REPORT NUMBER: NCAP-CAL-24-002

NEW CAR ASSESSMENT PROGRAM (NCAP)
FRONTAL BARRIER IMPACT TEST

Hyundai Motor Company
2024 Hyundai Kona
5 Door SUV

NHTSA No: M20244203

PREPARED BY:
CALSPAN CORPORATION
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June 3, 2024

FINAL REPORT

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

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

Date: _____

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

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16. Abstract

A 56.30 km/h (35 mph), NCAP frontal rigid barrier impact test was conducted on a 2024 Hyundai Kona 5 Door SUV in accordance with the specifications of the Office of Crashworthiness Standards Laboratory Procedure for NCAP Full Frontal Rigid Barrier Impact Testing. The test was conducted at Calspan Corporation's Transportation Test Operations facility in Buffalo, New York on May 21, 2024.

The impact velocity of the vehicle was 56.24 km/h, and the ambient temperature at the barrier face at the time of impact was 21°C. The target vehicle post-test maximum crush was 345 mm at the vehicle centerline. The test vehicle's occupant performance data is as follows:

Measurement Description	Units	Driver ATD (Serial No. 065)		Passenger ATD (Serial No. 137)	
		Threshold	Result	Threshold	Result
Head Injury Criteria (HIC15)		700	395.313	700	279.981
Maximum Chest Compression	mm	63	-26.239	52	-19.624
Nij		1	0.269	1	0.424
Neck Tension	N	4170	758.035	2620	875.838
Neck Compression	N	4000	-246.614	2520	-619.012
Left Femur Force	N	10008	-164.072	6805	-535.537
Right Femur Force	N	10008	-73.695	6805	-653.358

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SECTION 1

PURPOSE AND SUMMARY OF TEST

PURPOSE

This 56.3 km/h frontal barrier impact test is part of the Vehicle Barrier Impact Testing Program sponsored by the National Highway Traffic Safety Administration (NHTSA) under Contract No. 693JJ919D000005. The purpose of this test was to obtain vehicle crashworthiness and occupant restraint system performance data for consumer information purposes.

The 56.3 km/h frontal barrier impact test was conducted in accordance with the Office of Crashworthiness Standards Laboratory Procedure for NCAP Full Frontal Rigid Barrier Impact Testing.

SUMMARY

A load cell barrier consisting of 128 load cells was impacted by a 2024 Hyundai Kona 5 Door SUV at a velocity of 56.24 km/h. The test was performed at Calspan Corporation's Transportation Test Operations facility in Buffalo, New York on May 21, 2024. Pre- and post-test photographs of the vehicle and dummies to document the test can be found in Appendix A. One real-time camera and 16 high-speed cameras were used to document the frontal barrier impact event. Camera locations and other pertinent camera information can be found in Data Sheet 6 of this report.

One Part 572E, 50th percentile male anthropomorphic test device (ATD), was placed in the driver seating position and one Part 572O 5th percentile female ATD was placed in the right-front passenger seating position according to dummy placement instructions specified in the Laboratory Procedure for NCAP Full Frontal Rigid Barrier Impact Testing. Both ATDs were fully instrumented with head, chest and pelvis tri-axial accelerometers, chest displacement potentiometers, upper neck transducers, femur load cells, and lower leg instrumentation. Seat belt load cells were installed on the driver's lap and shoulder belts and Passenger's Shoulder belt to measure dummy torso and pelvic section loading. The driver (position 1) ATD (Serial No. 065) and the right-front passenger (position 2) ATD (Serial No. 137) were qualified prior to this test. Certification details, along with instrumentation calibration data, can be found in Appendix C of this report.

The 486 channels of data were recorded on an on-board data acquisition system. Appendix B contains the vehicle, load cell barrier and dummy response data traces.

There was 100 percent windshield retention and no intrusion into the protected zone of the windshield during the event. There was a total of 0.0 grams of Stoddard solvent / electrolyte leakage after the event or during any phase of the static rollover. The maximum static crush of the vehicle was 345 mm and both driver and passenger side doors remained closed during the impact event and were operable after the impact.

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

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

The occupant data is summarized below.

ATD Position	HIC_{15}	Nij	Neck Tension (N)	Neck Comp. (N)	3ms Chest Clip (Gs)	Chest Disp. (mm)	Left Femur (N)	Right Femur (N)
Driver (50th)	395.313	0.269	758.035	-246.614	48.010	-26.239	-164.072	-73.695
Passenger (5th)	279.981	0.424	875.838	-619.012	55.987	-19.624	-535.537	-653.358

GENERAL COMMENTS:

1. P1 (Driver) serial number - 065
2. P2 (Passenger) serial number - 137

Data Anomalies:

- No Questionable Channels

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 No. 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: 2024 Hyundai Kona 5 Door SUV
NHTSA No.: M20244203
Test Program: NCAP Frontal Barrier Impact Test
Test Date: 05/21/2024

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA No.	M20244203	Traction Control System (TCS)	Yes
Model Year	2024	Power Steering	Yes
Make	Hyundai	Power Window Auto-Reverse	Yes
Model	Kona	Driver Frontal Airbag	Yes
Body Style	SUV	Driver Curtain Airbag	Yes
VIN	KM8HACAB3RU127277	Driver Head/Torso Airbag	No
Body Color	Denim Blue Pearl	Driver Torso Airbag	No
Odometer Reading (km /mi)	78 mi	Driver Torso/Pelvis Airbag	Yes
Engine Displacement (L)	2.0	Driver Pelvis Airbag	No
Type / No. Cylinders	I4	Driver Knee Airbag	No
Engine Placement	Transverse	Front Pass. Frontal Airbag	Yes
Transmission Type	Automatic	Front Pass. Curtain Airbag	Yes
Transmission Speeds	Intelligent Variable	Front Pass. Head/Torso Airbag	No
Overdrive	Yes	Front Pass. Torso Airbag	No
Final Drive	All Wheel Drive	Front Pass. Torso/Pelvis Airbag	Yes
Roof Rack	No	Front Pass. Pelvis Airbag	No
Sunroof / T-Top	No	Front Pass. Knee Airbag	No
Running Boards	No	Driver Pretensioner	Yes
Tilt Steering Wheel	Yes	Driver Load Limiter	Yes
Power Seats	No	Front Pass. Pretensioner	Yes
Anti-Lock Brakes (ABS)	Yes	Front Pass. Load Limiter	Yes
Automatic Door Locks (ADLs)	Yes	Other –	N/A

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

DATA FROM CERTIFICATION LABEL

Manufactured By	Hyundai Motor Company	GVWR (KG)	1940
Date of Manufacture	JAN/2024	GVWR Front (KG)	1100
		GVWR Rear (KG)	952

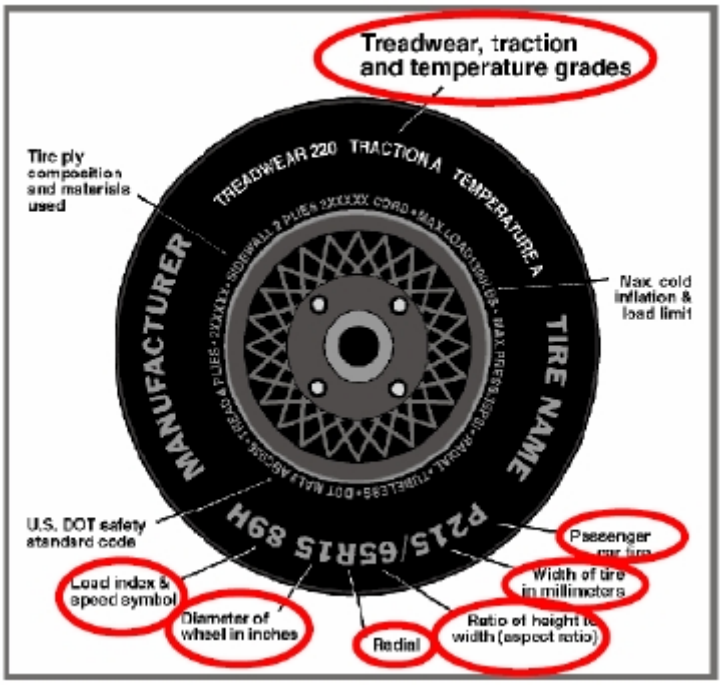
VEHICLE SEATING AND WEIGHT CAPACITY DATA

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Split Bench	N/A	
Number of Occupants	2	3	N/A	5
Capacity Wt. (VCW) (kg)				390
Cargo Wt. (RCLW) (kg)				50

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

Test Vehicle:	2024 Hyundai Kona 5 Door SUV	NHTSA No.:	M20244203
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	05/21/2024

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	215/60R17	215/60R17
Tire Size on Vehicle	215/60R17	215/60R17
Tire Manufacturer	KUMHO	KUMHO
Tire Model	Solus	Solus
Treadwear	520	520
Traction	A	A
Temperature Grades	A	A
Tire Plies Sidewall	1 Polyester	1 Polyester
Tire Plies Body	2 Steel, 1 Polyester, 1 Nylon	2 Steel, 1 Polyester, 1 Nylon
Load Index / Speed Symbol	96H	96H
Tire Material	Rubber	Rubber
DOT Safety Code Left	127EDYATC5223	127EDYATC5223
DOT Safety Code Right	127EDYATC5223	127EDYATC4623

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

Test Vehicle: 2024 Hyundai Kona 5 Door SUV NHTSA No.: M20244203
Test Program: NCAP Frontal Barrier Impact Test Test Date: 05/21/2024

TEST VEHICLE WEIGHTS

	Units	As Delivered Weights (UVW)			As Tested Weights (ATW)		
		Front Axle	Rear Axle	Total	Front Axle	Rear Axle	Total
Left	kg	431	302		489	340	
Right	kg	429	284		458	344	
Ratio	%	59.5	40.5		58.1	41.9	
Total	kg	860	586	1446	947	684	1631

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value	
Total Delivered Weight (UVW)	kg	1446	(A)
Weight of 1 P572E ATD & 1 P572O ATD	kg	142	(B)
Rated Cargo / Luggage Weight (RCLW)	kg	50	(C)
Calculated Vehicle Target Weight (TVTW)	kg	1638	(A+B+C)

TEST VEHICLE ATTITUDES AND CG

Condition	Units	LF	RF	LR	RR	CG (aft of front axle)
As Delivered	mm	925	927	970	970	1079
As Tested	mm	917	918	949	951	1116
Post-Test	mm	936	928	948	955	

GENERAL TEST VEHICLE DATA

Measurement Description	Units	Value
Total Vehicle Wheel Base	mm	2662
Total Vehicle Length at Left Side	mm	4298
Total Vehicle Length at Centerline	mm	4348
Total Vehicle Length at Right Side	mm	4298
Weight of Ballast in Cargo Area	kg	0
Weight of Vehicle Components Removed	kg	44.5
Amount of Stoddard Solvent in Fuel Tank	L	43.7

LIST OF COMPONENTS REMOVED TO MEET TEST WEIGHT:

Rear bumper and rear bumper fascia.

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

Test Vehicle:	2024 Hyundai Kona 5 Door SUV	NHTSA No.:	M20244203
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	05/21/2024

TARGET VEHICLE STRUCTURAL MEASUREMENT

No.	Description	Pre-Test
1	Total Length	4348
2	Total Width	1801
3*	Bumper Top Height	601
4*	Bumper Bottom Height	480
5*	Longitudinal Member Top Height	603
6	Distance Between Longitudinal Members	1056
7	Longitudinal Member Width	62
8*	Engine Top Height	886
9*	Engine Bottom Height	263
10	Engine and Gearbox Width	456
11	Front Bumper-Engine Distance	635
12*	Front Shock Absorber Fixing Height	953
13*	Bonnet Leading Edge Height	924
14	Front Shock Absorber Fixing Width	1185
15	Front Bumper – Front Axle Distance	858
16	Front Axle – A Pillar Distance	481
17	A-Pillar – B-Pillar Distance	1107
18	B-Pillar – Rear Axle Distance	1073
19	B-Pillar – C-Pillar Distance	909
20*	Roof Sill Bottom Height	1525
21*	Roof Sill Top Height	1570
22*	Floor Sill Bottom Height	361
23*	Floor Sill Top Height	439

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

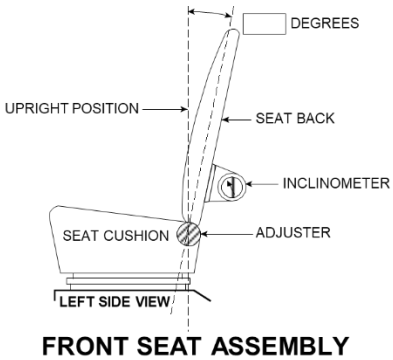
DATA SHEET NO. 2
SEAT ADJUSTMENT, FUEL SYSTEM, AND STEERING WHEEL DATA

Test Vehicle:	2024 Hyundai Kona 5 Door SUV	NHTSA No.:	M20244203
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	05/21/2024

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	0.4
Passenger Seat Back Angle	0.55



FRONT SEAT ASSEMBLY

SEAT FORE / AFT POSITIONS

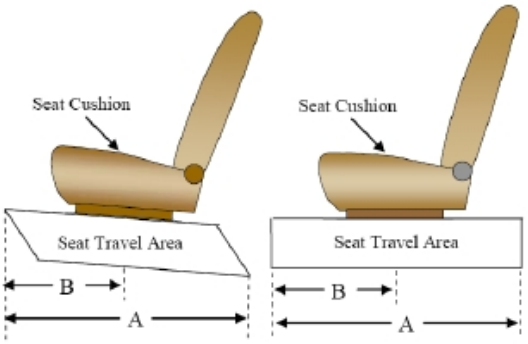
The driver's seat was positioned at the mid-point of fore/aft travel at its lowest position. The passenger's seat was positioned at the most forward position of fore/aft travel. Zero is defined as the forward most position.

Seating Position	Total Fore / Aft Travel	Placed in Position #
Driver Seat	326 (0-65)	25
Passenger Seat	248 (0-62)	0

SEAT BELT UPPER ANCHORAGE

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

Seating Position	Total # of Positions	Placed in Position #
Driver Seat	4 (0-3)	0
Passenger Seat	4 (0-3)	0



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

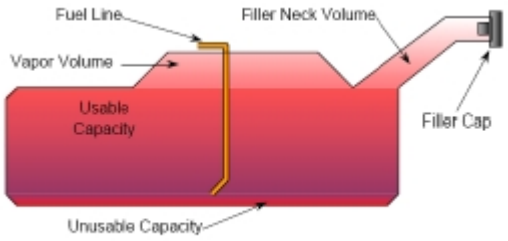
Test Vehicle:	2024 Hyundai Kona 5 Door SUV	NHTSA No.:	M20244203
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	05/21/2024

FUEL TANK CAPACITY

Description	Liters
Usable Capacity of “Standard Tank”	47
Usable Capacity of “Optional Tank”	N/A
92%-94% of Usable Capacity	43.2 - 44.2
Actual Amount of Solvent Used	43.7
1/3 of Usable Capacity	15.6

FUEL PUMP

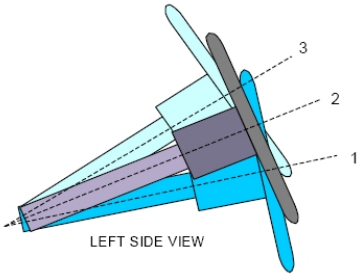
The vehicle is equipped with an electric fuel pump. The fuel filler neck is on the left side of the vehicle. The pump creates positive pressure in the fuel lines, pushing the gasoline to the engine. See form 1 for more information.



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.



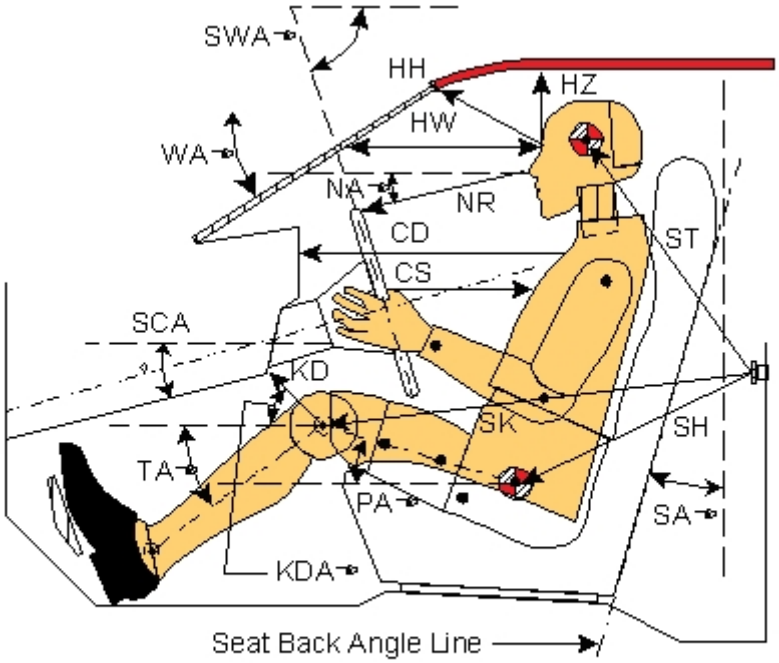
STEERING COLUMN ASSEMBLY

STEERING COLUMN POSITIONS

Description	Degrees	Fore / Aft Position (mm)
Lowermost position No. 1	22.5	
Geometric center position No. 2	25.1	
Uppermost position No. 3	27.7	
Telescoping Steering Wheel Travel		50
Test Position	25.1	25

DATA SHEET NO. 3
DUMMY LONGITUDINAL CLEARANCE DIMENSIONS

Test Vehicle:	2024 Hyundai Kona 5 Door SUV	NHTSA No.:	M20244203
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	05/21/2024

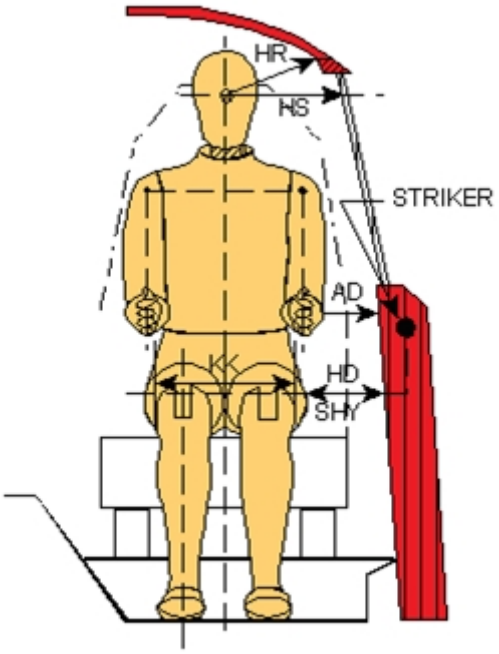


Left Side View

Code	Measurement Description	Driver (SN: 065)		Passenger (SN: 137)	
		Length (mm)	Angle (°)	Length (mm)	Angle (°)
WA°	Windshield Angle		30.4		
SWA°	Steering Wheel Angle		24.9		
SCA°	Steering Column Angle		65.1		
SA°	Seat Back Angle (on headrest post)		0.4		0.55
HZ	Head to Roof (Z)	210	90	234	90
HH	Head to Header	371	26.9	330	47.0
HW	Head to Windshield	610	0.0	610	0.0
NR	Nose to Rim / Dash	419	11.3	467	15.6
CD	Chest to Dash	613		442	
CS	Chest to Steering Hub	330	7.6		
RA	Rim to Abdomen	220	14.5		
KDL	Left Knee to Dash	192	24.0	134	35.2
KDR	Right Knee to Dash	175	24.7	133	33.0
PA°	Pelvic Angle		24.1		19.5
TA°	Tibia Angle		31.2		42.0
SK	Striker to Knee	625	20.85	697	20.3
ST	Striker to Head	375	70.5	334	54.7
SH	Striker to H-Point	371	62.0	466	39.2

DATA SHEET NO. 4
DUMMY LATERAL CLEARANCE DIMENSIONS

Test Vehicle:	2024 Hyundai Kona 5 Door SUV	NHTSA No.:	M20244203
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	05/21/2024

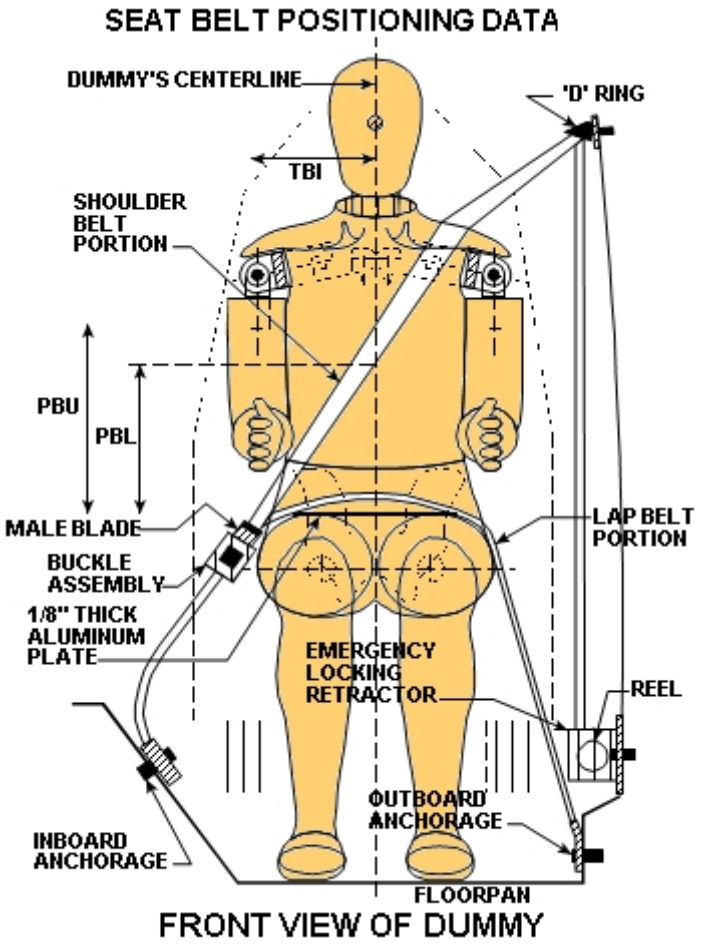


Front View

Code	Description	Driver (mm)	Passenger (mm)
AD	Arm to Door	94	90
HD	H-Point to Door	145	242
HR	Head to Side Header	230	275
HS	Head to Side Window	345	387
KK	Knee to Knee	325	211
SHY	Striker to H-Point (Y Direction)	255	302
AA	Ankle to Ankle	380	167

DATA SHEET NO. 5
SEAT BELT POSITIONING DATA

Test Vehicle:	2024 Hyundai Kona 5 Door SUV	NHTSA No.:	M20244203
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	05/21/2024



SEAT BELT POSITIONING MEASUREMENTS

Measurement Description	Units	Driver	Passenger
PBU — Top surface of reference to belt upper edge	mm	360	315
PBL — Top surface of reference to belt lower edge	mm	270	225

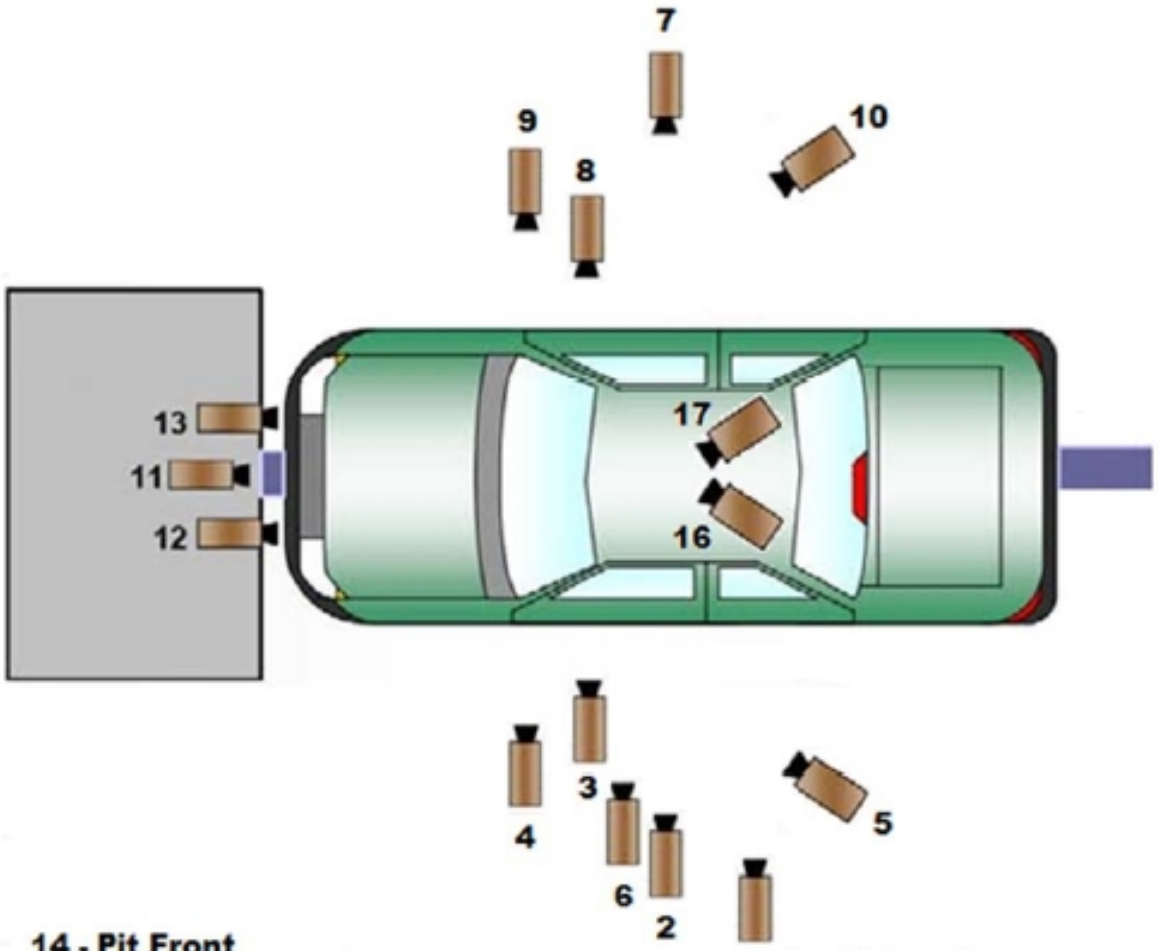
BELT LENGTH DATA

Measurement Description	Units	Driver	Passenger
Shoulder belt length as measured on ATD	mm	895	910
Lap Belt Length as measured on ATD	mm	565	615
Remainder of belt on reel	mm	970	905
Total belt length for continuous webbing systems	mm	2430	2430

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

Test Vehicle:	2024 Hyundai Kona 5 Door SUV	NHTSA No.:	M20244203
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	05/21/2024

CAMERA POSITIONS FOR FRONTAL IMPACTS



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

Test Vehicle: 2024 Hyundai Kona 5 Door SUV NHTSA No.: M20244203
Test Program: NCAP Frontal Barrier Impact Test Test Date: 05/21/2024

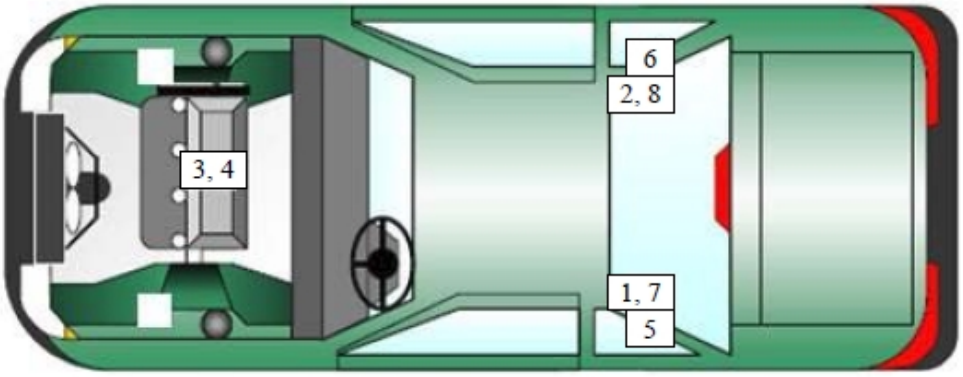
CAMERA LOCATIONS

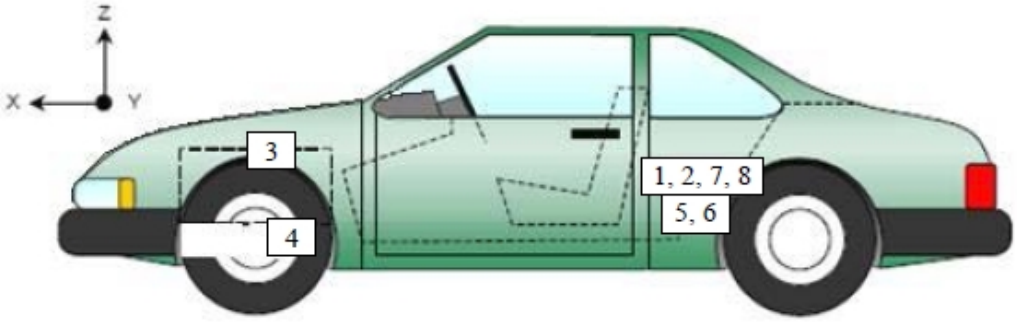
No.	Camera View	Location (mm)			Lens (mm)	Speed (fps)
		X	Y	Z		
1	Real-Time Left Overall				Zoom	60
2	Left Overall	-1921	-7122	-1488	24	1000
3	Driver Close-Up	-1199	-6740	-1402	50	1000
4	Left Front Half	-517	-6004	-1347	28	1000
5	Left Angle	-4347	-3622	-2615	75	1000
6	Steering Column	-1557	-7351	-2436	50	1000
7	Right Overall	-1472	7227	-1458	24	1000
8	Passenger Close-Up	-1006	6658	-1398	50	1000
9	Right Front Half	-571	6745	-1488	28	1000
10	Right Angle	-4149	2990	-2668	50	1000
11	Windshield	1338	0	-3743	12.5	1000
12	Driver Windshield	916	-457	-2264	25	1000
13	Passenger Windshield	916	457	-2264	25	1000
14	Pit Front	-1163	0	2246	12.5	1000
15	Pit Rear	-2698	0	2291	12.5	1000
16	Onboard Driver Airbag (Optional)				8	1000
17	Onboard Passenger Airbag (Optional)				8	1000

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

DATA SHEET NO. 7
VEHICLE ACCELEROMETER LOCATIONS

Test Vehicle:	2024 Hyundai Kona 5 Door SUV	NHTSA No.:	M20244203
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	05/21/2024





VEHICLE ACCELEROMETER PRE-TEST LOCATIONS

No.	Accelerometer Location	Measurements (mm)		
		X	Y	Z
1	Left Rear Accelerometer – X Direction	1653	-366	185
2	Right Rear Accelerometer – X Direction	1654	347	190
3	Engine Top X	3686	190	-312
4	Engine Bottom X	3645	21	267
5	Left Rear Accelerometer – Z Direction	1653	-366	185
6	Right Rear Accelerometer – Z Direction	1654	347	190
7	Left Rear Accelerometer – X Direction Redundant	1653	-351	185
8	Right Rear Accelerometer – X Direction Redundant	1654	364	189

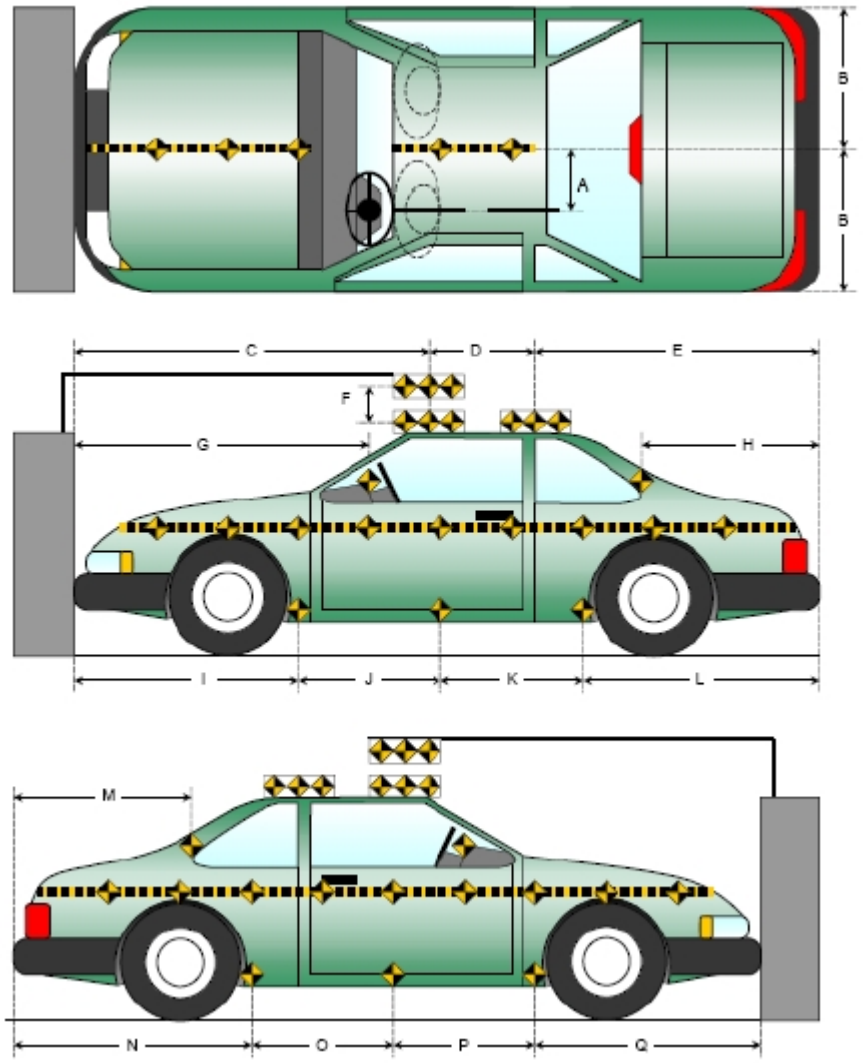
Reference Points:
X – Rear Surface of Vehicle (+ forward)
Y – Vehicle Centerline (+ to right)
Z – Ground Plane (+ down)

DATA SHEET NO. 8
PHOTOGRAPHIC REFERENCE TARGET LOCATIONS

Test Vehicle:	2024 Hyundai Kona 5 Door SUV	NHTSA No.:	M20244203
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	05/21/2024

Item	Value
A	386
B	901
C	2316
D	860
E	1172
F	281
G	1643
H	916
I	1322
J	870
K	871
L	1285
M	916
N	1284
O	870
P	870
Q	1324

All units in millimeters



DATA SHEET NO. 9
LOAD CELL LOCATIONS ON FIXED BARRIER

Test Vehicle:	2024 Hyundai Kona 5 Door SUV	NHTSA No.:	M20244203
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	05/21/2024

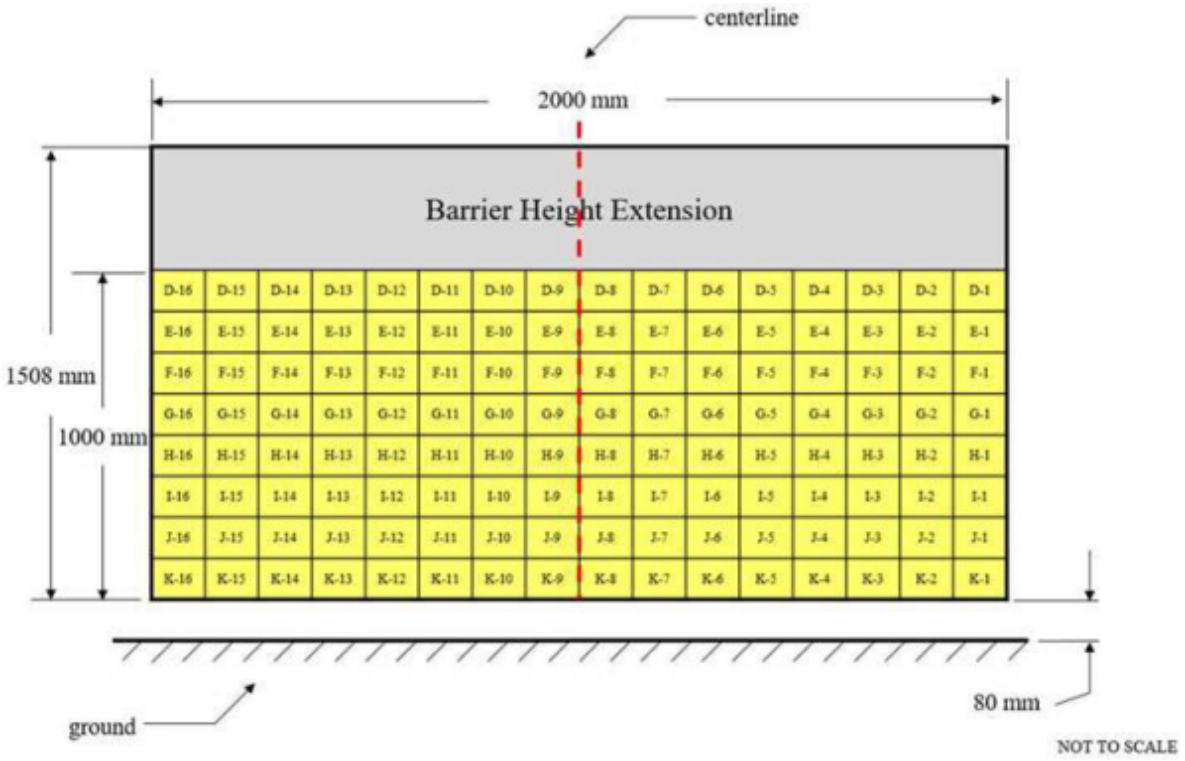


Figure 1 - Load Cell Locations on a 128-Load Cell Barrier with Plywood Height Extension*
Please note above diagram is not actual representation of load cell barrier used.

DATA SHEET NO. 10
TEST VEHICLE SUMMARY OF RESULTS

Test Vehicle:	2024 Hyundai Kona 5 Door SUV	NHTSA No.:	M20244203
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	05/21/2024

INSTRUMENTATION

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

CAMERA COVERAGE

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

DATA SHEET NO. 11
POST-TEST OBSERVATIONS

Test Vehicle: 2024 Hyundai Kona 5 Door SUV
NHTSA No.: M20244203
Test Program: NCAP Frontal Barrier Impact Test
Test Date: 05/21/2024

TEST DUMMY INFORMATION AND CONTACT LOCATIONS

Description	Driver	Passenger
Dummy Type / Serial No.	H3-50th Male / SN: 065	H3-5th Female / SN: 137
Head Contact	Frontal Airbag & Headrest	Frontal Airbag & Headrest
Upper Torso Contact	Frontal Airbag	Frontal Airbag
Lower Torso Contact	None	None
Left Knee Contact	Steering Column & Knee Bolster	Glove Box
Right Knee Contact	Knee Bolster	Glove Box

DOOR OPENING AND SEAT TRACK INFORMATION

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

POST-TEST STRUCTURAL OBSERVATIONS

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

VEHICLE REBOUND FROM BARRIER

Measured Parameter	Units	Value
Left Side	mm	1777
Center	mm	1750
Right Side	mm	1717
Average	mm	1748

DATA SHEET NO. 11 … (CONTINUED)
POST-TEST OBSERVATIONS

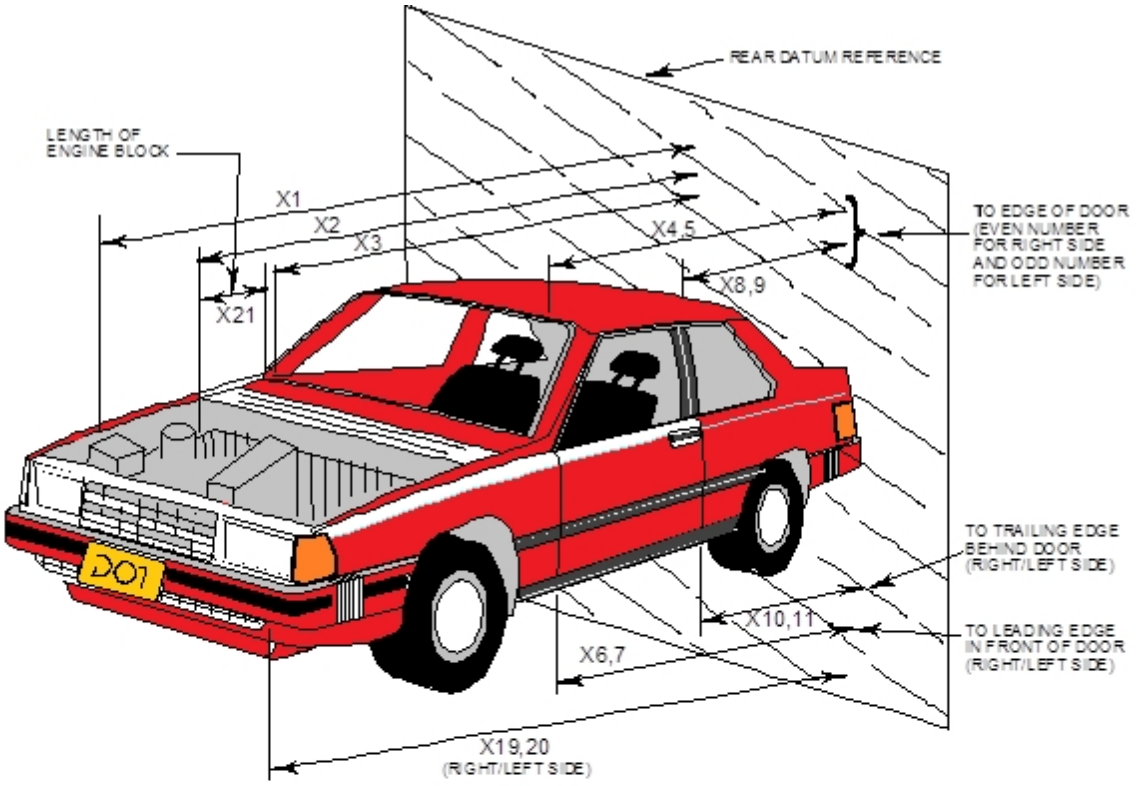
Test Vehicle: 2024 Hyundai Kona 5 Door SUV NHTSA No.: M20244203
Test Program: NCAP Frontal Barrier Impact Test Test Date: 05/21/2024

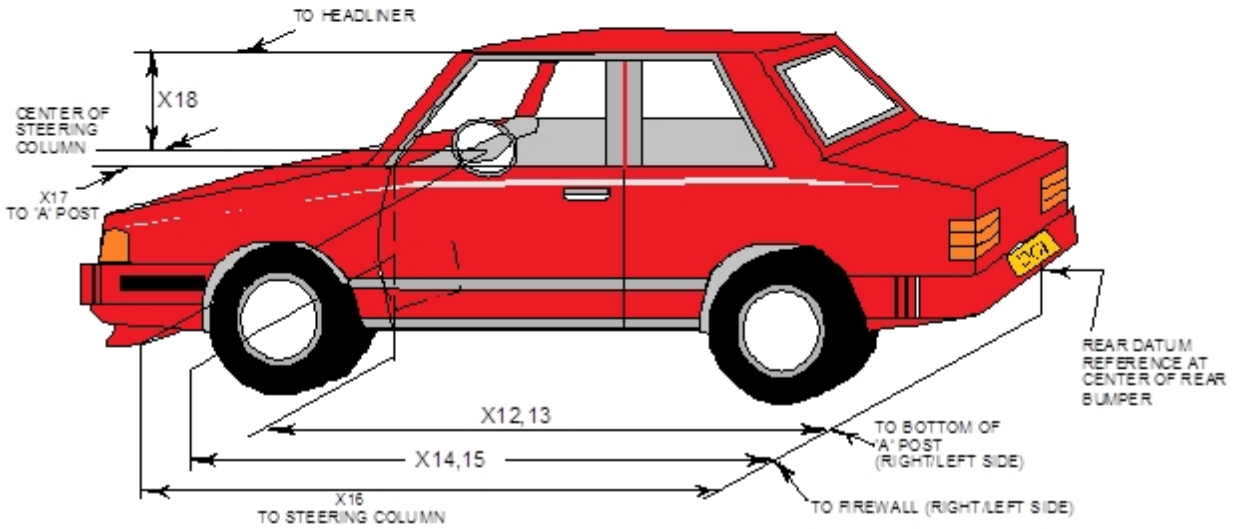
SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

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	Yes	No	Yes	No
Knee Airbag	No	N/A	No	N/A
Seat Belt Pretensioner	Yes	Yes	Yes	Yes
Seat Belt Load Limiter	Yes	Yes	Yes	Yes
Other				

DATA SHEET NO. 12
VEHICLE PROFILE MEASUREMENTS

Test Vehicle:	2024 Hyundai Kona 5 Door SUV	NHTSA No.:	M20244203
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	05/21/2024





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

Test Vehicle: 2024 Hyundai Kona 5 Door SUV
NHTSA No.: M20244203
Test Program: NCAP Frontal Barrier Impact Test
Test Date: 05/21/2024

No.	Measurement Description	Pre-Test	Post-Test	Difference
1	Total Length of Vehicle at Centerline	4348	4003	-345
2	Rear Surface of Vehicle (RSOV) to Front of Engine	3713	3528	-185
3	RSOV to Firewall	3248	3234	-14
4	RSOV to Upper Leading Edge of Right Door	3002	3001	-1
5	RSOV to Upper Leading Edge of Left Door	3001	3001	0
6	RSOV to Lower Leading Edge of Right Door	2992	2994	2
7	RSOV to Lower Leading Edge of Left Door	2993	2994	1
8	RSOV to Upper Trailing Edge of Right Door	1912	1911	-1
9	RSOV to Upper Trailing Edge of Left Door	1911	1911	0
10	RSOV to Lower Trailing Edge of Right Door	1950	1950	0
11	RSOV to Lower Trailing Edge of Left Door	1952	1952	0
12	RSOV to Bottom of “A” Post of Right Side	3069	3068	-1
13	RSOV to Bottom of “A” Post of Left Side	3067	3069	2
14	RSOV to Firewall, Right Side	3559	3559	0
15	RSOV to Firewall, Left Side	3564	3526	-38
16	RSOV to Steering Column	2532	2591	59
17	Center of Steering Column to “A” Post	309	303	-6
18	Center of Steering Column to Headliner	440	451	11
19	RSOV to Right Side of Front Bumper	4305	4035	-270
20	RSOV to Left Side of Front Bumper	4304	4018	-286
21	Length of Engine Block	186	186	0
RD	RSOV to Right Side of Dash Panel	2732	2733	1
CD	RSOV to Center of Dash Panel	2701	2702	1
LD	RSOV to Left Side of Dash Panel	2807	2808	1

All Dimensions in mm

DATA SHEET NO. 13
ACCIDENT INVESTIGATION DIVISION DATA

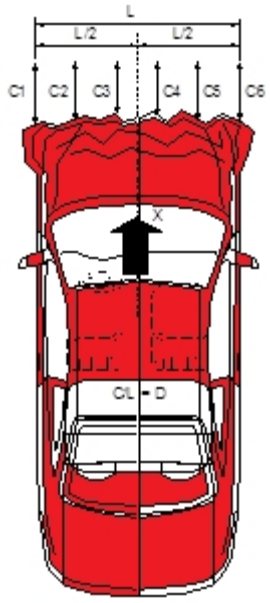
Test Vehicle:	2024 Hyundai Kona 5 Door SUV	NHTSA No.:	M20244203
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	05/21/2024

VEHICLE INFORMATION

VIN:	KM8HACAB3RU127277	Wheelbase (mm):	2662
Vehicle Size Category:	MPV	Test Weight (kg):	1631

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):	56.24
Velocity Change (km/h):	65.670
Time of Separation (ms):	129



CRUSH PROFILE

Collision Deformation Classification:	12FDEW2
Midpoint of Damage:	C3
Damage Region Length (mm):	1575
Impact Mode:	Frontal

No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
C1	Crush Zone 1 at Left Side	mm	4132	3935	197
C2	Crush Zone 2 at Left Side	mm	4295	4051	244
C3	Crush Zone 3 at Left Side	mm	4338	4085	253
C4	Crush Zone 4 at Right Side	mm	4337	4090	247
C5	Crush Zone 5 at Right Side	mm	4297	4061	236
C6	Crush Zone 6 at Right Side	mm	4139	3962	177
L	C1 to C6	mm	1526	1575	-49

DATA SHEET NO. 14
VEHICLE INTRUSION MEASUREMENTS

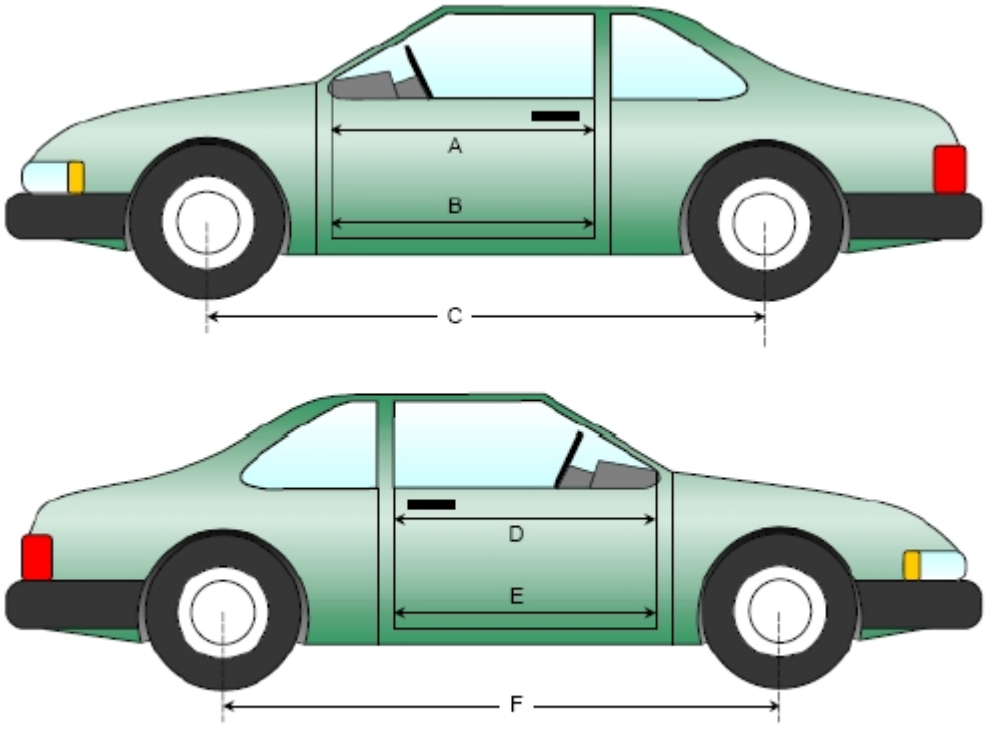
Test Vehicle:	2024 Hyundai Kona 5 Door SUV	NHTSA No.:	M20244203
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	05/21/2024

DOOR OPENING WIDTH

Item	Description	Units	Pre-Test	Post-Test	Difference
A	Left Side Upper	mm	987	987	0
B	Left Side Lower	mm	892	892	0
D	Right Side Upper	mm	986	986	0
E	Right Side Lower	mm	888	887	-1

WHEELBASE MEASUREMENTS

Item	Description	Units	Pre-Test	Post-Test	Difference
C	Left Side Wheelbase	mm	2662	2588	-74
F	Right Side Wheelbase	mm	2662	2594	-68



Left & Right Side Views

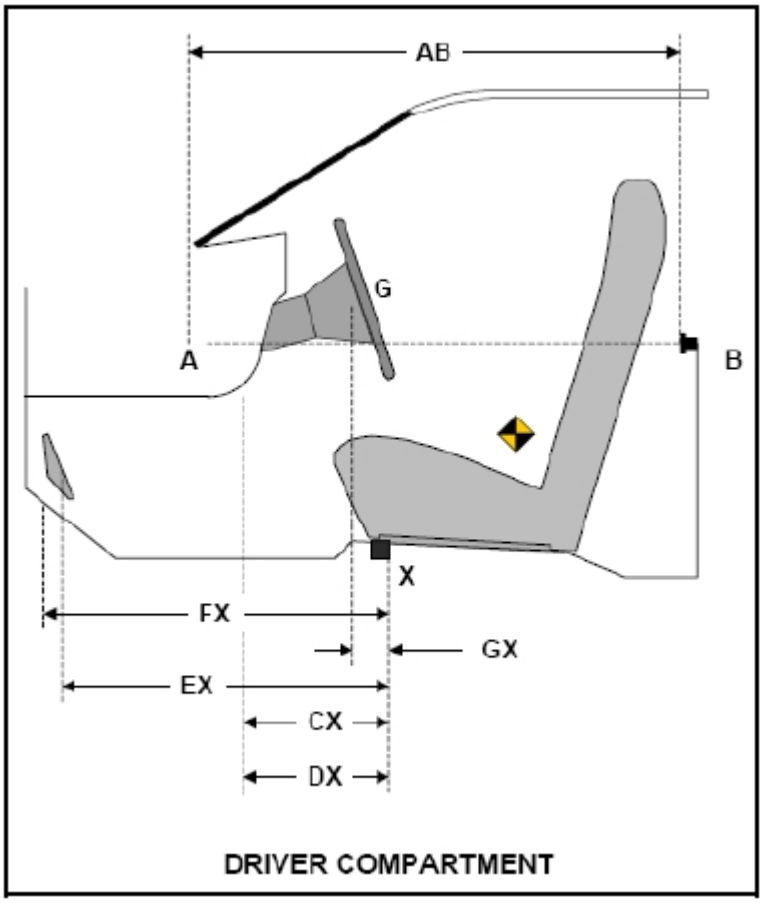
DATA SHEET NO.14 … (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle:	2024 Hyundai Kona 5 Door SUV	NHTSA No.:	M20244203
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	05/21/2024

DRIVER COMPARTMENT INTRUSION

Item	Description	Units	Pre-Test	Post-Test	Difference
AB	Door Opening (Inside Window Jam)	mm	747	747	0
CX	Left Knee Bolster to X	mm	304	302	-2
DX	Right Knee Bolster to X	mm	315	315	0
EX	Brake Pedal to X	mm	549	509	-40
FX	Foot Rest to X	mm	560	546	-14
GX	Center of Steering Column Wheel Hub to X	mm	55	111	56

X = Front of Seat Track (Stationary)



DRIVER COMPARTMENT

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

Test Vehicle:	2024 Hyundai Kona 5 Door SUV	NHTSA No.:	M20244203
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	05/21/2024

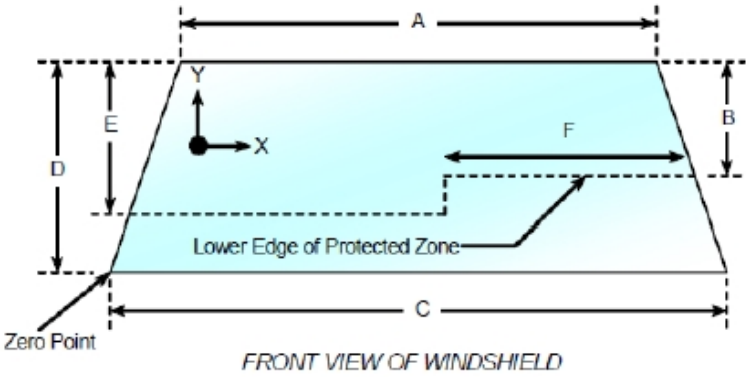
Windshield Mounting Details: A trim surrounds the top and side of windshield while a plastic shroud is on the bottom.

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	2168	2168	100%
Right Side	2168	2168	100%
Total	4336	4336	100%



FRONT VIEW OF WINDSHIELD

Item	Units	Value
A	mm	1234
B	mm	482
C	mm	1550
D	mm	776
E	mm	492
F	mm	570

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

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

X	Y

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

Test Vehicle:	2024 Hyundai Kona 5 Door SUV	NHTSA No.:	M20244203
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	05/21/2024

FMVSS 301 FUEL SYSTEM INTEGRITY POST IMPACT DATA

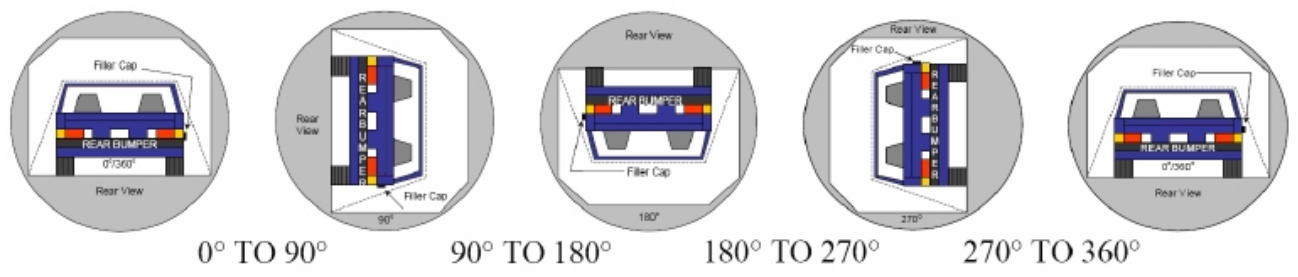
Temperature at Time of Impact: 21°C Test Time: 10:13 AM

STODDARD SOLVENT SPILLAGE MEASUREMENTS

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

DATA SHEET NO. 16
FMVSS 301 STATIC ROLLOVER RESULTS

Test Vehicle:	2024 Hyundai Kona 5 Door SUV	NHTSA No.:	M20244203
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	05/21/2024



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

SOLVENT COLLECTION TIME TABLE IN SECONDS

Test Phase	Rotation Time	Hold Time	Total Time
0° to 90°	69	300	369
90° to 180°	65	300	365
180° to 270°	63	300	363
270° to 360°	65	300	365

FMVSS 301 SPILLAGE TABLE

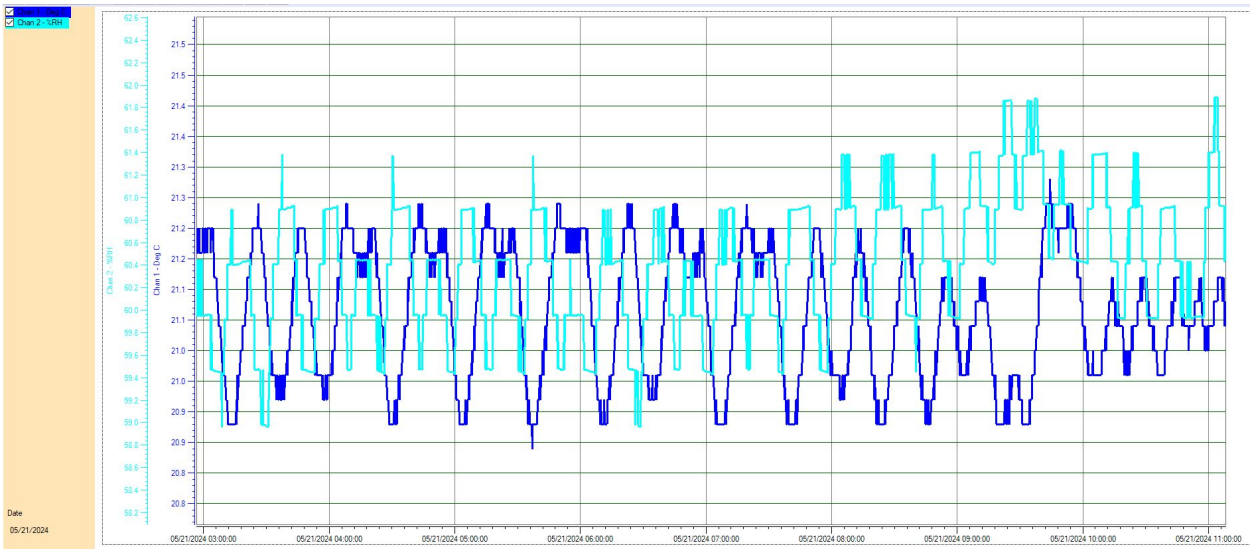
Test Phase	First 5 Minutes	Sixth Minute	Seventh Minute	Eighth Minute
0° to 90°	0	0	0	
90° to 180°	0	0	0	
180° to 270°	0	0	0	
270° to 360°	0	0	0	

SOLVENT SPILLAGE LOCATION TABLE

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

DATA SHEET NO. 17
DUMMY / VEHICLE TEMPERATURE STABILIZATION CHART

Test Vehicle:	2024 Hyundai Kona 5 Door SUV	NHTSA No.:	M20244203
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	05/21/2024



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

APPENDIX A

PHOTOGRAPHS

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

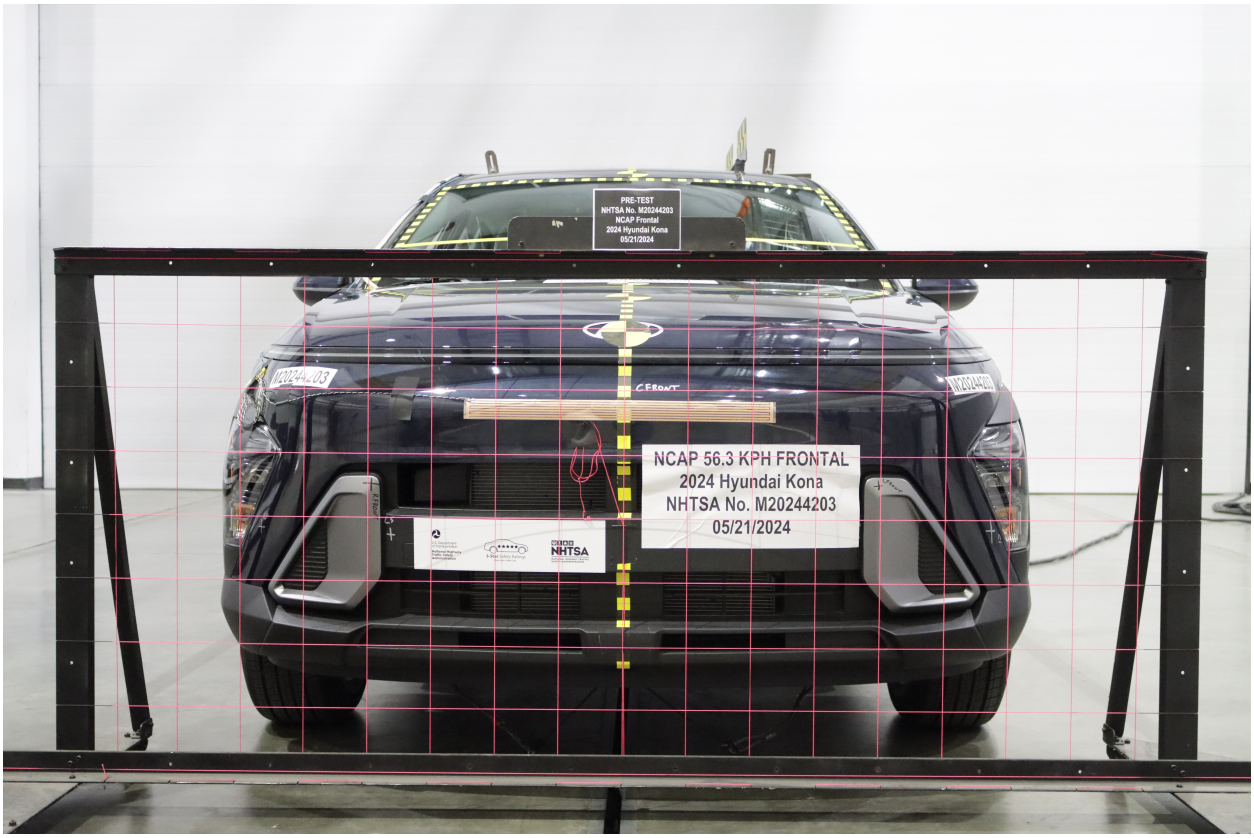

Figure A-1: Load Cell Location



Figure A-2: Pre-Test Load Cell Wall



Figure A-3: Post-Test Load Cell Wall



Figure A-4: Manufacturer's Label

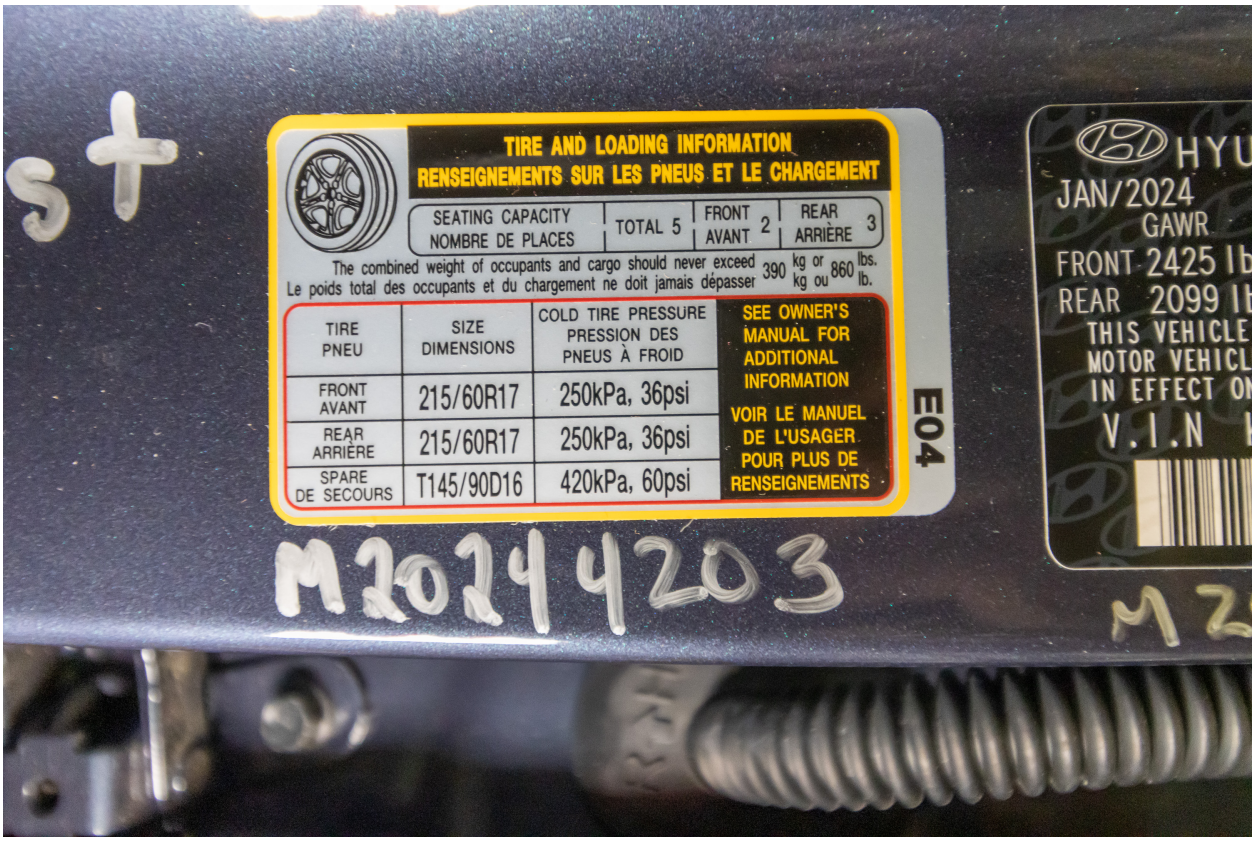

Figure A-5: Tire Placard



Figure A-6: 2024 Hyundai Kona Frontal As Delivered



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



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

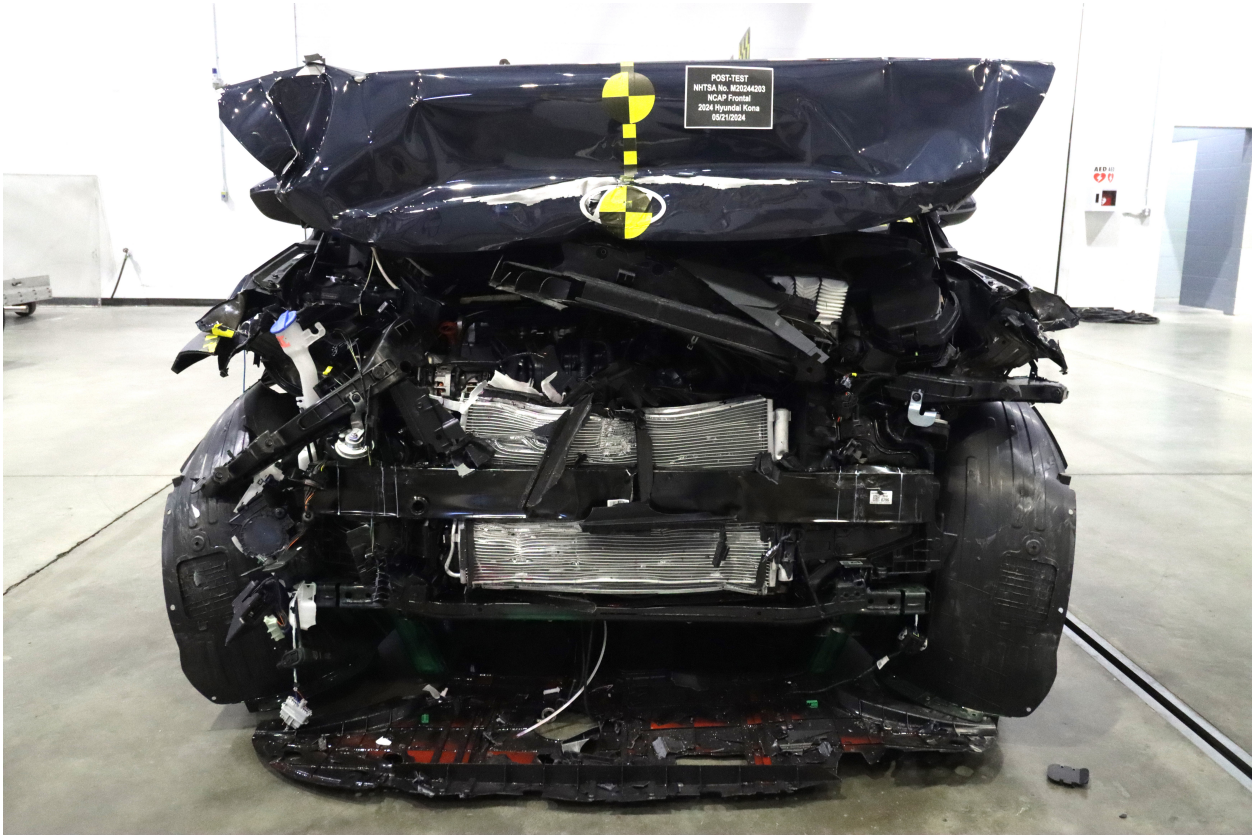

Figure A-9: Post-Test Front View of Test Vehicle



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



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



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



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



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



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



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



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



Figure A-18: Pre-Test Windshield View

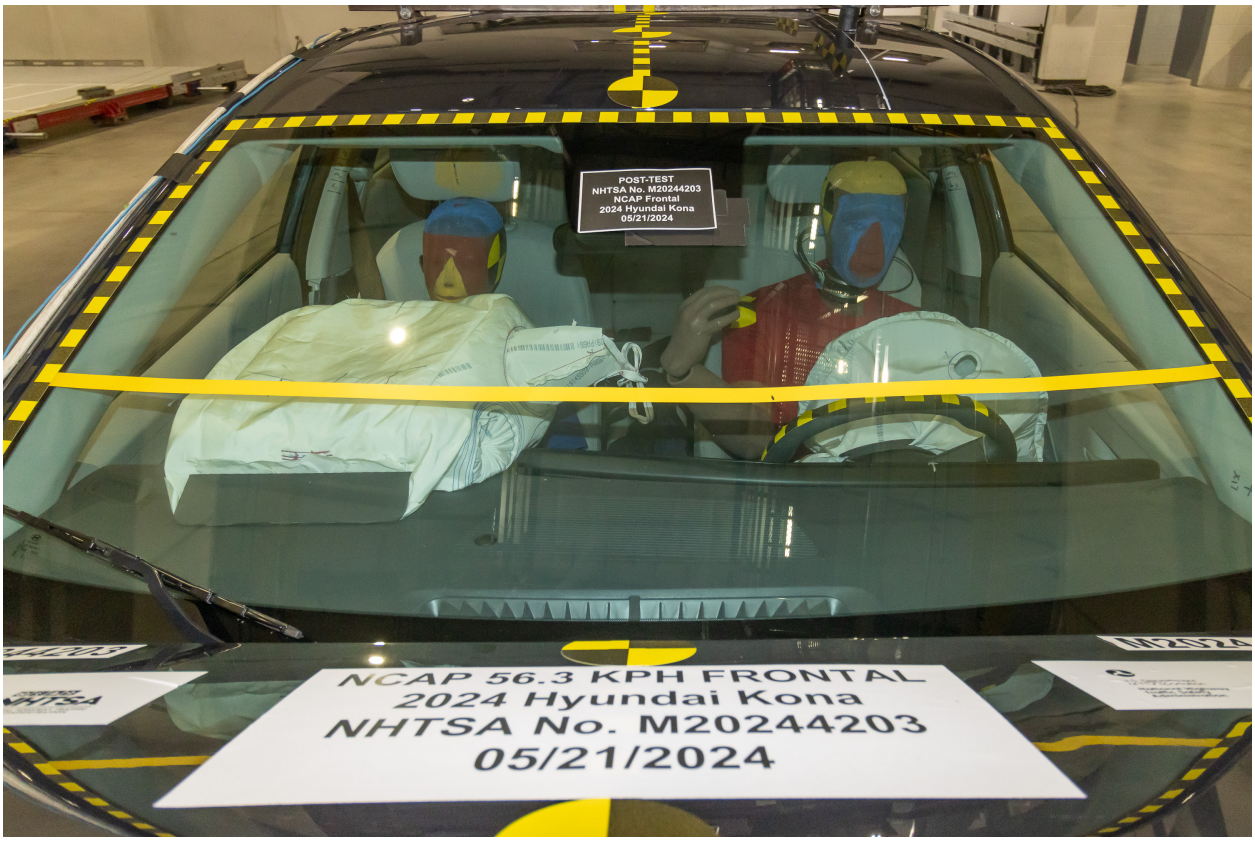

Figure A-19: Post-Test Windshield View

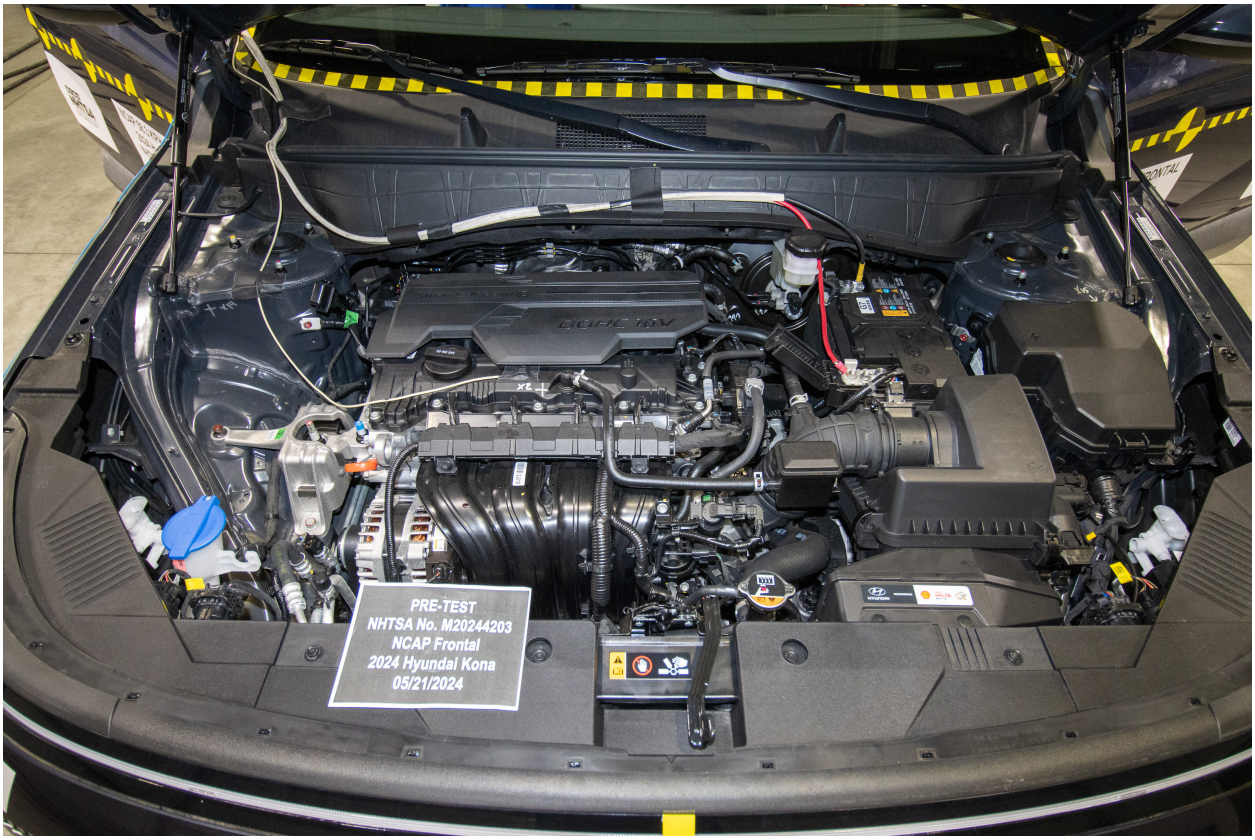

Figure A-20: Pre-Test Engine Compartment View



Figure A-21: Post-Test Engine Compartment View



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



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



Figure A-24: Pre-Test Front Underbody View

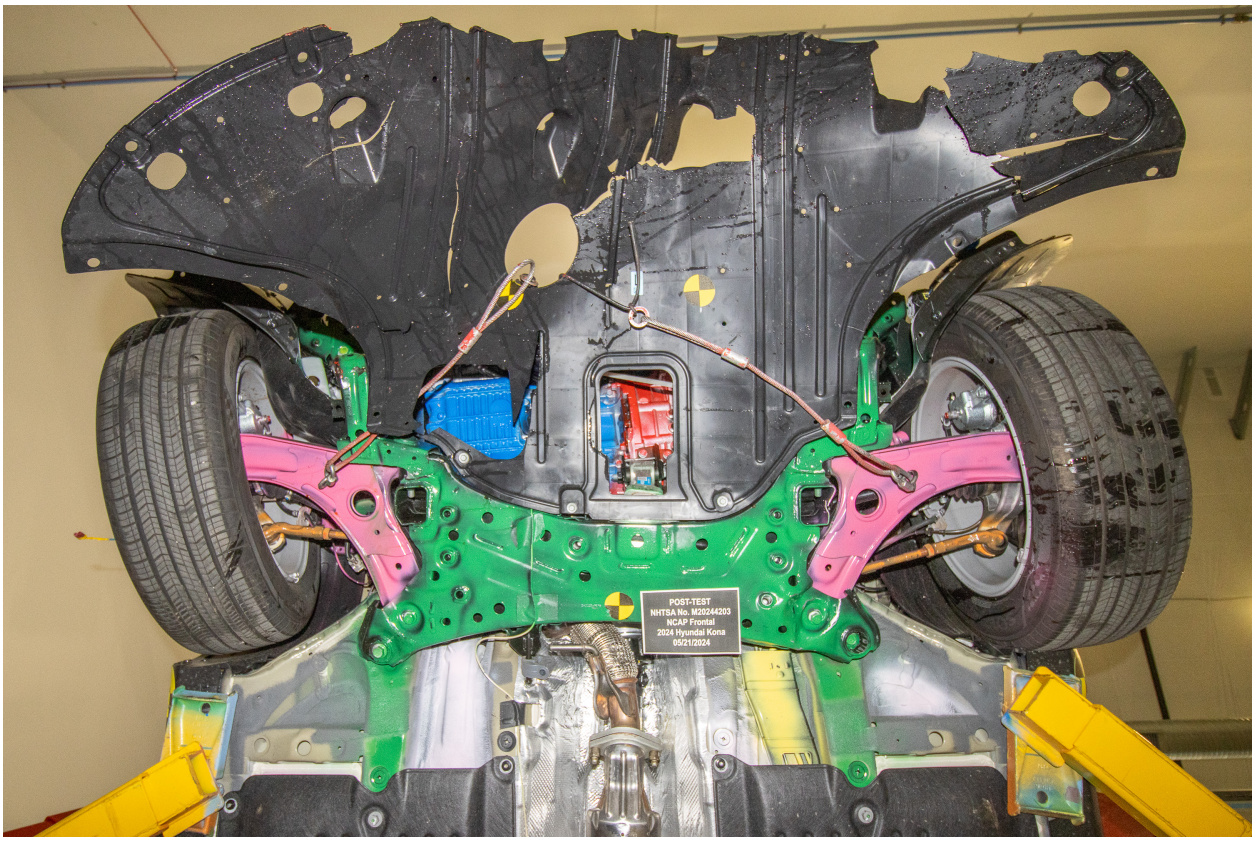

Figure A-25: Post-Test Front Underbody View

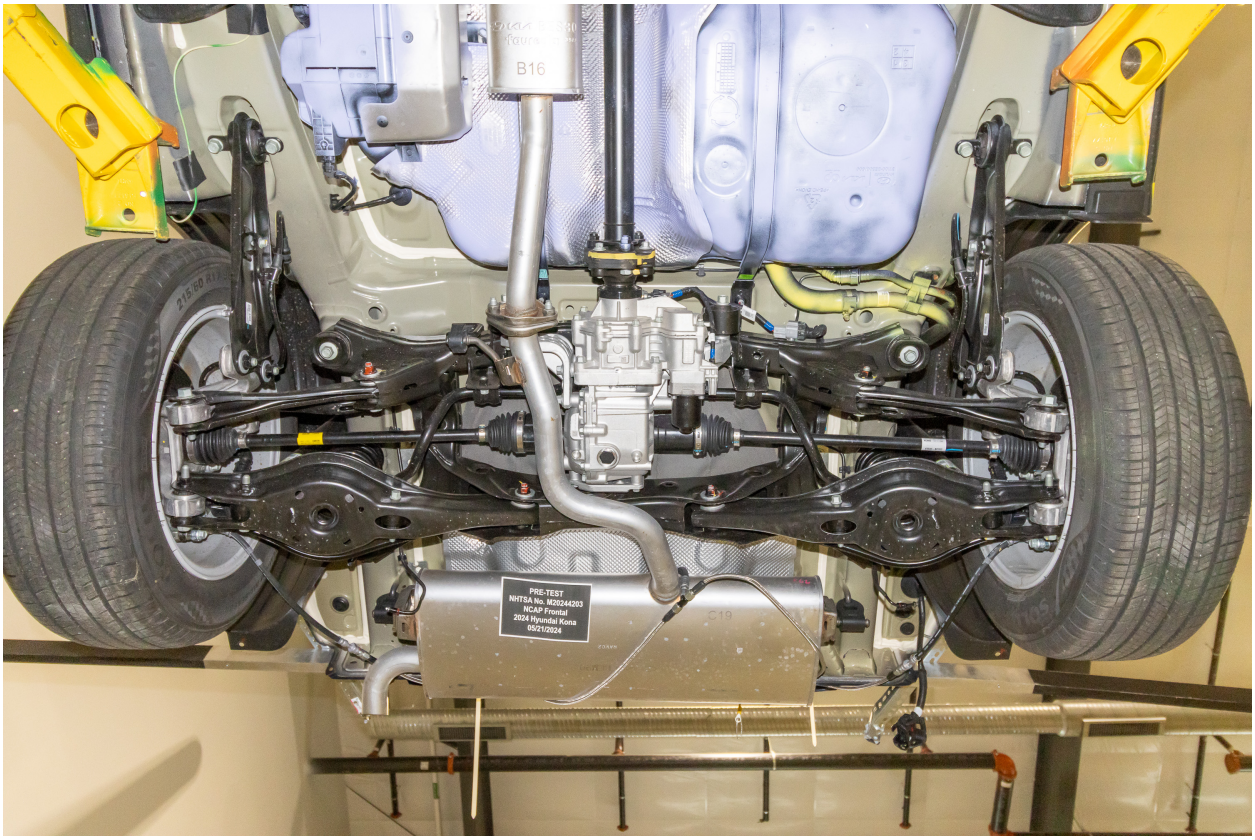

Figure A-26: Pre-Test Rear Underbody View



Figure A-27: Post-Test Rear Underbody View



Figure A-28: Pre-Test Dummy Cable Routing



Figure A-29: Post-Test Dummy Cable Routing



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



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



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



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



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



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



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



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

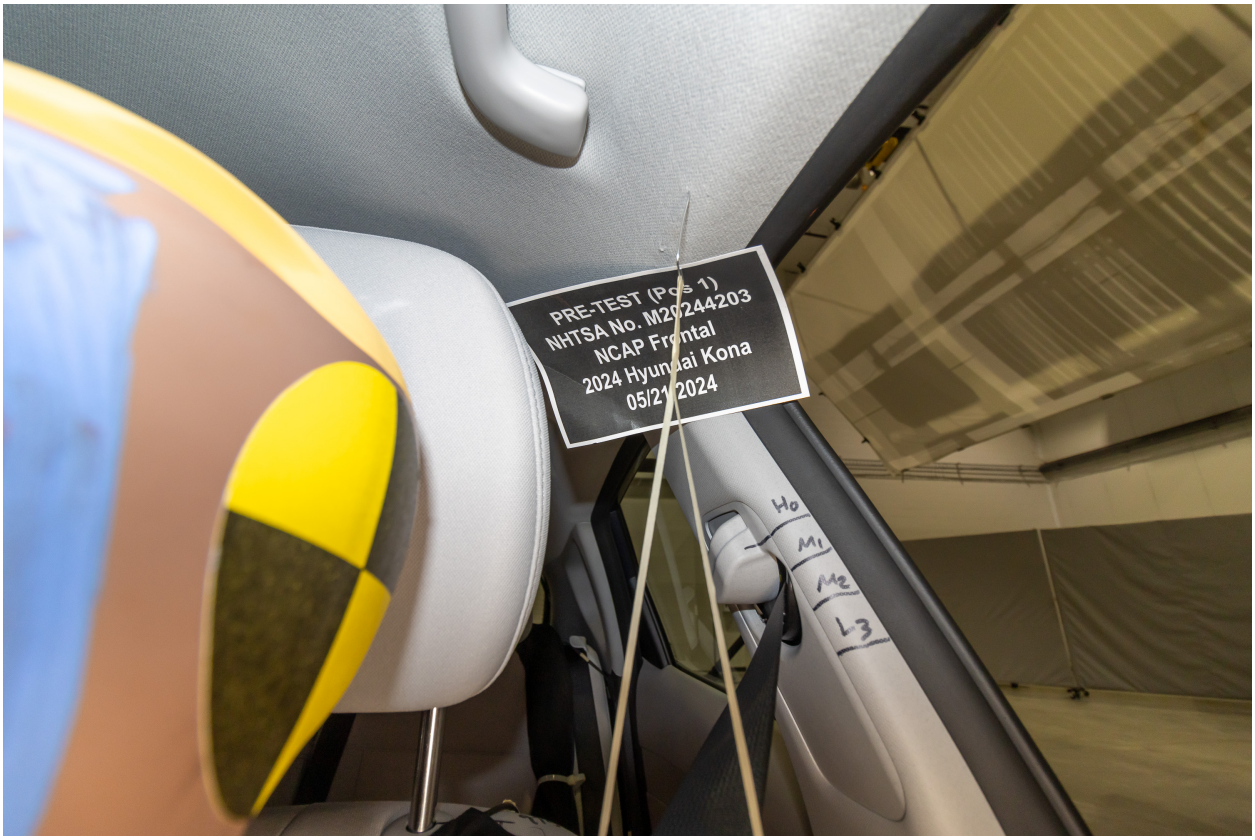

Figure A-38: Pre-Test View of Belt Anchorage for Driver Dummy



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



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



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



Figure A-42: Pre-Test Driver Dummy Feet



Figure A-43: Post-Test Driver Dummy Feet



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

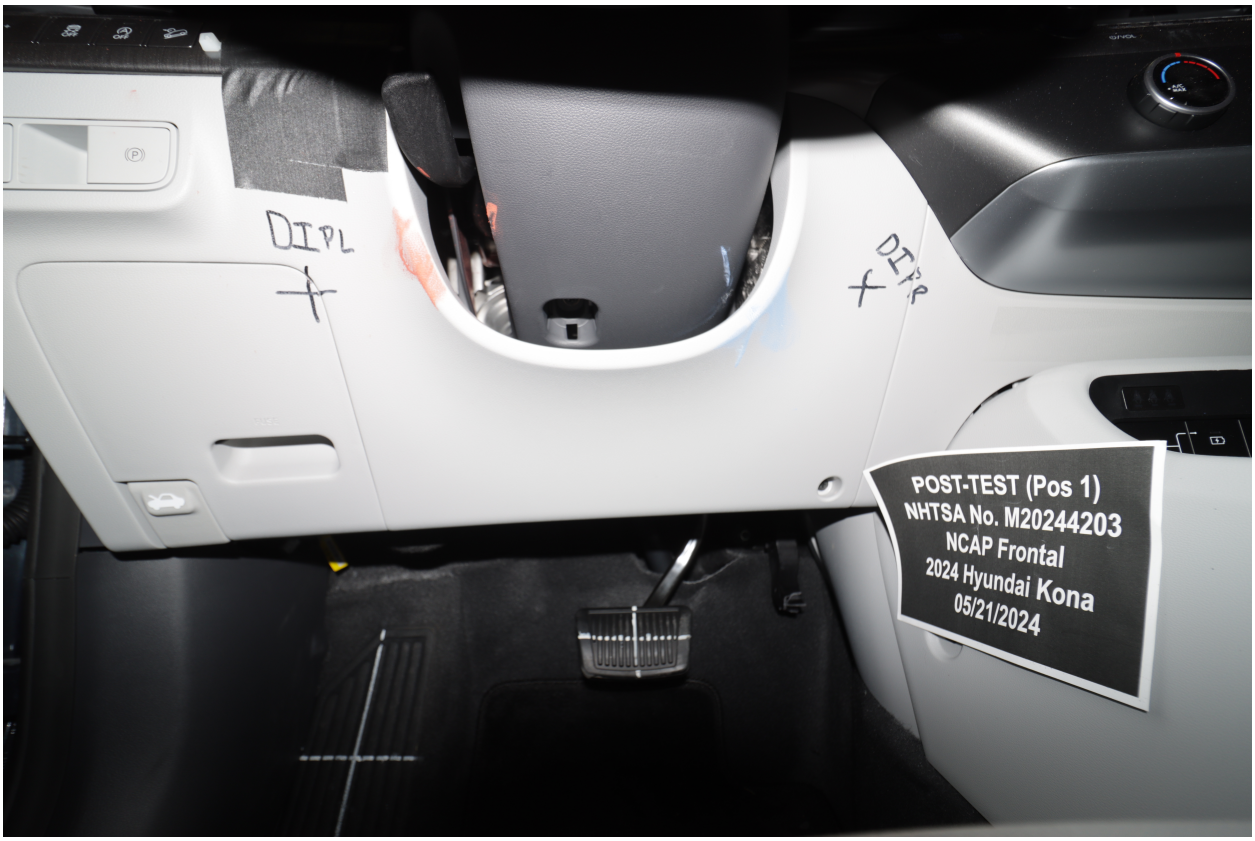

Figure A-45: Post-Test Driver's Side Knee Bolster



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



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



Figure A-48: Post-Test Driver Dummy Face



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



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



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



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



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

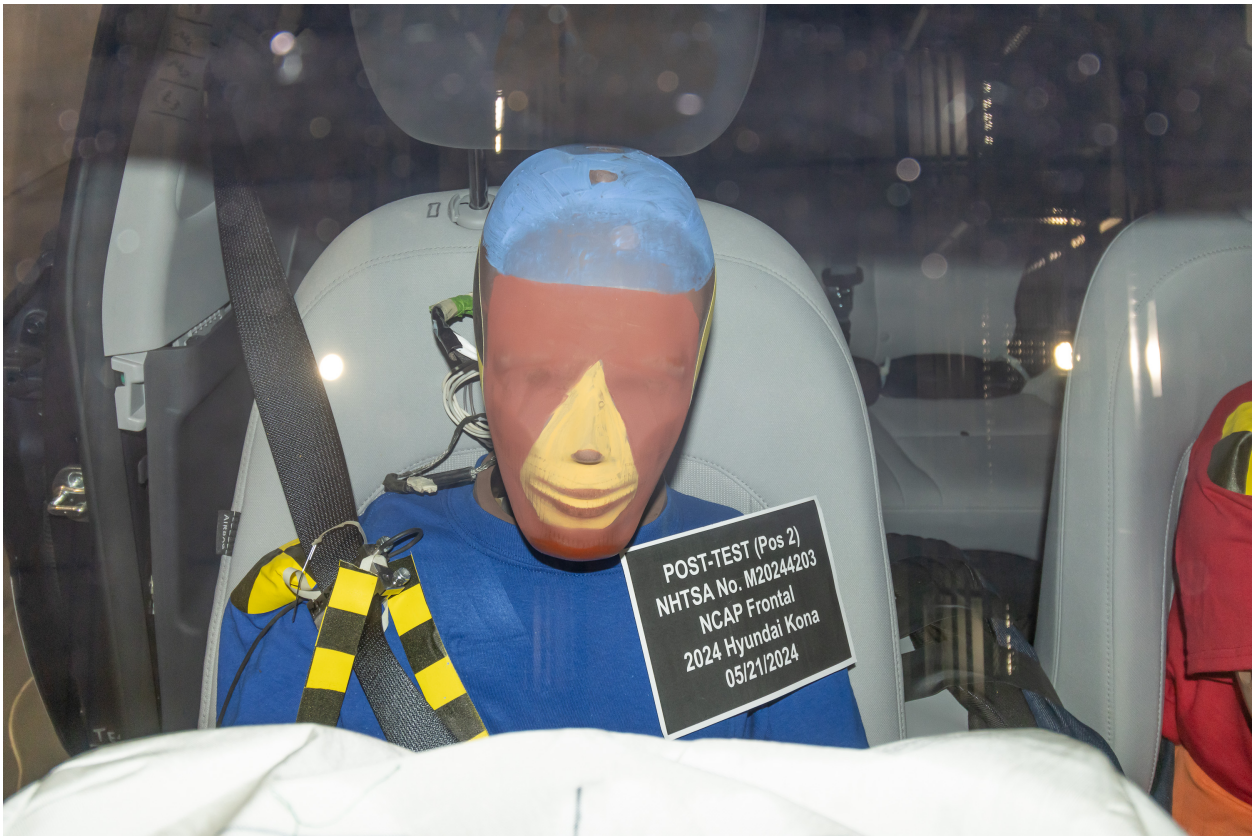

Figure A-54: Post-Test Passenger Dummy Front View



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



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



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



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

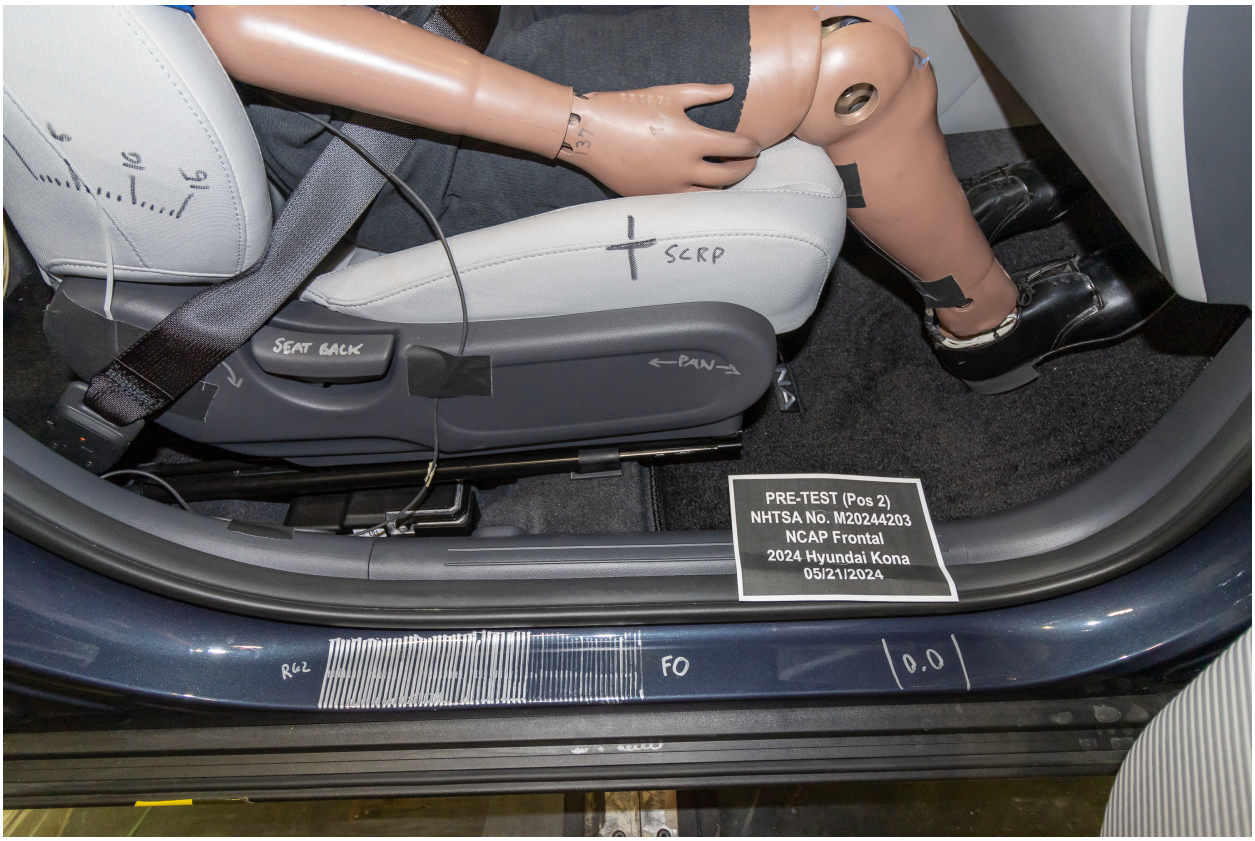

Figure A-59: Pre-Test Passenger's Seat Fore-Aft Markings



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

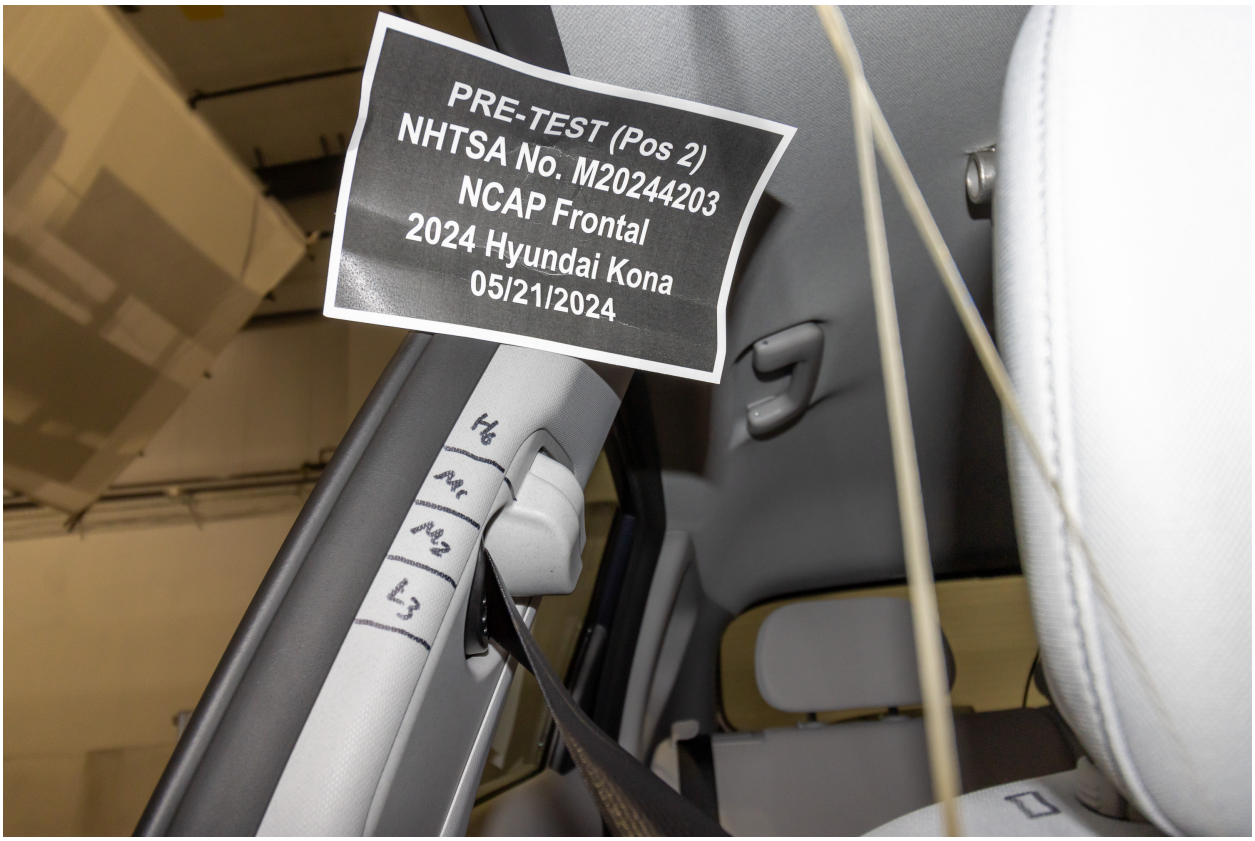

Figure A-61: Pre-Test View of Belt Anchorage for Passenger Dummy



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



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



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



Figure A-65: Pre-Test Passenger Dummy Feet



Figure A-66: Post-Test Passenger Dummy Feet



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



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



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



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



Figure A-71: Post-Test Passenger Dummy Face



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



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



Figure A-74: Photograph of Ballast Installed in Vehicle

Photo Not Applicable

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



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



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

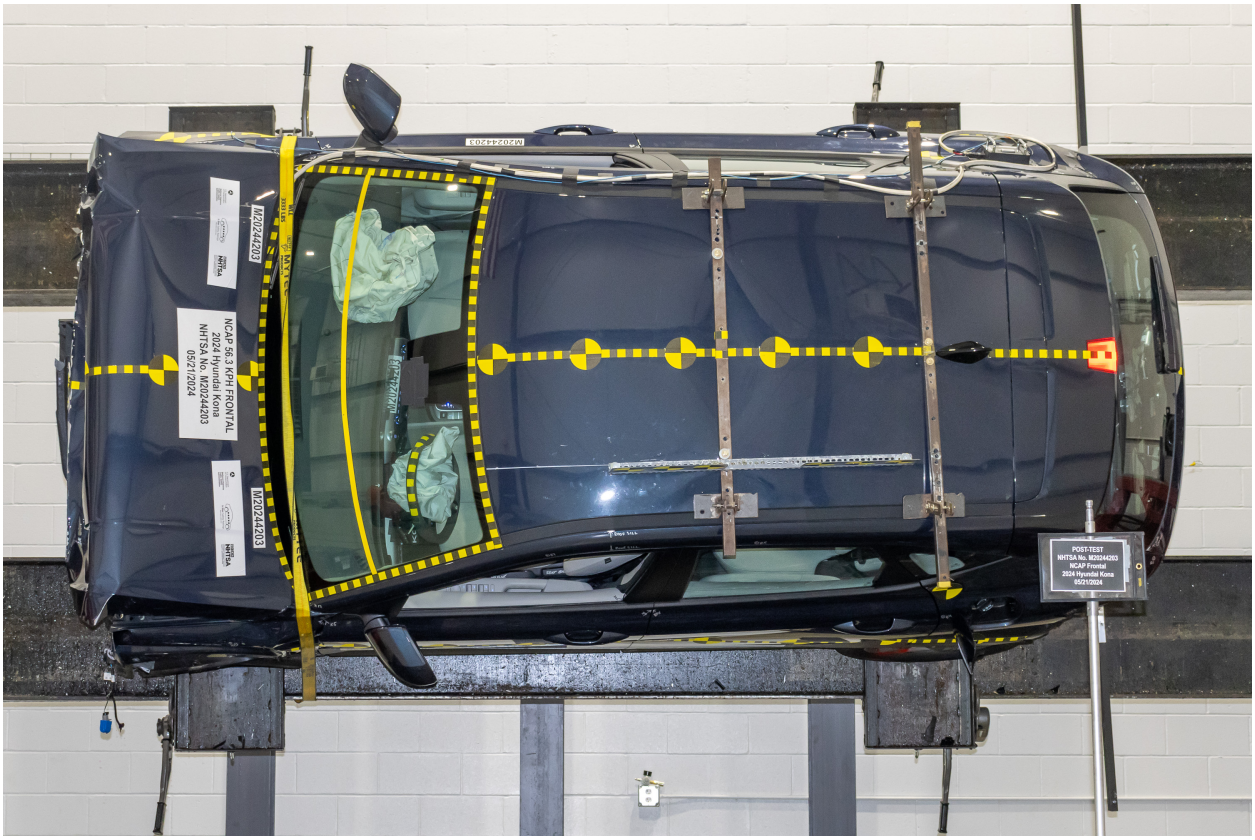

Figure A-78: Vehicle at 90º on Static Rollover Device

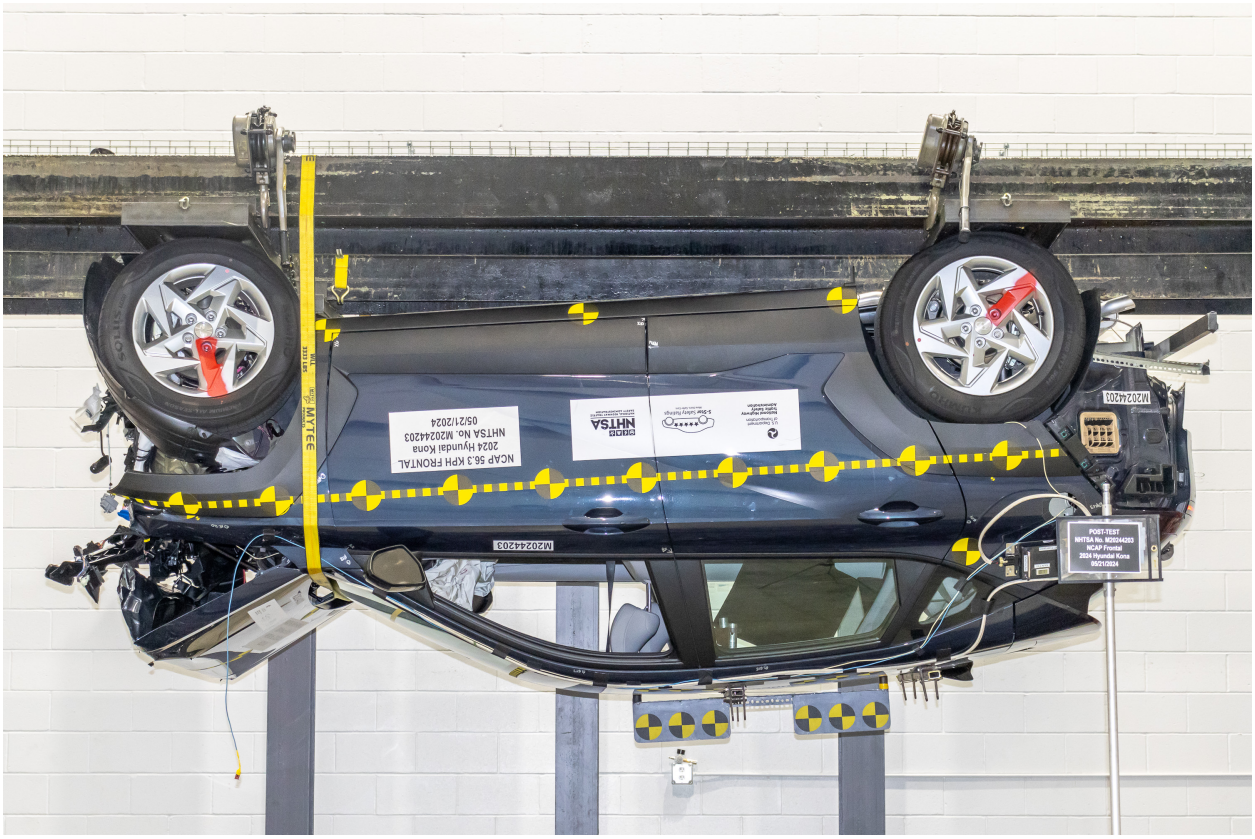

Figure A-79: Vehicle at 180º on Static Rollover Device

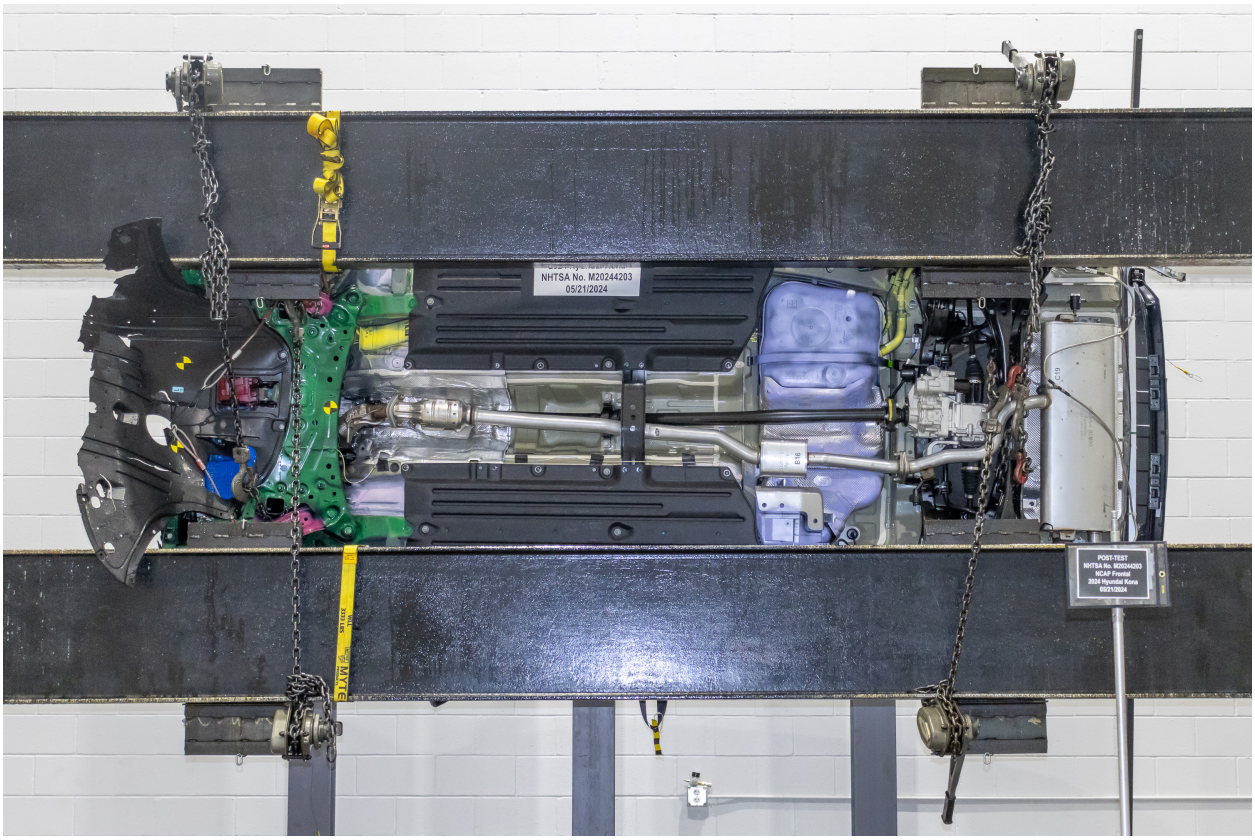

Figure A-80: Vehicle at 270º on Static Rollover Device



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



Figure A-82: 2024 Hyundai Kona Frontal Impact Event

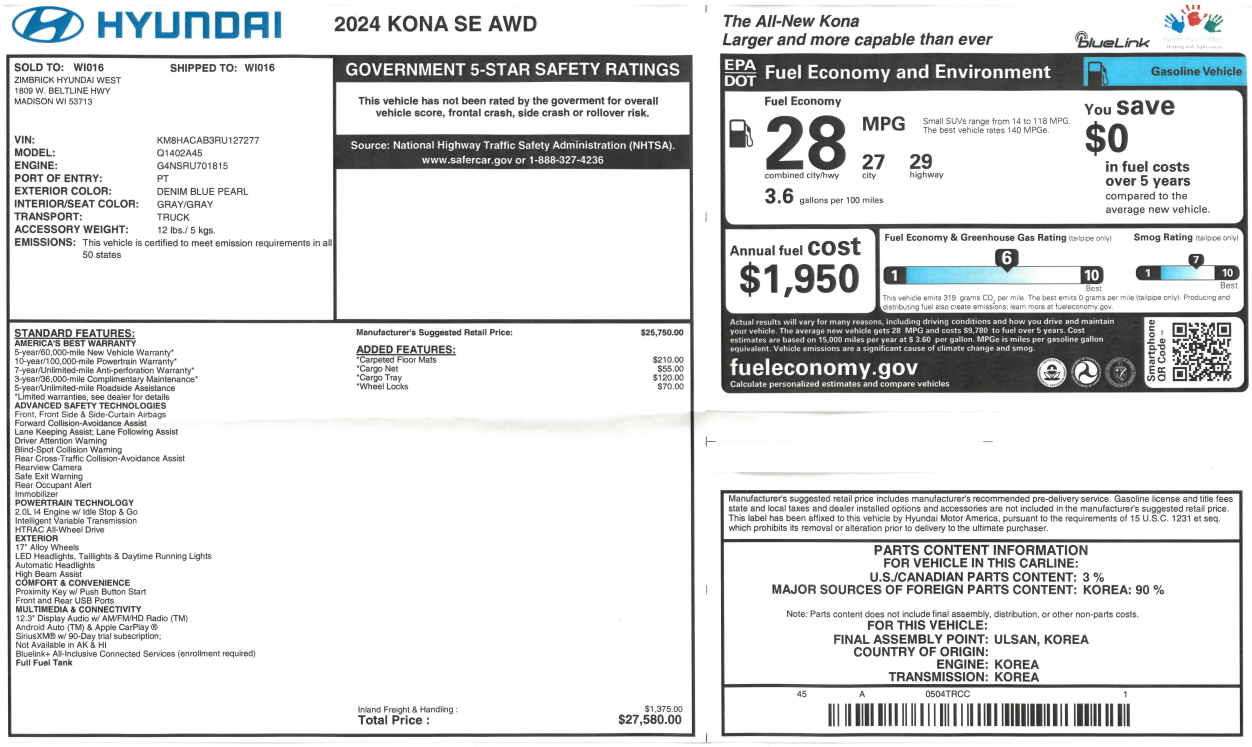

Figure A-83: Monroney Label Photograph

APPENDIX B
VEHICLE AND DUMMY RESPONSE DATA TRACES

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Plot 29	Passenger Left Femur Force vs. Time	B-12
Plot 30	Passenger Right Femur Force vs. Time	B-12

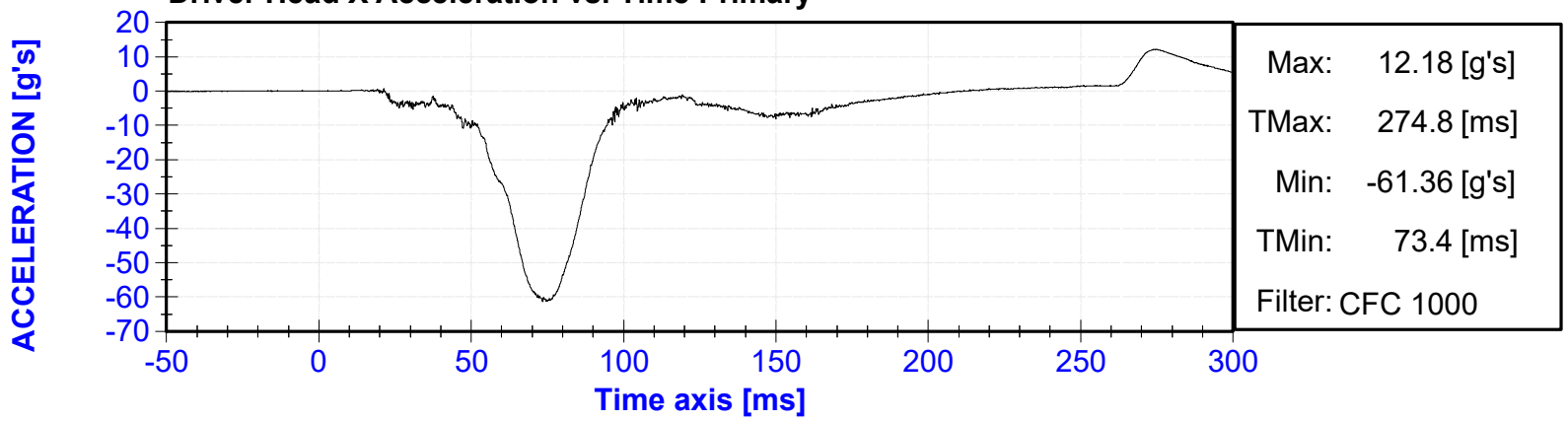
The following additional dummy and vehicle response data can be found in the R&D section of the NHTSA website at www.NHTSA.gov

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

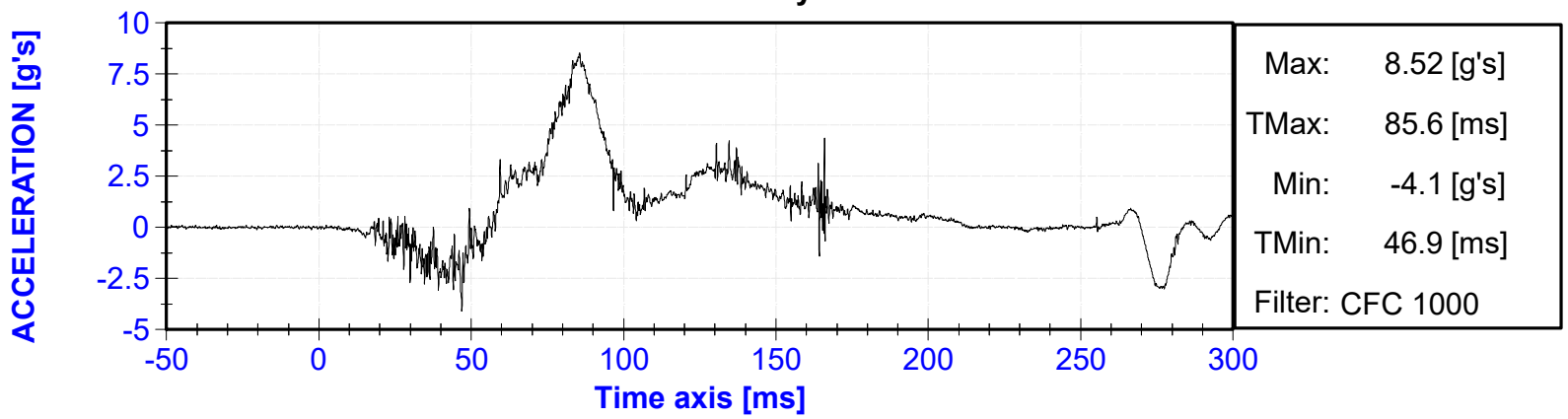
Driver Left Upper Tibia Force Z
Driver Left Lower Tibia Moment X
Driver Left Lower Tibia Moment Y
Driver Left Lower Tibia Force Z
Driver Right Upper Tibia Moment X
Driver Right Upper Tibia Moment Y
Driver Right Upper Tibia Force Z
Driver Right Lower Tibia Moment X
Driver Right Lower Tibia Moment Y
Driver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

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

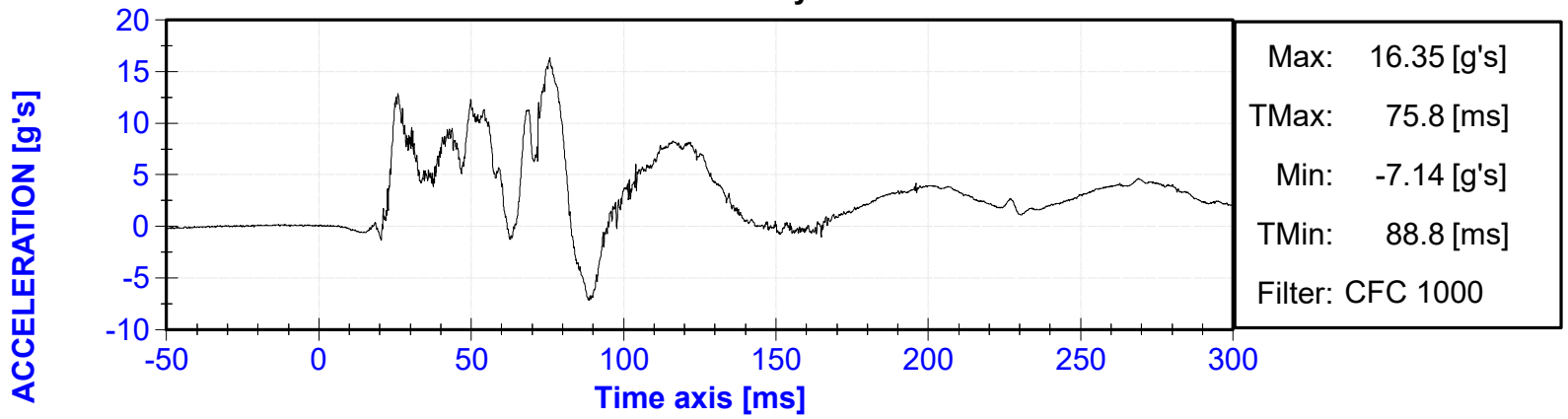
Driver Head X Acceleration vs. Time Primary



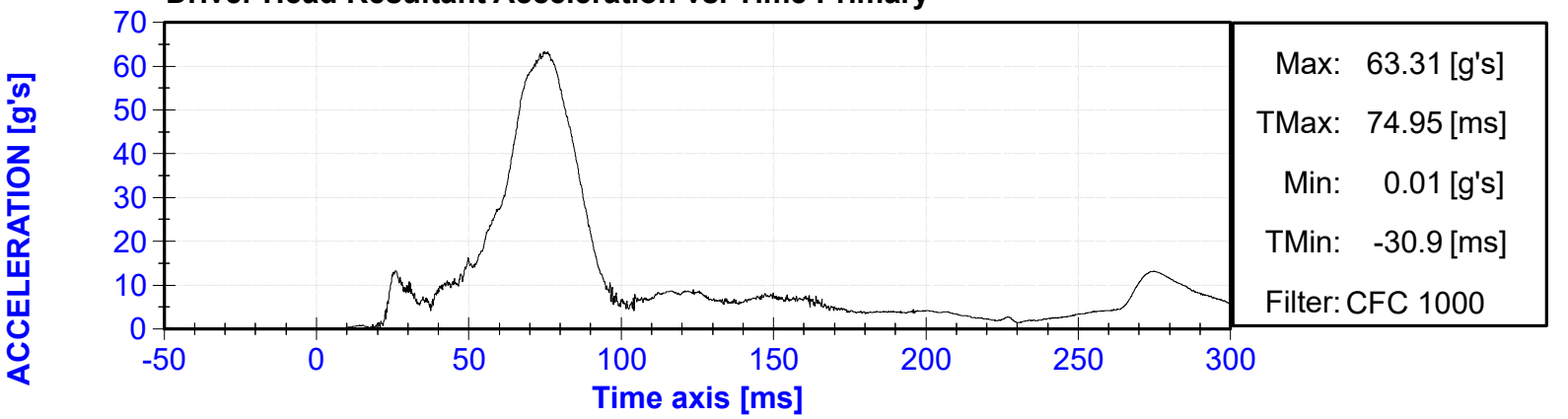
Driver Head Y Acceleration vs. Time Primary



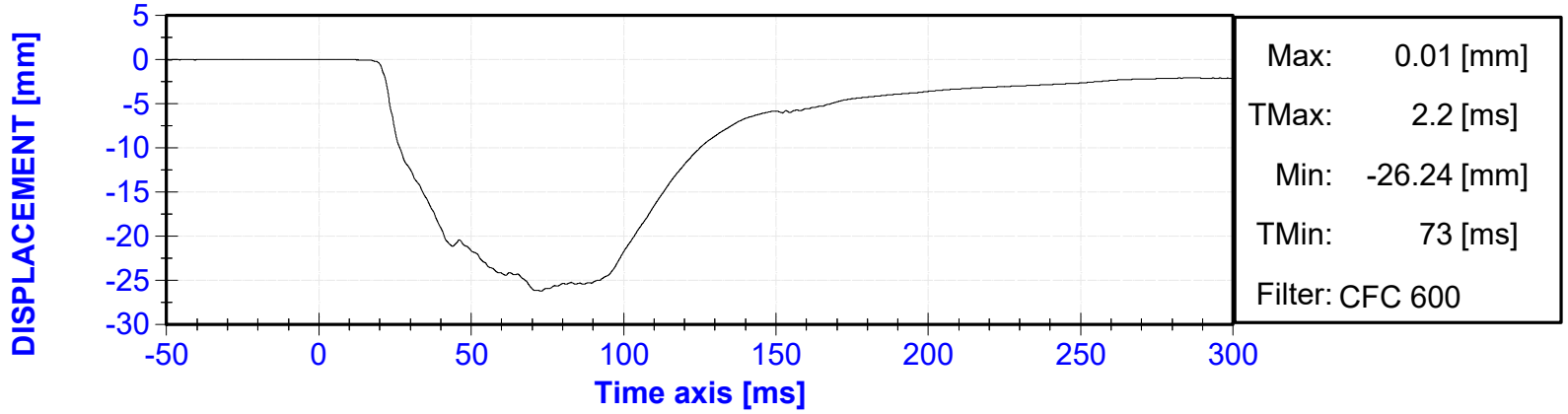
Driver Head Z Acceleration vs. Time Primary



Driver Head Resultant Acceleration vs. Time Primary



Driver Chest X Deflection vs. Time



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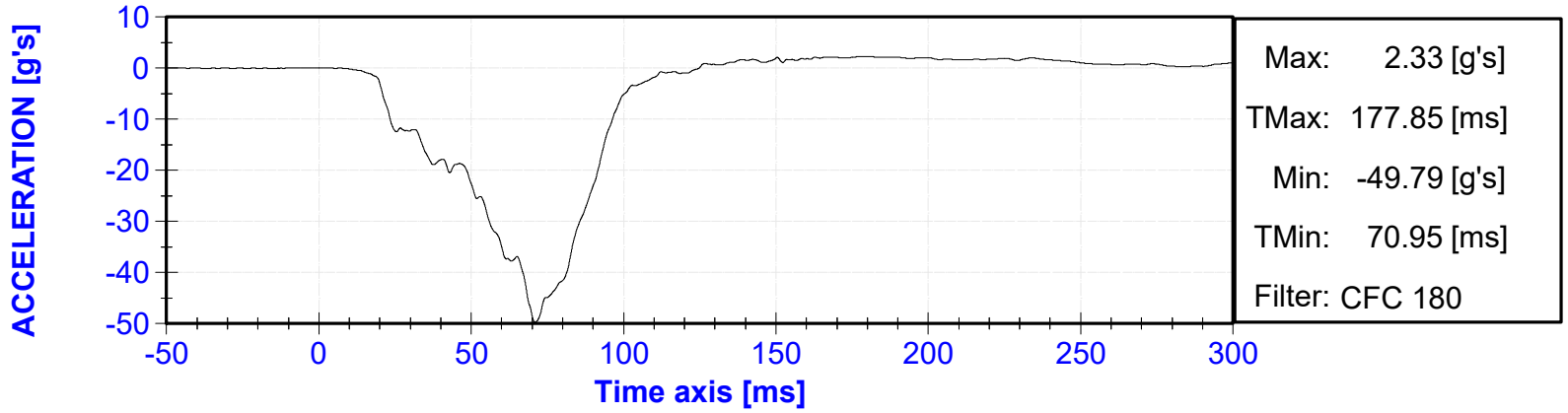
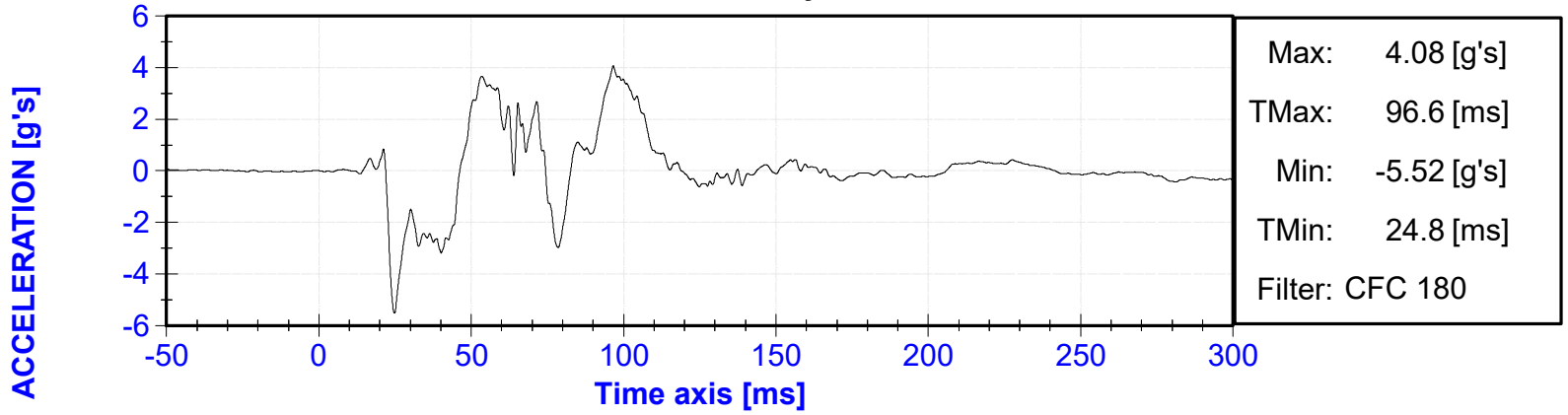
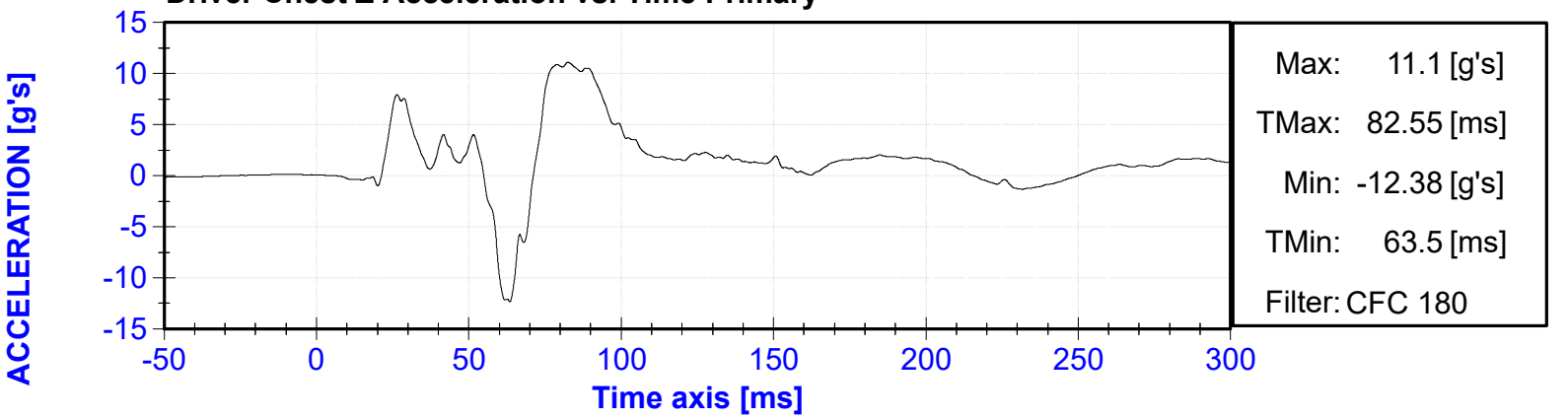


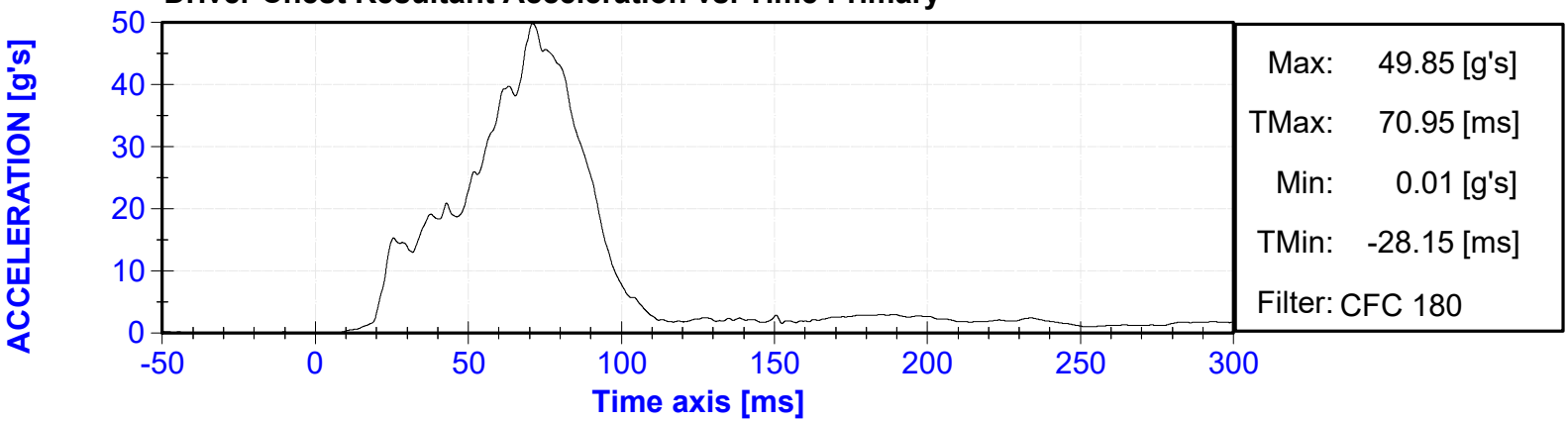
Driver Chest Y Acceleration vs. Time Primary



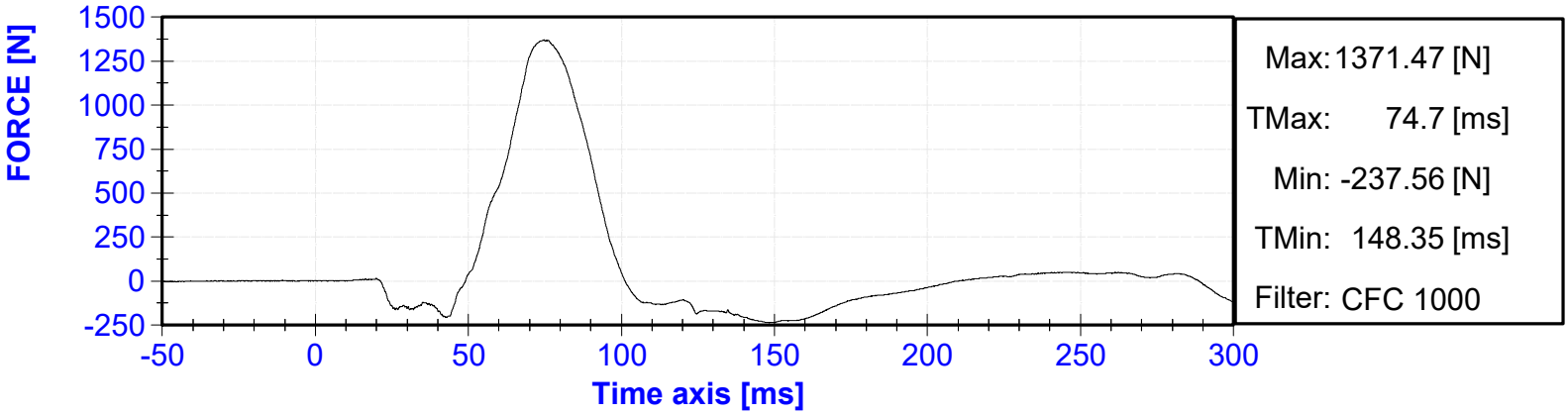
Driver Chest Z Acceleration vs. Time Primary



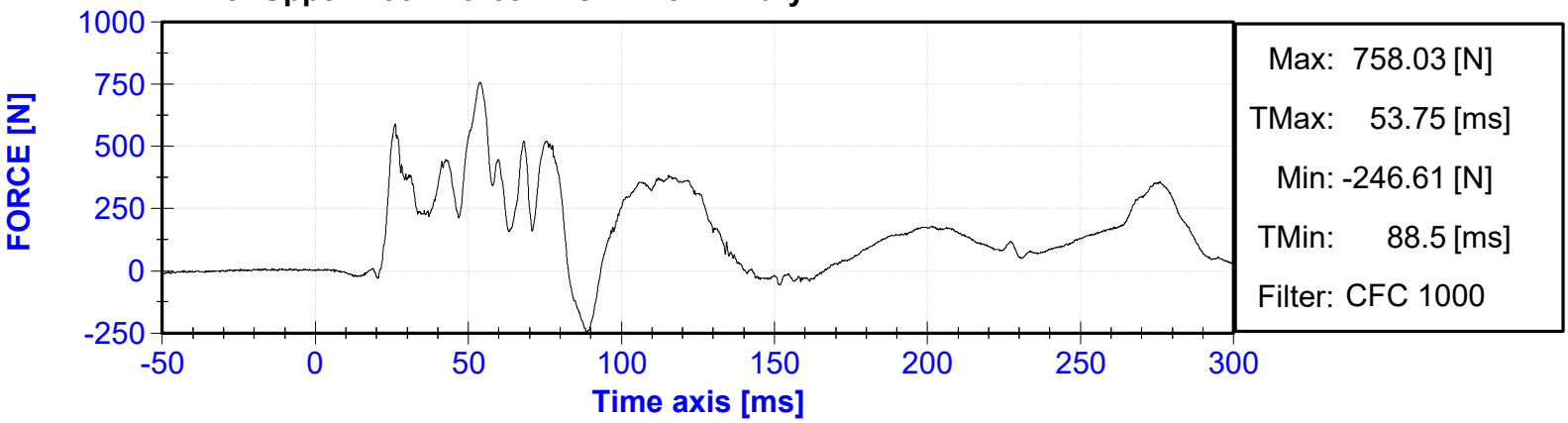
Driver Chest Resultant Acceleration vs. Time Primary



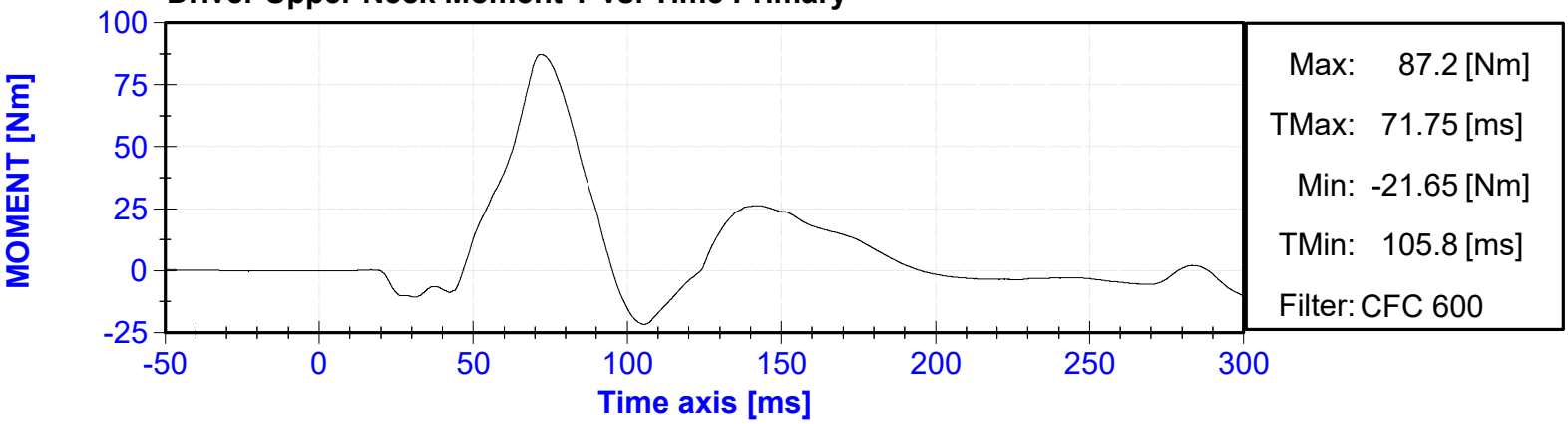
Driver Upper Neck Force X vs. Time Primary



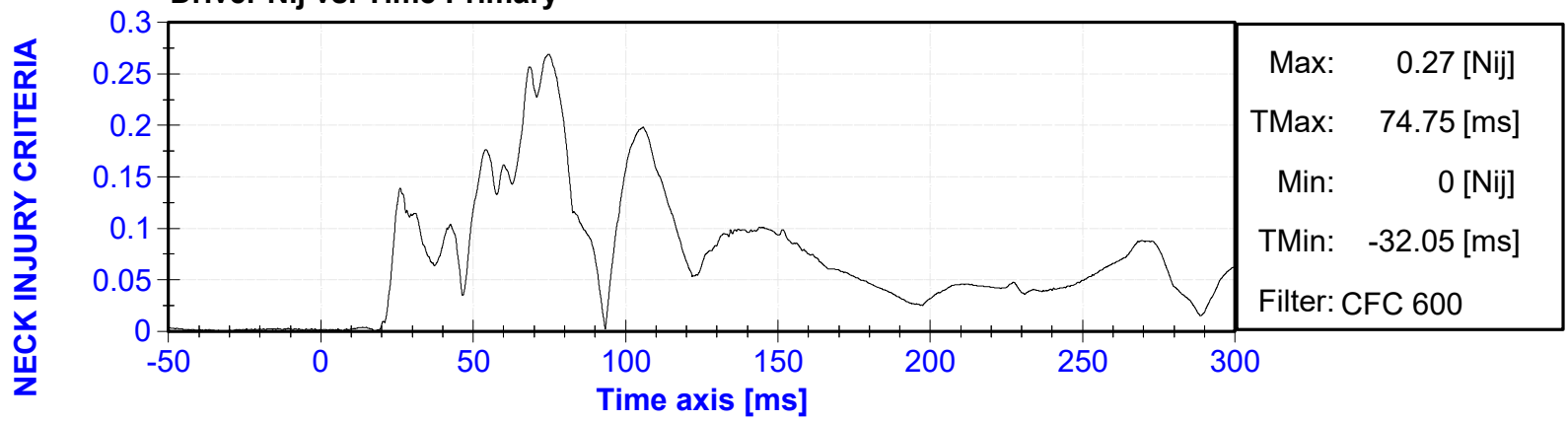
Driver Upper Neck Force Z vs. Time Primary



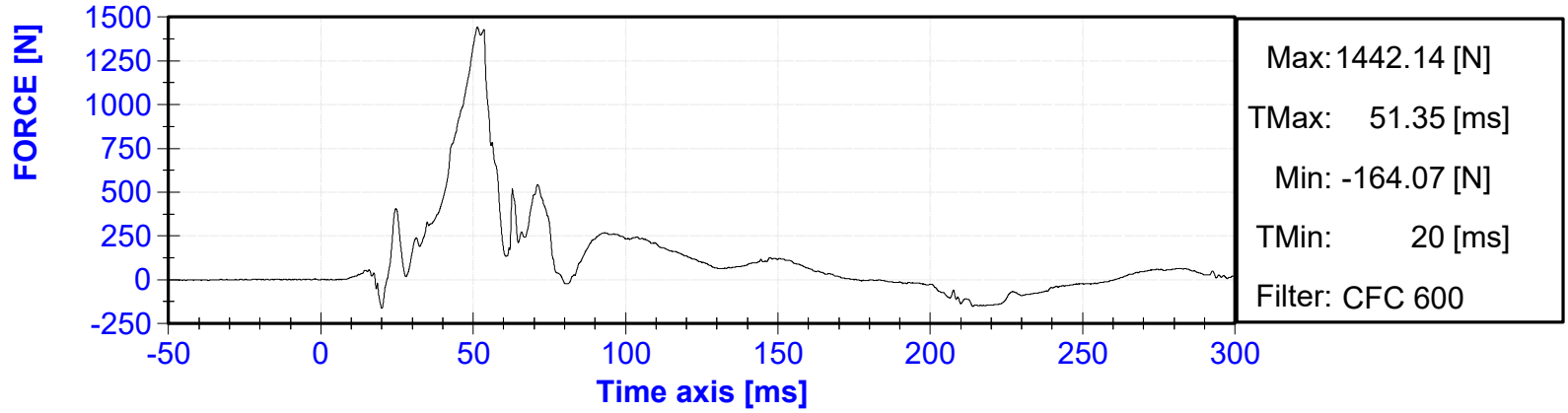
Driver Upper Neck Moment Y vs. Time Primary



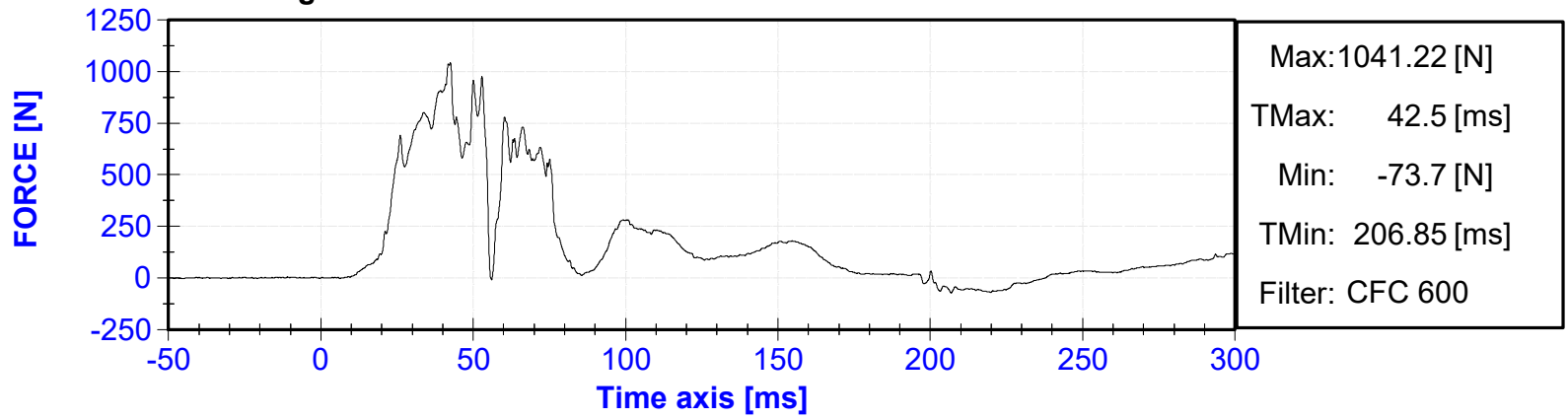
Driver Nij vs. Time Primary



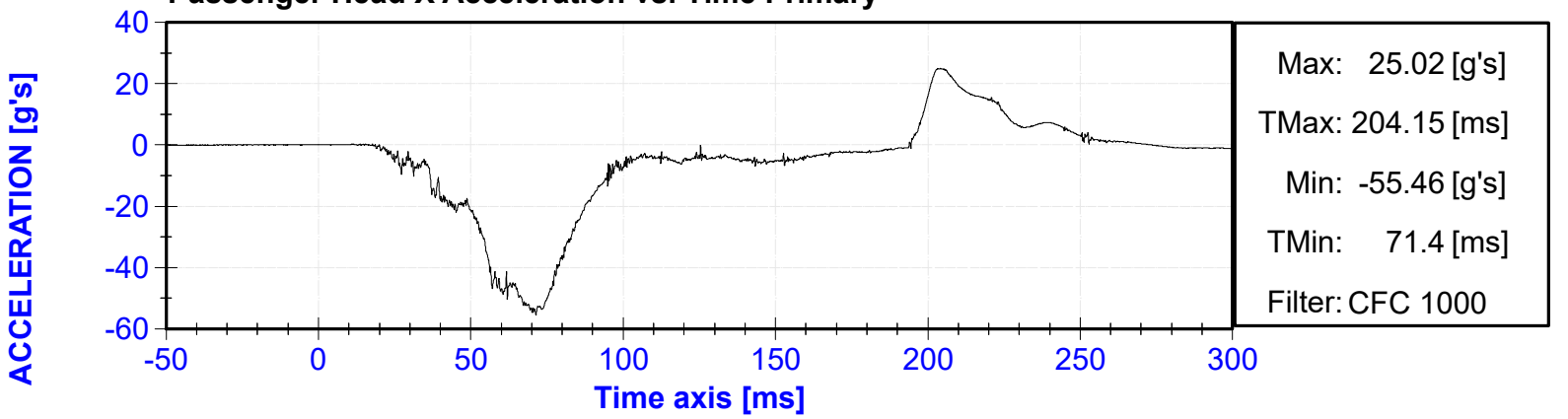
Driver Left Femur Force vs. Time



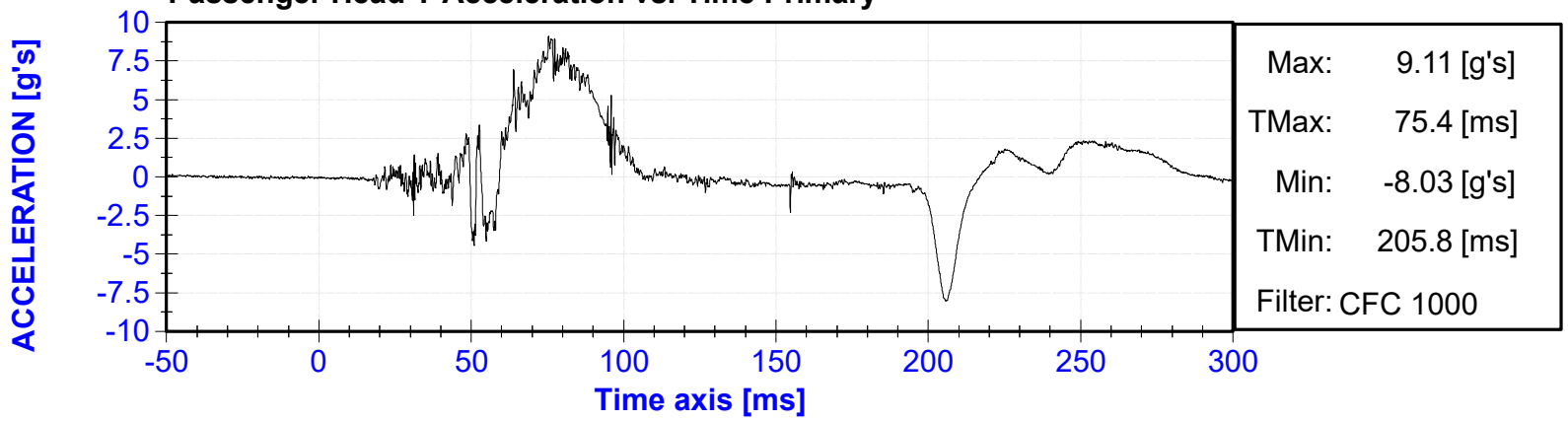
Driver Right Femur Force vs. Time



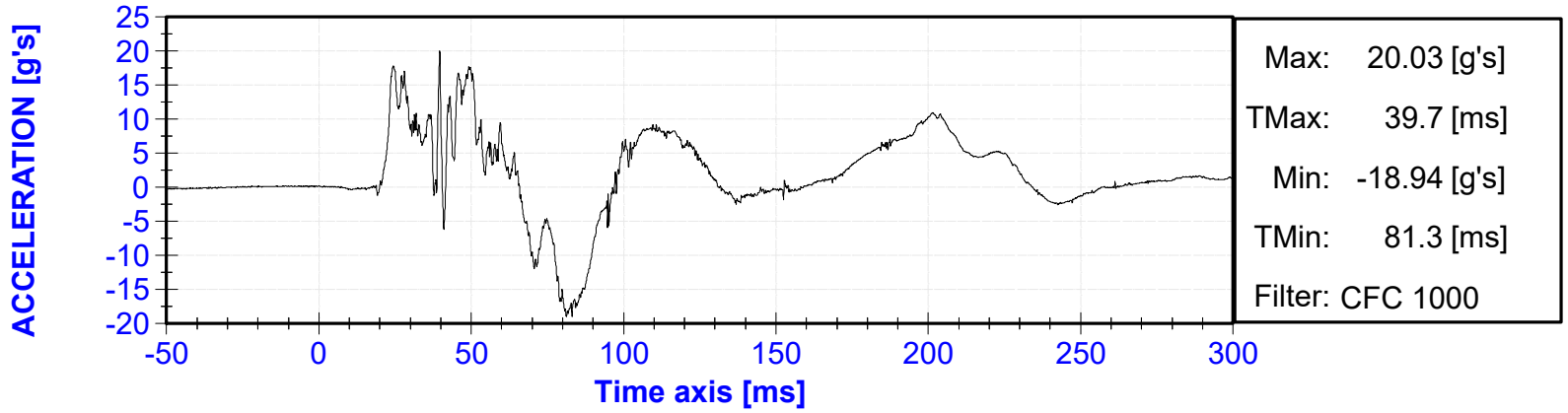
Passenger Head X Acceleration vs. Time Primary



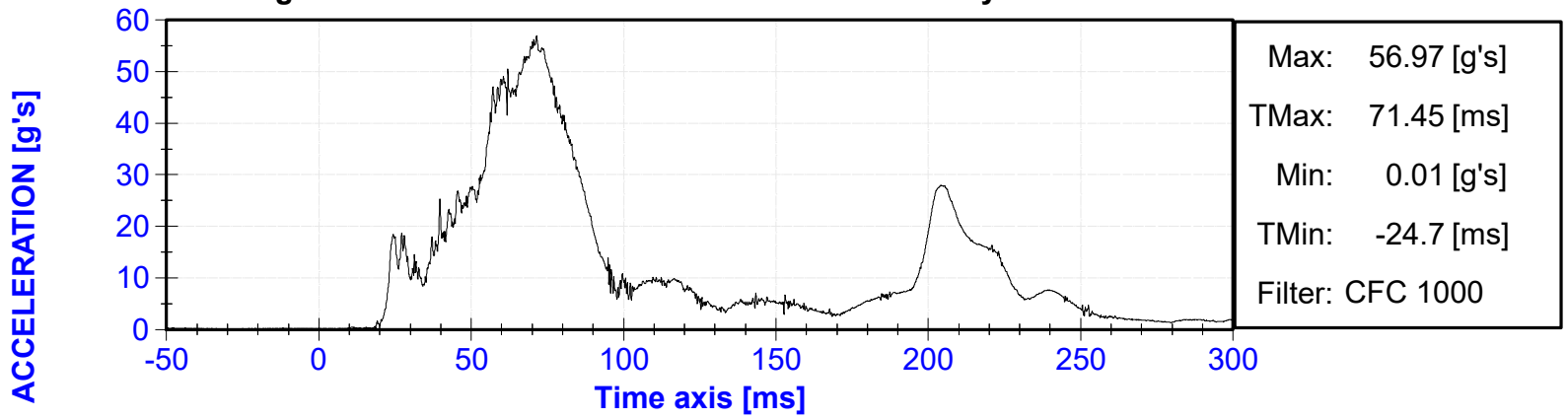
Passenger Head Y Acceleration vs. Time Primary



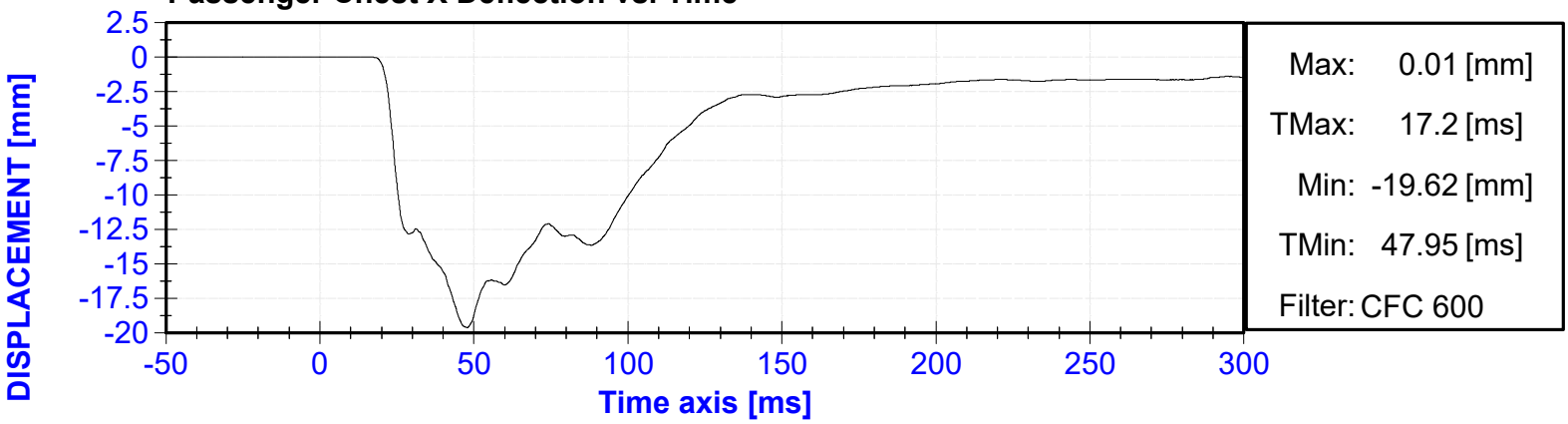
Passenger Head Z Acceleration vs. Time Primary



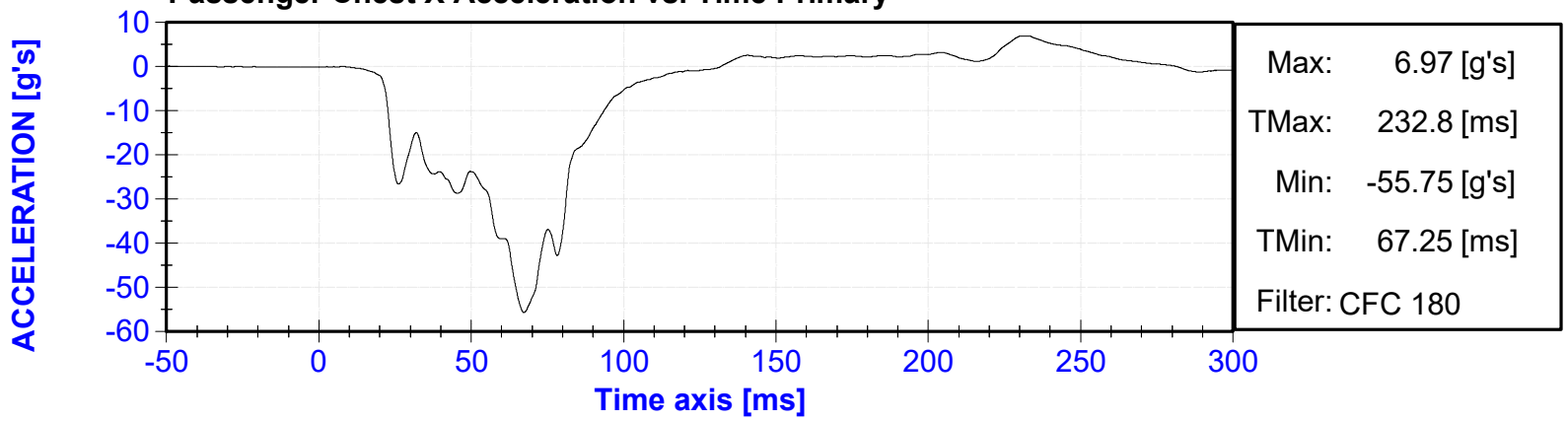
Passenger Head Resultant Acceleration vs. Time Primary



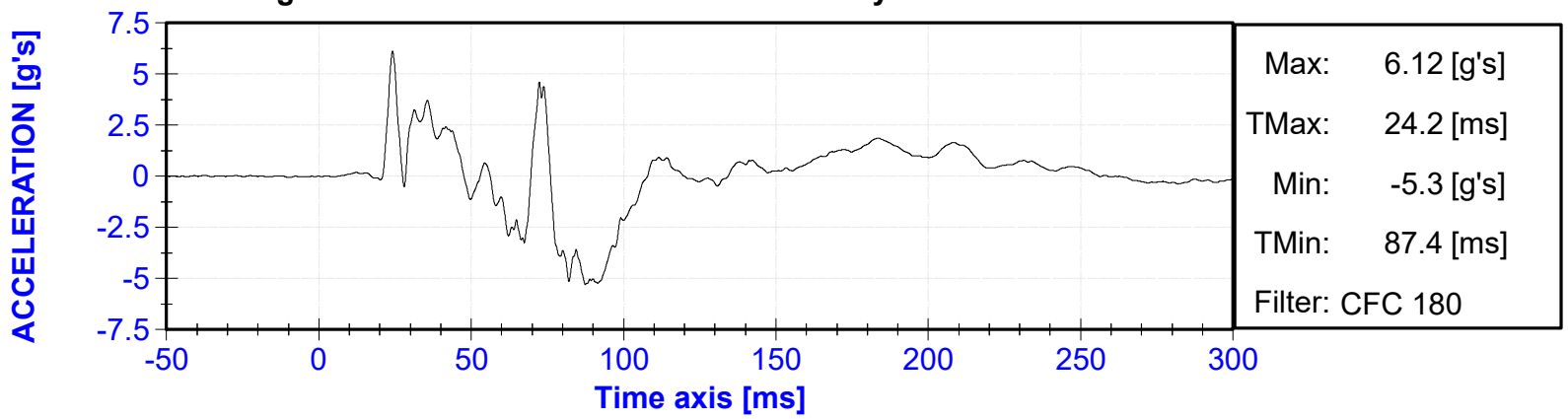
Passenger Chest X Deflection vs. Time



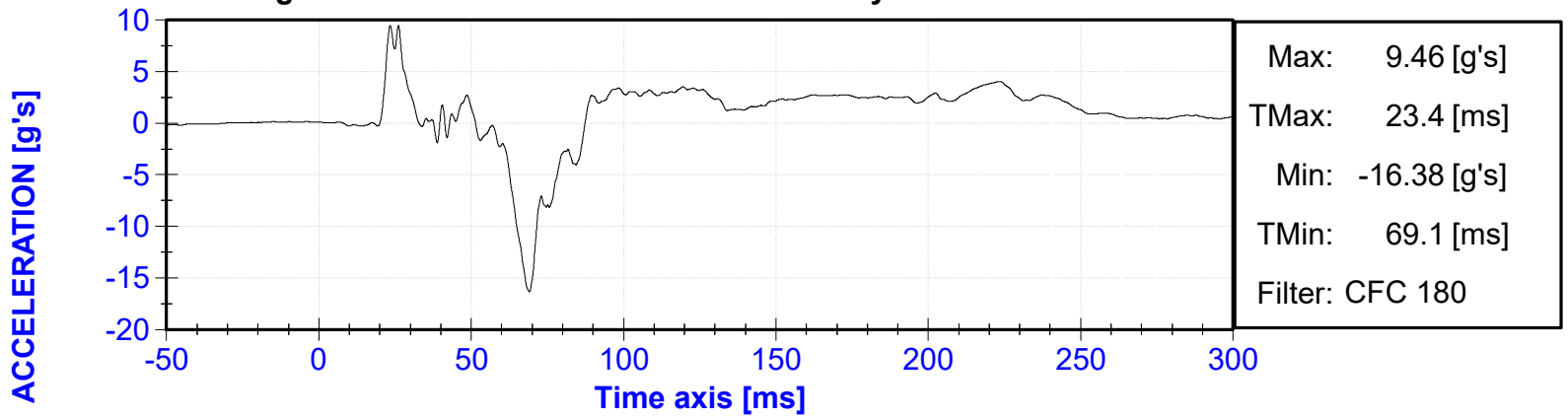
Passenger Chest X Acceleration vs. Time Primary



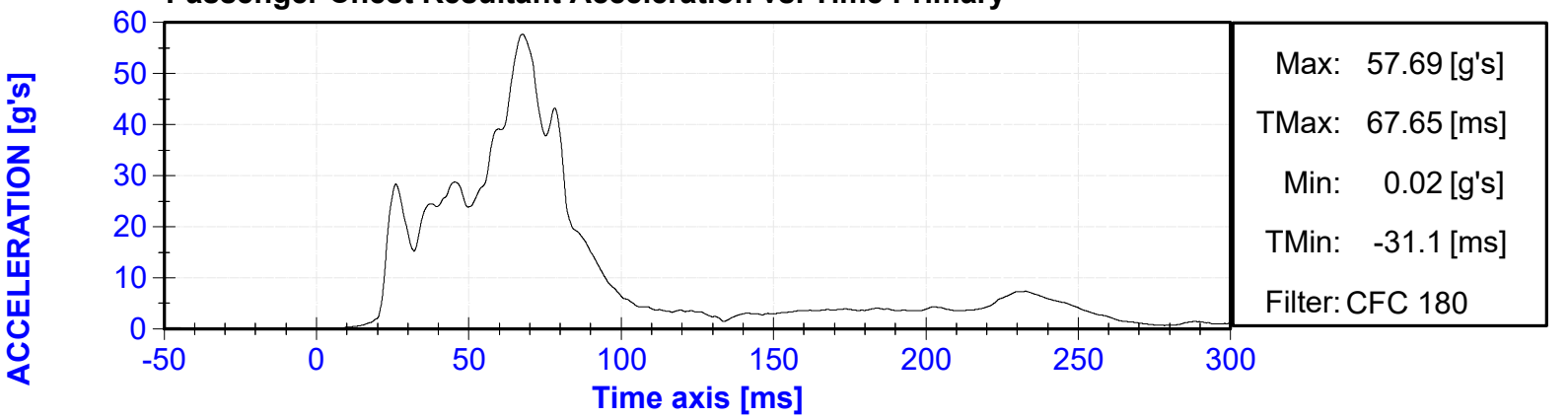
Passenger Chest Y Acceleration vs. Time Primary

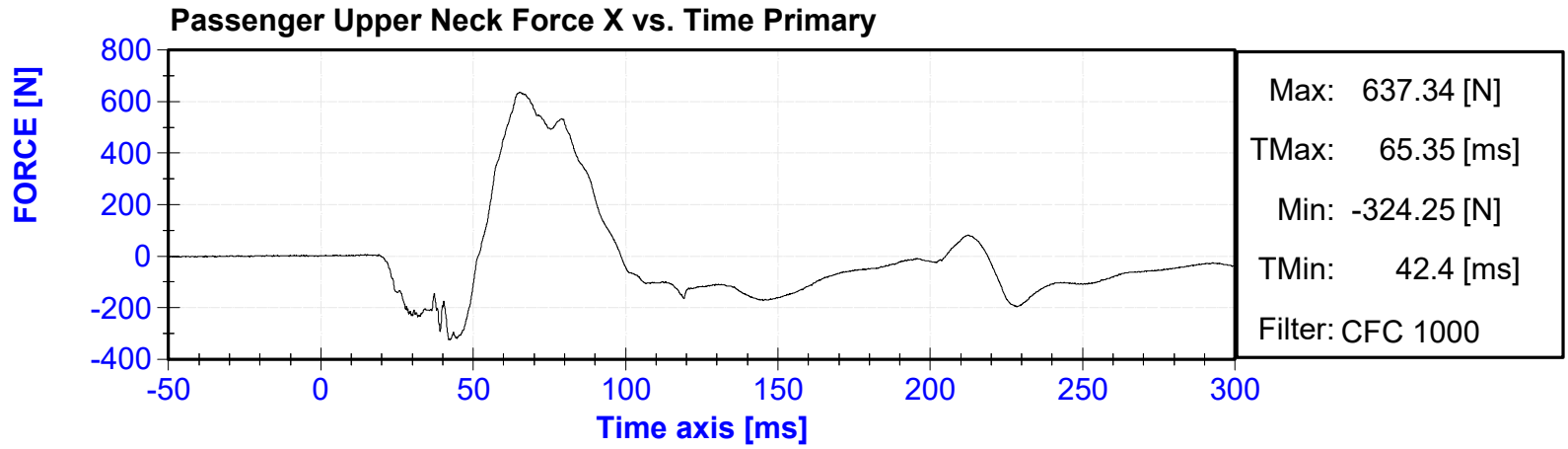


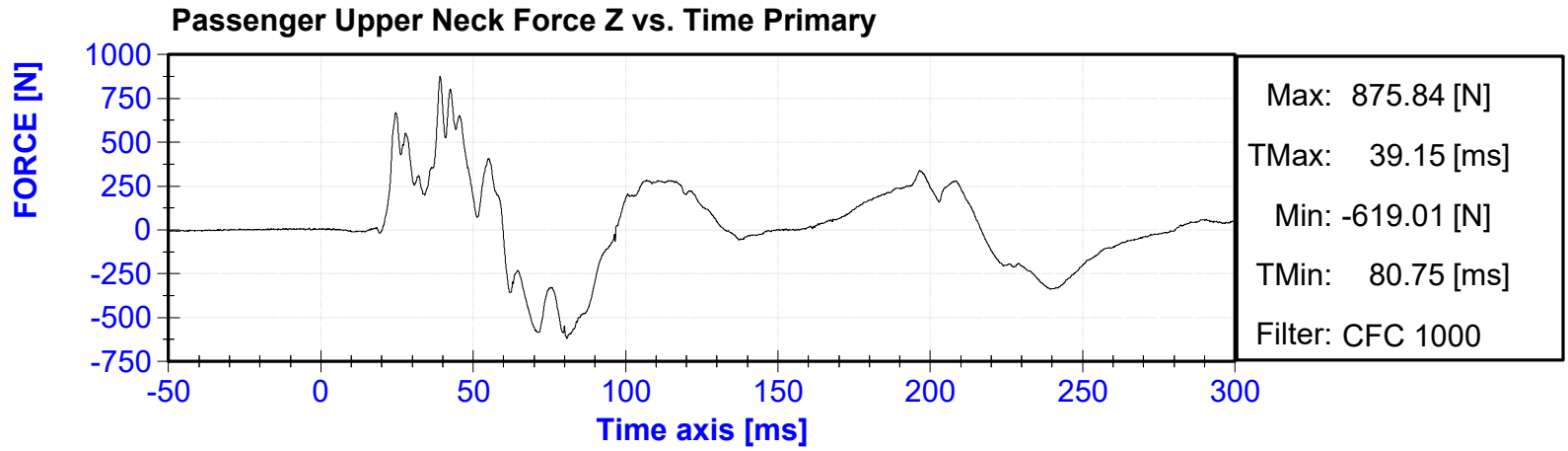
Passenger Chest Z Acceleration vs. Time Primary

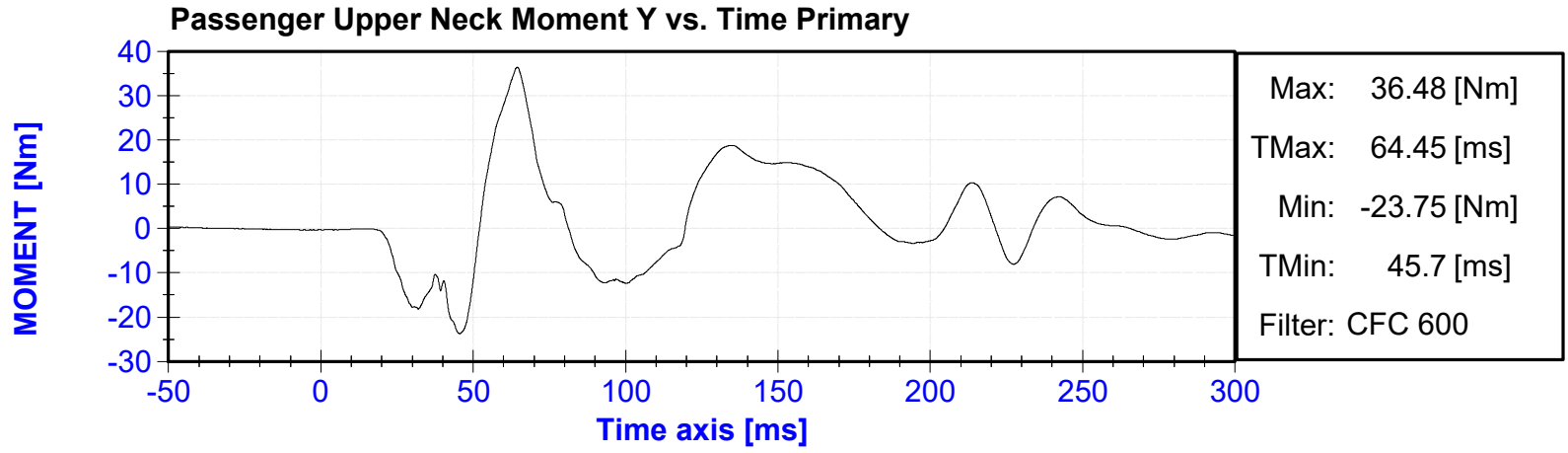


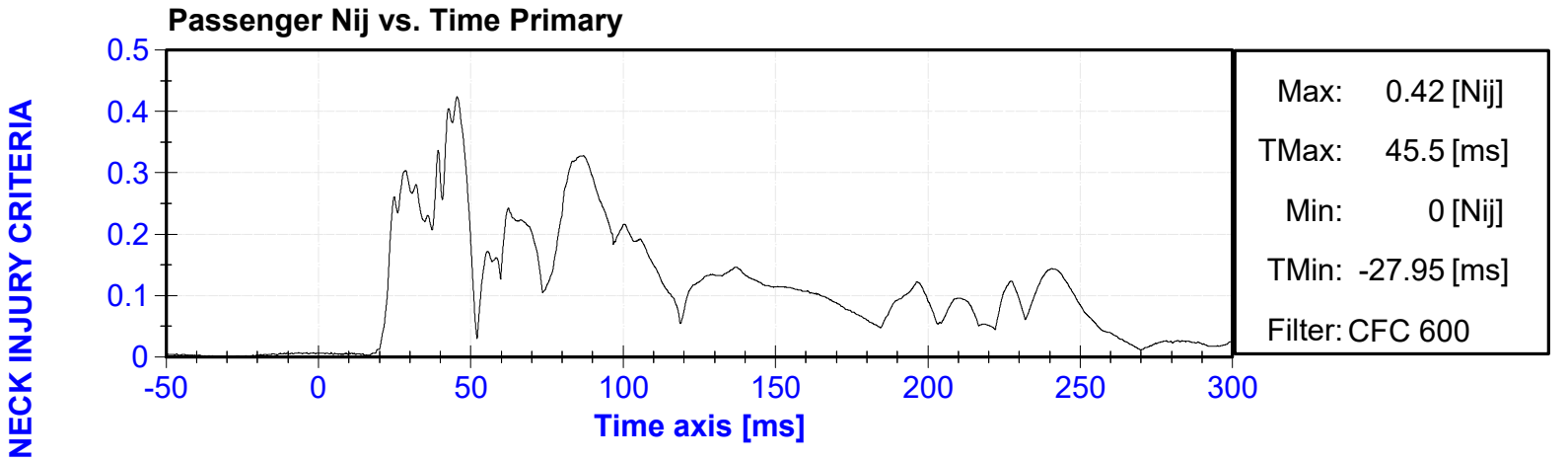
Passenger Chest Resultant Acceleration vs. Time Primary

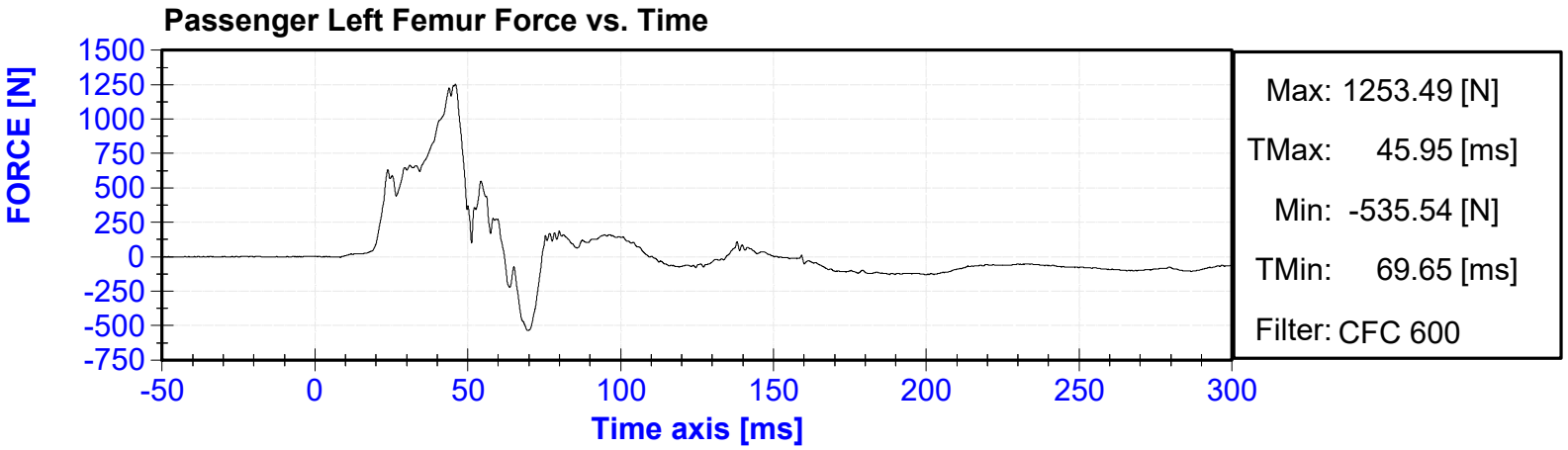


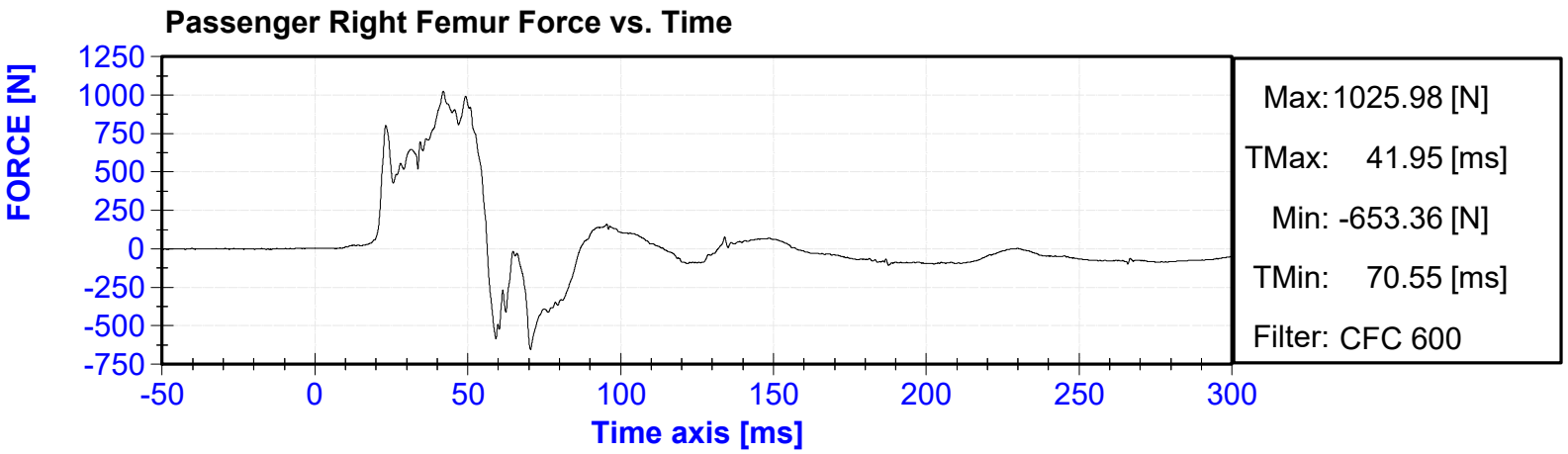

Passenger Upper Neck Force X vs. Time Primary
FORCE [N]
800
600
400
200
0
-200
-400
-50
0
50
100
150
200
250
300
Time axis [ms]
Max: 637.34 [N]
TMax: 65.35 [ms]
Min: -324.25 [N]
TMin: 42.4 [ms]
Filter: CFC 1000


Passenger Upper Neck Force Z vs. Time Primary
FORCE [N]
1000
750
500
250
0
-250
-500
-750
-50
0
50
100
150
200
250
300
Time axis [ms]
Max: 875.84 [N]
TMax: 39.15 [ms]
Min: -619.01 [N]
TMin: 80.75 [ms]
Filter: CFC 1000


Passenger Upper Neck Moment Y vs. Time Primary
MOMENT [Nm]
40
30
20
10
0
-10
-20
-30
-50
0
50
100
150
200
250
300
Time axis [ms]
Max: 36.48 [Nm]
TMax: 64.45 [ms]
Min: -23.75 [Nm]
TMin: 45.7 [ms]
Filter: CFC 600


Passenger Nij vs. Time Primary
NECK INJURY CRITERIA
0.5
0.4
0.3
0.2
0.1
0
-50
0
50
100
150
200
250
300
Time axis [ms]
Max: 0.42 [Nij]
TMax: 45.5 [ms]
Min: 0 [Nij]
TMin: -27.95 [ms]
Filter: CFC 600


Passenger Left Femur Force vs. Time
FORCE [N]
1500
1250
1000
750
500
250
0
-250
-500
-750
-50
0
50
100
150
200
250
300
Time axis [ms]
Max: 1253.49 [N]
TMax: 45.95 [ms]
Min: -535.54 [N]
TMin: 69.65 [ms]
Filter: CFC 600


Passenger Right Femur Force vs. Time
FORCE [N]
1250
1000
750
500
250
0
-250
-500
-750
-50
0
50
100
150
200
250
300
Time axis [ms]
Max: 1025.98 [N]
TMax: 41.95 [ms]
Min: -653.36 [N]
TMin: 70.55 [ms]
Filter: CFC 600

APPENDIX C

DUMMY CALIBRATION AND PERFORMANCE VERIFICATION DATA

CALIBRATION TEST RESULTS

PRE-TEST

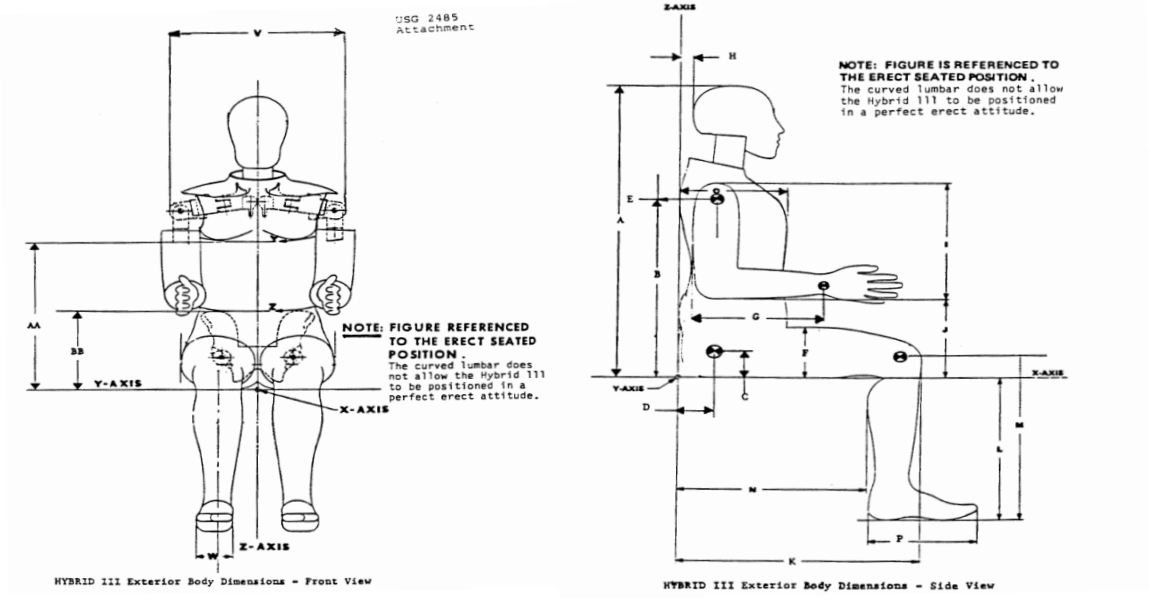
HYBRID III 50TH PERCENTILE MALE - DRIVER ATD

SERIAL NO: 065

External Measurements - Hybrid 3 - 50th Male

Technician: K. Brogan Date: 05/17/2024

Dummy Serial Number: 065



Symbol	Description	Specification (in)		Result (in)	Pass/Fail
A	Sitting Height	34.6	35.0	34.8	Pass
B	Shoulder Pivot Height	19.9	20.5	20.2	Pass
C	H-Point Height	3.3	3.5	3.4	Pass
D	H-Point from Backline	5.3	5.5	5.4	Pass
E	Shoulder Pivot from Backline	3.3	3.7	3.4	Pass
F	Thigh Clearance	5.5	6.1	6.0	Pass
G	Back of Elbow to Wrist Pivot	11.4	12.0	11.8	Pass
H	Head Back to Backline	1.6	1.8	1.7	Pass
I	Shoulder to Elbow Length	13.0	13.6	13.4	Pass
J	Elbow Rest Height	7.5	8.3	7.9	Pass
K	Buttock to Knee Length	22.8	23.8	23.5	Pass
L	Popliteal Height	16.9	17.9	17.5	Pass
M	Knee Pivot Height	19.1	19.7	19.5	Pass
N	Buttock Popliteal Length	17.8	18.8	18.4	Pass
O	Chest Depth without Jacket	8.4	9.0	8.8	Pass
P	Foot Length (right)	9.9	10.5	10.2	Pass
V	Shoulder Breadth	16.3	17.2	16.9	Pass
W	Foot Breadth	3.6	4.2	3.9	Pass
Y	Chest Circumference with Jacket	38.2	39.4	38.8	Pass
Z	Waist Circumference	32.9	34.1	33.6	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

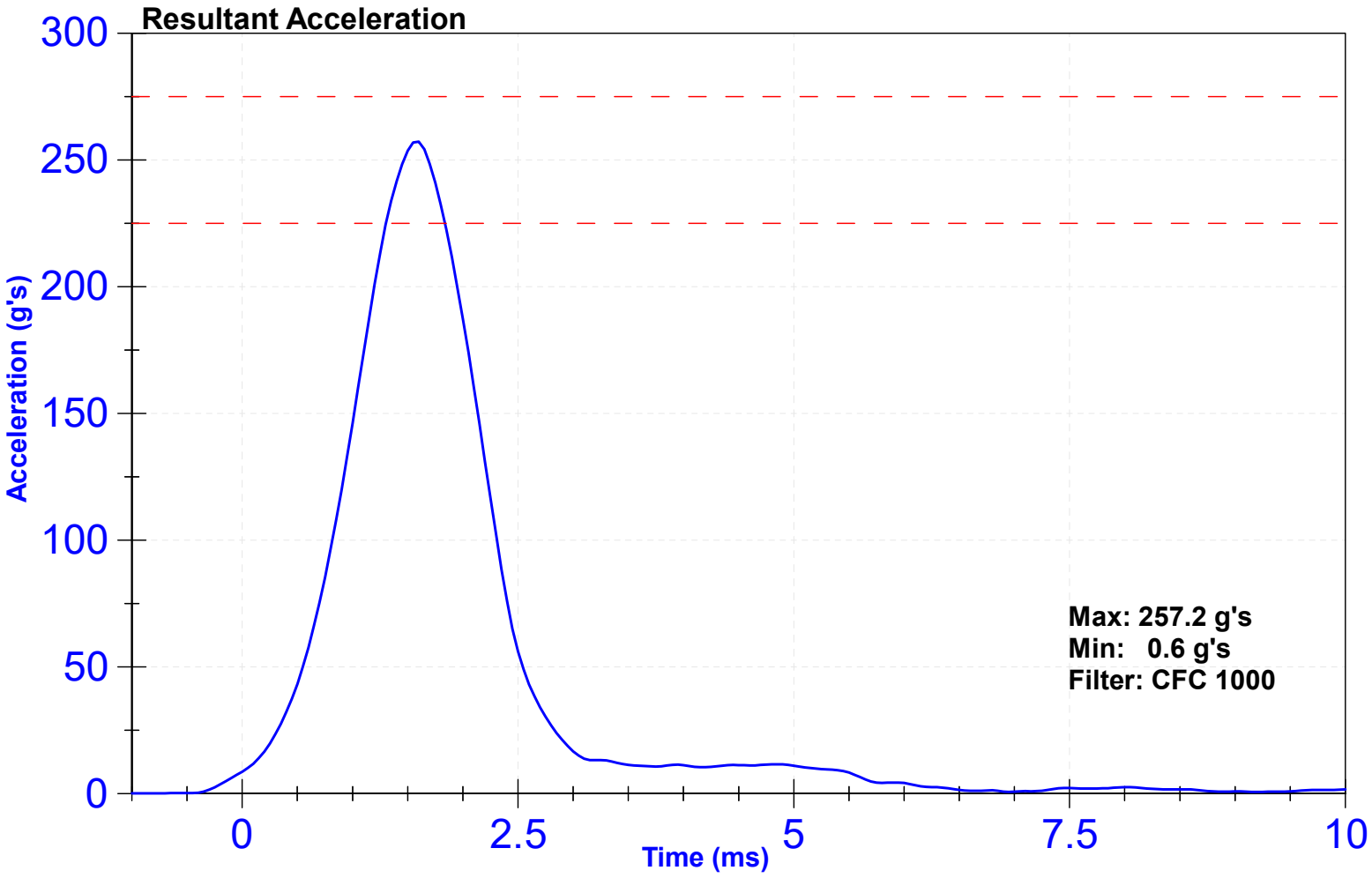
ATD Manufacturer	Humanetics	Test Technician	J. Kinderman
ATD Serial Number	065	Laboratory Supervisor	C. Mantell

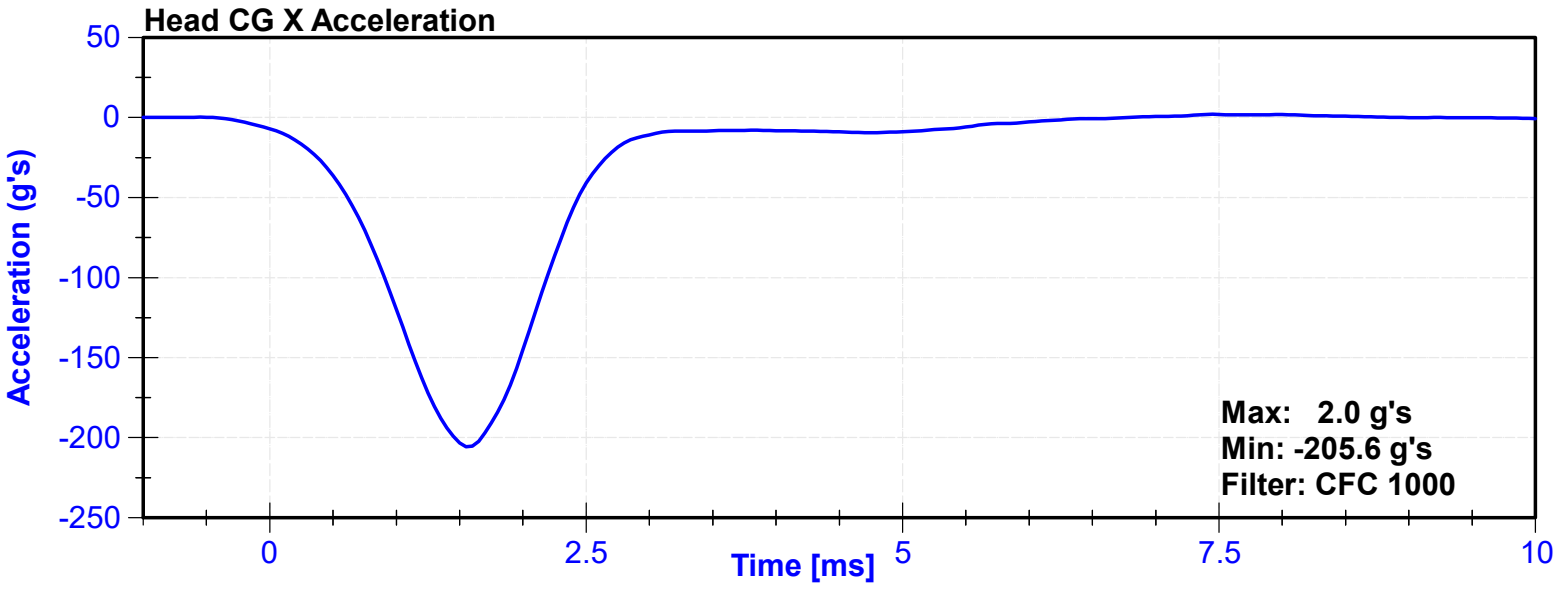
Results

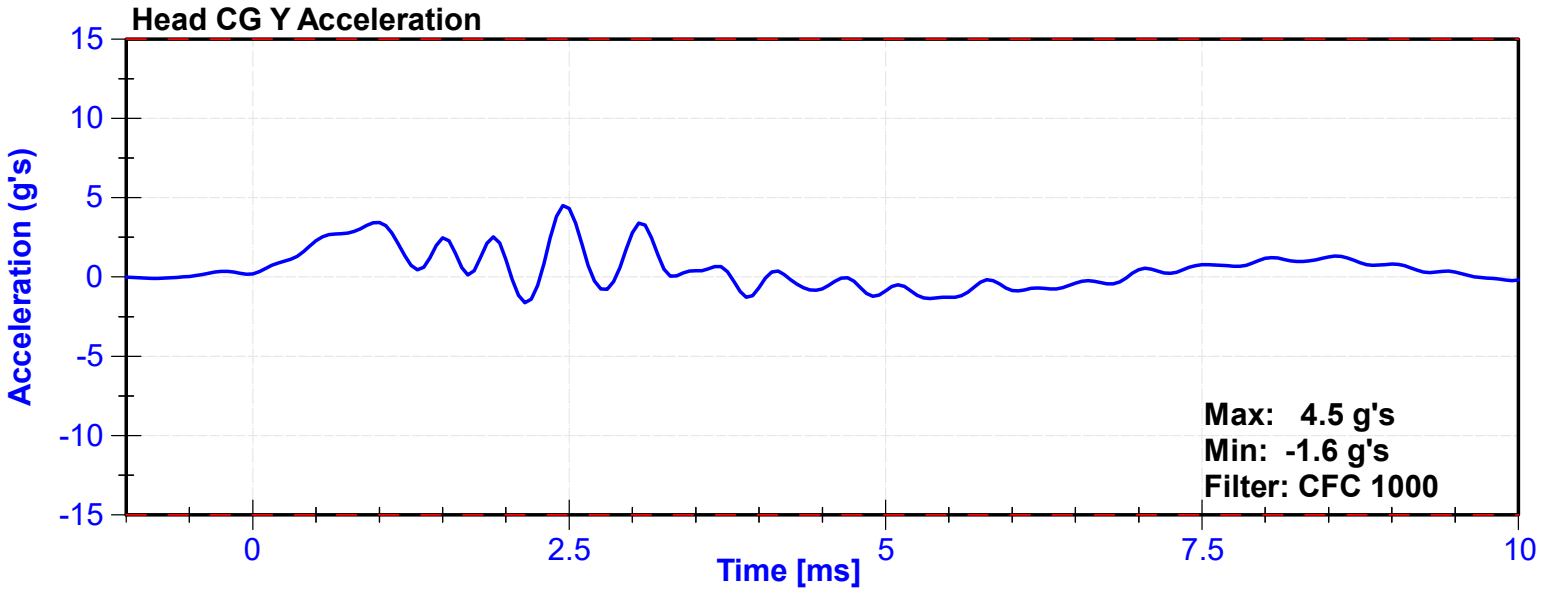
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	20.9	Pass
Humidity	10	70	%	40	Pass
Resultant Acceleration	225	275	g's	257.2	Pass
Oscillation	0	10	%	5.1	Pass
Lateral Acceleration	-15	15	g's	4.5	Pass

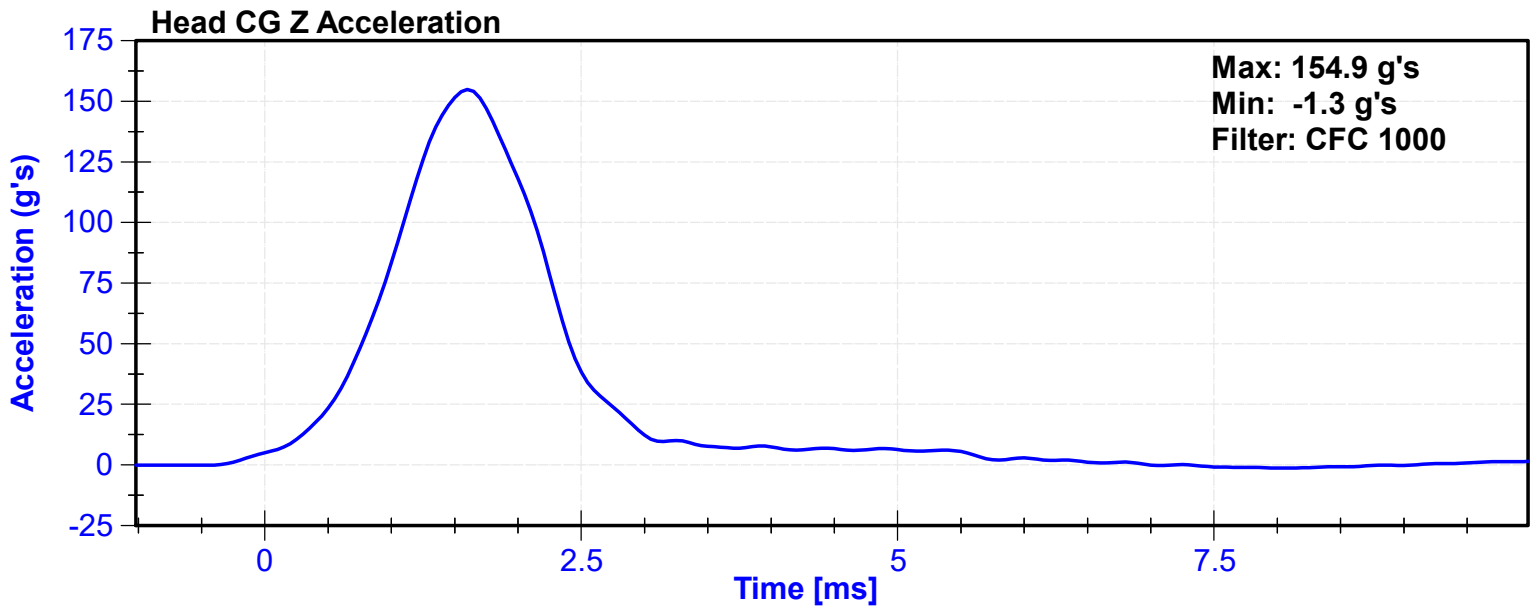
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	Endevco	P79591	4/30/2024	10/27/2024
Y Accelerometer	Endevco	P58888	4/30/2024	10/27/2024
Z Accelerometer	Endevco	P58911	4/30/2024	10/27/2024




Head CG X Acceleration
Acceleration (g's)
50
0
-50
-100
-150
-200
-250
0
2.5
5
7.5
10
Time [ms]
Max: 2.0 g's
Min: -205.6 g's
Filter: CFC 1000


Head CG Y Acceleration
Acceleration (g's)
15
10
5
0
-5
-10
-15
0
2.5
5
7.5
10
Time [ms]
Max: 4.5 g's
Min: -1.6 g's
Filter: CFC 1000


Head CG Z Acceleration
Acceleration (g's)
175
150
125
100
75
50
25
0
-25
0
2.5
5
7.5
Time [ms]
Max: 154.9 g's
Min: -1.3 g's
Filter: CFC 1000

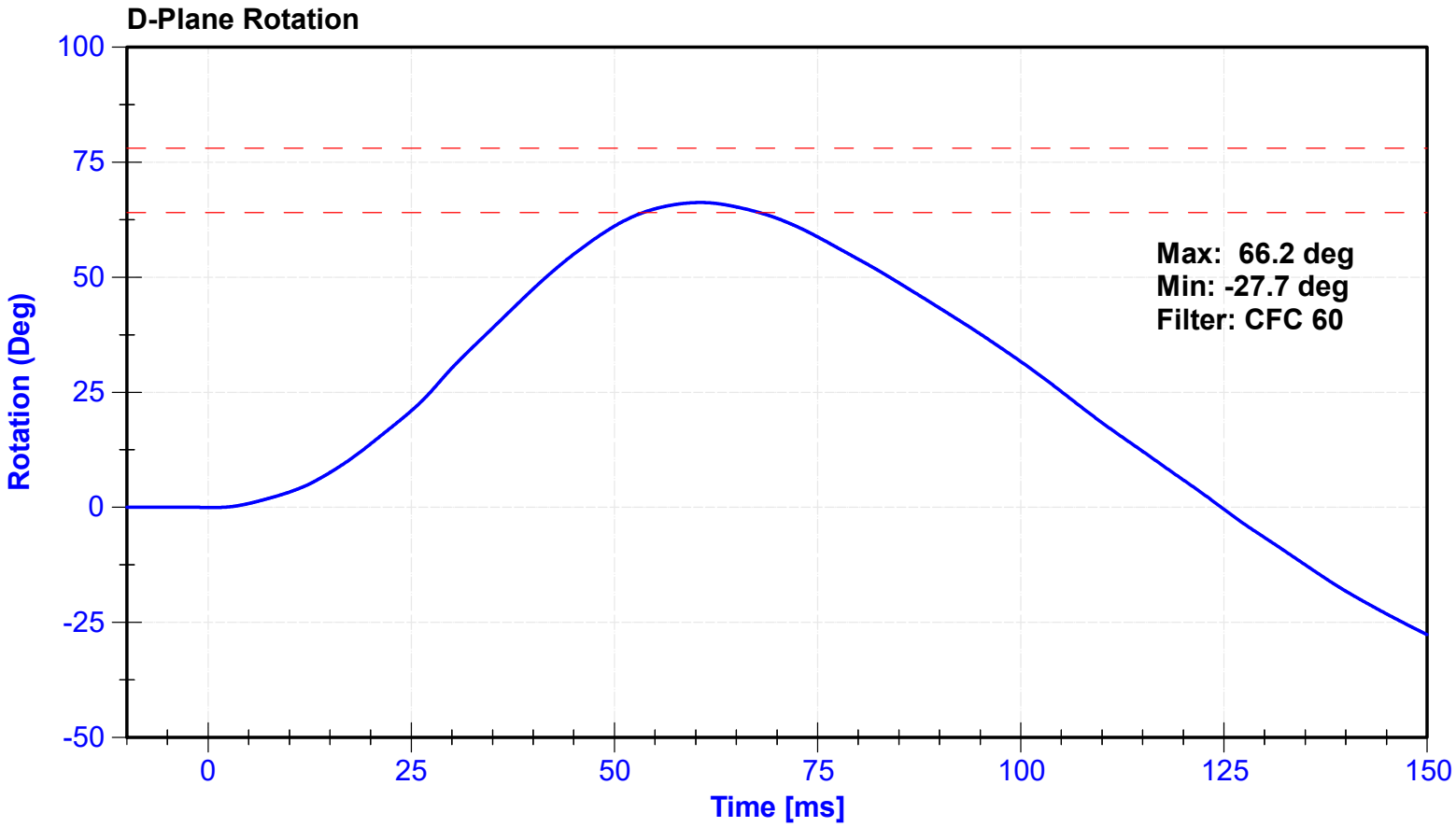
ATD Manufacturer	Humanetics	Test Technician	J. Kinderman
ATD Serial Number	065	Laboratory Supervisor	C. Mantell

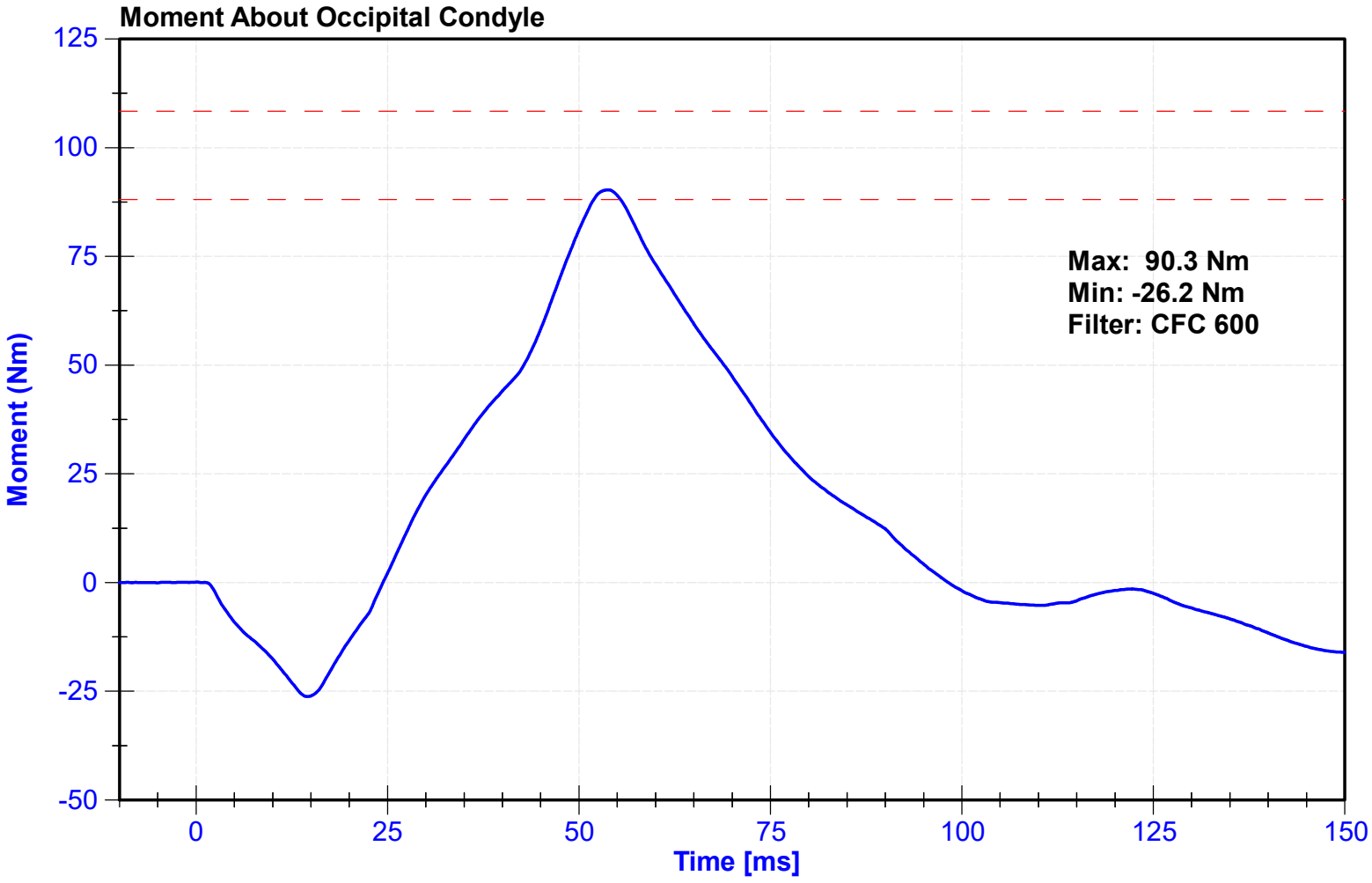
Results

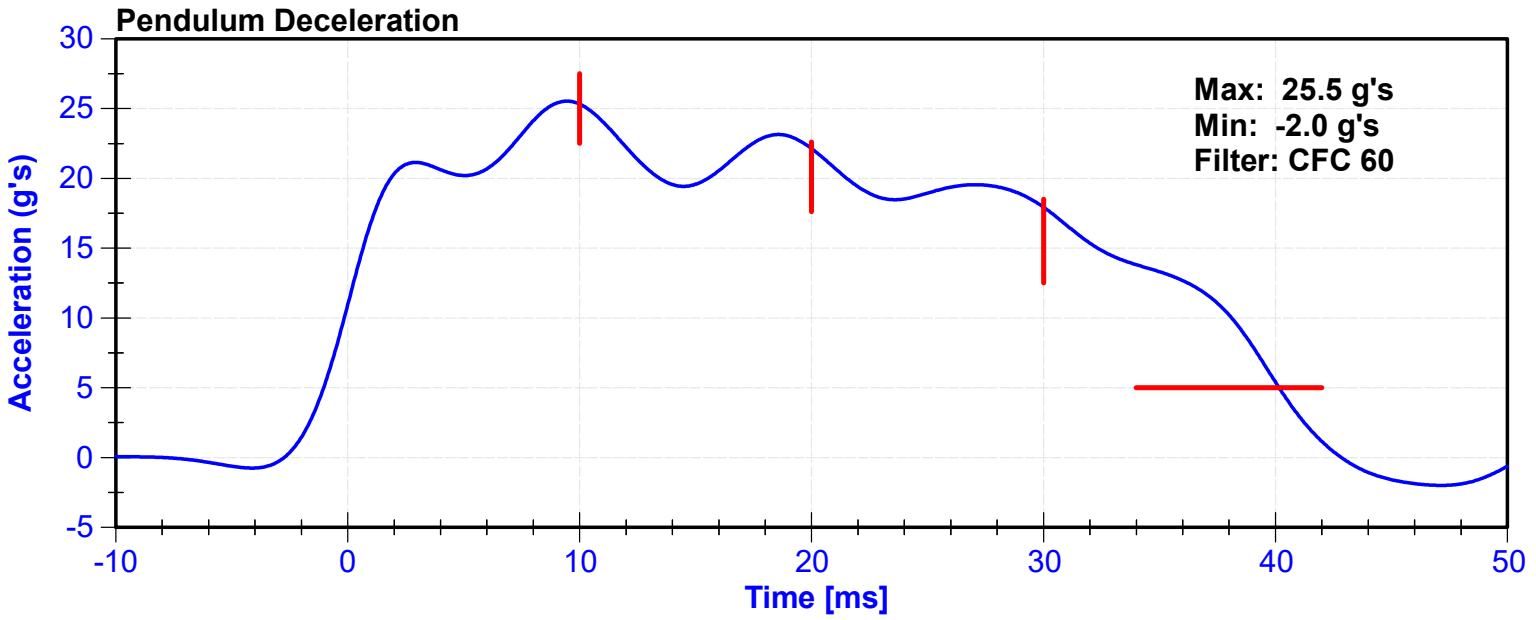
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.9	Pass
Humidity	10	70	%	43	Pass
Velocity	6.89	7.13	m/s	7.060	Pass
Pendulum Deceleration at 10ms	22.5	27.5	g's	25.31	Pass
Pendulum Deceleration at 20ms	17.6	22.6	g's	22.12	Pass
Pendulum Deceleration at 30ms	12.5	18.5	g's	17.93	Pass
Max. Pendulum Deceleration After 30ms	0	29	g's	25.5	Pass
Pendulum Deceleration Time to 5 g's	34	42	ms	40.2	Pass
Maximum D Plane Rotation	64	78	deg	66.2	Pass
Time to Maximum Rotation	57	64	ms	60.5	Pass
Rotation Decay to Zero	113	127	ms	124.7	Pass
Moment About Occipital Condyle	88.1	108.4	Nm	90.31	Pass
Time to Maximum Moment	47	58	ms	53.8	Pass
Moment Decay to Zero	97	107	ms	98.2	Pass

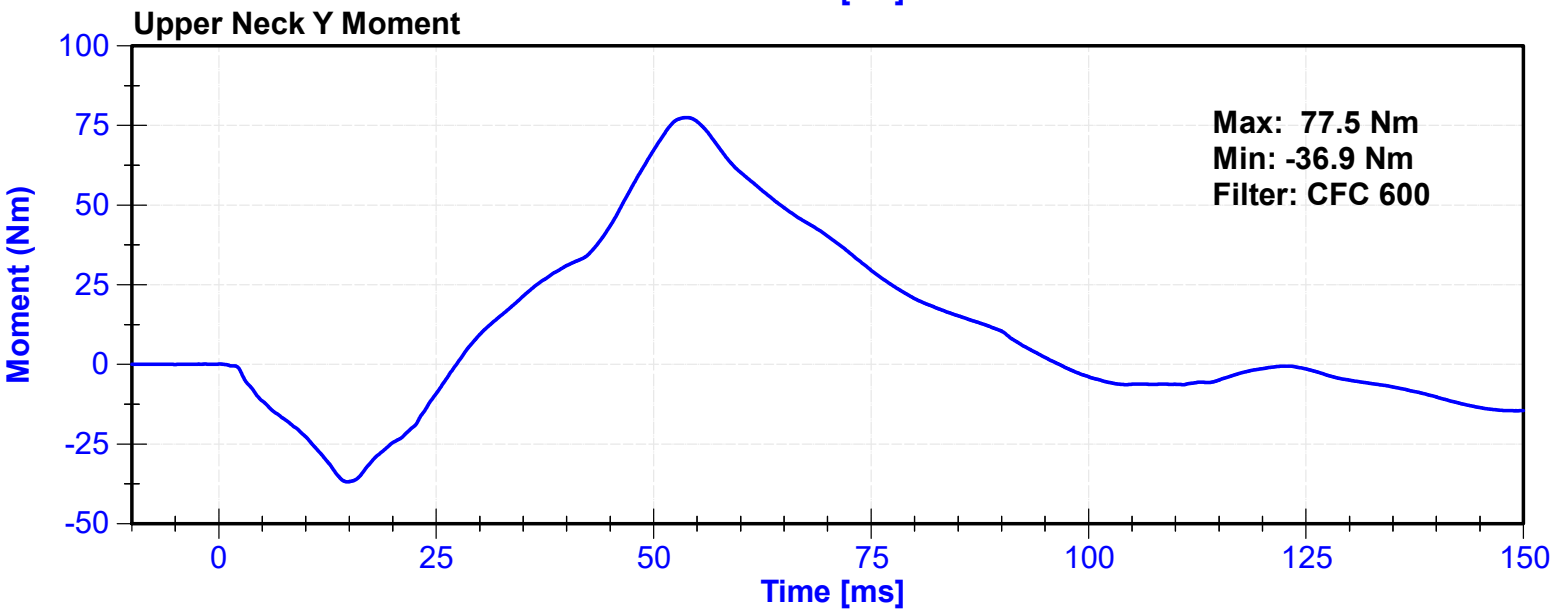
Transducer Calibrations

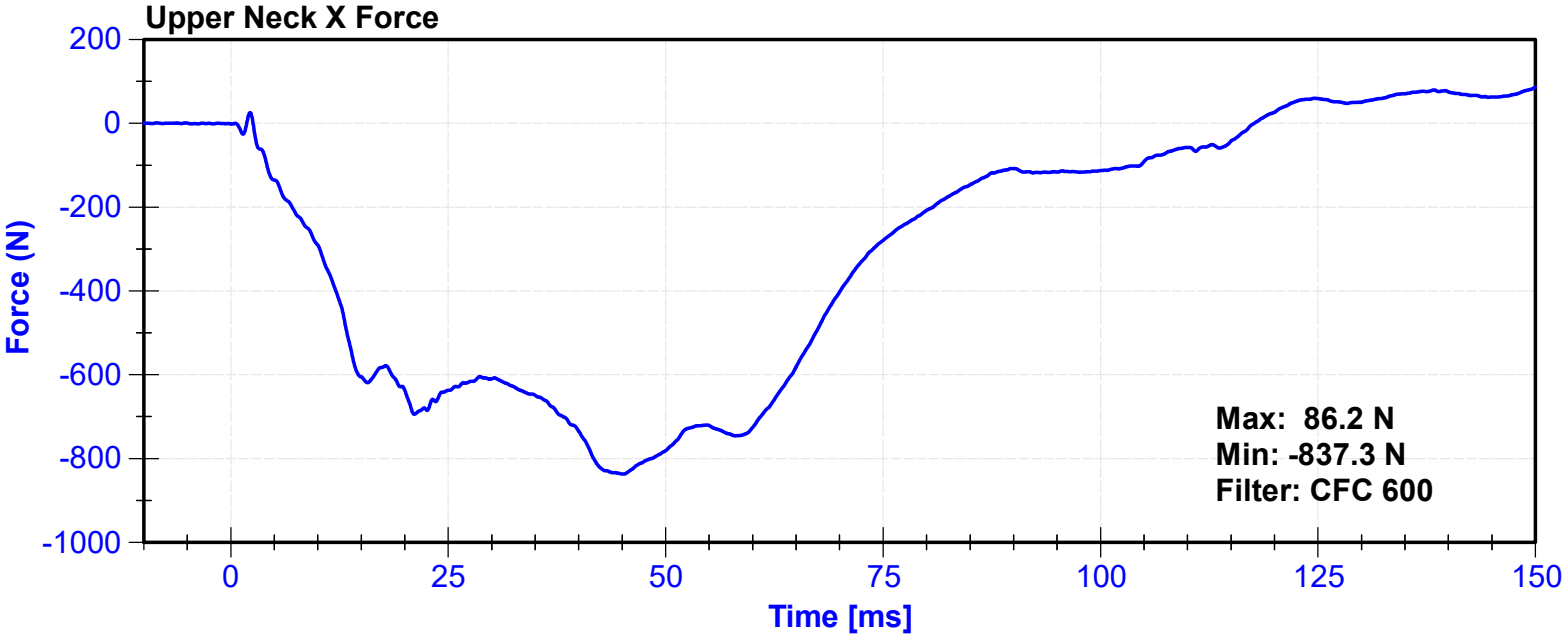
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	7231C-750	10/31/2023	10/30/2024
Pendulum Potentiometer	ETI	SP22G_LABPOT1	5/7/2024	5/7/2025
Condyle Potentiometer	ETI	SP22G_LABPOT2	5/7/2024	5/7/2025
Upper Neck Load Cell	Humanetics	1916-FX	9/12/2023	9/11/2024


D-Plane Rotation
Rotation (Deg)
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]
Max: 66.2 deg
Min: -27.7 deg
Filter: CFC 60


Moment About Occipital Condyle
Moment (Nm)
125
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]
Max: 90.3 Nm
Min: -26.2 Nm
Filter: CFC 600


Pendulum Deceleration
Max: 25.5 g's
Min: -2.0 g's
Filter: CFC 60
Acceleration (g's)
Time [ms]


Upper Neck Y Moment
Max: 77.5 Nm
Min: -36.9 Nm
Filter: CFC 600
Moment (Nm)
Time [ms]


Upper Neck X Force
Max: 86.2 N
Min: -837.3 N
Filter: CFC 600
Force (N)
Time [ms]

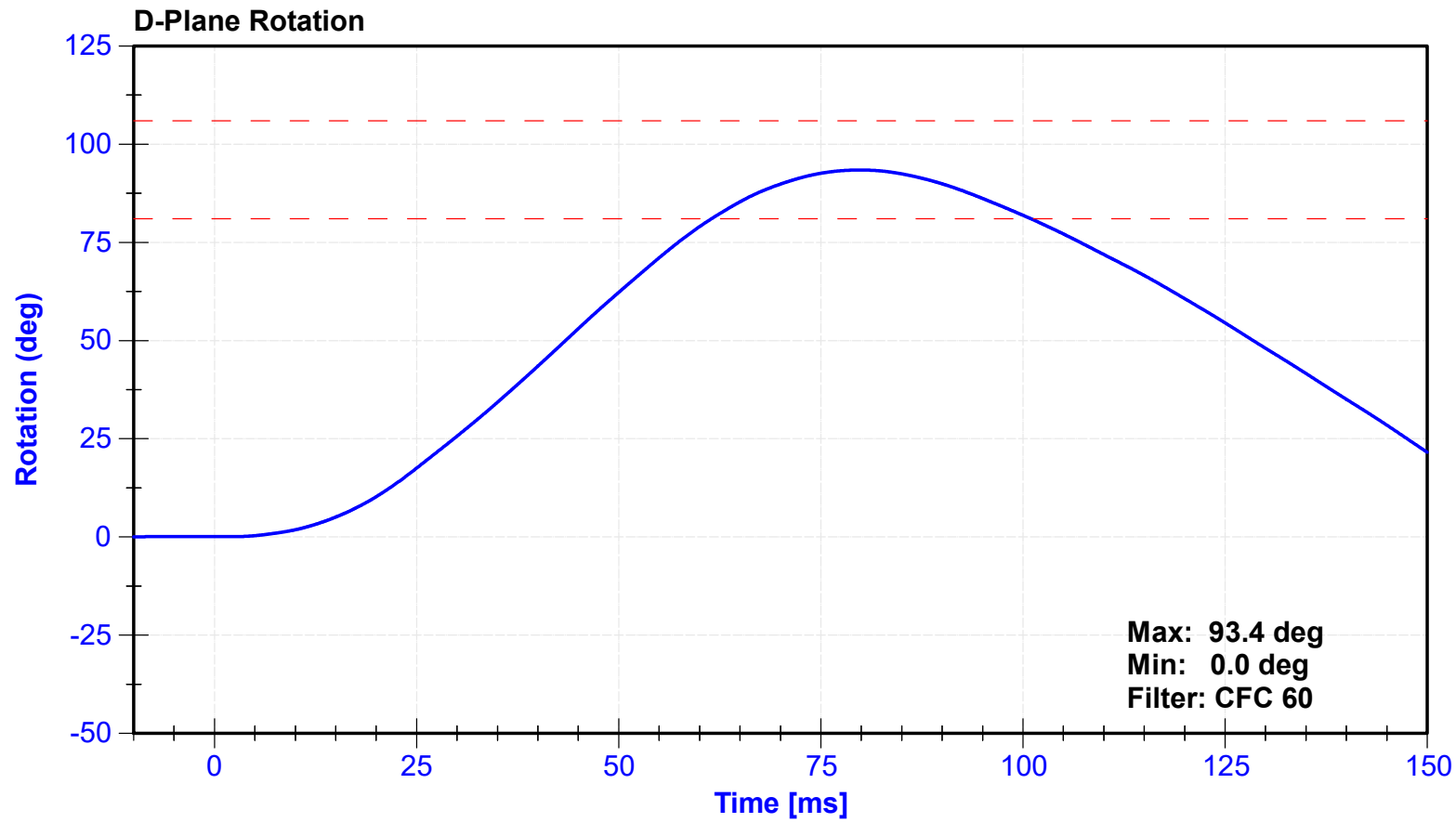
ATD Manufacturer	Humanetics	Test Technician	J. Kinderman
ATD Serial Number	065	Laboratory Supervisor	C. Mantell

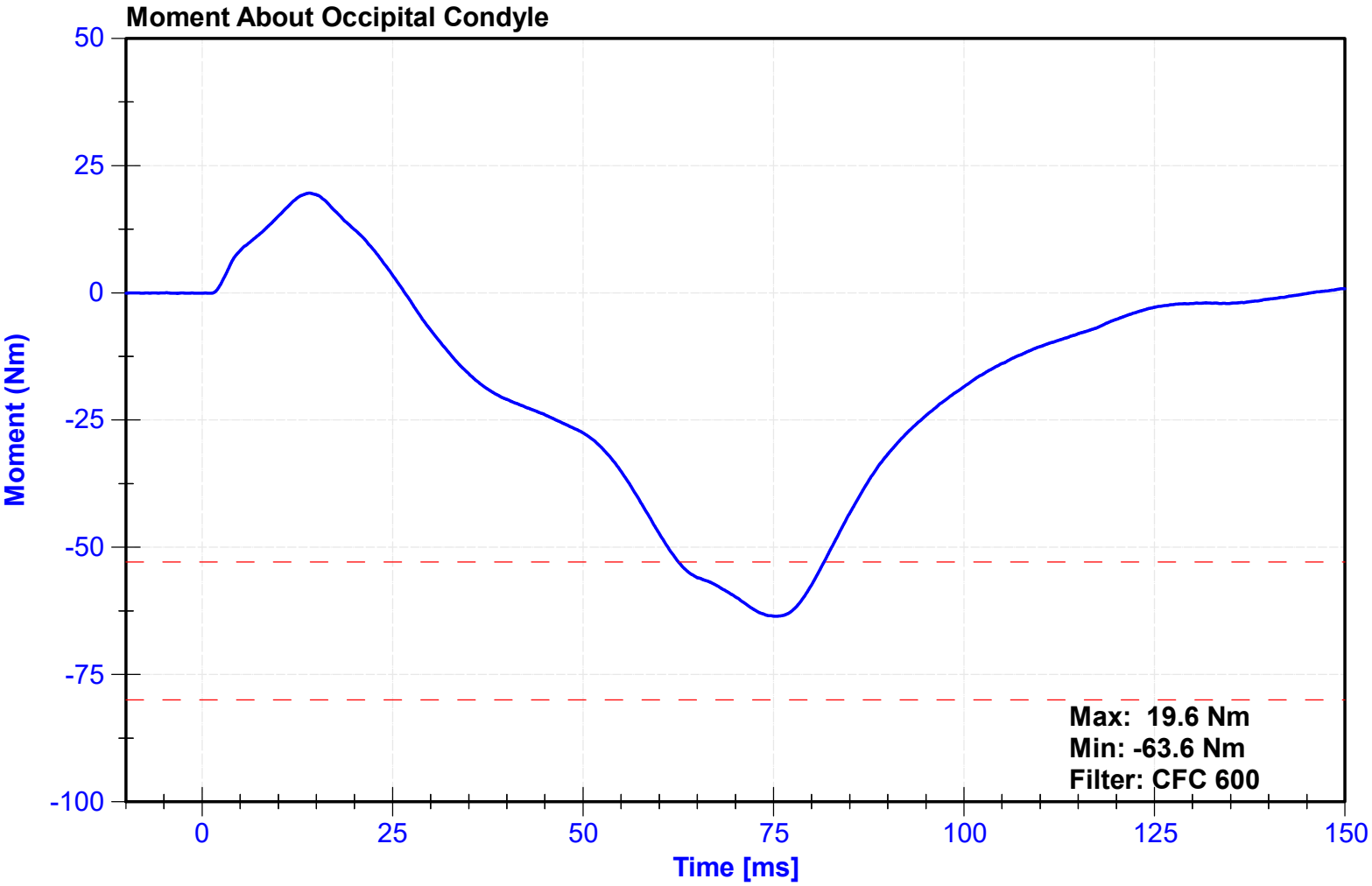
Results

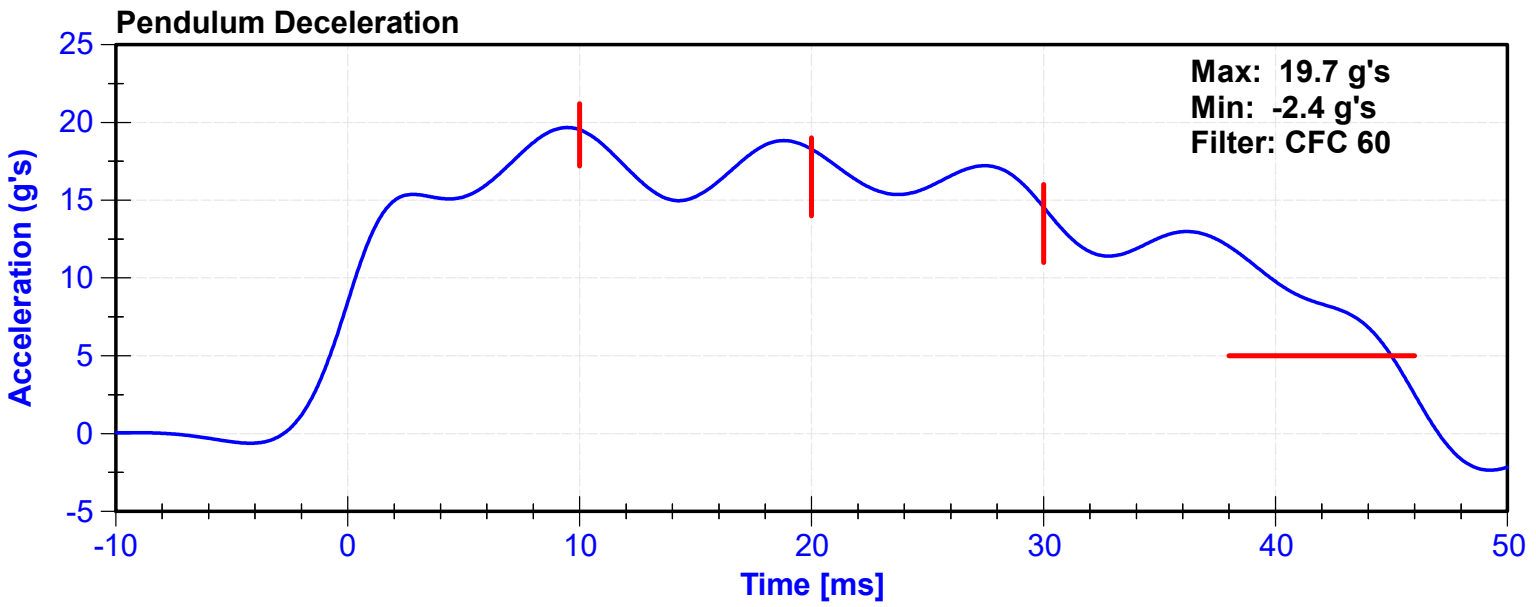
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.9	Pass
Humidity	10	70	%	43	Pass
Velocity	5.94	6.19	m/s	6.185	Pass
Pendulum Deceleration at 10ms	17.2	21.2	g's	19.52	Pass
Pendulum Deceleration at 20ms	14	19	g's	18.3	Pass
Pendulum Deceleration at 30ms	11	16	g's	14.6	Pass
Max. Pendulum Deceleration After 30ms	0	22	g's	19.7	Pass
Pendulum Deceleration Time to 5 g's	38	46	ms	45.0	Pass
Maximum D Plane Rotation	81	106	deg	93.4	Pass
Time to Maximum Rotation	72	82	ms	79.9	Pass
Rotation Decay to Zero	147	174	ms	166.8	Pass
Minimum Moment About OC	-80	-52.9	Nm	-63.59	Pass
Time to Minimum Moment	65	79	ms	75.3	Pass
Moment Decay to Zero	120	148	ms	145.6	Pass

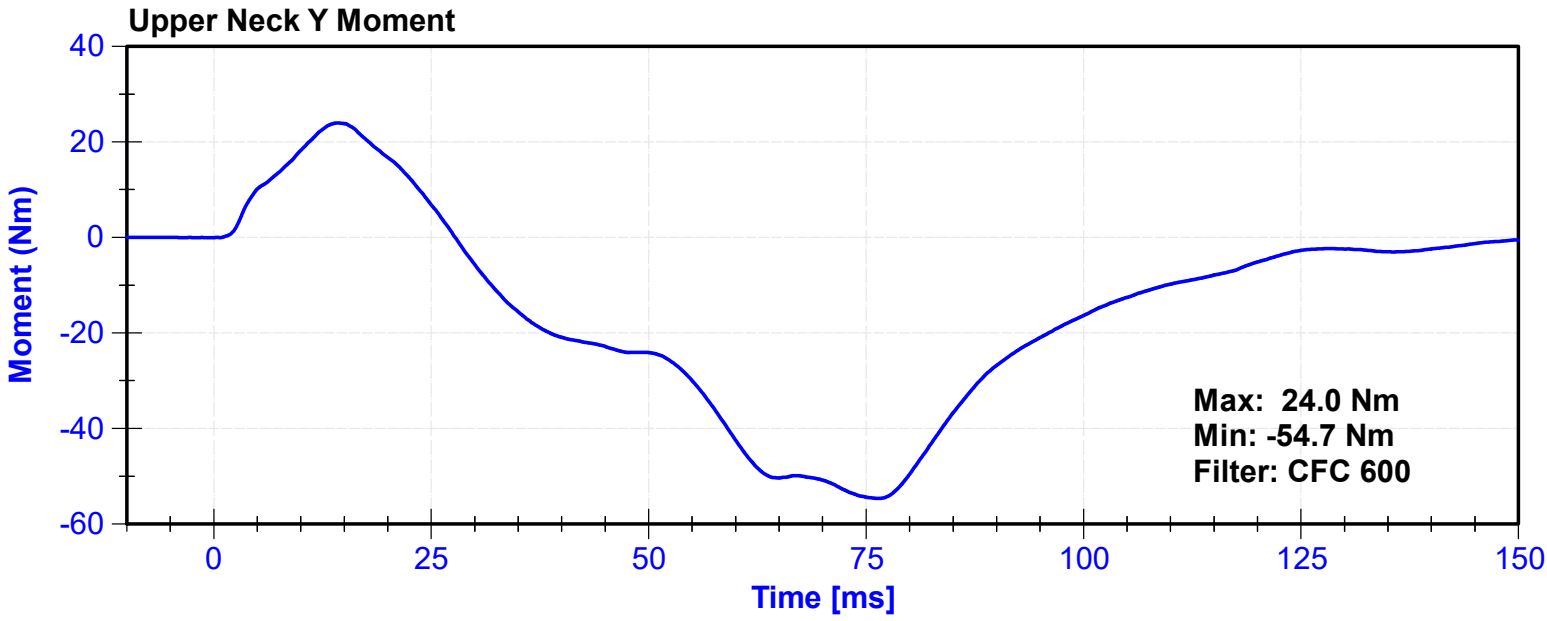
Transducer Calibrations

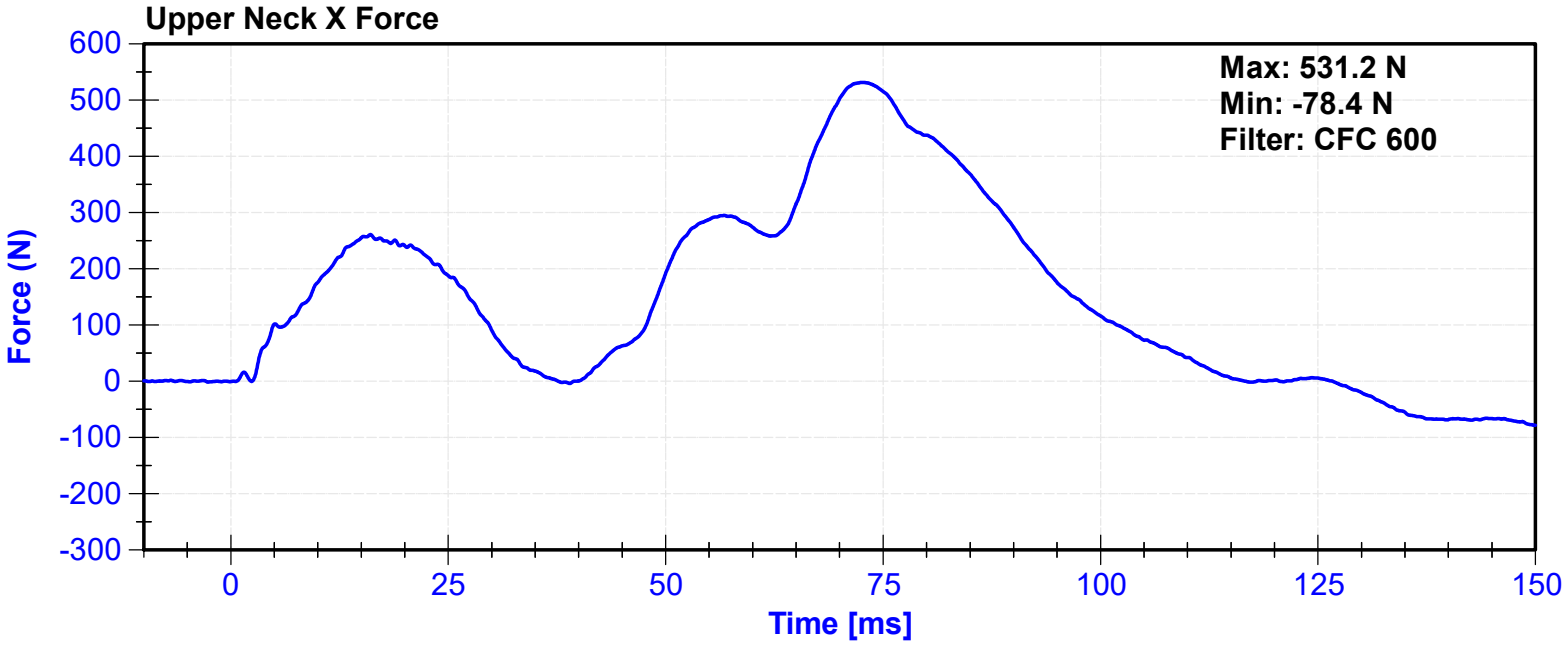
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	C16650	10/31/2023	10/30/2024
Pendulum Potentiometer	ETI	SP22G_LABPOT1	5/7/2024	5/7/2025
Condyle Potentiometer	ETI	SP22G_LABPOT2	5/7/2024	5/7/2025
Upper Neck Load Cell	Humanetics	1916-FX	9/12/2023	9/11/2024


D-Plane Rotation
Rotation (deg)
125
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]
Max: 93.4 deg
Min: 0.0 deg
Filter: CFC 60


Moment About Occipital Condyle
Moment (Nm)
50
25
0
-25
-50
-75
-100
0
25
50
75
100
125
150
Time [ms]
Max: 19.6 Nm
Min: -63.6 Nm
Filter: CFC 600


Pendulum Deceleration
Max: 19.7 g's
Min: -2.4 g's
Filter: CFC 60
Acceleration (g's)
25
20
15
10
5
0
-5
-10
0
10
20
30
40
50
Time [ms]


Upper Neck Y Moment
Max: 24.0 Nm
Min: -54.7 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: 531.2 N
Min: -78.4 N
Filter: CFC 600
Force (N)
600
500
400
300
200
100
0
-100
-200
-300
0
25
50
75
100
125
150
Time [ms]

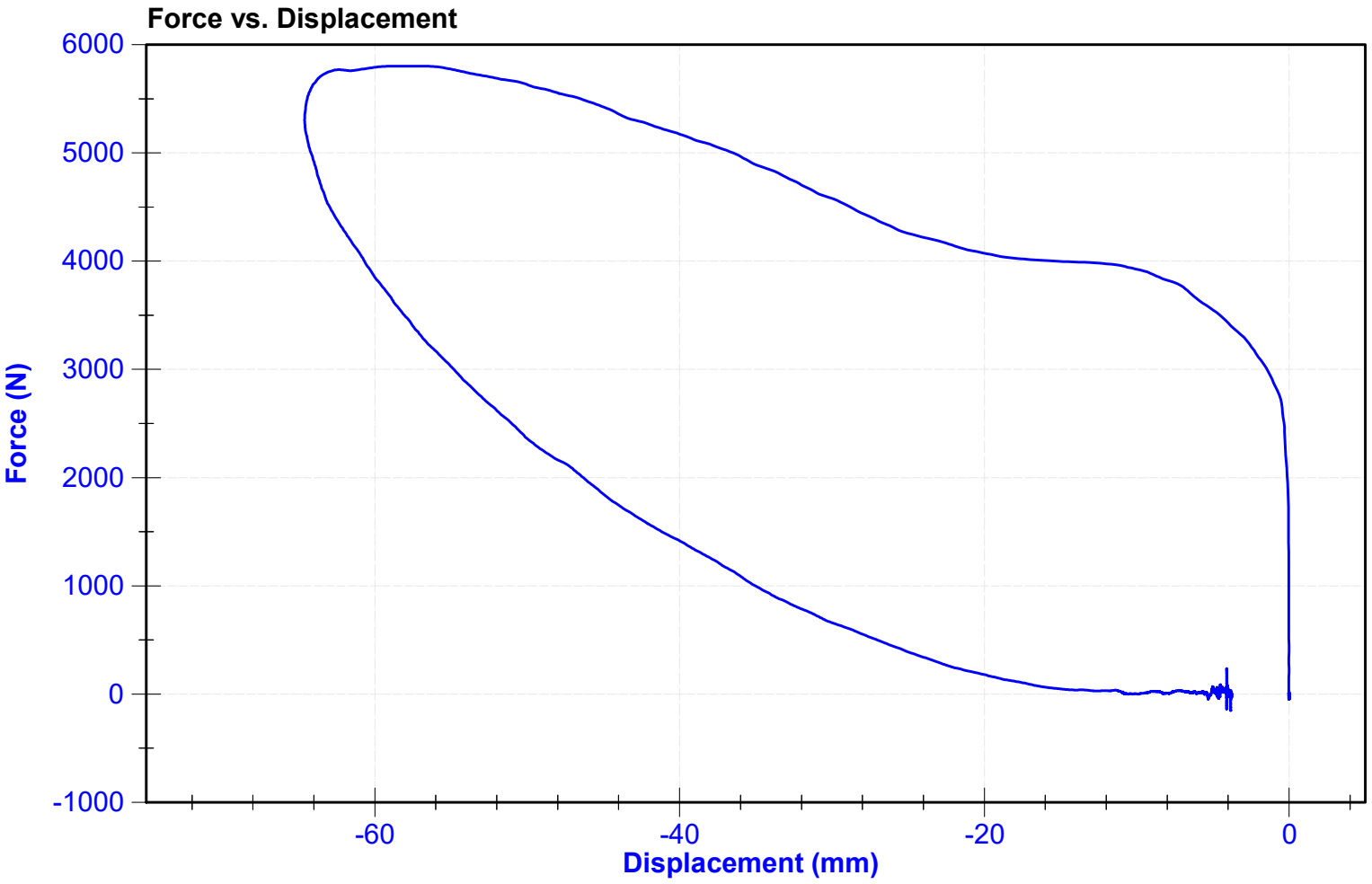
ATD Manufacturer	Humanetics	Test Technician	J. Kinderman
ATD Serial Number	065	Laboratory Supervisor	C. Mantell

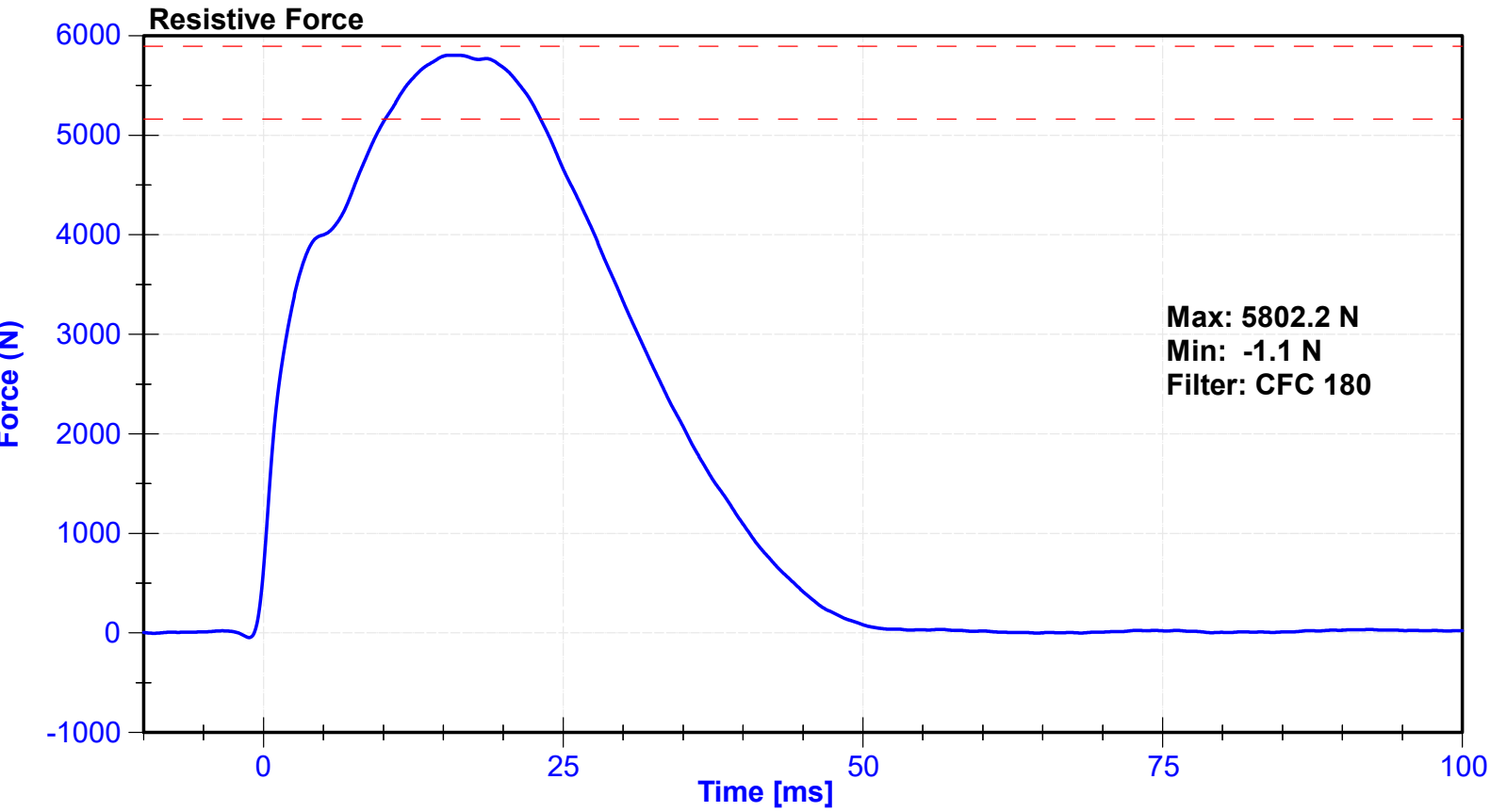
Results

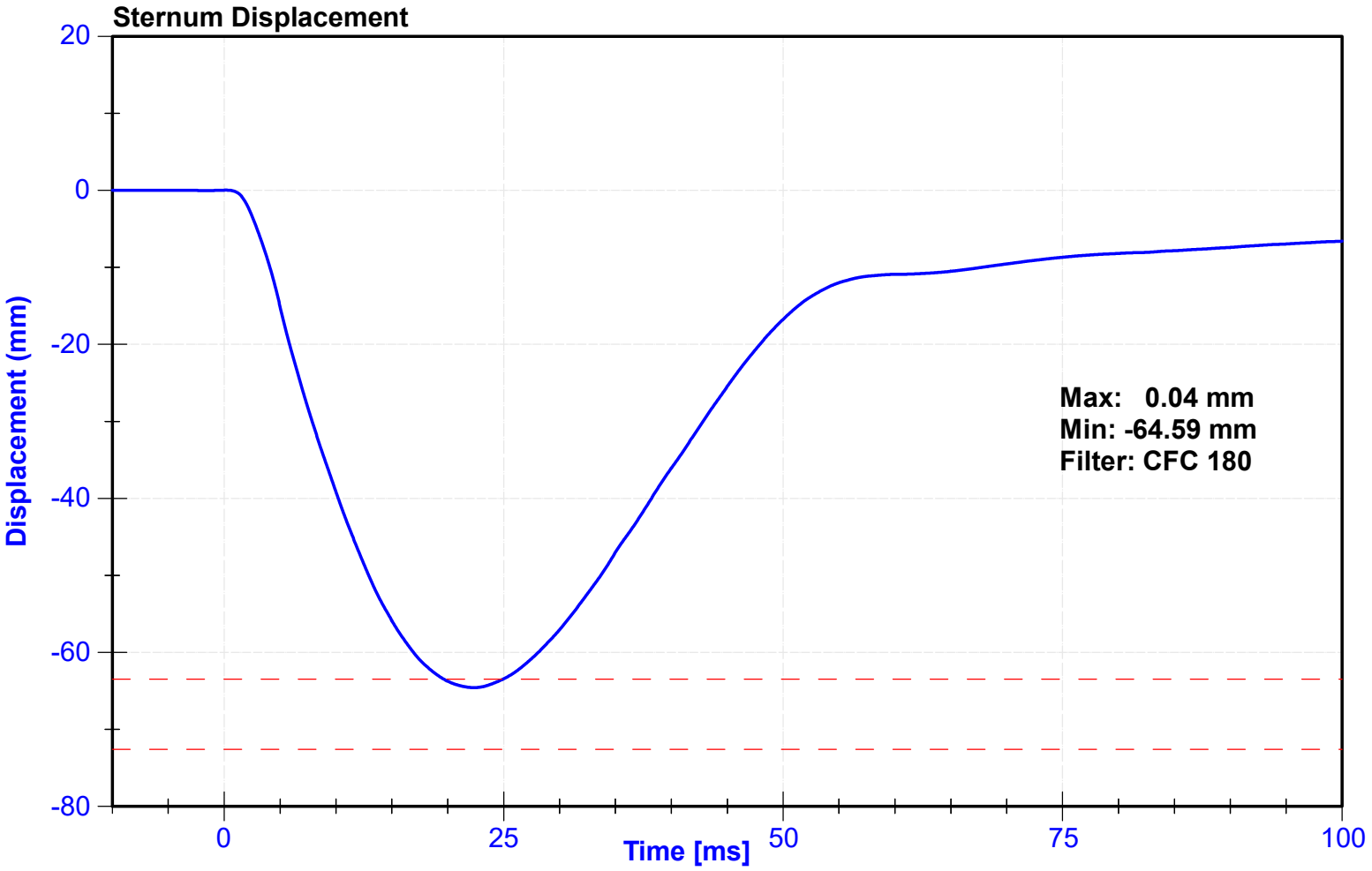
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21,4	Pass
Humidity	10	70	%	36	Pass
Velocity	6.59	6.83	m/s	6.661	Pass
Chest Displacement	-72.6	-63.5	mm	-64.59	Pass
Resistive Force	5160	5894	N	5802.2	Pass
Hysteresis	69	85	%	72.3	Pass

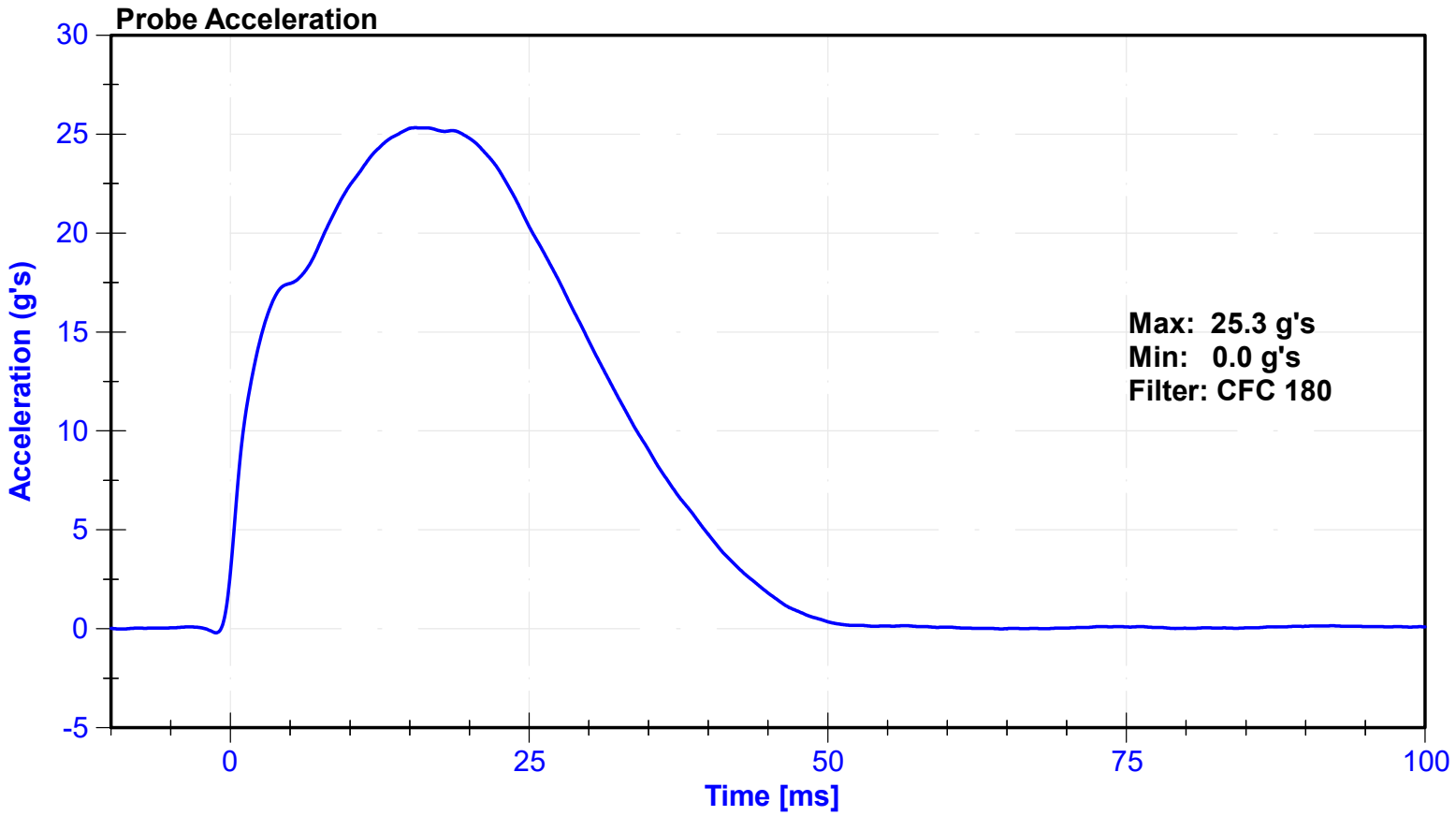
Transducer Calibrations

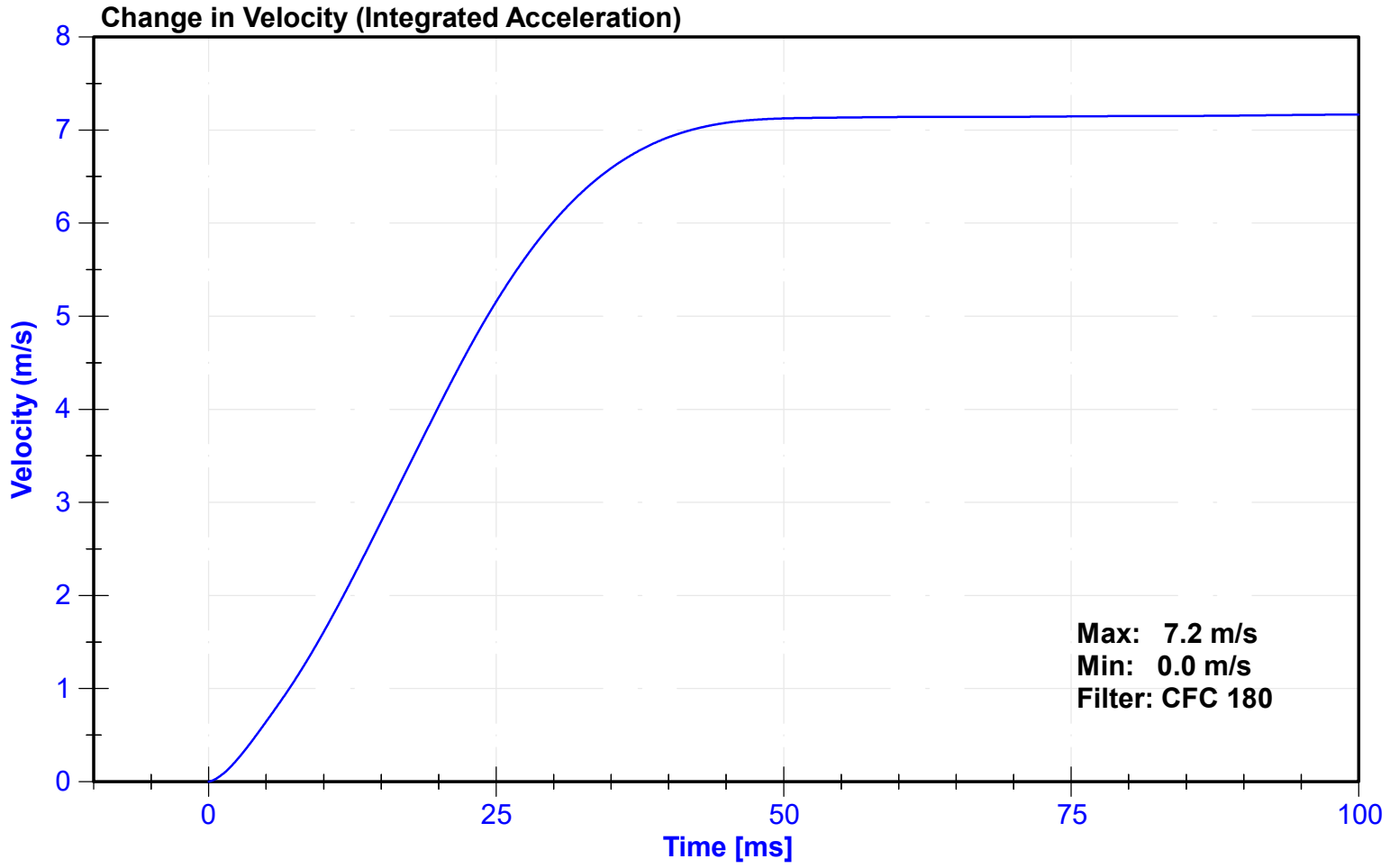
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18587	11/20/2023	11/19/2024
Chest Potentiometer	Servo	1046	4/30/2024	10/29/2024




Resistive Force
Force (N)
6000
5000
4000
3000
2000
1000
0
-1000
0
25
50
75
100
Time [ms]
Max: 5802.2 N
Min: -1.1 N
Filter: CFC 180


Sternum Displacement
Displacement (mm)
20
0
-20
-40
-60
-80
0
25
50
75
100
Time [ms]
Max: 0.04 mm
Min: -64.59 mm
Filter: CFC 180


Probe Acceleration
Acceleration (g's)
30
25
20
15
10
5
0
-5
0
25
50
75
100
Time [ms]
Max: 25.3 g's
Min: 0.0 g's
Filter: CFC 180


Change in Velocity (Integrated Acceleration)
Velocity (m/s)
8
7
6
5
4
3
2
1
0
0
25
50
75
100
Time [ms]
Max: 7.2 m/s
Min: 0.0 m/s
Filter: CFC 180

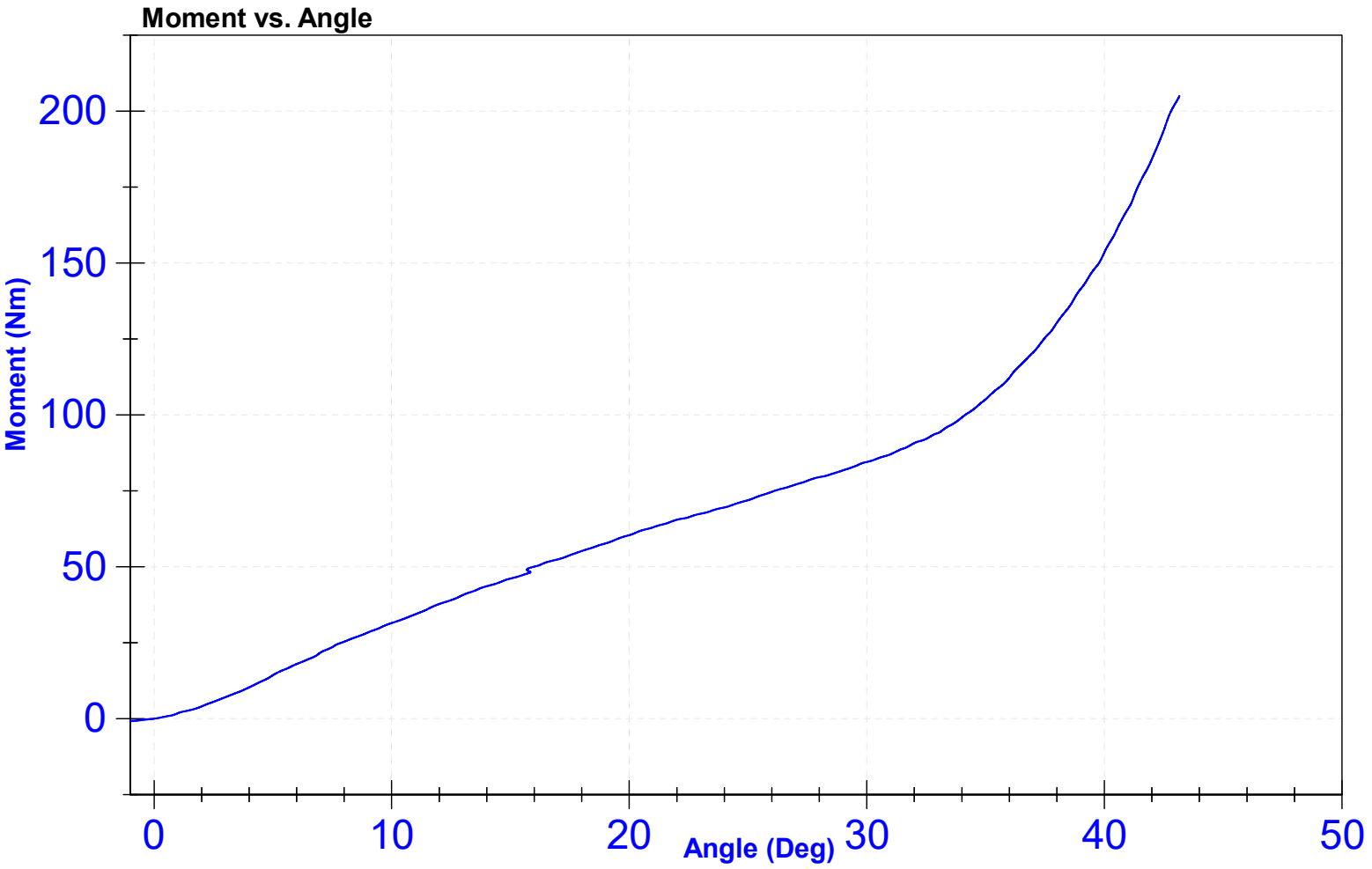
ATD Manufacturer	Humanetics	Test Technician	J. Kinderman
ATD Serial Number	065	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.0	Pass
Humidity	10	70	%	45	Pass
Average Velocity	5	10	deg/s	7.1	Pass
Angle at 203Nm	40	50	deg	43.0	Pass
Moment at 30 degrees	0	94.9	Nm	84.5	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	ETI SP22	DS-0008	10/6/2023	10/5/2024
Load Cell	PCB 2301-02	2301-02_115	2023-10-30	2024-10-29



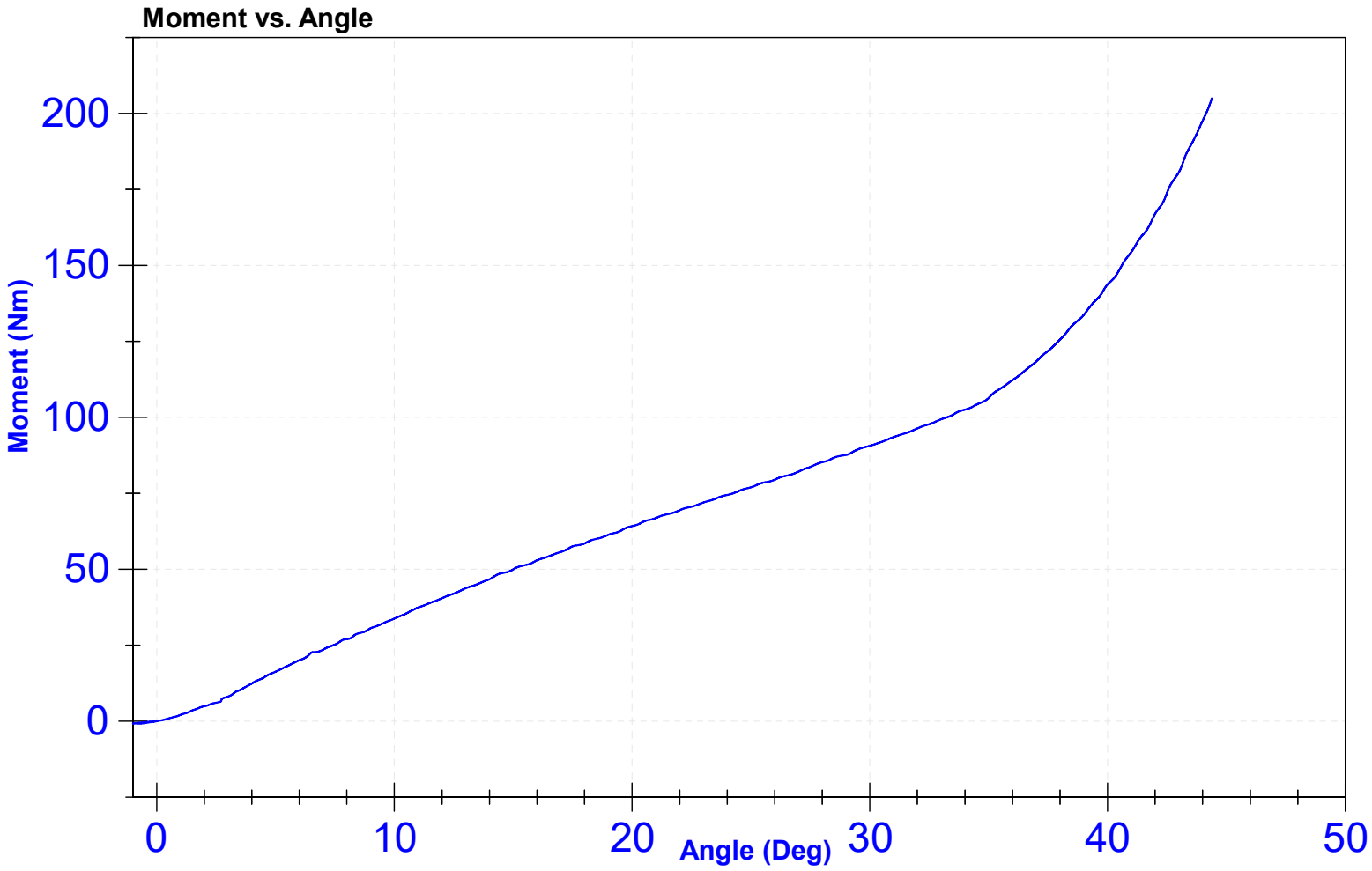
ATD Manufacturer	Humanetics	Test Technician	J. Kinderman
ATD Serial Number	065	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.0	Pass
Humidity	10	70	%	45	Pass
Average Velocity	5	10	deg/s	6.9	Pass
Angle at 203Nm	40	50	deg	44.3	Pass
Moment at 30 degrees	0	94.9	Nm	90.6	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	ETI SP22	DS-0008	10/6/2023	10/5/2024
Load Cell	PCB 2301-02	2301-02_115	2023-10-30	2024-10-29



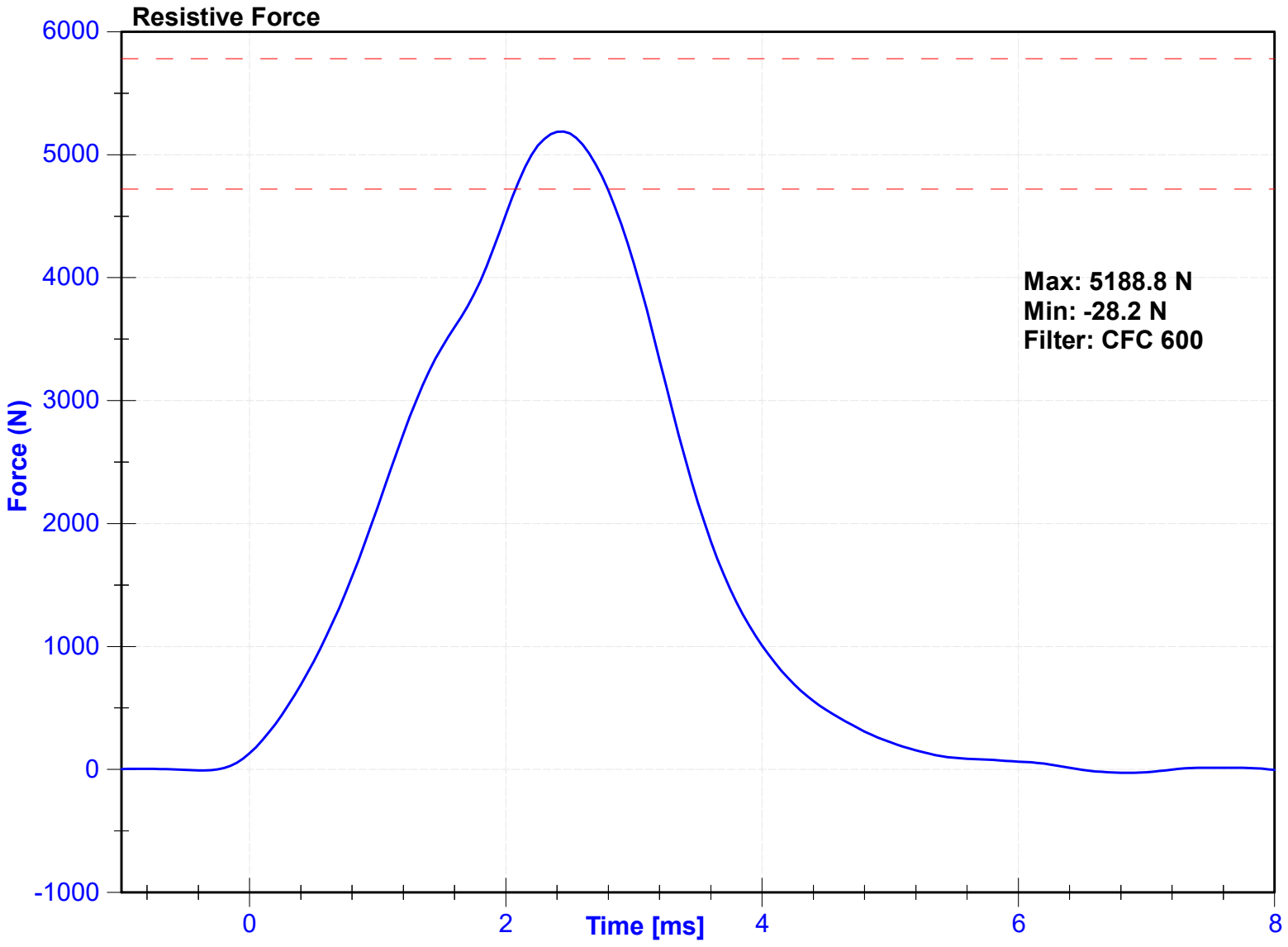
ATD Manufacturer	Humanetics	Test Technician	J. Kinderman
ATD Serial Number	065	Laboratory Supervisor	C. Mantell

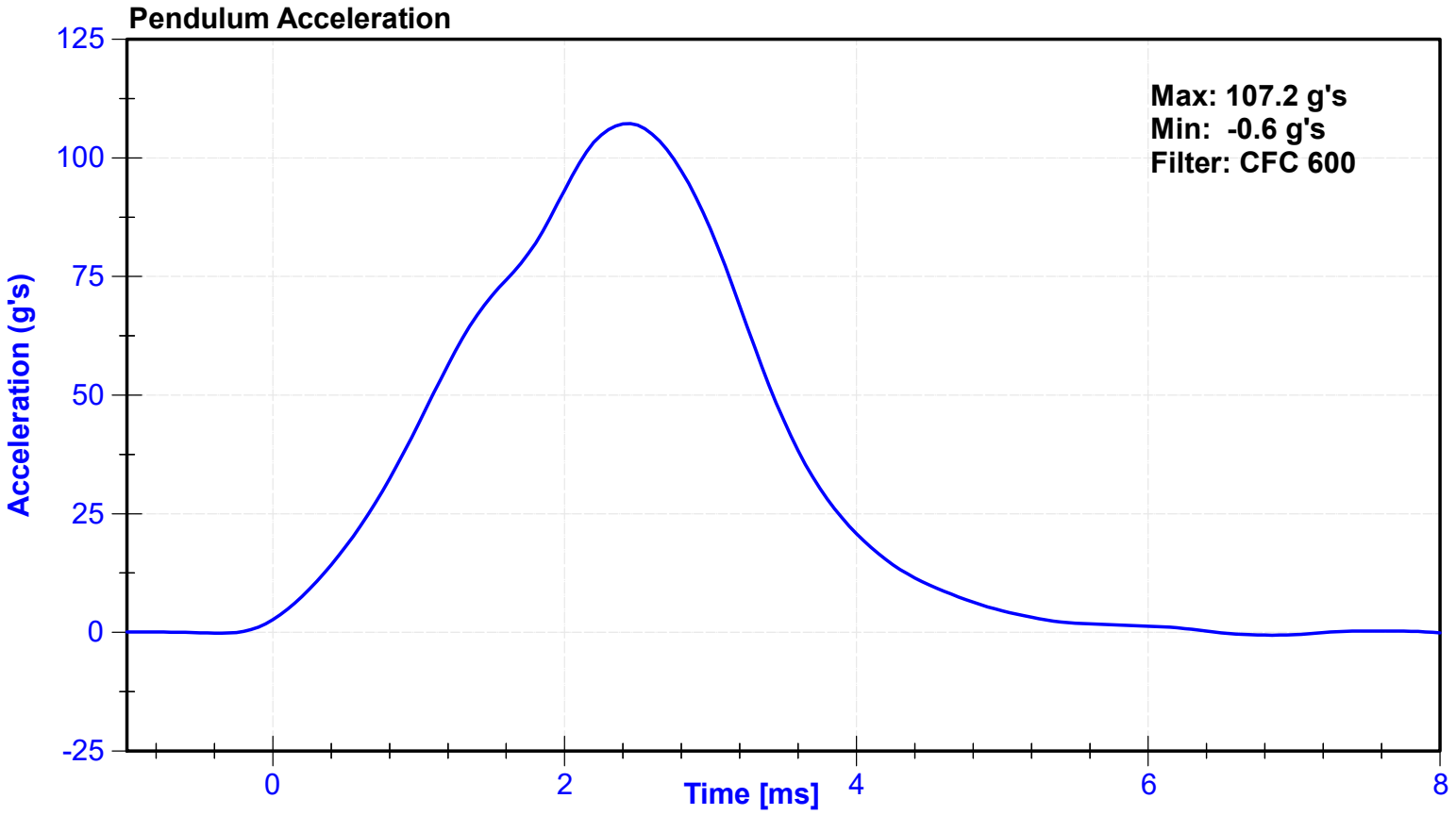
Results

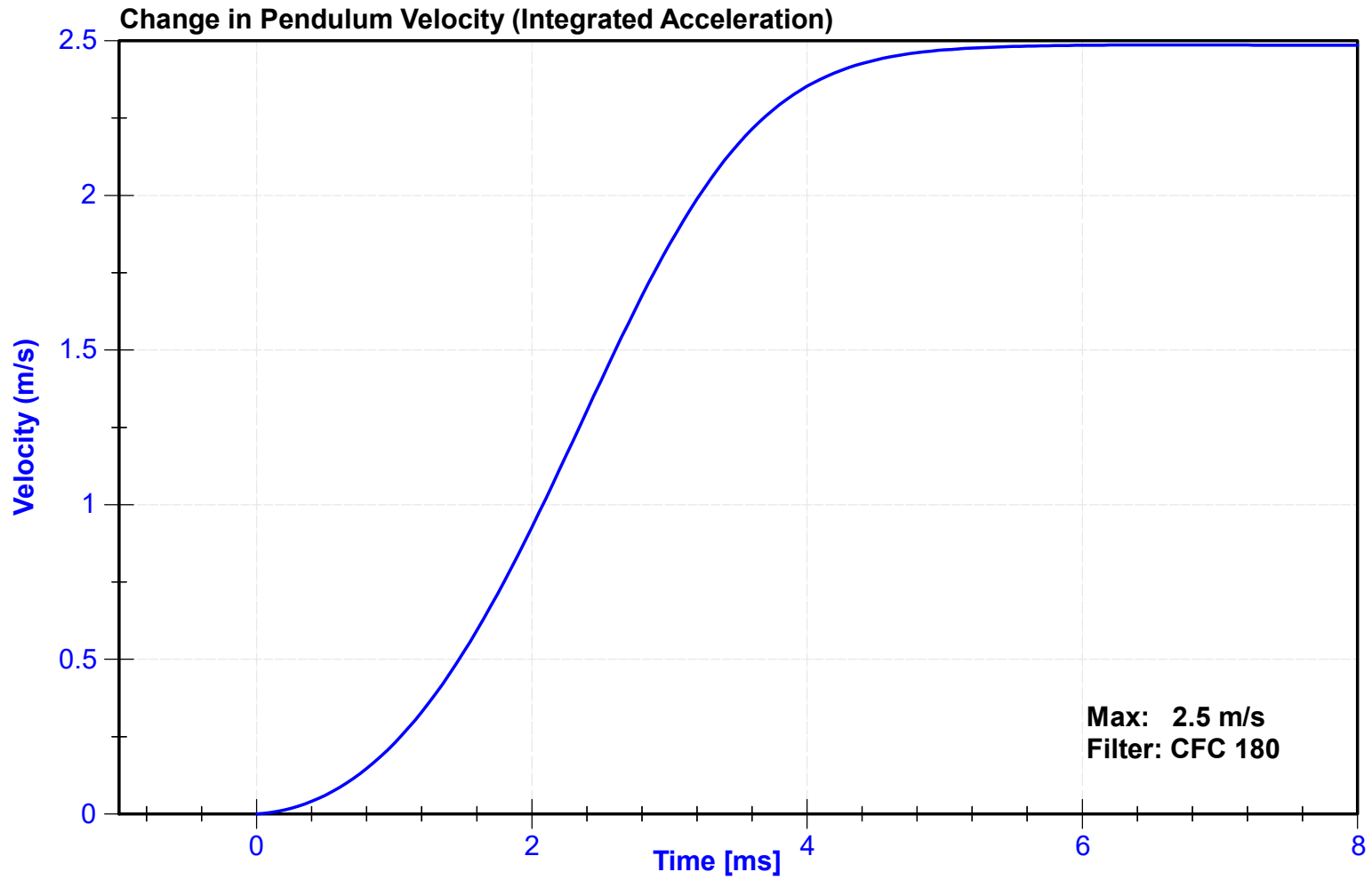
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.2	Pass
Humidity	10	70	%	47	Pass
Velocity	2.07	2.13	m/s	2.112	Pass
Maximum Resistive Force	4720	5780	N	5188.8	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18619	3/29/2024	9/25/2024




Pendulum Acceleration
Max: 107.2 g's
Min: -0.6 g's
Filter: CFC 600
Acceleration (g's)
125
100
75
50
25
0
-25
0
2
4
6
8
Time [ms]


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

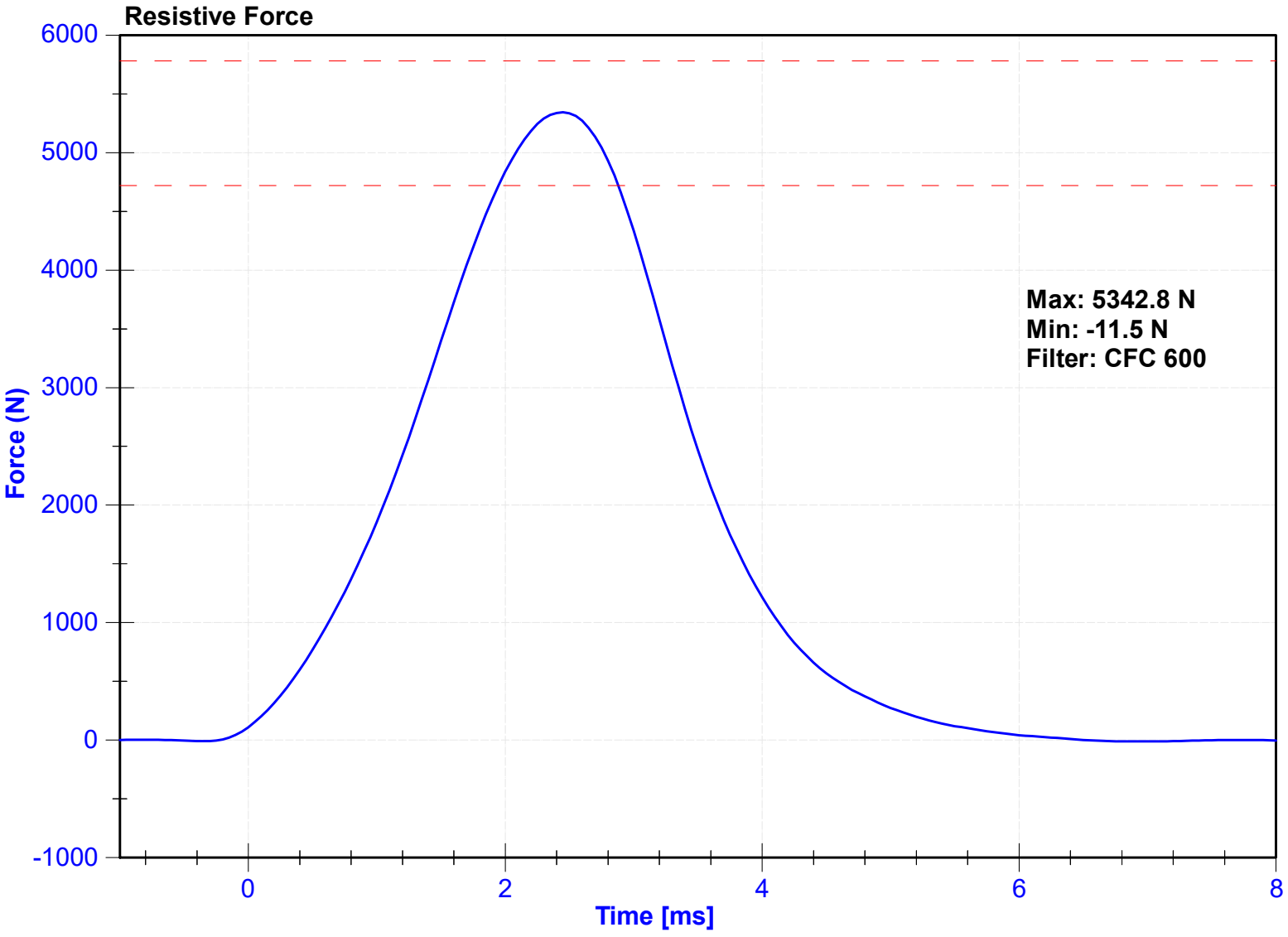
ATD Manufacturer	Humanetics	Test Technician	J. Kinderman
ATD Serial Number	065	Laboratory Supervisor	C. Mantell

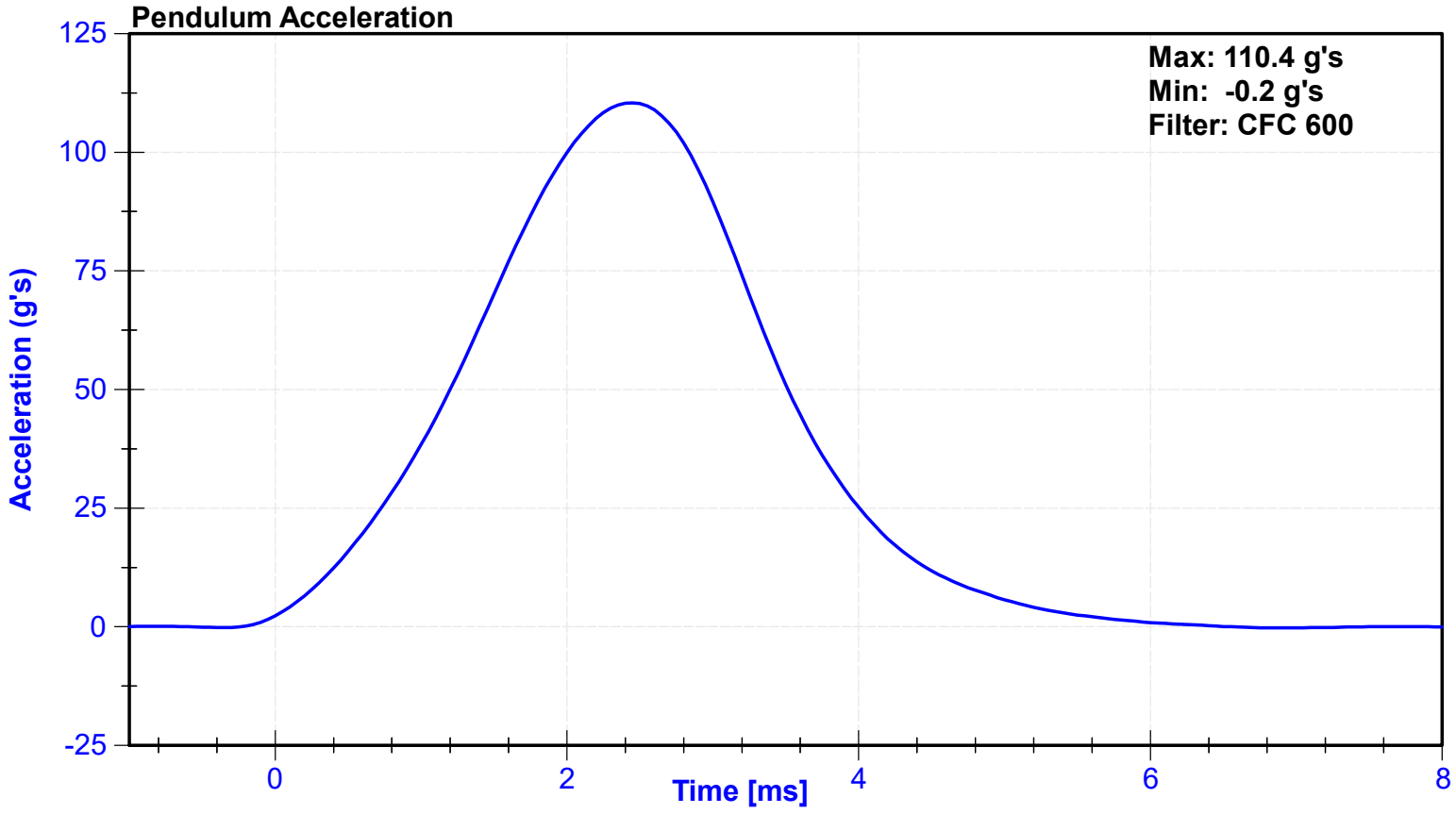
Results

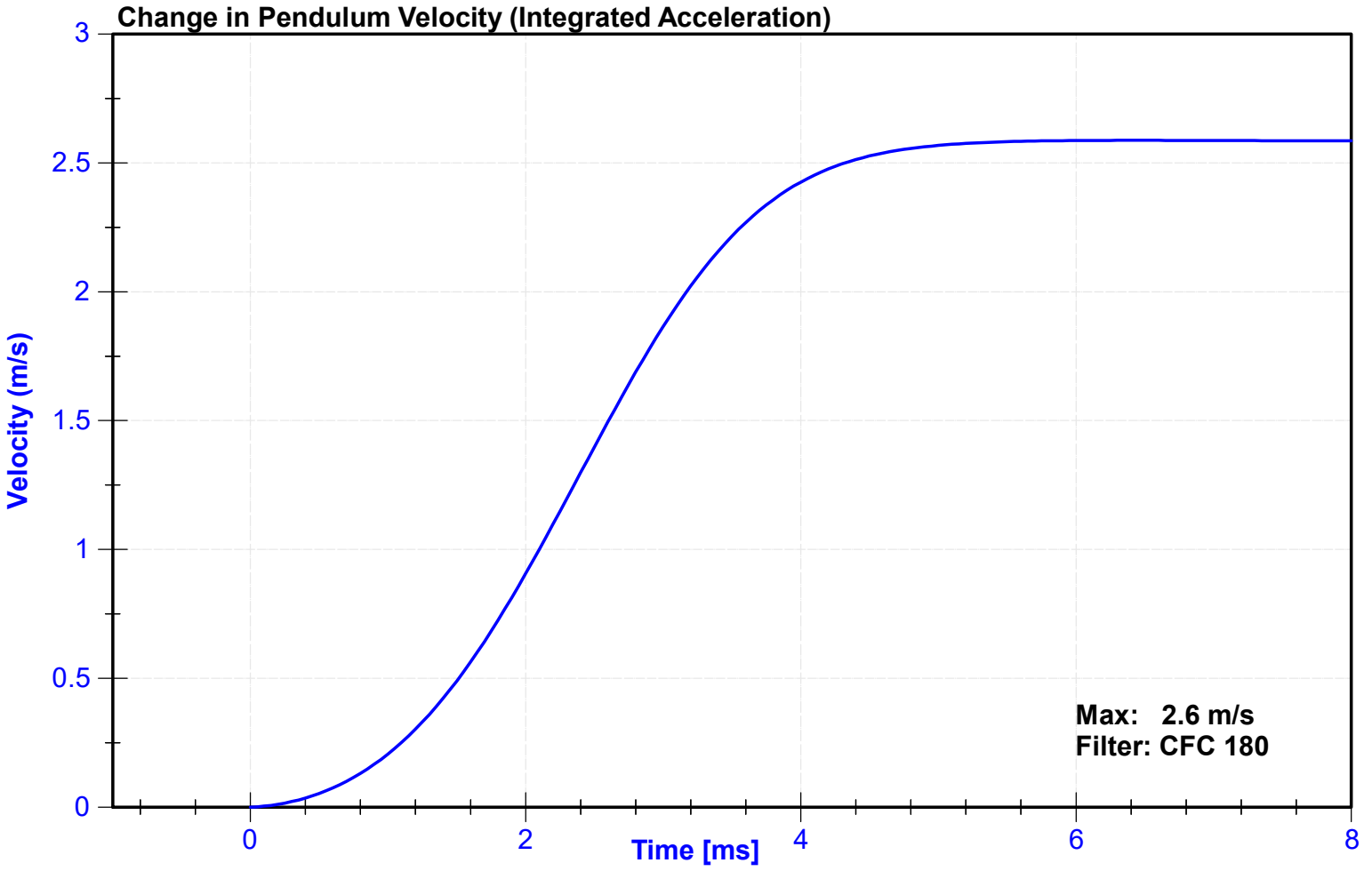
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.2	Pass
Humidity	10	70	%	47	Pass
Velocity	2.07	2.13	m/s	2.113	Pass
Maximum Resistive Force	4720	5780	N	5342.8	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18619	3/29/2024	9/25/2024




Pendulum Acceleration
Max: 110.4 g's
Min: -0.2 g's
Filter: CFC 600
Acceleration (g's)
125
100
75
50
25
0
-25
0
2
4
6
8
Time [ms]


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

CALIBRATION TEST RESULTS

PRE-TEST

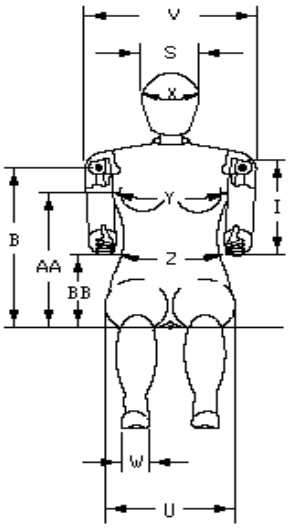
HYBRID III 5TH PERCENTILE - PASSENGER ATD

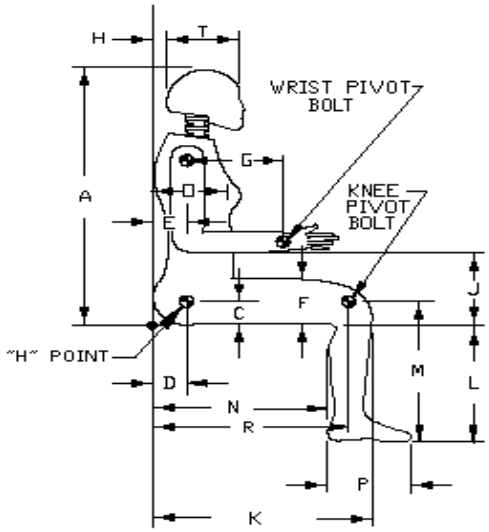
SERIAL NO: 137

External Measurements - Hybrid 3 - 5th Female

Technician: K. Brogan Date: 05/17/2024

Dummy Serial Number: 137





Symbol	Description	Specification (mm)		Result (mm)	Pass/Fail
A	Sitting Height	775	800	785	Pass
B	Shoulder Pivot Height	432	457	445	Pass
C	H-Point Height	81	86	84	Pass
D	H-Point from Backline	145	150	148	Pass
E	Shoulder Pivot from Backline	69	84	78	Pass
F	Thigh Clearance	119	135	129	Pass
G	Back of Elbow to Wrist Pivot	244	259	252	Pass
H	Head Back to Backline	43	48	45	Pass
I	Shoulder to Elbow Length	277	297	287	Pass
J	Elbow Rest Height	183	203	199	Pass
K	Buttock to Knee Length	521	546	535	Pass
L	Popliteal Height	356	376	369	Pass
M	Knee Pivot Height	394	419	409	Pass
N	Buttock Popliteal Length	414	439	429	Pass
O	Chest Depth without Jacket	175	191	185	Pass
P	Foot Length (right)	219	234	230	Pass
R	Buttock To Knee Pivot Length	457	483	466	Pass
S	Head Breadth	137	147	142	Pass
T	Head Depth	178	188	182	Pass
U	Hip Breadth	300	315	311	Pass
V	Shoulder Breadth	351	366	360	Pass
W	Foot Breadth	79	94	86	Pass
X	Head Circumference	528	549	538	Pass
Y	Chest Circumference with Jacket	851	881	872	Pass
Z	Waist Circumference	460	790	651	Pass
AA	Reference Location (Chest Circumference)	333	358	346	Pass
BB	Reference Location (Waist Circumference)	160	170	167	Pass

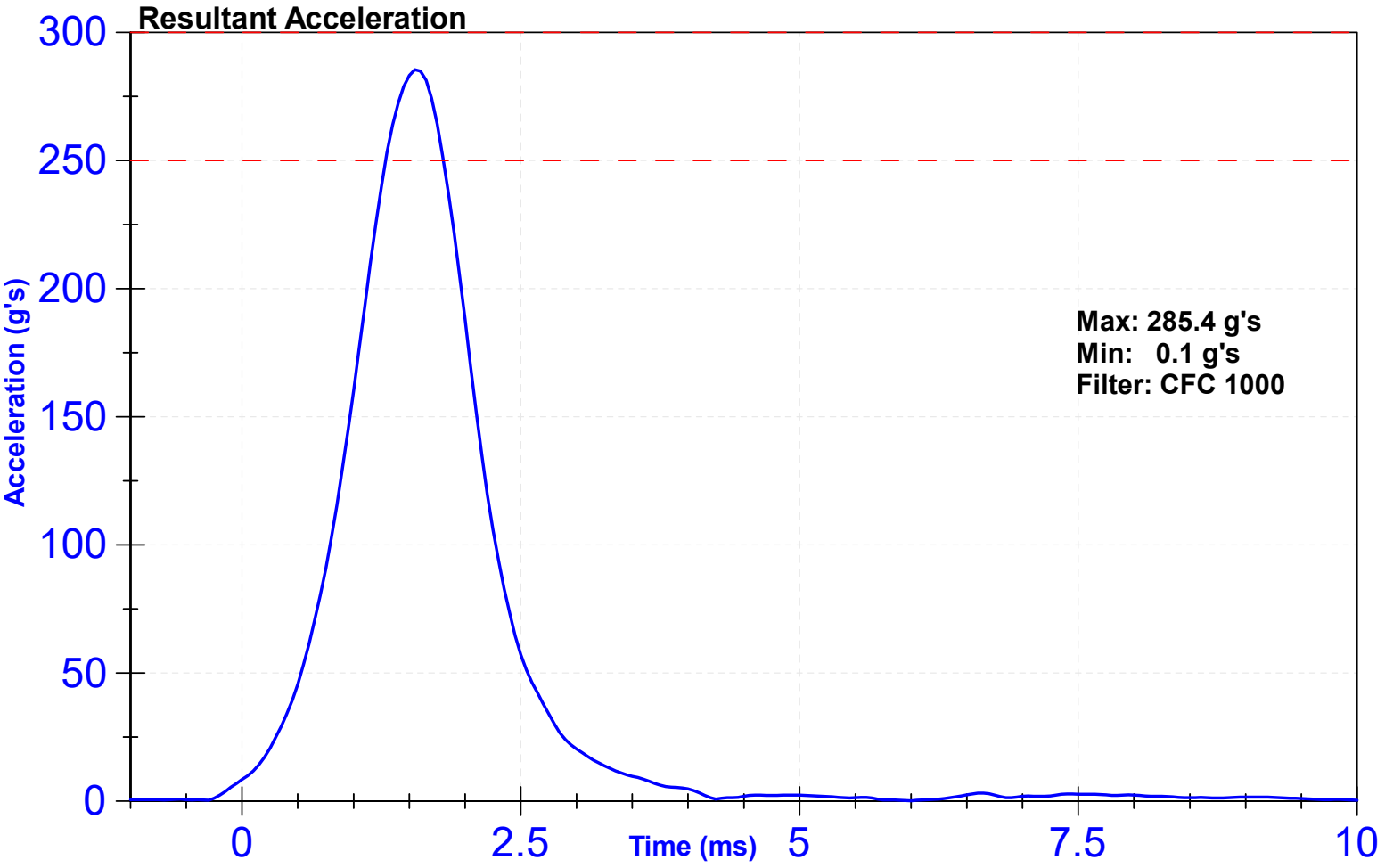
ATD Manufacturer	Humanetics	Test Technician	J. Rios
ATD Serial Number	137	Laboratory Supervisor	C. Mantell

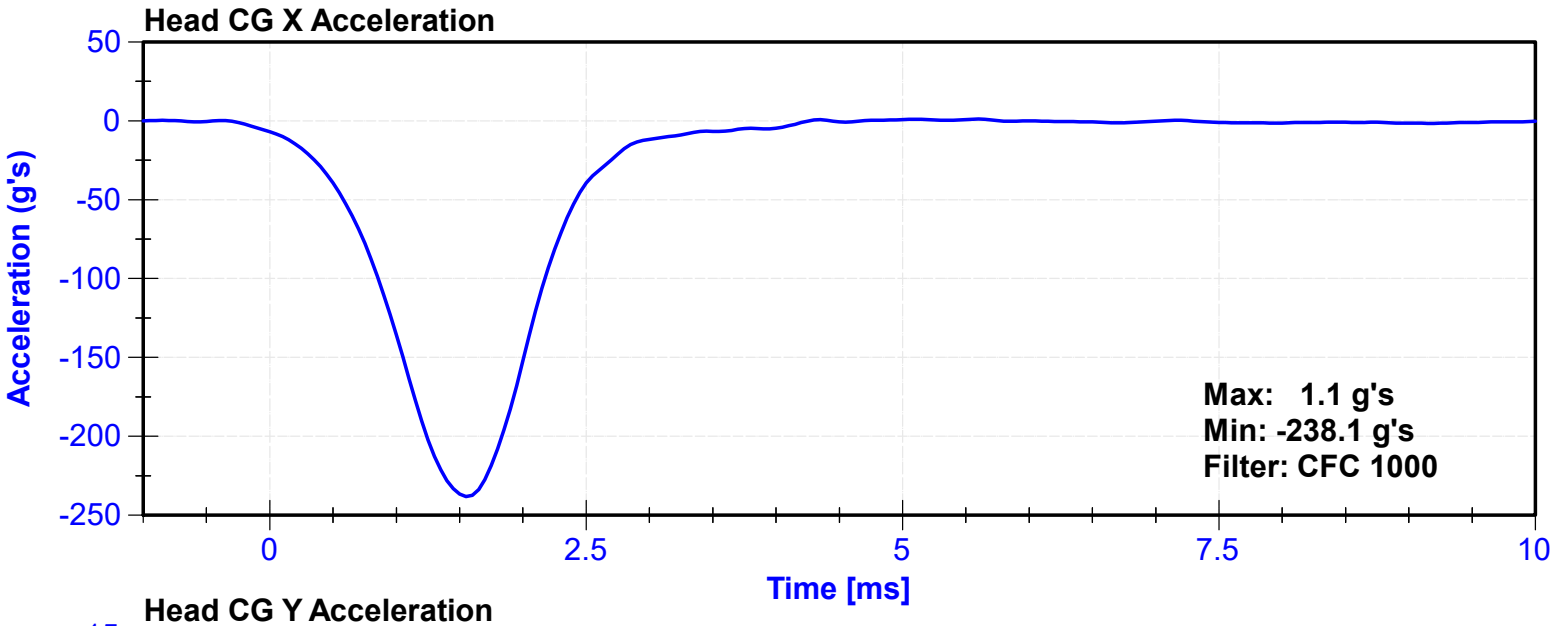
Results

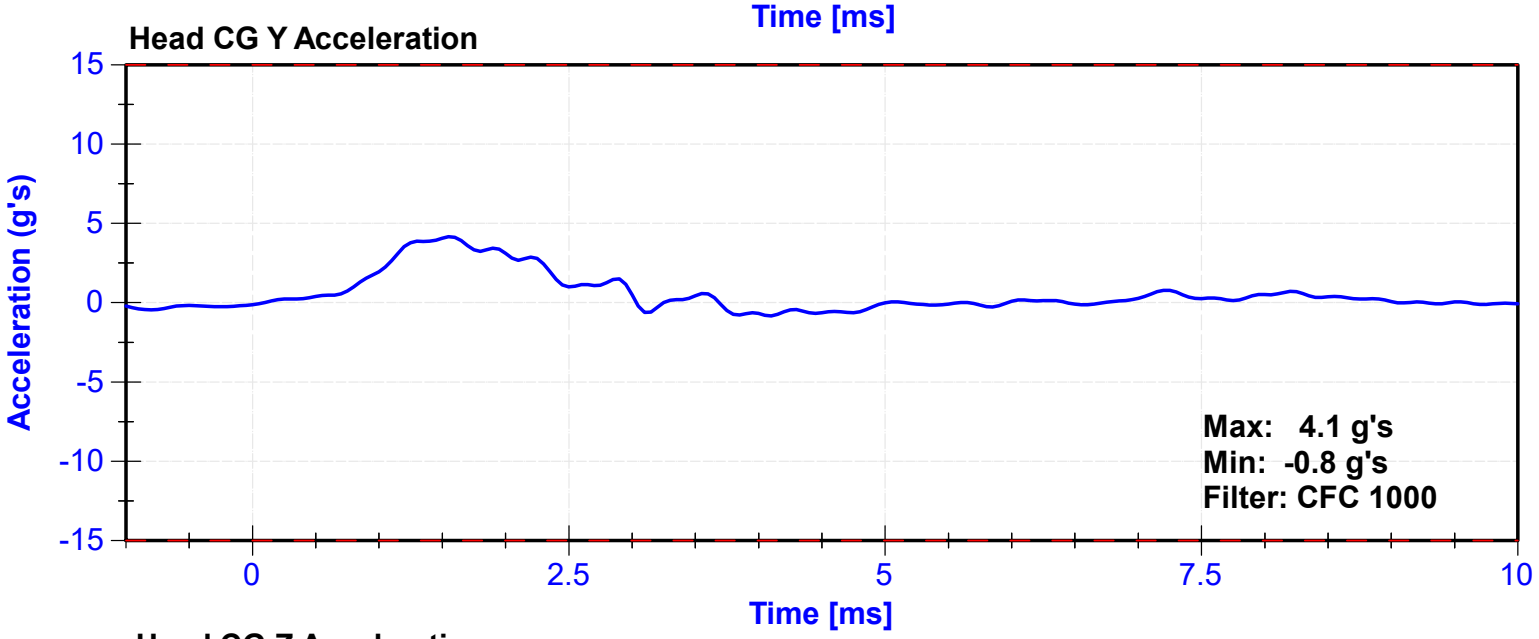
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	22.0	Pass
Humidity	10	70	%	45	Pass
Resultant Acceleration	250	300	g's	285.4	Pass
Oscillation	0	10	%	1.1	Pass
Lateral Acceleration	-15	15	g's	4.1	Pass

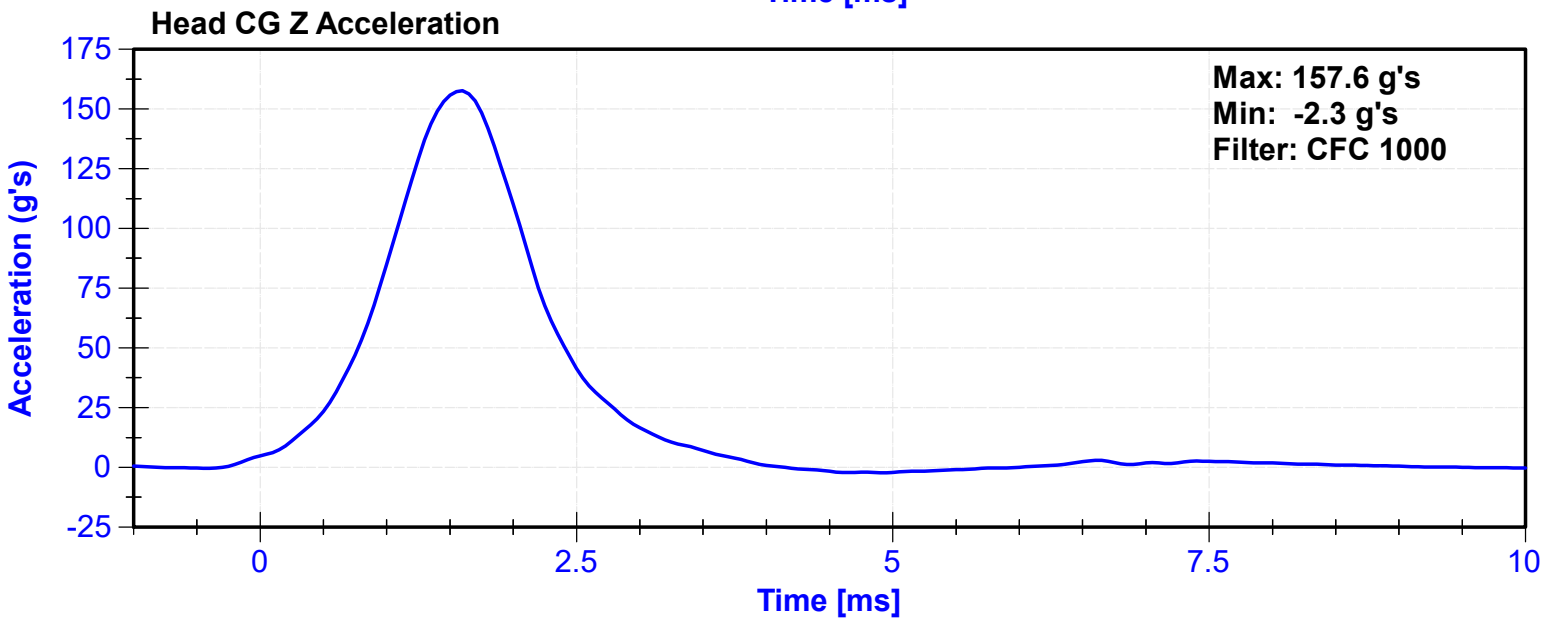
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	Endevco	P79417	1/4/2024	7/2/2024
Y Accelerometer	Endevco	P83335	1/4/2024	7/2/2024
Z Accelerometer	Endevco	P64149	1/4/2024	7/2/2024




Head CG X Acceleration
Acceleration (g's)
50
0
-50
-100
-150
-200
-250
0
2.5
5
7.5
10
Time [ms]
Max: 1.1 g's
Min: -238.1 g's
Filter: CFC 1000


Head CG Y Acceleration
Acceleration (g's)
15
10
5
0
-5
-10
-15
0
2.5
5
7.5
10
Time [ms]
Max: 4.1 g's
Min: -0.8 g's
Filter: CFC 1000


Head CG Z Acceleration
Acceleration (g's)
175
150
125
100
75
50
25
0
-25
0
2.5
5
7.5
10
Time [ms]
Max: 157.6 g's
Min: -2.3 g's
Filter: CFC 1000

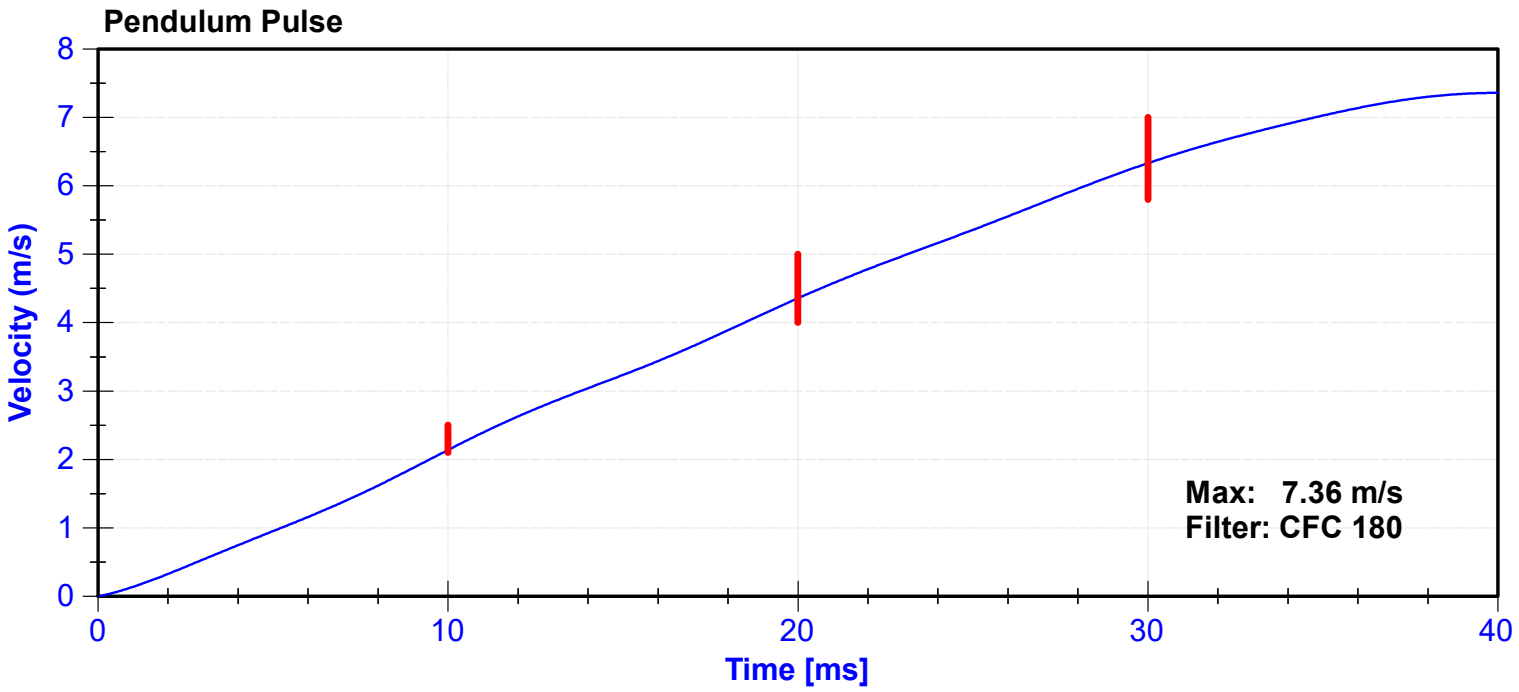
ATD Manufacturer	Humanetics	Test Technician	J. Rios
ATD Serial Number	137	Laboratory Supervisor	C. Mantell

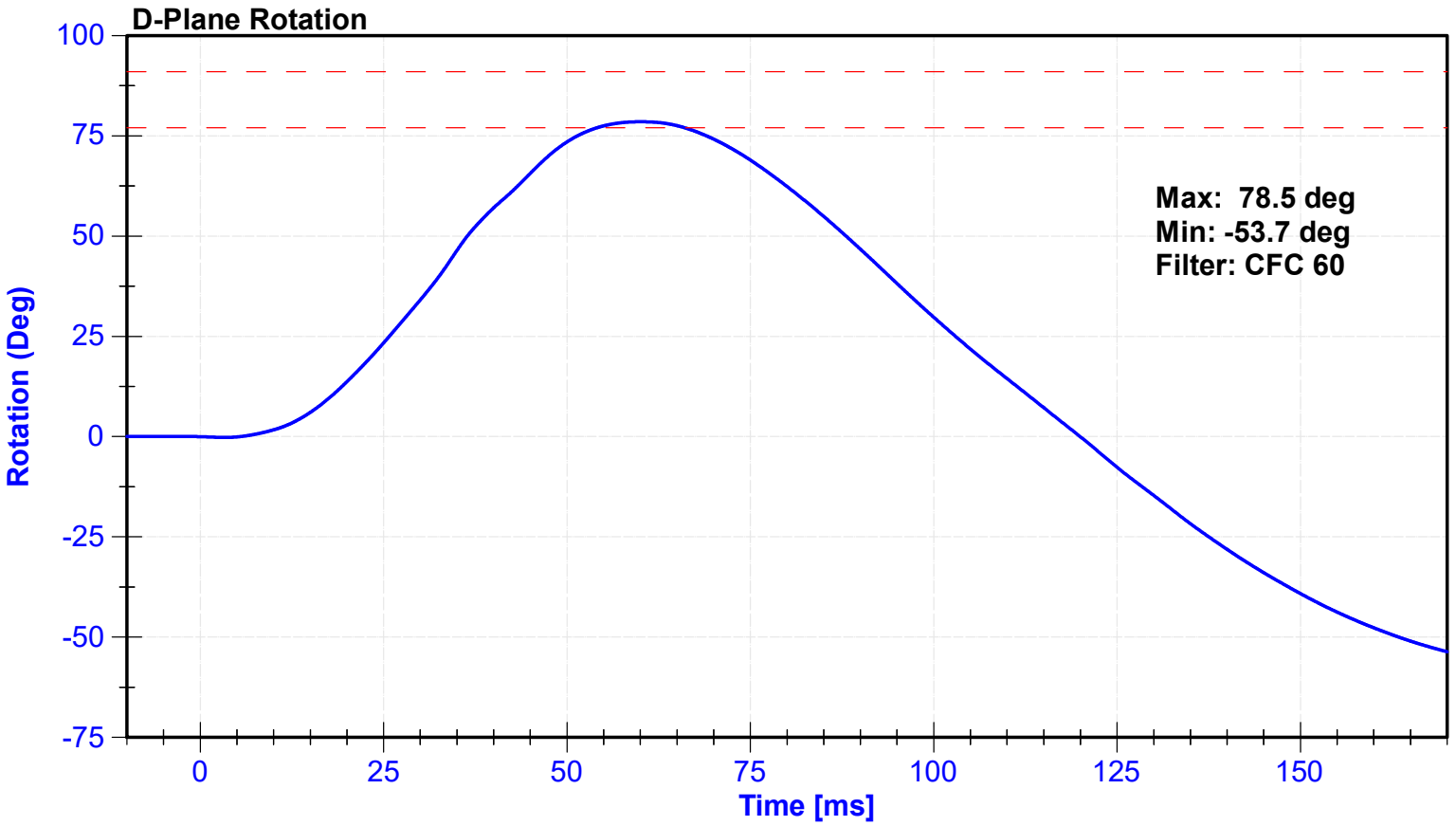
Results

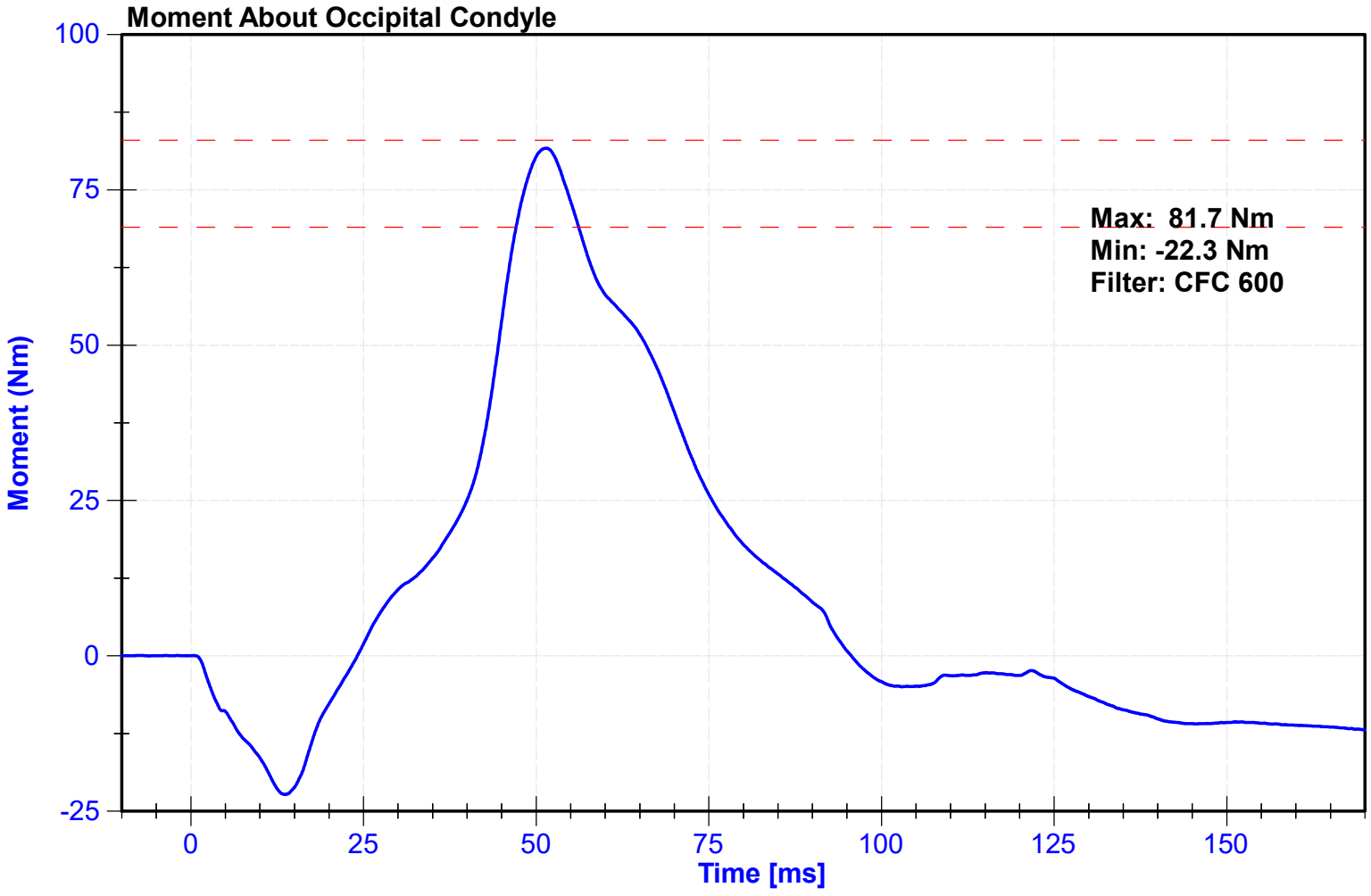
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.9	Pass
Humidity	10	70	%	43	Pass
Velocity	6.89	7.13	m/s	7.026	Pass
Pendulum Impulse at 10ms	2.1	2.5	m/s	2.14	Pass
Pendulum Impulse at 20ms	4.0	5.0	m/s	4.36	Pass
Pendulum Impulse at 30ms	5.8	7.0	m/s	6.33	Pass
Max D Plane Rotation	77	91	deg	78.5	Pass
Max Moment During Rotation Interval	69	83	Nm	81.7	Pass
Moment Decay to 10.0 Nm	80	100	ms	88.6	Pass

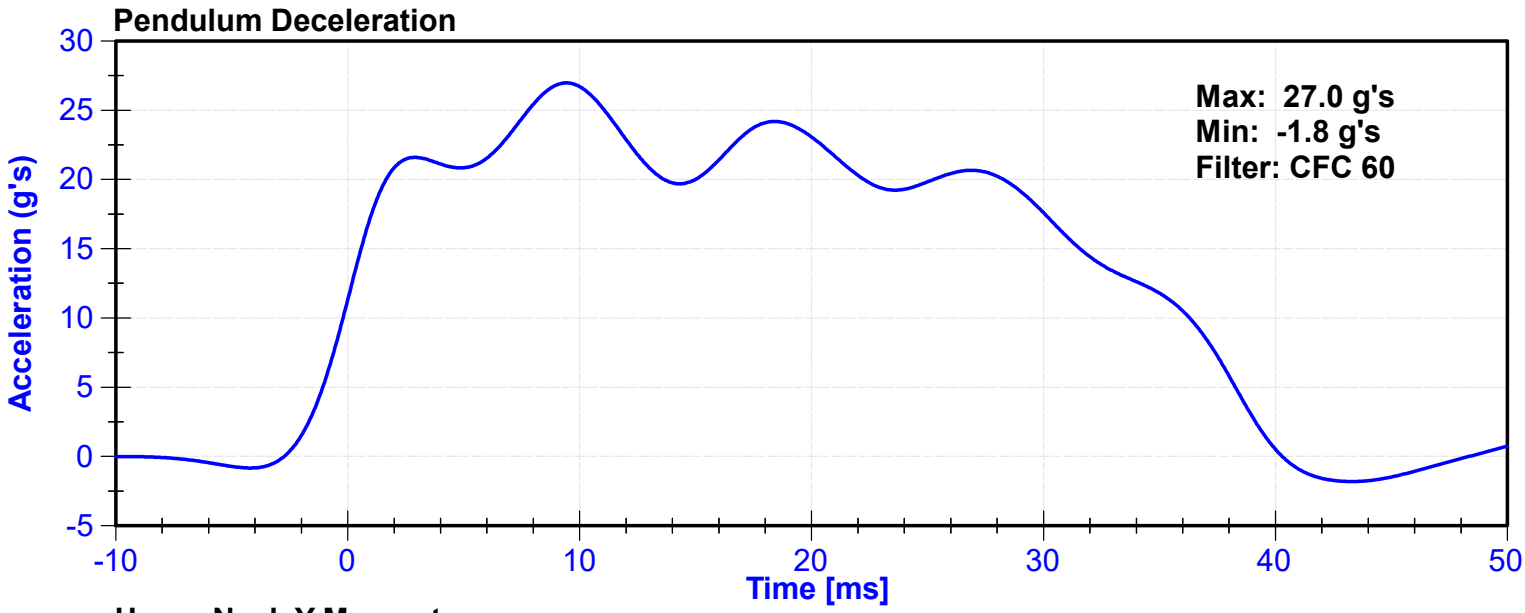
Transducer Calibrations

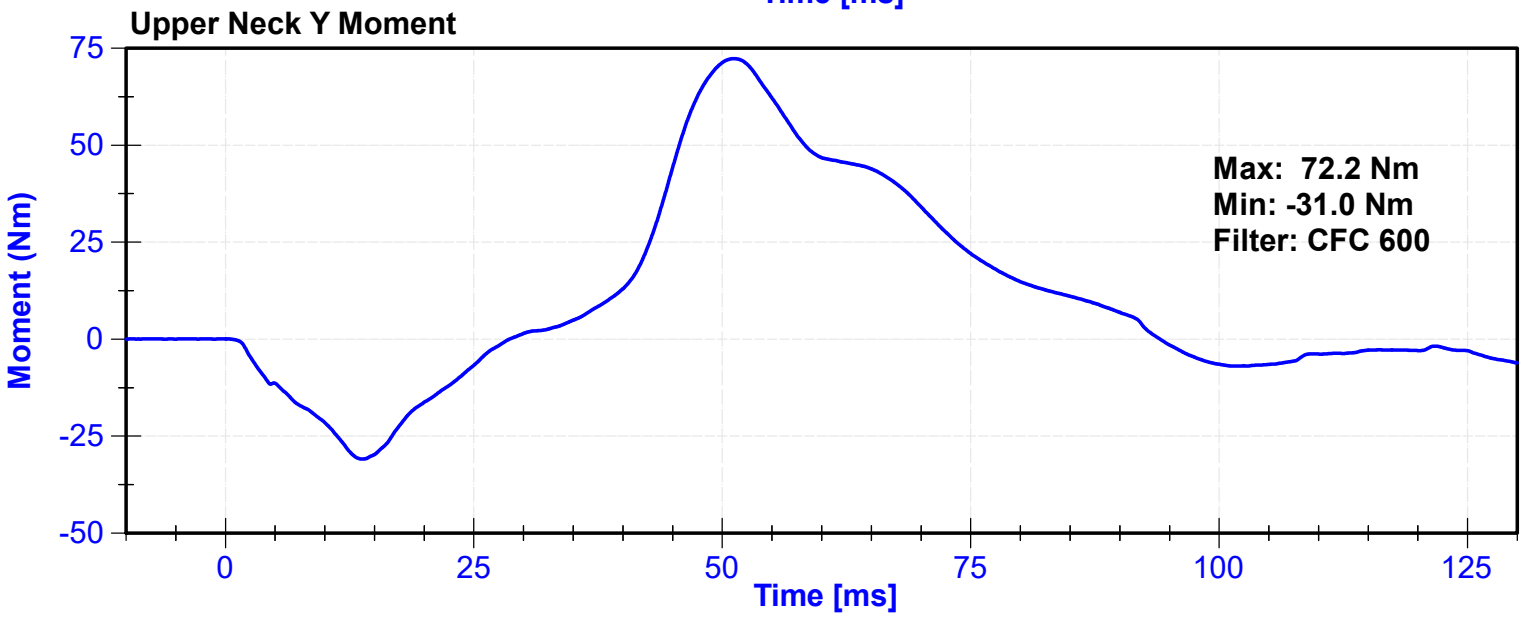
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	7231C-750	10/31/2023	10/30/2024
Pendulum Potentiometer	ETI	SP22G_LABPOT1	5/7/2024	5/7/2025
Condyle Potentiometer	ETI	SP22G_LABPOT2	5/7/2024	5/7/2025
Upper Neck Load Cell	Humanetics	2019-FX	9/12/2023	9/11/2024

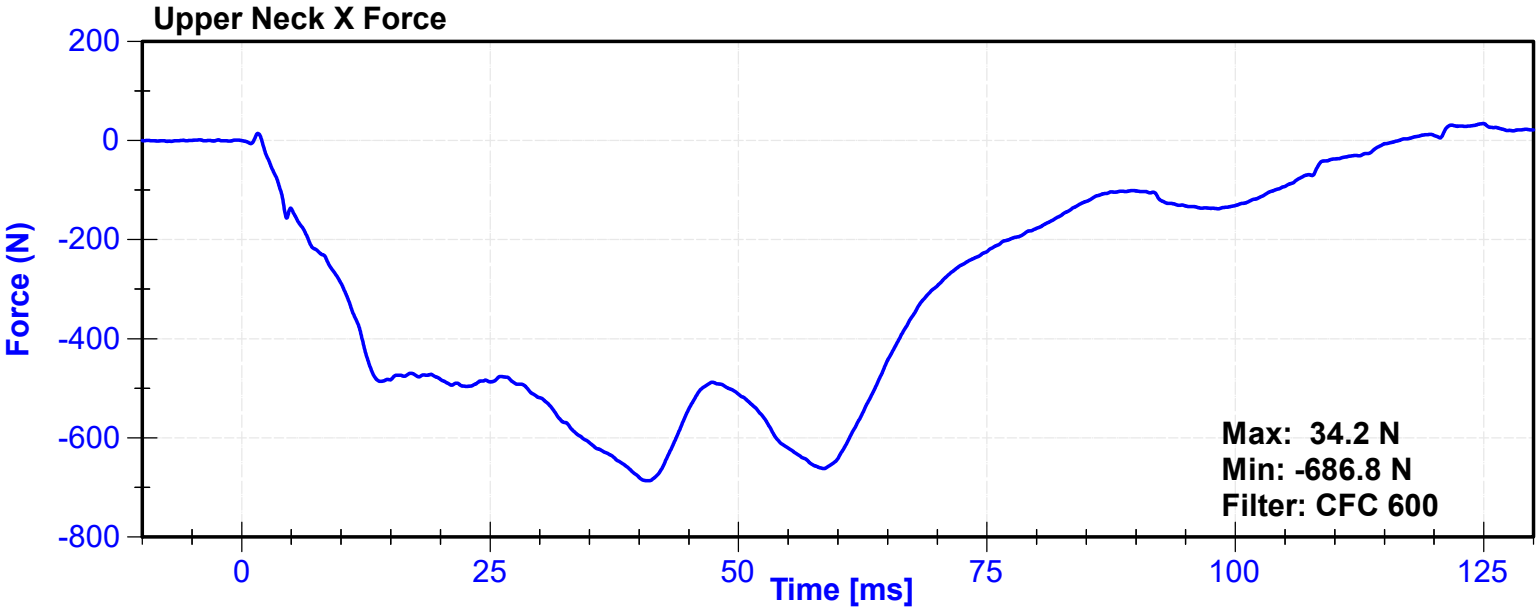



D-Plane Rotation
Max: 78.5 deg
Min: -53.7 deg
Filter: CFC 60
Rotation (Deg)
100
75
50
25
0
-25
-50
-75
0
25
50
75
100
125
150
Time [ms]


Moment About Occipital Condyle
Max: 81.7 Nm
Min: -22.3 Nm
Filter: CFC 600
Moment (Nm)
100
75
50
25
0
-25
0
25
50
75
100
125
150
Time [ms]


Pendulum Deceleration
Acceleration (g's)
Time [ms]
Max: 27.0 g's
Min: -1.8 g's
Filter: CFC 60


Upper Neck Y Moment
Moment (Nm)
Time [ms]
Max: 72.2 Nm
Min: -31.0 Nm
Filter: CFC 600


Upper Neck X Force
Force (N)
Time [ms]
Max: 34.2 N
Min: -686.8 N
Filter: CFC 600

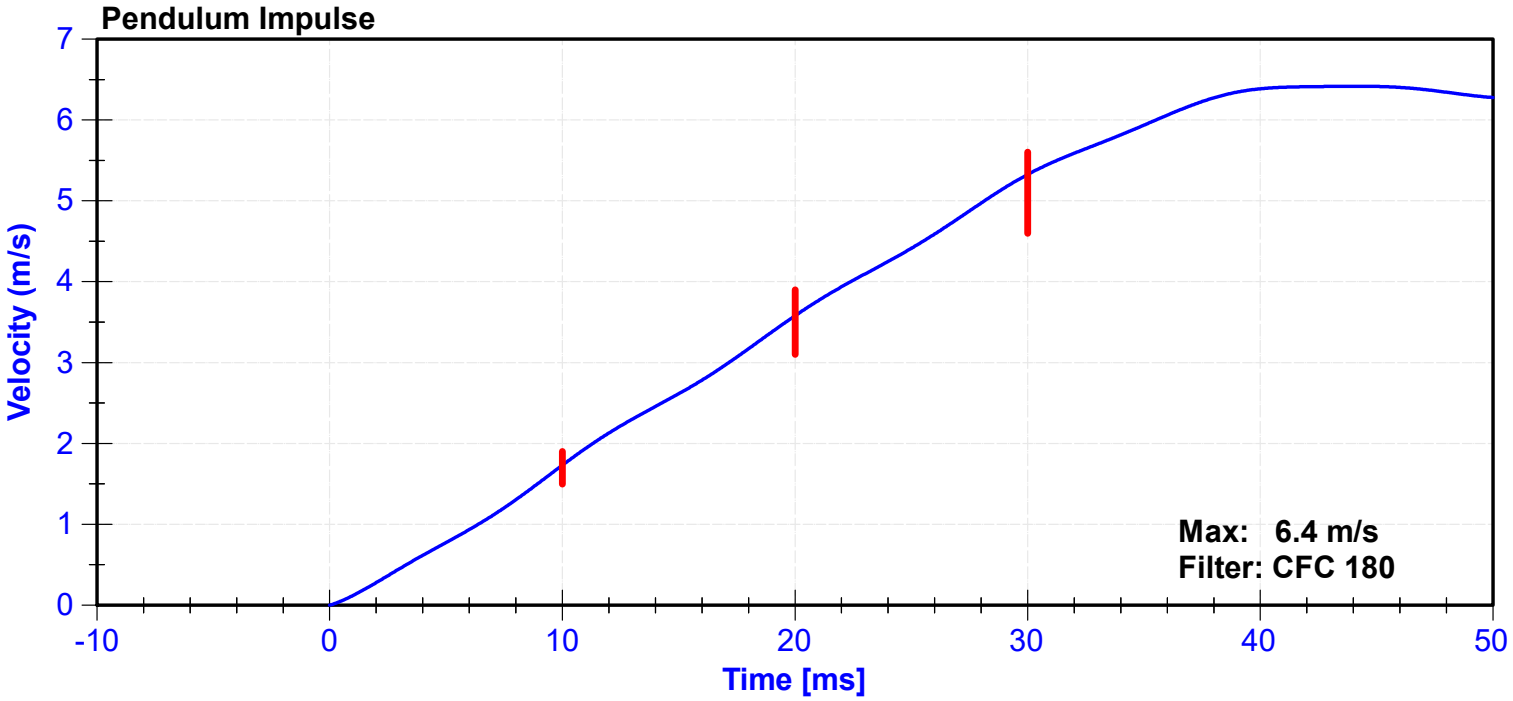
ATD Manufacturer	Humanetics	Test Technician	J. Rios
ATD Serial Number	137	Laboratory Supervisor	C. Mantell

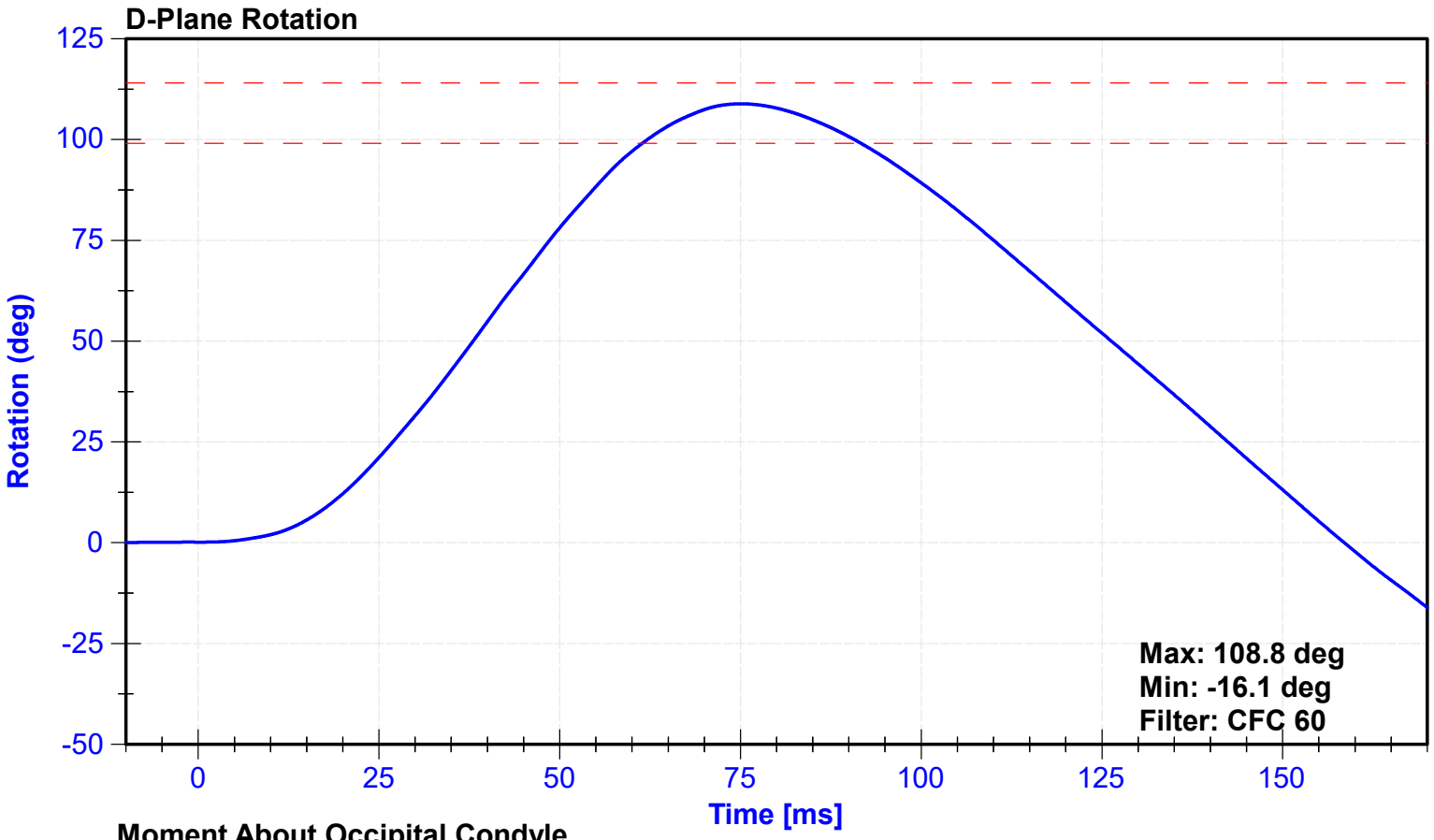
Results

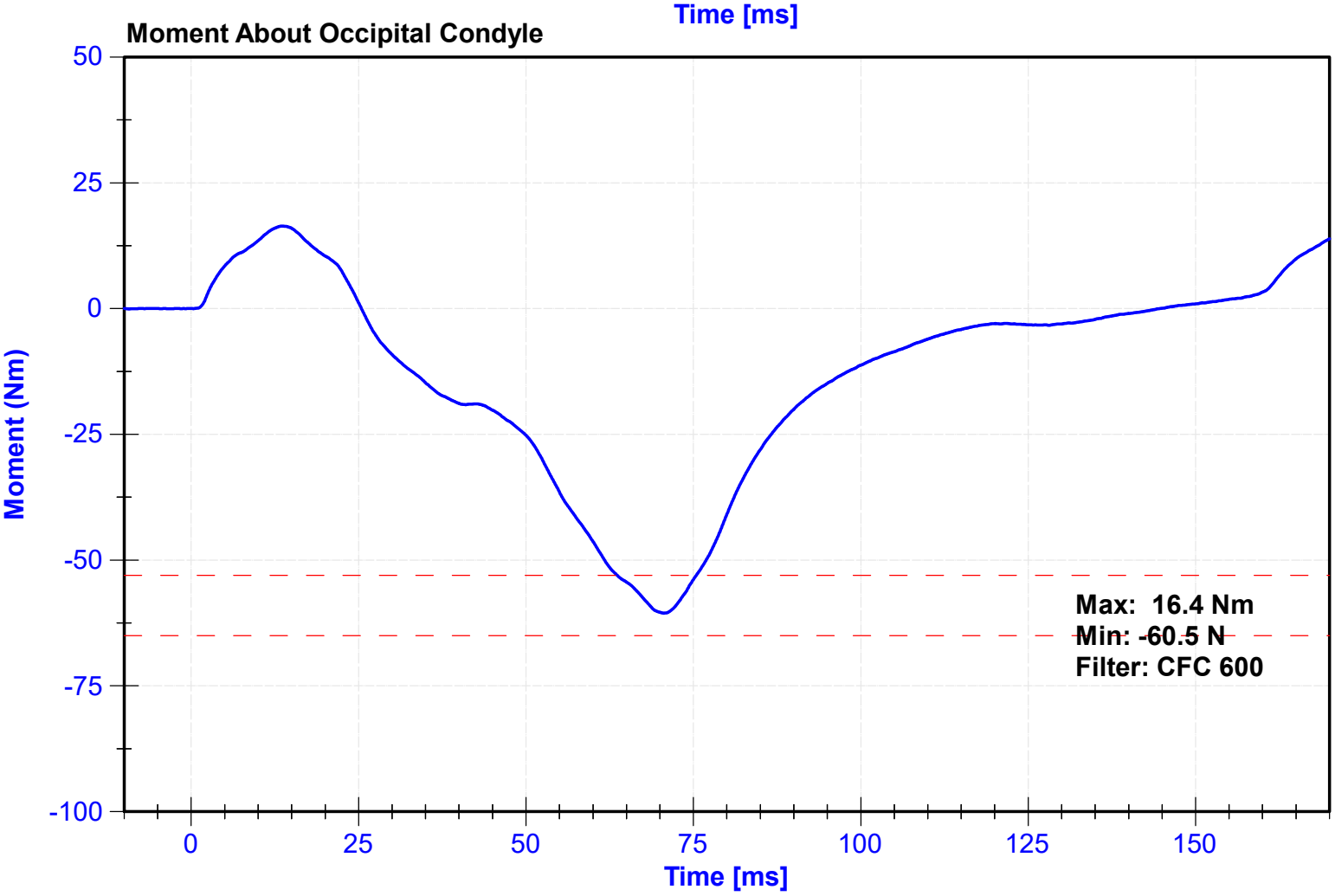
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.9	Pass
Humidity	10	70	%	43	Pass
Velocity	5.95	6.19	m/s	6.141	Pass
Pendulum Impulse at 10ms	1.5	1.9	m/s	1.73	Pass
Pendulum Impulse at 20ms	3.1	3.9	m/s	3.58	Pass
Pendulum Impulse at 30ms	4.6	5.6	m/s	5.33	Pass
D Plane Rotation	99	114	deg	108.8	Pass
Moment During Rotation Interval	-65	-53	Nm	-60.5	Pass
Moment Decay to -10Nm	94	114	ms	102.1	Pass

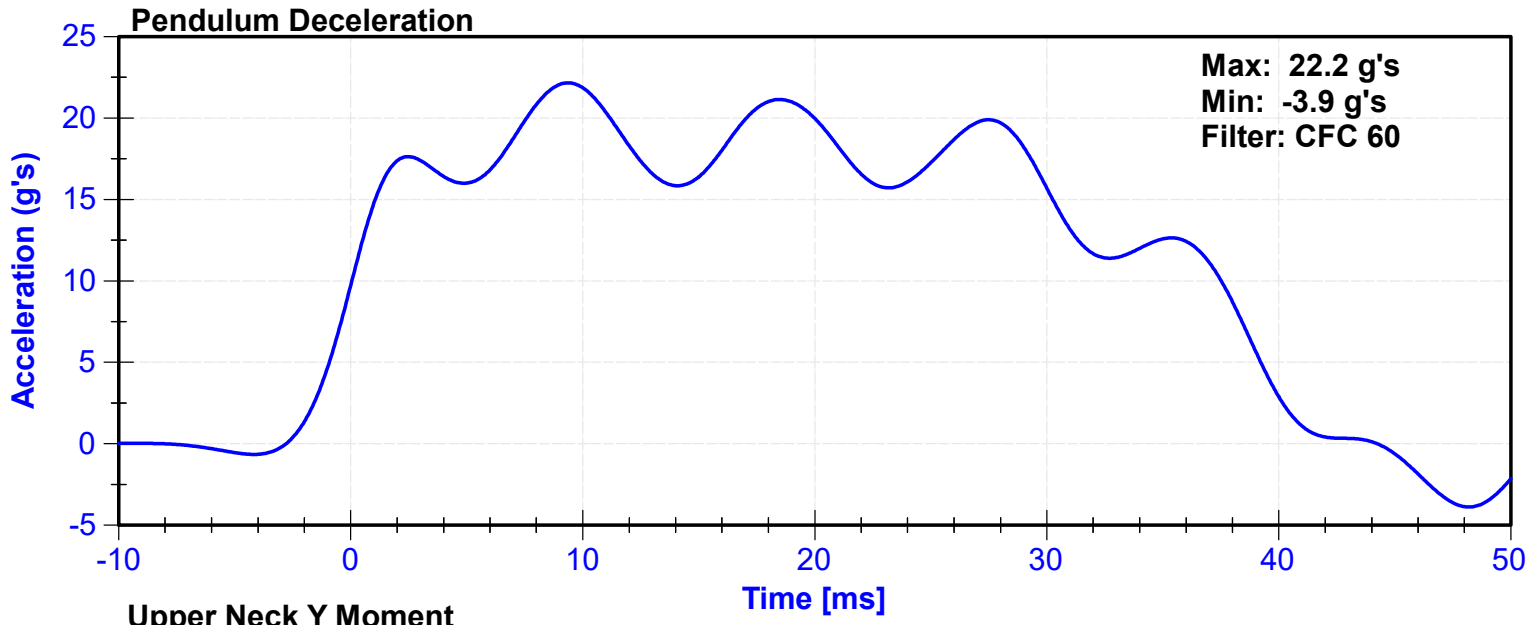
Transducer Calibrations

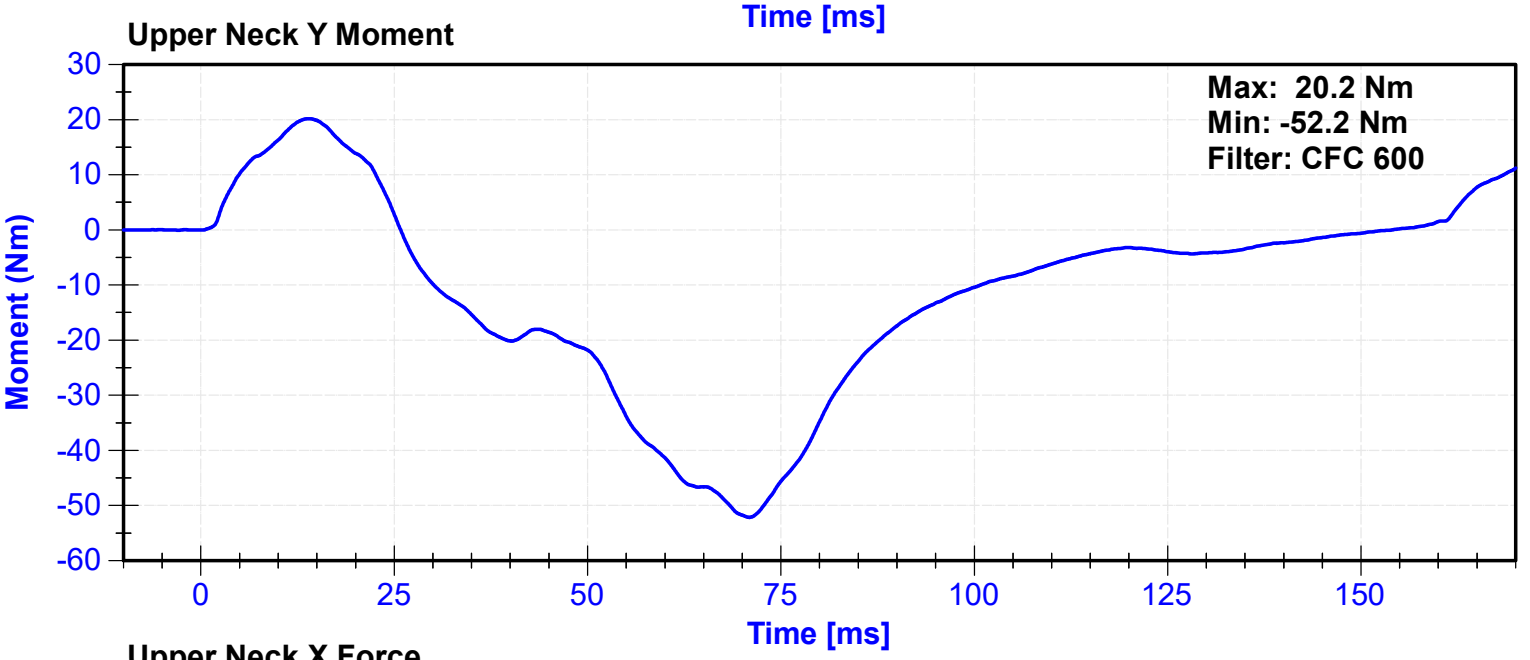
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	C16650	10/31/2023	10/30/2024
Pendulum Potentiometer	ETI	SP22G_LABPOT1	5/7/2024	5/7/2025
Condyle Potentiometer	ETI	SP22G_LABPOT2	5/7/2024	5/7/2025
Upper Neck Load Cell	Humanetics	2019-FX	9/12/2023	9/11/2024

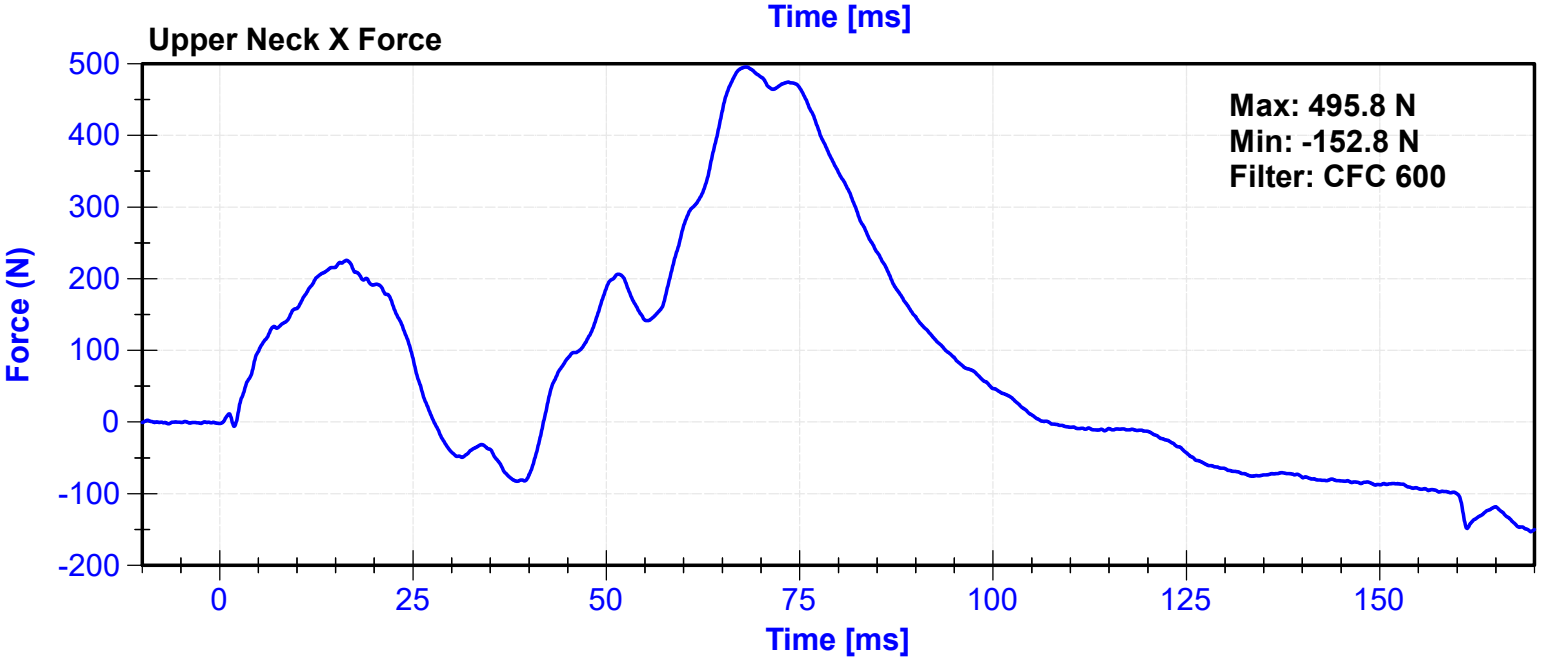



D-Plane Rotation
Rotation (deg)
125
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]
Max: 108.8 deg
Min: -16.1 deg
Filter: CFC 60


Moment About Occipital Condyle
Moment (Nm)
50
25
0
-25
-50
-75
-100
0
25
50
75
100
125
150
Time [ms]
Max: 16.4 Nm
Min: -60.5 N
Filter: CFC 600


Pendulum Deceleration
Max: 22.2 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: 20.2 Nm
Min: -52.2 Nm
Filter: CFC 600
Moment (Nm)
30
20
10
0
-10
-20
-30
-40
-50
-60
0
25
50
75
100
125
150
Time [ms]


Upper Neck X Force
Max: 495.8 N
Min: -152.8 N
Filter: CFC 600
Force (N)
500
400
300
200
100
0
-100
-200
0
25
50
75
100
125
150
Time [ms]

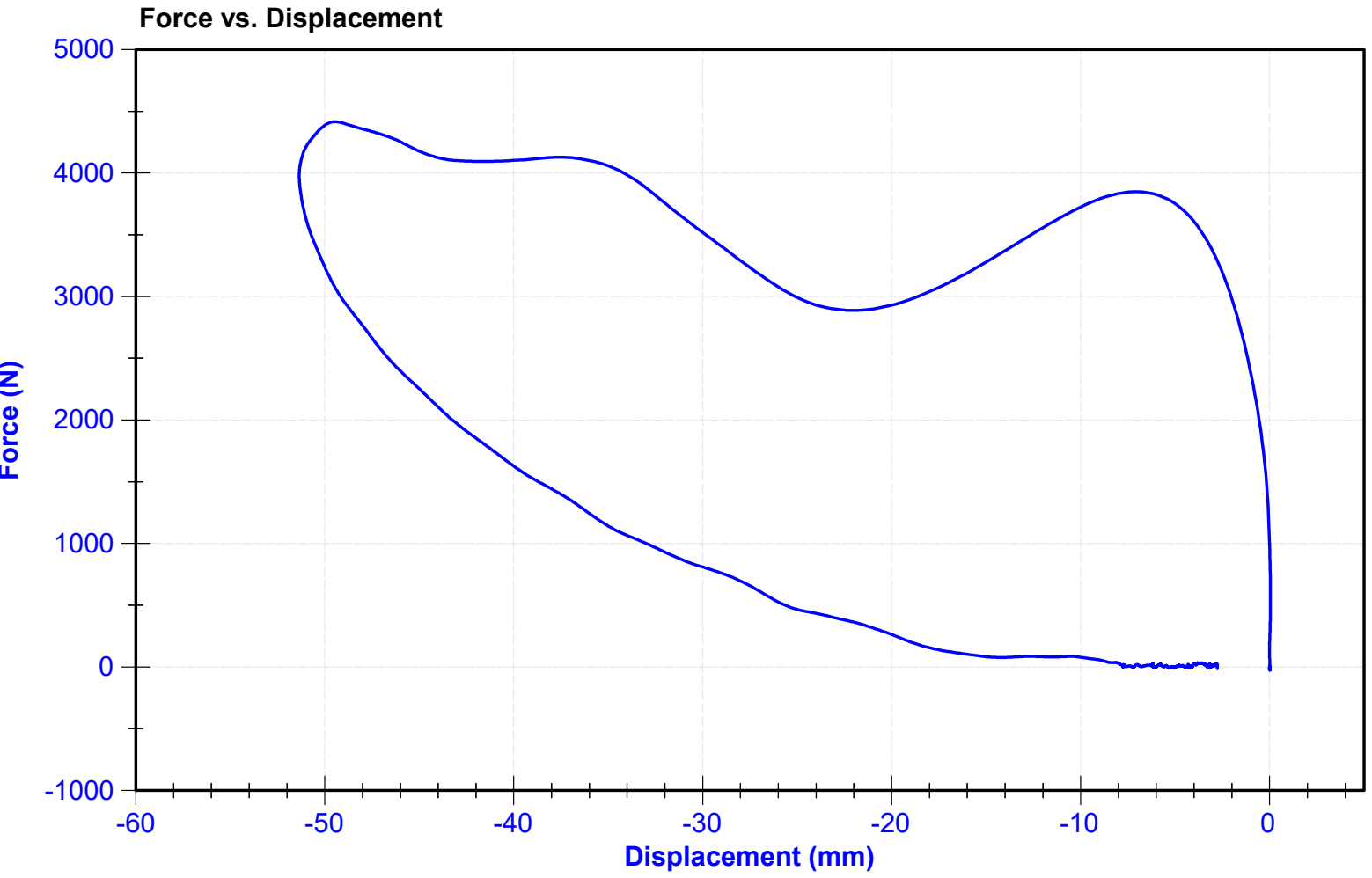
ATD Manufacturer	Humanetics	Test Technician	J. Rios
ATD Serial Number	137	Laboratory Supervisor	C. Mantel

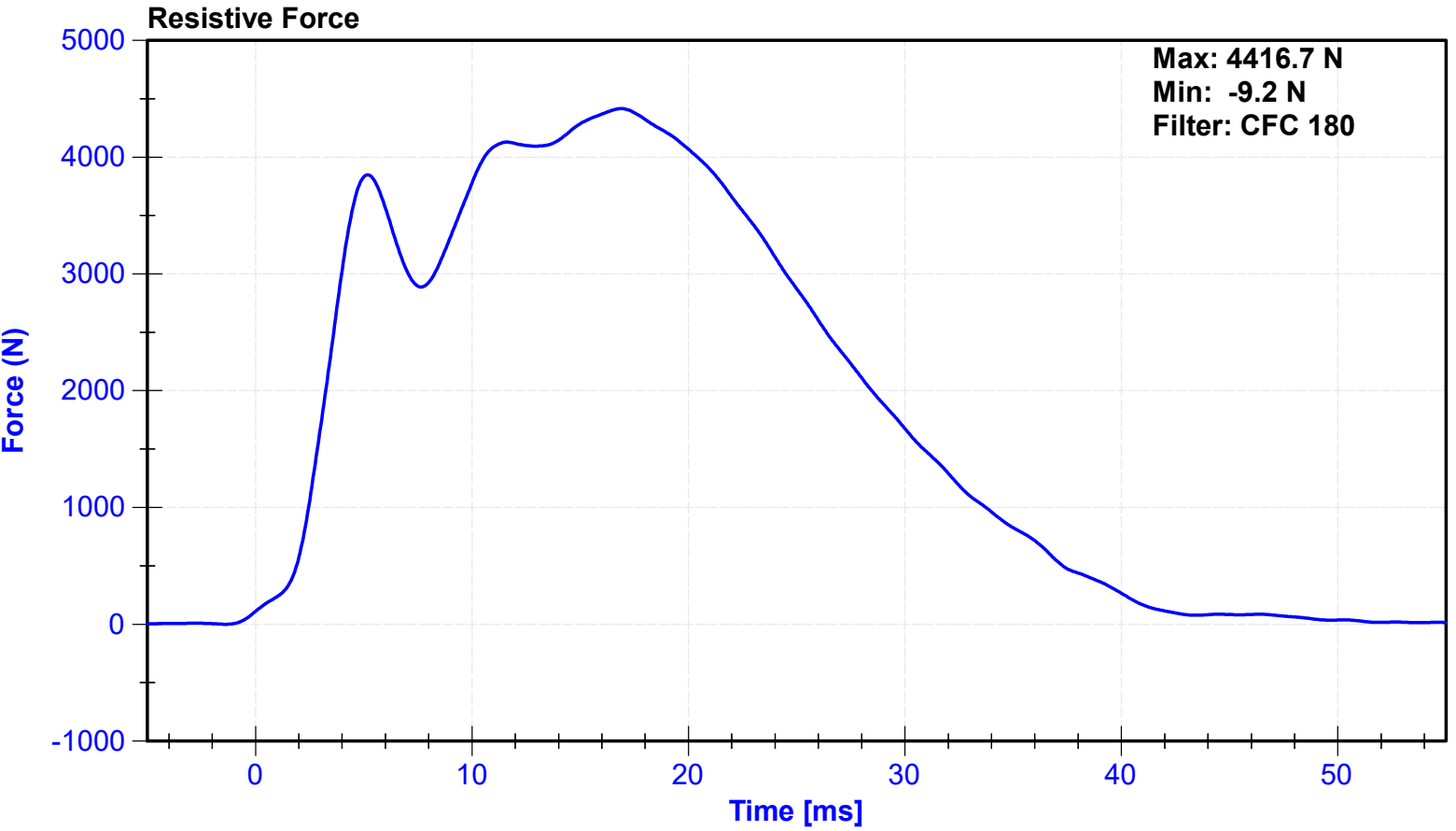
Results

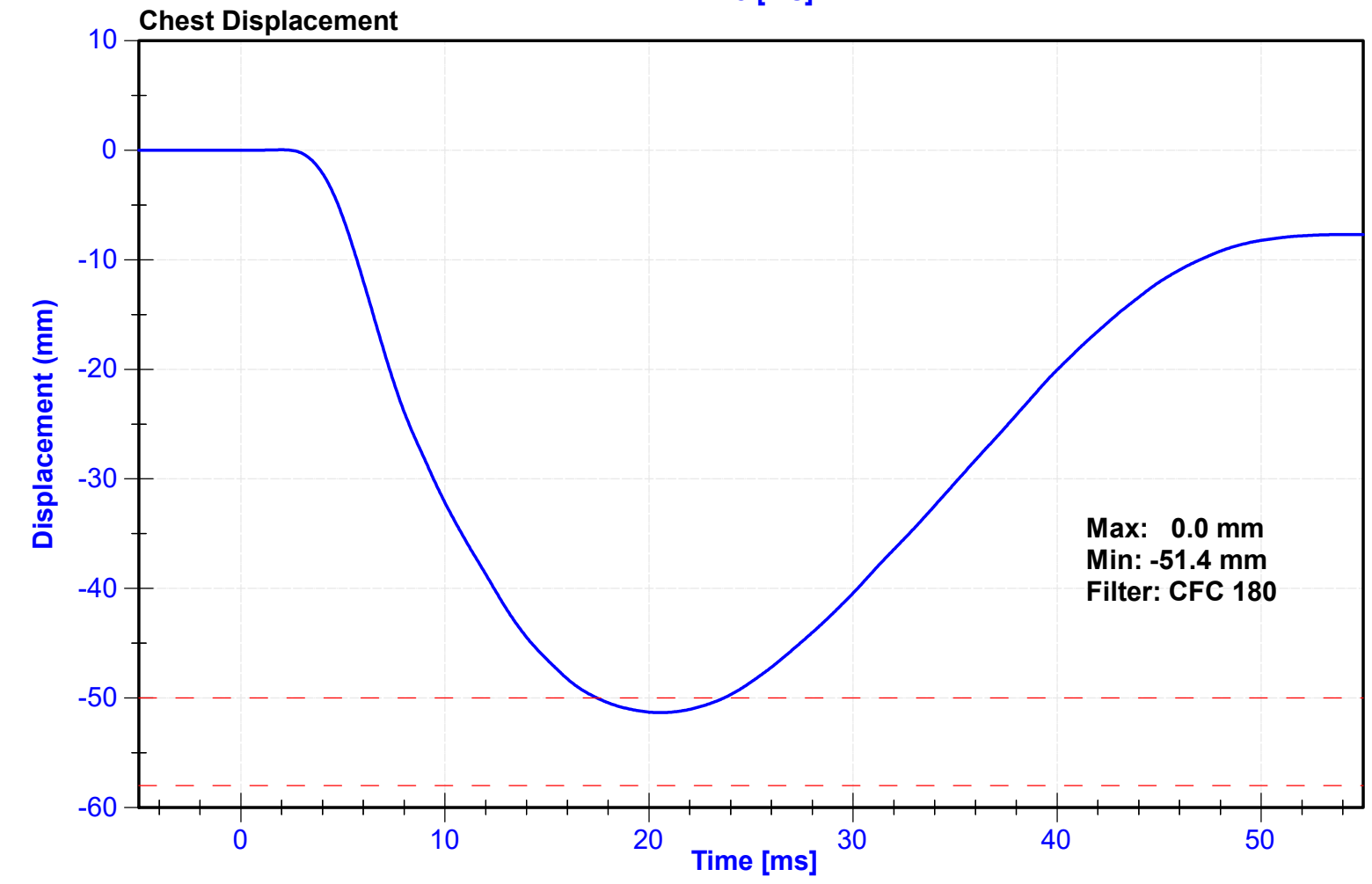
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.9	Pass
Humidity	10	70	%	47	Pass
Velocity	6.59	6.83	m/s	6.697	Pass
Chest Deflection	-58	-50	mm	-51.4	Pass
Maximum Resistive Force (50 to 58mm)	3900	4400	N	4391.1	Pass
Maximum Resistive Force (18 to 50mm)	0	4600	N	4416.7	Pass
Hysteresis	69	85	%	75.2	Pass

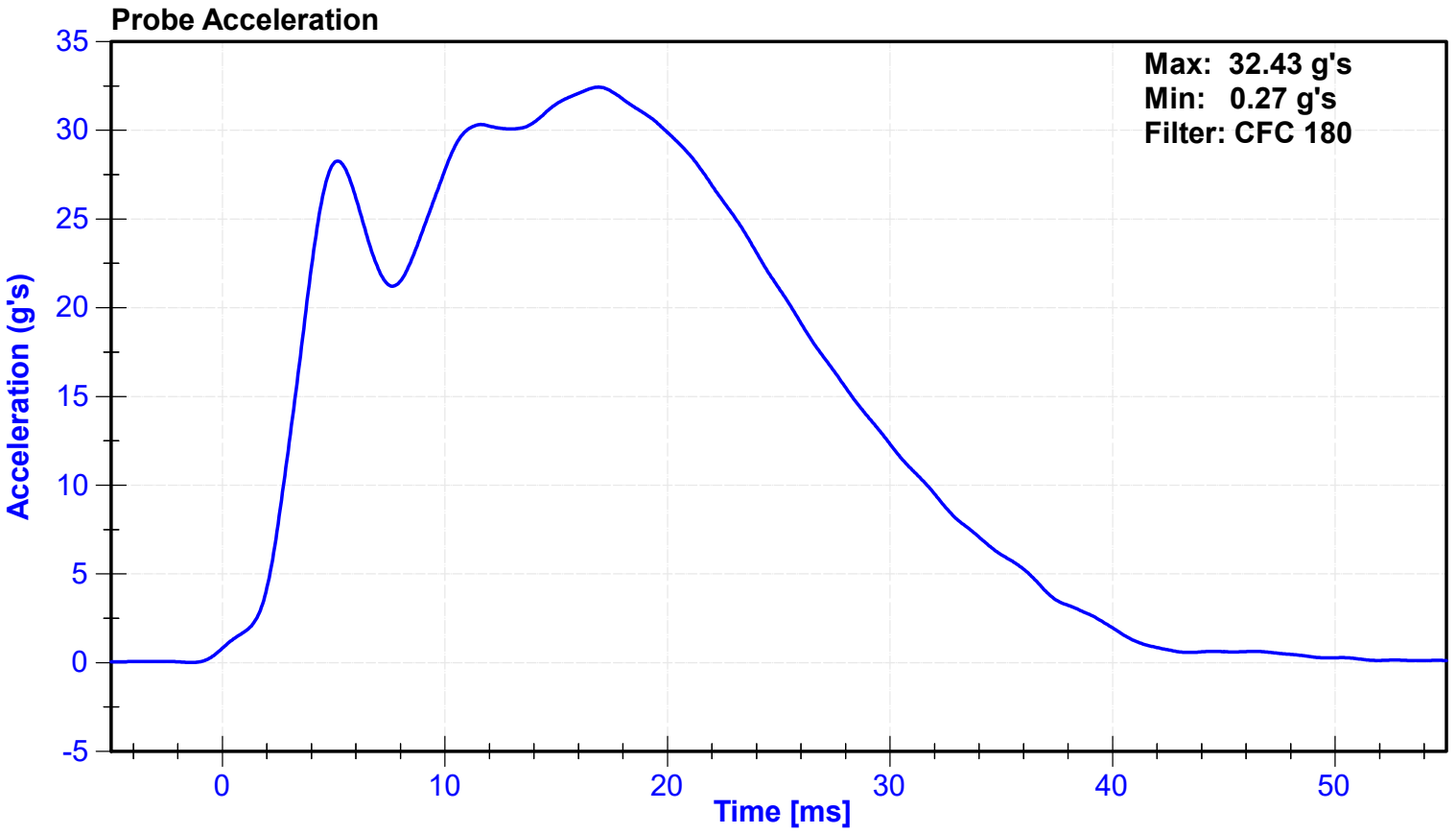
Transducer Calibrations

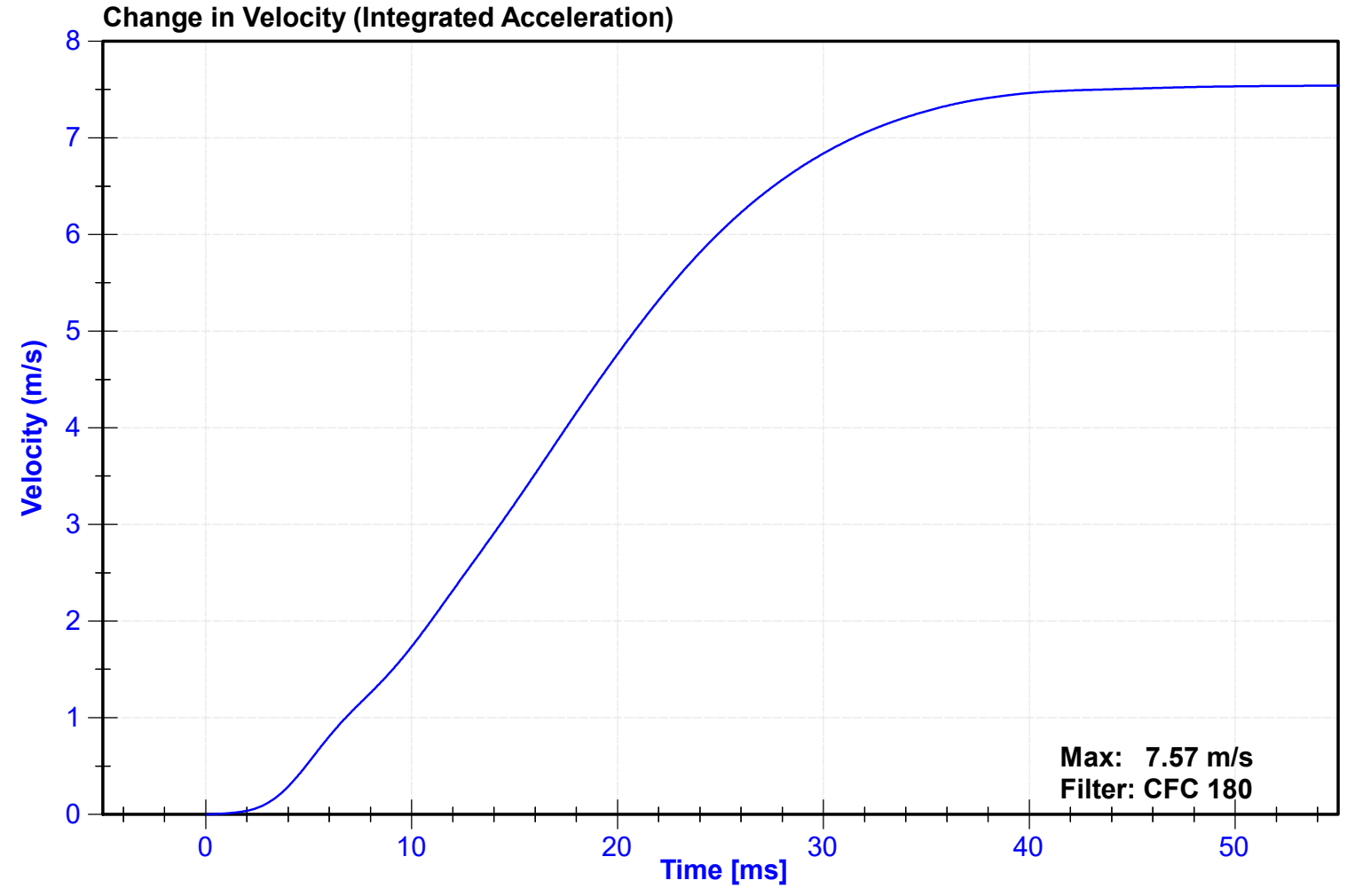
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18587	11/20/2023	11/19/2024
Chest Potentiometer	Servo	0720	1/5/2024	7/5/2024




Resistive Force
Max: 4416.7 N
Min: -9.2 N
Filter: CFC 180
Force (N)
5000
4000
3000
2000
1000
0
-1000
0
10
20
30
40
50
Time [ms]


Chest Displacement
Max: 0.0 mm
Min: -51.4 mm
Filter: CFC 180
Displacement (mm)
10
0
-10
-20
-30
-40
-50
-60
0
10
20
30
40
50
Time [ms]


Probe Acceleration
Max: 32.43 g's
Min: 0.27 g's
Filter: CFC 180
Acceleration (g's)
35
30
25
20
15
10
5
0
-5
0
10
20
30
40
50
Time [ms]


Change in Velocity (Integrated Acceleration)
Max: 7.57 m/s
Filter: CFC 180
Velocity (m/s)
8
7
6
5
4
3
2
1
0
0
10
20
30
40
50
Time [ms]

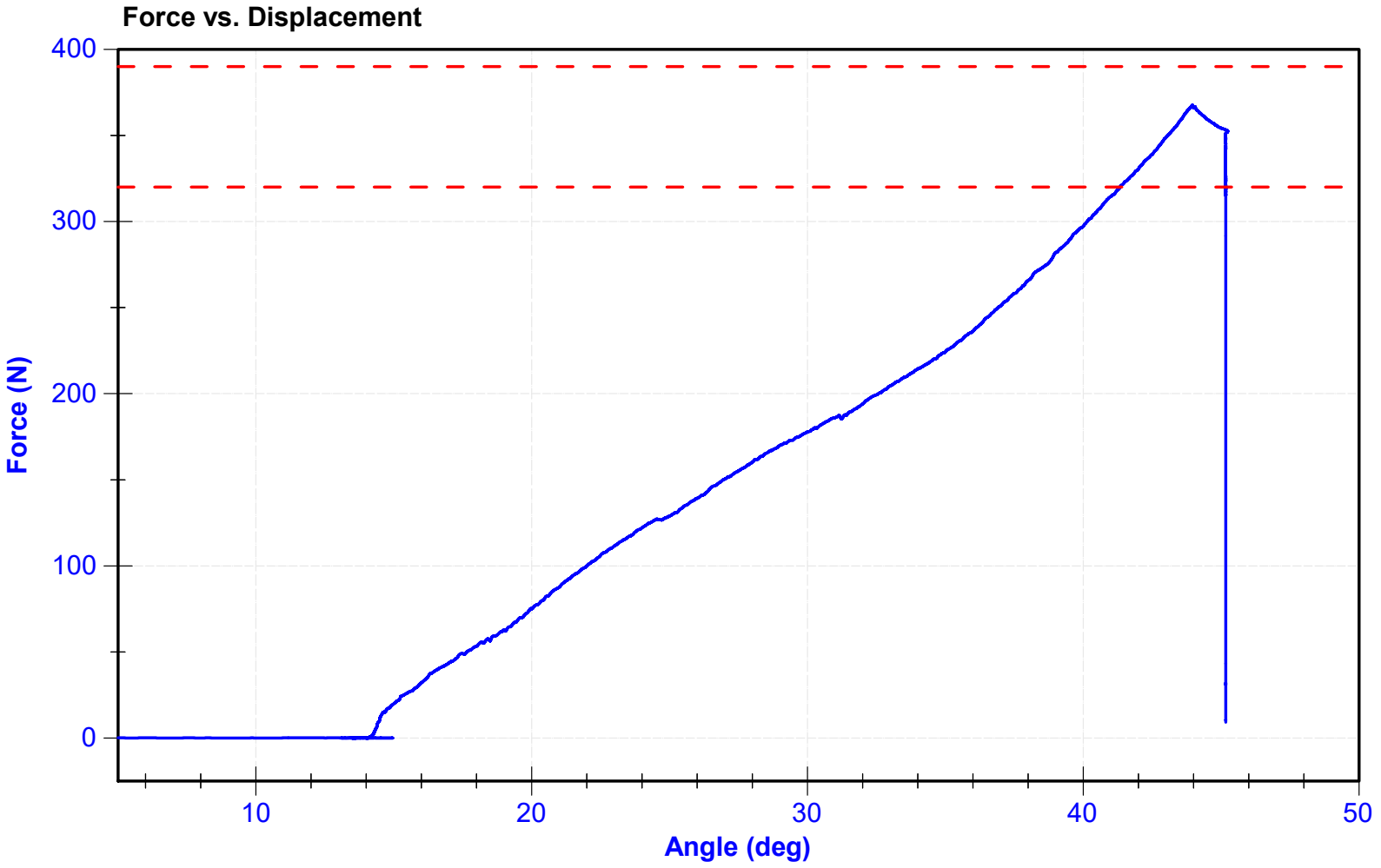
ATD Manufacturer	Humanetics	Test Technician	J. Rios
ATD Serial Number	137	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.6	25.6	ºC	21.9	Pass
Humidity	10	70	%	45	Pass
Initial Angle	0	20	deg	13.9	Pass
Force at 45 Degrees	320	390	N	367.6	Pass
Return Angle Relative to Initial	0	8	deg	6.2	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	Rieker	DS-1905226	2023-11-14	2024-11-13
Load Cell	Interface	1134516	2023-11-30	2024-11-29



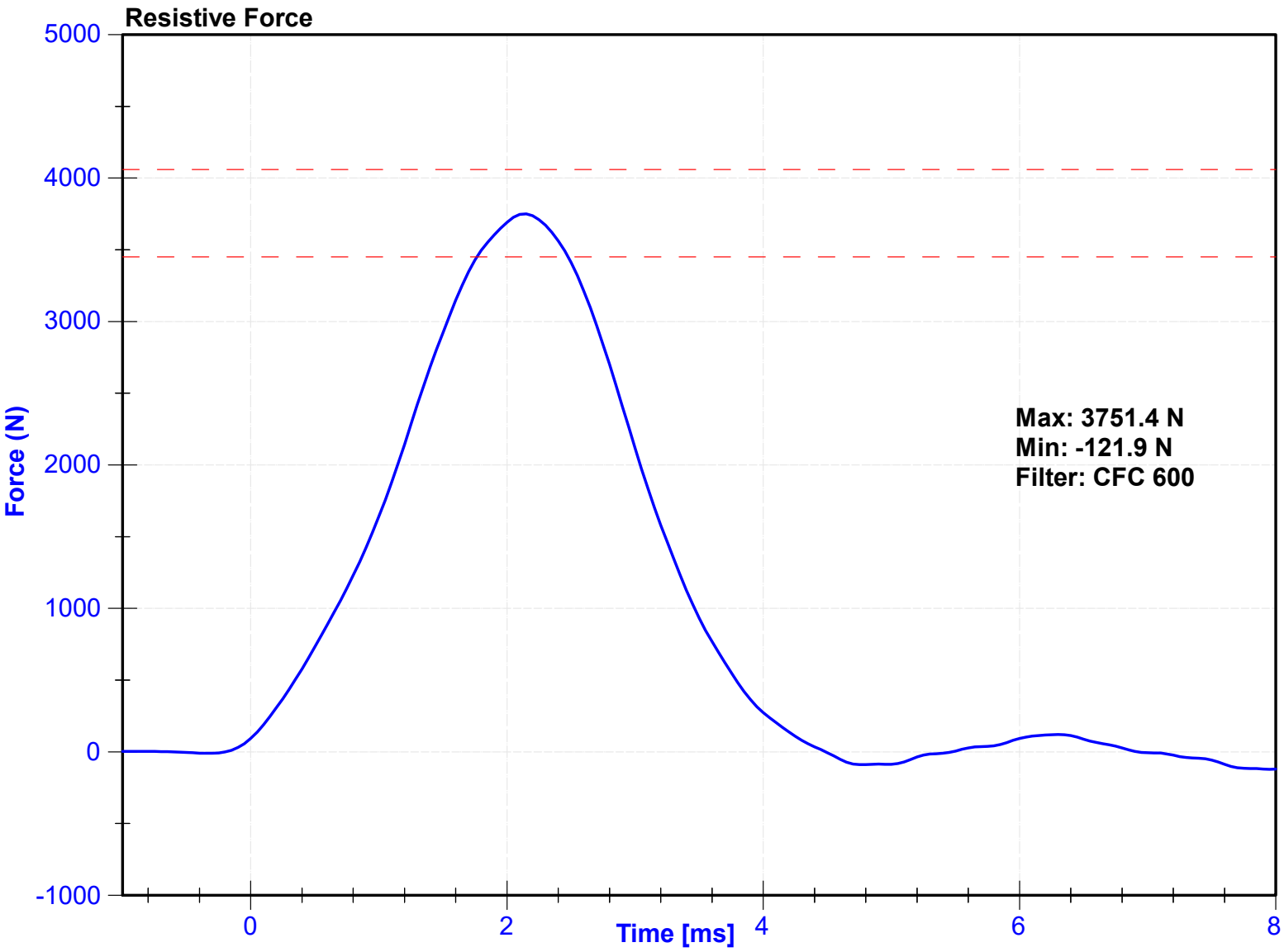
ATD Manufacturer	Humanetics	Test Technician	J. Rios
ATD Serial Number	137	Laboratory Supervisor	C. Mantell

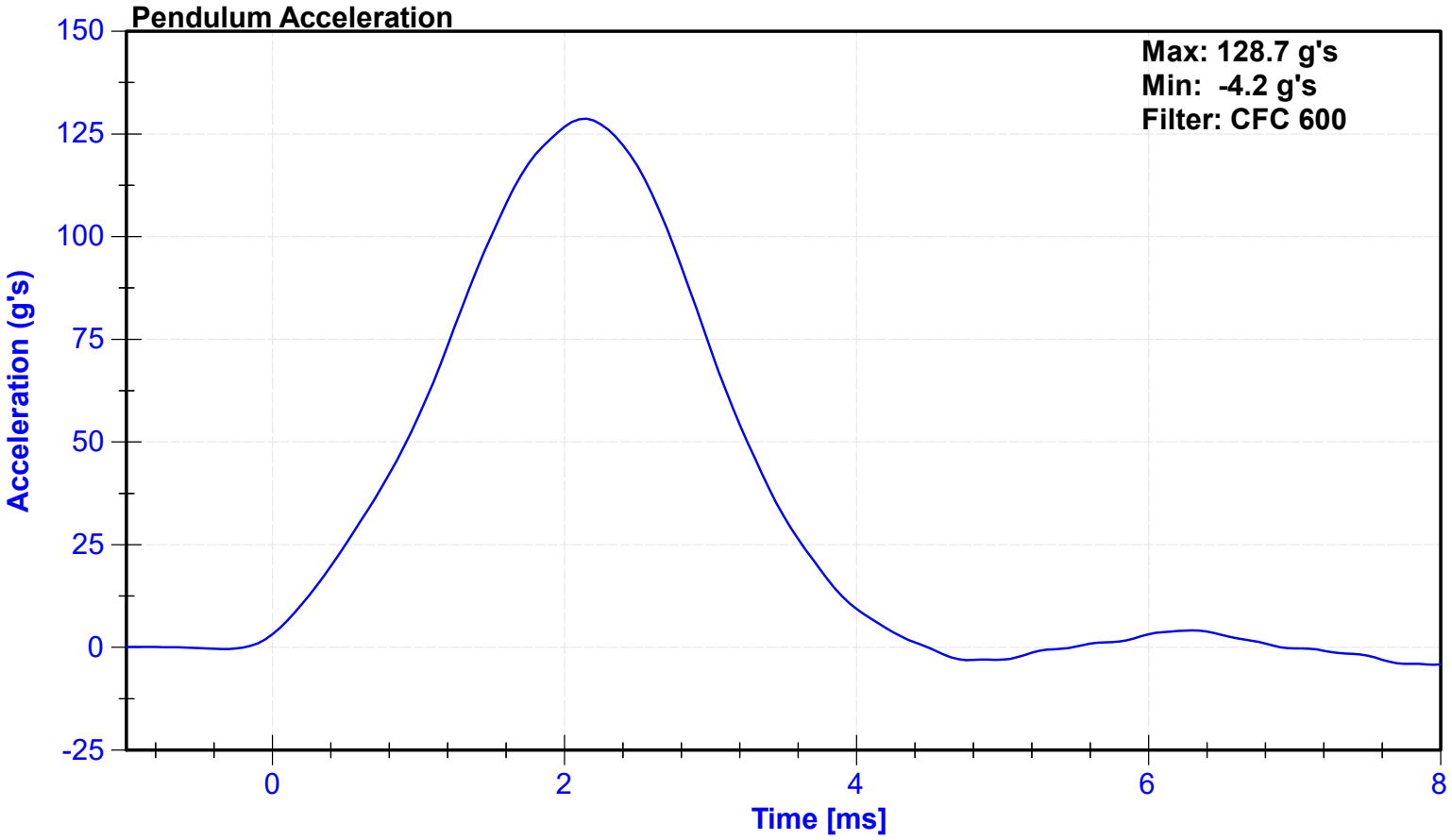
Results

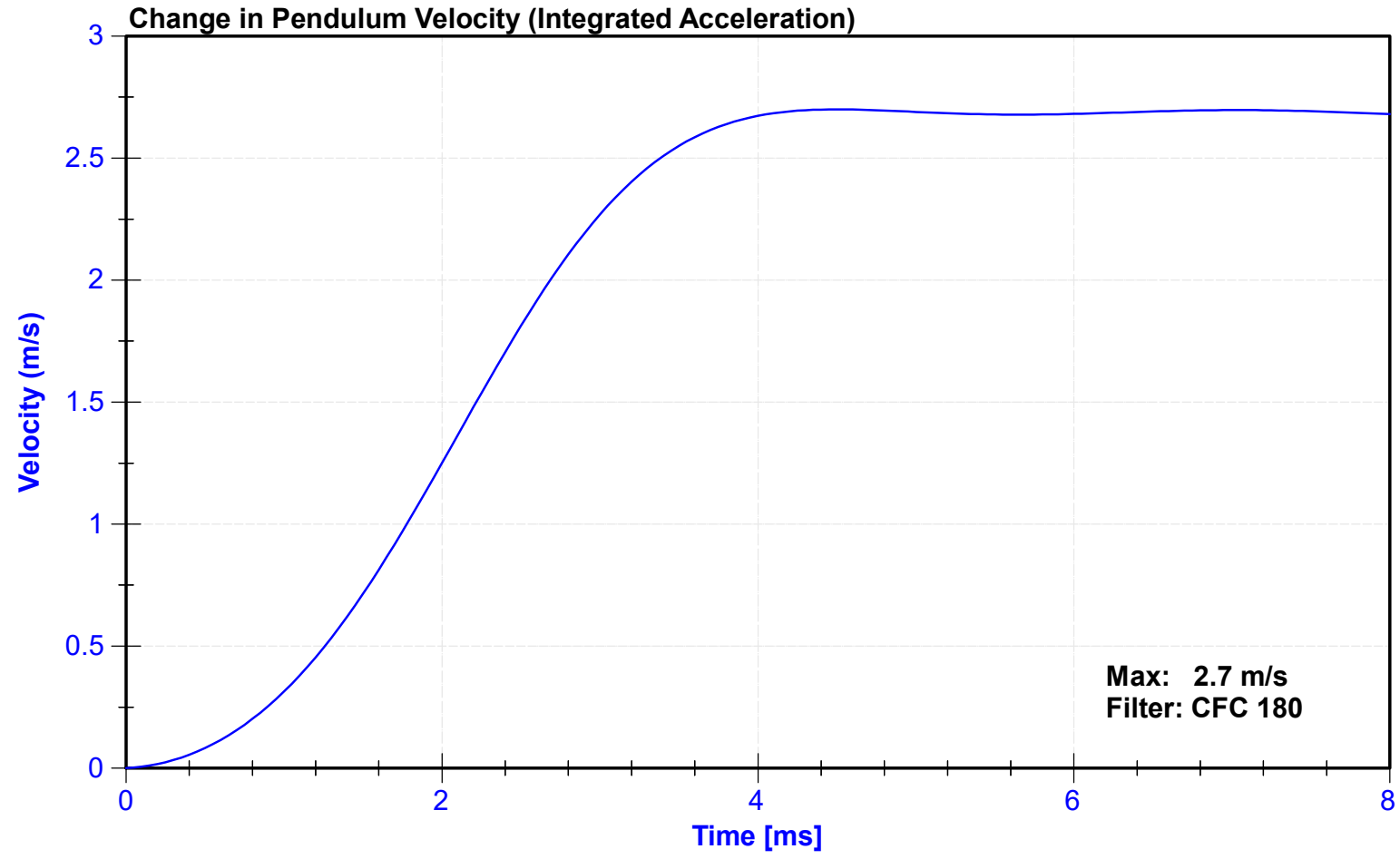
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.2	Pass
Humidity	10	70	%	47	Pass
Velocity	2.07	2.13	m/s	2.096	Pass
Resistive Force	3450	4060	N	3751.4	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18619	3/29/2024	9/25/2024




Pendulum Acceleration
Max: 128.7 g's
Min: -4.2 g's
Filter: CFC 600
Acceleration (g's)
150
125
100
75
50
25
0
-25
0
2
4
6
8
Time [ms]


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

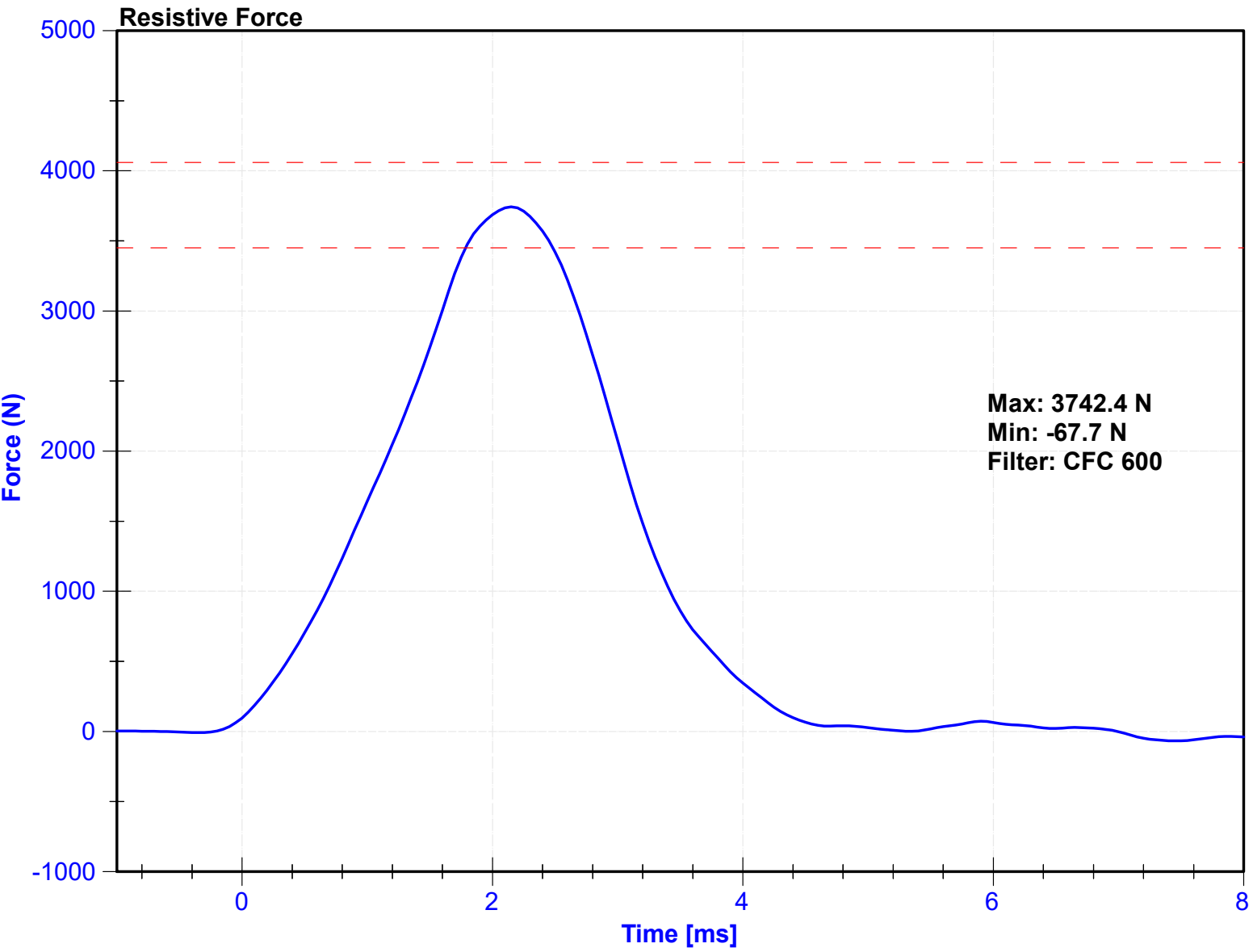
ATD Manufacturer	Humanetics	Test Technician	J. Rios
ATD Serial Number	137	Laboratory Supervisor	C. Mantell

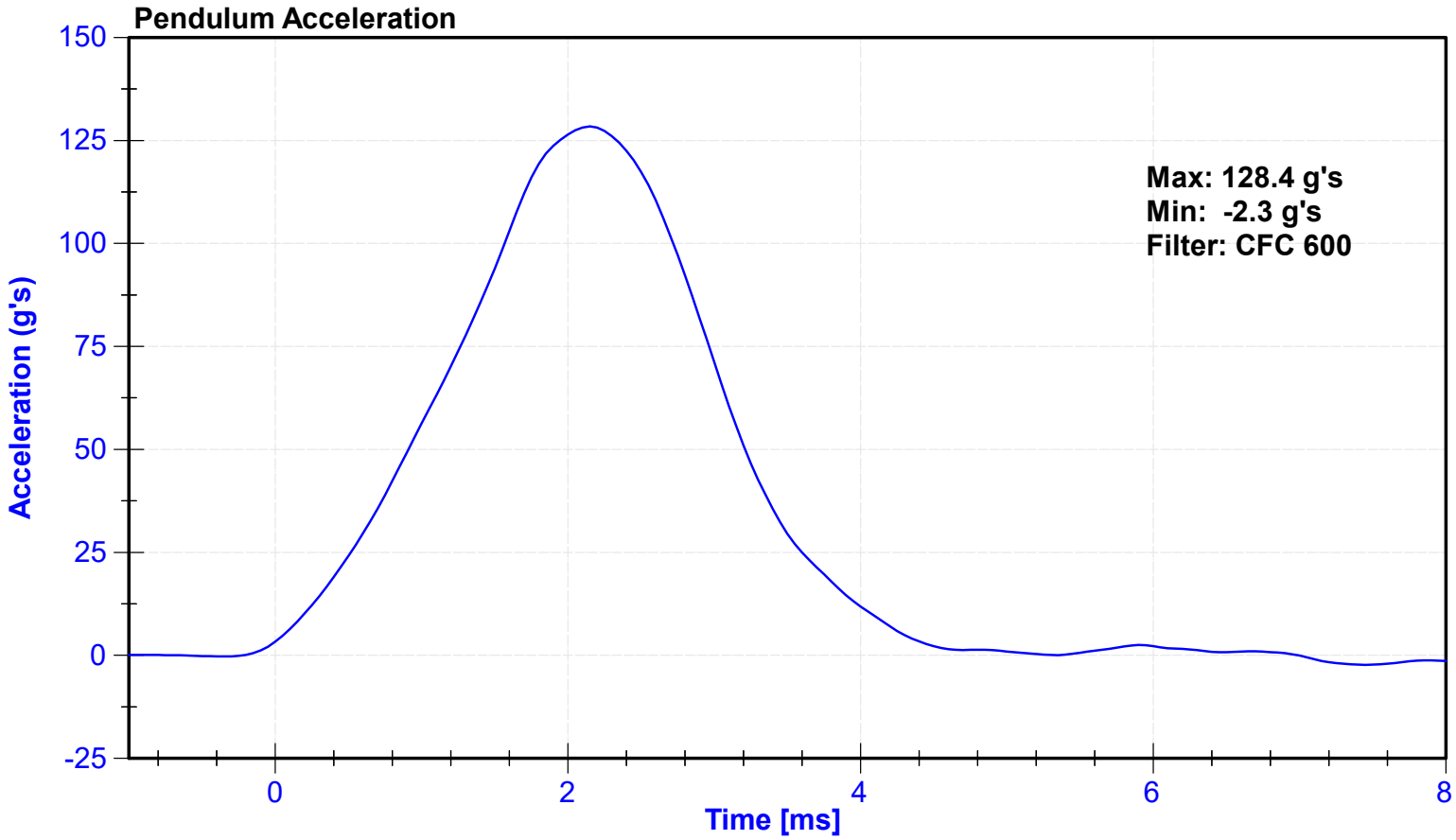
Results

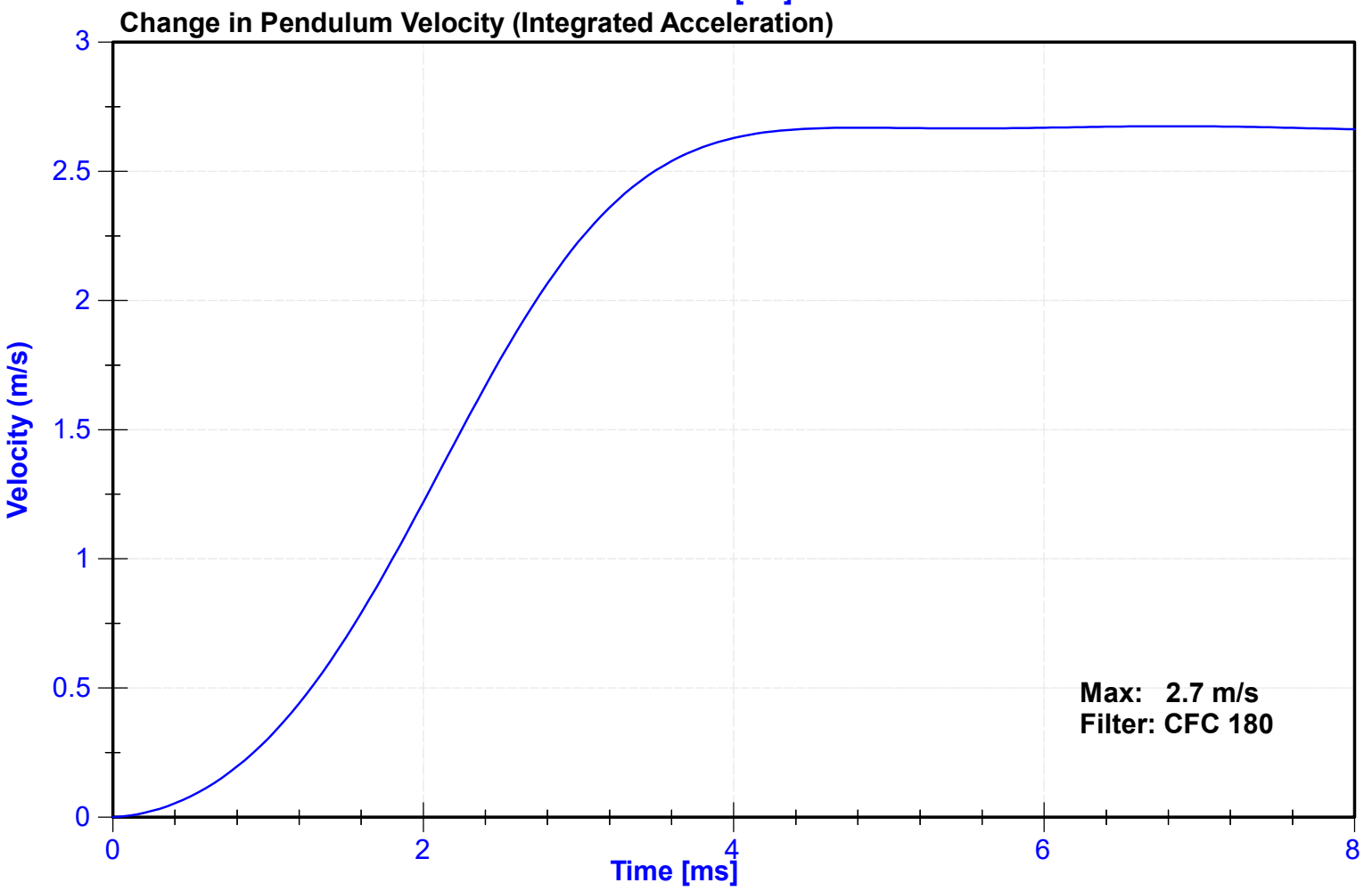
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.2	Pass
Humidity	10	70	%	47	Pass
Velocity	2.07	2.13	m/s	2.099	Pass
Resistive Force	3450	4060	N	3742.4	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18619	3/29/2024	9/25/2024




Pendulum Acceleration
Acceleration (g's)
150
125
100
75
50
25
0
-25
0
2
4
6
8
Time [ms]
Max: 128.4 g's
Min: -2.3 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: 2.7 m/s
Filter: CFC 180

CALIBRATION TEST RESULTS

POST-TEST

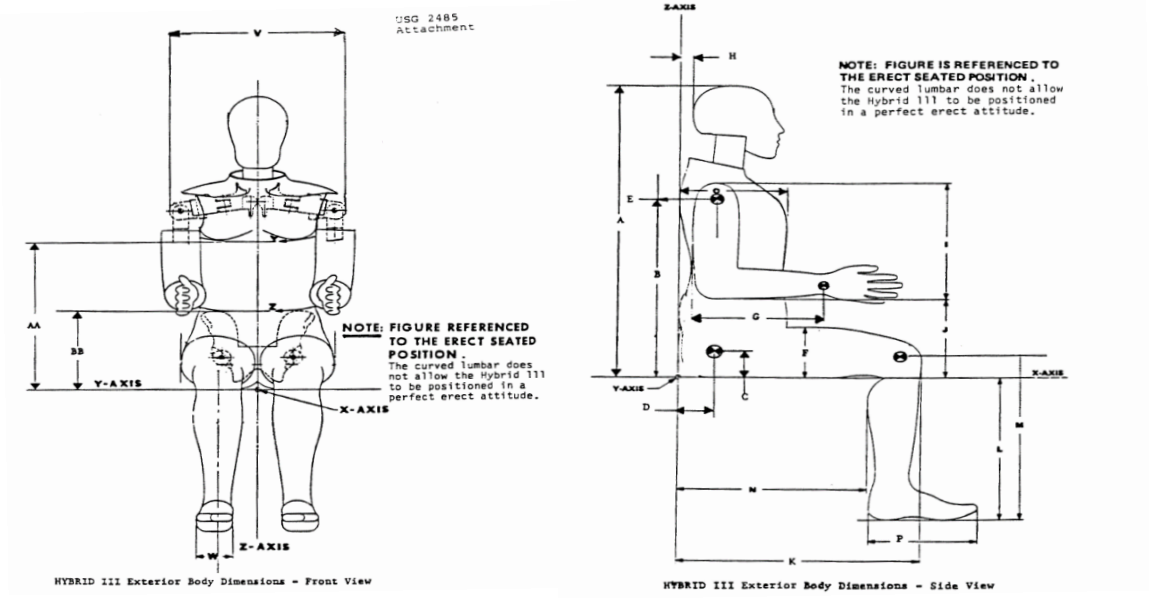
HYBRID III 50TH PERCENTILE MALE - DRIVER ATD

SERIAL NO: 065

External Measurements - Hybrid 3 - 50th Male

Technician: T. Roseman Date: 05/23/2024

Dummy Serial Number: 065



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	20.1	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	3.4	Pass
F	Thigh Clearance	5.5	6.1	6.0	Pass
G	Back of Elbow to Wrist Pivot	11.4	12.0	11.7	Pass
H	Head Back to Backline	1.6	1.8	1.7	Pass
I	Shoulder to Elbow Length	13.0	13.6	13.5	Pass
J	Elbow Rest Height	7.5	8.3	7.9	Pass
K	Buttock to Knee Length	22.8	23.8	23.5	Pass
L	Popliteal Height	16.9	17.9	17.6	Pass
M	Knee Pivot Height	19.1	19.7	19.5	Pass
N	Buttock Popliteal Length	17.8	18.8	18.4	Pass
O	Chest Depth without Jacket	8.4	9.0	8.8	Pass
P	Foot Length (right)	9.9	10.5	10.3	Pass
V	Shoulder Breadth	16.3	17.2	16.9	Pass
W	Foot Breadth	3.6	4.2	3.9	Pass
Y	Chest Circumference with Jacket	38.2	39.4	38.9	Pass
Z	Waist Circumference	32.9	34.1	33.6	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

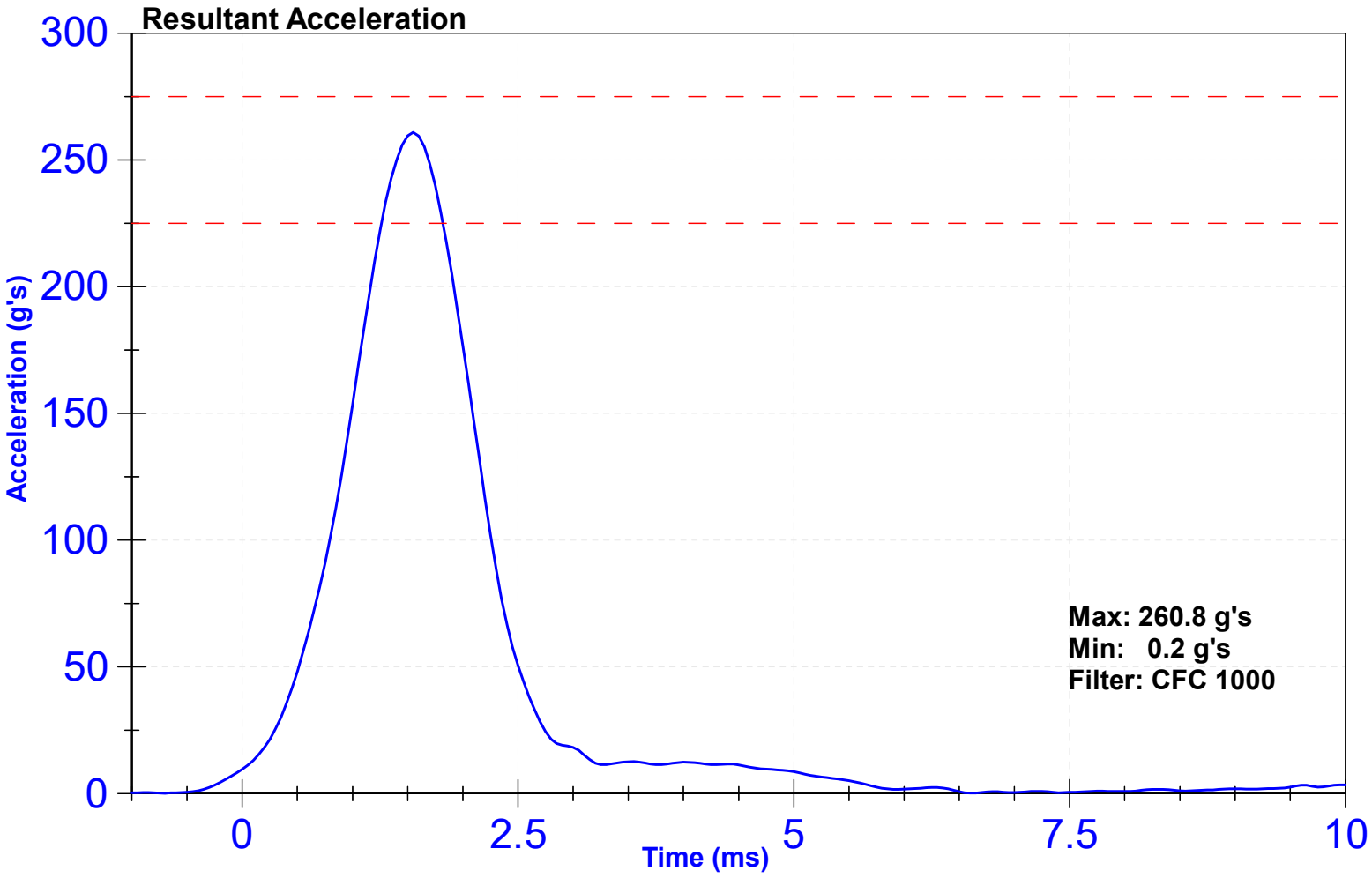
ATD Manufacturer	Humanetics	Test Technician	J. Kinderman
ATD Serial Number	065	Laboratory Supervisor	C. Mantell

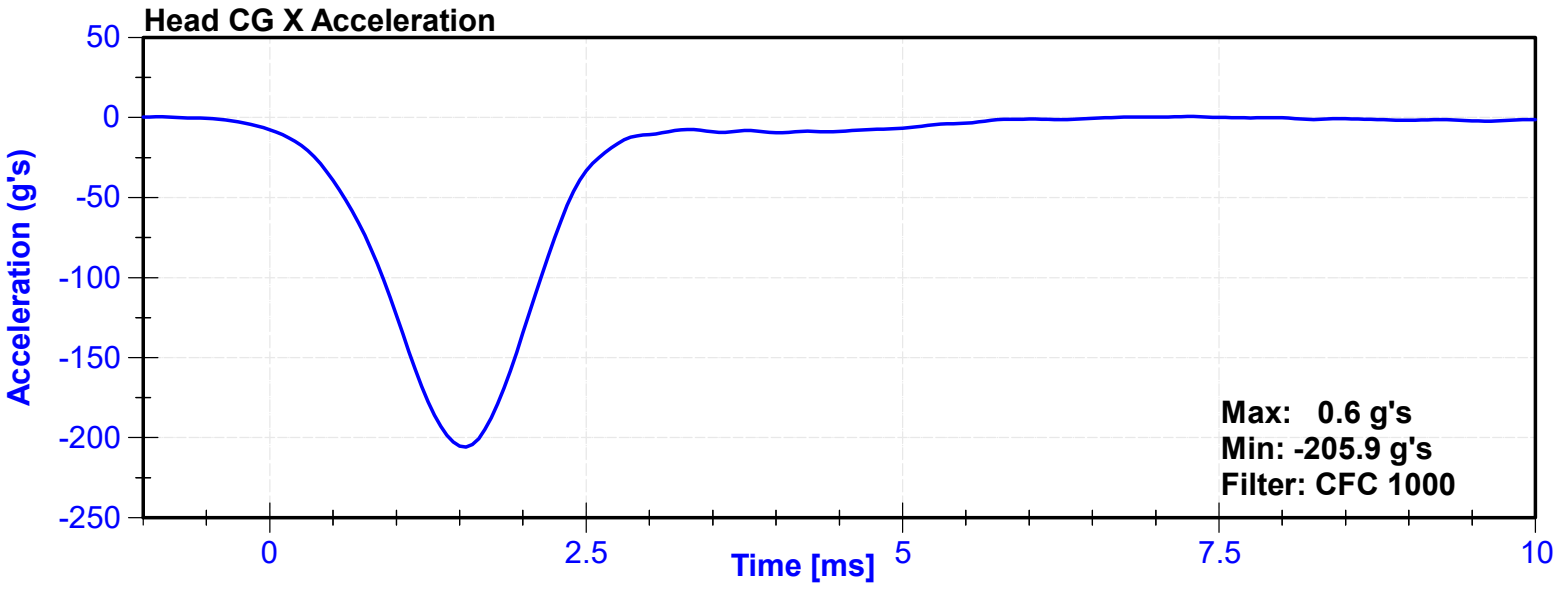
Results

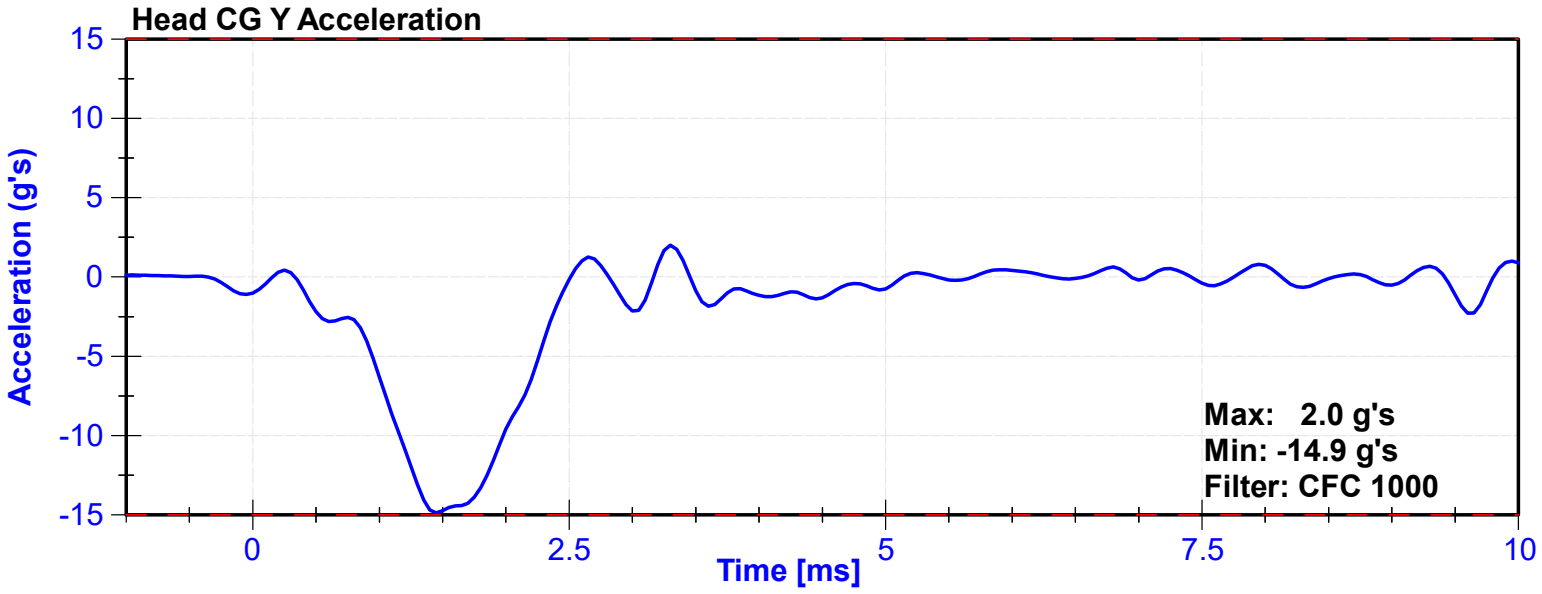
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	20.9	Pass
Humidity	10	70	%	40	Pass
Resultant Acceleration	225	275	g's	260.8	Pass
Oscillation	0	10	%	4.8	Pass
Lateral Acceleration	-15	15	g's	-14.9	Pass

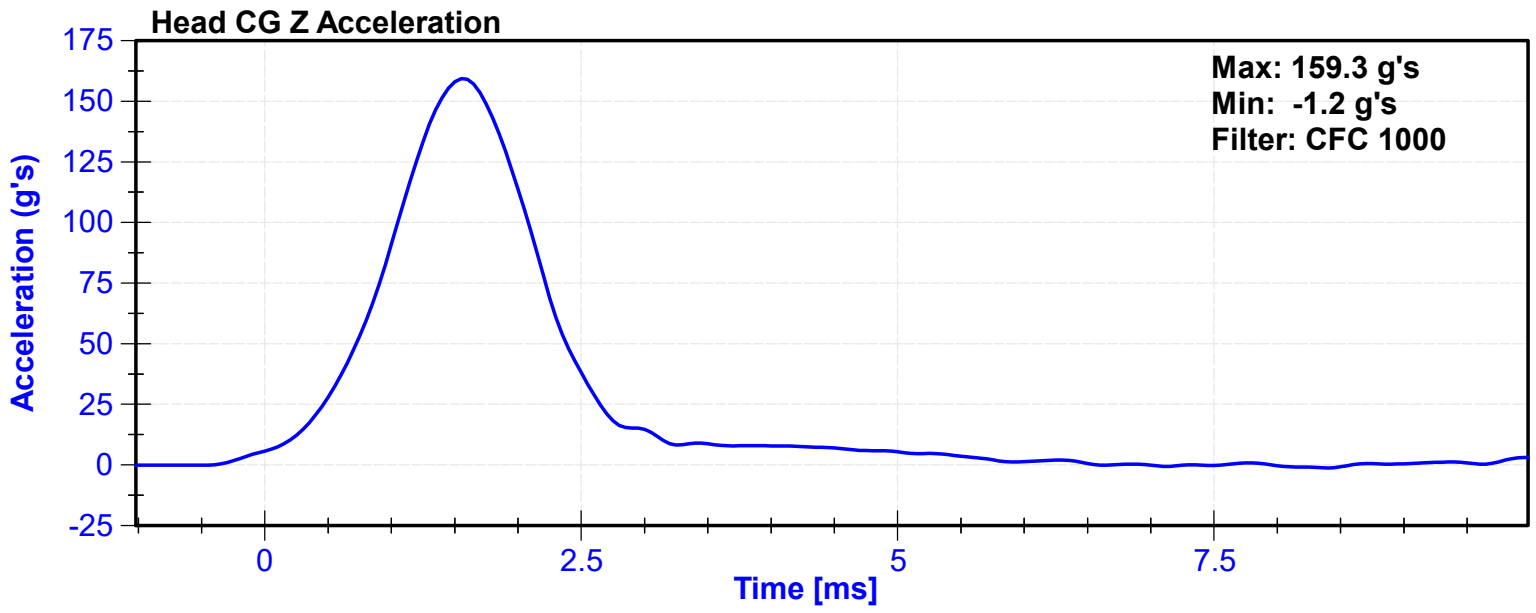
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	Endevco	P52152	4/30/2024	10/27/2024
Y Accelerometer	Endevco	P58888	4/30/2024	10/27/2024
Z Accelerometer	Endevco	P58911	4/30/2024	10/27/2024




Head CG X Acceleration
Acceleration (g's)
50
0
-50
-100
-150
-200
-250
0
2.5
5
7.5
10
Time [ms]
Max: 0.6 g's
Min: -205.9 g's
Filter: CFC 1000


Head CG Y Acceleration
Acceleration (g's)
15
10
5
0
-5
-10
-15
0
2.5
5
7.5
10
Time [ms]
Max: 2.0 g's
Min: -14.9 g's
Filter: CFC 1000


Head CG Z Acceleration
Acceleration (g's)
175
150
125
100
75
50
25
0
-25
0
2.5
5
7.5
Time [ms]
Max: 159.3 g's
Min: -1.2 g's
Filter: CFC 1000

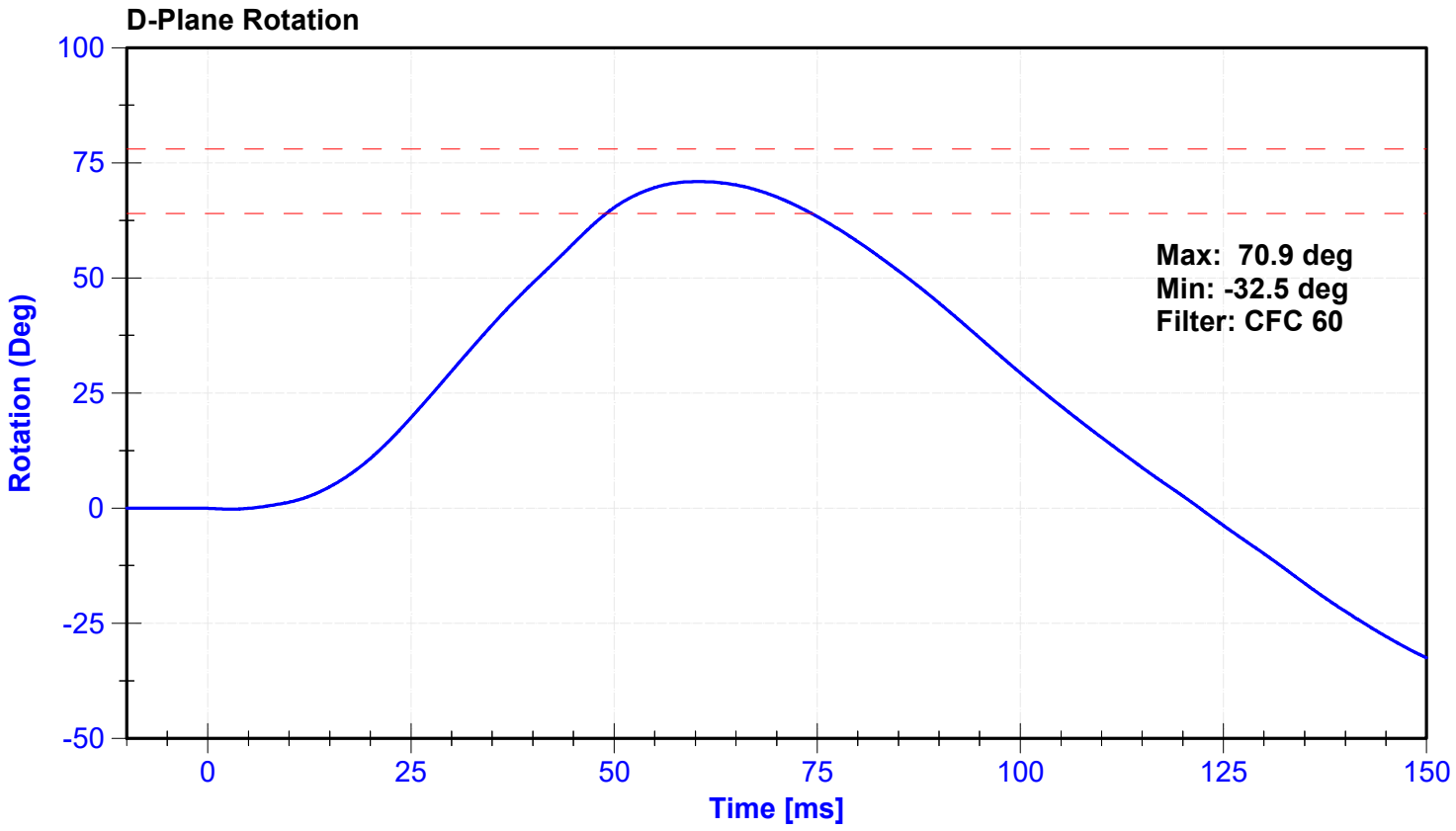
ATD Manufacturer	Humanetics	Test Technician	J. Kinderman
ATD Serial Number	065	Laboratory Supervisor	C. Mantell

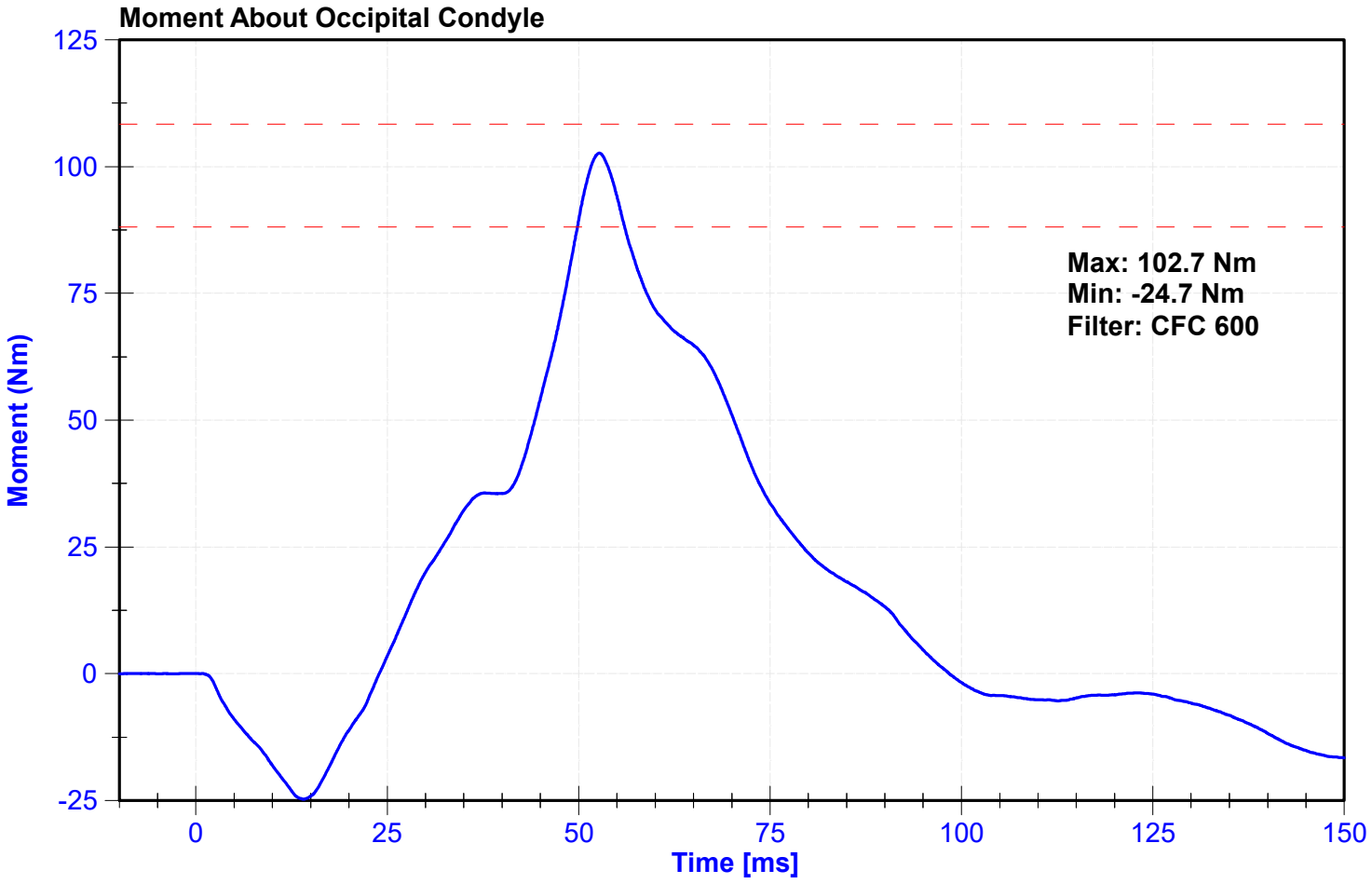
Results

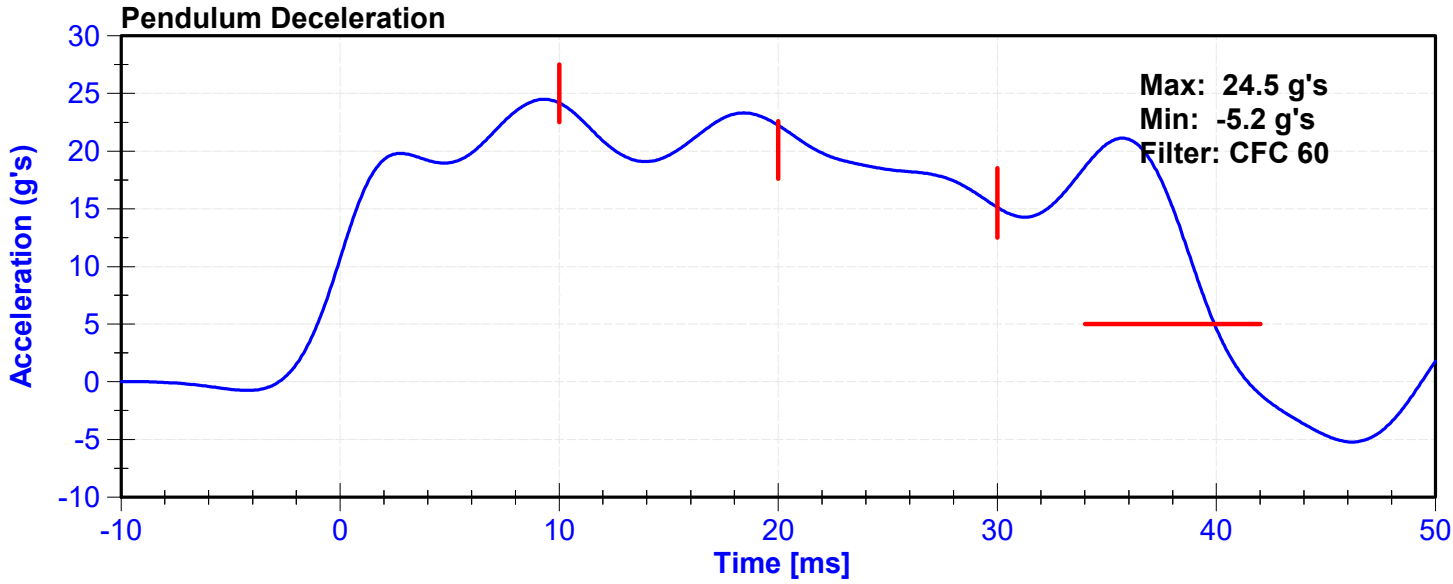
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.9	Pass
Humidity	10	70	%	43	Pass
Velocity	6.89	7.13	m/s	7.069	Pass
Pendulum Deceleration at 10ms	22.5	27.5	g's	24.17	Pass
Pendulum Deceleration at 20ms	17.6	22.6	g's	22.23	Pass
Pendulum Deceleration at 30ms	12.5	18.5	g's	15.12	Pass
Max. Pendulum Deceleration After 30ms	0	29	g's	24.5	Pass
Pendulum Deceleration Time to 5 g's	34	42	ms	39.9	Pass
Maximum D Plane Rotation	64	78	deg	70.9	Pass
Time to Maximum Rotation	57	64	ms	60.4	Pass
Rotation Decay to Zero	113	127	ms	122.1	Pass
Moment About Occipital Condyle	88.1	108.4	Nm	102.65	Pass
Time to Maximum Moment	47	58	ms	52.7	Pass
Moment Decay to Zero	97	107	ms	98.4	Pass

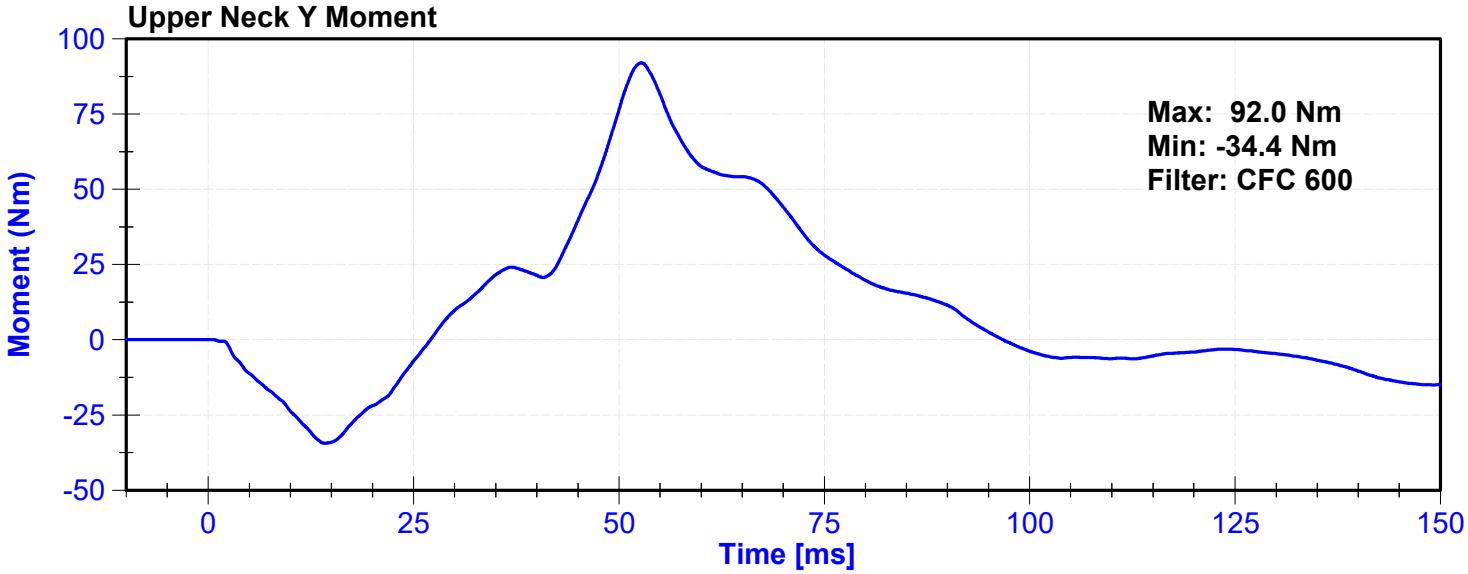
Transducer Calibrations

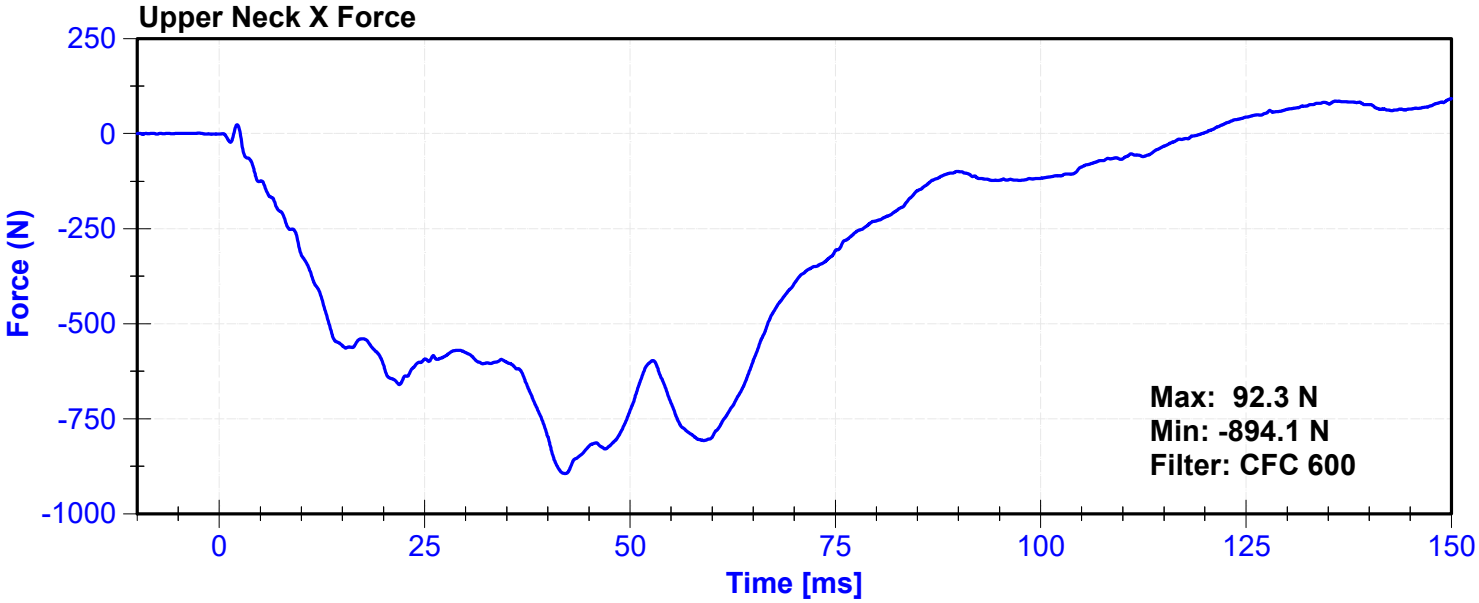
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	C16650	10/31/2023	10/30/2024
Pendulum Potentiometer	ETI	LABPOT1	5/7/2024	5/7/2025
Condyle Potentiometer	ETI	LABPOT2	5/7/2024	5/7/2025
Upper Neck Load Cell	Humanetics	1916-FX	9/12/2023	9/11/2024


D-Plane Rotation
Rotation (Deg)
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]
Max: 70.9 deg
Min: -32.5 deg
Filter: CFC 60


Moment About Occipital Condyle
Moment (Nm)
125
100
75
50
25
0
-25
0
25
50
75
100
125
150
Time [ms]
Max: 102.7 Nm
Min: -24.7 Nm
Filter: CFC 600


Pendulum Deceleration
Acceleration (g's)
Time [ms]
Max: 24.5 g's
Min: -5.2 g's
Filter: CFC 60


Upper Neck Y Moment
Moment (Nm)
Time [ms]
Max: 92.0 Nm
Min: -34.4 Nm
Filter: CFC 600


Upper Neck X Force
Force (N)
Time [ms]
Max: 92.3 N
Min: -894.1 N
Filter: CFC 600

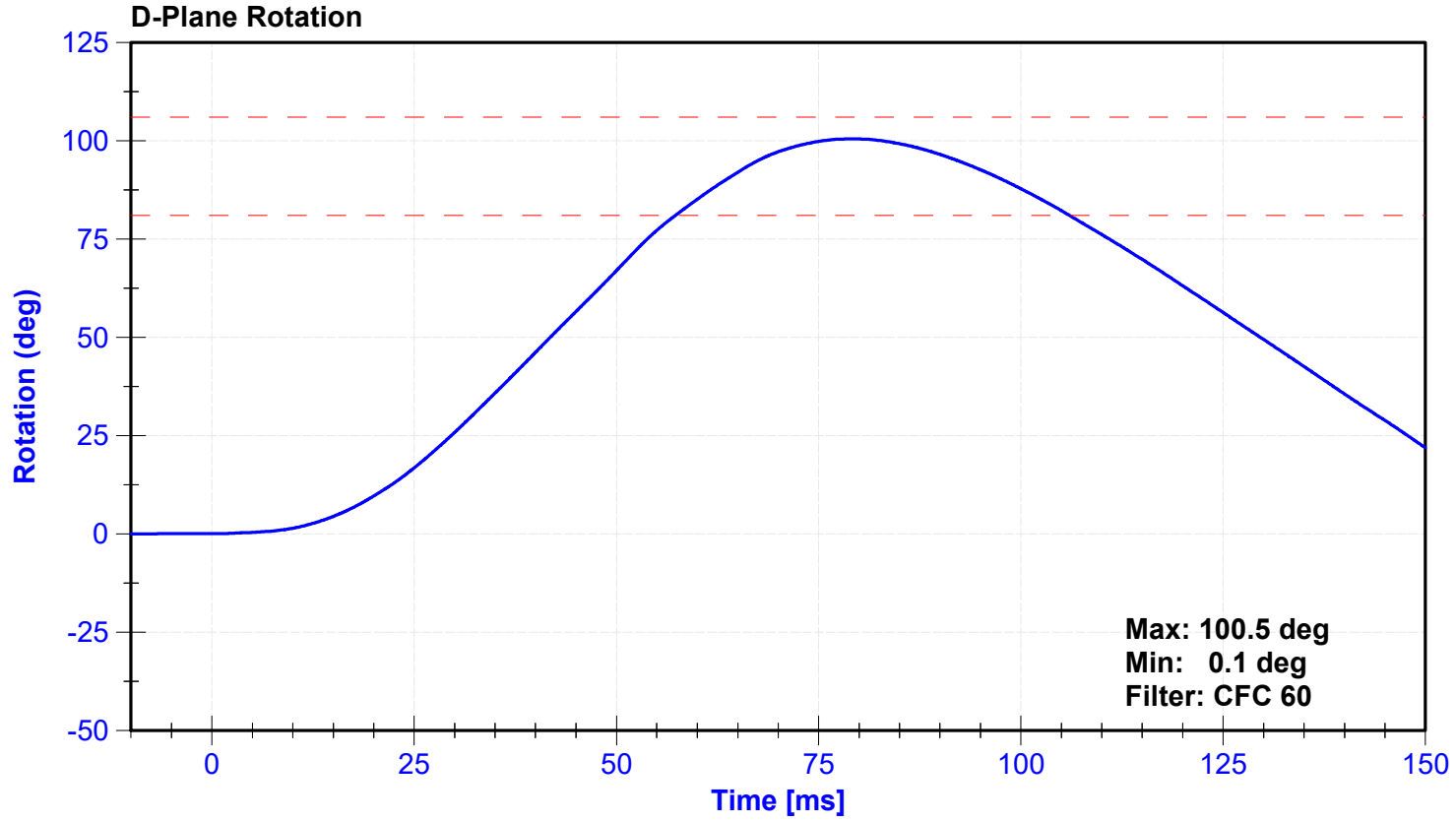
ATD Manufacturer	Humanetics	Test Technician	J. Kinderman
ATD Serial Number	065	Laboratory Supervisor	C. Mantell

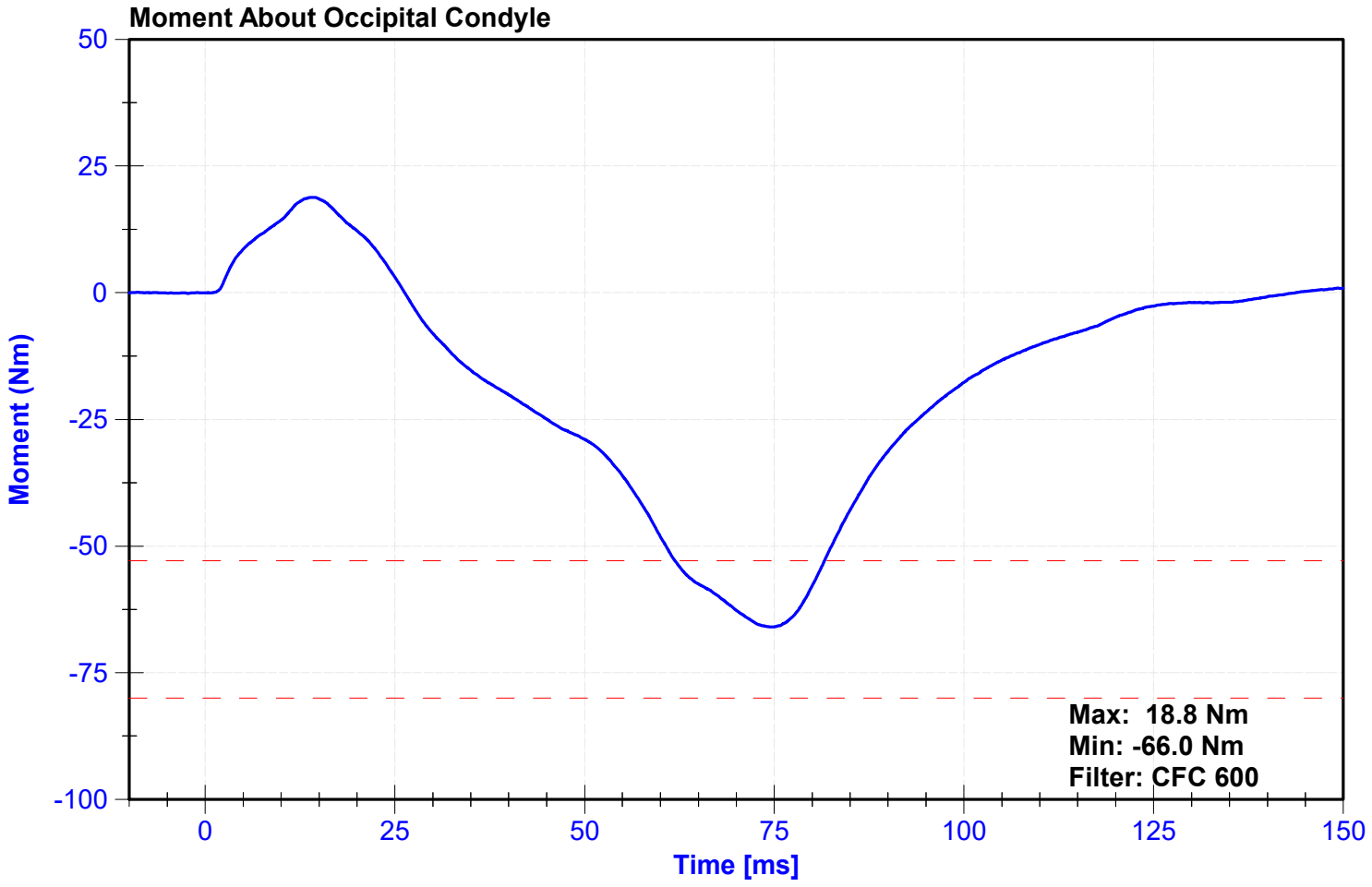
Results

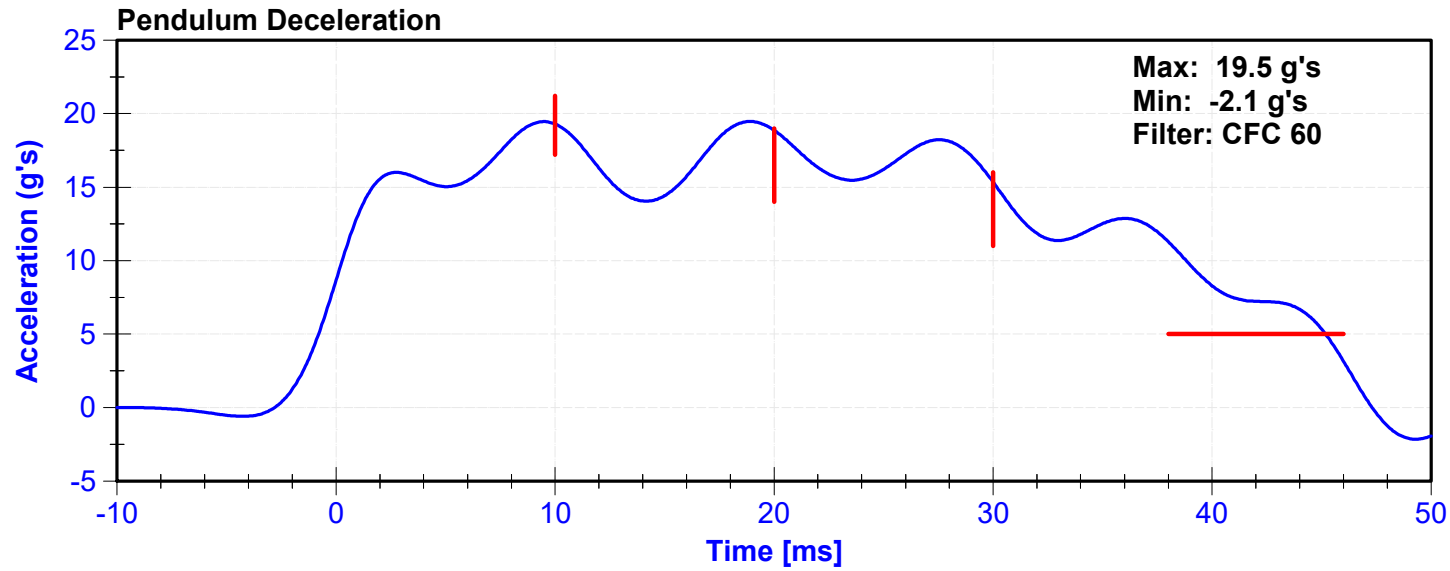
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.9	Pass
Humidity	10	70	%	43	Pass
Velocity	5.94	6.19	m/s	6.178	Pass
Pendulum Deceleration at 10ms	17.2	21.2	g's	19.29	Pass
Pendulum Deceleration at 20ms	14	19	g's	18.9	Pass
Pendulum Deceleration at 30ms	11	16	g's	15.3	Pass
Max. Pendulum Deceleration After 30ms	0	22	g's	19.5	Pass
Pendulum Deceleration Time to 5 g's	38	46	ms	45.2	Pass
Maximum D Plane Rotation	81	106	deg	100.5	Pass
Time to Maximum Rotation	72	82	ms	79.1	Pass
Rotation Decay to Zero	147	174	ms	166.3	Pass
Minimum Moment About OC	-80	-52.9	Nm	-65.96	Pass
Time to Minimum Moment	65	79	ms	74.7	Pass
Moment Decay to Zero	120	148	ms	143.7	Pass

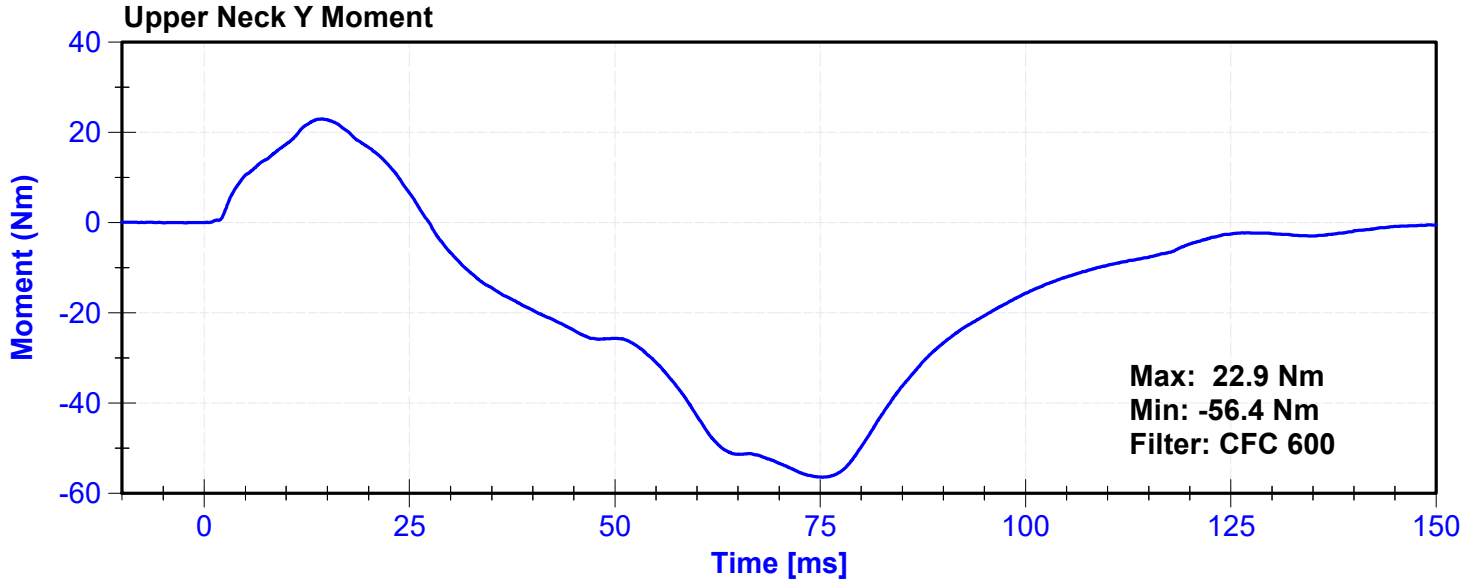
Transducer Calibrations

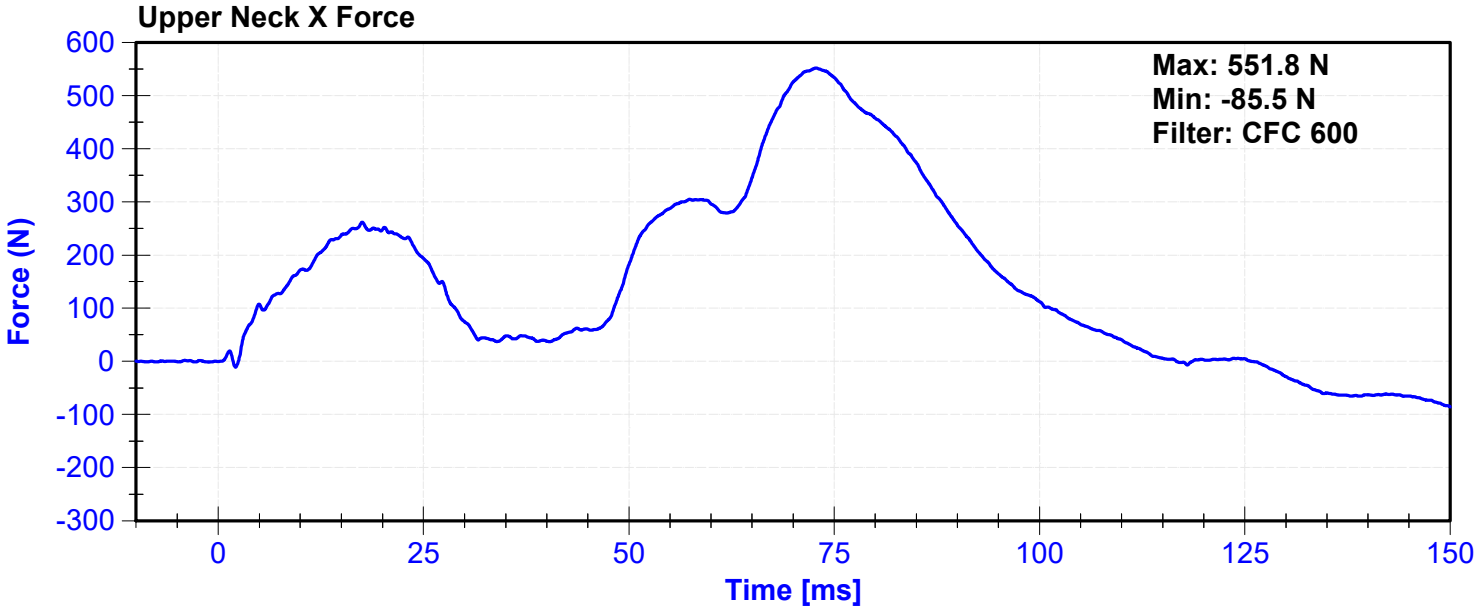
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	C16650	10/31/2023	10/30/2024
Pendulum Potentiometer	ETI	SP22G_LABPOT1	05-Jul-24	05-Jul-25
Condyle Potentiometer	ETI	SP22G_LABPOT2	05-Jul-24	05-Jul-25
Upper Neck Load Cell	Humanetics	1916-FX	9/12/2023	9/11/2024


D-Plane Rotation
Rotation (deg)
125
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]
Max: 100.5 deg
Min: 0.1 deg
Filter: CFC 60


Moment About Occipital Condyle
Moment (Nm)
50
25
0
-25
-50
-75
-100
0
25
50
75
100
125
150
Time [ms]
Max: 18.8 Nm
Min: -66.0 Nm
Filter: CFC 600


Pendulum Deceleration
Max: 19.5 g's
Min: -2.1 g's
Filter: CFC 60
Acceleration (g's)
Time [ms]


Upper Neck Y Moment
Max: 22.9 Nm
Min: -56.4 Nm
Filter: CFC 600
Moment (Nm)
Time [ms]


Upper Neck X Force
Max: 551.8 N
Min: -85.5 N
Filter: CFC 600
Force (N)
Time [ms]

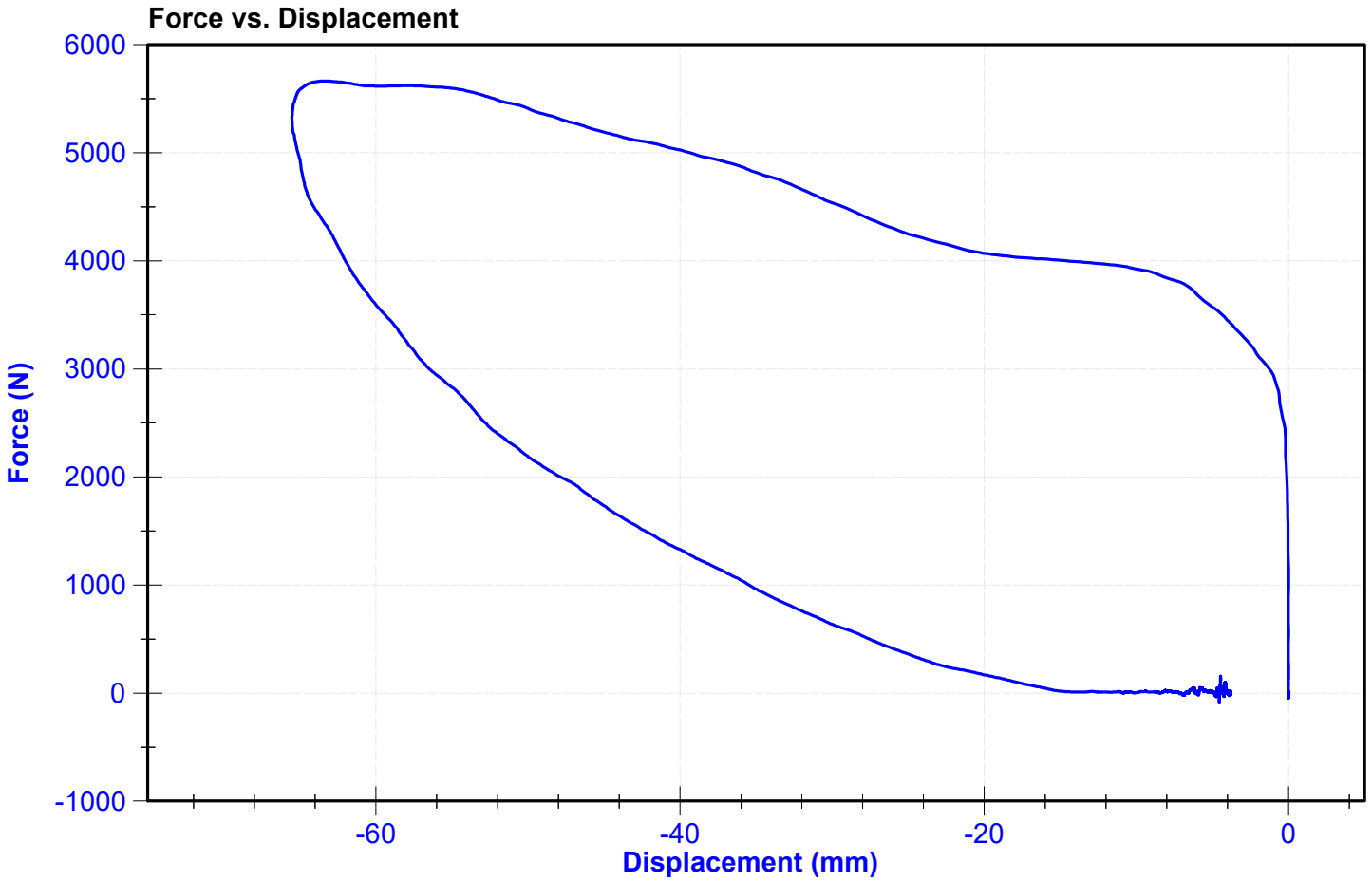
ATD Manufacturer	Humanetics	Test Technician	J. Kinderman
ATD Serial Number	065	Laboratory Supervisor	C. Mantell

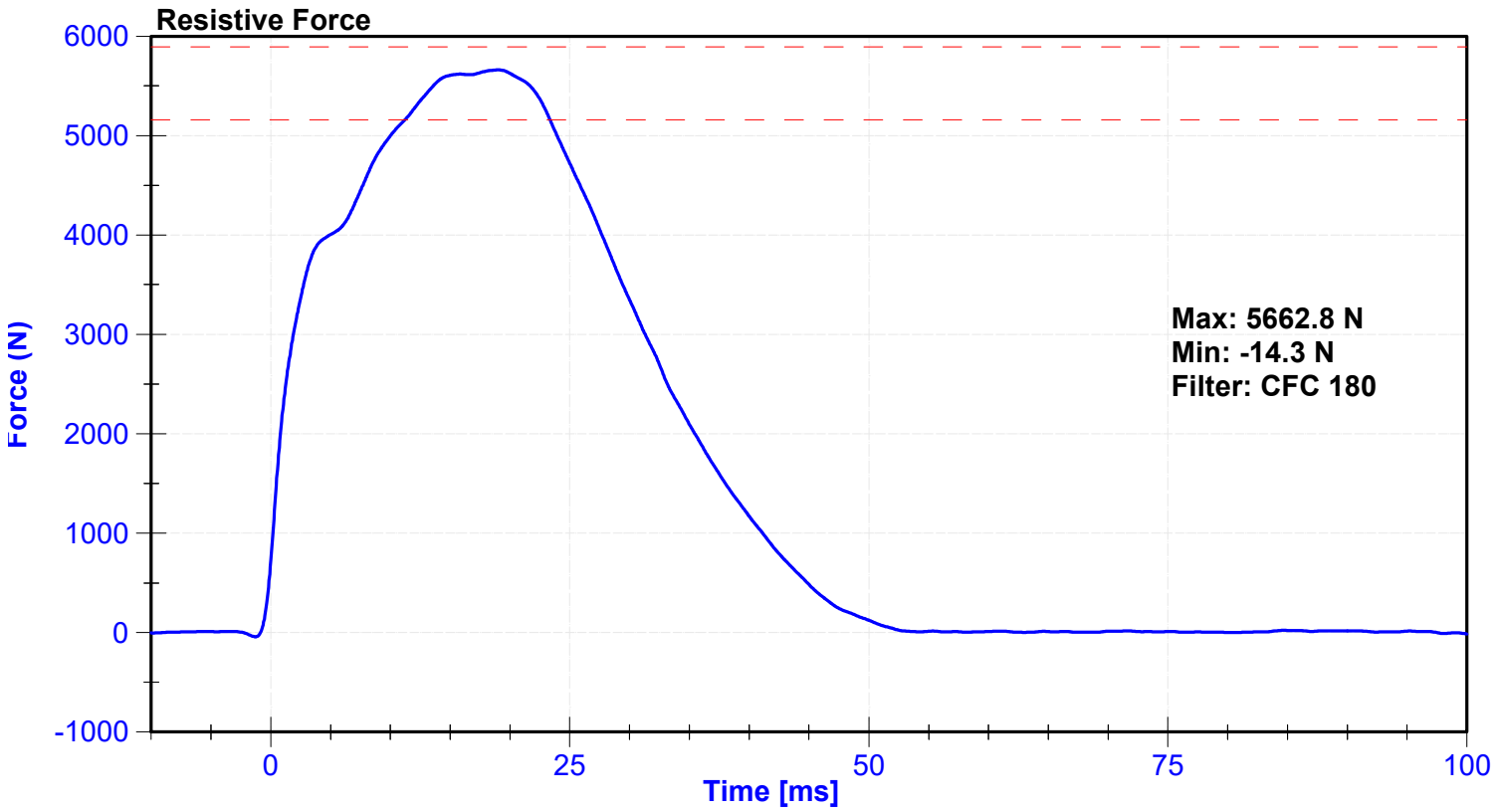
Results

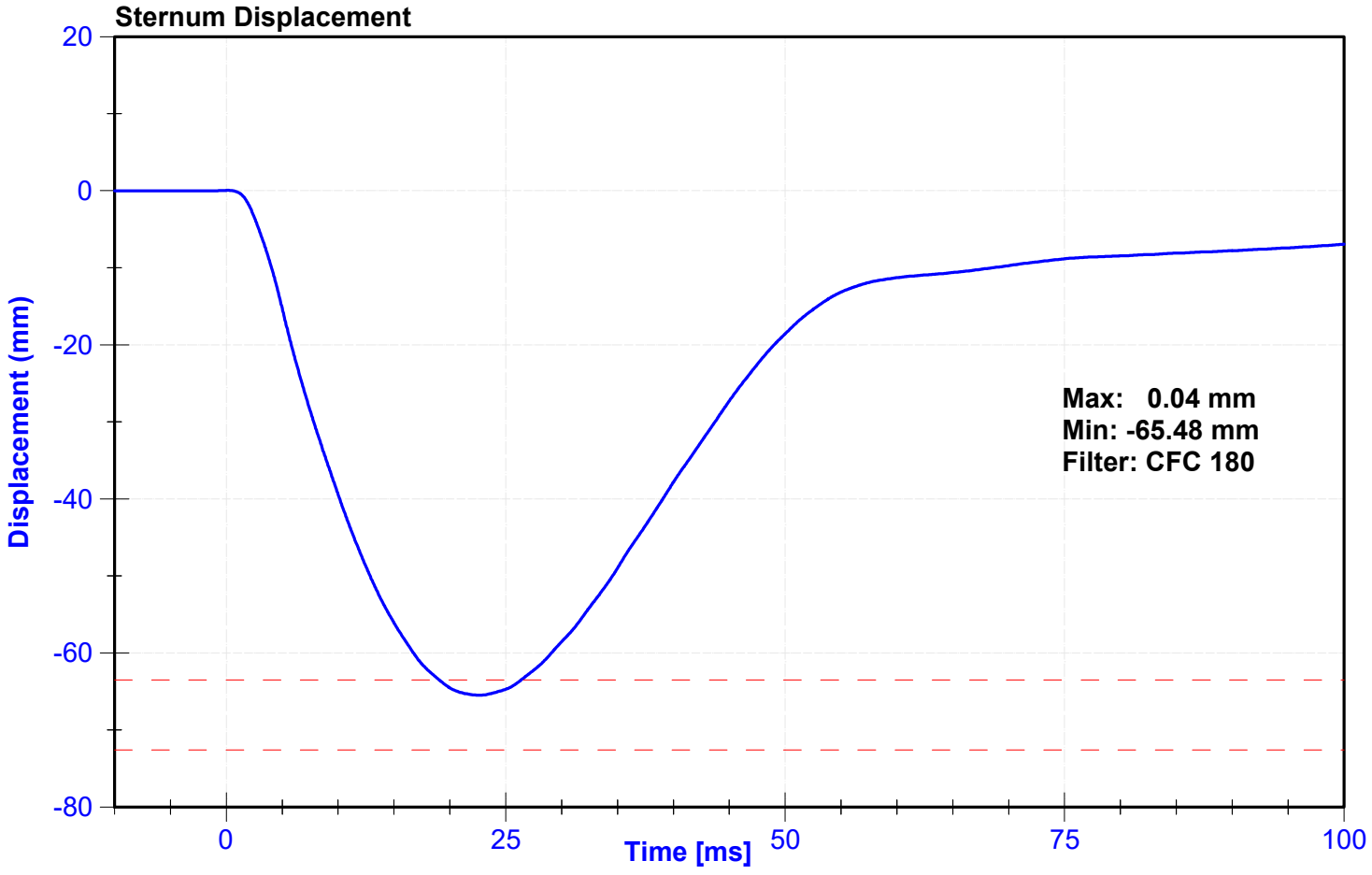
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21,4	Pass
Humidity	10	70	%	36	Pass
Velocity	6.59	6.83	m/s	6.666	Pass
Chest Displacement	-72.6	-63.5	mm	-65.48	Pass
Resistive Force	5160	5894	N	5662.8	Pass
Hysteresis	69	85	%	72.7	Pass

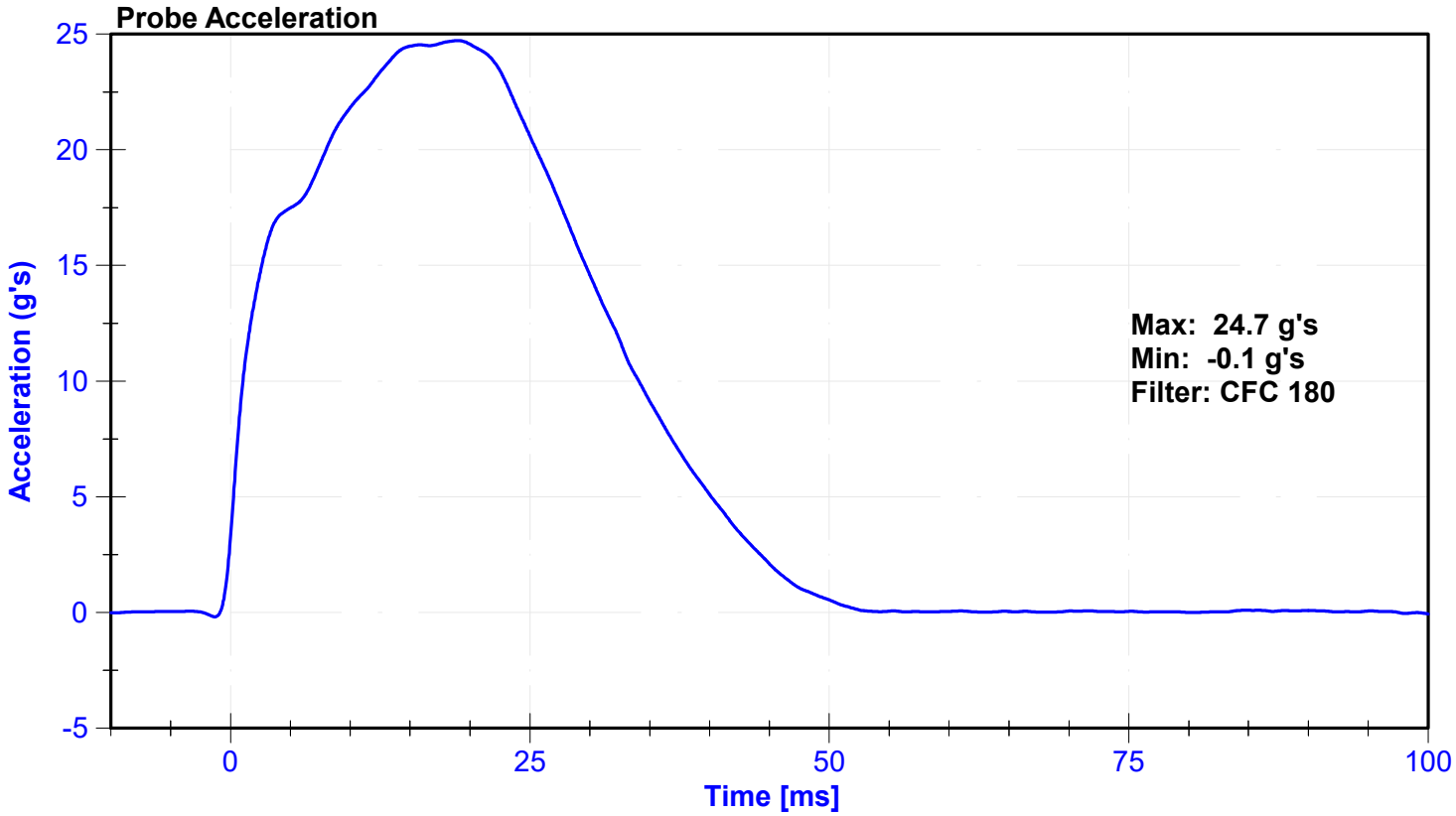
Transducer Calibrations

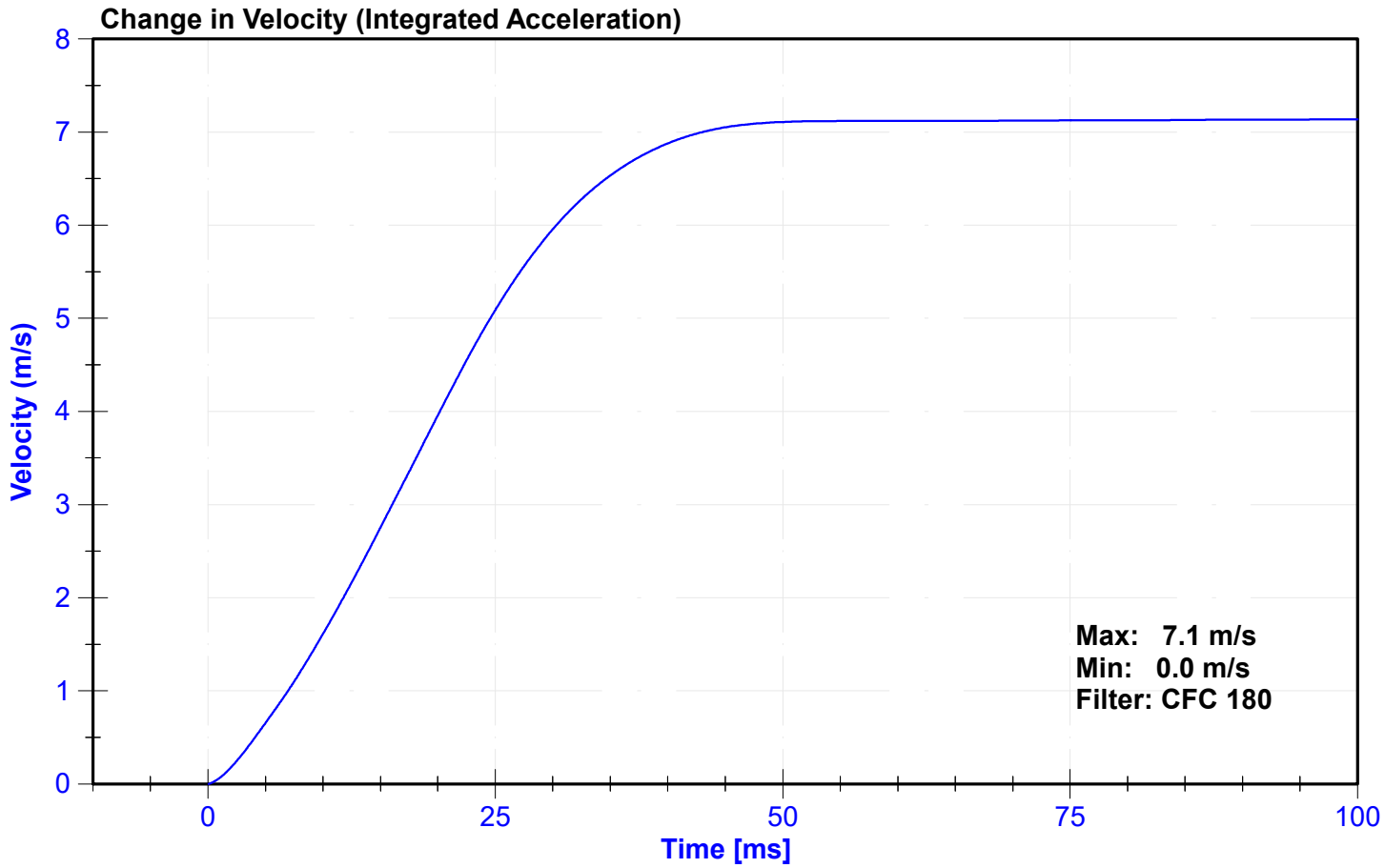
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18587	11/20/2023	11/19/2024
Chest Potentiometer	Servo	1046	4/30/2024	10/29/2024




Resistive Force
Force (N)
6000
5000
4000
3000
2000
1000
0
-1000
0
25
50
75
100
Time [ms]
Max: 5662.8 N
Min: -14.3 N
Filter: CFC 180


Sternum Displacement
Displacement (mm)
20
0
-20
-40
-60
-80
0
25
50
75
100
Time [ms]
Max: 0.04 mm
Min: -65.48 mm
Filter: CFC 180


Probe Acceleration
Acceleration (g's)
25
20
15
10
5
0
-5
0
25
50
75
100
Time [ms]
Max: 24.7 g's
Min: -0.1 g's
Filter: CFC 180


Change in Velocity (Integrated Acceleration)
Velocity (m/s)
8
7
6
5
4
3
2
1
0
0
25
50
75
100
Time [ms]
Max: 7.1 m/s
Min: 0.0 m/s
Filter: CFC 180

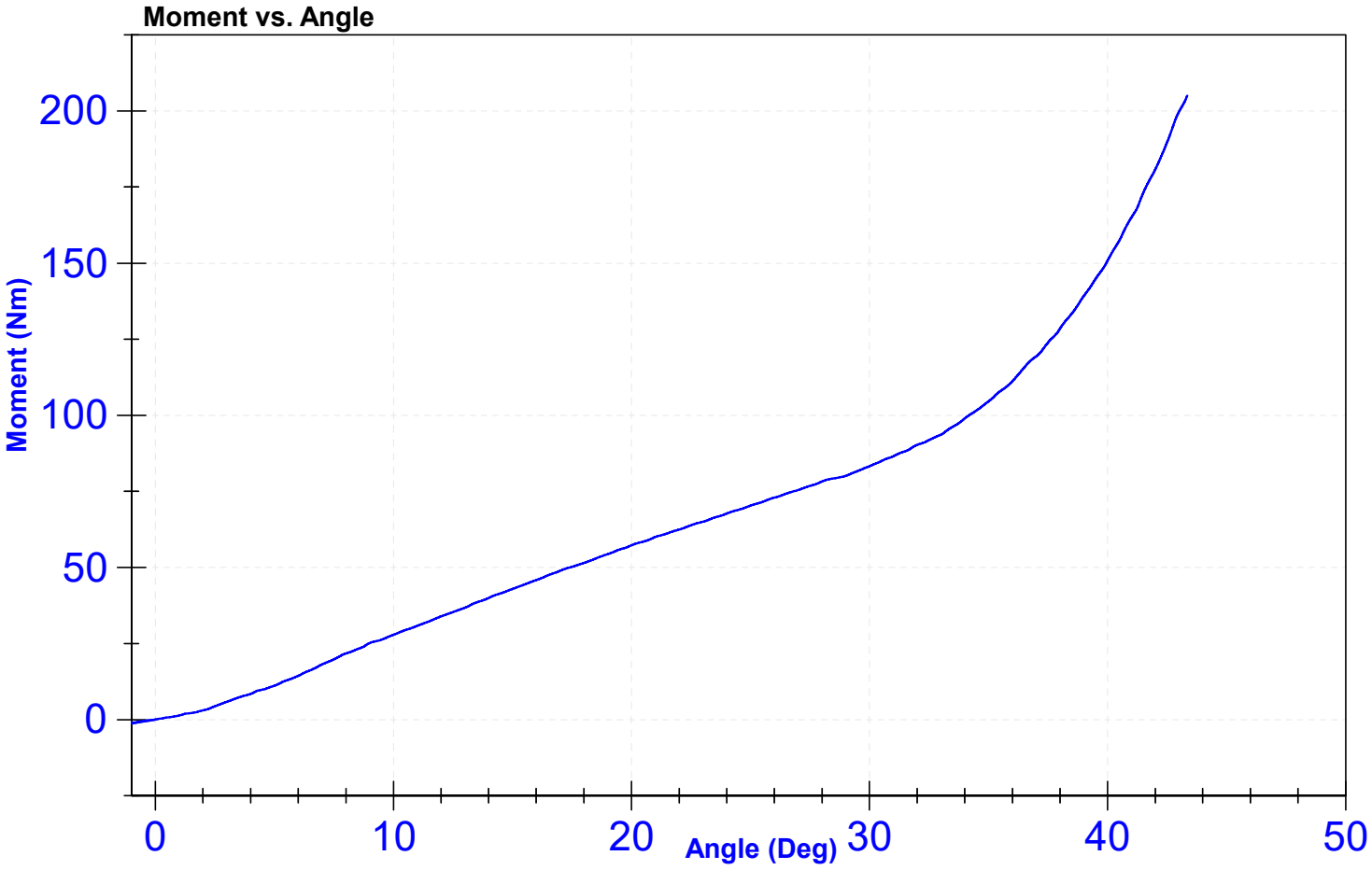
ATD Manufacturer	Humanetics	Test Technician	J. Kinderman
ATD Serial Number	065	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.0	Pass
Humidity	10	70	%	45	Pass
Average Velocity	5	10	deg/s	7.1	Pass
Angle at 203Nm	40	50	deg	43.2	Pass
Moment at 30 degrees	0	94.9	Nm	83.3	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	ETI SP22	DS-0008	10/6/2023	10/5/2024
Load Cell	PCB 2301-02	2301-02_115	2023-10-30	2024-10-29



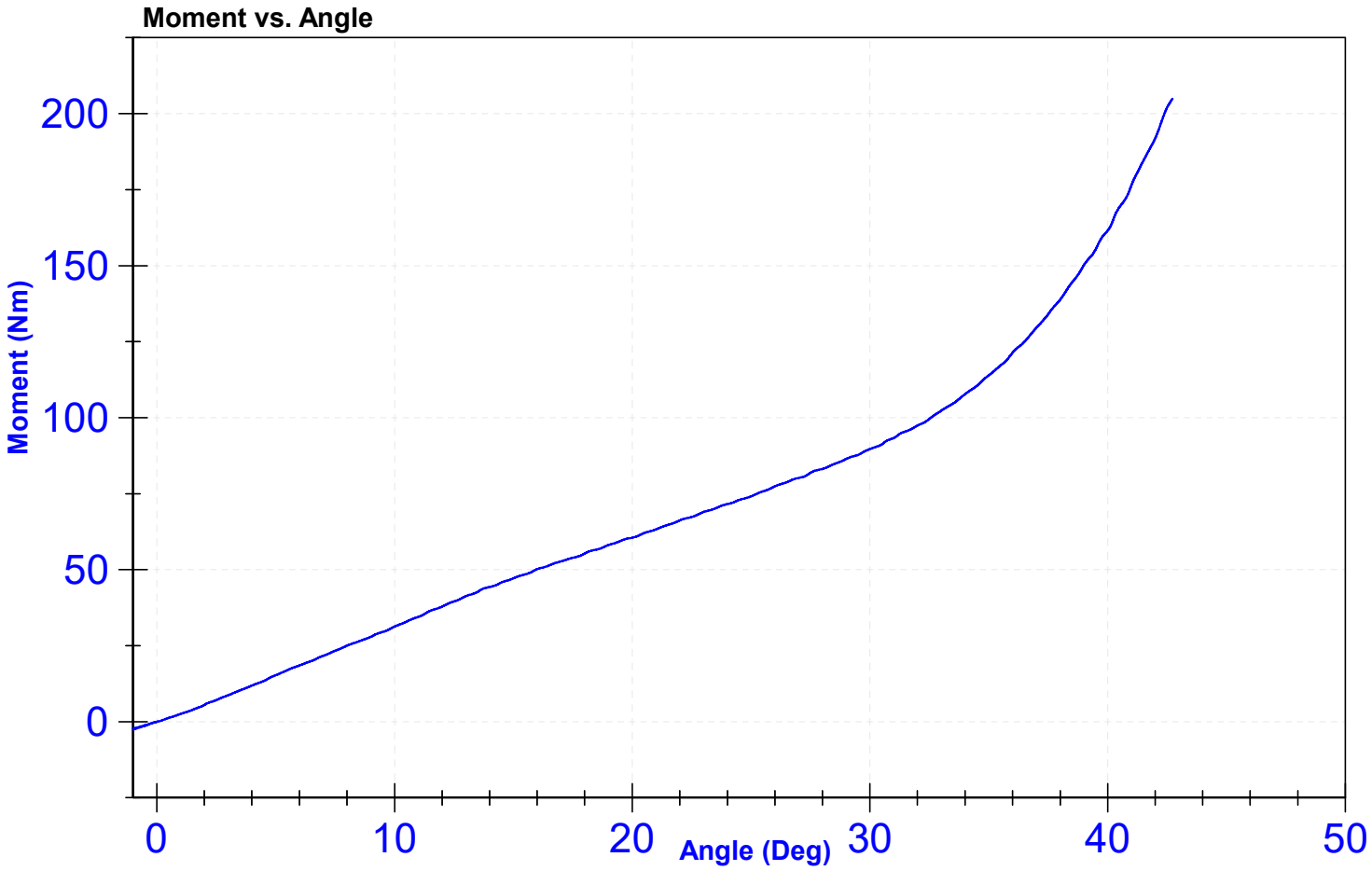
ATD Manufacturer	Humanetics	Test Technician	J. Kinderman
ATD Serial Number	065	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.0	Pass
Humidity	10	70	%	45	Pass
Average Velocity	5	10	deg/s	7.0	Pass
Angle at 203Nm	40	50	deg	42.6	Pass
Moment at 30 degrees	0	94.9	Nm	89.7	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	ETI SP22	DS-0008	10/6/2023	10/5/2024
Load Cell	PCB 2301-02	2301-02_115	2023-10-30	2024-10-29



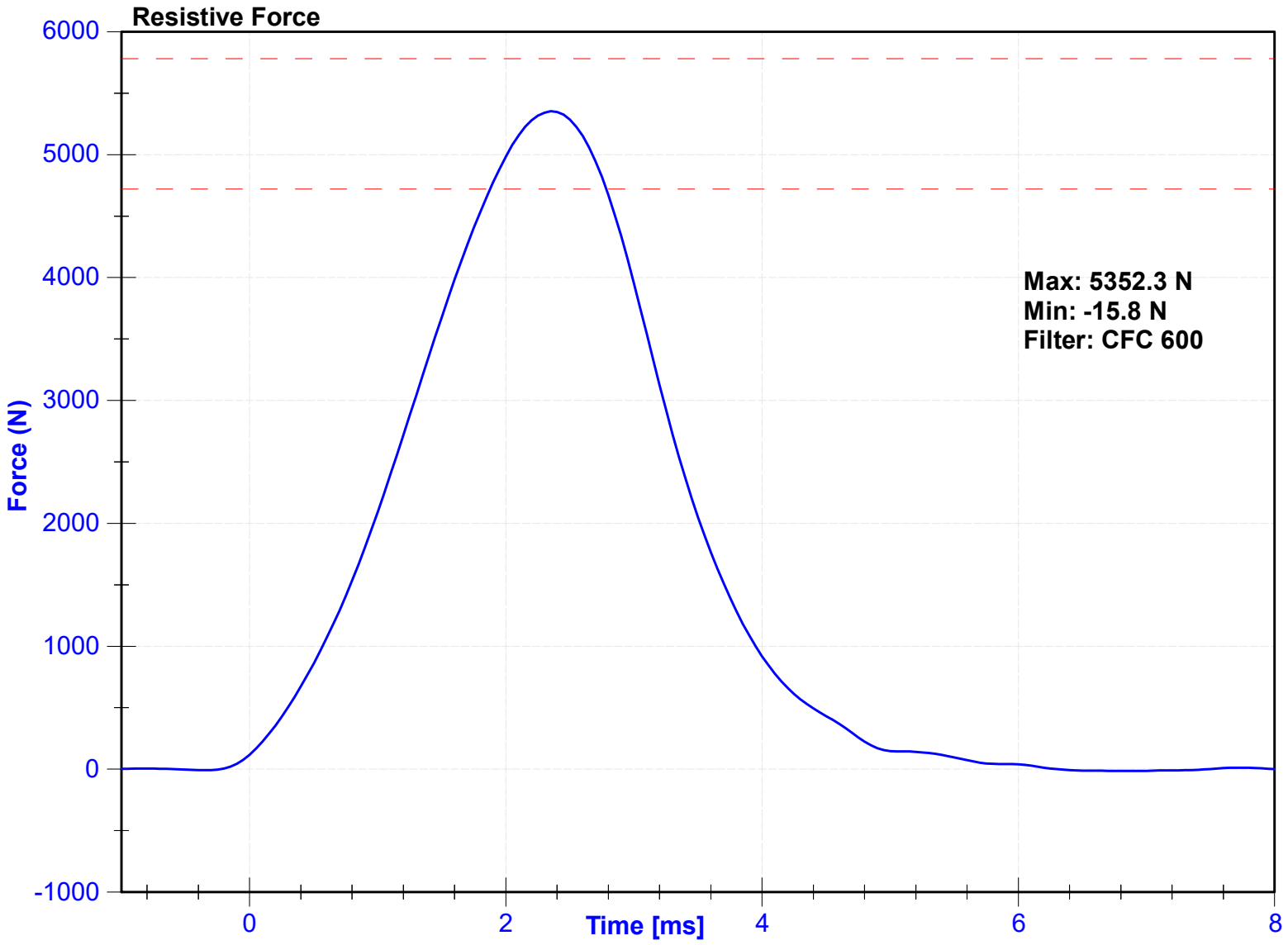
ATD Manufacturer	Humanetics	Test Technician	J. Kinderman
ATD Serial Number	065	Laboratory Supervisor	C. Mantell

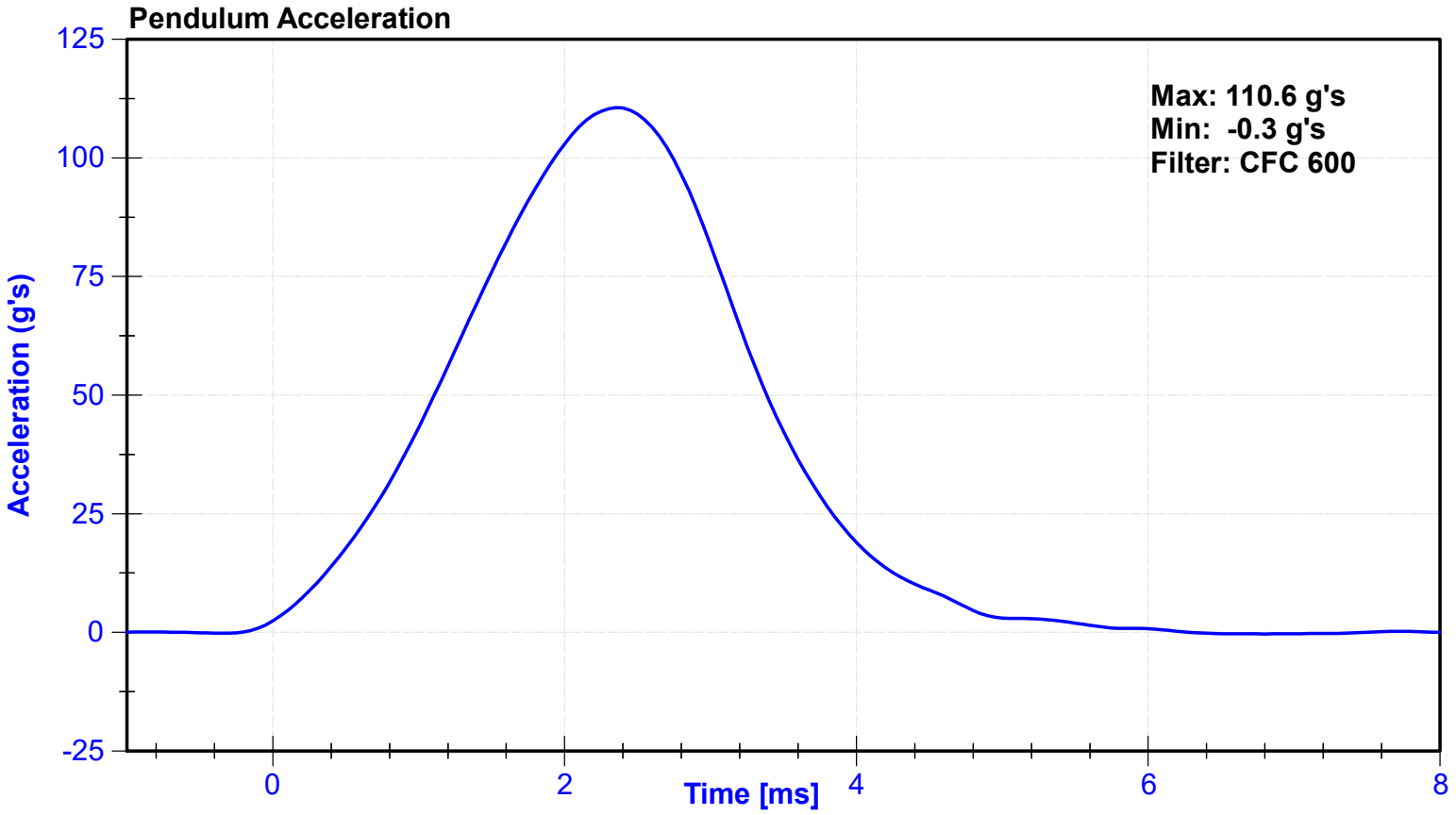
Results

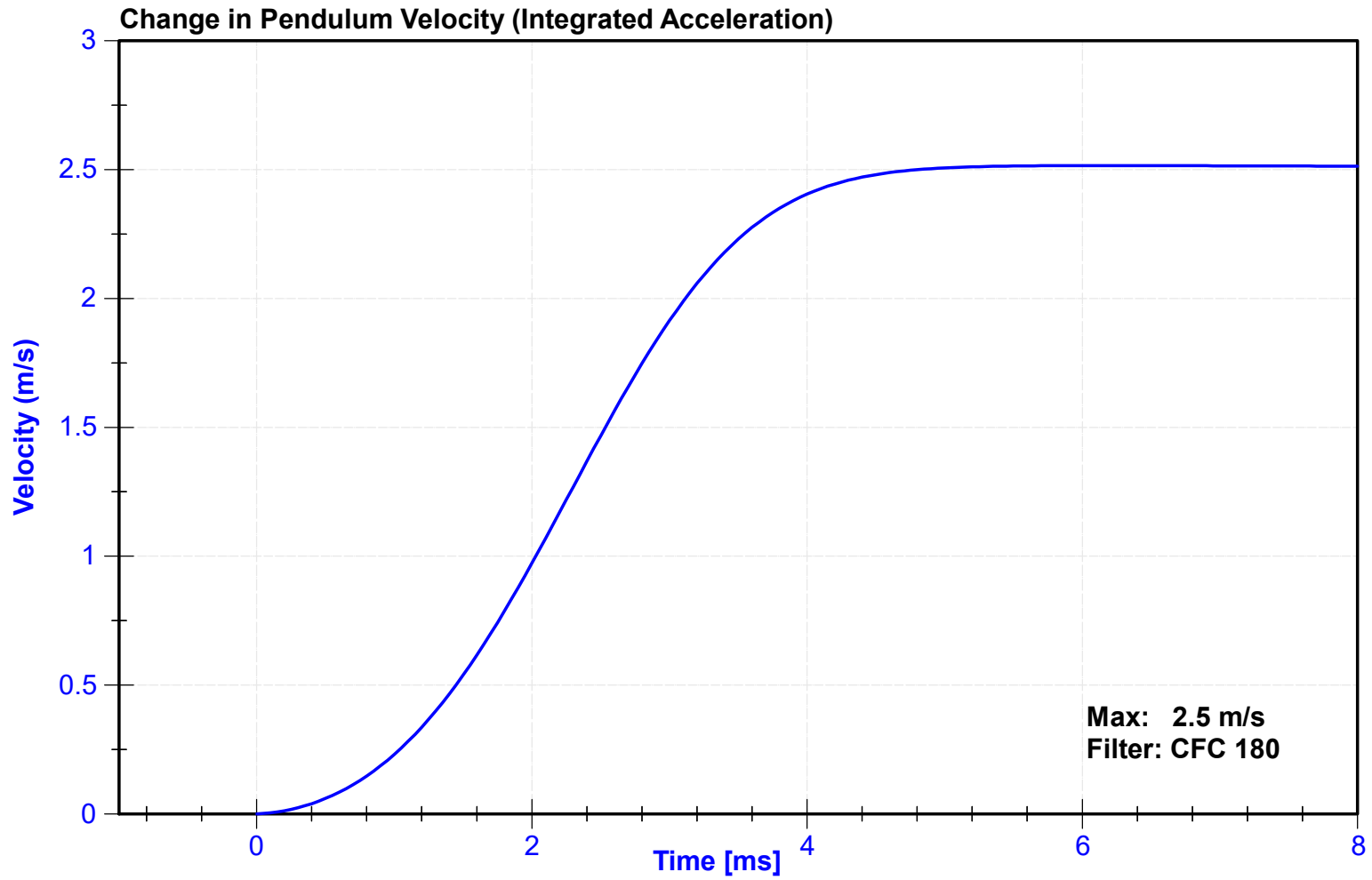
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.2	Pass
Humidity	10	70	%	47	Pass
Velocity	2.07	2.13	m/s	2.115	Pass
Maximum Resistive Force	4720	5780	N	5352.3	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18619	3/29/2024	9/25/2024




Pendulum Acceleration
Max: 110.6 g's
Min: -0.3 g's
Filter: CFC 600
Acceleration (g's)
125
100
75
50
25
0
-25
0
2
4
6
8
Time [ms]


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

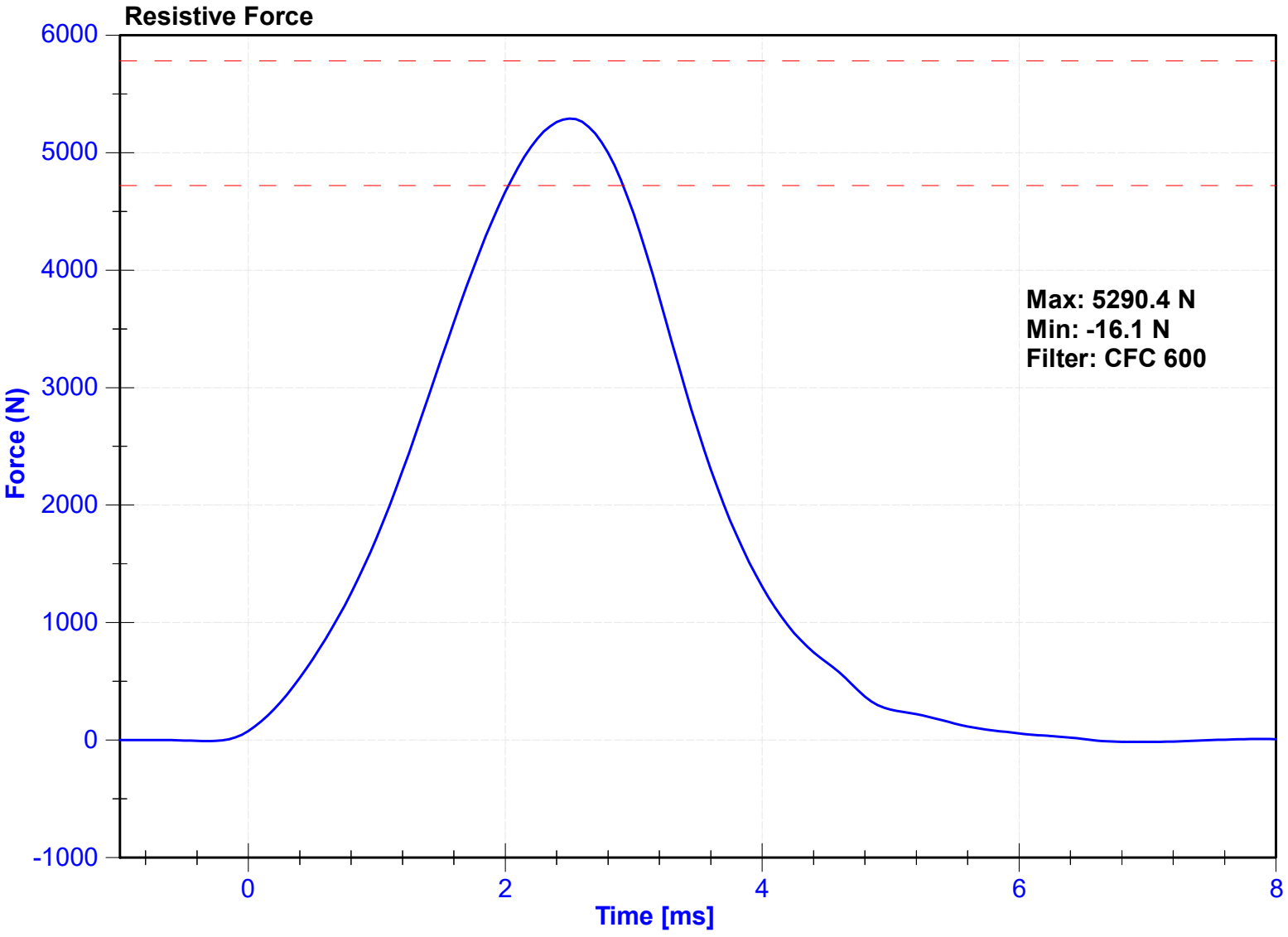
ATD Manufacturer	Humanetics	Test Technician	J. Kinderman
ATD Serial Number	065	Laboratory Supervisor	C. Mantell

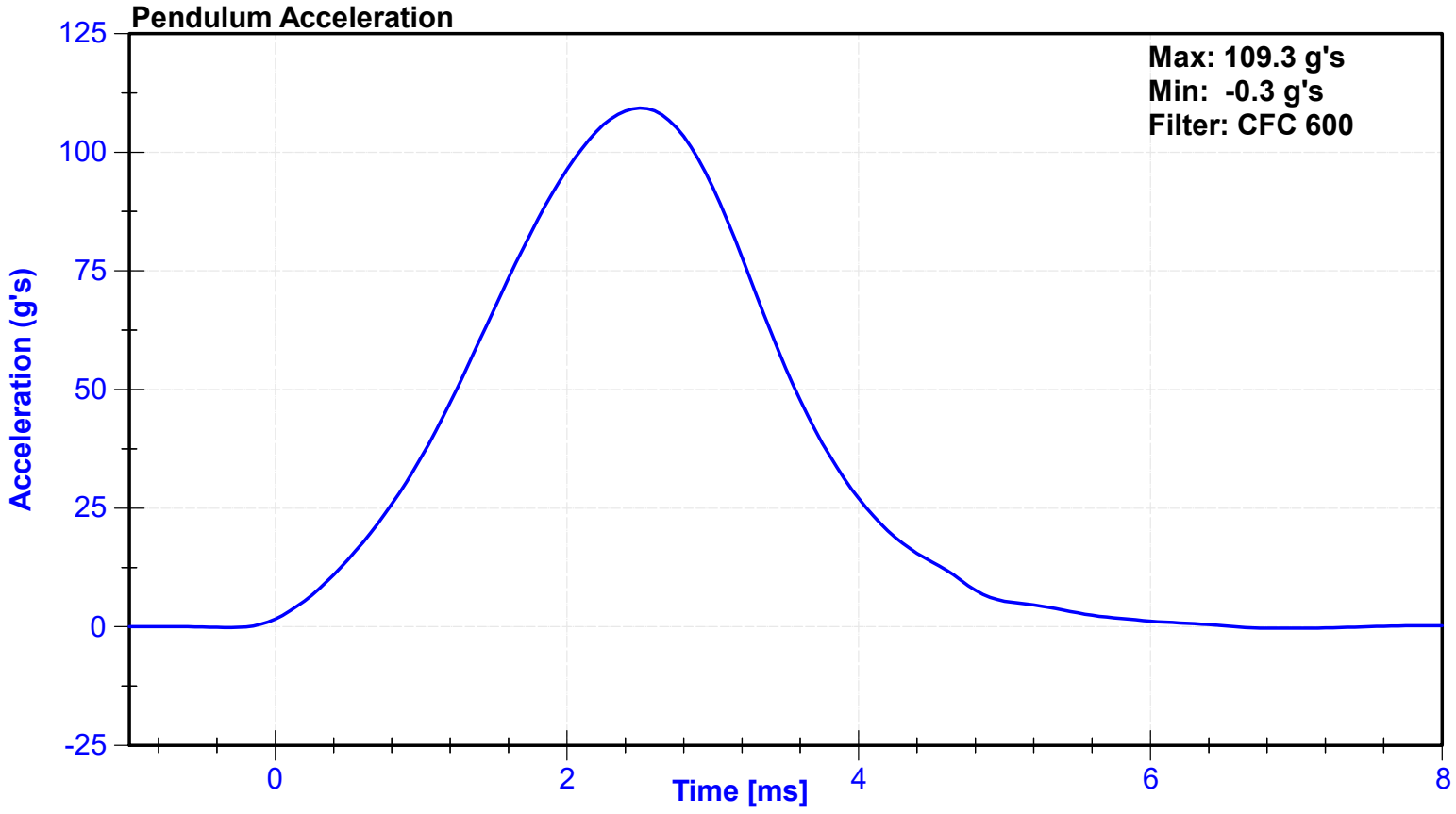
Results

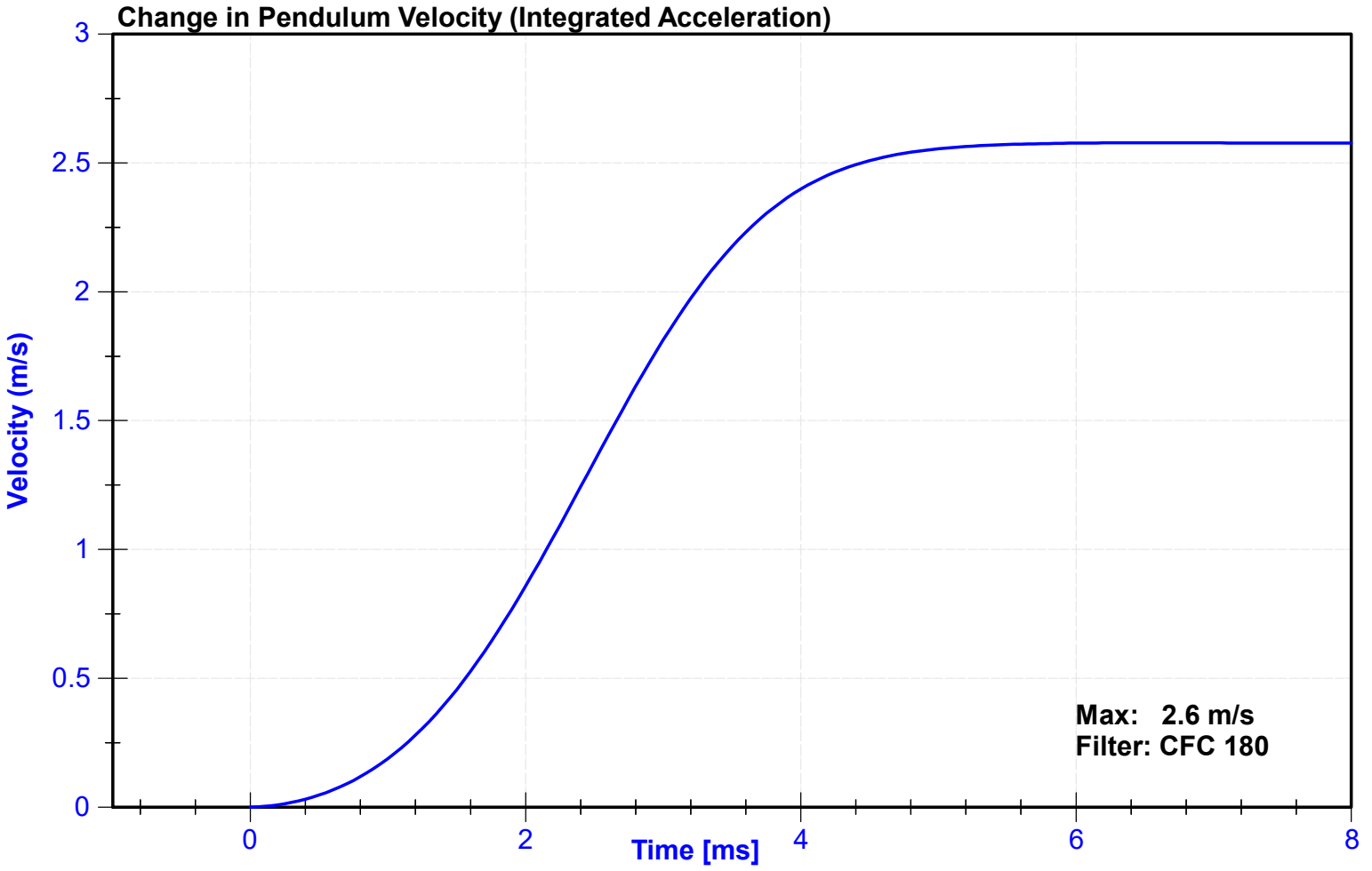
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.2	Pass
Humidity	10	70	%	47	Pass
Velocity	2.07	2.13	m/s	2.111	Pass
Maximum Resistive Force	4720	5780	N	5290.4	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18619	3/29/2024	9/25/2024




Pendulum Acceleration
Max: 109.3 g's
Min: -0.3 g's
Filter: CFC 600
Acceleration (g's)
125
100
75
50
25
0
-25
0
2
4
6
8
Time [ms]


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

CALIBRATION TEST RESULTS

POST-TEST

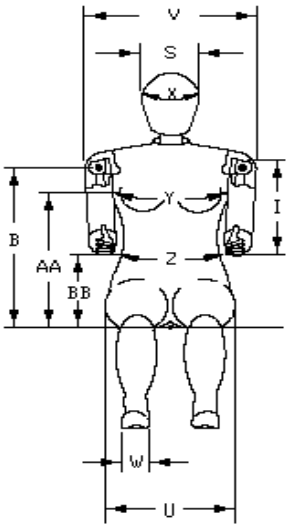
HYBRID III 5TH PERCENTILE FEMALE - PASSENGER ATD

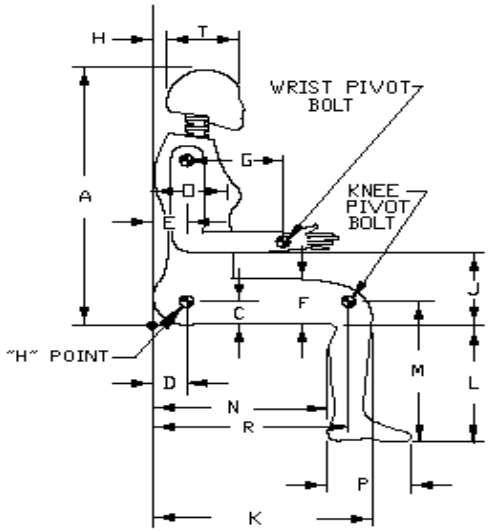
SERIAL NO: 137

External Measurements - Hybrid 3 - 5th Female

Technician: T. Roseman Date: 05/24/2024

Dummy Serial Number: 137





Symbol	Description	Specification (mm)		Result (mm)	Pass/Fail
A	Sitting Height	775	800	785	Pass
B	Shoulder Pivot Height	432	457	445	Pass
C	H-Point Height	81	86	84	Pass
D	H-Point from Backline	145	150	148	Pass
E	Shoulder Pivot from Backline	69	84	78	Pass
F	Thigh Clearance	119	135	129	Pass
G	Back of Elbow to Wrist Pivot	244	259	252	Pass
H	Head Back to Backline	43	48	45	Pass
I	Shoulder to Elbow Length	277	297	287	Pass
J	Elbow Rest Height	183	203	199	Pass
K	Buttock to Knee Length	521	546	535	Pass
L	Popliteal Height	356	376	369	Pass
M	Knee Pivot Height	394	419	409	Pass
N	Buttock Popliteal Length	414	439	429	Pass
O	Chest Depth without Jacket	175	191	185	Pass
P	Foot Length (right)	219	234	230	Pass
R	Buttock To Knee Pivot Length	457	483	466	Pass
S	Head Breadth	137	147	142	Pass
T	Head Depth	178	188	182	Pass
U	Hip Breadth	300	315	311	Pass
V	Shoulder Breadth	351	366	360	Pass
W	Foot Breadth	79	94	86	Pass
X	Head Circumference	528	549	538	Pass
Y	Chest Circumference with Jacket	851	881	872	Pass
Z	Waist Circumference	460	790	651	Pass
AA	Reference Location (Chest Circumference)	333	358	346	Pass
BB	Reference Location (Waist Circumference)	160	170	167	Pass

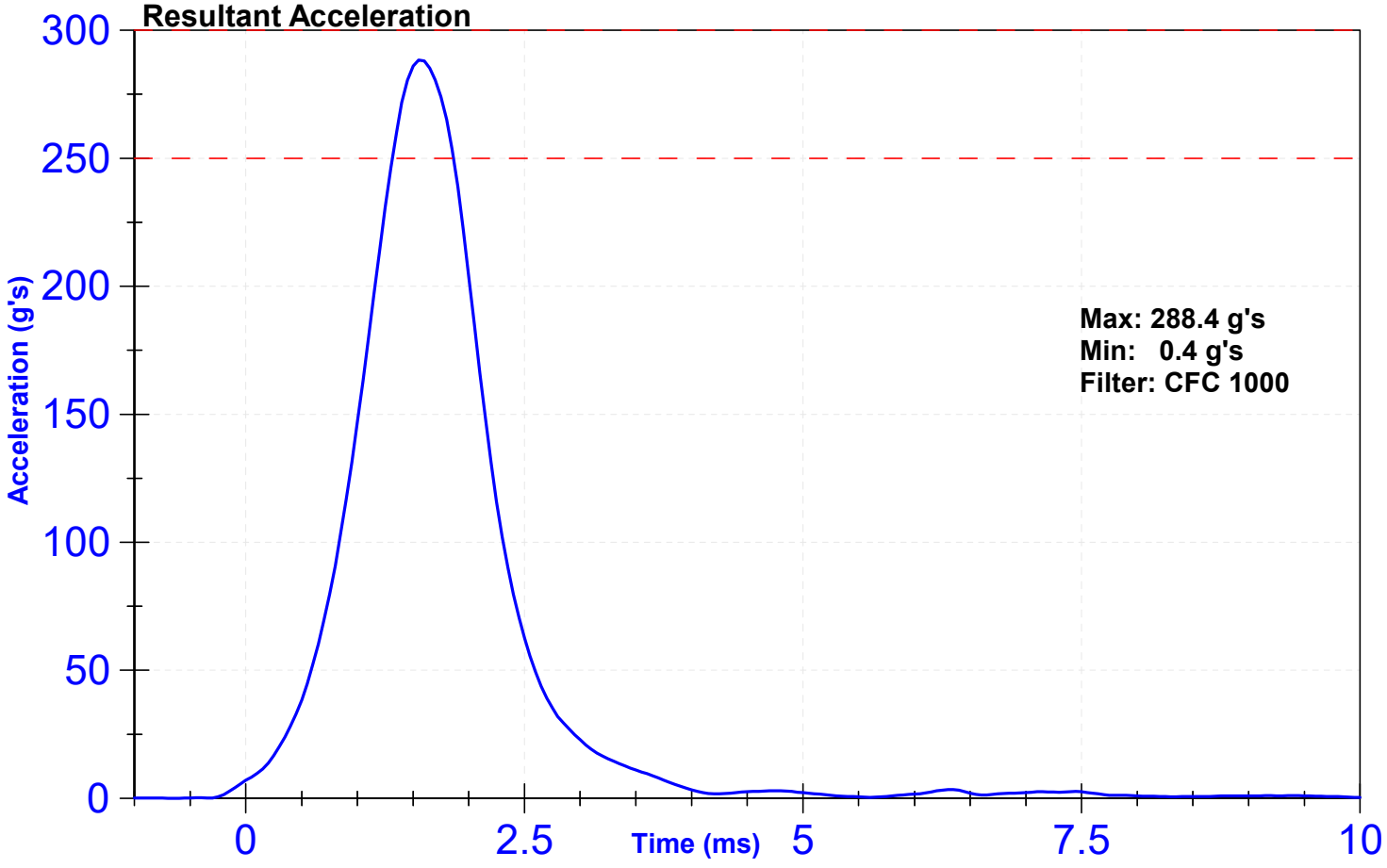
ATD Manufacturer	Humanetics	Test Technician	T. Roseman
ATD Serial Number	137	Laboratory Supervisor	C. Mantell

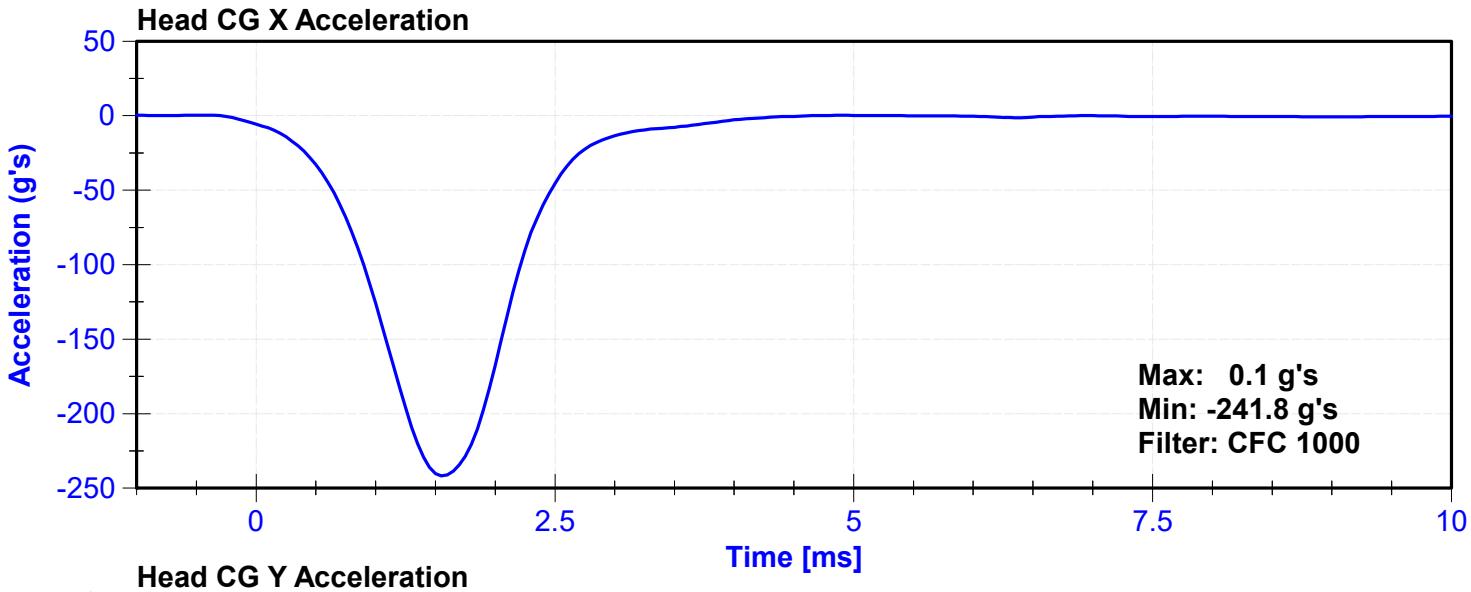
Results

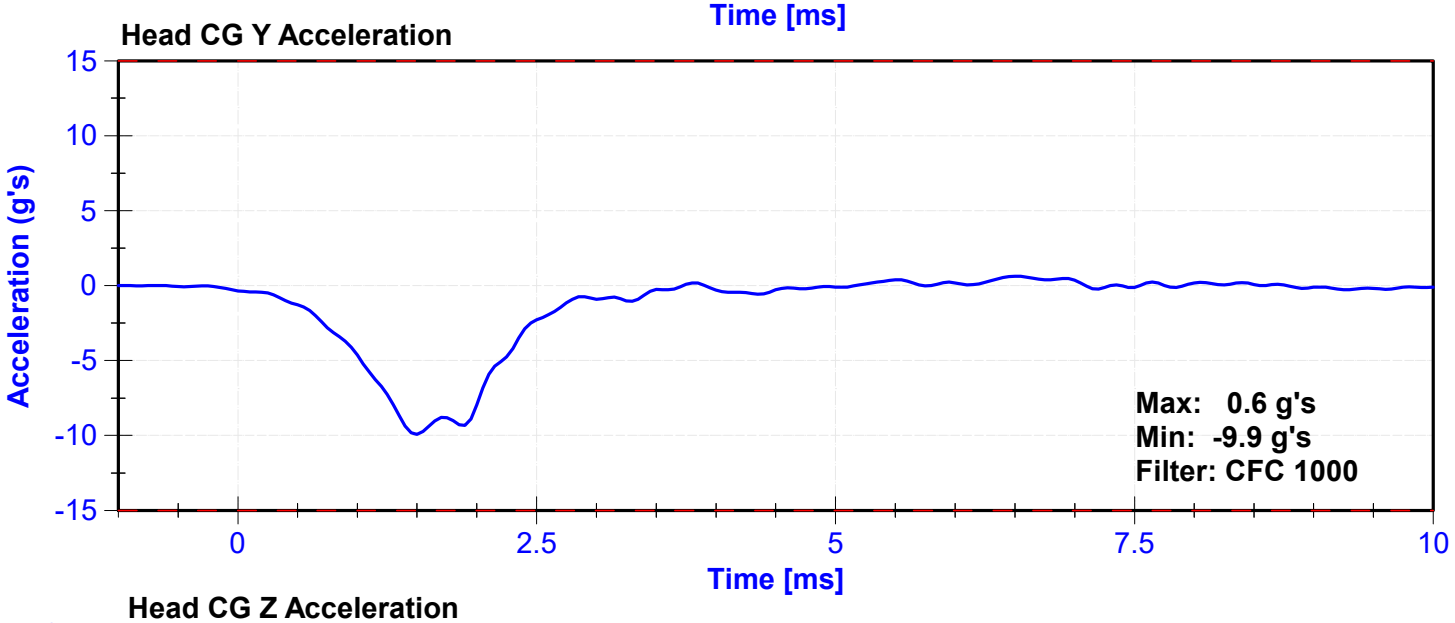
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	22.0	Pass
Humidity	10	70	%	45	Pass
Resultant Acceleration	250	300	g's	288.4	Pass
Oscillation	0	10	%	1.4	Pass
Lateral Acceleration	-15	15	g's	-9.9	Pass

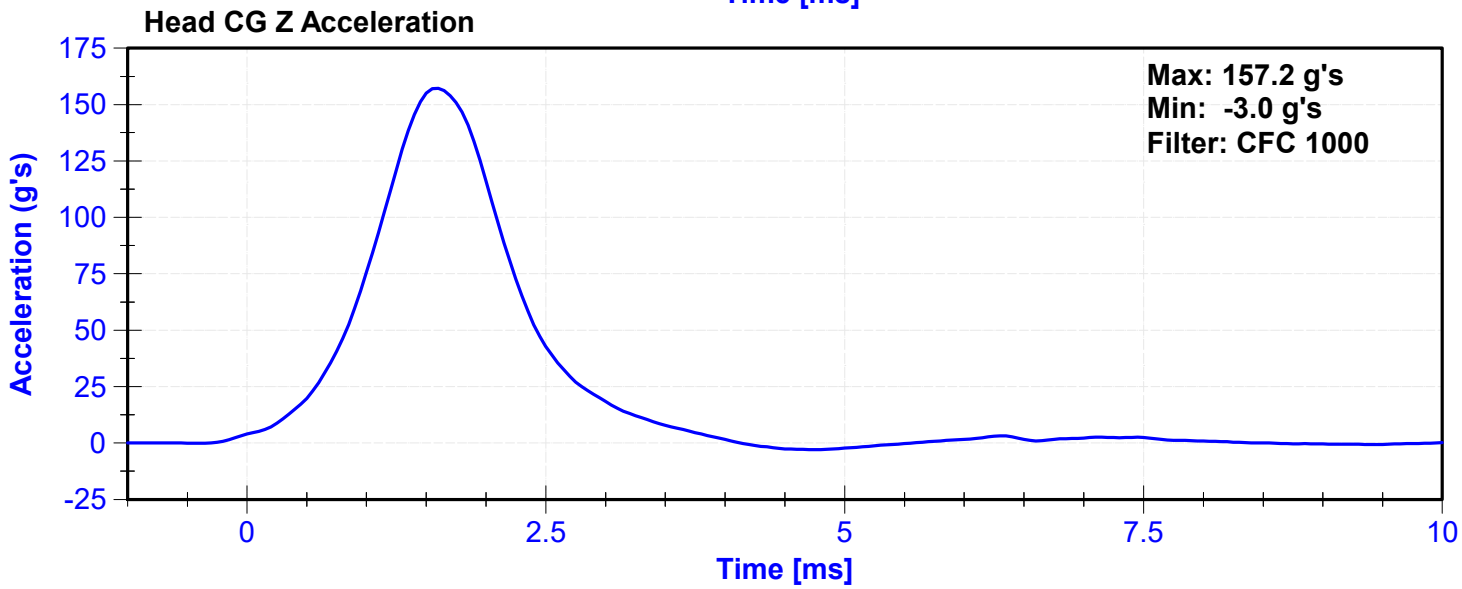
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	Endevco	P79417	1/4/2024	7/2/2024
Y Accelerometer	Endevco	P83335	1/4/2024	7/2/2024
Z Accelerometer	Endevco	P64149	1/4/2024	7/2/2024




Head CG X Acceleration
Acceleration (g's)
50
0
-50
-100
-150
-200
-250
0
2.5
5
7.5
10
Time [ms]
Max: 0.1 g's
Min: -241.8 g's
Filter: CFC 1000


Head CG Y Acceleration
Acceleration (g's)
15
10
5
0
-5
-10
-15
0
2.5
5
7.5
10
Time [ms]
Max: 0.6 g's
Min: -9.9 g's
Filter: CFC 1000


Head CG Z Acceleration
Acceleration (g's)
175
150
125
100
75
50
25
0
-25
0
2.5
5
7.5
10
Time [ms]
Max: 157.2 g's
Min: -3.0 g's
Filter: CFC 1000

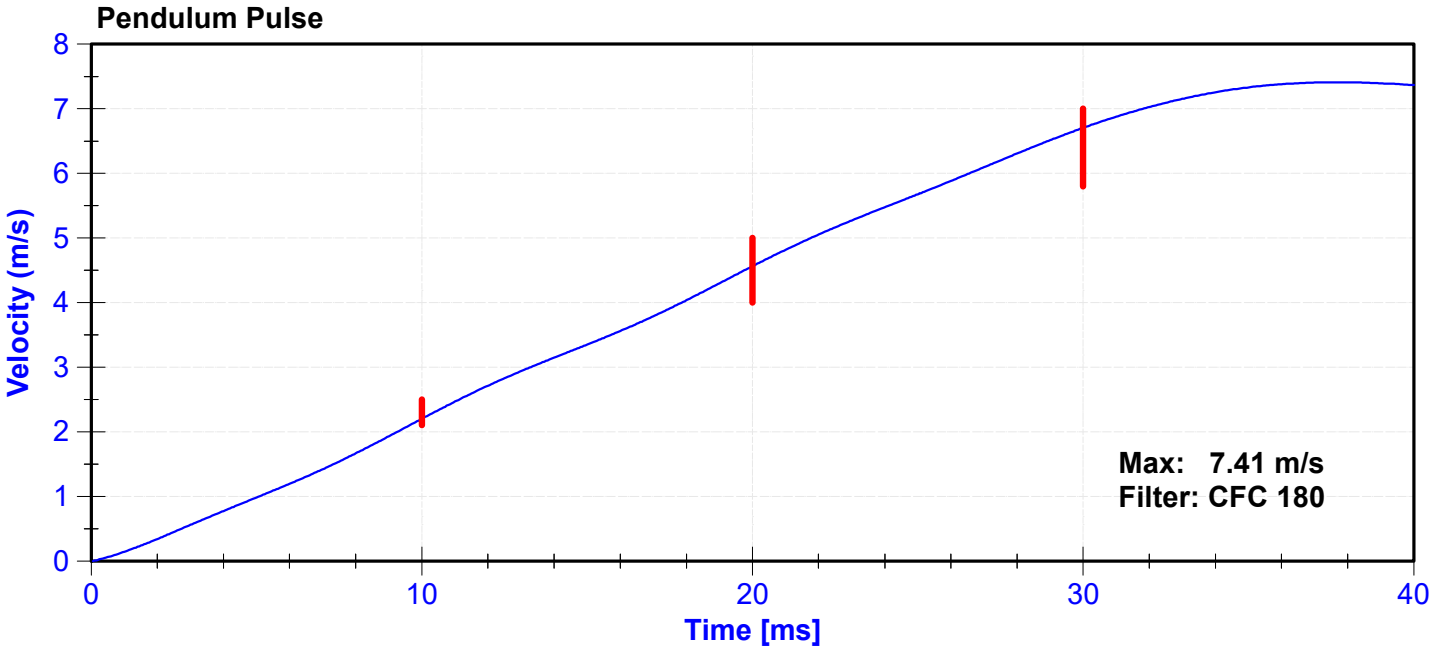
ATD Manufacturer	Humanetics	Test Technician	T. Roseman
ATD Serial Number	137	Laboratory Supervisor	C. Mantell

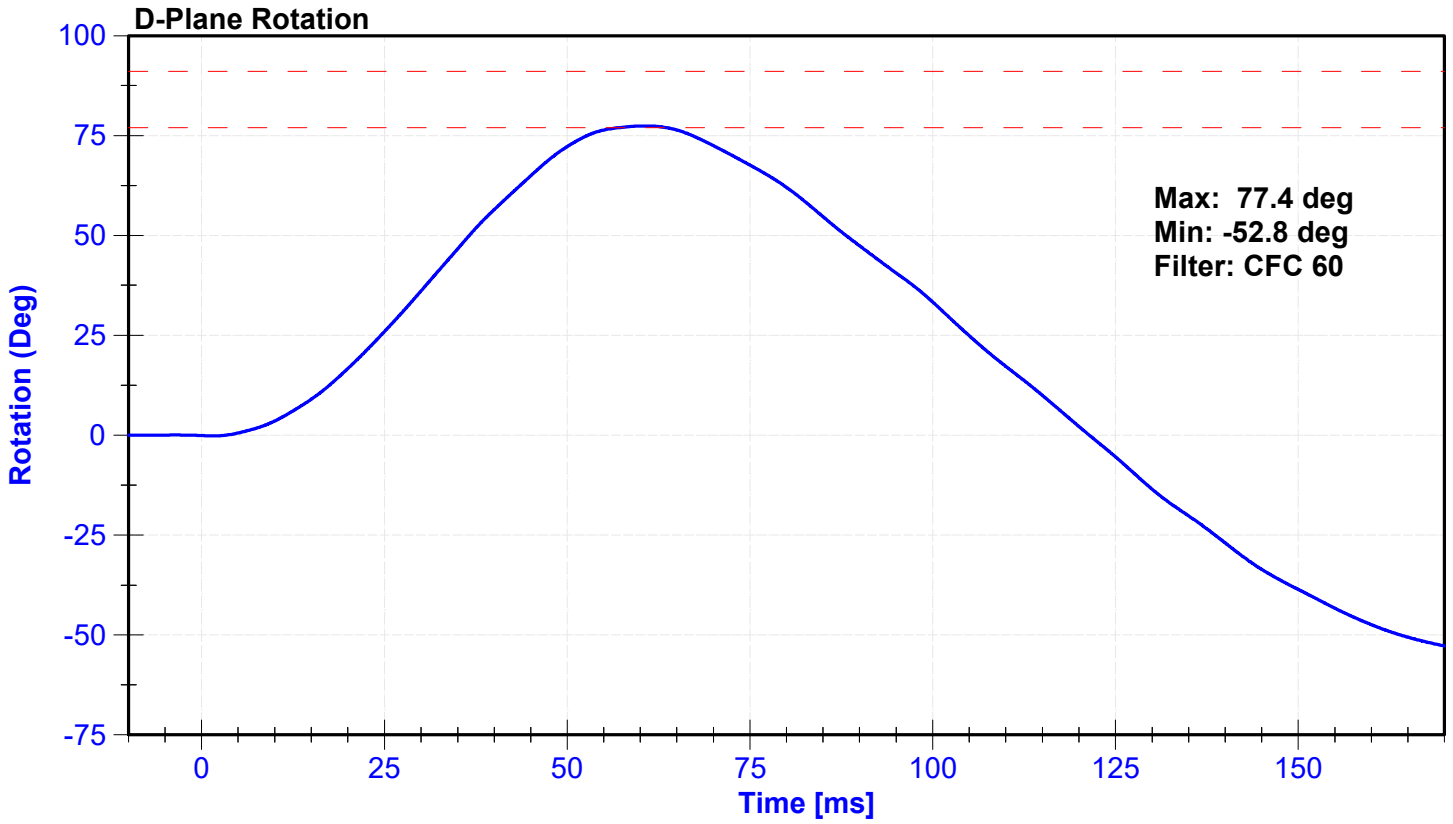
Results

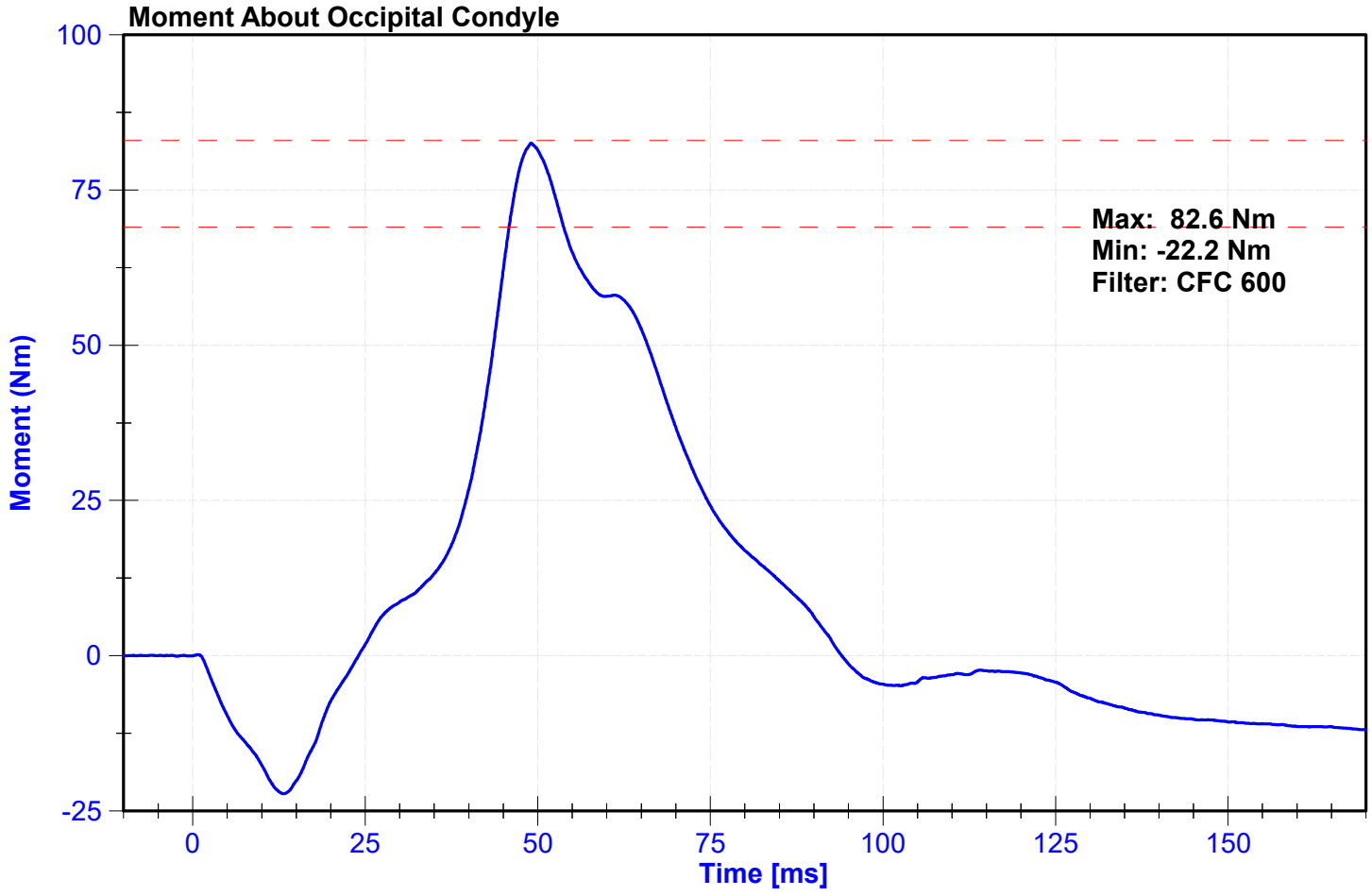
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.9	Pass
Humidity	10	70	%	43	Pass
Velocity	6.89	7.13	m/s	7.020	Pass
Pendulum Impulse at 10ms	2.1	2.5	m/s	2.20	Pass
Pendulum Impulse at 20ms	4.0	5.0	m/s	4.56	Pass
Pendulum Impulse at 30ms	5.8	7.0	m/s	6.70	Pass
Max D Plane Rotation	77	91	deg	77.4	Pass
Max Moment During Rotation Interval	69	83	Nm	82.6	Pass
Moment Decay to 10.0 Nm	80	100	ms	86.9	Pass

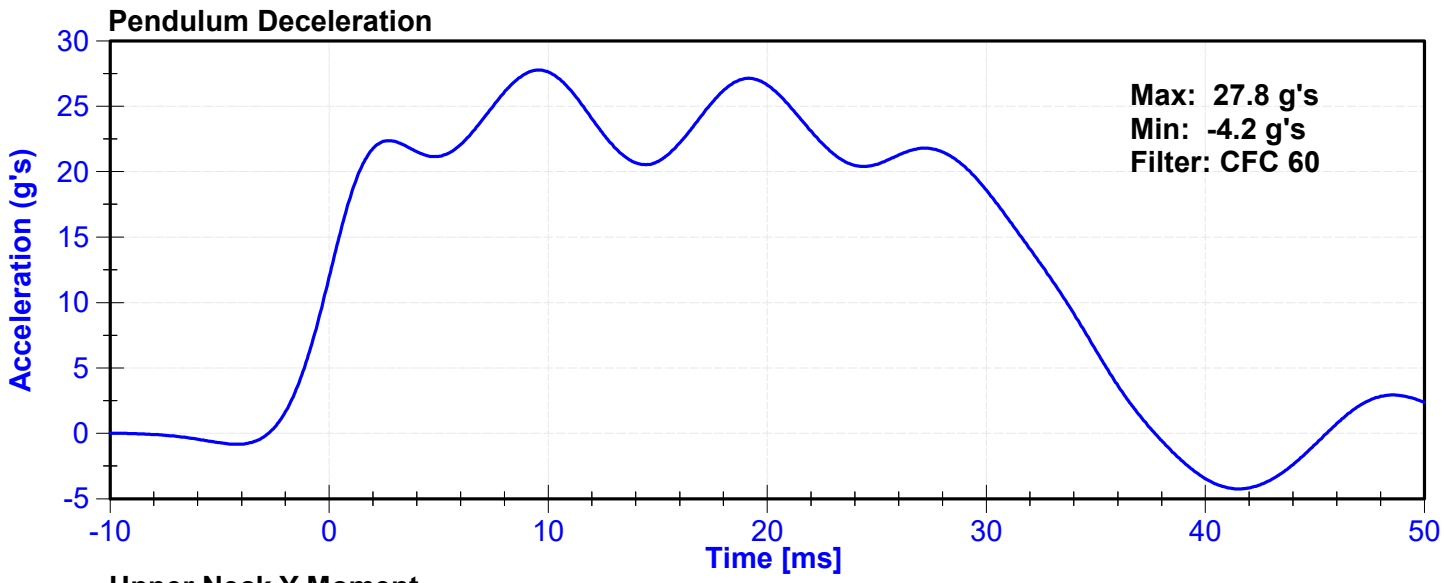
Transducer Calibrations

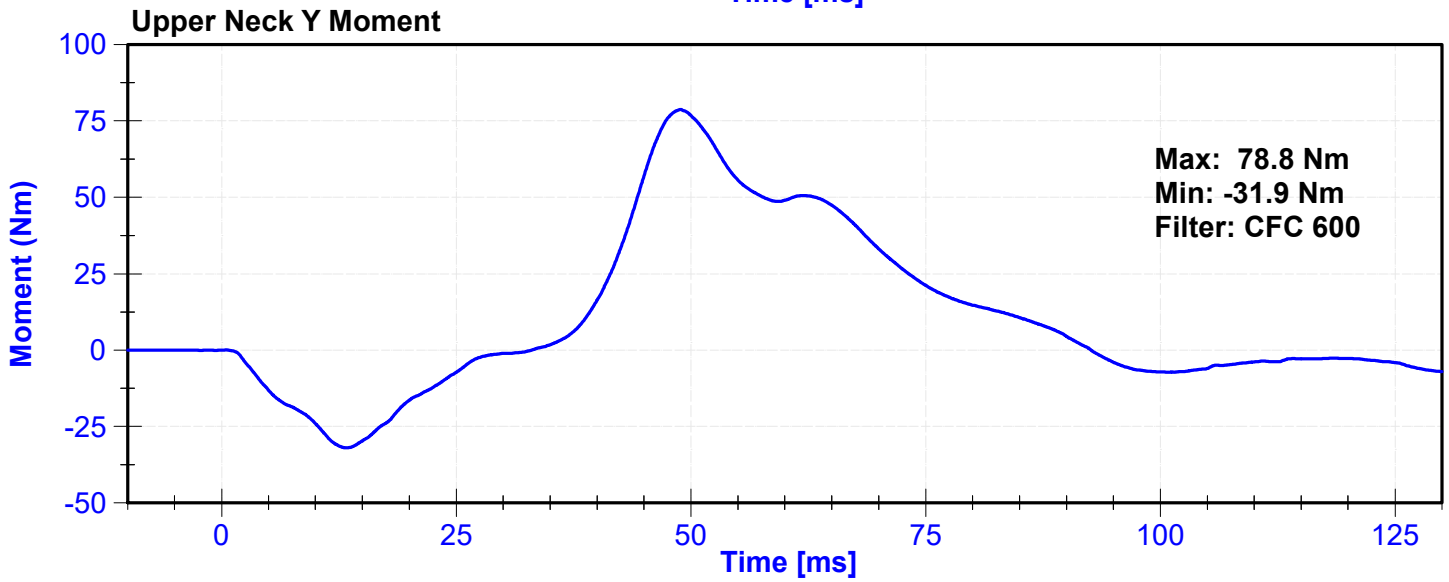
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	C16650	10/31/2023	10/30/2024
Pendulum Potentiometer	ETI	SP22G_LABPOT1	5/7/2024	5/7/2025
Condyle Potentiometer	ETI	SP22G_LABPOT2	5/7/2024	5/7/2025
Upper Neck Load Cell	Humanetics	2019-FX	9/12/2023	9/11/2024

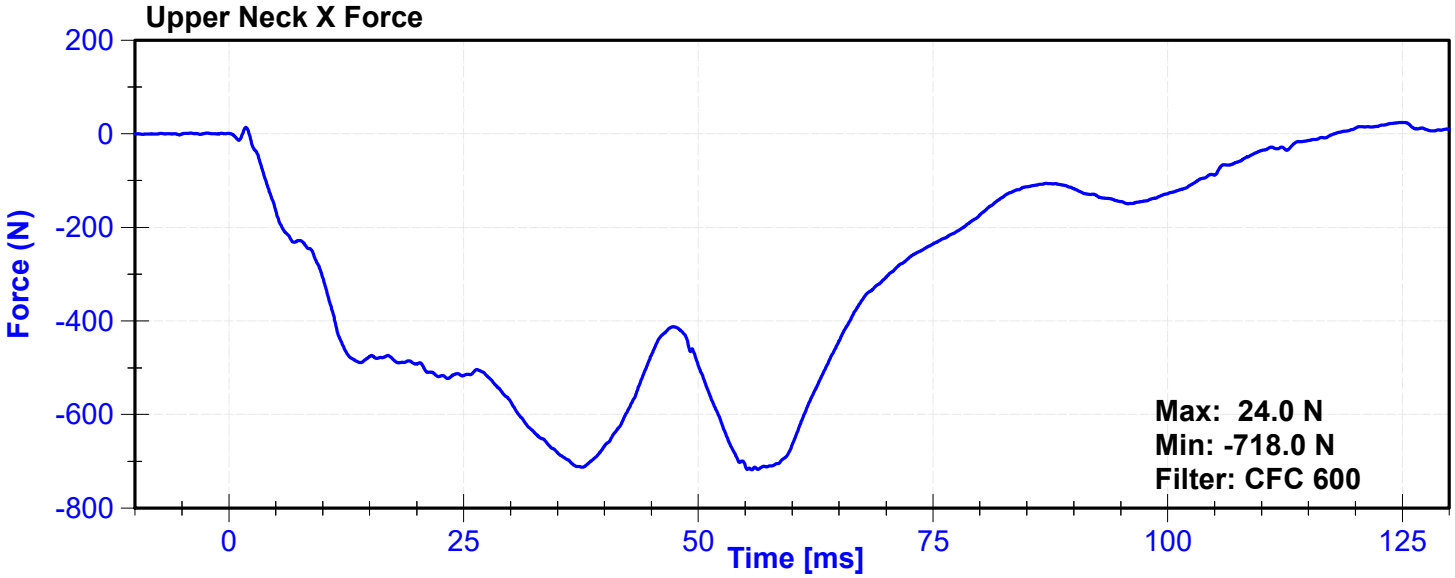



D-Plane Rotation
Max: 77.4 deg
Min: -52.8 deg
Filter: CFC 60
Rotation (Deg)
Time [ms]
100
75
50
25
0
-25
-50
-75
0
25
50
75
100
125
150


Moment About Occipital Condyle
Max: 82.6 Nm
Min: -22.2 Nm
Filter: CFC 600
Moment (Nm)
Time [ms]
100
75
50
25
0
-25
0
25
50
75
100
125
150


Pendulum Deceleration
Acceleration (g's)
Time [ms]
Max: 27.8 g's
Min: -4.2 g's
Filter: CFC 60


Upper Neck Y Moment
Moment (Nm)
Time [ms]
Max: 78.8 Nm
Min: -31.9 Nm
Filter: CFC 600


Upper Neck X Force
Force (N)
Time [ms]
Max: 24.0 N
Min: -718.0 N
Filter: CFC 600

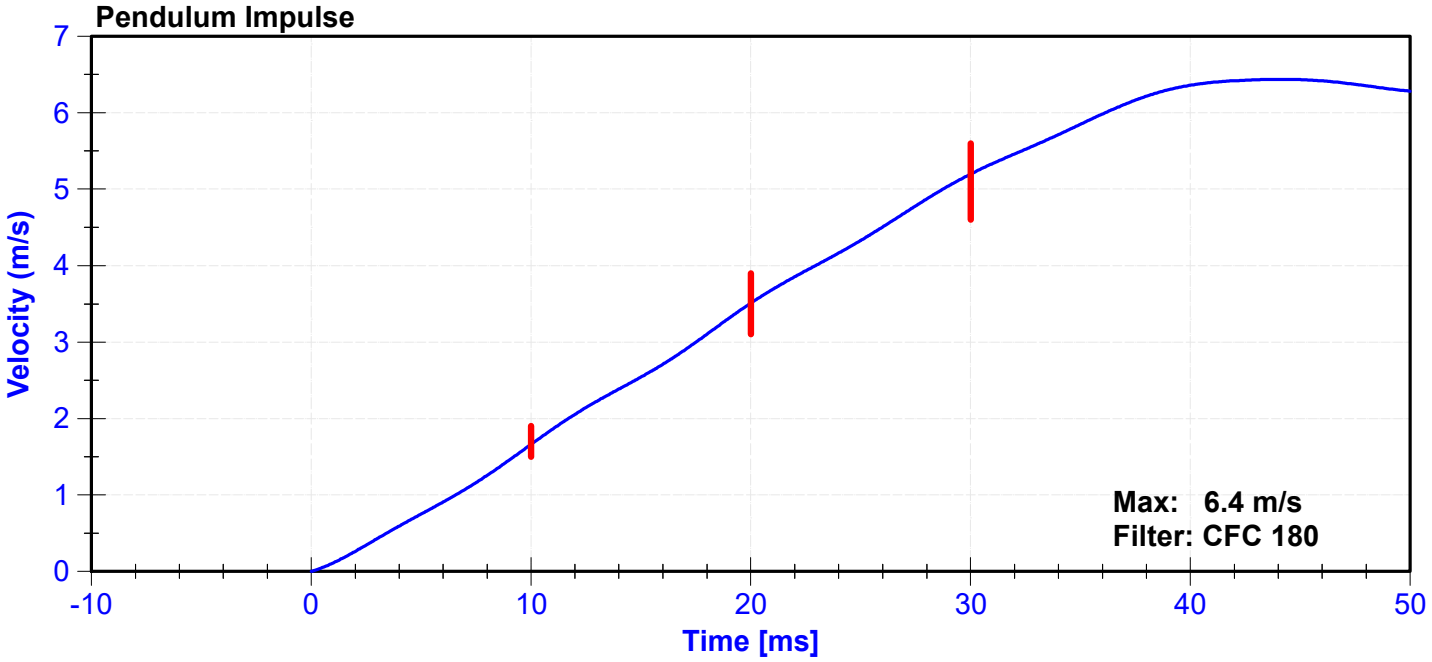
ATD Manufacturer	Humanetics	Test Technician	T. Roseman
ATD Serial Number	137	Laboratory Supervisor	C. Mantell

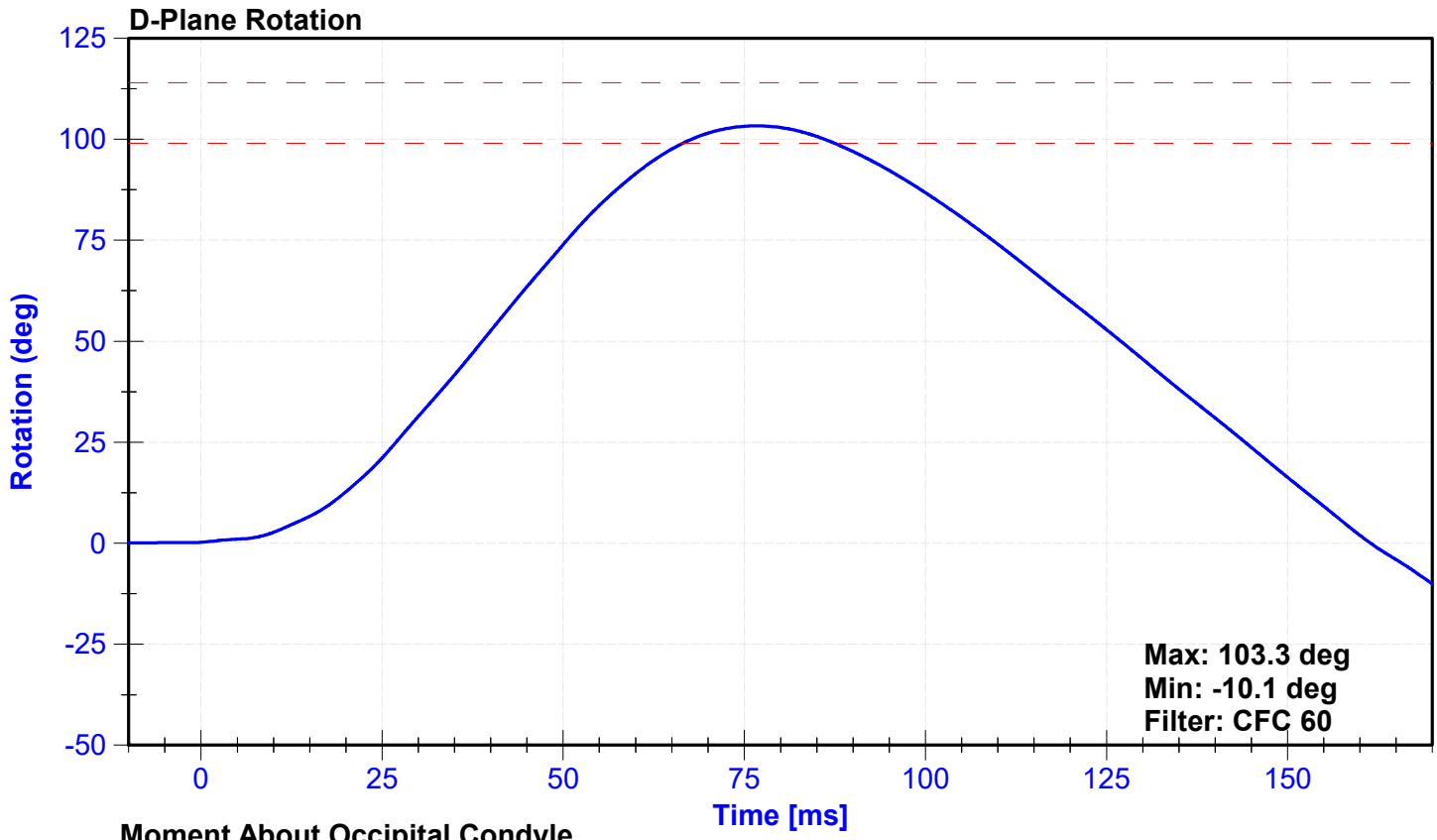
Results

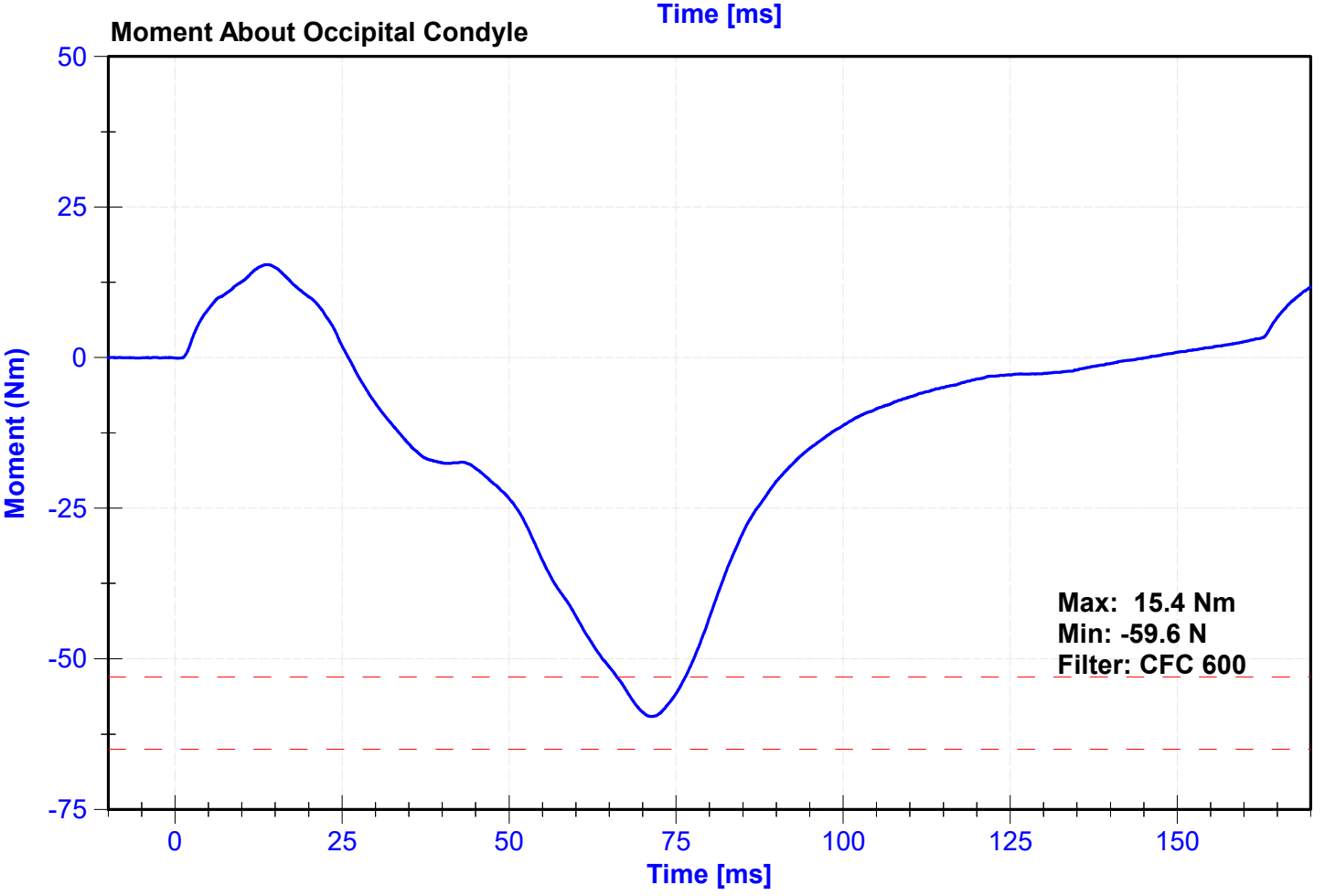
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.9	Pass
Humidity	10	70	%	43	Pass
Velocity	5.95	6.19	m/s	6.114	Pass
Pendulum Impulse at 10ms	1.5	1.9	m/s	1.66	Pass
Pendulum Impulse at 20ms	3.1	3.9	m/s	3.51	Pass
Pendulum Impulse at 30ms	4.6	5.6	m/s	5.20	Pass
D Plane Rotation	99	114	deg	103.3	Pass
Moment During Rotation Interval	-65	-53	Nm	-59.6	Pass
Moment Decay to -10Nm	94	114	ms	101.9	Pass

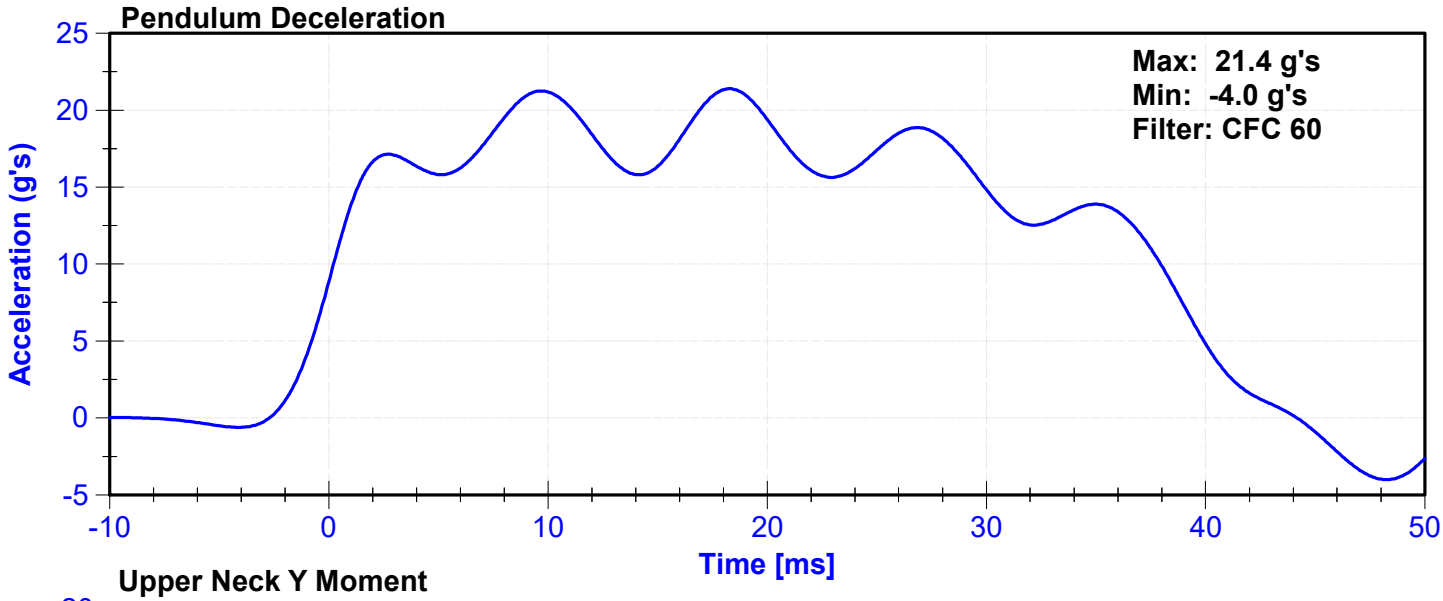
Transducer Calibrations

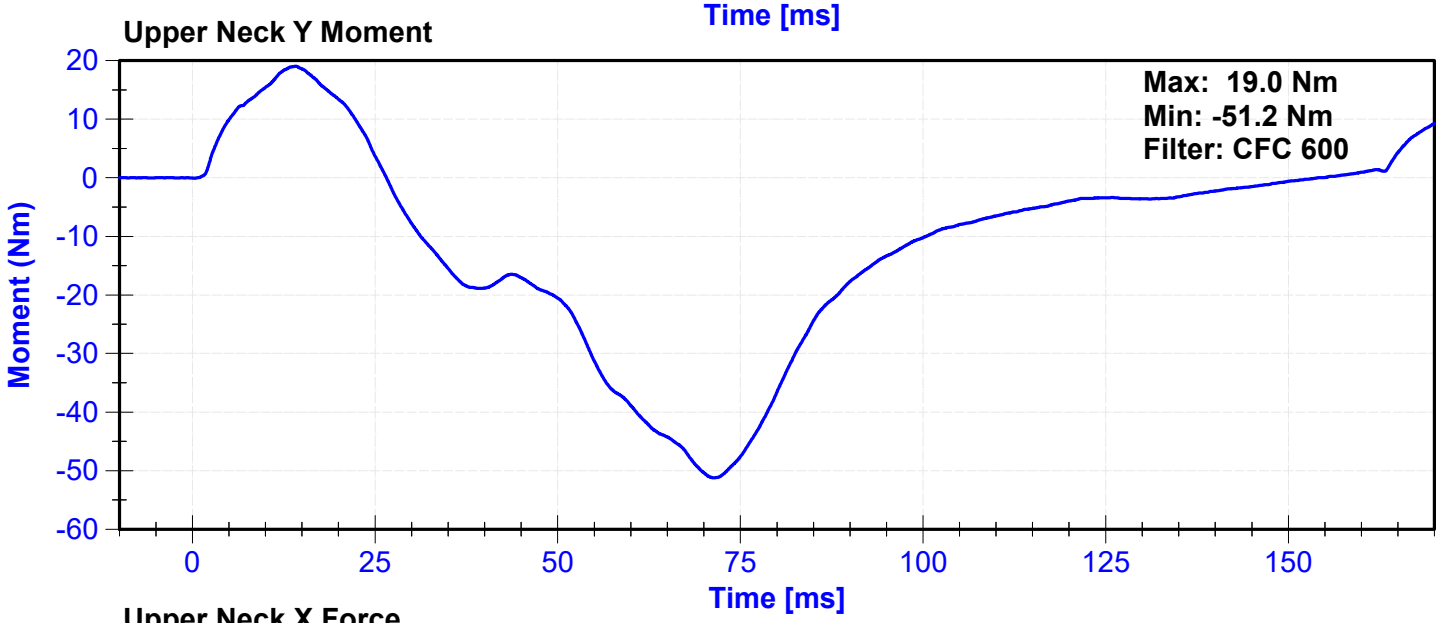
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	C16650	10/31/2023	10/30/2024
Pendulum Potentiometer	ETI	SP22G_LABPOT1	5/7/2024	5/7/2025
Condyle Potentiometer	ETI	SP22G_LABPOT2	5/7/2024	5/7/2025
Upper Neck Load Cell	Humanetics	2019-FX	9/12/2023	9/11/2024

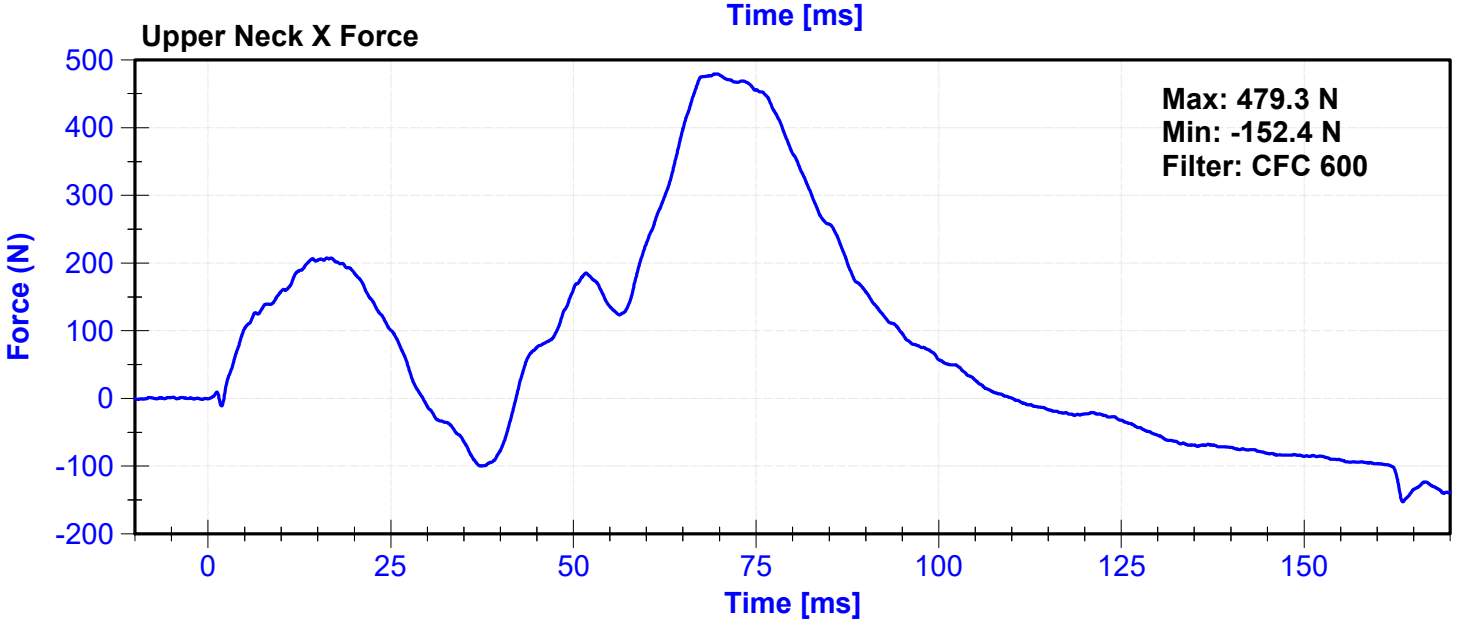



D-Plane Rotation
Rotation (deg)
125
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]
Max: 103.3 deg
Min: -10.1 deg
Filter: CFC 60


Moment About Occipital Condyle
Moment (Nm)
50
25
0
-25
-50
-75
0
25
50
75
100
125
150
Time [ms]
Max: 15.4 Nm
Min: -59.6 N
Filter: CFC 600


Pendulum Deceleration
Max: 21.4 g's
Min: -4.0 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: 19.0 Nm
Min: -51.2 Nm
Filter: CFC 600
Moment (Nm)
20
10
0
-10
-20
-30
-40
-50
-60
0
25
50
75
100
125
150
Time [ms]


Upper Neck X Force
Max: 479.3 N
Min: -152.4 N
Filter: CFC 600
Force (N)
500
400
300
200
100
0
-100
-200
0
25
50
75
100
125
150
Time [ms]

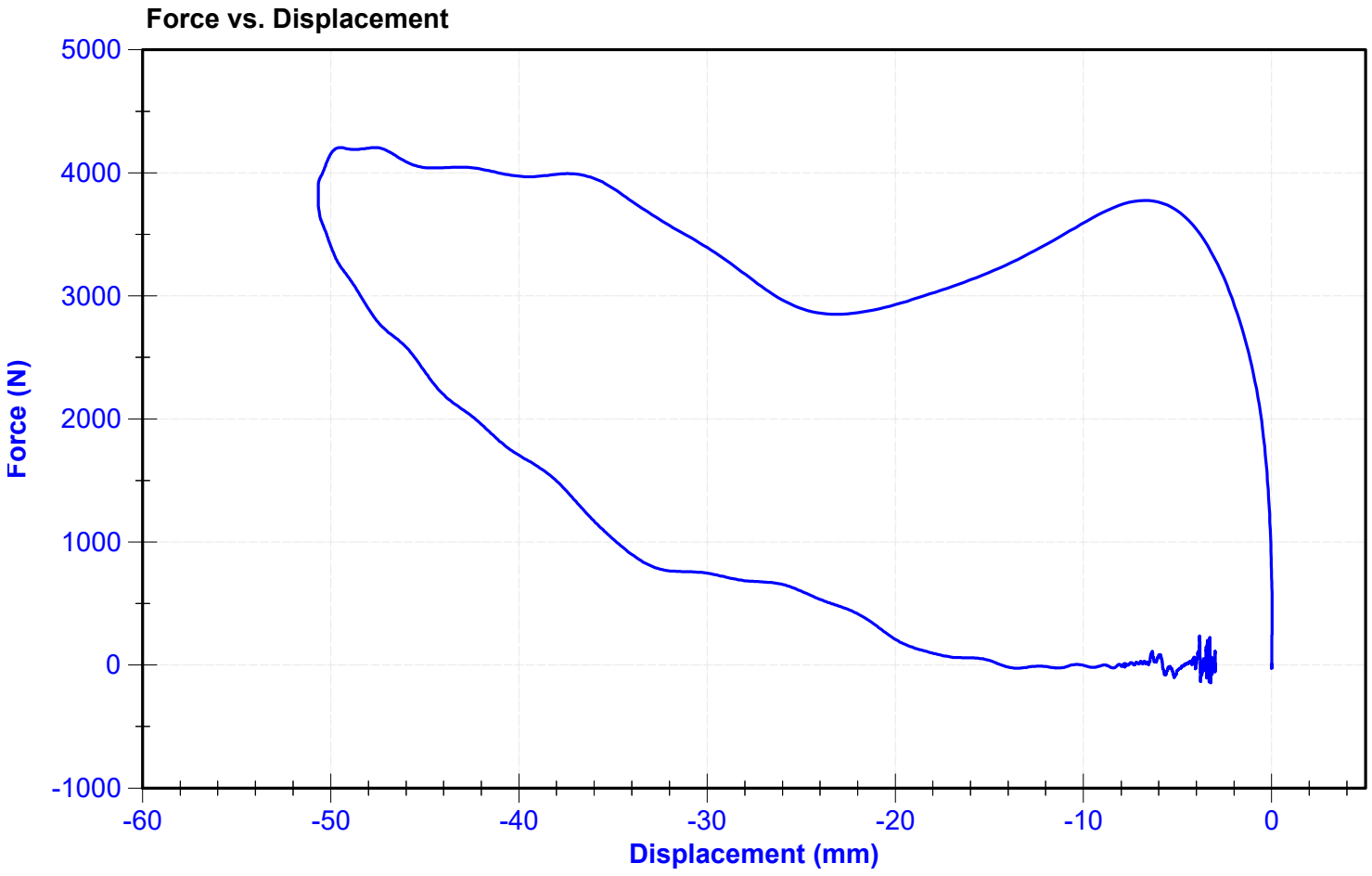
ATD Manufacturer	Humanetics	Test Technician	T. Roseman
ATD Serial Number	137	Laboratory Supervisor	C. Mantel

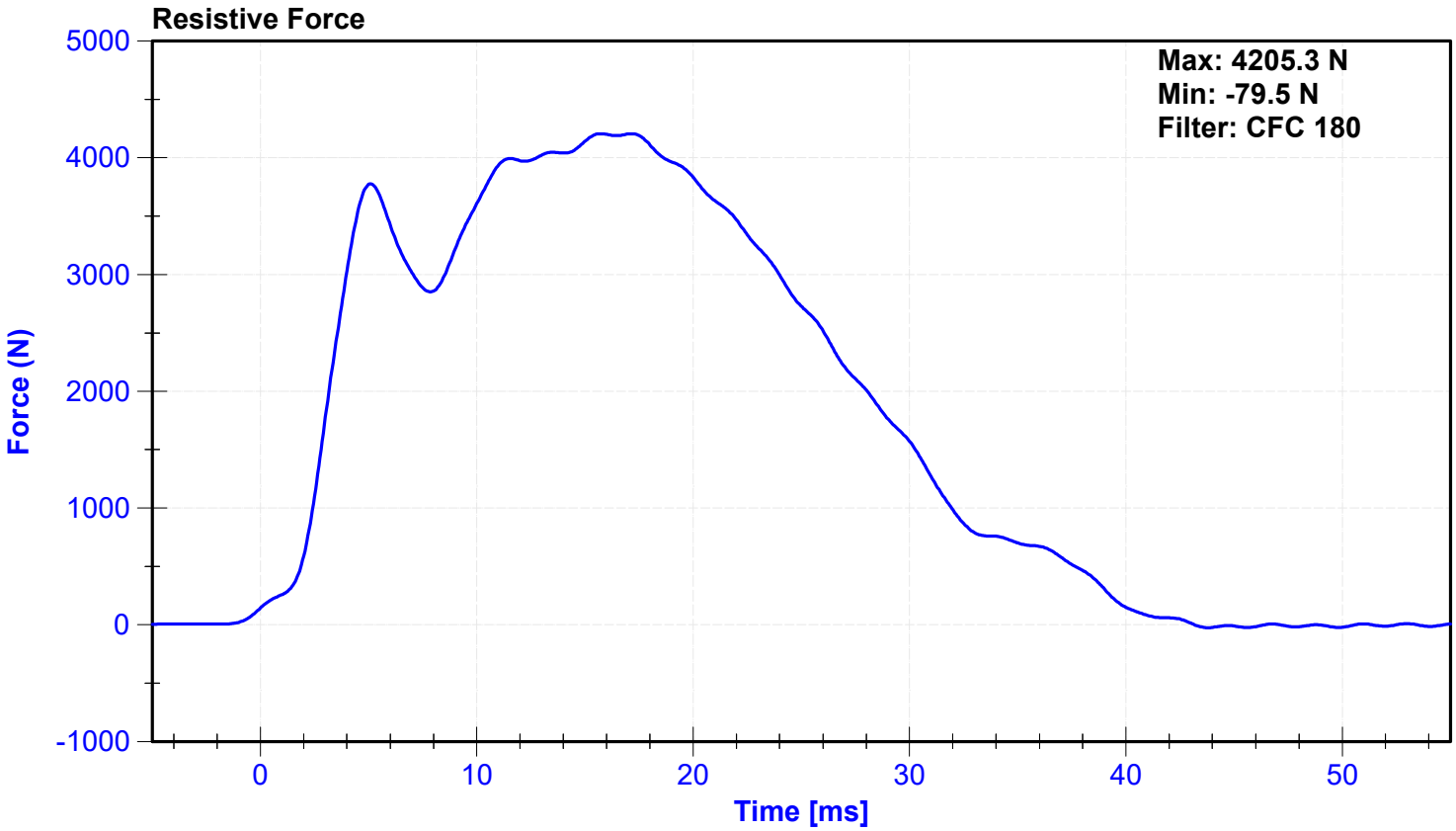
Results

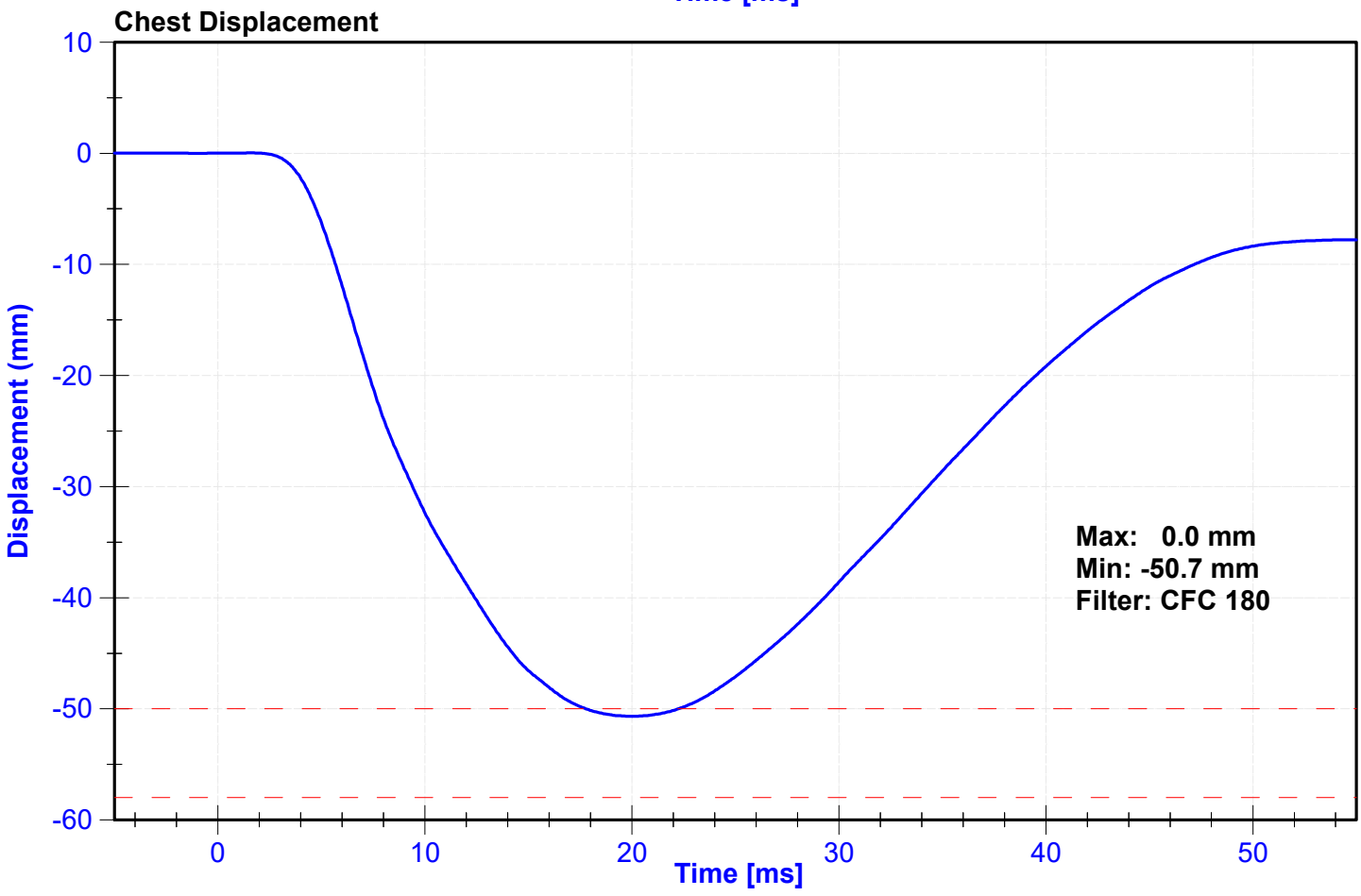
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.9	Pass
Humidity	10	70	%	47	Pass
Velocity	6.59	6.83	m/s	6.686	Pass
Chest Deflection	-58	-50	mm	-50.7	Pass
Maximum Resistive Force (50 to 58mm)	3900	4400	N	4156.8	Pass
Maximum Resistive Force (18 to 50mm)	0	4600	N	4205.3	Pass
Hysteresis	69	85	%	75.2	Pass

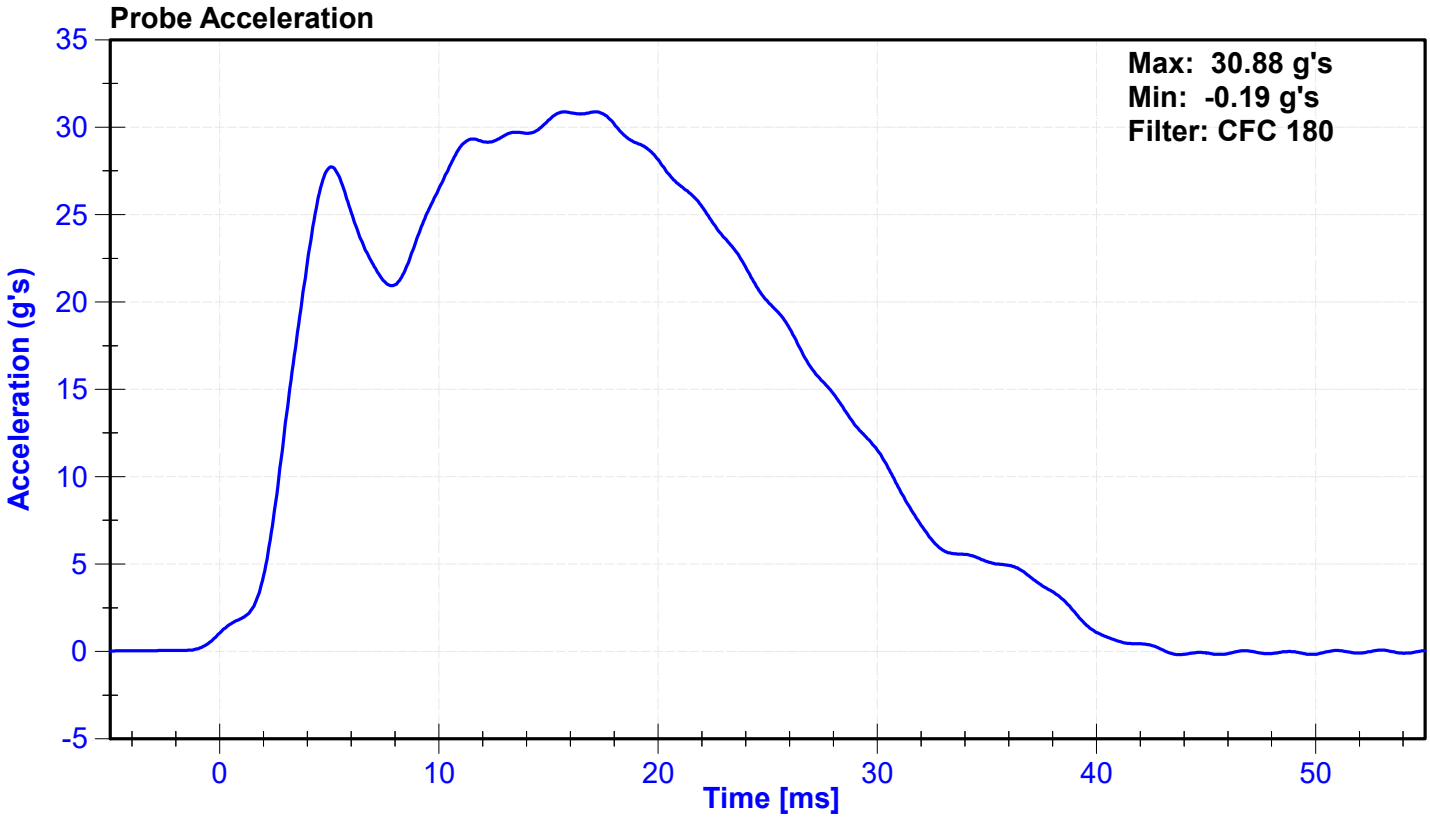
Transducer Calibrations

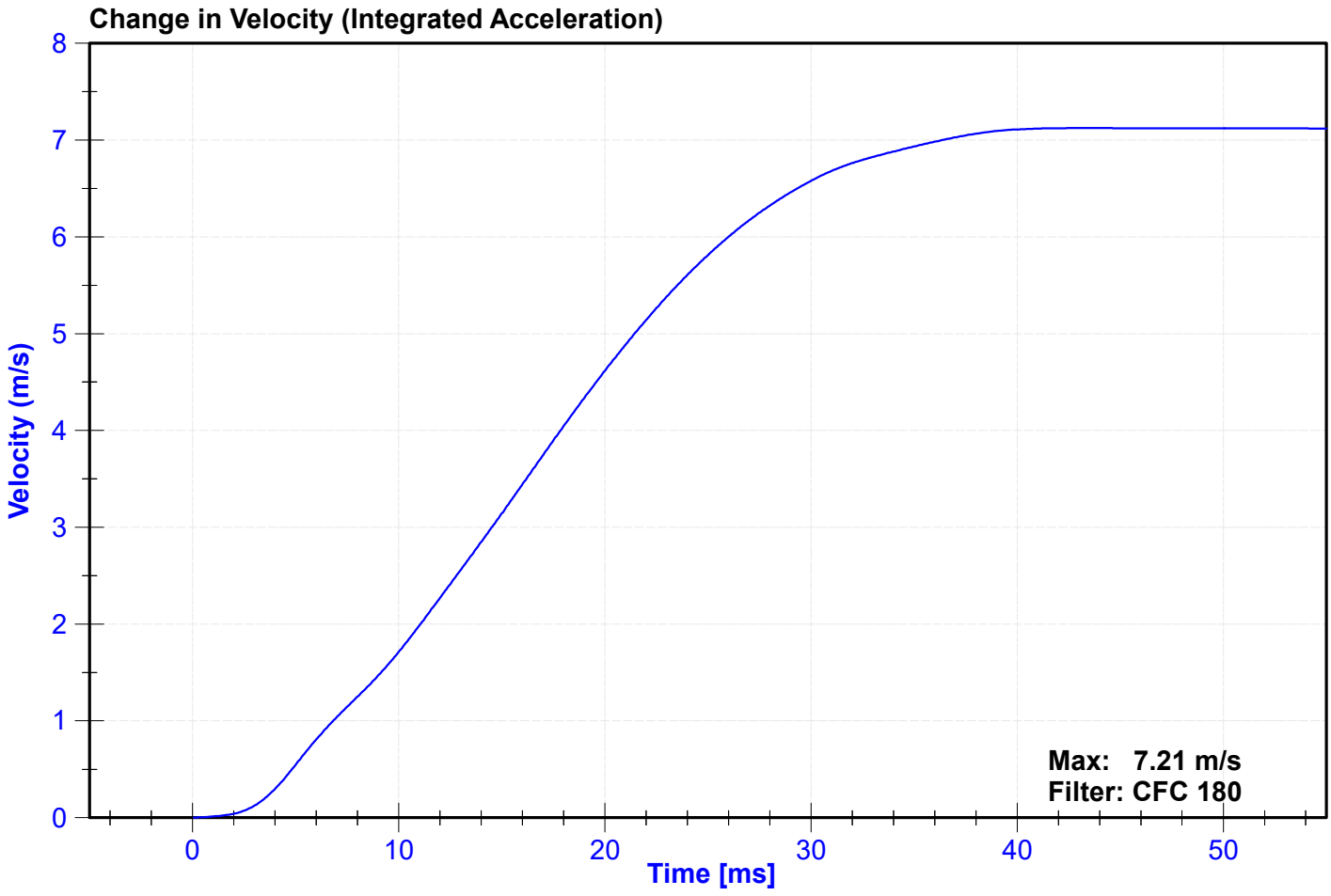
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18619	3/29/2024	9/25/2024
Chest Potentiometer	Servo	0720	1/5/2024	7/5/2024




Resistive Force
Max: 4205.3 N
Min: -79.5 N
Filter: CFC 180
Force (N)
5000
4000
3000
2000
1000
0
-1000
0
10
20
30
40
50
Time [ms]


Chest Displacement
Max: 0.0 mm
Min: -50.7 mm
Filter: CFC 180
Displacement (mm)
10
0
-10
-20
-30
-40
-50
-60
0
10
20
30
40
50
Time [ms]


Probe Acceleration
Max: 30.88 g's
Min: -0.19 g's
Filter: CFC 180
Acceleration (g's)
35
30
25
20
15
10
5
0
-5
0
10
20
30
40
50
Time [ms]


Change in Velocity (Integrated Acceleration)
Velocity (m/s)
8
7
6
5
4
3
2
1
0
Max: 7.21 m/s
Filter: CFC 180
0
10
20
30
40
50
Time [ms]

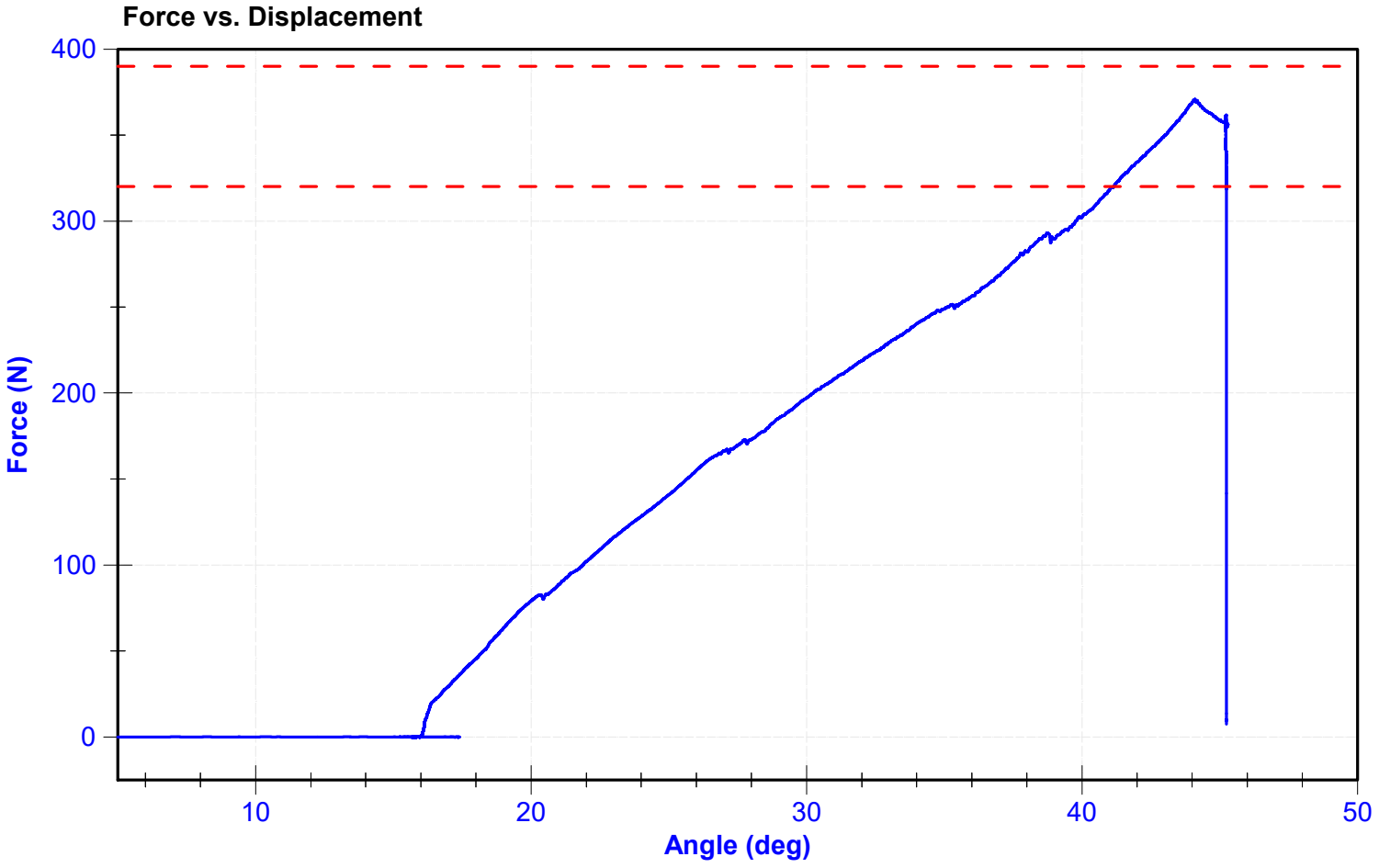
ATD Manufacturer	Humanetics	Test Technician	T. Roseman
ATD Serial Number	137	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.6	25.6	ºC	21.9	Pass
Humidity	10	70	%	45	Pass
Initial Angle	0	20	deg	15.9	Pass
Force at 45 Degrees	320	390	N	370.9	Pass
Return Angle Relative to Initial	0	8	deg	6.1	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	Rieker	DS-1905226	2023-11-14	2024-11-13
Load Cell	Interface	1134516	2023-11-30	2024-11-29



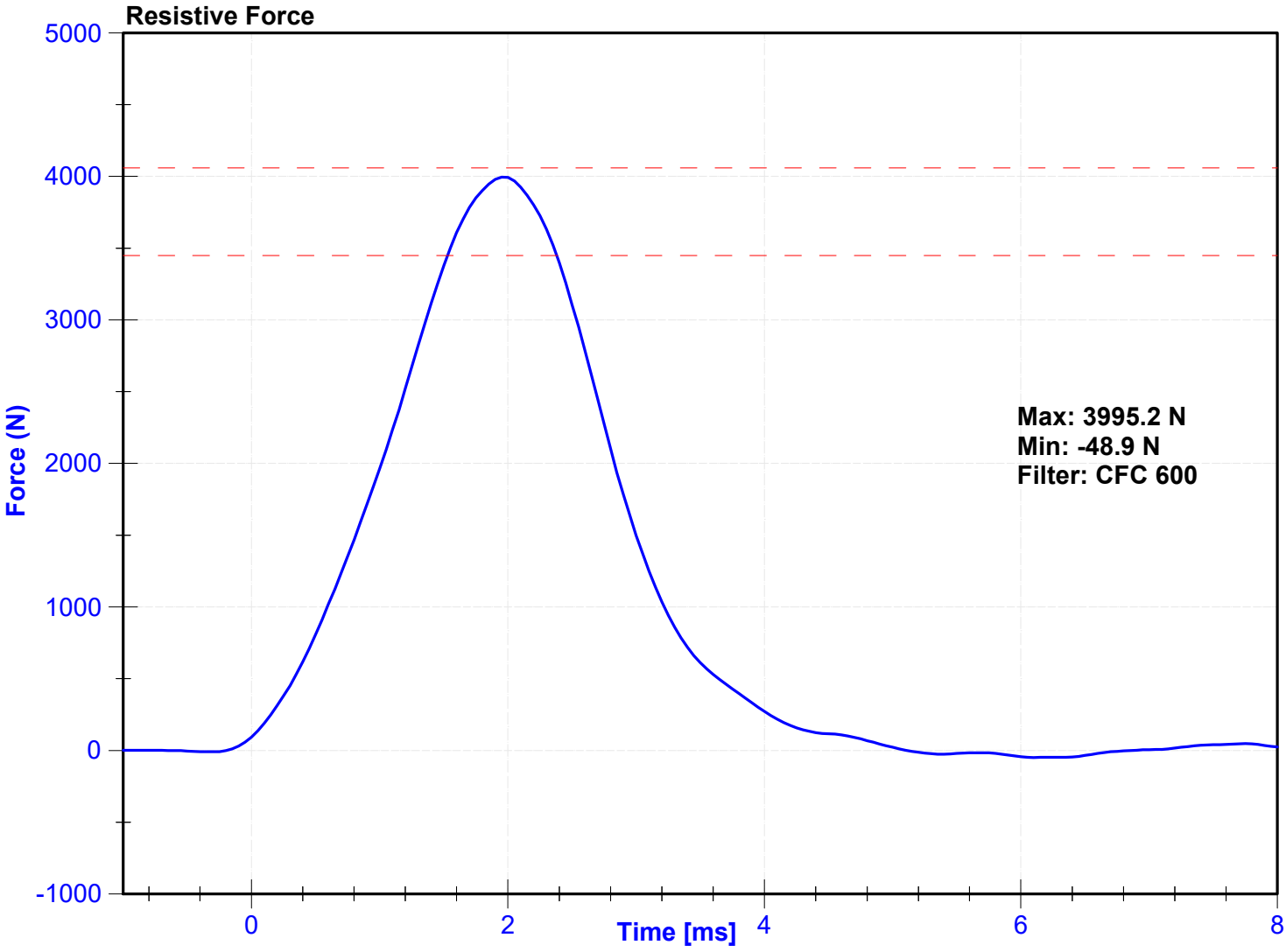
ATD Manufacturer	Humanetics	Test Technician	T. Roseman
ATD Serial Number	137	Laboratory Supervisor	C. Mantell

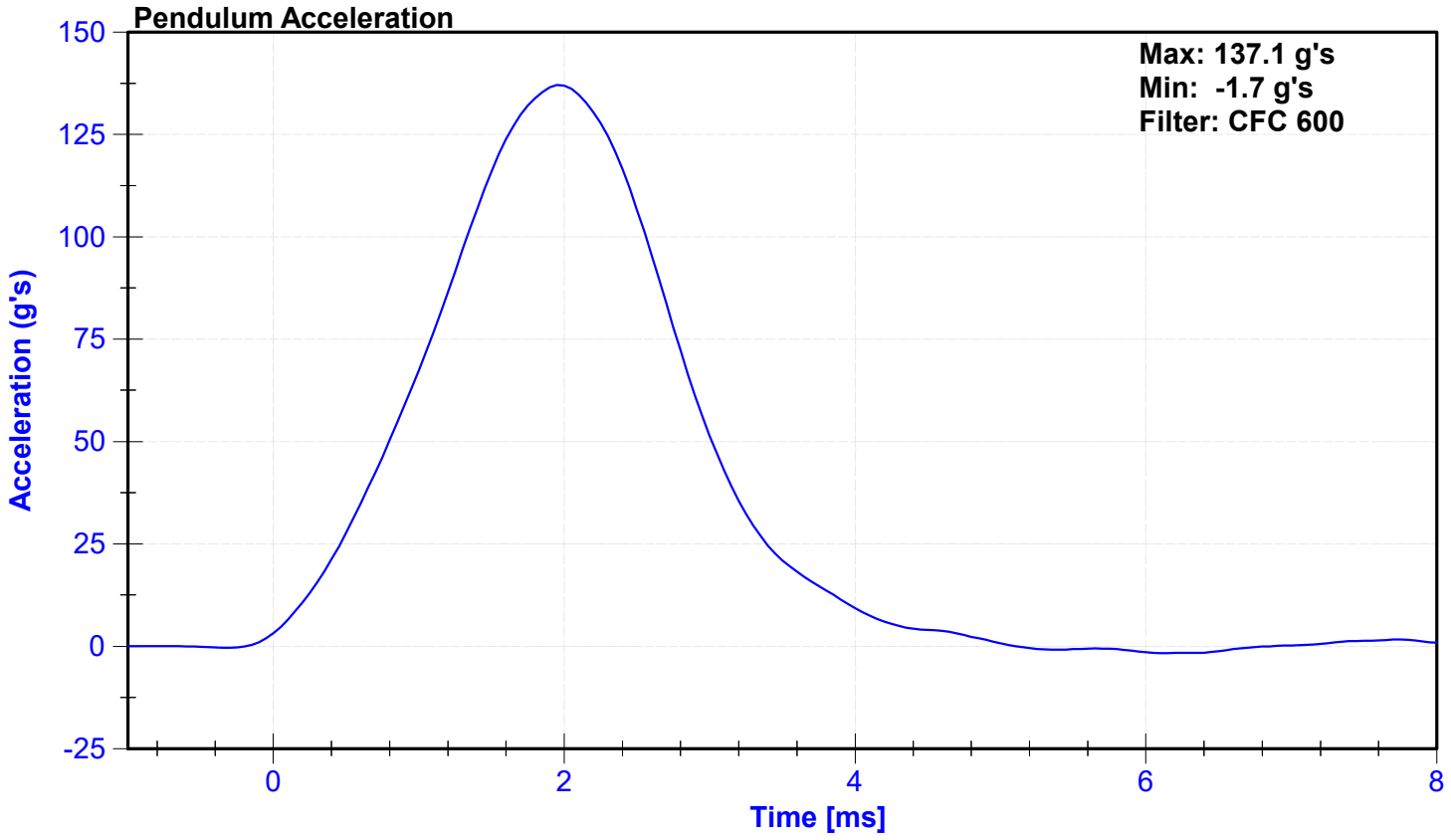
Results

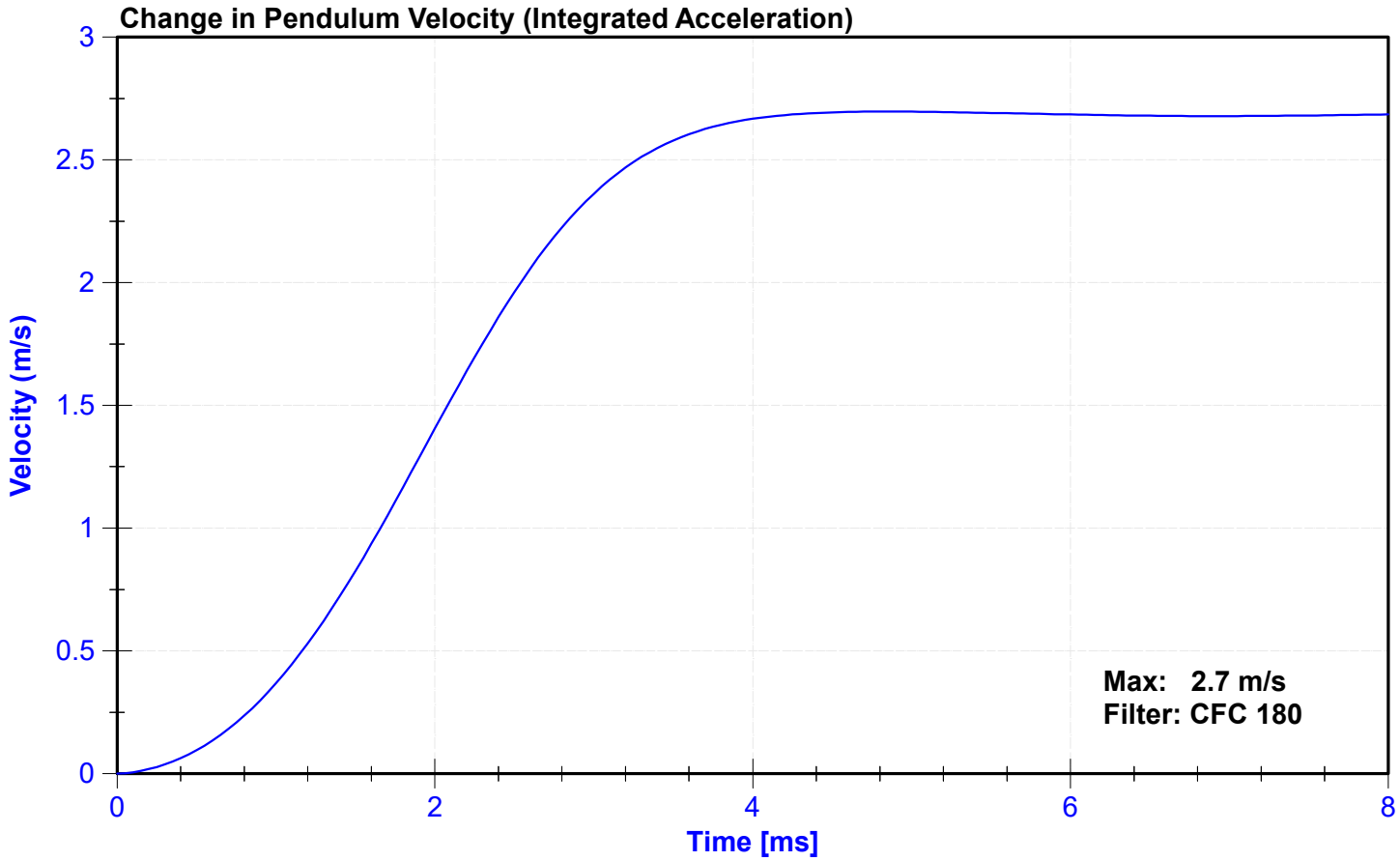
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.2	Pass
Humidity	10	70	%	47	Pass
Velocity	2.07	2.13	m/s	2.114	Pass
Resistive Force	3450	4060	N	3995.2	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18619	3/29/2024	9/25/2024




Pendulum Acceleration
Max: 137.1 g's
Min: -1.7 g's
Filter: CFC 600
Acceleration (g's)
150
125
100
75
50
25
0
-25
0
2
4
6
8
Time [ms]


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

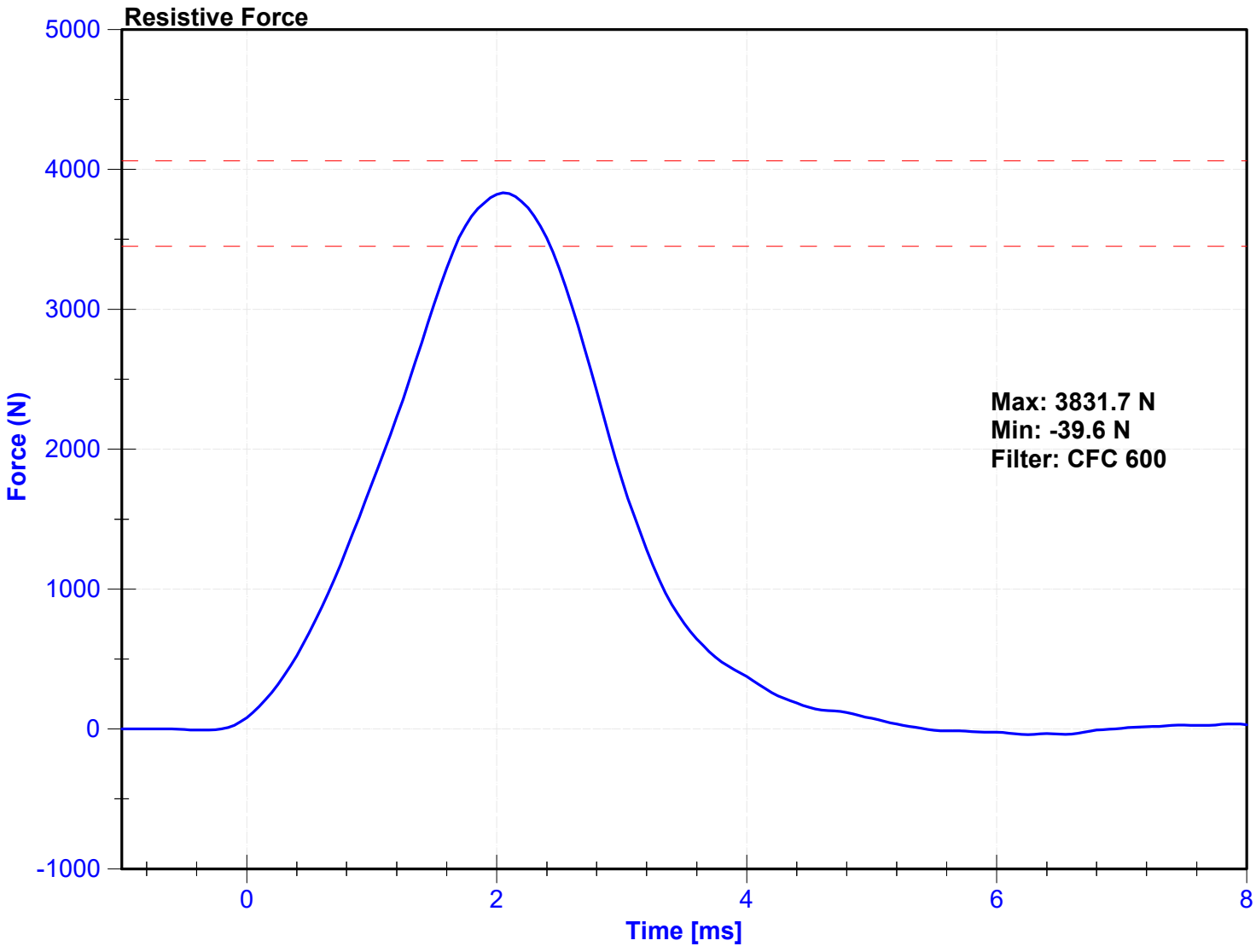
ATD Manufacturer	Humanetics	Test Technician	T. Roseman
ATD Serial Number	137	Laboratory Supervisor	C. Mantell

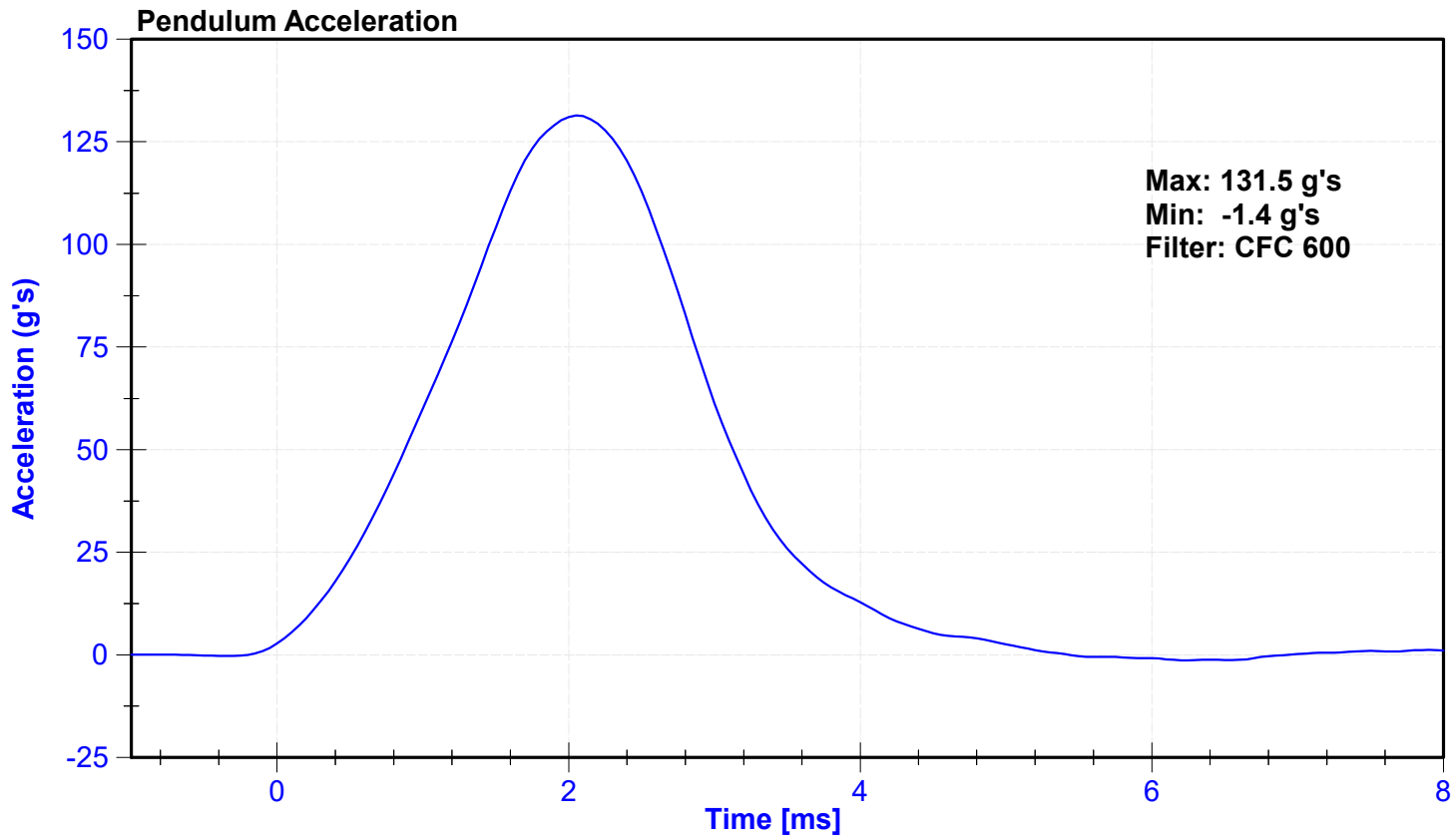
Results

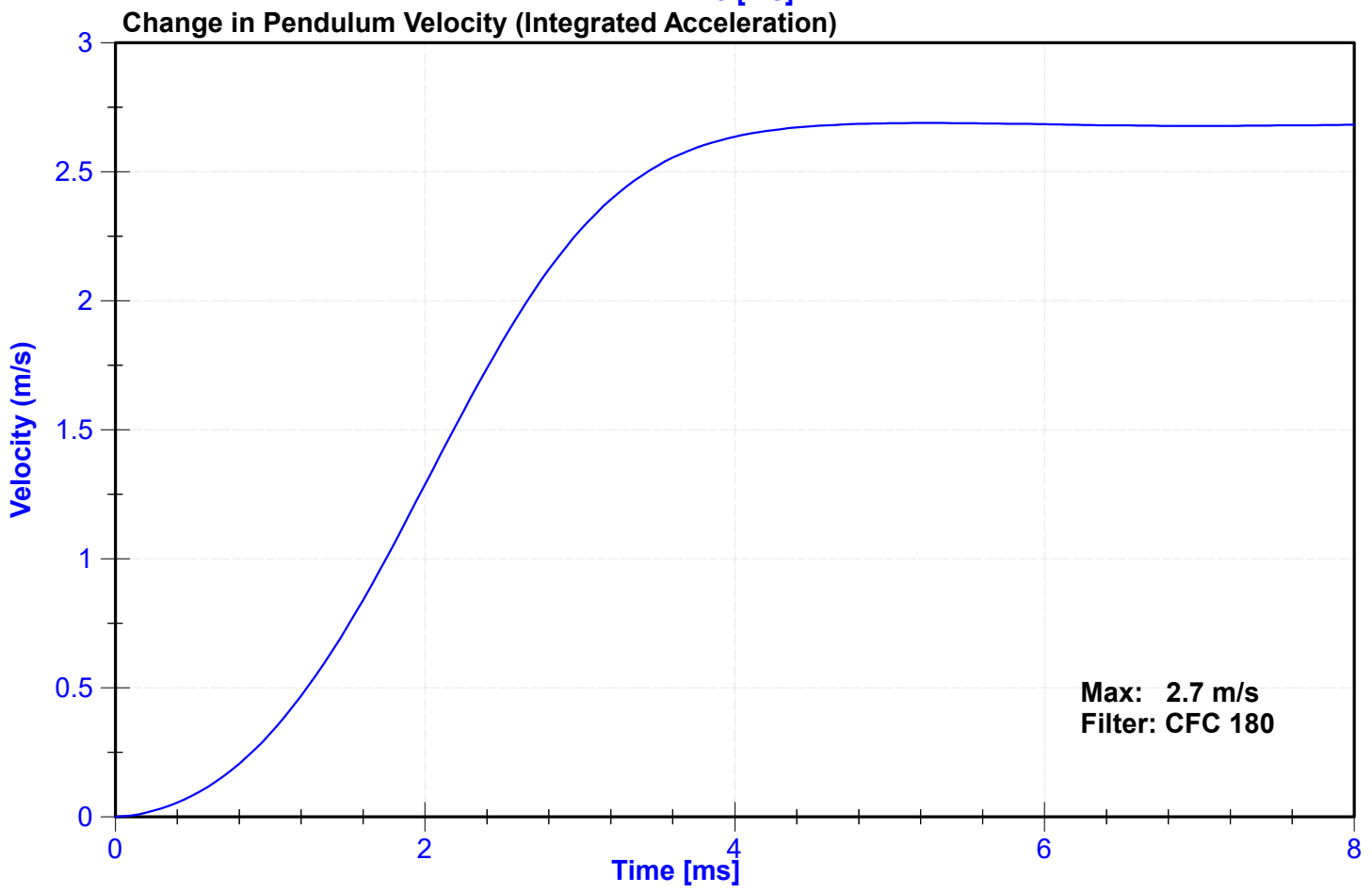
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.2	Pass
Humidity	10	70	%	47	Pass
Velocity	2.07	2.13	m/s	2.113	Pass
Resistive Force	3450	4060	N	3831.7	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18619	3/29/2024	9/25/2024




Pendulum Acceleration
Acceleration (g's)
150
125
100
75
50
25
0
-25
0
2
4
6
8
Time [ms]
Max: 131.5 g's
Min: -1.4 g's
Filter: CFC 600


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

APPENDIX D

TEST EQUIPMENT AND INSTRUMENTATION CALIBRATION

Table 1 – Driver Dummy Instrumentation

Instrumentation		Axis/Location	Hybrid III 50th S/N: 065		
			Serial Number	Manufacturer	Calibration Date
Head Accelerometers	Primary	X	P52152	Endevco	04/30/2024
		Y	P58888	Endevco	04/30/2024
		Z	P58911	Endevco	04/30/2024
	Redundant	X	P52012	Endevco	05/17/2024
		Y	P51979	Endevco	04/30/2024
		Z	P49204	Endevco	04/30/2024
Head Angular Rate Sensors		X	15212	DTS ARS	11/15/2023
		Y	15695	DTS ARS	11/17/2023
		Z	7603	DTS ARS	11/15/2023
Upper Neck Load Cell		FX, Fy, Fz MX,MY, MZ	1916-FX	Humanetics	09/12/2023
Chest Accelerometers	Primary	X	P58887	Endevco	04/30/2024
		Y	P66917	Endevco	04/30/2024
		Z	P49197	Endevco	04/30/2024
	Redundant	X	P49213	Endevco	04/30/2024
		Y	P63840	Endevco	04/30/2024
		Z	P83313	Endevco	04/30/2024
Chest Potentiometer		X	1046	Servo	04/30/2024
Pelvis Accelerometer		X	P51699	Endevco	04/30/2024
		Y	P94090	Endevco	04/30/2024
		Z	P83437	Endevco	04/30/2024
Femur Load Cells - Left	Primary	Z	DI4211-FZ1	Denton	09/12/2023
	Redundant	Z	DI4211-FZ2	Denton	09/12/2023
Femur Load Cells - Right	Primary	Z	136-FZ1	Denton	09/12/2023
	Redundant	Z	136-FZ2	Denton	09/12/2023
Tibia Load Cells - Left	Upper	MX, MY, FZ	407-FZ	Denton	09/13/2023
	Lower	MX, MY, FZ	490-FZ	Denton	09/13/2023
Tibia Load Cells – Right	Upper	MX, MY, FZ	368-FZ	Denton	09/13/2023
	Lower	MX, MY, FZ	396-FZ	Denton	09/13/2023
Foot Accelerometers - Left	Rear	X	P69797	Endevco	04/30/2024
	Front	Z	P51729	Endevco	04/30/2024
Foot Accelerometers - Right	Rear	X	T20878	Endevco	05/14/2024
	Front	Z	P51685	Endevco	04/30/2024
Seat belt Load Cells	Lap		295	GFE	02/08/2024
	Shoulder		292	GFE	02/08/2024

Table 2 – Front Passenger Dummy Instrumentation

Instrumentation		Axis/Location	Hybrid III 5th S/N: 137		
			Serial Number	Manufacturer	Calibration Date
Head Accelerometers	Primary	X	P79417	Endevco	01/04/2024
		Y	P83335	Endevco	01/04/2024
		Z	P64149	Endevco	01/04/2024
	Redundant	X	P52008	Endevco	01/04/2024
		Y	P52045	Endevco	01/04/2024
		Z	P74774	Endevco	01/03/2024
Head Angular Rate Sensors		X	7589	DTS ARS	11/15/2023
		Y	13095	DTS ARS	11/15/2023
		Z	4718	DTS ARS	11/15/2023
Upper Neck Load Cell		FX, Fy, Fz MX,MY, MZ	2019-FX	Humanetics	09/12/2023
Chest Accelerometers	Primary	X	T21142	Endevco	01/03/2024
		Y	P83346	Endevco	01/04/2024
		Z	P49190	Endevco	01/04/2024
	Redundant	X	P58794	Endevco	01/03/2024
		Y	P69791	Endevco	01/03/2024
		Z	T11253	Endevco	01/04/2024
Chest Potentiometer		X	0720	Servo	01/05/2024
Pelvis Accelerometer		X	P58735	Endevco	01/03/2024
		Y	P77587	Endevco	01/03/2024
		Z	P51285	Endevco	01/03/2024
Femur Load Cells - Left	Primary	Z	135-FZ1	Denton	09/12/2023
	Redundant	Z	135-FZ2	Denton	09/12/2023
Femur Load Cells - Right	Primary	Z	115-FZ1	Denton	09/12/2023
	Redundant	Z	115-FZ2	Denton	09/12/2023
Tibia Load Cells - Left	Upper	MX, MY, FZ	362-FZ	Denton	09/13/2023
	Lower	MX, MY, FZ	364-FZ	Denton	09/13/2023
Tibia Load Cells – Right	Upper	MX, MY, FZ	364-FZ	Denton	09/13/2023
	Lower	MX, MY, FZ	492-FZ	Denton	10/04/2023
Foot Accelerometers - Left	Rear	X	P78959	Endevco	01/03/2024
	Front	Z	P83418	Endevco	01/04/2024
Foot Accelerometers - Right	Rear	X	P63998	Endevco	01/03/2024
	Front	Z	P80265	Endevco	01/03/2024
Seat belt Load Cells	Shoulder		174	GFE	02/08/2024

Table 3 – Vehicle Instrumentation

Instrumentation			Axis	Serial Number	Manufacturer	Calibration Date
Crossmember/Rear Seat Accelerometers	Left	Primary	X	A255848	Measurement Specialties	03/15/2024
			Z	A280370	Measurement Specialties	03/15/2024
		Redundant	X	A315797	Measurement Specialties	03/15/2024
	Right	Primary	X	A400010	Measurement Specialties	01/29/2024
			Z	A400020	Measurement Specialties	01/29/2024
		Redundant	X	A400755	Measurement Specialties	01/29/2024
Engine Accelerometers	Top		X	G24310	Endevco	04/22/2024
	Bottom		X	G22727	Endevco	02/16/2024