REPORT NUMBER: NCAP-CAL-17-001

NEW CAR ASSESSMENT PROGRAM (NCAP)
FRONTAL BARRIER IMPACT TEST

Hyundai Motor Company
2017 Hyundai Elantra
Four Door Sedan

NHTSA No: M20174200

PREPARED BY:
CALSPAN CORPORATION
P.O. BOX 400
BUFFALO, NEW YORK 14225

August 30, 2016

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

This final test report was prepared for the U.S. Department of Transportation, National Highway Traffic Administration, in response to Contract Number DTNH22-12-D-00260.

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Prepared by: Vanessa Hansen Date: August 30, 2016
Vanessa Hansen, Senior Test Engineer

Approved by: Edward Dutton Date: August 30, 2016
Edward J. Dutton, Operations Manager
Transportation Test Operations

FINAL REPORT ACCEPTANCE BY OCWS:

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

Date: _____

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

Date: _____

TECHNICAL REPORT DOCUMENTATION PAGE

1. *Report No.* NCAP-CAL-17-001	***2. Government Accession No.***	***3. Recipient's Catalog No.***
4. Title and Subtitle Final Report of New Car Assessment Program Frontal Impact Testing of a 2017 Hyundai Elantra four door sedan NHTSA No.: M20174200		***5. Report Date*** August 30, 2016 ***6. Performing Organization Code*** CAL
7. Author(s) Vanessa Walsh, Senior Test Engineer Edward Dutton, Operations Manager		***8. Performing Organization Report No.*** CAL-DOT-2017-001
9. Performing Organization Name and Address Calspan Corporation Transportation Test Operations P.O. Box 400 Buffalo, New York 14225		***10. Work Unit No.*** ***11. Contract or Grant No.*** DTNH22-12-D-00260
12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Administration Office of Crashworthiness Standards (NRM-110) 1200 New Jersey Ave., SE, Room W43-410 Washington, D.C. 20590		***13. Type of Report and Period Covered:*** Final Test Report June 22, 2016 - August 30, 2016 ***14. Sponsoring Agency Code*** NRM-110
15. Supplementary Notes		

16. Abstract

A 56.30 km/h (35 mph), NCAP Frontal Impact Test was conducted on a 2017 Hyundai Elantra 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 June 22, 2016.

The impact velocity of the vehicle was 56.15 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 543 mm at left side of front bumper. The test vehicle's occupant performance data is as follows:

Measurement Description	Units	Driver ATD (Serial No. 142)		Passenger ATD (Serial No. 139)	
		Threshold	Result	Threshold	Result
Head Injury Criteria (HIC_{15})		700	150.39	700	255.430
Maximum Chest Compression	mm	63	-31.665	52	-15.591
Nij		1	0.263	1	0.414
Neck Tension	N	4,170	1022.039	2,620	826.528
Neck Compression	N	4,000	-295.898	2,520	-428.842
Left Femur Force	N	10,008	-842.562	6,805	-809.044
Right Femur Force	N	10,008	-1366.895	6,805	-155.075

17. Key Words 35 mph Frontal Barrier Impact Test New Car Assessment Program (NCAP)	***18. Distribution Statement*** Copies of this report are available from: National Highway Traffic Safety Administration Technical Information Services Division, NPO-411 1200 New Jersey Ave, SE Washington, DC 20590 e-mail: tis@nhtsa.dot.gov FAX: 202-493-2833

19. Security Class. (of this report)	***20. Security Class. (of this page)***	***21. No. of Pages***	***22. Price***
UNCLASSIFIED	UNCLASSIFIED	160	

Form DOT F1700.7 (8-69)

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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 2017 Hyundai Elantra four door sedan at a velocity of 56.15 km/h. The test was performed at Calspan Corporation's Transportation Test Operations facility in Buffalo, New York on June 22, 2016. 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 543 mm at 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. Both knees contacted the knee air bag.

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

The occupant data is summarized below.

ATD Position	HIC_{15}	Nij	Neck Tension (N)	Neck Comp. (N)	3ms Chest Clip (Gs)	Chest Disp. (mm)	Left Femur (N)	Right Femur (N)
Driver (50^{th})	150.39	0.263	1022.039	-295.898	49.09	-31.665	-842.562	-1366.895
Passenger (5^{th})	255.430	0.414	826.528	-428.842	49.267	-15.591	-809.044	-155.075

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: 2017 Hyundai Elantra four door sedan NHTSA No.: M20174200
Test Program: NCAP Frontal Barrier Impact Test Test Date: 6/22/2016

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA No.	M20174200	Traction Control System (TCS)	Yes
Model Year	2017	Power Steering	Yes
Make	Hyundai	Power Window Auto-Reverse	No
Model	Elantra	Driver Frontal Airbag	Yes
Body Style	Four Door Sedan	Driver Curtain Airbag	Yes
VIN	KMHD74LF3HU123487	Driver Head/Torso Airbag	No
Body Color	Red	Driver Torso Airbag	No
Odometer Reading (km /mi)	27.4 km / 17 mi	Driver Torso/Pelvis Airbag	Yes
Engine Displacement (L)	2.0	Driver Pelvis Airbag	No
Type / No. Cylinders	I4	Driver Knee Airbag	Yes
Engine Placement	Transverse	Front Pass. Frontal Airbag	Yes
Transmission Type	Automatic	Front Pass. Curtain Airbag	Yes
Transmission Speeds	6-Speed	Front Pass. Head/Torso Airbag	No
Overdrive	Yes	Front Pass. Torso Airbag	No
Final Drive	FWD	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	-

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

DATA FROM CERTIFICATION LABEL

Manufactured By	Hyundai Motor Company	GVWR (kg)	1780
Date of Manufacture	FEB/23/16	GAWR Front (kg)	990
		GAWR Rear (kg)	910

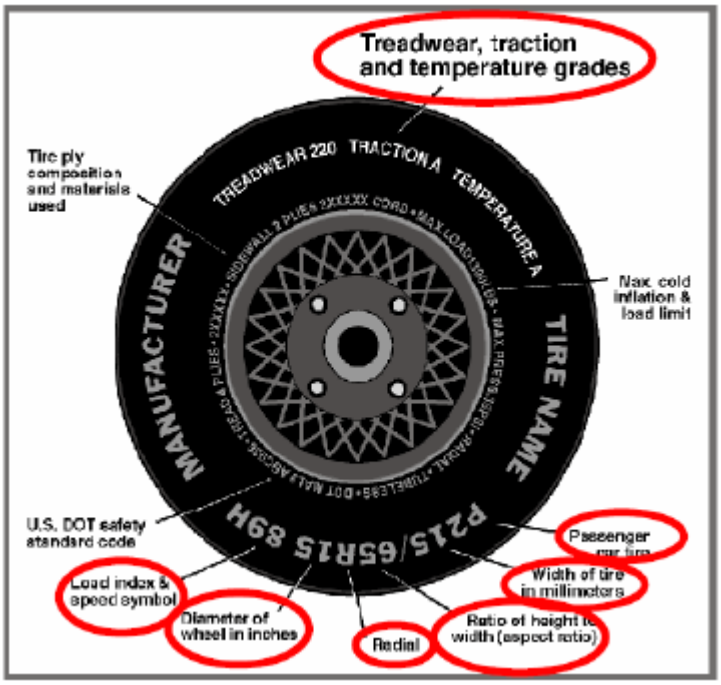
VEHICLE SEATING AND WEIGHT CAPACITY DATA

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

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

Test Vehicle:	2017 Hyundai Elantra four door sedan	NHTSA No.:	M20174200
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	6/22/2016

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



VEHICLE TIRE INFORMATION

Measured Parameter	Front	Rear
Maximum Tire Pressure (kPa)	350	350
Cold Pressure (kPa)	250	250
Recommended Tire Size	P195/65R15	P195/65R15
Tire Size on Vehicle	P195/65R15	P195/65R15
Tire Manufacturer	Hankook	Hankook
Tire Model	Kinergy GT	Kinergy GT
Treadwear	540	540
Traction	A	A
Temperature Grades	A	A
Tire Plies Sidewall	1 Polyester	1 Polyester
Tire Plies Body	2 Steel, 1 Polyester	2 Steel, 1 Polyester
Load Index / Speed Symbol	91T	91T
Tire Material	Rubber	Rubber
DOT Safety Code Left	5MDH1BH0416	5MDH1BH0416
DOT Safety Code Right	5MDH1BH0416	5MDH1BH0416

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

Test Vehicle: 2017 Hyundai Elantra four door sedan NHTSA No.: M20174200
Test Program: NCAP Frontal Barrier Impact Test Test Date: 6/22/2016

TEST VEHICLE WEIGHTS

	Units	As Delivered Weights (UVW)			As Tested Weights (ATW)		
		Front Axle	Rear Axle	Total	Front Axle	Rear Axle	Total
Left	kg	389	272		434	326	
Right	kg	406	227		430	290	
Ratio	%	61	39		58	42	
Totals	kg	795	499	1294	864	616	1480

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value	
Total Delivered Weight (UVW)	kg	1294	(A)
Weight of 1 P572E ATD & 1 P572O ATD	kg	147	(B)
Rated Cargo / Luggage Weight (RCLW)	kg	44.8	(C)
Calculated Vehicle Target Weight (TVTW)	kg	1485.8	(A+B+C)

TEST VEHICLE ATTITUDES AND CG

Condition	Units	LF	RF	LR	RR	CG (aft of front axle)
As Delivered	mm	684	666	680	697	1040
As Tested	mm	676	683	662	671	1123
Post-Test	mm	761	723	681	657	

GENERAL TEST VEHICLE DATA

Measurement Description	Units	Value
Total Vehicle Wheel Base	mm	2698
Total Vehicle Length at Left Side	mm	4446
Total Vehicle Length at Centerline	mm	4574
Total Vehicle Length at Right Side	mm	4446
Weight of Ballast in Cargo Area	kg	0
Weight of Vehicle Components Removed	kg	43
Amount of Stoddard Solvent in Fuel Tank	L	49.29

LIST OF COMPONENTS REMOVED TO MEET TEST WEIGHT:

Rear seats, mirrors, trunk carpeting, spare tire, jack, tail light.

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

Test Vehicle: 2017 Hyundai Elantra four door sedan NHTSA No.: M20174200
Test Program: NCAP Frontal Barrier Impact Test Test Date: 6/22/2016

TARGET VEHICLE STRUCTURAL MEASUREMENT

No.	Description	Pre-Test
1	Total Length	4574
2	Total Width	1777
3*	Bumper Top Height	518
4*	Bumper Bottom Height	405
5*	Longitudinal Member Top Height	527
6	Distance Between Longitudinal Members	1031
7	Longitudinal Member Width	60
8*	Engine Top Height	849
9*	Engine Bottom Height	227
10	Engine and Gearbox Width	495
11	Front Bumper-Engine Distance	601
12*	Front Shock Absorber Fixing Height	847
13*	Bonnet Leading Edge Height	720
14	Front Shock Absorber Fixing Width	1172
15	Front Bumper – Front Axle Distance	882
16	Front Axle – A Pillar Distance	401
17	A-Pillar – B-Pillar Distance	1189
18	B-Pillar – Rear Axle Distance	1108
19	B-Pillar – C-Pillar Distance	1136
20*	Roof Sill Bottom Height	1312
21*	Roof Sill Top Height	1361
22*	Floor Sill Bottom Height	259
23*	Floor Sill Top Height	349

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

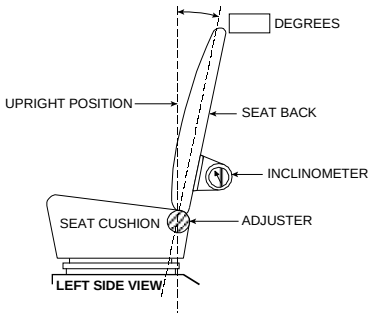
DATA SHEET NO. 2
SEAT ADJUSTMENT, FUEL SYSTEM, AND STEERING WHEEL DATA

Test Vehicle:	2017 Hyundai Elantra four door sedan	NHTSA No.:	M20174200
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	6/22/2016

NOMINAL DESIGN RIDING POSITION

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

Seating Position	Degrees
Driver Seat Back Angle	+1.2
Passenger Seat Back Angle	+0.4



FRONT SEAT ASSEMBLY

SEAT FORE / AFT POSITIONS

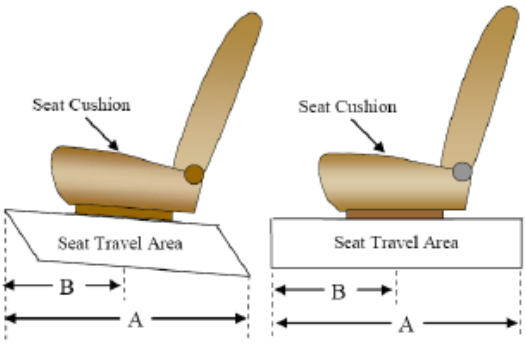
The driver's seat was positioned at the mid-point of fore/aft travel at its lowest position. The passenger's seat was positioned at the most forward position of fore/aft travel. Zero is defined as the forward most position.

Seating Position	Total Fore / Aft Travel	Placed in Position #
Driver Seat	38 (0 – 37)	15
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 – Uppermost
Passenger Seat	3	0 – Uppermost



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

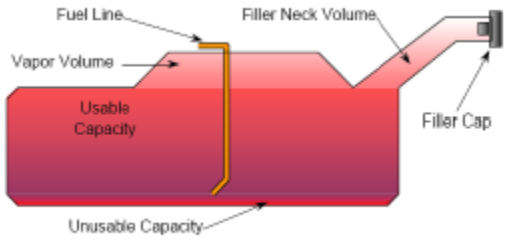
Test Vehicle:	2017 Hyundai Elantra four door sedan	NHTSA No.:	M20174200
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	6/22/2016

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	49.29
1/3 of Usable Capacity	17.6

FUEL PUMP

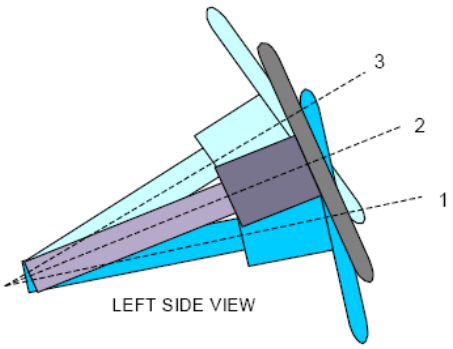
The vehicle is equipped with an electric fuel pump. The fuel filler neck is on the left side of the vehicle. The pump creates positive pressure in the fuel lines, pushing the gasoline to the engine. See form 1 for more information.



VEHICLE FUEL TANK ASSEMBLY

STEERING COLUMN ADJUSTMENT

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



STEERING COLUMN ASSEMBLY

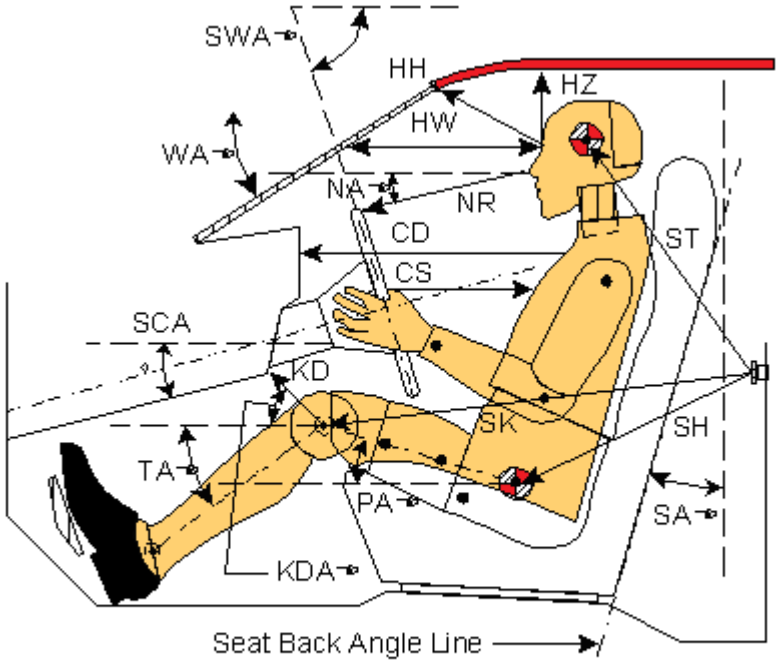
STEERING COLUMN POSITIONS

Description	Degrees	Fore / Aft Position (mm)
Lowermost position No. 1	21	
Geometric center position No. 2	23.7	
Uppermost position No. 3	26.4	
Telescoping Steering Wheel Travel		50
Test Position	23.7	25

DATA SHEET NO. 3
DUMMY LONGITUDINAL CLEARANCE DIMENSIONS

Test Vehicle: 2017 Hyundai Elantra four door sedan
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20174200
Test Date: 6/22/2016

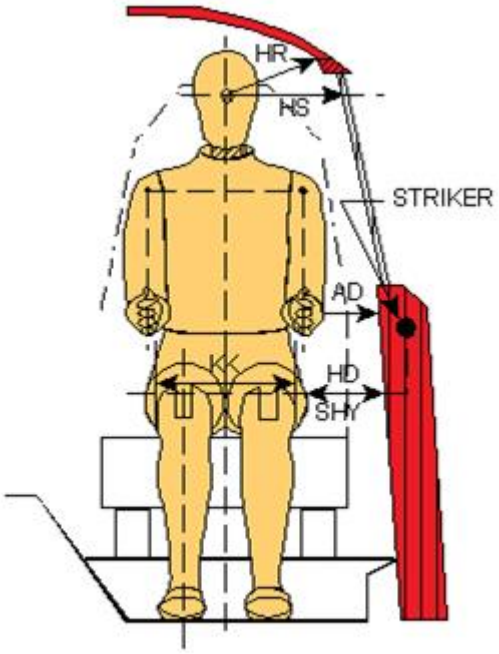


Left Side View

Code	Measurement Description	Driver (SN: 142)		Passenger (SN: 139)	
		Length (mm)	Angle (°)	Length (mm)	Angle (°)
WA°	Windshield Angle		26.1		
SWA°	Steering Wheel Angle		23.4		
SCA°	Steering Column Angle		66.6		
SA°	Seat Back Angle (on headrest post)		1.9		0.4
HZ	Head to Roof (Z)	192	90	231	90
HH	Head to Header	372	24.3	325	45.7
HW	Head to Windshield	715	0	675	0
NR	Nose to Rim	417	6.2	499	26
CD	Chest to Dash	542		447	
CS	Chest to Steering Hub	332	2.8		
RA	Rim to Abdomen	218	7.5		
KDL	Left Knee to Dash	227	28.5	148	35.4
KDR	Right Knee to Dash	198	38	150	34.4
PA°	Pelvic Angle		21.8		21.3
TA°	Tibia Angle		20.5		34.3
SK	Striker to Knee	577	13.5	660	12
ST	Striker to Head	418	83.6	386	64.2
SH	Striker to H-Point	307	52.9	384	34.2

DATA SHEET NO. 4
DUMMY LATERAL CLEARANCE DIMENSIONS

Test Vehicle: 2017 Hyundai Elantra four door sedan
Test Program: NCAP Frontal Barrier Impact Test
NHTSA No.: M20174200
Test Date: 6/22/2016

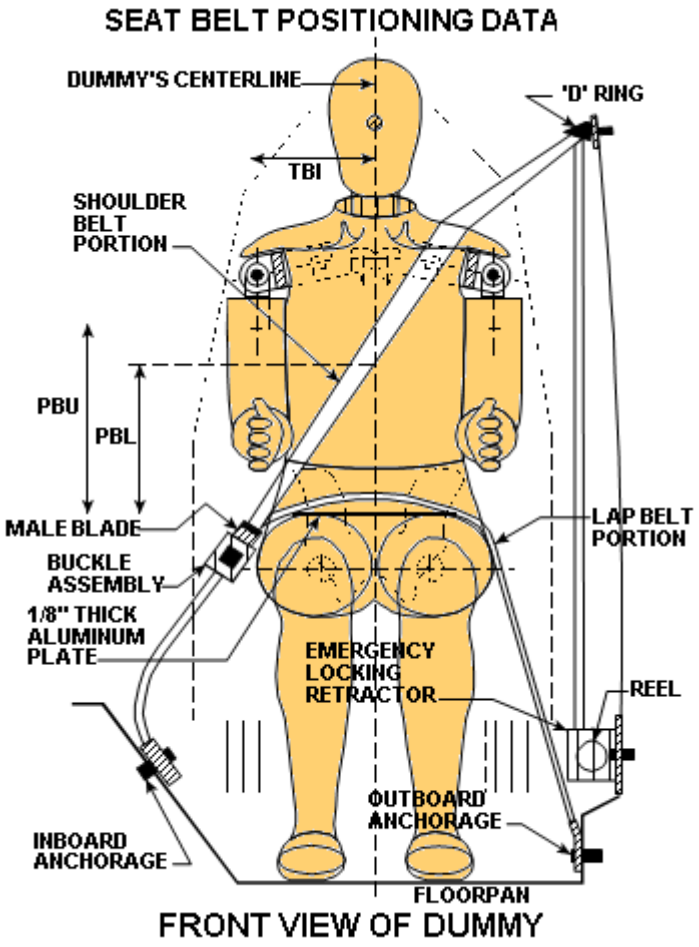


Front View

Code	Description	Driver (mm)	Passenger (mm)
AD	Arm to Door	117	80
HD	H-Point to Door	155	177
HR	Head to Side Header	214	260
HS	Head to Side Window	335	368
KK	Knee to Knee	345	165
SHY	Striker to H-Point (Y Direction)	240	285
AA	Ankle to Ankle	386	157

DATA SHEET NO. 5
SEAT BELT POSITIONING DATA

Test Vehicle:	2017 Hyundai Elantra four door sedan	NHTSA No.:	M20174200
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	6/22/2016



SEAT BELT POSITIONING MEASUREMENTS

Measurement Description	Units	Driver	Passenger
PBU — Top surface of reference to belt upper edge	mm	380	305
PBL — Top surface of reference to belt lower edge	mm	305	220

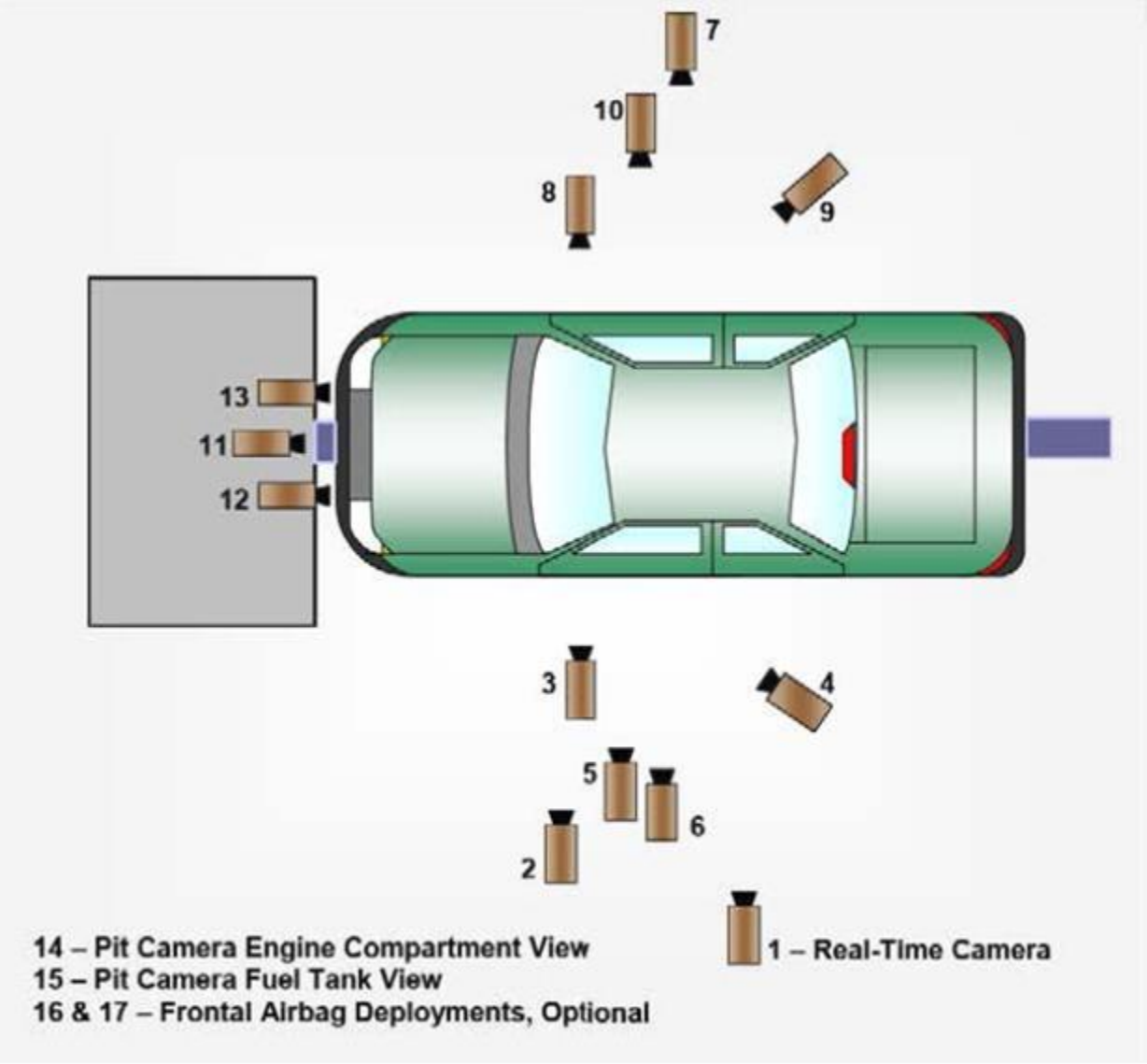
BELT LENGTH DATA

Measurement Description	Units	Driver	Passenger
Shoulder belt length as measured on ATD	mm	820	868
Lap Belt Length as measured on ATD	mm	610	659
Remainder of belt on reel	mm	970	873
Total belt length for continuous webbing systems	mm	2400	2400

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

Test Vehicle:	2017 Hyundai Elantra four door sedan	NHTSA No.:	M20174200
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	6/22/2016

CAMERA POSITIONS FOR FRONTAL IMPACTS



Top View

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

Test Vehicle: 2017 Hyundai Elantra four door sedan NHTSA No.: M20174200
Test Program: NCAP Frontal Barrier Impact Test Test Date: 6/22/2016

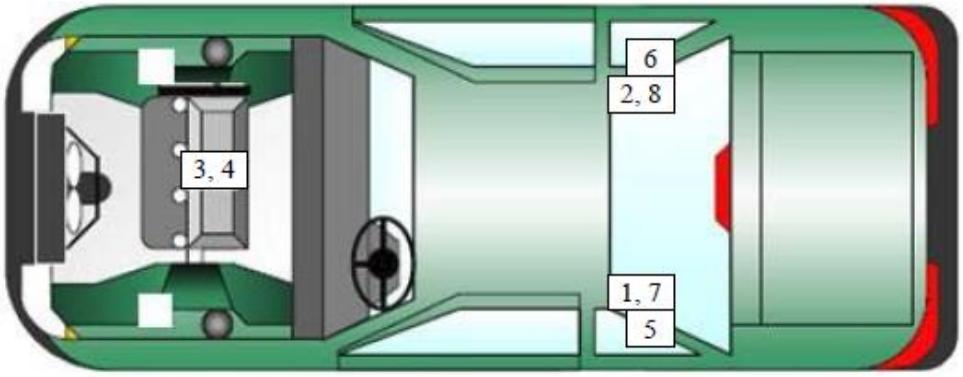
CAMERA LOCATIONS

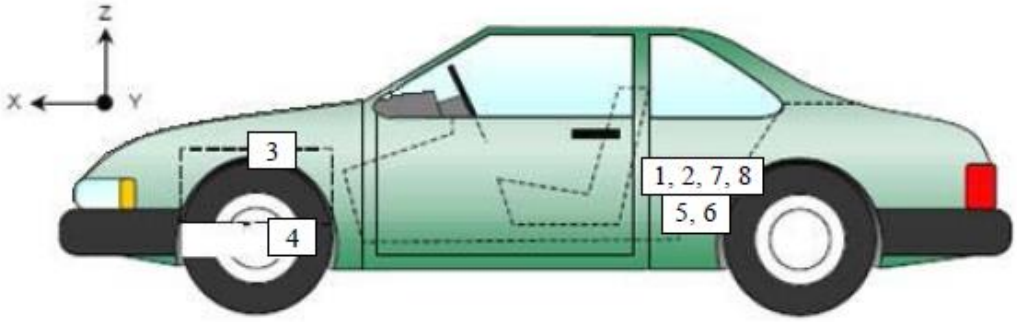
No.	Camera View	Location (mm)			Lens (mm)	Speed (fps)
		X	Y	Z		
1	Real-Time Left Overall	-	-	-		60
2	Driver Close-Up	-1550	-8448	-1436	50	1000
3	Left Front Half	-966	-9748	-1599	50	1000
4	Left Angle	-2756	-2770	-2116	24	1000
5	Steering Column - Top					
6	Steering Column - Bottom					
7	Right Overall	-2096	6726	-1096	24	1000
8	Passenger Close-Up	-1366	6075	-1186	50	1000
9	Right Front Half	-922	9010	-1070	28	1000
10	Right Angle	-2786	2974	-2164	24	1000
11	Windshield	950	0	-3504	20	1000
12	Driver Windshield	395	-600	-2051	25	1000
13	Passenger Windshield	395	600	-2051	25	1000
14	Pit Front	-755	0	1800	12.5	1000
15	Pit Rear	-2443	0	1961	12.5	1000
16	Onboard Driver Airbag (Optional)				12.5	1000
17	Onboard Passenger Airbag (Optional)				12.5	1000

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

DATA SHEET NO. 7
VEHICLE ACCELEROMETER LOCATIONS

Test Vehicle: 2017 Hyundai Elantra four door sedan
NHTSA No.: M20174200
Test Program: NCAP Frontal Barrier Impact Test
Test Date: 6/22/2016





VEHICLE ACCELEROMETER PRE-TEST LOCATIONS

No.	Accelerometer Location	Measurements (mm)		
		X	Y	Z
1	Left Rear Accelerometer – X Direction	1828	-523	189
2	Right Rear Accelerometer – X Direction	1830	520	179
3	Engine Top X	3910	-48	-382
4	Engine Bottom X	3825	-132	227
5	Left Rear Accelerometer – Z Direction	1828	-523	189
6	Right Rear Accelerometer – Z Direction	1830	520	179
7	Left Rear Accelerometer – X Direction Redundant	1828	-515	187
8	Right Rear Accelerometer – X Direction Redundant	1830	542	178

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

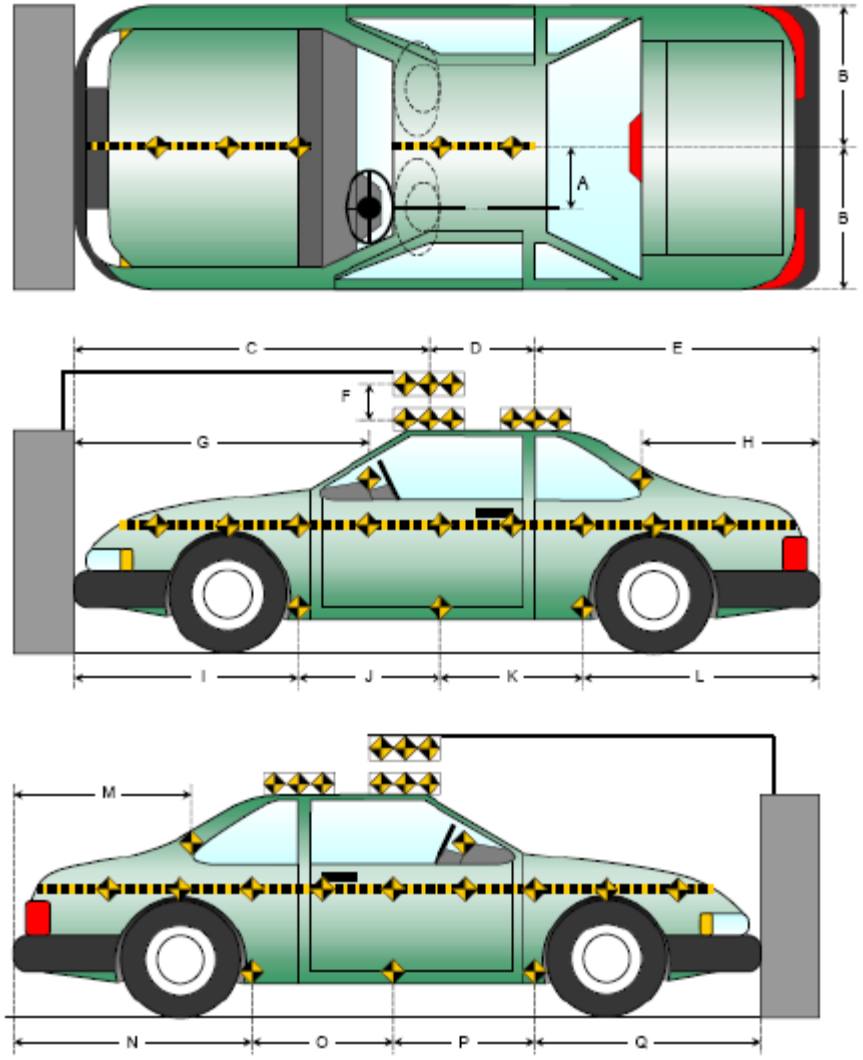
DATA SHEET NO. 8
PHOTOGRAPHIC REFERENCE TARGET LOCATIONS

Test Vehicle: 2017 Hyundai Elantra four door sedan
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20174200
Test Date: 6/22/2016

Item	Value
A	362
B	889
C	2582
D	612
E	1380
F	188
G	1699
H	2838
I	1318
J	914
K	451
L	1890
M	2840
N	1896
O	450
P	915
Q	1313

All units in millimeters



DATA SHEET NO. 9
LOAD CELL LOCATIONS ON FIXED BARRIER

Test Vehicle:	2017 Hyundai Elantra four door sedan	NHTSA No.:	M20174200
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	6/22/2016

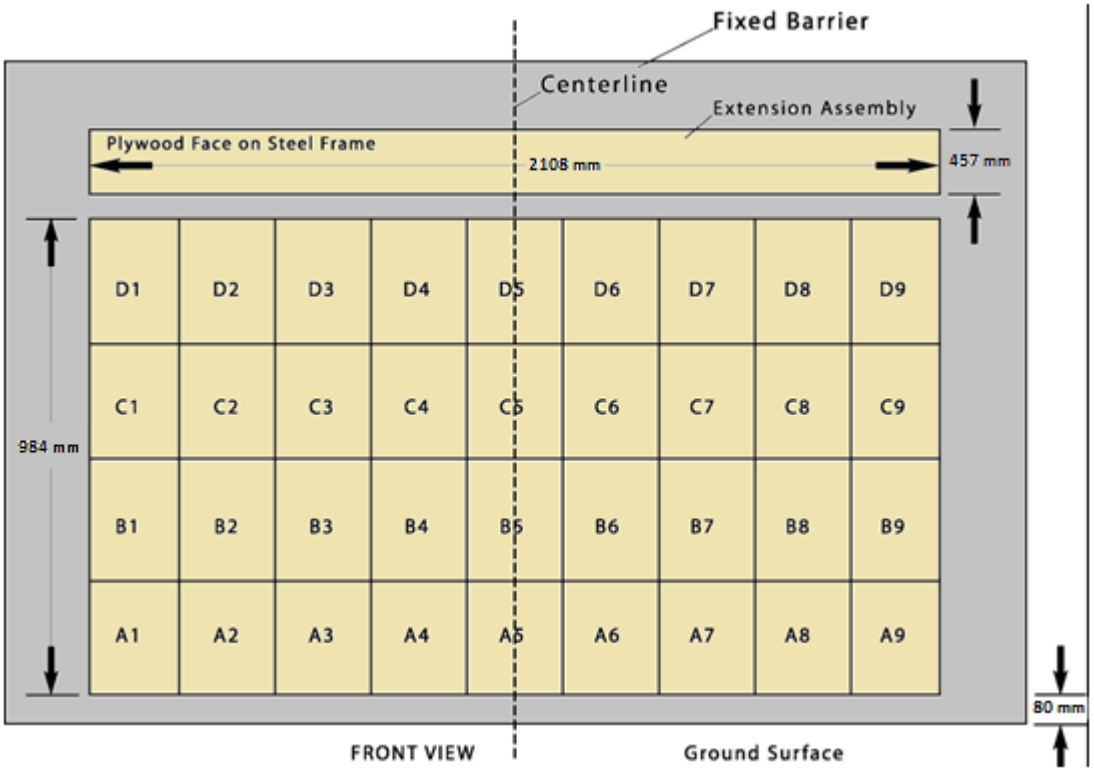


Figure 1 - Load Cell Locations on a 36-Load Cell Barrier with Plywood Height Extension*

DATA SHEET NO. 10
TEST VEHICLE SUMMARY OF RESULTS

Test Vehicle: 2017 Hyundai Elantra four door sedan
NHTSA No.: M20174200
Test Program: NCAP Frontal Barrier Impact Test
Test Date: 6/22/2016

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: 2017 Hyundai Elantra four door sedan NHTSA No.: M20174200
Test Program: NCAP Frontal Barrier Impact Test Test Date: 6/22/2016

TEST DUMMY INFORMATION AND CONTACT LOCATIONS

Description	Driver	Passenger
Dummy Type / Serial No.	P572E 50th Male / 142	P5720 5th Female / 139
Head Contact	Front Airbag & Headrest	Front Airbag & Headrest
Upper Torso Contact	Front Airbag	Front Airbag
Lower Torso Contact	None	None
Left Knee Contact	Knee Airbag	Glove Box
Right Knee Contact	Knee Airbag	None

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	Minor Cracks
Window Damage	None
Other Notable Effects	None

VEHICLE REBOUND FROM BARRIER

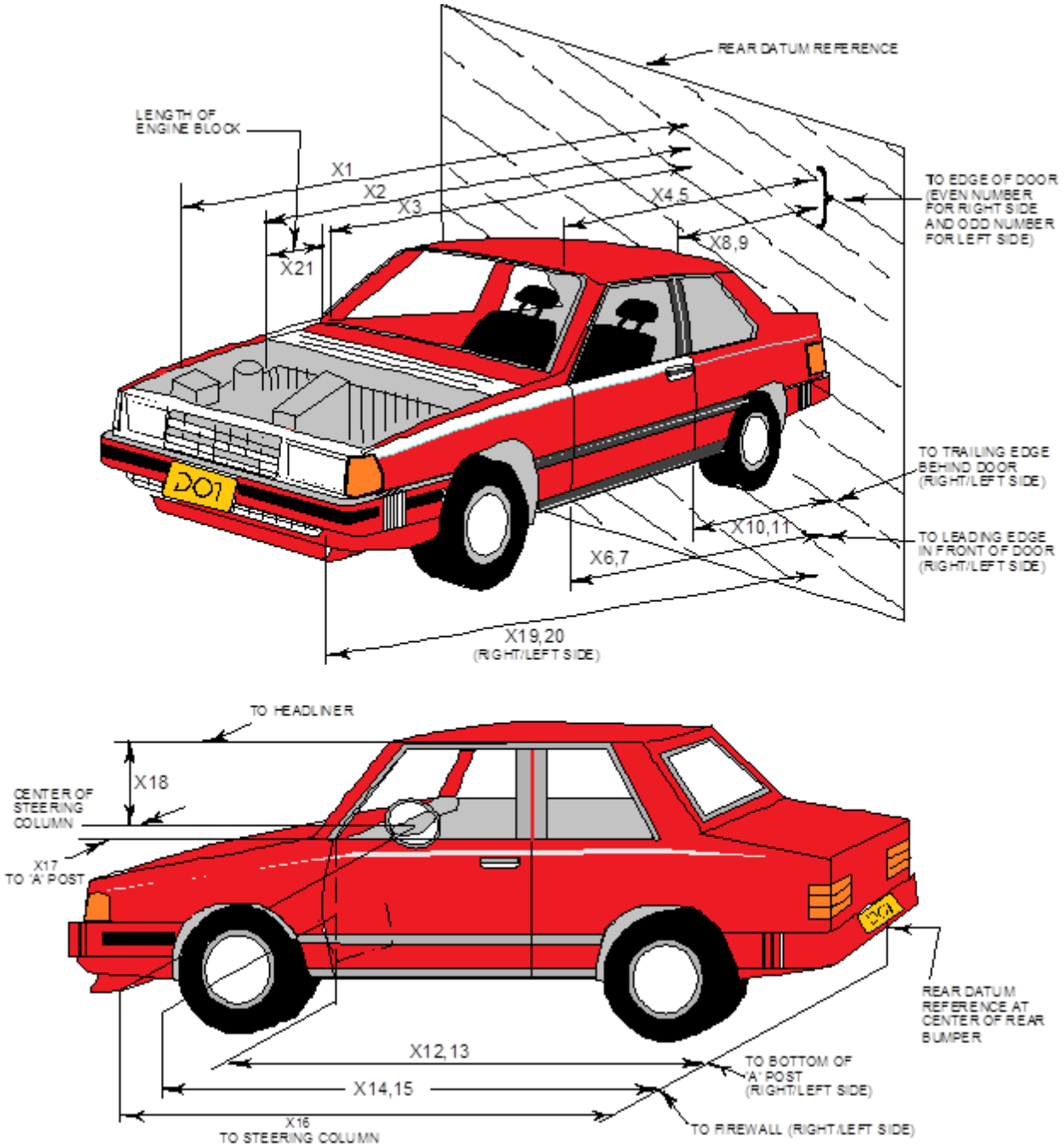
Measured Parameter	Units	Value
Left Side	mm	772
Center	mm	780
Right Side	mm	815
Average	mm	789

SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

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

DATA SHEET NO. 12
VEHICLE PROFILE MEASUREMENTS

Test Vehicle:	2017 Hyundai Elantra four door sedan	NHTSA No.:	M20174200
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	6/22/2016



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

Test Vehicle: 2017 Hyundai Elantra four door sedan NHTSA No.: M20174200
Test Program: NCAP Frontal Barrier Impact Test Test Date: 6/22/2016

No.	Measurement Description	Pre-Test	Post-Test	Difference
1	Total Length of Vehicle at Centerline	4574	4107	-467
2	Rear Surface of Vehicle (RSOV) to Front of Engine	3973	3716	-257
3	RSOV to Firewall	3639	3617	-22
4	RSOV to Upper Leading Edge of Right Door	3214	3214	0
5	RSOV to Upper Leading Edge of Left Door	3212	3211	-1
6	RSOV to Lower Leading Edge of Right Door	3208	3210	2
7	RSOV to Lower Leading Edge of Left Door	3209	3209	0
8	RSOV to Upper Trailing Edge of Right Door	2107	2106	-1
9	RSOV to Upper Trailing Edge of Left Door	2105	2104	-1
10	RSOV to Lower Trailing Edge of Right Door	2117	2121	3
11	RSOV to Lower Trailing Edge of Left Door	2117	2117	0
12	RSOV to Bottom of “A” Post of Right Side	3395	3395	-1
13	RSOV to Bottom of “A” Post of Left Side	3393	3392	0
14	RSOV to Firewall, Right Side	3701	3698	-3
15	RSOV to Firewall, Left Side	3700	3688	-12
16	RSOV to Steering Column	2716	2781	66
17	Center of Steering Column to “A” Post	282	291	9
18	Center of Steering Column to Headliner	392	415	22
19	RSOV to Right Side of Front Bumper	4501	4051	-450
20	RSOV to Left Side of Front Bumper	4499	3955	-543
21	Length of Engine Block	288	288	0
RD	RSOV to Right Side of Dash Panel	2946	2947	2
CD	RSOV to Center of Dash Panel	2907	2911	4
LD	RSOV to Left Side of Dash Panel	2946	2948	2

*UR= Unrecoverable data point
All Dimensions in mm

DATA SHEET NO. 13
ACCIDENT INVESTIGATION DIVISION DATA

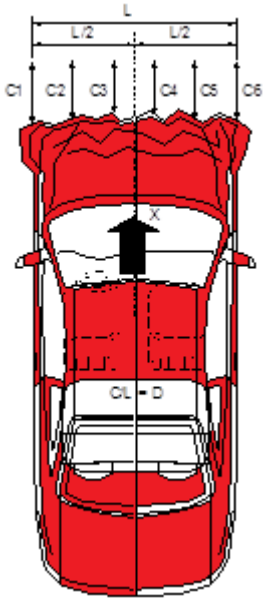
Test Vehicle:	2017 Hyundai Elantra four door sedan	NHTSA No.:	M20174200
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	6/22/2016

VEHICLE INFORMATION

VIN:	KMHD74LF3HU123487	Wheelbase (mm):	2,698
Vehicle Size Category:	Passenger	Test Weight (kg):	1480

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):	56.15
Velocity Change (km/h):	56.15
Time of Separation (ms):	110



CRUSH PROFILE

Collision Deformation Classification:	12FDEW3
Midpoint of Damage:	Vehicle Centerline
Damage Region Length (mm):	1345
Impact Mode:	Frontal

No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
C1	Crush Zone 1 at Left Side	mm	4351	3977	374
C2	Crush Zone 2 at Left Side	mm	4500	4049	451
C3	Crush Zone 3 at Left Side	mm	4559	4108	451
C4	Crush Zone 4 at Right Side	mm	4559	4113	446
C5	Crush Zone 5 at Right Side	mm	4502	4074	428
C6	Crush Zone 6 at Right Side	mm	4354	3969	385
L	C1 to C6	mm	1345	1373	-28

DATA SHEET NO. 14
VEHICLE INTRUSION MEASUREMENTS

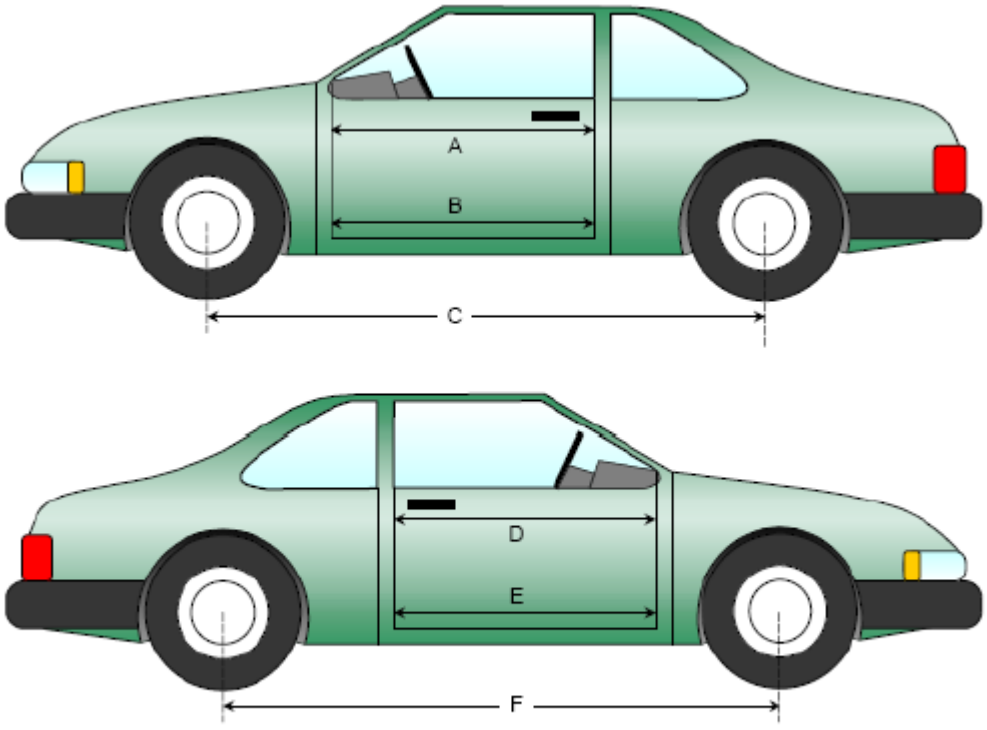
Test Vehicle: 2017 Hyundai Elantra four door sedan
NHTSA No.: M20174200
Test Program: NCAP Frontal Barrier Impact Test
Test Date: 6/22/2016

DOOR OPENING WIDTH

Item	Description	Units	Pre-Test	Post-Test	Difference
A	Left Side Upper	mm	1023	1023	0
B	Left Side Lower	mm	916	917	1
D	Right Side Upper	mm	1021	1023	2
E	Right Side Lower	mm	912	913	1

WHEELBASE MEASUREMENTS

Item	Description	Units	Pre-Test	Post-Test	Difference
C	Left Side Wheelbase	mm	2698	2640	-58
F	Right Side Wheelbase	mm	2698	2677	-21



Left & Right Side Views

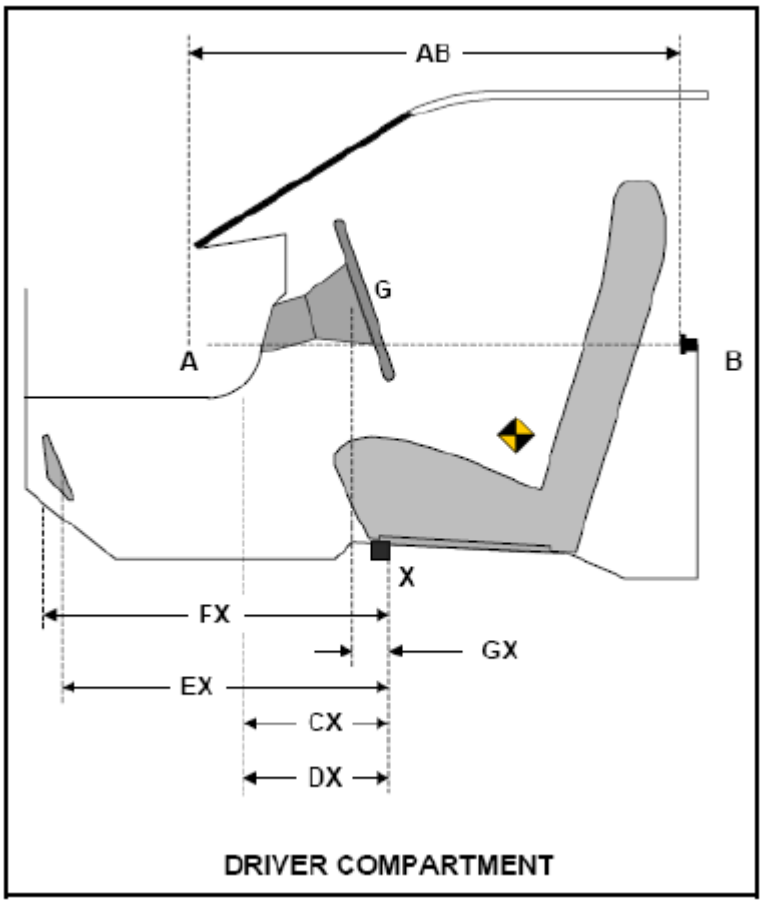
DATA SHEET NO.14 … (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2017 Hyundai Elantra four door sedan NHTSA No.: M20174200
Test Program: NCAP Frontal Barrier Impact Test Test Date: 6/22/2016

DRIVER COMPARTMENT INTRUSION

Item	Description	Units	Pre-Test	Post-Test	Difference
AB	Door Opening (Inside Window Jam)	mm	817	820	3
CX	Left Knee Bolster to X	mm	296	298	2
DX	Right Knee Bolster to X	mm	276	284	8
EX	Brake Pedal to X	mm	576	542	-34
FX	Foot Rest to X	mm	652	642	-10
GX	Center of Steering Column Wheel Hub to X	mm	70	134	64

X = Front of Seat Track (Stationary)



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

Test Vehicle: 2017 Hyundai Elantra four door sedan NHTSA No.: M20174200
Test Program: NCAP Frontal Barrier Impact Test Test Date: 6/22/2016

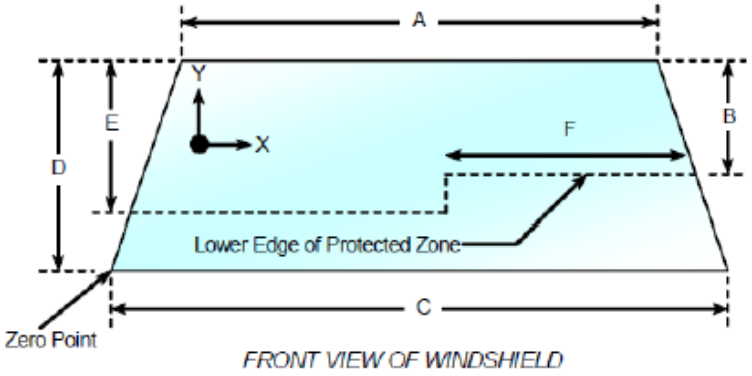
Windshield Mounting Details: A 0.8 mm trim surrounds the top and side of windshield while a plastic shroud is on the bottom.

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	2196	2196	100.0%
Right Side	2196	2196	100.0%
Total	4392	4392	100.0%



FRONT VIEW OF WINDSHIELD

Item	Units	Value
A	mm	1205
B	mm	474
C	mm	1455
D	mm	866
E	mm	538
F	mm	475

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:	2017 Hyundai Elantra four door sedan	NHTSA No.:	M20174200
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	6/22/2016

FMVSS 301 FUEL SYSTEM INTEGRITY POST IMPACT DATA

Temperature at Time of Impact: 21 ° C Test Time: 12:02 PM

STODDARD SOLVENT SPILLAGE MEASUREMENTS

A. From impact until vehicle motion ceases: 0 oz.
(Maximum allowable is 1 oz.)

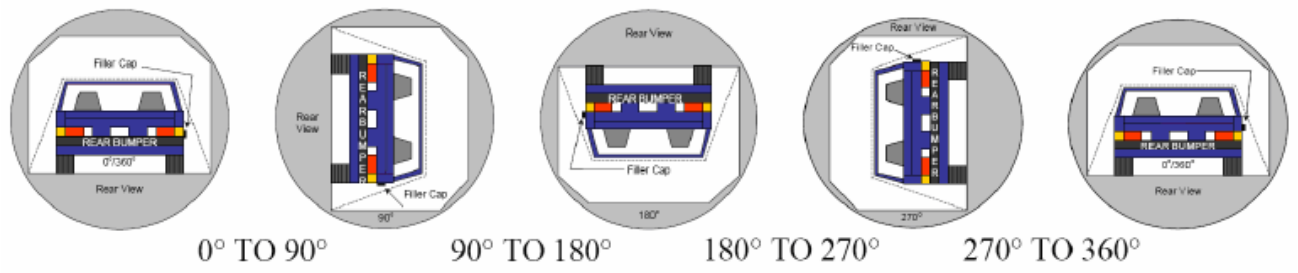
B. For the 5-minute period after motion ceases: 0 oz.
(Maximum allowable is 5 oz.)

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:	2017 Hyundai Elantra four door sedan	NHTSA No.:	M20174200
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	6/22/2016



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

SOLVENT COLLECTION TIME TABLE IN SECONDS

Test Phase	Rotation Time	Hold Time	Total Time
0° to 90°	72	300	372
90° to 180°	60	300	360
180° to 270°	61	300	361
270° to 360°	71	300	371

FMVSS 301 SPILLAGE TABLE

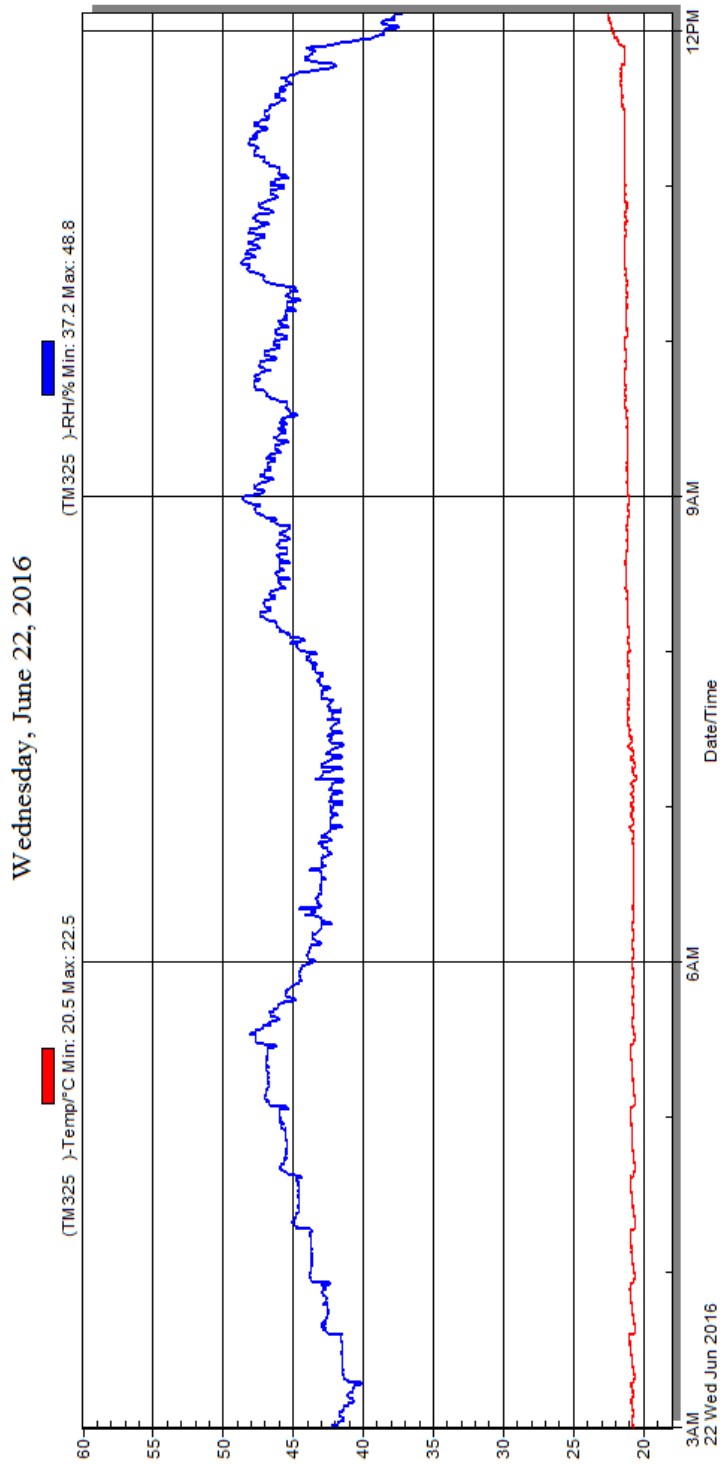
Test Phase	First 5 Minutes	Sixth Minute	Seventh Minute	Eighth Minute
0° to 90°	0	0	0	
90° to 180°	0	0	0	
180° to 270°	0	0	0	
270° to 360°	0	0	0	

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:	2017 Hyundai Elantra four door sedan	NHTSA No.:	M20174200
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	6/22/2016



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

APPENDIX A

PHOTOGRAPHS

TABLE OF PHOTOGRAPHS

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

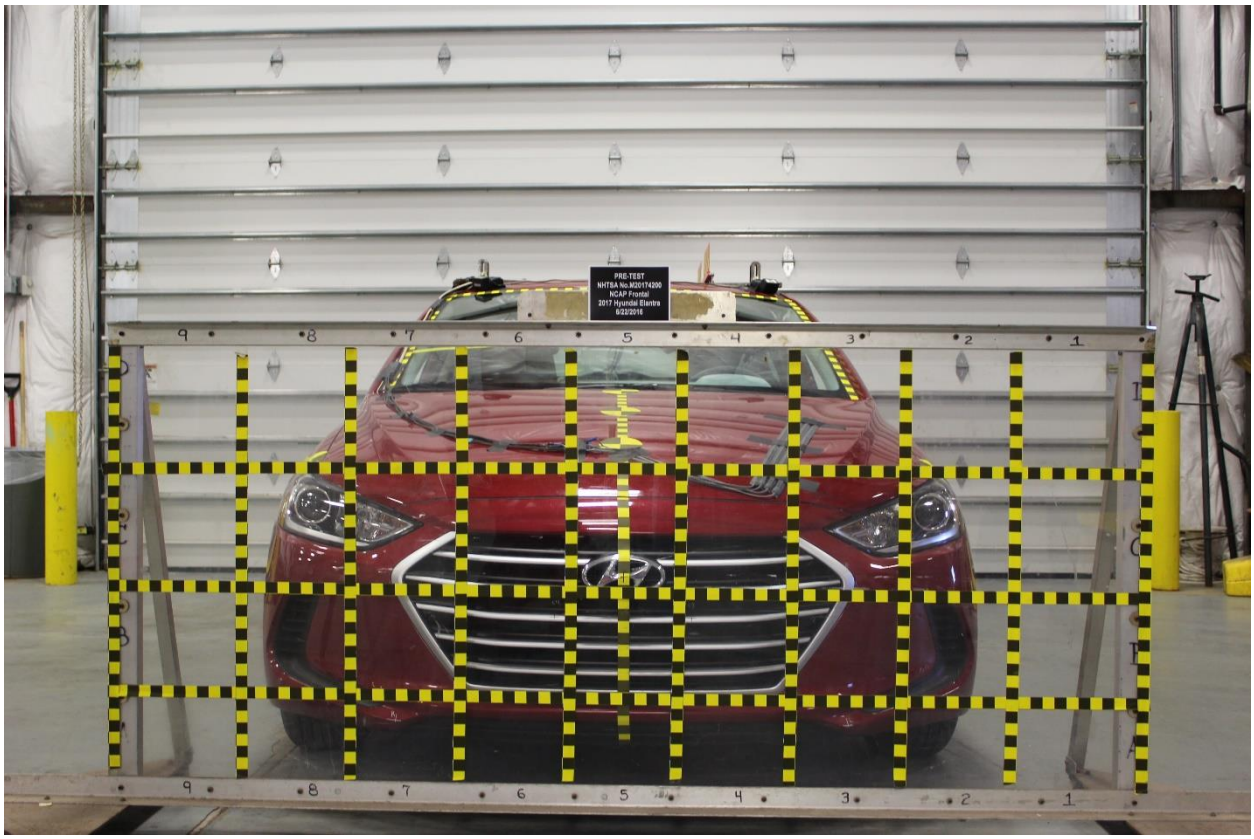


Figure A-1: Load Cell Location

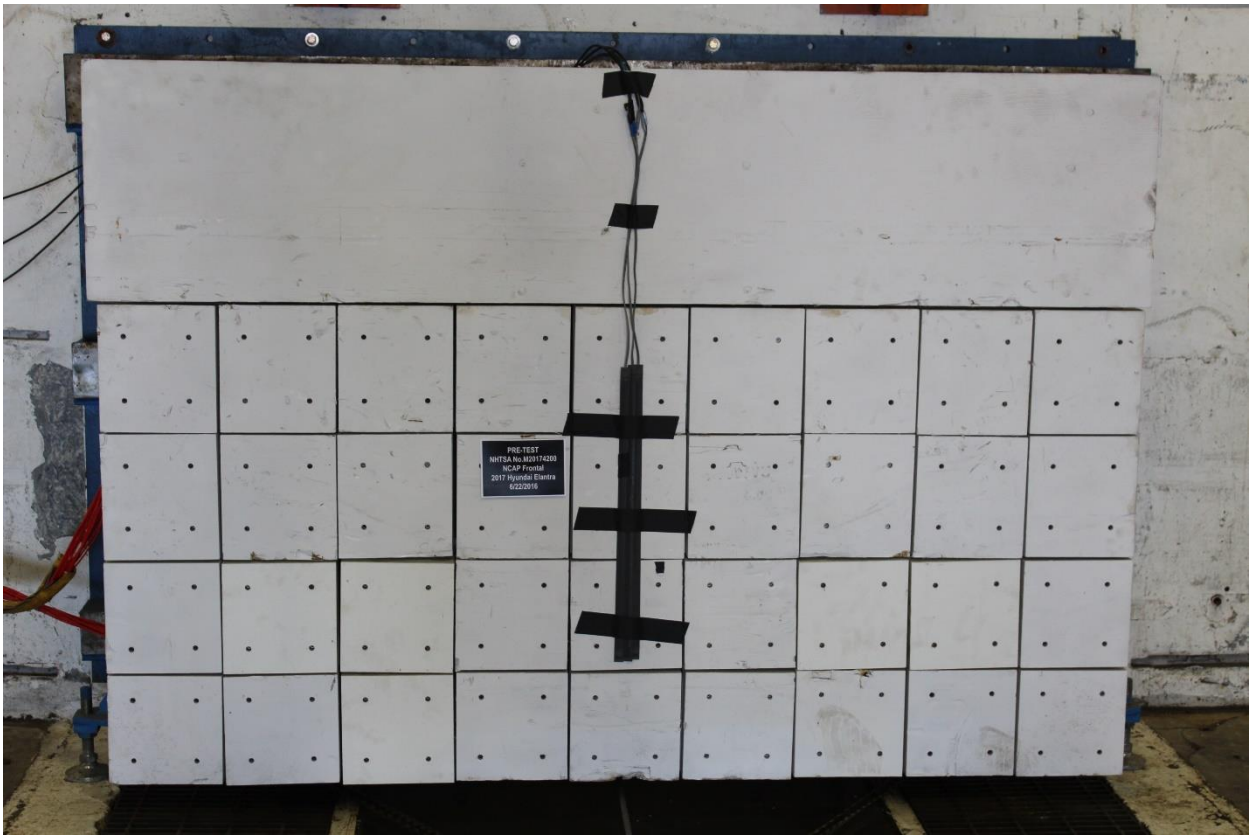


Figure A-2: Pre-Test Load Cell Wall

Figure A-3: Post-Test Load Cell Wall

Figure A-4: Manufacturer's Label

Figure A-5: Tire Placard

Figure A-6: 2017 Hyundai Elantra Frontal As Delivered

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

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

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

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

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

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

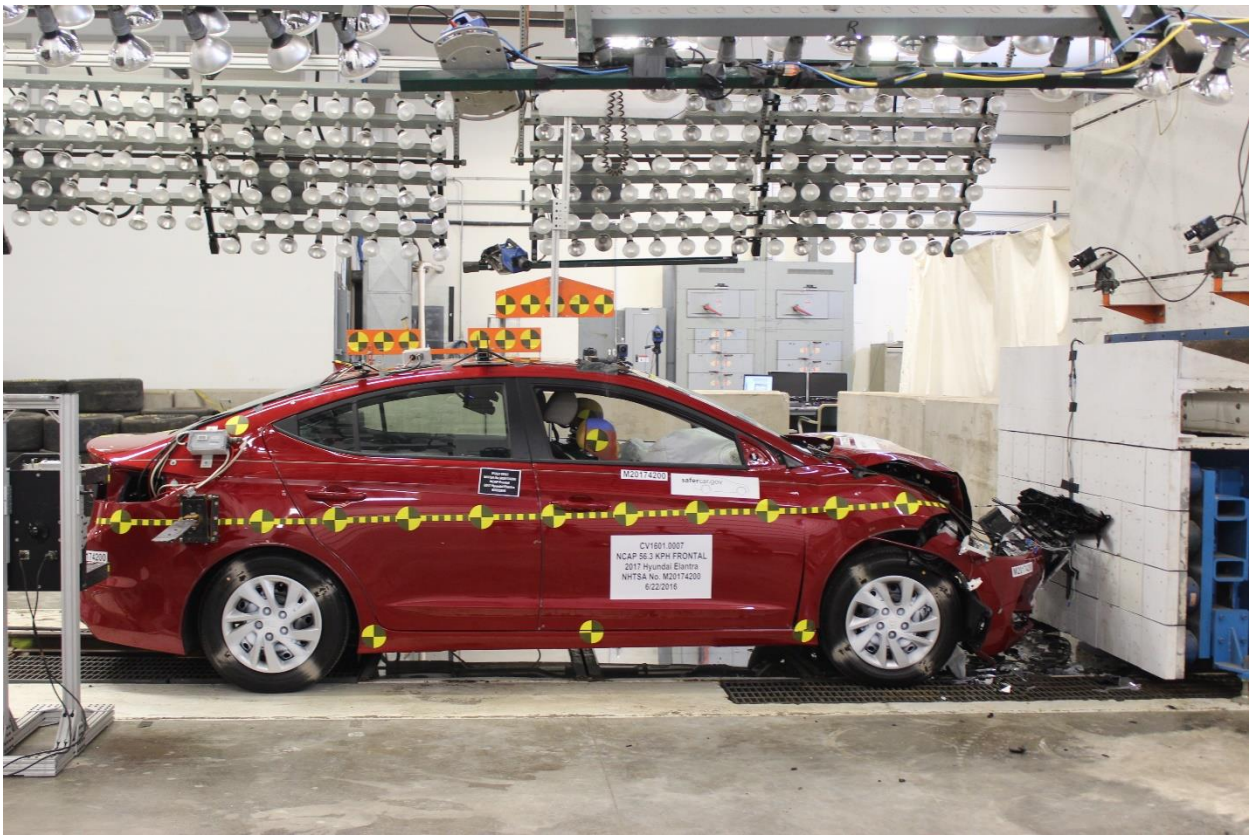


Figure A-13: Post-Test Right View of Test Vehicle

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

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

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

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

Figure A-18: Pre-Test Windshield View

Figure A-19: Post-Test Windshield View

Figure A-20: Pre-Test Engine Compartment View

Figure A-21: Post-Test Engine Compartment View

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

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

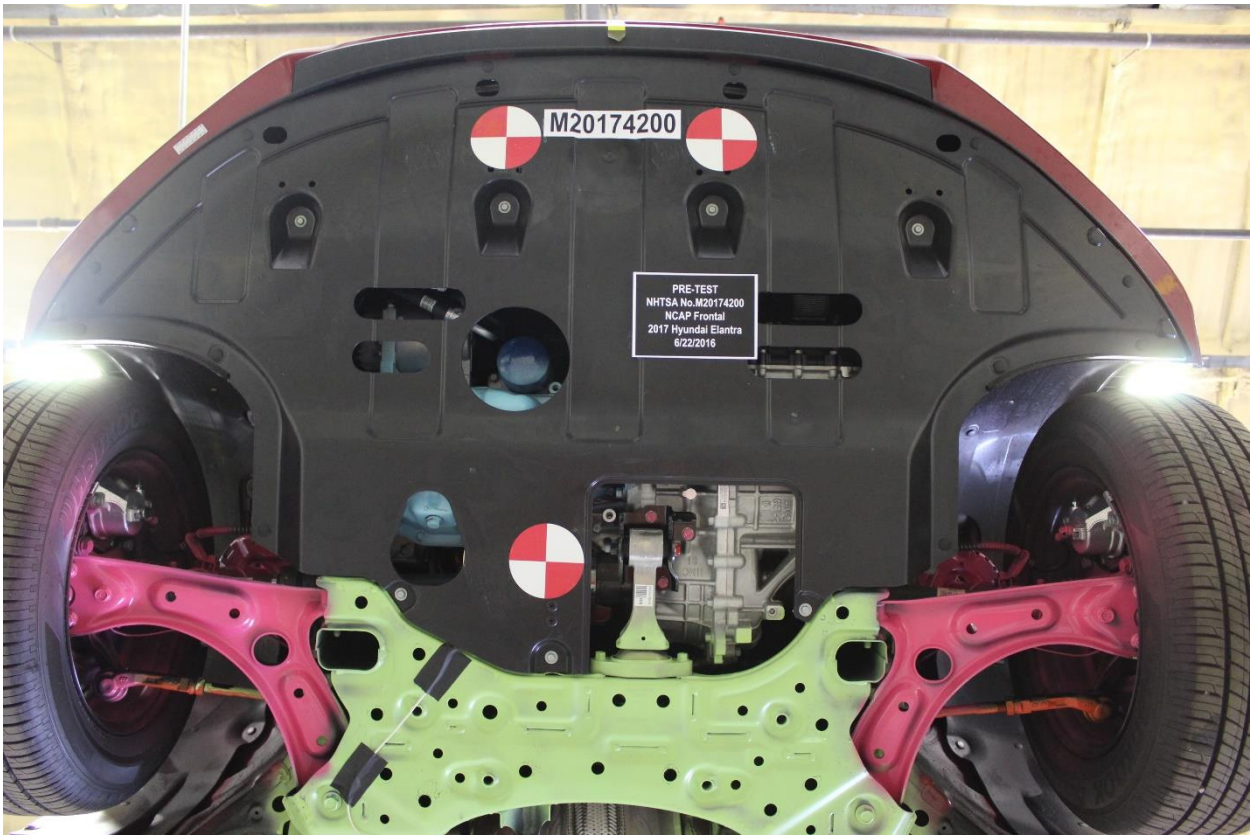


Figure A-24: Pre-Test Front Underbody View

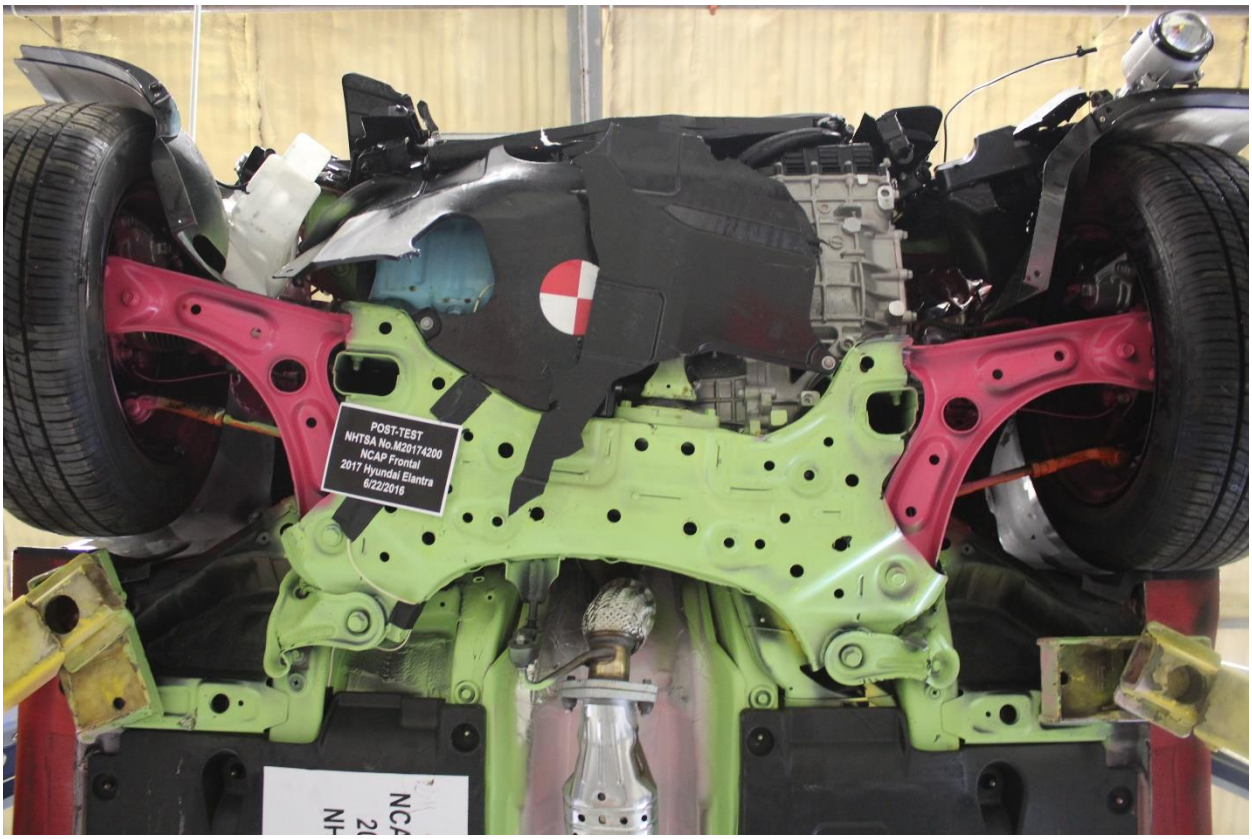


Figure A-25: Post-Test Front Underbody View

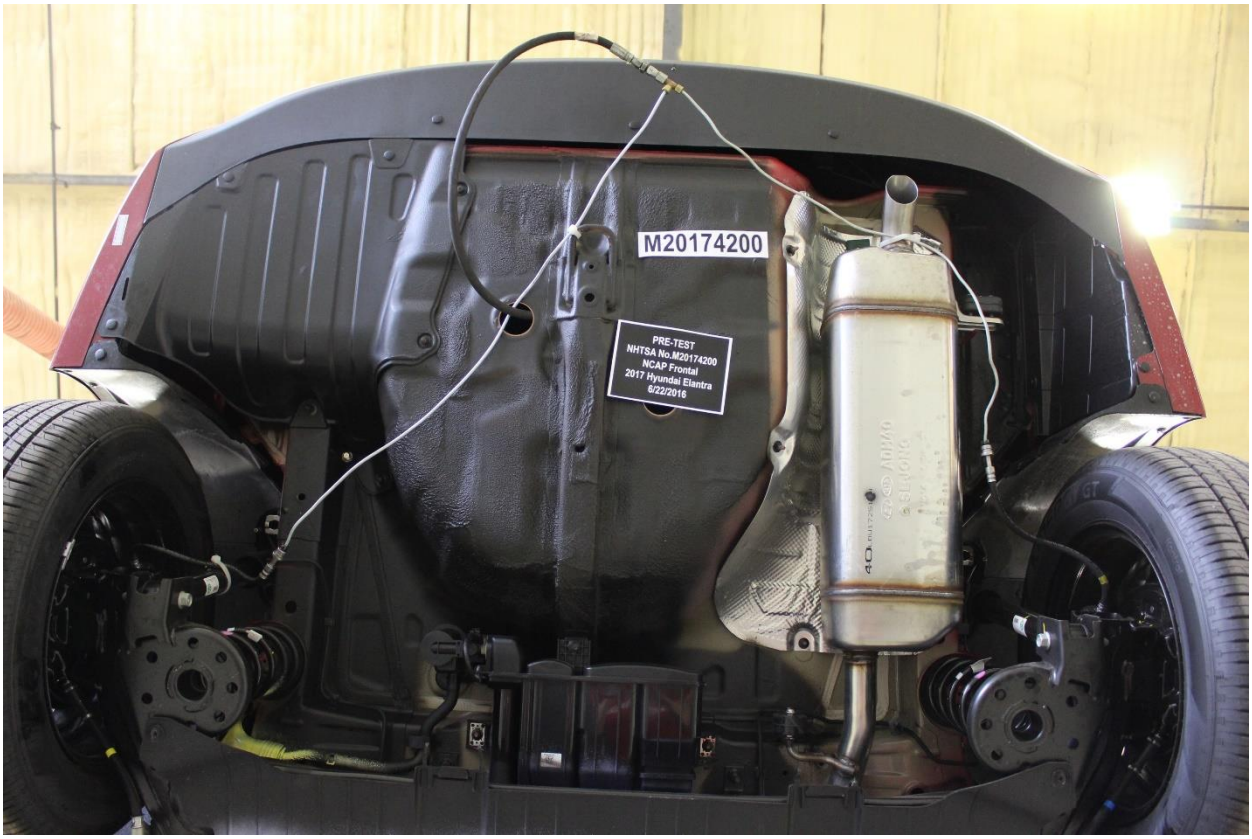


Figure A-26: Pre-Test Rear Underbody View

Figure A-27: Post-Test Rear Underbody View

Figure A-28: Pre-Test Dummy Cable Routing

Figure A-29: Post-Test Dummy Cable Routing

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

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

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

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

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

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

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

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

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

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

Figure A-40: Pre-Test Driver Dummy Feet

Figure A-41: Post-Test Driver Dummy Feet

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

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

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

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

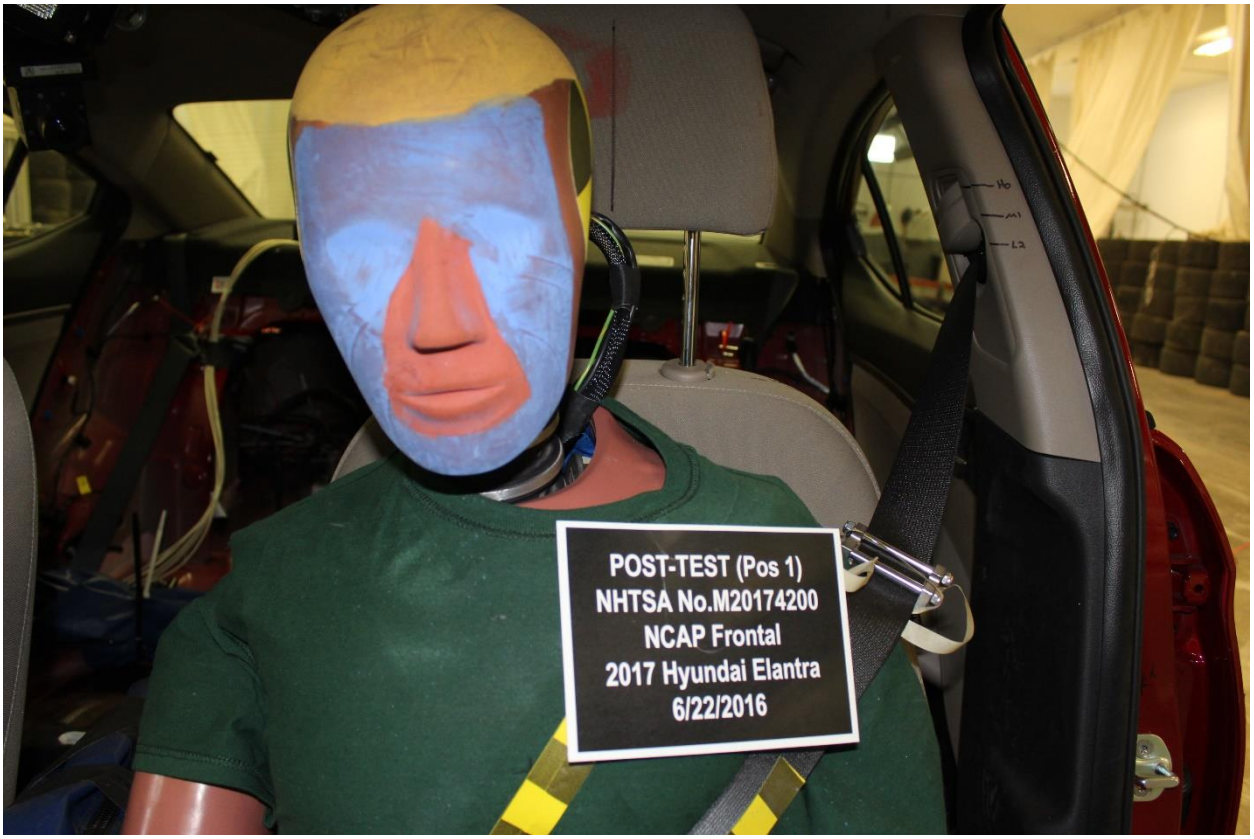


Figure A-46: Post-Test Driver Dummy Face

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

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

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

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

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

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

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

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

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

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

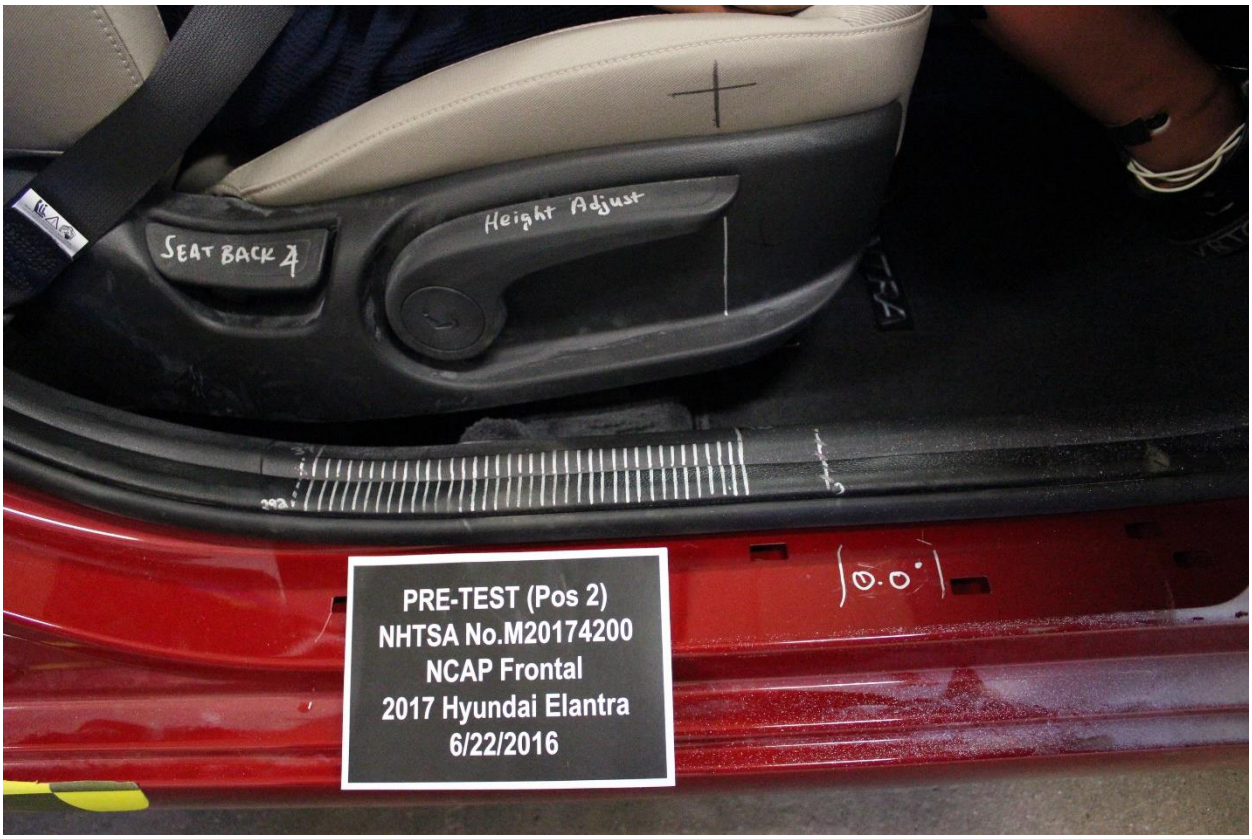


Figure A-57: Pre-Test Passenger's Seat Fore-Aft Markings

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

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

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

Figure A-61: Pre-Test Passenger Dummy Feet

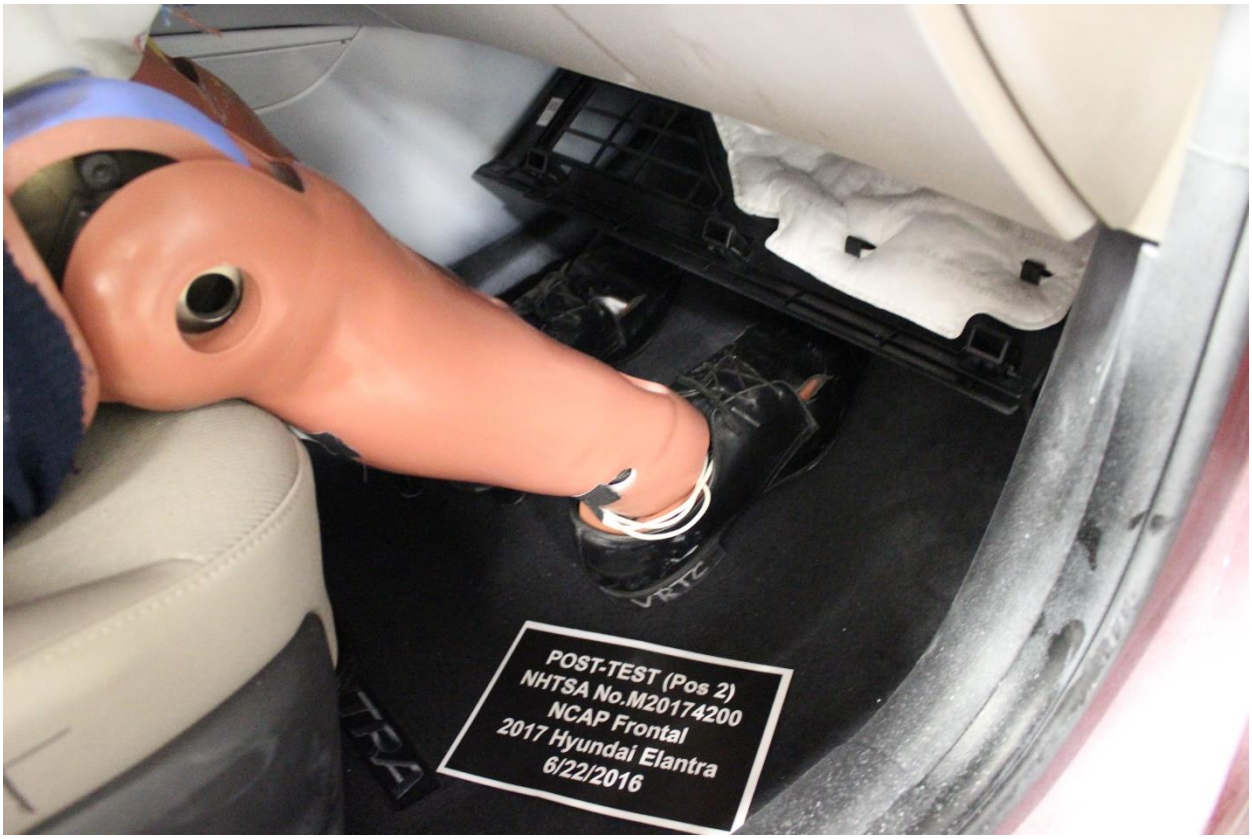


Figure A-62: Post-Test Passenger Dummy Feet

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

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

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

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

Figure A-67: Post-Test Passenger Dummy Face

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

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

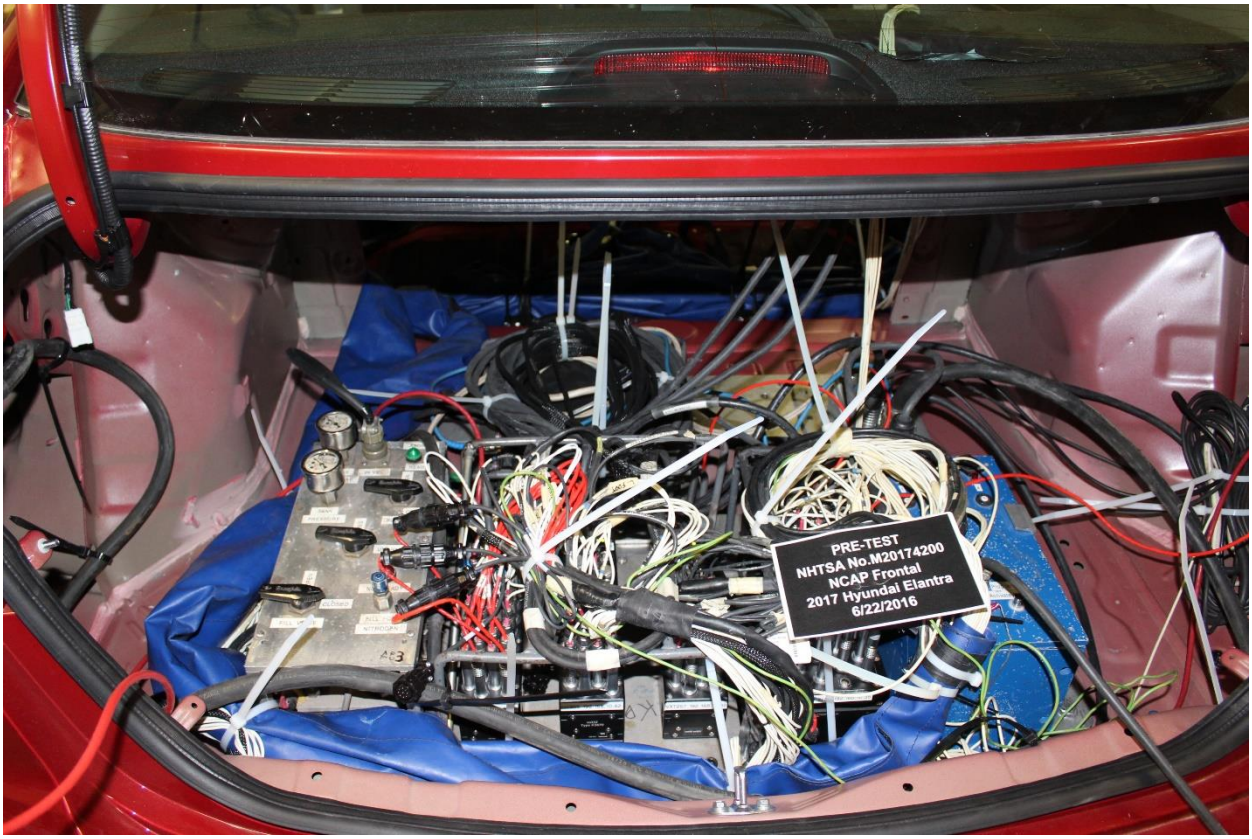


Figure A-70: Photograph of Ballast Installed in Vehicle

Photo Not Applicable

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

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

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

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

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

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

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

Figure A-78: 2017 Hyundai Elantra Frontal Impact Event

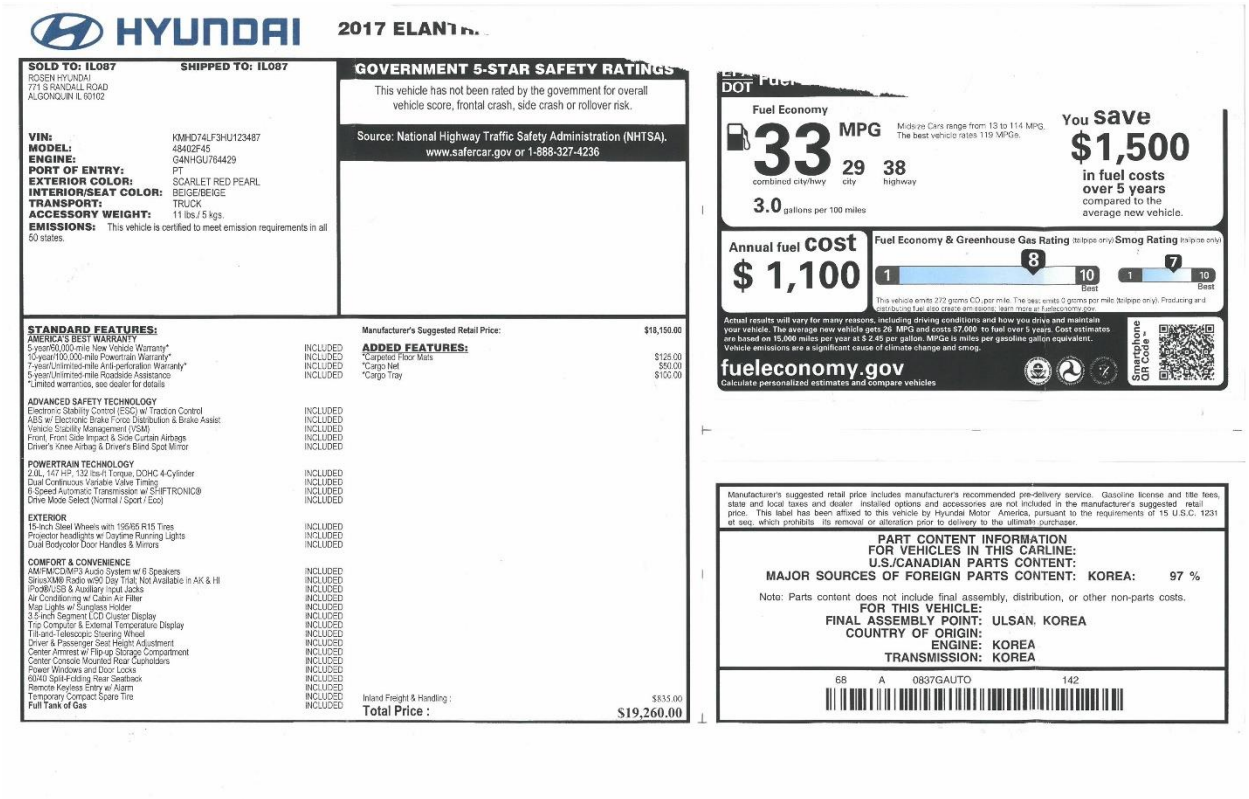
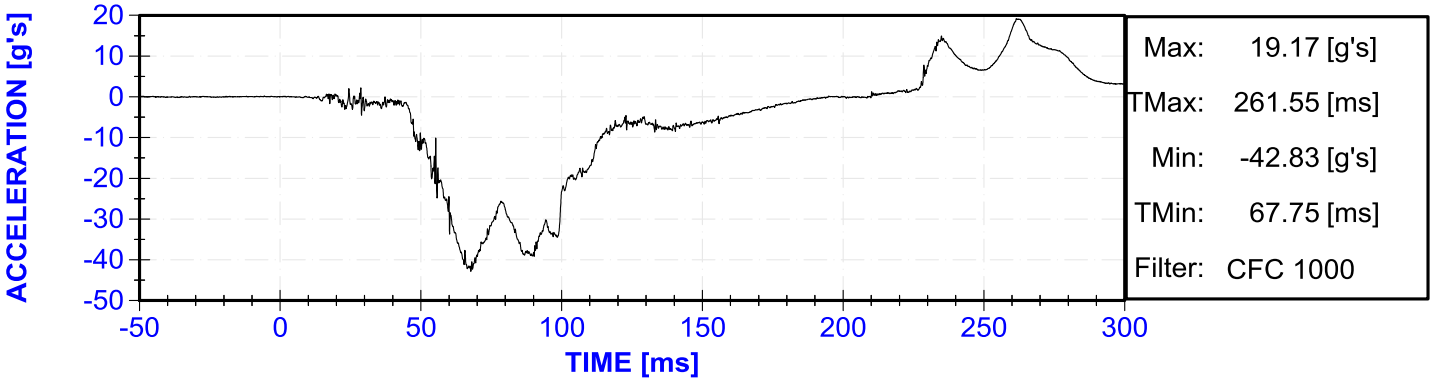


Figure A-79: Monroney Label Photograph

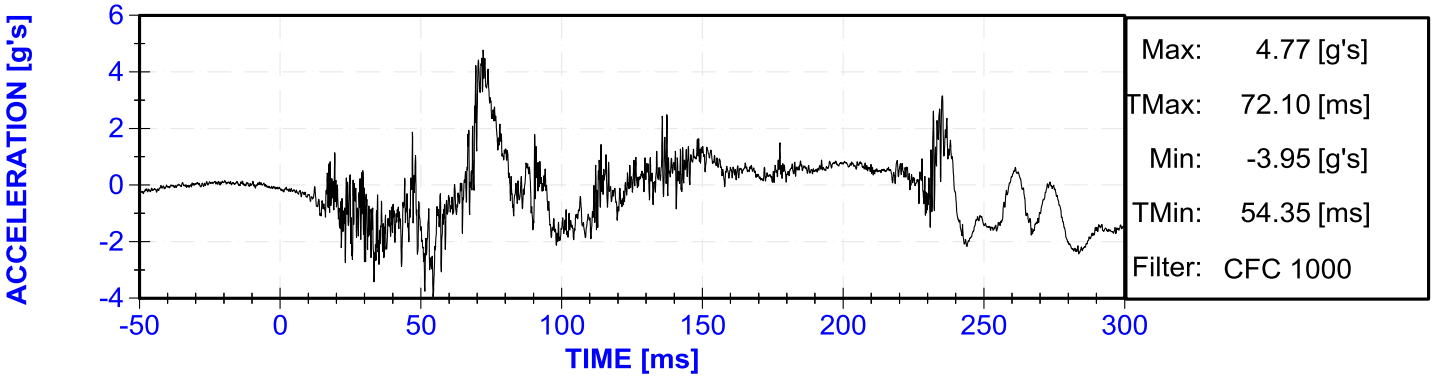
APPENDIX B
VEHICLE & DUMMY RESPONSE DATA TRACES

Table of Data Plots

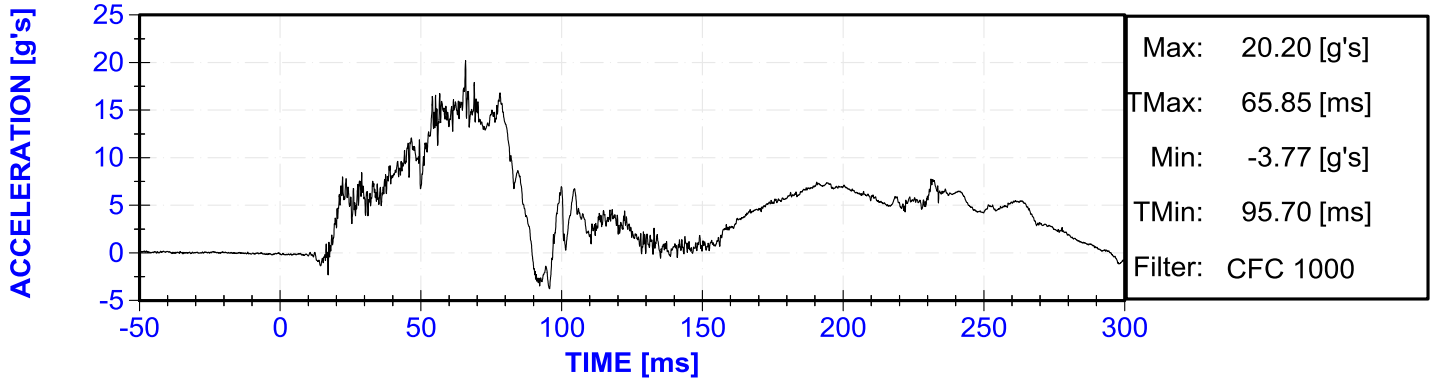
Driver Head X Acceleration vs. Time Primary



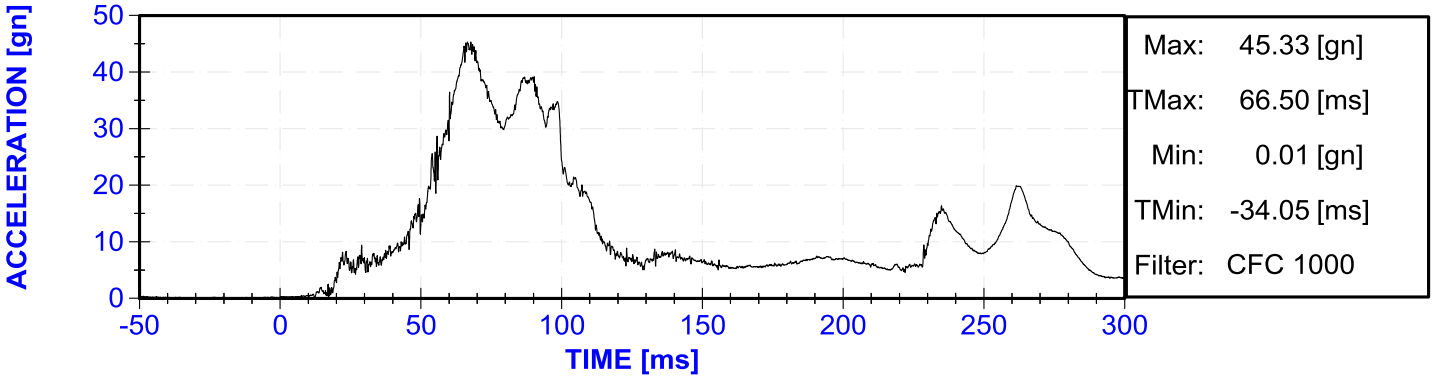
Driver Head Y Acceleration vs. Time Primary



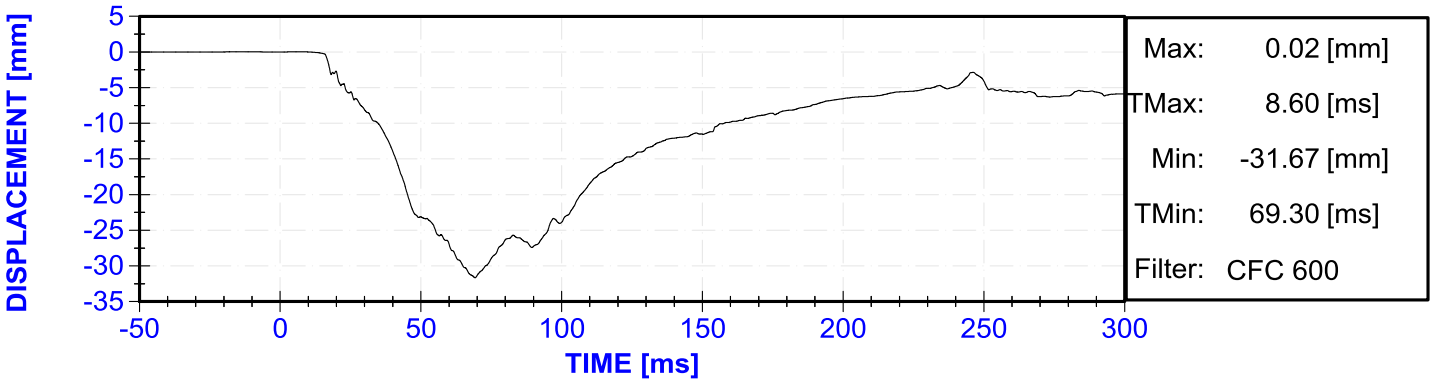
Driver Head Z Acceleration vs. Time Primary



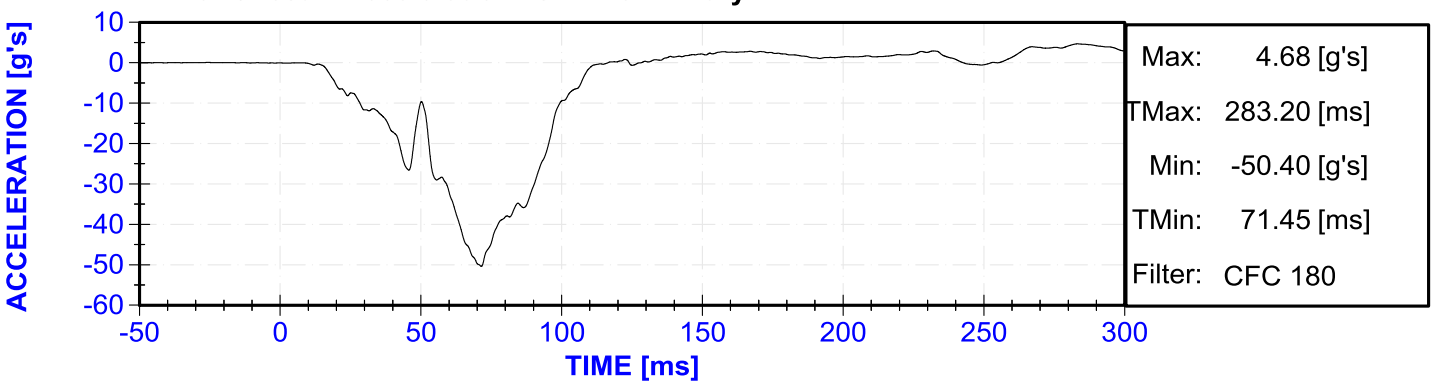
Driver Head Resultant Acceleration vs. Time Primary



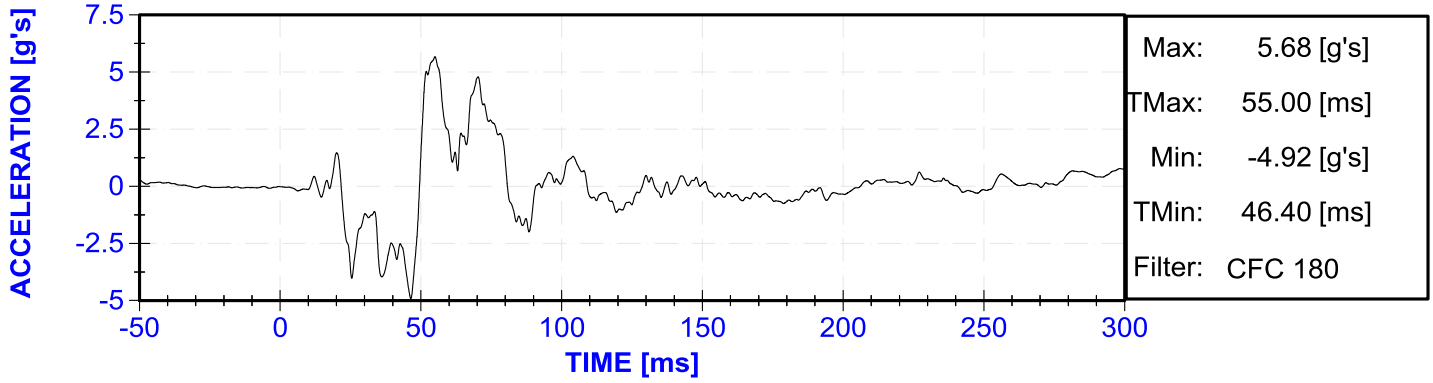
Driver Chest X Deflection vs. Time



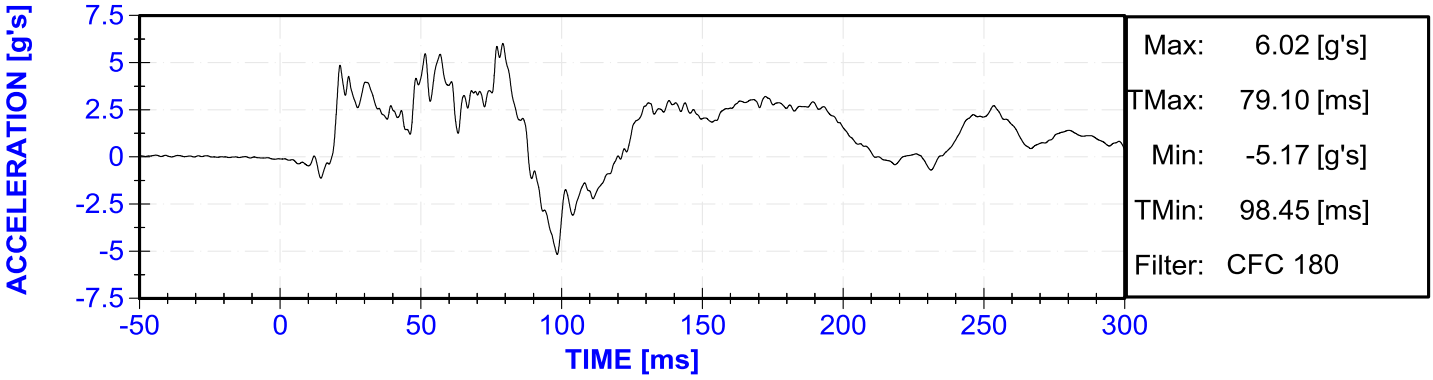
Driver Chest X Acceleration vs. Time Primary



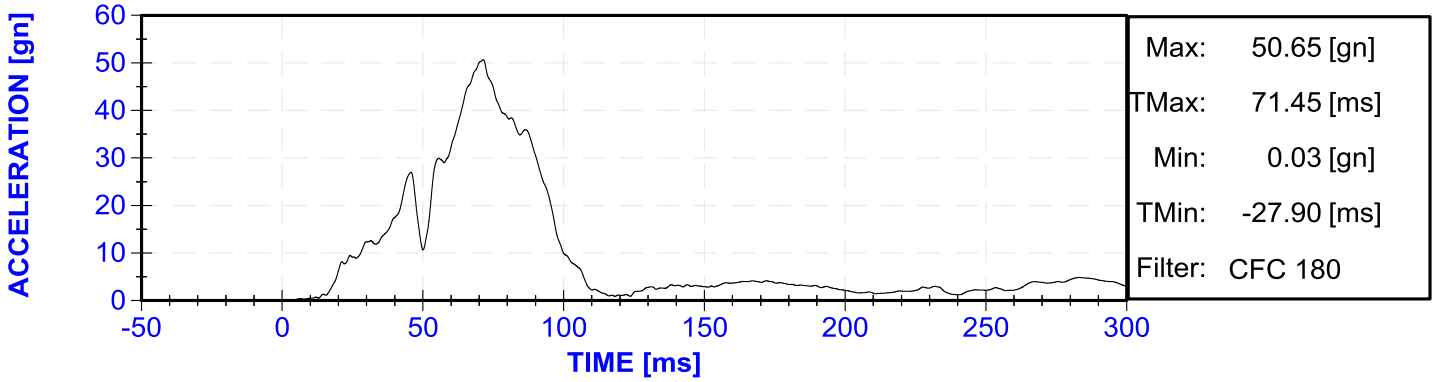
Driver Chest Y Acceleration vs. Time Primary



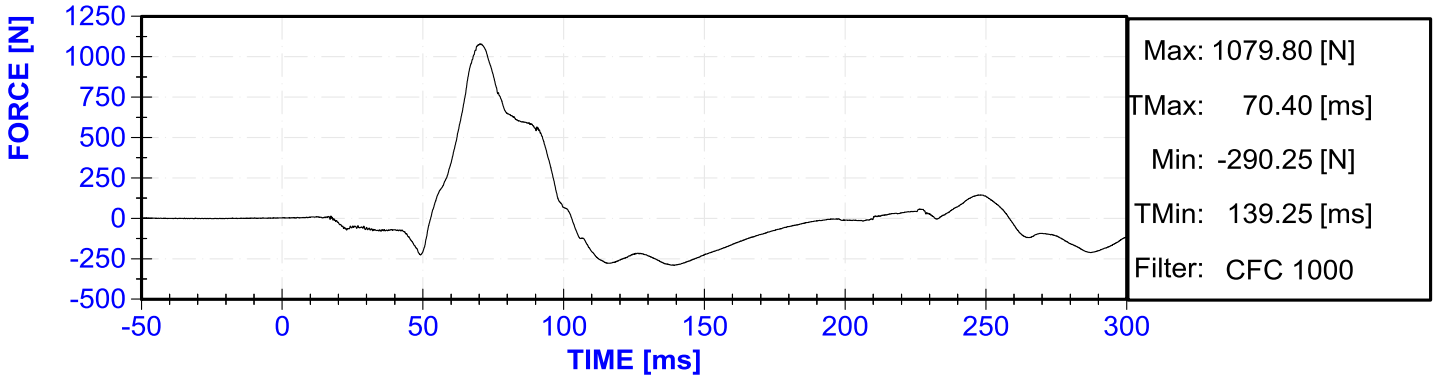
Driver Chest Z Acceleration vs. Time Primary



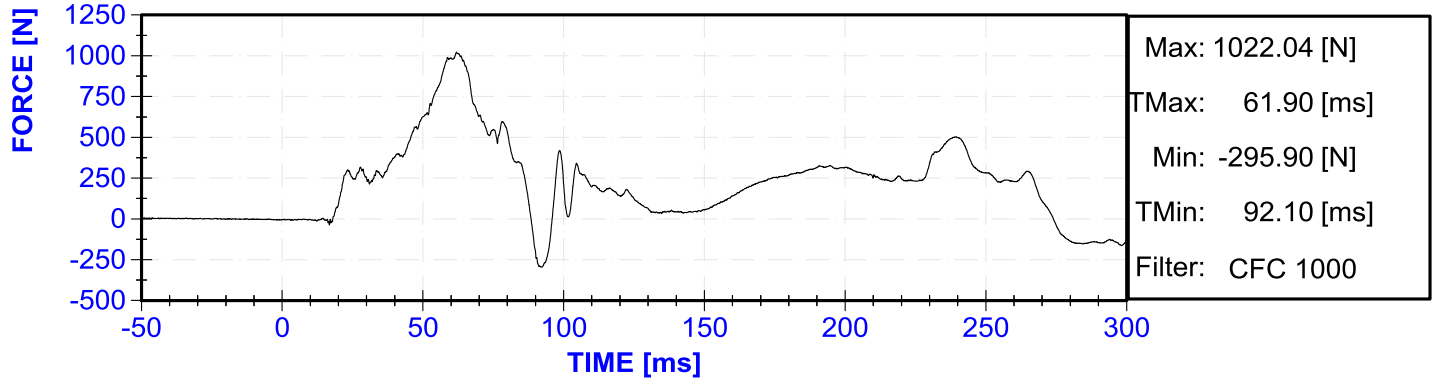
Driver Chest Resultant Acceleration vs. Time Primary



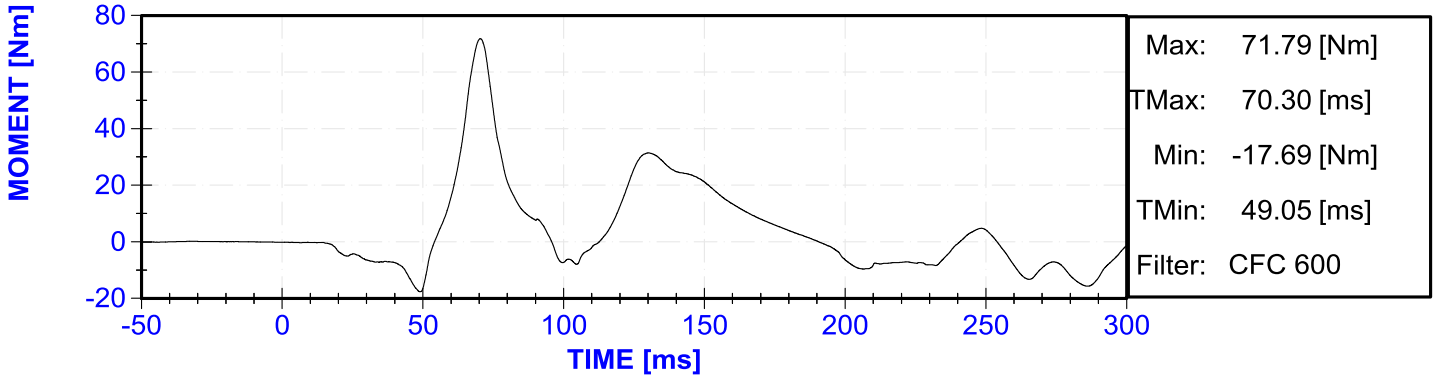
Driver Upper Neck Force X vs. Time Primary



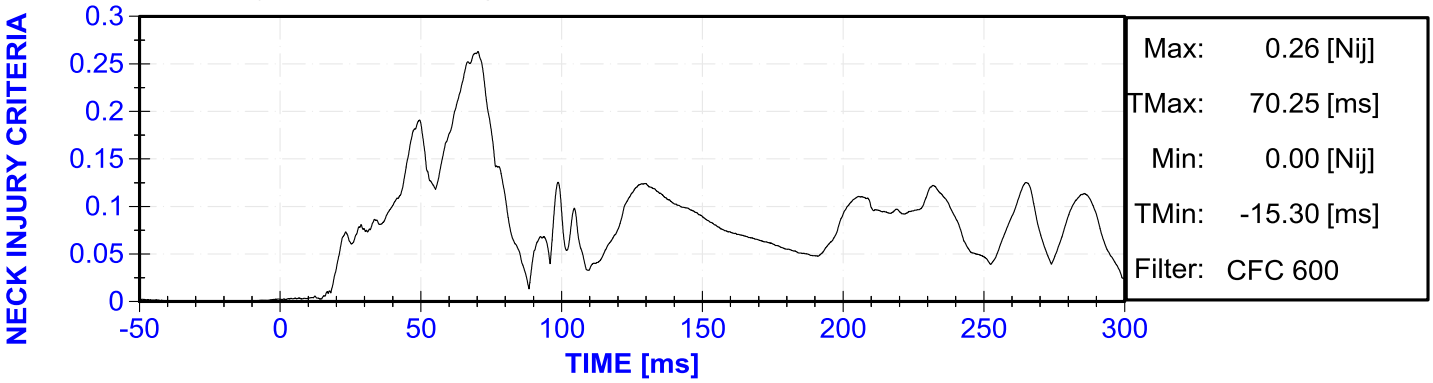
Driver Upper Neck Force Z vs. Time Primary



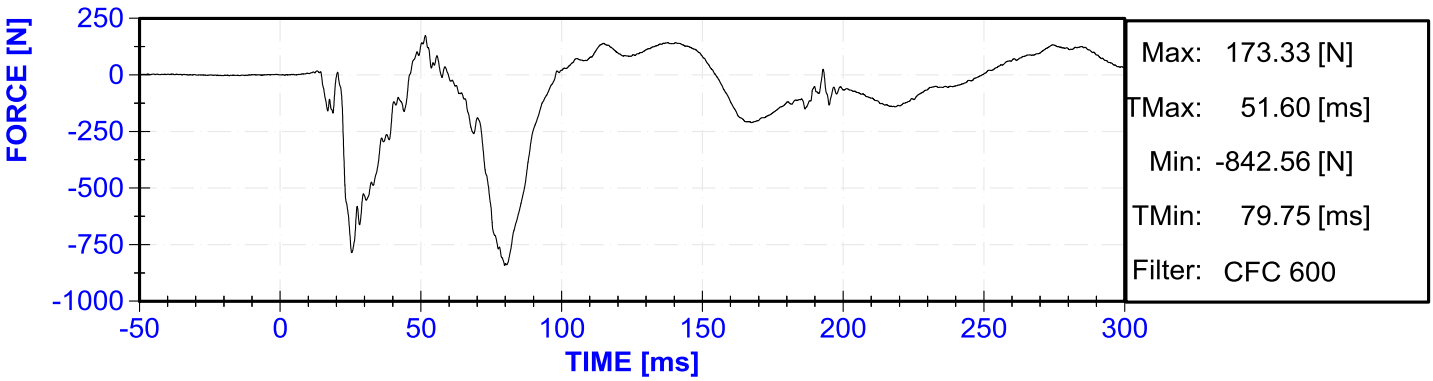
Driver Upper Neck Moment Y vs. Time Primary



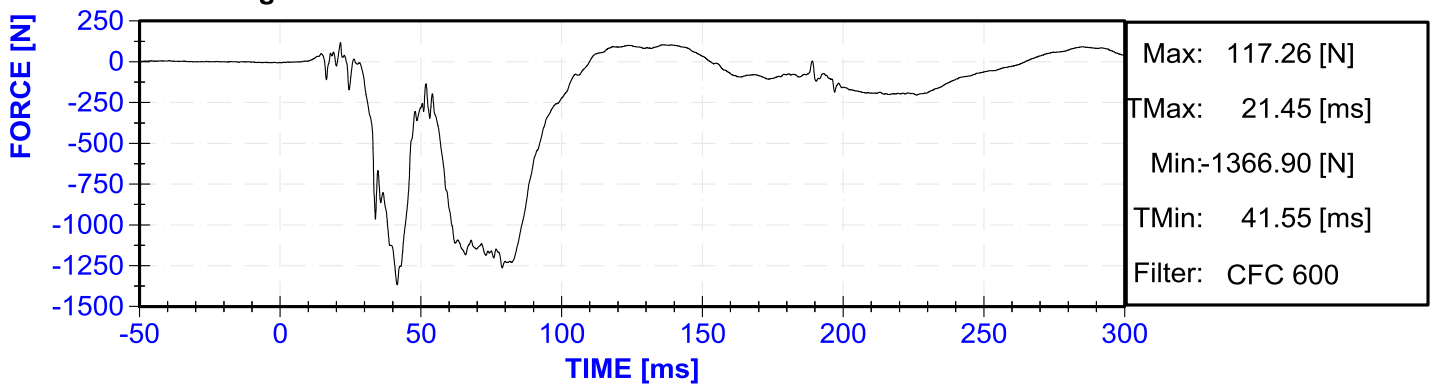
Driver Nij vs. Time Primary



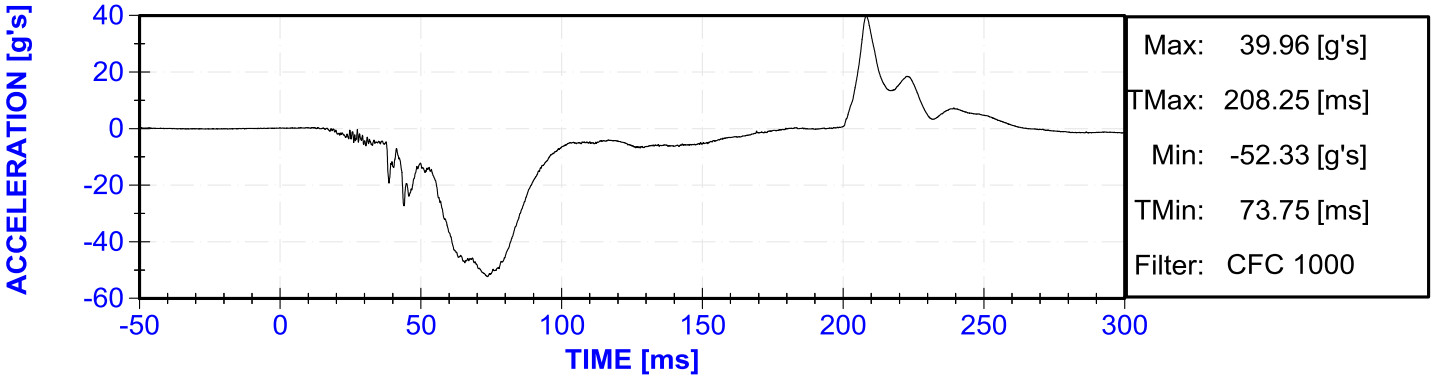
Driver Left Femur Force vs. Time



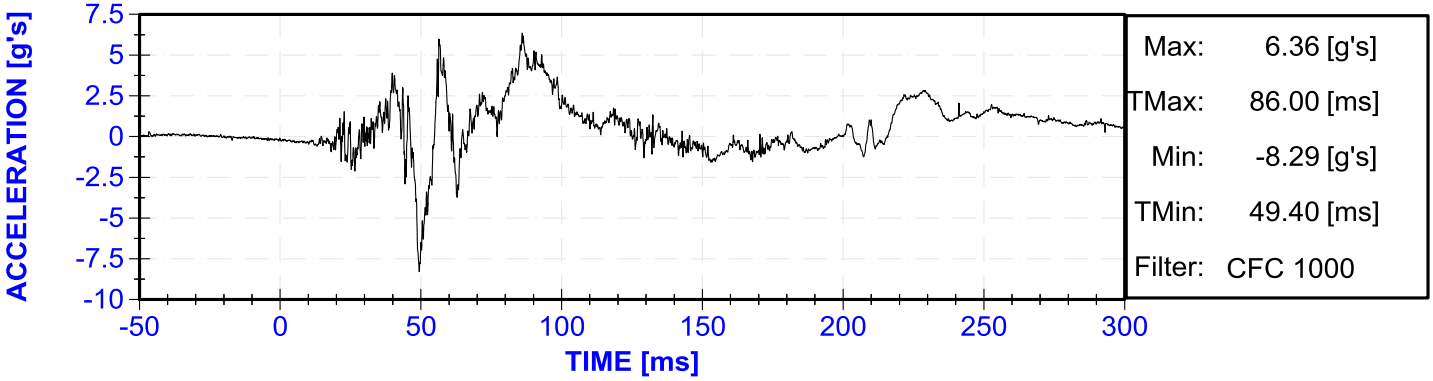
Driver Right Femur Force vs. Time



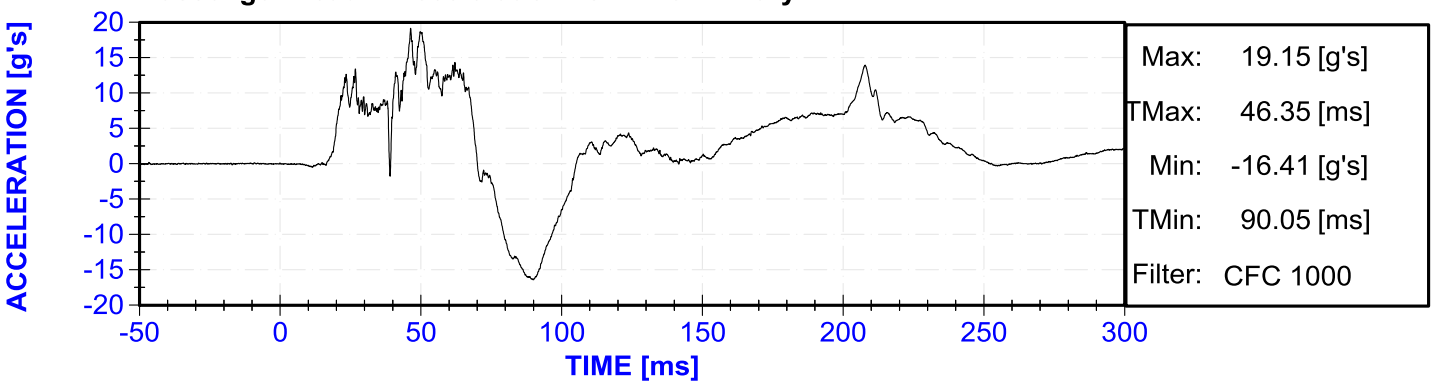
Passenger Head X Acceleration vs. Time Primary



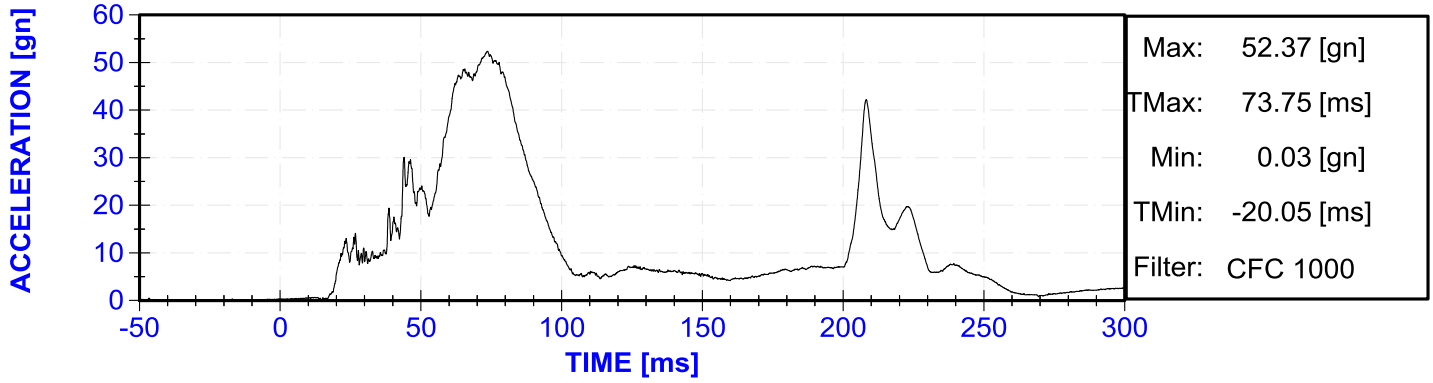
Passenger Head Y Acceleration vs. Time Primary



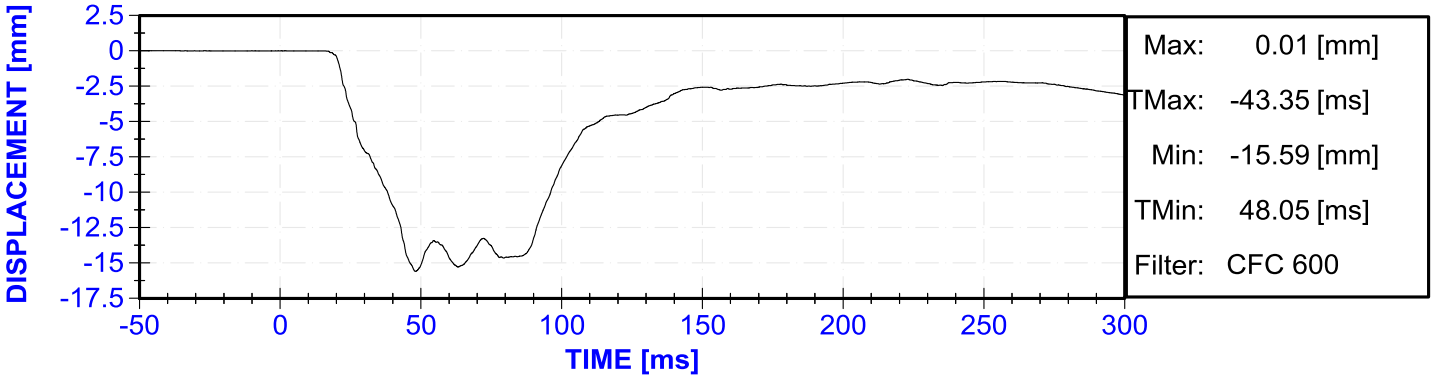
Passenger Head Z Acceleration vs. Time Primary



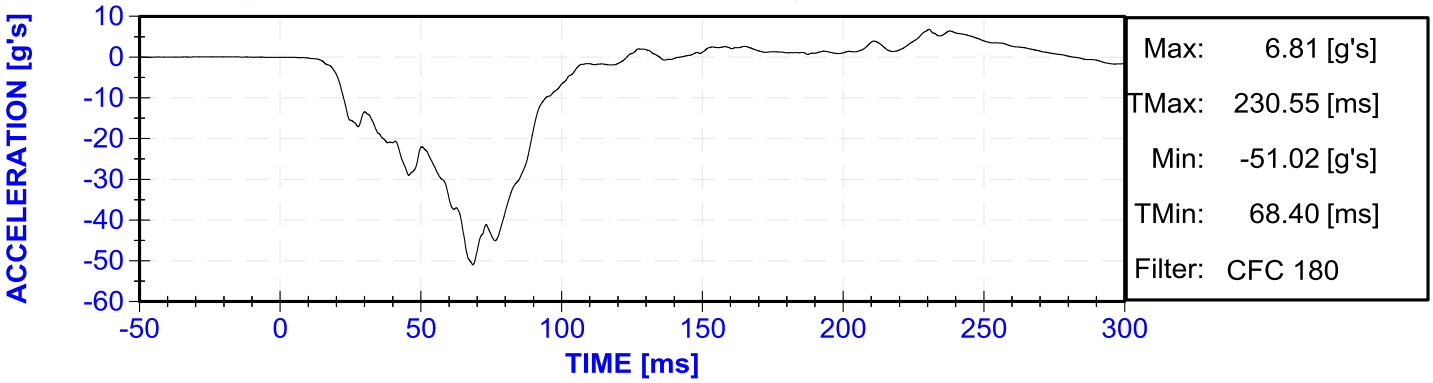
Passenger Head Resultant Acceleration vs. Time Primary



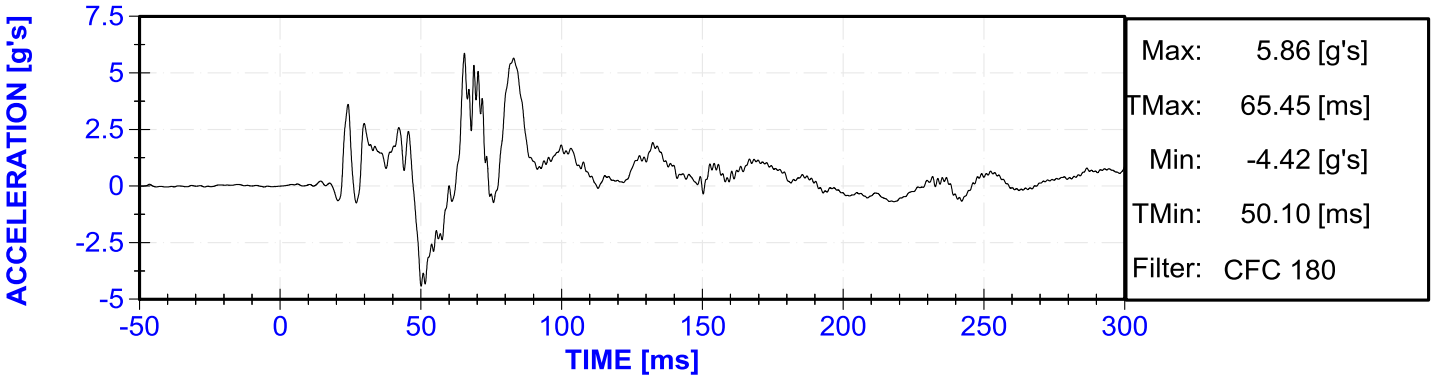
Passenger Chest X Deflection vs. Time



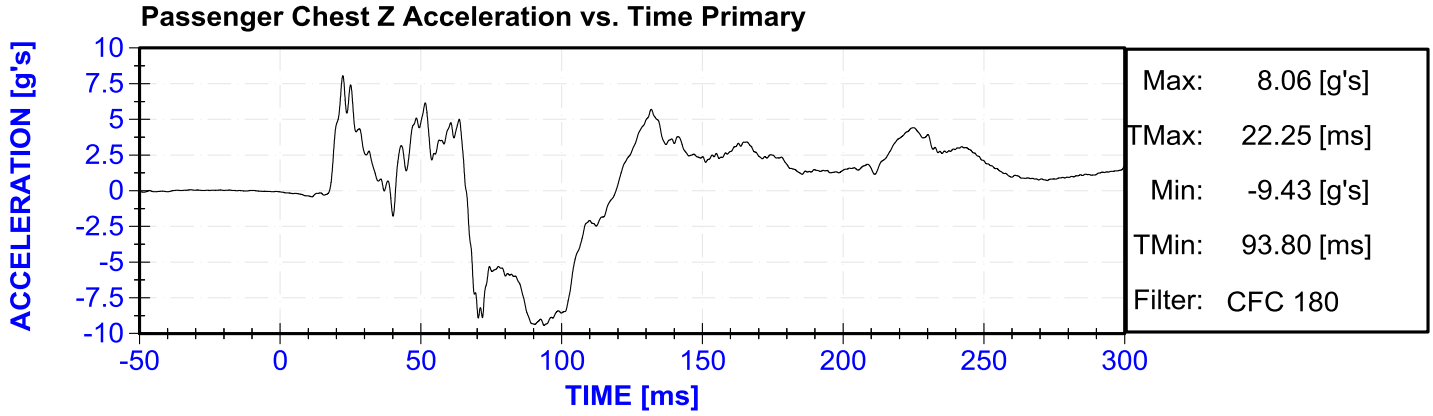
Passenger Chest X Acceleration vs. Time Primary



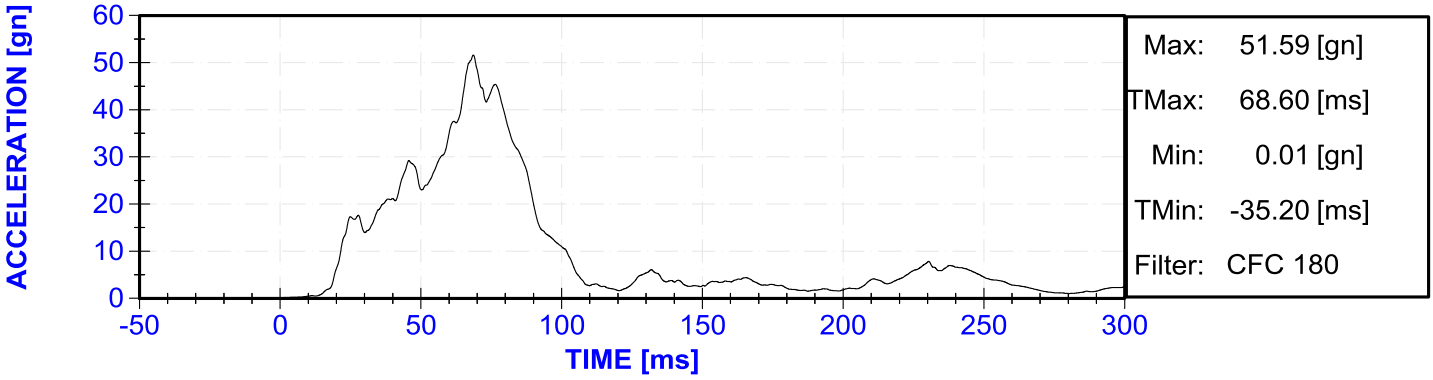
Passenger Chest Y Acceleration vs. Time Primary



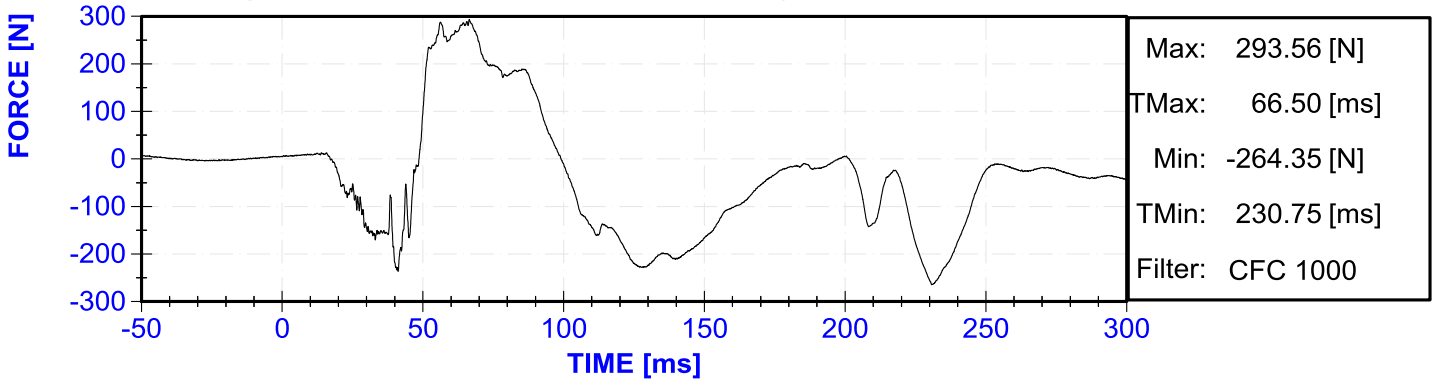
Passenger Chest Z Acceleration vs. Time Primary



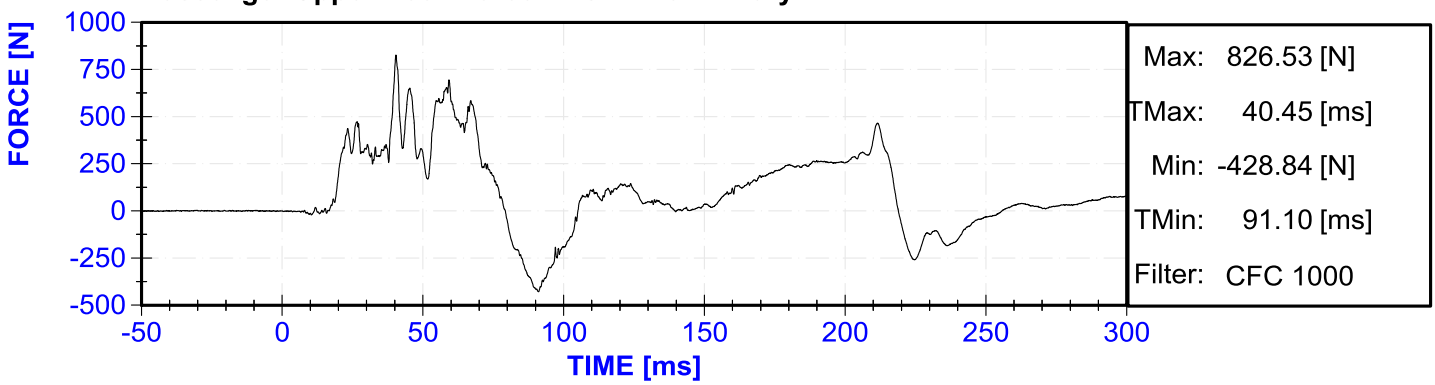
Passenger Chest Resultant Acceleration vs. Time Primary



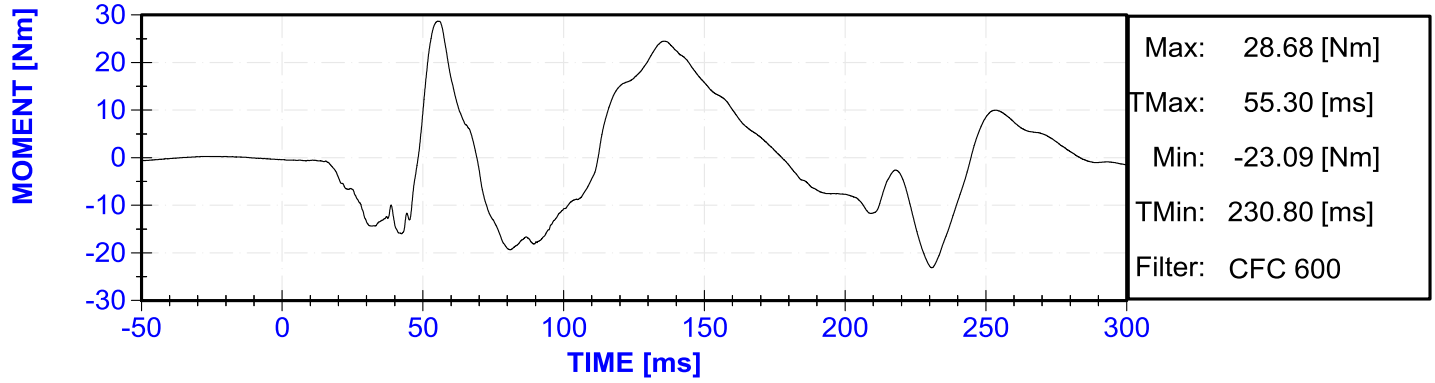
Passenger Upper Neck Force X vs. Time Primary



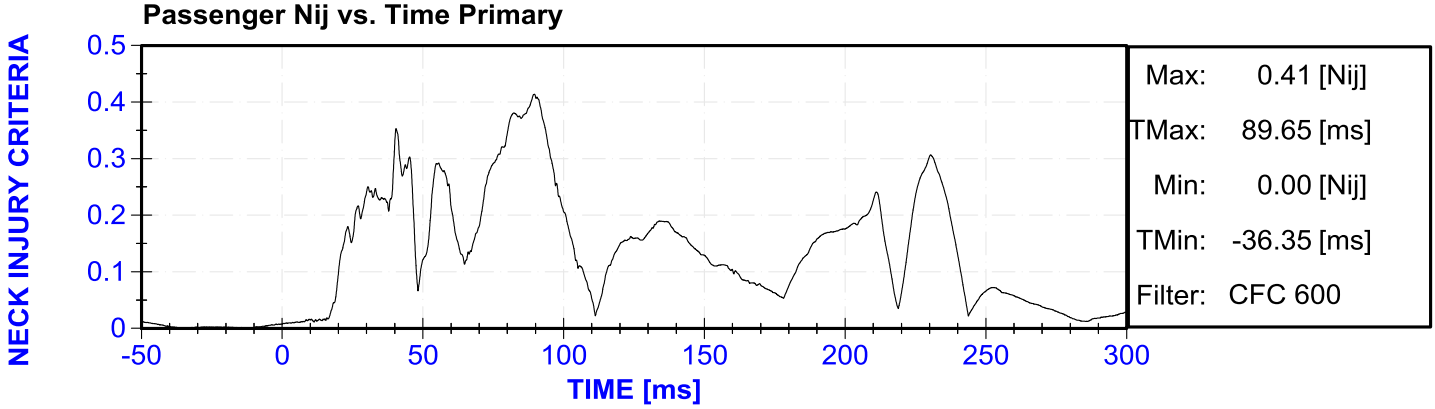
Passenger Upper Neck Force Z vs. Time Primary

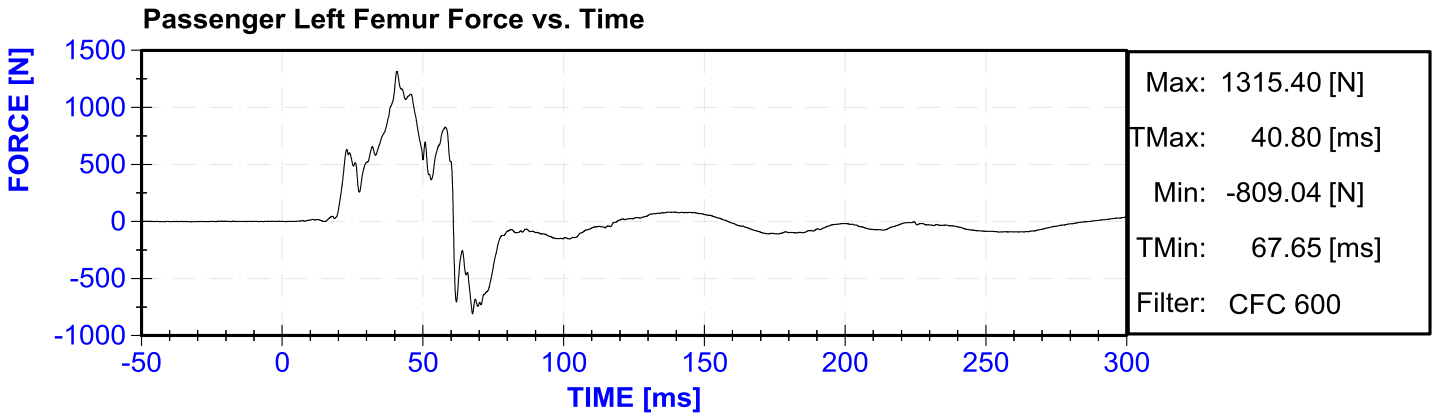


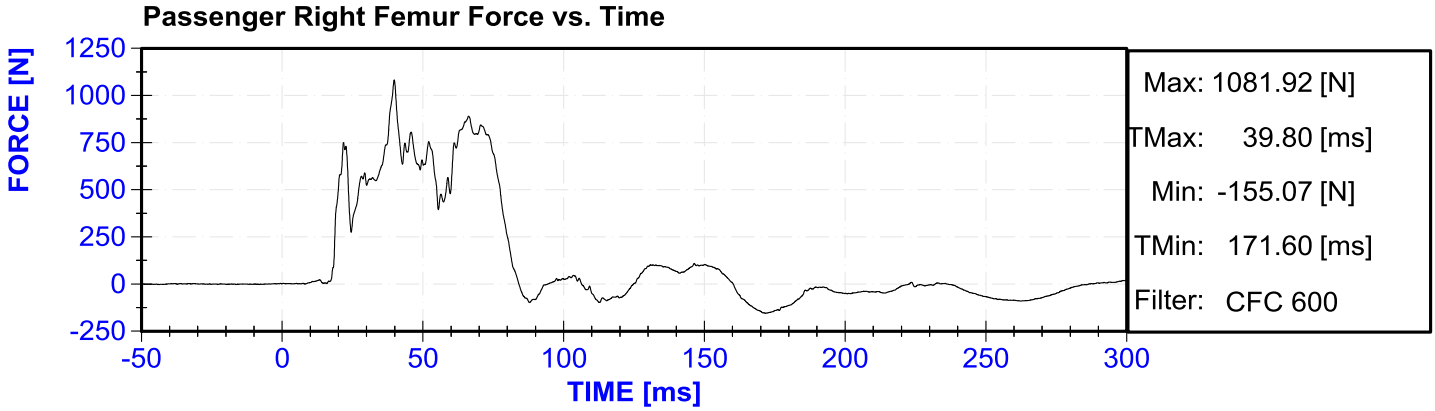
Passenger Upper Neck Moment Y vs. Time Primary



Passenger Nij vs. Time Primary




Passenger Left Femur Force vs. Time
FORCE [N]
1500
1000
500
0
-500
-1000
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 1315.40 [N]
TMax: 40.80 [ms]
Min: -809.04 [N]
TMin: 67.65 [ms]
Filter: CFC 600


Passenger Right Femur Force vs. Time
FORCE [N]
1250
1000
750
500
250
0
-250
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 1081.92 [N]
TMax: 39.80 [ms]
Min: -155.07 [N]
TMin: 171.60 [ms]
Filter: CFC 600

APPENDIX C

DUMMY CALIBRATION AND PERFORMANCE VERIFICATION DATA

CALIBRATION TEST RESULTS

PRE-TEST

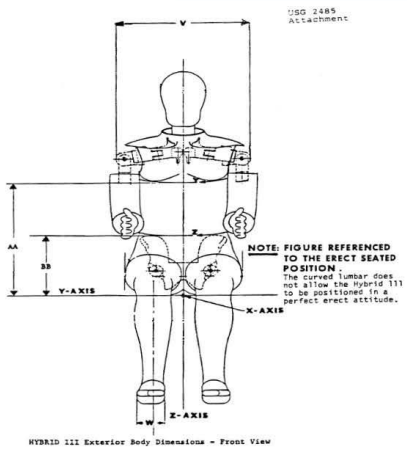
HYBRID III 50TH PERCENTILE MALE - DRIVER ATD

SERIAL NO: 142

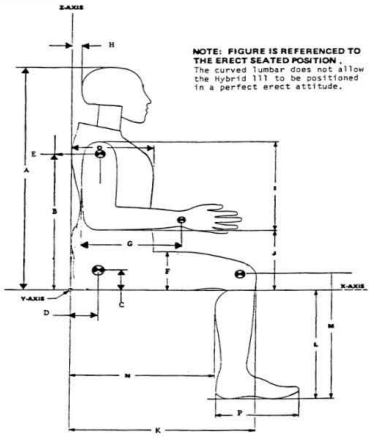
External Measurements - Hybrid 3 - 50th Male

Technician: I. Dunkle Date: 6/15/2016

Dummy Serial Number: 142



HYBRID III Exterior Body Dimensions - Front View



HYBRID III Exterior Body Dimensions - Side View

Symbol	Description	Specification (in)		Result (in)	Pass/Fail
A	Sitting Height	34.6	35.0	34.6	Pass
B	Shoulder Pivot Height	19.9	20.5	20.1	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	11.5	Pass
H	Head Back to Backline	1.6	1.8	1.7	Pass
I	Shoulder to Elbow Length	13.0	13.6	13.3	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	17.4	Pass
M	Knee Pivot Height	19.1	19.7	19.5	Pass
N	Buttock Popliteal Length	17.8	18.8	18.3	Pass
O	Chest Depth without Jacket	8.4	9.0	8.5	Pass
P	Foot Length (right)	9.9	10.5	10.3	Pass
V	Shoulder Breadth	16.3	17.2	17.0	Pass
W	Foot Breadth	3.6	4.2	4.0	Pass
Y	Chest Circumference with Jacket	38.2	39.4	39.3	Pass
Z	Waist Circumference	32.9	34.1	34.0	Pass
AA	Reference Location (Chest Circumference)	16.9	17.1	17.0	Pass
BB	Reference Location (Waist Circumference)	8.9	9.1	9.0	Pass

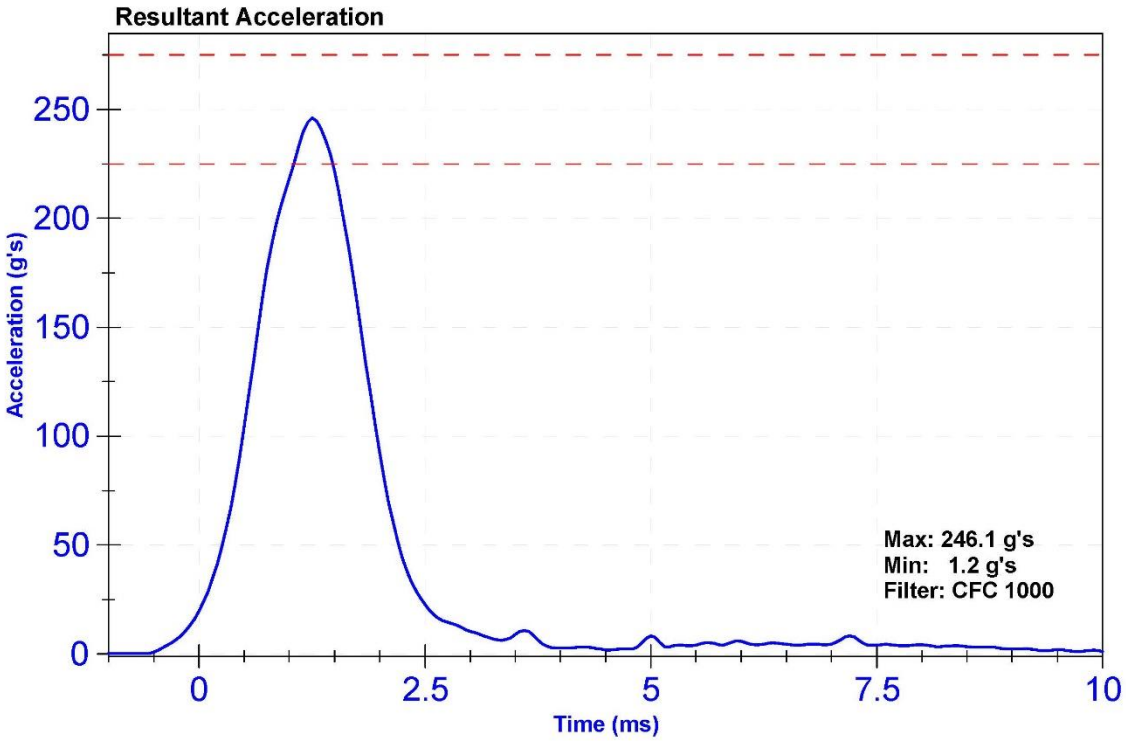
ATD Manufacturer	Humanetics	Test Technician	I. Dunkle
ATD Serial Number	142	Laboratory Supervisor	M. Goehle

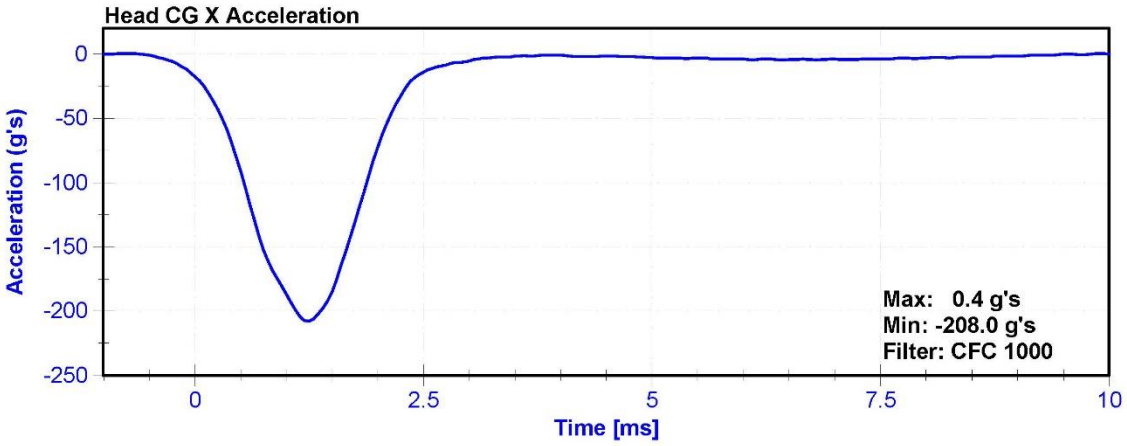
Results

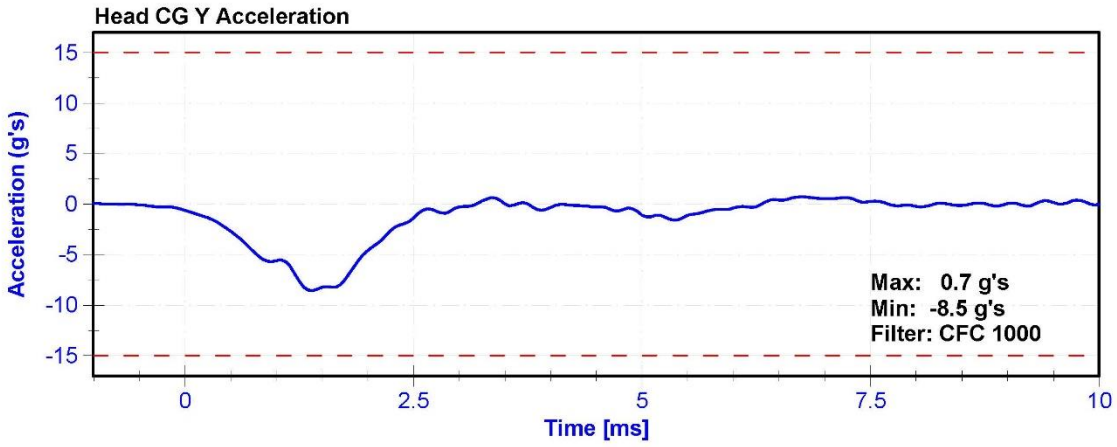
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	22.2	Pass
Humidity	10	70	%	39.8	Pass
Resultant Acceleration	225	275	g's	246.1	Pass
Oscillation	0	10	%	4.4	Pass
Lateral Acceleration	-15	15	g's	-8.5	Pass

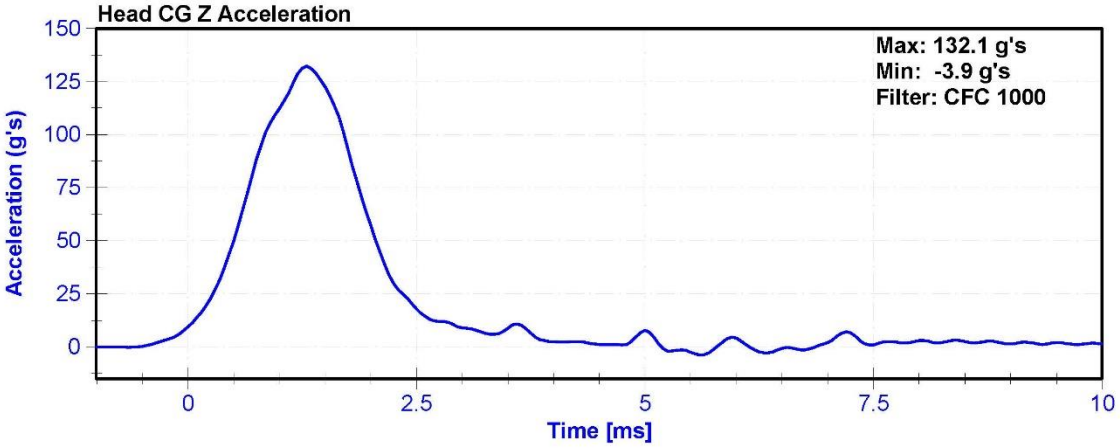
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	ENDEVCO 7264CT	AC-P58998	6/8/2016	12/7/2016
Y Accelerometer	ENDEVCO 7264CT	AC-P58912	6/8/2016	12/7/2016
Z Accelerometer	ENDEVCO 7264CT	AC-P58997	6/8/2016	12/7/2016




Head CG X Acceleration
Acceleration (g's)
0
-50
-100
-150
-200
-250
0
2.5
5
7.5
10
Time [ms]
Max: 0.4 g's
Min: -208.0 g's
Filter: CFC 1000


Head CG Y Acceleration
Acceleration (g's)
15
10
5
0
-5
-10
-15
0
2.5
5
7.5
10
Time [ms]
Max: 0.7 g's
Min: -8.5 g's
Filter: CFC 1000


Head CG Z Acceleration
Acceleration (g's)
150
125
100
75
50
25
0
0
2.5
5
7.5
10
Time [ms]
Max: 132.1 g's
Min: -3.9 g's
Filter: CFC 1000

ATD Manufacturer	Humanetics	Test Technician	I. Dunkle
ATD Serial Number	142	Laboratory Supervisor	M. Goehle

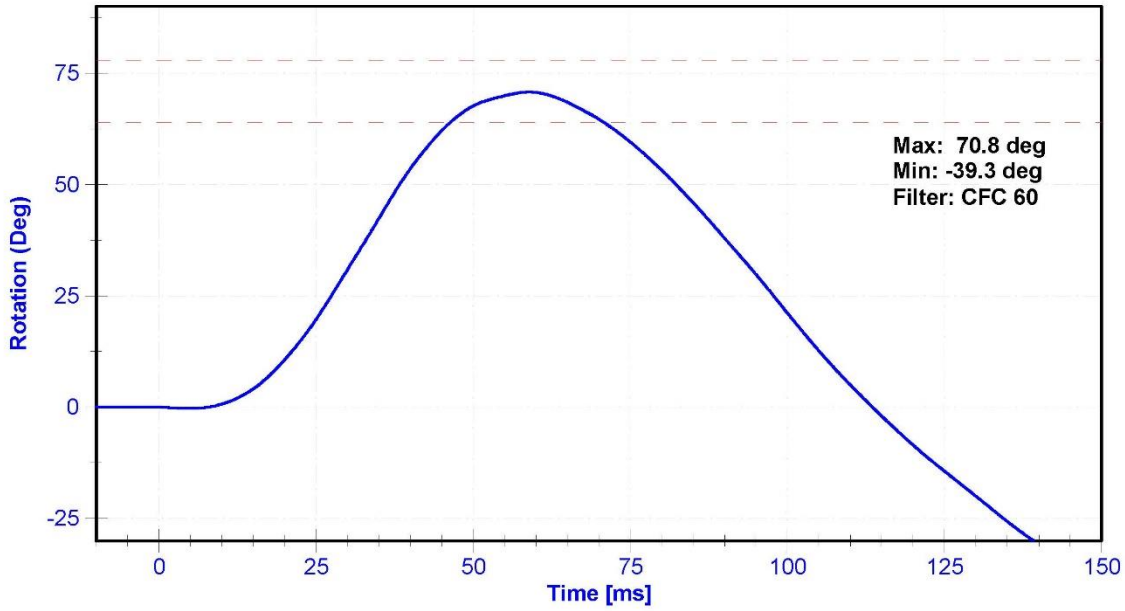
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.0	Pass
Humidity	10	70	%	37.8	Pass
Velocity	6.89	7.13	m/s	6.979	Pass
Pendulum Deceleration at 10ms	22.5	27.5	g's	23.62	Pass
Pendulum Deceleration at 20ms	17.6	22.6	g's	21.98	Pass
Pendulum Deceleration at 30ms	12.5	18.5	g's	15.33	Pass
Max. Pendulum Deceleration After 30ms	0	29	g's	24.5	Pass
Pendulum Deceleration Time to 5 g's	34	42	ms	39.2	Pass
Maximum D Plane Rotation	64	78	deg	70.8	Pass
Time to Maximum Rotation	57	64	ms	58.9	Pass
Rotation Decay to Zero	113	127	ms	113.5	Pass
Moment About Occipital Condyle	88.1	108.4	Nm	93.87	Pass
Time to Maximum Moment	47	58	ms	50.8	Pass
Moment Decay to Zero	97	107	ms	99.5	Pass

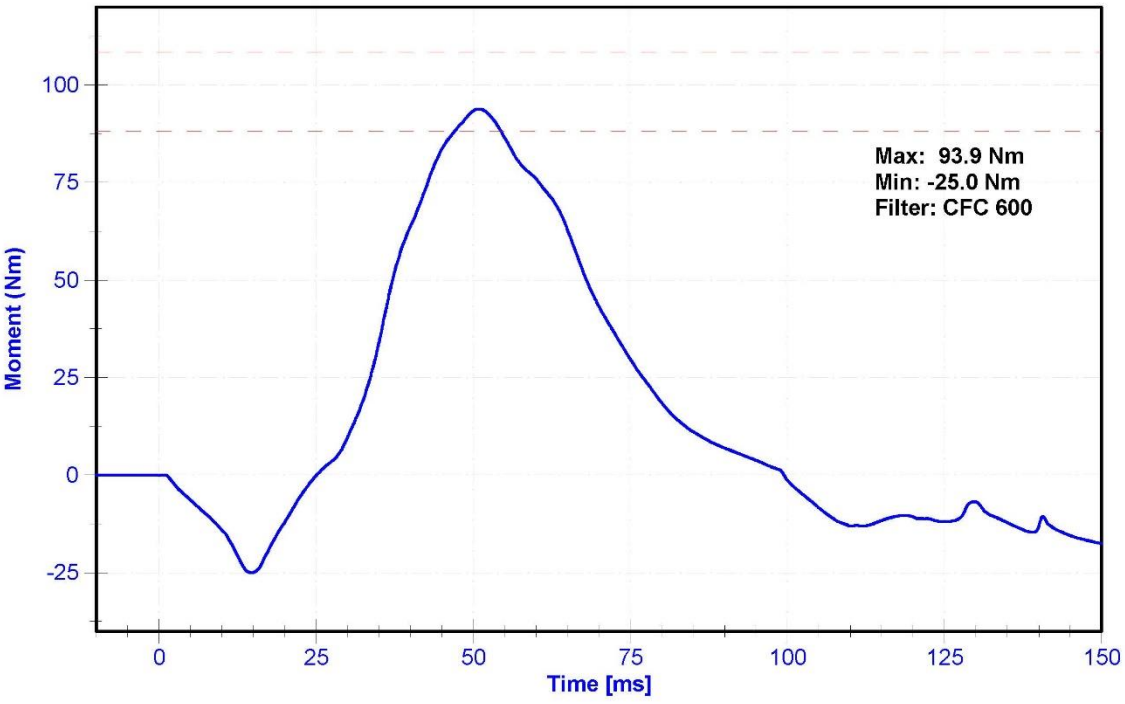
Transducer Calibrations

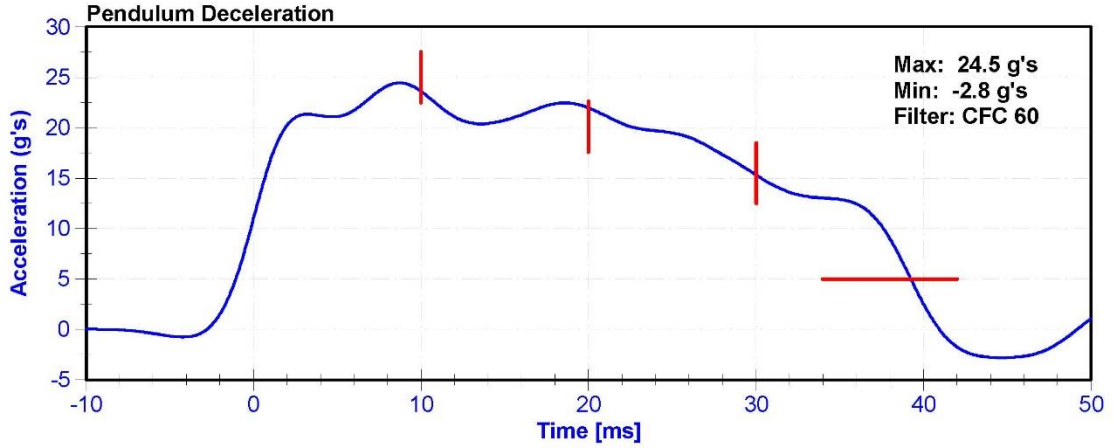
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-AH5F3	5/10/2016	5/10/2017
Pendulum Potentiometer	ETI SP22G	DS-PendPot	9/28/2015	9/27/2016
Condyle Potentiometer	ETI SP22G	DS-CondPot	9/28/2015	9/27/2016
Upper Neck Load Cell	FTSS IF-205	LC-161Fx	5/24/2016	5/24/2017

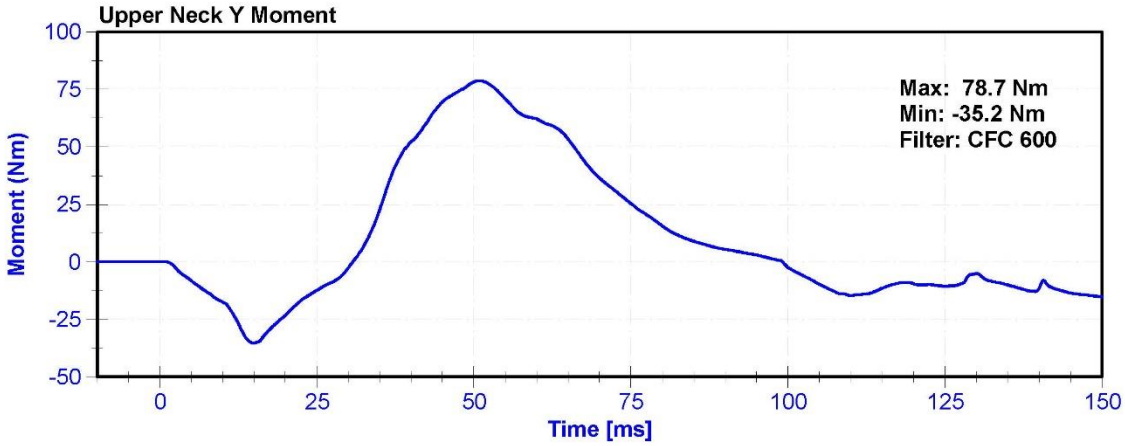
D-Plane Rotation

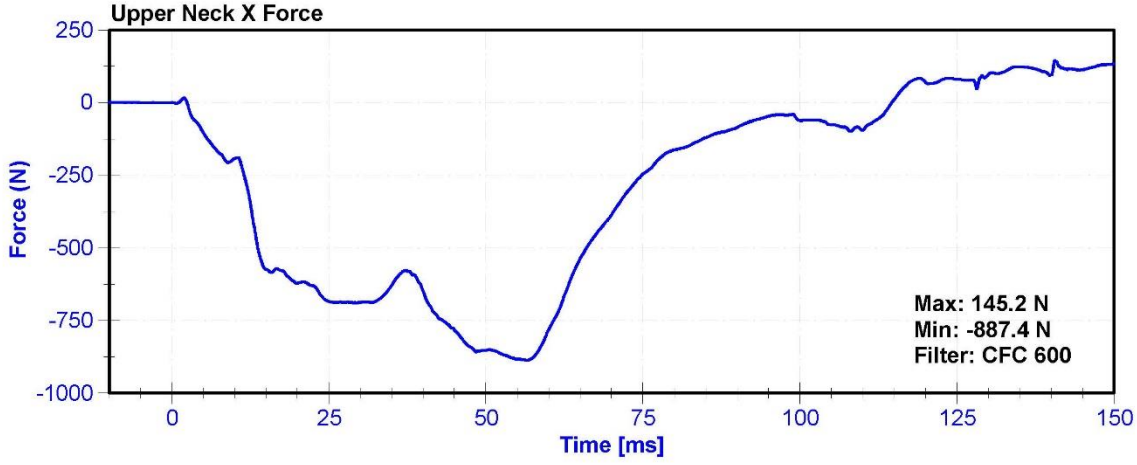


Moment About Occipital Condyle




Pendulum Deceleration
Max: 24.5 g's
Min: -2.8 g's
Filter: CFC 60
Acceleration (g's)
Time [ms]


Upper Neck Y Moment
Max: 78.7 Nm
Min: -35.2 Nm
Filter: CFC 600
Moment (Nm)
Time [ms]


Upper Neck X Force
Max: 145.2 N
Min: -887.4 N
Filter: CFC 600
Force (N)
Time [ms]

ATD Manufacturer	Humanetics	Test Technician	I. Dunkle
ATD Serial Number	142	Laboratory Supervisor	M. Goehle

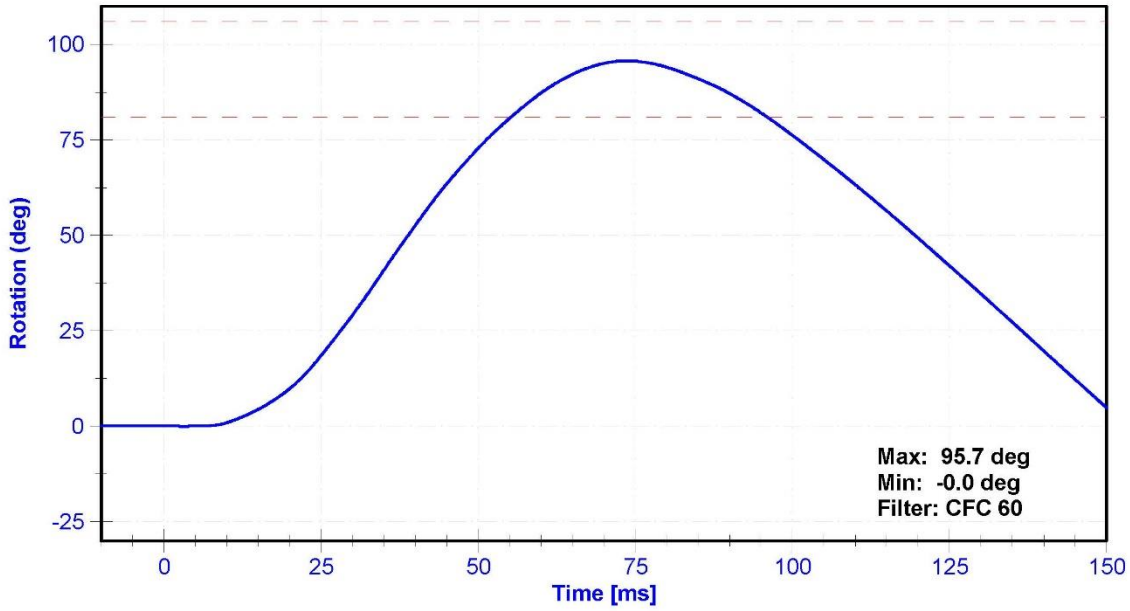
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.3	Pass
Humidity	10	70	%	36.4	Pass
Velocity	5.94	6.19	m/s	6.068	Pass
Pendulum Deceleration at 10ms	17.2	21.2	g's	19.97	Pass
Pendulum Deceleration at 20ms	14	19	g's	18.2	Pass
Pendulum Deceleration at 30ms	11	16	g's	14.1	Pass
Max. Pendulum Deceleration After 30ms	0	22	g's	20.5	Pass
Pendulum Deceleration Time to 5 g's	38	46	ms	39.2	Pass
Maximum D Plane Rotation	81	106	deg	95.7	Pass
Time to Maximum Rotation	72	82	ms	73.7	Pass
Rotation Decay to Zero	147	174	ms	153.3	Pass
Minimum Moment About OC	-80	-52.9	Nm	-69.60	Pass
Time to Minimum Moment	65	79	ms	68.9	Pass
Moment Decay to Zero	120	148	ms	137.1	Pass

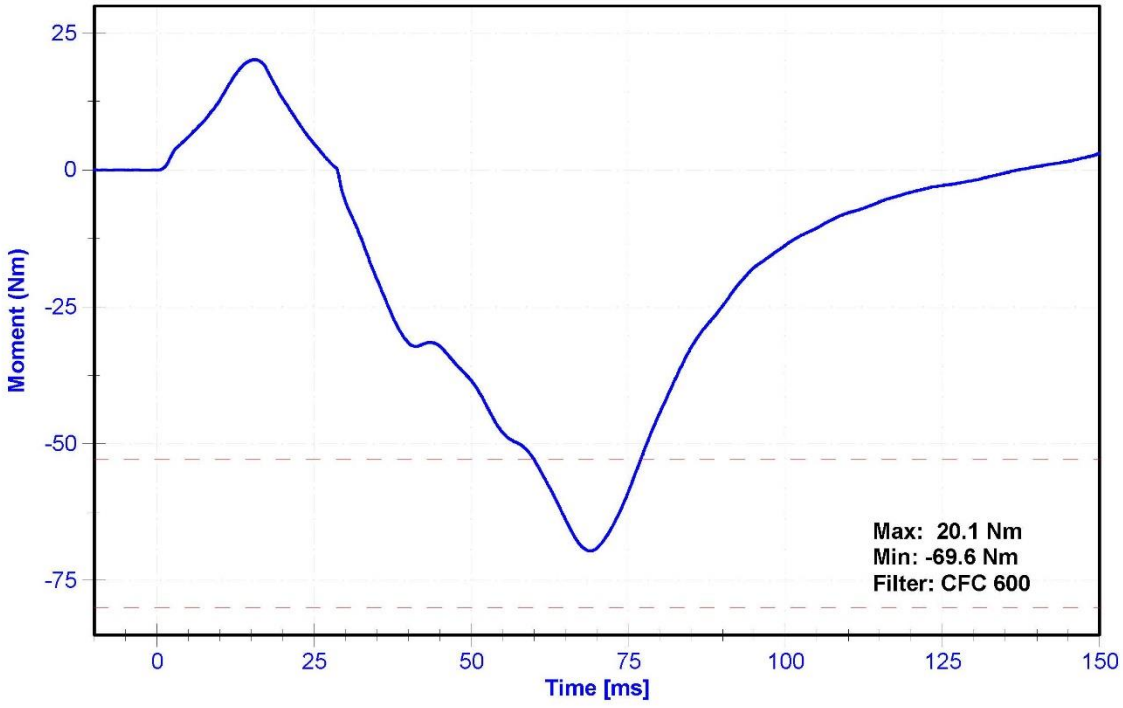
Transducer Calibrations

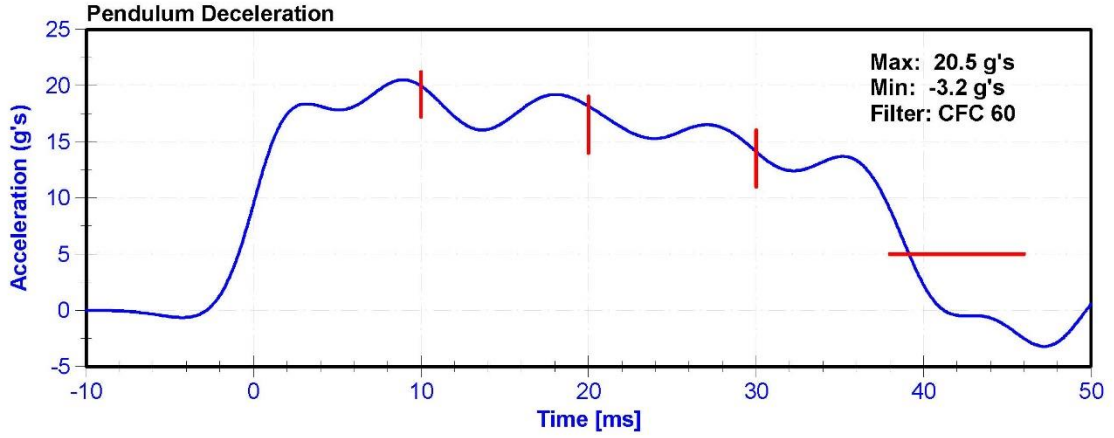
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-AH5F3	5/10/2016	5/10/2017
Pendulum Potentiometer	ETI SP22G	DS-PendPot	9/28/2015	9/27/2016
Condyle Potentiometer	ETI SP22G	DS-CondPot	9/28/2015	9/27/2016
Upper Neck Load Cell	FTSS IF-205	LC-161Fx	5/24/2016	5/24/2017

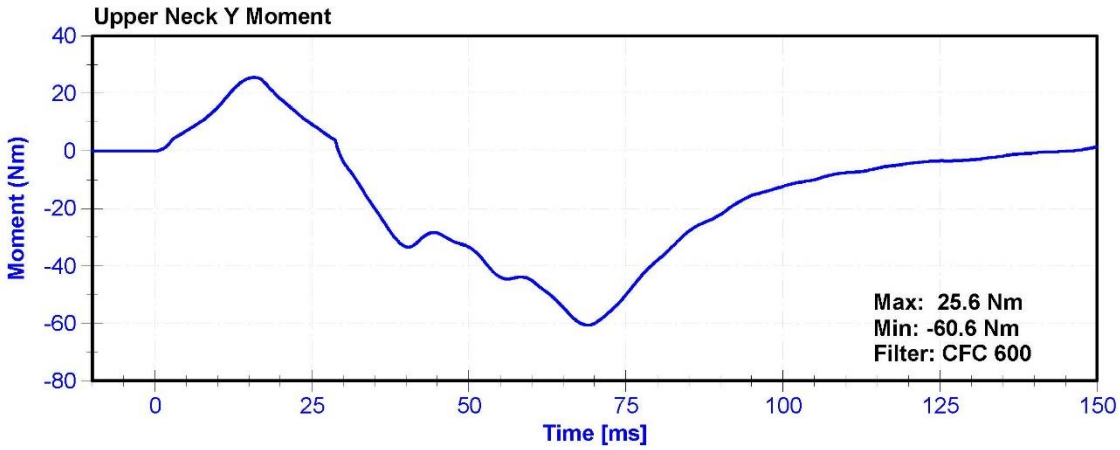
D-Plane Rotation

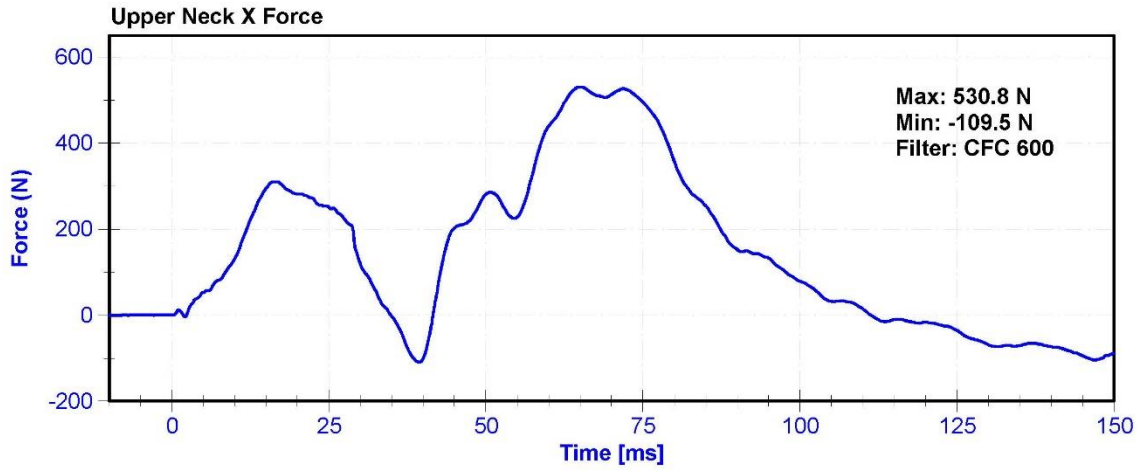


Moment About Occipital Condyle




Pendulum Deceleration
Max: 20.5 g's
Min: -3.2 g's
Filter: CFC 60
Acceleration (g's)
Time [ms]


Upper Neck Y Moment
Max: 25.6 Nm
Min: -60.6 Nm
Filter: CFC 600
Moment (Nm)
Time [ms]


Upper Neck X Force
Max: 530.8 N
Min: -109.5 N
Filter: CFC 600
Force (N)
Time [ms]

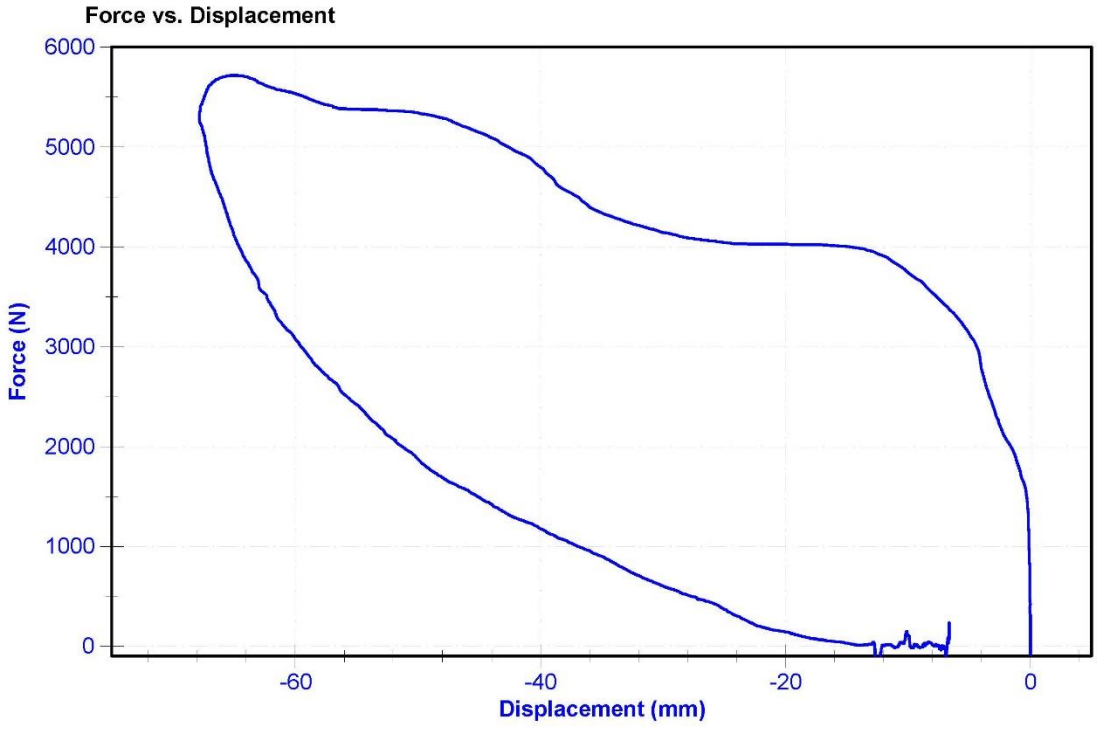
ATD Manufacturer	Humanetics	Test Technician	M. Goehle
ATD Serial Number	142	Laboratory Supervisor	M. Goehle

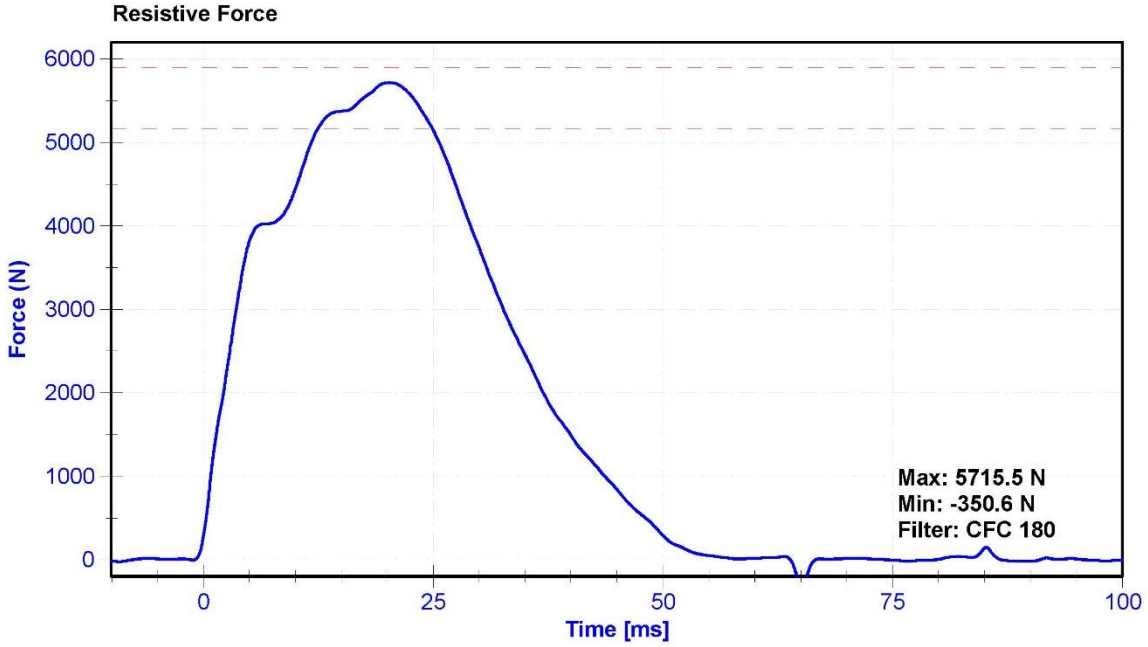
Results

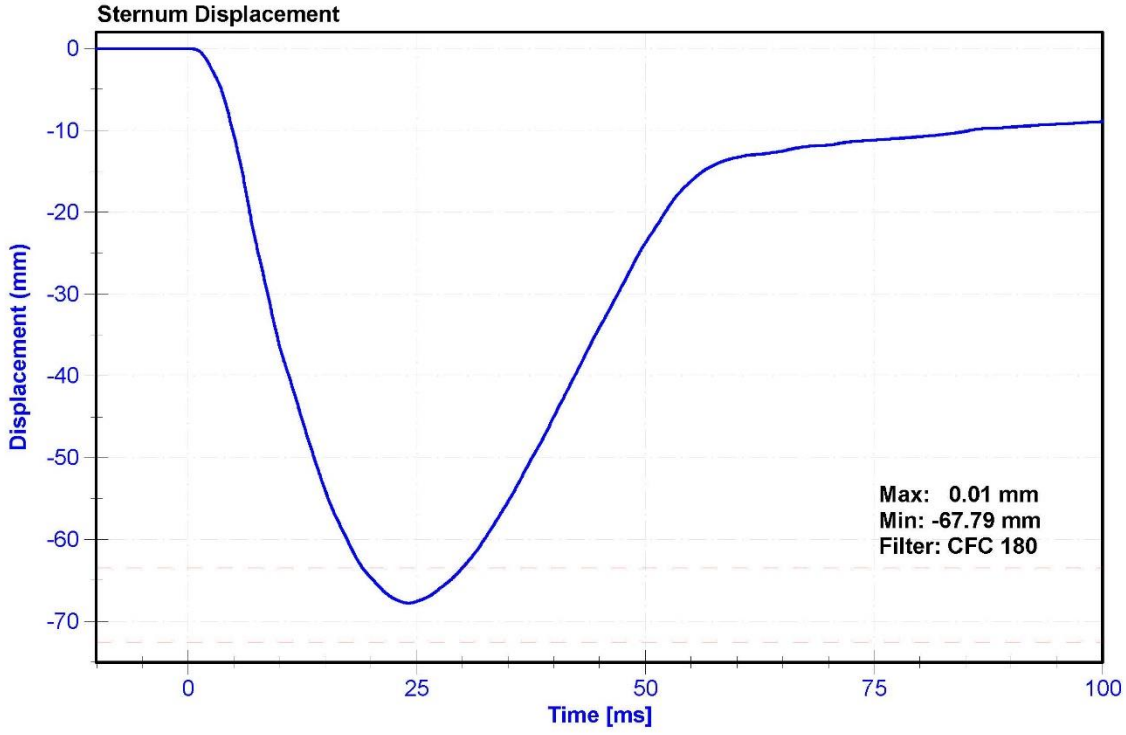
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.9	Pass
Humidity	10	70	%	36.5	Pass
Velocity	6.59	6.83	m/s	6.684	Pass
Chest Displacement	-72.6	-63.5	mm	-67.79	Pass
Resistive Force	5160	5894	N	5715.5	Pass
Hysteresis	65	85	%	72.6	Pass

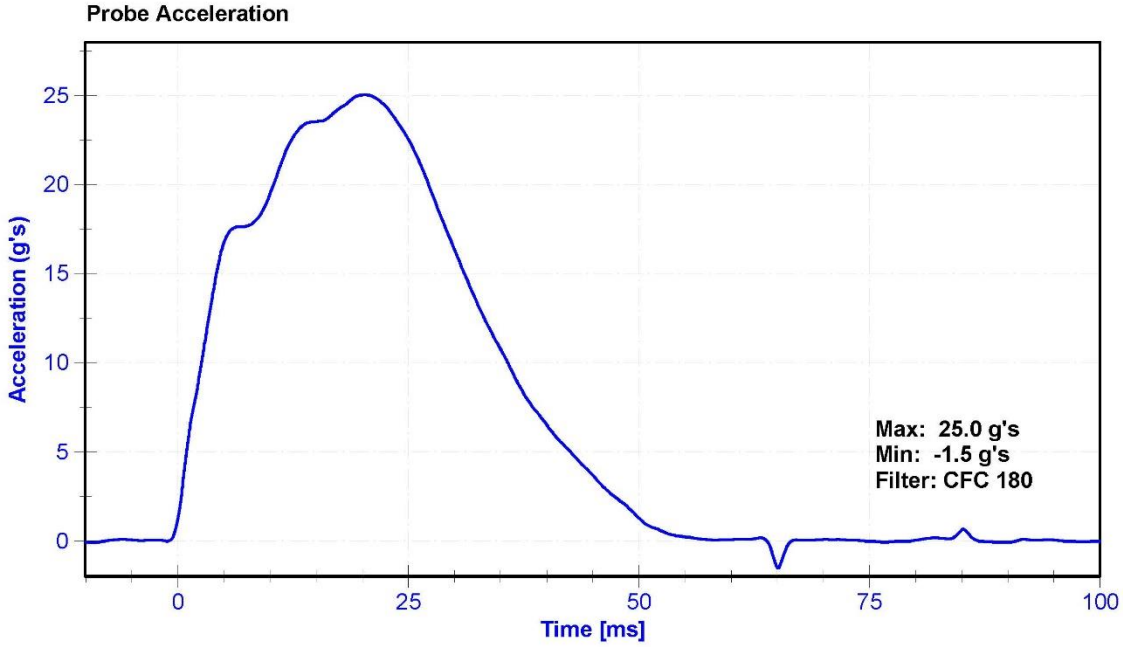
Transducer Calibrations

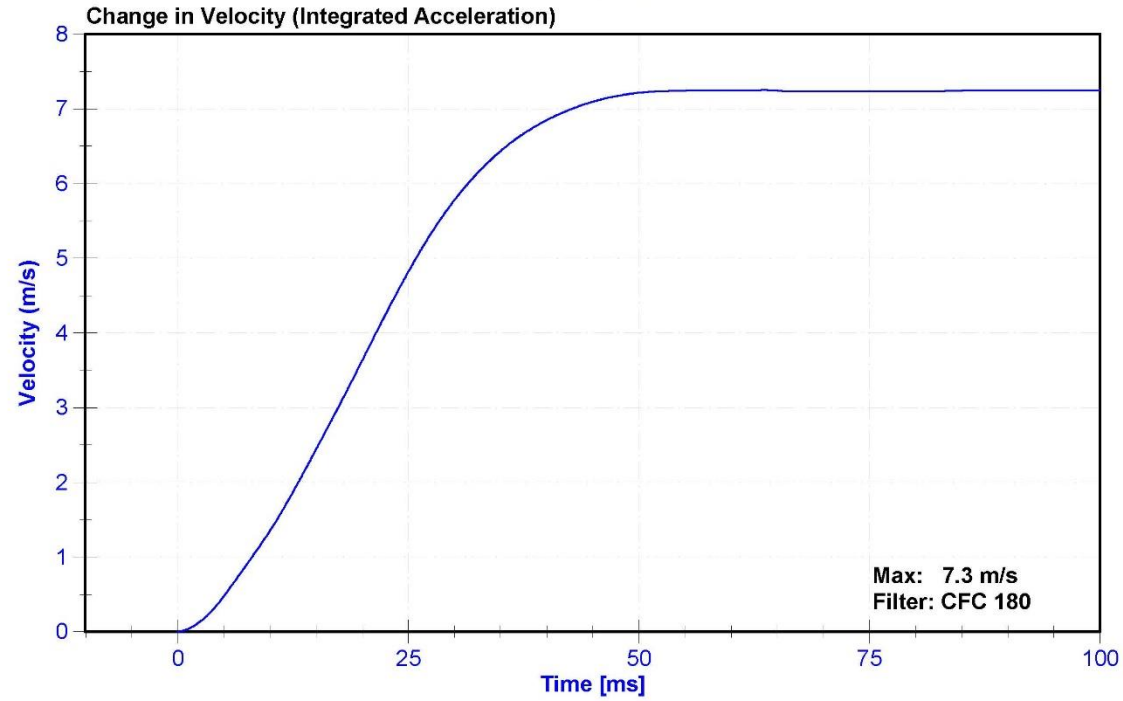
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7264CT	AC-P23155	1/13/2016	7/14/2016
Chest Potentiometer	JDK 6209-2038	DS-142	6/8/2016	6/8/2017




Resistive Force
6000
5000
4000
3000
2000
1000
0
Force (N)
0
25
50
75
100
Time [ms]
Max: 5715.5 N
Min: -350.6 N
Filter: CFC 180


Sternum Displacement
0
-10
-20
-30
-40
-50
-60
-70
Displacement (mm)
0
25
50
75
100
Time [ms]
Max: 0.01 mm
Min: -67.79 mm
Filter: CFC 180


Probe Acceleration
Acceleration (g's)
25
20
15
10
5
0
0
25
50
75
100
Time [ms]
Max: 25.0 g's
Min: -1.5 g's
Filter: CFC 180


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

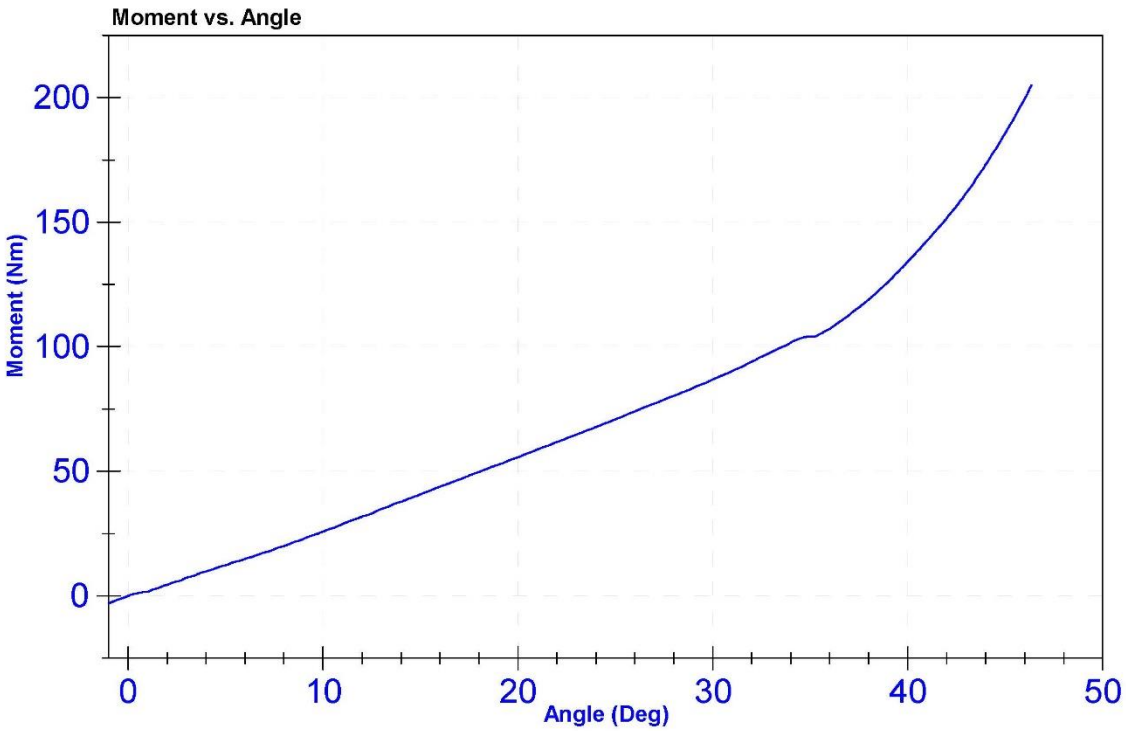
ATD Manufacturer	Humanetics	Test Technician	I. Dunkle
ATD Serial Number	142	Laboratory Supervisor	M. Goehle

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	21.0	Pass
Humidity	10	70	%	41.8	Pass
Average Velocity	5	10	deg/s	7.5	Pass
Angle at 203Nm	40	50	deg	46.2	Pass
Moment at 30 degrees	0	94.9	Nm	86.8	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	ETI SP22	DS-0008	4/4/2016	4/4/2017
Load Cell	Key Trans 2301-02	LC-115 My	10/3/2015	10/2/2016



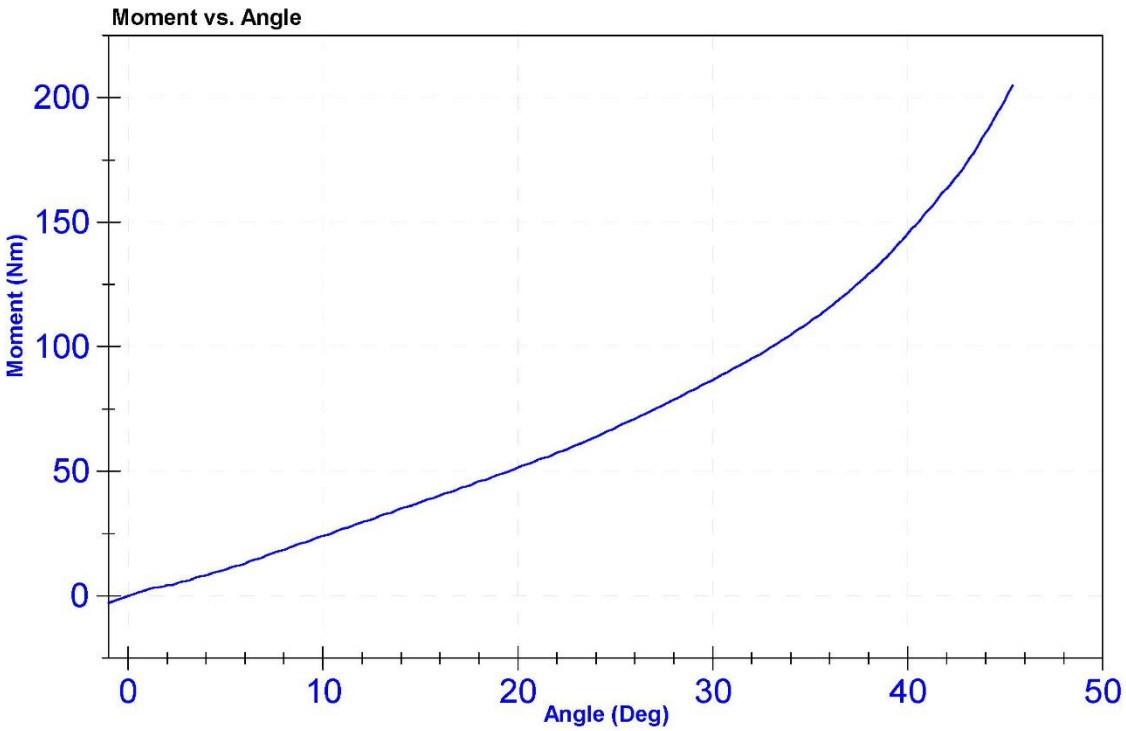
ATD Manufacturer	Humanetics	Test Technician	I. Dunkle
ATD Serial Number	142	Laboratory Supervisor	M. Goehle

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	20.9	Pass
Humidity	10	70	%	41.6	Pass
Average Velocity	5	10	deg/s	7.3	Pass
Angle at 203Nm	40	50	deg	45.2	Pass
Moment at 30 degrees	0	94.9	Nm	86.6	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	ETI SP22	DS-0008	4/4/2016	4/4/2017
Load Cell	Key Trans 2301-02	LC-115 My	10/3/2015	10/2/2016



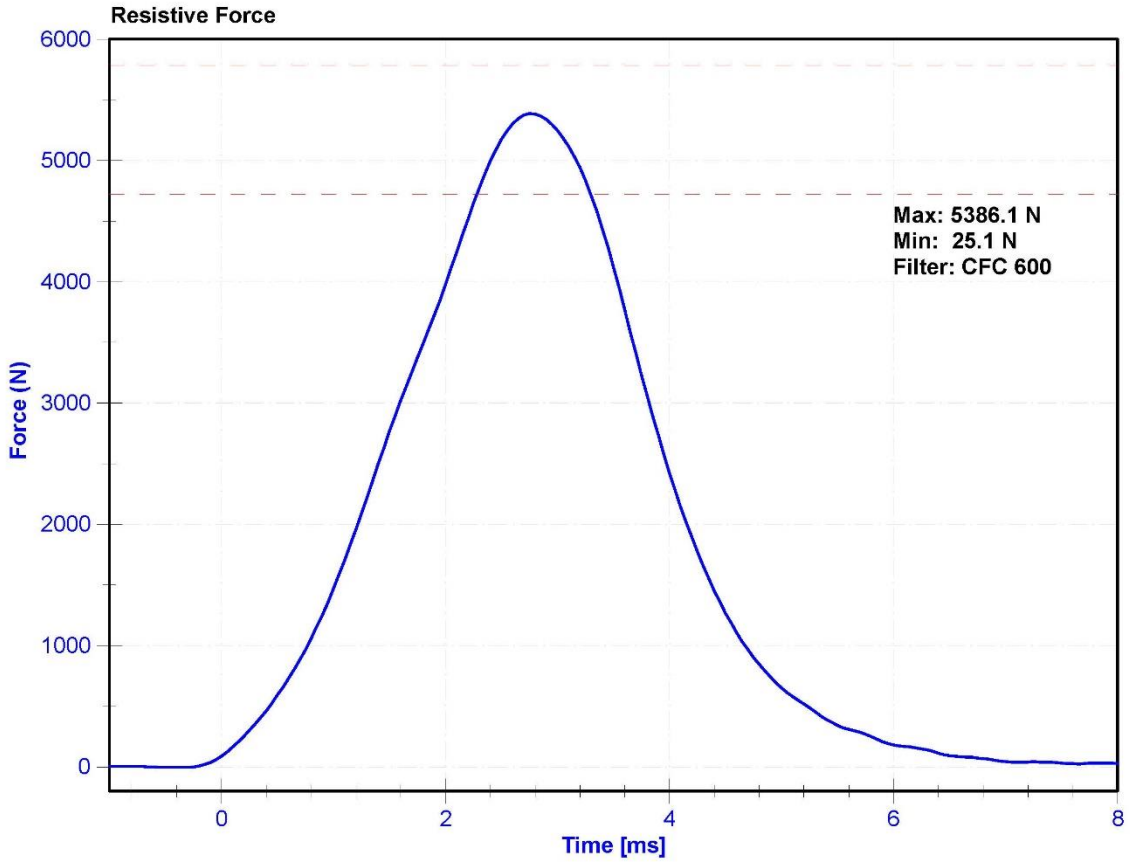
ATD Manufacturer	Humanetics	Test Technician	I. Dunkle
ATD Serial Number	142	Laboratory Supervisor	M. Goehle

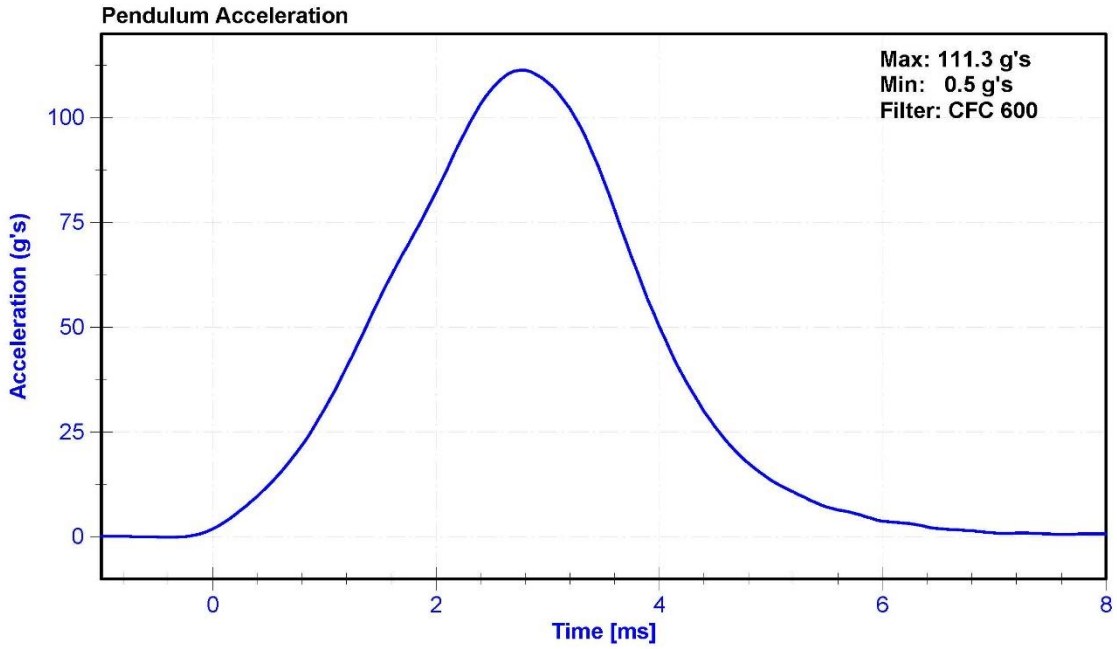
Results

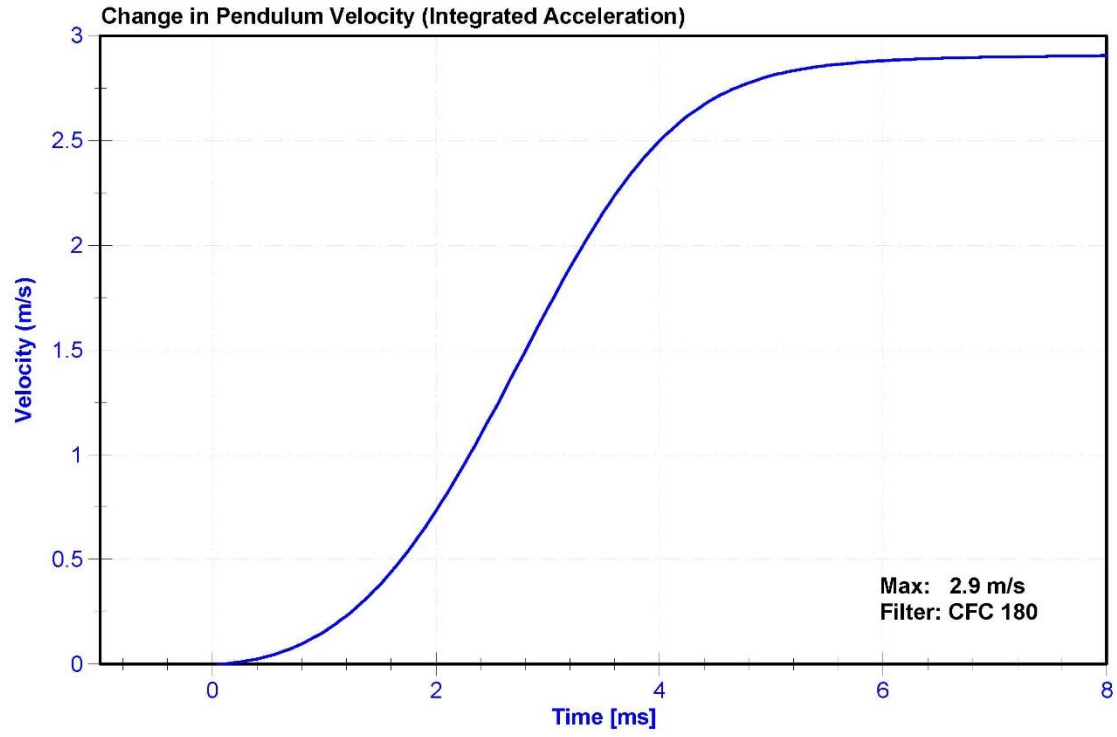
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	22.1	Pass
Humidity	10	70	%	34.5	Pass
Velocity	2.07	2.13	m/s	2.081	Pass
Maximum Resistive Force	4720	5780	N	5386.1	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7264CT	AC-P23155	1/13/2016	7/14/2016




Pendulum Acceleration
Max: 111.3 g's
Min: 0.5 g's
Filter: CFC 600
Acceleration (g's)
100
75
50
25
0
0
2
4
6
8
Time [ms]


Change in Pendulum Velocity (Integrated Acceleration)
Velocity (m/s)
3
2.5
2
1.5
1
0.5
0
Max: 2.9 m/s
Filter: CFC 180
0
2
4
6
8
Time [ms]

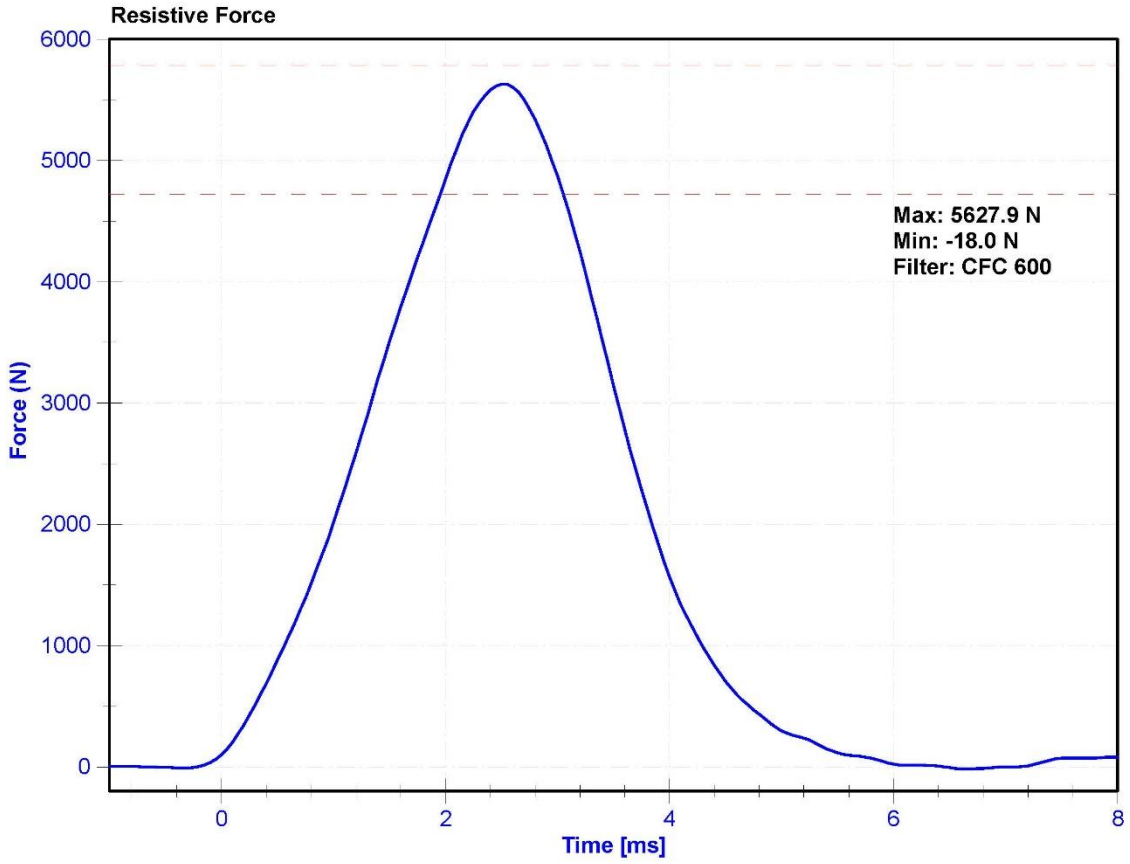
ATD Manufacturer	Humanetics	Test Technician	I. Dunkle
ATD Serial Number	142	Laboratory Supervisor	M. Goehle

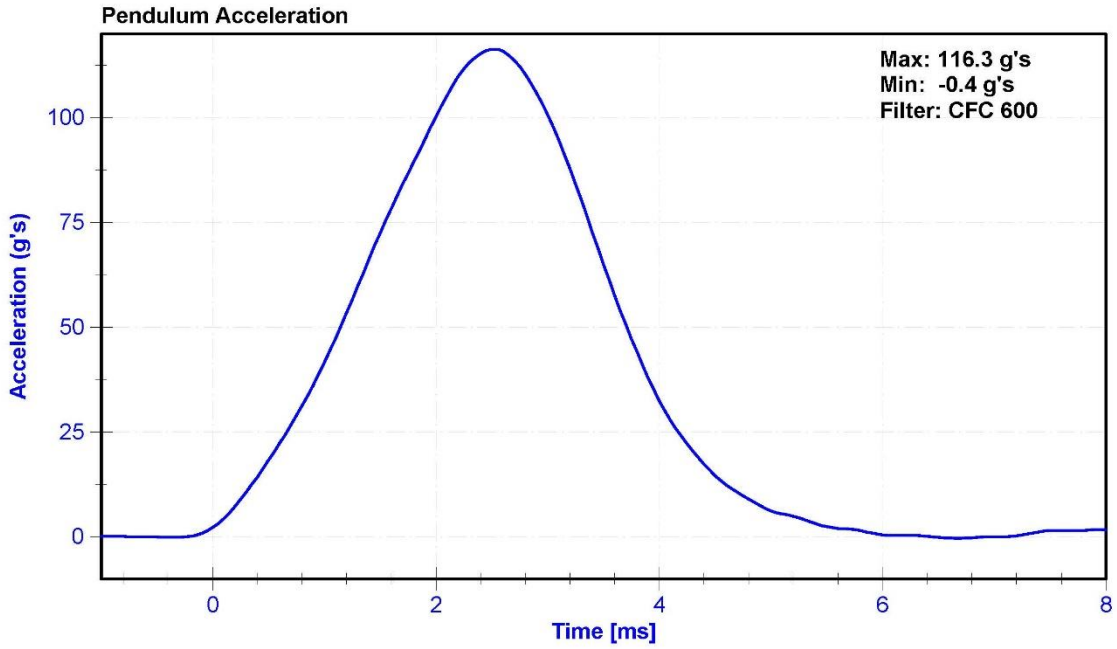
Results

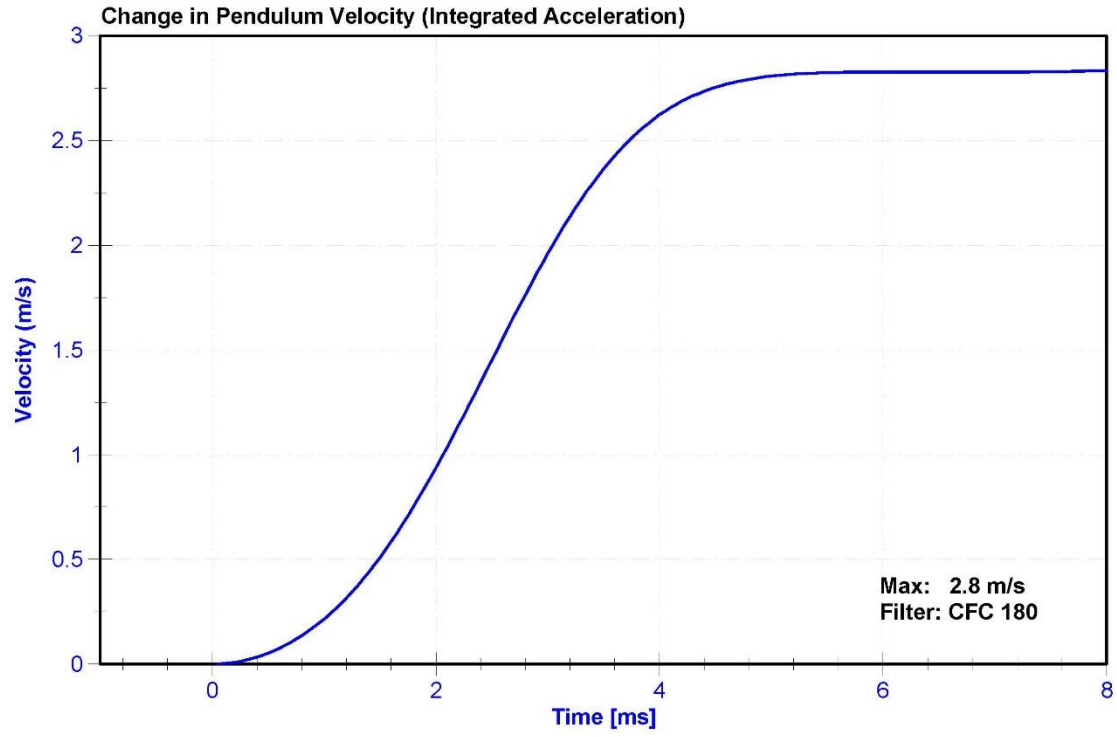
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	21.1	Pass
Humidity	10	70	%	38.2	Pass
Velocity	2.07	2.13	m/s	2.079	Pass
Maximum Resistive Force	4720	5780	N	5627.9	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7264CT	AC-P23155	1/13/2016	7/14/2016




Pendulum Acceleration
Max: 116.3 g's
Min: -0.4 g's
Filter: CFC 600
Acceleration (g's)
100
75
50
25
0
0
2
4
6
8
Time [ms]


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

CALIBRATION TEST RESULTS

PRE-TEST

HYBRID III 5TH PERCENTILE FEMALE - PASSENGER ATD

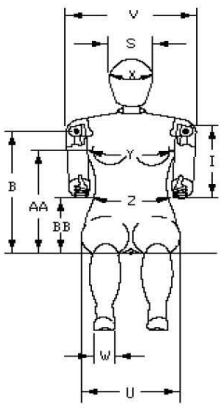
SERIAL NO: 139

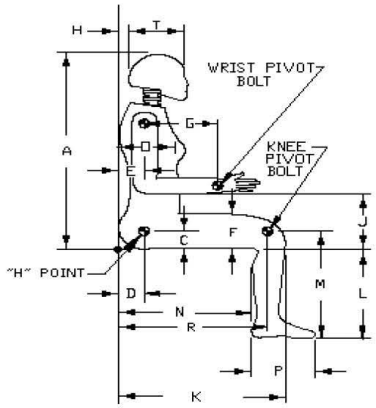
Calspan

External Measurements - Hybrid 3 - 5th Female

Technician: Steve Keller Date: 6/15/2016

Dummy Serial Number: 139





Symbol	Description	Specification (mm)		Result (mm)	Pass/Fail
A	Sitting Height	775	800	787	Pass
B	Shoulder Pivot Height	432	457	450	Pass
C	H-Point Height	81	86	83	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	250	Pass
H	Head Back to Backline	43	48	46	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	542	Pass
L	Popliteal Height	356	376	363	Pass
M	Knee Pivot Height	394	419	398	Pass
N	Buttock Popliteal Length	414	439	425	Pass
O	Chest Depth without Jacket	175	191	185	Pass
P	Foot Length (right)	219	234	220	Pass
R	Buttock To Knee Pivot Length	457	483	473	Pass
S	Head Breadth	137	147	142	Pass
T	Head Depth	178	188	180	Pass
U	Hip Breadth	300	315	301	Pass
V	Shoulder Breadth	351	366	362	Pass
W	Foot Breadth	79	94	84	Pass
X	Head Circumference	528	549	535	Pass
Y	Chest Circumference with Jacket	851	881	854	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

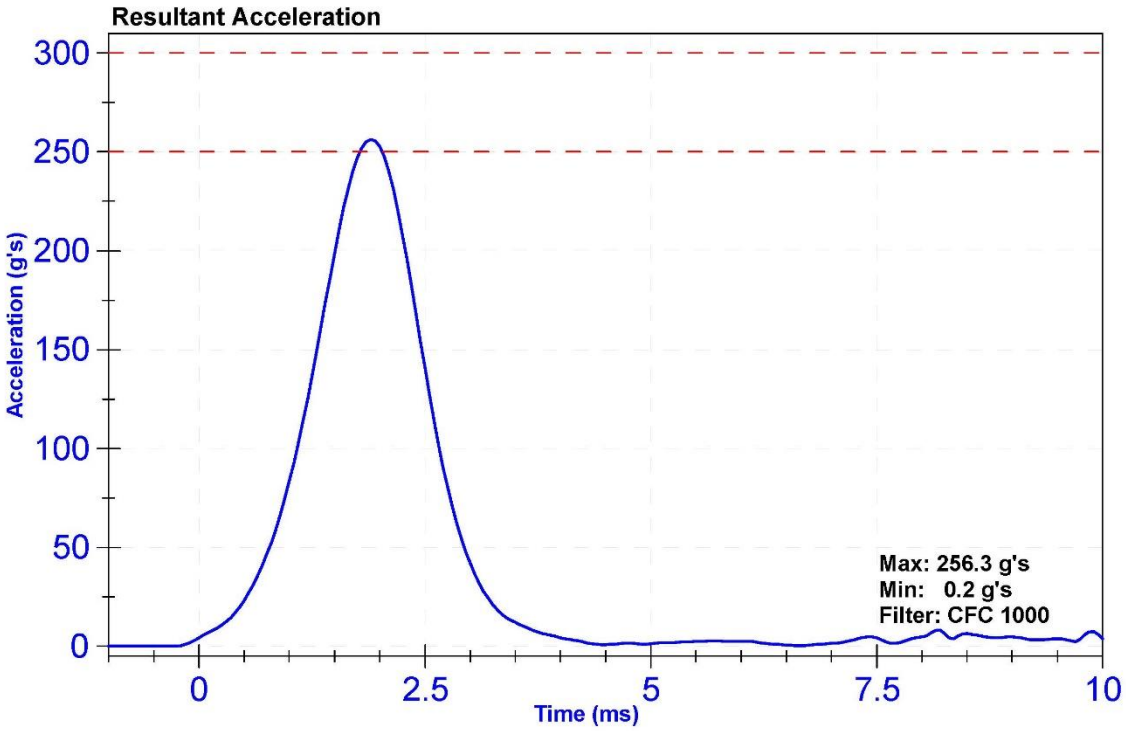
ATD Manufacturer	Denton	Test Technician	S. Keller
ATD Serial Number	139	Laboratory Supervisor	M. Goehle

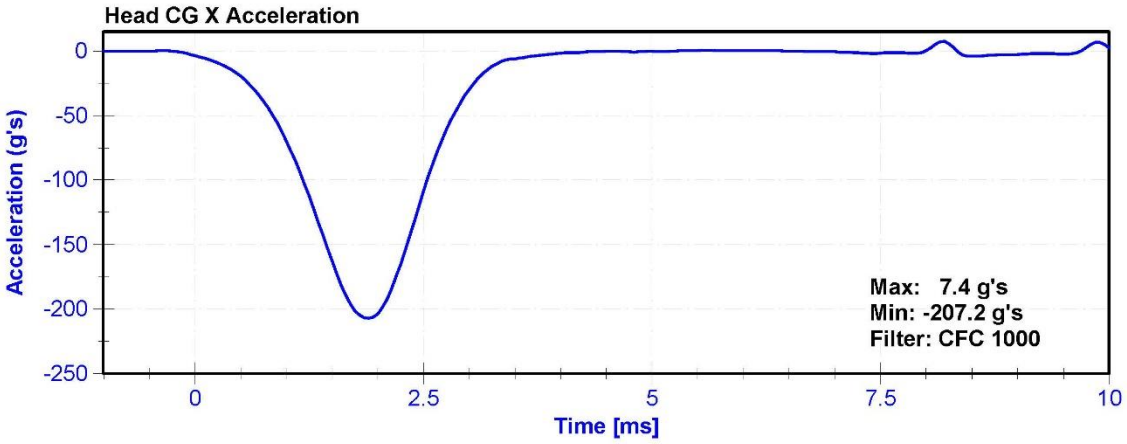
Results

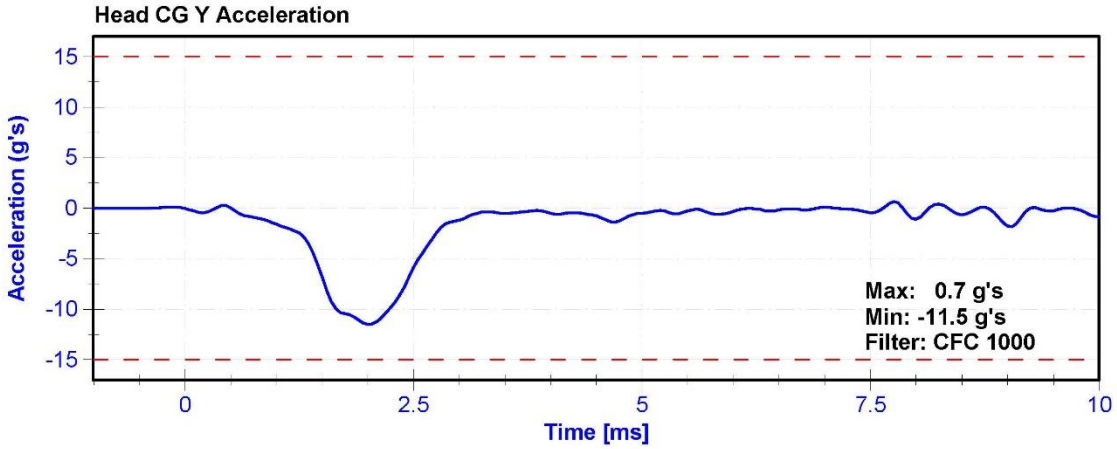
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	21.1	Pass
Humidity	10	70	%	38.2	Pass
Resultant Acceleration	250	300	g's	256.3	Pass
Oscillation	0	10	%	3.1	Pass
Lateral Acceleration	-15	15	g's	-11.5	Pass

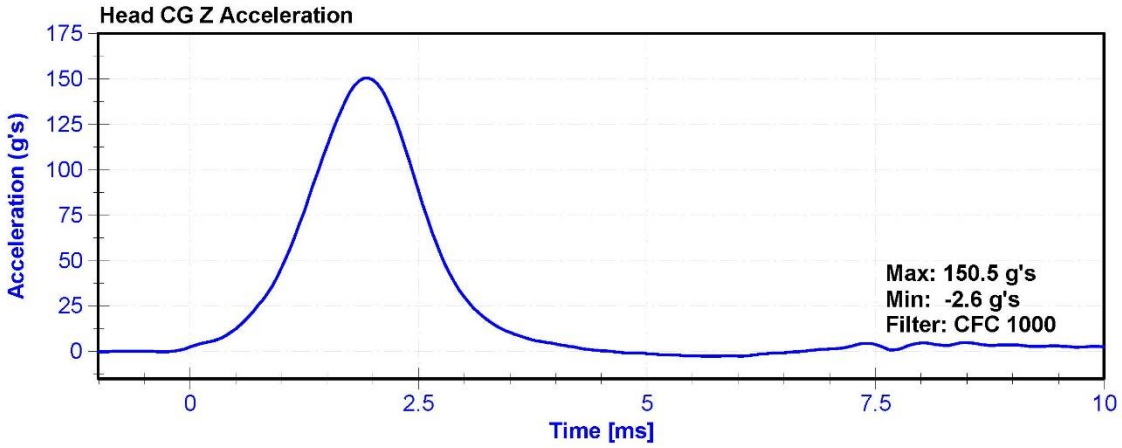
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	ENDEVCO 7264	AC-P52054	6/13/2016	12/12/2016
Y Accelerometer	ENDEVCO 7264	AC-P52007	6/13/2016	12/12/2016
Z Accelerometer	ENDEVCO 7264	AC-P51298	6/13/2016	12/12/2016




Head CG X Acceleration
Acceleration (g's)
0
-50
-100
-150
-200
-250
0
2.5
5
7.5
10
Time [ms]
Max: 7.4 g's
Min: -207.2 g's
Filter: CFC 1000


Head CG Y Acceleration
Acceleration (g's)
15
10
5
0
-5
-10
-15
0
2.5
5
7.5
10
Time [ms]
Max: 0.7 g's
Min: -11.5 g's
Filter: CFC 1000


Head CG Z Acceleration
Acceleration (g's)
175
150
125
100
75
50
25
0
0
2.5
5
7.5
10
Time [ms]
Max: 150.5 g's
Min: -2.6 g's
Filter: CFC 1000

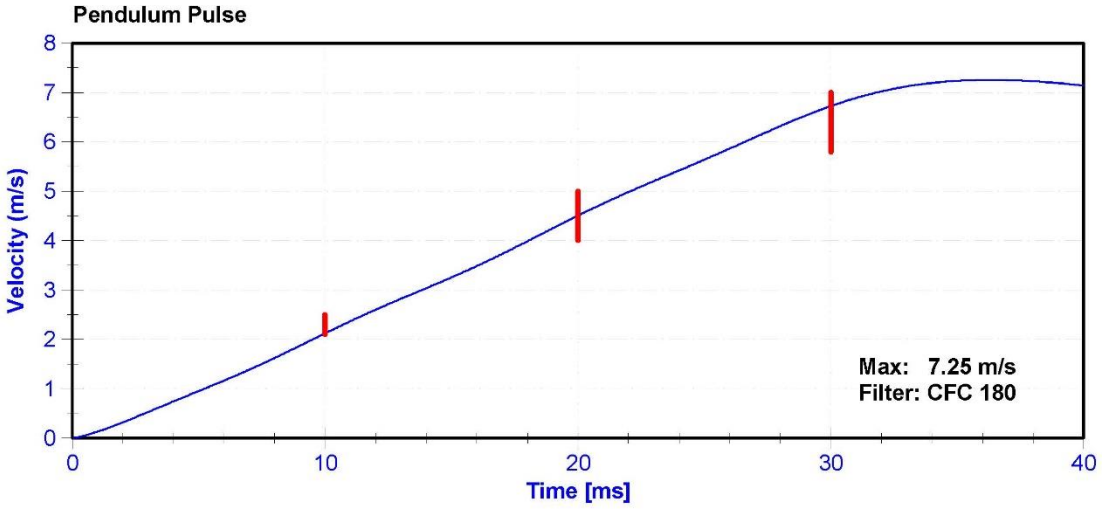
ATD Manufacturer	Denton	Test Technician	S. Keller
ATD Serial Number	139	Laboratory Supervisor	M. Goehle

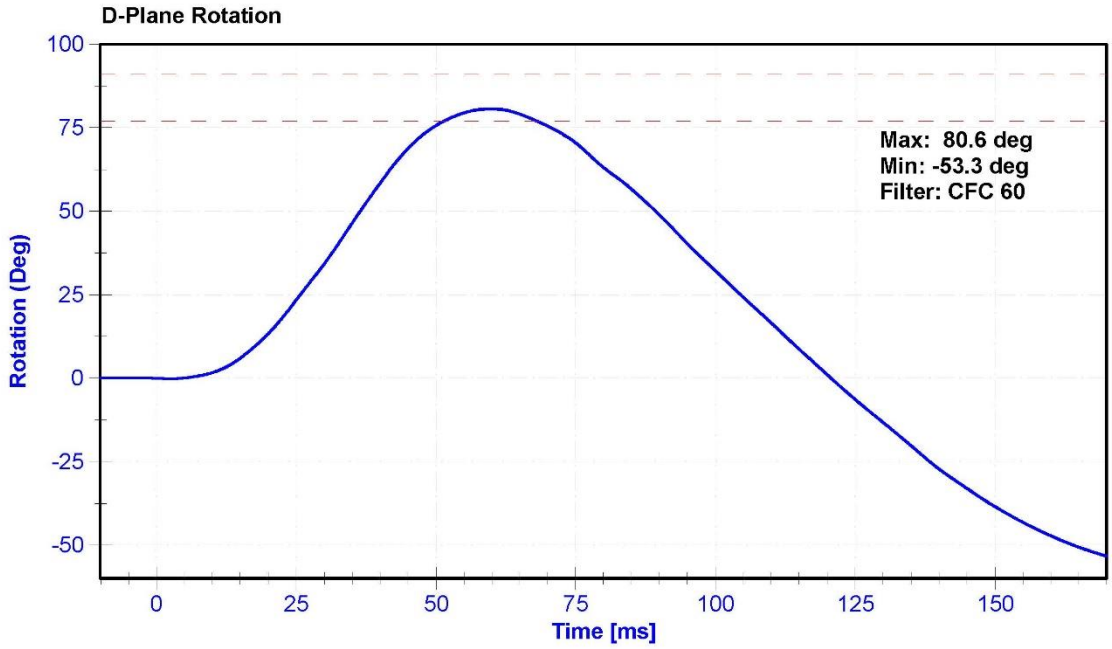
Results

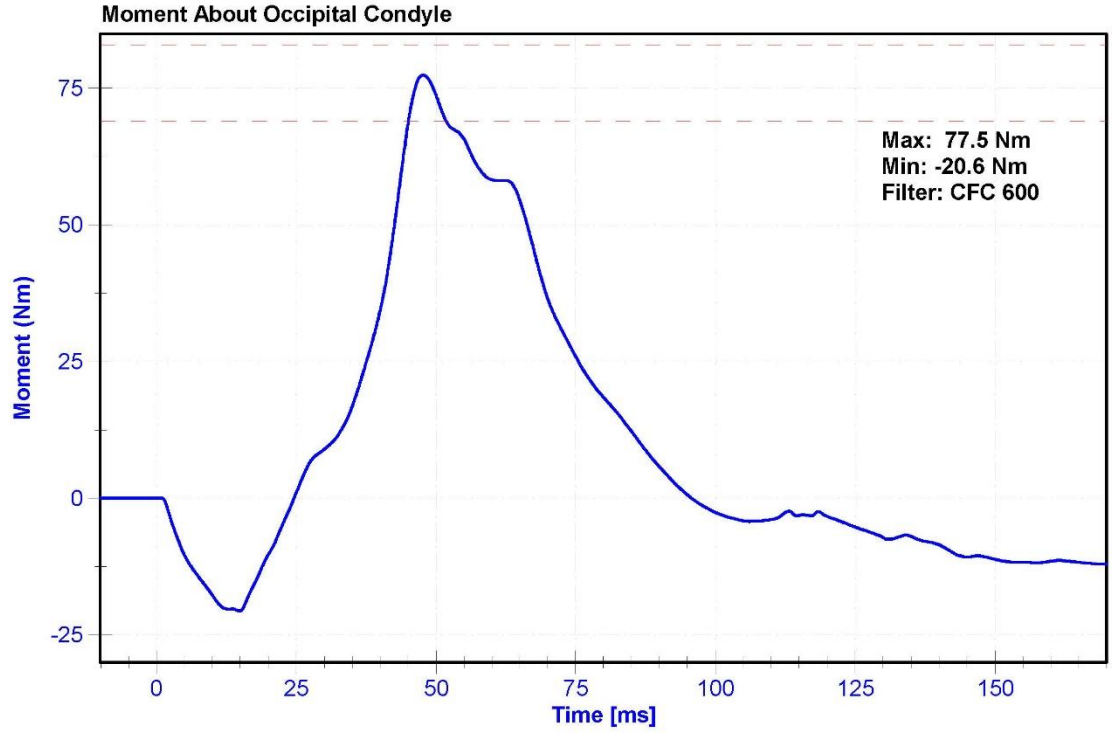
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.2	Pass
Humidity	10	70	%	43.0	Pass
Velocity	6.89	7.13	m/s	6.979	Pass
Pendulum Impulse at 10ms	2.1	2.5	m/s	2.12	Pass
Pendulum Impulse at 20ms	4.0	5.0	m/s	4.51	Pass
Pendulum Impulse at 30ms	5.8	7.0	m/s	6.72	Pass
Max D Plane Rotation	77	91	deg	80.6	Pass
Max Moment During Rotation Interval	69	83	Nm	77.5	Pass
Moment Decay to 10.0 Nm	80	100	ms	86.6	Pass

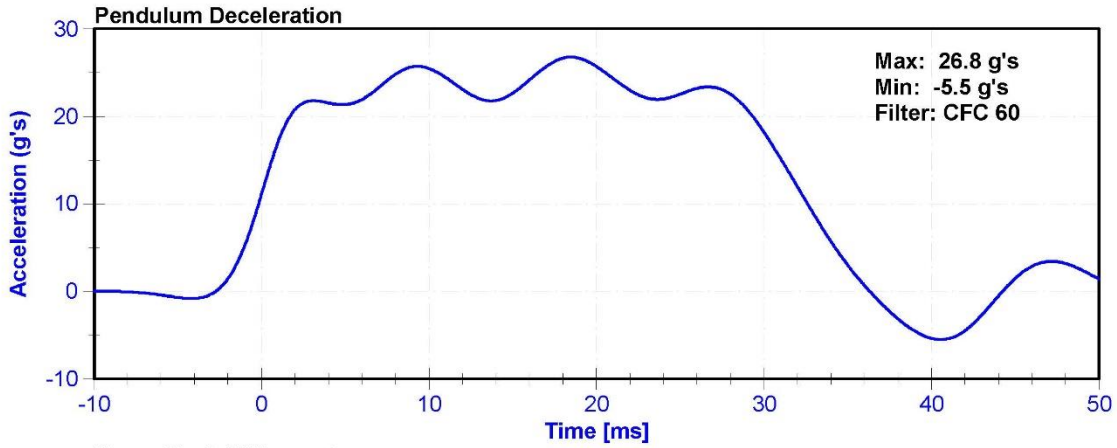
Transducer Calibrations

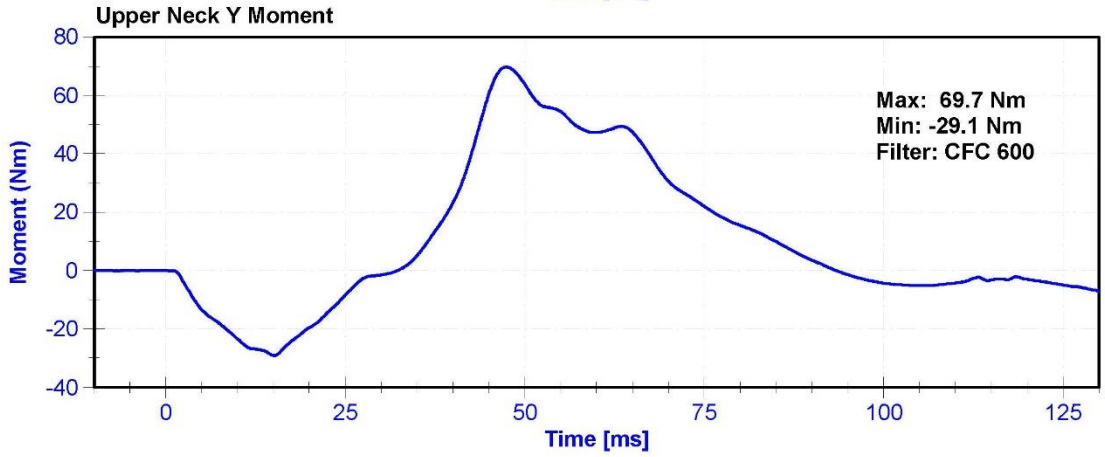
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-AH5F3	5/10/2016	5/10/2017
Pendulum Potentiometer	ETI SP22G	DS-PendPot	9/28/2015	9/27/2016
Condyle Potentiometer	ETI SP22G	DS-CondPot	9/28/2015	9/27/2016
Upper Neck Load Cell	Denton 1716A	LC-2018Fx	5/24/2016	5/24/2017

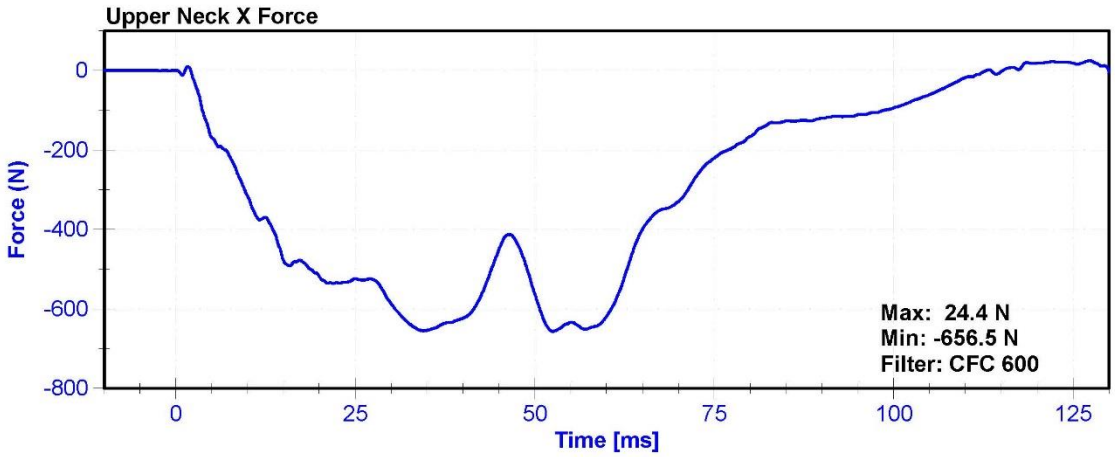



D-Plane Rotation
Max: 80.6 deg
Min: -53.3 deg
Filter: CFC 60
Rotation (Deg)
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]


Moment About Occipital Condyle
Max: 77.5 Nm
Min: -20.6 Nm
Filter: CFC 600
Moment (Nm)
75
50
25
0
-25
0
25
50
75
100
125
150
Time [ms]


Pendulum Deceleration
Acceleration (g's)
Time [ms]
Max: 26.8 g's
Min: -5.5 g's
Filter: CFC 60


Upper Neck Y Moment
Moment (Nm)
Time [ms]
Max: 69.7 Nm
Min: -29.1 Nm
Filter: CFC 600


Upper Neck X Force
Force (N)
Time [ms]
Max: 24.4 N
Min: -656.5 N
Filter: CFC 600

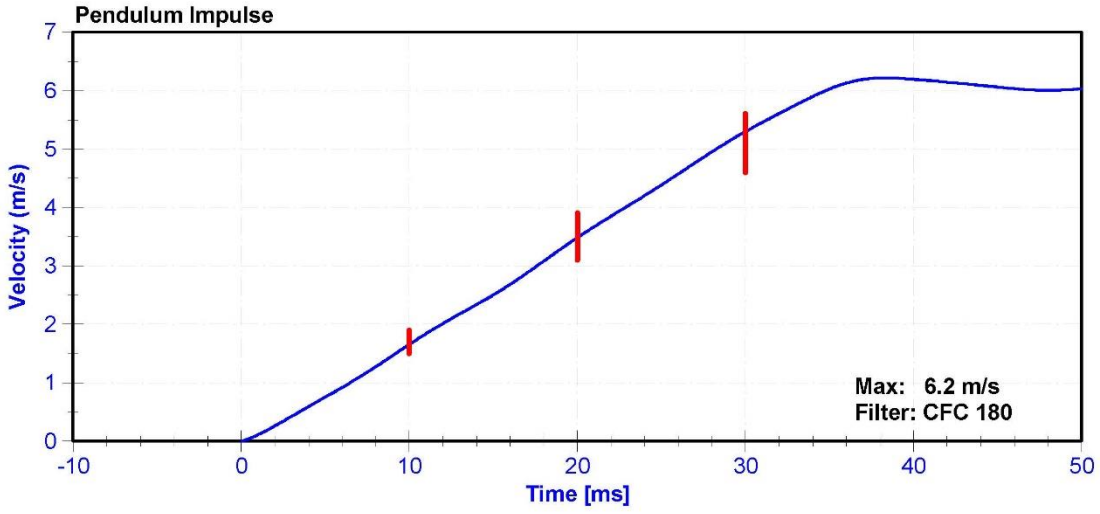
ATD Manufacturer	Denton	Test Technician	S. Keller
ATD Serial Number	139	Laboratory Supervisor	M. Goehle

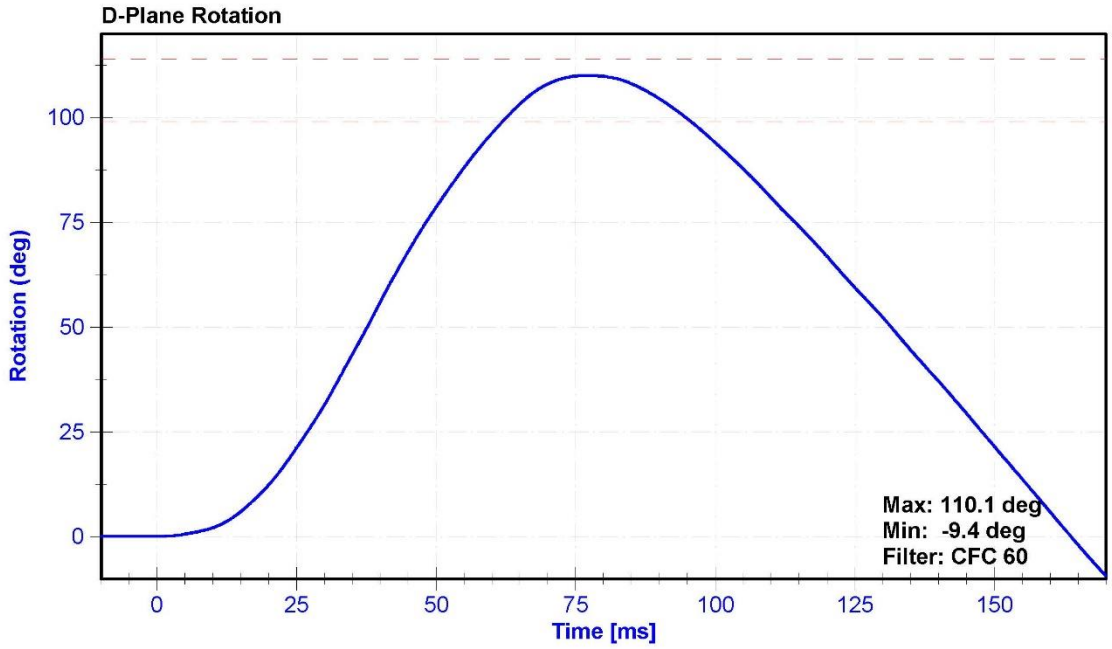
Results

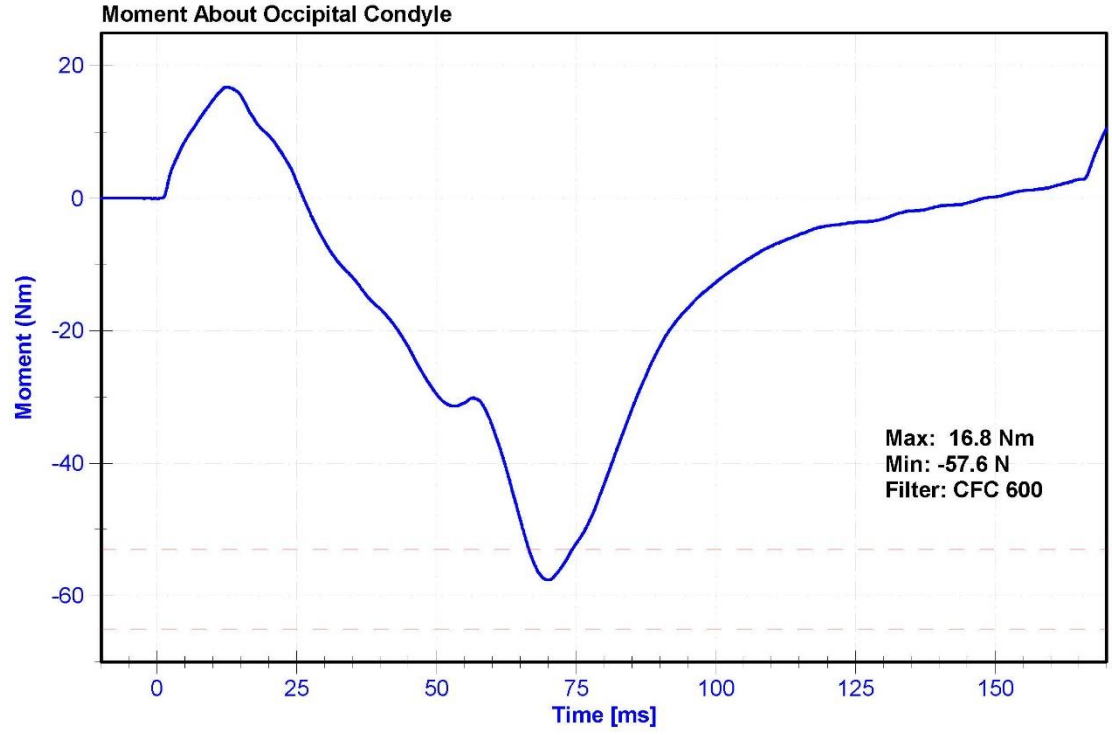
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.1	Pass
Humidity	10	70	%	43.1	Pass
Velocity	5.95	6.19	m/s	6.025	Pass
Pendulum Impulse at 10ms	1.5	1.9	m/s	1.66	Pass
Pendulum Impulse at 20ms	3.1	3.9	m/s	3.48	Pass
Pendulum Impulse at 30ms	4.6	5.6	m/s	5.30	Pass
D Plane Rotation	99	114	deg	110.1	Pass
Moment During Rotation Interval	-65	-53	Nm	-57.6	Pass
Moment Decay to -10Nm	94	114	ms	104.4	Pass

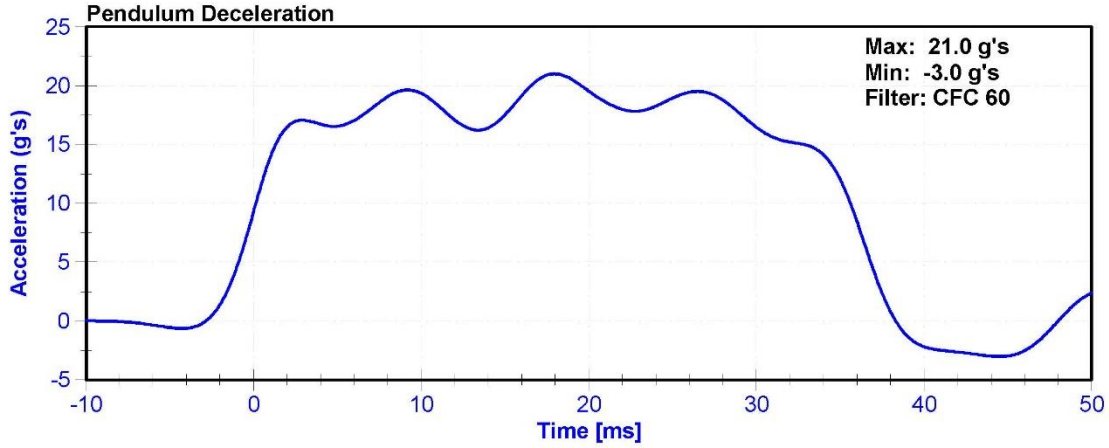
Transducer Calibrations

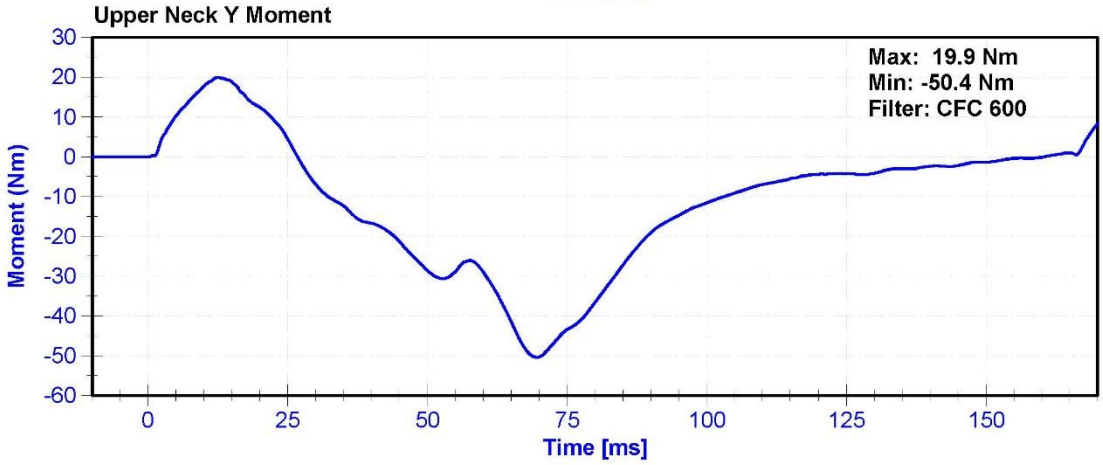
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-AH5F3	5/10/2016	5/10/2017
Pendulum Potentiometer	ETI SP22G	DS-PendPot	9/28/2015	9/27/2016
Condyle Potentiometer	ETI SP22G	DS-CondPot	9/28/2015	9/27/2016
Upper Neck Load Cell	Denton 1716A	LC-2018Fx	5/24/2016	5/24/2017

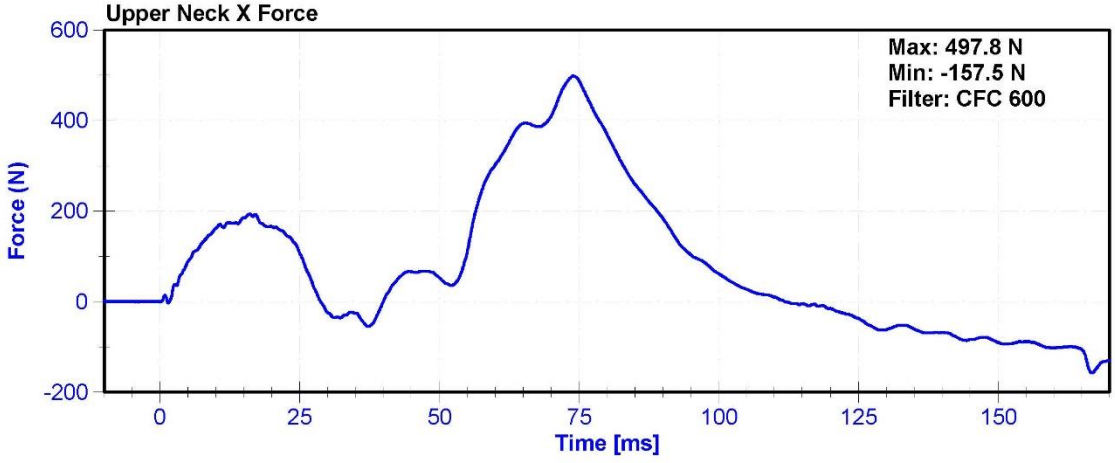



D-Plane Rotation
Rotation (deg)
100
75
50
25
0
0
25
50
75
100
125
150
Time [ms]
Max: 110.1 deg
Min: -9.4 deg
Filter: CFC 60


Moment About Occipital Condyle
Moment (Nm)
20
0
-20
-40
-60
0
25
50
75
100
125
150
Time [ms]
Max: 16.8 Nm
Min: -57.6 N
Filter: CFC 600


Pendulum Deceleration
Max: 21.0 g's
Min: -3.0 g's
Filter: CFC 60
Acceleration (g's)
Time [ms]


Upper Neck Y Moment
Max: 19.9 Nm
Min: -50.4 Nm
Filter: CFC 600
Moment (Nm)
Time [ms]


Upper Neck X Force
Max: 497.8 N
Min: -157.5 N
Filter: CFC 600
Force (N)
Time [ms]

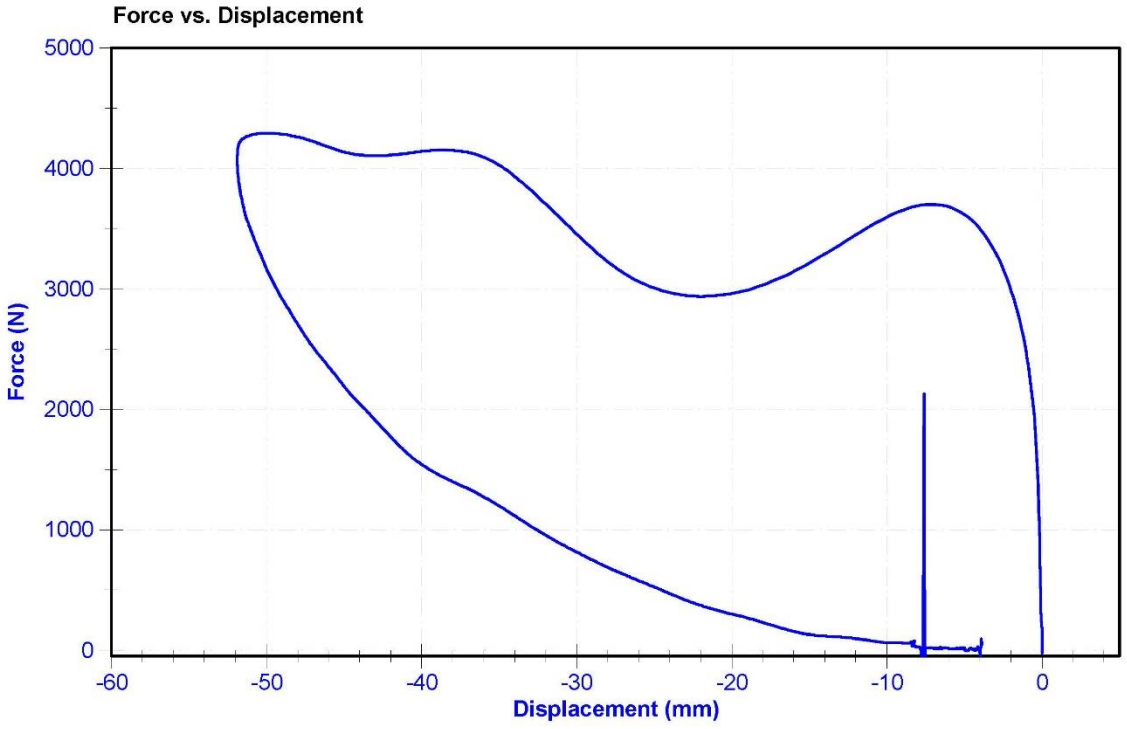
ATD Manufacturer	Denton	Test Technician	S. Keller
ATD Serial Number	139	Laboratory Supervisor	M. Goehle

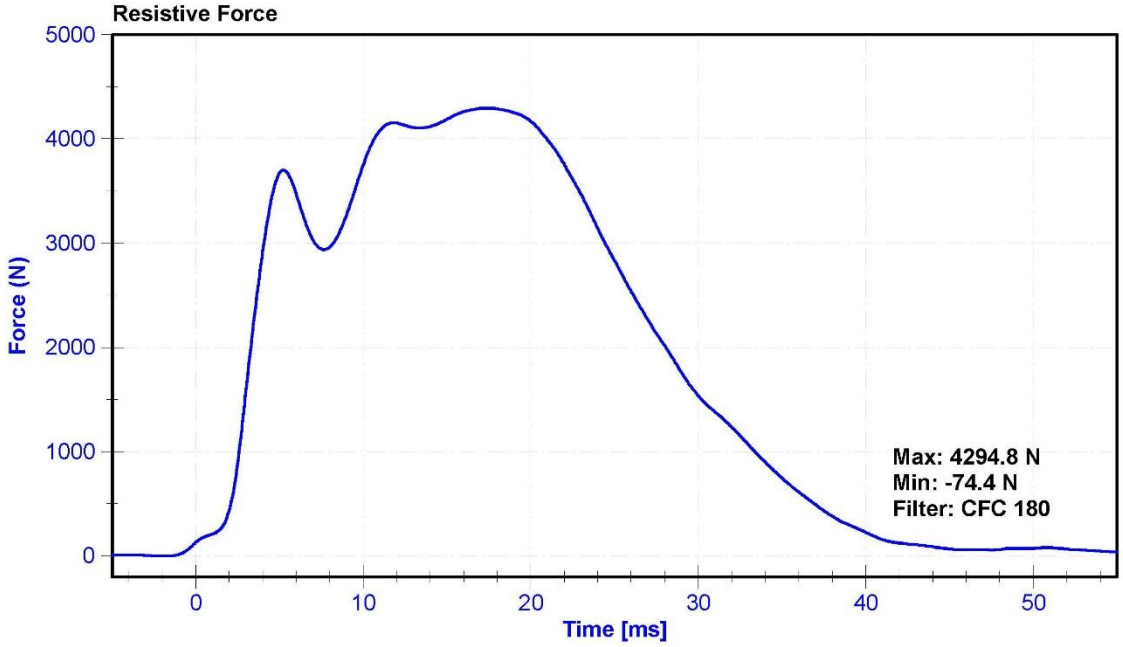
Results

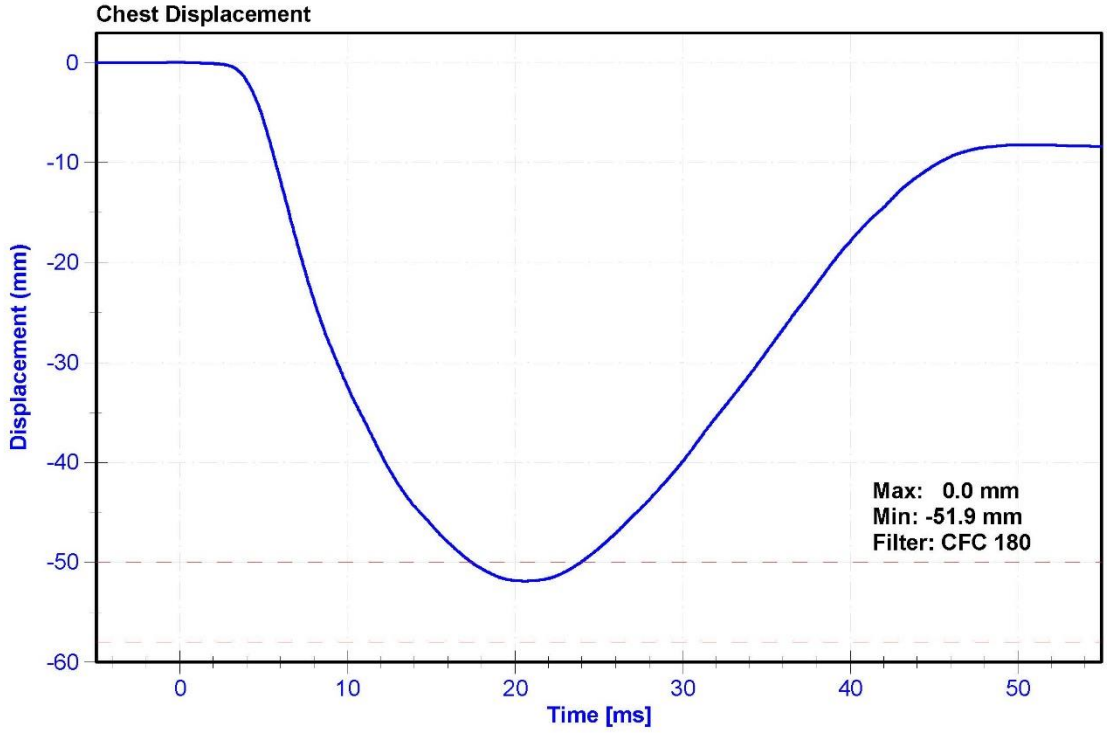
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.8	Pass
Humidity	10	70	%	40.2	Pass
Velocity	6.59	6.83	m/s	6.743	Pass
Chest Deflection	-58	-50	mm	-51.9	Pass
Maximum Resistive Force (50 to 58mm)	3900	4400	N	4294.8	Pass
Maximum Resistive Force (18 to 50mm)	0	4600	N	4294.8	Pass
Hysteresis	69	85	%	74.1	Pass

Transducer Calibrations

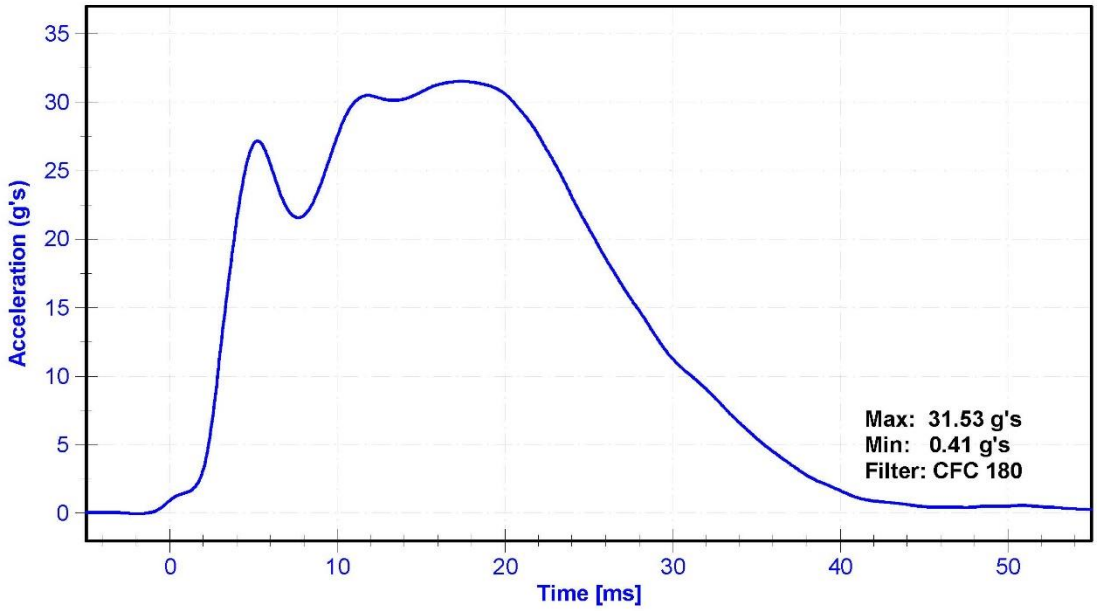
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7264CT	AC-P23155	1/13/2016	7/14/2016
Chest Potentiometer	Servo 14CBI-3615	DS-139	6/9/2016	6/9/2017



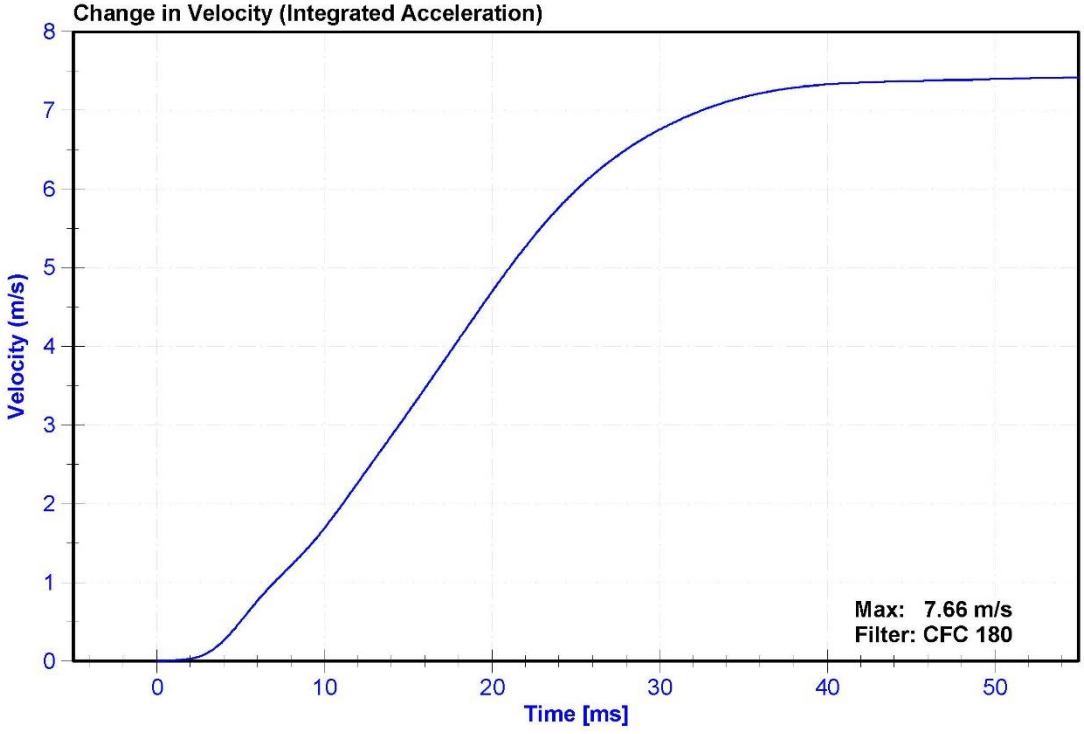

Resistive Force
5000
4000
3000
2000
1000
0
Force (N)
0
10
20
30
40
50
Time [ms]
Max: 4294.8 N
Min: -74.4 N
Filter: CFC 180


Chest Displacement
0
-10
-20
-30
-40
-50
-60
Displacement (mm)
0
10
20
30
40
50
Time [ms]
Max: 0.0 mm
Min: -51.9 mm
Filter: CFC 180

Probe Acceleration



Change in Velocity (Integrated Acceleration)



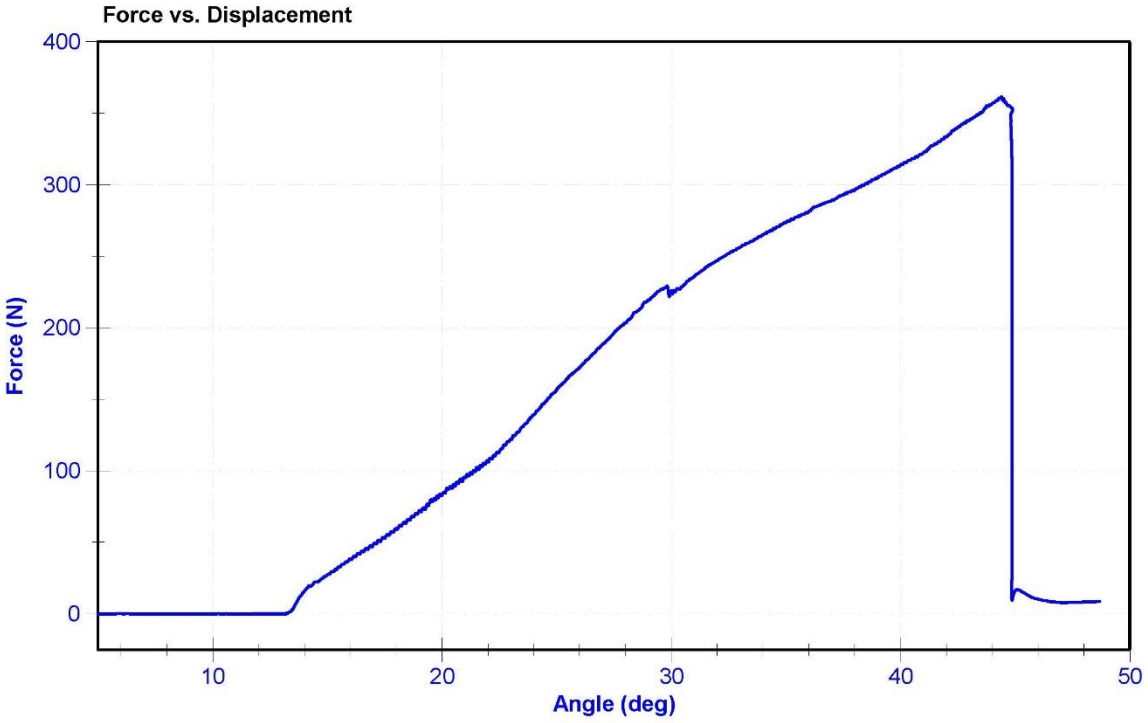
ATD Manufacturer	Denton	Test Technician	S. Keller
ATD Serial Number	139	Laboratory Supervisor	M. Goehle

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.6	25.6	°C	21	Pass
Humidity	10	70	%	43.1	Pass
Initial Angle	0	20	deg	12.5	Pass
Force at 45 Degrees	320	390	N	361.3	Pass
Return Angle Relative to Initial	0	8	deg	7.3	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	Rieker N4C-1	DS-13051548	8/14/2015	8/13/2016
Load Cell	Interface SML-200	LC-493319	8/13/2015	8/12/2016



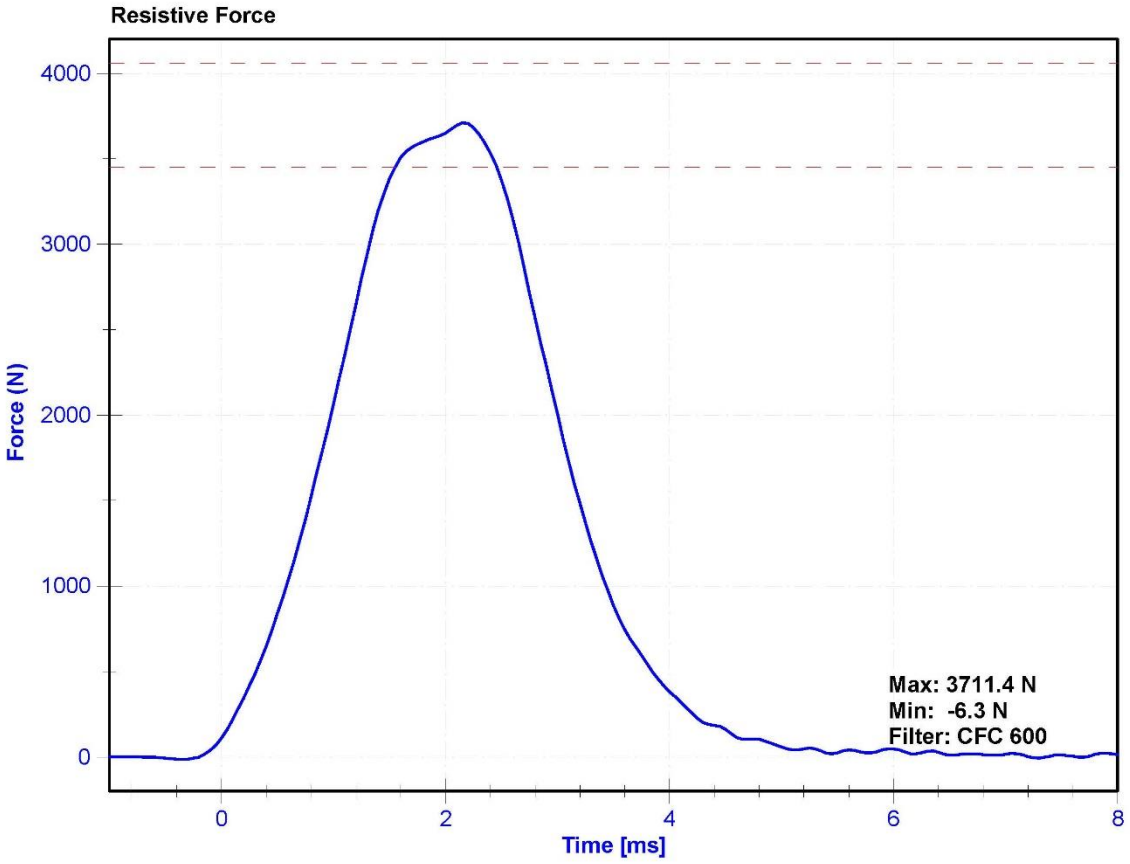
ATD Manufacturer	Denton	Test Technician	S. Keller
ATD Serial Number	139	Laboratory Supervisor	M. Gorhle

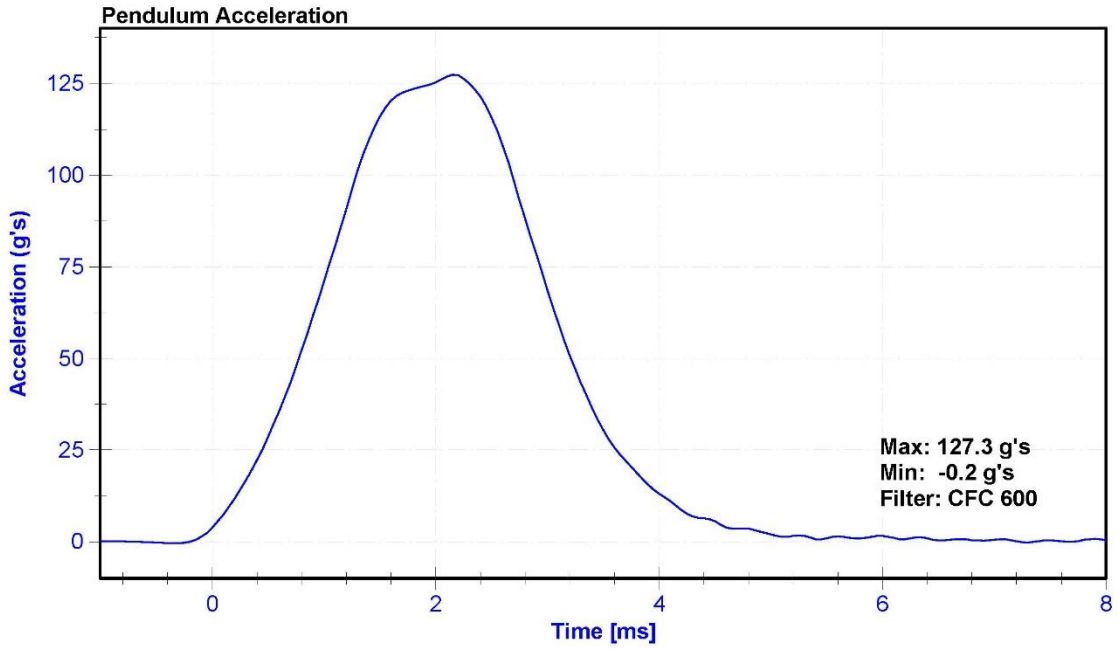
Results

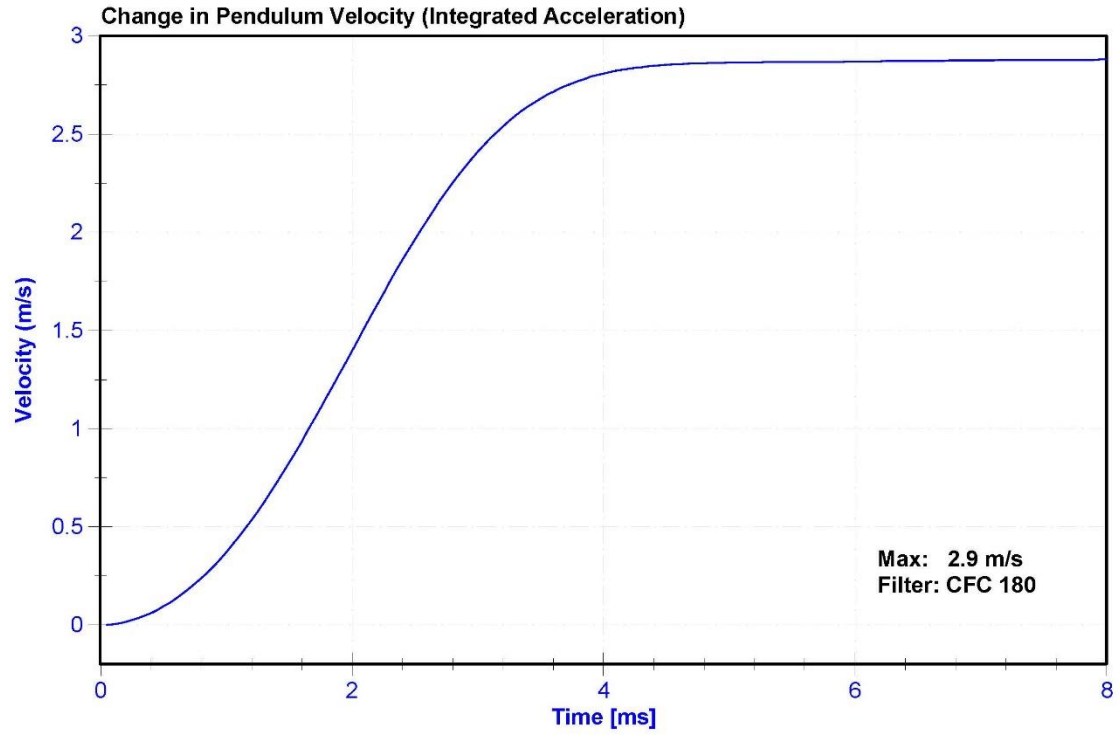
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	21.3	Pass
Humidity	10	70	%	33.4	Pass
Velocity	2.07	2.13	m/s	2.099	Pass
Resistive Force	3450	4060	N	3711.4	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7264CT	AC-P23155	1/13/2016	7/14/2016




Pendulum Acceleration
Acceleration (g's)
125
100
75
50
25
0
0
2
4
6
8
Time [ms]
Max: 127.3 g's
Min: -0.2 g's
Filter: CFC 600


Change in Pendulum Velocity (Integrated Acceleration)
Velocity (m/s)
3
2.5
2
1.5
1
0.5
0
0
2
4
6
8
Time [ms]
Max: 2.9 m/s
Filter: CFC 180

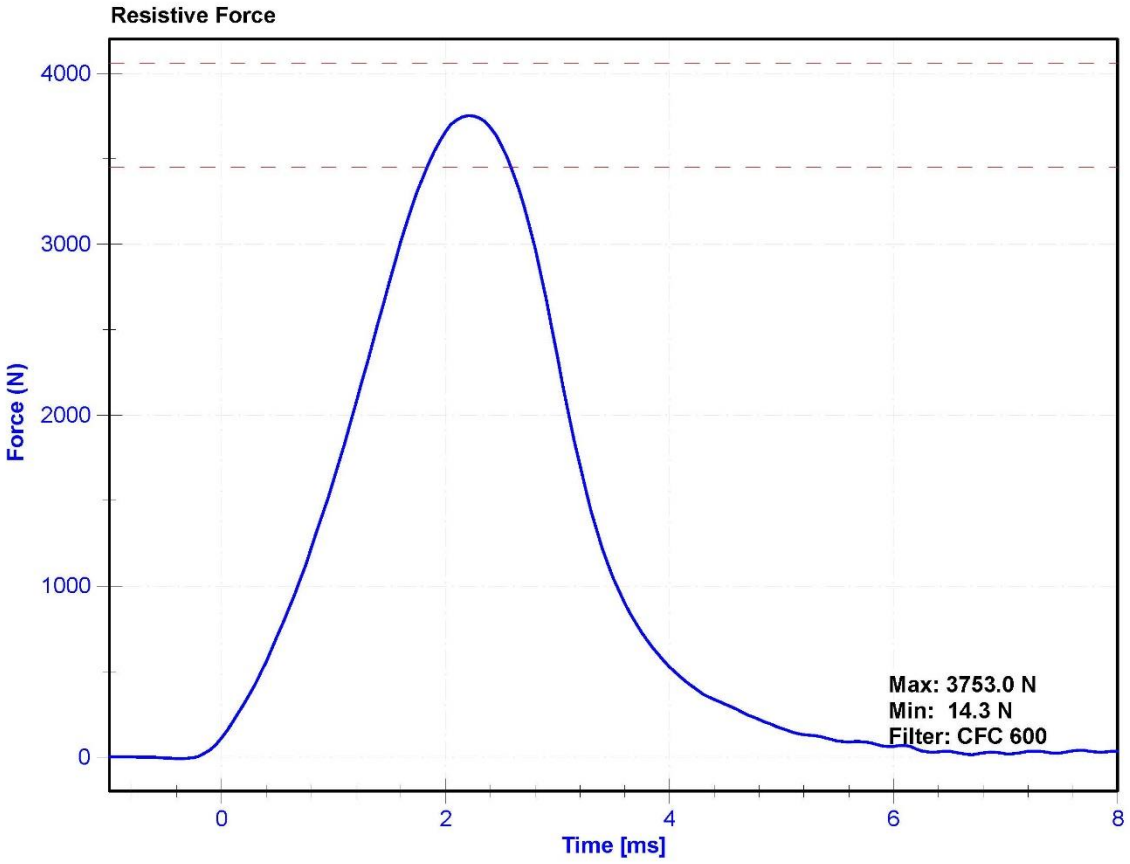
ATD Manufacturer	Denton	Test Technician	S. Keller
ATD Serial Number	139	Laboratory Supervisor	M. Gorhle

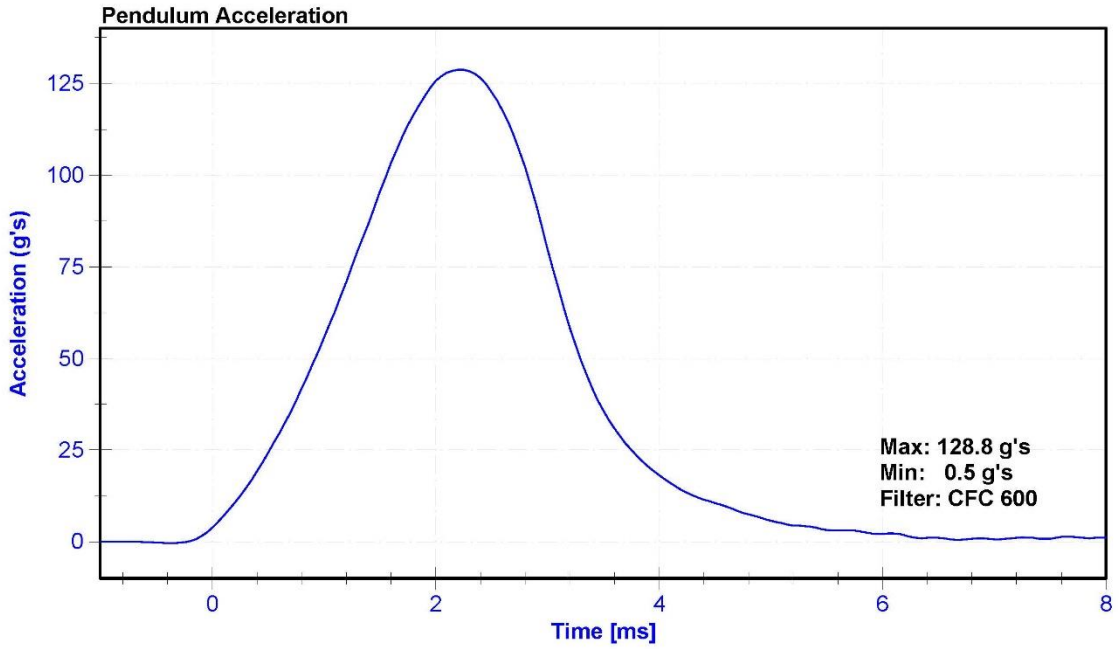
Results

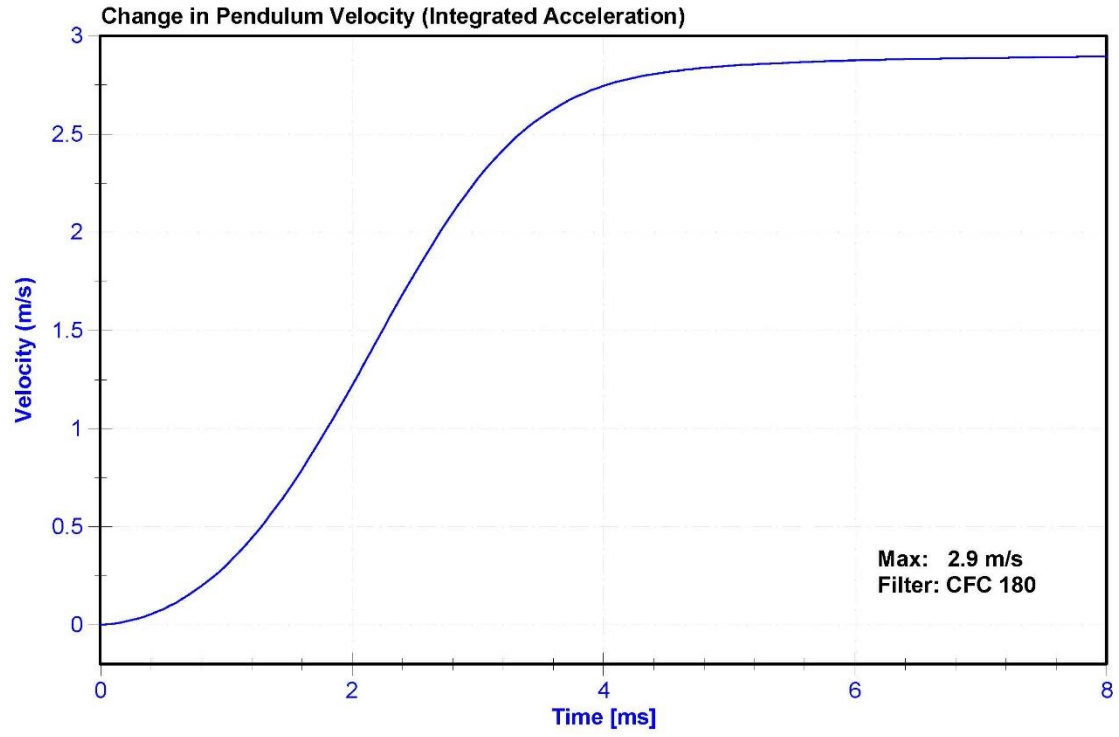
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	21.9	Pass
Humidity	10	70	%	32.7	Pass
Velocity	2.07	2.13	m/s	2.091	Pass
Resistive Force	3450	4060	N	3753.0	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7264CT	AC-P23155	1/13/2016	7/14/2016




Pendulum Acceleration
Acceleration (g's)
125
100
75
50
25
0
0
2
4
6
8
Time [ms]
Max: 128.8 g's
Min: 0.5 g's
Filter: CFC 600


Change in Pendulum Velocity (Integrated Acceleration)
Velocity (m/s)
3
2.5
2
1.5
1
0.5
0
0
2
4
6
8
Time [ms]
Max: 2.9 m/s
Filter: CFC 180

CALIBRATION TEST RESULTS

POST-TEST

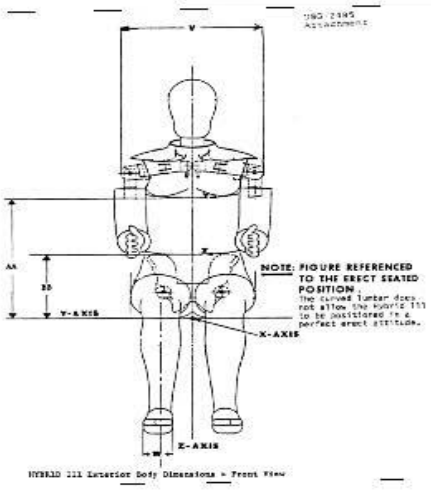
HYBRID III 50TH PERCENTILE MALE - DRIVER ATD

SERIAL NO: 142

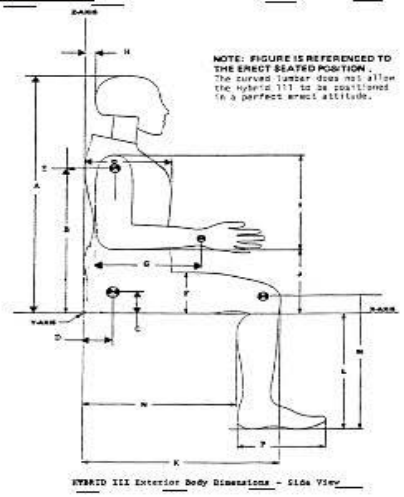
External Measurements - Hybrid 3 - 50th Male

Technician: Ian Dunkle Date: 6/27/2016

Dummy Serial Number: 142



HYBRID III Exterior Body Dimensions - Front View



HYBRID III Exterior Body Dimensions - Side View

Symbol	Description	Specification (in)		Result (in)	Pass/Fail
A	Sitting Height	34.6	35.0	34.8	Pass
B	Shoulder Pivot Height	19.9	20.5	20.0	Pass
C	H-Point Height	3.3	3.5	3.5	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	6.0	Pass
G	Back of Elbow to Wrist Pivot	11.4	12.0	11.5	Pass
H	Head Back to Backline	1.6	1.8	1.7	Pass
I	Shoulder to Elbow Length	13.0	13.6	13.1	Pass
J	Elbow Rest Height	7.5	8.3	8.2	Pass
K	Buttock to Knee Length	22.8	23.8	23.0	Pass
L	Popliteal Height	16.9	17.9	17.8	Pass
M	Knee Pivot Height	19.1	19.7	19.6	Pass
N	Buttock Popliteal Length	17.8	18.8	18.3	Pass
O	Chest Depth without Jacket	8.4	9.0	8.5	Pass
P	Foot Length (right)	9.9	10.5	10.3	Pass
V	Shoulder Breadth	16.3	17.2	17.0	Pass
W	Foot Breadth	3.6	4.2	4.0	Pass
Y	Chest Circumference with Jacket	38.2	39.4	39.3	Pass
Z	Waist Circumference	32.9	34.1	34.0	Pass
AA	Reference Location (Chest Circumference)	16.9	17.1	17.0	Pass
BB	Reference Location (Waist Circumference)	8.9	9.1	9.0	Pass

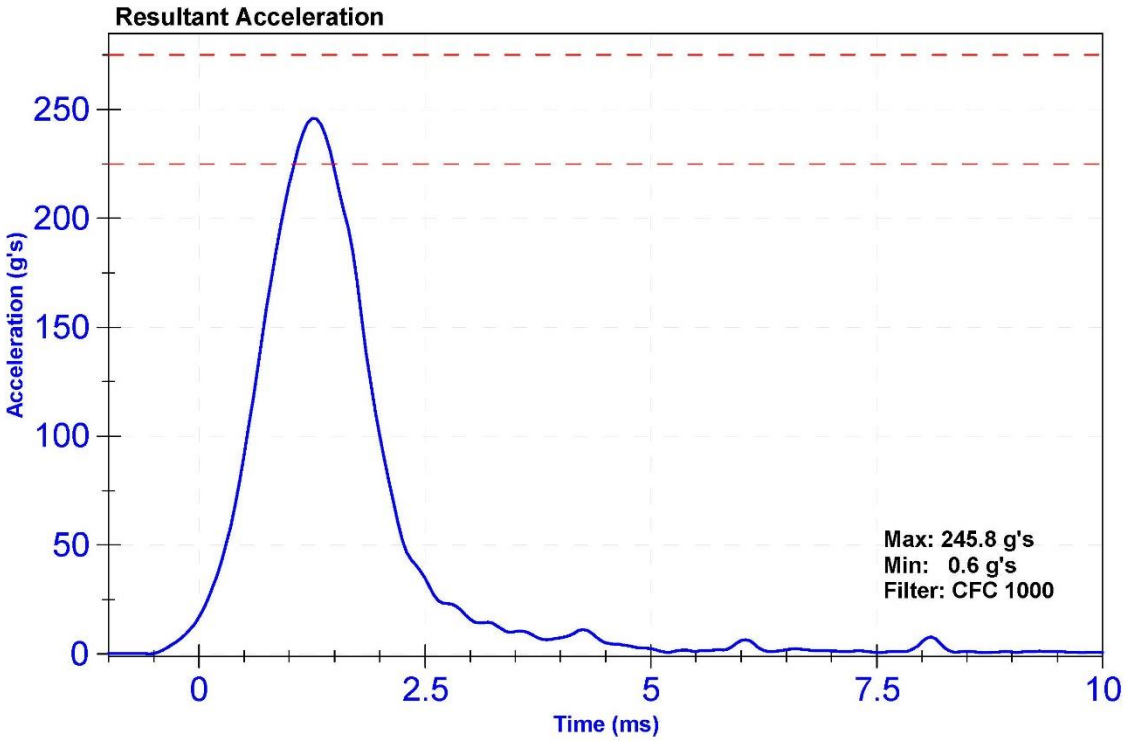
ATD Manufacturer	Humanetics	Test Technician	I. Dunkle
ATD Serial Number	142	Laboratory Supervisor	M. Goehle

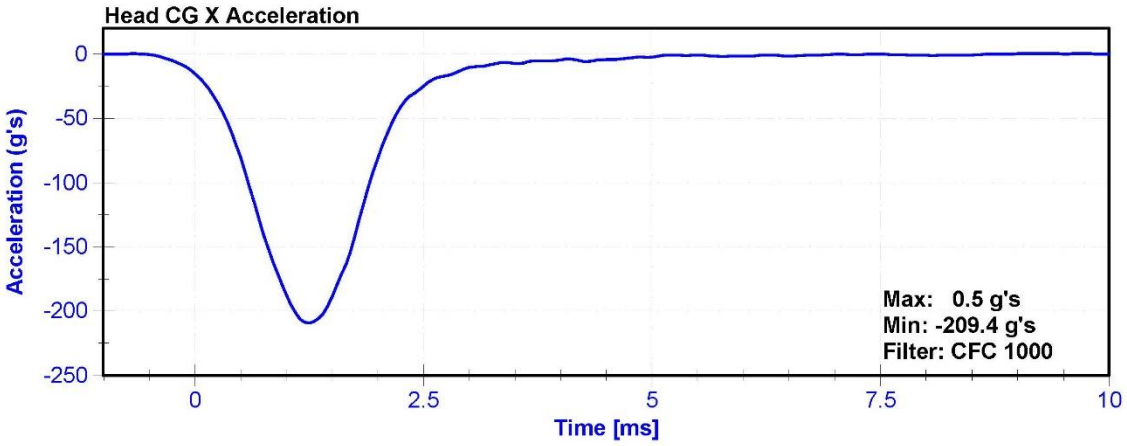
Results

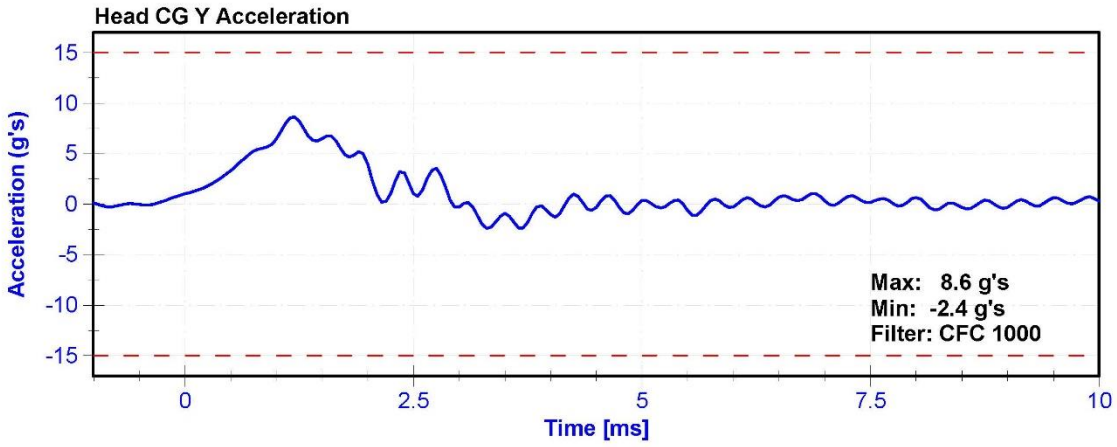
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	21.1	Pass
Humidity	10	70	%	44.2	Pass
Resultant Acceleration	225	275	g's	245.8	Pass
Oscillation	0	10	%	4.6	Pass
Lateral Acceleration	-15	15	g's	8.6	Pass

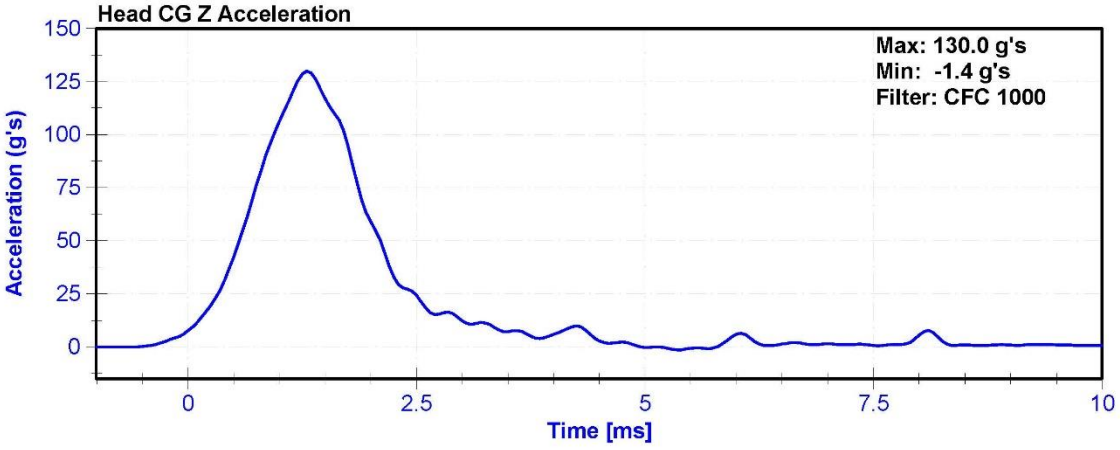
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	ENDEVCO 7264CT	AC-P58998	6/8/2016	12/7/2016
Y Accelerometer	ENDEVCO 7264CT	AC-P58912	6/8/2016	12/7/2016
Z Accelerometer	ENDEVCO 7264CT	AC-P58997	6/8/2016	12/7/2016




Head CG X Acceleration
Acceleration (g's)
0
-50
-100
-150
-200
-250
0
2.5
5
7.5
10
Time [ms]
Max: 0.5 g's
Min: -209.4 g's
Filter: CFC 1000


Head CG Y Acceleration
Acceleration (g's)
15
10
5
0
-5
-10
-15
0
2.5
5
7.5
10
Time [ms]
Max: 8.6 g's
Min: -2.4 g's
Filter: CFC 1000


Head CG Z Acceleration
Acceleration (g's)
150
125
100
75
50
25
0
0
2.5
5
7.5
10
Time [ms]
Max: 130.0 g's
Min: -1.4 g's
Filter: CFC 1000

ATD Manufacturer	Humanetics	Test Technician	I. Dunkle
ATD Serial Number	142	Laboratory Supervisor	M. Goehle

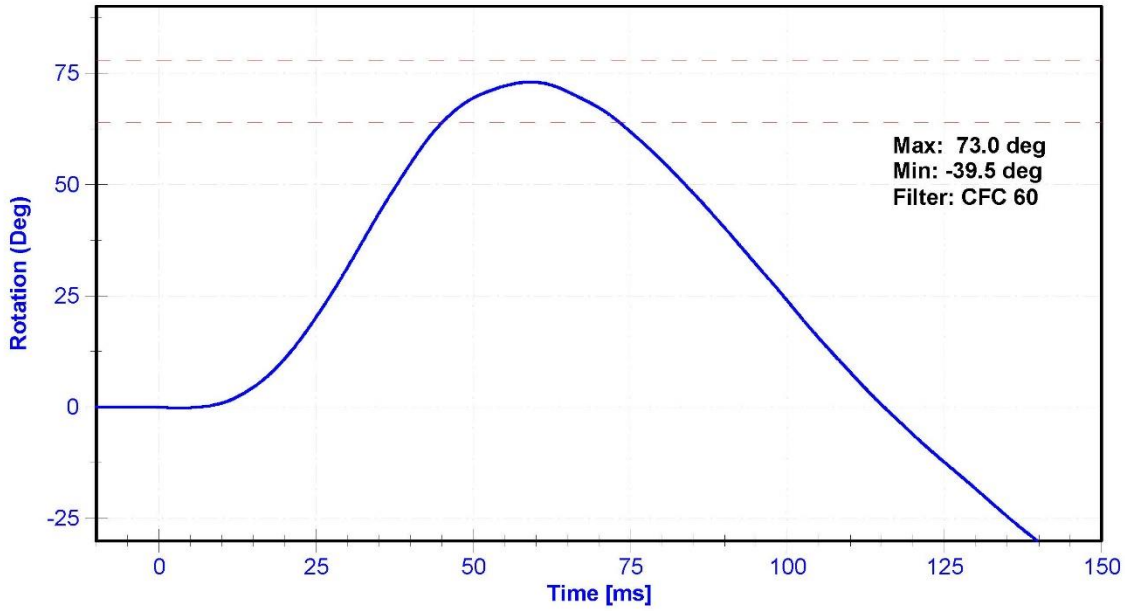
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.2	Pass
Humidity	10	70	%	40.6	Pass
Velocity	6.89	7.13	m/s	6.979	Pass
Pendulum Deceleration at 10ms	22.5	27.5	g's	23.71	Pass
Pendulum Deceleration at 20ms	17.6	22.6	g's	22.25	Pass
Pendulum Deceleration at 30ms	12.5	18.5	g's	14.67	Pass
Max. Pendulum Deceleration After 30ms	0	29	g's	24.9	Pass
Pendulum Deceleration Time to 5 g's	34	42	ms	38.4	Pass
Maximum D Plane Rotation	64	78	deg	73.0	Pass
Time to Maximum Rotation	57	64	ms	59.1	Pass
Rotation Decay to Zero	113	127	ms	115.4	Pass
Moment About Occipital Condyle	88.1	108.4	Nm	93.85	Pass
Time to Maximum Moment	47	58	ms	50.0	Pass
Moment Decay to Zero	97	107	ms	100.1	Pass

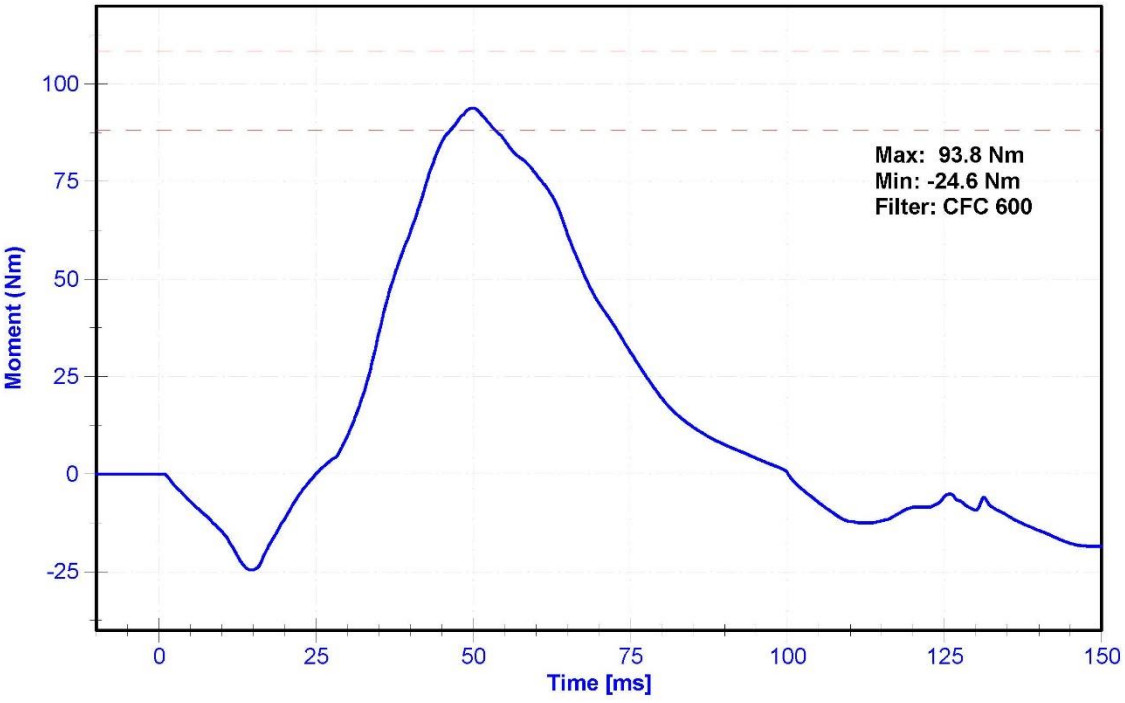
Transducer Calibrations

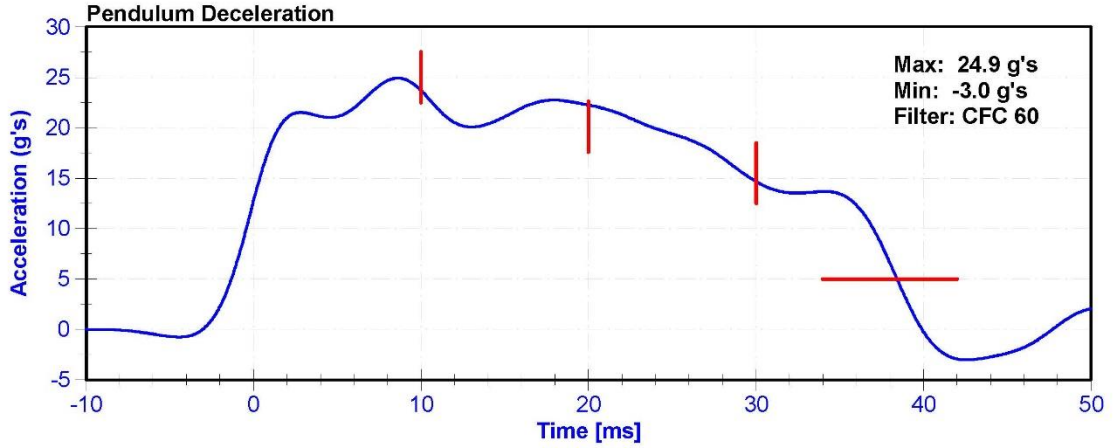
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-AH5F3	5/10/2016	5/10/2017
Pendulum Potentiometer	ETI SP22G	DS-PendPot	9/28/2015	9/27/2016
Condyle Potentiometer	ETI SP22G	DS-CondPot	9/28/2015	9/27/2016
Upper Neck Load Cell	FTSS IF-205	LC-161Fx	5/24/2016	5/24/2017

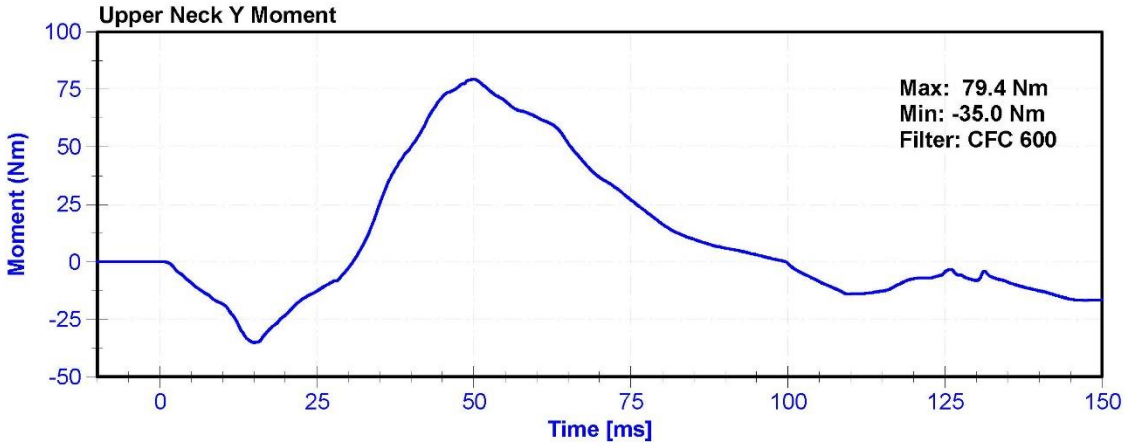
D-Plane Rotation

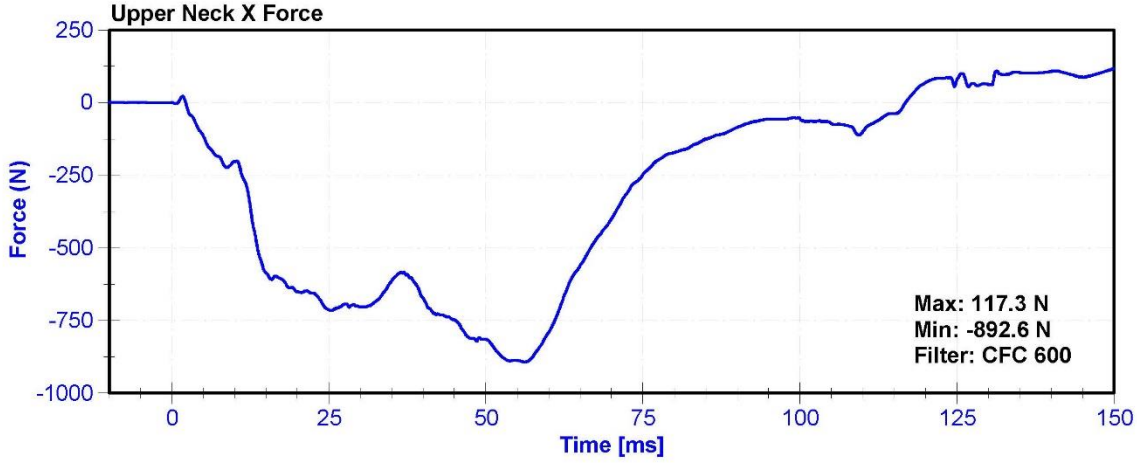


Moment About Occipital Condyle




Pendulum Deceleration
Max: 24.9 g's
Min: -3.0 g's
Filter: CFC 60
Acceleration (g's)
Time [ms]


Upper Neck Y Moment
Max: 79.4 Nm
Min: -35.0 Nm
Filter: CFC 600
Moment (Nm)
Time [ms]


Upper Neck X Force
Max: 117.3 N
Min: -892.6 N
Filter: CFC 600
Force (N)
Time [ms]

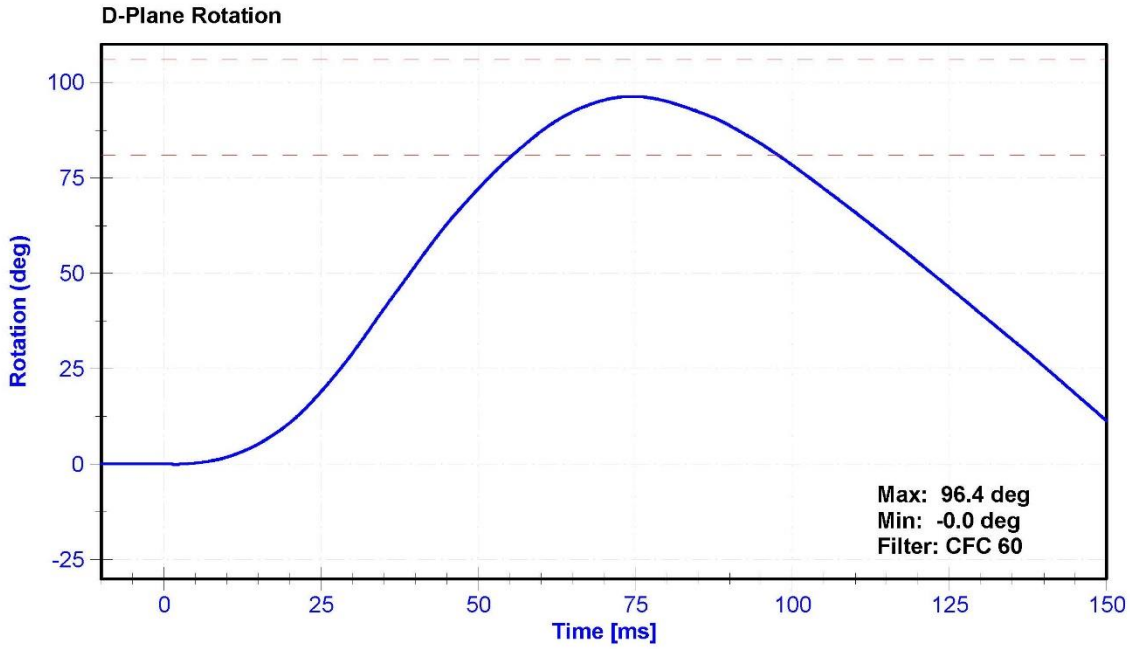
ATD Manufacturer	Humanetics	Test Technician	I. Dunkle
ATD Serial Number	142	Laboratory Supervisor	M. Goehle

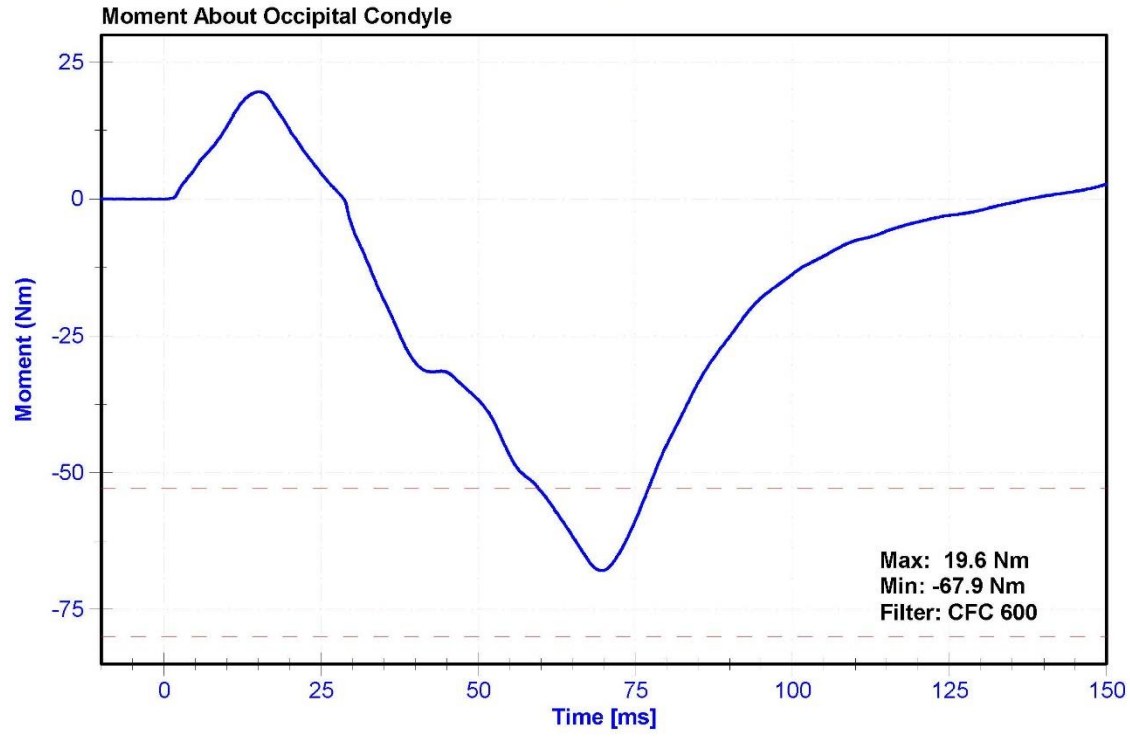
Results

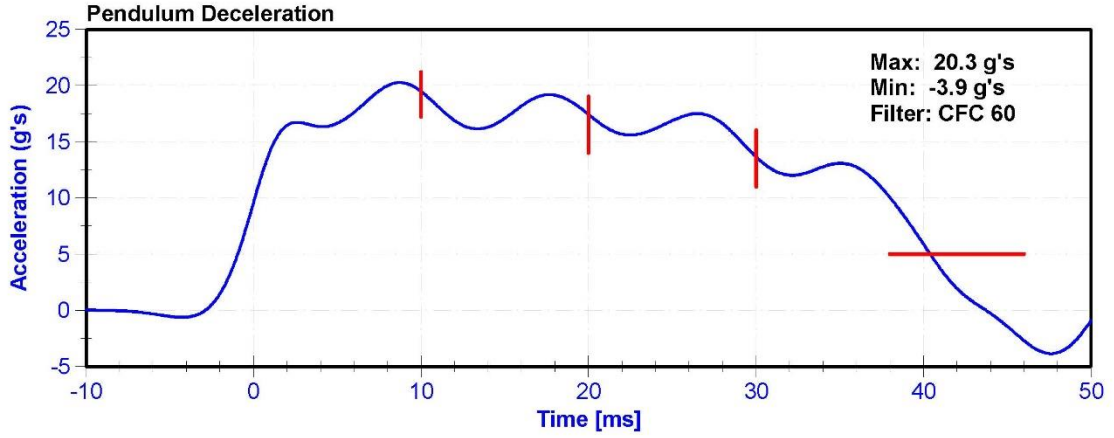
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.9	Pass
Humidity	10	70	%	41.7	Pass
Velocity	5.94	6.19	m/s	6.068	Pass
Pendulum Deceleration at 10ms	17.2	21.2	g's	19.48	Pass
Pendulum Deceleration at 20ms	14	19	g's	17.4	Pass
Pendulum Deceleration at 30ms	11	16	g's	13.7	Pass
Max. Pendulum Deceleration After 30ms	0	22	g's	20.3	Pass
Pendulum Deceleration Time to 5 g's	38	46	ms	40.4	Pass
Maximum D Plane Rotation	81	106	deg	96.4	Pass
Time to Maximum Rotation	72	82	ms	74.6	Pass
Rotation Decay to Zero	147	174	ms	157.8	Pass
Minimum Moment About OC	-80	-52.9	Nm	-67.91	Pass
Time to Minimum Moment	65	79	ms	69.7	Pass
Moment Decay to Zero	120	148	ms	137.7	Pass

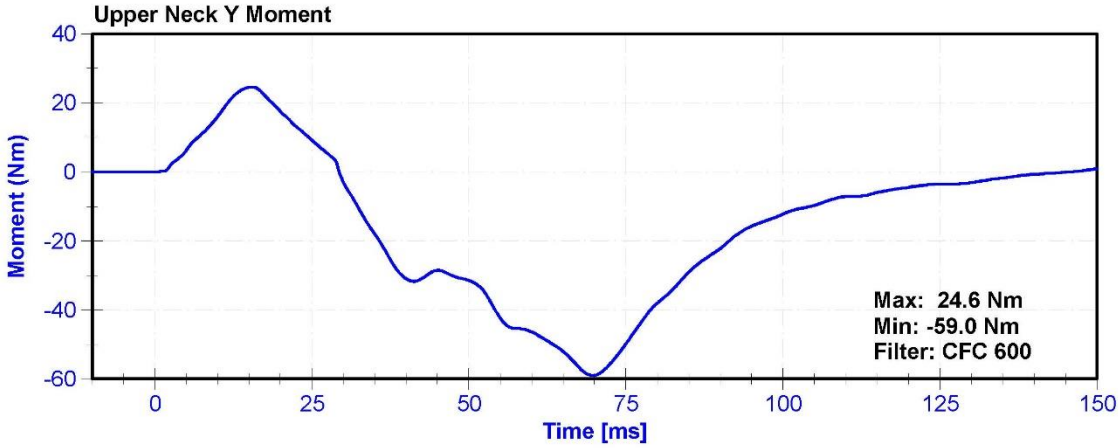
Transducer Calibrations

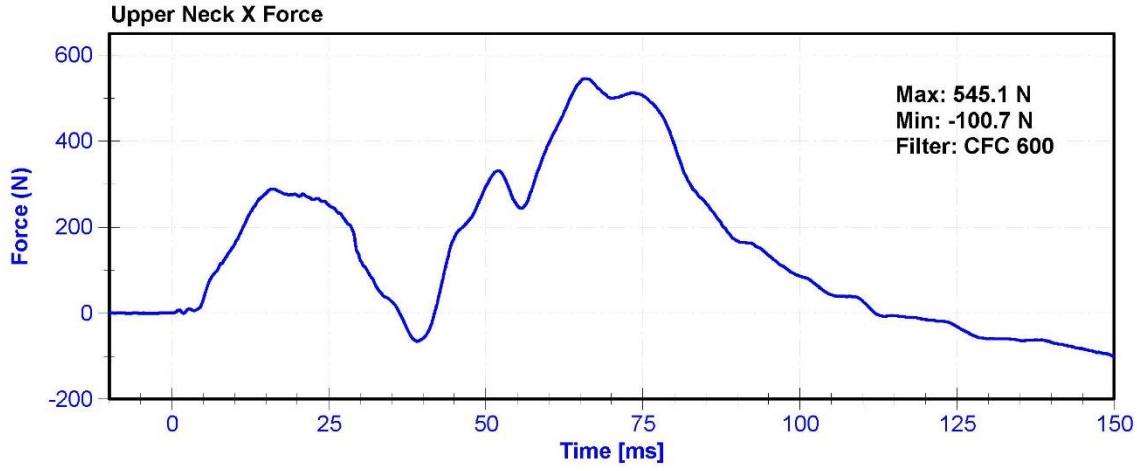
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-AH5F3	5/10/2016	5/10/2017
Pendulum Potentiometer	ETI SP22G	DS-PendPot	9/28/2015	9/27/2016
Condyle Potentiometer	ETI SP22G	DS-CondPot	9/28/2015	9/27/2016
Upper Neck Load Cell	FTSS IF-205	LC-161Fx	5/24/2016	5/24/2017


D-Plane Rotation
Rotation (deg)
100
75
50
25
0
-25
0
25
50
75
100
125
150
Time [ms]
Max: 96.4 deg
Min: -0.0 deg
Filter: CFC 60


Moment About Occipital Condyle
Moment (Nm)
25
0
-25
-50
-75
0
25
50
75
100
125
150
Time [ms]
Max: 19.6 Nm
Min: -67.9 Nm
Filter: CFC 600


Pendulum Deceleration
Max: 20.3 g's
Min: -3.9 g's
Filter: CFC 60
Acceleration (g's)
25
20
15
10
5
0
-5
-10
0
10
20
30
40
50
Time [ms]


Upper Neck Y Moment
Max: 24.6 Nm
Min: -59.0 Nm
Filter: CFC 600
Moment (Nm)
40
20
0
-20
-40
-60
0
25
50
75
100
125
150
Time [ms]


Upper Neck X Force
Max: 545.1 N
Min: -100.7 N
Filter: CFC 600
Force (N)
600
400
200
0
-200
0
25
50
75
100
125
150
Time [ms]

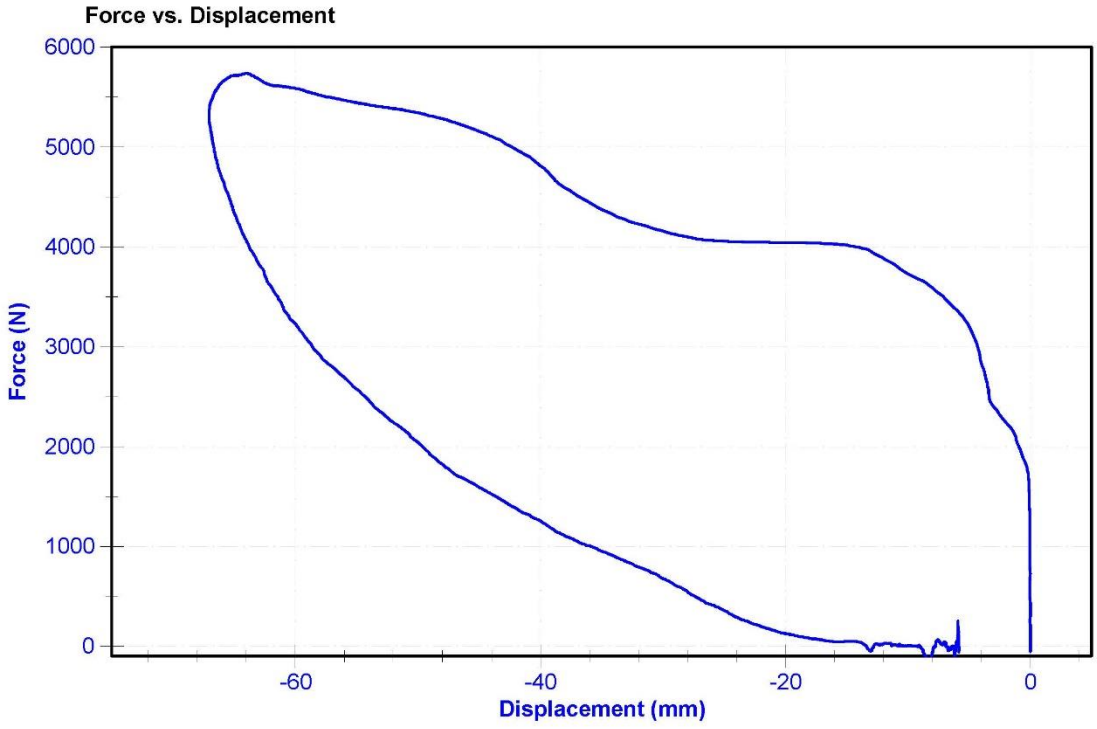
ATD Manufacturer	Humanetics	Test Technician	I. Dunkle
ATD Serial Number	142	Laboratory Supervisor	M. Goehle

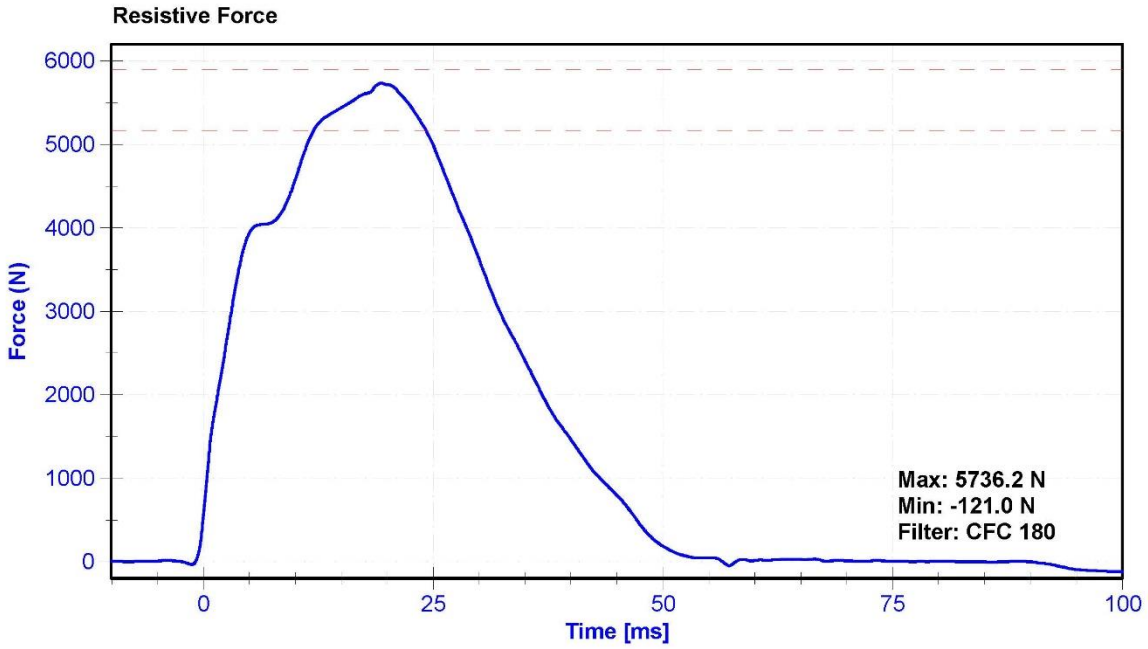
Results

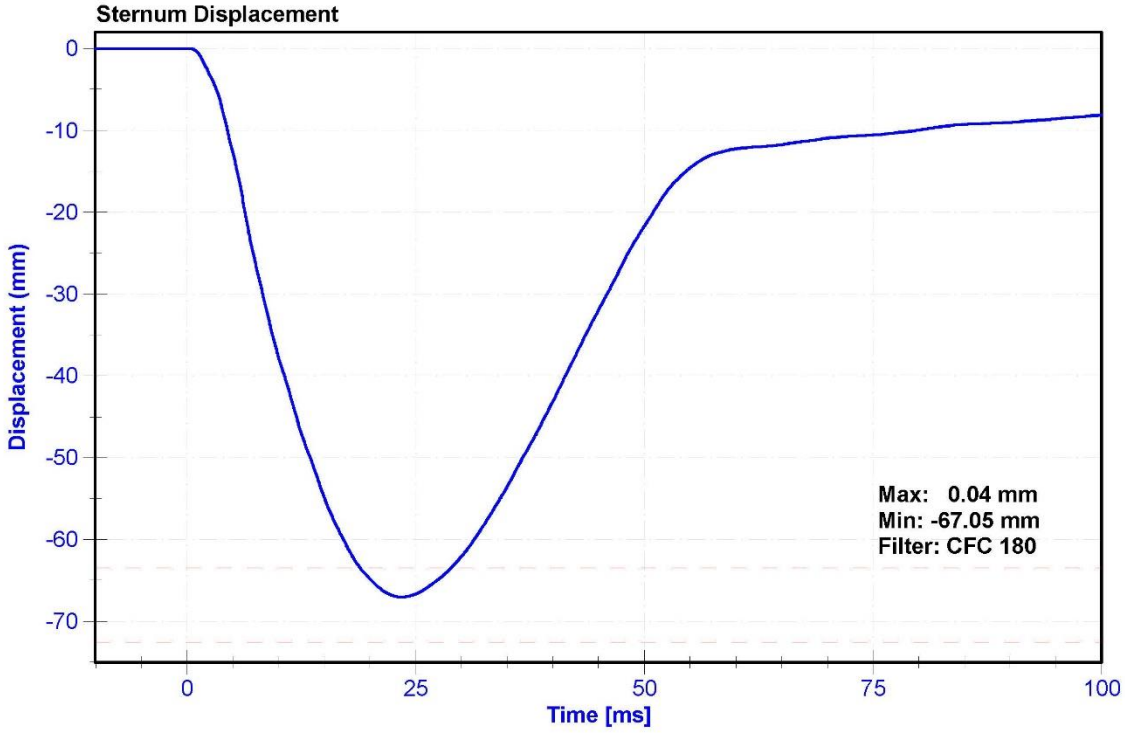
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.8	Pass
Humidity	10	70	%	64.9	Pass
Velocity	6.59	6.83	m/s	6.655	Pass
Chest Displacement	-72.6	-63.5	mm	-67.05	Pass
Resistive Force	5160	5894	N	5736.2	Pass
Hysteresis	65	85	%	72.0	Pass

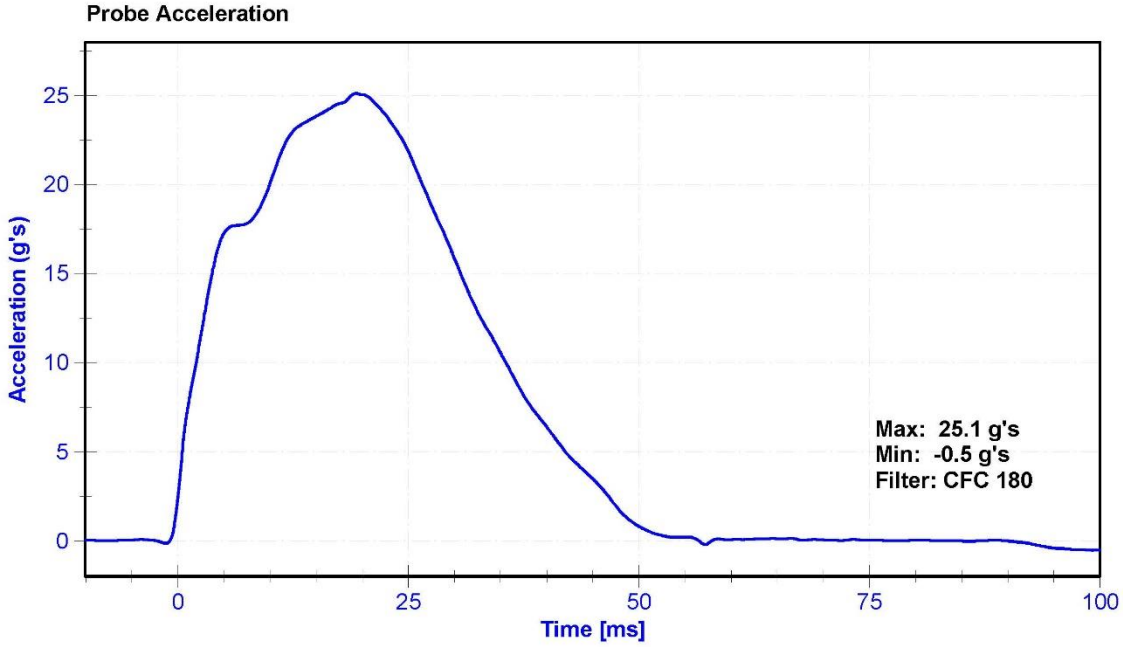
Transducer Calibrations

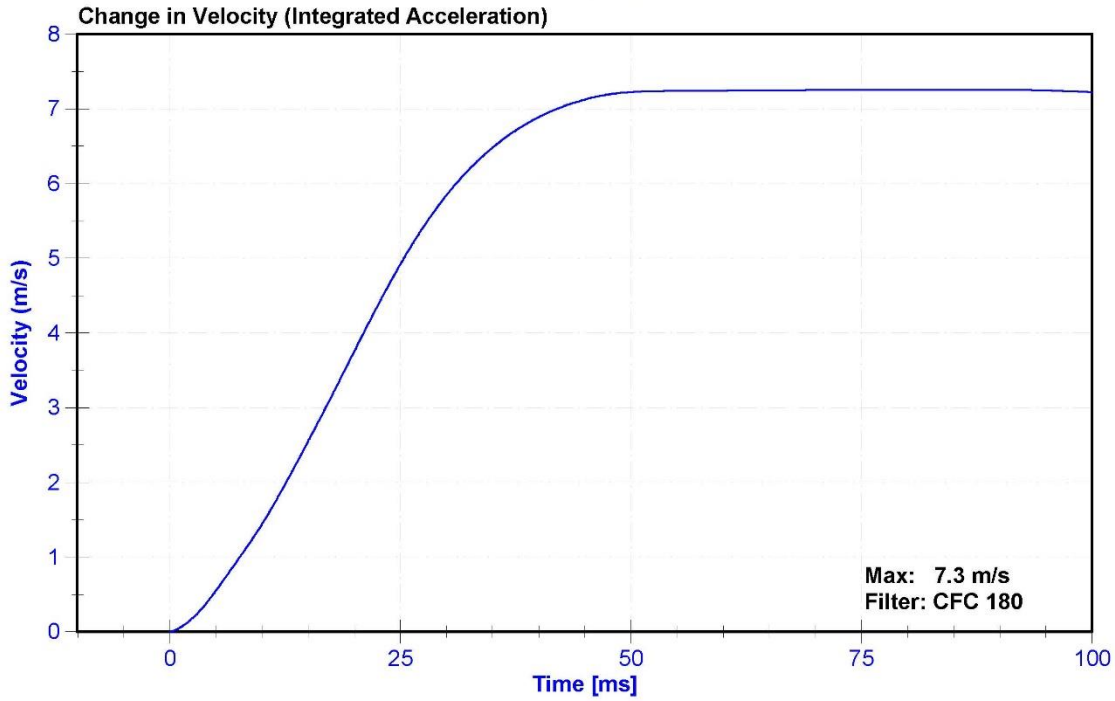
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7264CT	AC-P23155	1/13/2016	7/14/2016
Chest Potentiometer	JDK 6209-2038	DS-142	6/8/2016	6/8/2017




Resistive Force
6000
5000
4000
3000
2000
1000
0
Force (N)
0
25
50
75
100
Time [ms]
Max: 5736.2 N
Min: -121.0 N
Filter: CFC 180


Sternum Displacement
0
-10
-20
-30
-40
-50
-60
-70
Displacement (mm)
0
25
50
75
100
Time [ms]
Max: 0.04 mm
Min: -67.05 mm
Filter: CFC 180


Probe Acceleration
Acceleration (g's)
25
20
15
10
5
0
0
25
50
75
100
Time [ms]
Max: 25.1 g's
Min: -0.5 g's
Filter: CFC 180


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

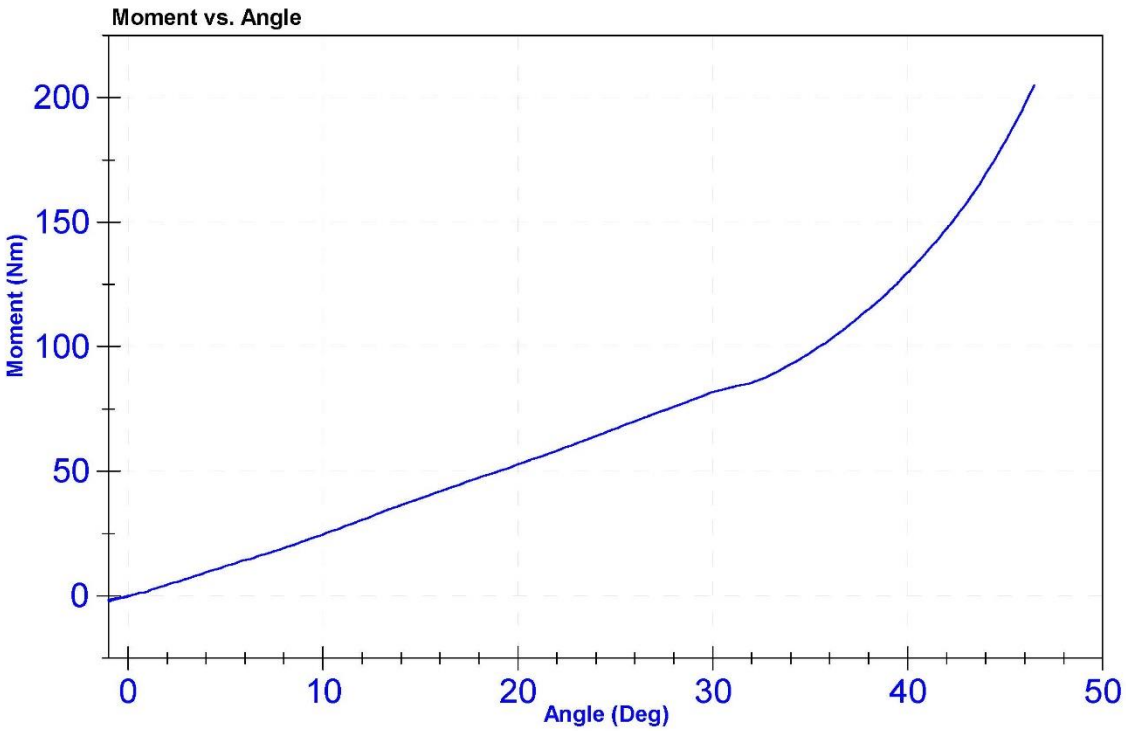
ATD Manufacturer	Humanetics	Test Technician	I. Dunkle
ATD Serial Number	142	Laboratory Supervisor	M. Goehle

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	21.1	Pass
Humidity	10	70	%	42.5	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	81.8	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	ETI SP22	DS-0008	4/4/2016	4/4/2017
Load Cell	Key Trans 2301-02	LC-115 My	10/3/2015	10/2/2016



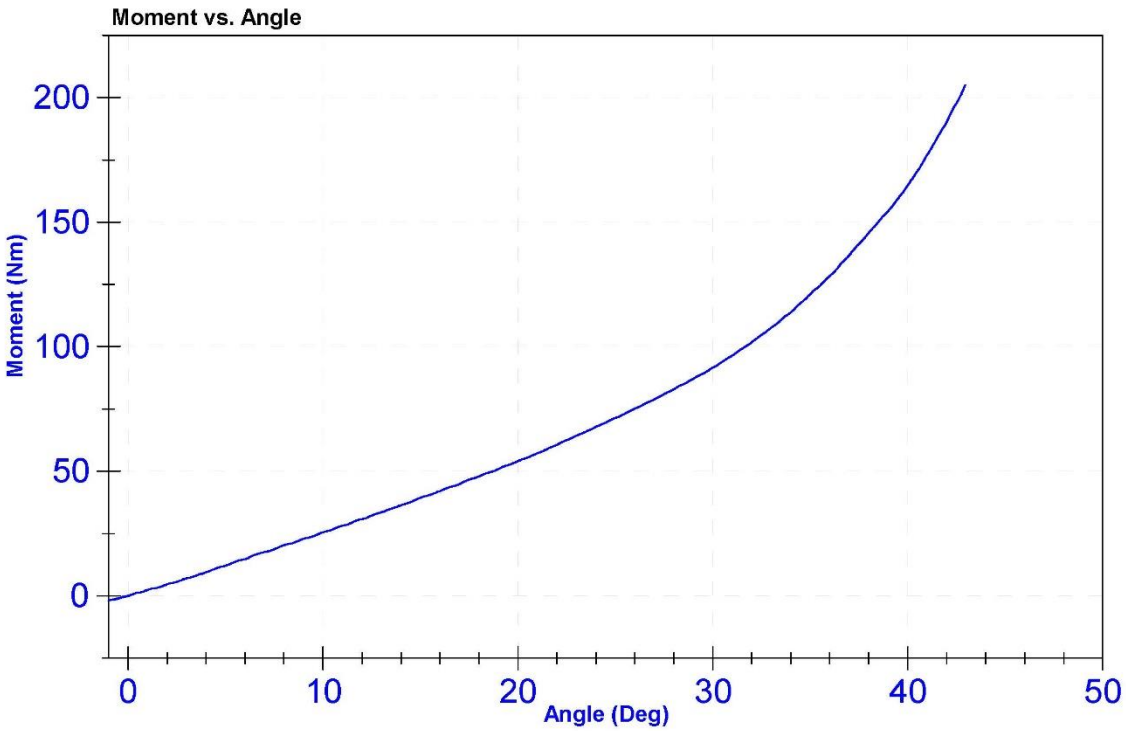
ATD Manufacturer	Humanetics	Test Technician	I. Dunkle
ATD Serial Number	142	Laboratory Supervisor	M. Goehle

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	21.3	Pass
Humidity	10	70	%	43.0	Pass
Average Velocity	5	10	deg/s	7.3	Pass
Angle at 203Nm	40	50	deg	42.8	Pass
Moment at 30 degrees	0	94.9	Nm	91.6	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	ETI SP22	DS-0008	4/4/2016	4/4/2017
Load Cell	Key Trans 2301-02	LC-115 My	10/3/2015	10/2/2016



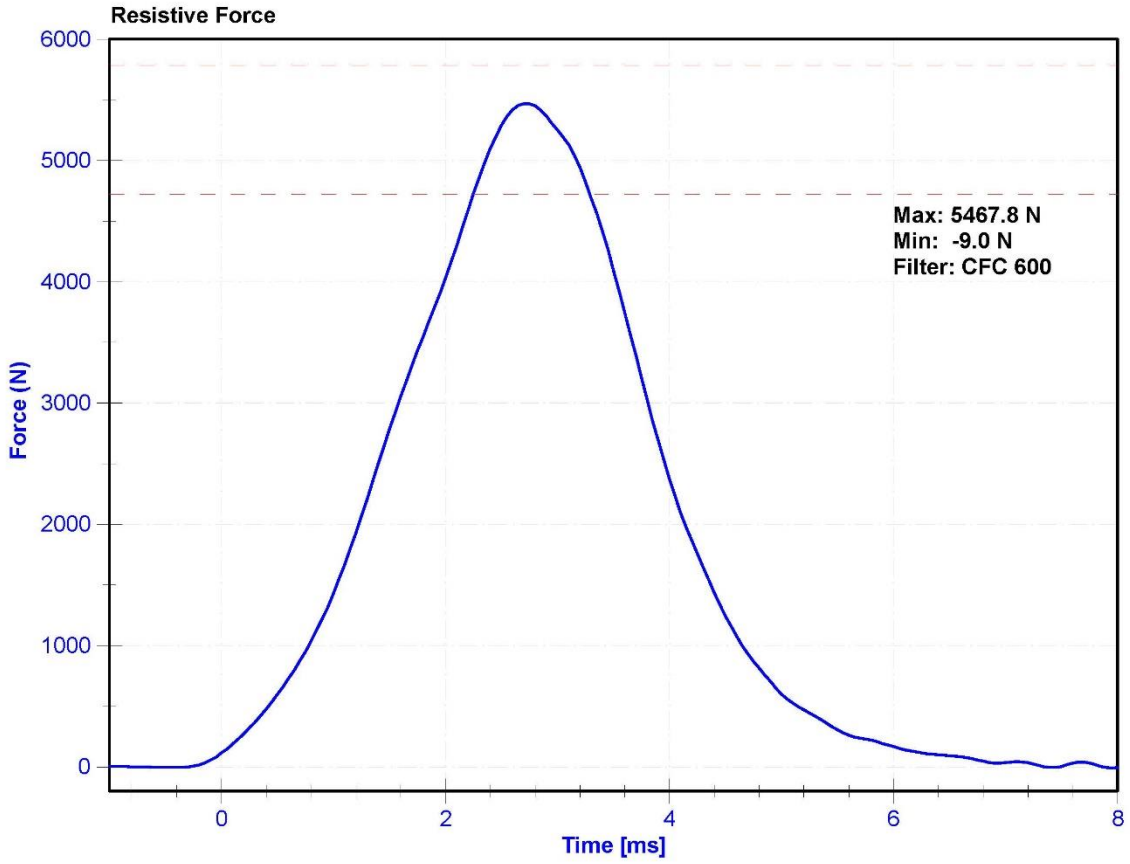
ATD Manufacturer	Humanetics	Test Technician	I. Dunkle
ATD Serial Number	142	Laboratory Supervisor	M. Goehle

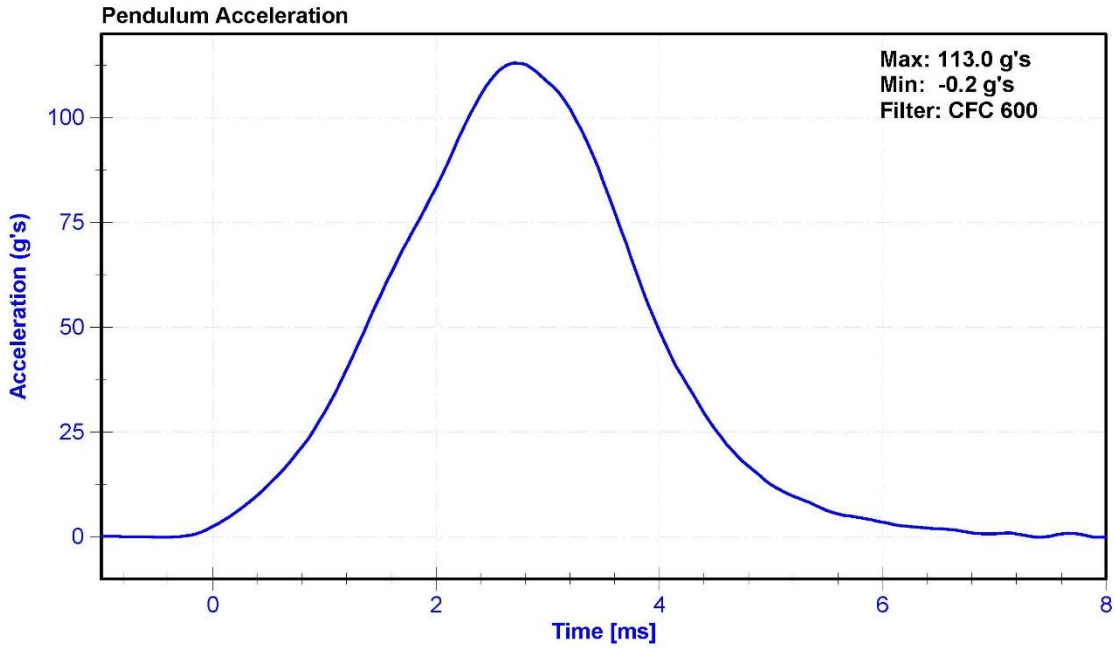
Results

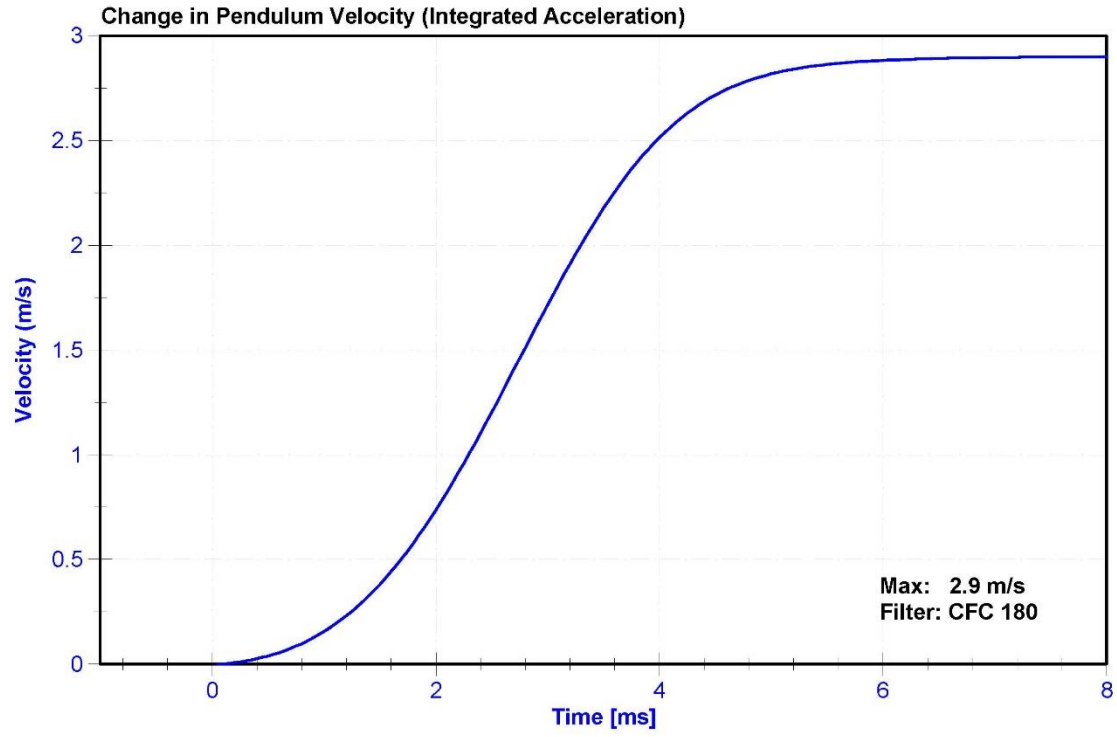
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	21.8	Pass
Humidity	10	70	%	39	Pass
Velocity	2.07	2.13	m/s	2.079	Pass
Maximum Resistive Force	4720	5780	N	5467.8	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7264CT	AC-P23155	1/13/2016	7/14/2016




Pendulum Acceleration
Max: 113.0 g's
Min: -0.2 g's
Filter: CFC 600
Acceleration (g's)
100
75
50
25
0
0
2
4
6
8
Time [ms]


Change in Pendulum Velocity (Integrated Acceleration)
Velocity (m/s)
3
2.5
2
1.5
1
0.5
0
Max: 2.9 m/s
Filter: CFC 180
0
2
4
6
8
Time [ms]

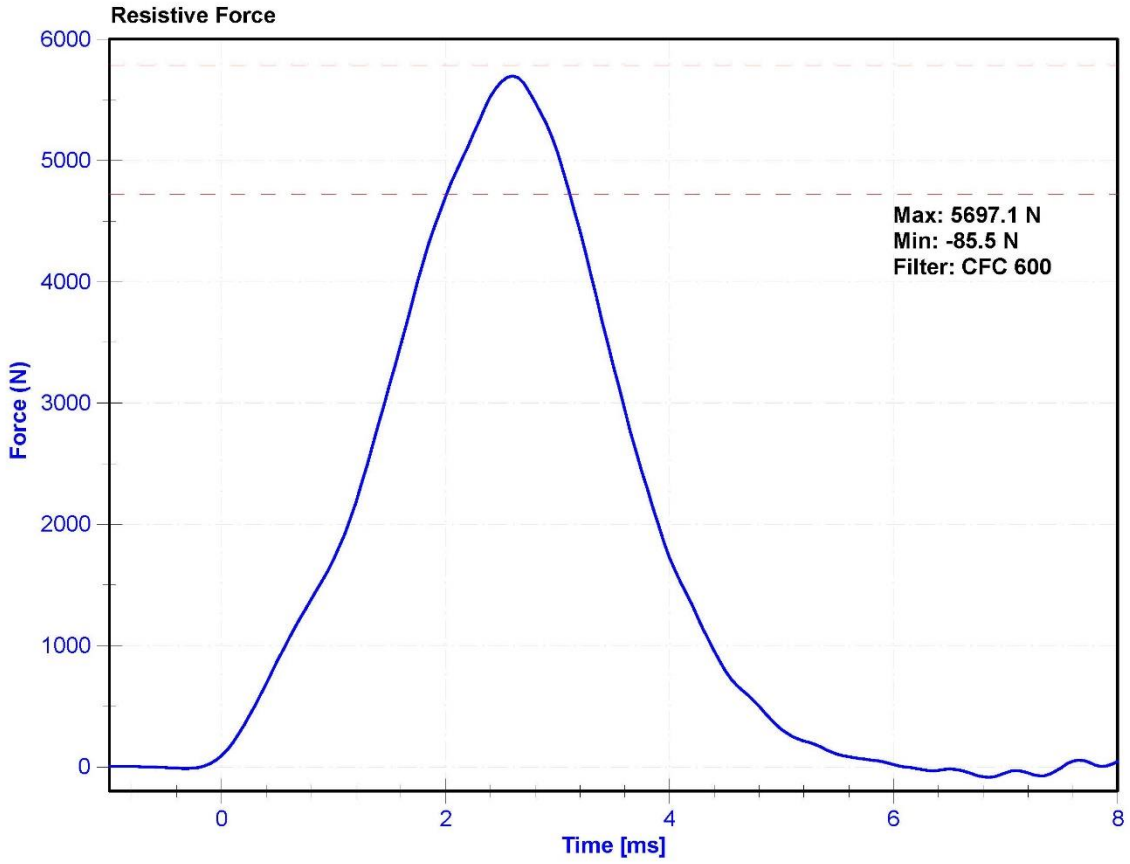
ATD Manufacturer	Humanetics	Test Technician	I. Dunkle
ATD Serial Number	142	Laboratory Supervisor	M. Goehle

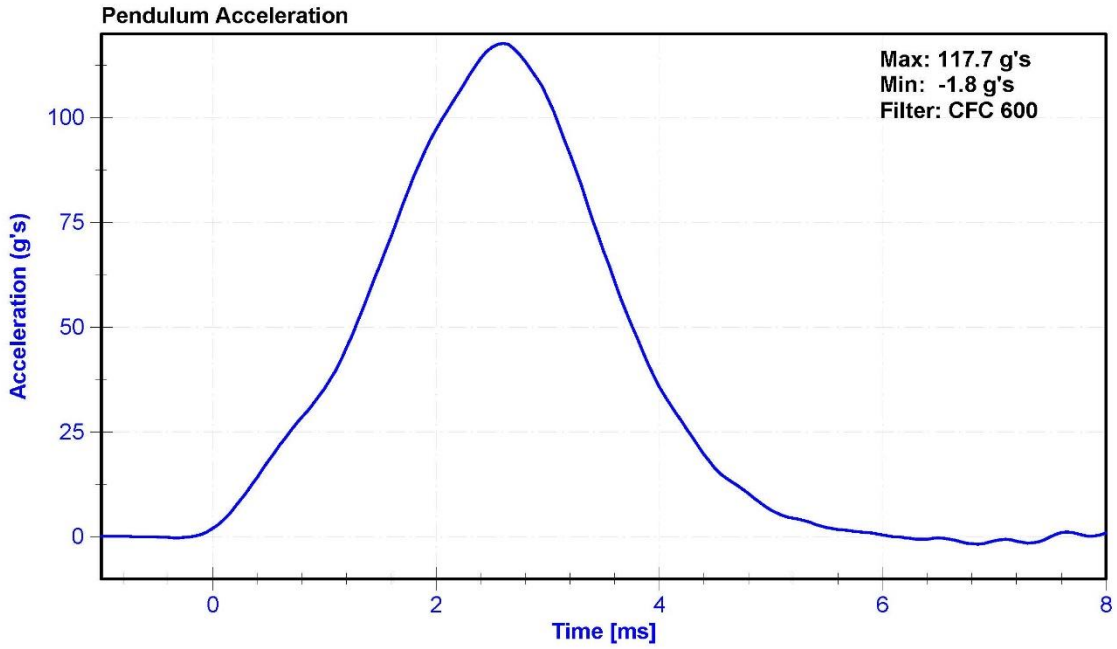
Results

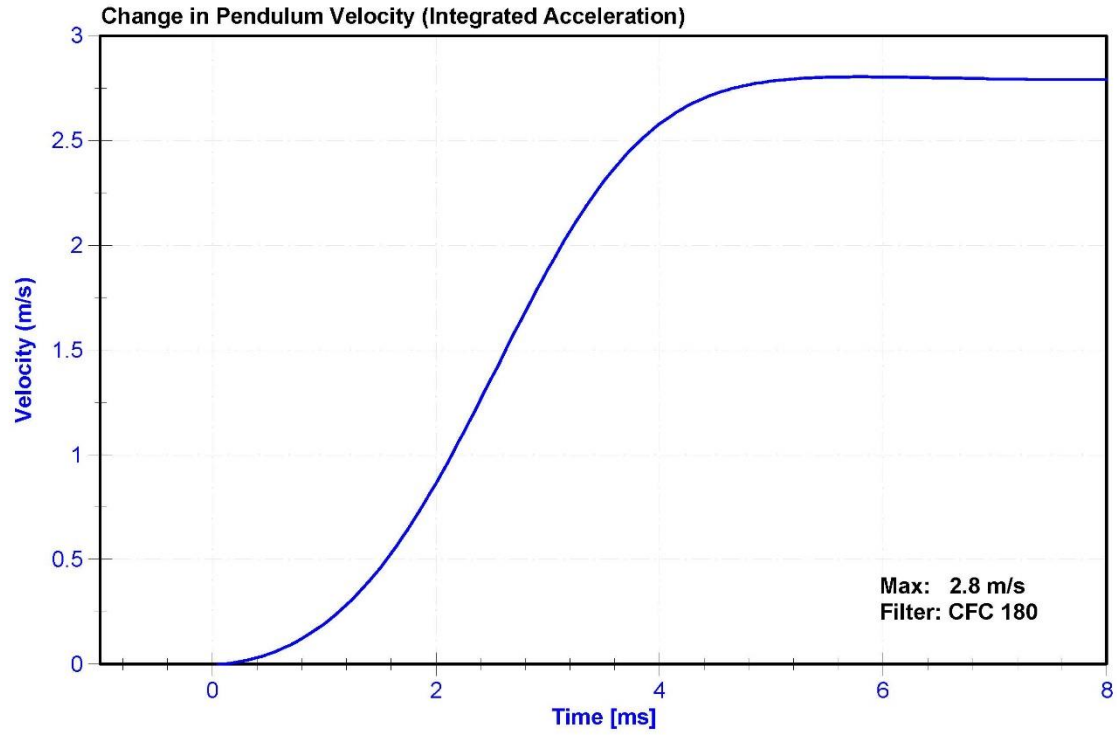
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	21.8	Pass
Humidity	10	70	%	39	Pass
Velocity	2.07	2.13	m/s	2.076	Pass
Maximum Resistive Force	4720	5780	N	5697.1	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7264CT	AC-P23155	1/13/2016	7/14/2016




Pendulum Acceleration
Max: 117.7 g's
Min: -1.8 g's
Filter: CFC 600
Acceleration (g's)
100
75
50
25
0
0
2
4
6
8
Time [ms]


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

CALIBRATION TEST RESULTS

POST-TEST

HYBRID III 5TH PERCENTILE FEMALE - PASSENGER ATD

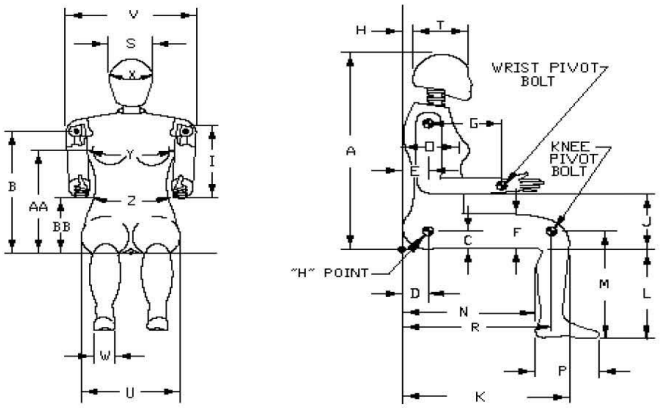
SERIAL NO: 139

Calspan

External Measurements - Hybrid 3 - 5th Female

Technician: Steve Keller Date: 6/23/2016

Dummy Serial Number: 139



Symbol	Description	Specification (mm)		Result (mm)	Pass/Fail
A	Sitting Height	775	800	786	Pass
B	Shoulder Pivot Height	432	457	451	Pass
C	H-Point Height	81	86	84	Pass
D	H-Point from Backline	145	150	147	Pass
E	Shoulder Pivot from Backline	69	84	77	Pass
F	Thigh Clearance	119	135	123	Pass
G	Back of Elbow to Wrist Pivot	244	259	251	Pass
H	Head Back to Backline	43	48	46	Pass
I	Shoulder to Elbow Length	277	297	290	Pass
J	Elbow Rest Height	183	203	188	Pass
K	Buttock to Knee Length	521	546	541	Pass
L	Popliteal Height	356	376	362	Pass
M	Knee Pivot Height	394	419	399	Pass
N	Buttock Popliteal Length	414	439	425	Pass
O	Chest Depth without Jacket	175	191	185	Pass
P	Foot Length (right)	219	234	221	Pass
R	Buttock To Knee Pivot Length	457	483	474	Pass
S	Head Breadth	137	147	142	Pass
T	Head Depth	178	188	181	Pass
U	Hip Breadth	300	315	302	Pass
V	Shoulder Breadth	351	366	362	Pass
W	Foot Breadth	79	94	85	Pass
X	Head Circumference	528	549	536	Pass
Y	Chest Circumference with Jacket	851	881	855	Pass
Z	Waist Circumference	460	790	774	Pass
AA	Reference Location (Chest Circumference)	333	358	345	Pass
BB	Reference Location (Waist Circumference)	160	170	165	Pass

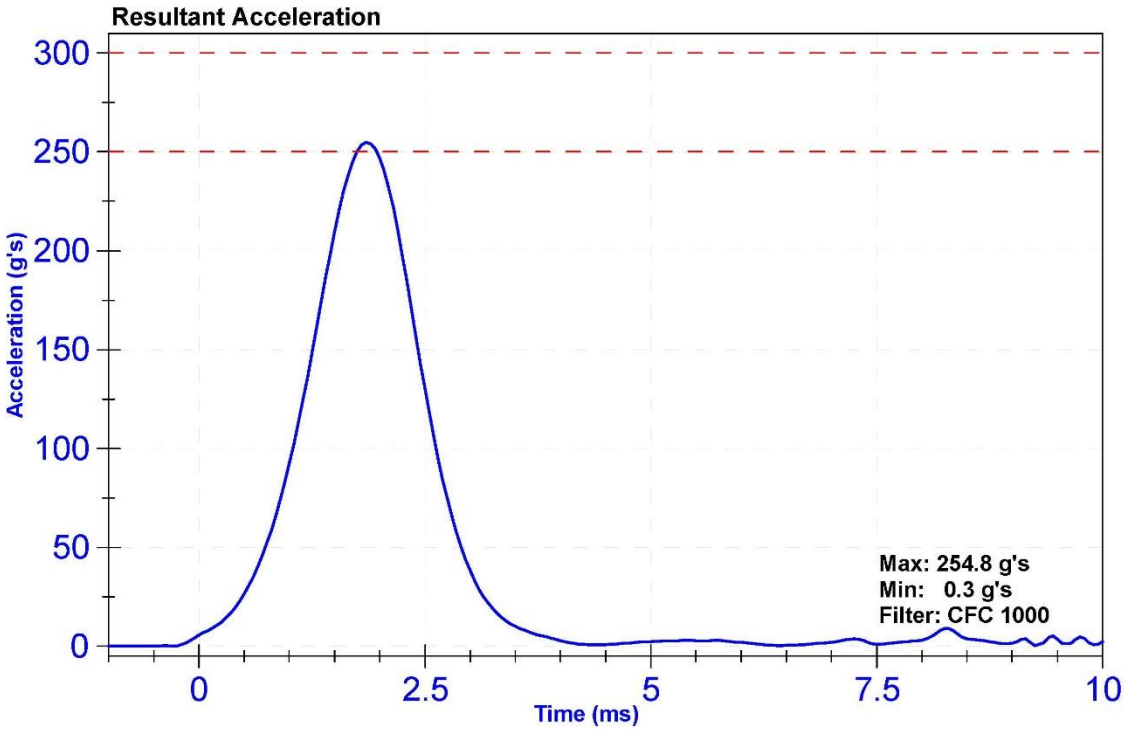
ATD Manufacturer	Denton	Test Technician	S. Keller
ATD Serial Number	139	Laboratory Supervisor	M. Goehle

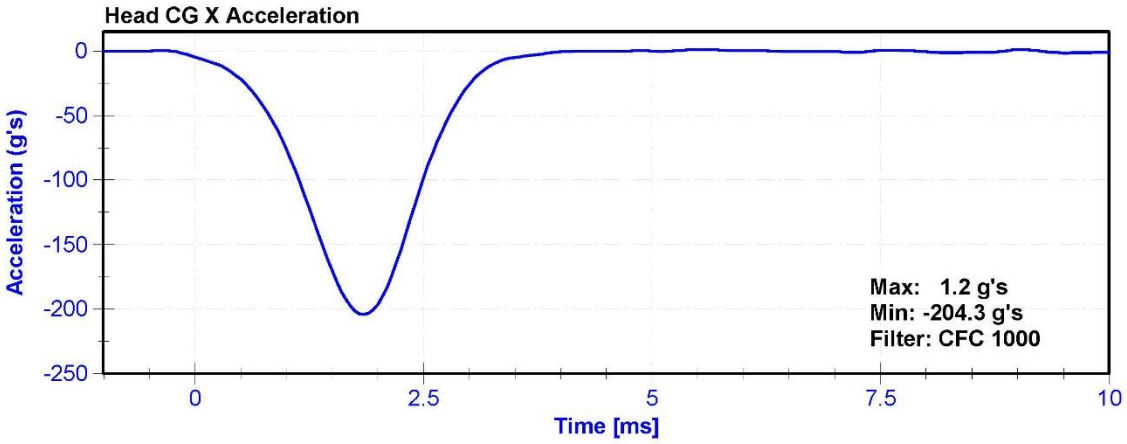
Results

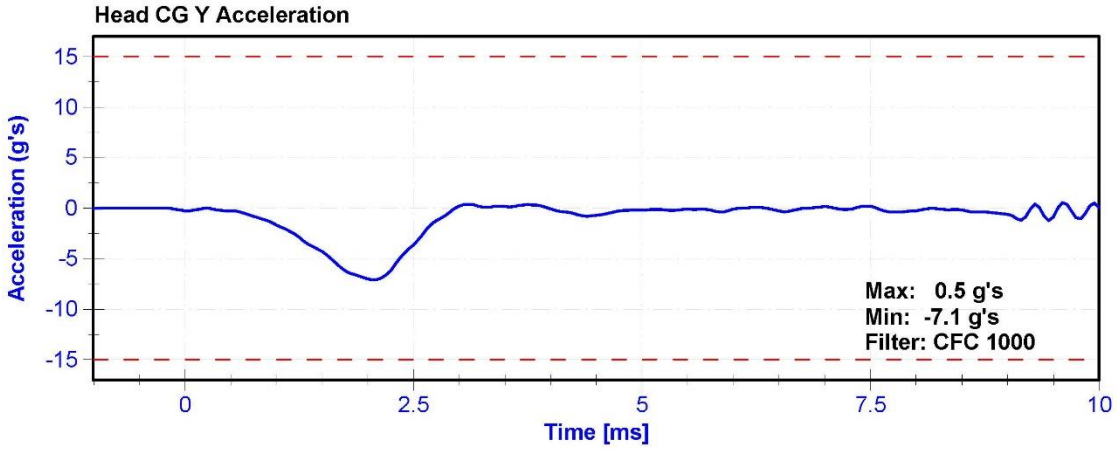
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	21.2	Pass
Humidity	10	70	%	41.9	Pass
Resultant Acceleration	250	300	g's	254.8	Pass
Oscillation	0	10	%	3.5	Pass
Lateral Acceleration	-15	15	g's	-7.1	Pass

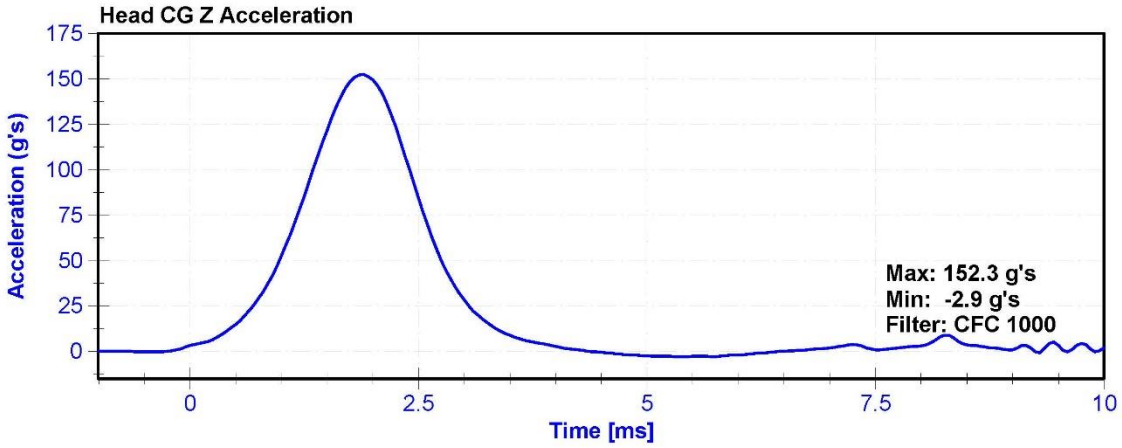
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	ENDEVCO 7264	AC-P52054	6/13/2016	12/12/2016
Y Accelerometer	ENDEVCO 7264	AC-P52007	6/13/2016	12/12/2016
Z Accelerometer	ENDEVCO 7264	AC-P51298	6/13/2016	12/12/2016




Head CG X Acceleration
Acceleration (g's)
0
-50
-100
-150
-200
-250
0
2.5
5
7.5
10
Time [ms]
Max: 1.2 g's
Min: -204.3 g's
Filter: CFC 1000


Head CG Y Acceleration
Acceleration (g's)
15
10
5
0
-5
-10
-15
0
2.5
5
7.5
10
Time [ms]
Max: 0.5 g's
Min: -7.1 g's
Filter: CFC 1000


Head CG Z Acceleration
Acceleration (g's)
175
150
125
100
75
50
25
0
0
2.5
5
7.5
10
Time [ms]
Max: 152.3 g's
Min: -2.9 g's
Filter: CFC 1000

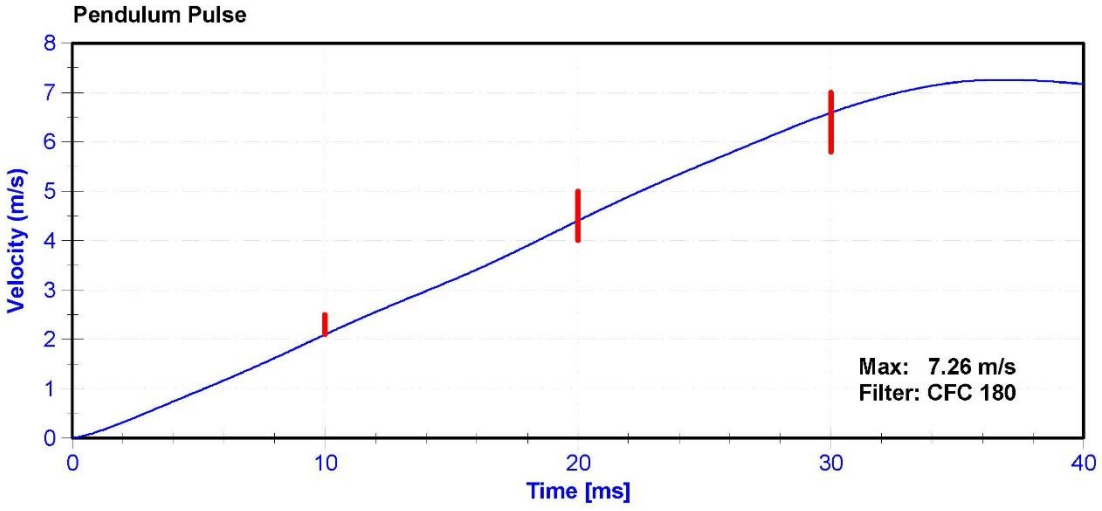
ATD Manufacturer	Denton	Test Technician	S. Keller
ATD Serial Number	139	Laboratory Supervisor	M. Goehle

Results

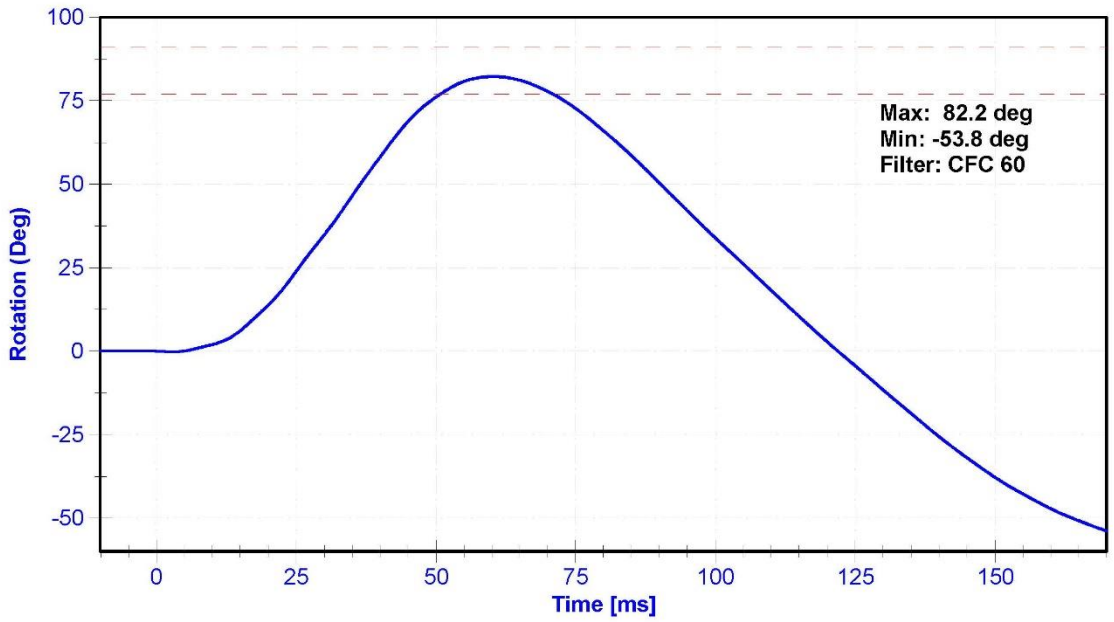
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.4	Pass
Humidity	10	70	%	40.1	Pass
Velocity	6.89	7.13	m/s	7.037	Pass
Pendulum Impulse at 10ms	2.1	2.5	m/s	2.10	Pass
Pendulum Impulse at 20ms	4.0	5.0	m/s	4.40	Pass
Pendulum Impulse at 30ms	5.8	7.0	m/s	6.59	Pass
Max D Plane Rotation	77	91	deg	82.2	Pass
Max Moment During Rotation Interval	69	83	Nm	75.5	Pass
Moment Decay to 10.0 Nm	80	100	ms	88.1	Pass

Transducer Calibrations

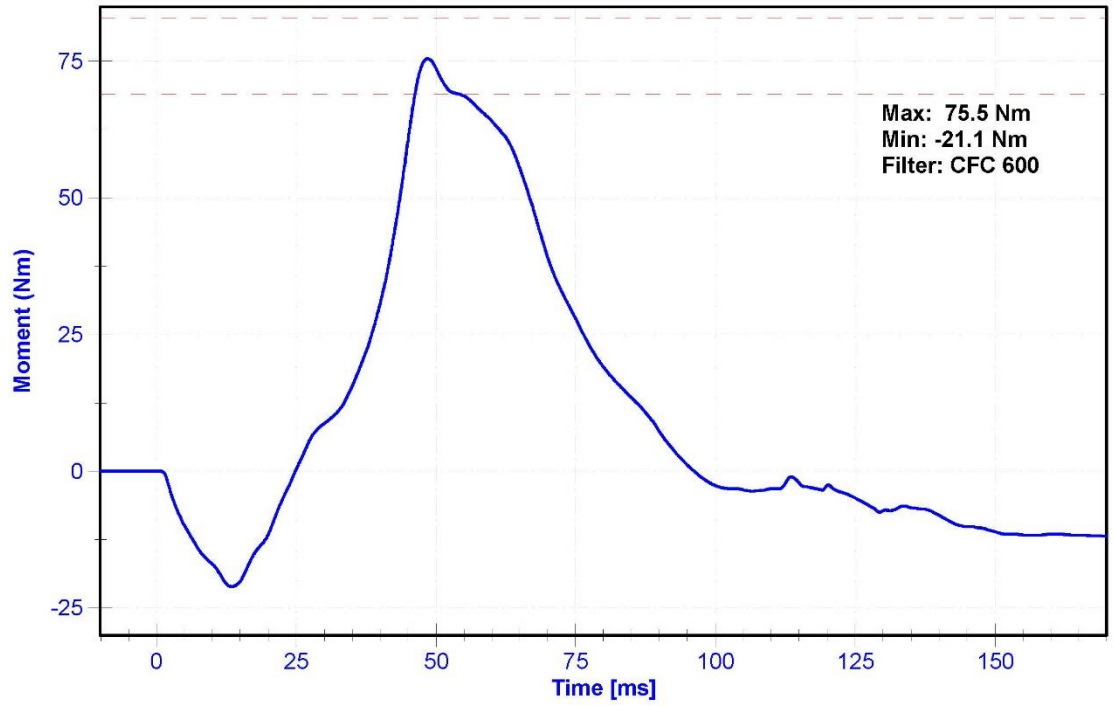
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-AH5F3	5/10/2016	5/10/2017
Pendulum Potentiometer	ETI SP22G	DS-PendPot	9/28/2015	9/27/2016
Condyle Potentiometer	ETI SP22G	DS-CondPot	9/28/2015	9/27/2016
Upper Neck Load Cell	Denton 1716A	LC-2018Fx	5/24/2016	5/24/2017

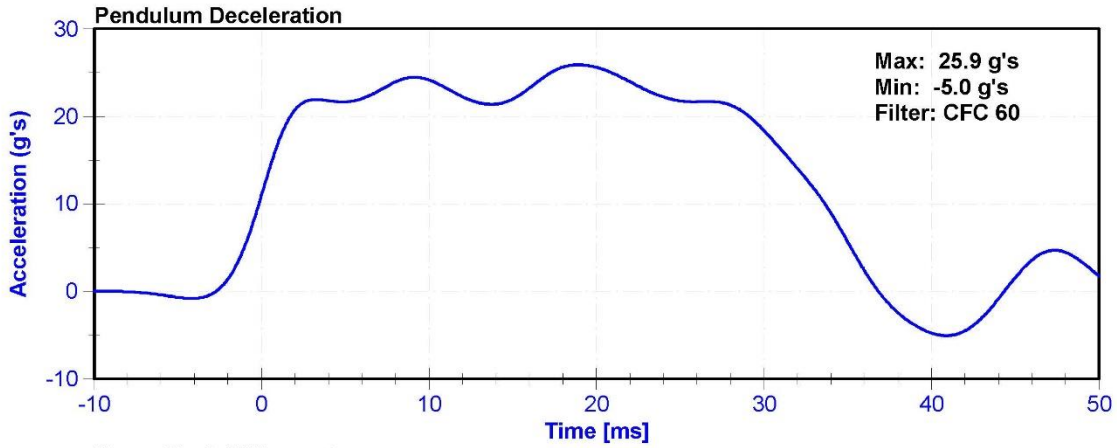


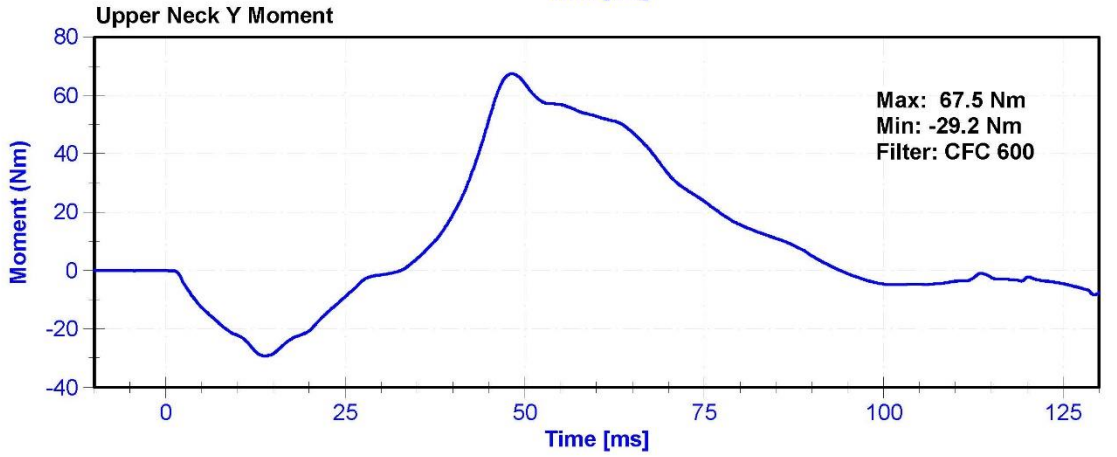
D-Plane Rotation

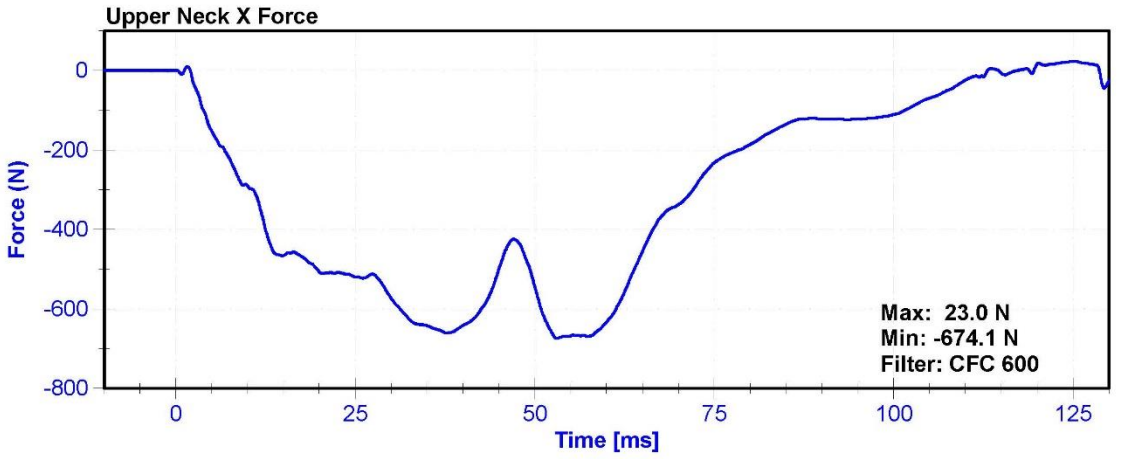


Moment About Occipital Condyle




Pendulum Deceleration
Max: 25.9 g's
Min: -5.0 g's
Filter: CFC 60
Acceleration (g's)
30
20
10
0
-10
-10
0
10
20
30
40
50
Time [ms]


Upper Neck Y Moment
Max: 67.5 Nm
Min: -29.2 Nm
Filter: CFC 600
Moment (Nm)
80
60
40
20
0
-20
-40
0
25
50
75
100
125
Time [ms]


Upper Neck X Force
Max: 23.0 N
Min: -674.1 N
Filter: CFC 600
Force (N)
0
-200
-400
-600
-800
0
25
50
75
100
125
Time [ms]

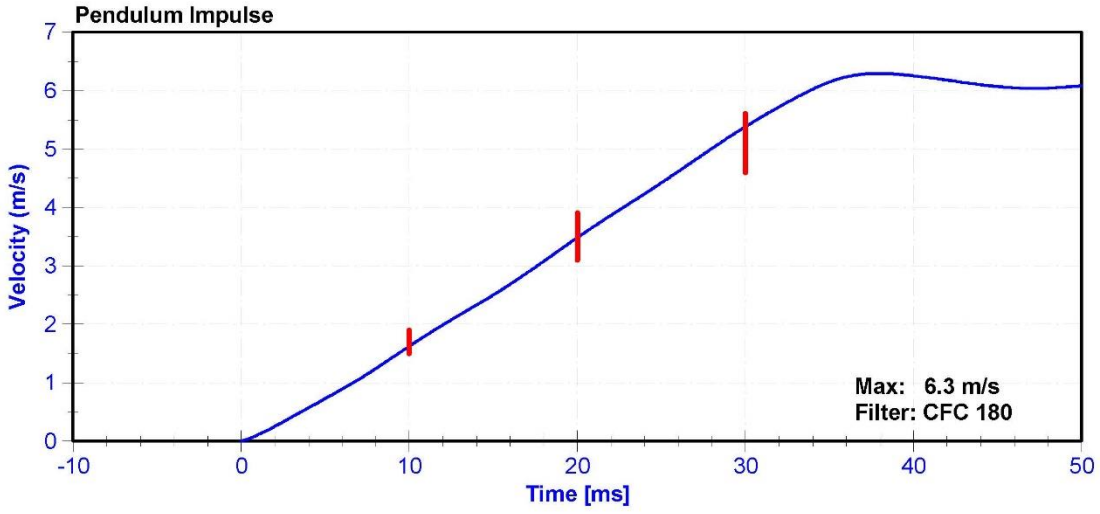
ATD Manufacturer	Denton	Test Technician	S. Keller
ATD Serial Number	139	Laboratory Supervisor	M. Gorhle

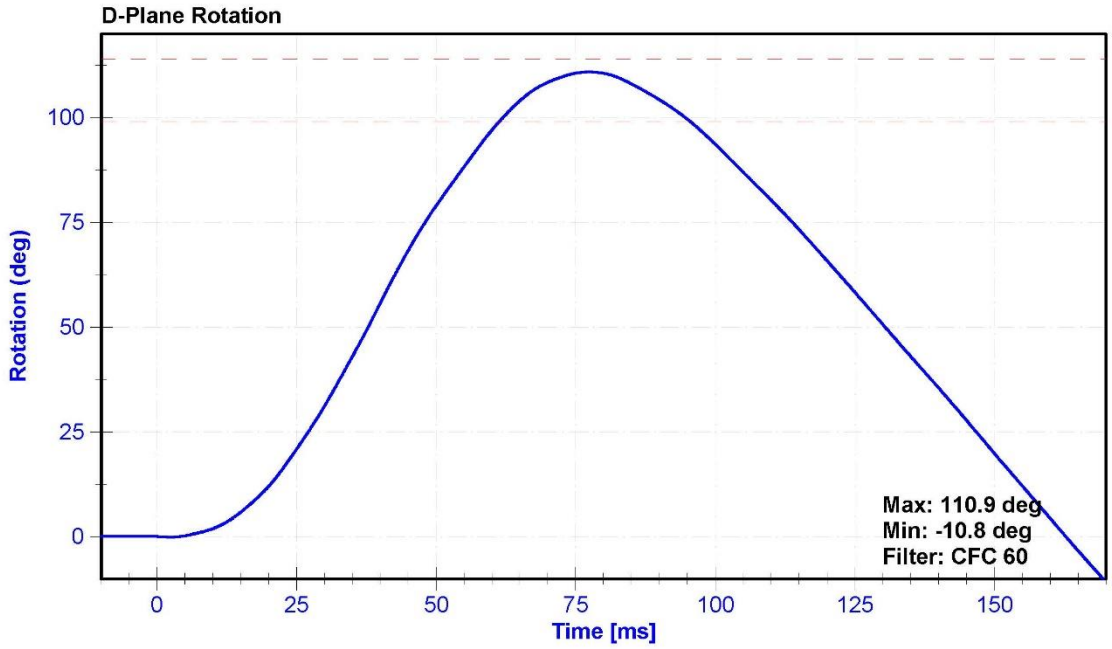
Results

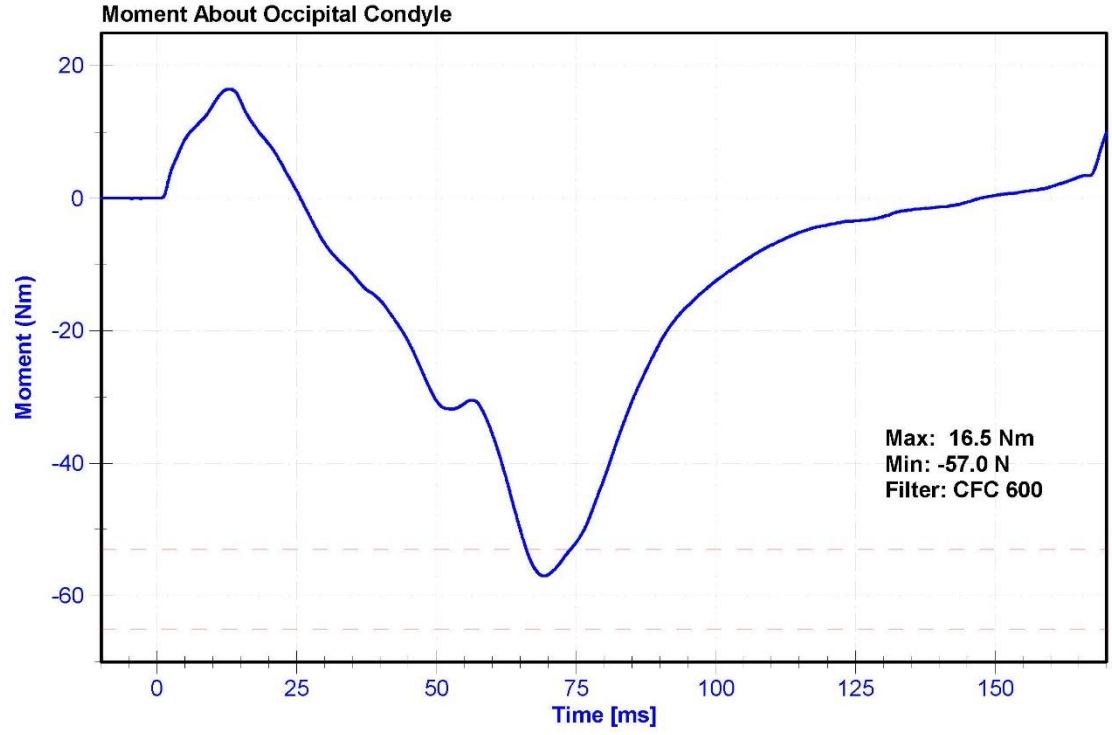
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.3	Pass
Humidity	10	70	%	60.5	Pass
Velocity	5.95	6.19	m/s	6.025	Pass
Pendulum Impulse at 10ms	1.5	1.9	m/s	1.63	Pass
Pendulum Impulse at 20ms	3.1	3.9	m/s	3.48	Pass
Pendulum Impulse at 30ms	4.6	5.6	m/s	5.38	Pass
D Plane Rotation	99	114	deg	110.9	Pass
Moment During Rotation Interval	-65	-53	Nm	-57.0	Pass
Moment Decay to -10Nm	94	114	ms	104.2	Pass

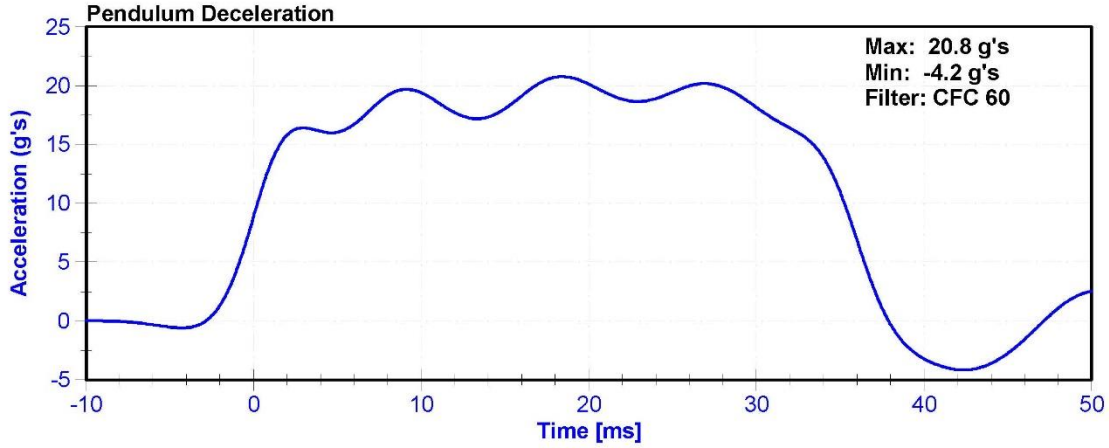
Transducer Calibrations

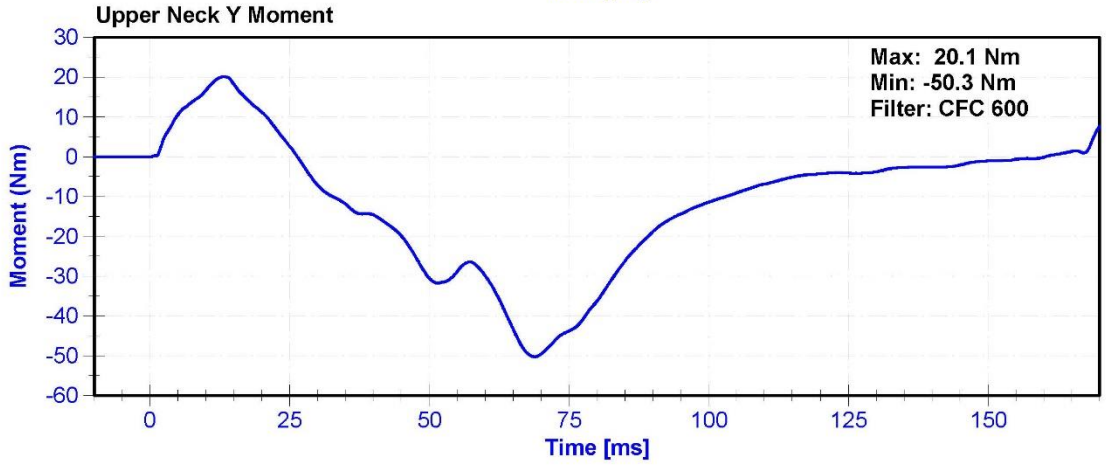
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-AH5F3	5/10/2016	5/10/2017
Pendulum Potentiometer	ETI SP22G	DS-PendPot	9/28/2015	9/27/2016
Condyle Potentiometer	ETI SP22G	DS-CondPot	9/28/2015	9/27/2016
Upper Neck Load Cell	FTSS IF-205	LC-161Fx	5/24/2016	5/24/2017

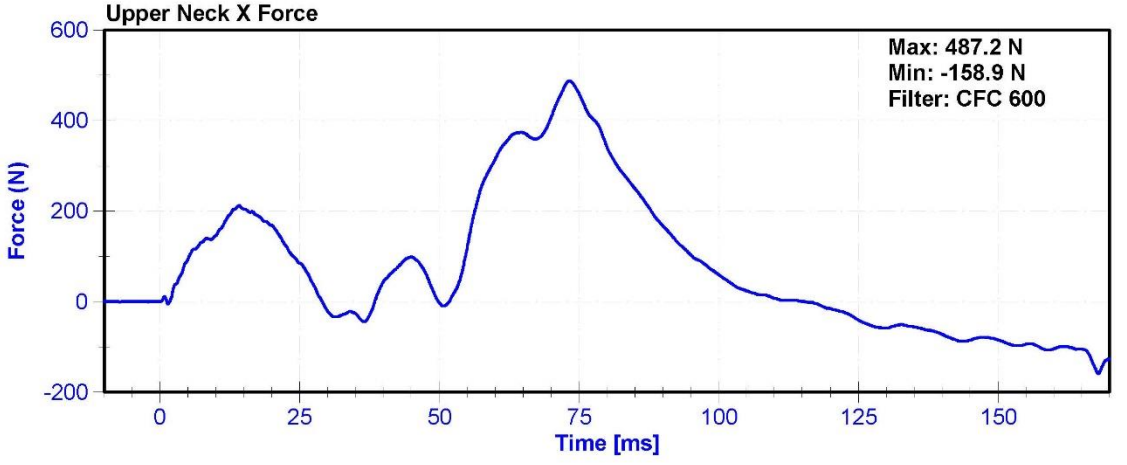



D-Plane Rotation
Rotation (deg)
100
75
50
25
0
0
25
50
75
100
125
150
Time [ms]
Max: 110.9 deg
Min: -10.8 deg
Filter: CFC 60


Moment About Occipital Condyle
Moment (Nm)
20
0
-20
-40
-60
0
25
50
75
100
125
150
Time [ms]
Max: 16.5 Nm
Min: -57.0 N
Filter: CFC 600


Pendulum Deceleration
Max: 20.8 g's
Min: -4.2 g's
Filter: CFC 60
Acceleration (g's)
25
20
15
10
5
0
-5
-10
0
10
20
30
40
50
Time [ms]


Upper Neck Y Moment
Max: 20.1 Nm
Min: -50.3 Nm
Filter: CFC 600
Moment (Nm)
30
20
10
0
-10
-20
-30
-40
-50
-60
0
25
50
75
100
125
150
Time [ms]


Upper Neck X Force
Max: 487.2 N
Min: -158.9 N
Filter: CFC 600
Force (N)
600
400
200
0
-200
0
25
50
75
100
125
150
Time [ms]

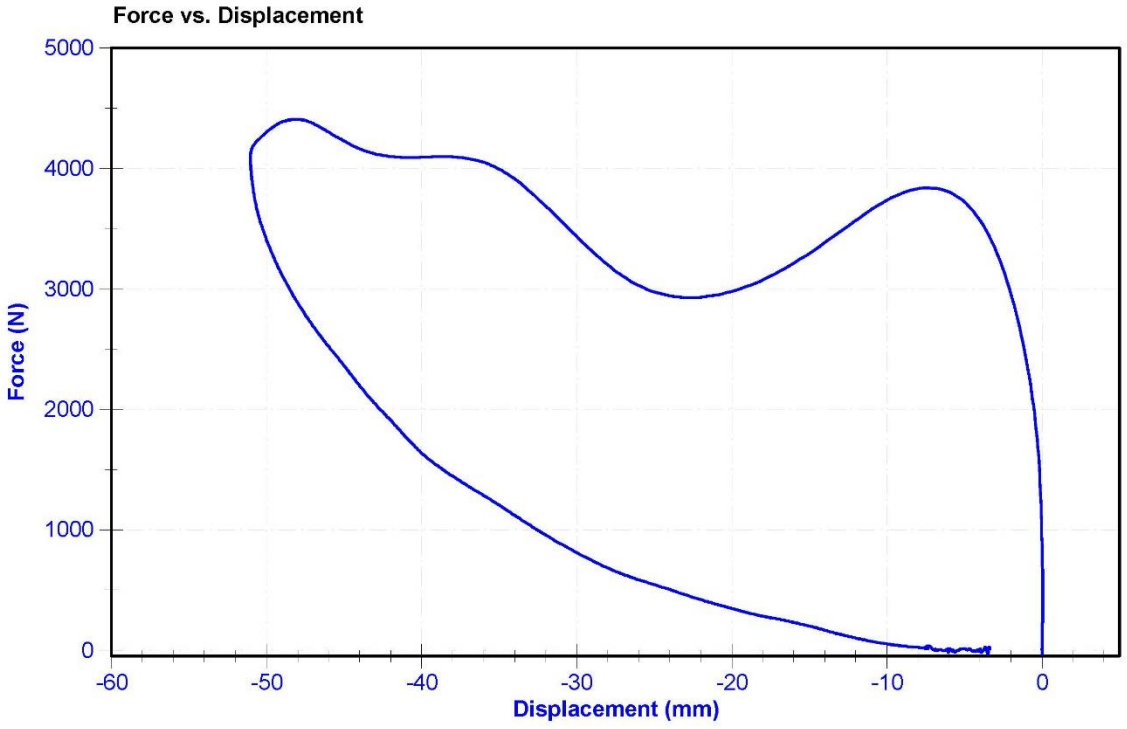
ATD Manufacturer	Denton	Test Technician	S. Keller
ATD Serial Number	139	Laboratory Supervisor	M. Goehle

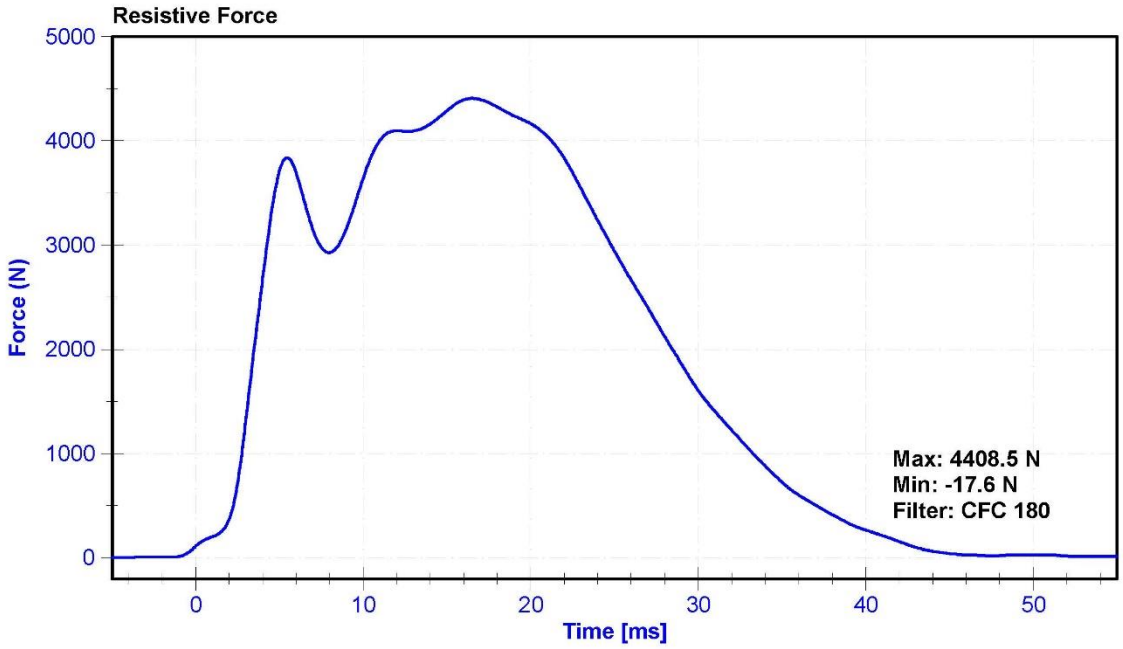
Results

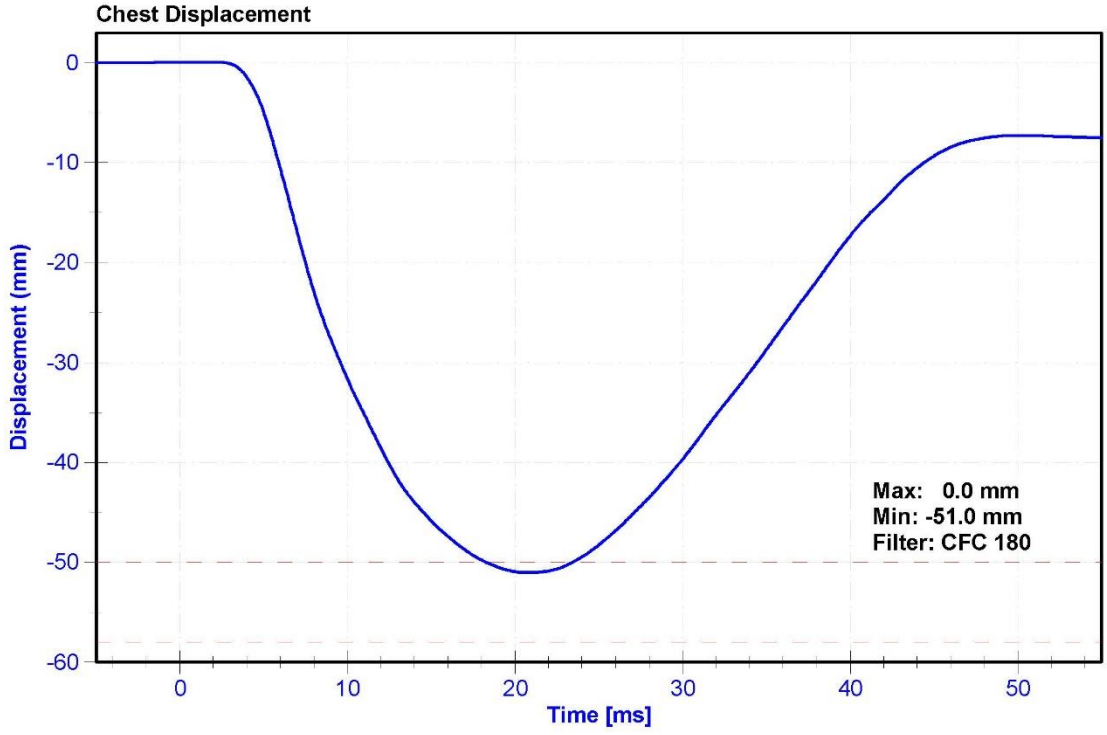
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.6	Pass
Humidity	10	70	%	59.7	Pass
Velocity	6.59	6.83	m/s	6.728	Pass
Chest Deflection	-58	-50	mm	-51.0	Pass
Maximum Resistive Force (50 to 58mm)	3900	4400	N	4304.2	Pass
Maximum Resistive Force (18 to 50mm)	0	4600	N	4408.5	Pass
Hysteresis	69	85	%	74.2	Pass

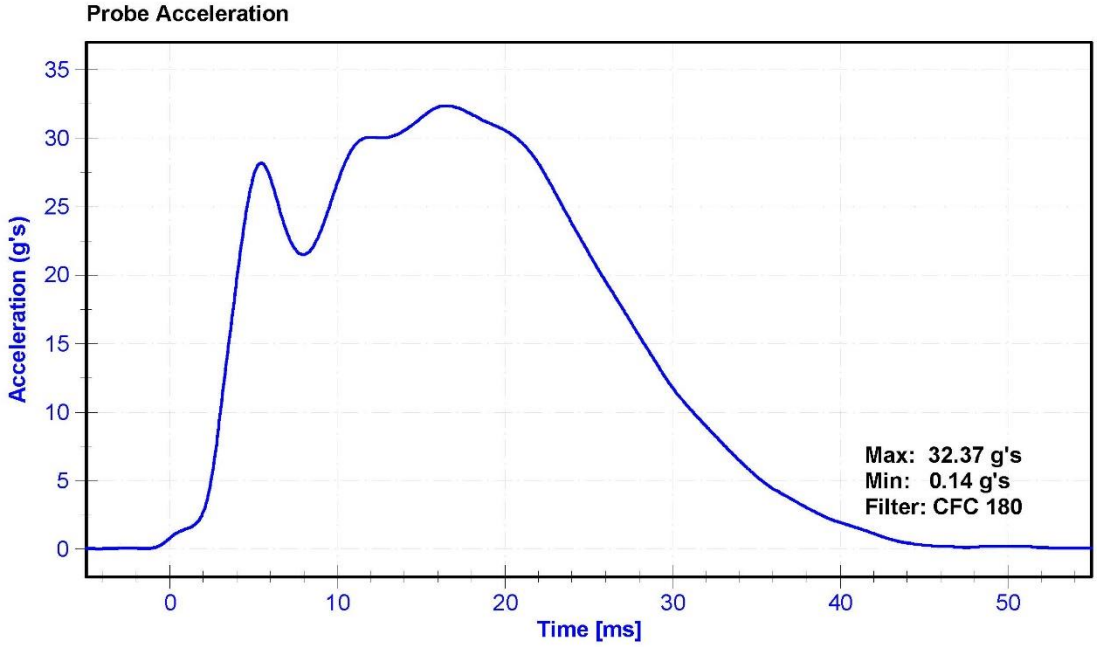
Transducer Calibrations

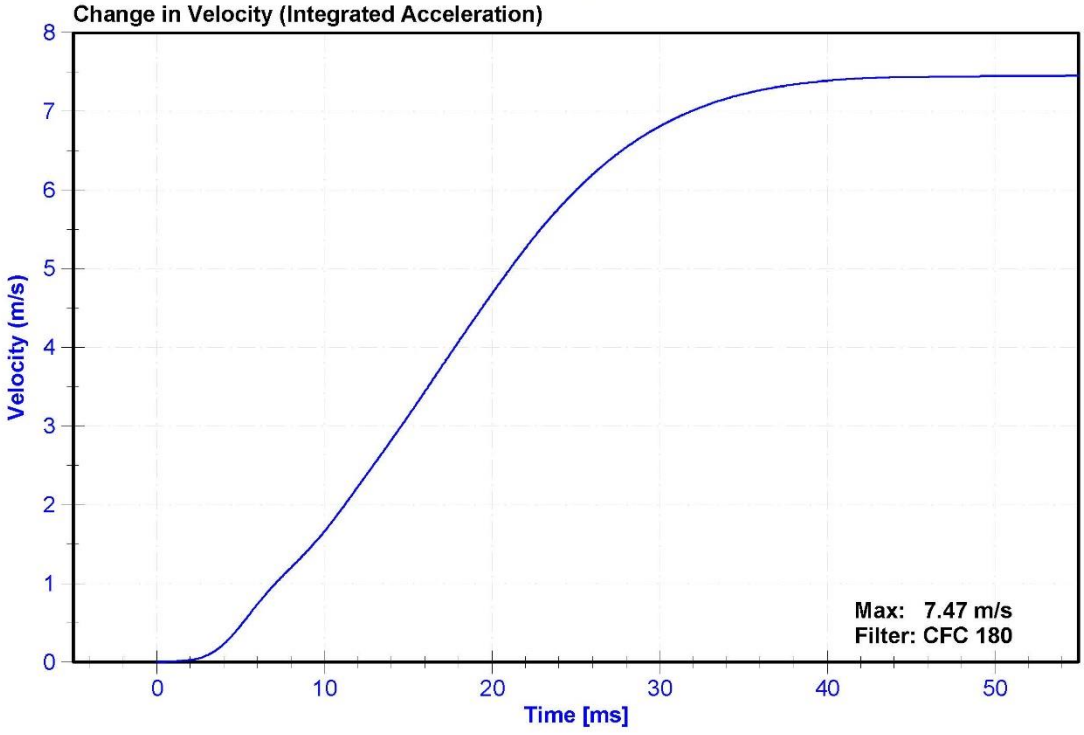
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7264CT	AC-P23155	1/13/2016	7/14/2016
Chest Potentiometer	Servo 14CBI-3615	DS-139	6/9/2016	6/9/2017




Resistive Force
5000
4000
3000
2000
1000
0
Force (N)
0
10
20
30
40
50
Time [ms]
Max: 4408.5 N
Min: -17.6 N
Filter: CFC 180


Chest Displacement
0
-10
-20
-30
-40
-50
-60
Displacement (mm)
0
10
20
30
40
50
Time [ms]
Max: 0.0 mm
Min: -51.0 mm
Filter: CFC 180


Probe Acceleration
Acceleration (g's)
35
30
25
20
15
10
5
0
0
10
20
30
40
50
Time [ms]
Max: 32.37 g's
Min: 0.14 g's
Filter: CFC 180


Change in Velocity (Integrated Acceleration)
Velocity (m/s)
8
7
6
5
4
3
2
1
0
0
10
20
30
40
50
Time [ms]
Max: 7.47 m/s
Filter: CFC 180

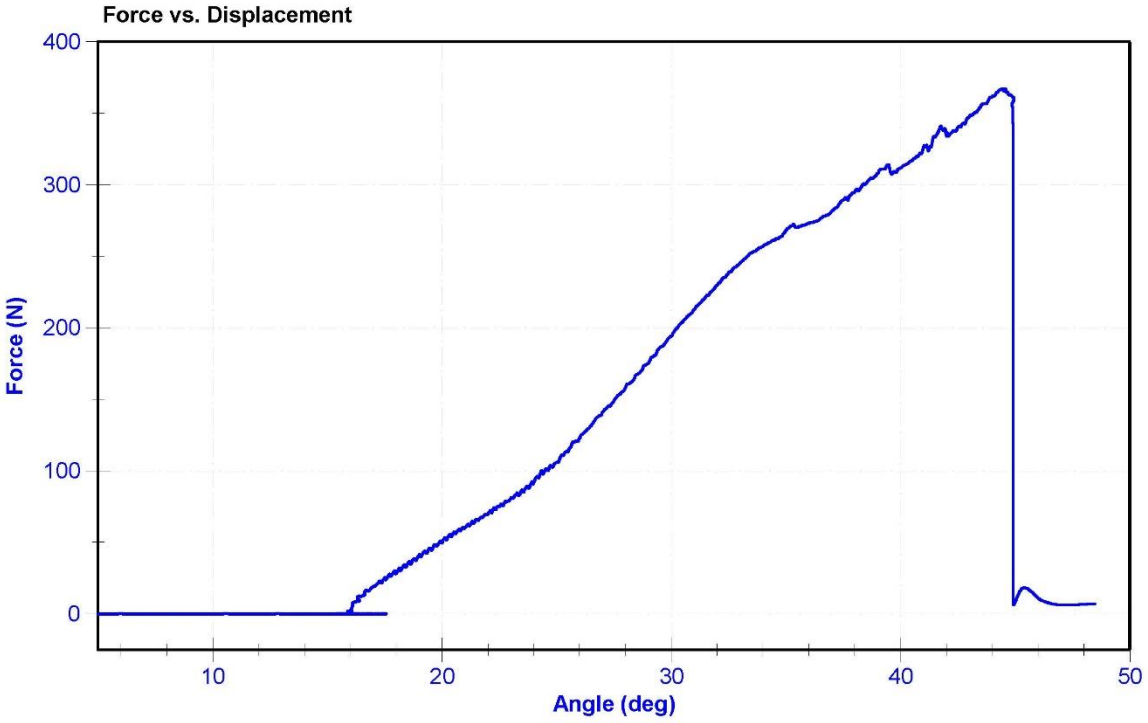
ATD Manufacturer	Denton	Test Technician	S. Keller
ATD Serial Number	139	Laboratory Supervisor	M. Gorhle

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.6	25.6	°C	21.3	Pass
Humidity	10	70	%	57.5	Pass
Initial Angle	0	20	deg	15.9	Pass
Force at 45 Degrees	320	390	N	367.1	Pass
Return Angle Relative to Initial	0	8	deg	5.6	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	Rieker N4C-1	DS-13051548	8/14/2015	8/13/2016
Load Cell	Interface SML-200	LC-493319	8/13/2015	8/12/2016



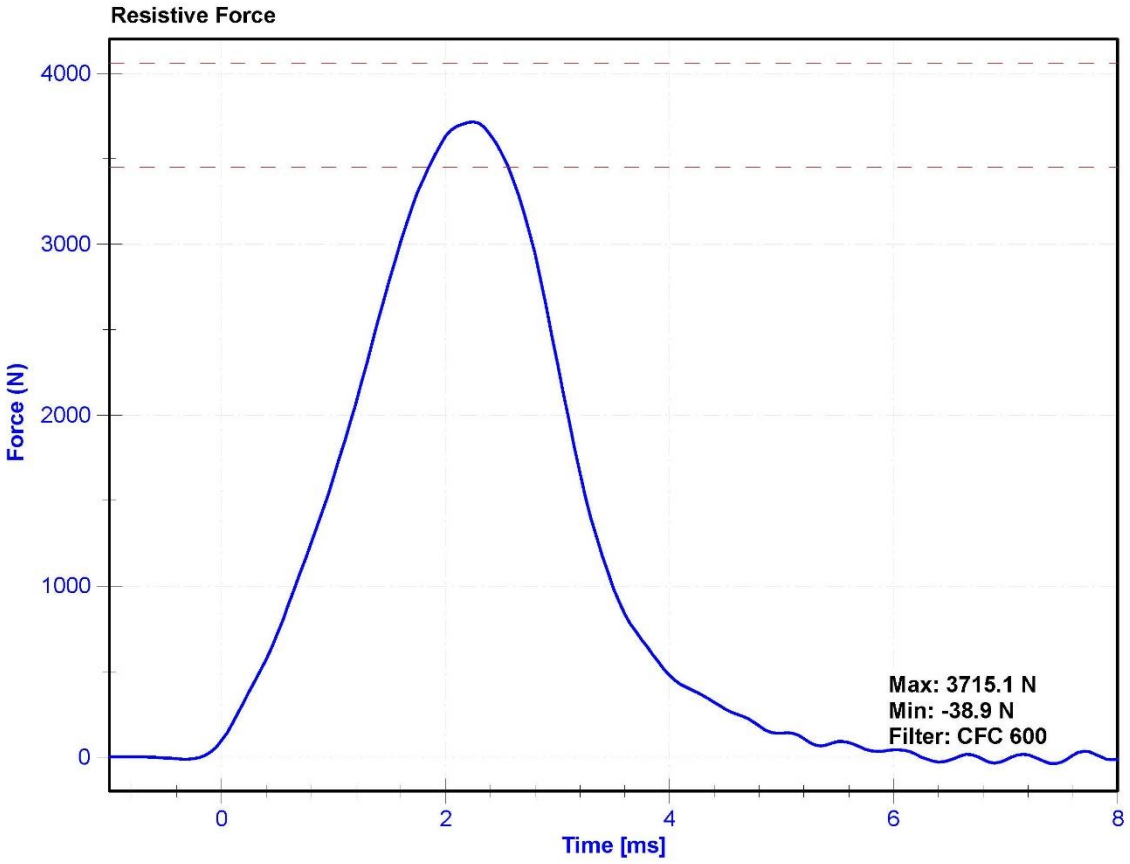
ATD Manufacturer	Denton	Test Technician	S. Keller
ATD Serial Number	139	Laboratory Supervisor	M. Goehle

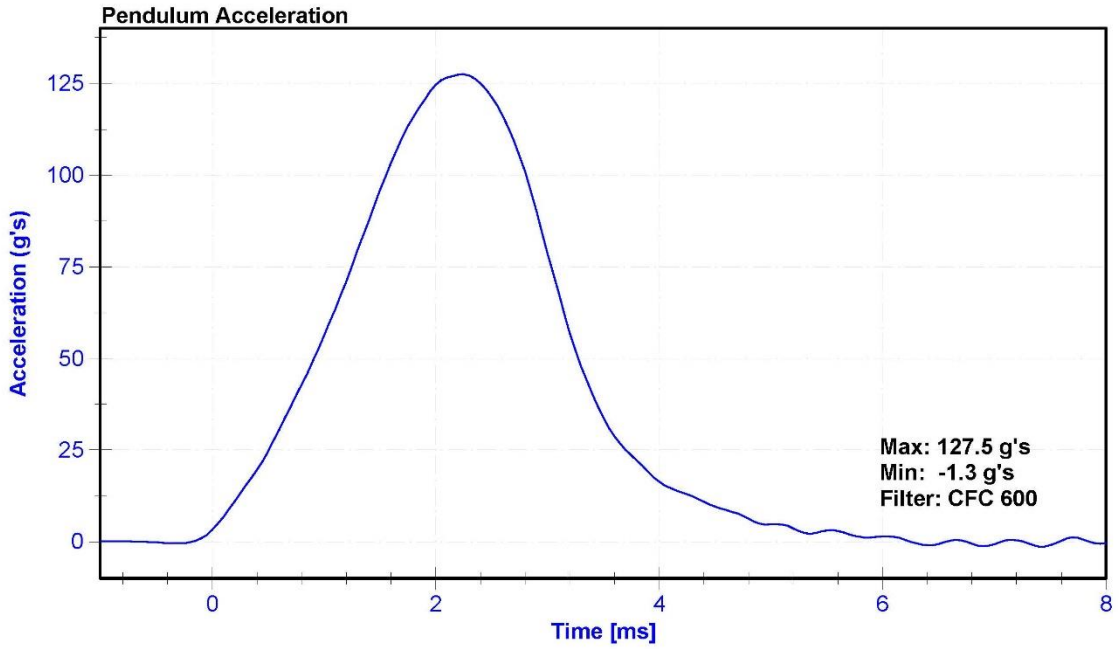
Results

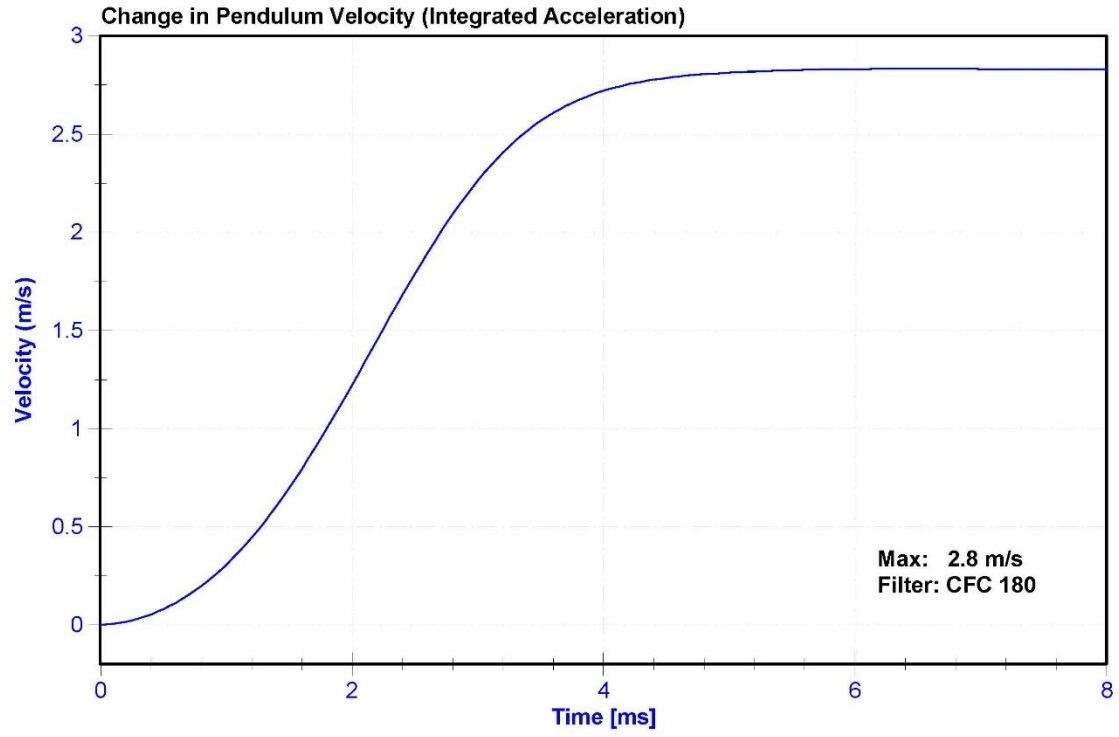
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	21.9	Pass
Humidity	10	70	%	48.2	Pass
Velocity	2.07	2.13	m/s	2.082	Pass
Resistive Force	3450	4060	N	3715.1	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7264CT	AC-P23155	1/13/2016	7/14/2016




Pendulum Acceleration
Acceleration (g's)
125
100
75
50
25
0
0
2
4
6
8
Time [ms]
Max: 127.5 g's
Min: -1.3 g's
Filter: CFC 600


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

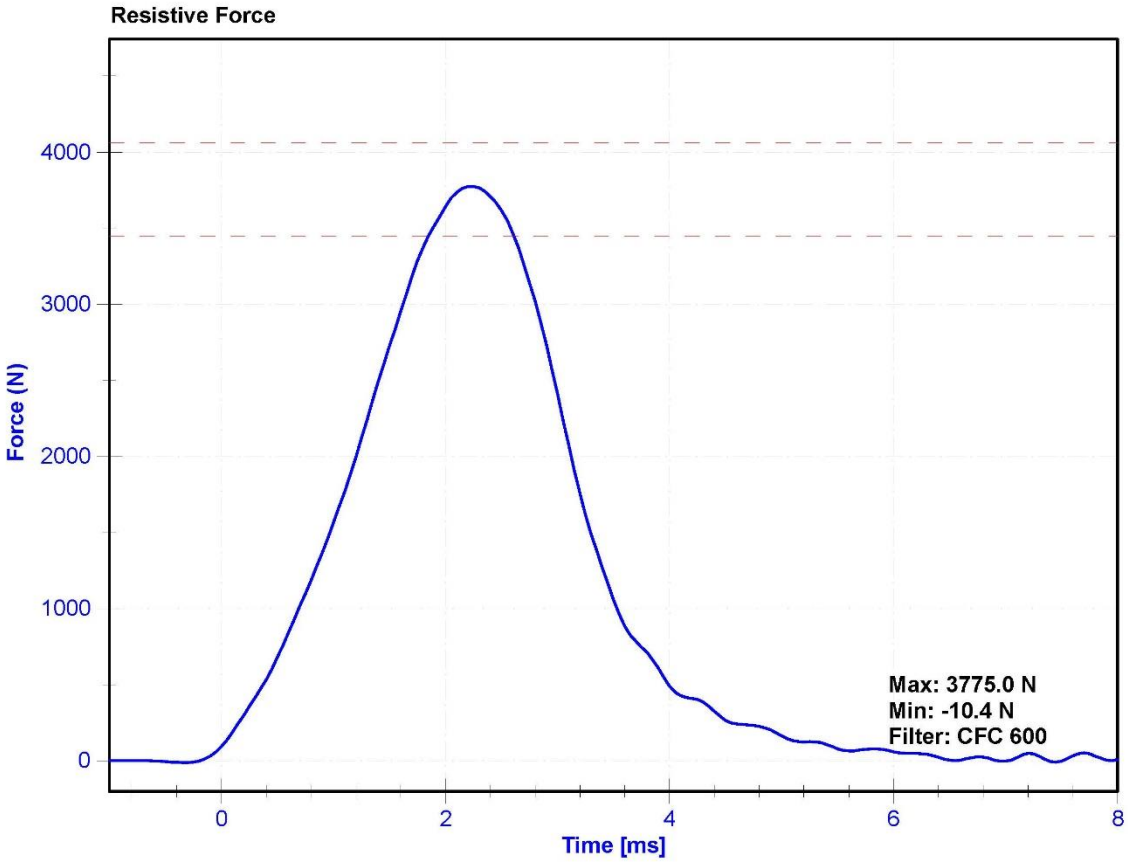
ATD Manufacturer	Denton	Test Technician	S. Keller
ATD Serial Number	139	Laboratory Supervisor	M. Goehle

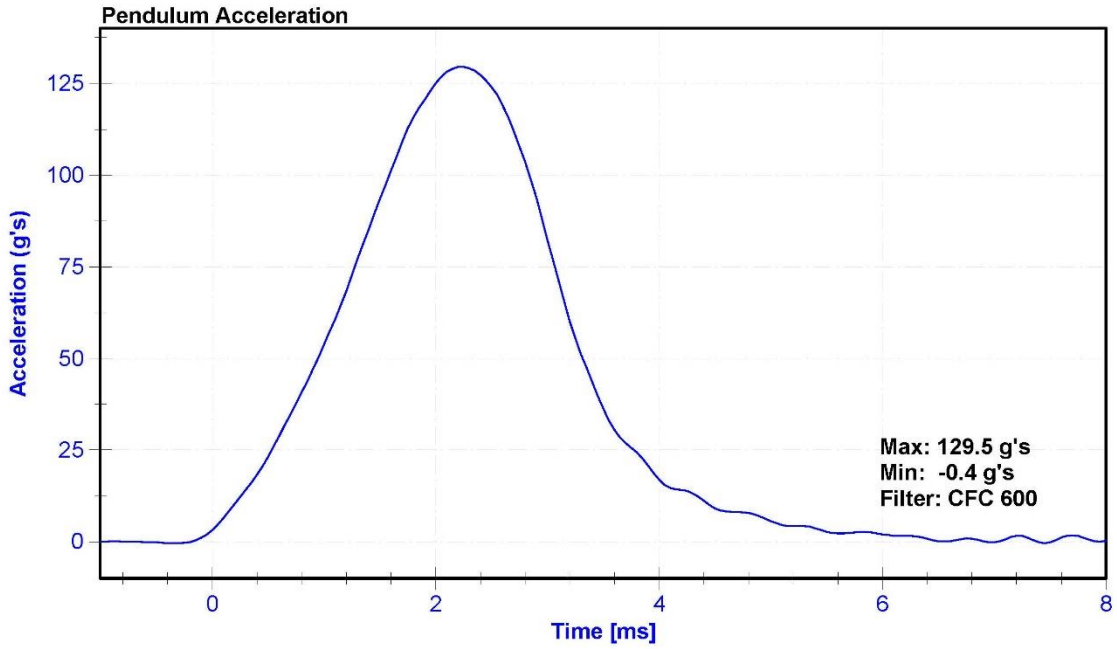
Results

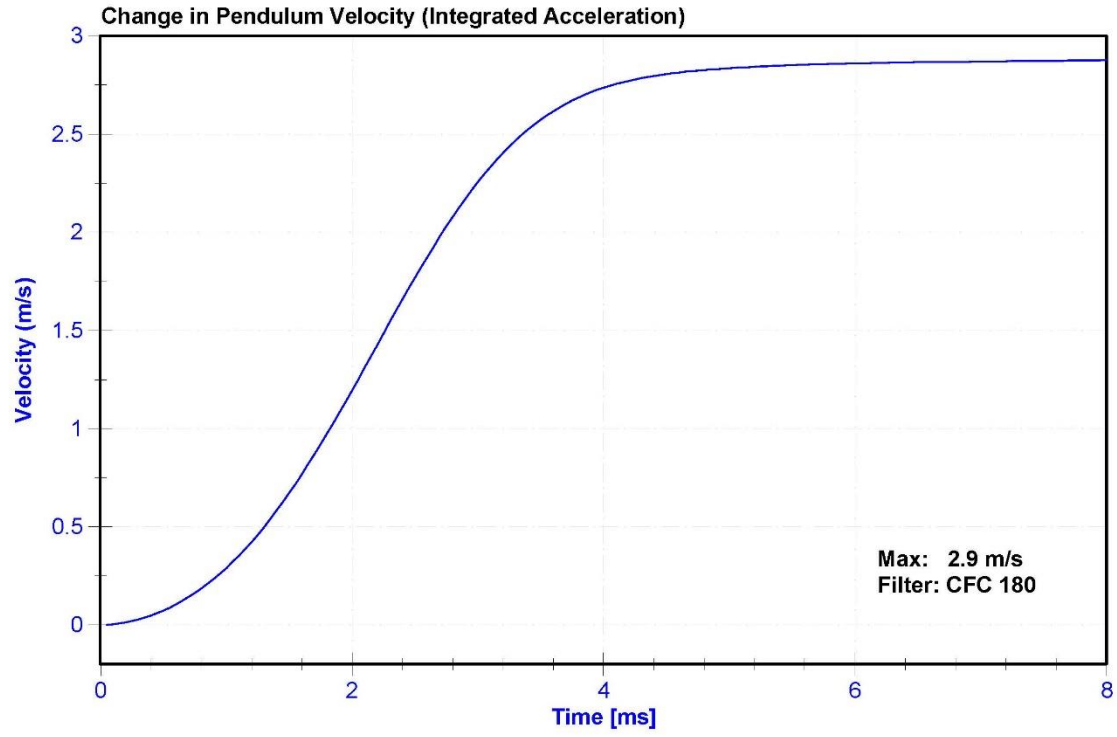
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	°C	21.7	Pass
Humidity	10	70	%	46.5	Pass
Velocity	2.07	2.13	m/s	2.086	Pass
Resistive Force	3450	4060	N	3775.0	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7264CT	AC-P23155	1/13/2016	7/14/2016




Pendulum Acceleration
Acceleration (g's)
125
100
75
50
25
0
0
2
4
6
8
Time [ms]
Max: 129.5 g's
Min: -0.4 g's
Filter: CFC 600


Change in Pendulum Velocity (Integrated Acceleration)
Velocity (m/s)
3
2.5
2
1.5
1
0.5
0
0
2
4
6
8
Time [ms]
Max: 2.9 m/s
Filter: CFC 180