REPORT NUMBER: NCAP-CAL-24-006

NEW CAR ASSESSMENT PROGRAM (NCAP)
FRONTAL BARRIER IMPACT TEST

SAIC General Motors Corporation Limited for General Motors LLC
2024 Buick Envision
5 Door SUV

NHTSA No: M20240116

PREPARED BY:
CALSPAN CORPORATION
P.O. BOX 400
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January 2, 2025

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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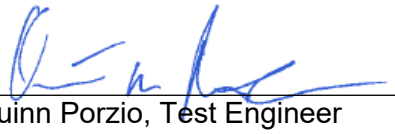
Prepared by:  Date: January 2, 2025
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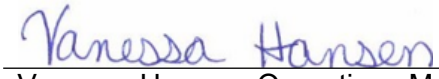
Approved by:  Date: January 2, 2025
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FINAL REPORT ACCEPTANCE BY OCWS:

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

Date: _____

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

Date: _____

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15. Supplementary Notes

16. Abstract

A 56.30 km/h (35 mph), NCAP frontal rigid barrier impact test was conducted on a 2024 Buick Envision 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 September 9, 2024.

The impact velocity of the vehicle was 56.52 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 445 mm at crush zone 3. 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	314.915	700	246.469
Maximum Chest Compression	mm	63	-25.113	52	-16.525
Nij		1	0.312	1	0.245
Neck Tension	N	4170	1064.415	2620	612.038
Neck Compression	N	4000	-37.871	2520	-414.193
Left Femur Force	N	10008	-667.654	6805	-1168.961
Right Femur Force	N	10008	-548.000	6805	-298.251

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

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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 dated May 2018.

SUMMARY

A load cell barrier consisting of 128 load cells was impacted by a 2024 Buick Envision 5 Door SUV at a velocity of 56.52 km/h. The test was performed at Calspan Corporation's Transportation Test Operations facility in Buffalo, New York on September 9, 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 and passenger's lap and shoulder belts 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 230 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 445 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 air bag.

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)	314.915	0.312	1064.415	-37.871	43.770	-25.113	-667.654	-548.000
Passenger (5th)	246.469	0.245	612.038	-414.193	47.628	-16.525	-1168.961	-298.251

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 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 Buick Envision 5 Door SUV
NHTSA No.: M20240116
Test Program: NCAP Frontal Barrier Impact Test
Test Date: 09/09/2024

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA No.	M20240116	Traction Control System (TCS)	Yes
Model Year	2024	Power Steering	Yes
Make	Buick	Power Window Auto-Reverse	Yes
Model	Envision	Driver Frontal Airbag	Yes
Body Style	SUV	Driver Curtain Airbag	Yes
VIN	LRBFZME48RD024280	Driver Head/Torso Airbag	No
Body Color	Ebony Twilight Metallic	Driver Torso Airbag	No
Odometer Reading (km /mi)	124 mi	Driver Torso/Pelvis Airbag	Yes
Engine Displacement (L)	2.0	Driver Pelvis Airbag	No
Type / No. Cylinders	I4	Driver Knee Airbag	Yes
Engine Placement	Transverse	Front Pass. Frontal Airbag	Yes
Transmission Type	Automatic	Front Pass. Curtain Airbag	Yes
Transmission Speeds	9-Speed	Front Pass. Head/Torso Airbag	No
Overdrive	Yes	Front Pass. Torso Airbag	No
Final Drive	AWD	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	Yes	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	SAIC General Motors Corporation Limited for General Motors LLC	GVWR (KG)	2300
Date of Manufacture	12/23	GVWR Front (KG)	1270
		GVWR Rear (KG)	1225

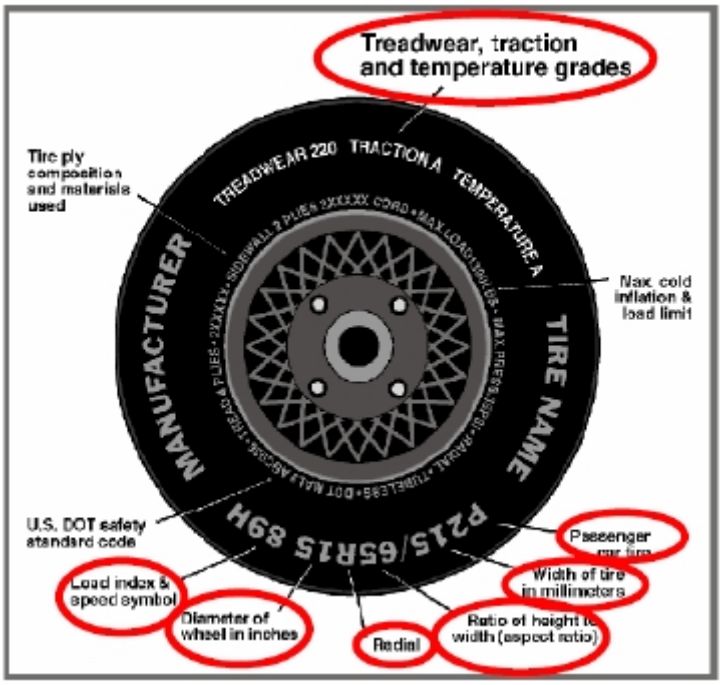
VEHICLE SEATING AND WEIGHT CAPACITY DATA

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)				484
Cargo Wt. (RCLW) (kg)				136

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

Test Vehicle:	2024 Buick Envision 5 Door SUV	NHTSA No.:	M20240116
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	09/09/2024

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)	240	240
Recommended Tire Size	235/60R18	235/60R18
Tire Size on Vehicle	235/60R18	235/60R18
Tire Manufacturer	Continental	Continental
Tire Model	ProContact	ProContact
Treadwear	500	500
Traction	A	A
Temperature Grades	A	A
Tire Plies Sidewall	2 Polyester	2 Polyester
Tire Plies Body	2 Polyester, 2 Steel, 1 Polyamide	2 Polyester, 2 Steel, 1 Polyamide
Load Index / Speed Symbol	103H	103H
Tire Material	Rubber	Rubber
DOT Safety Code Left	ILF0FBBYB4823	ILF0FBBYB4823
DOT Safety Code Right	ILF0FBBYB4823	ILF0FBBYB4823

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

Test Vehicle: 2024 Buick Envision 5 Door SUV | NHTSA No.: M20240116
Test Program: NCAP Frontal Barrier Impact Test | Test Date: 09/09/2024

TEST VEHICLE WEIGHTS

	Units	As Delivered Weights (UVW)			As Tested Weights (ATW)		
		Front Axle	Rear Axle	Total	Front Axle	Rear Axle	Total
Left	kg	537.5	370		589	461	
Right	kg	524	350		536	467	
Ratio	%	59.6	40.4		54.8	45.2	
Total	kg	1061.5	720	1781.5	1125	928	2053

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value	
Total Delivered Weight (UVW)	kg	1781.5	(A)
Weight of 1 P572E ATD & 1 P572O ATD	kg	142	(B)
Rated Cargo / Luggage Weight (RCLW)	kg	136	(C)
Calculated Vehicle Target Weight (TVTW)	kg	2059.5	(A+B+C)

TEST VEHICLE ATTITUDES AND CG

Condition	Units	LF	RF	LR	RR	CG (aft of front axle)
As Delivered	mm	862	868	896	900	1123
As Tested	mm	849	855	854	857	1256
Post-Test	mm	907	886	869	846	

GENERAL TEST VEHICLE DATA

Measurement Description	Units	Value
Total Vehicle Wheel Base	mm	2778
Total Vehicle Length at Left Side	mm	4524
Total Vehicle Length at Centerline	mm	4642
Total Vehicle Length at Right Side	mm	4524
Weight of Ballast in Cargo Area	kg	70.3
Weight of Vehicle Components Removed	kg	30
Amount of Stoddard Solvent in Fuel Tank	L	56.6

LIST OF COMPONENTS REMOVED TO MEET TEST WEIGHT:

Truck carpeting, spare tire, jack, and tail light.

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

Test Vehicle:	2024 Buick Envision 5 Door SUV	NHTSA No.:	M20240116
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	09/09/2024

TARGET VEHICLE STRUCTURAL MEASUREMENT

No.	Description	Pre-Test
1	Total Length	4642
2	Total Width	1859
3*	Bumper Top Height	616
4*	Bumper Bottom Height	490
5*	Longitudinal Member Top Height	669
6	Distance Between Longitudinal Members	1020
7	Longitudinal Member Width	62
8*	Engine Top Height	952
9*	Engine Bottom Height	226
10	Engine and Gearbox Width	559
11	Front Bumper-Engine Distance	625
12*	Front Shock Absorber Fixing Height	948
13*	Bonnet Leading Edge Height	866
14	Front Shock Absorber Fixing Width	1197
15	Front Bumper – Front Axle Distance	981
16	Front Axle – A Pillar Distance	516
17	A-Pillar – B-Pillar Distance	1112
18	B-Pillar – Rear Axle Distance	1150
19	B-Pillar – C-Pillar Distance	1089
20*	Roof Sill Bottom Height	1548
21*	Roof Sill Top Height	1595
22*	Floor Sill Bottom Height	338
23*	Floor Sill Top Height	442

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

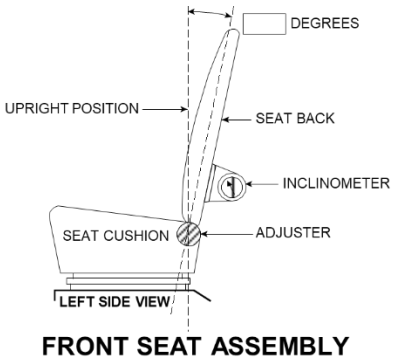
DATA SHEET NO. 2
SEAT ADJUSTMENT, FUEL SYSTEM, AND STEERING WHEEL DATA

Test Vehicle:	2024 Buick Envision 5 Door SUV	NHTSA No.:	M20240116
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	09/09/2024

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	10.9
Passenger Seat Back Angle	18.9



FRONT SEAT ASSEMBLY

SEAT FORE / AFT POSITIONS

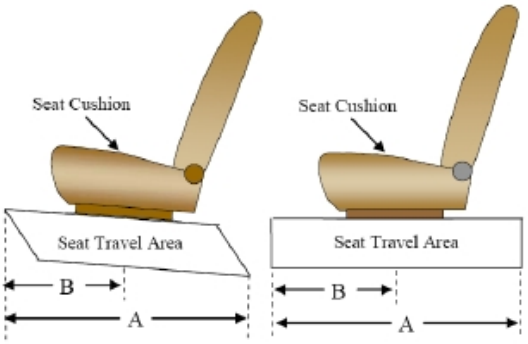
The driver's seat was positioned at the mid-point of fore/aft travel at its lowest position. The passenger's seat was positioned at the most forward position of fore/aft travel. Zero is defined as the forward most position.

Seating Position	Total Fore / Aft Travel	Placed in Position #
Driver Seat	315	157.5
Passenger Seat	25 (0-24)	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



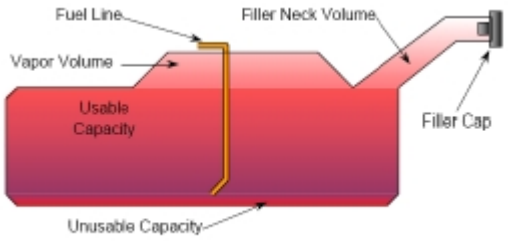
Test Vehicle: 2024 Buick Envision 5 Door SUV | NHTSA No.: M20240116
Test Program: NCAP Frontal Barrier Impact Test | Test Date: 09/09/2024

FUEL TANK CAPACITY

Description	Liters
Usable Capacity of "Standard Tank"	60.9
Usable Capacity of "Optional Tank"	N/A
92%-94% of Usable Capacity	56.0 - 57.2
Actual Amount of Solvent Used	56.6
1/3 of Usable Capacity	20.3

FUEL PUMP

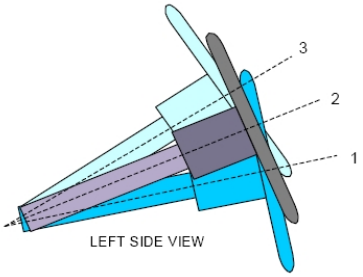
The vehicle is equipped with an electric fuel pump. The fuel filler neck is on the right side of the vehicle. The pump creates positive pressure in the fuel lines, pushing the gasoline to the engine. See form 1 for more information.



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.



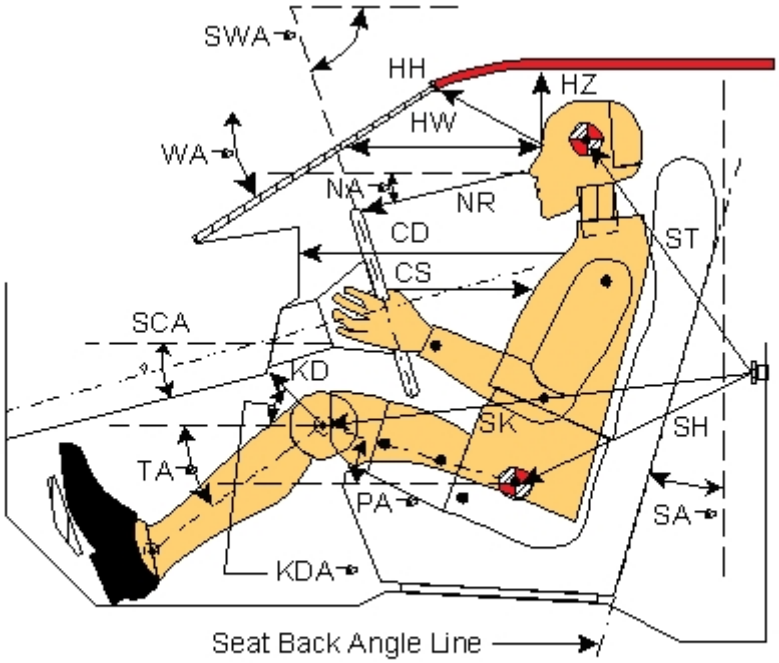
STEERING COLUMN ASSEMBLY

STEERING COLUMN POSITIONS

Description	Degrees	Fore / Aft Position (mm)
Lowermost position No. 1	22.8	
Geometric center position No. 2	24.9	
Uppermost position No. 3	27.1	
Telescoping Steering Wheel Travel		55
Test Position	24.9	27.5

DATA SHEET NO. 3
DUMMY LONGITUDINAL CLEARANCE DIMENSIONS

Test Vehicle:	2024 Buick Envision 5 Door SUV	NHTSA No.:	M20240116
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	09/09/2024

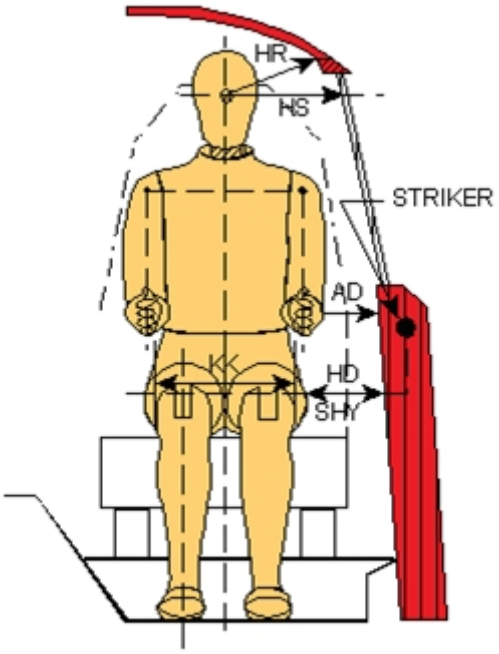


Left Side View

Code	Measurement Description	Driver (SN: 065)		Passenger (SN: 137)	
		Length (mm)	Angle (°)	Length (mm)	Angle (°)
WA°	Windshield Angle		28.7		
SWA°	Steering Wheel Angle		24.9		
SCA°	Steering Column Angle		65.1		
SA°	Seat Back Angle (on headrest post)		10.95		18.9
HZ	Head to Roof (Z)	264	90	257	90
HH	Head to Header	459	22.1	379	40.6
HW	Head to Windshield	773	0.2	707	0.4
NR	Nose to Rim / Dash	443	7.1	444	25.6
CD	Chest to Dash	617		402	
CS	Chest to Steering Hub	363	5.4		
RA	Rim to Abdomen	228	0.1		
KDL	Left Knee to Dash	221	26.1	133	32.2
KDR	Right Knee to Dash	229	15.8	135	29.2
PA°	Pelvic Angle		24.5		20.1
TA°	Tibia Angle		49.8		41.4
SK	Striker to Knee	563	9.7	633	9.8
ST	Striker to Head	500	89.5	443	70.1
SH	Striker to H-Point	186	56.1	285	33.1

DATA SHEET NO. 4
DUMMY LATERAL CLEARANCE DIMENSIONS

Test Vehicle:	2024 Buick Envision 5 Door SUV	NHTSA No.:	M20240116
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	09/09/2024

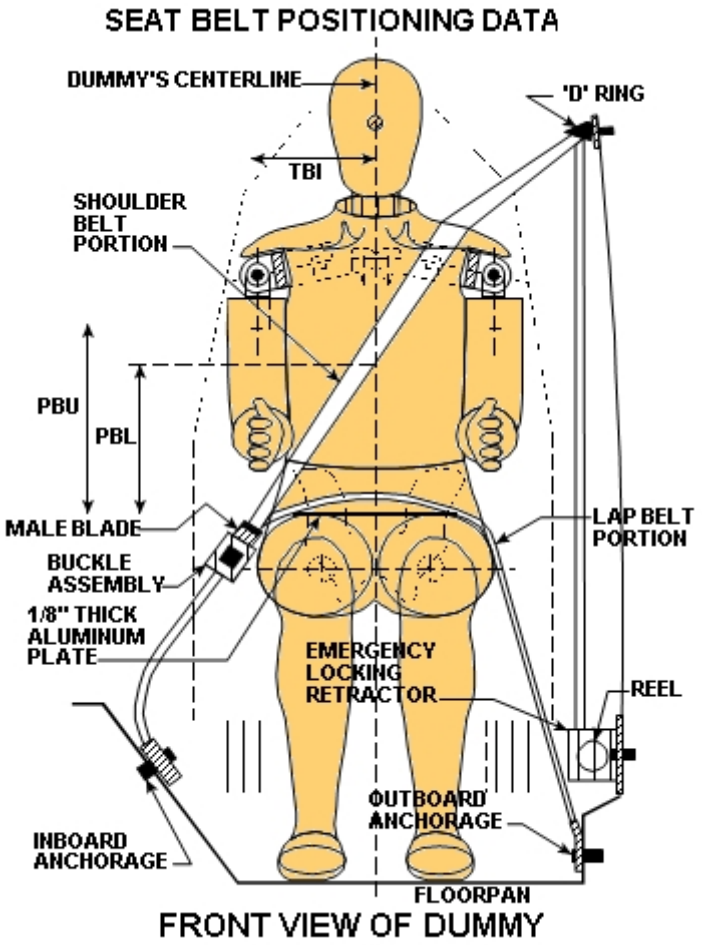


Front View

Code	Description	Driver (mm)	Passenger (mm)
AD	Arm to Door	108	90
HD	H-Point to Door	141	178
HR	Head to Side Header	255	277
HS	Head to Side Window	368	385
KK	Knee to Knee	320	210
SHY	Striker to H-Point (Y Direction)	254	295
AA	Ankle to Ankle	331	165

DATA SHEET NO. 5
SEAT BELT POSITIONING DATA

Test Vehicle:	2024 Buick Envision 5 Door SUV	NHTSA No.:	M20240116
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	09/09/2024



SEAT BELT POSITIONING MEASUREMENTS

Measurement Description	Units	Driver	Passenger
PBU — Top surface of reference to belt upper edge	mm	371	290
PBL — Top surface of reference to belt lower edge	mm	286	200

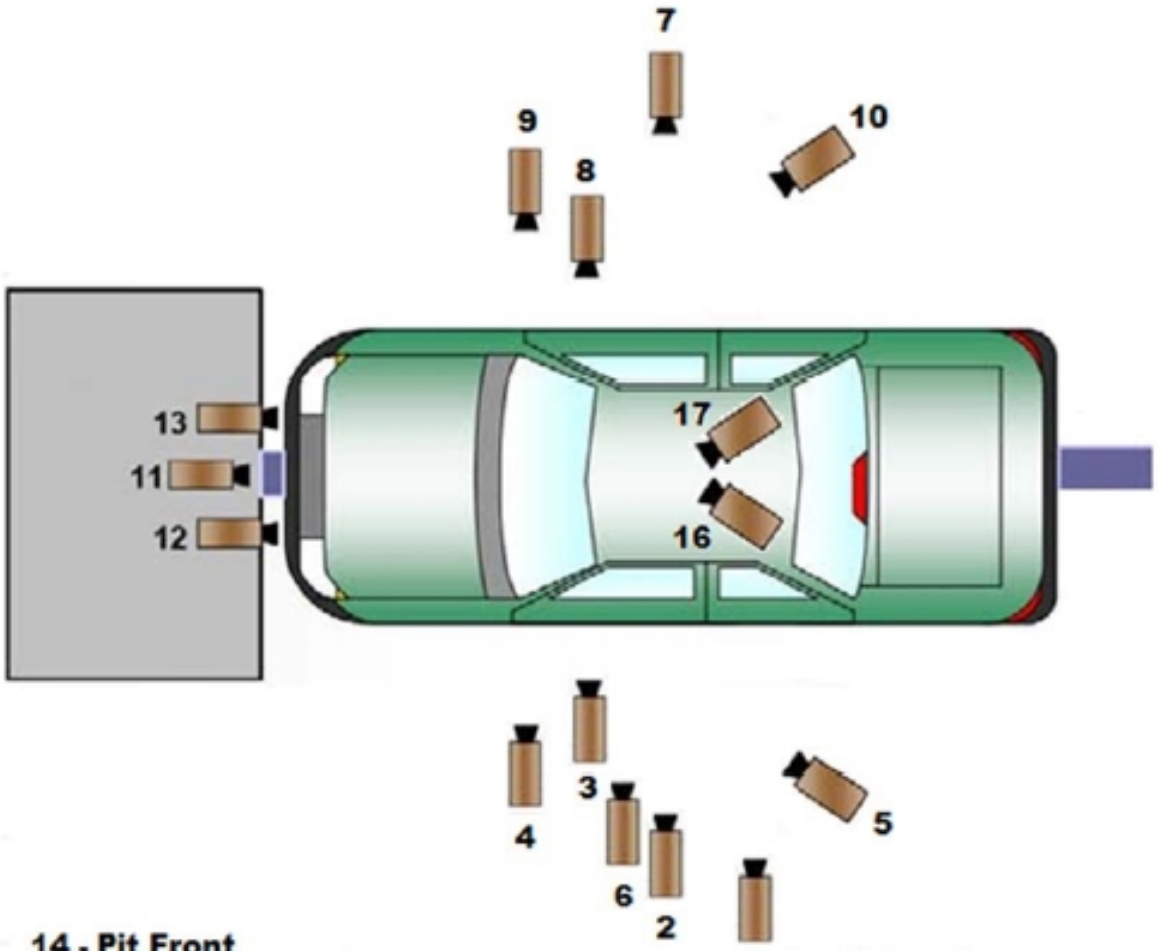
BELT LENGTH DATA

Measurement Description	Units	Driver	Passenger
Shoulder belt length as measured on ATD	mm	828	880
Lap Belt Length as measured on ATD	mm	512	590
Remainder of belt on reel	mm	1005	830
Total belt length for continuous webbing systems	mm	2345	2300

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

Test Vehicle:	2024 Buick Envision 5 Door SUV	NHTSA No.:	M20240116
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	09/09/2024

CAMERA POSITIONS FOR FRONTAL IMPACTS



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

Test Vehicle:	2024 Buick Envision 5 Door SUV	NHTSA No.:	M20240116
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	09/09/2024

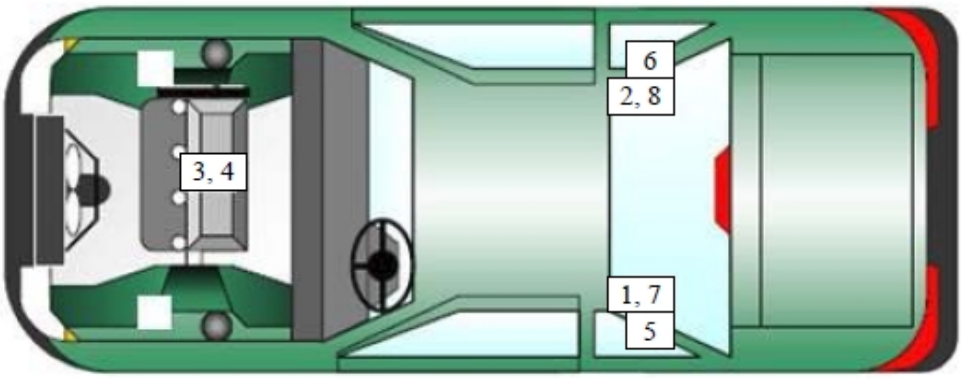
CAMERA LOCATIONS

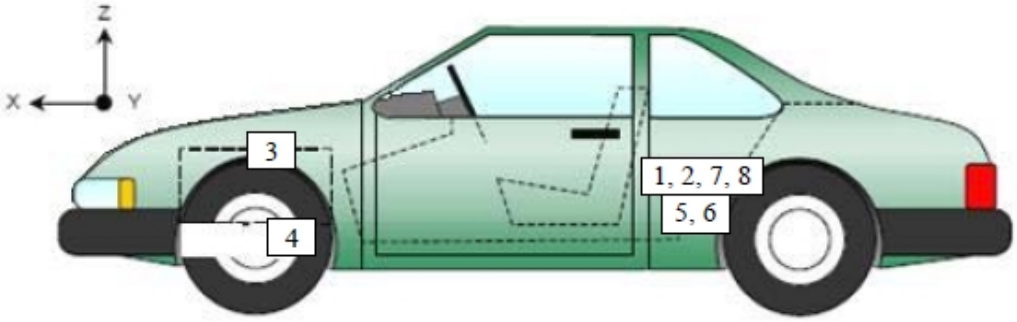
No.	Camera View	Location (mm)			Lens (mm)	Speed (fps)
		X	Y	Z		
1	Real-Time Left Overall				Zoom	60
2	Left Overall	-2215	-6873	-1472	24	1000
3	Driver Close-Up	-1437	-6339	-1497	50	1000
4	Left Front Half	-727	-6464	-1467	28	1000
5	Left Angle	-4135	-4145	-2568	50	1000
6	Steering Column	-2002	-7402	-2391	75	1000
7	Right Overall	-2268	6757	-1444	24	1000
8	Passenger Close-Up	-1308	6127	-1420	50	1000
9	Right Front Half	-906	6543	-1473	28	1000
10	Right Angle	-3997	4435	-2511	50	1000
11	Windshield	1197	0	-2913	12.5	1000
12	Driver Windshield	864	-471	-2221	25	1000
13	Passenger Windshield	864	471	-2221	25	1000
14	Pit Front	-1121	0	2241	12.5	1000
15	Pit Rear	-2691	0	2237	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 Buick Envision 5 Door SUV	NHTSA No.:	M20240116
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	09/09/2024





VEHICLE ACCELEROMETER PRE-TEST LOCATIONS

No.	Accelerometer Location	Measurements (mm)		
		X	Y	Z
1	Left Rear Accelerometer – X Direction	1701	-330	254
2	Right Rear Accelerometer – X Direction	1701	311	255
3	Engine Top X	3718	340	-101
4	Engine Bottom X	3754	138	434
5	Left Rear Accelerometer – Z Direction	1701	-330	254
6	Right Rear Accelerometer – Z Direction	1701	311	255
7	Left Rear Accelerometer – X Direction Redundant	1700	-343	254
8	Right Rear Accelerometer – X Direction Redundant	1700	325	254

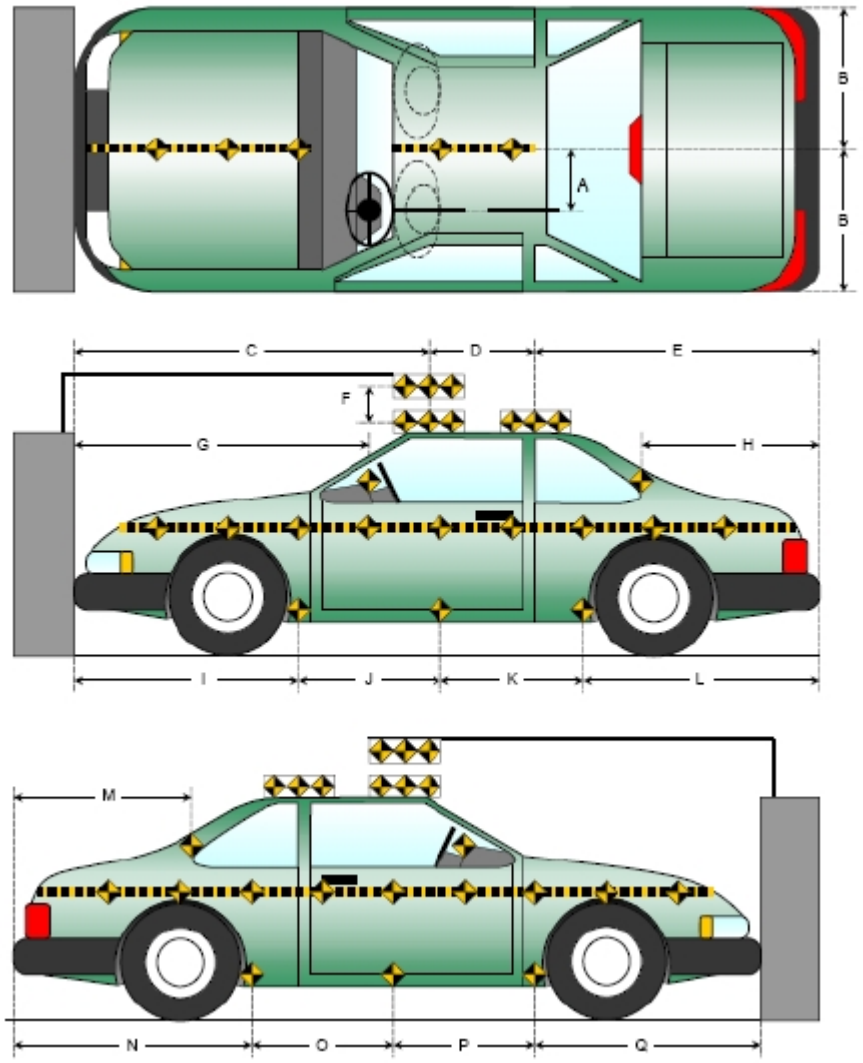
Reference Points: *X – Rear Surface of Vehicle (+ forward)*
Y – Vehicle Centerline (+ to right)
Z – Ground Plane (+ down)

DATA SHEET NO. 8
PHOTOGRAPHIC REFERENCE TARGET LOCATIONS

Test Vehicle:	2024 Buick Envision 5 Door SUV	NHTSA No.:	M20240116
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	09/09/2024

Item	Value
A	342
B	930
C	1987
D	606
E	2049
F	339
G	1832
H	887
I	1465
J	907
K	910
L	1360
M	884
N	1358
O	910
P	908
Q	1466

All units in millimeters



DATA SHEET NO. 9
LOAD CELL LOCATIONS ON FIXED BARRIER

Test Vehicle:	2024 Buick Envision 5 Door SUV	NHTSA No.:	M20240116
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	09/09/2024

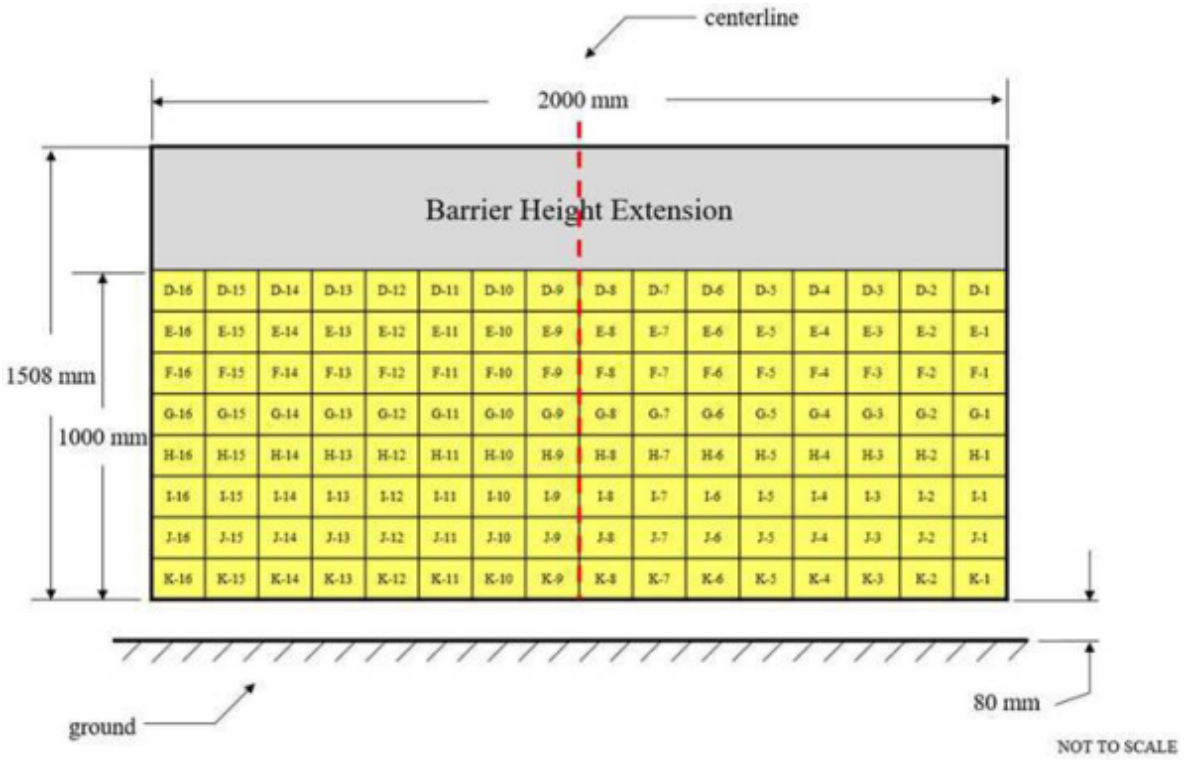


Figure 1 - Load Cell Locations on a 128-Load Cell Barrier with Plywood Height Extension*
Please note above diagram is not actual representation of load cell barrier used.

DATA SHEET NO. 10
TEST VEHICLE SUMMARY OF RESULTS

Test Vehicle:	2024 Buick Envision 5 Door SUV	NHTSA No.:	M20240116
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	09/09/2024

INSTRUMENTATION

Instrumentation	Number of Channels Collected
Driver Dummy Accelerometers	47
Passenger Dummy Accelerometers	47
Vehicle Structure Accelerometers	8
Load Cell Barrier	128
Total	230

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 Buick Envision 5 Door SUV
Test Program: NCAP Frontal Barrier Impact Test
NHTSA No.: M20240116
Test Date: 09/09/2024

TEST DUMMY INFORMATION AND CONTACT LOCATIONS

Description	Driver	Passenger
Dummy Type / Serial No.	H3 50th Male/065	H3 5th Female/137
Head Contact	Frontal Airbag & Head Restraint	Frontal Airbag & Head Restraint
Upper Torso Contact	Frontal Airbag	Frontal Airbag
Lower Torso Contact	None	None
Left Knee Contact	Knee Airbag	Glove Box
Right Knee Contact	Knee Airbag	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	825
Center	mm	625
Right Side	mm	803
Average	mm	751

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

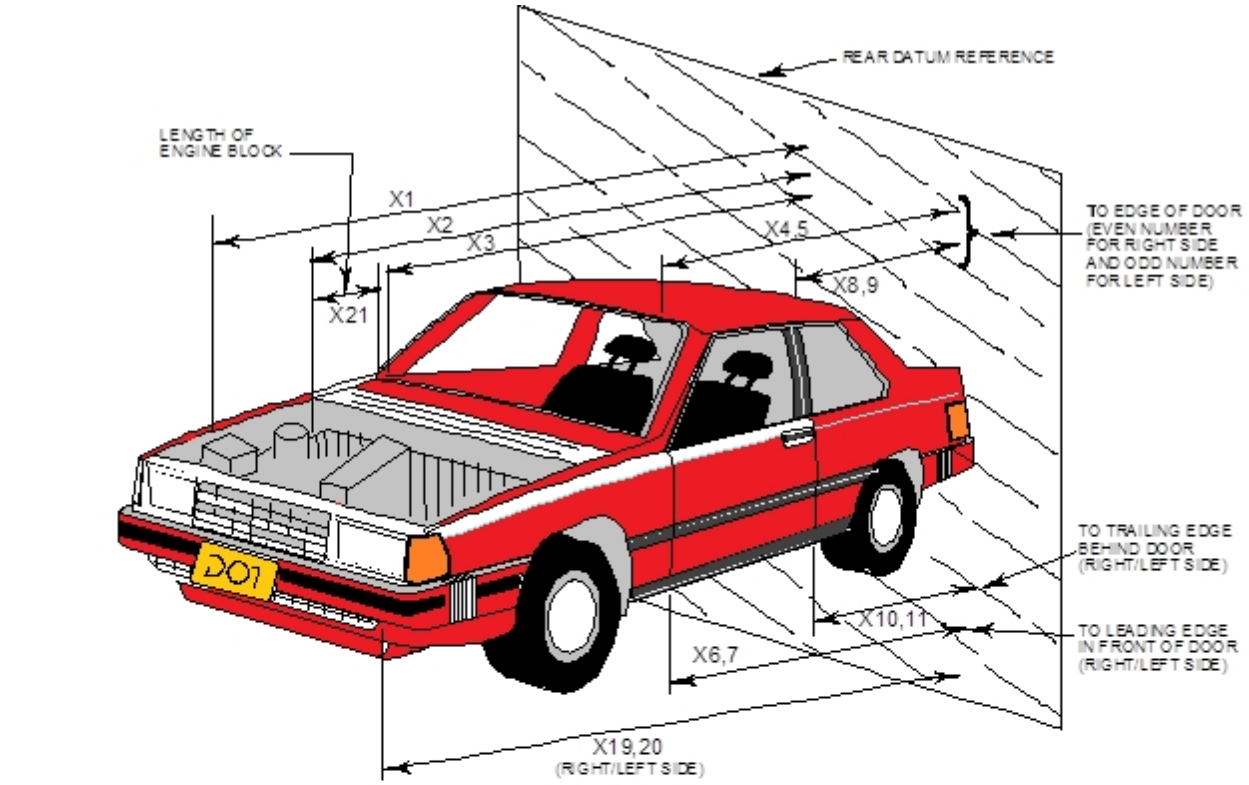
Test Vehicle: 2024 Buick Envision 5 Door SUV
NHTSA No.: M20240116
Test Program: NCAP Frontal Barrier Impact Test
Test Date: 09/09/2024

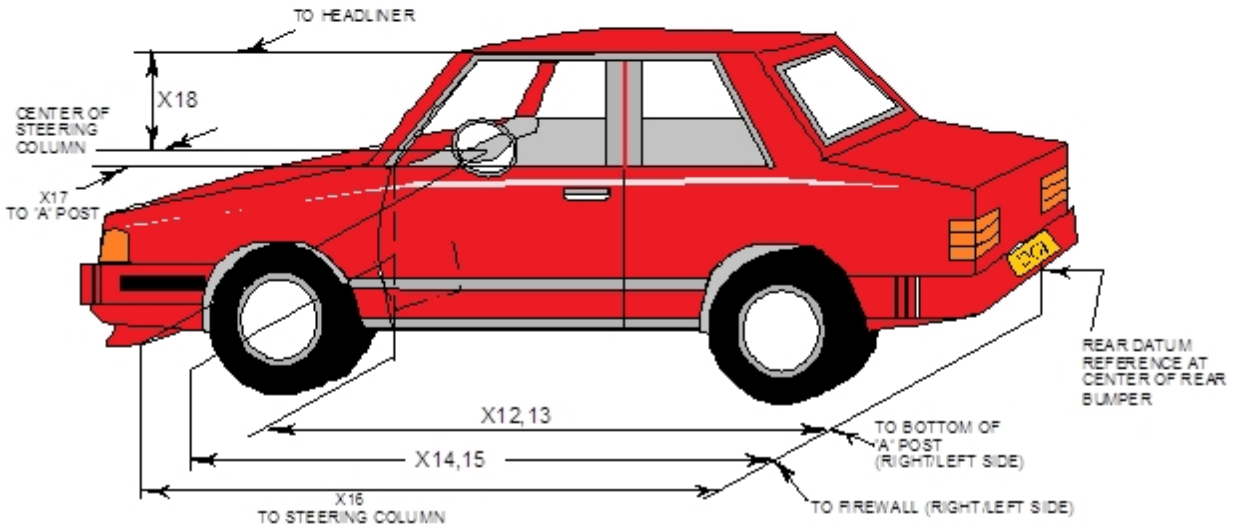
SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

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

DATA SHEET NO. 12
VEHICLE PROFILE MEASUREMENTS

Test Vehicle:	2024 Buick Envision 5 Door SUV	NHTSA No.:	M20240116
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	09/09/2024





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

Test Vehicle: 2024 Buick Envision 5 Door SUV
NHTSA No.: M20240116
Test Program: NCAP Frontal Barrier Impact Test
Test Date: 09/09/2024

No.	Measurement Description	Pre-Test	Post-Test	Change
1	Total Length of Vehicle at Centerline	4642	4197	-445
2	Rear Surface of Vehicle (RSOV) to Front of Engine	4017	3792	-225
3	RSOV to Firewall	3532	3511	-21
4	RSOV to Upper Leading Edge of Right Door	3138	3142	4
5	RSOV to Upper Leading Edge of Left Door	3138	3137	-1
6	RSOV to Lower Leading Edge of Right Door	3105	3104	-1
7	RSOV to Lower Leading Edge of Left Door	3108	3106	-2
8	RSOV to Upper Trailing Edge of Right Door	2038	2042	4
9	RSOV to Upper Trailing Edge of Left Door	2039	2041	2
10	RSOV to Lower Trailing Edge of Right Door	2053	2052	-1
11	RSOV to Lower Trailing Edge of Left Door	2053	2055	2
12	RSOV to Bottom of “A” Post of Right Side	3070	3072	2
13	RSOV to Bottom of “A” Post of Left Side	3069	3068	-1
14	RSOV to Firewall, Right Side	3605	3601	-4
15	RSOV to Firewall, Left Side	3601	3598	-3
16	RSOV to Steering Column	2639	2725	86
17	Center of Steering Column to “A” Post	288	284	-4
18	Center of Steering Column to Headliner	444	482	38
19	RSOV to Right Side of Front Bumper	4572	4225	-347
20	RSOV to Left Side of Front Bumper	4573	4171	-402
21	Length of Engine Block	429	429	0
RD	RSOV to Right Side of Dash Panel	2839	2837	-2
CD	RSOV to Center of Dash Panel	2788	2784	-4
LD	RSOV to Left Side of Dash Panel	2830	2829	-1

All Dimensions in mm

DATA SHEET NO. 13
ACCIDENT INVESTIGATION DIVISION DATA

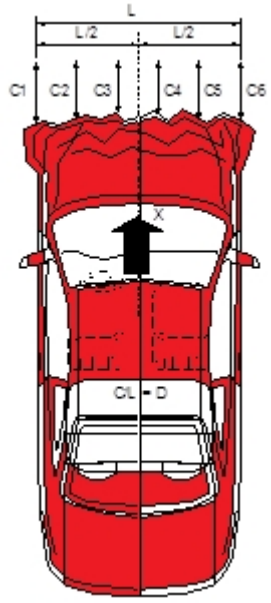
Test Vehicle:	2024 Buick Envision 5 Door SUV	NHTSA No.:	M20240116
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	09/09/2024

VEHICLE INFORMATION

VIN:	LRBFZME48RD024280	Wheelbase (mm):	2778
Vehicle Size Category:	MPV	Test Weight (kg):	2053

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):	56.52
Velocity Change (km/h):	67.73
Time of Separation (ms):	125



CRUSH PROFILE

Collision Deformation Classification:	12FDEW2
Midpoint of Damage:	C3
Damage Region Length (mm):	1472
Impact Mode:	Frontal

No.	Measurement Description	Units	Pre-Test	Post-Test	Crush
C1	Crush Zone 1 at Left Side	mm	4426	4138	288
C2	Crush Zone 2 at Left Side	mm	4579	4187	392
C3	Crush Zone 3 at Left Side	mm	4617	4224	393
C4	Crush Zone 4 at Right Side	mm	4617	4236	381
C5	Crush Zone 5 at Right Side	mm	4578	4227	351
C6	Crush Zone 6 at Right Side	mm	4424	4162	262
L	C1 to C6	mm	1432	1472	-40

DATA SHEET NO. 14
VEHICLE INTRUSION MEASUREMENTS

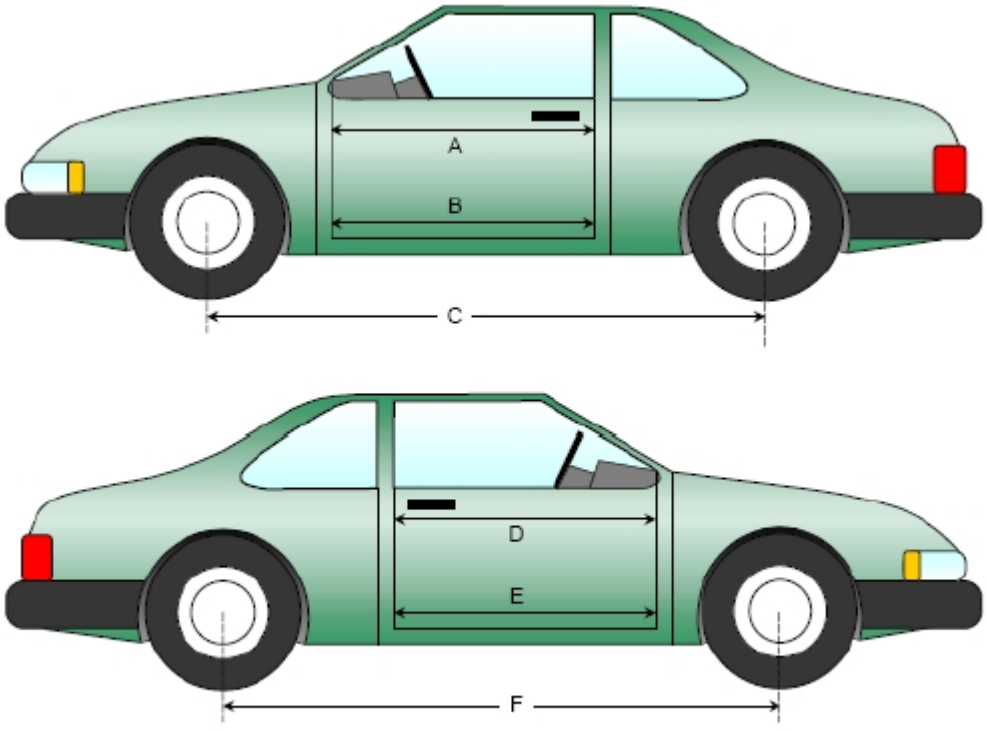
Test Vehicle:	2024 Buick Envision 5 Door SUV	NHTSA No.:	M20240116
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	09/09/2024

DOOR OPENING WIDTH

Item	Description	Units	Pre-Test	Post-Test	Change
A	Left Side Upper	mm	989	987	-2
B	Left Side Lower	mm	868	868	0
D	Right Side Upper	mm	988	986	-2
E	Right Side Lower	mm	868	867	-1

WHEELBASE MEASUREMENTS

Item	Description	Units	Pre-Test	Post-Test	Change
C	Left Side Wheelbase	mm	2778	2706	-72
F	Right Side Wheelbase	mm	2778	2706	-72



Left & Right Side Views

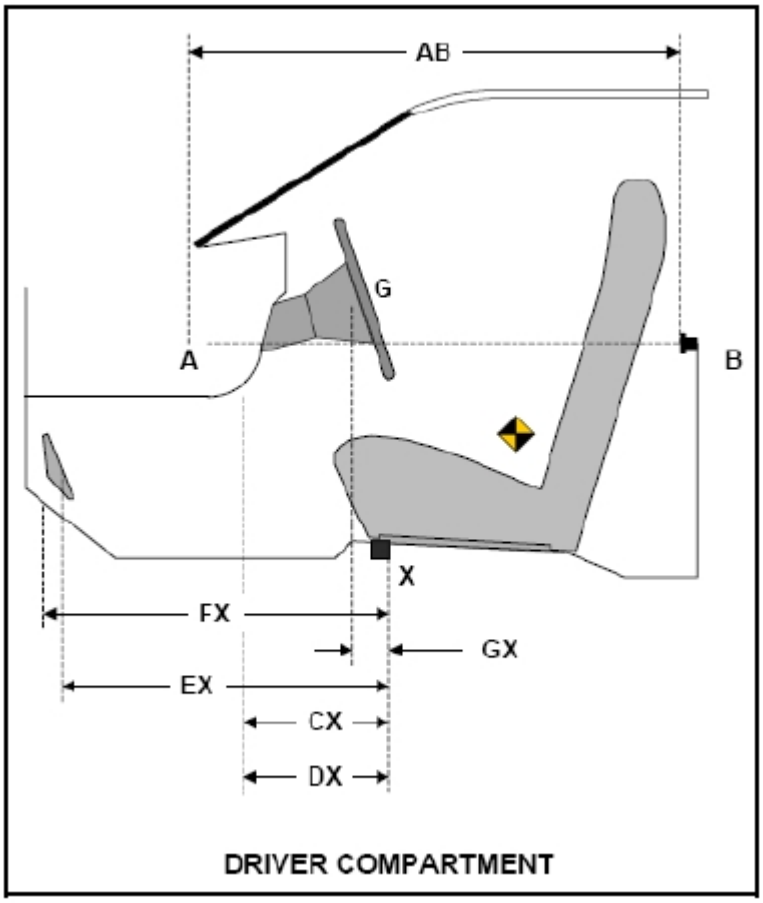
DATA SHEET NO.14 … (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2024 Buick Envision 5 Door SUV
NHTSA No.: M20240116
Test Program: NCAP Frontal Barrier Impact Test
Test Date: 09/09/2024

DRIVER COMPARTMENT INTRUSION

Item	Description	Units	Pre-Test	Post-Test	Change
AB	Door Opening (Inside Window Jam)	mm	720	718	-2
CX	Left Knee Bolster to X	mm	369	368	-1
DX	Right Knee Bolster to X	mm	367	365	-2
EX	Brake Pedal to X	mm	547	601	54
FX	Foot Rest to X	mm	574	566	-8
GX	Center of Steering Column Wheel Hub to X	mm	90	178	88

X = Front of Seat Track (Stationary)



DRIVER COMPARTMENT

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

Test Vehicle:	2024 Buick Envision 5 Door SUV	NHTSA No.:	M20240116
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	09/09/2024

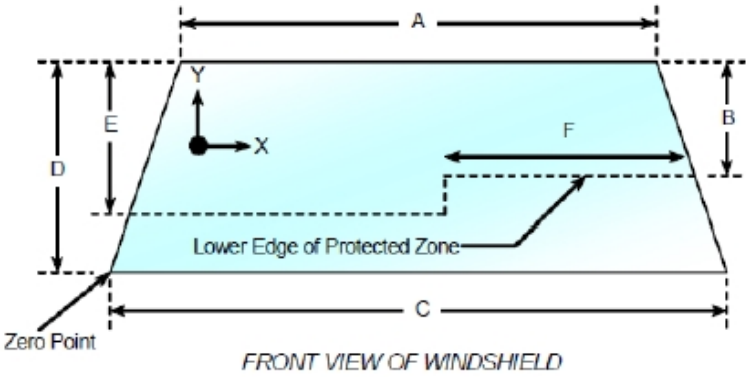
Windshield Mounting Details: A trim surrounds the top and side of windshield while a plastic shroud is on the bottom.

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	2365	2365	100%
Right Side	2365	2365	100%
Total	4730	4730	100%



FRONT VIEW OF WINDSHIELD

Item	Units	Value
A	mm	1240
B	mm	519
C	mm	1830
D	mm	830
E	mm	523
F	mm	355

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 Buick Envision 5 Door SUV	NHTSA No.:	M20240116
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	09/09/2024

FMVSS 301 FUEL SYSTEM INTEGRITY POST IMPACT DATA

Temperature at Time of Impact: 21°C Test Time: 10:01 AM

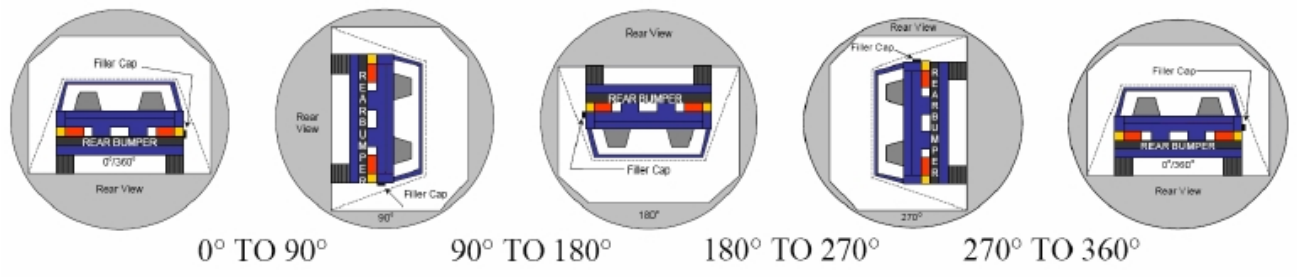
STODDARD SOLVENT SPILLAGE MEASUREMENTS

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 Occurred

DATA SHEET NO. 16
FMVSS 301 STATIC ROLLOVER RESULTS

Test Vehicle:	2024 Buick Envision 5 Door SUV	NHTSA No.:	M20240116
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	09/09/2024



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 Occurred

SOLVENT COLLECTION TIME TABLE IN SECONDS

Test Phase	Rotation Time	Hold Time	Total Time
0° to 90°	66	300	366
90° to 180°	65	300	365
180° to 270°	65	300	365
270° to 360°	69	300	369

FMVSS 301 SPILLAGE TABLE

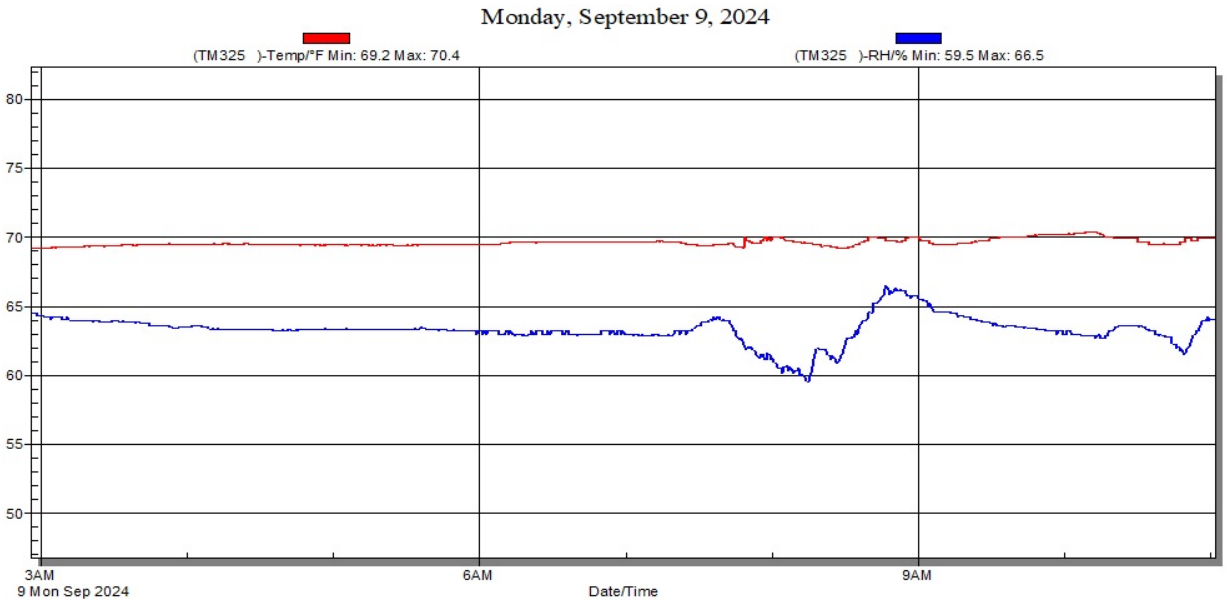
Test Phase	First 5 Minutes	Sixth Minute	Seventh Minute	Eighth Minute
0° to 90°	0	0	0	
90° to 180°	0	0	0	
180° to 270°	0	0	0	
270° to 360°	0	0	0	

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 Buick Envision 5 Door SUV	NHTSA No.:	M20240116
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	09/09/2024



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

APPENDIX A

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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.*

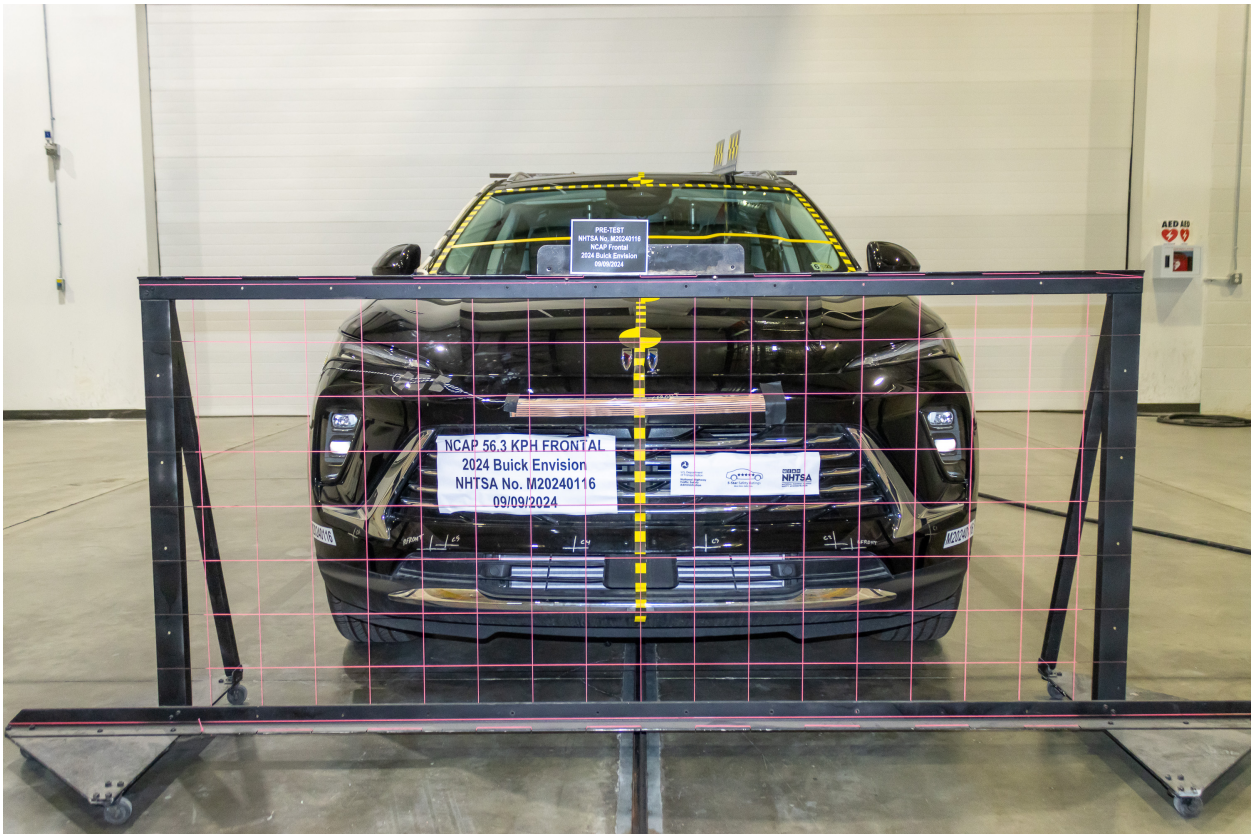

Figure A-1: Load Cell Location

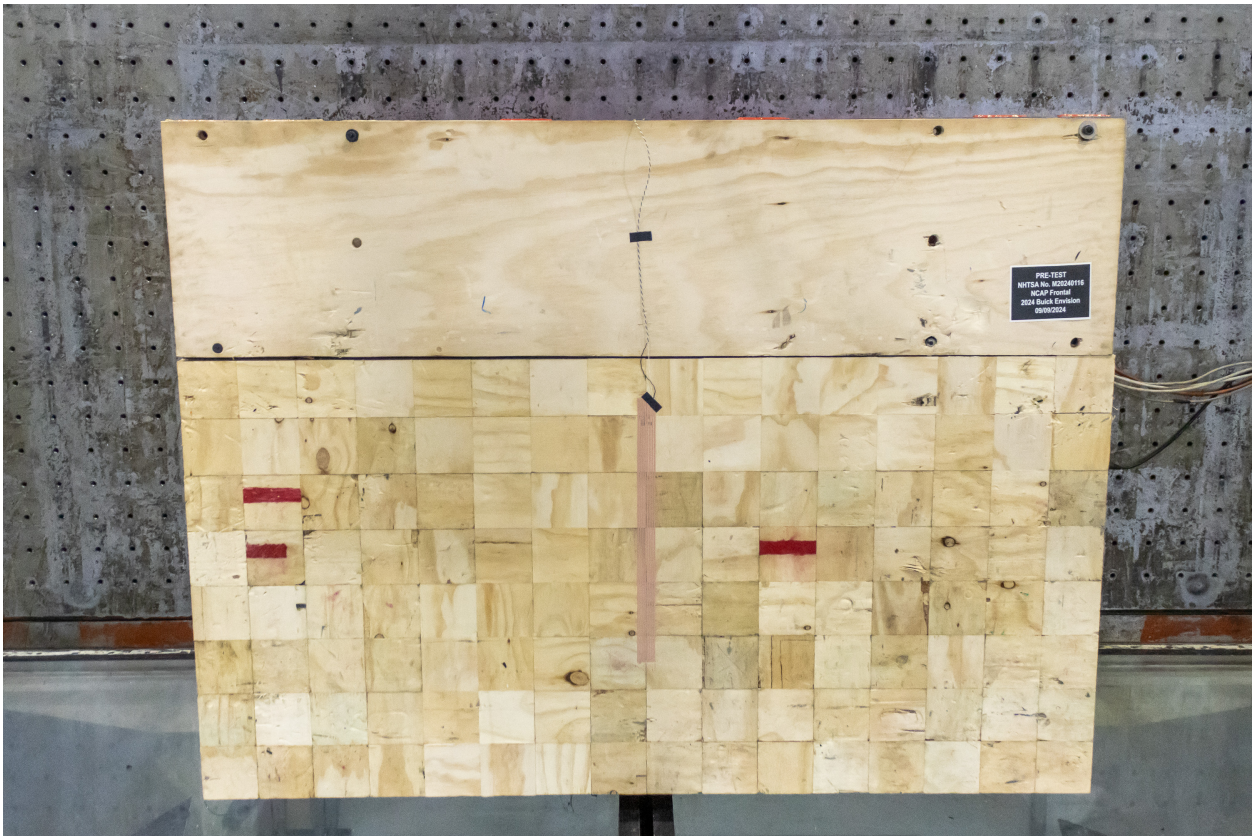

Figure A-2: Pre-Test Load Cell Wall



Figure A-3: Post-Test Load Cell Wall

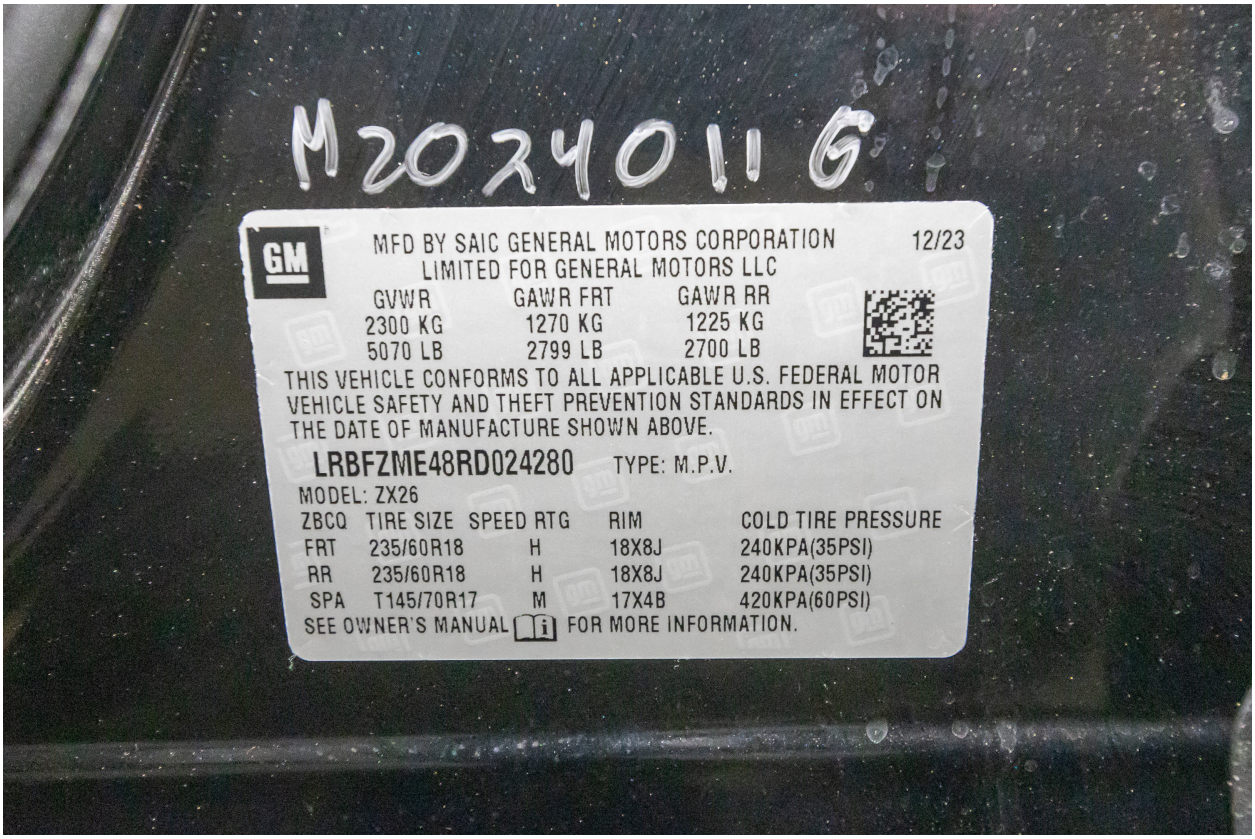

Figure A-4: Manufacturer's Label



Figure A-5: Tire Placard



Figure A-6: 2024 Buick Envision Frontal As Delivered



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

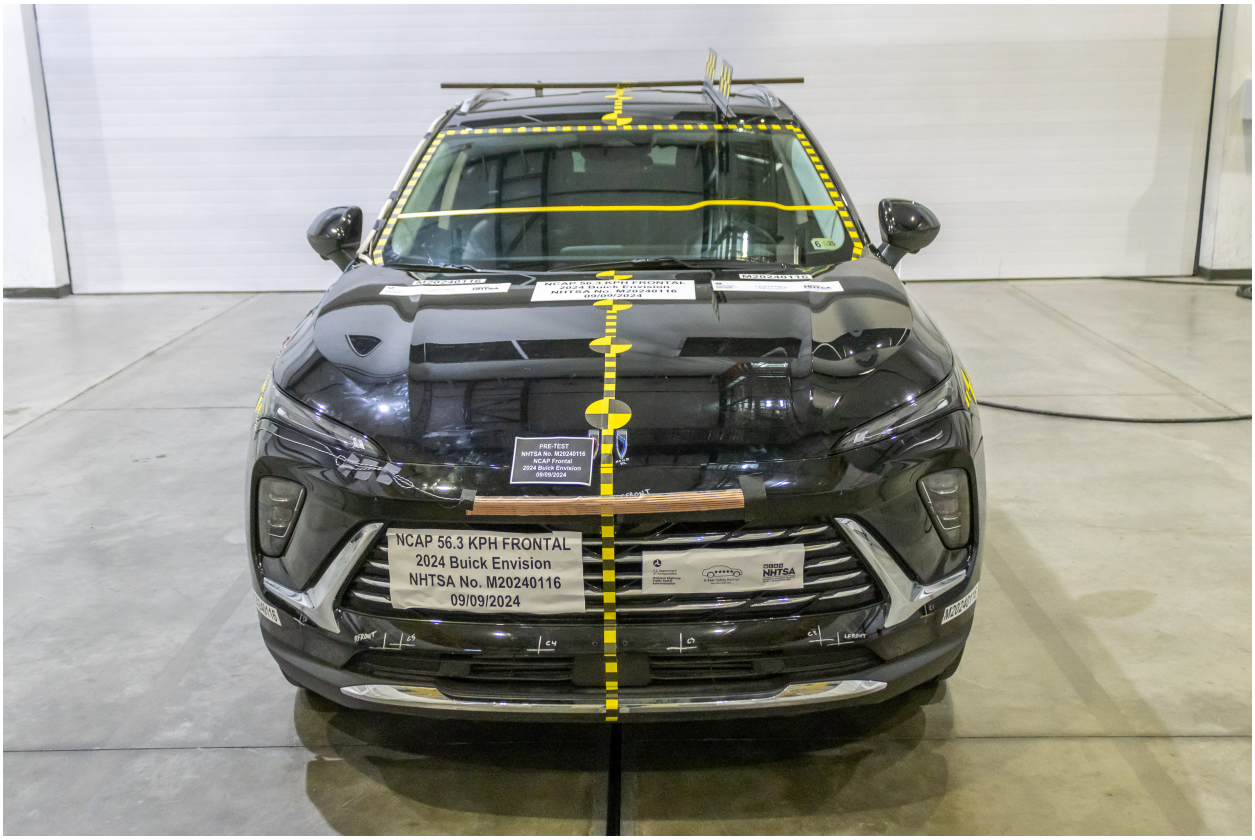

Figure A-8: Pre-Test Front View of Test Vehicle



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

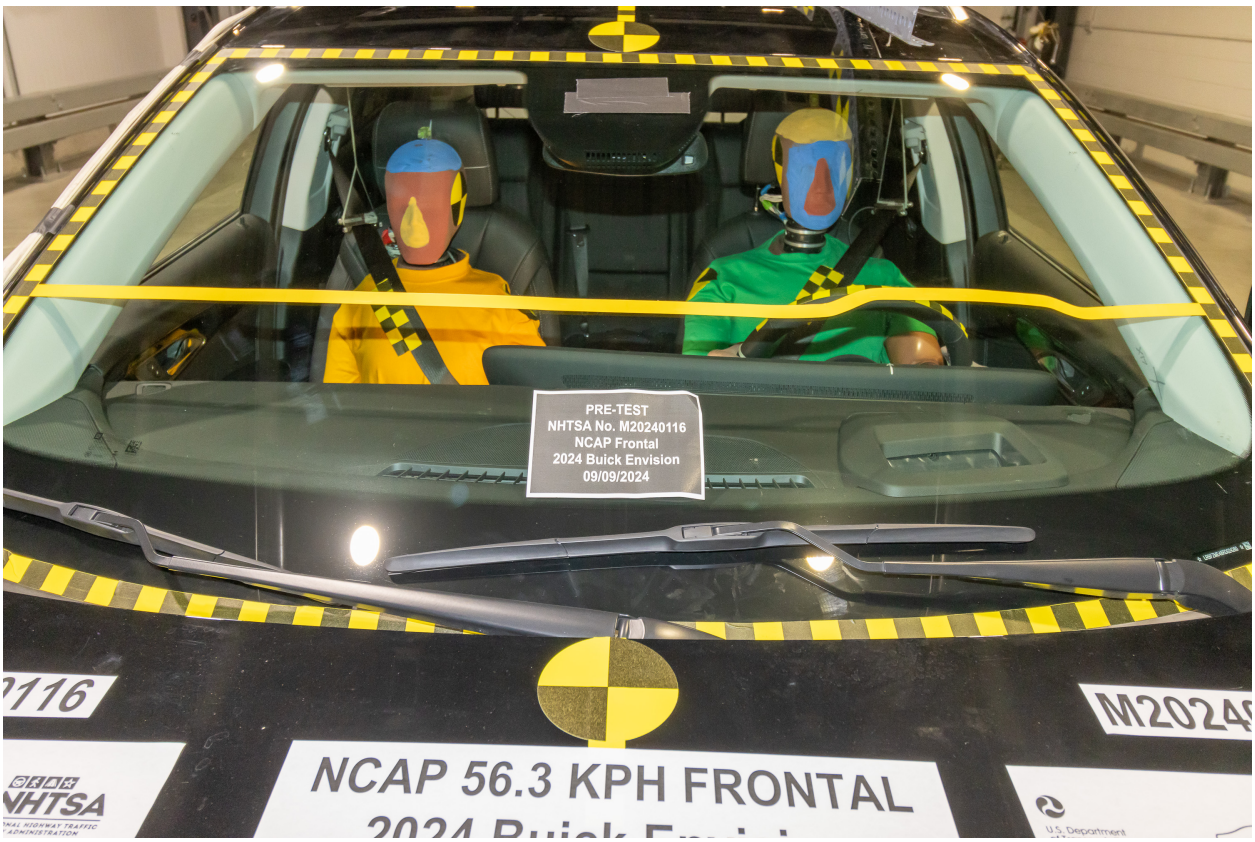

Figure A-18: Pre-Test Windshield View



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

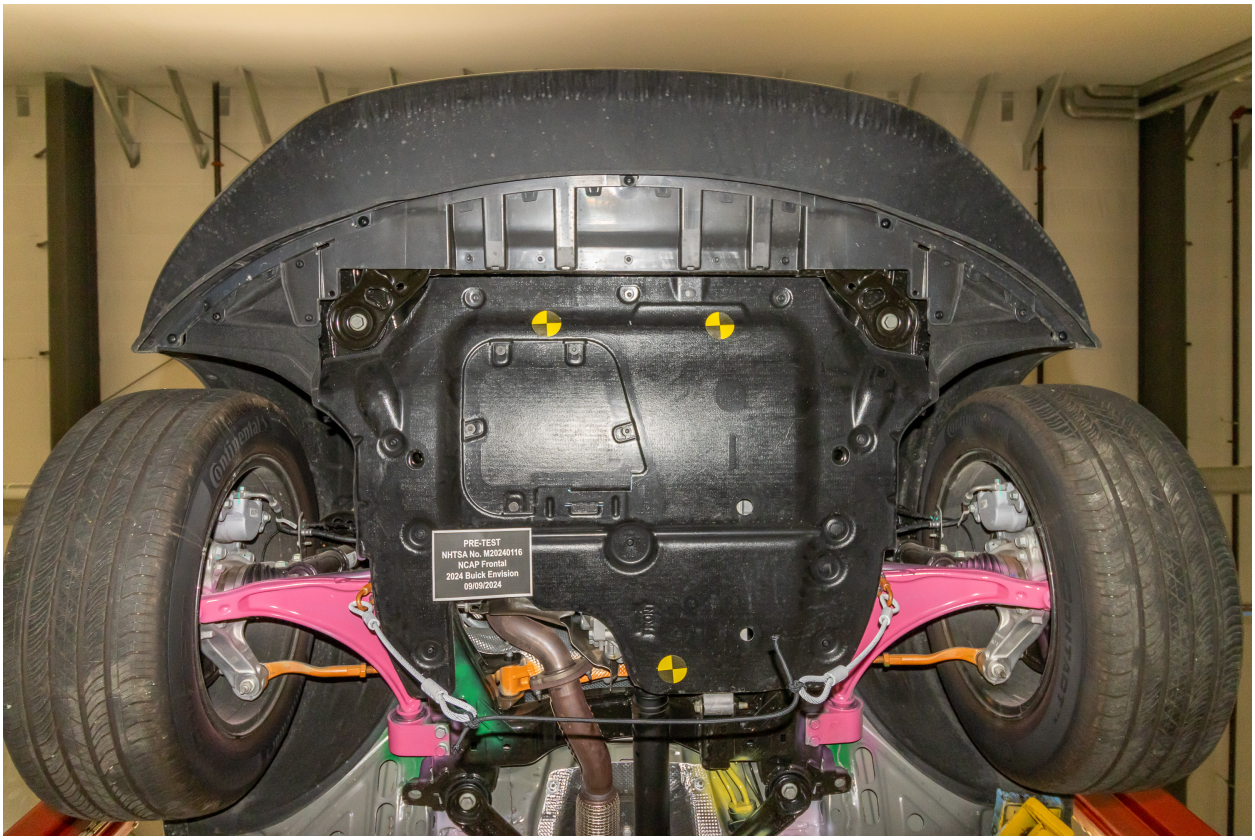

Figure A-24: Pre-Test Front Underbody View

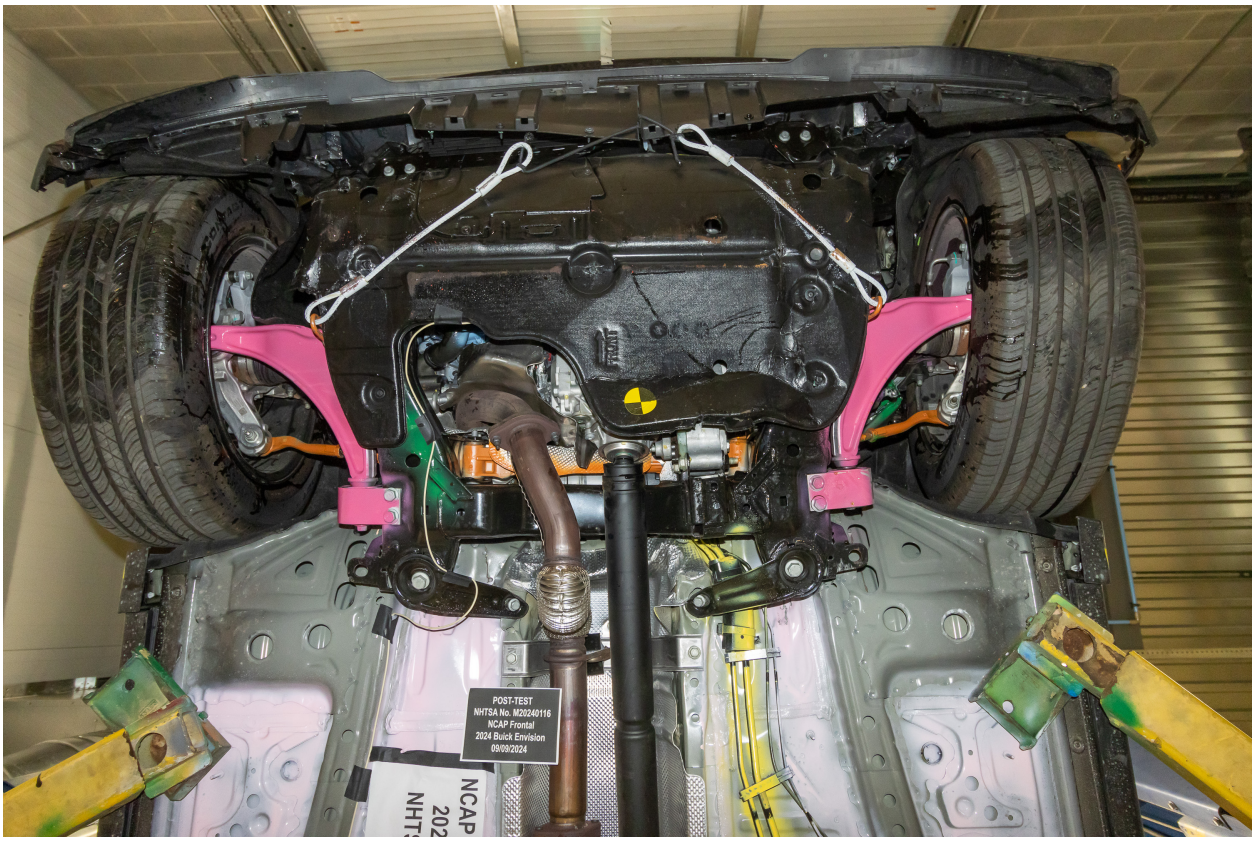

Figure A-25: Post-Test Front Underbody View

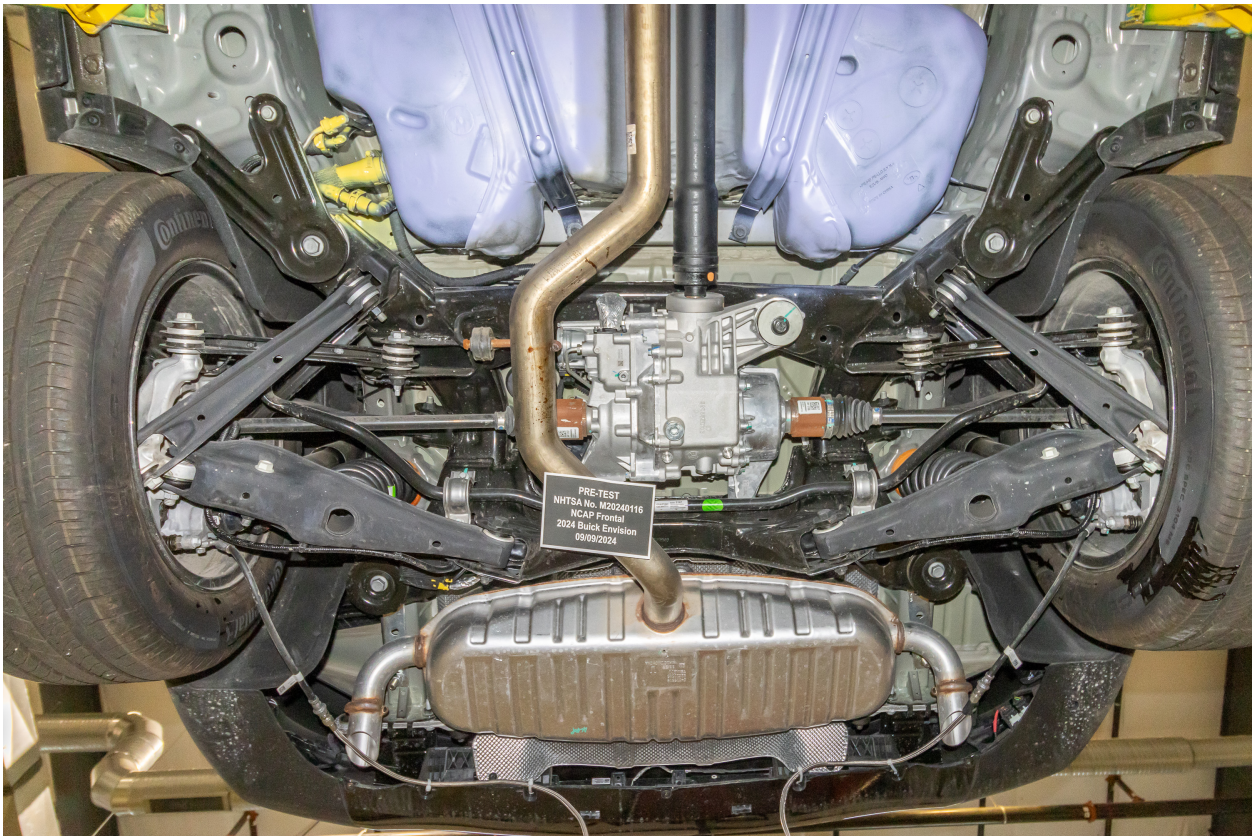

Figure A-26: Pre-Test Rear Underbody View

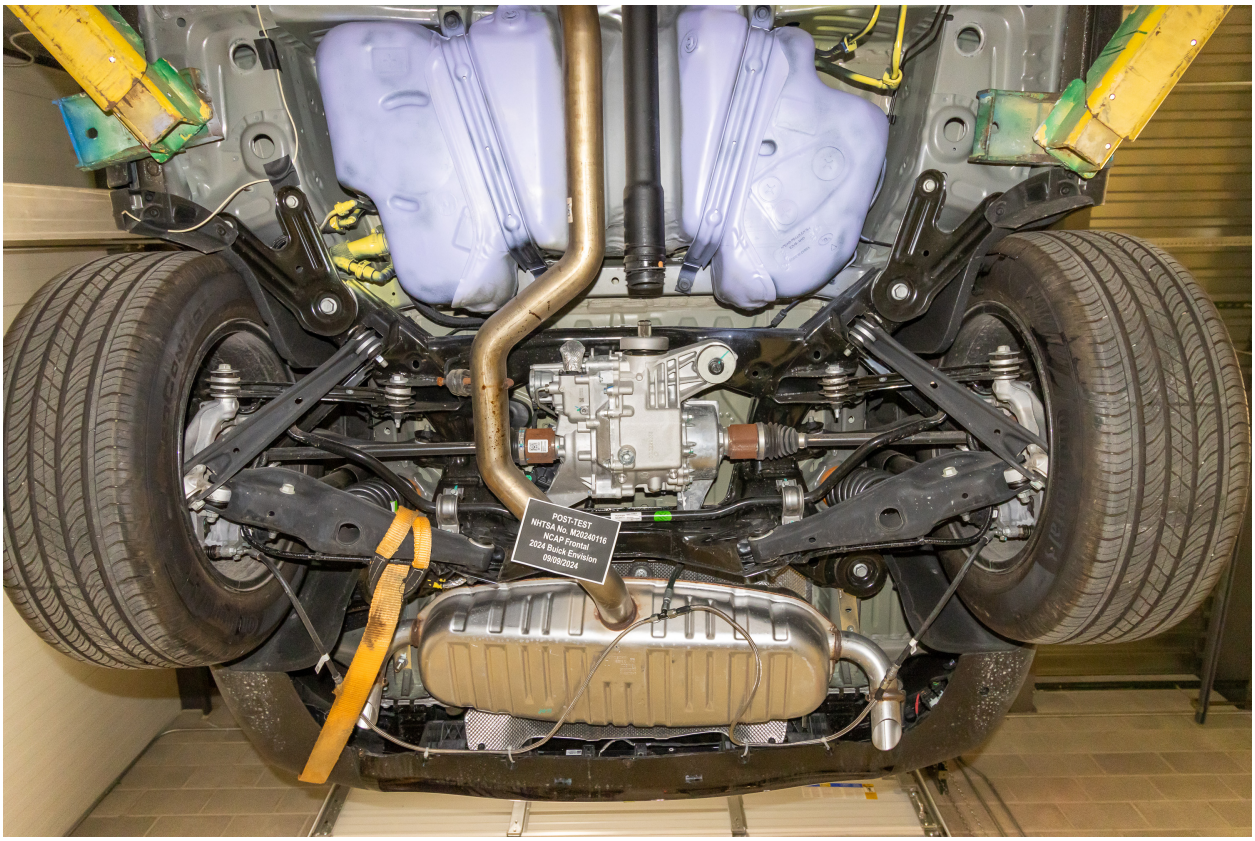

Figure A-27: Post-Test Rear Underbody View



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

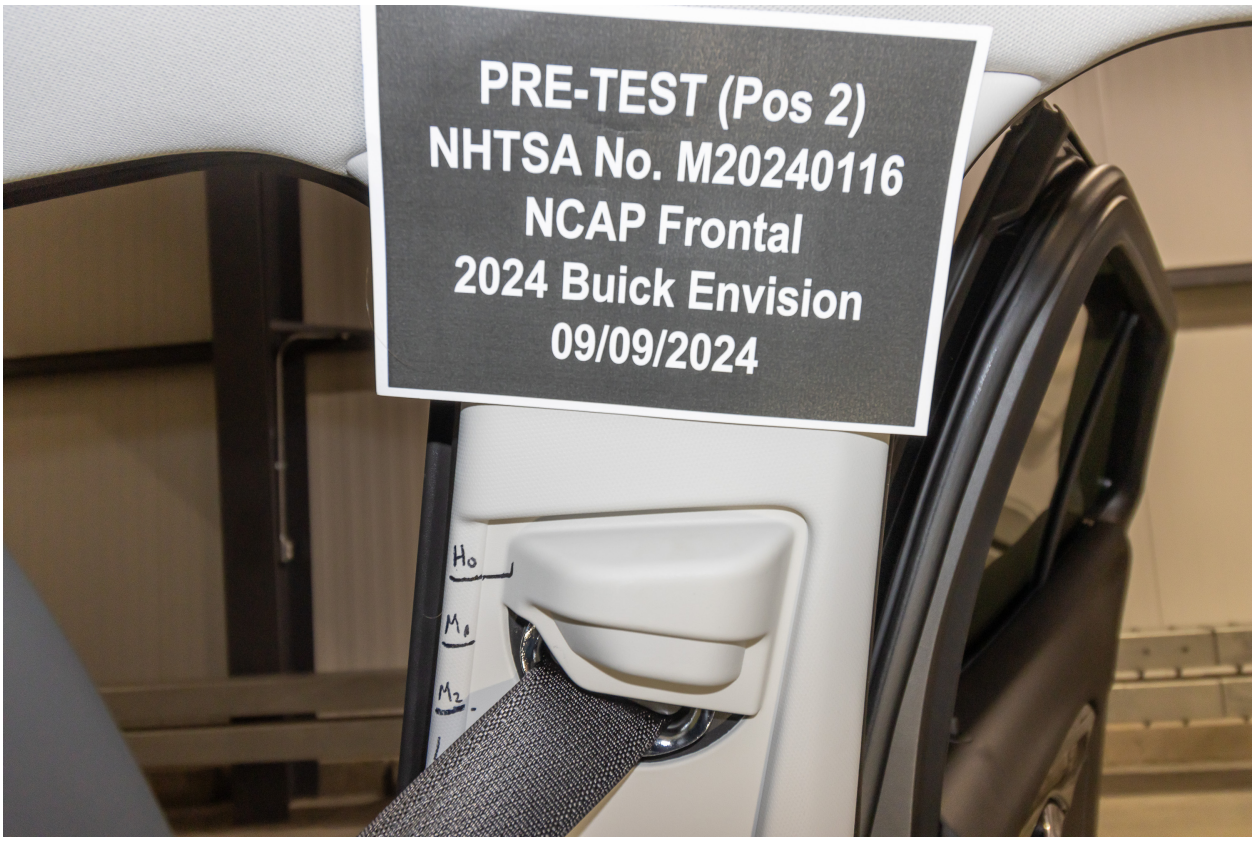

Figure A-61: Pre-Test View of Belt Anchorage for Passenger Dummy

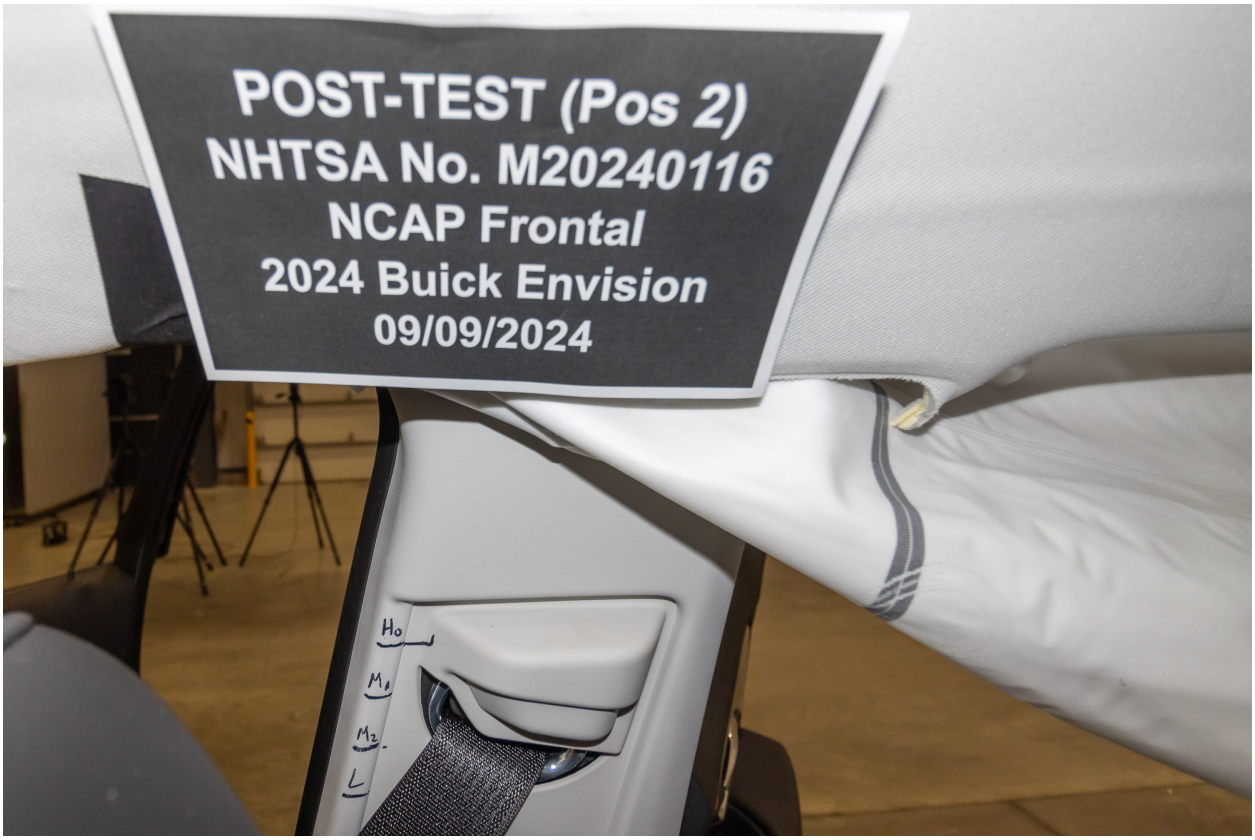

Figure A-62: Post-Test View of Belt Anchorage for Passenger Dummy



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

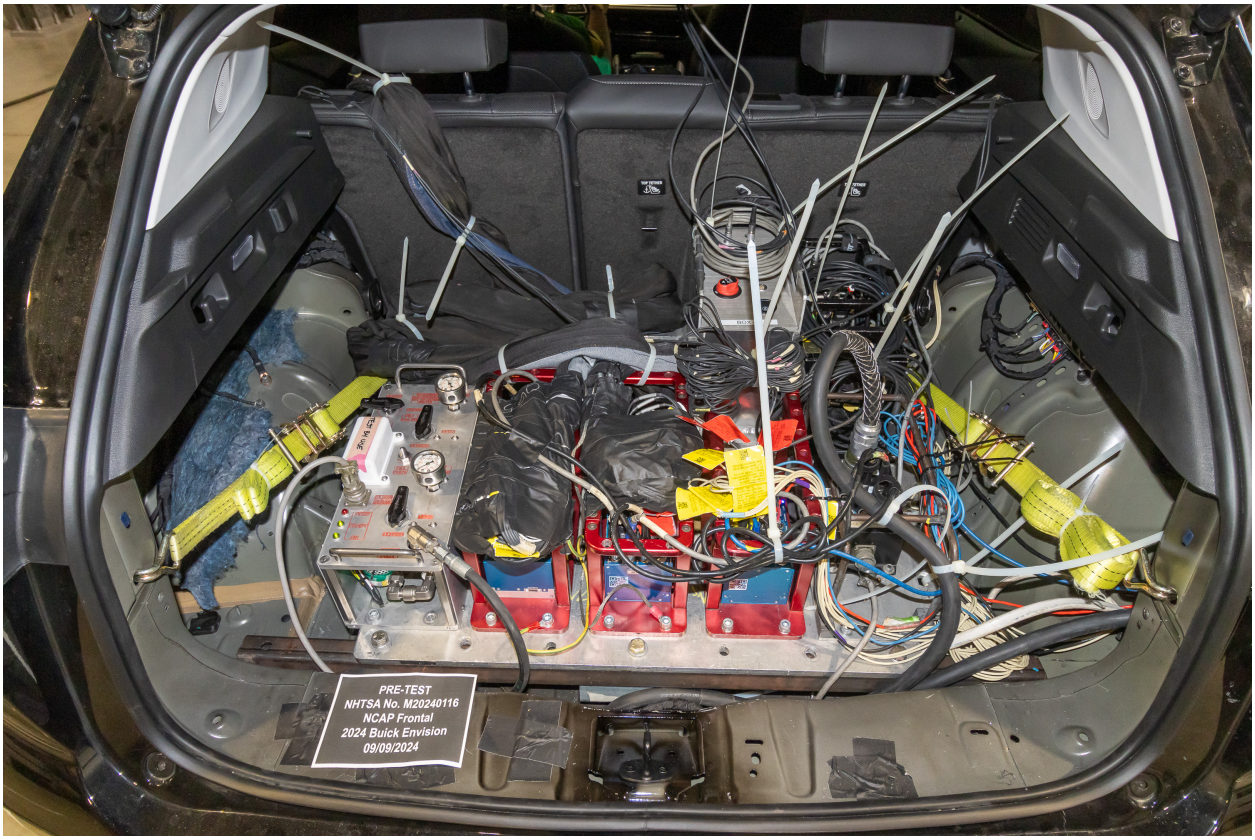

Figure A-74: Photograph of Ballast Installed in Vehicle

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

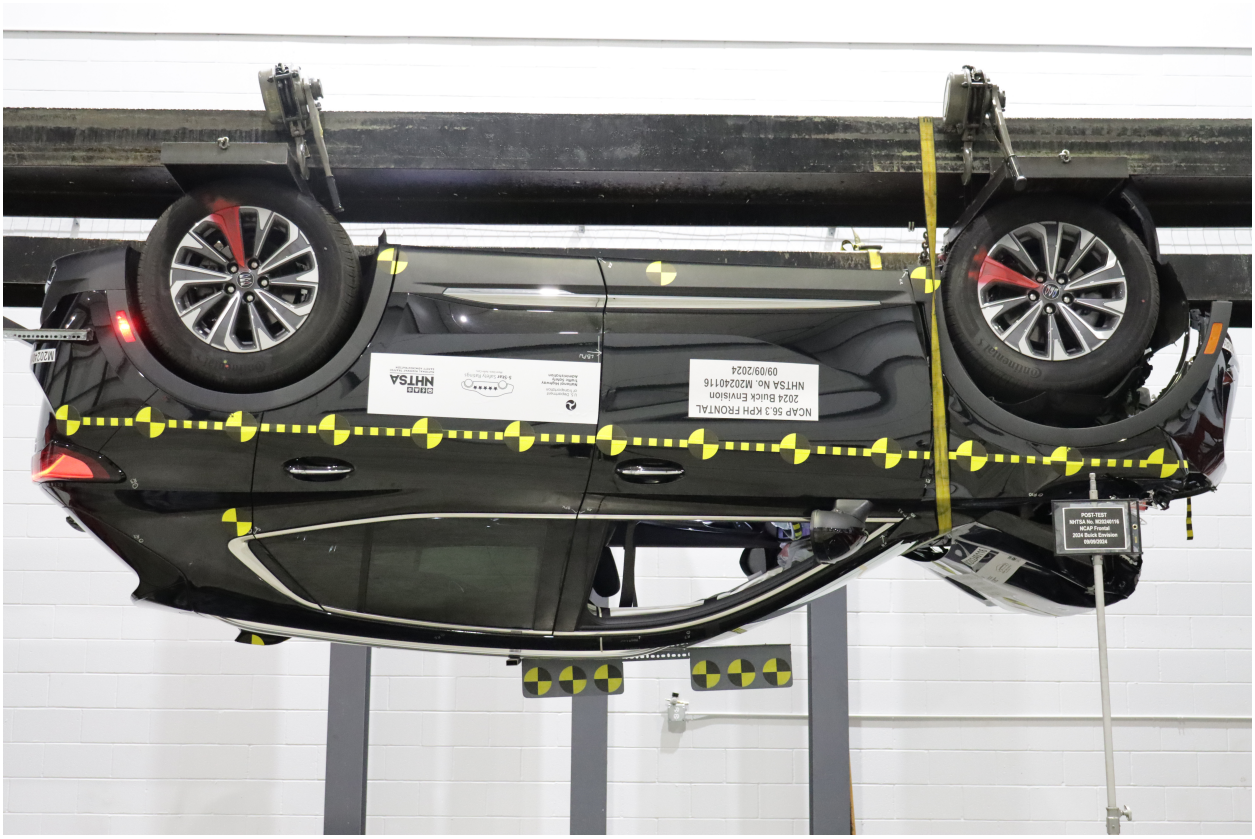

Figure A-79: Vehicle at 180º on Static Rollover Device

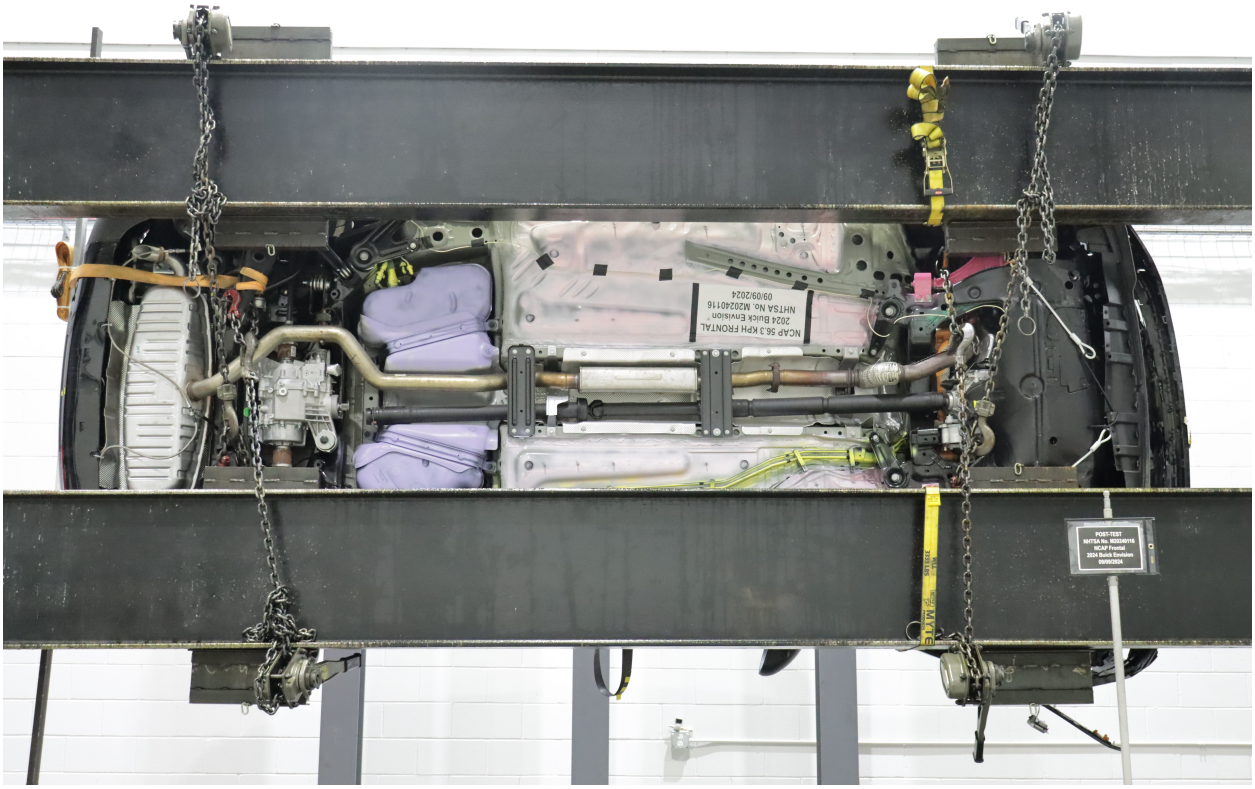

Figure A-80: Vehicle at 270º on Static Rollover Device



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



Figure A-82: 2024 Buick Envision Frontal Impact Event

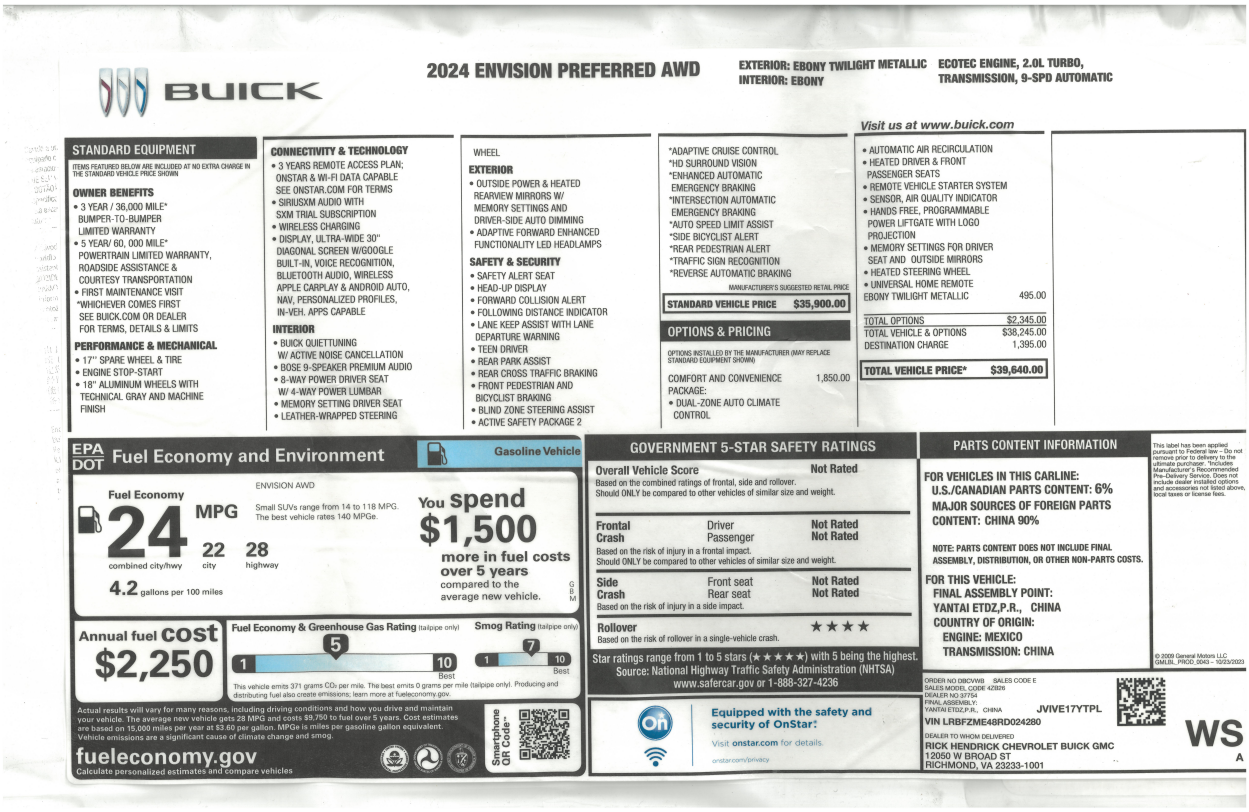

Figure A-83: Monroney Label Photograph

APPENDIX B
VEHICLE AND DUMMY RESPONSE DATA TRACES

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Plot 4	Driver Head Resultant Acceleration vs. Time Primary	B-5
Plot 5	Driver Chest X Deflection vs. Time	B-6
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Plot 21	Passenger Chest X Acceleration vs. Time Primary	B-10
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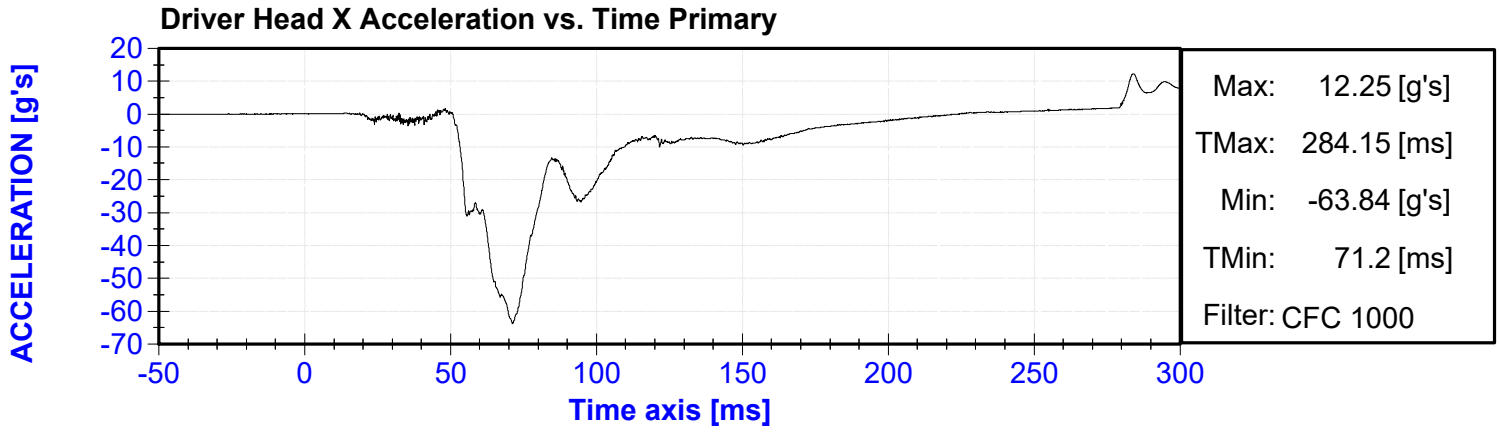
The following additional dummy and vehicle response data can be found in the R&D section of the NHTSA website at www.NHTSA.gov

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
ACCELERATION [g's]
20
10
0
-10
-20
-30
-40
-50
-60
-70
-50
0
50
100
150
200
250
300
Time axis [ms]
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TMax: 284.15 [ms]
Min: -63.84 [g's]
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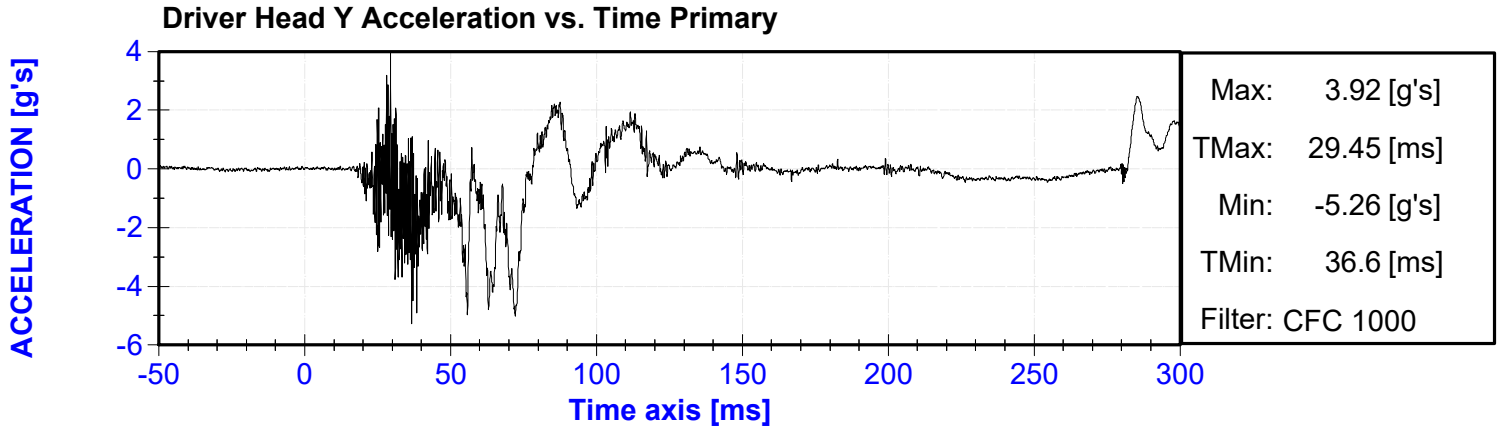
Filter: CFC 1000


Driver Head Y Acceleration vs. Time Primary
ACCELERATION [g's]
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2
0
-2
-4
-6
-50
0
50
100
150
200
250
300
Time axis [ms]
Max: 3.92 [g's]
TMax: 29.45 [ms]
Min: -5.26 [g's]
TMin: 36.6 [ms]
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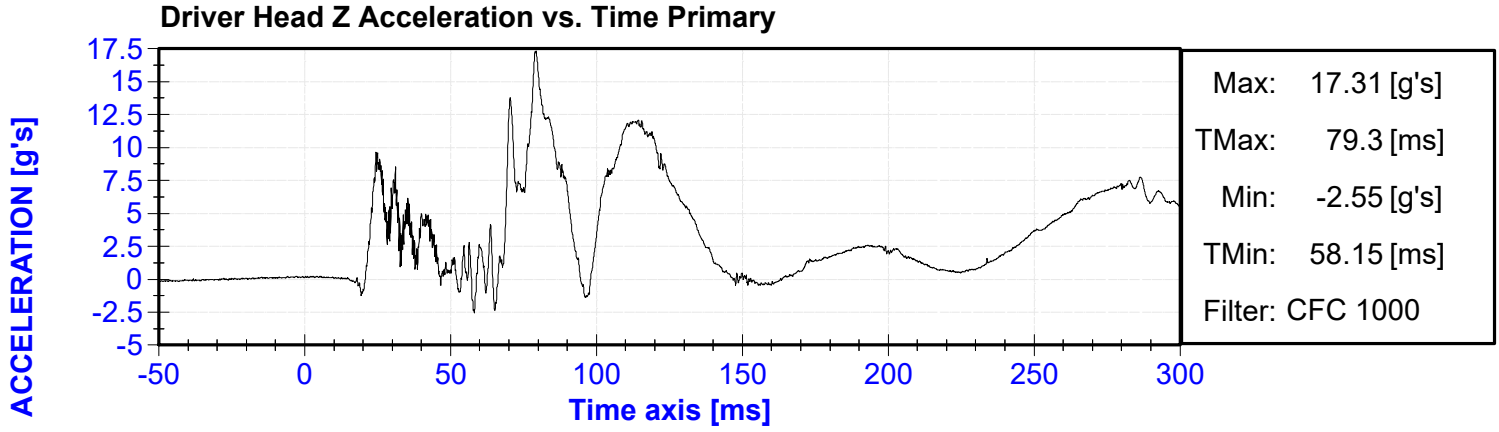
Driver Head Z Acceleration vs. Time Primary
ACCELERATION [g's]
17.5
15
12.5
10
7.5
5
2.5
0
-2.5
-5
-50
0
50
100
150
200
250
300
Time axis [ms]
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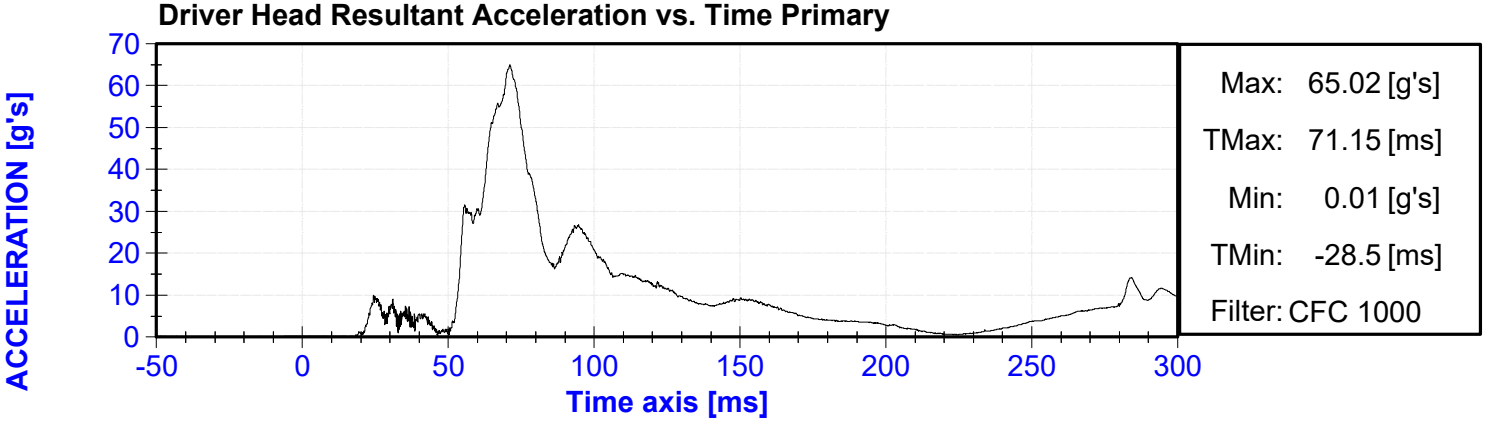
TMax: 79.3 [ms]
Min: -2.55 [g's]
TMin: 58.15 [ms]
Filter: CFC 1000


Driver Head Resultant Acceleration vs. Time Primary
ACCELERATION [g's]
70
60
50
40
30
20
10
0
-50
0
50
100
150
200
250
300
Time axis [ms]
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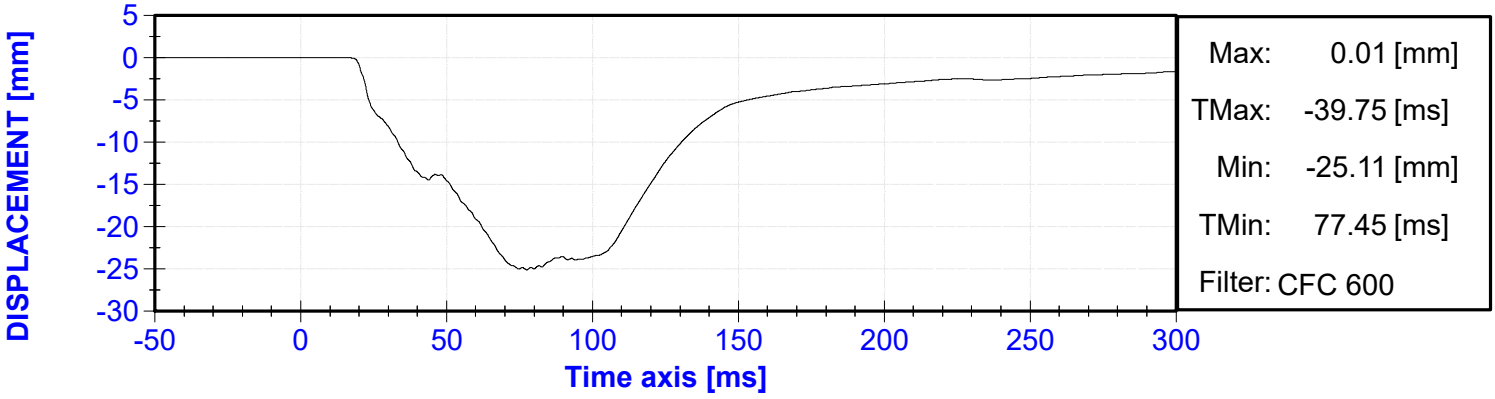
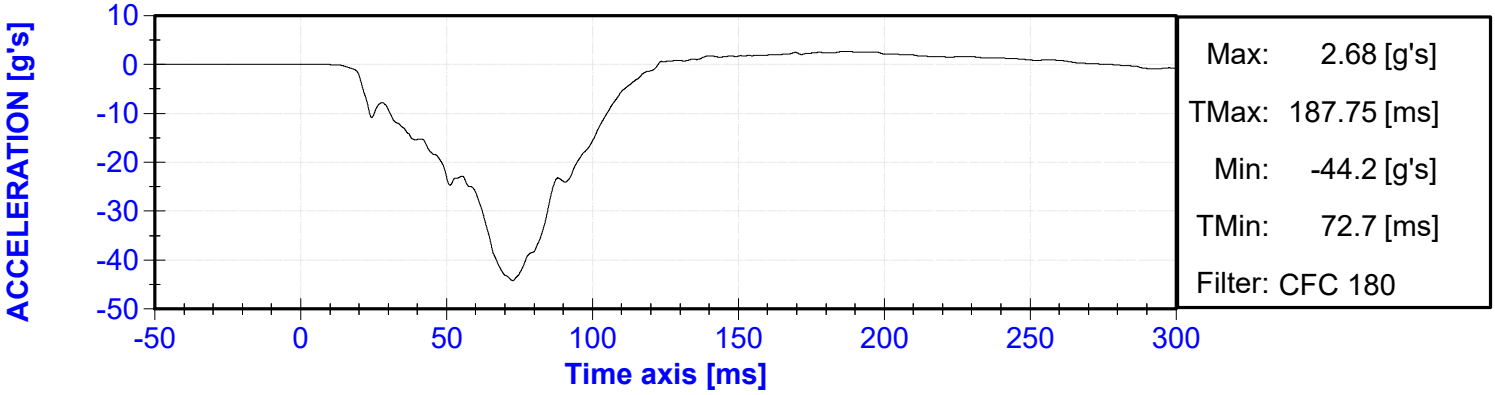
TMax: 71.15 [ms]
Min: 0.01 [g's]
TMin: -28.5 [ms]
Filter: CFC 1000

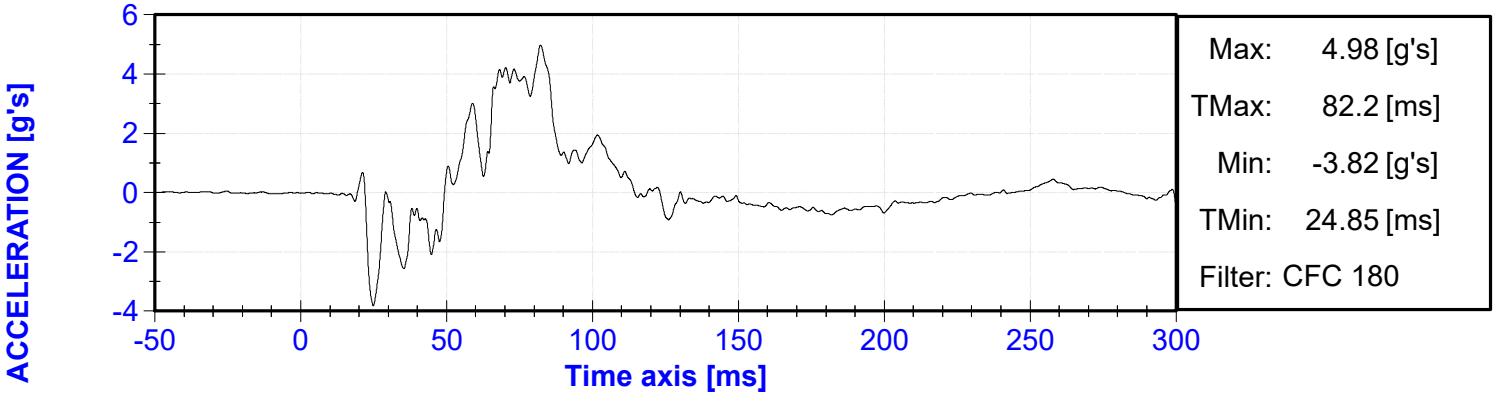
Driver Chest X Deflection vs. Time



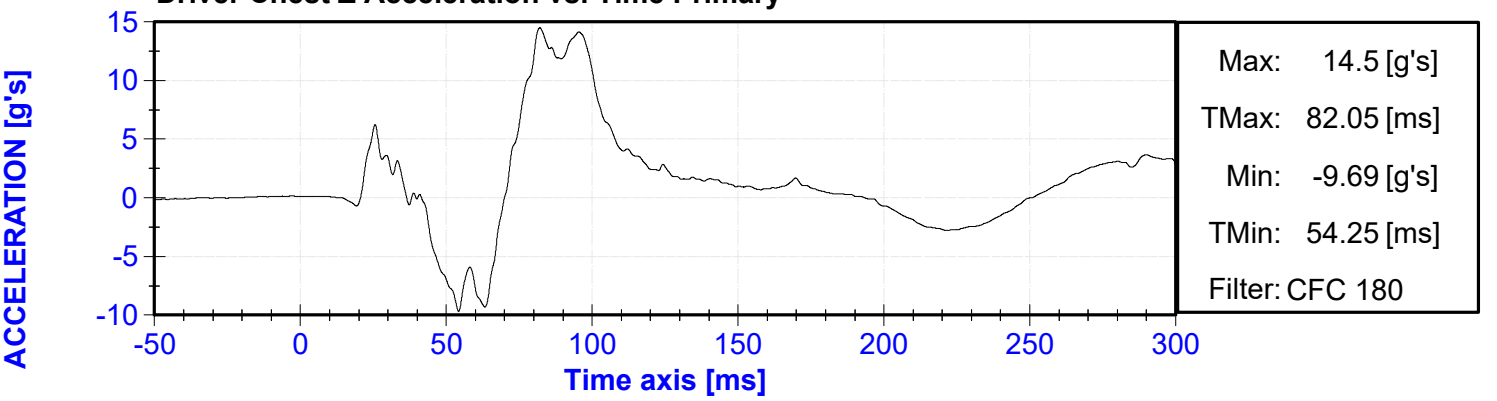
Driver Chest X Acceleration vs. Time Primary



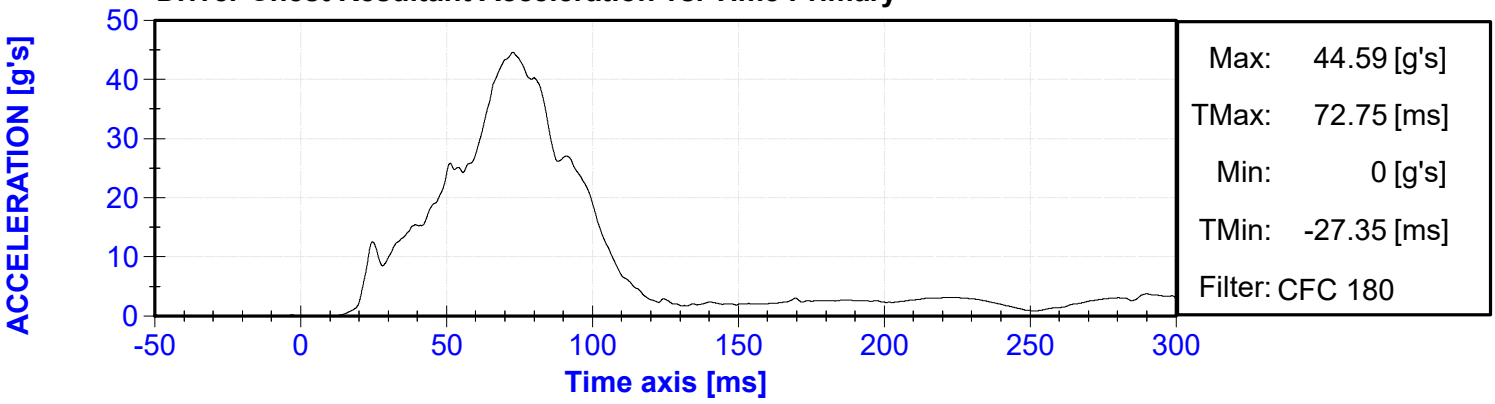
Driver Chest Y Acceleration vs. Time Primary



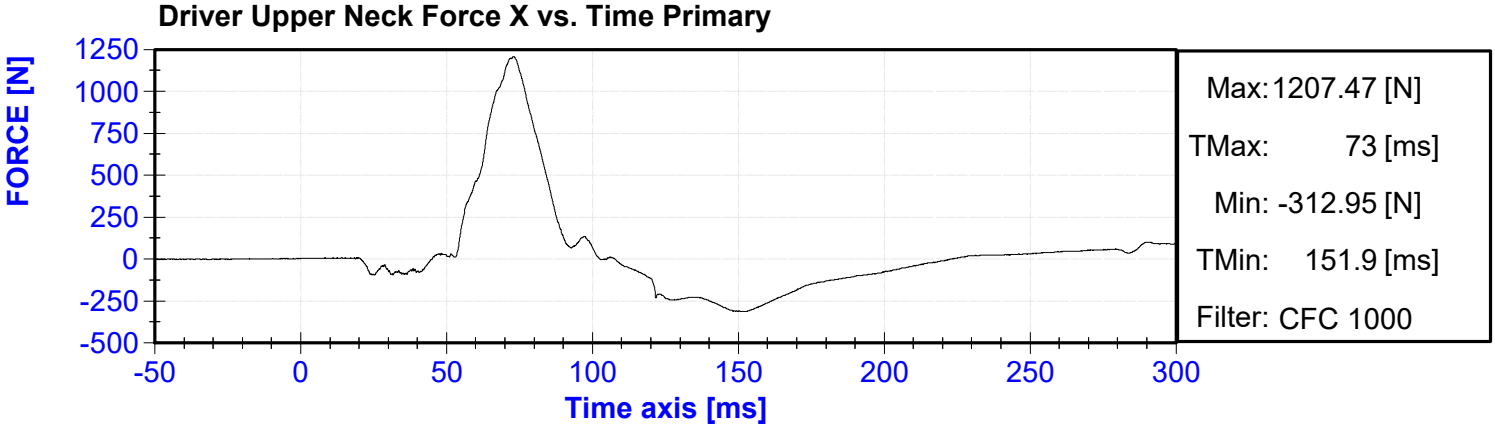
Driver Chest Z Acceleration vs. Time Primary



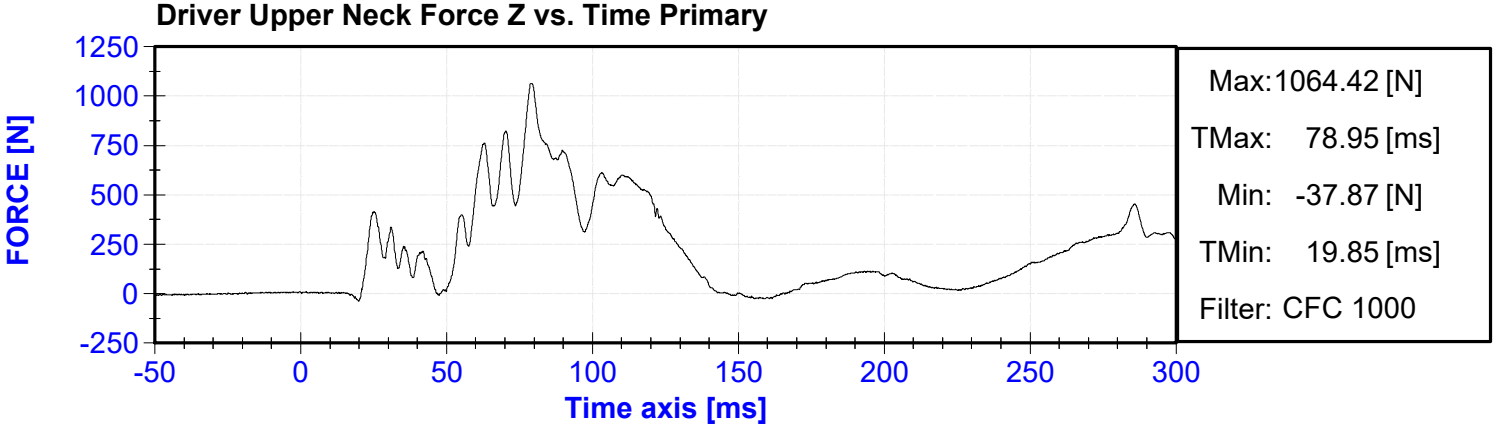
Driver Chest Resultant Acceleration vs. Time Primary



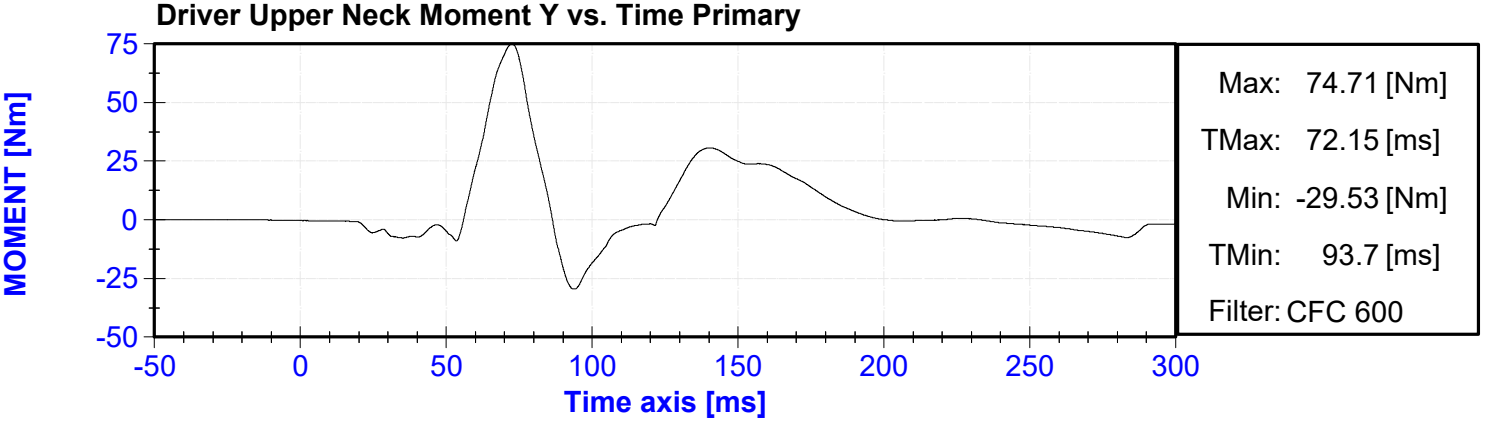
Driver Upper Neck Force X vs. Time Primary



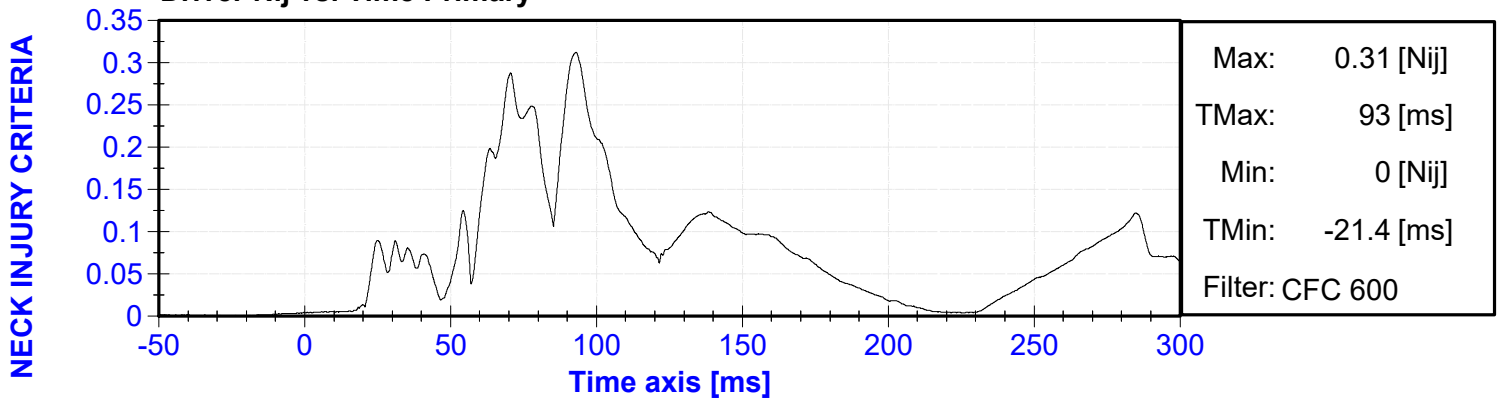
Driver Upper Neck Force Z vs. Time Primary



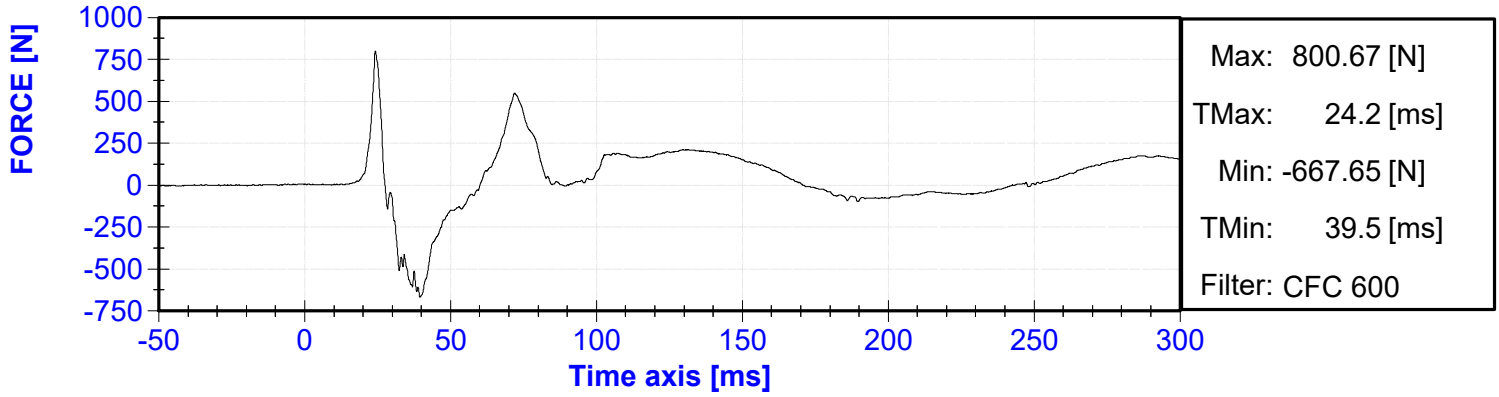
Driver Upper Neck Moment Y vs. Time Primary



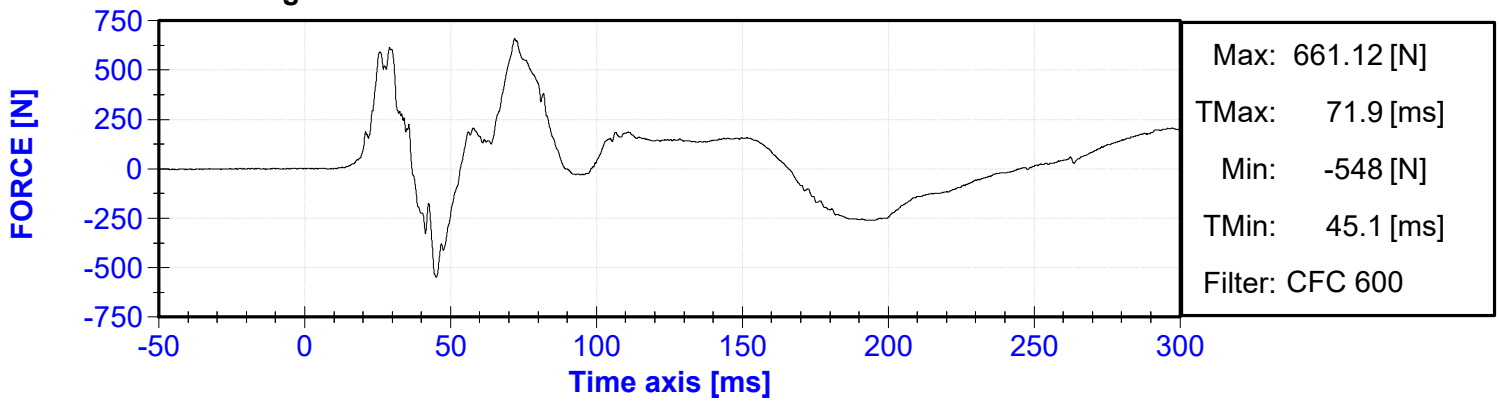
Driver Nij vs. Time Primary



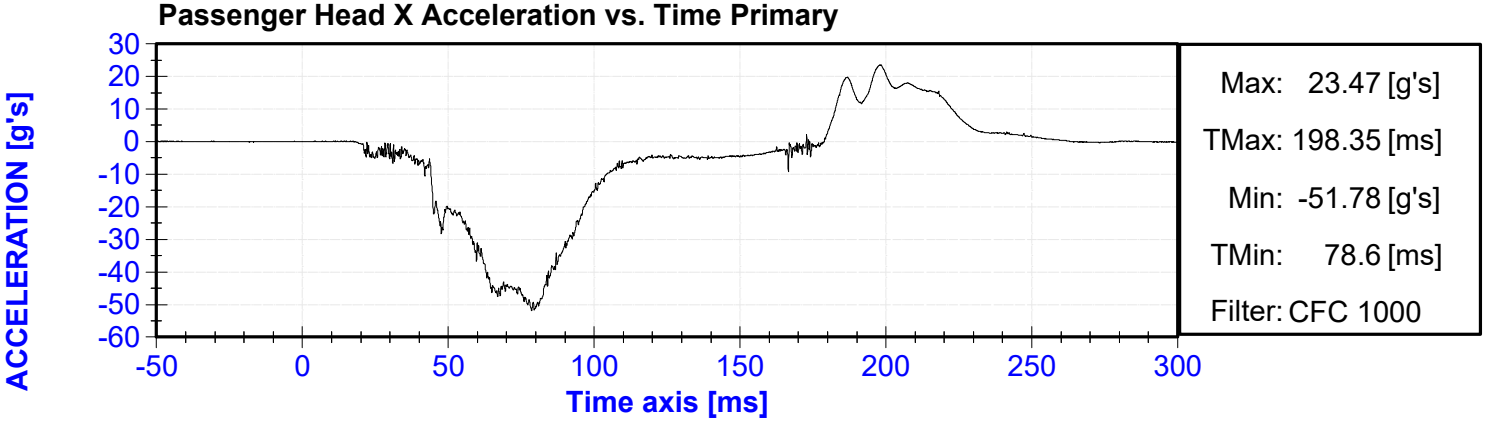
Driver Left Femur Force vs. Time



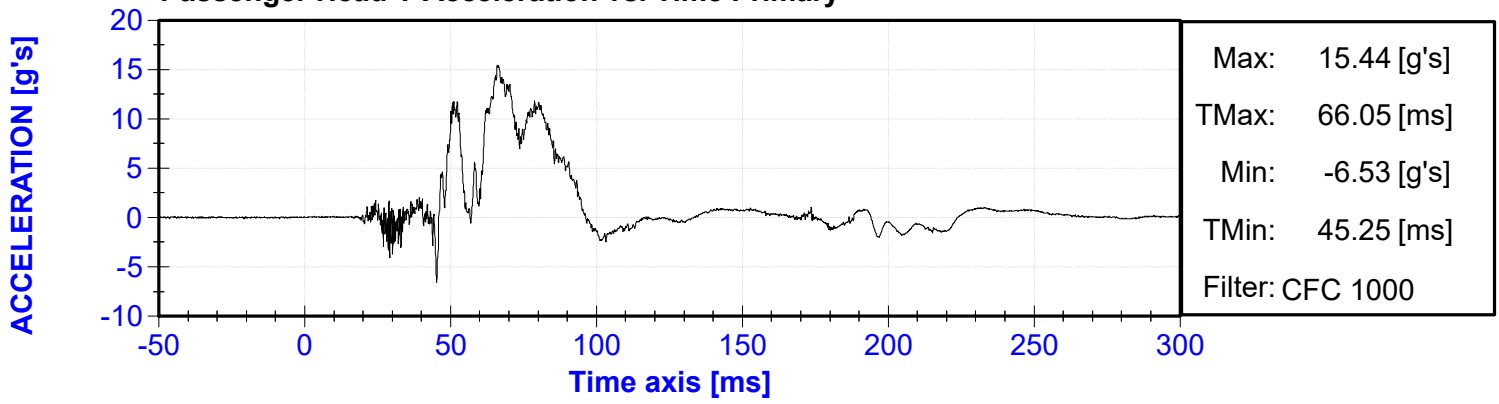
Driver Right Femur Force vs. Time



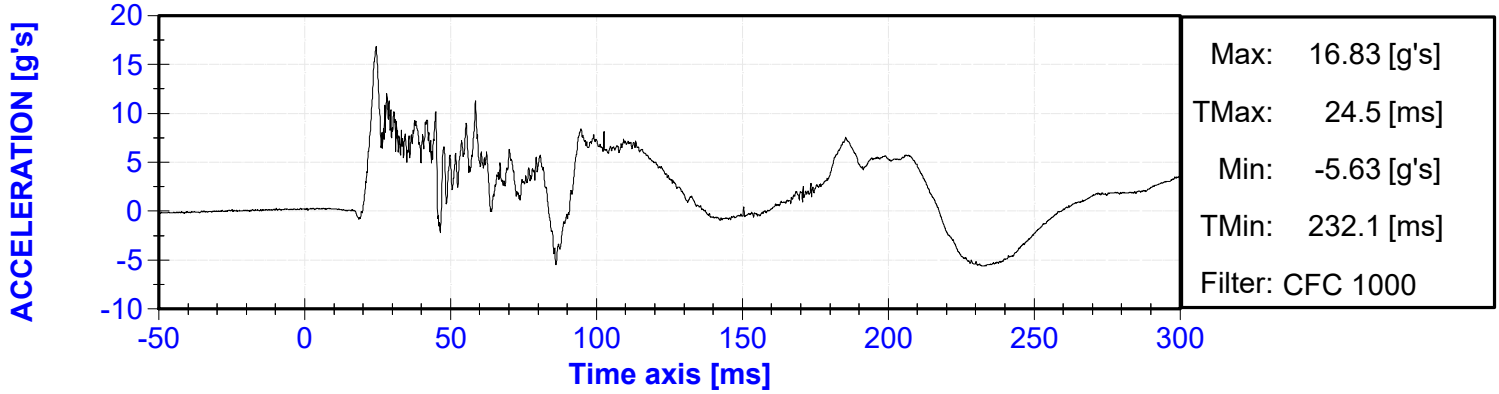
Passenger Head X Acceleration vs. Time Primary



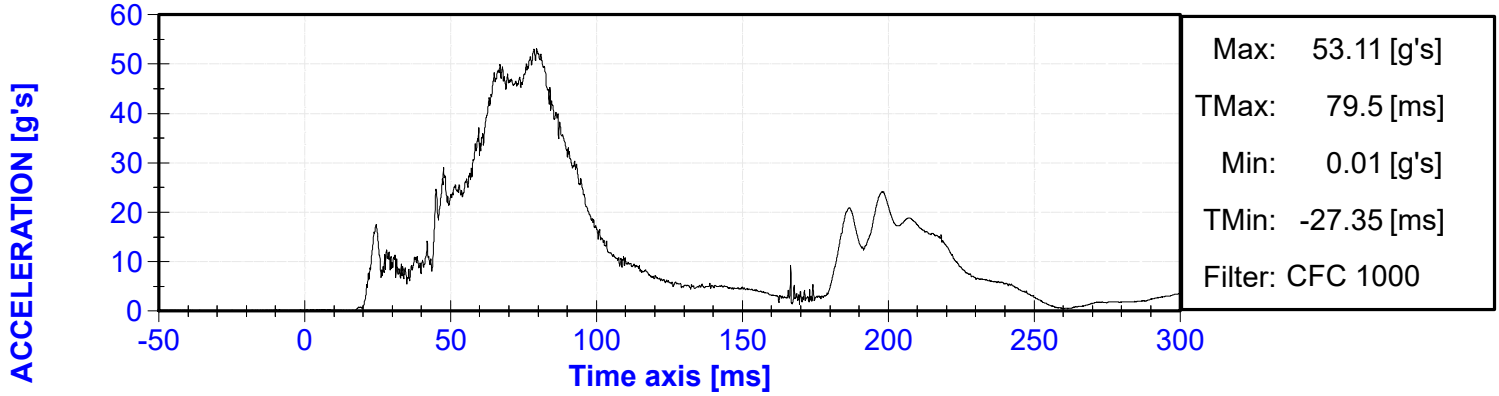
Passenger Head Y Acceleration vs. Time Primary



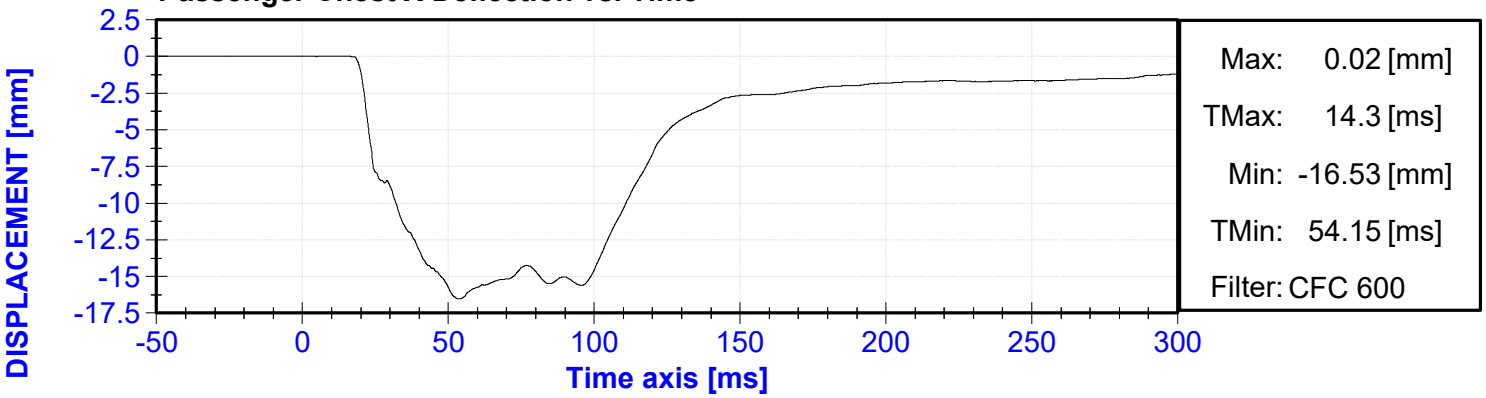
Passenger Head Z Acceleration vs. Time Primary

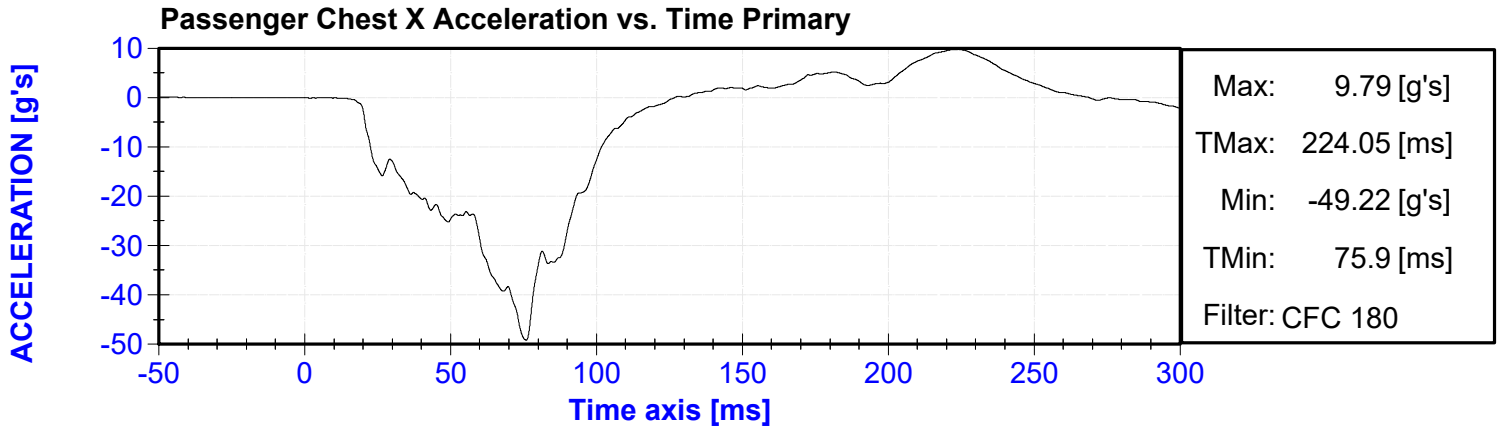


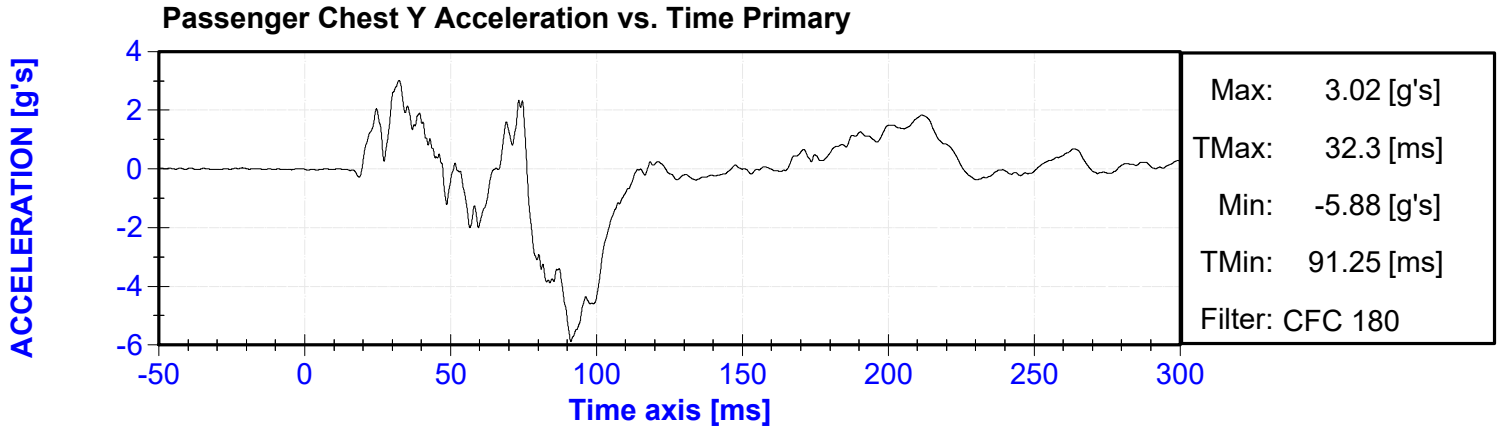
Passenger Head Resultant Acceleration vs. Time Primary

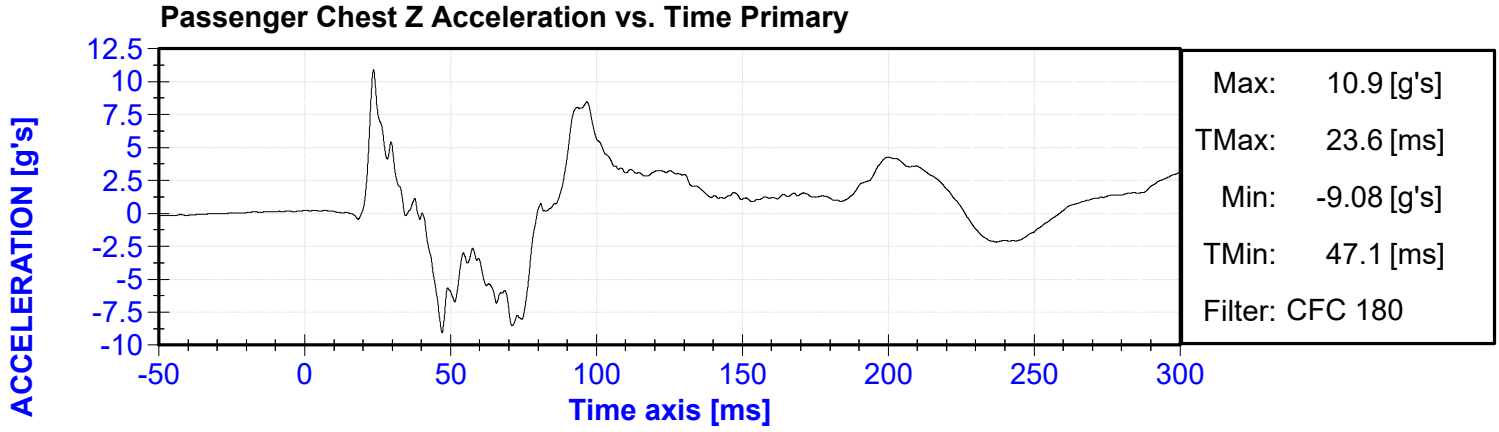


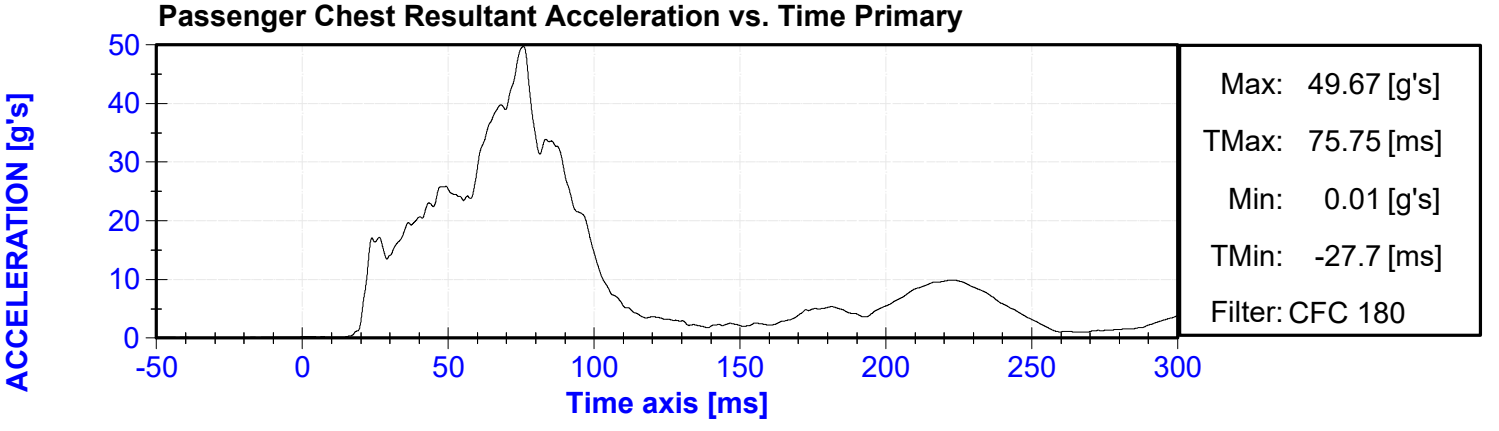
Passenger Chest X Deflection vs. Time

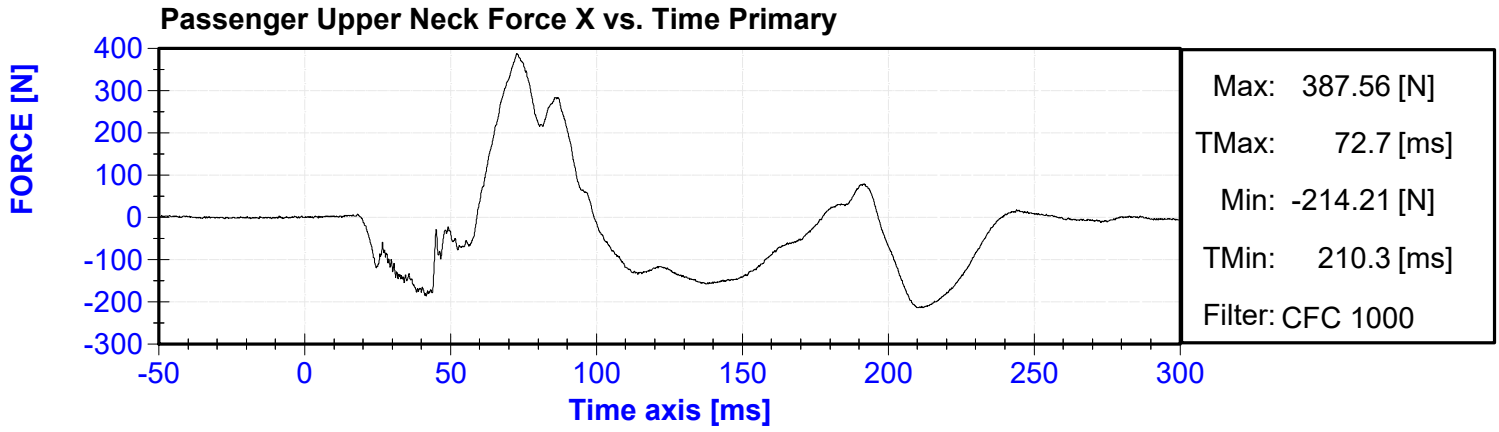


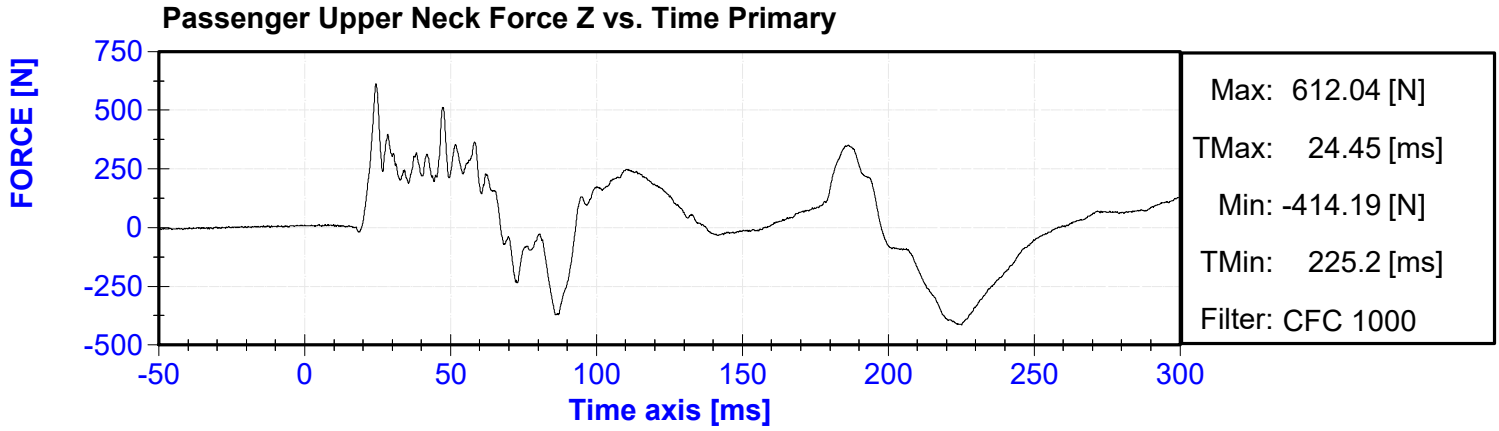

Passenger Chest X Acceleration vs. Time Primary
ACCELERATION [g's]
10
0
-10
-20
-30
-40
-50
-50
0
50
100
150
200
250
300
Time axis [ms]
Max: 9.79 [g's]
TMax: 224.05 [ms]
Min: -49.22 [g's]
TMin: 75.9 [ms]
Filter: CFC 180

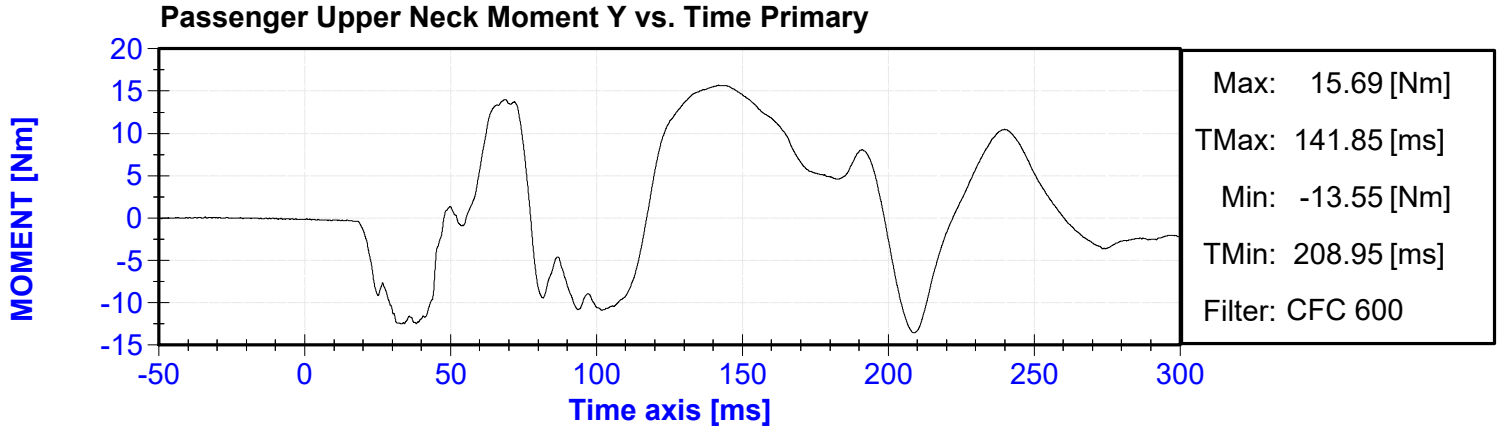

Passenger Chest Y Acceleration vs. Time Primary
ACCELERATION [g's]
4
2
0
-2
-4
-6
-50
0
50
100
150
200
250
300
Time axis [ms]
Max: 3.02 [g's]
TMax: 32.3 [ms]
Min: -5.88 [g's]
TMin: 91.25 [ms]
Filter: CFC 180

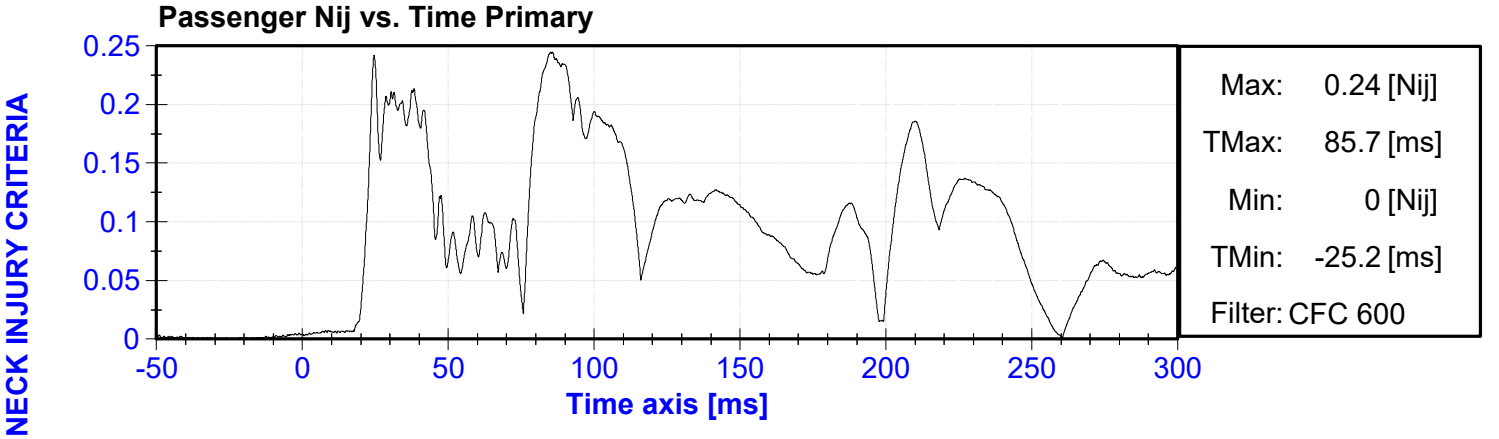

Passenger Chest Z Acceleration vs. Time Primary
ACCELERATION [g's]
12.5
10
7.5
5
2.5
0
-2.5
-5
-7.5
-10
-50
0
50
100
150
200
250
300
Time axis [ms]
Max: 10.9 [g's]
TMax: 23.6 [ms]
Min: -9.08 [g's]
TMin: 47.1 [ms]
Filter: CFC 180

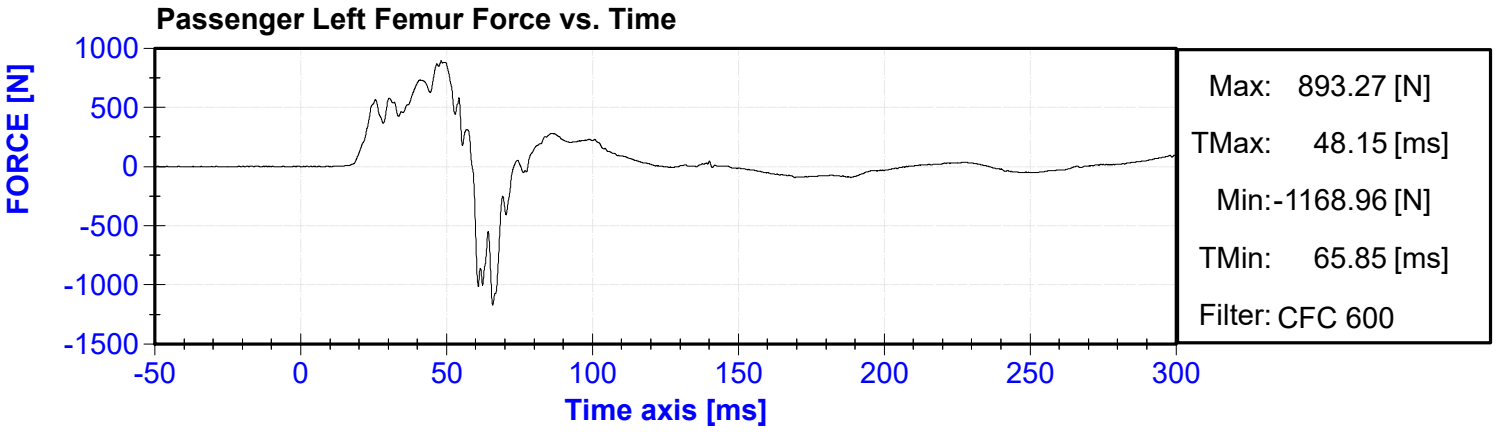

Passenger Chest Resultant Acceleration vs. Time Primary
ACCELERATION [g's]
50
40
30
20
10
0
-50
0
50
100
150
200
250
300
Time axis [ms]
Max: 49.67 [g's]
TMax: 75.75 [ms]
Min: 0.01 [g's]
TMin: -27.7 [ms]
Filter: CFC 180

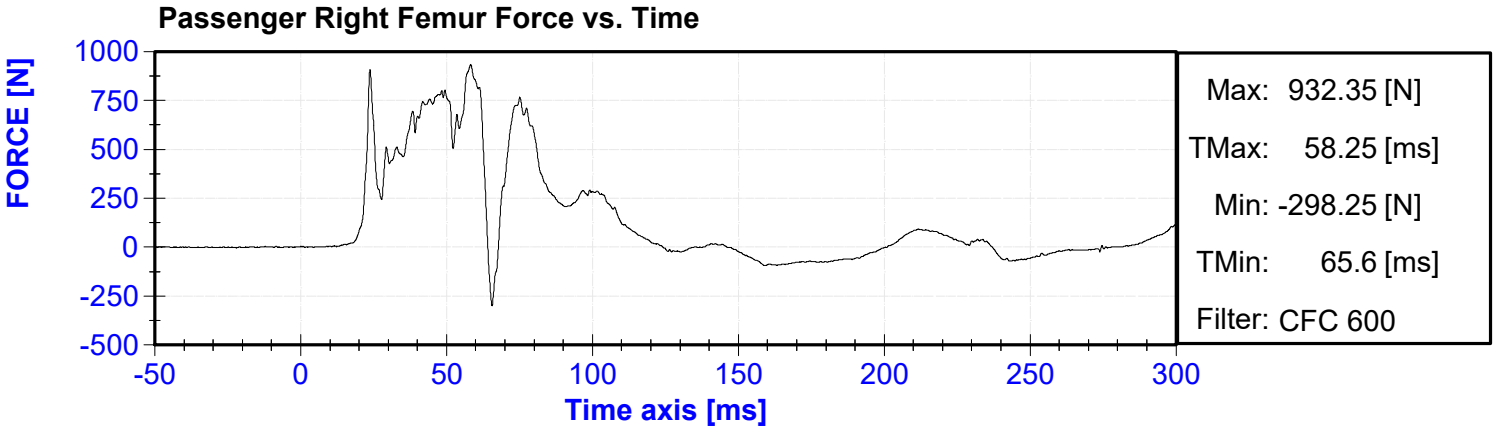

Passenger Upper Neck Force X vs. Time Primary
FORCE [N]
400
300
200
100
0
-100
-200
-300
-50
0
50
100
150
200
250
300
Time axis [ms]
Max: 387.56 [N]
TMax: 72.7 [ms]
Min: -214.21 [N]
TMin: 210.3 [ms]
Filter: CFC 1000


Passenger Upper Neck Force Z vs. Time Primary
FORCE [N]
750
500
250
0
-250
-500
-50
0
50
100
150
200
250
300
Time axis [ms]
Max: 612.04 [N]
TMax: 24.45 [ms]
Min: -414.19 [N]
TMin: 225.2 [ms]
Filter: CFC 1000


Passenger Upper Neck Moment Y vs. Time Primary
MOMENT [Nm]
20
15
10
5
0
-5
-10
-15
-50
0
50
100
150
200
250
300
Time axis [ms]
Max: 15.69 [Nm]
TMax: 141.85 [ms]
Min: -13.55 [Nm]
TMin: 208.95 [ms]
Filter: CFC 600


Passenger Nij vs. Time Primary
NECK INJURY CRITERIA
0.25
0.2
0.15
0.1
0.05
0
-50
0
50
100
150
200
250
300
Time axis [ms]
Max: 0.24 [Nij]
TMax: 85.7 [ms]
Min: 0 [Nij]
TMin: -25.2 [ms]
Filter: CFC 600


Passenger Left Femur Force vs. Time
FORCE [N]
1000
500
0
-500
-1000
-1500
-50
0
50
100
150
200
250
300
Time axis [ms]
Max: 893.27 [N]
TMax: 48.15 [ms]
Min: -1168.96 [N]
TMin: 65.85 [ms]
Filter: CFC 600


Passenger Right Femur Force vs. Time
FORCE [N]
1000
750
500
250
0
-250
-500
-50
0
50
100
150
200
250
300
Time axis [ms]
Max: 932.35 [N]
TMax: 58.25 [ms]
Min: -298.25 [N]
TMin: 65.6 [ms]
Filter: CFC 600

APPENDIX C

DUMMY CALIBRATION AND PERFORMANCE VERIFICATION DATA

CALIBRATION TEST RESULTS

PRE-TEST

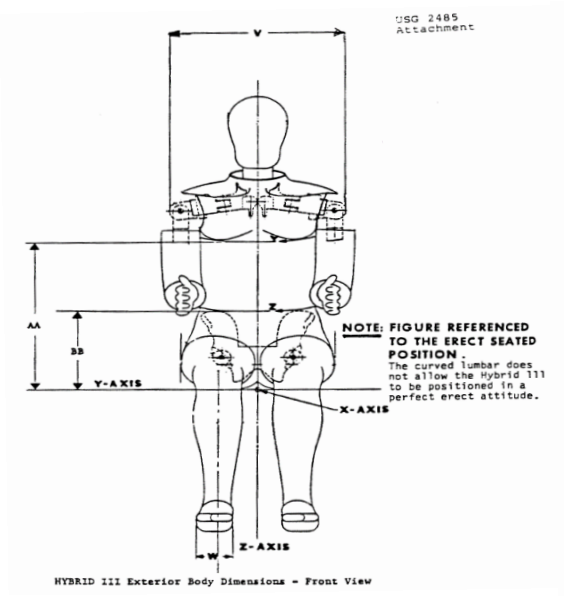
HYBRID III 50TH PERCENTILE MALE - DRIVER ATD

SERIAL NO: 065

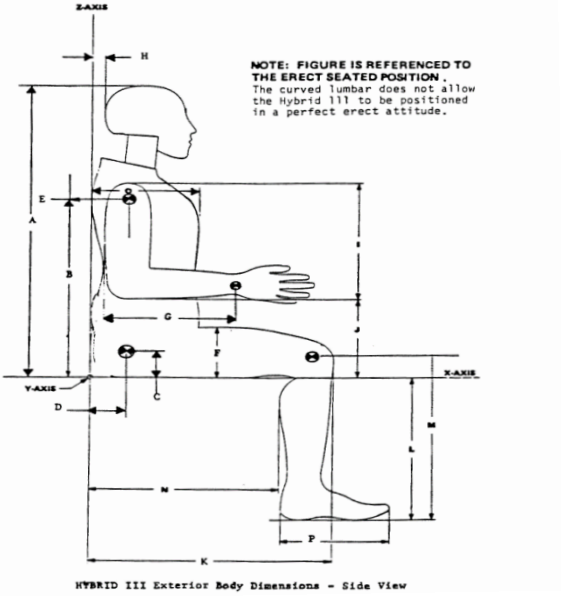
External Measurements - Hybrid 3 - 50th Male

Technician: J. Rios Date: 09/04/2024

Dummy Serial Number: 065



HYBRID III Exterior Body Dimensions - Front View



HYBRID III Exterior Body Dimensions - Side View

Symbol	Description	Specification (in)		Result (in)	Pass/Fail
A	Sitting Height	34.6	35.0	34.9	Pass
B	Shoulder Pivot Height	19.9	20.5	20.4	Pass
C	H-Point Height	3.3	3.5	3.4	Pass
D	H-Point from Backline	5.3	5.5	5.5	Pass
E	Shoulder Pivot from Backline	3.3	3.7	3.6	Pass
F	Thigh Clearance	5.5	6.1	5.8	Pass
G	Back of Elbow to Wrist Pivot	11.4	12.0	11.8	Pass
H	Head Back to Backline	1.6	1.8	1.6	Pass
I	Shoulder to Elbow Length	13.0	13.6	13.3	Pass
J	Elbow Rest Height	7.5	8.3	7.8	Pass
K	Buttock to Knee Length	22.8	23.8	23.7	Pass
L	Popliteal Height	16.9	17.9	17.4	Pass
M	Knee Pivot Height	19.1	19.7	19.4	Pass
N	Buttock Popliteal Length	17.8	18.8	18.3	Pass
O	Chest Depth without Jacket	8.4	9.0	8.7	Pass
P	Foot Length (right)	9.9	10.5	10.1	Pass
V	Shoulder Breadth	16.3	17.2	16.8	Pass
W	Foot Breadth	3.6	4.2	3.8	Pass
Y	Chest Circumference with Jacket	38.2	39.4	39.1	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	8.9	Pass

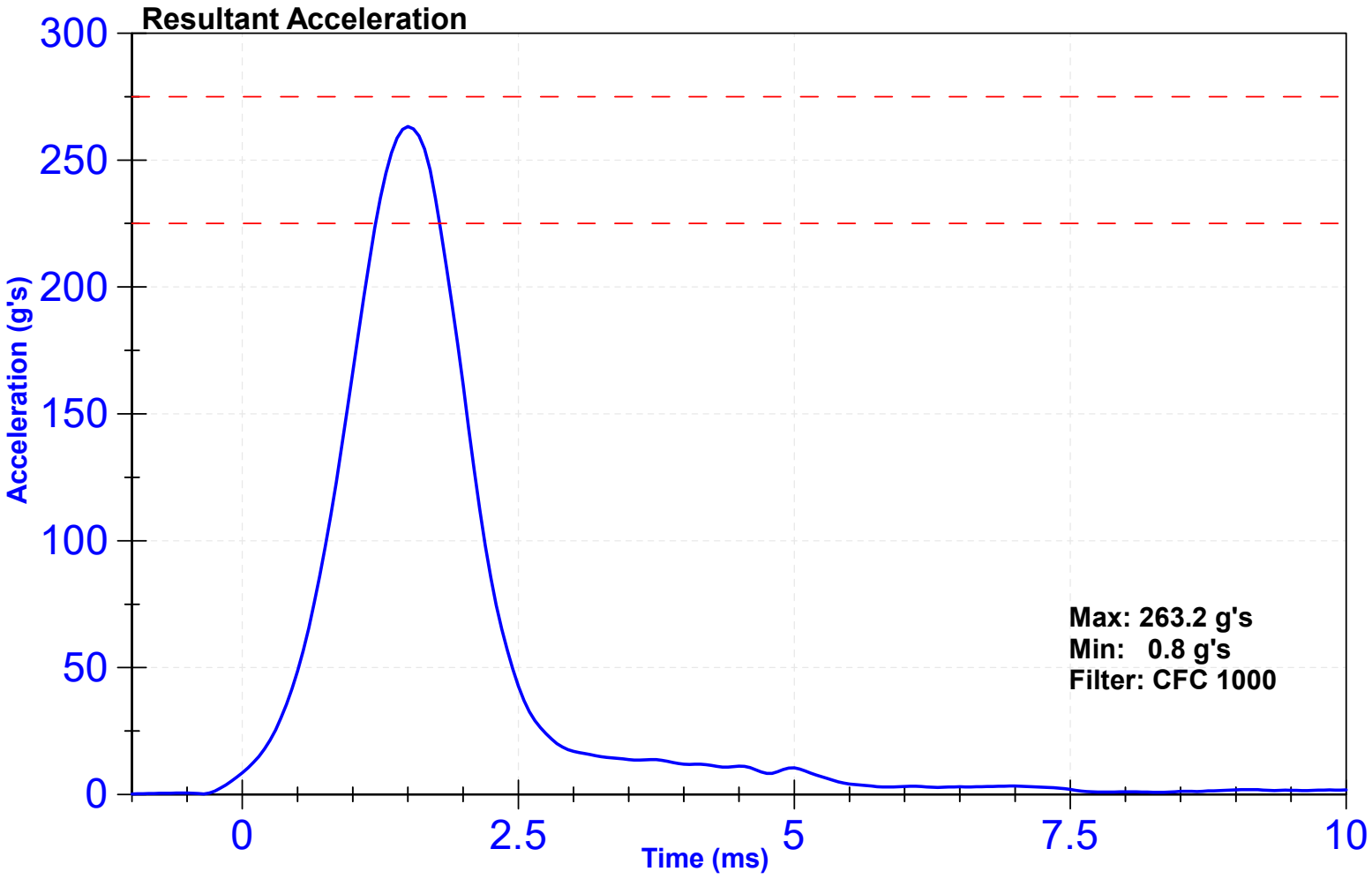
ATD Manufacturer	Humanetics	Test Technician	AG
ATD Serial Number	065	Laboratory Supervisor	ZP

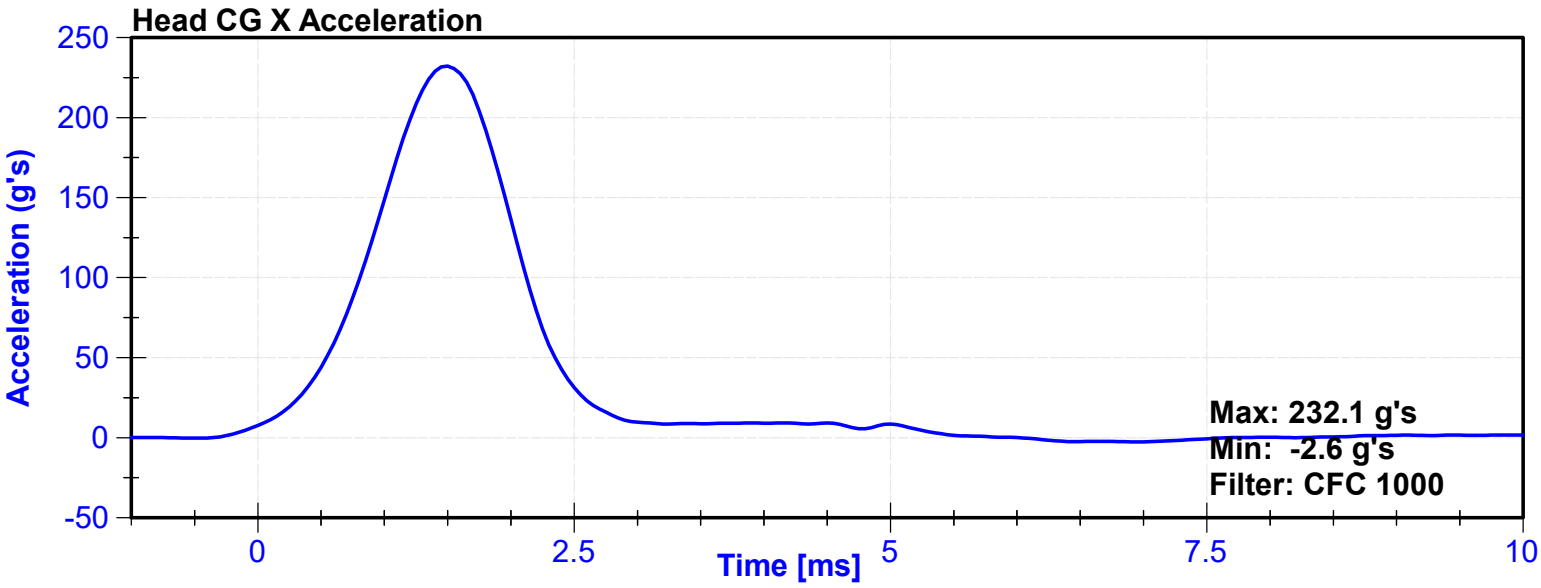
Results

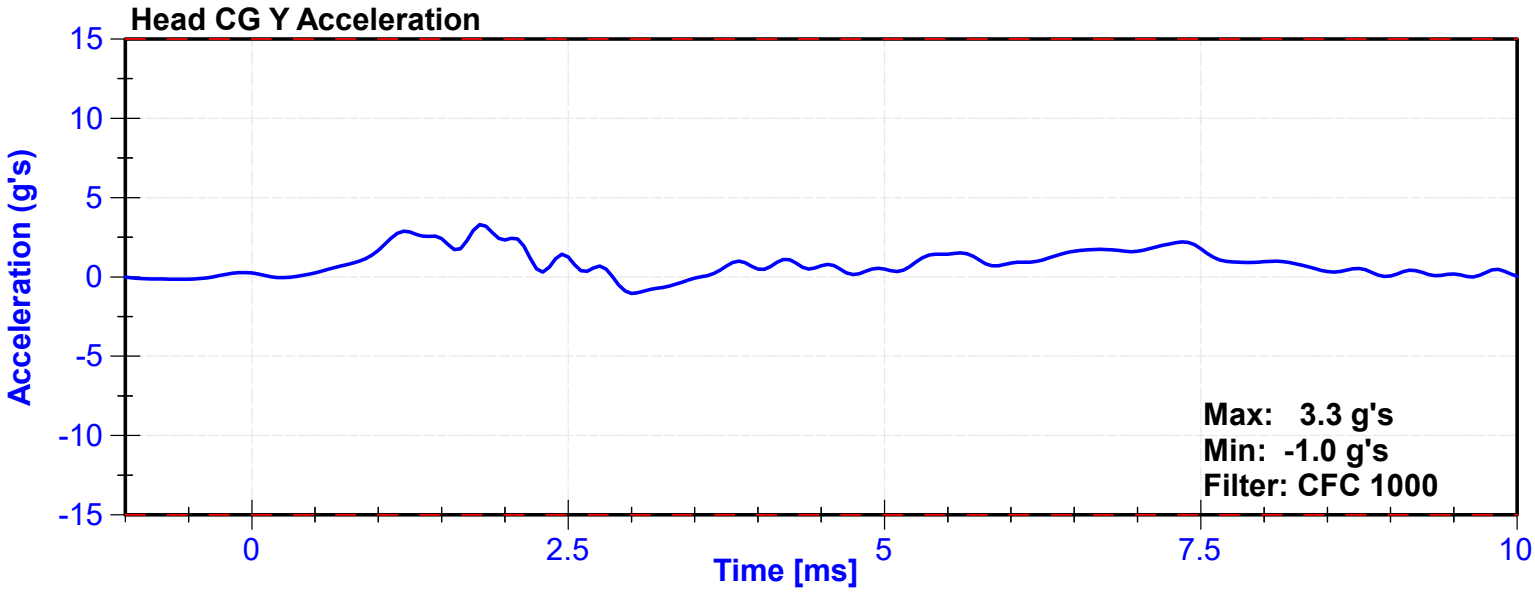
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.2	Pass
Humidity	10	70	%	48.7	Pass
Resultant Acceleration	225	275	g's	263.2	Pass
Oscillation	0	10	%	5.2	Pass
Lateral Acceleration	-15	15	g's	3.3	Pass

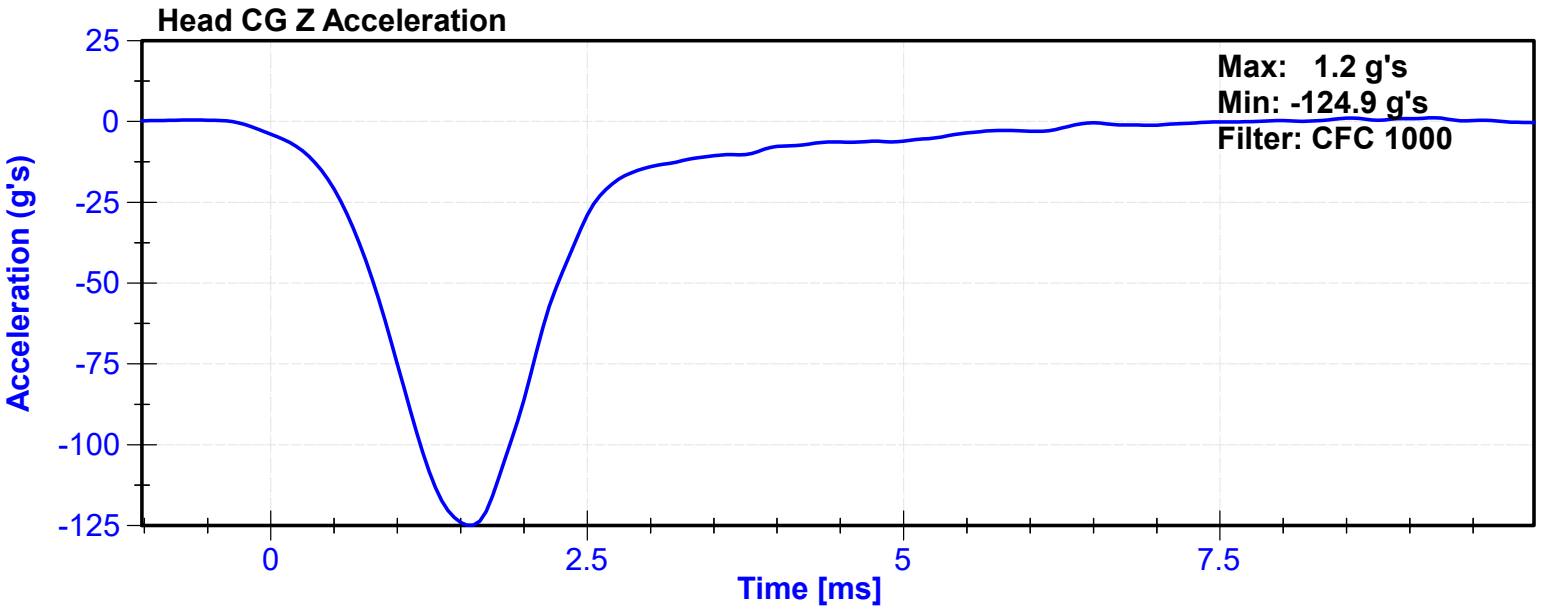
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	Measurement Specialties	A260183	7/10/2024	1/6/2025
Y Accelerometer	Measurement Specialties	A341246	3/13/2024	9/9/2024
Z Accelerometer	Measurement Specialties	A260527	7/10/2024	1/6/2025




Head CG X Acceleration
Acceleration (g's)
250
200
150
100
50
0
-50
0
2.5
5
7.5
10
Time [ms]
Max: 232.1 g's
Min: -2.6 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: 3.3 g's
Min: -1.0 g's
Filter: CFC 1000


Head CG Z Acceleration
Acceleration (g's)
25
0
-25
-50
-75
-100
-125
0
2.5
5
7.5
Time [ms]
Max: 1.2 g's
Min: -124.9 g's
Filter: CFC 1000

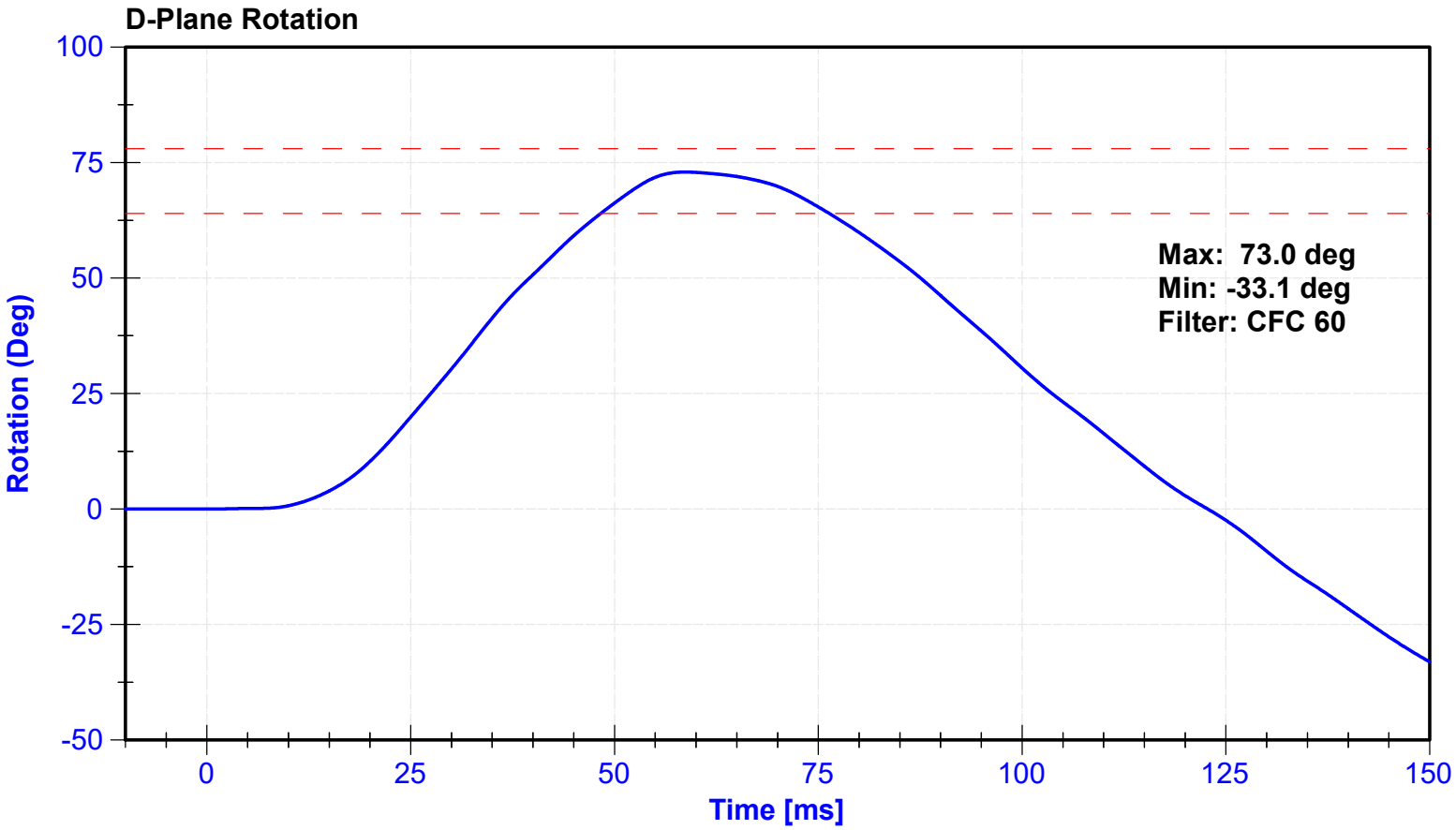
ATD Manufacturer	Humaetics	Test Technician	AG
ATD Serial Number	065	Laboratory Supervisor	ZP

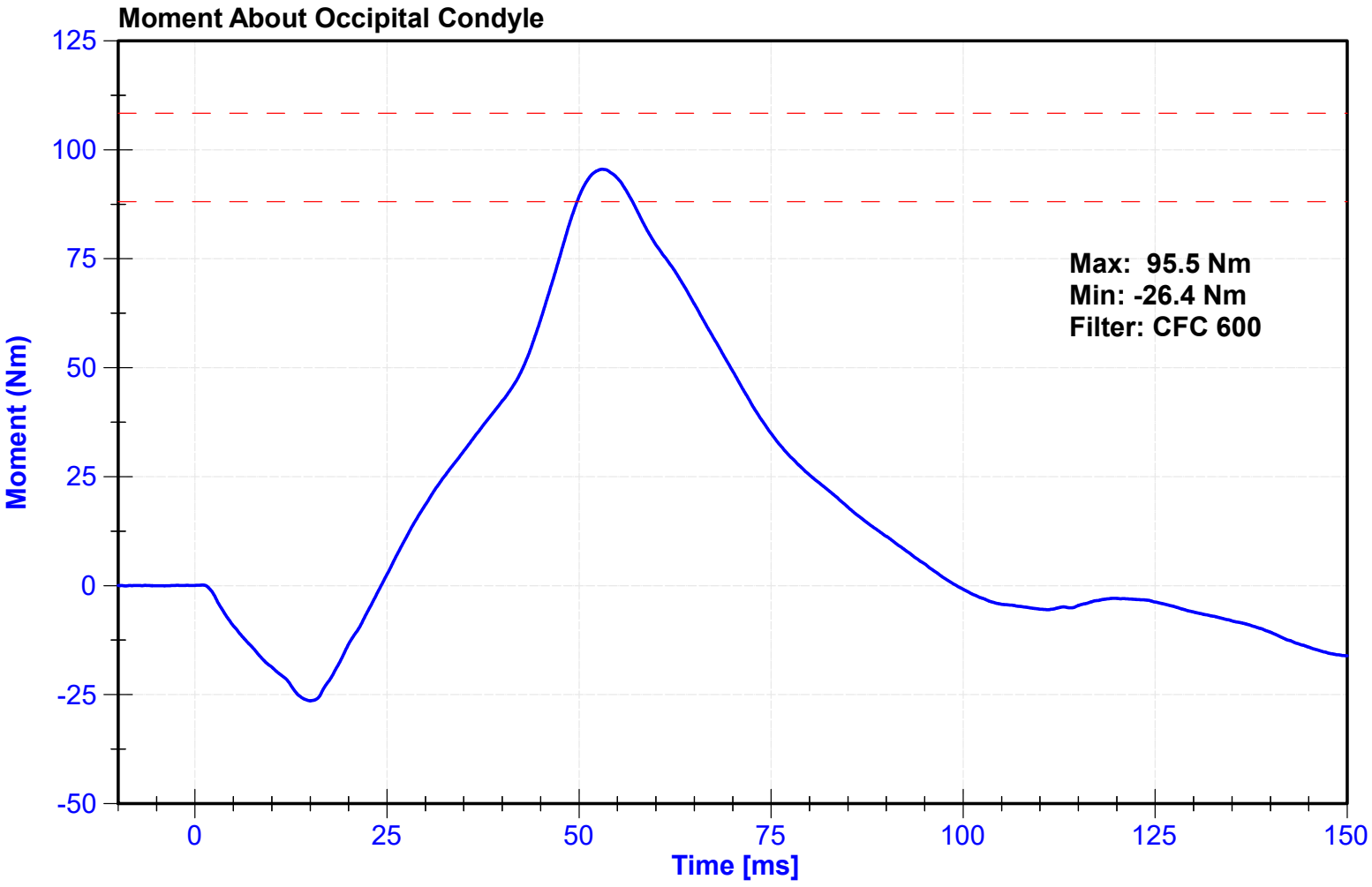
Results

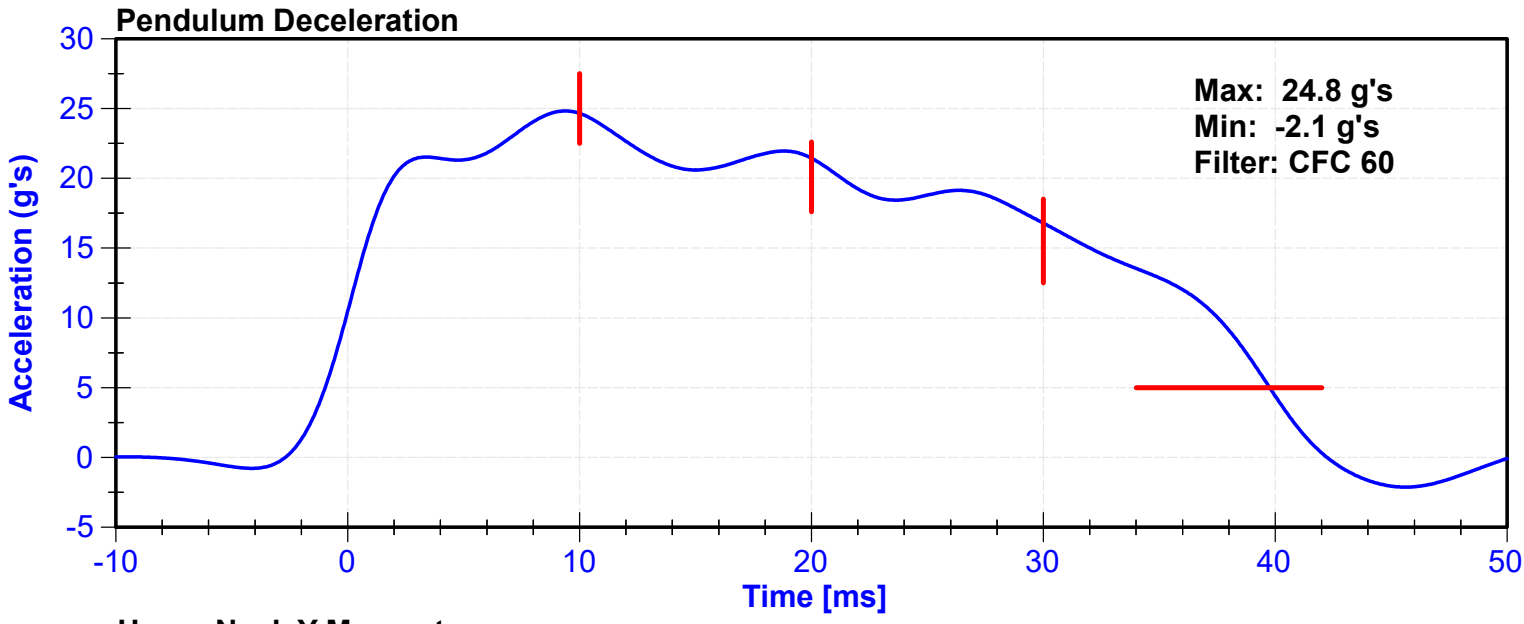
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.2	Pass
Humidity	10	70	%	40.7	Pass
Velocity	6.89	7.13	m/s	7.031	Pass
Pendulum Deceleration at 10ms	22.5	27.5	g's	24.65	Pass
Pendulum Deceleration at 20ms	17.6	22.6	g's	21.43	Pass
Pendulum Deceleration at 30ms	12.5	18.5	g's	16.78	Pass
Max. Pendulum Deceleration After 30ms	0	29	g's	24.8	Pass
Pendulum Deceleration Time to 5 g's	34	42	ms	39.8	Pass
Maximum D Plane Rotation	64	78	deg	73.0	Pass
Time to Maximum Rotation	57	64	ms	58.7	Pass
Rotation Decay to Zero	113	127	ms	122.8	Pass
Moment About Occipital Condyle	88.1	108.4	Nm	95.54	Pass
Time to Maximum Moment	47	58	ms	53.0	Pass
Moment Decay to Zero	97	107	ms	99.2	Pass

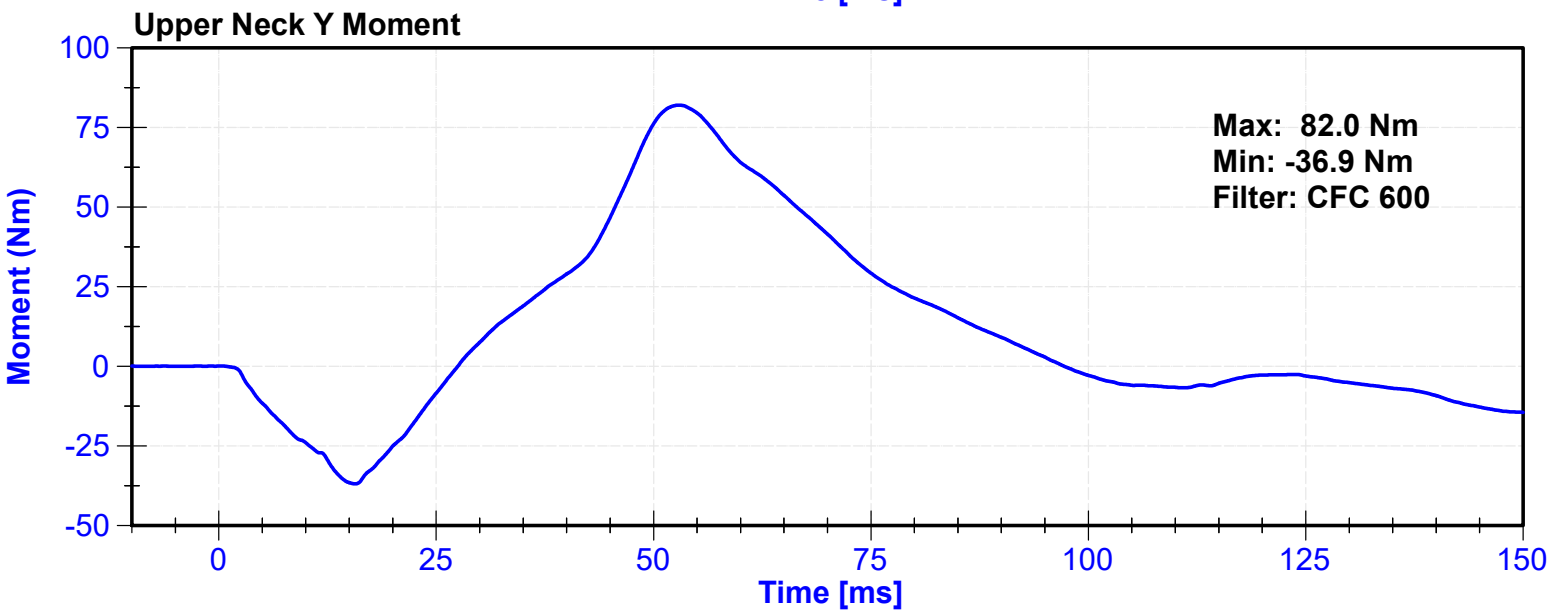
Transducer Calibrations

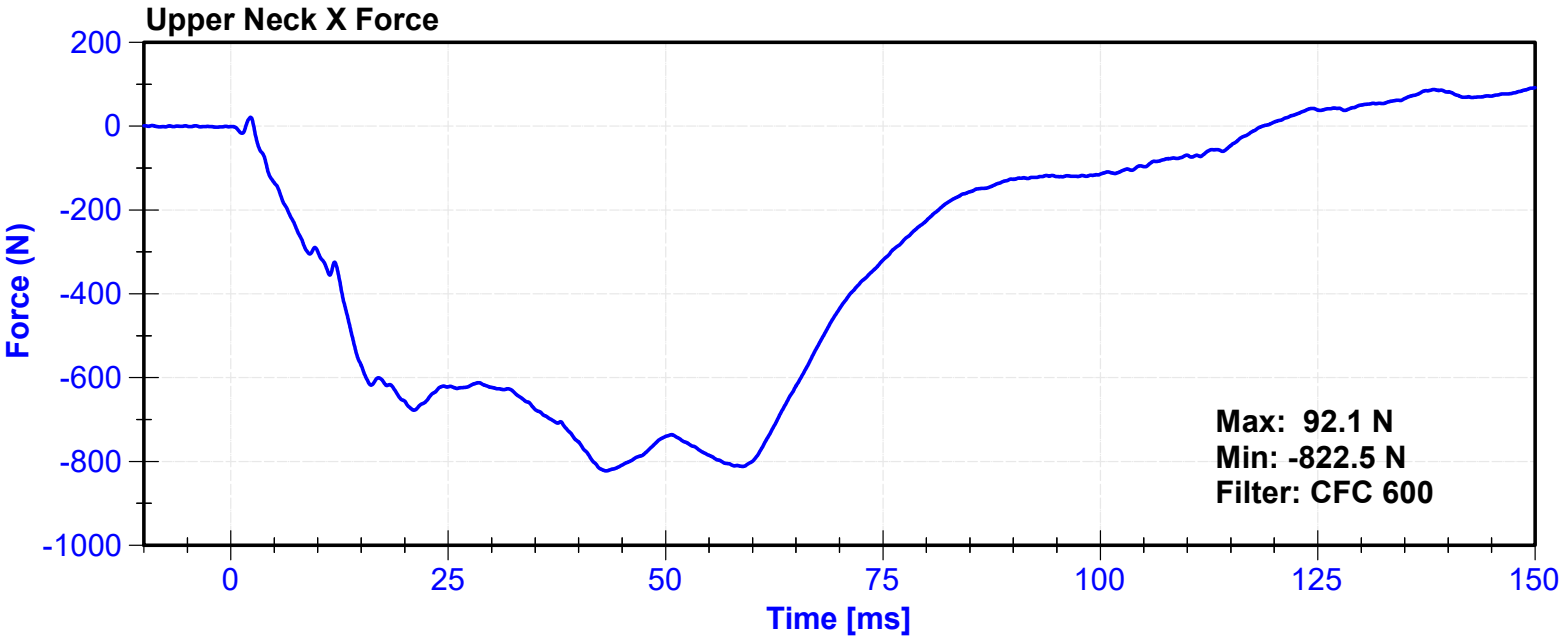
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	C16678	8/29/2024	2/25/2025
Pendulum Potentiometer	ETI	1412	12/18/2023	12/17/2024
Condyle Potentiometer	ETI	1911	12/18/2023	12/17/2024
Upper Neck Load Cell	Denton	1629-FX	12/8/2023	12/7/2024


D-Plane Rotation
Rotation (Deg)
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]
Max: 73.0 deg
Min: -33.1 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: 95.5 Nm
Min: -26.4 Nm
Filter: CFC 600


Pendulum Deceleration
Max: 24.8 g's
Min: -2.1 g's
Filter: CFC 60
Acceleration (g's)
Time [ms]


Upper Neck Y Moment
Max: 82.0 Nm
Min: -36.9 Nm
Filter: CFC 600
Moment (Nm)
Time [ms]


Upper Neck X Force
Max: 92.1 N
Min: -822.5 N
Filter: CFC 600
Force (N)
Time [ms]

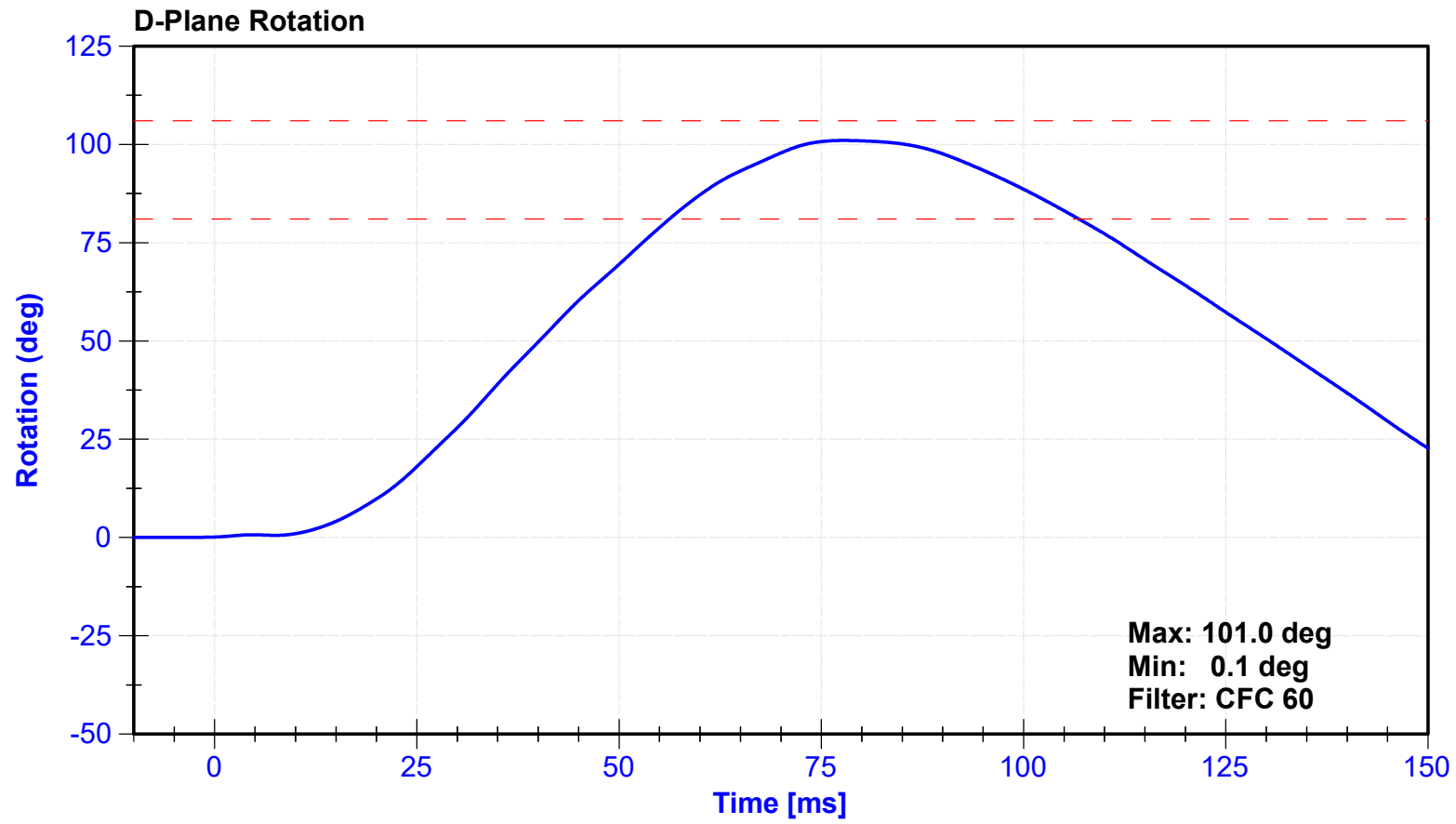
ATD Manufacturer	Humanetics	Test Technician	AG
ATD Serial Number	065	Laboratory Supervisor	ZP

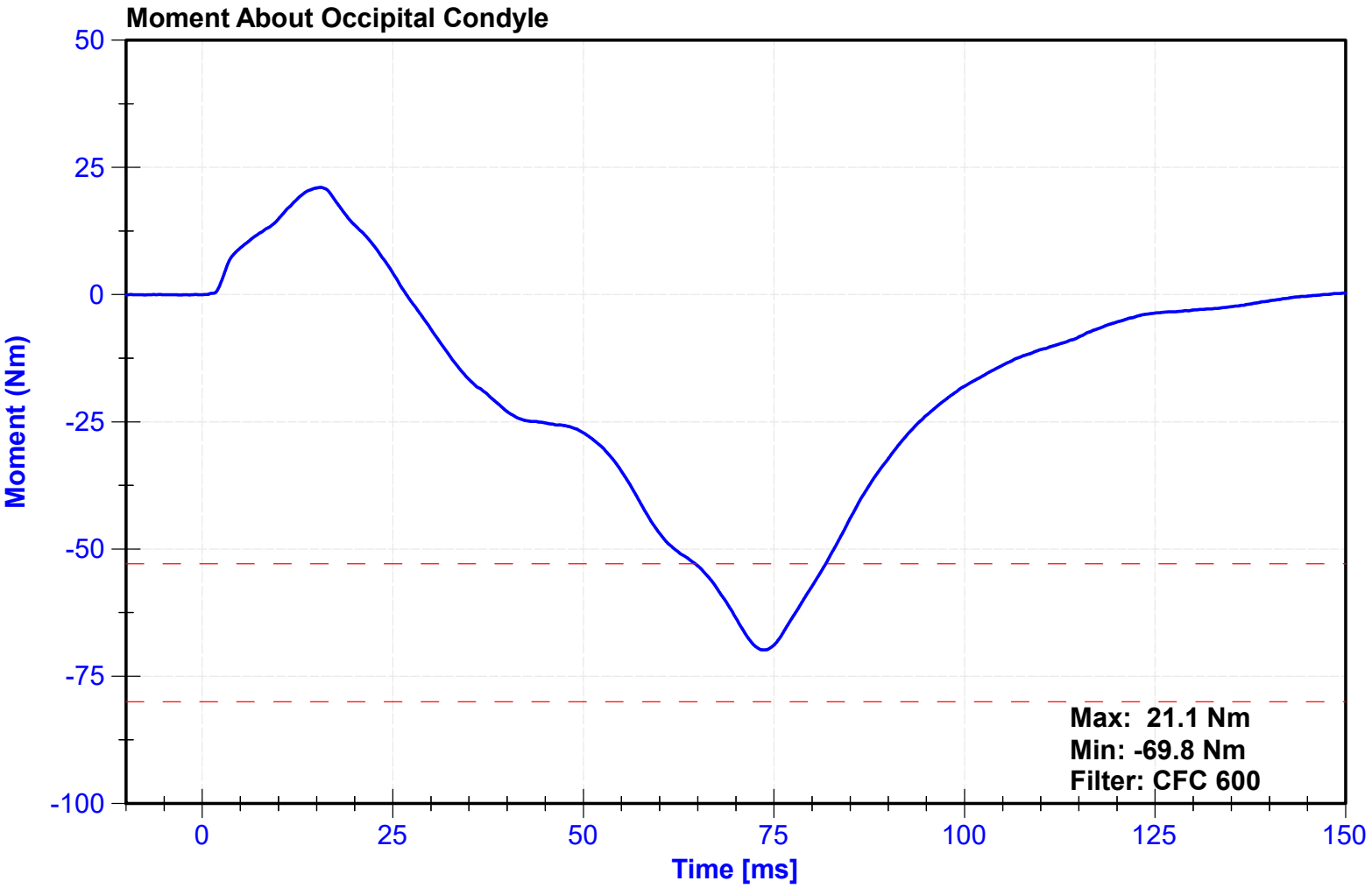
Results

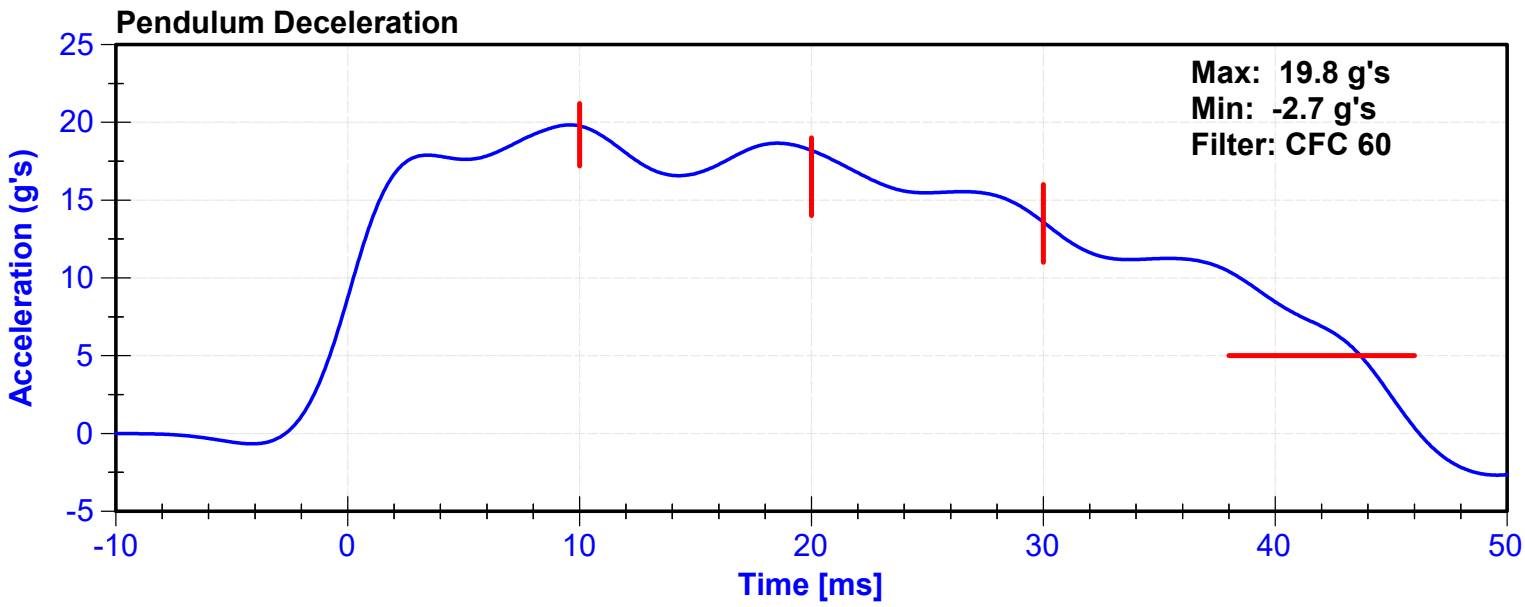
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.2	Pass
Humidity	10	70	%	40.7	Pass
Velocity	5.94	6.19	m/s	6.136	Pass
Pendulum Deceleration at 10ms	17.2	21.2	g's	19.77	Pass
Pendulum Deceleration at 20ms	14	19	g's	18.2	Pass
Pendulum Deceleration at 30ms	11	16	g's	13.6	Pass
Max. Pendulum Deceleration After 30ms	0	22	g's	19.8	Pass
Pendulum Deceleration Time to 5 g's	38	46	ms	43.7	Pass
Maximum D Plane Rotation	81	106	deg	101.0	Pass
Time to Maximum Rotation	72	82	ms	77.8	Pass
Rotation Decay to Zero	147	174	ms	166.7	Pass
Minimum Moment About OC	-80	-52.9	Nm	-69.80	Pass
Time to Minimum Moment	65	79	ms	73.8	Pass
Moment Decay to Zero	120	148	ms	147.0	Pass

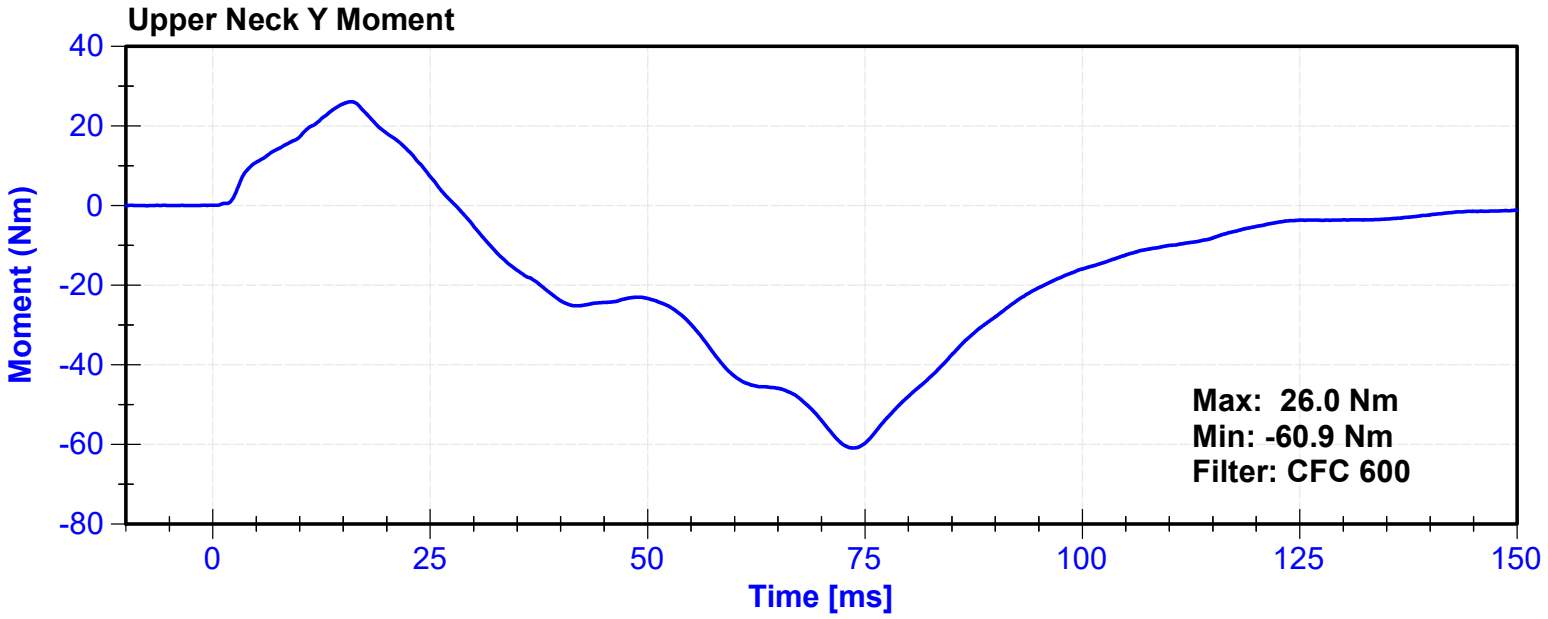
Transducer Calibrations

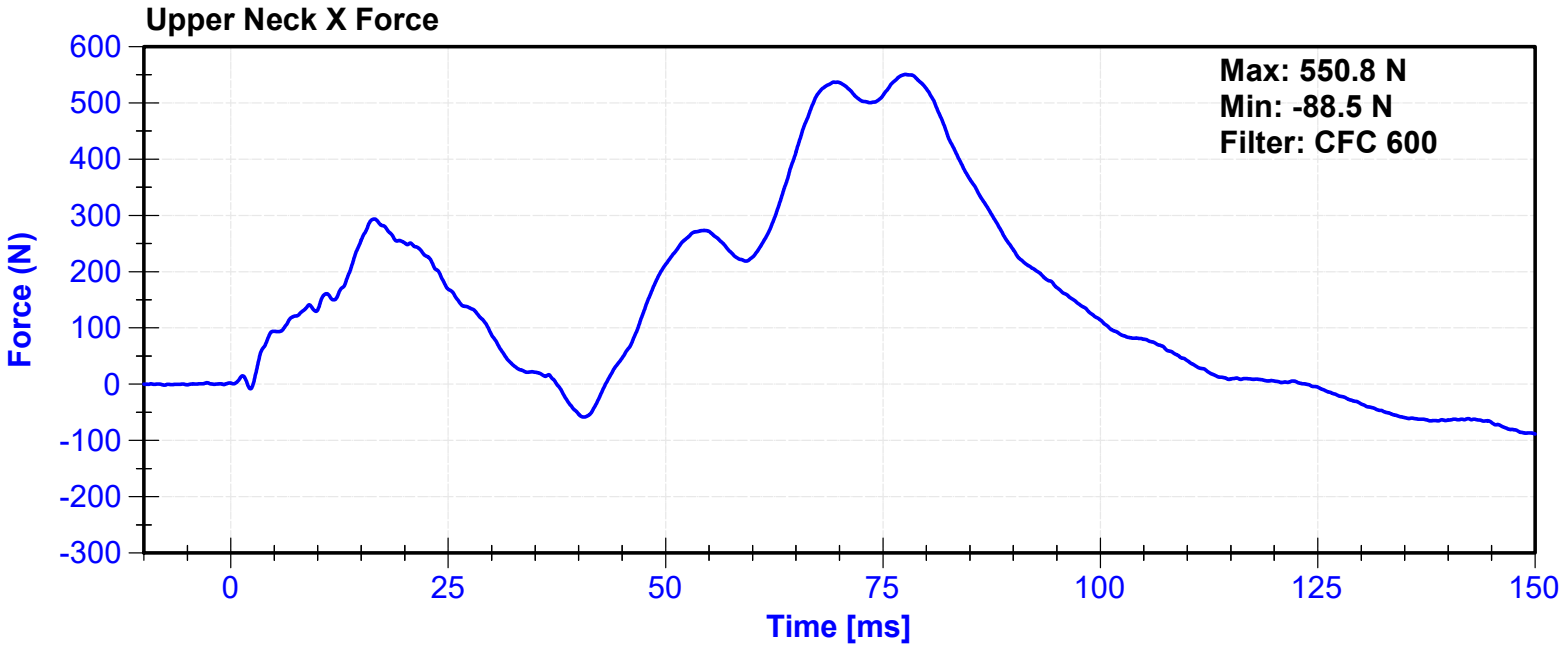
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	C16678	8/29/2024	2/25/2025
Pendulum Potentiometer	ETI	SP22G_1412	12/18/2023	12/17/2024
Condyle Potentiometer	ETI	SP22G_1911	12/18/2023	12/17/2024
Upper Neck Load Cell	Denton	1629-FX	12/8/2023	12/7/2024


D-Plane Rotation
Rotation (deg)
125
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]
Max: 101.0 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: 21.1 Nm
Min: -69.8 Nm
Filter: CFC 600


Pendulum Deceleration
Max: 19.8 g's
Min: -2.7 g's
Filter: CFC 60
Acceleration (g's)
Time [ms]


Upper Neck Y Moment
Max: 26.0 Nm
Min: -60.9 Nm
Filter: CFC 600
Moment (Nm)
Time [ms]


Upper Neck X Force
Max: 550.8 N
Min: -88.5 N
Filter: CFC 600
Force (N)
Time [ms]

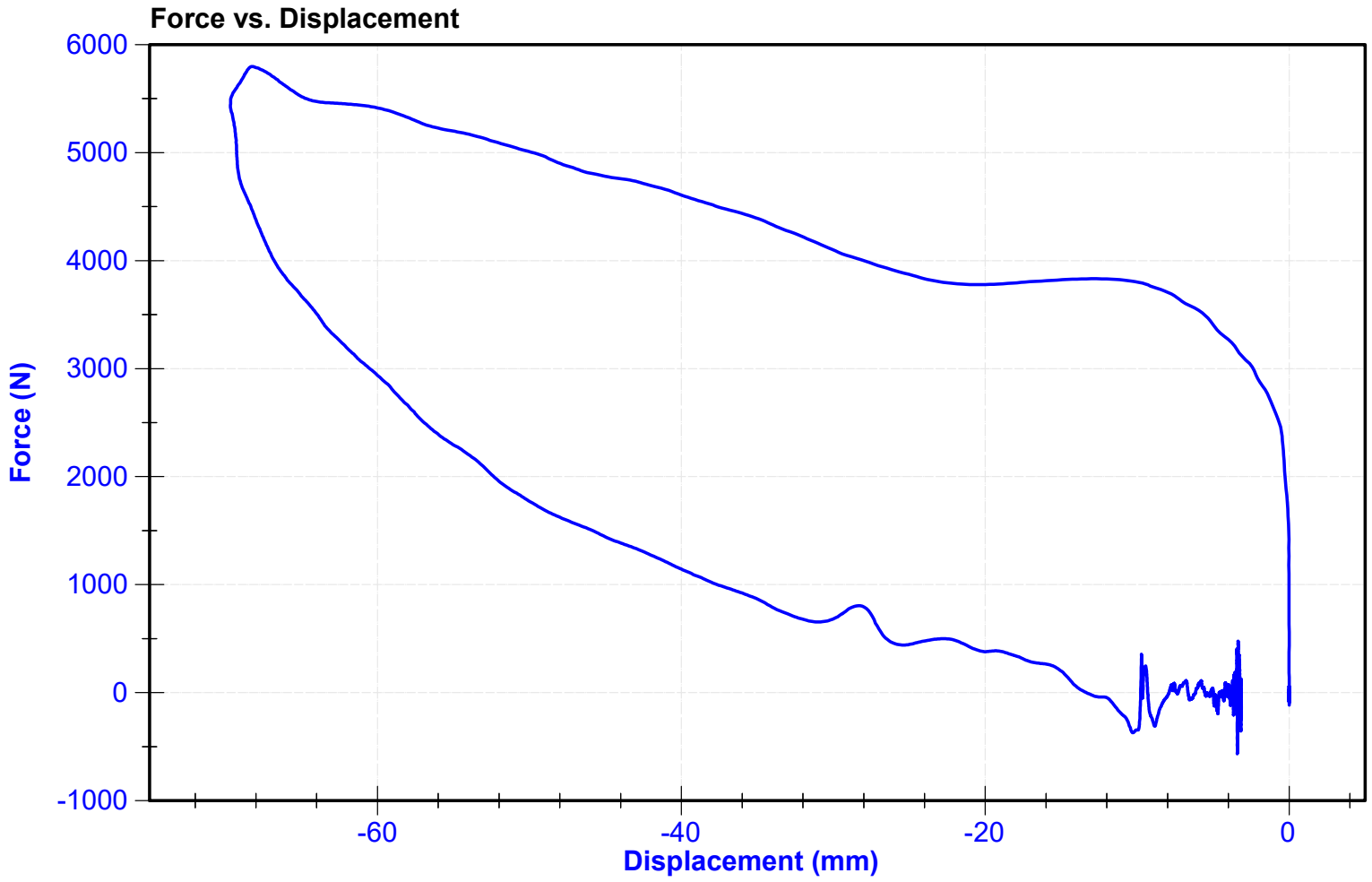
ATD Manufacturer	HUMANETICS	Test Technician	AG
ATD Serial Number	065	Laboratory Supervisor	ZP

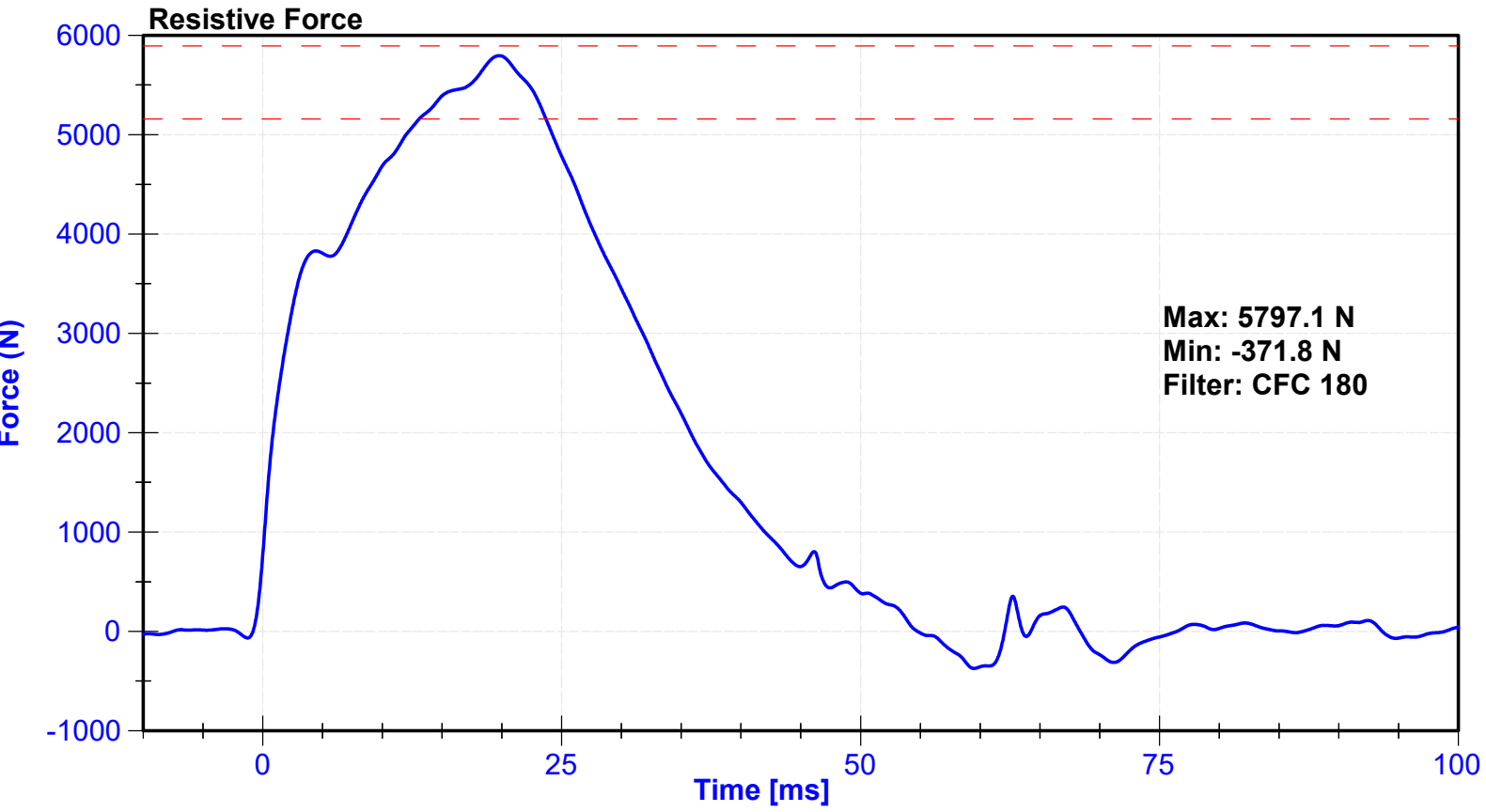
Results

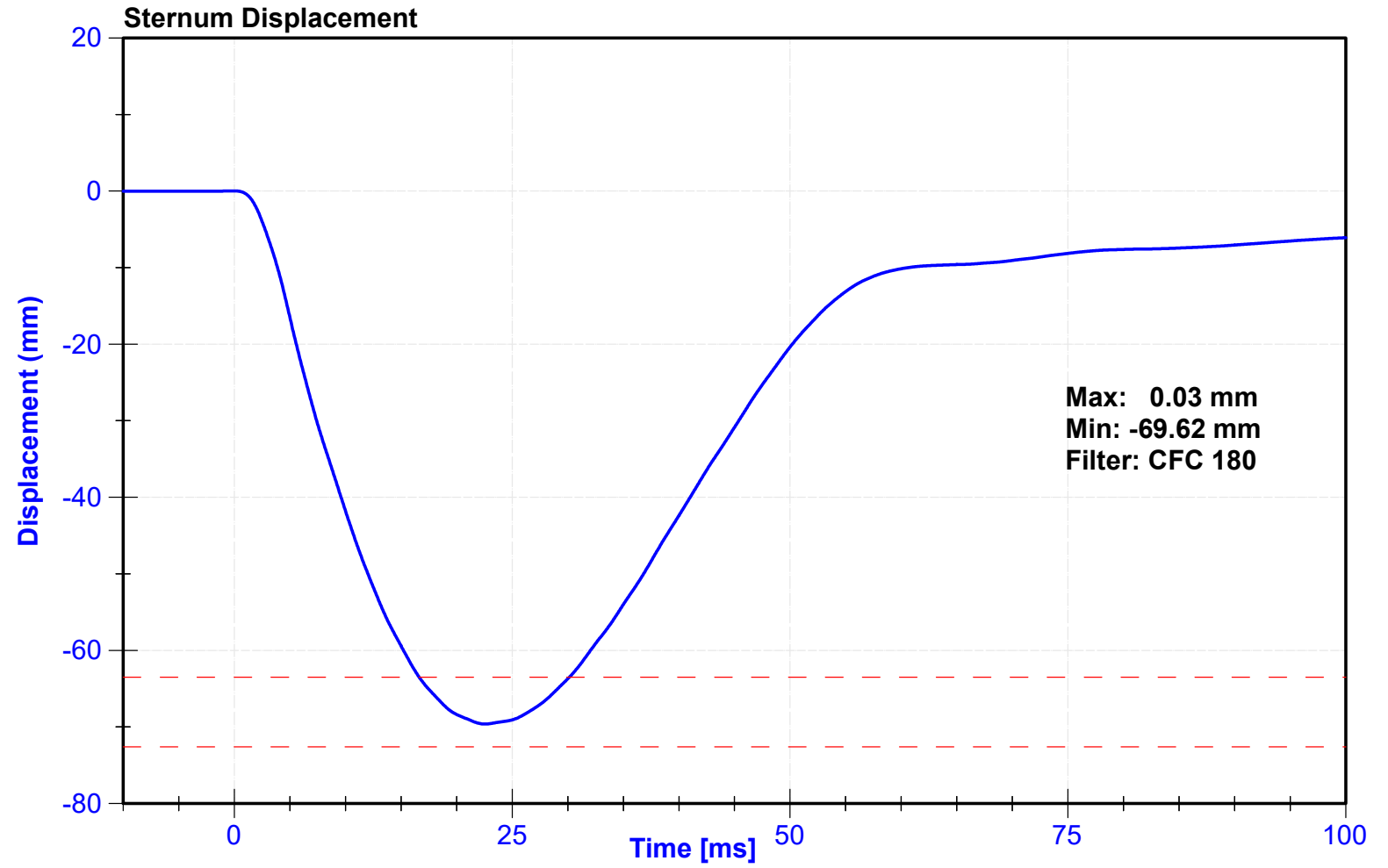
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.2	Pass
Humidity	10	70	%	52.6	Pass
Velocity	6.59	6.83	m/s	6.734	Pass
Chest Displacement	-72.6	-63.5	mm	-69.62	Pass
Resistive Force	5160	5894	N	5797.1	Pass
Hysteresis	69	85	%	70.9	Pass

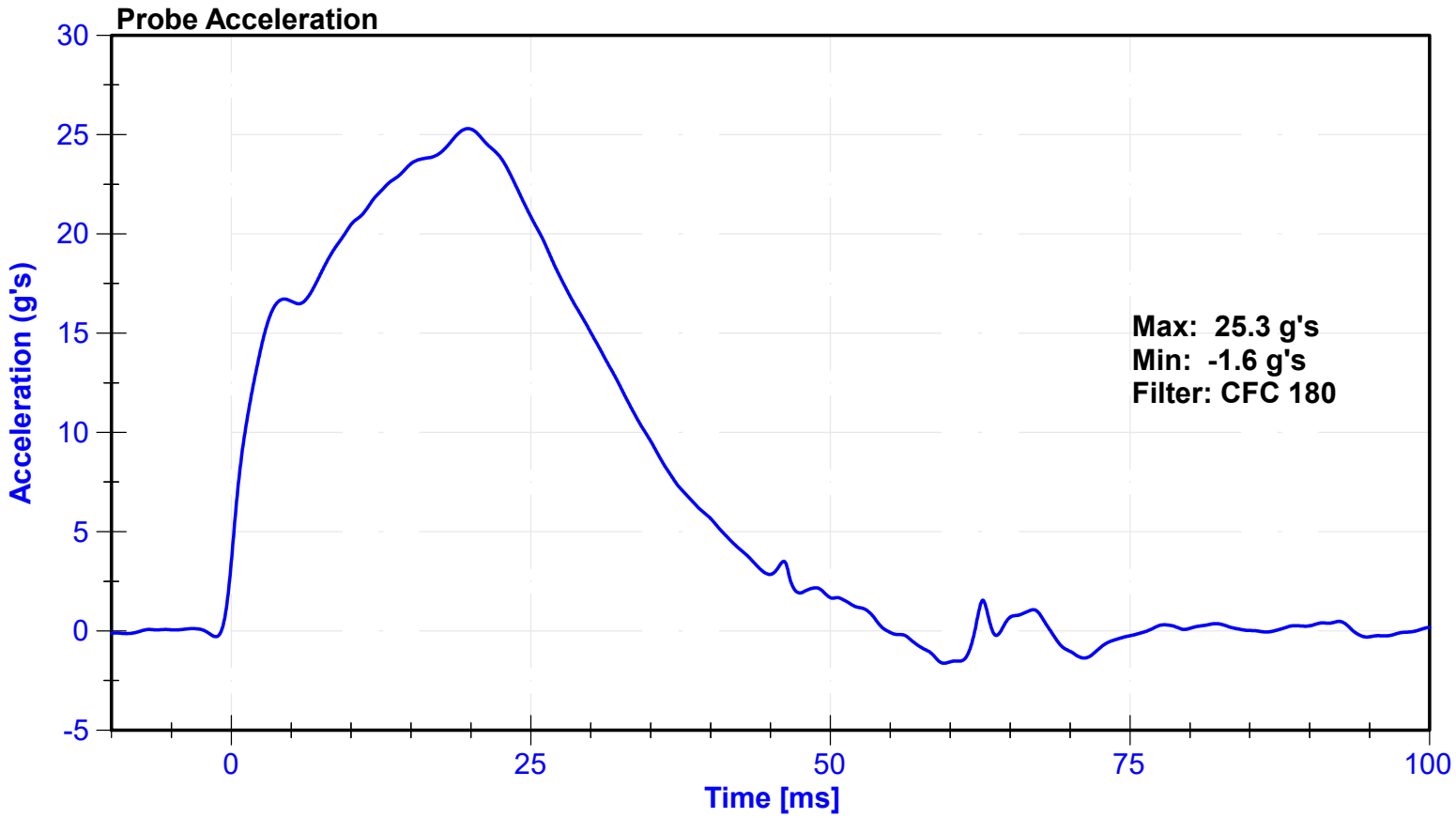
Transducer Calibrations

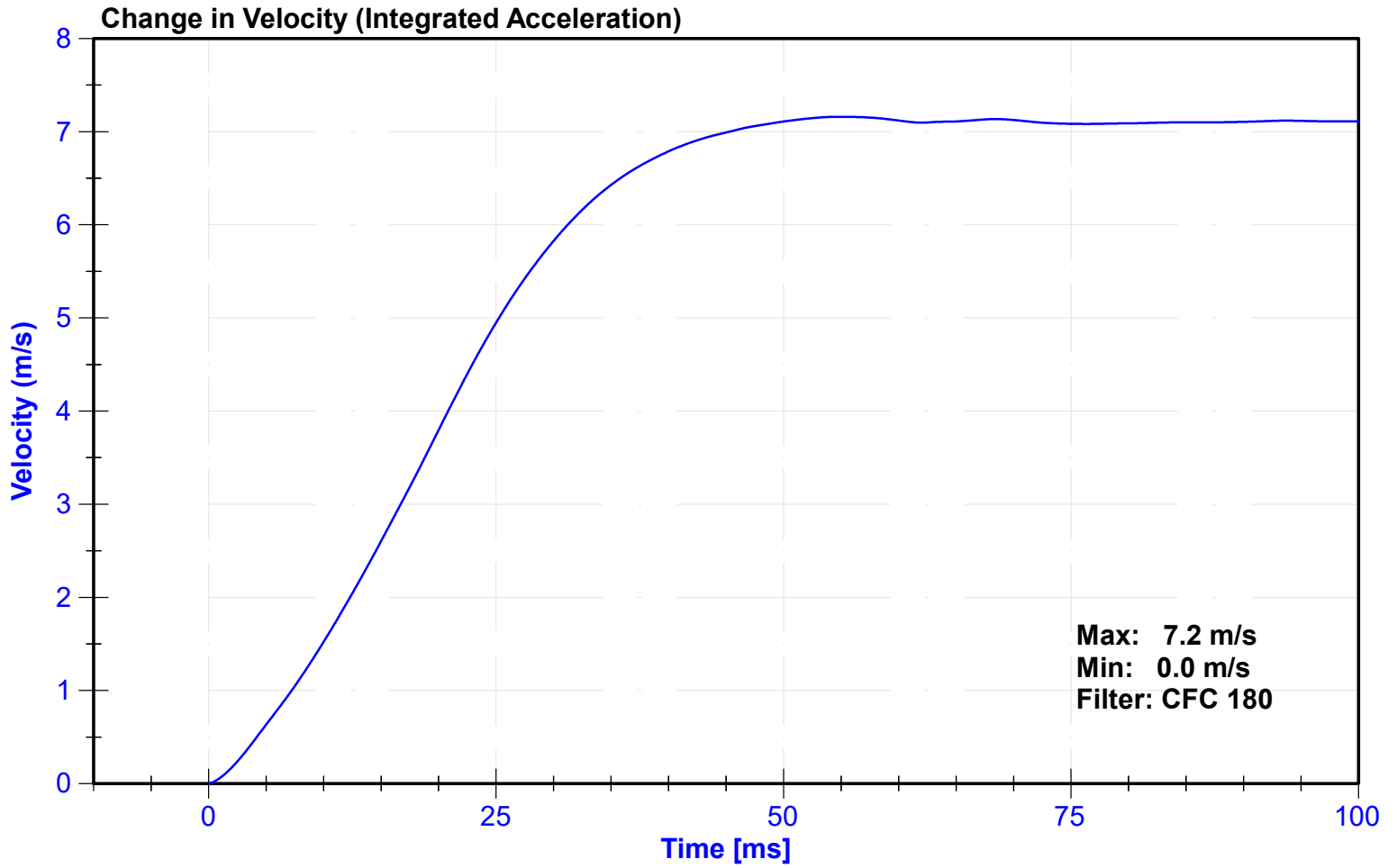
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Measurement	MS26647	3/27/2024	9/23/2024
Chest Potentiometer	Servo	1046	4/30/2024	10/29/2024




Resistive Force
Force (N)
6000
5000
4000
3000
2000
1000
0
-1000
0
25
50
75
100
Time [ms]
Max: 5797.1 N
Min: -371.8 N
Filter: CFC 180


Sternum Displacement
Displacement (mm)
20
0
-20
-40
-60
-80
0
25
50
75
100
Time [ms]
Max: 0.03 mm
Min: -69.62 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: -1.6 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

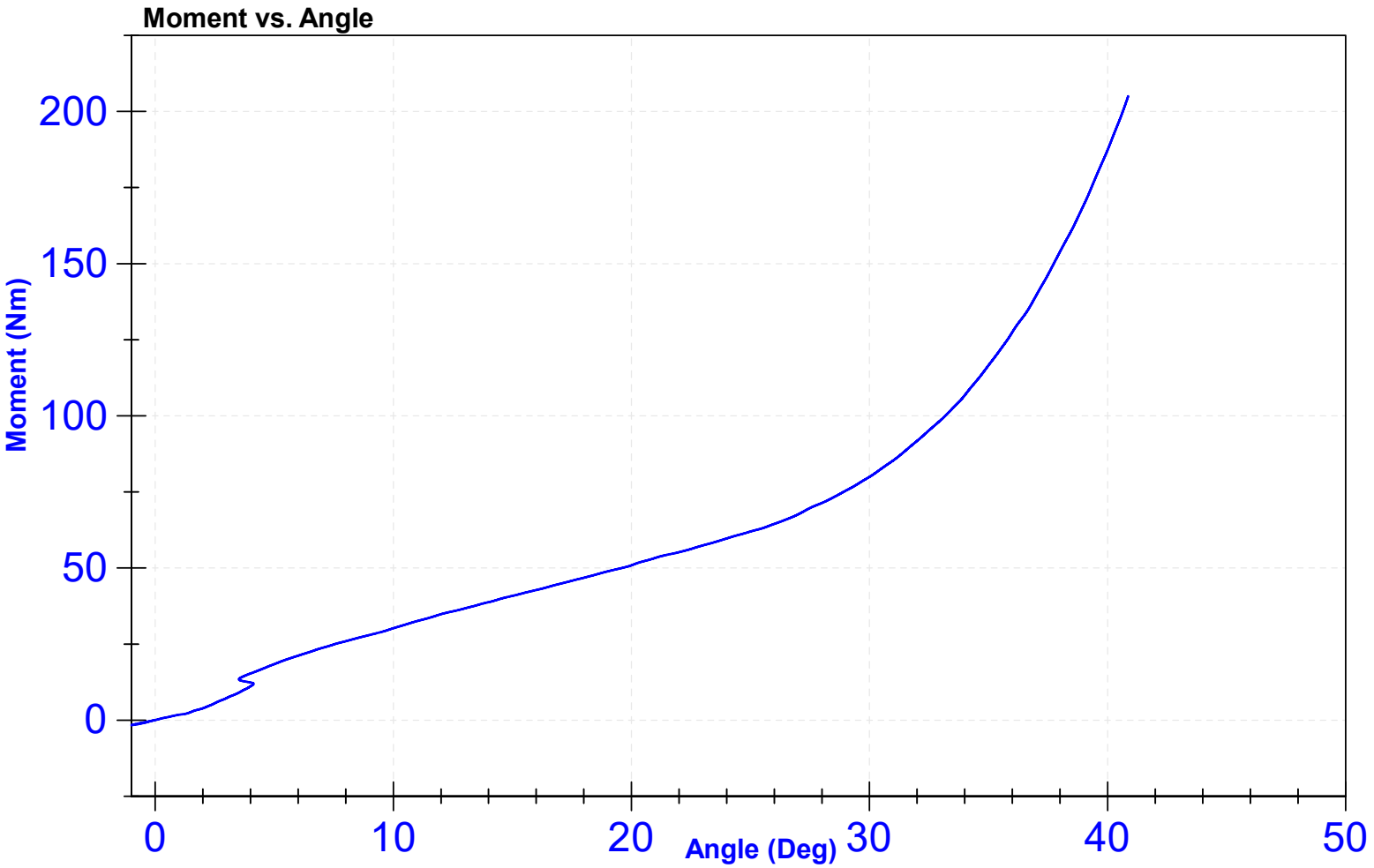
ATD Manufacturer	Humanetics	Test Technician	AG
ATD Serial Number	065	Laboratory Supervisor	ZP

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.6	Pass
Humidity	10	70	%	40.2	Pass
Average Velocity	5	10	deg/s	6.8	Pass
Angle at 203Nm	40	50	deg	40.8	Pass
Moment at 30 degrees	0	94.9	Nm	79.9	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	Servo 14CB1-3615	3203	11/16/2023	11/15/2024
Load Cell	PCB 2301-02A	111	2023-09-21	2024-09-20



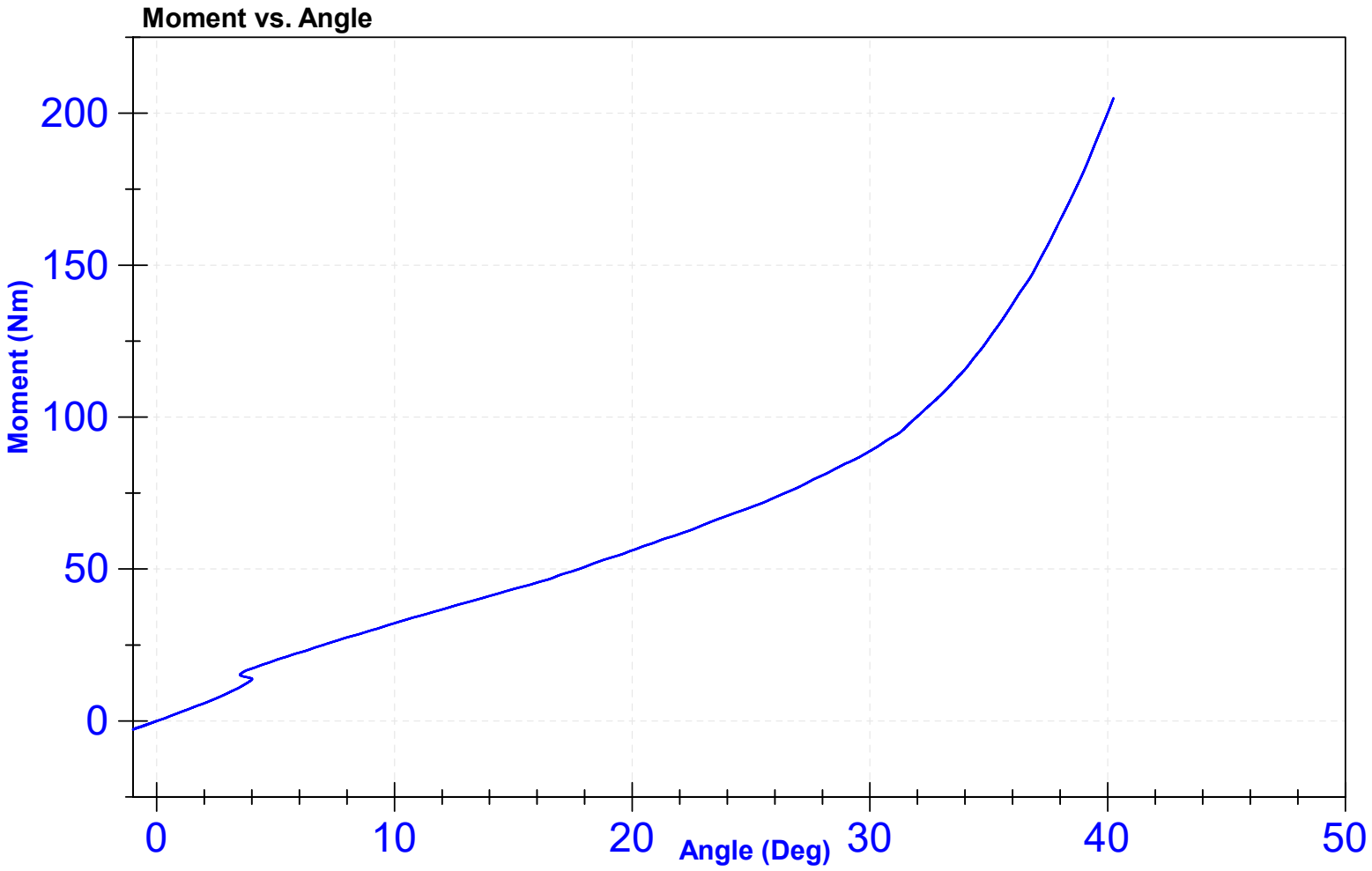
ATD Manufacturer	Humanetics	Test Technician	AG
ATD Serial Number	065	Laboratory Supervisor	ZP

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.6	Pass
Humidity	10	70	%	40.2	Pass
Average Velocity	5	10	deg/s	6.9	Pass
Angle at 203Nm	40	50	deg	40.1	Pass
Moment at 30 degrees	0	94.9	Nm	88.8	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	Servo 14CB1-3615	3203	11/16/2023	11/15/2024
Load Cell	PCB 2301-02A	111	2023-09-21	2024-09-20



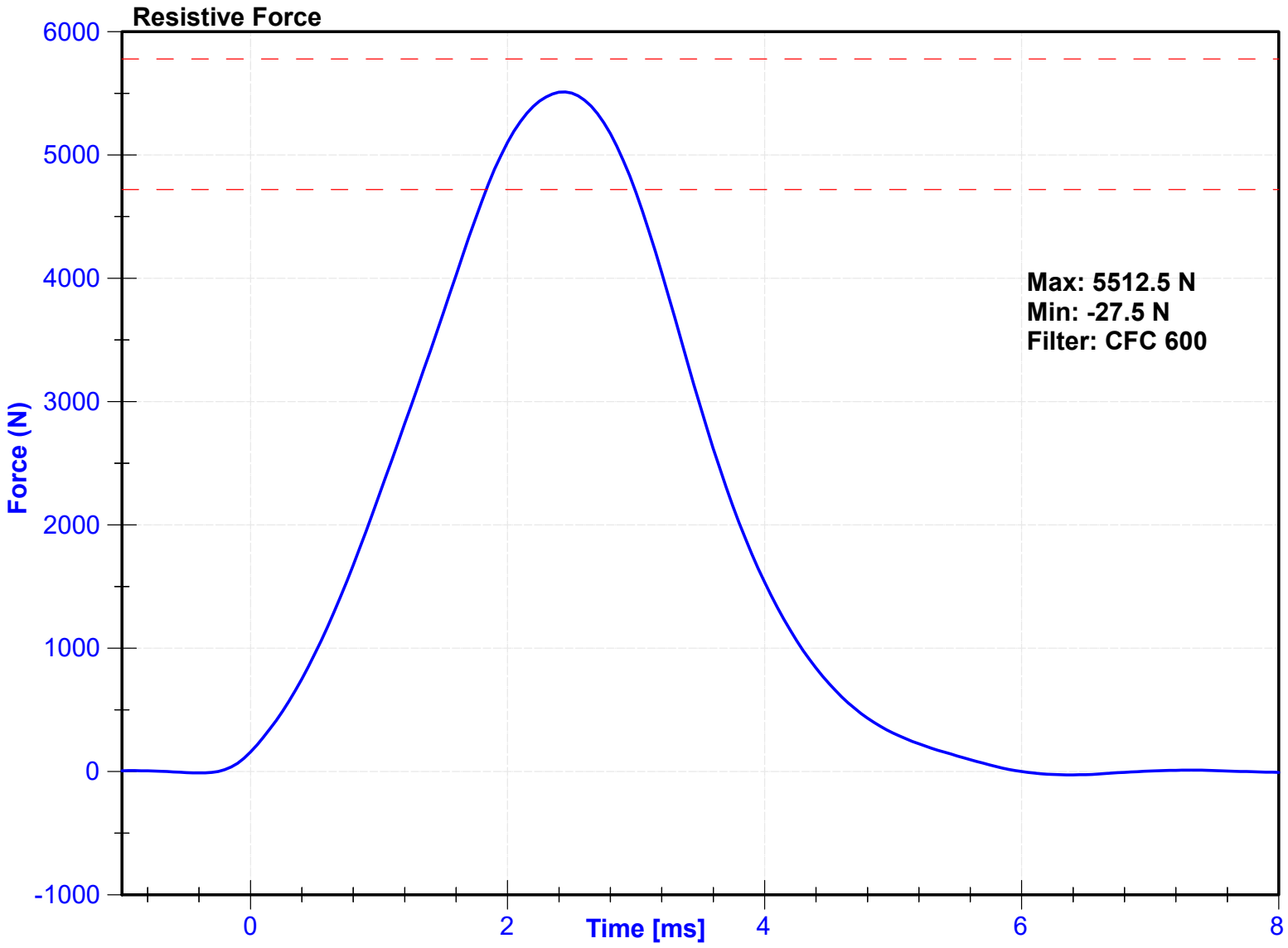
ATD Manufacturer	Humanetics	Test Technician	AG
ATD Serial Number	065	Laboratory Supervisor	ZP

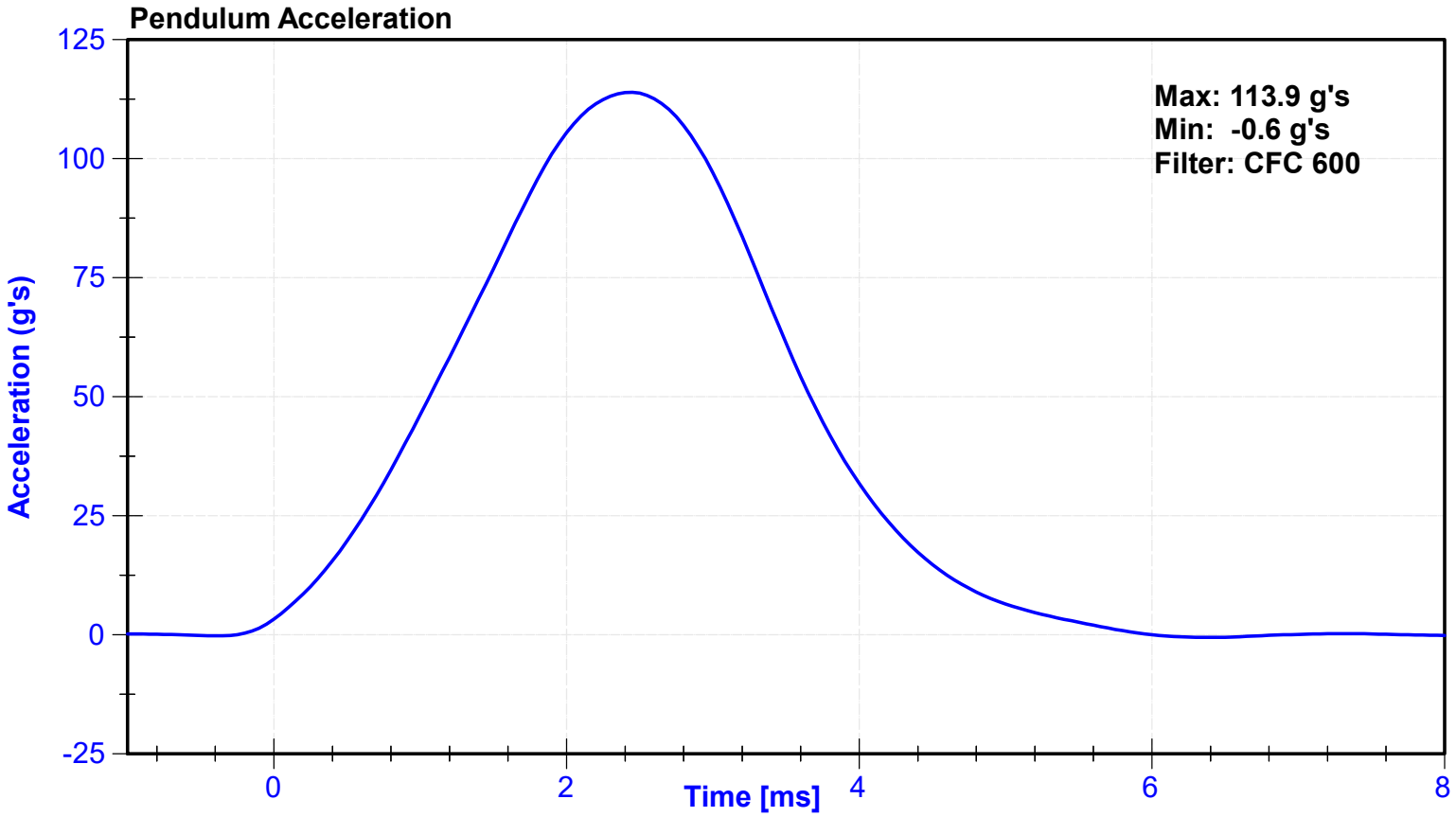
Results

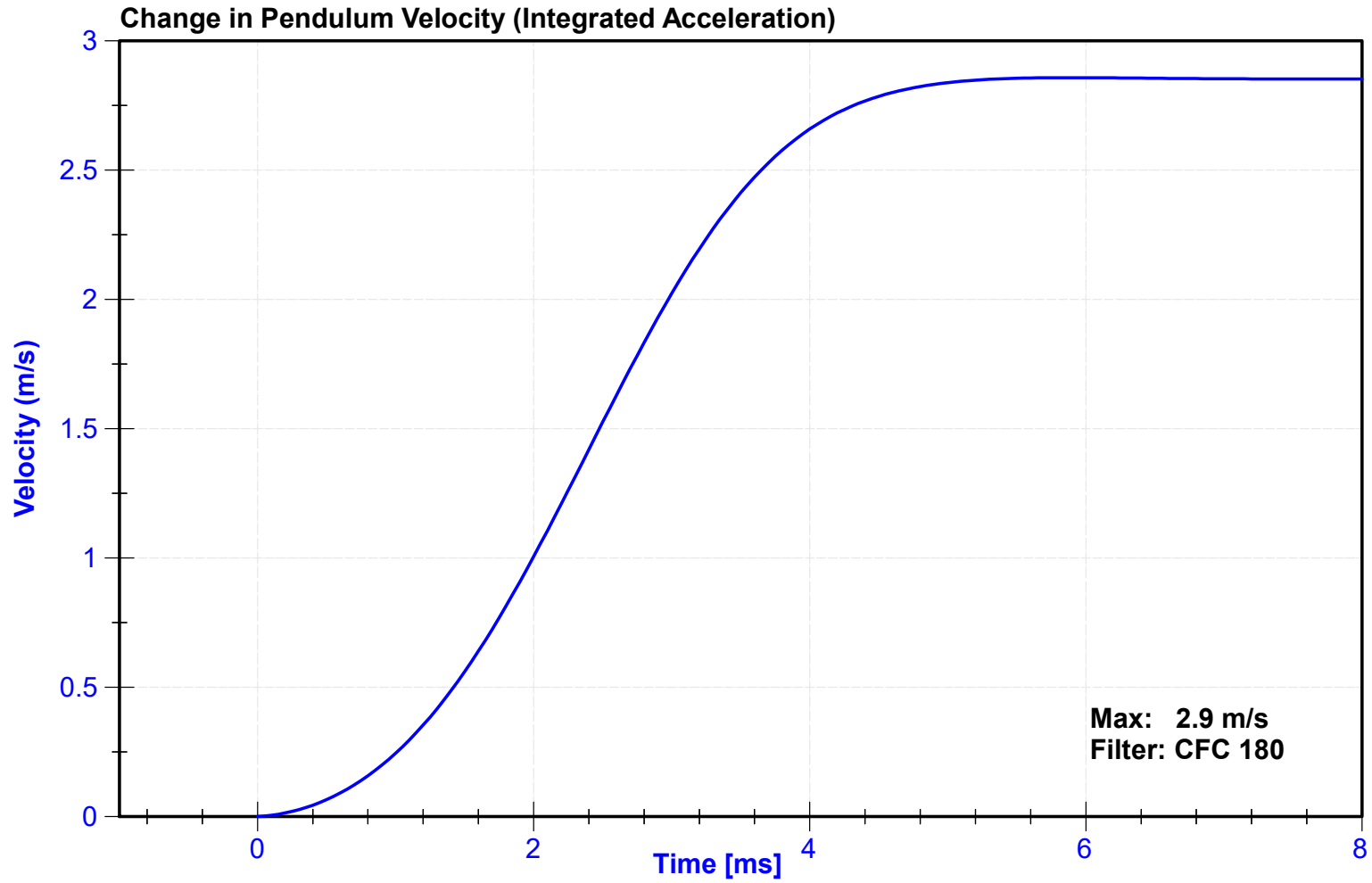
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.3	Pass
Humidity	10	70	%	51.8	Pass
Velocity	2.07	2.13	m/s	2.13	Pass
Maximum Resistive Force	4720	5780	N	5512.5	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	T29720	6/12/2024	12/9/2024




Pendulum Acceleration
Max: 113.9 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: 2.9 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]

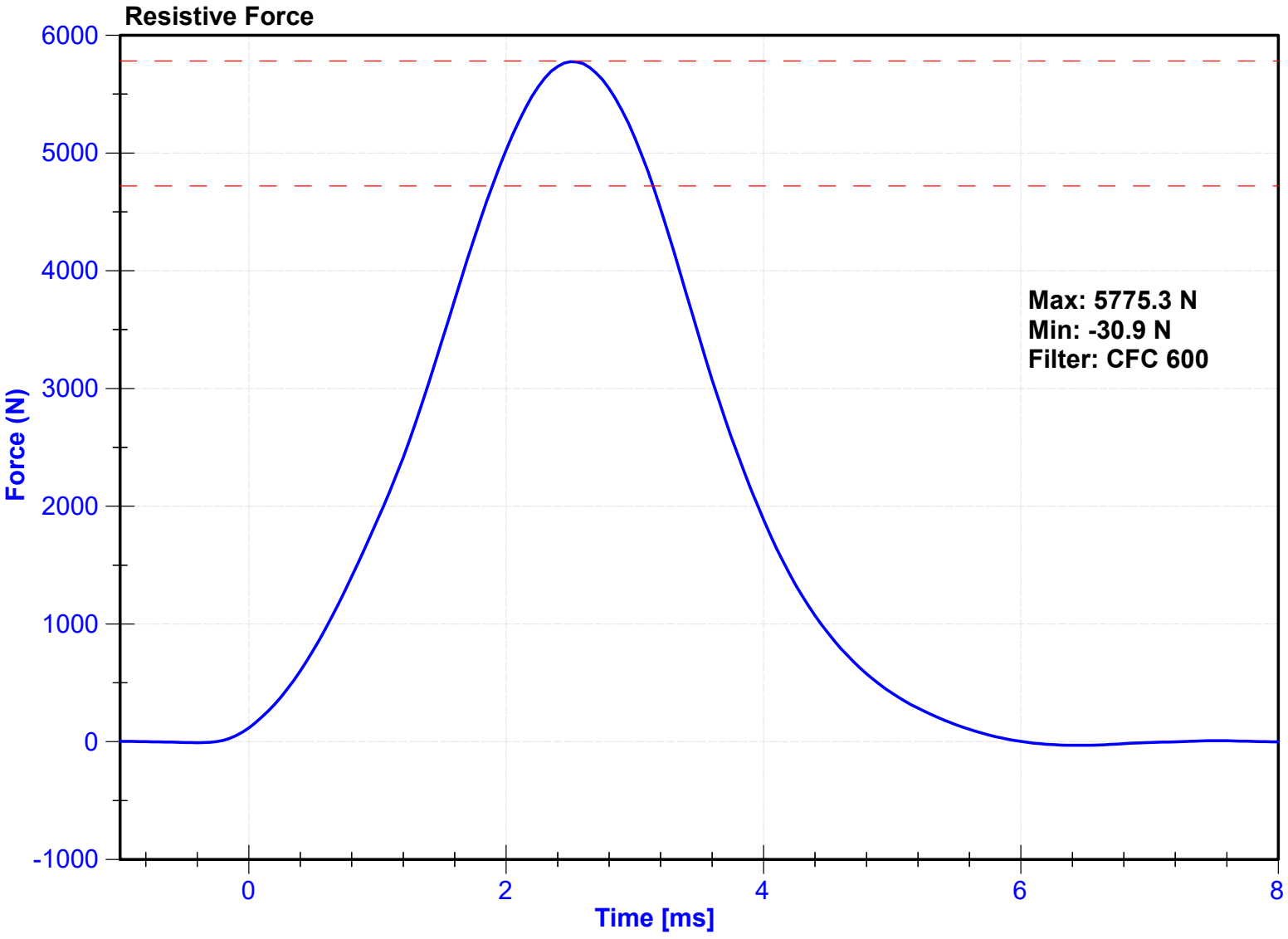
ATD Manufacturer	Humanetics	Test Technician	AG
ATD Serial Number	065	Laboratory Supervisor	ZP

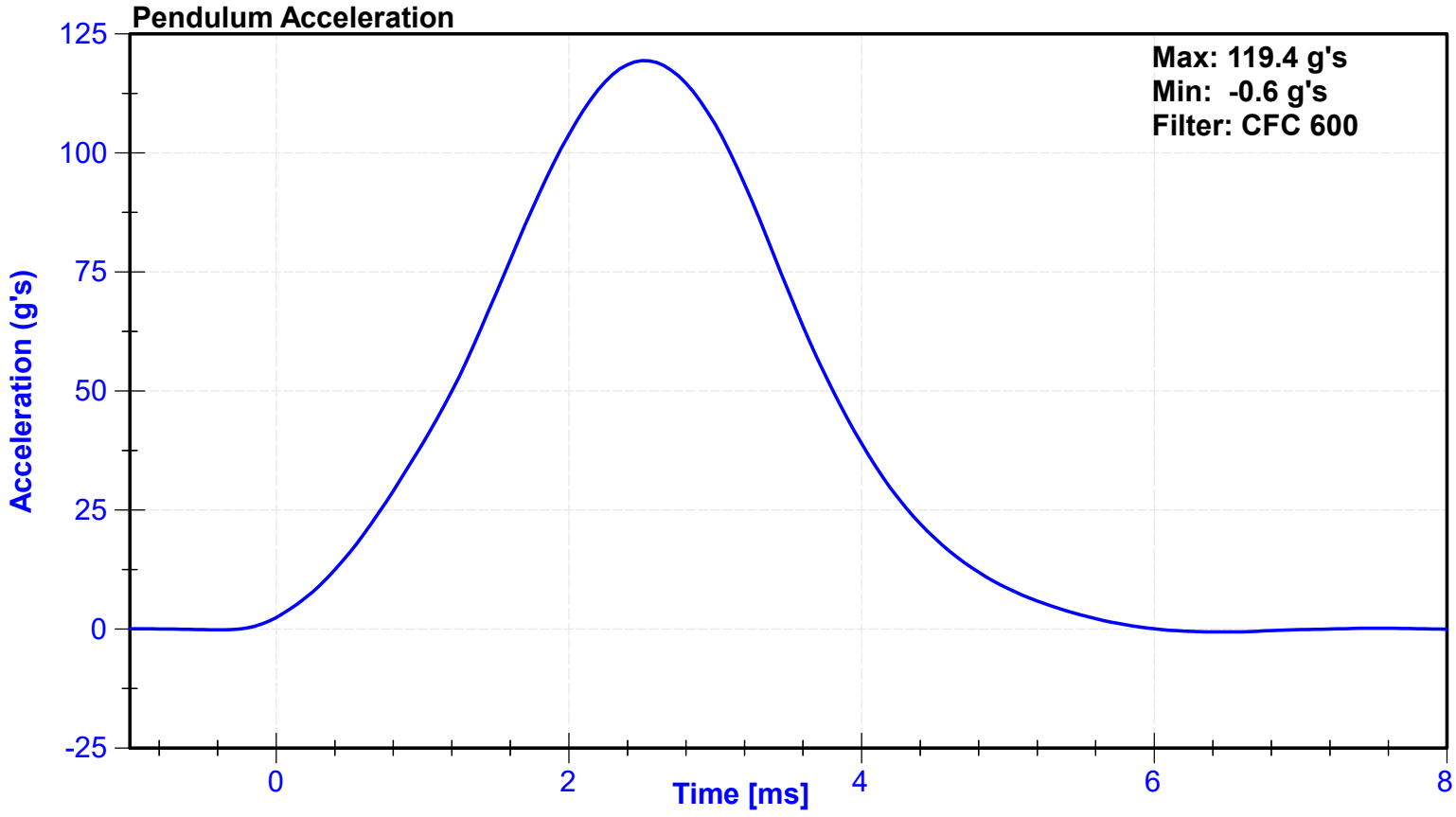
Results

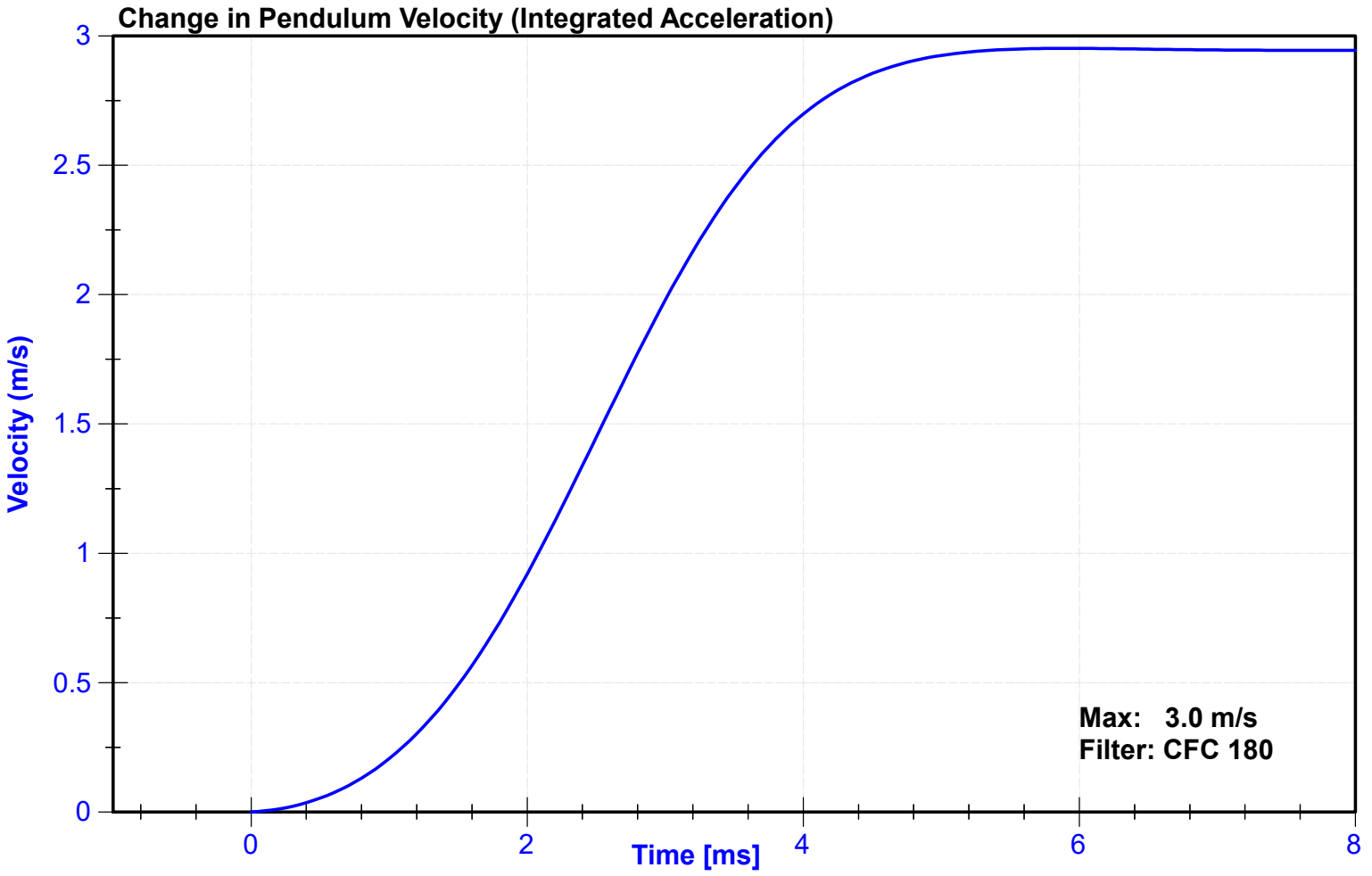
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.3	Pass
Humidity	10	70	%	51.8	Pass
Velocity	2.07	2.13	m/s	2.120	Pass
Maximum Resistive Force	4720	5780	N	5775.3	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	T29720	6/12/2024	12/9/2024




Pendulum Acceleration
Max: 119.4 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: 3.0 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

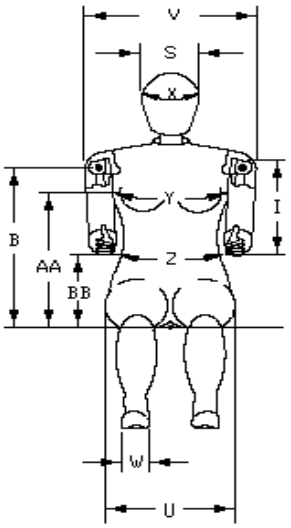
HYBRID III 5TH PERCENTILE - PASSENGER ATD

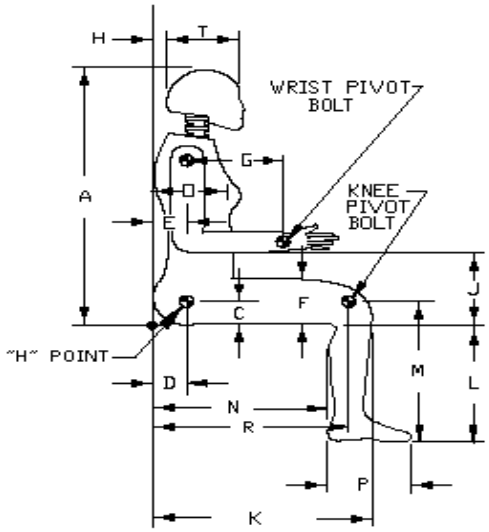
SERIAL NO: 137

External Measurements - Hybrid 3 - 5th Female

Technician: J. Rios Date: 09/04/2024

Dummy Serial Number: 137





Symbol	Description	Specification (mm)		Result (mm)	Pass/Fail
A	Sitting Height	775	800	795	Pass
B	Shoulder Pivot Height	432	457	435	Pass
C	H-Point Height	81	86	84	Pass
D	H-Point from Backline	145	150	145	Pass
E	Shoulder Pivot from Backline	69	84	76	Pass
F	Thigh Clearance	119	135	129	Pass
G	Back of Elbow to Wrist Pivot	244	259	251	Pass
H	Head Back to Backline	43	48	45	Pass
I	Shoulder to Elbow Length	277	297	285	Pass
J	Elbow Rest Height	183	203	199	Pass
K	Buttock to Knee Length	521	546	525	Pass
L	Popliteal Height	356	376	369	Pass
M	Knee Pivot Height	394	419	411	Pass
N	Buttock Popliteal Length	414	439	425	Pass
O	Chest Depth without Jacket	175	191	183	Pass
P	Foot Length (right)	219	234	230	Pass
R	Buttock To Knee Pivot Length	457	483	466	Pass
S	Head Breadth	137	147	145	Pass
T	Head Depth	178	188	183	Pass
U	Hip Breadth	300	315	311	Pass
V	Shoulder Breadth	351	366	362	Pass
W	Foot Breadth	79	94	86	Pass
X	Head Circumference	528	549	538	Pass
Y	Chest Circumference with Jacket	851	881	852	Pass
Z	Waist Circumference	460	790	611	Pass
AA	Reference Location (Chest Circumference)	333	358	339	Pass
BB	Reference Location (Waist Circumference)	160	170	166	Pass

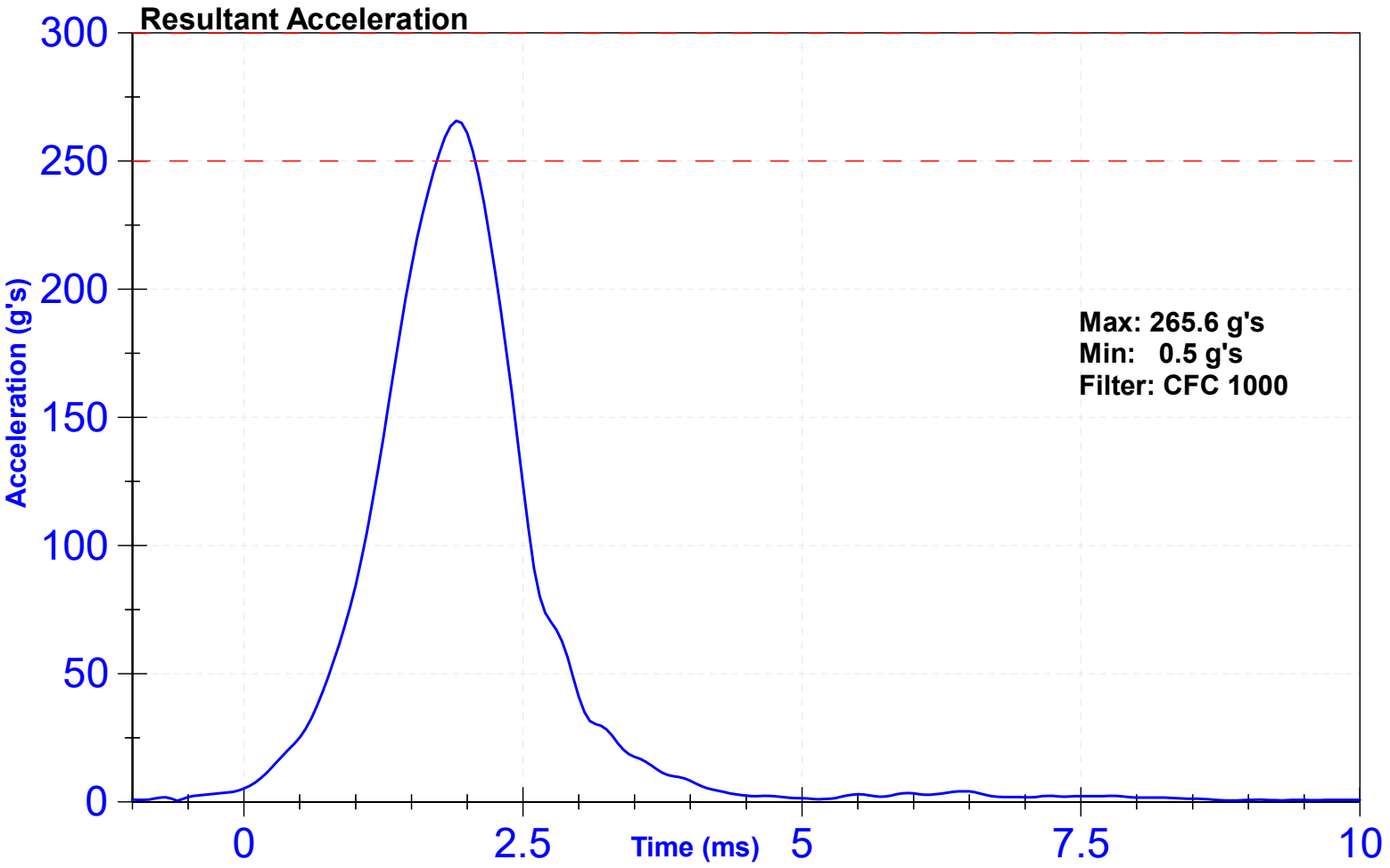
ATD Manufacturer	Humanetics	Test Technician	K. Konieczny
ATD Serial Number	137	Laboratory Supervisor	C. Mantell

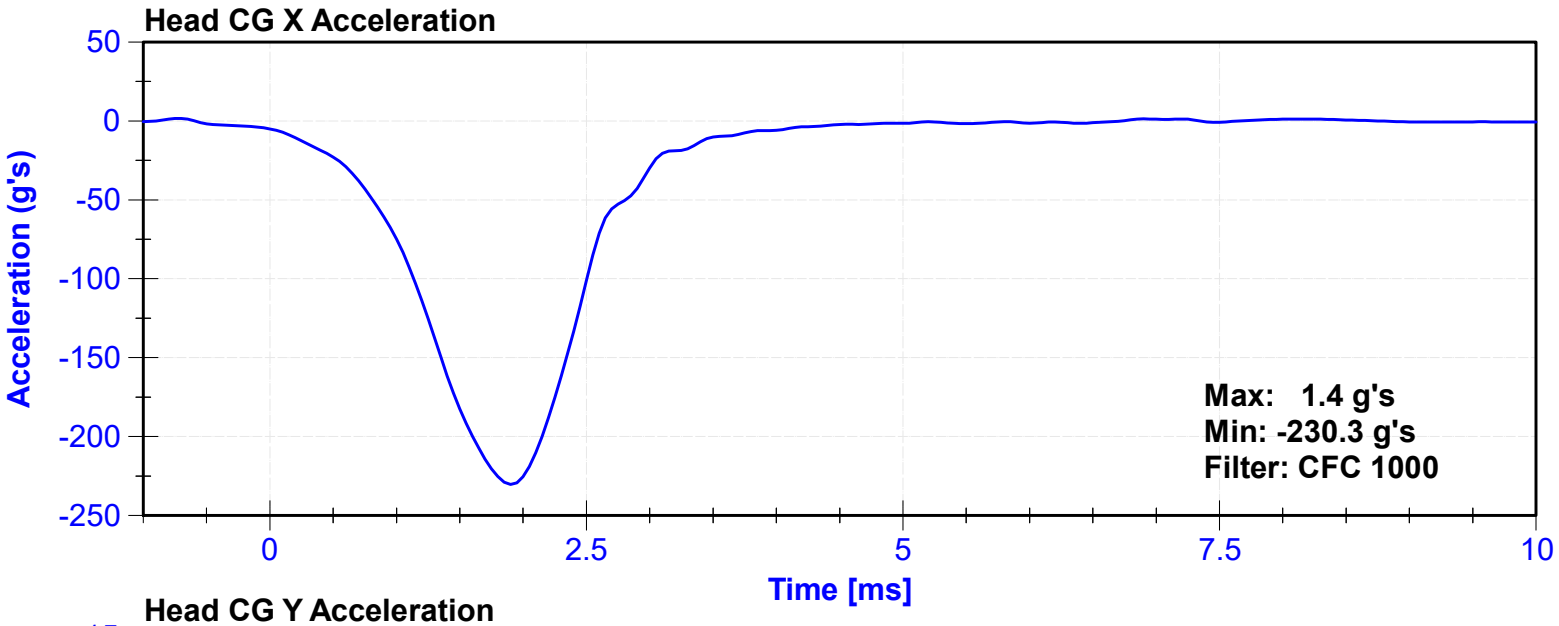
Results

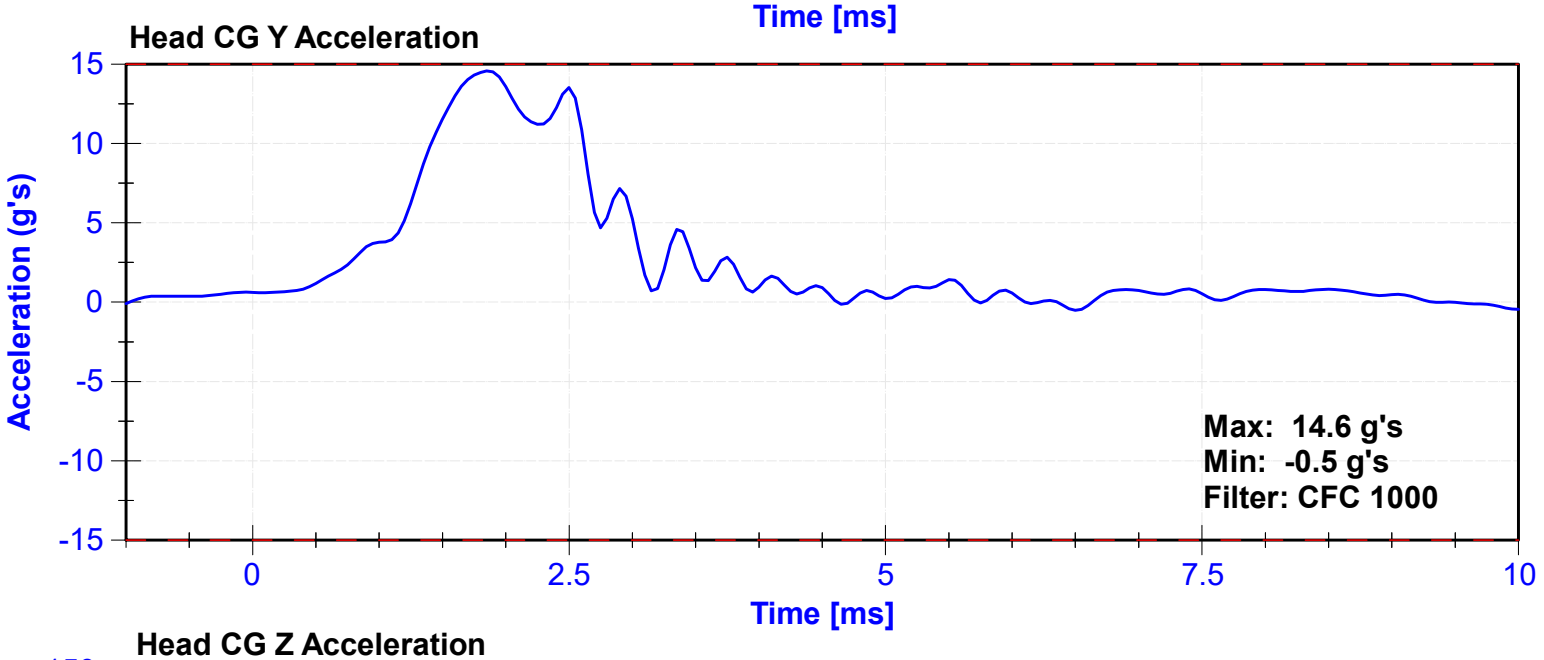
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	20.9	Pass
Humidity	10	70	%	64	Pass
Resultant Acceleration	250	300	g's	265.6	Pass
Oscillation	0	10	%	1.7	Pass
Lateral Acceleration	-15	15	g's	14.6	Pass

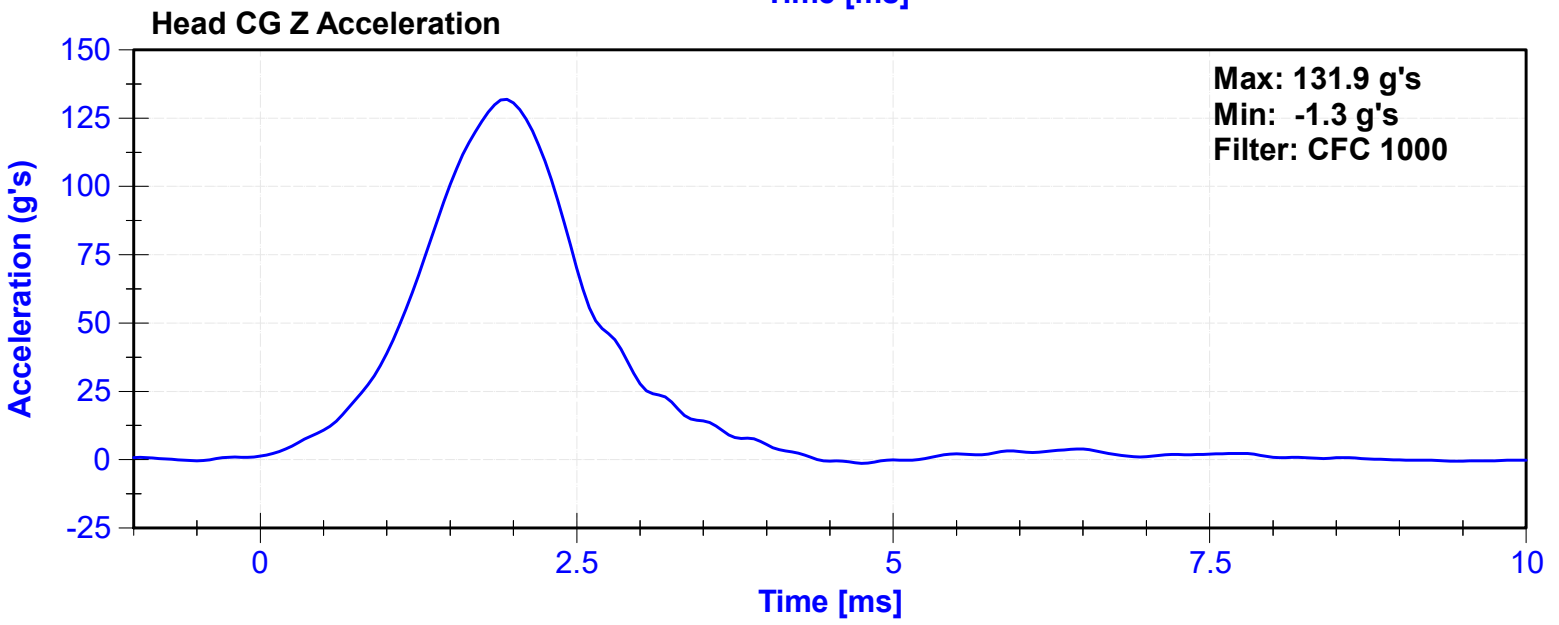
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	Endevco	P79417	8/19/2024	2/15/2025
Y Accelerometer	Endevco	P83335	8/19/2024	2/15/2025
Z Accelerometer	Endevco	P64149	8/19/2024	2/15/2025




Head CG X Acceleration
Acceleration (g's)
50
0
-50
-100
-150
-200
-250
0
2.5
5
7.5
10
Time [ms]
Max: 1.4 g's
Min: -230.3 g's
Filter: CFC 1000


Head CG Y Acceleration
Acceleration (g's)
15
10
5
0
-5
-10
-15
0
2.5
5
7.5
10
Time [ms]
Max: 14.6 g's
Min: -0.5 g's
Filter: CFC 1000


Head CG Z Acceleration
Acceleration (g's)
150
125
100
75
50
25
0
-25
0
2.5
5
7.5
10
Time [ms]
Max: 131.9 g's
Min: -1.3 g's
Filter: CFC 1000

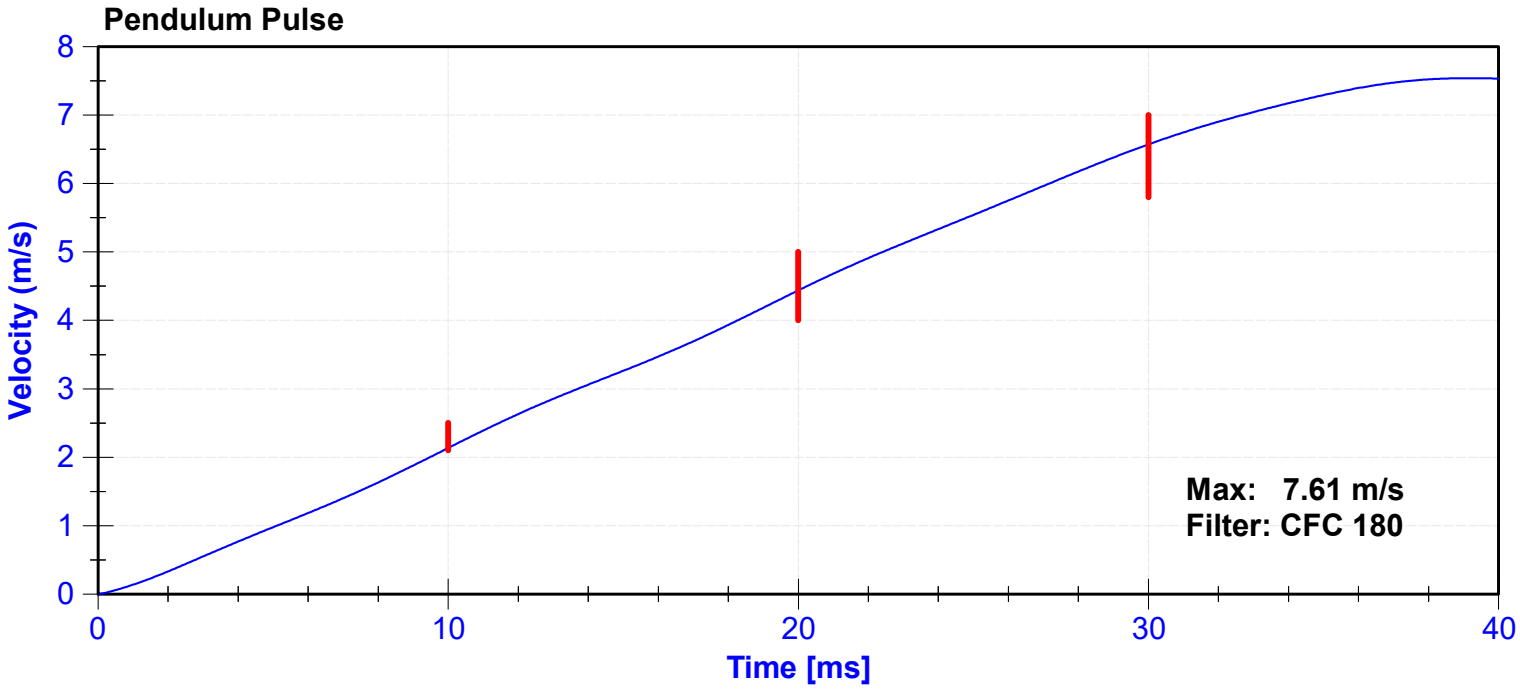
ATD Manufacturer	Humanetics	Test Technician	K. Konieczny
ATD Serial Number	137	Laboratory Supervisor	C. Mantell

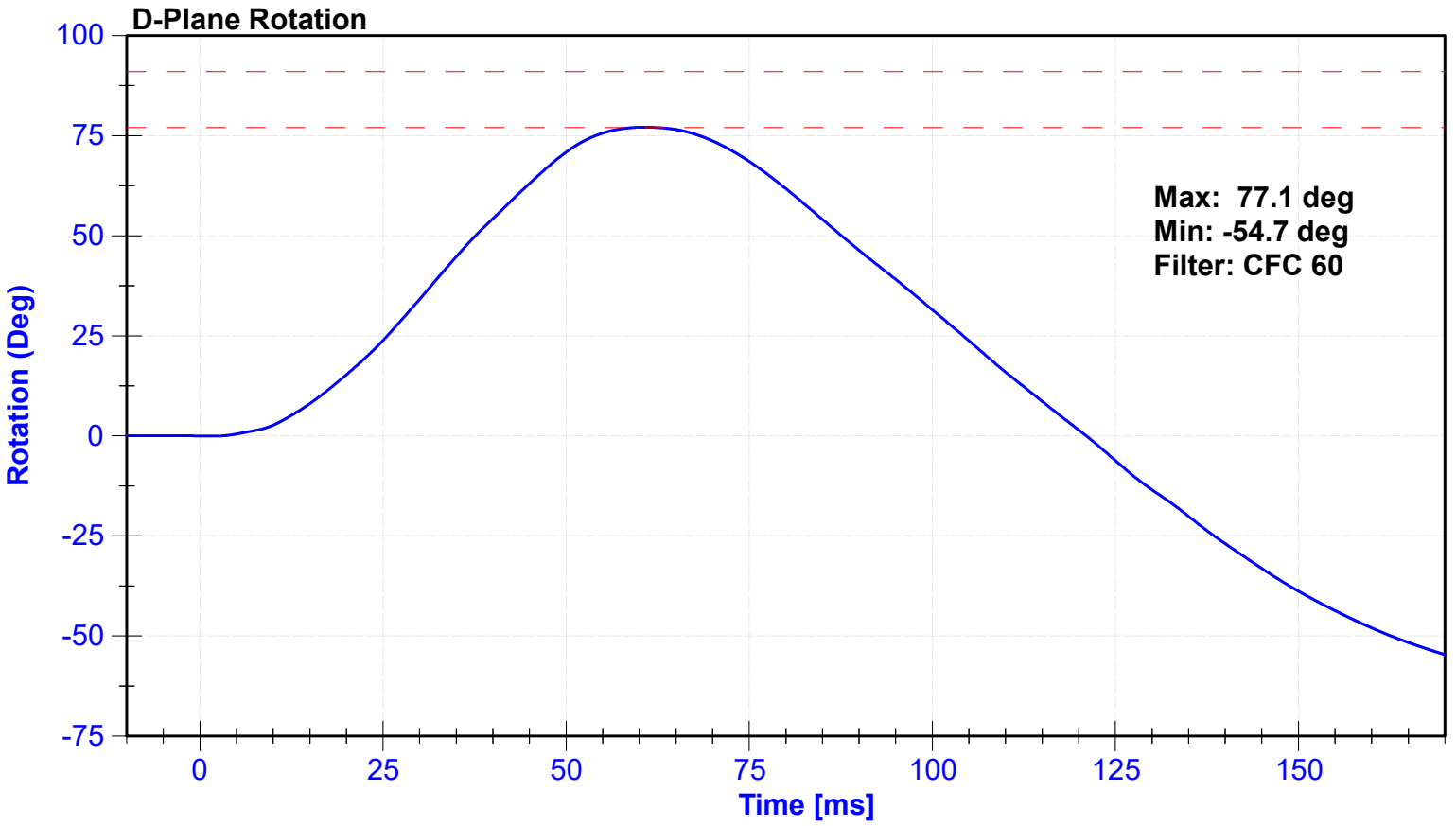
Results

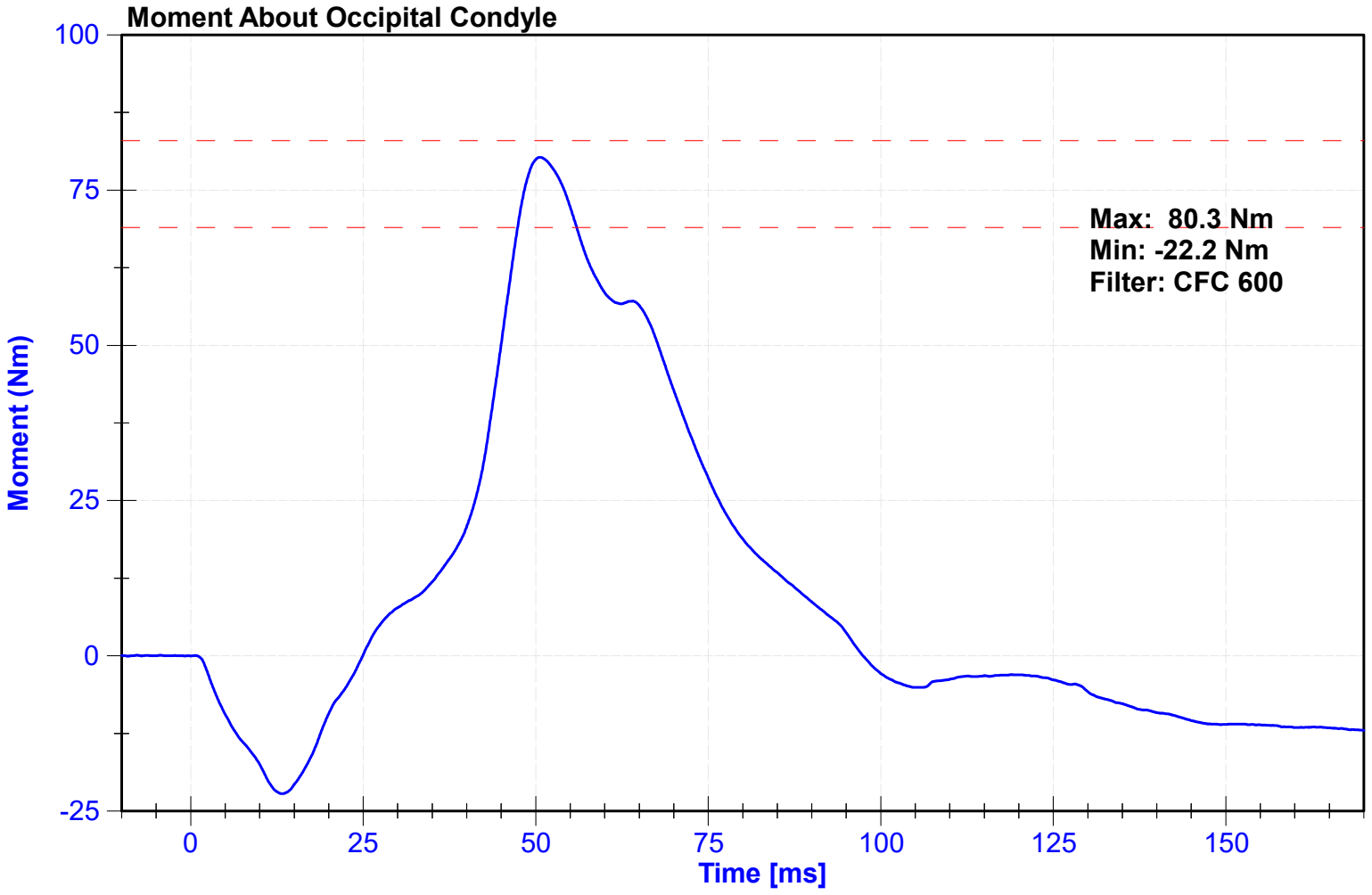
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21..	Pass
Humidity	10	70	%	64.4	Pass
Velocity	6.89	7.13	m/s	7.018	Pass
Pendulum Impulse at 10ms	2.1	2.5	m/s	2.13	Pass
Pendulum Impulse at 20ms	4.0	5.0	m/s	4.44	Pass
Pendulum Impulse at 30ms	5.8	7.0	m/s	6.57	Pass
Max D Plane Rotation	77	91	deg	77.1	Pass
Max Moment During Rotation Interval	69	83	Nm	80.3	Pass
Moment Decay to 10.0 Nm	80	100	ms	88.6	Pass

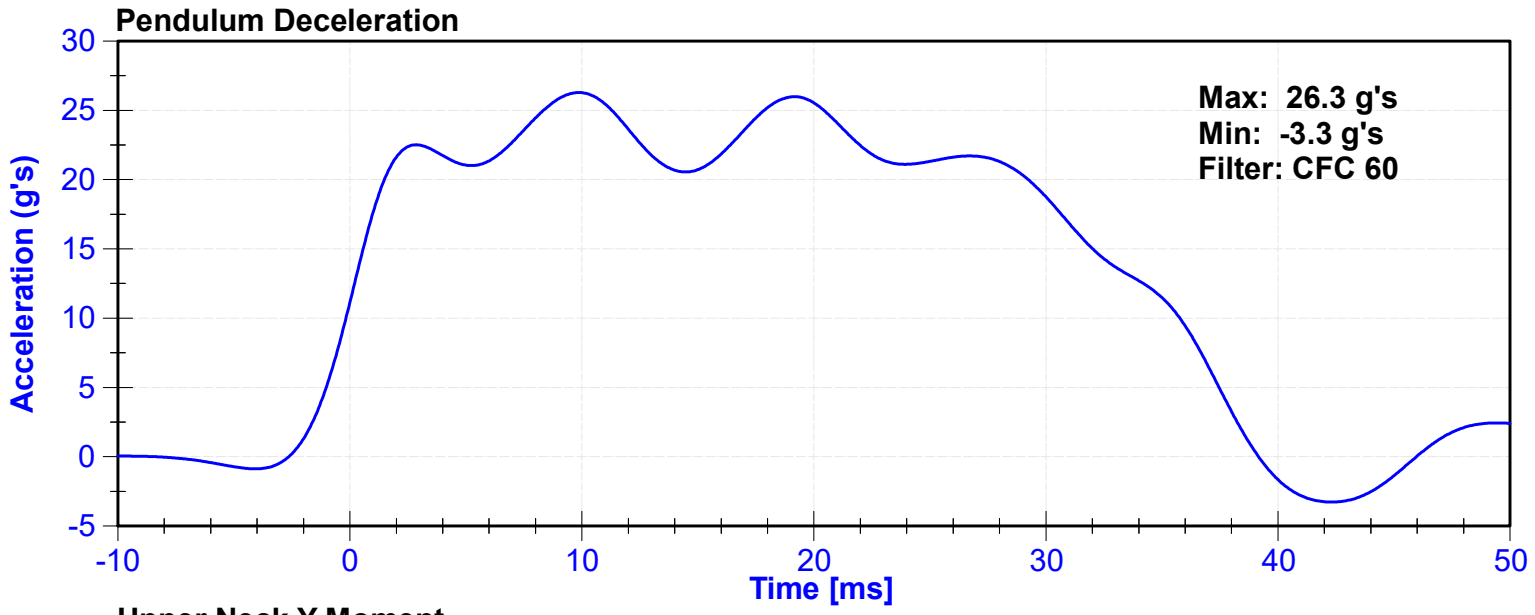
Transducer Calibrations

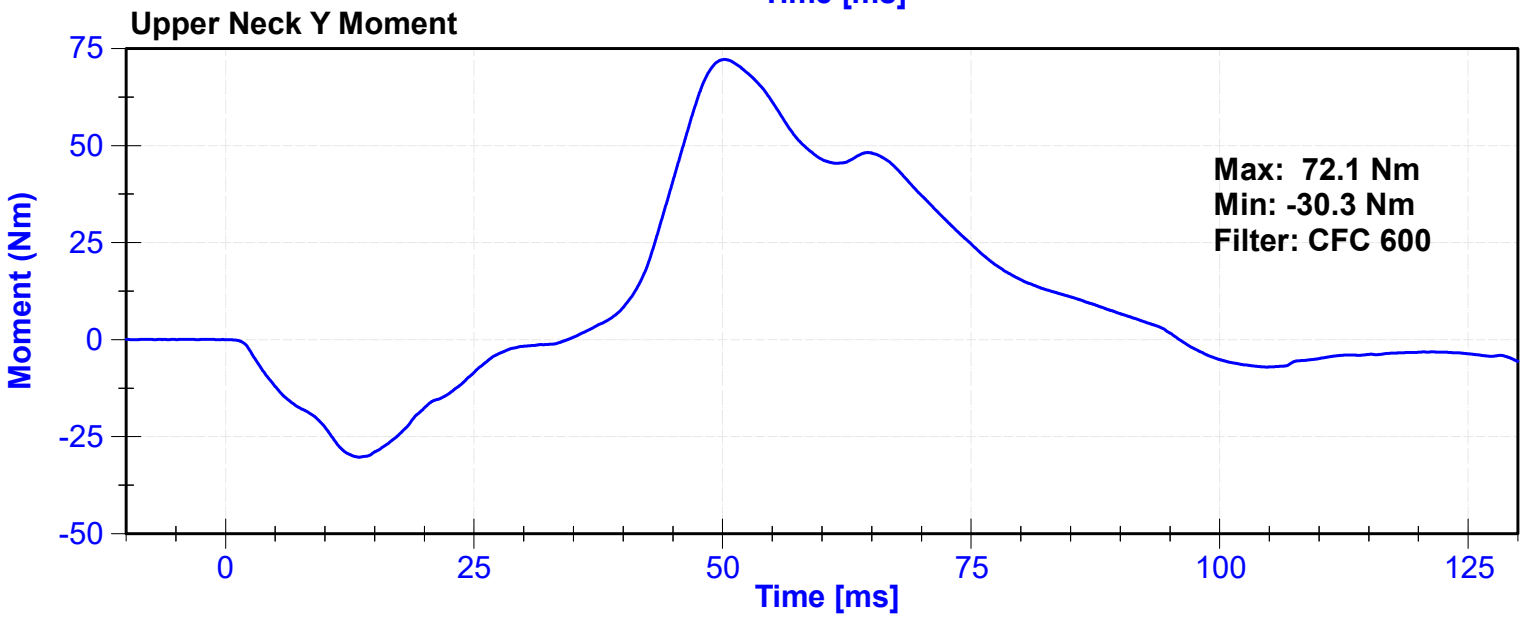
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	C16503	4/29/2024	10/26/2024
Pendulum Potentiometer	ETI	SP22G_LABPOT1	5/7/2024	5/7/2025
Condyle Potentiometer	ETI	SP22G_LABPOT2	5/7/2024	5/7/2025
Upper Neck Load Cell	Denton	2184-FX	7/10/2024	7/10/2025

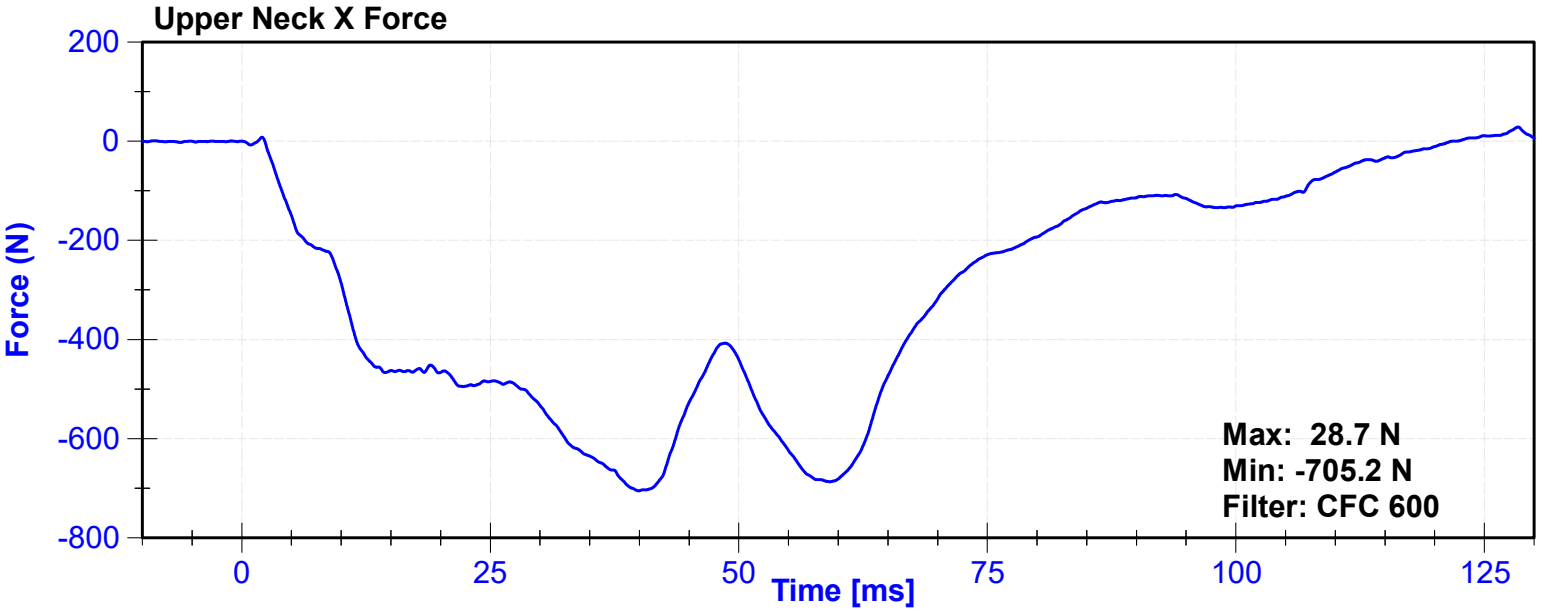



D-Plane Rotation
Max: 77.1 deg
Min: -54.7 deg
Filter: CFC 60
Rotation (Deg)
100
75
50
25
0
-25
-50
-75
0
25
50
75
100
125
150
Time [ms]


Moment About Occipital Condyle
Max: 80.3 Nm
Min: -22.2 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: 26.3 g's
Min: -3.3 g's
Filter: CFC 60


Upper Neck Y Moment
Moment (Nm)
Time [ms]
Max: 72.1 Nm
Min: -30.3 Nm
Filter: CFC 600


Upper Neck X Force
Force (N)
Time [ms]
Max: 28.7 N
Min: -705.2 N
Filter: CFC 600

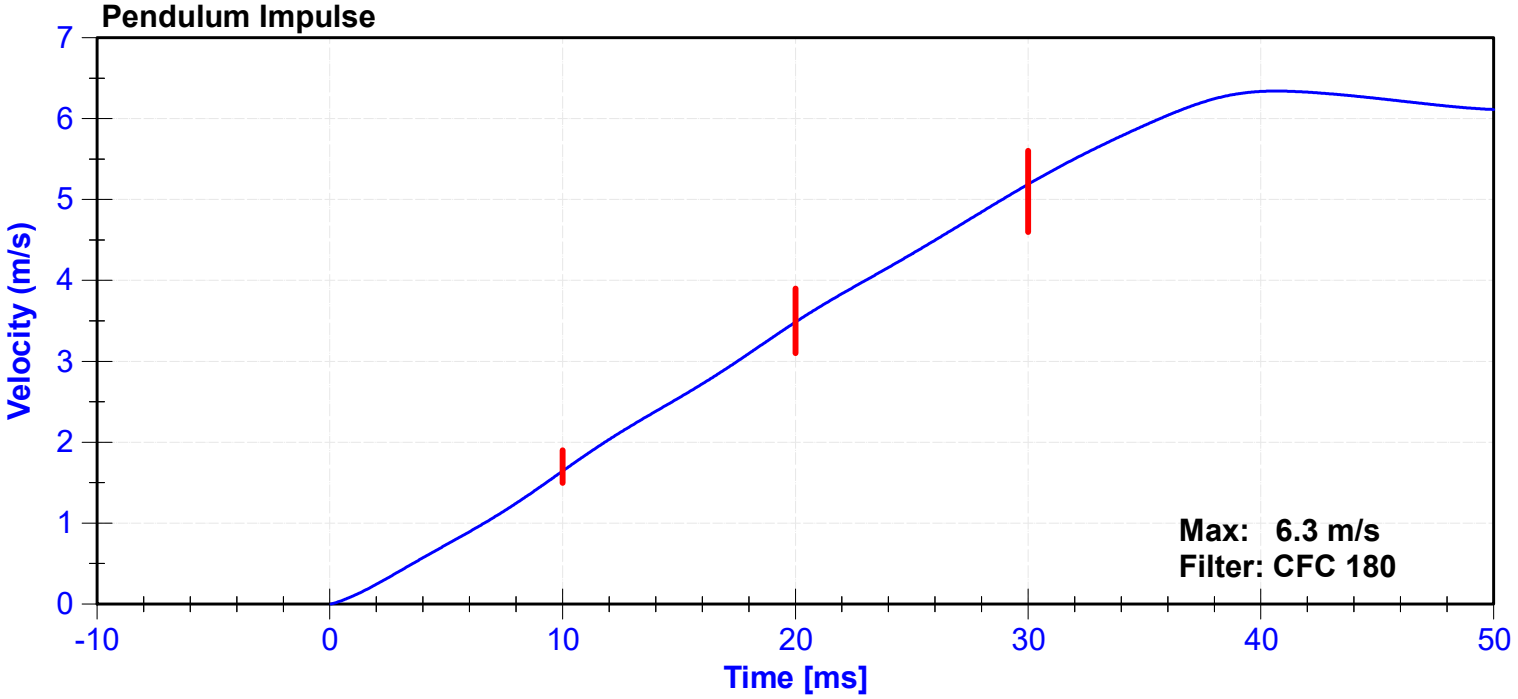
ATD Manufacturer	Humanetics	Test Technician	K. Konieczny
ATD Serial Number	137	Laboratory Supervisor	C. Mantell

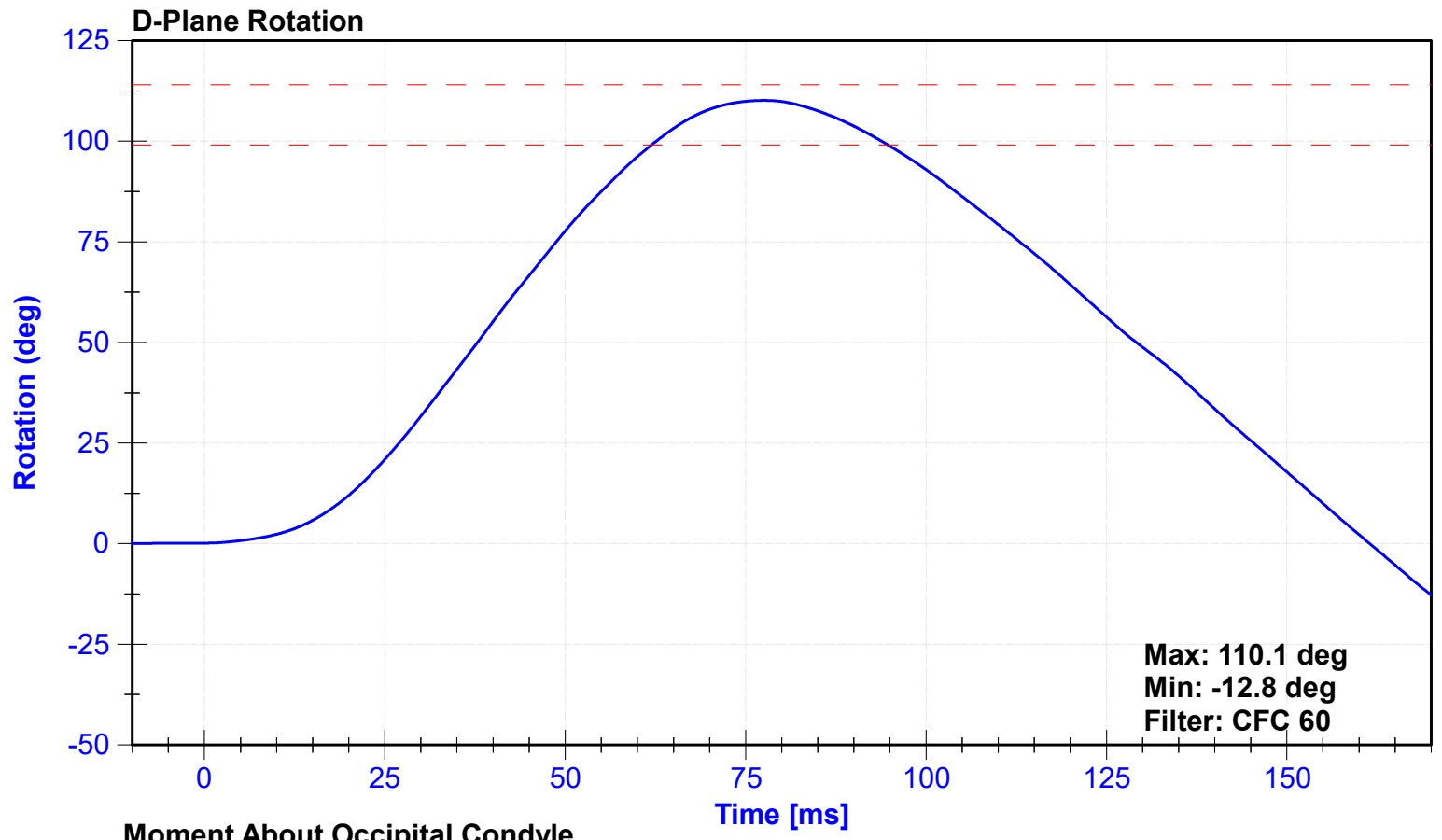
Results

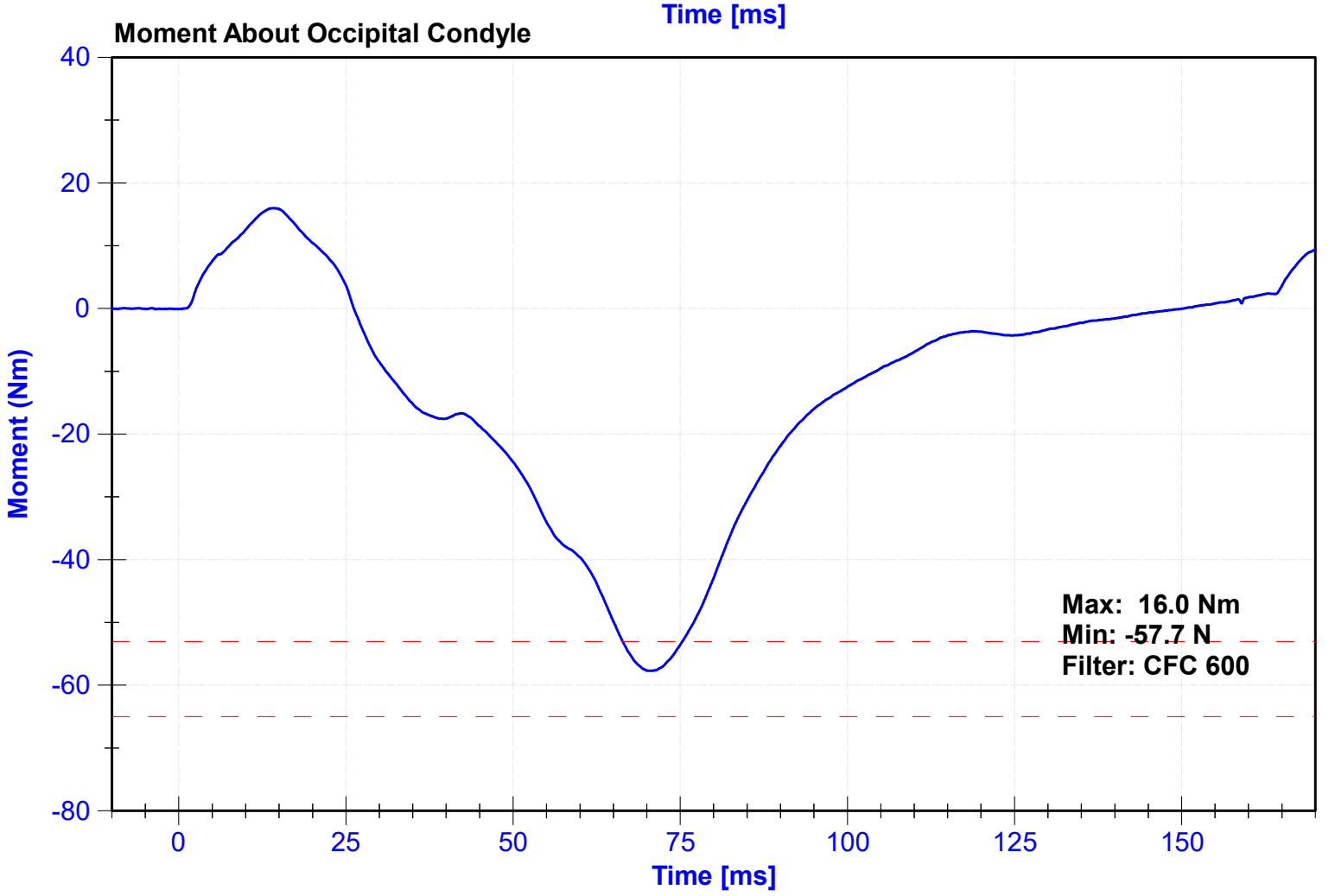
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21..	Pass
Humidity	10	70	%	64.4	Pass
Velocity	5.95	6.19	m/s	5.991	Pass
Pendulum Impulse at 10ms	1.5	1.9	m/s	1.64	Pass
Pendulum Impulse at 20ms	3.1	3.9	m/s	3.48	Pass
Pendulum Impulse at 30ms	4.6	5.6	m/s	5.19	Pass
D Plane Rotation	99	114	deg	110.1	Pass
Moment During Rotation Interval	-65	-53	Nm	-57.7	Pass
Moment Decay to -10Nm	94	114	ms	104.3	Pass

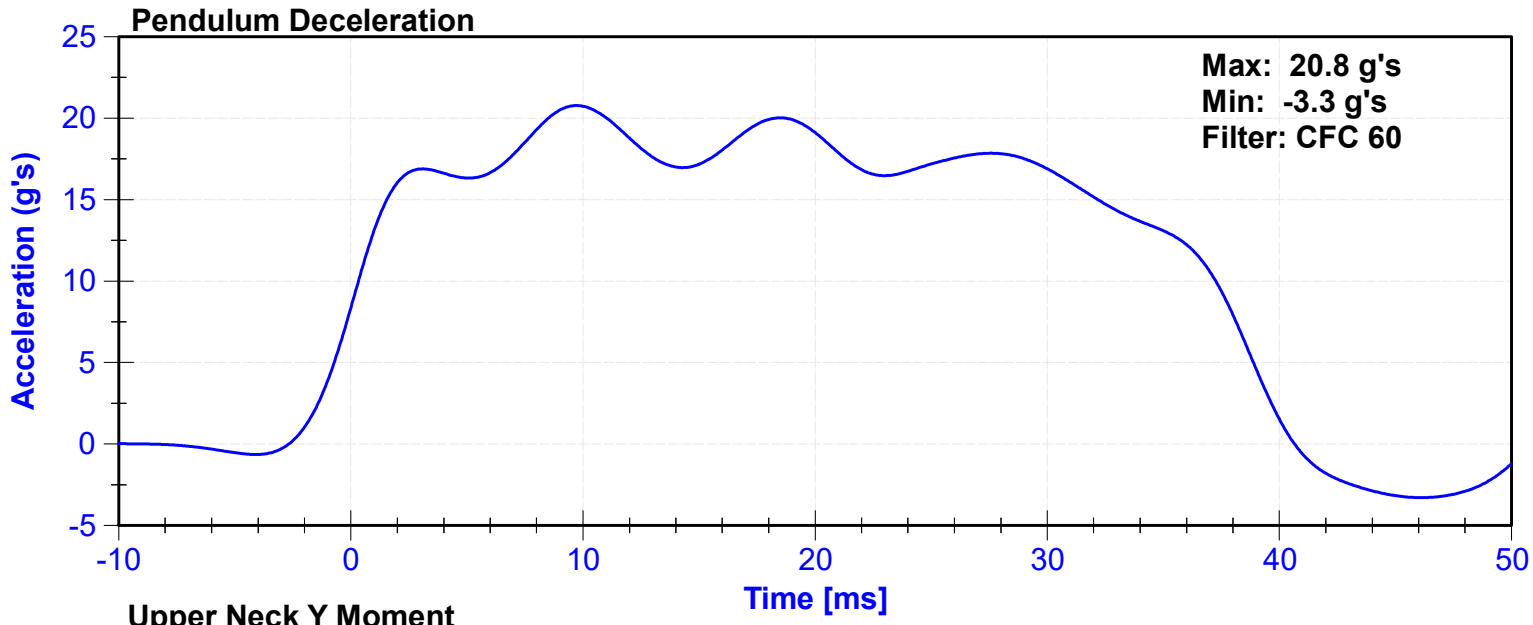
Transducer Calibrations

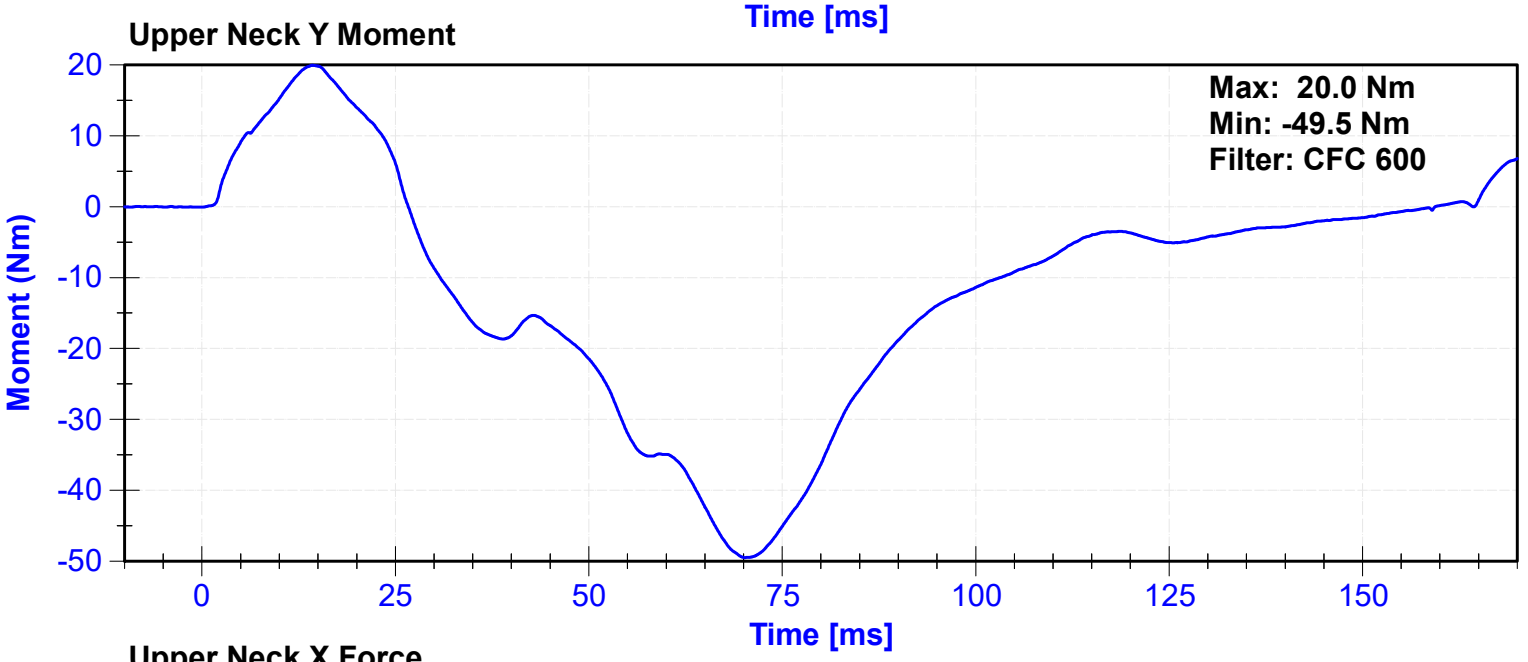
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	C16503	4/29/2024	10/26/2024
Pendulum Potentiometer	ETI	SP22G_LABPOT1	5/7/2024	5/7/2025
Condyle Potentiometer	ETI	SP22G_LABPOT2	5/7/2024	5/7/2025
Upper Neck Load Cell	Denton	2184-FX	7/10/2024	7/10/2025

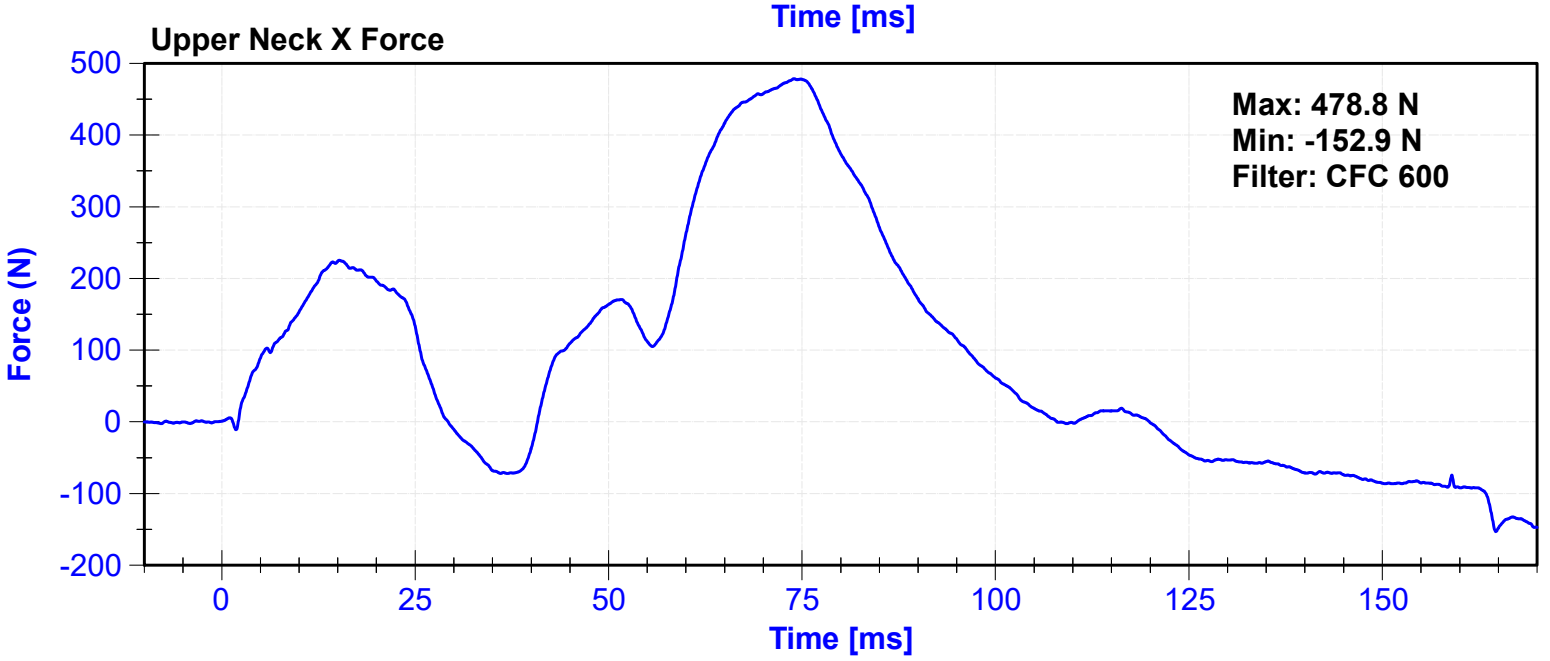



D-Plane Rotation
Rotation (deg)
125
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]
Max: 110.1 deg
Min: -12.8 deg
Filter: CFC 60


Moment About Occipital Condyle
Moment (Nm)
40
20
0
-20
-40
-60
-80
0
25
50
75
100
125
150
Time [ms]
Max: 16.0 Nm
Min: -57.7 N
Filter: CFC 600


Pendulum Deceleration
Max: 20.8 g's
Min: -3.3 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: 20.0 Nm
Min: -49.5 Nm
Filter: CFC 600
Moment (Nm)
20
10
0
-10
-20
-30
-40
-50
0
25
50
75
100
125
150
Time [ms]


Upper Neck X Force
Max: 478.8 N
Min: -152.9 N
Filter: CFC 600
Force (N)
500
400
300
200
100
0
-100
-200
0
25
50
75
100
125
150
Time [ms]

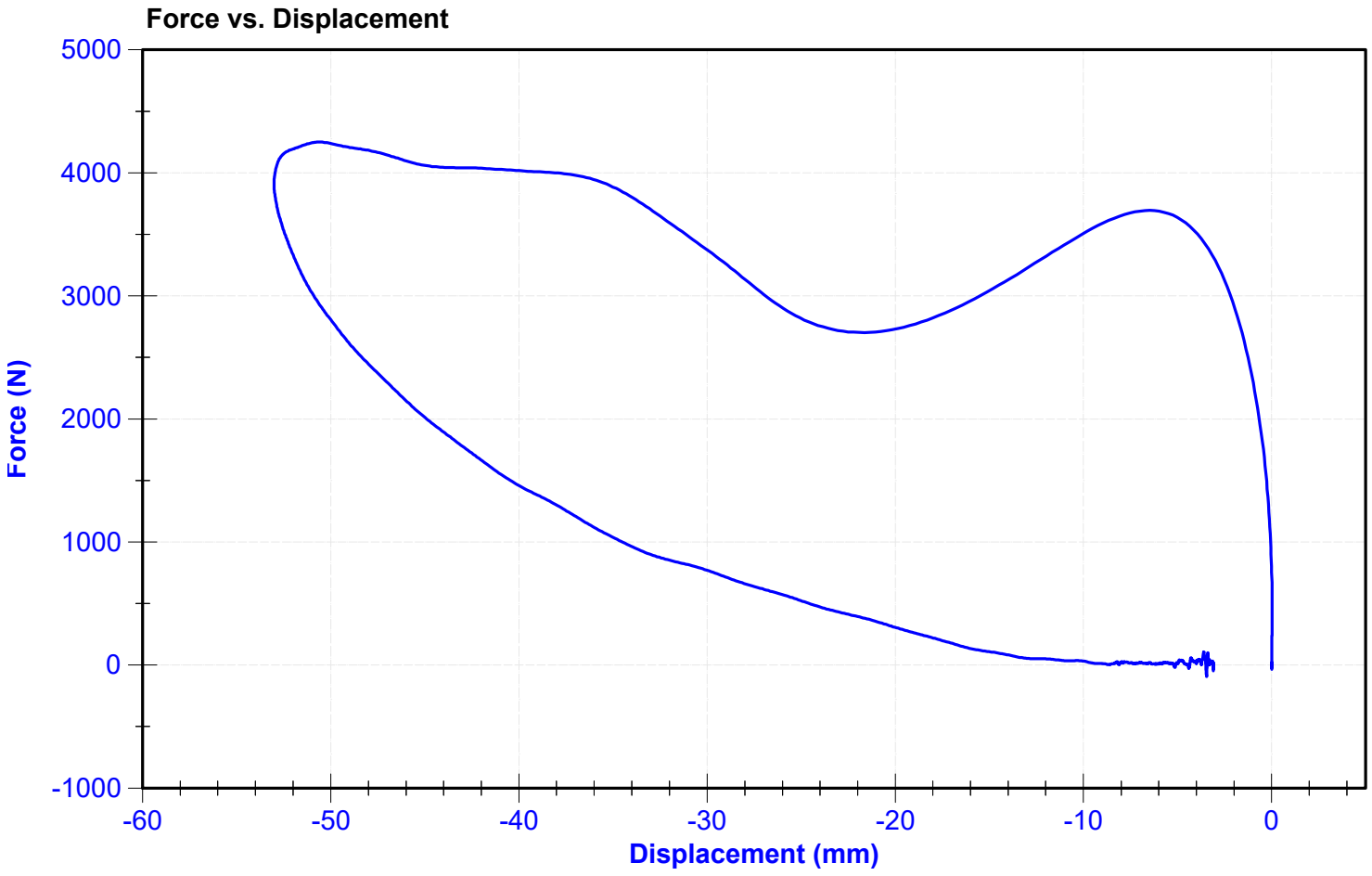
ATD Manufacturer	Humanetics	Test Technician	K. Konieczny
ATD Serial Number	137	Laboratory Supervisor	C. Mantel

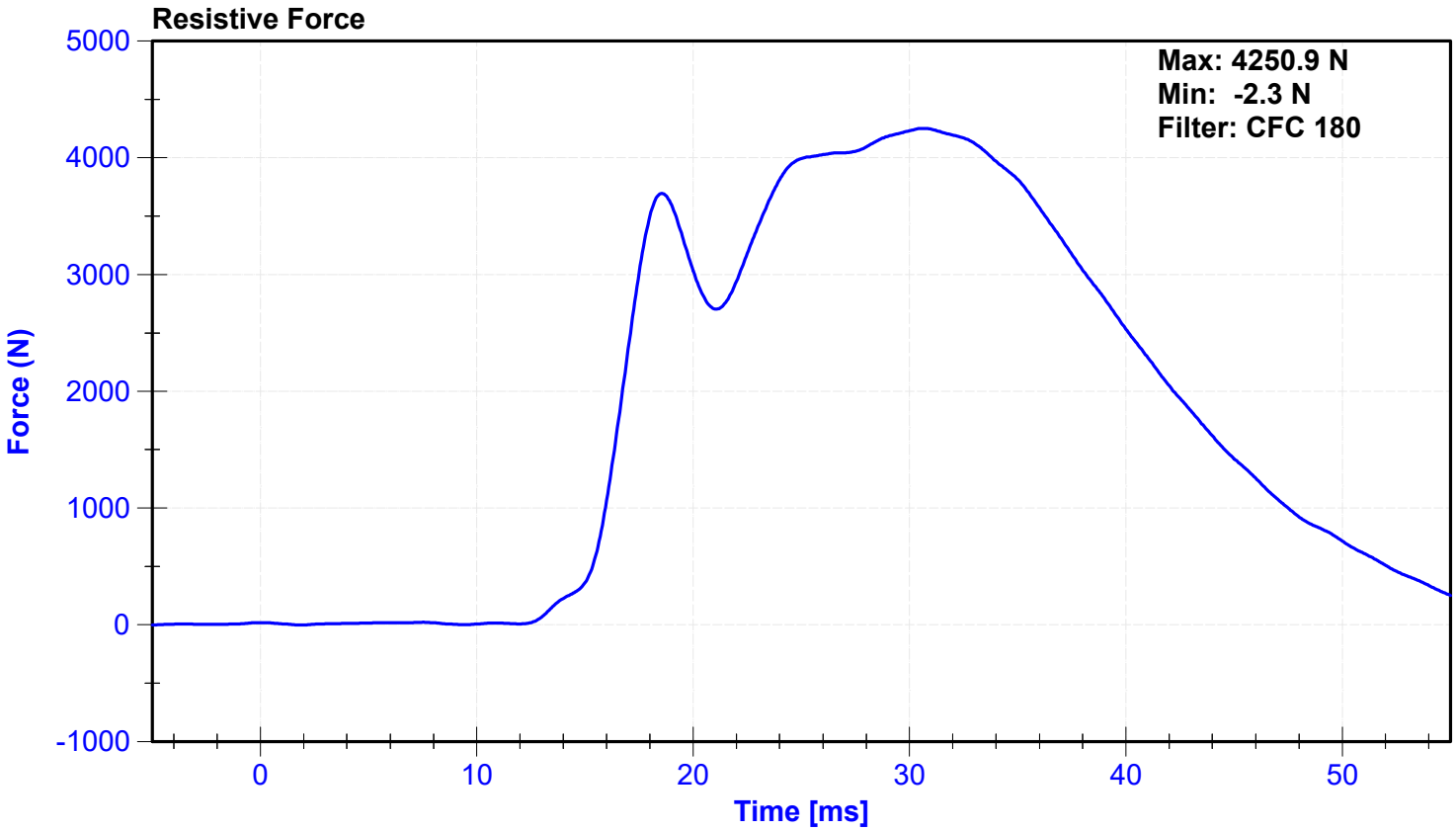
Results

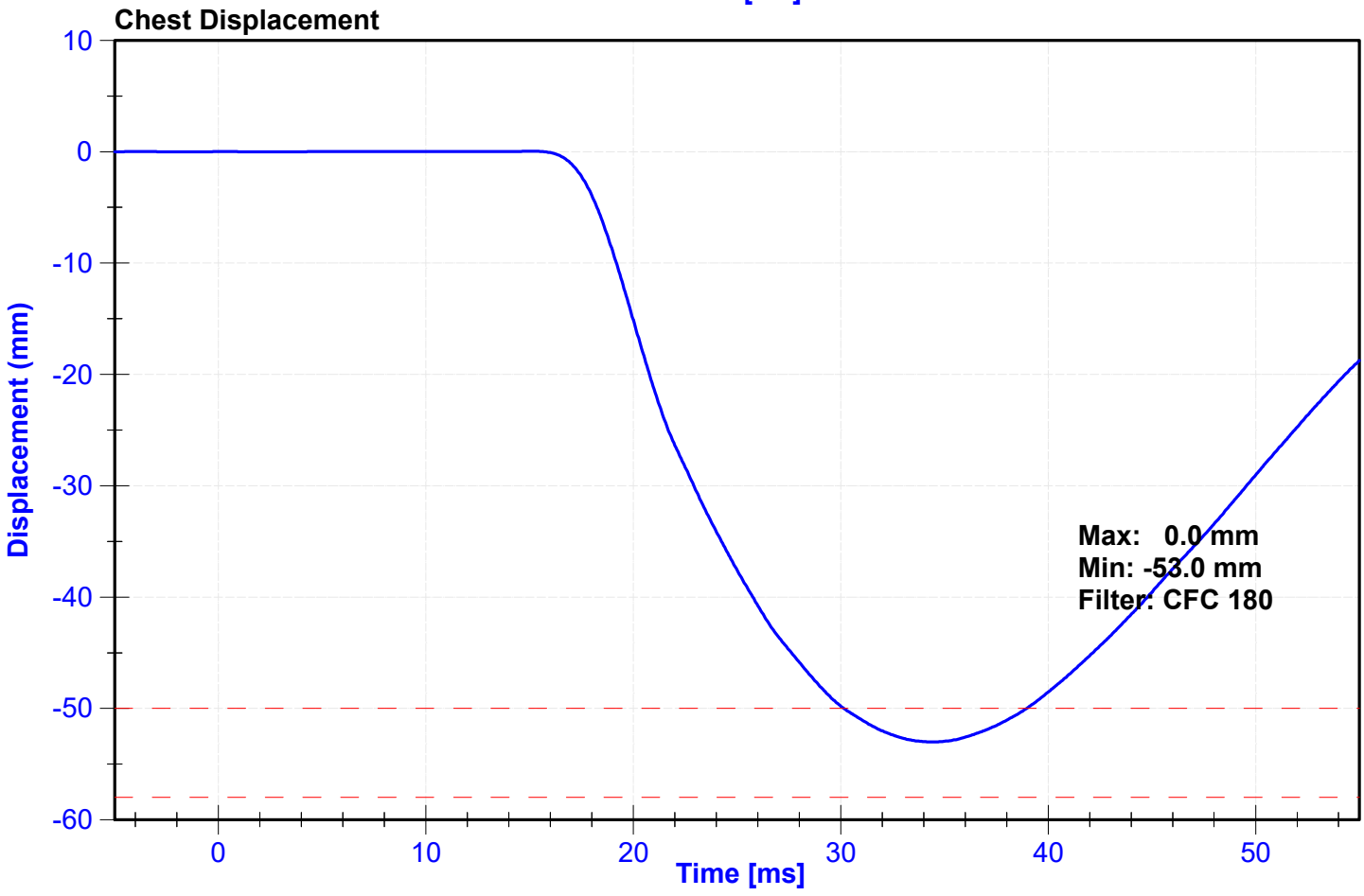
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.9	Pass
Humidity	10	70	%	47	Pass
Velocity	6.59	6.83	m/s	6.645	Pass
Chest Deflection	-58	-50	mm	-53.0	Pass
Maximum Resistive Force (50 to 58mm)	3900	4400	N	4250.9	Pass
Maximum Resistive Force (18 to 50mm)	0	4600	N	4236.1	Pass
Hysteresis	69	85	%	74.2	Pass

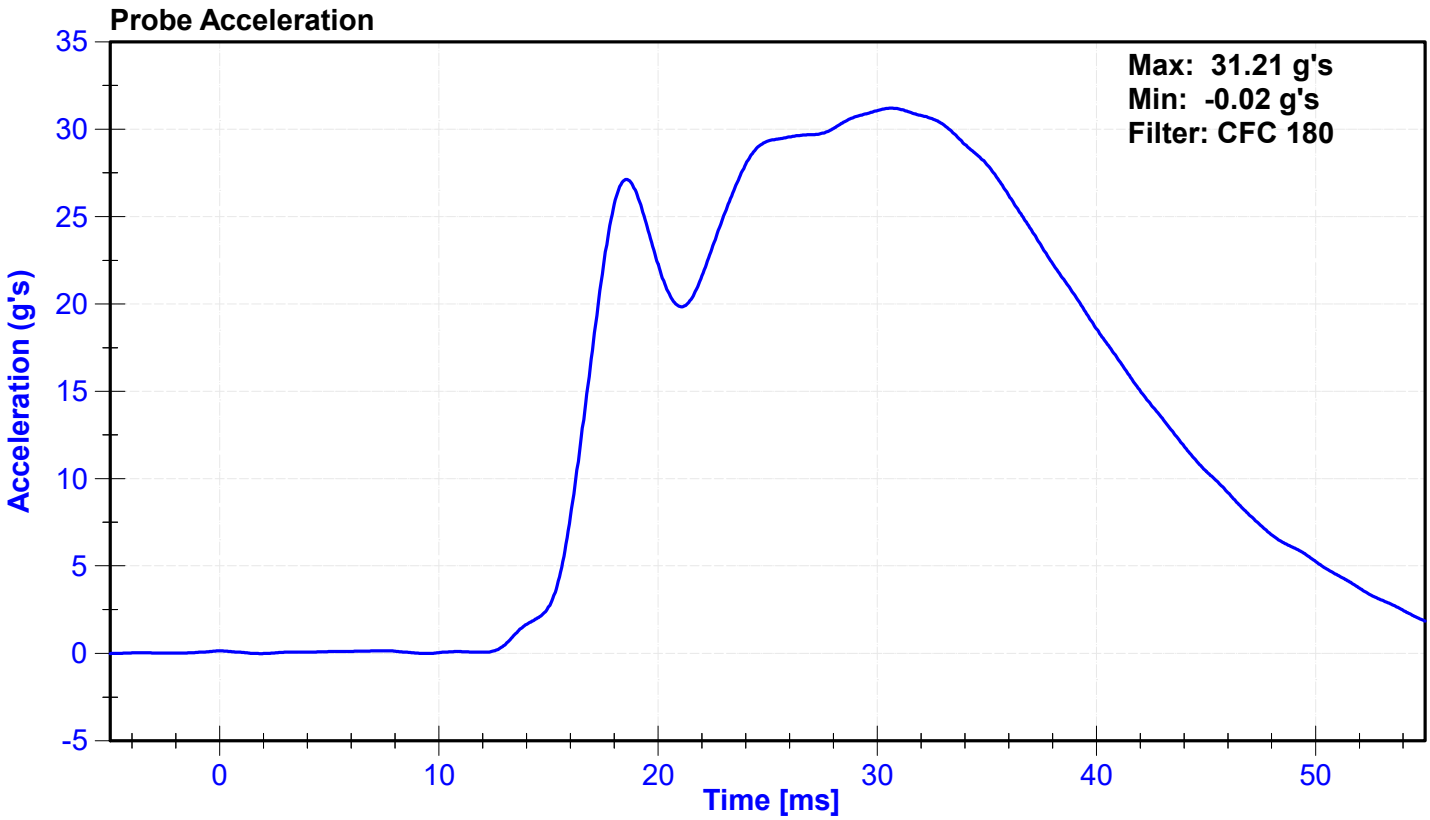
Transducer Calibrations

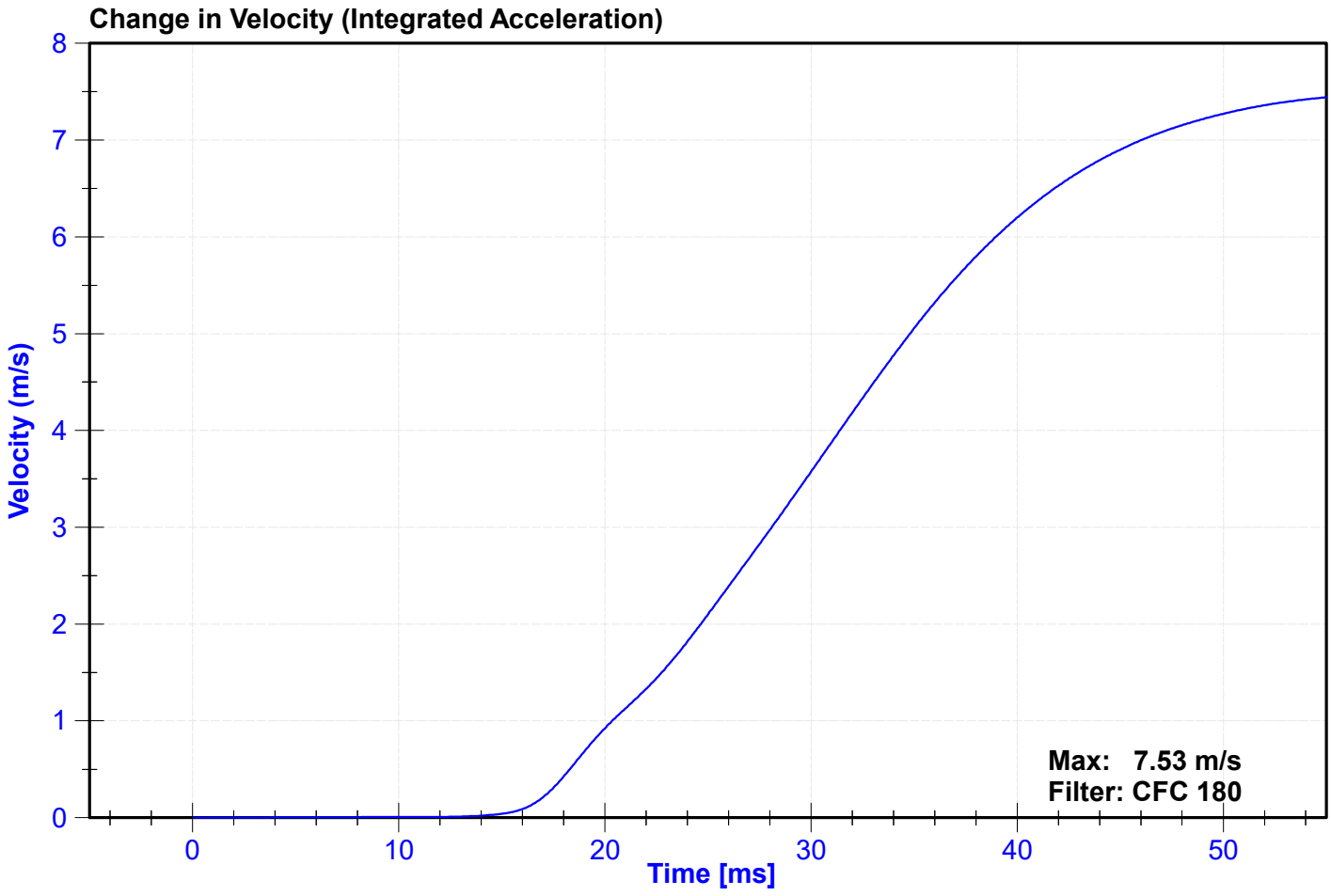
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18587	11/20/2023	11/19/2024
Chest Potentiometer	Servo	0720	8/19/2024	2/17/2025




Resistive Force
Max: 4250.9 N
Min: -2.3 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: -53.0 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: 31.21 g's
Min: -0.02 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: 7.53 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]

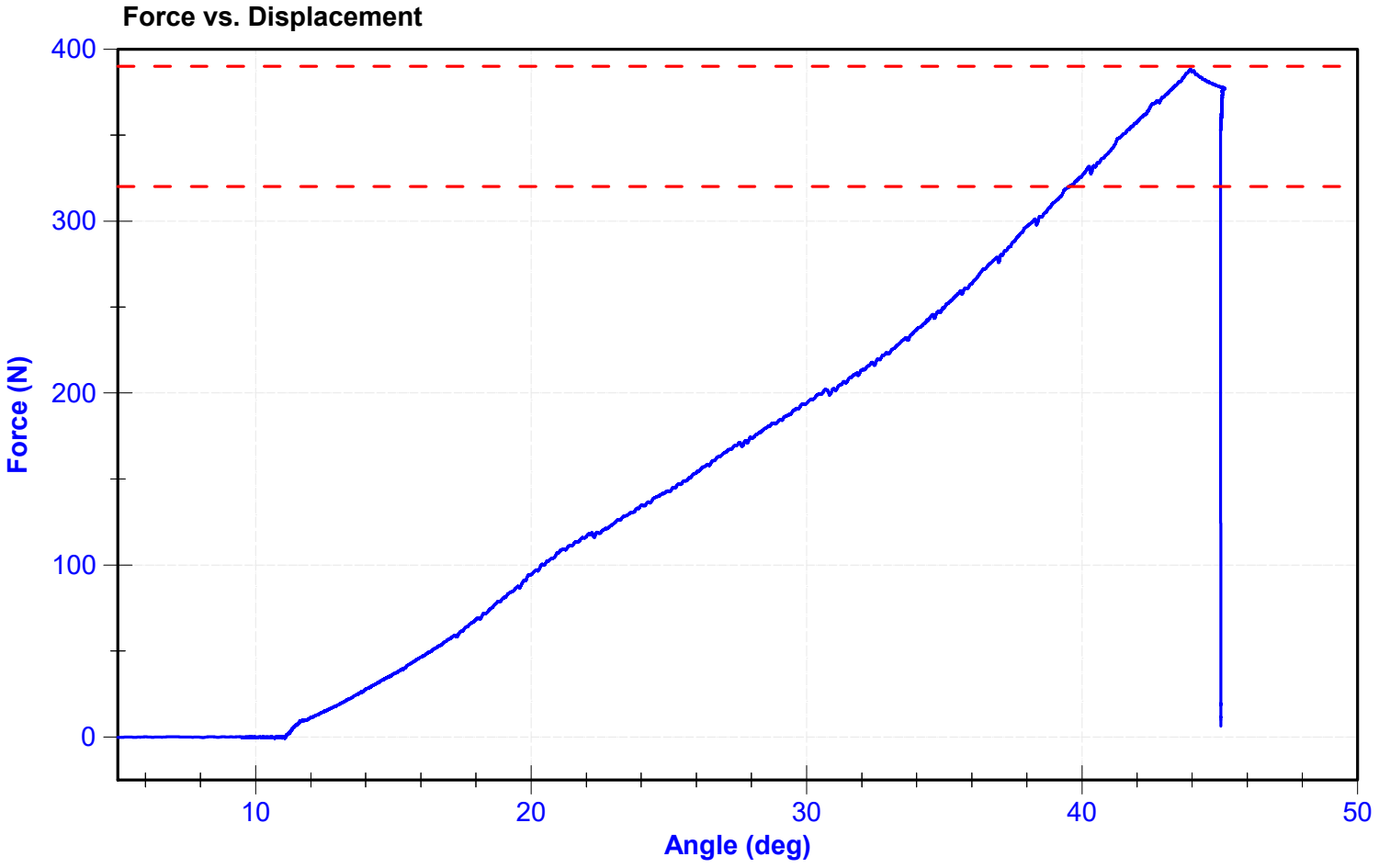
ATD Manufacturer	Humanetics	Test Technician	K. Konieczny
ATD Serial Number	137	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.6	25.6	ºC	20.9	Pass
Humidity	10	70	%	42	Pass
Initial Angle	0	20	deg	10.3	Pass
Force at 45 Degrees	320	390	N	388.3	Pass
Return Angle Relative to Initial	0	8	deg	6.0	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



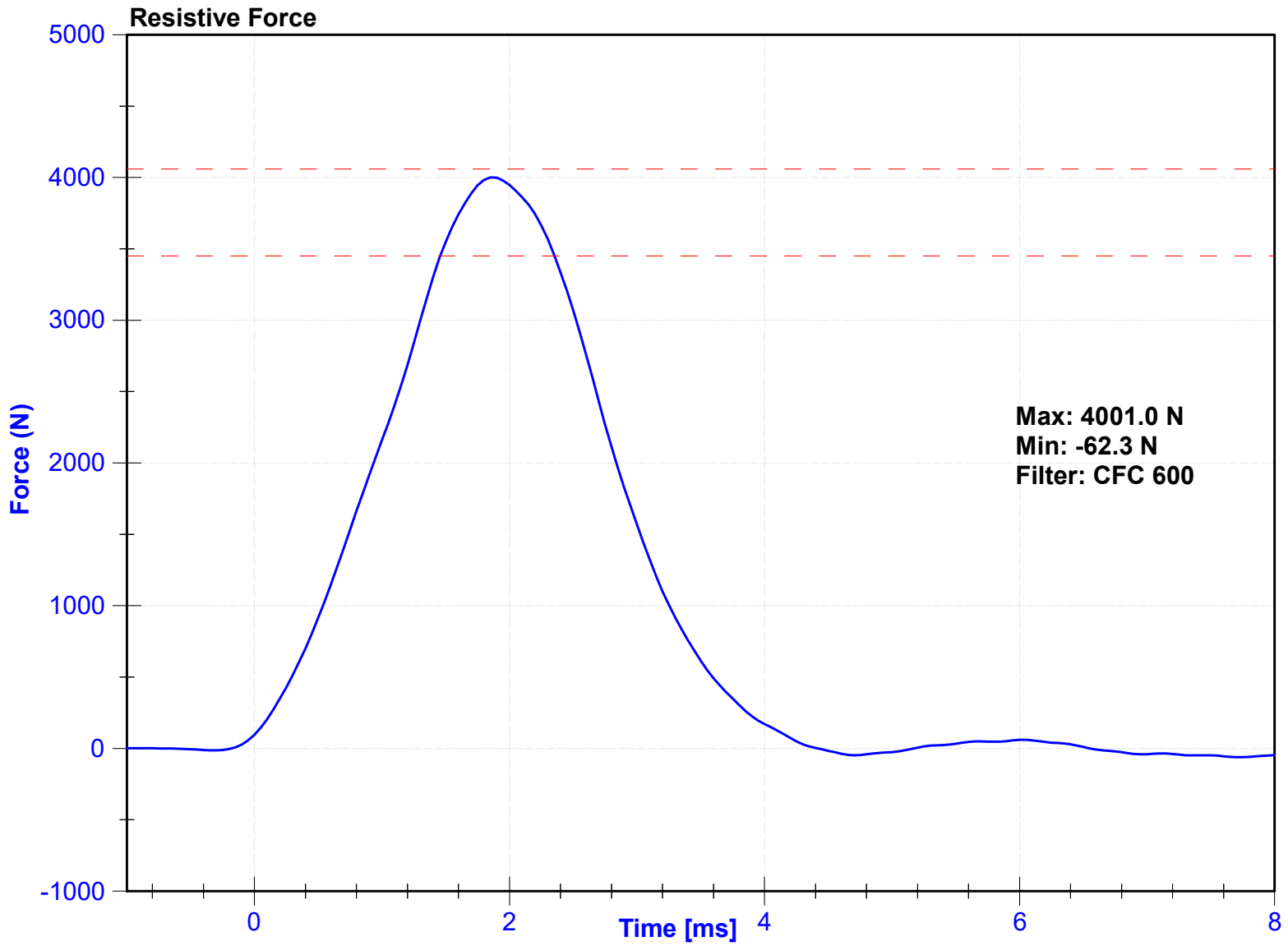
ATD Manufacturer	Humanetics	Test Technician	K. Konieczny
ATD Serial Number	143	Laboratory Supervisor	C. Mantell

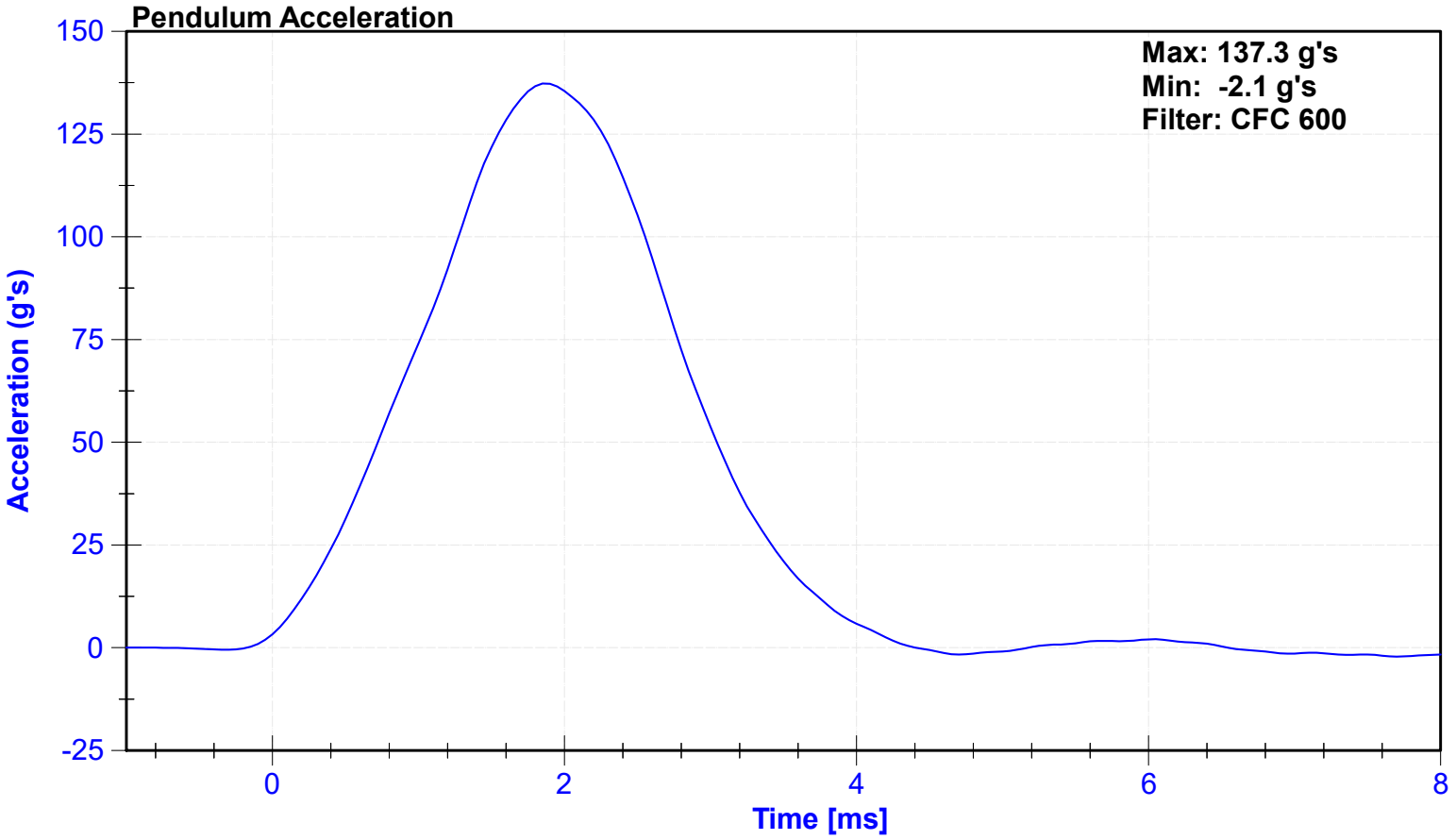
Results

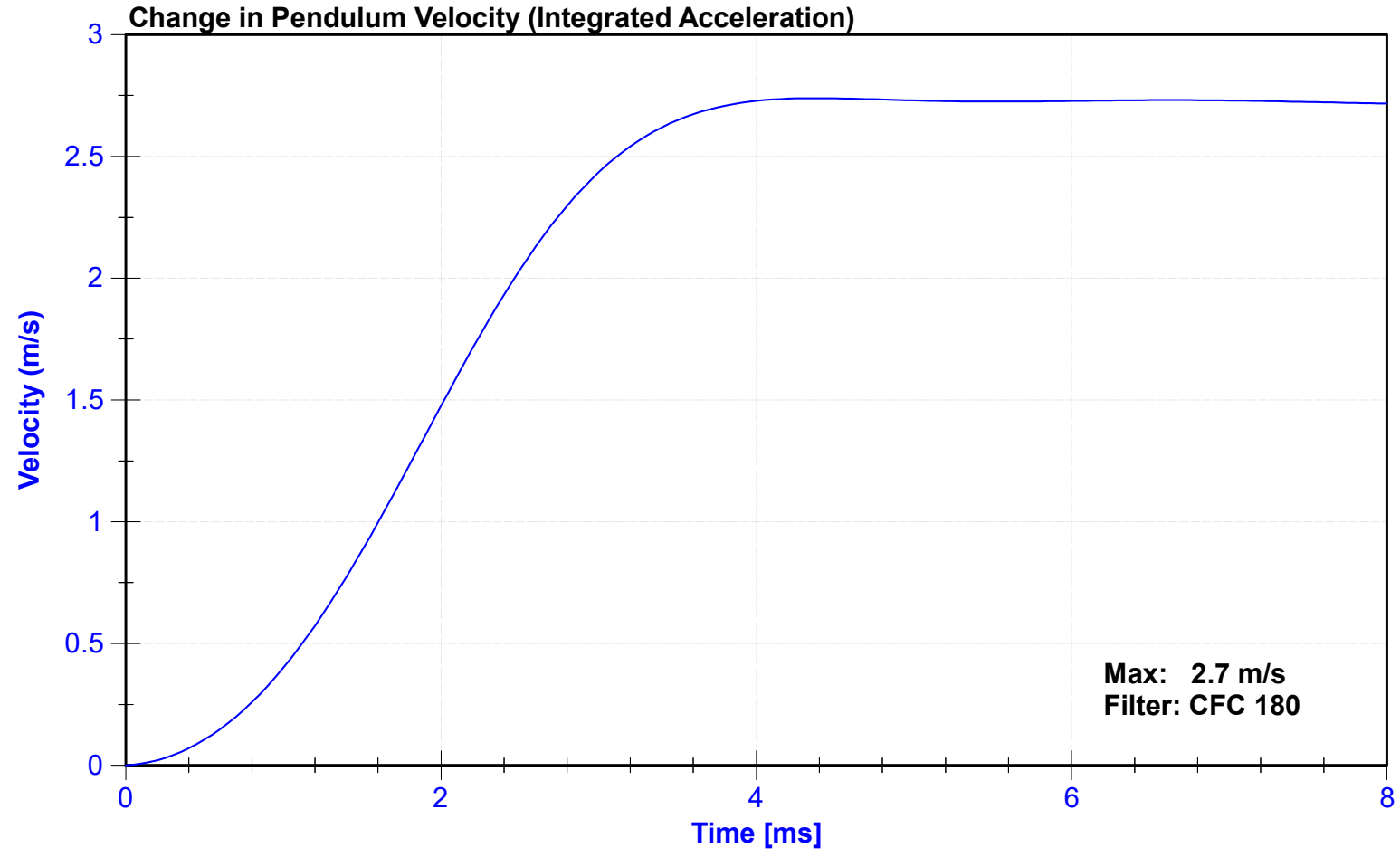
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.5	Pass
Humidity	10	70	%	61	Pass
Velocity	2.07	2.13	m/s	2.099	Pass
Resistive Force	3450	4060	N	4001.0	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18587	11/20/2023	11/19/2024




Pendulum Acceleration
Max: 137.3 g's
Min: -2.1 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

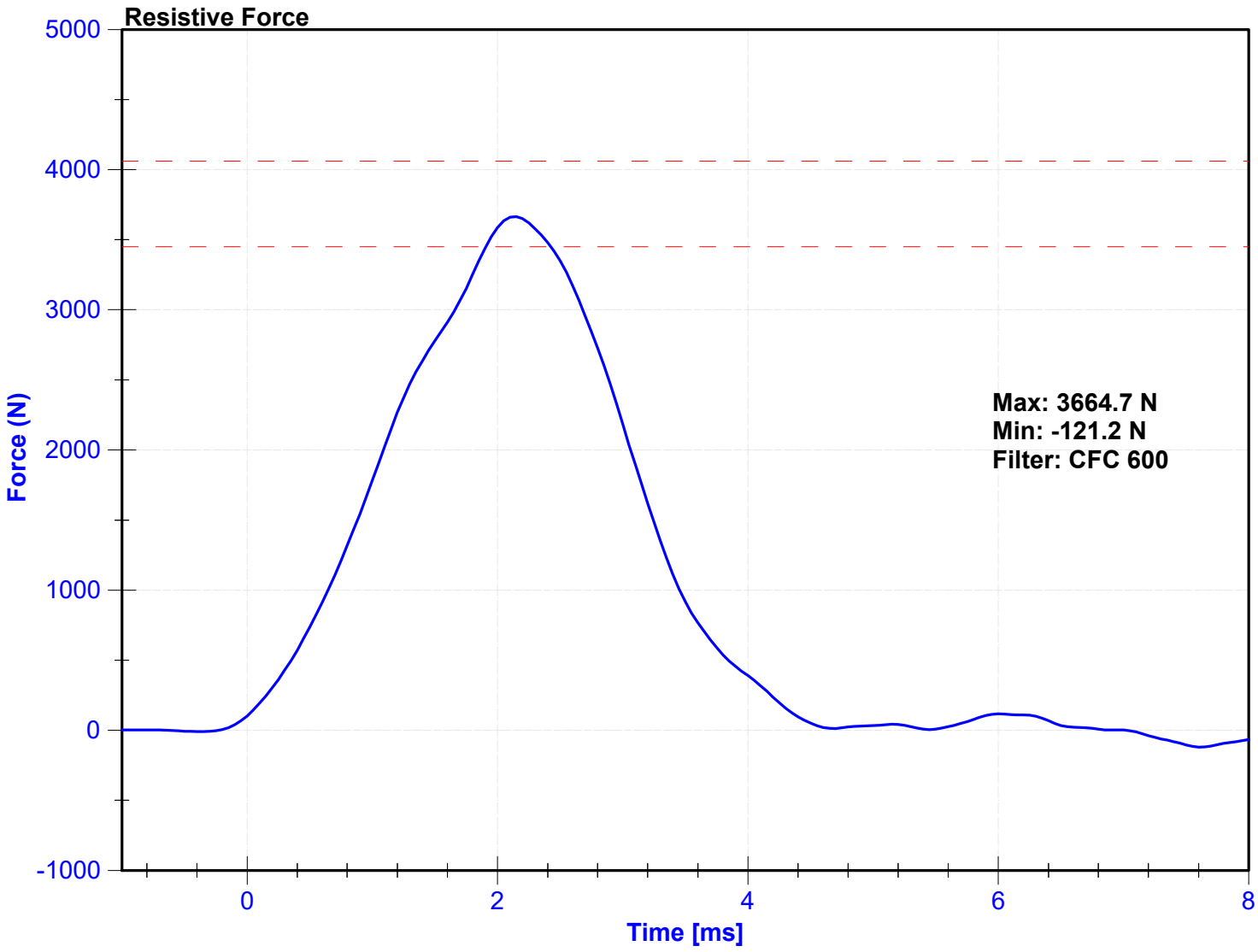
ATD Manufacturer	Humanetics	Test Technician	J. Rios
ATD Serial Number	143	Laboratory Supervisor	C. Mantell

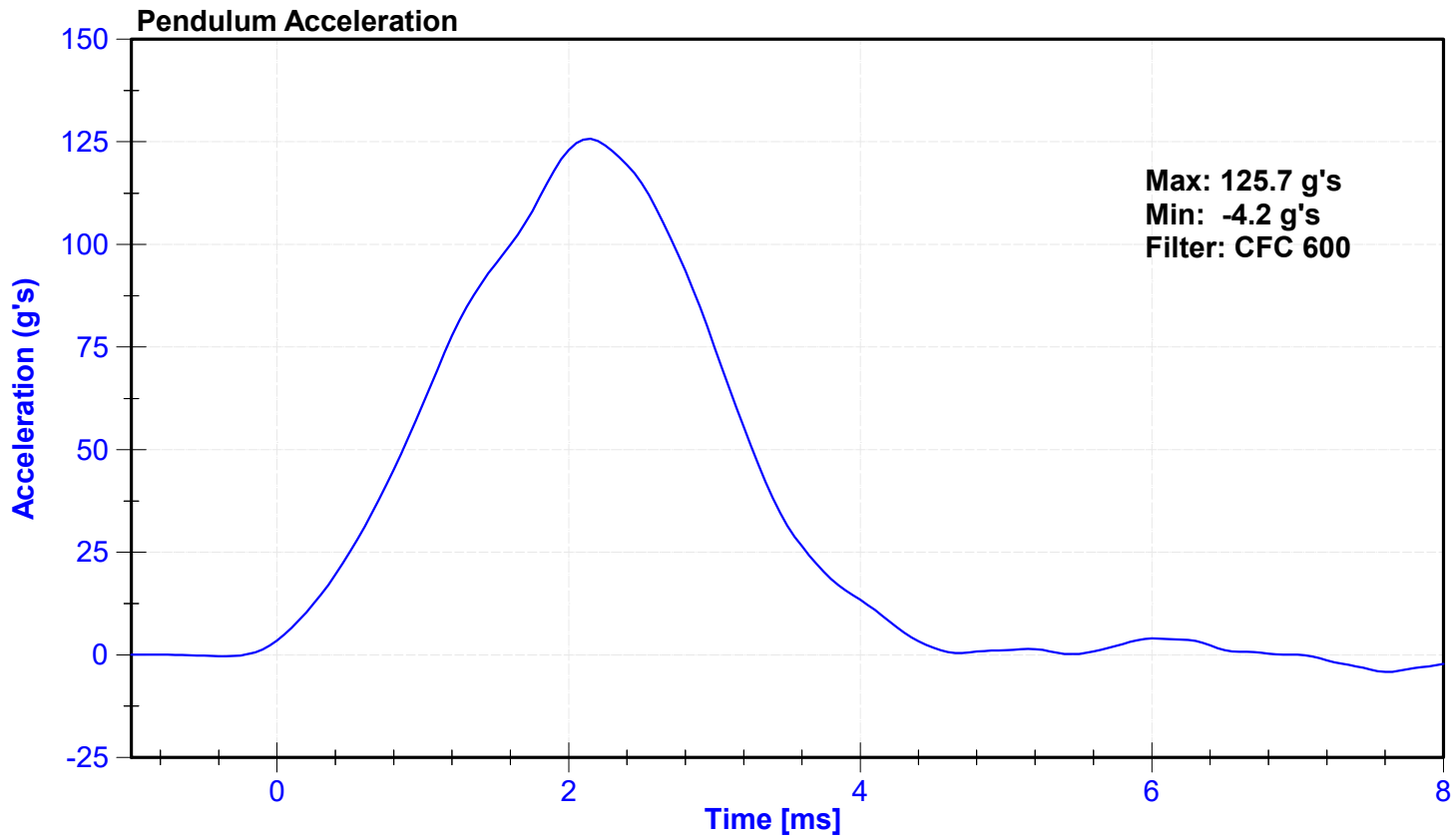
Results

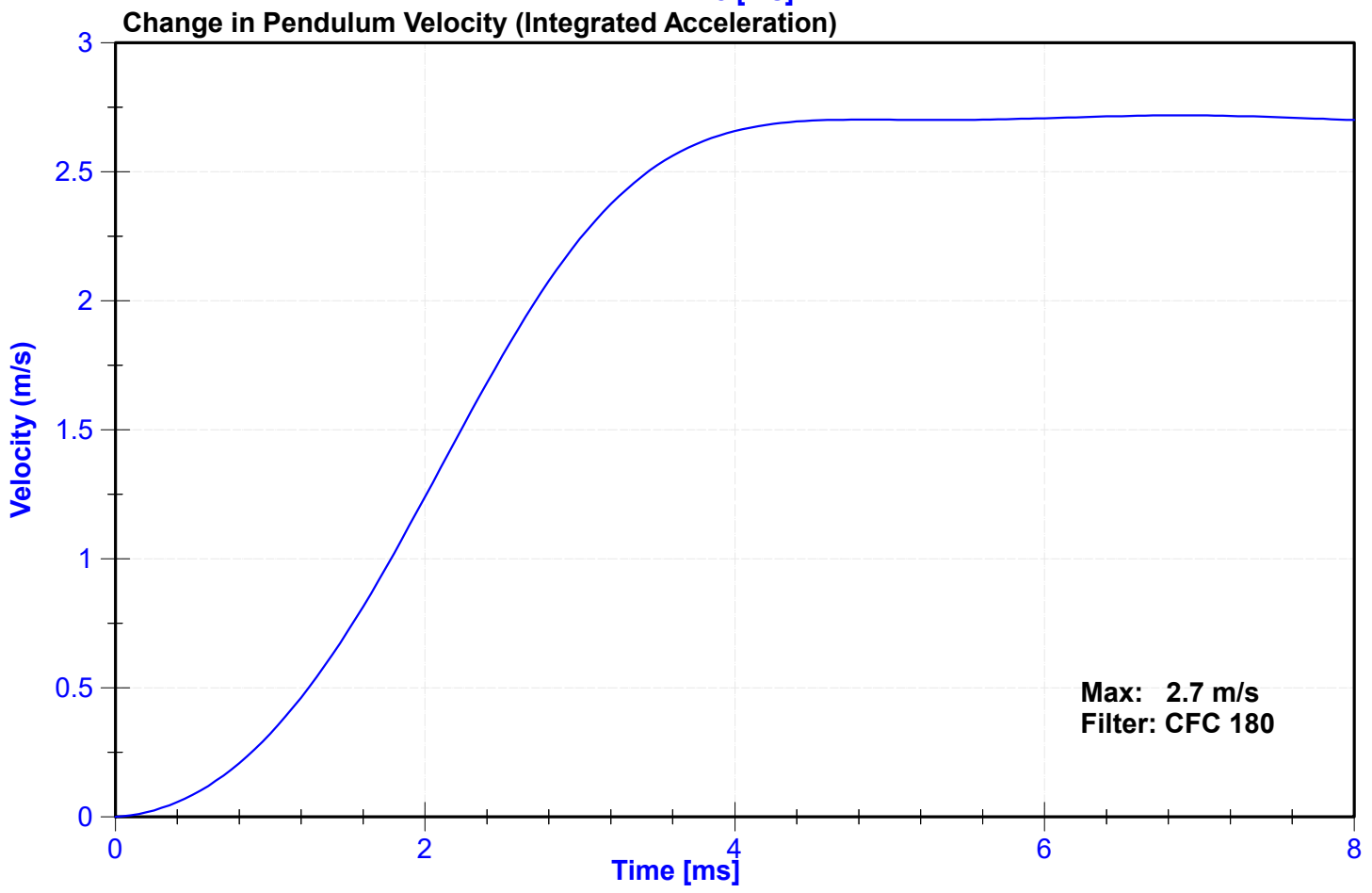
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	20.8	Pass
Humidity	10	70	%	41	Pass
Velocity	2.07	2.13	m/s	2.093	Pass
Resistive Force	3450	4060	N	3664.7	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18587	11/20/2023	11/19/2024




Pendulum Acceleration
Acceleration (g's)
150
125
100
75
50
25
0
-25
0
2
4
6
8
Time [ms]
Max: 125.7 g's
Min: -4.2 g's
Filter: CFC 600


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

CALIBRATION TEST RESULTS

POST-TEST

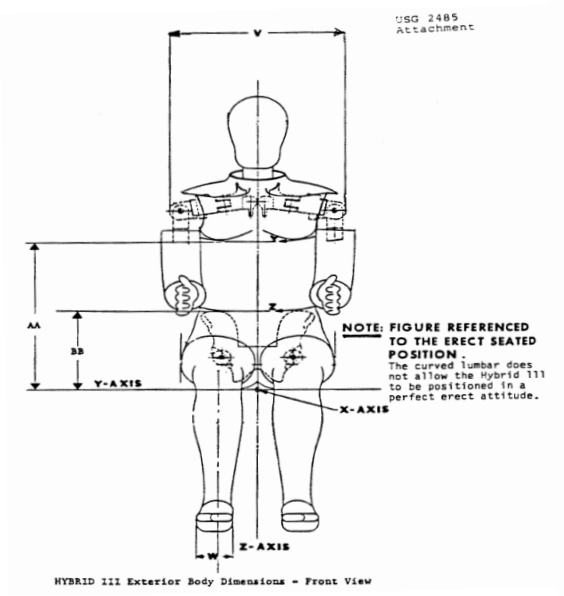
HYBRID III 50TH PERCENTILE MALE - DRIVER ATD

SERIAL NO: 065

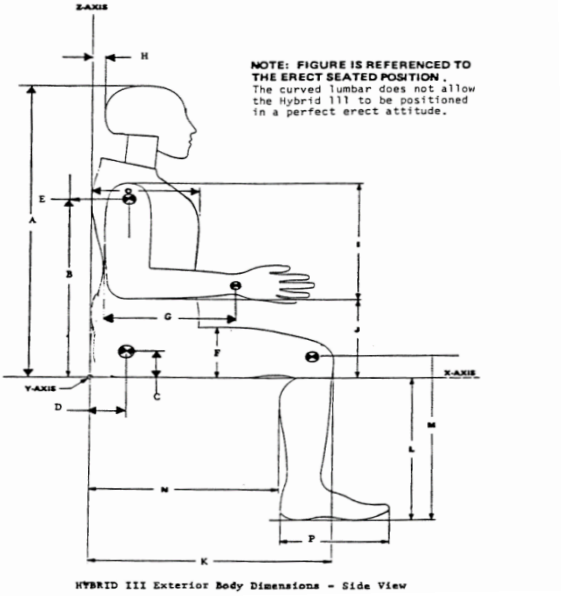
External Measurements - Hybrid 3 - 50th Male

Technician: J. Rios Date: 09/12/2024

Dummy Serial Number: 065



HYBRID III Exterior Body Dimensions - Front View



HYBRID III Exterior Body Dimensions - Side View

Symbol	Description	Specification (in)		Result (in)	Pass/Fail
A	Sitting Height	34.6	35.0	34.8	Pass
B	Shoulder Pivot Height	19.9	20.5	20.2	Pass
C	H-Point Height	3.3	3.5	3.4	Pass
D	H-Point from Backline	5.3	5.5	5.5	Pass
E	Shoulder Pivot from Backline	3.3	3.7	3.6	Pass
F	Thigh Clearance	5.5	6.1	5.9	Pass
G	Back of Elbow to Wrist Pivot	11.4	12.0	11.8	Pass
H	Head Back to Backline	1.6	1.8	1.7	Pass
I	Shoulder to Elbow Length	13.0	13.6	13.3	Pass
J	Elbow Rest Height	7.5	8.3	7.8	Pass
K	Buttock to Knee Length	22.8	23.8	23.4	Pass
L	Popliteal Height	16.9	17.9	17.4	Pass
M	Knee Pivot Height	19.1	19.7	19.3	Pass
N	Buttock Popliteal Length	17.8	18.8	18.3	Pass
O	Chest Depth without Jacket	8.4	9.0	8.7	Pass
P	Foot Length (right)	9.9	10.5	10.2	Pass
V	Shoulder Breadth	16.3	17.2	16.8	Pass
W	Foot Breadth	3.6	4.2	3.8	Pass
Y	Chest Circumference with Jacket	38.2	39.4	39.0	Pass
Z	Waist Circumference	32.9	34.1	33.5	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

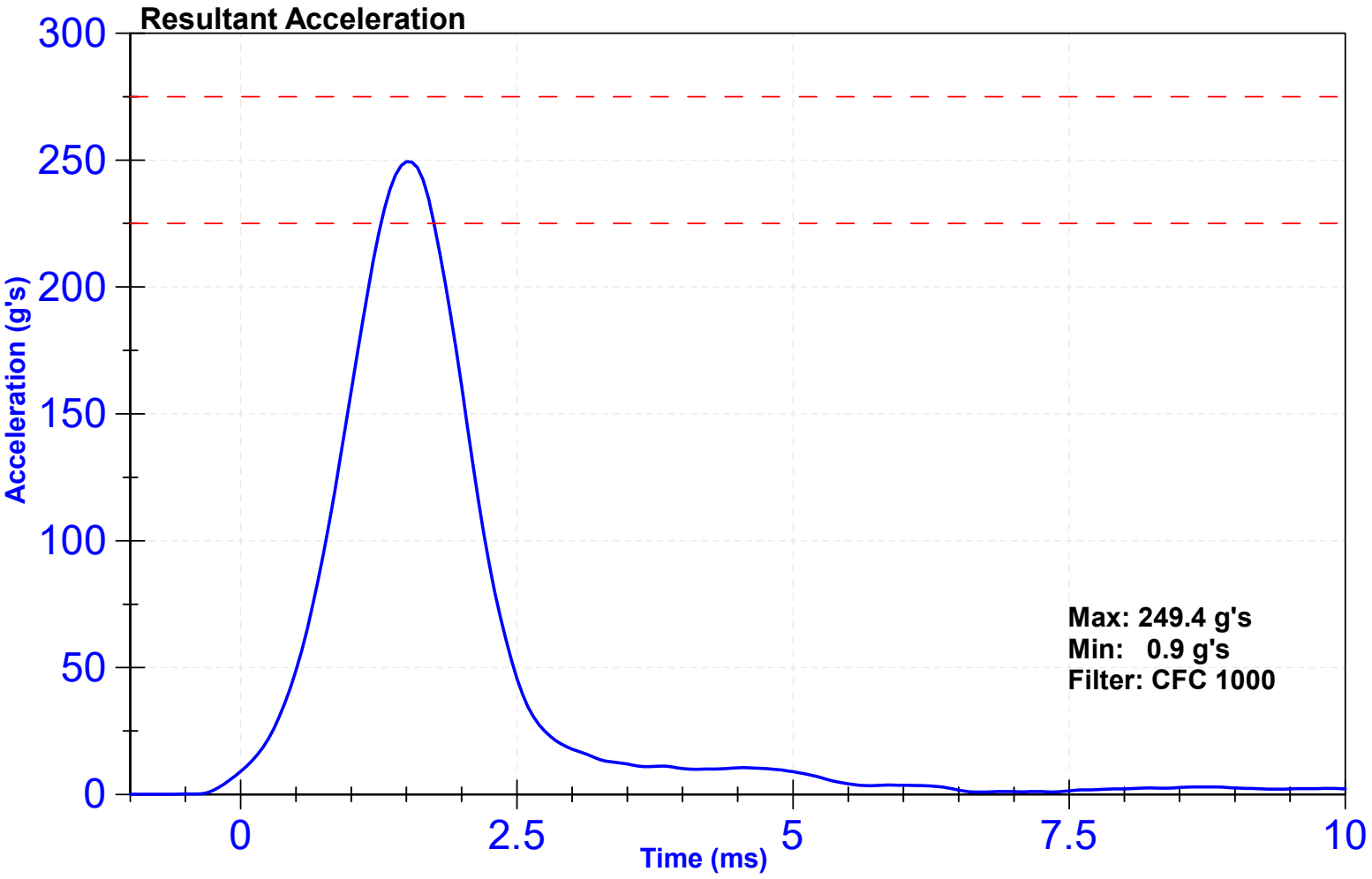
ATD Manufacturer	Humanetics	Test Technician	AG
ATD Serial Number	065	Laboratory Supervisor	ZP

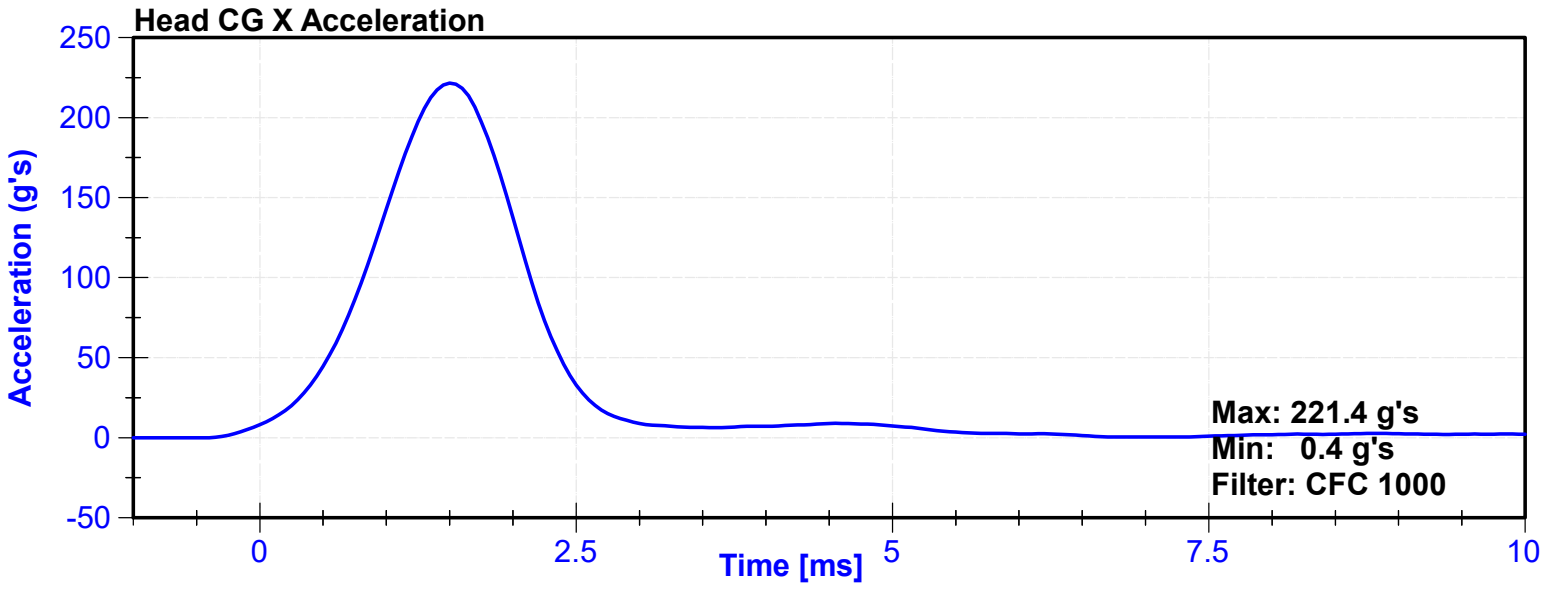
Results

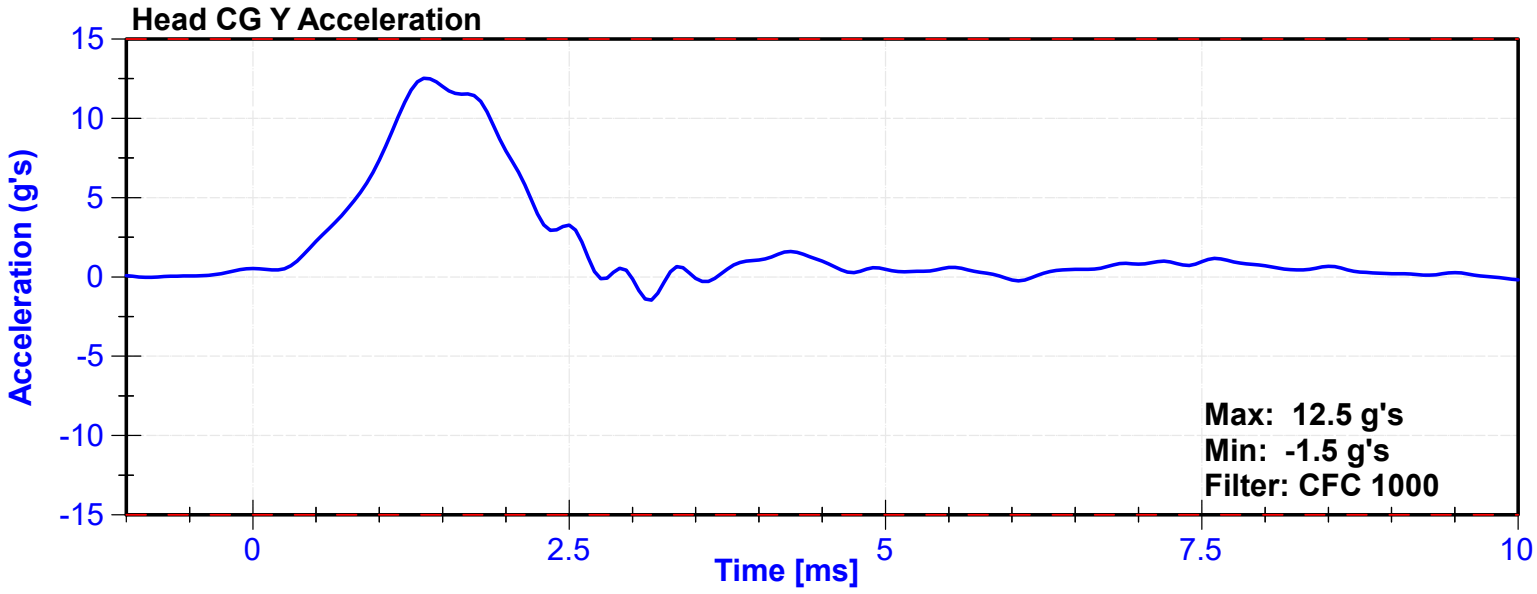
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.8	Pass
Humidity	10	70	%	48.1	Pass
Resultant Acceleration	225	275	g's	249.4	Pass
Oscillation	0	10	%	4.4	Pass
Lateral Acceleration	-15	15	g's	12.5	Pass

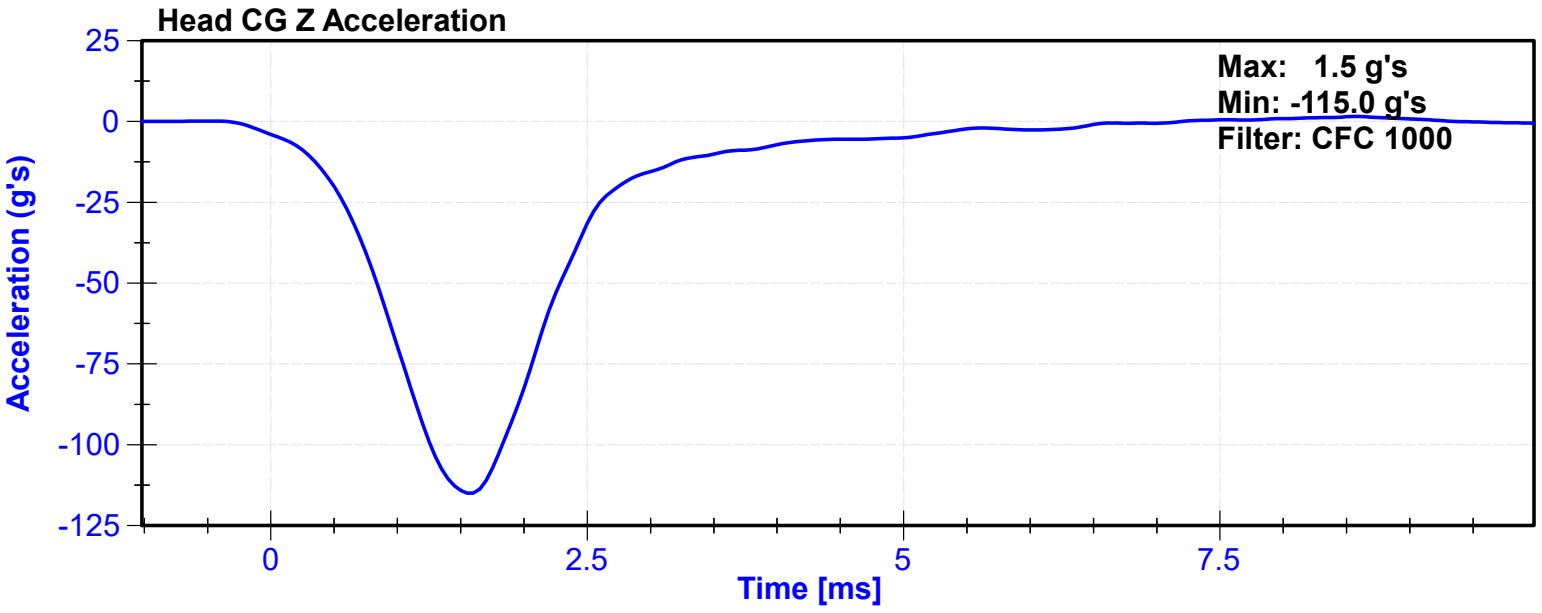
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	Endevco	P52383	9/9/2024	3/8/2025
Y Accelerometer	Measurement Specialties	A341256	9/9/2024	3/8/2025
Z Accelerometer	Endevco	P71303	9/9/2024	3/8/2025




Head CG X Acceleration
Acceleration (g's)
250
200
150
100
50
0
-50
0
2.5
5
7.5
10
Time [ms]
Max: 221.4 g's
Min: 0.4 g's
Filter: CFC 1000


Head CG Y Acceleration
Acceleration (g's)
15
10
5
0
-5
-10
-15
0
2.5
5
7.5
10
Time [ms]
Max: 12.5 g's
Min: -1.5 g's
Filter: CFC 1000


Head CG Z Acceleration
Acceleration (g's)
25
0
-25
-50
-75
-100
-125
0
2.5
5
7.5
Time [ms]
Max: 1.5 g's
Min: -115.0 g's
Filter: CFC 1000

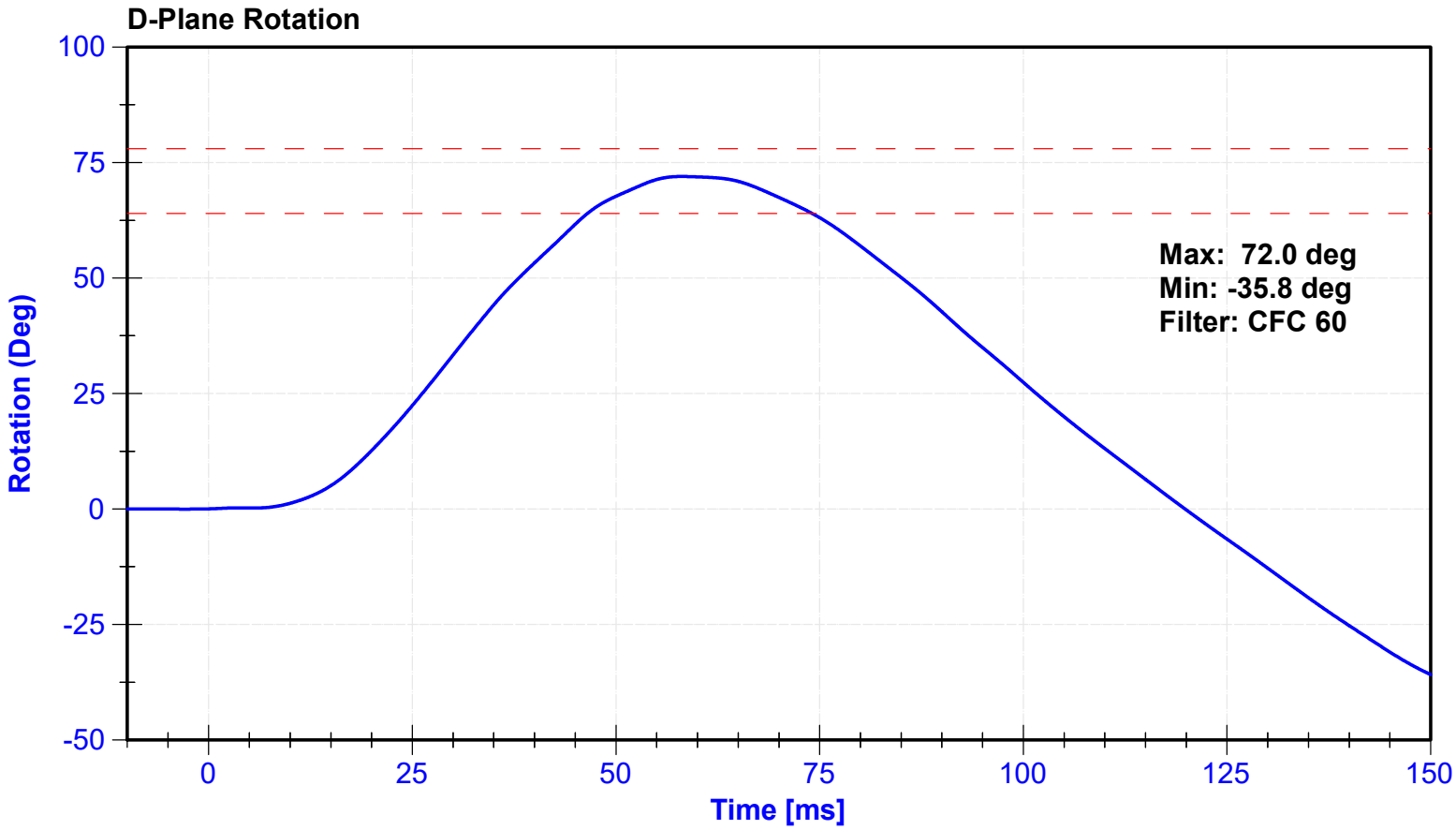
ATD Manufacturer	Humanetics	Test Technician	AG
ATD Serial Number	065	Laboratory Supervisor	ZP

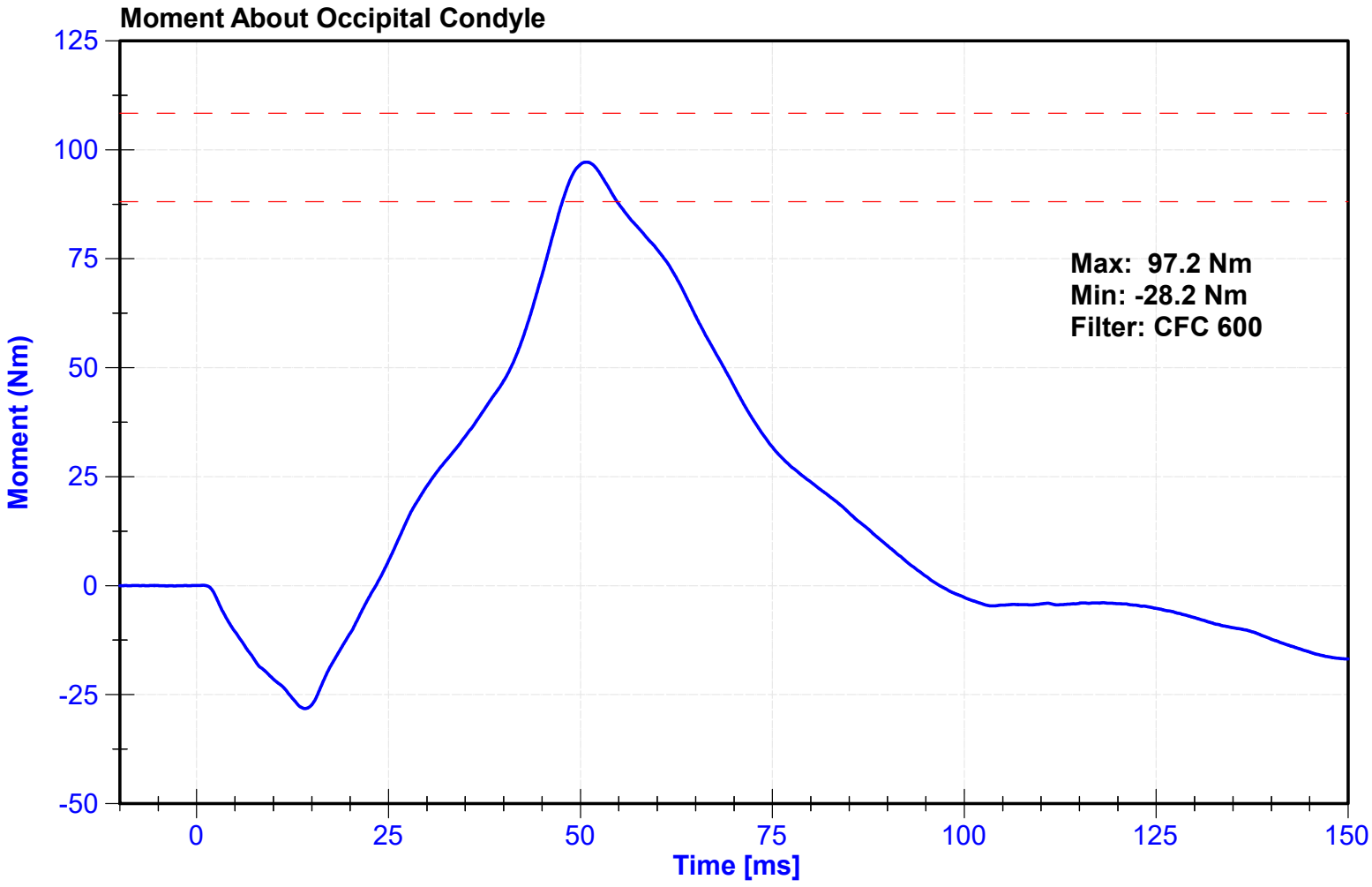
Results

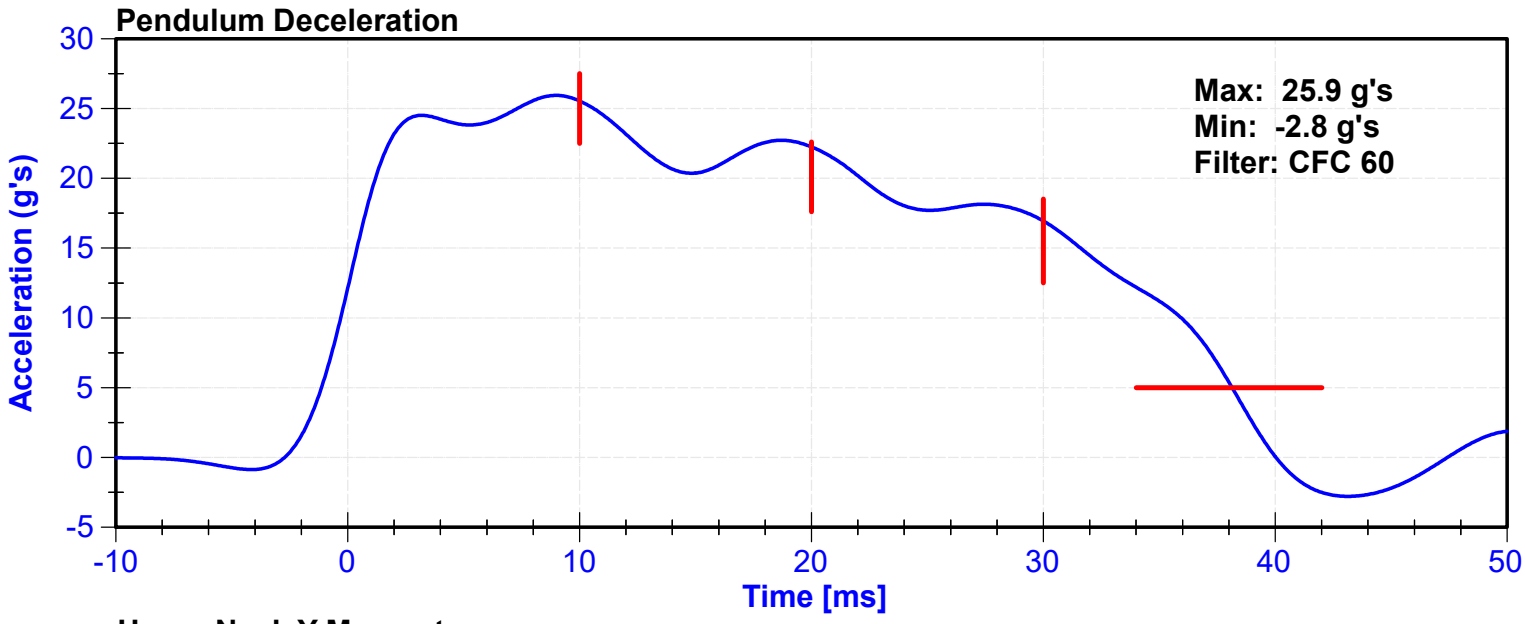
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.8	Pass
Humidity	10	70	%	48.1	Pass
Velocity	6.89	7.13	m/s	7.016	Pass
Pendulum Deceleration at 10ms	22.5	27.5	g's	25.53	Pass
Pendulum Deceleration at 20ms	17.6	22.6	g's	22.24	Pass
Pendulum Deceleration at 30ms	12.5	18.5	g's	16.93	Pass
Max. Pendulum Deceleration After 30ms	0	29	g's	25.9	Pass
Pendulum Deceleration Time to 5 g's	34	42	ms	38.2	Pass
Maximum D Plane Rotation	64	78	deg	72.0	Pass
Time to Maximum Rotation	57	64	ms	58.1	Pass
Rotation Decay to Zero	113	127	ms	119.9	Pass
Moment About Occipital Condyle	88.1	108.4	Nm	97.19	Pass
Time to Maximum Moment	47	58	ms	50.8	Pass
Moment Decay to Zero	97	107	ms	97.1	Pass

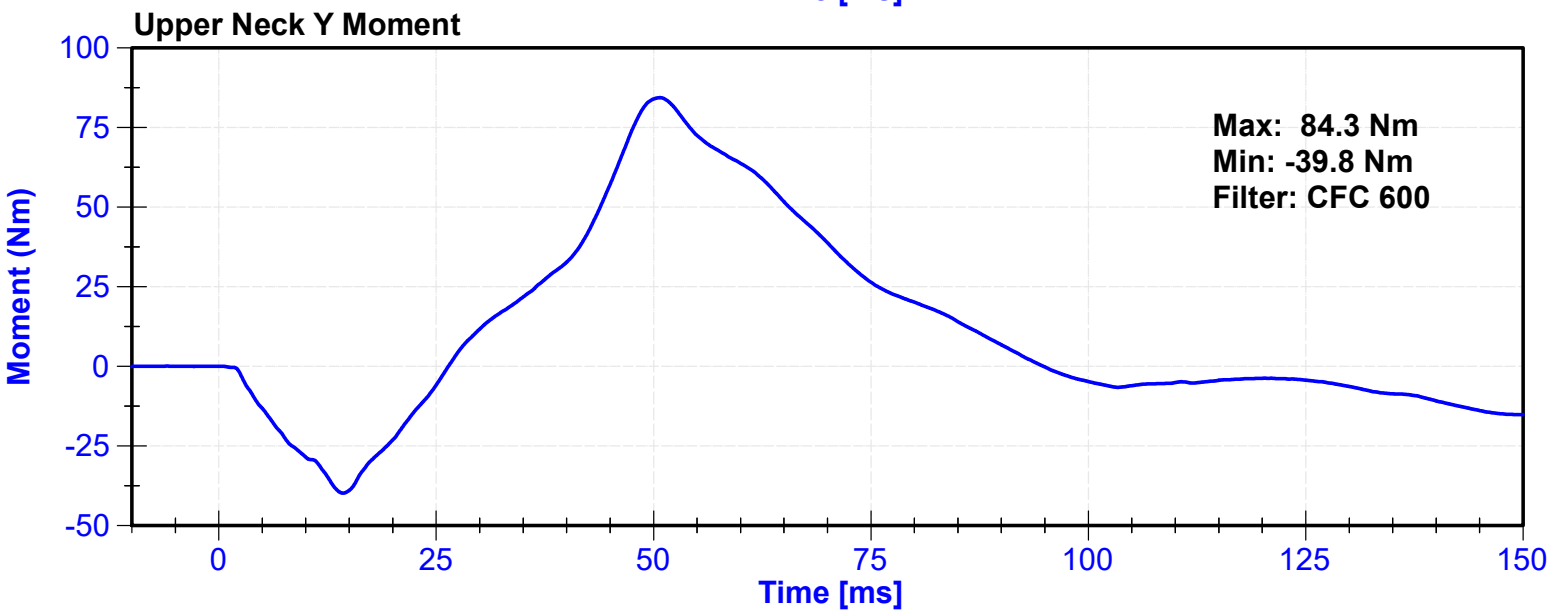
Transducer Calibrations

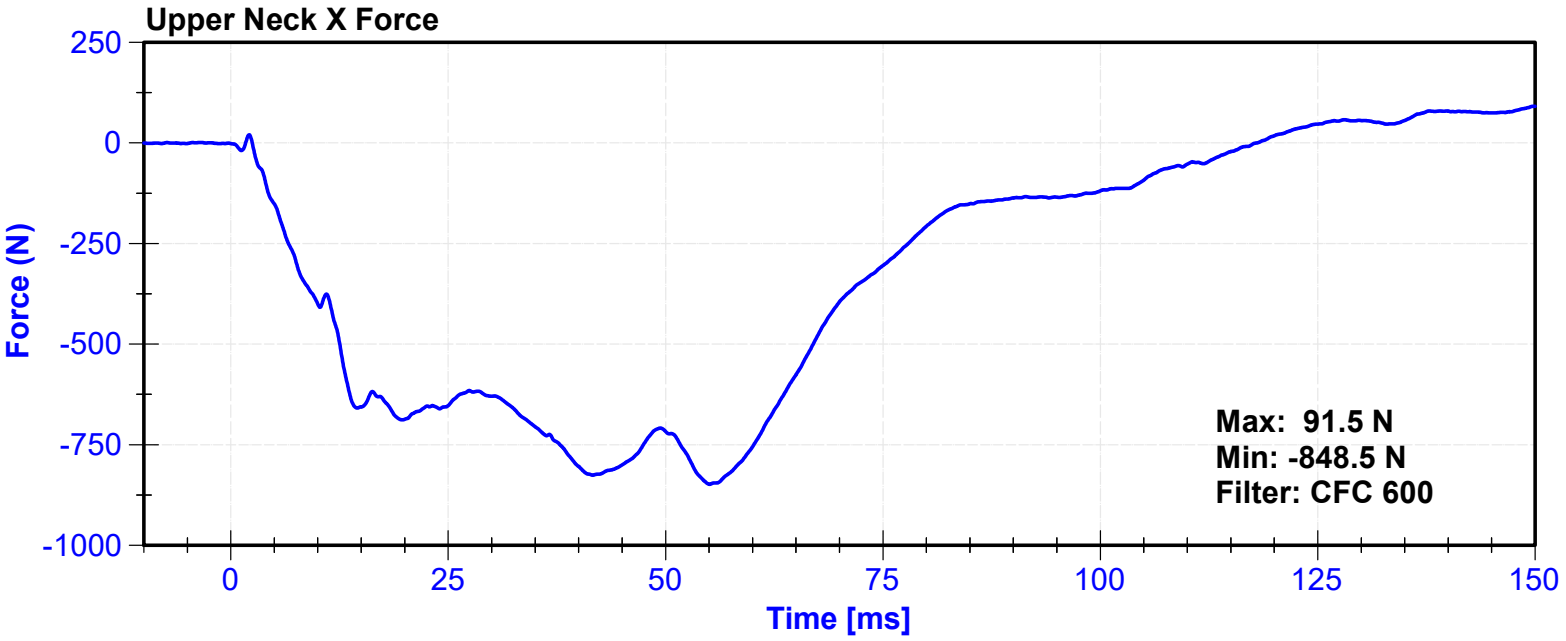
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	C16678	8/29/2024	2/25/2025
Pendulum Potentiometer	ETI	1412	12/18/2023	12/17/2024
Condyle Potentiometer	ETI	1911	12/18/2023	12/17/2024
Upper Neck Load Cell	Denton	1629-FX	12/8/2023	12/7/2024


D-Plane Rotation
Rotation (Deg)
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]
Max: 72.0 deg
Min: -35.8 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: 97.2 Nm
Min: -28.2 Nm
Filter: CFC 600


Pendulum Deceleration
Max: 25.9 g's
Min: -2.8 g's
Filter: CFC 60
Acceleration (g's)
Time [ms]


Upper Neck Y Moment
Max: 84.3 Nm
Min: -39.8 Nm
Filter: CFC 600
Moment (Nm)
Time [ms]


Upper Neck X Force
Max: 91.5 N
Min: -848.5 N
Filter: CFC 600
Force (N)
Time [ms]

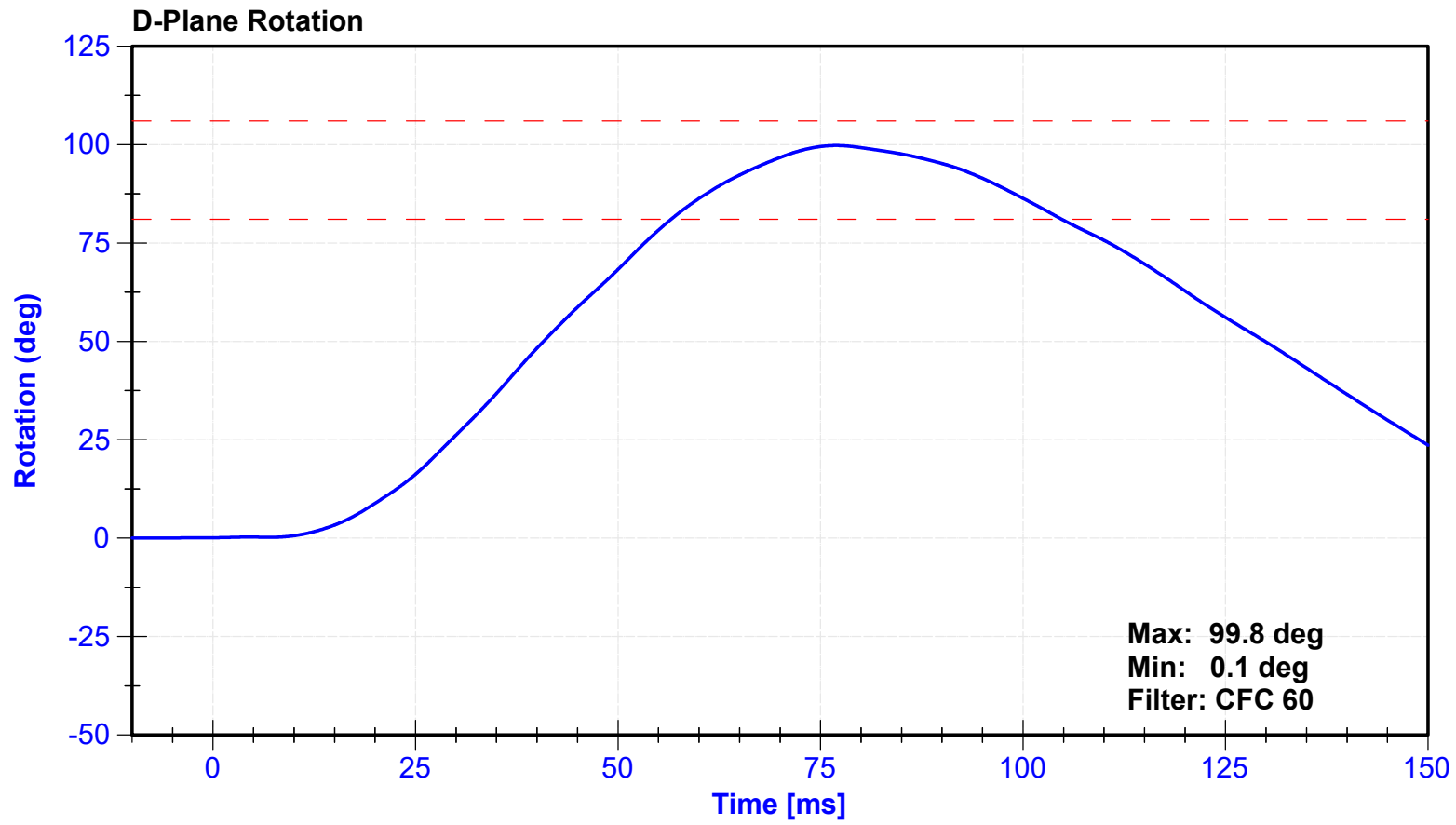
ATD Manufacturer	Humanetics	Test Technician	AG
ATD Serial Number	065	Laboratory Supervisor	ZP

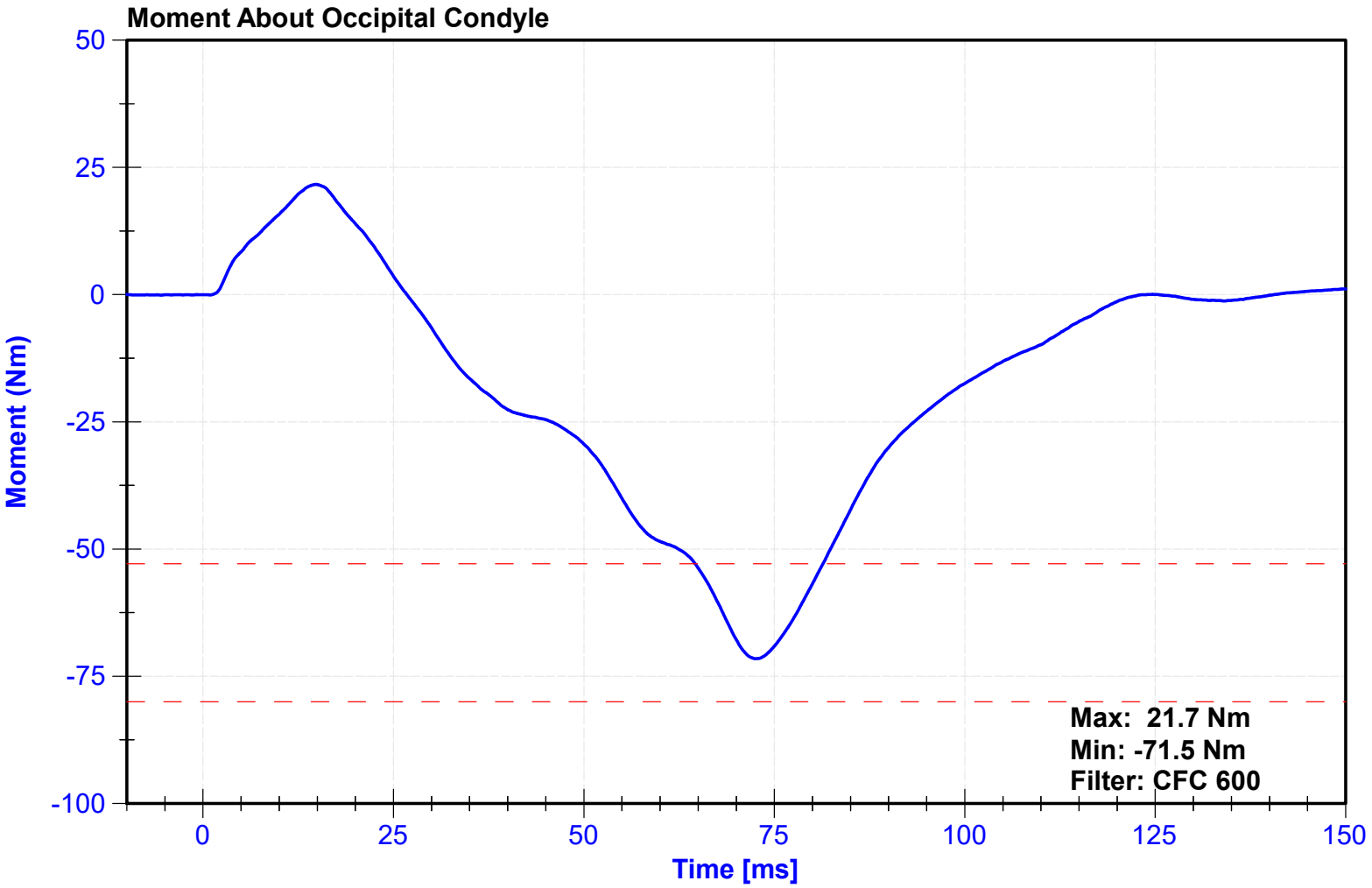
Results

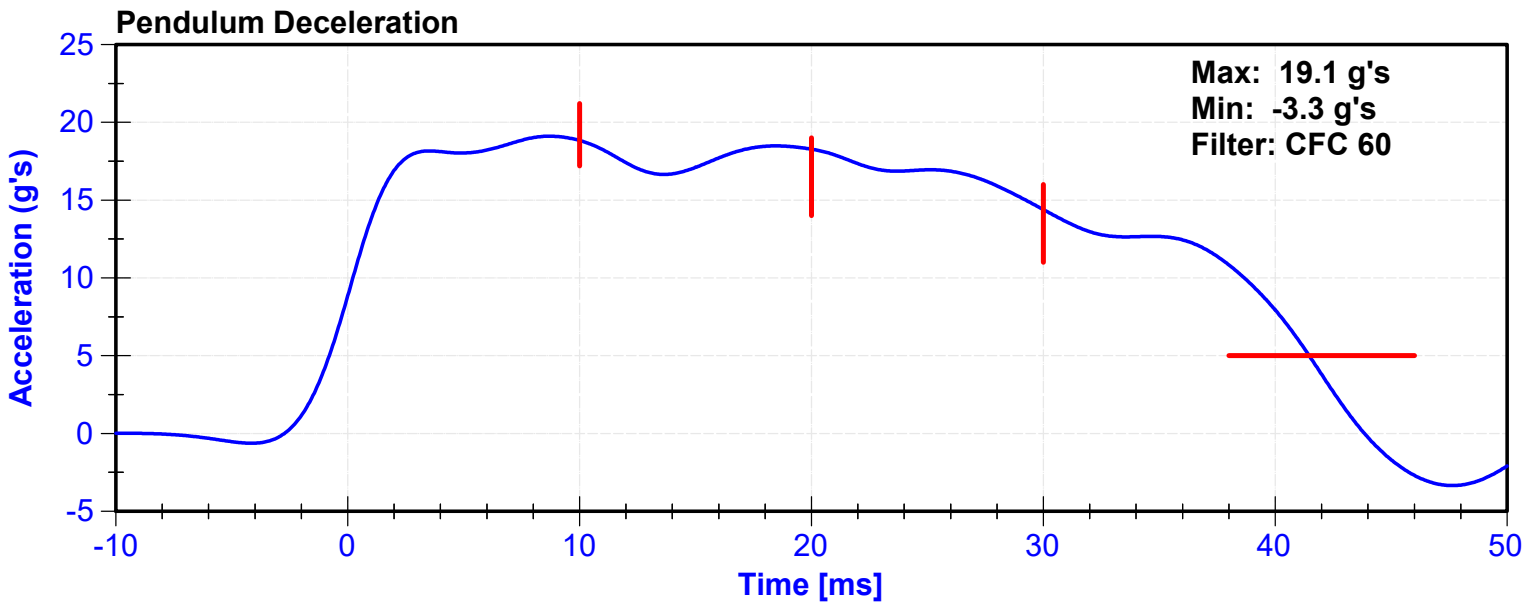
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.8	Pass
Humidity	10	70	%	48.1	Pass
Velocity	5.94	6.19	m/s	6.132	Pass
Pendulum Deceleration at 10ms	17.2	21.2	g's	18.83	Pass
Pendulum Deceleration at 20ms	14	19	g's	18.3	Pass
Pendulum Deceleration at 30ms	11	16	g's	14.4	Pass
Max. Pendulum Deceleration After 30ms	0	22	g's	19.1	Pass
Pendulum Deceleration Time to 5 g's	38	46	ms	41.5	Pass
Maximum D Plane Rotation	81	106	deg	99.8	Pass
Time to Maximum Rotation	72	82	ms	76.9	Pass
Rotation Decay to Zero	147	174	ms	169.5	Pass
Minimum Moment About OC	-80	-52.9	Nm	-71.53	Pass
Time to Minimum Moment	65	79	ms	72.5	Pass
Moment Decay to Zero	120	148	ms	123.9	Pass

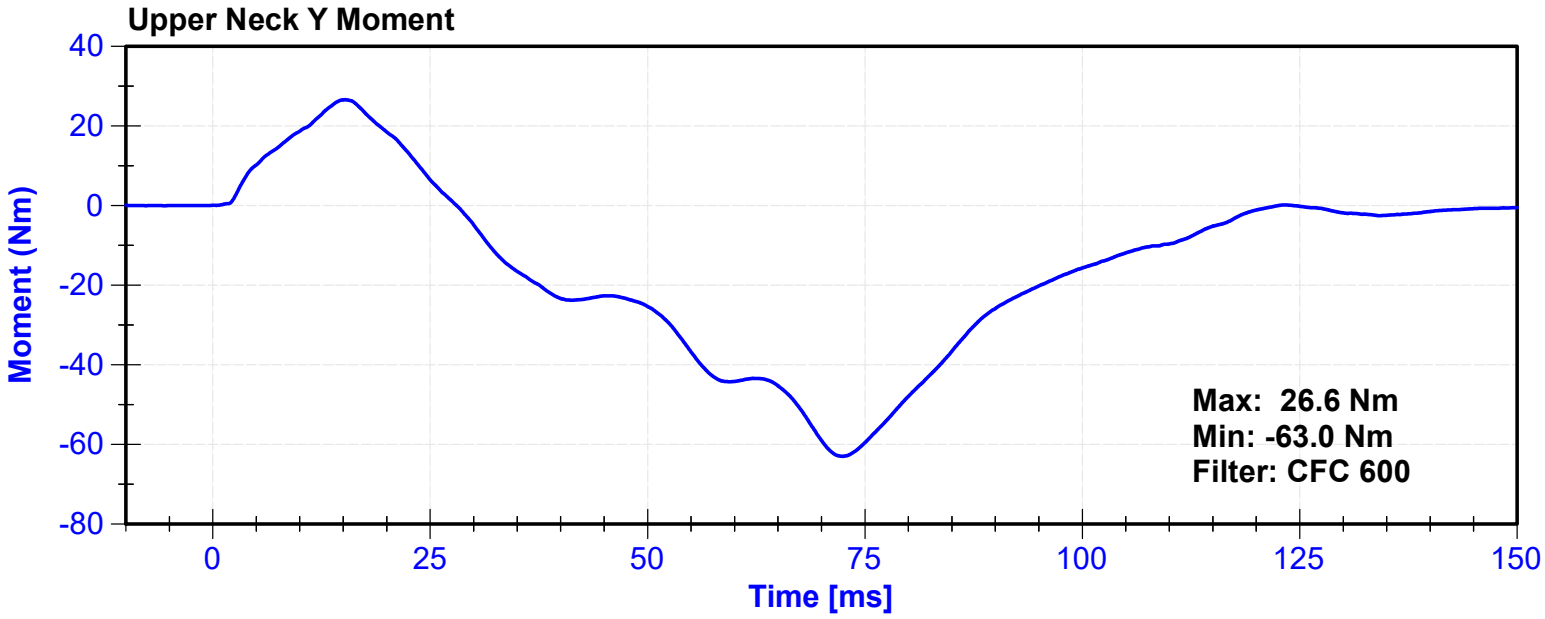
Transducer Calibrations

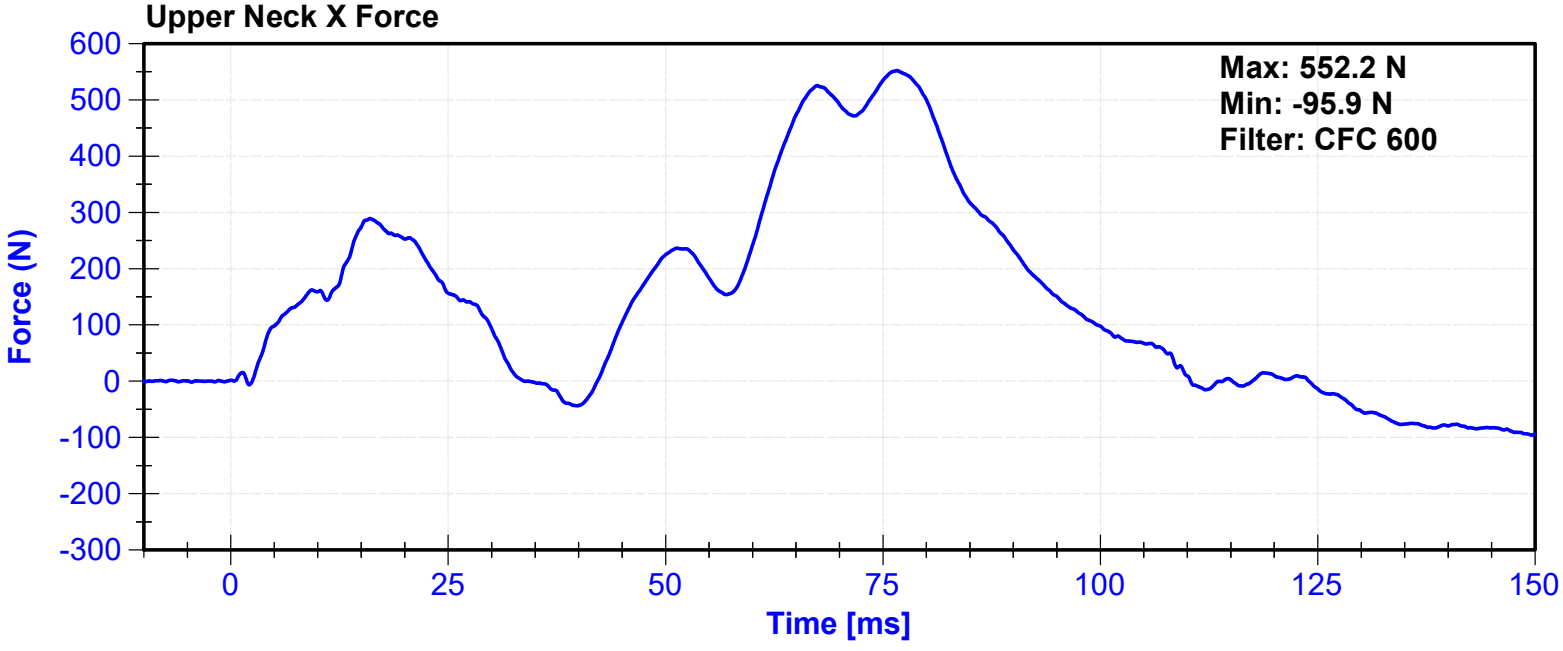
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	C16678	8/29/2024	2/25/2025
Pendulum Potentiometer	ETI	SP22G_1412	12/18/2023	12/17/2024
Condyle Potentiometer	ETI	SP22G_1911	12/18/2023	12/17/2024
Upper Neck Load Cell	Denton	1629-FX	12/8/2023	12/7/2024


D-Plane Rotation
Rotation (deg)
125
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]
Max: 99.8 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: 21.7 Nm
Min: -71.5 Nm
Filter: CFC 600


Pendulum Deceleration
Max: 19.1 g's
Min: -3.3 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: 26.6 Nm
Min: -63.0 Nm
Filter: CFC 600
Moment (Nm)
40
20
0
-20
-40
-60
-80
0
25
50
75
100
125
150
Time [ms]


Upper Neck X Force
Max: 552.2 N
Min: -95.9 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]

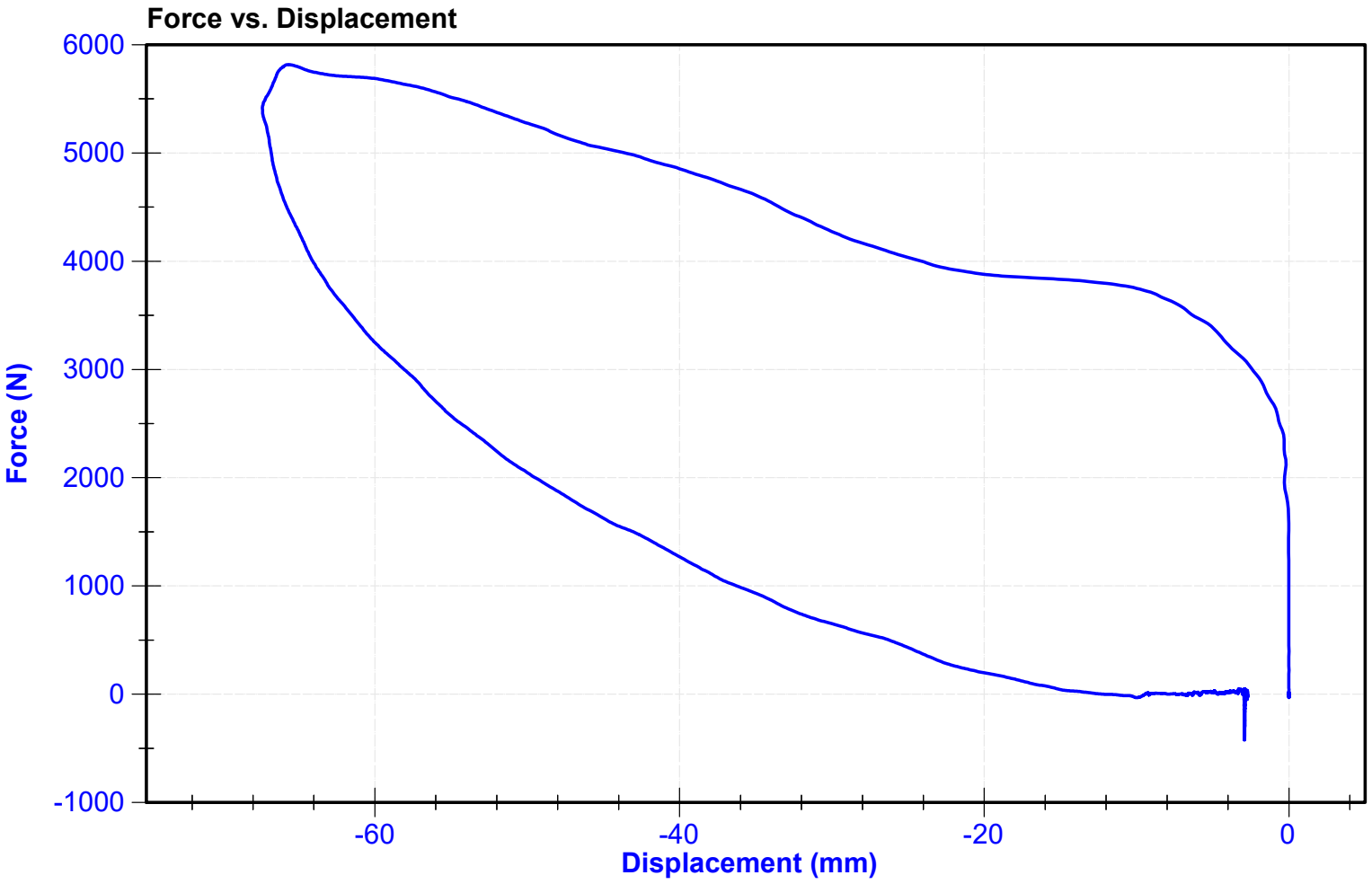
ATD Manufacturer	Humanetics	Test Technician	AG
ATD Serial Number	065	Laboratory Supervisor	ZP

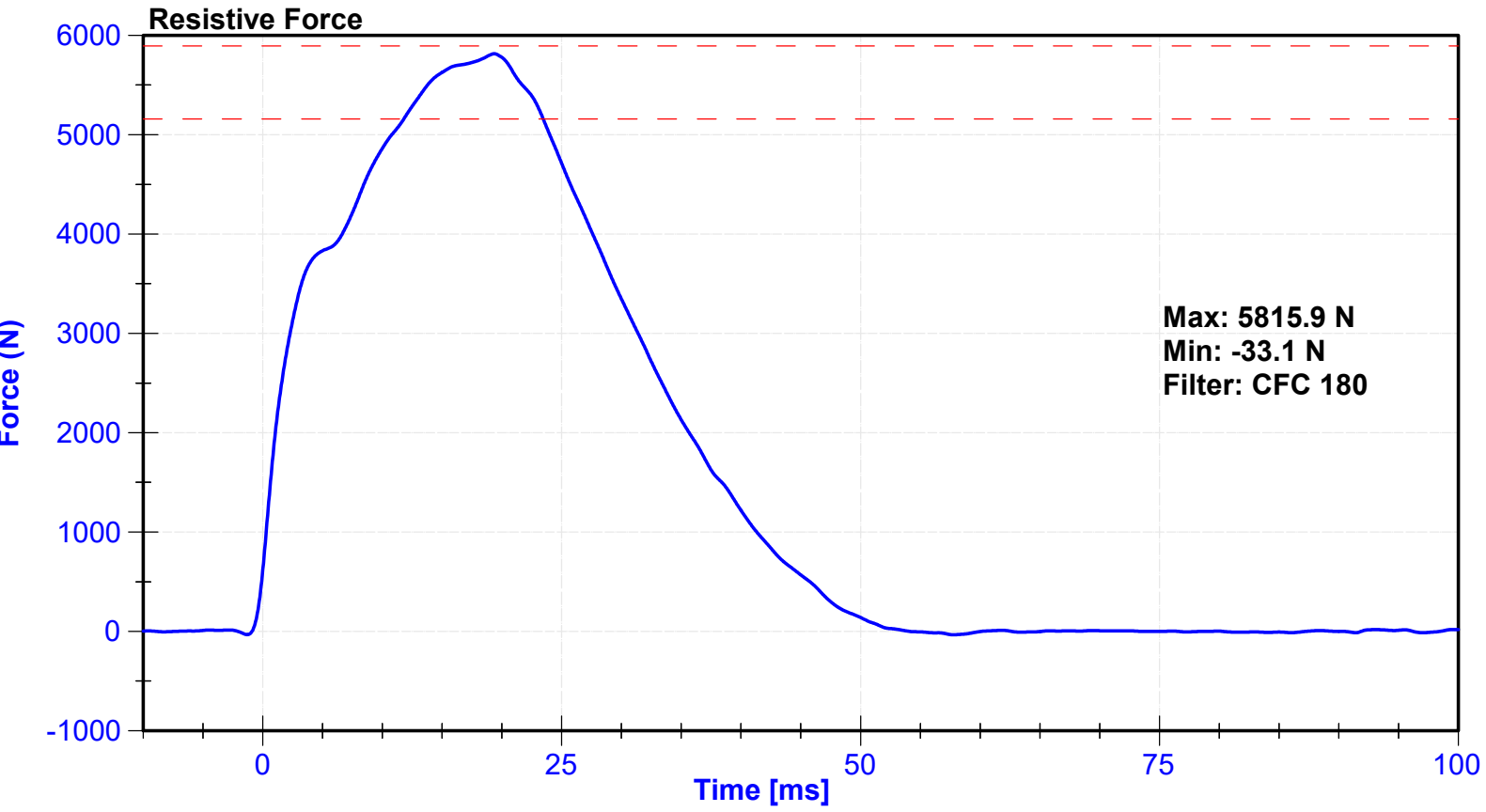
Results

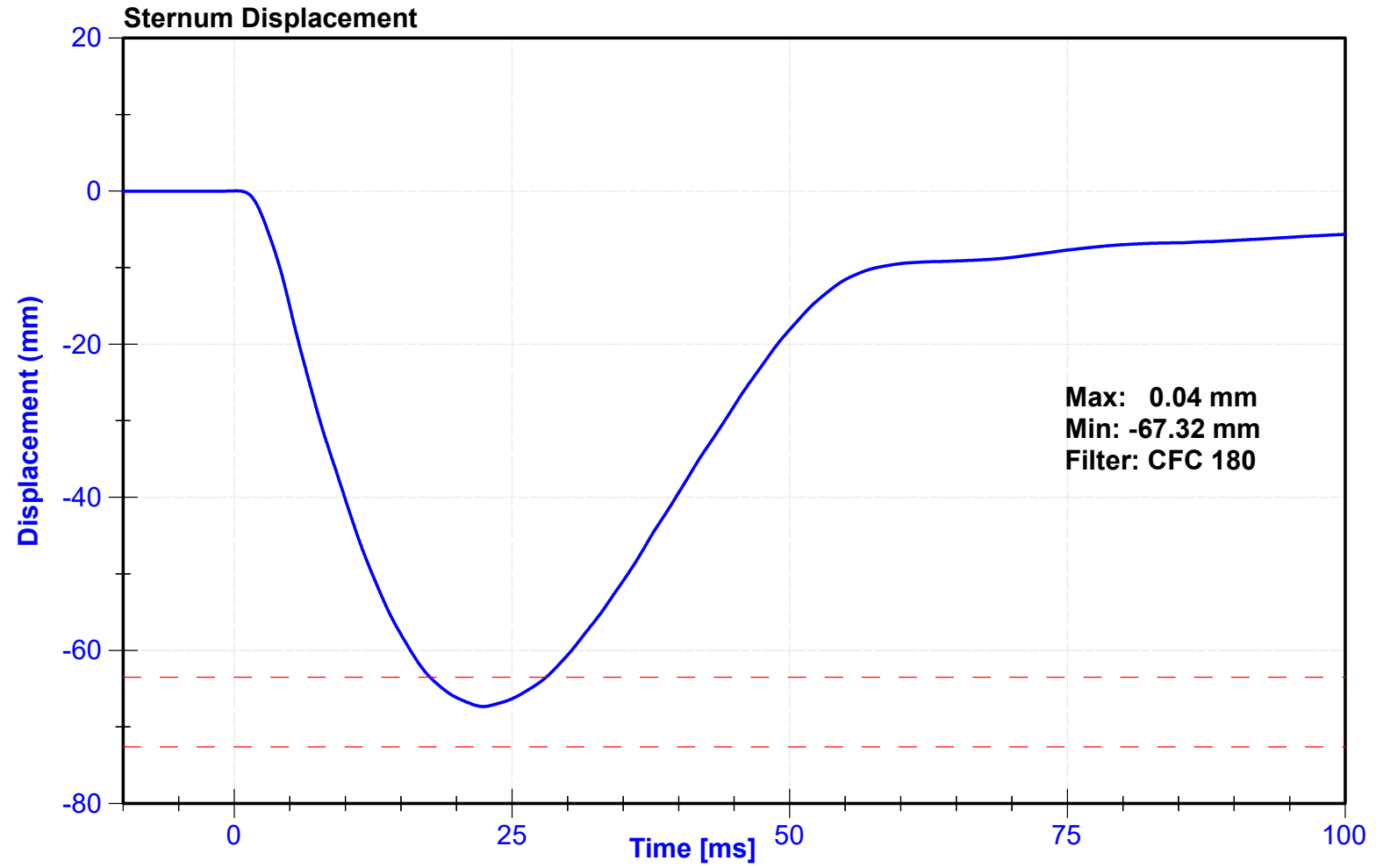
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	22.1	Pass
Humidity	10	70	%	42.8	Pass
Velocity	6.59	6.83	m/s	6.713	Pass
Chest Displacement	-72.6	-63.5	mm	-67.32	Pass
Resistive Force	5160	5894	N	5815.9	Pass
Hysteresis	69	85	%	71.7	Pass

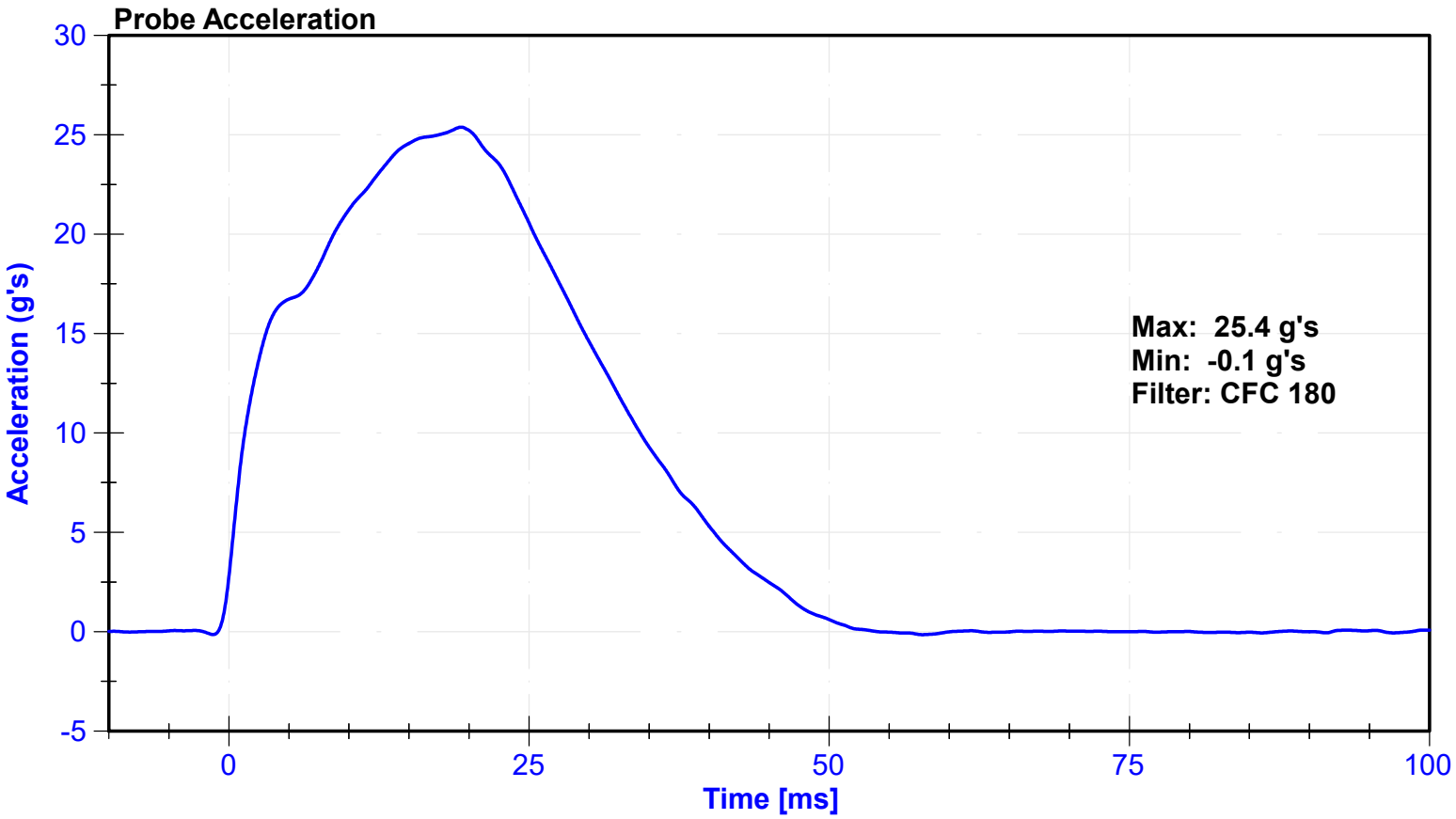
Transducer Calibrations

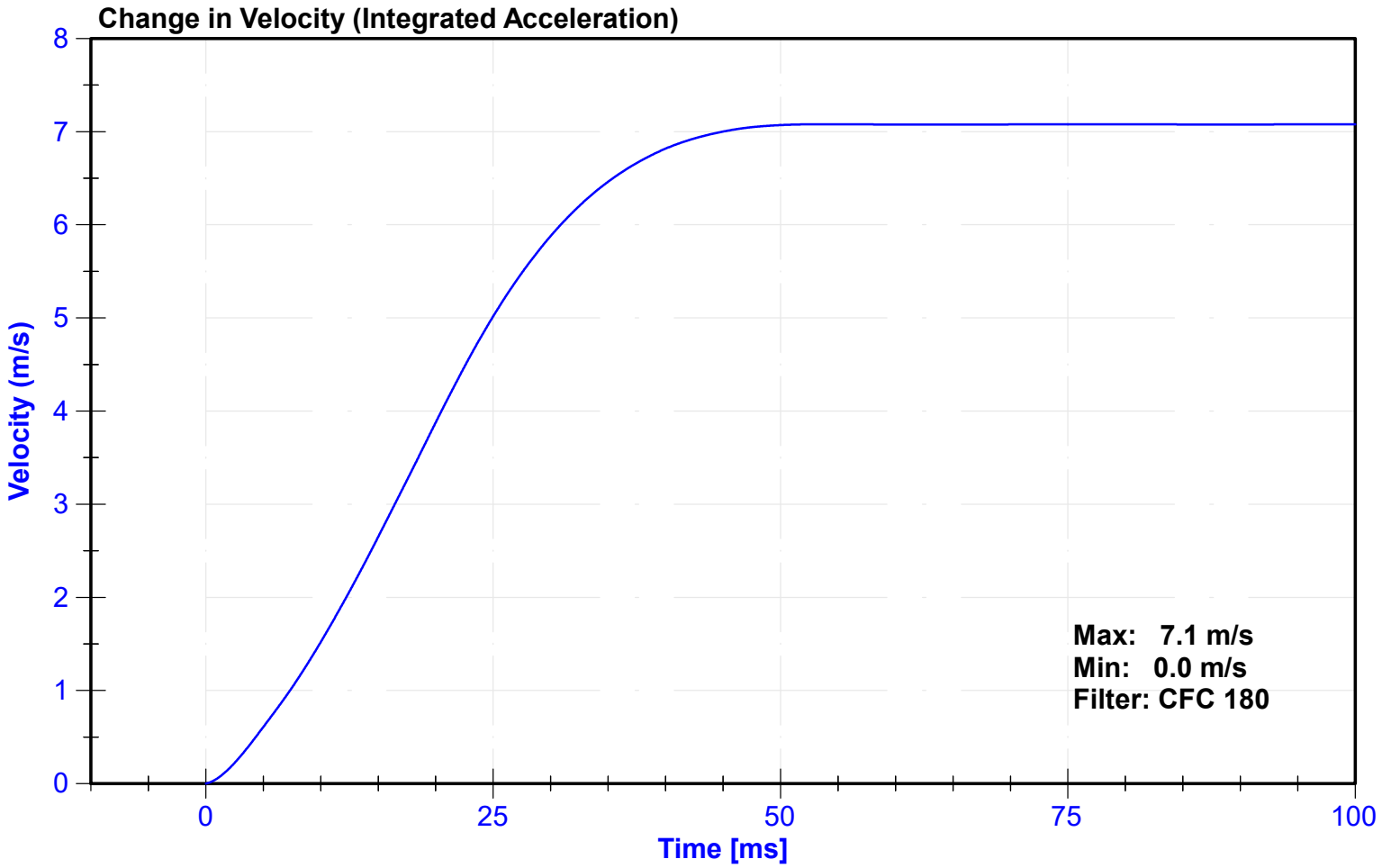
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	T31053	8/21/2023	2/17/2024
Chest Potentiometer	Servo	1046	4/30/2024	10/29/2024




Resistive Force
Force (N)
6000
5000
4000
3000
2000
1000
0
-1000
0
25
50
75
100
Time [ms]
Max: 5815.9 N
Min: -33.1 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: -67.32 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: 25.4 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

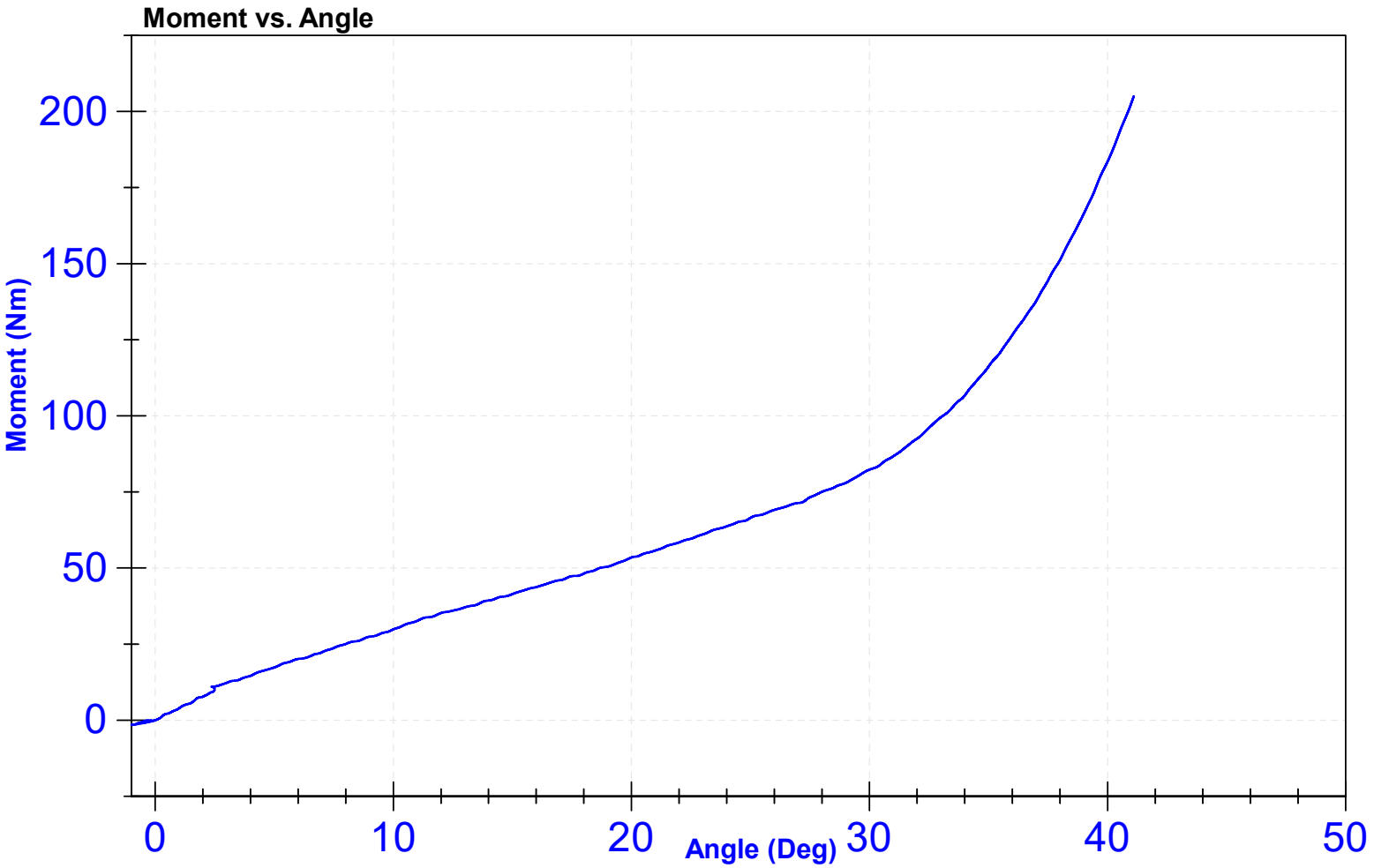
ATD Manufacturer	Humanetics	Test Technician	AG
ATD Serial Number	065	Laboratory Supervisor	ZP

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.7	Pass
Humidity	10	70	%	44.2	Pass
Average Velocity	5	10	deg/s	7.0	Pass
Angle at 203Nm	40	50	deg	41.0	Pass
Moment at 30 degrees	0	94.9	Nm	82.3	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	Servo 14CB1-3615	3203	11/16/2023	11/15/2024
Load Cell	PCB 2301-02A	111	2023-09-21	2024-09-20



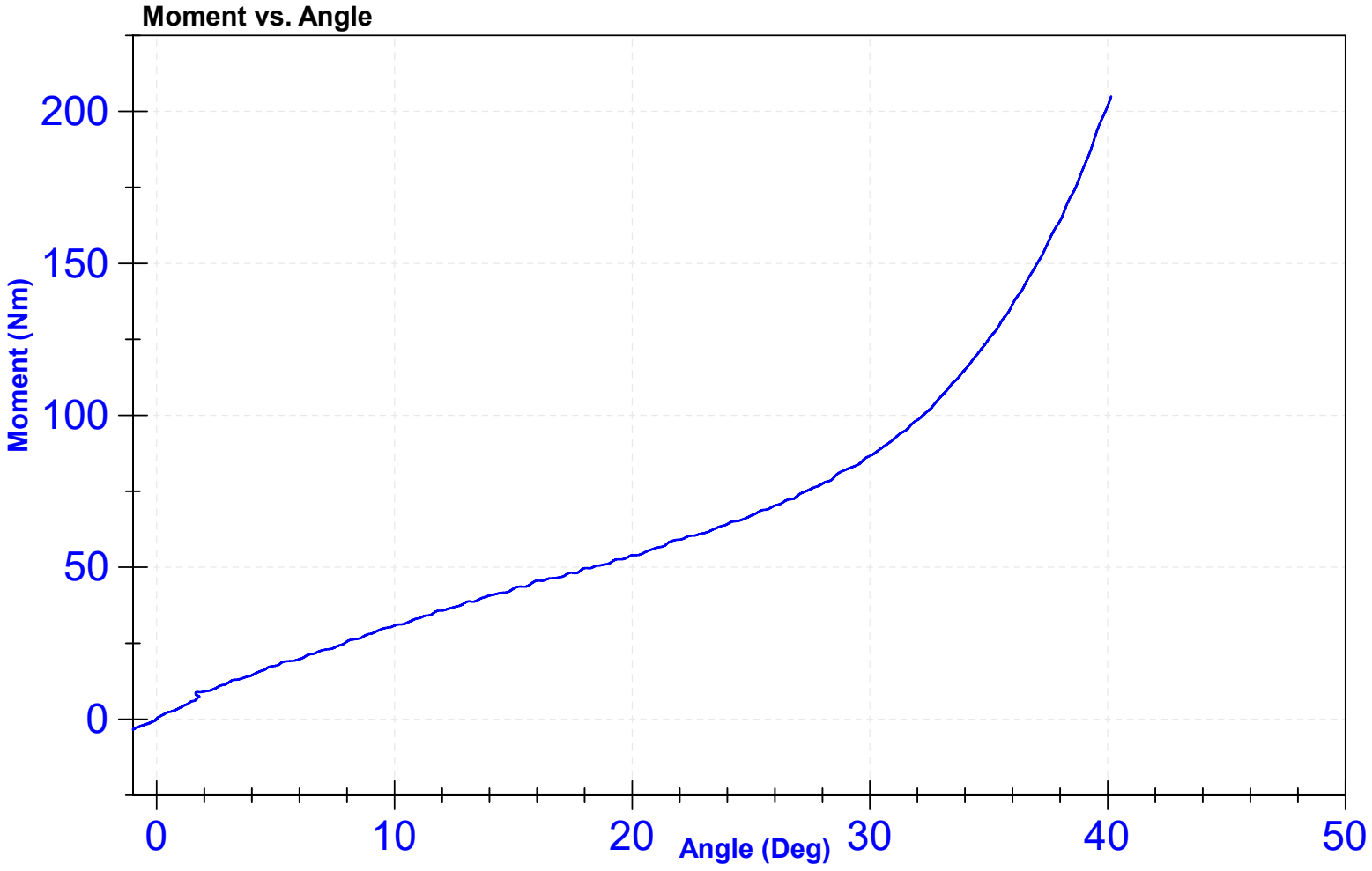
ATD Manufacturer	Humanetics	Test Technician	AG
ATD Serial Number	065	Laboratory Supervisor	ZP

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.7	Pass
Humidity	10	70	%	44.2	Pass
Average Velocity	5	10	deg/s	6.8	Pass
Angle at 203Nm	40	50	deg	40.1	Pass
Moment at 30 degrees	0	94.9	Nm	86.7	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	Servo 14CB1-3615	3203	11/16/2023	11/15/2024
Load Cell	PCB 2301-02A	111	2023-09-21	2024-09-20



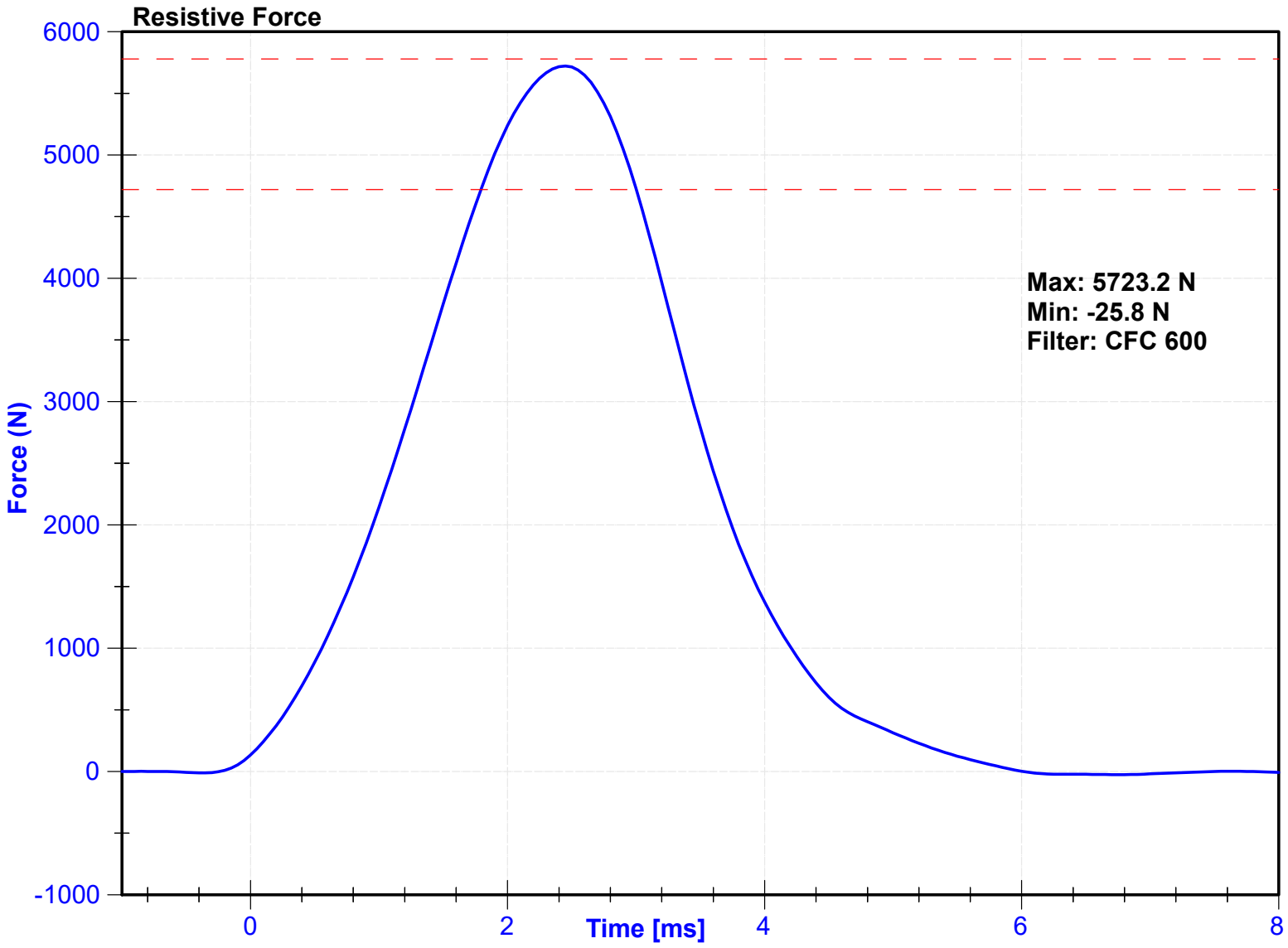
ATD Manufacturer	Humanetics	Test Technician	AG
ATD Serial Number	065	Laboratory Supervisor	ZP

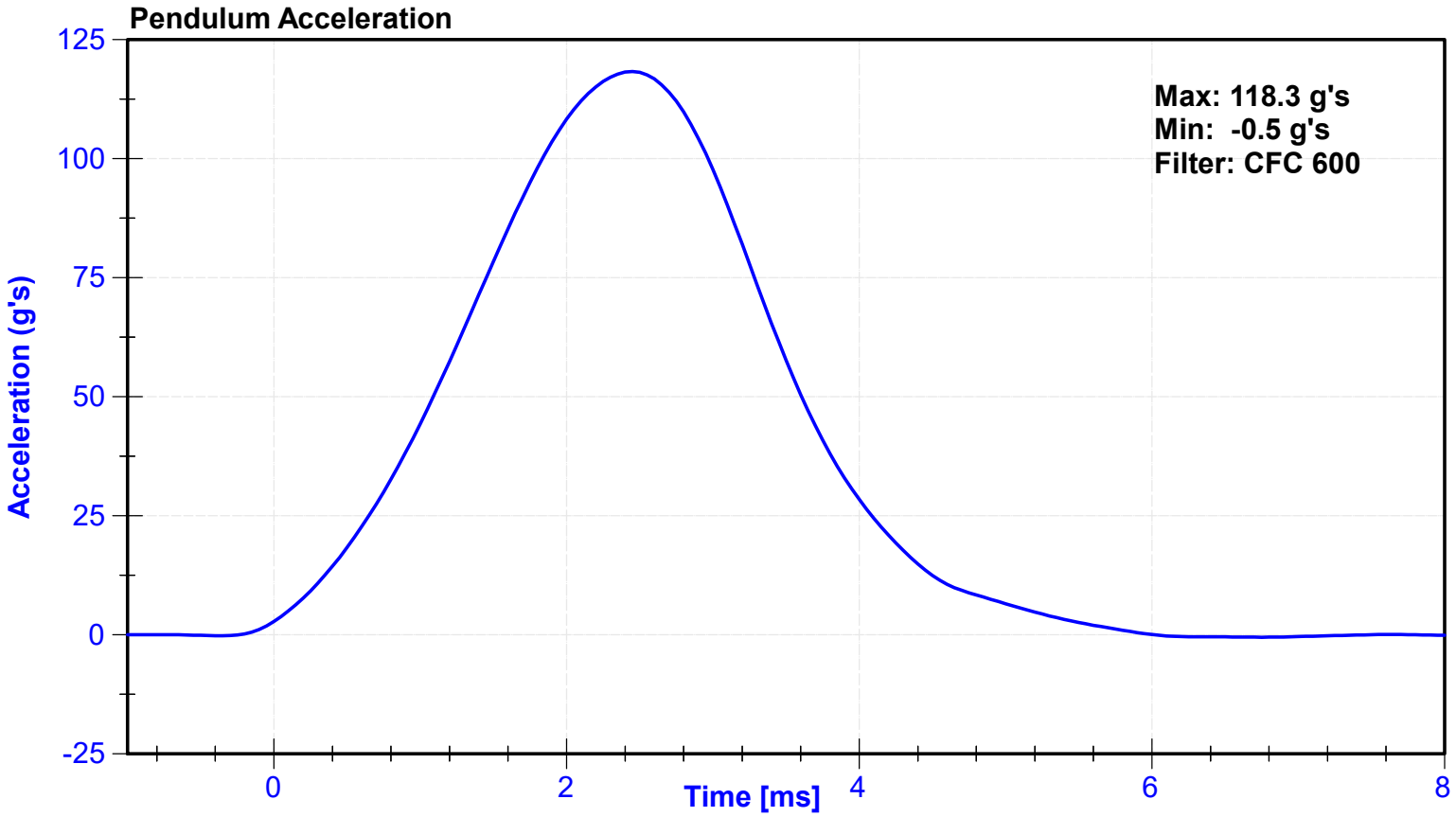
Results

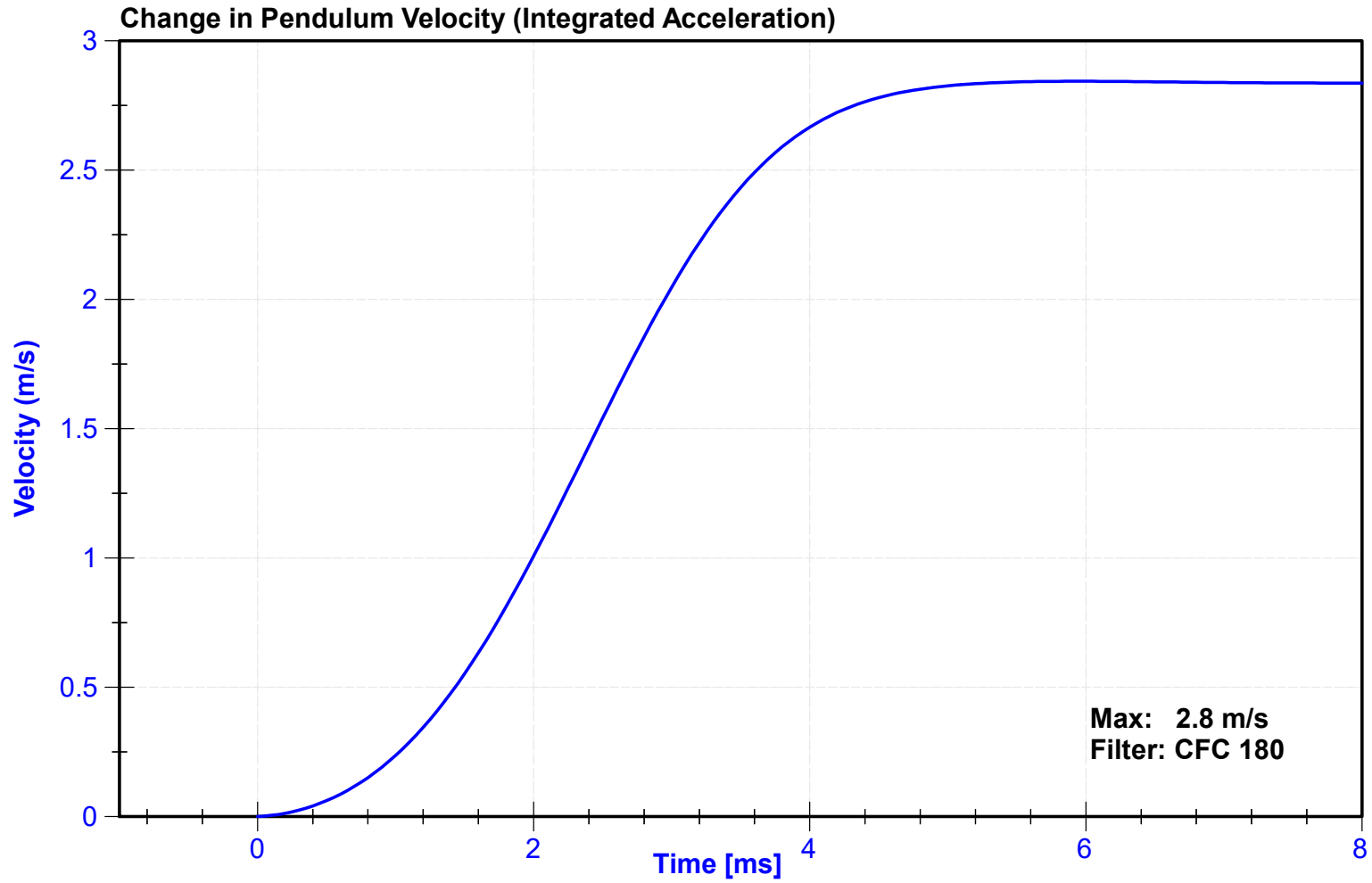
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.7	Pass
Humidity	10	70	%	44.2	Pass
Velocity	2.07	2.13	m/s	2.115	Pass
Maximum Resistive Force	4720	5780	N	5723.2	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	T29720	6/12/2024	12/9/2024




Pendulum Acceleration
Max: 118.3 g's
Min: -0.5 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: 2.8 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]

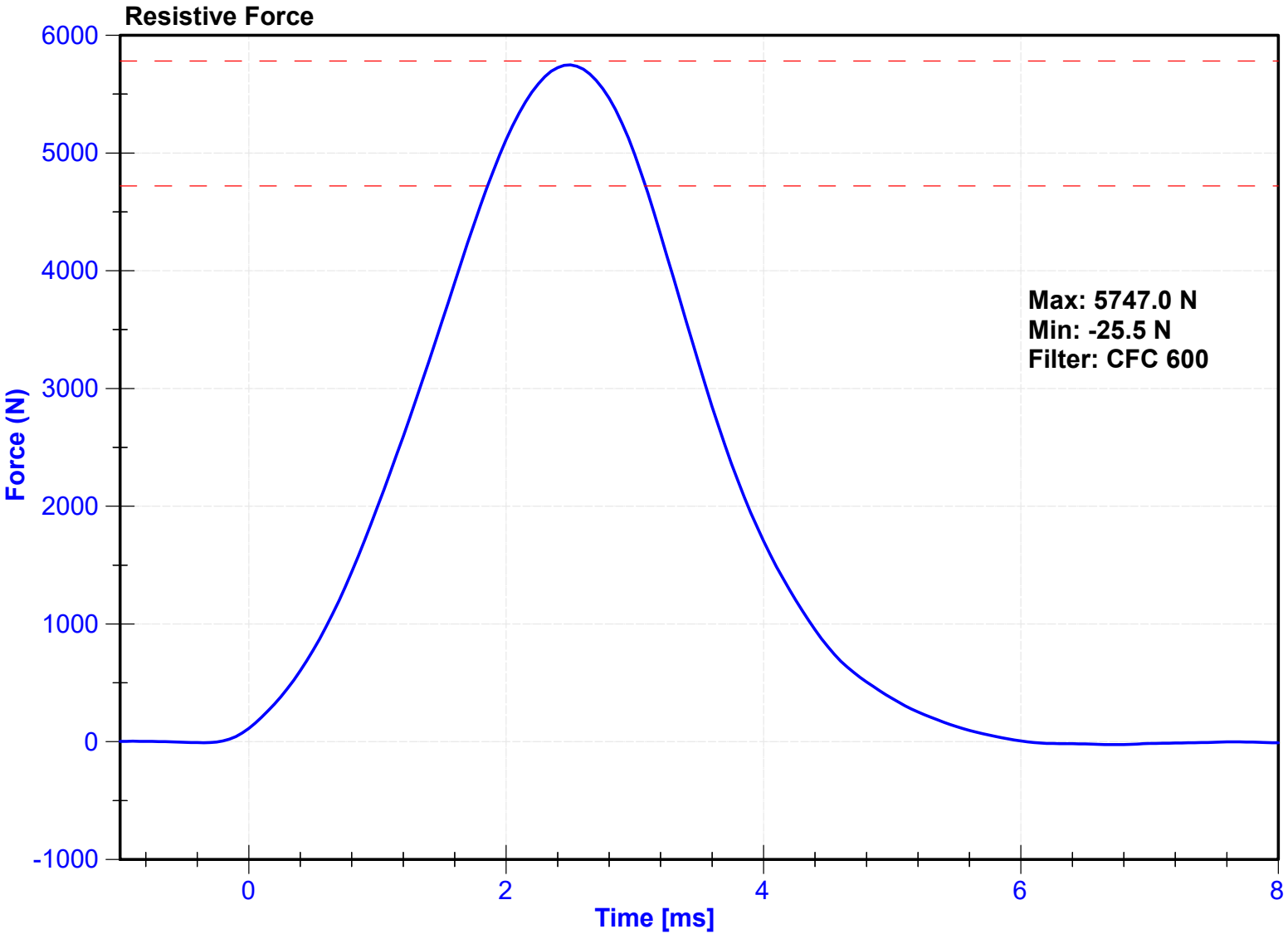
ATD Manufacturer	Humanetics	Test Technician	AG
ATD Serial Number	065	Laboratory Supervisor	ZP

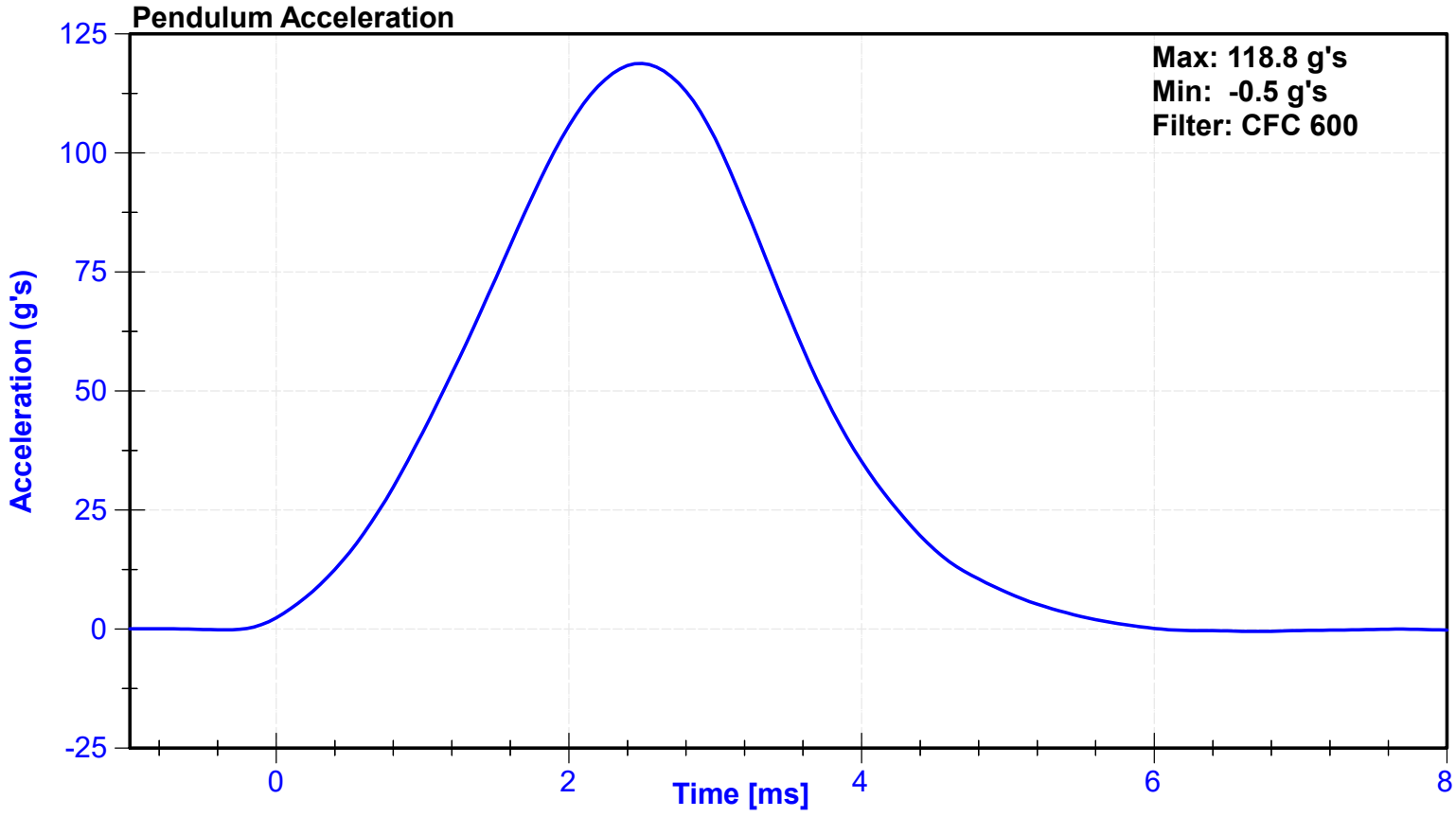
Results

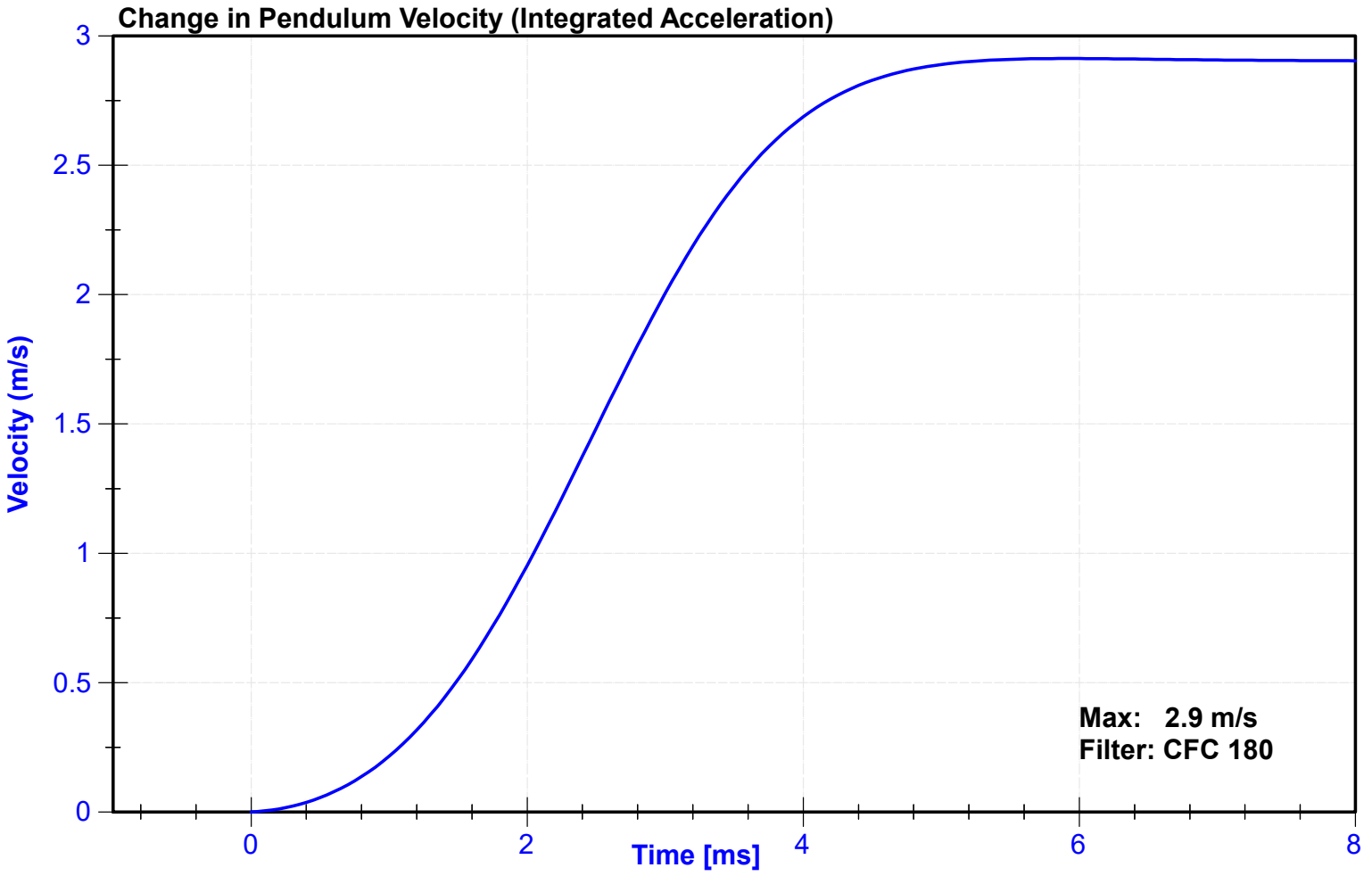
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.7	Pass
Humidity	10	70	%	44.2	Pass
Velocity	2.07	2.13	m/s	2.123	Pass
Maximum Resistive Force	4720	5780	N	5747.0	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	T29720	6/12/2024	12/9/2024




Pendulum Acceleration
Max: 118.8 g's
Min: -0.5 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: 2.9 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

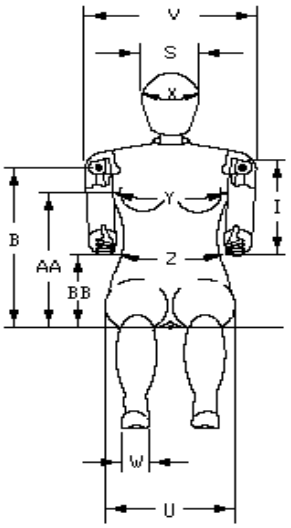
HYBRID III 5TH PERCENTILE FEMALE - PASSENGER ATD

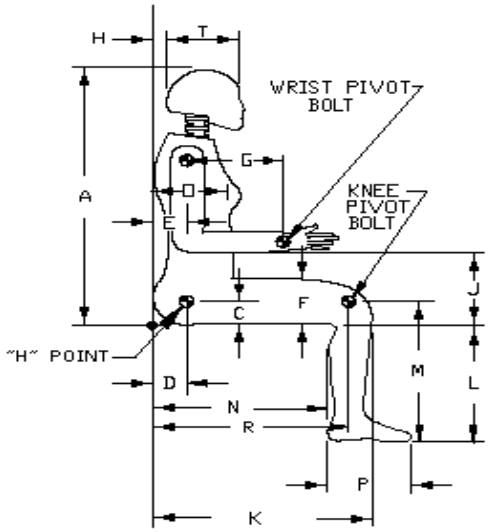
SERIAL NO: 137

External Measurements - Hybrid 3 - 5th Female

Technician: J. Rios Date: 09/10/2024

Dummy Serial Number: 137





Symbol	Description	Specification (mm)		Result (mm)	Pass/Fail
A	Sitting Height	775	800	788	Pass
B	Shoulder Pivot Height	432	457	431	Pass
C	H-Point Height	81	86	83	Pass
D	H-Point from Backline	145	150	147	Pass
E	Shoulder Pivot from Backline	69	84	74	Pass
F	Thigh Clearance	119	135	127	Pass
G	Back of Elbow to Wrist Pivot	244	259	251	Pass
H	Head Back to Backline	43	48	46	Pass
I	Shoulder to Elbow Length	277	297	285	Pass
J	Elbow Rest Height	183	203	195	Pass
K	Buttock to Knee Length	521	546	527	Pass
L	Popliteal Height	356	376	369	Pass
M	Knee Pivot Height	394	419	410	Pass
N	Buttock Popliteal Length	414	439	425	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	467	Pass
S	Head Breadth	137	147	145	Pass
T	Head Depth	178	188	184	Pass
U	Hip Breadth	300	315	311	Pass
V	Shoulder Breadth	351	366	360	Pass
W	Foot Breadth	79	94	85	Pass
X	Head Circumference	528	549	537	Pass
Y	Chest Circumference with Jacket	851	881	857	Pass
Z	Waist Circumference	460	790	617	Pass
AA	Reference Location (Chest Circumference)	333	358	340	Pass
BB	Reference Location (Waist Circumference)	160	170	165	Pass

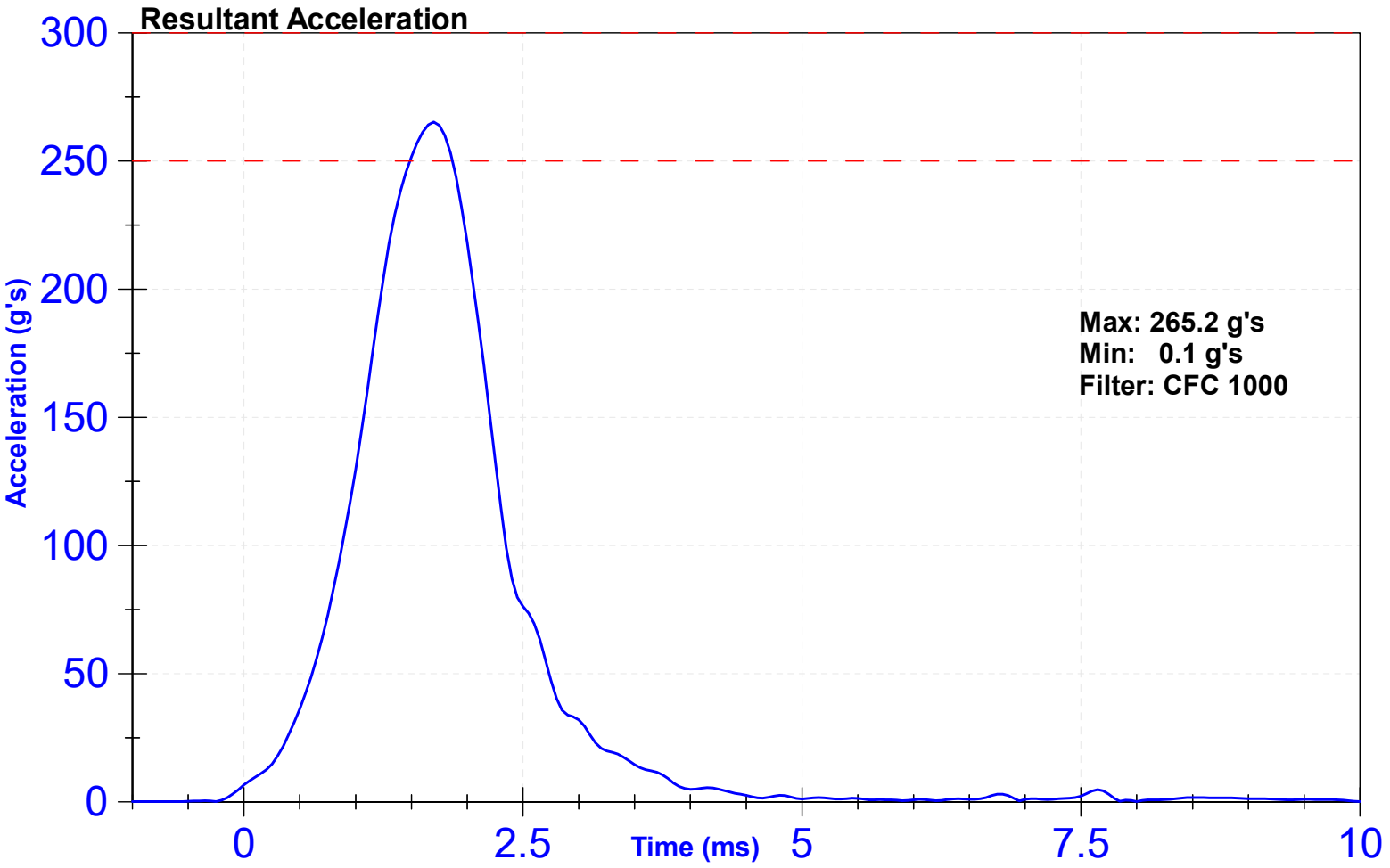
ATD Manufacturer	Humanetics	Test Technician	K. Konieczny
ATD Serial Number	137	Laboratory Supervisor	C. Mantell

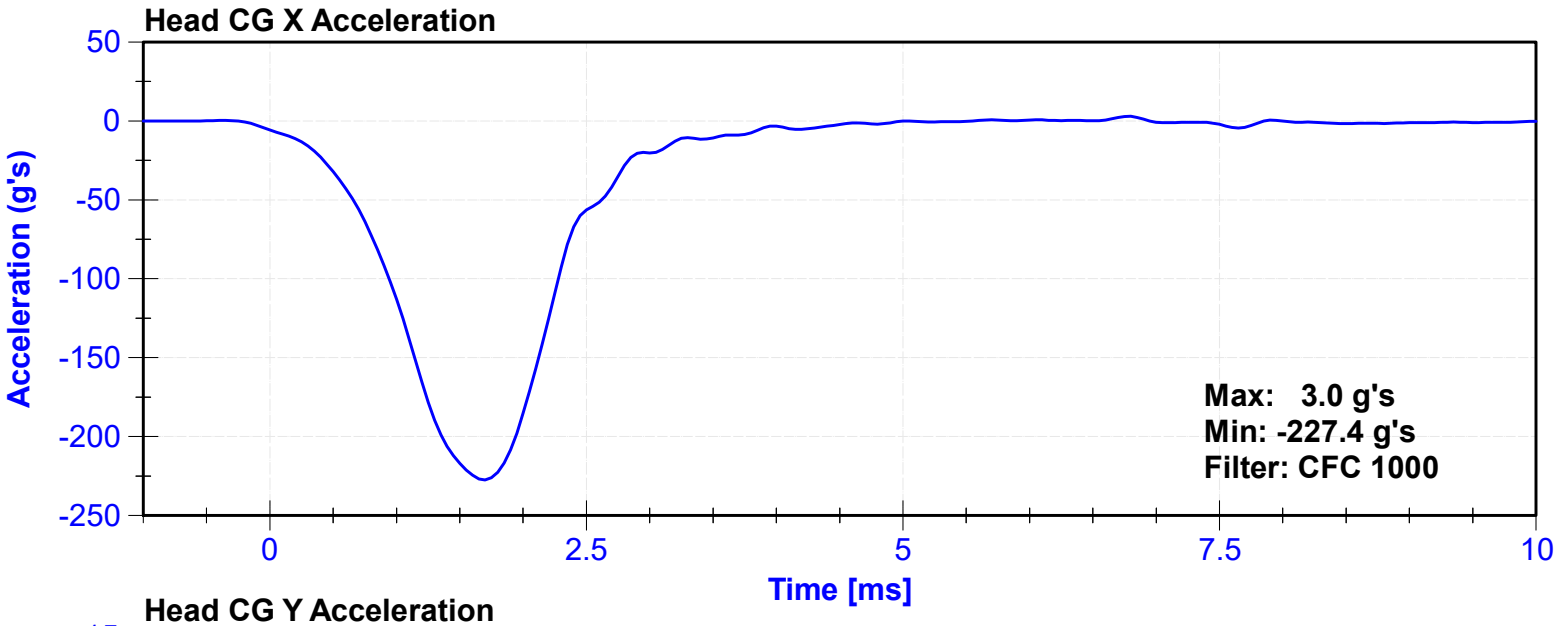
Results

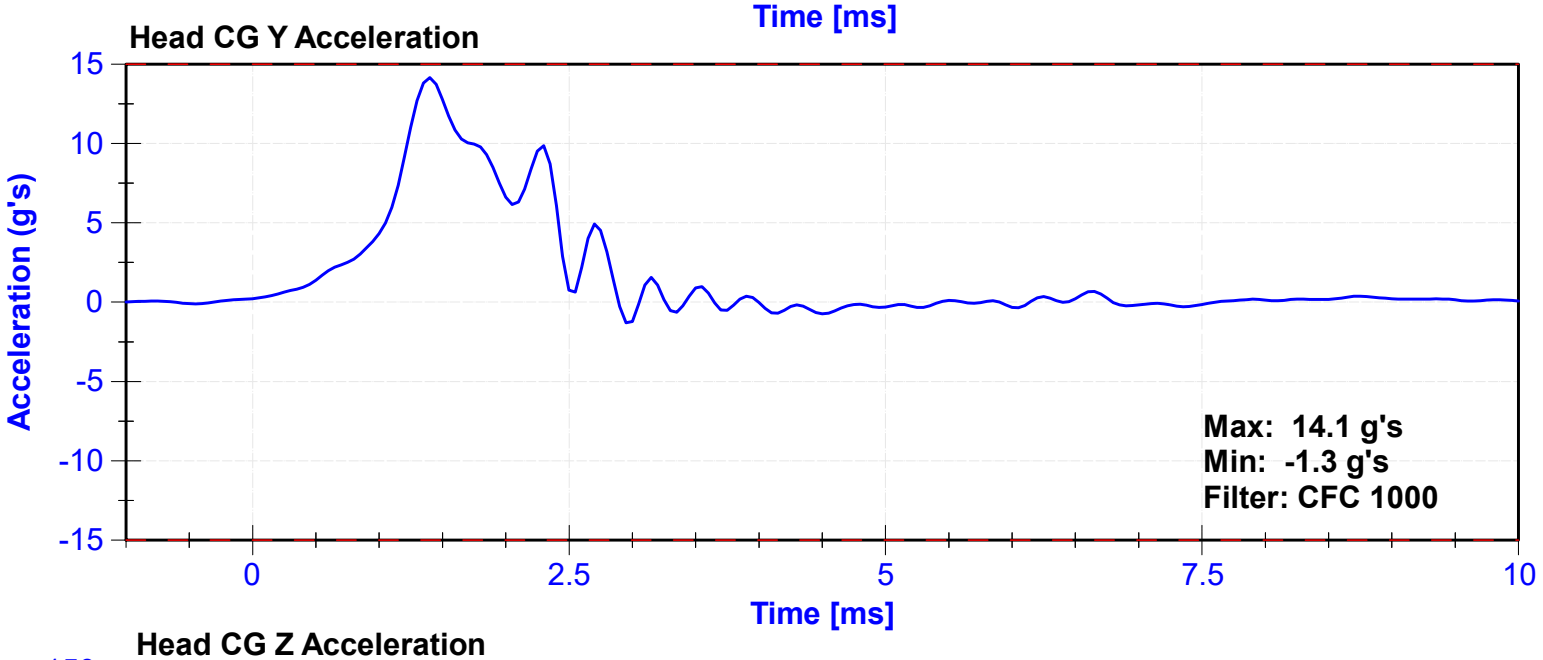
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	20.9	Pass
Humidity	10	70	%	57	Pass
Resultant Acceleration	250	300	g's	265.2	Pass
Oscillation	0	10	%	2.0	Pass
Lateral Acceleration	-15	15	g's	14.1	Pass

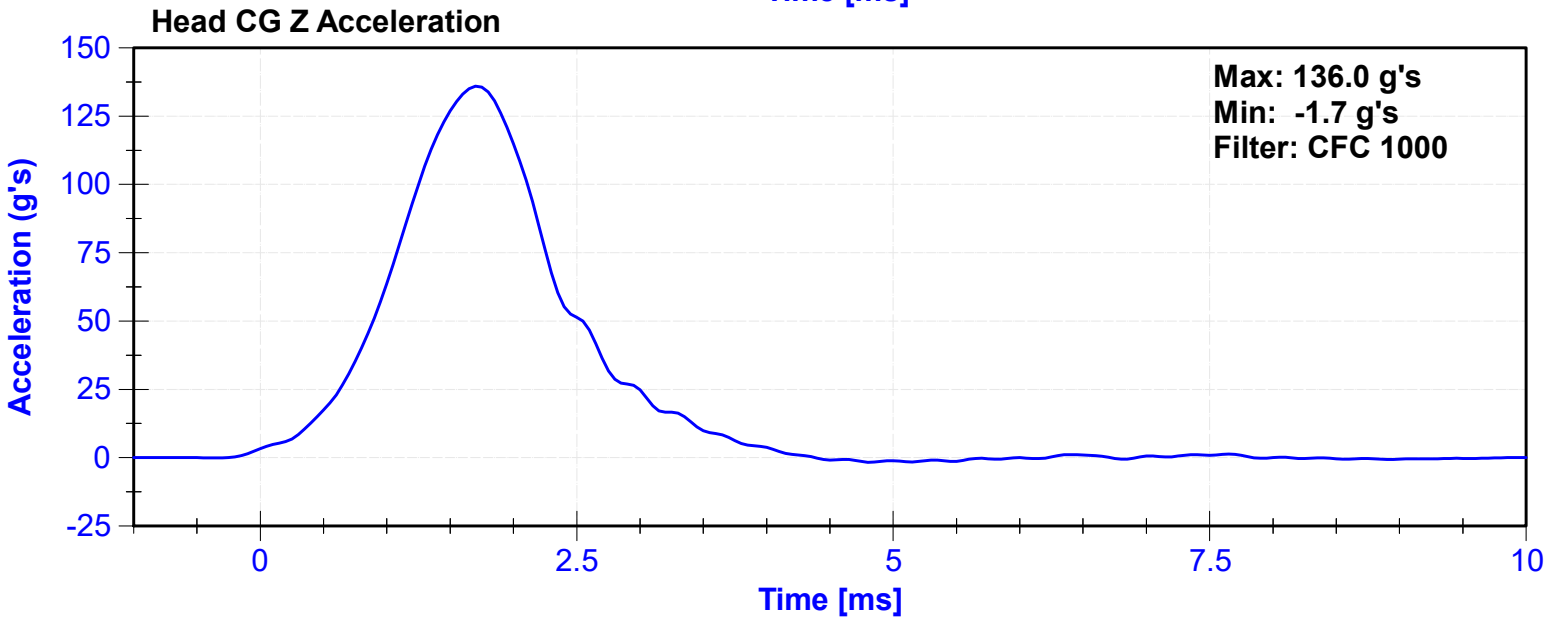
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	Endevco	P79417	8/19/2024	2/15/2025
Y Accelerometer	Endevco	P83335	8/19/2024	2/15/2025
Z Accelerometer	Endevco	P64149	8/19/2024	2/15/2025




Head CG X Acceleration
Acceleration (g's)
50
0
-50
-100
-150
-200
-250
0
2.5
5
7.5
10
Time [ms]
Max: 3.0 g's
Min: -227.4 g's
Filter: CFC 1000


Head CG Y Acceleration
Acceleration (g's)
15
10
5
0
-5
-10
-15
0
2.5
5
7.5
10
Time [ms]
Max: 14.1 g's
Min: -1.3 g's
Filter: CFC 1000


Head CG Z Acceleration
Acceleration (g's)
150
125
100
75
50
25
0
-25
0
2.5
5
7.5
10
Time [ms]
Max: 136.0 g's
Min: -1.7 g's
Filter: CFC 1000

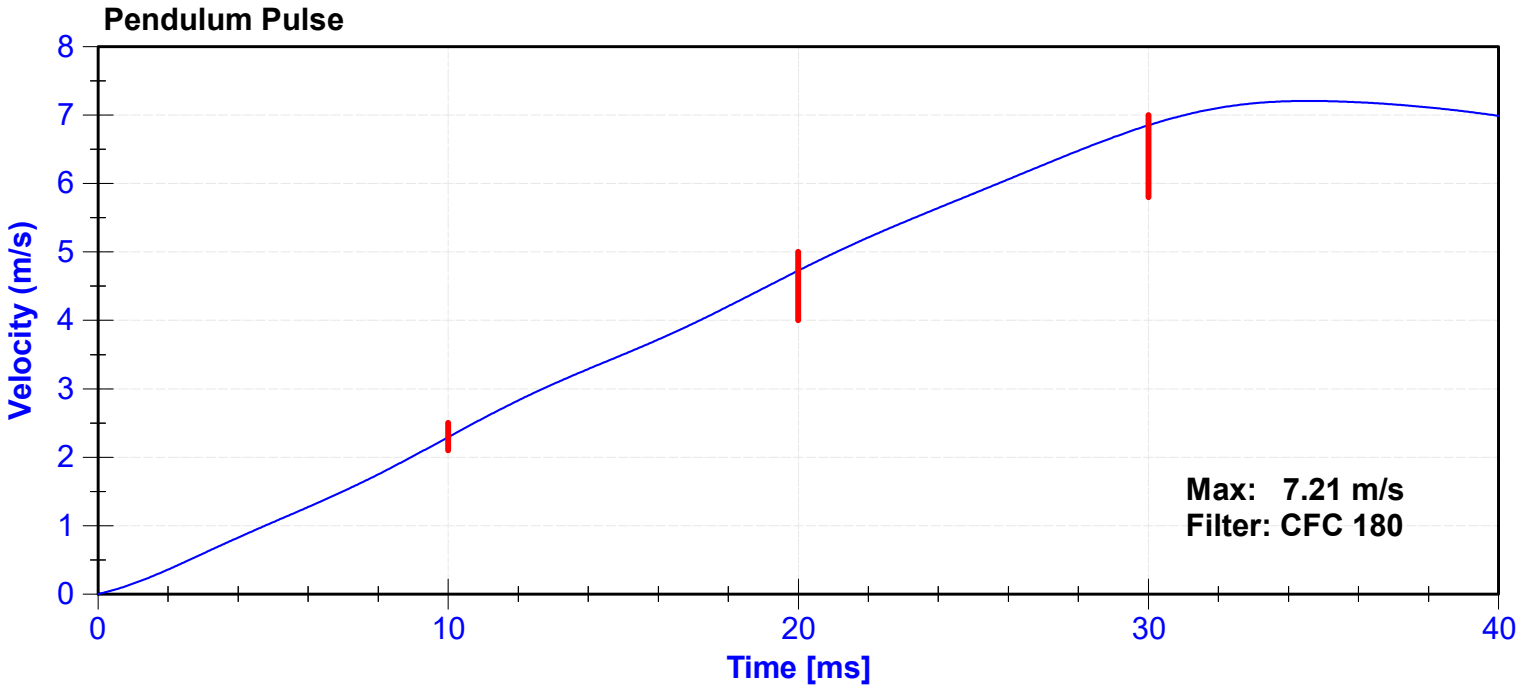
ATD Manufacturer	Humanetics	Test Technician	K. Konieczny
ATD Serial Number	137	Laboratory Supervisor	C. Mantell

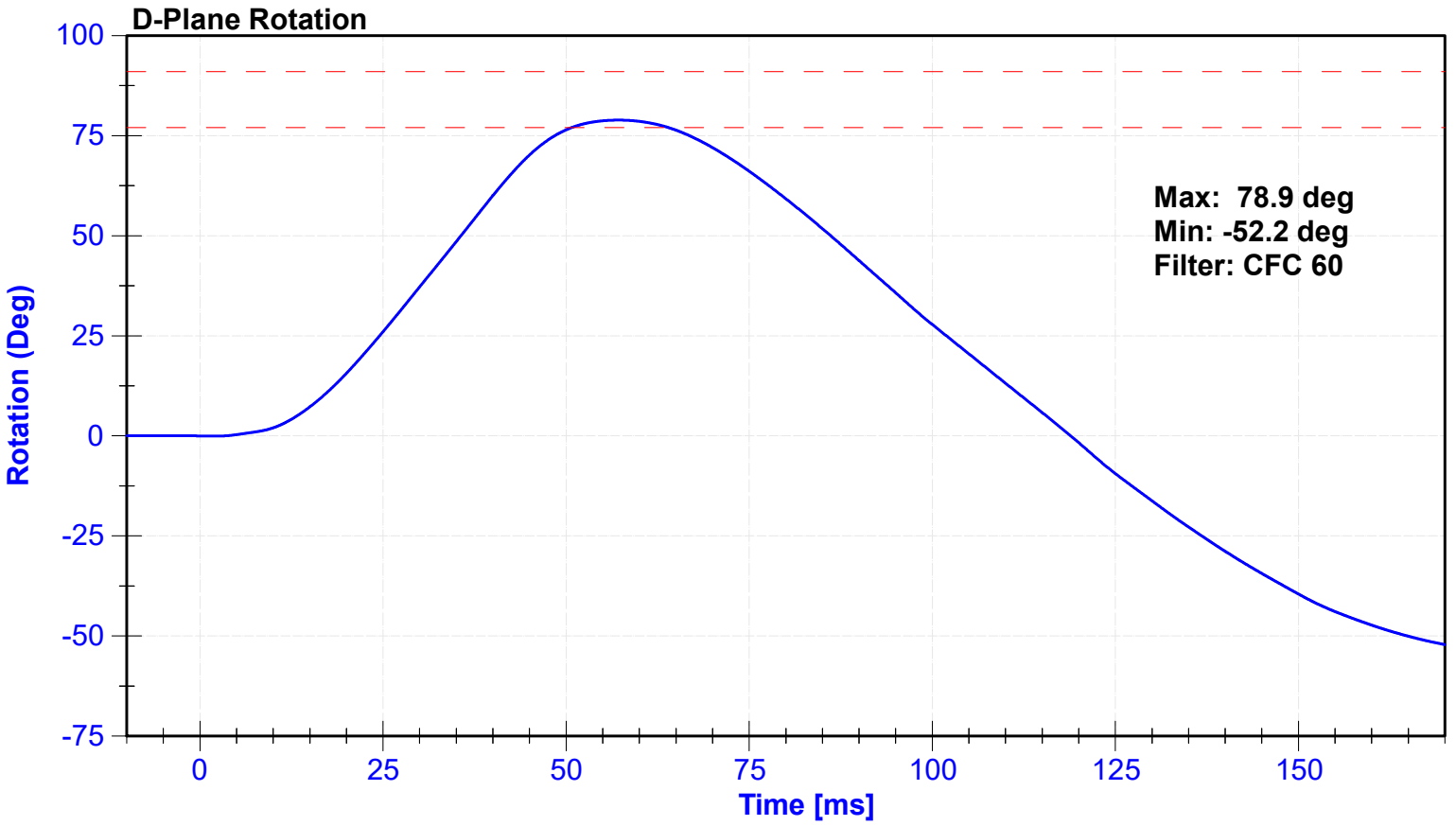
Results

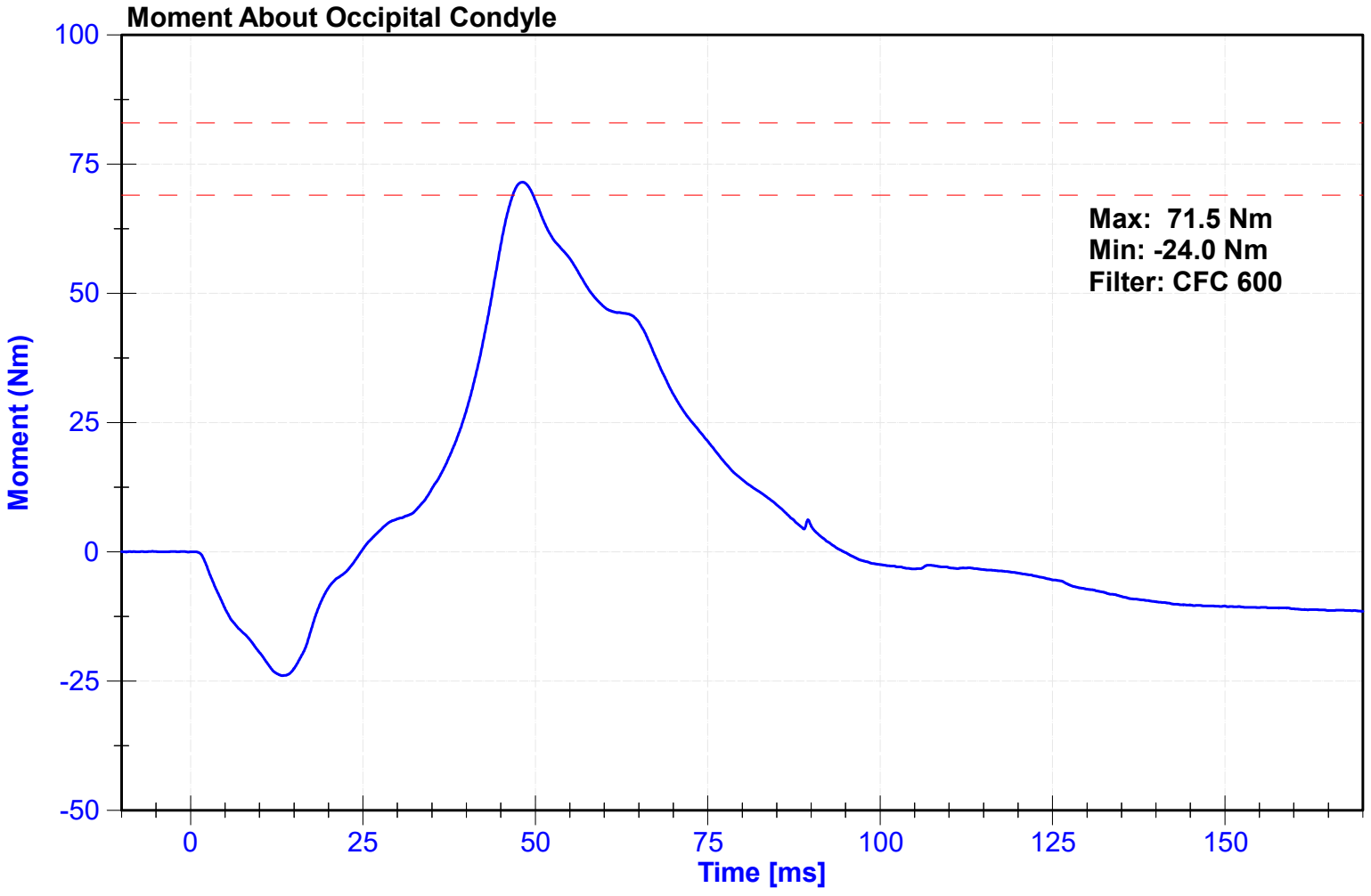
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.6	Pass
Humidity	10	70	%	55	Pass
Velocity	6.89	7.13	m/s	7.034	Pass
Pendulum Impulse at 10ms	2.1	2.5	m/s	2.29	Pass
Pendulum Impulse at 20ms	4.0	5.0	m/s	4.73	Pass
Pendulum Impulse at 30ms	5.8	7.0	m/s	6.85	Pass
Max D Plane Rotation	77	91	deg	78.9	Pass
Max Moment During Rotation Interval	69	83	Nm	71.5	Pass
Moment Decay to 10.0 Nm	80	100	ms	84.2	Pass

Transducer Calibrations

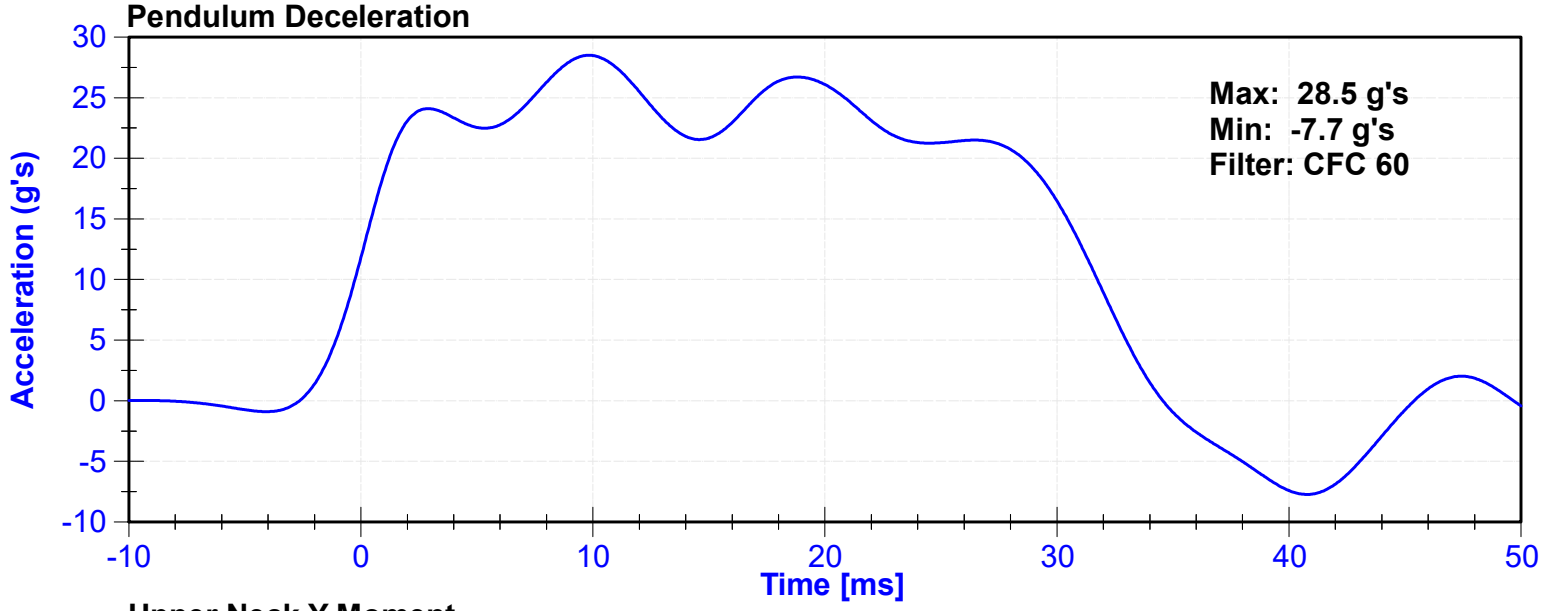
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	C16503	4/29/2024	10/26/2024
Pendulum Potentiometer	ETI	SP22G_LABPOT1	5/7/2024	5/7/2025
Condyle Potentiometer	ETI	SP22G_LABPOT2	5/7/2024	5/7/2025
Upper Neck Load Cell	Denton	2184-FX	7/10/2024	7/10/2025



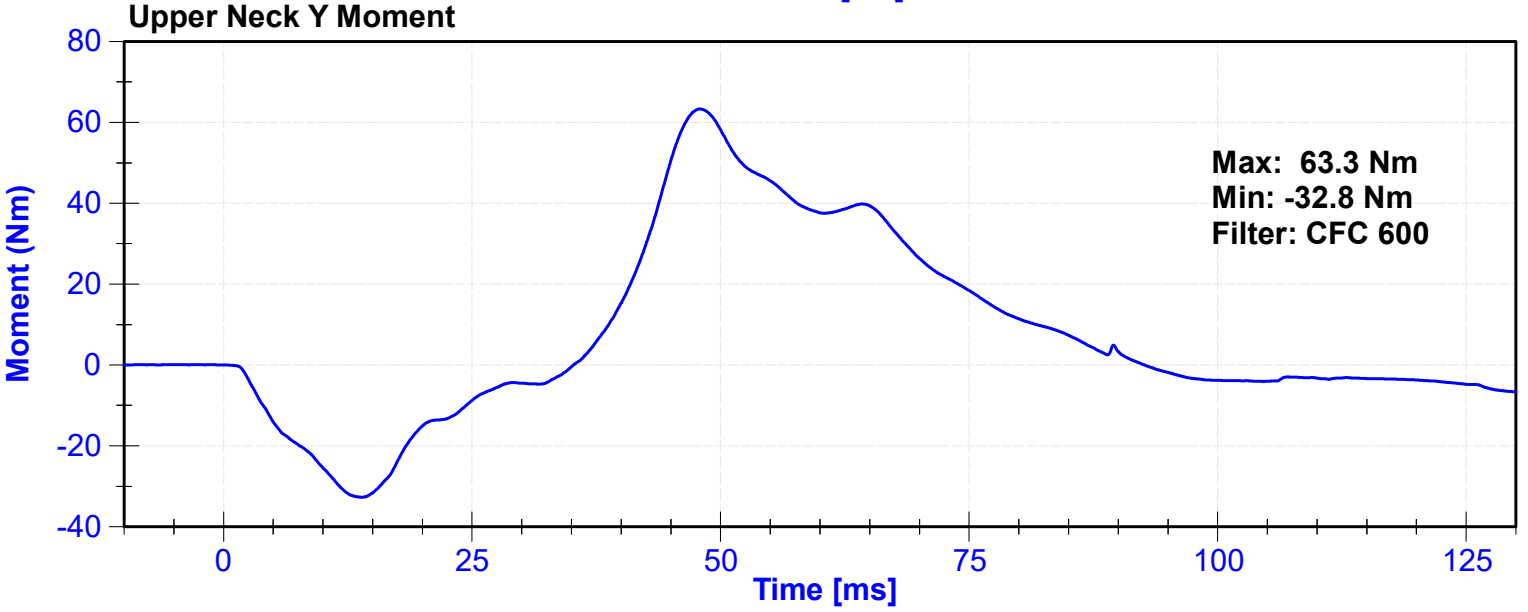

D-Plane Rotation
Max: 78.9 deg
Min: -52.2 deg
Filter: CFC 60
Rotation (Deg)
Time [ms]
100
75
50
25
0
-25
-50
-75
0
25
50
75
100
125
150


Moment About Occipital Condyle
Max: 71.5 Nm
Min: -24.0 Nm
Filter: CFC 600
Moment (Nm)
Time [ms]
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150

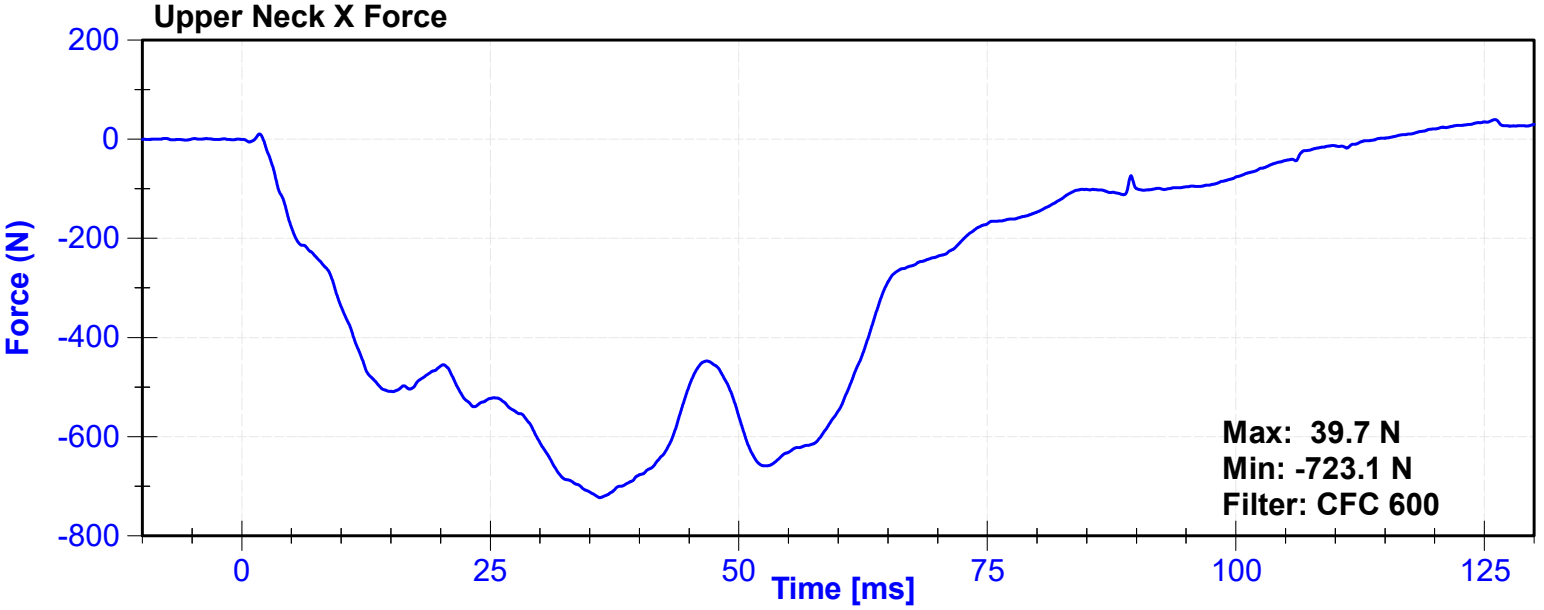
Pendulum Deceleration



Upper Neck Y Moment



Upper Neck X Force



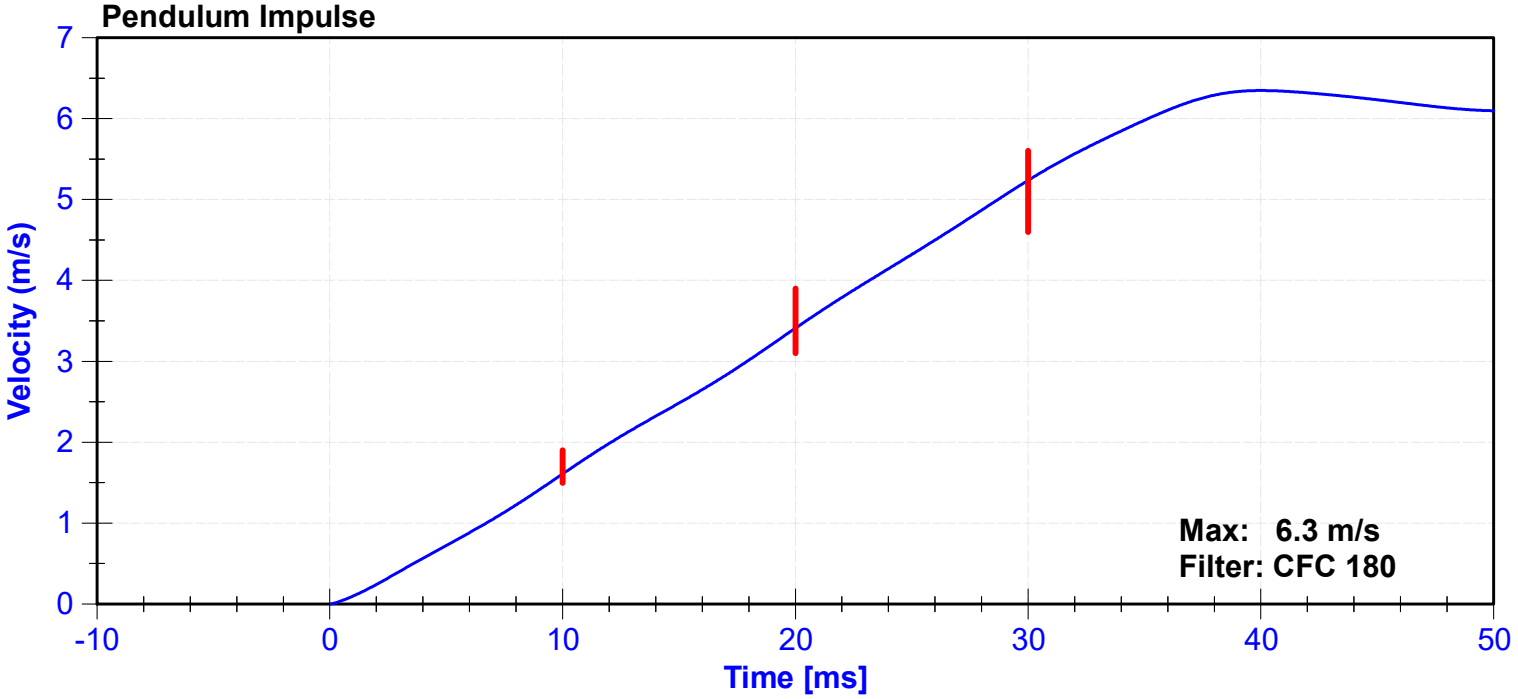
ATD Manufacturer	Humanetics	Test Technician	K. Konieczny
ATD Serial Number	137	Laboratory Supervisor	C. Mantell

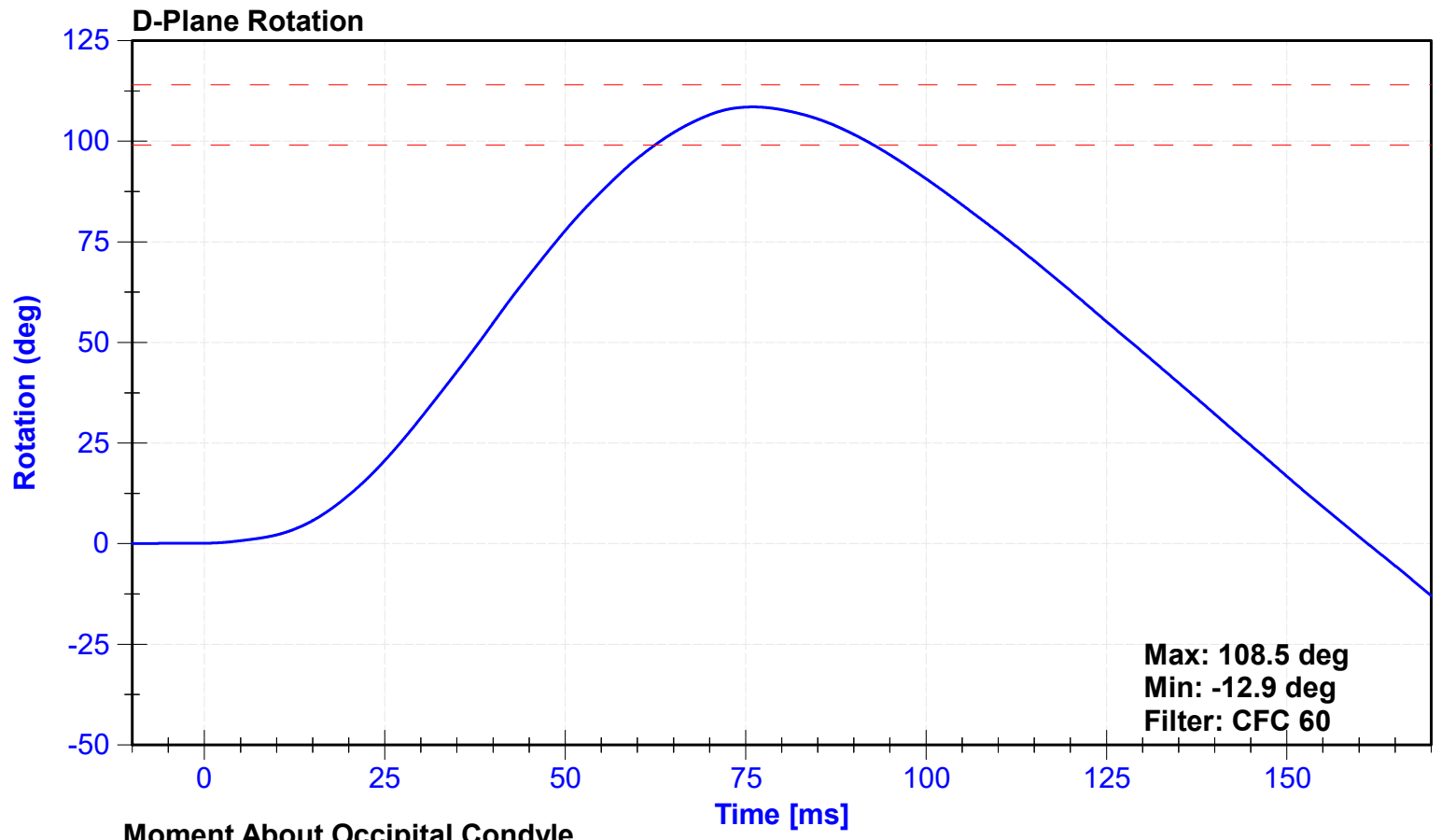
Results

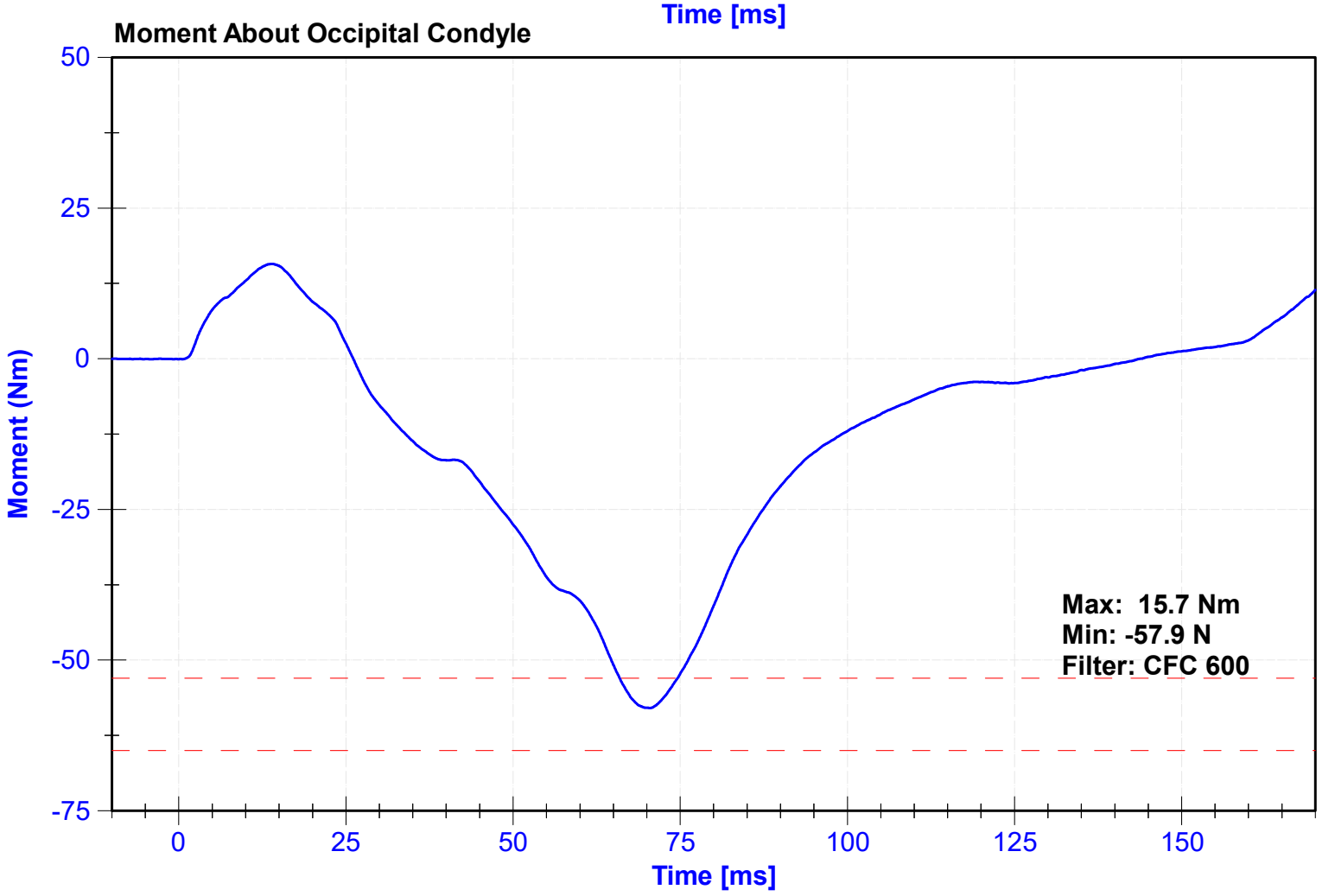
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.6	Pass
Humidity	10	70	%	55	Pass
Velocity	5.95	6.19	m/s	6.009	Pass
Pendulum Impulse at 10ms	1.5	1.9	m/s	1.61	Pass
Pendulum Impulse at 20ms	3.1	3.9	m/s	3.41	Pass
Pendulum Impulse at 30ms	4.6	5.6	m/s	5.24	Pass
D Plane Rotation	99	114	deg	108.5	Pass
Moment During Rotation Interval	-65	-53	Nm	-57.9	Pass
Moment Decay to -10Nm	94	114	ms	103.5	Pass

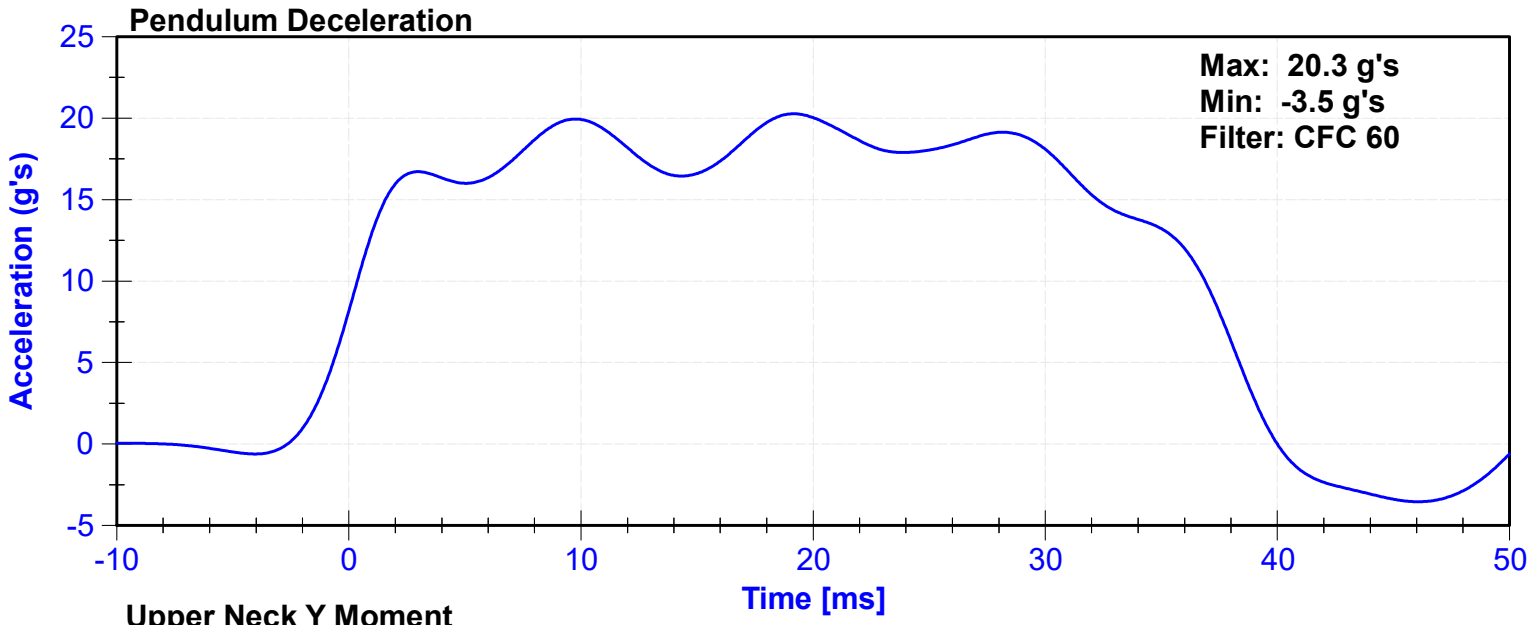
Transducer Calibrations

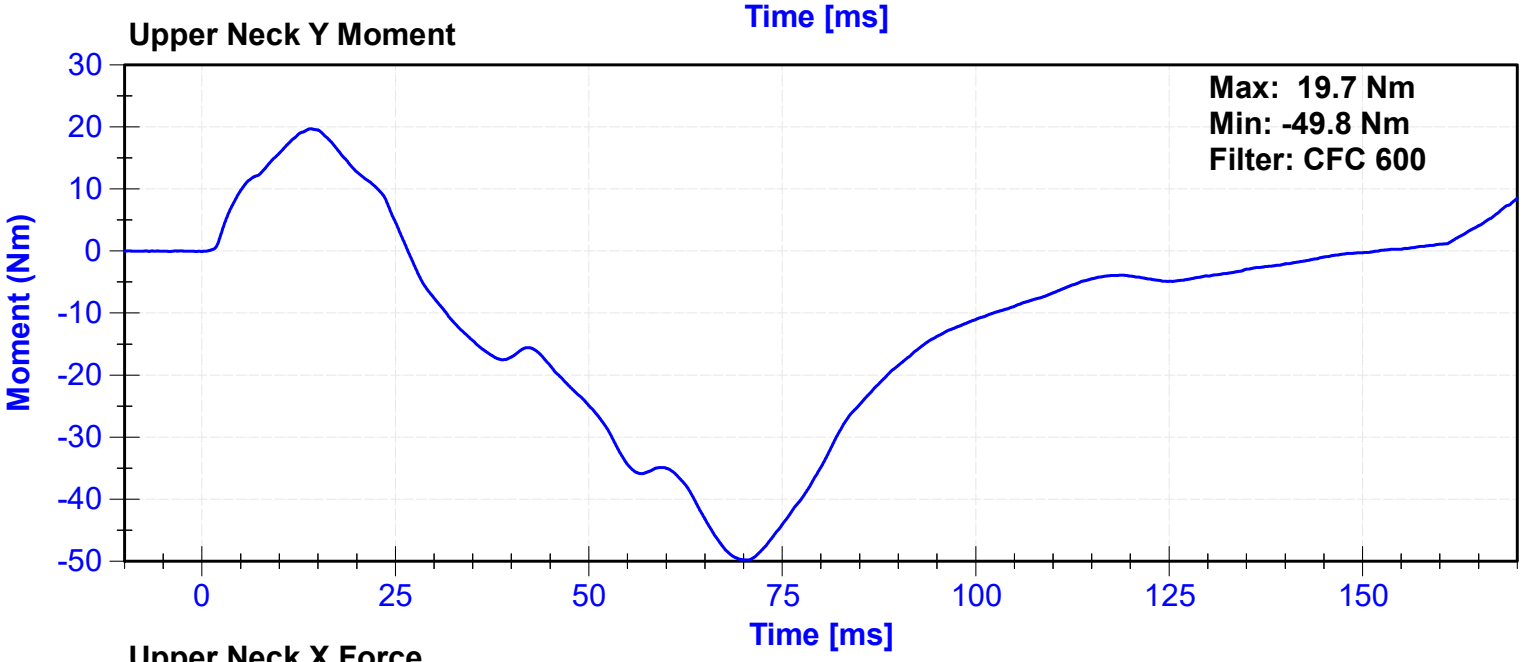
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	C16503	4/29/2024	10/26/2024
Pendulum Potentiometer	ETI	SP22G_LABPOT1	5/7/2024	5/7/2025
Condyle Potentiometer	ETI	SP22G_LABPOT2	5/7/2024	5/7/2025
Upper Neck Load Cell	Denton	2184-FX	7/10/2024	7/10/2025

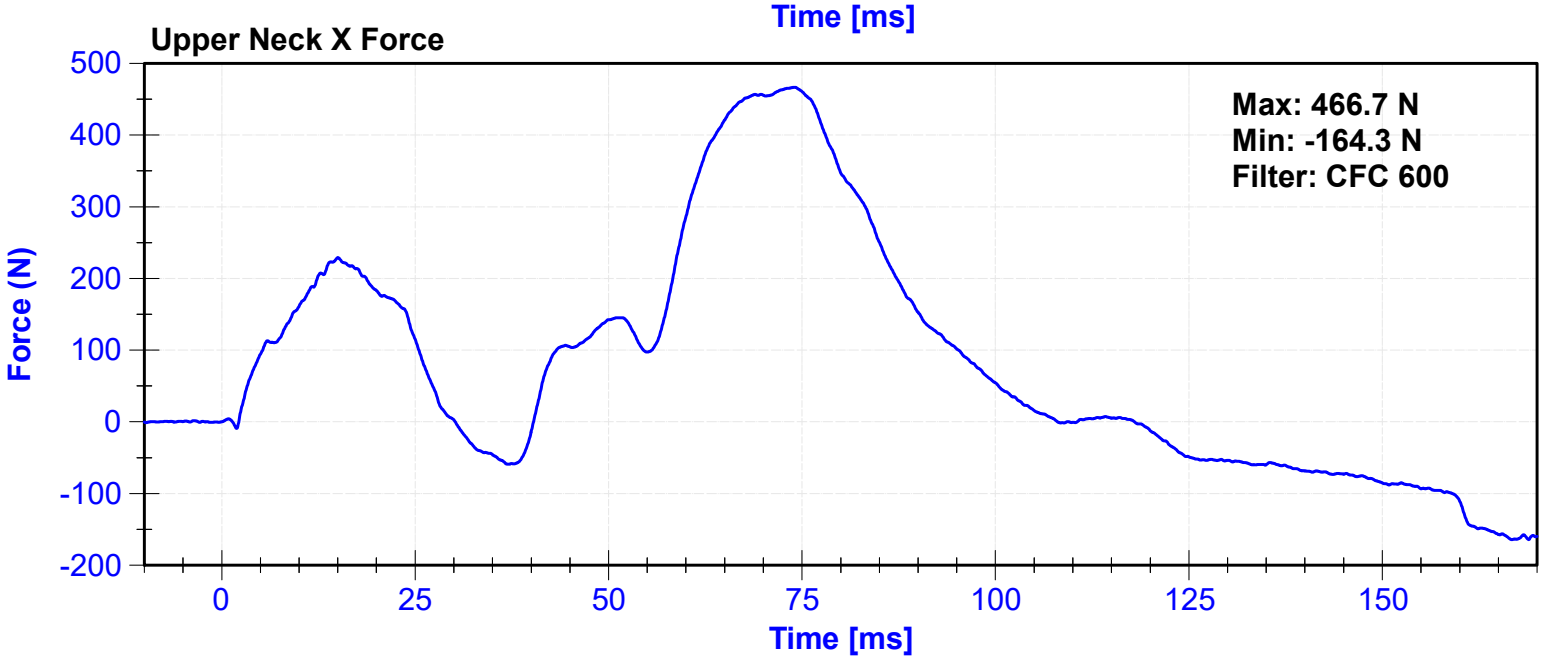



D-Plane Rotation
Rotation (deg)
125
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]
Max: 108.5 deg
Min: -12.9 deg
Filter: CFC 60


Moment About Occipital Condyle
Moment (Nm)
50
25
0
-25
-50
-75
0
25
50
75
100
125
150
Time [ms]
Max: 15.7 Nm
Min: -57.9 N
Filter: CFC 600


Pendulum Deceleration
Max: 20.3 g's
Min: -3.5 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: 19.7 Nm
Min: -49.8 Nm
Filter: CFC 600
Moment (Nm)
30
20
10
0
-10
-20
-30
-40
-50
0
25
50
75
100
125
150
Time [ms]


Upper Neck X Force
Max: 466.7 N
Min: -164.3 N
Filter: CFC 600
Force (N)
500
400
300
200
100
0
-100
-200
0
25
50
75
100
125
150
Time [ms]

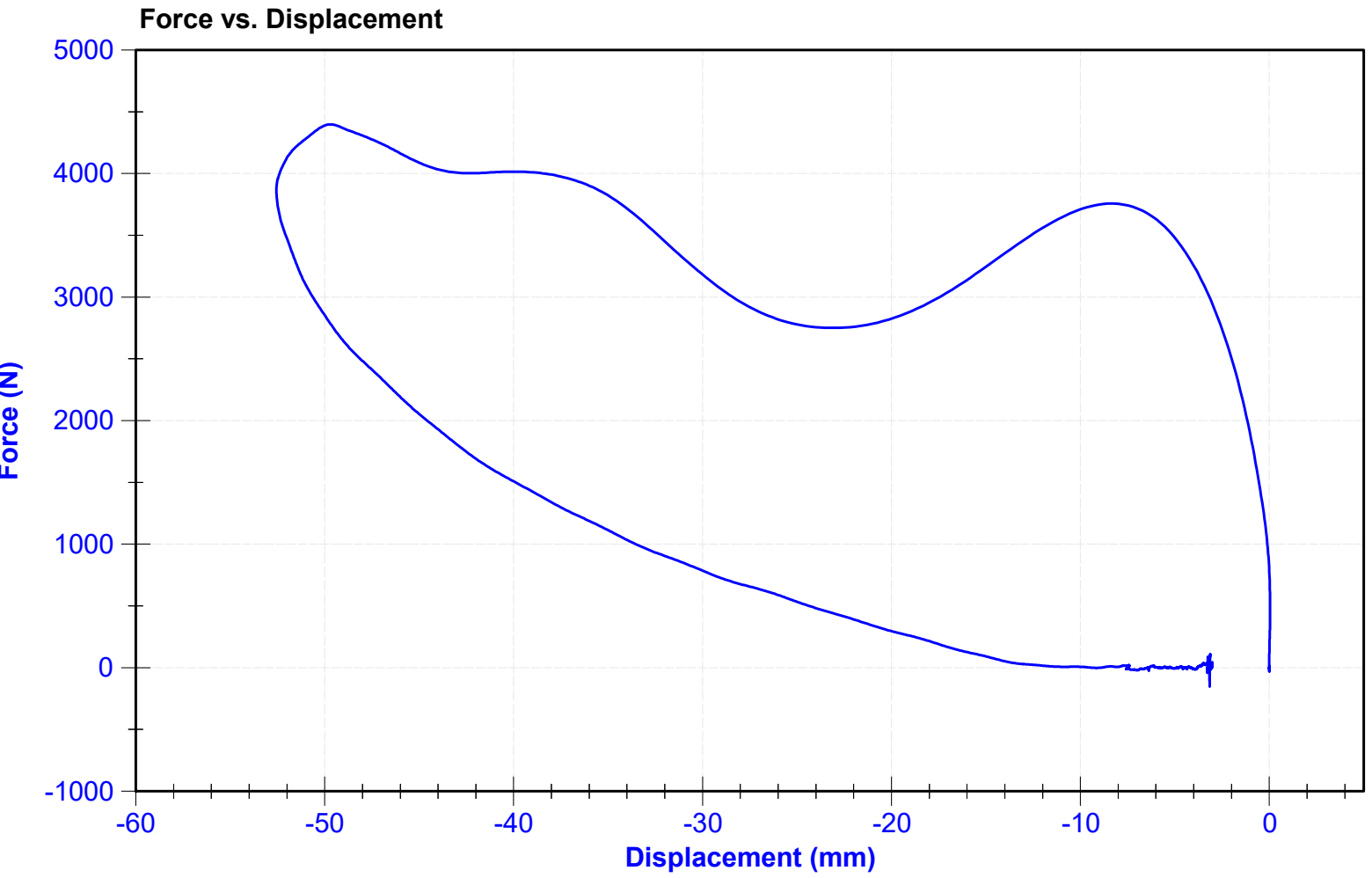
ATD Manufacturer	Humanetics	Test Technician	K. Konieczny
ATD Serial Number	137	Laboratory Supervisor	C. Mantell

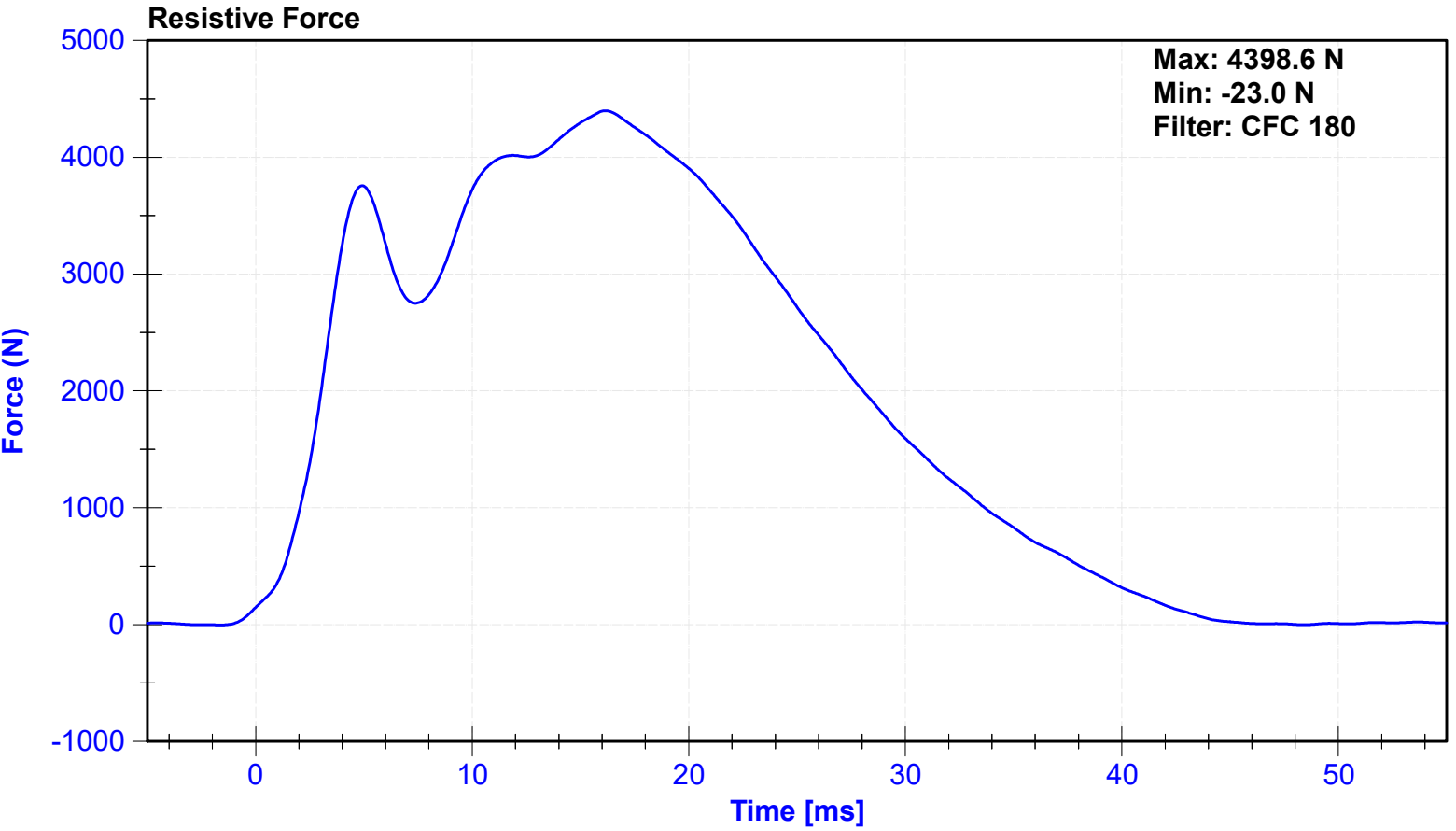
Results

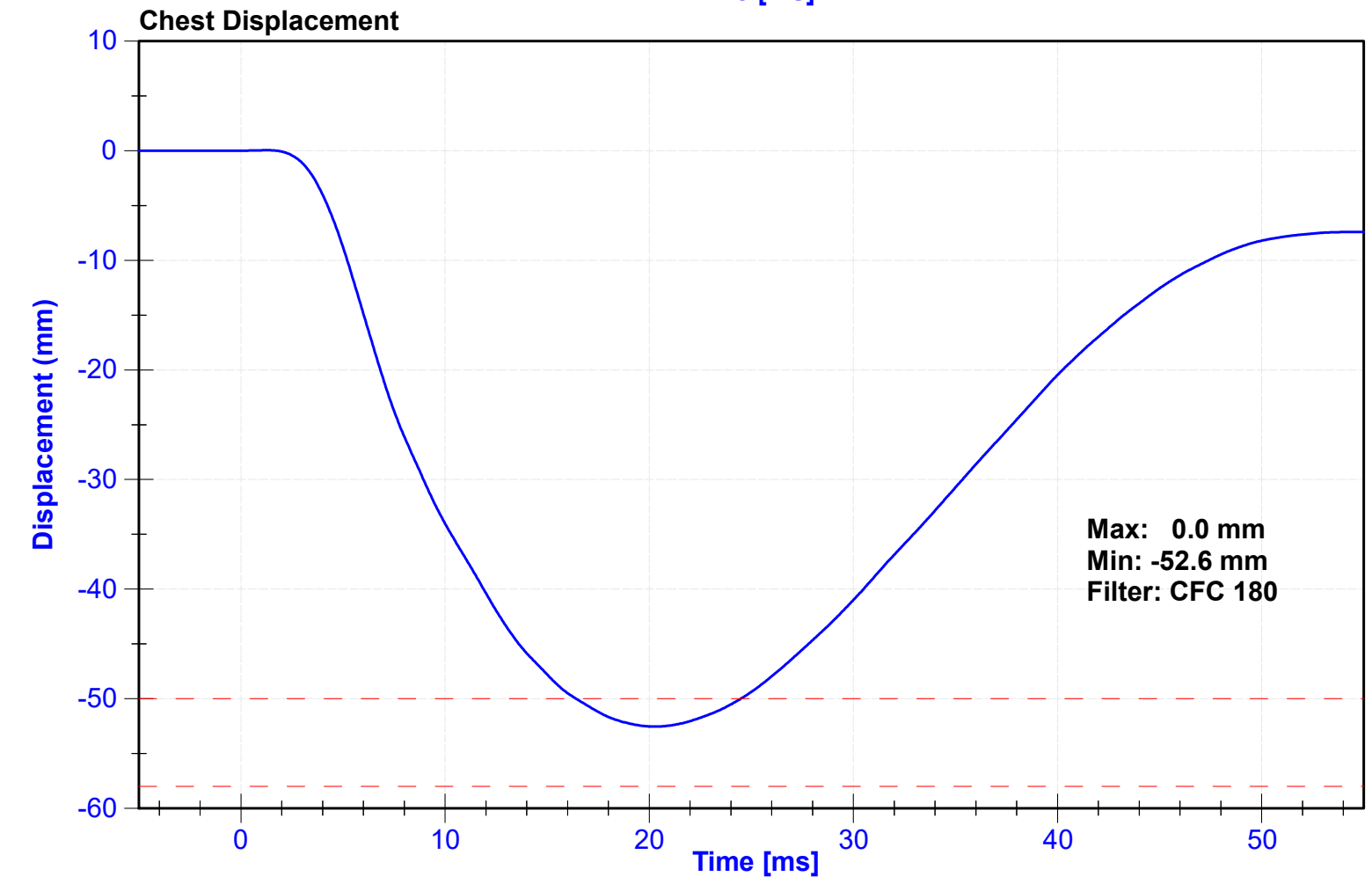
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.9	Pass
Humidity	10	70	%	57	Pass
Velocity	6.59	6.83	m/s	6.615	Pass
Chest Deflection	-58	-50	mm	-52.6	Pass
Maximum Resistive Force (50 to 58mm)	3900	4400	N	4389.8	Pass
Maximum Resistive Force (18 to 50mm)	0	4600	N	4398.6	Pass
Hysteresis	69	85	%	74.2	Pass

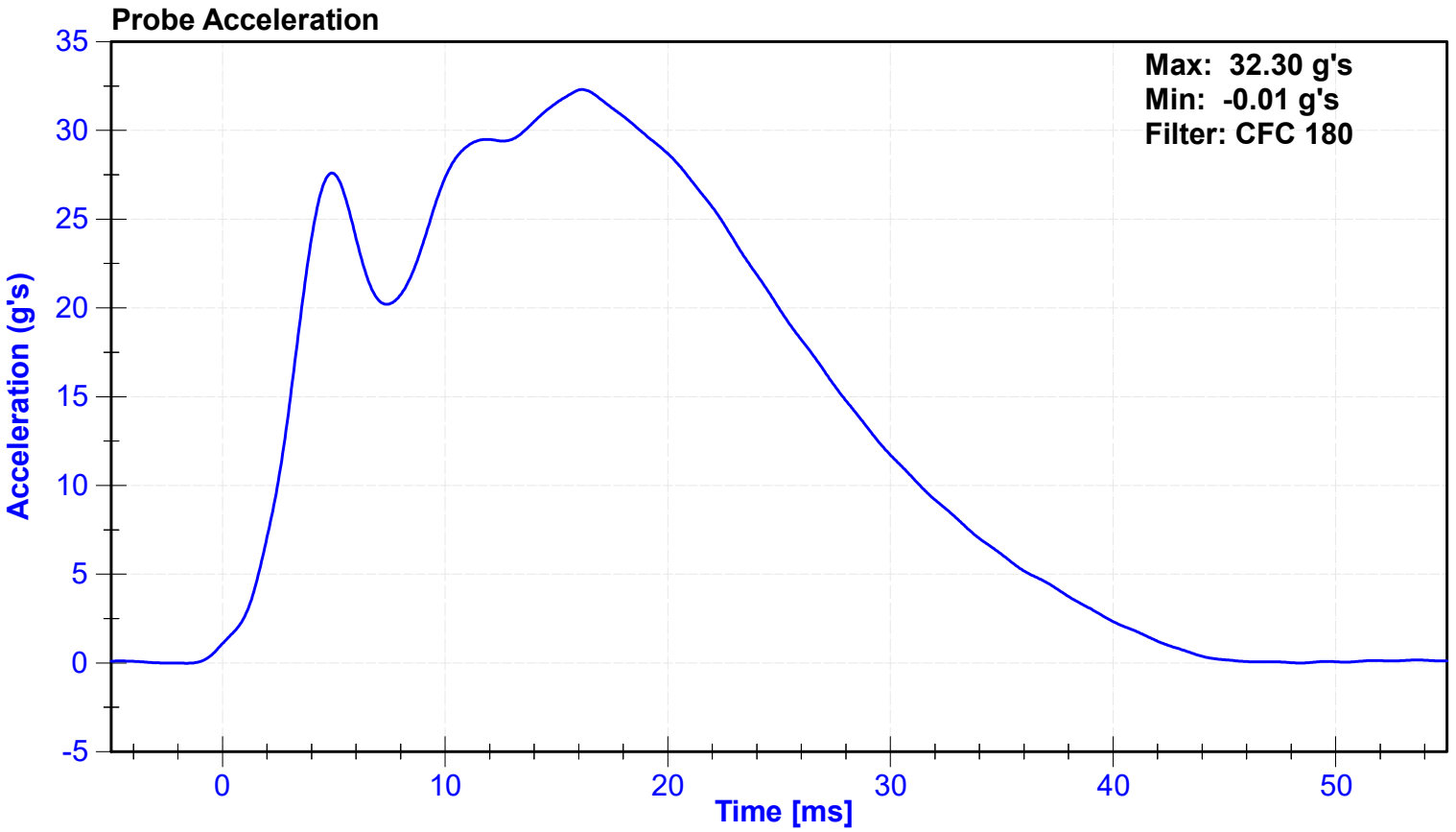
Transducer Calibrations

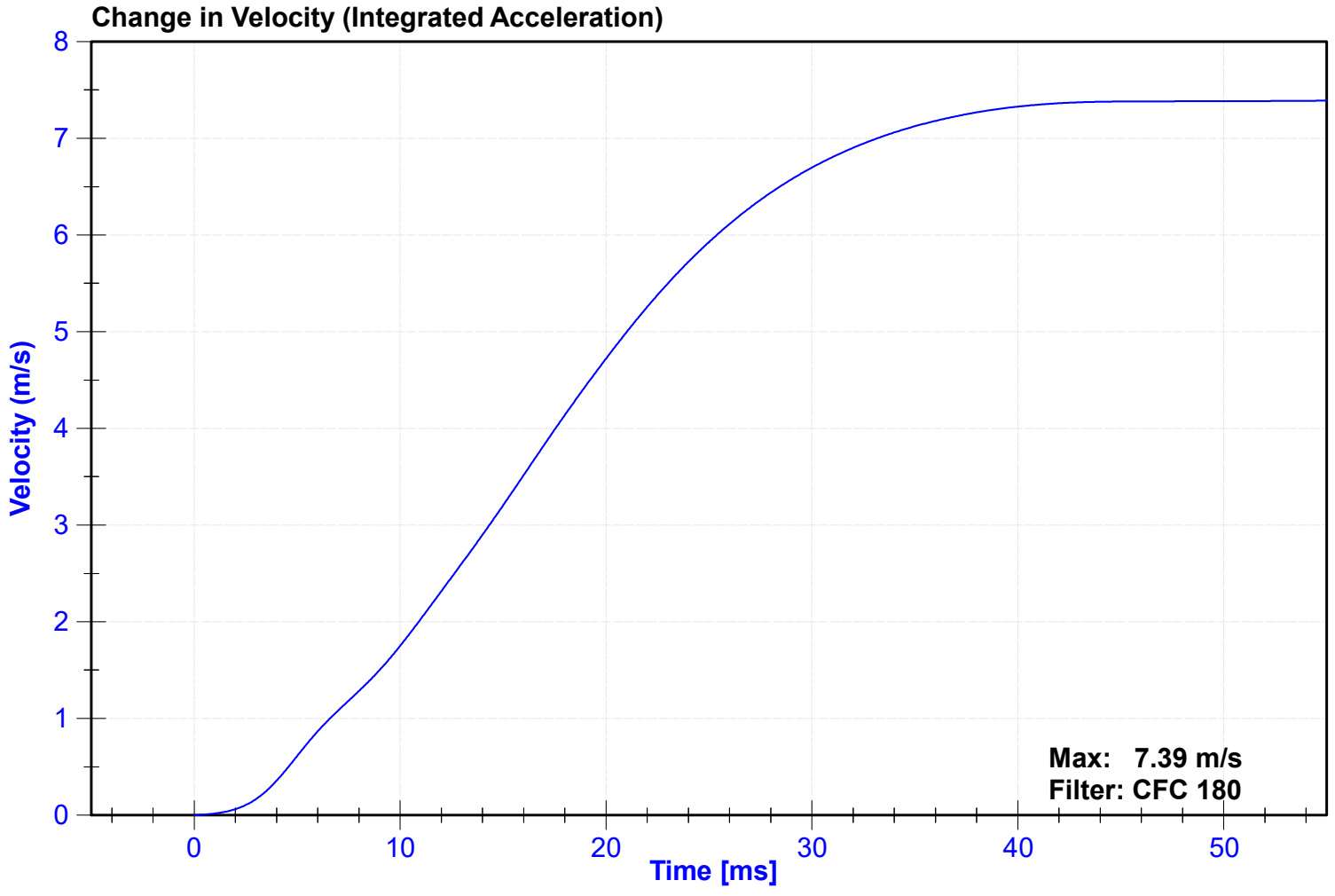
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18587	11/20/2023	11/19/2024
Chest Potentiometer	Servo	0720	8/19/2024	2/17/2025




Resistive Force
Max: 4398.6 N
Min: -23.0 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: -52.6 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: 32.30 g's
Min: -0.01 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: 7.39 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]

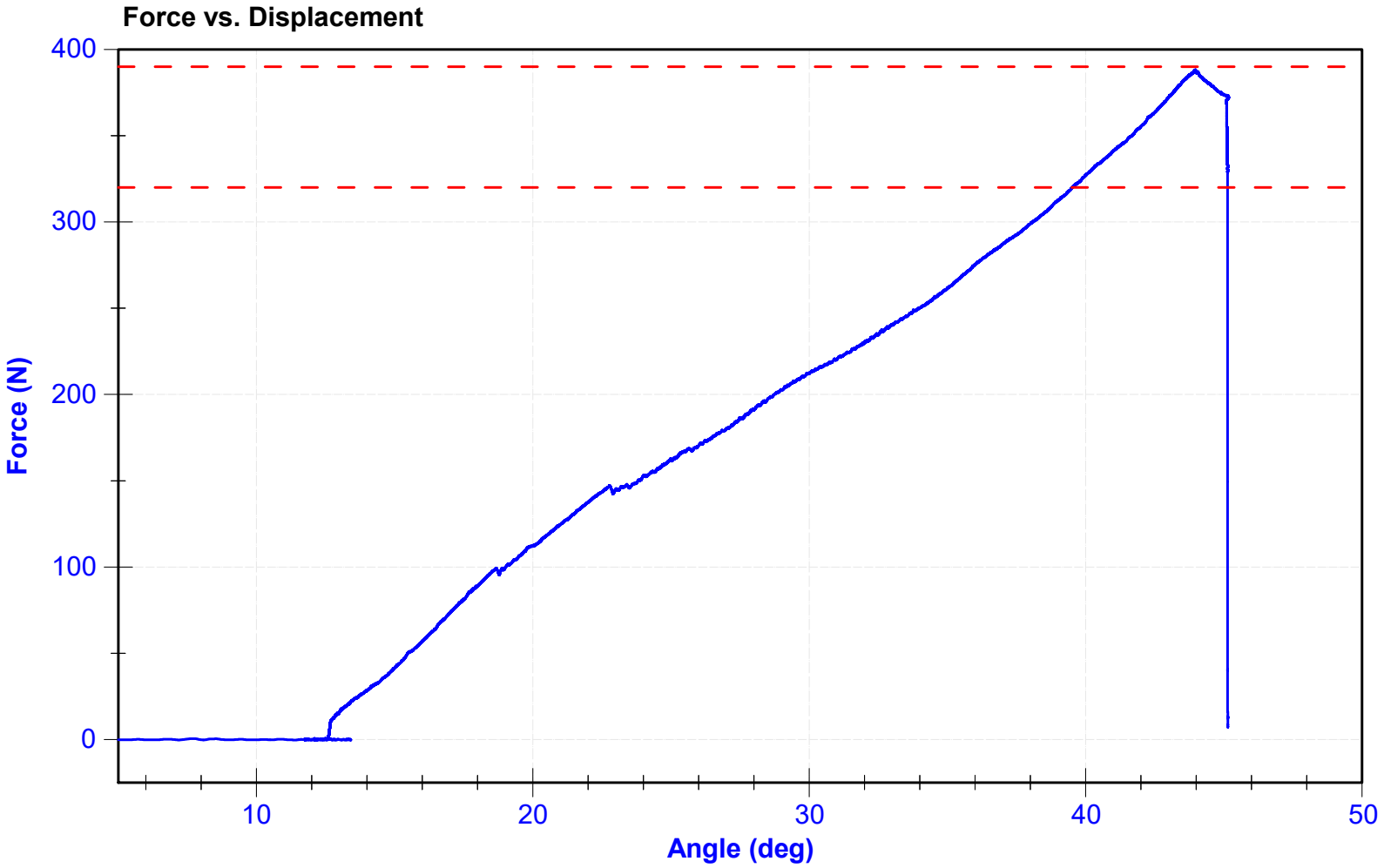
ATD Manufacturer	Humanetics	Test Technician	K. Konieczny
ATD Serial Number	137	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.6	25.6	ºC	20.9	Pass
Humidity	10	70	%	58	Pass
Initial Angle	0	20	deg	12.5	Pass
Force at 45 Degrees	320	390	N	388.3	Pass
Return Angle Relative to Initial	0	8	deg	5.0	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



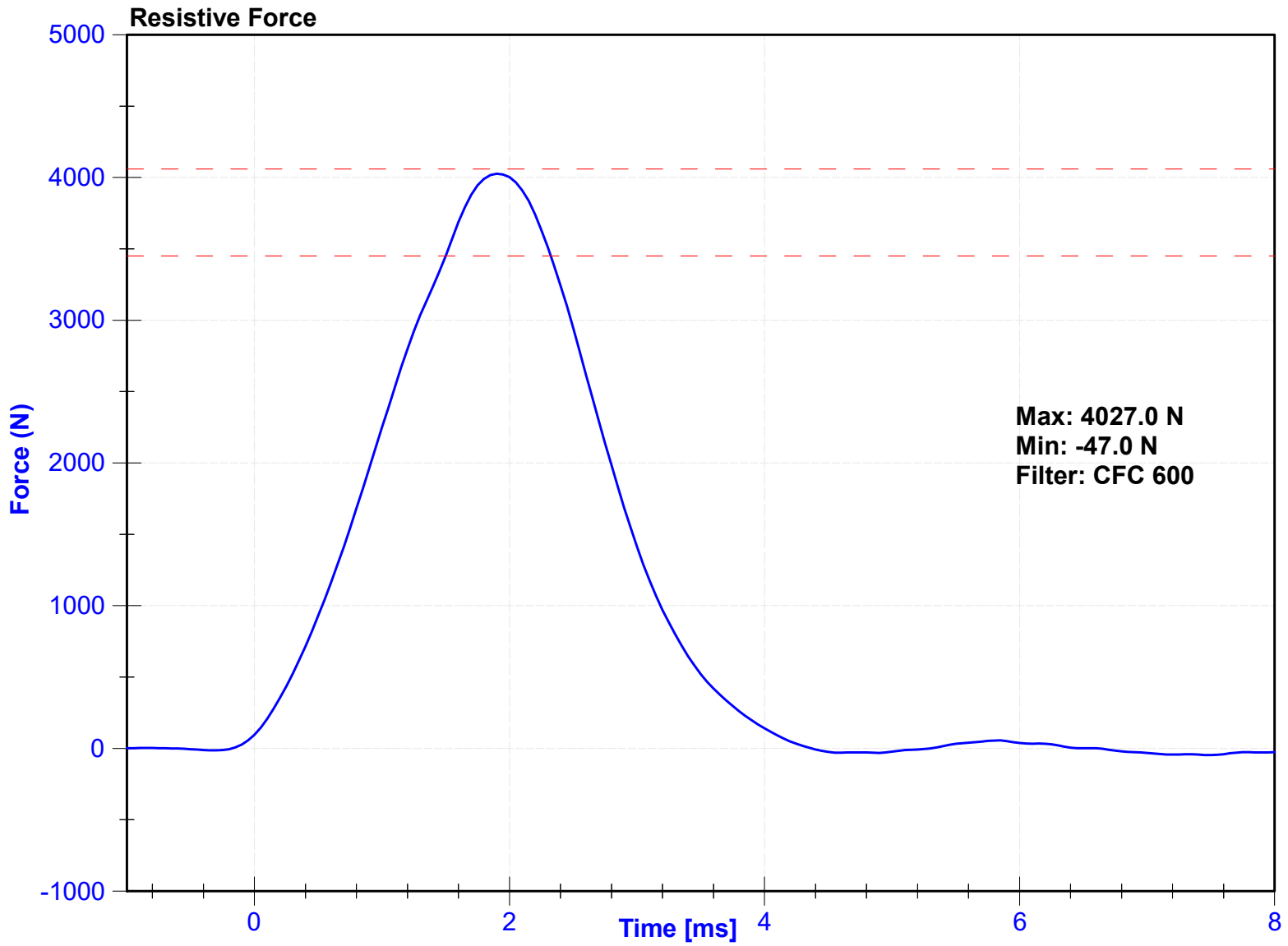
ATD Manufacturer	Humanetics	Test Technician	K. Konieczny
ATD Serial Number	137	Laboratory Supervisor	C. Mantell

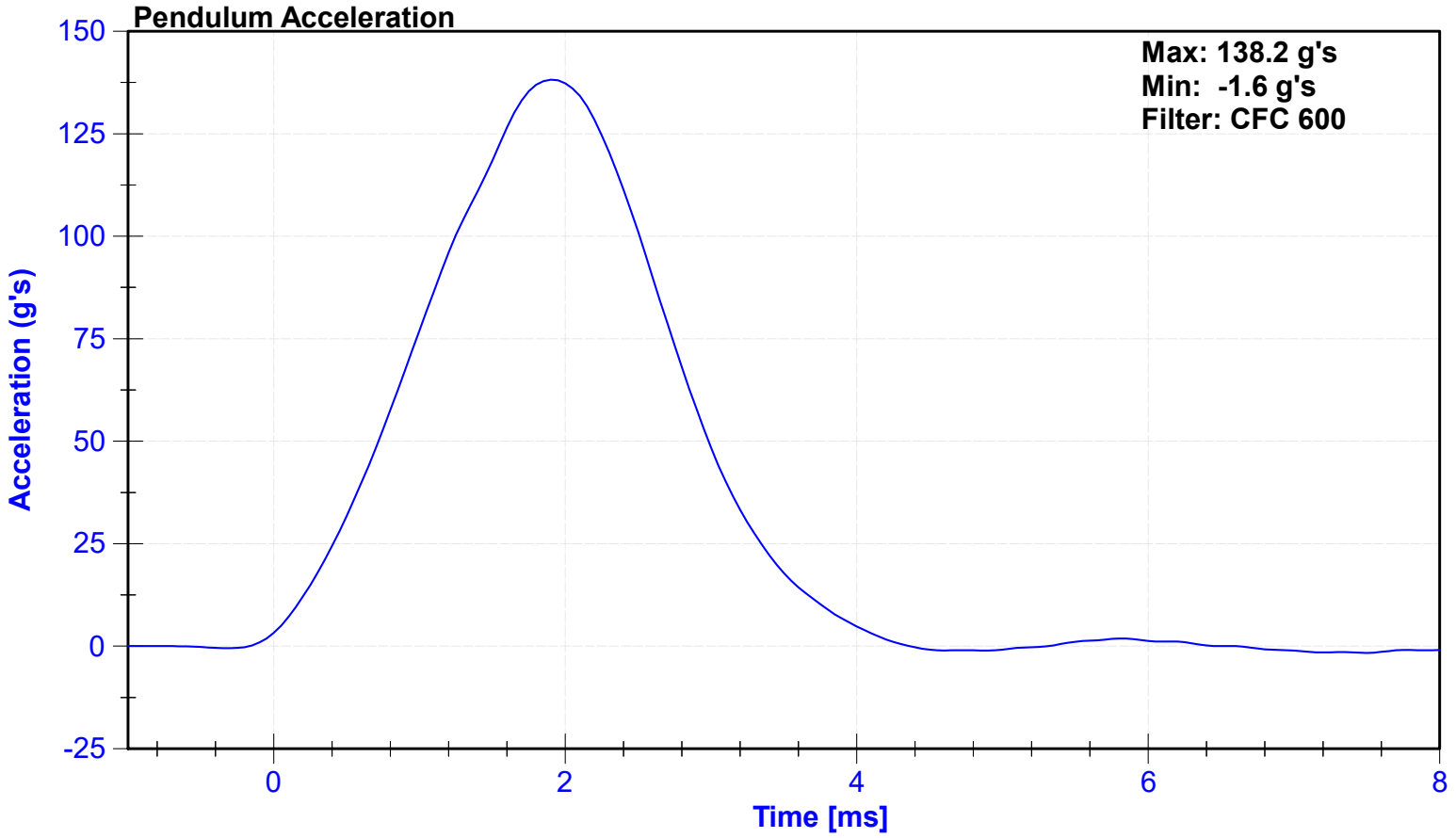
Results

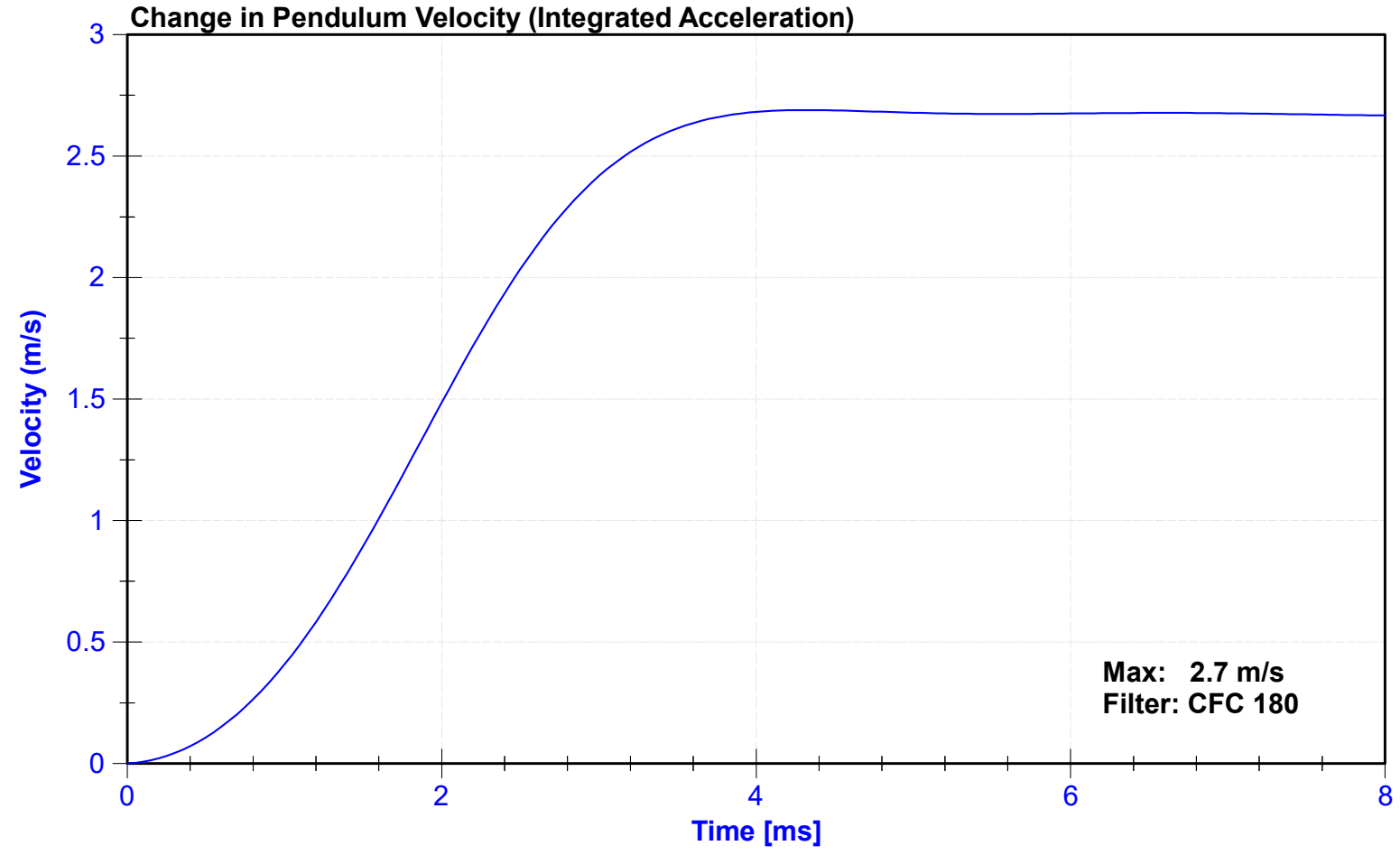
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	20.8	Pass
Humidity	10	70	%	57	Pass
Velocity	2.07	2.13	m/s	2.081	Pass
Resistive Force	3450	4060	N	4027.0	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18587	11/20/2023	11/19/2024




Pendulum Acceleration
Max: 138.2 g's
Min: -1.6 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]

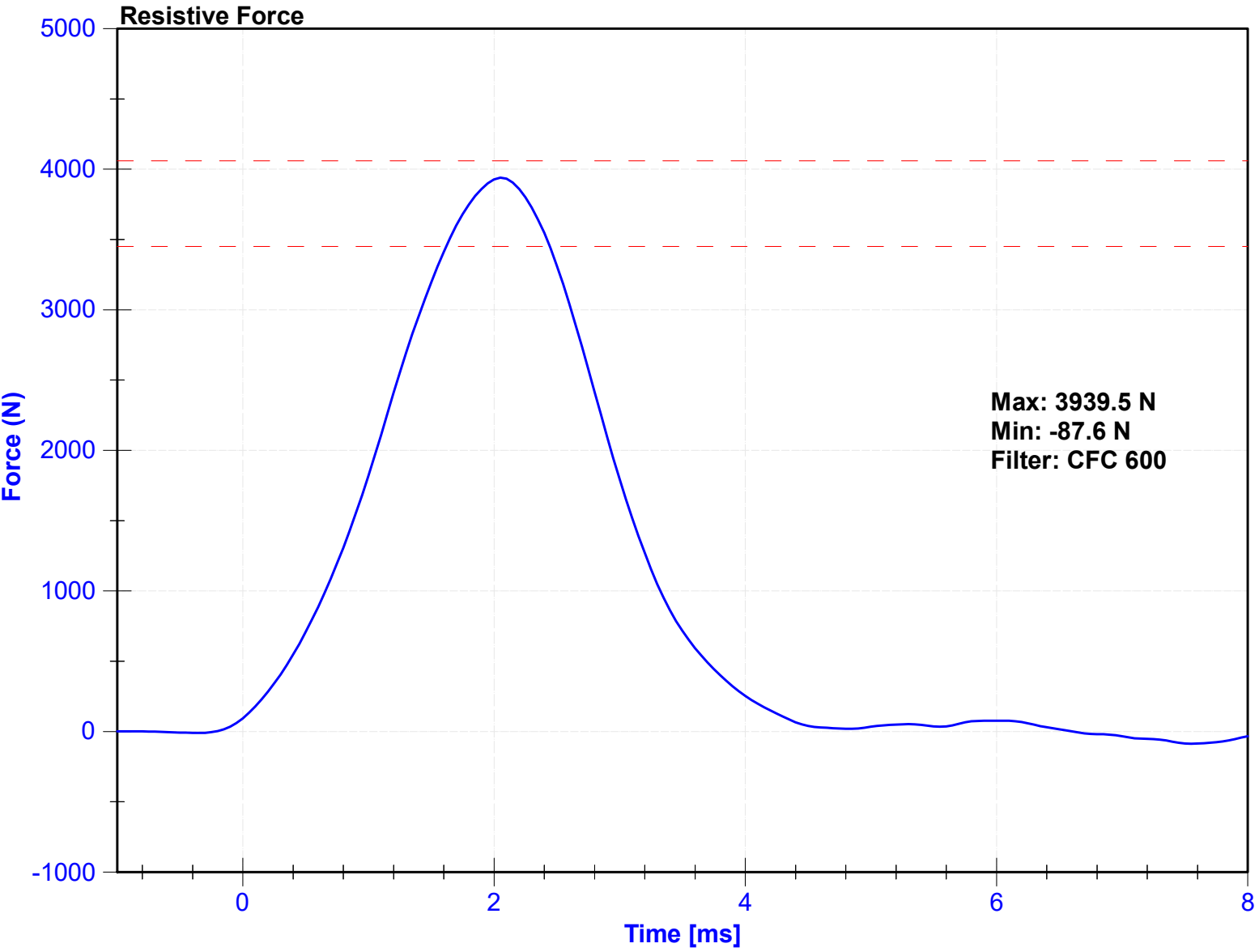
ATD Manufacturer	Humanetics	Test Technician	K. Konieczny
ATD Serial Number	137	Laboratory Supervisor	C. Mantell

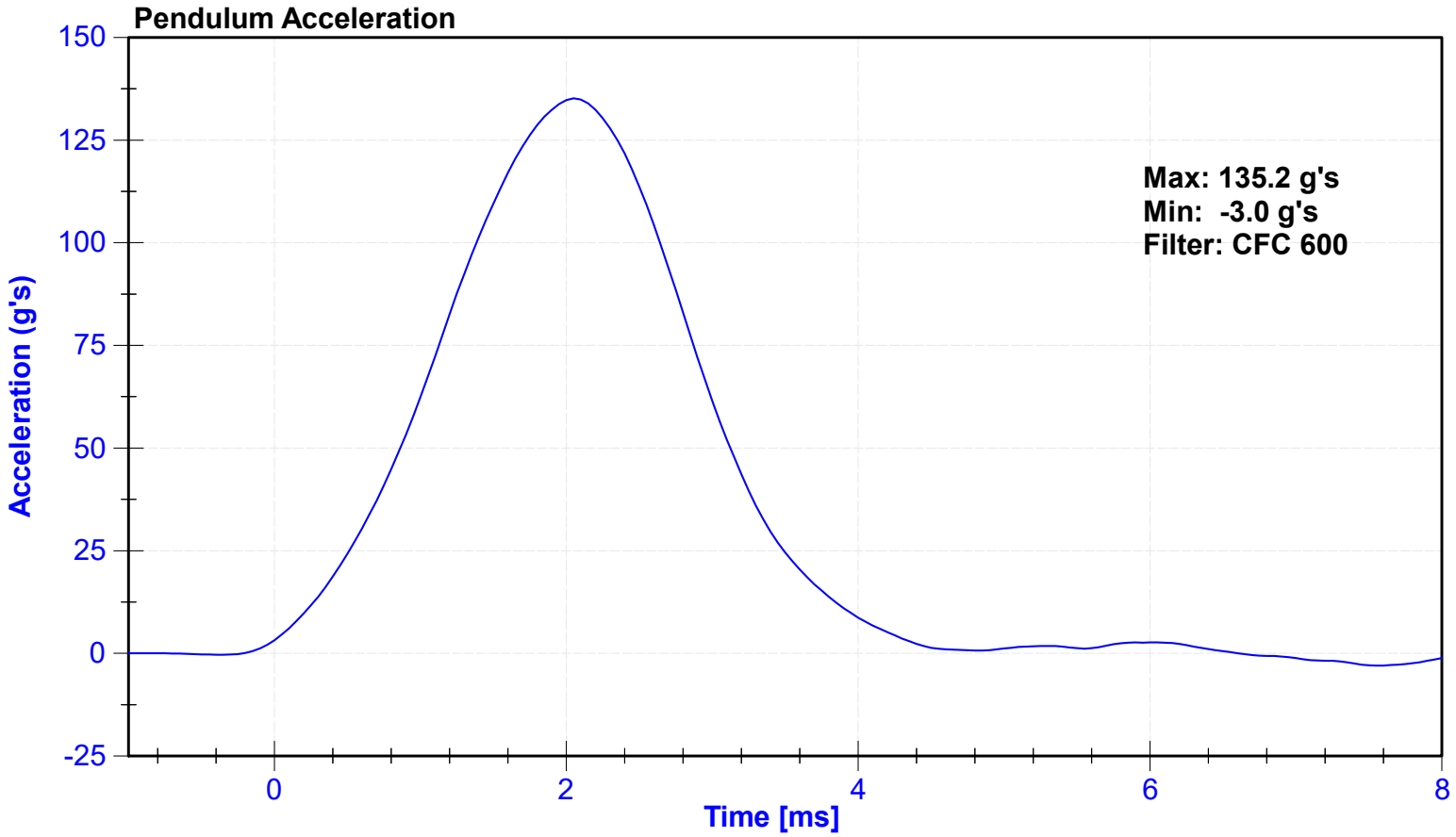
Results

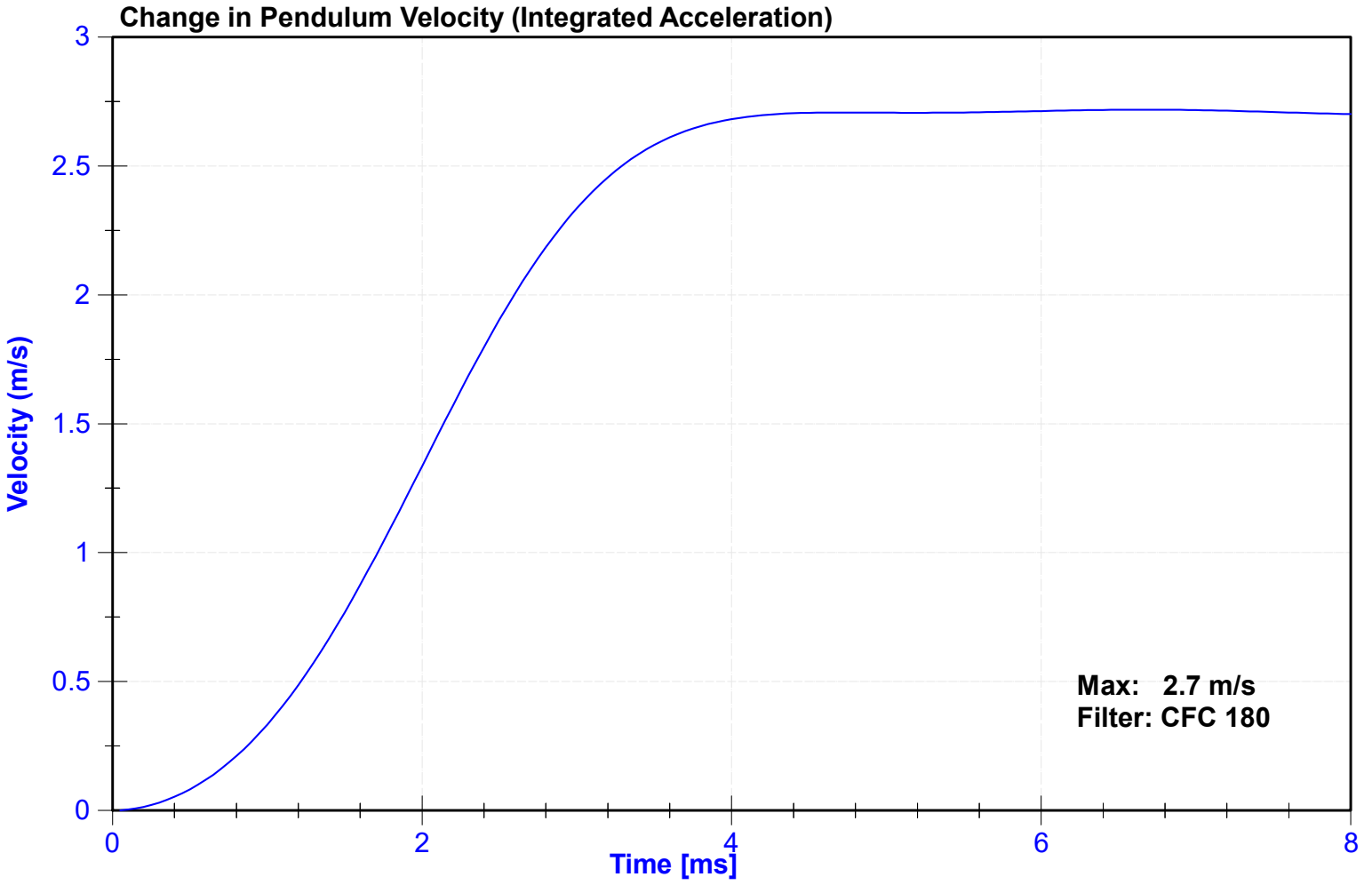
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	20.8	Pass
Humidity	10	70	%	57	Pass
Velocity	2.07	2.13	m/s	2.082	Pass
Resistive Force	3450	4060	N	3939.5	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18587	11/20/2023	11/19/2024




Pendulum Acceleration
Max: 135.2 g's
Min: -3.0 g's
Filter: CFC 600
Acceleration (g's)
Time [ms]
150
125
100
75
50
25
0
-25
0
2
4
6
8


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

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	851-FX	Humanetics	05/22/2024
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	117-FZ1	Denton	05/22/2024
	Redundant	Z	117-FZ2	Denton	05/22/2024
Femur Load Cells - Right	Primary	Z	109-FZ1	Denton	05/22/2024
	Redundant	Z	109-FZ2	Denton	05/22/2024
Tibia Load Cells - Left	Upper	MX, MY, FZ	652-FZ	Denton	05/20/2024
	Lower	MX, MY, FZ	360-FZ	Denton	05/20/2024
Tibia Load Cells – Right	Upper	MX, MY, FZ	371-FZ	Denton	05/20/2024
	Lower	MX, MY, FZ	360-FZ	Denton	05/20/2024
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		174	GFE	02/08/2024
	Shoulder		168	Denton	06/21/2024

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	08/19/2024
		Y	P83335	Endevco	08/19/2024
		Z	P64149	Endevco	08/19/2024
	Redundant	X	P52008	Endevco	08/19/2024
		Y	P52045	Endevco	08/19/2024
		Z	P74774	Endevco	08/19/2024
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	2184-FX	Denton	07/10/2024
Chest Accelerometers	Primary	X	P58780	Endevco	08/19/2024
		Y	P83346	Endevco	08/19/2024
		Z	P49190	Endevco	08/19/2024
	Redundant	X	P58794	Endevco	08/19/2024
		Y	P69791	Endevco	08/19/2024
		Z	T11253	Endevco	08/19/2024
Chest Potentiometer		X	0720	Servo	08/19/2024
Pelvis Accelerometer		X	P58735	Endevco	08/19/2024
		Y	P77587	Endevco	08/19/2024
		Z	P51285	Endevco	08/19/2024
Femur Load Cells - Left	Primary	Z	DT0998-FZ1	Denton	05/22/2024
	Redundant	Z	DT0998-FZ2	Denton	05/22/2024
Femur Load Cells - Right	Primary	Z	DH3271-FZ1	Denton	05/22/2024
	Redundant	Z	DH3271-FZ2	Denton	05/22/2024
Tibia Load Cells - Left	Upper	MX, MY, FZ	476-FZ	Denton	05/20/2024
	Lower	MX, MY, FZ	363-FZ	Denton	05/20/2024
Tibia Load Cells – Right	Upper	MX, MY, FZ	361-FZ	Denton	05/20/2024
	Lower	MX, MY, FZ	359-FZ	Denton	05/20/2024
Foot Accelerometers - Left	Rear	X	P78959	Endevco	08/19/2024
	Front	Z	P83418	Endevco	08/19/2024
Foot Accelerometers - Right	Rear	X	P63998	Endevco	08/19/2024
	Front	Z	P80265	Endevco	08/19/2024
Seat belt Load Cells	Lap		292	GFE	02/08/2024
	Shoulder		295	GFE	02/08/2024

Table 3 – Vehicle Instrumentation

Instrumentation			Axis	Serial Number	Manufacturer	Calibration Date
Crossmember/Rear Seat Accelerometers	Left	Primary	X	G25278	Endevco	07/18/2024
			Z	G25392	Endevco	07/18/2024
		Redundant	X	A350949	Measurement Specialties	07/18/2024
	Right	Primary	X	G23878	Endevco	06/21/2024
			Z	G24187	Endevco	06/21/2024
		Redundant	X	G24196	Endevco	06/21/2024
Engine Accelerometers	Top		X	G24336	Endevco	06/21/2024
	Bottom		X	G24235	Endevco	05/03/2024