

REPORT NUMBER: 214P-CAL-24-003

**SAFETY COMPLIANCE TESTING FOR FMVSS 214
DYNAMIC SIDE IMPACT PROTECTION
RIGID POLE TEST**

**Mazda Motor Corporation
2024 Mazda CX-90
5 Door SUV**

NHTSA No: C20245402

**PREPARED BY:
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November 01, 2023

FINAL REPORT

**PREPARED FOR:
U. S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
ENFORCEMENT
OFFICE OF VEHICLE SAFETY COMPLIANCE
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WASHINGTON, D.C. 20590**

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Date: November 01, 2023

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Date: November 01, 2023

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Accepted by

Date: _____

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16. Abstract A 31.00 km/h (19.3 mph), 75° oblique compliance test was conducted on the subject 2024 Mazda CX-90 5 Door SUV in accordance with the specifications of the Office of Vehicle Safety Compliance TP-214P-01 for the determination of FMVSS No.214 Side Impact Protection compliance. This test was conducted at Calspan Corporation's Transportation Test Operations facility in Buffalo, New York on October 16, 2023. The impact velocity of the vehicle was 31.01 km/h, and the ambient temperature at the struck (driver's) side of the target vehicle was 21°C. The target vehicle's maximum post-test static crush was 289 mm located at level 3. The test vehicle's occupant performance data is as follows: <table border="1"> <thead> <tr> <th rowspan="2">Measurement Description</th> <th colspan="3">Driver ATD (ES-2re)</th> </tr> <tr> <th>Units</th> <th>IARV</th> <th>Result</th> </tr> </thead> <tbody> <tr> <td>Head Injury Criteria (HIC36)</td> <td></td> <td>1000</td> <td>382.154</td> </tr> <tr> <td>Maximum Thoracic Rib Deflection</td> <td>mm</td> <td>44</td> <td>22.935</td> </tr> <tr> <td>Total Abdominal Force</td> <td>N</td> <td>2500</td> <td>814.015</td> </tr> <tr> <td>Pubic Symphysis Force</td> <td>N</td> <td>6000</td> <td>1996.595</td> </tr> </tbody> </table> The two doors on the struck side of the vehicle did not separate from the body at the hinges or latches and the opposite doors did not open during the side impact event.						Measurement Description	Driver ATD (ES-2re)			Units	IARV	Result	Head Injury Criteria (HIC36)		1000	382.154	Maximum Thoracic Rib Deflection	mm	44	22.935	Total Abdominal Force	N	2500	814.015	Pubic Symphysis Force	N	6000	1996.595
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Pubic Symphysis Force	N	6000	1996.595																									
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SECTION 1

PURPOSE AND SUMMARY OF TEST

PURPOSE

This side impact test was conducted as part of the FY 2024 FMVSS 214 Side Impact Protection Compliance Test Program, sponsored by the National Highway Traffic Safety Administration (NHTSA), under Contract No. 693JJ923D000043. The purpose of this test was to evaluate side impact protection in a 2024 Mazda CX-90 5 Door SUV. The side impact test was conducted in accordance with the Office of Vehicle Safety Compliance's Laboratory Test Procedure, TP-214P-01 dated September 2012.

SUMMARY

A rigid pole side impact test was conducted on a 2024 Mazda CX-90 5 Door SUV. The subject vehicle was towed into the rigid pole at an angle of 75° and a velocity of 31.01 km/h. The test was conducted by Calspan Corporation's Transportation Test Operations facility in Buffalo, New York on October 16, 2023. Pre-test and post-test photographs of the test vehicle and side impact dummy (ES2re) are included in Appendix I of this report.

One Part 572U (ES-2re) dummy was placed in the driver designated seating position according to instructions specified in the TP-214P-01 Test Procedure, dated September 2012. The side impact event was documented by nine High Speed Cameras and one real time camera.

The ES2re male dummy was instrumented accordingly:

- Primary and redundant head CG tri-axial accelerometers
- Chest upper rib, middle rib, and lower rib y-axis displacement potentiometers
- Abdomen forward, middle, and rear y-axis load cells
- Lower spine (T12) tri-axial accelerometers
- Public symphysis y-axis load cell

Appendix II contains the dummy response data. Dummy configuration and performance verification data can be found in Appendix IV of this report. Appendix V identifies all serial numbers, manufacturers, and calibration dates for test equipment, dummy sensors, potentiometers, and load cells used to collect data during the test.

Injury readings for the ES2re dummy were recorded as follows:

INJURY READINGS

Measurement Description	Driver ATD (ES2re)		
	Units	IARV	Result
Head Injury Criteria (HIC36)		1000	382.154
Upper Rib Deflection	mm	44	22.085
Mid Rib Deflection	mm	44	19.274
Lower Rib Deflection	mm	44	22.935
Abdominal Load (front)	N		244.630
Abdominal Load (mid)	N		291.609
Abdominal Load (rear)	N		283.864
Total Abdominal Force	N	2500	814.015
Pubic Symphysis Force	N	6000	1996.595

SECTION 2

OCCUPANT AND VEHICLE INFORMATION

This section contains information reporting for the following Data Sheets:

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DATA SHEET NO. 1
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2024 Mazda CX-90 5 Door SUV

NHTSA No.: C20245402

Test Facility: Calspan

Test Date: 10/16/2023

TEST VEHICLE INFORMATION AND OPTIONS

Make	Mazda	Anti-Lock Brakes (ABS)	Yes
Model	CX-90	All-Wheel Drive (AWD)	Yes
Body Style	SUV	Traction Control System (TCS)	Yes
VIN	JM3KKAHD5R1117846	Electric Stability Control (ECS)	Yes
Body Color	White	Curtain Airbags	Yes
Engine Displacement (L)	3.3	Torso Airbags – Front Seats	Yes
Type / No. Cylinders	I6 Turbo	Torso Airbags – Rear Seats	Yes
Engine Placement	Longitudinal	Combination/Head Torso Bag	No
Transmission Type	Automatic	Pelvic Airbag – Front Seats	No
Transmission Speeds	8-Speed	Pelvis Airbag – Rear Seats	No
Overdrive	Yes	Knee Airbag – Driver	Yes
Final Drive	All Wheel Drive	Knee Airbag – Front Passenger	Yes
Odometer Reading (mi)	19 mi	Seat Belt Pretensioners – Front Seats	Yes
		Seat Belt Pretensioners – Rear Seats	Yes
		Seat Belt Load Limiter – Front Seats	Yes
		Seat Belt Load Limiter – Rear Seats	Yes
		Tire Pressure Monitoring System (TPMS)	Yes
		Tilt Steering Wheel	Yes
		Automatic Door Locks (ADL)	Yes
		Power Window Auto-reverse	Yes
		Power Seats	Yes
		Other Safety Restraint	N/A

DATA FROM CERTIFICATION LABEL

Manufactured By	Mazda Motor Corporation	GVWR (kg)	2911
Date of Manufacture	06/23	GVWR Front (kg)	1263
Vehicle Type	MPV	GVWR Rear (kg)	1694

VEHICLE SEATING AND WEIGHT CAPACITY DATA

Measured Parameter	Front	Rear	Third	Total
Type of Seats (Bench or Bucket)	Bucket	Split Bench	N/A	
Designated Seating Capacity (DSC)	2	3	N/A	5
Capacity Weight (VCW) (kg)				616
Cargo Weight (RCLW) (kg)				71.68

DATA SHEET NO. 2

VEHICLE TIRE INFORMATION

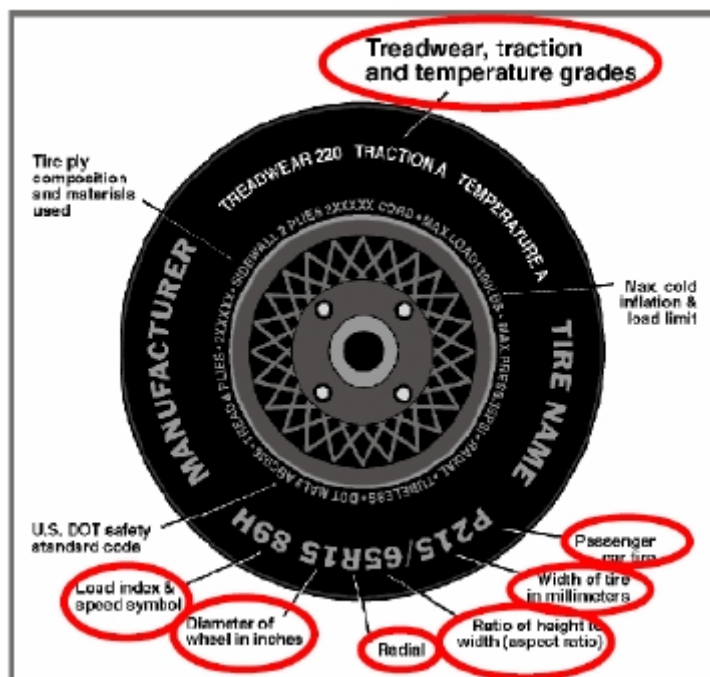
Test Vehicle: 2024 Mazda CX-90 5 Door SUV

Test Facility: Calspan

NHTSA No.: C20245402

Test Date: 10/16/2023

Collected for year, make, model, & VIN, all items circled in red, tire manufacturer and tire name



VEHICLE TIRE INFORMATION

Tire Placard	Front	Rear
Recommended Cold Pressure (kPa)	250	250
Recommended Tire Size	265/55R19	265/55R19
Tire Sidewall	Front	Rear
Maximum Tire Pressure (kPa)	350	350
Tire Size on Vehicle	265/55R19	265/55R19
Tire Manufacturer Model	Toyo	Toyo
Tire Name	Open Country A51	Open Country A51
Tire Type	All Season	All Season
Tire Width	265	265
Aspect Ratio	55	55
Radial	Yes	Yes
Wheel Diameter	19"	19"
Load Index / Speed Symbol	109V	109V
Treadwear	300	300
Traction Grade	B	B
Temperature Grades	A	A

DATA SHEET NO. 3
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2024 Mazda CX-90 5 Door SUV
Test Facility: Calspan

NHTSA No.: C20245402
Test Date: 10/16/2023

TIRE PRESSURES

	Units	LF	RF	LR	RR
As Delivered	kPa	247	245	248	242
Tire Placard	kPa	250	250	250	250

TEST VEHICLE WEIGHTS

	Units	As Delivered (UVW)			Fully Loaded			As Tested		
		Front	Rear	Total	Front	Rear	Total	Front	Rear	Total
Left	kg	558	520		584	593		600	565	
Right	kg	552	516		554	570		556	569	
Ratio	%	51.7	48.3		49.5	50.5		50.5	49.5	
Totals	kg	1110	1036	2146	1138	1163	2301	1156	1134	2290

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value	
Total As Delivered Weight (UVW)	kg	2146	(A)
Weight of Test Dummy	kg	81	(B)
Rated Cargo / Luggage Weight (RCLW)	kg	71.68	(C)
Calculated Vehicle Target Weight (TVTW)	kg	2298.7	(A+B+C)

TEST VEHICLE ATTITUDES AND CG

Measurement Description	Units	As Delivered	Fully Loaded	As Tested
Driver Door Sill Angle	Deg	-0.05	-0.10	-0.05
Front Passenger Sill Angle	Deg	+0.10	+0.15	+0.15
Front Bumper-Line Angle	Deg	+0.30	+0.65	+0.30
Rear Bumper-Line Angle	Deg	-0.10	-0.15	-0.10

ND = Nose Down (-), NU = Nose Up (+), LD = Left Down (-), LU = Left Up (+)

CALCULATION OF VERTICAL IMPACT REFERENCE LINE

Measured Parameter	Units	Value
Test Vehicle Wheelbase	mm	3117
Vertical Impact Reference Line Aft of Front Axle	mm	1541

WEIGHT OF BALLAST AND VEHICLE COMPONENTS REMOVED TO MEET TVTW

Component Description	Weight (kg)
Trunk Carpeting	6
Spare Tire	10
Jack	3
Third Row Seat	34
Right Rear Window	3
Ballast (if any)	79

DATA SHEET NO. 4
SEAT AND SEAT BELT ANCHORAGE ADJUSTMENT DATA

Test Vehicle: 2024 Mazda CX-90 5 Door SUV
Test Facility: Calspan

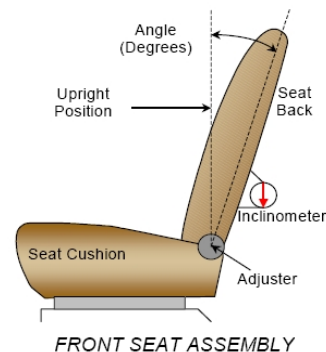
NHTSA No.: C20245402
Test Date: 10/16/2023

SEAT BACK ANGLE ADJUSTMENT

The driver and passenger seat backs are positioned to the manufacturer's designated angle provided in the Form1.

	Units	Seat Back Angle
Driver Seat	degrees	5.5
Front Passenger Seat	degrees	7.6

*Measurement taken on Headrest Post



SEAT HEIGHT AND ANGLE

Seat	As Tested SCRL Angle (Mid) (°)	SCR P Height Position	SCR P Height (mm)		
			Rearmost	Mid-Fore / Aft	Forward-Most
Driver Seat	12.3	Max	51	66	78
		Mid	28	44	56
		Min	4	22	33
Front Passenger Seat	Fixed	Max			
		Mid			
		Min			

SEAT FORE / AFT POSITION

Seat	Total Fore / Aft Travel		Placed in Position #	
	mm	Detents*	mm	Detents*
Driver Seat	256	Power	128	Power
Front Passenger Seat	230	30 (0-29)	119	15

SEAT BELT ANCHORAGE ADJUSTMENT

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

HEAD RESTRAINT ADJUSTMENT

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

DATA SHEET NO. 5
FUEL SYSTEMS AND STEERING WHEEL POSITION DATA

Test Vehicle: 2024 Mazda CX-90 5 Door SUV
 Test Facility: Calspan

NHTSA No.: C20245402
 Test Date: 10/16/2023

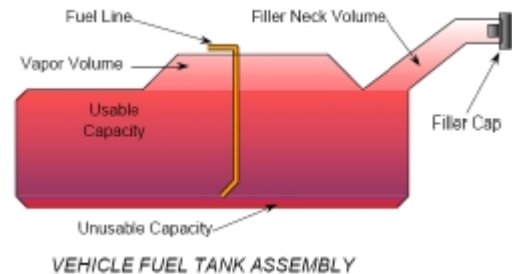
FUEL TANK CAPACITY DATA

Description	Liters
Usable Capacity of (Form No.1)	70
Usable Capacity of (Owner's Manual)	70
92 - 94% of Usable Capacity	64.4 - 65.8
Actual Amount of Solvent Used in Test	65.1

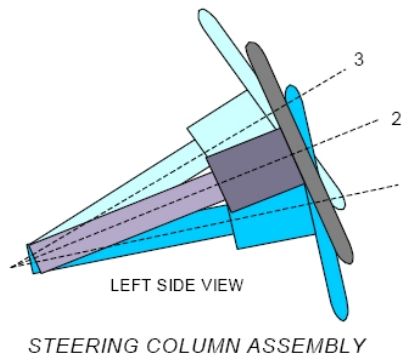
FUEL PUMP

Describe the operation of the fuel pump.

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



STEERING COLUMN POSITIONS

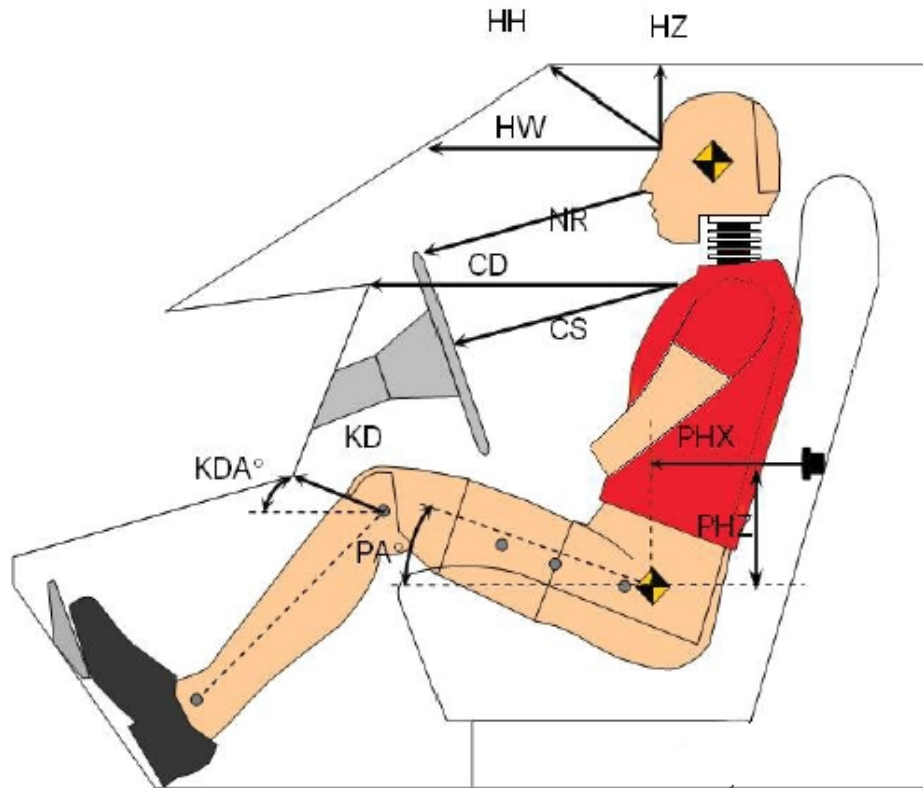


	Degrees	Fore / Aft Position (mm)
Lowermost - Position No. 1	23.1	
Geometric center - Position No. 2	25.4	
Uppermost - Position No. 3	27.7	
Telescoping Steering Wheel Travel		74
Test Position	25.4	37

DATA SHEET NO. 6
DUMMY LONGITUDINAL CLEARANCE DIMENSIONS

Test Vehicle: 2024 Mazda CX-90 5 Door SUV
 Test Facility: Calspan

NHTSA No.: C20245402
 Test Date: 10/16/2023



Left Side View

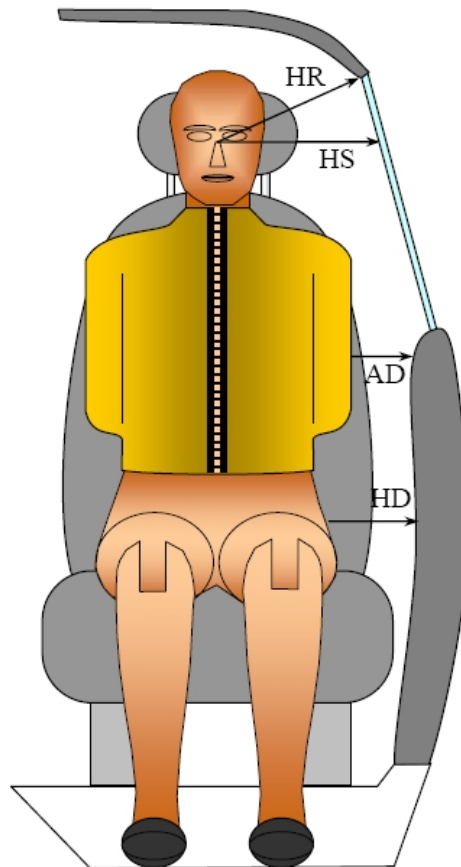
DUMMY LONGITUDINAL CLEARANCE DIMENSION INFORMATION

Driver Code	Description	Driver	
		Length (mm)	Angle (°)
HH	Head to Header	347	
HW	Head to Windshield	588	
HZ	Head to Roof Liner	176	
NR	Nose to Rim	450	
CD	Chest to Dash	561	
CS	Chest to Steering Wheel	349	
KD(L) / KDA(L)°	Left Knee to Dash	179	34.7
KD(R) / KDA(R)°	Right Knee to Dash	180	32.3
PAX°	Pelvic Tilt Angle (X-Axis)		21.0
PAY°	Pelvic Tilt Angle (Y-Axis)		-0.2
PHX	Hip Point to Striker (X-Axis)	185	
PHZ	Hip Point to Striker (Z-Axis)	139	

DATA SHEET NO. 7
DUMMY LATERAL CLEARANCE DIMENSIONS

Test Vehicle: 2024 Mazda CX-90 5 Door SUV
 Test Facility: Calspan

NHTSA No.: C20245402
 Test Date: 10/16/2023



FRONT VIEW OF DUMMY

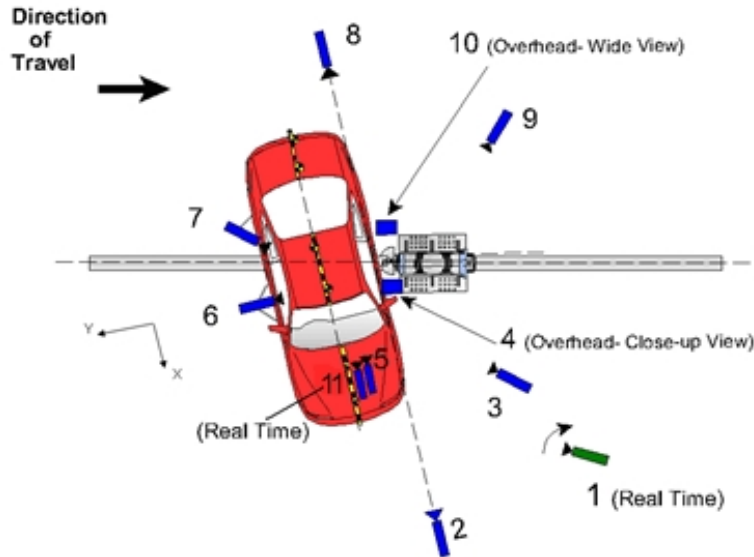
DUMMY LATERAL CLEARANCE DIMENSION INFORMATION

Code	Measurement Description	Units	Driver
HR	Head to Side Header	mm	218
HS	Head to Side Window	mm	341
AD	Arm to Door	mm	83
HD	H-Point to Door	mm	166

DATA SHEET NO. 8 LOCATION OF CAMERA

Test Vehicle: 2024 Mazda CX-90 5 Door SUV
Test Facility: Calspan

NHTSA No.: C20245402
Test Date: 10/16/2023



CAMERA LOCATIONS AND DATA

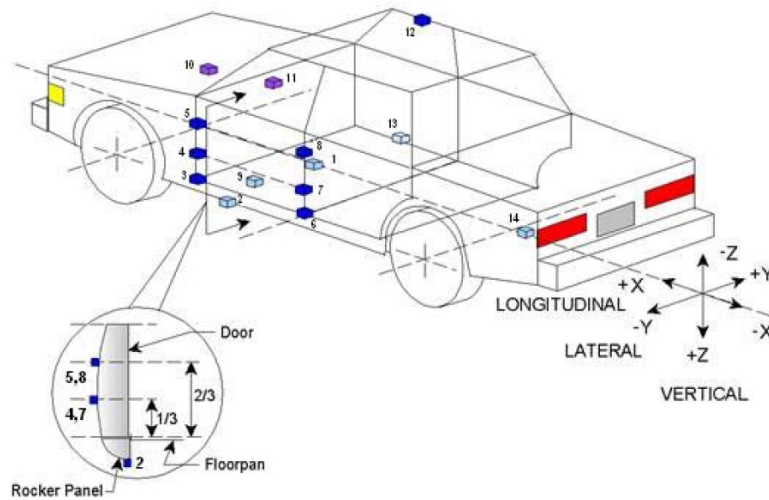
No.	Camera View	Coordinates (mm)			Lens Length (mm)	Operating Frame Rate (fps)
		X	Y	Z		
1	Real-time (24 - 30 fps) pan view of impact				Zoom	30
2	Front ground level - impact view	0	8453	-1755	28	1000
3	Impact side 45° - forward pole view	712	5534	-1558	24	1000
4	Overhead Close-up view of impact	0	0	-9200	28	1000
5	Onboard - dummy front view				25	1000
6	Onboard - dummy side view				12.5	1000
7	Onboard - dummy rear oblique view				12.5	1000
8	Rear ground level - impact view	0	-8848	-1582	28	1000
9	Impact side 45° - rearward pole view	-3909	-4030	-1514	24	1000
10	Overhead wide - view of impact	0	0	-9200	16	1000

Notes: Reference - From Point of Impact for X and Y; from Ground for Z
+X = Forward of vehicle, +Y = Right of vehicle, +Z = Down
* All measurements accurate to ± 6 mm. Vehicle is at a 75° angle to the rigid pole.

DATA SHEET NO. 9
TEST VEHICLE ACCELEROMETER LOCATIONS

Test Vehicle: 2024 Mazda CX-90 5 Door SUV
Test Facility: Calspan

NHTSA No.: C20245402
Test Date: 10/16/2023



TEST VEHICLE ACCELEROMETER LOCATIONS

No.	Accelerometer Location	Coordinates (mm)		
		X	Y	Z
1	Vehicle CG	2321	3	108
2	Left Floor Sill	3253	-679	274
3	A-Pillar Sill	3451	-622	246
4	A-Pillar Low	3506	-640	3
5	A-Pillar Mid	3347	-659	-468
6	B-Pillar Sill	2423	-680	265
7	B-Pillar Low	2468	-714	31
8	B-Pillar Mid	2390	-692	-401
9	Seat	2764	-551	257
10	Engine	4360	-1	-205
11	Firewall	3713	-573	-224
12	Roof	2500	651	-960
13	Right Floor Sill	3105	684	270
14	Rear Deck	827	2	226

Reference: X – Rear surface of vehicle (+ forward)
Y – Vehicle centerline (+ to right)
Z – Ground plane (+ down)

DATA SHEET NO. 10
TEST VEHICLE ACCELEROMETER DATA SUMMARY

Test Vehicle: 2024 Mazda CX-90 5 Door SUV
Test Facility: Calspan

NHTSA No.: C20245402
Test Date: 10/16/2023

Loc. No	Description	Axes	Units	Positive Direction		Negative Direction	
				Max	Time (ms)	Max	Time (ms)
1	Vehicle CG	X	g	14.32	36.20	-31.80	57.90
	Vehicle CG	Y	g	51.46	48.50	-17.53	42.35
	Vehicle CG	Z	g	14.56	43.85	-17.67	22.75
	Vehicle CG Resultant	N/A	g	51.59	48.55	0.02	-14.55
2	Floor Sill (Left)	Y	g	74.52	18.10	-31.52	21.90
3	A Pillar Sill	Y	g	60.99	18.75	-48.42	41.40
4	A Pillar Low	Y	g	46.84	48.25	-37.29	45.00
5	A Pillar Mid	Y	g	68.01	42.25	-49.84	37.70
6	B Pillar Sill	Y	g	159.87	21.25	-163.99	25.90
7	B Pillar Low	Y	g	138.28	18.20	-27.38	36.55
8	B Pillar Mid	Y	g	134.56	12.80	-34.82	27.05
9	Seat	Y	g	25.93	18.25	-53.22	39.70
10	Engine Top	X	g	3.48	113.05	-13.24	49.30
	Engine Top	Y	g	26.32	49.30	-12.52	33.90
11	Firewall	Y	g	19.79	45.80	-2.24	53.40
12	Roof	Y	g	59.62	42.95	-4.83	18.20
13	Floor Sill (Right)	Y	g	23.17	47.90	-1.91	176.50
14	Rear Deck	X	g	3.40	127.20	-6.20	67.85
	Rear Deck	Y	g	17.12	63.20	-3.36	180.70

DATA SHEET NO. 11
DUMMY INJURY RESPONSE DATA
(Subpart U, ES-2re)

Test Vehicle: 2024 Mazda CX-90 5 Door SUV

NHTSA No.: C20245402

Test Facility: Calspan

Test Date: 10/16/2023

Dummy Serial No. D037

Description	Axes	Positive Direction		Negative Direction	
		MAX	TIME (ms)	MAX	TIME (ms)
HEAD ACCELERATION (g)					
Longitudinal	X	4.27	90.30	-29.19	49.25
Lateral	Y	56.11	56.65	-15.13	96.85
Vertical	Z	14.04	43.40	-4.34	63.15
Resultant	N/A	59.94	56.65		
HIC36 (t1, t2)	N/A	382.15		t1 =44.35	t2 =69.55
THORAX DEFLECTION (mm)					
Upper Rib	Y	22.09	56.55	-5.25	25.15
Middle Rib	Y	19.27	55.80	-4.65	95.55
Lower Rib	Y	22.94	53.05	-0.08	122.80
ABDOMINAL FORCES (N)					
Front	Y	244.63	44.65	-11.33	14.45
Middle	Y	291.61	40.05	-1.81	265.25
Rear	Y	283.86	40.10	-7.83	116.50
SUM	N/A	814.01	44.60		
PELVIS FORCES (N)					
Pubic Symphysis	Y	55.94	249.70	-1996.60	65.65

Reference: Positive Direction - Longitudinal (X) = forward
 - Lateral (Y) = to right
 - Vertical (Z) = down

DATA SHEET NO. 12
POST-TEST OBSERVATIONS

Test Vehicle: 2024 Mazda CX-90 5 Door SUV
Test Facility: Calspan

NHTSA No.: C20245402
Test Date: 10/16/2023

IMPACT POINT DATA

Measured Parameter	Units	Value
Vertical Impact Ref Line - Aft of Front Axle, Intended Impact Pt	mm	1541
Actual Impact Point - Aft of Front Axle	mm	1540
Difference	mm	1

TEST DUMMY INFORMATION AND CONTACT POINTS

Dummy Body Part	Driver Seat Dummy (ES2re)
Head Contact	Side Header, Curtain Airbag & Headrest
Upper Torso Contact	Seatback & Torso/Pelvis Airbag
Lower Torso Contact	Seatback
Left Knee Contact	Driver door
Right Knee Contact	Left Knee

POST-TEST DOOR PERFORMANCE

Description	Struck Side		Non-Struck Side		Rear Hatch/Other
	Front	Rear	Front	Rear	
Remained Closed and Operational	No	No	Yes	Yes	Yes
Total Separation from Vehicle at Hinges or Latches	No	No	No	No	No
Latch or Hinge Systems Pulled Out of Their Anchorages	No	No	No	No	No
Disengaged from Latched Position	No	No	No	No	No
Latch Separated from Striker	No	No	No	No	No
Jammed Shut	Yes	Yes	No	No	No
If Door Opened at Striker, Width of Opening at Striker (mm)	0	0	0	0	0

POST-TEST SEAT PERFORMANCE

Description	Struck Side		Non-Struck Side	
	Front	Rear	Front	Rear
Seat Movement Along Seat Track	No	No	No	No
Seat Disengagement from Floor Pan	No	No	No	No

POST-TEST STRUCTURAL OBSERVATIONS

Critical Areas of Performance	Observations and Conclusions
Pillar Performance	B-Pillar & C-Pillar Buckled
Sill Separation	310mm along struck side sill
Windshield Damage	Cracked throughout
Side Window Damage	Driver window shattered on impact
Other Notable Effects	None

DATA SHEET NO. 12 ... (CONTINUED)
POST-TEST OBSERVATIONS

Test Vehicle: 2024 Mazda CX-90 5 Door SUV
 Test Facility: Calspan

NHTSA No.: C20245402
 Test Date: 10/16/2023

SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

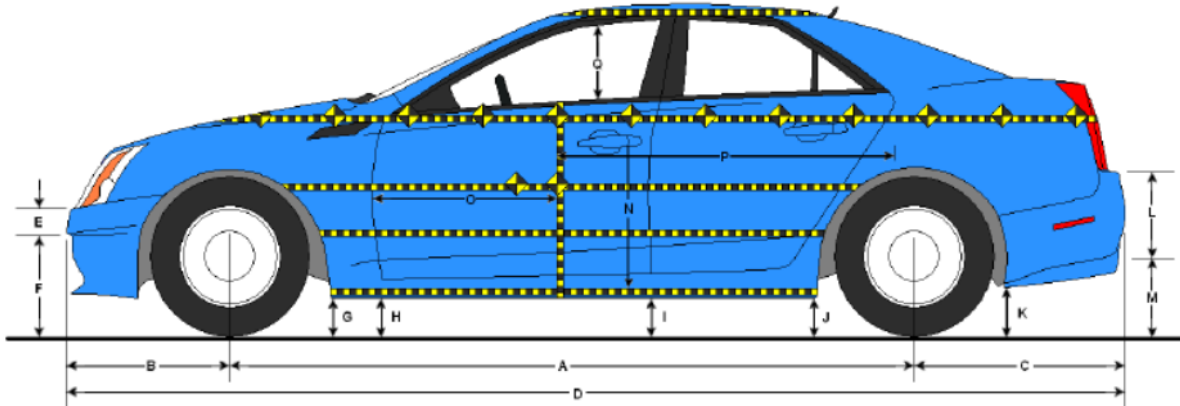
Restraint Type	Struck Side Front Occupant	
	Mounted	Deployed
Front Airbag	Yes	No
Knee Airbag	Yes	No
Head Airbag*	Yes	Yes
Side Airbag 2 - Torso/Pelvis Airbag	Yes	Yes
Seat Belt Pretensioner	Yes	Yes
Seat Belt Load Limiter	Yes	Yes
Other		

*Head Airbag was a curtain airbag

DATA SHEET NO. 13
VEHICLE PRE TEST AND POST TEST MEASUREMENTS

Test Vehicle: 2024 Mazda CX-90 5 Door SUV
 Test Facility: Calspan

NHTSA No.: C20245402
 Test Date: 10/16/2023



LEFT SIDE VIEW

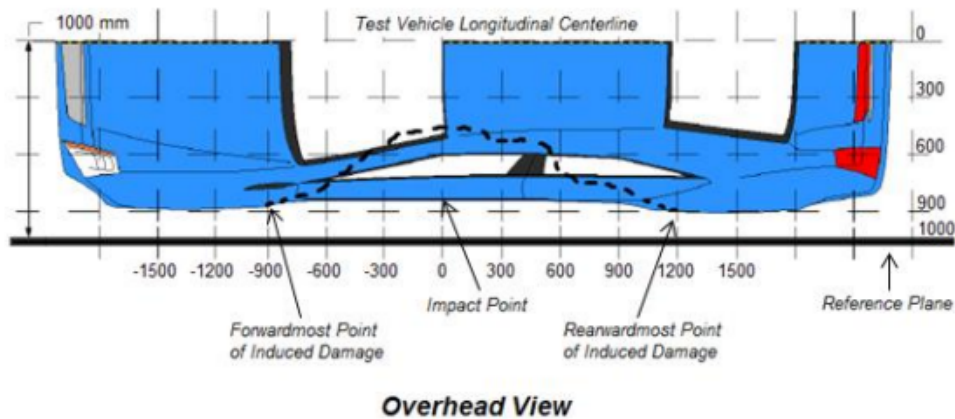
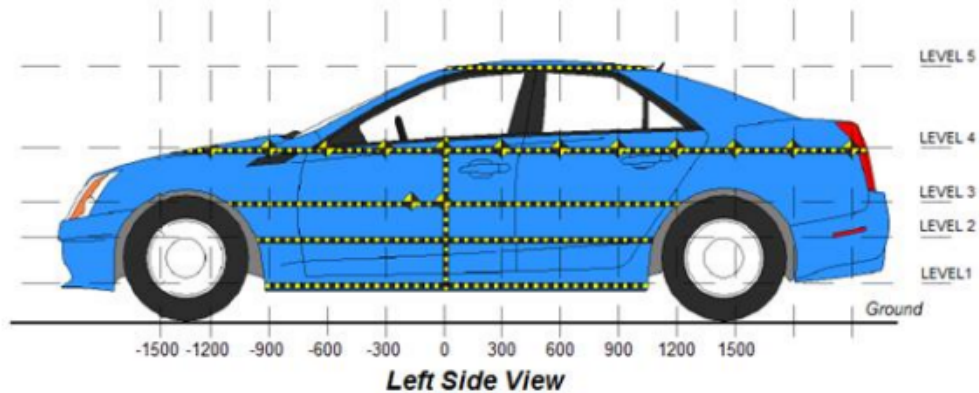
VEHICLE PRE- AND POST-TEST MEASUREMENT INFORMATION

No.	Measurement Description	Pre-Test	Post-Test	Difference
A	Vehicle Wheelbase	3117	3078	39
B	Front Axle to FSOV	855	878	-22
C	Rear Axle to RSOV	1127	1122	5
D	Total Vehicle Length at Centerline	5100	5078	22
E	Front Bumper Thickness	115	115	0
F	Front Bumper Bottom to Ground	456	468	-12
G	Sill Height at Front Wheel Well	241	238	3
H	Sill Height at Front Door Leading Edge	243	243	0
I	Sill Height at B Pillar	255	248	7
J1	Sill Height at Rear Wheel Well	258	271	-13
J2	Pinch Weld Height at Rear Wheel Well	256	275	-19
K	Sill Height Aft of Rear Wheel Well	269	279	-10
L	Rear Bumper Thickness	202	202	0
M	Rear Bumper Bottom to Ground	514	503	11
N	Sill Height to Window Bottom Sill	917	927	-11
O	Front Door Leading Edge to Impact CL	790	742	48
P	Rear Door Trailing Edge to Impact CL	1445	1373	72
Q	Front Window Opening	432	401	31
R	Right Side Length	5027	5021	6
S	Left Side Length	5028	4999	29
T	Vehicle Width at B-Pillars	1913	1784	129

DATA SHEET NO. 14
TEST VEHICLE EXTERIOR CRUSH MEASUREMENTS

Test Vehicle: 2024 Mazda CX-90 5 Door SUV
 Test Facility: Calspan

NHTSA No.: C20245402
 Test Date: 10/16/2023



MAXIMUM EXTERIOR CRUSH MEASUREMENTS

Level	Measurement Description	Units	Height Above Ground	Maximum Exterior Static Crush	Distance from Impact
1	Sill Top	mm	379	213	150
2	Occupant H-Point	mm	747	291	0
3	Mid-Door	mm	809	289	0
4	Window Sill	mm	1150	245	0
5	Window Top	mm	1703	20	150

NOTE: The above measurements should be taken along the vertical impact reference line. Vehicle measurements forward of the vertical impact reference line are negative.

DATA SHEET NO. 14
VEHICLE EXTERIOR CRUSH MEASUREMENTS (CONTINUED)

Test Vehicle: 2024 Mazda CX-90 5 Door SUV
 Test Facility: Calspan

NHTSA No.: C20245402
 Test Date: 10/16/2023

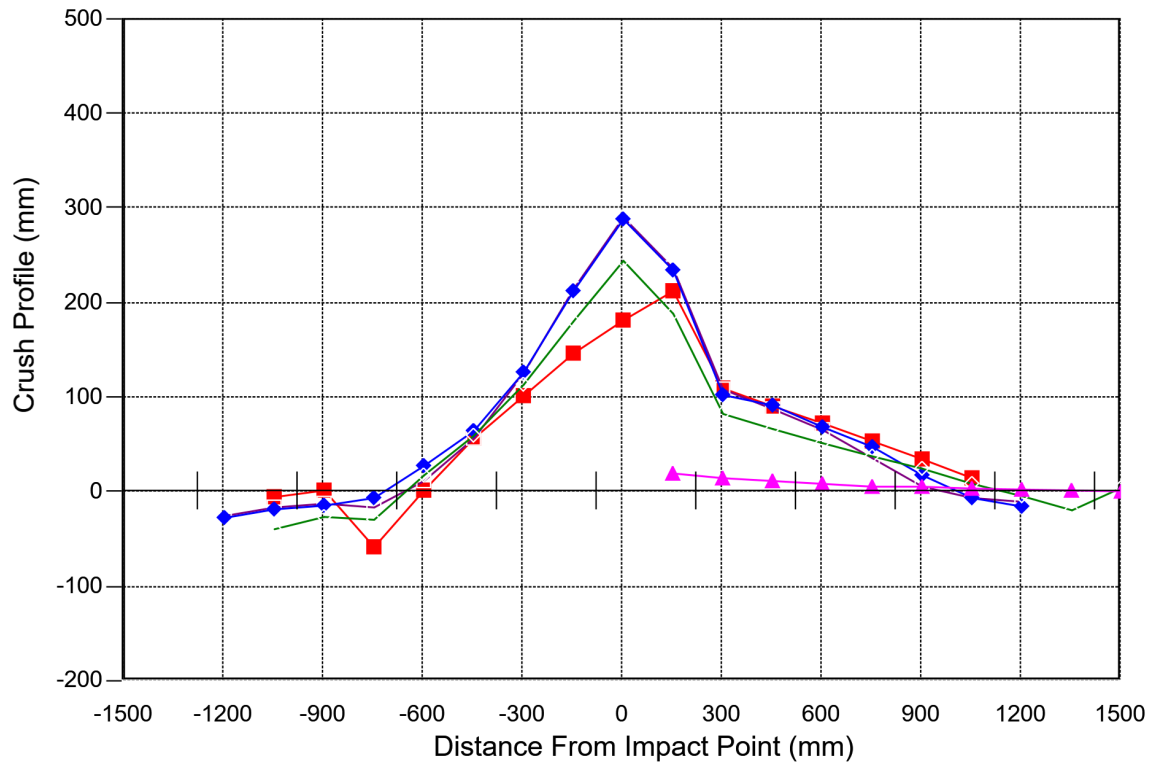
EXTERIOR CRUSH MEASUREMENTS AT EACH LEVEL

	Pre-Test					Post-Test					Difference				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
-1500															
-1350															
-1200		997	983				1022	1010				-25	-27		
-1050	982	973	965	828		987	989	983	867		-5	-16	-18	-39	
-900	972	949	945	841		970	961	959	867		2	-12	-14	-26	
-750	965	939	936	850		1023	955	942	879		-58	-16	-6	-29	
-600	960	934	933	858		958	922	905	840		2	12	28	18	
-450	957	932	931	872		900	875	866	812		57	57	65	60	
-300	955	931	931	882		853	805	804	768		102	126	127	114	
-150	953	931	931	889		806	716	718	708		147	215	213	181	
0	951	932	931	896		769	641	642	651		182	291	289	245	
150	949	932	931	899	640	736	695	696	710	620	213	237	235	189	20
300	947	931	930	902	645	837	822	827	819	630	110	109	103	83	15
450	946	932	931	903	646	855	844	839	836	634	91	88	92	67	12
600	946	935	932	904	645	873	869	863	852	636	73	66	69	52	9
750	948	938	935	904	643	894	902	887	866	637	54	36	48	38	6
900	954	947	942	905	643	919	941	924	880	637	35	6	18	25	6
1050	967	968	960	902	639	952	974	966	893	635	15	-6	-6	9	4
1200		987	982	901	633		997	997	905	630		-10	-15	-4	3
1350				898	619				917	617				-19	2
1500				897	603				892	602				5	1

DATA SHEET NO. 14
TEST VEHICLE EXTERIOR CRUSH MEASUREMENTS (CONTINUED)

Test Vehicle: 2024 Mazda CX-90 5 Door SUV
 Test Facility: Calspan

NHTSA No.: C20245402
 Test Date: 10/16/2023



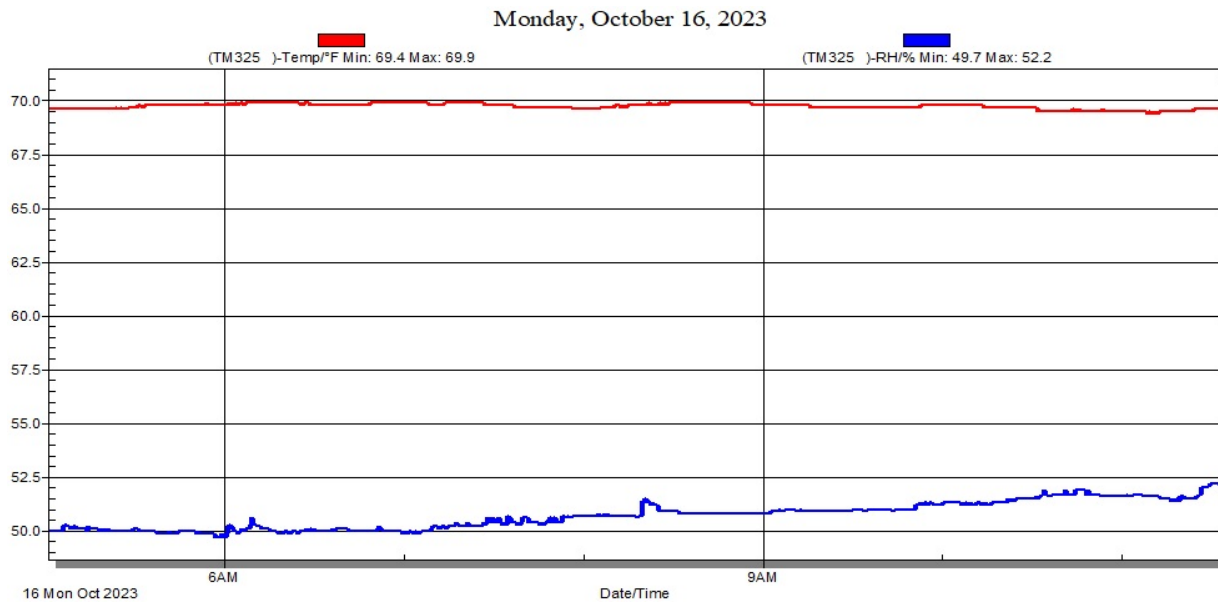
— LEVEL 1 Side Sill: -370 mm above ground	— LEVEL 2 H-Point: -2 mm above ground
— LEVEL 3 Mid Door: 60 mm above ground	— LEVEL 4 Window Sill: 401 mm above ground
— LEVEL 5 Window Top: 954 mm above ground	

Vehicle Exterior Crush Measurements - Visual Representation

DATA SHEET NO. 16
DUMMY / VEHICLE TEMPERATURE AND HUMIDITY STABILIZATION DATA

Test Vehicle: 2024 Mazda CX-90 5 Door SUV
Test Facility: Calspan

NHTSA No.: C20245402
Test Date: 10/16/2023



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

APPENDIX I
PHOTOGRAPHS

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24	Post-Test Close-Up View of Impact Point Target	I-14
25	Close-Up View of Vehicle's Certification Label	I-15
26	Close-Up View of Vehicle's Tire Placard Label	I-15



Figure A-1: Pre-Test Frontal View of Test Vehicle

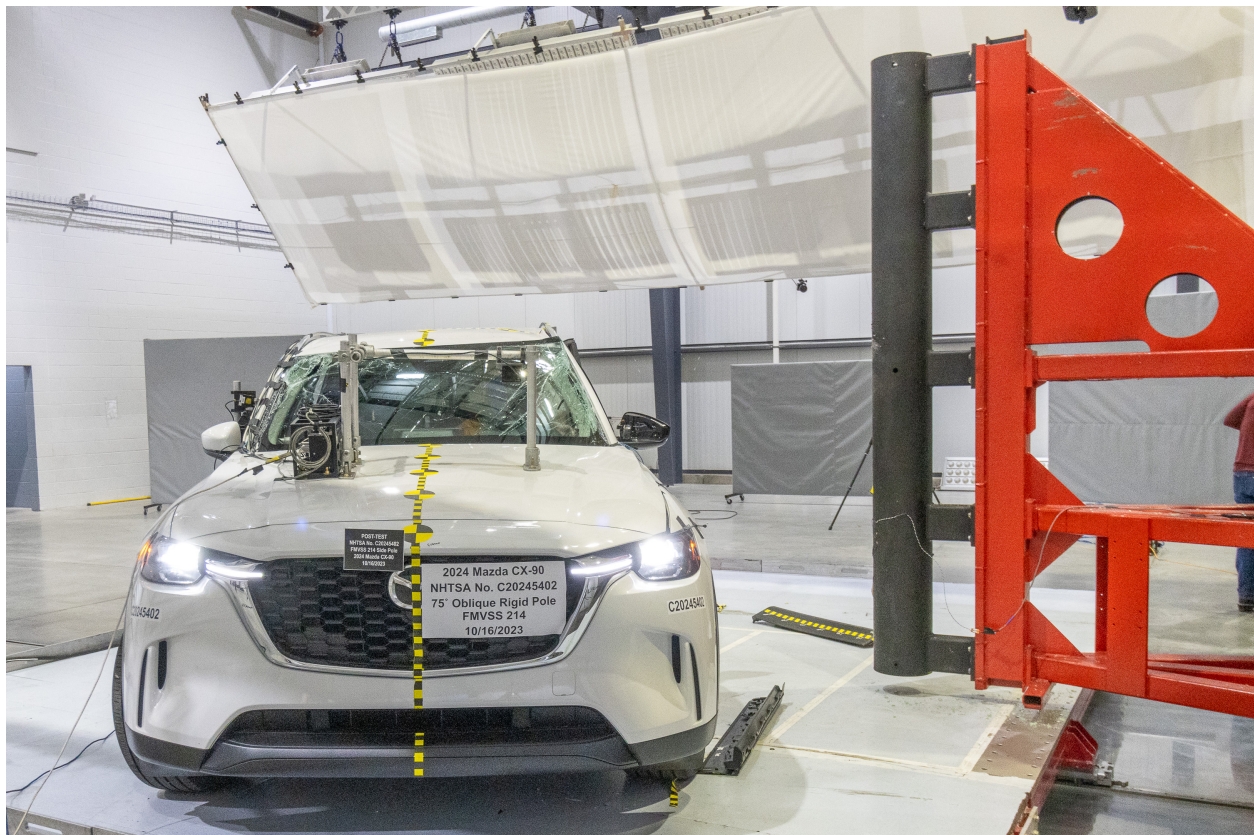


Figure A-2: Post Test Frontal View of Test Vehicle



Figure A-3: Pre-Test Rear View of Test Vehicle



Figure A-4: Post-Test Rear View of Test Vehicle



Figure A-5: Pre-Test Impacted Side View of Test Vehicle



Figure A-6: Post-Test Impacted Side View of Test Vehicle



Figure A-7: Pre-Test Left $\frac{3}{4}$ Front View of Vehicle and Pole



Figure A-8: Pre-Test Left $\frac{3}{4}$ Rear View of Vehicle and Pole

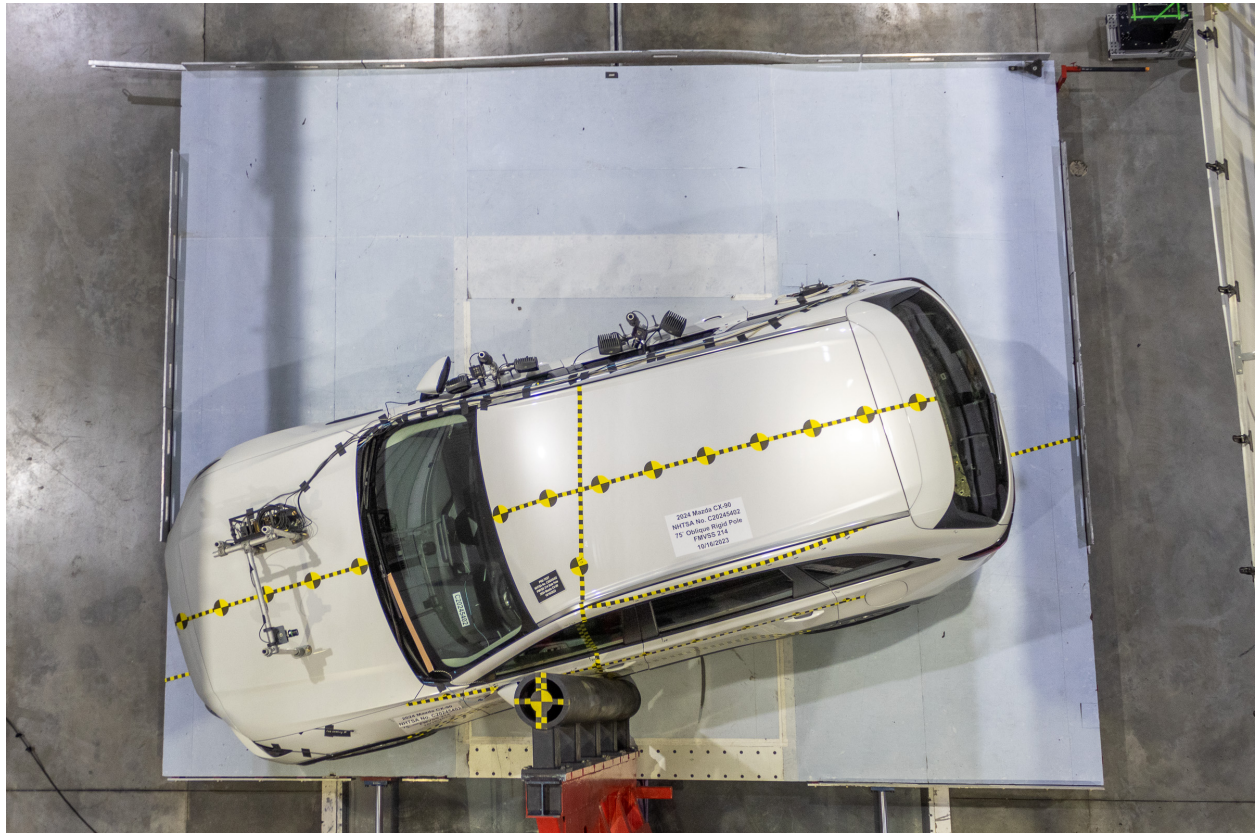


Figure A-9: Pre-Test Overhead View of Test Vehicle

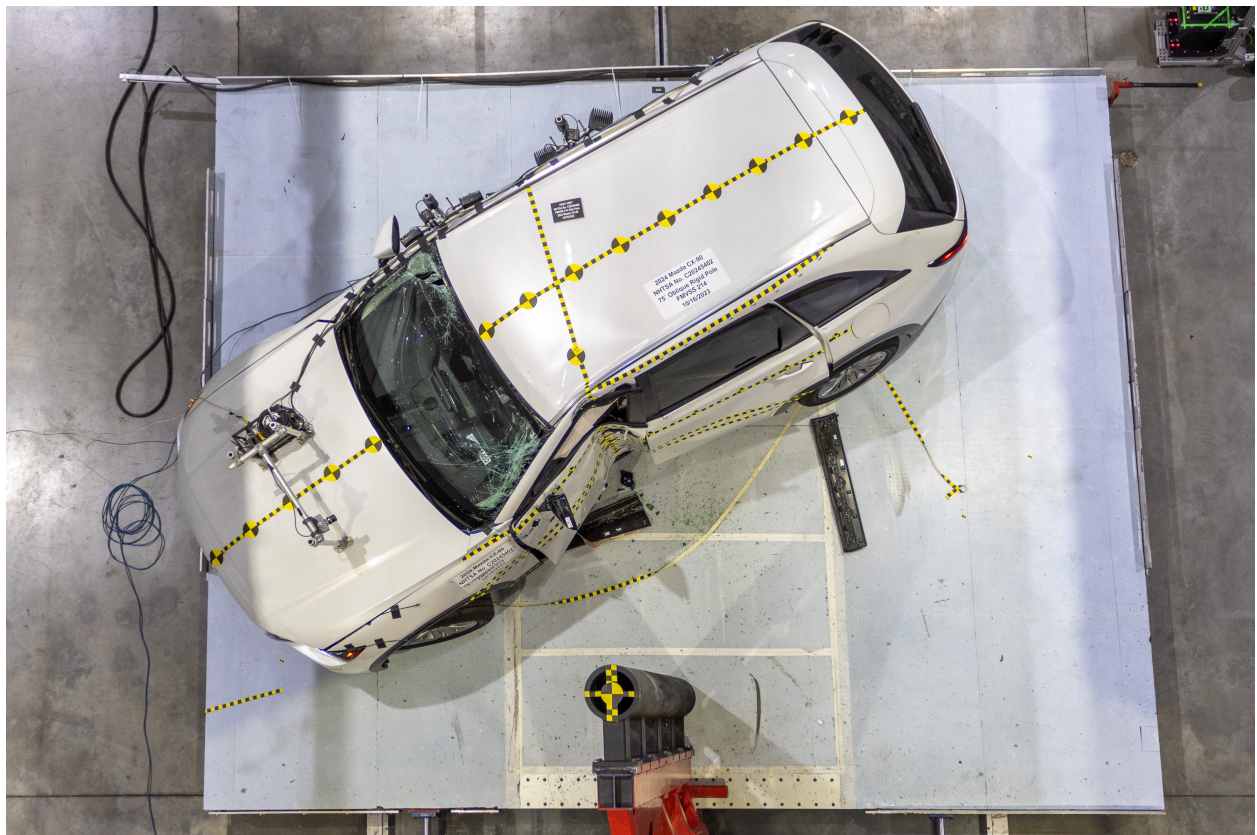


Figure A-10: Post-Test Overhead View of Test Vehicle



Figure A-11: Pre-Test Dummy Through Opposite Window



Figure A-12: Post-Test Dummy Through Opposite Window



Figure A-13: Pre-Test Close-Up of Dummy with Door Closed (Impact Side)



Figure A-14: Post-Test Close-Up of Dummy with Door Closed (Impact Side)



Figure A-15: Pre-Test Dummy with Door Open



Figure A-16: Pre-Test Dummy Shoulder and Door Top View



Figure A-17: Post-Test Dummy Shoulder and Door Top View



Figure A-18: Pre-Test Interior of Front Door Closed (through opposite window)



Figure A-19: Post-Test Interior of Front Door Showing Dummy Impact Locations



Figure A-20: Impact Event



Figure A-21: Post-Test Impact Zone Close-Up View



Figure A-22: Post-Test $\frac{3}{4}$ Front View of Impact Zone



Figure A-23: Post-Test ¾ Rear View of Impact Zone



Figure A-24: Post-Test Close-Up View of Impact Point Target

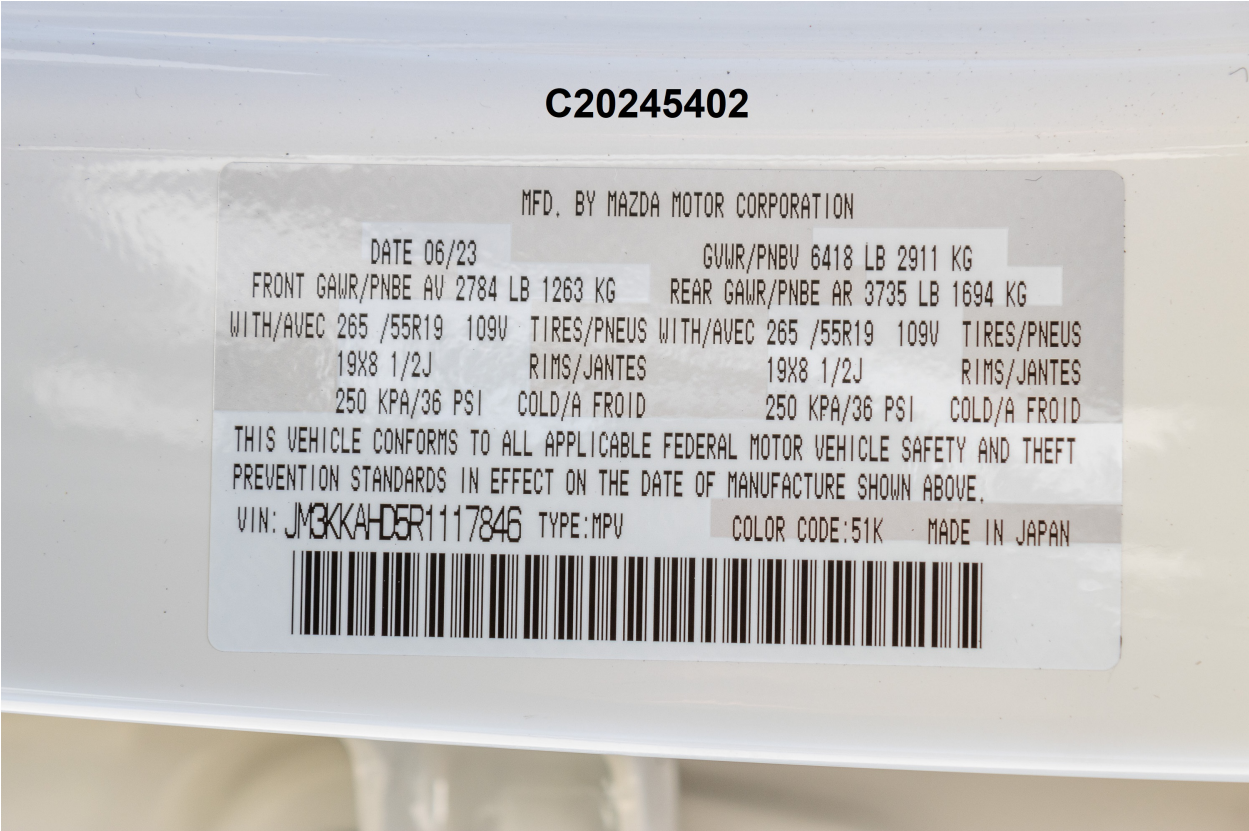


Figure A-25: Close-Up View of Vehicle’s Certification Label



Figure A-26: Close-Up View of Vehicle’s Tire Placard Label

APPENDIX II

ES-2re DUMMY RESPONSE DATA TRACES

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9	ES-2re Upper Thorax Rib Deflection (Y) vs. Time	II-5
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11	ES-2re Middle Thorax Rib Deflection (Y) vs. Time	II-5
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15	ES-2re Middle Abdomen Force (Y) vs. Time	II-6
16	ES-2re Rear Abdomen Force (Y) vs. Time	II-6
17	ES-2re Sum of Abdomen Forces vs. Time	II-7
18	ES-2re Pubic Symphysis Force (Y) vs. Time	II-7

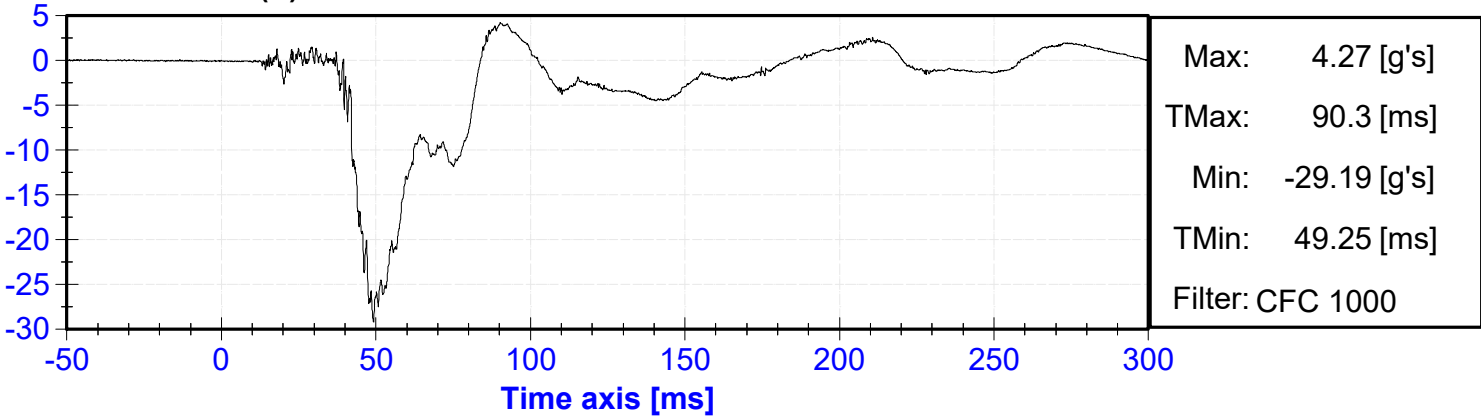
ACCELERATION [g's]

ACCELERATION [g's]

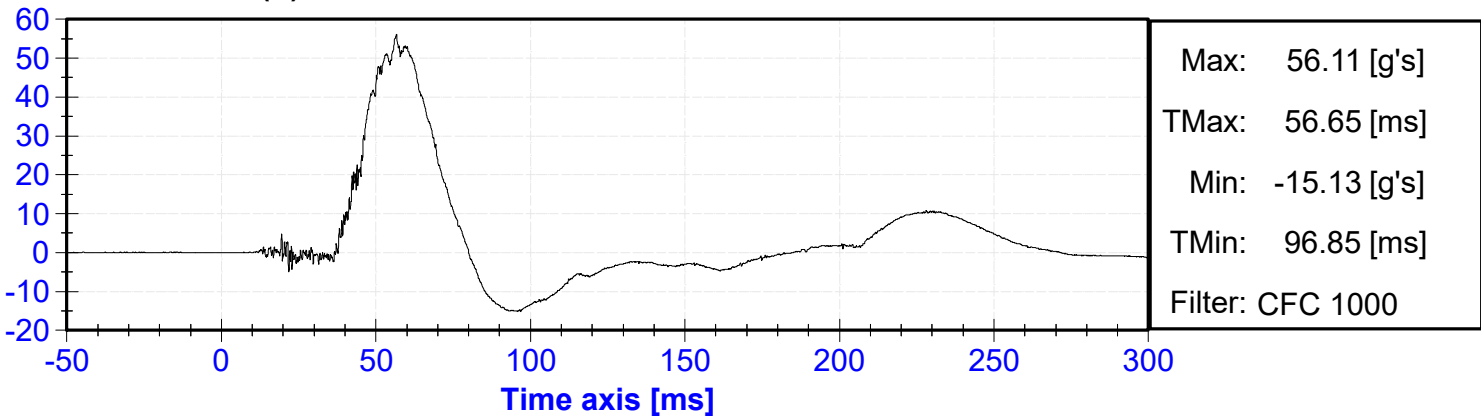
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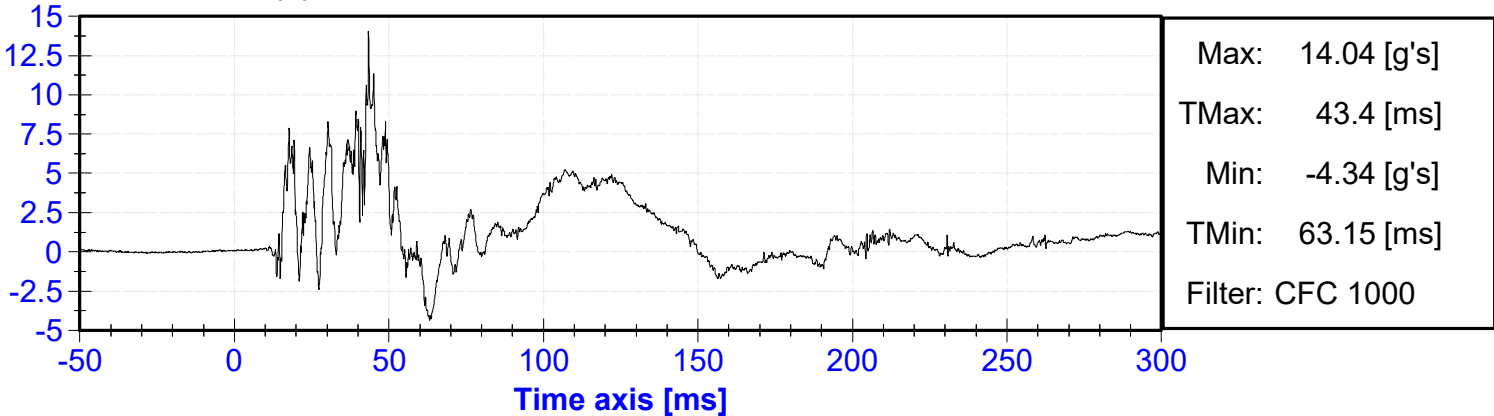
ES-2re Head (X) Acceleration vs. Time



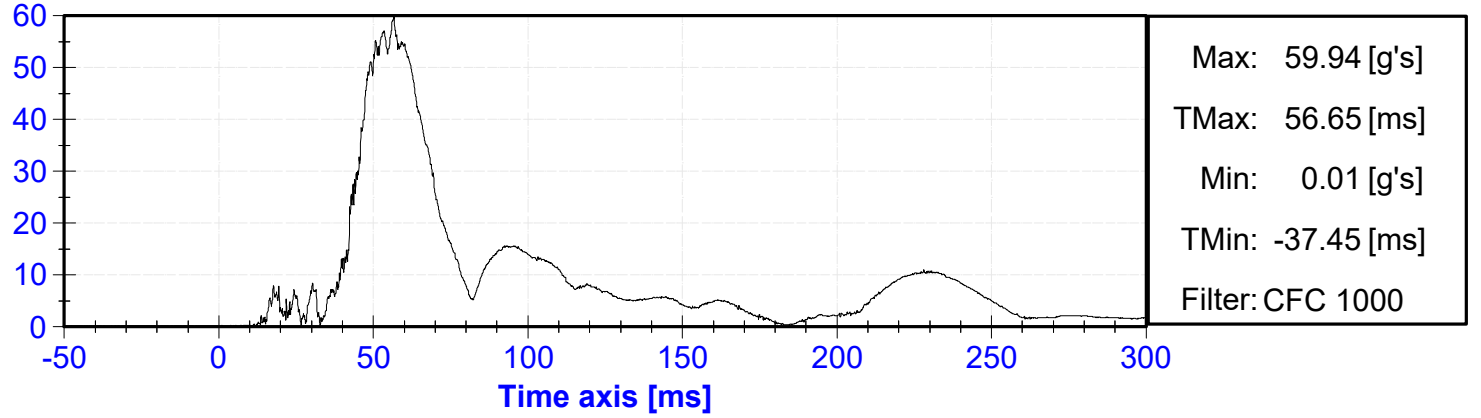
ES-2re Head (Y) Acceleration vs. Time



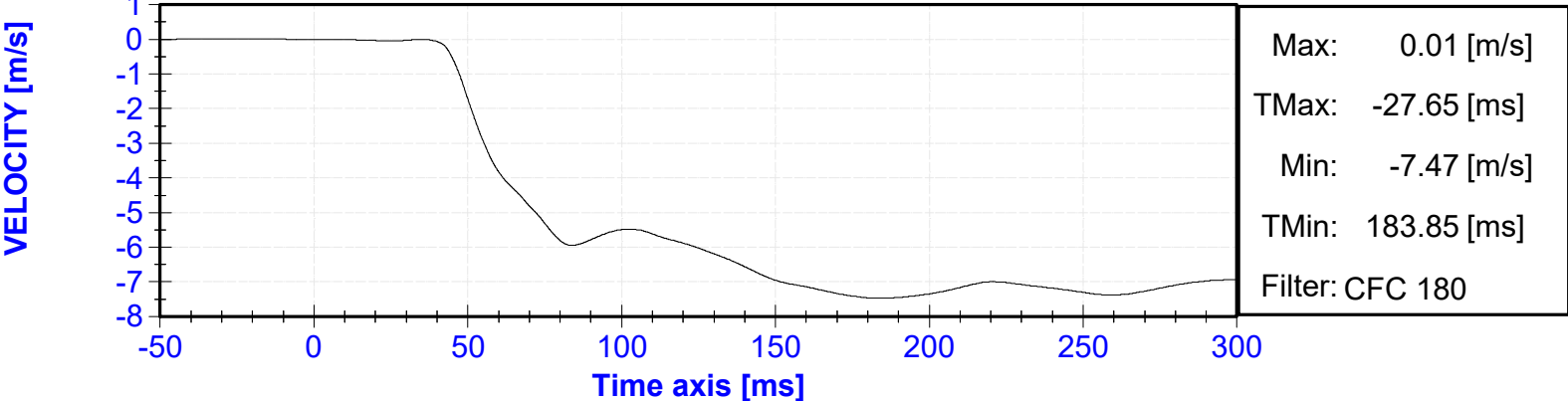
ES-2re Head (Z) Acceleration vs. Time



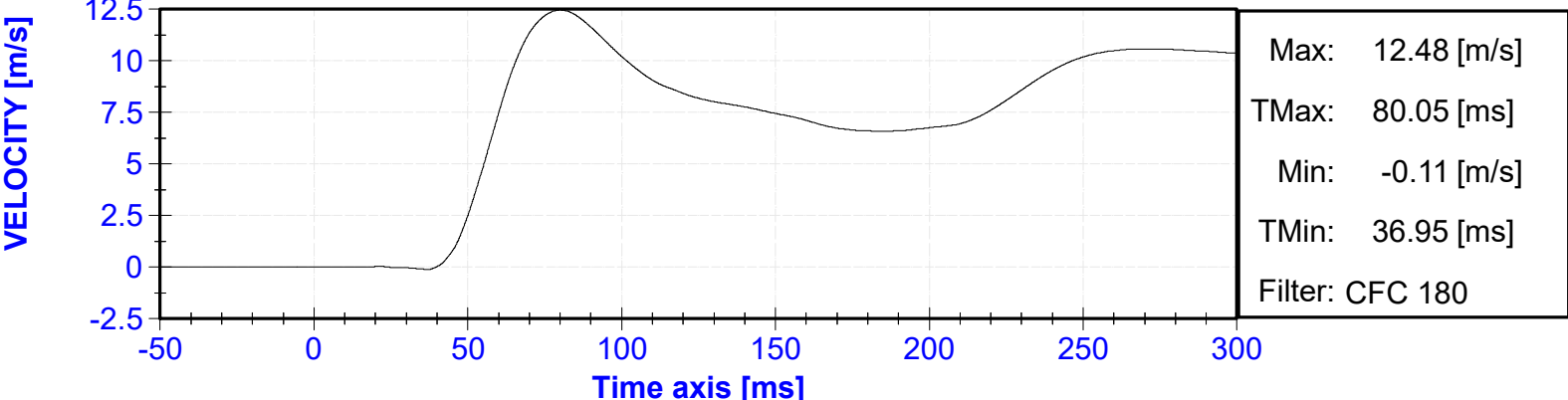
ES-2re Head Resultant Acceleration vs. Time



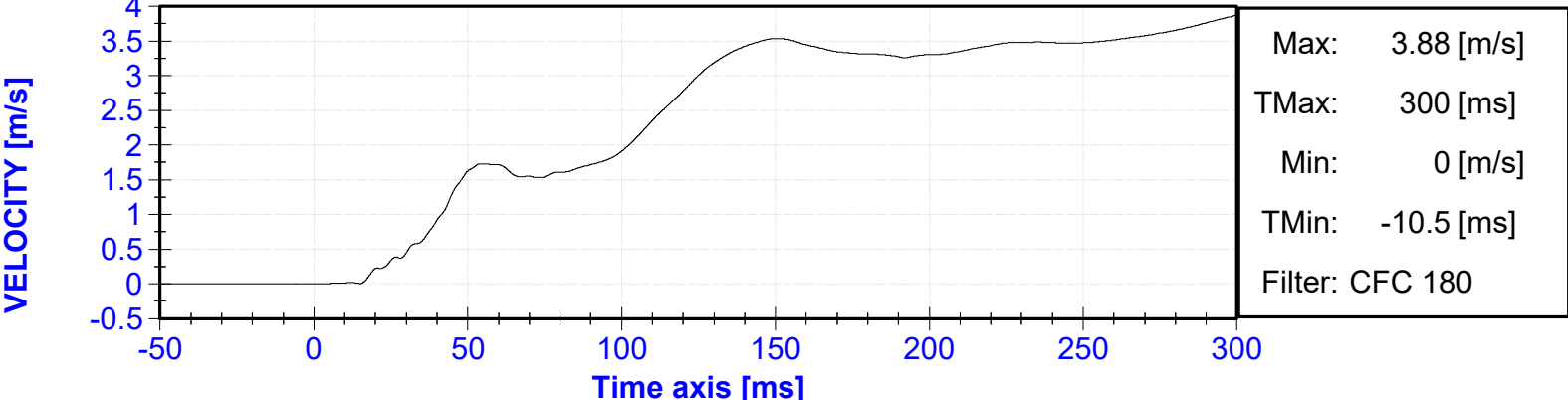
ES-2re Head (X) Velocity vs. Time



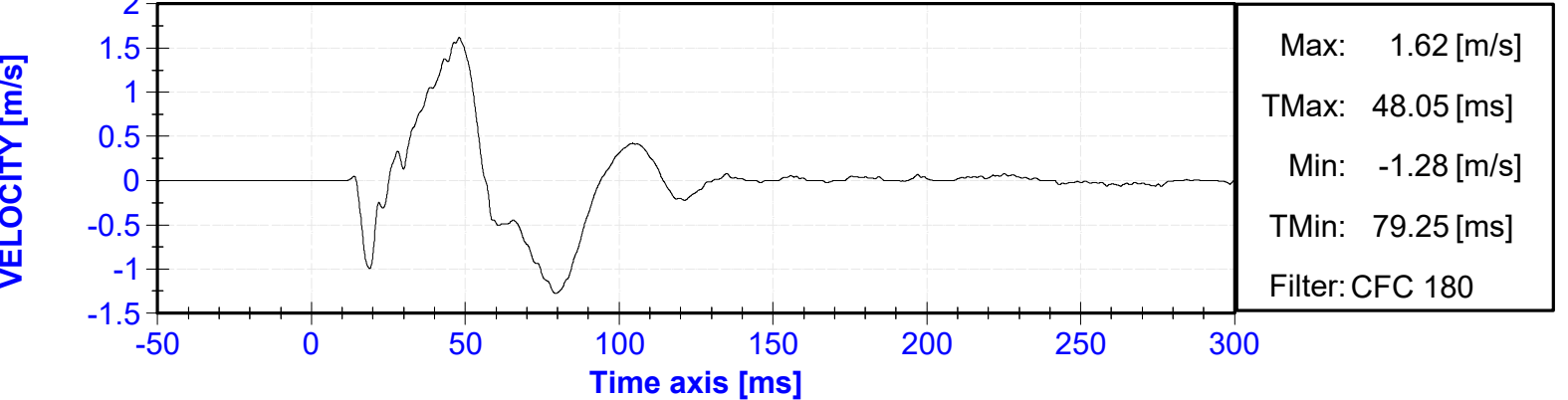
ES-2re Head (Y) Velocity vs. Time



ES-2re Head (Z) Velocity vs. Time

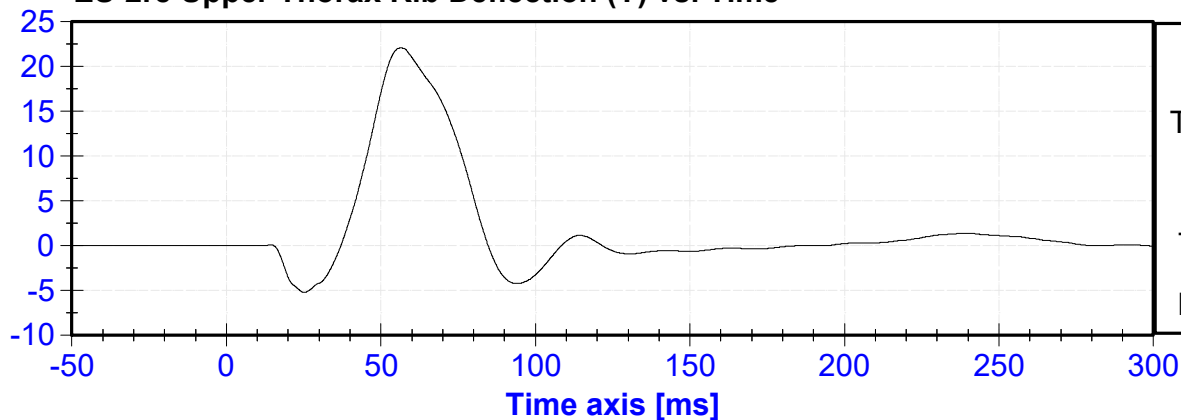


ES-2re Upper Thorax Rib Deflection Rate vs. Time



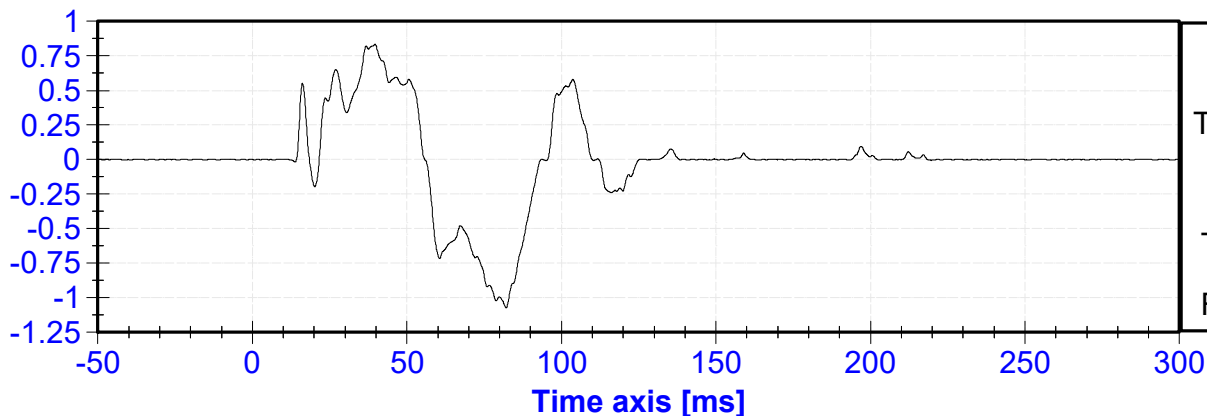
ES-2re Upper Thorax Rib Deflection (Y) vs. Time

DISPLACEMENT [mm]



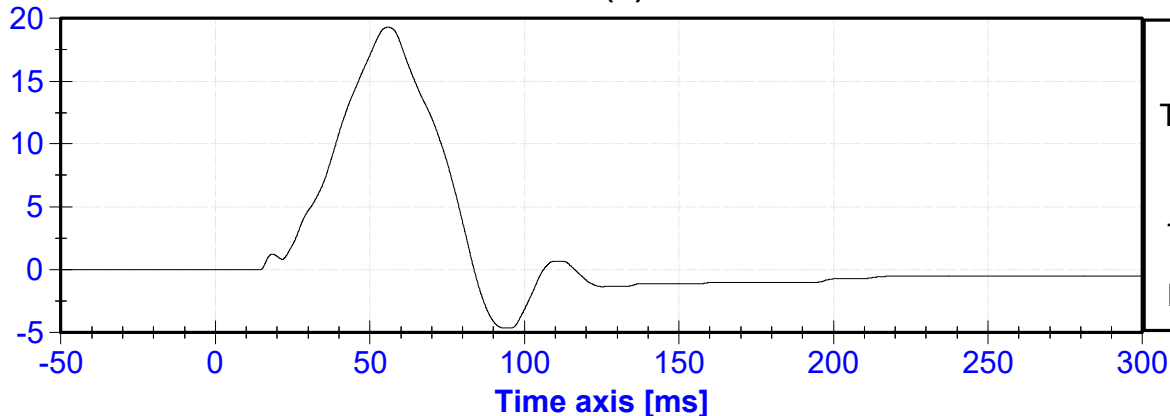
ES-2re Middle Thorax Rib Deflection Rate vs. Time

VELOCITY [m/s]



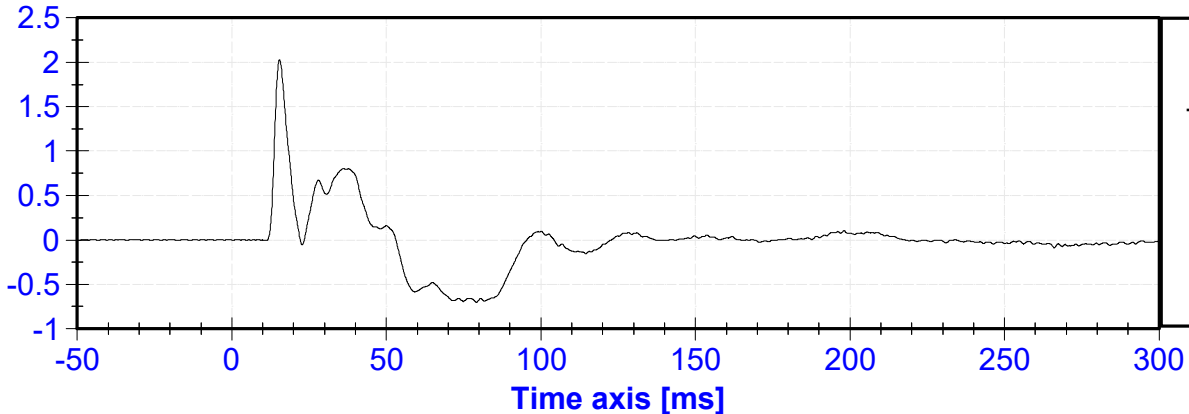
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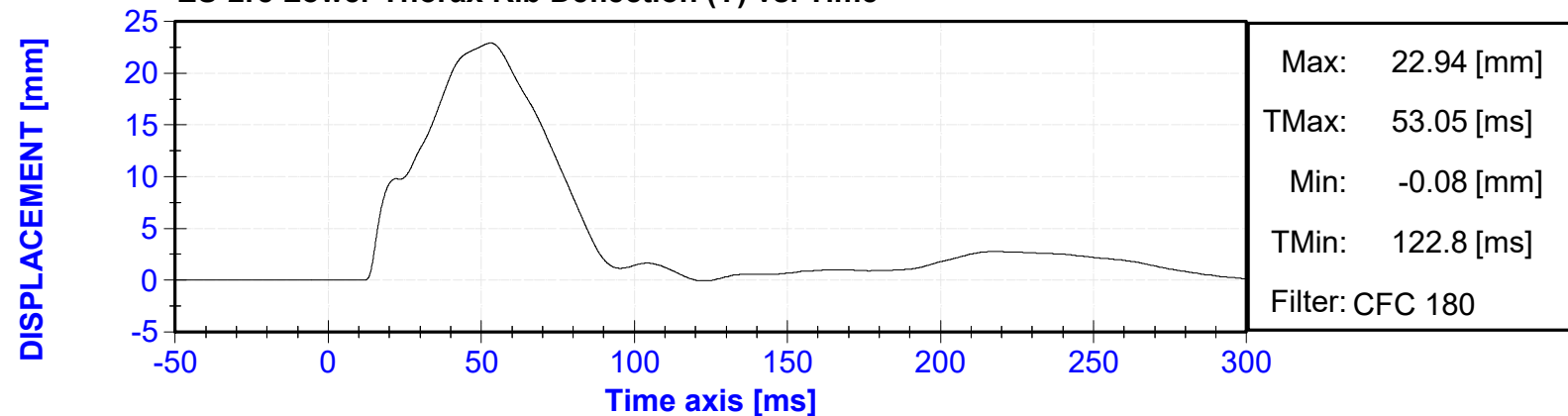


ES-2re Lower Thorax Rib Deflection Rate vs. Time

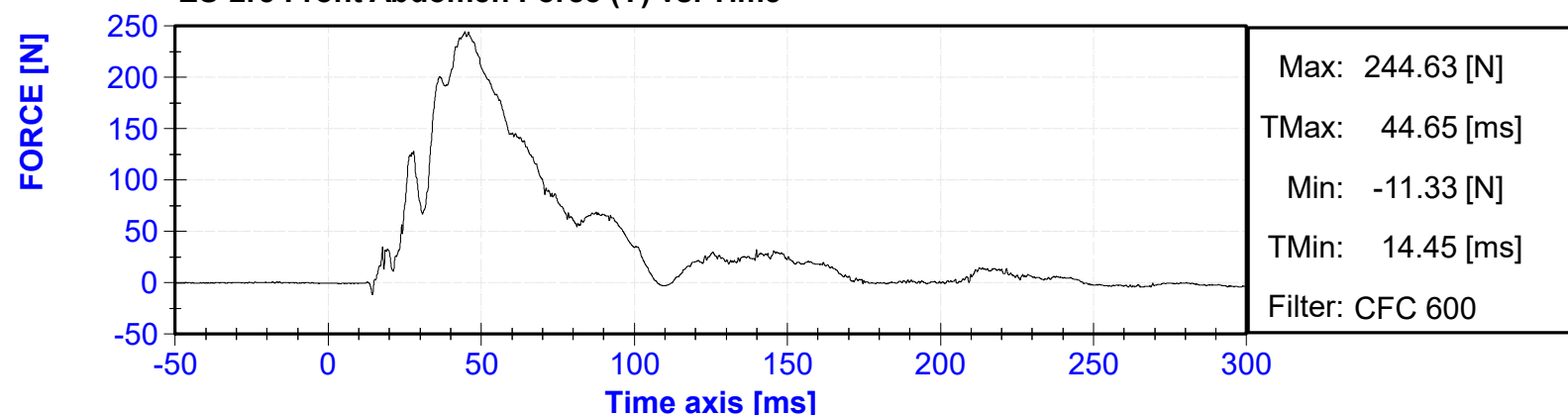
VELOCITY [m/s]



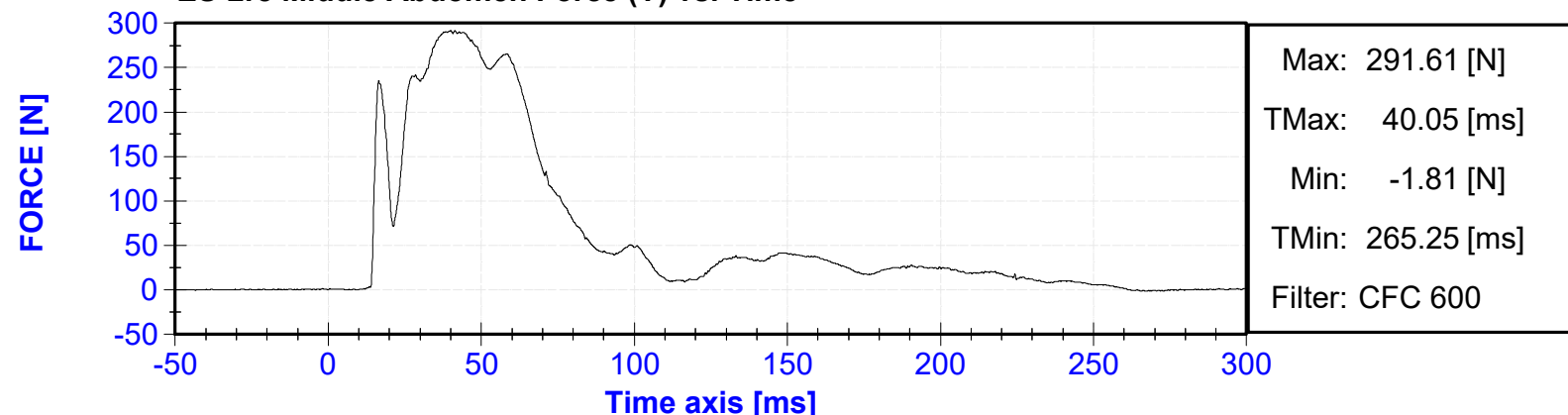
ES-2re Lower Thorax Rib Deflection (Y) vs. Time



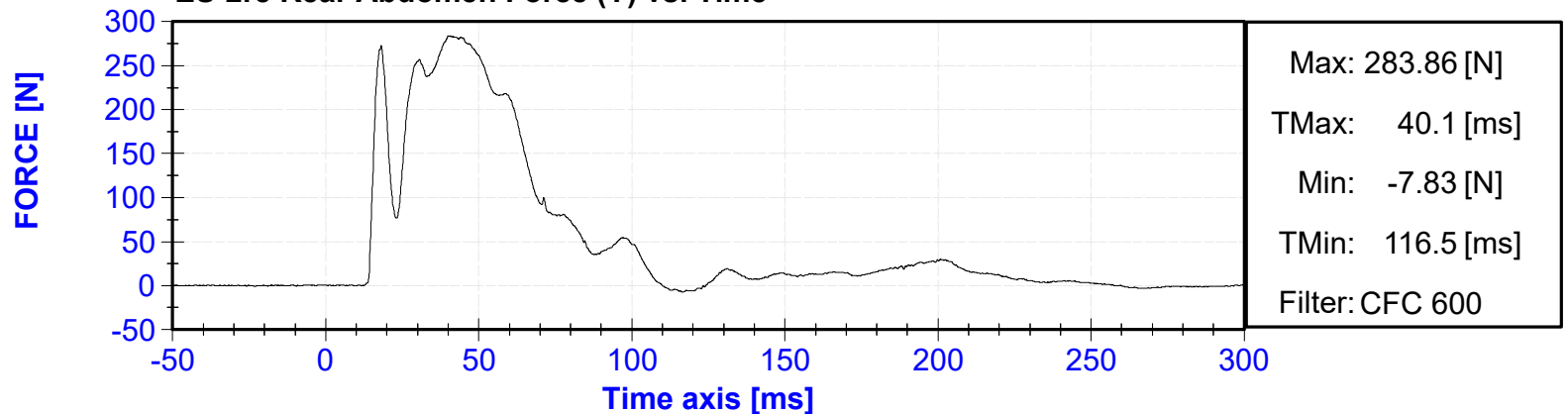
ES-2re Front Abdomen Force (Y) vs. Time



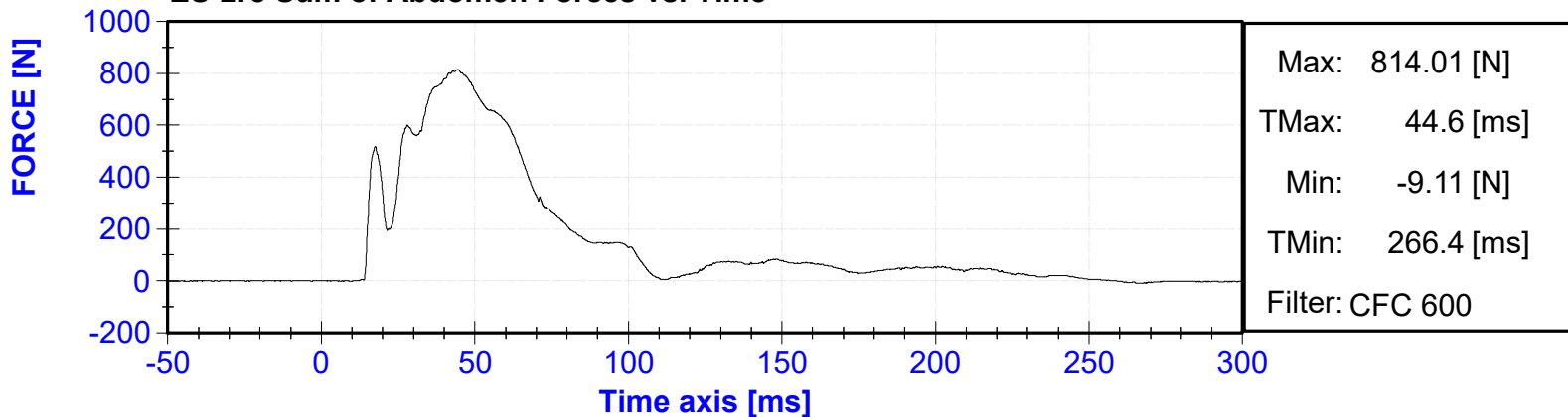
ES-2re Middle Abdomen Force (Y) vs. Time



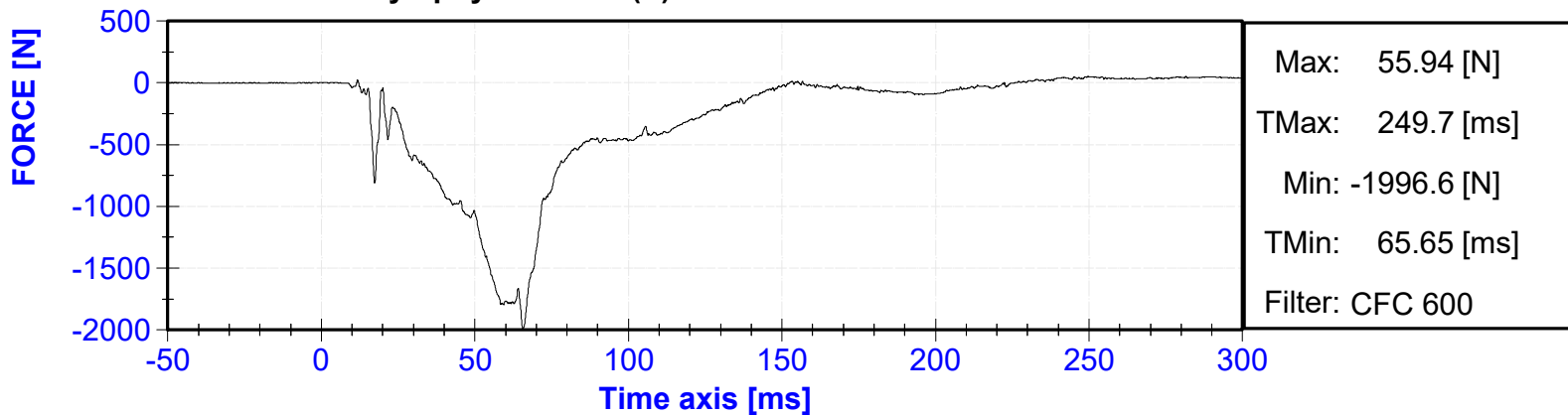
ES-2re Rear Abdomen Force (Y) vs. Time



ES-2re Sum of Abdomen Forces vs. Time



ES-2re Pubic Symphysis Force (Y) vs. Time

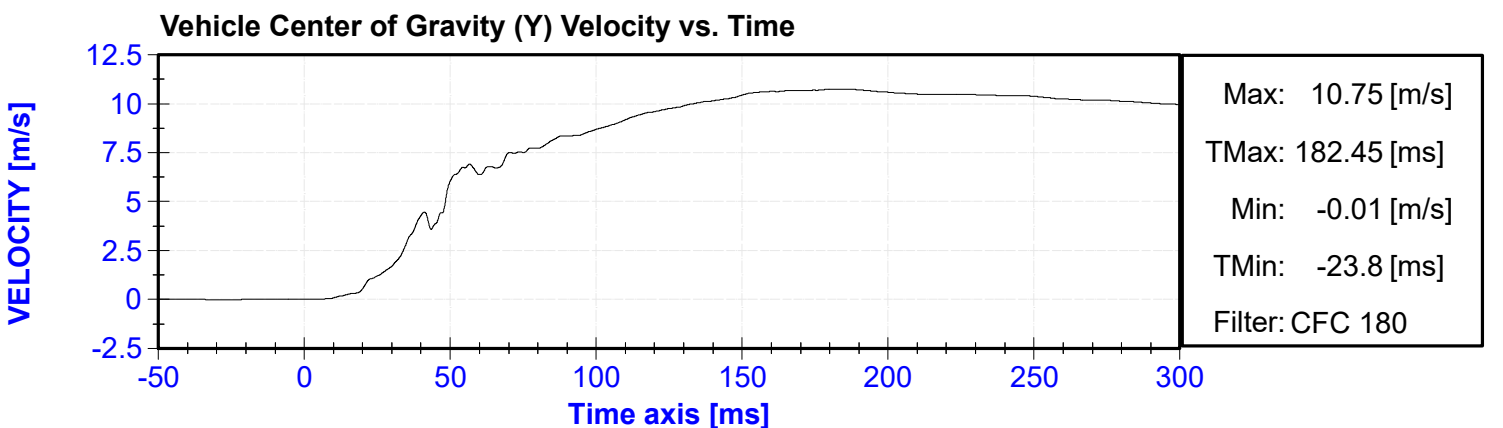
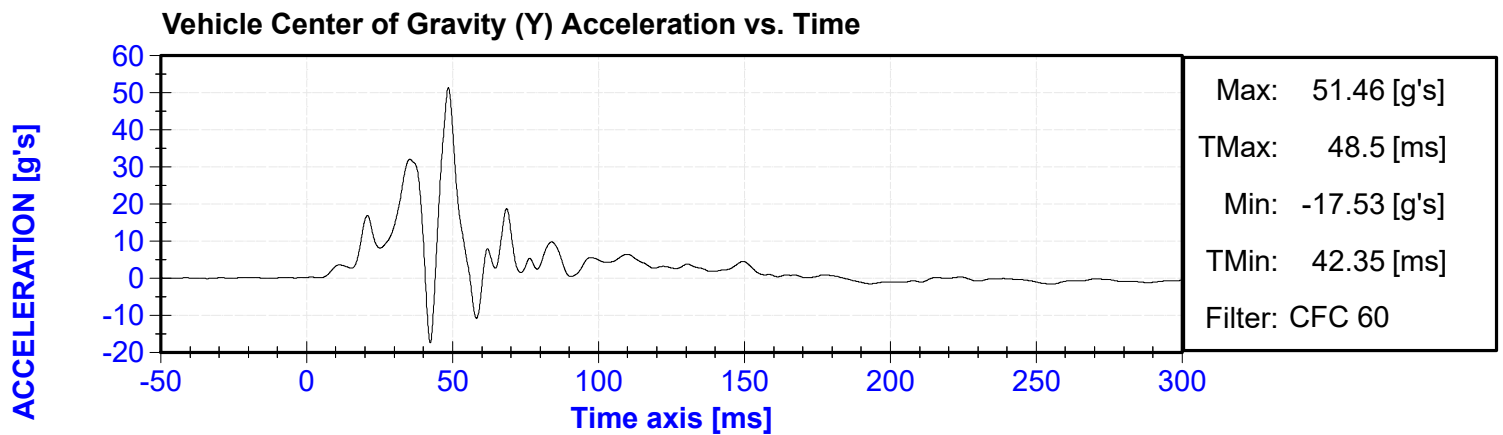
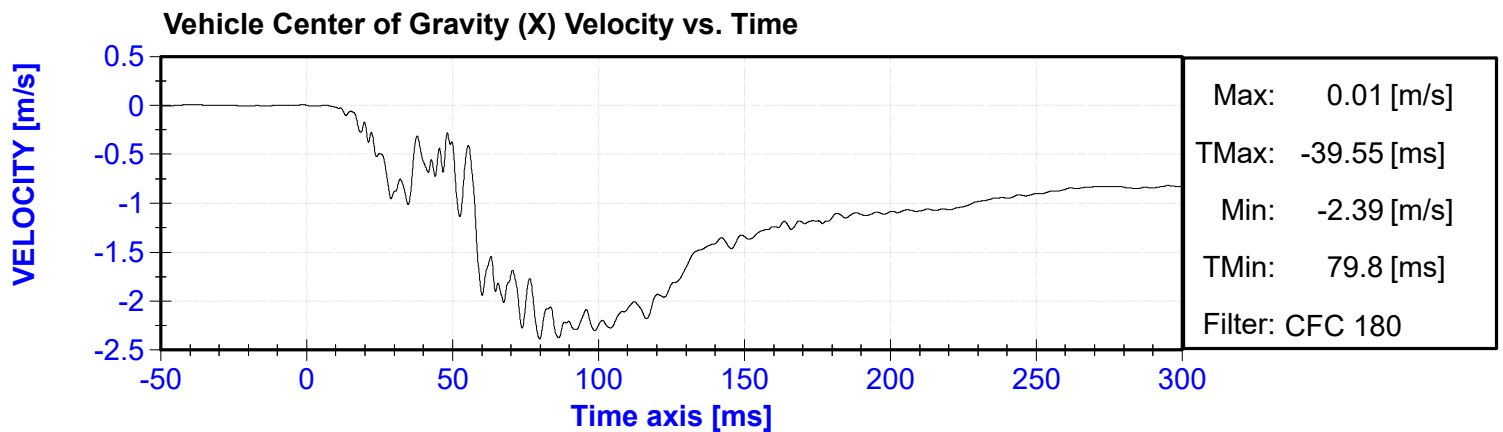
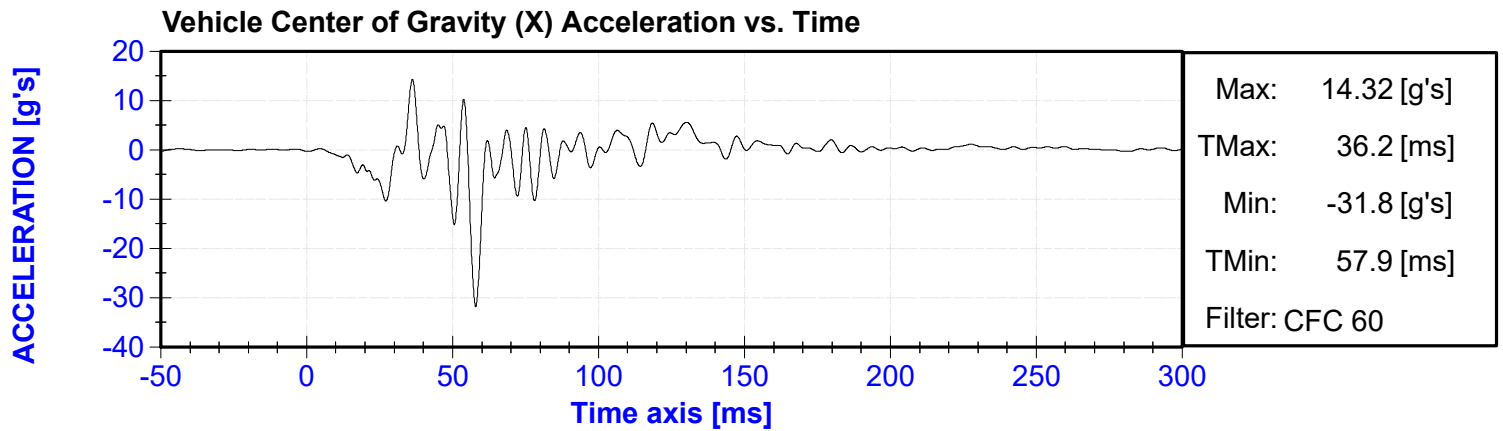


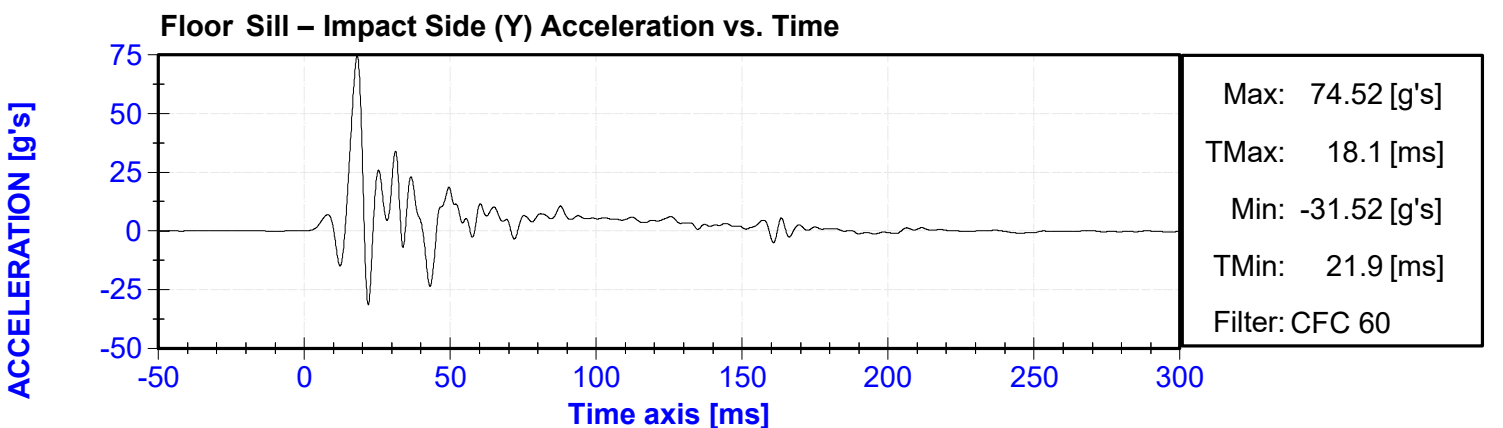
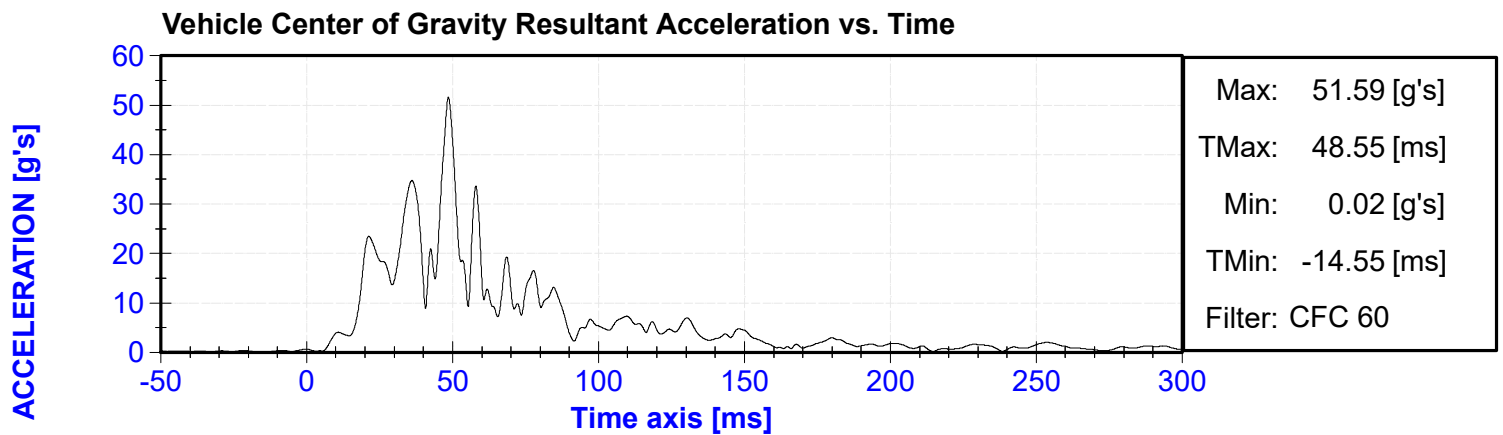
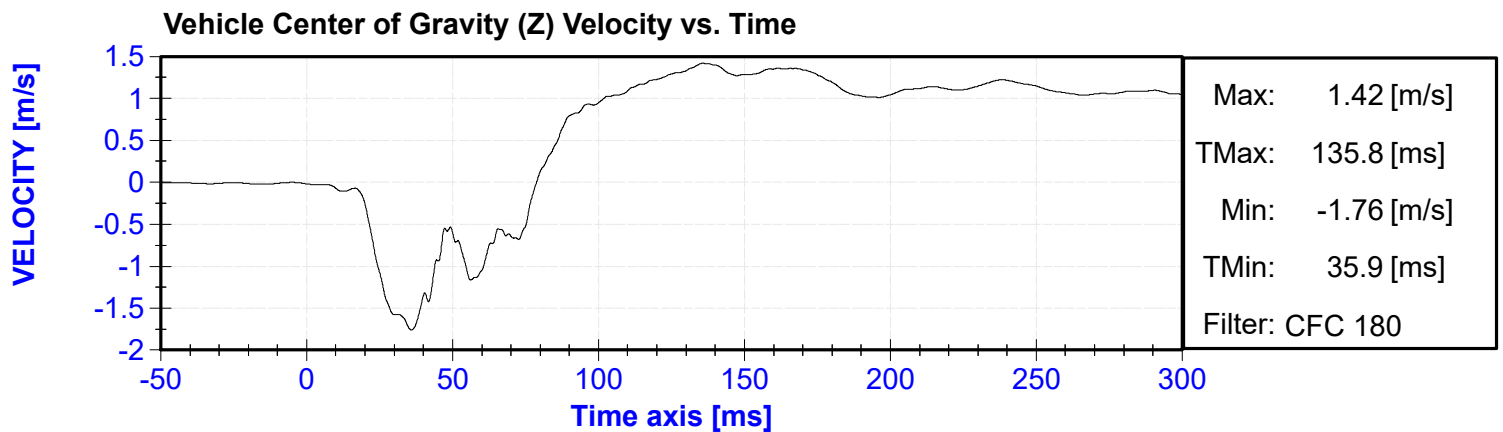
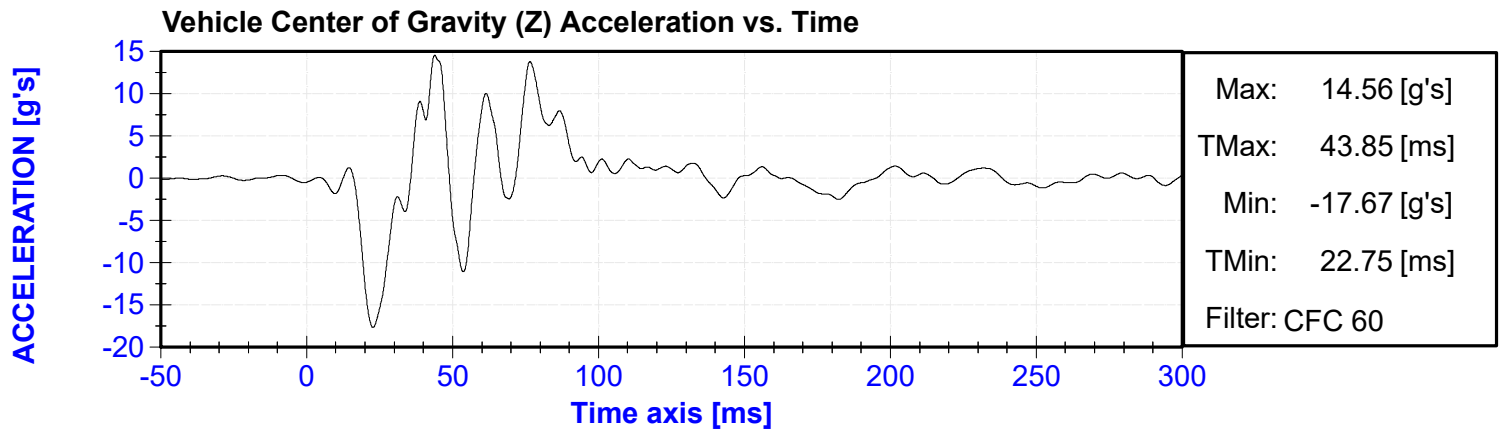
APPENDIX III

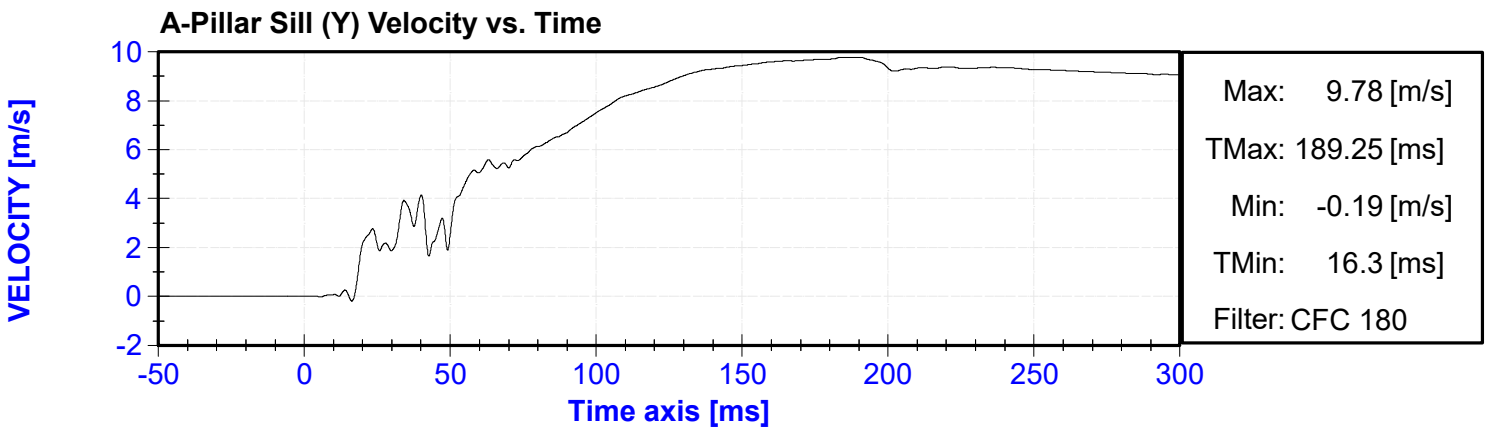
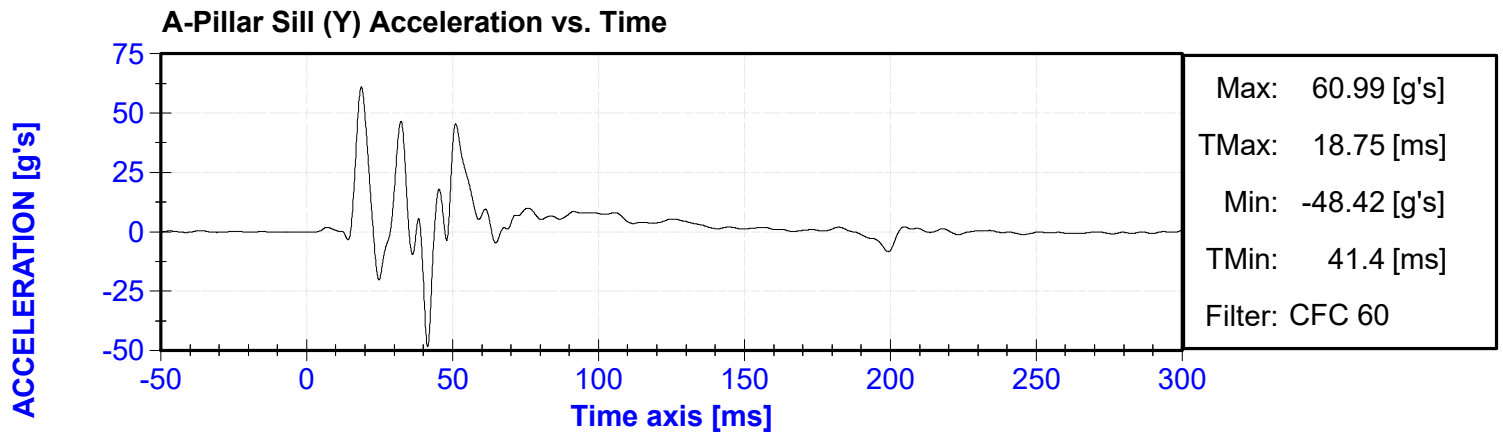
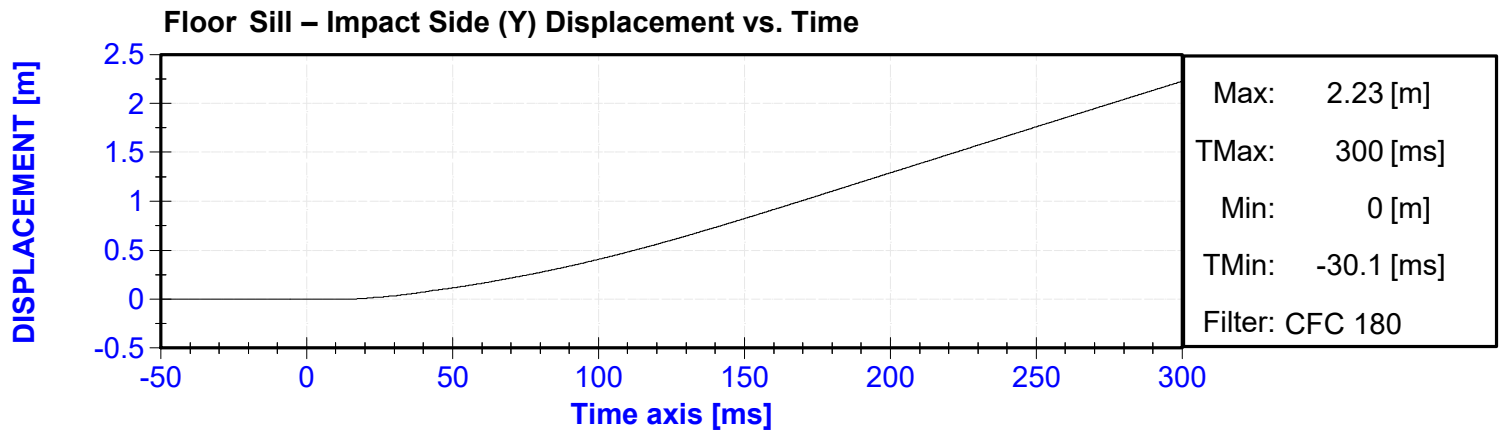
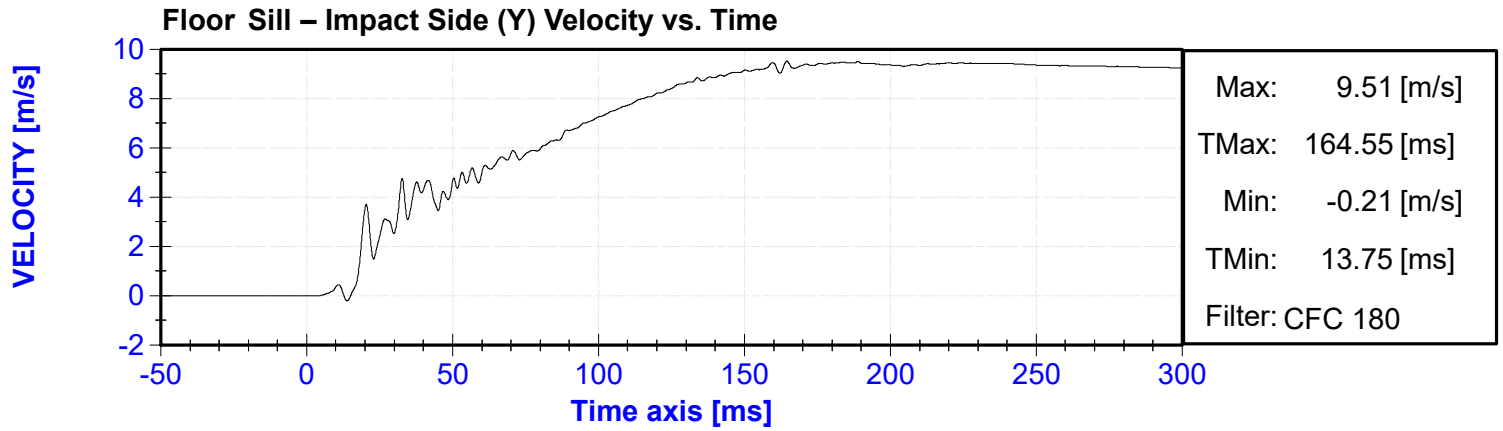
VEHICLE ACCELEROMETER RESPONSE DATA

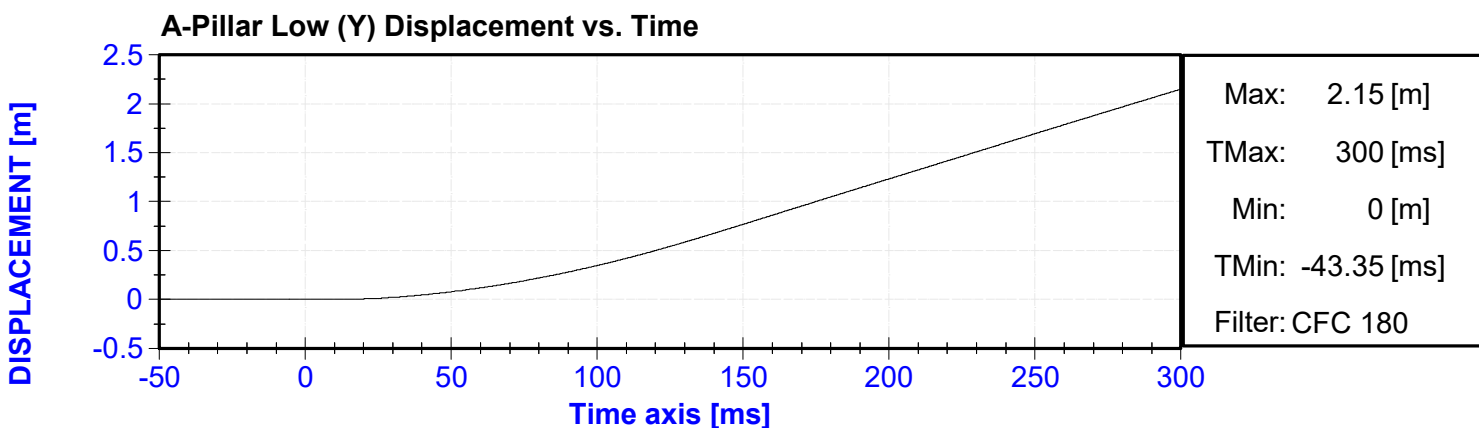
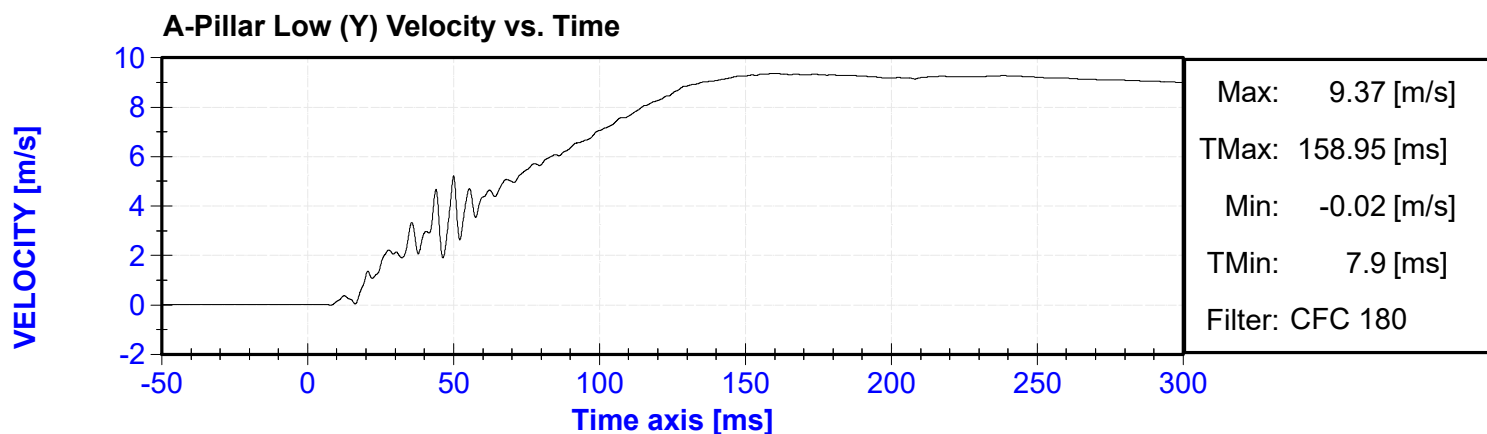
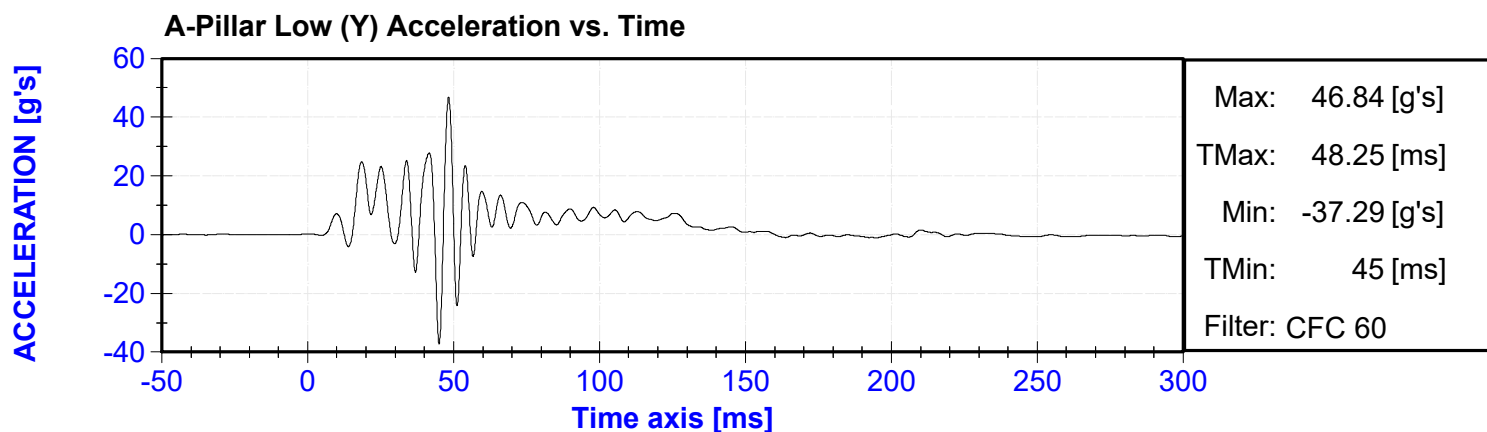
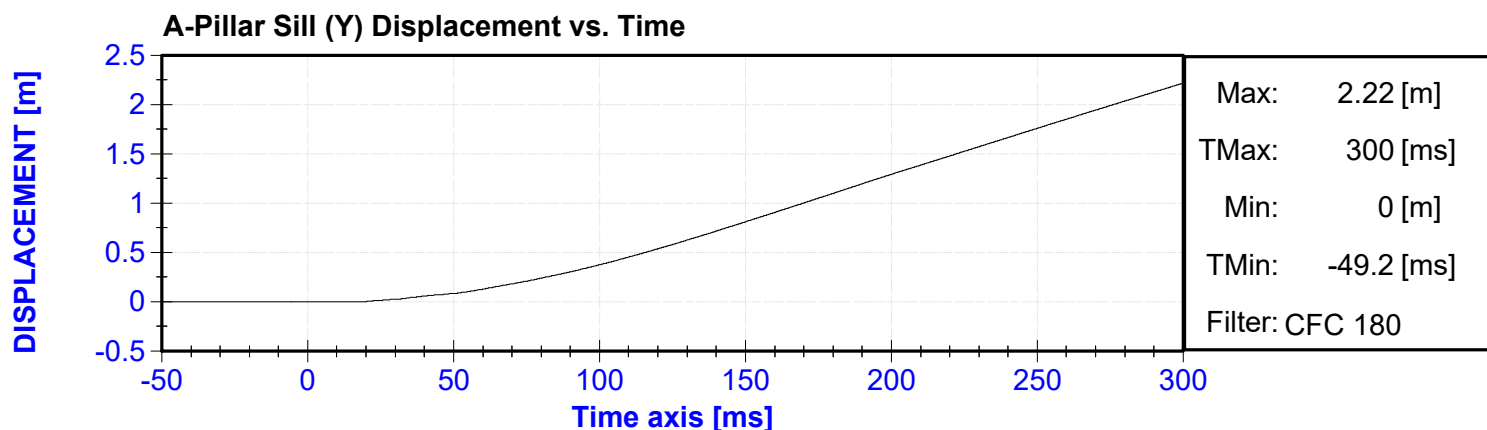
Table of Data Plots

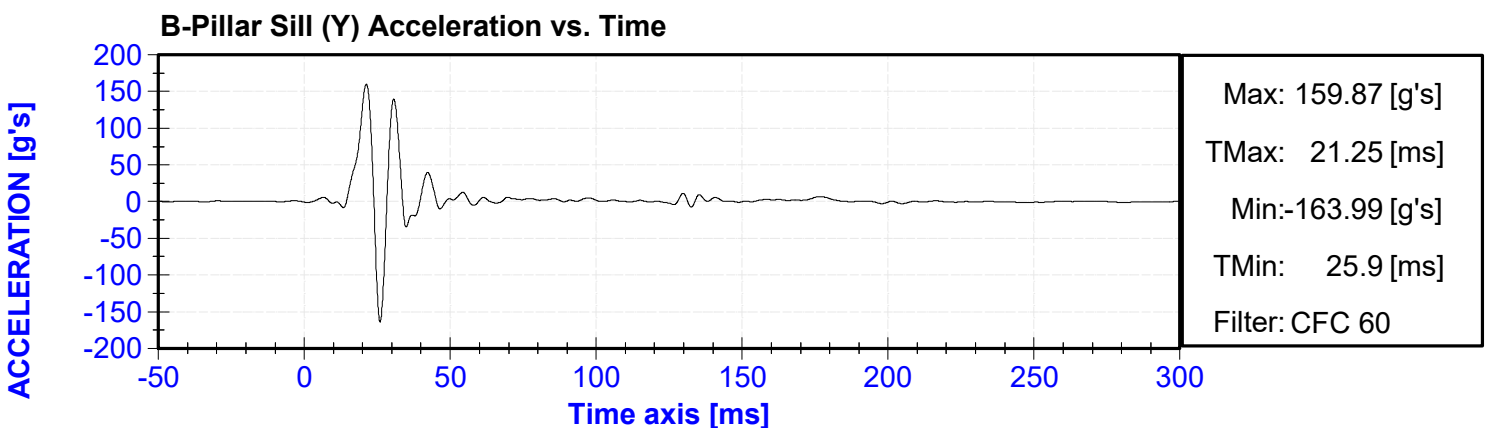
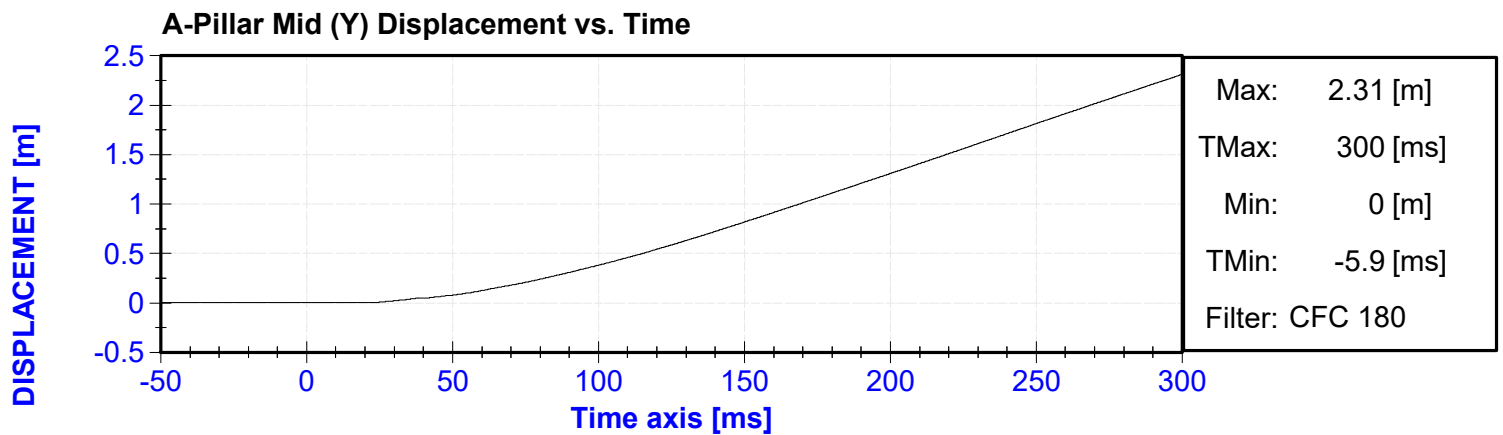
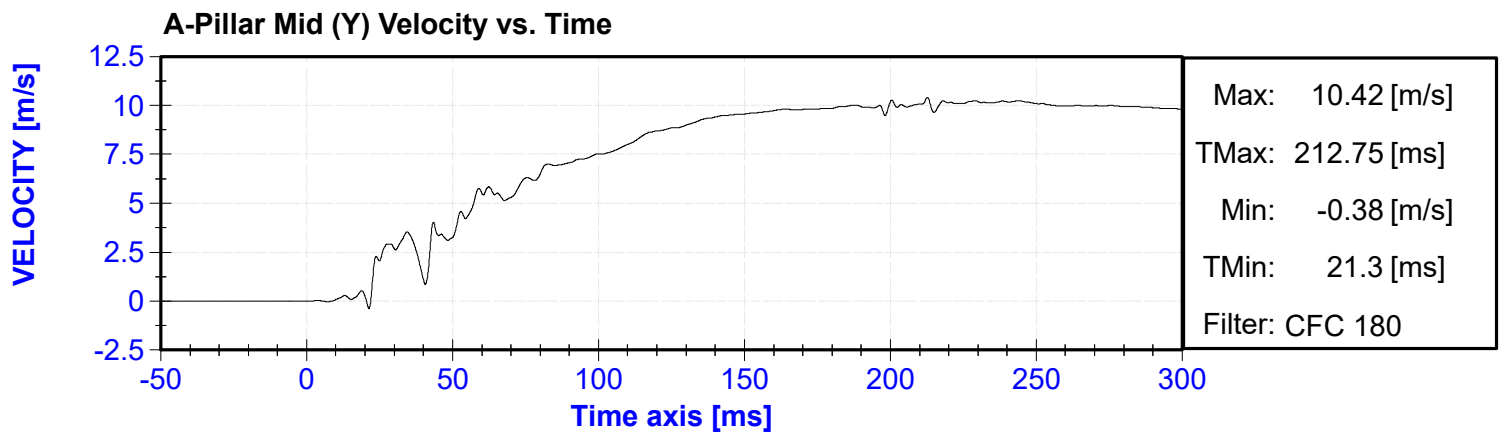
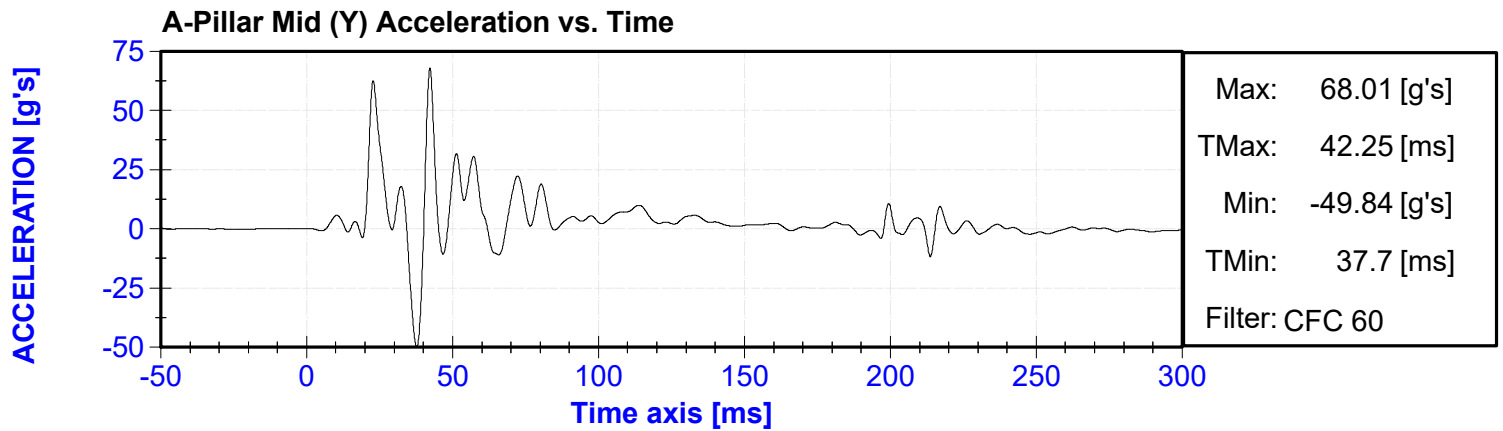
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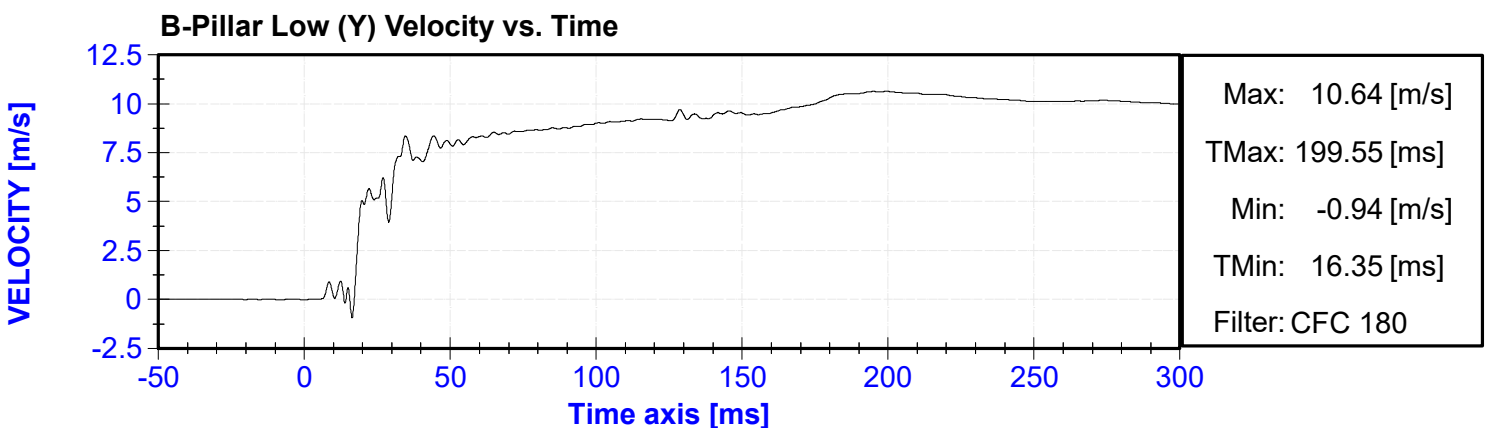
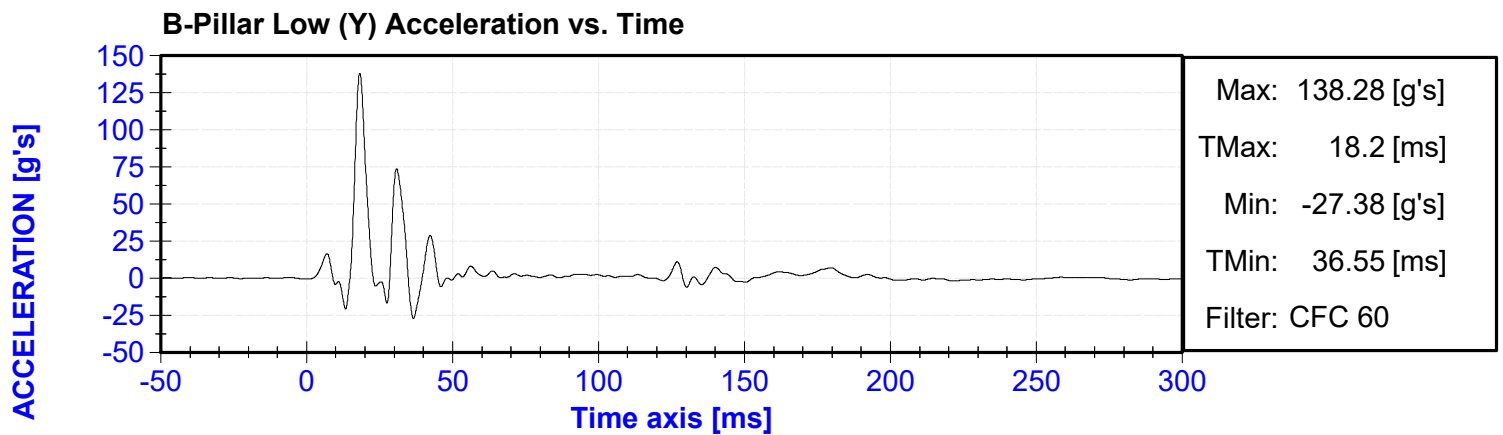
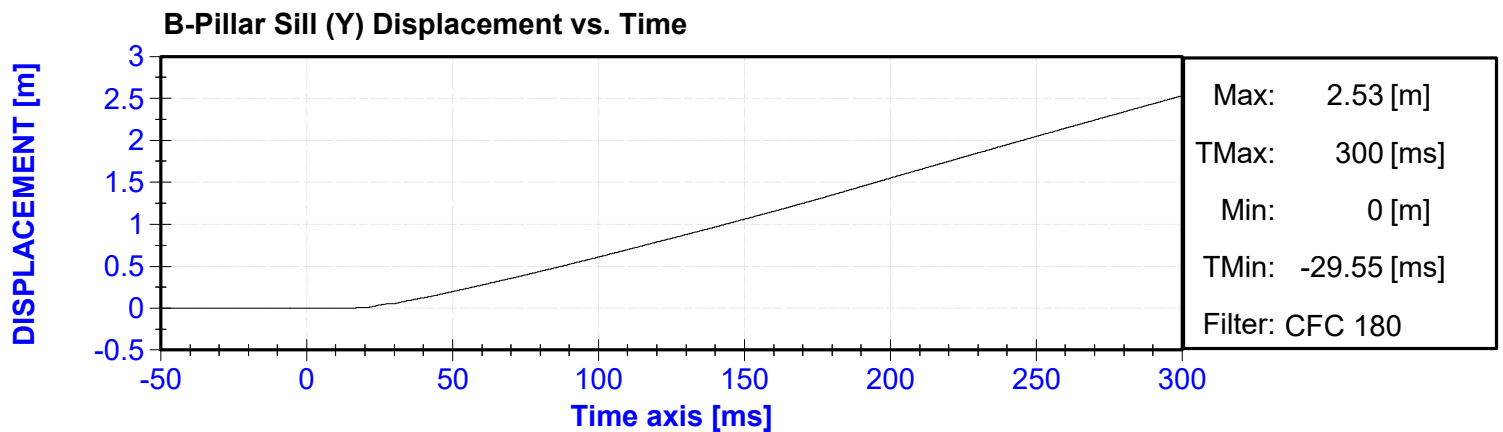
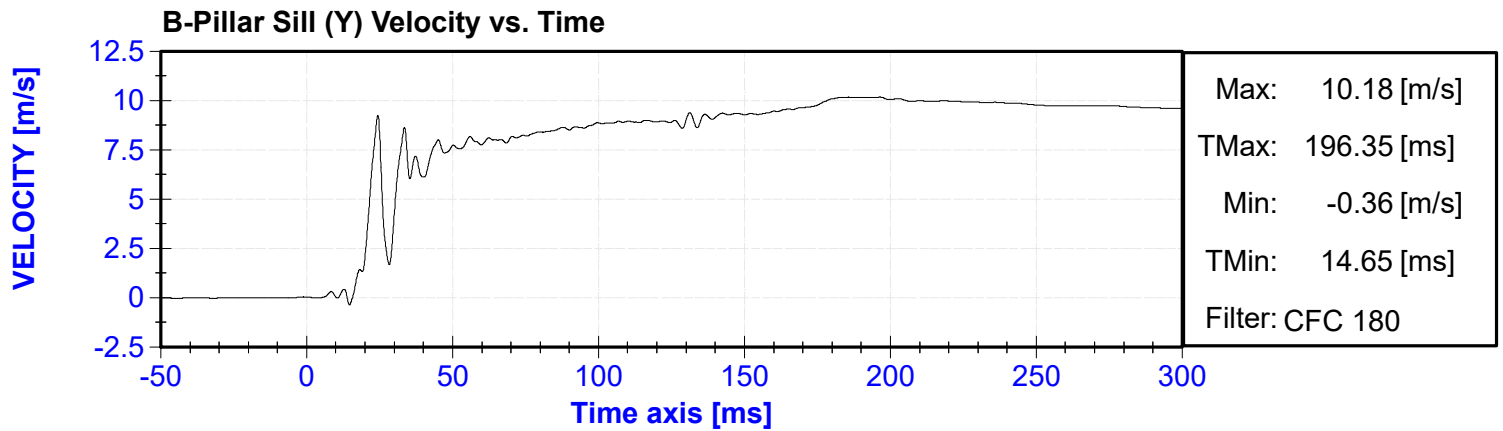


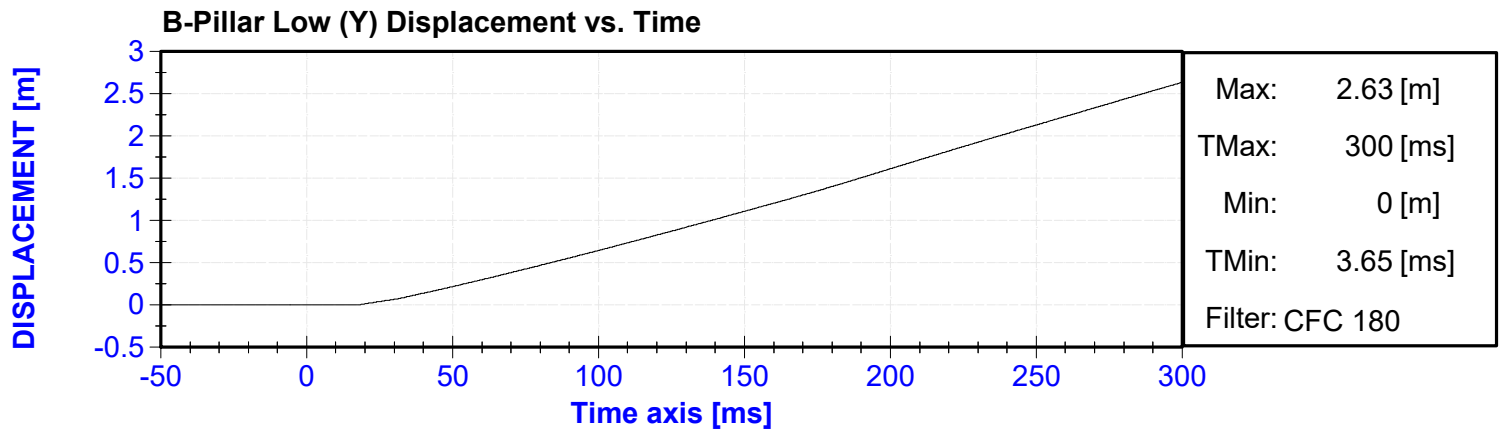




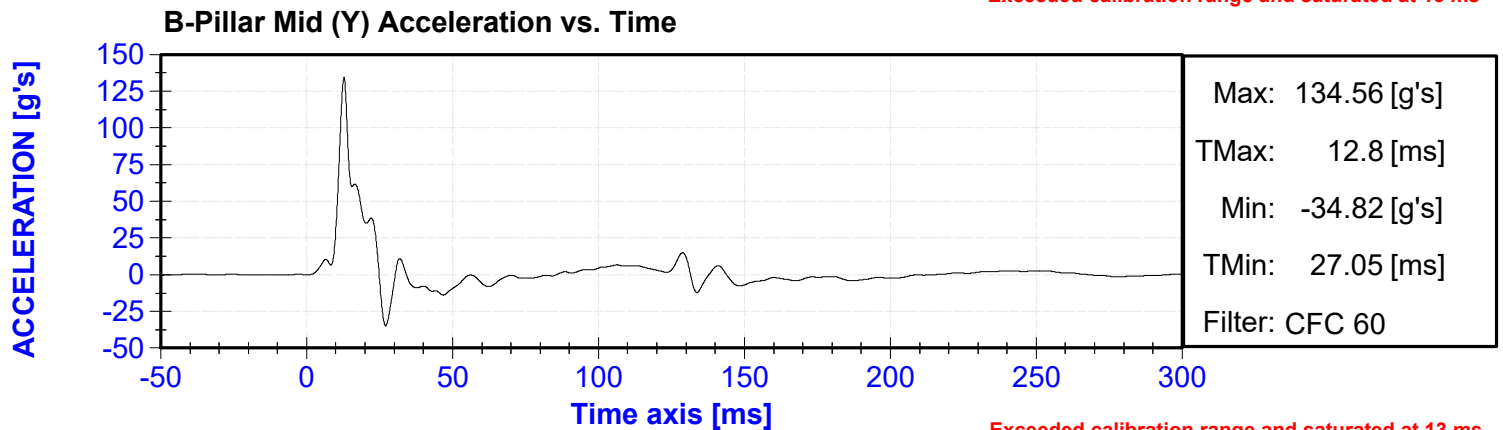




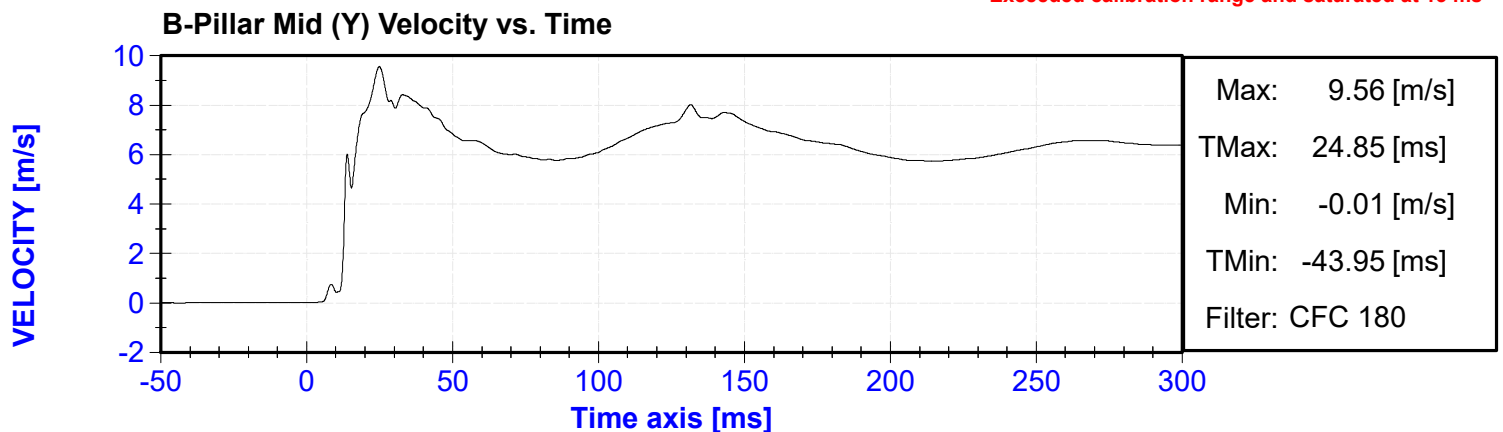




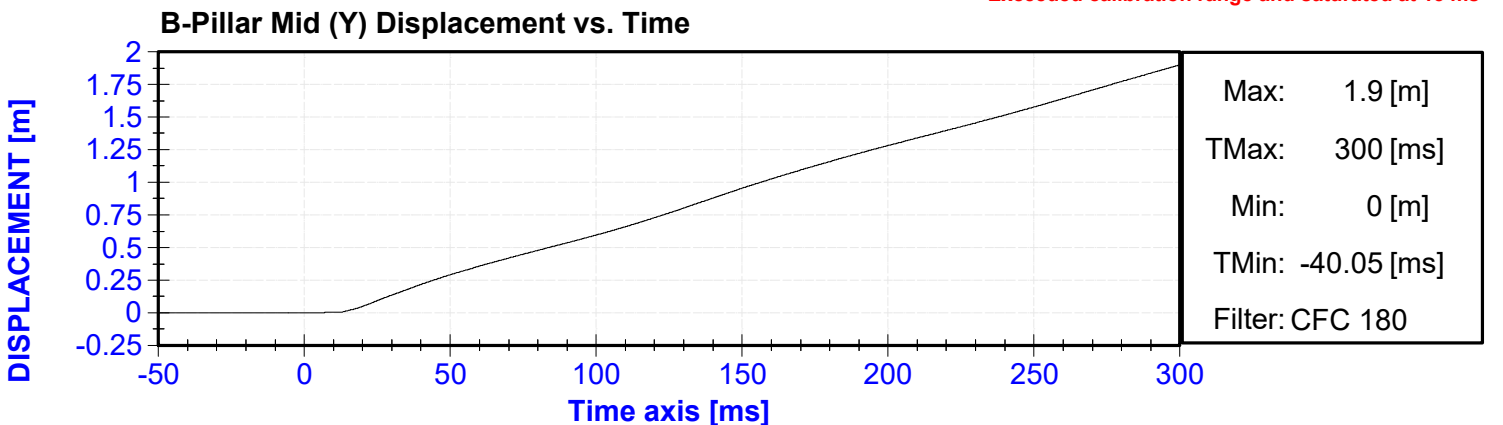
Exceeded calibration range and saturated at 13 ms



Exceeded calibration range and saturated at 13 ms



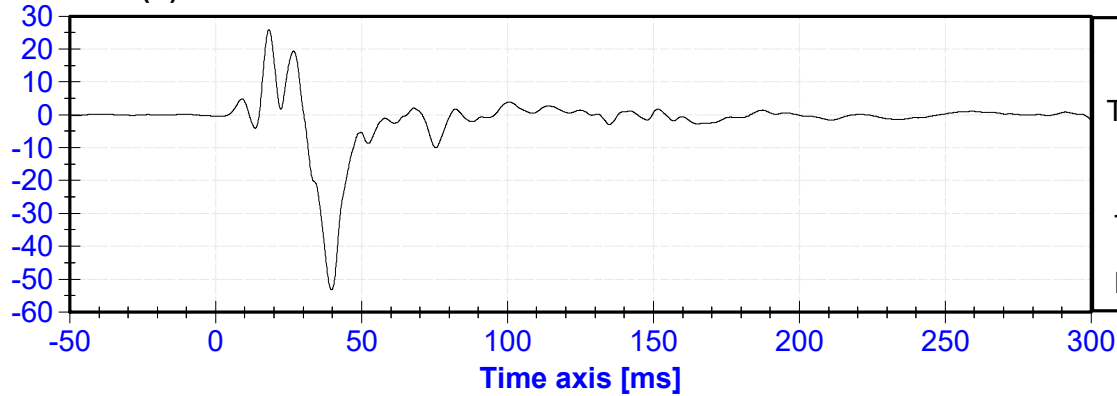
Exceeded calibration range and saturated at 13 ms



ACCELERATION [g's]

Seat (Y) Acceleration vs. Time

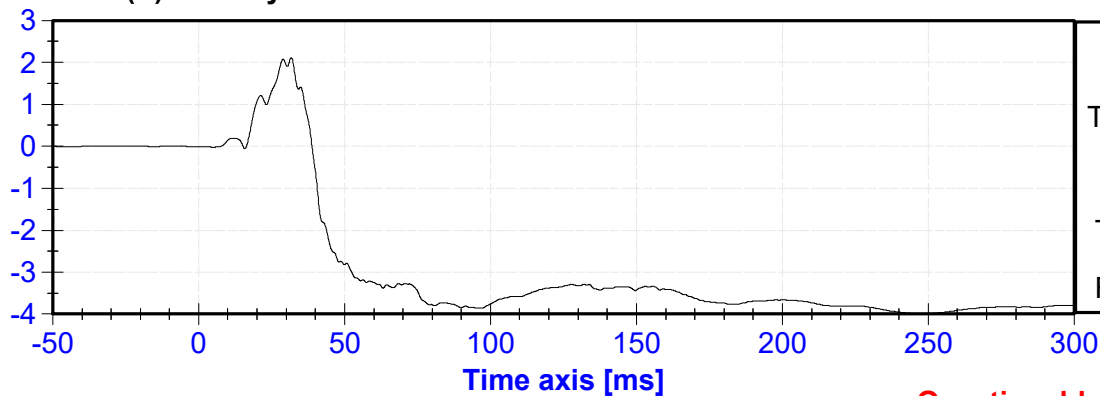
Questionable data after 32.41 ms



VELOCITY [m/s]

Seat (Y) Velocity vs. Time

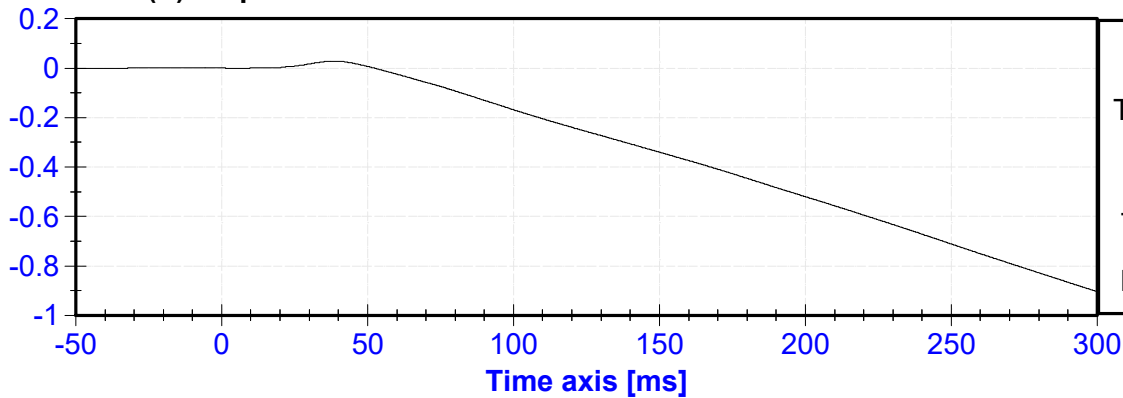
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DISPLACEMENT [m]

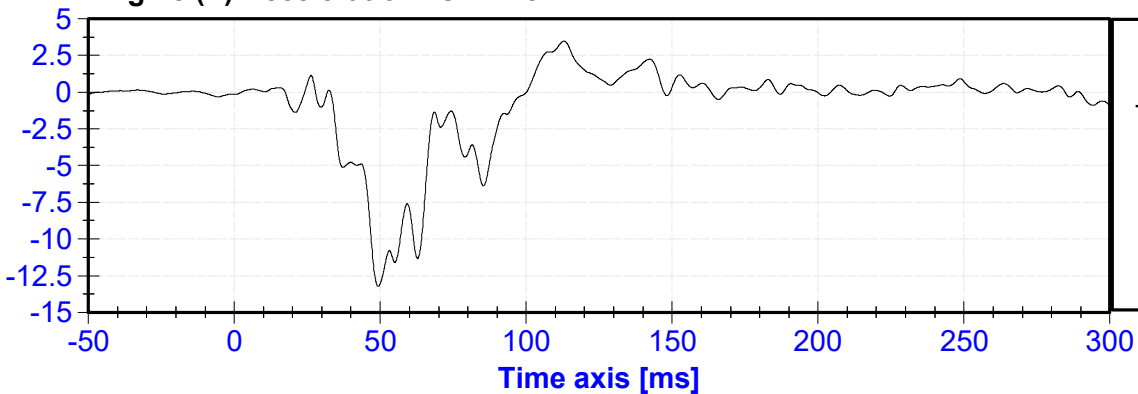
Seat (Y) Displacement vs. Time

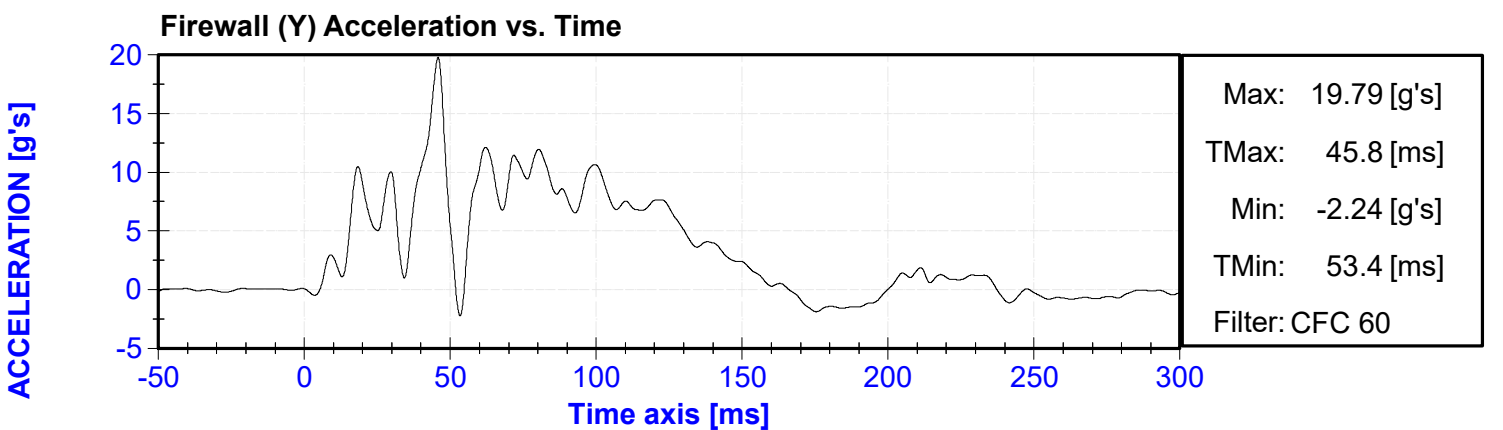
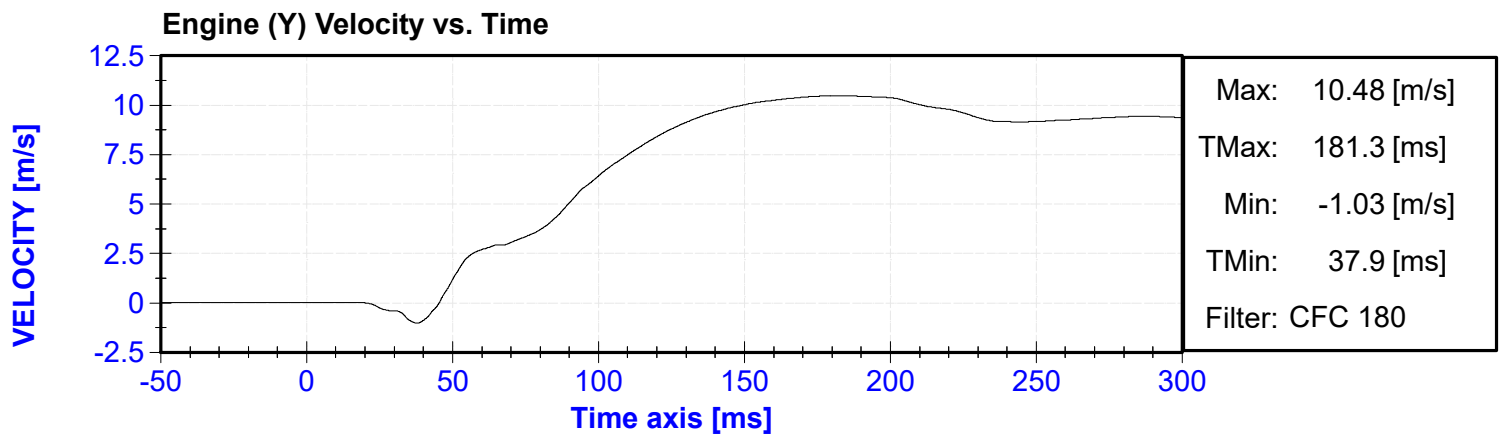
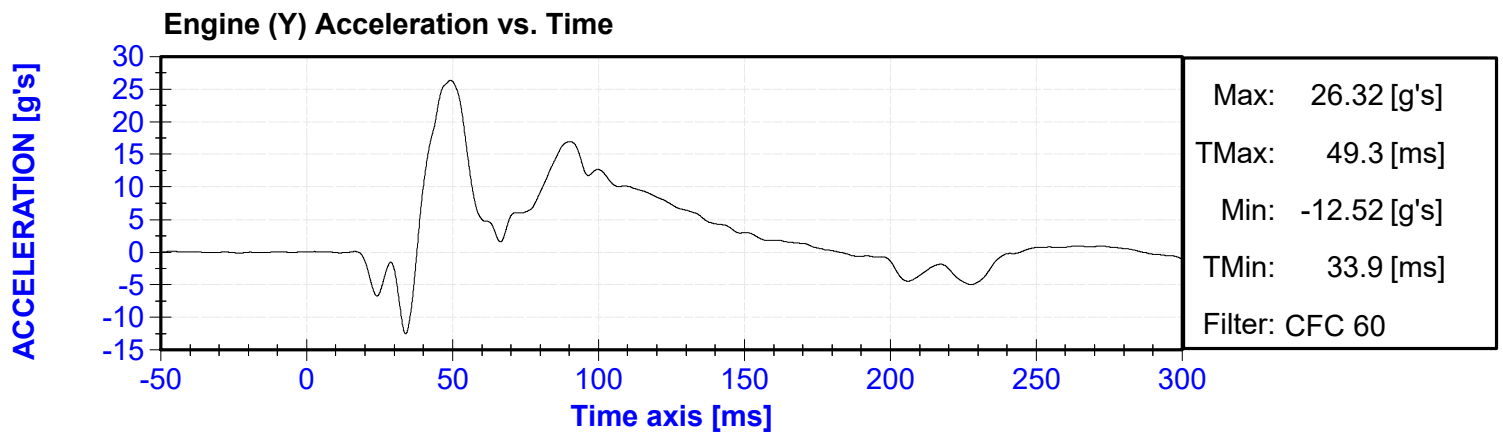
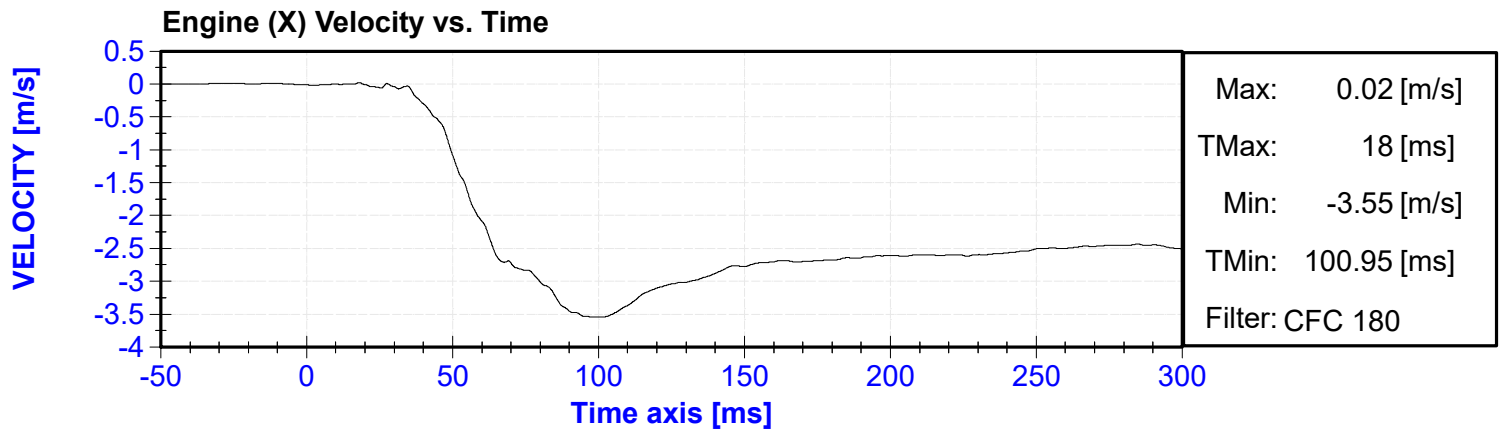
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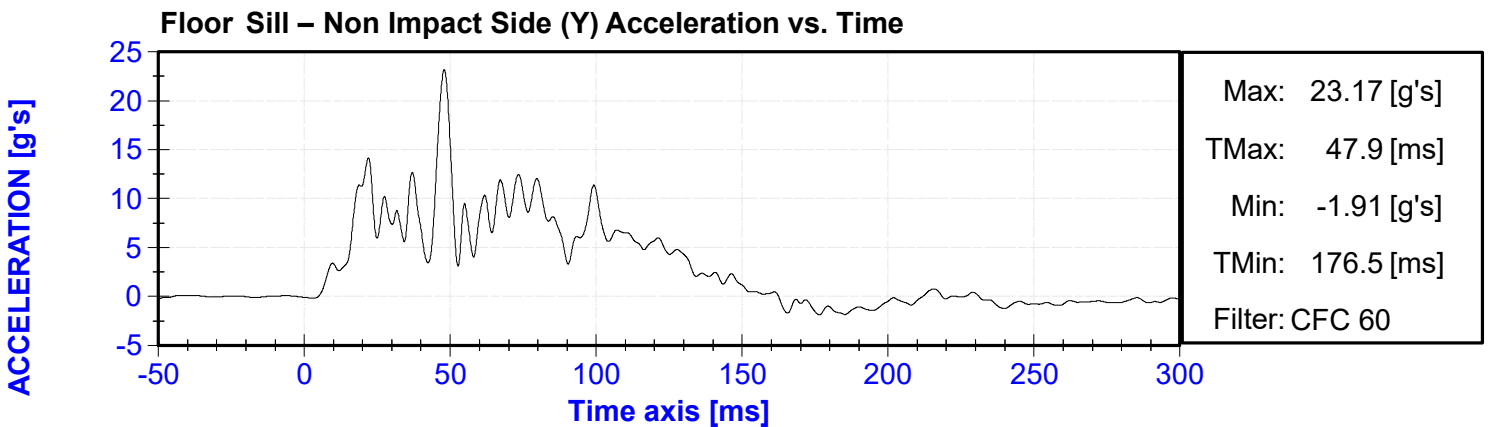
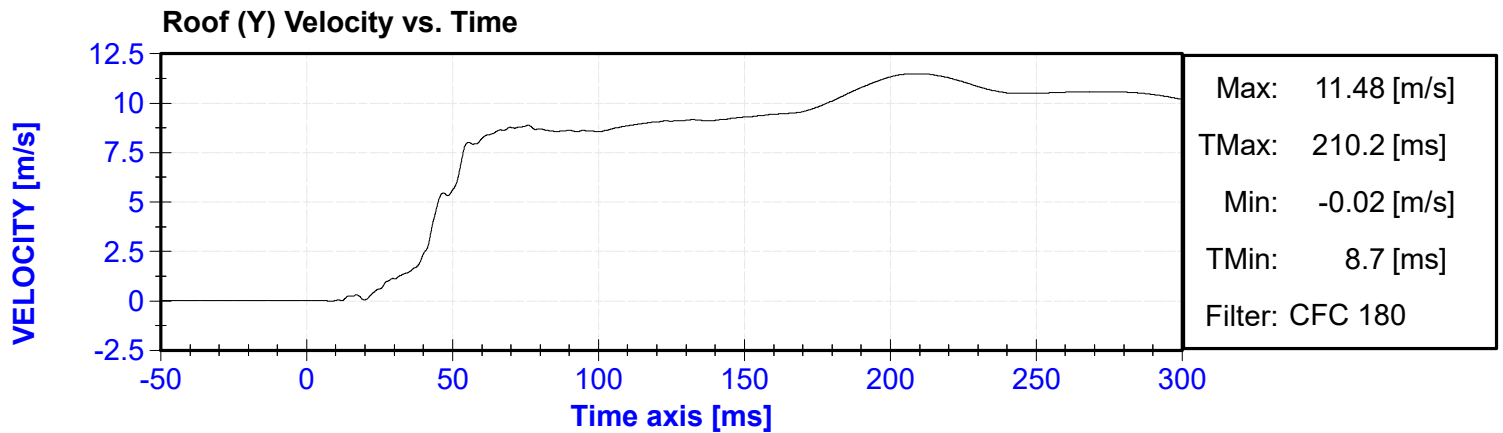
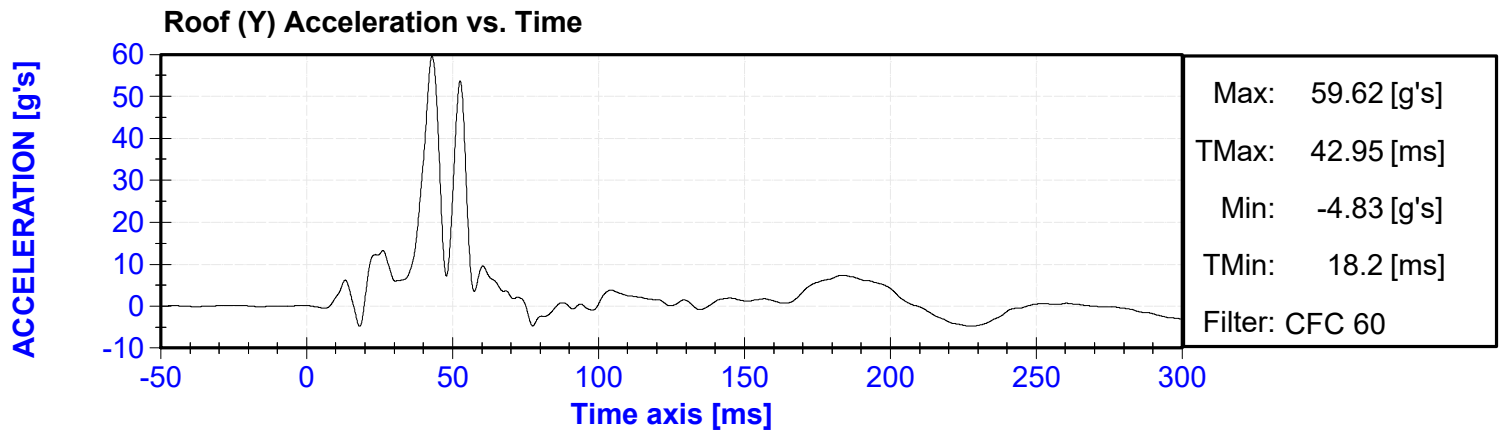
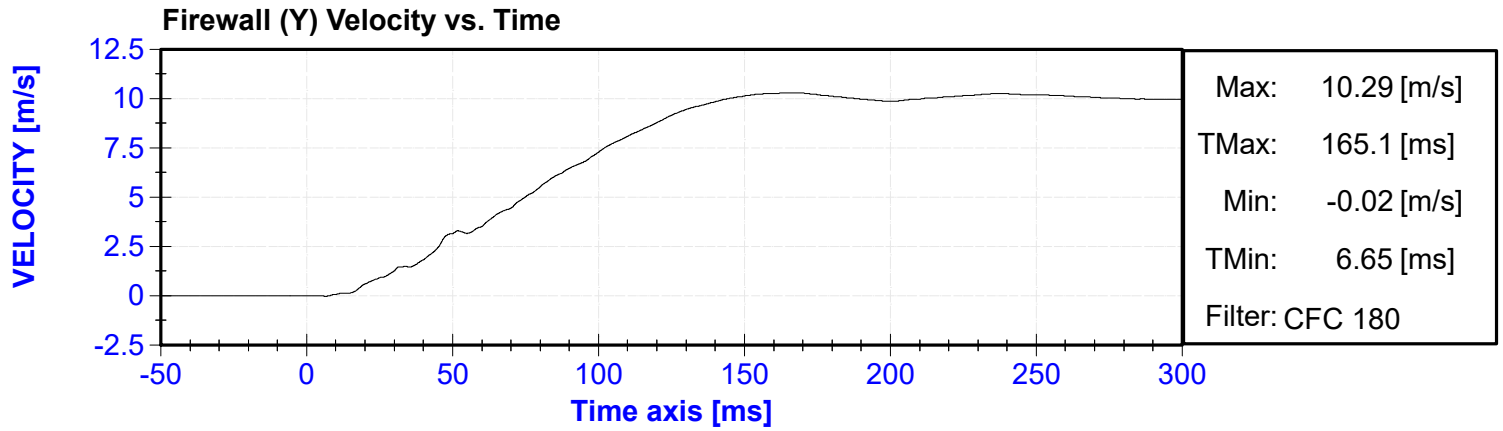


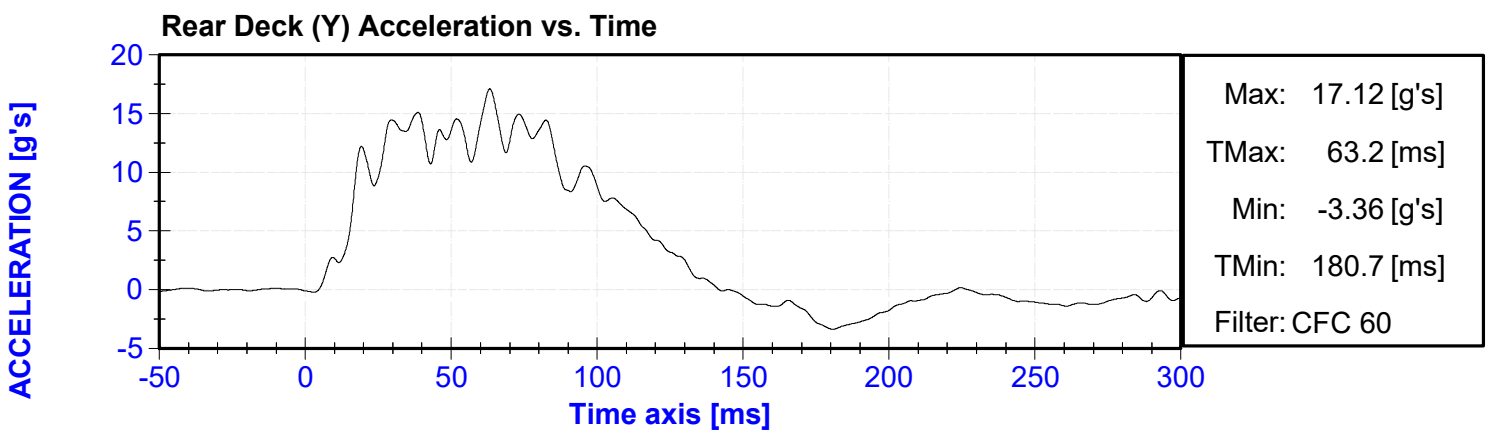
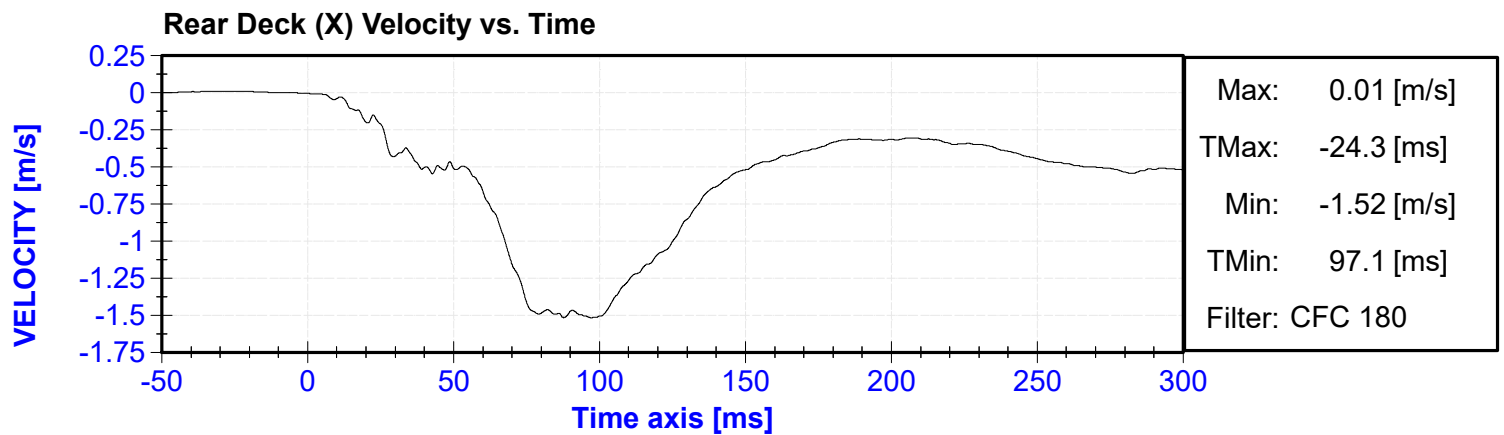
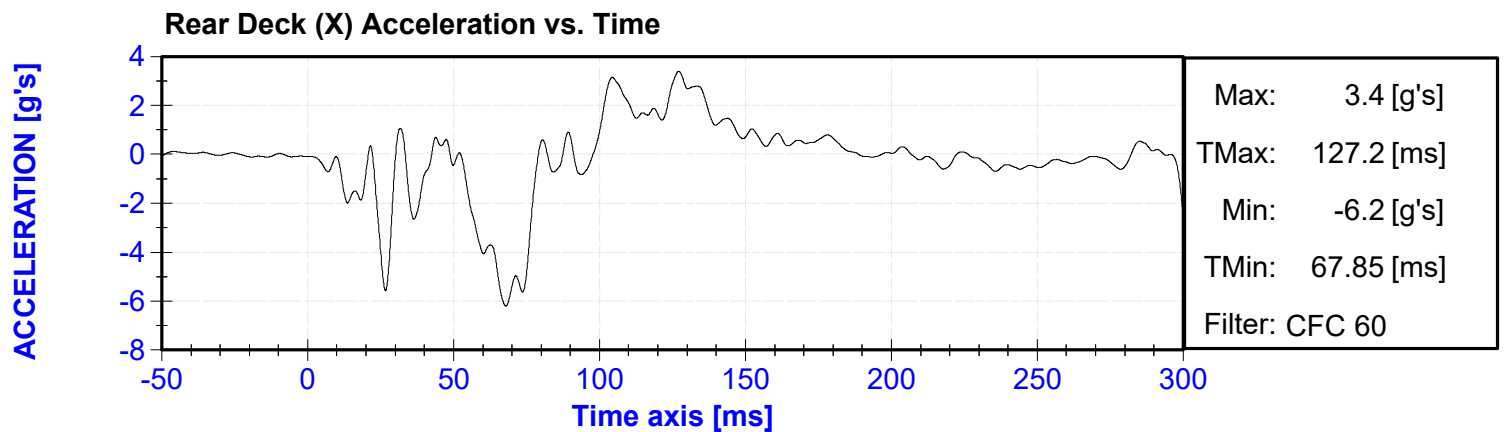
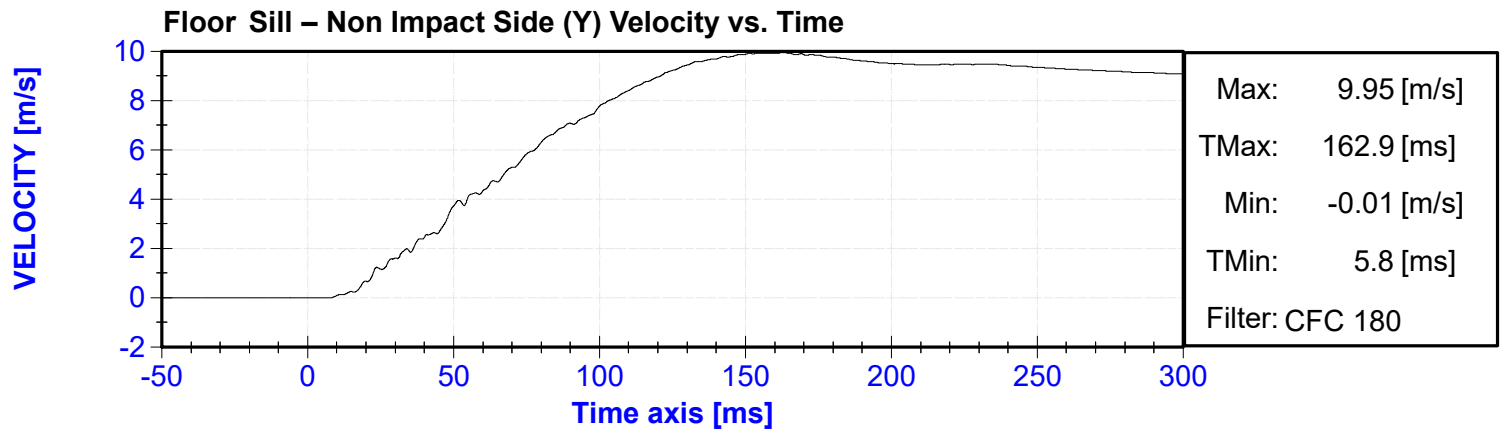
ACCELERATION [g's]

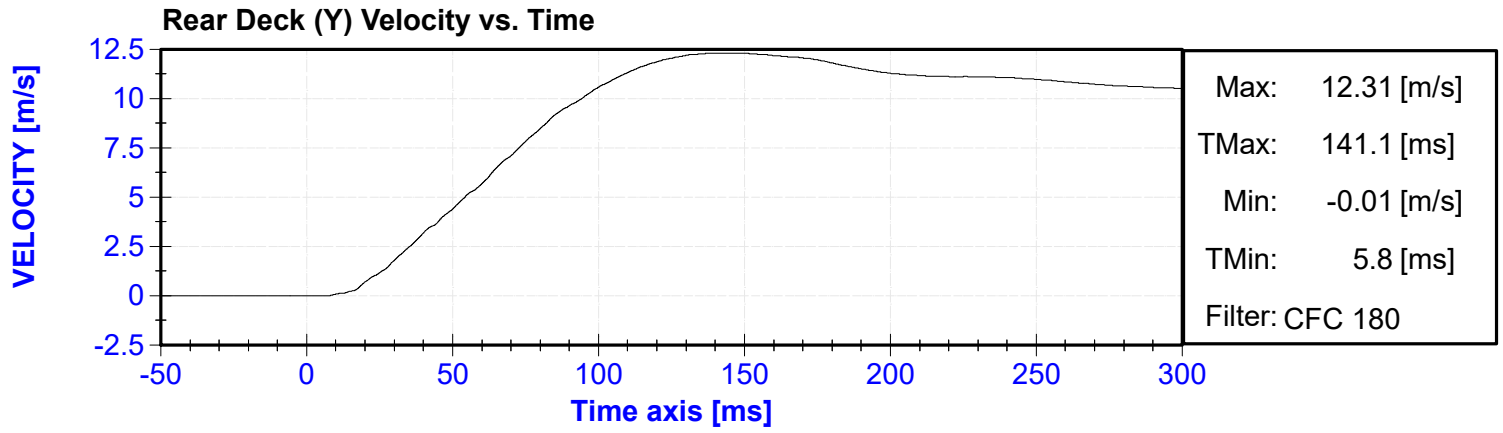
Engine (X) Acceleration vs. Time











APPENDIX IV

PRE-TEST DUMMY PERFORMANCE CALIBRATION TEST DATA

(Subpart U, ES-2re)

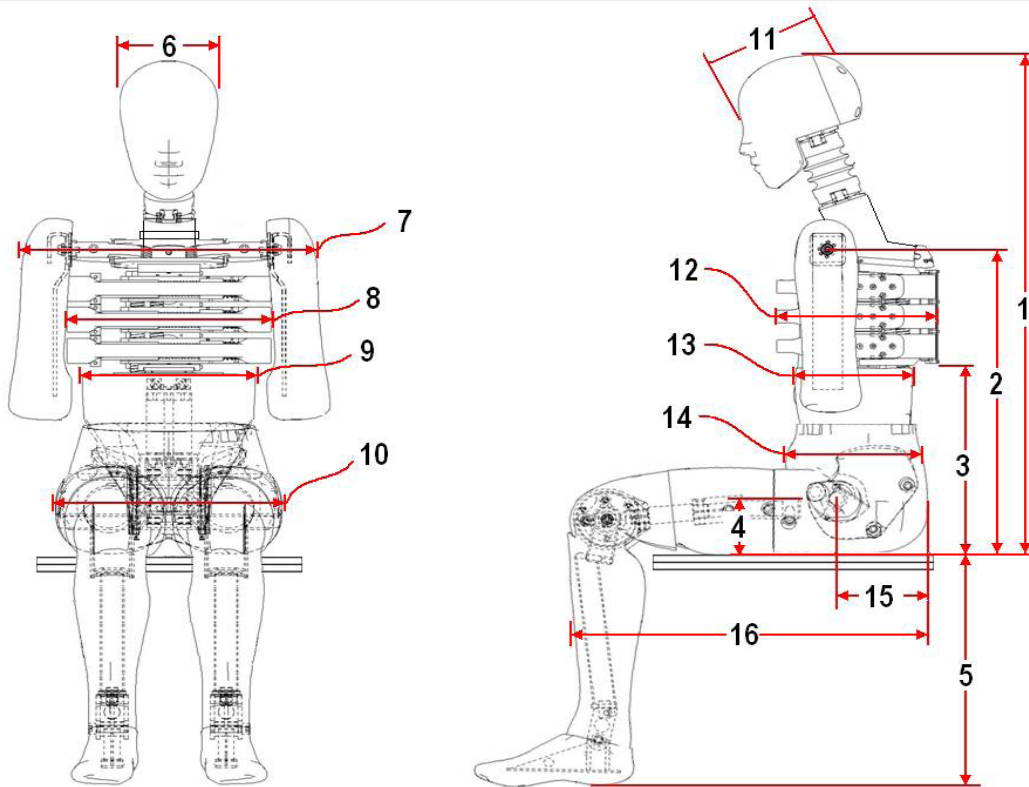


External Measurements - EuroSID-2re

Technician: K. Brogan

Date: 10/10/2023

Dummy Serial Number: D037



FRONT VIEW

SIDE VIEW

Dim. No.	Description	Specification (mm)		Result (mm)	Pass/Fail
1	Sitting Height	900	918	909	Pass
2	Seat to Shoulder Joint	558	572	564	Pass
3	Seat to Lower Face of Thoracic Spine Box	346	356	353	Pass
4	Seat to Hip Joint (center of bolt)	97	103	101	Pass
5	Sole to Seat, Sitting	333	451	420	Pass
6	Head Width	152	158	155	Pass
7	Shoulder/Arm Width	461	479	470	Pass
8	Thorax Width	322	332	329	Pass
9	Abdomen Width	273	287	280	Pass
10	Pelvis Lap Width	359	373	364	Pass
11	Head Depth	196	206	199	Pass
12	Thorax Depth	262	272	266	Pass
13	Abdomen Depth	194	204	197	Pass
14	Pelvis Depth	235	245	241	Pass
15	Back of Buttocks to Hip Joint (center of bolt)	150	160	154	Pass
16	Back of Buttocks to Front Knee	597	615	605	Pass

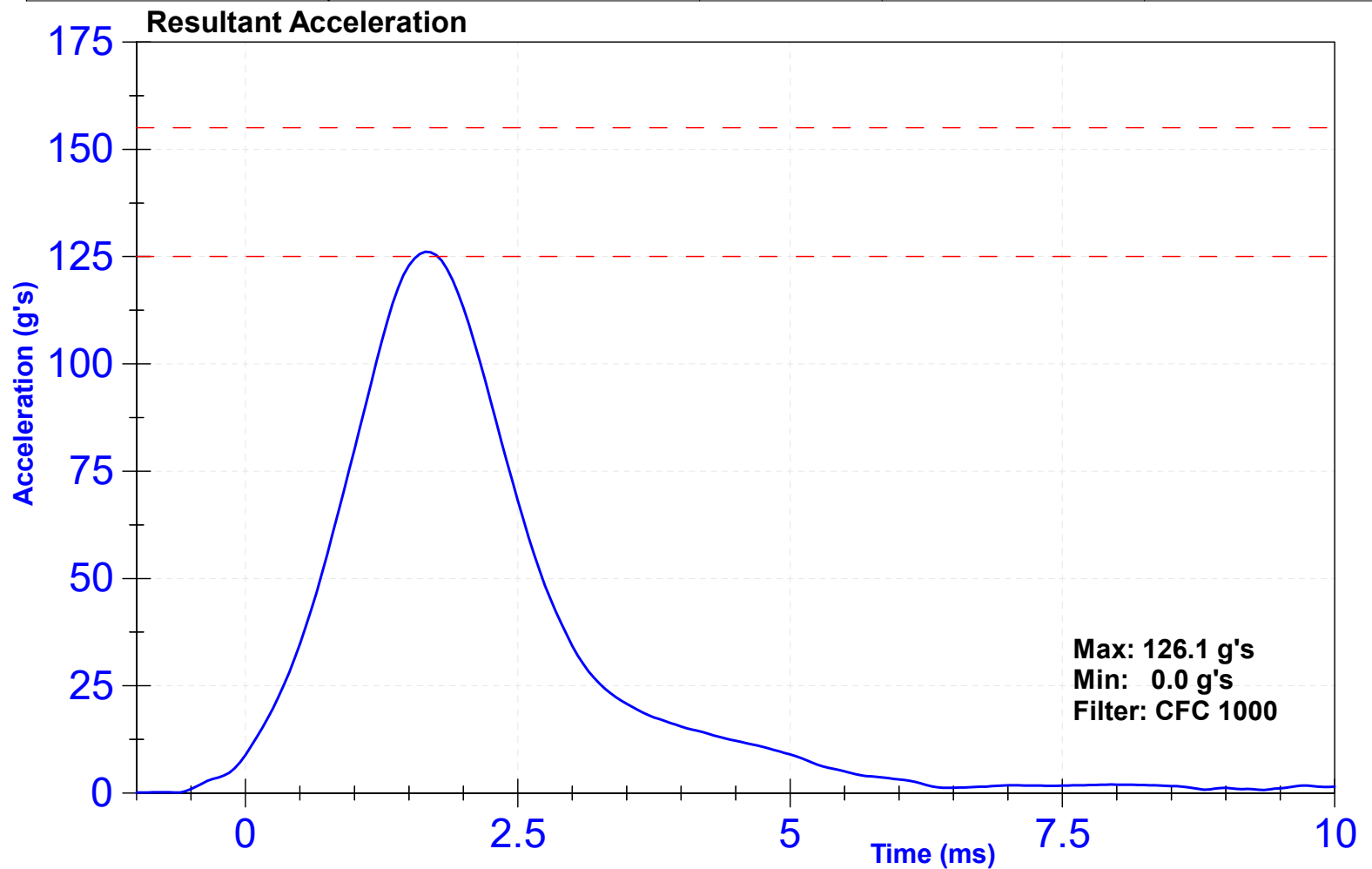
ATD Manufacturer	Denton	Test Technician	J. Rios
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

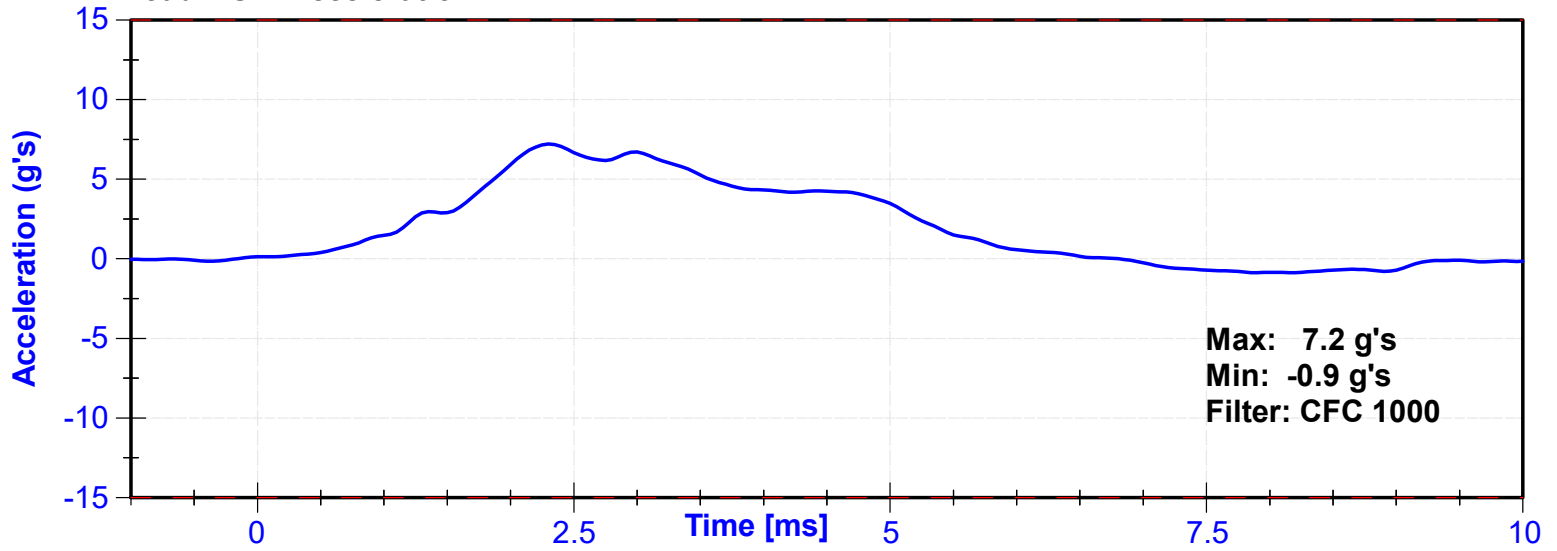
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.6	Pass
Humidity	10	70	%	33	Pass
Resultant Acceleration	125	155	g's	126.1	Pass
Oscillation	0	15	%	1.85	Pass
Fore-Aft Acceleration	-15	15	g's	7.2	Pass

Transducer Calibrations

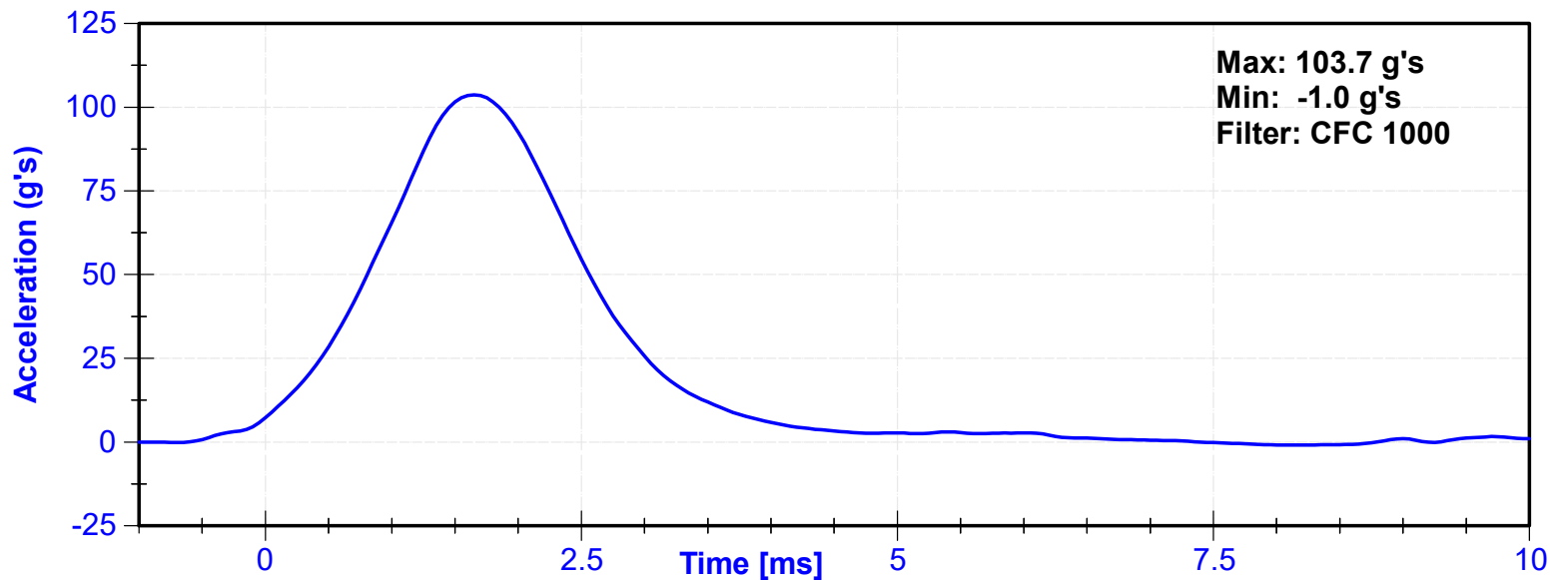
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	Endevco	T21724	8/8/2023	2/4/2024
Y Accelerometer	Endevco	T22281	8/8/2023	2/4/2024
Z Accelerometer	Endevco	T26050	8/8/2023	2/4/2024



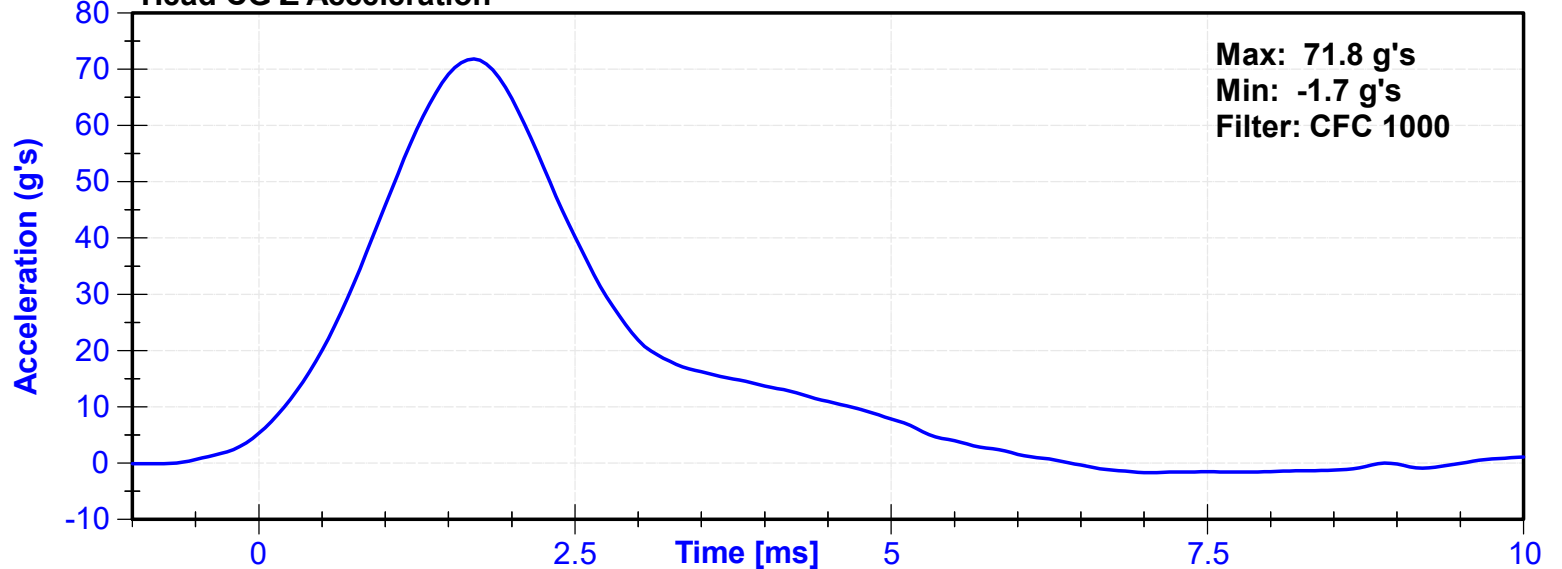
Head CG X Acceleration



Head CG Y Acceleration



Head CG Z Acceleration



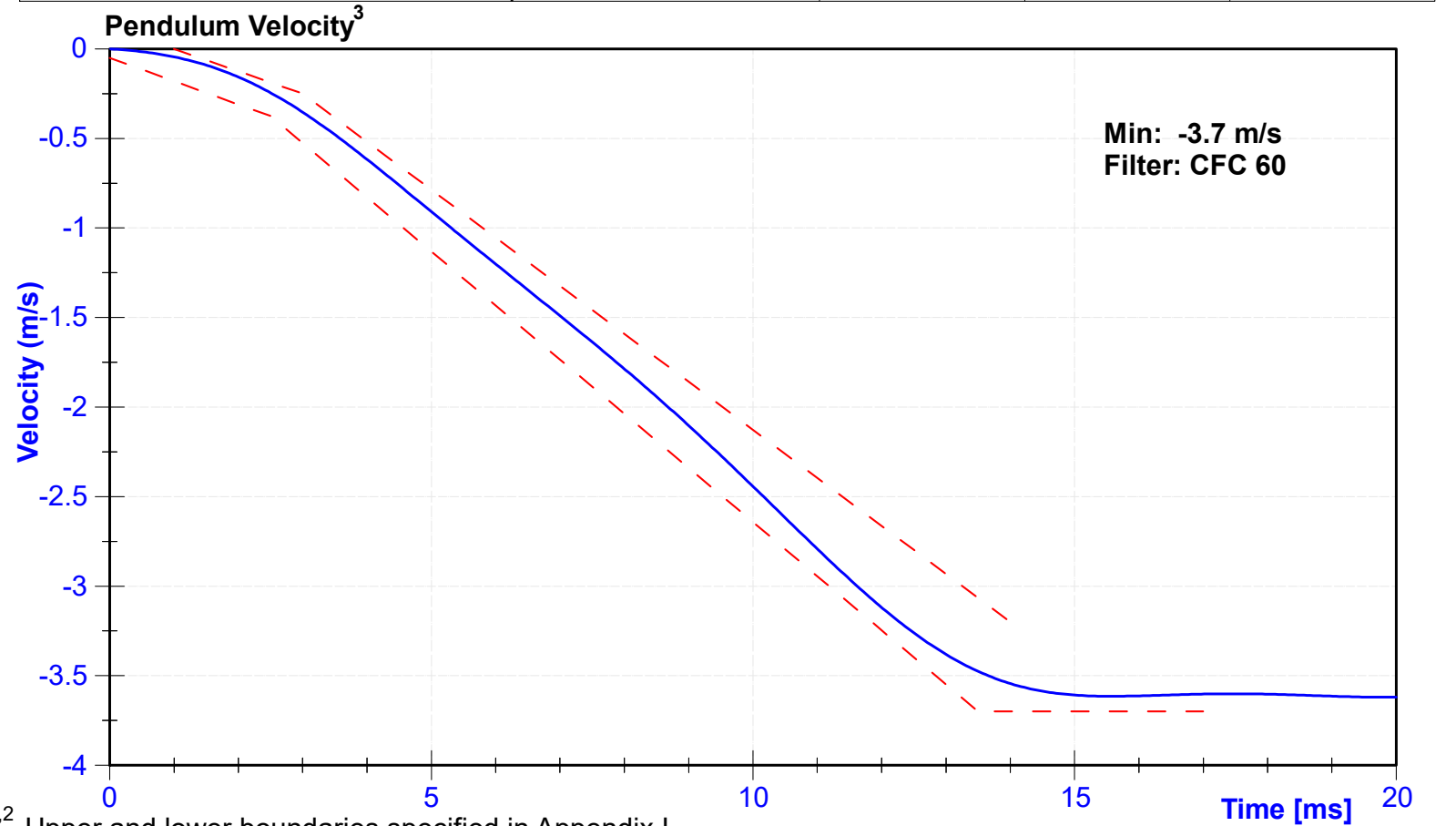
ATD Manufacturer	Denton	Test Technician	J. Rios
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

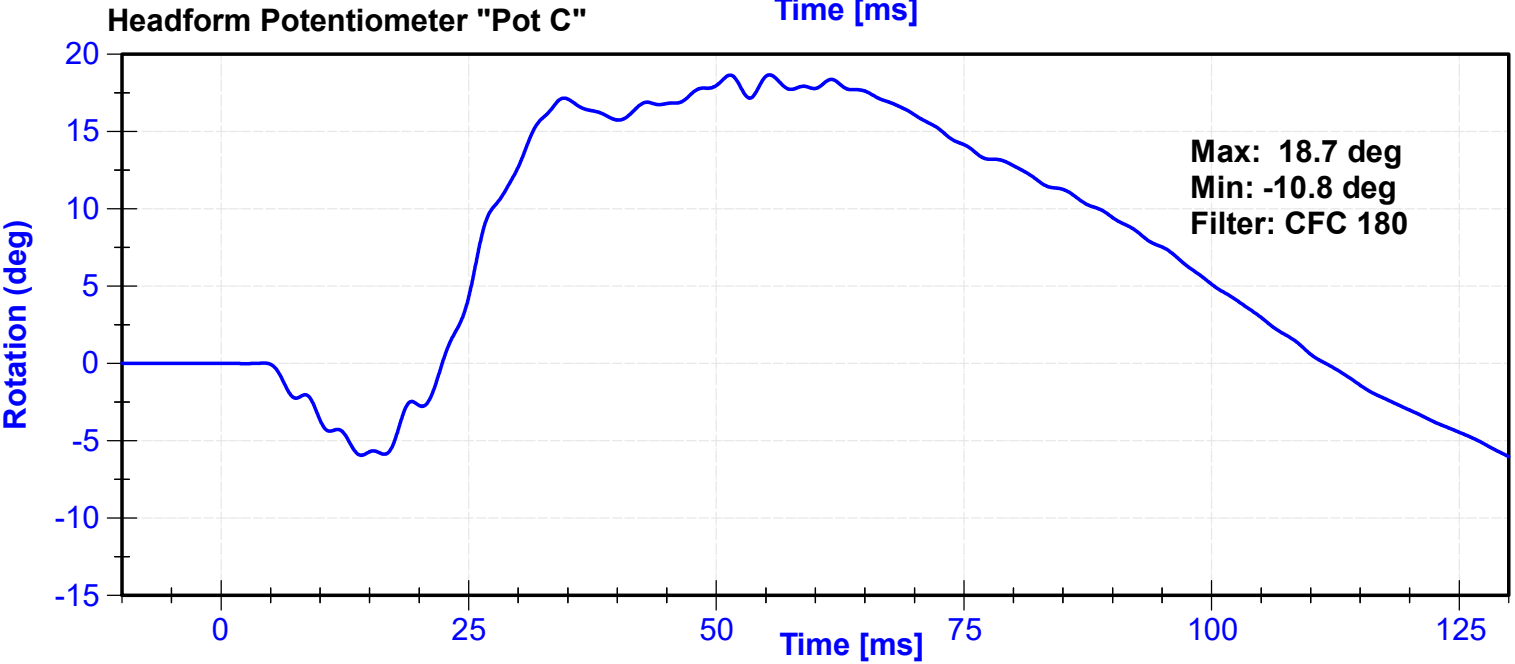
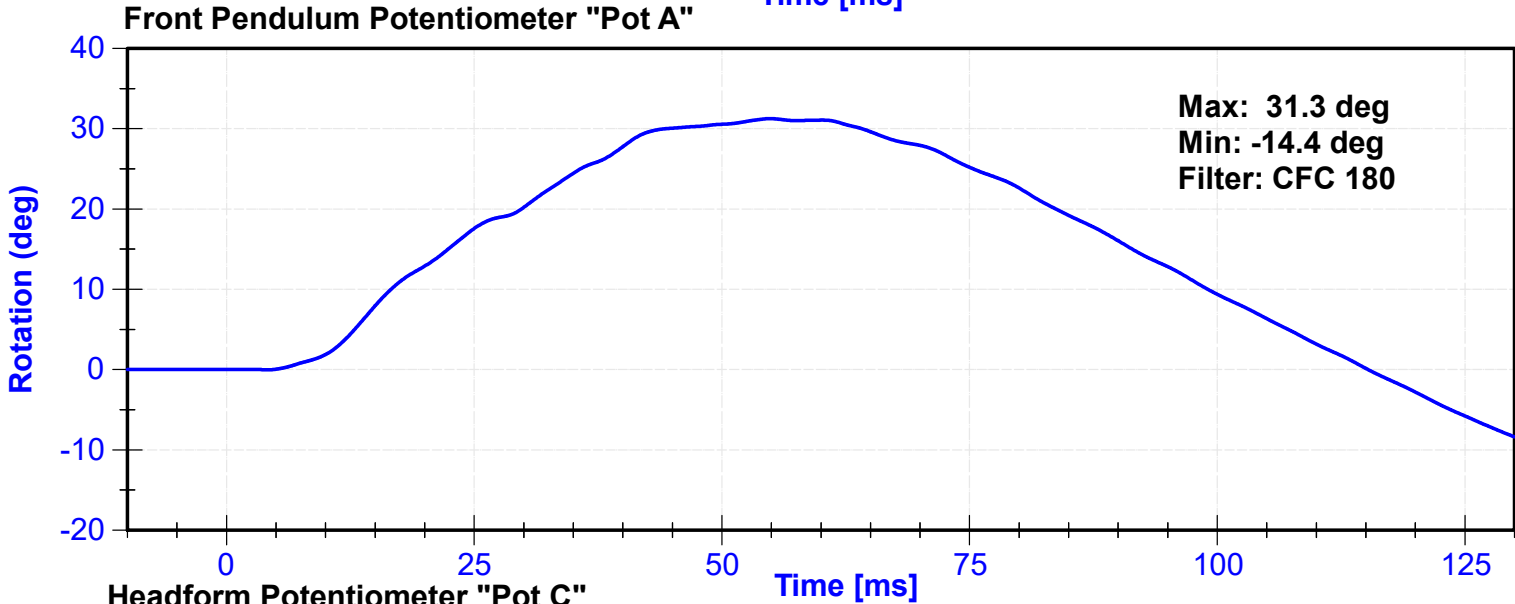
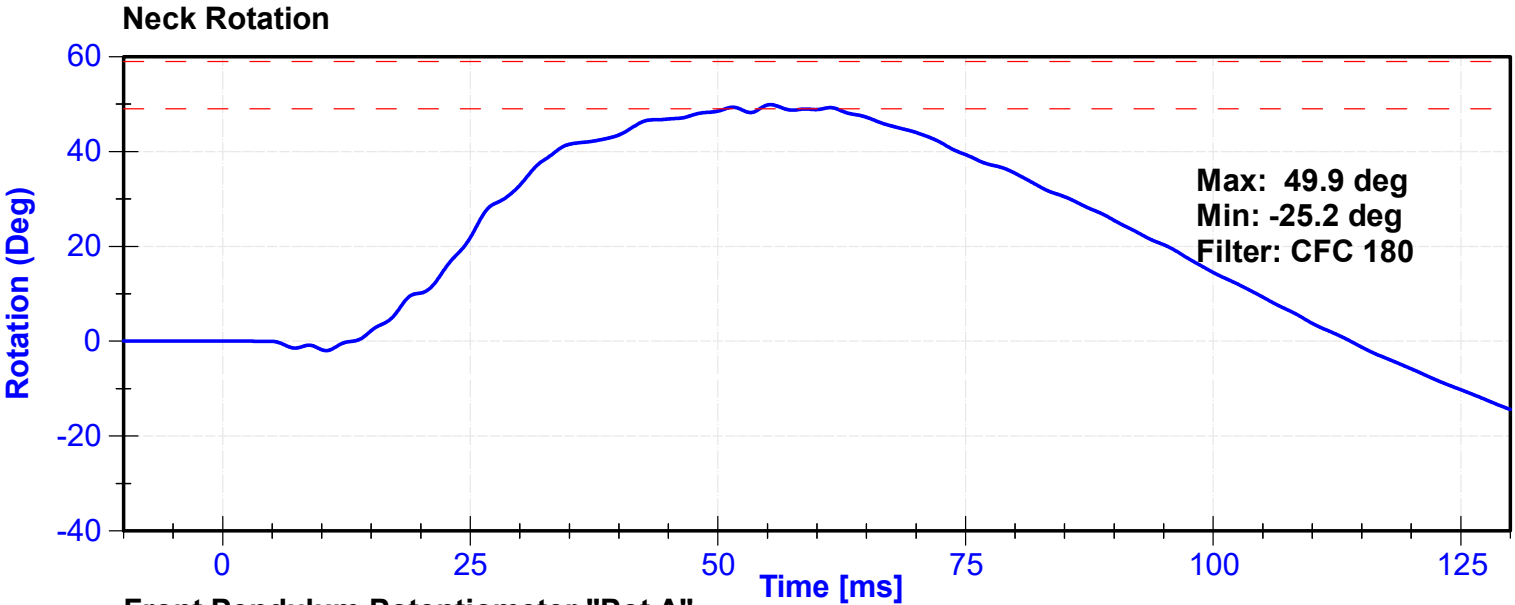
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.6	Pass
Humidity	10	70	%	32.0	Pass
Velocity	3.3	3.5	m/s	3.40	Pass
Lateral Neck Rotation	49	59	deg	49.9	Pass
Time at Maximum Rotation	54	66	ms	55.3	Pass
Time of Rotation Decay from Maximum	53	88	ms	58.6	Pass
Pendulum Velocity Overall Corridor	Lower Boundary ¹	Upper Boundary ²	m/s	See Plot ³	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	C16503	10/26/2022	10/26/2023
Front Pendulum Potentiometer	Sfernice	094	9/29/2023	9/28/2024
Headform Potentiometer	Sfernice	095	9/29/2023	9/28/2024





Appendix I

² Upper Boundary Corridor		¹ Lower Boundary Corridor	
Time (ms)	Velocity (m/s)	Time (ms)	Velocity (m/s)
1.0	0.00	0.0	-0.05
3.0	-0.25	2.5	-0.375
14.0	-3.20	13.5	-3.7
		17.0	-3.7

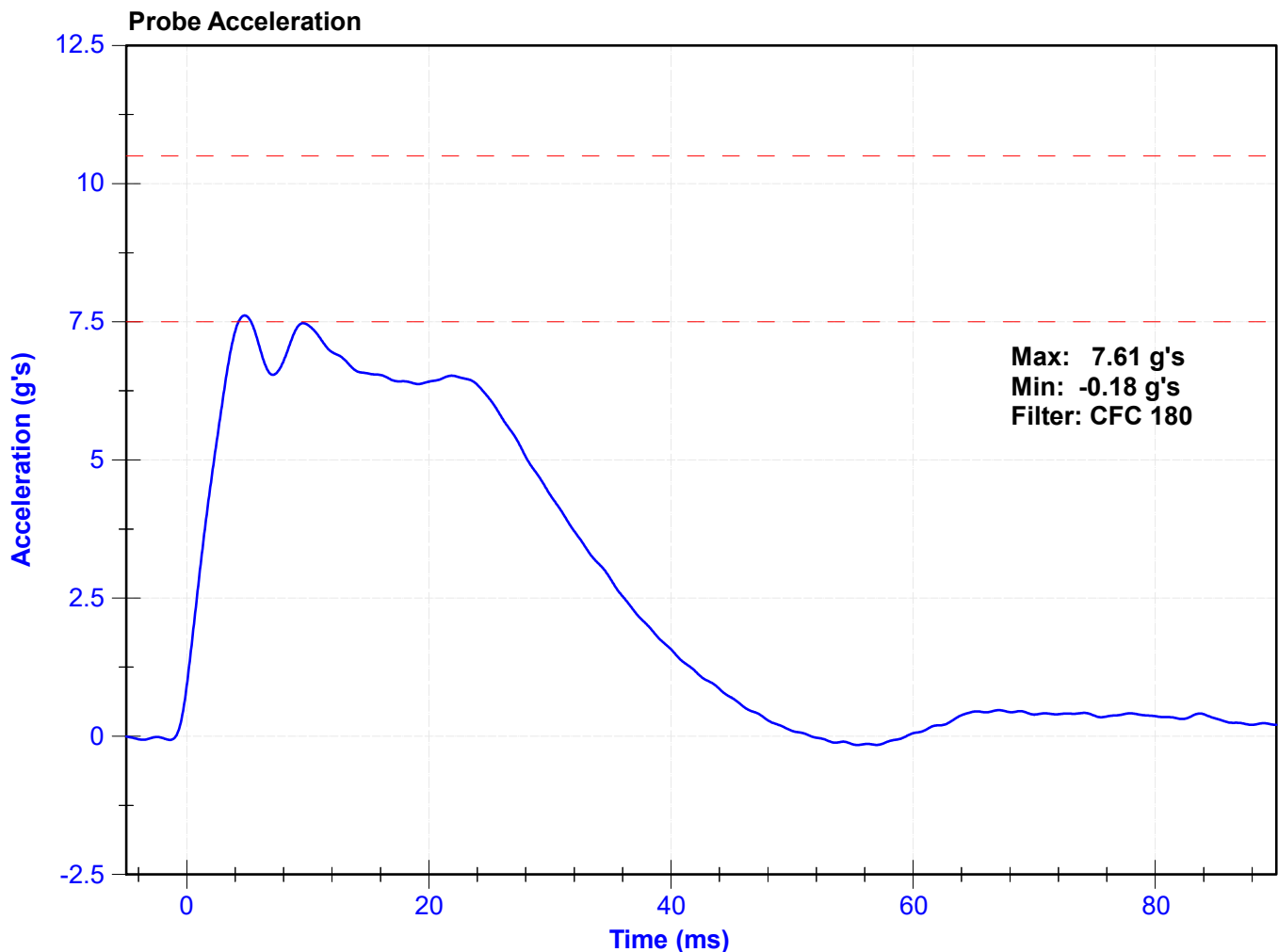
ATD Manufacturer	Denton	Test Technician	J. Rios
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.6	Pass
Humidity	10	70	%	39	Pass
Velocity	4.2	4.4	m/s	4.35	Pass
Probe Acceleration	7.5	10.5	g's	7.61	Pass

Transducer Calibrations

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



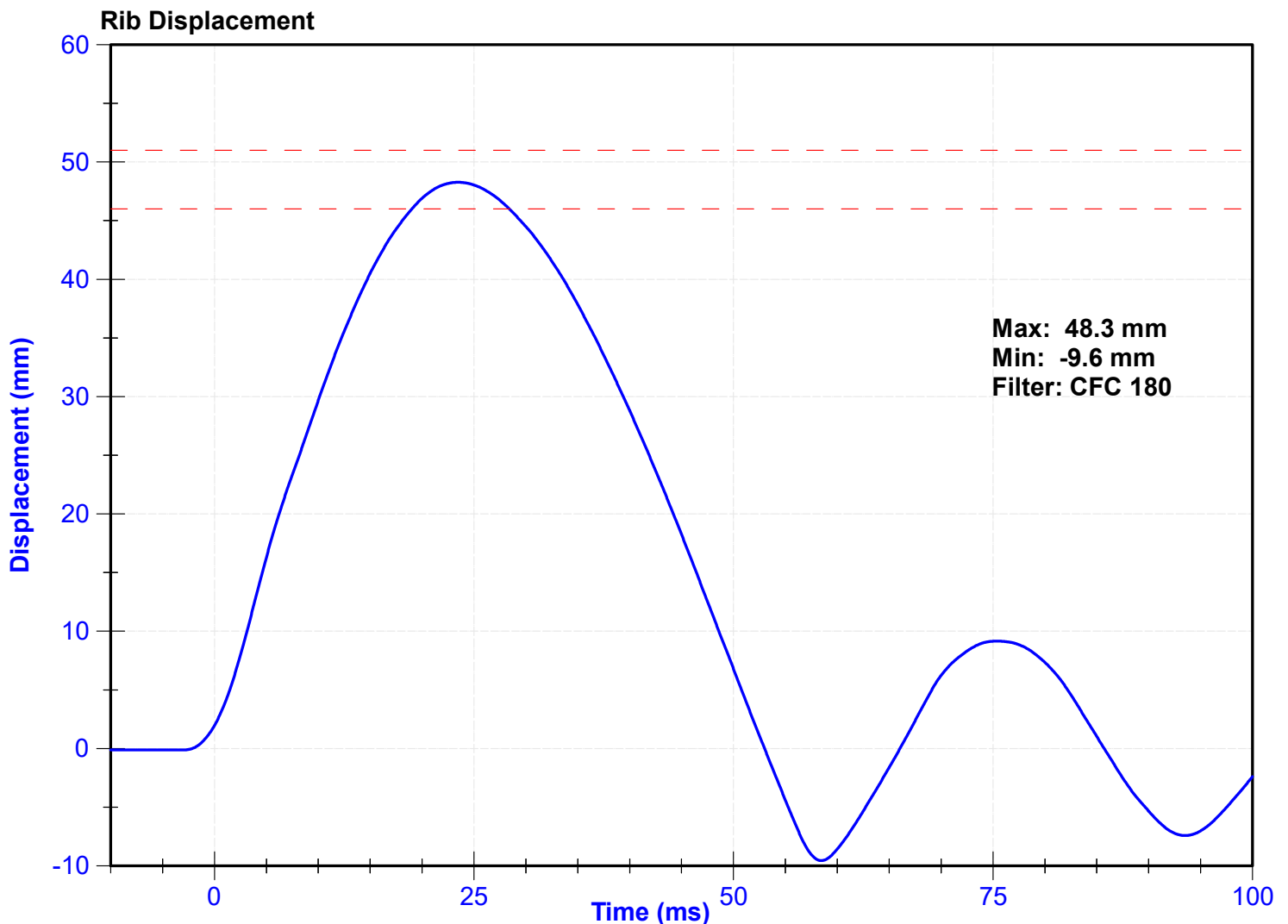
ATD Manufacturer	Denton	Test Technician	J. Rios
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.6	Pass
Humidity	10	70	%	36	Pass
Rib Displacement	46	51	mm	48.3	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	0552-01	8/7/2023	2/5/2024



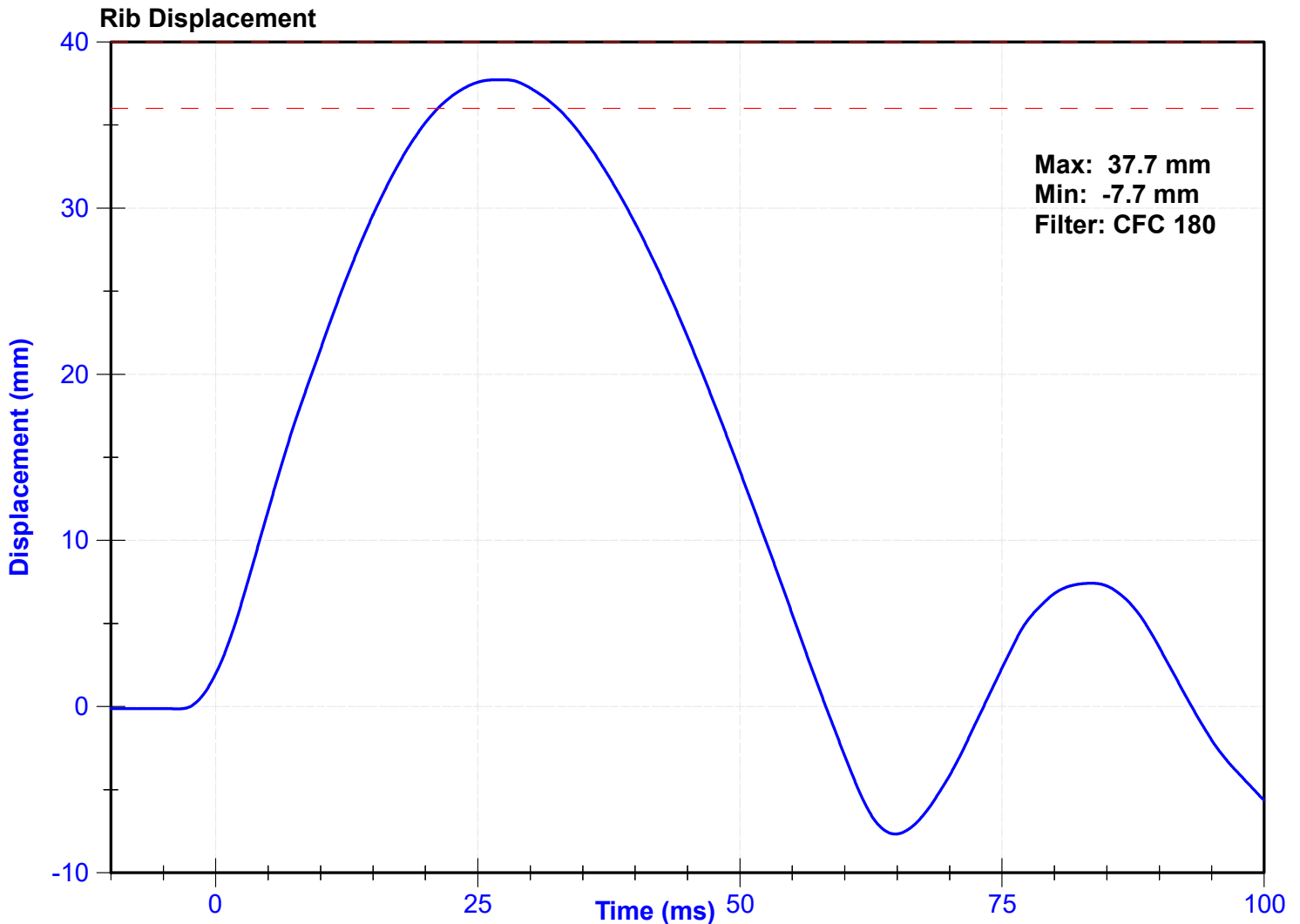
ATD Manufacturer	Denton	Test Technician	J. Rios
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.6	Pass
Humidity	10	70	%	36	Pass
Rib Displacement	36	40	mm	37.7	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	0552-01	8/7/2023	2/5/2024



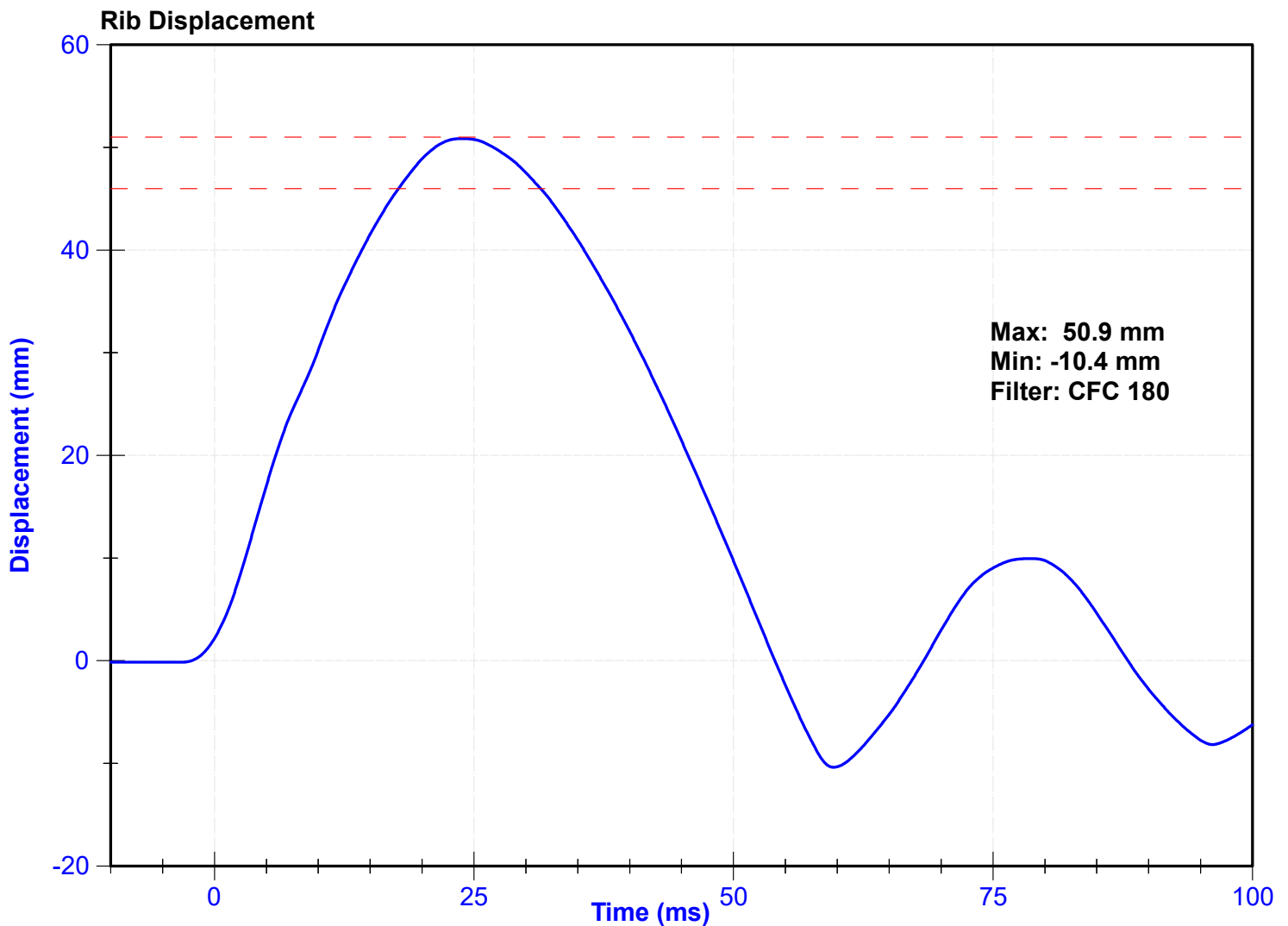
ATD Manufacturer	Denton	Test Technician	J. Rios
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.6	Pass
Humidity	10	70	%	36	Pass
Rib Displacement	46	51	mm	50.9	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	807	8/7/2023	2/5/2024



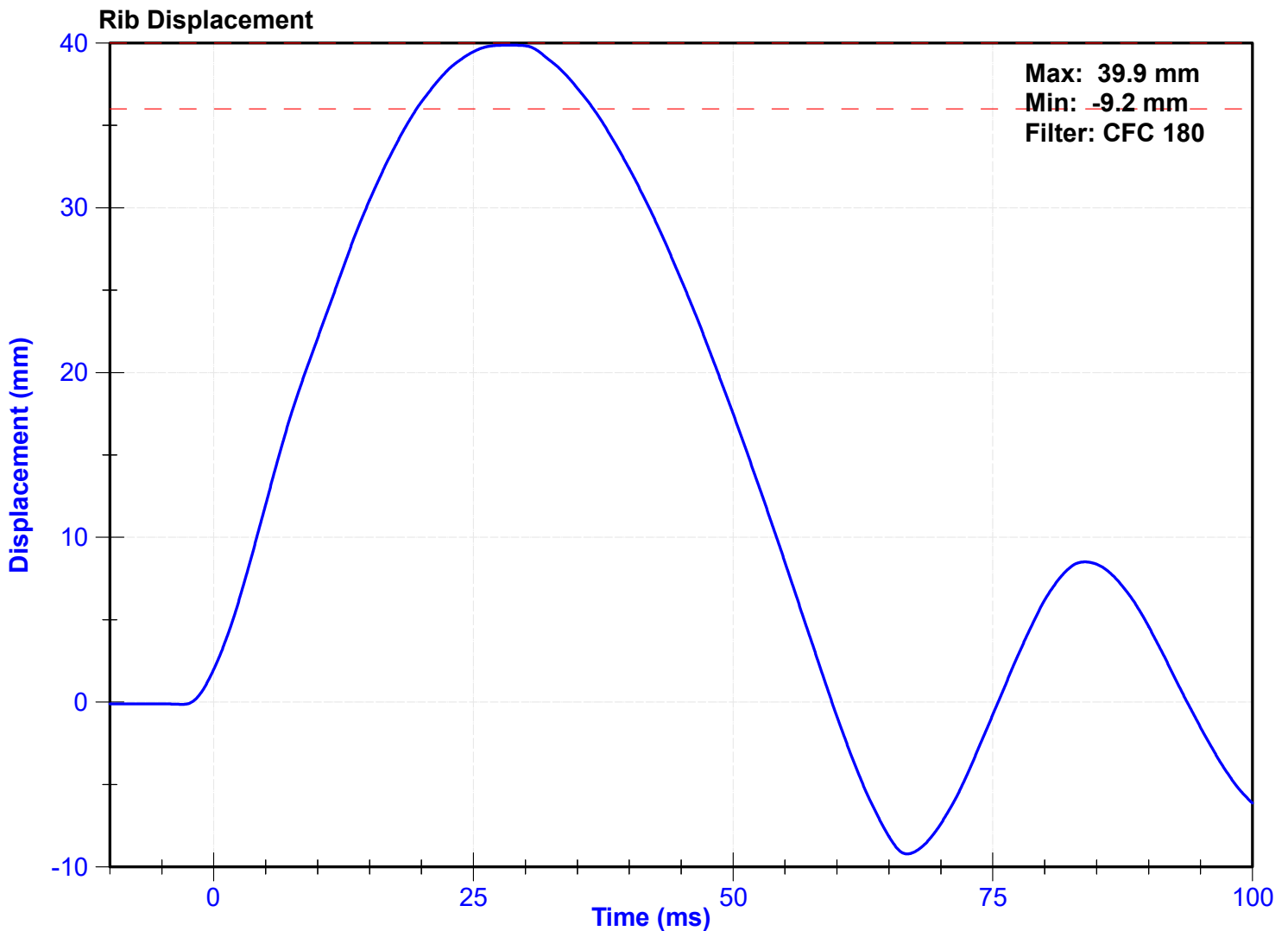
ATD Manufacturer	Denton	Test Technician	J. Rios
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.6	Pass
Humidity	10	70	%	36	Pass
Rib Displacement	36	40	mm	39.9	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	807	8/7/2023	2/5/2024



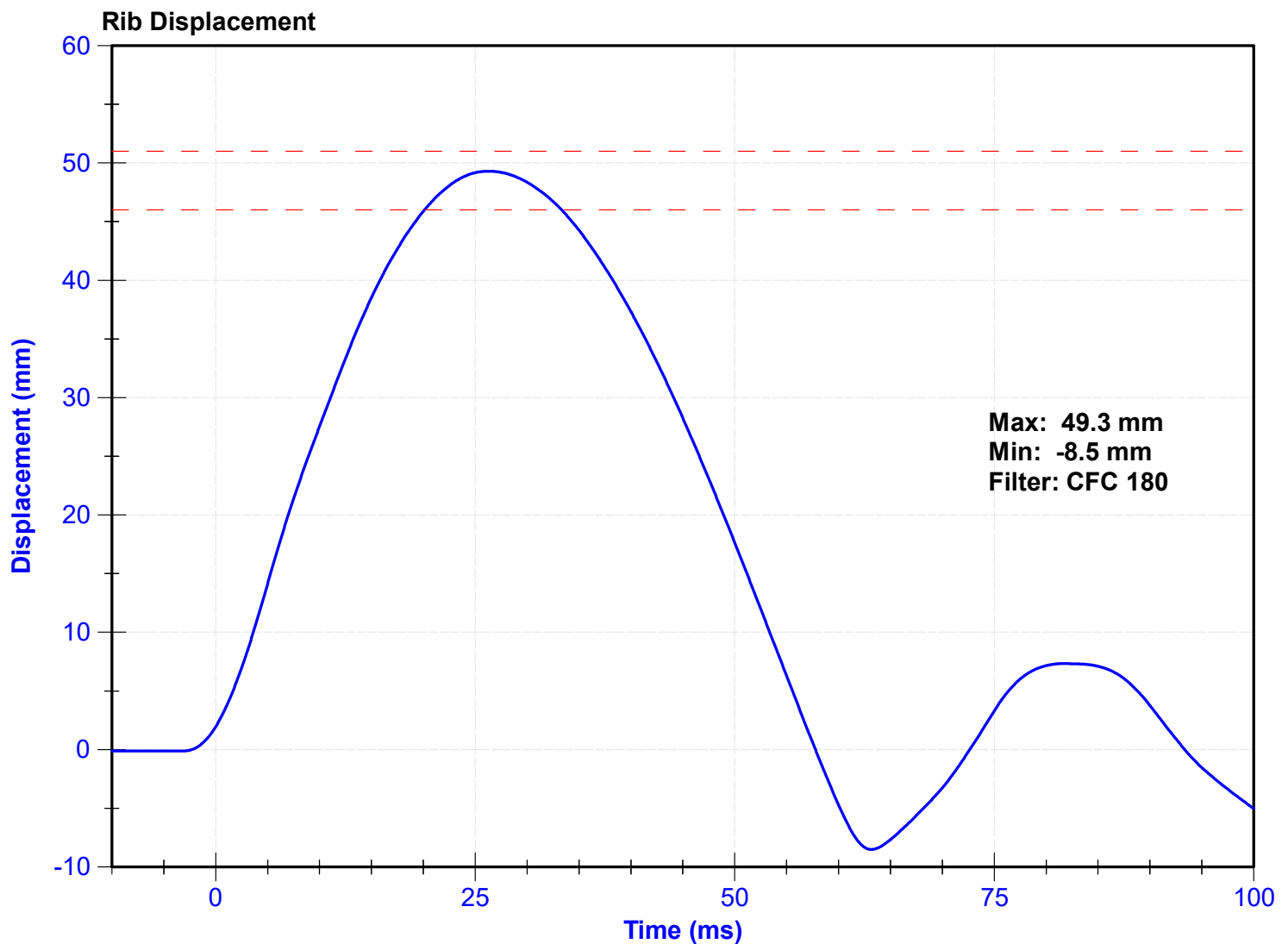
ATD Manufacturer	Denton	Test Technician	J. Rios
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.6	Pass
Humidity	10	70	%	36	Pass
Rib Displacement	46	51	mm	49.3	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	0552-03	8/7/2023	2/5/2024



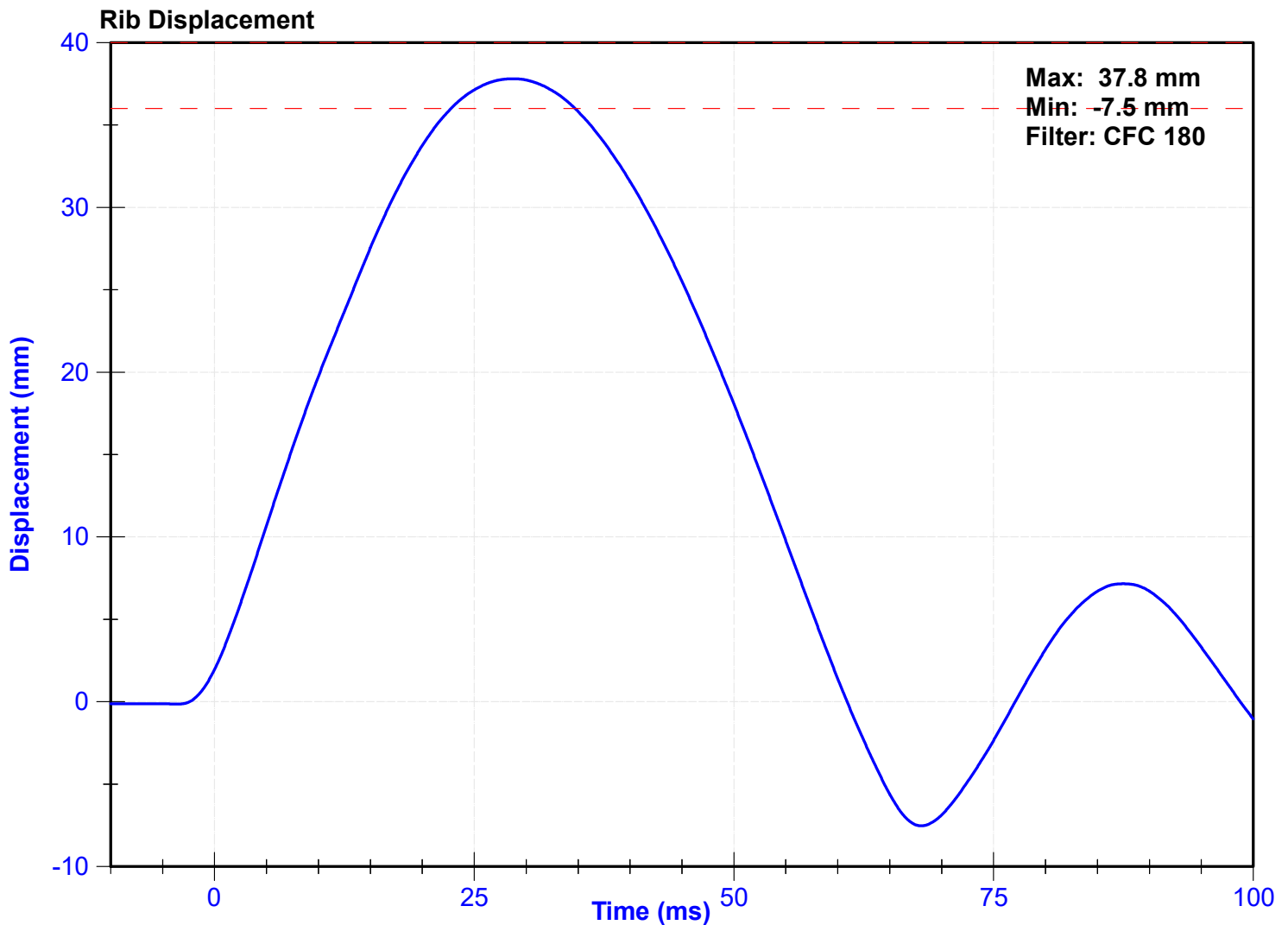
ATD Manufacturer	Denton	Test Technician	J. Rios
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.6	Pass
Humidity	10	70	%	36	Pass
Rib Displacement	36	40	mm	37.8	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	0552-03	8/7/2023	2/5/2024



ATD Manufacturer	Denton	Test Technician	J. Rios
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

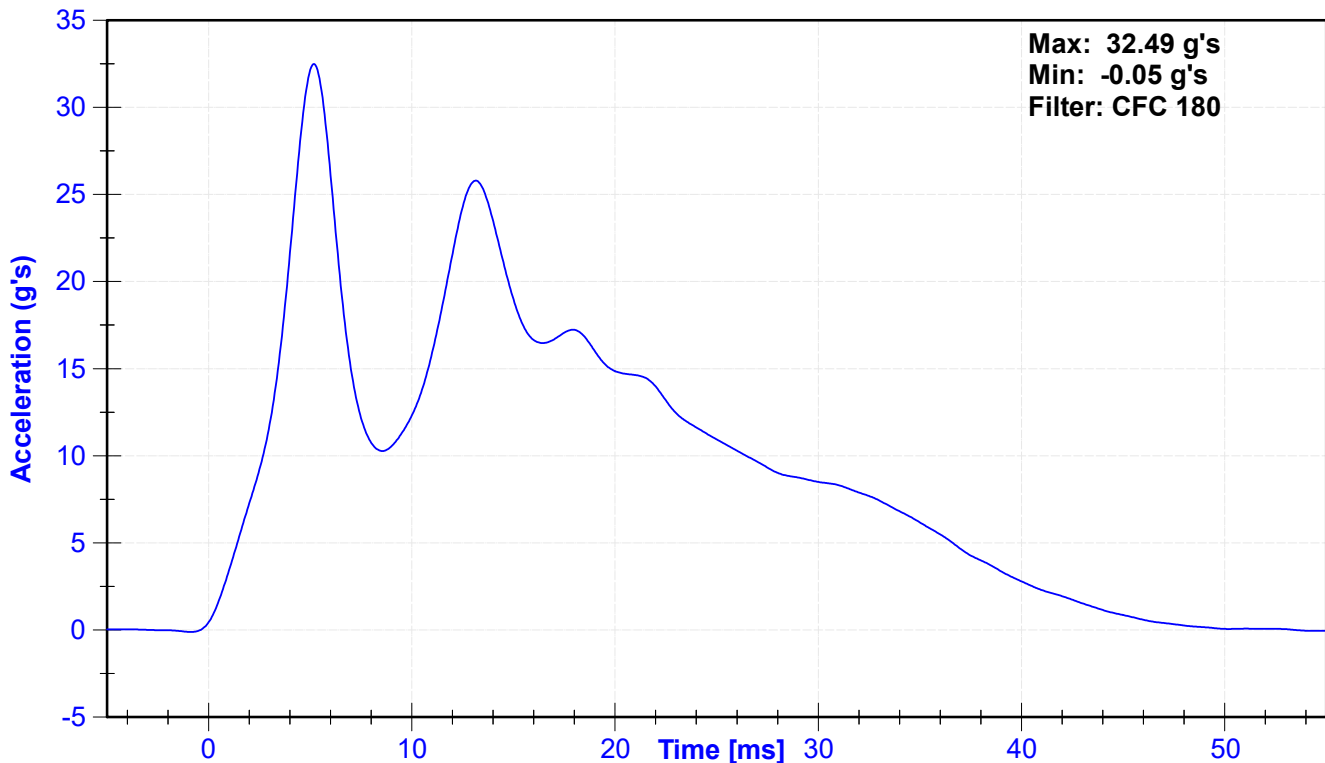
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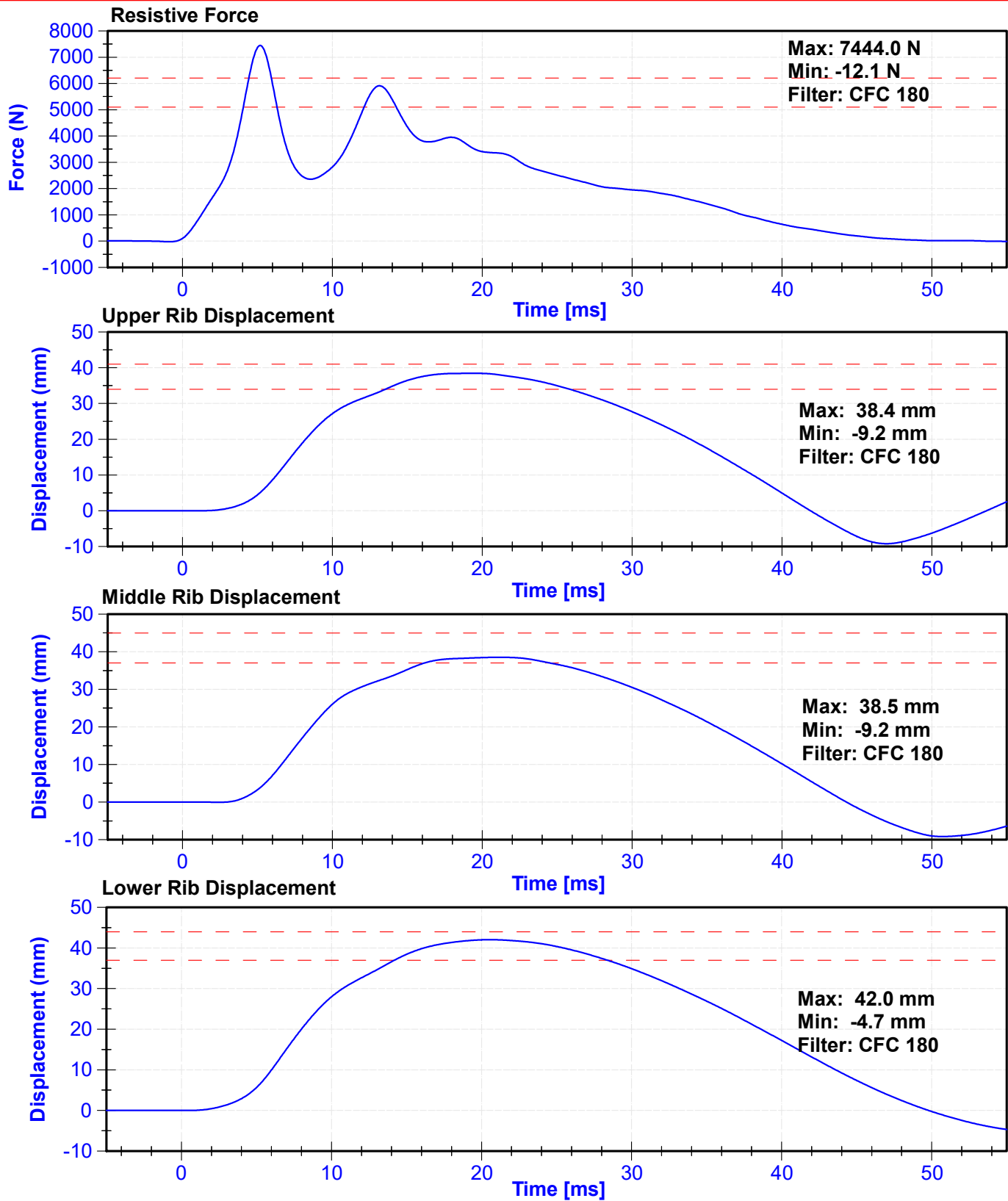
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.6	Pass
Humidity	10	70	%	39	Pass
Velocity	5.4	5.6	m/s	5.54	Pass
Resistive Force after 6ms	5100	6200	N	5977.5	Pass
Upper Thorax Rib Deflection	34	41	mm	38.4	Pass
Mid Thorax Rib Deflection	37	45	mm	38.5	Pass
Lower Thorax Rib Deflection	37	44	mm	42.0	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Probe Accelerometer	Endevco	18546	11/19/2022	11/18/2023
Upper Thorax Rib Potentiometer	Honeywell	0552-01	8/7/2023	2/5/2024
Middle Thorax Rib Potentiometer	Honeywell	807	8/7/2023	2/5/2024
Lower Thorax Rib Potentiometer	Honeywell	0552-03	8/7/2023	2/5/2024

Probe Acceleration





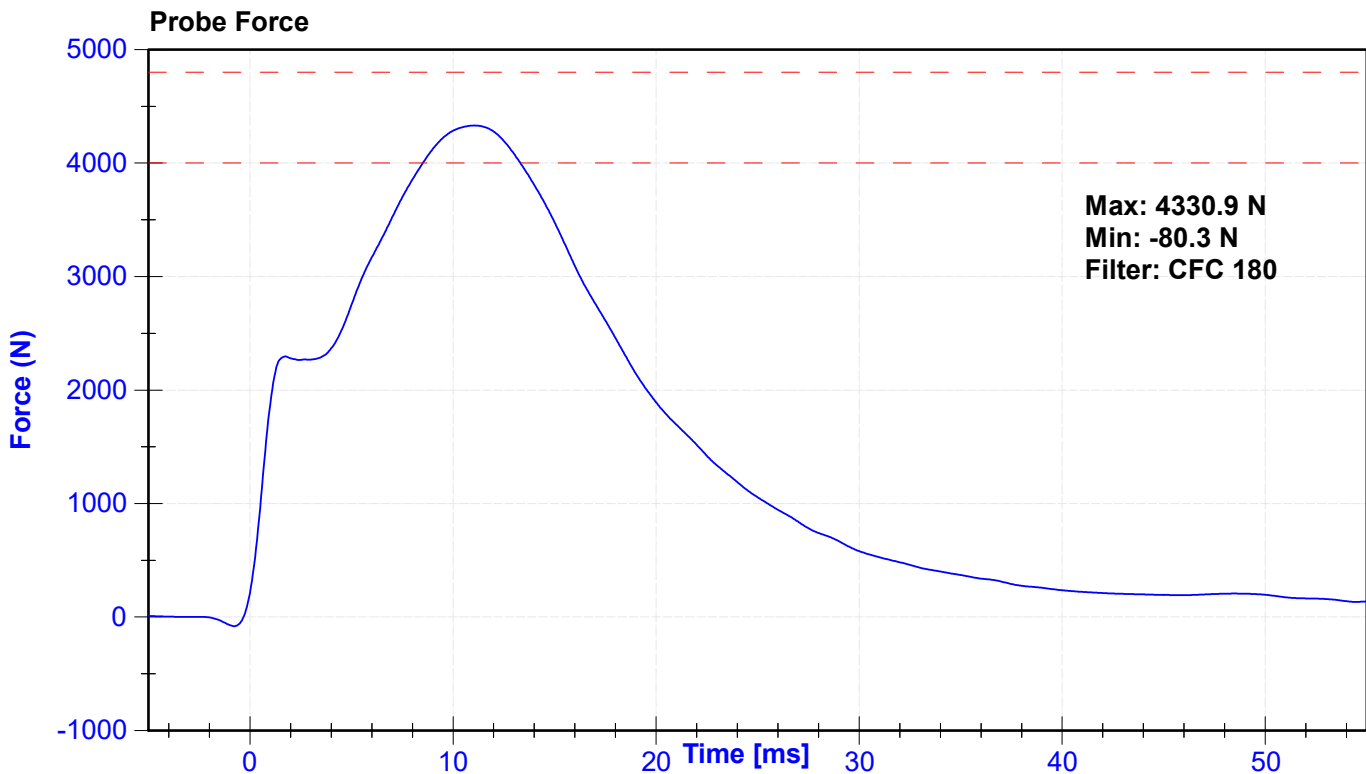
ATD Manufacturer	Denton	Test Technician	J. Rios
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

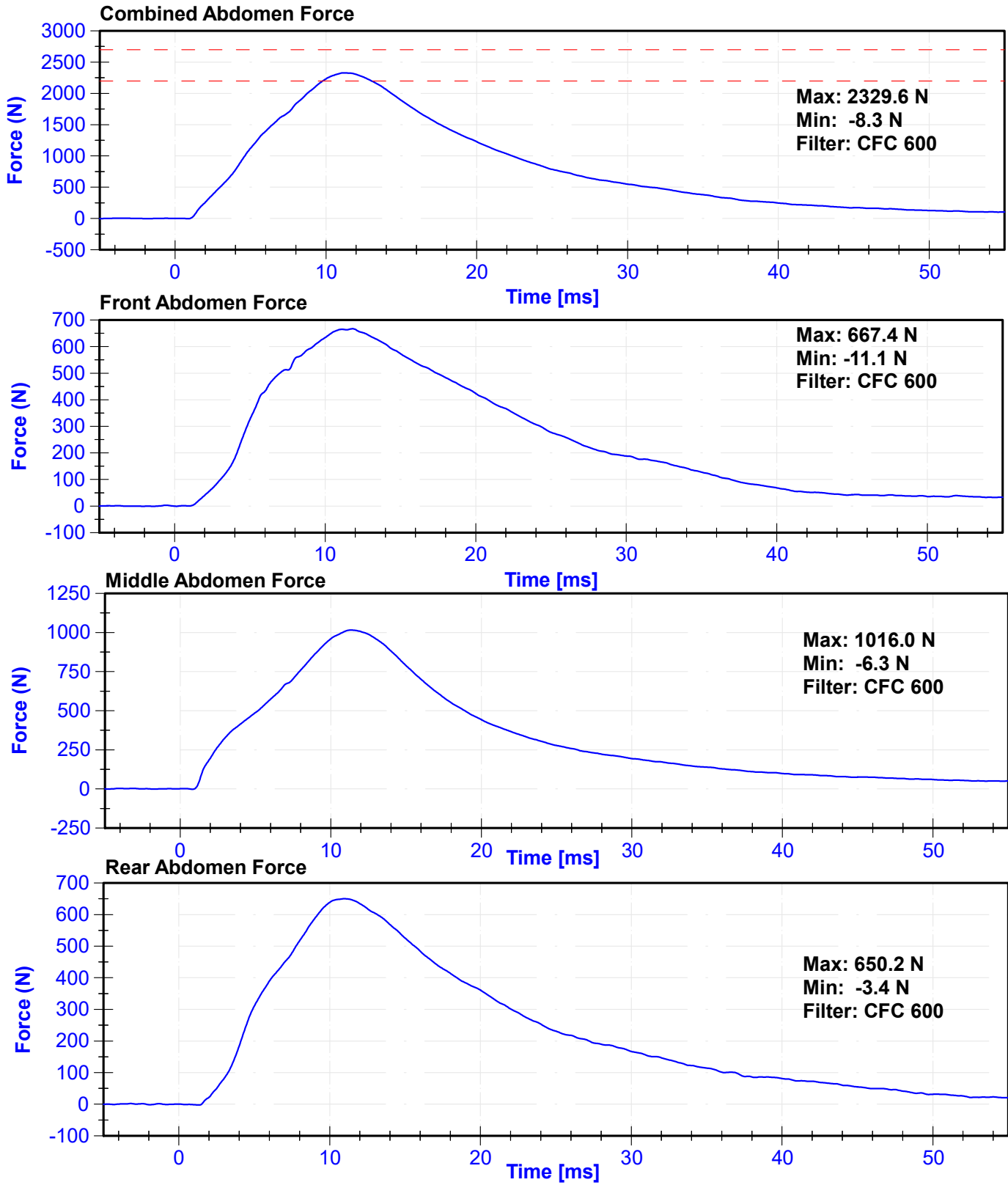
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.6	Pass
Humidity	10	70	%	39	Pass
Velocity	3.9	4.1	m/s	4.00	Pass
Combined Abdomen Force	2200	2700	N	2329.6	Pass
Time at Peak Abdomen Force	10.0	12.3	ms	11.20	Pass
Resistive Probe Force	4000	4800	N	4330.9	Pass
Time at Peak Resistive Force	10.6	13.0	ms	11.05	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18546	11/19/2022	11/18/2023
Front Abdomen Load Cell	Denton	1440	8/8/2023	8/7/2024
Middle Abdomen Load Cell	Denton	1525	8/8/2023	8/7/2024
Rear Abdomen Load Cell	Denton	1528	8/8/2023	8/7/2024





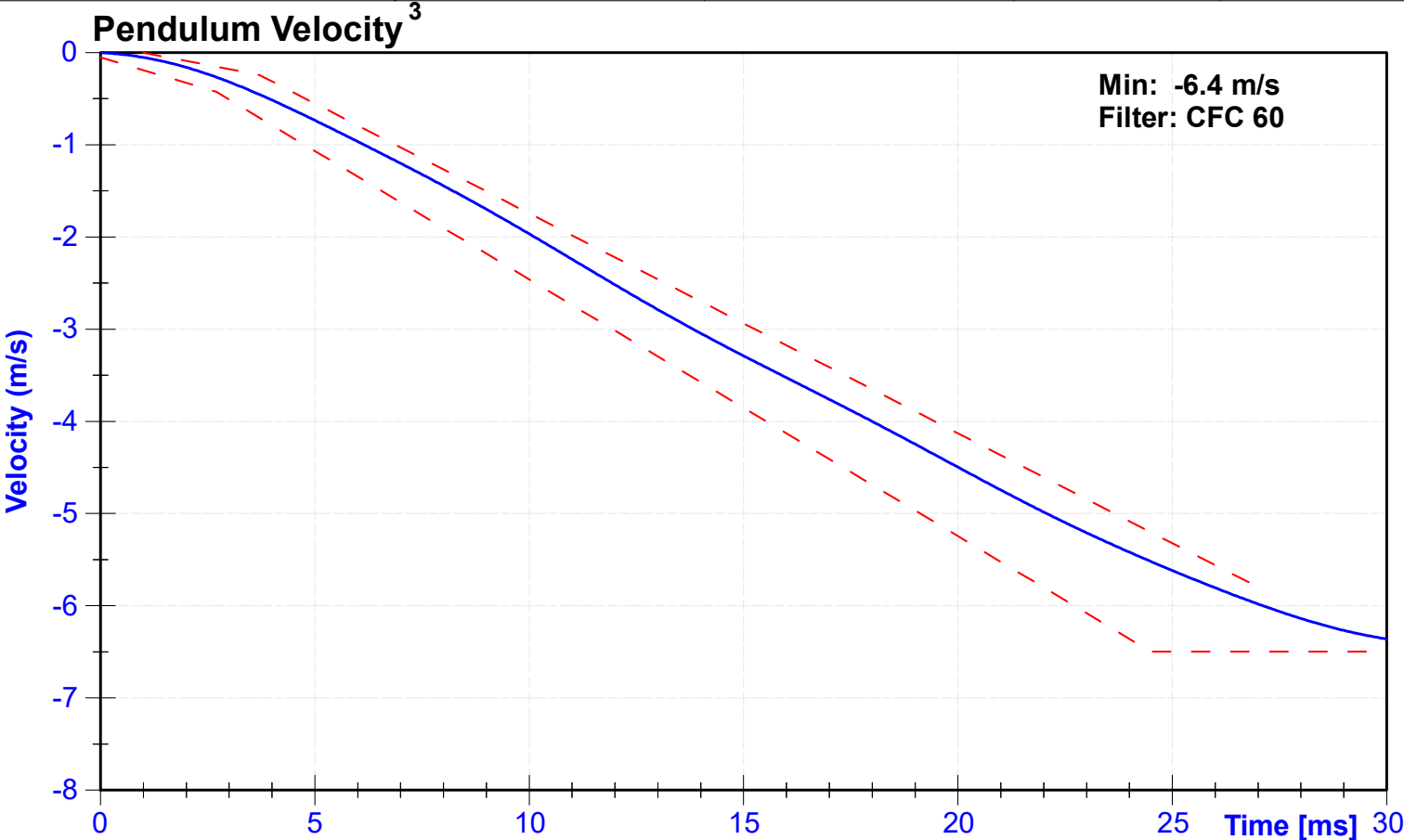
ATD Manufacturer	Denton	Test Technician	J. Rios
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

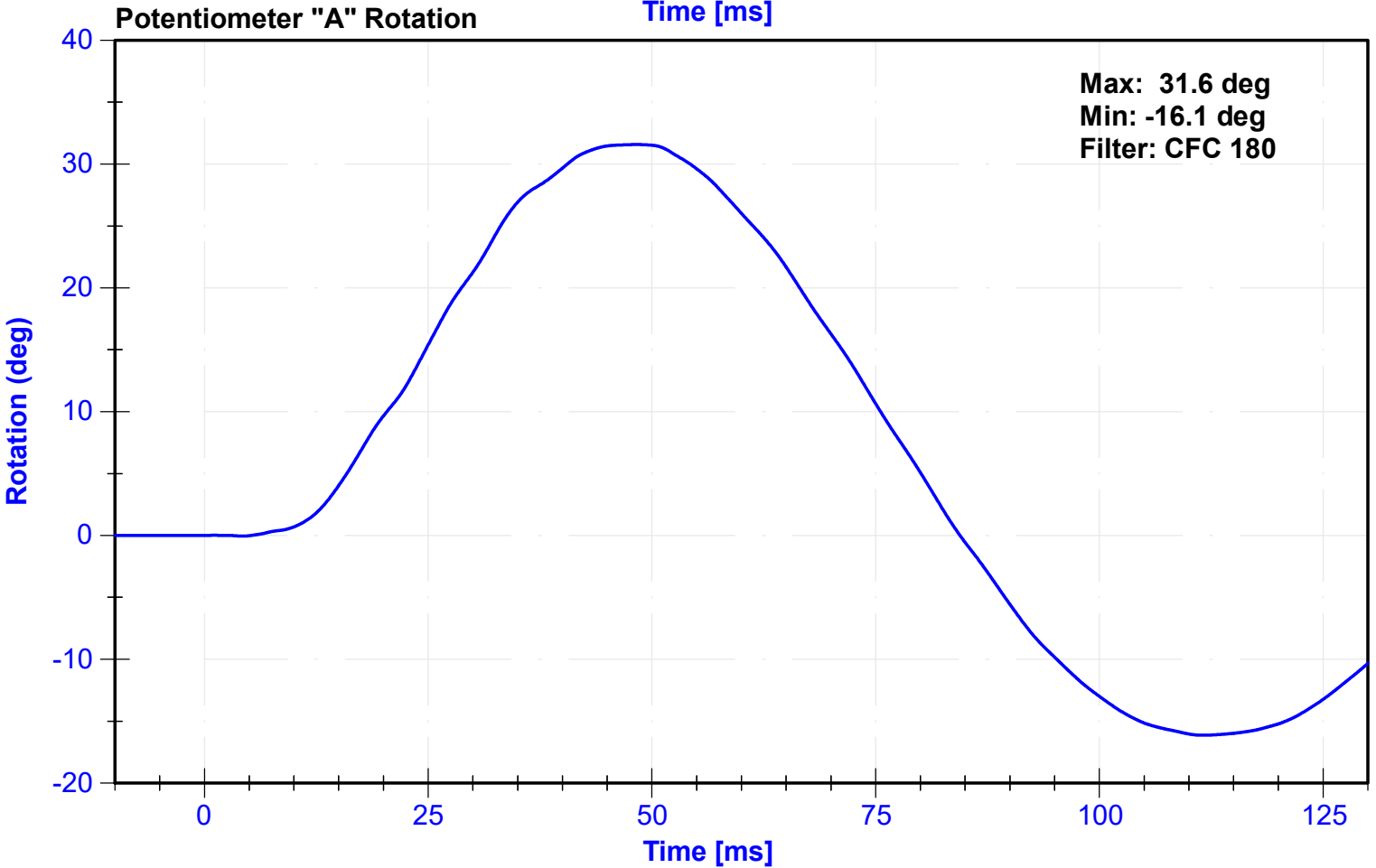
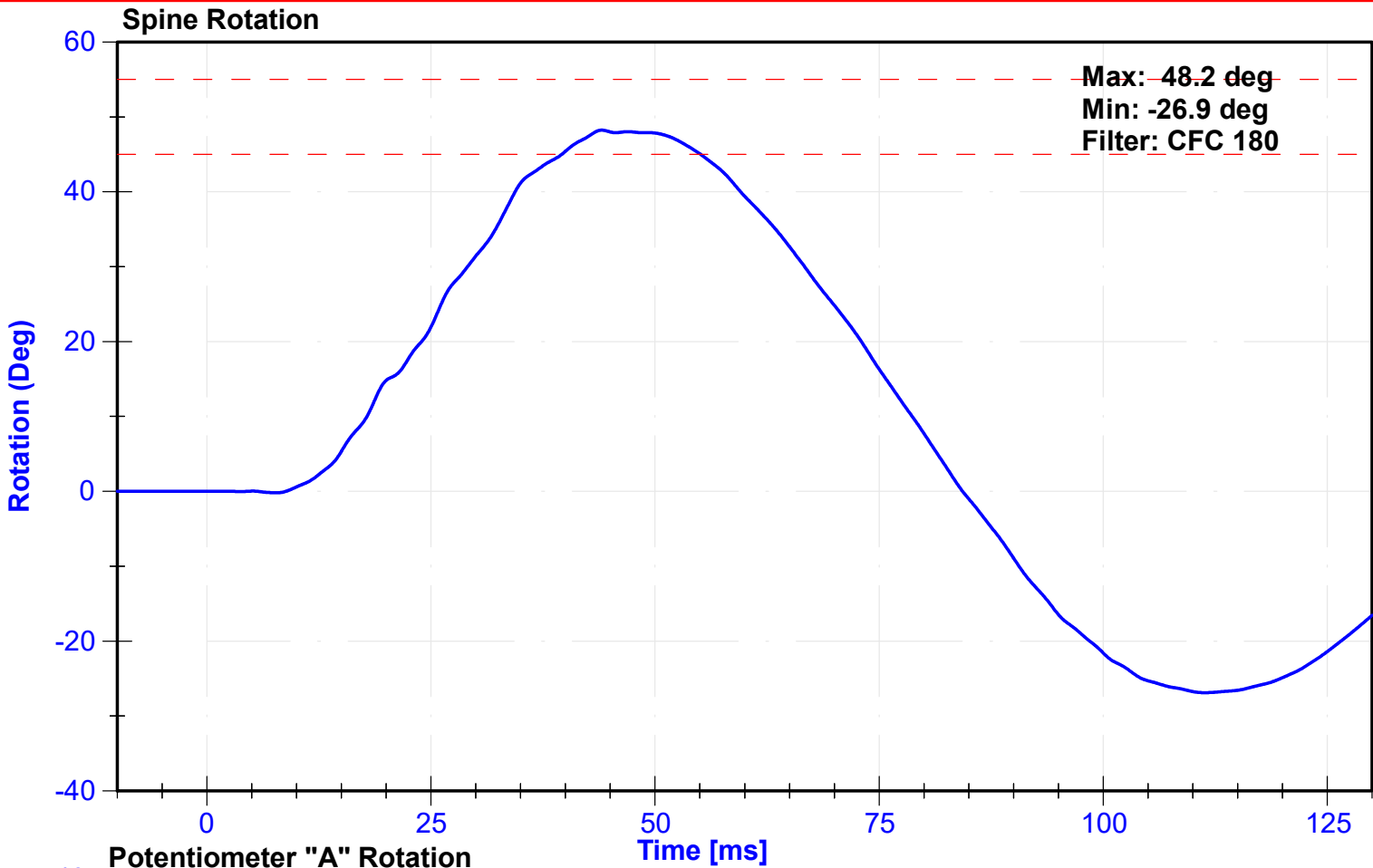
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.6	Pass
Humidity	10	70	%	32.0	Pass
Velocity	5.95	6.15	m/s	6.033	Pass
Lateral Spine Rotation	45	55	deg	48.2	Pass
Time at Maximum Rotation	39	53	ms	44.0	Pass
Time of Decay to Zero Degrees	37	57	ms	40.3	Pass
Pendulum Velocity Overall Corridor	Lower Boundary ¹	Upper Boundary ²	m/s	See Plot ³	Pass

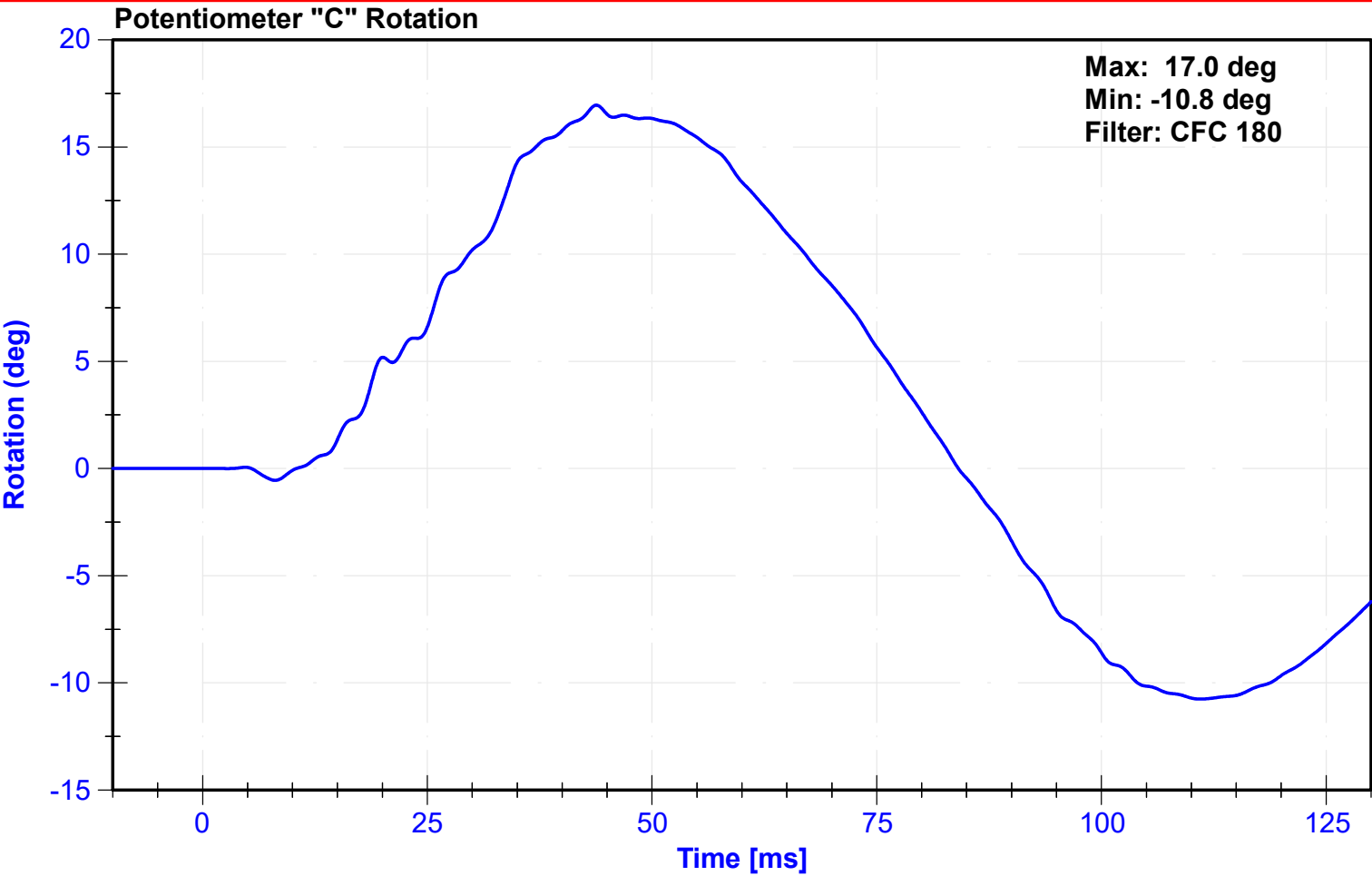
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	C16503	10/26/2022	10/26/2023
Pendulum "A" Potentiometer	Sfernice	094	9/29/2023	9/28/2024
Condyle "B" Potentiometer	Sfernice	095	9/29/2023	9/28/2024



^{1,2} Upper and lower boundaries specified in Appendix I
IV-19





Appendix I

² Upper Boundary Corridor		¹ Lower Boundary Corridor	
Time (ms)	Velocity (m/s)	Time (ms)	Velocity (m/s)
1.0	0.00	0.0	-0.05
3.7	-0.24	2.7	-0.425
27.0	-5.80	24.5	-6.5
		30.0	-6.5

ATD Manufacturer	Denton	Test Technician	J. Rios
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

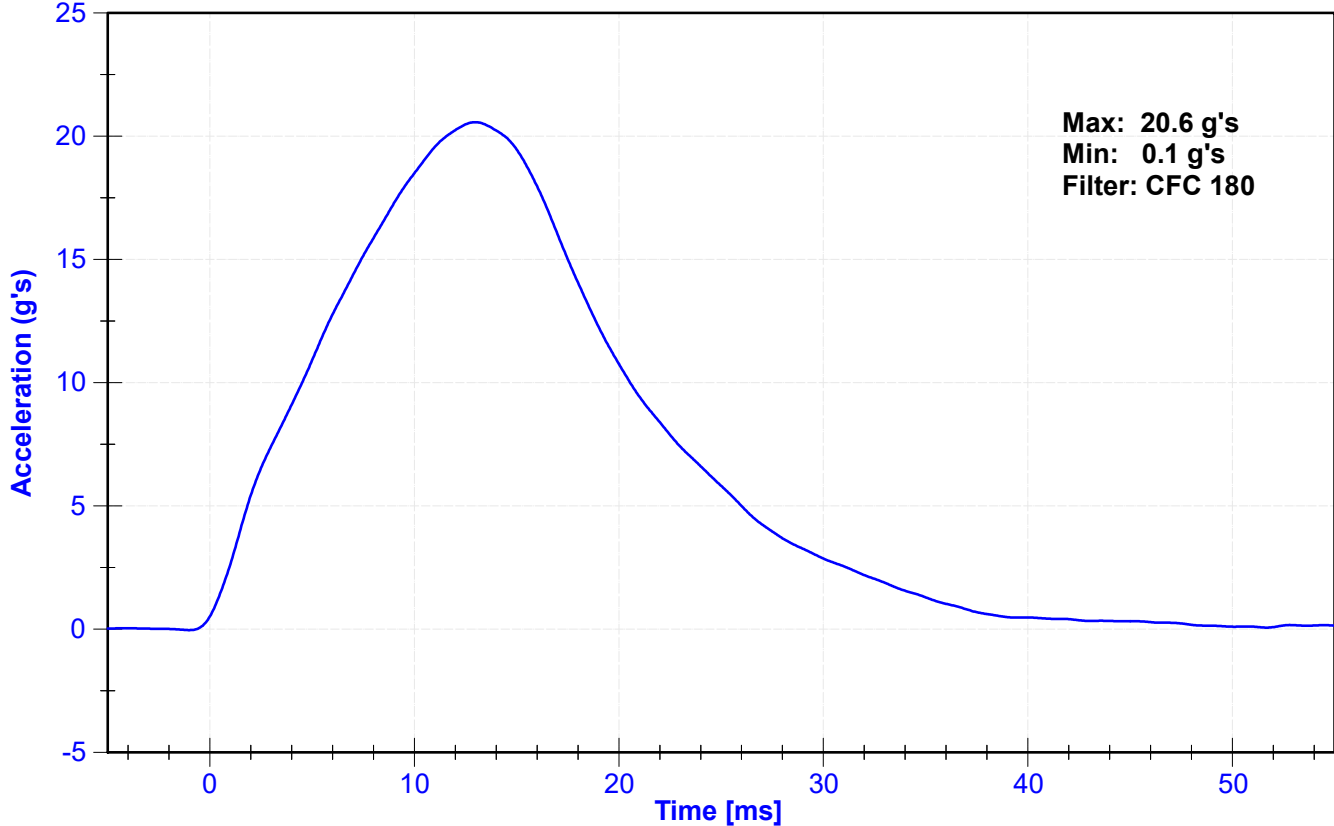
Results

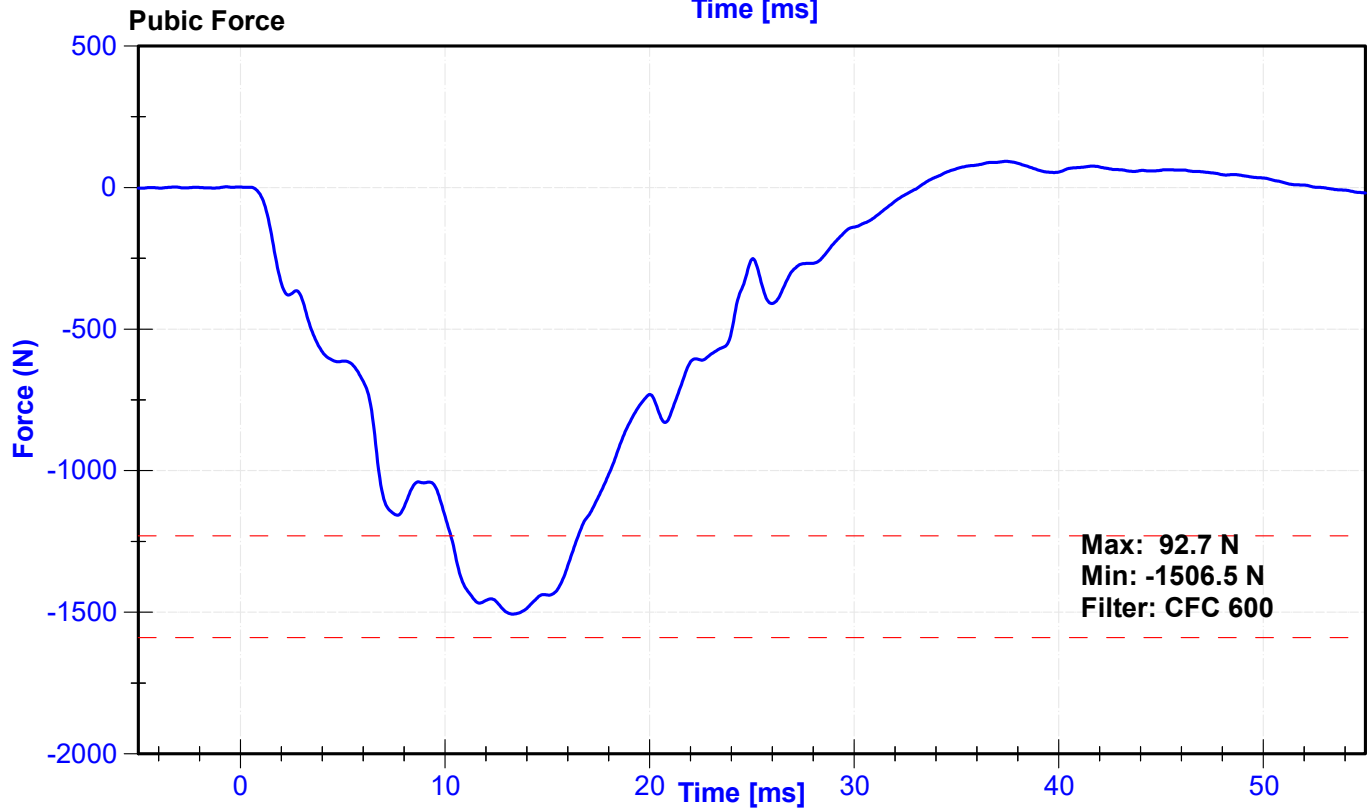
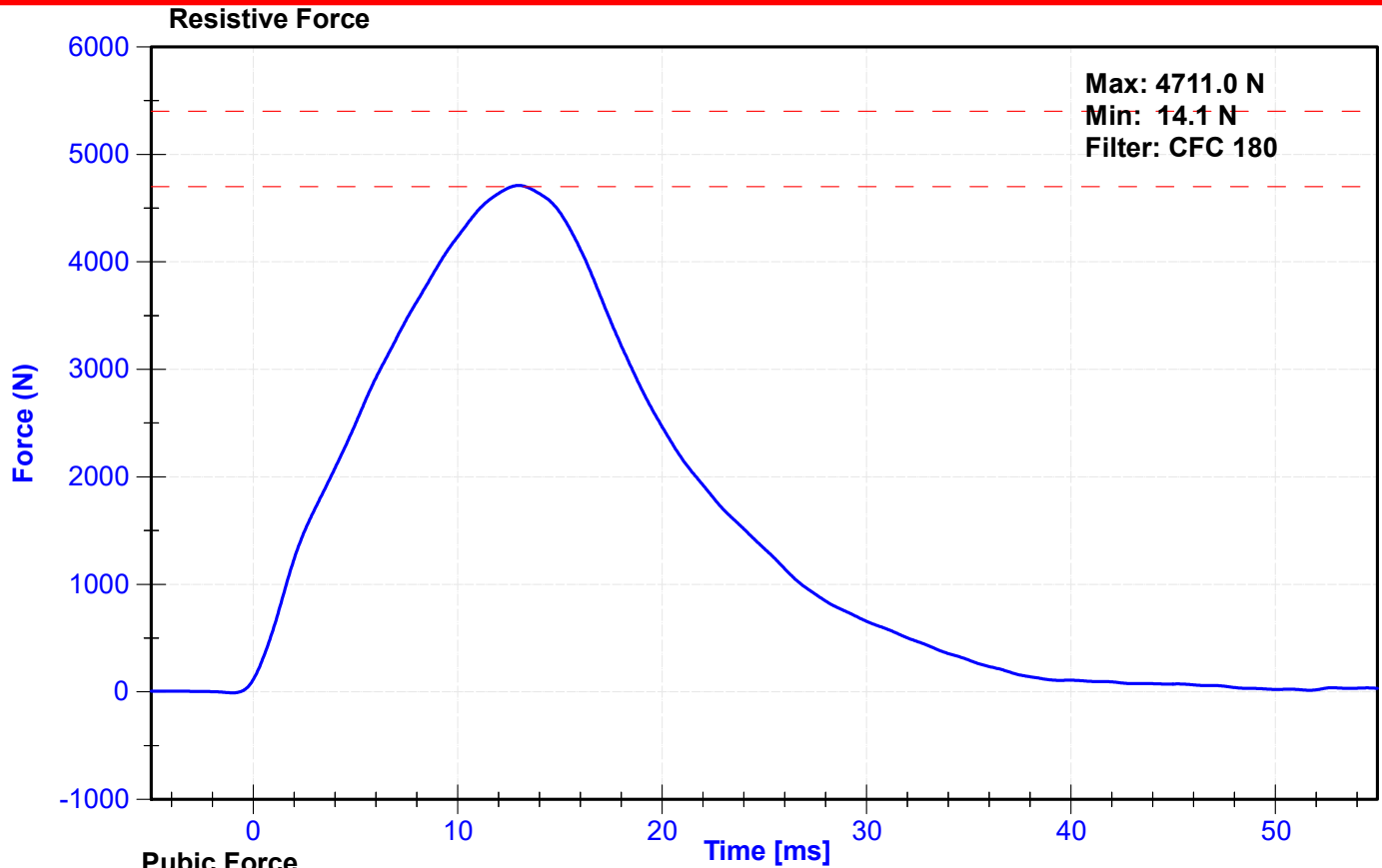
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.6	Pass
Humidity	10	70	%	39	Pass
Velocity	4.2	4.4	m/s	4.28	Pass
Resistive Force	4700	5400	N	4711.0	Pass
Time at Peak Resistive Force	11.8	16.1	ms	12.95	Pass
Pubic Force	-1590	-1230	N	-1506.5	Pass
Time at Peak Pubic Force	12.2	17.0	ms	13.30	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18546	11/19/2022	11/18/2023
Pubic Load Cell	Denton	456-FY	8/8/2023	8/7/2024

Probe Acceleration





POST-TEST DUMMY PERFORMANCE CALIBRATION TEST DATA
(Subpart U, ES-2re)

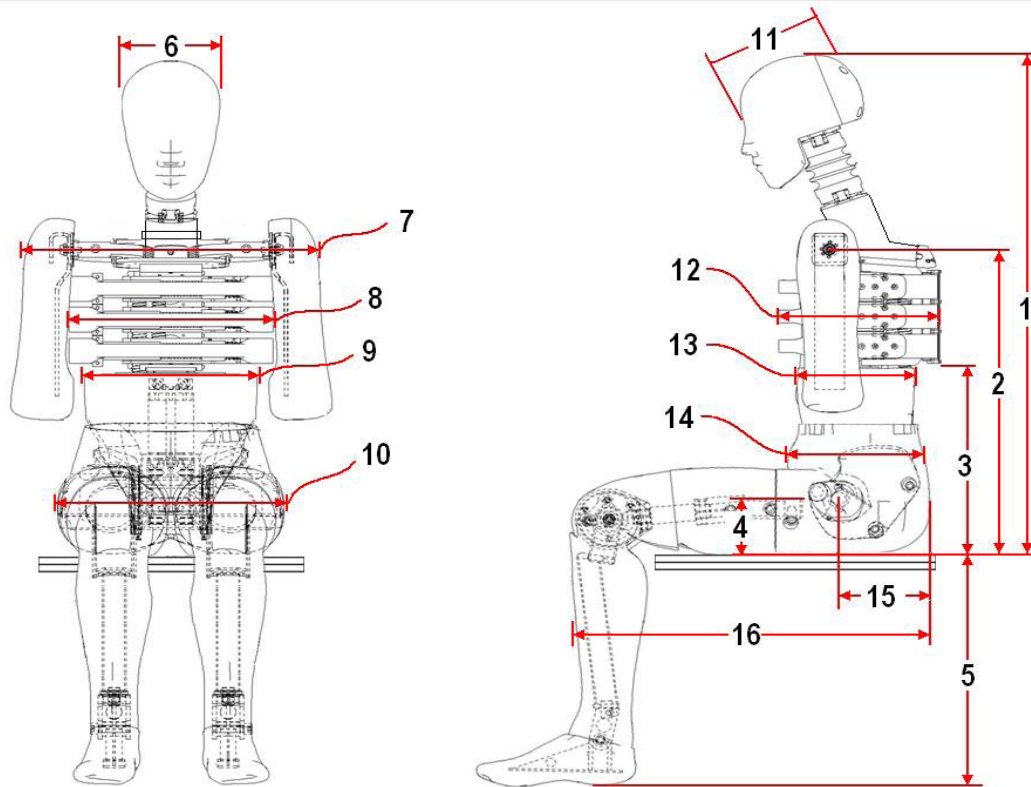


External Measurements - EuroSID-2re

Technician: K. Brogan

Date: 10/19/2023

Dummy Serial Number: D037



FRONT VIEW

SIDE VIEW

Dim. No.	Description	Specification (mm)		Result (mm)	Pass/Fail
1	Sitting Height	900	918	909	Pass
2	Seat to Shoulder Joint	558	572	563	Pass
3	Seat to Lower Face of Thoracic Spine Box	346	356	353	Pass
4	Seat to Hip Joint (center of bolt)	97	103	100	Pass
5	Sole to Seat, Sitting	333	451	420	Pass
6	Head Width	152	158	154	Pass
7	Shoulder/Arm Width	461	479	470	Pass
8	Thorax Width	322	332	330	Pass
9	Abdomen Width	273	287	280	Pass
10	Pelvis Lap Width	359	373	363	Pass
11	Head Depth	196	206	199	Pass
12	Thorax Depth	262	272	267	Pass
13	Abdomen Depth	194	204	197	Pass
14	Pelvis Depth	235	245	240	Pass
15	Back of Buttocks to Hip Joint (center of bolt)	150	160	154	Pass
16	Back of Buttocks to Front Knee	597	615	604	Pass

ATD Manufacturer	Denton	Test Technician	T. Roseman
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

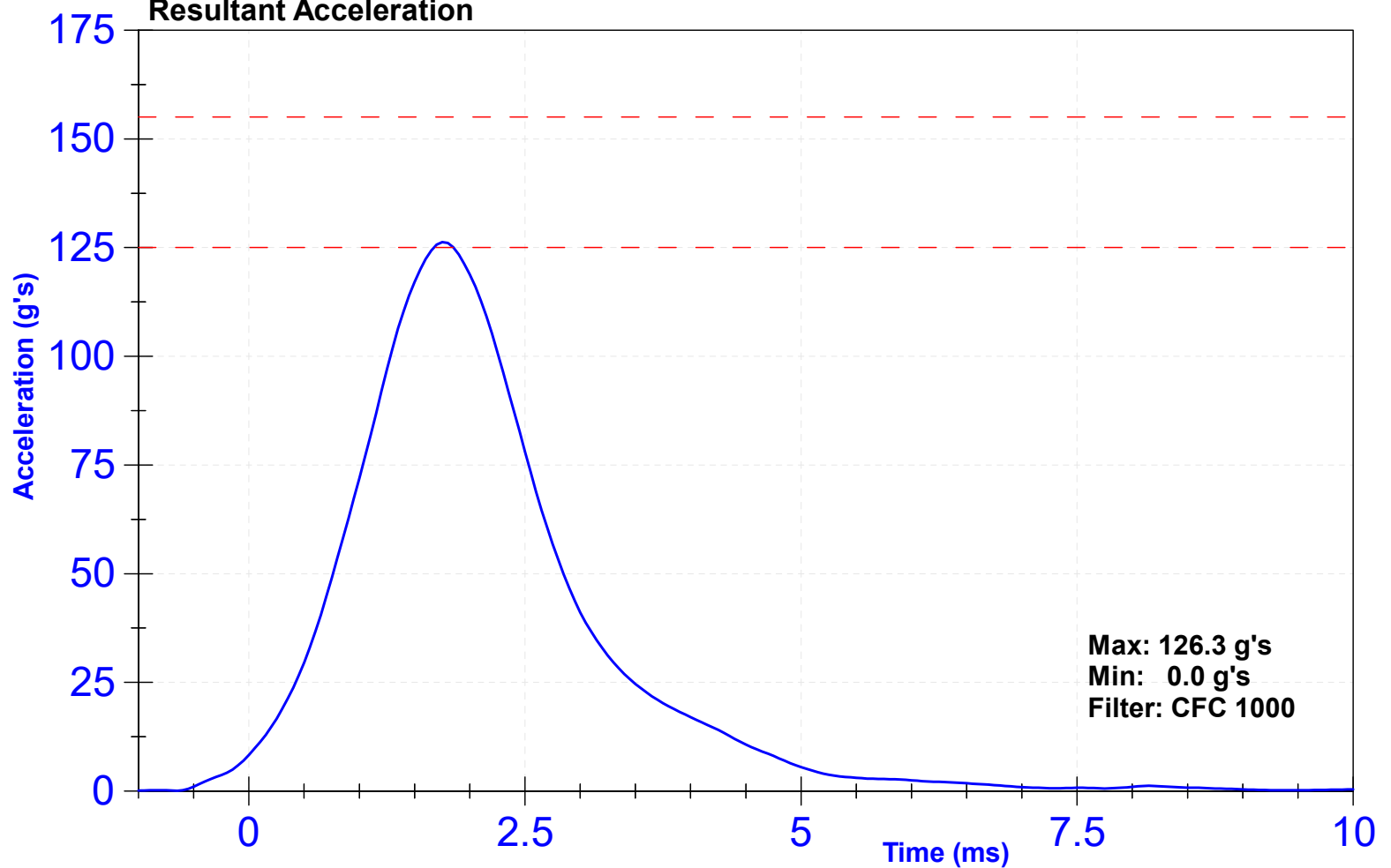
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.5	Pass
Humidity	10	70	%	45.3	Pass
Resultant Acceleration	125	155	g's	126.3	Pass
Oscillation	0	15	%	1.14	Pass
Fore-Aft Acceleration	-15	15	g's	12.6	Pass

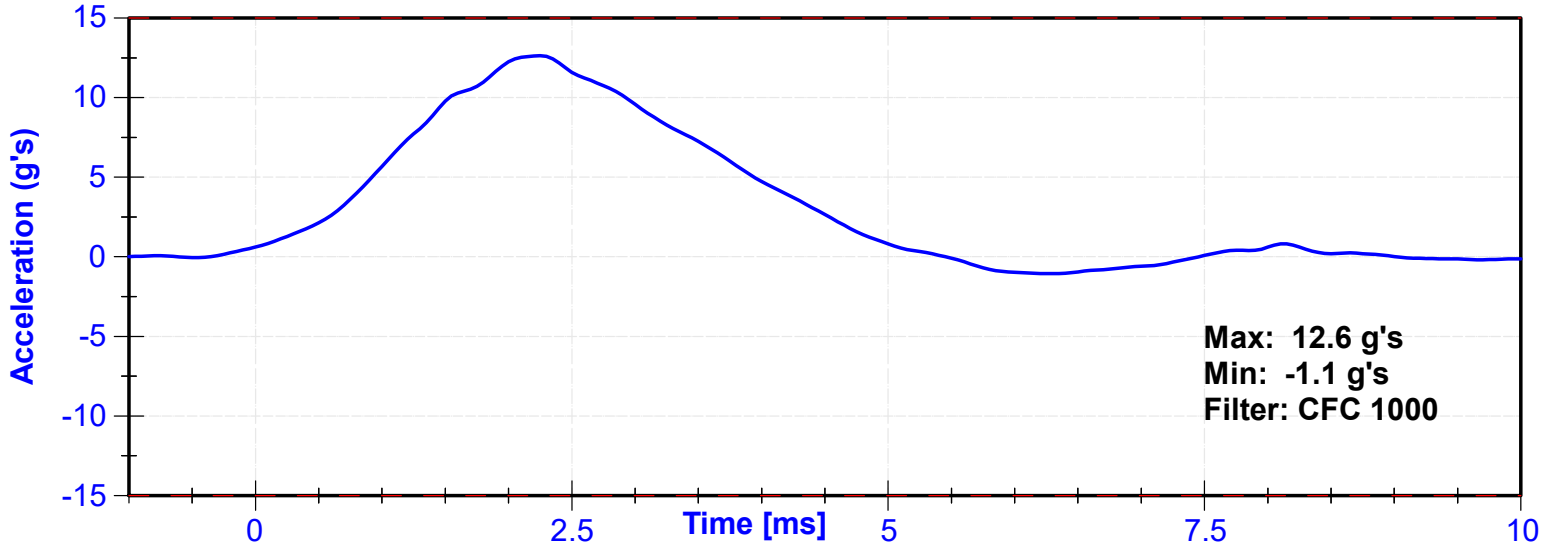
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	Endevco	T21724	8/8/2023	2/4/2024
Y Accelerometer	Endevco	T22281	8/8/2023	2/4/2024
Z Accelerometer	Endevco	T26050	8/8/2023	2/4/2024

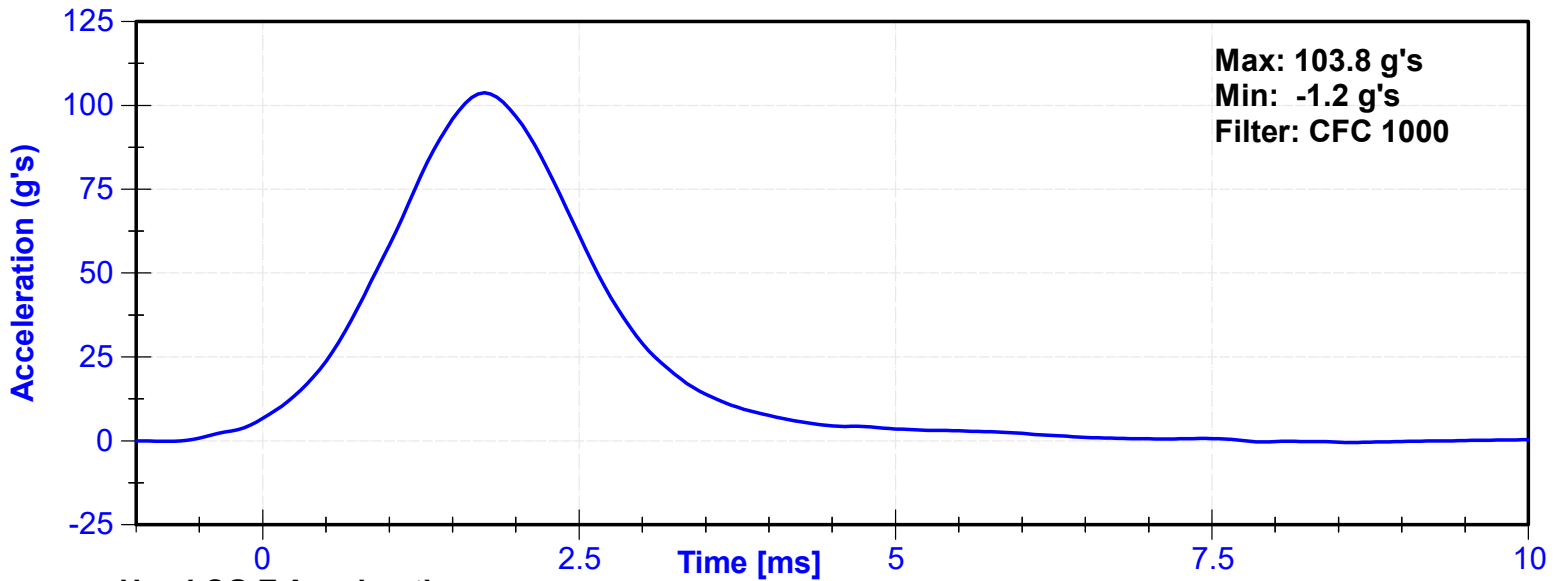
Resultant Acceleration



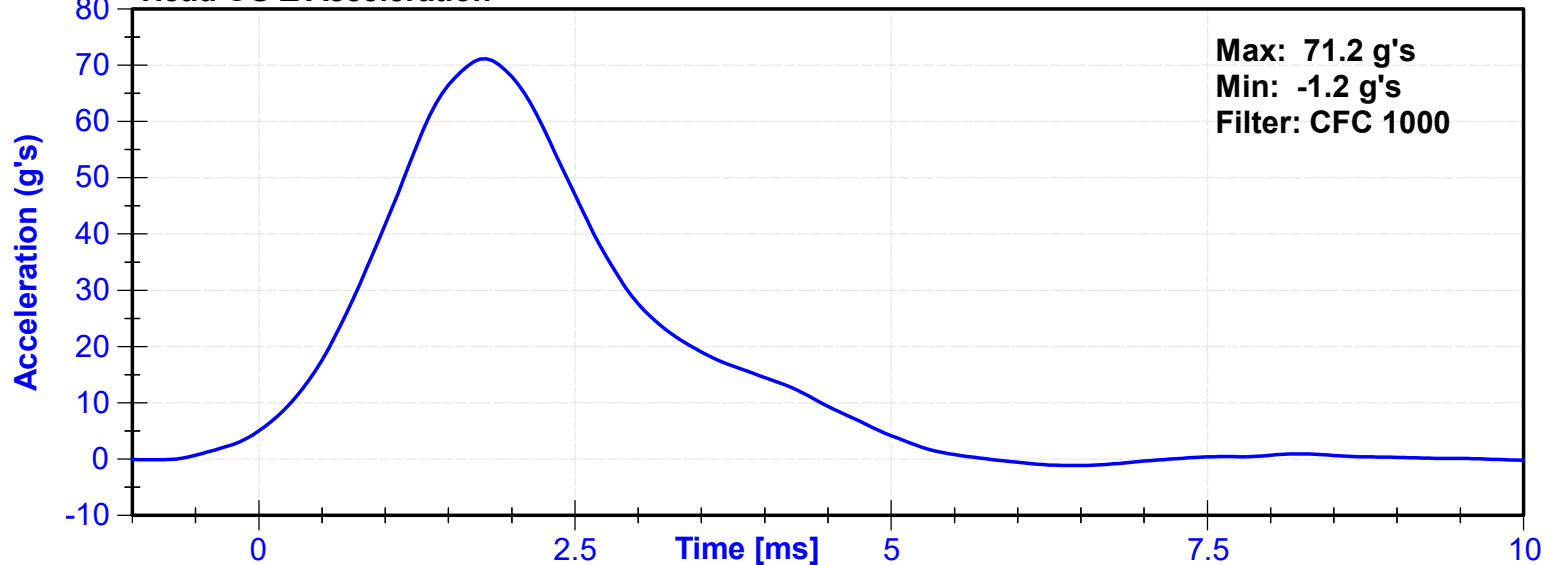
Head CG X Acceleration



Head CG Y Acceleration



Head CG Z Acceleration



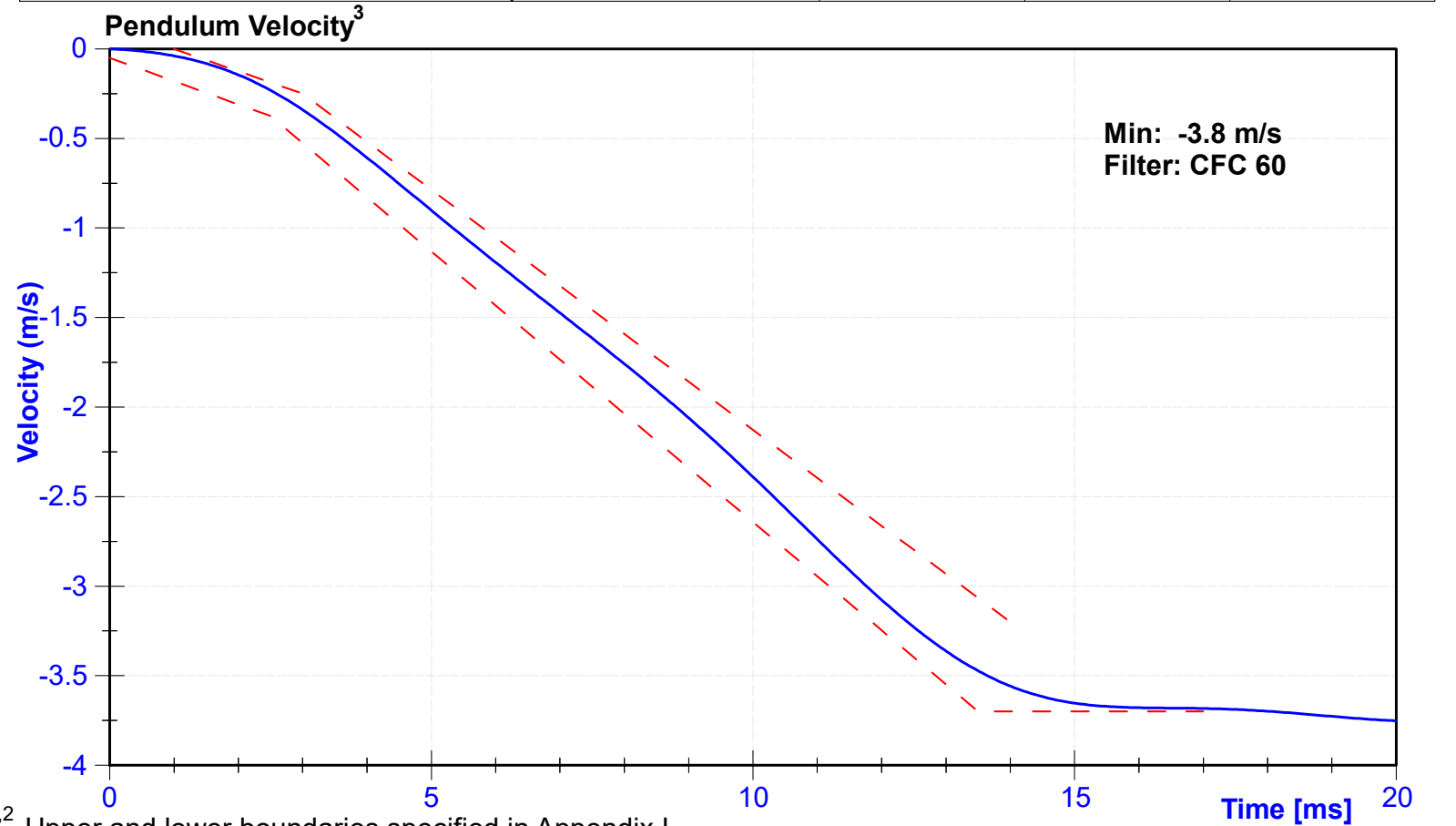
ATD Manufacturer	Denton	Test Technician	D. Sakona
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.6	Pass
Humidity	10	70	%	41	Pass
Velocity	3.3	3.5	m/s	3.46	Pass
Lateral Neck Rotation	49	59	deg	51.7	Pass
Time at Maximum Rotation	54	66	ms	60.2	Pass
Time of Rotation Decay from Maximum	53	88	ms	55.3	Pass
Pendulum Velocity Overall Corridor	Lower Boundary ¹	Upper Boundary ²	m/s	See Plot ³	Pass

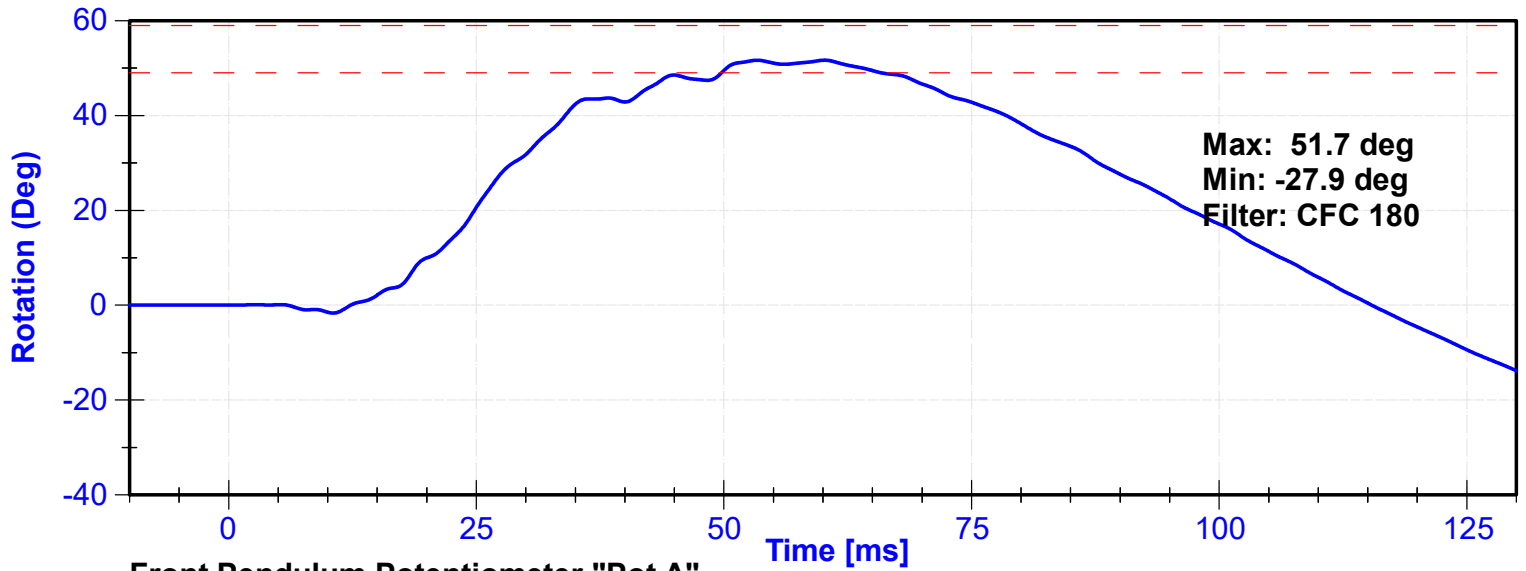
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	C16650	10/31/2022	10/31/2023
Front Pendulum Potentiometer	Sfernice	094	9/29/2023	9/28/2024
Headform Potentiometer	Sfernice	095	9/29/2023	9/28/2024

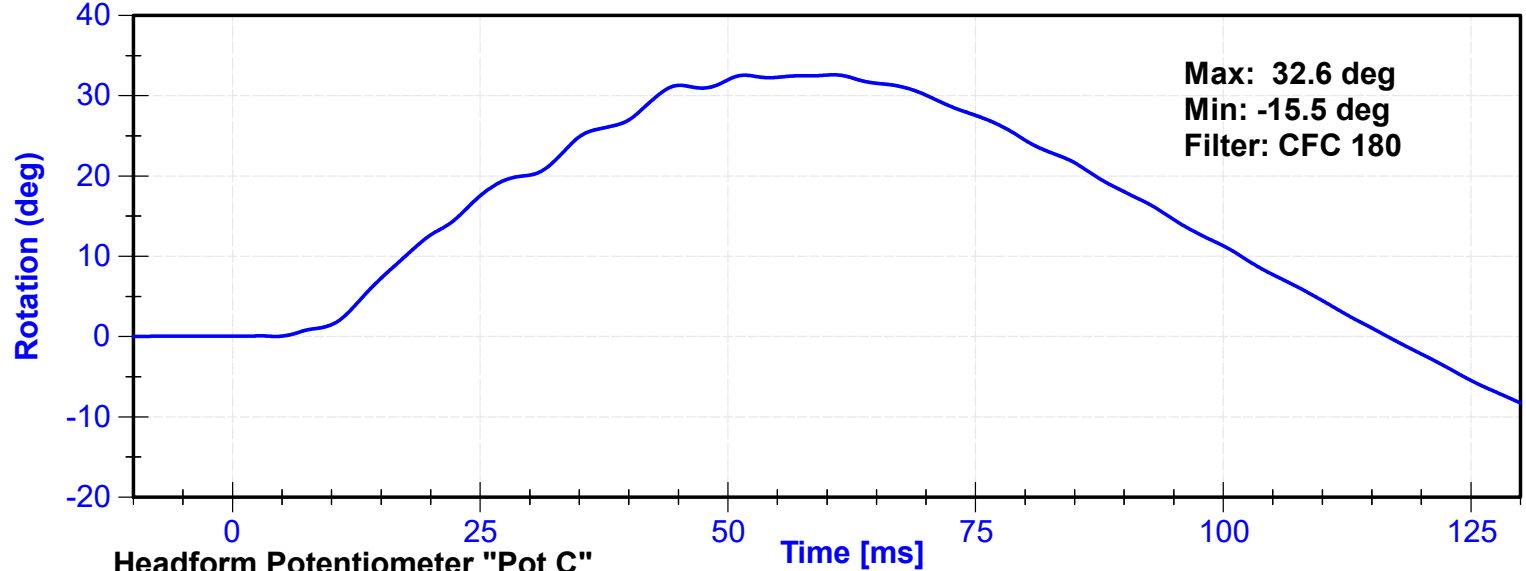


^{1,2} Upper and lower boundaries specified in Appendix I

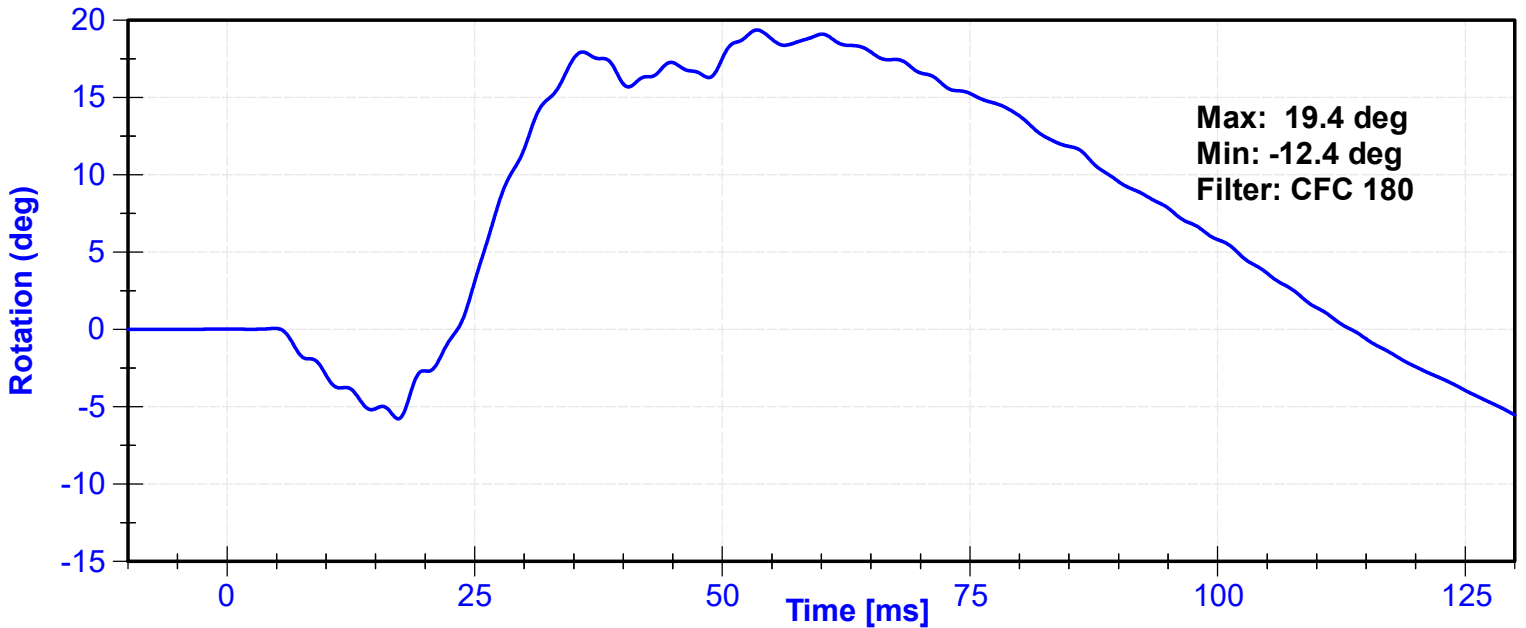
Neck Rotation



Front Pendulum Potentiometer "Pot A"



Headform Potentiometer "Pot C"



Appendix I

² Upper Boundary Corridor		¹ Lower Boundary Corridor	
Time (ms)	Velocity (m/s)	Time (ms)	Velocity (m/s)
1.0	0.00	0.0	-0.05
3.0	-0.25	2.5	-0.375
14.0	-3.20	13.5	-3.7
		17.0	-3.7

ATD Manufacturer	Denton	Test Technician	D. Sakona
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

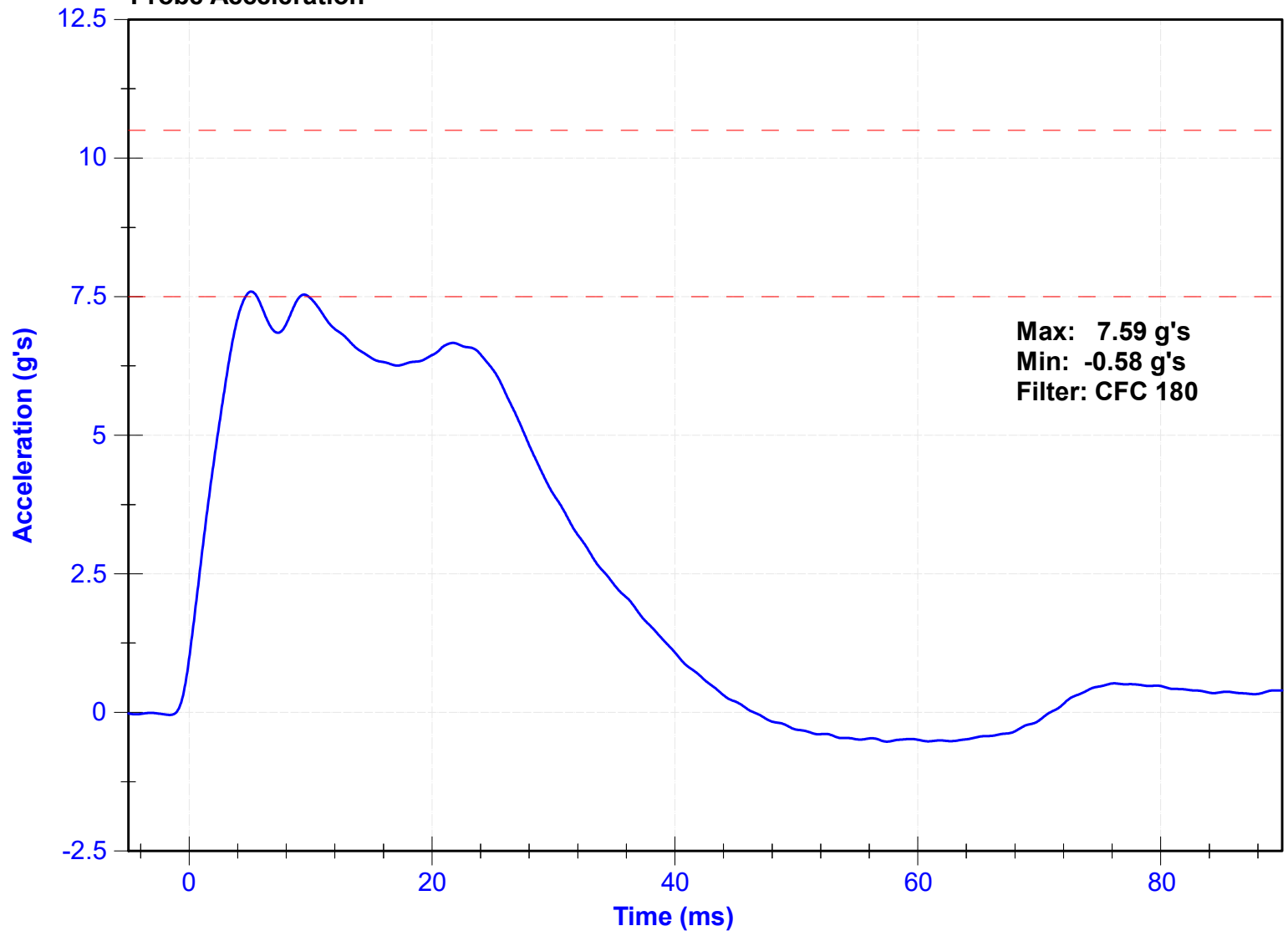
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.6	Pass
Humidity	10	70	%	35	Pass
Velocity	4.2	4.4	m/s	4.29	Pass
Probe Acceleration	7.5	10.5	g's	7.59	Pass

Transducer Calibrations

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

Probe Acceleration



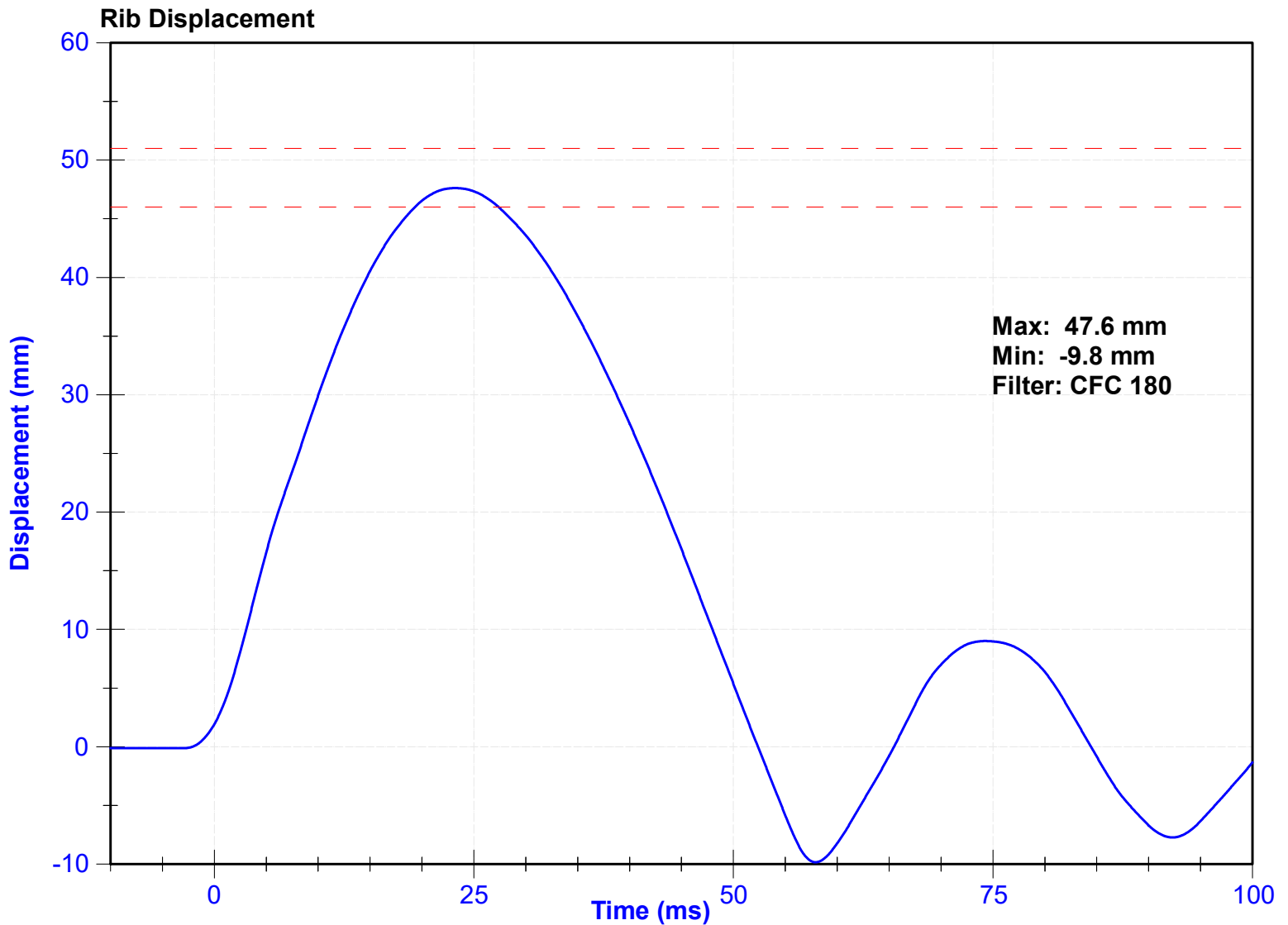
ATD Manufacturer	Denton	Test Technician	T. Roseman
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.9	Pass
Humidity	10	70	%	36.3	Pass
Rib Displacement	46	51	mm	47.6	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	0552-01	8/7/2023	2/5/2024



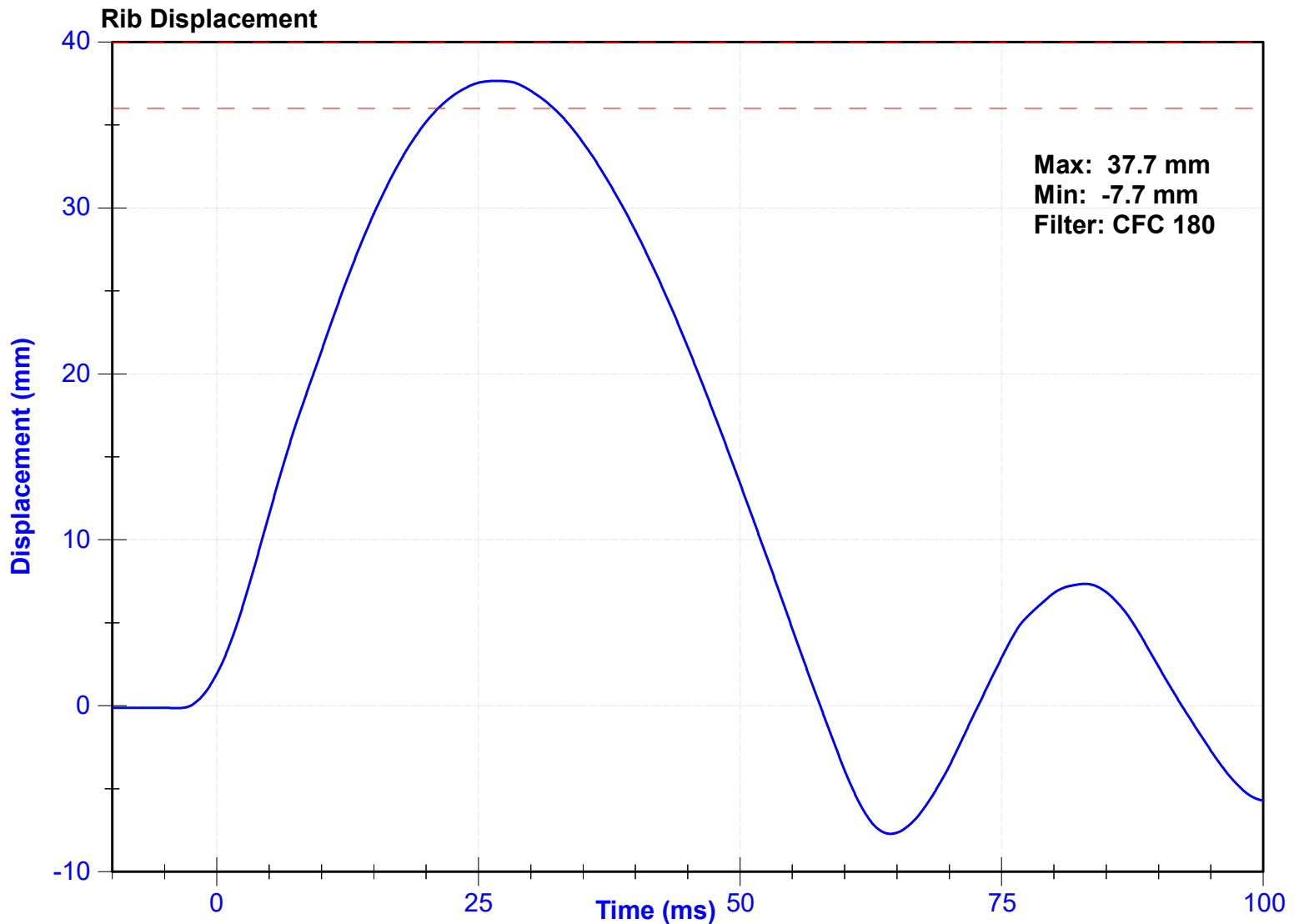
ATD Manufacturer	Denton	Test Technician	T. Roseman
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.9	Pass
Humidity	10	70	%	36.3	Pass
Rib Displacement	36	40	mm	37.7	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	0552-01	8/7/2023	2/5/2024



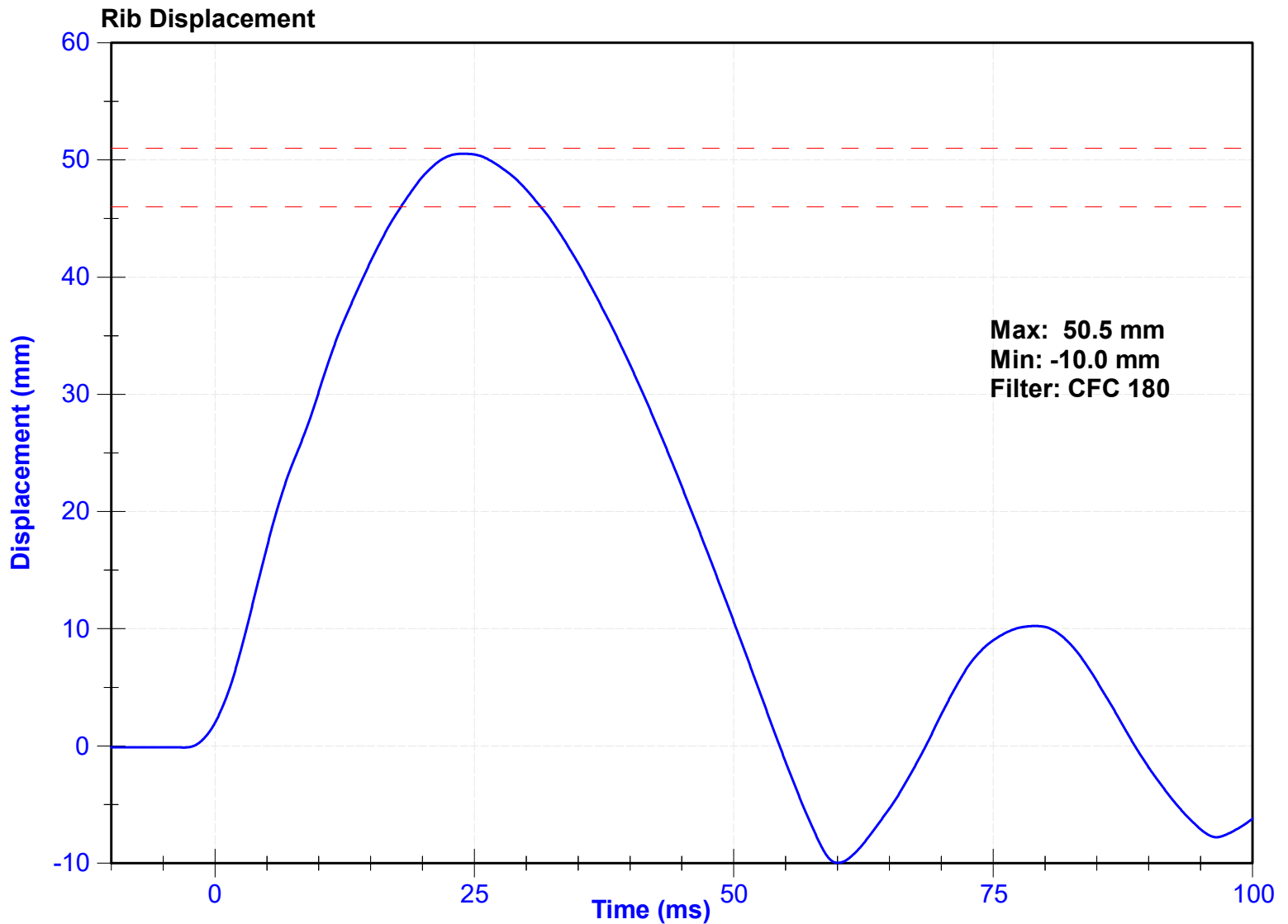
ATD Manufacturer	Denton	Test Technician	T. Roseman
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.9	Pass
Humidity	10	70	%	36.3	Pass
Rib Displacement	46	51	mm	50.5	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	807	8/7/2023	2/5/2024



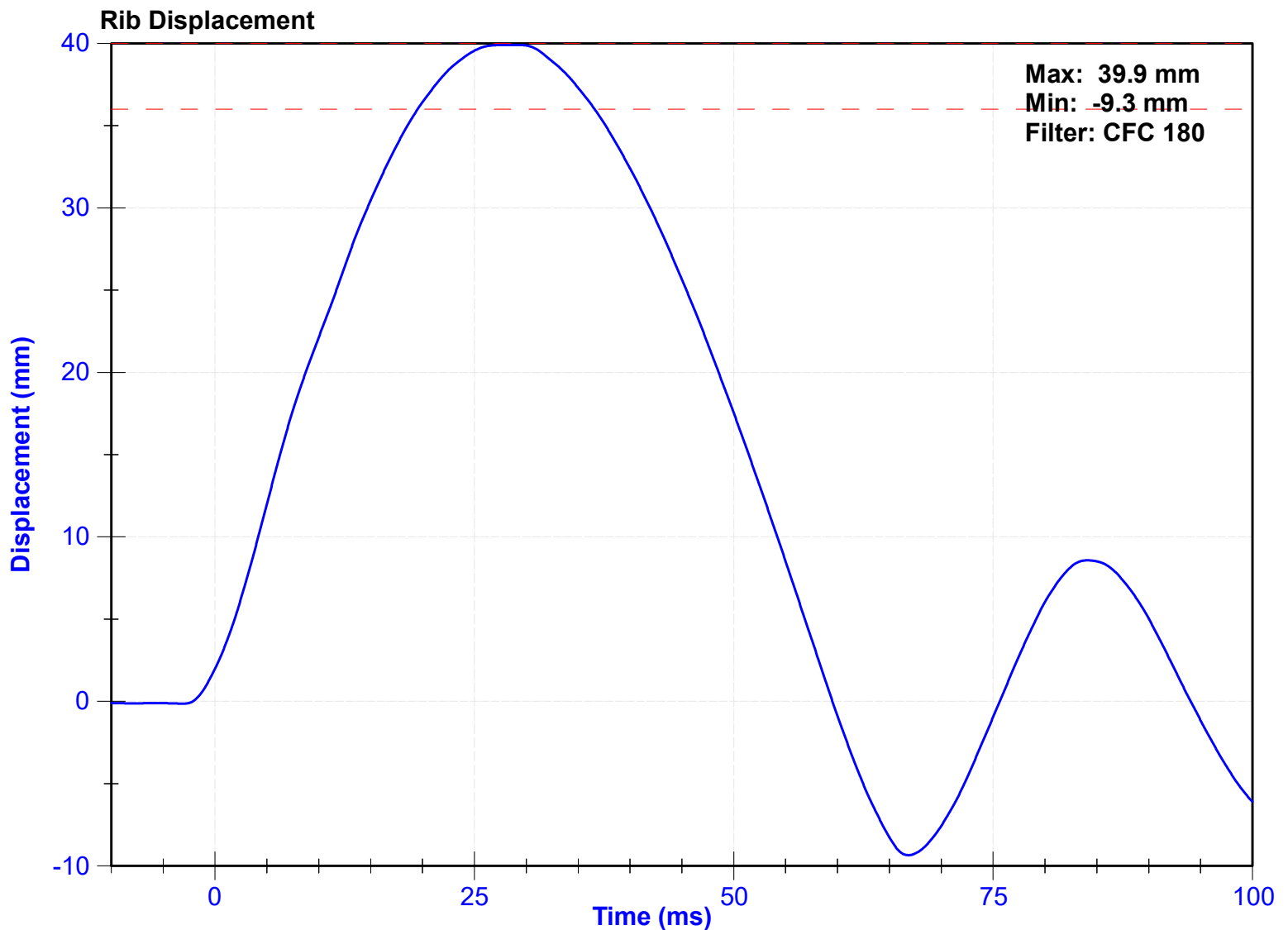
ATD Manufacturer	Denton	Test Technician	T. Roseman
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.9	Pass
Humidity	10	70	%	36.3	Pass
Rib Displacement	36	40	mm	39.9	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	807	8/7/2023	2/5/2024



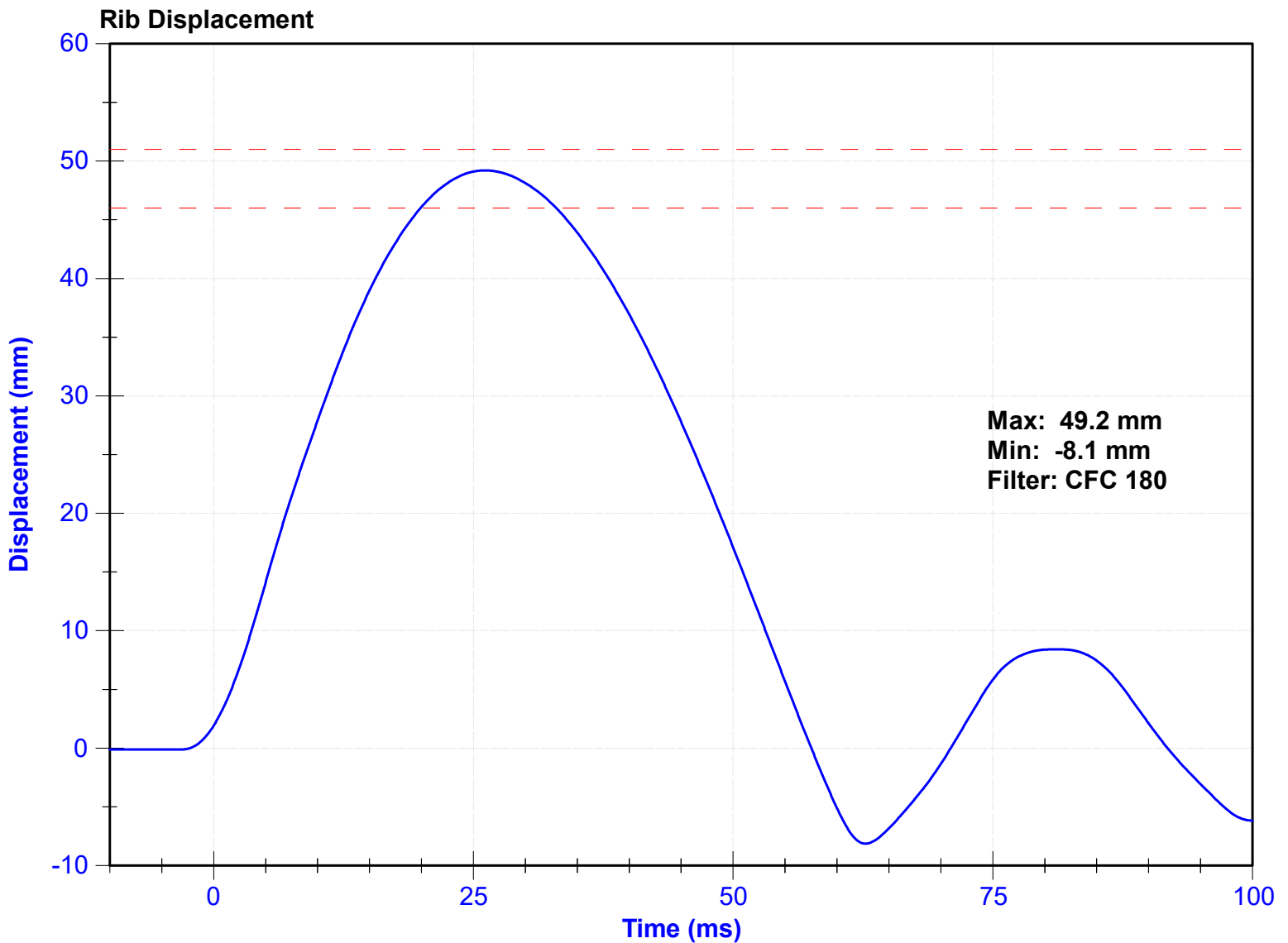
ATD Manufacturer	Denton	Test Technician	T. Roseman
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.9	Pass
Humidity	10	70	%	36.3	Pass
Rib Displacement	46	51	mm	49.2	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	0552-03	8/7/2023	2/5/2024



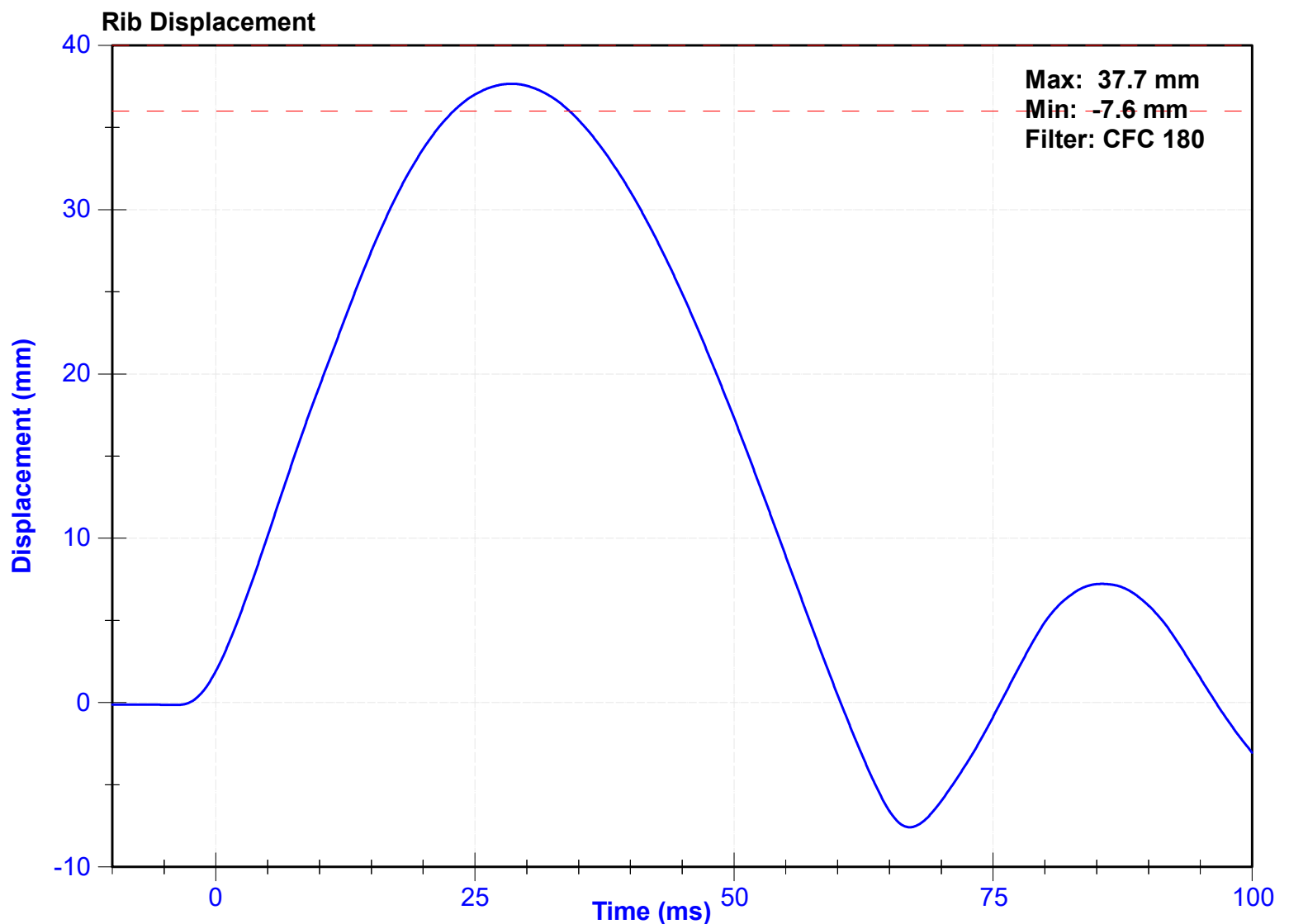
ATD Manufacturer	Denton	Test Technician	T. Roseman
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.9	Pass
Humidity	10	70	%	36.3	Pass
Rib Displacement	36	40	mm	37.7	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	0552-03	8/7/2023	2/5/2024



ATD Manufacturer	Denton	Test Technician	D. Sakona
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

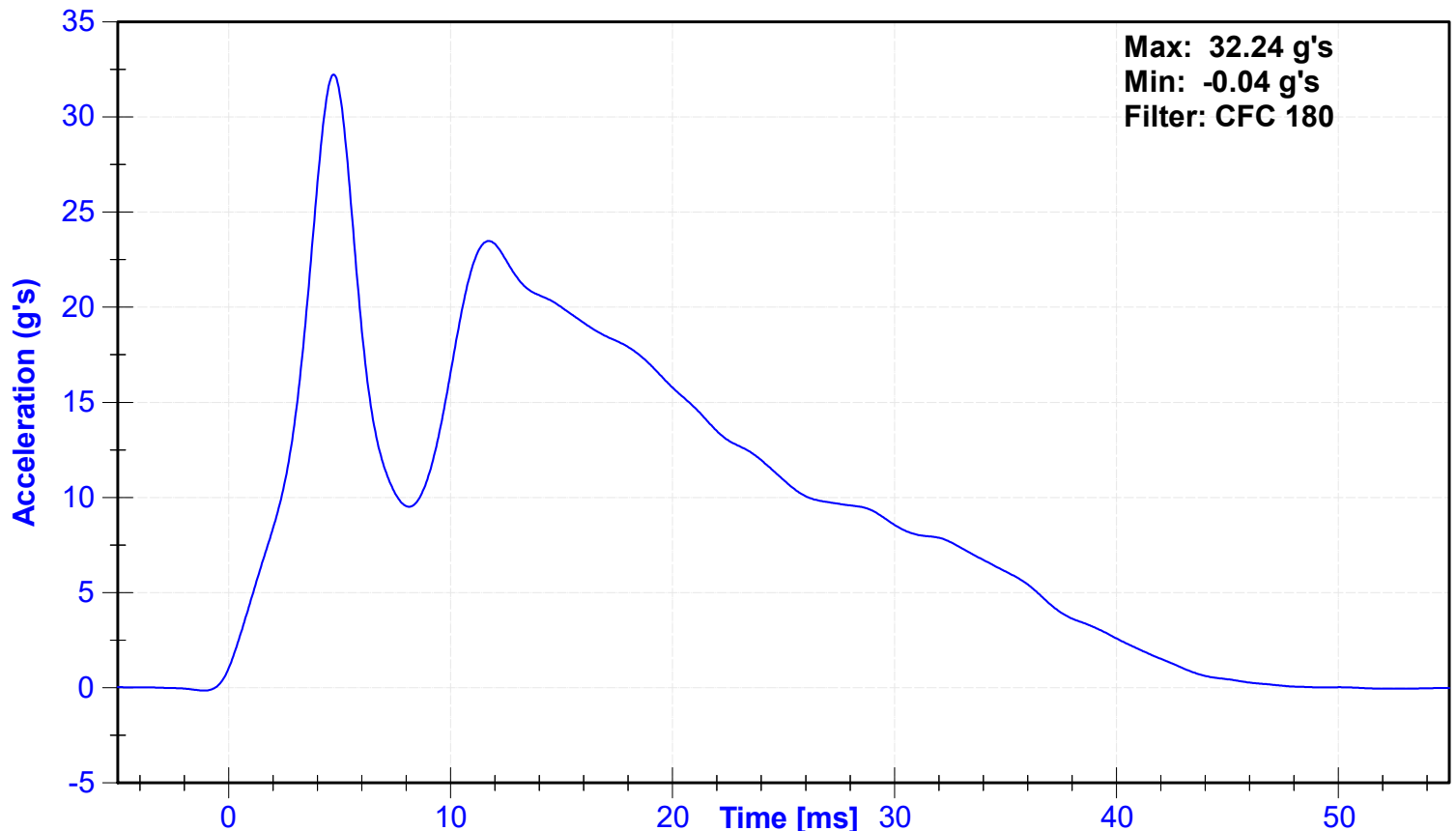
Results

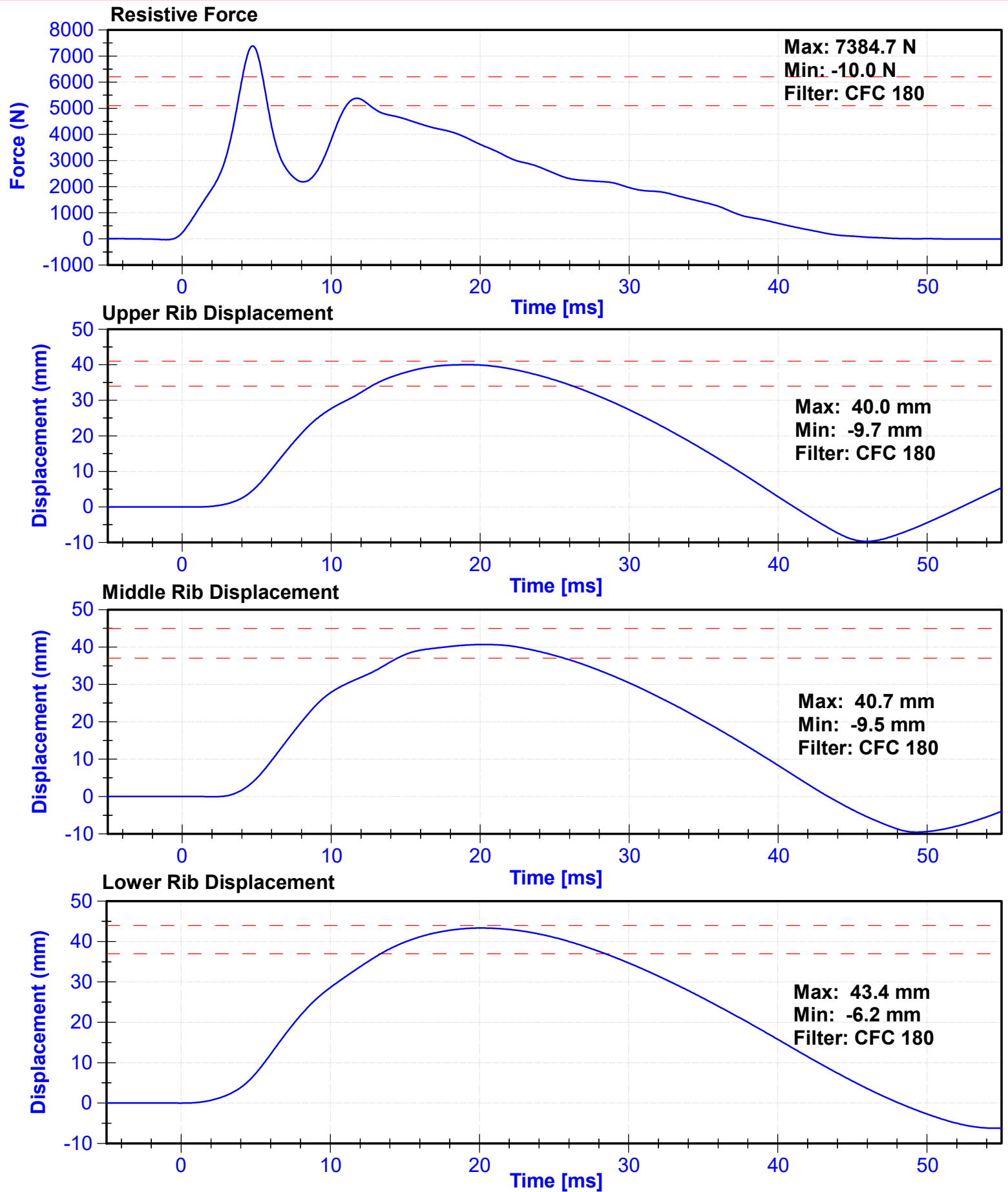
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20,6	Pass
Humidity	10	70	%	35	Pass
Velocity	5.4	5.6	m/s	5.55	Pass
Resistive Force after 6ms	5100	6200	N	5380.6	Pass
Upper Thorax Rib Deflection	34	41	mm	40.0	Pass
Mid Thorax Rib Deflection	37	45	mm	40.7	Pass
Lower Thorax Rib Deflection	37	44	mm	43.4	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Probe Accelerometer	Endevco	18546	11/19/2022	11/18/2023
Upper Thorax Rib Potentiometer	Honeywell	0552-01	8/7/2023	2/5/2024
Middle Thorax Rib Potentiometer	Honeywell	807	8/7/2023	2/5/2024
Lower Thorax Rib Potentiometer	Honeywell	0552-03	8/7/2023	2/5/2024

Probe Acceleration





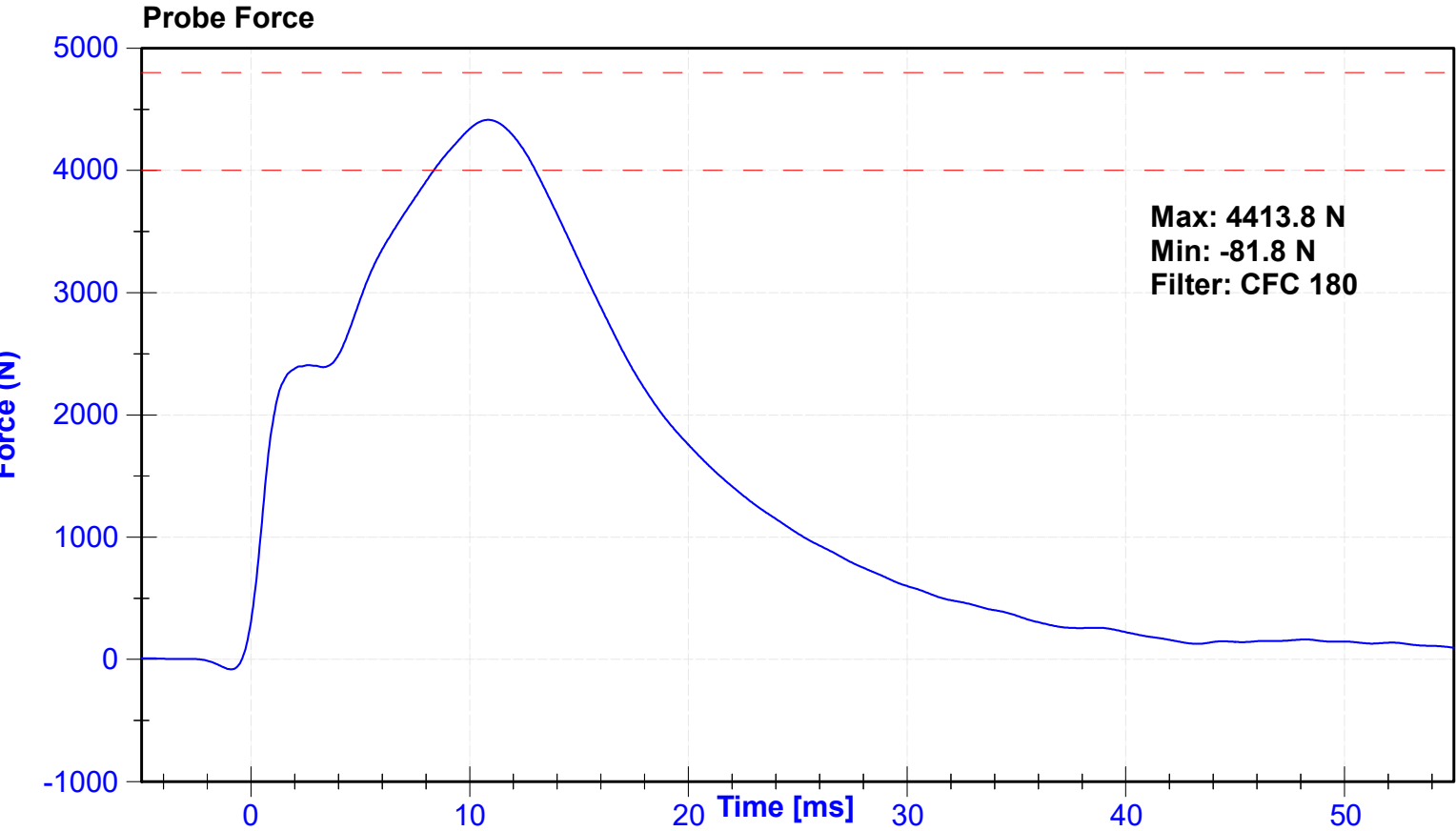
ATD Manufacturer	Denton	Test Technician	D. Sakona
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

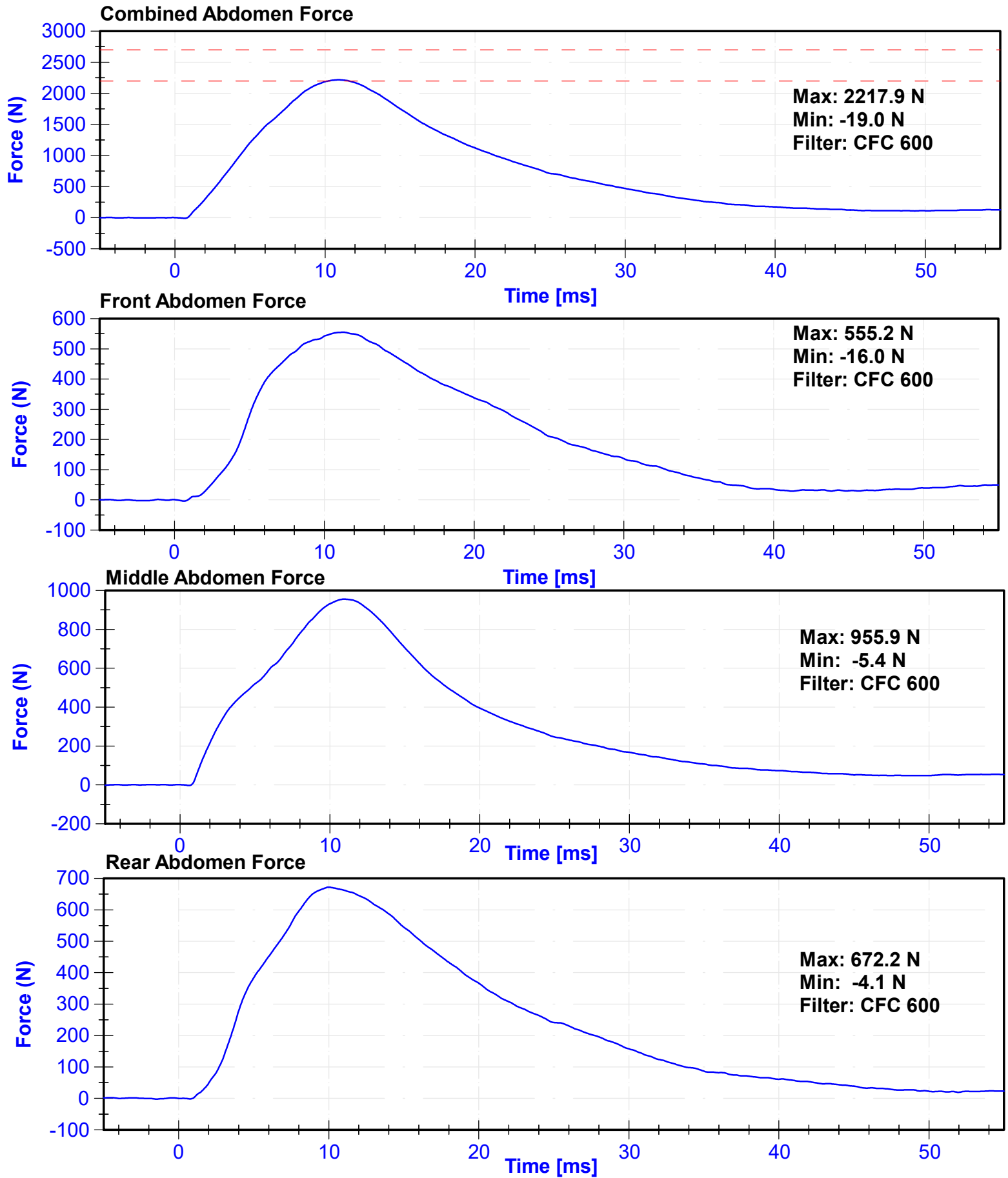
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.6	Pass
Humidity	10	70	%	35	Pass
Velocity	3.9	4.1	m/s	3.94	Pass
Combined Abdomen Force	2200	2700	N	2217.9	Pass
Time at Peak Abdomen Force	10.0	12.3	ms	10.90	Pass
Resistive Probe Force	4000	4800	N	4413.8	Pass
Time at Peak Resistive Force	10.6	13.0	ms	10.85	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18546	11/19/2022	11/18/2023
Front Abdomen Load Cell	Denton	1440	8/8/2023	8/7/2024
Middle Abdomen Load Cell	Denton	1525	8/8/2023	8/7/2024
Rear Abdomen Load Cell	Denton	1528	8/8/2023	8/7/2024





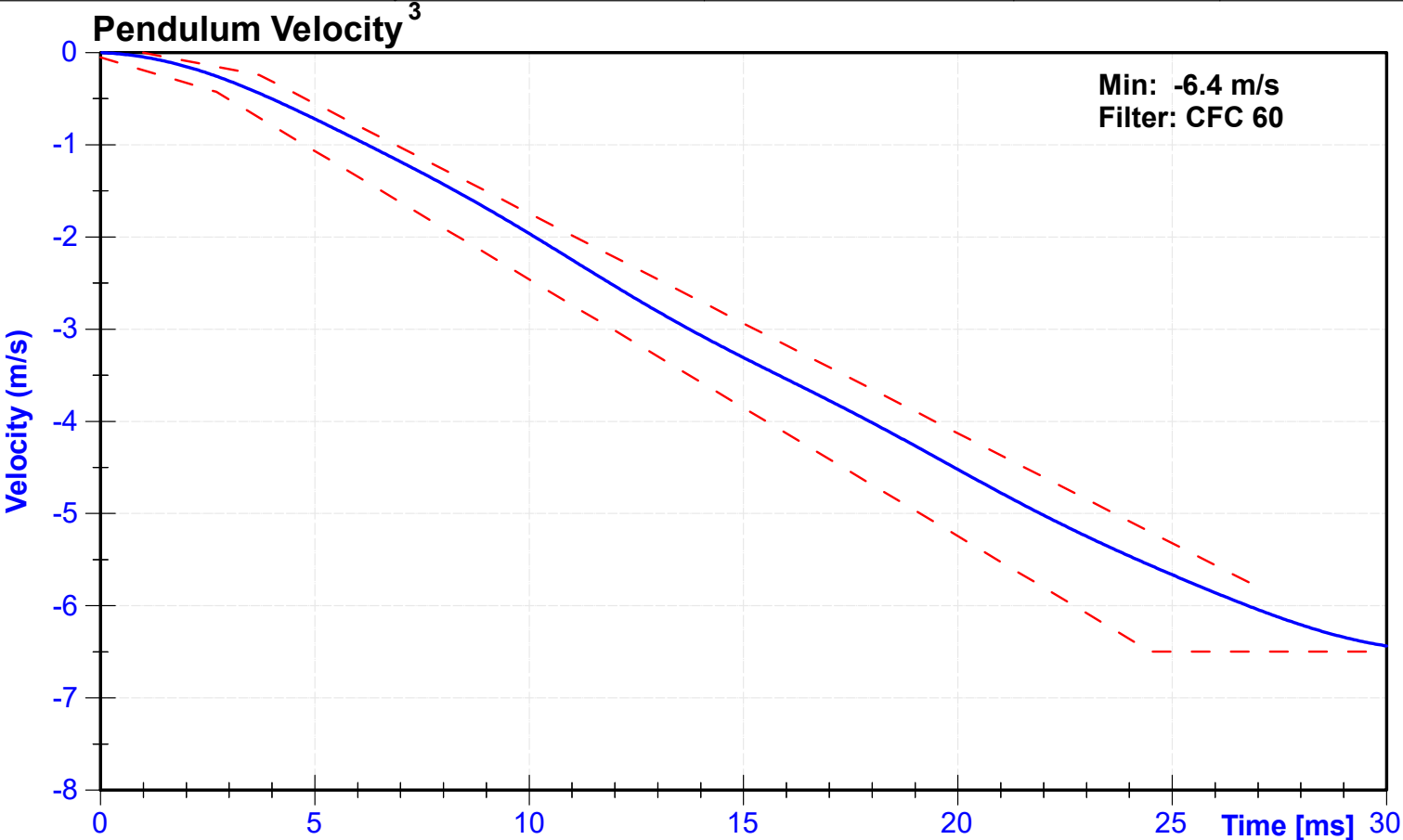
ATD Manufacturer	Denton	Test Technician	D. Sakona
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

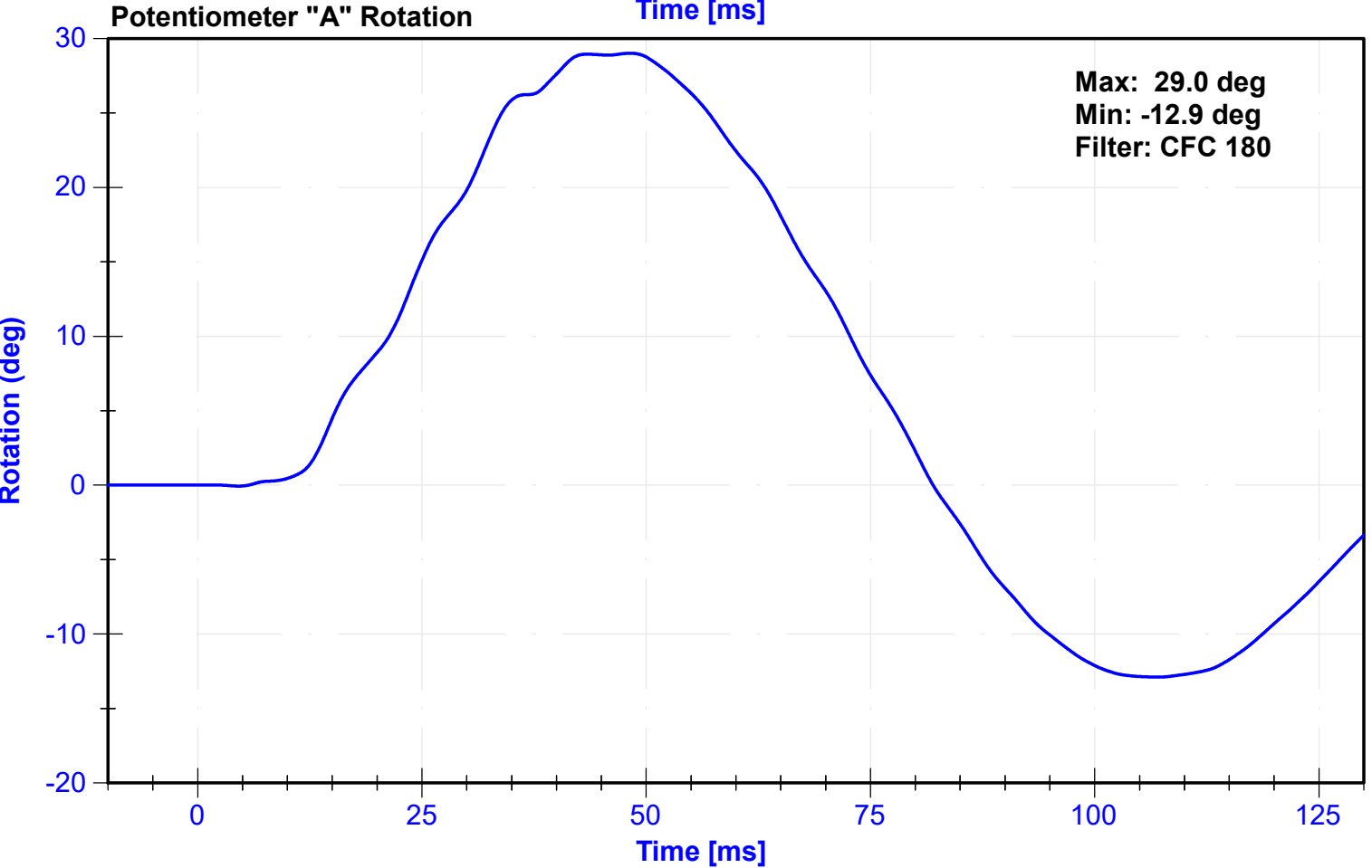
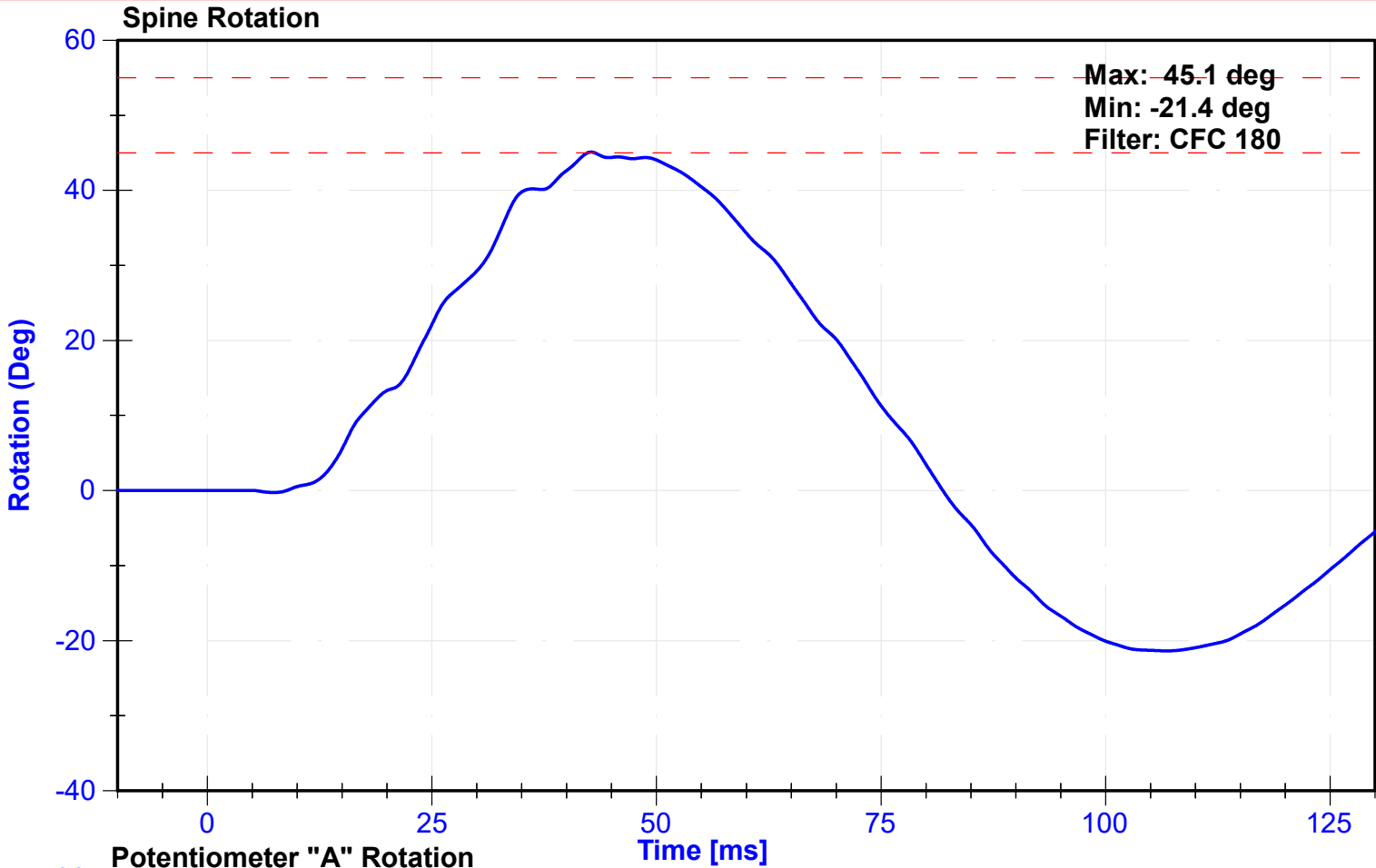
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.6	Pass
Humidity	10	70	%	41	Pass
Velocity	5.95	6.15	m/s	6.088	Pass
Lateral Spine Rotation	45	55	deg	45.1	Pass
Time at Maximum Rotation	39	53	ms	42.7	Pass
Time of Decay to Zero Degrees	37	57	ms	39.2	Pass
Pendulum Velocity Overall Corridor	Lower Boundary ¹	Upper Boundary ²	m/s	See Plot ³	Pass

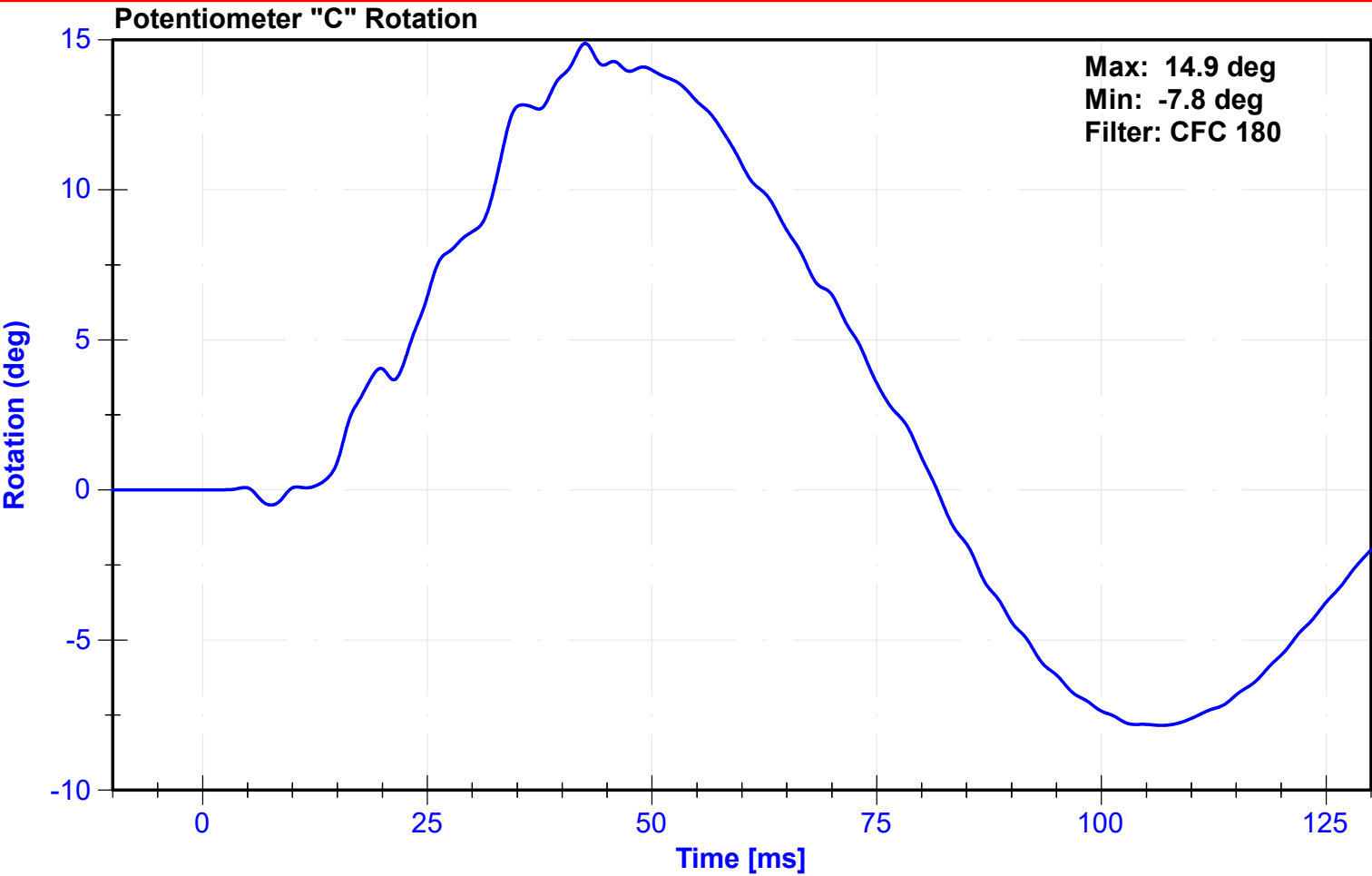
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	C16650	10/31/2022	10/31/2023
Pendulum "A" Potentiometer	Sfernice	094	9/29/2023	9/28/2024
Condyle "B" Potentiometer	Sfernice	095	9/29/2023	9/28/2024



^{1,2} Upper and lower boundaries specified in Appendix I
IV-42





Appendix I

² Upper Boundary Corridor		¹ Lower Boundary Corridor	
Time (ms)	Velocity (m/s)	Time (ms)	Velocity (m/s)
1.0	0.00	0.0	-0.05
3.7	-0.24	2.7	-0.425
27.0	-5.80	24.5	-6.5
		30.0	-6.5

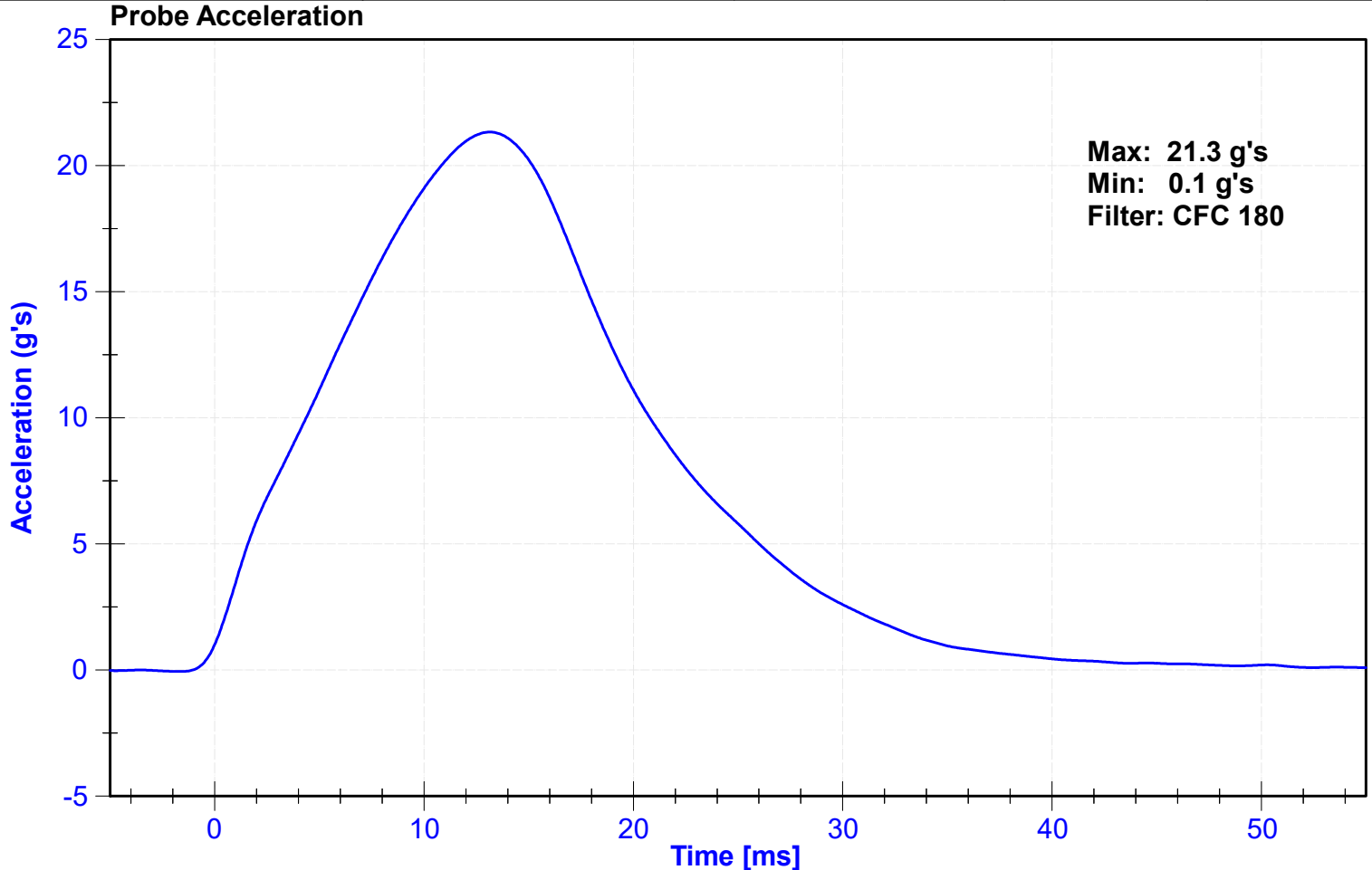
ATD Manufacturer	Denton	Test Technician	D. Sakona
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

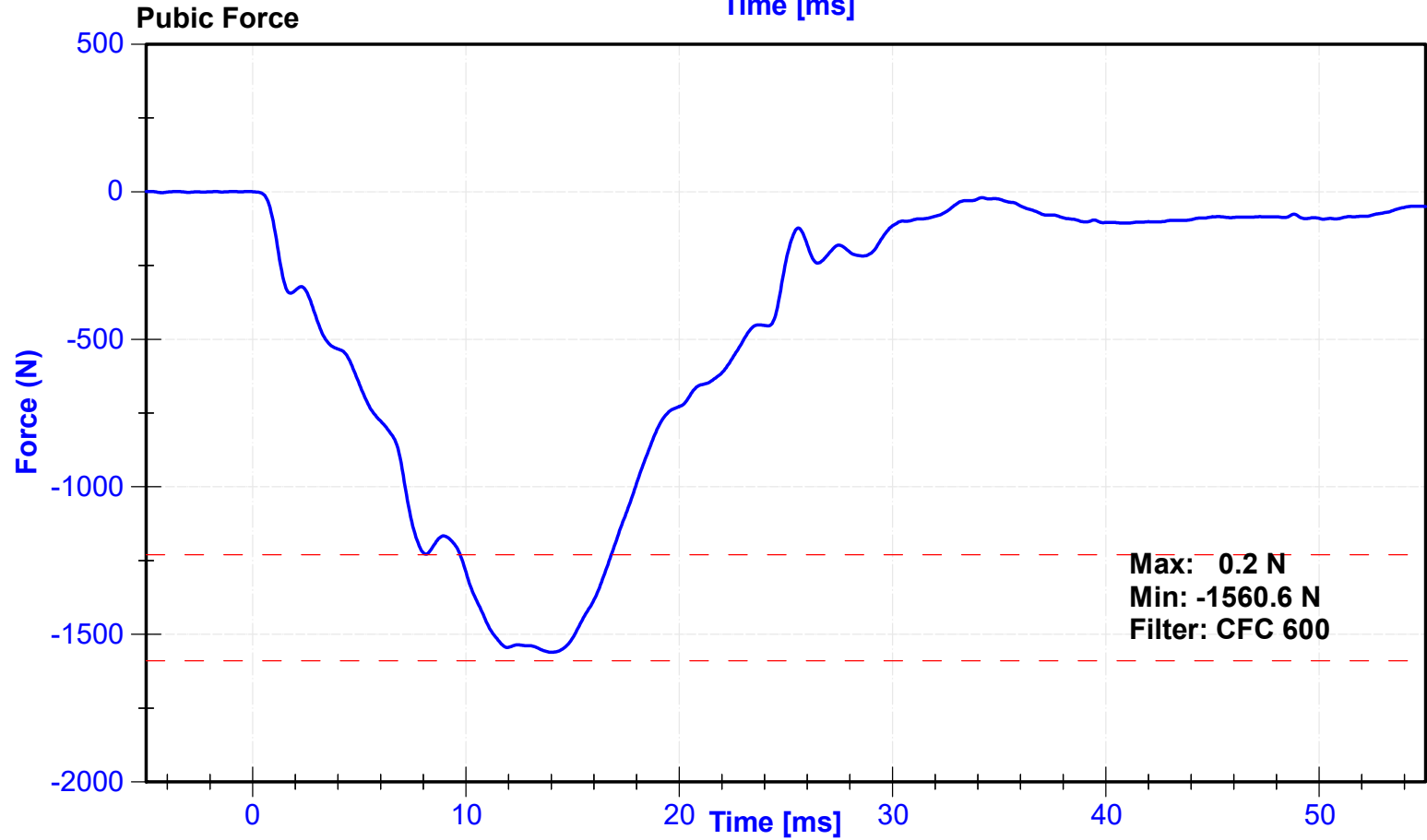
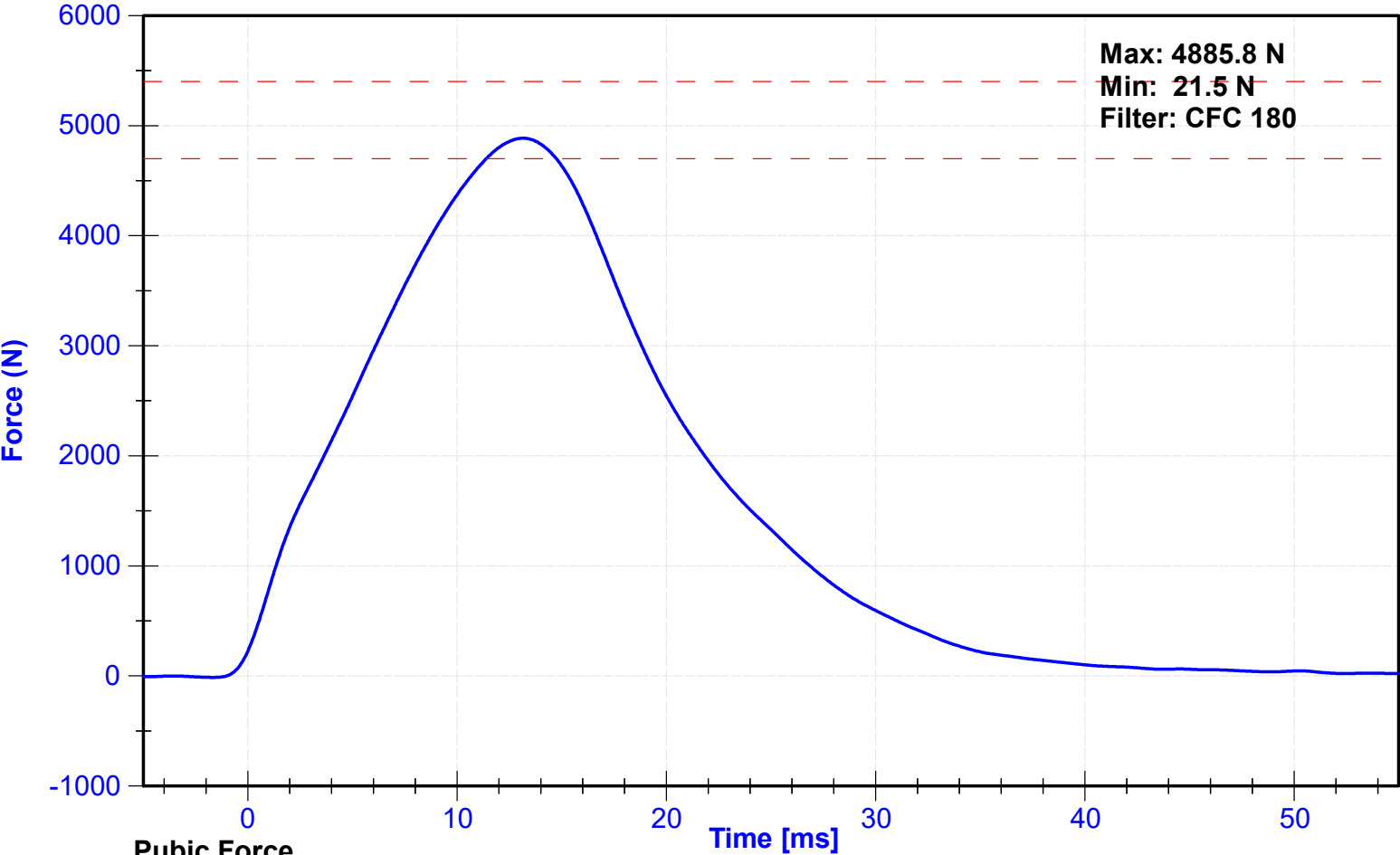
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.6	Pass
Humidity	10	70	%	35	Pass
Velocity	4.2	4.4	m/s	4.28	Pass
Resistive Force	4700	5400	N	4885.8	Pass
Time at Peak Resistive Force	11.8	16.1	ms	13.15	Pass
Pubic Force	-1590	-1230	N	-1560.6	Pass
Time at Peak Pubic Force	12.2	17.0	ms	14.00	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18546	11/19/2022	11/18/2023
Pubic Load Cell	Denton	456-FY	8/8/2023	8/7/2024



Resistive Force



APPENDIX V

TEST EQUIPMENT AND INSTRUMENTATION CALIBRATION DATA

Table 1 – Dummy Instrumentation (ES-2re)

			ES-2re S/N _D037_		
			Serial Number	Manufacturer	Calibration Date
Head Accelerometers	Primary	X	T21724	Endevco	08/08/2023
		Y	T22281	Endevco	08/08/2023
		Z	T26050	Endevco	08/08/2023
	Redundant	X	T21682	Endevco	08/08/2023
		Y	T25989	Endevco	08/08/2023
		Z	T25864	Endevco	08/08/2023
Thorax Rib Displacement Potentiometers	Upper	Y	0552-01	Honeywell	08/07/2023
	Middle	Y	807	Honeywell	08/07/2023
	Lower	Y	0552-03	Honeywell	08/07/2023
Abdomen Load Cells	Forward	Y	1440	Denton	08/08/2023
	Middle	Y	1525	Denton	08/08/2023
	Rear	Y	1528	Denton	08/08/2023
Lower Spine Accelerometers (T12)		X	P71278	Endevco	08/08/2023
		Y	18618	Endevco	08/10/2023
		Z	18617	Endevco	08/10/2023
Pubic Symphysis Load Cell		Y	456-FY	Denton	08/08/2023

Table 2 – Vehicle Instrumentation

Vehicle Instrumentation		Serial Number	Manufacturer	Calibration Date
Vehicle Center of Gravity	X	A280841	Measurement Specialties	09/20/2023
Vehicle Center of Gravity	Y	A283613	Measurement Specialties	09/20/2023
Vehicle Center of Gravity	Z	A428001	Measurement Specialties	09/30/2023
Left Floor Sill	Y	A400741	Measurement Specialties	09/16/2023
A-Pillar Sill	Y	G22199	Endevco	09/27/2023
A-Pillar Low	Y	G22832	Endevco	08/16/2023
A-Pillar Mid	Y	A274253	Measurement Specialties	09/09/2023
B-Pillar Sill	Y	A370927	Measurement Specialties	06/01/2023
B-Pillar Low	Y	G22915	Endevco	08/10/2023
B-Pillar Mid	Y	A431368	Measurement Specialties	09/30/2023
Driver Seat	Y	A315892	Measurement Specialties	09/30/2023
Engine Top	X	A335480	Measurement Specialties	09/22/2023
Engine Top	Y	A352412	Measurement Specialties	09/22/2023
Firewall	Y	A400749	Measurement Specialties	09/08/2023
Right Roof	Y	A372827	Measurement Specialties	09/16/2023
Right Floor Sill	Y	G22902	Endevco	09/30/2023
Rear Floorpan	X	A279985	Measurement Specialties	09/28/2023
Rear Floorpan	Y	A352340	Measurement Specialties	09/28/2023