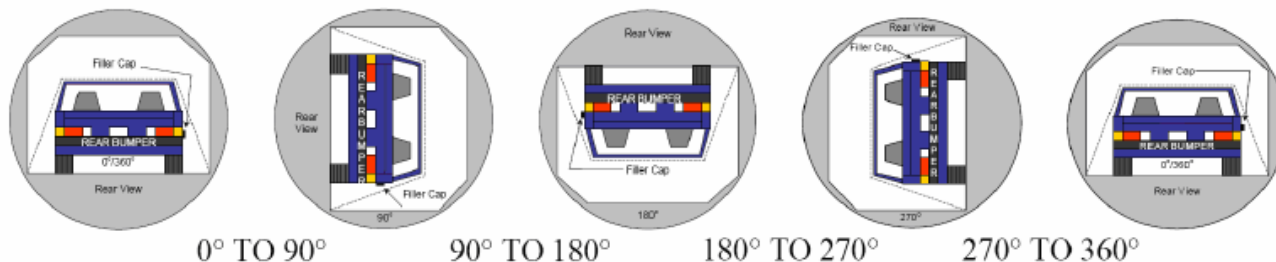
STODDARD SOLVENT SPILLAGE MEASUREMENTS

- 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 KIA Forte four door sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20194206
 Test Date: 2/20/2019



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°	82	300	382
90° to 180°	75	300	375
180° to 270°	75	300	375
270° to 360°	68	300	368

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	

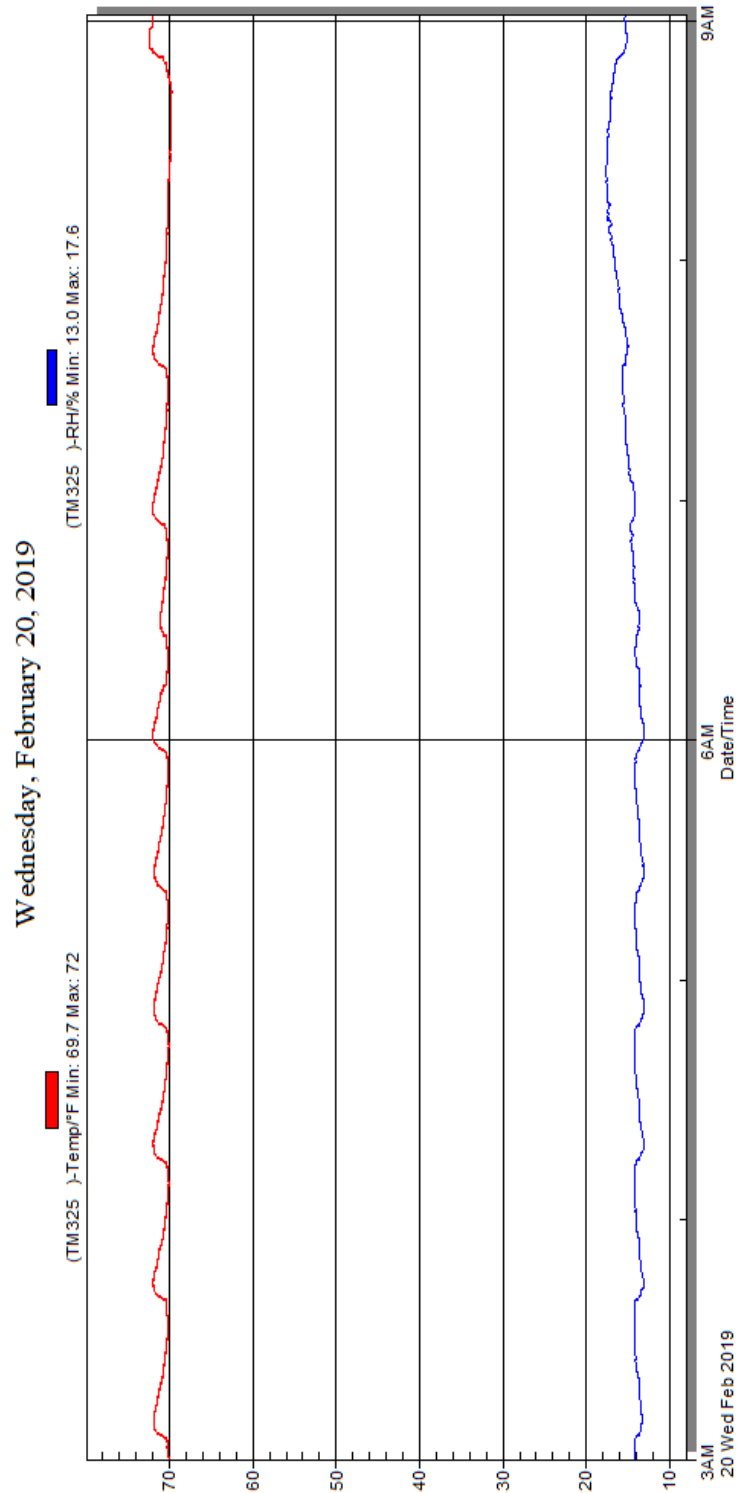
SOLVENT SPILLAGE LOCATION TABLE

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 KIA Forte four door sedan
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20194206
Test Date: 2/20/2019



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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77	Vehicle at 360° on Static Rollover Device	A-43
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¹**NOTE:** *The underbody views should include the following vehicle components: fuel pump, fuel lines, sender unit, fuel tank filler pipe and any other visible system components.*

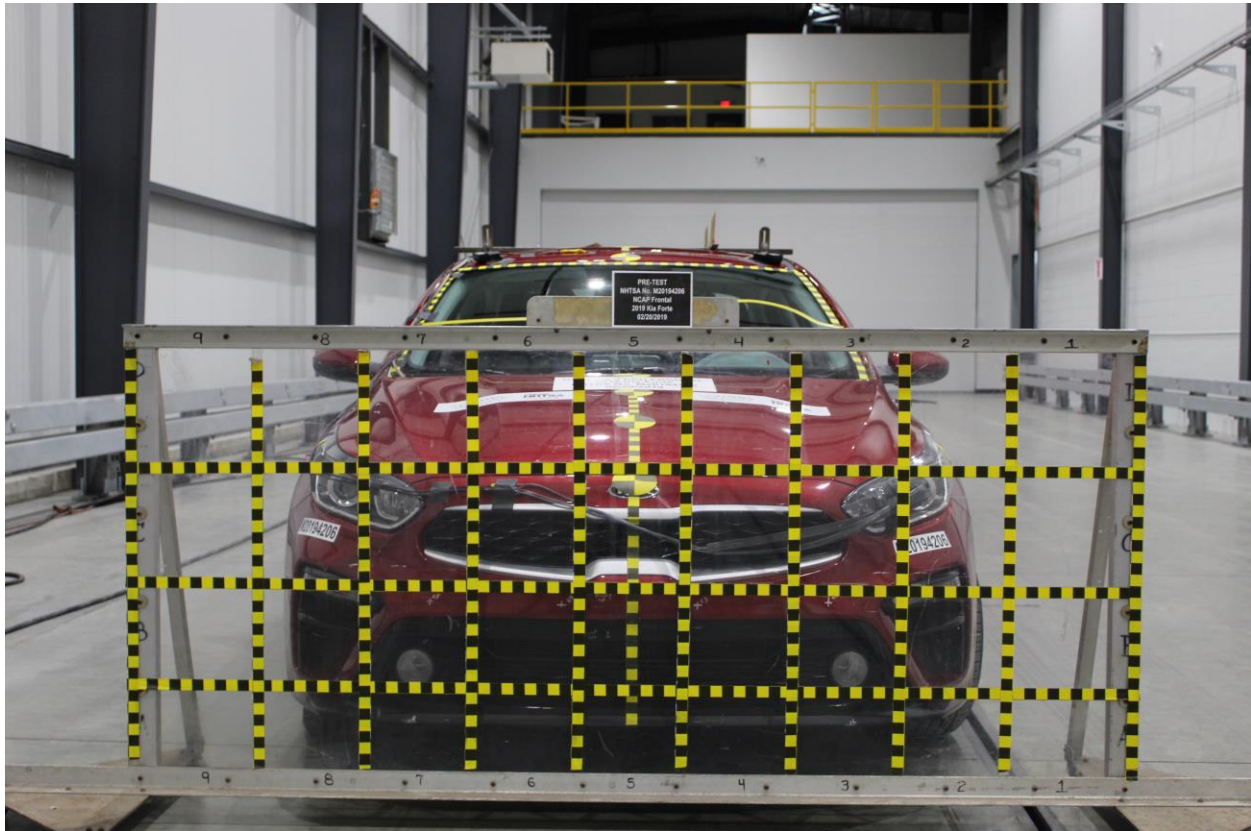


Figure A-1: Load Cell Location

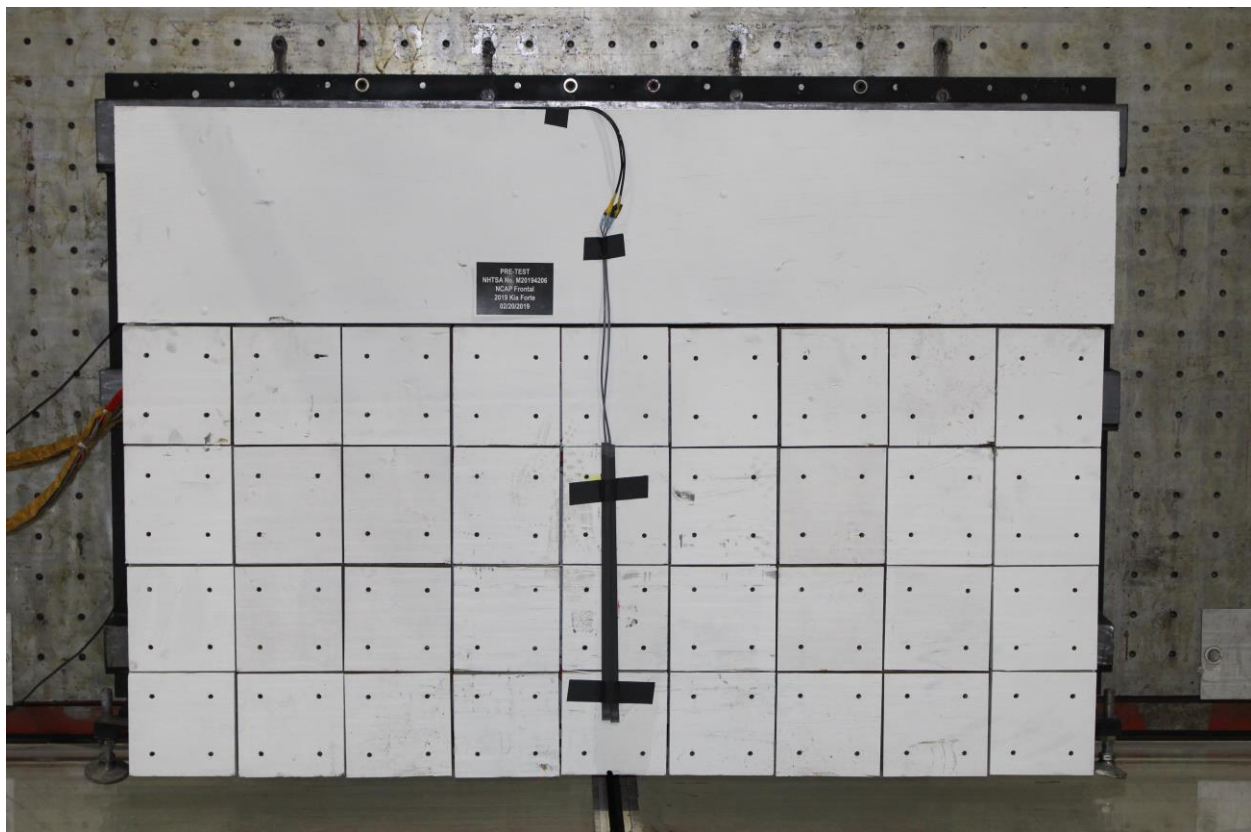


Figure A-2: Pre-Test Load Cell Wall

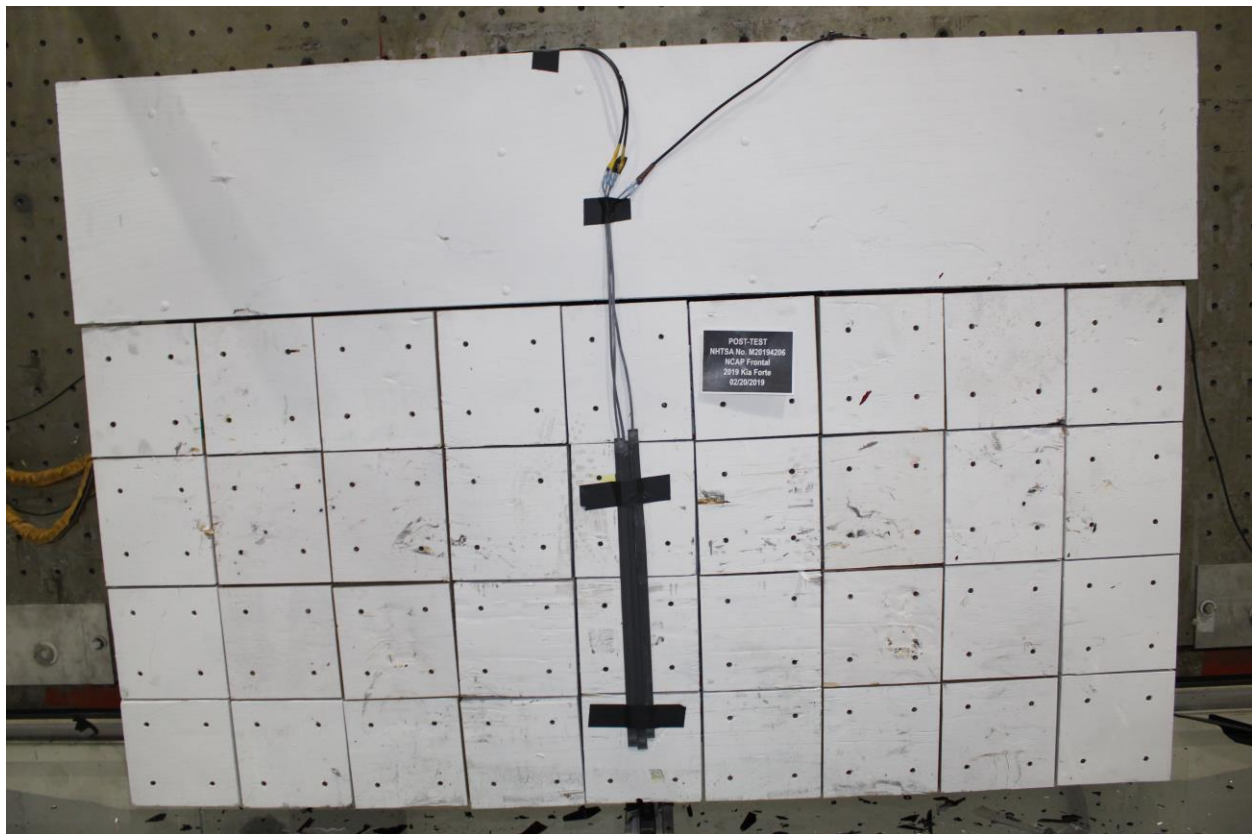


Figure A-3: Post-Test Load Cell Wall



Figure A-4: Manufacturer's Label



Figure A-5: Tire Placard



Figure A-6: 2019 KIA Forte Frontal As Delivered



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

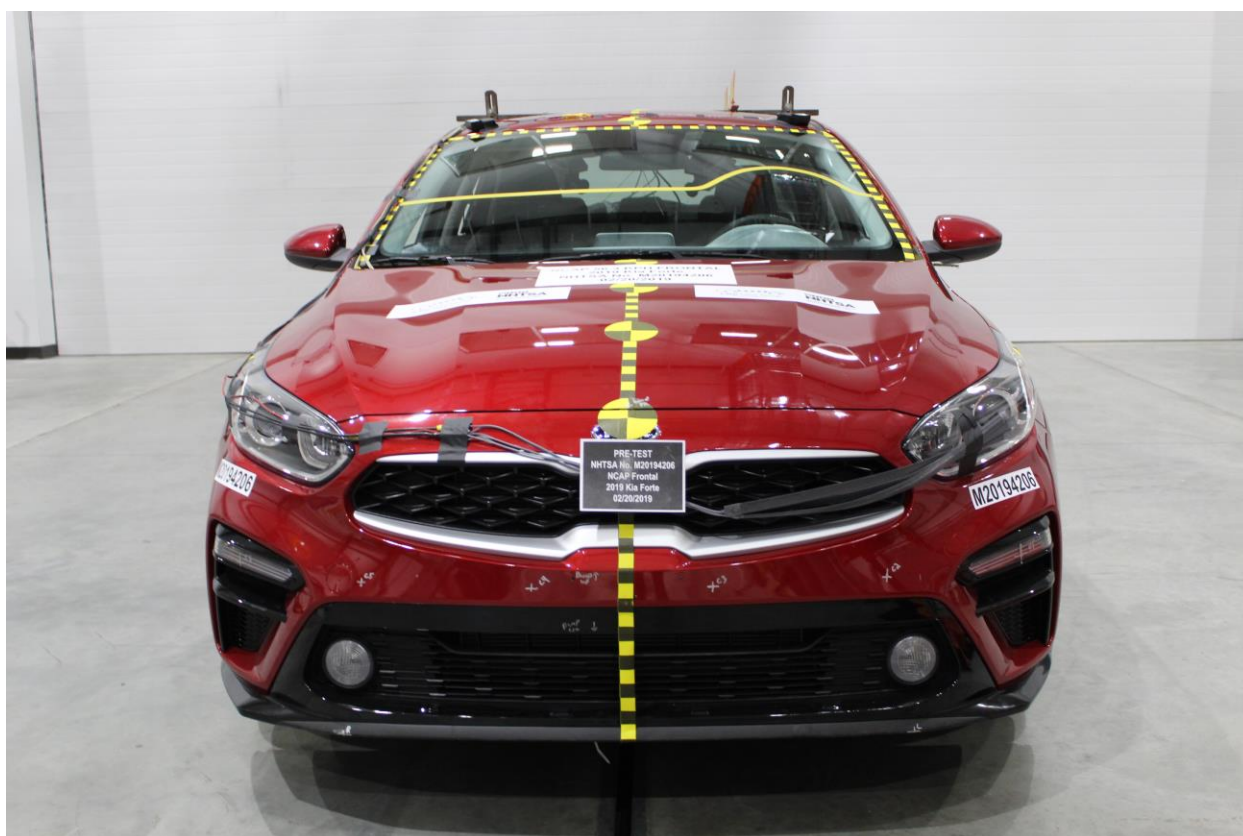


Figure A-8: Pre-Test Front View of Test Vehicle

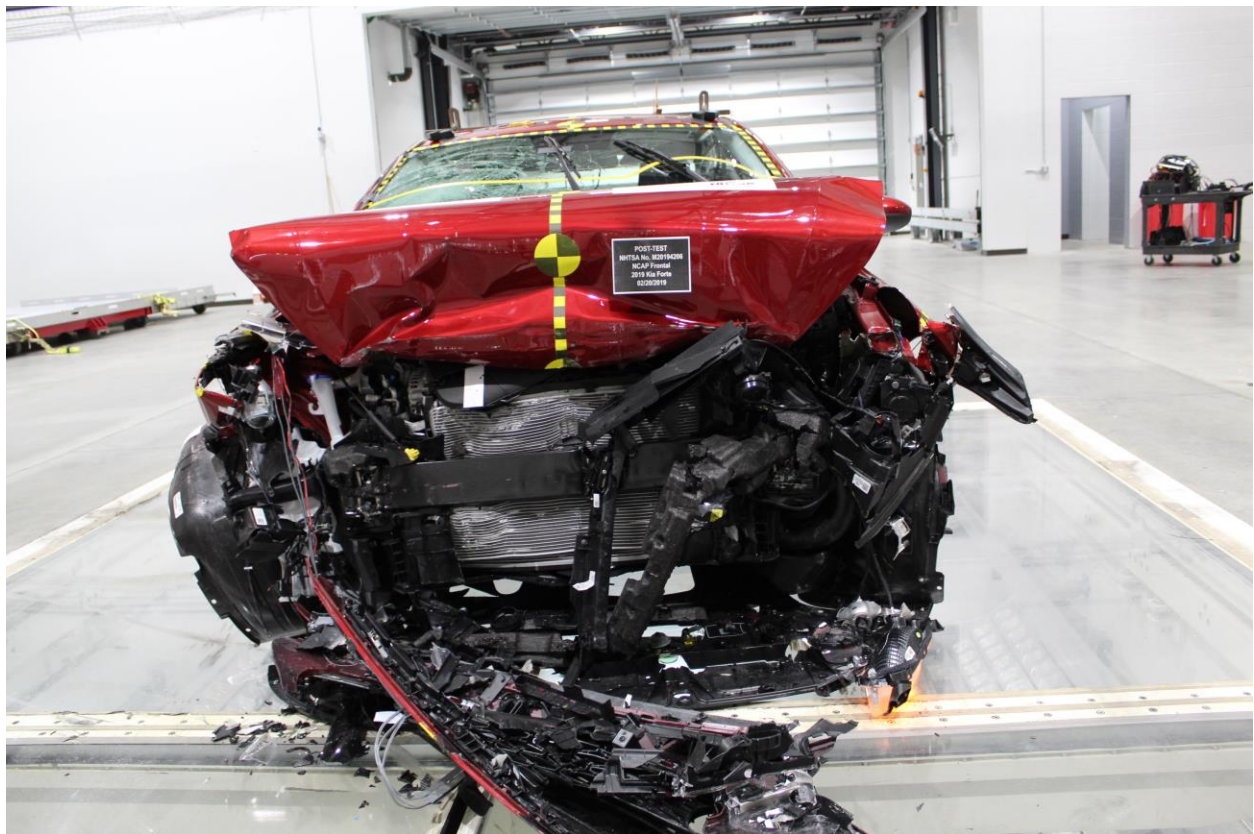


Figure A-9: Post-Test Front View of Test Vehicle



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

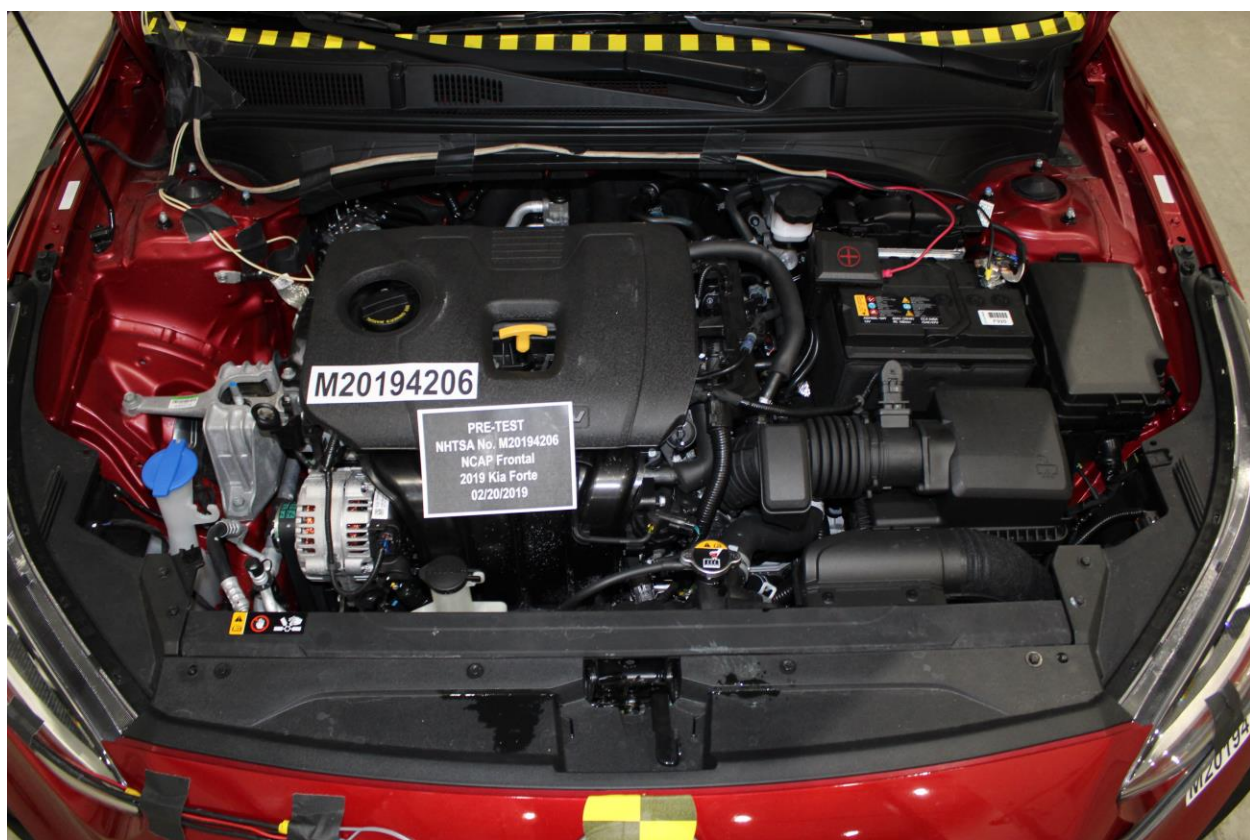


Figure A-20: Pre-Test Engine Compartment View

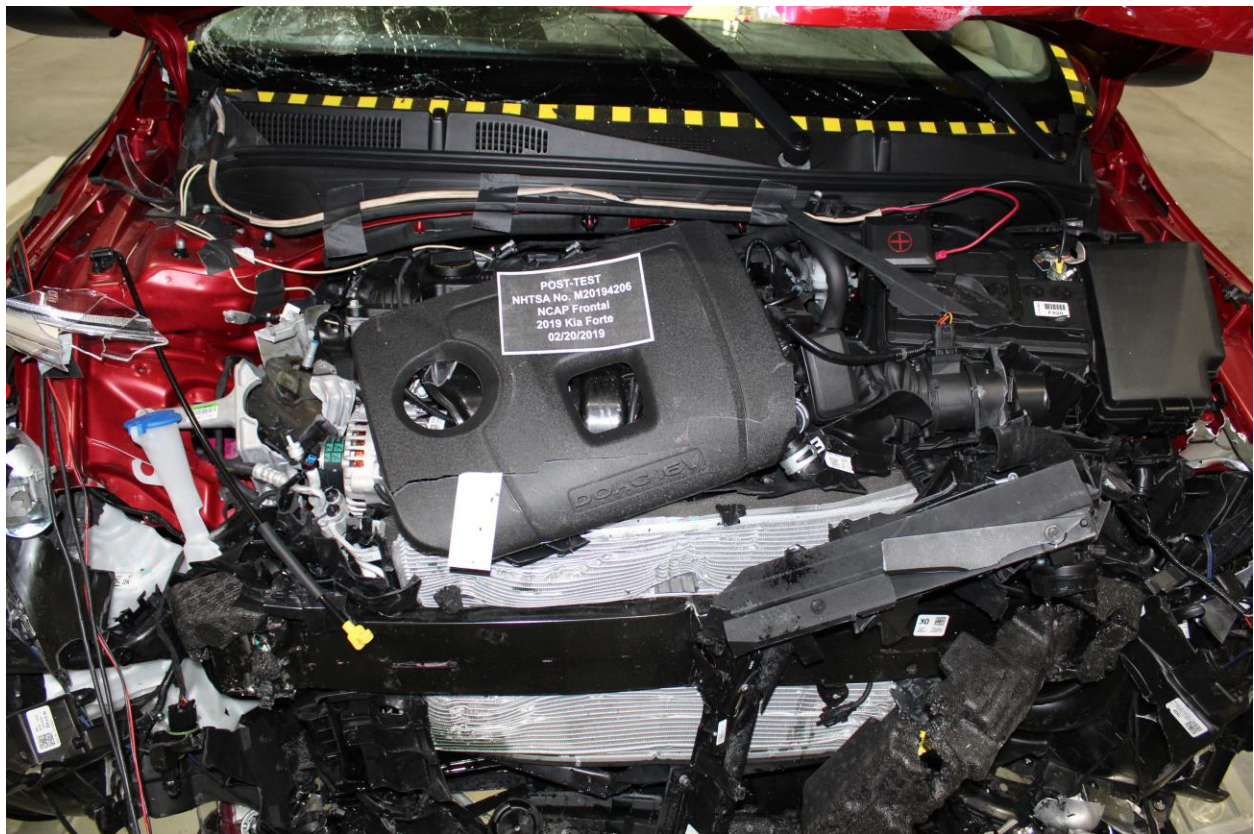


Figure A-21: Post-Test Engine Compartment View



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



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

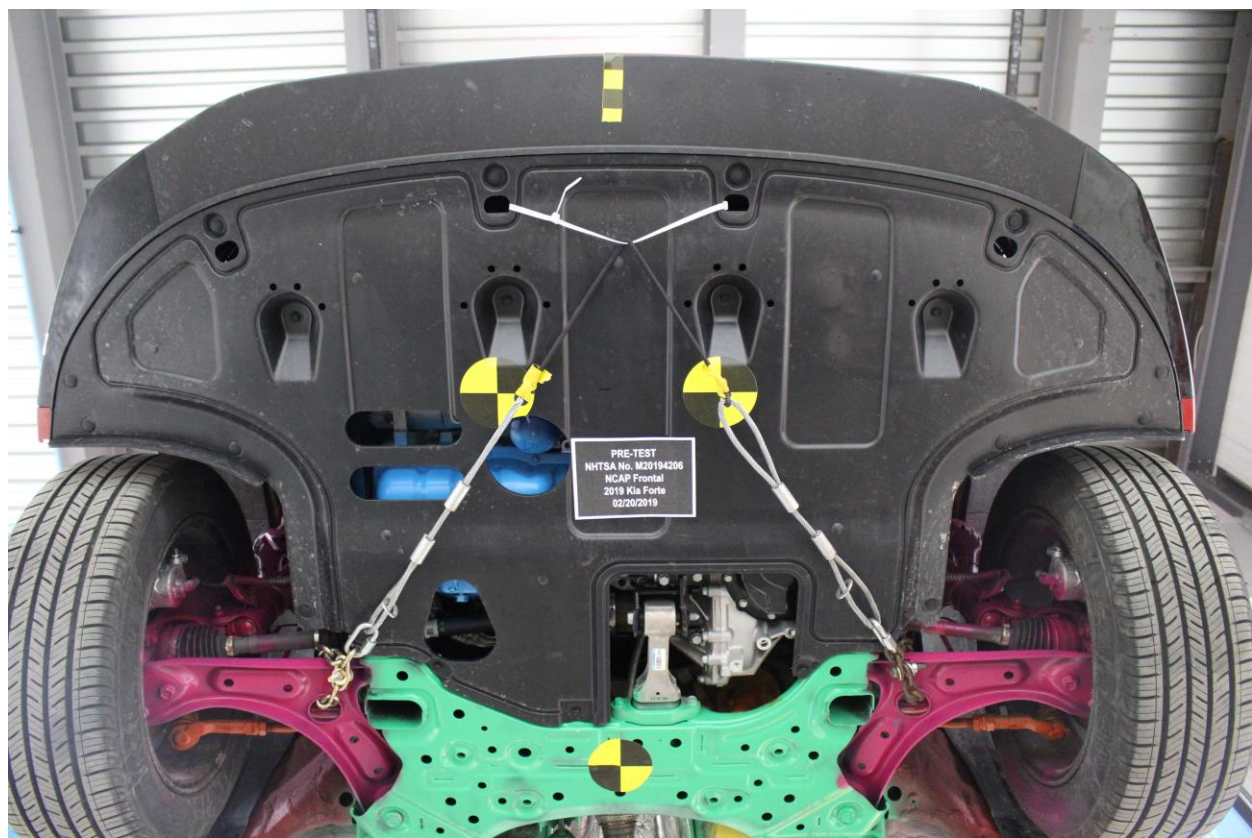


Figure A-24: Pre-Test Front Underbody View

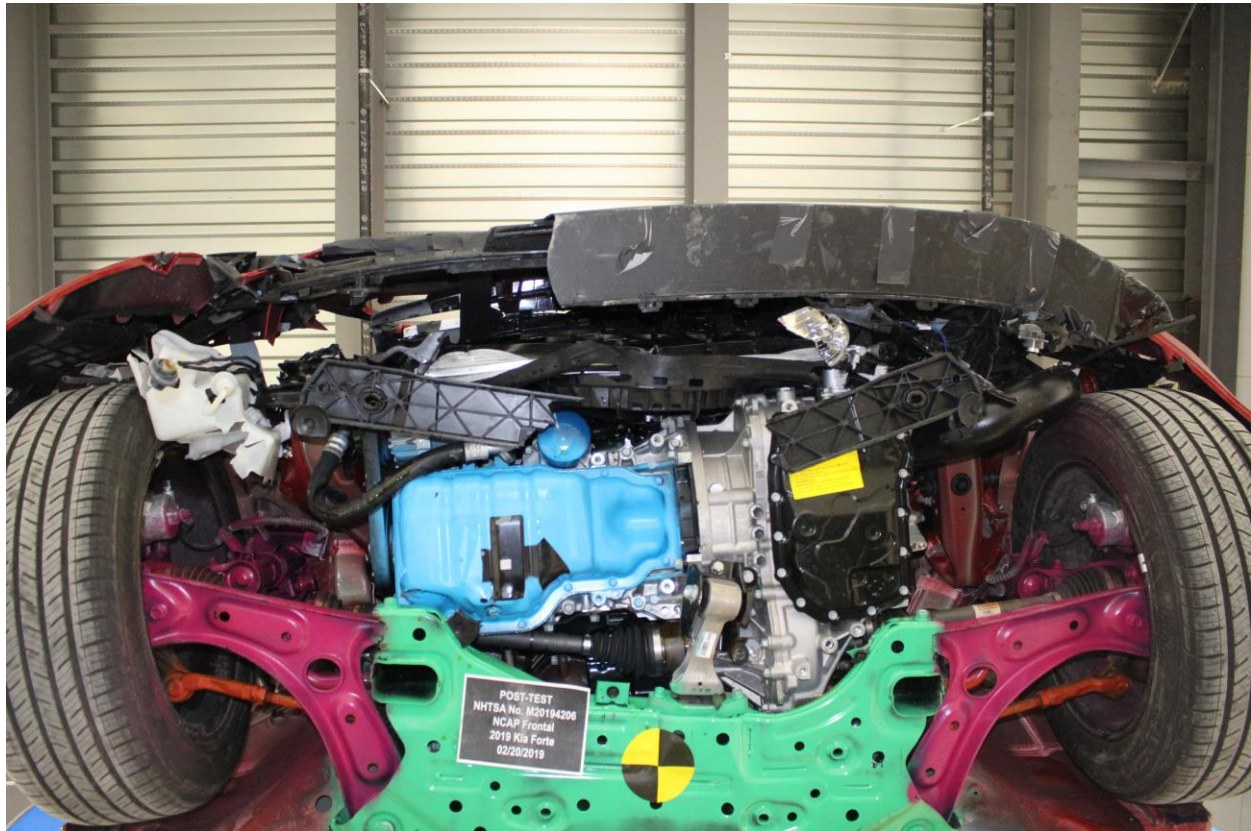


Figure A-25: Post-Test Front Underbody View



Figure A-26: Pre-Test Rear Underbody View



Figure A-27: Post-Test Rear Underbody View

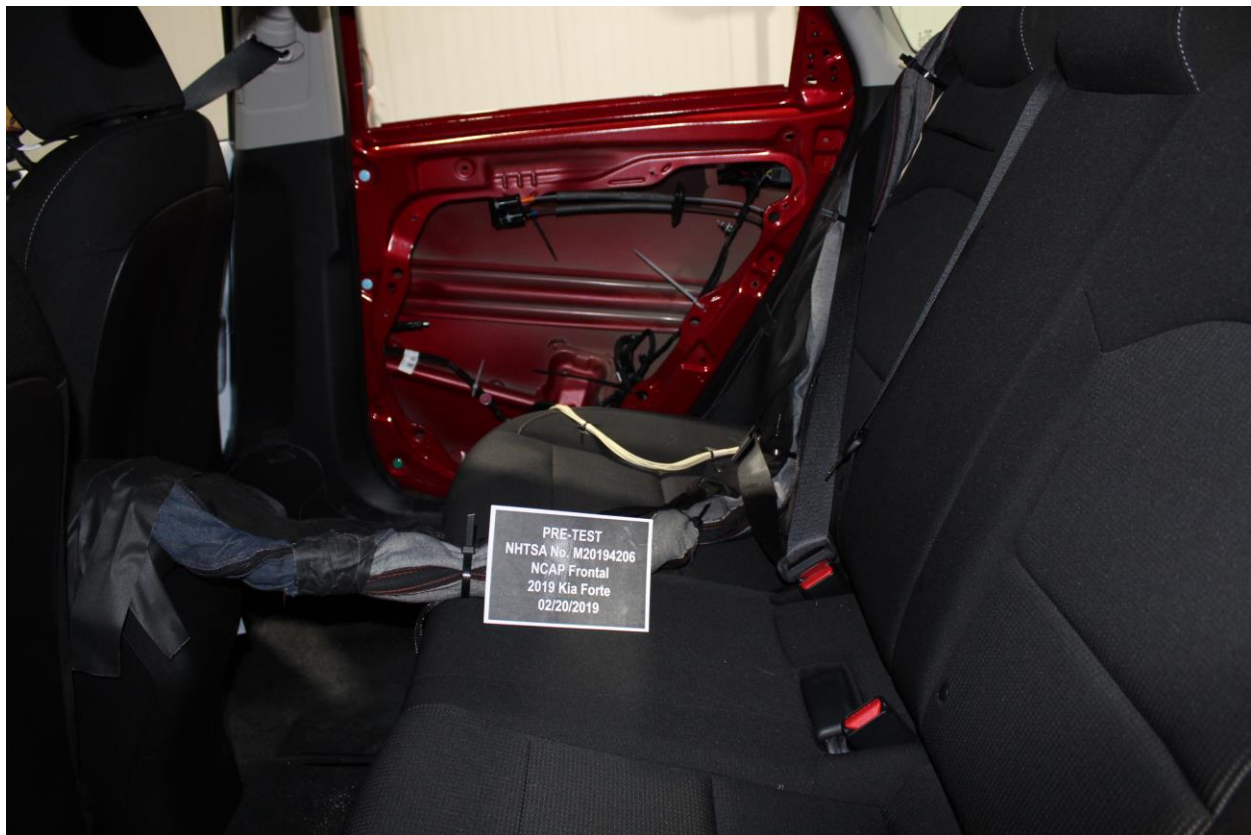


Figure A-28: Pre-Test Dummy Cable Routing



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

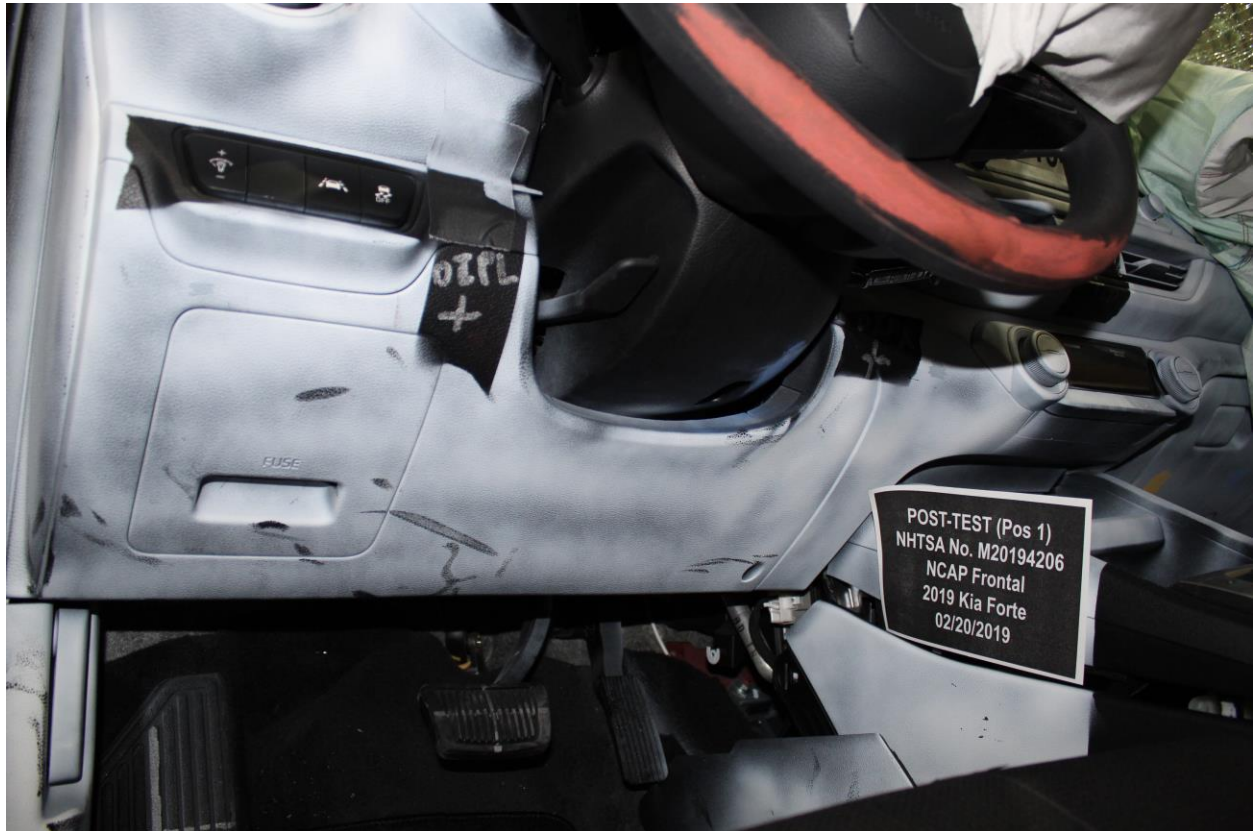


Figure A-43: Post-Test Driver's Side Knee Bolster



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

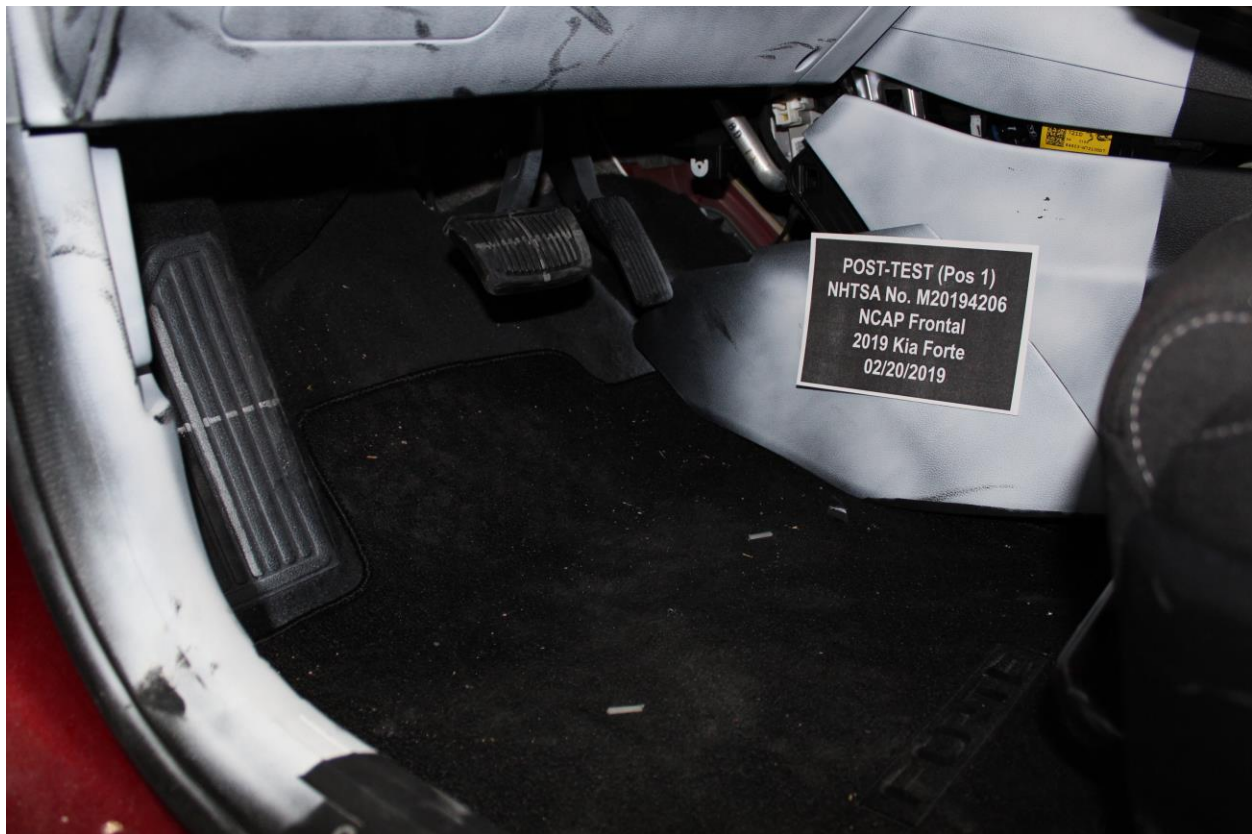


Figure A-45: Post-Test Driver's Side Floorpan



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

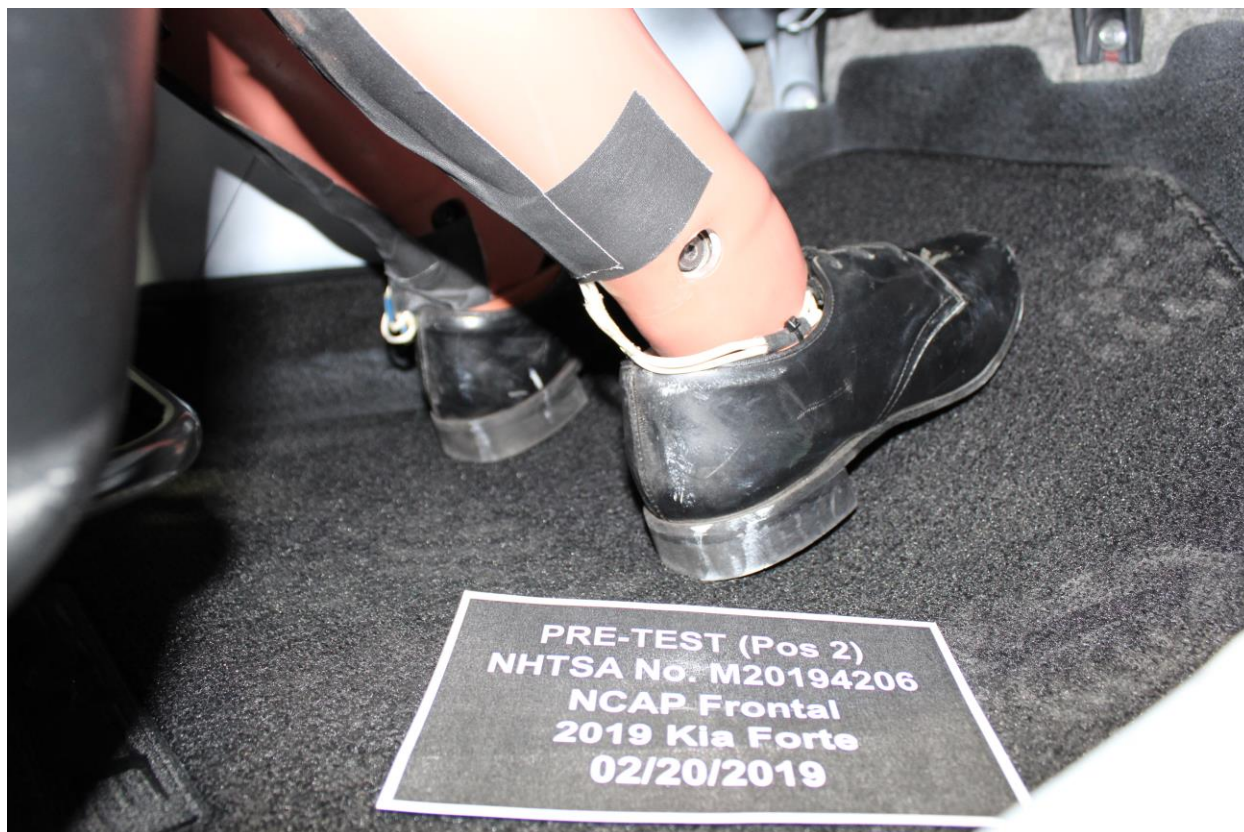


Figure A-61: Pre-Test Passenger Dummy Feet



Figure A-62: Post-Test Passenger Dummy Feet

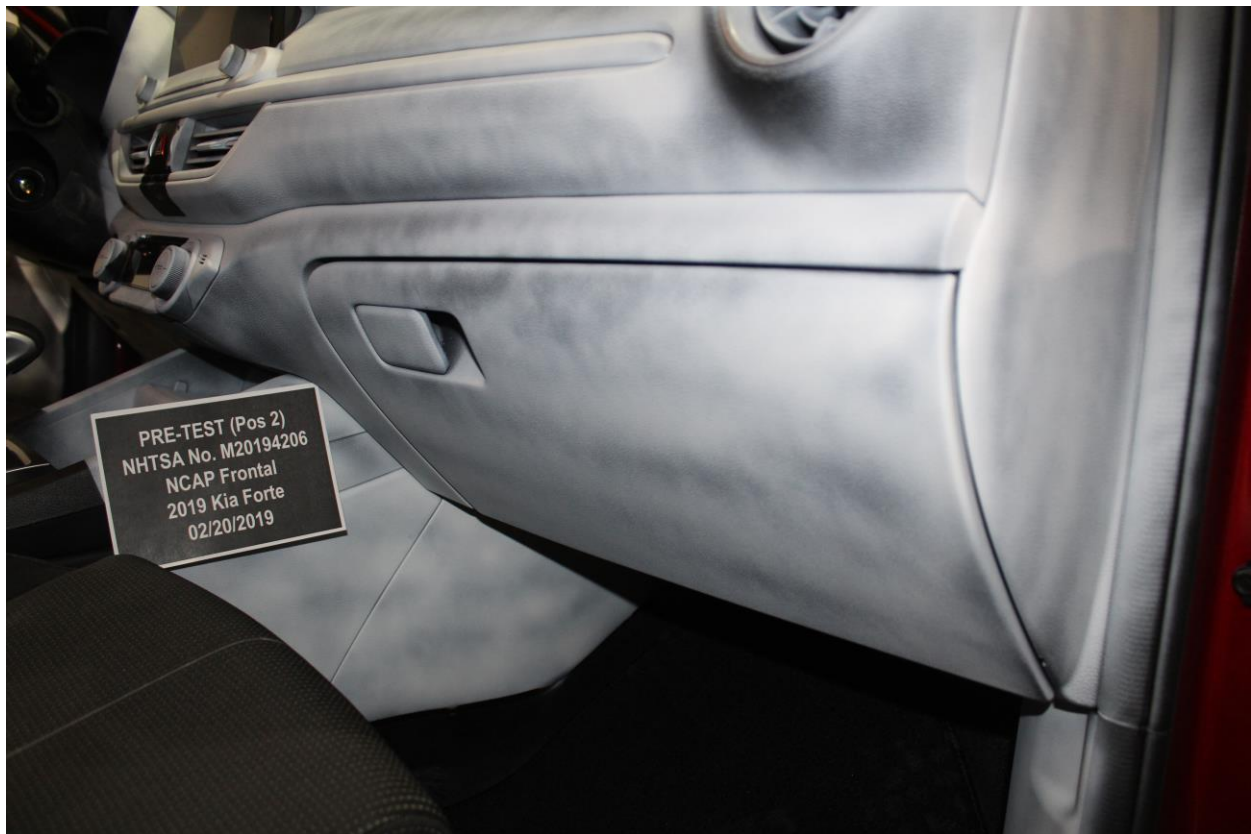


Figure A-63: Pre-Test Passenger's Side Knee Bolster



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

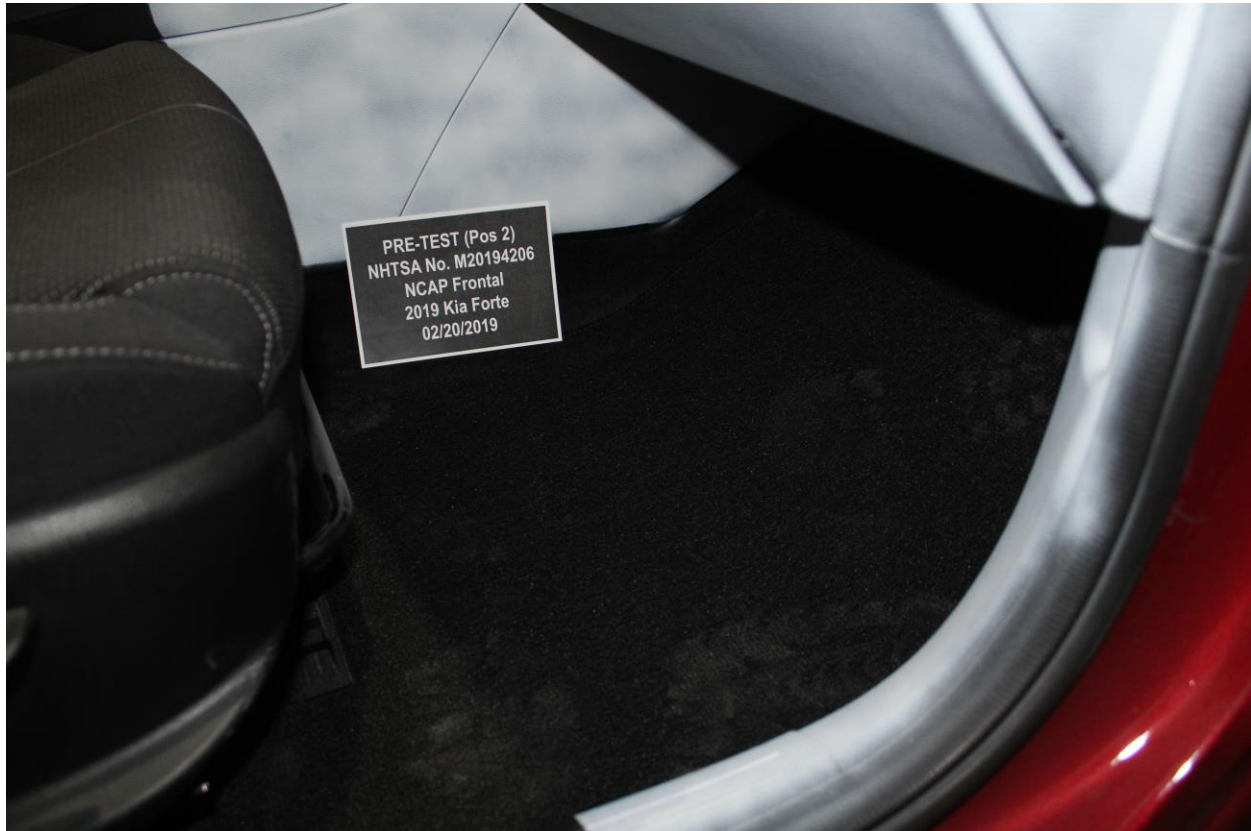


Figure A-65: Pre-Test Passenger's Side Floorpan

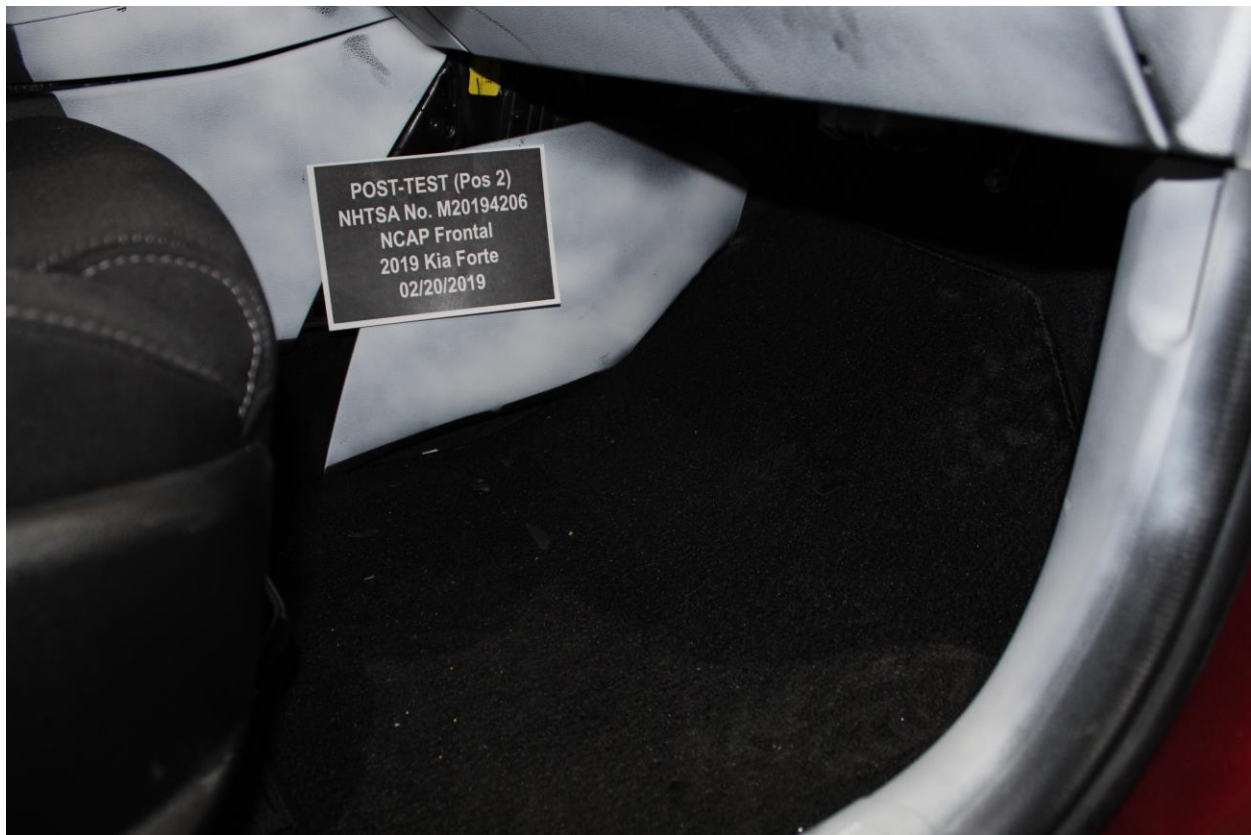


Figure A-66: Post-Test Passenger's Side Floorpan



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

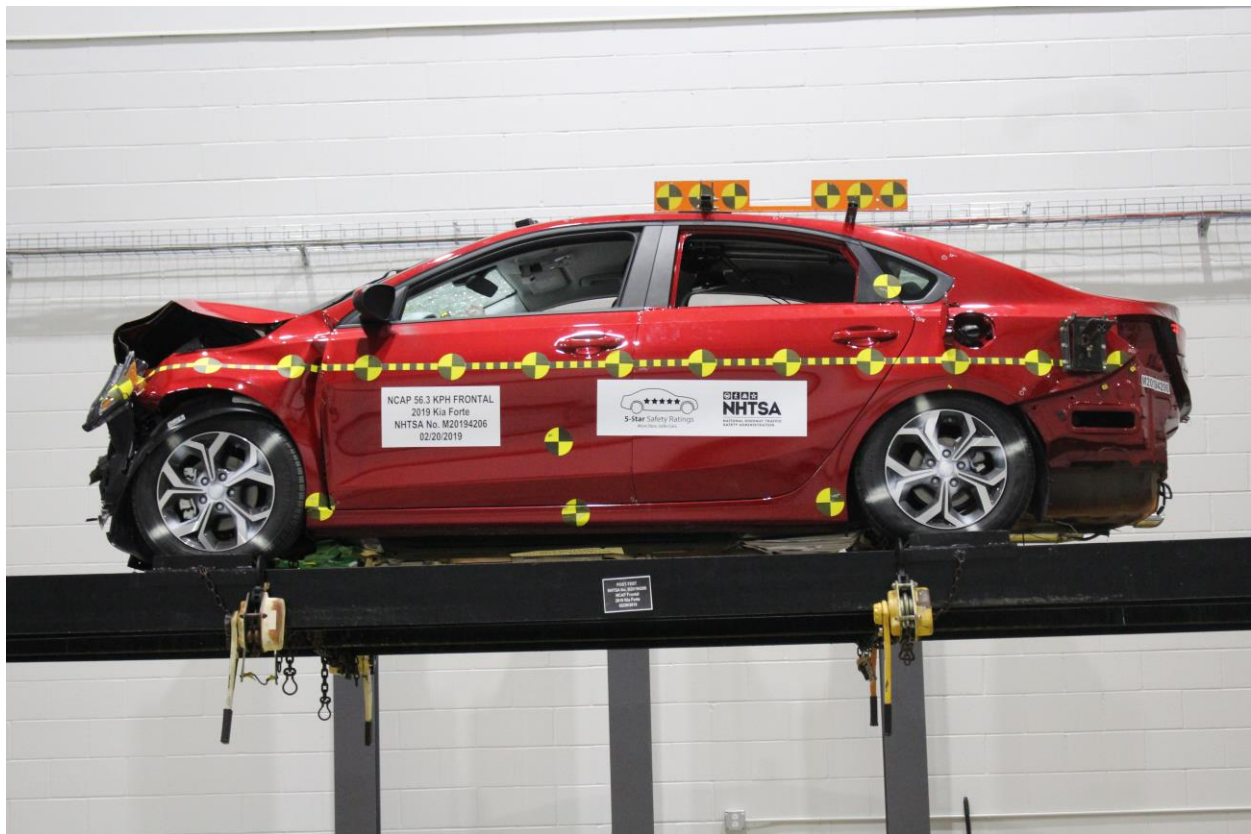


Figure A-73: Vehicle at 0° on Static Rollover Device



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

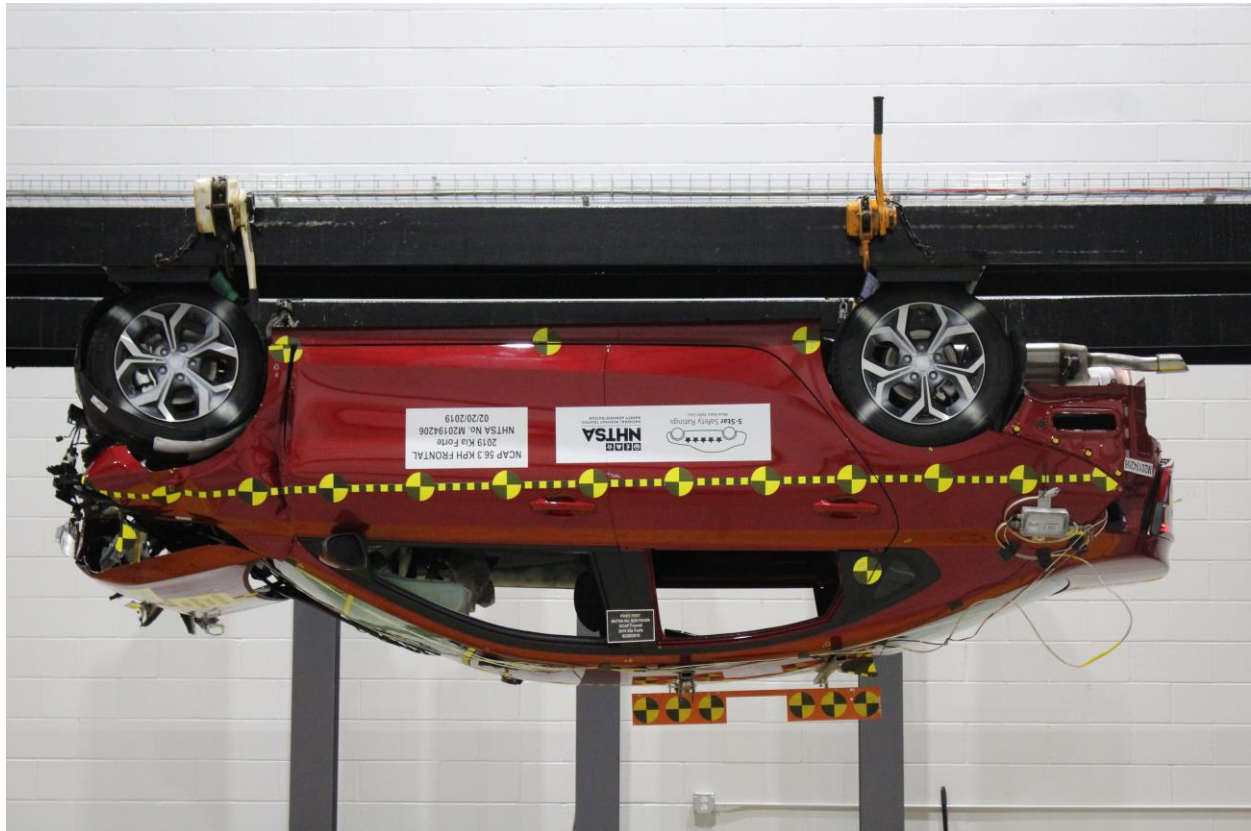


Figure A-75: Vehicle at 180° on Static Rollover Device

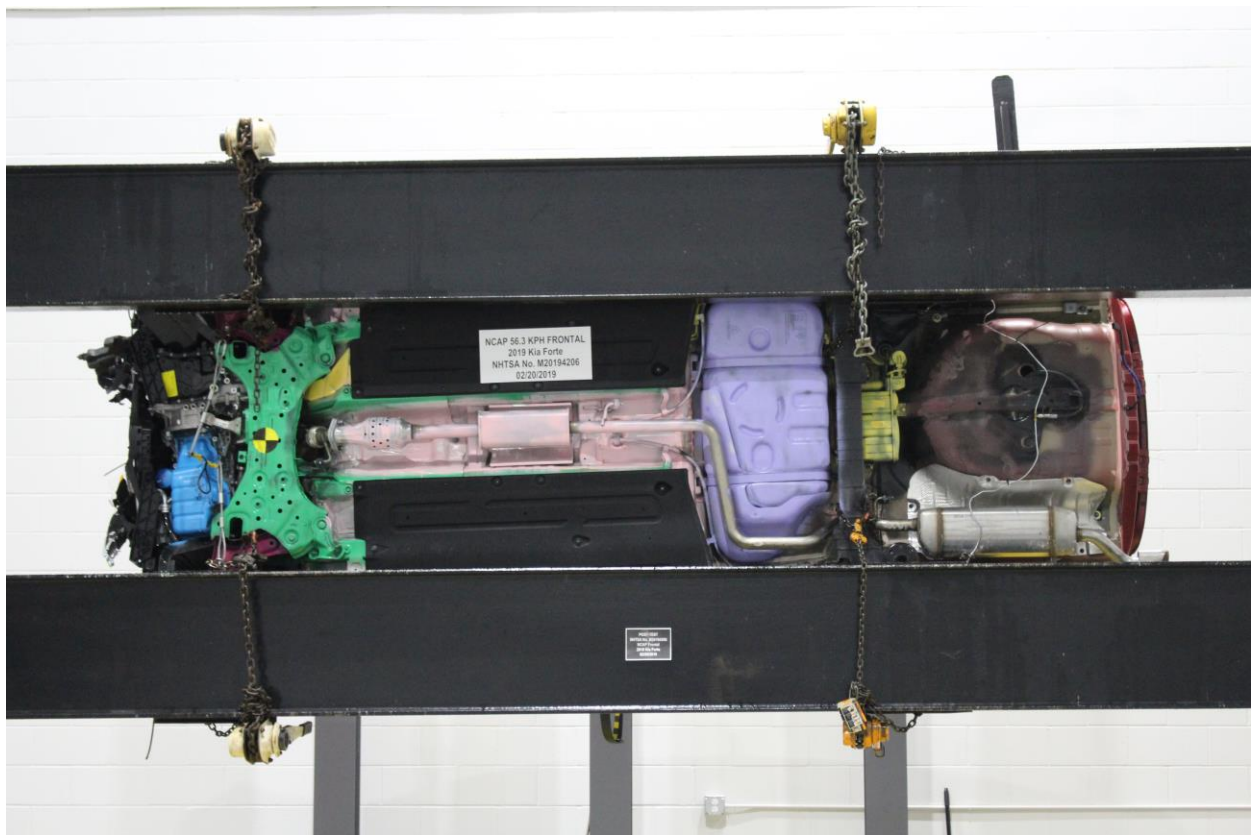


Figure A-76: Vehicle at 270° on Static Rollover Device



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



Figure A-78: 2019 KIA Forte Frontal Impact Event

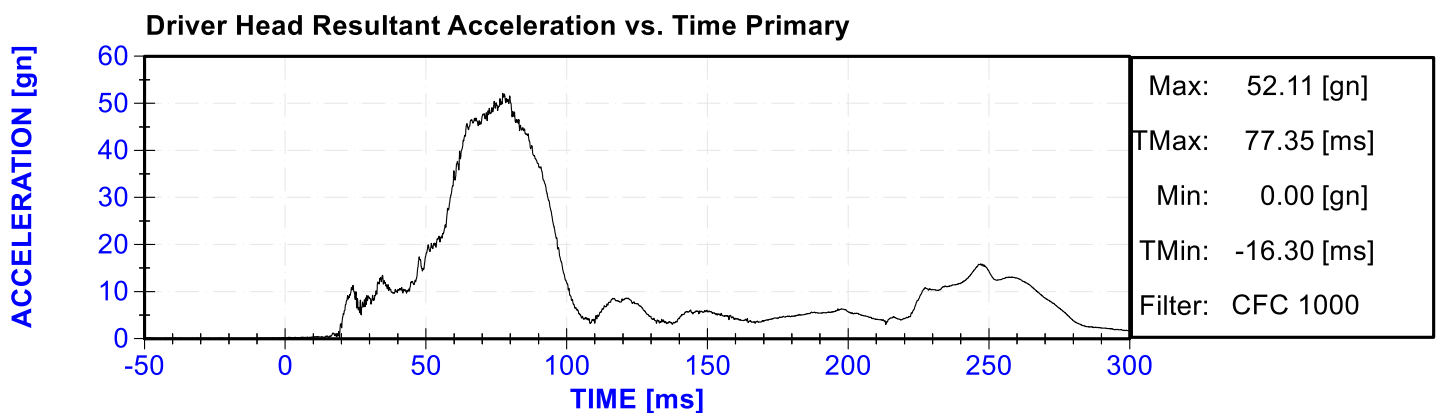
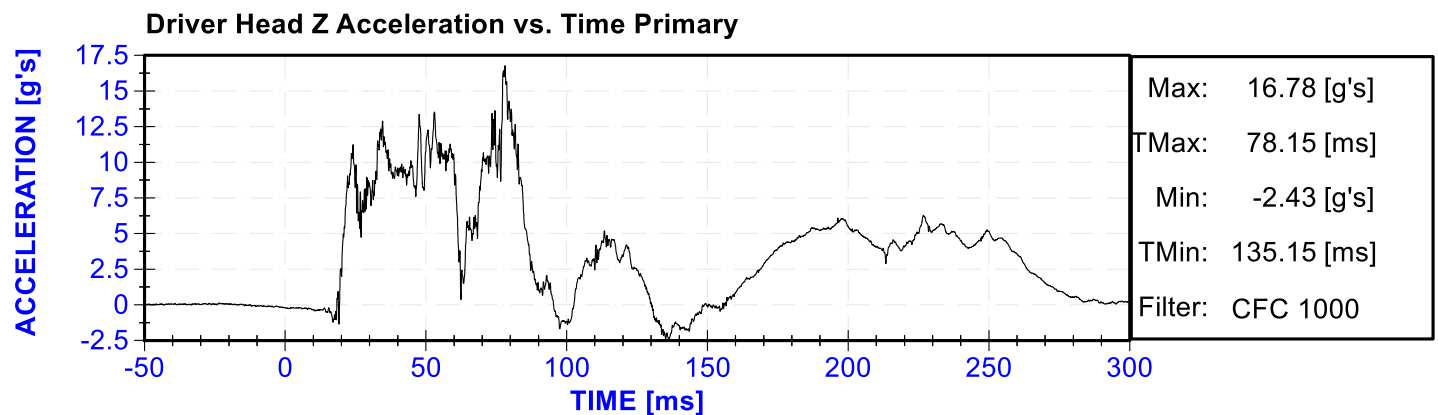
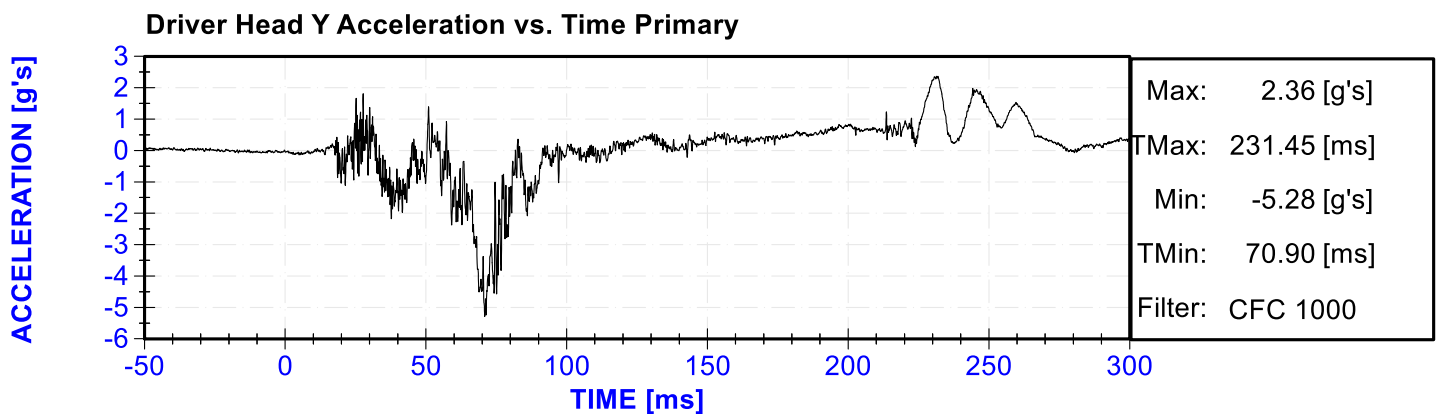
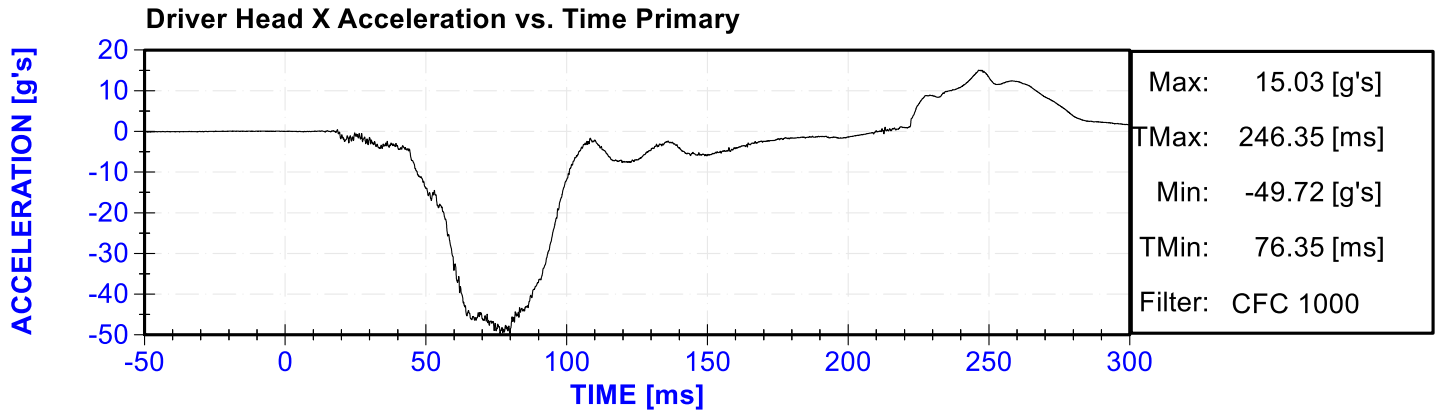
2019 FORTE LXS MODEL/PT CODE: C3422/010 EXTERIOR COLOR: CURRANT RED INTERIOR COLOR: BLACK VEHICLE ID NUMBER: 3KPF24AD7KE032256 PORT OF ENTRY: PHILADELPHIA		Sold To: NY096 Maguire Kia 370 ELMIRA ROAD ITHACA NY 14850		Ship To: NY096		 "Highest Ranked Brand in Initial Quality, 4 Years in a Row" Mass Market, 2019 For 10 Power 2018 award information, go to jdpower.com/awards																											
STANDARD FEATURES MECHANICAL 2.0L Multi-Port Injection (MPI) 4-Cyl Engine Intelligent Variable Transmission (IVT) Drive Mode Select (DMS) 16" Alloy Wheels SAFETY Dual Front Advanced Airbags Dual Front Seat-Mounted Side Airbags Full-Length Side Curtain Airbags Lower Anchors and Tethers for Children (LATCH) Anti-Lock Braking System (ABS) Traction Control System (TCS) Electronic Stability Control (ESC) Vehicle Stability Management (VSM) Hill-start Assist Control (HAC) Tire Pressure Monitoring System (TPMS) INTERIOR, COMFORT & CONVENIENCE Dual-Zone Automatic Climate Control Power Windows, Door Locks & Outside Mirrors UVO play, which includes: - AM/FM/MP3 w/ 8" Touchscreen & Rear Camera - Android Auto & Apple CarPlay Smartphone Integration USB / Auxiliary Input Jack and 12 Volt Outlet Bluetooth® Wireless Technology Multi-Adjustable Front Seats 60/40 Split Folding Rear Seats Remote Keyless Entry Tilt & Telescopic Steering Column Steering Wheel Controls (Bluetooth/Audio/Cruise) Driver Attention Warning (DAW) Forward Collision-Avoidance Assist-Car (FCA-Car) Forward Collision Warning (FCW) Lane Departure Warning (LDW) Lane Keeping Assist-Line (LKA-L) EXTERIOR Auto-On / Off Projection Headlights Daytime Running Lights WARRANTY 10 Year/100,000 Mile Limited Powertrain Warranty 5 Year/60,000 Mile Limited Basic Warranty 5 Year/60,000 Mile Roadside Assistance		MANUFACTURER'S SUGGESTED RETAIL PRICE ▶ \$ 19,090.00 \$195.00 \$125.00 \$50.00 \$19,460.00 \$895.00 TOTAL MANUFACTURER'S SUGGESTED RETAIL PRICE ▶ \$ 20,355.00		Fuel Economy and Environment Fuel Economy 34 MPG combined city/hwy 2.9 gallons per 100 miles MID/size CARS range from 14 to 136 MPG. The best vehicle rates 136 MPG. You Save \$1,500 in fuel costs over 5 years compared to the average new vehicle. Annual fuel cost \$1,100 Fuel Economy & Greenhouse Gas Rating (tailpipe only) Smog Rating (tailpipe only) 1 8 10 1 7 10 This vehicle emits 287 grams CO ₂ per mile. The best emits 6 grams per mile (tailpipe only). Producing and distributing fuel also create emissions. Learn more at fueleconomy.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 costs \$7,000 to fuel over 5 years. Cost estimates are based on 15,000 miles per year at \$2.35 per gallon. MPG is miles per gasoline gallon equivalent. Vehicle emissions are a significant cause of climate change and smog. fueleconomy.gov Calculate personalized estimates and compare vehicles		GOVERNMENT 5-STAR SAFETY RATINGS Overall Vehicle Score Not Rated Based on the combined rating of frontal, side and rollover. Should ONLY be compared to other vehicles of similar size and weight. <table border="1"> <tr> <td>Frontal</td> <td>Driver</td> <td>Not Rated</td> </tr> <tr> <td>Crash</td> <td>Passenger</td> <td>Not Rated</td> </tr> <tr> <td colspan="3">Based on the risk of injury in a frontal impact. Should ONLY be compared to other vehicles of similar size and weight.</td> </tr> <tr> <td>Side</td> <td>Front seat</td> <td>Not Rated</td> </tr> <tr> <td>Crash</td> <td>Rear seat</td> <td>Not Rated</td> </tr> <tr> <td colspan="3">Star ratings based on the risk of injury in a side impact.</td> </tr> <tr> <td>Rollover</td> <td></td> <td>Not Rated</td> </tr> <tr> <td colspan="3">Star ratings based on the risk of rollover in a single-vehicle crash.</td> </tr> </table> Star ratings range from 1 to 5 stars (★★★★★) with 5 being the highest. Source: National Highway Traffic Safety Administration (NHTSA). www.safercar.gov or 1-888-327-4236 Manufacturer's suggested retail price includes Manufacturer's recommended pre-delivery service. License and title fees, state and local taxes and other dealer-installed options and accessories are not included in the manufacturer's suggested retail price.		Frontal	Driver	Not Rated	Crash	Passenger	Not Rated	Based on the risk of injury in a frontal impact. Should ONLY be compared to other vehicles of similar size and weight.			Side	Front seat	Not Rated	Crash	Rear seat	Not Rated	Star ratings based on the risk of injury in a side impact.			Rollover		Not Rated	Star ratings based on the risk of rollover in a single-vehicle crash.			PARTS CONTENT INFORMATION FOR VEHICLES IN THIS CAR LINE U.S./CANADIAN PARTS CONTENT: 2 % MAJOR SOURCES OF FOREIGN PARTS: MEXICO: 55% KOREA: 43% NOTE: PARTS CONTENT DOES NOT INCLUDE FINAL ASSEMBLY, DISTRIBUTION, OR OTHER NON-PARTS COSTS. FOR THIS VEHICLE FINAL ASSEMBLY POINT: PESQUERIA, NL, MEXICO COUNTRY OF ORIGIN ENGINE: MEXICO TRANSMISSION: MEXICO	
Frontal	Driver	Not Rated																															
Crash	Passenger	Not Rated																															
Based on the risk of injury in a frontal impact. Should ONLY be compared to other vehicles of similar size and weight.																																	
Side	Front seat	Not Rated																															
Crash	Rear seat	Not Rated																															
Star ratings based on the risk of injury in a side impact.																																	
Rollover		Not Rated																															
Star ratings based on the risk of rollover in a single-vehicle crash.																																	
TOTAL ADDITIONAL WEIGHT: 7.3																																	

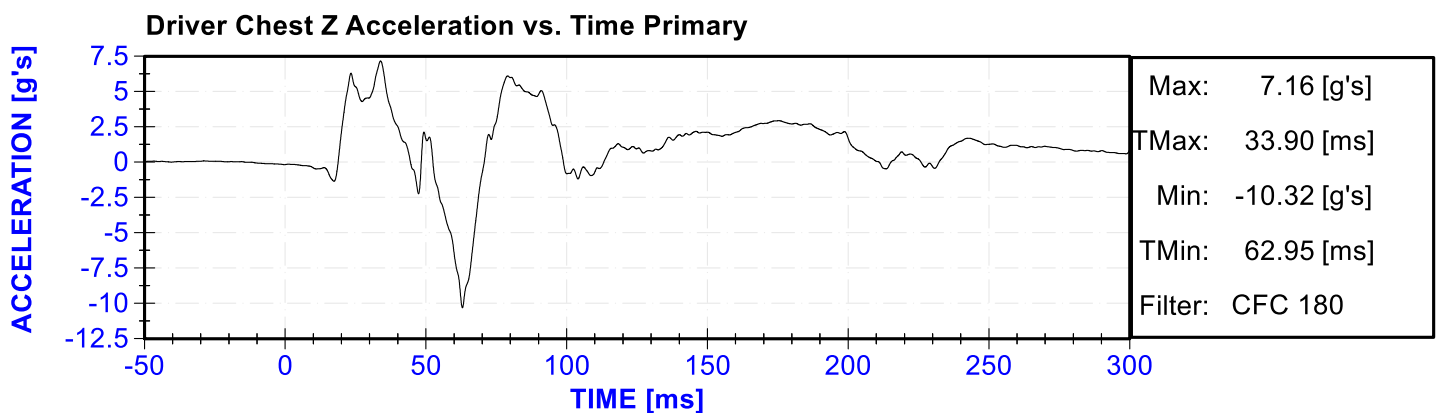
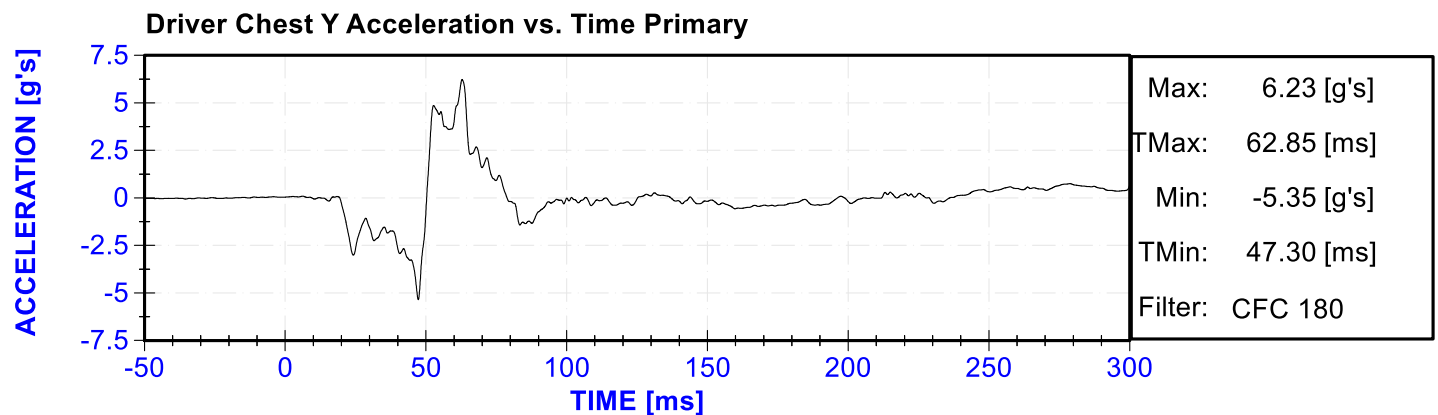
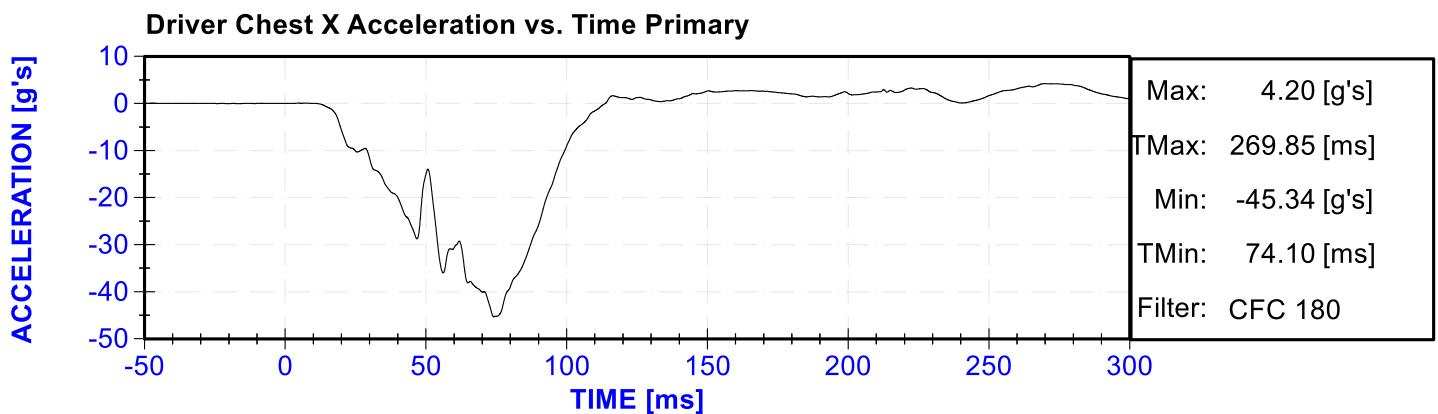
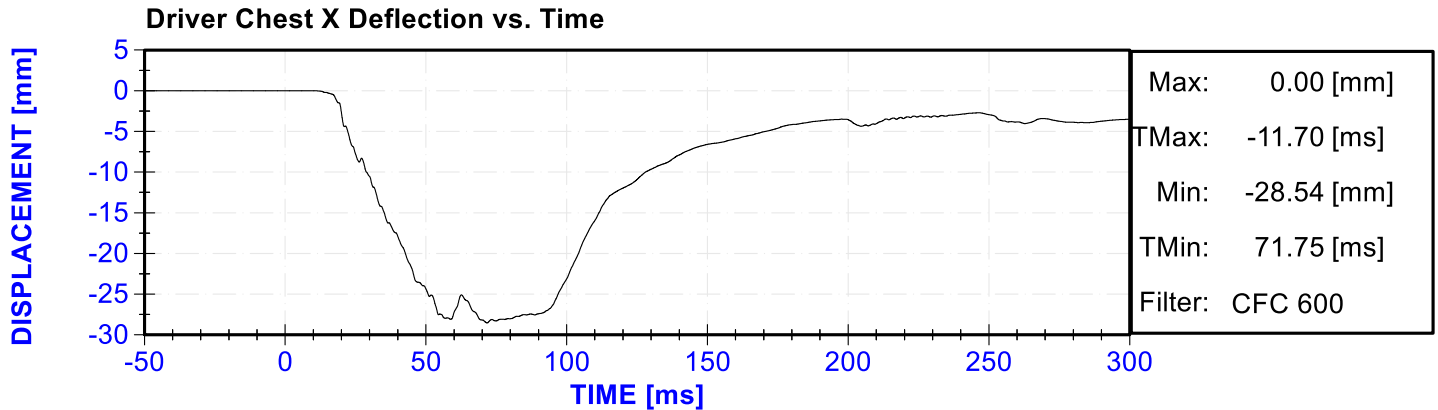
Figure A-79: Monroney Label Photograph

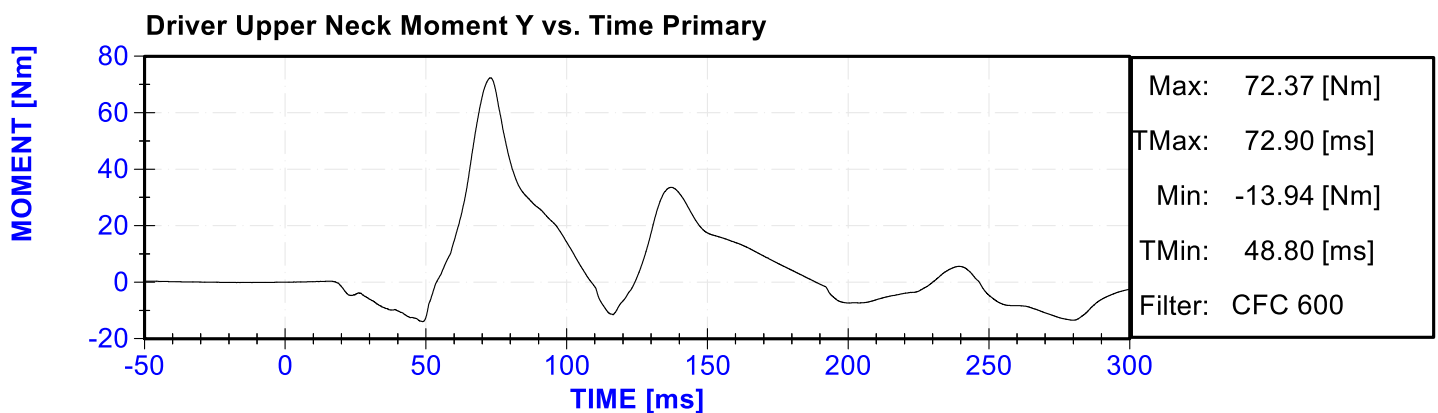
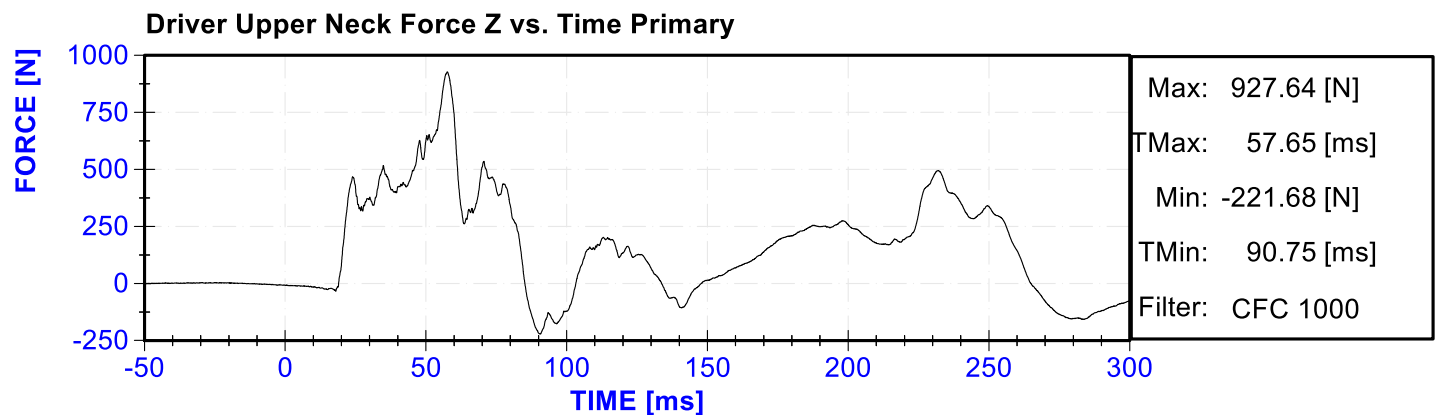
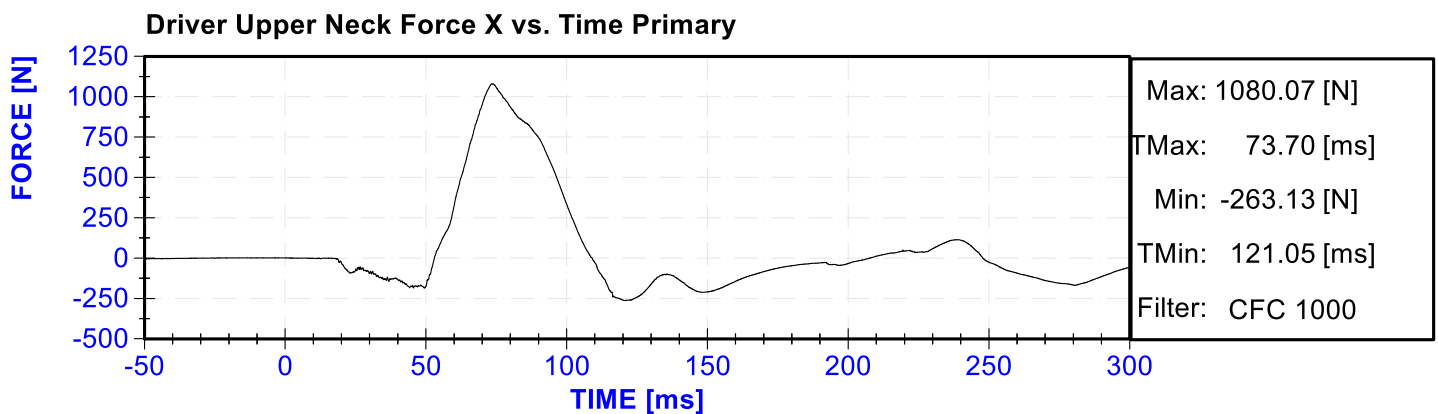
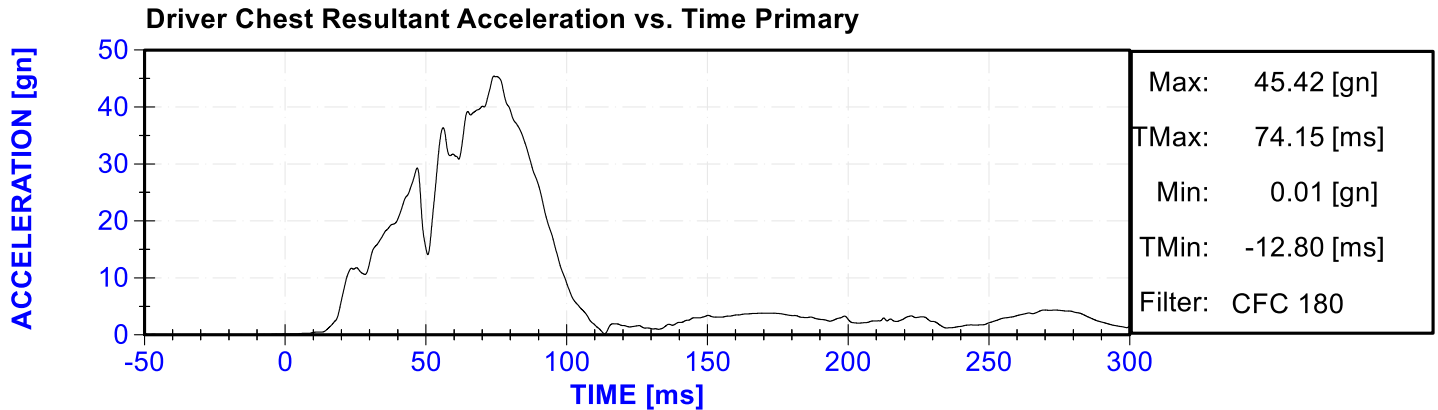
APPENDIX B
VEHICLE & DUMMY RESPONSE DATA TRACES

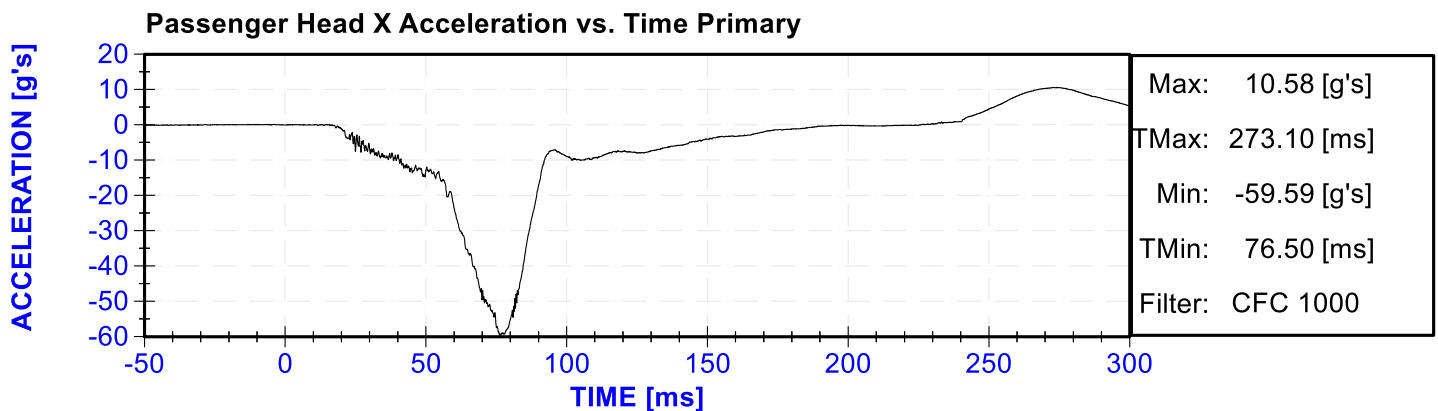
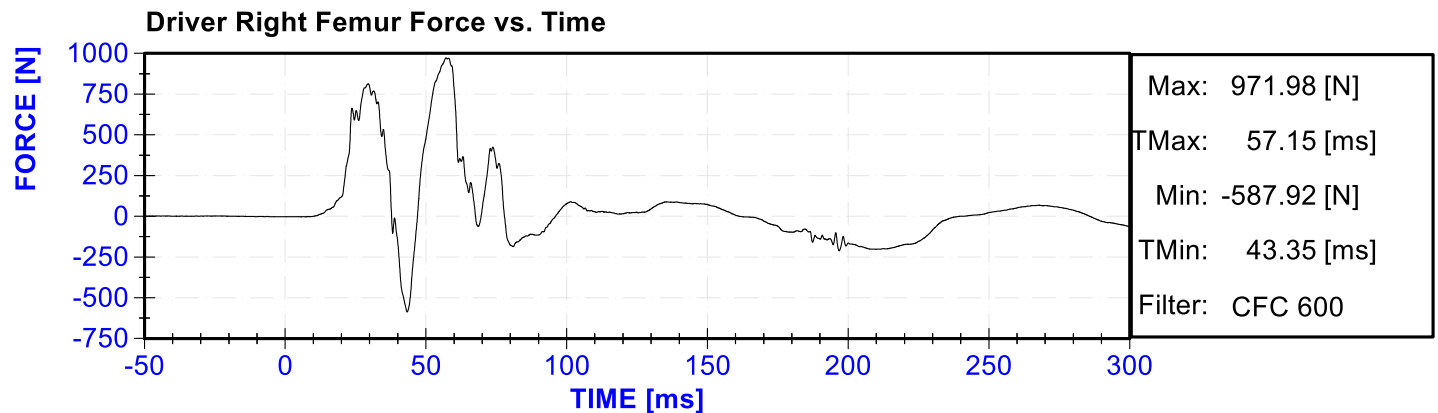
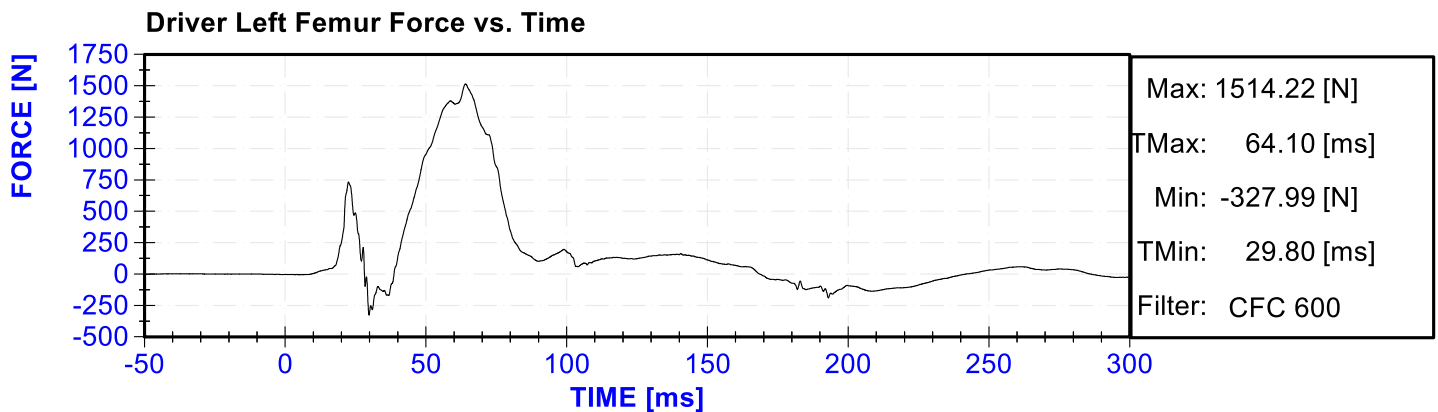
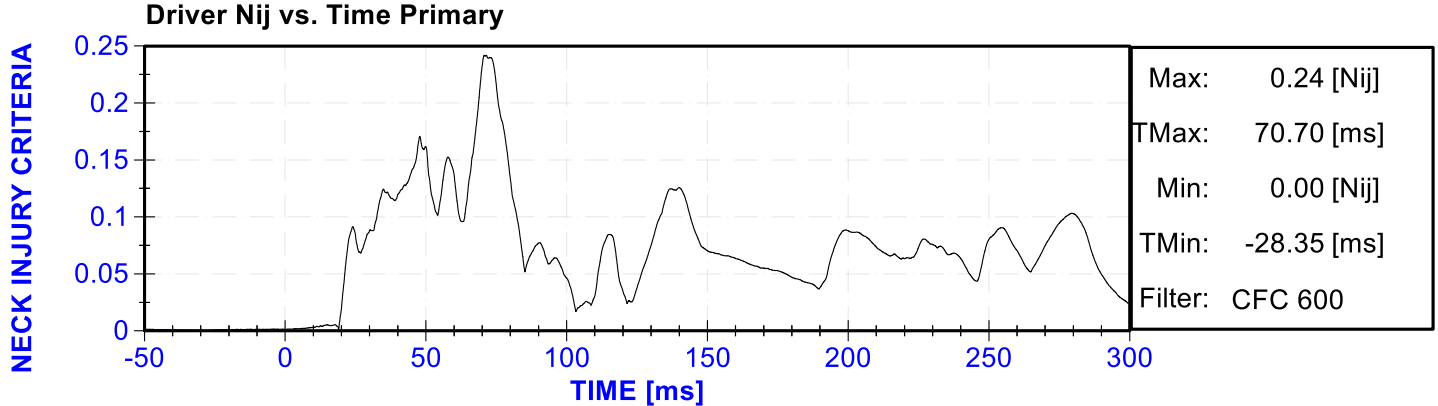
Table of Data Plots

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
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Plot 16	Passenger Head X Acceleration vs. Time Primary	B-6
Plot 17	Passenger Head Y Acceleration vs. Time Primary	B-7
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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

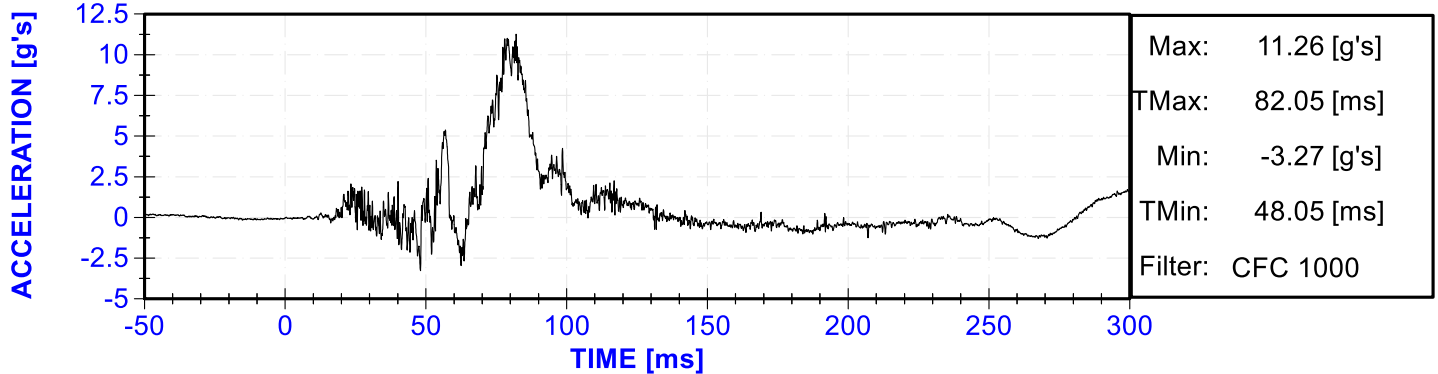




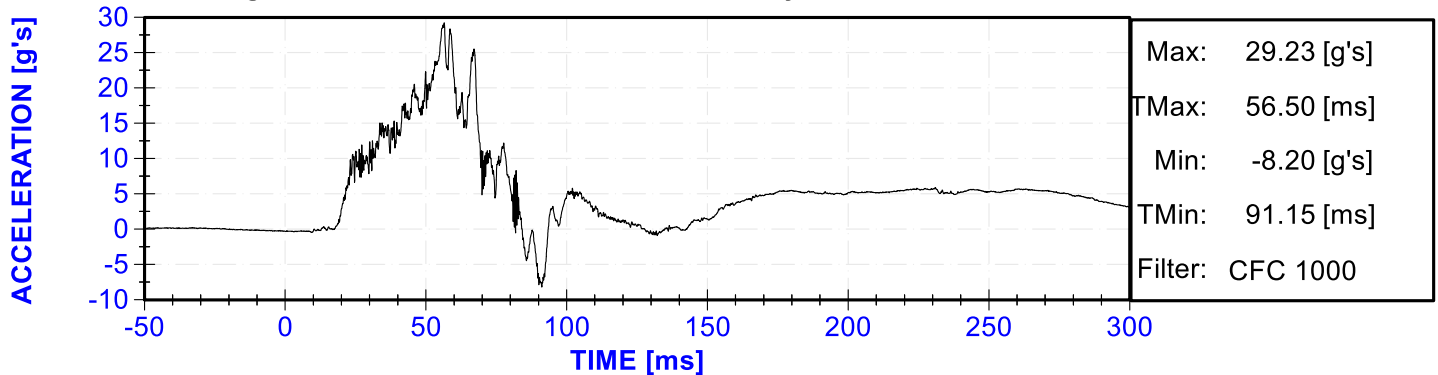




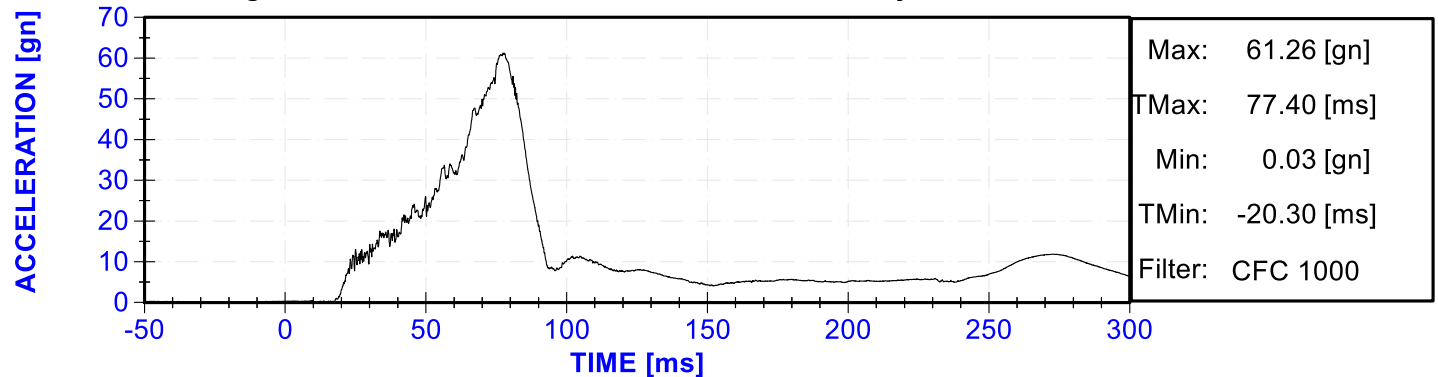
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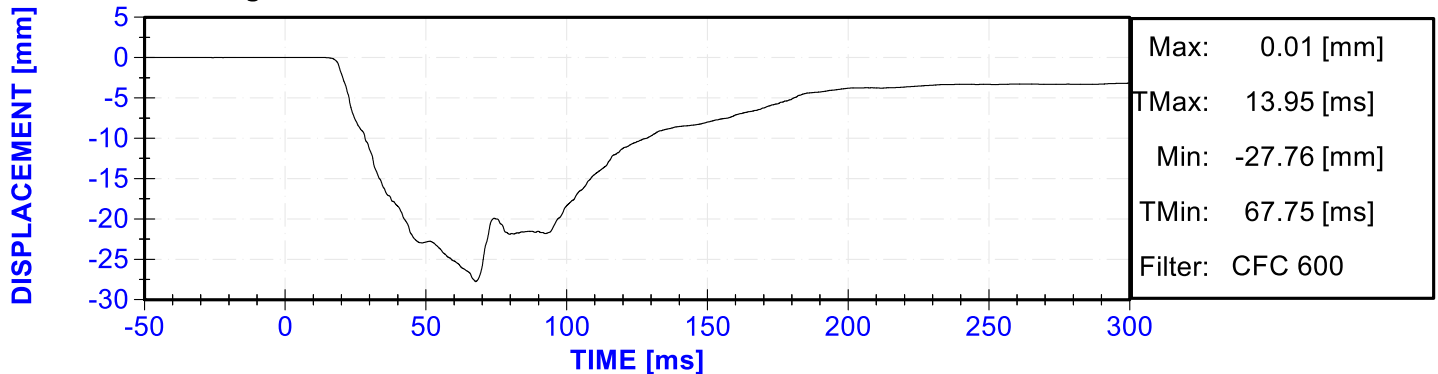
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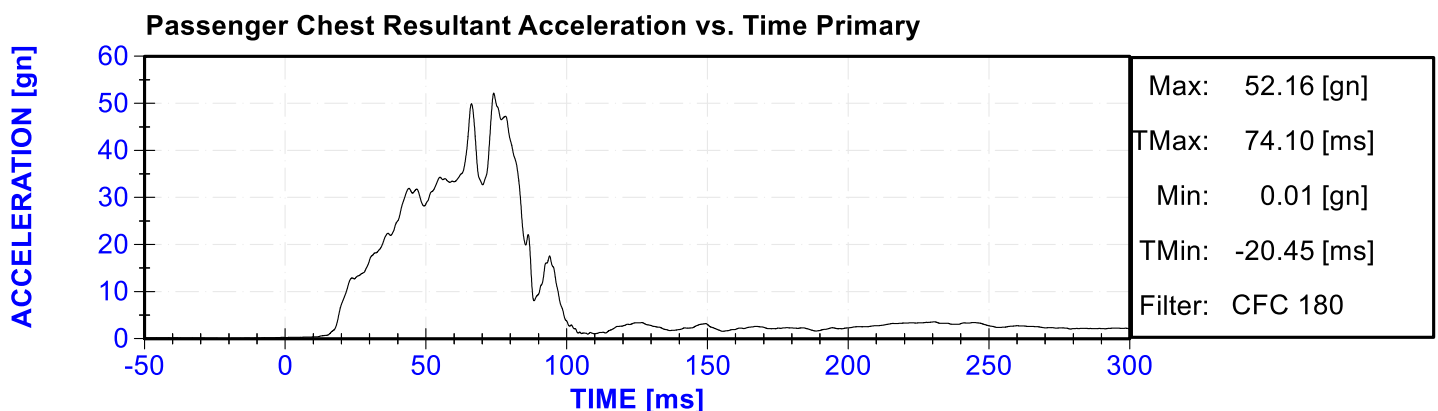
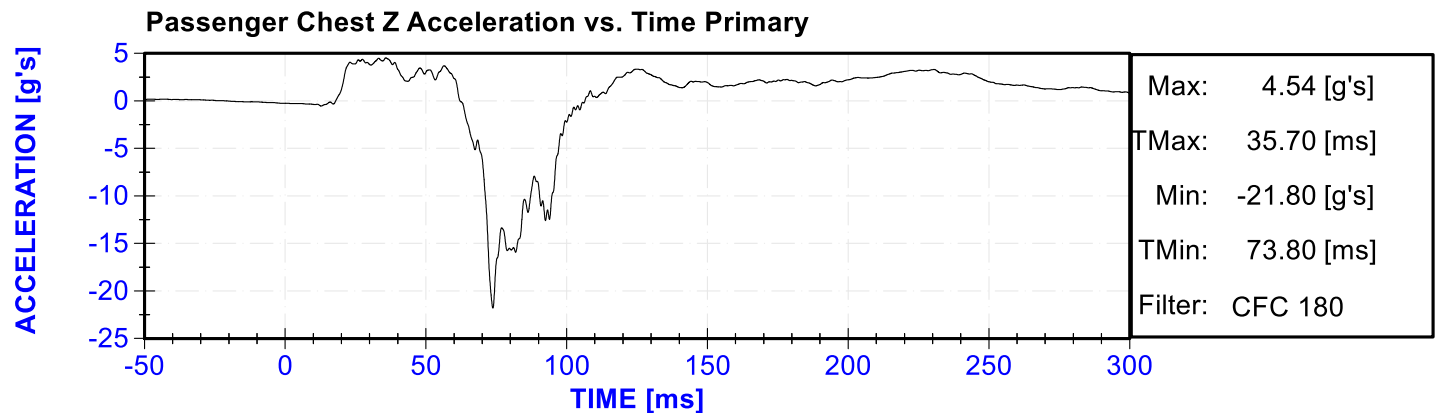
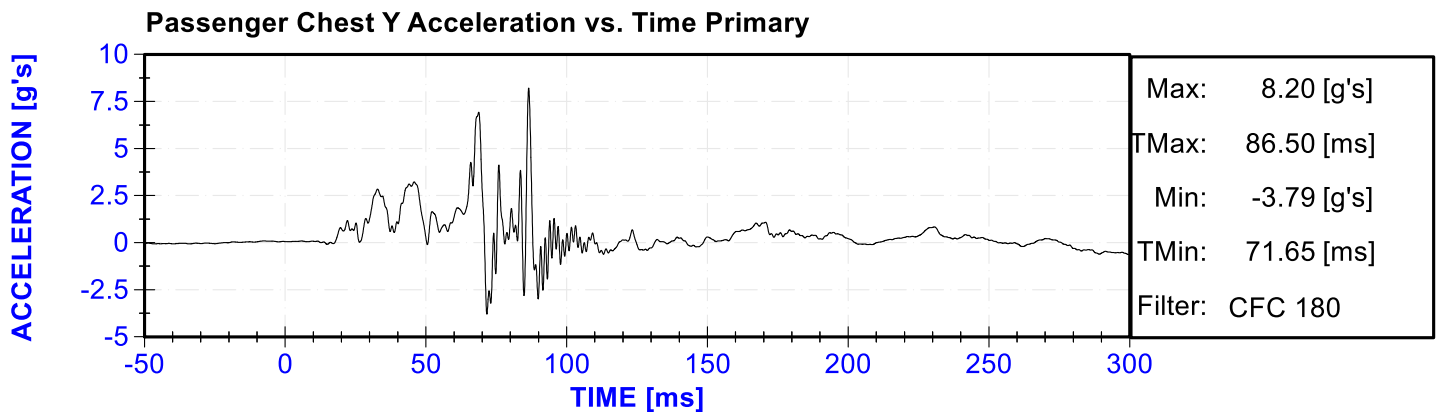
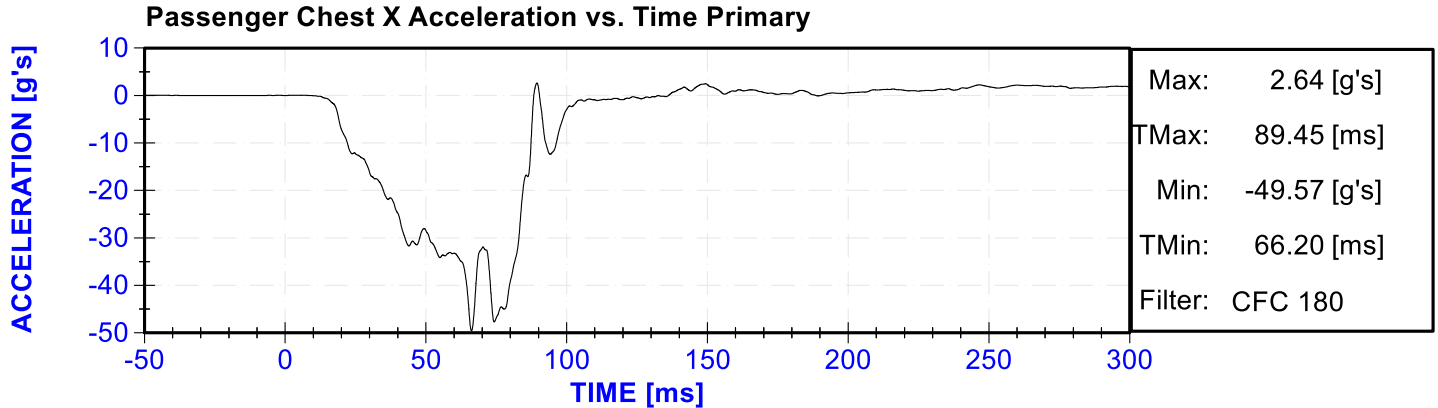


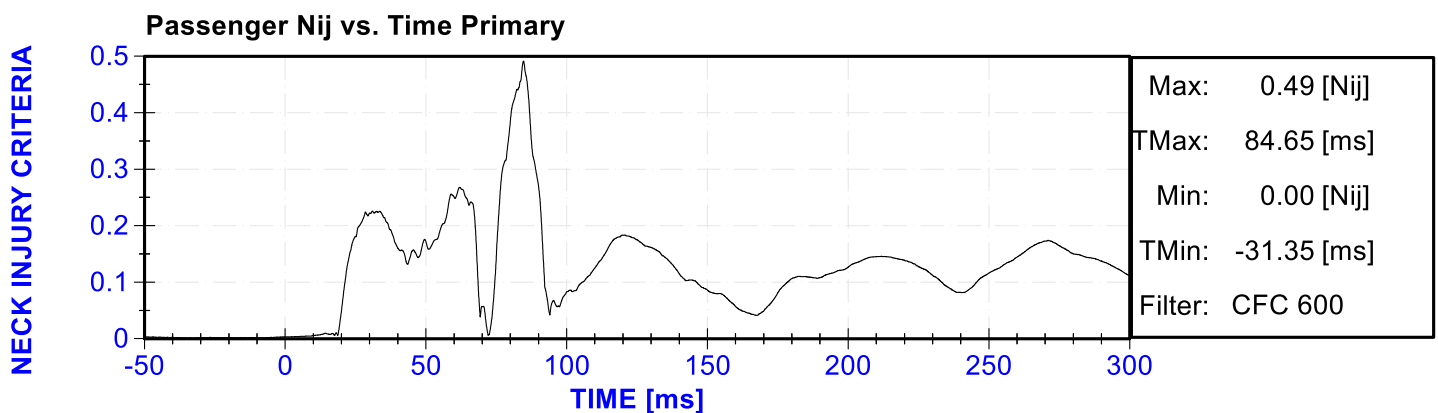
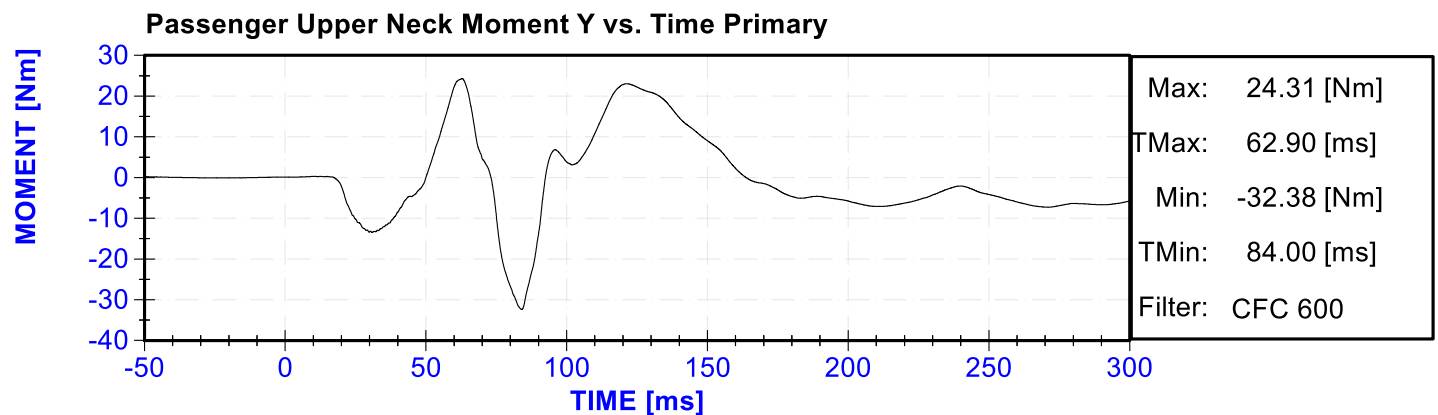
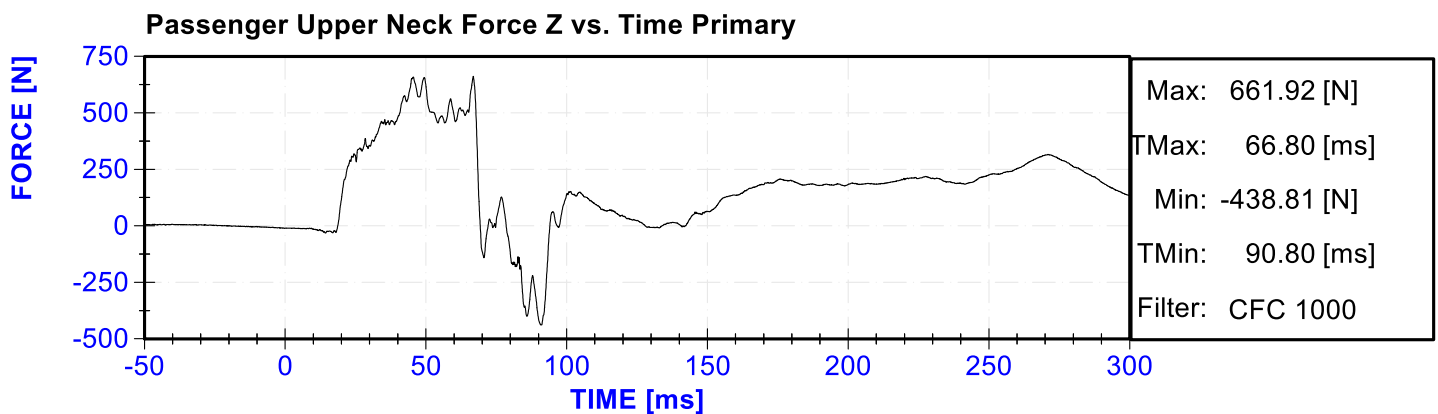
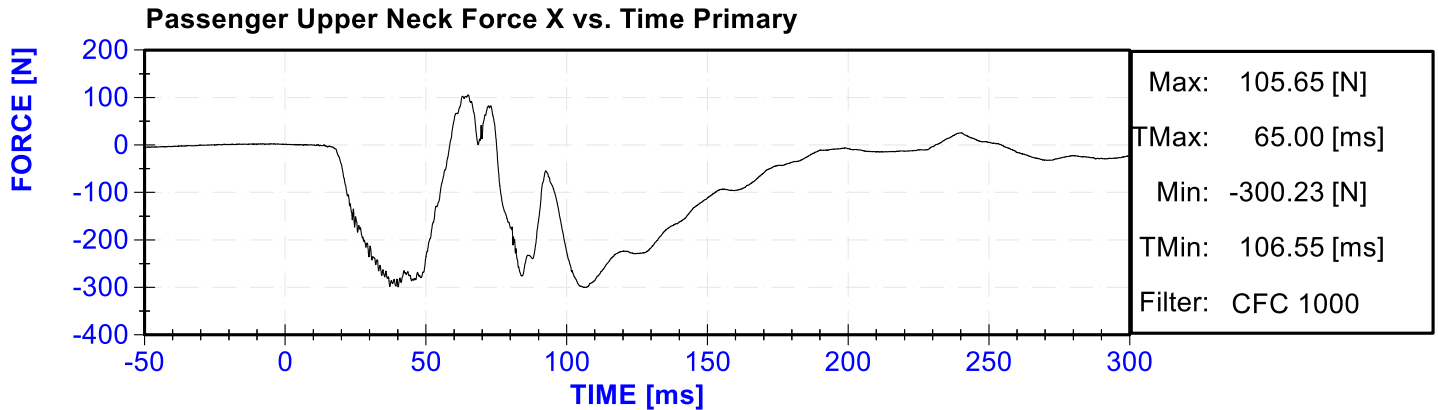
Passenger Head Resultant Acceleration vs. Time Primary



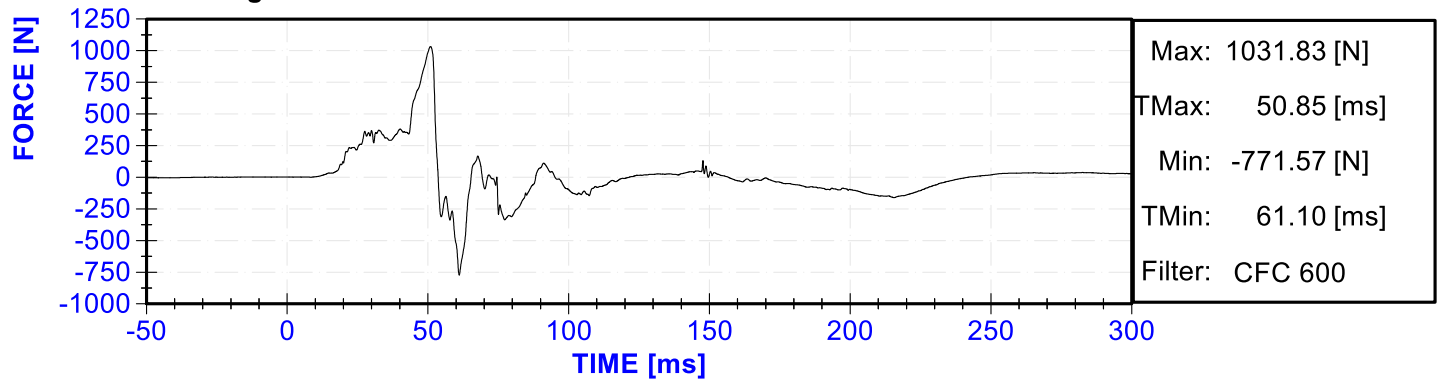
Passenger Chest X Deflection vs. Time



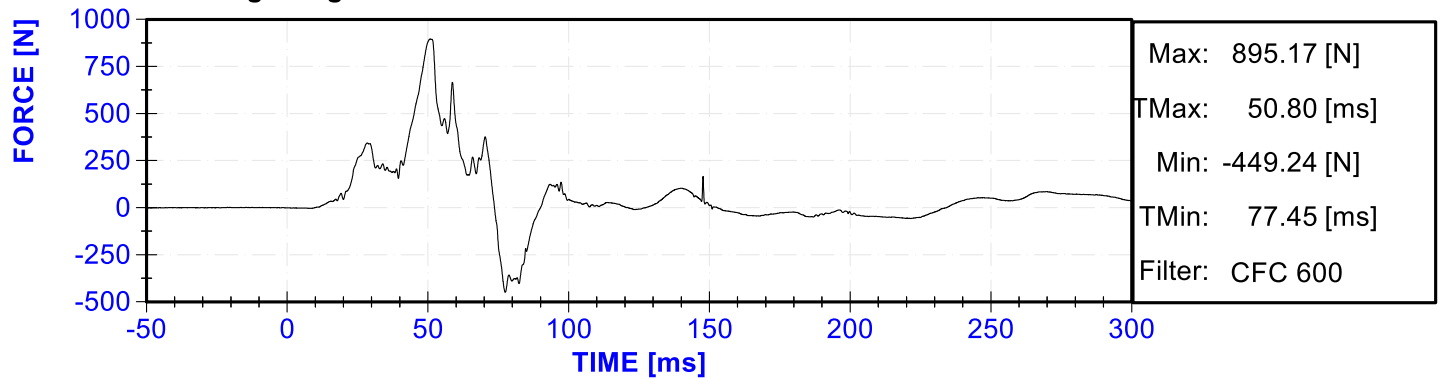




Passenger Left Femur Force vs. Time



Passenger Right Femur Force vs. Time



APPENDIX C

DUMMY CALIBRATION AND PERFORMANCE VERIFICATION DATA

CALIBRATION TEST RESULTS

PRE-TEST

HYBRID III 50TH PERCENTILE MALE - DRIVER ATD

SERIAL NO: 142



Date: 01/14/2019

USD 2485
Attachment

NOTE: FIGURE IS REFERENCED TO THE ERCT SEATED POSITION.
The curved lumbar does not allow the Hybrid III to be positioned in a perfect erect attitude.

HYBRID III Exterior Body Dimensions - Front View

HYBRID III Exterior Body Dimensions - Side View

Symbol	Description	Specification (in)		Result (in)	Pass/Fail
A	Sitting Height	34.6	35.0	34.7	Pass
B	Shoulder Pivot Height	19.9	20.5	20.2	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	8.1	Pass
K	Buttock to Knee Length	22.8	23.8	23.0	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	18.3	Pass
O	Chest Depth without Jacket	8.4	9.0	8.6	Pass
P	Foot Length (right)	9.9	10.5	10.2	Pass
V	Shoulder Breadth	16.3	17.2	16.7	Pass
W	Foot Breadth	3.6	4.2	3.8	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

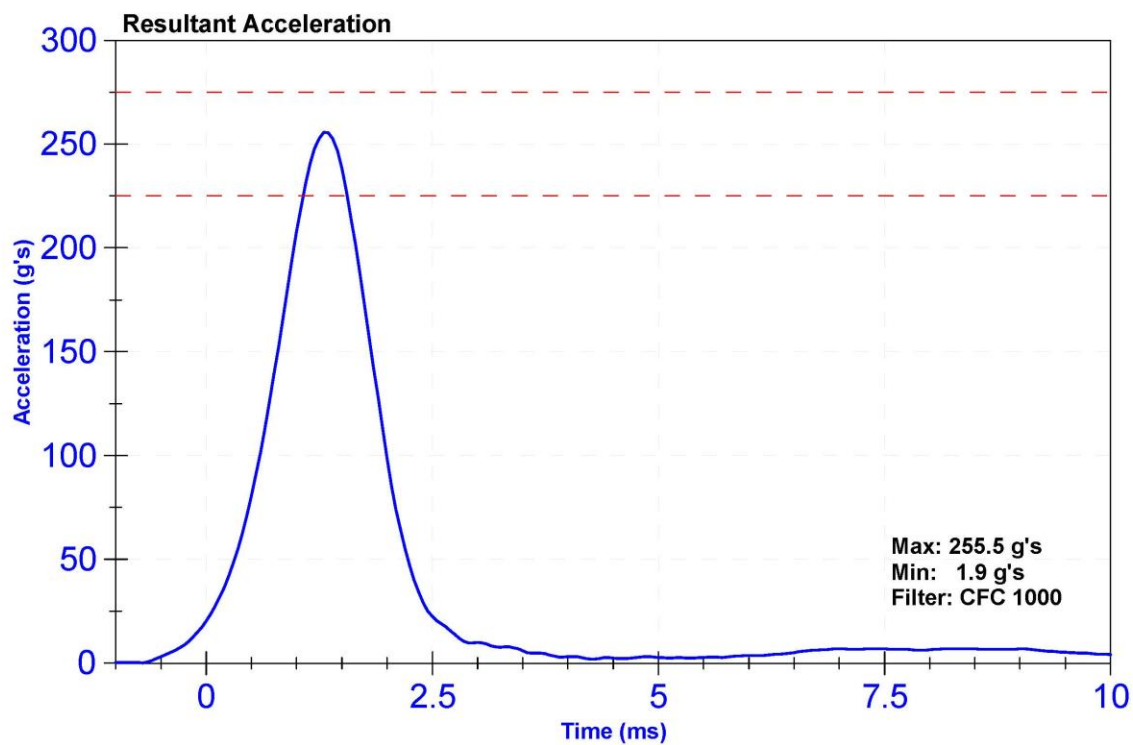
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ATD Serial Number	142	Laboratory Supervisor	K. Brogan

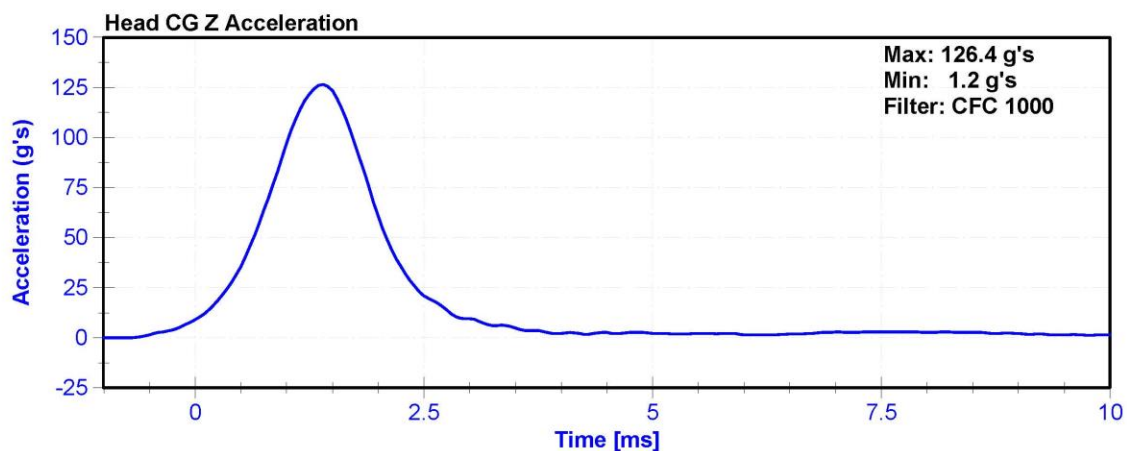
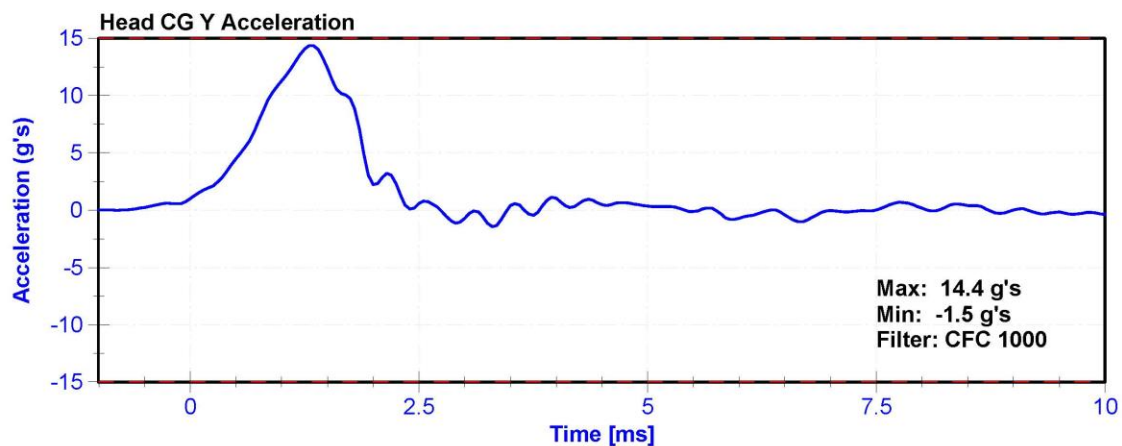
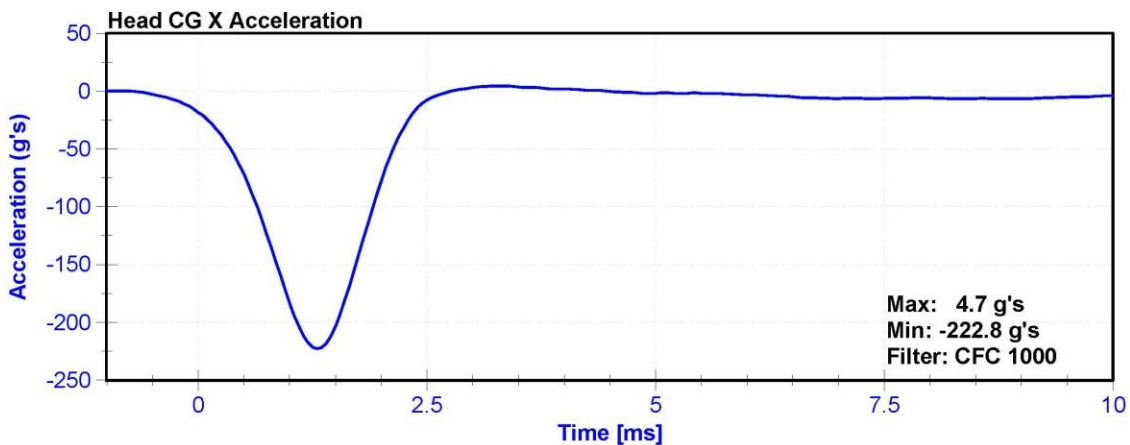
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	20.1	Pass
Humidity	10	70	%	17.9	Pass
Resultant Acceleration	225	275	g's	255.5	Pass
Oscillation	0	10	%	3.9	Pass
Lateral Acceleration	-15	15	g's	14.4	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





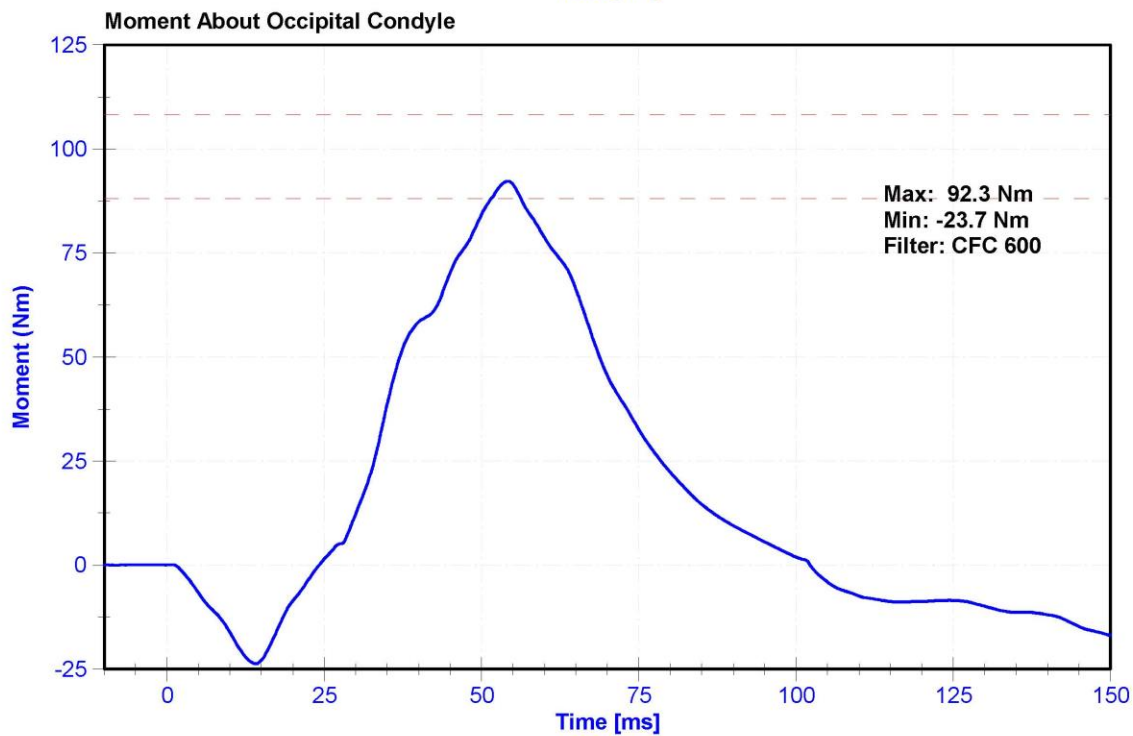
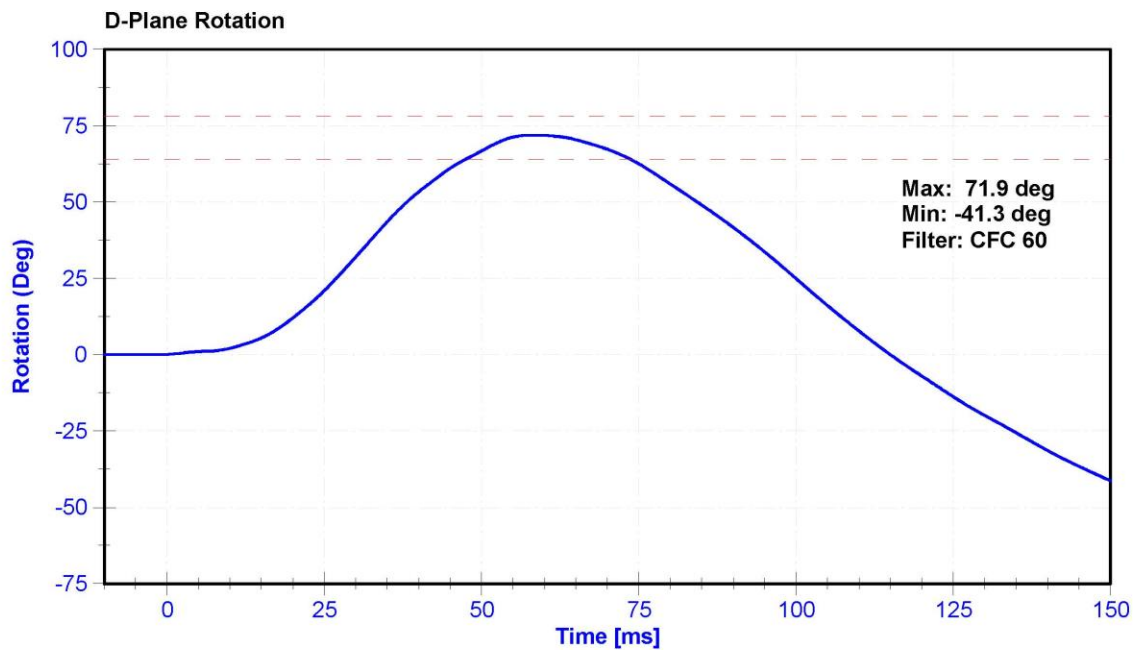
ATD Manufacturer	Humanetics	Test Technician	C. Mantell
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

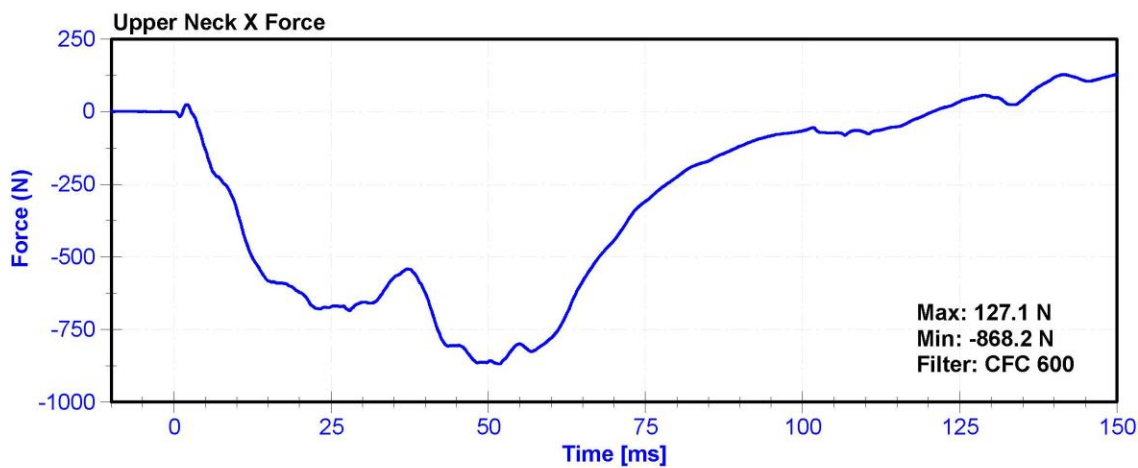
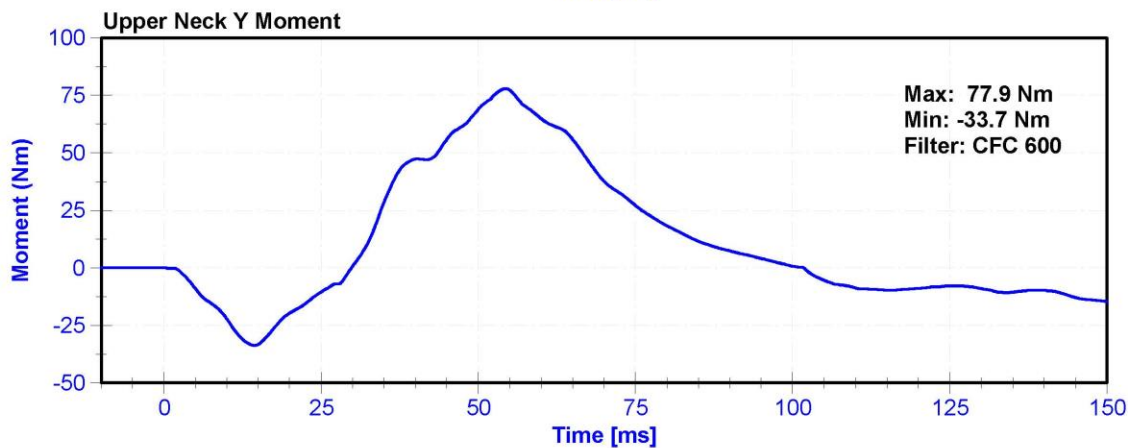
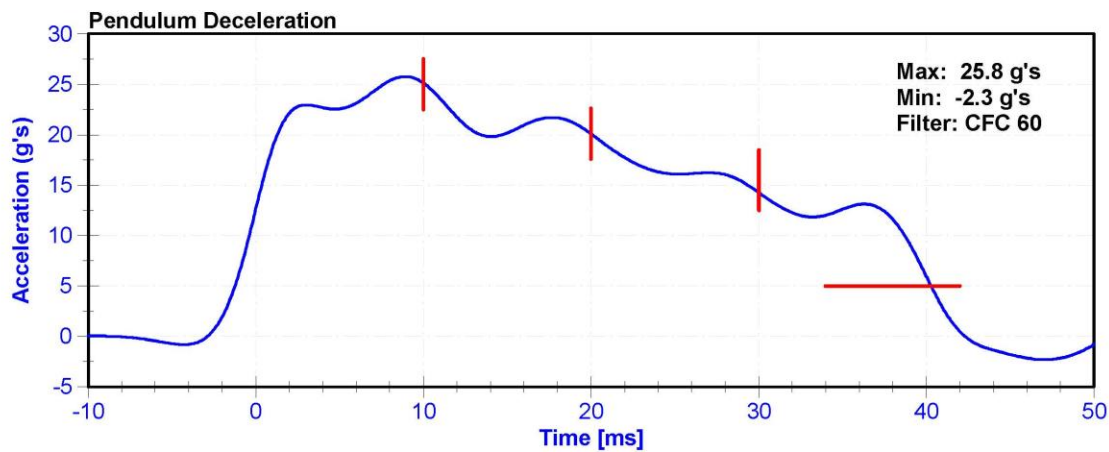
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.7	Pass
Humidity	10	70	%	18.0	Pass
Velocity	6.89	7.13	m/s	7.037	Pass
Pendulum Deceleration at 10ms	22.5	27.5	g's	25.13	Pass
Pendulum Deceleration at 20ms	17.6	22.6	g's	20.09	Pass
Pendulum Deceleration at 30ms	12.5	18.5	g's	14.27	Pass
Max. Pendulum Deceleration After 30ms	0	29	g's	25.8	Pass
Pendulum Deceleration Time to 5 g's	34	42	ms	40.3	Pass
Maximum D Plane Rotation	64	78	deg	71.9	Pass
Time to Maximum Rotation	57	64	ms	58.2	Pass
Rotation Decay to Zero	113	127	ms	115.0	Pass
Moment About Occipital Condyle	88.1	108.4	Nm	92.28	Pass
Time to Maximum Moment	47	58	ms	54.1	Pass
Moment Decay to Zero	97	107	ms	102.3	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-AH5F3	5/11/2018	5/11/2019
Pendulum Potentiometer	ETI SP22G	DS-PendPot	10/12/2018	10/12/2019
Condyle Potentiometer	ETI SP22G	DS-CondPot	10/12/2018	10/12/2019
Upper Neck Load Cell	FTSS IF-205	LC-161Fx	9/28/2018	9/28/2019





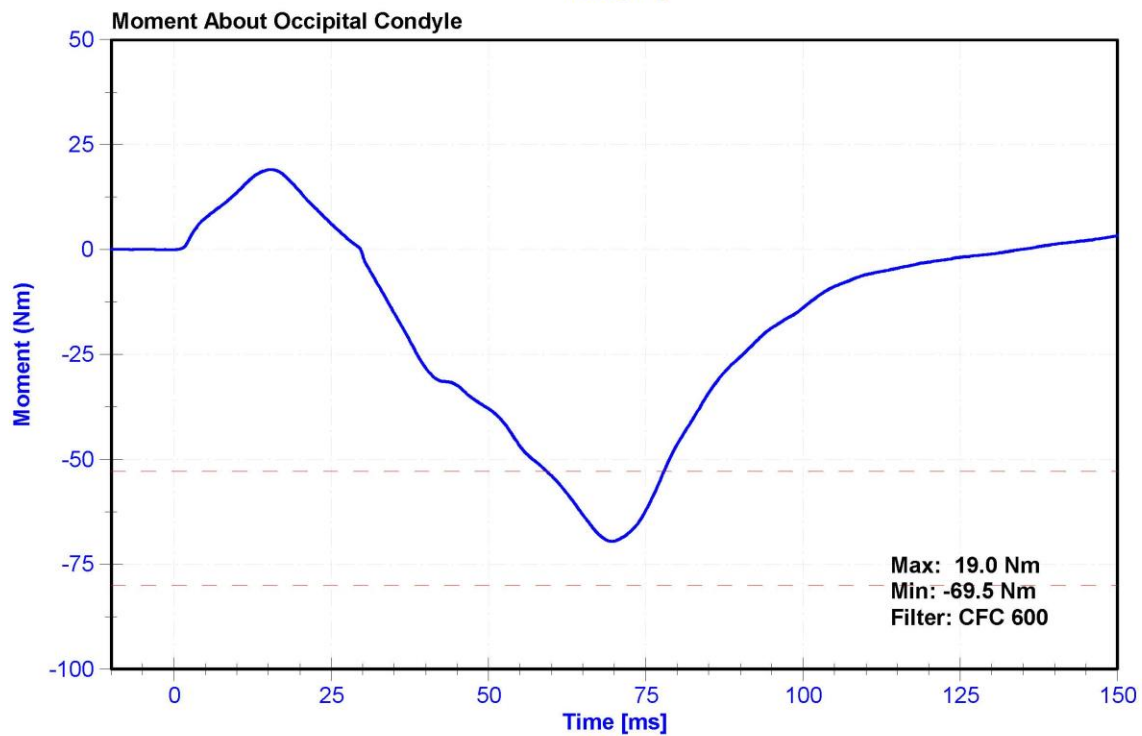
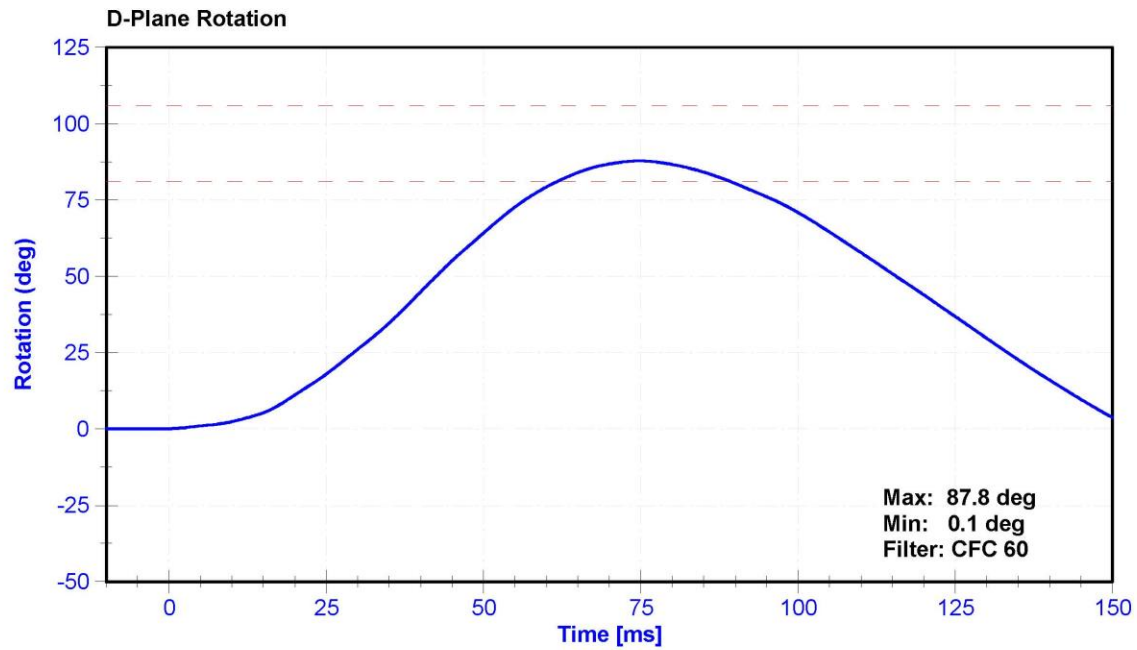
ATD Manufacturer	Humanetics	Test Technician	C. Mantell
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

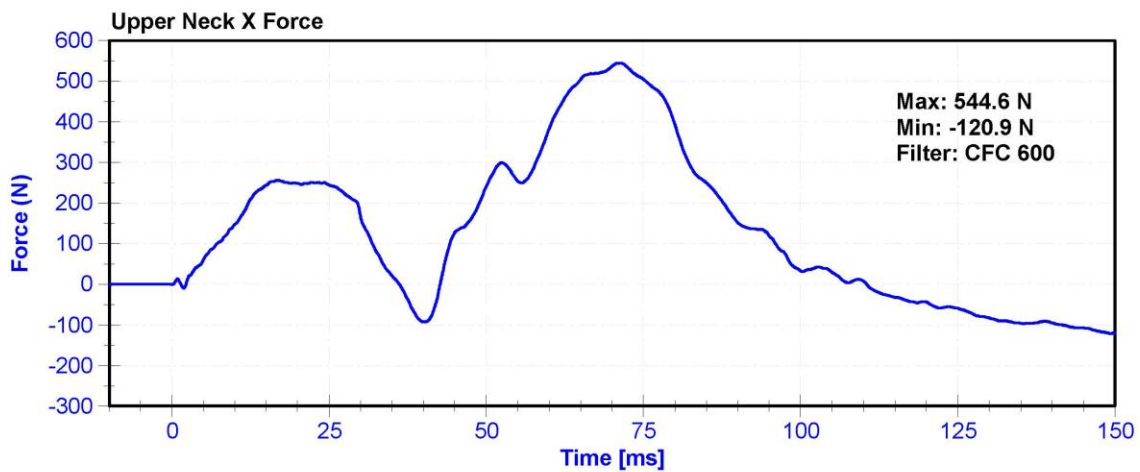
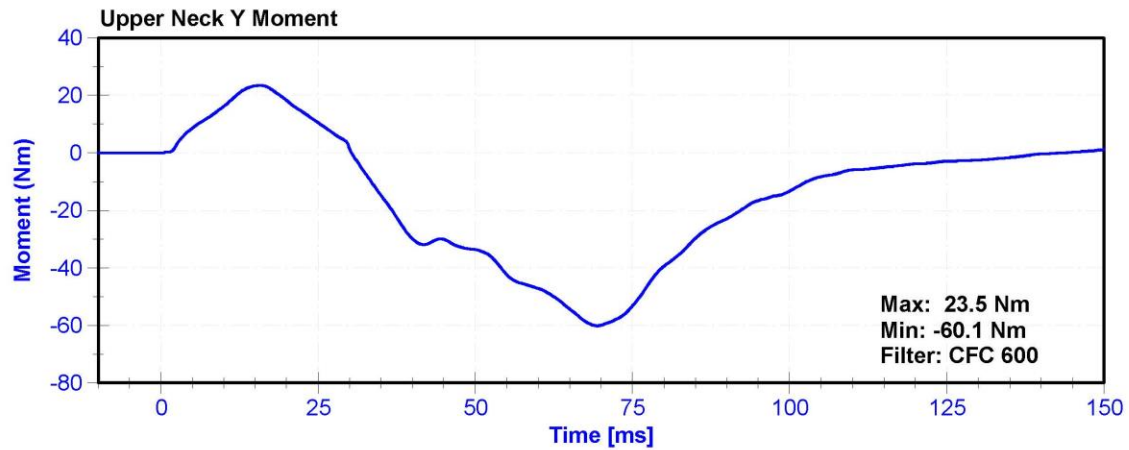
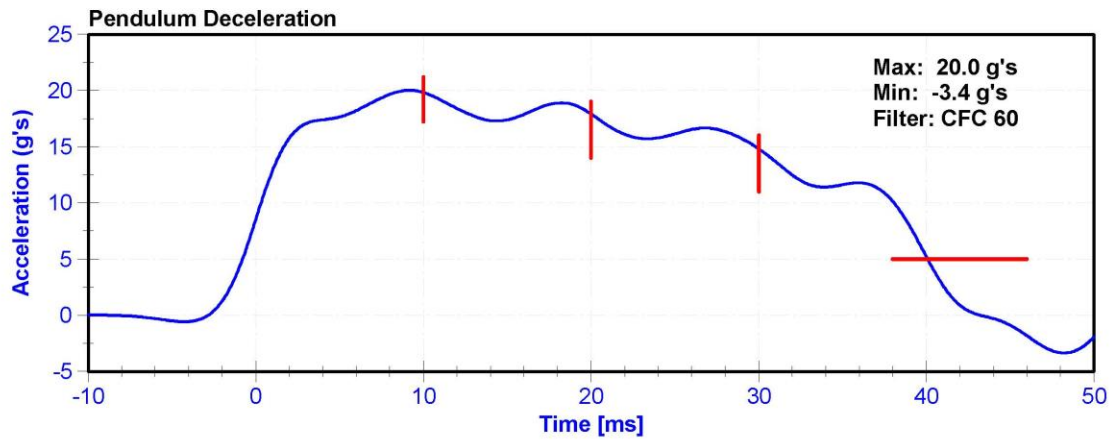
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.7	Pass
Humidity	10	70	%	19.2	Pass
Velocity	5.94	6.19	m/s	6.068	Pass
Pendulum Deceleration at 10ms	17.2	21.2	g's	19.83	Pass
Pendulum Deceleration at 20ms	14	19	g's	17.9	Pass
Pendulum Deceleration at 30ms	11	16	g's	14.8	Pass
Max. Pendulum Deceleration After 30ms	0	22	g's	20.0	Pass
Pendulum Deceleration Time to 5 g's	38	46	ms	40.1	Pass
Maximum D Plane Rotation	81	106	deg	87.8	Pass
Time to Maximum Rotation	72	82	ms	74.8	Pass
Rotation Decay to Zero	147	174	ms	153.4	Pass
Minimum Moment About OC	-80	-52.9	Nm	-69.52	Pass
Time to Minimum Moment	65	79	ms	69.6	Pass
Moment Decay to Zero	120	148	ms	134.7	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-AH5F3	5/11/2018	5/11/2019
Pendulum Potentiometer	ETI SP22G	DS-PendPot	10/12/2018	10/12/2019
Condyle Potentiometer	ETI SP22G	DS-CondPot	10/12/2018	10/12/2019
Upper Neck Load Cell	FTSS IF-205	LC-161Fx	9/28/2018	9/28/2019





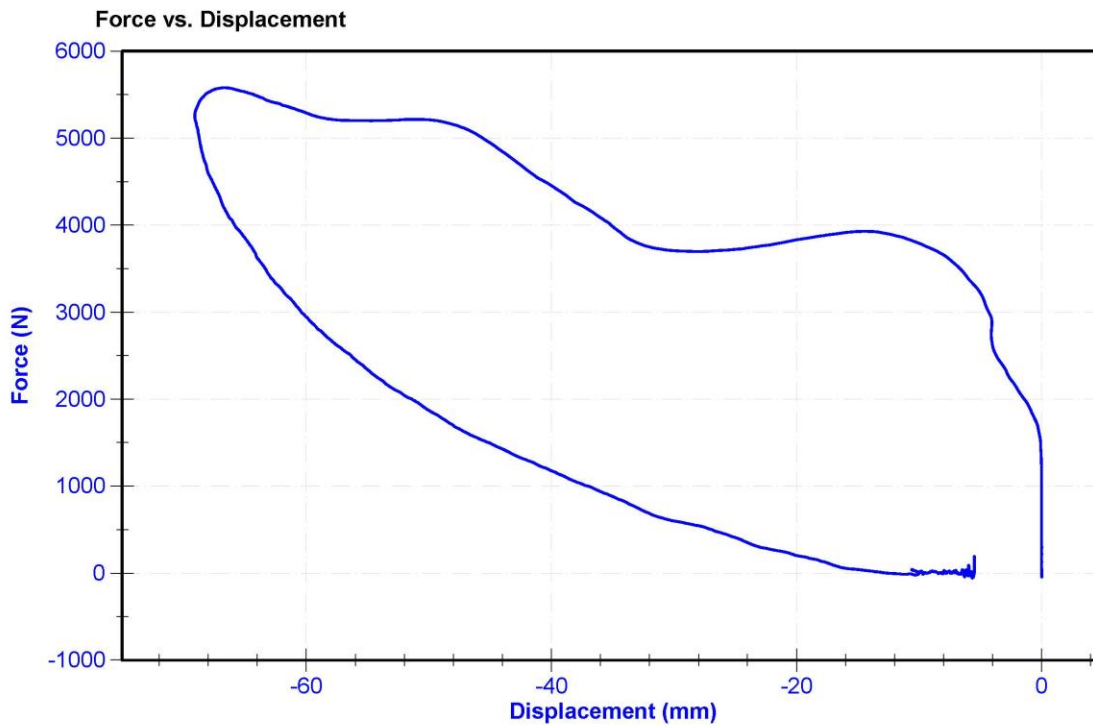
ATD Manufacturer	Humanetics	Test Technician	C. Mantell
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

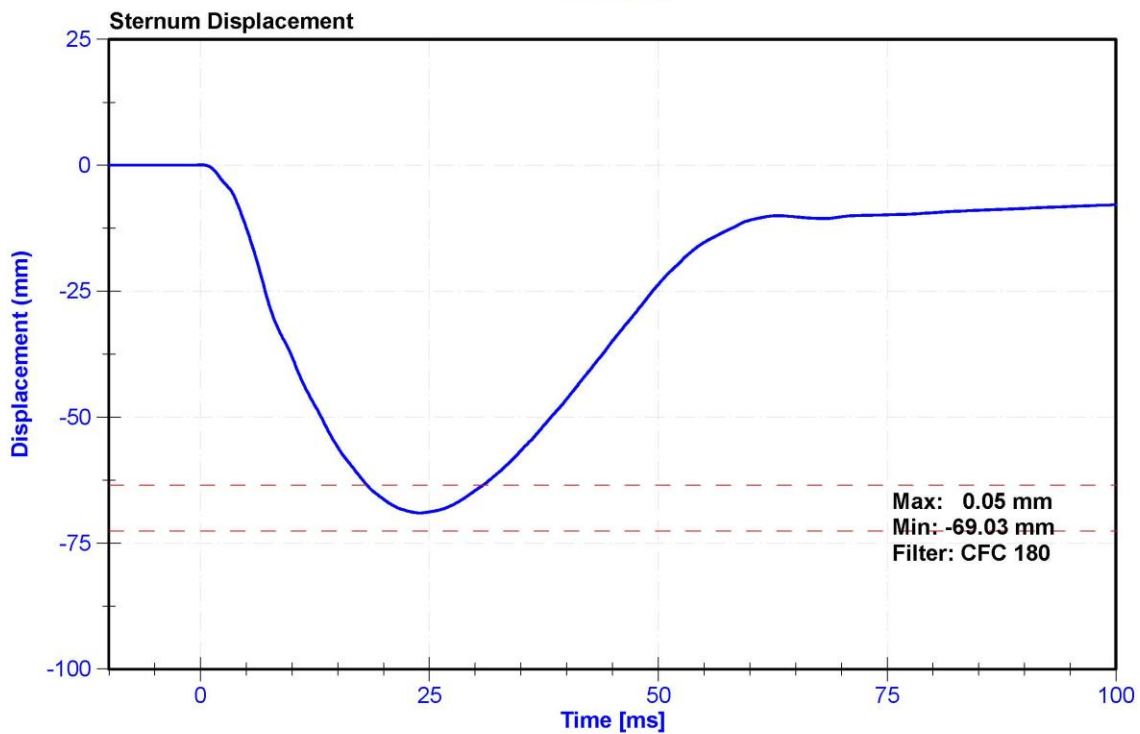
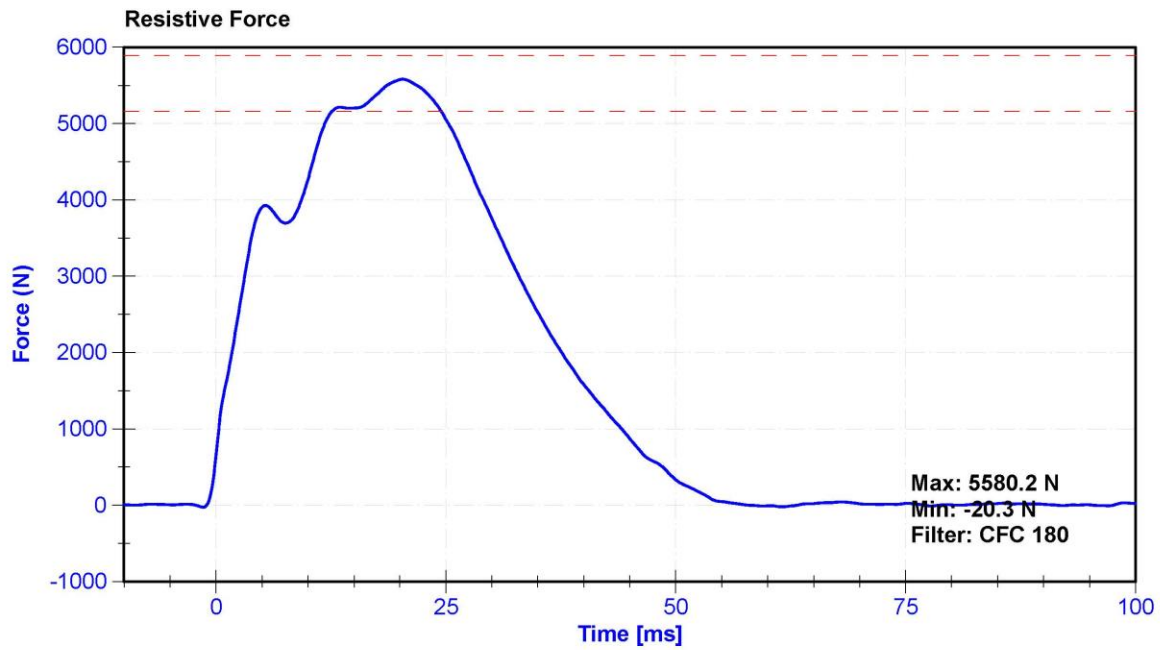
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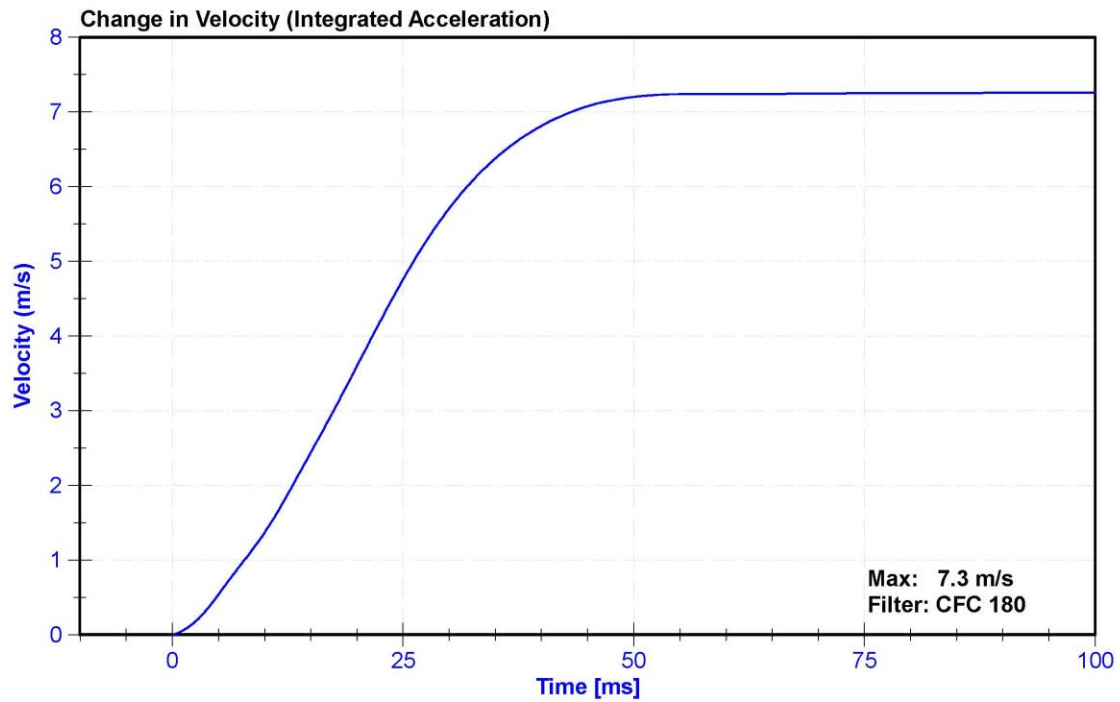
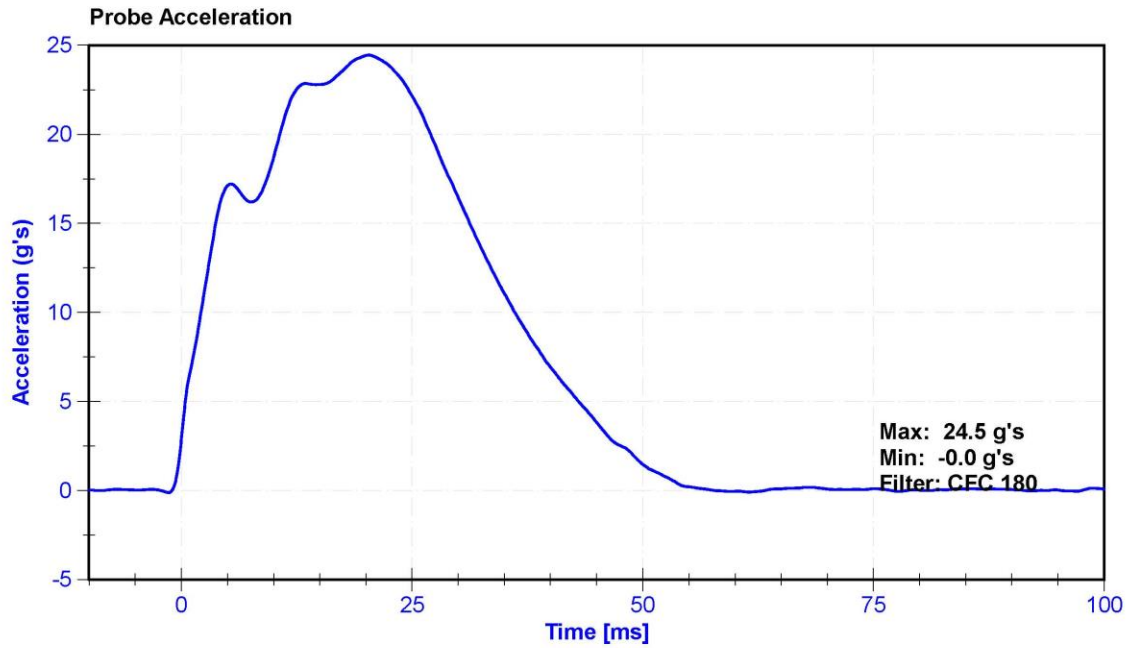
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.9	Pass
Humidity	10	70	%	19	Pass
Velocity	6.59	6.83	m/s	6.670	Pass
Chest Displacement	-72.6	-63.5	mm	-69.03	Pass
Resistive Force	5160	5894	N	5580.2	Pass
Hysteresis	65	85	%	70.8	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco 7264C-2KTZ-2-360MCI-794667	11/1/2018	11/1/2019	
Chest Potentiometer	JDK 6209-2038	DS-142	10/22/2018	10/22/2019







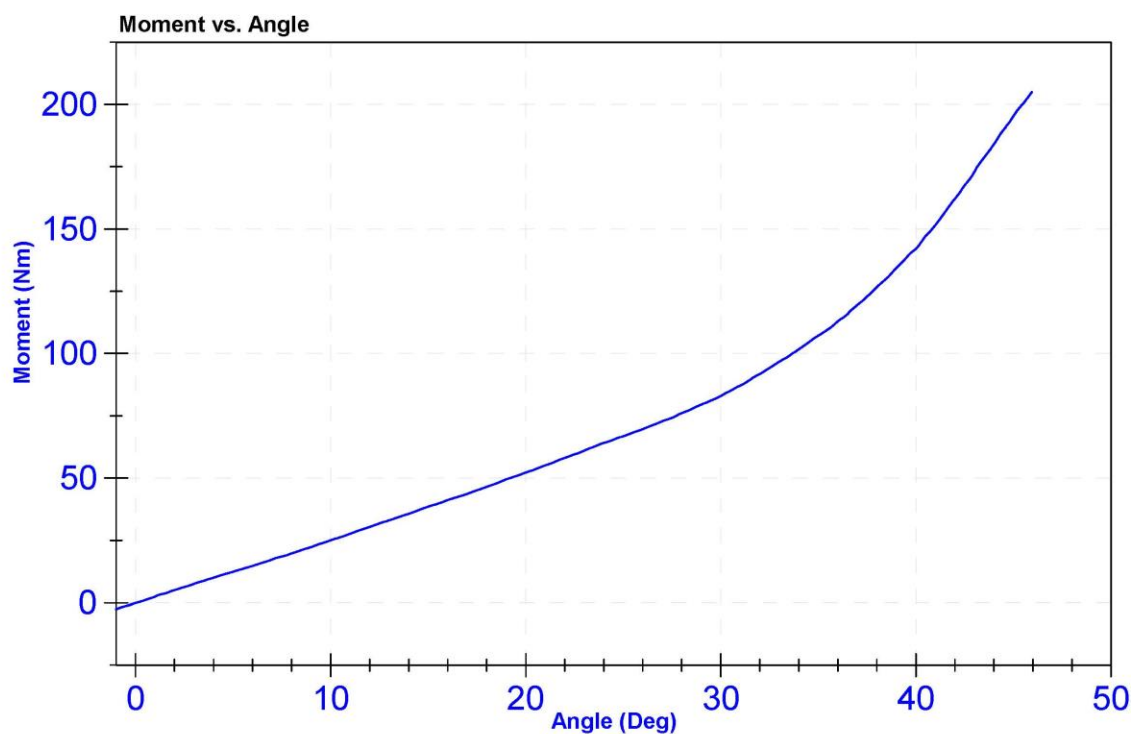
ATD Manufacturer	Humanetics	Test Technician	D. Reinhard
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	21.9	Pass
Humidity	10	70	%	17.2	Pass
Average Velocity	5	10	deg/s	7.4	Pass
Angle at 203Nm	40	50	deg	45.8	Pass
Moment at 30 degrees	0	94.9	Nm	83.0	Pass

Transducer Calibrations

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



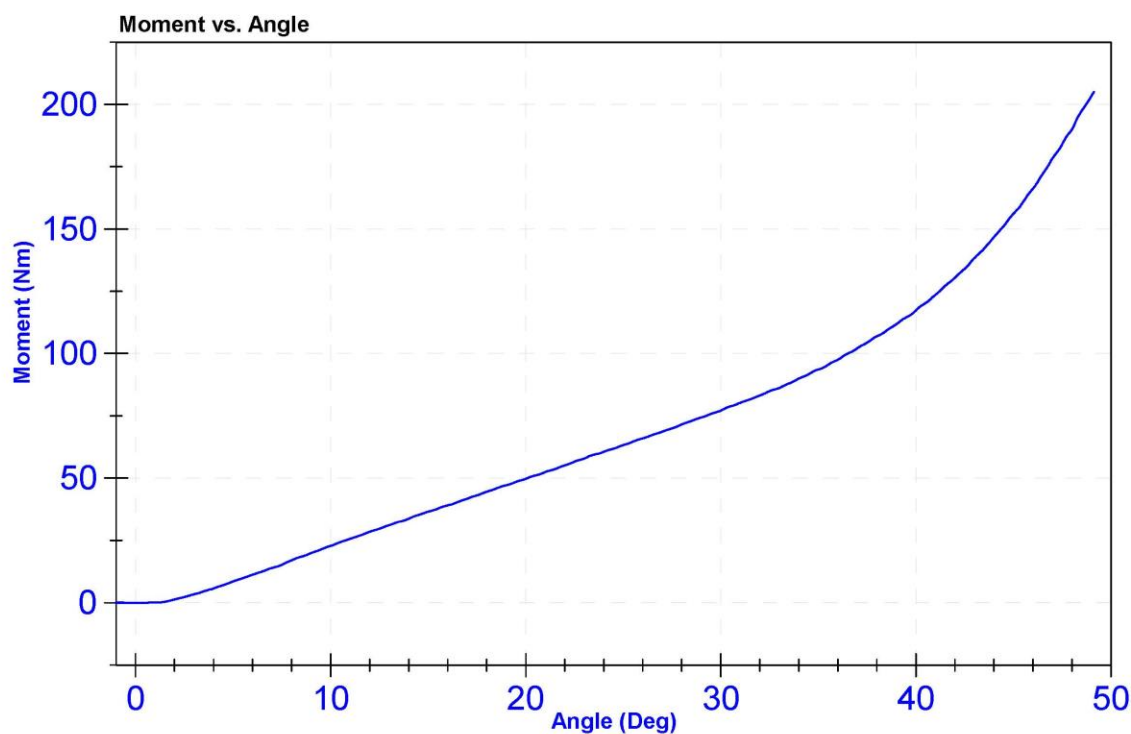
ATD Manufacturer	Humanetics	Test Technician	D. Reinhard
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	22.0	Pass
Humidity	10	70	%	16.0	Pass
Average Velocity	5	10	deg/s	7.4	Pass
Angle at 203Nm	40	50	deg	49.0	Pass
Moment at 30 degrees	0	94.9	Nm	77.1	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



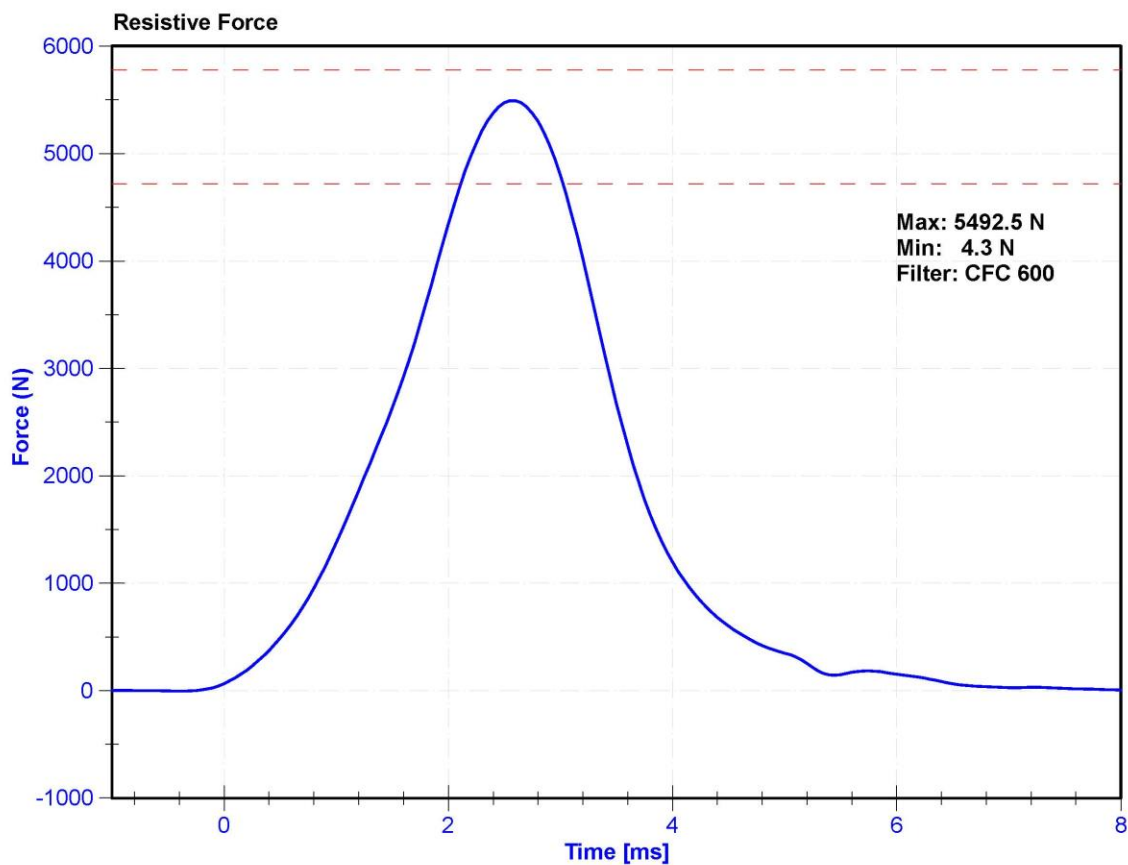
ATD Manufacturer	Humanetics	Test Technician	D.Reinhard
ATD Serial Number	142	Laboratory Supervisor	K.Brogan

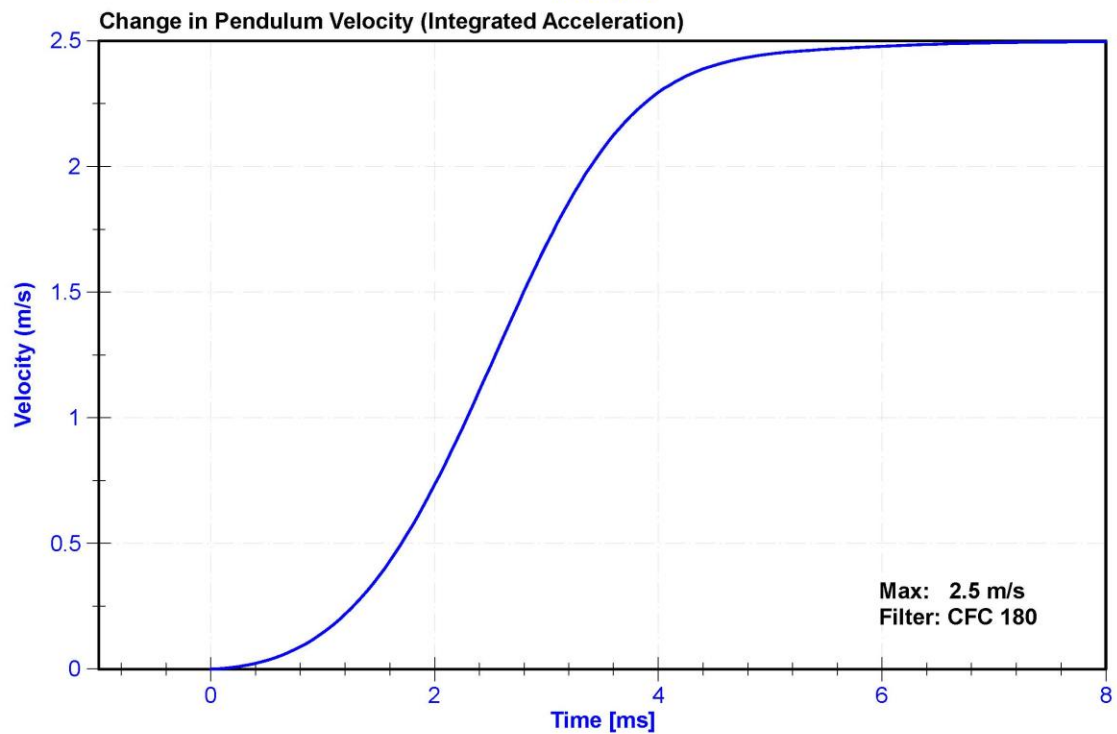
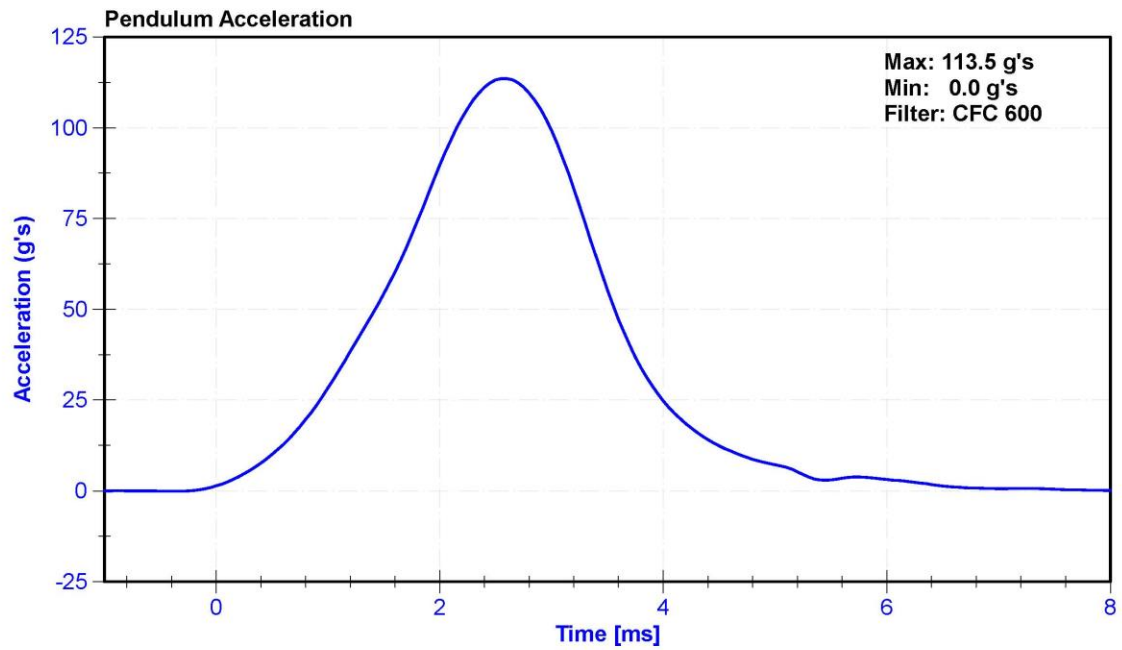
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	22	Pass
Humidity	10	70	%	17.3	Pass
Velocity	2.07	2.13	m/s	2.115	Pass
Maximum Resistive Force	4720	5780	N	5492.5	Pass

Transducer Calibrations

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





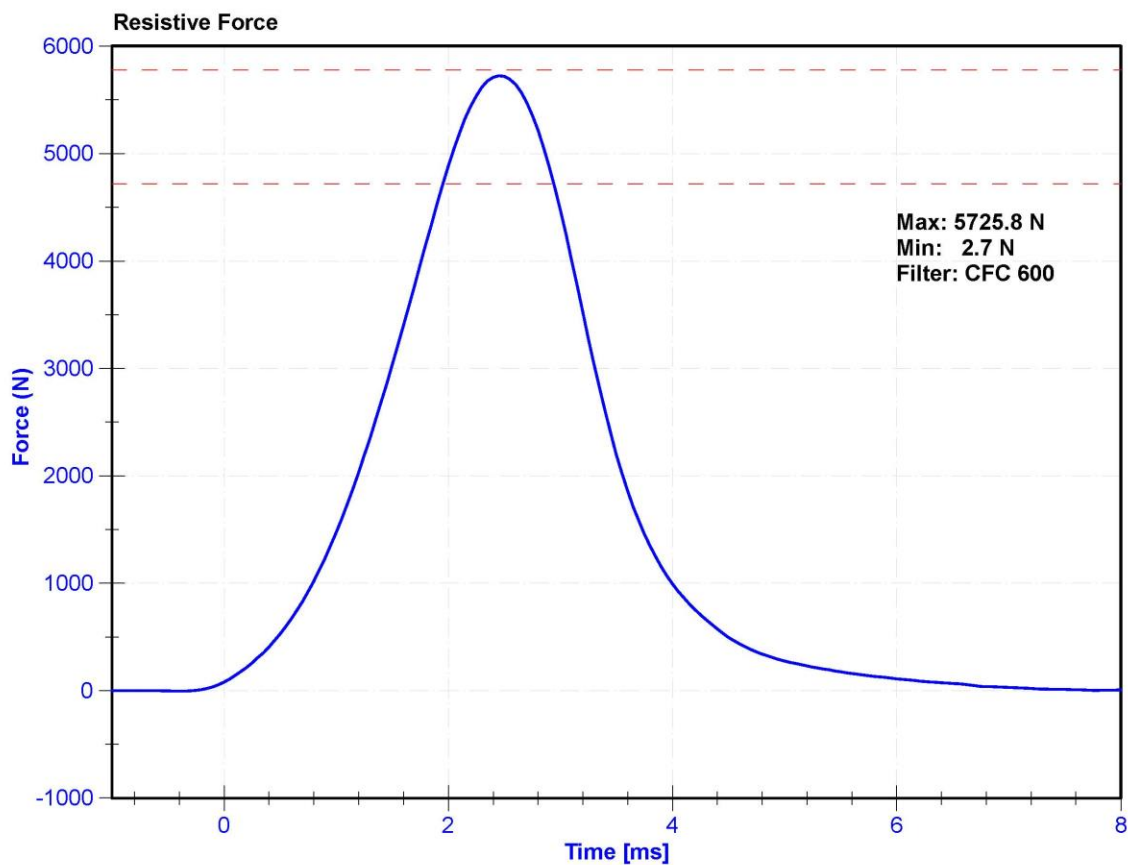
ATD Manufacturer	Humanetics	Test Technician	D.Reinhard
ATD Serial Number	142	Laboratory Supervisor	K.Brogan

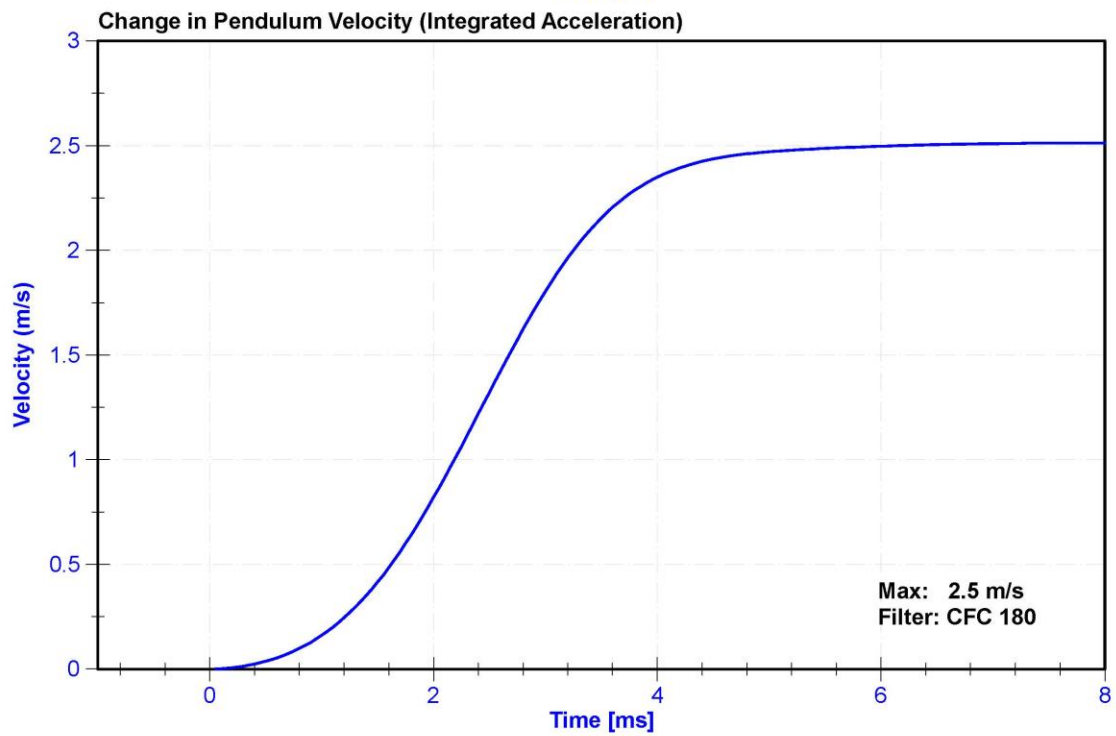
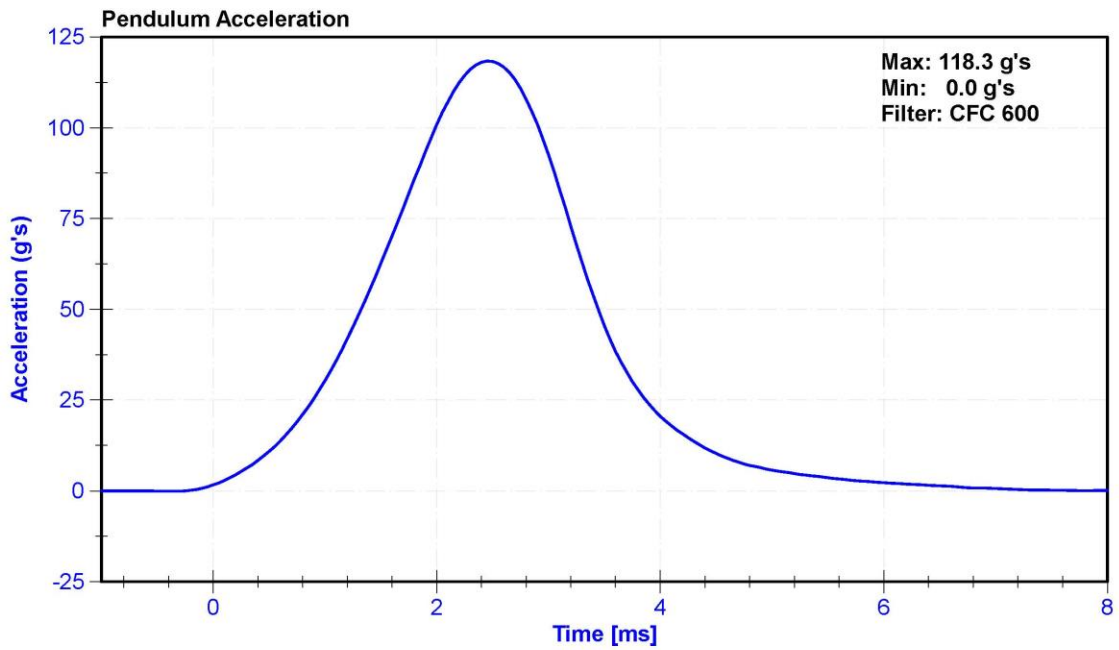
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	22	Pass
Humidity	10	70	%	19.4	Pass
Velocity	2.07	2.13	m/s	2.118	Pass
Maximum Resistive Force	4720	5780	N	5725.8	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

PRE-TEST

HYBRID III 5TH PERCENTILE - PASSENGER ATD

SERIAL NO: 139

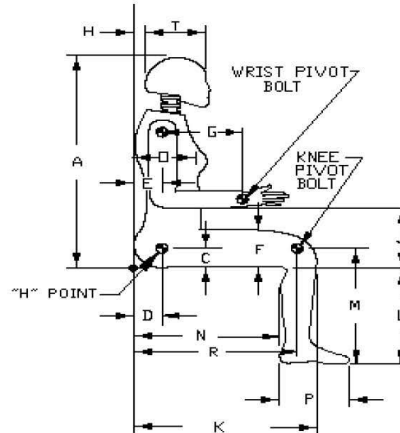
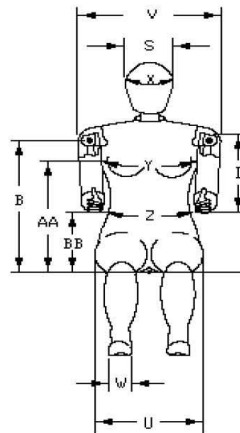


External Measurements - Hybrid 3 - 5th Female

Technician: K. Brogan

Date: 02/01/2018

Dummy Serial Number: 139



Symbol	Description	Specification (mm)		Result (mm)	Pass/Fail
A	Sitting Height	775	800	789	Pass
B	Shoulder Pivot Height	432	457	446	Pass
C	H-Point Height	81	86	84	Pass
D	H-Point from Backline	145	150	147	Pass
E	Shoulder Pivot from Backline	69	84	76	Pass
F	Thigh Clearance	119	135	124	Pass
G	Back of Elbow to Wrist Pivot	244	259	251	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	188	Pass
K	Buttock to Knee Length	521	546	541	Pass
L	Popliteal Height	356	376	363	Pass
M	Knee Pivot Height	394	419	398	Pass
N	Buttock Popliteal Length	414	439	424	Pass
O	Chest Depth without Jacket	175	191	185	Pass
P	Foot Length (right)	219	234	225	Pass
R	Buttock To Knee Pivot Length	457	483	473	Pass
S	Head Breadth	137	147	141	Pass
T	Head Depth	178	188	182	Pass
U	Hip Breadth	300	315	308	Pass
V	Shoulder Breadth	351	366	362	Pass
W	Foot Breadth	79	94	86	Pass
X	Head Circumference	528	549	535	Pass
Y	Chest Circumference with Jacket	851	881	861	Pass
Z	Waist Circumference	460	790	773	Pass
AA	Reference Location (Chest Circumference)	333	358	345	Pass
BB	Reference Location (Waist Circumference)	160	170	165	Pass

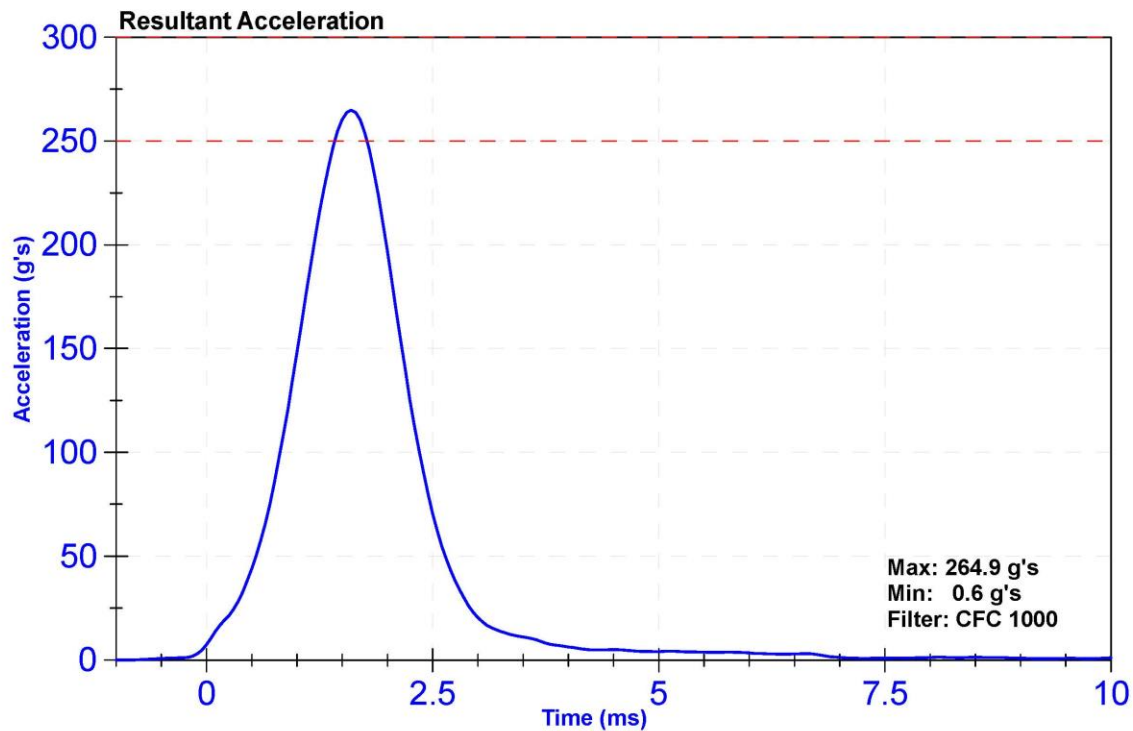
ATD Manufacturer	Denton	Test Technician	C. Mantell
ATD Serial Number	139	Laboratory Supervisor	K. Brogan

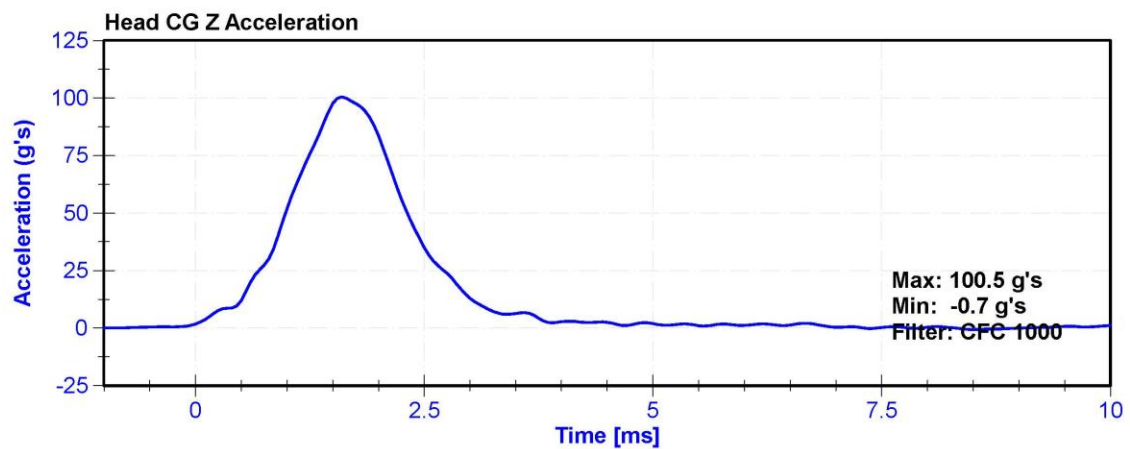
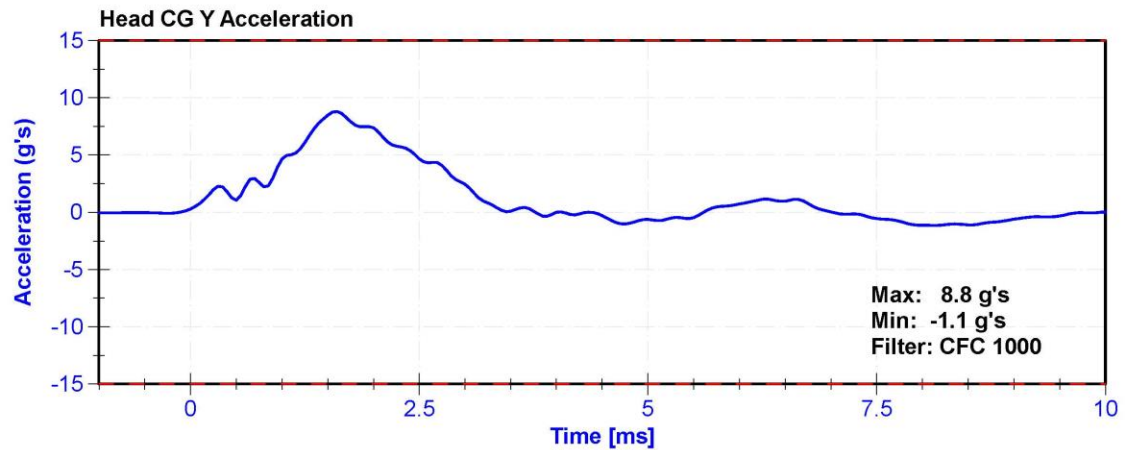
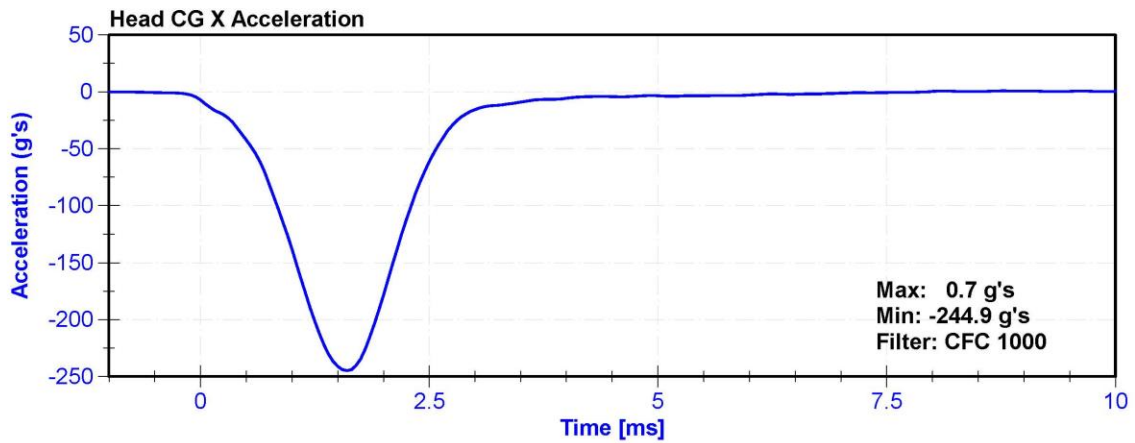
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	21.8	Pass
Humidity	10	70	%	29.3	Pass
Resultant Acceleration	250	300	g's	264.9	Pass
Oscillation	0	10	%	1.9	Pass
Lateral Acceleration	-15	15	g's	8.8	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	ENDEVCO 7264	AC-P51303	10/15/2018	4/15/2019
Y Accelerometer	ENDEVCO 7264CT	AC-P49216	10/15/2018	4/15/2019
Z Accelerometer	ENDEVCO 7264	AC-P58868	10/15/2018	4/15/2019





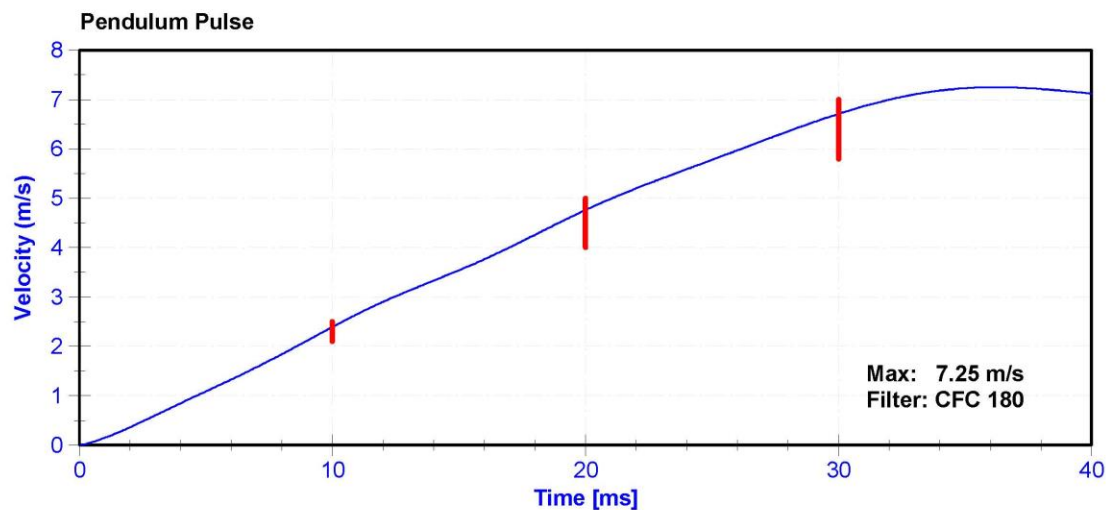
ATD Manufacturer	Denton	Test Technician	K. Dutton
ATD Serial Number	139	Laboratory Supervisor	K. Brogan

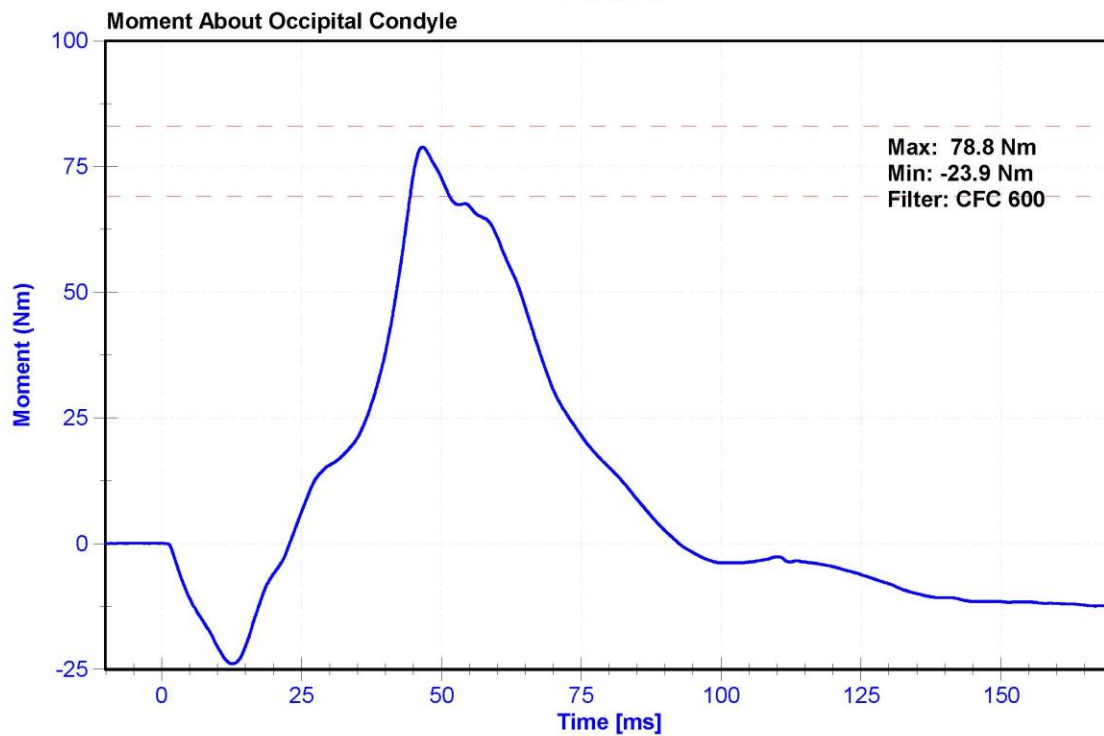
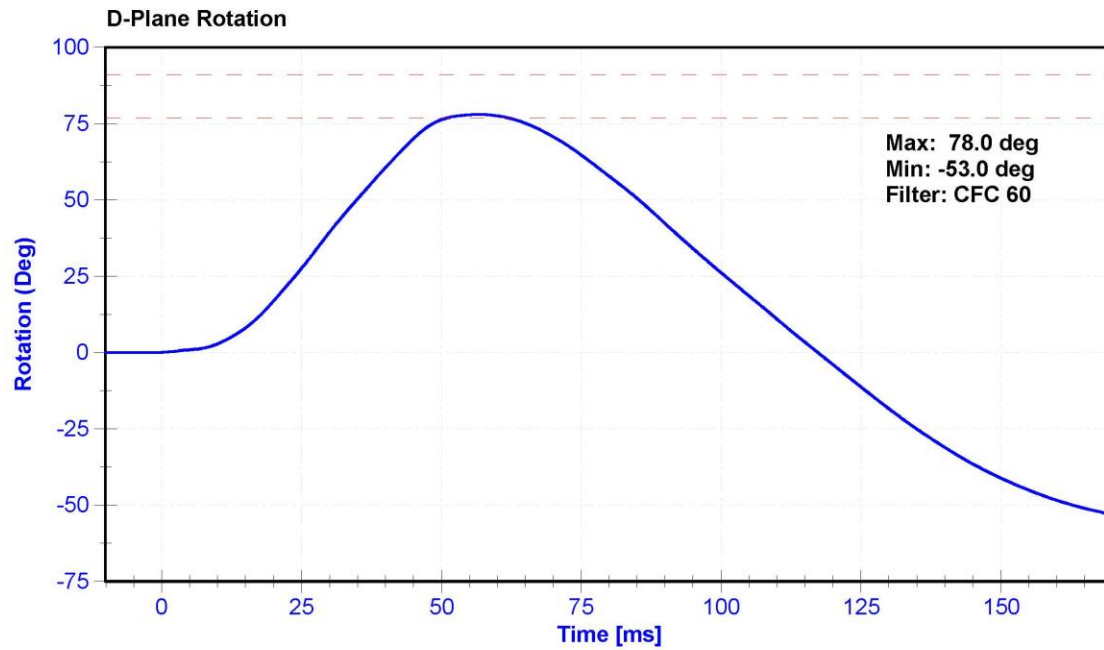
Results

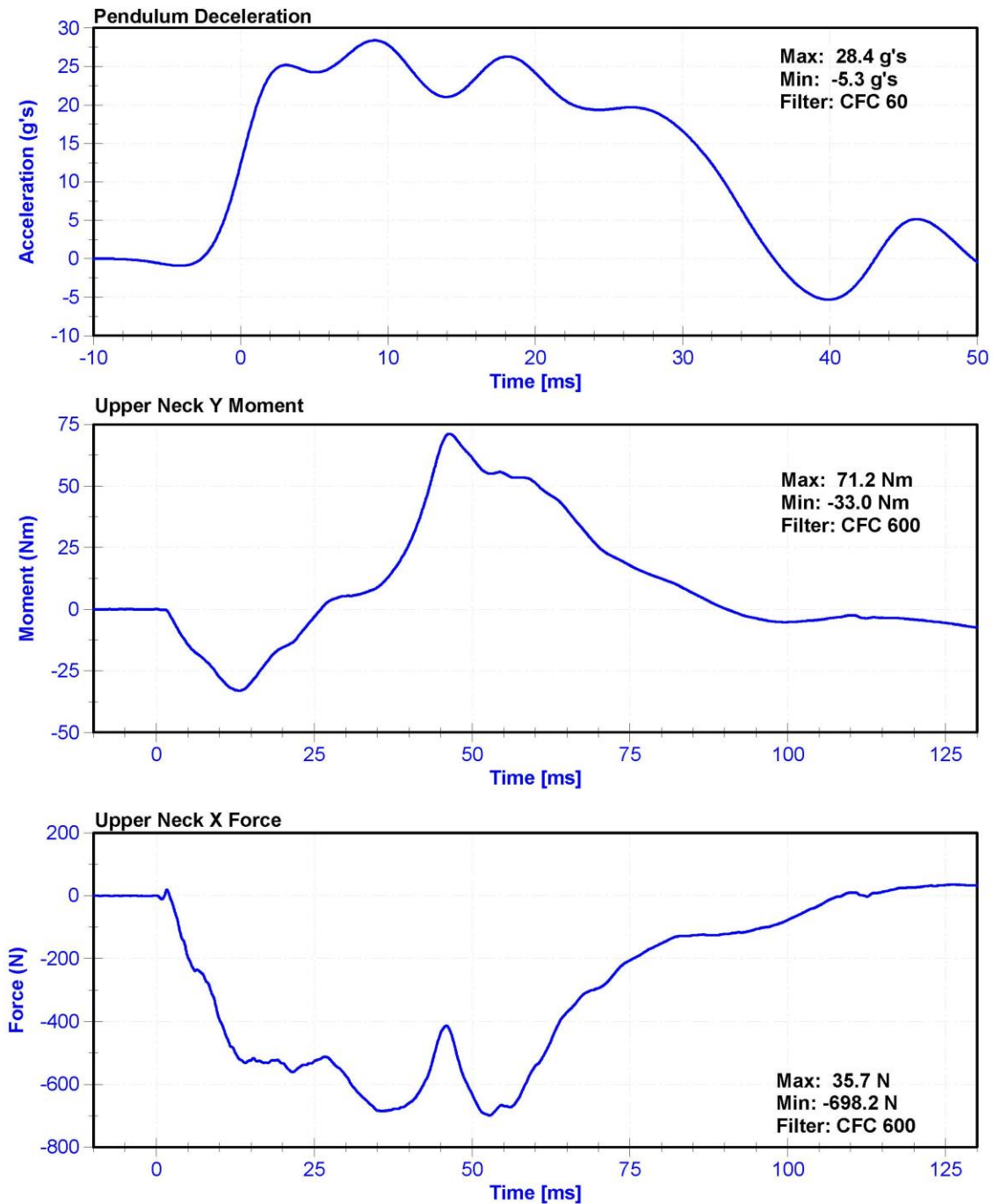
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.8	Pass
Humidity	10	70	%	41.3	Pass
Velocity	6.89	7.13	m/s	7.037	Pass
Pendulum Impulse at 10ms	2.1	2.5	m/s	2.39	Pass
Pendulum Impulse at 20ms	4.0	5.0	m/s	4.76	Pass
Pendulum Impulse at 30ms	5.8	7.0	m/s	6.71	Pass
Max D Plane Rotation	77	91	deg	78.0	Pass
Max Moment During Rotation Interval	69	83	Nm	78.8	Pass
Moment Decay to 10.0 Nm	80	100	ms	84.1	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-AH5F3	5/11/2018	5/11/2019
Pendulum Potentiometer	ETI SP22G	DS-PendPot	10/12/2018	10/12/2019
Condyle Potentiometer	ETI SP22G	DS-CondPot	10/12/2018	10/12/2019
Upper Neck Load Cell	DENTON 1716A	LC-1591Fx	9/28/2018	9/28/2019







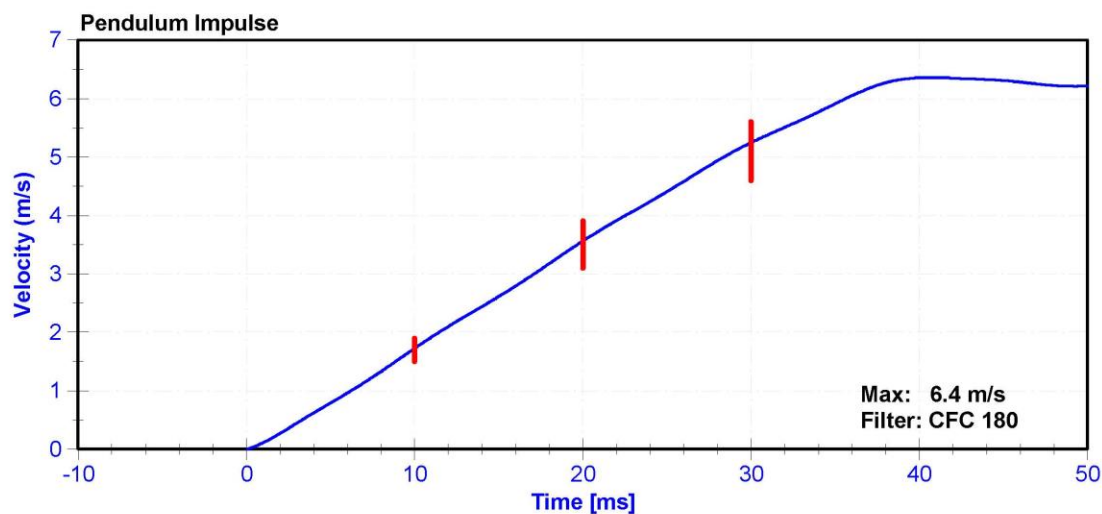
ATD Manufacturer	Denton	Test Technician	K. Dutton
ATD Serial Number	139	Laboratory Supervisor	K. Brogan

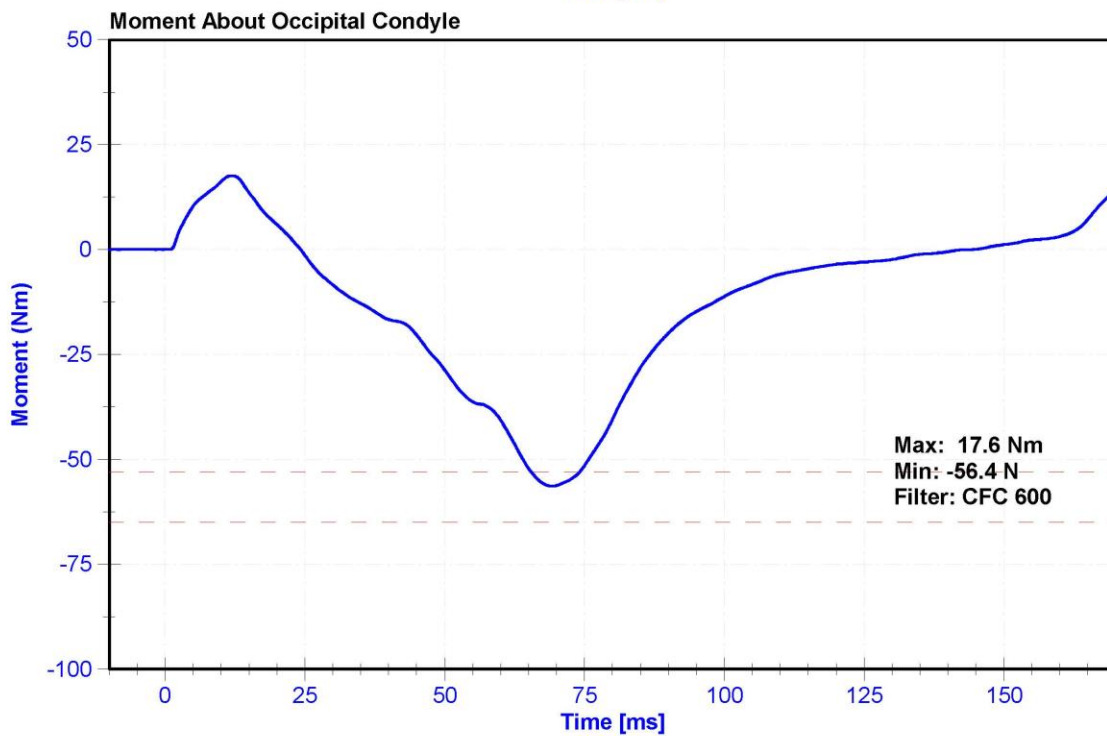
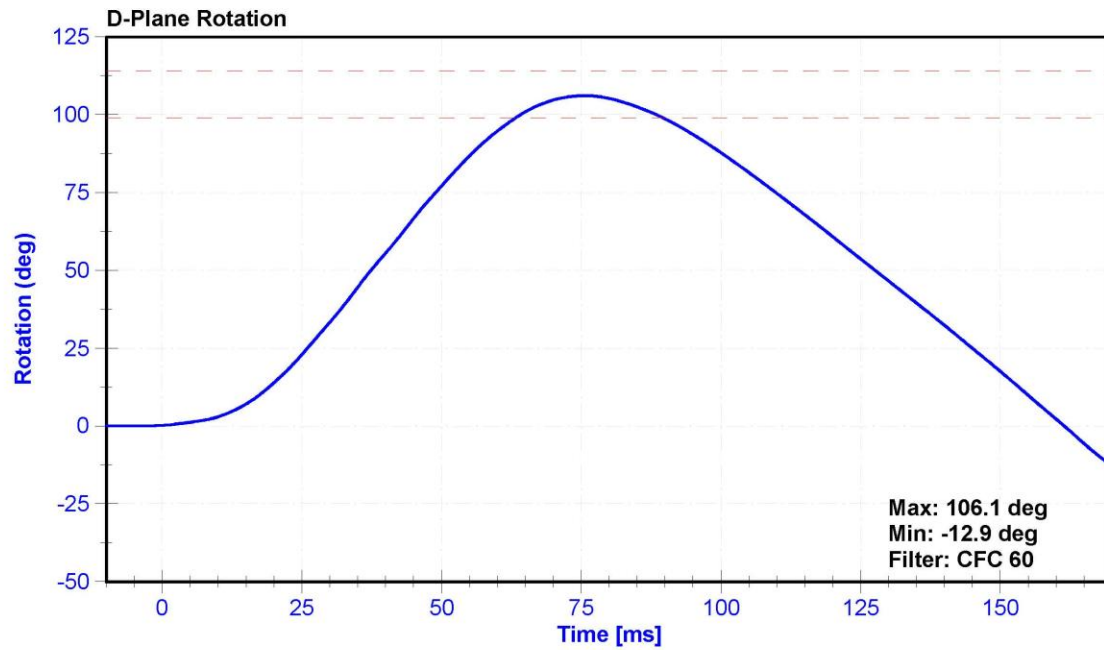
Results

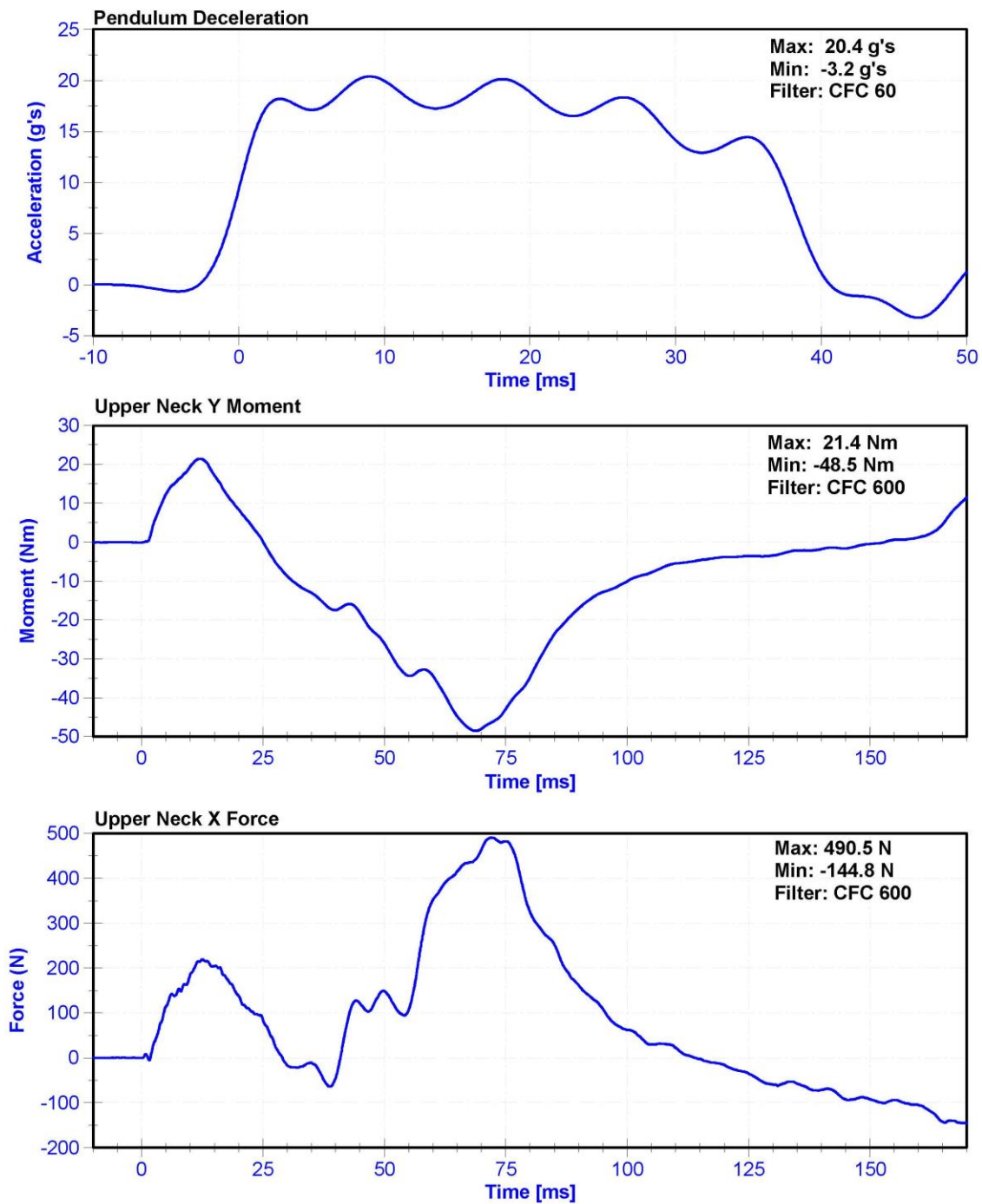
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.8	Pass
Humidity	10	70	%	41.3	Pass
Velocity	5.95	6.19	m/s	6.158	Pass
Pendulum Impulse at 10ms	1.5	1.9	m/s	1.73	Pass
Pendulum Impulse at 20ms	3.1	3.9	m/s	3.56	Pass
Pendulum Impulse at 30ms	4.6	5.6	m/s	5.25	Pass
D Plane Rotation	99	114	deg	106.1	Pass
Moment During Rotation Interval	-65	-53	Nm	-56.4	Pass
Moment Decay to -10Nm	94	114	ms	101.8	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-AH5F3	5/11/2018	5/11/2019
Pendulum Potentiometer	ETI SP22G	DS-PendPot	10/12/2018	10/12/2019
Condyle Potentiometer	ETI SP22G	DS-CondPot	10/12/2018	10/12/2019
Upper Neck Load Cell	DENTON 1716A	LC-1591Fx	9/28/2018	9/28/2019







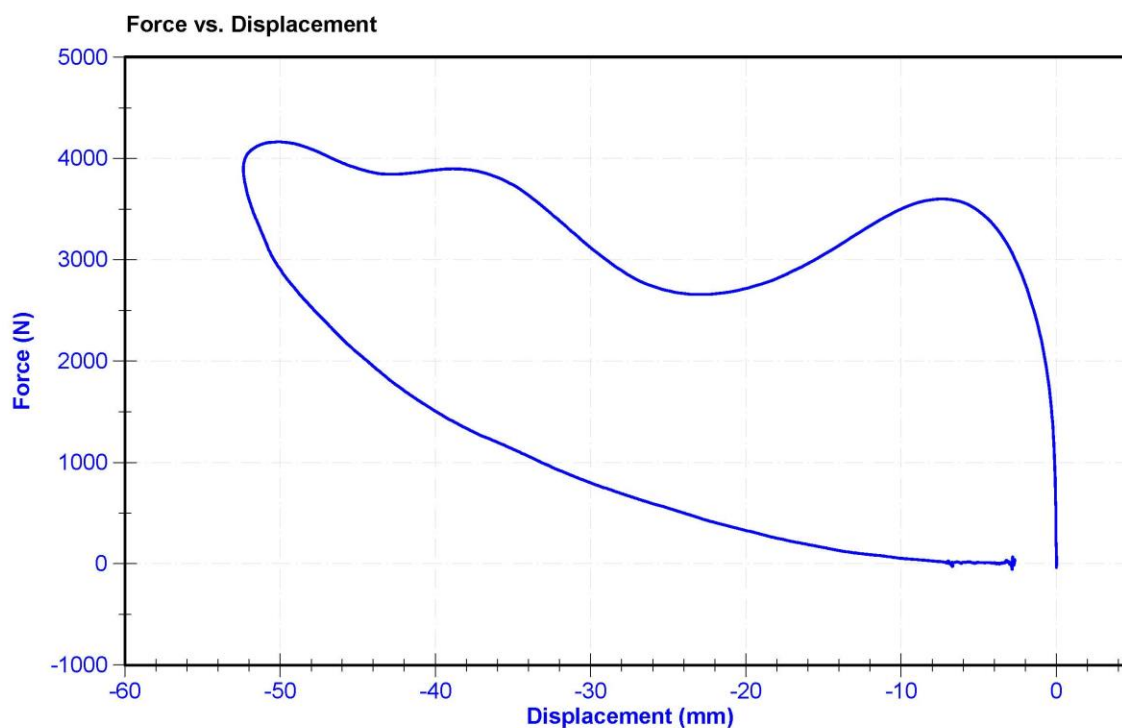
ATD Manufacturer	Denton	Test Technician	D. Reinhard
ATD Serial Number	139	Laboratory Supervisor	K. Brogan

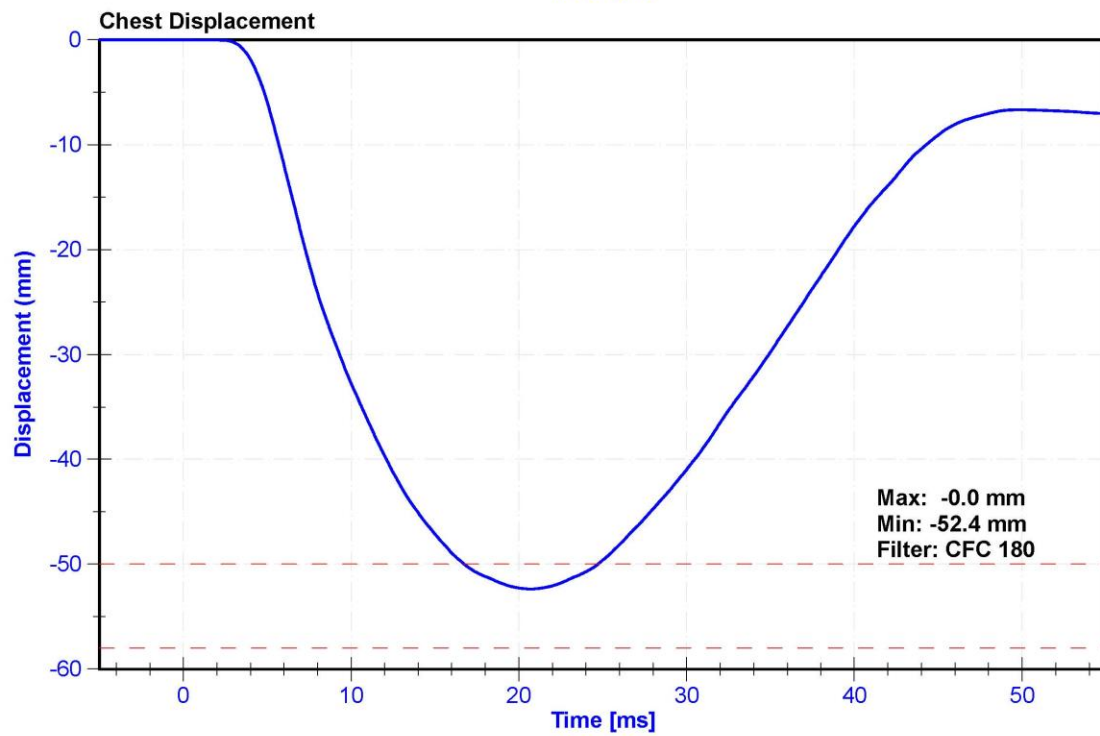
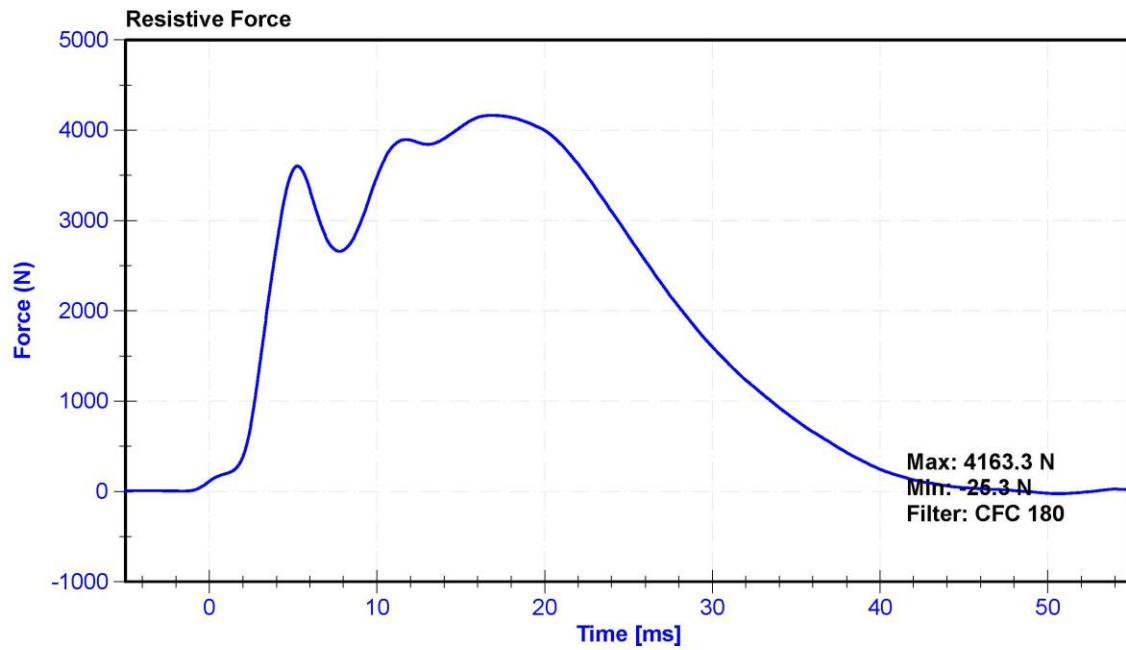
Results

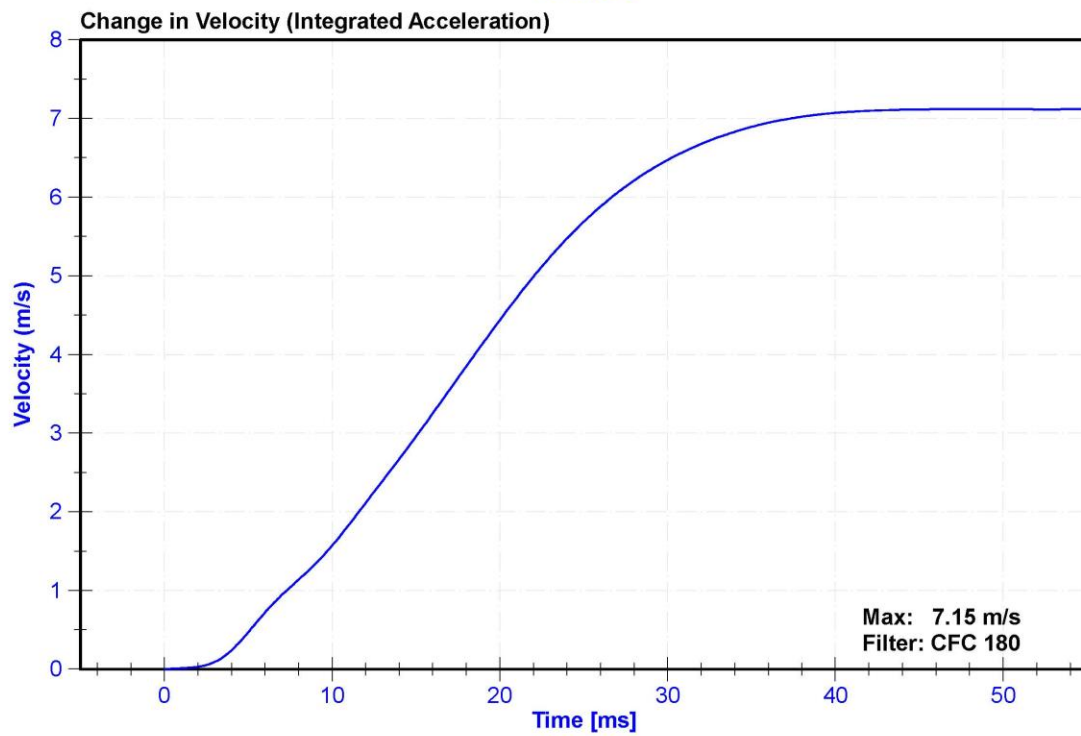
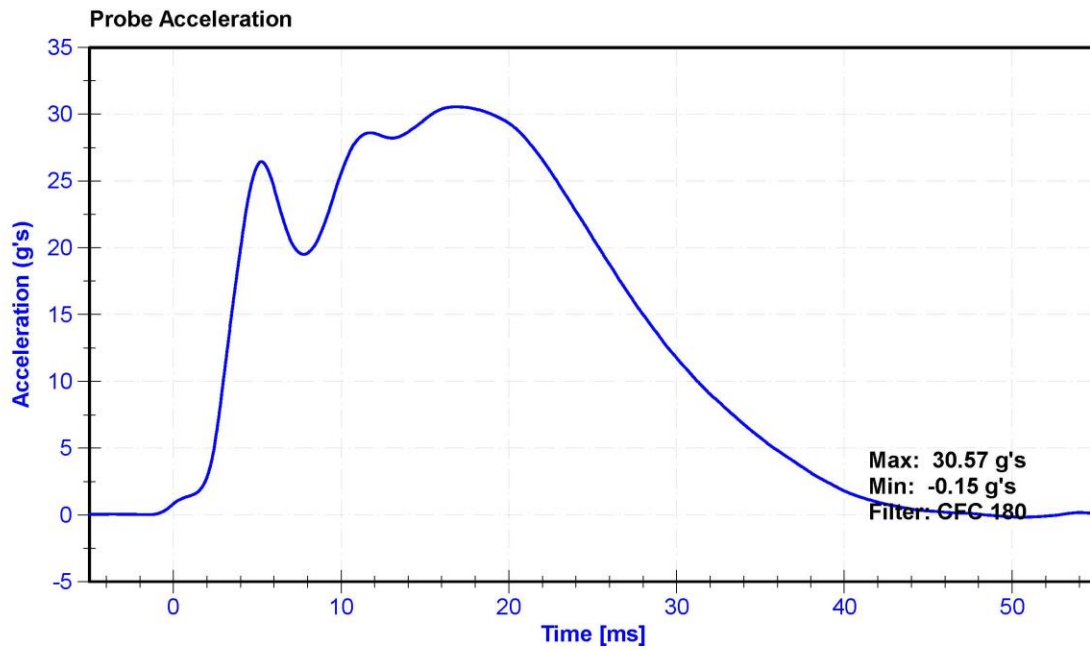
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.7	Pass
Humidity	10	70	%	28.1	Pass
Velocity	6.59	6.83	m/s	6.804	Pass
Chest Deflection	-58	-50	mm	-52.4	Pass
Maximum Resistive Force (50 to 58mm)	3900	4400	N	4163.3	Pass
Maximum Resistive Force (18 to 50mm)	0	4600	N	4162.6	Pass
Hysteresis	69	85	%	72.9	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 14CB1-2897	DS-288	10/22/2018	10/22/2019







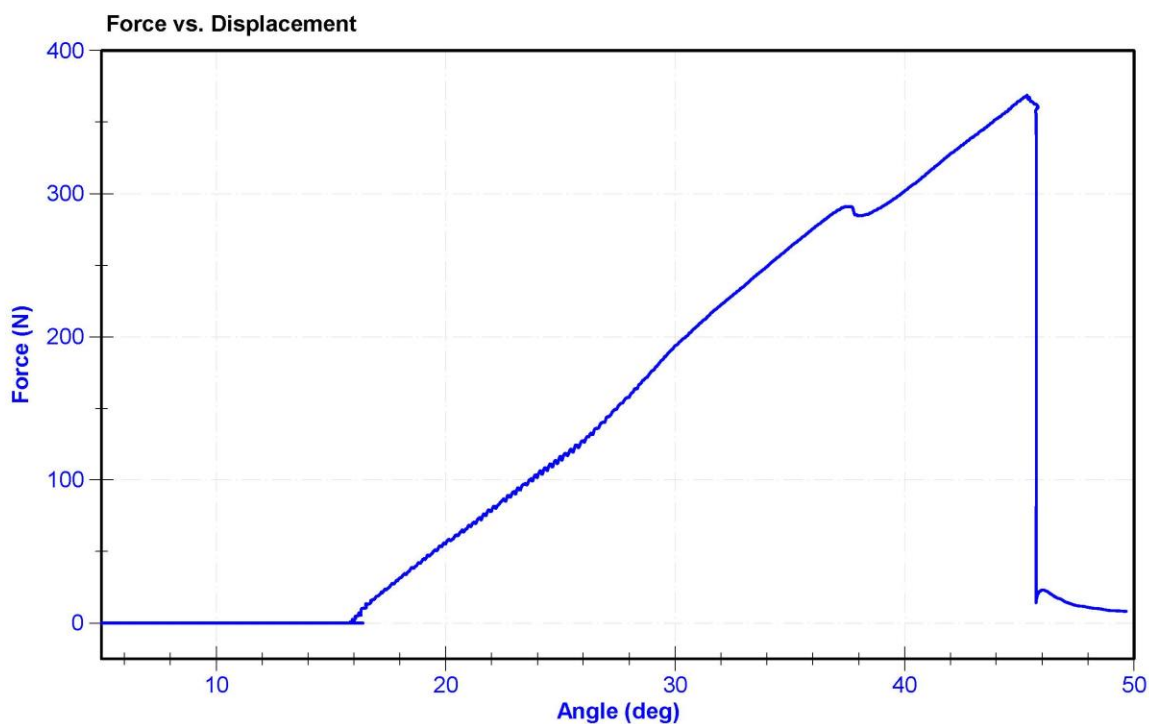
ATD Manufacturer	Denton	Test Technician	C.Mantell
ATD Serial Number	139	Laboratory Supervisor	K. Brogan

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.6	25.6	°C	22	Pass
Humidity	10	70	%	28	Pass
Initial Angle	0	20	deg	15.3	Pass
Force at 45 Degrees	320	390	N	368.8	Pass
Return Angle Relative to Initial	0	8	deg	1.5	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



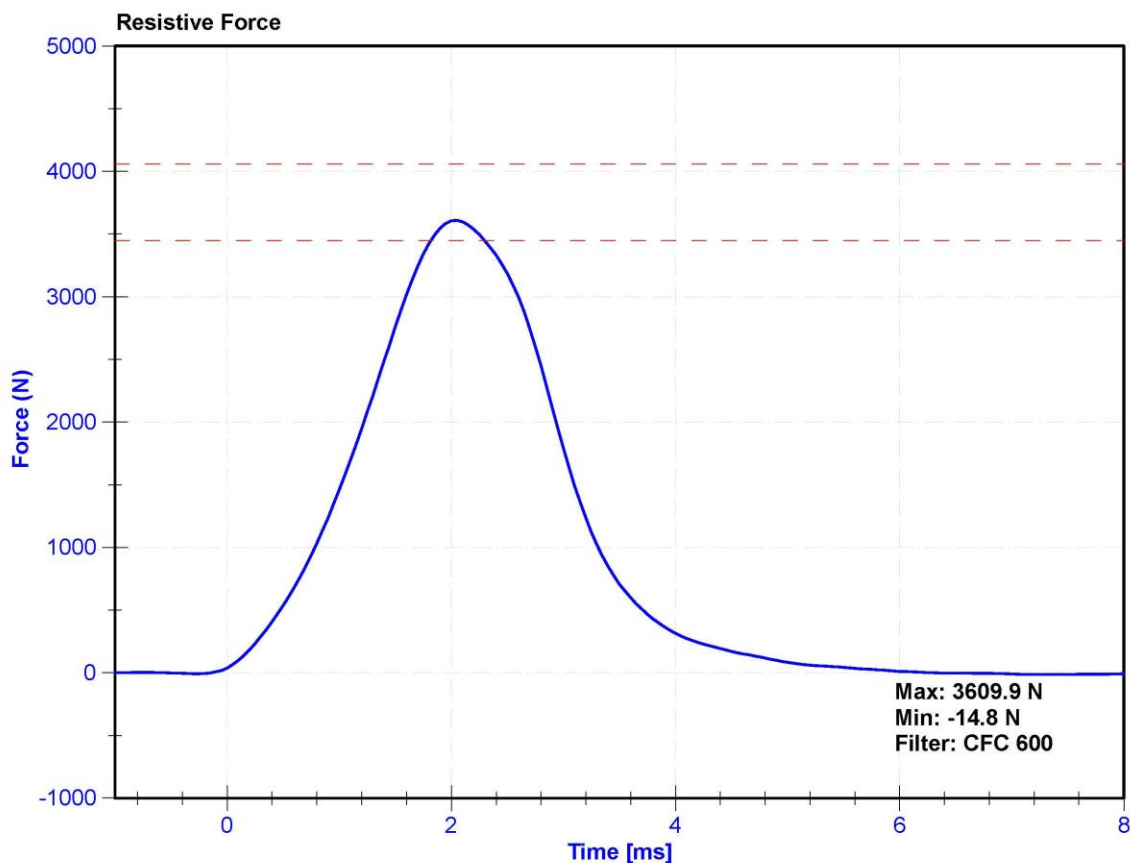
ATD Manufacturer	Denton	Test Technician	C. Mantell
ATD Serial Number	139	Laboratory Supervisor	K. Brogan

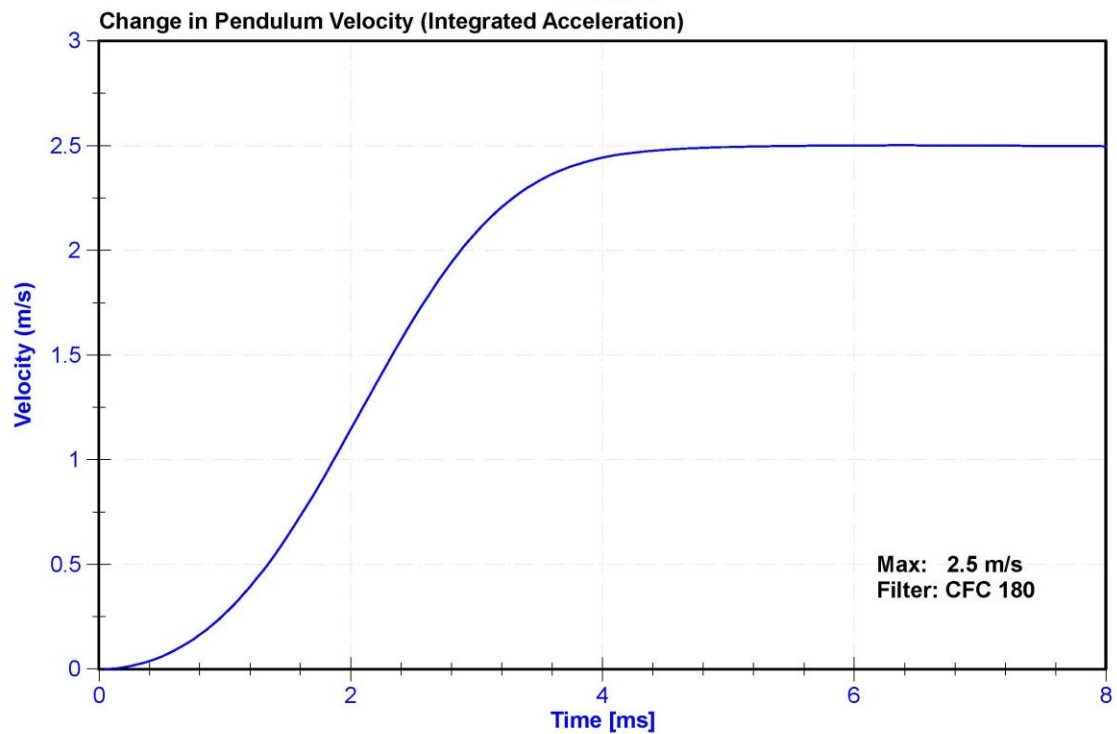
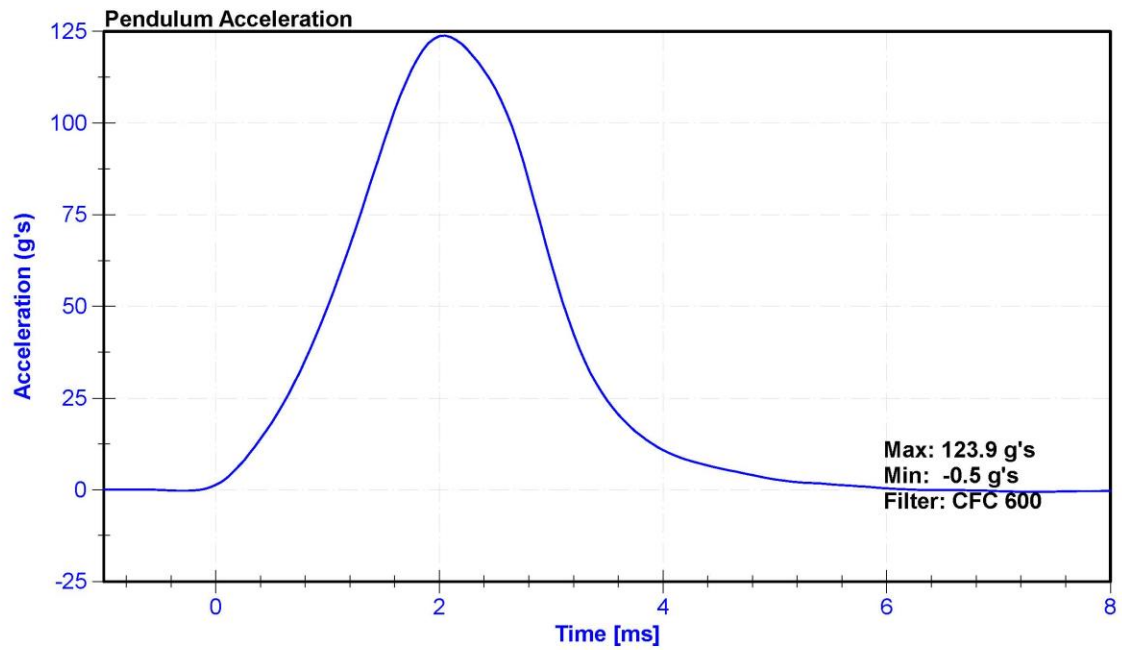
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	22.0	Pass
Humidity	10	70	%	33.3	Pass
Velocity	2.07	2.13	m/s	2.104	Pass
Resistive Force	3450	4060	N	3609.9	Pass

Transducer Calibrations

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





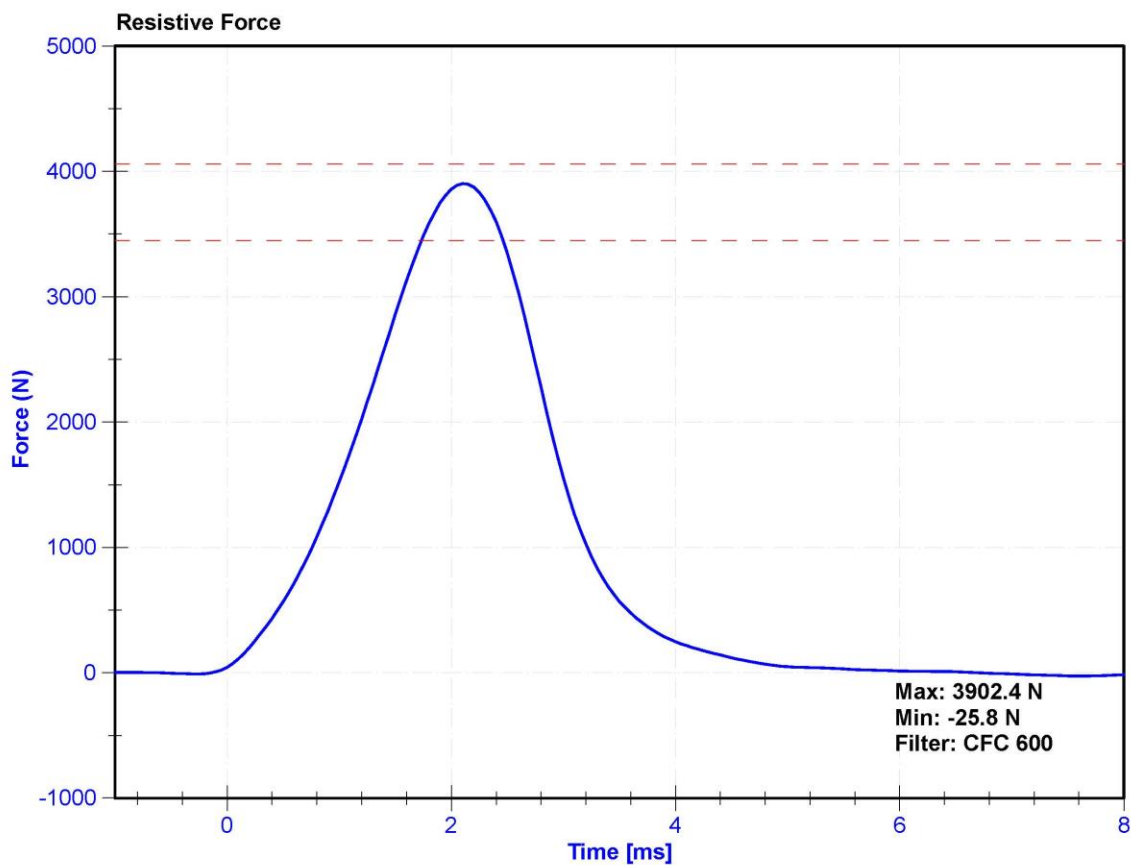
ATD Manufacturer	Denton	Test Technician	C. Mantell
ATD Serial Number	139	Laboratory Supervisor	K. Brogan

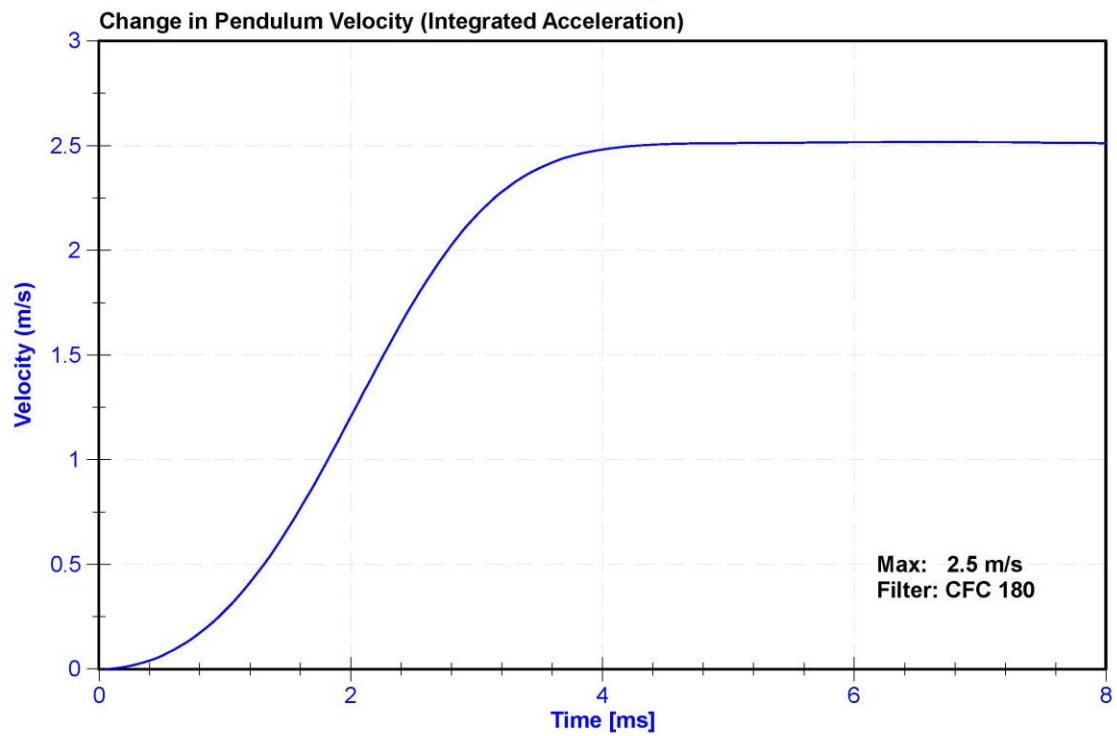
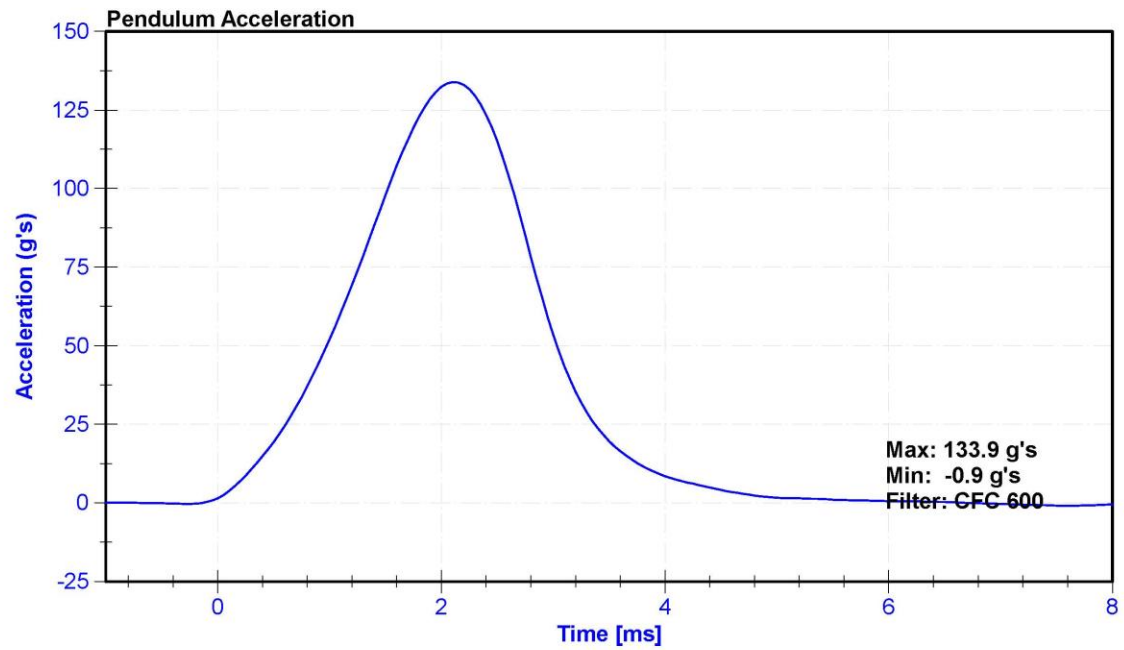
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	22.0	Pass
Humidity	10	70	%	32.7	Pass
Velocity	2.07	2.13	m/s	2.101	Pass
Resistive Force	3450	4060	N	3902.4	Pass

Transducer Calibrations

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





CALIBRATION TEST RESULTS

POST-TEST

HYBRID III 50TH PERCENTILE MALE - DRIVER ATD

SERIAL NO: 142



Date: 02/21/2019

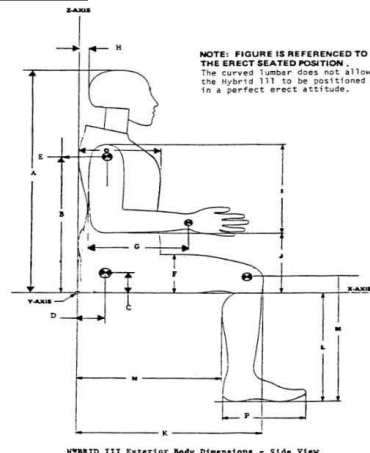
Diagram illustrating the front view of a seated female figure, showing body dimensions and axes for the Hybrid 11 attachment.

Dimensions labeled:

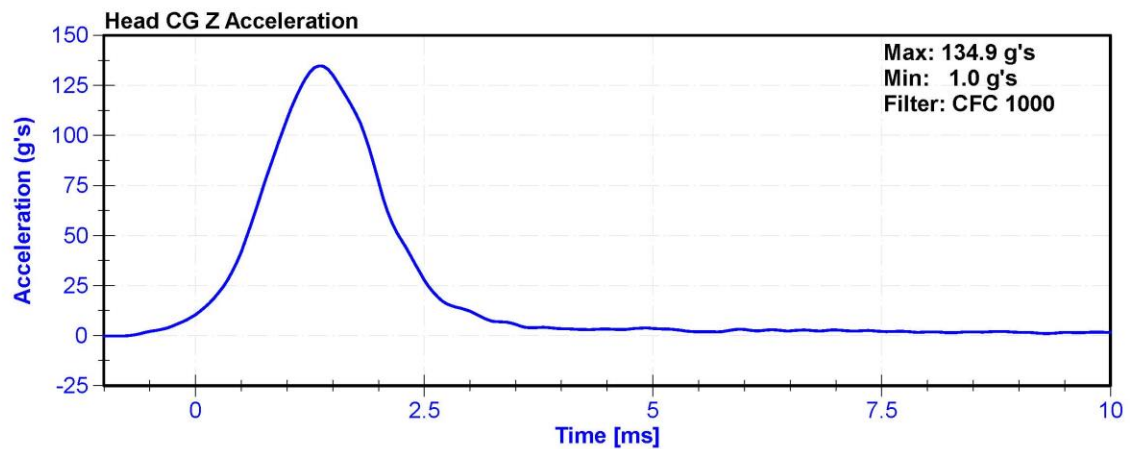
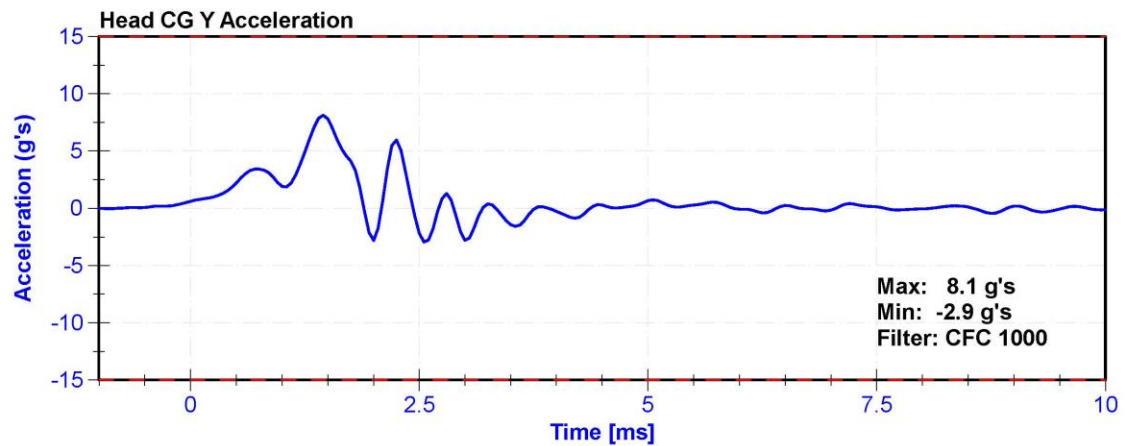
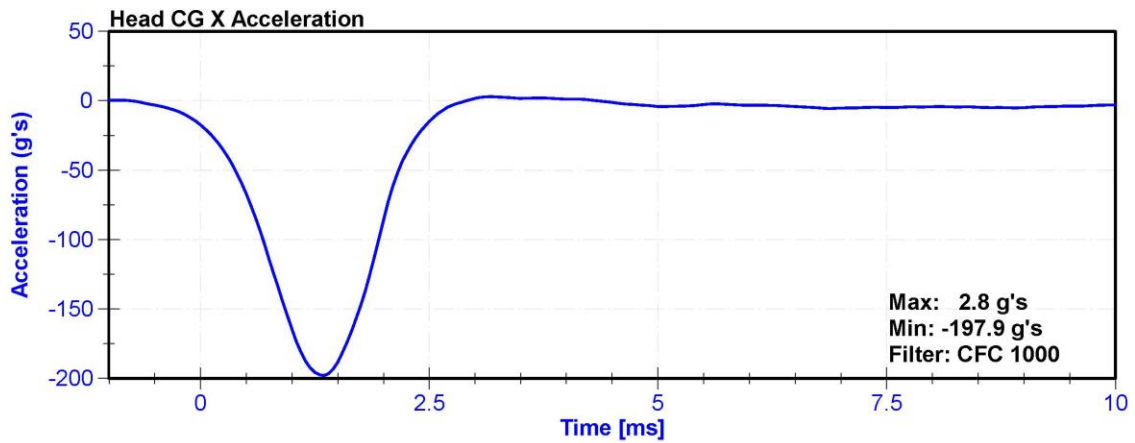
- Y: Total height (from top of head to bottom of feet).
- AA: Height from the top of the head to the top of the torso.
- BB: Height from the top of the torso to the top of the thighs.
- V-AXIS: Vertical axis.
- X-AXIS: Horizontal axis (across the hips).
- Z-AXIS: Horizontal axis (across the feet).
- W: Width (across the feet).

NOTE: FIGURE REFERENCED TO THE ERECT SEATED POSITION. The curved lumbar does not allow the hybrid 11 to be positioned in a perfect erect attitude.

HYBRID 11 Exterior Body Dimensions - Front View



C-40



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	%	28.3	Pass
Velocity	6.89	7.13	m/s	6.903	Pass
Pendulum Deceleration at 10ms	22.5	27.5	g's	26.72	Pass
Pendulum Deceleration at 20ms	17.6	22.6	g's	22.19	Pass
Pendulum Deceleration at 30ms	12.5	18.5	g's	15.00	Pass
Max. Pendulum Deceleration After 30ms	0	29	g's	27.2	Pass
Pendulum Deceleration Time to 5 g's	34	42	ms	39.9	Pass
Maximum D Plane Rotation	64	78	deg	74.4	Pass
Time to Maximum Rotation	57	64	ms	59.7	Pass
Rotation Decay to Zero	113	127	ms	115.7	Pass
Moment About Occipital Condyle	88.1	108.4	Nm	92.10	Pass
Time to Maximum Moment	47	58	ms	53.9	Pass
Moment Decay to Zero	97	107	ms	101.3	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

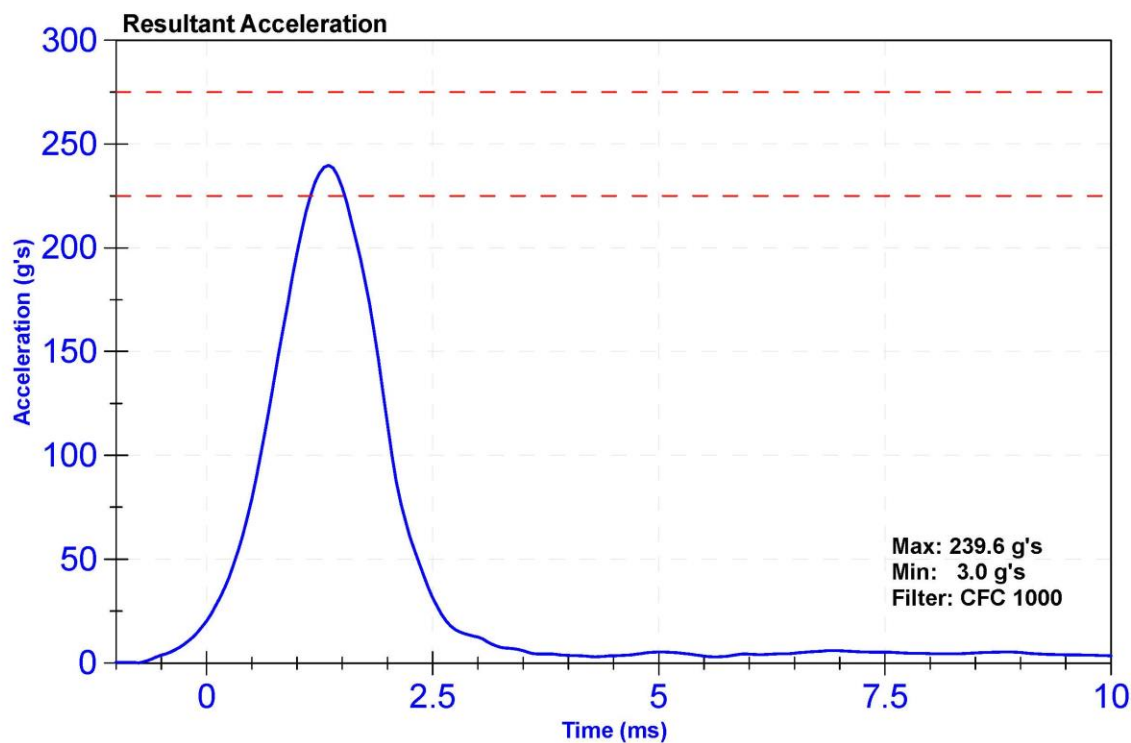
ATD Manufacturer	Humanetics	Test Technician	C. Mantell
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

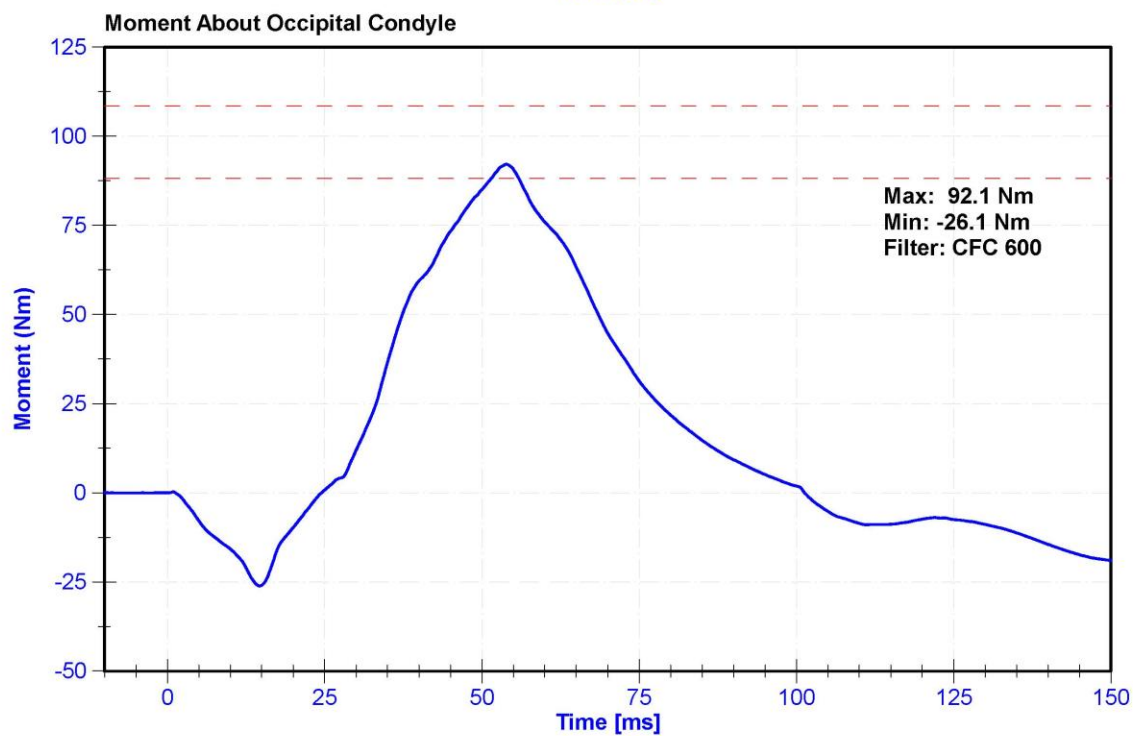
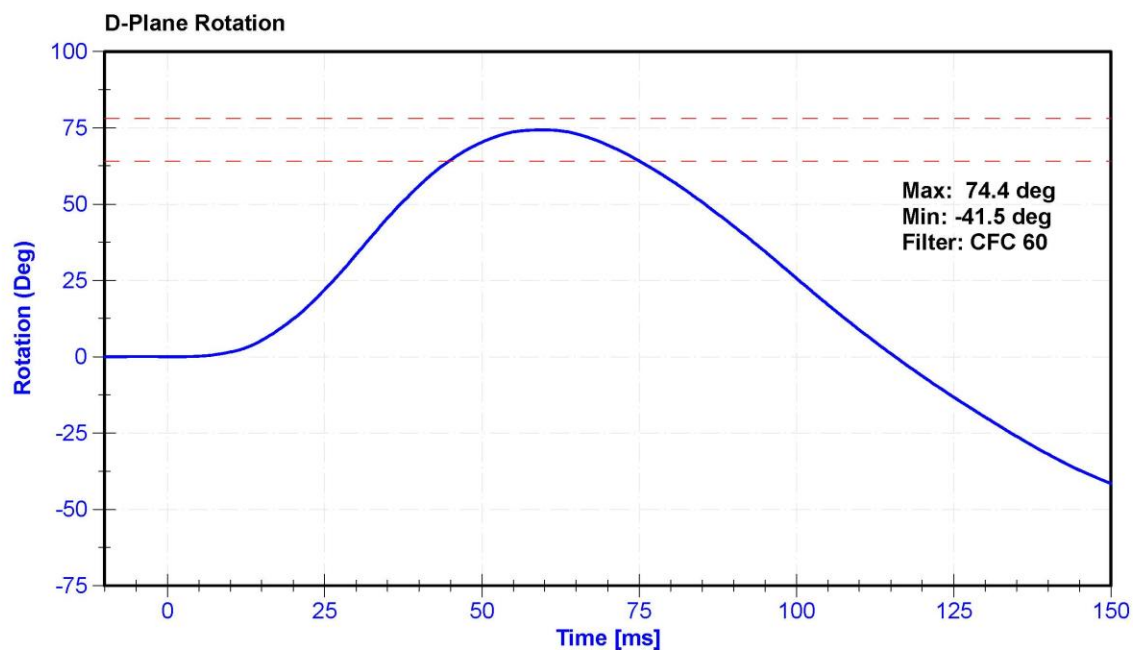
Results

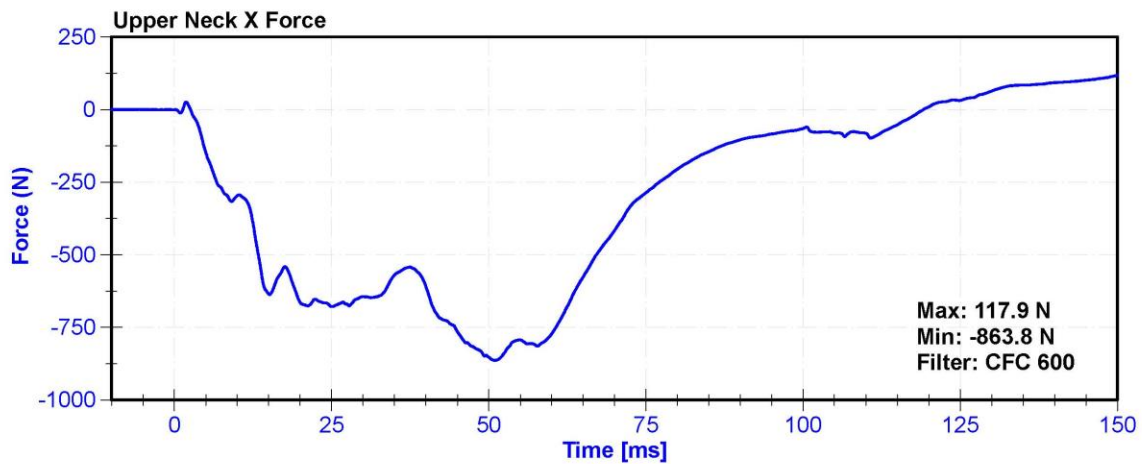
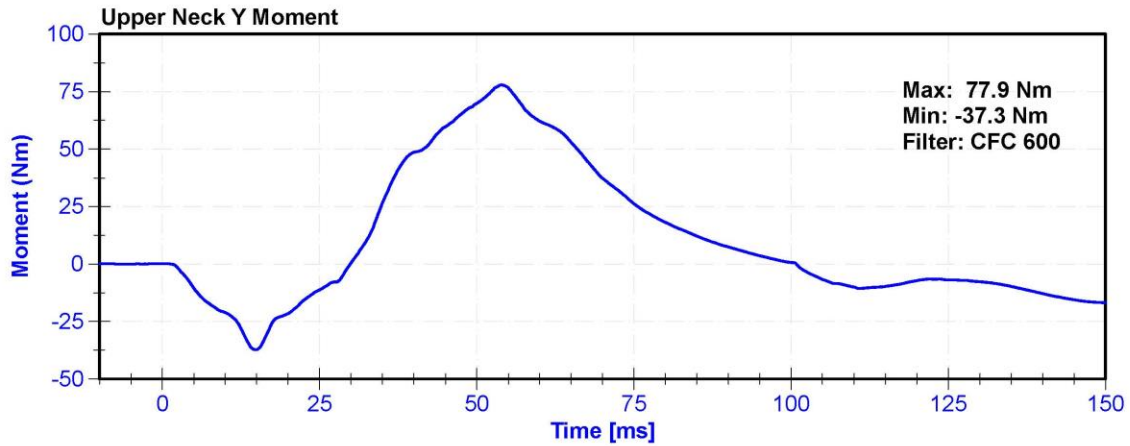
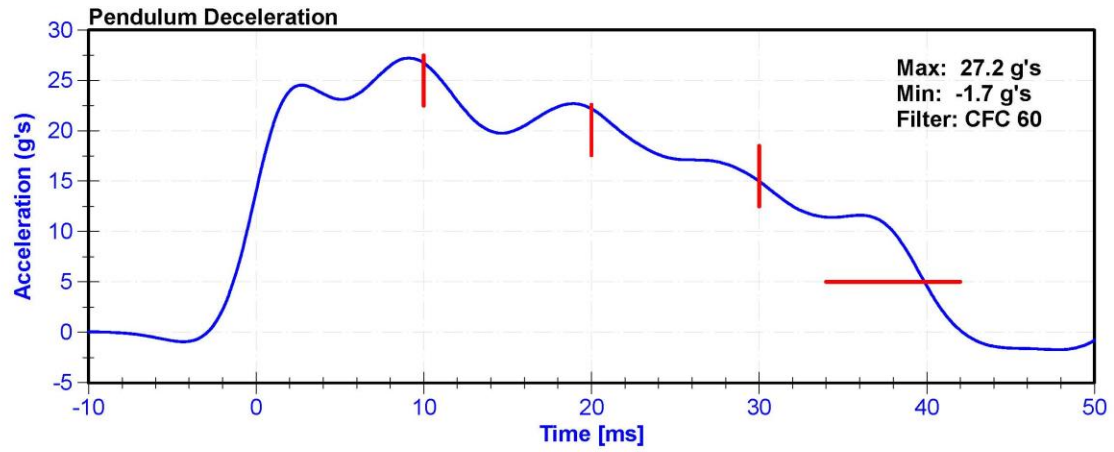
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	22.0	Pass
Humidity	10	70	%	26.8	Pass
Resultant Acceleration	225	275	g's	239.6	Pass
Oscillation	0	10	%	2.5	Pass
Lateral Acceleration	-15	15	g's	8.1	Pass

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







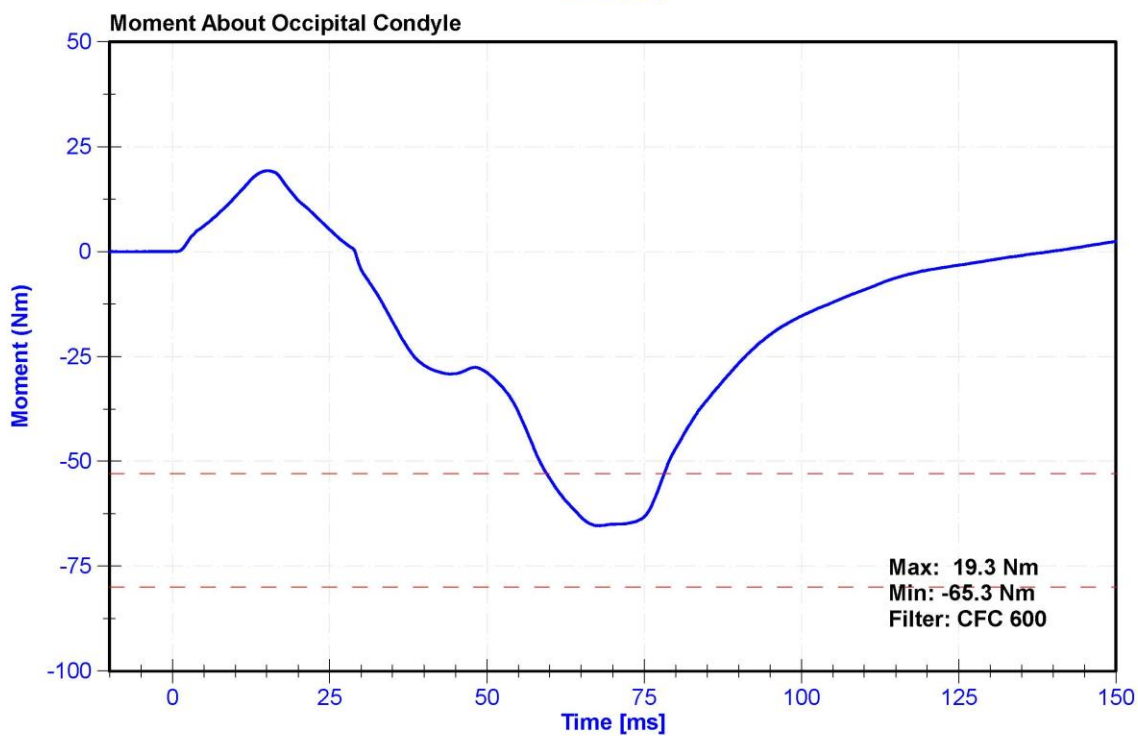
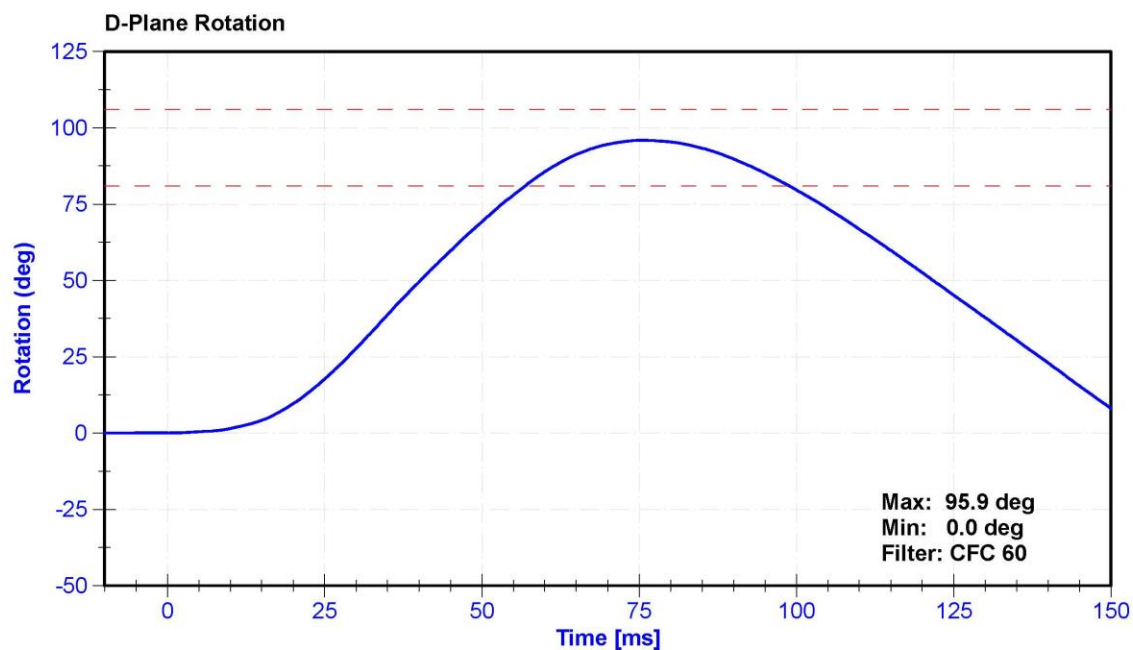
ATD Manufacturer	Humanetics	Test Technician	C. Mantell
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

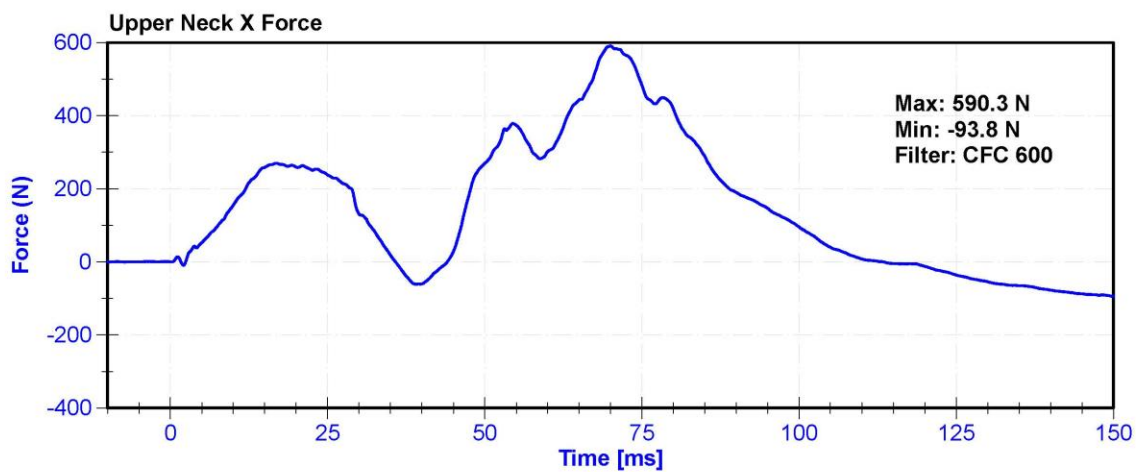
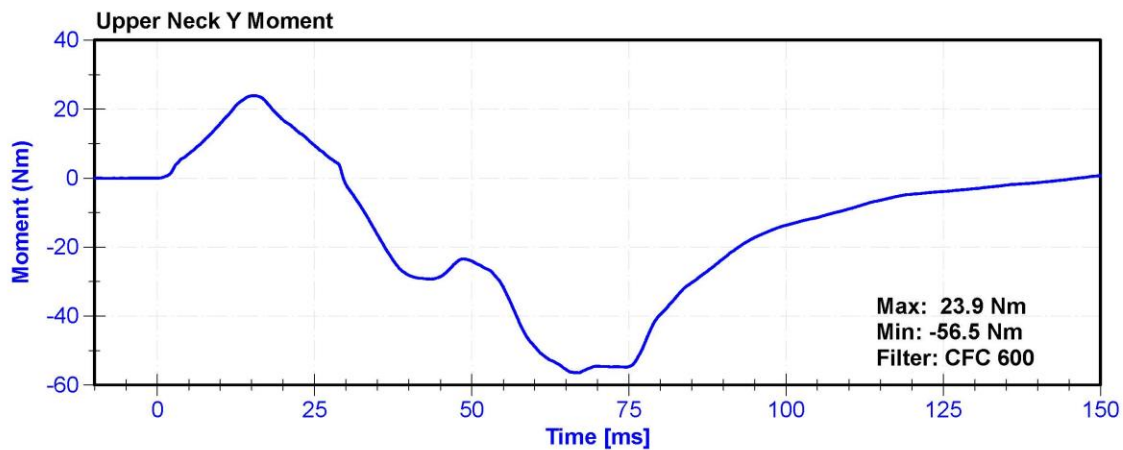
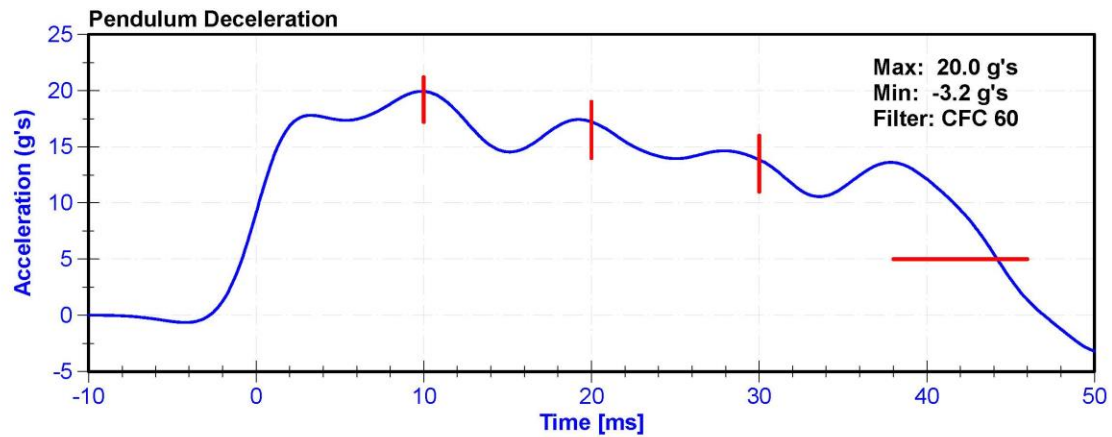
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	22	Pass
Humidity	10	70	%	28	Pass
Velocity	5.94	6.19	m/s	5.964	Pass
Pendulum Deceleration at 10ms	17.2	21.2	g's	19.95	Pass
Pendulum Deceleration at 20ms	14	19	g's	17.2	Pass
Pendulum Deceleration at 30ms	11	16	g's	13.9	Pass
Max. Pendulum Deceleration After 30ms	0	22	g's	20.0	Pass
Pendulum Deceleration Time to 5 g's	38	46	ms	44.2	Pass
Maximum D Plane Rotation	81	106	deg	95.9	Pass
Time to Maximum Rotation	72	82	ms	75.4	Pass
Rotation Decay to Zero	147	174	ms	155.1	Pass
Minimum Moment About OC	-80	-52.9	Nm	-65.31	Pass
Time to Minimum Moment	65	79	ms	67.4	Pass
Moment Decay to Zero	120	148	ms	139.6	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





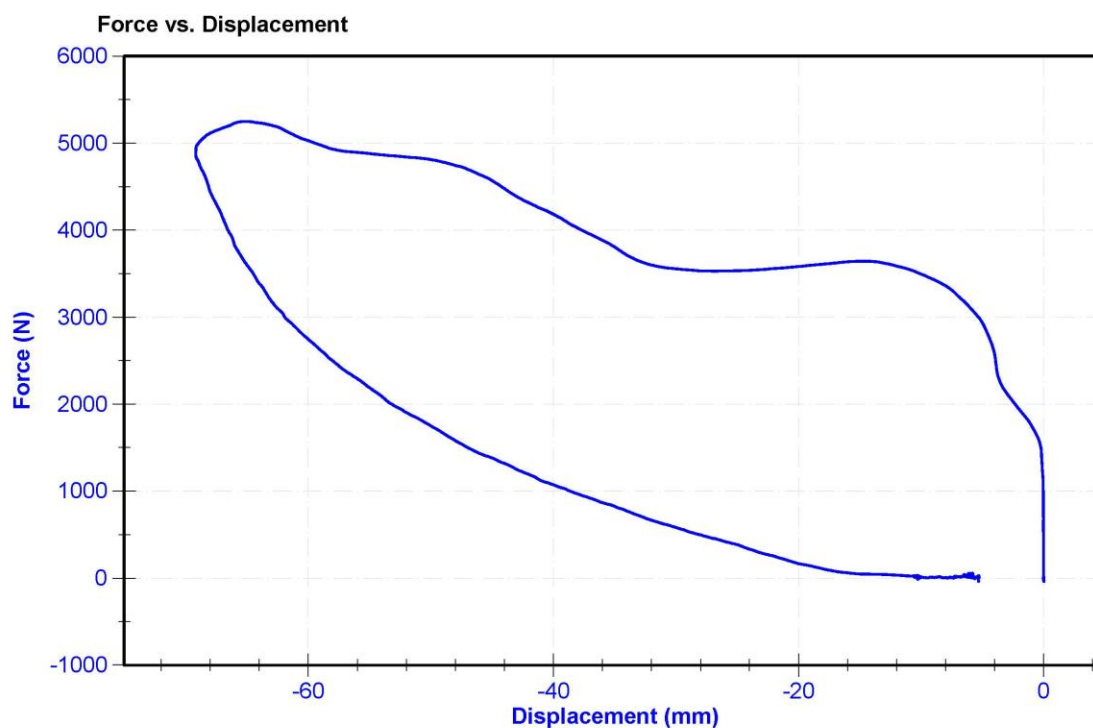
ATD Manufacturer	Humanetics	Test Technician	K. Dutton
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

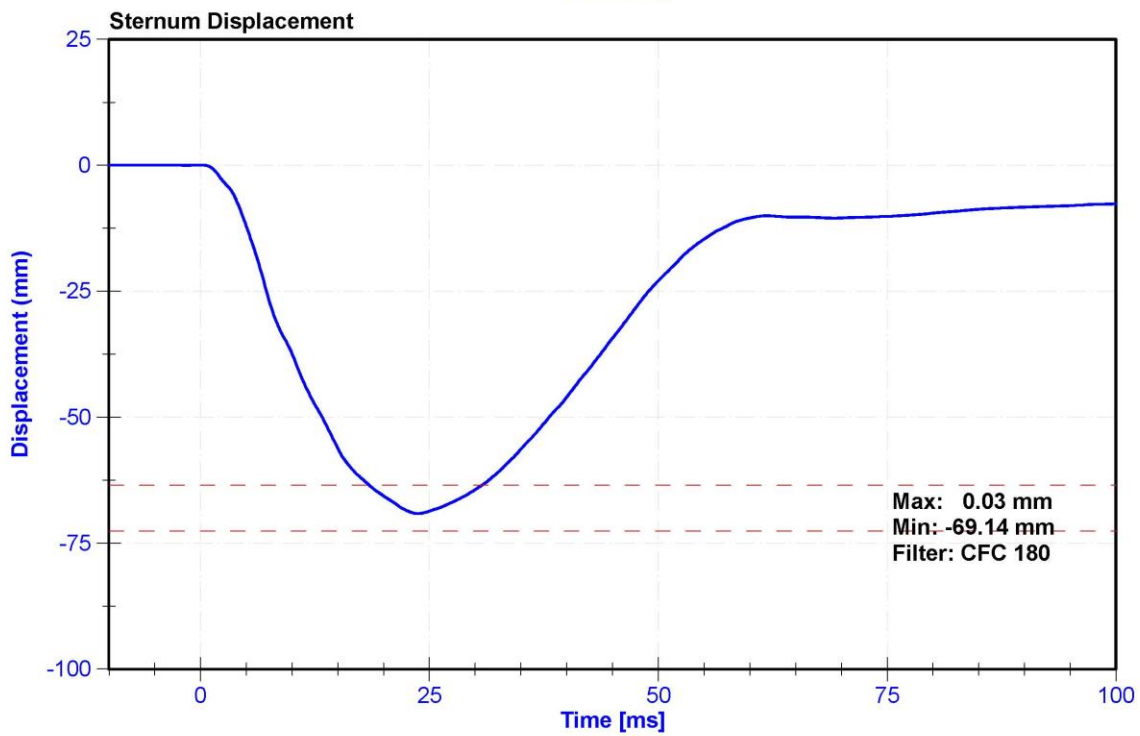
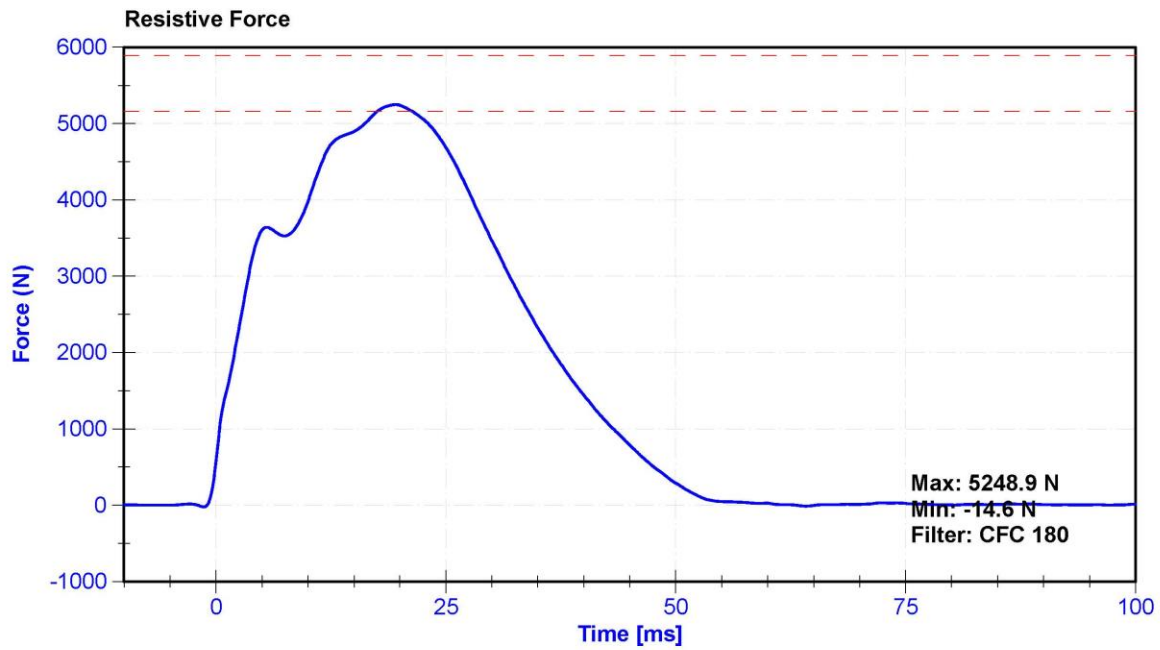
Results

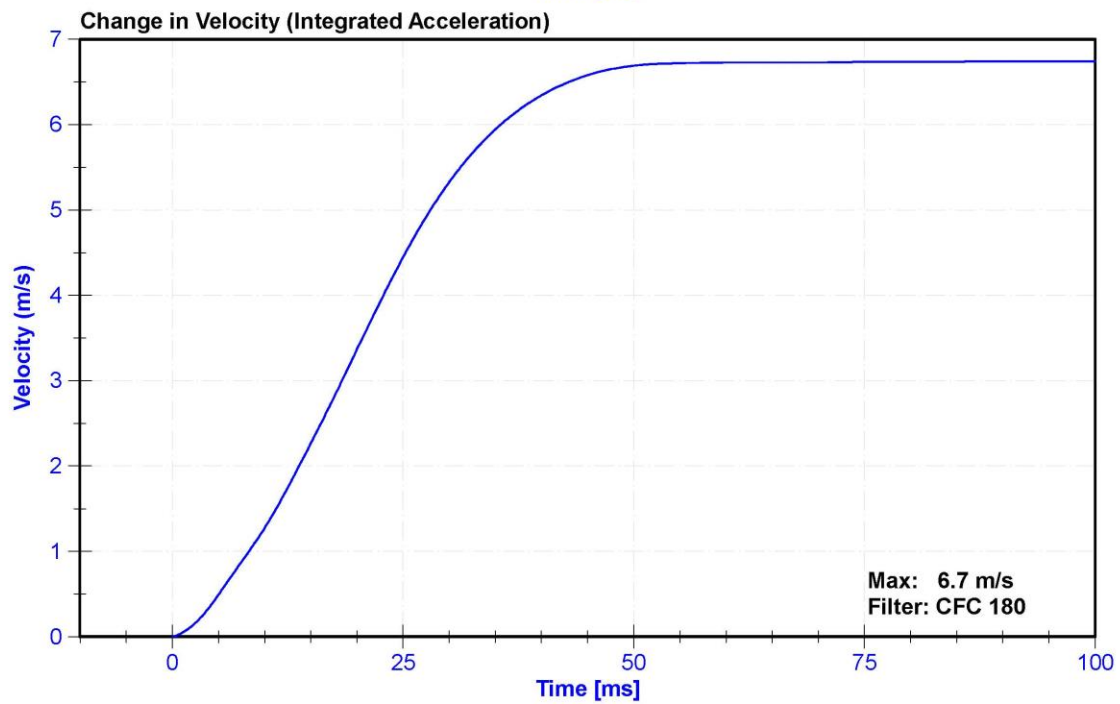
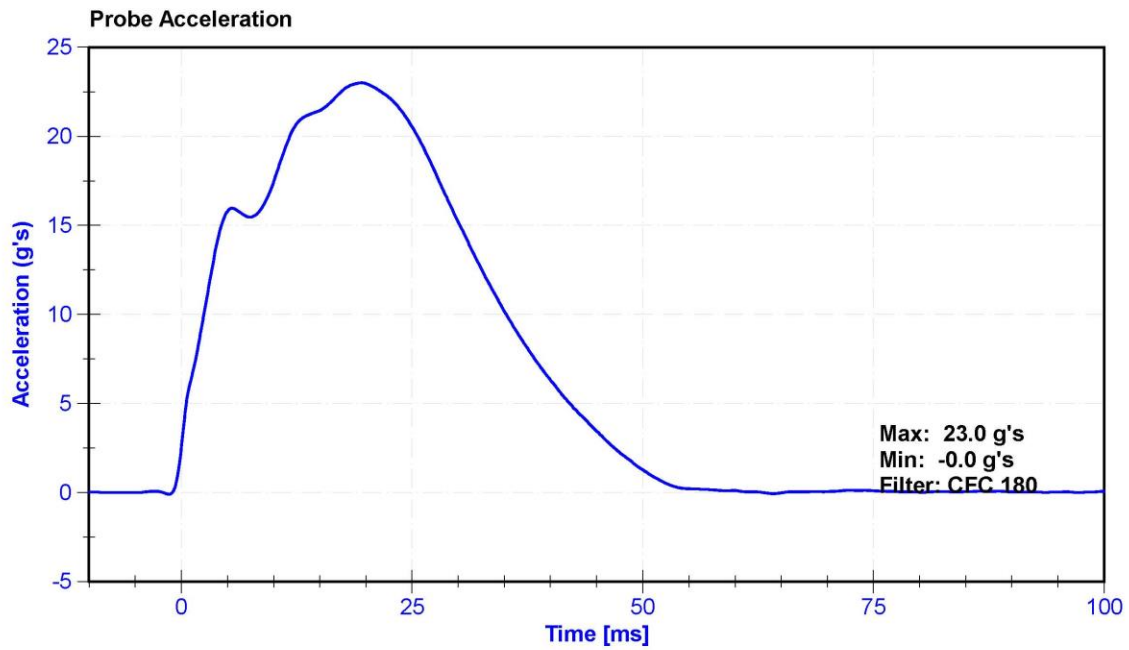
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	22	Pass
Humidity	10	70	%	27.5	Pass
Velocity	6.59	6.83	m/s	6.597	Pass
Chest Displacement	-72.6	-63.5	mm	-69.14	Pass
Resistive Force	5160	5894	N	5248.9	Pass
Hysteresis	65	85	%	70.7	Pass

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







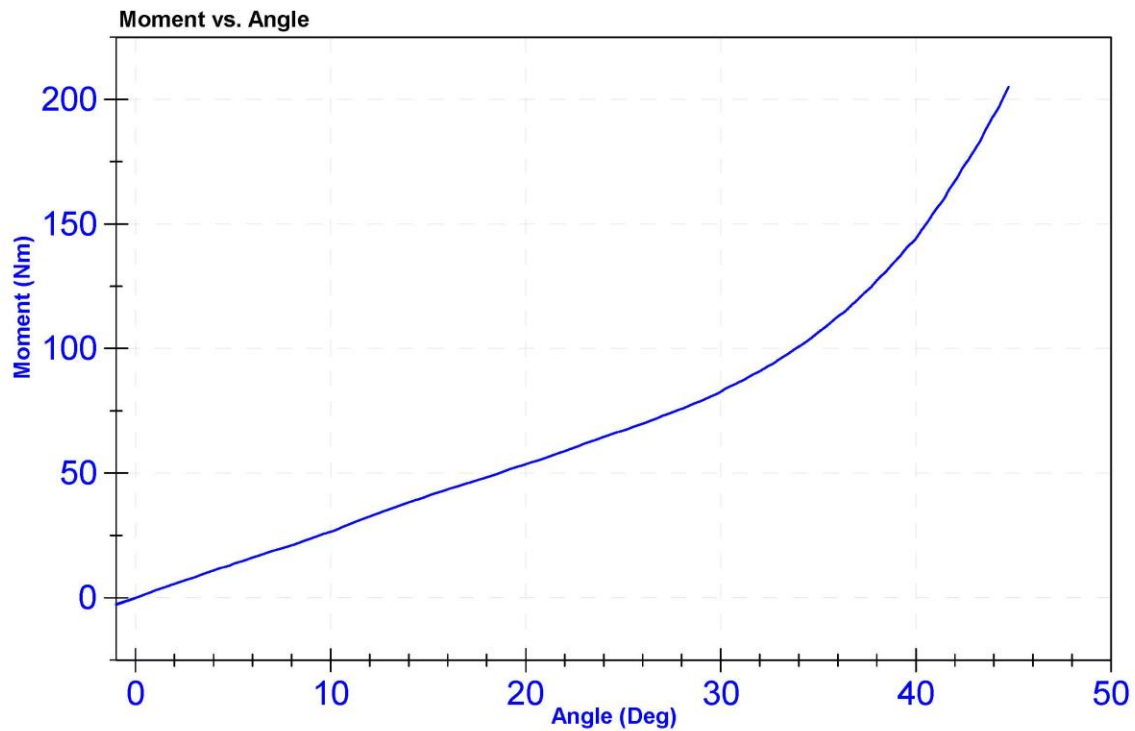
ATD Manufacturer	Humanetics	Test Technician	K. Dutton
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	22.0	Pass
Humidity	10	70	%	28.1	Pass
Average Velocity	5	10	deg/s	7.4	Pass
Angle at 203Nm	40	50	deg	44.6	Pass
Moment at 30 degrees	0	94.9	Nm	82.7	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



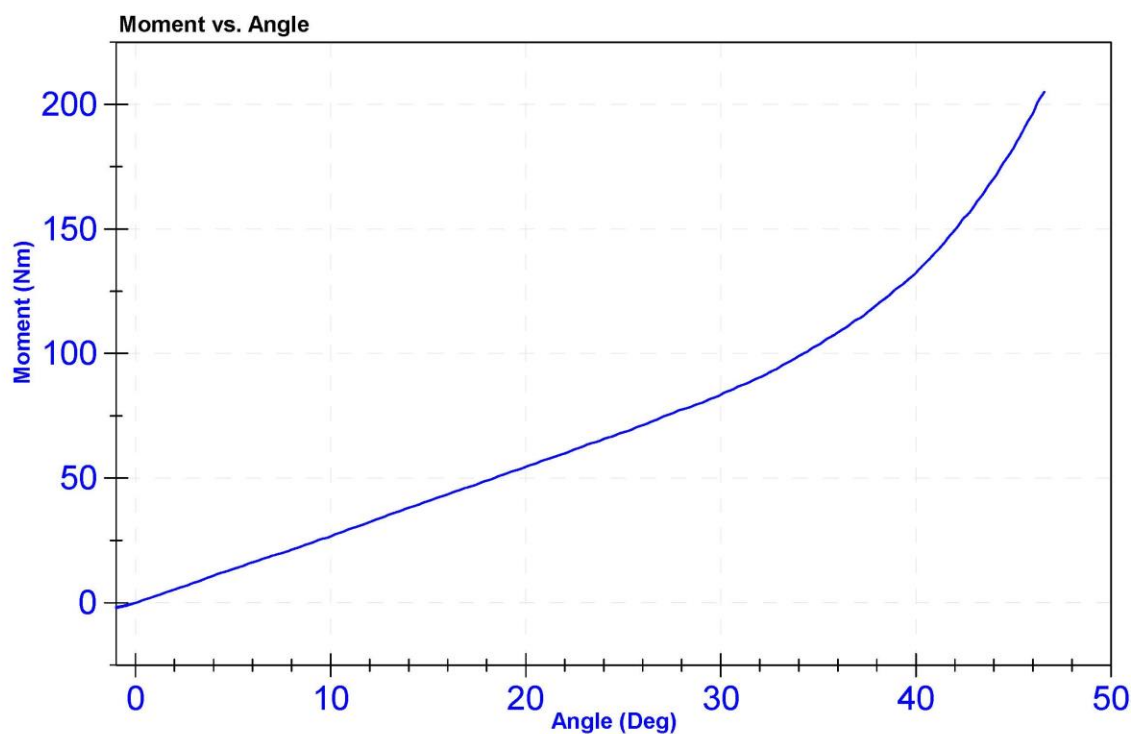
ATD Manufacturer	Humanetics	Test Technician	K. Dutton
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	22.0	Pass
Humidity	10	70	%	29.2	Pass
Average Velocity	5	10	deg/s	7.5	Pass
Angle at 203Nm	40	50	deg	46.4	Pass
Moment at 30 degrees	0	94.9	Nm	83.5	Pass

Transducer Calibrations

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



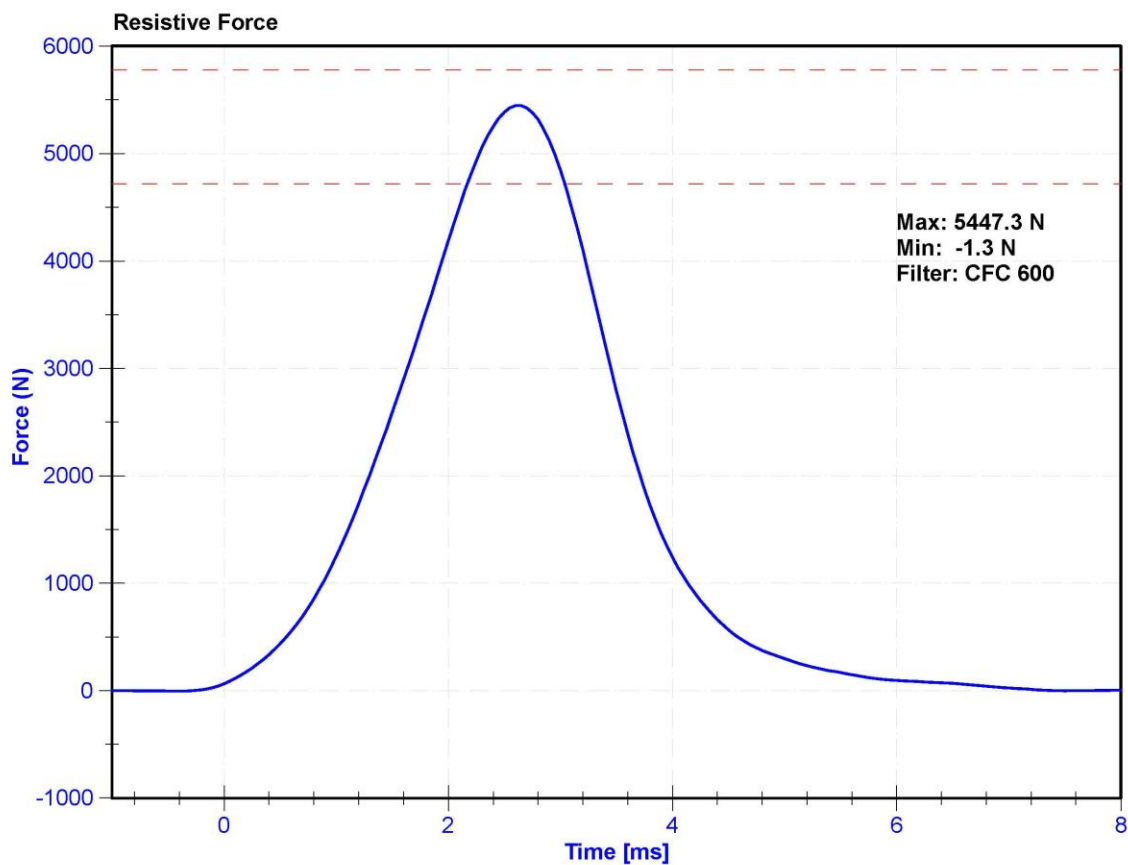
ATD Manufacturer	Humanetics	Test Technician	D.Reinhard
ATD Serial Number	142	Laboratory Supervisor	K.Brogan

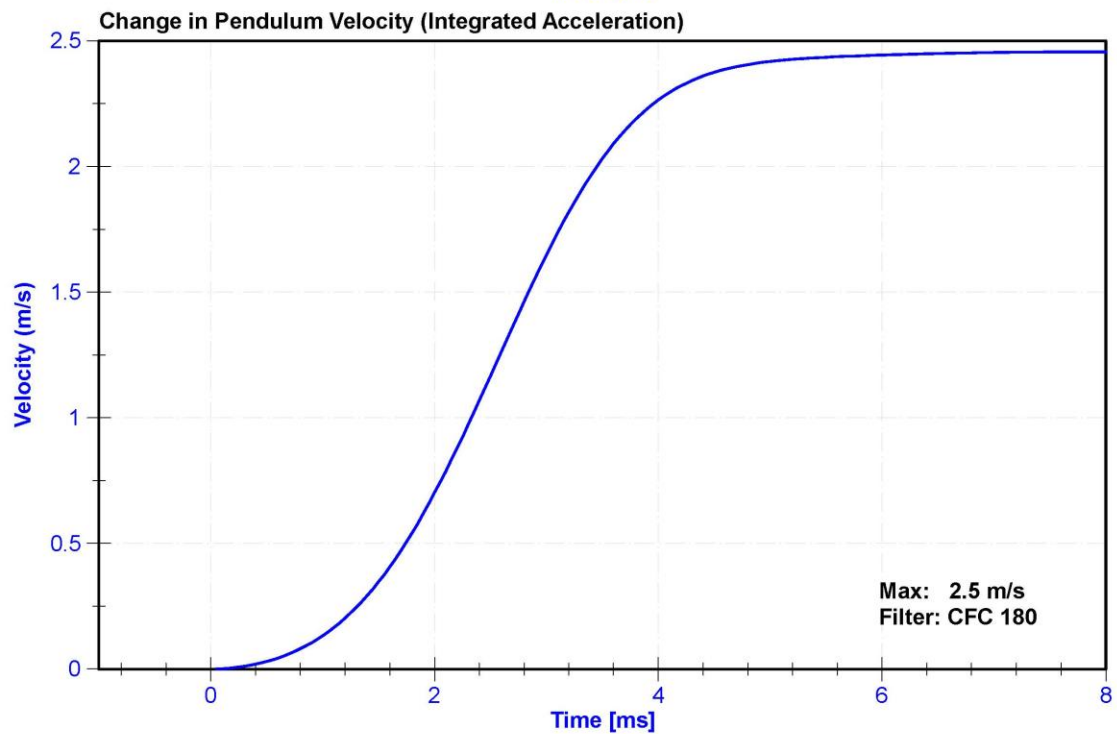
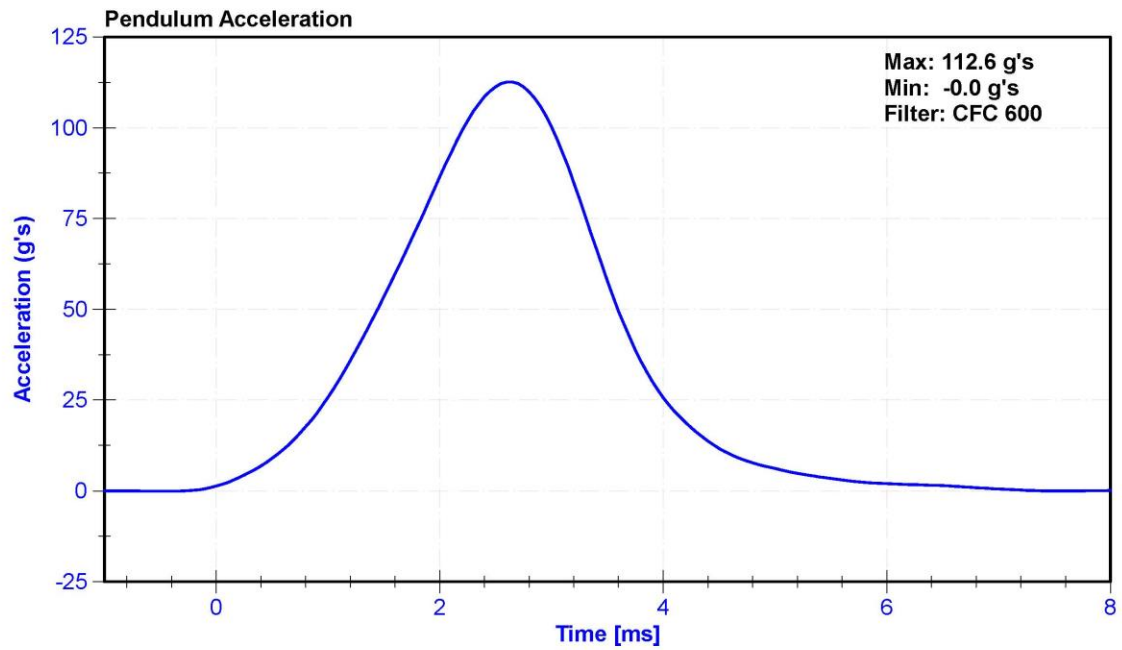
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	22	Pass
Humidity	10	70	%	28.5	Pass
Velocity	2.07	2.13	m/s	2.120	Pass
Maximum Resistive Force	4720	5780	N	5447.3	Pass

Transducer Calibrations

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





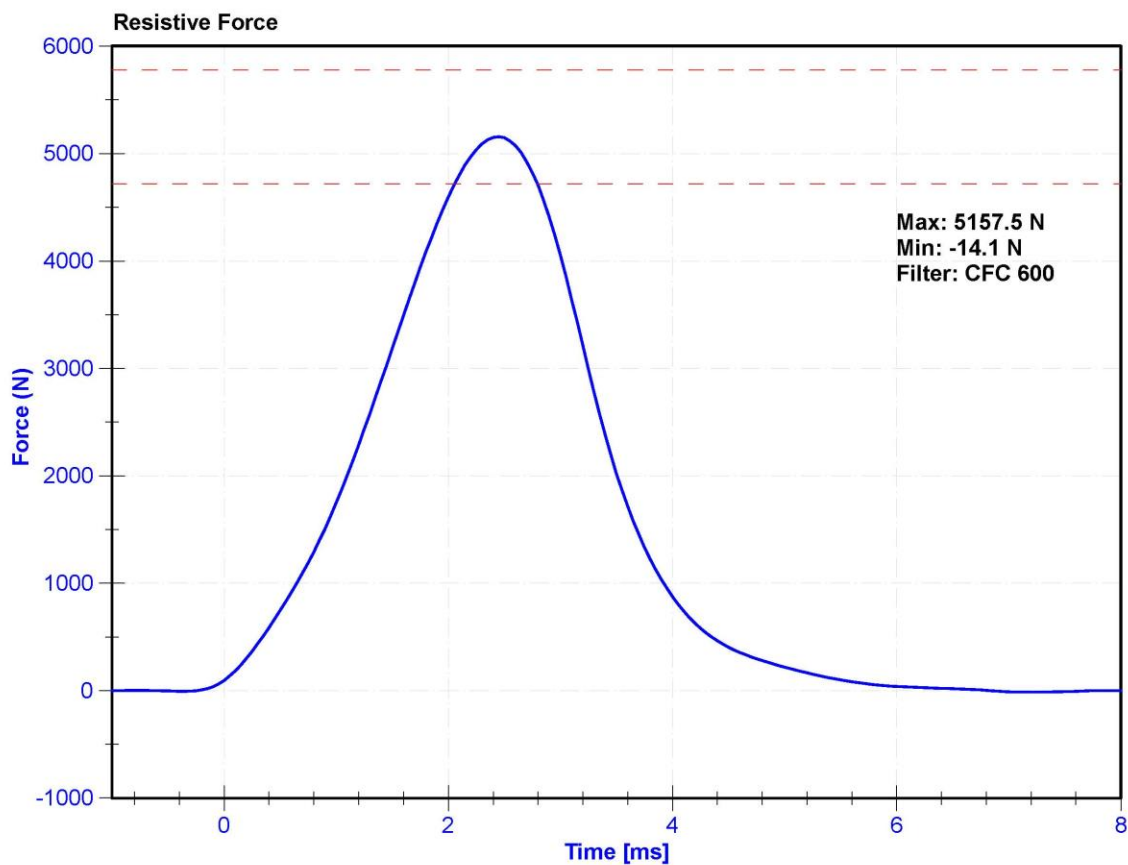
ATD Manufacturer	Humanetics	Test Technician	K. Dutton
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

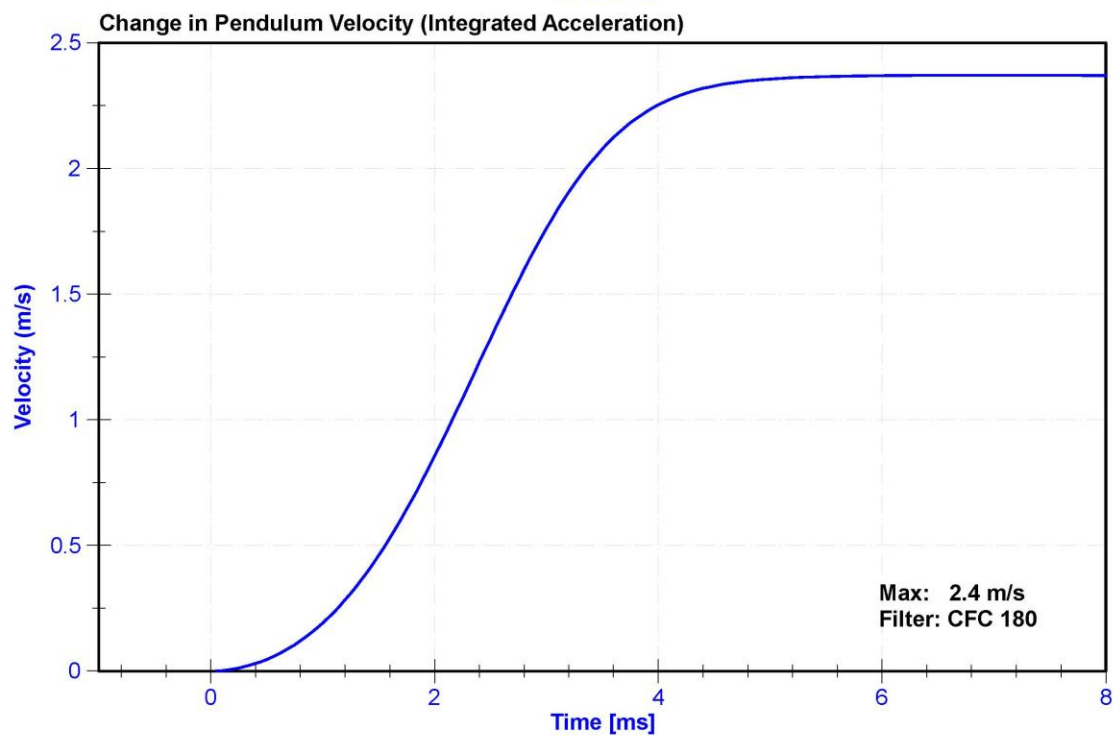
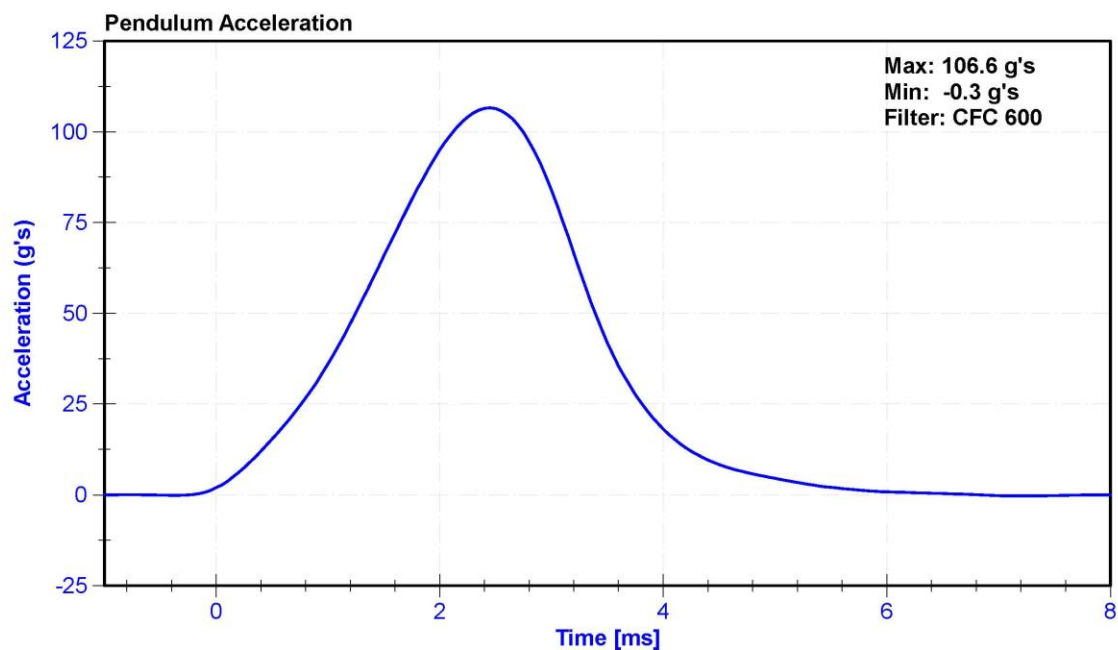
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	22	Pass
Humidity	10	70	%	29.5	Pass
Velocity	2.07	2.13	m/s	2.120	Pass
Maximum Resistive Force	4720	5780	N	5157.5	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 5TH PERCENTILE FEMALE - PASSENGER ATD

SERIAL NO: 139

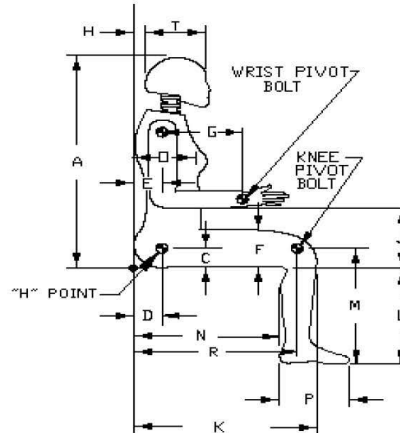
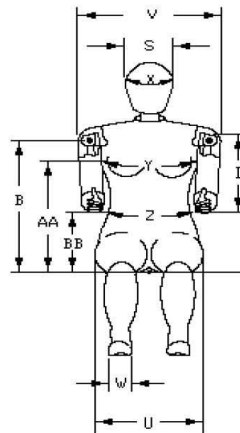


External Measurements - Hybrid 3 - 5th Female

Technician: K. Brogan

Date: 02/01/2018

Dummy Serial Number: 139



Symbol	Description	Specification (mm)		Result (mm)	Pass/Fail
A	Sitting Height	775	800	789	Pass
B	Shoulder Pivot Height	432	457	446	Pass
C	H-Point Height	81	86	84	Pass
D	H-Point from Backline	145	150	147	Pass
E	Shoulder Pivot from Backline	69	84	76	Pass
F	Thigh Clearance	119	135	124	Pass
G	Back of Elbow to Wrist Pivot	244	259	251	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	188	Pass
K	Buttock to Knee Length	521	546	541	Pass
L	Popliteal Height	356	376	363	Pass
M	Knee Pivot Height	394	419	398	Pass
N	Buttock Popliteal Length	414	439	424	Pass
O	Chest Depth without Jacket	175	191	185	Pass
P	Foot Length (right)	219	234	225	Pass
R	Buttock To Knee Pivot Length	457	483	473	Pass
S	Head Breadth	137	147	141	Pass
T	Head Depth	178	188	182	Pass
U	Hip Breadth	300	315	308	Pass
V	Shoulder Breadth	351	366	362	Pass
W	Foot Breadth	79	94	86	Pass
X	Head Circumference	528	549	535	Pass
Y	Chest Circumference with Jacket	851	881	861	Pass
Z	Waist Circumference	460	790	773	Pass
AA	Reference Location (Chest Circumference)	333	358	345	Pass
BB	Reference Location (Waist Circumference)	160	170	165	Pass

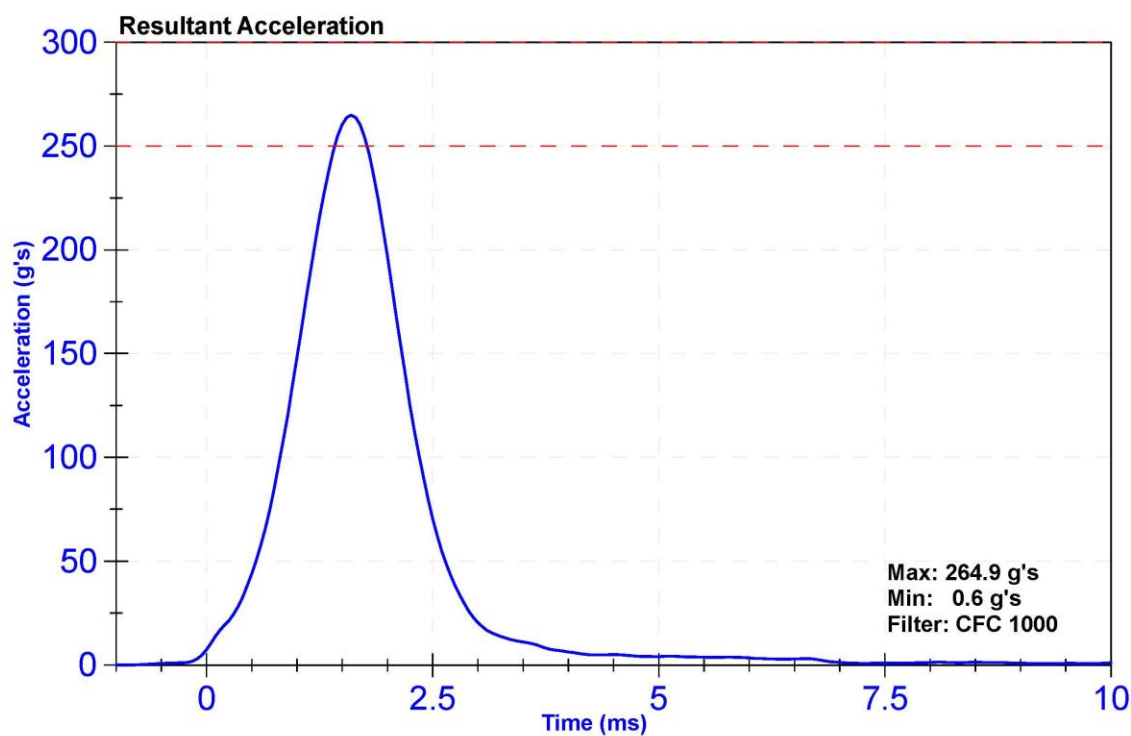
ATD Manufacturer	Denton	Test Technician	C. Mantell
ATD Serial Number	139	Laboratory Supervisor	K. Brogan

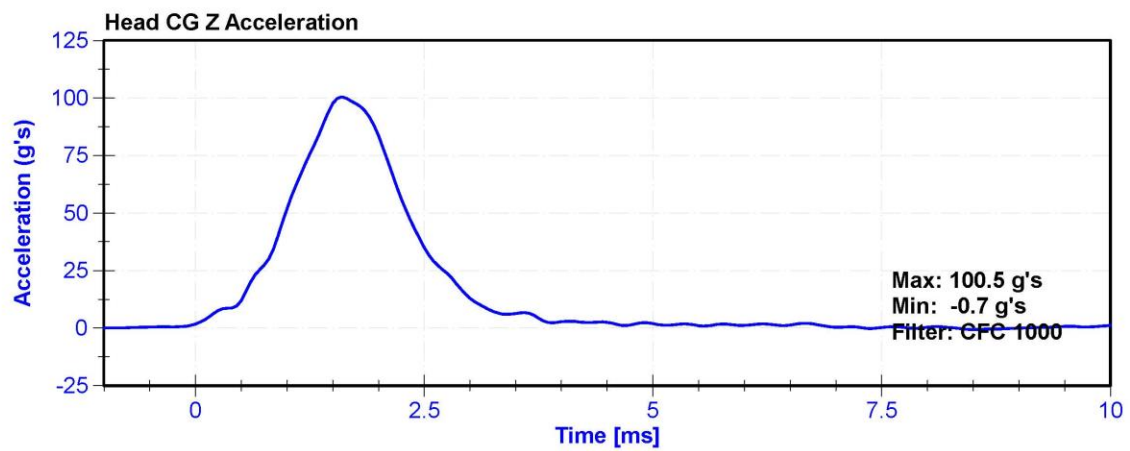
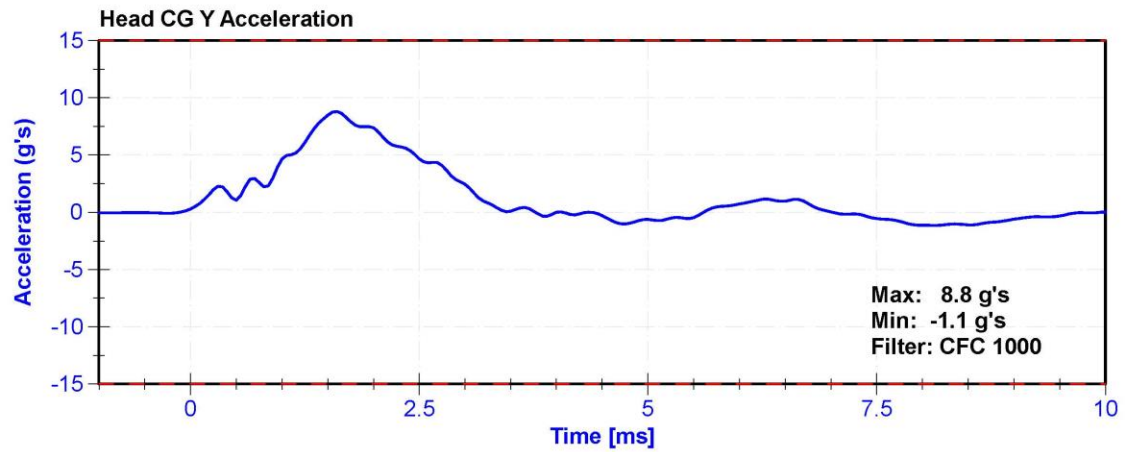
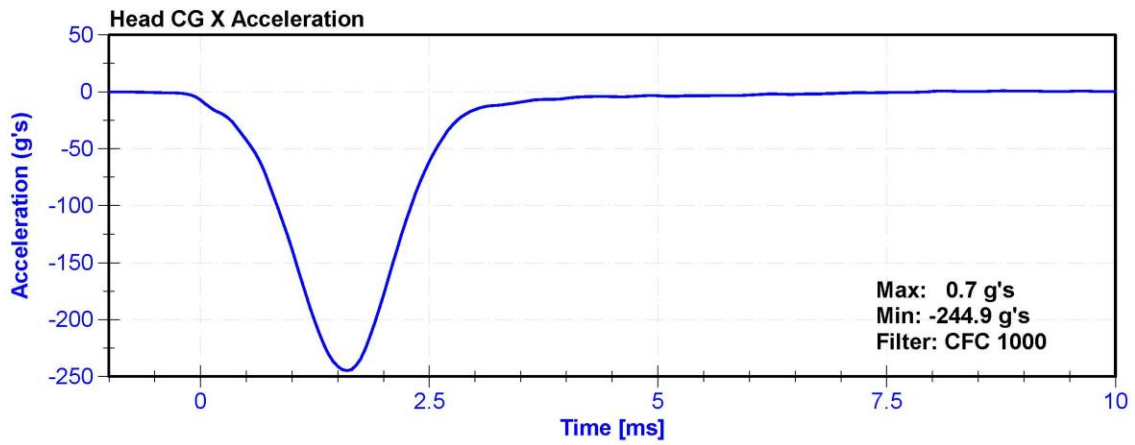
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	21.8	Pass
Humidity	10	70	%	29.3	Pass
Resultant Acceleration	250	300	g's	264.9	Pass
Oscillation	0	10	%	1.9	Pass
Lateral Acceleration	-15	15	g's	8.8	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	ENDEVCO 7264	AC-P51303	10/15/2018	4/15/2019
Y Accelerometer	ENDEVCO 7264CT	AC-P49216	10/15/2018	4/15/2019
Z Accelerometer	ENDEVCO 7264	AC-P58868	10/15/2018	4/15/2019





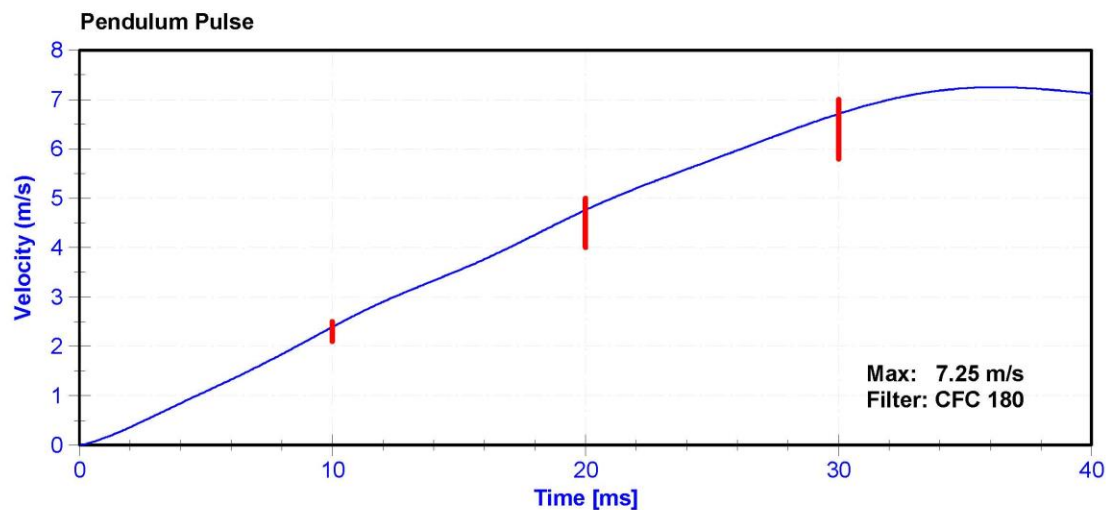
ATD Manufacturer	Denton	Test Technician	K. Dutton
ATD Serial Number	139	Laboratory Supervisor	K. Brogan

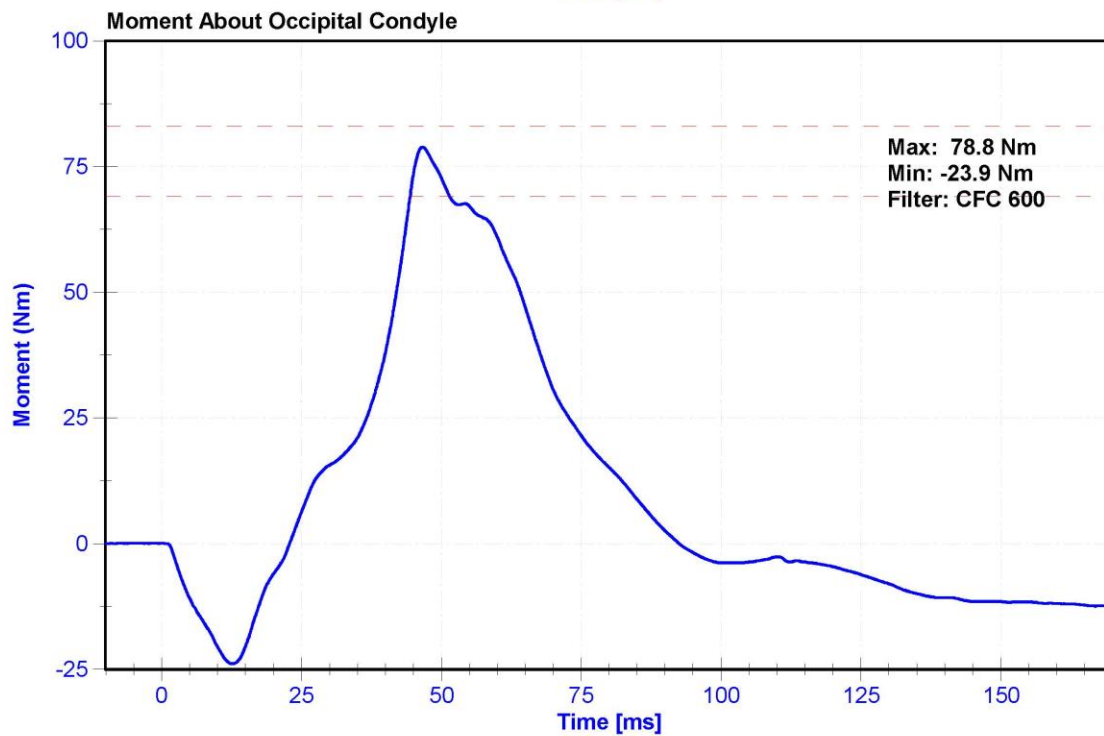
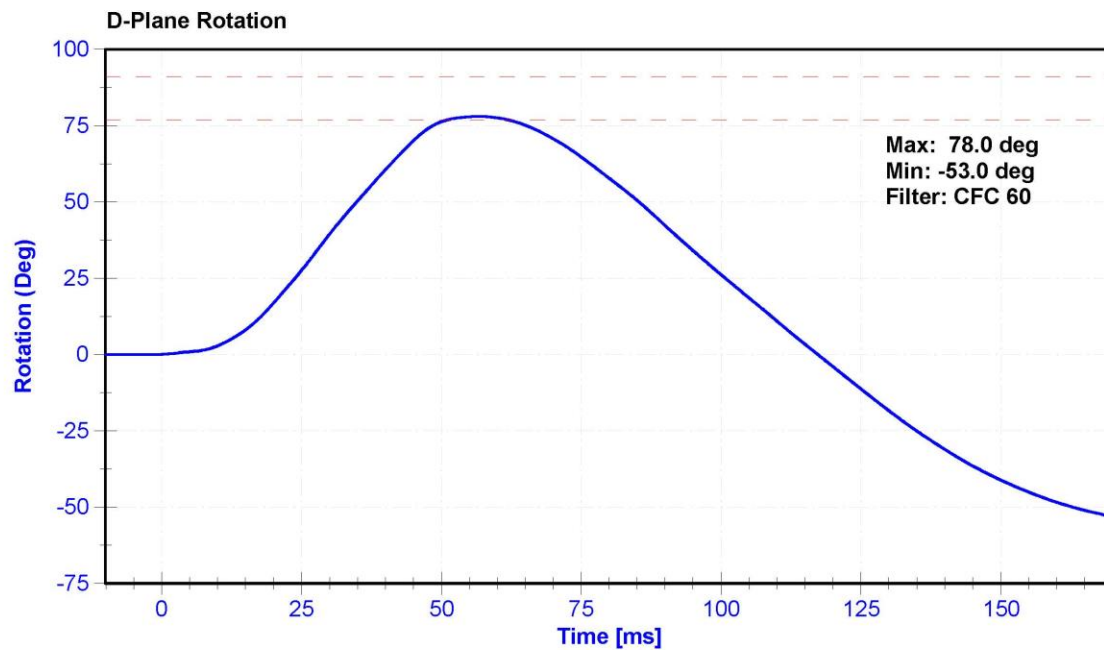
Results

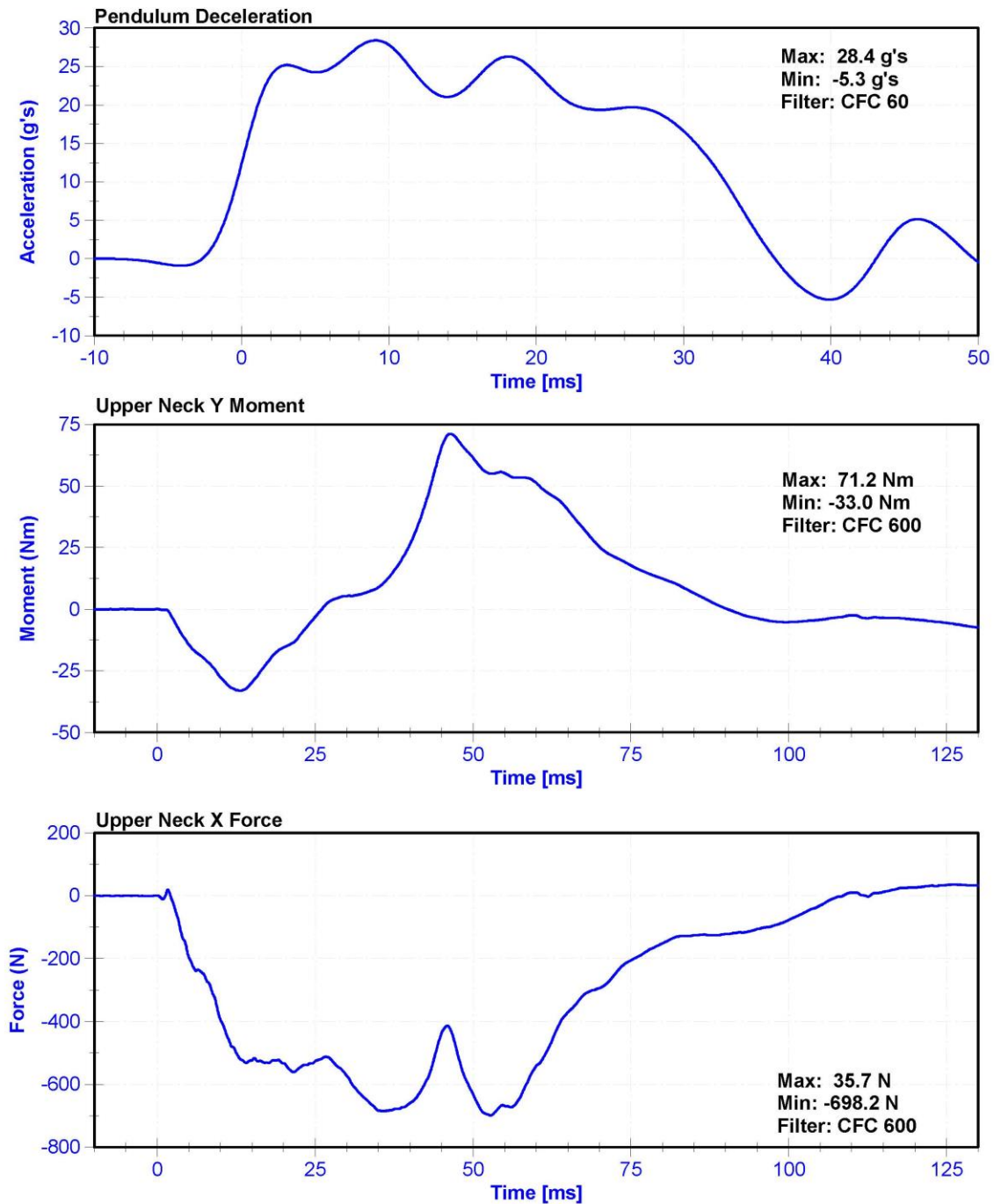
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.8	Pass
Humidity	10	70	%	41.3	Pass
Velocity	6.89	7.13	m/s	7.037	Pass
Pendulum Impulse at 10ms	2.1	2.5	m/s	2.39	Pass
Pendulum Impulse at 20ms	4.0	5.0	m/s	4.76	Pass
Pendulum Impulse at 30ms	5.8	7.0	m/s	6.71	Pass
Max D Plane Rotation	77	91	deg	78.0	Pass
Max Moment During Rotation Interval	69	83	Nm	78.8	Pass
Moment Decay to 10.0 Nm	80	100	ms	84.1	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-AH5F3	5/11/2018	5/11/2019
Pendulum Potentiometer	ETI SP22G	DS-PendPot	10/12/2018	10/12/2019
Condyle Potentiometer	ETI SP22G	DS-CondPot	10/12/2018	10/12/2019
Upper Neck Load Cell	DENTON 1716A	LC-1591Fx	9/28/2018	9/28/2019







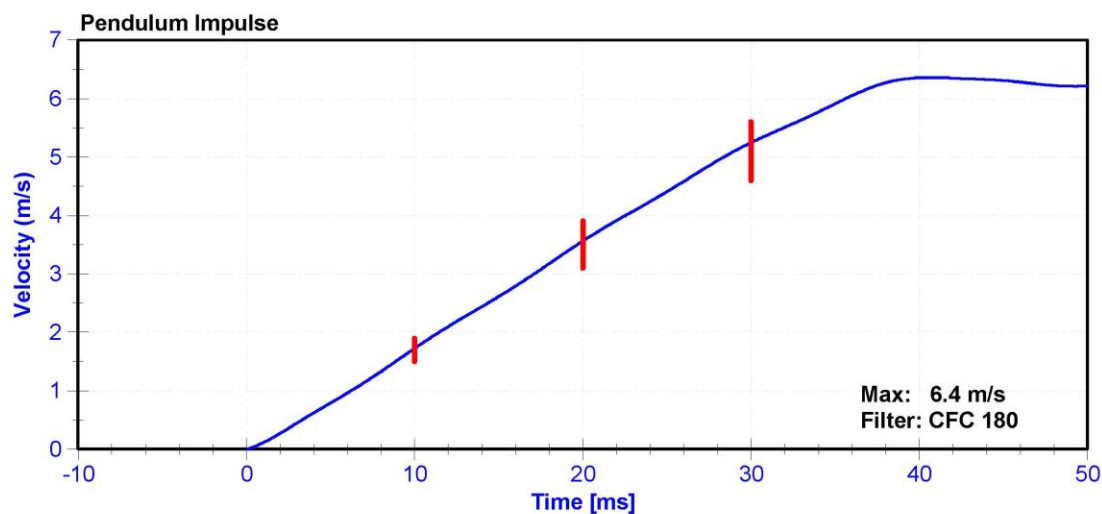
ATD Manufacturer	Denton	Test Technician	K. Dutton
ATD Serial Number	139	Laboratory Supervisor	K. Brogan

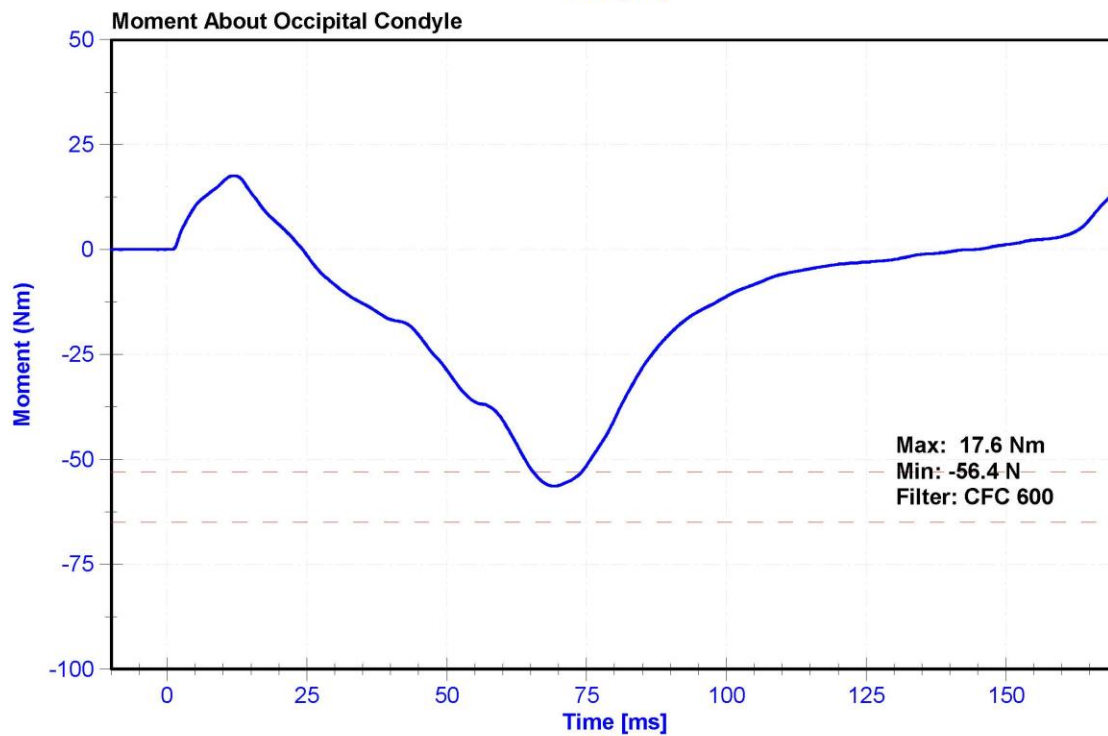
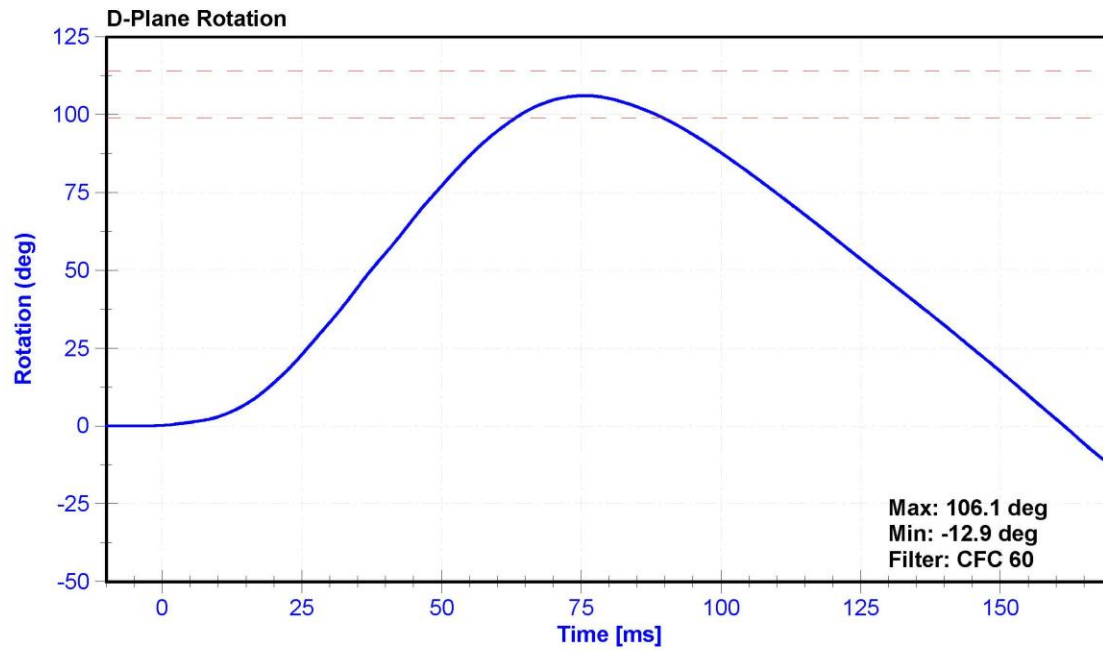
Results

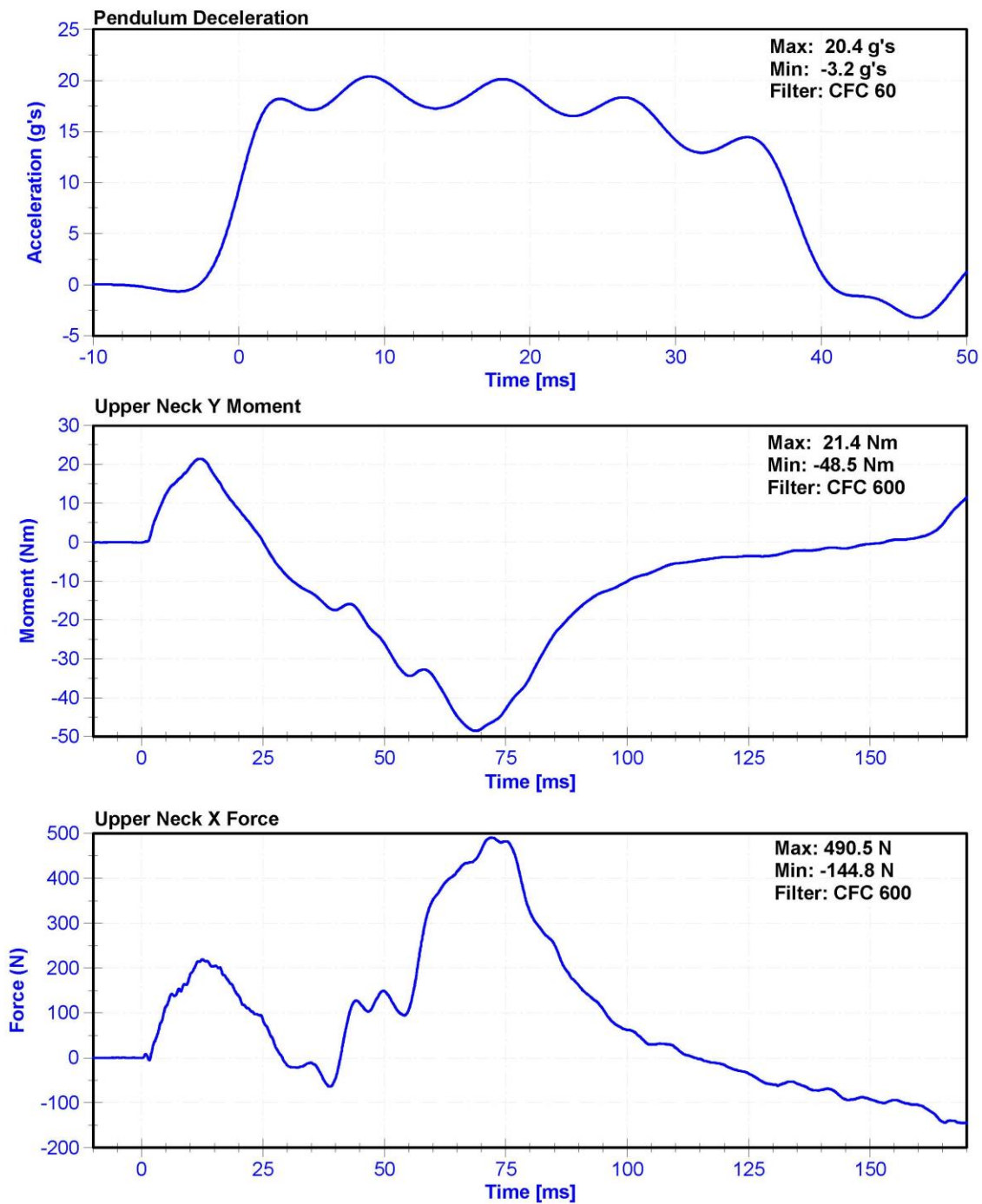
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.8	Pass
Humidity	10	70	%	41.3	Pass
Velocity	5.95	6.19	m/s	6.158	Pass
Pendulum Impulse at 10ms	1.5	1.9	m/s	1.73	Pass
Pendulum Impulse at 20ms	3.1	3.9	m/s	3.56	Pass
Pendulum Impulse at 30ms	4.6	5.6	m/s	5.25	Pass
D Plane Rotation	99	114	deg	106.1	Pass
Moment During Rotation Interval	-65	-53	Nm	-56.4	Pass
Moment Decay to -10Nm	94	114	ms	101.8	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-AH5F3	5/11/2018	5/11/2019
Pendulum Potentiometer	ETI SP22G	DS-PendPot	10/12/2018	10/12/2019
Condyle Potentiometer	ETI SP22G	DS-CondPot	10/12/2018	10/12/2019
Upper Neck Load Cell	DENTON 1716A	LC-1591Fx	9/28/2018	9/28/2019







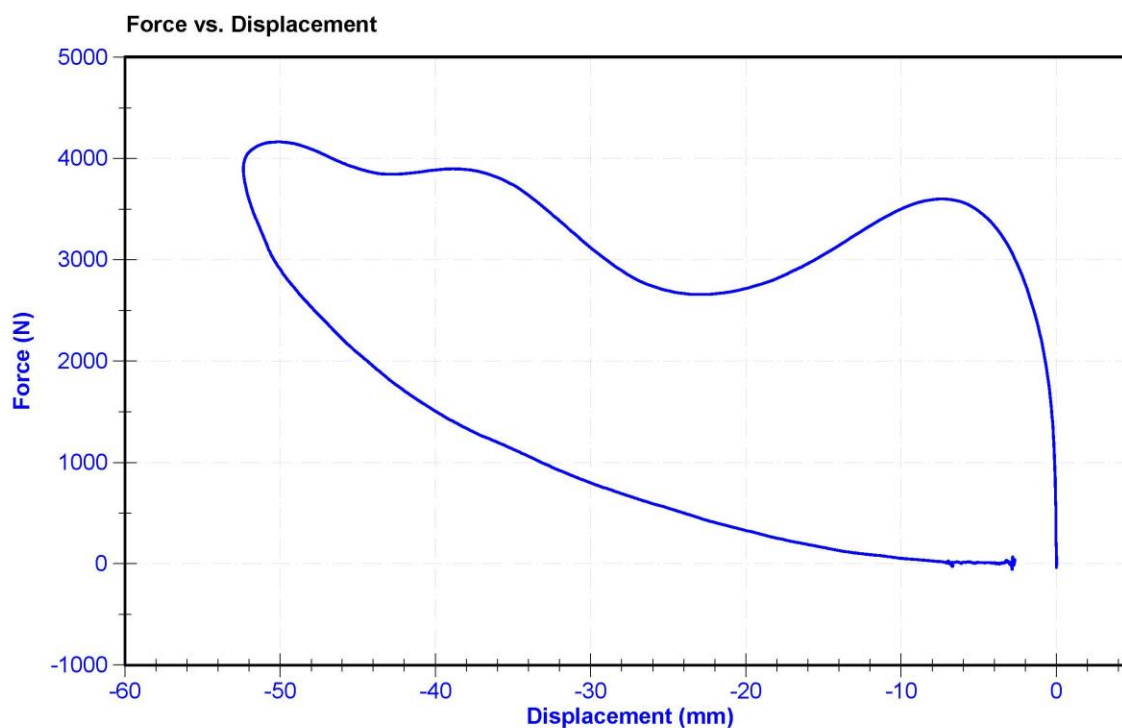
ATD Manufacturer	Denton	Test Technician	D. Reinhard
ATD Serial Number	139	Laboratory Supervisor	K. Brogan

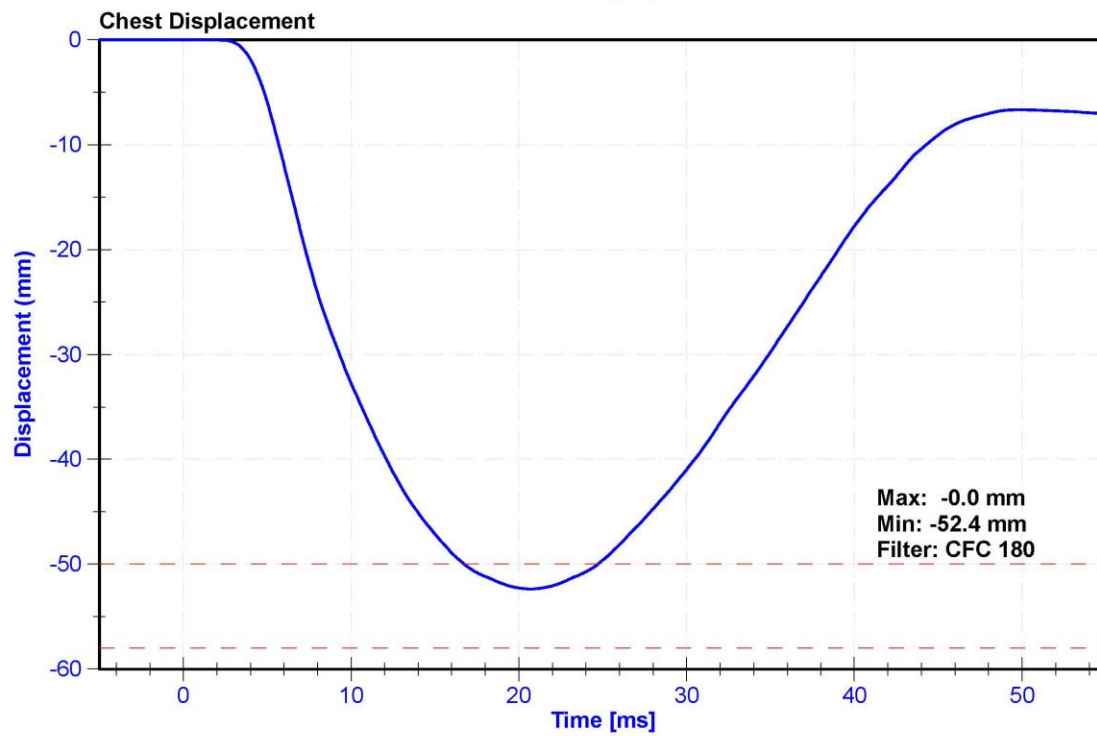
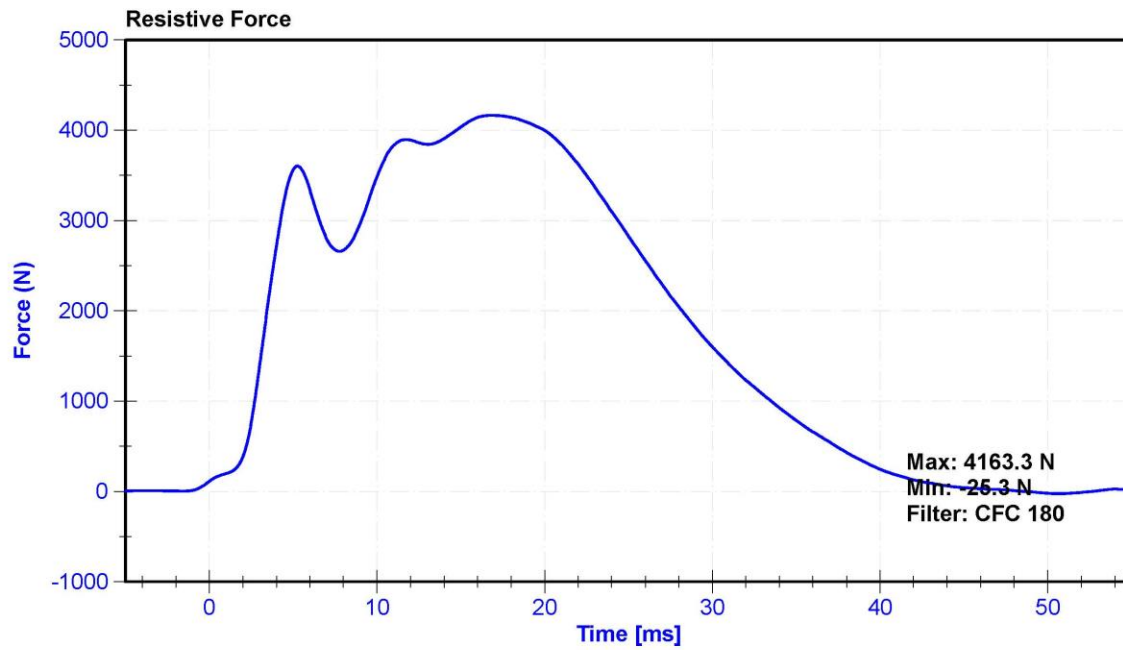
Results

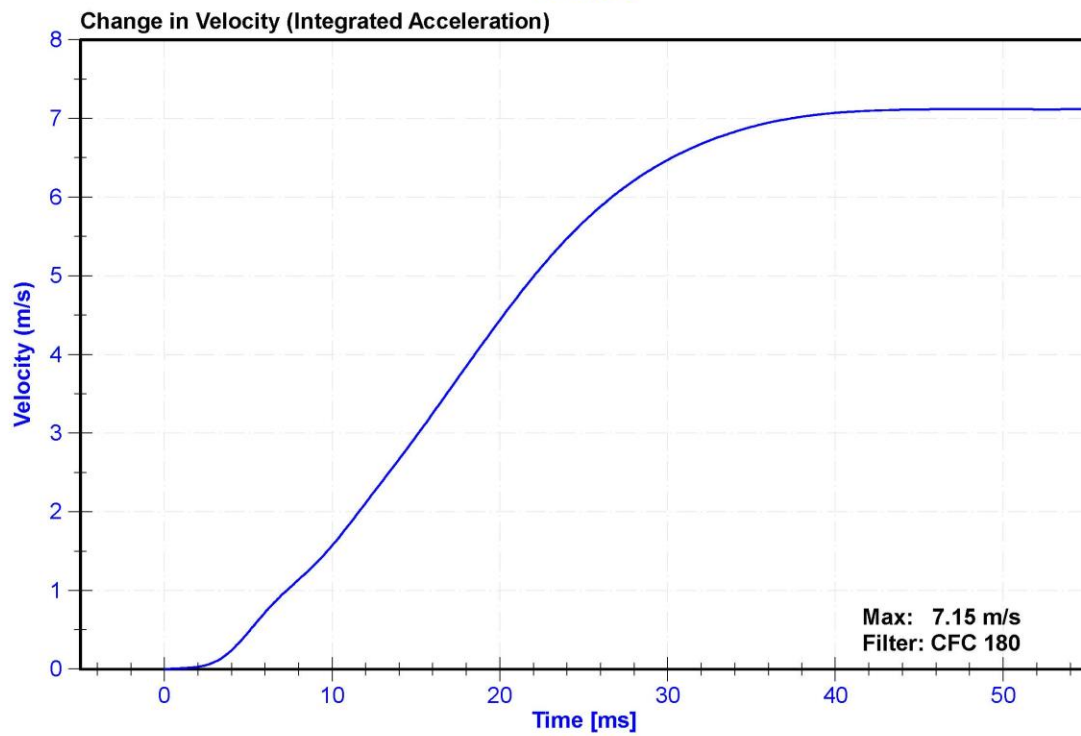
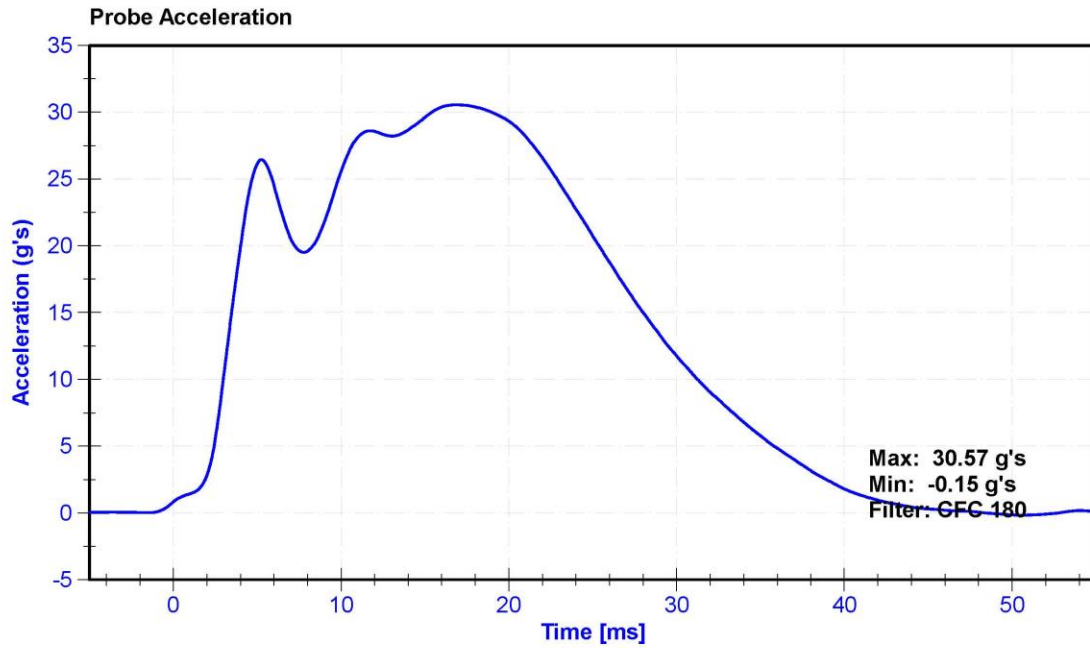
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.7	Pass
Humidity	10	70	%	28.1	Pass
Velocity	6.59	6.83	m/s	6.804	Pass
Chest Deflection	-58	-50	mm	-52.4	Pass
Maximum Resistive Force (50 to 58mm)	3900	4400	N	4163.3	Pass
Maximum Resistive Force (18 to 50mm)	0	4600	N	4162.6	Pass
Hysteresis	69	85	%	72.9	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco 7264C-2KTZ-2-360M	AG-P94667	11/1/2018	11/1/2019
Chest Potentiometer	SERVO 14CB1-2897	DS-288	10/22/2018	10/22/2019







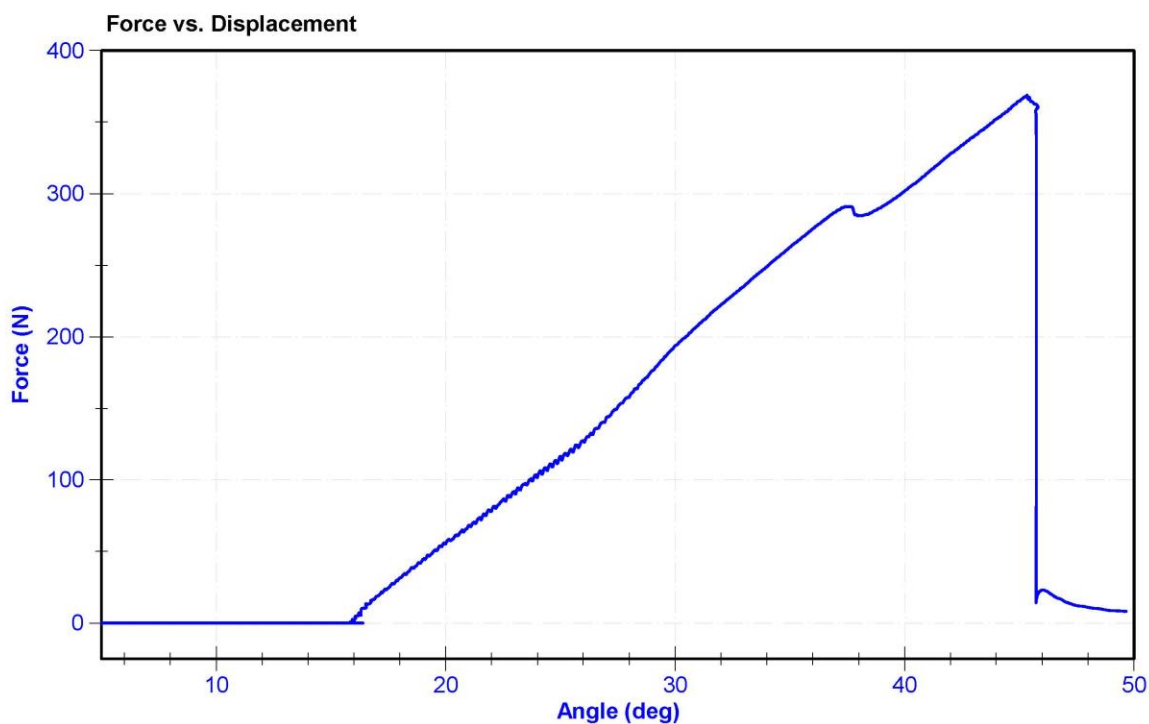
ATD Manufacturer	Denton	Test Technician	C.Mantell
ATD Serial Number	139	Laboratory Supervisor	K. Brogan

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.6	25.6	°C	22	Pass
Humidity	10	70	%	28	Pass
Initial Angle	0	20	deg	15.3	Pass
Force at 45 Degrees	320	390	N	368.8	Pass
Return Angle Relative to Initial	0	8	deg	1.5	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



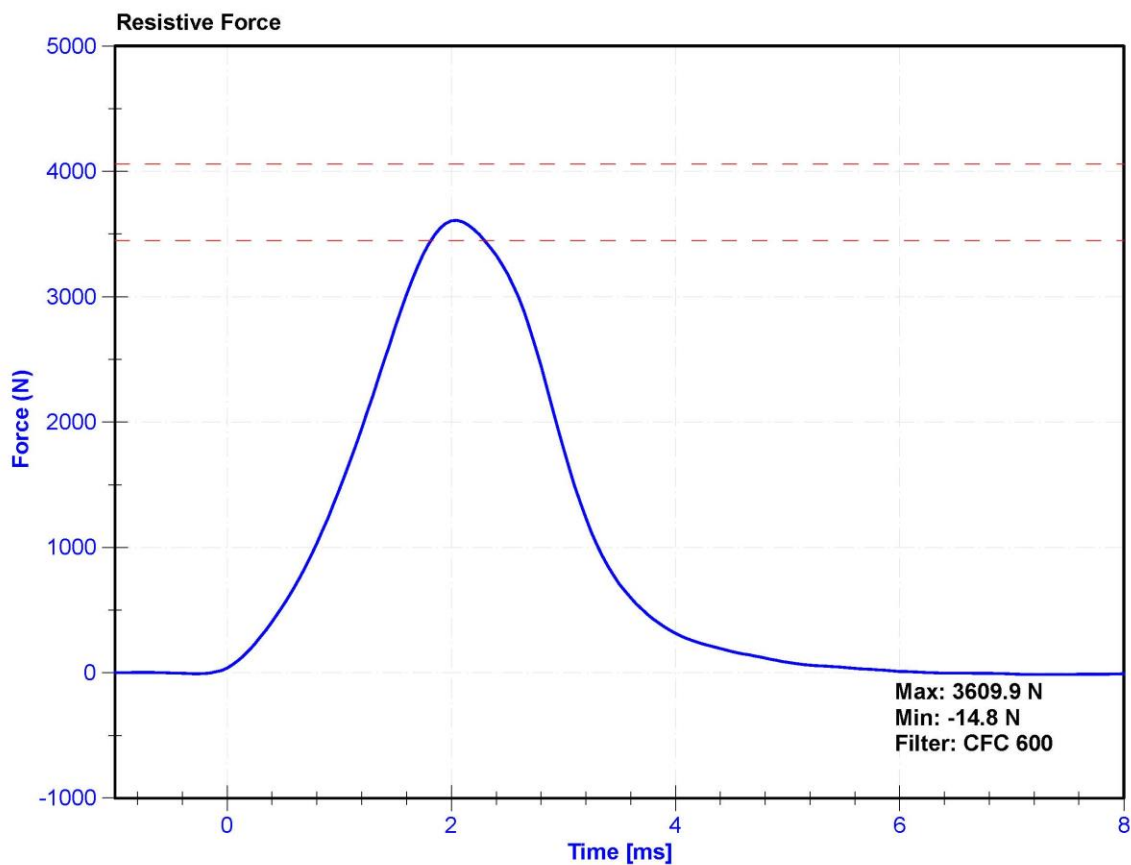
ATD Manufacturer	Denton	Test Technician	C. Mantell
ATD Serial Number	139	Laboratory Supervisor	K. Brogan

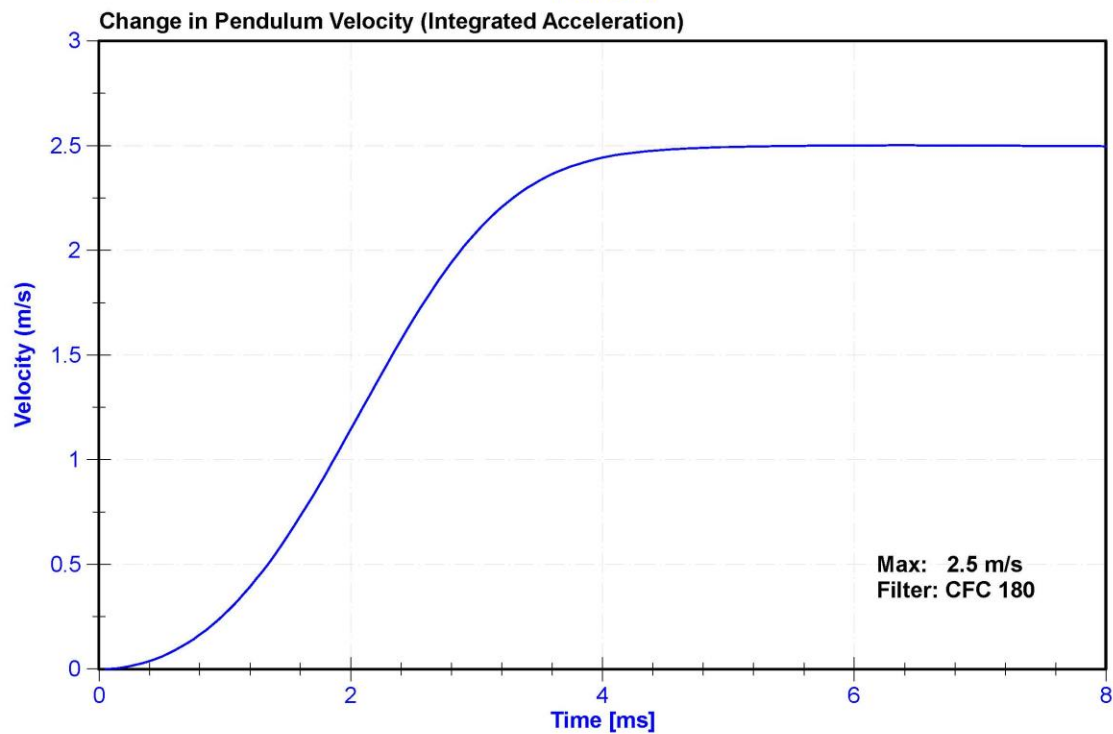
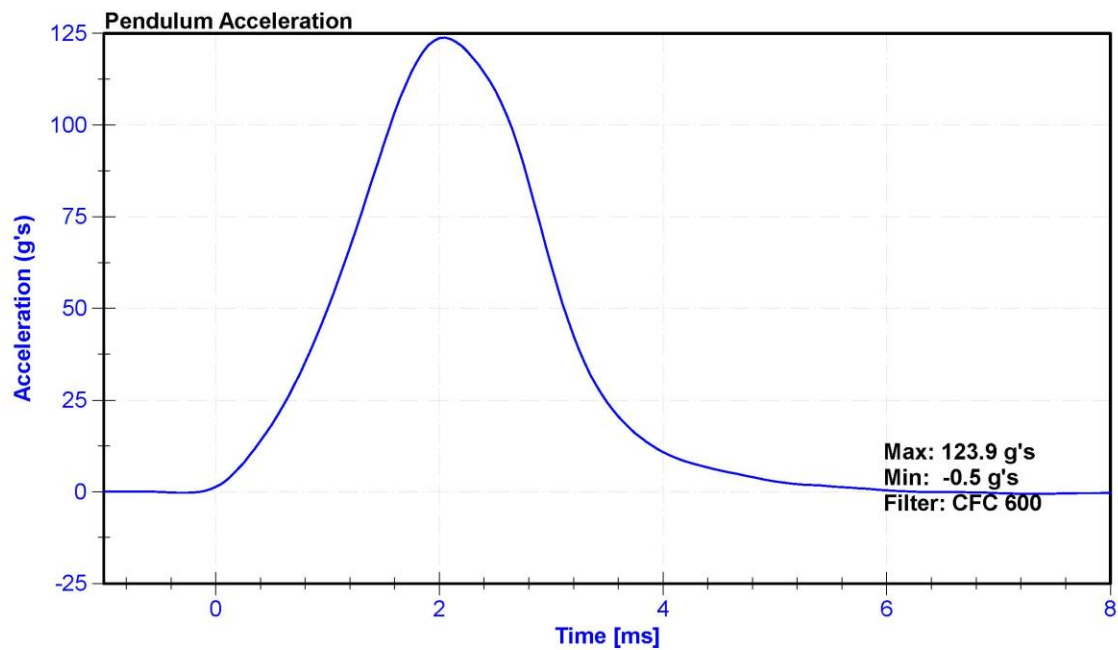
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	22.0	Pass
Humidity	10	70	%	33.3	Pass
Velocity	2.07	2.13	m/s	2.104	Pass
Resistive Force	3450	4060	N	3609.9	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	Denton	Test Technician	C. Mantell
ATD Serial Number	139	Laboratory Supervisor	K. Brogan

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	22.0	Pass
Humidity	10	70	%	32.7	Pass
Velocity	2.07	2.13	m/s	2.101	Pass
Resistive Force	3450	4060	N	3902.4	Pass

Transducer Calibrations

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

