REPORT NUMBER: SPNCAP-CAL-23-003

NEW CAR ASSESSMENT PROGRAM (NCAP)
FRONTAL BARRIER IMPACT TEST

FCA US LLC
2023 Jeep Grand Cherokee 4xe
5 Door SUV

NHTSA No: M20230302

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

December 8, 2023

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

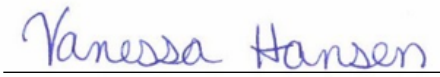
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Prepared by:  Date: December 8, 2023

Quinn Porzio, Test Engineer

Approved by:  Date: December 8, 2023

Vanessa Hansen, Operations Manager

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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4. Title and Subtitle Final Report of New Car Assessment Program Frontal Impact Testing and FMVSS No. 305 Indicant Testing of a 2023 Jeep Grand Cherokee 4xe 5 Door SUV NHTSA No.: M20230302		***5. Report Date*** December 8, 2023 ***6. Performing Organization Code*** CAL
7. Author(s) Quinn Porzio, Test Engineer Vanessa Hansen, Operations Manager		***8. Performing Organization Report No.*** CAL-DOT-2023-003
9. Performing Organization Name and Address Calspan Corporation Transportation Test Operations P.O. Box 400 Buffalo, New York 14225		***10. Work Unit No.*** ***11. Contract or Grant No.*** 693JJ919D000005
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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 2023 Jeep Grand Cherokee 4xe 5 Door SUV in accordance with the specifications of the Office of Crashworthiness Standards Laboratory Procedure for NCAP Full Frontal Rigid Barrier Impact Testing. This test was conducted to obtain data related to FMVSS Nos. 208, 212, 219 (partial), 301, and 305 performance. The test was conducted at Calspan Corporation's Transportation Test Operations facility in Buffalo, New York on February 22, 2023.

The impact velocity of the vehicle was 56.18 km/h, and the ambient temperature at the barrier face at the time of impact was 20.9 °C. The target vehicle post-test maximum crush was 537 mm at crush zone 2. The test vehicle's occupant performance data is as follows:

Measurement Description	Units	Driver ATD (Serial No. 142)		Passenger ATD (Serial No. 137)	
		Threshold	Result	Threshold	Result
Head Injury Criteria (HIC15)		700	172.227	700	122.445
Maximum Chest Compression	mm	63	-24.960	52	-13.843
Nij		1	0.340	1	0.294
Neck Tension	N	4170	882.937	2620	529.483
Neck Compression	N	4000	-46.505	2520	-73.855
Left Femur Force	N	10008	-1473.237	6805	-1444.439
Right Femur Force	N	10008	-705.939	6805	-1418.123

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SECTION 1

PURPOSE AND SUMMARY OF TEST

PURPOSE

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

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

SUMMARY

A load cell barrier consisting of 128 load cells was impacted by a 2023 Jeep Grand Cherokee 4xe 5 Door SUV at a velocity of 56.18 km/h. The test was performed at Calspan Corporation's Transportation Test Operations facility in Buffalo, New York on February 22, 2023. 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. 142) and the right-front passenger (position 2) ATD (Serial No. 137) were qualified prior to this test. Certification details, along with instrumentation calibration data, can be found in Appendix C of this report.

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

There was 98.6 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 537 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 passenger's visible contact points were as follows:

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)	172.227	0.340	882.937	-46.505	45.920	-24.960	-1473.237	-705.939
Passenger (5th)	122.445	0.294	529.483	-73.855	34.795	-13.843	-1444.439	-1418.123

GENERAL COMMENTS:

1. P1 (Driver) serial number - 142
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 Indicant FMVSS No. 212 and FMVSS No. 219 (Partial)

Data Sheet No. 16 – FMVSS 301 Barrier Impact and Static Rollover Results

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

Data Sheet No. 305-1 – General Test and Parameter Data for Indicant FMVSS No. 305 Testing

Data Sheet No. 305-2 – Pre-Impact Data for Indicant FMVSS No. 305 Testing

Data Sheet No. 305-3 – Pre-Impact Electrical Isolation Measurements and Calculations for Indicant FMVSS No. 305 Testing

Data Sheet No. 305-4 – Post-Impact Data for Indicant FMVSS No. 305 Testing

Data Sheet No. 305-5 –Static Rollover Test Data for Indicant FMVSS No. 305 Testing

DATA SHEET NO. 1
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle:	2023 Jeep Grand Cherokee 4xe 5 Door SUV	NHTSA No.:	M20230302
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	02/22/2023

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA No.	M20230302	Traction Control System (TCS)	Yes
Model Year	2023	Power Steering	Yes
Make	Jeep	Power Window Auto-Reverse	Yes
Model	Grand Cherokee 4xe	Driver Frontal Airbag	Yes
Body Style	SUV	Driver Curtain Airbag	Yes
VIN	1C4RJYB60P8785801	Driver Head/Torso Airbag	No
Body Color	Black	Driver Torso Airbag	No
Odometer Reading (km /mi)	11 Miles	Driver Torso/Pelvis Airbag	Yes
Engine Displacement (L)	2.0	Driver Pelvis Airbag	No
Type / No. Cylinders	I4 PHEV	Driver Knee Airbag	Yes
Engine Placement	Inline	Front Pass. Frontal Airbag	Yes
Transmission Type	Automatic	Front Pass. Curtain Airbag	Yes
Transmission Speeds	8-Speeds	Front Pass. Head/Torso Airbag	No
Overdrive	Yes	Front Pass. Torso Airbag	No
Final Drive	Four Wheel Drive	Front Pass. Torso/Pelvis Airbag	Yes
Roof Rack	No	Front Pass. Pelvis Airbag	No
Sunroof / T-Top	Yes	Front Pass. Knee Airbag	Yes
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	FCA US LLC	GVWR	3130
Date of Manufacture	1/23	GVWR Front	1452
		GVWR Rear	1724

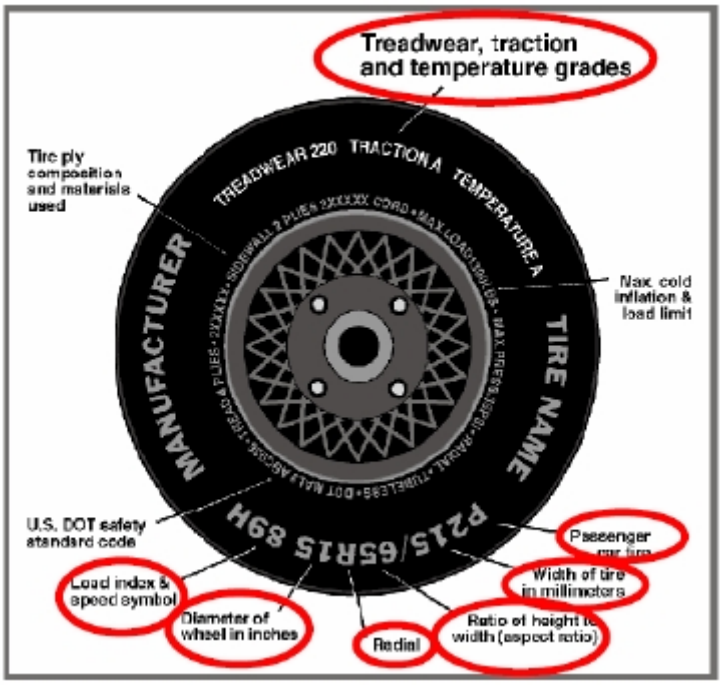
VEHICLE SEATING AND WEIGHT CAPACITY DATA

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)				476
Cargo Wt. (RCLW) (kg)				135.8

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

Test Vehicle:	2023 Jeep Grand Cherokee 4xe 5 Door SUV	NHTSA No.:	M20230302
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	02/22/2023

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



VEHICLE TIRE INFORMATION

Measured Parameter	Front	Rear
Maximum Tire Pressure (kPa)	300	300
Cold Pressure (kPa)	270	290
Recommended Tire Size	265/50R20	265/50R20
Tire Size on Vehicle	265/50R20	265/50R20
Tire Manufacturer	Bridgestone	Bridgestone
Tire Model	Dueler H/L	Dueler H/L
Treadwear	600	600
Traction	A	A
Temperature Grades	B	B
Tire Plies Sidewall	2 Polyester	2 Polyester
Tire Plies Body	2 Polyester, 2 Steel, 1 Nylon	2 Polyester, 2 Steel, 1 Nylon
Load Index / Speed Symbol	107T	107T
Tire Material	Rubber	Rubber
DOT Safety Code Left	7XUM4015222	7XUM4015222
DOT Safety Code Right	7XUM4014422	7XUM4015222

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

Test Vehicle: 2023 Jeep Grand Cherokee 4xe 5 Door SUV
NHTSA No.: M20230302
Test Program: NCAP Frontal Barrier Impact Test
Test Date: 02/22/2023

TEST VEHICLE WEIGHTS

	Units	As Delivered Weights (UVW)			As Tested Weights (ATW)		
		Front Axle	Rear Axle	Total	Front Axle	Rear Axle	Total
Left	kg	629.0	594.5		694.0	687.0	
Right	kg	655.0	569.0		670.0	668.0	
Ratio	%	52.5	47.5		50.2	49.8	
Total	kg	1284.0	1163.5	2447.5	1364.0	1355.0	2719.0

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value	
Total Delivered Weight (UVW)	kg	2447.5	(A)
Weight of 1 P572E ATD & 1 P572O ATD	kg	142	(B)
Rated Cargo / Luggage Weight (RCLW)	kg	135.8	(C)
Calculated Vehicle Target Weight (TVTW)	kg	2725.3	(A+B+C)

TEST VEHICLE ATTITUDES AND CG

Condition	Units	LF	RF	LR	RR	CG (aft of front axle)
As Delivered	mm	937	934	963	967	1409
As Tested	mm	927	927	939	940	1477
Post-Test	mm	1009	1020	926	928	

GENERAL TEST VEHICLE DATA

Measurement Description	Units	Value
Total Vehicle Wheel Base	mm	2964
Total Vehicle Length at Left Side	mm	4813
Total Vehicle Length at Centerline	mm	4901
Total Vehicle Length at Right Side	mm	4813
Weight of Ballast in Cargo Area	kg	93
Weight of Vehicle Components Removed	kg	56
Amount of Stoddard Solvent in Fuel Tank	L	67

LIST OF COMPONENTS REMOVED TO MEET TEST WEIGHT:

Trunk Carpeting, Spare Tire, Jack, Rear Speaker, EV Charger, Tool Kit, and Rear Plastic Trim

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

Test Vehicle:	2023 Jeep Grand Cherokee 4xe 5 Door SUV	NHTSA No.:	M20230302
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	02/22/2023

TARGET VEHICLE STRUCTURAL MEASUREMENT

No.	Description	Pre-Test
1	Total Length	4901
2	Total Width	1898
3*	Bumper Top Height	643
4*	Bumper Bottom Height	506
5*	Longitudinal Member Top Height	981
6	Distance Between Longitudinal Members	1210
7	Longitudinal Member Width	29
8*	Engine Top Height	983
9*	Engine Bottom Height	249
10	Engine and Gearbox Width	357
11	Front Bumper-Engine Distance	819
12*	Front Shock Absorber Fixing Height	1035
13*	Bonnet Leading Edge Height	1014
14	Front Shock Absorber Fixing Width	884
15	Front Bumper – Front Axle Distance	906
16	Front Axle – A Pillar Distance	647
17	A-Pillar – B-Pillar Distance	1151
18	B-Pillar – Rear Axle Distance	1165
19	B-Pillar – C-Pillar Distance	969
20*	Roof Sill Bottom Height	1680
21*	Roof Sill Top Height	1730
22*	Floor Sill Bottom Height	460
23*	Floor Sill Top Height	490

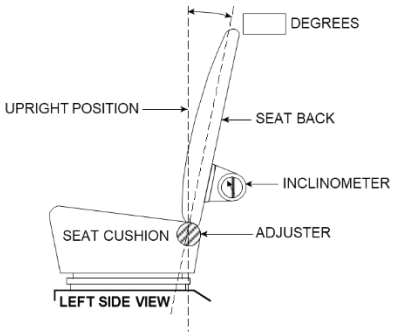
*Height Measurements are taken from the ground
Note: All measurements are in millimeters

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

Test Vehicle:	2023 Jeep Grand Cherokee 4xe 5 Door SUV	NHTSA No.:	M20230302
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	02/22/2023

NOMINAL DESIGN RIDING POSITION

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



FRONT SEAT ASSEMBLY

Seating Position	Degrees
Driver Seat Back Angle	4.9
Passenger Seat Back Angle	6.7

SEAT FORE / AFT POSITIONS

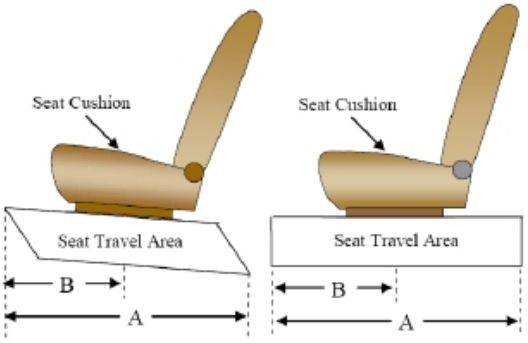
The driver's seat was positioned at the mid-point of fore/aft travel at its lowest position. The passenger's seat was positioned at the most forward position of fore/aft travel. Zero is defined as the forward most position.

Seating Position	Total Fore / Aft Travel	Placed in Position #
Driver Seat	312	156
Passenger Seat	316	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)	3



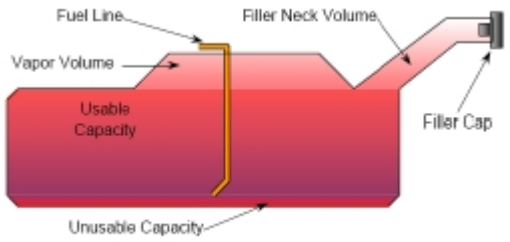
Test Vehicle:	2023 Jeep Grand Cherokee 4xe 5 Door SUV	NHTSA No.:	M20230302
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	02/22/2023

FUEL TANK CAPACITY

Description	Liters
Usable Capacity of "Standard Tank"	71.9
Usable Capacity of "Optional Tank"	N/A
92%-94% of Usable Capacity	66.15 - 67.59
Actual Amount of Solvent Used	67
1/3 of Usable Capacity	23.97

FUEL PUMP

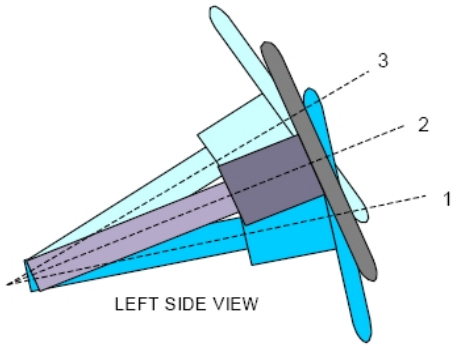
The vehicle is equipped with an electric fuel pump. The fuel filler neck is on the left side of the vehicle. The pump creates positive pressure in the fuel lines, pushing the gasoline to the engine. There is also a charge port on the left front of the vehicle to charge the HV battery. See form 1 for 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.



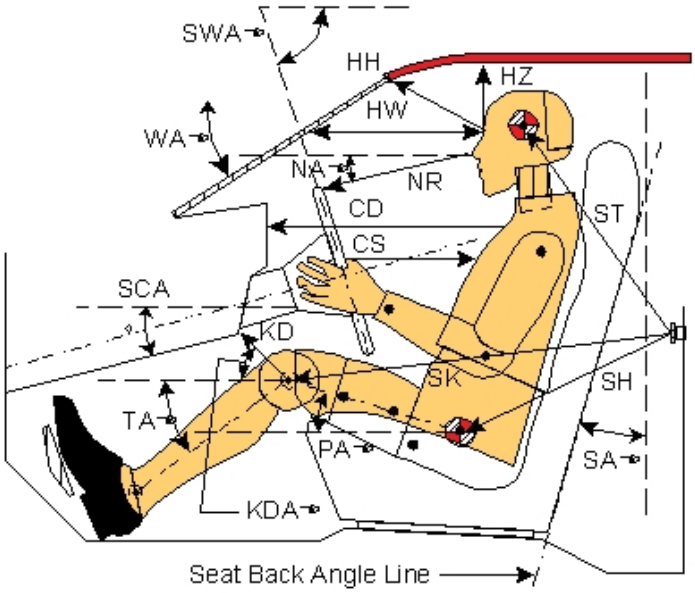
STEERING COLUMN ASSEMBLY

STEERING COLUMN POSITIONS

Description	Degrees	Fore / Aft Position (mm)
Lowermost position No. 1	20.1	
Geometric center position No. 2	22.7	
Uppermost position No. 3	25.2	
Telescoping Steering Wheel Travel		72
Test Position	22.7	36

DATA SHEET NO. 3
DUMMY LONGITUDINAL CLEARANCE DIMENSIONS

Test Vehicle: 2023 Jeep Grand Cherokee 4xe 5 Door SUV
NHTSA No.: M20230302
Test Program: NCAP Frontal Barrier Impact Test
Test Date: 02/22/2023

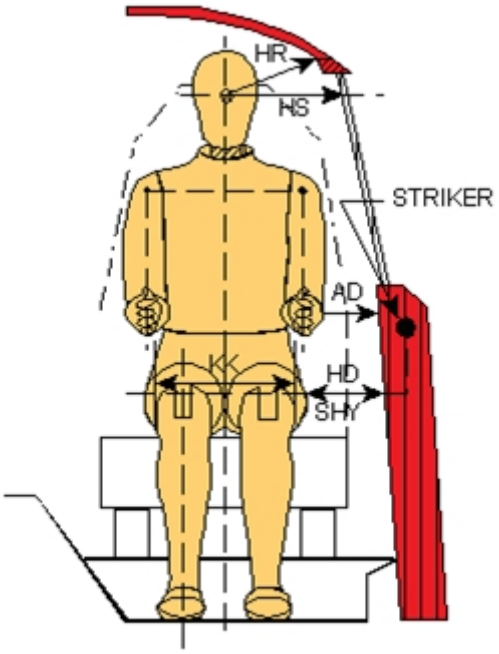


Left Side View

Code	Measurement Description	Driver (SN: 142)		Passenger (SN: 137)	
		Length (mm)	Angle (°)	Length (mm)	Angle (°)
WA°	Windshield Angle		30.3		
SWA°	Steering Wheel Angle		22.8		
SCA°	Steering Column Angle		67.2		
SA°	Seat Back Angle (on headrest post)		4.9		6.7
HZ	Head to Roof (Z)	200	90.0	218	90.0
HH	Head to Header	487	21.3	358	39.3
HW	Head to Windshield	744	0.0	665	0.0
NR	Nose to Rim / Dash	448	6.4	462	27.6
CD	Chest to Dash	615		386	
CS	Chest to Steering Hub	366	0.8		
RA	Rim to Abdomen	244	3.7		
KDL	Left Knee to Dash	228	27.8	112	35.9
KDR	Right Knee to Dash	220	24.4	127	31.0
PA°	Pelvic Angle		22.6		19.6
TA°	Tibia Angle		26.4		47.8
SK	Striker to Knee	530	3.0	662	0.5
ST	Striker to Head	570	85.6	550	71.6
SH	Striker to H-Point	163	45.1	299	16.6

DATA SHEET NO. 4
DUMMY LATERAL CLEARANCE DIMENSIONS

Test Vehicle:	2023 Jeep Grand Cherokee 4xe 5 Door SUV	NHTSA No.:	M20230302
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	02/22/2023

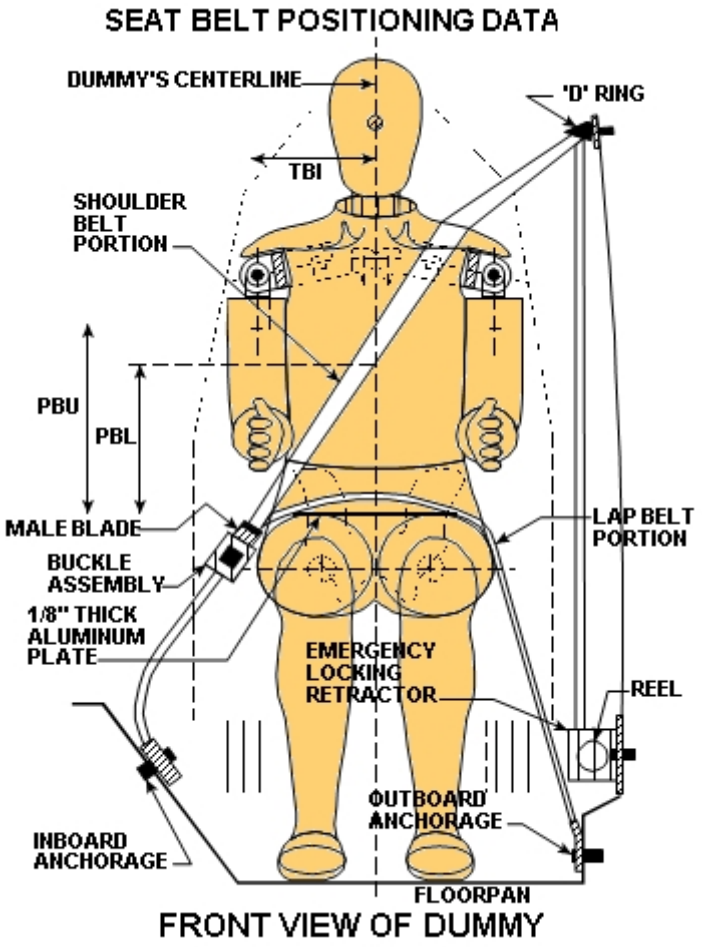


Front View

Code	Description	Driver (mm)	Passenger (mm)
AD	Arm to Door	105	125
HD	H-Point to Door	164	192
HR	Head to Side Header	244	285
HS	Head to Side Window	368	394
KK	Knee to Knee	315	211
SHY	Striker to H-Point (Y Direction)	260	295
AA	Ankle to Ankle	316	164

DATA SHEET NO. 5
SEAT BELT POSITIONING DATA

Test Vehicle:	2023 Jeep Grand Cherokee 4xe 5 Door SUV	NHTSA No.:	M20230302
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	02/22/2023



SEAT BELT POSITIONING MEASUREMENTS

Measurement Description	Units	Driver	Passenger
PBU — Top surface of reference to belt upper edge	mm	350	270
PBL — Top surface of reference to belt lower edge	mm	260	185

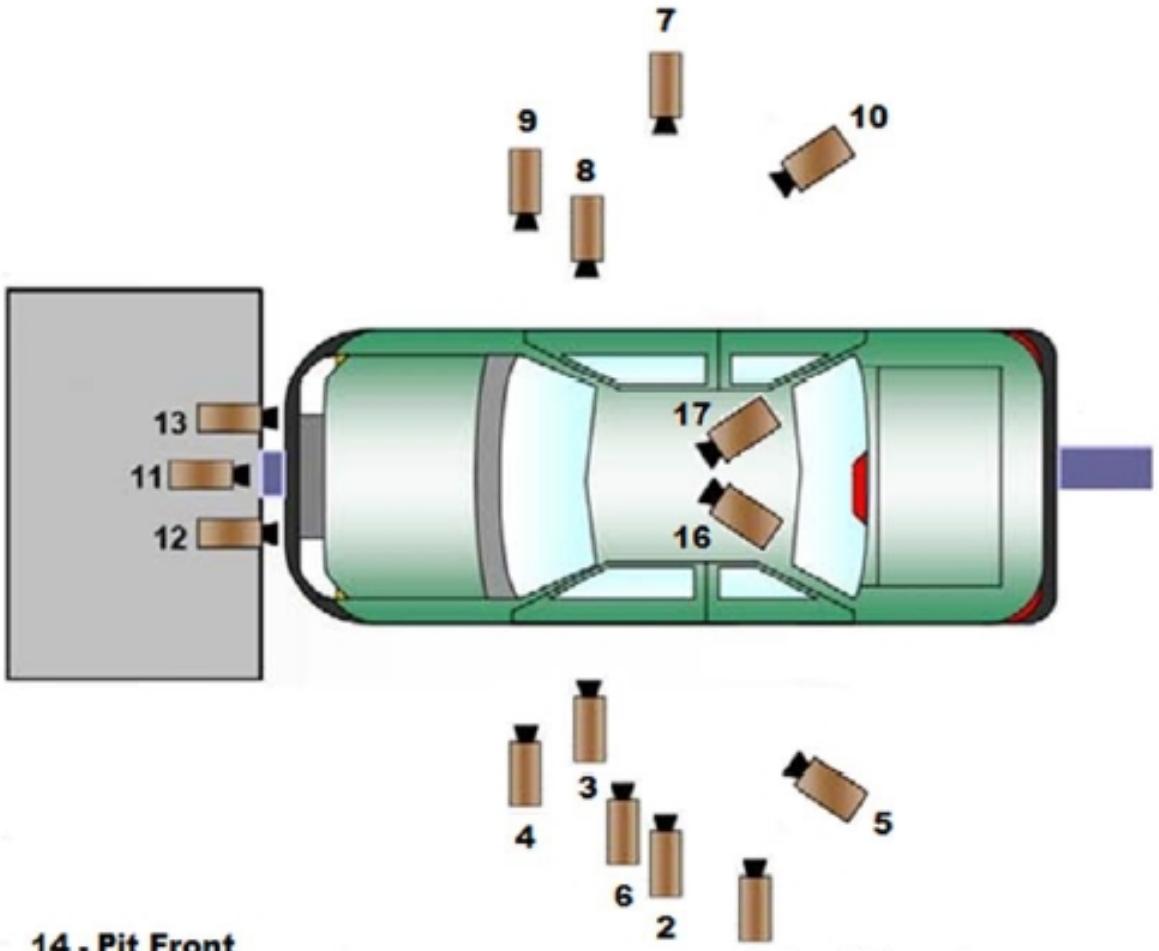
BELT LENGTH DATA

Measurement Description	Units	Driver	Passenger
Shoulder belt length as measured on ATD	mm	820	885
Lap Belt Length as measured on ATD	mm	640	740
Remainder of belt on reel	mm	940	775
Total belt length for continuous webbing systems	mm	2400	2400

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

Test Vehicle:	2023 Jeep Grand Cherokee 4xe 5 Door SUV	NHTSA No.:	M20230302
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	02/22/2023

CAMERA POSITIONS FOR FRONTAL IMPACTS



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

Test Vehicle:	2023 Jeep Grand Cherokee 4xe 5 Door SUV	NHTSA No.:	M20230302
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	02/22/2023

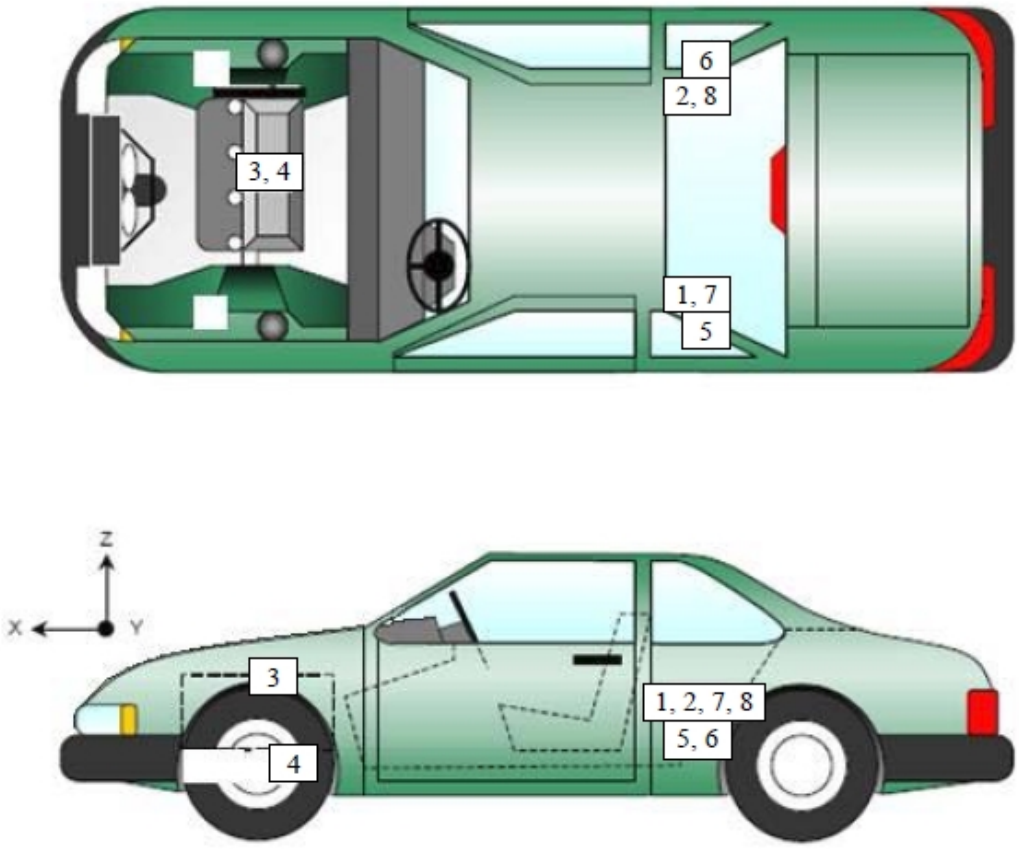
CAMERA LOCATIONS

No.	Camera View	Location (mm)			Lens (mm)	Speed (fps)
		X	Y	Z		
1	Real-Time Left Overall				Zoom	60
2	Left Overall	-2278	-8132	-144	24	1000
3	Driver Close-Up	-1620	-7296	-1536	50	1000
4	Left Front Half	-916	-6765	-1374	28	1000
5	Left Angle	-4235	-4492	-2407	50	1000
6	Steering Column	-1772	-8394	-2352	75	1000
7	Right Overall	-2499	8000	-1417	24	1000
8	Passenger Close-Up	-1837	7322	-1404	50	1000
9	Right Front Half	-1273	6599	-1414	28	1000
10	Right Angle	-4311	-4934	-2480	50	1000
11	Windshield	1186	0	-4150	12.5	1000
12	Driver Windshield	843	-400	-2330	25	1000
13	Passenger Windshield	843	400	-2330	25	1000
14	Pit Front	-1044	0	2668	12.5	1000
15	Pit Rear	-2954	0	2664	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:	2023 Jeep Grand Cherokee 4xe 5 Door SUV	NHTSA No.:	M20230302
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	02/22/2023



VEHICLE ACCELEROMETER PRE-TEST LOCATIONS

No.	Accelerometer Location	Measurements (mm)		
		X	Y	Z
1	Left Rear Accelerometer – X Direction	1896	-371	210
2	Right Rear Accelerometer – X Direction	1894	392	223
3	Engine Top X	3958	135	-267
4	Engine Bottom X	3950	40	446
5	Left Rear Accelerometer – Z Direction	1896	-371	210
6	Right Rear Accelerometer – Z Direction	1894	392	223
7	Left Rear Accelerometer – X Direction Redundant	1895	-395	211
8	Right Rear Accelerometer – X Direction Redundant	1894	367	221

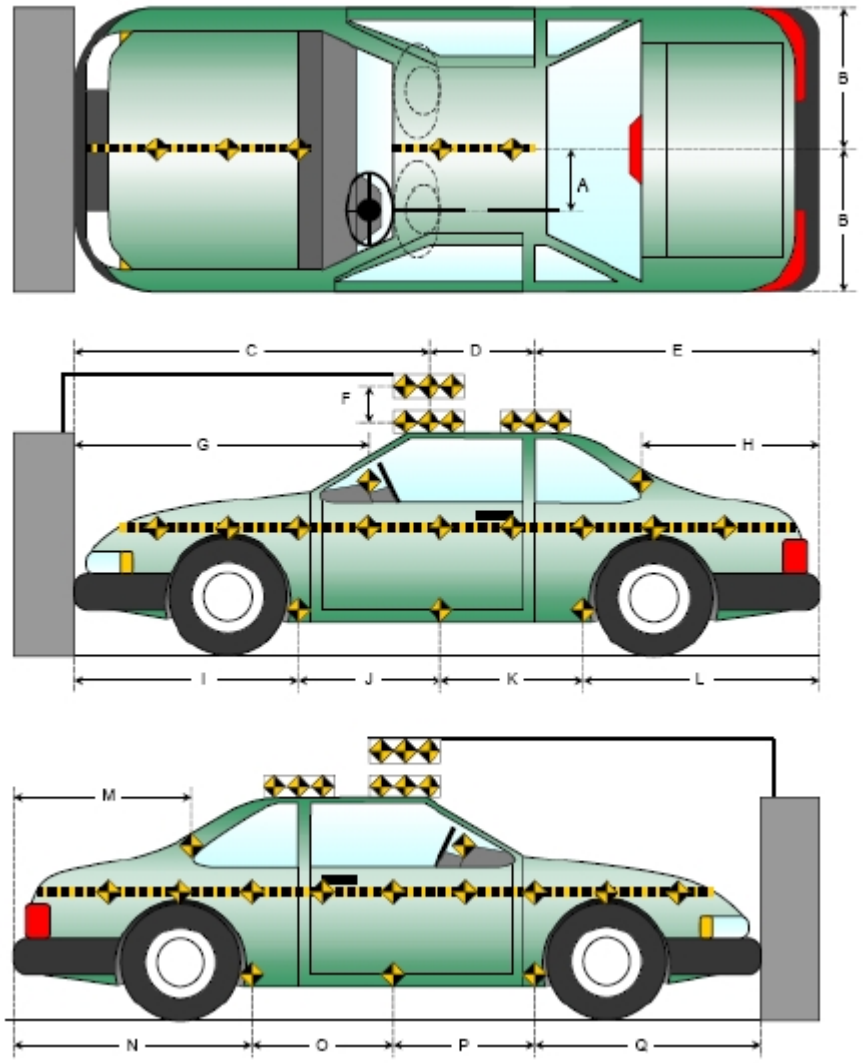
Reference Points: *X – Rear Surface of Vehicle (+ forward)*
Y – Vehicle Centerline (+ to right)
Z – Ground Plane (+ down)

DATA SHEET NO. 8
PHOTOGRAPHIC REFERENCE TARGET LOCATIONS

Test Vehicle:	2023 Jeep Grand Cherokee 4xe 5 Door SUV	NHTSA No.:	M20230302
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	02/22/2023

Item	Value
A	370
B	949
C	2773
D	610
E	1518
F	205
G	1986
H	1170
I	1467
J	924
K	933
L	1577
M	1168
N	1564
O	937
P	931
Q	1469

All units in millimeters



DATA SHEET NO. 9
LOAD CELL LOCATIONS ON FIXED BARRIER

Test Vehicle:	2023 Jeep Grand Cherokee 4xe 5 Door SUV	NHTSA No.:	M20230302
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	02/22/2023

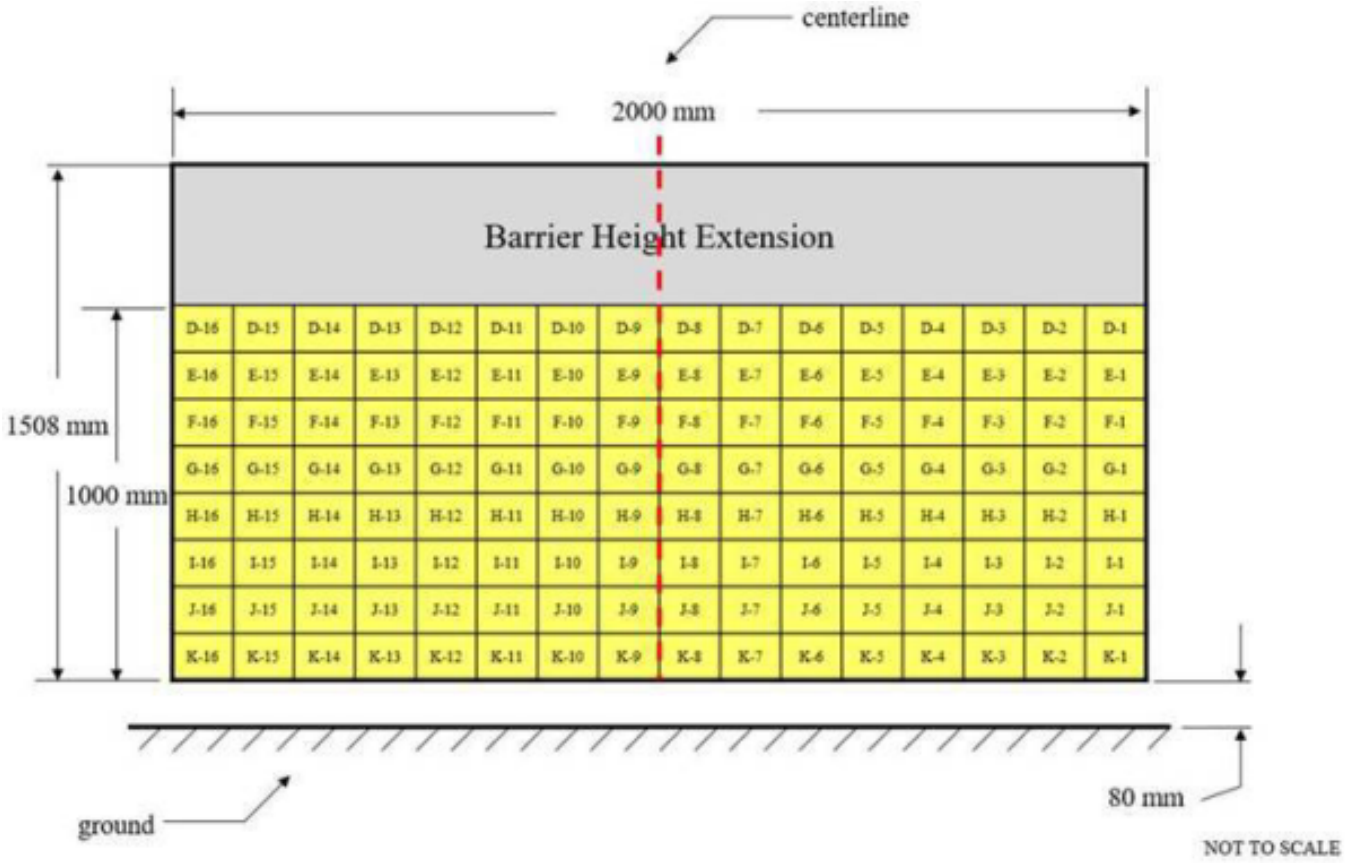


Figure 1 - Load Cell Locations on a 128-Load Cell Barrier with Plywood Height Extension*
Please note above diagram is not actual representation of load cell barrier used.

DATA SHEET NO. 10
TEST VEHICLE SUMMARY OF RESULTS

Test Vehicle:	2023 Jeep Grand Cherokee 4xe 5 Door SUV	NHTSA No.:	M20230302
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	02/22/2023

INSTRUMENTATION

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

CAMERA COVERAGE

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

DATA SHEET NO. 11
POST-TEST OBSERVATIONS

Test Vehicle: 2023 Jeep Grand Cherokee 4xe 5 Door SUV
NHTSA No.: M20230302
Test Program: NCAP Frontal Barrier Impact Test
Test Date: 02/22/2023

TEST DUMMY INFORMATION AND CONTACT LOCATIONS

Description	Driver	Passenger
Dummy Type / Serial No.	H3 50th Male/142	H3 5th Female/137
Head Contact	Frontal Airbag & Headrest	Frontal Airbag & Headrest
Upper Torso Contact	Frontal Airbag	Frontal Airbag
Lower Torso Contact	None	None
Left Knee Contact	Knee Airbag	Knee Airbag
Right Knee Contact	Knee Airbag	Knee Airbag

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	Cracked Throughout
Window Damage	None
Other	None

VEHICLE REBOUND FROM BARRIER

Measured Parameter	Units	Value
Left Side	mm	779
Center	mm	770
Right Side	mm	830
Average	mm	793

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

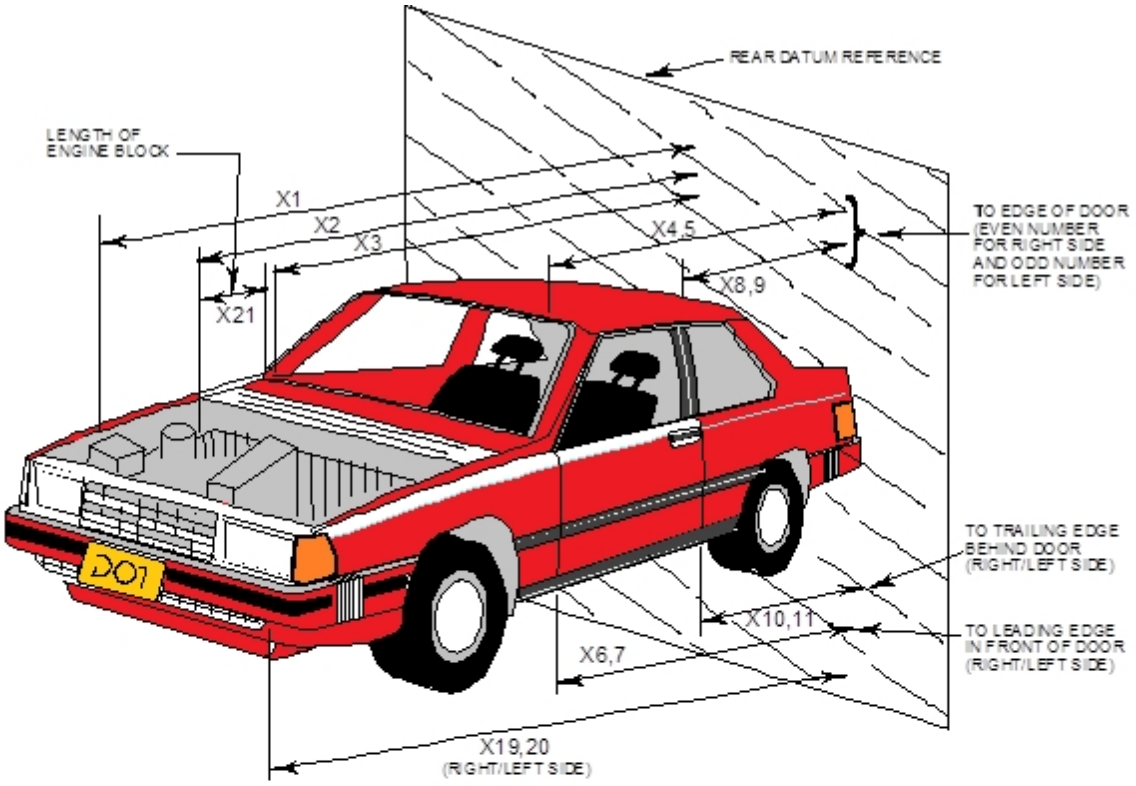
Test Vehicle: 2023 Jeep Grand Cherokee 4xe 5 Door SUV NHTSA No.: M20230302
Test Program: NCAP Frontal Barrier Impact Test Test Date: 02/22/2023

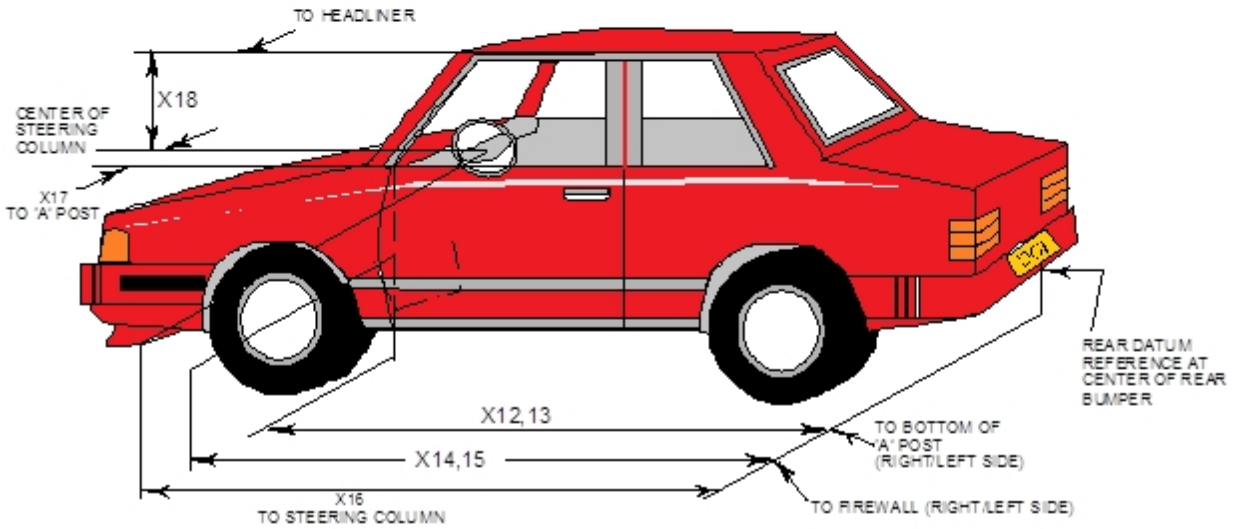
SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

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

DATA SHEET NO. 12
VEHICLE PROFILE MEASUREMENTS

Test Vehicle:	2023 Jeep Grand Cherokee 4xe 5 Door SUV	NHTSA No.:	M20230302
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	02/22/2023





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

Test Vehicle: 2023 Jeep Grand Cherokee 4xe 5 Door SUV NHTSA No.: M20230302
Test Program: NCAP Frontal Barrier Impact Test Test Date: 02/22/2023

No.	Measurement Description	Pre-Test	Post-Test	Change
1	Total Length of Vehicle at Centerline	4901	4369	-532
2	Rear Surface of Vehicle (RSOV) to Front of Engine	4082	3927	-155
3	RSOV to Firewall	3838	3820	-18
4	RSOV to Upper Leading Edge of Right Door	3349	3342	-7
5	RSOV to Upper Leading Edge of Left Door	3348	3347	-1
6	RSOV to Lower Leading Edge of Right Door	3329	3319	-10
7	RSOV to Lower Leading Edge of Left Door	3327	3324	-3
8	RSOV to Upper Trailing Edge of Right Door	2207	2199	-8
9	RSOV to Upper Trailing Edge of Left Door	2206	2204	-2
10	RSOV to Lower Trailing Edge of Right Door	2266	2260	-6
11	RSOV to Lower Trailing Edge of Left Door	2262	2259	-3
12	RSOV to Bottom of “A” Post of Right Side	3423	3415	-8
13	RSOV to Bottom of “A” Post of Left Side	3423	3421	-2
14	RSOV to Firewall, Right Side	3815	3790	-25
15	RSOV to Firewall, Left Side	3778	3769	-9
16	RSOV to Steering Column	2818	2907	89
17	Center of Steering Column to “A” Post	290	284	-6
18	Center of Steering Column to Headliner	424	458	34
19	RSOV to Right Side of Front Bumper	4848	4333	-515
20	RSOV to Left Side of Front Bumper	4849	4331	-518
21	Length of Engine Block	311	311	0
RD	RSOV to Right Side of Dash Panel	3136	3130	-6
CD	RSOV to Center of Dash Panel	3061	3056	-5
LD	RSOV to Left Side of Dash Panel	3134	3132	-2

All Dimensions in mm

DATA SHEET NO. 13
ACCIDENT INVESTIGATION DIVISION DATA

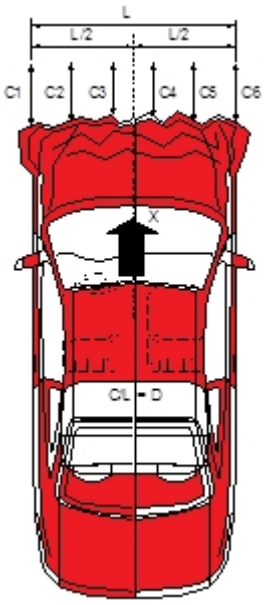
Test Vehicle:	2023 Jeep Grand Cherokee 4xe 5 Door SUV	NHTSA No.:	M20230302
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	02/22/2023

VEHICLE INFORMATION

VIN:	1C4RJYB60P8785801	Wheelbase (mm):	2964
Vehicle Size Category:	MPV	Test Weight (kg):	2719.0

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):	56.18
Velocity Change (km/h):	66.2
Time of Separation (ms):	145



CRUSH PROFILE

Collision Deformation Classification:	12FDEW3
Midpoint of Damage:	C3
Damage Region Length (mm):	1610
Impact Mode:	Frontal

No.	Measurement Description	Units	Pre-Test	Post-Test	Crush
C1	Crush Zone 1 at Left Side	mm	4692	4278	414
C2	Crush Zone 2 at Left Side	mm	4859	4322	537
C3	Crush Zone 3 at Left Side	mm	4897	4366	531
C4	Crush Zone 4 at Right Side	mm	4897	4368	529
C5	Crush Zone 5 at Right Side	mm	4858	4321	537
C6	Crush Zone 6 at Right Side	mm	4693	4377	316
L	C1 to C6	mm	1552	1610	-58

DATA SHEET NO. 14
VEHICLE INTRUSION MEASUREMENTS

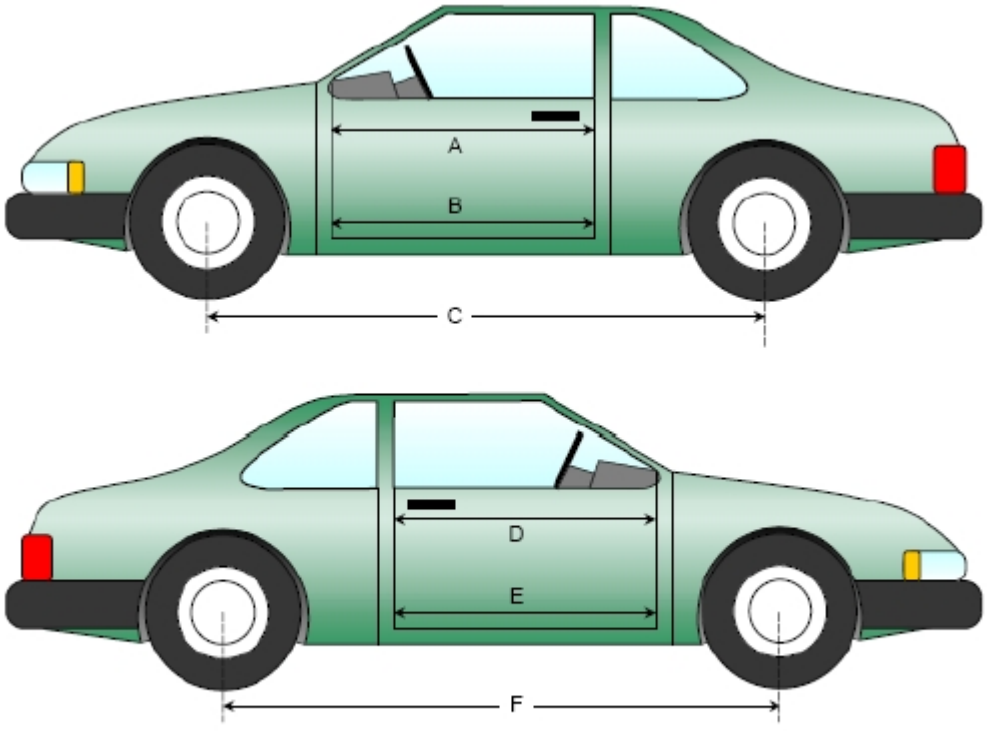
Test Vehicle:	2023 Jeep Grand Cherokee 4xe 5 Door SUV	NHTSA No.:	M20230302
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	02/22/2023

DOOR OPENING WIDTH

Item	Description	Units	Pre-Test	Post-Test	Change
A	Left Side Upper	mm	975	975	0
B	Left Side Lower	mm	868	868	0
D	Right Side Upper	mm	977	974	-3
E	Right Side Lower	mm	866	864	-2

WHEELBASE MEASUREMENTS

Item	Description	Units	Pre-Test	Post-Test	Change
C	Left Side Wheelbase	mm	2964	2871	-93
F	Right Side Wheelbase	mm	2964	2934	-30



Left & Right Side Views

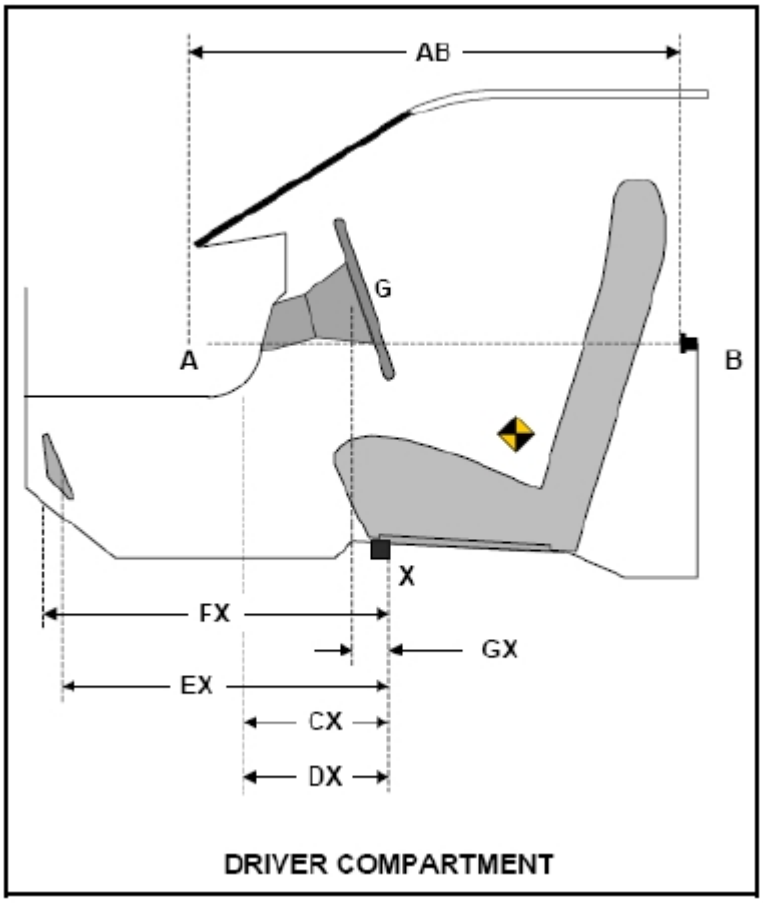
DATA SHEET NO.14 … (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2023 Jeep Grand Cherokee 4xe 5 Door SUV
NHTSA No.: M20230302
Test Program: NCAP Frontal Barrier Impact Test
Test Date: 02/22/2023

DRIVER COMPARTMENT INTRUSION

Item	Description	Units	Pre-Test	Post-Test	Change
AB	Door Opening (Inside Window Jam)	mm	768	766	-2
CX	Left Knee Bolster to X	mm	353	352	-1
DX	Right Knee Bolster to X	mm	327	326	-1
EX	Brake Pedal to X	mm	583	553	-30
FX	Foot Rest to X	mm	611	604	-7
GX	Center of Steering Column Wheel Hub to X	mm	86	174	88

X = Front of Seat Track (Stationary)



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

Test Vehicle:	2023 Jeep Grand Cherokee 4xe 5 Door SUV	NHTSA No.:	M20230302
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	02/22/2023

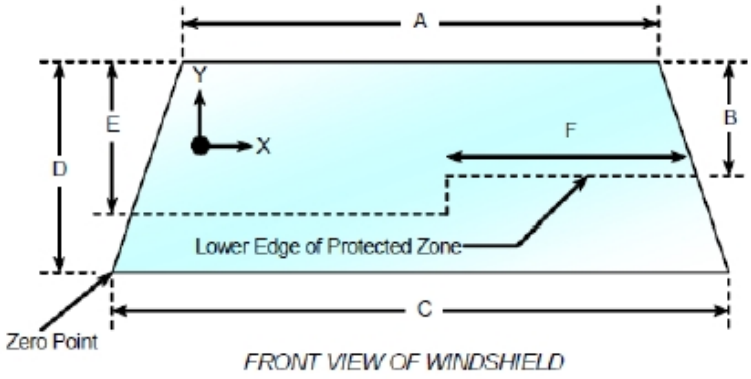
Windshield Mounting Details: A trim surrounds the top and side of windshield while a plastic shroud is on the bottom.

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: 20.9 °C

WINDSHIELD PERIPHERY MEASUREMENTS

Measurement	Pre-Test (mm)	Post-Test (mm)	% Retention
Left Side	2288.5	2227.5	97.3%
Right Side	2288.5	2288.5	100.0%
Total	4577	4516	98.6%



FRONT VIEW OF WINDSHIELD

Item	Units	Value
A	mm	1344
B	mm	475
C	mm	1625
D	mm	804
E	mm	409
F	mm	561

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:	2023 Jeep Grand Cherokee 4xe 5 Door SUV	NHTSA No.:	M20230302
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	02/22/2023

FMVSS 301 FUEL SYSTEM INTEGRITY POST IMPACT DATA

Temperature at Time of Impact: 20.9°C Test Time: 9:51 AM

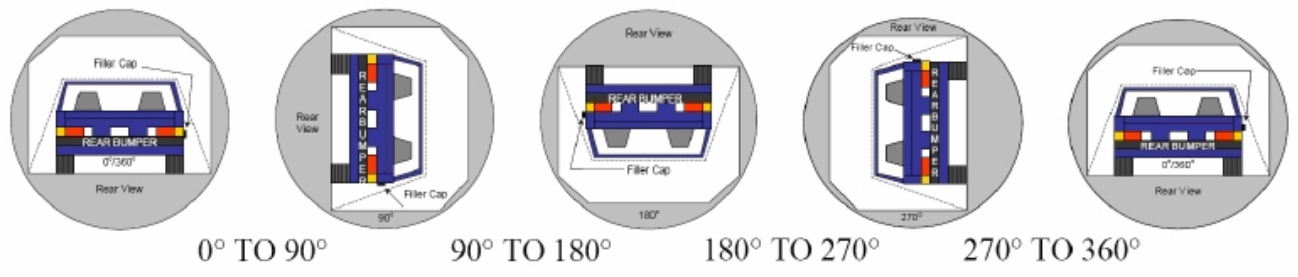
STODDARD SOLVENT SPILLAGE MEASUREMENTS

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 Detail: No Spillage Occurred

DATA SHEET NO. 16
FMVSS 301 STATIC ROLLOVER RESULTS

Test Vehicle:	2023 Jeep Grand Cherokee 4xe 5 Door SUV	NHTSA No.:	M20230302
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	02/22/2023



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°	67	300	367
90° to 180°	68	300	368
180° to 270°	61	300	361
270° to 360°	70	300	370

FMVSS 301 SPILLAGE TABLE

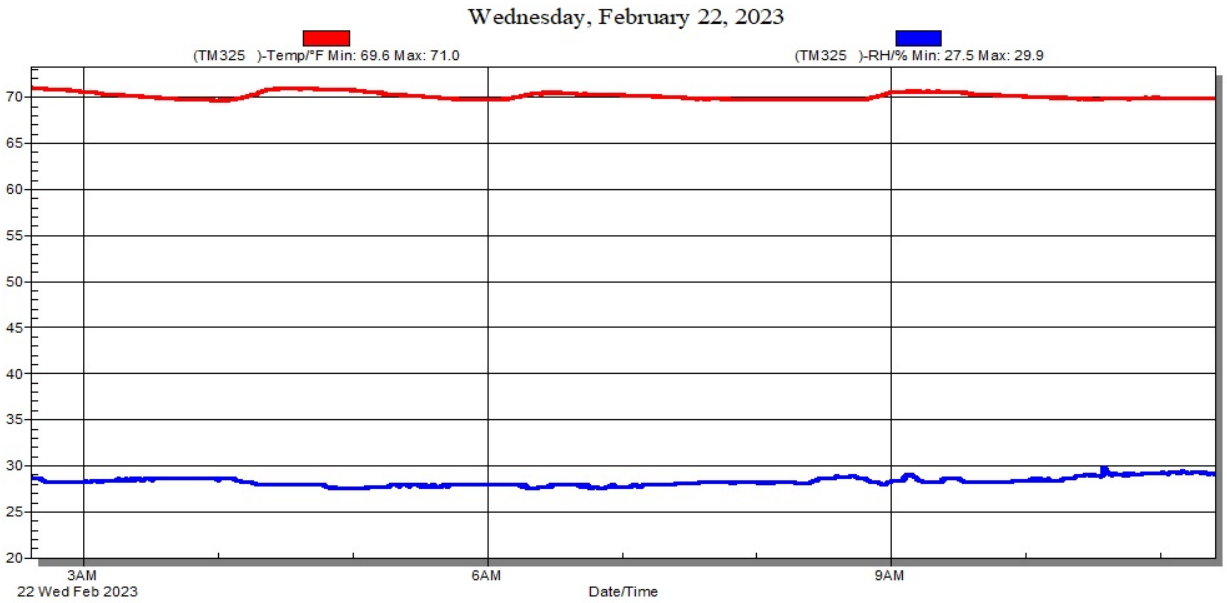
Test Phase	First 5 Minutes	Sixth Minute	Seventh Minute	Eighth Minute
0° to 90°	0	0	0	
90° to 180°	0	0	0	
180° to 270°	0	0	0	
270° to 360°	0	0	0	

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:	2023 Jeep Grand Cherokee 4xe 5 Door SUV	NHTSA No.:	M20230302
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	02/22/2023



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

DATA SHEET NO. 305-1
GENERAL TEST AND VEHICLE PARAMETER DATA FOR INDICANT FMVSS NO. 305 TESTING

Test Vehicle:	2023 Jeep Grand Cherokee 4xe 5 Door SUV	NHTSA No.:	M20230302
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	02/22/2023

ELECTRIC VEHICLE PROPULSION SYSTEM

Measured Parameter	Value
Type of Electric Vehicle (Electric/Gas-Electric Hybrid/Fuel Cell-Electric Hybrid)	Gasoline-Electric Hybrid
Propulsion Battery Type	NMC Lithium Ion Polymer
Nominal Voltage (Volts)	400
Is this Vehicle equipped with an Automatic Propulsion Battery Disconnect?	Yes
Physical Location of Automatic Propulsion Battery Disconnect, if applicable	Located on Driver's Side of Trunk
Auxiliary Battery Type	N/A

PROPULSION BATTERY SYSTEM DATA (COTR SUPPLIED)

Measured Parameter	Value
Electrolyte Fluid Type	Organic solvent – carbonate based
Electrolyte Fluid Specific Gravity	1.2g/cm^3
Electrolyte Fluid Kinematic Viscosity (centistokes)	~3.52cP (@25ºC)
Electrolyte Fluid Color	Clear
Propulsion Battery Coolant Type, Color and Specific Gravity (if applicable)	Ethylene-Glycol/Water mixture, Pink
Location of Battery Modules (Inside or Outside of Passenger Compartment?)	Outside Passenger Compartment

PROPULSION BATTERY STATE OF CHARGE

Measured Parameter	Units	Value
For all battery types: Voltage Range corresponding to **useable energy** of the battery:		
Minimum State of Charge	V	336.3
Maximum State of Charge	V	372
95% of Maximum	V	353.4
Test Voltage *	V	370.1
For batteries that are rechargeable ONLY by an energy source on the vehicle: Voltage range corresponding to **useable energy** of the battery:		
Minimum State of Charge	V	
Maximum State of Charge	V	
95% of Maximum	V	
Test Voltage *	V	

* *For all battery types-No less than 95% of Maximum Operating Voltage; for batteries that are rechargeable ONLY by an energy source on the vehicle-maximum practicable state of charge within normal operating range.*

DATA SHEET NO. 305-2
PRE-IMPACT DATA FOR INDICANT FMVSS NO. 305 TESTING

Test Vehicle:	2023 Jeep Grand Cherokee 4xe 5 Door SUV	NHTSA No.:	M20230302
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	02/22/2023

VEHICLE CHASSIS GROUND PT(S) LOCATION(S) & PROPULSION BATTERY SYSTEM

Measured Parameter	Value
Details of Vehicle Chassis Ground Points & Locations	The Mopar test point adapter tool provided by OEM includes a ground lead along with positive and negative meter leads.
Details of Propulsion Battery Components	Propulsion battery is located underneath the vehicle along the rear passenger side of the vehicle.

DATA SHEET NO. 305-3
PRE-IMPACT ELECTRICAL ISOLATION MEASUREMENTS AND CALCULATIONS FOR INDICANT FMVSS NO. 305 TESTING

Test Vehicle:	2023 Jeep Grand Cherokee 4xe 5 Door SUV	NHTSA No.:	M20230302
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	02/22/2023

VOLTMETER INFORMATION

Measured Parameter	Units	Value
Make & Model		Fluke 1587
Serial No.		58100115
Internal Impedance Value	MΩ	10
Resolution	V	0.001
Last Calibration Date		04/28/2022

NOTES:

- *The voltmeter used in this test shall measure DC values and have an internal impedance of at least 10 M Ω*
- *An oscilloscope meeting the above requirements may need to be used to adequately measure voltage in some vehicles.*

PROPULSION BATTERY VOLTAGE, RESISTANCE & ELECTRICAL ISOLATION MEASUREMENTS & CALCULATIONS

Measured Parameter	Symbol	Units	Value
Normal operating voltage range specified by the manufacturer	V_b	V	336.3 - 396.5 V
Propulsion Battery Voltage: (ready to drive position)	V_b	V	370.1
Propulsion Battery to Vehicle Chassis	V_1	V	311.6
Propulsion Battery to Vehicle Chassis	V_2	V	302.4
Propulsion Battery to Vehicle Chassis Across Known Resistor	R_o	Ω	200,000
Propulsion Battery to Vehicle Chassis with R_o installed	V_1'	V	93.2
Propulsion Battery to Vehicle Chassis with R_o installed	V_2'	V	97.7
$R_{i1}= R_o*(1+V_2/V_1)*[(V_1-V_1')/V_1']$	R_{i1}	Ω	923,502
$R_{i2}= R_o*(1+V_1/V_2)*[(V_2-V_2')/V_2']$	R_{i2}	Ω	850,824
Lesser value of R_{i1} and R_{i2}	R_i	Ω	850,824
Electrical Isolation Value (Minimum E.I. Value is 500 Ω/V)	R_i/V_b	Ω/V	2,299

Is the Electrical Isolation Value ≥ 500 Ω/V (Yes/No)? [X] Yes [ ] No (Fail)

NOTES:

- *The measurement shall be made with the propulsion battery connected to the vehicle propulsion system, and the vehicle in the "ready-to-drive" (propulsion motor(s) activated) position.*
- *If the voltage measurement is not at the voltage or within the normal operating voltage range specified by the manufacturer, the battery must be charged.*
- *The known resistance Ro (in Ohms) should be approximately 500 times the nominal operating voltage of the vehicle (in volts) per SAE J1766*
- *If measured voltage is zero and results in a division by zero, record "Zero Volts." This "zero voltage" condition is considered as being compliant*

DATA SHEET NO. 305-4
POST-IMPACT DATA FOR INDICANT FMVSS NO. 305 TESTING

Test Vehicle:	2023 Jeep Grand Cherokee 4xe 5 Door SUV	NHTSA No.:	M20230302
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	02/22/2023

VOLTMETER INFORMATION

Measured Parameter	Units	Value
Make & Model		Fluke 1587
Serial No.		58100115
Internal Impedance Value	MΩ	10
Resolution	V	0.001
Last Calibration Date		04/28/2022

NOTES:

- *The voltmeter used in this test shall measure DC values and have an internal impedance of at least 10 M Ω*
- *An oscilloscope meeting the above requirements may need to be used to adequately measure voltage in some vehicles.*

ELECTRICAL ISOLATION MEASUREMENTS & IMPACT CALCULATIONS

Parameter	Value	Units		Value		Value	
V_b =	0.140	V	Time:	1	Minutes	28	Seconds
V_1 =	0.030	V	Time:	1	Minutes	35	Seconds
V_2 =	0.050	V	Time:	1	Minutes	43	Seconds
R_o =	200,000	Ω					
V_1' =	0.000	V	Time:	1	Minutes	51	Seconds
V_2' =	0.010	Ω	Time:	1	Minutes	59	Seconds
R_{i1} =	Zero Volts	Ω	Time:	1	Minutes	51	Seconds
R_{i2} =	1,280,000	Ω	Time:	1	Minutes	59	Seconds
R_i =	1,280,000	Ω/V	Time:	1	Minutes	59	Seconds
R_i/V_b =	9,142,857	Ω/V	Time:	1	Minutes	59	Seconds

Is the Electrical Isolation Value ≥ 500 Ω/V (Yes/No)?	X	Yes		No (Fail)

NOTES:

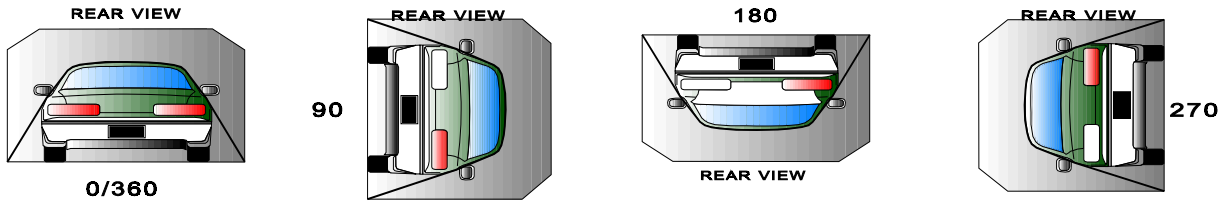
- *R_{i1}= R_o*(1+V_2/V_1)*[(V_1-V_1')/V_1'], R_{i2}= R_o*(1+V_1/V_2)*[(V_2-V_2')/V_2'], R_i = Lesser value of R_{i1} and R_{i2}*
- *If measured voltage is zero and results in a division by zero, record "Zero Volts." This "zero voltage" condition is considered as being compliant*
- *Minimum Electrical Isolation Value is 500 Ω/V*

PROPULSION BATTERY SYSTEM COMPONENTS

Measured Parameter	Comments	Passed	Failed
Propulsion Battery Module movement within the passenger compartment	None	X	
Intrusion of an outside Propulsion Battery Component into the passenger compartment	None	X	
Is propulsion battery electrolyte spillage visible in the passenger compartment?	None	X	

DATA SHEET NO. 305-5
STATIC ROLLOVER TEST DATA FOR INDICANT FMVSS NO. 305 TESTING

Test Vehicle:	2023 Jeep Grand Cherokee 4xe 5 Door SUV	NHTSA No.:	M20230302
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	02/22/2023



Rear View

DETERMINATION OF PROPULSION BATTERY ELECTROLYTE COLLECTION TIME PERIOD

Rollover Stage	Rotation Time (spec. 1 -3 min)		FMVSS 301 Hold Time	Total Time		Next Whole Minute Interval
	Minutes	Seconds	Minutes	Minutes	Seconds	Minutes
0° to 90°	1	7	5	6	7	7
90° to 180°	1	8	5	6	8	7
180° to 270°	1	1	5	6	1	7
270° to 360°	1	10	5	6	10	7

ACTUAL TEST VEHICLE PROPULSION BATTERY ELECTROLYTE SPILLAGE

Rollover Stage	Propulsion Battery Electrolyte Spillage	Units	Spillage Location
0° to 90°	0	Liters	No Spillage Occurred
90° to 180°	0	Liters	No Spillage Occurred
180° to 270°	0	Liters	No Spillage Occurred
270° to 360°	0	Liters	No Spillage Occurred
Total Spillage	0	Liters	No Spillage Occurred

** FMVSS 305 Requirements: Maximum allowable propulsion battery electrolyte spillage is **5.0 Liters***

Is the total spillage of propulsion battery electrolyte greater than 5.0 Liters?		Yes (Fail)	X	No
Is propulsion battery electrolyte spillage visible in the passenger compartment?		Yes (Fail)	X	No

VOLTMETER INFORMATION

Measured Parameter	Units	Value
Make & Model		Fluke 1587
Serial No.		58100115
Internal Impedance Value	MΩ	10

NOTES:

- *The voltmeter used in this test shall measure DC values and have an internal impedance of at least 10 M Ω*
- *An oscilloscope meeting the above requirements may need to be used to adequately measure voltage in some vehicles.*

DATA SHEET NO. 305-5
STATIC ROLLOVER TEST DATA FOR INDICANT FMVSS NO. 305 TESTING (CONT'D)

Test Vehicle: 2023 Jeep Grand Cherokee 4xe 5 Door SUV NHTSA No.: M20230302
Test Program: NCAP Frontal Barrier Impact Test Test Date: 02/22/2023

ELECTRICAL ISOLATION MEASUREMENTS & CALCULATIONS

Parameter	Rollover Stage	Value	Units	R_o=200,000Ω	Minutes	Seconds
V_b =	90°	0.00	V	Time:	1	5
	180°	0.00	V		10	31
	270°	0.00	V		16	51
	360°	0.00	V		21	31
V_1 =	90°	0.00	V	Time:	1	13
	180°	0.00	V		10	39
	270°	0.00	V		16	57
	360°	0.00	V		21	39
V_2 =	90°	0.00	V	Time:	1	14
	180°	0.00	V		10	41
	270°	0.00	V		17	0
	360°	0.00	V		21	44
V_1' =	90°	0.00	V	Time:	1	15
	180°	0.00	V		10	41
	270°	0.00	V		17	3
	360°	0.00	V		21	48
V_2' =	90°	0.00	Ω	Time:	1	19
	180°	0.00	Ω		10	45
	270°	0.00	Ω		17	5
	360°	0.00	Ω		21	52
R_{i1} =	90°	Zero Volts	Ω	Time:	1	15
	180°	Zero Volts	Ω		10	41
	270°	Zero Volts	Ω		17	3
	360°	Zero Volts	Ω		21	48
R_{i2} =	90°	Zero Volts	Ω	Time:	1	19
	180°	Zero Volts	Ω		10	45
	270°	Zero Volts	Ω		17	5
	360°	Zero Volts	Ω		21	52
R_i =	90°	Zero Volts	Ω/V	Time:	1	19
	180°	Zero Volts	Ω/V		10	45
	270°	Zero Volts	Ω/V		17	5
	360°	Zero Volts	Ω/V		21	52
R_i/V_b =	90°	Zero Volts	Ω/V	Time:	1	19
	180°	Zero Volts	Ω/V		10	45
	270°	Zero Volts	Ω/V		17	5
	360°	Zero Volts	Ω/V		21	52

Is the Electrical Isolation Value ≥ 500 Ω/V (Yes/No)? [X] Yes [ ] No (Fail)

APPENDIX A

PHOTOGRAPHS

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

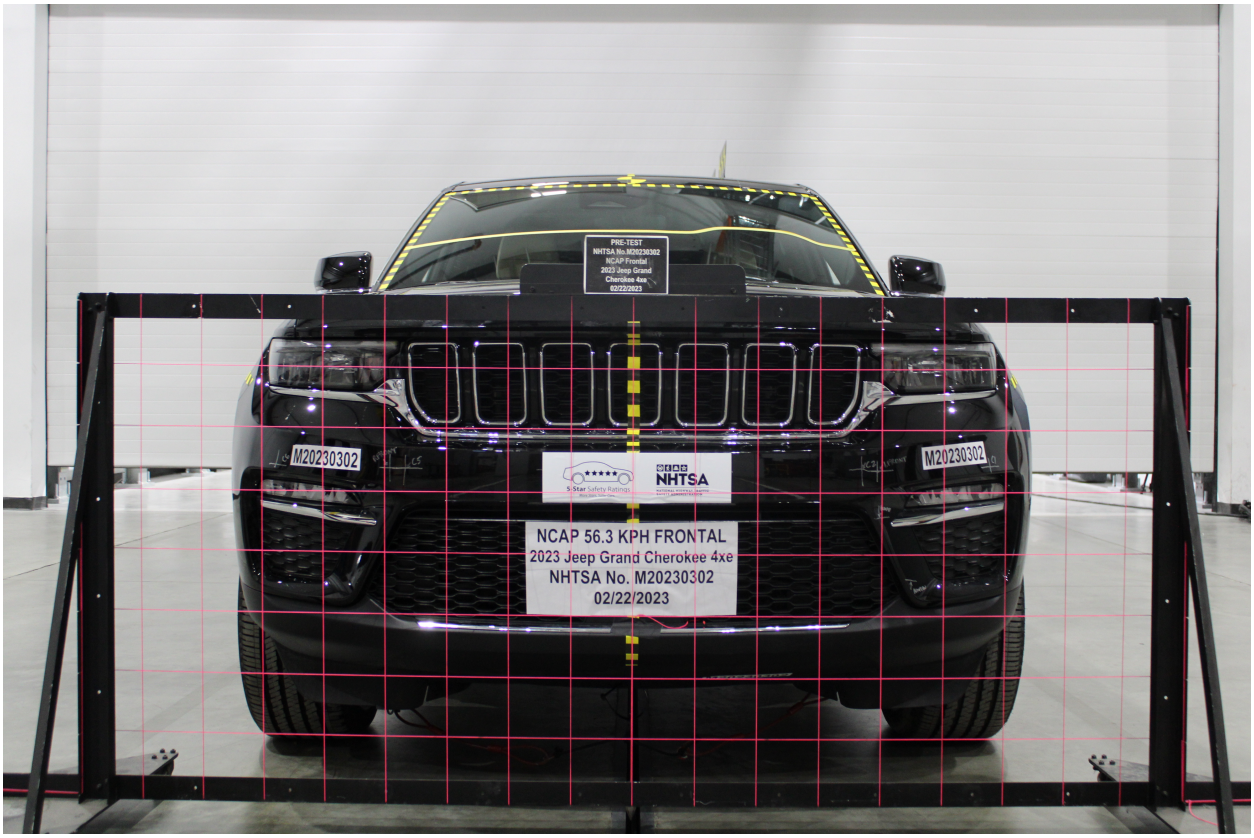


Figure A-1: Load Cell Location



Figure A-2: Pre-Test Load Cell Wall



Figure A-3: Post-Test Load Cell Wall



Figure A-4: Manufacturer's Label

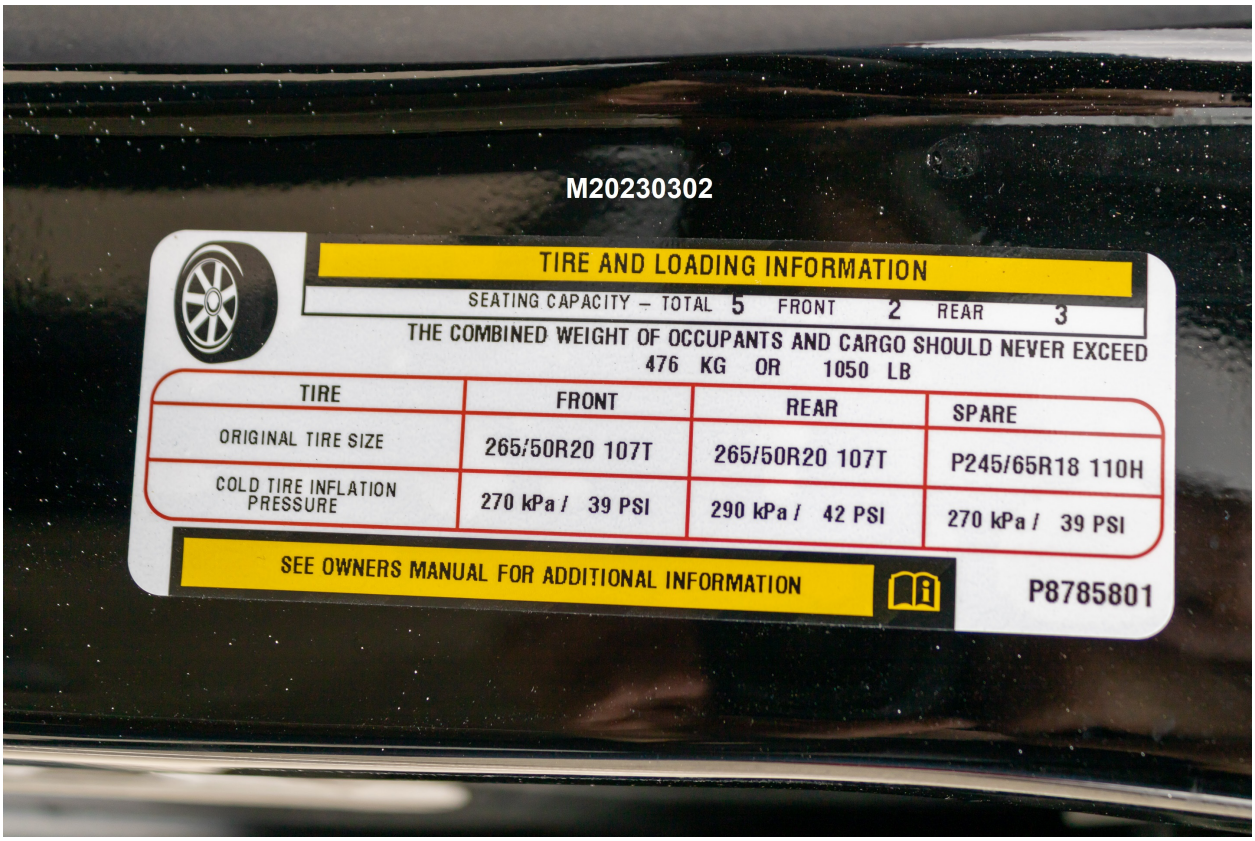


Figure A-5: Tire Placard



Figure A-6: 2023 Jeep Grand Cherokee 4xe 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

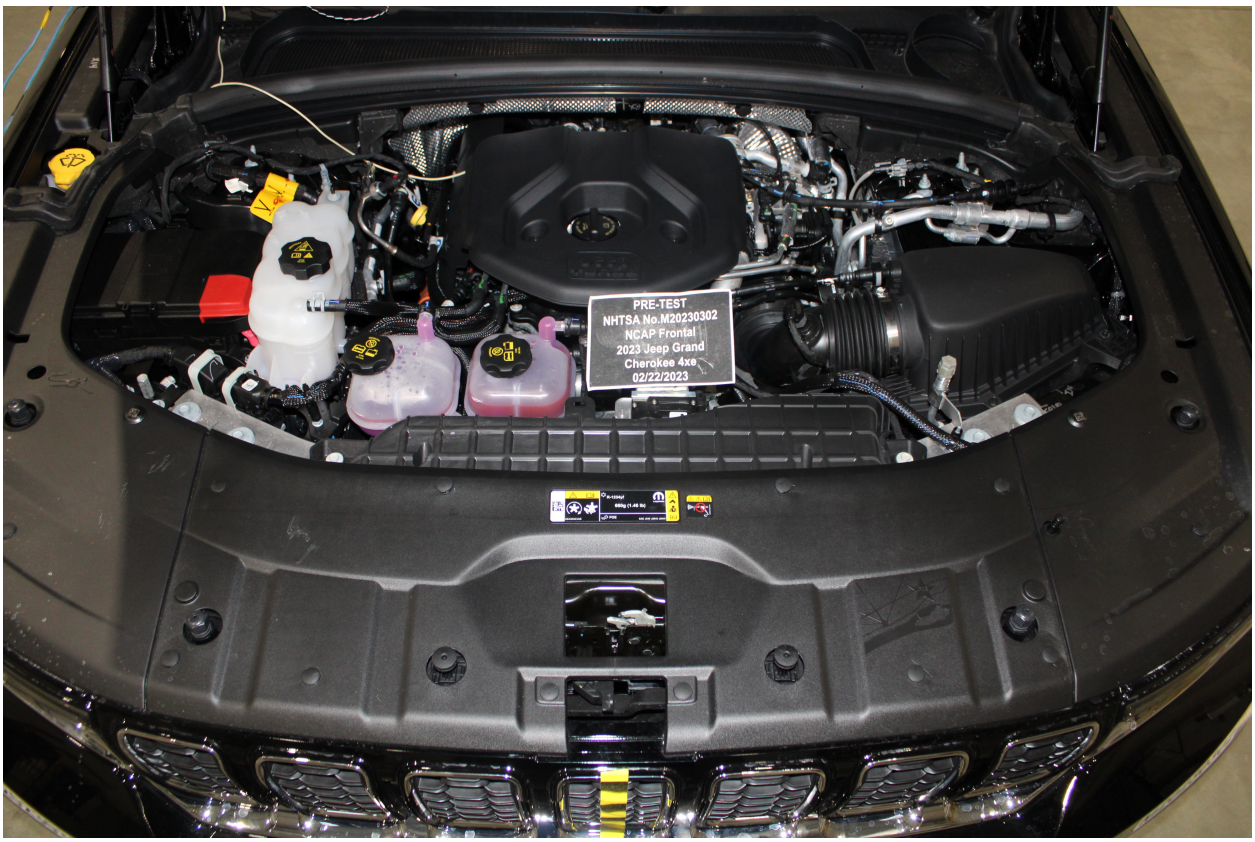


Figure A-20: Pre-Test Engine Compartment View



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

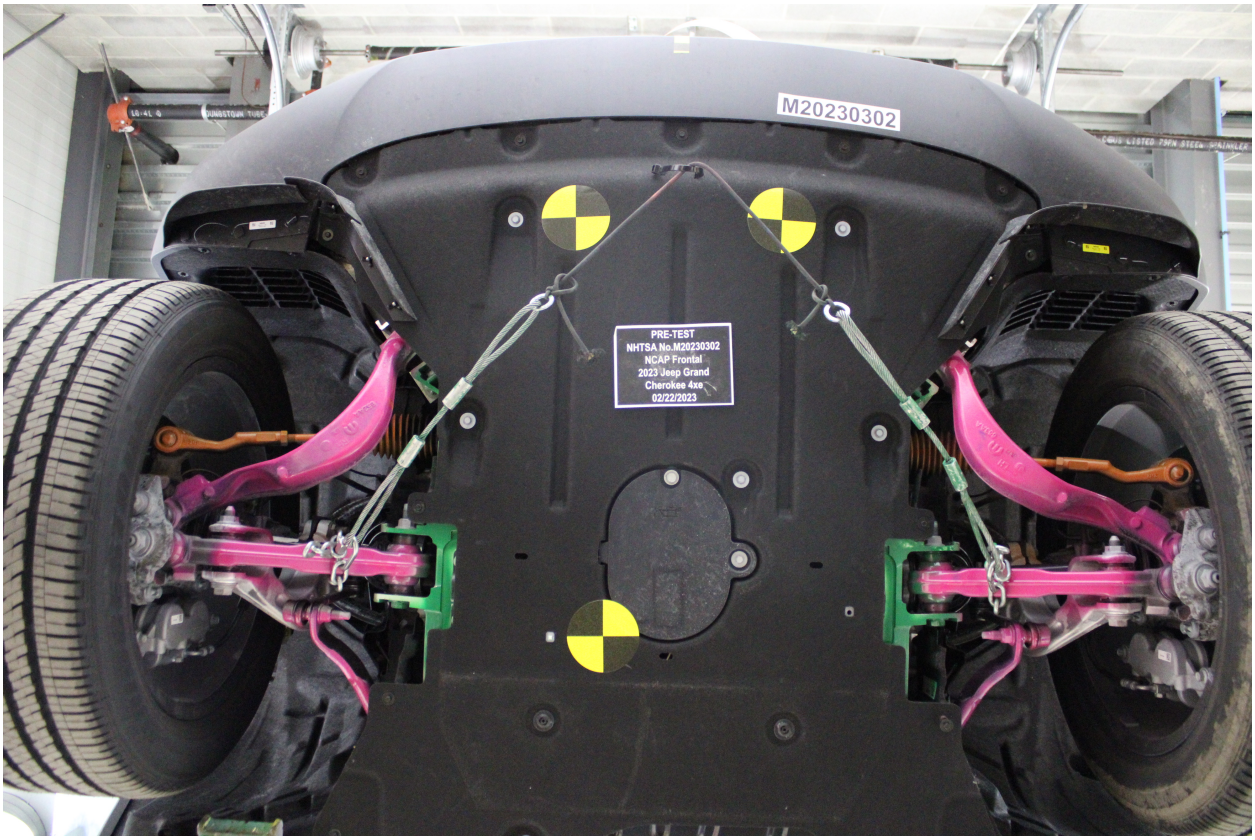


Figure A-24: Pre-Test Front Underbody View

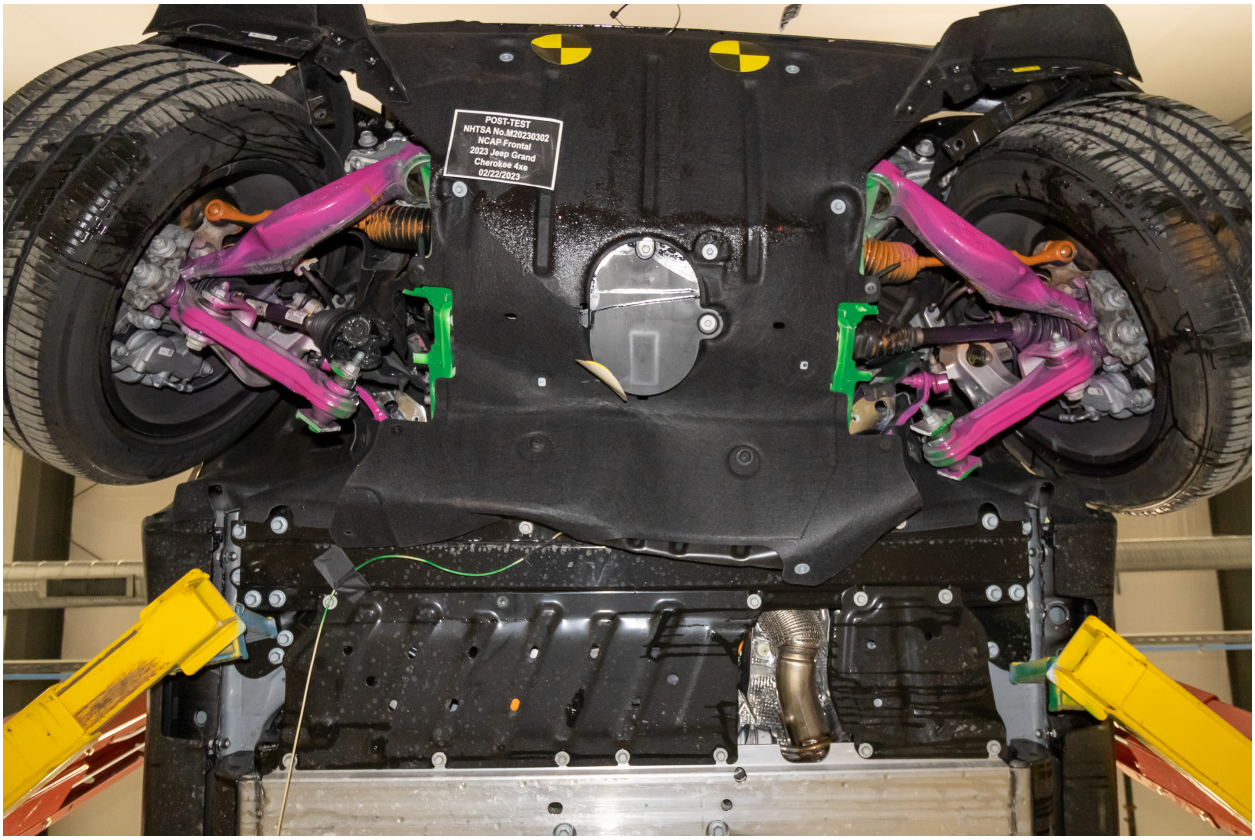


Figure A-25: Post-Test Front Underbody View

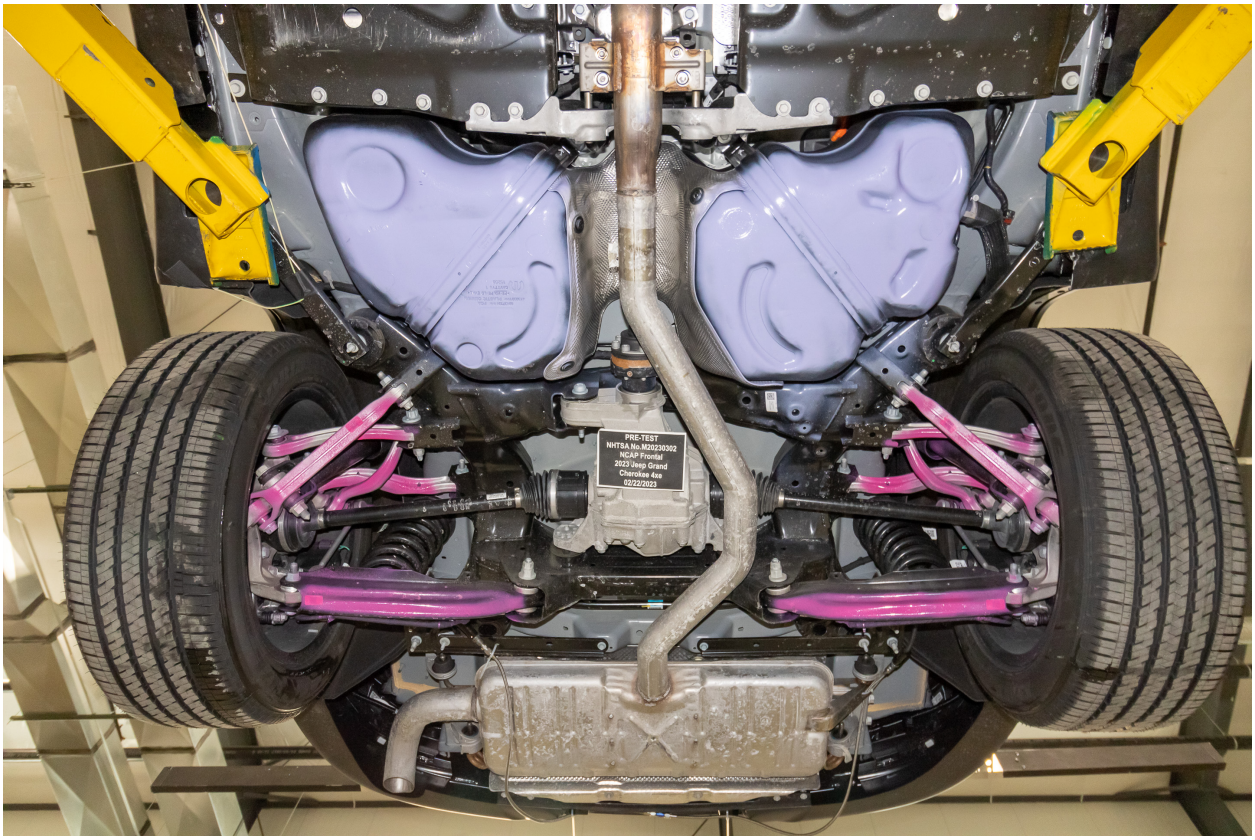


Figure A-26: Pre-Test Rear Underbody View

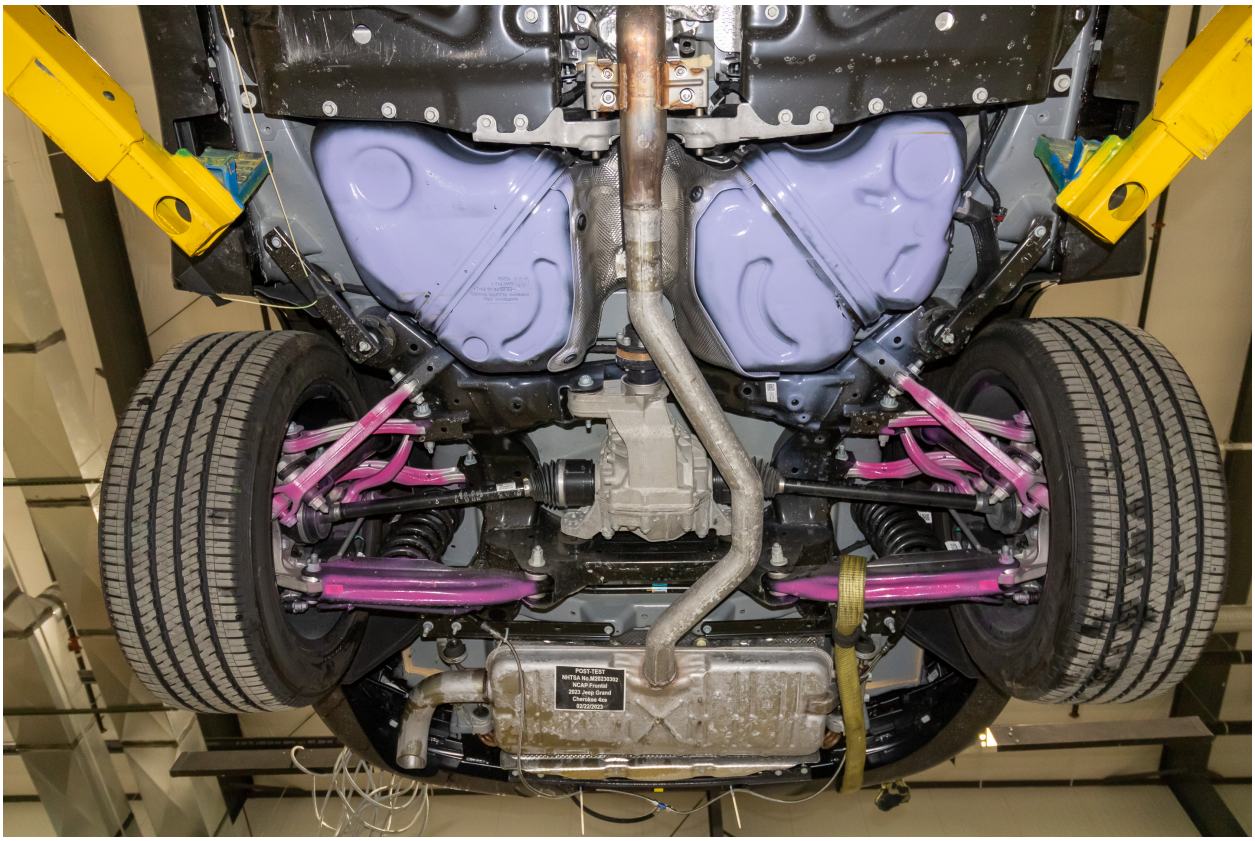


Figure A-27: Post-Test Rear Underbody View



Figure A-28: Pre-Test Dummy Cable Routing



Figure A-29: Post-Test Dummy Cable Routing

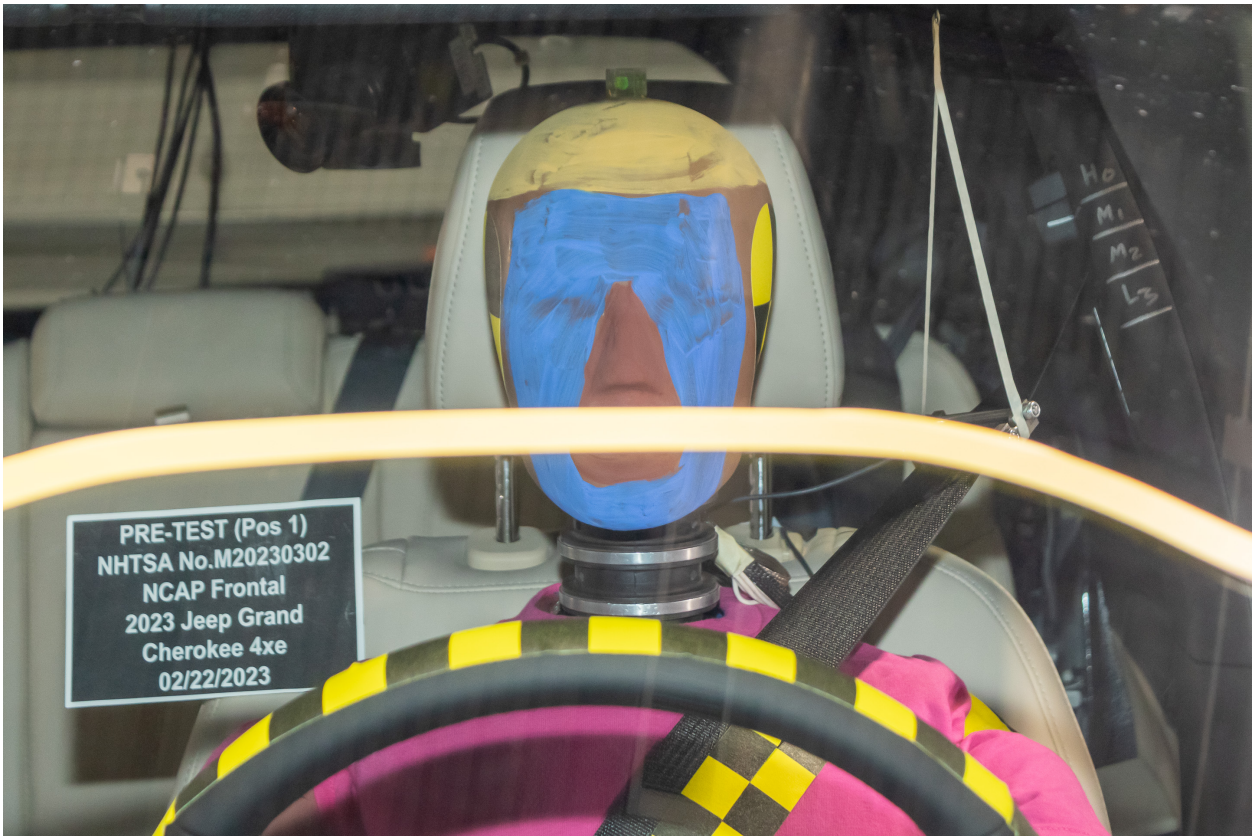


Figure A-30: Pre-Test Driver Dummy Front View

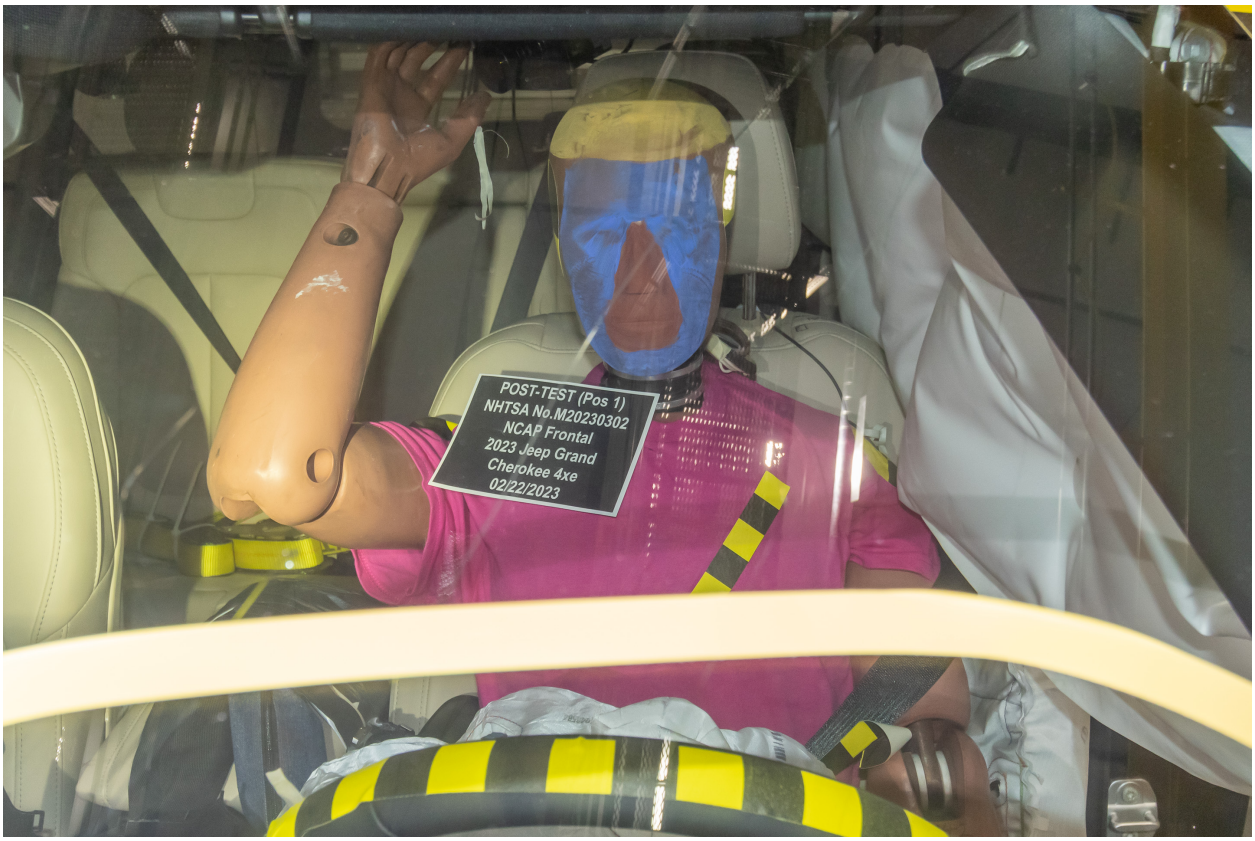


Figure A-31: Post-Test Driver Dummy Front View



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

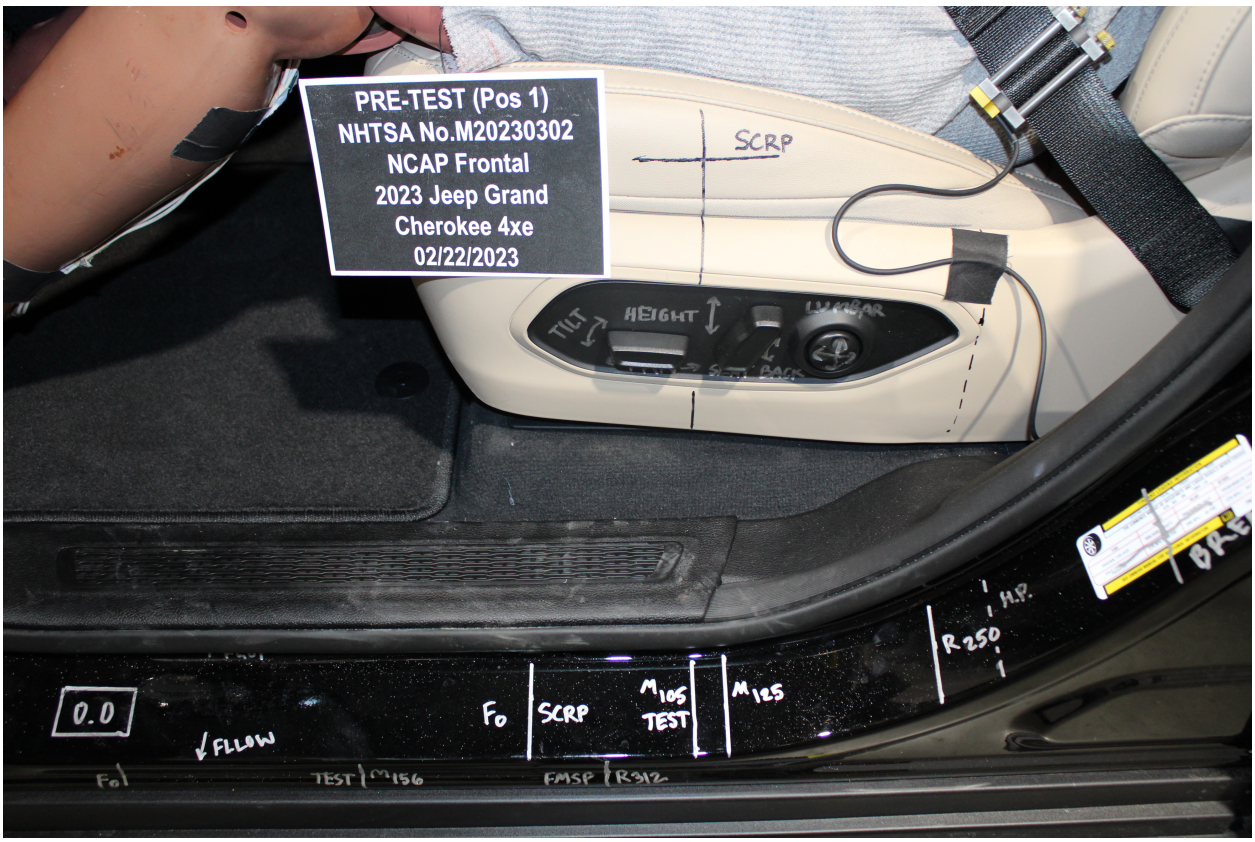


Figure A-36: Pre-Test Driver's Seat Fore-Aft Markings



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

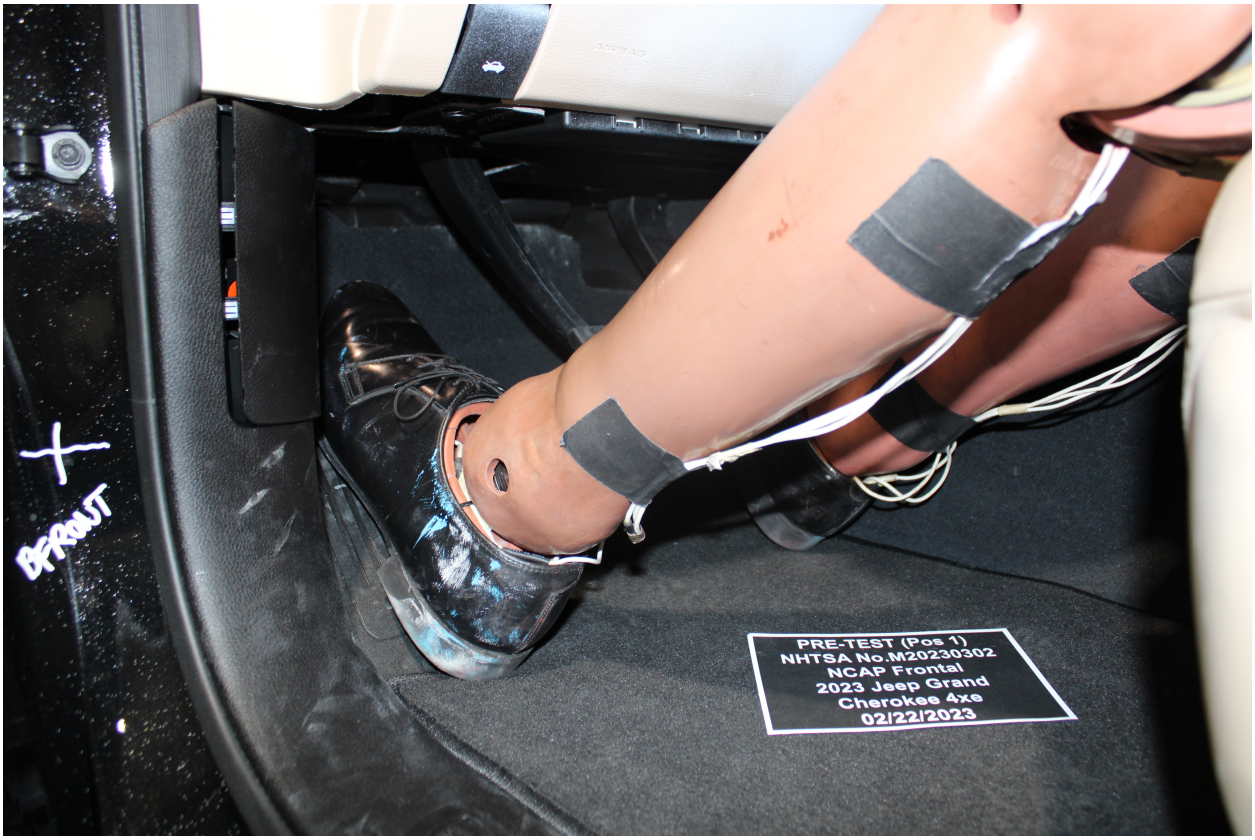


Figure A-42: Pre-Test Driver Dummy Feet



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

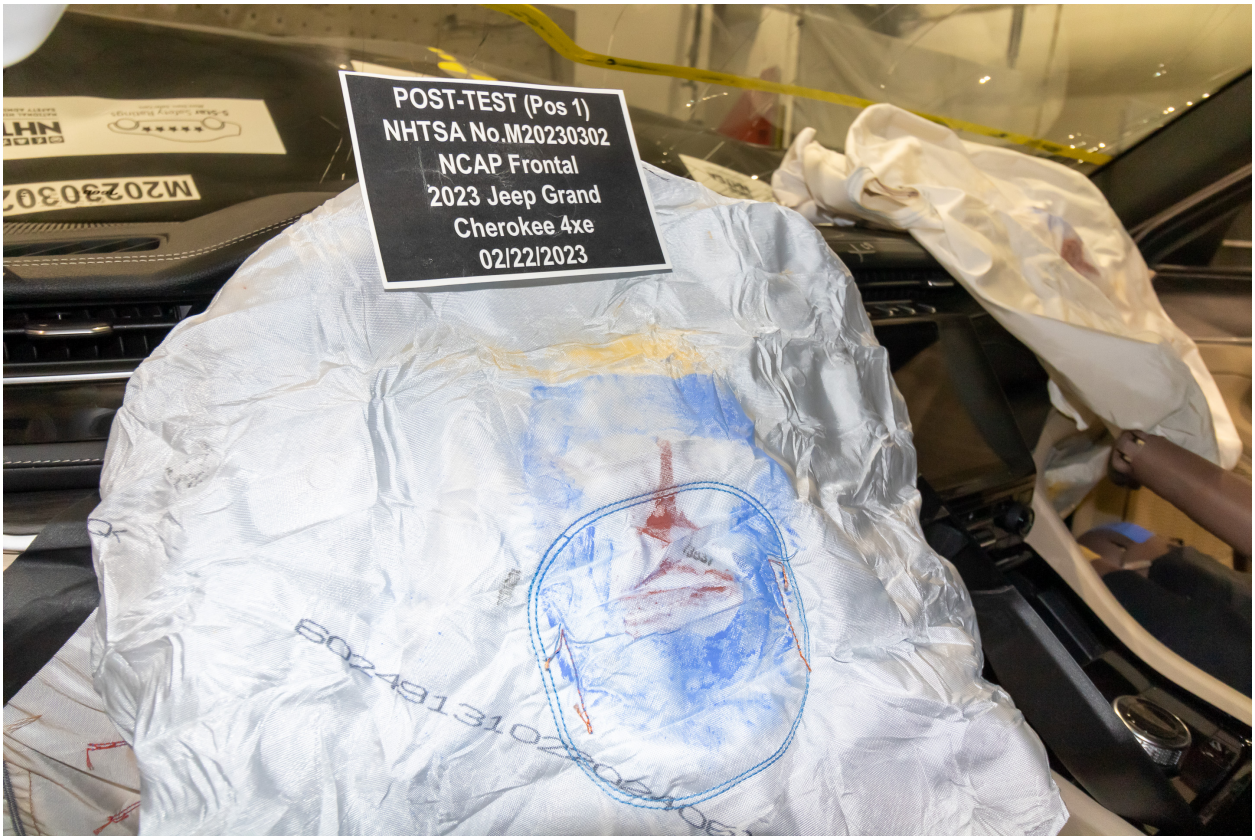


Figure A-49: Post-Test Driver Dummy Contact With Airbag



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

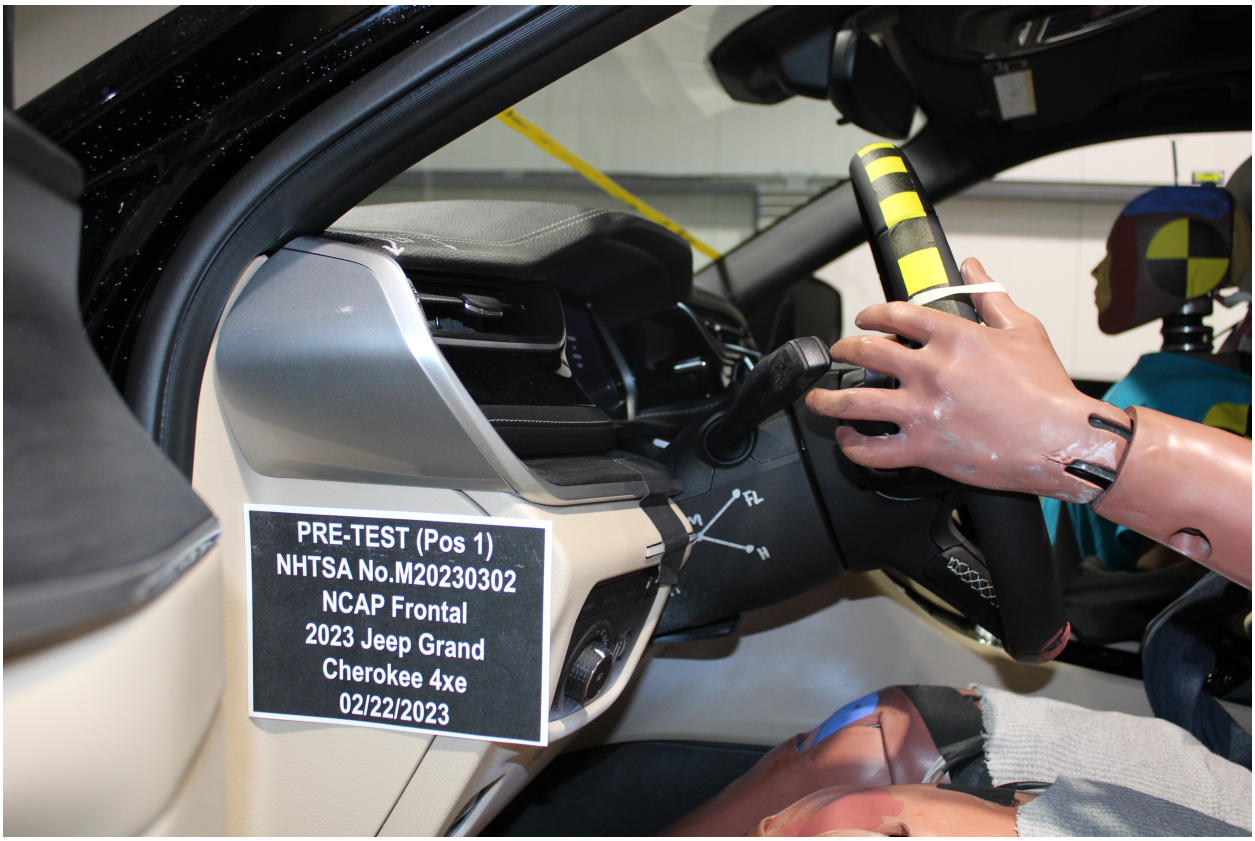


Figure A-51: Pre-Test View of the Steering Wheel



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

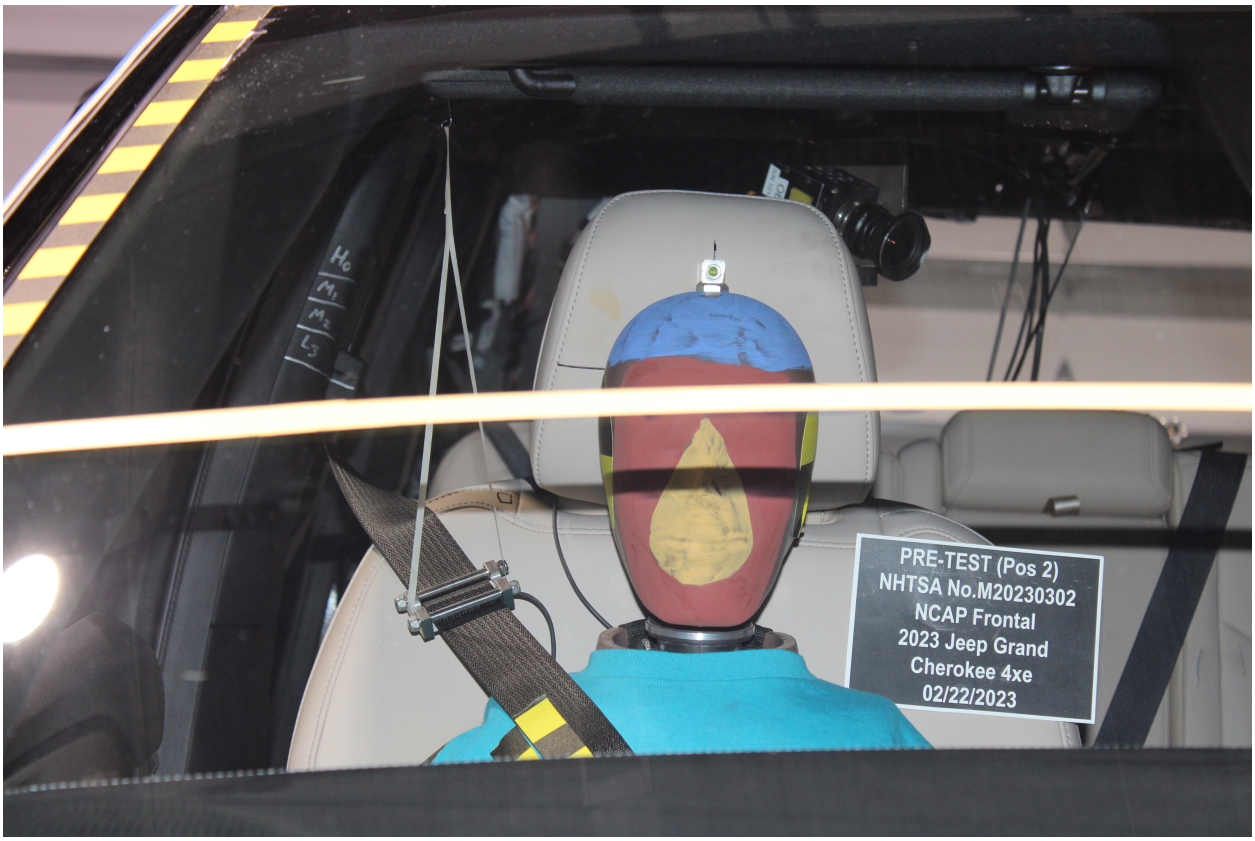


Figure A-53: Pre-Test Passenger Dummy Front View



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

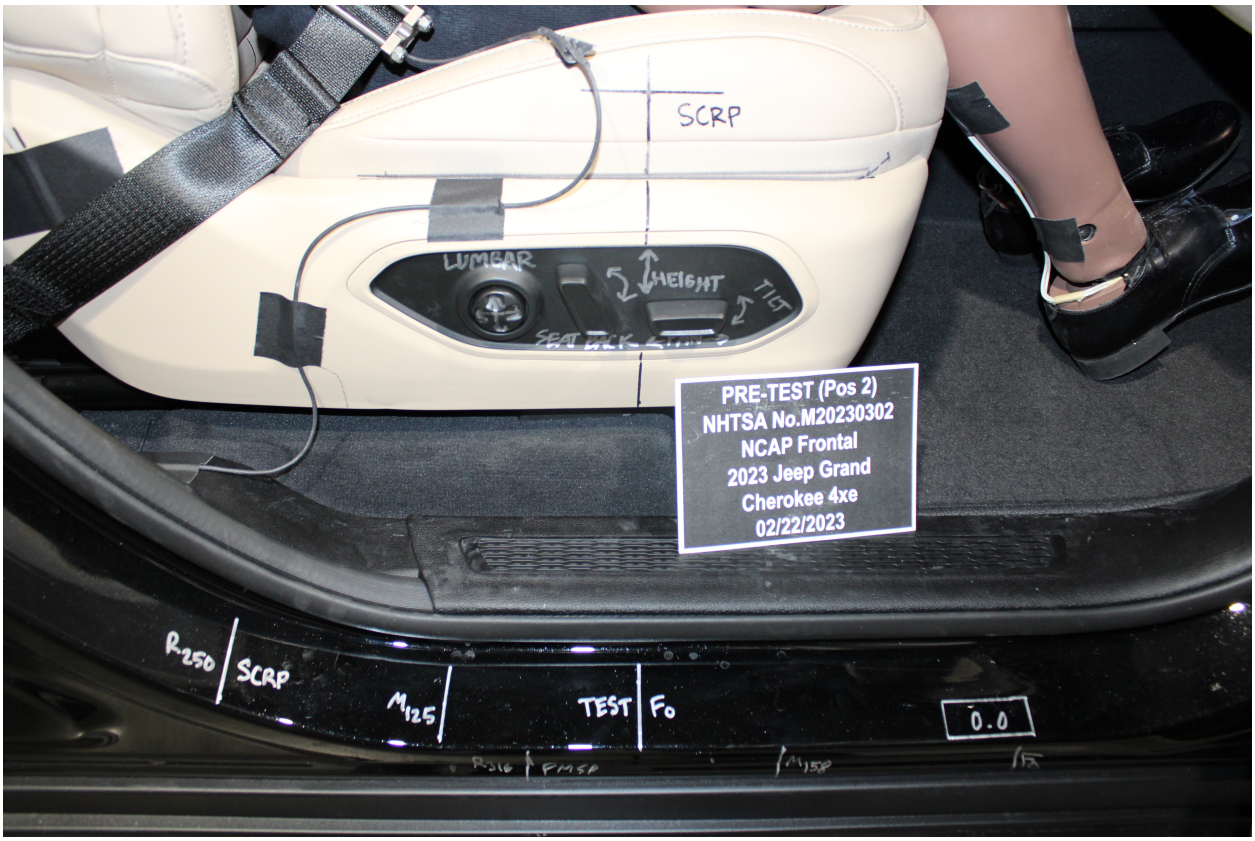


Figure A-59: Pre-Test Passenger's Seat Fore-Aft Markings

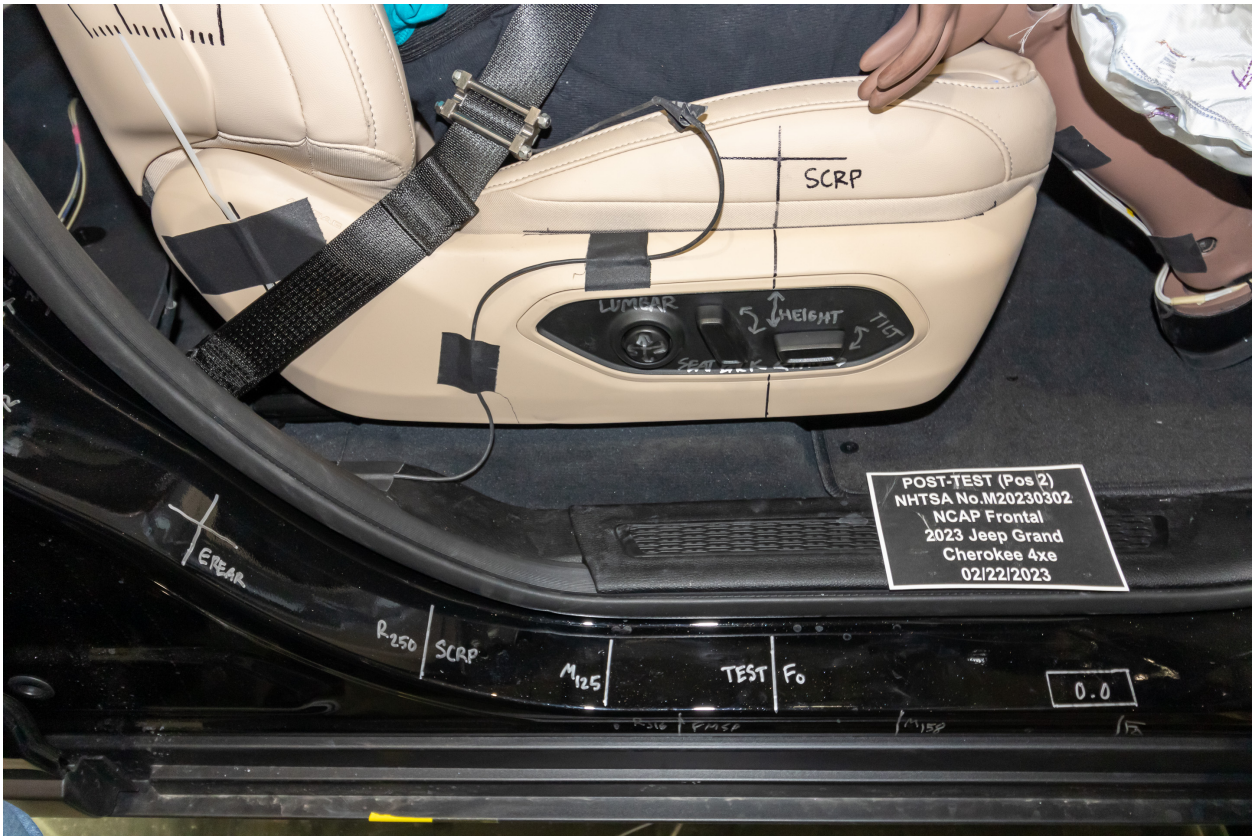


Figure A-60: Post-Test Passenger's Seat Fore-Aft Markings



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

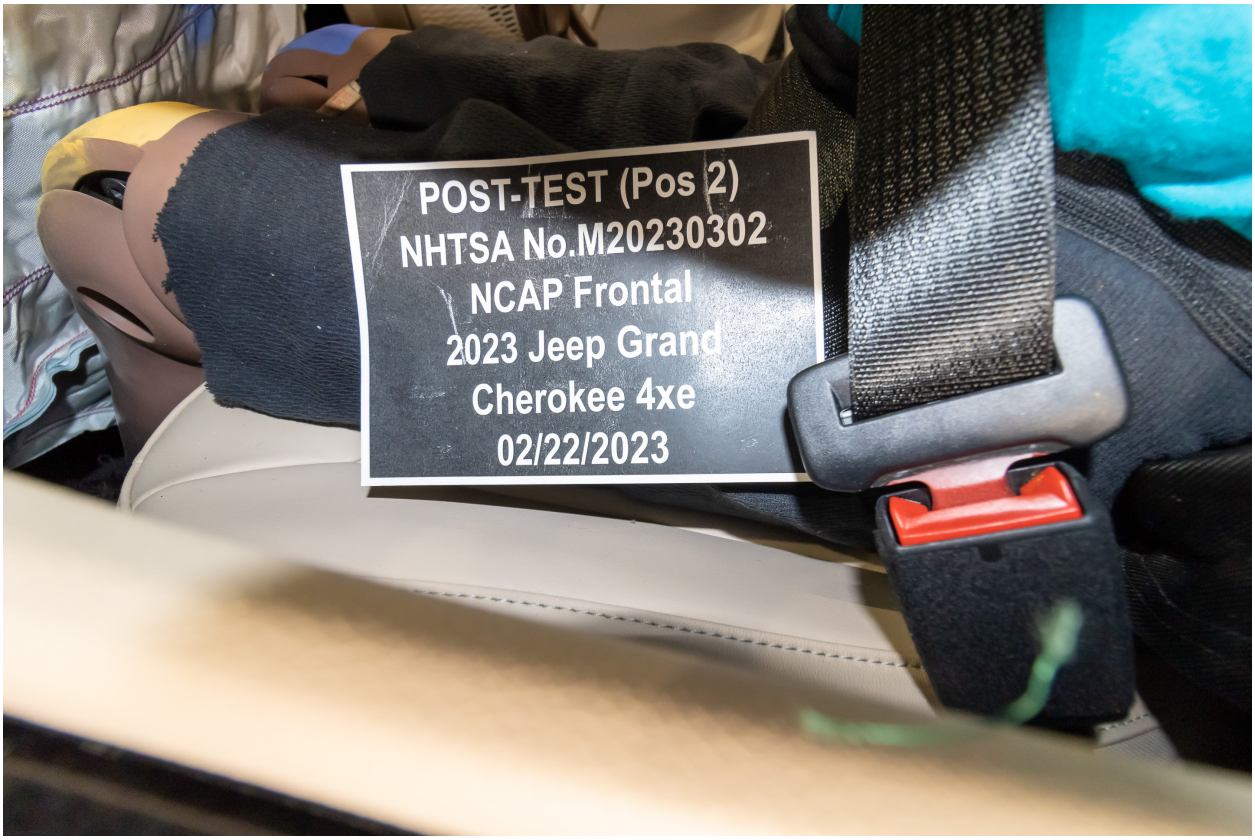


Figure A-64: Post-Test View of Belt Buckle and Latch Plate for Passenger Dummy



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

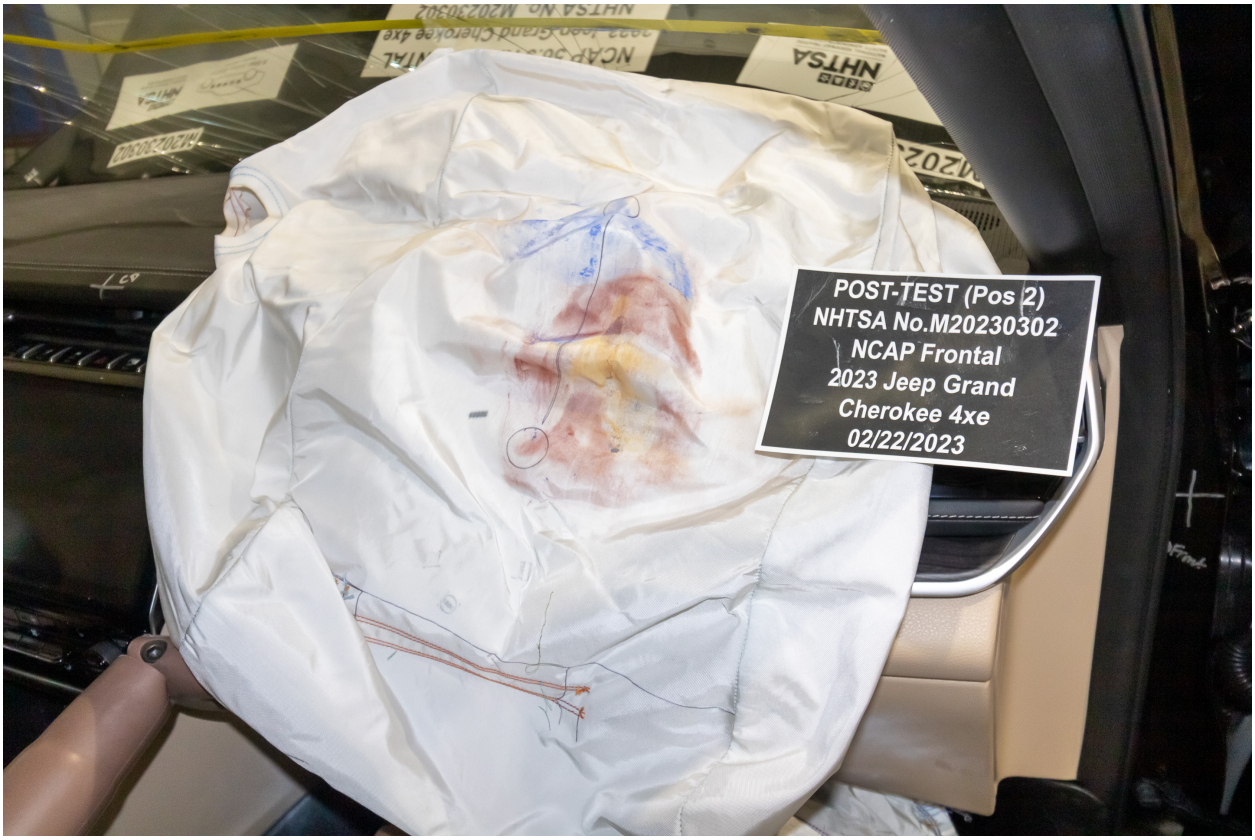


Figure A-72: Post-Test Passenger Dummy Contact With Airbag

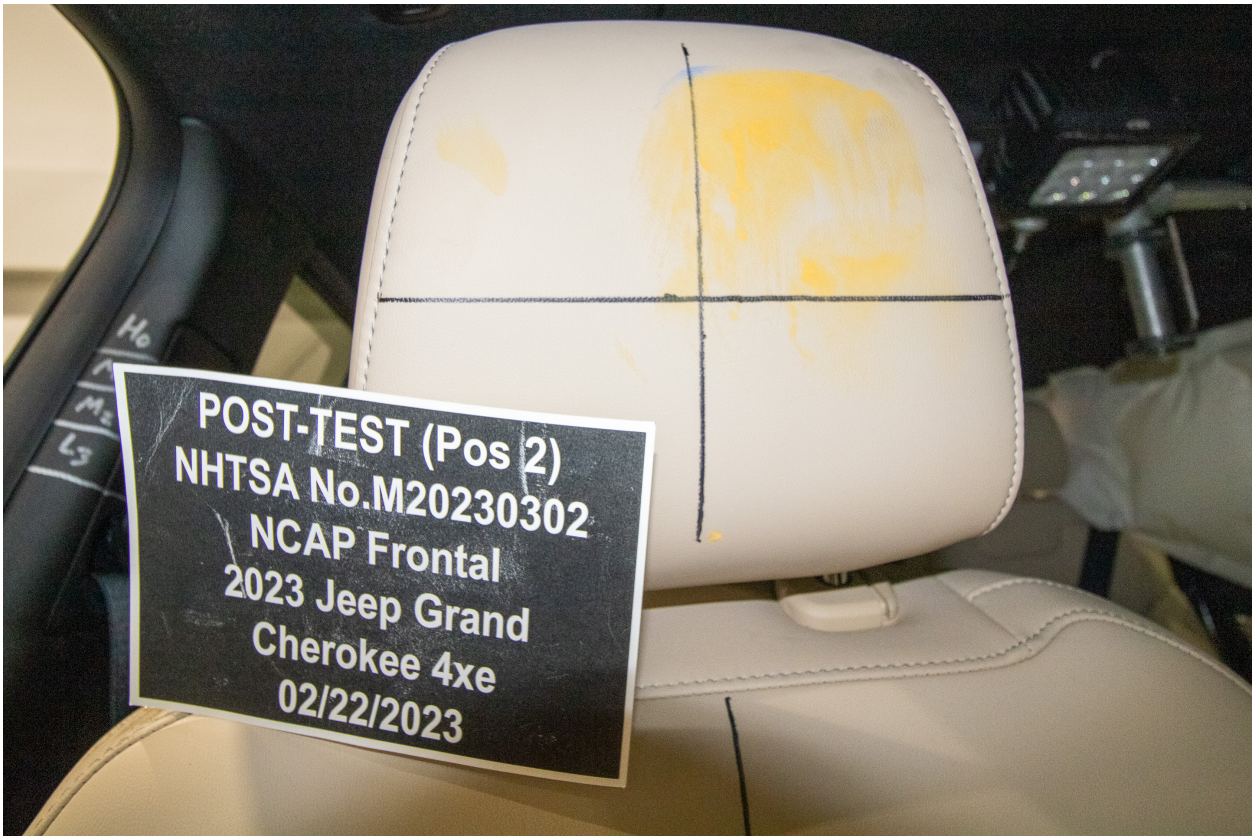


Figure A-73: Post-Test Passenger Dummy Contact With Headrest



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

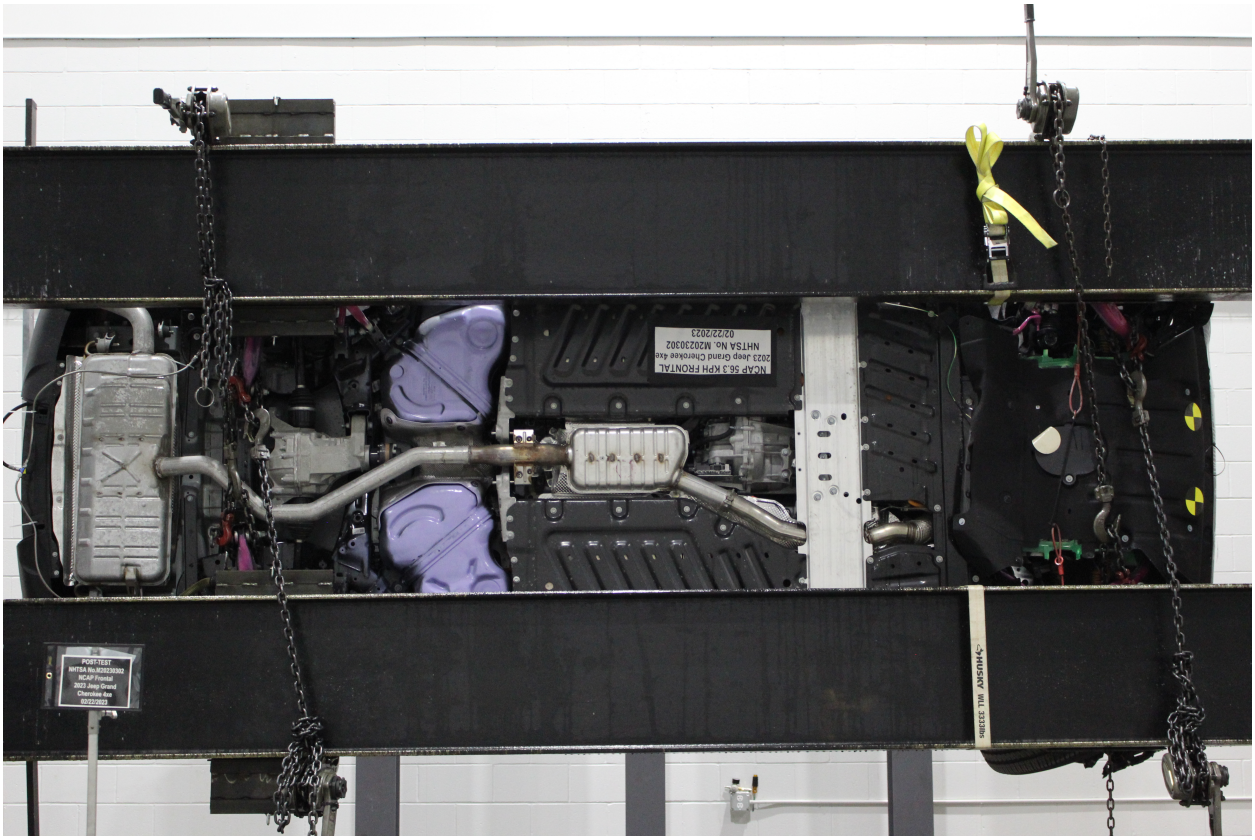


Figure A-78: Vehicle at 90º on Static Rollover Device



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

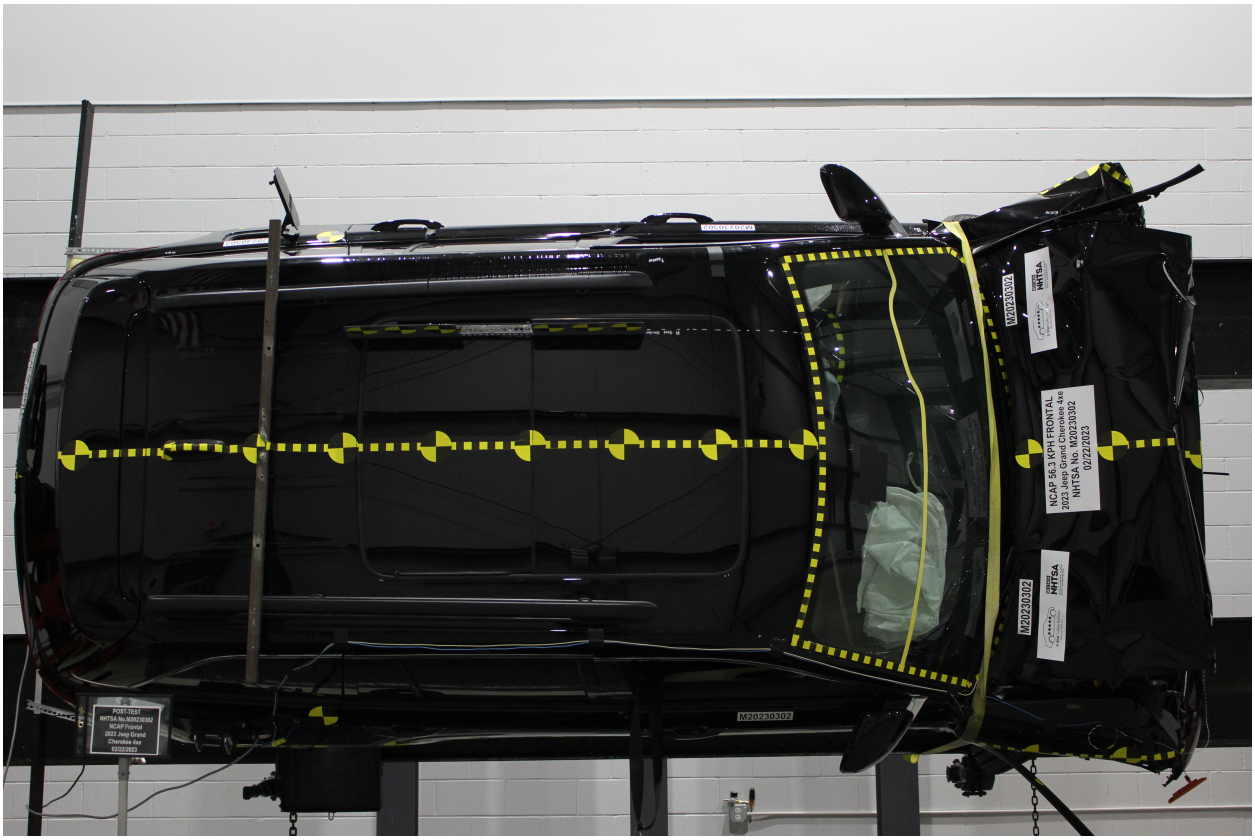


Figure A-80: Vehicle at 270º on Static Rollover Device



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



Figure A-82: 2023 Jeep Grand Cherokee Frontal Impact Event

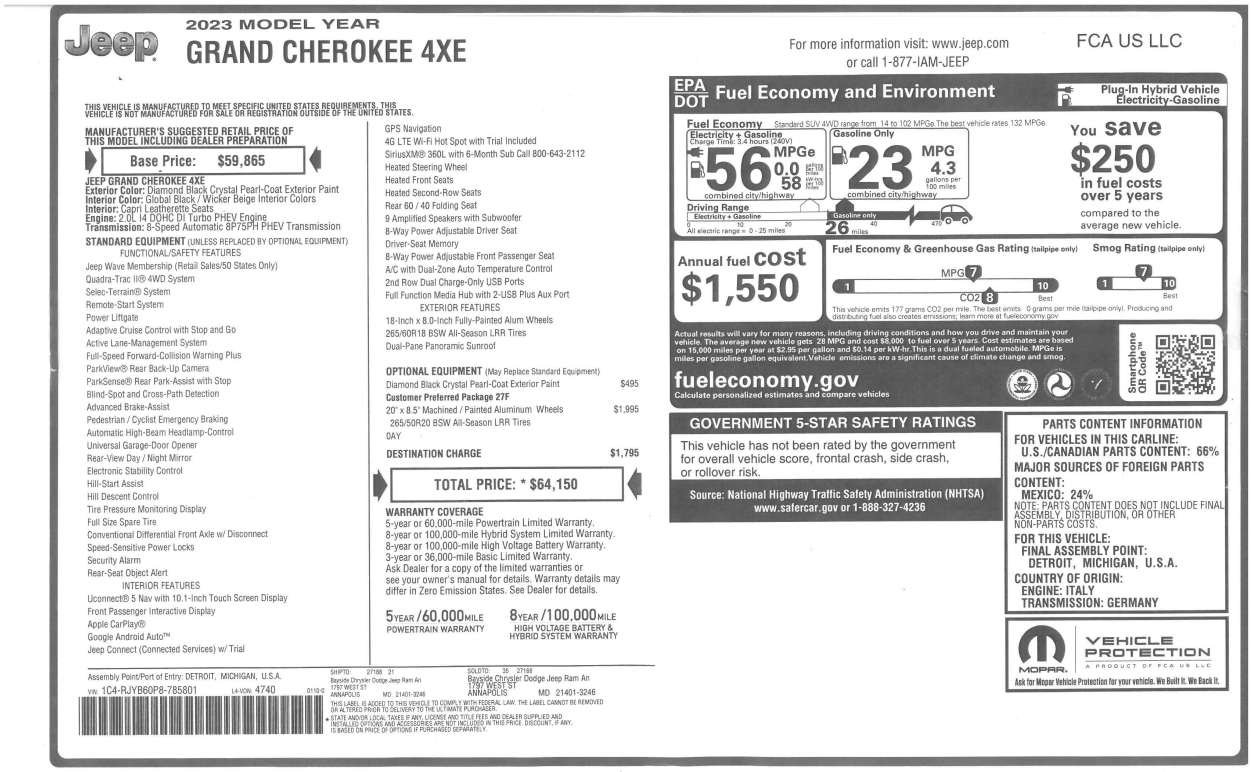


Figure A-83: Monroney Label Photograph



Figure 305-1: Auxiliary Power Module Warning Label

Photo Not Applicable

Figure 305-2: Power Inverter Warning Label



Figure 305-3 First Responder Warning Label



Figure 305-4: First Responder Warning Label Location

Photo Not Applicable

Figure 305-5: Other Vehicle Label Related to Electric Propulsion System



Figure 305-6: Manual High Voltage Service Disconnect in Place



Figure 305-7: Manual High Voltage Service Disconnect Removed (Show Plug)

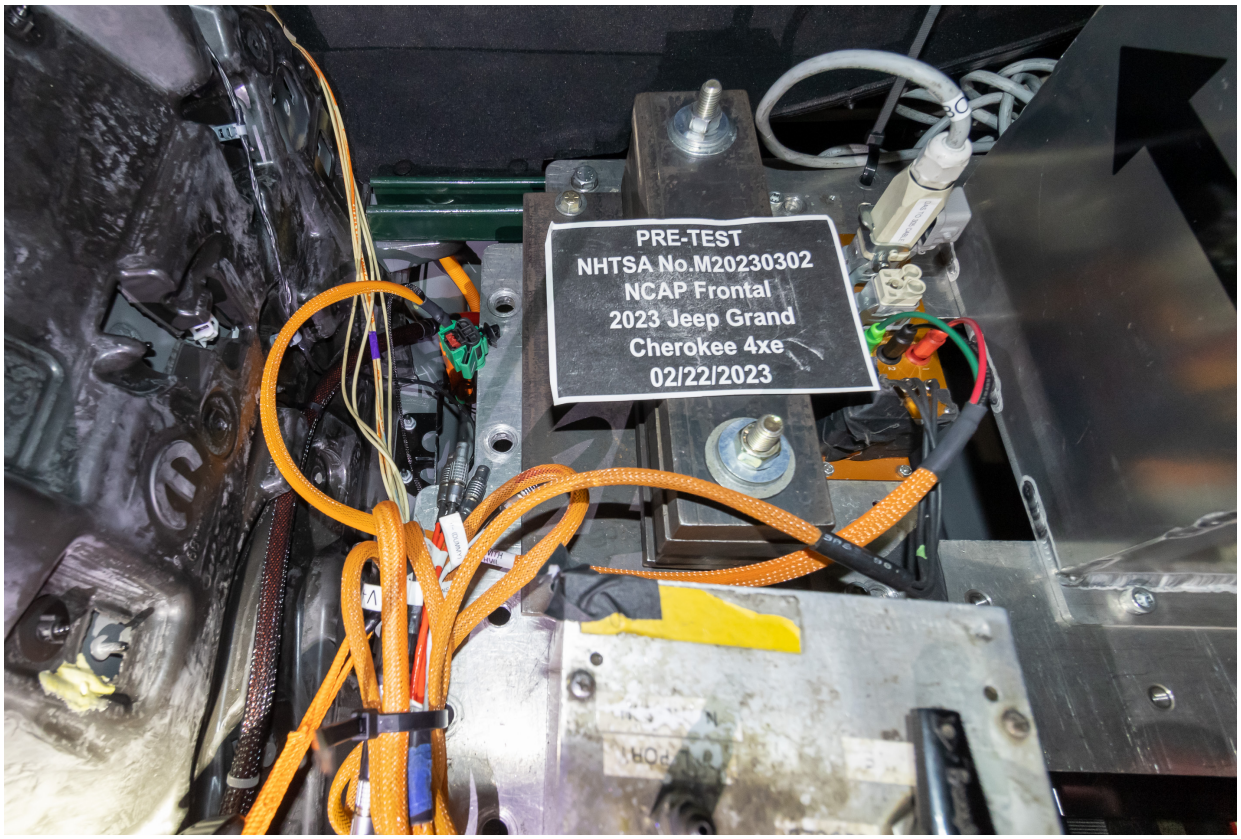


Figure 305-8: Manual High Voltage Service Disconnect Removed Location

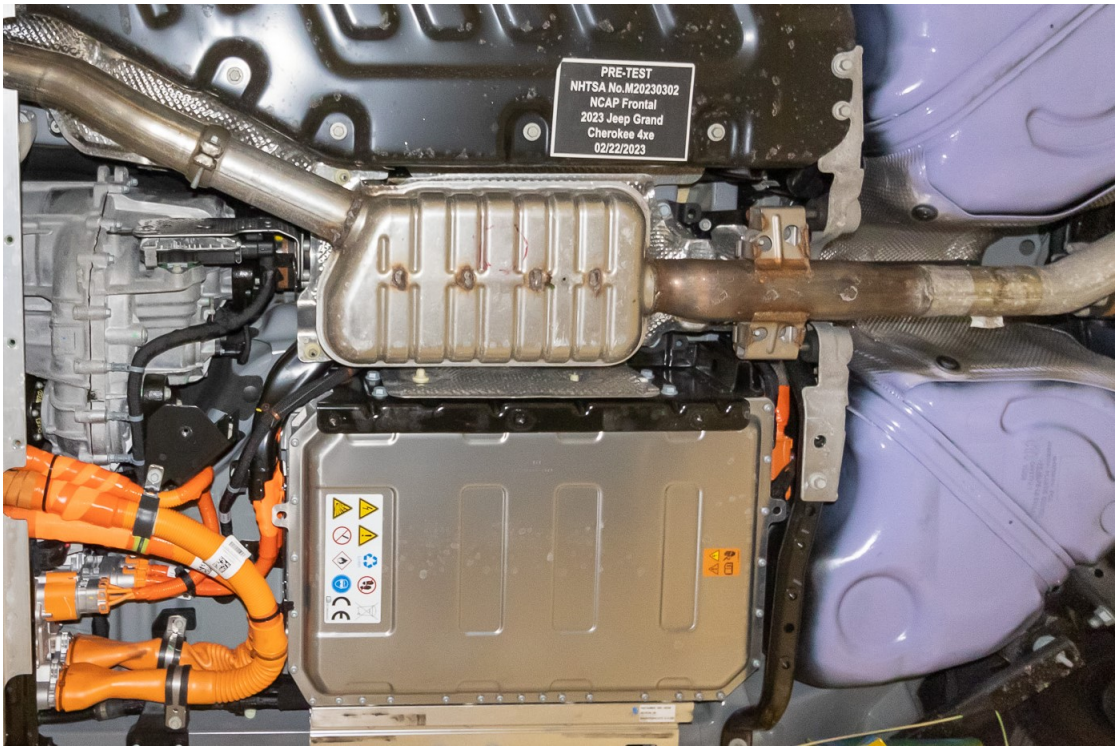


Figure 305-9: Pre-Impact View of Propulsion Battery



Figure 305-10: Post-Impact Front View of Propulsion Battery



Figure 305-11: Post-Impact Rear View of Propulsion Battery (if any part of it is visible)



Figure 305-12: Pre-Impact View of Battery Box(s) or Container(s) Which Holds Individual Battery Modules

Figure 305-13: Post-Impact View of Battery Box(s) or Container(s) Which Holds Individual Battery Modules



Figure 305-14: Pre-Impact View of Propulsion Battery Module(s)

Figure 305-15: Post-Impact View of Propulsion Battery Module(s)

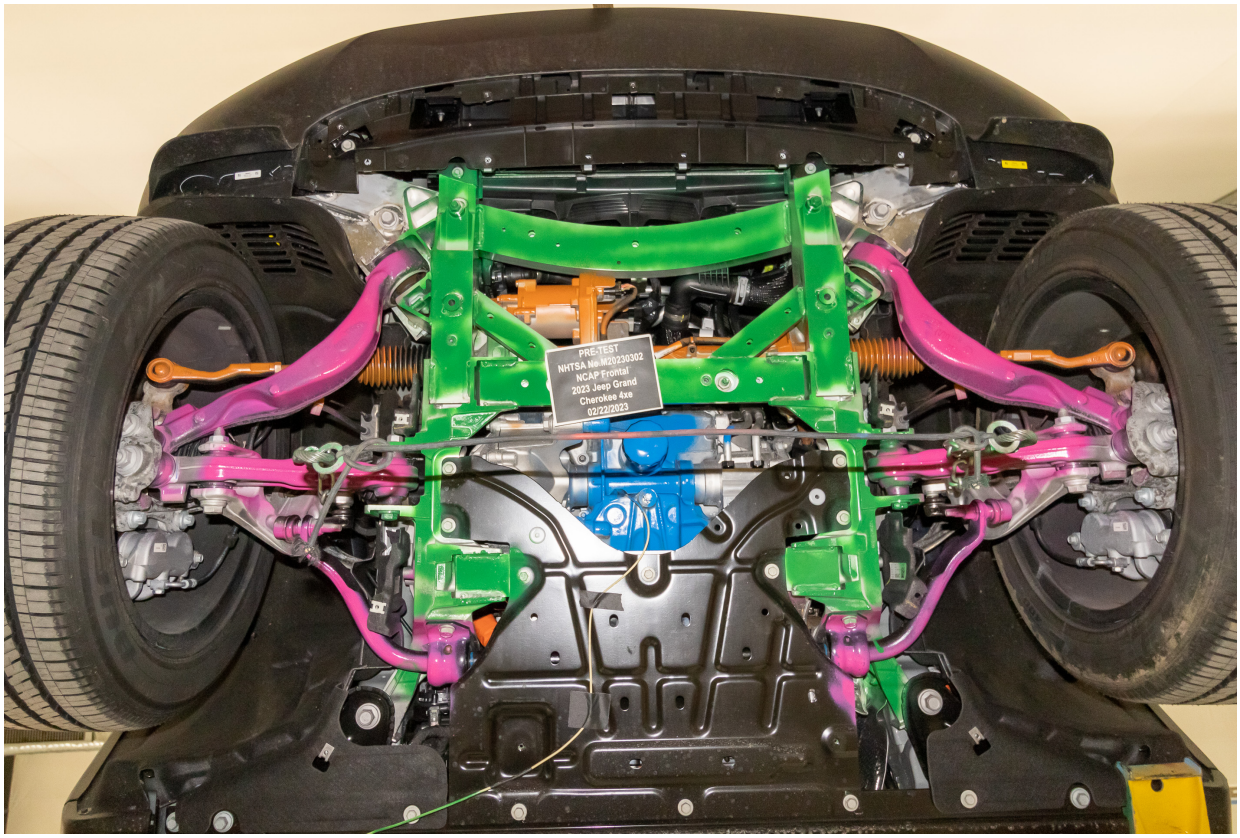


Figure 305-16: Pre-Impact View of Electric Propulsion Drive

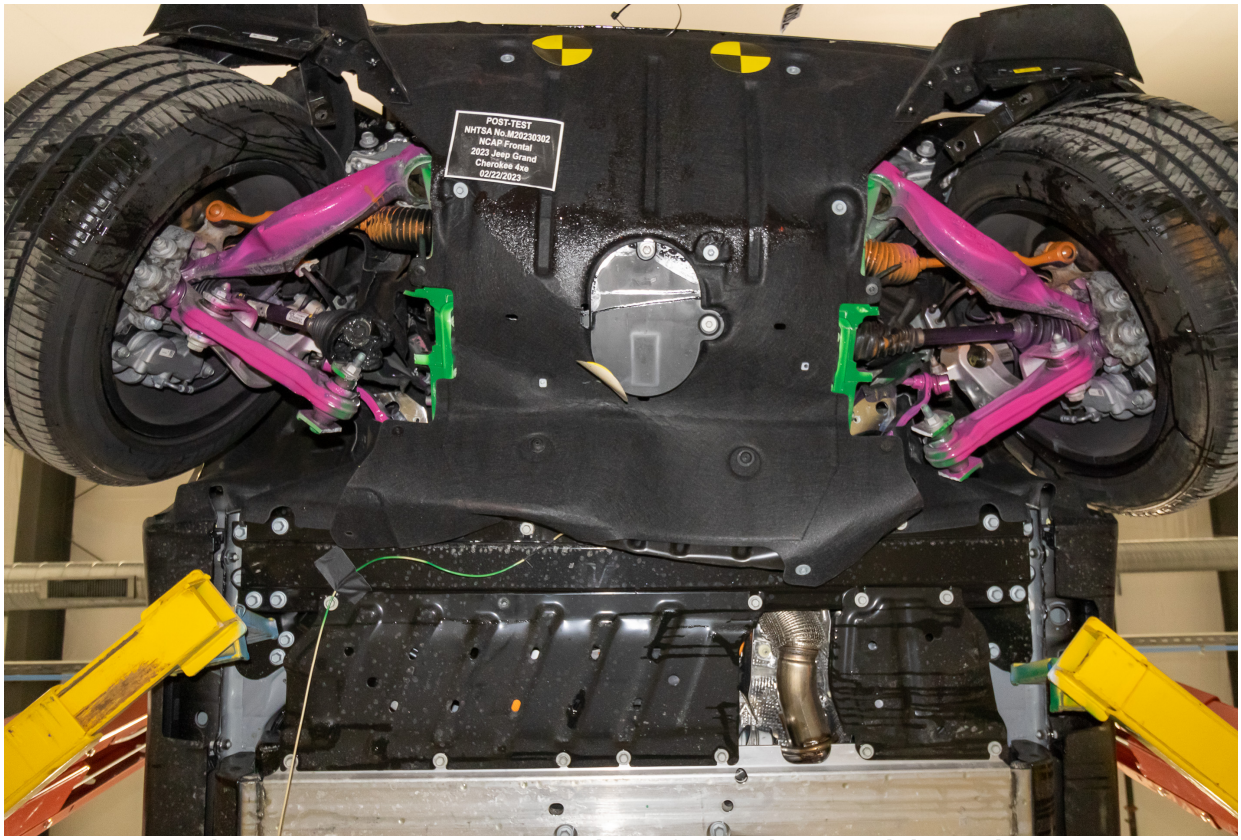


Figure 305-17: Post-Impact View of Electric Propulsion Drive

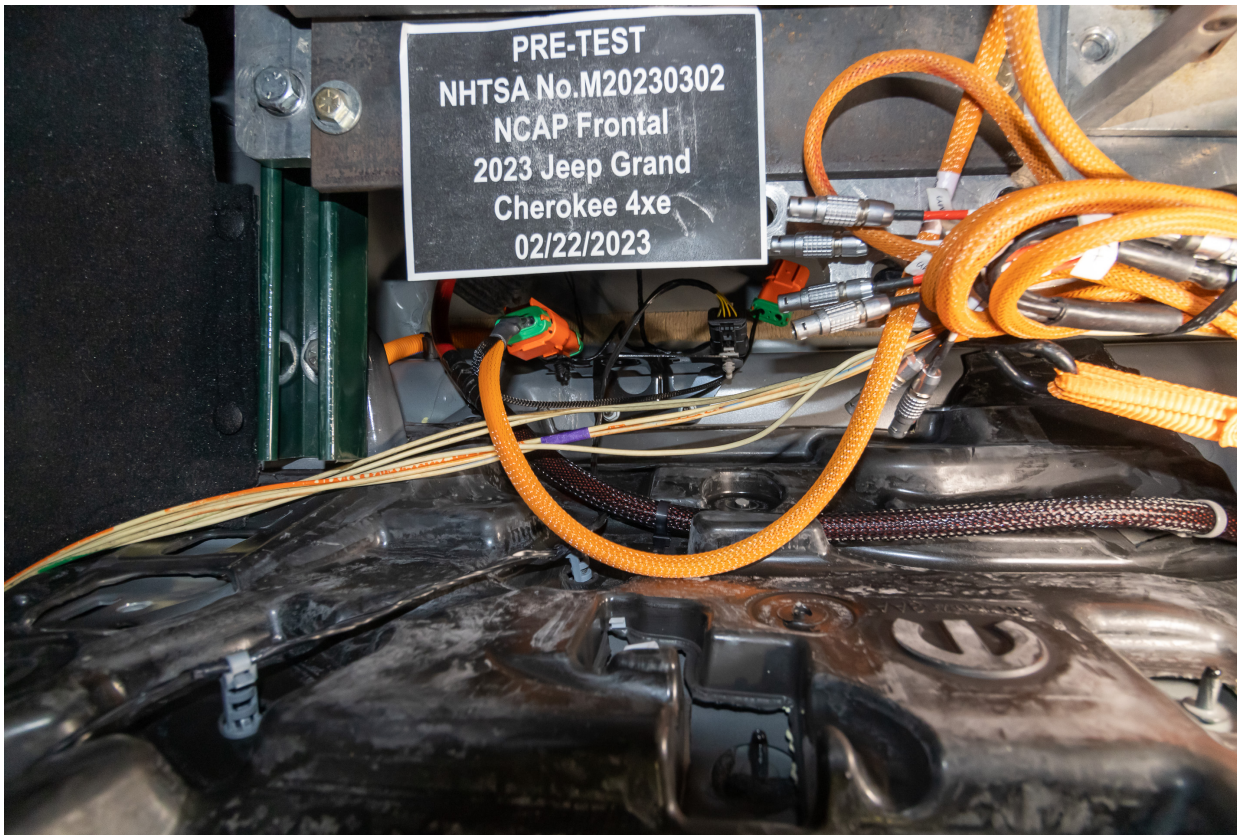


Figure 305-18: Pre-Impact View of High Voltage Interconnects

Photo Not Applicable

Figure 305-19: Pre-Impact View of Propulsion Battery Venting System

Photo Not Applicable

Figure 305-20: Pre-Impact View of Other Visible Electric Propulsion Components



Figure 305-21: Pre-Impact View of Ground Lead Attached

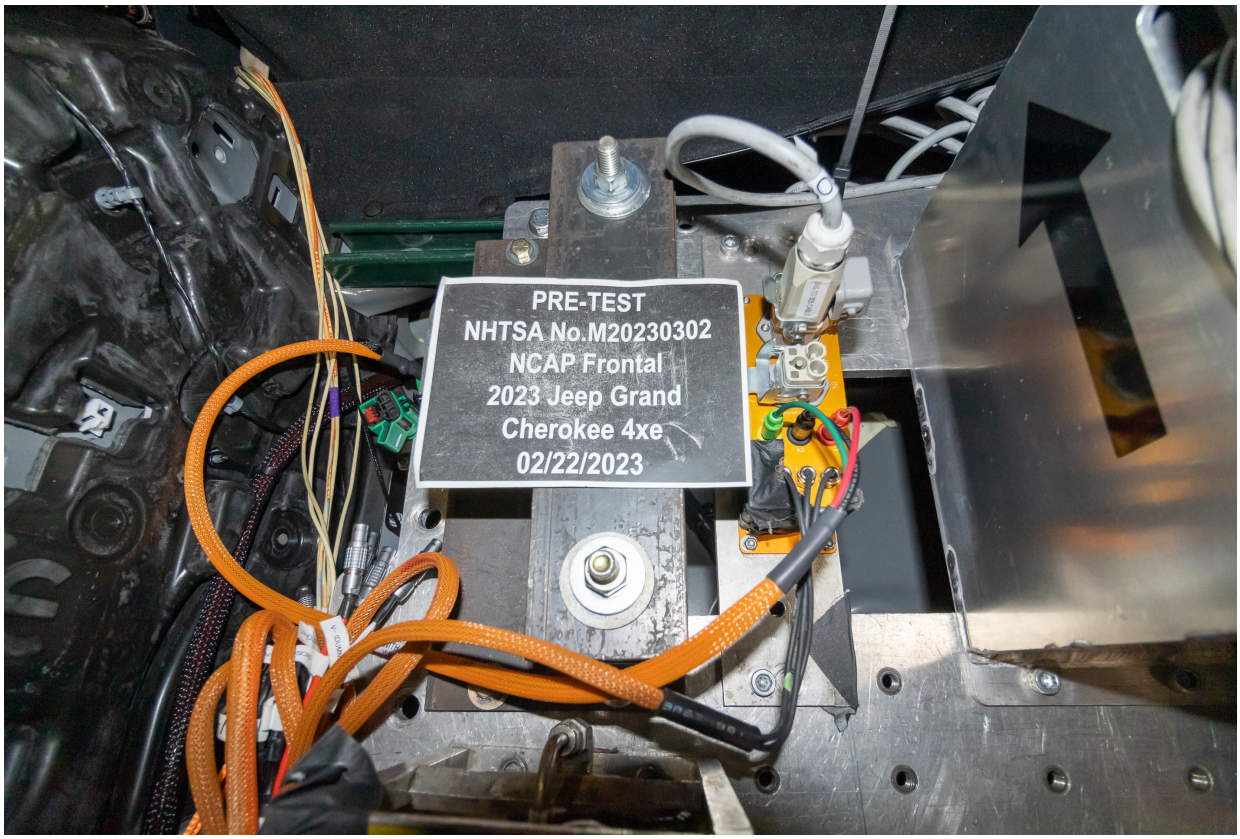


Figure 305-22: Pre-Impact View of High Voltage Leads Attached



Figure 305-23: Pre-Impact Close Up View of High Voltage Leads Attached

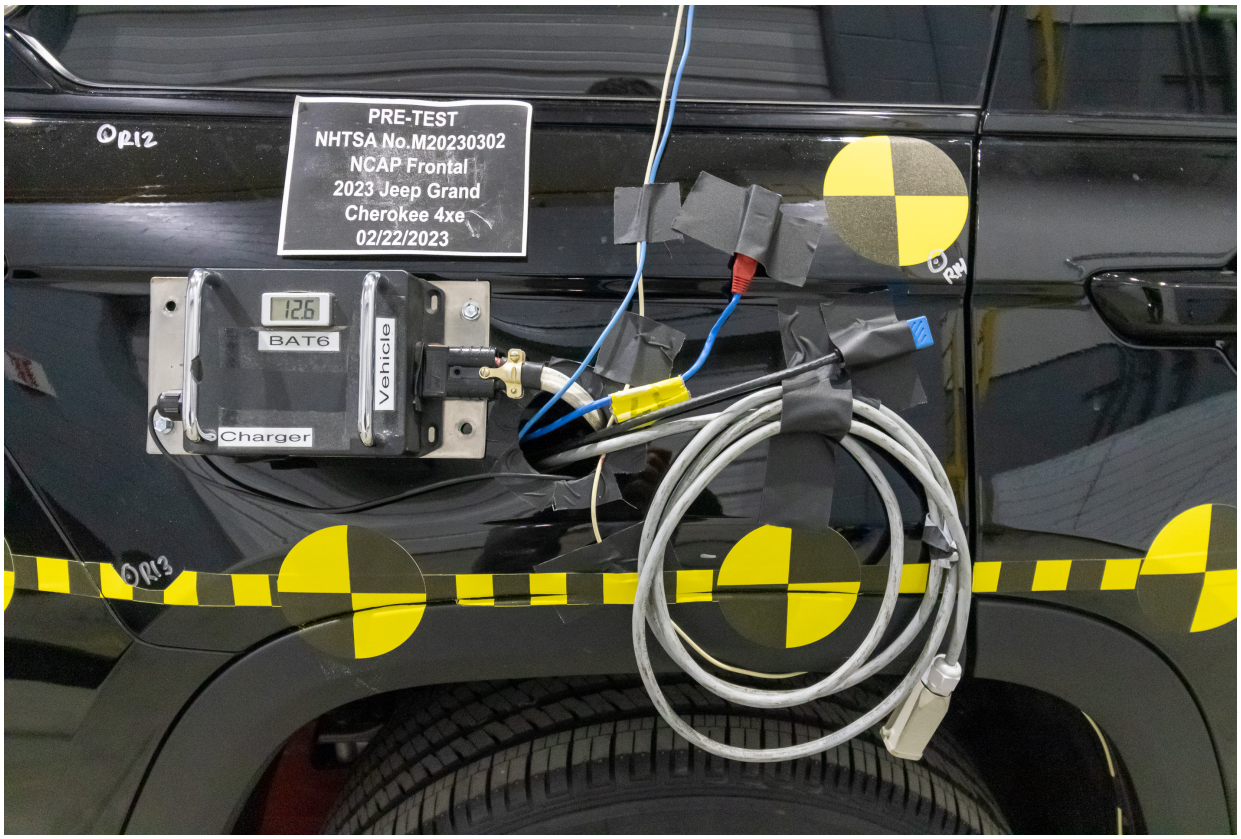


Figure 305-24: Pre-Impact View of Installed Test Interface Port



Figure 305-25: Post-Impact View of Installed Test Interface Port



Figure 305-26: Pre-Impact View of Other Test Devices

Figure 305-27: Post-Impact View of Other Test Devices

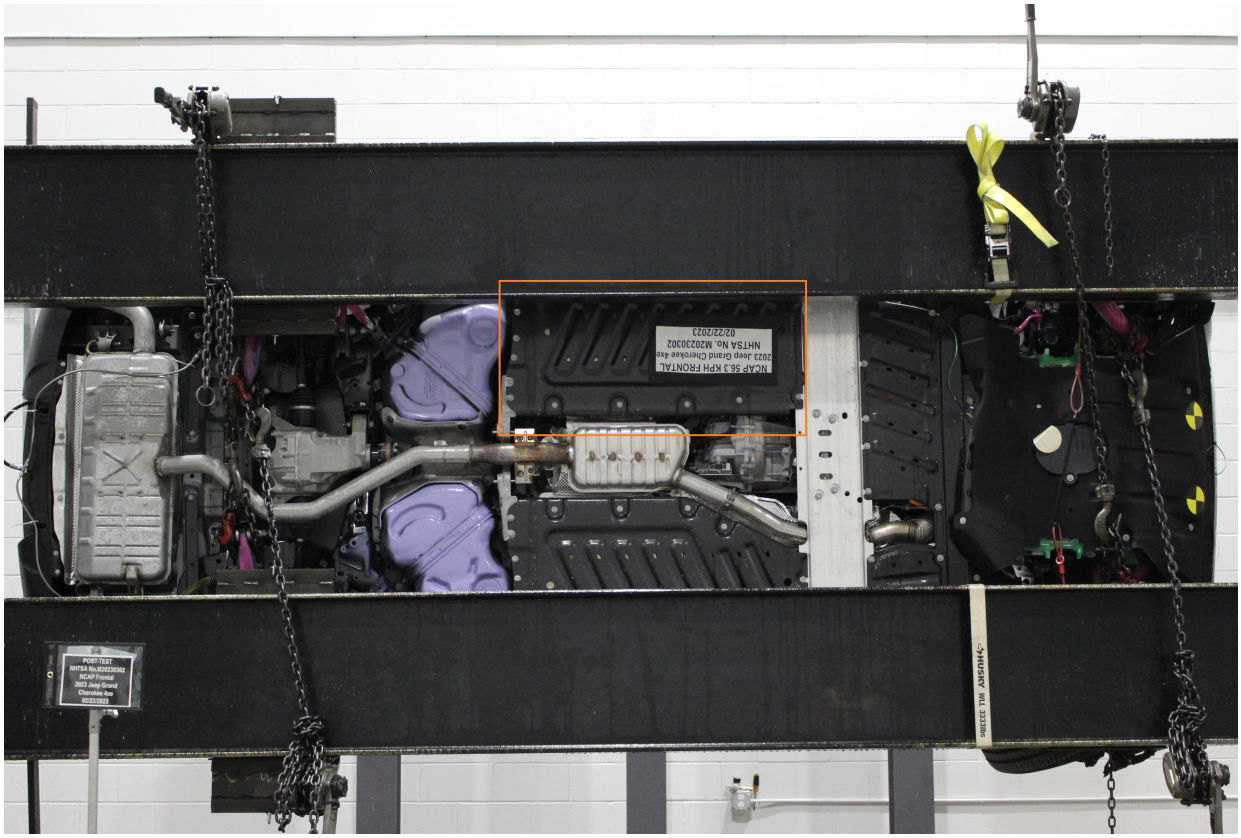


Figure 305-28: FMVSS No. 305 Static Rollover 90 Degrees

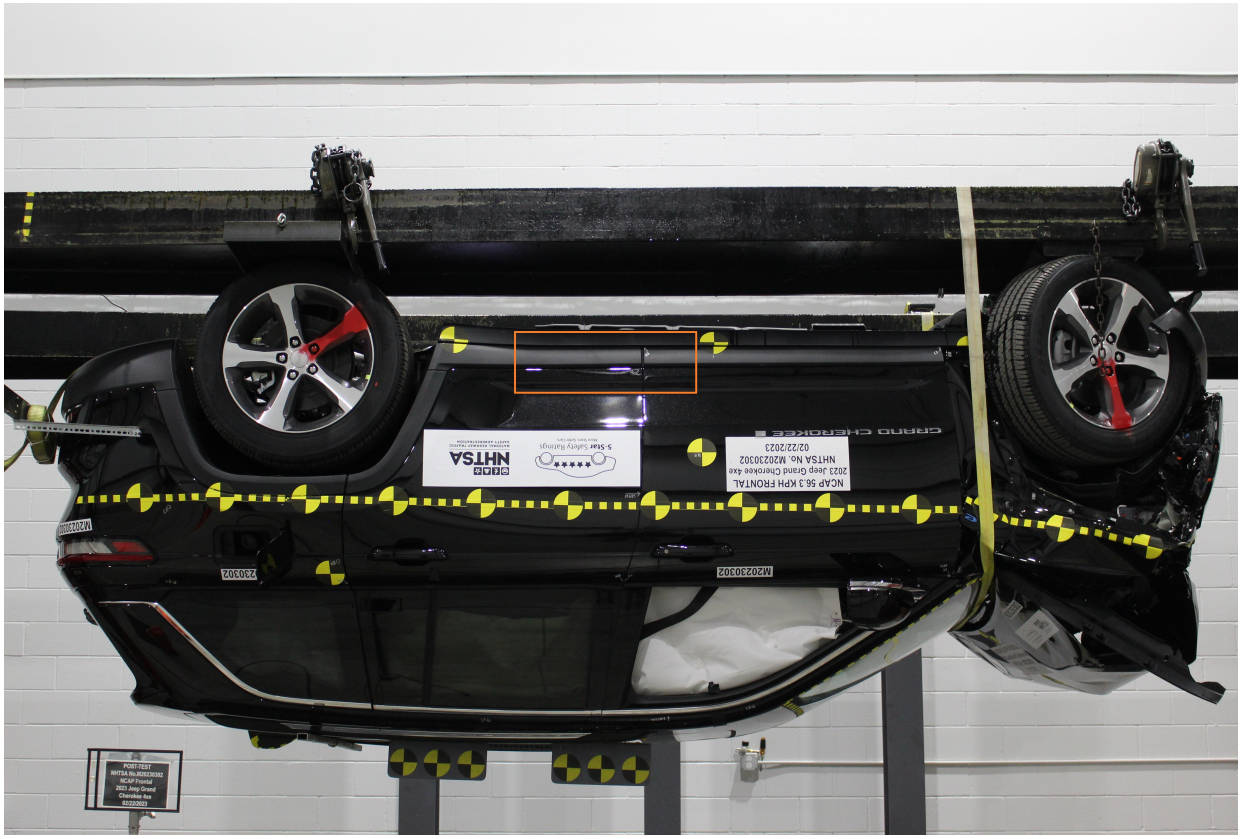


Figure 305-29: FMVSS No. 305 Static Rollover 180 Degrees

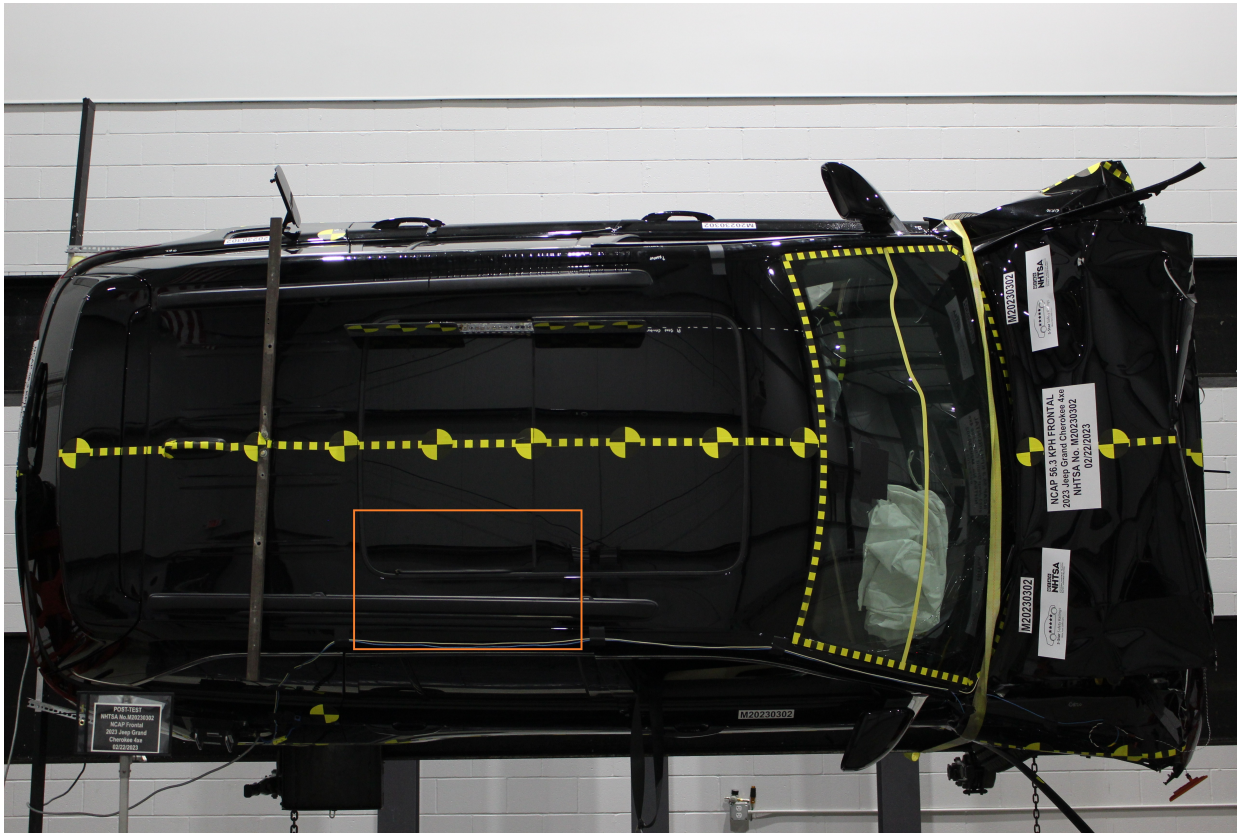


Figure 305-30: FMVSS No. 305 Static Rollover 270 Degrees



Figure 305-31: FMVSS No. 305 Static Rollover 360 Degrees



Figure 305-32: Pre-Impact View of the Vehicle Passenger Compartment Adjacent to Propulsion Battery



Figure 305-33: Post-Impact View of the Vehicle Passenger Compartment Adjacent to Propulsion Battery

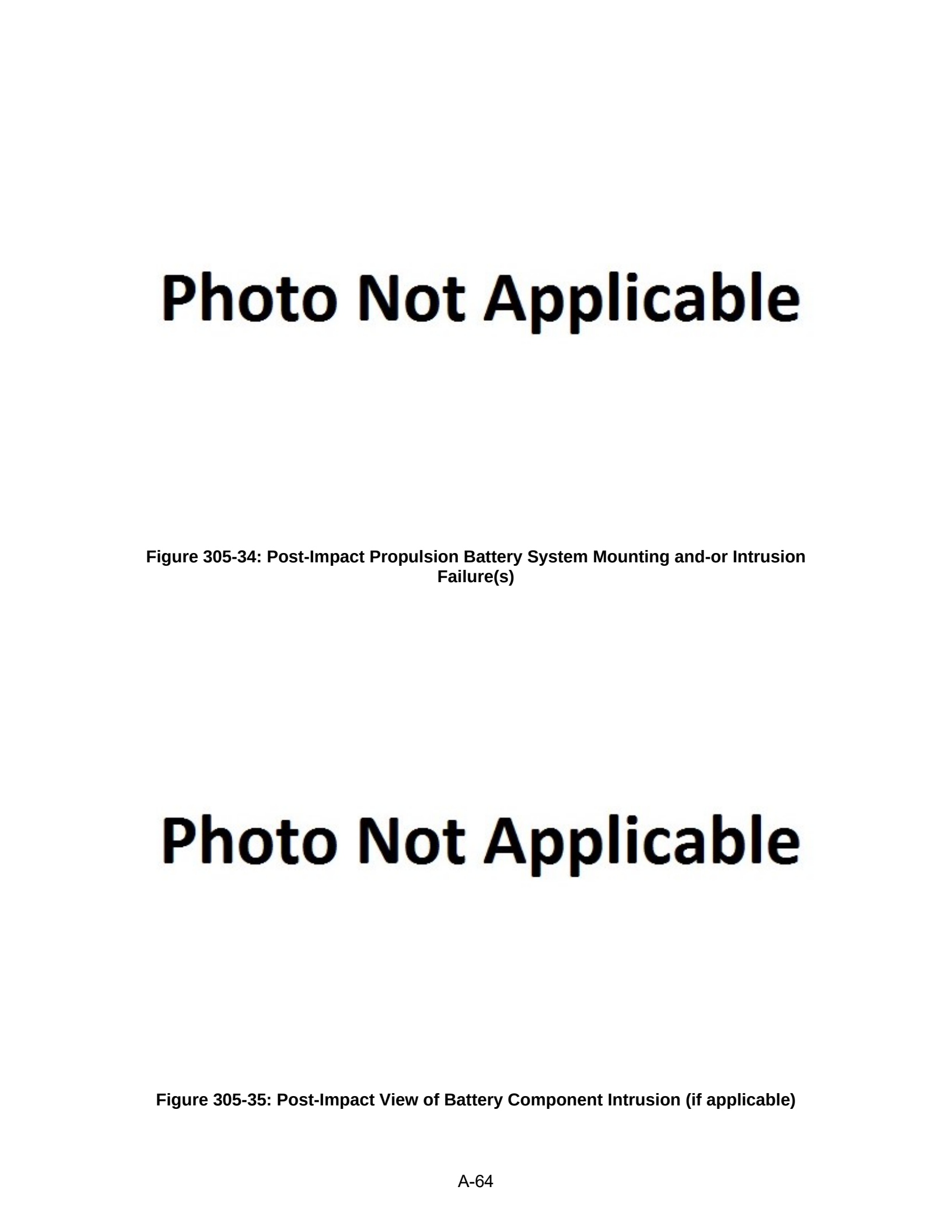


Figure 305-34: Post-Impact Propulsion Battery System Mounting and-or Intrusion Failure(s)

Figure 305-35: Post-Impact View of Battery Component Intrusion (if applicable)

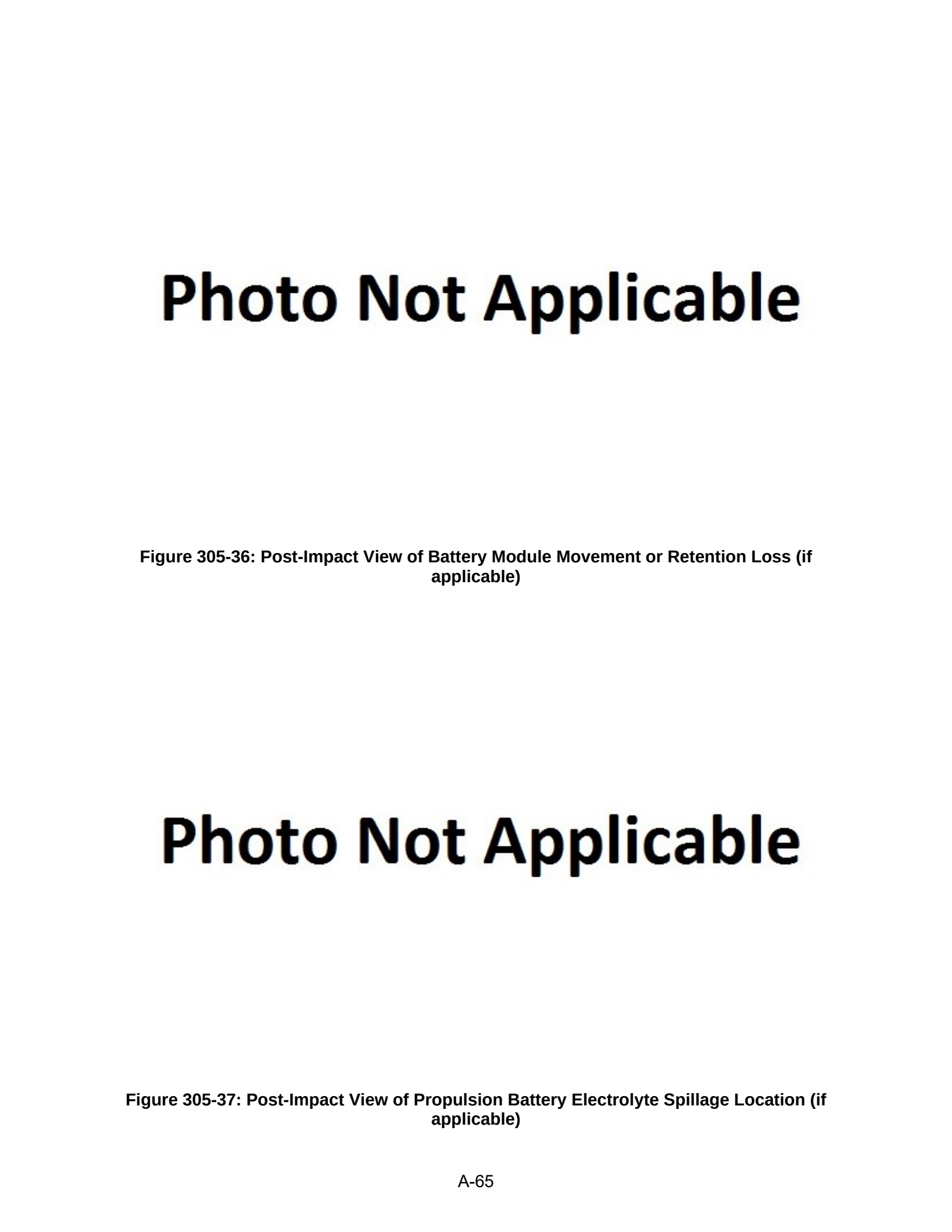


Figure 305-36: Post-Impact View of Battery Module Movement or Retention Loss (if applicable)

Figure 305-37: Post-Impact View of Propulsion Battery Electrolyte Spillage Location (if applicable)

Photo Not Applicable

Figure 305-38: Post-Impact View of Propulsion Battery Electrolyte Spillage Location (after rollover)



Figure 305-39: Pre-Test Charging Port View



Figure 305-40: Post-Test Charging Port View

APPENDIX B
VEHICLE & DUMMY RESPONSE DATA TRACES

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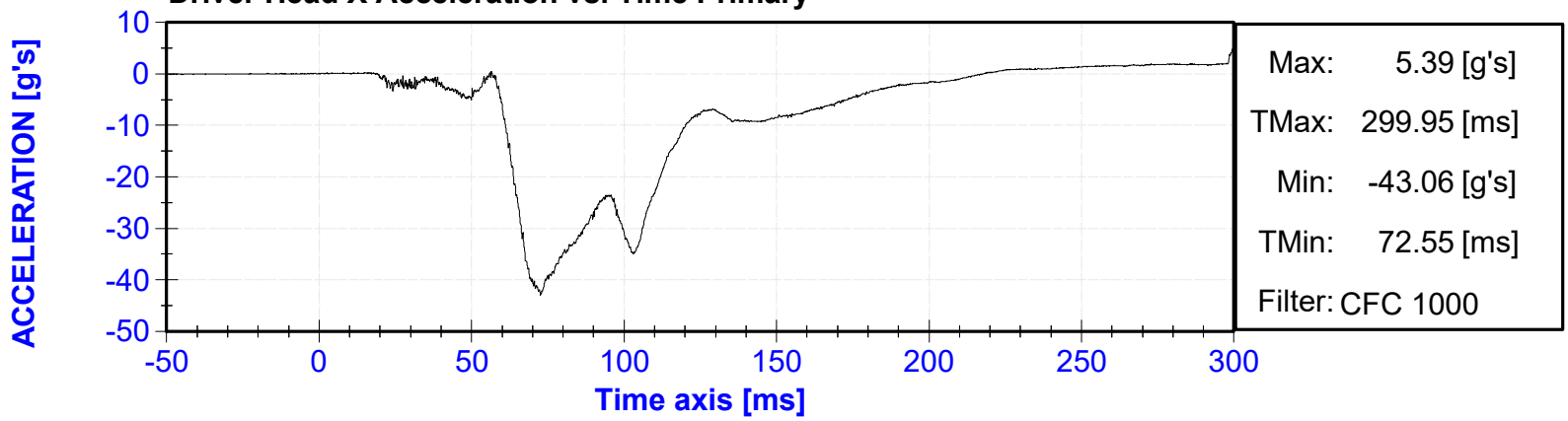
The following additional dummy and vehicle response data can be found in the R&D section of the NHTSA website at www.NHTSA.gov

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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

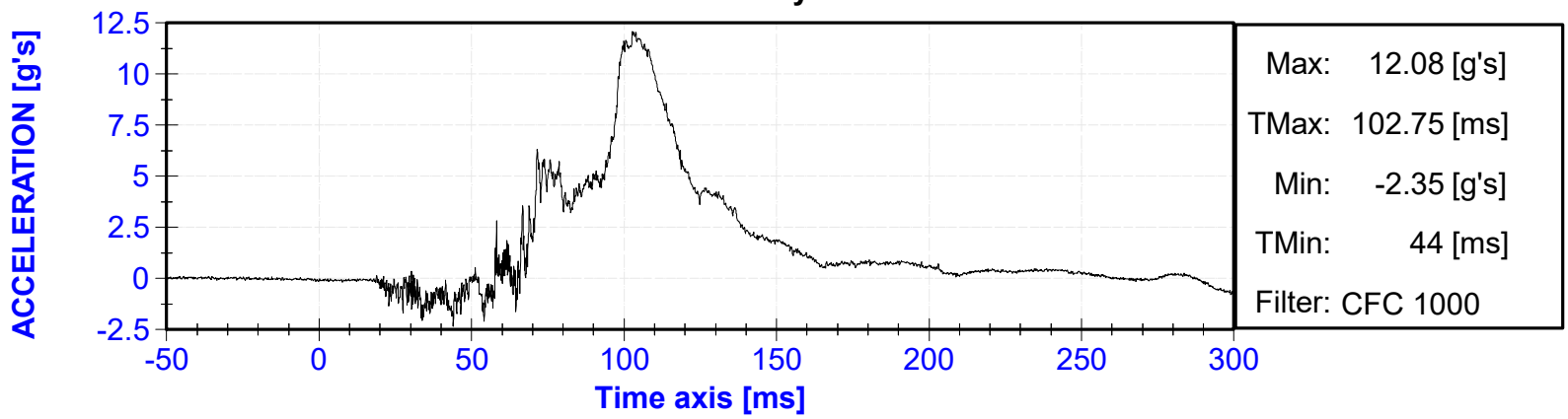
Driver Left Upper Tibia Force Z
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Driver Left Lower Tibia Moment Y
Driver Left Lower Tibia Force Z
Driver Right Upper Tibia Moment X
Driver Right Upper Tibia Moment Y
Driver Right Upper Tibia Force Z
Driver Right Lower Tibia Moment X
Driver Right Lower 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

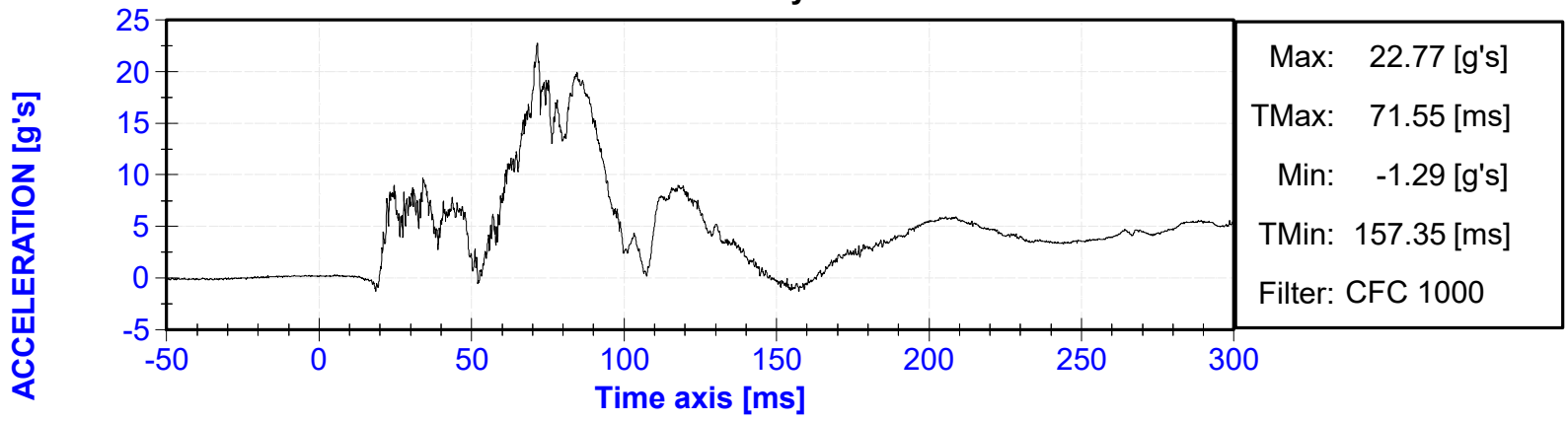
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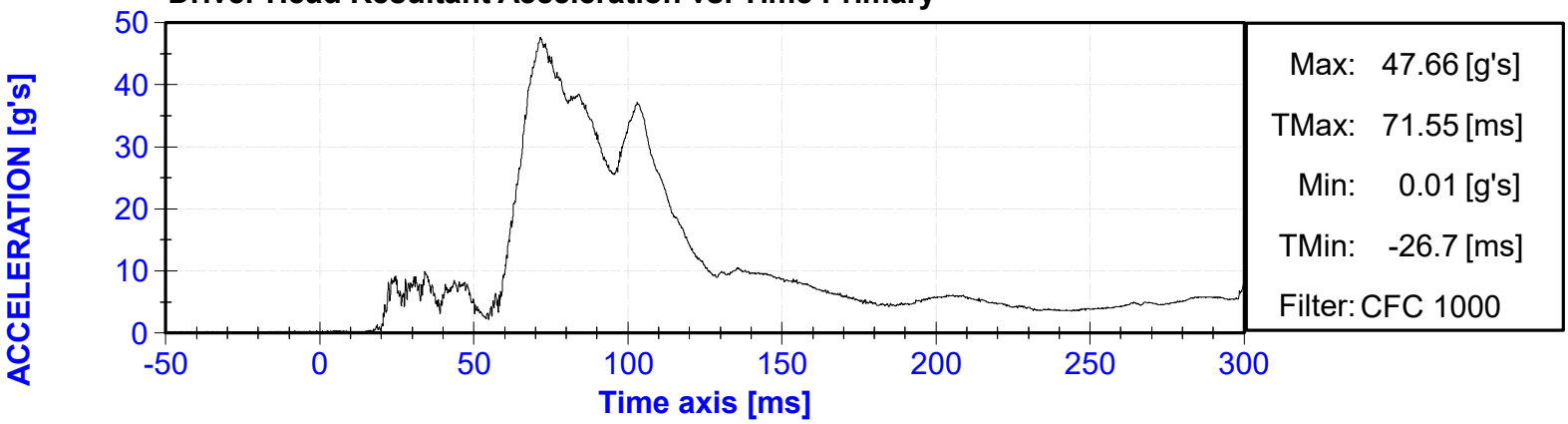
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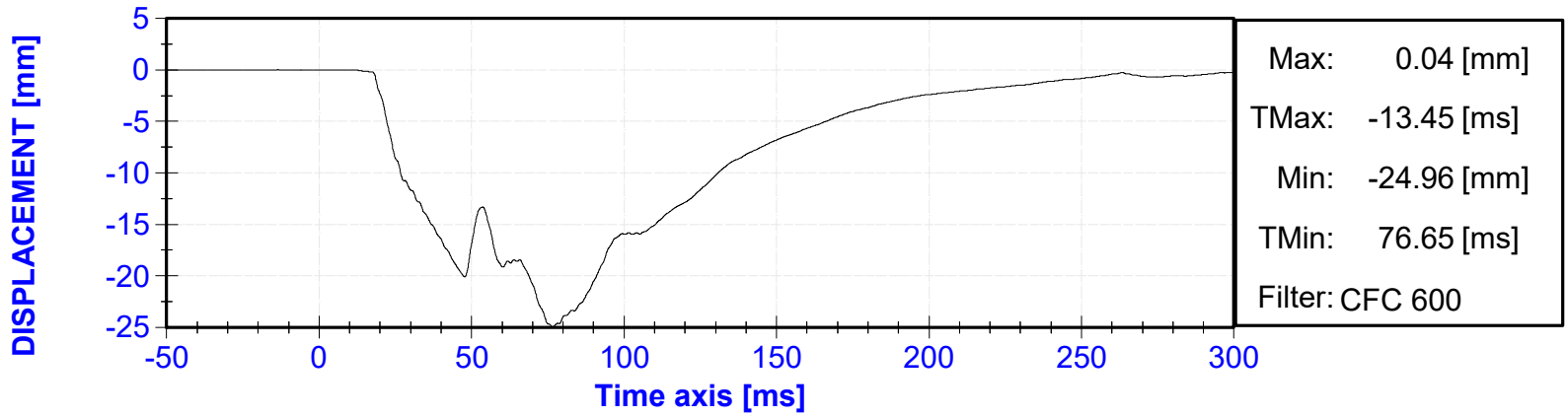
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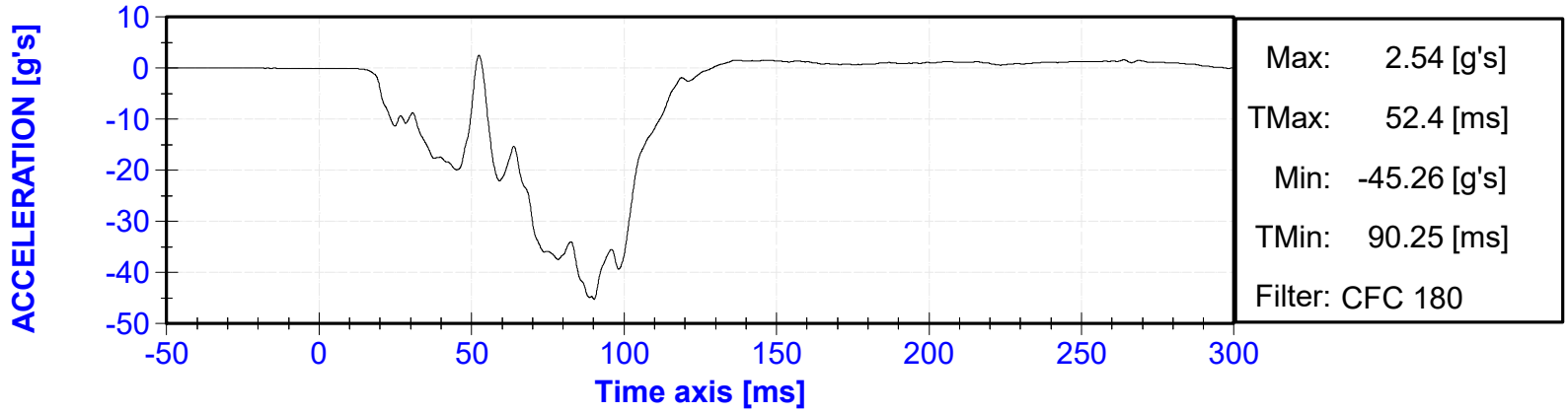
Driver Head Resultant Acceleration vs. Time Primary



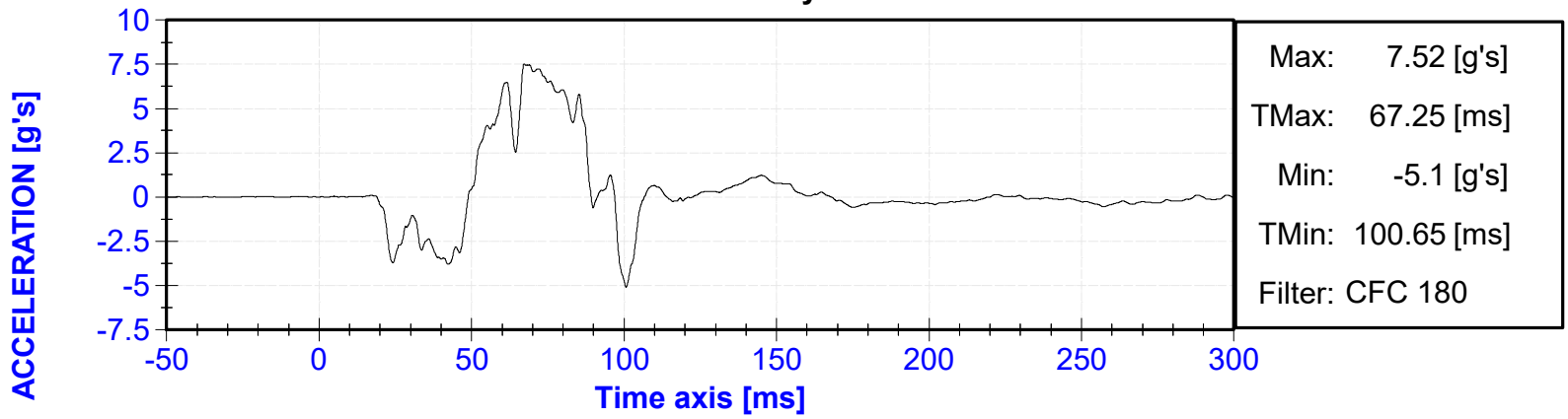
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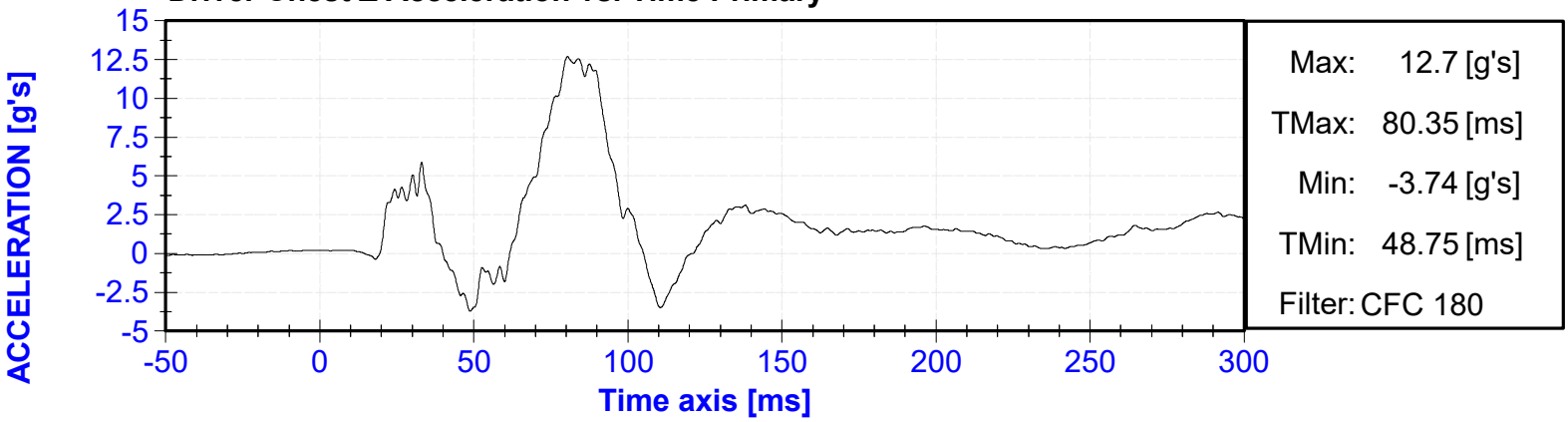
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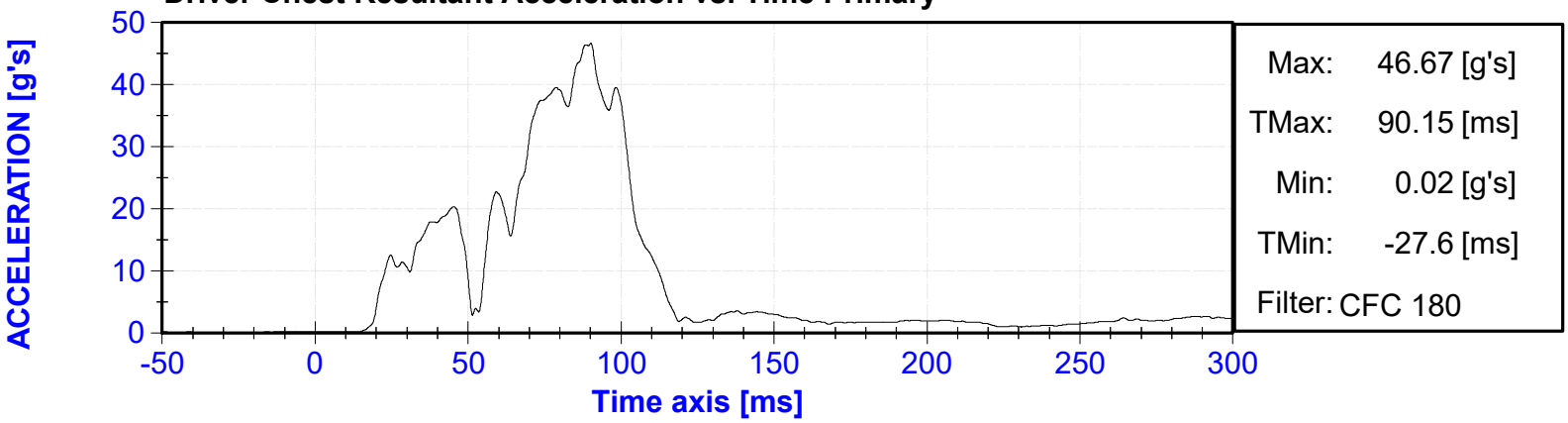
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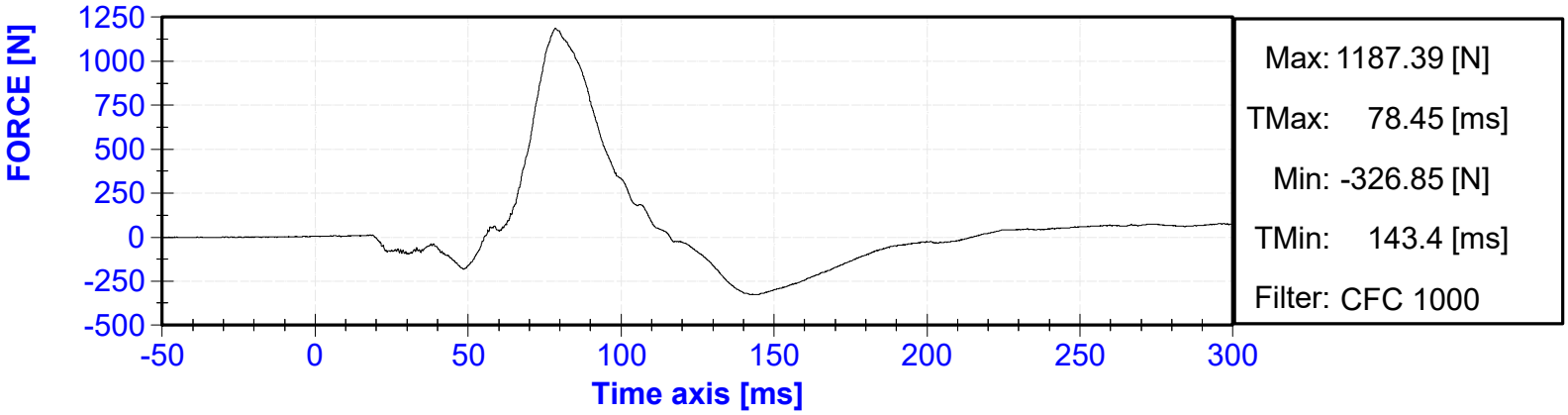
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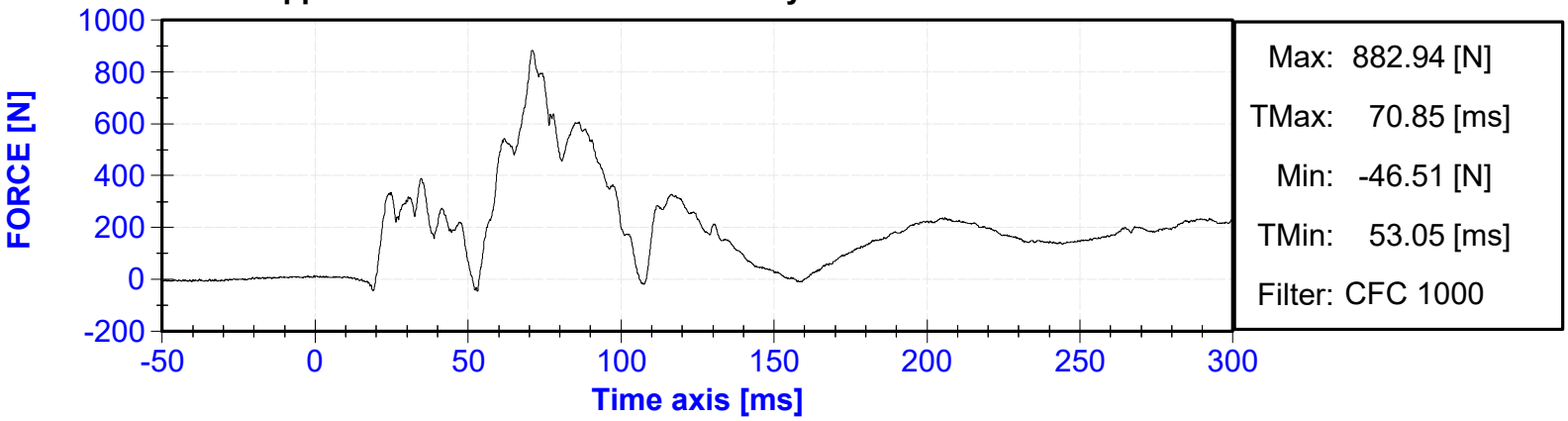
Driver Chest Resultant Acceleration vs. Time Primary



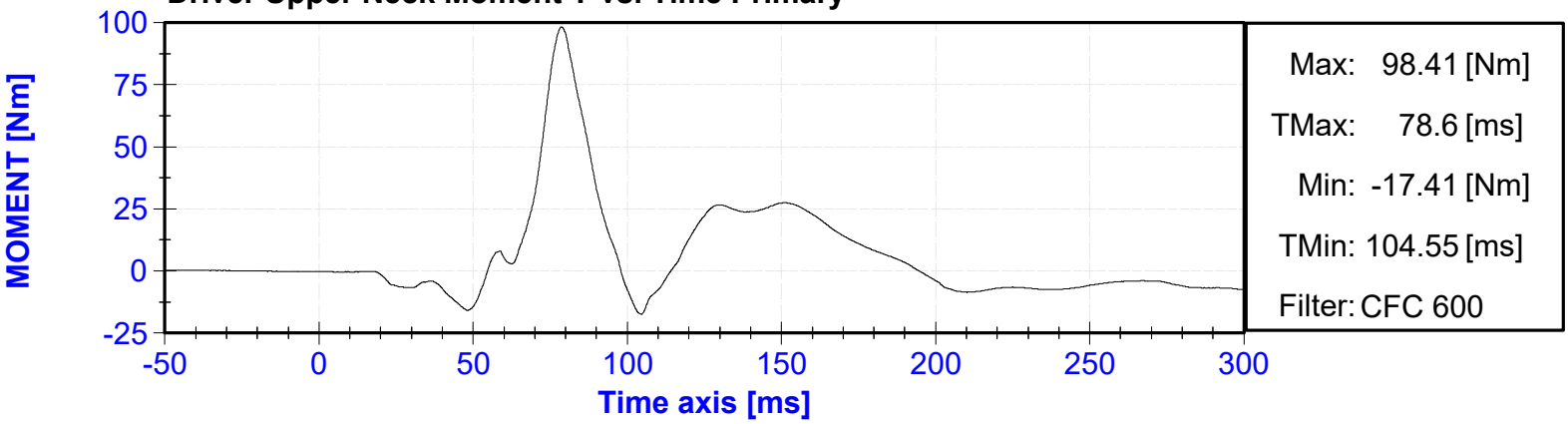
Driver Upper Neck Force X vs. Time Primary



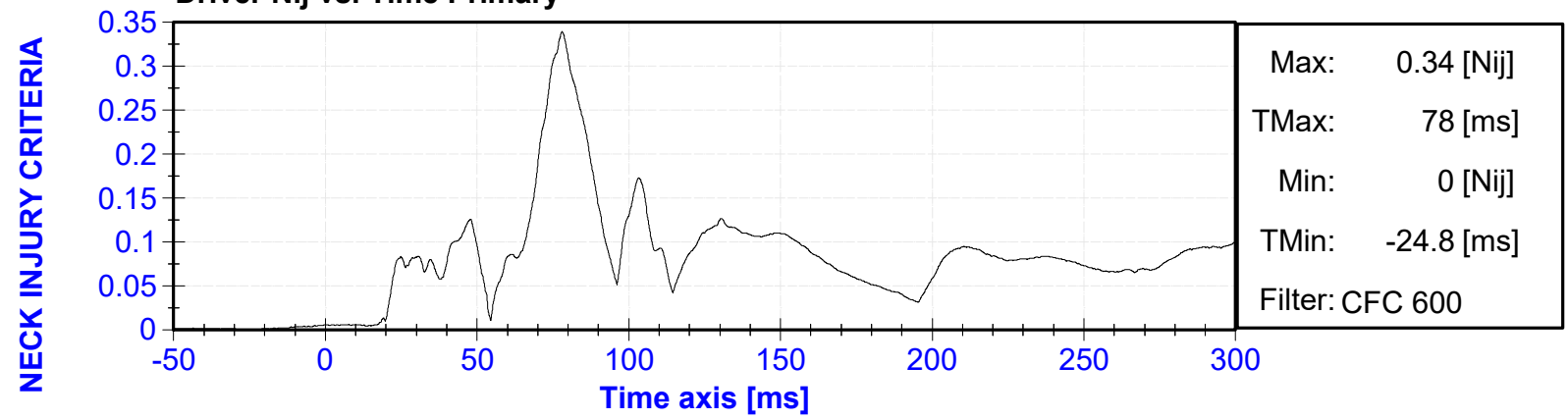
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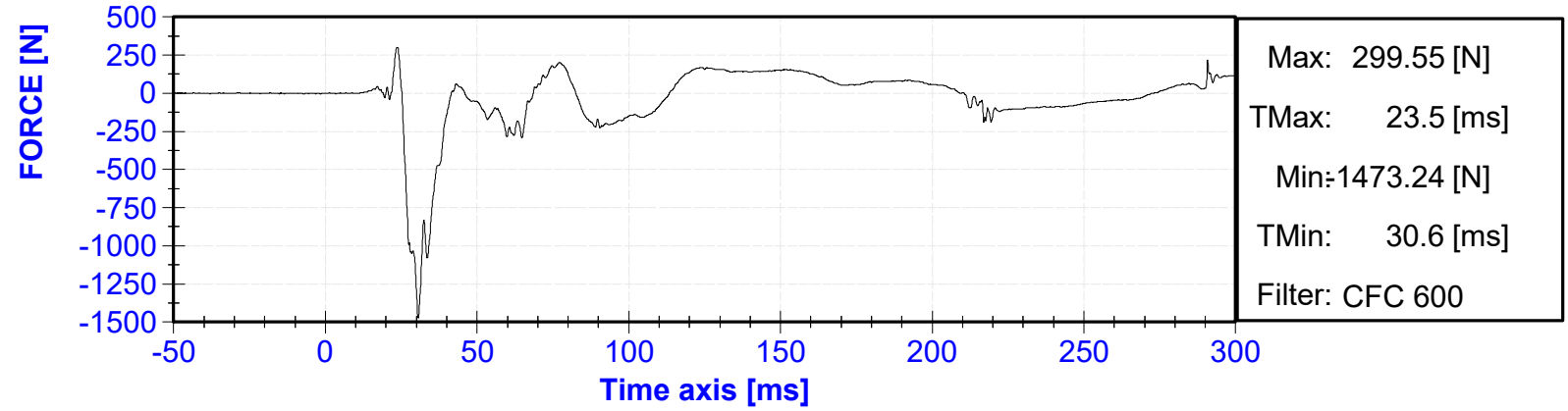
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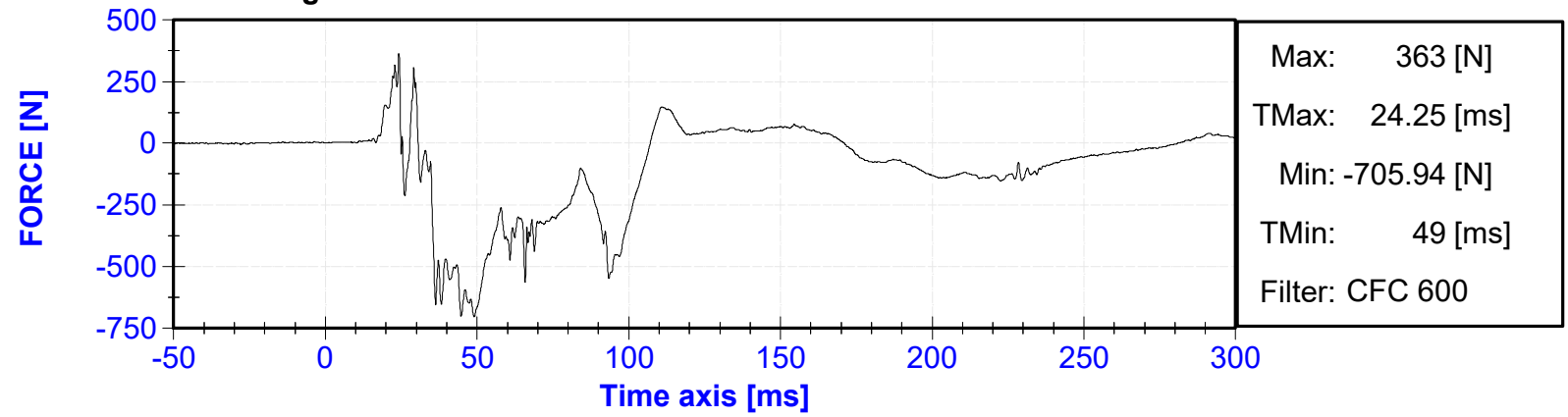
Driver Nij vs. Time Primary



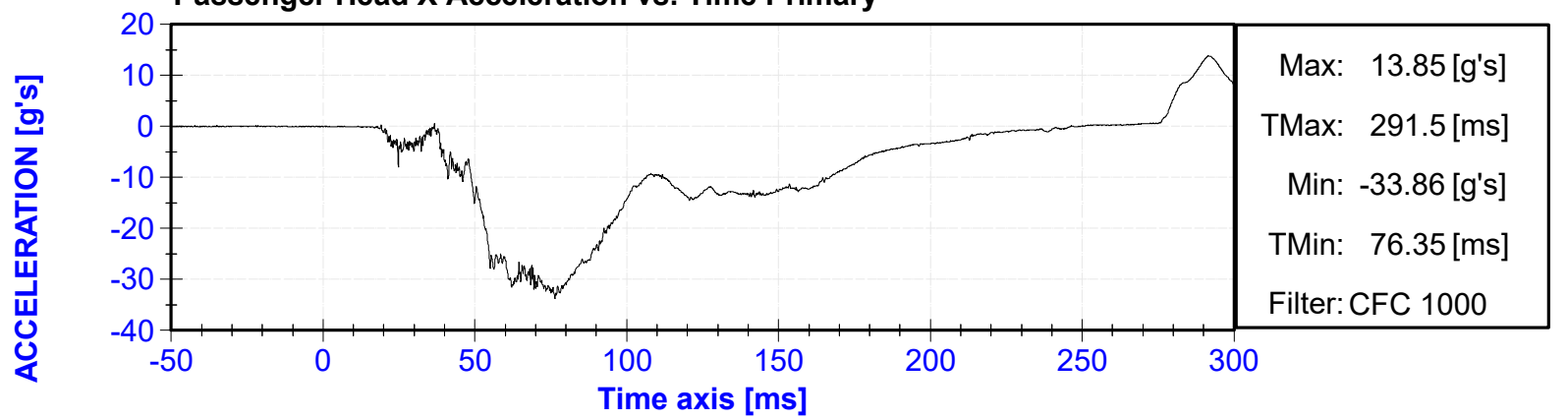
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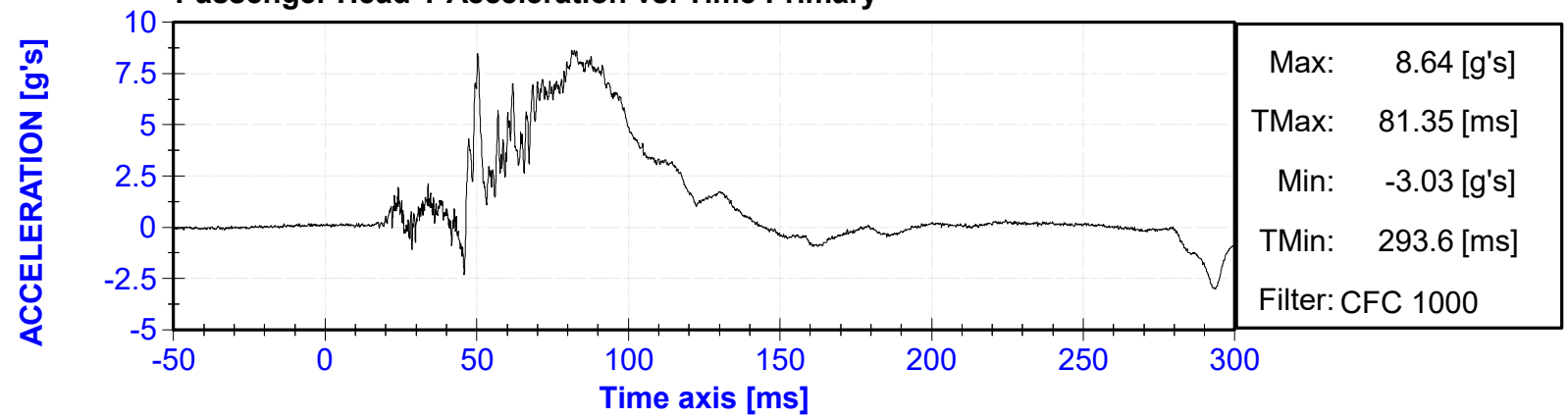
Driver Right Femur Force vs. Time



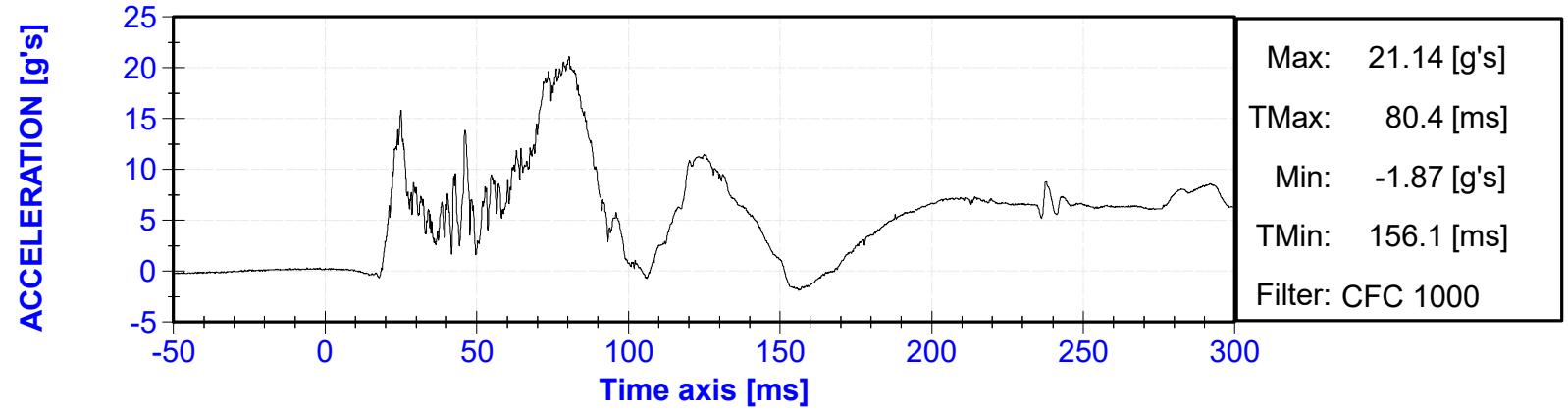
Passenger Head X Acceleration vs. Time Primary



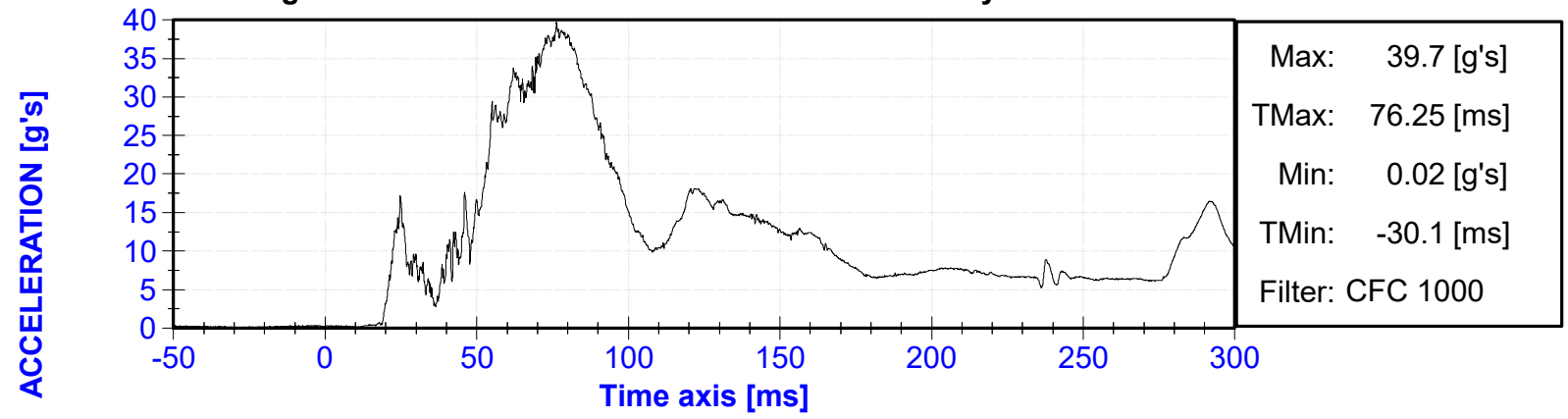
Passenger Head Y Acceleration vs. Time Primary



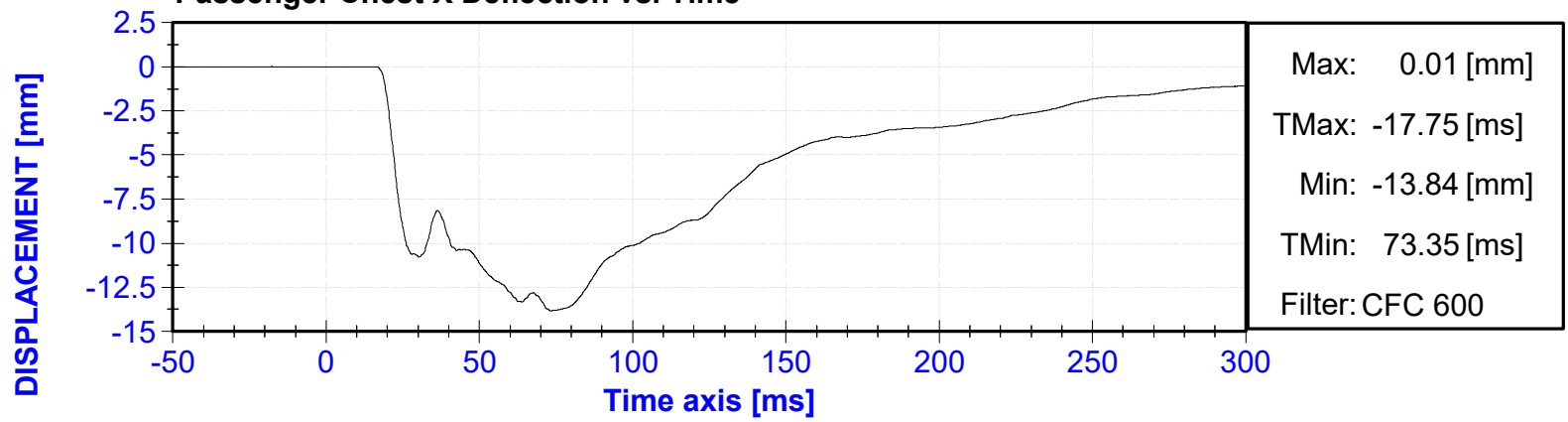
Passenger Head Z Acceleration vs. Time Primary



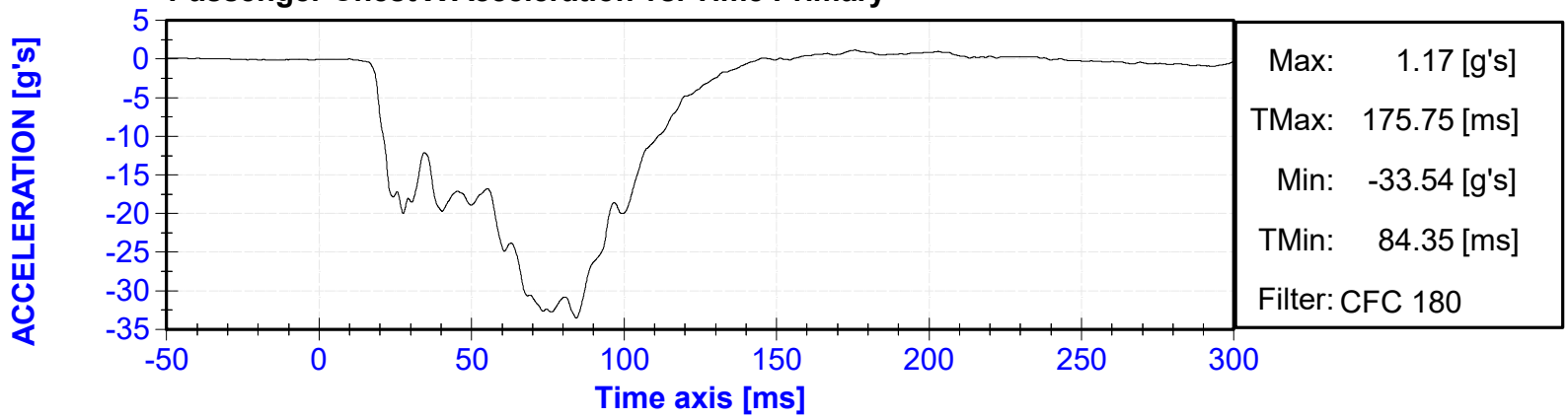
Passenger Head Resultant Acceleration vs. Time Primary



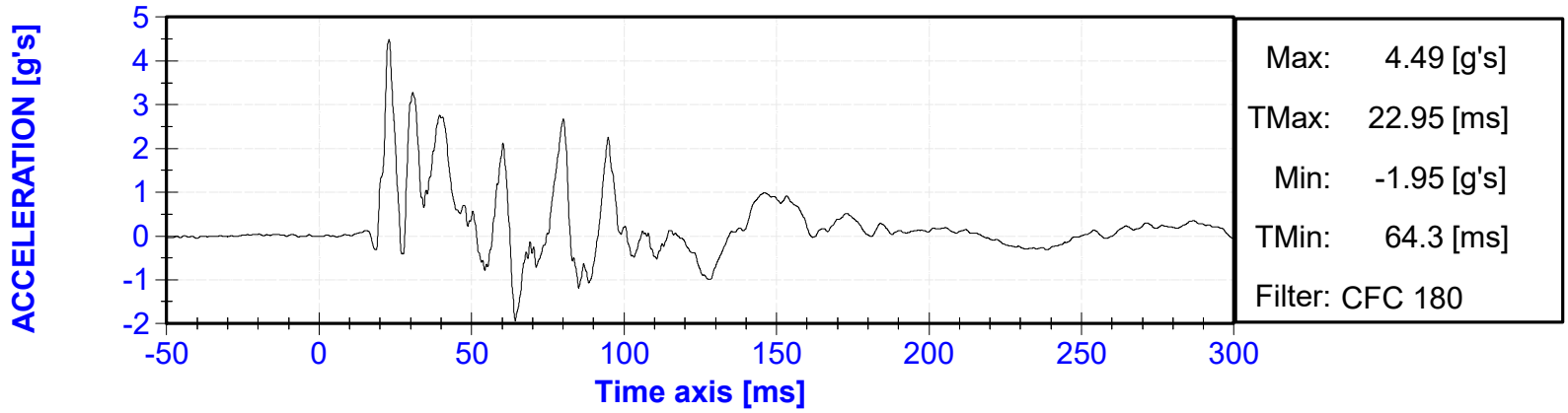
Passenger Chest X Deflection vs. Time



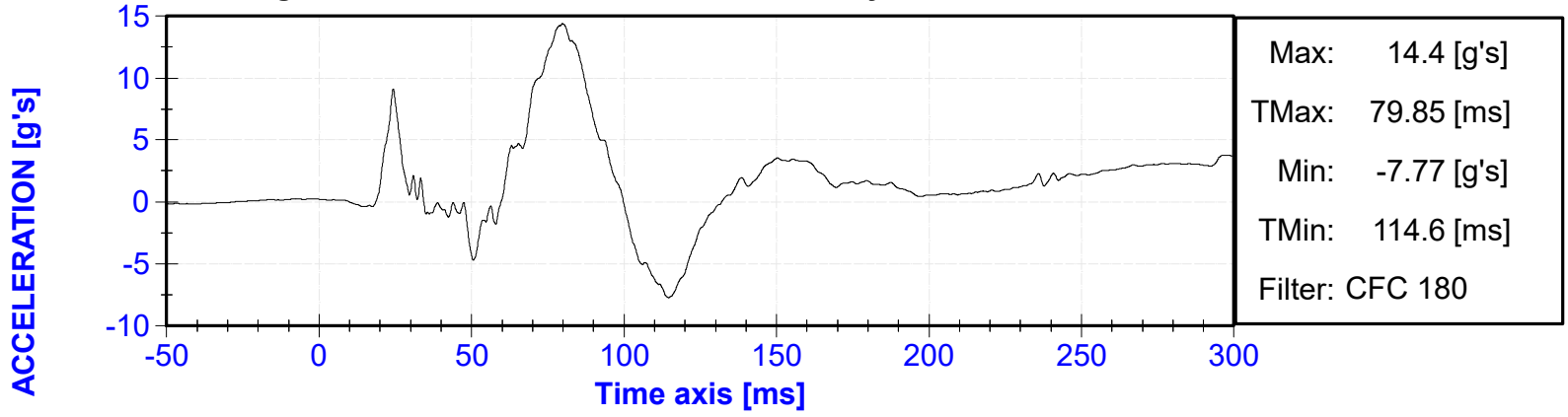
Passenger Chest X Acceleration vs. Time Primary



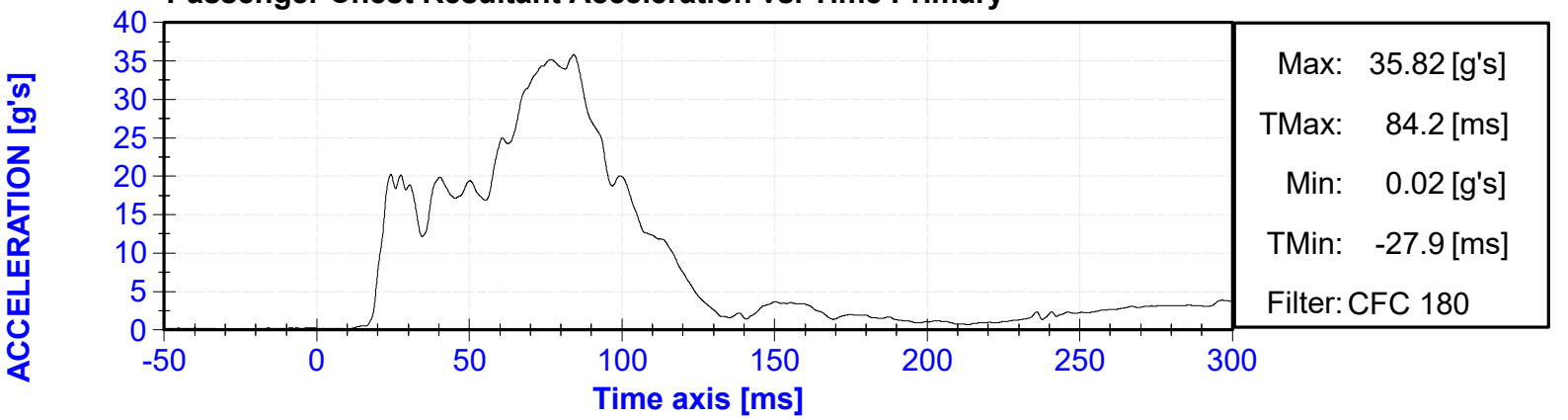
Passenger Chest Y Acceleration vs. Time Primary



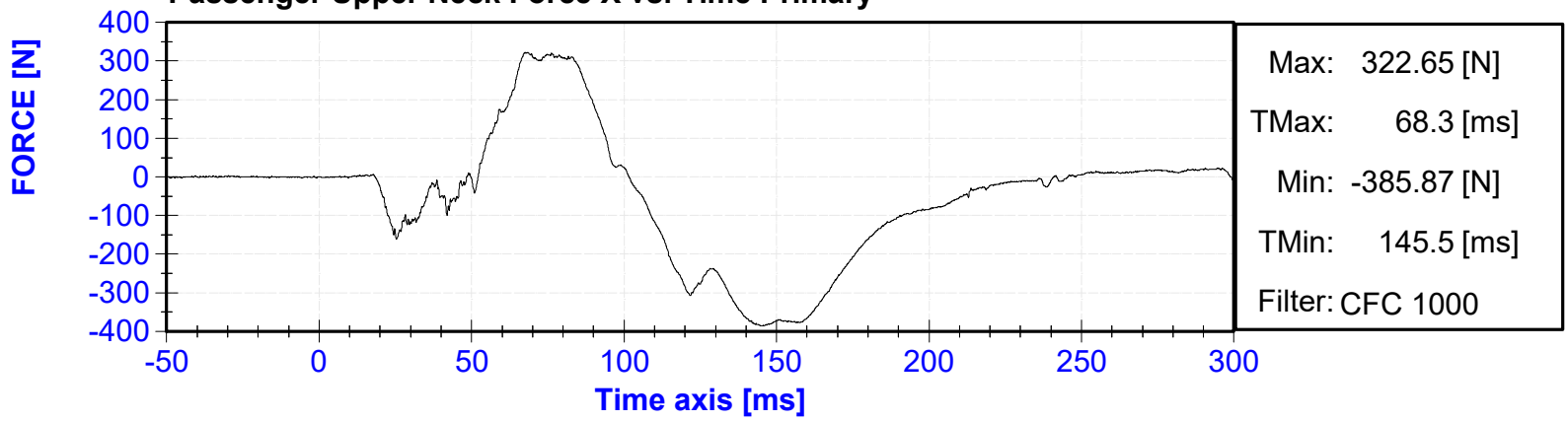
Passenger Chest Z Acceleration vs. Time Primary



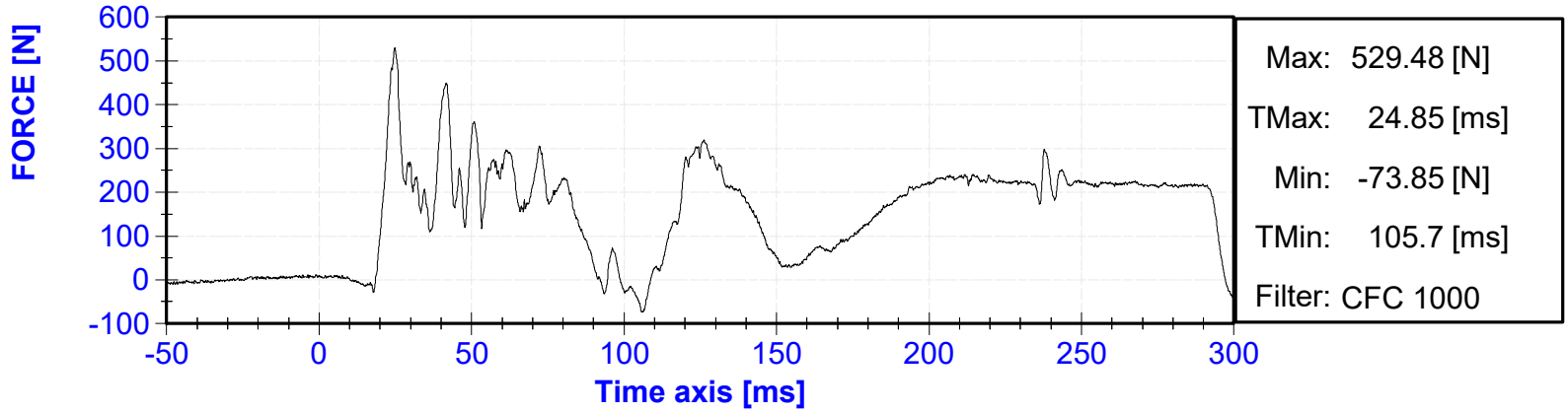
Passenger Chest Resultant Acceleration vs. Time Primary



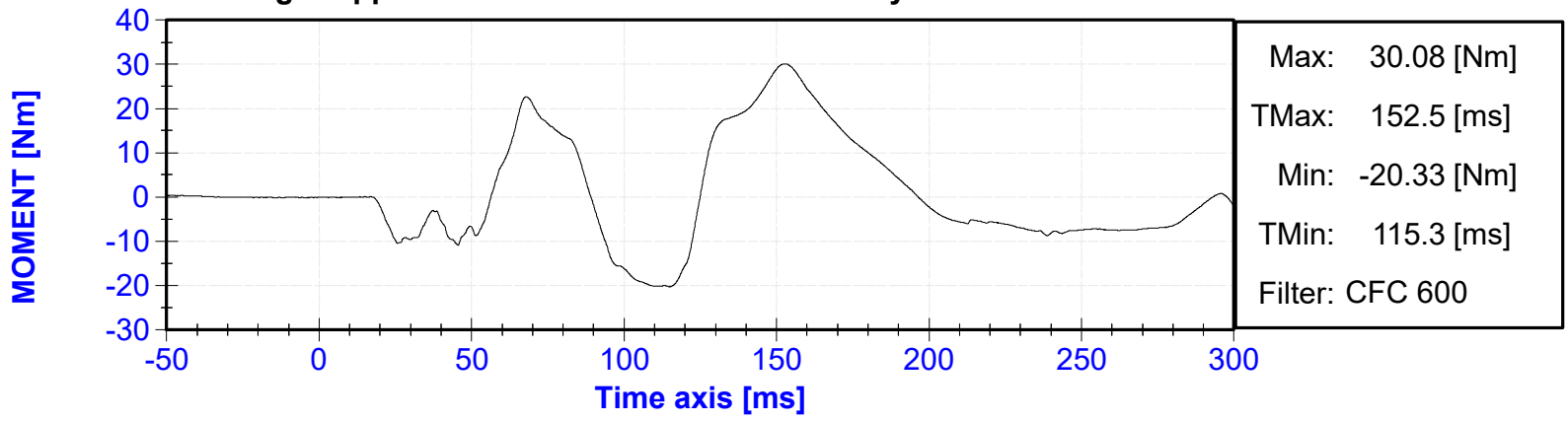
Passenger Upper Neck Force X vs. Time Primary



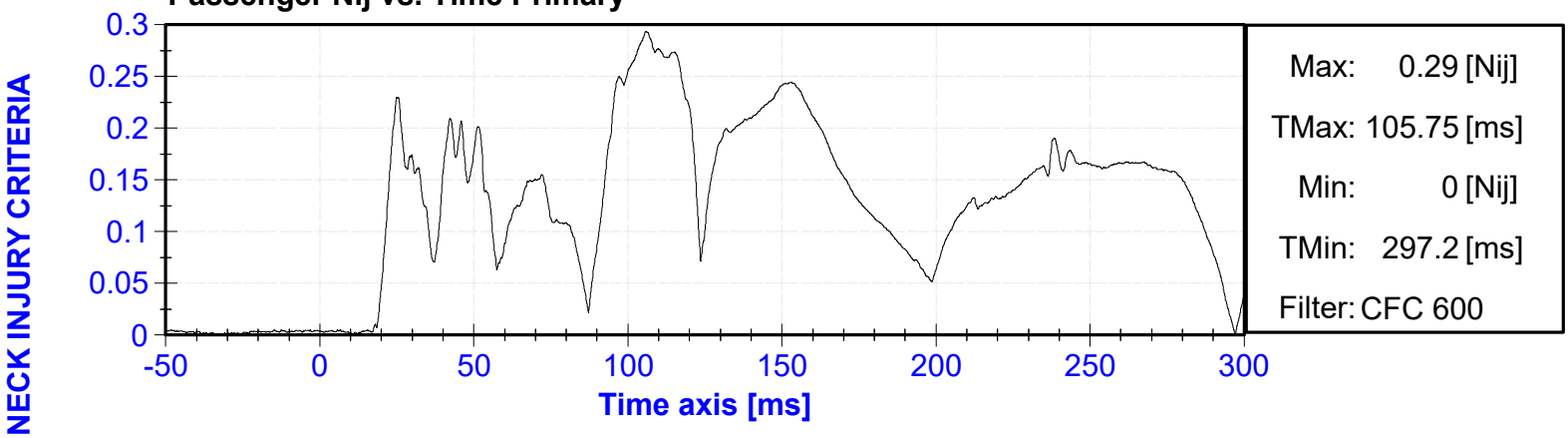
Passenger Upper Neck Force Z vs. Time Primary

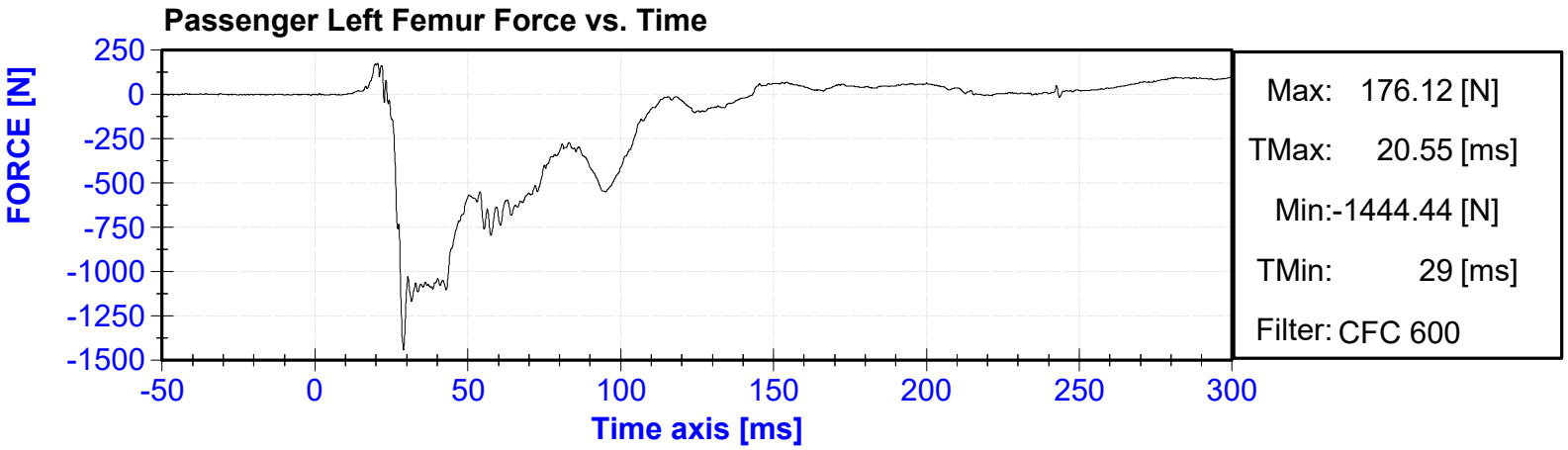


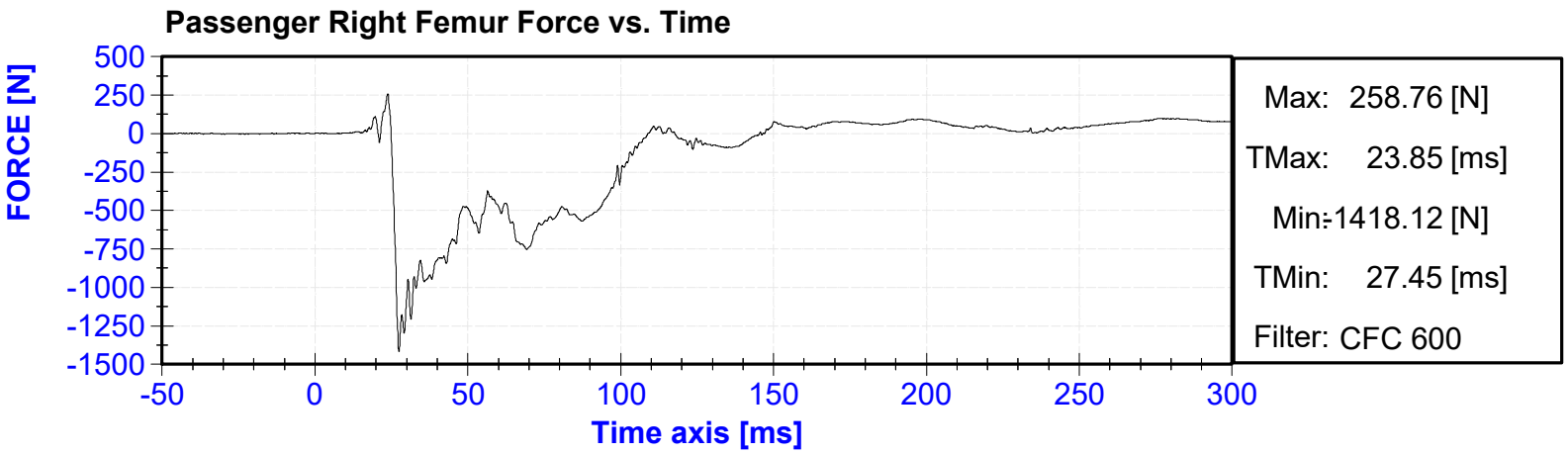
Passenger Upper Neck Moment Y vs. Time Primary



Passenger Nij vs. Time Primary




Passenger Left Femur Force vs. Time
FORCE [N]
250
0
-250
-500
-750
-1000
-1250
-1500
-50
0
50
100
150
200
250
300
Time axis [ms]
Max: 176.12 [N]
TMax: 20.55 [ms]
Min:-1444.44 [N]
TMin: 29 [ms]
Filter: CFC 600


Passenger Right Femur Force vs. Time
FORCE [N]
500
250
0
-250
-500
-750
-1000
-1250
-1500
-50
0
50
100
150
200
250
300
Time axis [ms]
Max: 258.76 [N]
TMax: 23.85 [ms]
Min:-1418.12 [N]
TMin: 27.45 [ms]
Filter: CFC 600

APPENDIX C

DUMMY CALIBRATION AND PERFORMANCE VERIFICATION DATA

CALIBRATION TEST RESULTS

PRE-TEST

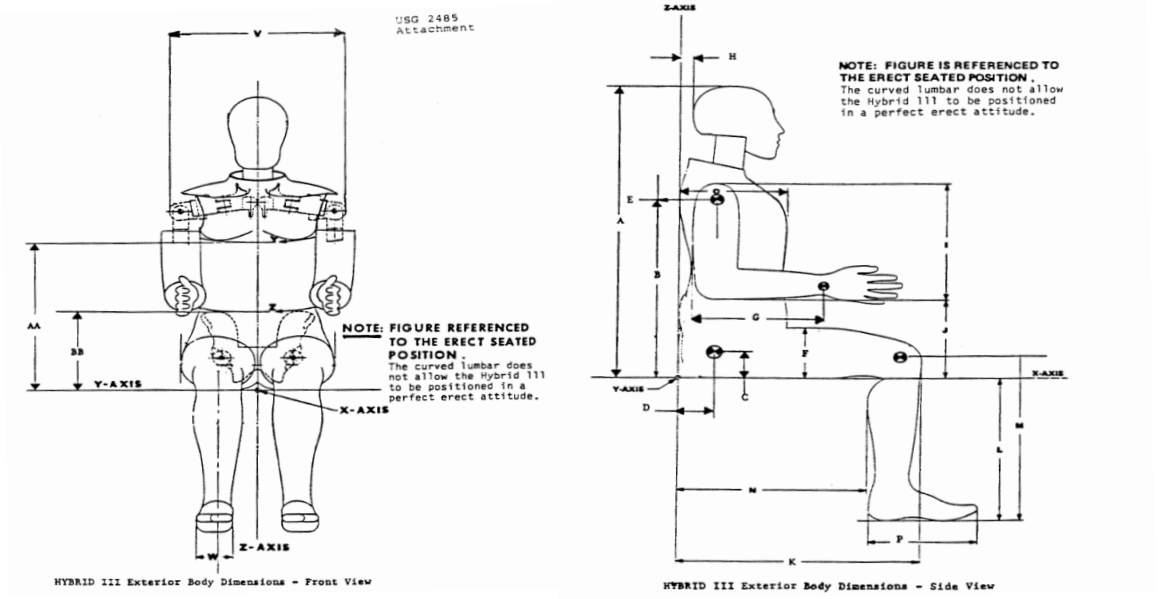
HYBRID III 50TH PERCENTILE MALE - DRIVER ATD

SERIAL NO: 142

External Measurements - Hybrid 3 - 50th Male

Technician: K. Brogan Date: 02/21/2023

Dummy Serial Number: 142



Symbol	Description	Specification (in)		Result (in)	Pass/Fail
A	Sitting Height	34.6	35.0	34.8	Pass
B	Shoulder Pivot Height	19.9	20.5	20.2	Pass
C	H-Point Height	3.3	3.5	3.4	Pass
D	H-Point from Backline	5.3	5.5	5.4	Pass
E	Shoulder Pivot from Backline	3.3	3.7	3.6	Pass
F	Thigh Clearance	5.5	6.1	5.8	Pass
G	Back of Elbow to Wrist Pivot	11.4	12.0	11.7	Pass
H	Head Back to Backline	1.6	1.8	1.7	Pass
I	Shoulder to Elbow Length	13.0	13.6	13.3	Pass
J	Elbow Rest Height	7.5	8.3	7.9	Pass
K	Buttock to Knee Length	22.8	23.8	23.5	Pass
L	Popliteal Height	16.9	17.9	17.3	Pass
M	Knee Pivot Height	19.1	19.7	19.4	Pass
N	Buttock Popliteal Length	17.8	18.8	18.3	Pass
O	Chest Depth without Jacket	8.4	9.0	8.7	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	3.9	Pass
Y	Chest Circumference with Jacket	38.2	39.4	39.1	Pass
Z	Waist Circumference	32.9	34.1	33.3	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

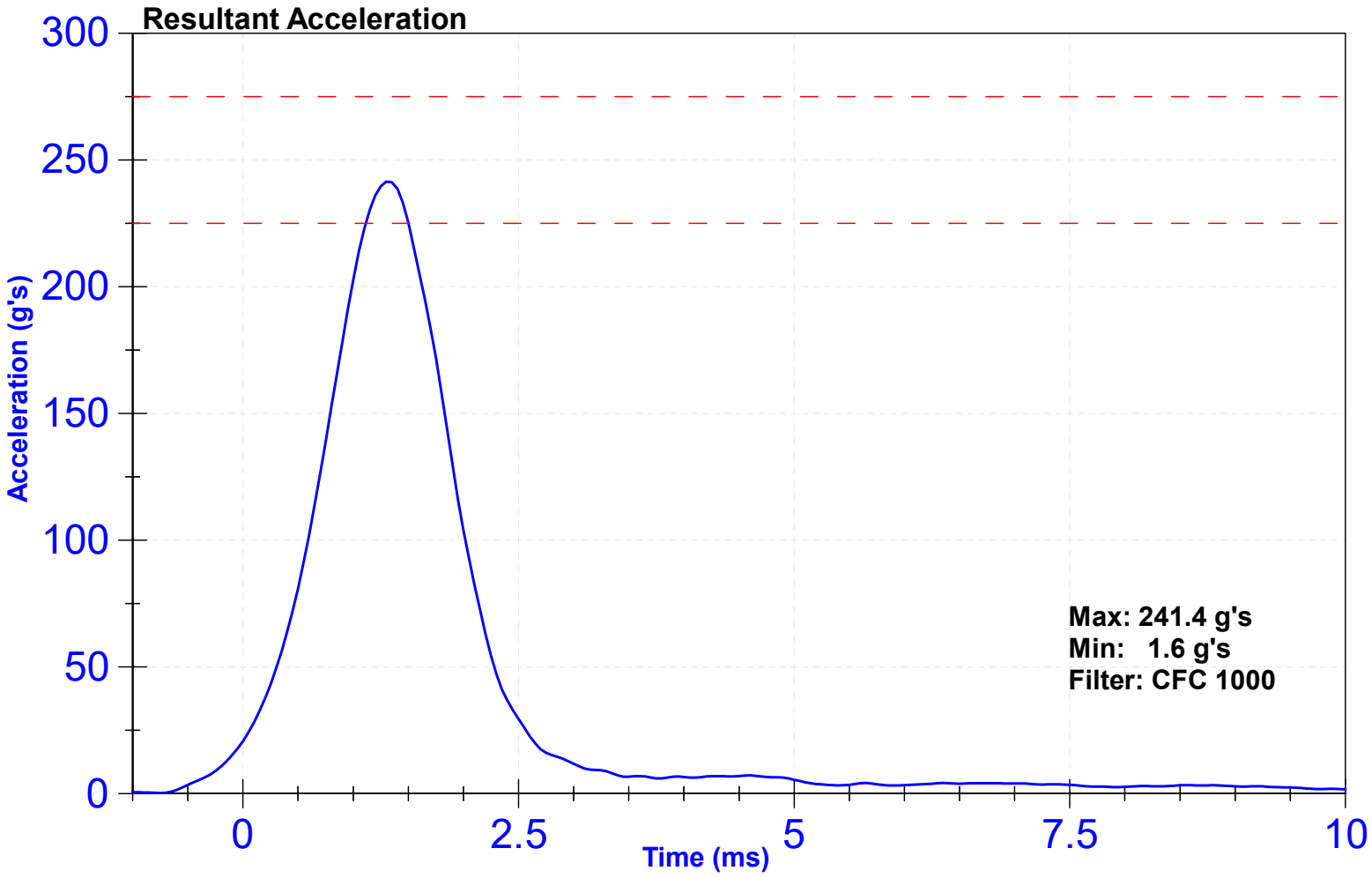
ATD Manufacturer	Humanetics	Test Technician	D. Sakona
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

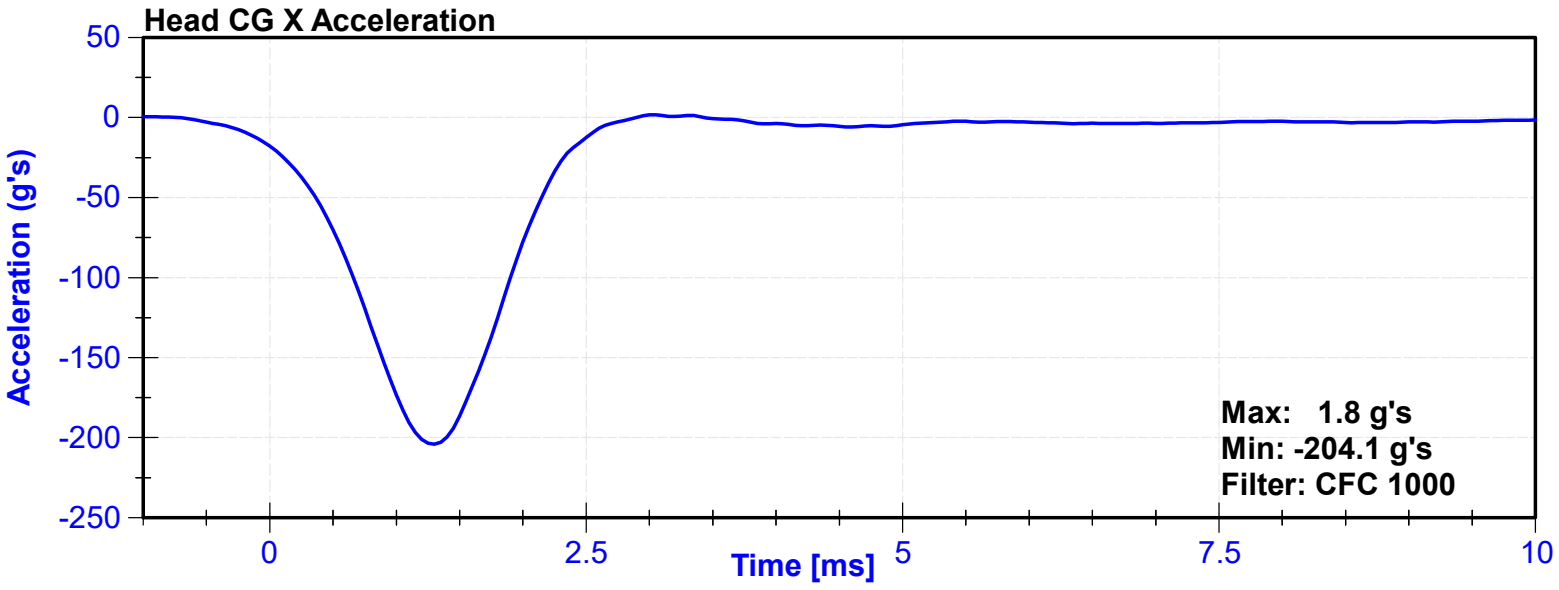
Results

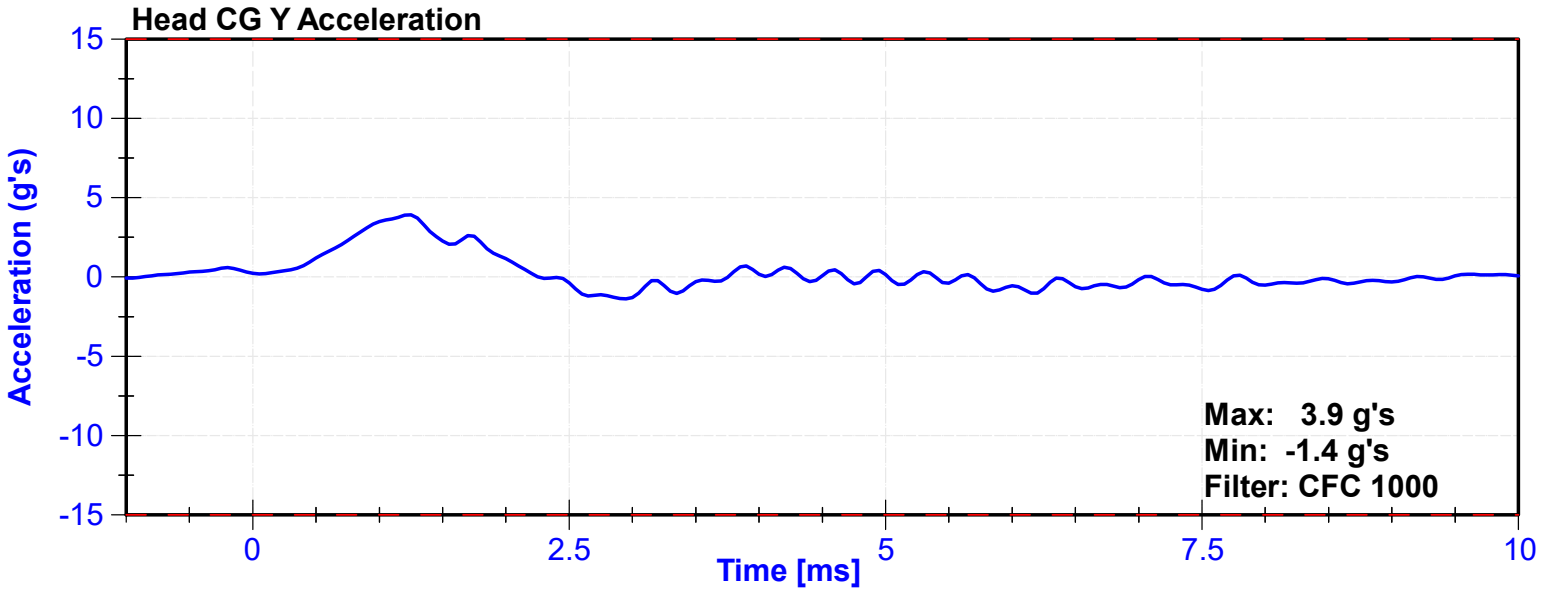
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.0	Pass
Humidity	10	70	%	23.5	Pass
Resultant Acceleration	225	275	g's	241.4	Pass
Oscillation	0	10	%	2.9	Pass
Lateral Acceleration	-15	15	g's	3.9	Pass

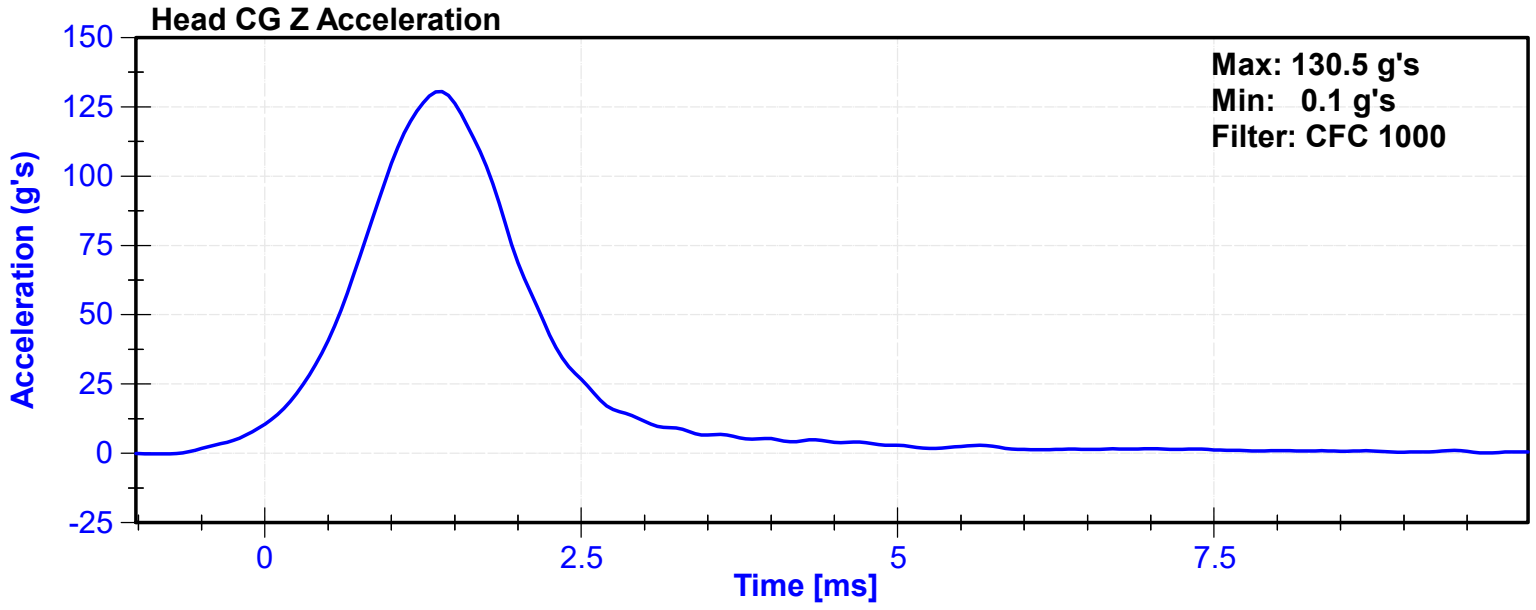
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	Endevco	P51681	9/30/2022	3/29/2023
Y Accelerometer	Endevco	P64151	9/30/2022	3/29/2023
Z Accelerometer	Endevco	P52114	9/30/2022	3/29/2023




Head CG X Acceleration
Acceleration (g's)
50
0
-50
-100
-150
-200
-250
0
2.5
5
7.5
10
Time [ms]
Max: 1.8 g's
Min: -204.1 g's
Filter: CFC 1000


Head CG Y Acceleration
Acceleration (g's)
15
10
5
0
-5
-10
-15
0
2.5
5
7.5
10
Time [ms]
Max: 3.9 g's
Min: -1.4 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
Time [ms]
Max: 130.5 g's
Min: 0.1 g's
Filter: CFC 1000

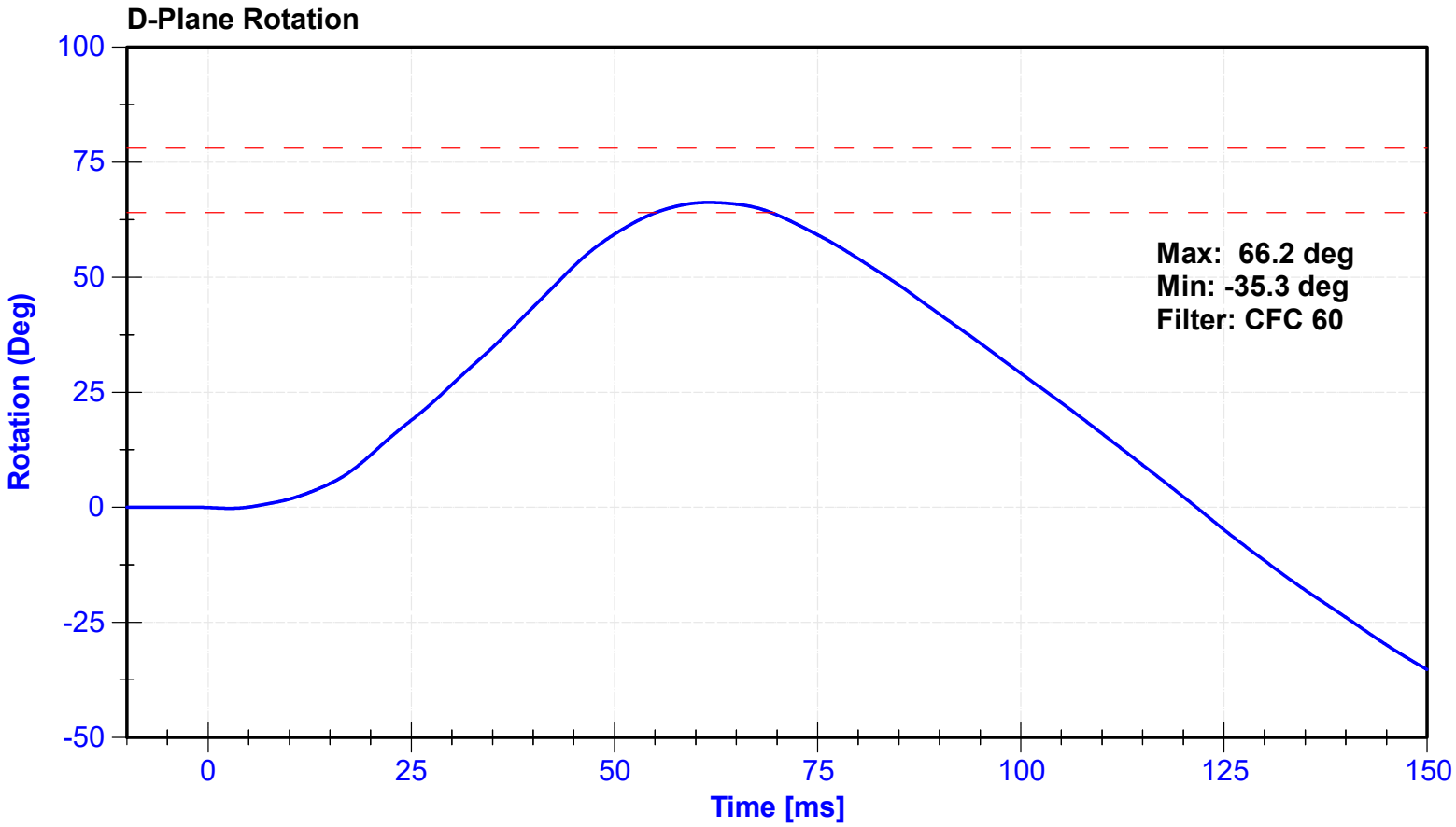
ATD Manufacturer	Humanetics	Test Technician	D. Sakona
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

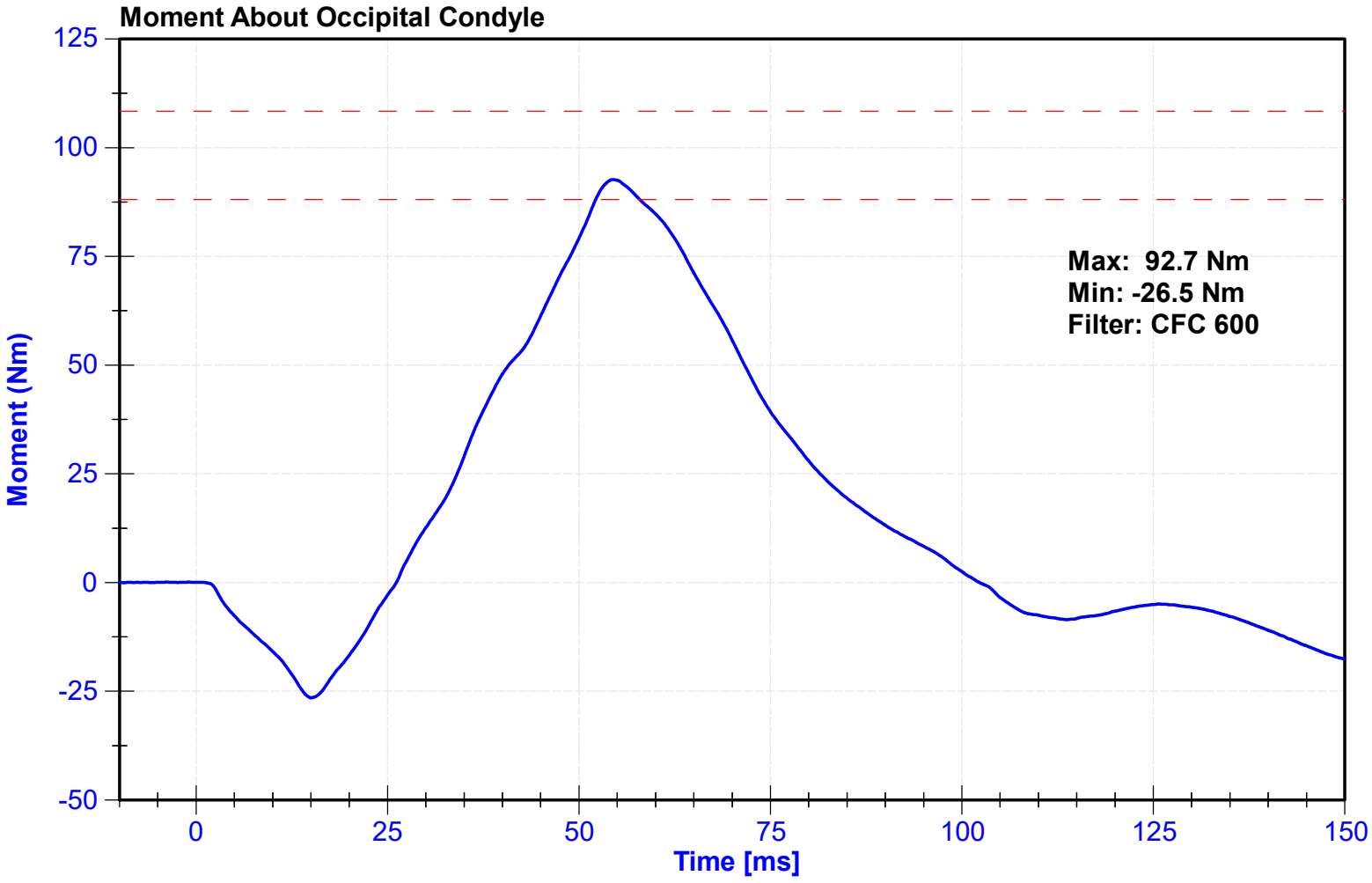
Results

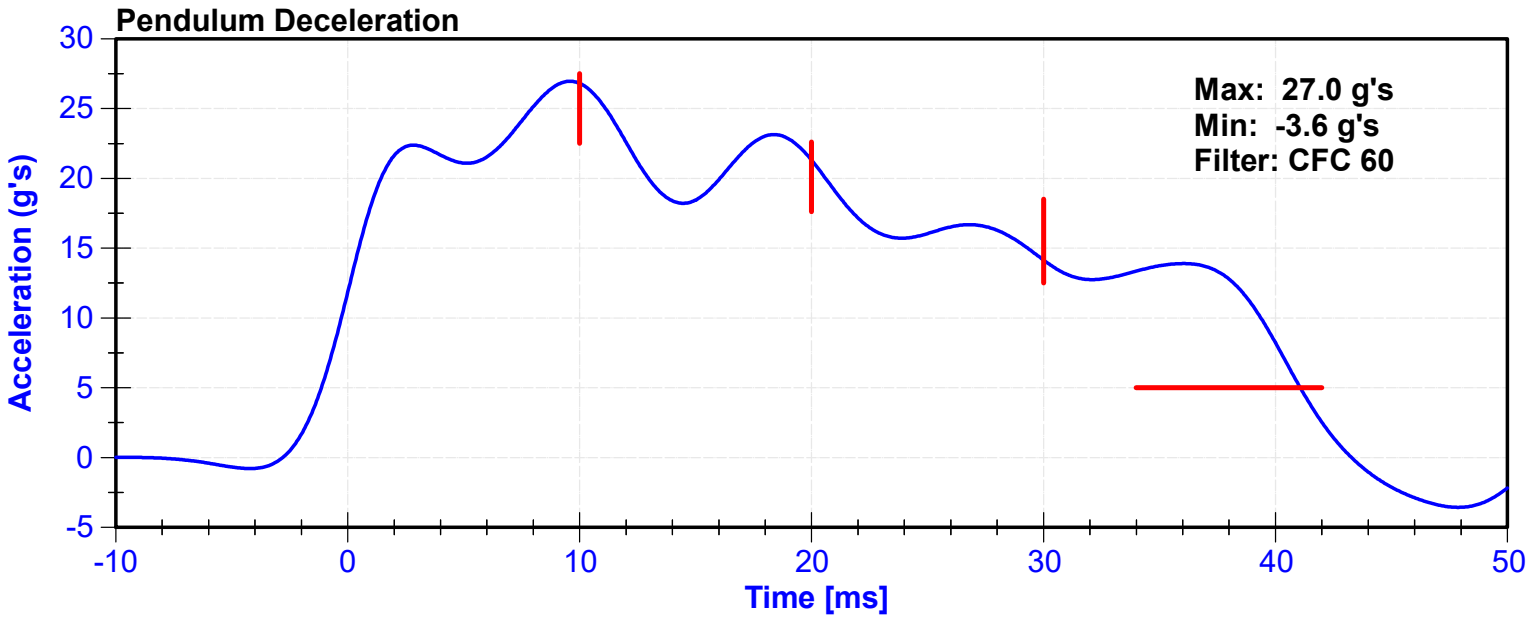
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.0	Pass
Humidity	10	70	%	23.5	Pass
Velocity	6.89	7.13	m/s	6.931	Pass
Pendulum Deceleration at 10ms	22.5	27.5	g's	26.80	Pass
Pendulum Deceleration at 20ms	17.6	22.6	g's	21.29	Pass
Pendulum Deceleration at 30ms	12.5	18.5	g's	14.14	Pass
Max. Pendulum Deceleration After 30ms	0	29	g's	27.0	Pass
Pendulum Deceleration Time to 5 g's	34	42	ms	41.1	Pass
Maximum D Plane Rotation	64	78	deg	66.2	Pass
Time to Maximum Rotation	57	64	ms	61.6	Pass
Rotation Decay to Zero	113	127	ms	121.7	Pass
Moment About Occipital Condyle	88.1	108.4	Nm	92.67	Pass
Time to Maximum Moment	47	58	ms	54.4	Pass
Moment Decay to Zero	97	107	ms	102.3	Pass

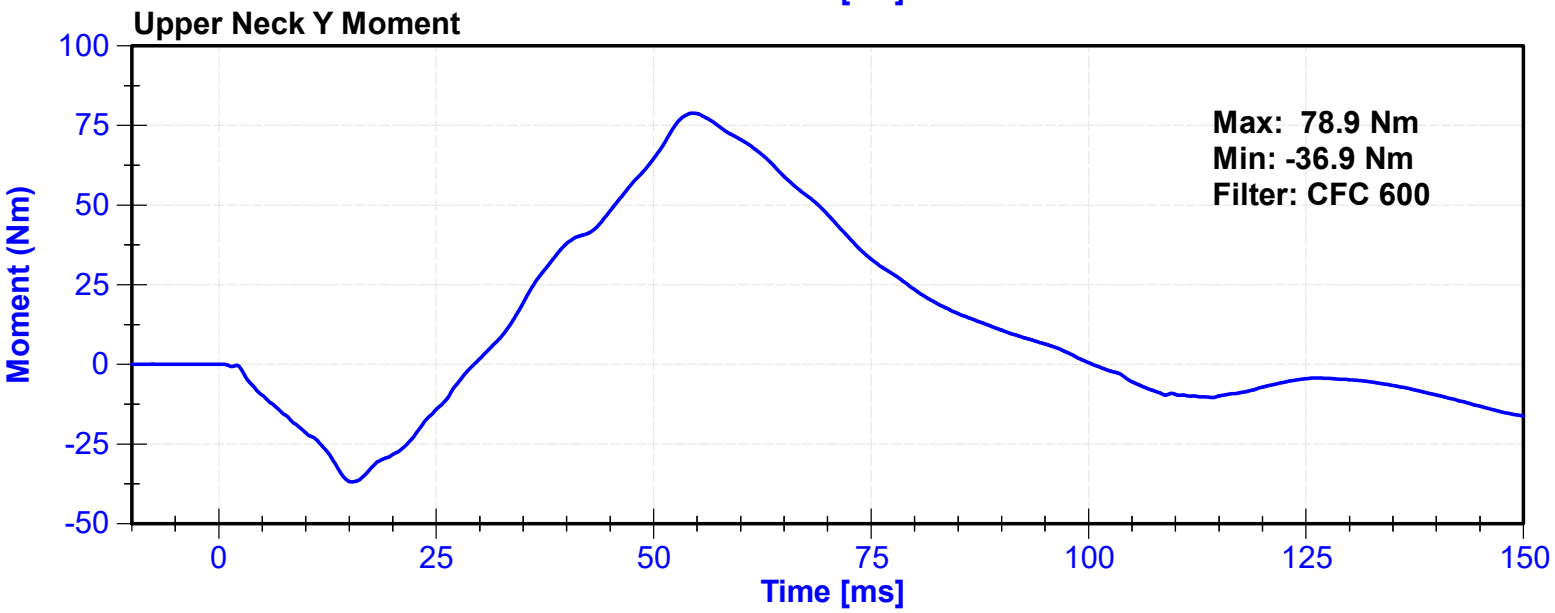
Transducer Calibrations

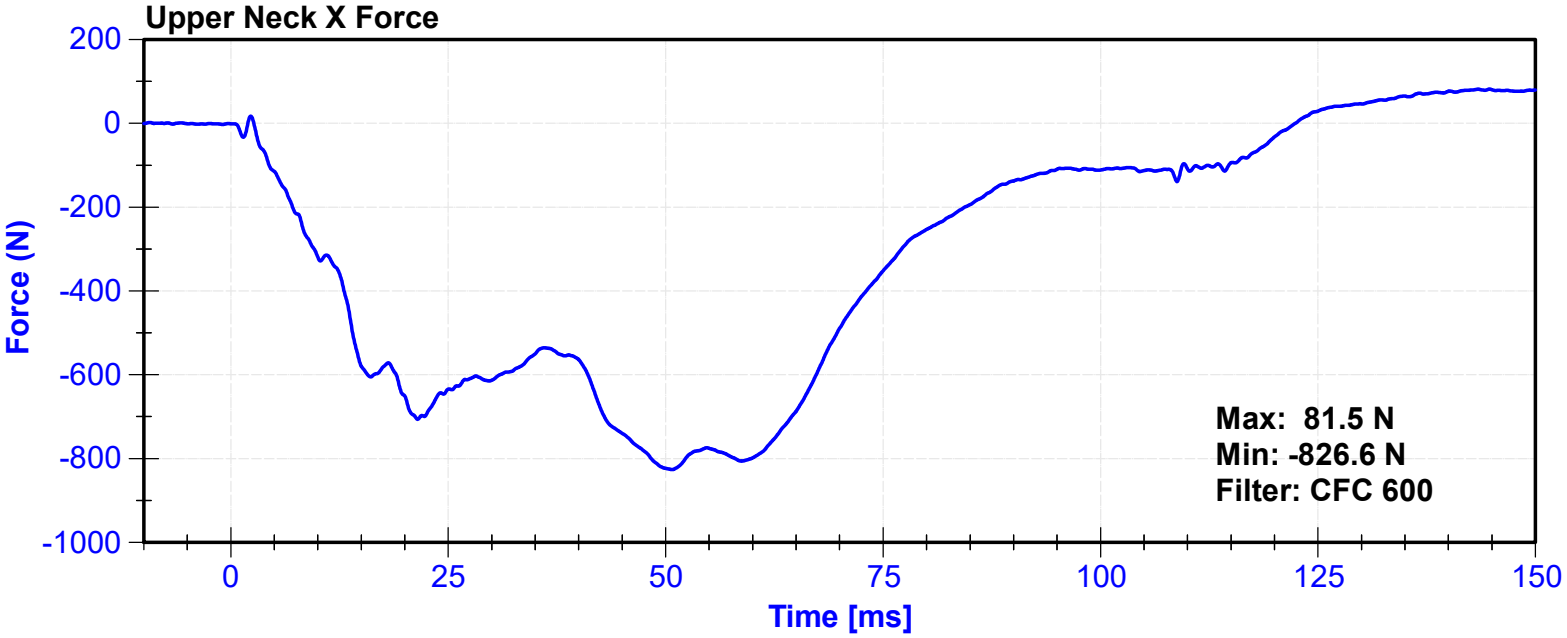
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	7231C-750	10/31/2022	4/29/2023
Pendulum Potentiometer	ETI	LABPOT1	5/9/2022	5/9/2023
Condyle Potentiometer	ETI	LABPOT2	5/9/2022	5/9/2023
Upper Neck Load Cell	Denton	2187-FX	6/13/2022	6/13/2023


D-Plane Rotation
Rotation (Deg)
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]
Max: 66.2 deg
Min: -35.3 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: 92.7 Nm
Min: -26.5 Nm
Filter: CFC 600


Pendulum Deceleration
Max: 27.0 g's
Min: -3.6 g's
Filter: CFC 60
Acceleration (g's)
Time [ms]


Upper Neck Y Moment
Max: 78.9 Nm
Min: -36.9 Nm
Filter: CFC 600
Moment (Nm)
Time [ms]


Upper Neck X Force
Max: 81.5 N
Min: -826.6 N
Filter: CFC 600
Force (N)
Time [ms]

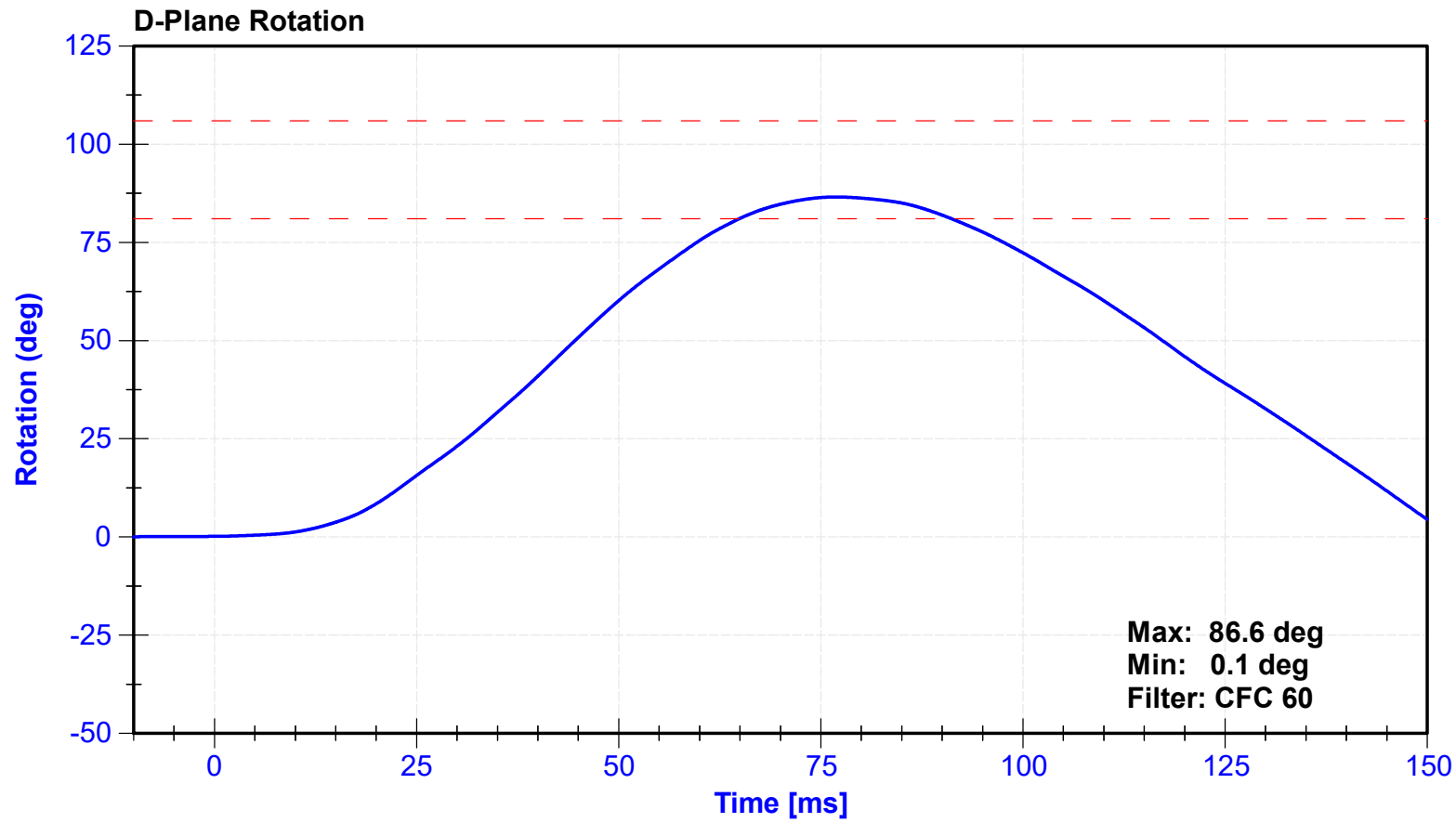
ATD Manufacturer	Humanetics	Test Technician	D. Sakona
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

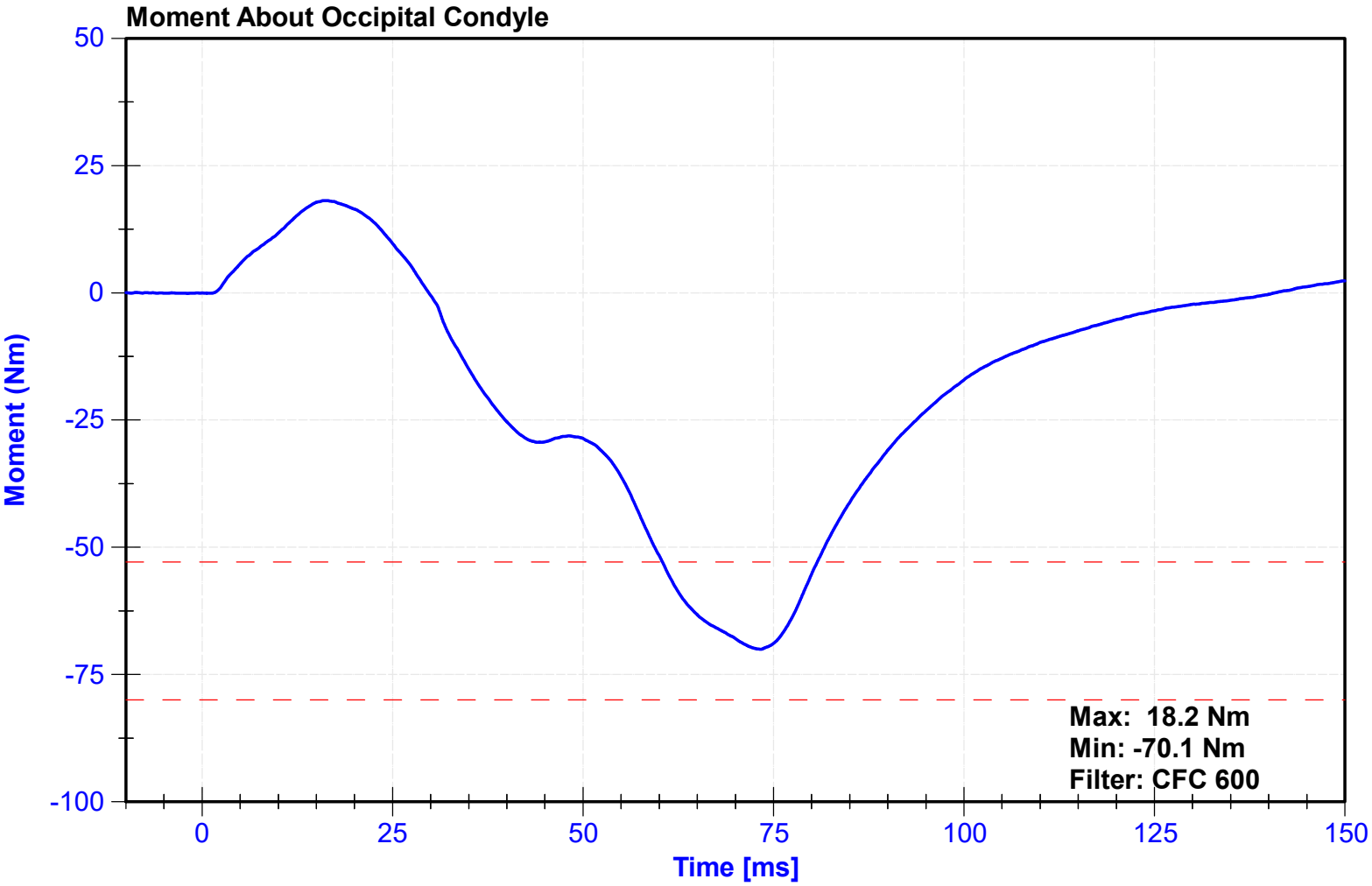
Results

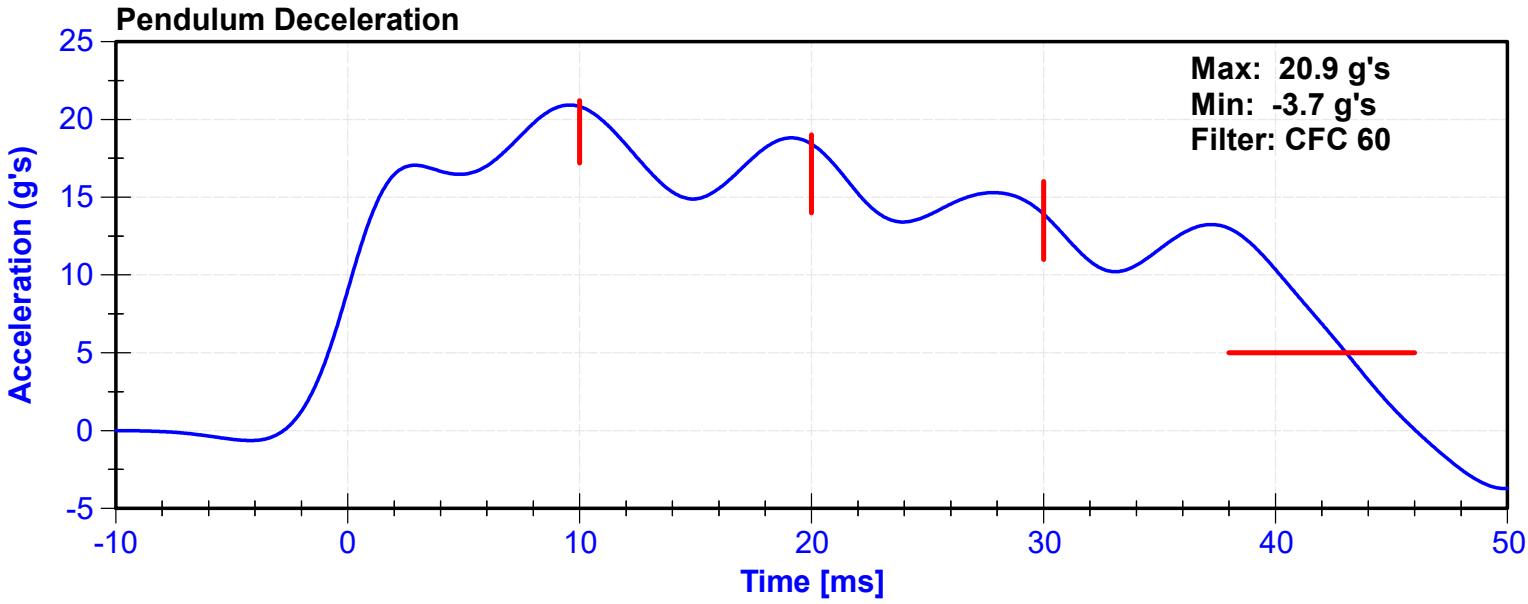
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.0	Pass
Humidity	10	70	%	23.5	Pass
Velocity	5.94	6.19	m/s	6.025	Pass
Pendulum Deceleration at 10ms	17.2	21.2	g's	20.82	Pass
Pendulum Deceleration at 20ms	14	19	g's	18.4	Pass
Pendulum Deceleration at 30ms	11	16	g's	13.9	Pass
Max. Pendulum Deceleration After 30ms	0	22	g's	20.9	Pass
Pendulum Deceleration Time to 5 g's	38	46	ms	43.0	Pass
Maximum D Plane Rotation	81	106	deg	86.6	Pass
Time to Maximum Rotation	72	82	ms	76.9	Pass
Rotation Decay to Zero	147	174	ms	153.3	Pass
Minimum Moment About OC	-80	-52.9	Nm	-70.06	Pass
Time to Minimum Moment	65	79	ms	73.3	Pass
Moment Decay to Zero	120	148	ms	140.8	Pass

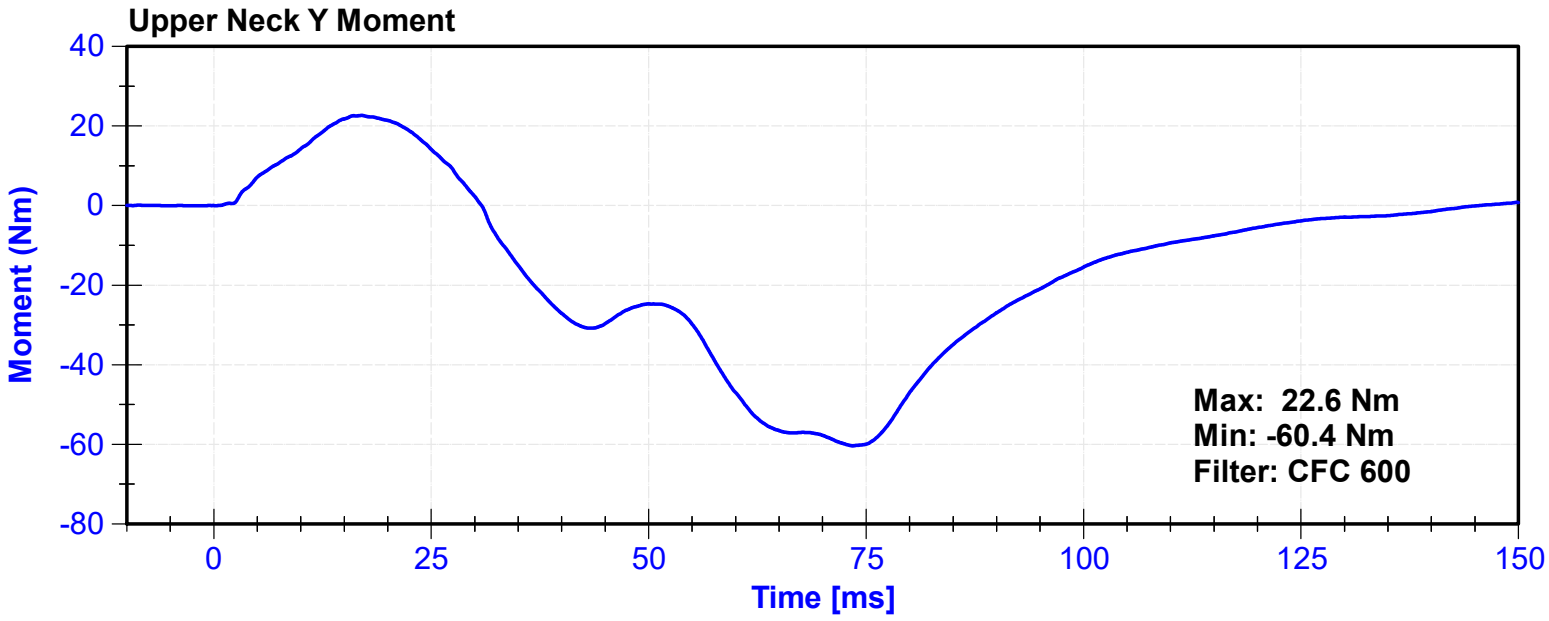
Transducer Calibrations

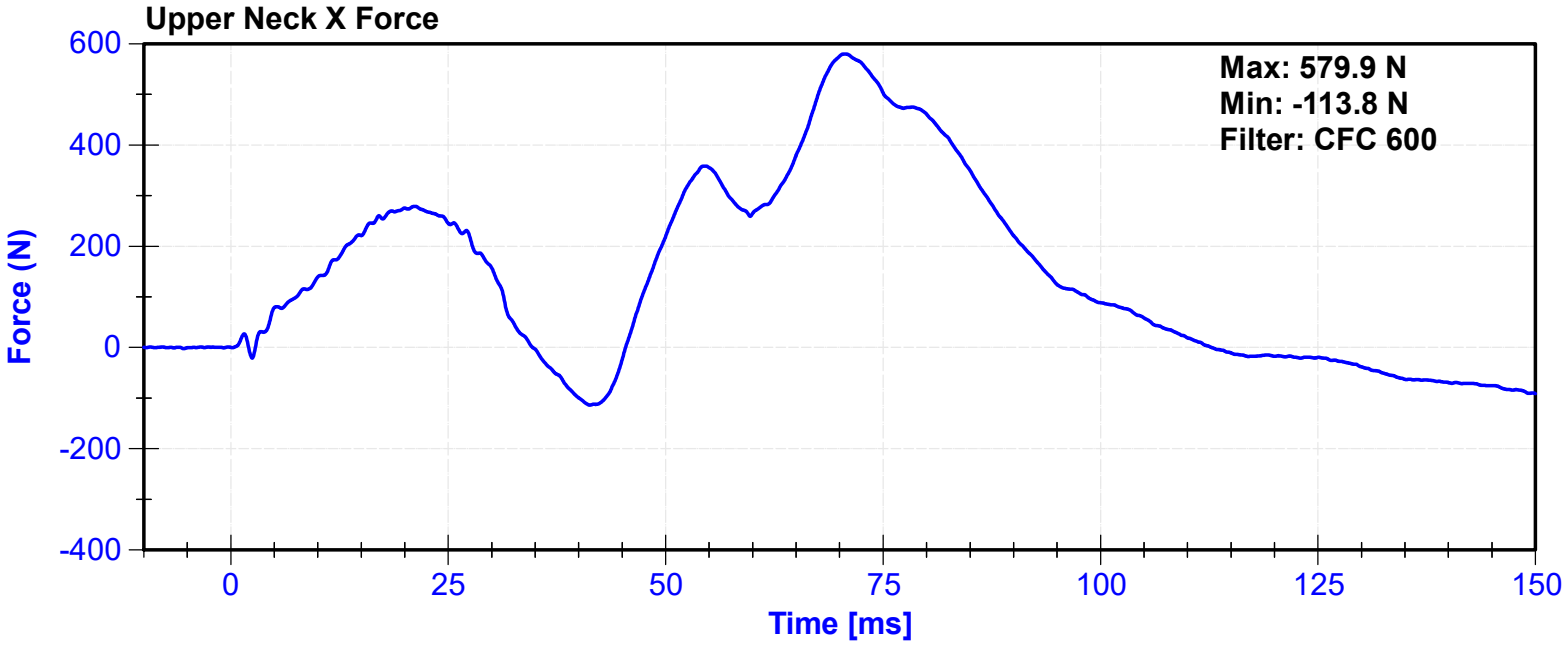
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	C16650	10/31/2022	4/29/2023
Pendulum Potentiometer	ETI	LABPOT1	5/9/2022	5/9/2023
Condyle Potentiometer	ETI	LABPOT2	5/9/2022	5/9/2023
Upper Neck Load Cell	Denton	2187-FX	6/13/2022	6/13/2023


D-Plane Rotation
Rotation (deg)
125
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]
Max: 86.6 deg
Min: 0.1 deg
Filter: CFC 60


Moment About Occipital Condyle
Moment (Nm)
50
25
0
-25
-50
-75
-100
0
25
50
75
100
125
150
Time [ms]
Max: 18.2 Nm
Min: -70.1 Nm
Filter: CFC 600


Pendulum Deceleration
Max: 20.9 g's
Min: -3.7 g's
Filter: CFC 60
Acceleration (g's)
Time [ms]


Upper Neck Y Moment
Max: 22.6 Nm
Min: -60.4 Nm
Filter: CFC 600
Moment (Nm)
Time [ms]


Upper Neck X Force
Max: 579.9 N
Min: -113.8 N
Filter: CFC 600
Force (N)
Time [ms]

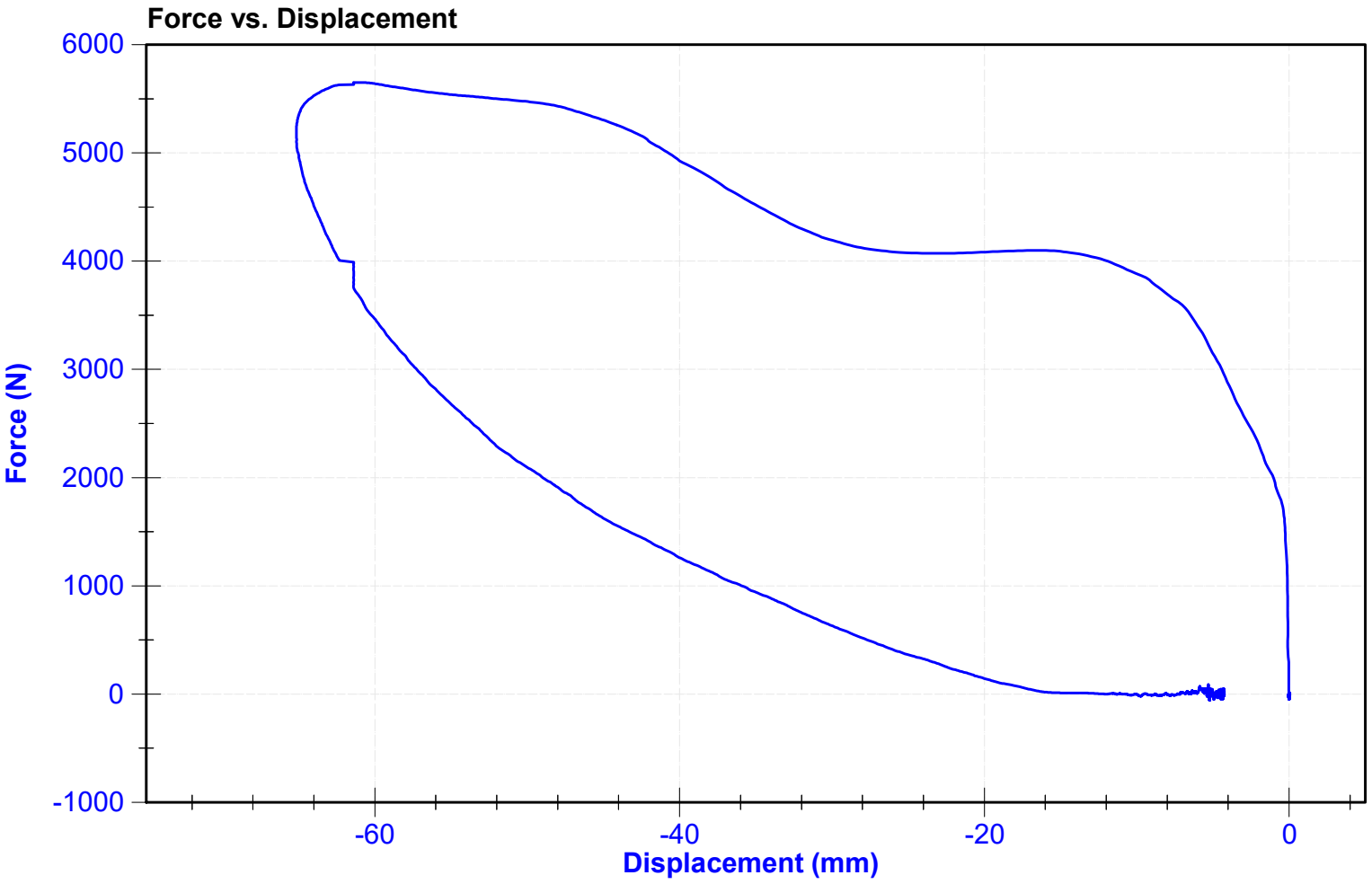
ATD Manufacturer	Humanetics	Test Technician	D. Sakona
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

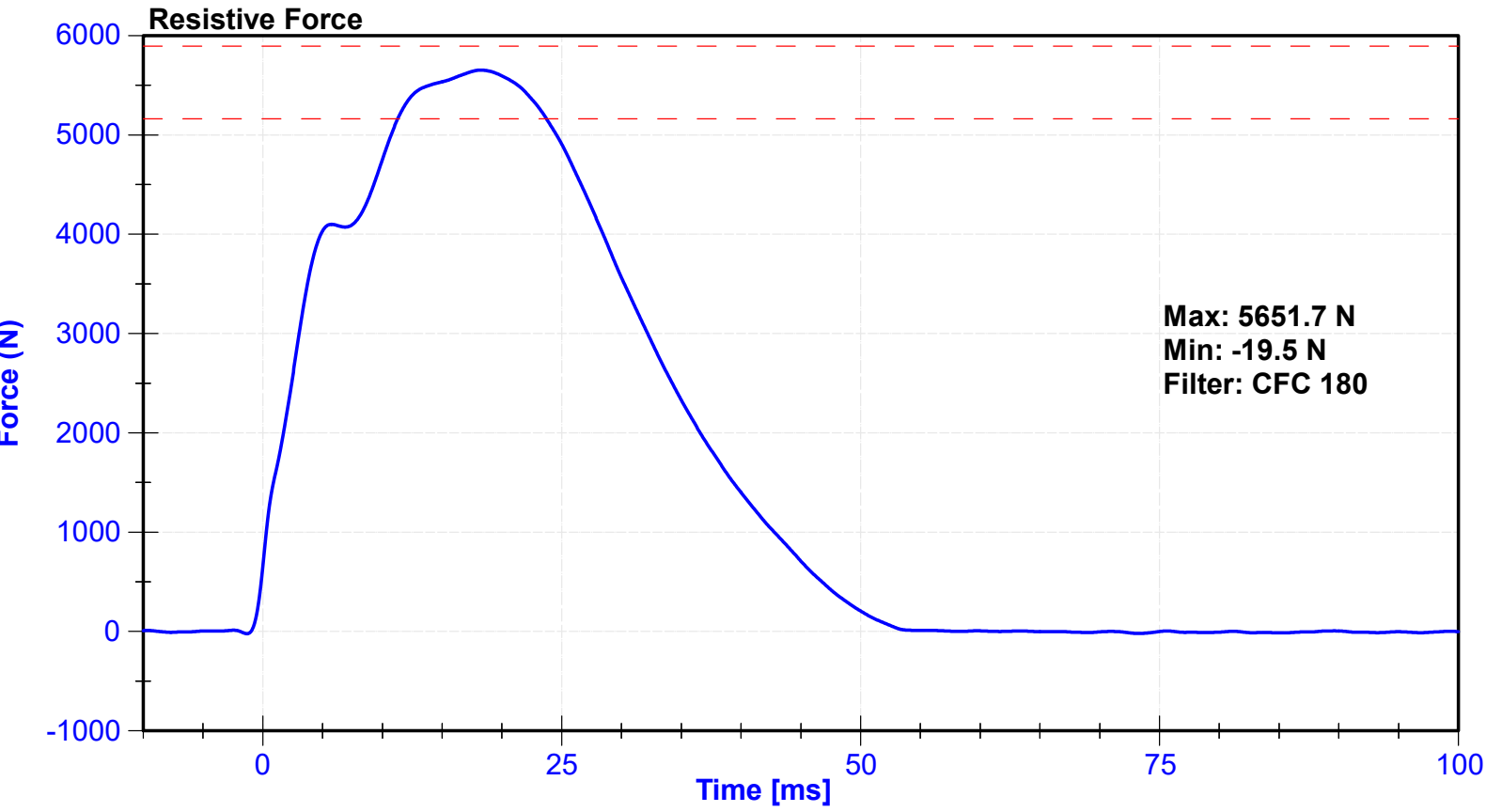
Results

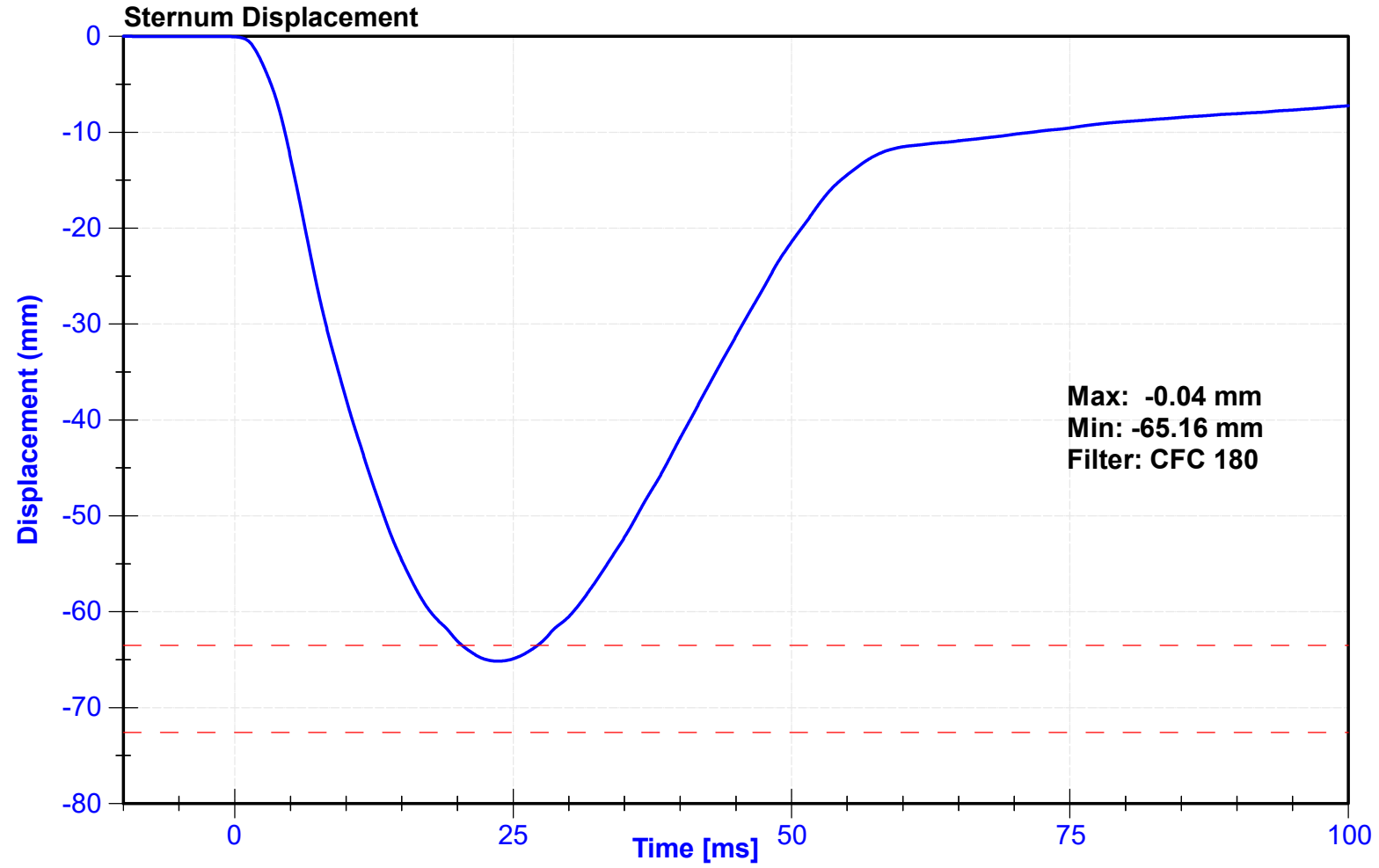
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.2	Pass
Humidity	10	70	%	25.5	Pass
Velocity	6.59	6.83	m/s	6.685	Pass
Chest Displacement	-72.6	-63.5	mm	-65.16	Pass
Resistive Force	5160	5894	N	5651.7	Pass
Hysteresis	69	85	%	73.3	Pass

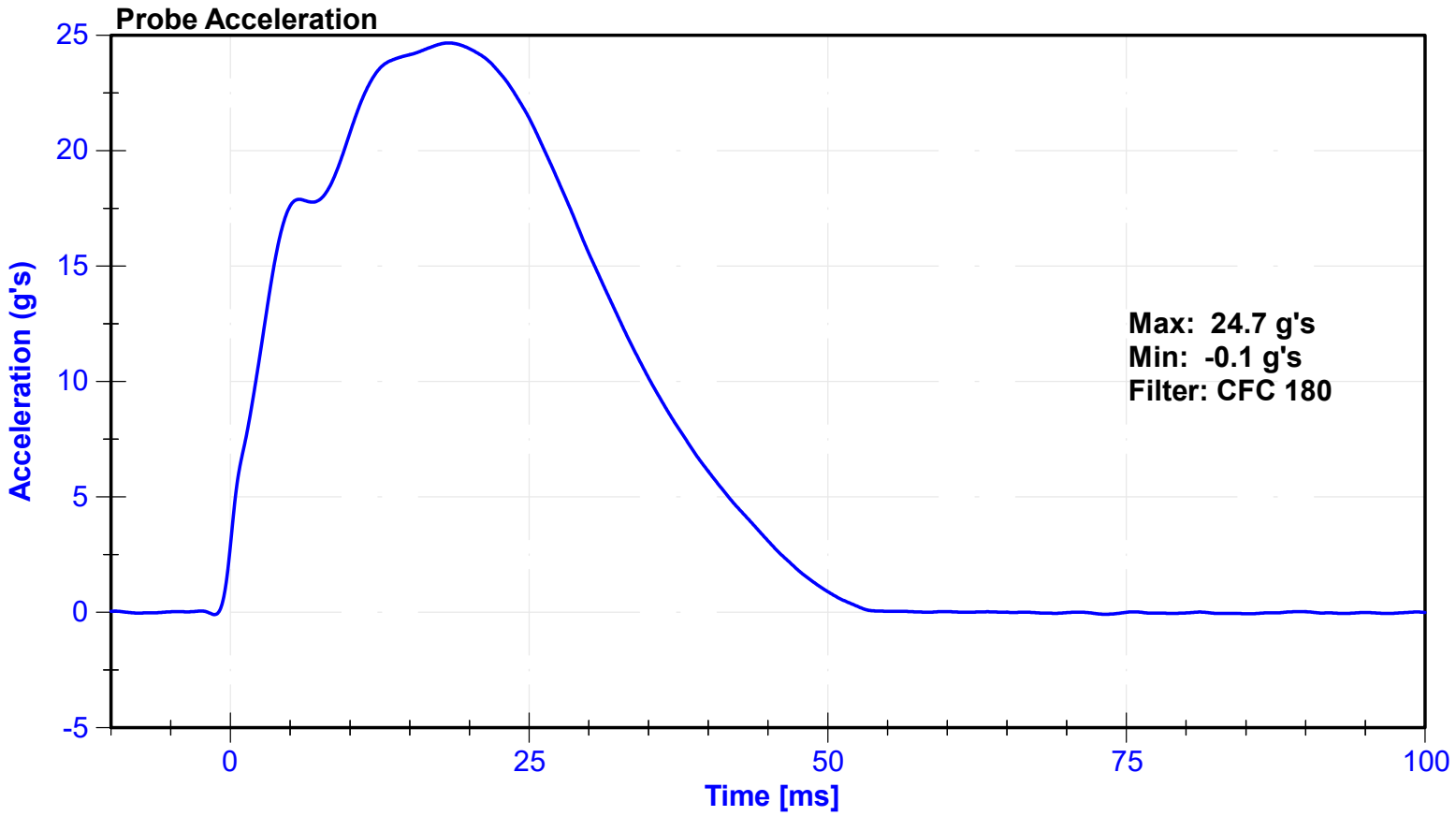
Transducer Calibrations

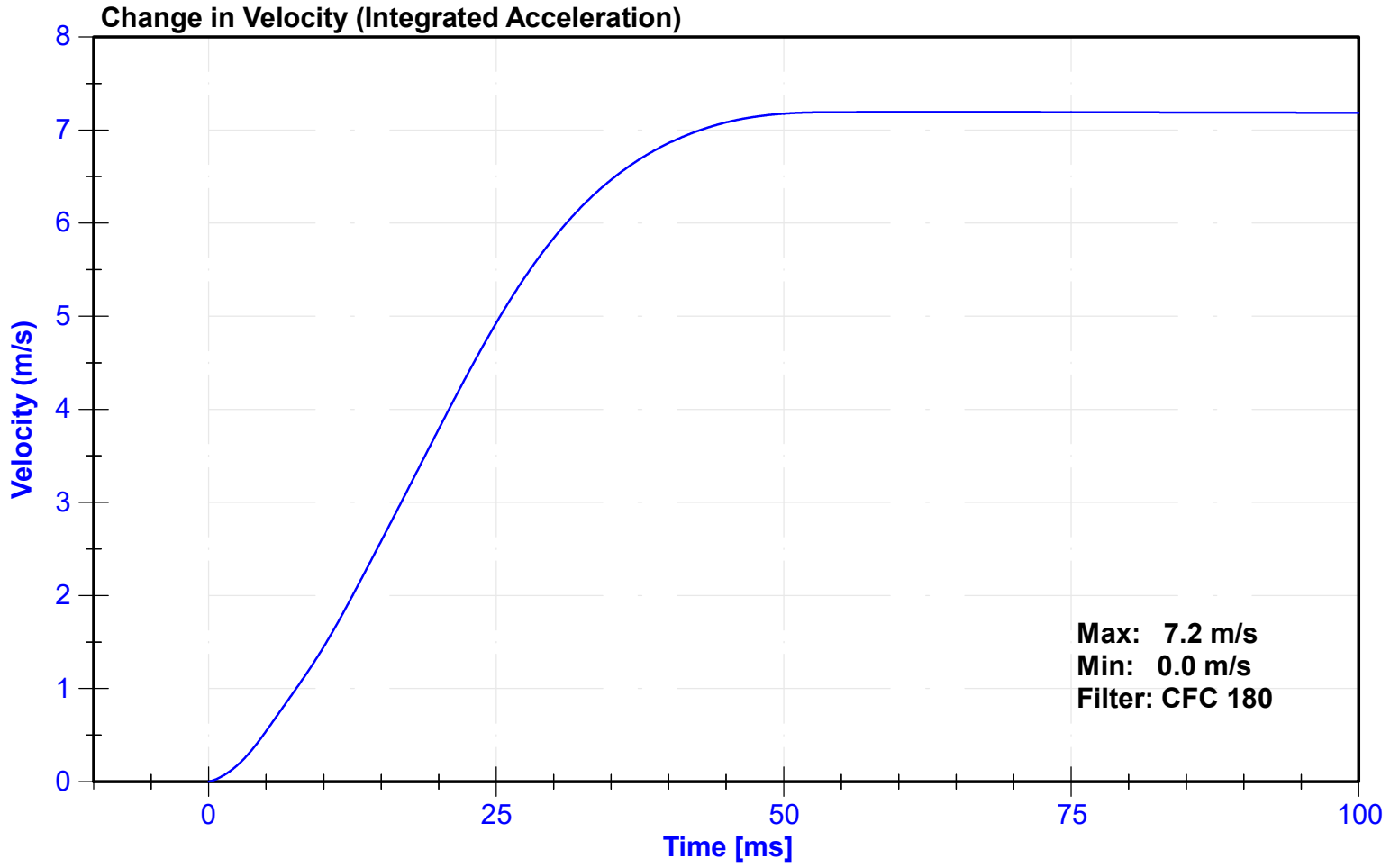
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	P51736	10/25/2022	10/25/2023
Chest Potentiometer	JDK	0075	10/3/2022	4/3/2023




Resistive Force
Force (N)
6000
5000
4000
3000
2000
1000
0
-1000
0
25
50
75
100
Time [ms]
Max: 5651.7 N
Min: -19.5 N
Filter: CFC 180


Sternum Displacement
Displacement (mm)
0
-10
-20
-30
-40
-50
-60
-70
-80
0
25
50
75
100
Time [ms]
Max: -0.04 mm
Min: -65.16 mm
Filter: CFC 180


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


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

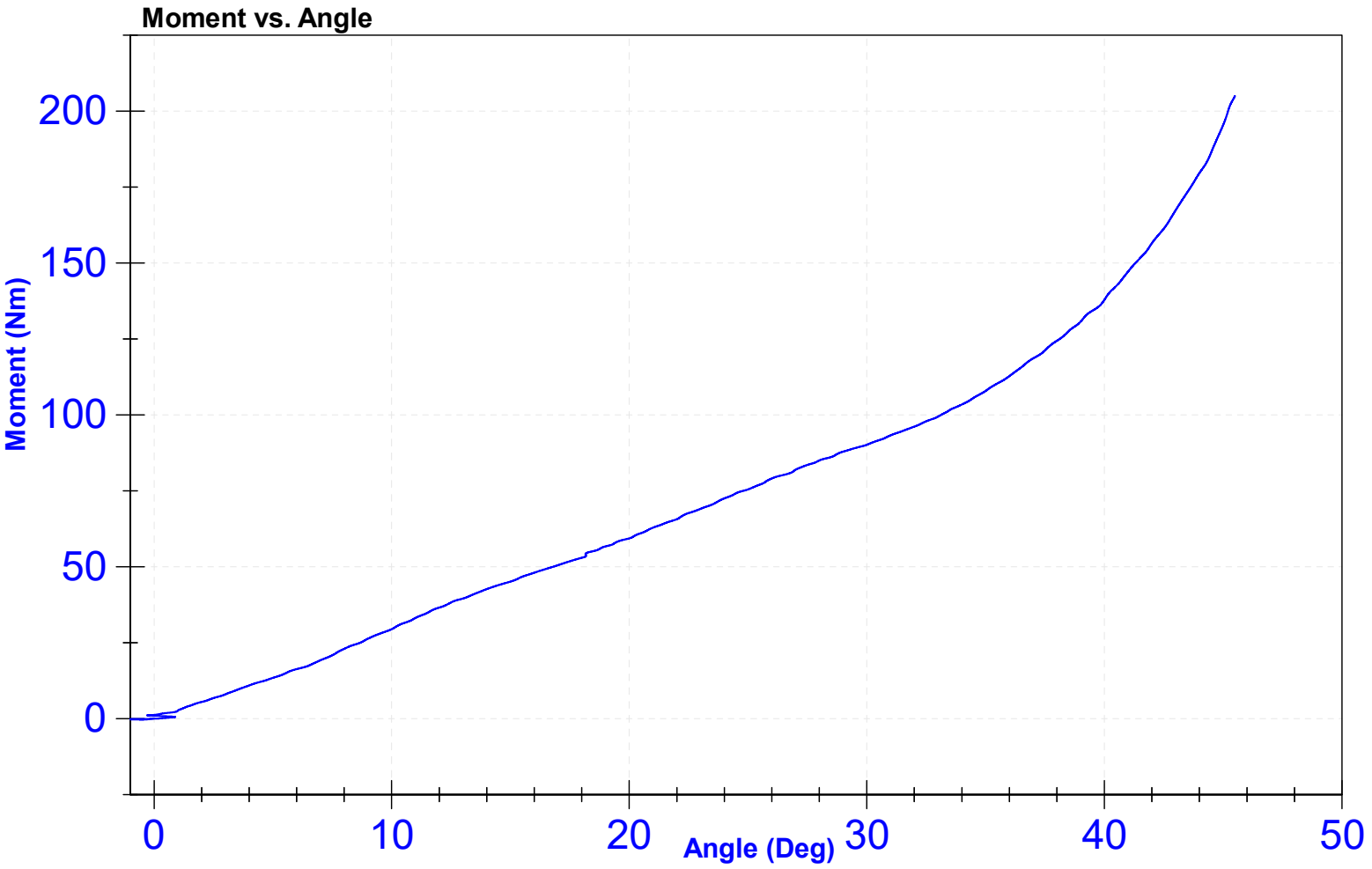
ATD Manufacturer	Humanetics	Test Technician	D. Sakona
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.0	Pass
Humidity	10	70	%	23.5	Pass
Average Velocity	5	10	deg/s	7.0	Pass
Angle at 203Nm	40	50	deg	45.4	Pass
Moment at 30 degrees	0	94.9	Nm	90.2	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	ETI SP22	DS-0008	10/4/2022	10/4/2023
Load Cell	PCB 2301-02	2301-02_115	2022-09-06	2023-09-06



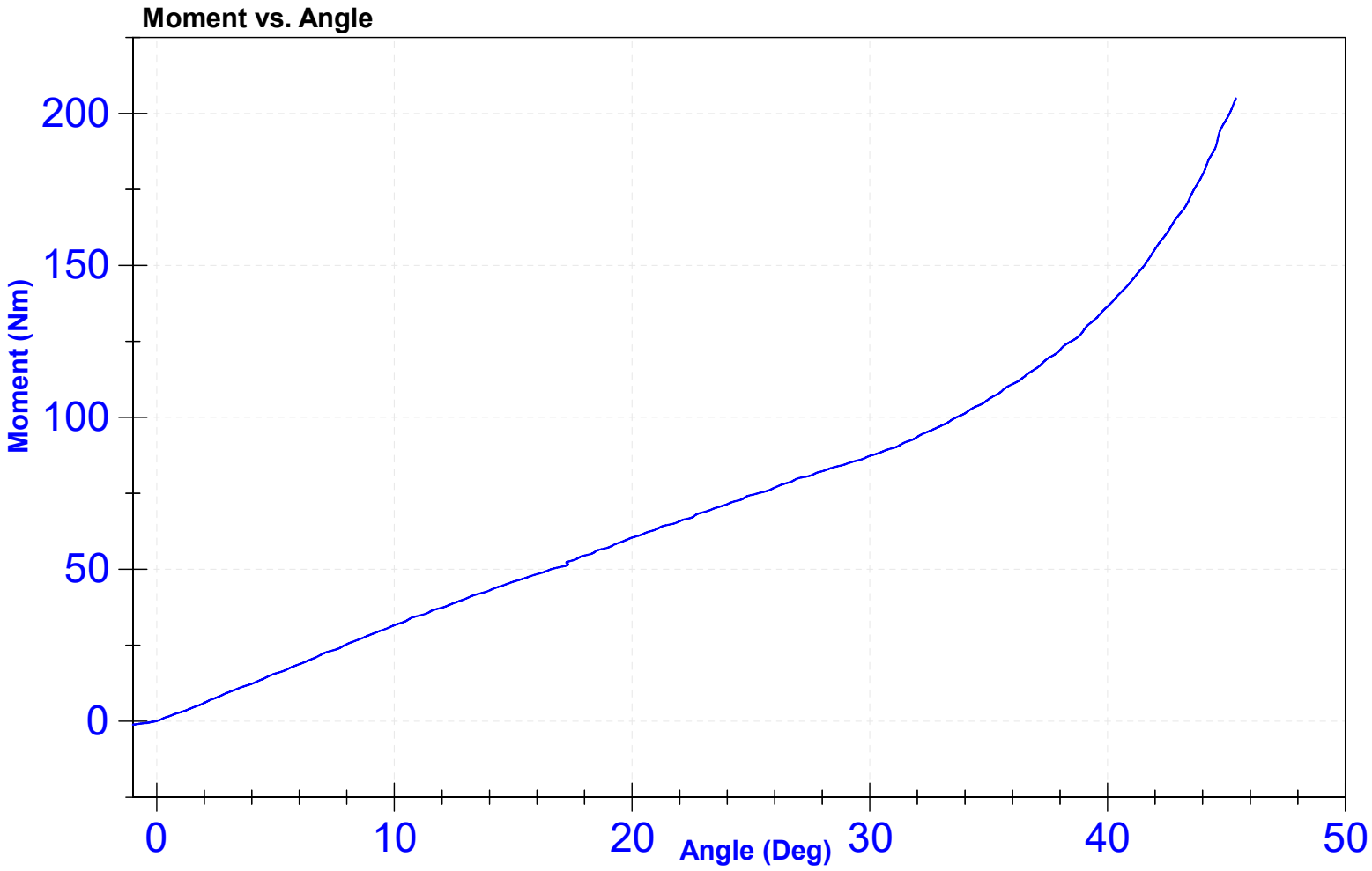
ATD Manufacturer	Humanetics	Test Technician	D. Sakona
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.0	Pass
Humidity	10	70	%	23.5	Pass
Average Velocity	5	10	deg/s	7.3	Pass
Angle at 203Nm	40	50	deg	45.3	Pass
Moment at 30 degrees	0	94.9	Nm	87.3	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	ETI SP22	DS-0008	10/4/2022	10/4/2023
Load Cell	PCB 2301-02	2301-02_115	2022-09-06	2023-09-06



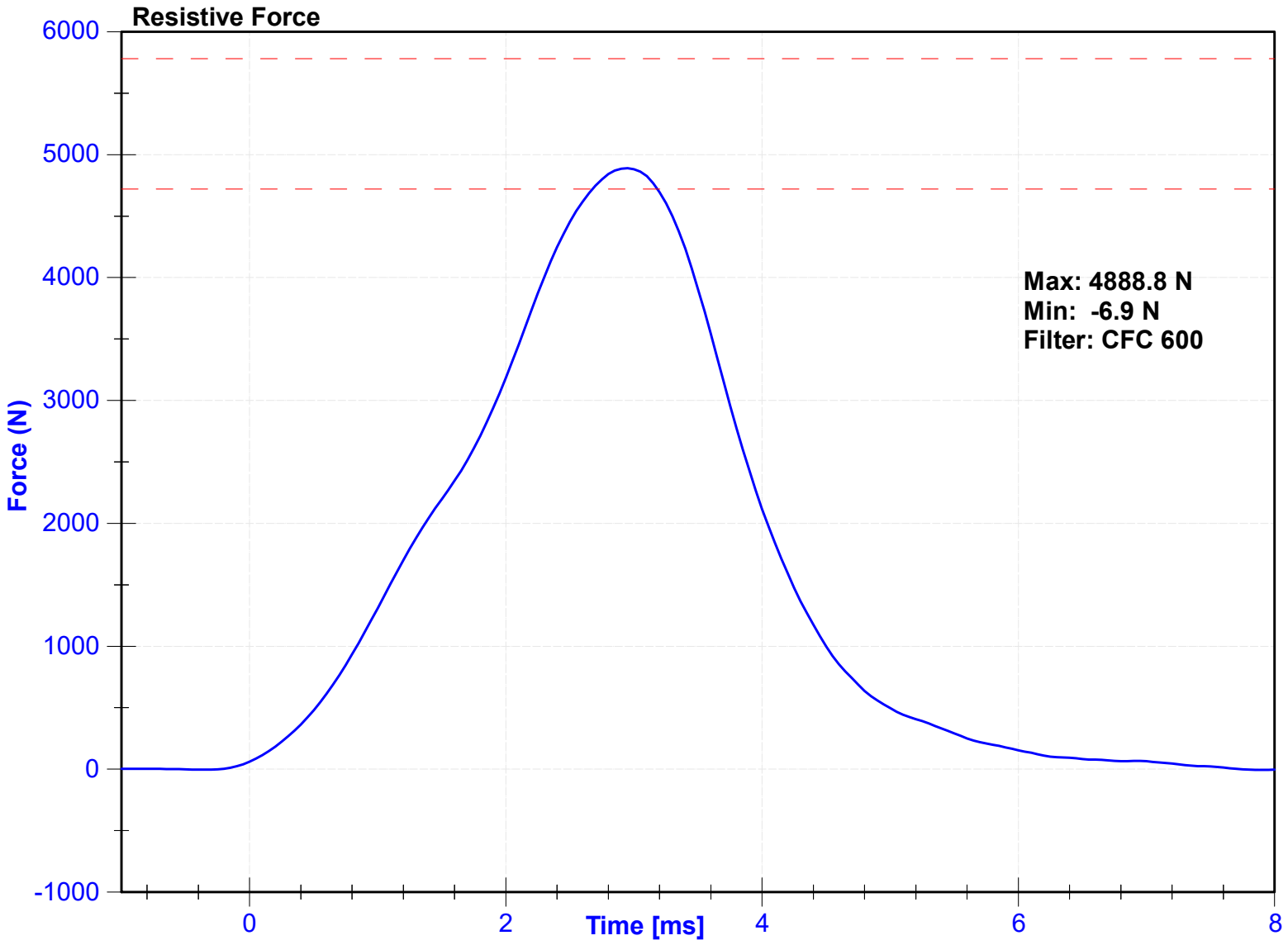
ATD Manufacturer	Humanetics	Test Technician	T. Roseman
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

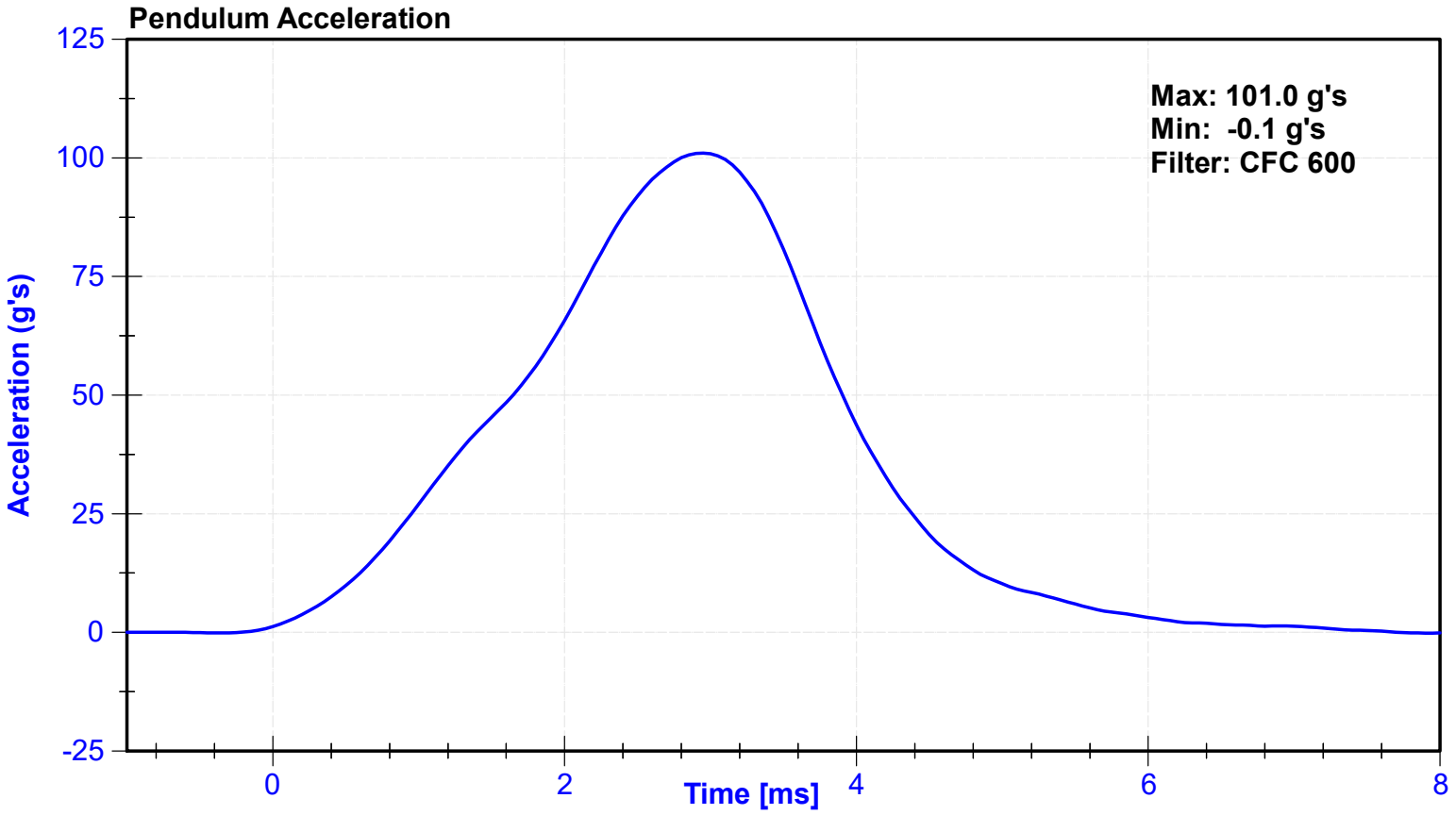
Results

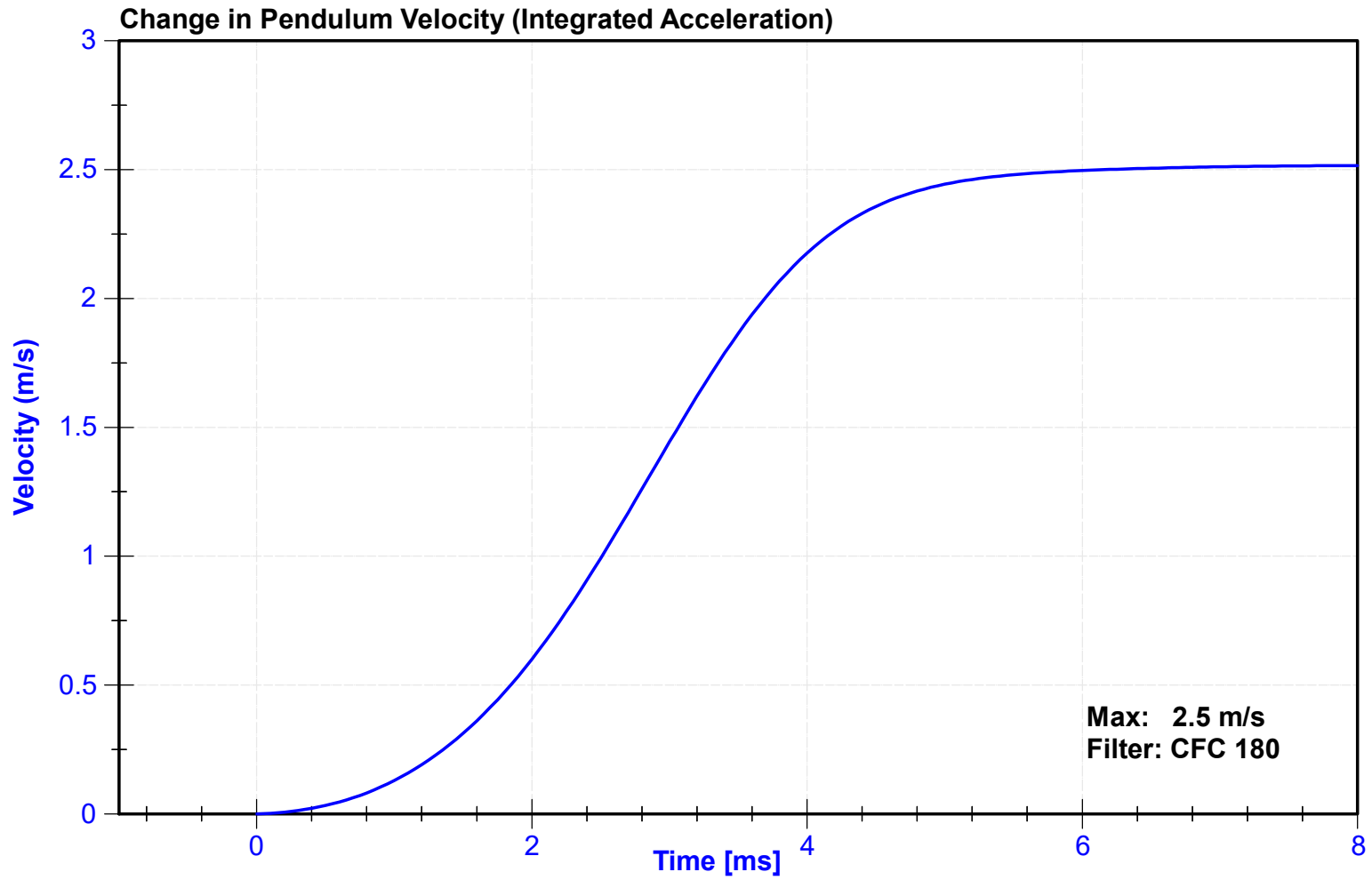
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	20.9	Pass
Humidity	10	70	%	24.3	Pass
Velocity	2.07	2.13	m/s	2.072	Pass
Maximum Resistive Force	4720	5780	N	4888.8	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18546	11/19/2022	5/18/2023




Pendulum Acceleration
Max: 101.0 g's
Min: -0.1 g's
Filter: CFC 600
Acceleration (g's)
125
100
75
50
25
0
-25
0
2
4
6
8
Time [ms]


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

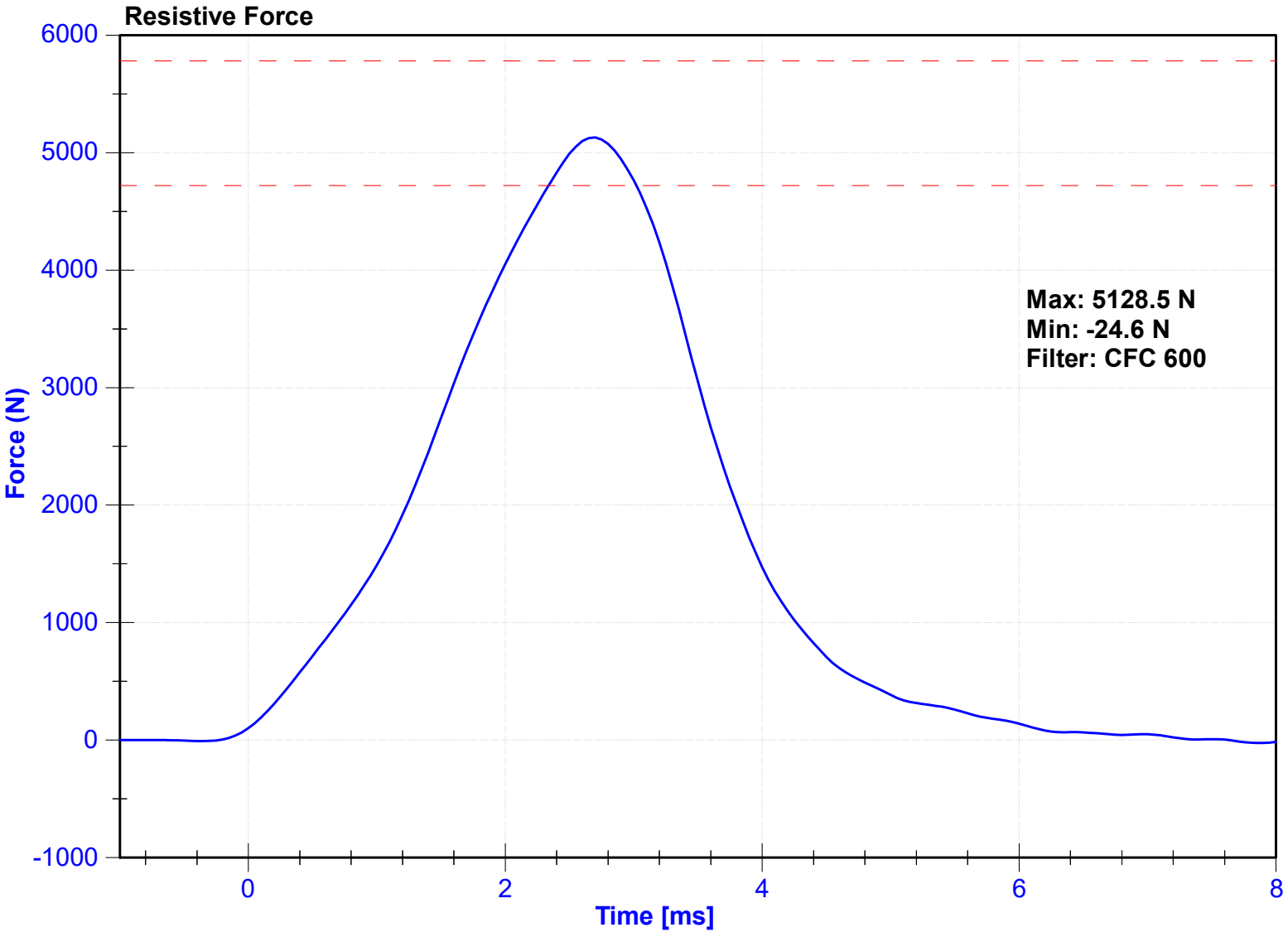
ATD Manufacturer	Humanetics	Test Technician	T. Roseman
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

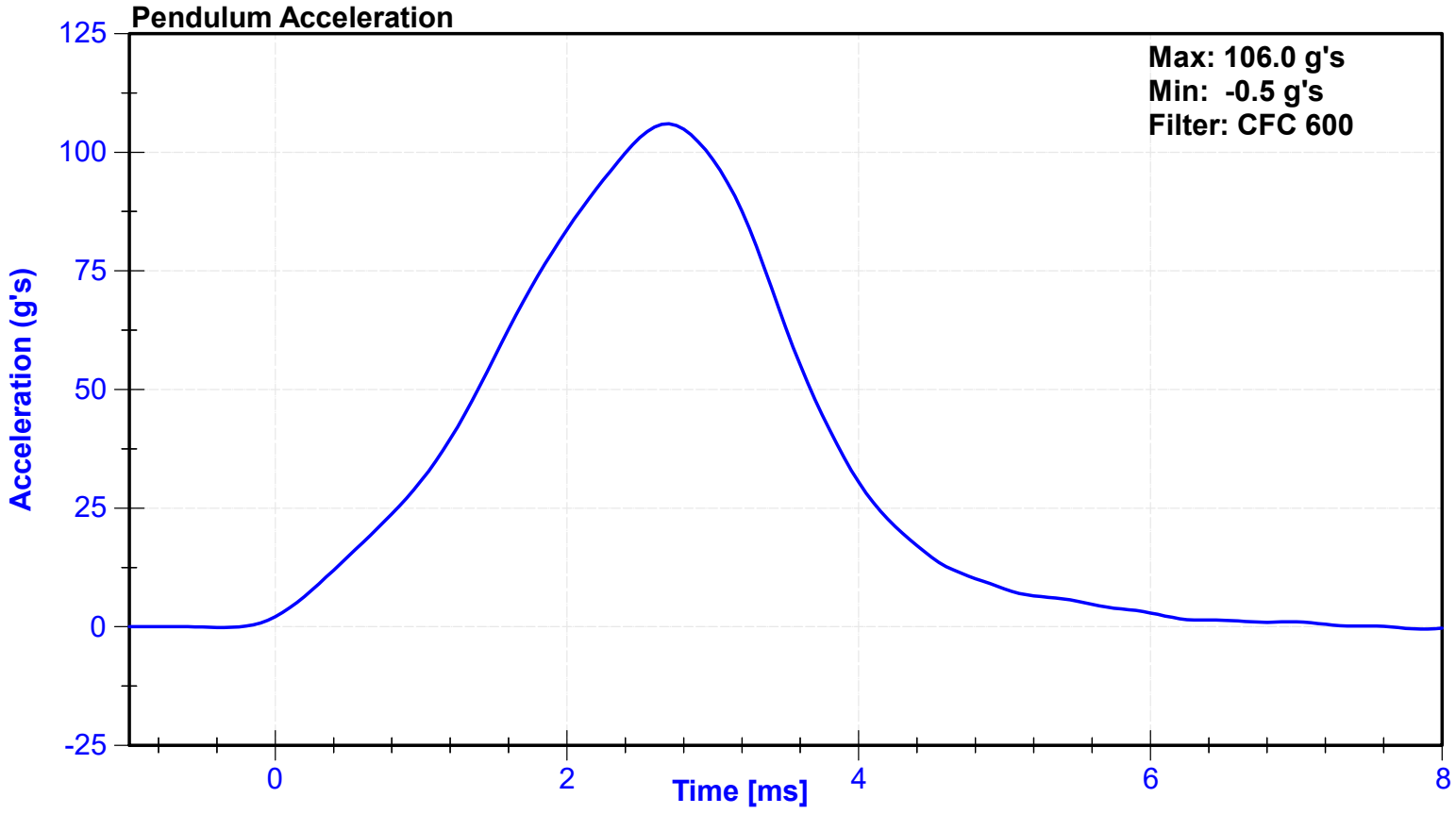
Results

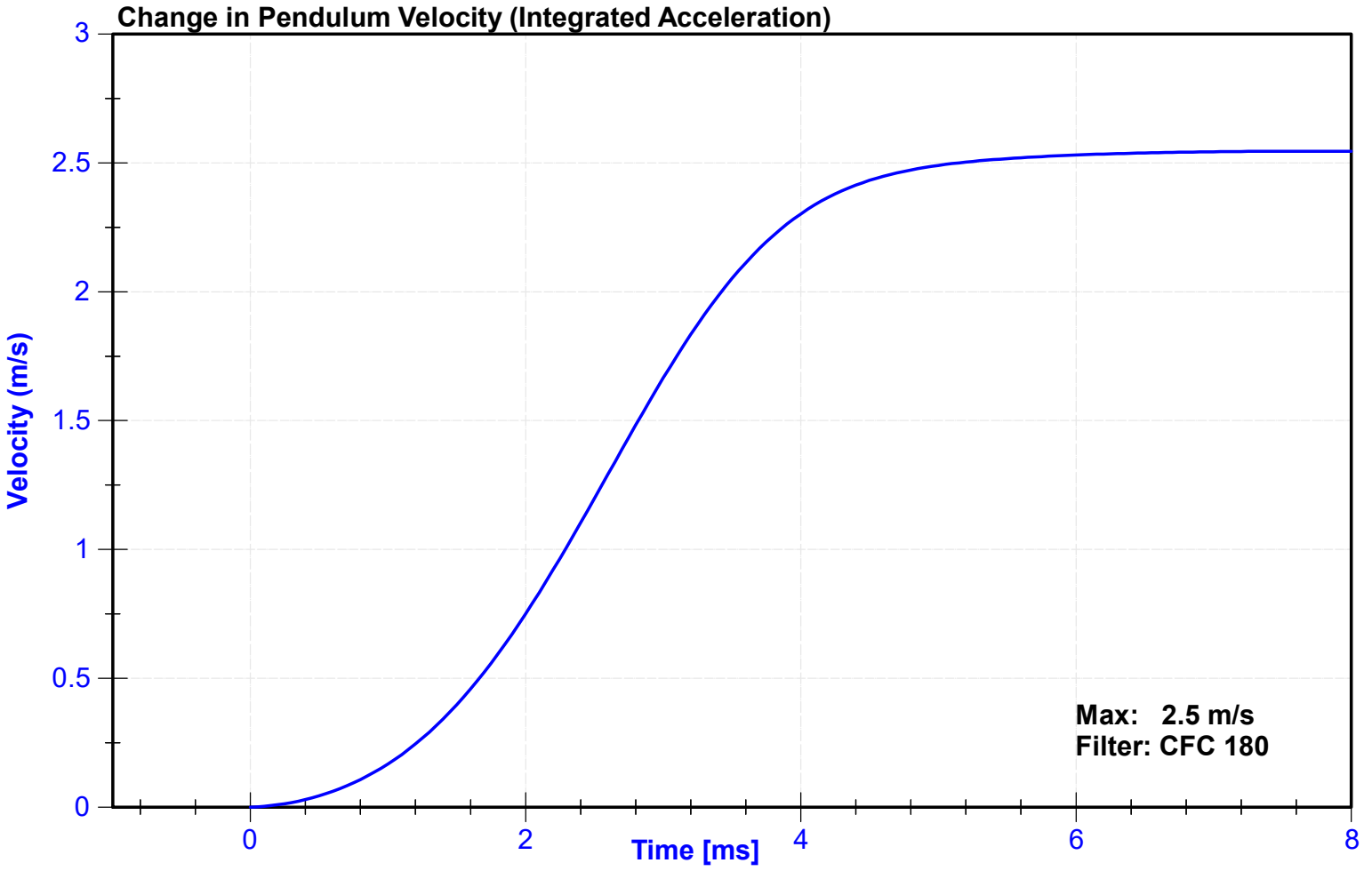
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	20.9	Pass
Humidity	10	70	%	24.3	Pass
Velocity	2.07	2.13	m/s	2.100	Pass
Maximum Resistive Force	4720	5780	N	5128.5	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18546	11/19/2022	5/18/2023




Pendulum Acceleration
Max: 106.0 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)
Velocity (m/s)
3
2.5
2
1.5
1
0.5
0
Max: 2.5 m/s
Filter: CFC 180
0
2
4
6
8
Time [ms]

CALIBRATION TEST RESULTS

PRE-TEST

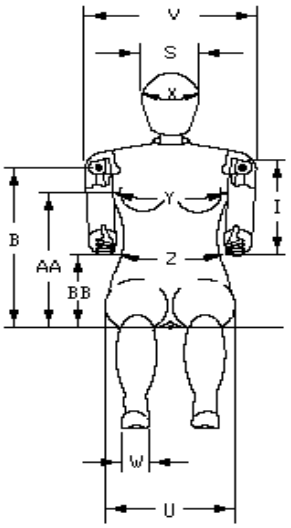
HYBRID III 5TH PERCENTILE - PASSENGER ATD

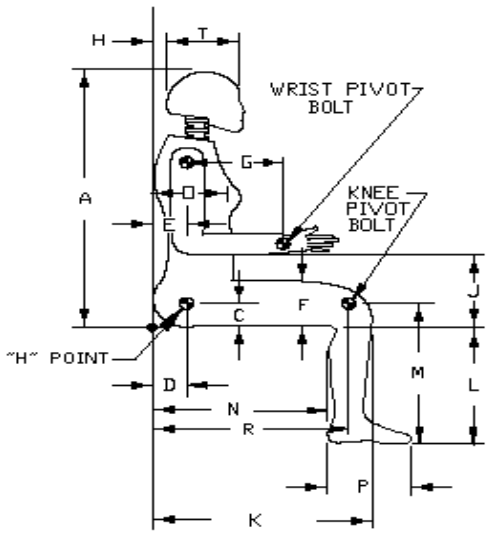
SERIAL NO: 137

External Measurements - Hybrid 3 - 5th Female

Technician: K. Brogan Date: 02/21/2023

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	445	Pass
C	H-Point Height	81	86	85	Pass
D	H-Point from Backline	145	150	146	Pass
E	Shoulder Pivot from Backline	69	84	76	Pass
F	Thigh Clearance	119	135	128	Pass
G	Back of Elbow to Wrist Pivot	244	259	252	Pass
H	Head Back to Backline	43	48	45	Pass
I	Shoulder to Elbow Length	277	297	289	Pass
J	Elbow Rest Height	183	203	195	Pass
K	Buttock to Knee Length	521	546	538	Pass
L	Popliteal Height	356	376	368	Pass
M	Knee Pivot Height	394	419	409	Pass
N	Buttock Popliteal Length	414	439	426	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	467	Pass
S	Head Breadth	137	147	143	Pass
T	Head Depth	178	188	184	Pass
U	Hip Breadth	300	315	311	Pass
V	Shoulder Breadth	351	366	358	Pass
W	Foot Breadth	79	94	85	Pass
X	Head Circumference	528	549	543	Pass
Y	Chest Circumference with Jacket	851	881	872	Pass
Z	Waist Circumference	460	790	652	Pass
AA	Reference Location (Chest Circumference)	333	358	347	Pass
BB	Reference Location (Waist Circumference)	160	170	165	Pass

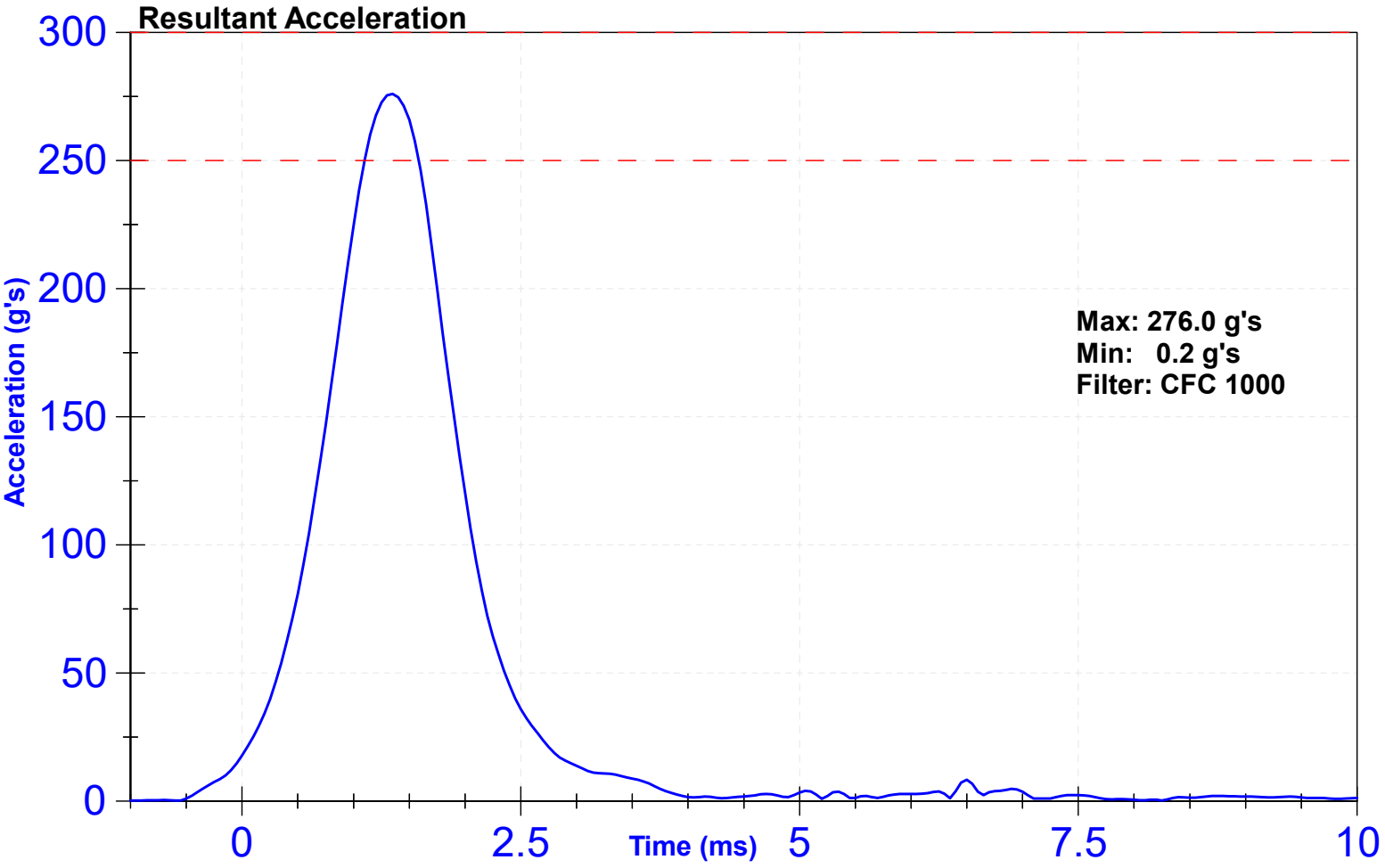
ATD Manufacturer	Humanetics	Test Technician	D. Sakona
ATD Serial Number	137	Laboratory Supervisor	K. Brogan

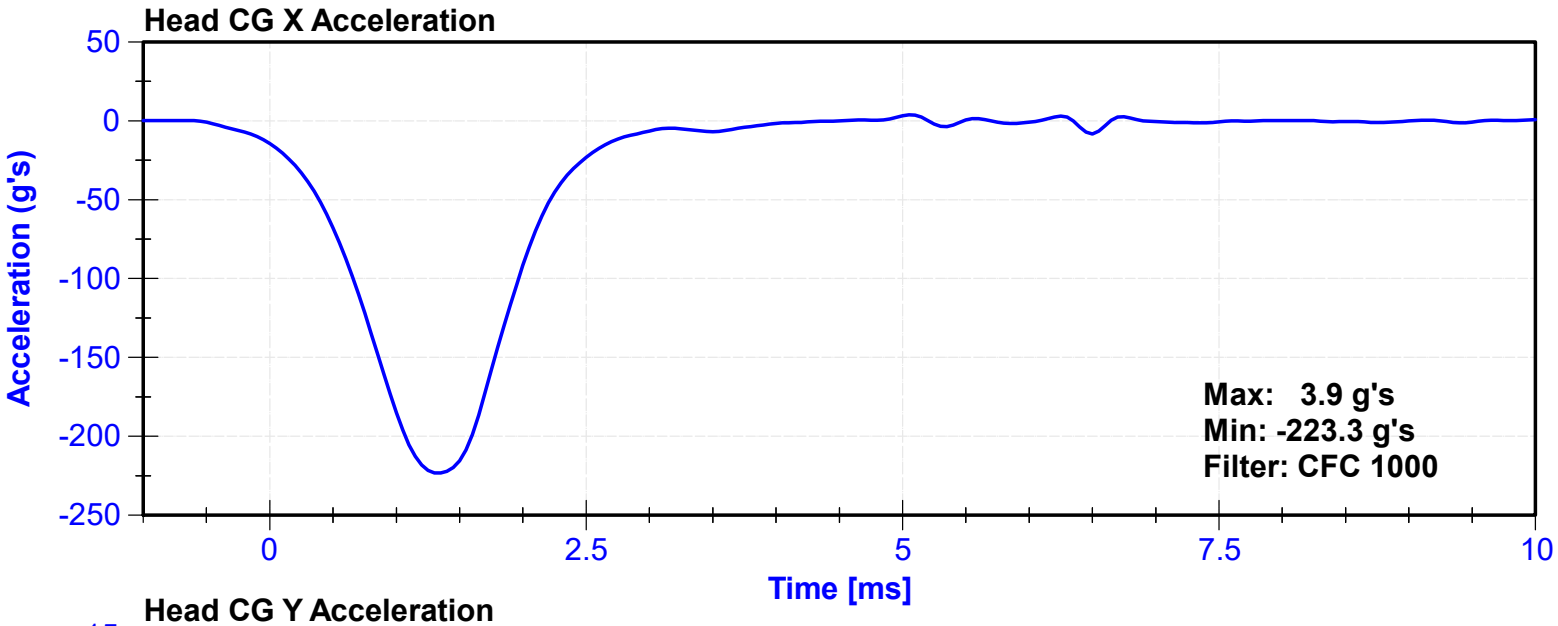
Results

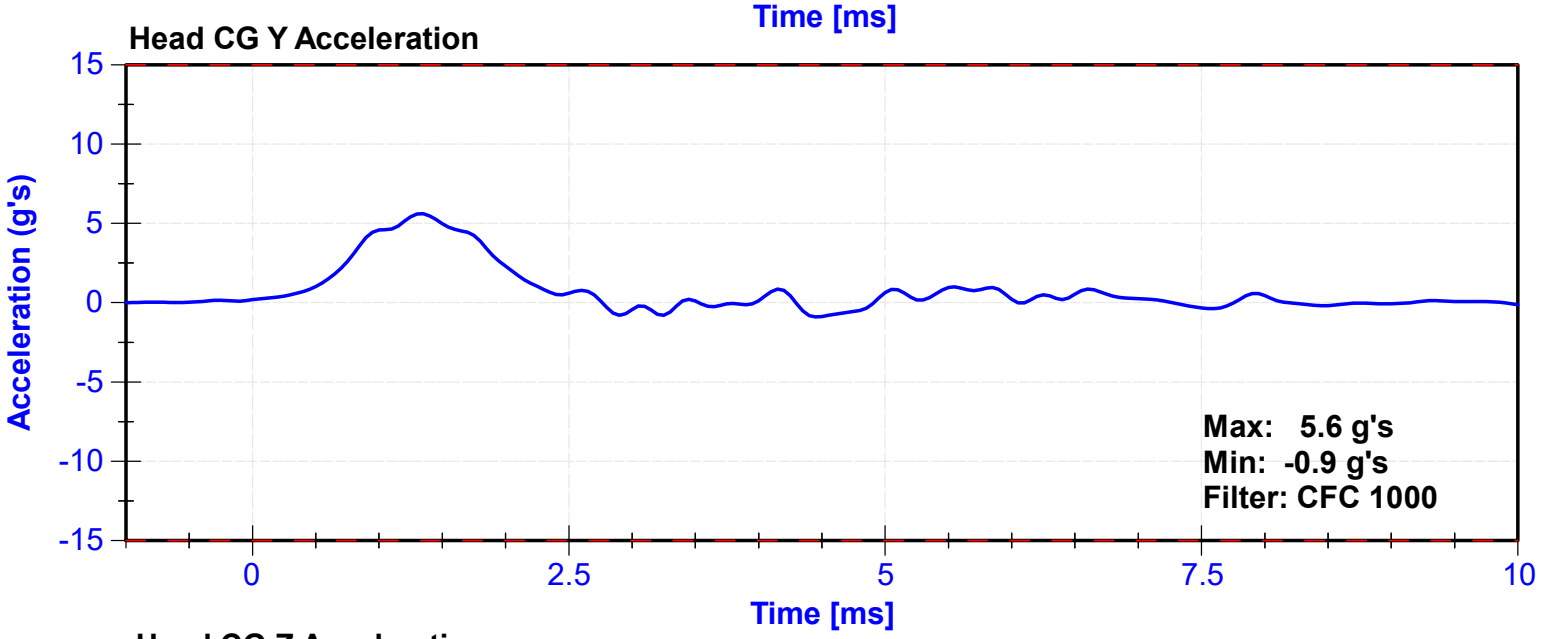
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.0	Pass
Humidity	10	70	%	23.5	Pass
Resultant Acceleration	250	300	g's	276.0	Pass
Oscillation	0	10	%	3.0	Pass
Lateral Acceleration	-15	15	g's	5.6	Pass

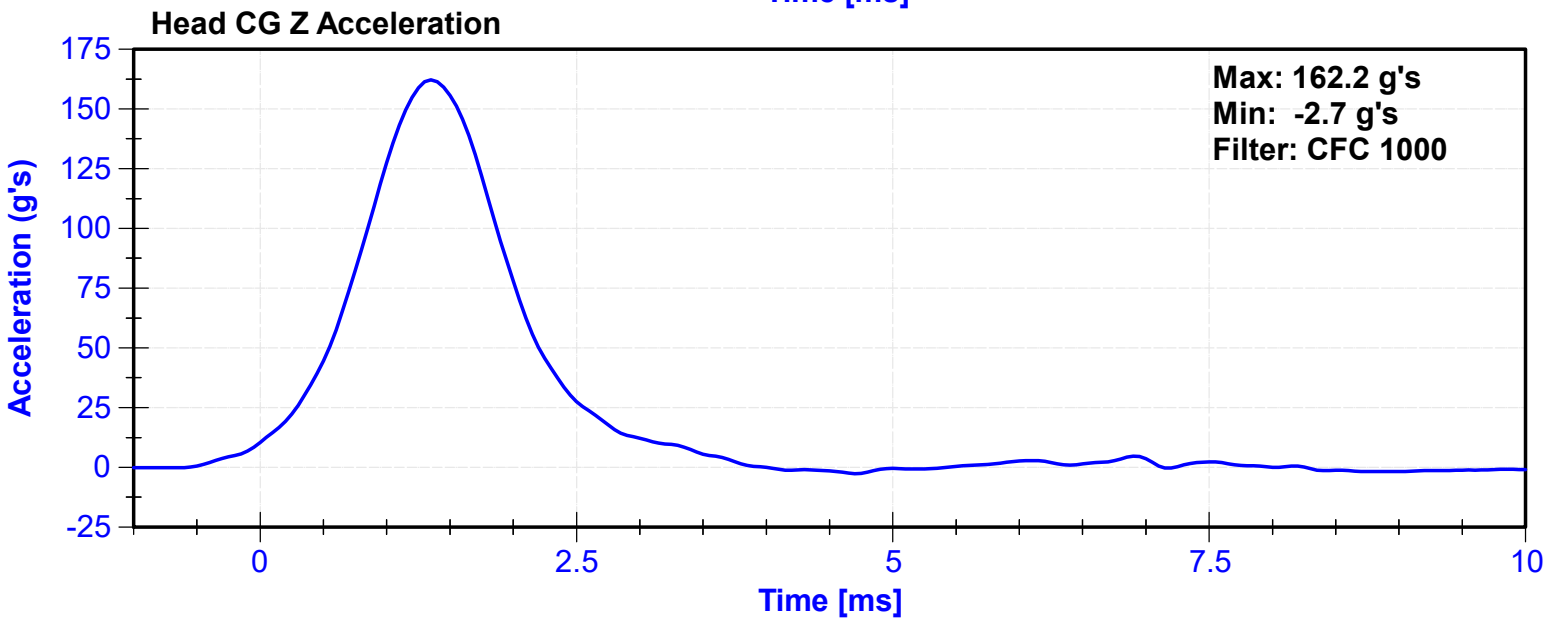
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	Endevco	P79417	12/13/2022	6/11/2023
Y Accelerometer	Endevco	P83335	12/13/2022	6/11/2023
Z Accelerometer	Endevco	P64149	12/12/2022	6/10/2023




Head CG X Acceleration
Acceleration (g's)
50
0
-50
-100
-150
-200
-250
0
2.5
5
7.5
10
Time [ms]
Max: 3.9 g's
Min: -223.3 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: 5.6 g's
Min: -0.9 g's
Filter: CFC 1000


Head CG Z Acceleration
Acceleration (g's)
175
150
125
100
75
50
25
0
-25
0
2.5
5
7.5
10
Time [ms]
Max: 162.2 g's
Min: -2.7 g's
Filter: CFC 1000

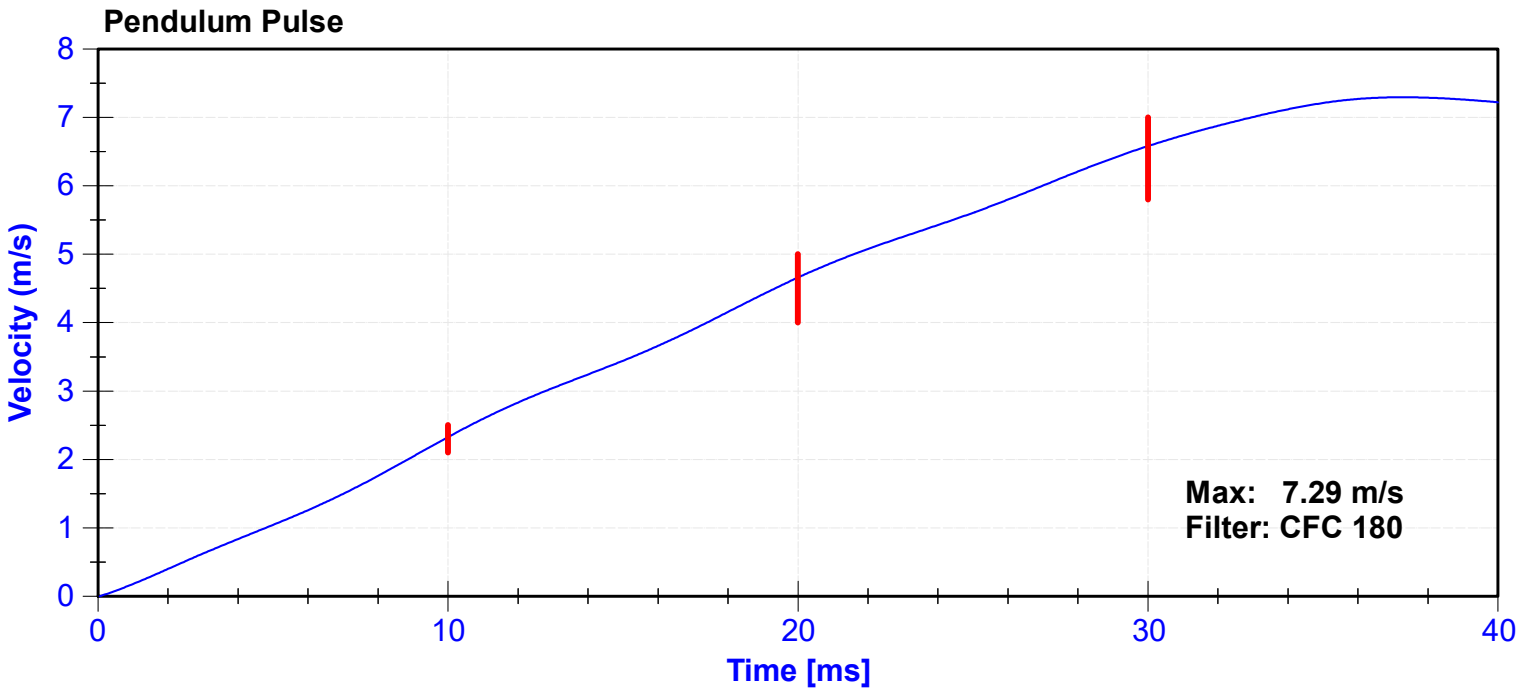
ATD Manufacturer	Humanetics	Test Technician	D. Sakona
ATD Serial Number	137	Laboratory Supervisor	K. Brogan

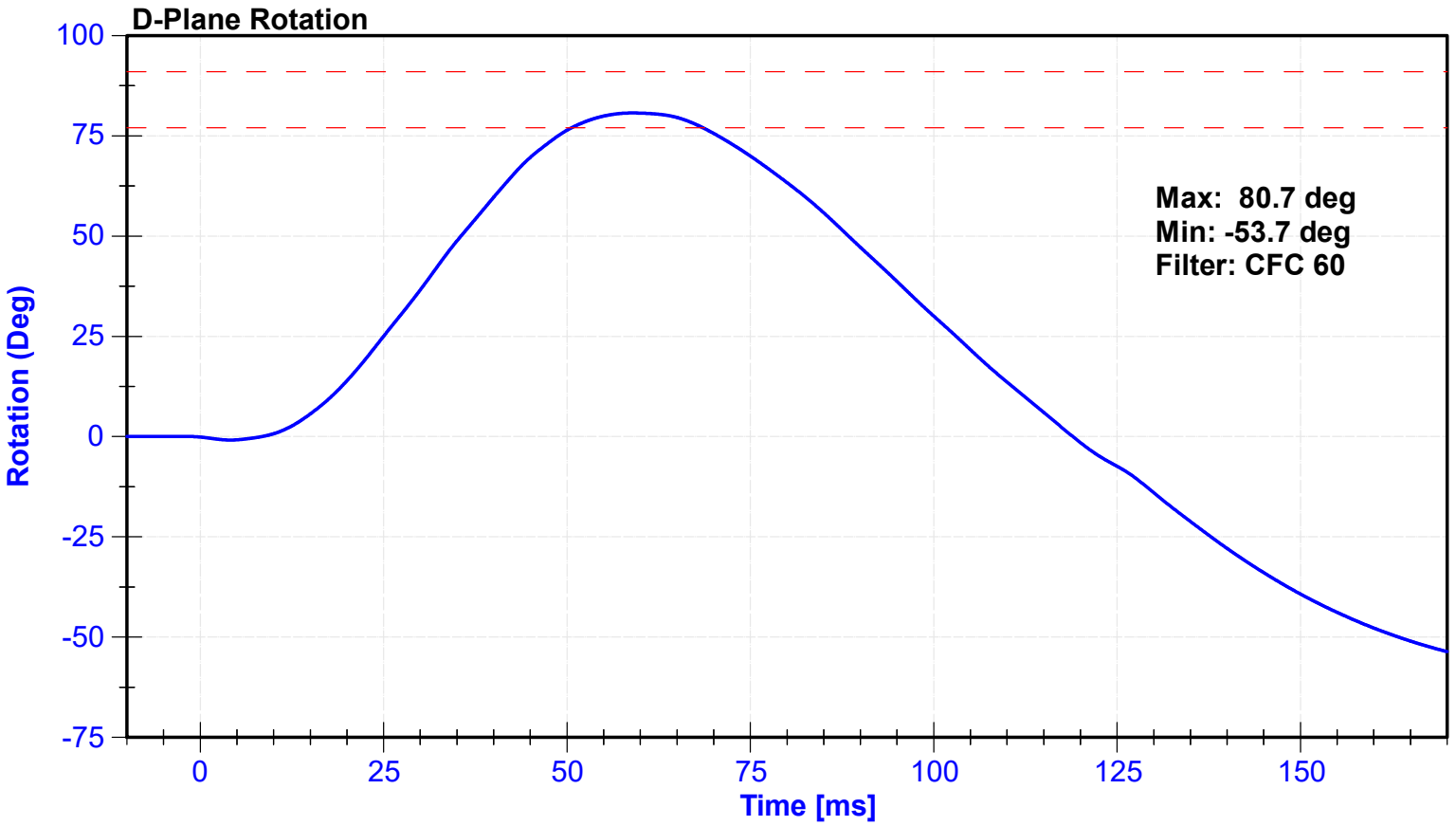
Results

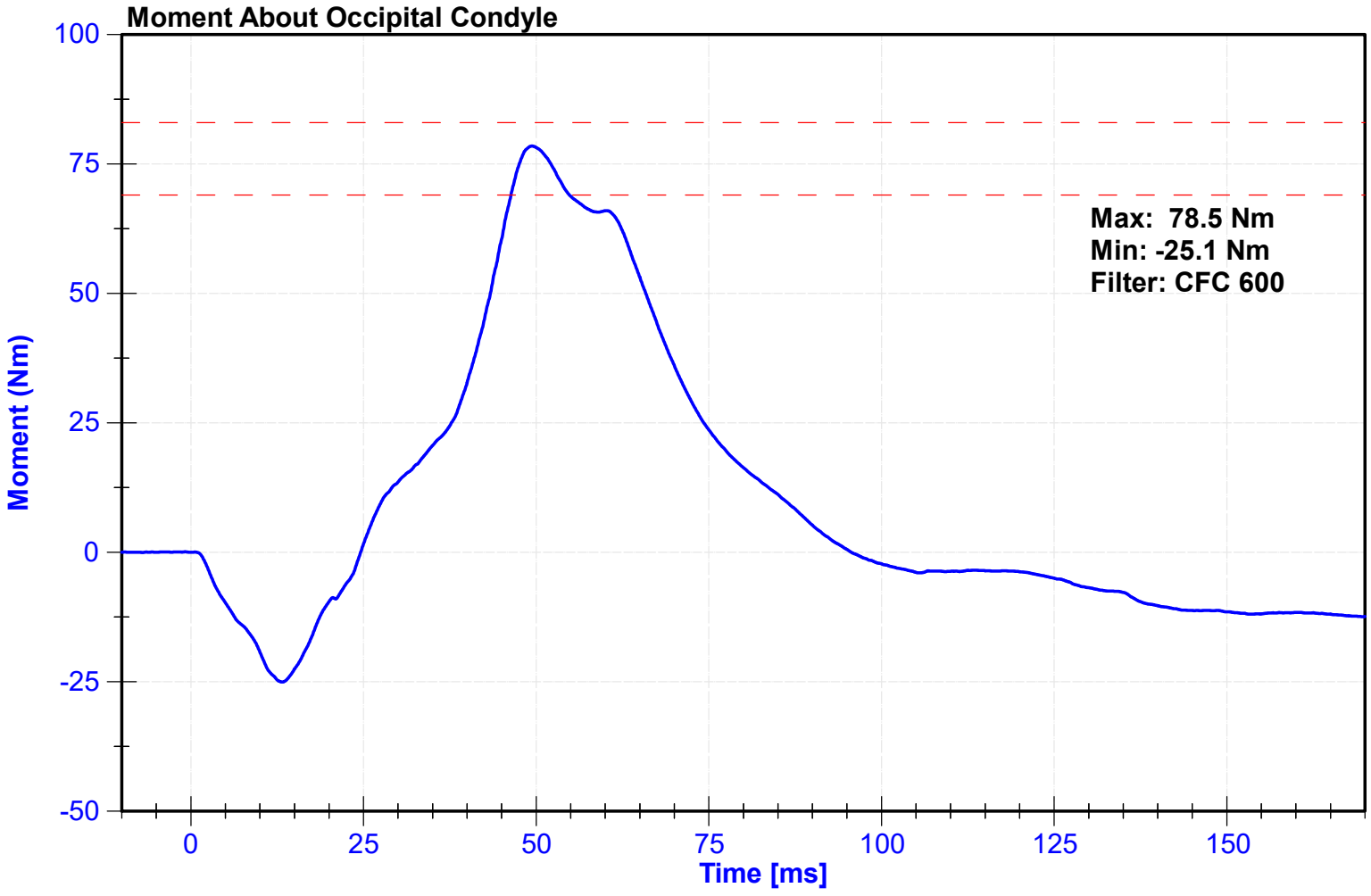
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.4	Pass
Humidity	10	70	%	21.0	Pass
Velocity	6.89	7.13	m/s	6.939	Pass
Pendulum Impulse at 10ms	2.1	2.5	m/s	2.33	Pass
Pendulum Impulse at 20ms	4.0	5.0	m/s	4.66	Pass
Pendulum Impulse at 30ms	5.8	7.0	m/s	6.58	Pass
Max D Plane Rotation	77	91	deg	80.7	Pass
Max Moment During Rotation Interval	69	83	Nm	78.5	Pass
Moment Decay to 10.0 Nm	80	100	ms	86.0	Pass

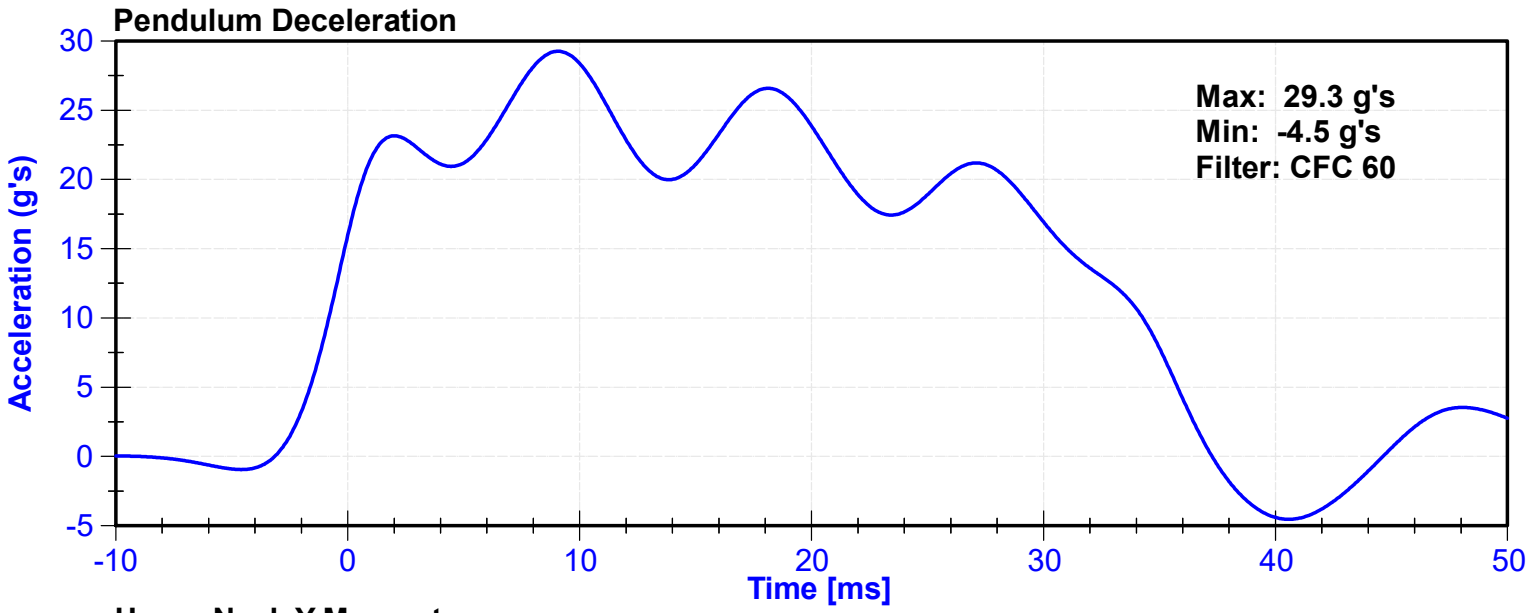
Transducer Calibrations

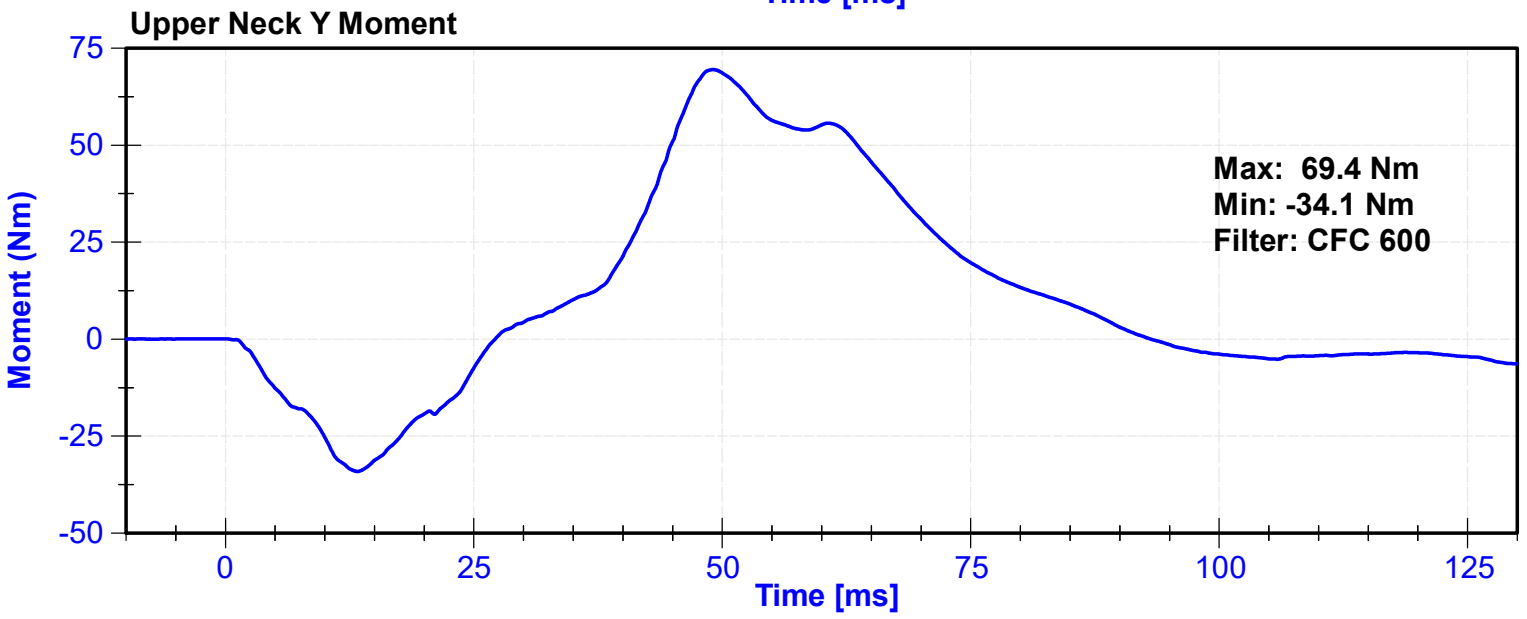
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	7231C-750	10/31/2022	4/29/2023
Pendulum Potentiometer	ETI	LABPOT1	5/9/2022	5/9/2023
Condyle Potentiometer	ETI	LABPOT2	5/9/2022	5/9/2023
Upper Neck Load Cell	Humanetics	1916-FX	6/10/2022	6/10/2023

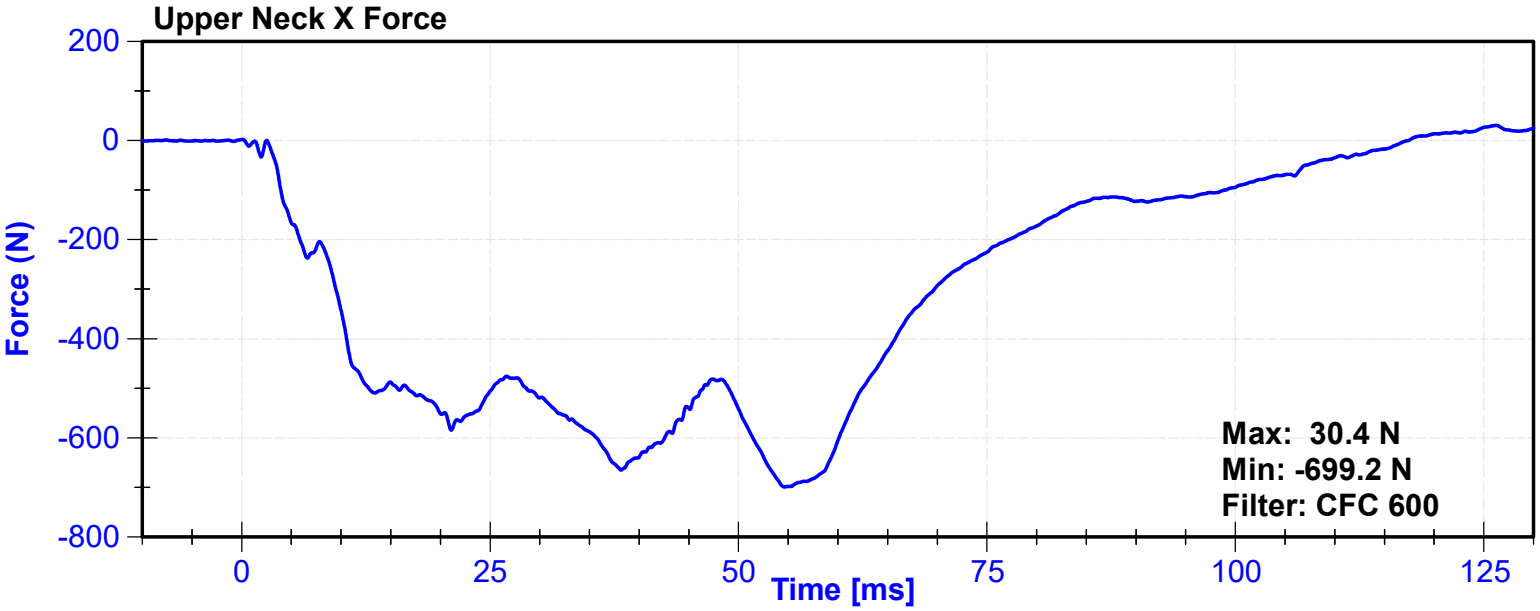



D-Plane Rotation
Max: 80.7 deg
Min: -53.7 deg
Filter: CFC 60
Rotation (Deg)
100
75
50
25
0
-25
-50
-75
0
25
50
75
100
125
150
Time [ms]


Moment About Occipital Condyle
Max: 78.5 Nm
Min: -25.1 Nm
Filter: CFC 600
Moment (Nm)
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]


Pendulum Deceleration
Acceleration (g's)
Time [ms]
Max: 29.3 g's
Min: -4.5 g's
Filter: CFC 60


Upper Neck Y Moment
Moment (Nm)
Time [ms]
Max: 69.4 Nm
Min: -34.1 Nm
Filter: CFC 600


Upper Neck X Force
Force (N)
Time [ms]
Max: 30.4 N
Min: -699.2 N
Filter: CFC 600

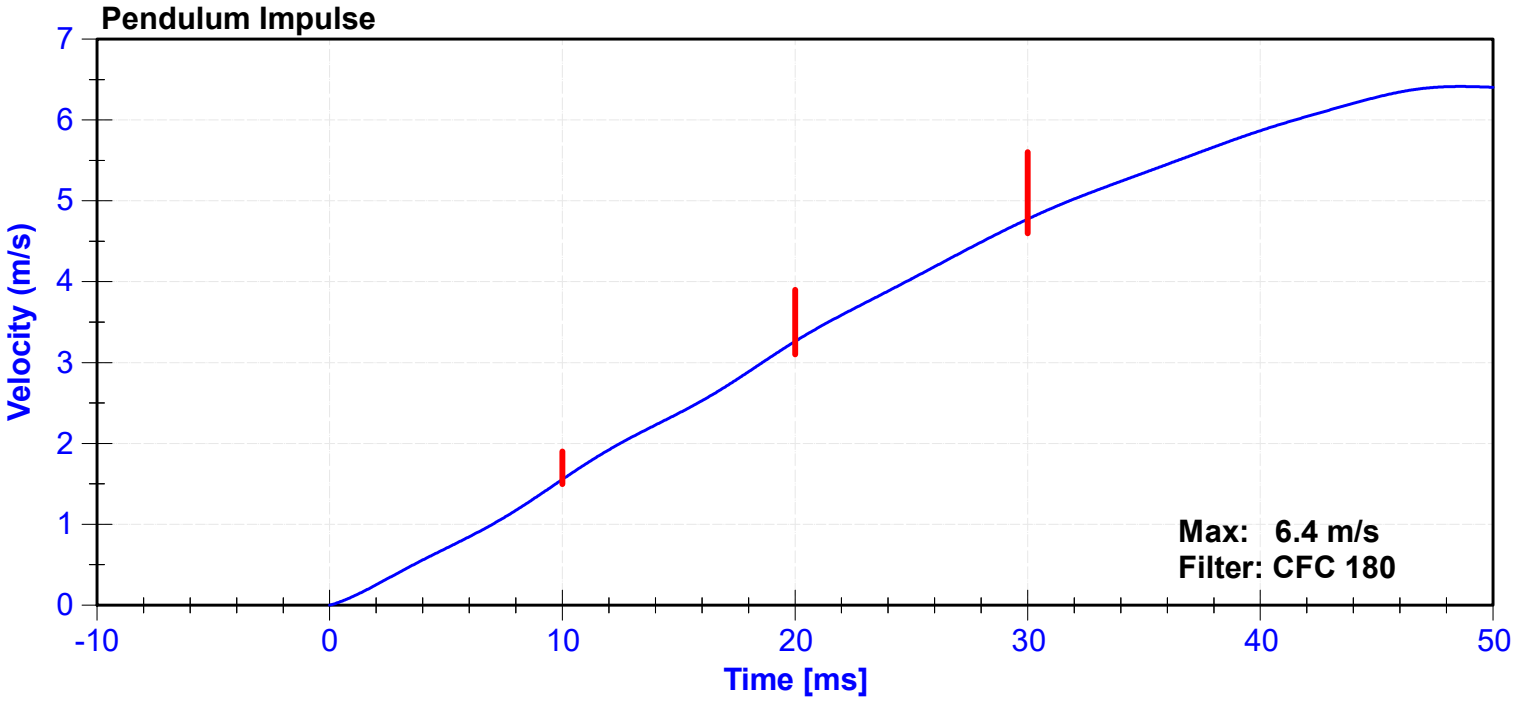
ATD Manufacturer	Humanetics	Test Technician	D. Sakona
ATD Serial Number	137	Laboratory Supervisor	K. Brogan

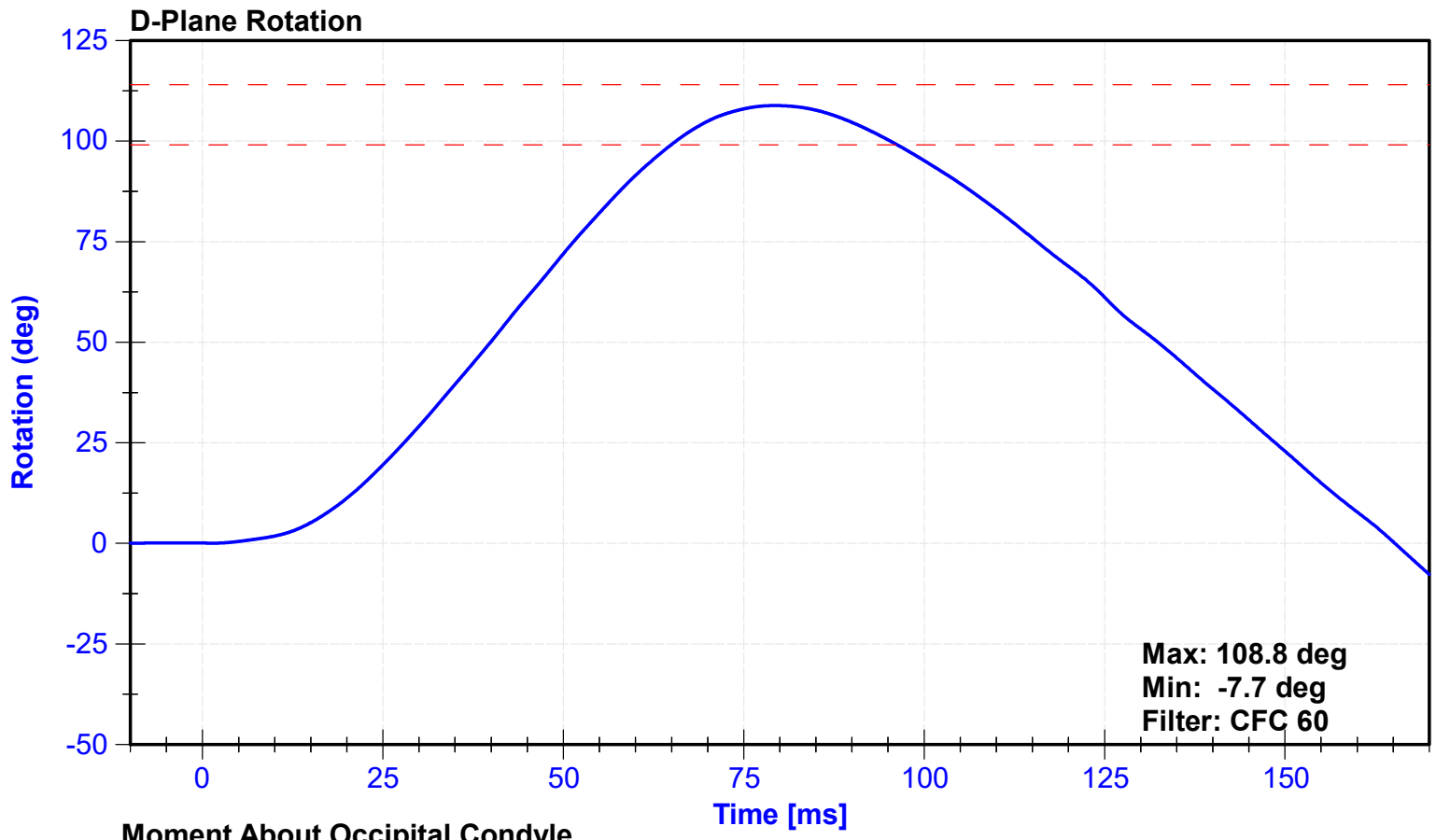
Results

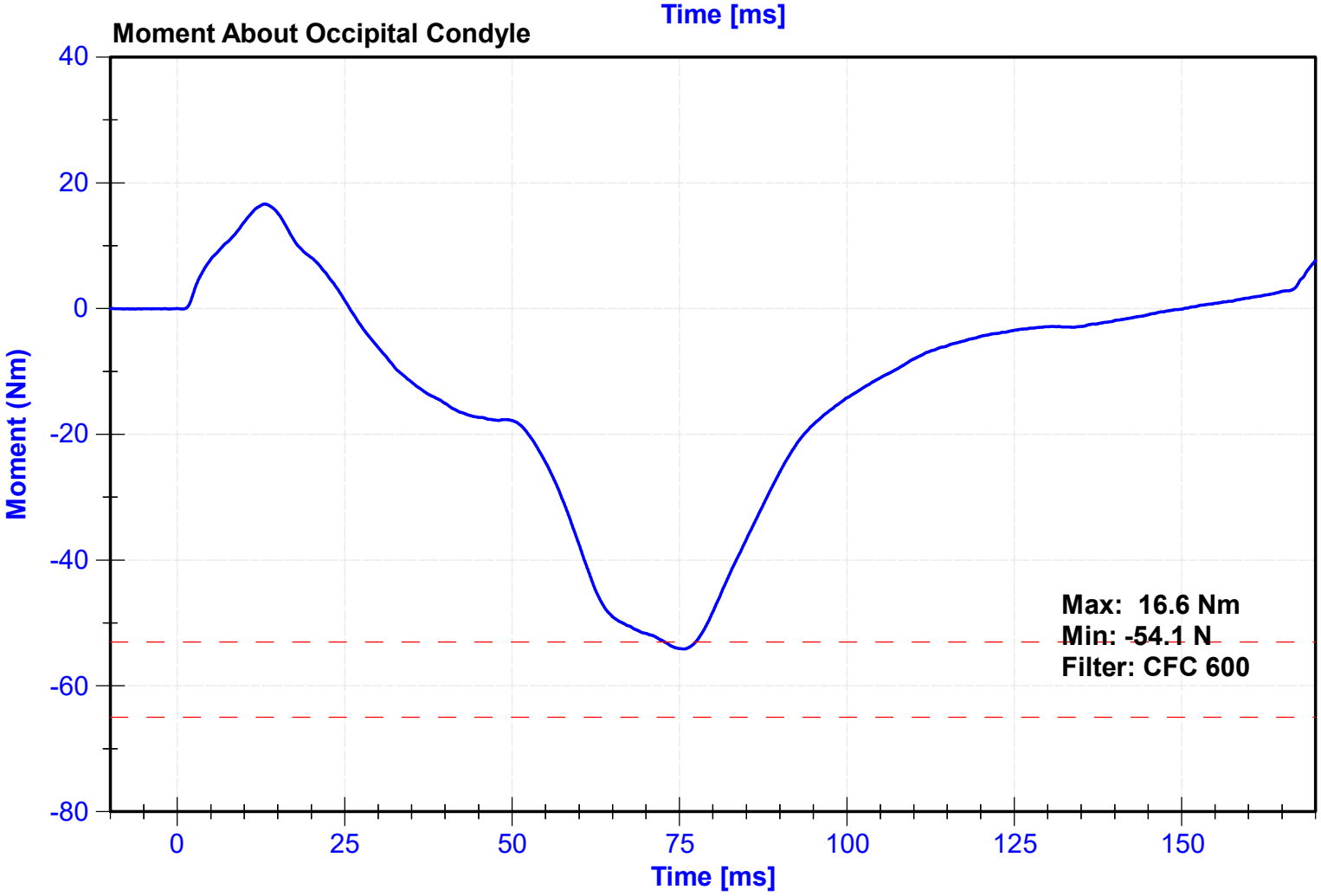
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.4	Pass
Humidity	10	70	%	21.0	Pass
Velocity	5.95	6.19	m/s	6.104	Pass
Pendulum Impulse at 10ms	1.5	1.9	m/s	1.56	Pass
Pendulum Impulse at 20ms	3.1	3.9	m/s	3.26	Pass
Pendulum Impulse at 30ms	4.6	5.6	m/s	4.77	Pass
D Plane Rotation	99	114	deg	108.8	Pass
Moment During Rotation Interval	-65	-53	Nm	-54.1	Pass
Moment Decay to -10Nm	94	114	ms	106.9	Pass

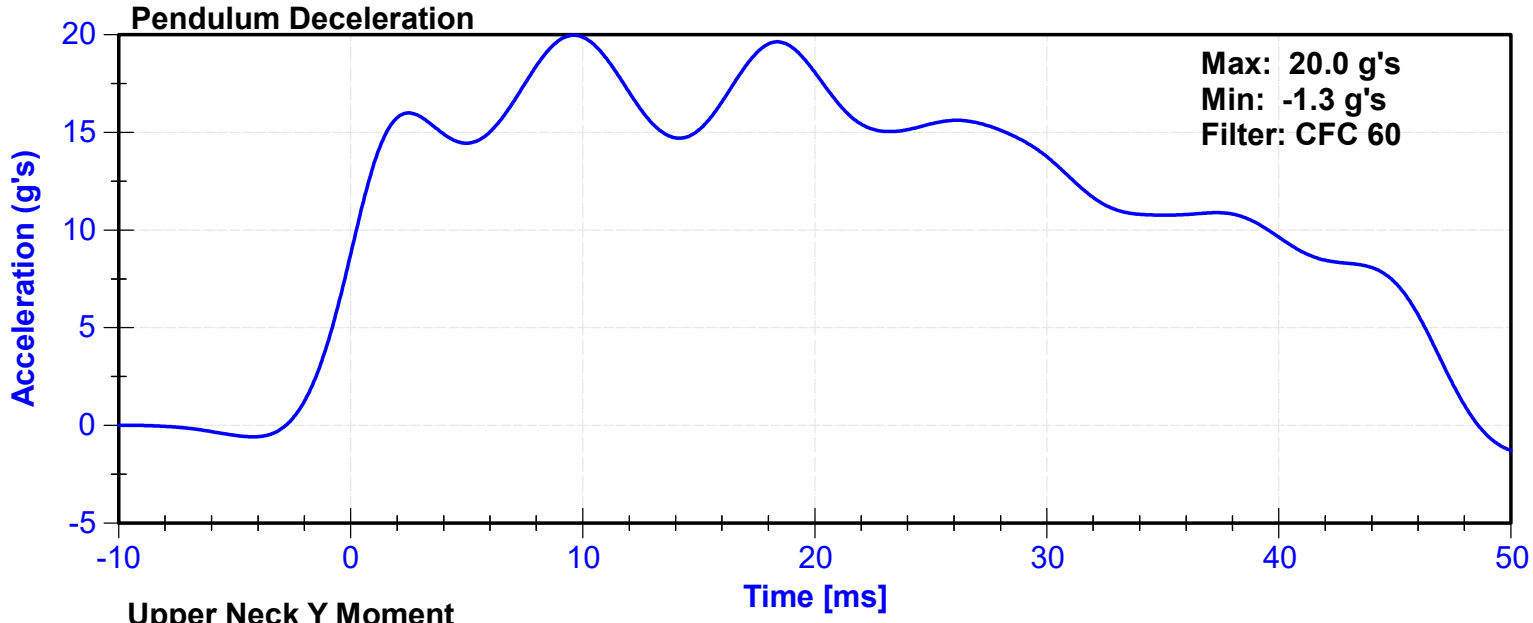
Transducer Calibrations

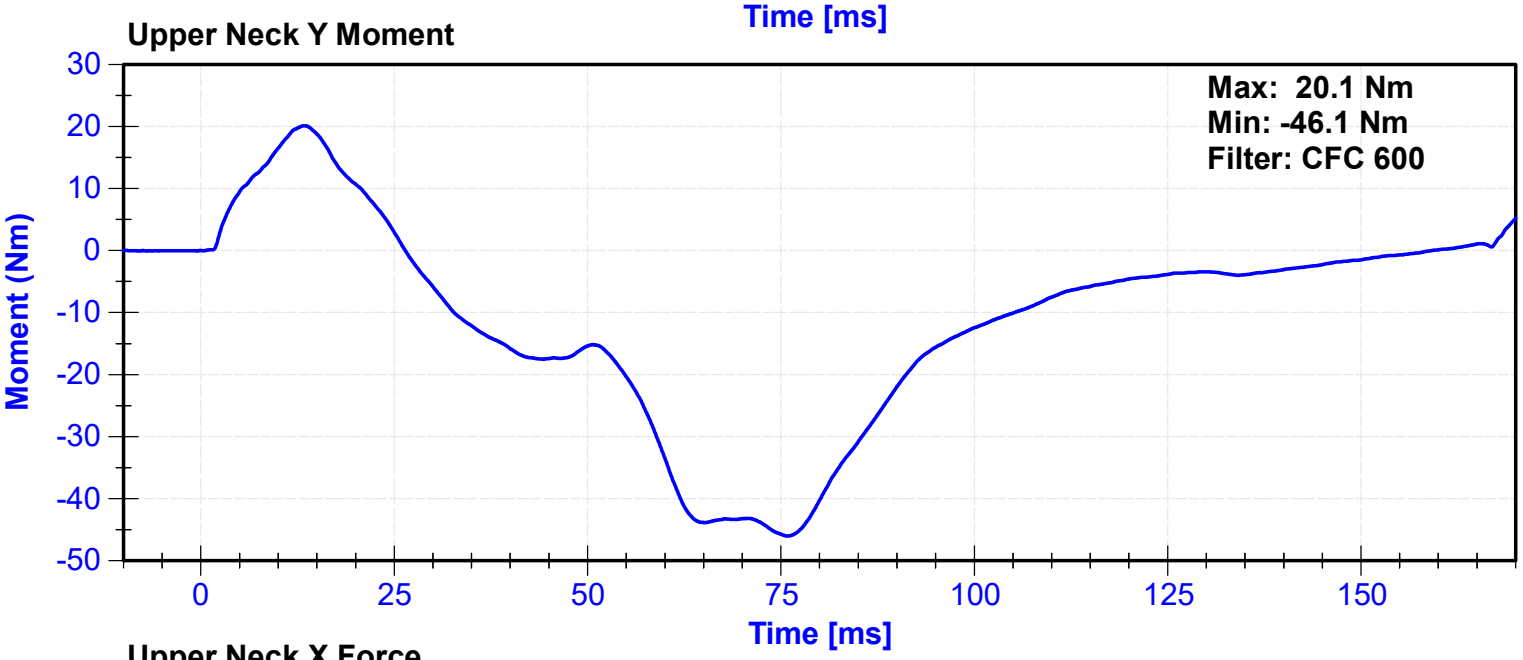
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	C16650	10/31/2022	4/29/2023
Pendulum Potentiometer	ETI	LABPOT1	5/9/2022	5/9/2023
Condyle Potentiometer	ETI	LABPOT2	5/9/2022	5/9/2023
Upper Neck Load Cell	Humanetics	1916-FX	6/10/2022	6/10/2023

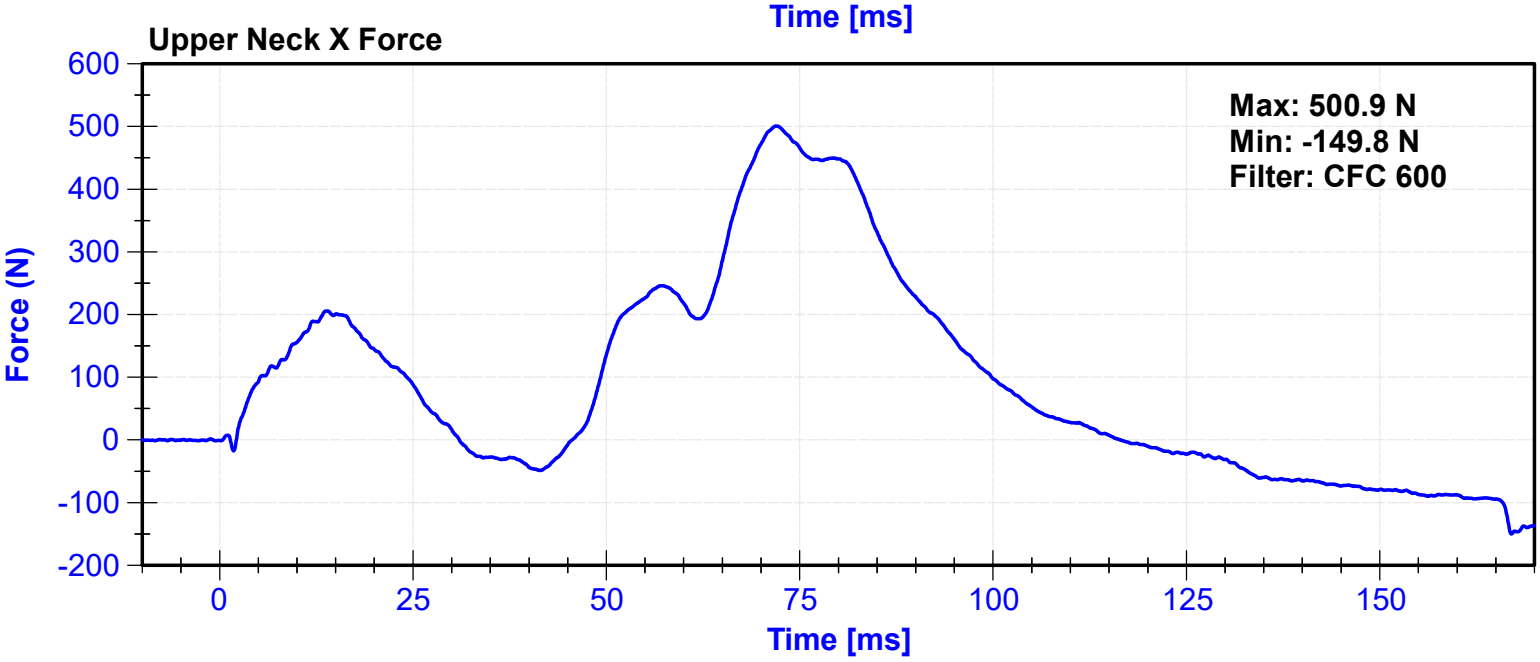



D-Plane Rotation
Rotation (deg)
125
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]
Max: 108.8 deg
Min: -7.7 deg
Filter: CFC 60


Moment About Occipital Condyle
Moment (Nm)
40
20
0
-20
-40
-60
-80
0
25
50
75
100
125
150
Time [ms]
Max: 16.6 Nm
Min: -54.1 N
Filter: CFC 600


Pendulum Deceleration
Max: 20.0 g's
Min: -1.3 g's
Filter: CFC 60
Acceleration (g's)
Time [ms]


Upper Neck Y Moment
Max: 20.1 Nm
Min: -46.1 Nm
Filter: CFC 600
Moment (Nm)
Time [ms]


Upper Neck X Force
Max: 500.9 N
Min: -149.8 N
Filter: CFC 600
Force (N)
Time [ms]

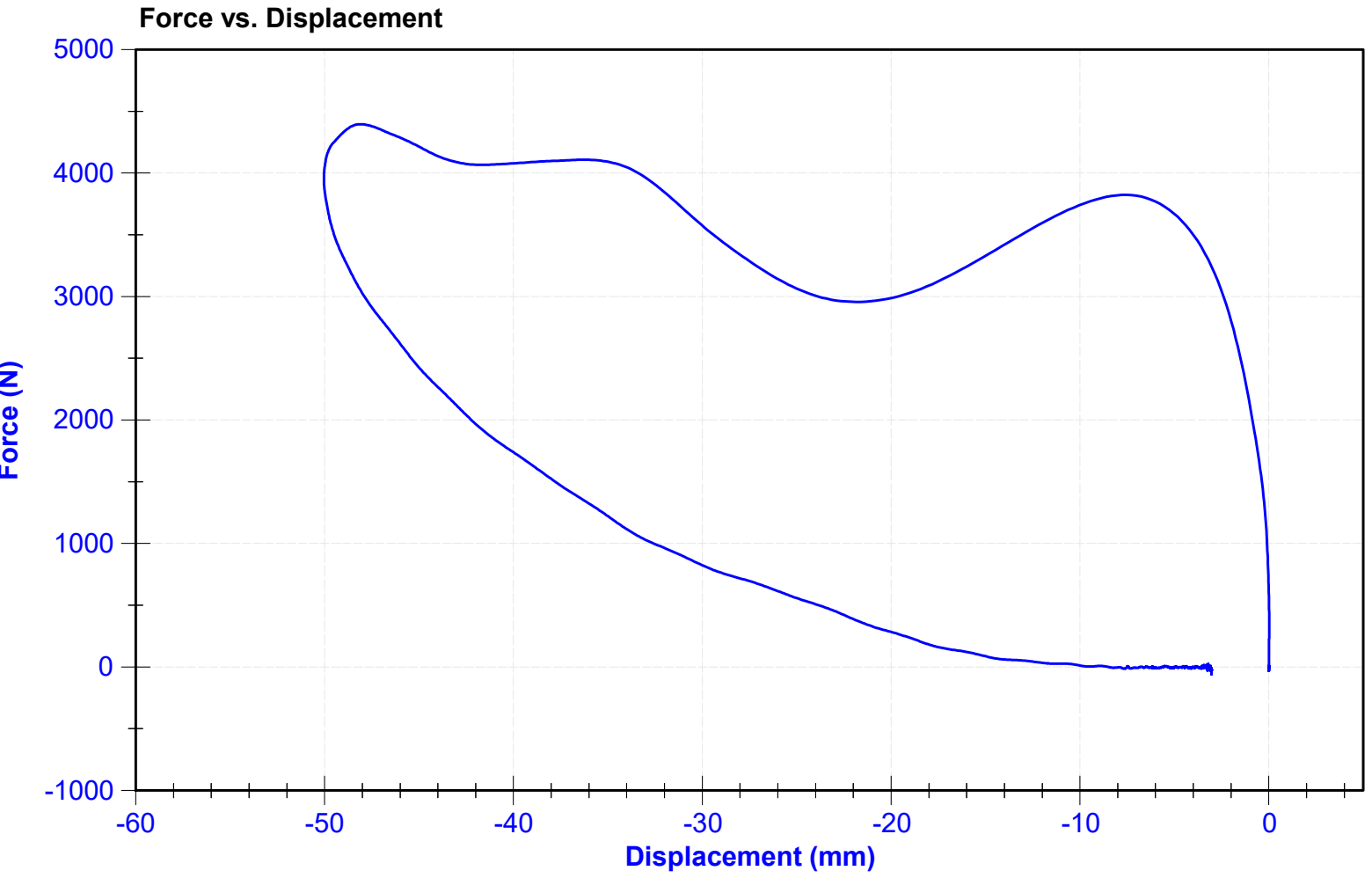
ATD Manufacturer	Humanetics	Test Technician	D. Sakona
ATD Serial Number	137	Laboratory Supervisor	K. Brogan

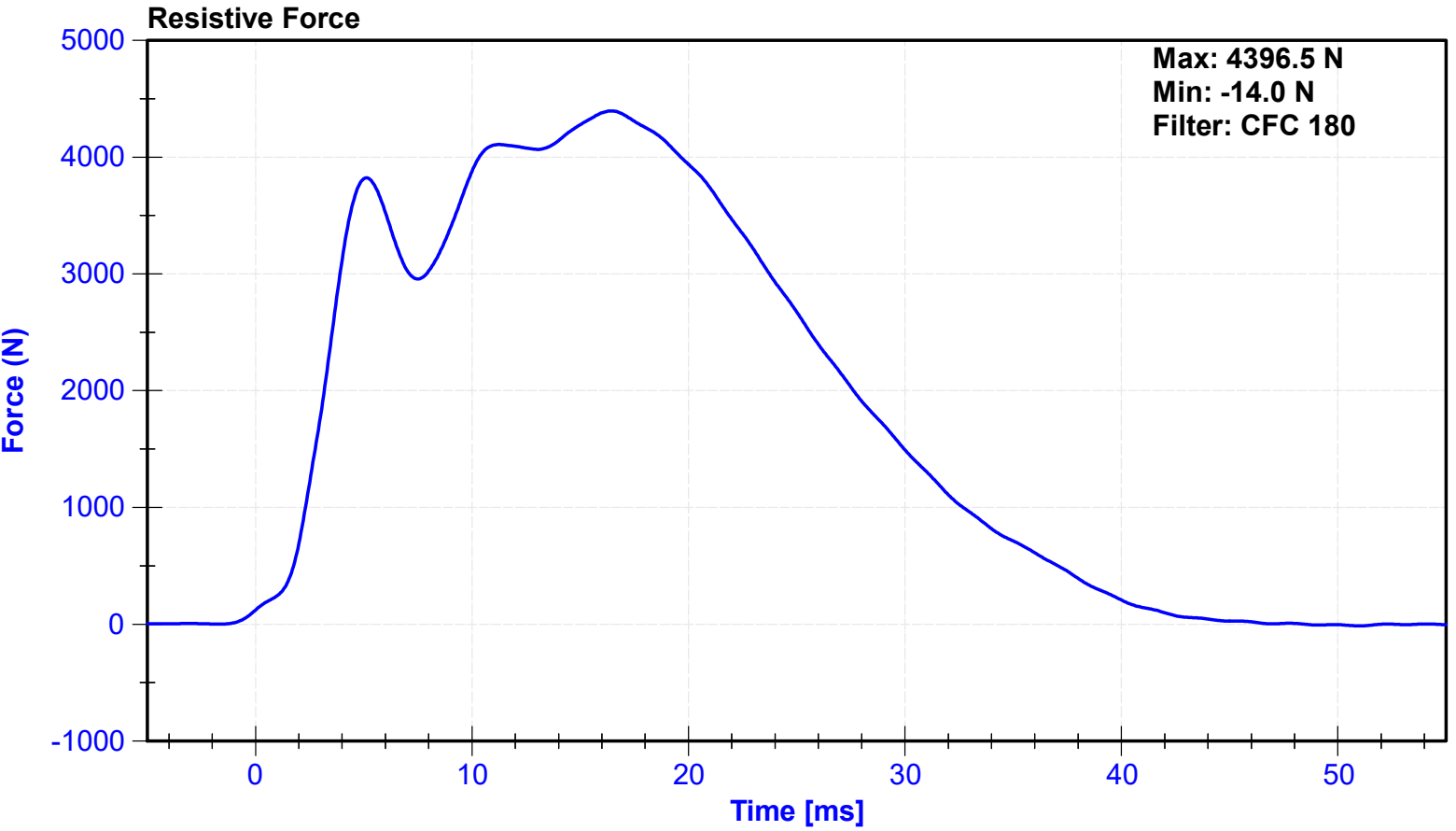
Results

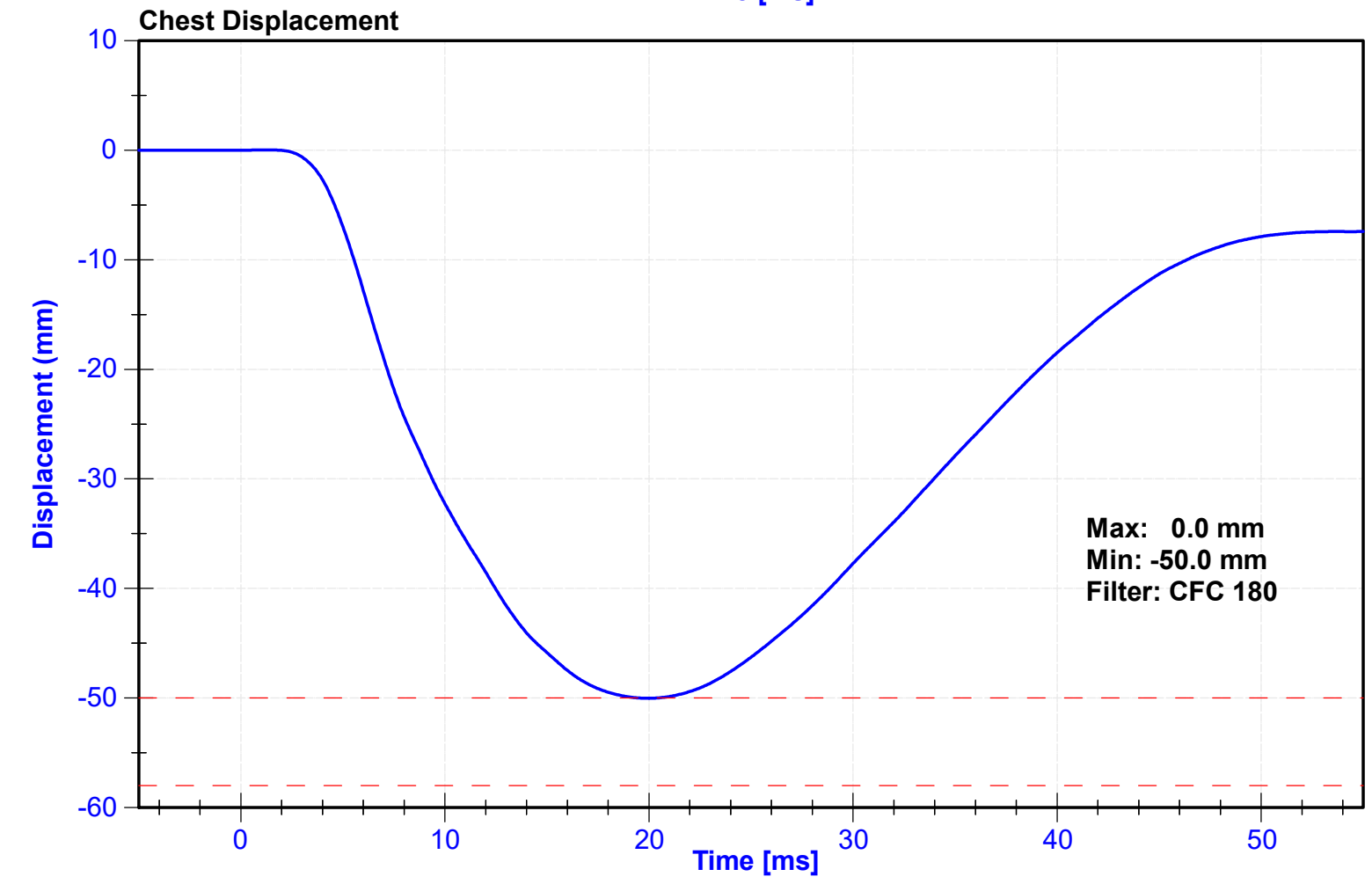
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.2	Pass
Humidity	10	70	%	25.5	Pass
Velocity	6.59	6.83	m/s	6.685	Pass
Chest Deflection	-58	-50	mm	-50.0	Pass
Maximum Resistive Force (50 to 58mm)	3900	4400	N	4047.3	Pass
Maximum Resistive Force (18 to 50mm)	0	4600	N	4396.5	Pass
Hysteresis	69	85	%	75.4	Pass

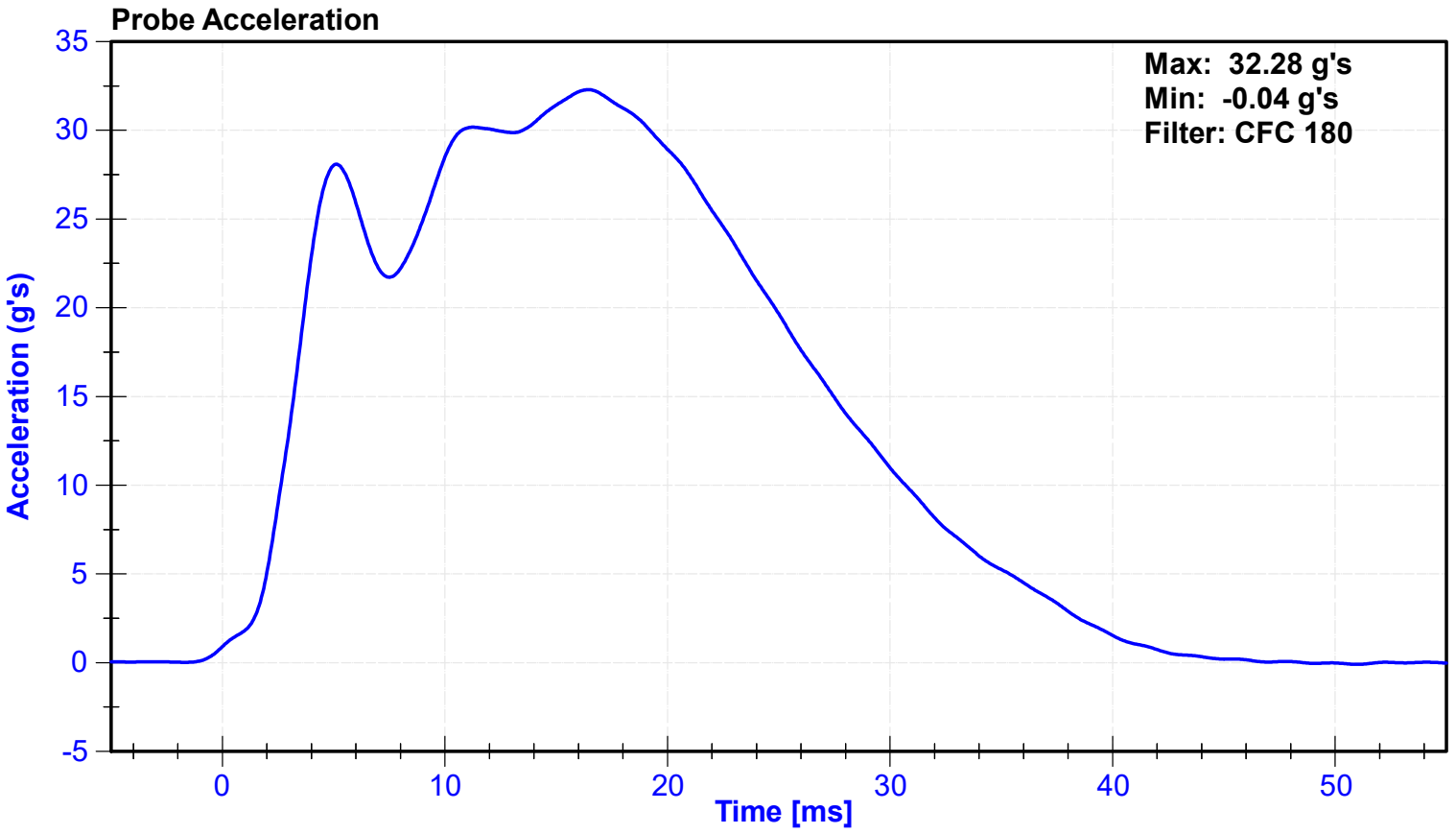
Transducer Calibrations

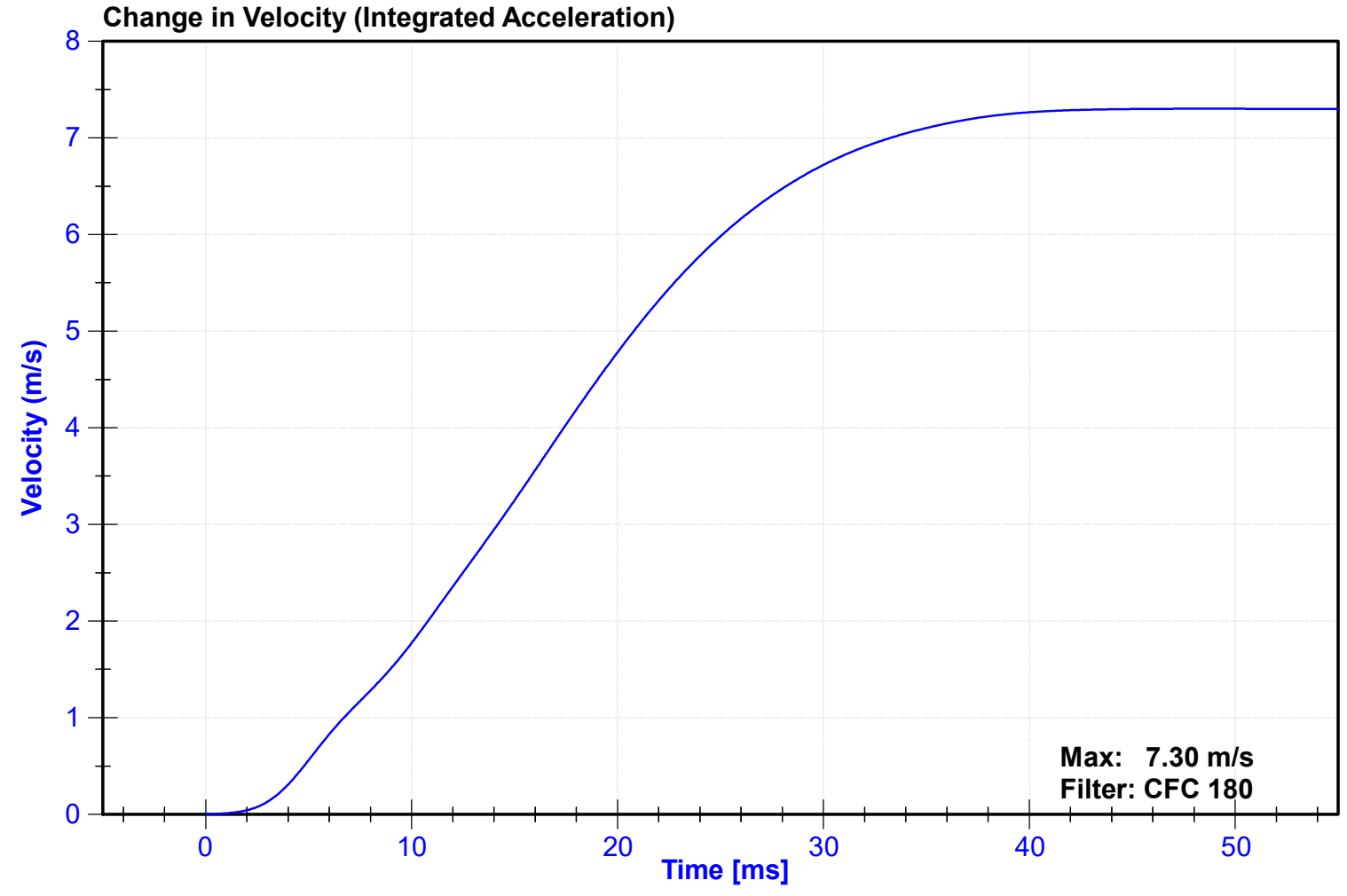
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	P51736	10/25/2022	10/25/2023
Chest Potentiometer	Servo	0720	12/12/2022	6/12/2023




Resistive Force
Max: 4396.5 N
Min: -14.0 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: -50.0 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: 32.28 g's
Min: -0.04 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: 7.30 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]

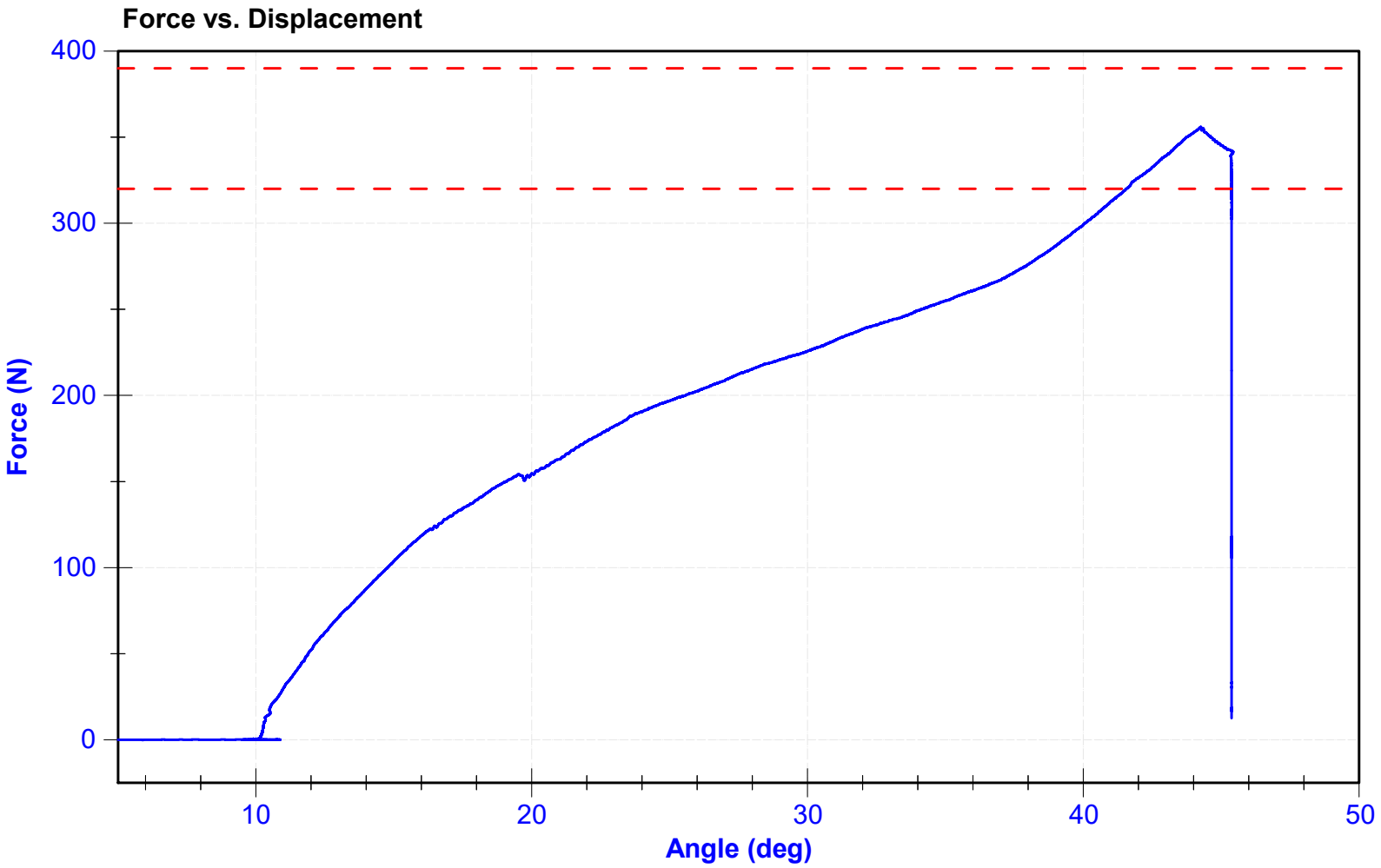
ATD Manufacturer	Humanetics	Test Technician	T. Roseman
ATD Serial Number	137	Laboratory Supervisor	K. Brogan

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.6	25.6	ºC	21.4	Pass
Humidity	10	70	%	13.5	Pass
Initial Angle	0	20	deg	10.1	Pass
Force at 45 Degrees	320	390	N	355.9	Pass
Return Angle Relative to Initial	0	8	deg	3.7	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	Rieker	DS-1905226	2022-11-09	2023-11-09
Load Cell	Interface	1134516	2022-09-27	2023-09-27



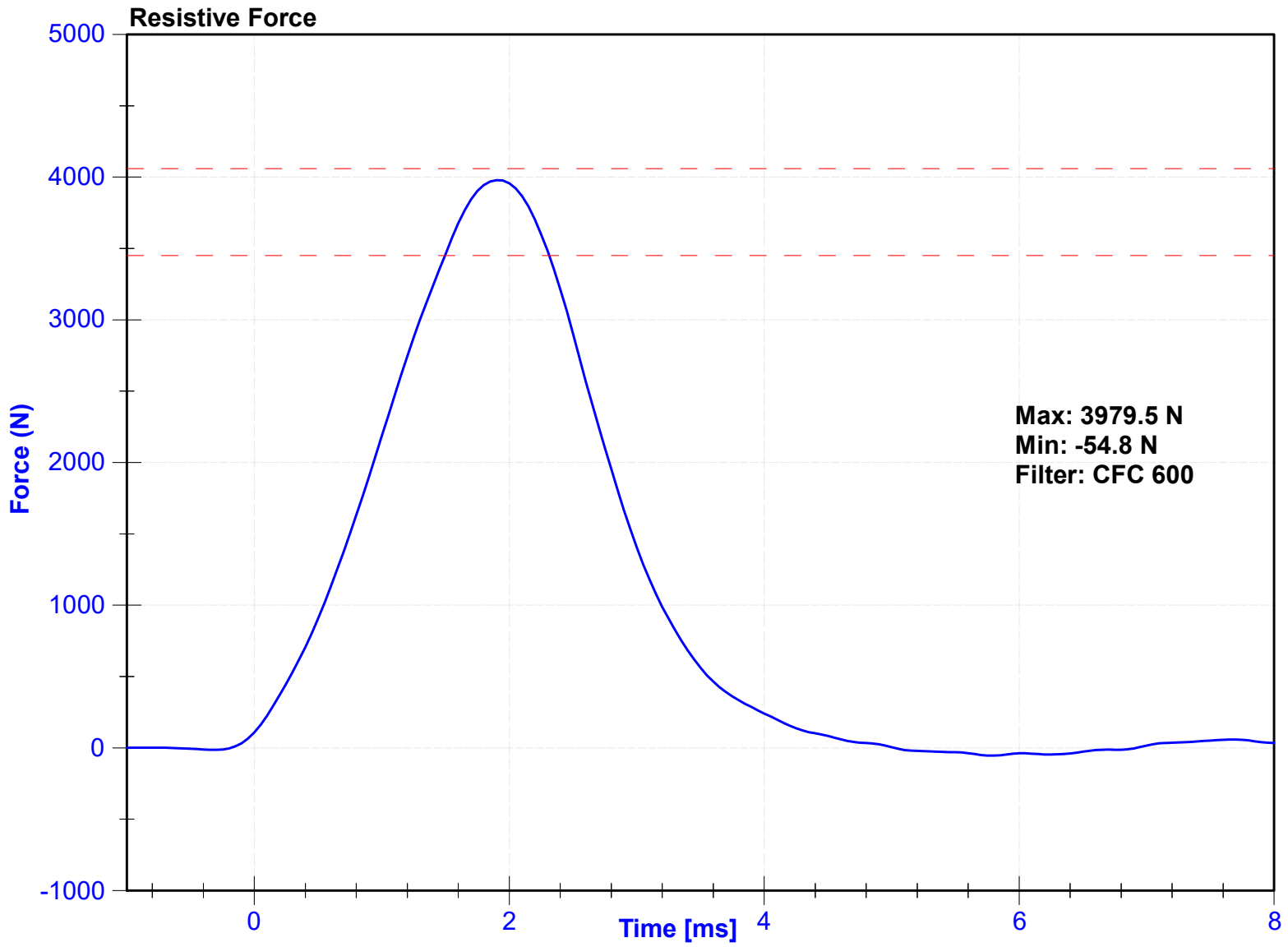
ATD Manufacturer	Humanetics	Test Technician	T. Roseman
ATD Serial Number	137	Laboratory Supervisor	K. Brogan

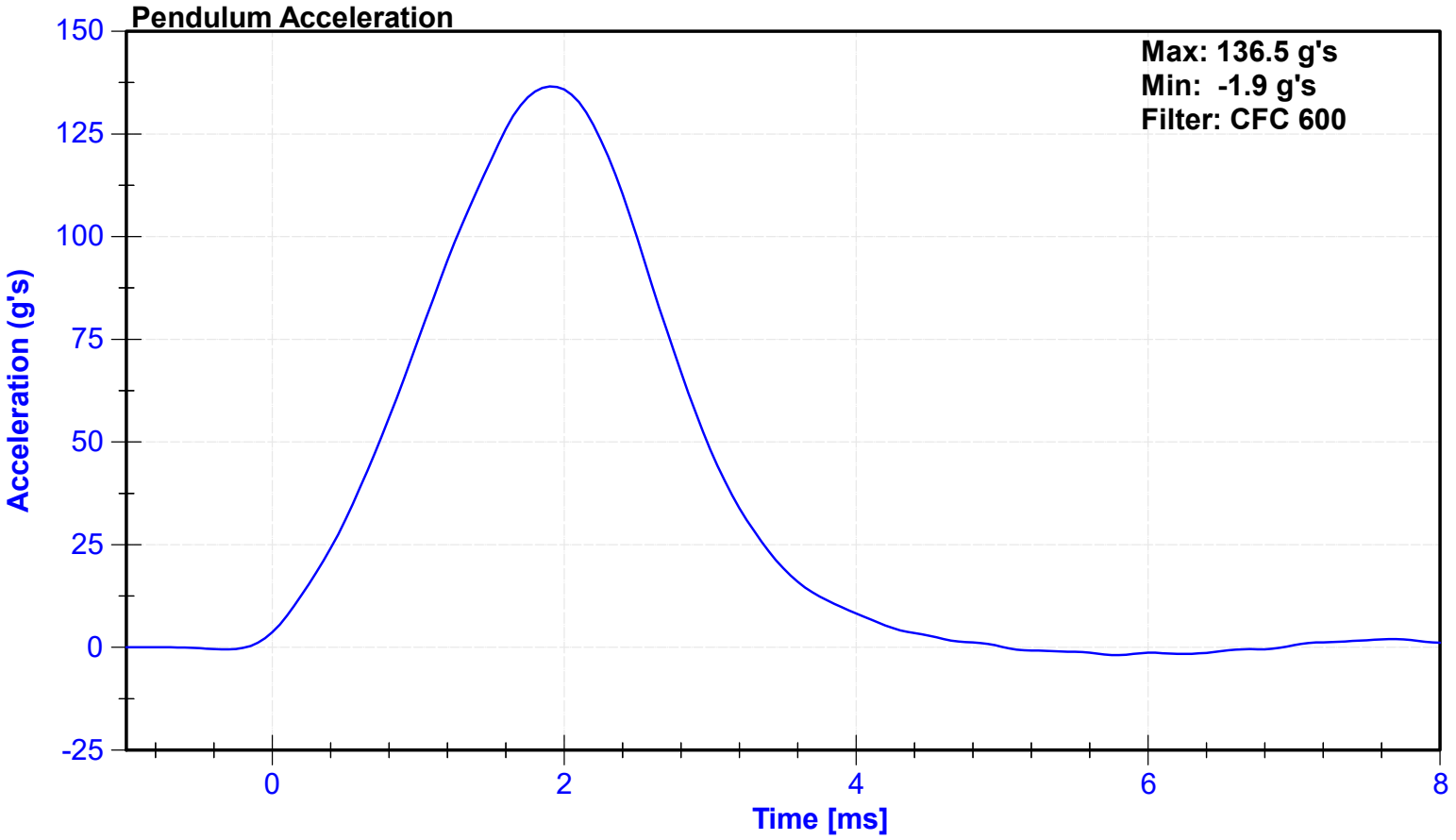
Results

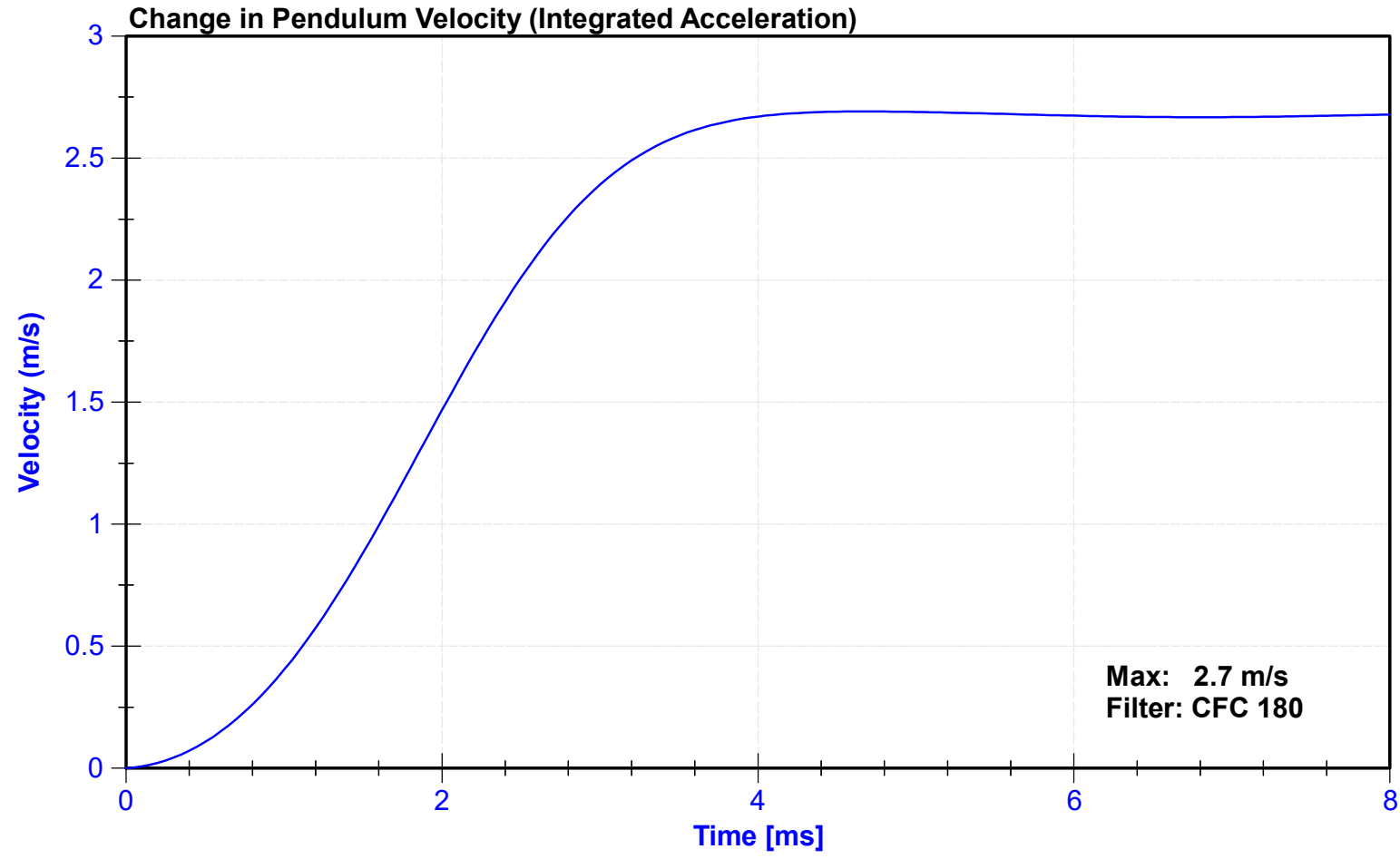
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	20.9	Pass
Humidity	10	70	%	24.3	Pass
Velocity	2.07	2.13	m/s	2.087	Pass
Resistive Force	3450	4060	N	3979.5	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18546	11/19/2022	5/18/2023




Pendulum Acceleration
Max: 136.5 g's
Min: -1.9 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

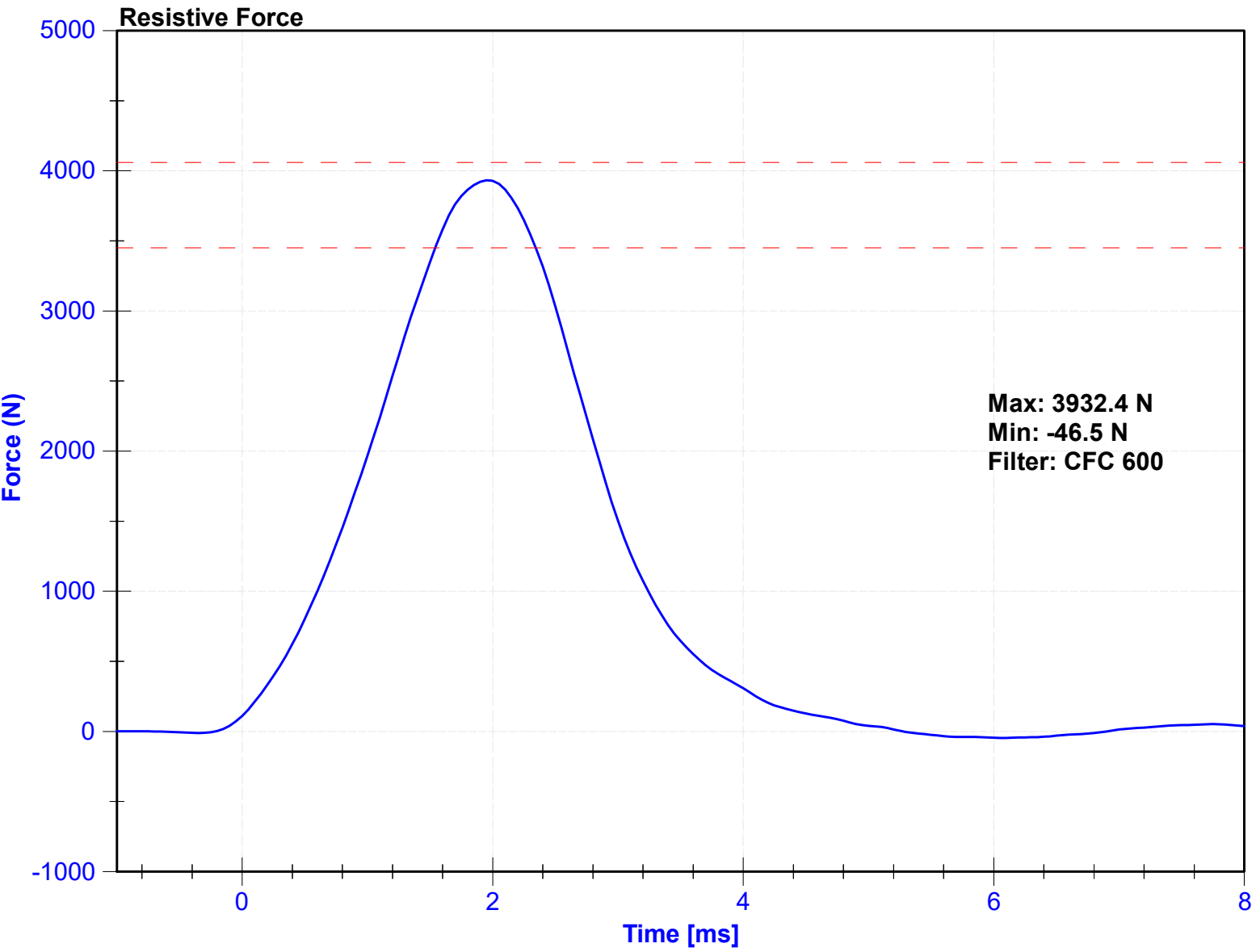
ATD Manufacturer	Humanetics	Test Technician	T. Roseman
ATD Serial Number	137	Laboratory Supervisor	K. Brogan

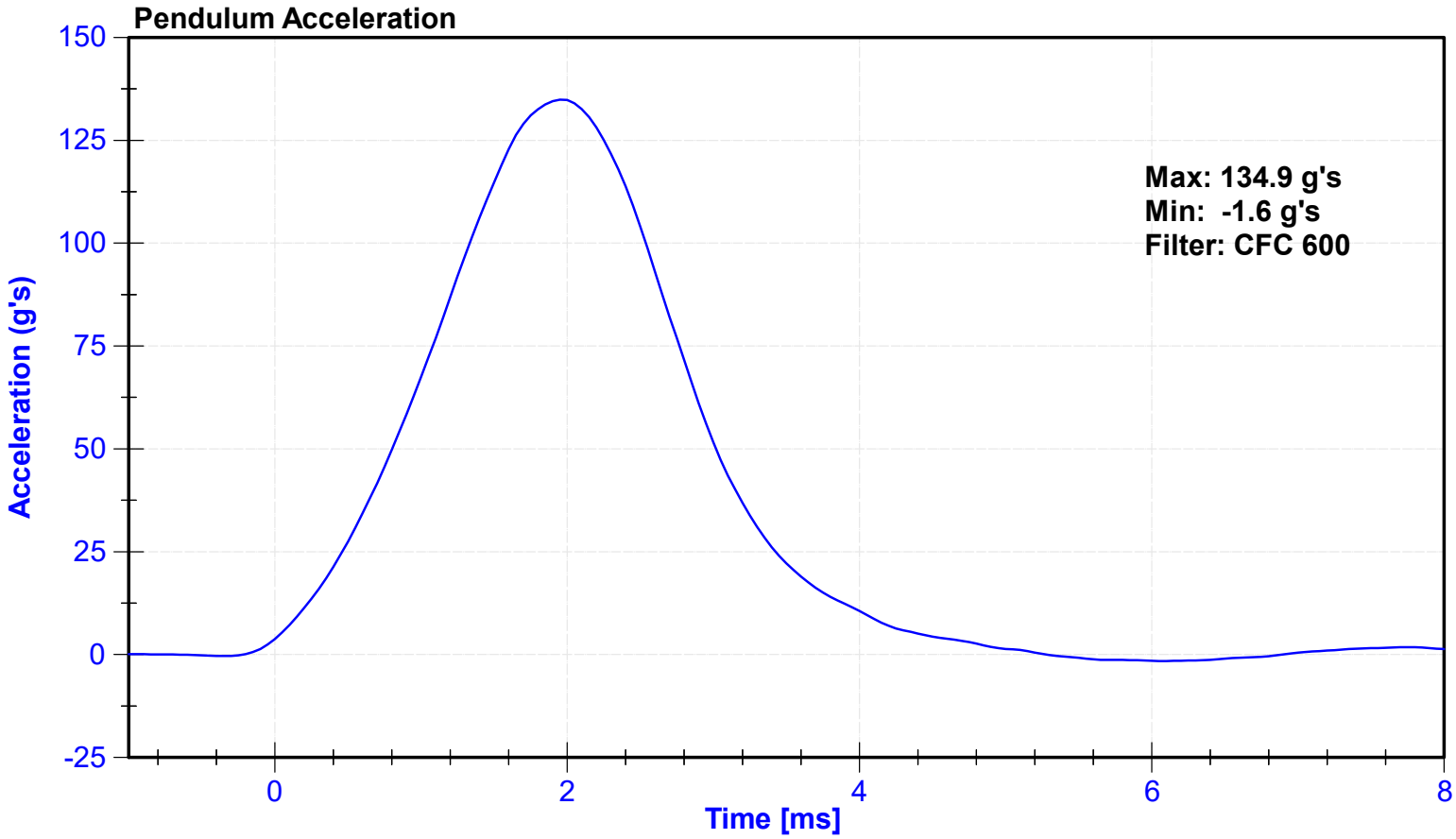
Results

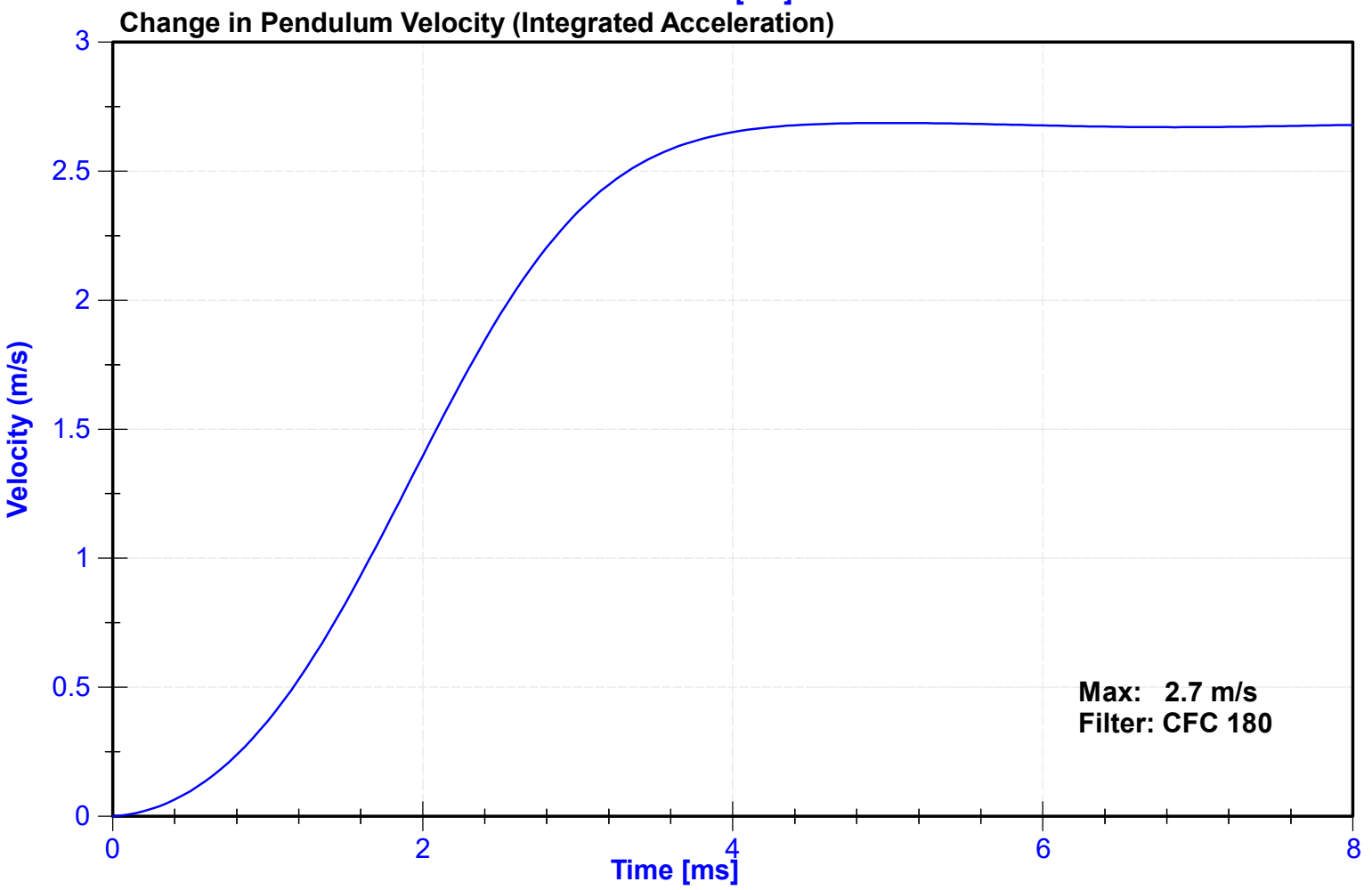
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	20.9	Pass
Humidity	10	70	%	24.3	Pass
Velocity	2.07	2.13	m/s	2.084	Pass
Resistive Force	3450	4060	N	3932.4	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18546	11/19/2022	5/18/2023




Pendulum Acceleration
Max: 134.9 g's
Min: -1.6 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

CALIBRATION TEST RESULTS

POST-TEST

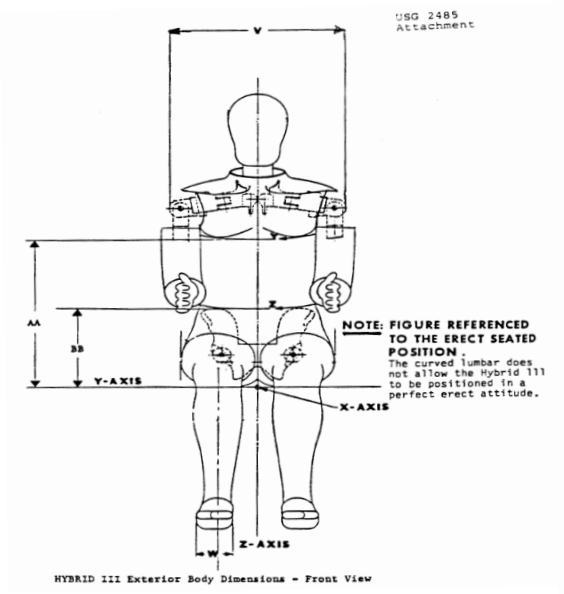
HYBRID III 50TH PERCENTILE MALE - DRIVER ATD

SERIAL NO: 142

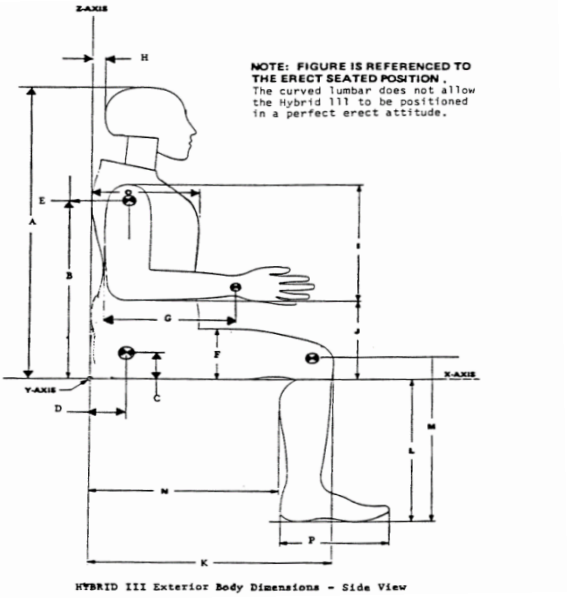
External Measurements - Hybrid 3 - 50th Male

Technician: K. Brogan Date: 02/22/2023

Dummy Serial Number: 142



HYBRID III Exterior Body Dimensions - Front View



HYBRID III Exterior Body Dimensions - Side View

Symbol	Description	Specification (in)		Result (in)	Pass/Fail
A	Sitting Height	34.6	35.0	34.8	Pass
B	Shoulder Pivot Height	19.9	20.5	20.2	Pass
C	H-Point Height	3.3	3.5	3.3	Pass
D	H-Point from Backline	5.3	5.5	5.3	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	11.6	Pass
H	Head Back to Backline	1.6	1.8	1.7	Pass
I	Shoulder to Elbow Length	13.0	13.6	13.2	Pass
J	Elbow Rest Height	7.5	8.3	7.9	Pass
K	Buttock to Knee Length	22.8	23.8	23.5	Pass
L	Popliteal Height	16.9	17.9	17.1	Pass
M	Knee Pivot Height	19.1	19.7	19.4	Pass
N	Buttock Popliteal Length	17.8	18.8	18.3	Pass
O	Chest Depth without Jacket	8.4	9.0	8.6	Pass
P	Foot Length (right)	9.9	10.5	10.2	Pass
V	Shoulder Breadth	16.3	17.2	16.8	Pass
W	Foot Breadth	3.6	4.2	3.9	Pass
Y	Chest Circumference with Jacket	38.2	39.4	39.0	Pass
Z	Waist Circumference	32.9	34.1	33.3	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

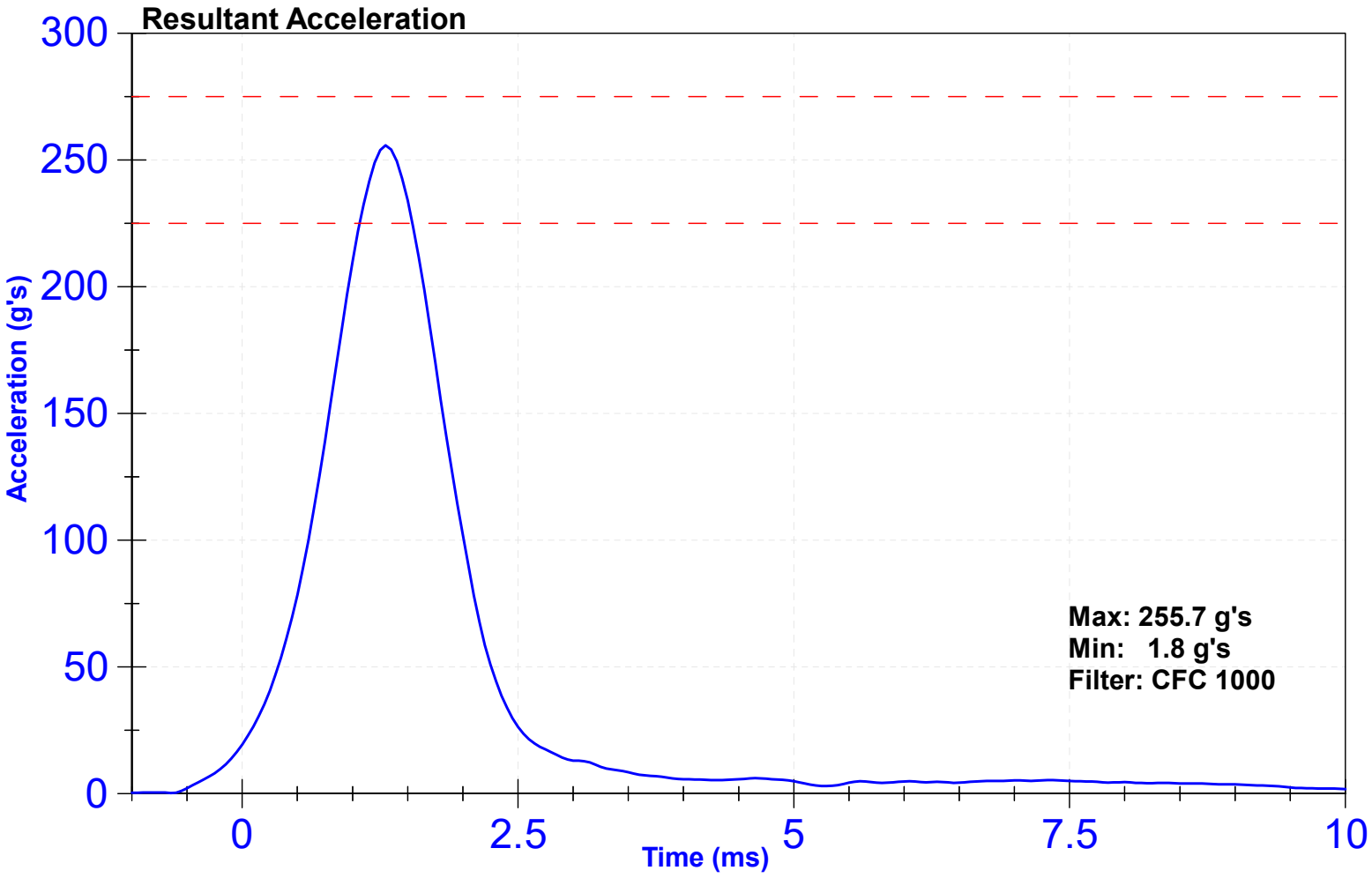
ATD Manufacturer	Humanetics	Test Technician	T. Roseman
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

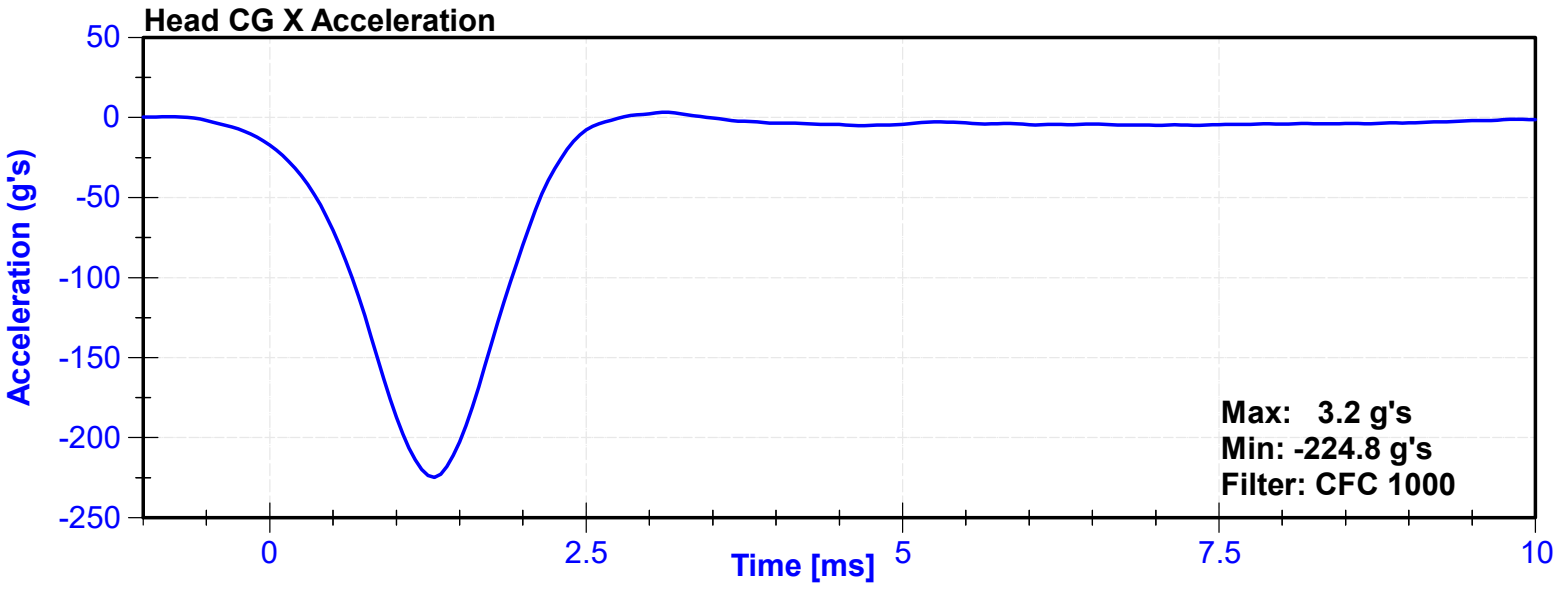
Results

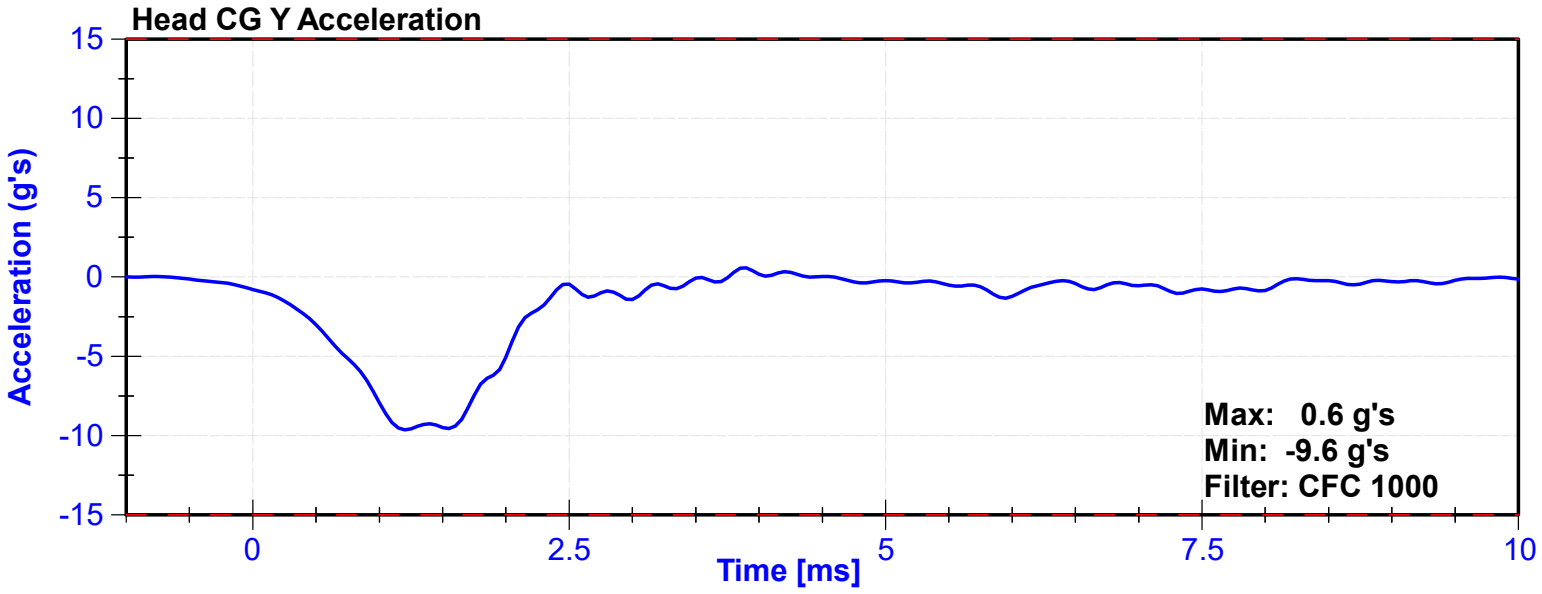
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.0	Pass
Humidity	10	70	%	24.2	Pass
Resultant Acceleration	225	275	g's	255.7	Pass
Oscillation	0	10	%	2.3	Pass
Lateral Acceleration	-15	15	g's	-9.6	Pass

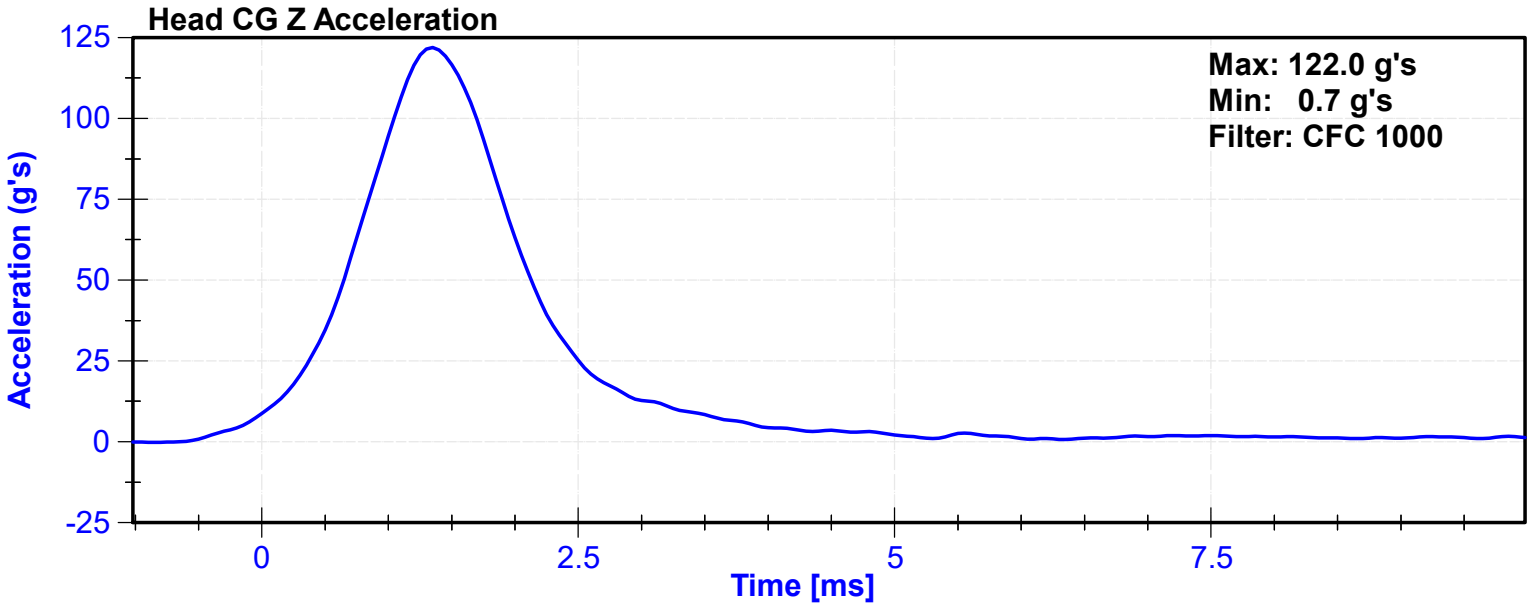
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	Endevco	P51681	9/30/2022	3/29/2023
Y Accelerometer	Endevco	P64151	9/30/2022	3/29/2023
Z Accelerometer	Endevco	P52114	9/30/2022	3/29/2023




Head CG X Acceleration
Acceleration (g's)
50
0
-50
-100
-150
-200
-250
0
2.5
5
7.5
10
Time [ms]
Max: 3.2 g's
Min: -224.8 g's
Filter: CFC 1000


Head CG Y Acceleration
Acceleration (g's)
15
10
5
0
-5
-10
-15
0
2.5
5
7.5
10
Time [ms]
Max: 0.6 g's
Min: -9.6 g's
Filter: CFC 1000


Head CG Z Acceleration
Acceleration (g's)
125
100
75
50
25
0
-25
0
2.5
5
7.5
Time [ms]
Max: 122.0 g's
Min: 0.7 g's
Filter: CFC 1000

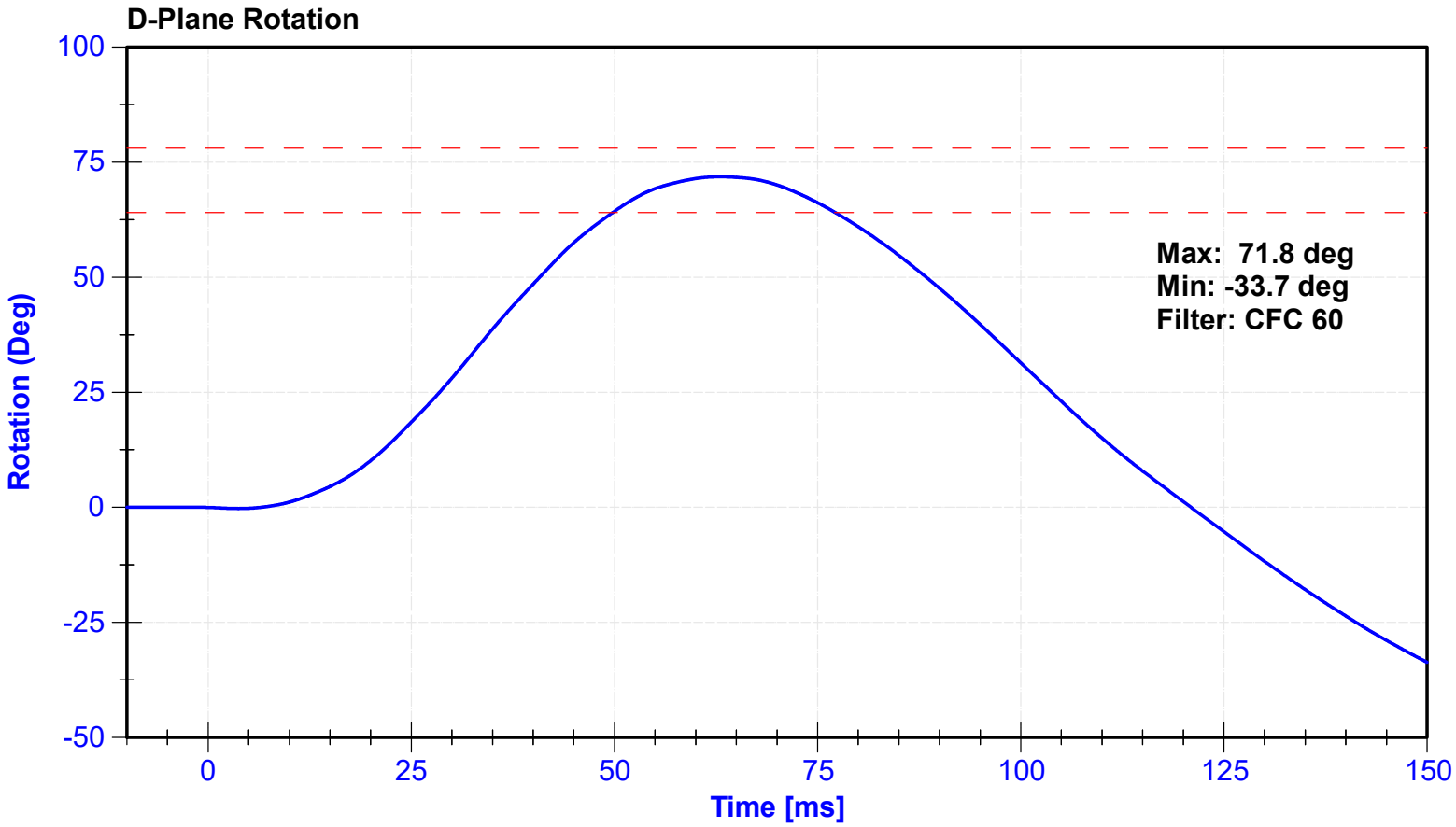
ATD Manufacturer	Humanetics	Test Technician	T. Roseman
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

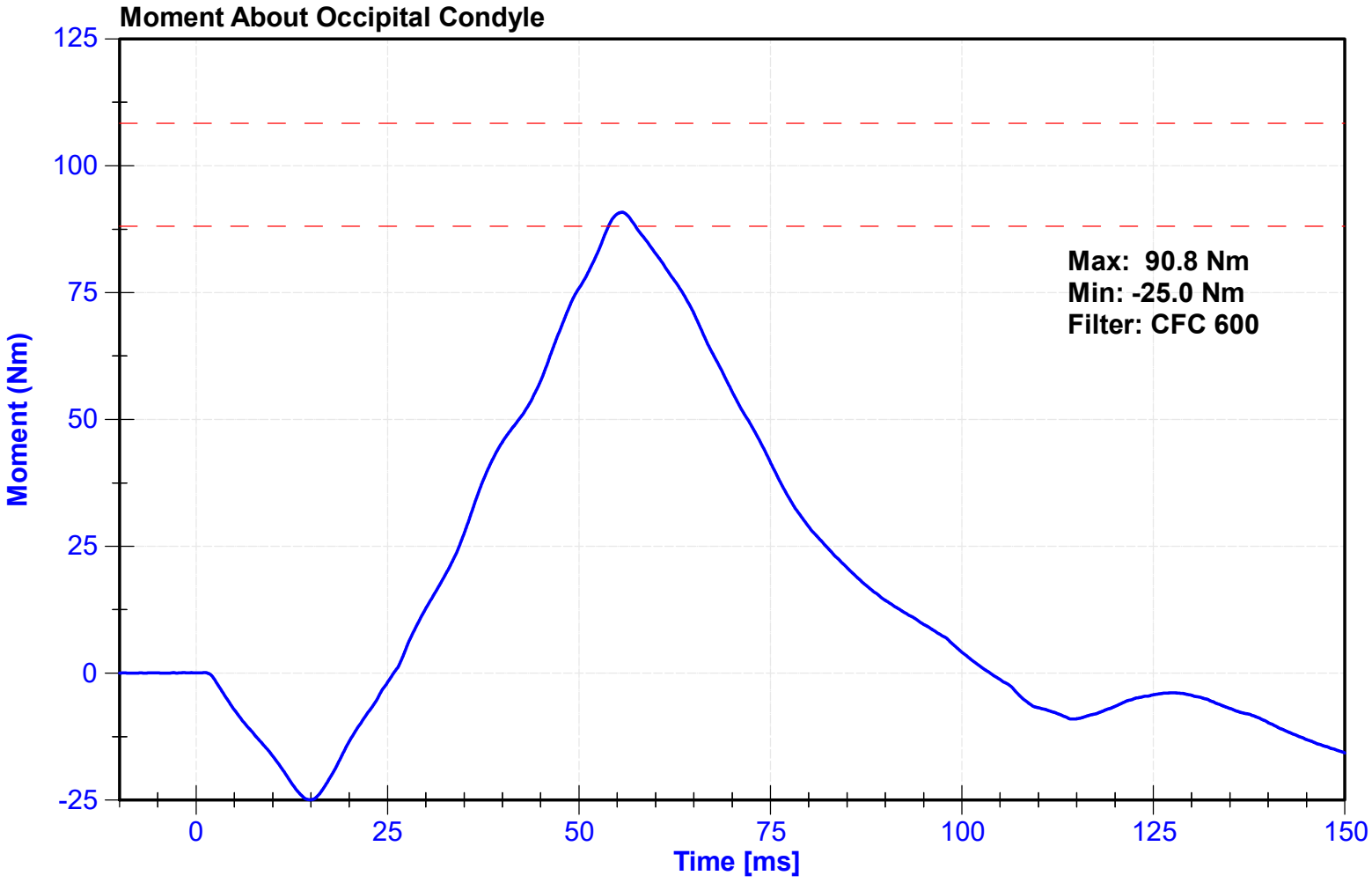
Results

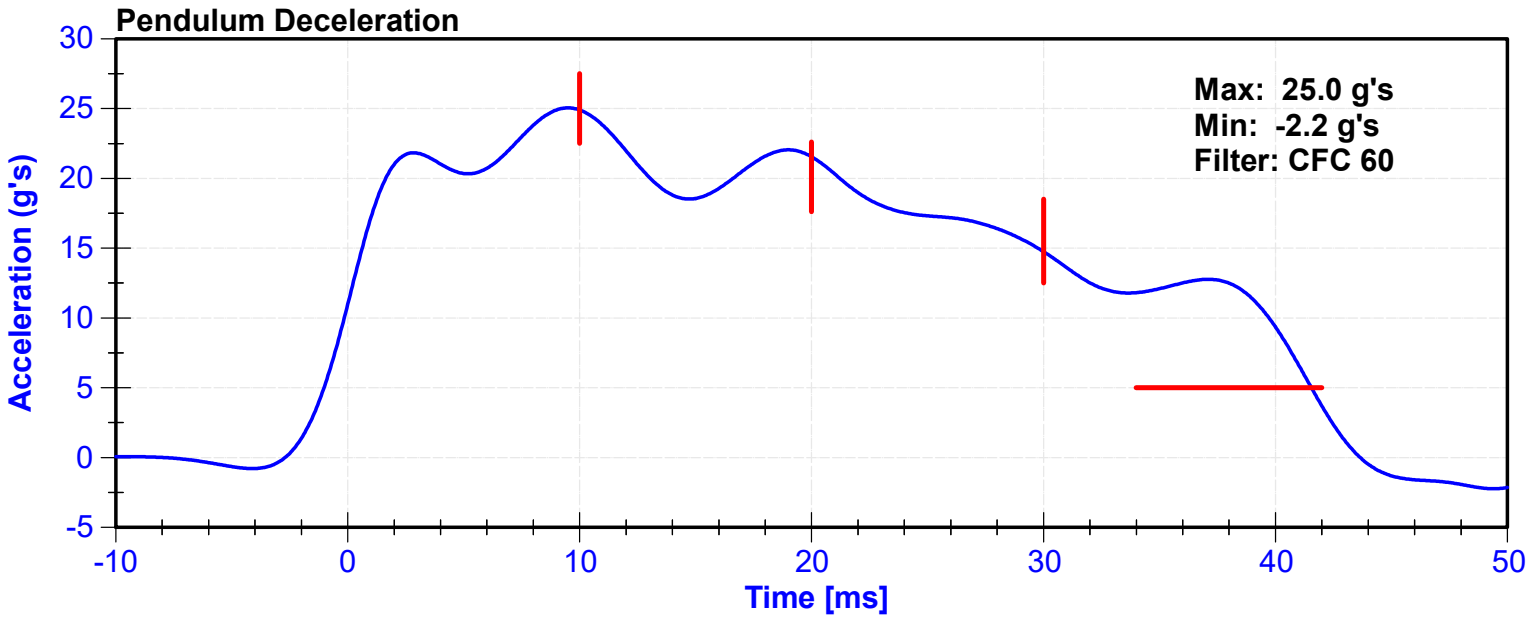
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.0	Pass
Humidity	10	70	%	23.5	Pass
Velocity	6.89	7.13	m/s	6.999	Pass
Pendulum Deceleration at 10ms	22.5	27.5	g's	24.89	Pass
Pendulum Deceleration at 20ms	17.6	22.6	g's	21.54	Pass
Pendulum Deceleration at 30ms	12.5	18.5	g's	14.74	Pass
Max. Pendulum Deceleration After 30ms	0	29	g's	25.0	Pass
Pendulum Deceleration Time to 5 g's	34	42	ms	41.6	Pass
Maximum D Plane Rotation	64	78	deg	71.8	Pass
Time to Maximum Rotation	57	64	ms	63.0	Pass
Rotation Decay to Zero	113	127	ms	121.0	Pass
Moment About Occipital Condyle	88.1	108.4	Nm	90.85	Pass
Time to Maximum Moment	47	58	ms	55.6	Pass
Moment Decay to Zero	97	107	ms	103.8	Pass

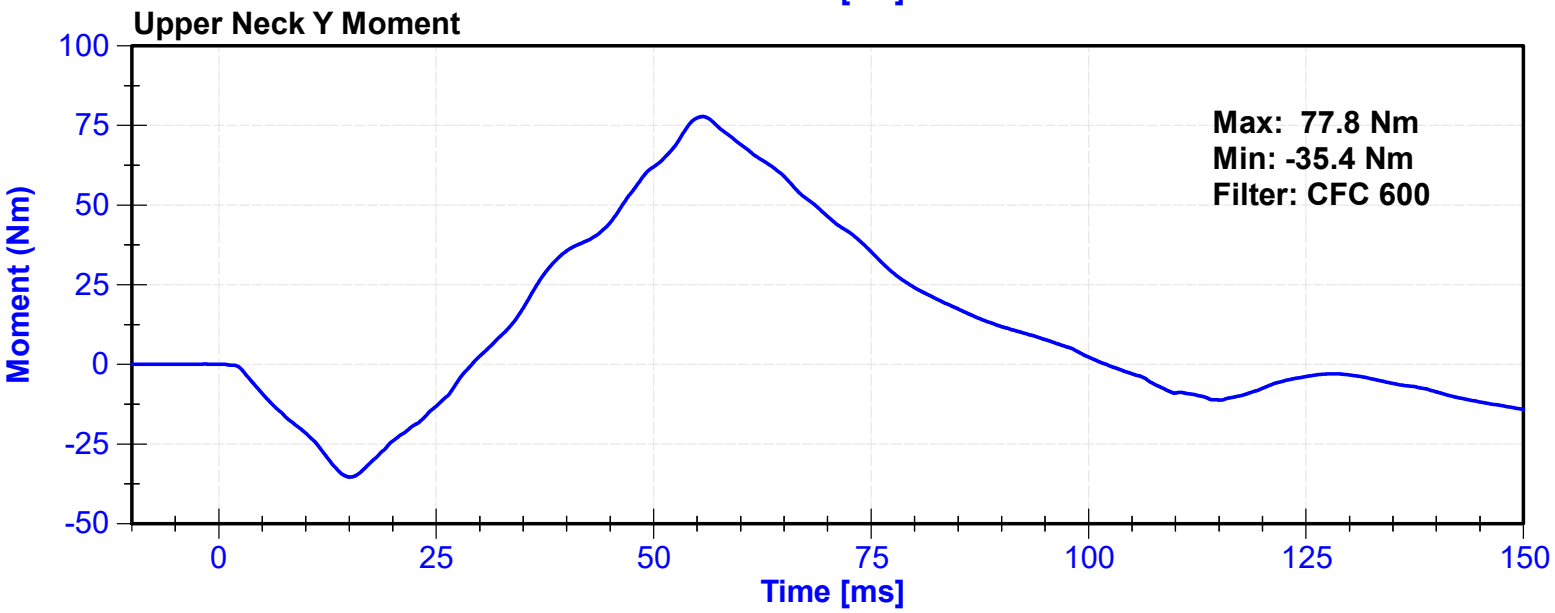
Transducer Calibrations

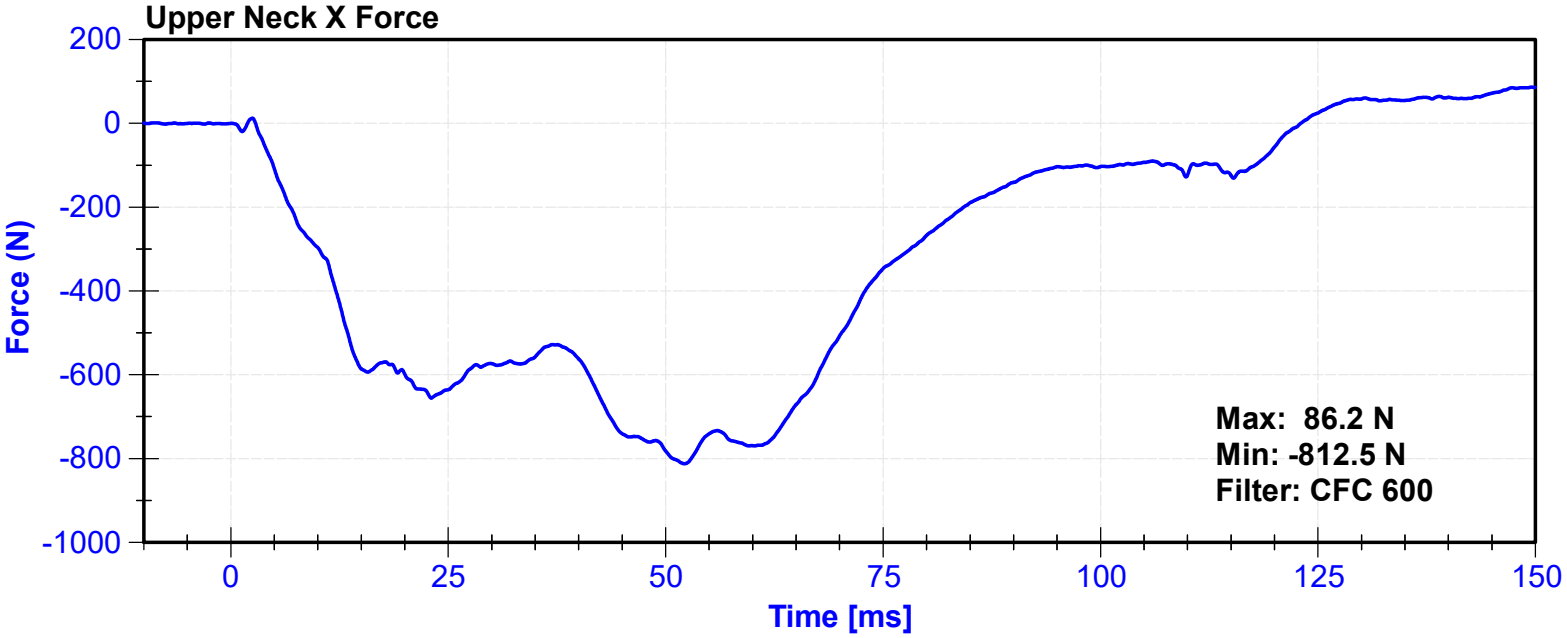
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	7231C-750	10/26/2022	10/26/2023
Pendulum Potentiometer	ETI	LABPOT1	5/9/2022	5/9/2023
Condyle Potentiometer	ETI	LABPOT2	5/9/2022	5/9/2023
Upper Neck Load Cell	Denton	2187-FX	6/13/2022	6/13/2023


D-Plane Rotation
Rotation (Deg)
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]
Max: 71.8 deg
Min: -33.7 deg
Filter: CFC 60


Moment About Occipital Condyle
Moment (Nm)
125
100
75
50
25
0
-25
0
25
50
75
100
125
150
Time [ms]
Max: 90.8 Nm
Min: -25.0 Nm
Filter: CFC 600


Pendulum Deceleration
Max: 25.0 g's
Min: -2.2 g's
Filter: CFC 60
Acceleration (g's)
Time [ms]


Upper Neck Y Moment
Max: 77.8 Nm
Min: -35.4 Nm
Filter: CFC 600
Moment (Nm)
Time [ms]


Upper Neck X Force
Max: 86.2 N
Min: -812.5 N
Filter: CFC 600
Force (N)
Time [ms]

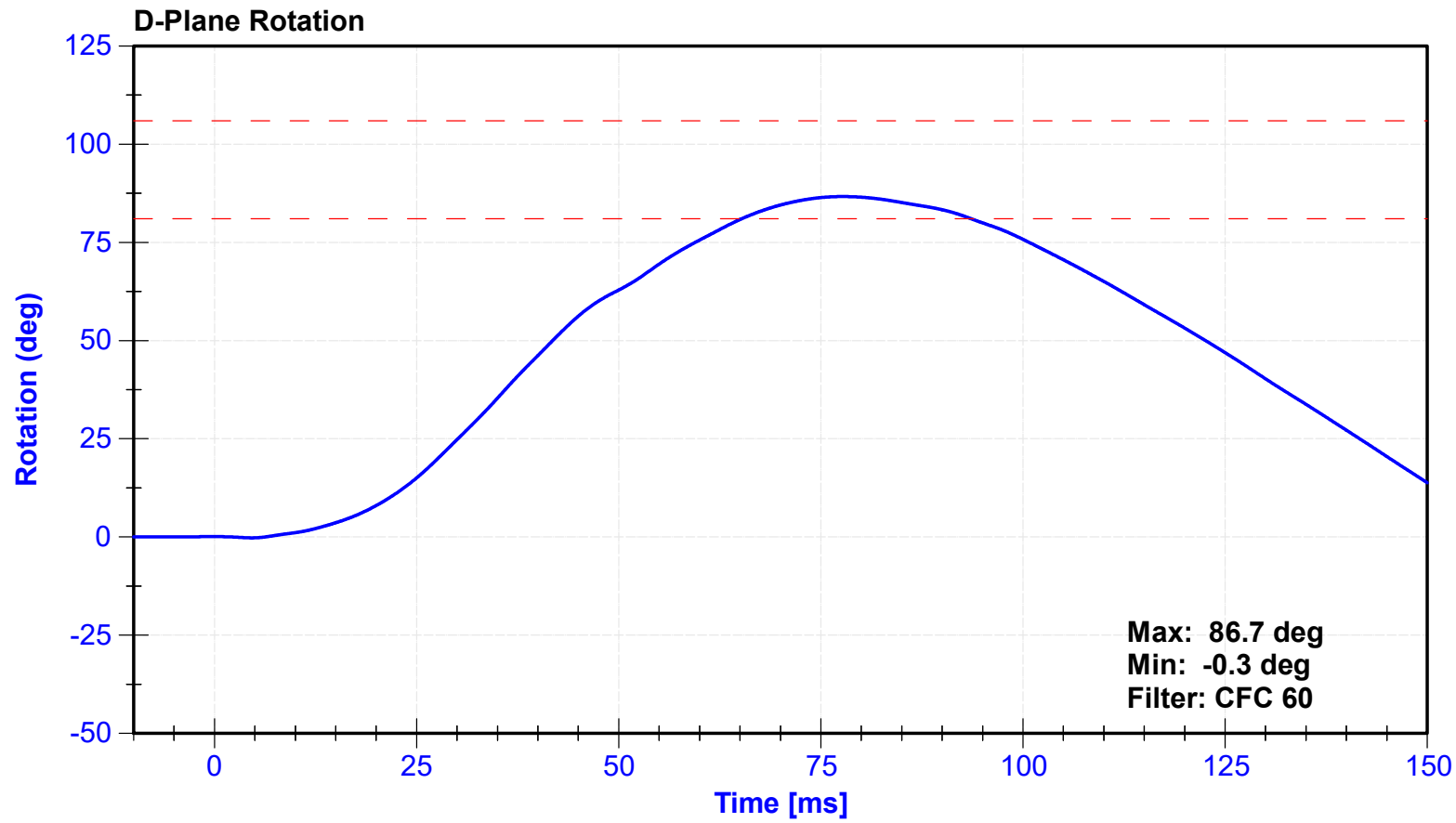
ATD Manufacturer	Humanetics	Test Technician	T. Roseman
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

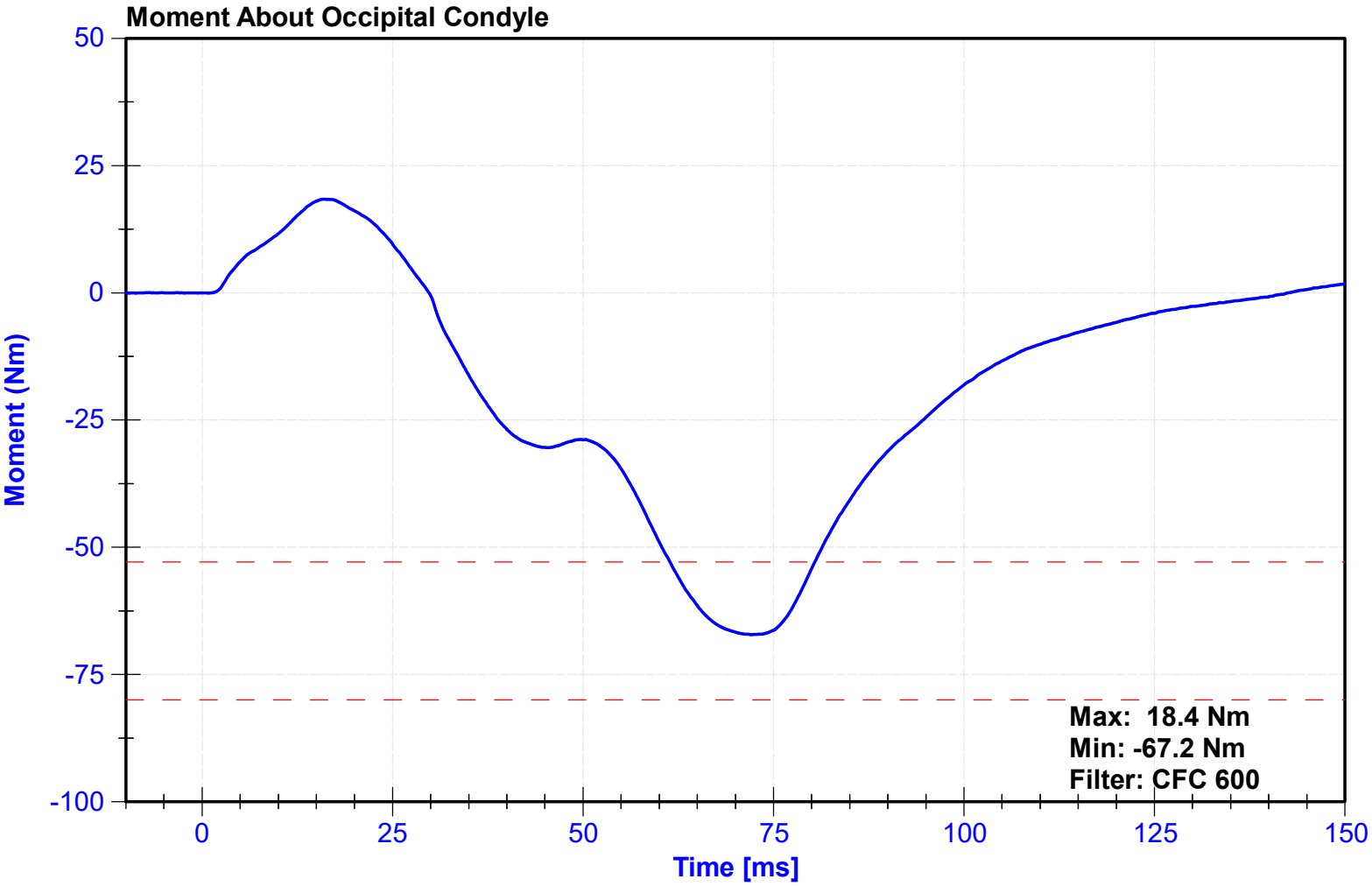
Results

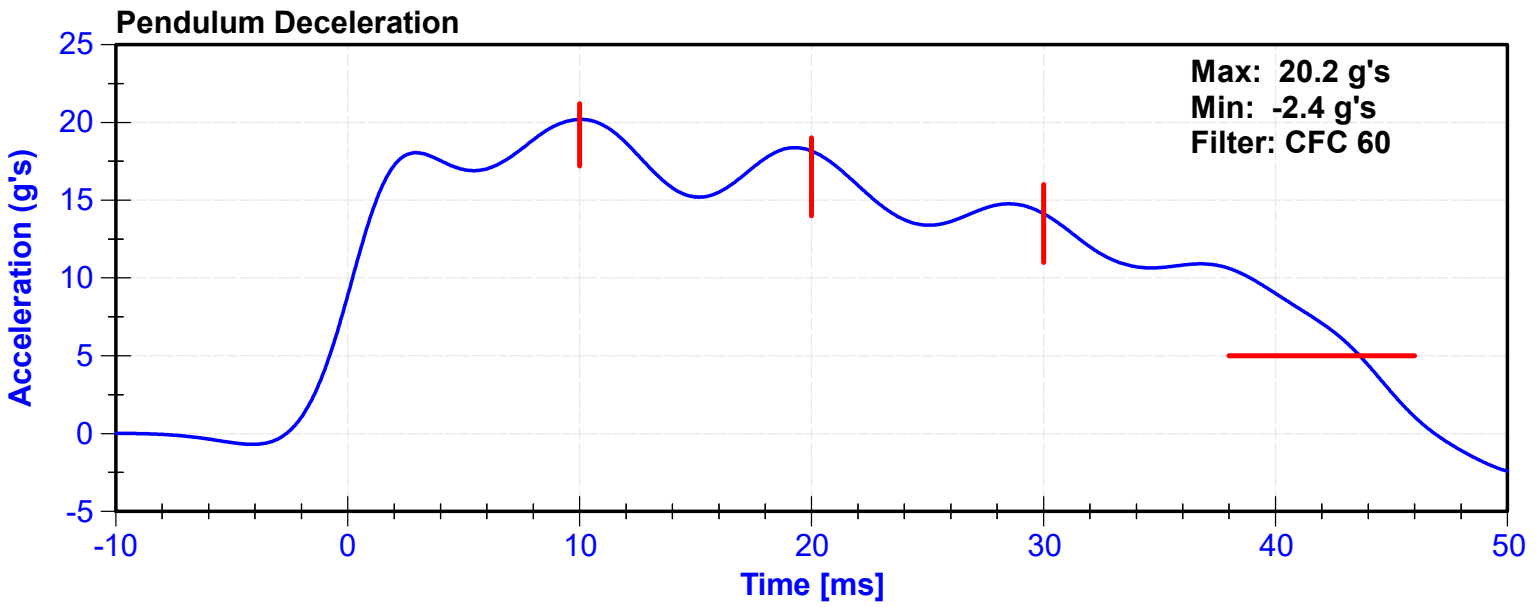
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.0	Pass
Humidity	10	70	%	23.5	Pass
Velocity	5.94	6.19	m/s	6.062	Pass
Pendulum Deceleration at 10ms	17.2	21.2	g's	20.19	Pass
Pendulum Deceleration at 20ms	14	19	g's	18.2	Pass
Pendulum Deceleration at 30ms	11	16	g's	14.1	Pass
Max. Pendulum Deceleration After 30ms	0	22	g's	20.2	Pass
Pendulum Deceleration Time to 5 g's	38	46	ms	43.7	Pass
Maximum D Plane Rotation	81	106	deg	86.7	Pass
Time to Maximum Rotation	72	82	ms	77.7	Pass
Rotation Decay to Zero	147	174	ms	160.6	Pass
Minimum Moment About OC	-80	-52.9	Nm	-67.19	Pass
Time to Minimum Moment	65	79	ms	72.1	Pass
Moment Decay to Zero	120	148	ms	142.6	Pass

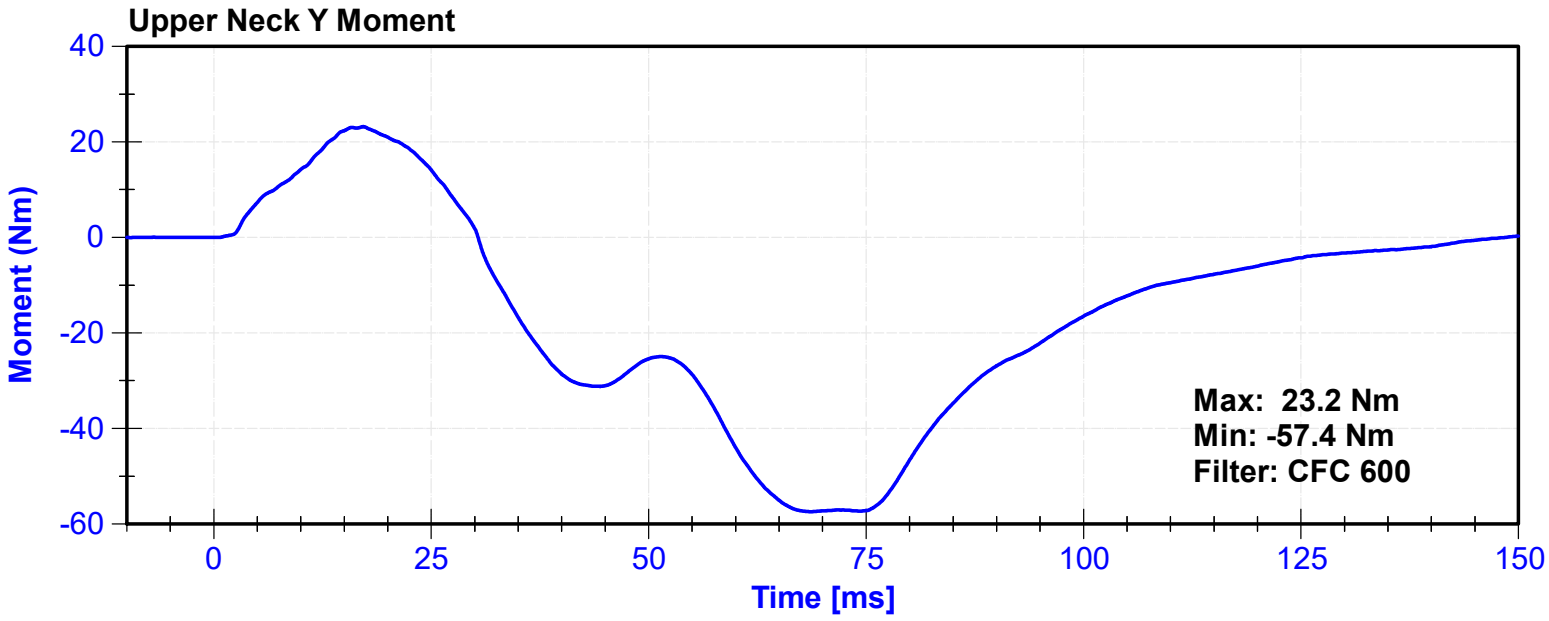
Transducer Calibrations

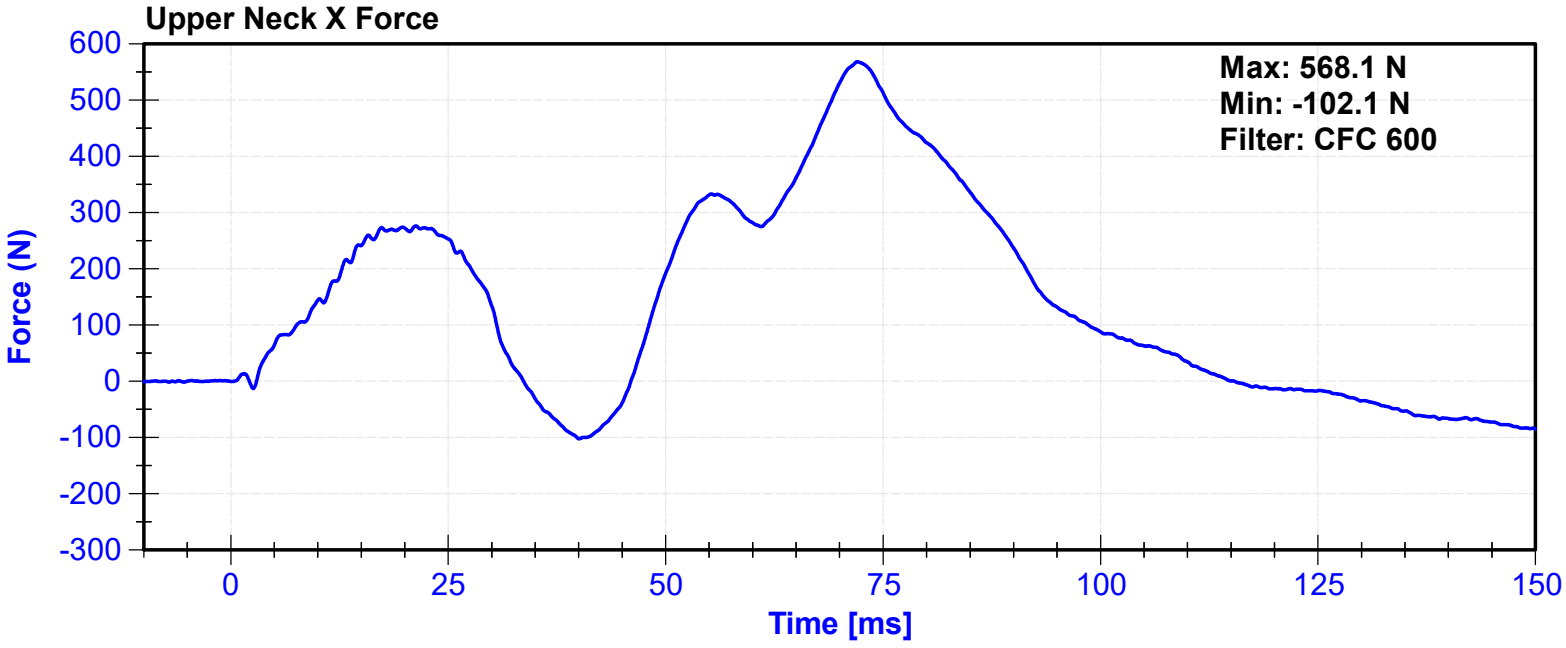
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	C16503	10/26/2022	10/26/2023
Pendulum Potentiometer	ETI	LABPOT1	5/9/2022	5/9/2023
Condyle Potentiometer	ETI	LABPOT2	5/9/2022	5/9/2023
Upper Neck Load Cell	Denton	2187-FX	6/13/2022	6/13/2023


D-Plane Rotation
Rotation (deg)
125
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]
Max: 86.7 deg
Min: -0.3 deg
Filter: CFC 60


Moment About Occipital Condyle
Moment (Nm)
50
25
0
-25
-50
-75
-100
0
25
50
75
100
125
150
Time [ms]
Max: 18.4 Nm
Min: -67.2 Nm
Filter: CFC 600


Pendulum Deceleration
Max: 20.2 g's
Min: -2.4 g's
Filter: CFC 60
Acceleration (g's)
25
20
15
10
5
0
-5
-10
0
10
20
30
40
50
Time [ms]


Upper Neck Y Moment
Max: 23.2 Nm
Min: -57.4 Nm
Filter: CFC 600
Moment (Nm)
40
20
0
-20
-40
-60
0
25
50
75
100
125
150
Time [ms]


Upper Neck X Force
Max: 568.1 N
Min: -102.1 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]

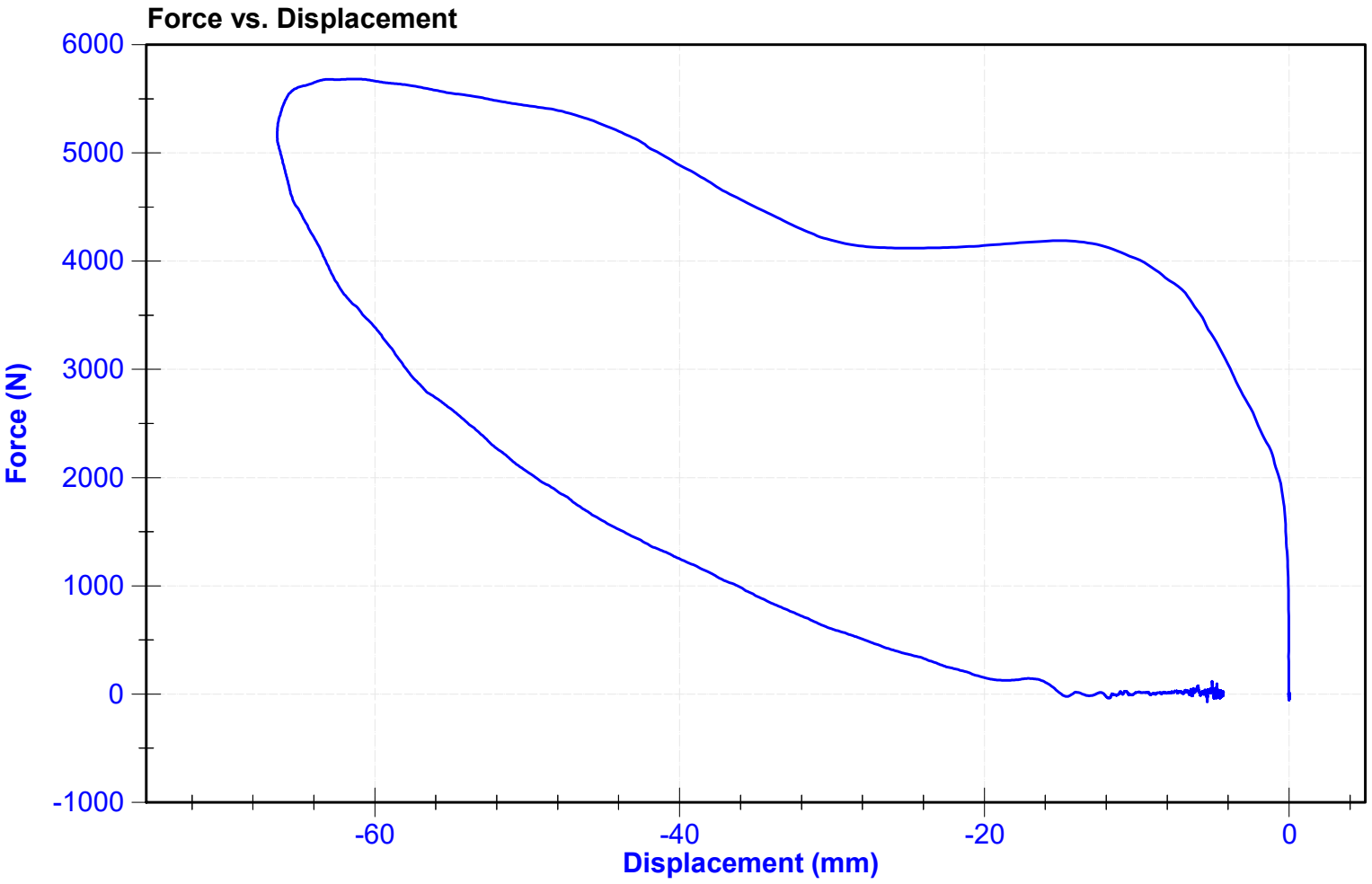
ATD Manufacturer	Humanetics	Test Technician	C. Mantell
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

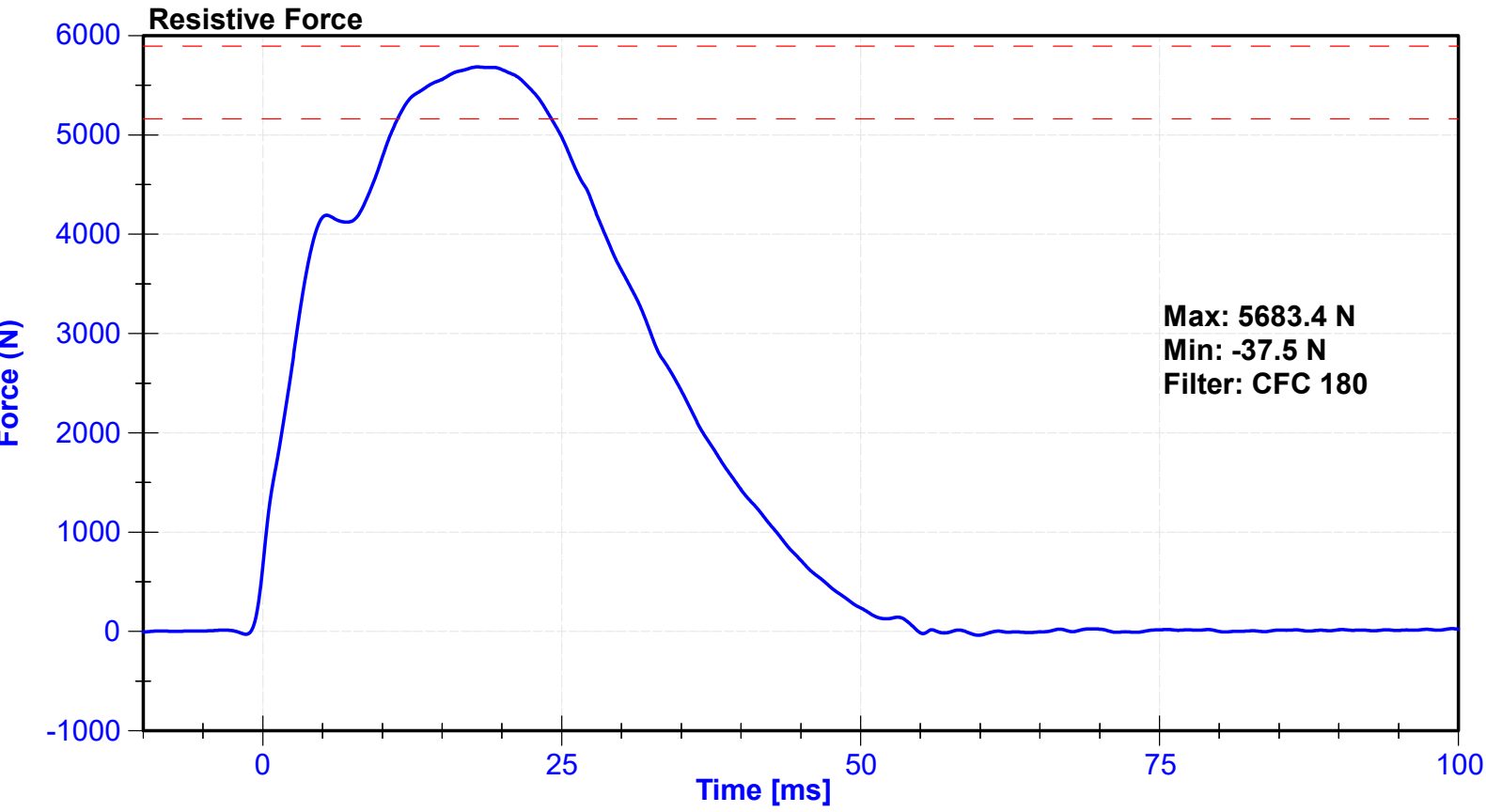
Results

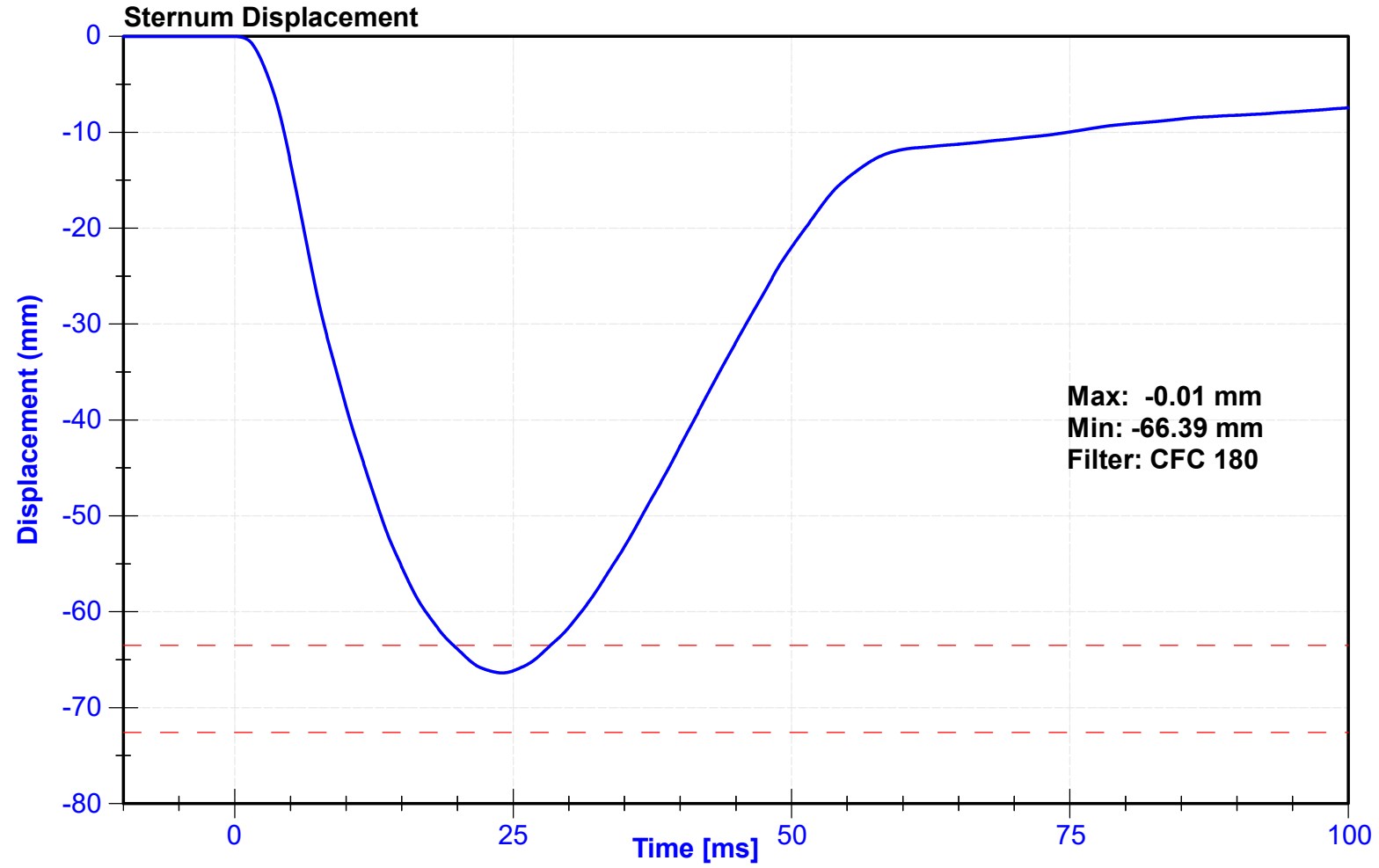
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.1	Pass
Humidity	10	70	%	19	Pass
Velocity	6.59	6.83	m/s	6.727	Pass
Chest Displacement	-72.6	-63.5	mm	-66.39	Pass
Resistive Force	5160	5894	N	5683.4	Pass
Hysteresis	69	85	%	72.9	Pass

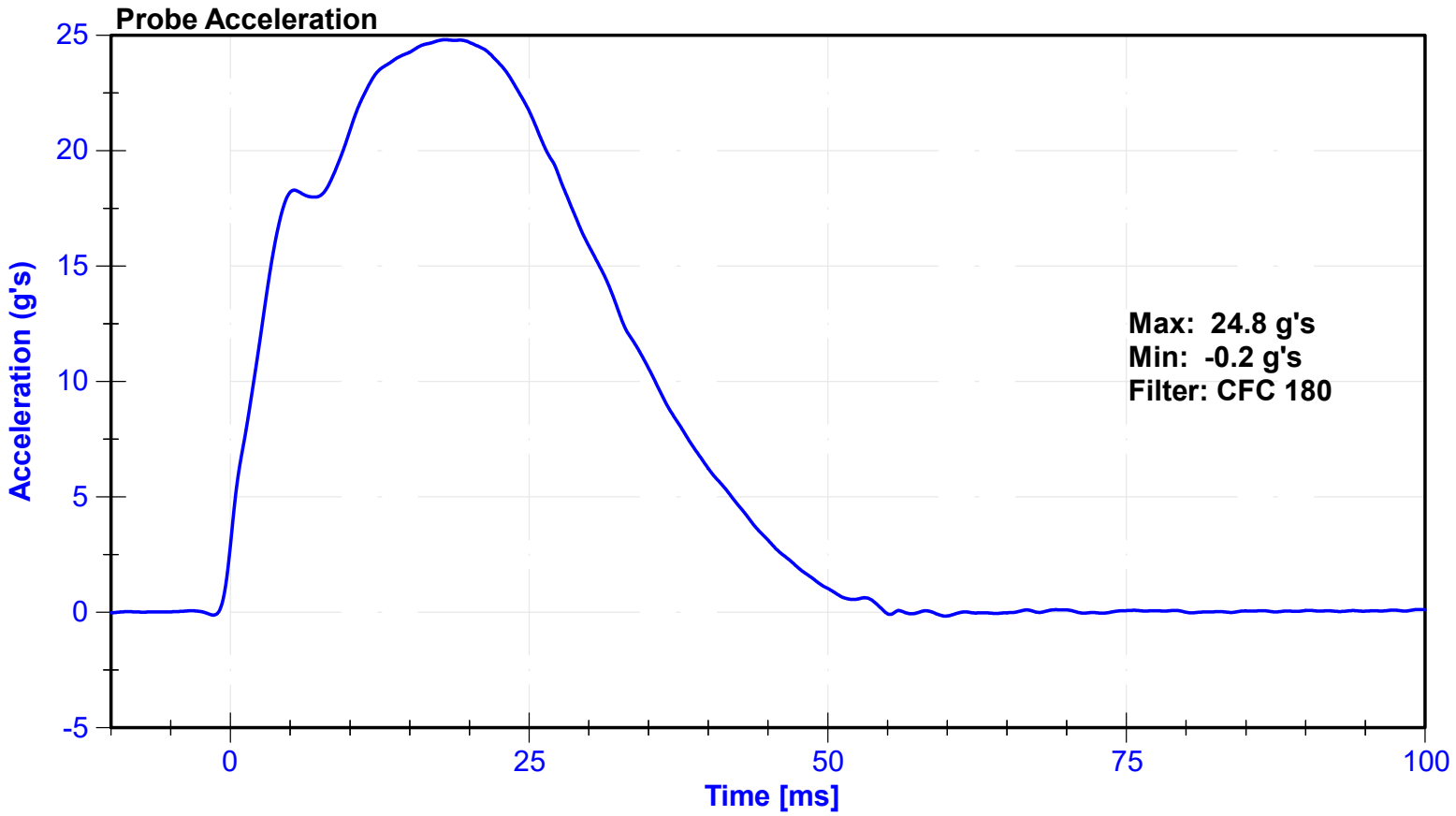
Transducer Calibrations

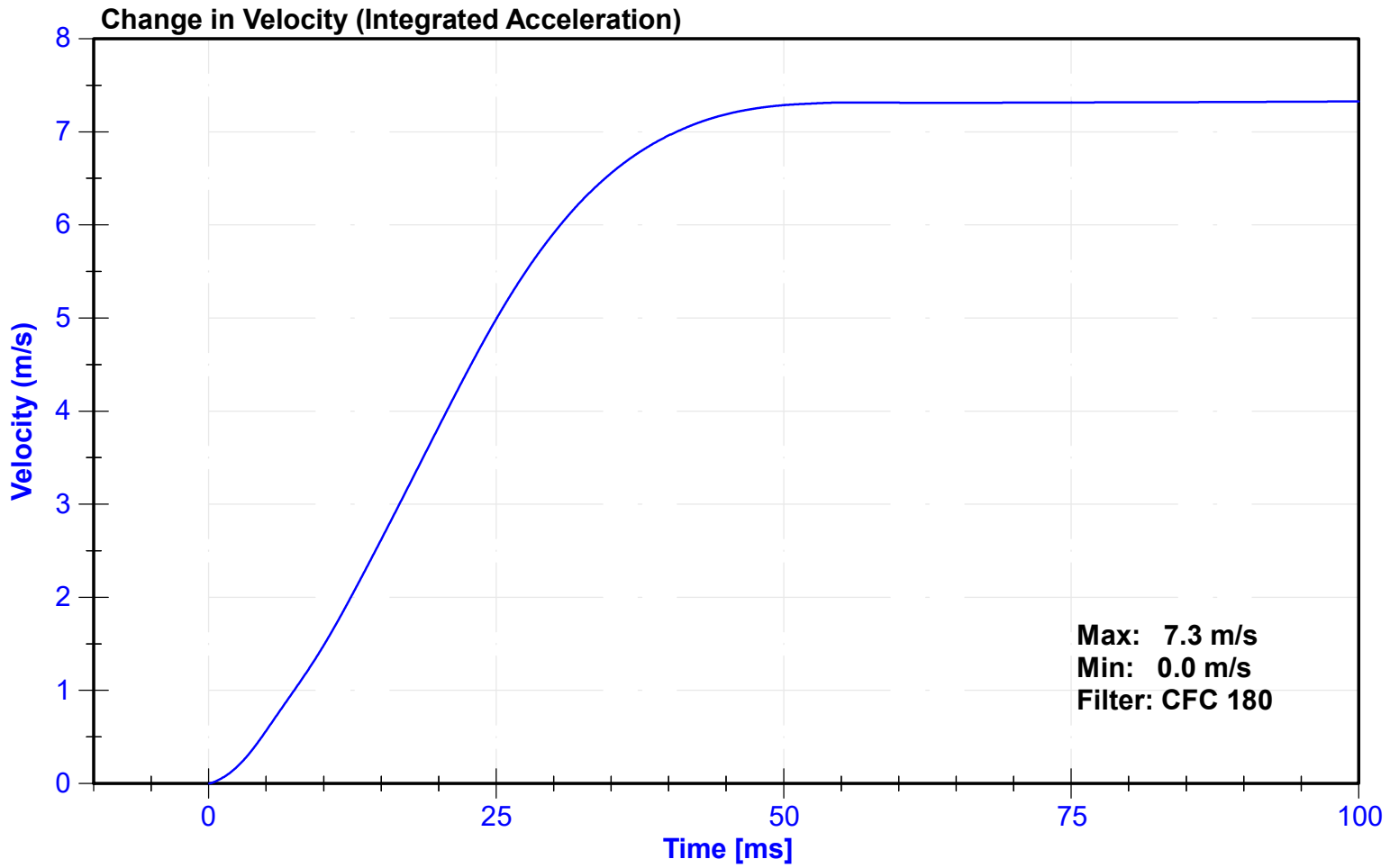
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18546	11/19/2022	5/18/2023
Chest Potentiometer	JDK	0075	10/3/2022	4/3/2023




Resistive Force
Force (N)
6000
5000
4000
3000
2000
1000
0
-1000
0
25
50
75
100
Time [ms]
Max: 5683.4 N
Min: -37.5 N
Filter: CFC 180


Sternum Displacement
Displacement (mm)
0
-10
-20
-30
-40
-50
-60
-70
-80
0
25
50
75
100
Time [ms]
Max: -0.01 mm
Min: -66.39 mm
Filter: CFC 180


Probe Acceleration
Acceleration (g's)
25
20
15
10
5
0
-5
0
25
50
75
100
Time [ms]
Max: 24.8 g's
Min: -0.2 g's
Filter: CFC 180


Change in Velocity (Integrated Acceleration)
Velocity (m/s)
8
7
6
5
4
3
2
1
0
0
25
50
75
100
Time [ms]
Max: 7.3 m/s
Min: 0.0 m/s
Filter: CFC 180

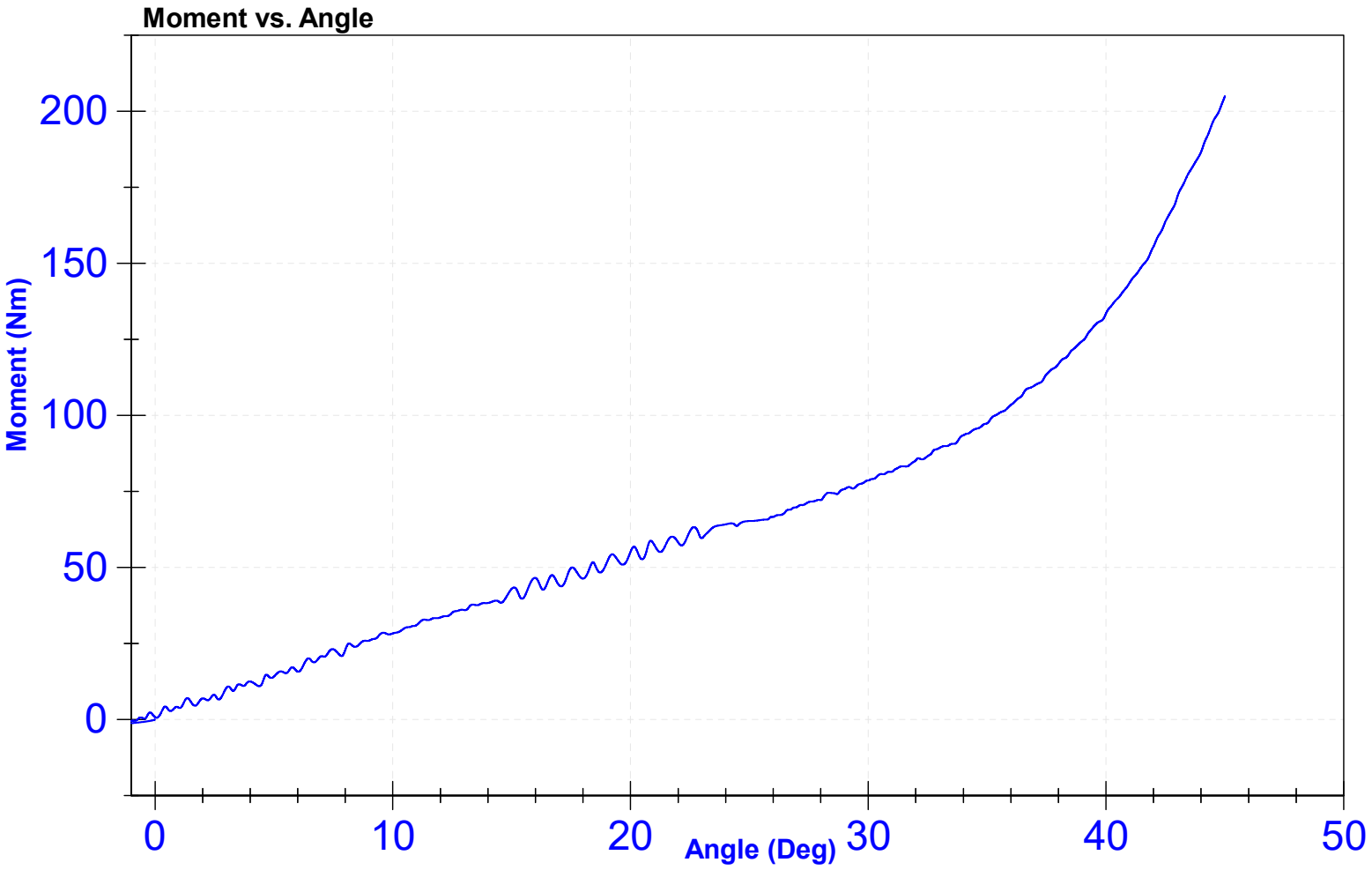
ATD Manufacturer	Humanetics	Test Technician	T. Roseman
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.0	Pass
Humidity	10	70	%	24.2	Pass
Average Velocity	5	10	deg/s	7.7	Pass
Angle at 203Nm	40	50	deg	44.9	Pass
Moment at 30 degrees	0	94.9	Nm	78.6	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	ETI SP22	DS-0008	10/4/2022	10/4/2023
Load Cell	PCB 2301-02	2301-02_115	2022-09-06	2023-09-06



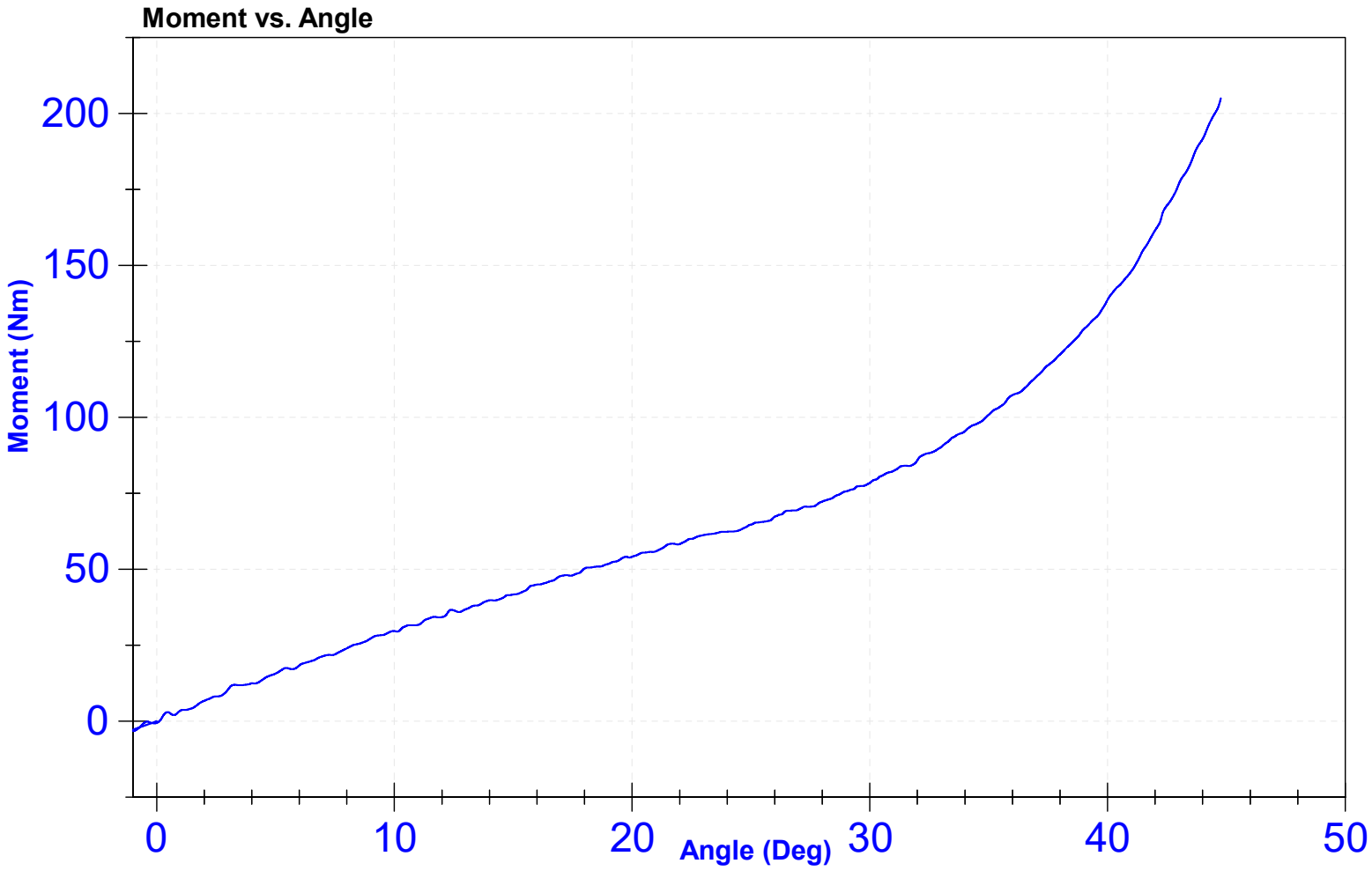
ATD Manufacturer	Humanetics	Test Technician	T. Roseman
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.0	Pass
Humidity	10	70	%	24.2	Pass
Average Velocity	5	10	deg/s	7.7	Pass
Angle at 203Nm	40	50	deg	44.7	Pass
Moment at 30 degrees	0	94.9	Nm	78.4	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	ETI SP22	DS-0008	10/4/2022	10/4/2023
Load Cell	PCB 2301-02	2301-02_115	2022-09-06	2023-09-06



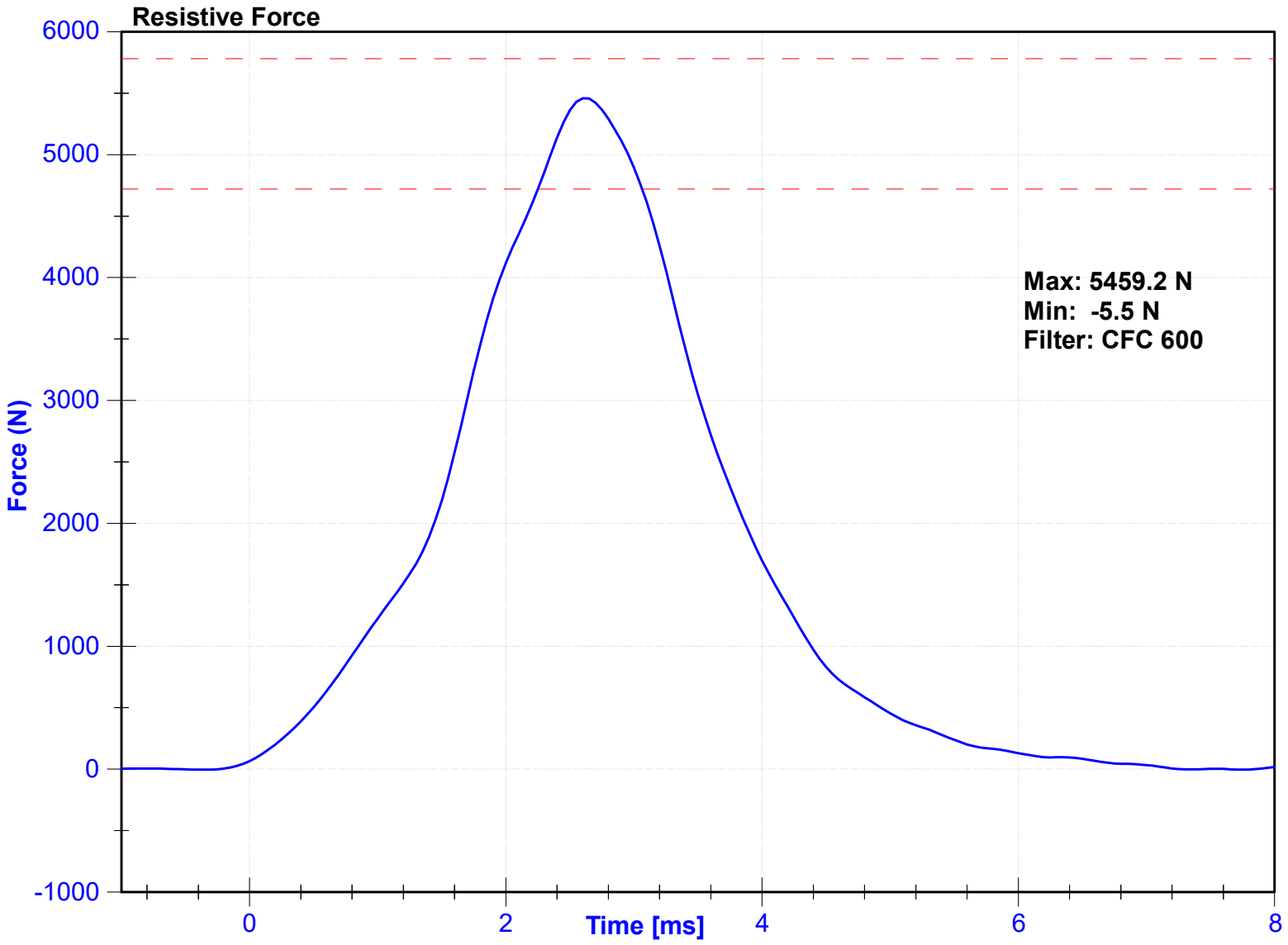
ATD Manufacturer	Humanetics	Test Technician	T. Roseman
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

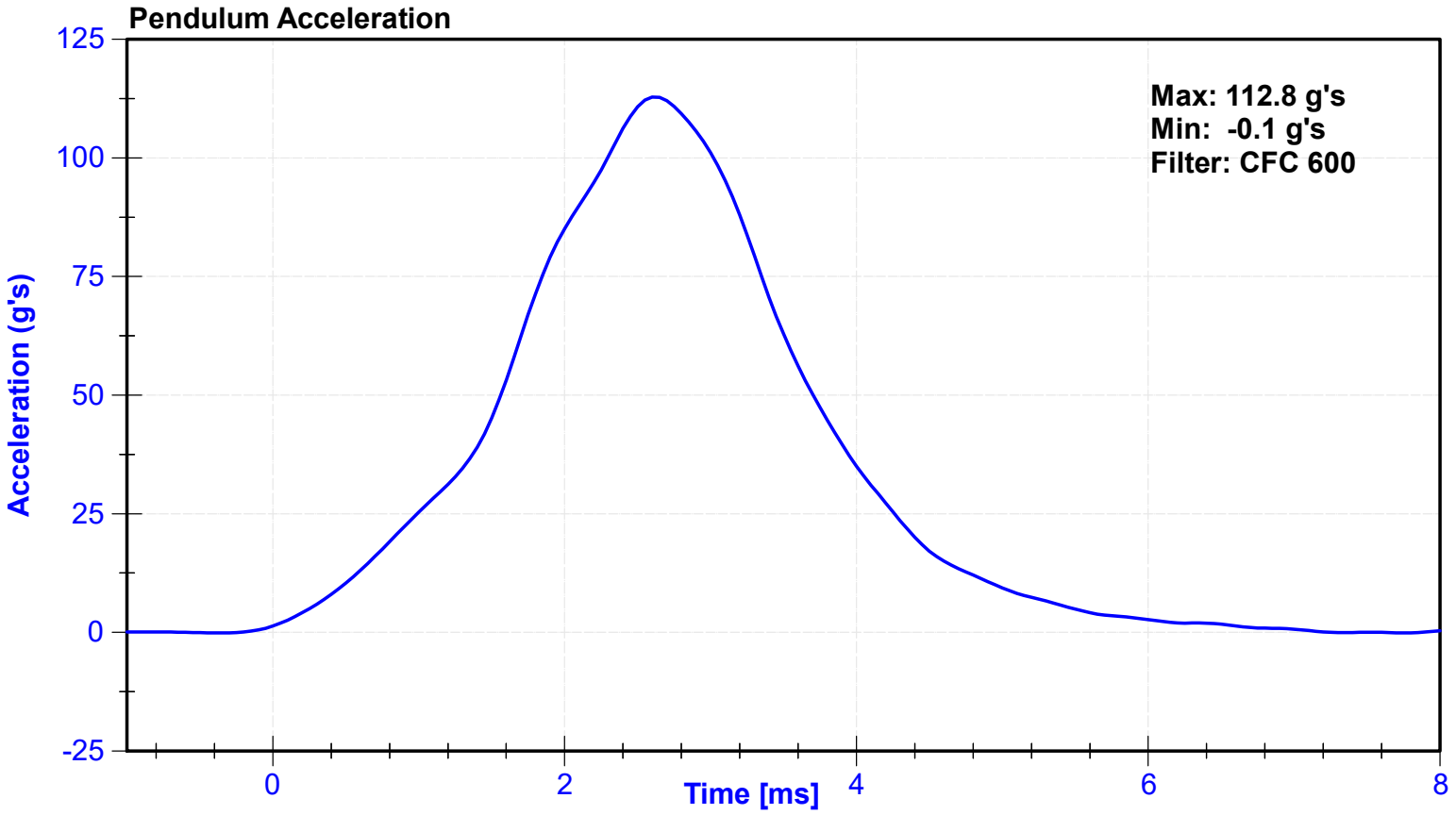
Results

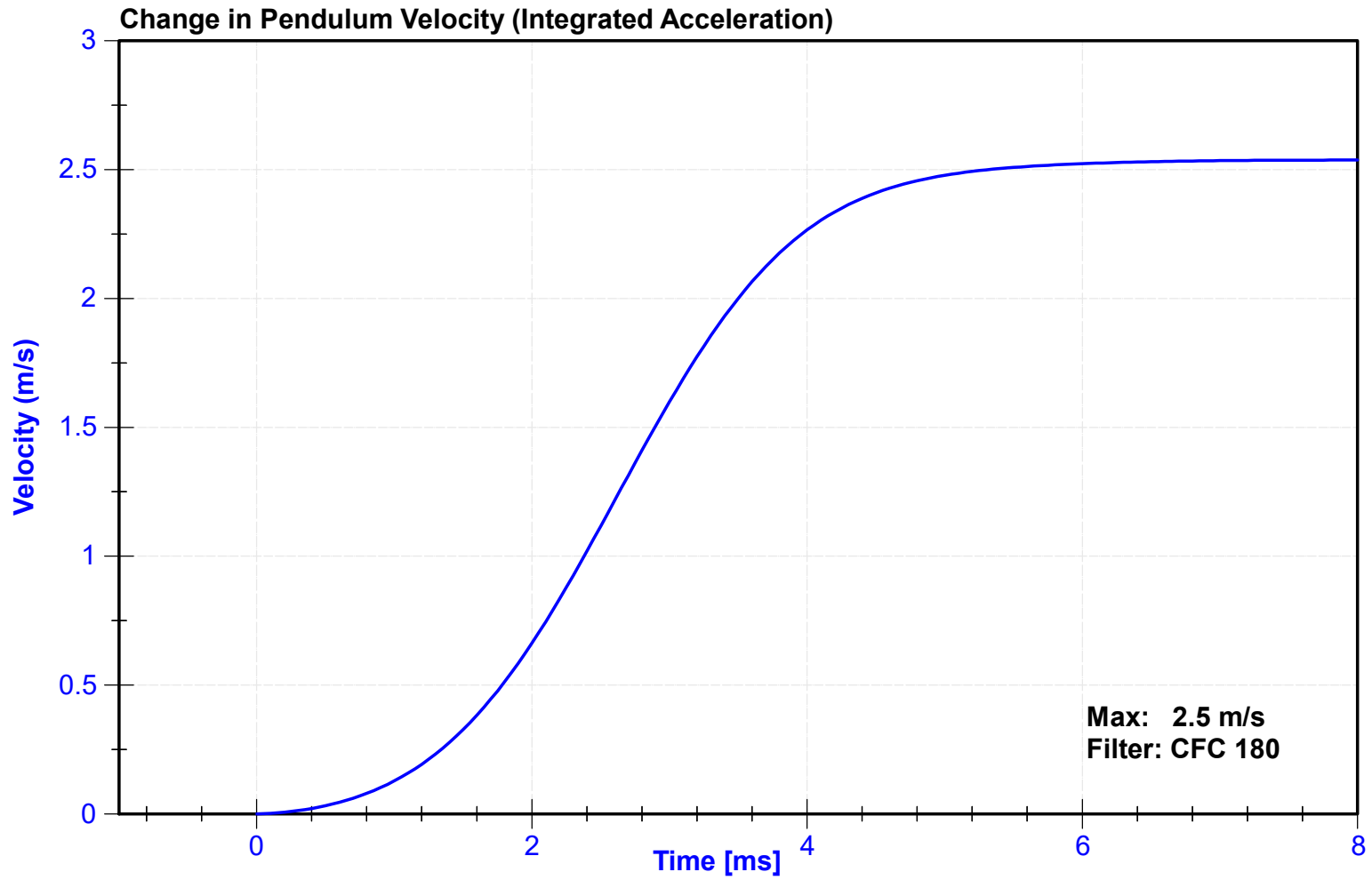
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	20.9	Pass
Humidity	10	70	%	24.3	Pass
Velocity	2.07	2.13	m/s	2.086	Pass
Maximum Resistive Force	4720	5780	N	5459.2	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18546	11/19/2022	5/18/2023




Pendulum Acceleration
Max: 112.8 g's
Min: -0.1 g's
Filter: CFC 600
Acceleration (g's)
125
100
75
50
25
0
-25
0
2
4
6
8
Time [ms]


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

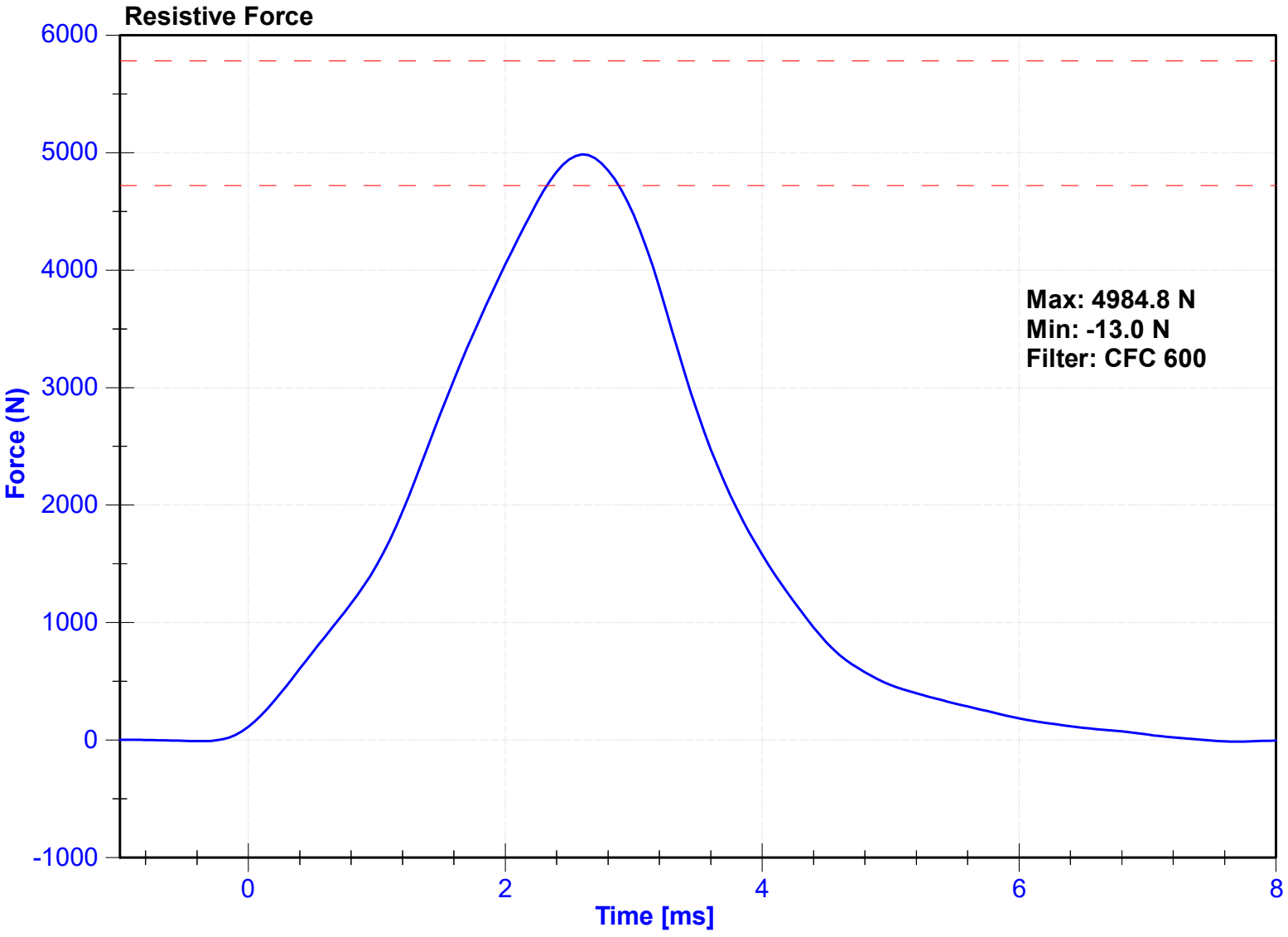
ATD Manufacturer	Humanetics	Test Technician	T. Roseman
ATD Serial Number	142	Laboratory Supervisor	K. Brogan

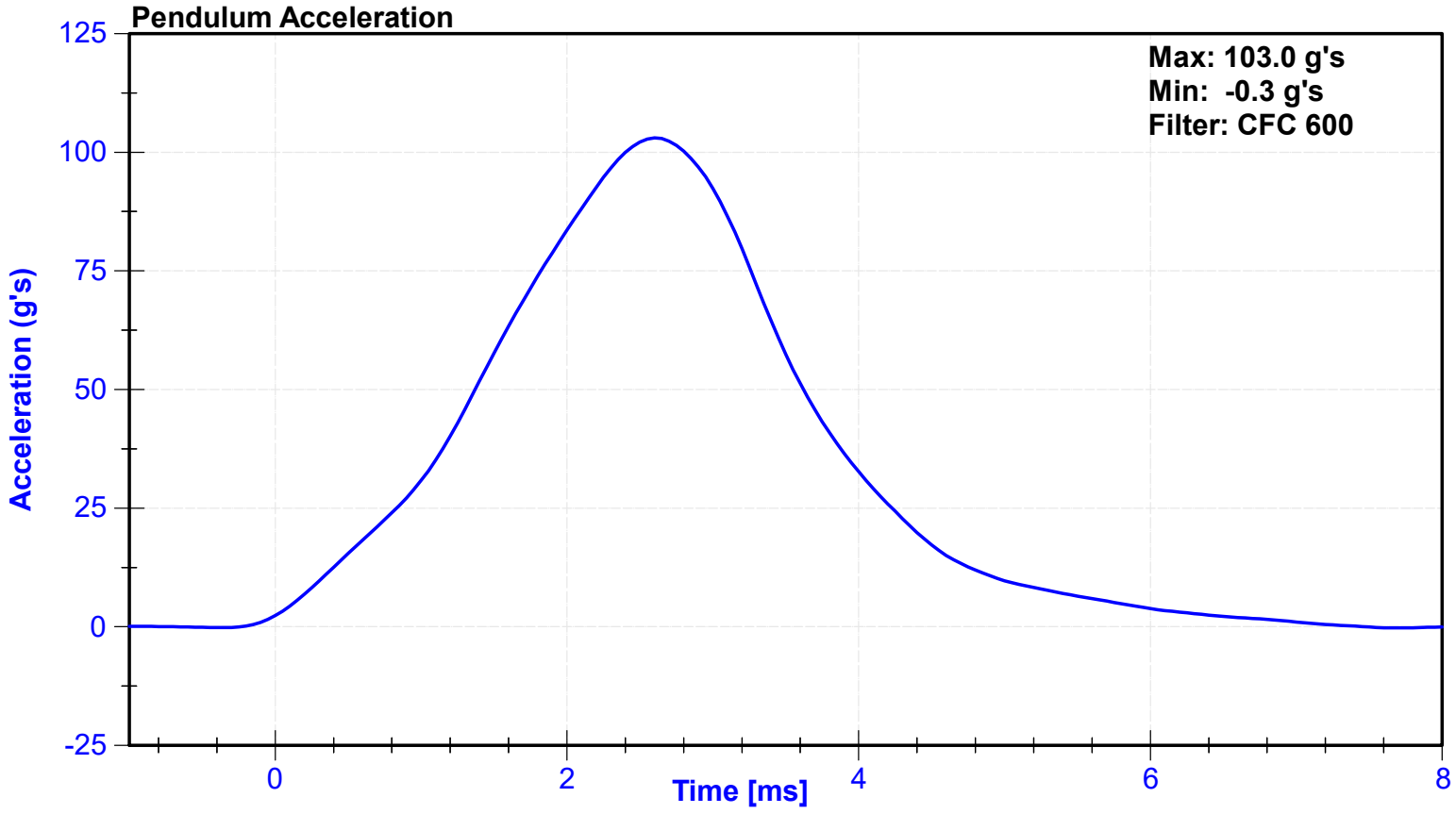
Results

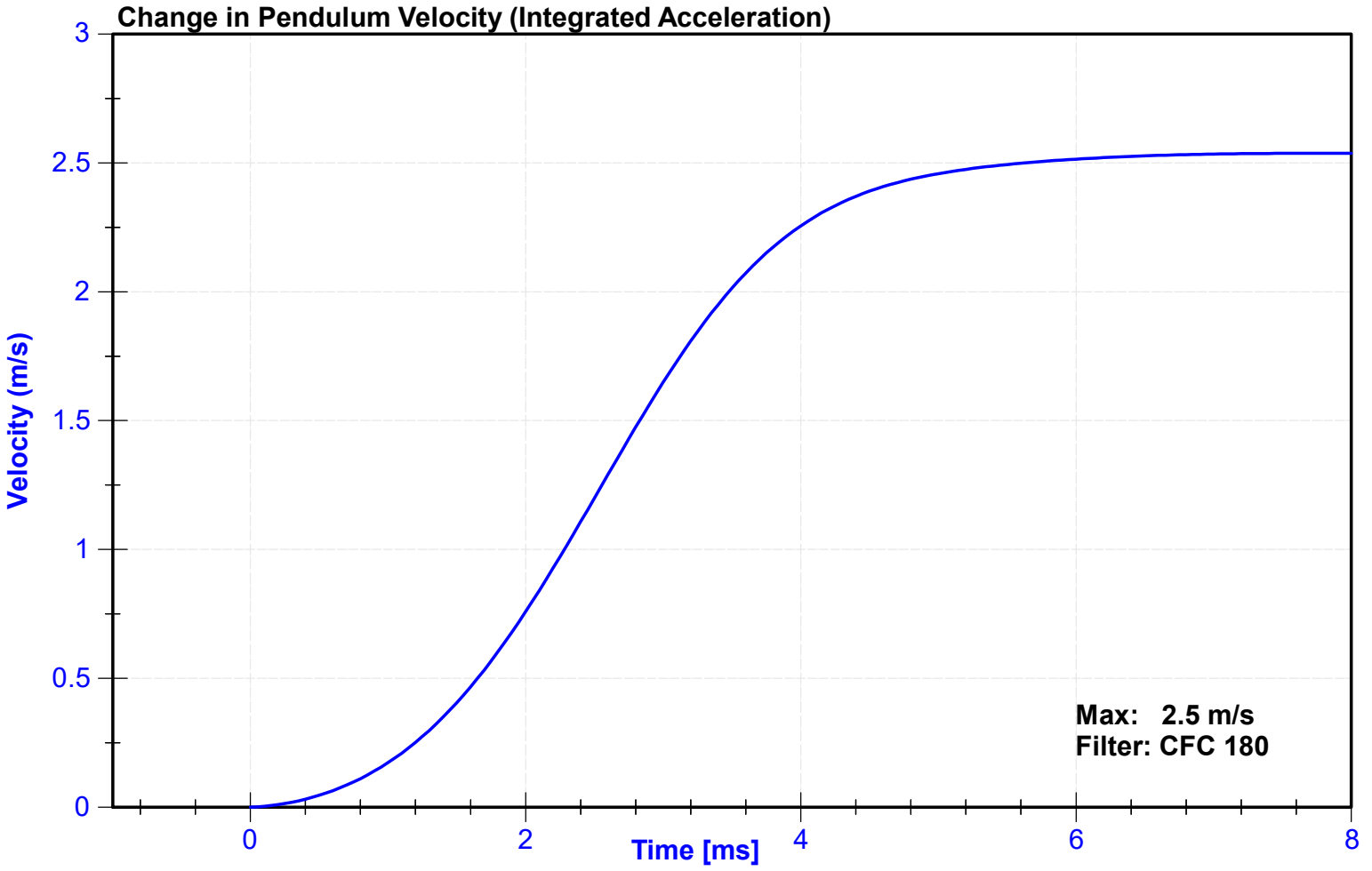
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	20.9	Pass
Humidity	10	70	%	24.3	Pass
Velocity	2.07	2.13	m/s	2.108	Pass
Maximum Resistive Force	4720	5780	N	4984.8	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18546	11/19/2022	5/18/2023




Pendulum Acceleration
Max: 103.0 g's
Min: -0.3 g's
Filter: CFC 600
Acceleration (g's)
125
100
75
50
25
0
-25
0
2
4
6
8
Time [ms]


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

CALIBRATION TEST RESULTS

POST-TEST

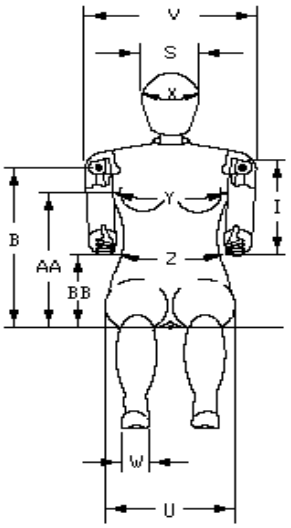
HYBRID III 5TH PERCENTILE FEMALE - PASSENGER ATD

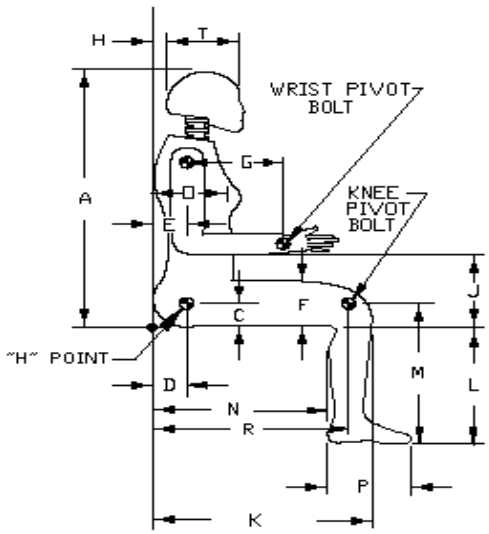
SERIAL NO: 137

External Measurements - Hybrid 3 - 5th Female

Technician: K. Brogan Date: 02/23/2023

Dummy Serial Number: 137





Symbol	Description	Specification (mm)		Result (mm)	Pass/Fail
A	Sitting Height	775	800	785	Pass
B	Shoulder Pivot Height	432	457	445	Pass
C	H-Point Height	81	86	85	Pass
D	H-Point from Backline	145	150	146	Pass
E	Shoulder Pivot from Backline	69	84	75	Pass
F	Thigh Clearance	119	135	130	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	287	Pass
J	Elbow Rest Height	183	203	195	Pass
K	Buttock to Knee Length	521	546	535	Pass
L	Popliteal Height	356	376	368	Pass
M	Knee Pivot Height	394	419	407	Pass
N	Buttock Popliteal Length	414	439	427	Pass
O	Chest Depth without Jacket	175	191	182	Pass
P	Foot Length (right)	219	234	231	Pass
R	Buttock To Knee Pivot Length	457	483	465	Pass
S	Head Breadth	137	147	143	Pass
T	Head Depth	178	188	180	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	544	Pass
Y	Chest Circumference with Jacket	851	881	872	Pass
Z	Waist Circumference	460	790	655	Pass
AA	Reference Location (Chest Circumference)	333	358	345	Pass
BB	Reference Location (Waist Circumference)	160	170	166	Pass

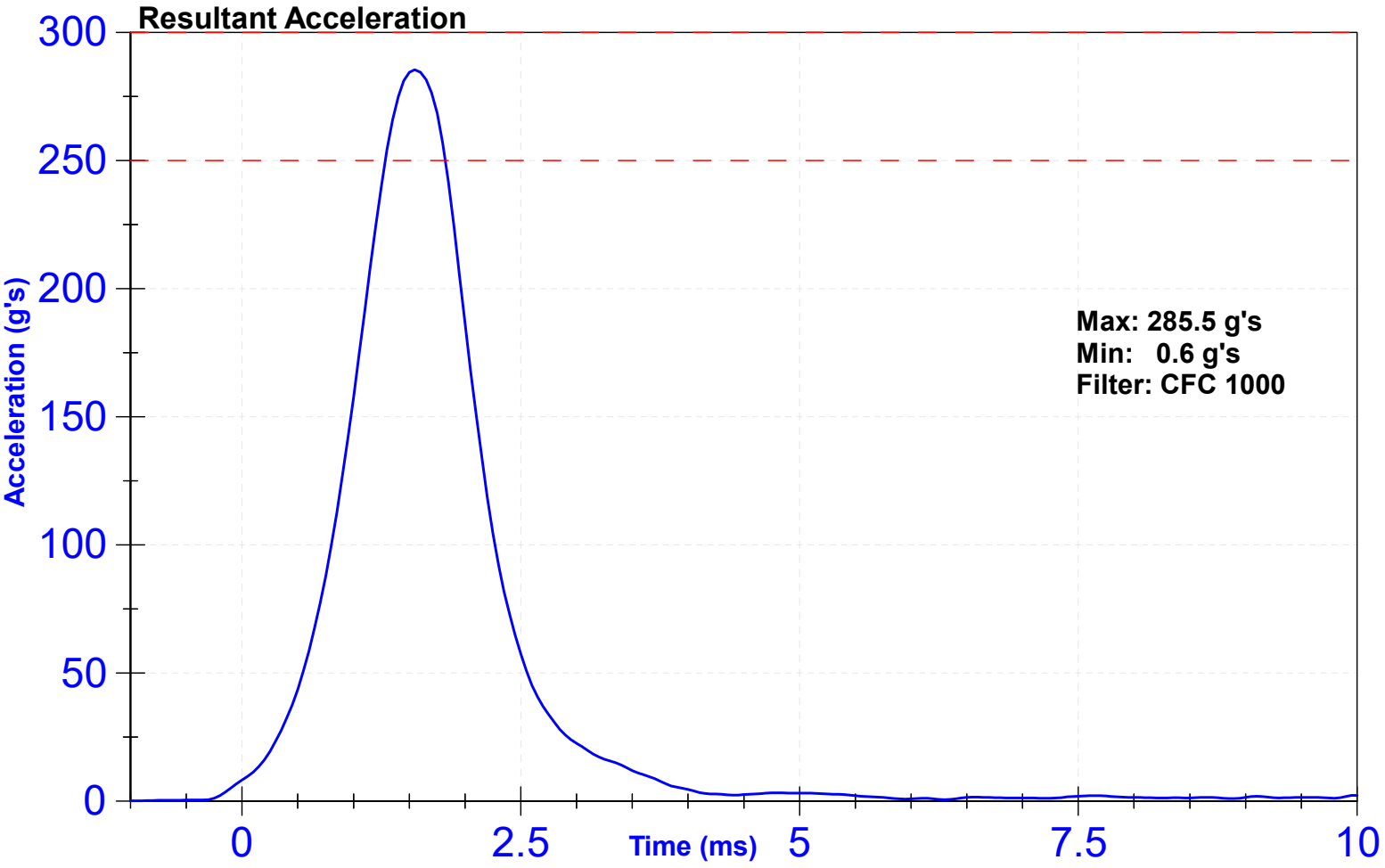
ATD Manufacturer	Humanetics	Test Technician	C. Mantell
ATD Serial Number	137	Laboratory Supervisor	K. Brogan

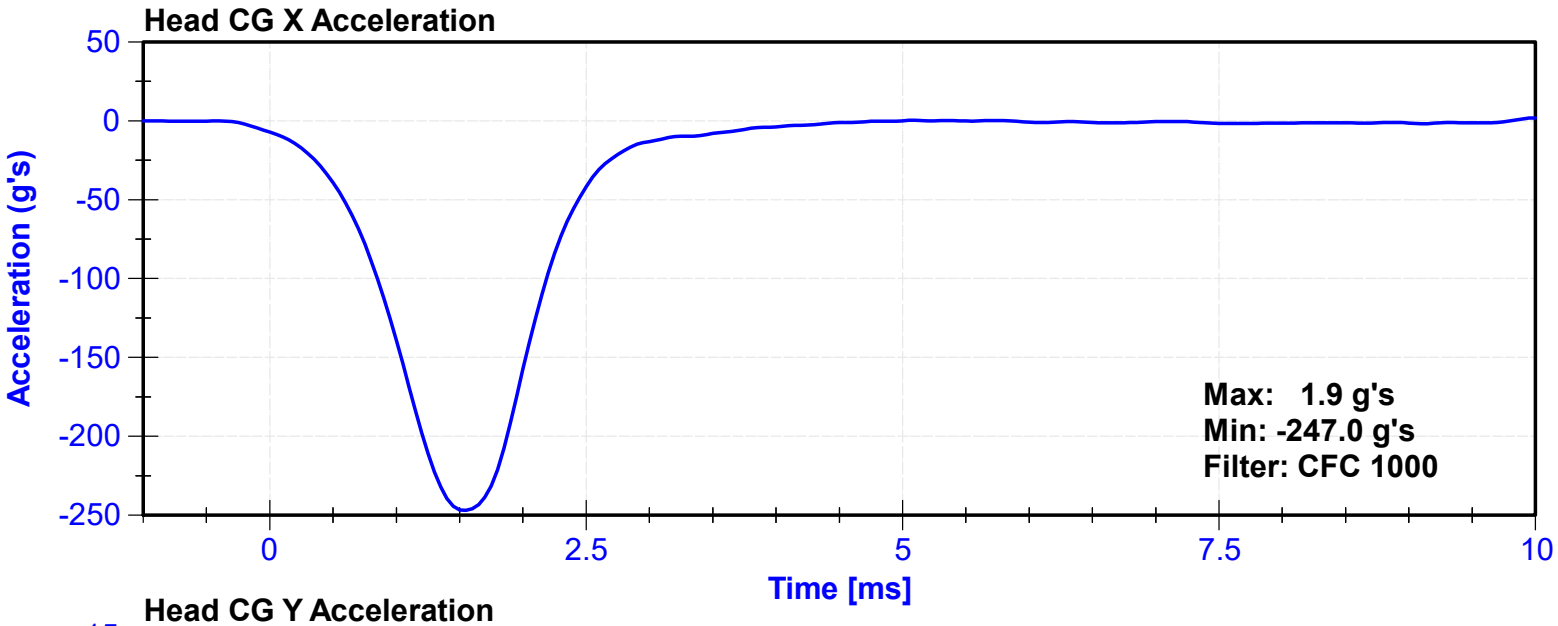
Results

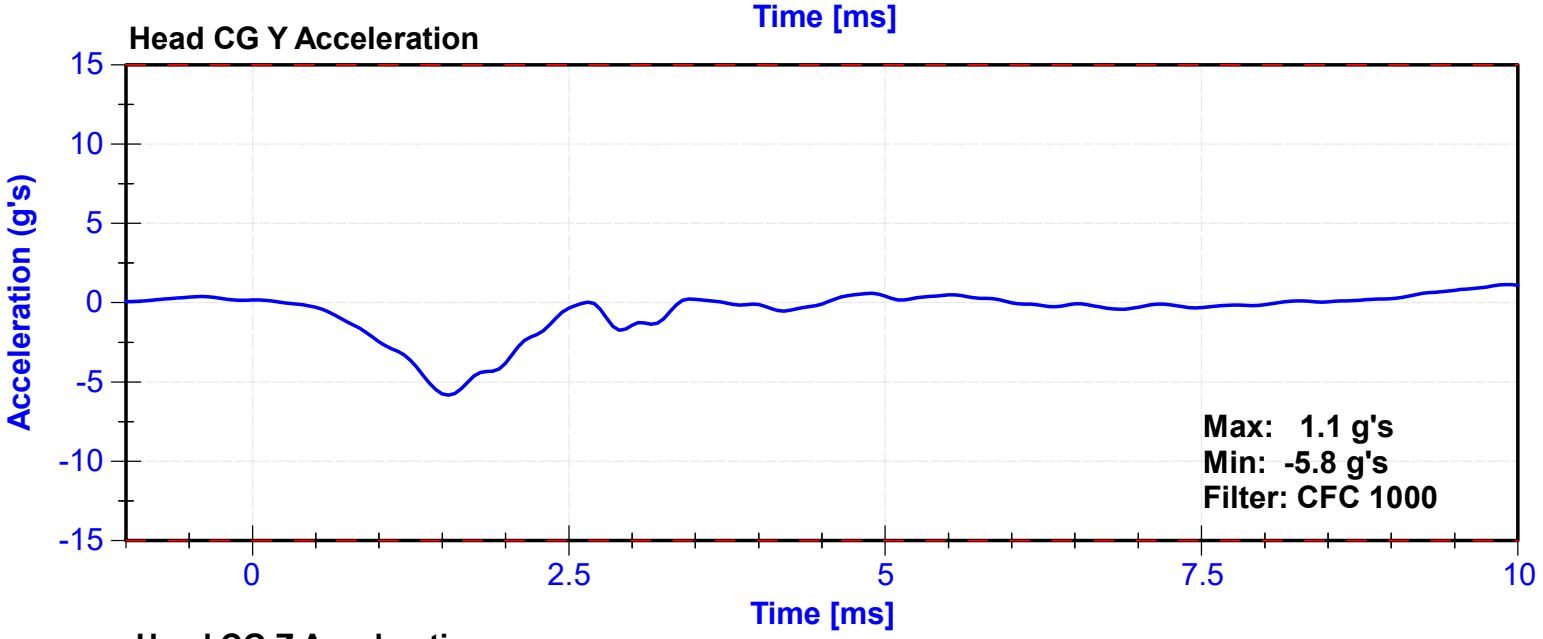
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	21.0	Pass
Humidity	10	70	%	19.0	Pass
Resultant Acceleration	250	300	g's	285.5	Pass
Oscillation	0	10	%	1.3	Pass
Lateral Acceleration	-15	15	g's	-5.8	Pass

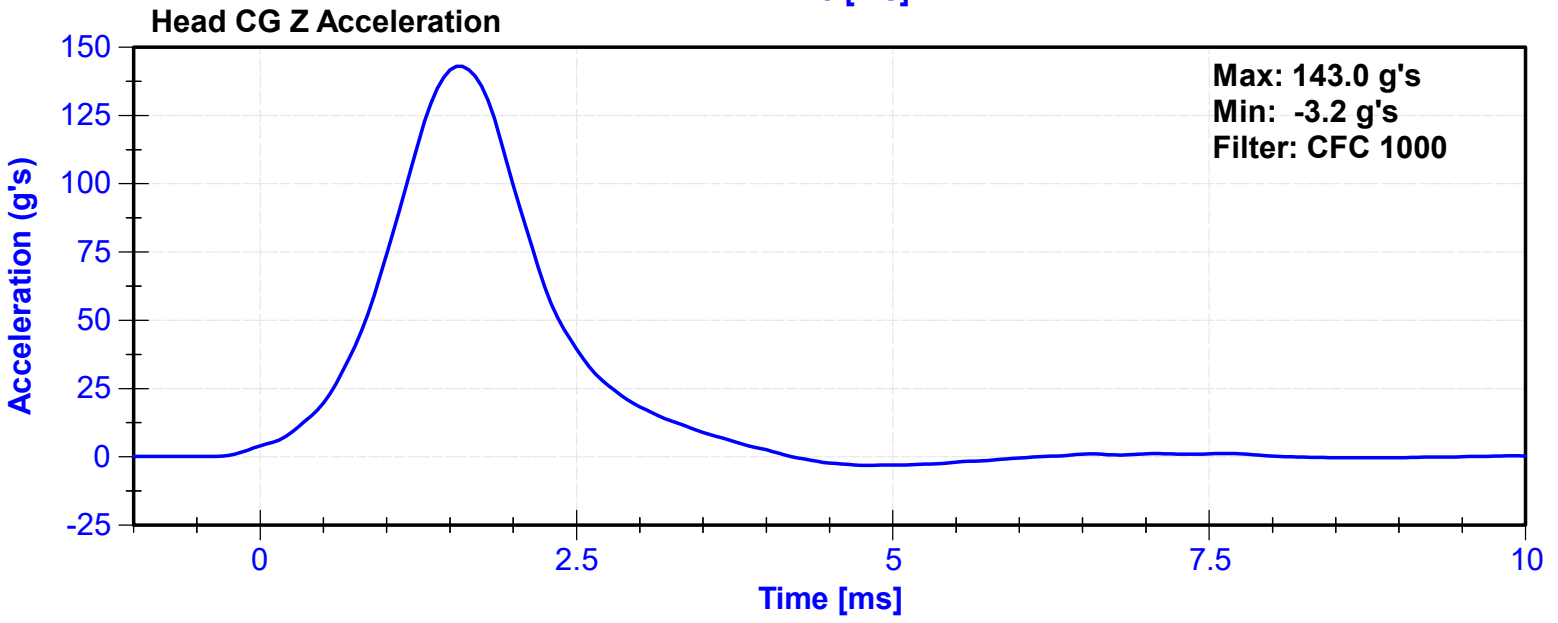
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	Endevco	P79417	12/13/2022	6/11/2023
Y Accelerometer	Endevco	P83335	12/13/2022	6/11/2023
Z Accelerometer	Endevco	P64149	12/12/2022	6/10/2023




Head CG X Acceleration
Acceleration (g's)
50
0
-50
-100
-150
-200
-250
0
2.5
5
7.5
10
Time [ms]
Max: 1.9 g's
Min: -247.0 g's
Filter: CFC 1000


Head CG Y Acceleration
Acceleration (g's)
15
10
5
0
-5
-10
-15
0
2.5
5
7.5
10
Time [ms]
Max: 1.1 g's
Min: -5.8 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: 143.0 g's
Min: -3.2 g's
Filter: CFC 1000

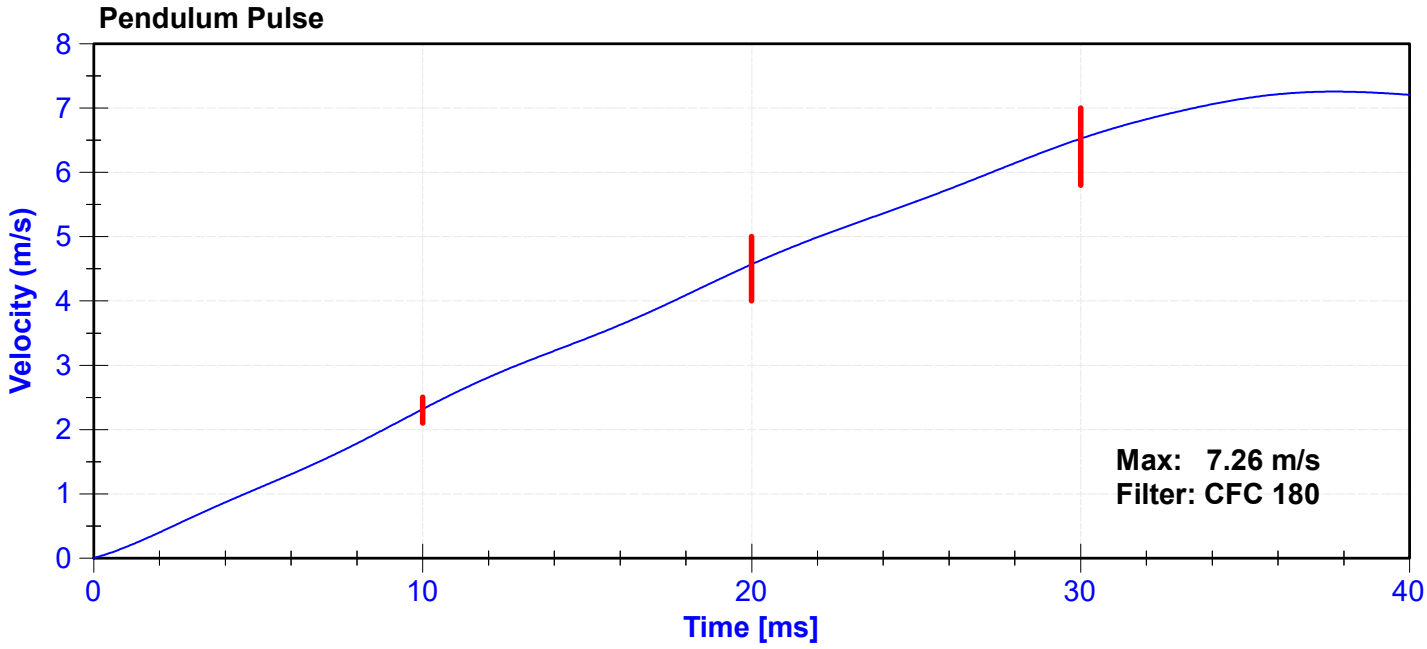
ATD Manufacturer	Humanetics	Test Technician	J. Miller
ATD Serial Number	137	Laboratory Supervisor	K. Brogan

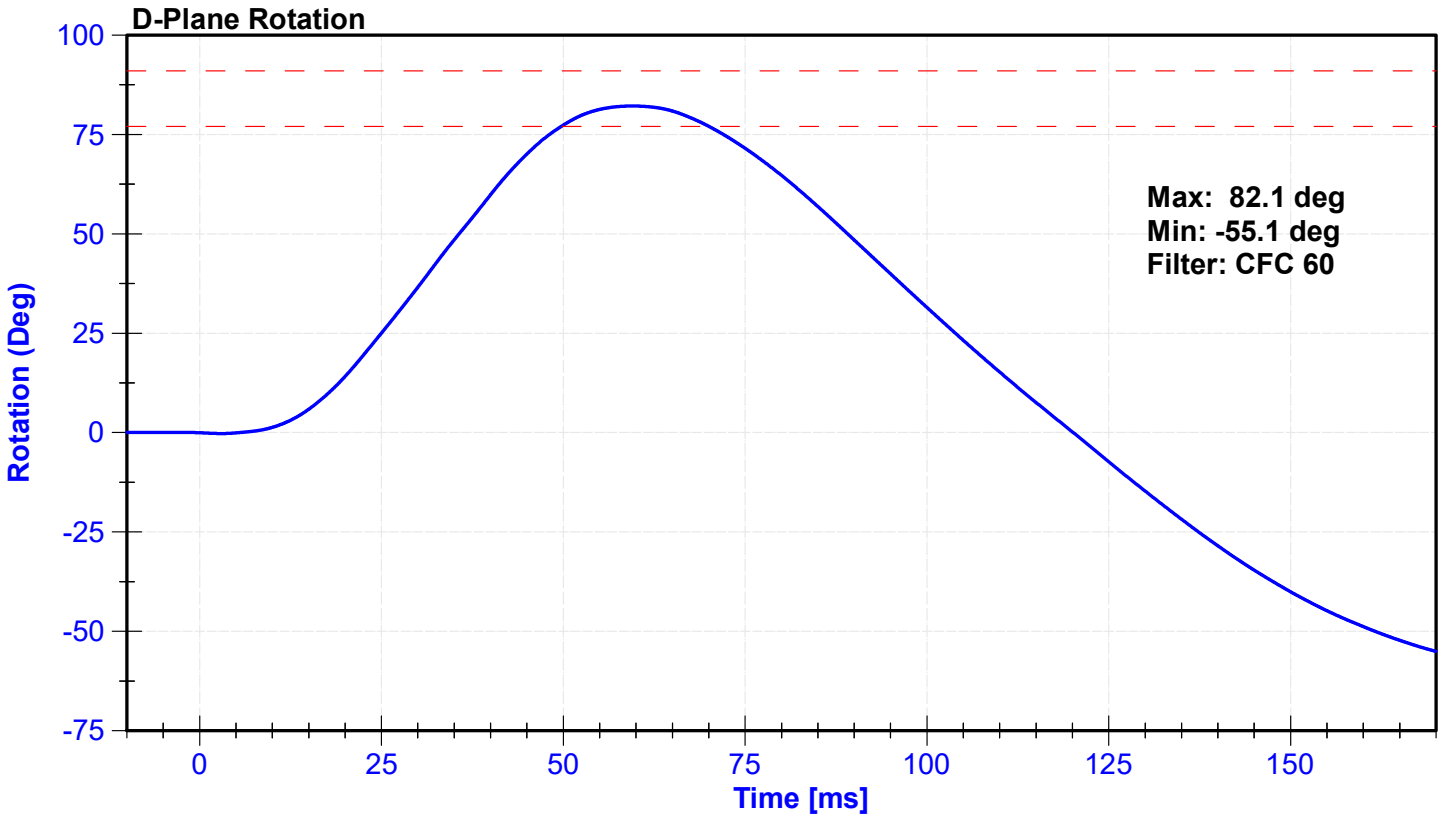
Results

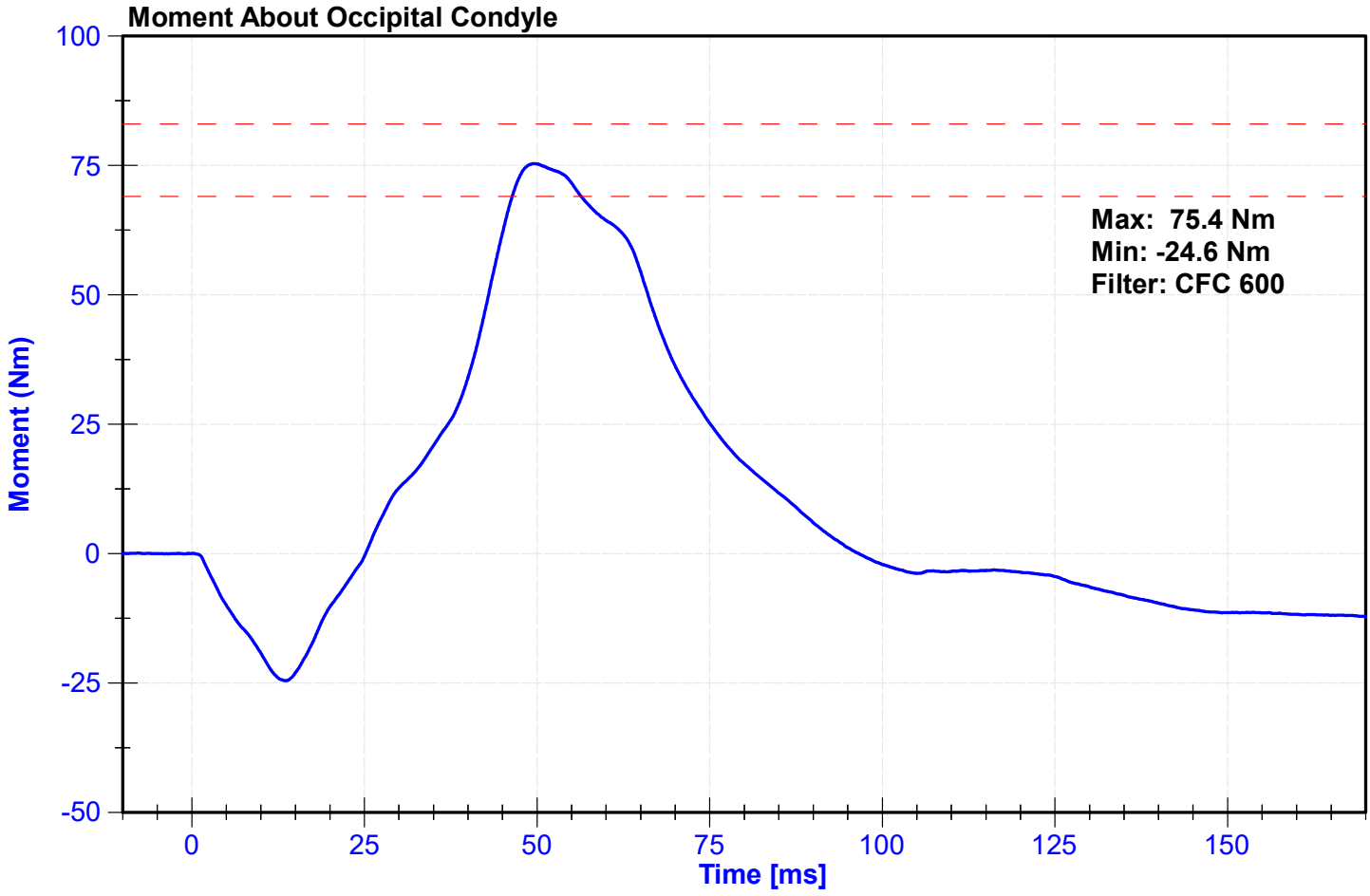
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.2	Pass
Humidity	10	70	%	19	Pass
Velocity	6.89	7.13	m/s	7.029	Pass
Pendulum Impulse at 10ms	2.1	2.5	m/s	2.32	Pass
Pendulum Impulse at 20ms	4.0	5.0	m/s	4.57	Pass
Pendulum Impulse at 30ms	5.8	7.0	m/s	6.52	Pass
Max D Plane Rotation	77	91	deg	82.1	Pass
Max Moment During Rotation Interval	69	83	Nm	75.4	Pass
Moment Decay to 10.0 Nm	80	100	ms	86.6	Pass

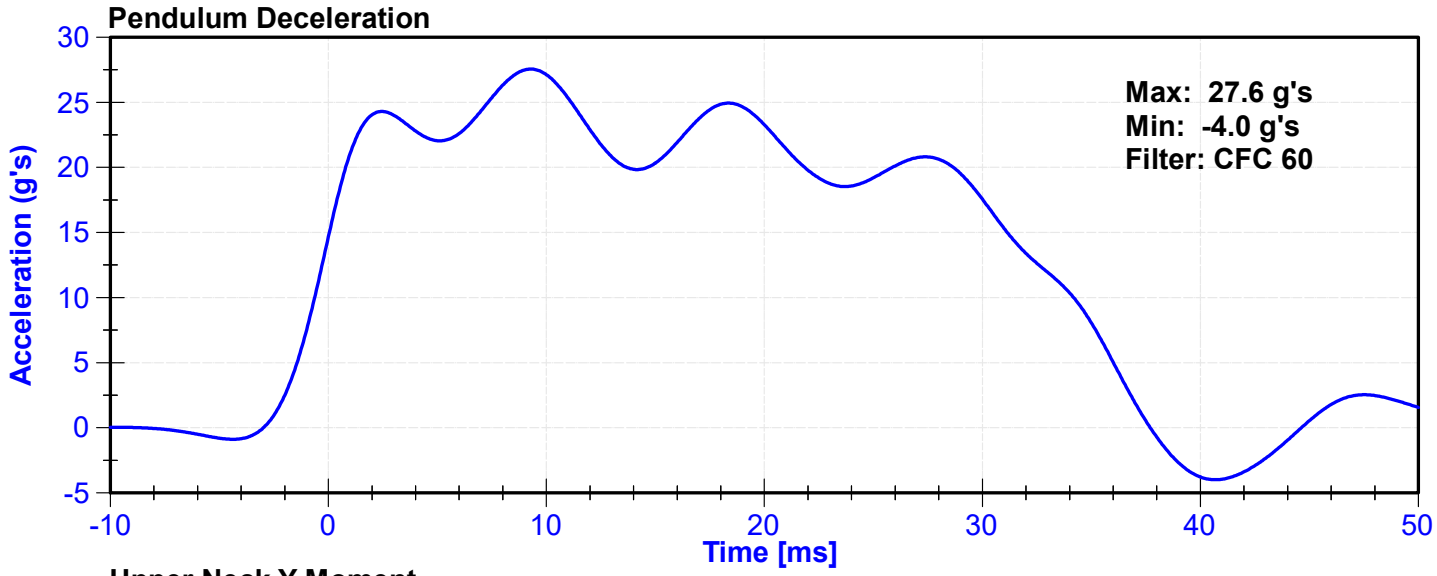
Transducer Calibrations

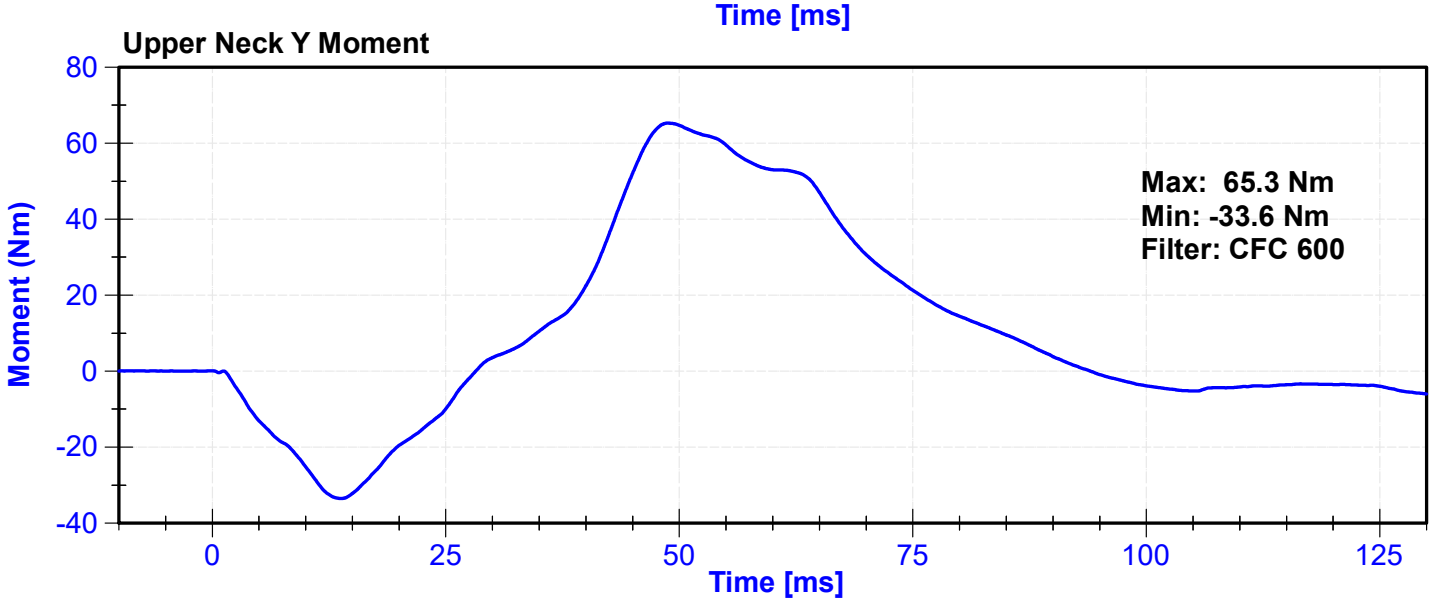
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	7231C-750	10/26/2022	10/26/2023
Pendulum Potentiometer	ETI	LABPOT1	5/9/2022	5/9/2023
Condyle Potentiometer	ETI	LABPOT2	5/9/2022	5/9/2023
Upper Neck Load Cell	Humanetics	1916-FX	6/10/2022	6/10/2023

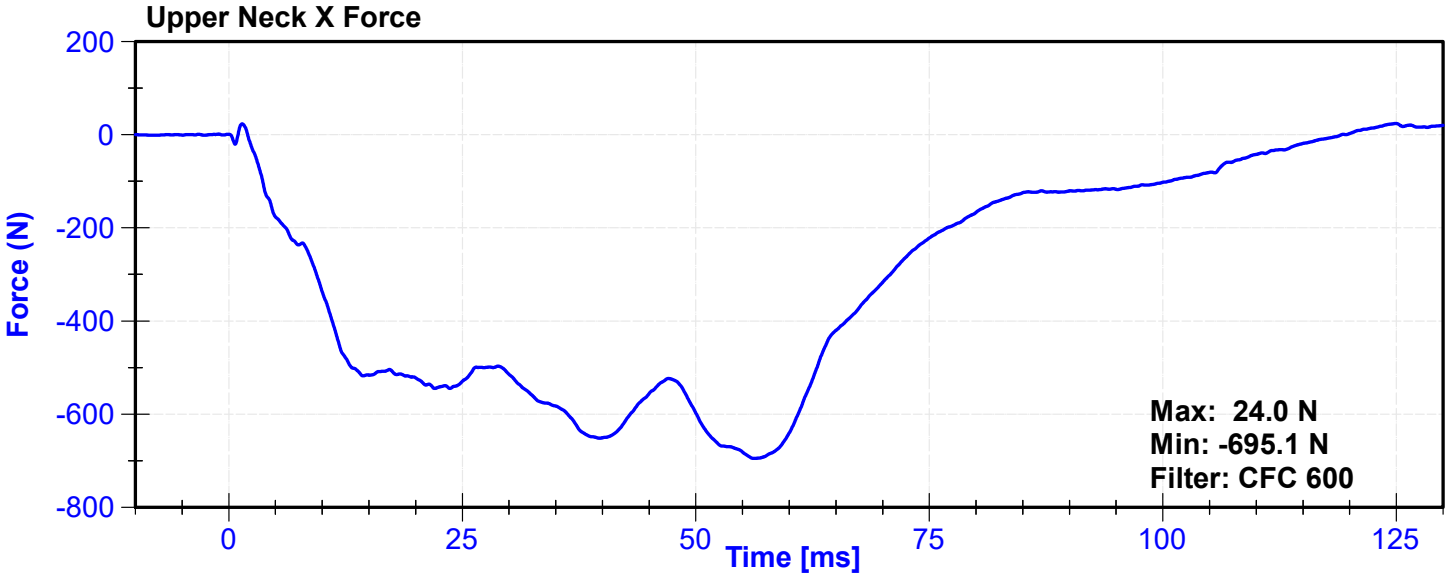



D-Plane Rotation
Rotation (Deg)
Time [ms]
Max: 82.1 deg
Min: -55.1 deg
Filter: CFC 60


Moment About Occipital Condyle
Moment (Nm)
Time [ms]
Max: 75.4 Nm
Min: -24.6 Nm
Filter: CFC 600


Pendulum Deceleration
Acceleration (g's)
Time [ms]
Max: 27.6 g's
Min: -4.0 g's
Filter: CFC 60


Upper Neck Y Moment
Moment (Nm)
Time [ms]
Max: 65.3 Nm
Min: -33.6 Nm
Filter: CFC 600


Upper Neck X Force
Force (N)
Time [ms]
Max: 24.0 N
Min: -695.1 N
Filter: CFC 600

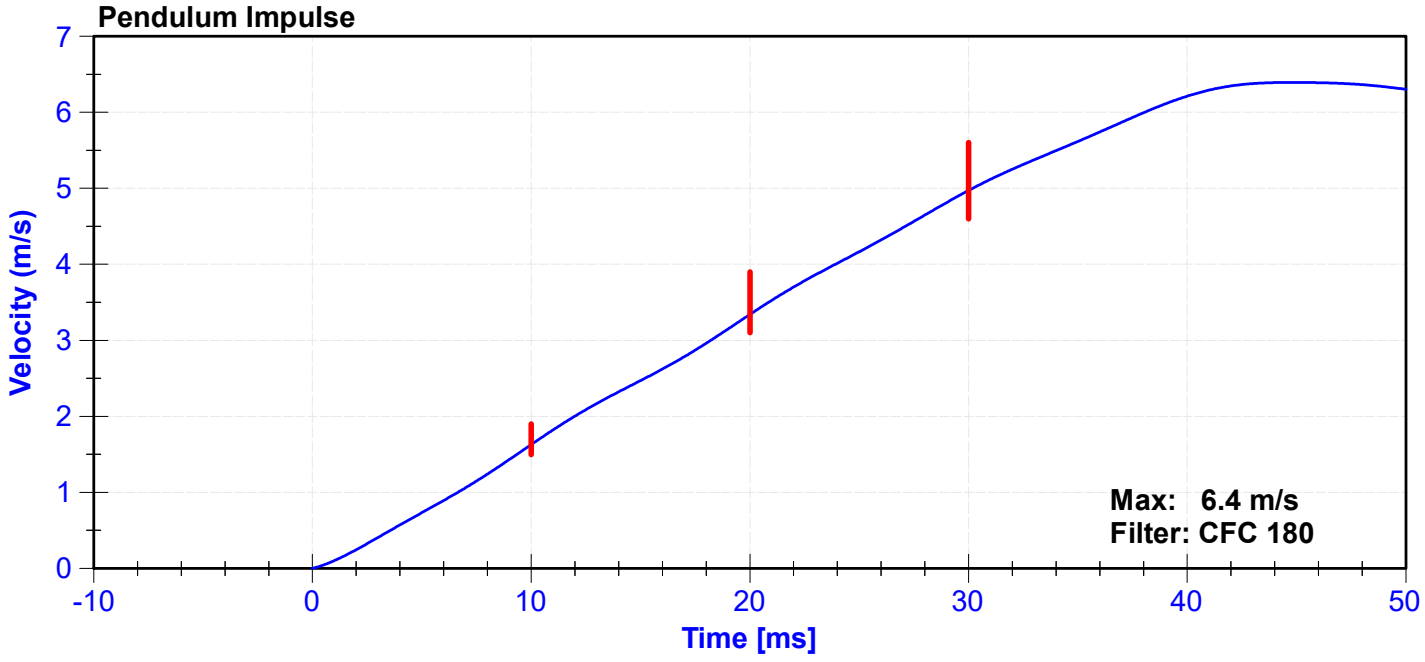
ATD Manufacturer	Humanetics	Test Technician	J. Miller
ATD Serial Number	137	Laboratory Supervisor	K. Brogan

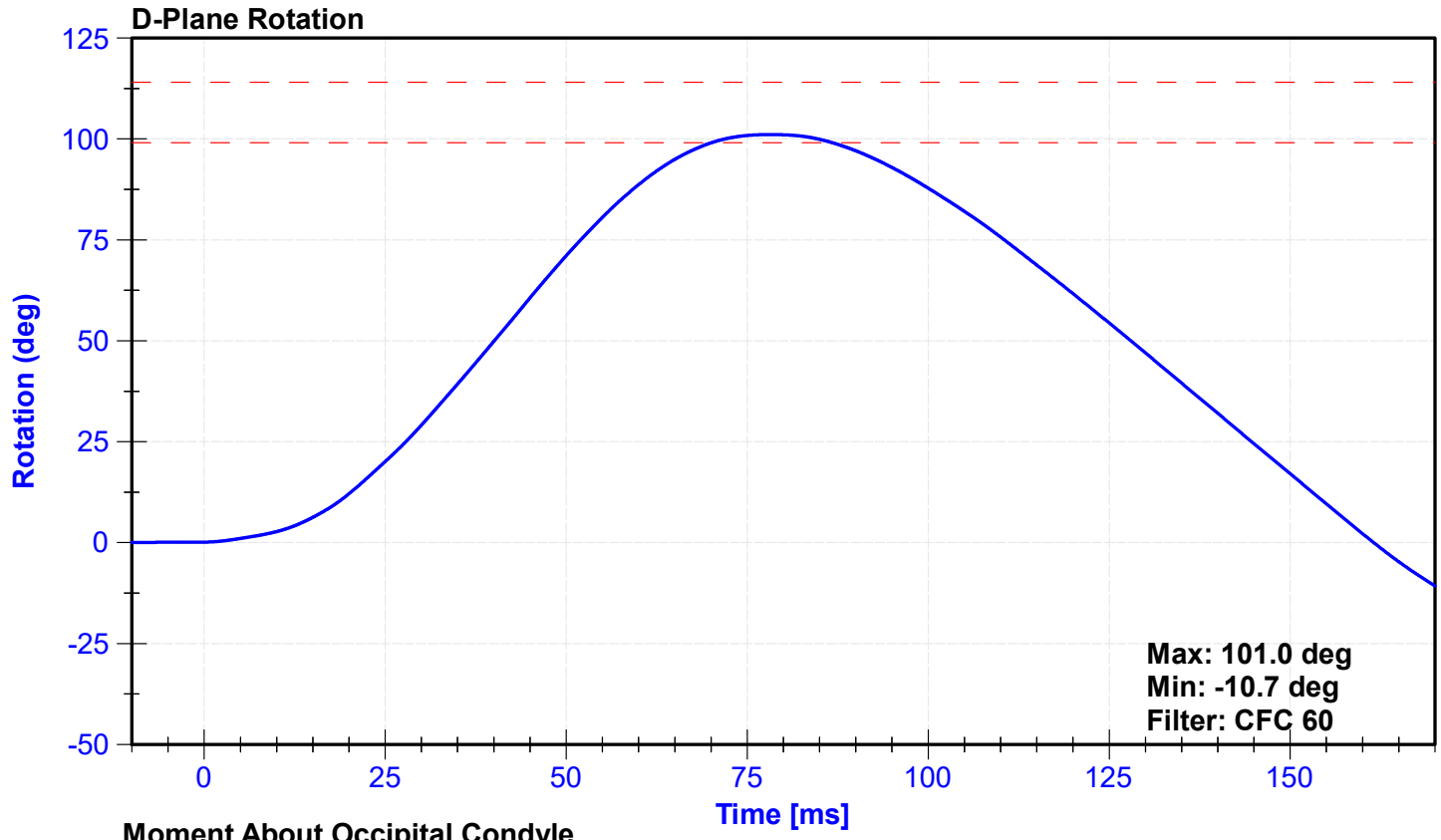
Results

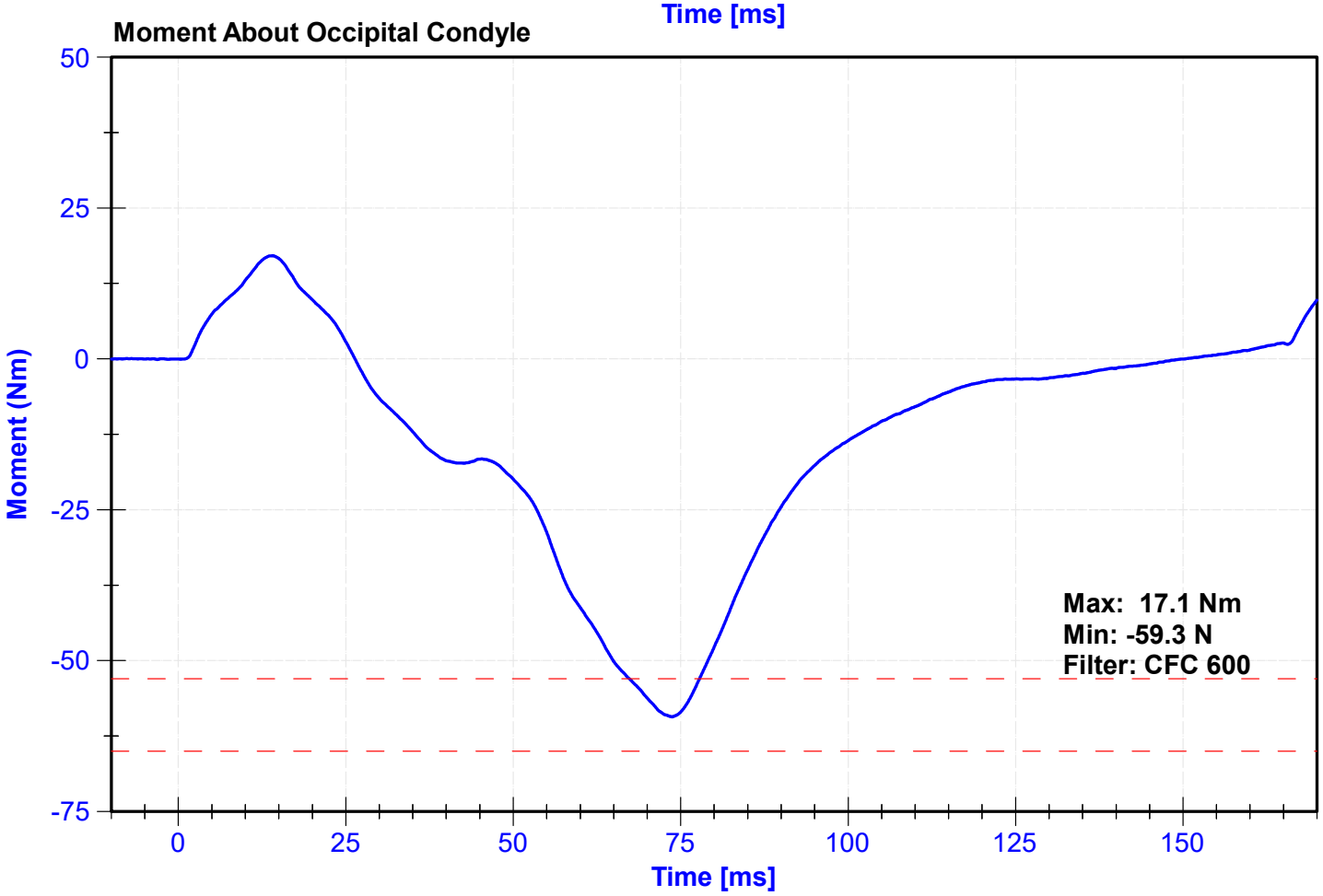
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.9	Pass
Humidity	10	70	%	20	Pass
Velocity	5.95	6.19	m/s	6.115	Pass
Pendulum Impulse at 10ms	1.5	1.9	m/s	1.63	Pass
Pendulum Impulse at 20ms	3.1	3.9	m/s	3.34	Pass
Pendulum Impulse at 30ms	4.6	5.6	m/s	4.97	Pass
D Plane Rotation	99	114	deg	101.0	Pass
Moment During Rotation Interval	-65	-53	Nm	-59.3	Pass
Moment Decay to -10Nm	94	114	ms	105.8	Pass

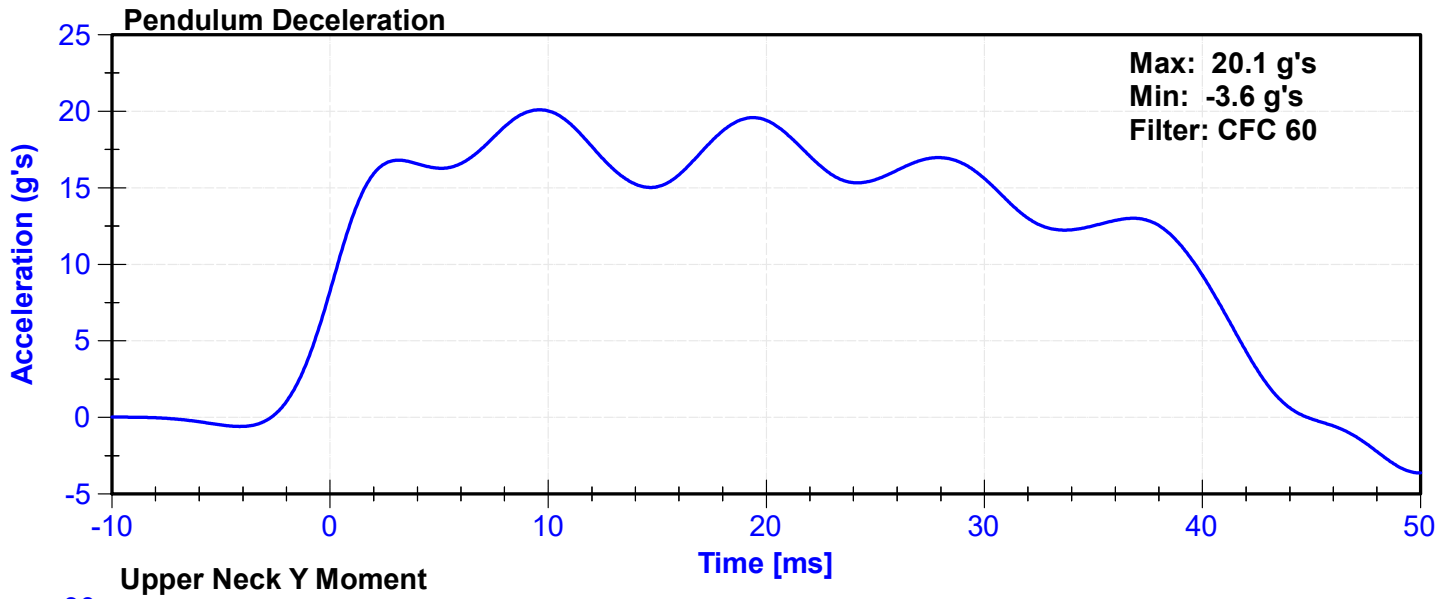
Transducer Calibrations

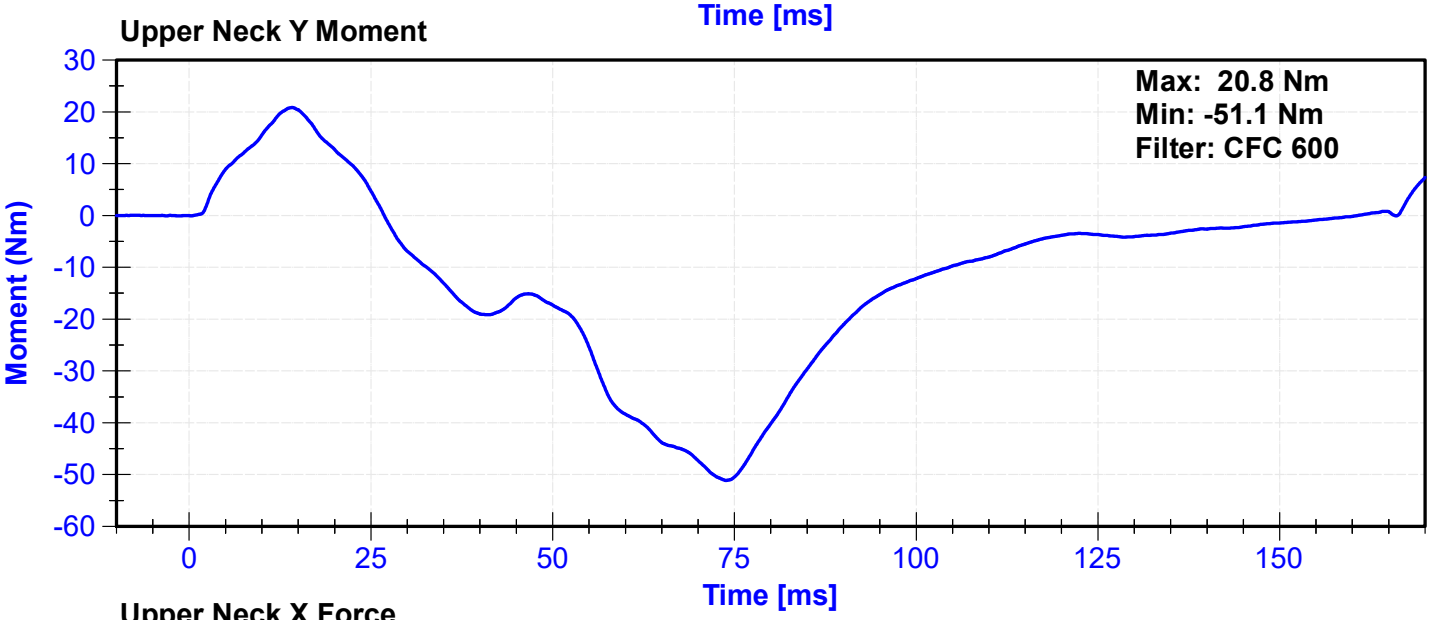
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	C16503	10/26/2022	10/26/2023
Pendulum Potentiometer	ETI	LABPOT1	5/9/2022	5/9/2023
Condyle Potentiometer	ETI	LABPOT2	5/9/2022	5/9/2023
Upper Neck Load Cell	Humanetics	1916-FX	6/10/2022	6/10/2023

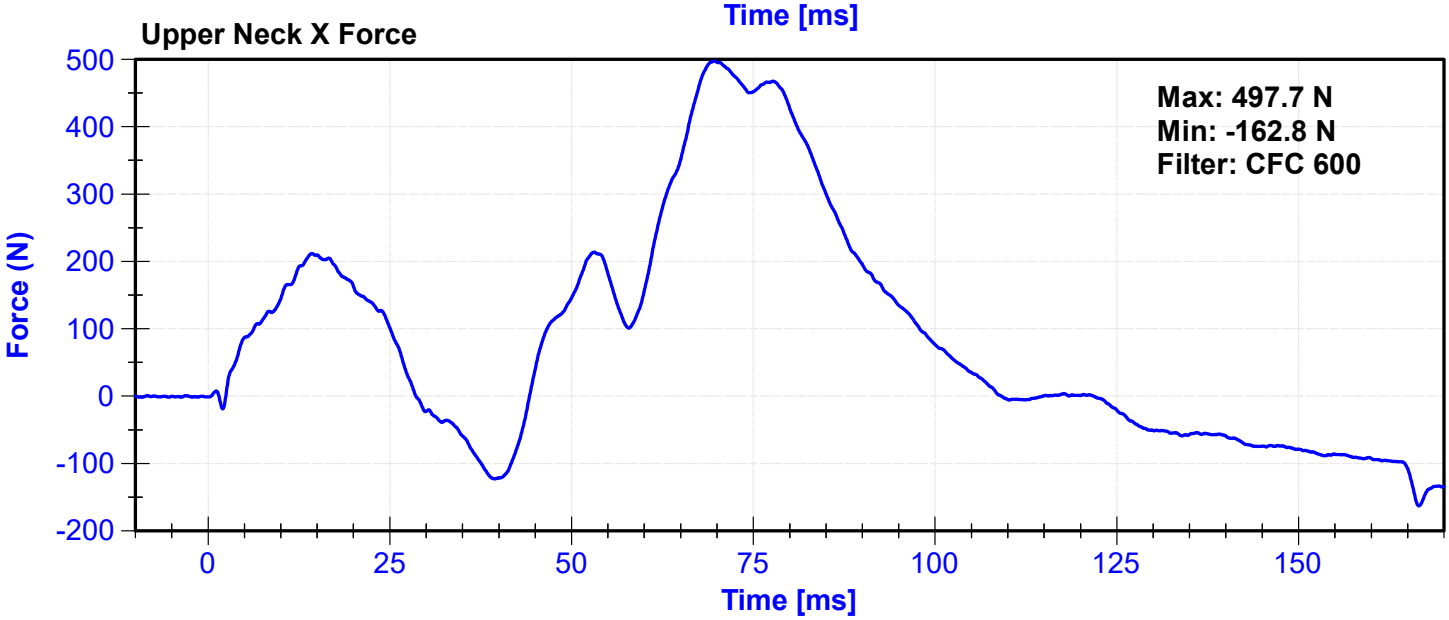



D-Plane Rotation
Rotation (deg)
125
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]
Max: 101.0 deg
Min: -10.7 deg
Filter: CFC 60


Moment About Occipital Condyle
Moment (Nm)
50
25
0
-25
-50
-75
0
25
50
75
100
125
150
Time [ms]
Max: 17.1 Nm
Min: -59.3 N
Filter: CFC 600


Pendulum Deceleration
Max: 20.1 g's
Min: -3.6 g's
Filter: CFC 60
Acceleration (g's)
Time [ms]


Upper Neck Y Moment
Max: 20.8 Nm
Min: -51.1 Nm
Filter: CFC 600
Moment (Nm)
Time [ms]


Upper Neck X Force
Max: 497.7 N
Min: -162.8 N
Filter: CFC 600
Force (N)
Time [ms]

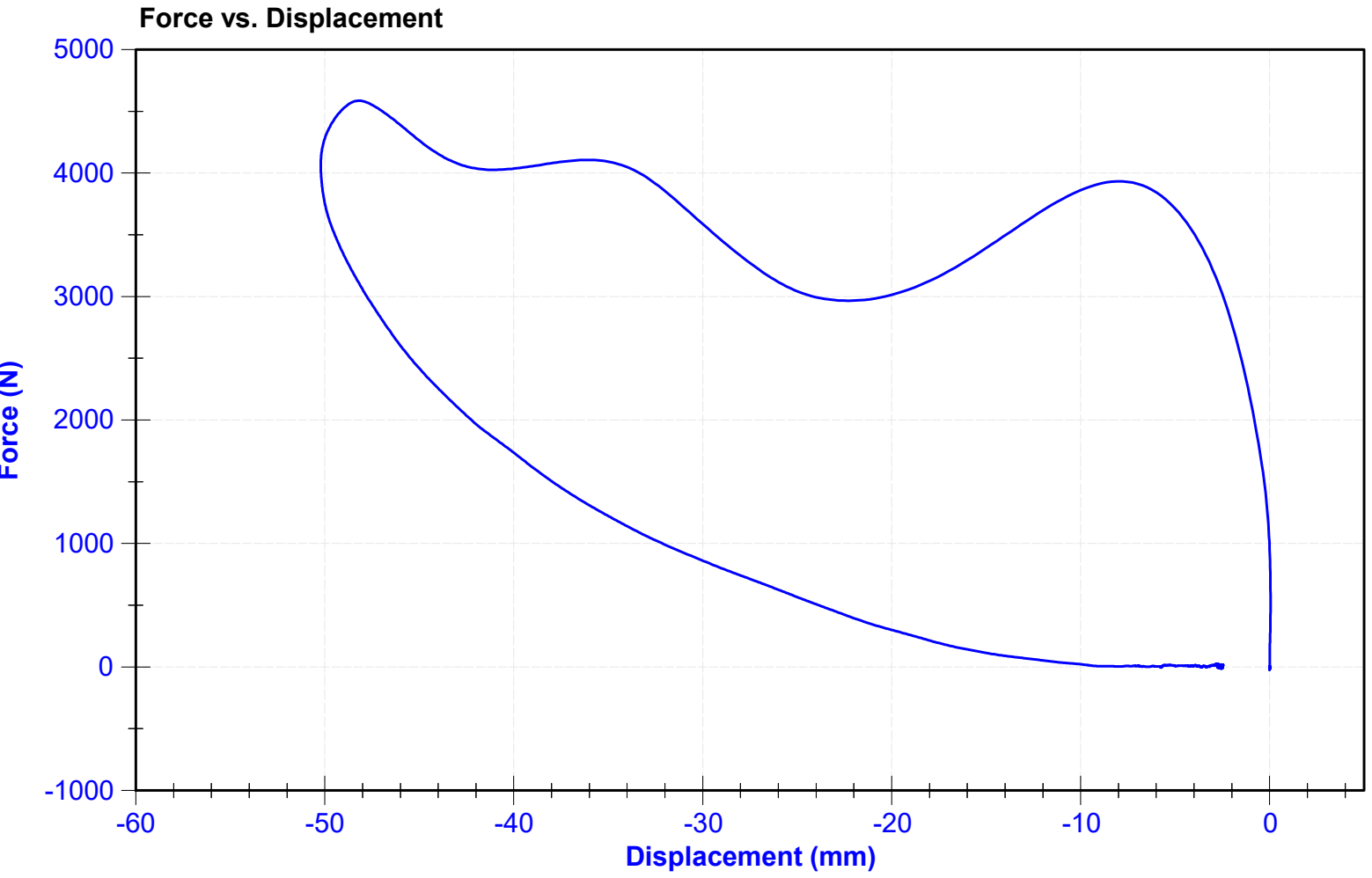
ATD Manufacturer	Humanetics	Test Technician	C. Mantell
ATD Serial Number	137	Laboratory Supervisor	K. Brogan

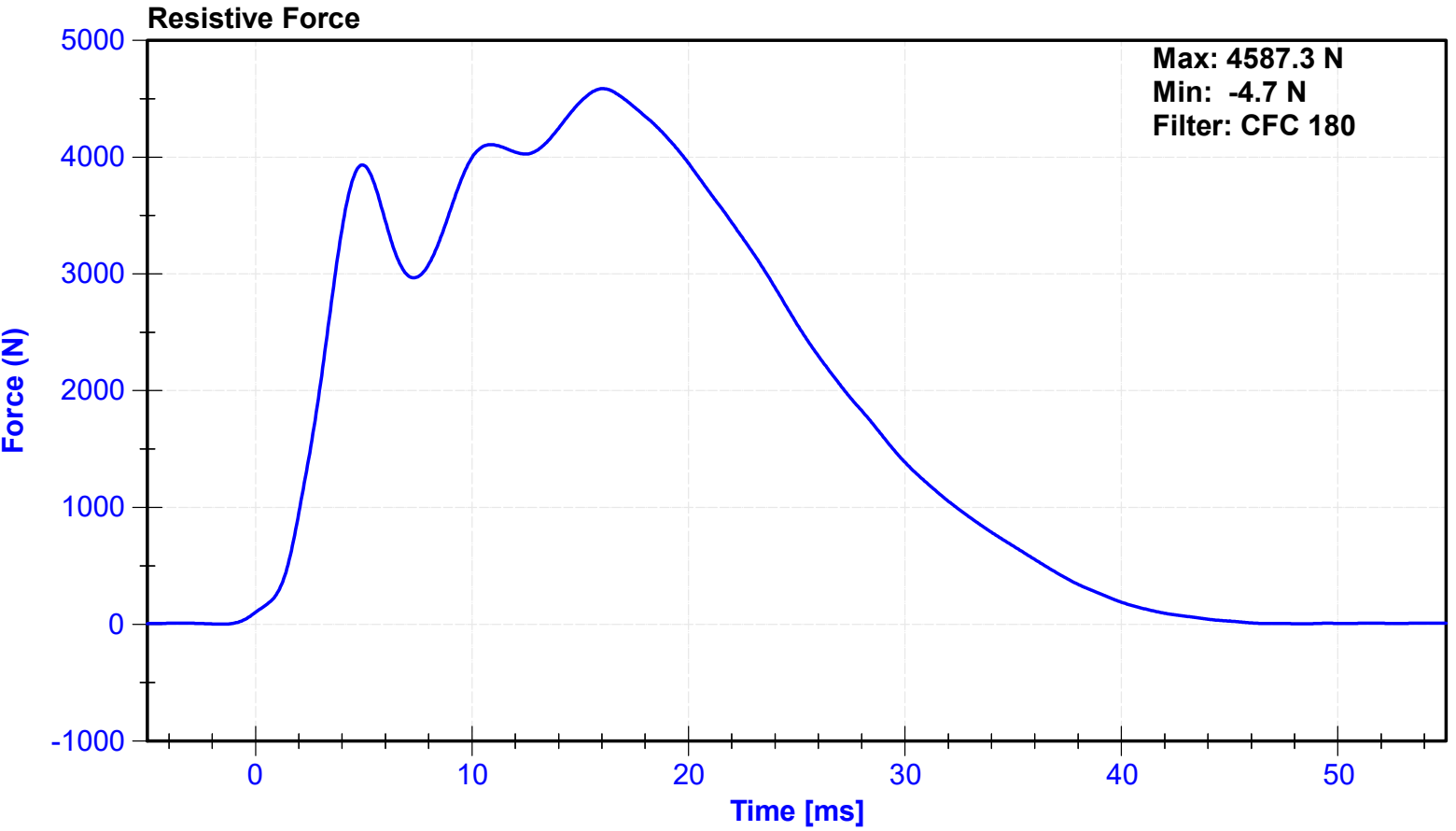
Results

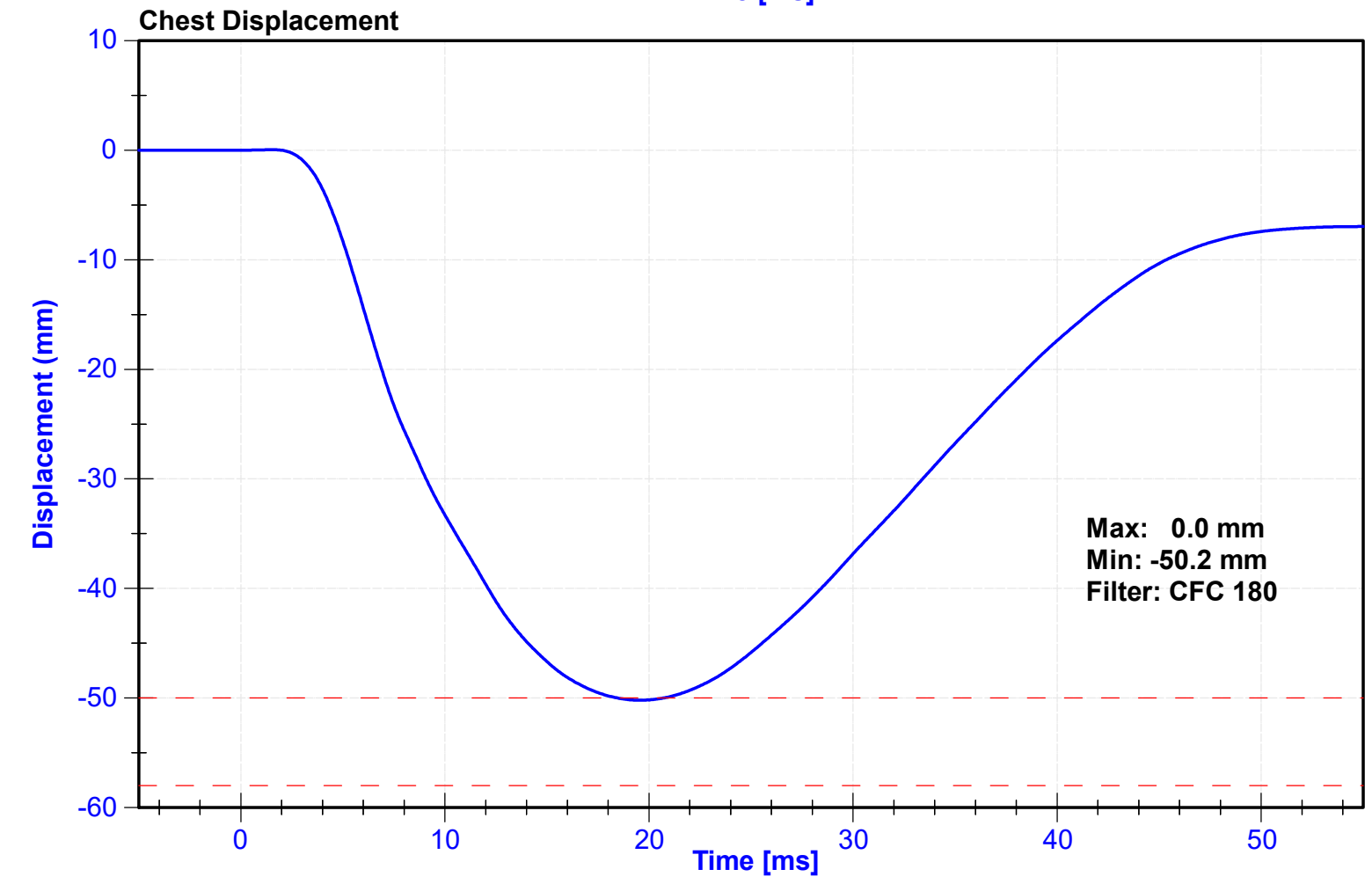
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.4	Pass
Humidity	10	70	%	22	Pass
Velocity	6.59	6.83	m/s	6.719	Pass
Chest Deflection	-58	-50	mm	-50.2	Pass
Maximum Resistive Force (50 to 58mm)	3900	4400	N	4285.3	Pass
Maximum Resistive Force (18 to 50mm)	0	4600	N	4587.3	Pass
Hysteresis	69	85	%	75.1	Pass

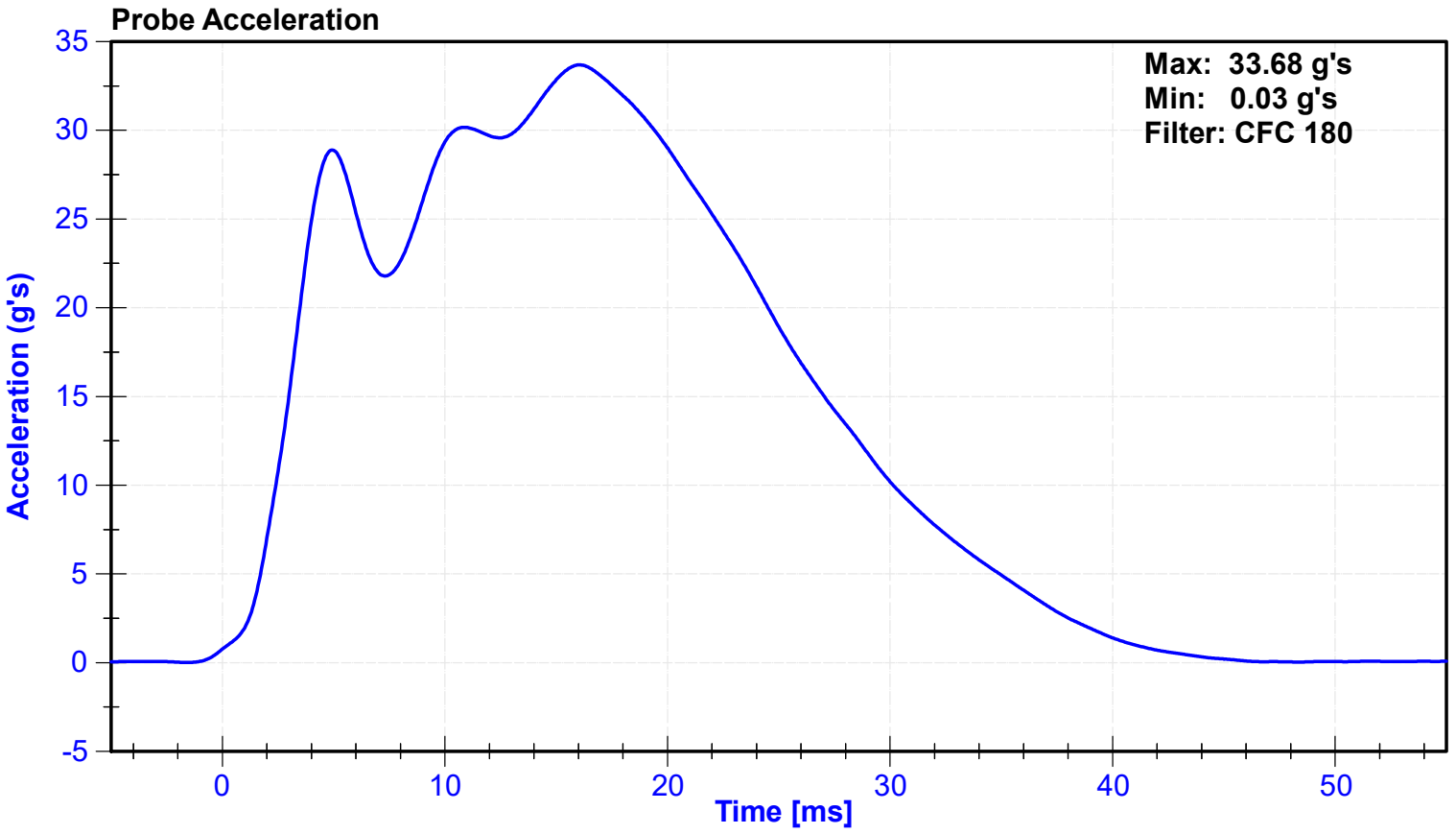
Transducer Calibrations

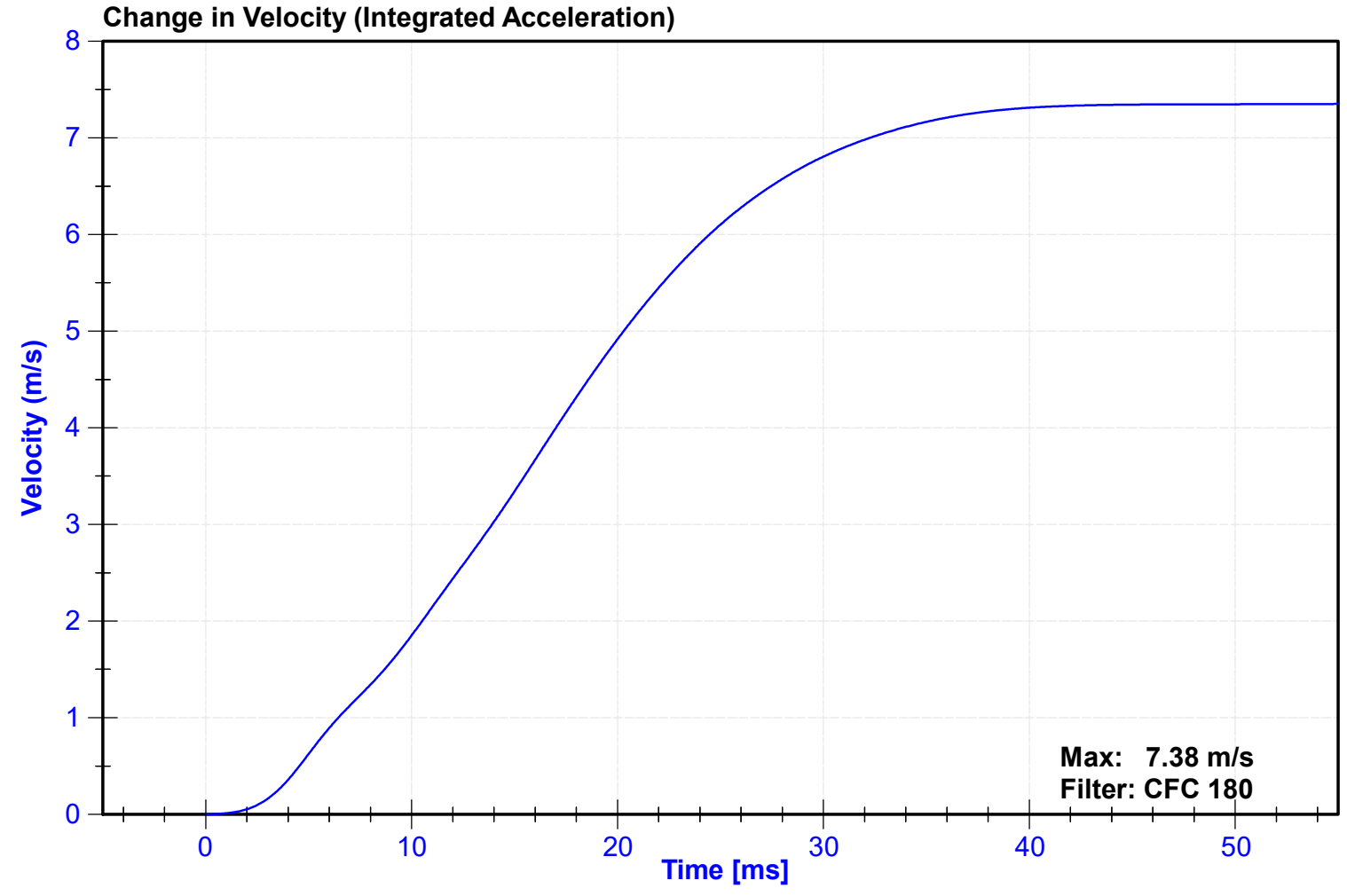
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18546	11/19/2022	5/18/2023
Chest Potentiometer	Servo	0720	12/12/2022	6/12/2023




Resistive Force
Max: 4587.3 N
Min: -4.7 N
Filter: CFC 180
Force (N)
5000
4000
3000
2000
1000
0
-1000
0
10
20
30
40
50
Time [ms]


Chest Displacement
Max: 0.0 mm
Min: -50.2 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: 33.68 g's
Min: 0.03 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: 7.38 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]

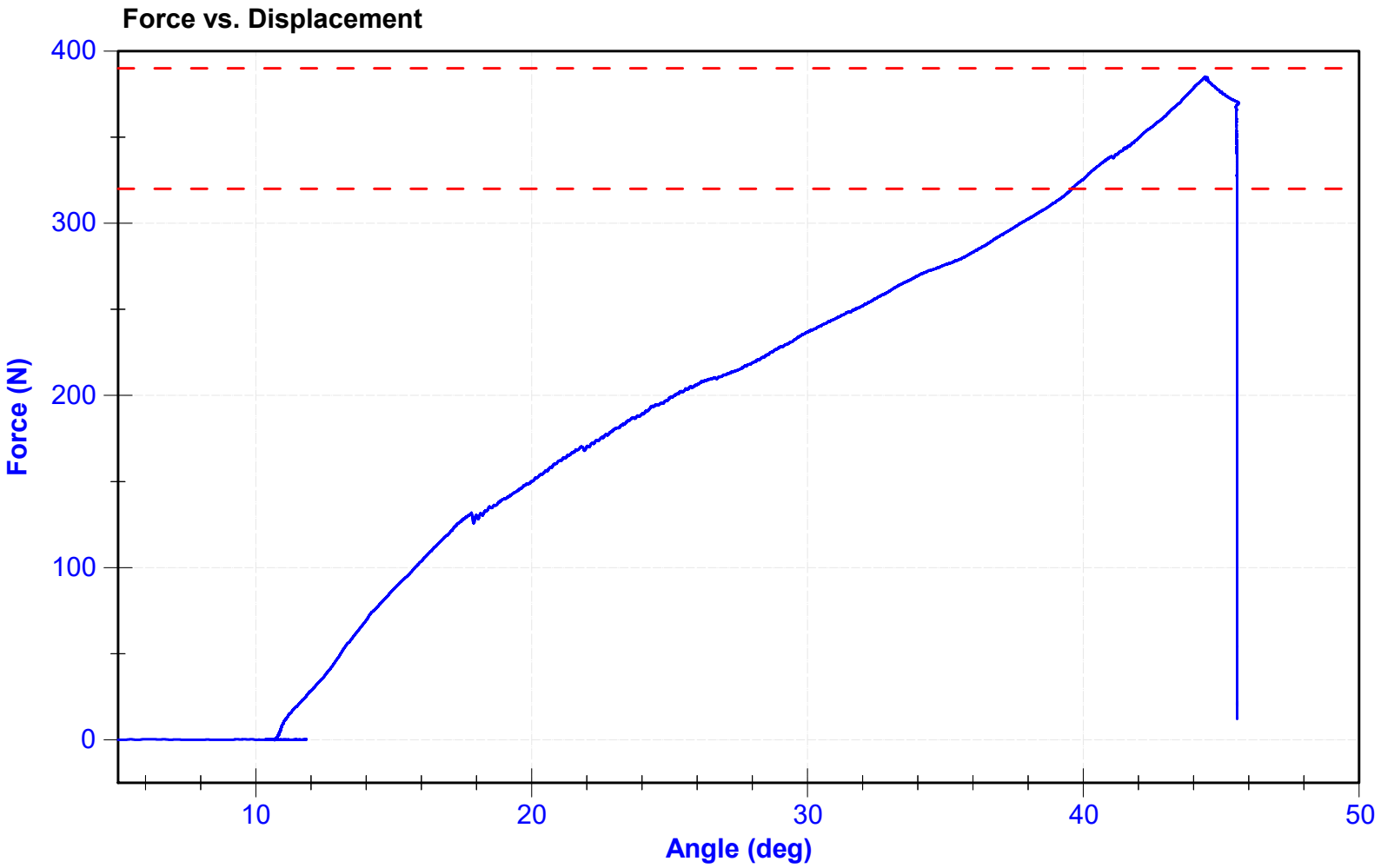
ATD Manufacturer	Humanetics	Test Technician	C. Mantell
ATD Serial Number	137	Laboratory Supervisor	K. Brogan

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.6	25.6	ºC	21.1	Pass
Humidity	10	70	%	19.3	Pass
Initial Angle	0	20	deg	10.7	Pass
Force at 45 Degrees	320	390	N	385.1	Pass
Return Angle Relative to Initial	0	8	deg	4.7	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Potentiometer	Rieker	DS-1905226	2022-11-09	2023-11-09
Load Cell	Interface	1134516	2022-09-27	2023-09-27



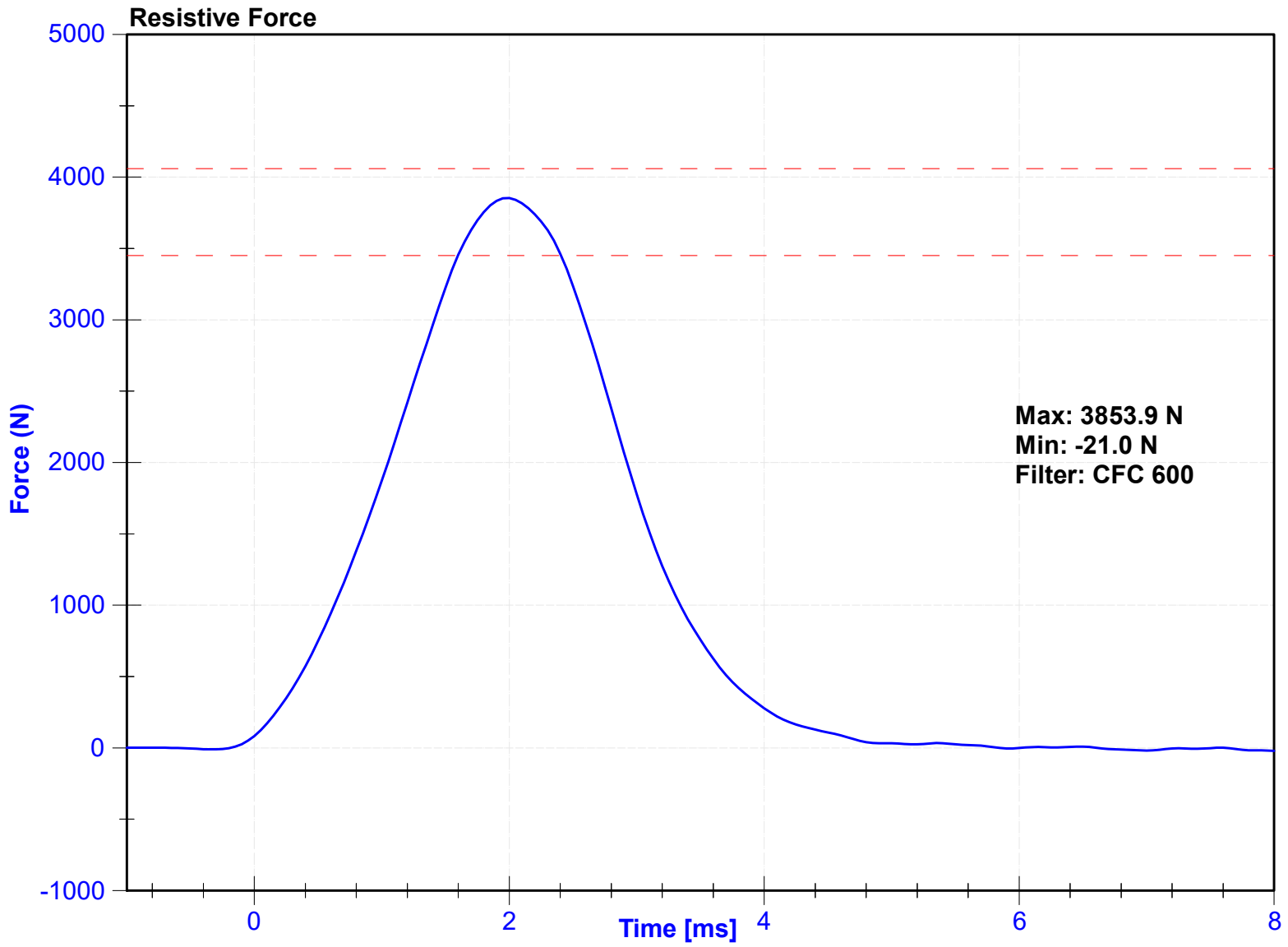
ATD Manufacturer	Humanetics	Test Technician	T. Roseman
ATD Serial Number	137	Laboratory Supervisor	K. Brogan

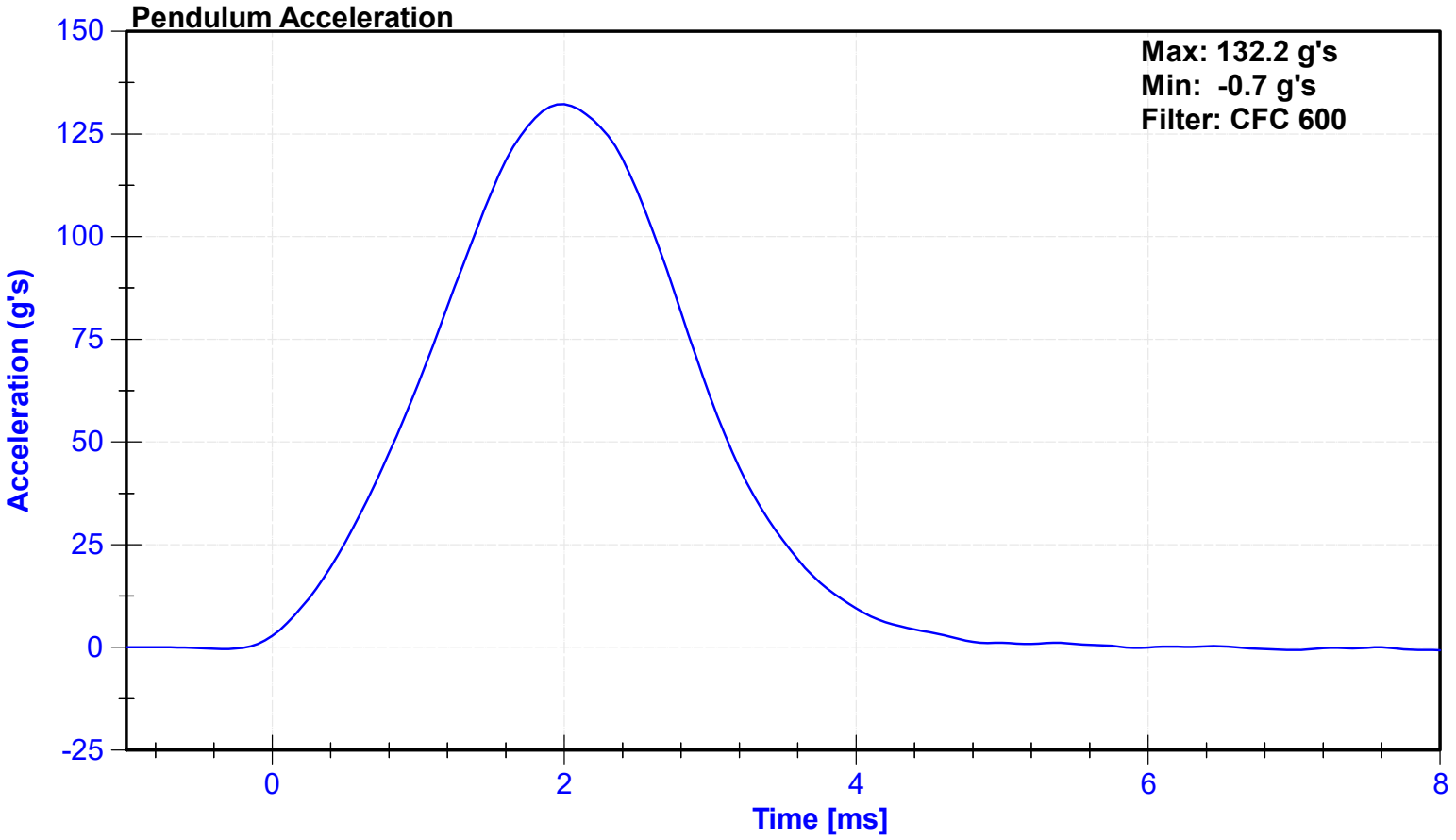
Results

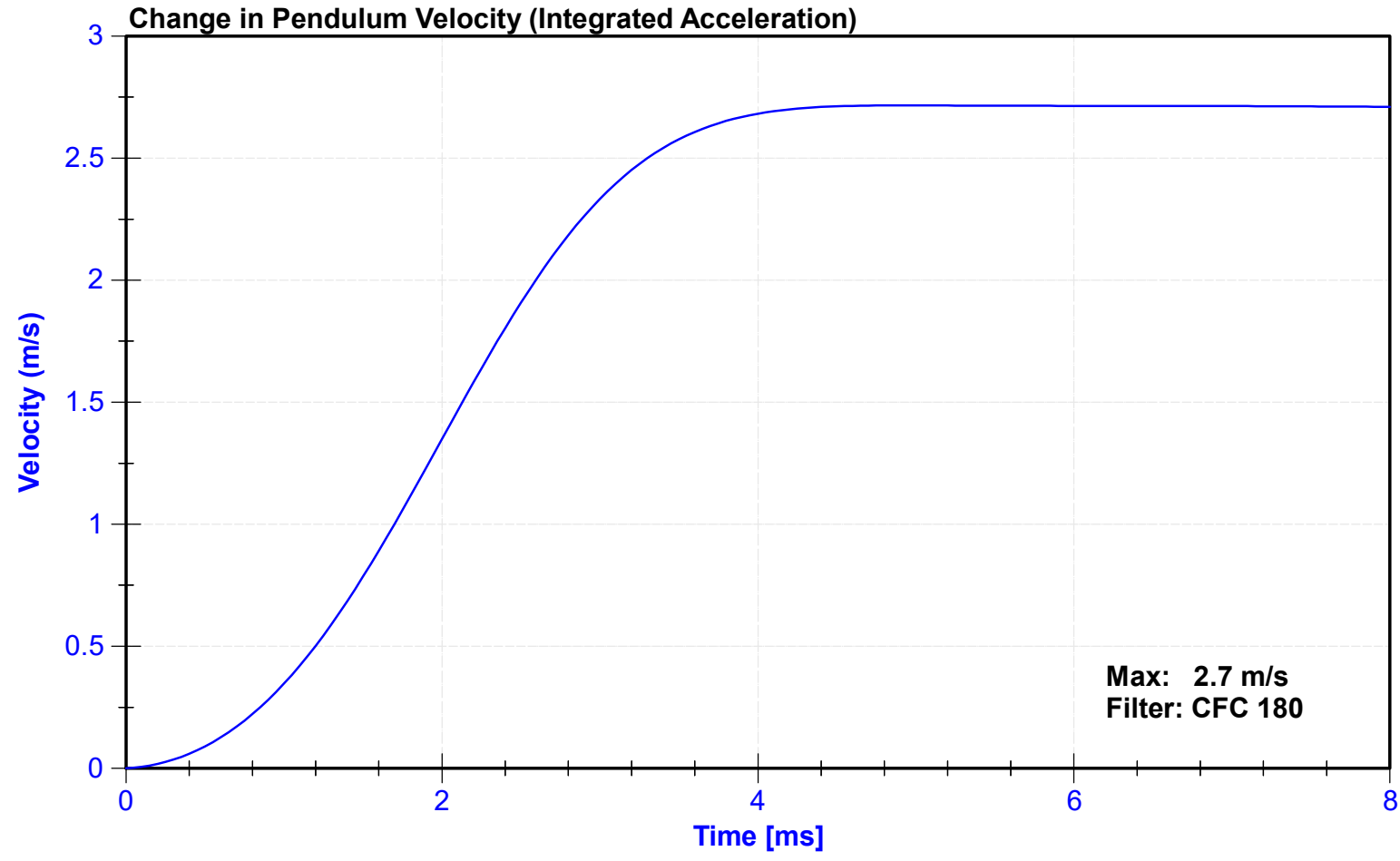
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	20.9	Pass
Humidity	10	70	%	24.3	Pass
Velocity	2.07	2.13	m/s	2.124	Pass
Resistive Force	3450	4060	N	3853.9	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18546	11/19/2022	5/18/2023




Pendulum Acceleration
Max: 132.2 g's
Min: -0.7 g's
Filter: CFC 600
Acceleration (g's)
150
125
100
75
50
25
0
-25
0
2
4
6
8
Time [ms]


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

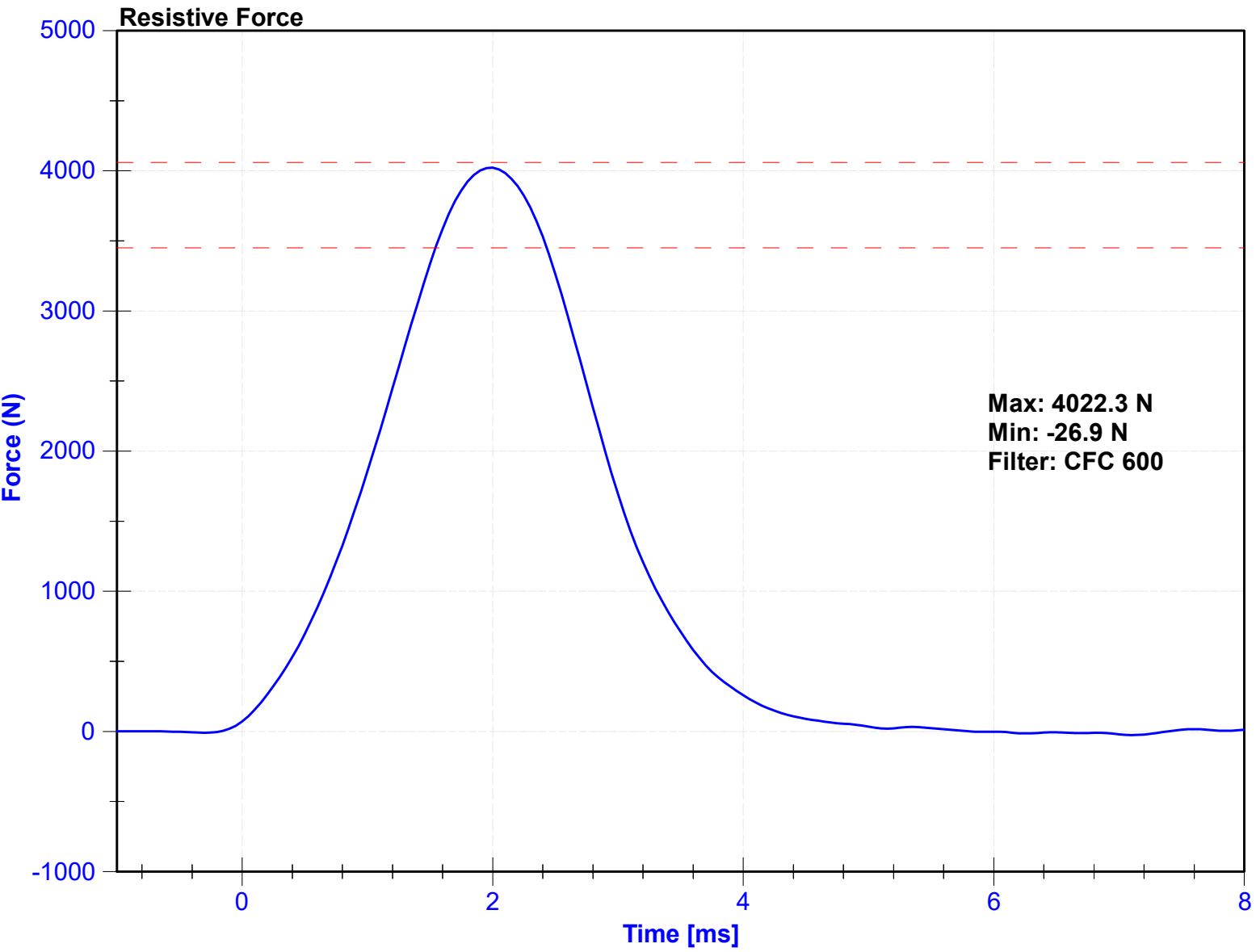
ATD Manufacturer	Humanetics	Test Technician	T. Roseman
ATD Serial Number	137	Laboratory Supervisor	K. Brogan

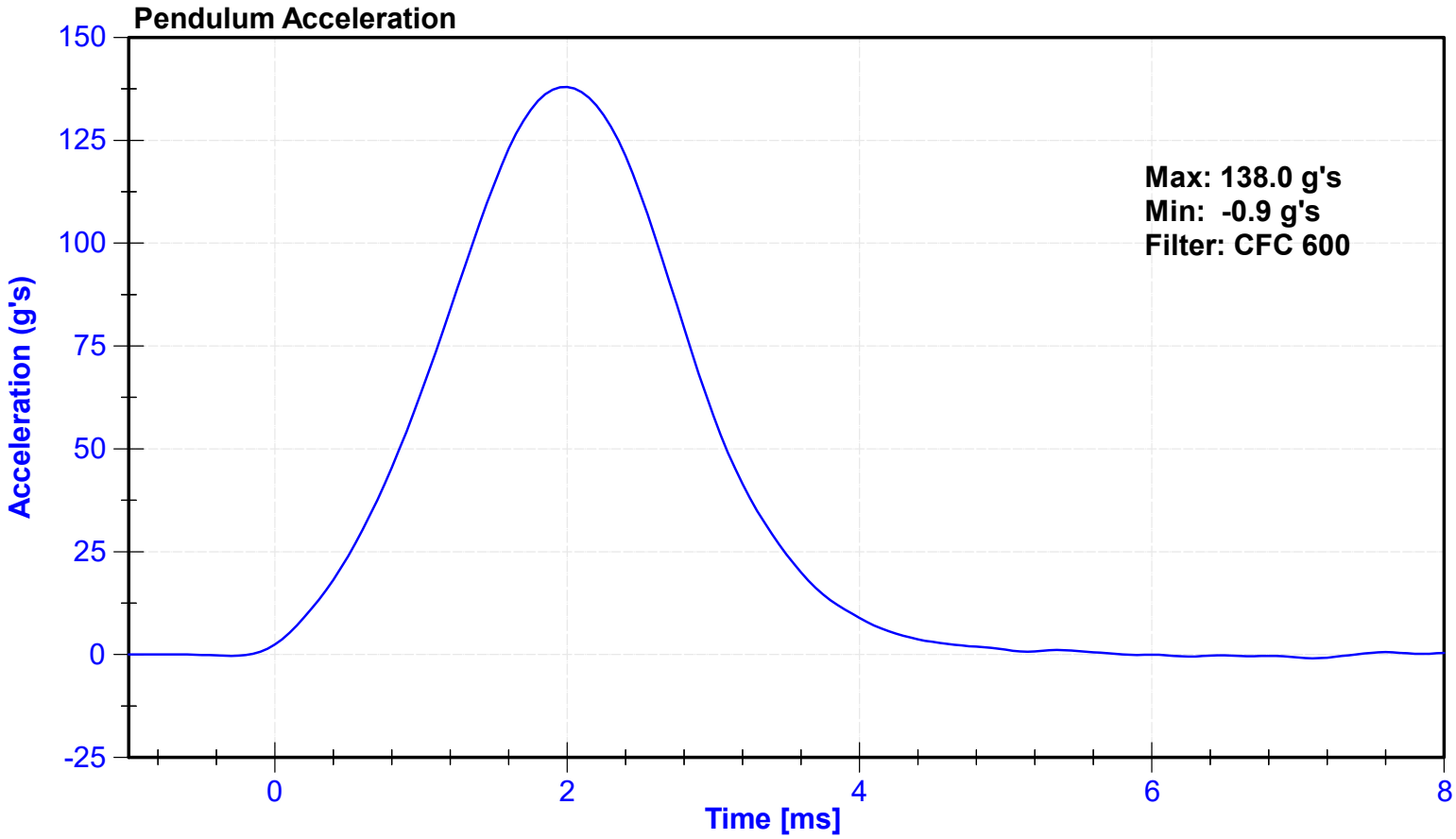
Results

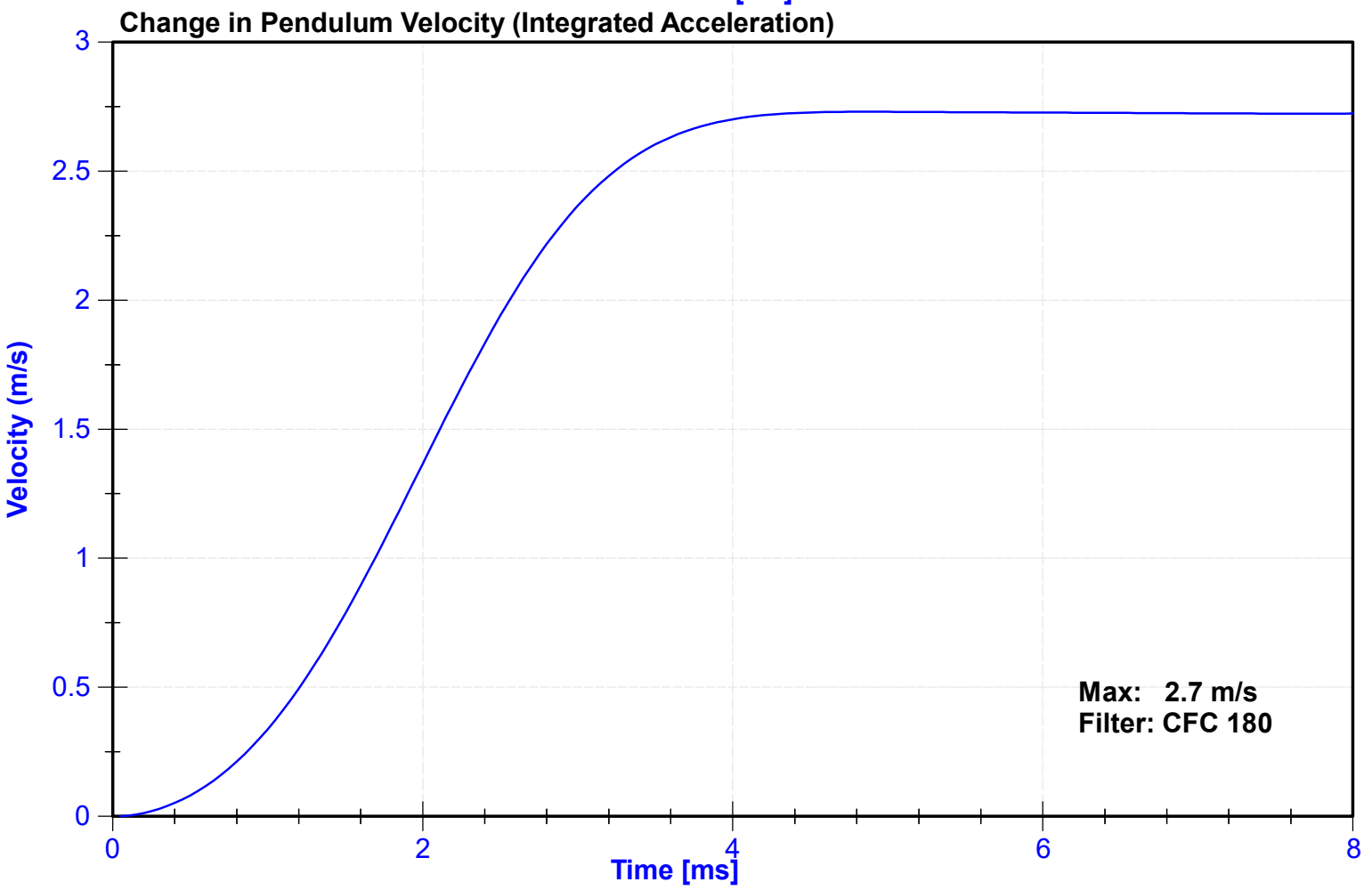
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	18.9	25.6	ºC	20.9	Pass
Humidity	10	70	%	24.3	Pass
Velocity	2.07	2.13	m/s	2.130	Pass
Resistive Force	3450	4060	N	4022.3	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18546	11/19/2022	5/18/2023




Pendulum Acceleration
Max: 138.0 g's
Min: -0.9 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]

APPENDIX D

DUMMY CALIBRATION AND PERFORMANCE VERIFICATION DATA

Table 1 – Driver Dummy Instrumentation

Instrumentation		Axis/Location	Hybrid III 50th S/N: 142		
			Serial Number	Manufacturer	Calibration Date
Head Accelerometers	Primary	X	P51681	Endevco	9/30/2022
		Y	P64151	Endevco	9/30/2022
		Z	P52114	Endevco	9/30/2022
	Redundant	X	P52079	Endevco	9/30/2022
		Y	P58905	Endevco	9/30/2022
		Z	P63996	Endevco	9/30/2022
Head Angular Rate Sensors		X	15693	DTS ARS	3/15/2022
		Y	15224	DTS ARS	3/15/2022
		Z	14919	DTS ARS	3/15/2022
Upper Neck Load Cell		FX, Fy, Fz MX,MY, MZ	2187-FX	Denton	6/13/2022
Chest Accelerometers	Primary	X	P51991	Endevco	9/30/2022
		Y	P51269	Endevco	9/30/2022
		Z	P49185	Endevco	9/30/2022
	Redundant	X	P68059	Endevco	9/30/2022
		Y	P51713	Endevco	9/30/2022
		Z	P78824	Endevco	9/30/2022
Chest Potentiometer		X	0075	JDK	10/3/2022
Pelvis Accelerometer		X	P58800	Endevco	9/30/2022
		Y	P52157	Endevco	9/30/2022
		Z	P83317	Endevco	9/30/2022
Femur Load Cells - Left	Primary	Z	DI4211-FZ1	Denton	6/14/2022
	Redundant	Z	DI4211-FZ2	Denton	6/14/2022
Femur Load Cells - Right	Primary	Z	115-FZ1	Denton	6/14/2022
	Redundant	Z	115-FZ2	Denton	6/14/2022
Tibia Load Cells - Left	Upper	MX, MY, FZ	407-FZ	Denton	6/10/2022
	Lower	MX, MY, FZ	396-FZ	Denton	6/9/2022
Tibia Load Cells – Right	Upper	MX, MY, FZ	362-FZ	Denton	6/9/2022
	Lower	MX, MY, FZ	364-FZ	Denton	6/9/2022
Foot Accelerometers - Left	Rear	X	P82756	Endevco	9/30/2022
	Front	Z	P51872	Endevco	9/30/2022
Foot Accelerometers - Right	Rear	X	P66942	Endevco	9/30/2022
	Front	Z	P58779	Endevco	9/30/2022
Seat belt Load Cells	Lap		1900807	MESSRING	2/7/2023
	Shoulder		168	GFE	6/10/2022

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	12/13/2022
		Y	P83335	Endevco	12/13/2022
		Z	P64149	Endevco	12/12/2022
	Redundant	X	P52008	Endevco	12/13/2022
		Y	P52045	Endevco	12/13/2022
		Z	P74774	Endevco	12/12/2022
Head Angular Rate Sensors		X	15217	DTS	3/15/2022
		Y	15697	DTS PRO-18K	3/16/2022
		Z	15696	DTS ARS	3/16/2022
Upper Neck Load Cell		FX, Fy, Fz MX,MY, MZ	1916-FX	Humanetics	6/10/2022
Chest Accelerometers	Primary	X	T21142	Endevco	12/12/2022
		Y	P83346	Endevco	12/12/2022
		Z	P49190	Endevco	12/12/2022
	Redundant	X	P58794	Endevco	12/12/2022
		Y	P69791	Endevco	12/12/2022
		Z	T11253	Endevco	12/12/2022
Chest Potentiometer		X	0720	Servo	12/12/2022
Pelvis Accelerometer		X	P58735	Endevco	12/12/2022
		Y	P77587	Endevco	12/12/2022
		Z	P51285	Endevco	12/12/2022
Femur Load Cells - Left	Primary	Z	135-FZ1	Denton	6/14/2022
	Redundant	Z	135-FZ2	Denton	6/14/2022
Femur Load Cells - Right	Primary	Z	136-FZ1	Denton	6/14/2022
	Redundant	Z	136-FZ2	Denton	6/14/2022
Tibia Load Cells - Left	Upper	MX, MY, FZ	364-FZ	Denton	6/10/2022
	Lower	MX, MY, FZ	398-FZ	Denton	6/8/2022
Tibia Load Cells – Right	Upper	MX, MY, FZ	368-FZ	Denton	6/10/2022
	Lower	MX, MY, FZ	490-FZ	Denton	6/8/2022
Foot Accelerometers - Left	Rear	X	P78959	Endevco	12/12/2022
	Front	Z	P83418	Endevco	12/12/2022
Foot Accelerometers - Right	Rear	X	P83428	Endevco	12/12/2022
	Front	Z	P80265	Endevco	12/12/2022
Seat belt Load Cells	Lap		278	GFE	6/14/2022
	Shoulder		290	GFE	6/14/2022

Table 3 – Vehicle Instrumentation

Instrumentation			Axis	Serial Number	Manufacturer	Calibration Date
Crossmember/Rear Seat Accelerometers	Left	Primary	X	A398651	Measurement Specialties	1/20/2023
			Z	A399938	Measurement Specialties	1/20/2023
		Redundant	X	A413583	Measurement Specialties	1/20/2023
	Right	Primary	X	A374310	Measurement Specialties	2/6/2023
			Z	A400035	Measurement Specialties	2/6/2023
		Redundant	X	G22188	Endevco	2/6/2023
Engine Accelerometers	Top		X	G22620	Endevco	11/2/2022
	Bottom		X	A398321	Measurement Specialties	11/29/2022