

REPORT NUMBER: 214P-CAL-23-013

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

**KIA Corporation
2023 KIA Niro EV Wave
5 Door SUV**

NHTSA No: C20234202

**PREPARED BY:
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October 3, 2023

FINAL REPORT

**PREPARED FOR:
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NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
ENFORCEMENT
OFFICE OF VEHICLE SAFETY COMPLIANCE
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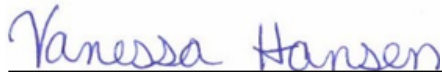
This final test report was prepared for the U.S. Department of Transportation, National Highway Traffic Safety Administration, in response to Contract Number DTNH22-17-D-00078.

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Date: October 3, 2023

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16. Abstract A 31.00 km/h (19.3 mph), 285° oblique compliance test was conducted on the subject 2023 KIA Niro EV Wave 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 September 12, 2023. The impact velocity of the vehicle was 30.99 km/h, and the ambient temperature at the struck (passenger's) side of the target vehicle was 21°C. The target vehicle's maximum post-test static crush was 0 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">Front Passenger 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>447.440</td> </tr> <tr> <td>Maximum Thoracic Rib Deflection</td> <td>mm</td> <td>44</td> <td>22.121</td> </tr> <tr> <td>Total Abdominal Force</td> <td>N</td> <td>2500</td> <td>774.848</td> </tr> <tr> <td>Pubic Symphysis Force</td> <td>N</td> <td>6000</td> <td>2456.608</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	Front Passenger ATD (ES-2re)			Units	IARV	Result	Head Injury Criteria (HIC36)		1000	447.440	Maximum Thoracic Rib Deflection	mm	44	22.121	Total Abdominal Force	N	2500	774.848	Pubic Symphysis Force	N	6000	2456.608
Measurement Description	Front Passenger ATD (ES-2re)																											
	Units	IARV	Result																									
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Maximum Thoracic Rib Deflection	mm	44	22.121																									
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Pubic Symphysis Force	N	6000	2456.608																									
17. Key Words Compliance Testing Side Impact Protection Pole Test ES-2re SID-IIs				18. Distribution Statement Copies of this report are available from: National Highway Traffic Safety Administration Technical Information Services (TIS) Room E12-100 East Bldg. 1200 New Jersey Ave. Washington, D.C. 20590 Telephone No. (202) 366-2588																								
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Form DOT F1700.7 (8-72)

TABLE OF CONTENTS

<u>Section</u>		<u>Page</u>
1	Test Purpose and Summary of the Test	1-1
2	Occupant and Vehicle Information	2-1
 <u>Data Sheet</u>		 <u>Page</u>
1	Test Vehicle Information and Options	2-2
2	Vehicle Tire Information	2-3
3	General Test and Vehicle Parameter Data	2-4
4	Seat and Seat Belt Adjustment Data	2-5
5	Fuel Systems and Steering Wheel Position Data	2-6
6	Dummy Longitudinal Clearance Dimensions	2-7
7	Dummy Lateral Clearance Dimensions	2-8
8	Location of Cameras	2-9
9	Test Vehicle Accelerometer Location	2-10
10	Test Vehicle Accelerometer Data Summary	2-11
11	Dummy Injury Response Data	2-12
12	Post Test Observations	2-13
13	Vehicle Pre-test and Post-test Measurements	2-15
14	Exterior Crush Measurements	2-16
15	Vehicle Exterior Crush Profiles	2-17
16	Temperature and Humidity Trace	2-19
 <u>Appendix</u>		 <u>Page</u>
I	Photographs	I-1
II	Dummy Response Data	II-1
III	Vehicle and Dummy Response Data Plots	III-1
IV	Dummy Performance Calibration Test Data	IV-1
V	Test Equipment and Instrumentation Calibration	V-1

SECTION 1

PURPOSE AND SUMMARY OF TEST

PURPOSE

This side impact test was conducted as part of the FY 2023 FMVSS 214 Side Impact Protection Compliance Test Program, sponsored by the National Highway Traffic Safety Administration (NHTSA), under Contract No. DTNH22-17-D-00078. The purpose of this test was to evaluate side impact protection in a 2023 KIA Niro EV Wave 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 2023 KIA Niro EV Wave 5 Door SUV. The subject vehicle was towed into the rigid pole at an angle of 285° and a velocity of 30.99 km/h. The test was conducted by Calspan Corporation's Transportation Test Operations facility in Buffalo, New York on September 12, 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 (ES2re) dummy was placed in the front passenger 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	Front Passenger ATD (ES2re)		
	Units	IARV	Result
Head Injury Criteria (HIC36)		1000	447.440
Upper Rib Deflection	mm	44	22.121
Mid Rib Deflection	mm	44	15.061
Lower Rib Deflection	mm	44	16.225
Abdominal Load (front)	N		152.867
Abdominal Load (mid)	N		275.047
Abdominal Load (rear)	N		358.341
Total Abdominal Force	N	2500	774.848
Pubic Symphysis Force	N	6000	2456.608

SECTION 2

OCCUPANT AND VEHICLE INFORMATION

This section contains information reporting for the following Data Sheets:

<u>Data Sheet</u>		<u>Page</u>
1	Test Vehicle Information and Options	2-2
2	Vehicle Tire Information	2-3
3	General Test and Vehicle Parameter Data	2-4
4	Seat and Seat Belt Adjustment Data	2-5
5	Fuel Systems and Steering Wheel Position Data	2-6
6	Dummy Longitudinal Clearance Dimensions	2-7
7	Dummy Lateral Clearance Dimensions	2-8
8	Location of Cameras	2-9
9	Test Vehicle Accelerometer Location	2-10
10	Test Vehicle Accelerometer Summary	2-11
11	Dummy Injury Response Data	2-12
12	Post Test Observations	2-13
13	Vehicle Pre-test and Post-test Measurements	2-15
14	Exterior Crush Measurements	2-16
15	Vehicle Exterior Crush Profiles	2-17
16	Temperature and Humidity Trace	2-19

DATA SHEET NO. 1
TEST VEHICLE INFORMATION AND OPTIONS

Test Vehicle: 2023 KIA Niro EV Wave 5 Door SUV
Test Facility: Calspan

NHTSA No.: C20234202
Test Date: 09/12/2023

TEST VEHICLE INFORMATION AND OPTIONS

Make	KIA	Anti-Lock Brakes (ABS)	Yes
Model	Niro EV Wave	All-Wheel Drive (AWD)	No
Body Style	SUV	Traction Control System (TCS)	Yes
VIN	KNDCT3L1XP5014513	Electric Stability Control (ECS)	Yes
Body Color	White	Curtain Airbags	Yes
Engine Displacement (L)	N/A	Torso Airbags – Front Seats	Yes
Type / No. Cylinders	N/A	Torso Airbags – Rear Seats	No
Engine Placement	N/A	Combination/Head Torso Bag	No
Transmission Type	Automatic	Pelvic Airbag – Front Seats	No
Transmission Speeds	1-Speed	Pelvis Airbag – Rear Seats	No
Overdrive	No	Knee Airbag – Driver	Yes
Final Drive	Front Wheel Drive	Knee Airbag – Front Passenger	No
Odometer Reading (mi)	724 miles	Seat Belt Pretensioners – Front Seats	Yes
		Seat Belt Pretensioners – Rear Seats	No
		Seat Belt Load Limiter – Front Seats	Yes
		Seat Belt Load Limiter – Rear Seats	No
		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	KIA Corporation	GVWR (kg)	2170
Date of Manufacture	08/22	GVWR Front (kg)	1130
Vehicle Type	MPV	GVWR Rear (kg)	1160

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)				390
Cargo Weight (RCLW) (kg)				49.8

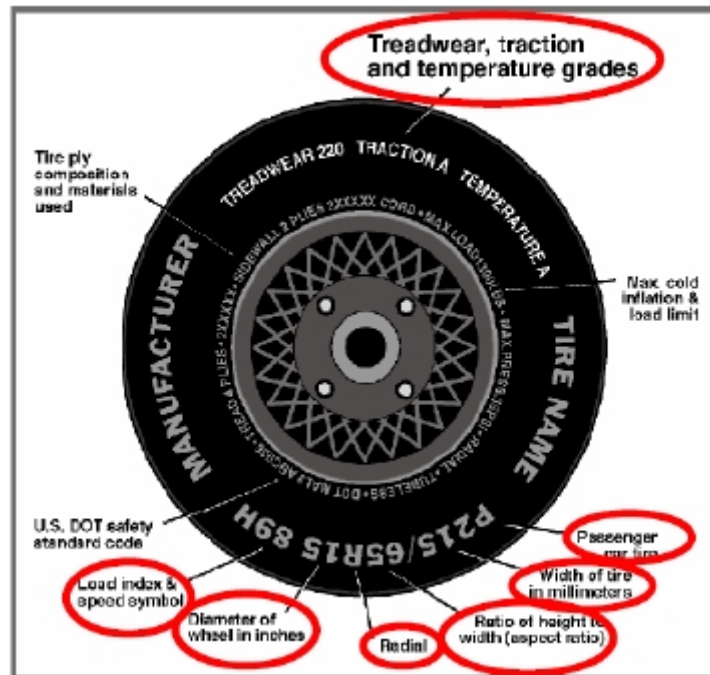
DATA SHEET NO. 2 VEHICLE TIRE INFORMATION

Test Vehicle: 2023 KIA Niro EV Wave 5 Door SUV
Test Facility: Calspan

NHTSA No.: C20234202
Test Date: 09/12/2023

VEHICLE TIRE INFORMATION

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



TIRE SIDEWALL INFORMATION

Tire Placard	Front	Rear
Recommended Cold Pressure (kPa)	250	250
Recommended Tire Size	215/55R17	215/55R17
Tire Sidewall	Front	Rear
Maximum Tire Pressure (kPa)	350	350
Tire Size on Vehicle	215/55R17	215/55R17
Tire Manufacturer Model	Kumho	Kumho
Tire Name	Solus TA31	Solus TA31
Tire Type	All Season	All Season
Tire Width	215	215
Aspect Ratio	55	55
Radial	Yes	Yes
Wheel Diameter	17"	17"
Load Index / Speed Symbol	94V	94V
Treadwear	500	500
Traction Grade	A	A
Temperature Grades	A	A

DATA SHEET NO. 3
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2023 KIA Niro EV Wave 5 Door SUV
Test Facility: Calspan

NHTSA No.: C20234202
Test Date: 09/12/2023

TIRE PRESSURES

	Units	LF	RF	LR	RR
As Delivered	kPa	223	221	214	210
Tire Placard	kPa	250	250	250	250

TEST VEHICLE AXLE WEIGHTS

	Units	As Delivered (UVW)			Fully Loaded			As Tested		
		Front	Rear	Total	Front	Rear	Total	Front	Rear	Total
Left	kg	478	392		494	423		495	423	
Right	kg	488	365		513	428		506	422	
Ratio	%	56.1	43.9		54.2	45.8		54.2	45.8	
Totals	kg	966	757	1723	1007	851	1858	1001	845	1846

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value	
Total As Delivered Weight (UVW)	kg	1723	(A)
Weight of Test Dummy	kg	81	(B)
Rated Cargo / Luggage Weight (RCLW)	kg	49.8	(C)
Calculated Vehicle Target Weight (TVTW)	kg	1853.8	(A+B+C)

TEST VEHICLE ATTITUDES AND CG

Measurement Description	Units	As Delivered	Fully Loaded	As Tested
Driver Door Sill Angle	Deg	+0.35	+0.20	+0.35
Front Passenger Sill Angle	Deg	-0.15	-0.10	-0.15
Front Bumper-Line Angle	Deg	+0.20	+0.25	+0.25
Rear Bumper-Line Angle	Deg	+0.20	-0.05	+0.20

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	2721
Vertical Impact Reference Line Aft of Front Axle	mm	1259

WEIGHT OF BALLAST AND VEHICLE COMPONENTS REMOVED TO MEET TVTW

Component Description	Weight (kg)
Trunk carpeting and trim	7
Rear speaker and tools	5
Door panels, window & speakers	8
Tail light, head light	7
Front bumper, Fender liners, frunk, side mirror	23
Ballast (if any)	0

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

Test Vehicle: 2023 KIA Niro EV Wave 5 Door SUV
Test Facility: Calspan

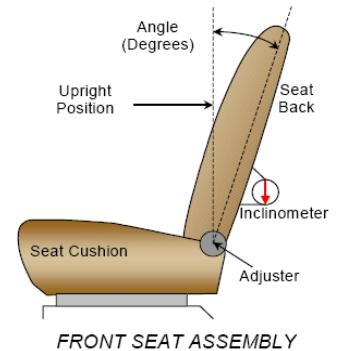
NHTSA No.: C20234202
Test Date: 09/12/2023

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	Degree	18.9
Front Passenger Seat	Degree	18.9

*Measurement taken on seatback



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	17.6	Max	72	84	96
		Mid	39	50	60
		Min	5	15	26
Front Passenger Seat	17.0	Max	72	86	93
		Mid	39	52	60
		Min	6	19	27

SEAT FORE / AFT POSITION

Seat	Total Fore / Aft Travel		Placed in Position #	
	mm	Detents	mm	Detents
Driver Seat	260	Power	130	Power
Front Passenger Seat	260	Power	130	Power

SEAT BELT ANCHORAGE ADJUSTMENT

Seat	Total # of Positions	Placed in Position #
Front Passenger Seat	3 (0-2)	Uppermost

HEAD RESTRAINT ADJUSTMENT

Seat	Total # of Positions	Placed in Position #
Front Passenger Seat	6 (0-5)	Uppermost

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

Test Vehicle: 2023 KIA Niro EV Wave 5 Door SUV
 Test Facility: Calspan

NHTSA No.: C20234202
 Test Date: 09/12/2023

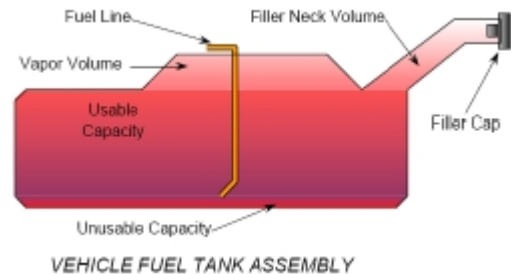
FUEL TANK CAPACITY

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

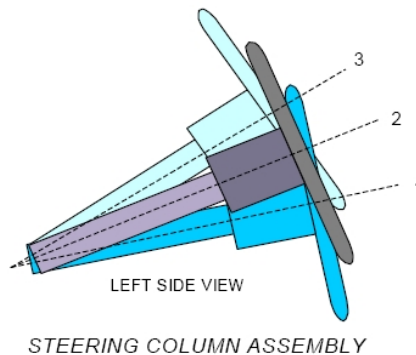
FUEL PUMP

Describe the operation of the fuel pump.

The vehicle is equipped with a charge port located on the front center of the vehicle.



STEERING COLUMN POSITIONS

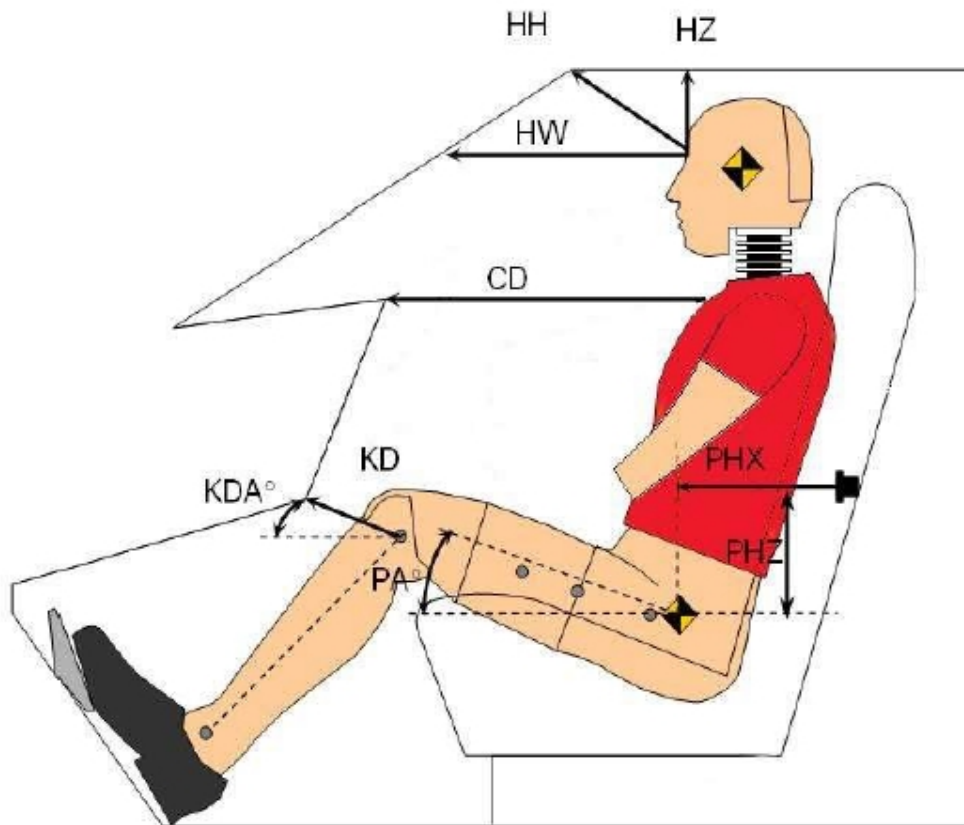


	Degrees	Fore / Aft Position (mm)
Lowermost - Position No. 1	23.2	
Geometric center - Position No. 2	26.0	
Uppermost - Position No. 3	28.7	
Telescoping Steering Wheel Travel		52
Test Position	26.0	26

DATA SHEET NO. 6
DUMMY LONGITUDINAL CLEARANCE DIMENSIONS

Test Vehicle: 2023 KIA Niro EV Wave 5 Door SUV
 Test Facility: Calspan

NHTSA No.: C20234202
 Test Date: 09/12/2023



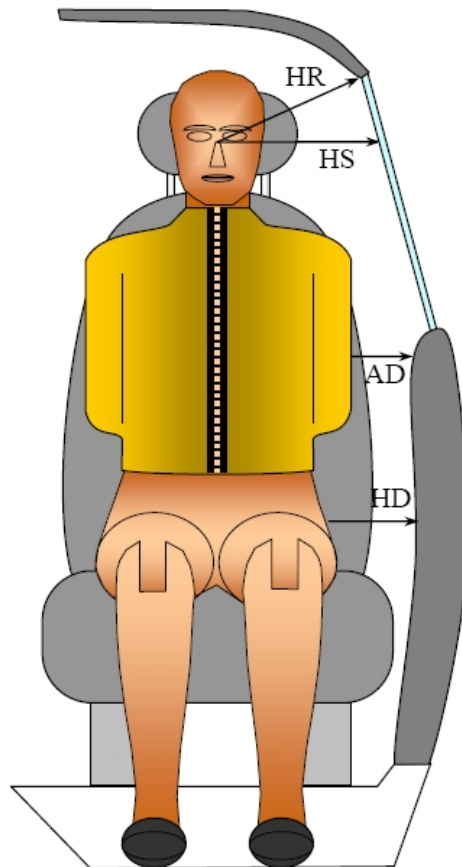
DUMMY LONGITUDINAL CLEARANCE DIMENSION INFORMATION

Driver Code	Description	Front Passenger	
		Length (mm)	Angle (°)
HH	Head to Header	384	
HW	Head to Windshield	645	
HZ	Head to Roof Liner	171	
CD	Chest to Dash	588	
KD(L) / KDA(L)°	Left Knee to Dash	220	33.8
KD(R) / KDA(R)°	Right Knee to Dash	220	28.4
PAX°	Pelvic Tilt Angle (X-Axis)		19.0
PAY°	Pelvic Tilt Angle (Y-Axis)		-0.1
PHX	Hip Point to Striker (X-Axis)	196	
PHZ	Hip Point to Striker (Z-Axis)	262	

DATA SHEET NO. 7
DUMMY LATERAL CLEARANCE DIMENSIONS

Test Vehicle: 2023 KIA Niro EV Wave 5 Door SUV
Test Facility: Calspan

NHTSA No.: C20234202
Test Date: 09/12/2023



FRONT VIEW OF DUMMY

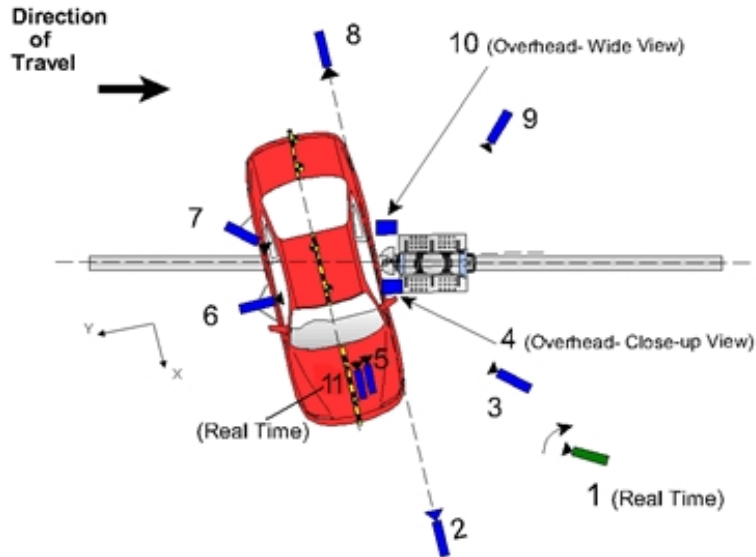
DUMMY LATERAL CLEARANCE DIMENSION INFORMATION

Code	Measurement Description	Units	Front Passenger
HR	Head to Side Header	mm	201
HS	Head to Side Window	mm	316
AD	Arm to Door	mm	125
HD	H-Point to Door	mm	160

DATA SHEET NO. 8 LOCATION OF CAMERAS

Test Vehicle: 2023 KIA Niro EV Wave 5 Door SUV
Test Facility: Calspan

NHTSA No.: C20234202
Test Date: 09/12/2023



CAMERA LOCATIONS AND DATA

CAMERA LOCATIONS AND DATA

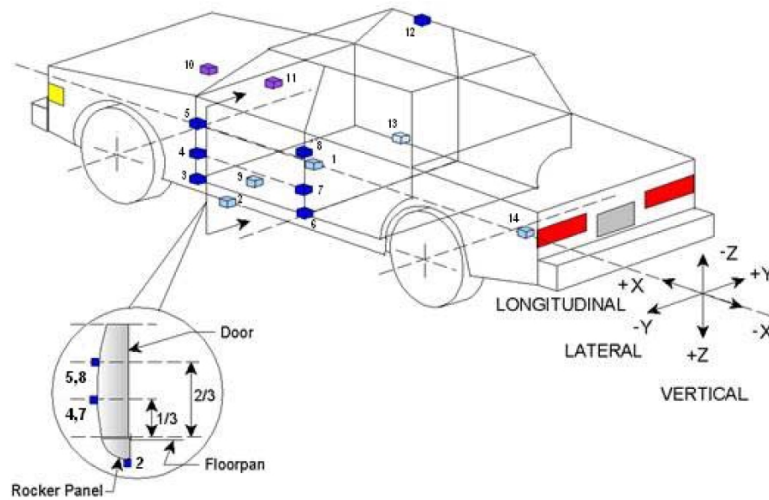
No.	Camera View	Coordinates (mm)			Lens Length (mm)	Operating Frame Rate (fps)
		X	Y	Z		
1	Real-time (24 - 30 fps) pan view of impact				Zoom	30
2	Front ground level - impact view	409	-7416	-1533	28	1000
3	Impact side 45° - forward pole view	1696	-5325	-1449	24	1000
4	Overhead Close-up view of impact	0	0	-9200	24	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	-494	8018	-1434	28	1000
9	Impact side 45° - rearward pole view	3257	5945	-1506	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: 2023 KIA Niro EV Wave 5 Door SUV
Test Facility: Calspan

NHTSA No.: C20234202
Test Date: 09/12/2023



TEST VEHICLE ACCELEROMETER LOCATIONS

No.	Accelerometer Location	Coordinates (mm)		
		X	Y	Z
1	Vehicle CG	1855	4	99
2	Left Floor Sill	2659	651	45
3	A-Pillar Sill	3021	627	51
4	A-Pillar Low	3117	624	-126
5	A-Pillar Mid	2998	644	-659
6	B-Pillar Sill	2036	657	20
7	B-Pillar Low	1984	673	-243
8	B-Pillar Mid	1928	654	-604
9	Seat	2280	557	54
10	Engine	3821	103	-276
11	Firewall	3314	213	-317
12	Roof	2127	-559	-1107
13	Right Floor Sill	2731	-646	51
14	Rear Deck	853	15	0

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: 2023 Kia Niro EV Wave 5 Door SUV
Test Facility: Calspan

NHTSA No.: C20234202
Test Date: 09/12/2023

Loc. No	Description	Axes	Units	Positive Direction		Negative Direction	
				Max	Time (ms)	Max	Time (ms)
1	Vehicle CG	X	g	3.67	30.85	-8.56	49.00
	Vehicle CG	Y	g	1.25	92.45	-53.11	24.70
	Vehicle CG	Z	g	15.35	24.85	-20.98	36.90
	Vehicle CG Resultant	N/A	g	55.62	24.75	0.05	115.15
2	Floor Sill (Left)	Y	g	1.67	176.75	-45.75	29.75
3	A Pillar Sill	Y	g	59.70	42.15	-155.50	46.20
4	A Pillar Low	Y	g	92.77	46.05	-96.38	50.10
5	A Pillar Mid	Y	g	3.92	27.20	-33.45	35.75
6	B Pillar Sill	Y	g	76.20	18.80	-113.37	14.00
7	B Pillar Low	Y	g	85.45	22.80	-116.36	17.10
8	B Pillar Mid	Y	g	44.94	14.20	-60.82	19.70
9	Seat	Y	g	4.08	51.65	-56.26	25.65
10	Engine Top	X	g	6.31	48.45	-18.38	32.35
	Engine Top	Y	g	4.69	119.20	-60.83	39.30
11	Firewall	Y	g	0.84	176.15	-28.21	28.95
12	Roof	Y	g	1.32	251.25	-32.42	51.40
13	Floor Sill (Right)	Y	g	31.95	17.55	-72.87	22.55
14	Rear Deck	X	g	6.72	65.30	-6.92	51.50
	Rear Deck	Y	g	2.66	143.35	-46.62	37.80

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

Test Vehicle: 2023 Kia Niro EV Wave 5 Door SUV

NHTSA No.: C20234202

Test Facility: Calspan

Test Date: 09/12/2023

Dummy Serial No. **DG5348**

Description	Axes	Positive Direction		Negative Direction	
		MAX	TIME (ms)	MAX	TIME (ms)
HEAD ACCELERATION (g)					
Longitudinal	X	7.11	77.60	-17.99	65.90
Lateral	Y	22.37	84.60	-64.93	50.70
Vertical	Z	13.10	43.25	-6.71	78.55
Resultant	N/A	65.93	50.70		
HIC36 (t1, t2)	N/A	447.44		t1 = 39.90	t2 = 61.85
THORAX DEFLECTION (mm)					
Upper Rib	Y	22.12	61.60	-1.53	19.25
Middle Rib	Y	15.06	60.75	-0.92	21.40
Lower Rib	Y	16.23	48.15	-0.81	227.40
ABDOMINAL FORCES (N)					
Front	Y	152.87	48.10	-16.46	101.00
Middle	Y	275.05	46.45	-9.30	99.15
Rear	Y	358.34	46.75	-15.75	105.95
SUM	N/A	774.85	46.60		
PELVIS FORCES (N)					
Pubic Symphysis	Y	37.71	219.80	-2456.61	53.90

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

DATA SHEET NO. 12
POST-TEST OBSERVATIONS

Test Vehicle: 2023 KIA Niro EV Wave 5 Door SUV
Test Facility: Calspan

NHTSA No.: C20234202
Test Date: 09/12/2023

IMPACT POINT DATA

Measured Parameter	Units	Value
Vertical Impact Ref Line - Aft of Front Axle, Intended Impact Pt	mm	1259
Actual Impact Point - Aft of Front Axle	mm	1265
Difference	mm	6

TEST DUMMY INFORMATION AND CONTACT POINTS

Dummy Body Part	Front Passenger Seat Dummy (ES2re)
Head Contact	Side Curtain Airbag, Headliner & Headrest
Upper Torso Contact	Seatback & Torso/Pelvis Airbag
Lower Torso Contact	Seatback & Torso/Pelvis Airbag
Left Knee Contact	Right Knee
Right Knee Contact	Passenger Door

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	A-Pillar & B-Pillar Buckled
Sill Separation	335 mm of separation behind impact location
Windshield Damage	Cracked throughout with separation along A-Pillar
Side Window Damage	Cracked throughout
Other Notable Effects	Passenger sun visor disconnected

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

Test Vehicle: 2023 KIA Niro EV Wave 5 Door SUV
Test Facility: Calspan

NHTSA No.: C20234202
Test Date: 09/12/2023

SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

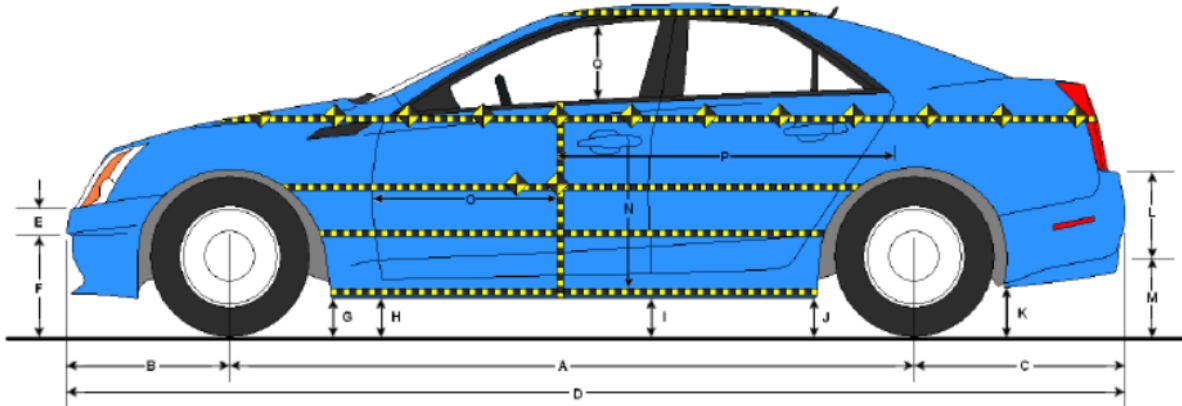
Restraint Type	Struck Side Front Occupant	
	Mounted	Deployed
Front Airbag	Yes	No
Knee Airbag	Yes	No
Head Airbag*	Yes	Yes
Side Airbag 2 - Torso Airbag	Yes	Yes
Seat Belt Pretensioner	Yes	Yes
Seat Belt Load Limiter	Yes	Yes
Other	N/A	N/A

*Head Airbag was a curtain airbag

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

Test Vehicle: 2023 KIA Niro EV Wave 5 Door SUV
 Test Facility: Calspan

NHTSA No.: C20234202
 Test Date: 09/12/2023



LEFT SIDE VIEW

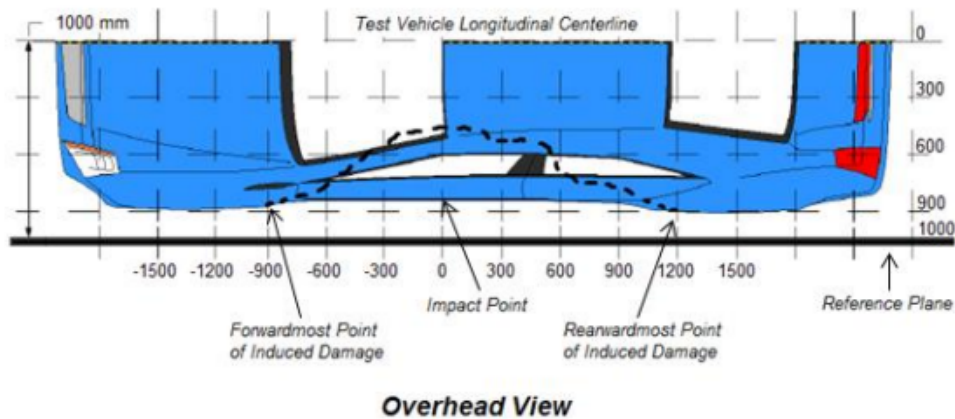
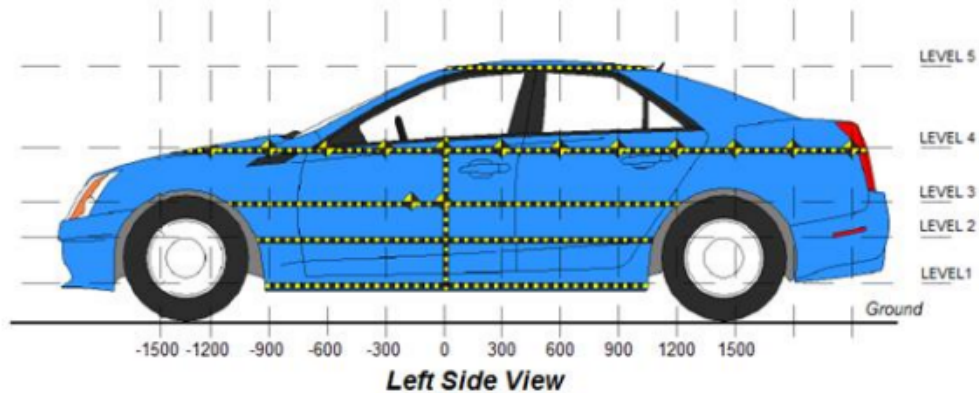
VEHICLE PRE- AND POST-TEST MEASUREMENT INFORMATION

No.	Measurement Description	Pre-Test	Post-Test	Difference
A	Vehicle Wheelbase	2721	2711	10
B	Front Axle to FSOV	809	805	4
C	Rear Axle to RSOV	809	811	-2
D	Total Vehicle Length at Centerline	4339	4326	13
E	Front Bumper Thickness	102	109	-7
F	Front Bumper Bottom to Ground	456	459	-3
G	Sill Height at Front Wheel Well	212	207	5
H	Sill Height at Front Door Leading Edge	213	206	7
I	Sill Height at B Pillar	217	210	7
J1	Sill Height at Rear Wheel Well	224	229	-5
J2	Pinch Weld Height at Rear Wheel Well	199	199	0
K	Sill Height Aft of Rear Wheel Well	290	284	6
L	Rear Bumper Thickness	120	120	0
M	Rear Bumper Bottom to Ground	514	507	7
N	Sill Height to Window Bottom Sill	850	862	-12
O	Front Door Leading Edge to Impact CL	800	769	31
P	Rear Door Trailing Edge to Impact CL	1389	1346	42
Q	Front Window Opening	399	392	7
R	Right Side Length	4226	4208	17
S	Left Side Length	4227	4225	2
T	Vehicle Width at B-Pillars	1779	1751	28

DATA SHEET NO. 14
TEST VEHICLE EXTERIOR CRUSH MEASUREMENTS

Test Vehicle: 2023 KIA Niro EV Wave 5 Door SUV
 Test Facility: Calspan

NHTSA No.: C20234202
 Test Date: 09/12/2023



MAXIMUM EXTERIOR CRUSH MEASUREMENTS

Level	Measurement Description	Units	Height Above Ground	Maximum Exterior Static Crush	Distance from Impact
1	Sill Top	mm	400	-154	0
2	Occupant H-Point	mm	592	-183	0
3	Mid-Door	mm	692	-196	0
4	Window Sill	mm	1017	-178	0
5	Window Top	mm	1489	-27	0

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: 2023 KIA Niro EV Wave 5 Door SUV
 Test Facility: Calspan

NHTSA No.: C20234202
 Test Date: 09/12/2023

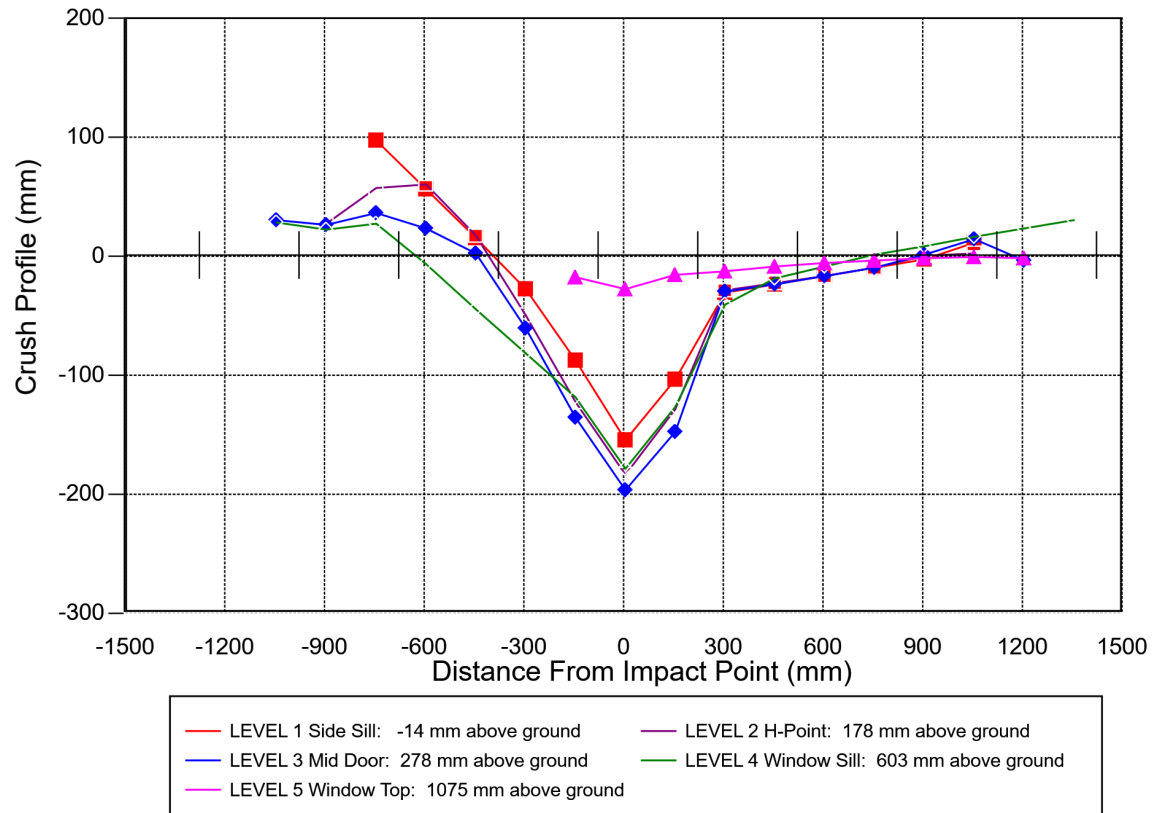
EXTERIOR CRUSH MEASUREMENTS AT EACH LEVEL

	Pre-Test					Post-Test					Difference				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
-1500															
-1350															
-1200															
-1050			-904	-772				-935	-801				31	29	
-900		-903	-897	-787			-931	-924	-810			28	27	23	
-750	-890	-884	-885	-793		-988	-942	-922	-821		98	58	37	28	
-600	-888	-879	-884	-803		-945	-940	-908	-797		57	61	24	-6	
-450	-887	-879	-883	-811		-903	-897	-886	-767		16	18	3	-44	
-300	-885	-878	-883	-820		-858	-829	-823	-739		-27	-49	-60	-81	
-150	-884	-877	-882	-824	-570	-797	-755	-747	-706	-553	-87	-122	-135	-118	-17
0	-882	-875	-881	-830	-594	-728	-692	-685	-652	-567	-154	-183	-196	-178	-27
150	-880	-874	-881	-833	-598	-777	-746	-734	-707	-583	-103	-128	-147	-126	-15
300	-872	-873	-881	-837	-599	-842	-845	-852	-797	-587	-30	-28	-29	-40	-12
450	-879	-872	-880	-837	-599	-856	-850	-857	-819	-591	-23	-22	-23	-18	-8
600	-878	-872	-878	-839	-599	-862	-856	-862	-831	-594	-16	-16	-16	-8	-5
750	-877	-876	-880	-837	-595	-868	-867	-871	-839	-592	-9	-9	-9	2	-3
900	-882	-888	-889	-837	-588	-880	-889	-891	-846	-587	-2	1	2	9	-1
1050	-887	-898	-901	-834	-577	-899	-901	-916	-851	-577	12	3	15	17	0
1200			-900	-831	-545			-897	-855	-544			-3	24	-1
1350				-827					-858					31	
1500															

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

Test Vehicle: 2023 KIA Niro EV Wave 5 Door SUV
Test Facility: Calspan

NHTSA No.: C20234202
Test Date: 09/12/2023

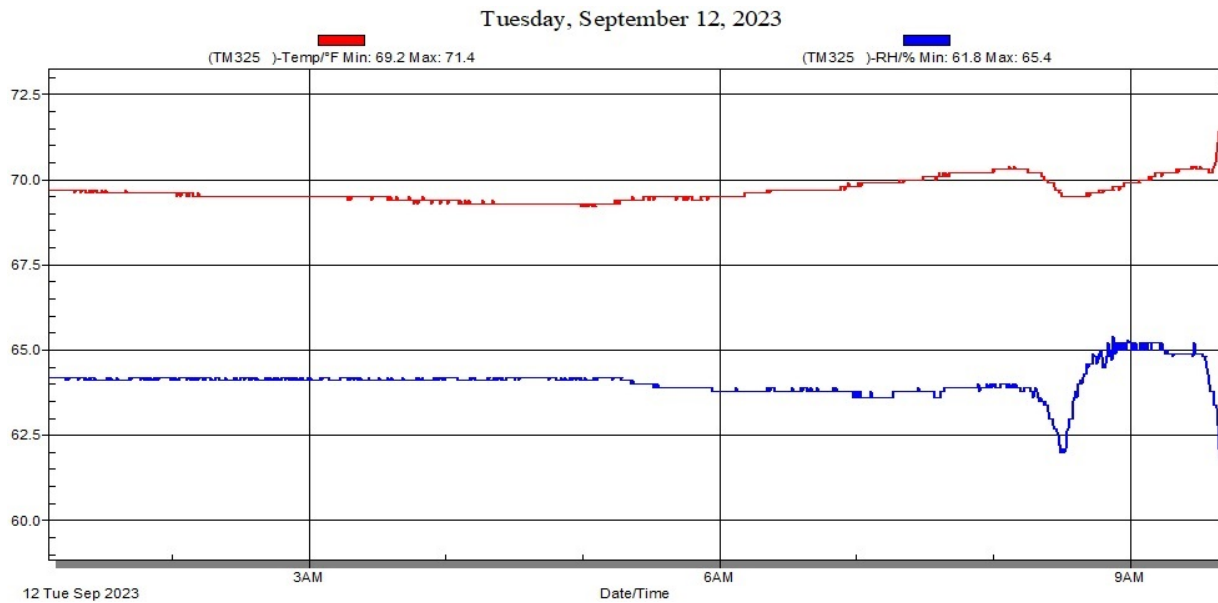


Vehicle Exterior Crush Measurements - Visual Representation

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

Test Vehicle: 2023 KIA Niro EV Wave 5 Door SUV
Test Facility: Calspan

NHTSA No.: C20234202
Test Date: 09/12/2023



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

APPENDIX I
PHOTOGRAPHS

TABLE OF PHOTOGRAPHS

Fig.	Description	Page
1	Pre-Test Frontal View of Test Vehicle	I-3
2	Post Test Frontal View of Test Vehicle	I-3
3	Pre-Test Rear View of Test Vehicle	I-4
4	Post-Test Rear View of Test Vehicle	I-4
5	Pre-Test Impacted Side View of Test Vehicle	I-5
6	Post-Test Impacted Side View of Test Vehicle	I-5
7	Pre-Test Right $\frac{3}{4}$ Front View of Vehicle and Pole	I-6
8	Pre-Test Right $\frac{3}{4}$ Rear View of Vehicle and Pole	I-6
9	Pre-Test Overhead View of Test Vehicle	I-7
10	Post-Test Overhead View of Test Vehicle	I-7
11	Pre-Test Dummy Through Opposite Window	I-8
12	Post-Test Dummy Through Opposite Window	I-8
13	Pre-Test Close-Up of Dummy with Door Closed (Impact Side)	I-9
14	Post-Test Close-Up of Dummy with Door Closed (Impact Side)	I-9
15	Pre-Test Dummy with Door Open	I-10
16	Pre-Test Dummy Shoulder and Door Top View	I-10
17	Post-Test Dummy Shoulder and Door Top View	I-11
18	Pre-Test Interior of Front Door Closed (through opposite window)	I-11
19	Post-Test Interior of Front Door Showing Dummy Impact Locations	I-12
20	Impact Event	I-12
21	Post-Test Impact Zone Close-Up View	I-13
22	Post-Test $\frac{3}{4}$ Front View of Impact Zone	I-13
23	Post-Test $\frac{3}{4}$ Rear View of Impact Zone	I-14
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

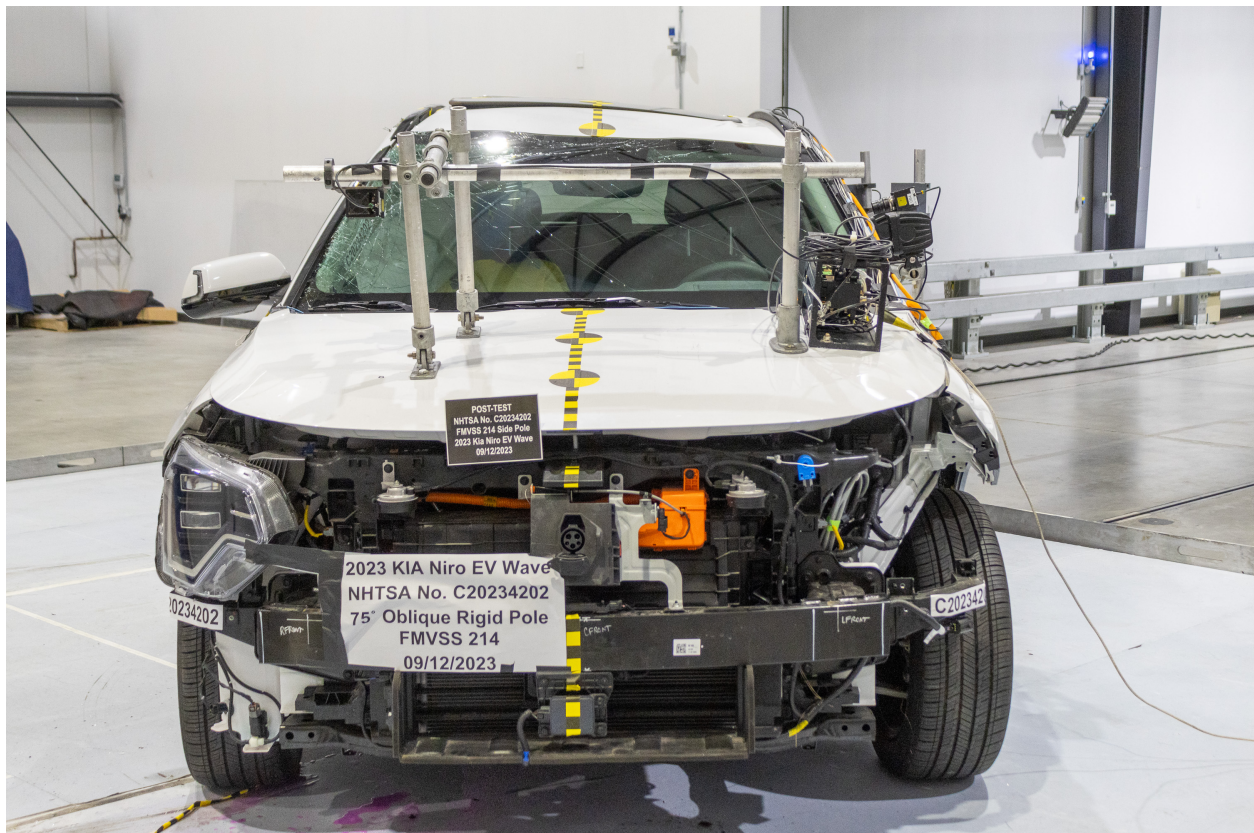


Figure A-2: Post Test Frontal View of Test Vehicle



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 Right $\frac{3}{4}$ Front View of Vehicle and Pole



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



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

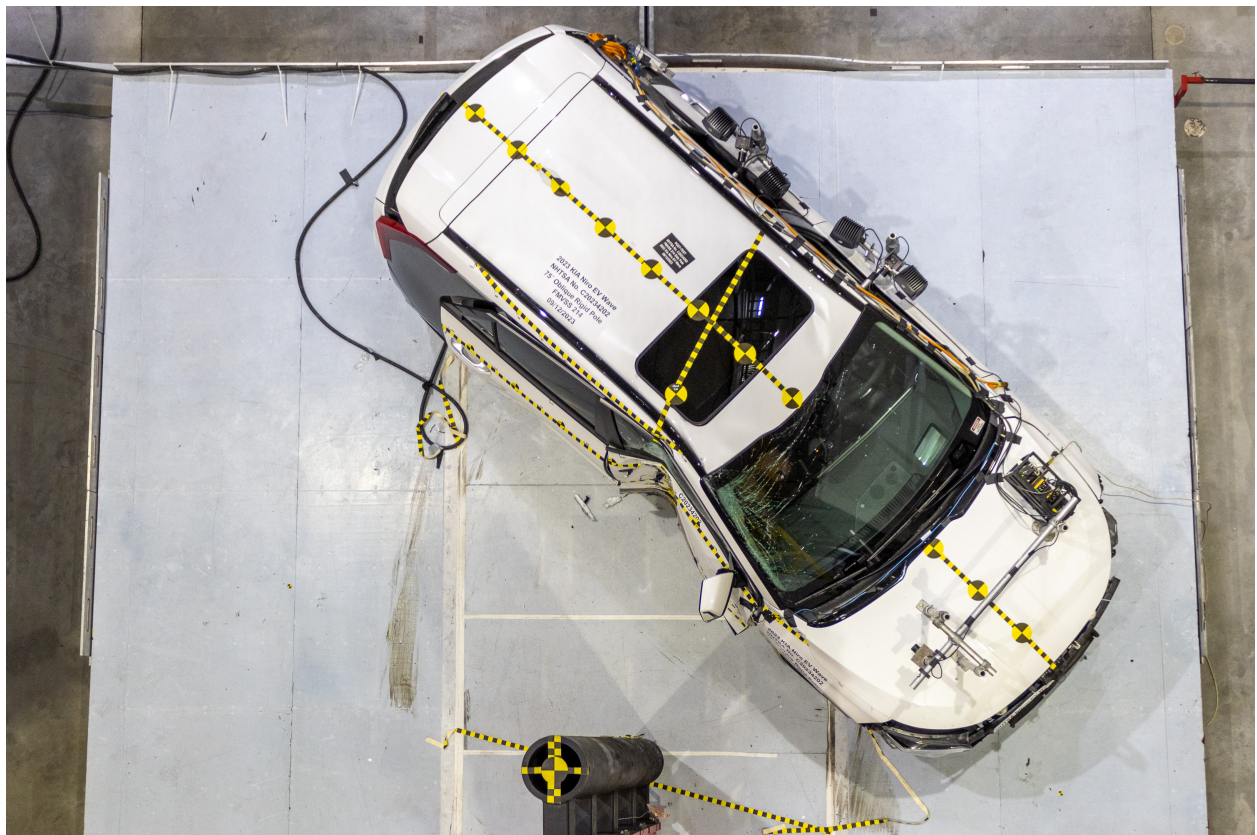


Figure A-10: Post-Test Overhead View of Test Vehicle



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-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

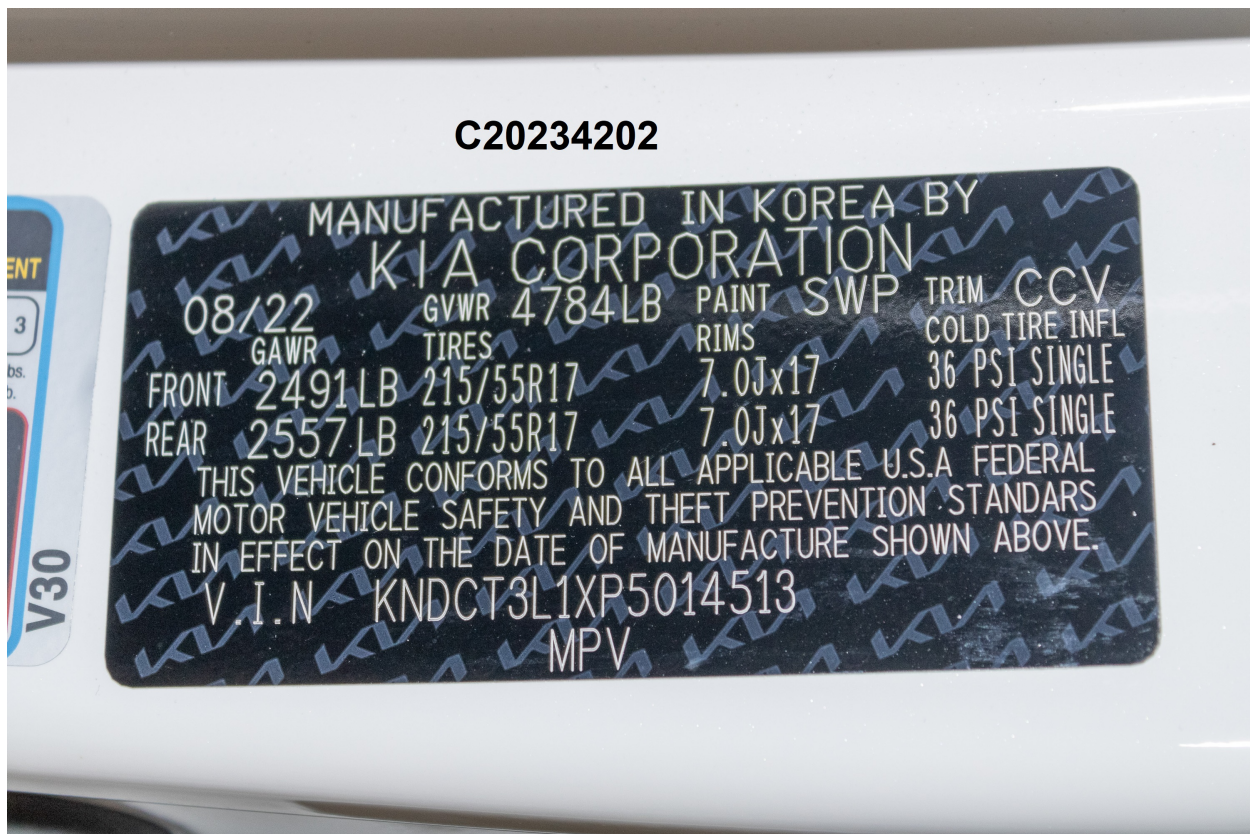


Figure A-25: Close-Up View of Vehicle's Certification Label



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

APPENDIX II

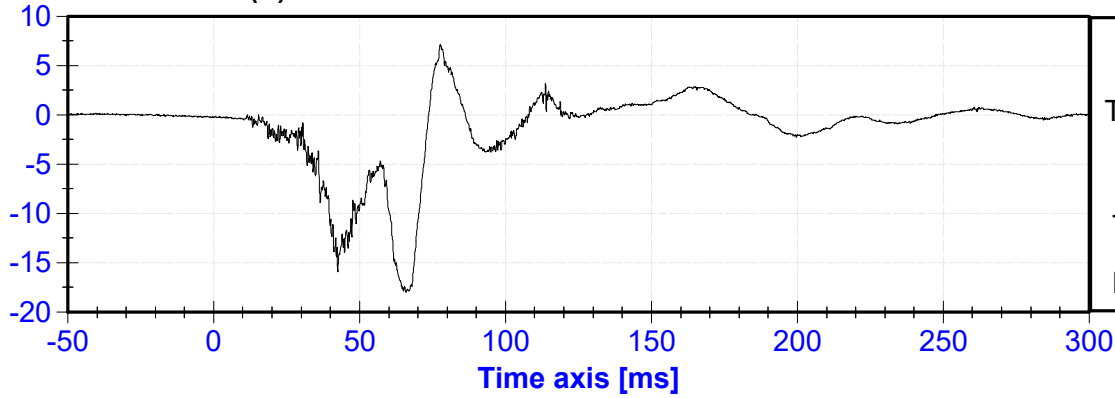
ES-2re DUMMY RESPONSE DATA TRACES

Table of Data Plots

No.	Description	Page
1	ES-2re Head (X) Acceleration vs. Time	II-3
2	ES-2re Head (Y) Acceleration vs. Time	II-3
3	ES-2re Head (Z) Acceleration vs. Time	II-3
4	ES-2re Head Resultant Acceleration vs. Time	II-3
5	ES-2re Head (X) Velocity vs. Time	II-4
6	ES-2re Head (Y) Velocity vs. Time	II-4
7	ES-2re Head (Z) Velocity vs. Time	II-4
8	ES-2re Upper Thorax Rib Deflection Rate vs. Time	II-4
9	ES-2re Upper Thorax Rib Deflection (Y) vs. Time	II-5
10	ES-2re Middle Thorax Rib Deflection Rate vs. Time	II-5
11	ES-2re Lower Thorax Rib Deflection Rate vs. Time	II-5
12	ES-2re Middle Thorax Rib Deflection (Y) vs. Time	II-5
13	ES-2re Lower Thorax Rib Deflection (Y) vs. Time	II-6
14	ES-2re Front Abdomen Force (Y) vs. Time	II-6
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

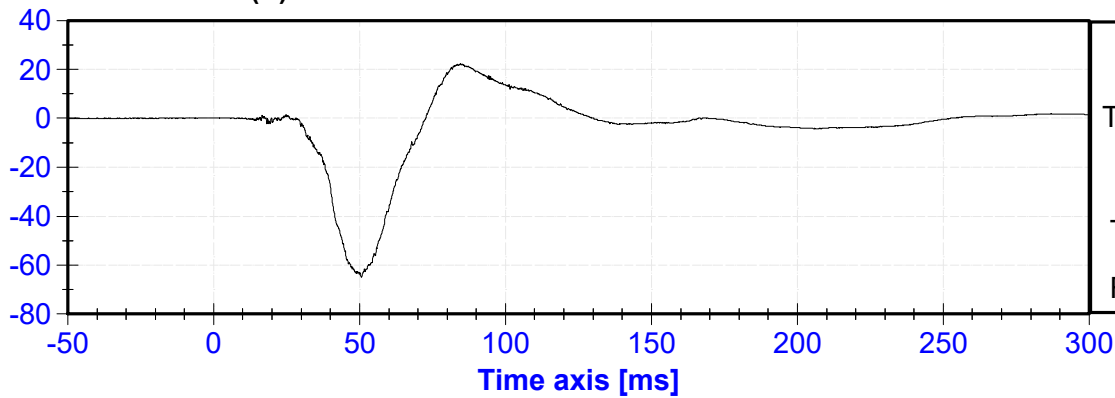
ACCELERATION [g's]

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



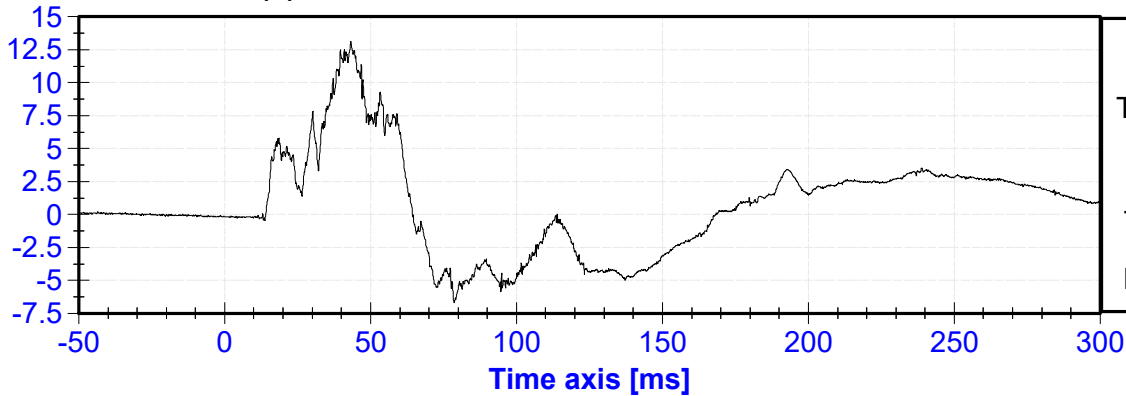
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ES-2re Head (Y) Acceleration vs. Time



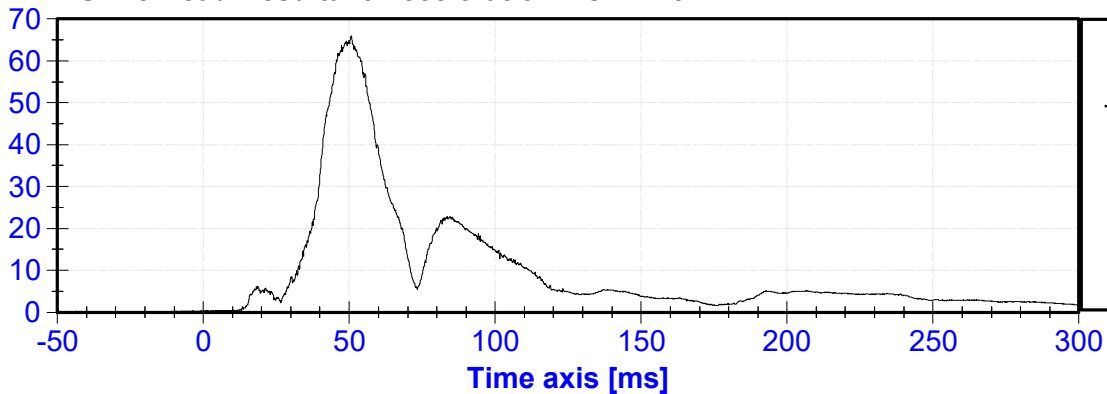
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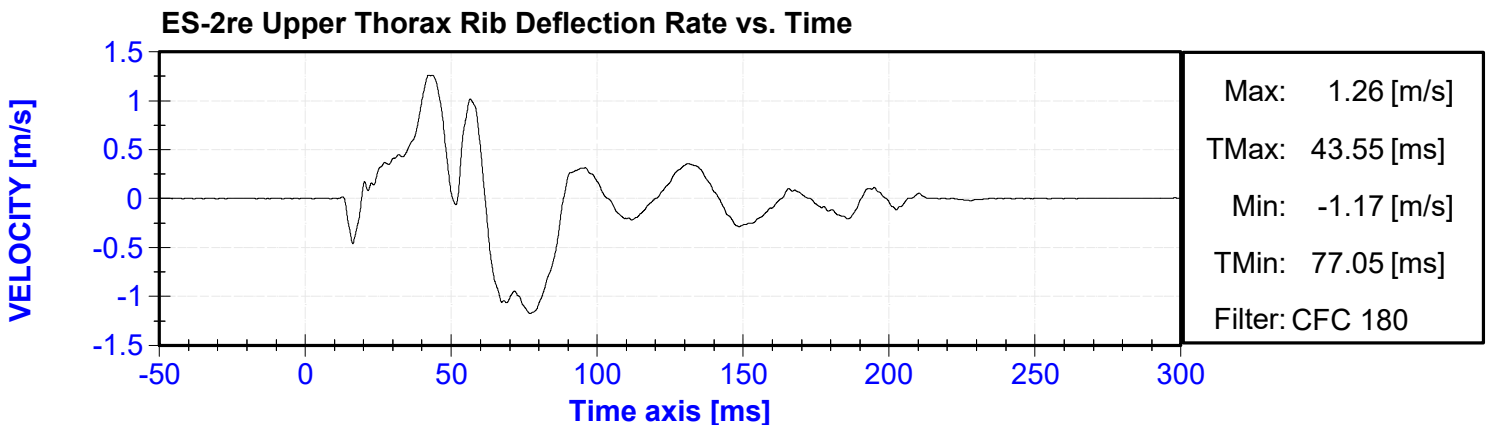
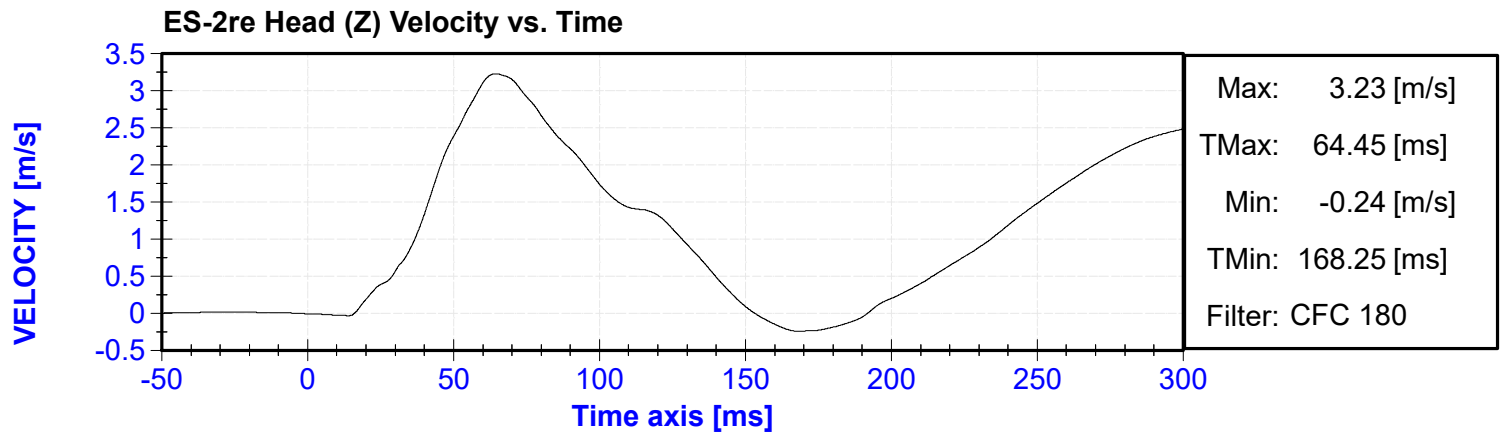
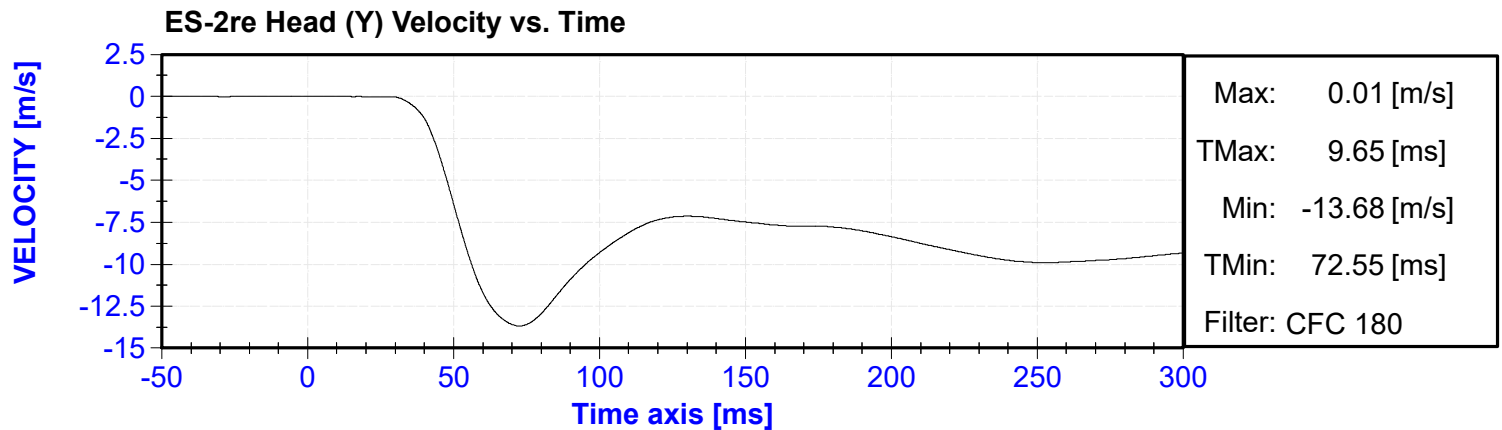
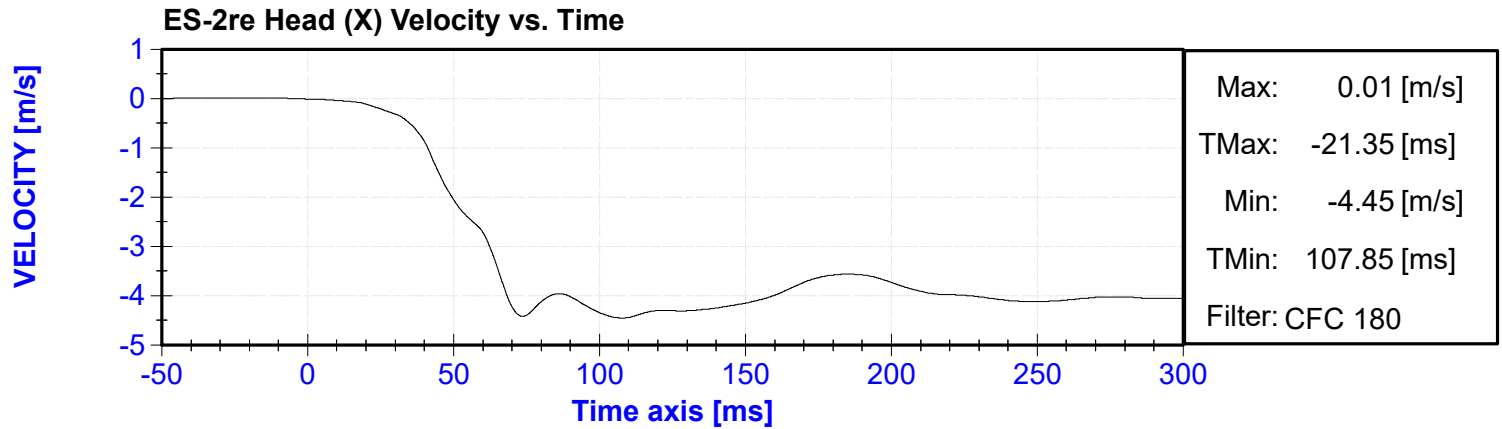
ES-2re Head (Z) Acceleration vs. Time

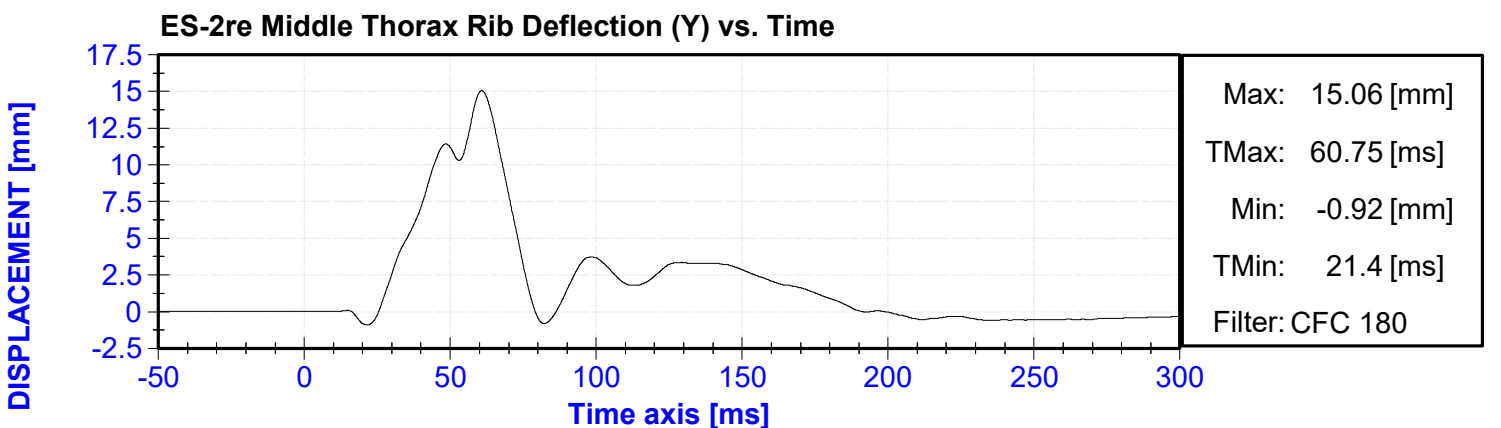
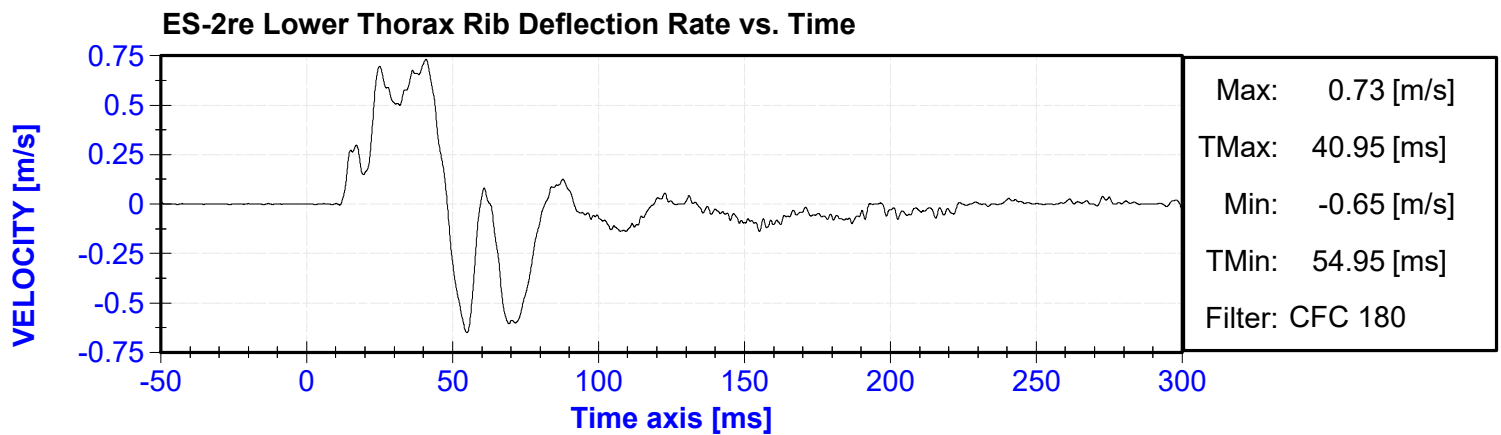
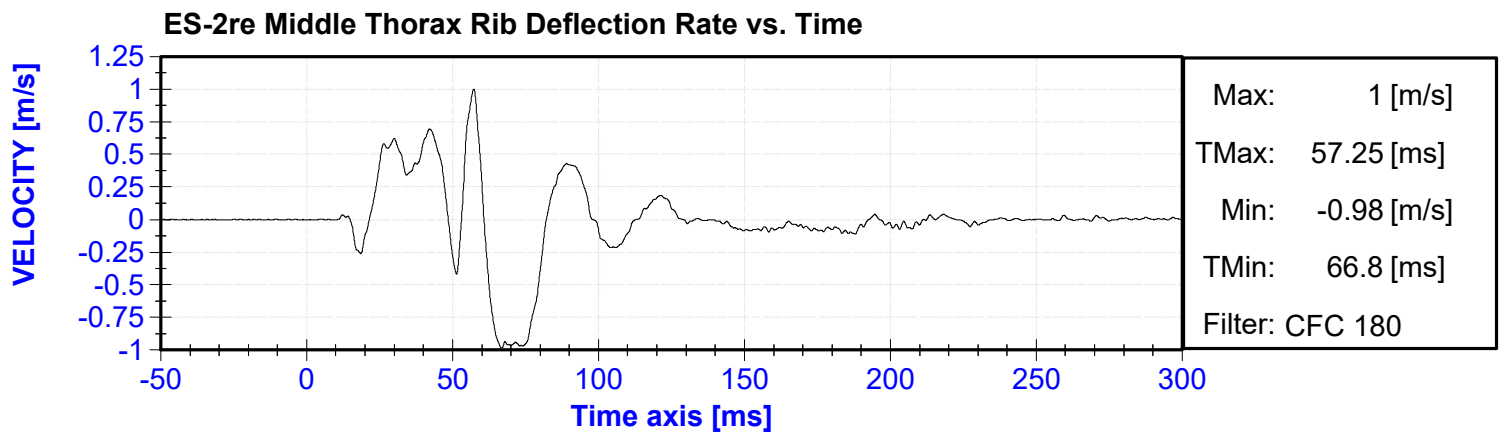
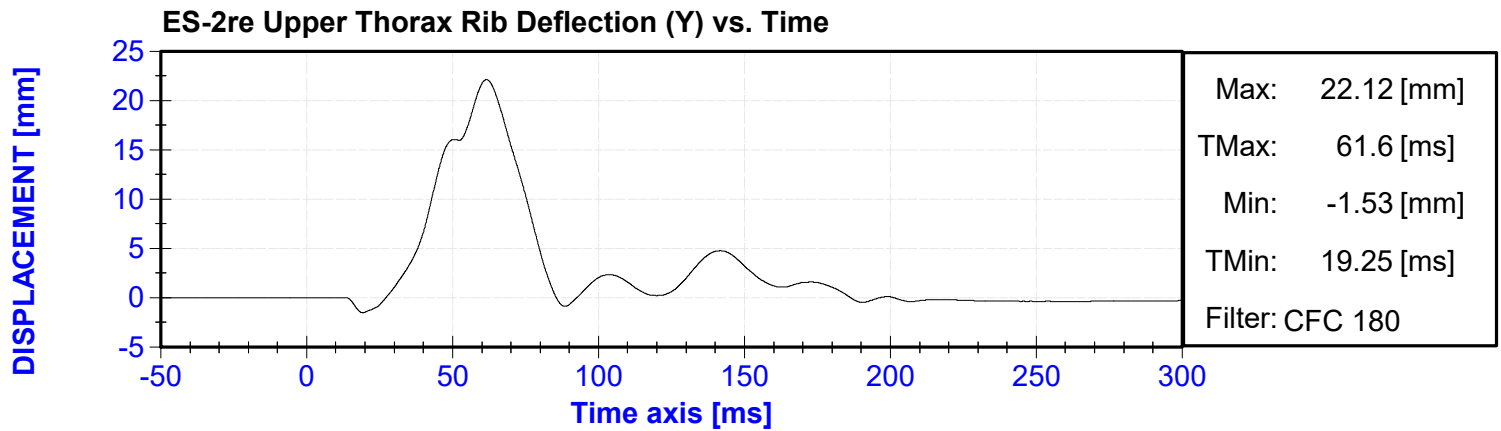


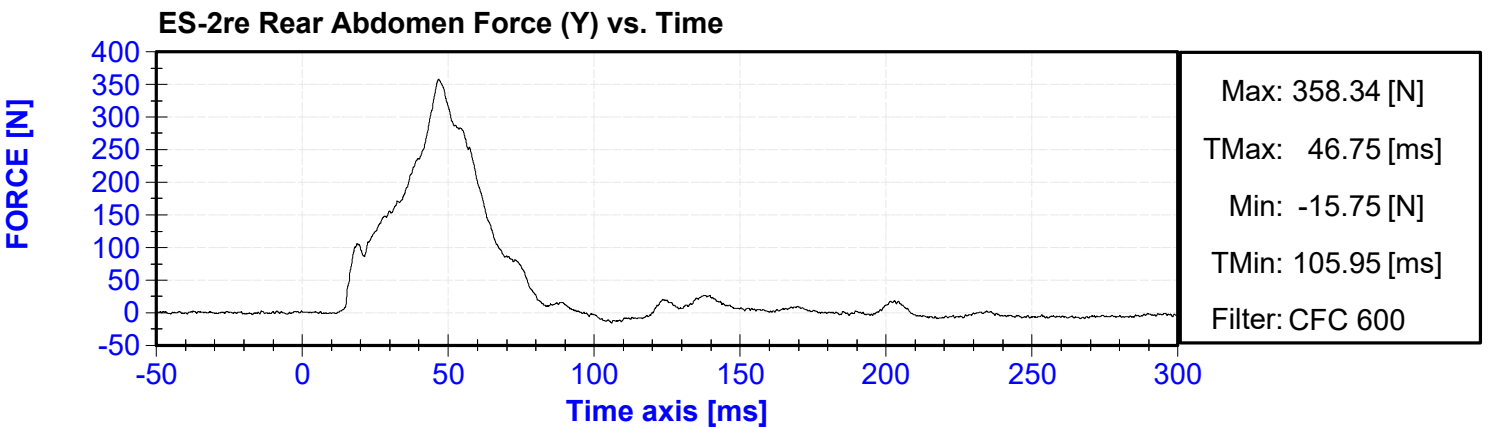
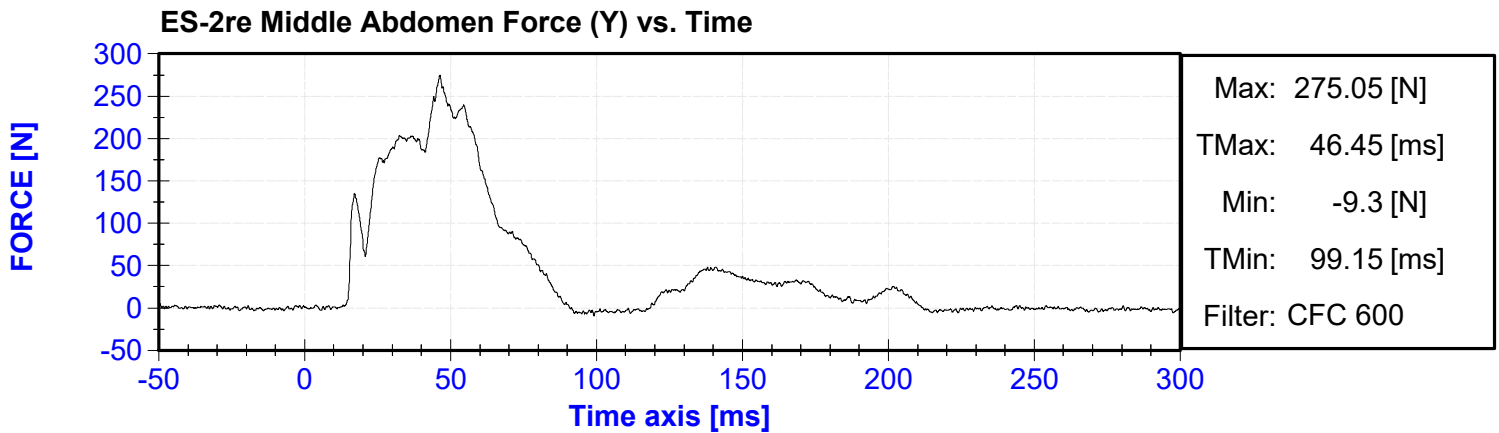
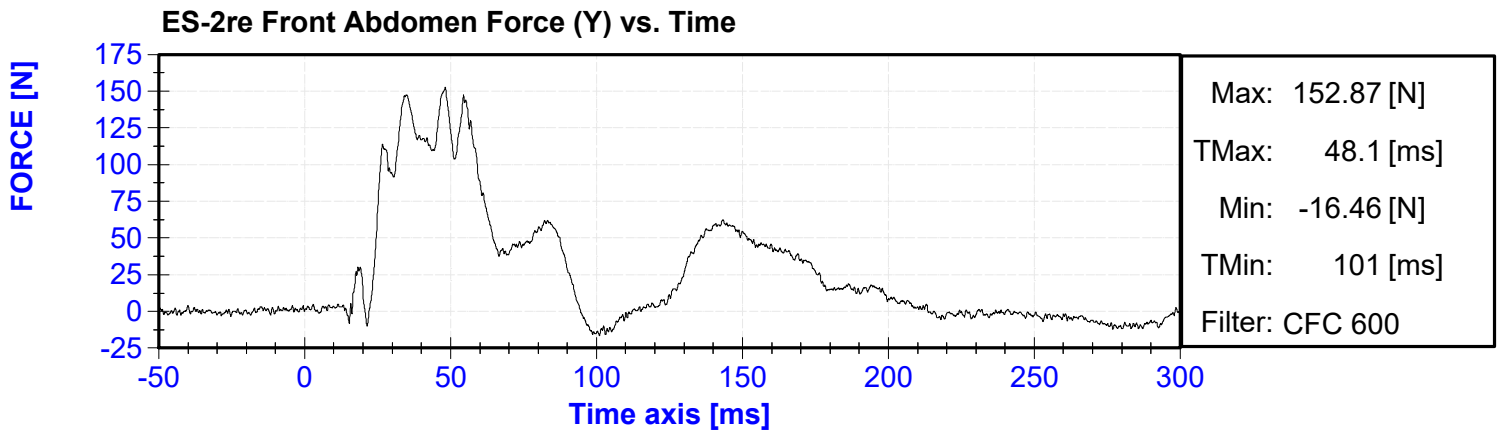
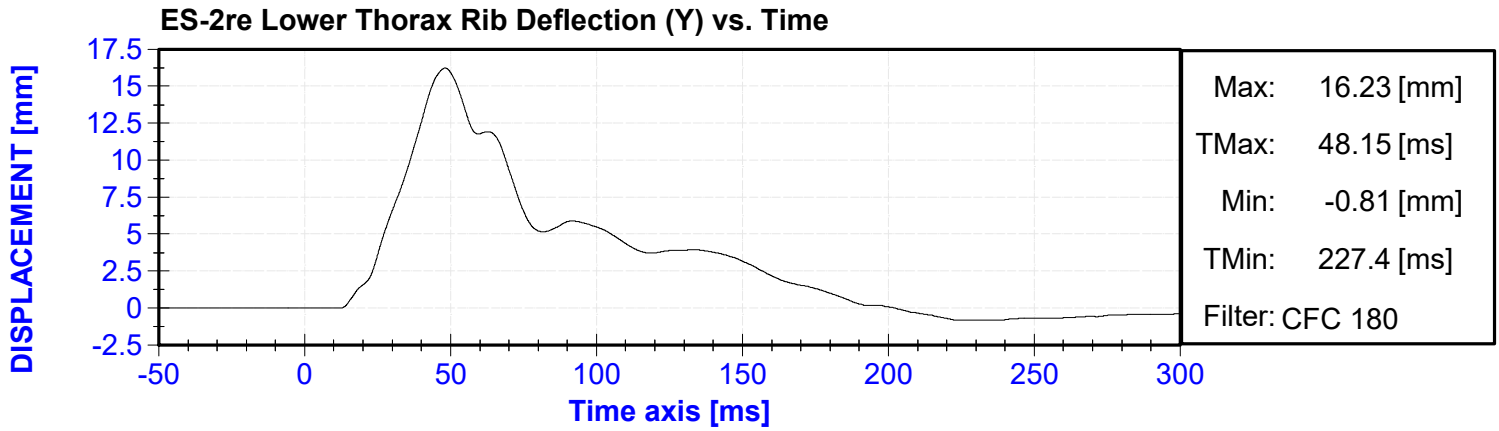
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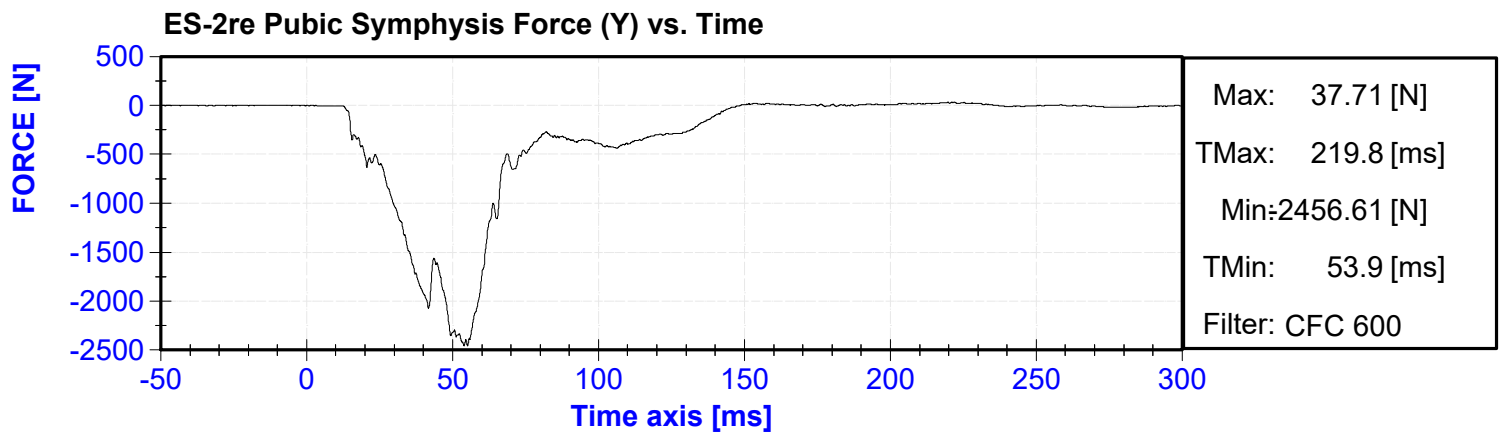
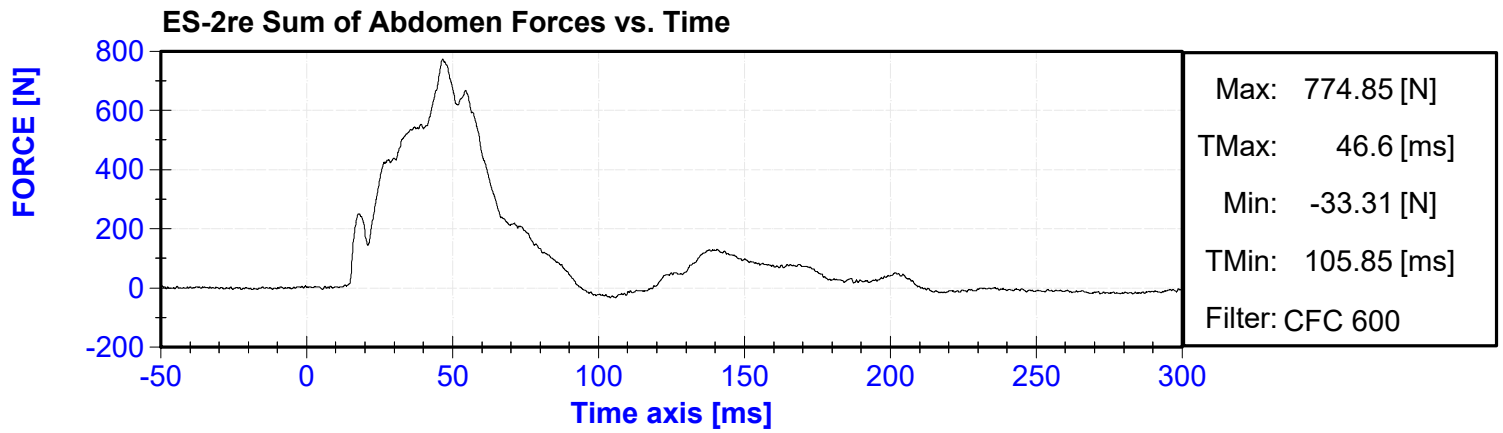
ES-2re Head Resultant Acceleration vs. Time









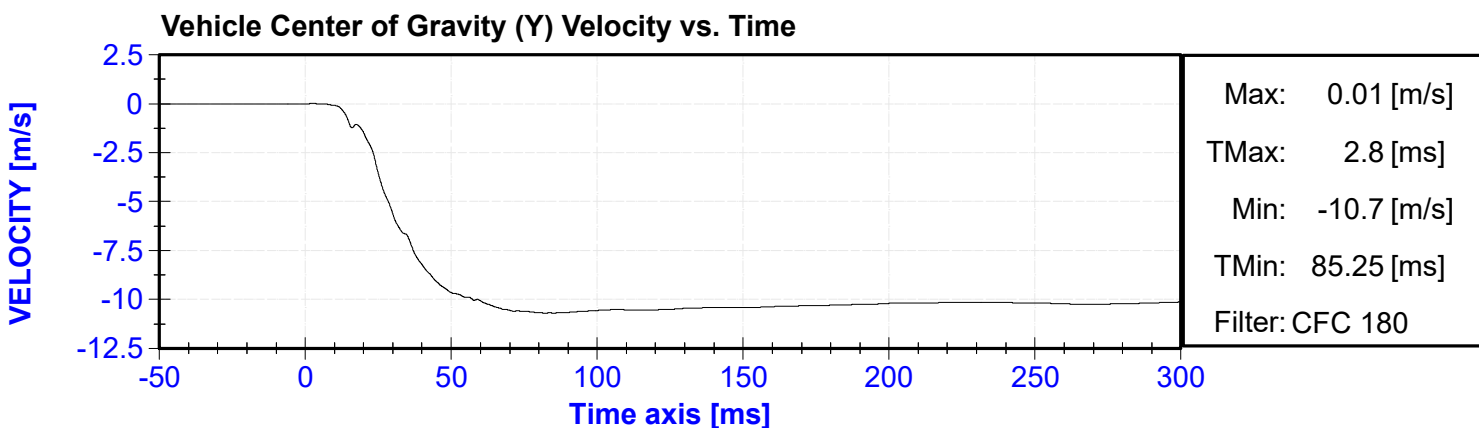
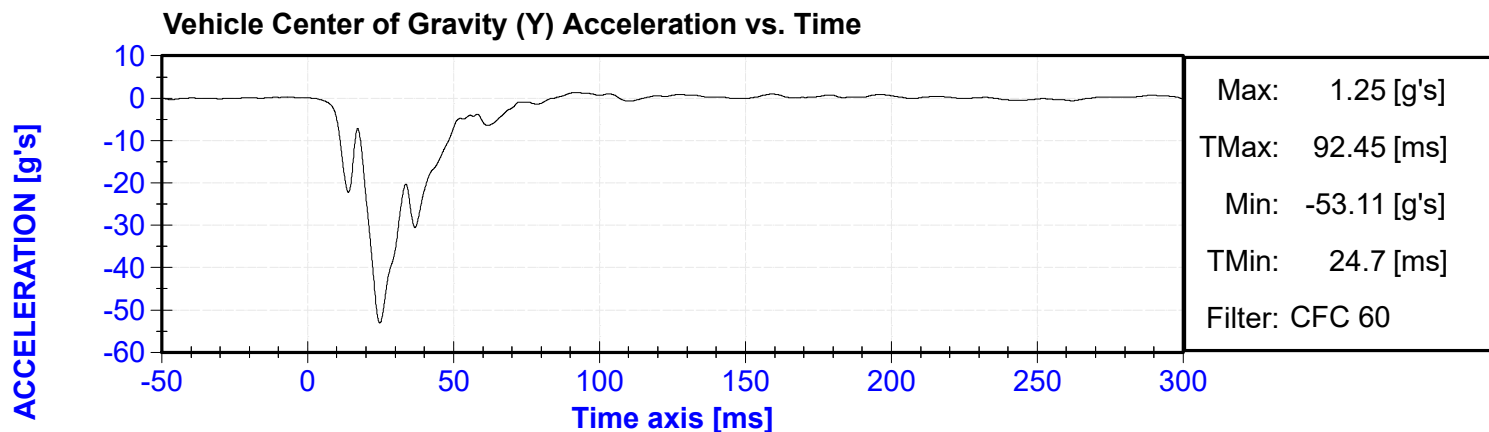
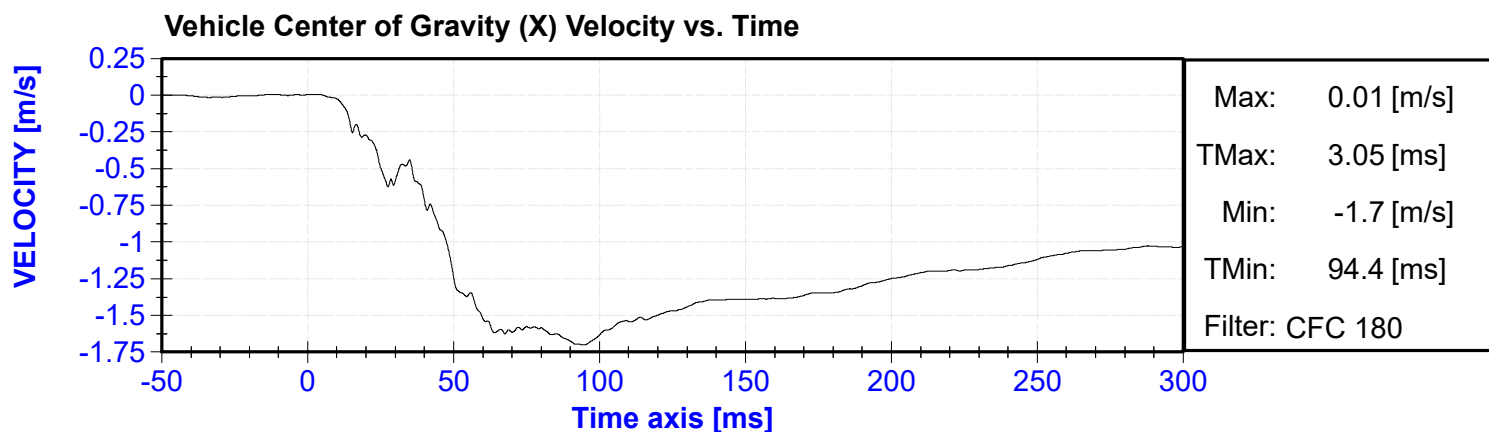
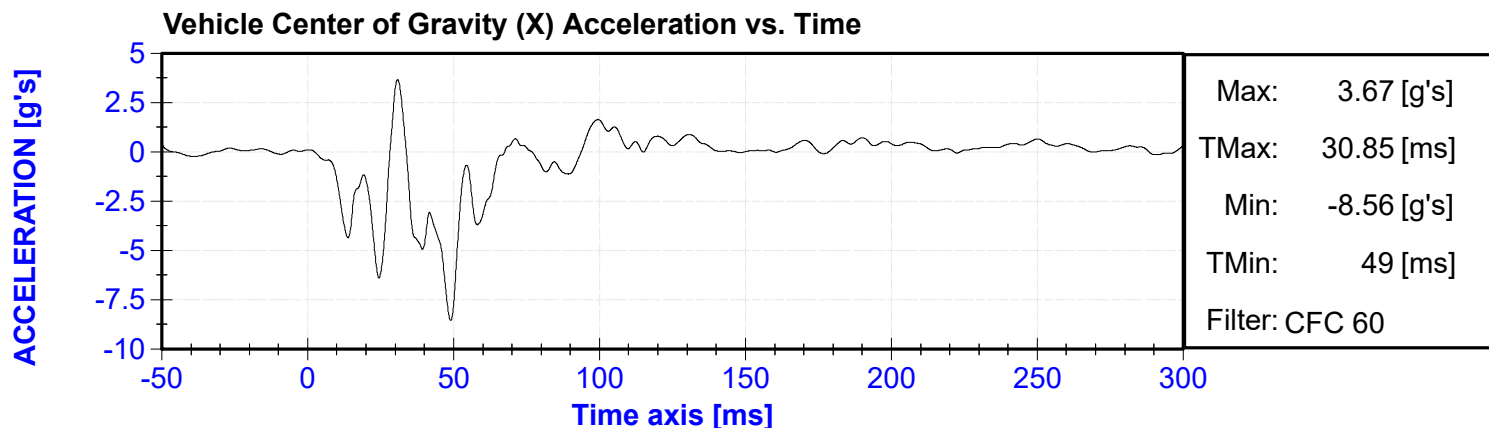


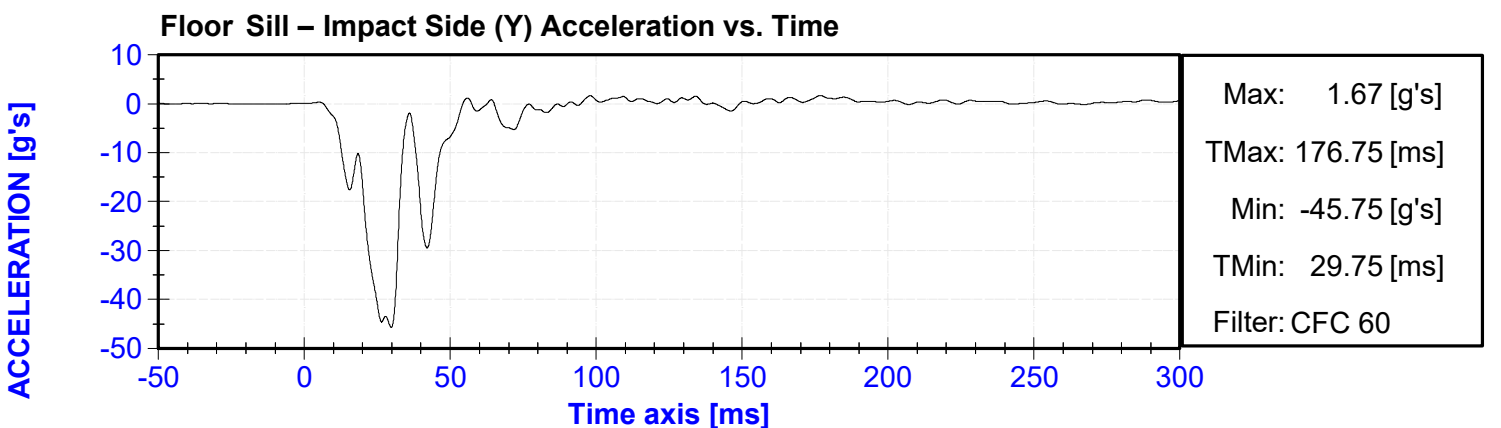
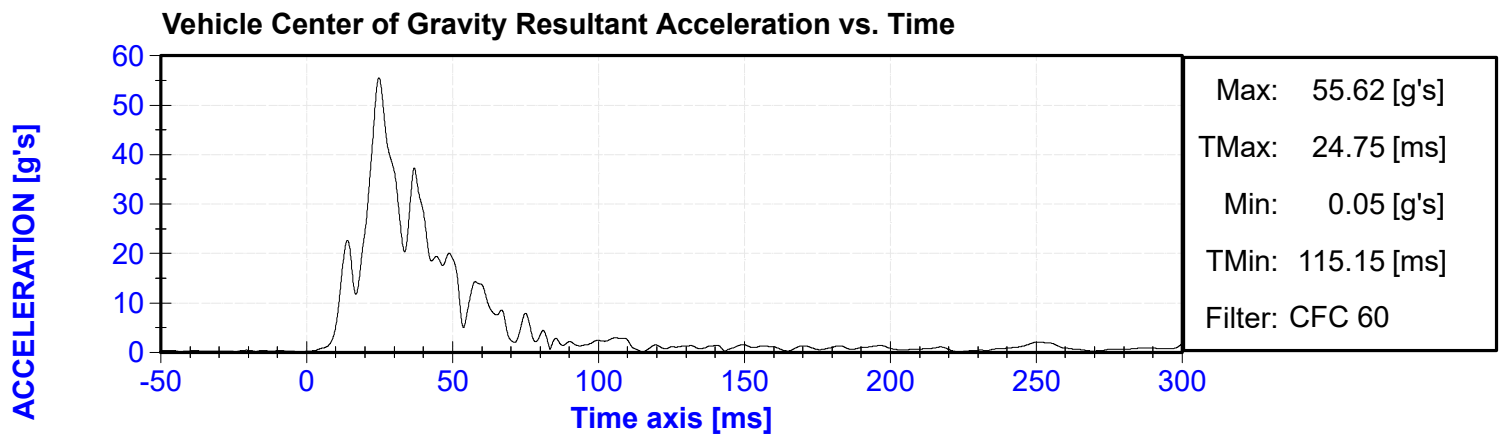
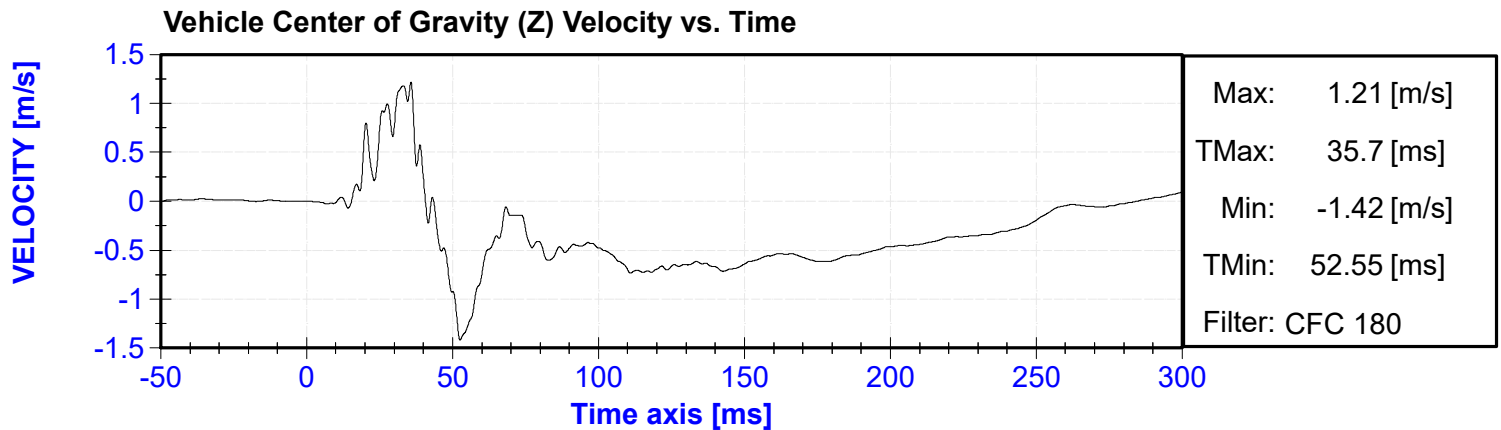
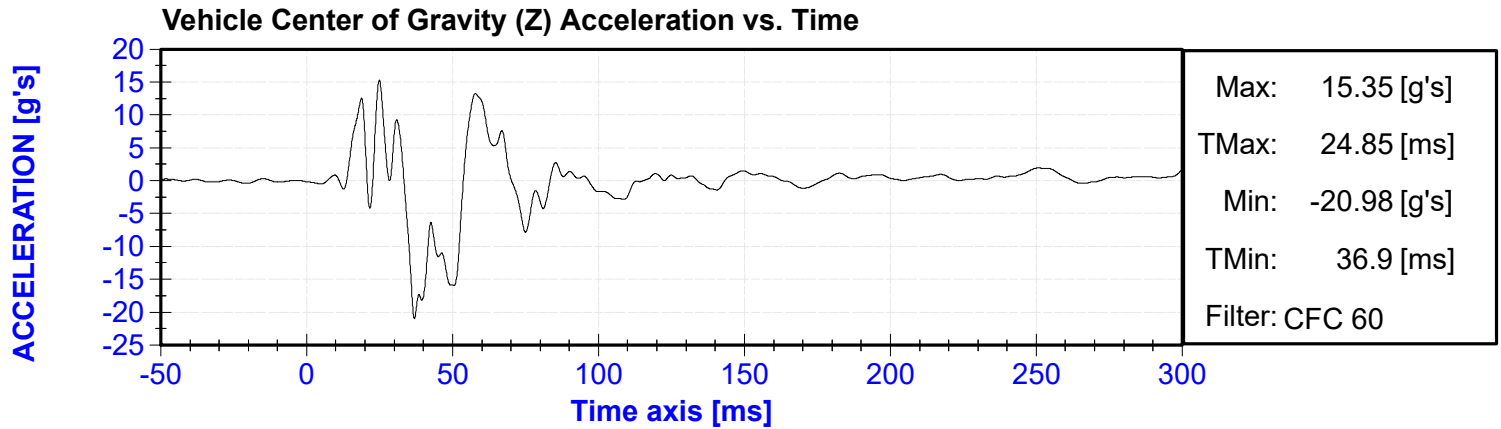
APPENDIX III

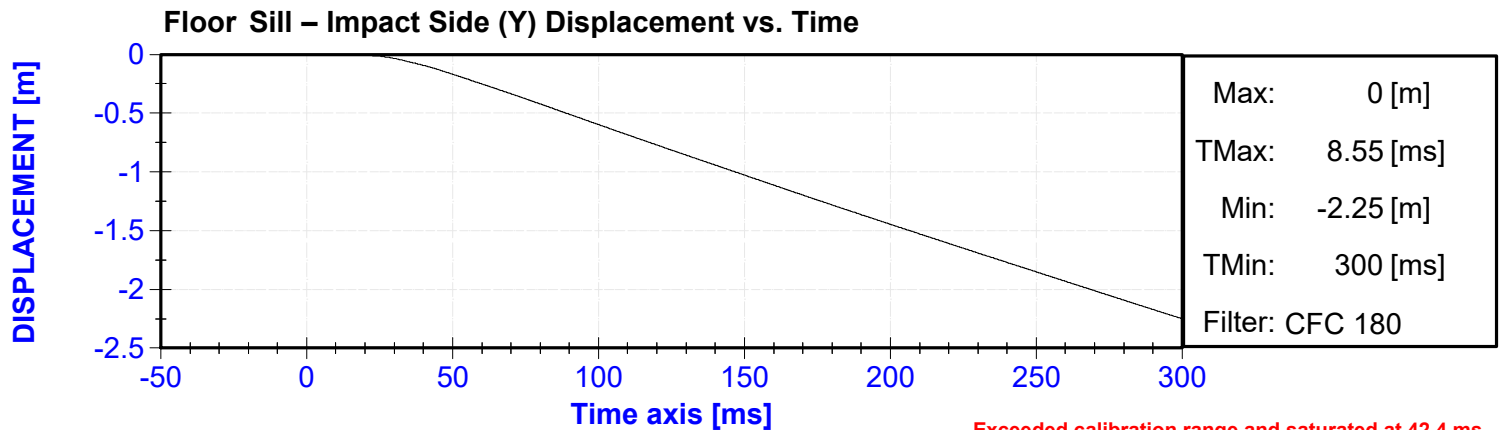
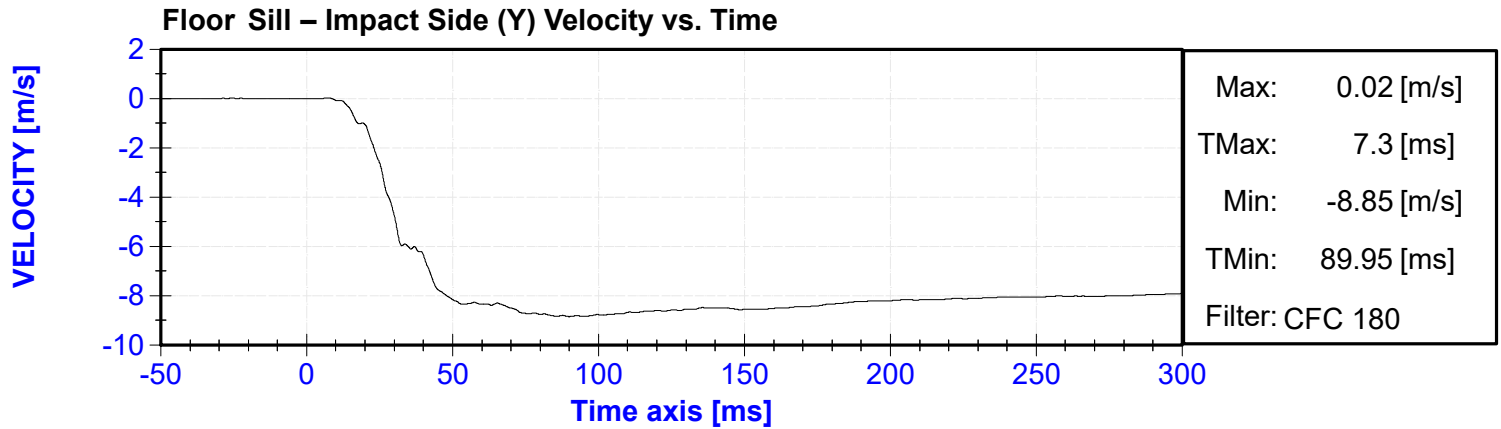
VEHICLE ACCELEROMETER RESPONSE DATA

Table of Data Plots

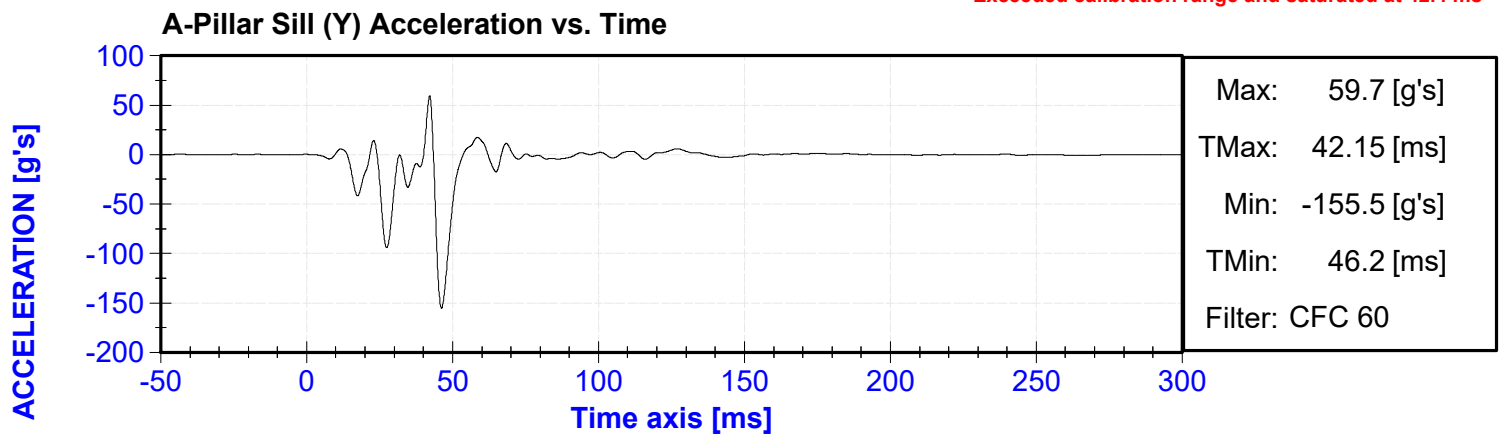
No.	Description	Page
1	Vehicle Center of Gravity (X) Acceleration vs. Time	III-3
2	Vehicle Center of Gravity (X) Velocity vs. Time	III-3
3	Vehicle Center of Gravity (Y) Acceleration vs. Time	III-3
4	Vehicle Center of Gravity (Y) Velocity vs. Time	III-3
5	Vehicle Center of Gravity (Z) Acceleration vs. Time	III-4
6	Vehicle Center of Gravity (Z) Velocity vs. Time	III-4
7	Vehicle Center of Gravity Resultant Acceleration vs. Time	III-4
8	Floor Sill – Impact Side (Y) Acceleration vs. Time	III-4
9	Floor Sill – Impact Side (Y) Velocity vs. Time	III-5
10	Floor Sill – Impact Side (Y) Displacement vs. Time	III-5
11	A-Pillar Sill (Y) Acceleration vs. Time	III-5
12	A-Pillar Sill (Y) Velocity vs. Time	III-5
13	A-Pillar Sill (Y) Displacement vs. Time	III-6
14	A-Pillar Low (Y) Acceleration vs. Time	III-6
15	A-Pillar Low (Y) Velocity vs. Time	III-6
16	A-Pillar Low (Y) Displacement vs. Time	III-6
17	A-Pillar Mid (Y) Acceleration vs. Time	III-7
18	A-Pillar Mid (Y) Velocity vs. Time	III-7
19	A-Pillar Mid (Y) Displacement vs. Time	III-7
20	B-Pillar Sill (Y) Acceleration vs. Time	III-7
21	B-Pillar Sill (Y) Velocity vs. Time	III-8
22	B-Pillar Sill (Y) Displacement vs. Time	III-8
23	B-Pillar Low (Y) Acceleration vs. Time	III-8
24	B-Pillar Low (Y) Velocity vs. Time	III-8
25	B-Pillar Low (Y) Displacement vs. Time	III-9
26	B-Pillar Mid (Y) Acceleration vs. Time	III-9
27	B-Pillar Mid (Y) Velocity vs. Time	III-9
28	B-Pillar Mid (Y) Displacement vs. Time	III-9
29	Seat (Y) Acceleration vs. Time	III-10
30	Seat (Y) Velocity vs. Time	III-10
31	Seat (Y) Displacement vs. Time	III-10
32	Engine (X) Acceleration vs. Time	III-10
33	Engine (X) Velocity vs. Time	III-11
34	Engine (Y) Acceleration vs. Time	III-11
35	Engine (Y) Velocity vs. Time	III-11
36	Firewall (Y) Acceleration vs. Time	III-11
37	Firewall (Y) Velocity vs. Time	III-12
38	Roof (Y) Acceleration vs. Time	III-12
39	Roof (Y) Velocity vs. Time	III-12
40	Floor Sill – Non Impact Side (Y) Acceleration vs. Time	III-12
41	Floor Sill – Non Impact Side (Y) Velocity vs. Time	III-13
42	Rear Deck (X) Acceleration vs. Time	III-13
43	Rear Deck (X) Velocity vs. Time	III-13
44	Rear Deck (Y) Acceleration vs. Time	III-13
45	Rear Deck (Y) Velocity vs. Time	III-14



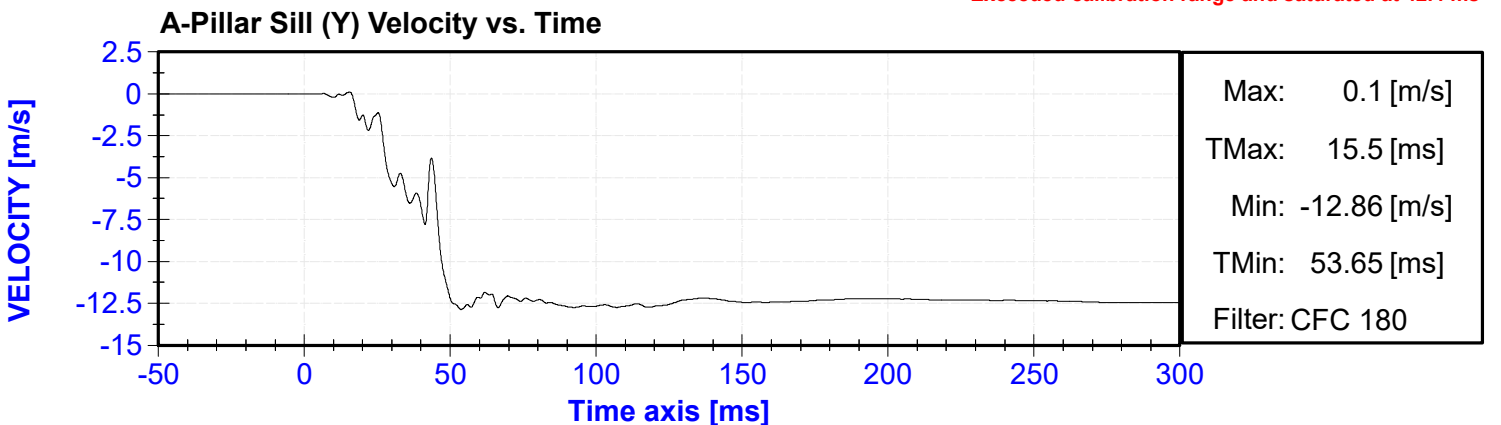




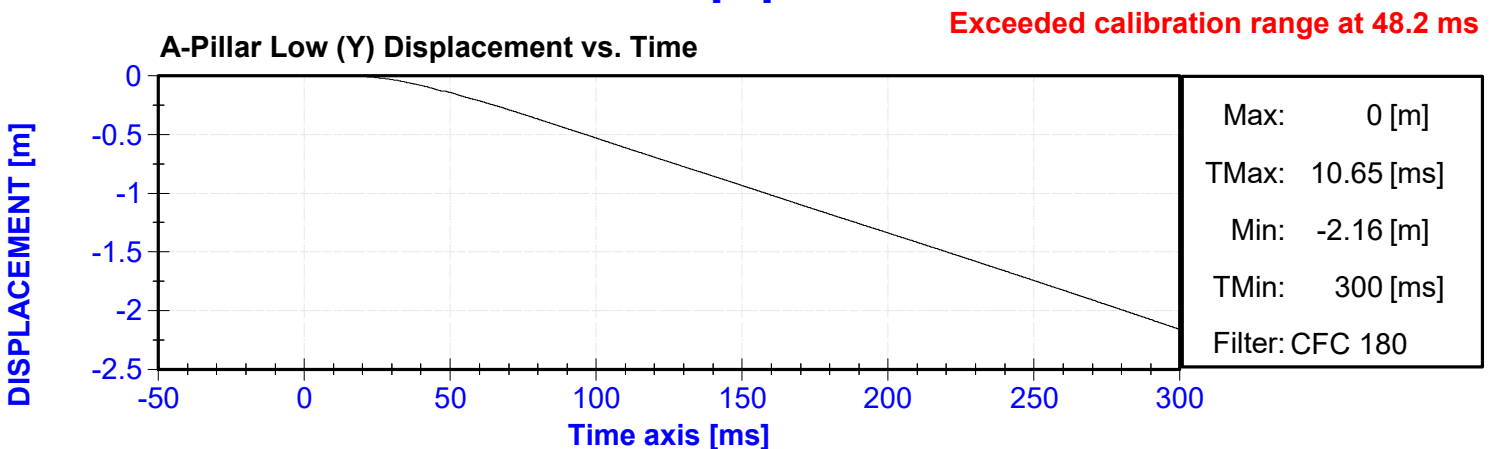
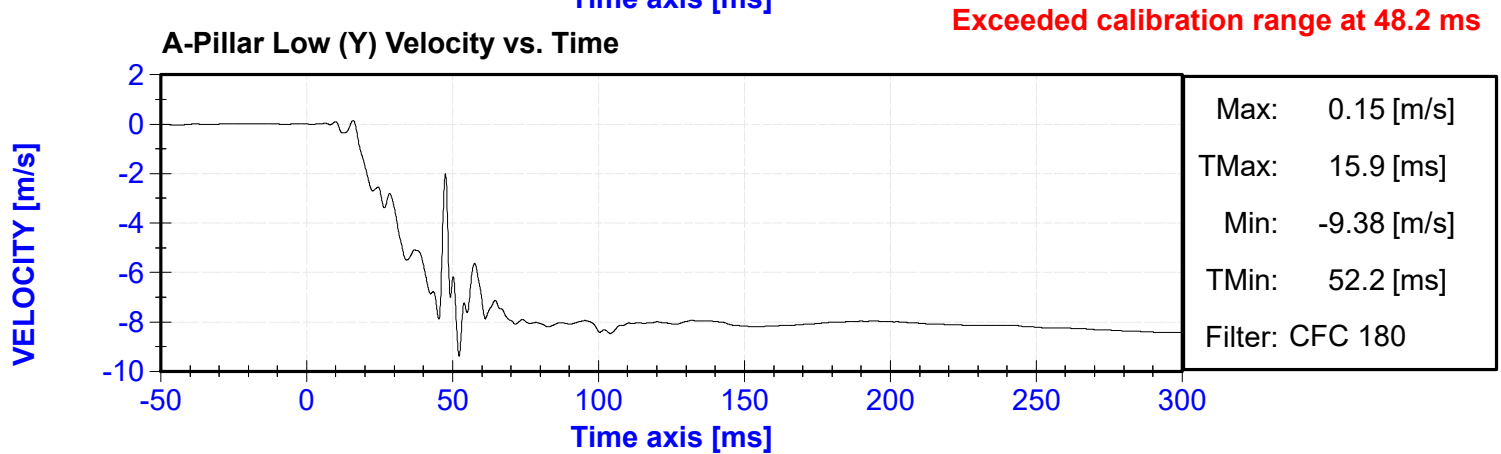
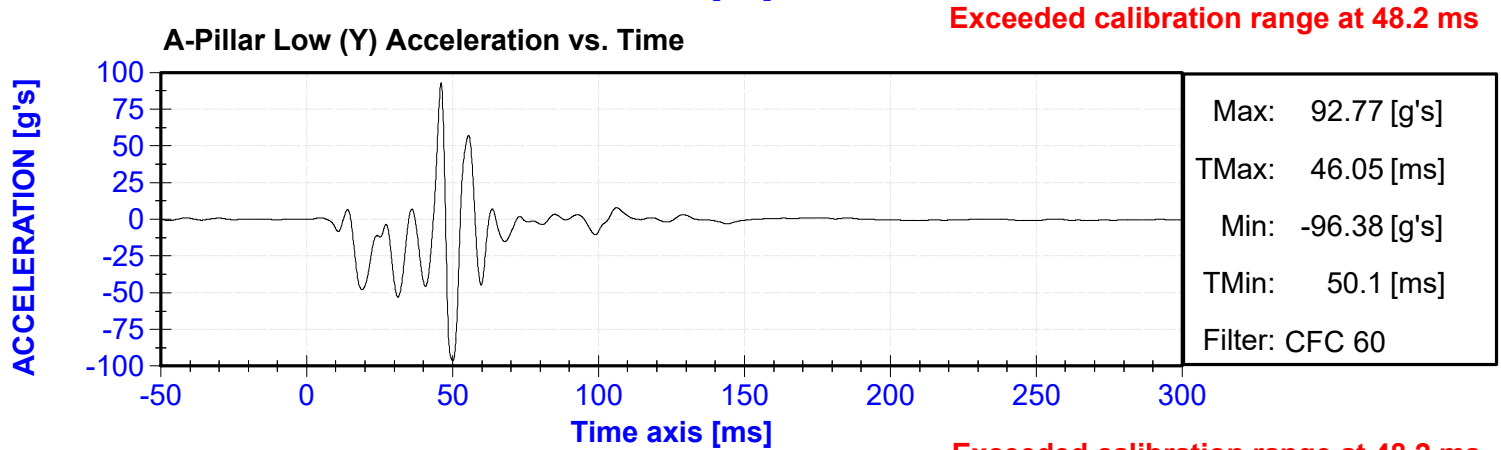
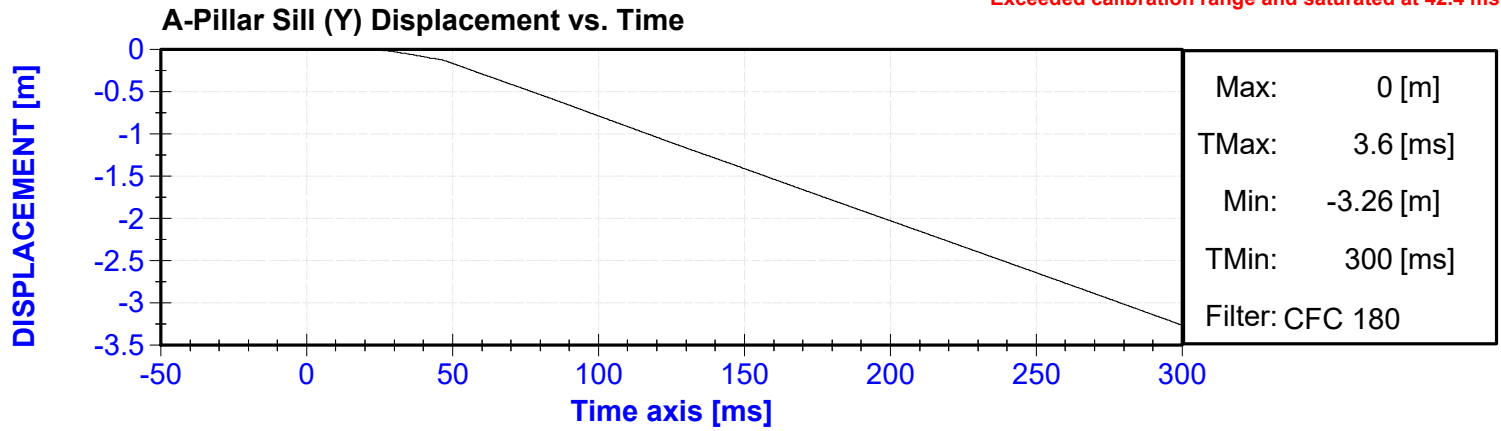
Exceeded calibration range and saturated at 42.4 ms

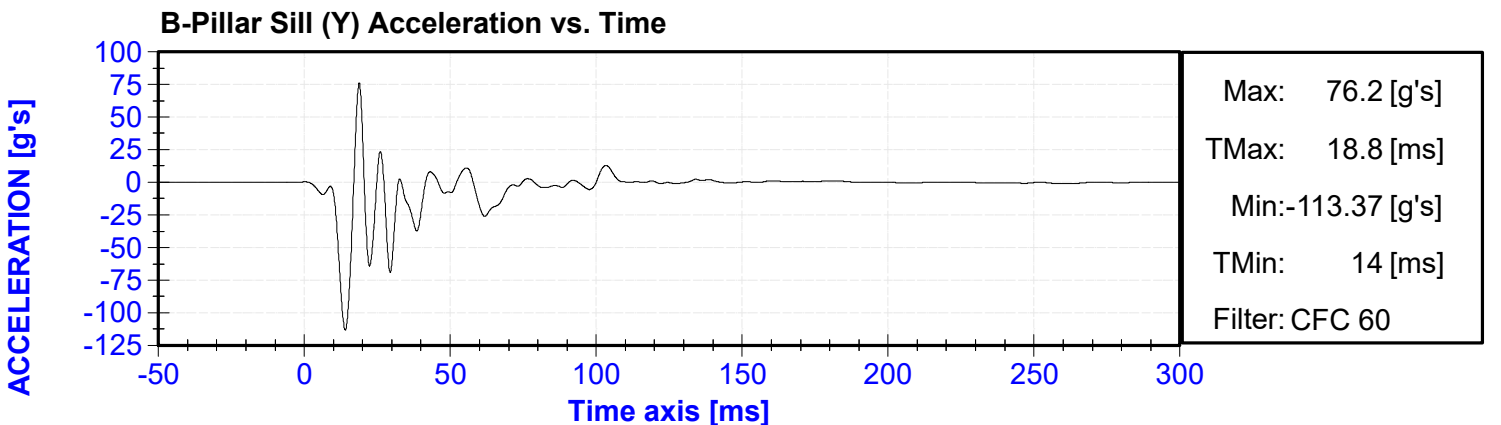
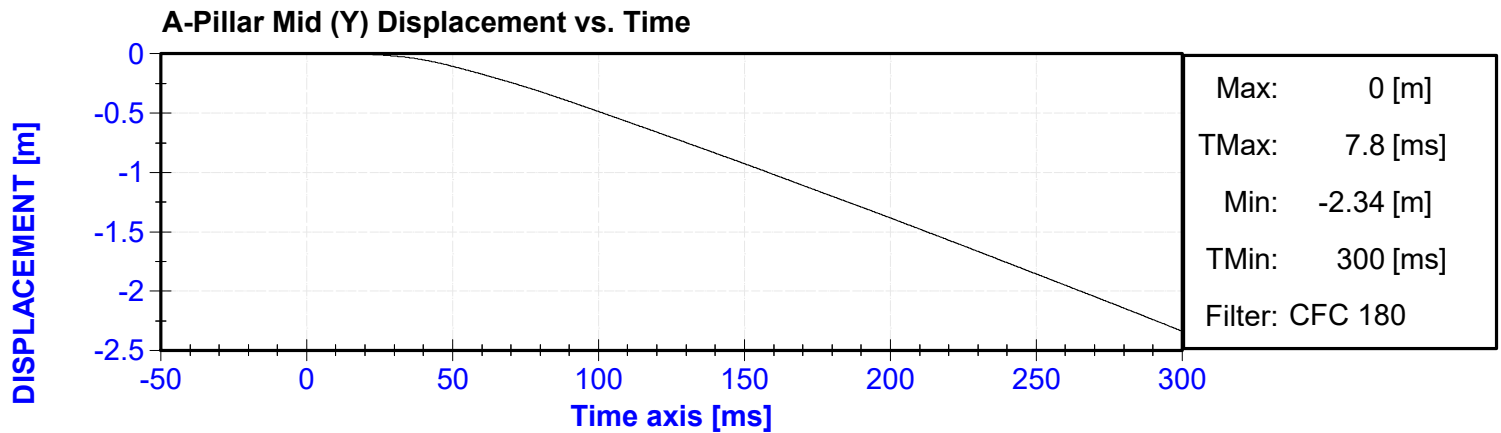
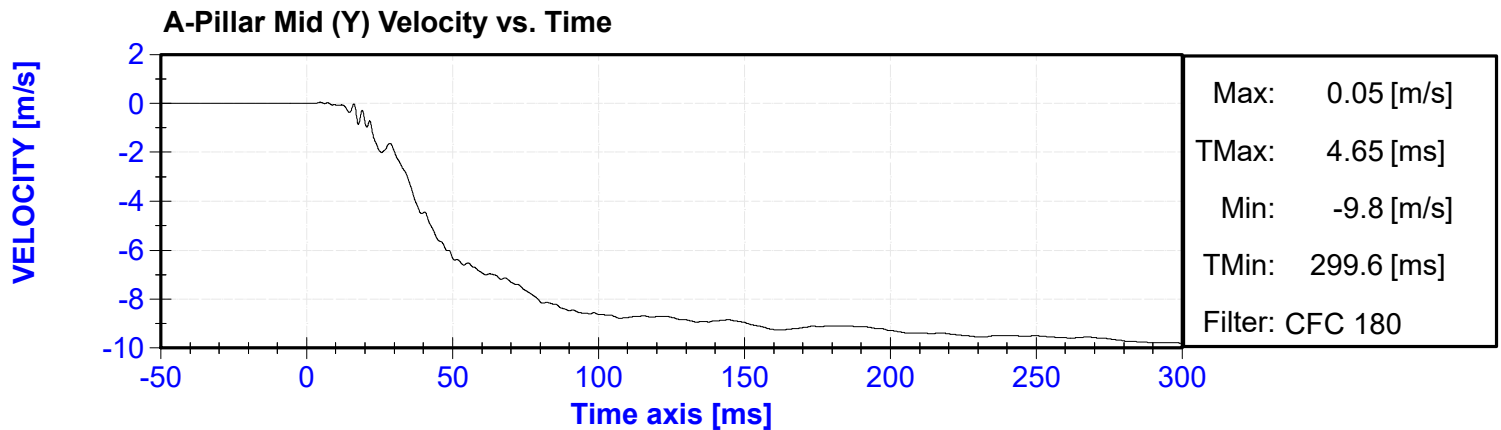
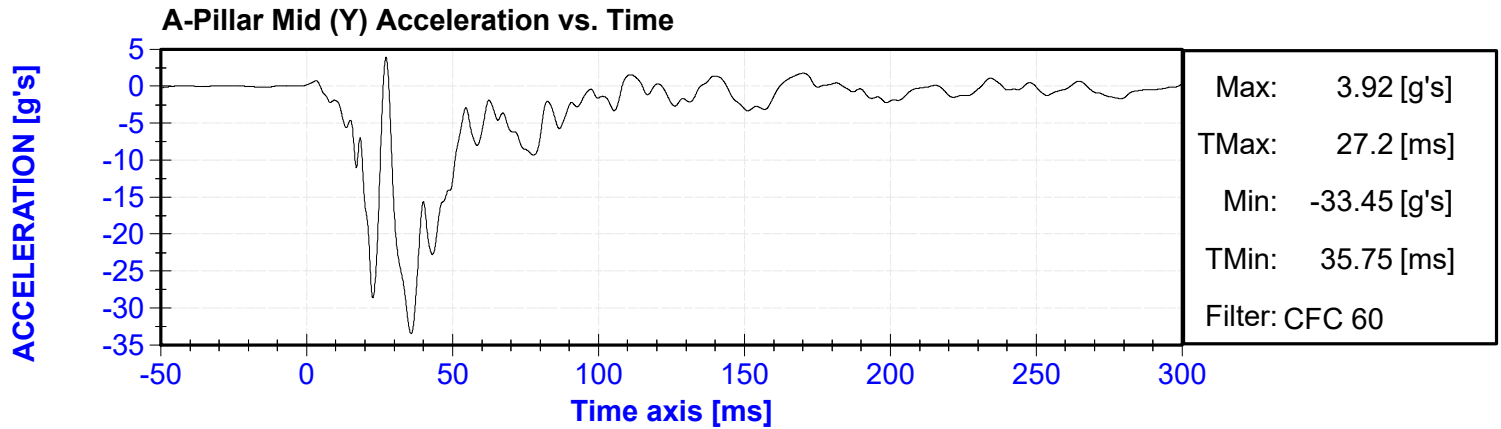


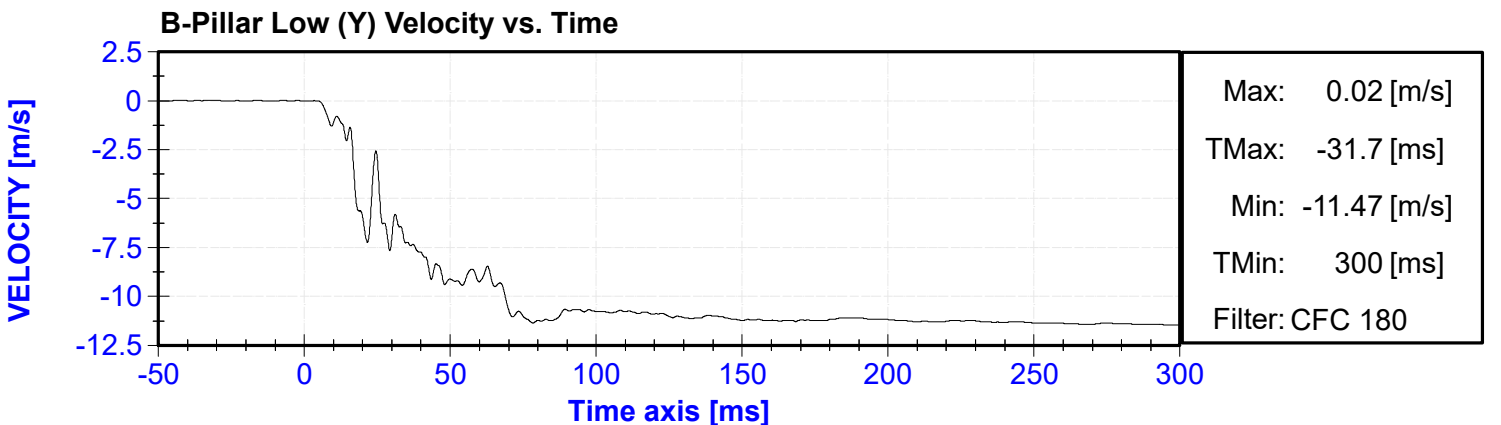
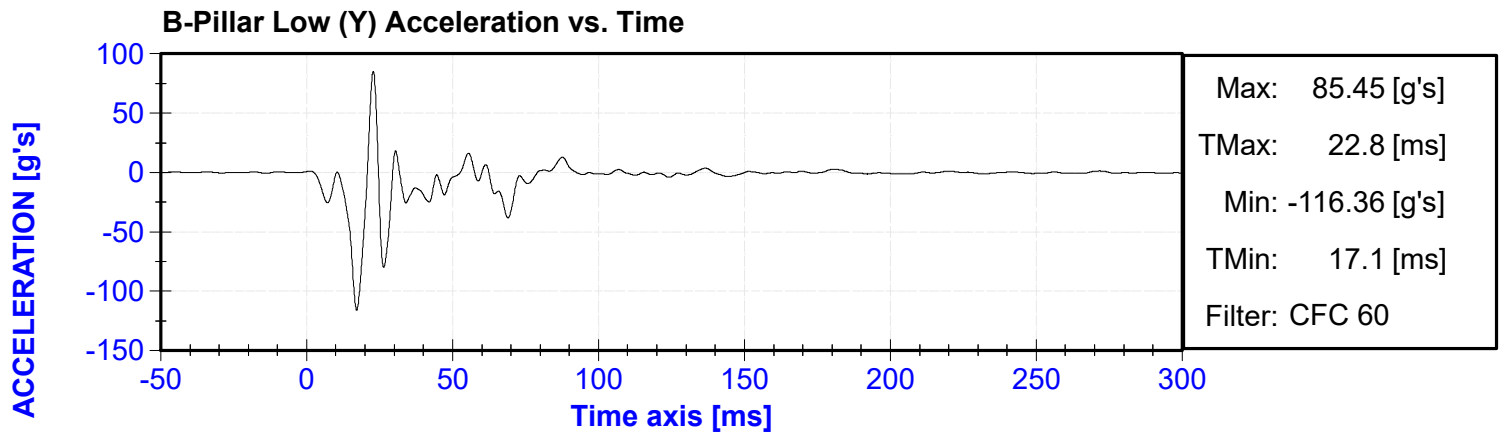
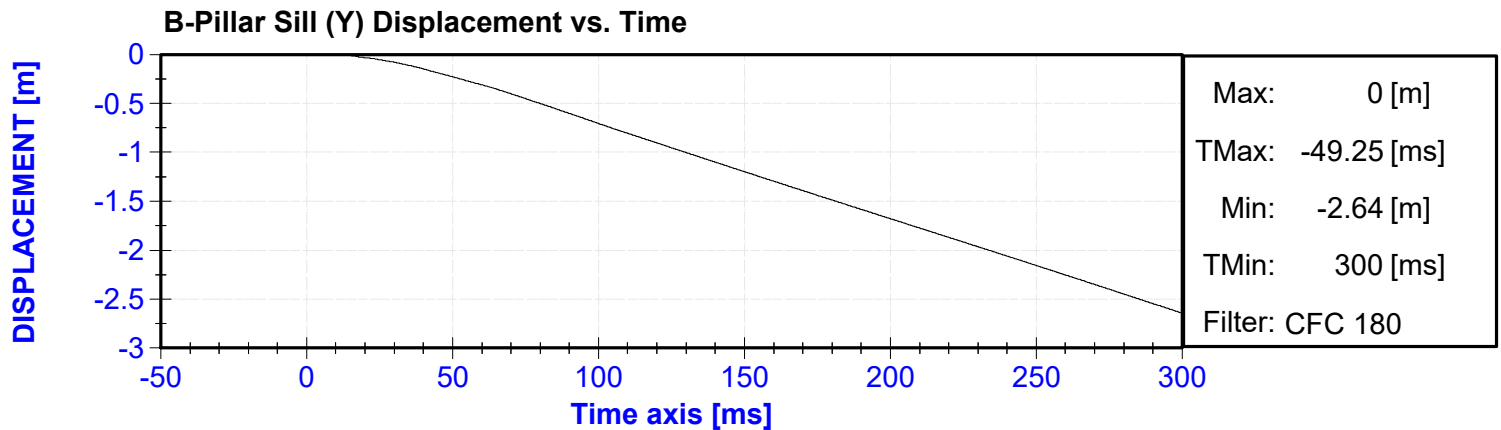
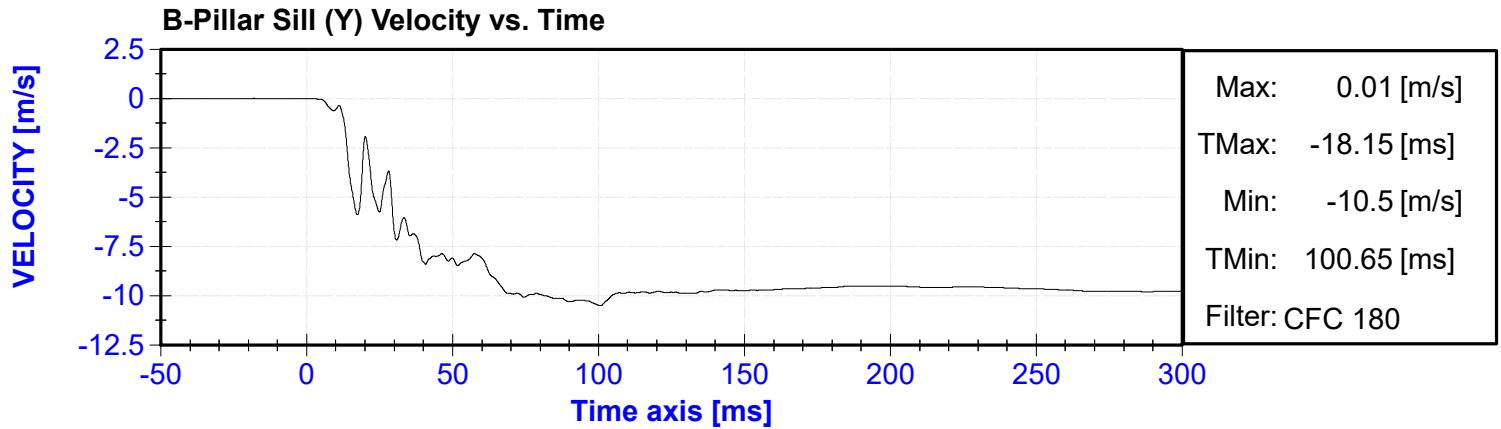
Exceeded calibration range and saturated at 42.4 ms



Exceeded calibration range and saturated at 42.4 ms

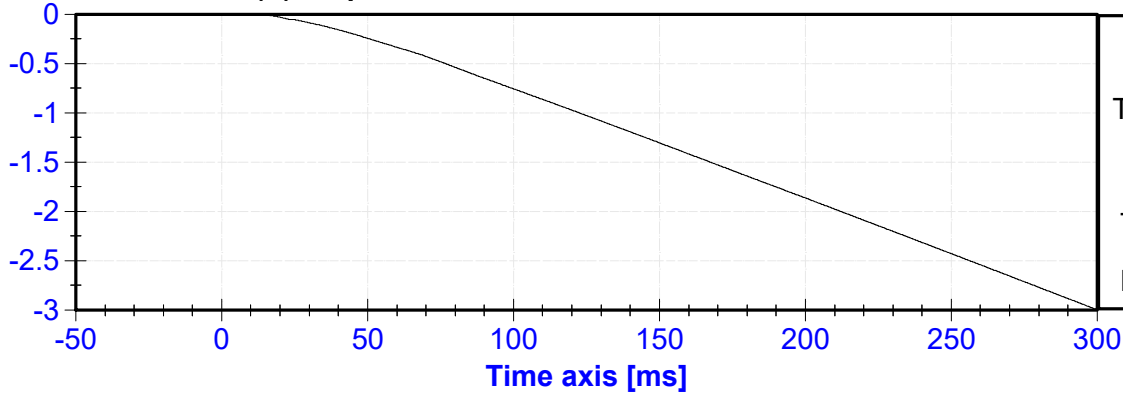






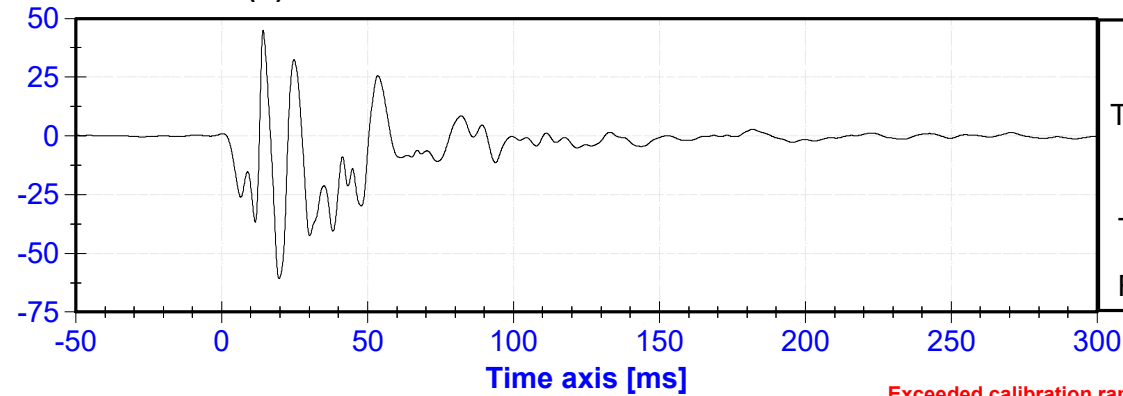
DISPLACEMENT [m]

B-Pillar Low (Y) Displacement vs. Time



ACCELERATION [g's]

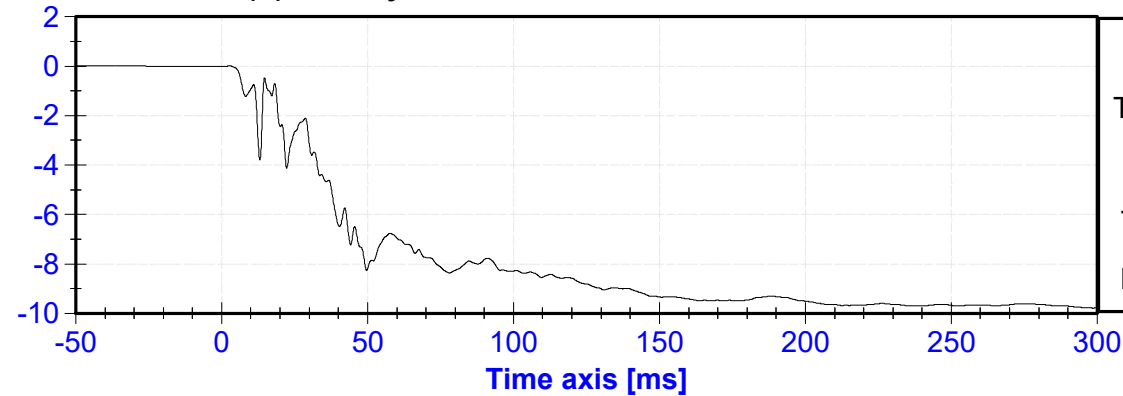
B-Pillar Mid (Y) Acceleration vs. Time



Exceeded calibration range and saturated at 13.3 ms

VELOCITY [m/s]

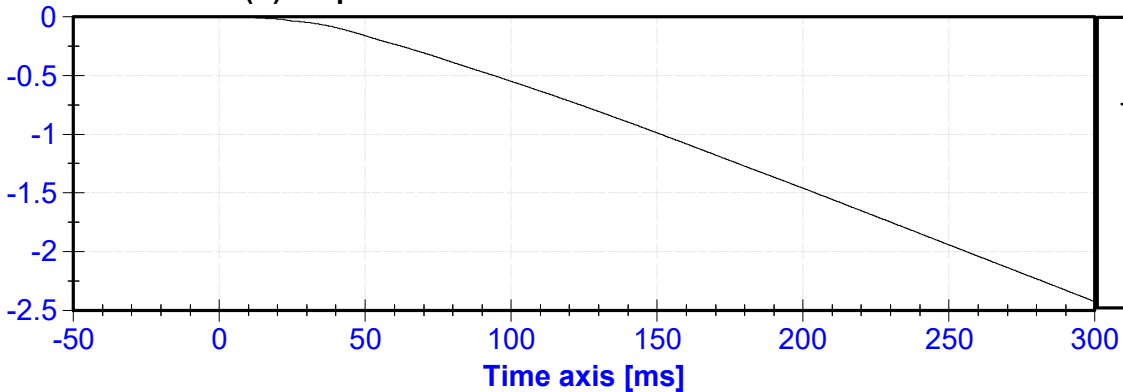
B-Pillar Mid (Y) Velocity vs. Time



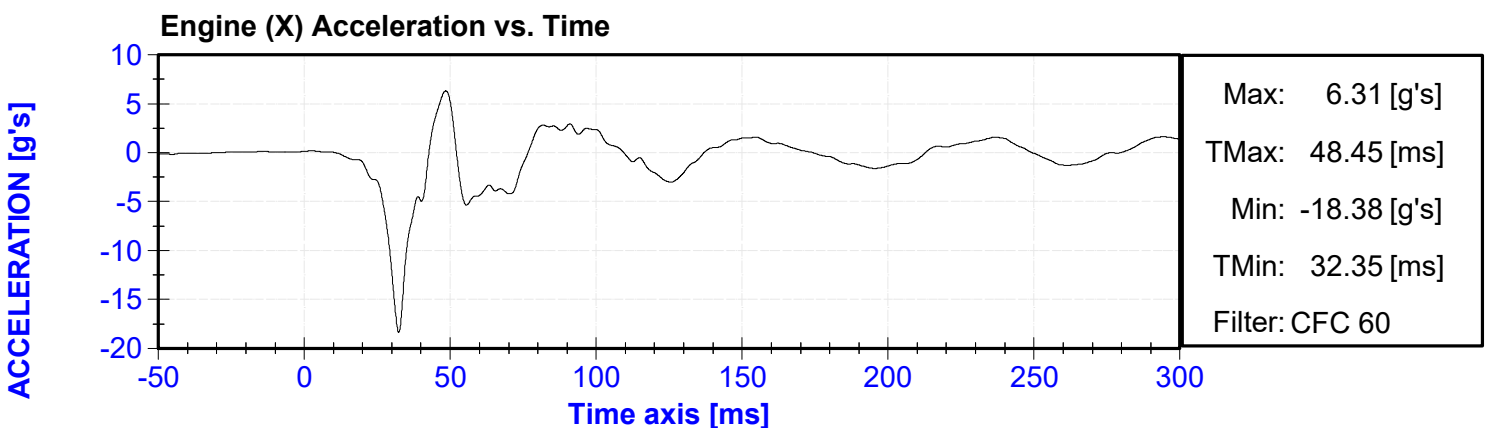
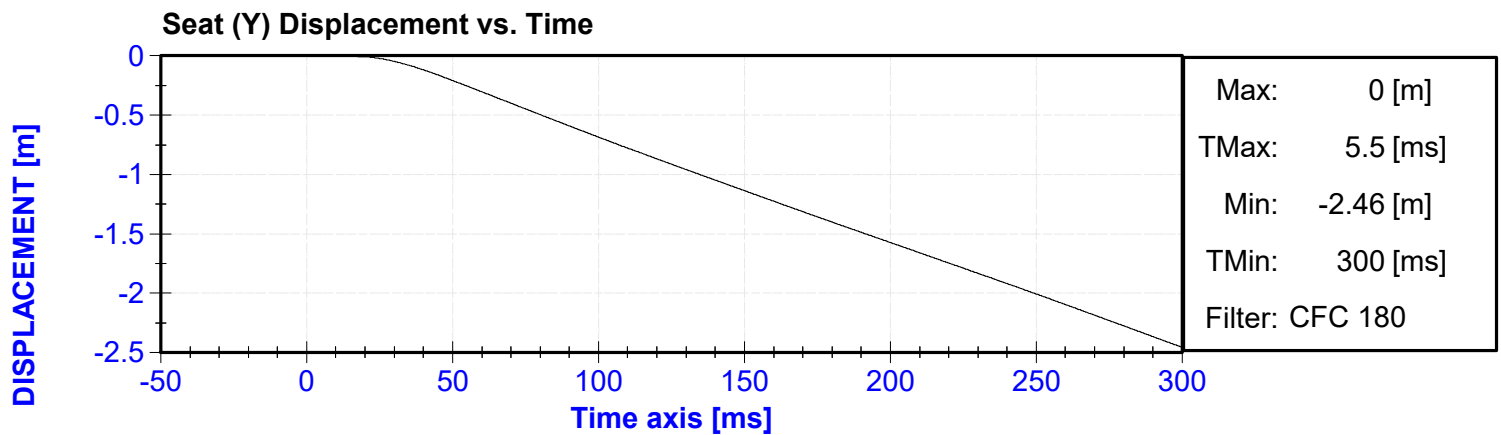
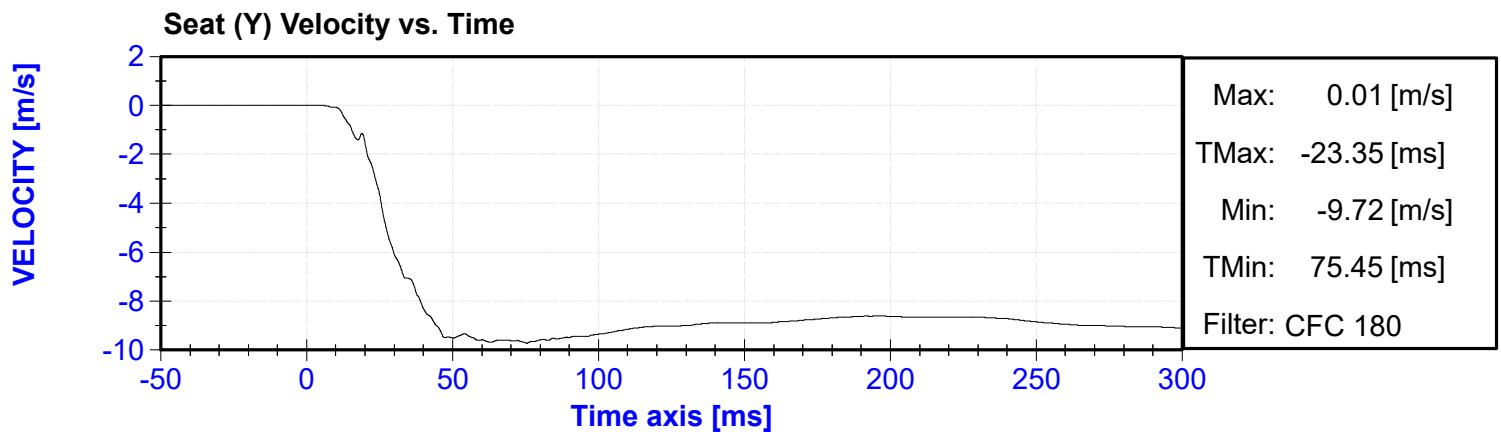
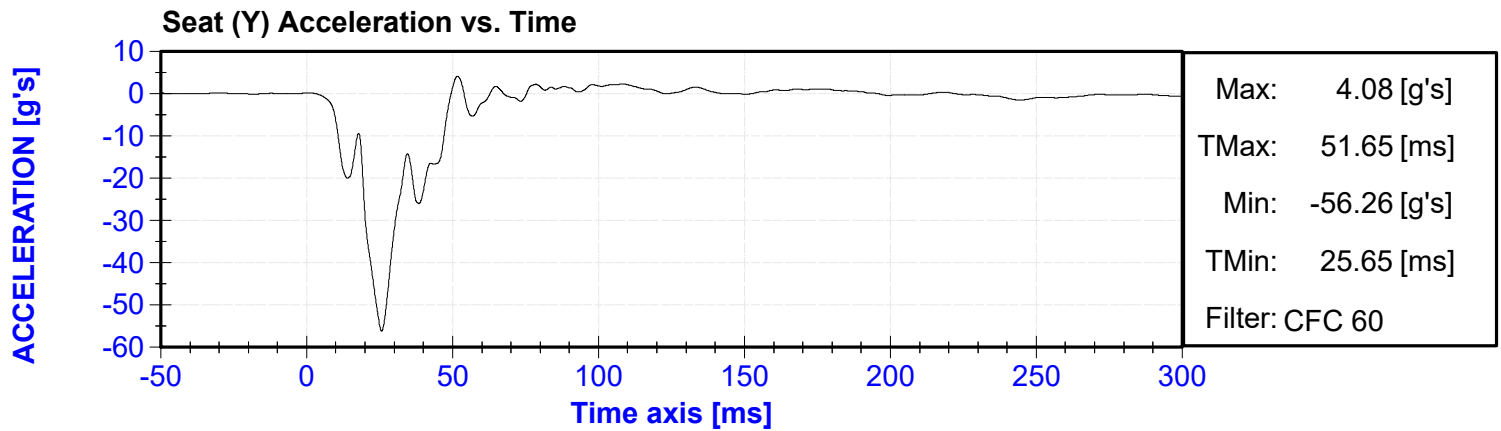
Exceeded calibration range and saturated at 13.3 ms

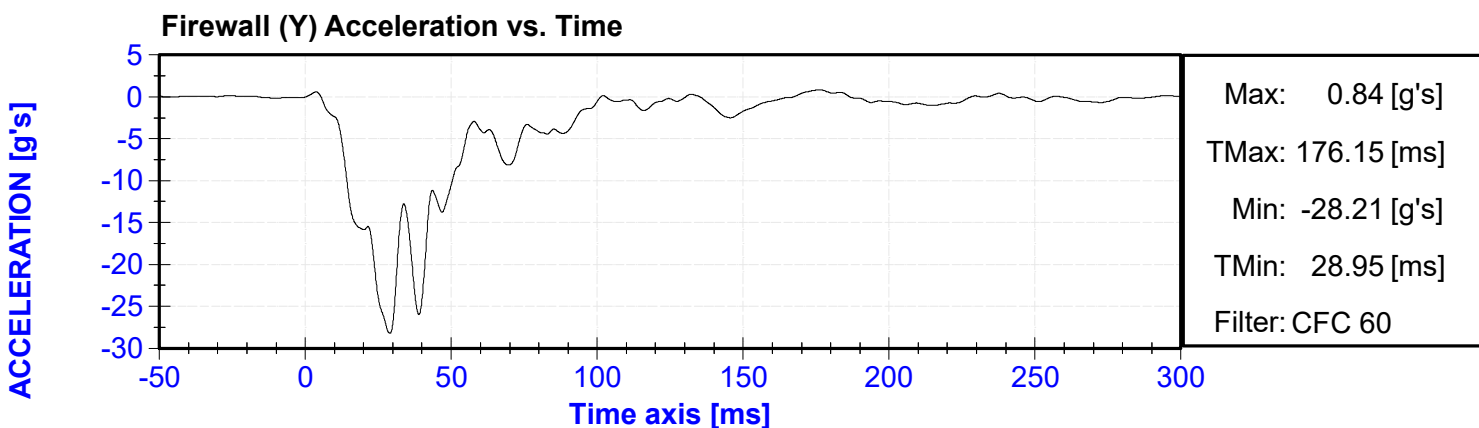
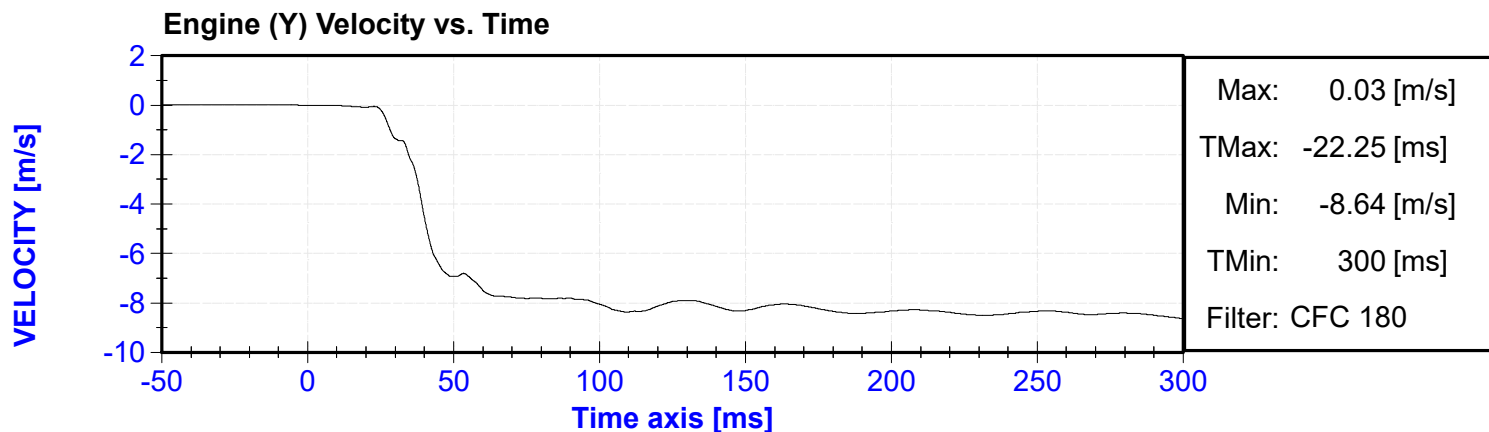
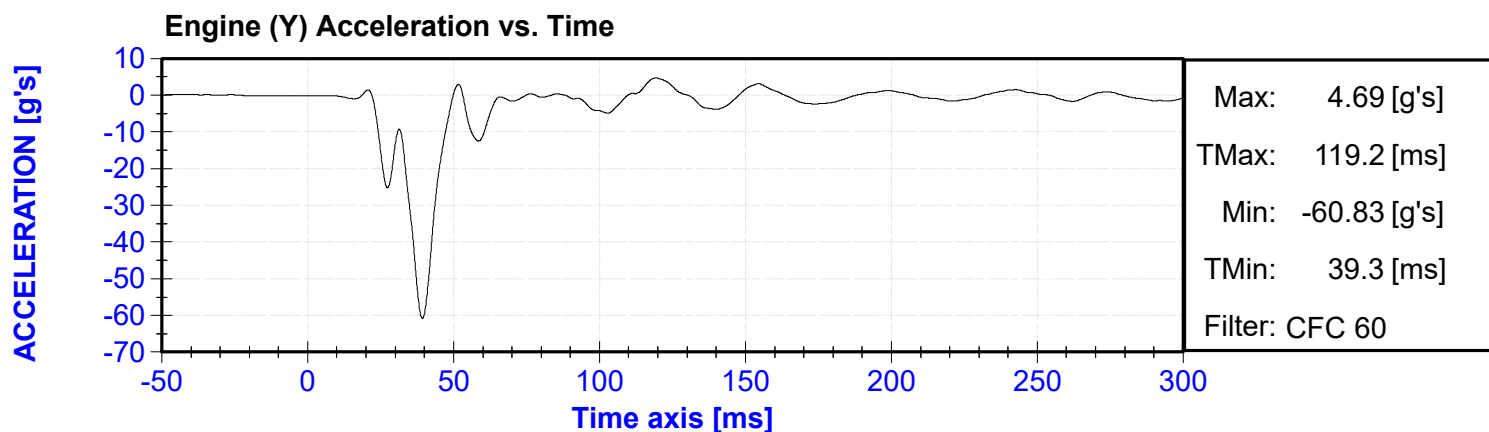
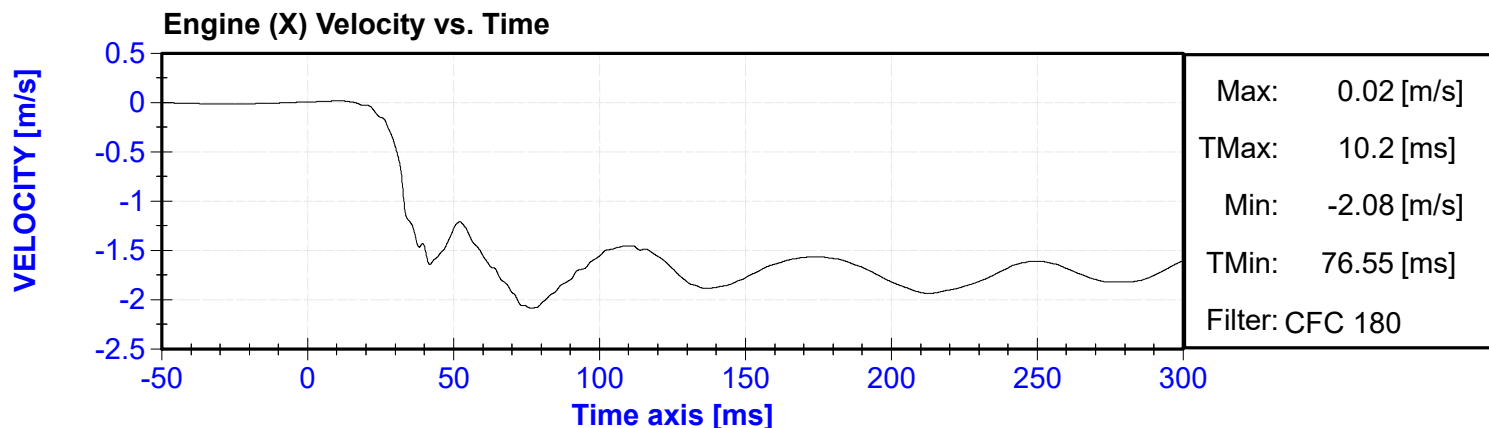
DISPLACEMENT [m]

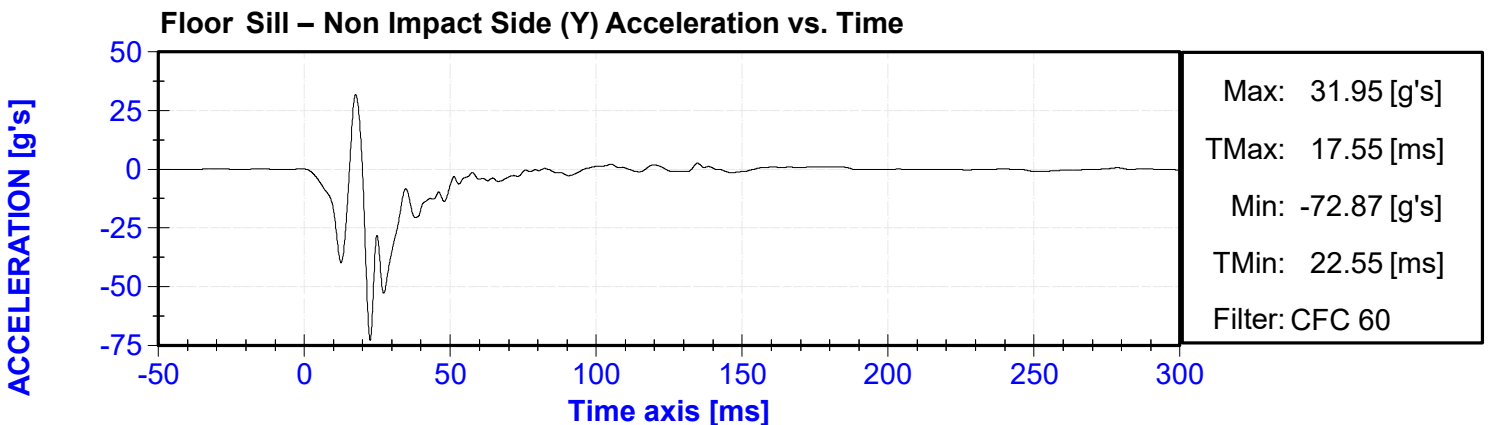
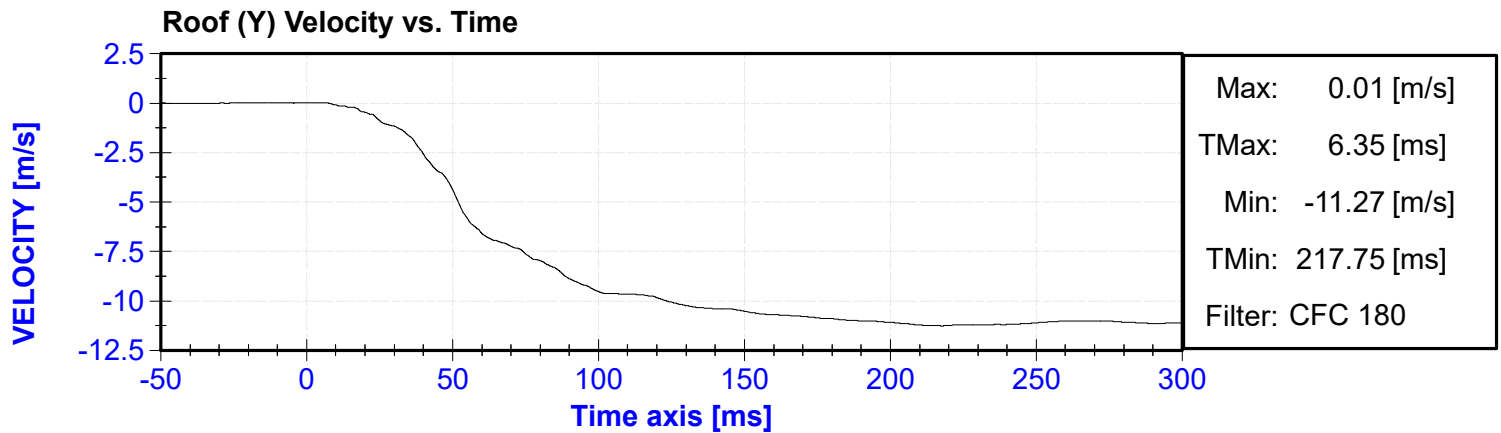
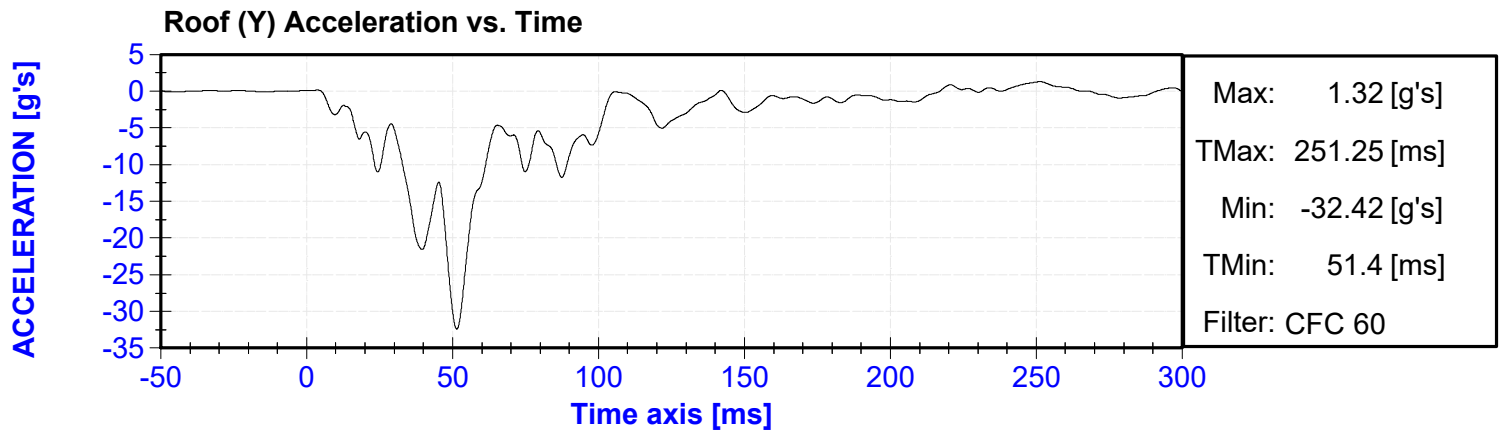
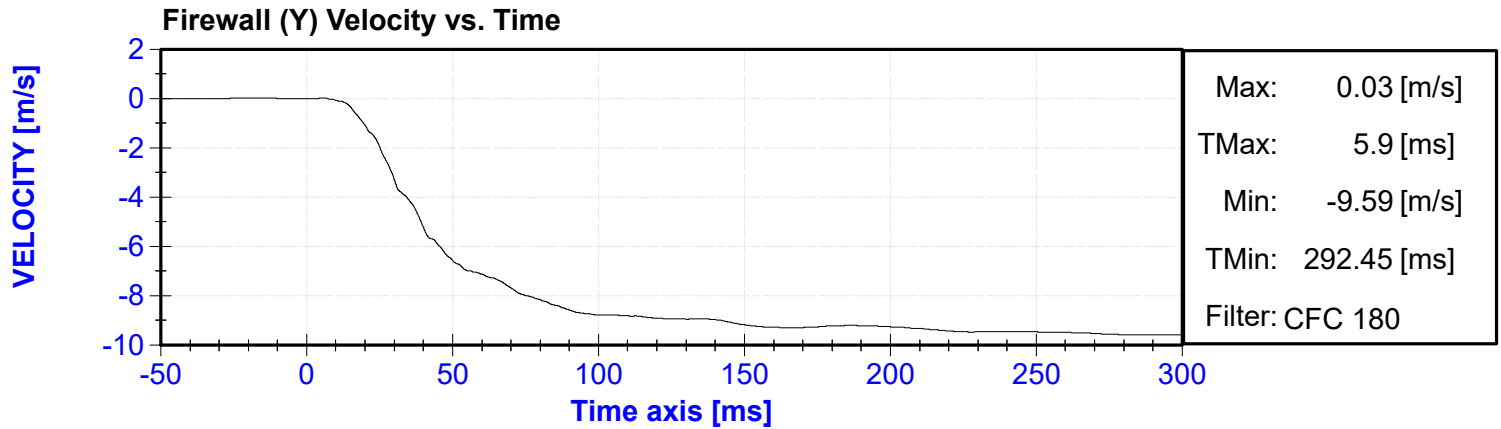
B-Pillar Mid (Y) Displacement vs. Time

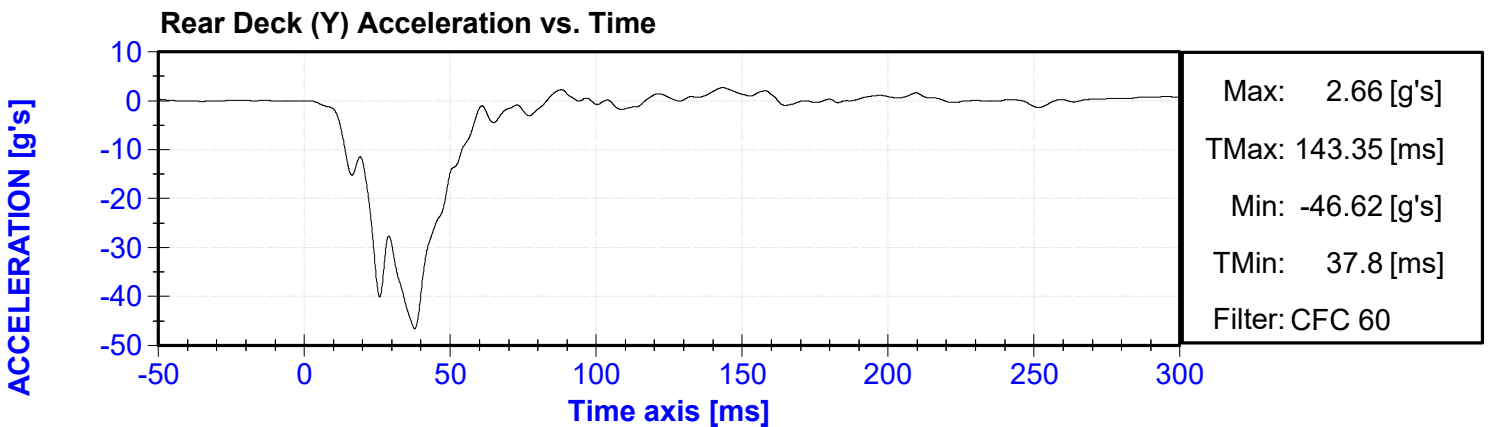
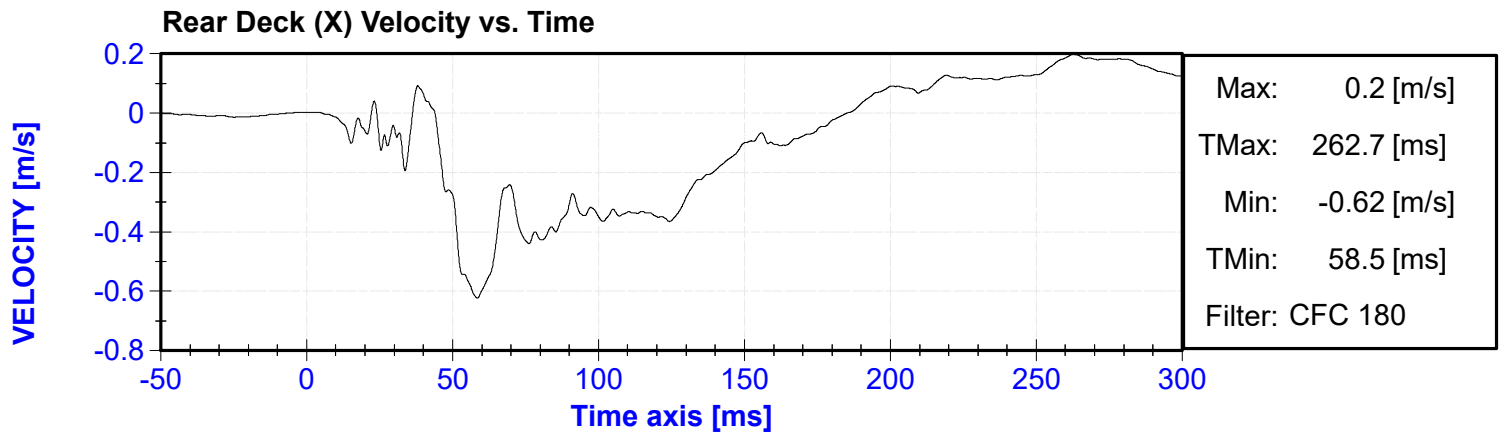
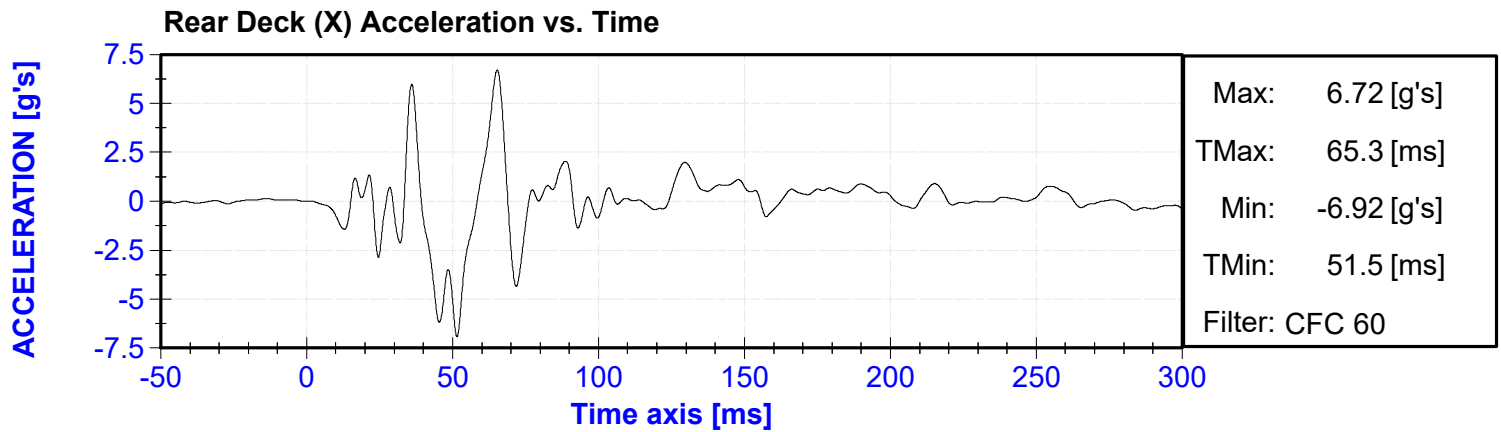
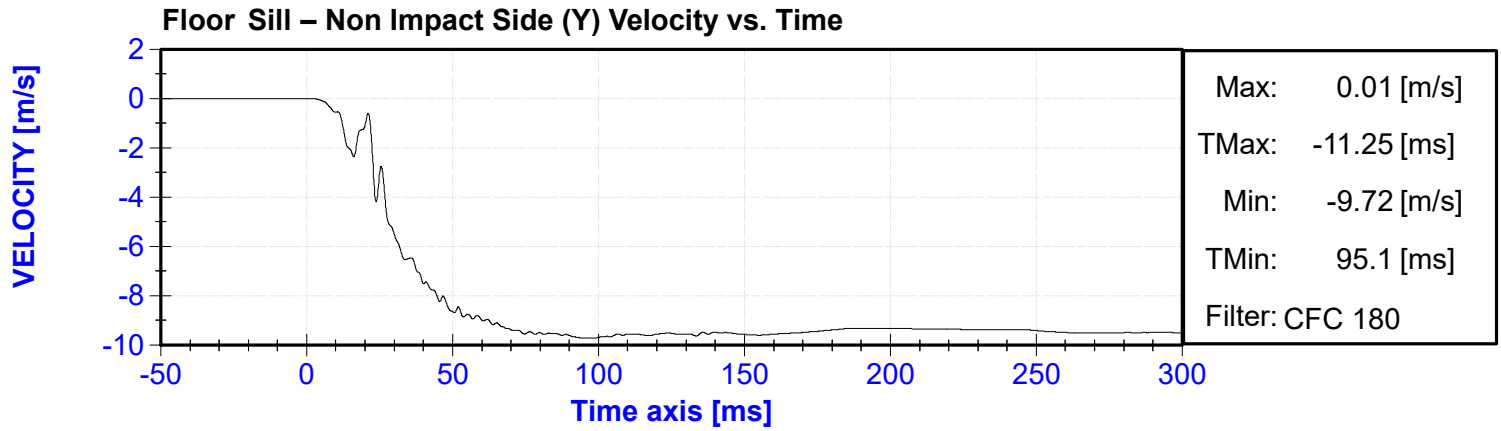


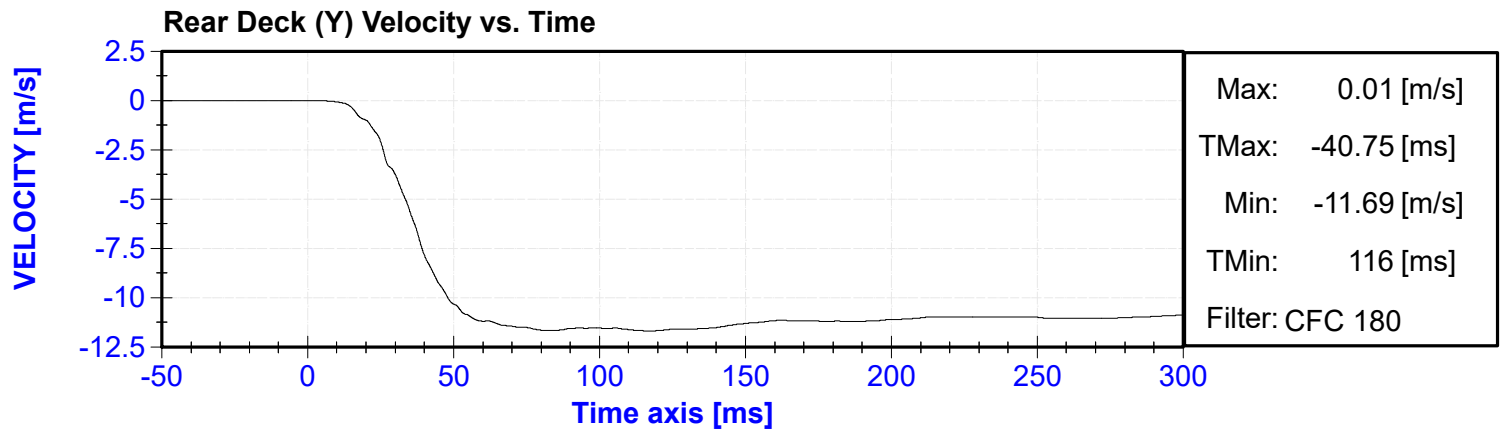
Exceeded calibration range and saturated at 13.3 ms











APPENDIX IV

PRE-TEST DUMMY PERFORMANCE CALIBRATION TEST DATA

(Subpart U, ES-2re)

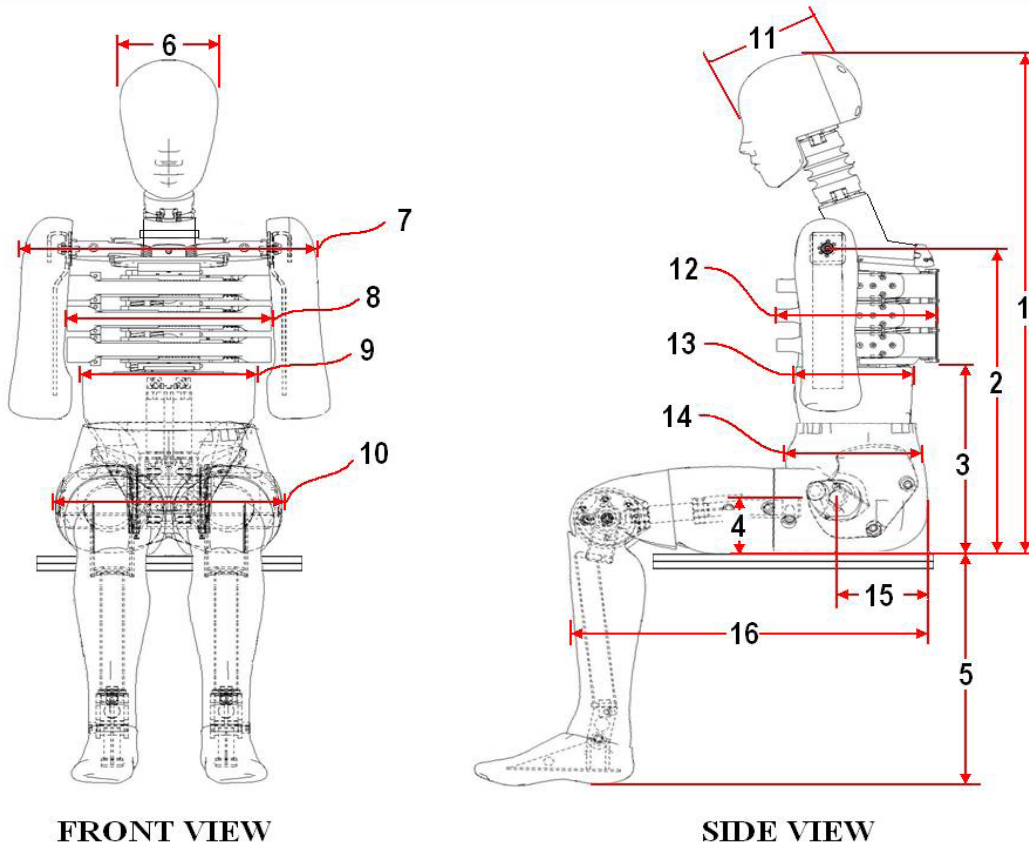


External Measurements - EuroSID-2re

Technician: K. Brogan

Date: 09/11/2023

Dummy Serial Number: DG5348



FRONT VIEW

SIDE VIEW

Dim. No.	Description	Specification (mm)		Result (mm)	Pass/Fail
1	Sitting Height	900	918	913	Pass
2	Seat to Shoulder Joint	558	572	568	Pass
3	Seat to Lower Face of Thoracic Spine Box	346	356	349	Pass
4	Seat to Hip Joint (center of bolt)	97	103	102	Pass
5	Sole to Seat, Sitting	333	451	412	Pass
6	Head Width	152	158	156	Pass
7	Shoulder/Arm Width	461	479	470	Pass
8	Thorax Width	322	332	325	Pass
9	Abdomen Width	273	287	282	Pass
10	Pelvis Lap Width	359	373	368	Pass
11	Head Depth	196	206	201	Pass
12	Thorax Depth	262	272	269	Pass
13	Abdomen Depth	194	204	198	Pass
14	Pelvis Depth	235	245	242	Pass
15	Back of Buttocks to Hip Joint (center of bolt)	150	160	155	Pass
16	Back of Buttocks to Front Knee	597	615	608	Pass

ATD Manufacturer	FTSS	Test Technician	J. Miller
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantell

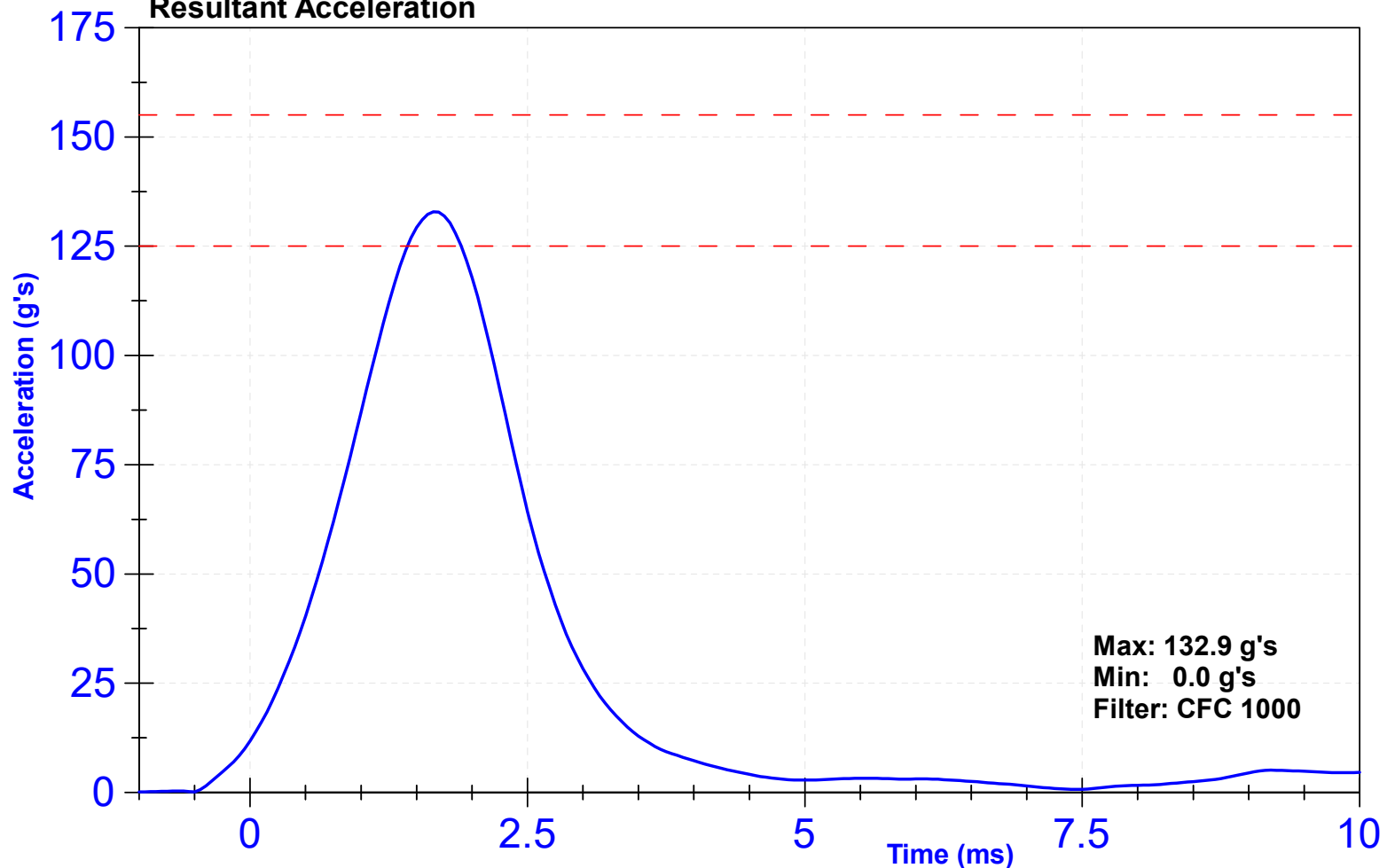
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.8	Pass
Humidity	10	70	%	61.3	Pass
Resultant Acceleration	125	155	g's	132.9	Pass
Oscillation	0	15	%	3.83	Pass
Fore-Aft Acceleration	-15	15	g's	9.3	Pass

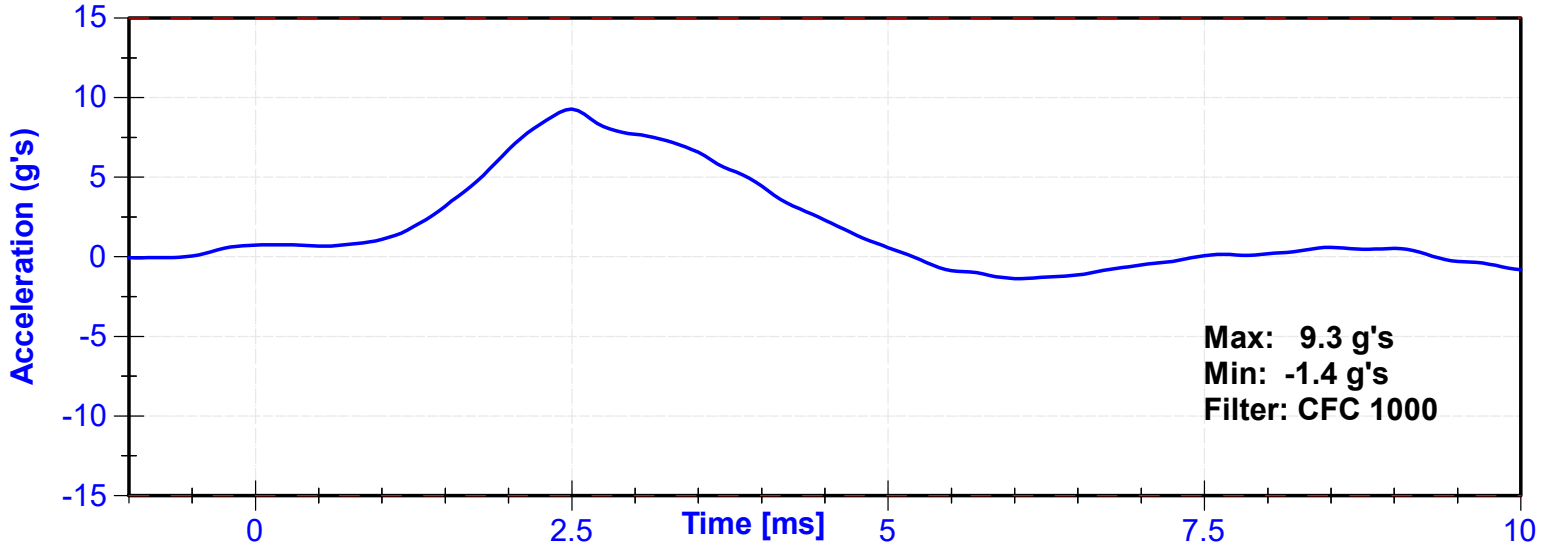
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	Endevco	18666	9/1/2023	2/28/2024
Y Accelerometer	Endevco	18472	9/1/2023	2/28/2024
Z Accelerometer	Endevco	18663	9/1/2023	2/28/2024

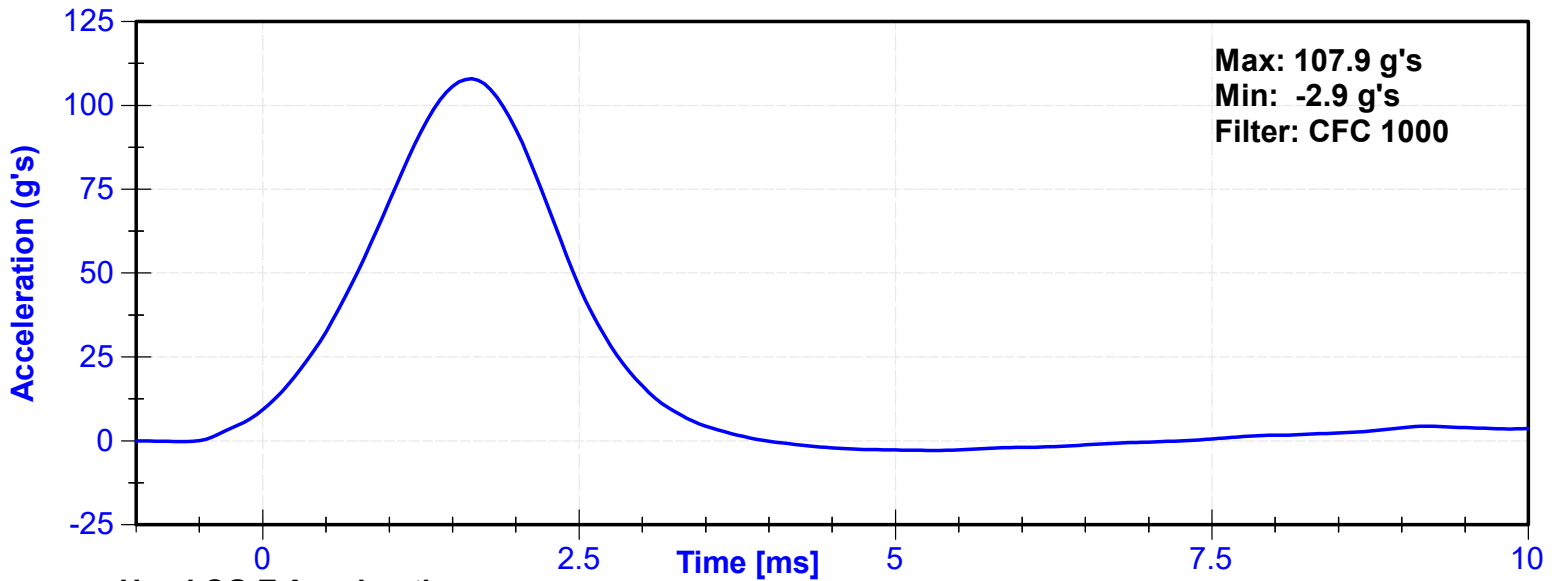
Resultant Acceleration



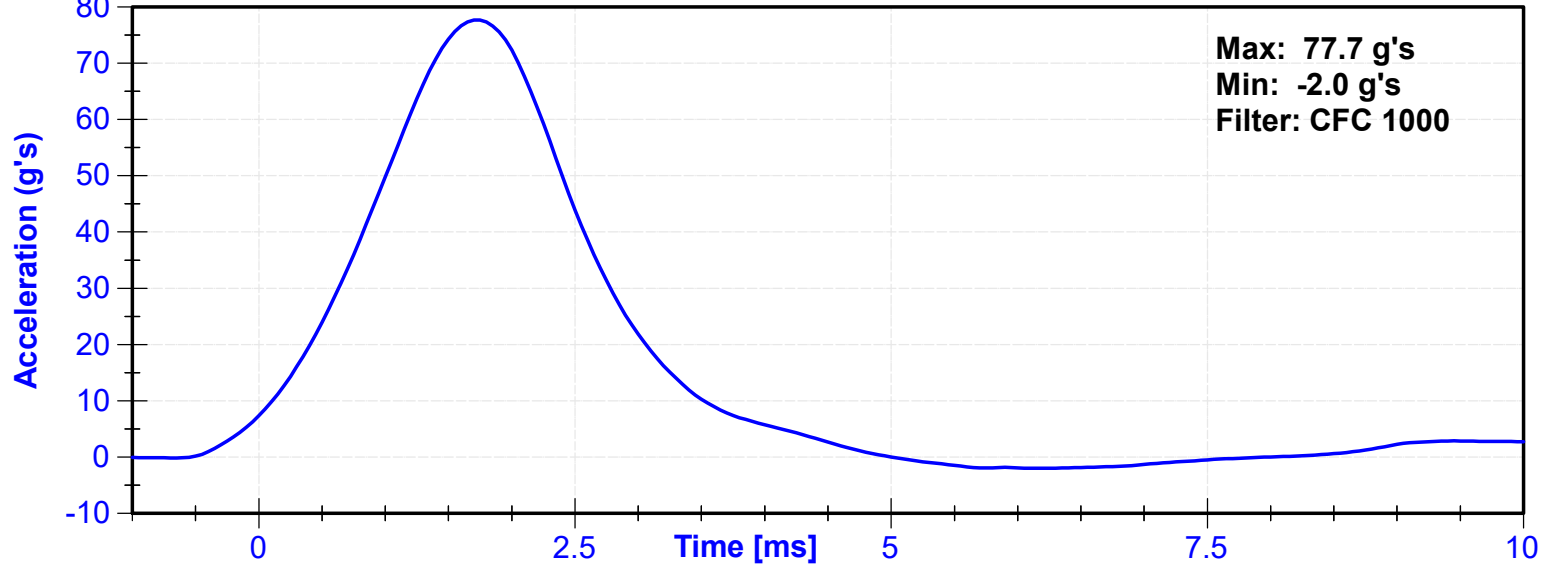
Head CG X Acceleration



Head CG Y Acceleration



Head CG Z Acceleration



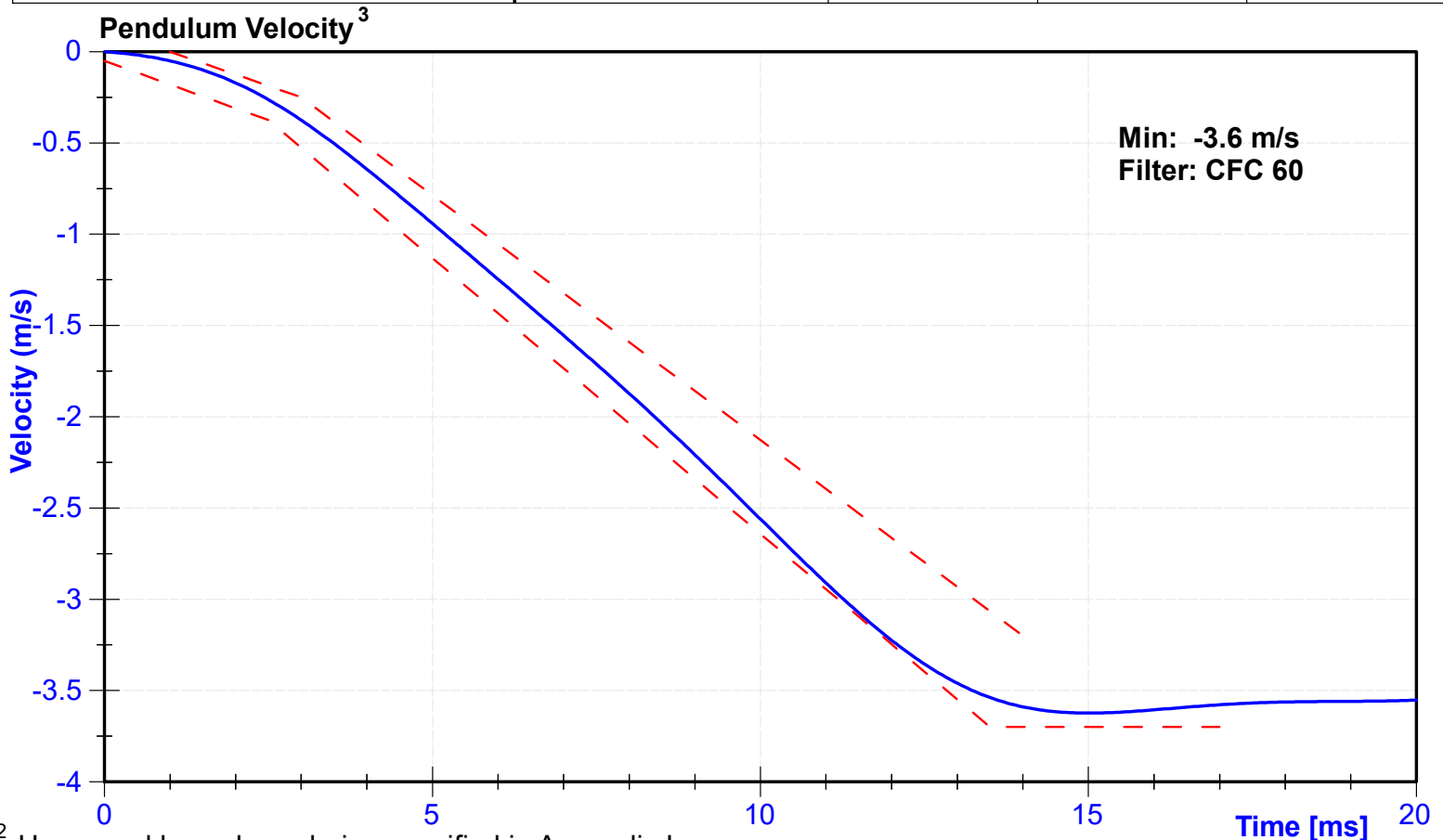
ATD Manufacturer	FTSS	Test Technician	J. Miller
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.7	Pass
Humidity	10	70	%	59.2	Pass
Velocity	3.3	3.5	m/s	3.40	Pass
Lateral Neck Rotation	49	59	deg	52.8	Pass
Time at Maximum Rotation	54	66	ms	57.7	Pass
Time of Rotation Decay from Maximum	53	88	ms	54.8	Pass
Pendulum Velocity Overall Corridor	Lower Boundary ¹	Upper Boundary ²	m/s	See Plot ³	Pass

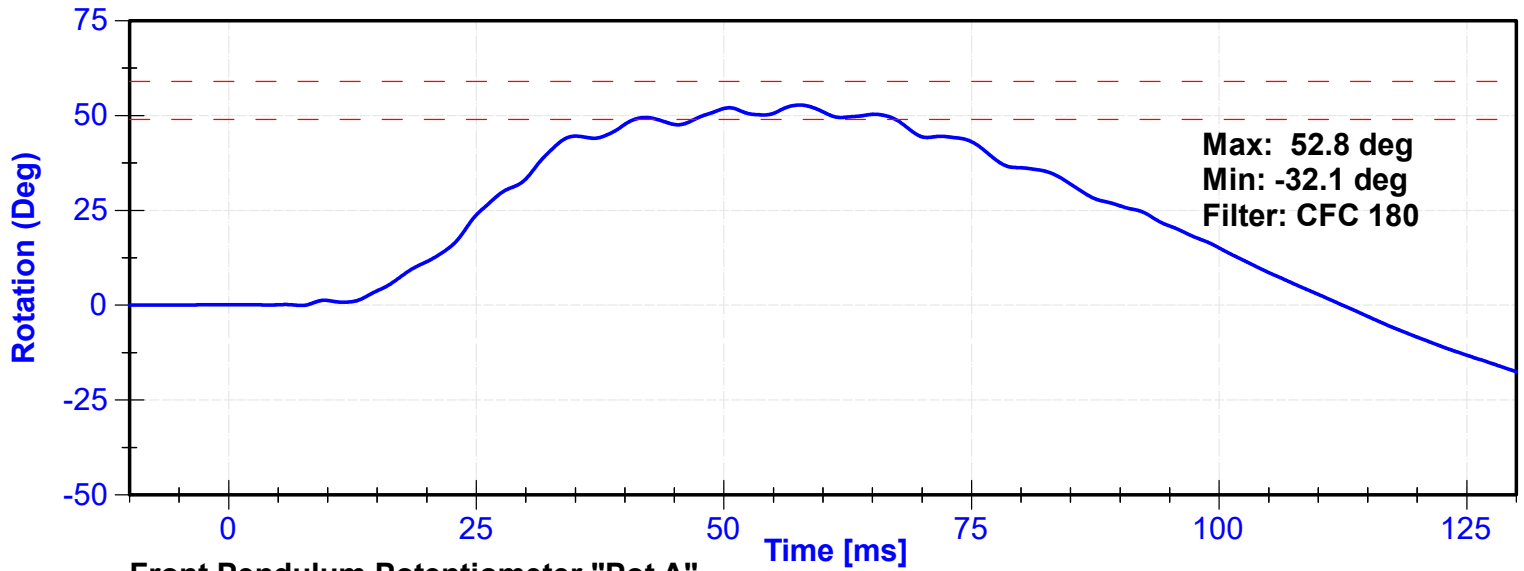
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	C16503	10/26/2022	10/26/2023
Front Pendulum Potentiometer	Sfernice	094	10/5/2022	10/5/2023
Headform Potentiometer	Sfernice	095	10/5/2022	10/5/2023

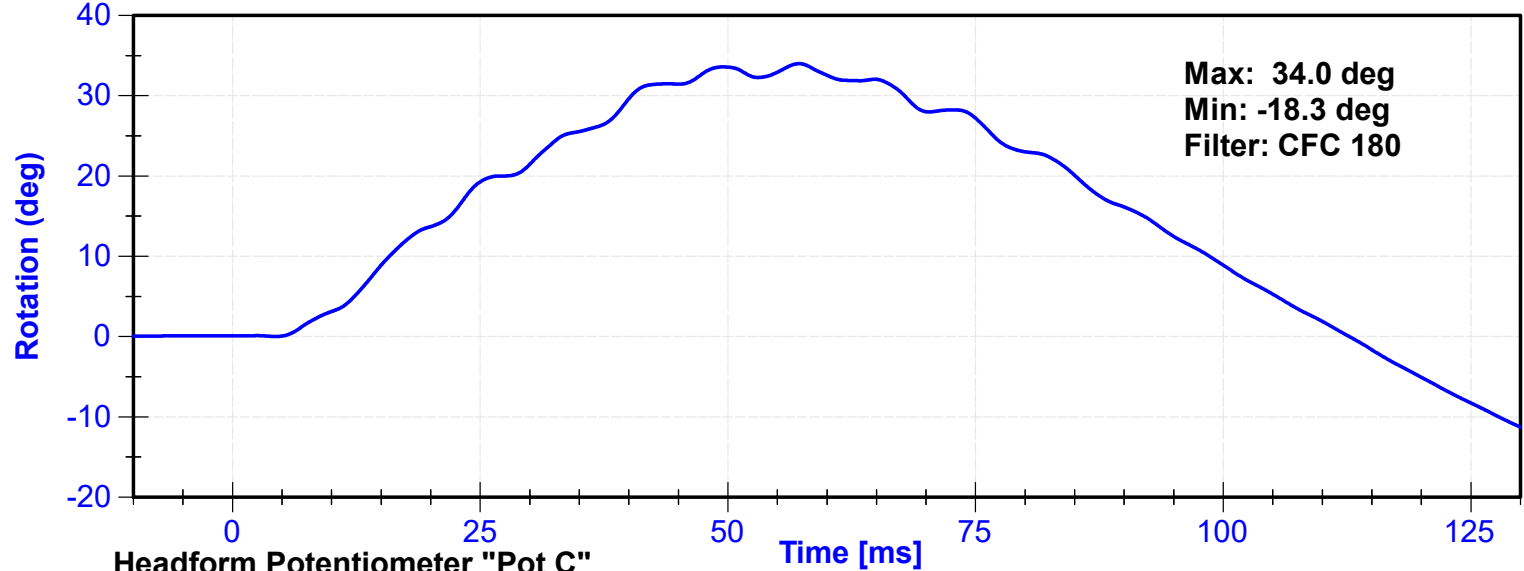


^{1,2} Upper and lower boundaries specified in Appendix I

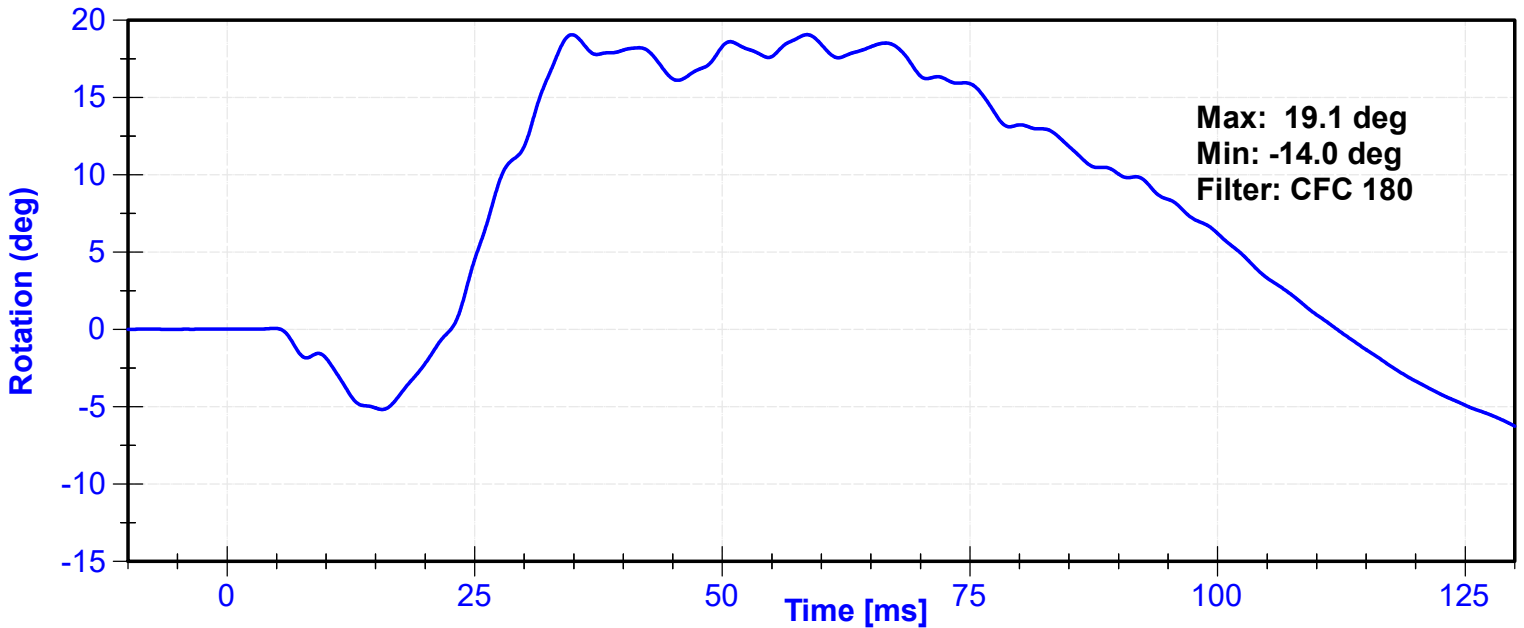
Neck Rotation



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	FTSS	Test Technician	J. Miller
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantell

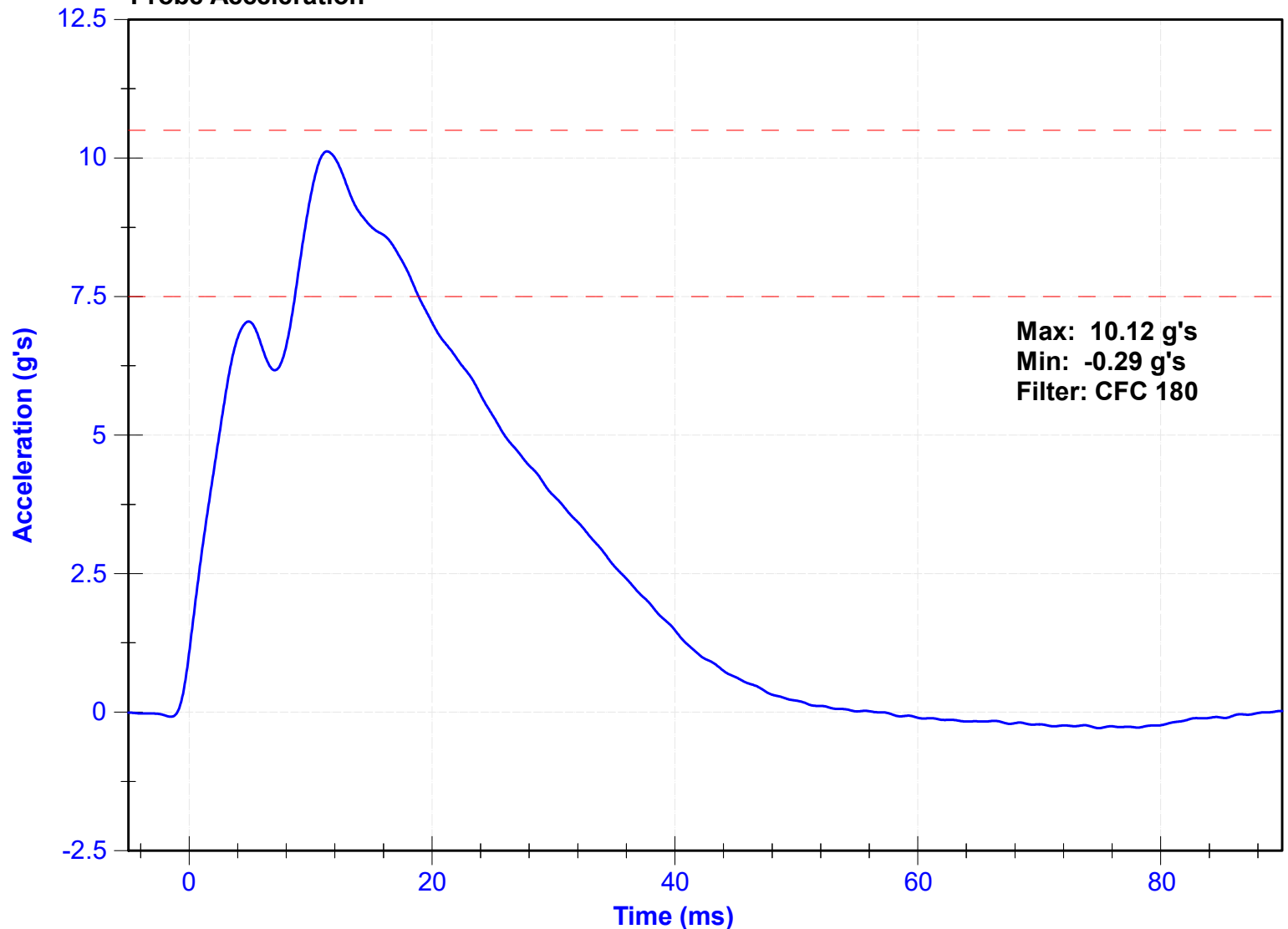
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.7	Pass
Humidity	10	70	%	54.1	Pass
Velocity	4.2	4.4	m/s	4.27	Pass
Probe Acceleration	7.5	10.5	g's	10.12	Pass

Transducer Calibrations

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

Probe Acceleration



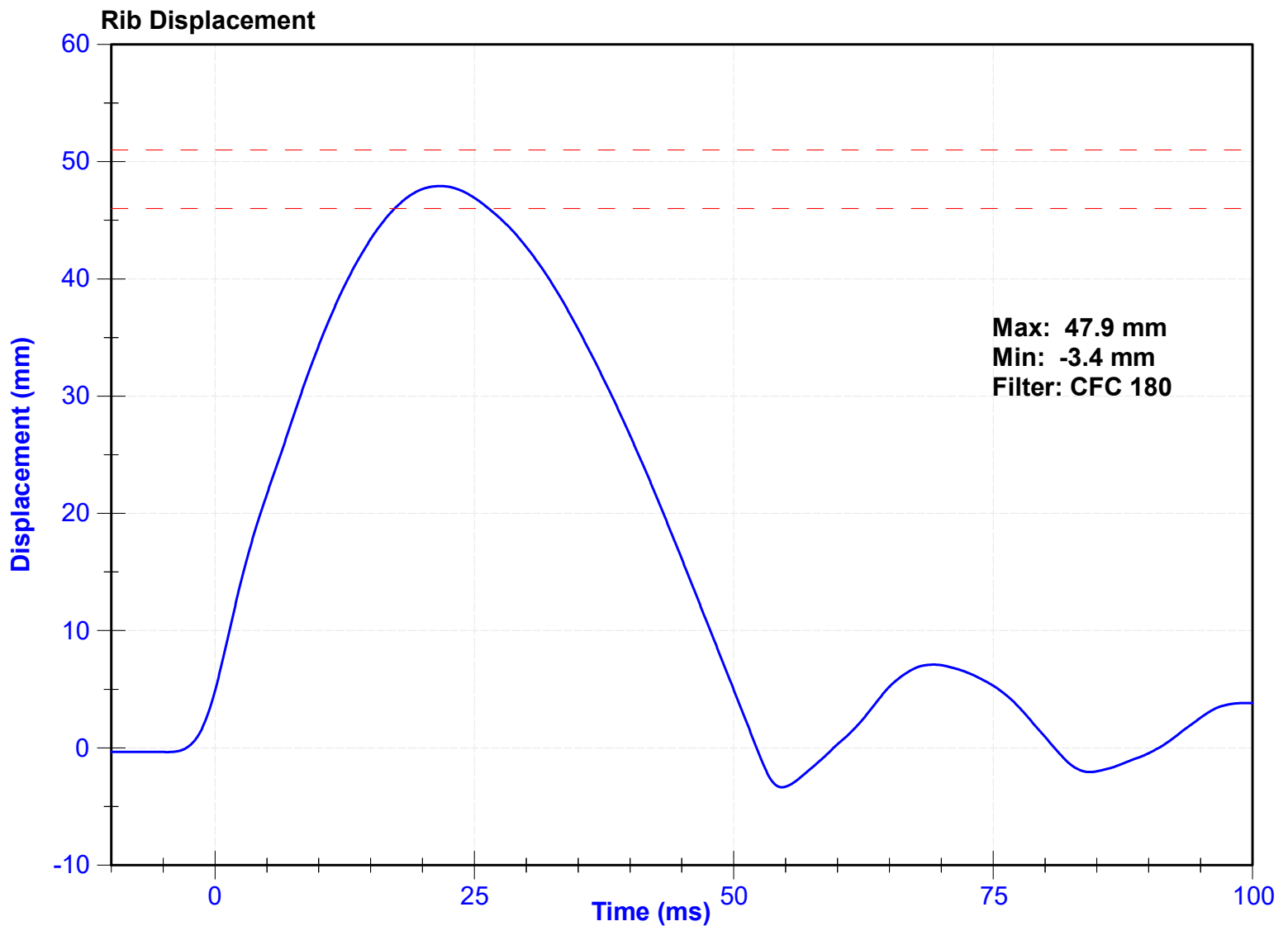
ATD Manufacturer	FTSS	Test Technician	J. Miller
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantel

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.8	Pass
Humidity	10	70	%	60.1	Pass
Rib Displacement	46	51	mm	47.9	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	268GFE	8/8/2023	2/6/2024



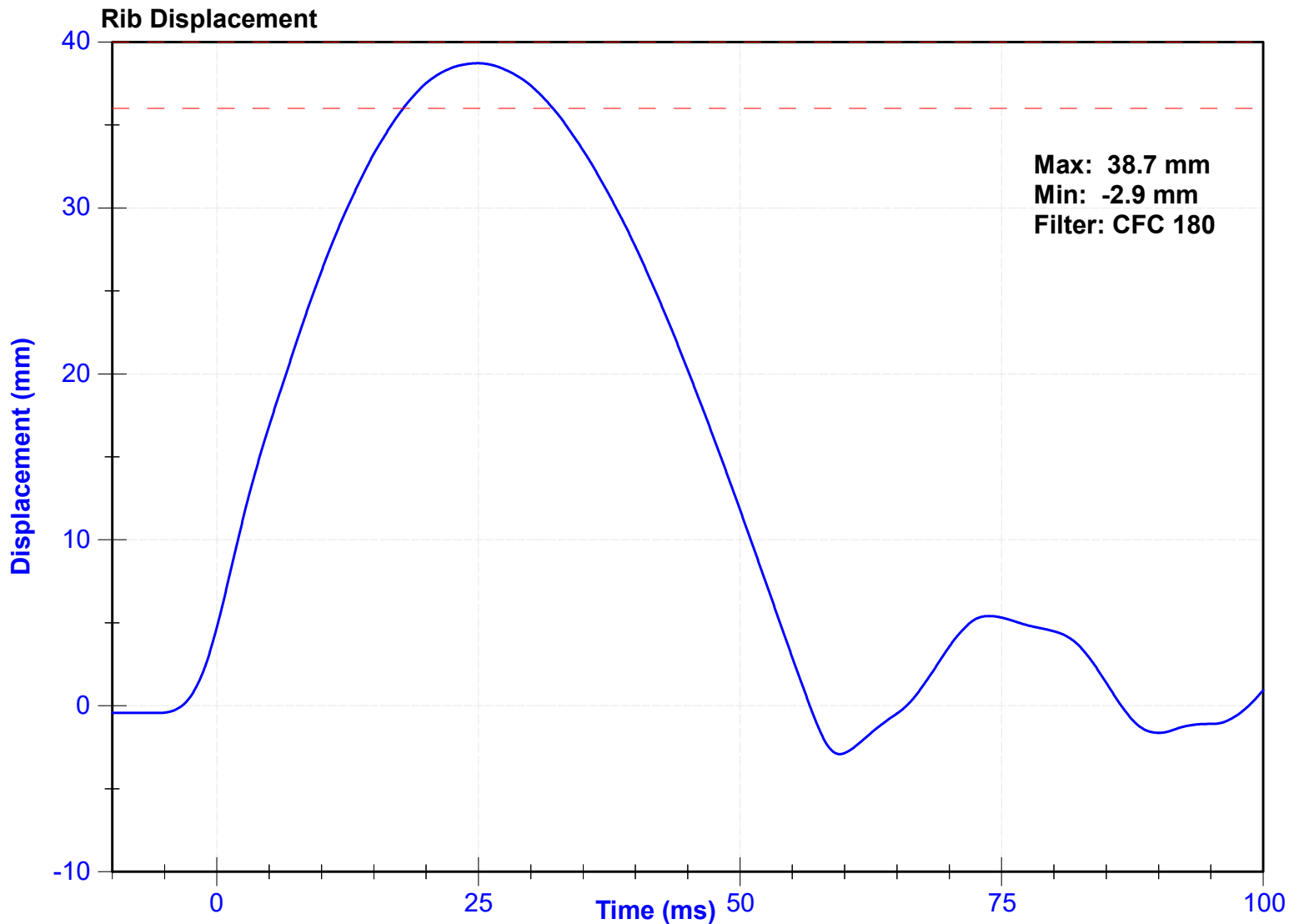
ATD Manufacturer	FTSS	Test Technician	J. Miller
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantel

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.8	Pass
Humidity	10	70	%	60.1	Pass
Rib Displacement	36	40	mm	38.7	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	268GFE	8/8/2023	2/6/2024



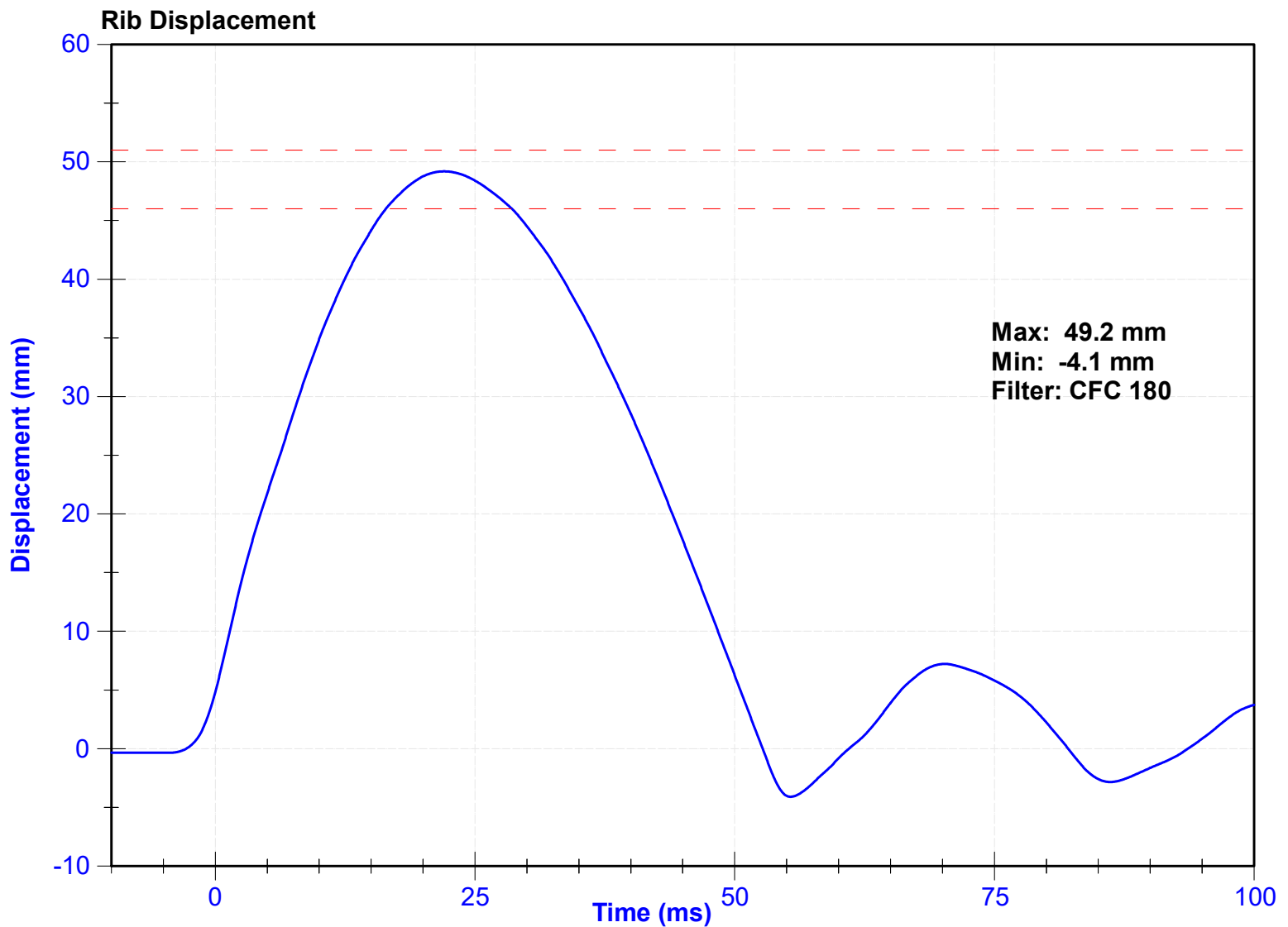
ATD Manufacturer	FTSS	Test Technician	J. Miller
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantel

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.7	Pass
Humidity	10	70	%	60.1	Pass
Rib Displacement	46	51	mm	49.2	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	269GFE	8/8/2023	2/6/2024



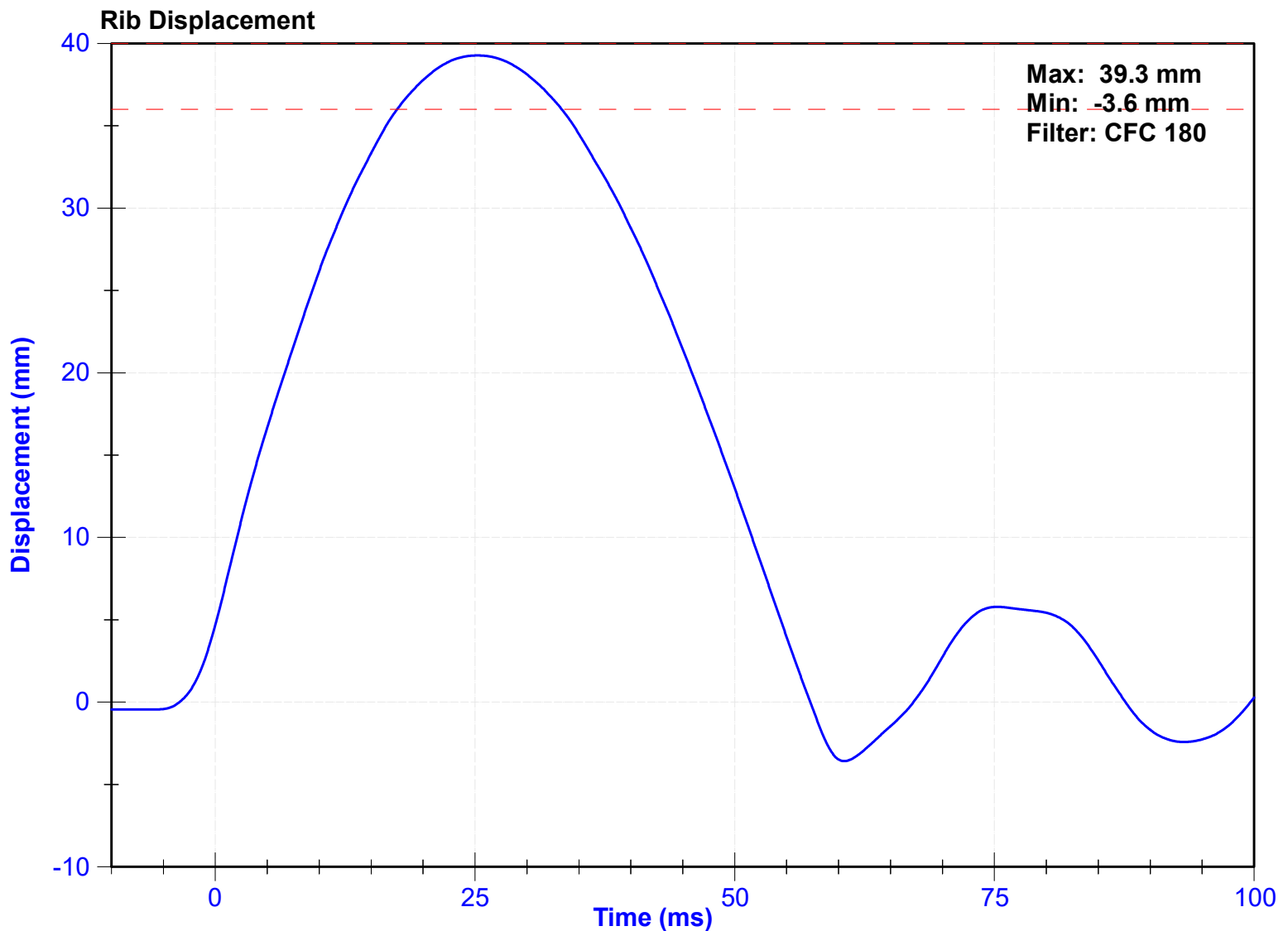
ATD Manufacturer	FTSS	Test Technician	J. Miller
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantel

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.7	Pass
Humidity	10	70	%	60.1	Pass
Rib Displacement	36	40	mm	39.3	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	269GFE	8/8/2023	2/6/2024



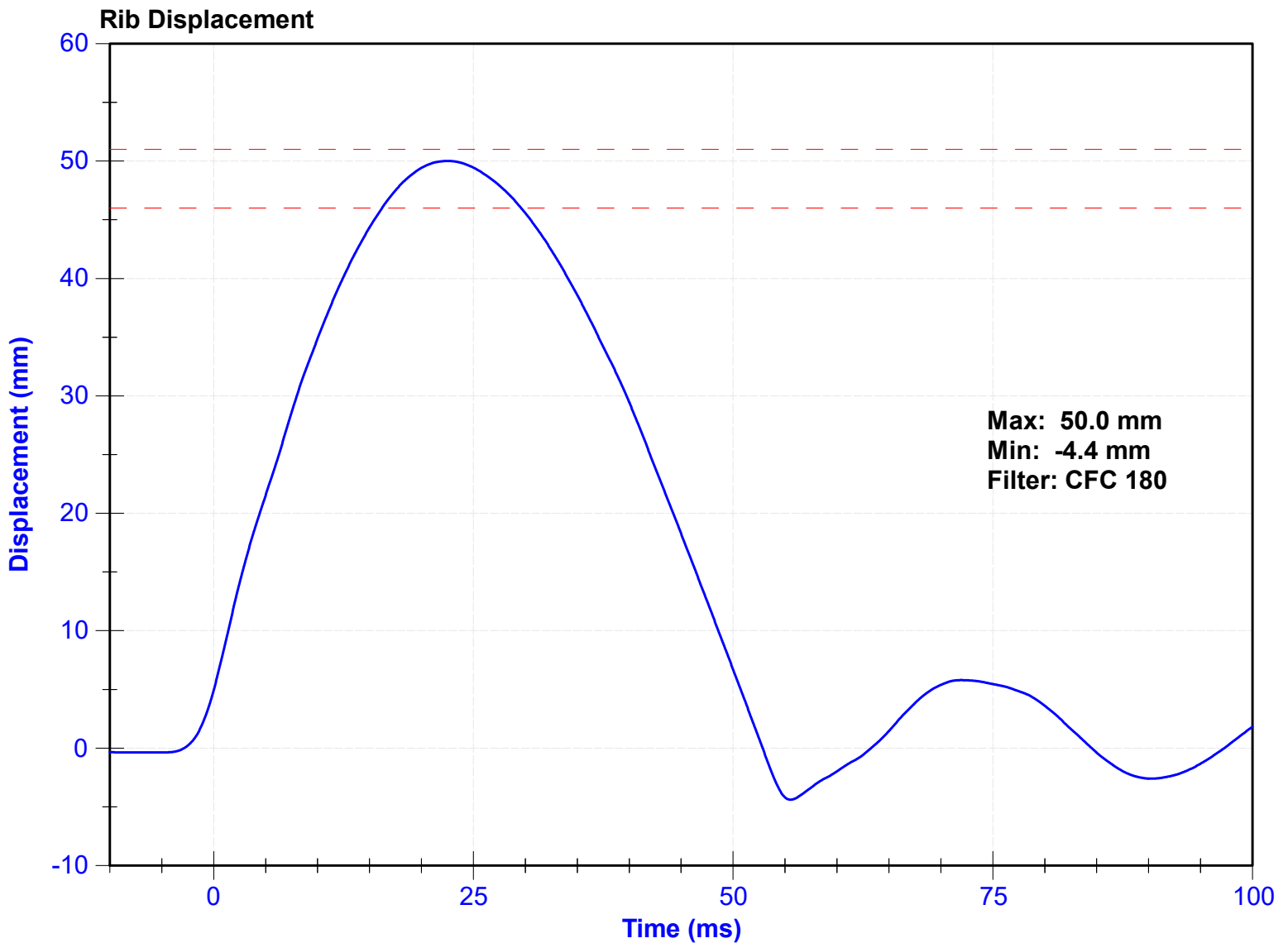
ATD Manufacturer	FTSS	Test Technician	J. Miller
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantel

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.7	Pass
Humidity	10	70	%	60.1	Pass
Rib Displacement	46	51	mm	50.0	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	270GFE	8/8/2023	2/6/2024



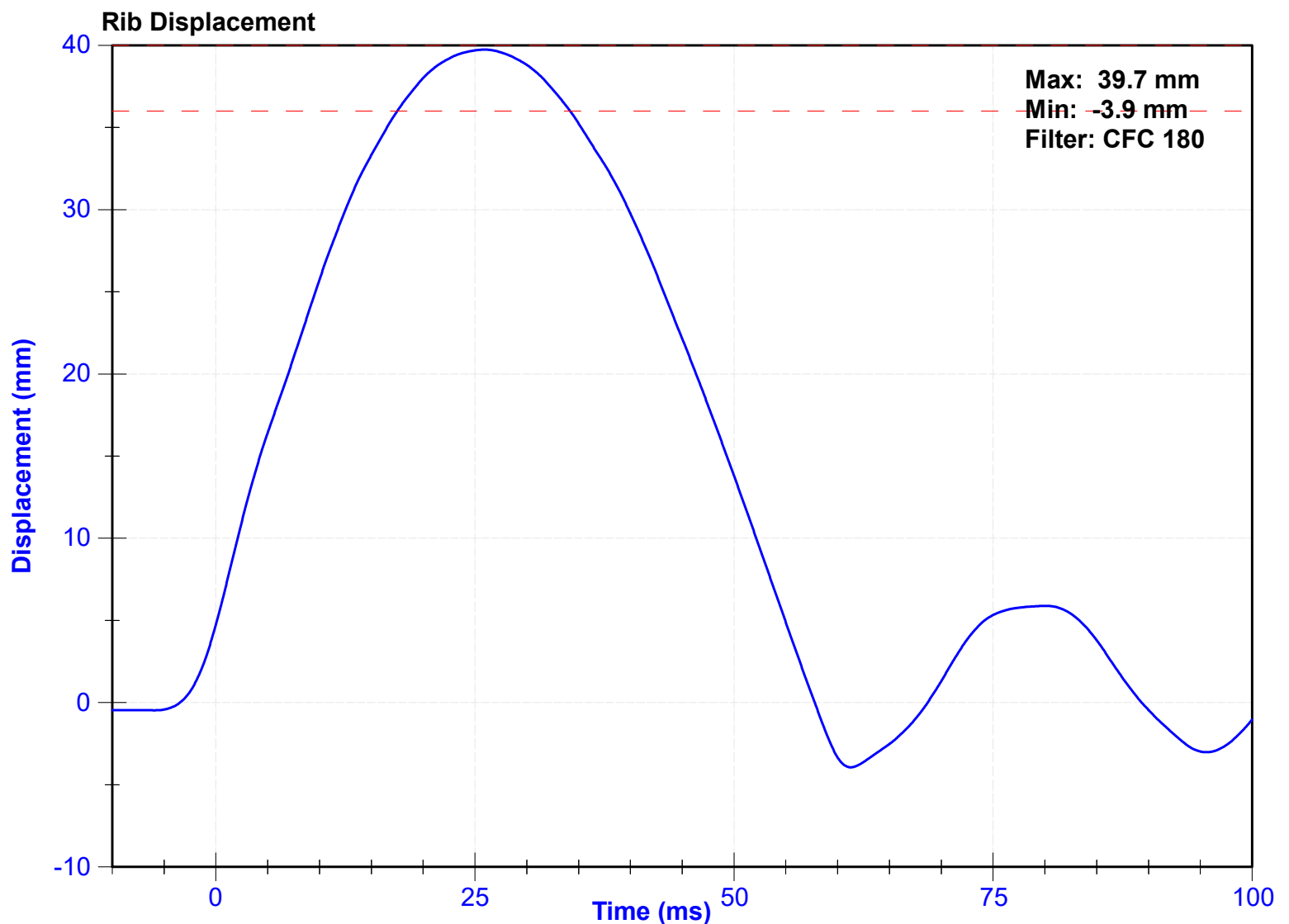
ATD Manufacturer	FTSS	Test Technician	J. Miller
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantel

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.7	Pass
Humidity	10	70	%	60.1	Pass
Rib Displacement	36	40	mm	39.7	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	270GFE	8/8/2023	2/6/2024



ATD Manufacturer	FTSS	Test Technician	J. Miller
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantell

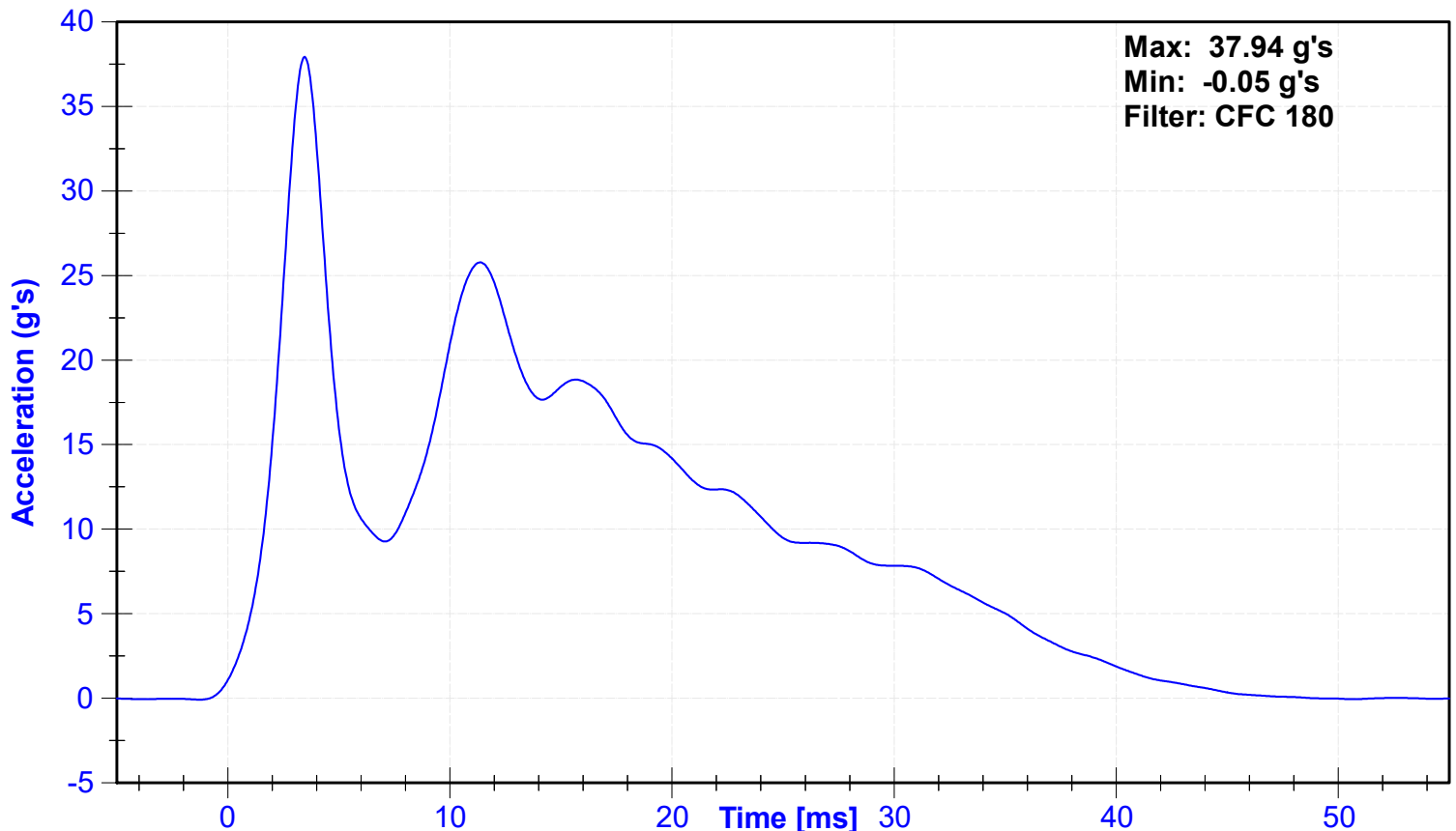
Results

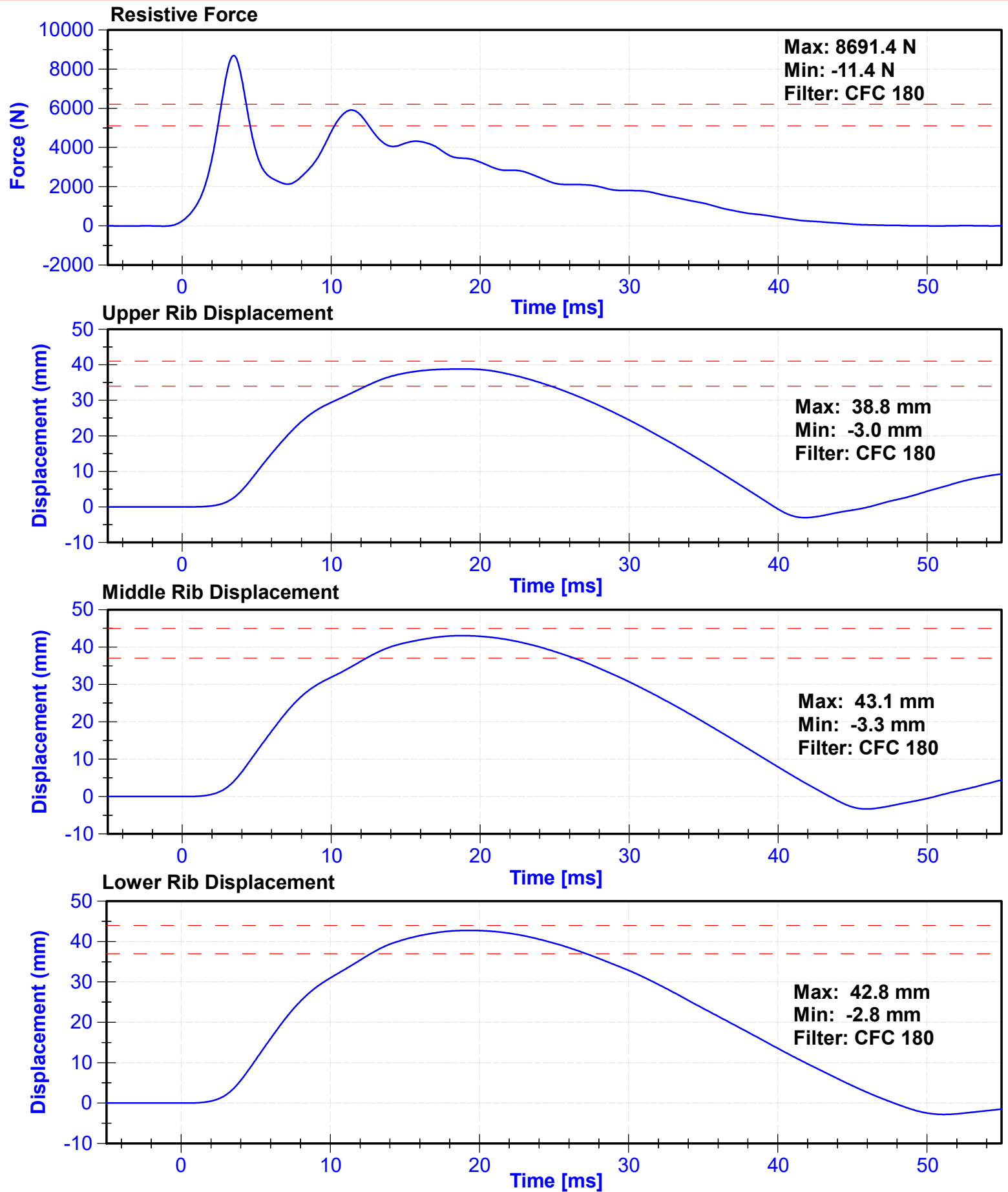
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.7	Pass
Humidity	10	70	%	54.1	Pass
Velocity	5.4	5.6	m/s	5.52	Pass
Resistive Force after 6ms	5100	6200	N	5906.8	Pass
Upper Thorax Rib Deflection	34	41	mm	38.8	Pass
Mid Thorax Rib Deflection	37	45	mm	43.1	Pass
Lower Thorax Rib Deflection	37	44	mm	42.8	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	268GFE	8/8/2023	2/6/2024
Middle Thorax Rib Potentiometer	Honeywell	269GFE	8/8/2023	2/6/2024
Lower Thorax Rib Potentiometer	Honeywell	270GFE	8/8/2023	2/6/2024

Probe Acceleration





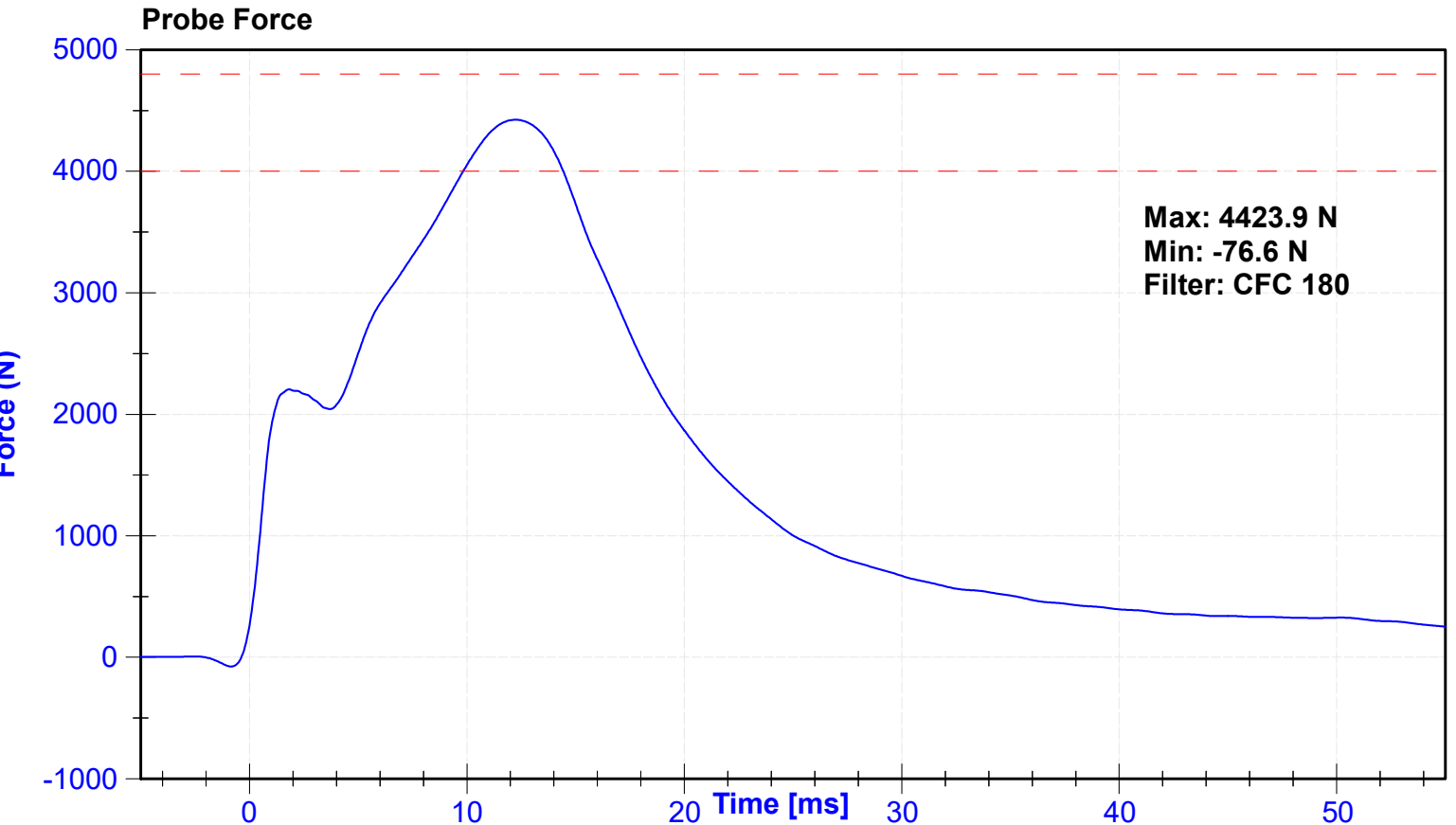
ATD Manufacturer	FTSS	Test Technician	J. Miller
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantell

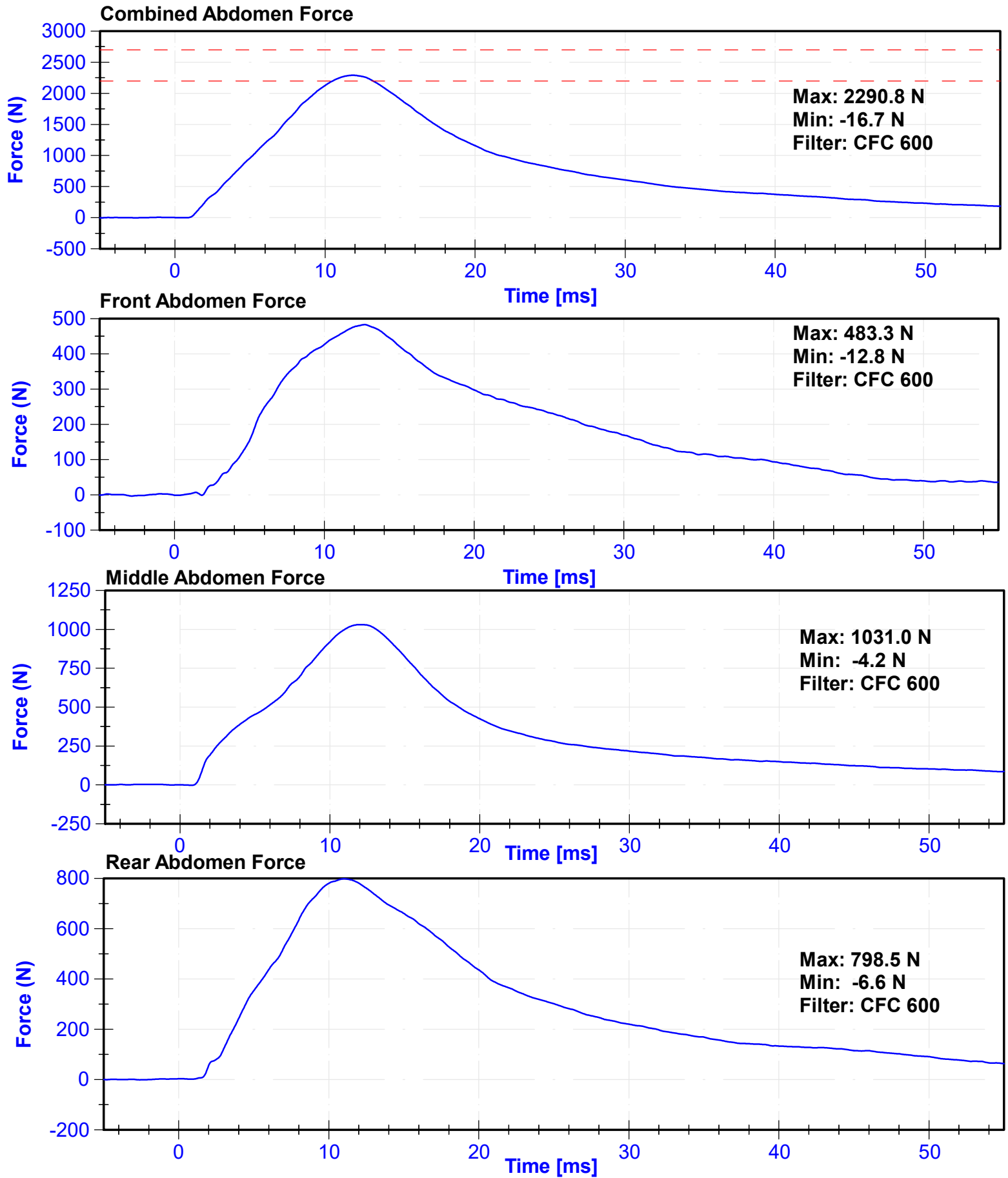
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.6	Pass
Humidity	10	70	%	56.1	Pass
Velocity	3.9	4.1	m/s	4.01	Pass
Combined Abdomen Force	2200	2700	N	2290.8	Pass
Time at Peak Abdomen Force	10.0	12.3	ms	11.85	Pass
Resistive Probe Force	4000	4800	N	4423.9	Pass
Time at Peak Resistive Force	10.6	13.0	ms	12.25	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	1512	8/15/2023	8/14/2024
Middle Abdomen Load Cell	Denton	1526	8/15/2023	8/14/2024
Rear Abdomen Load Cell	Denton	1516	8/15/2023	8/14/2024





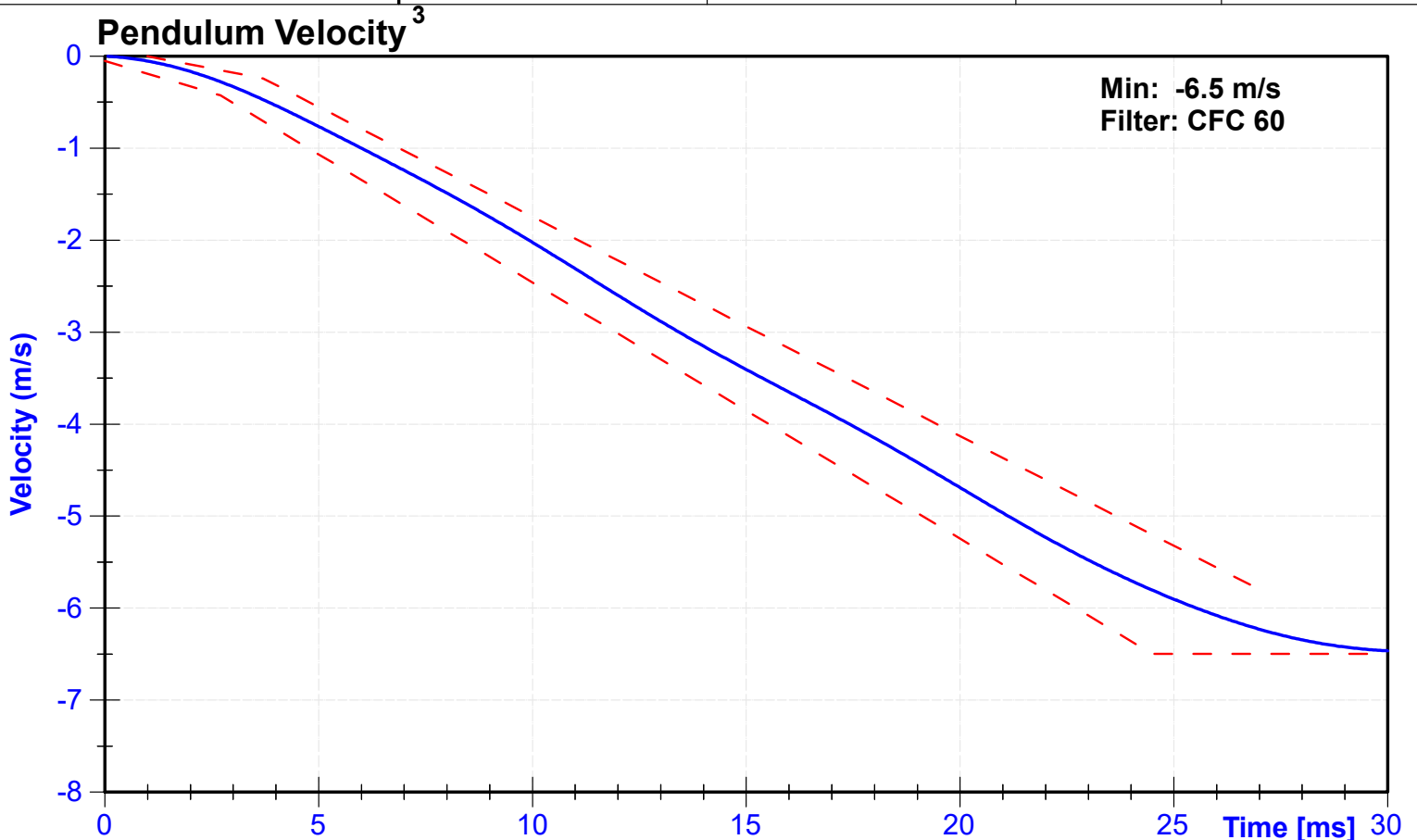
ATD Manufacturer	FTSS	Test Technician	T. Roseman
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.6	Pass
Humidity	10	70	%	60.1	Pass
Velocity	5.95	6.15	m/s	6.017	Pass
Lateral Spine Rotation	45	55	deg	51.9	Pass
Time at Maximum Rotation	39	53	ms	43.0	Pass
Time of Decay to Zero Degrees	37	57	ms	40.9	Pass
Pendulum Velocity Overall Corridor	Lower Boundary ¹	Upper Boundary ²	m/s	See Plot ³	Pass

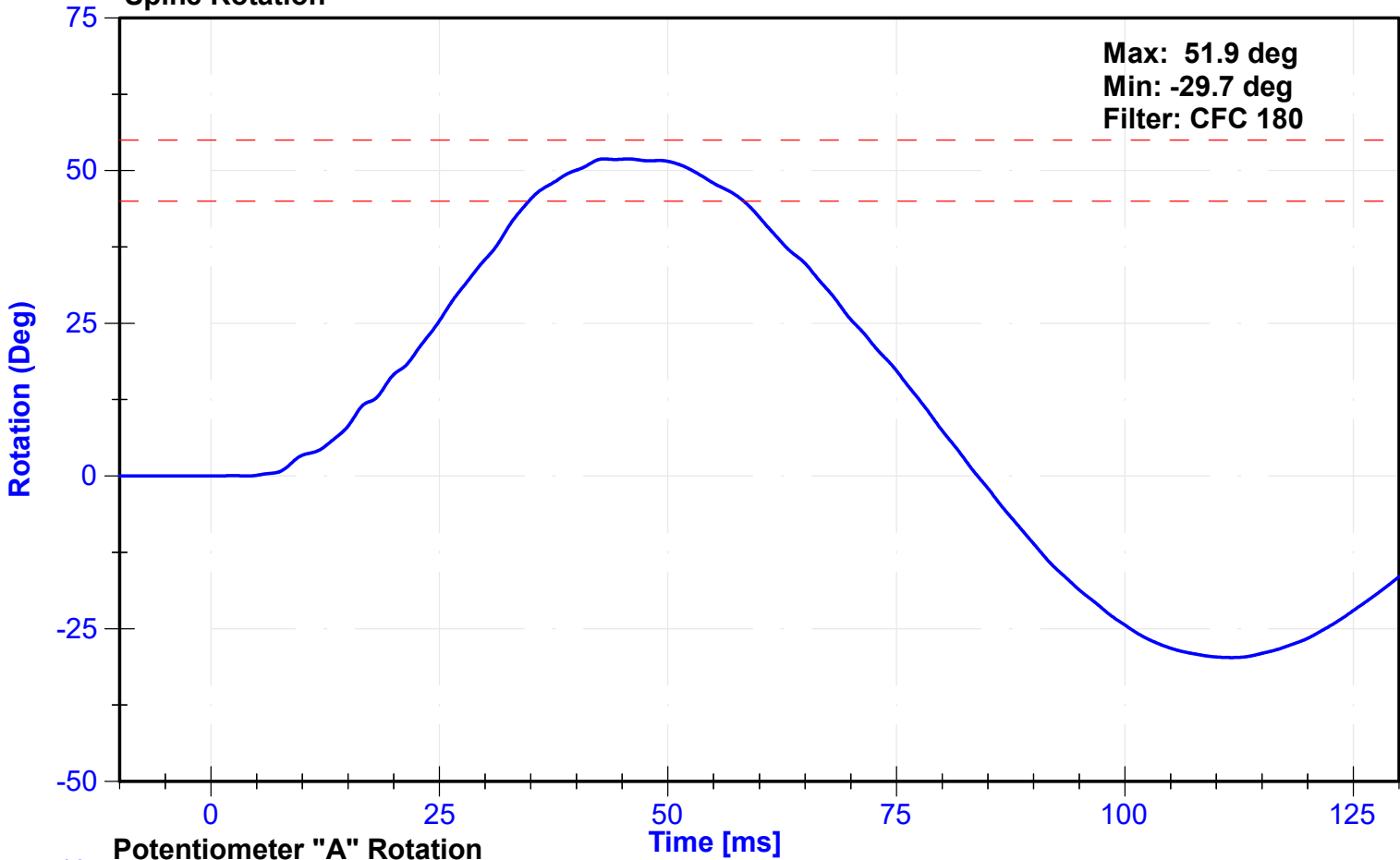
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	C16503	10/26/2022	10/26/2023
Pendulum "A" Potentiometer	Sfernice	094	10/5/2022	10/5/2023
Condyle "B" Potentiometer	Sfernice	095	10/5/2022	10/5/2023

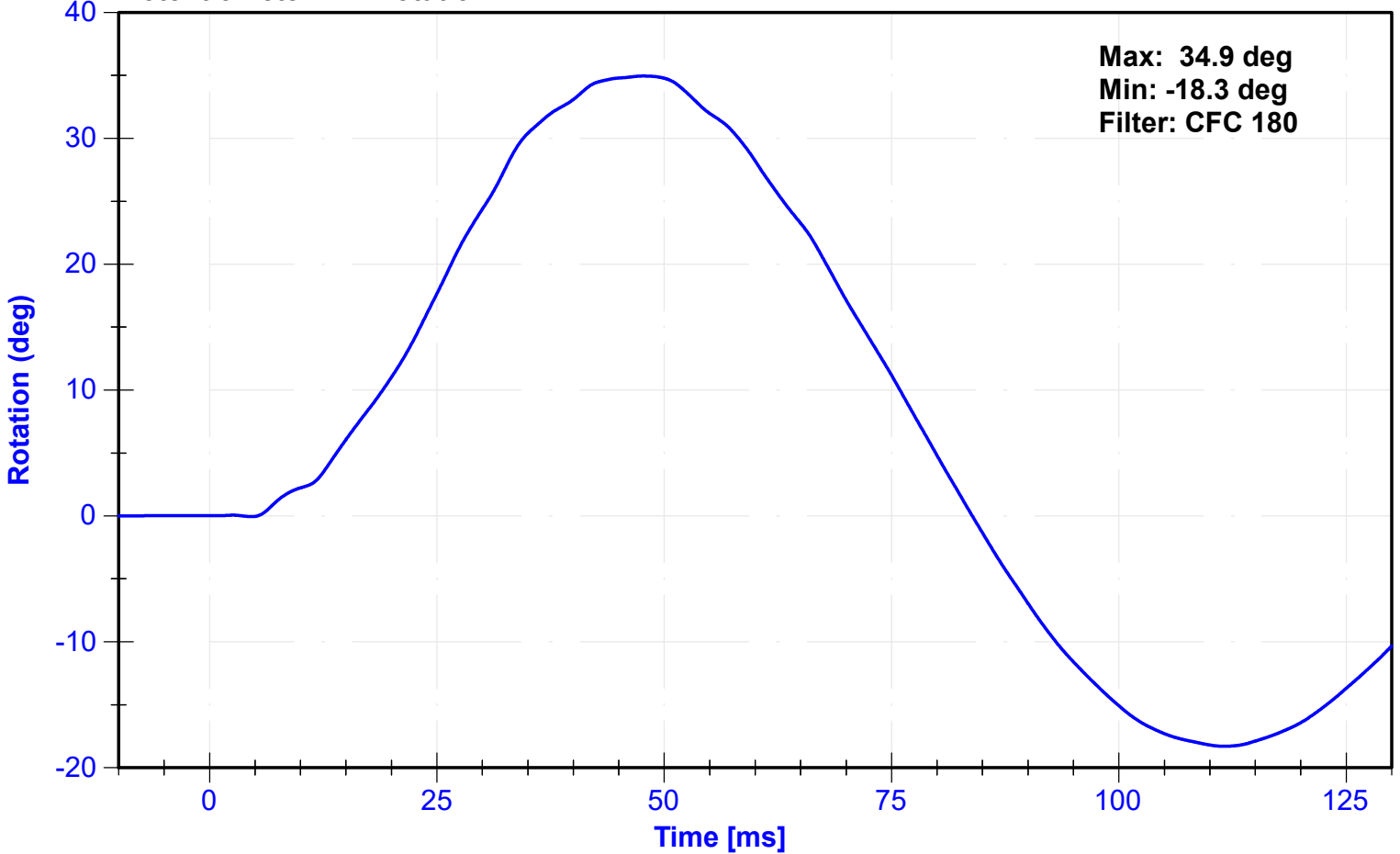


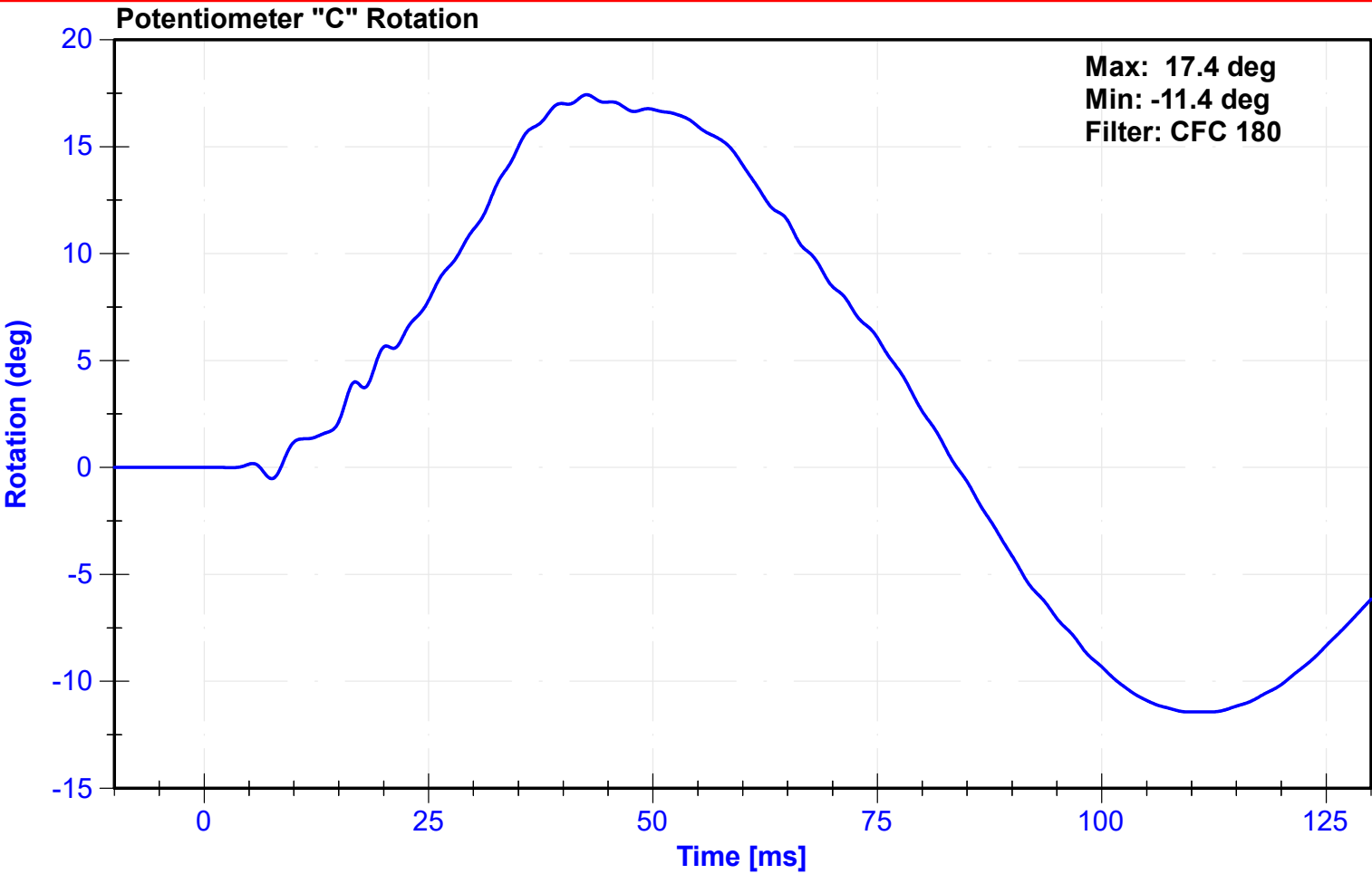
^{1,2} Upper and lower boundaries specified in Appendix I

Spine Rotation



Potentiometer "A" Rotation





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	FTSS	Test Technician	J. Miller
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantell

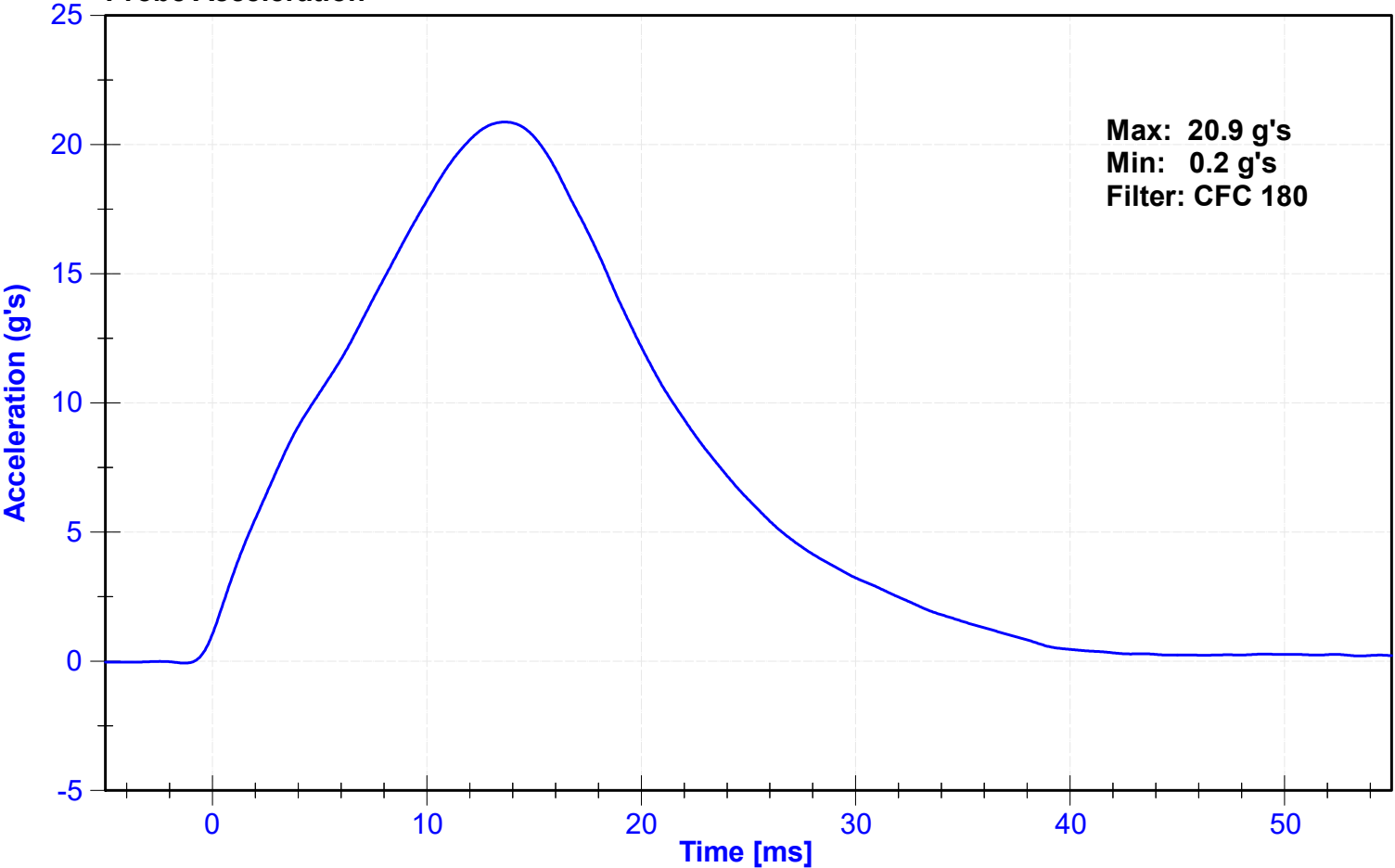
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.6	Pass
Humidity	10	70	%	56.2	Pass
Velocity	4.2	4.4	m/s	4.27	Pass
Resistive Force	4700	5400	N	4780.5	Pass
Time at Peak Resistive Force	11.8	16.1	ms	13.65	Pass
Pubic Force	-1590	-1230	N	-1333.3	Pass
Time at Peak Pubic Force	12.2	17.0	ms	13.90	Pass

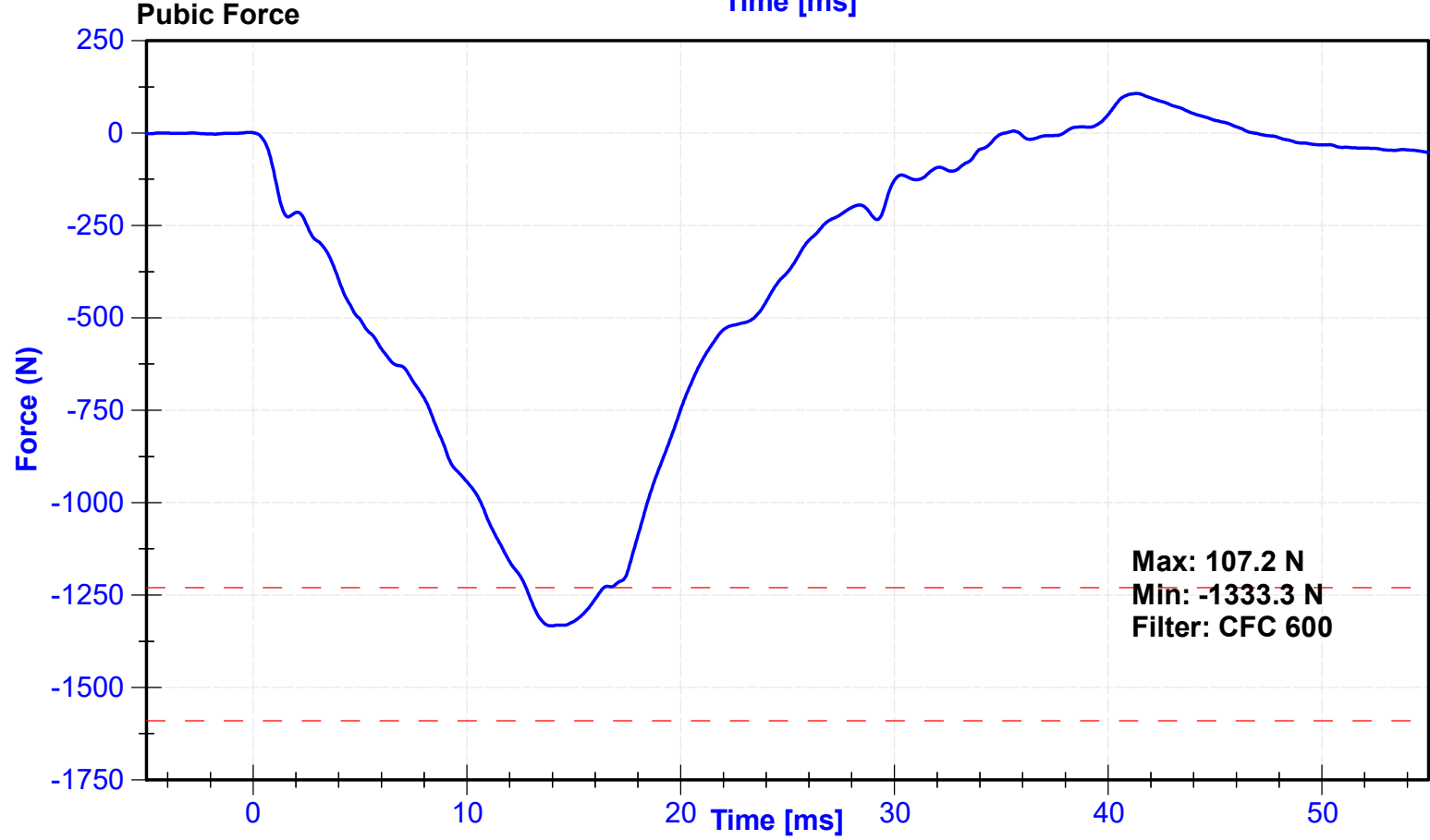
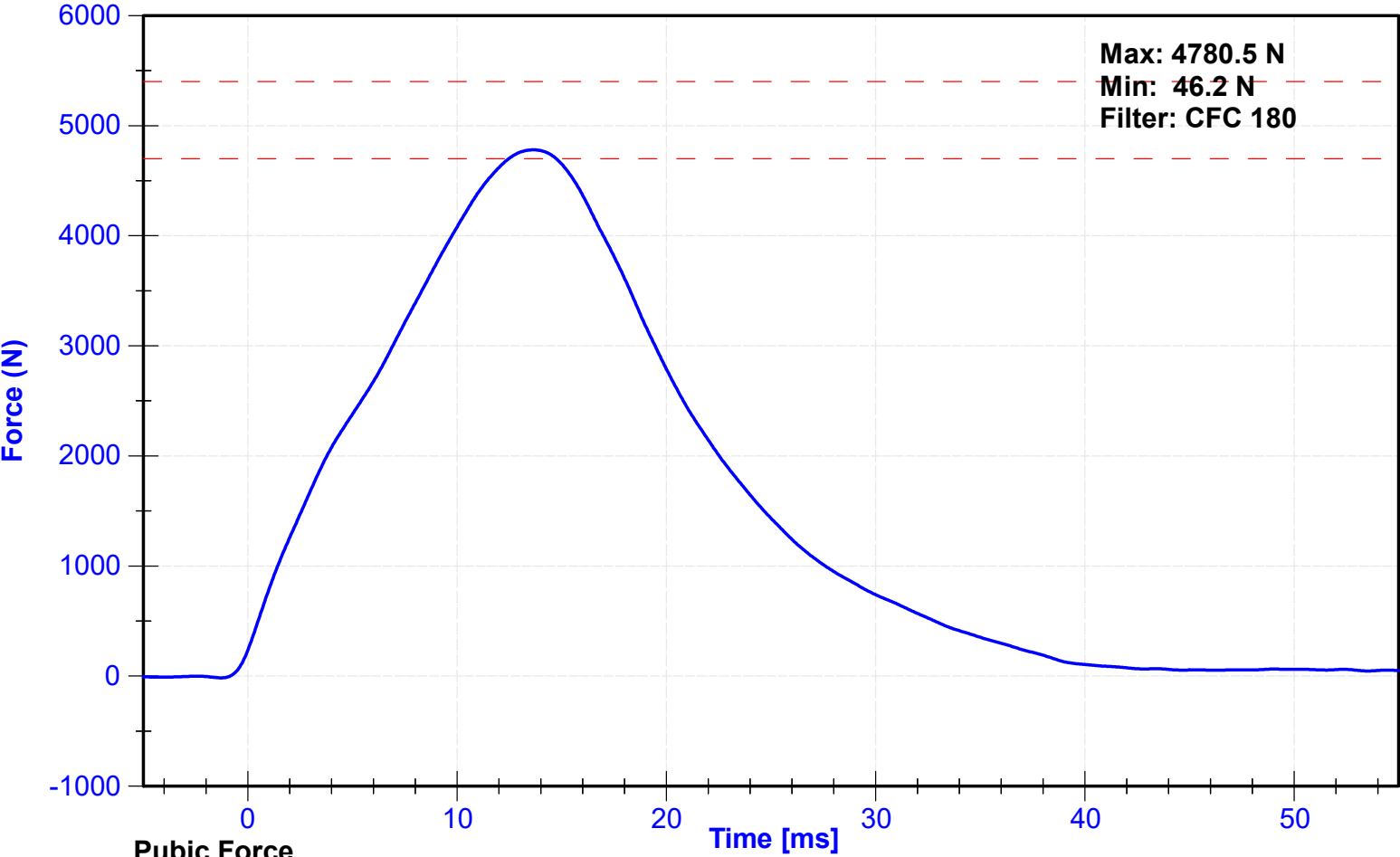
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18546	11/19/2022	11/18/2023
Pubic Load Cell	Denton	464-FY	8/15/2023	8/14/2024

Probe Acceleration



Resistive Force



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

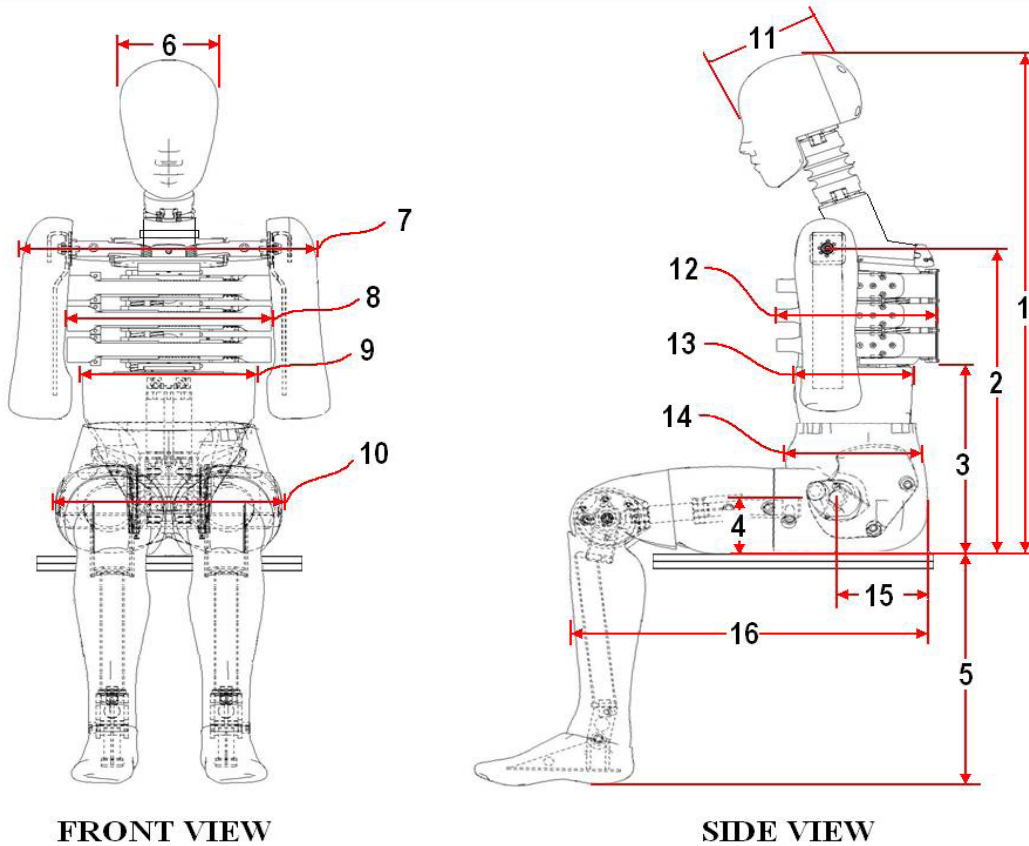


External Measurements - EuroSID-2re

Technician: K. Brogan

Date: 09/13/2023

Dummy Serial Number: DG5348



FRONT VIEW

SIDE VIEW

Dim. No.	Description	Specification (mm)		Result (mm)	Pass/Fail
1	Sitting Height	900	918	914	Pass
2	Seat to Shoulder Joint	558	572	568	Pass
3	Seat to Lower Face of Thoracic Spine Box	346	356	350	Pass
4	Seat to Hip Joint (center of bolt)	97	103	102	Pass
5	Sole to Seat, Sitting	333	451	414	Pass
6	Head Width	152	158	156	Pass
7	Shoulder/Arm Width	461	479	472	Pass
8	Thorax Width	322	332	325	Pass
9	Abdomen Width	273	287	281	Pass
10	Pelvis Lap Width	359	373	368	Pass
11	Head Depth	196	206	201	Pass
12	Thorax Depth	262	272	268	Pass
13	Abdomen Depth	194	204	198	Pass
14	Pelvis Depth	235	245	241	Pass
15	Back of Buttocks to Hip Joint (center of bolt)	150	160	155	Pass
16	Back of Buttocks to Front Knee	597	615	607	Pass

ATD Manufacturer	FTSS	Test Technician	D. Sakona
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantell

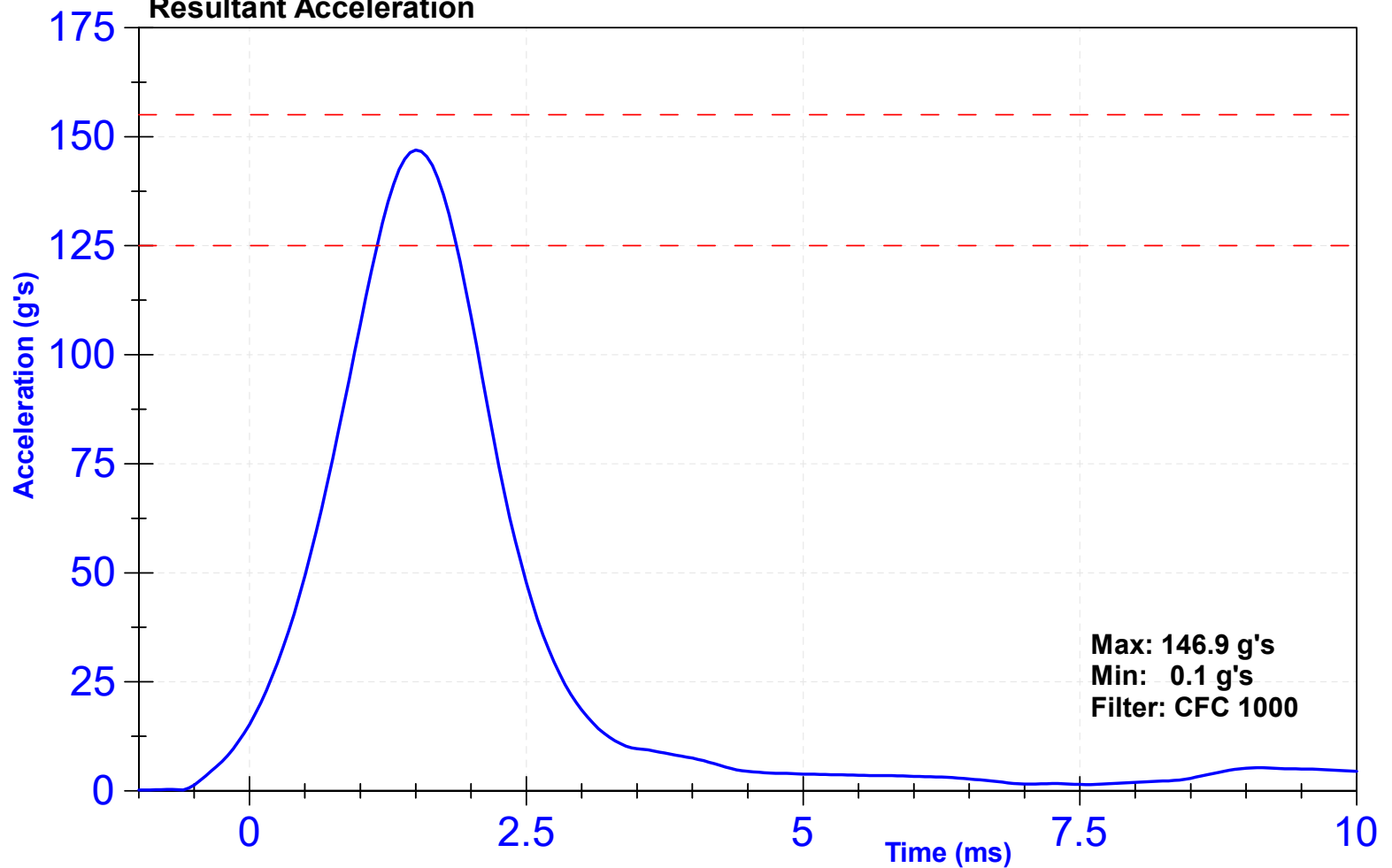
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.6	Pass
Humidity	10	70	%	61	Pass
Resultant Acceleration	125	155	g's	146.9	Pass
Oscillation	0	15	%	3.60	Pass
Fore-Aft Acceleration	-15	15	g's	8.2	Pass

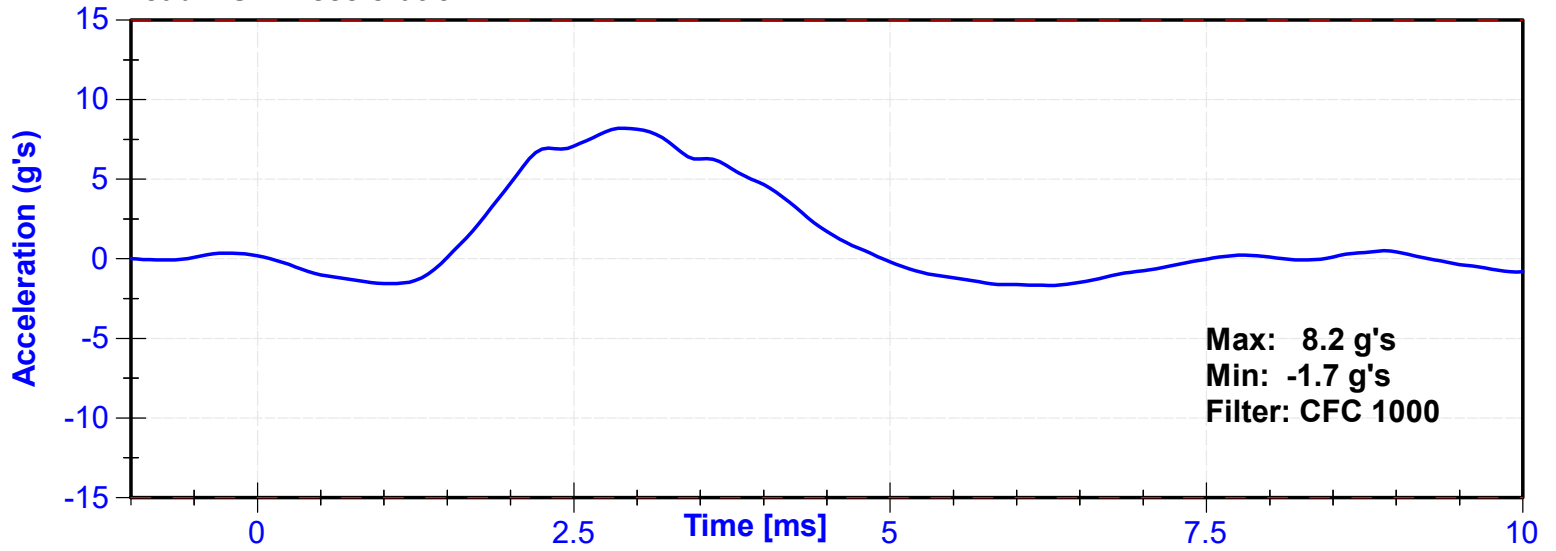
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	Endevco	18613	9/1/2023	2/28/2024
Y Accelerometer	Endevco	18472	9/1/2023	2/28/2024
Z Accelerometer	Endevco	18663	9/1/2023	2/28/2024

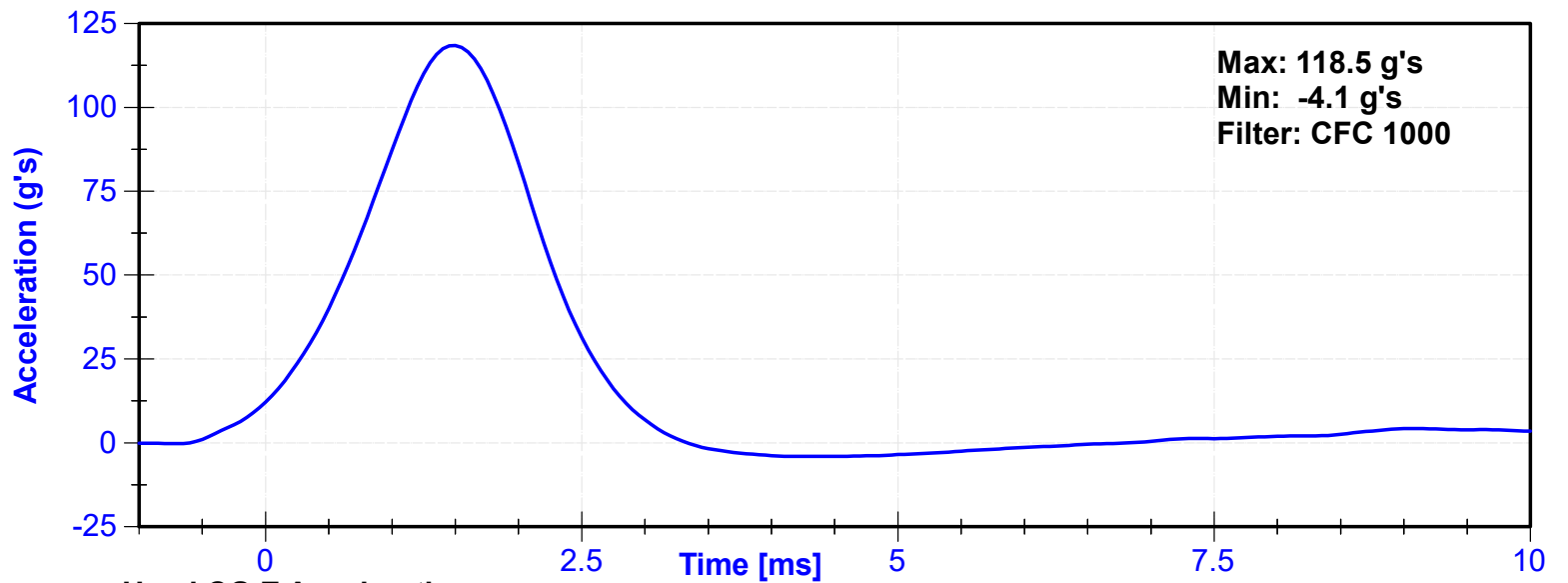
Resultant Acceleration



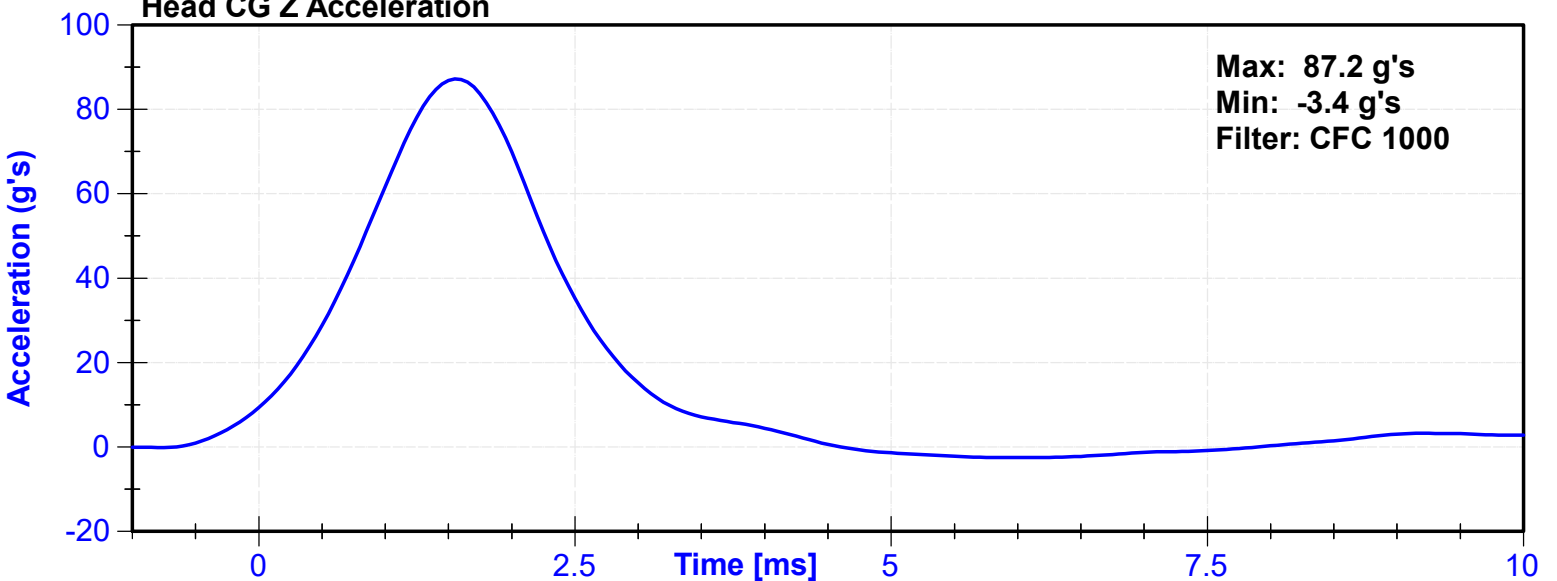
Head CG X Acceleration



Head CG Y Acceleration



Head CG Z Acceleration



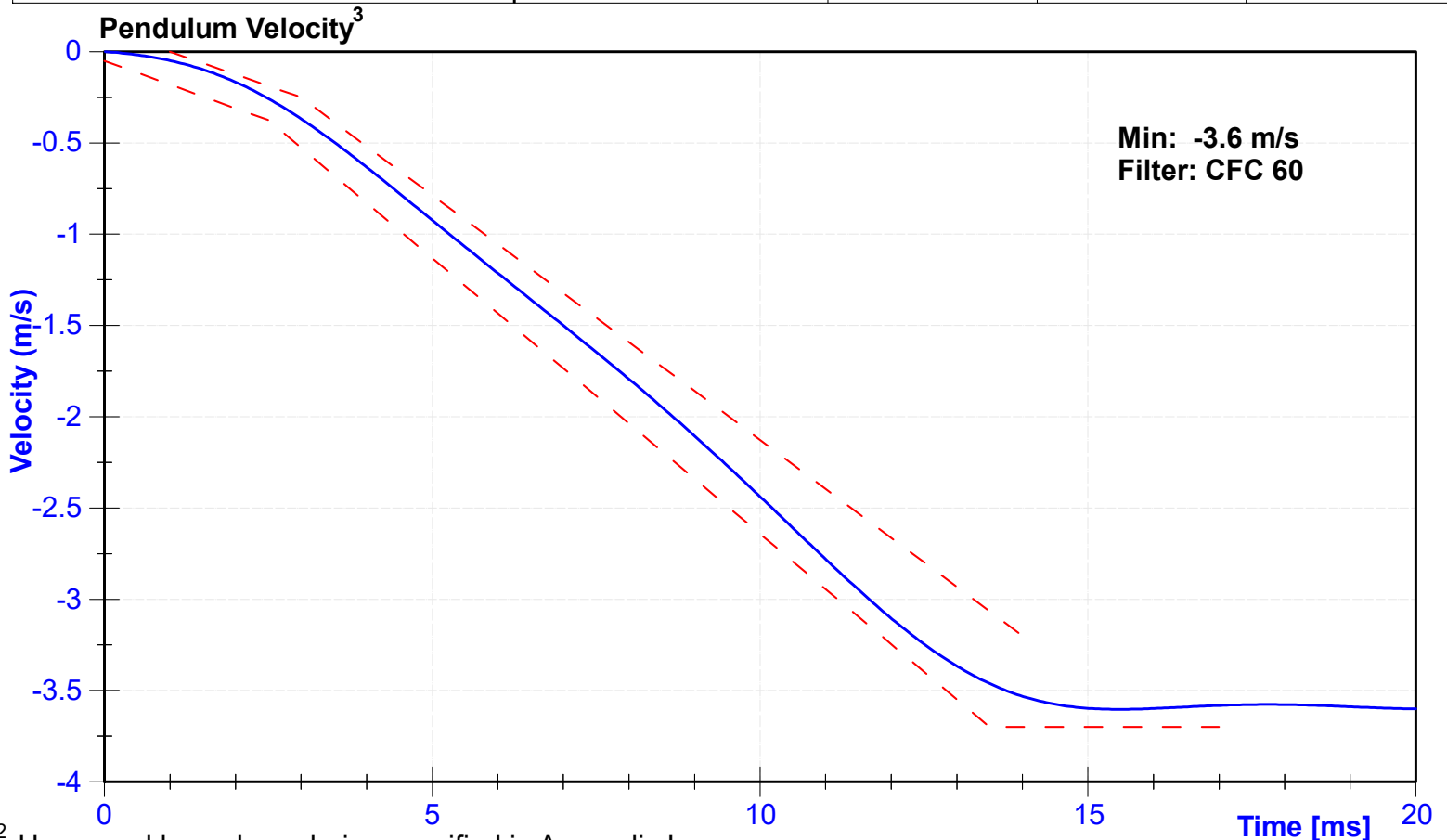
ATD Manufacturer	FTSS	Test Technician	D. Sakona
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.7	Pass
Humidity	10	70	%	51	Pass
Velocity	3.3	3.5	m/s	3.41	Pass
Lateral Neck Rotation	49	59	deg	52.6	Pass
Time at Maximum Rotation	54	66	ms	55.6	Pass
Time of Rotation Decay from Maximum	53	88	ms	58.3	Pass
Pendulum Velocity Overall Corridor	Lower Boundary ¹	Upper Boundary ²	m/s	See Plot ³	Pass

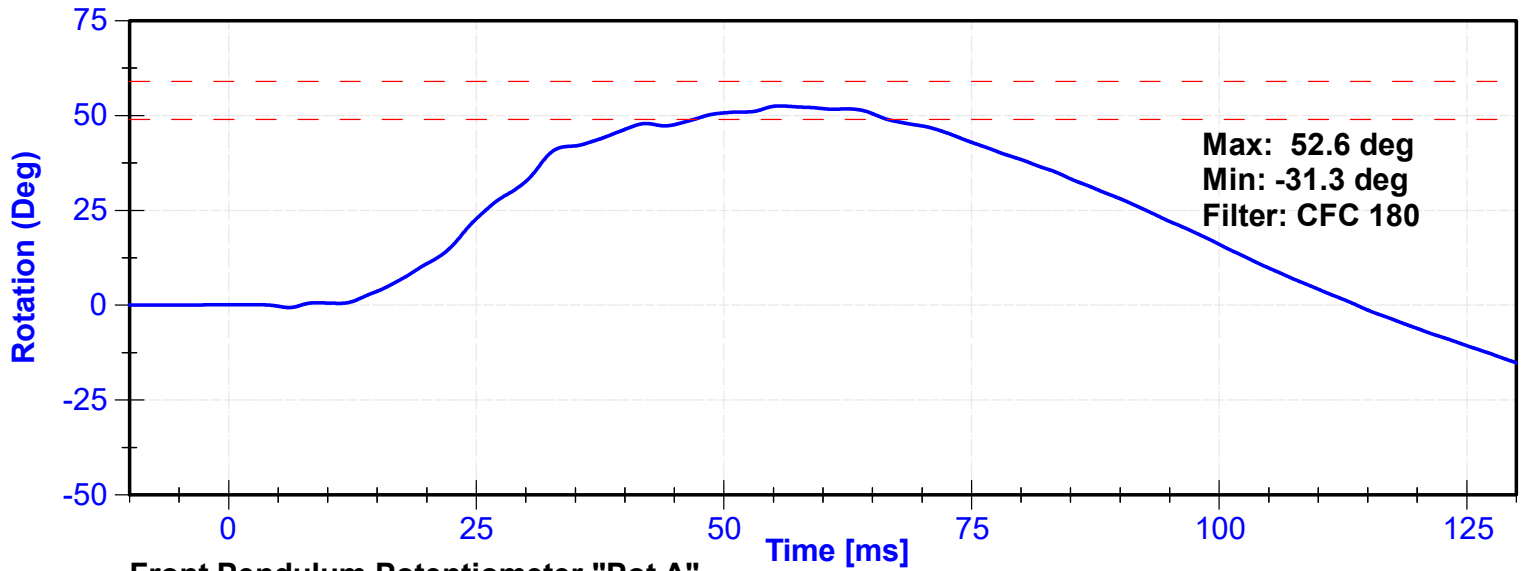
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	C16503	10/26/2022	10/26/2023
Front Pendulum Potentiometer	Sfernice	094	10/5/2022	10/5/2023
Headform Potentiometer	Sfernice	095	10/5/2022	10/5/2023

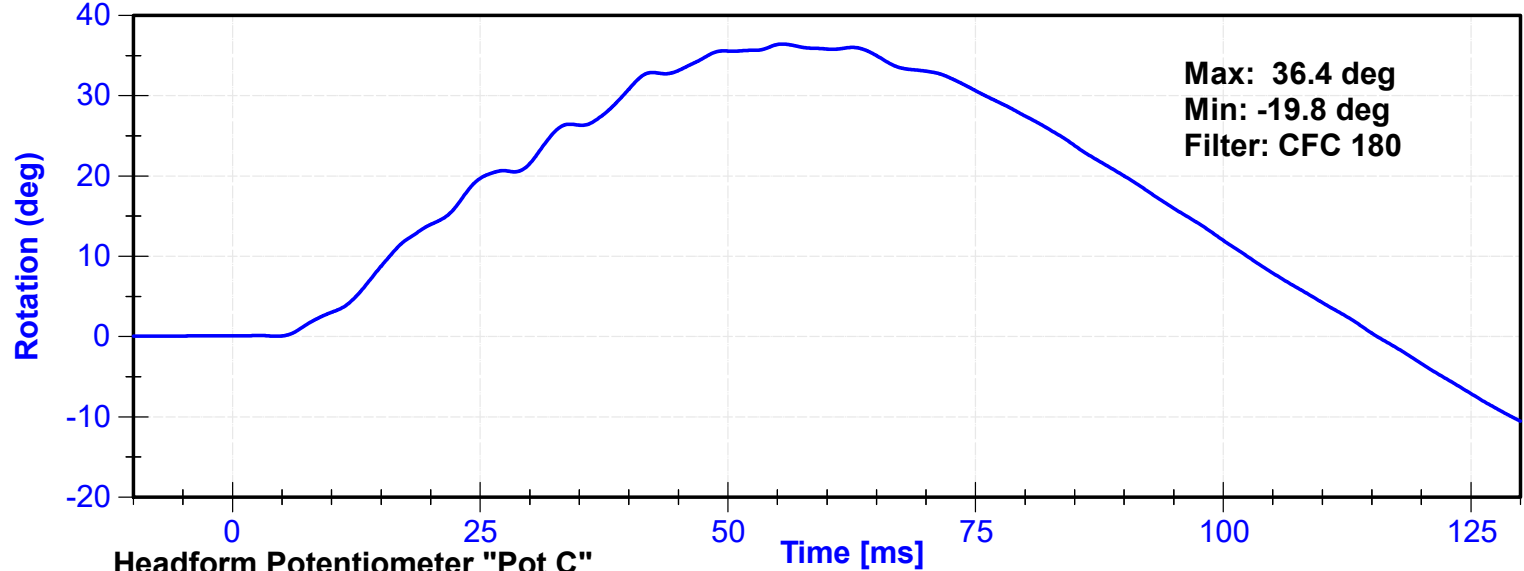


^{1,2} Upper and lower boundaries specified in Appendix I

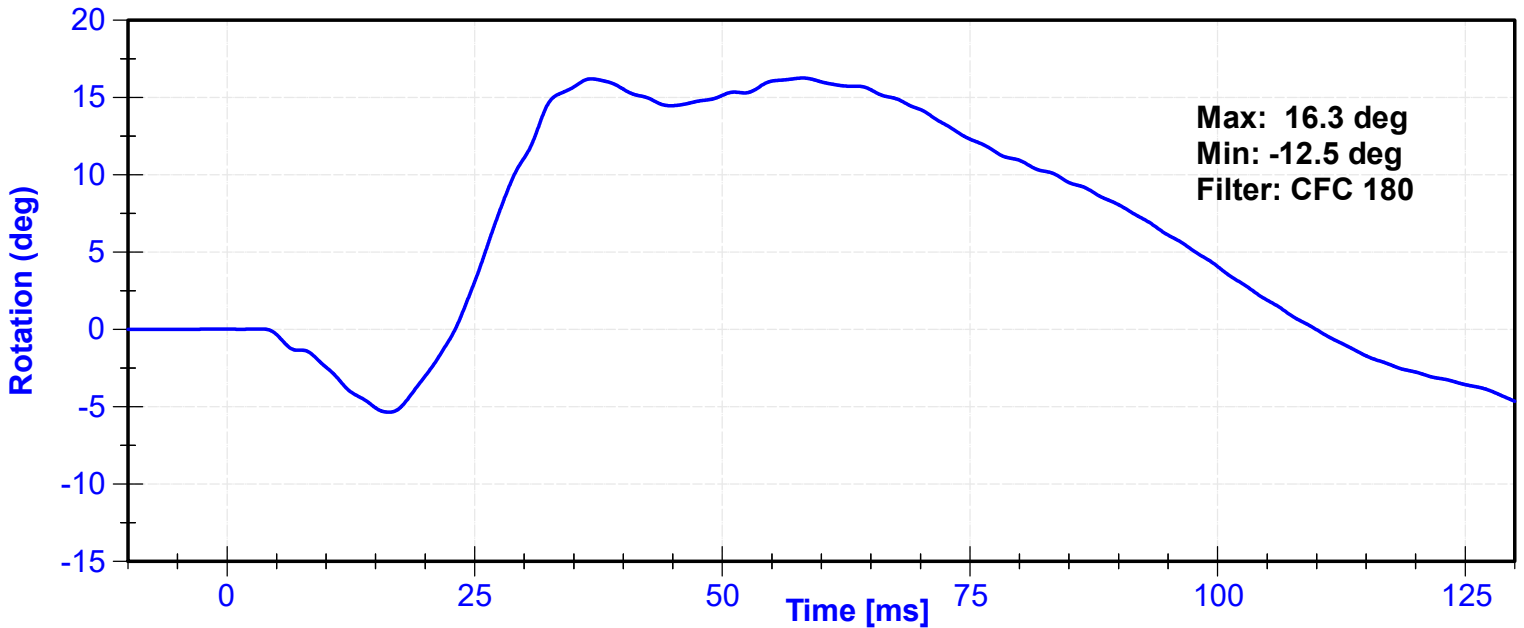
Neck Rotation



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	FTSS	Test Technician	D. Sakona
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantell

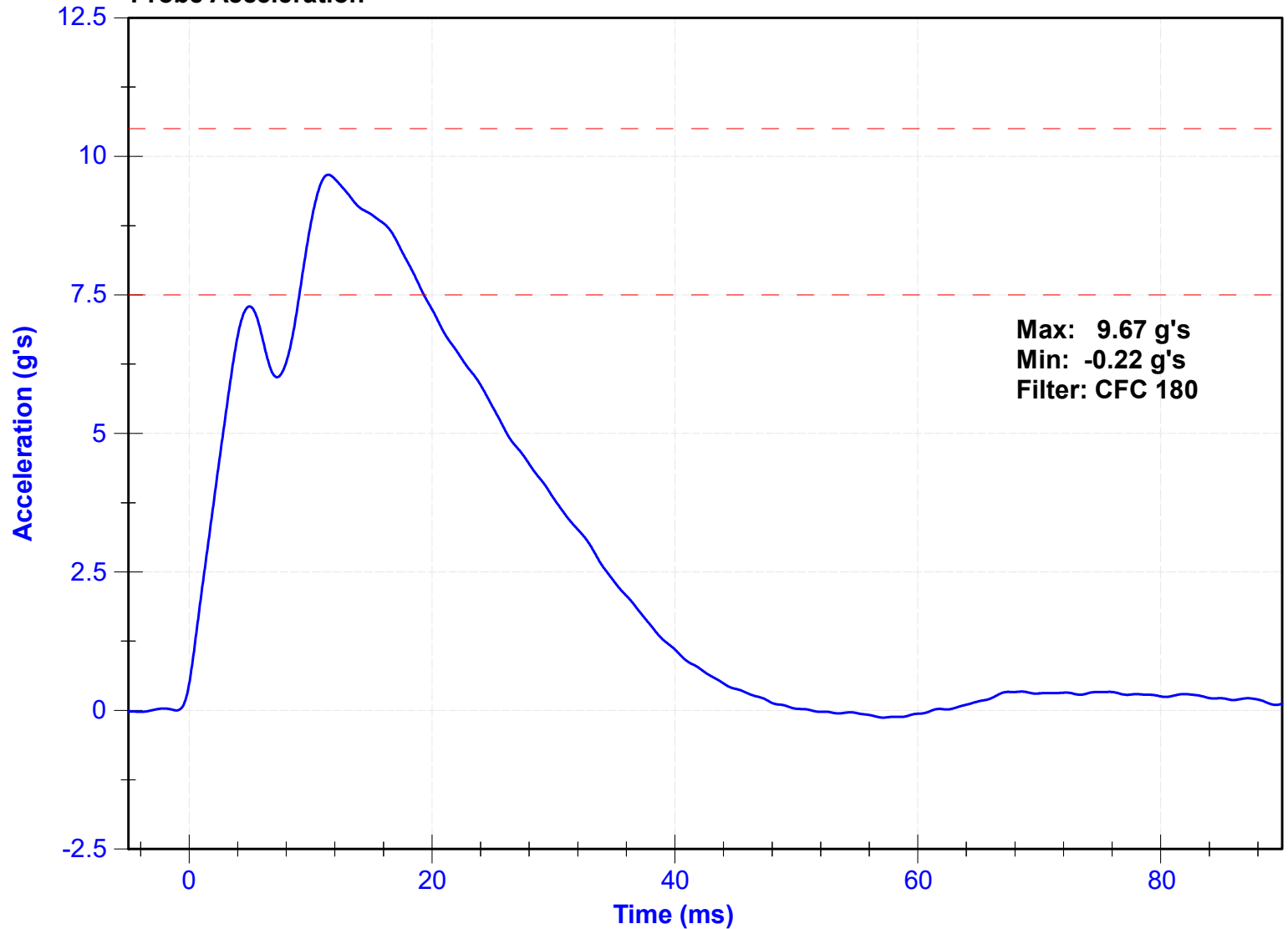
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.7	Pass
Humidity	10	70	%	51	Pass
Velocity	4.2	4.4	m/s	4.29	Pass
Probe Acceleration	7.5	10.5	g's	9.67	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Probe Accelerometer	Endevco	P51736	10/25/2022	10/25/2023

Probe Acceleration



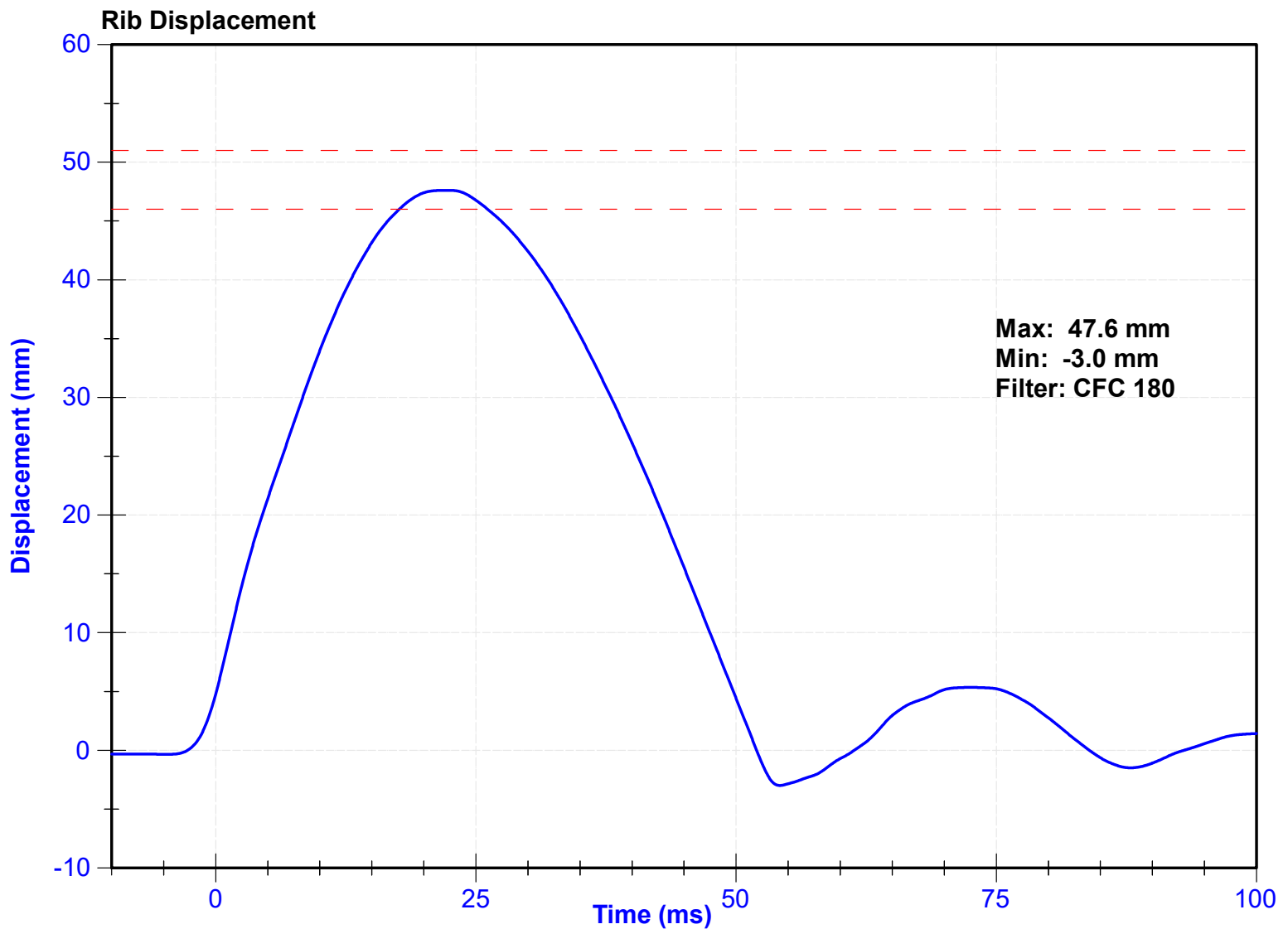
ATD Manufacturer	FTSS	Test Technician	D. Sakona
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantel

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.6	Pass
Humidity	10	70	%	61	Pass
Rib Displacement	46	51	mm	47.6	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	268GFE	8/8/2023	2/6/2024



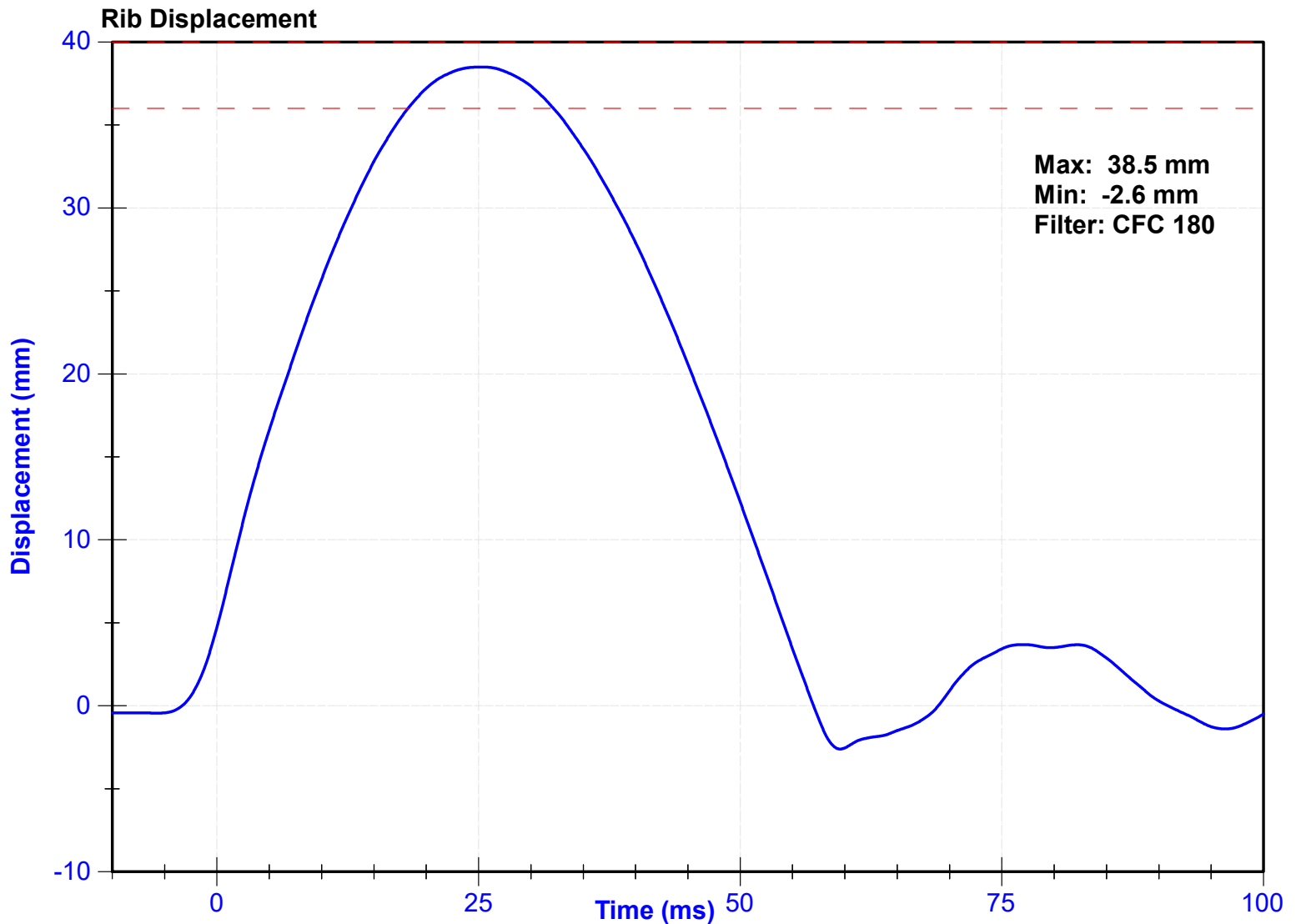
ATD Manufacturer	FTSS	Test Technician	D. Sakona
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantel

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.6	Pass
Humidity	10	70	%	61	Pass
Rib Displacement	36	40	mm	38.5	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	268GFE	8/8/2023	2/6/2024



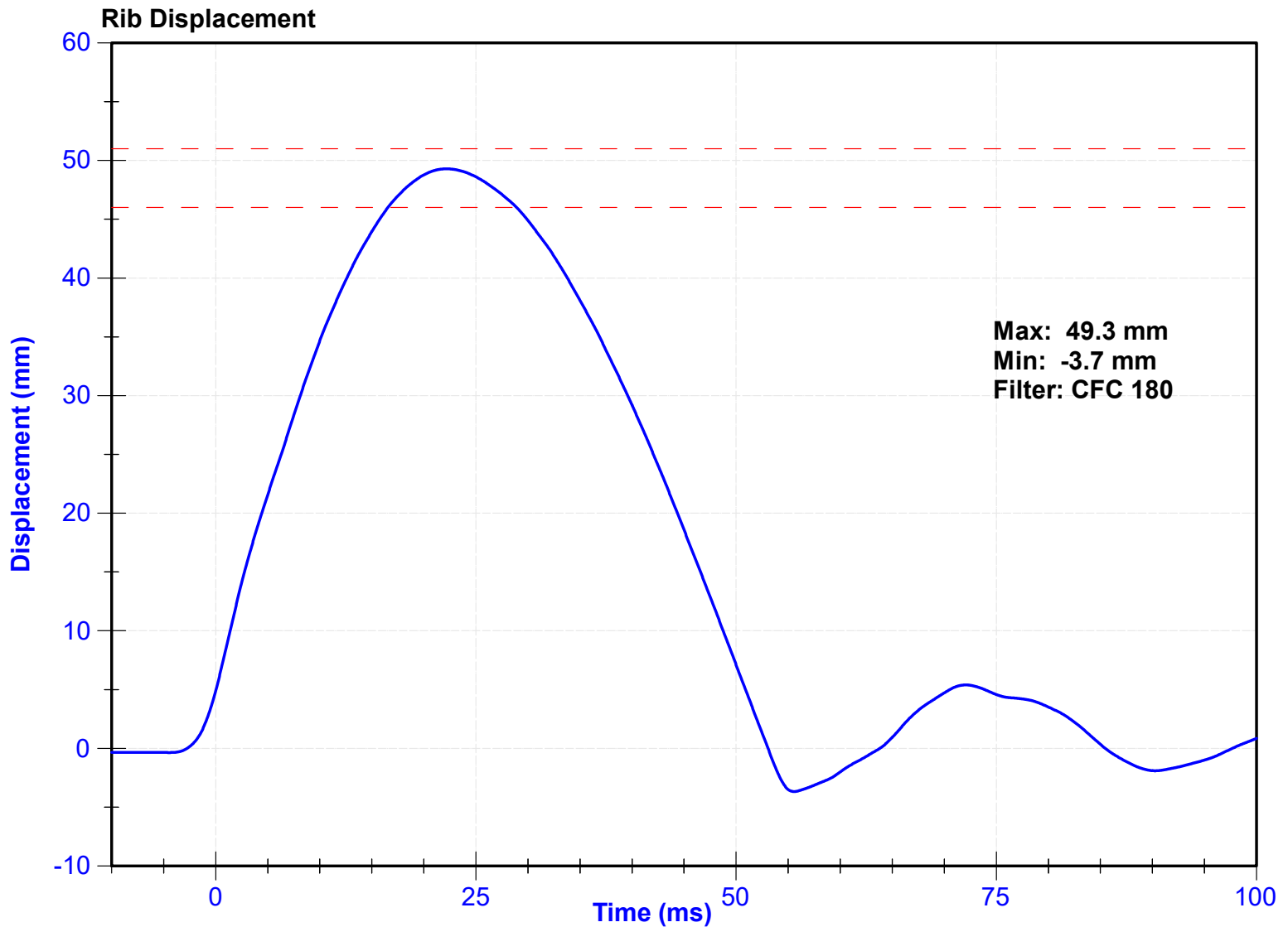
ATD Manufacturer	FTSS	Test Technician	D. Sakona
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantel

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.6	Pass
Humidity	10	70	%	61	Pass
Rib Displacement	46	51	mm	49.3	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	269GFE	8/8/2023	2/6/2024



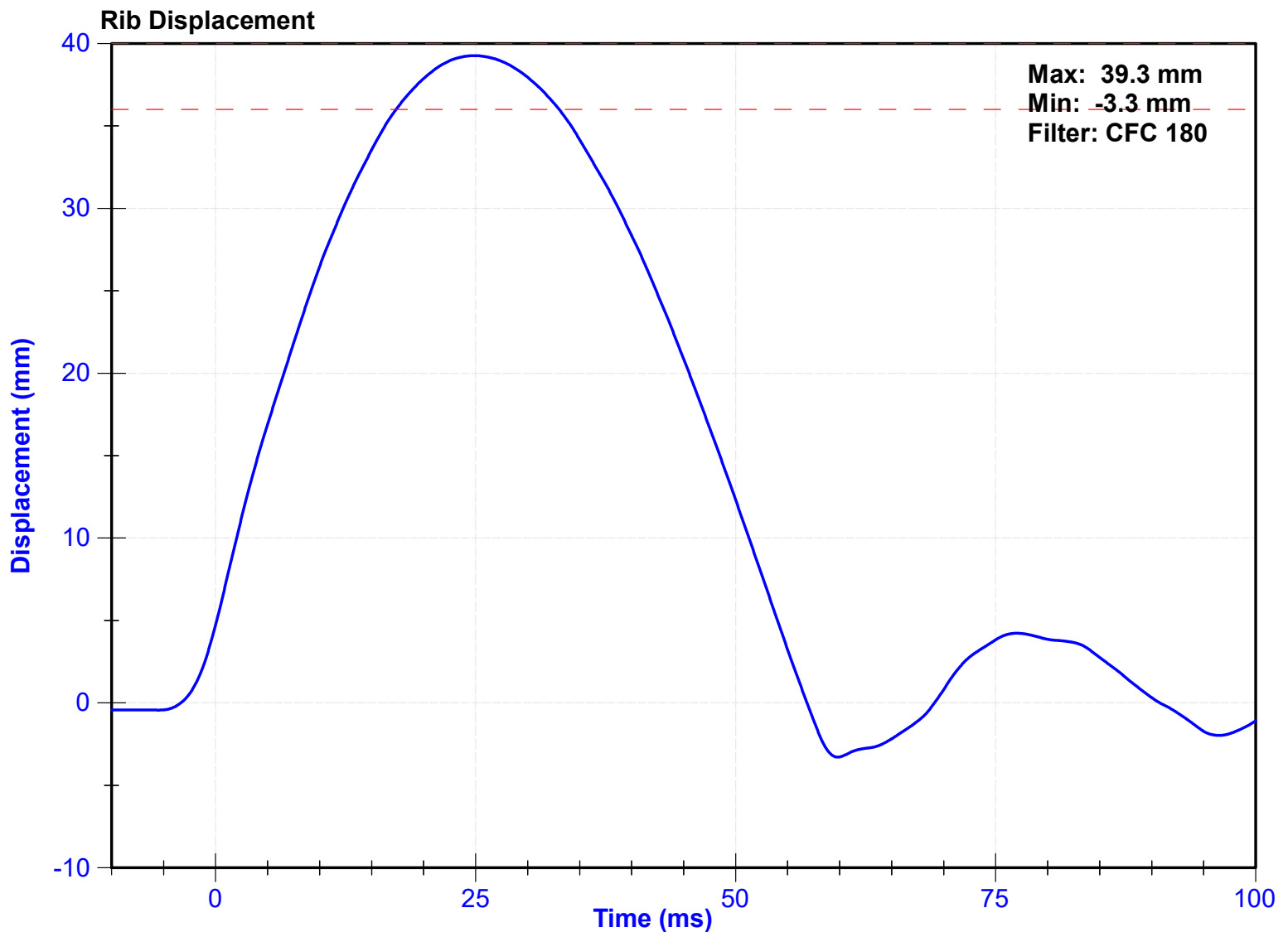
ATD Manufacturer	FTSS	Test Technician	D. Sakona
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantel

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.6	Pass
Humidity	10	70	%	61	Pass
Rib Displacement	36	40	mm	39.3	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	269GFE	8/8/2023	2/6/2024



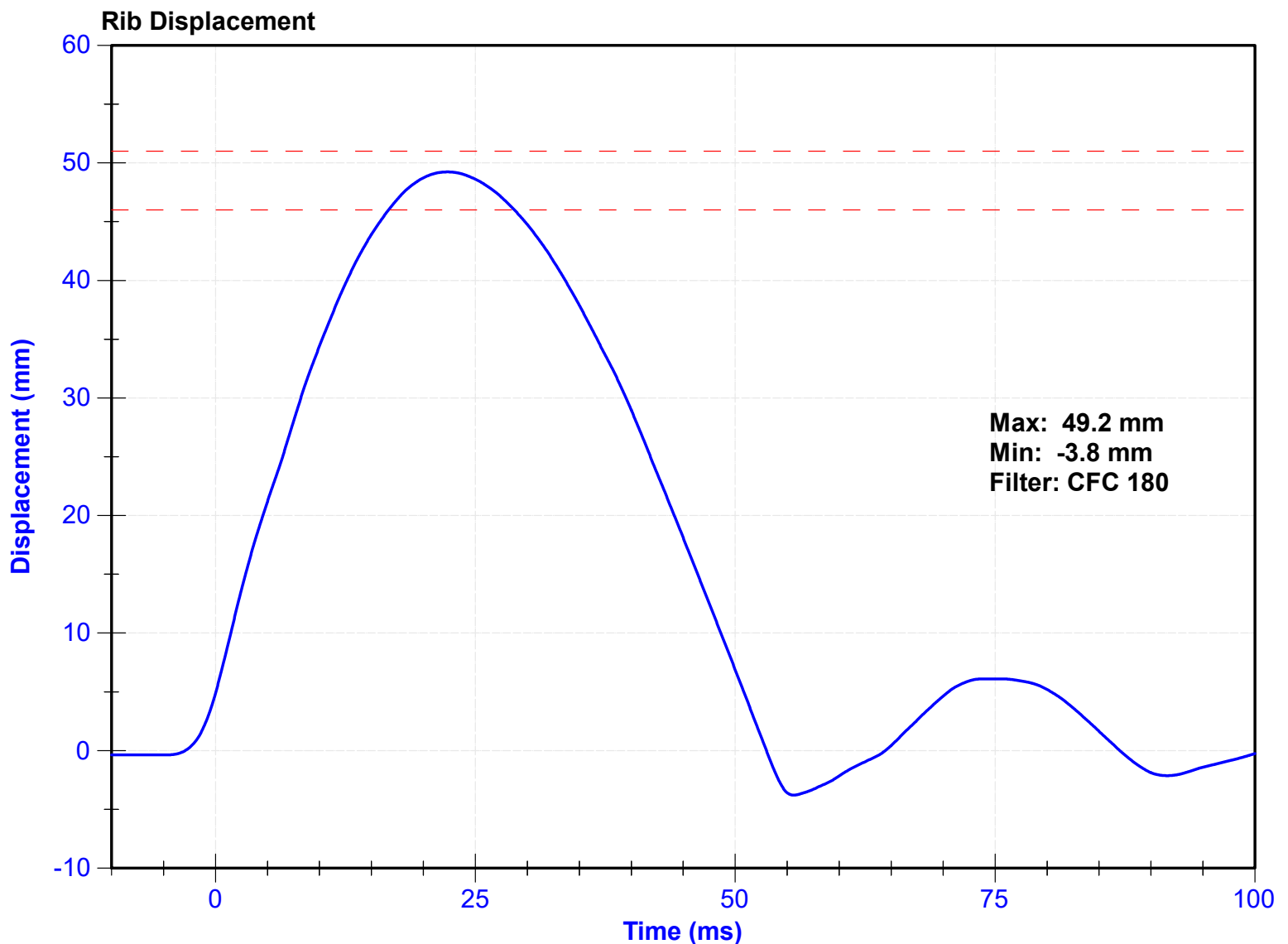
ATD Manufacturer	FTSS	Test Technician	D. Sakona
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantel

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.6	Pass
Humidity	10	70	%	61	Pass
Rib Displacement	46	51	mm	49.2	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	270GFE	8/8/2023	2/6/2024



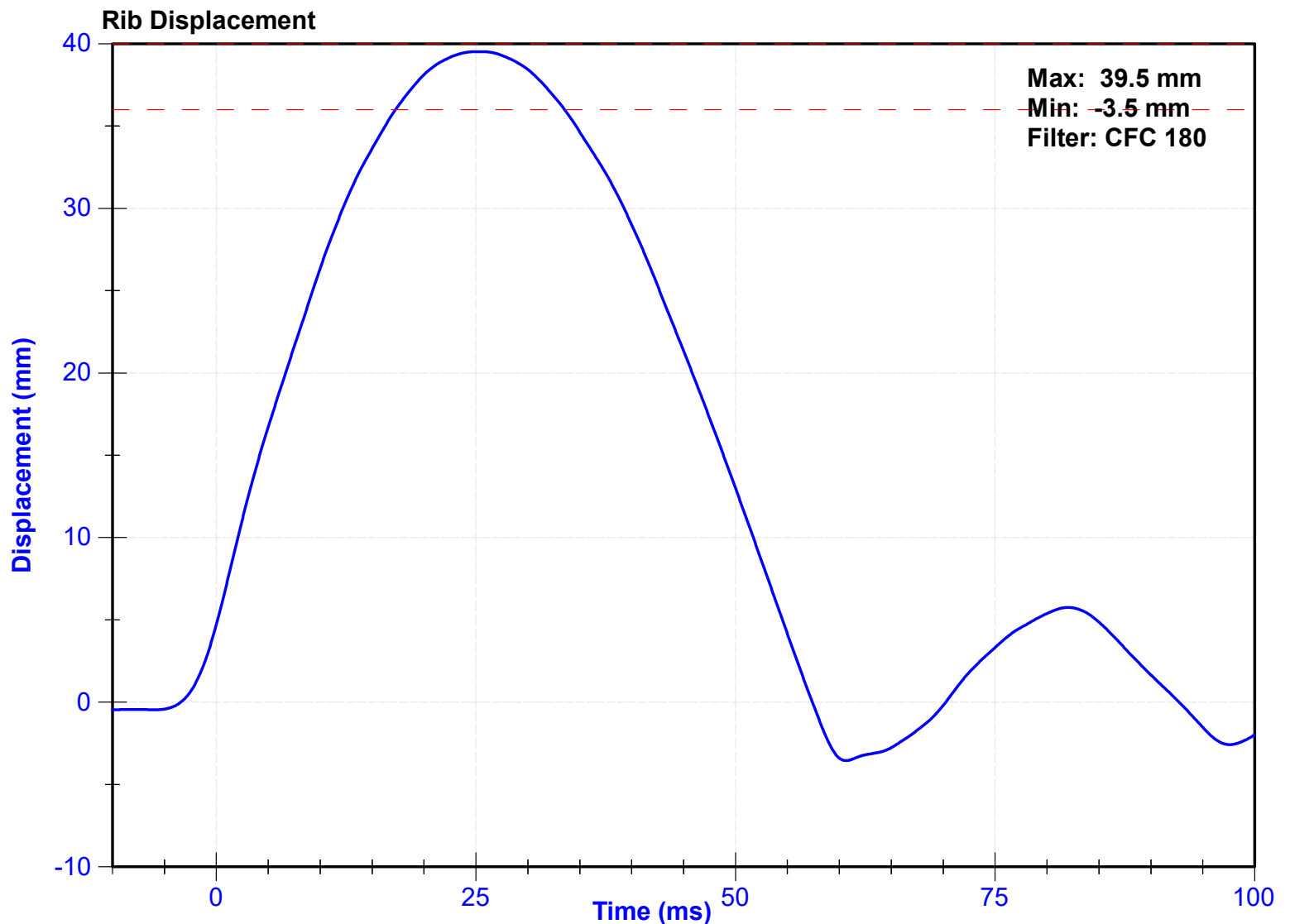
ATD Manufacturer	FTSS	Test Technician	D. Sakona
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantel

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.6	Pass
Humidity	10	70	%	61	Pass
Rib Displacement	36	40	mm	39.5	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	270GFE	8/8/2023	2/6/2024



ATD Manufacturer	FTSS	Test Technician	D. Sakona
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantell

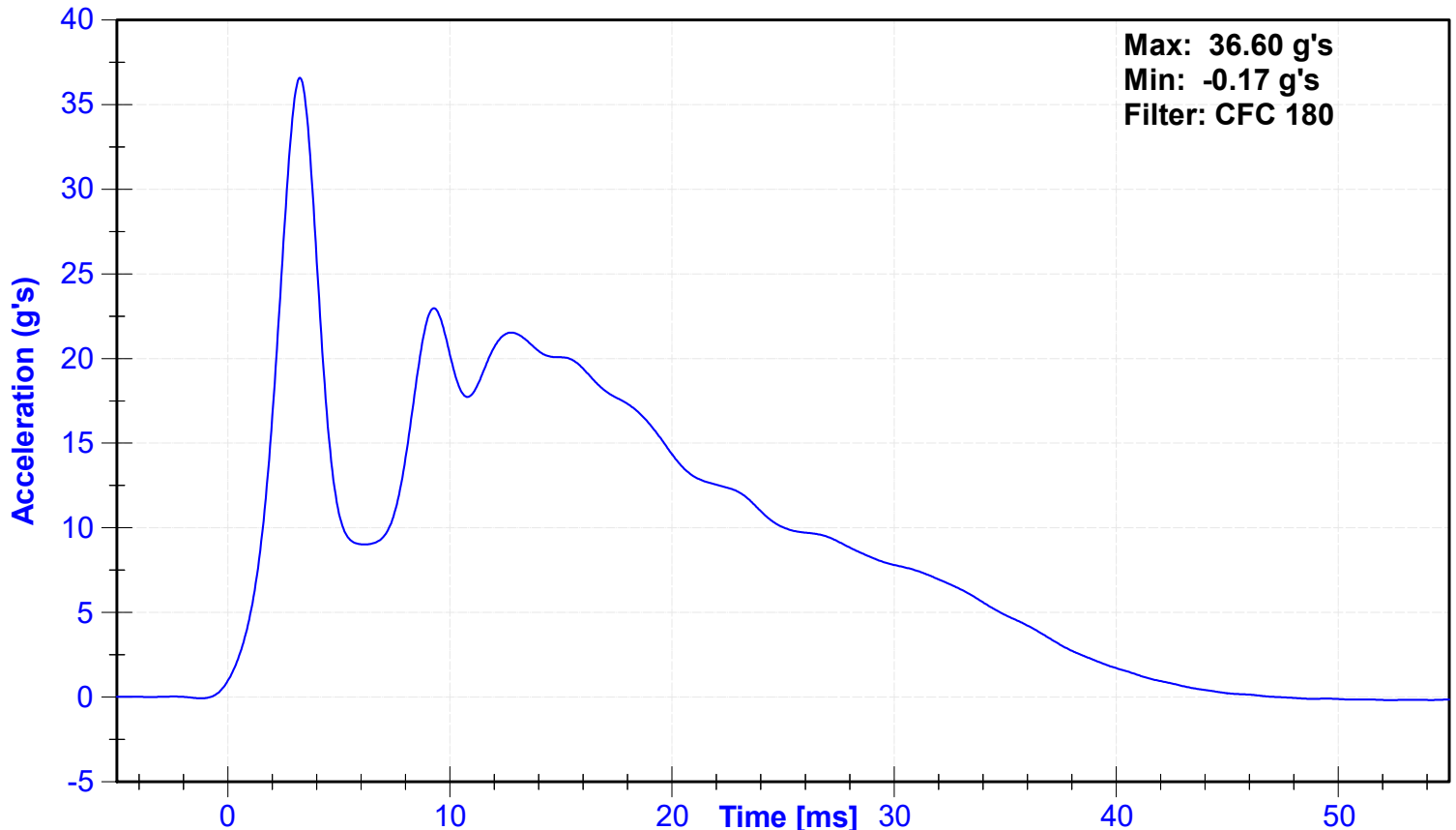
Results

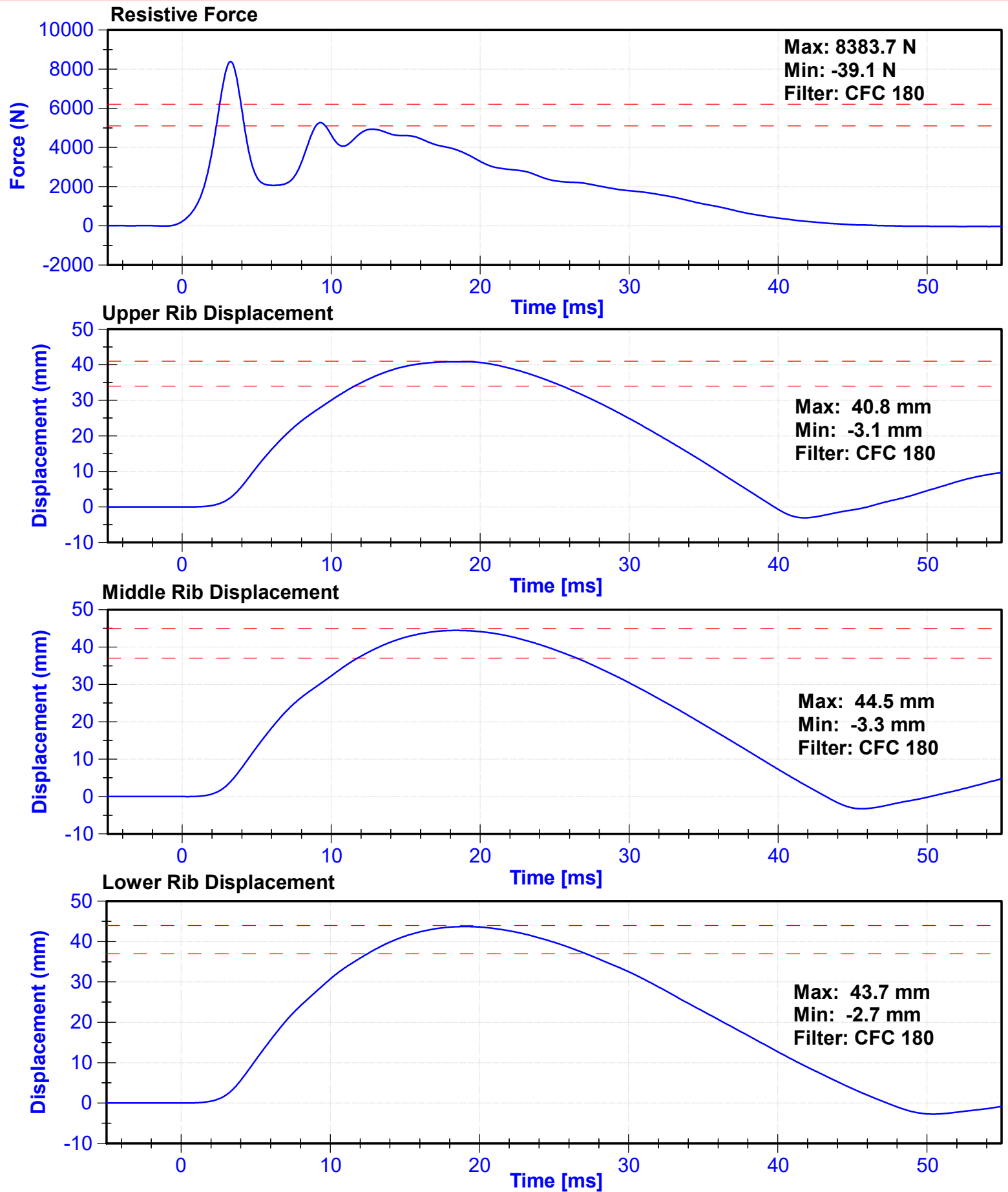
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.7	Pass
Humidity	10	70	%	51	Pass
Velocity	5.4	5.6	m/s	5.52	Pass
Resistive Force after 6ms	5100	6200	N	5263.8	Pass
Upper Thorax Rib Deflection	34	41	mm	40.8	Pass
Mid Thorax Rib Deflection	37	45	mm	44.5	Pass
Lower Thorax Rib Deflection	37	44	mm	43.7	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Probe Accelerometer	Endevco	P51736	10/25/2022	10/25/2023
Upper Thorax Rib Potentiometer	Honeywell	268GFE	8/8/2023	2/6/2024
Middle Thorax Rib Potentiometer	Honeywell	269GFE	8/8/2023	2/6/2024
Lower Thorax Rib Potentiometer	Honeywell	270GFE	8/8/2023	2/6/2024

Probe Acceleration





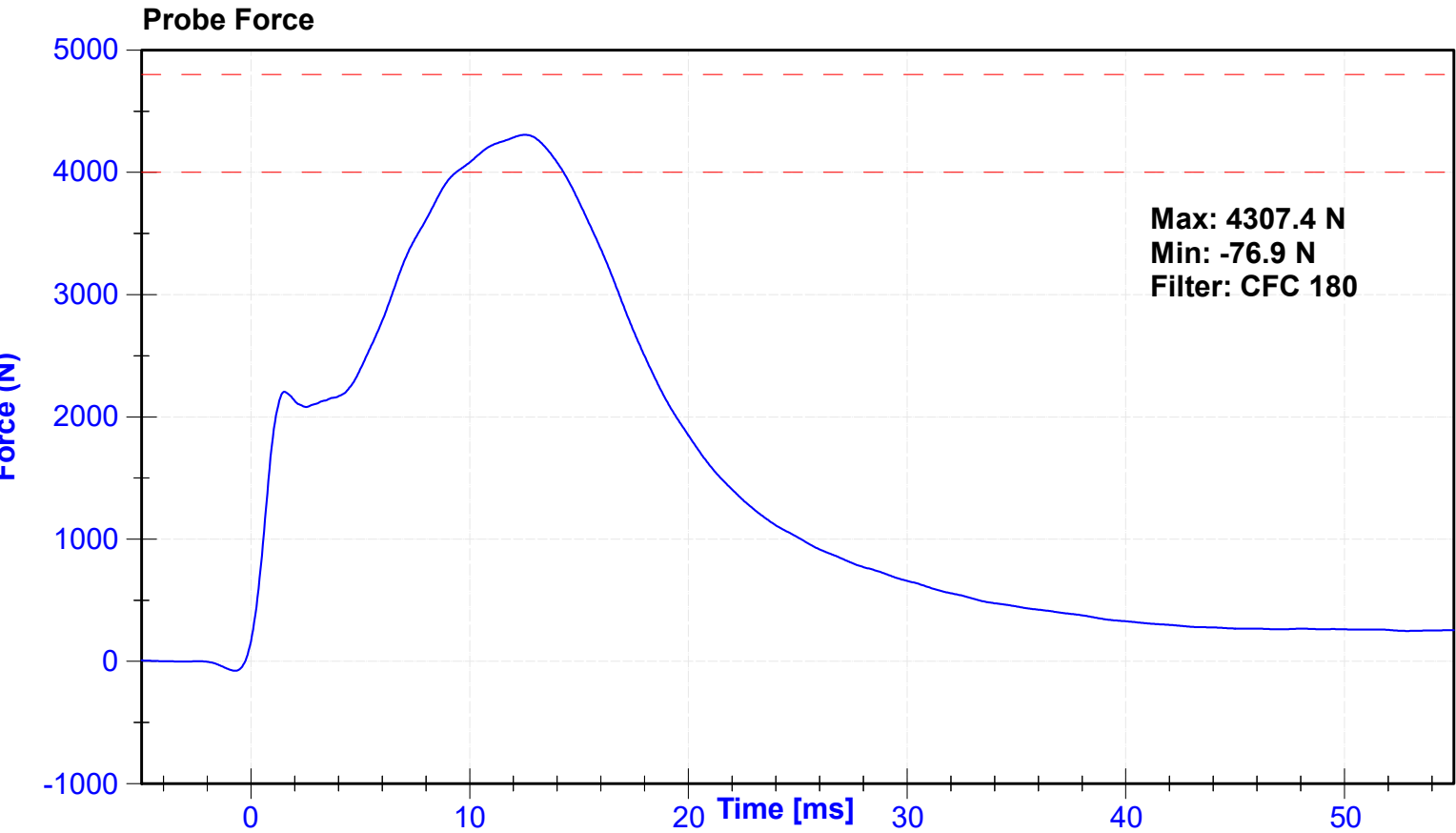
ATD Manufacturer	FTSS	Test Technician	D. Sakona
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantell

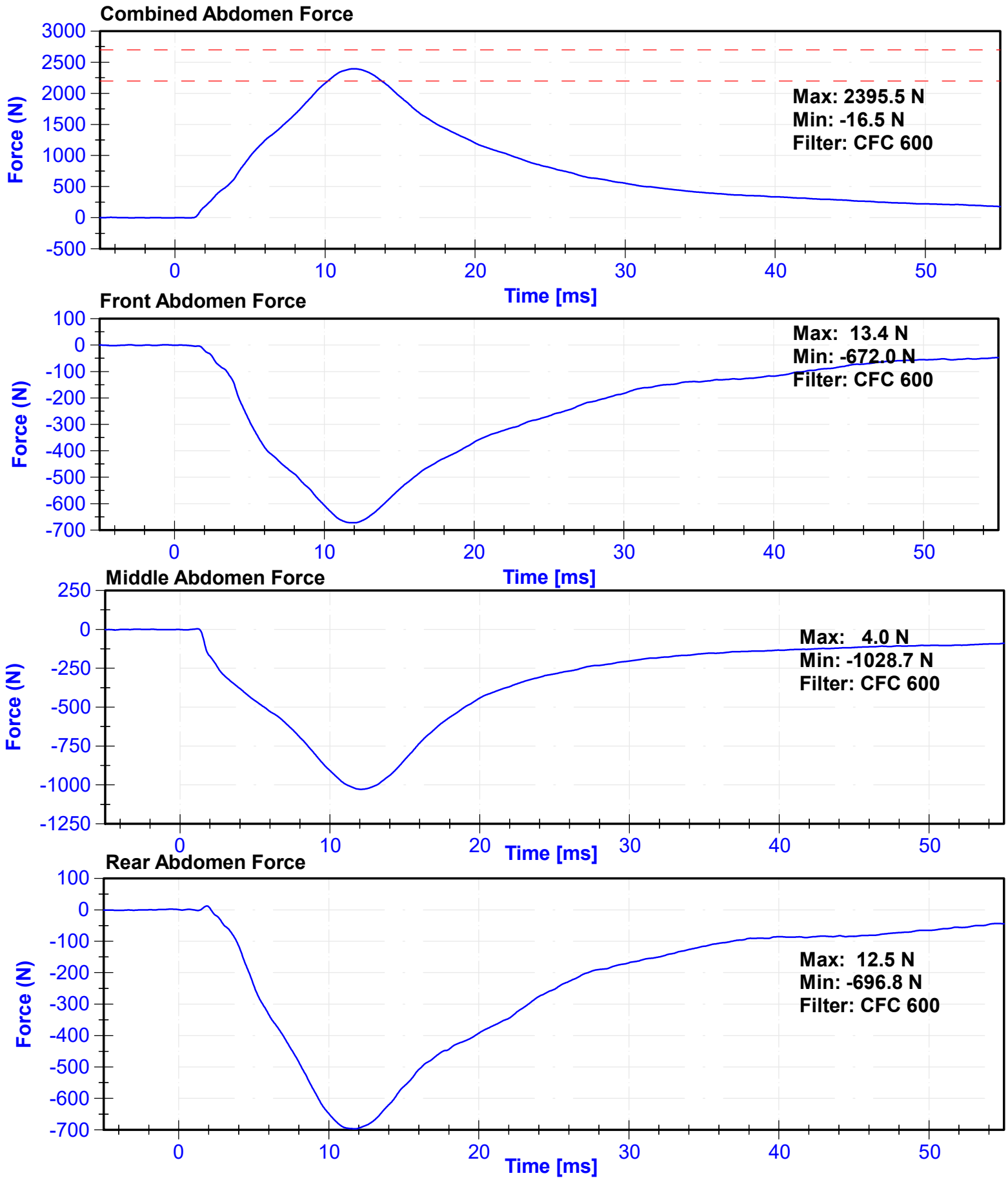
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.7	Pass
Humidity	10	70	%	51	Pass
Velocity	3.9	4.1	m/s	4.03	Pass
Combined Abdomen Force	2200	2700	N	2395.5	Pass
Time at Peak Abdomen Force	10.0	12.3	ms	11.95	Pass
Resistive Probe Force	4000	4800	N	4307.4	Pass
Time at Peak Resistive Force	10.6	13.0	ms	12.55	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	P51736	10/25/2022	10/25/2023
Front Abdomen Load Cell	Denton	1512	8/15/2023	8/14/2024
Middle Abdomen Load Cell	Denton	1526	8/15/2023	8/14/2024
Rear Abdomen Load Cell	Denton	1516	8/15/2023	8/14/2024





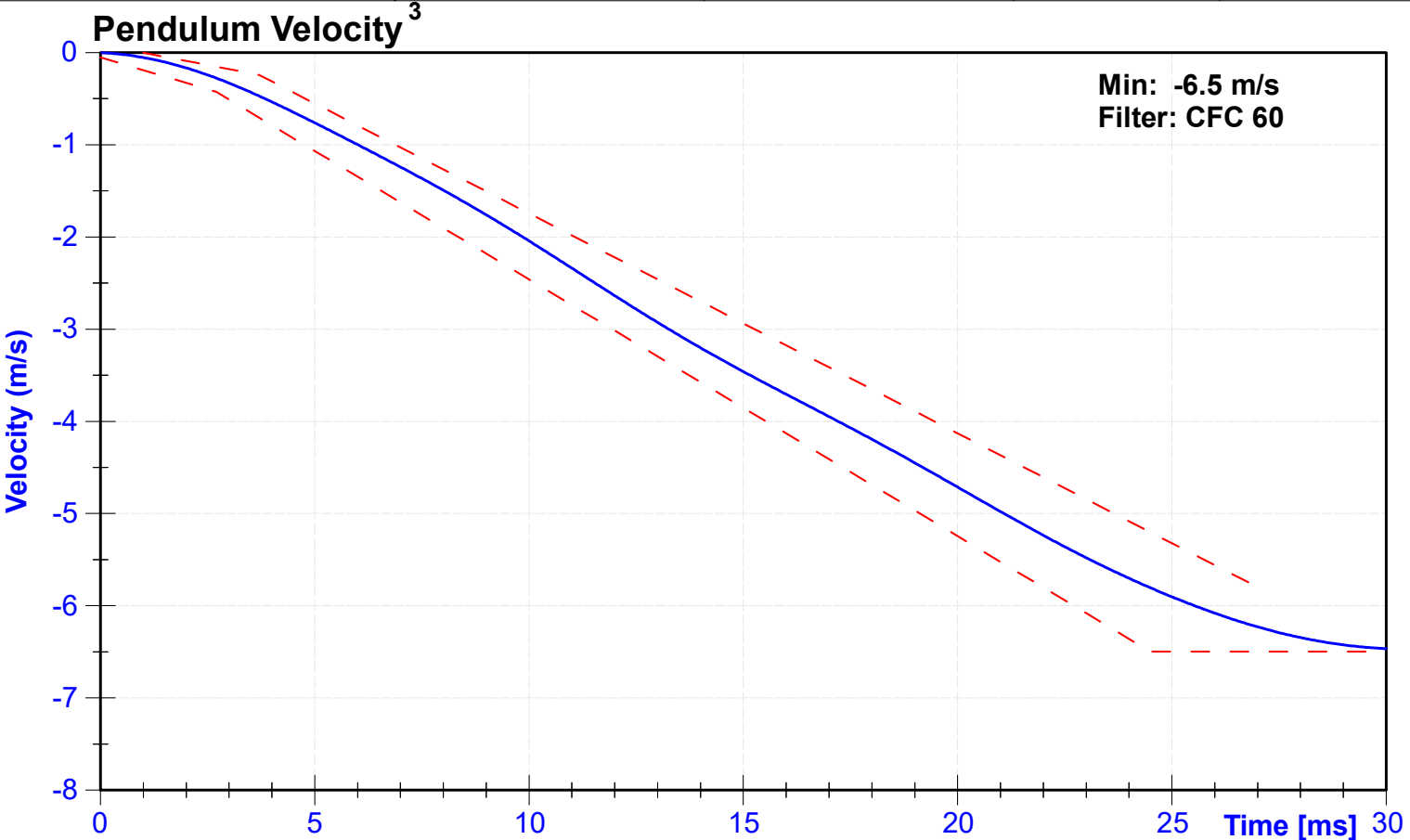
ATD Manufacturer	FTSS	Test Technician	D. Sakona
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.7	Pass
Humidity	10	70	%	51	Pass
Velocity	5.95	6.15	m/s	5.997	Pass
Lateral Spine Rotation	45	55	deg	50.4	Pass
Time at Maximum Rotation	39	53	ms	44.4	Pass
Time of Decay to Zero Degrees	37	57	ms	37.7	Pass
Pendulum Velocity Overall Corridor	Lower Boundary ¹	Upper Boundary ²	m/s	See Plot ³	Pass

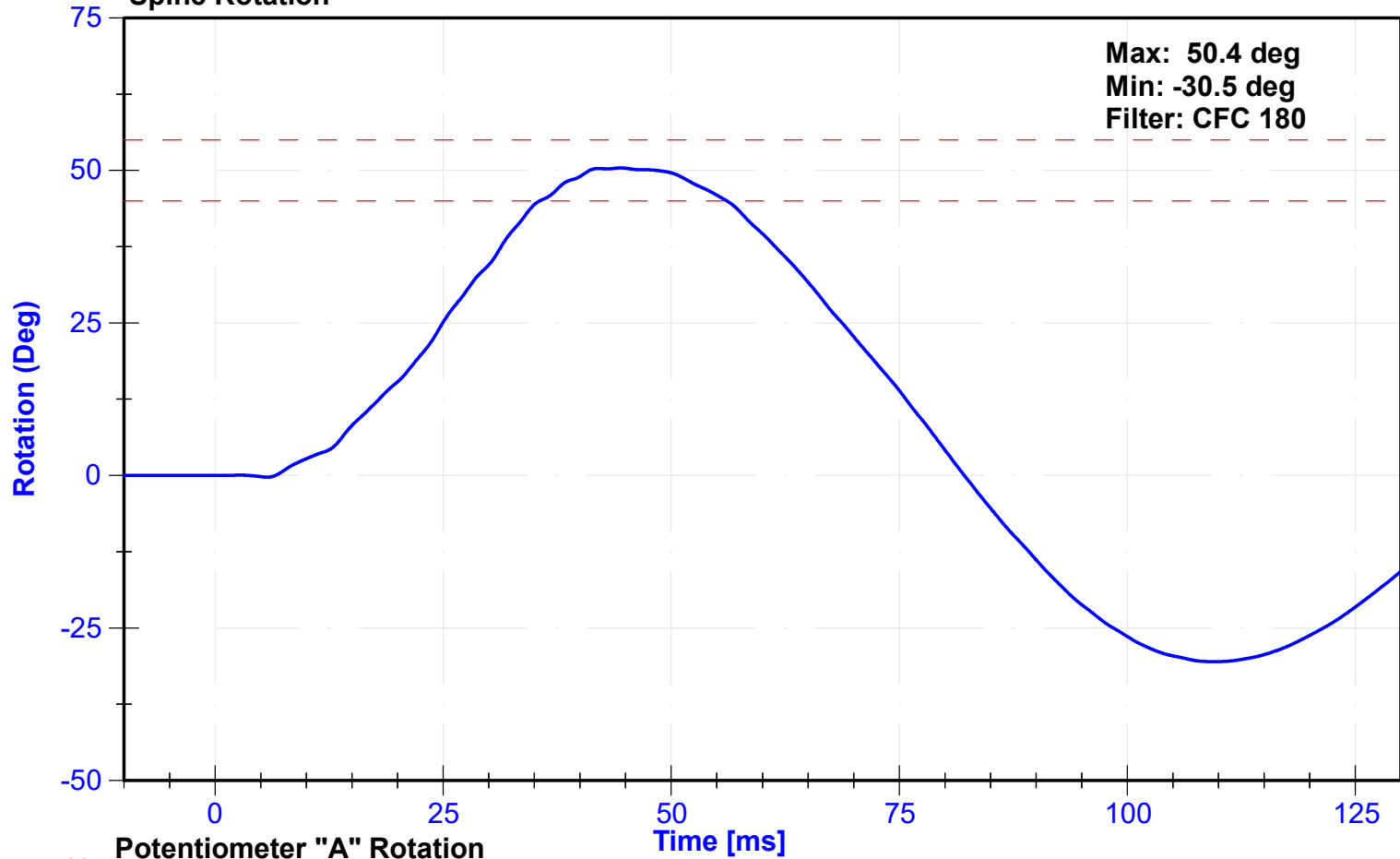
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	C16503	10/26/2022	10/26/2023
Pendulum "A" Potentiometer	Sfernice	094	10/5/2022	10/5/2023
Condyle "B" Potentiometer	Sfernice	095	10/5/2022	10/5/2023

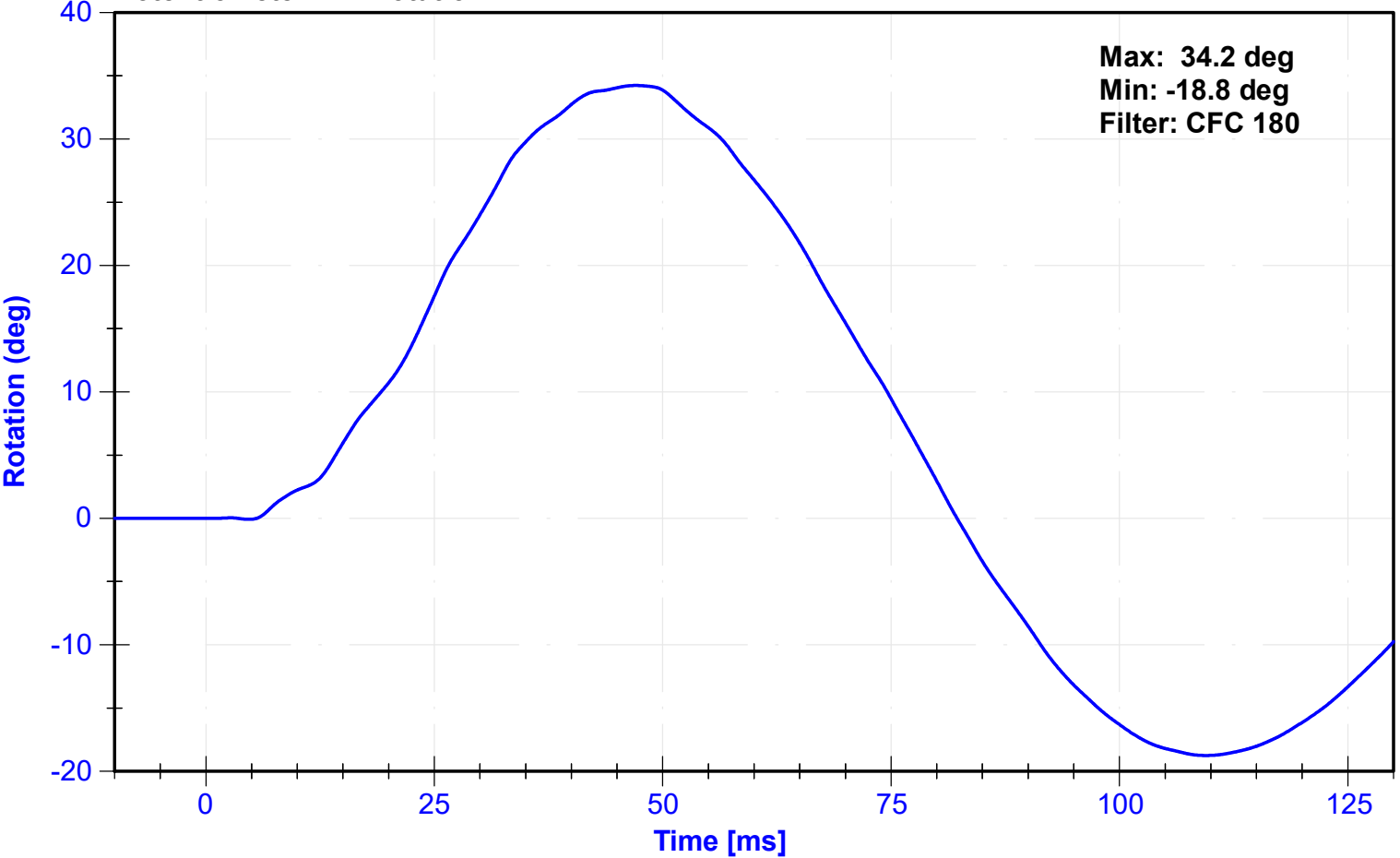


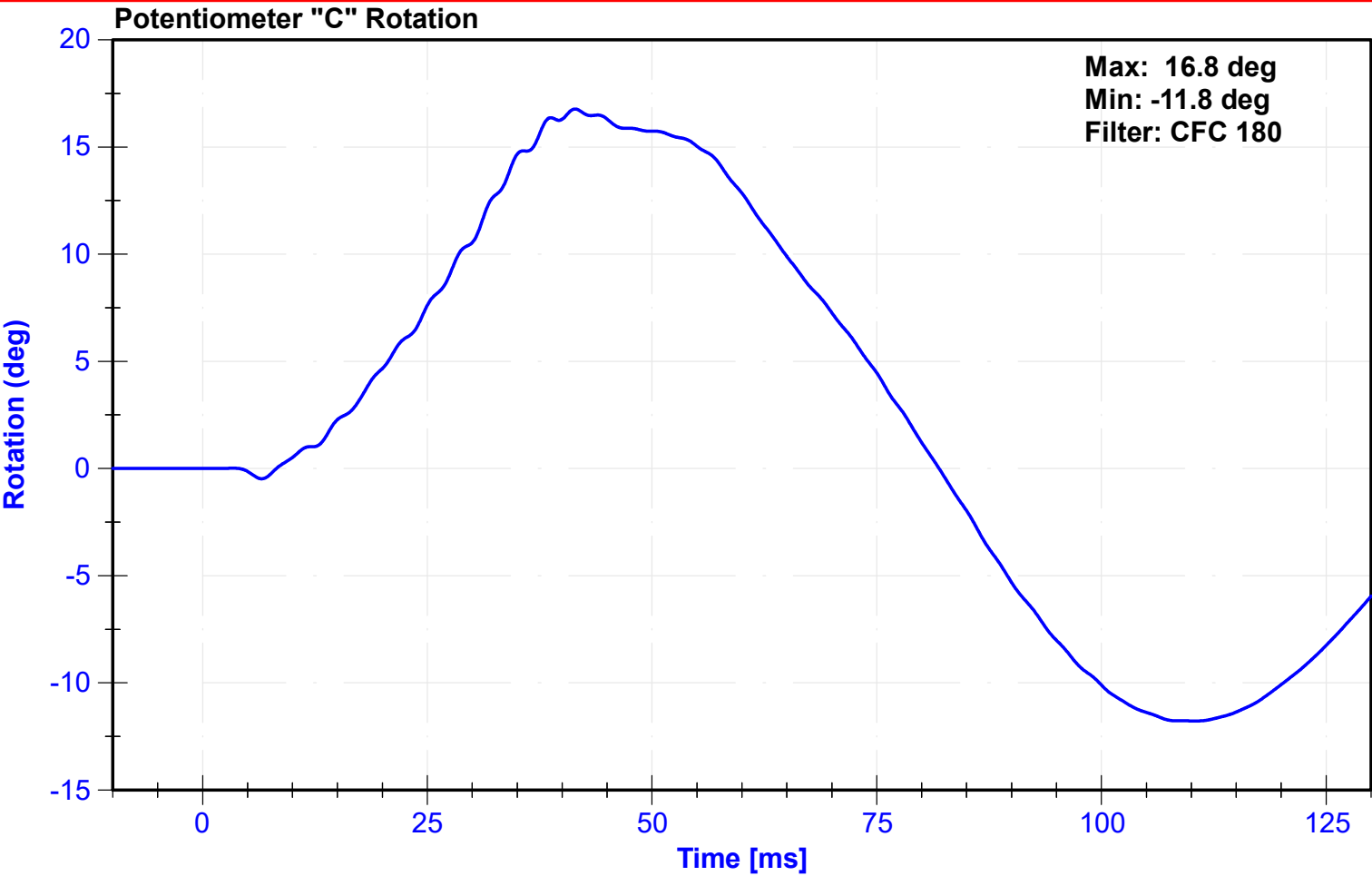
^{1,2} Upper and lower boundaries specified in Appendix I
IV-41

Spine Rotation



Potentiometer "A" Rotation





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	FTSS	Test Technician	D. Sakona
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantell

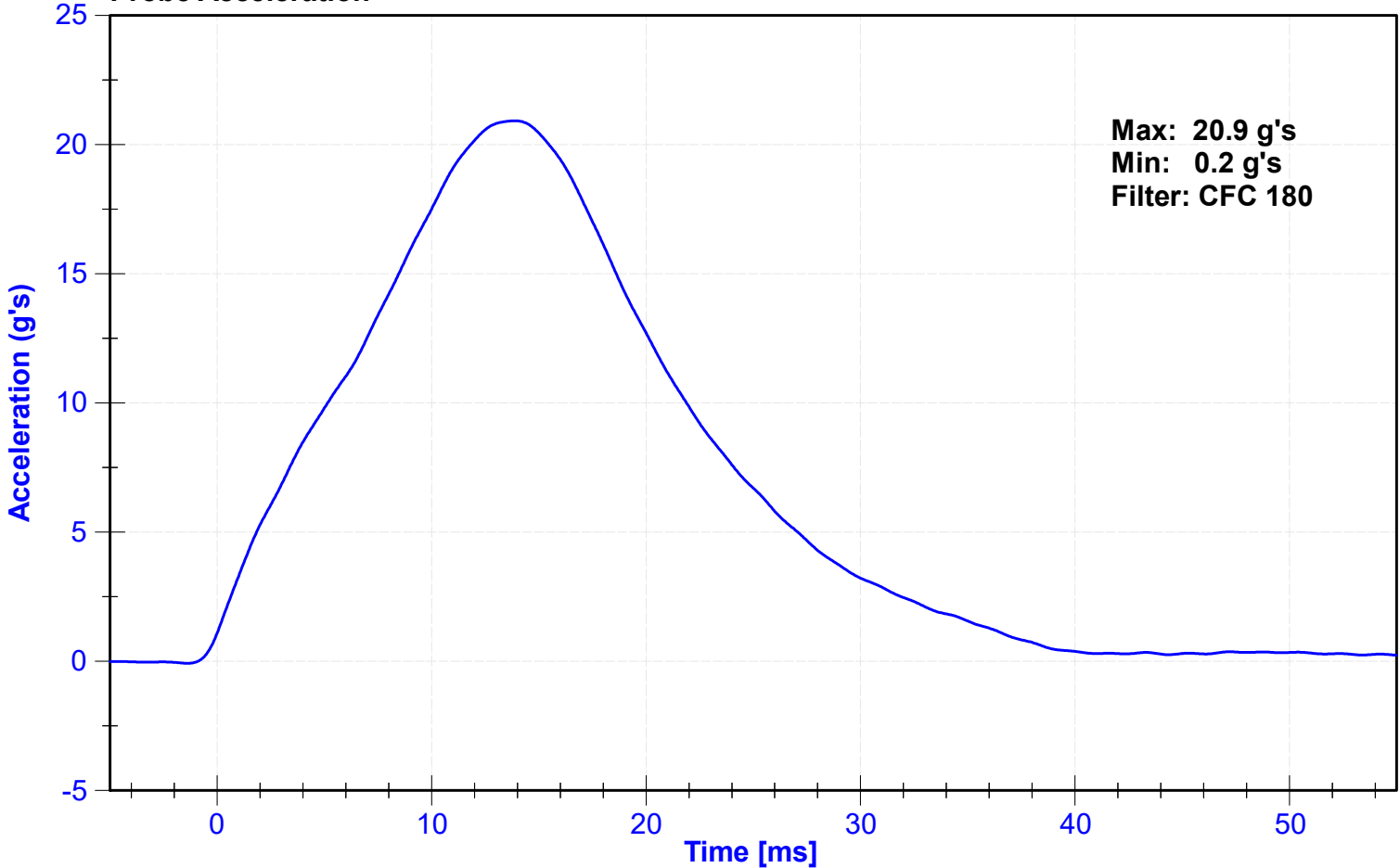
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.7	Pass
Humidity	10	70	%	51	Pass
Velocity	4.2	4.4	m/s	4.29	Pass
Resistive Force	4700	5400	N	4791.7	Pass
Time at Peak Resistive Force	11.8	16.1	ms	13.90	Pass
Pubic Force	-1590	-1230	N	-1385.0	Pass
Time at Peak Pubic Force	12.2	17.0	ms	15.60	Pass

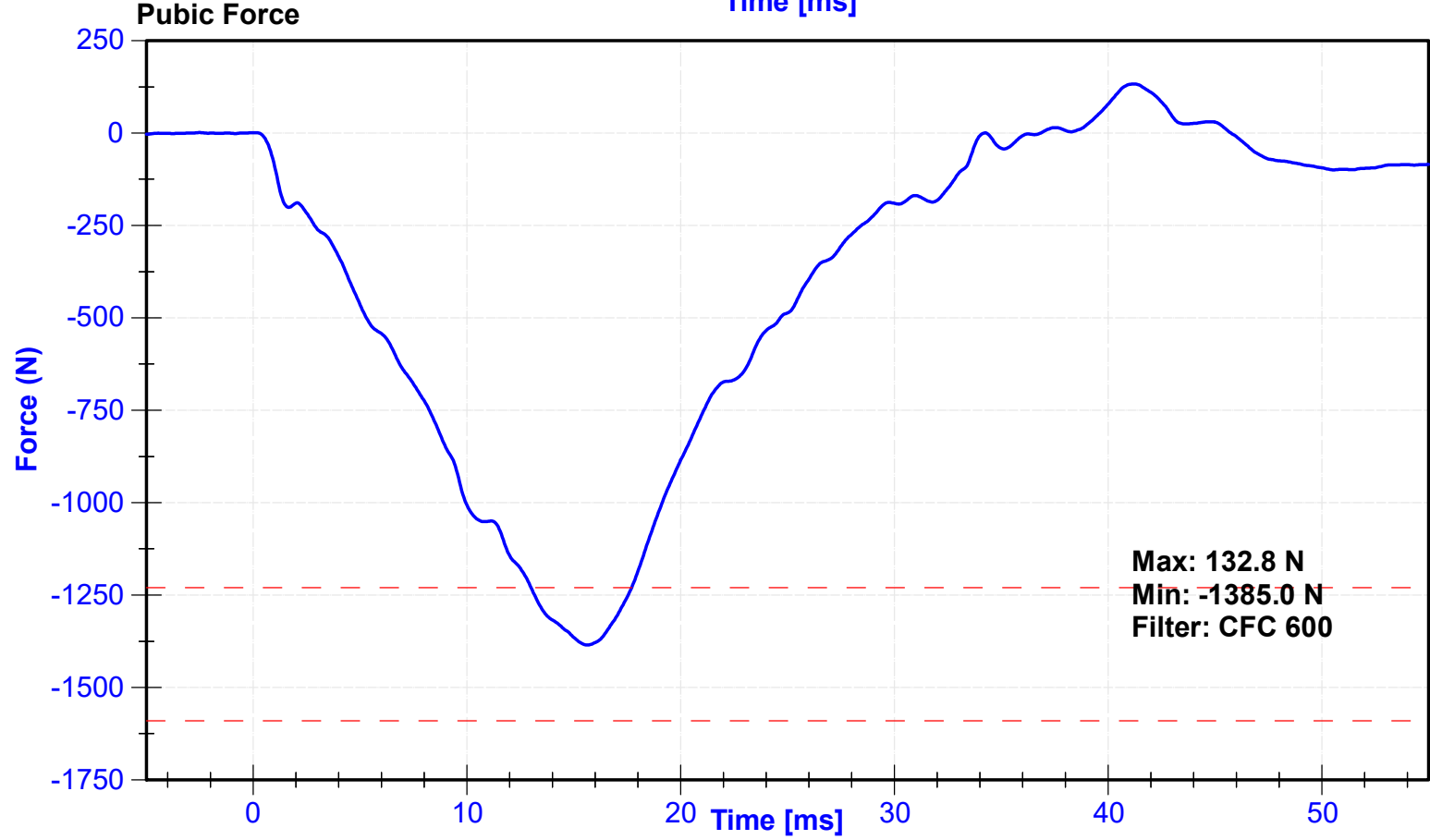
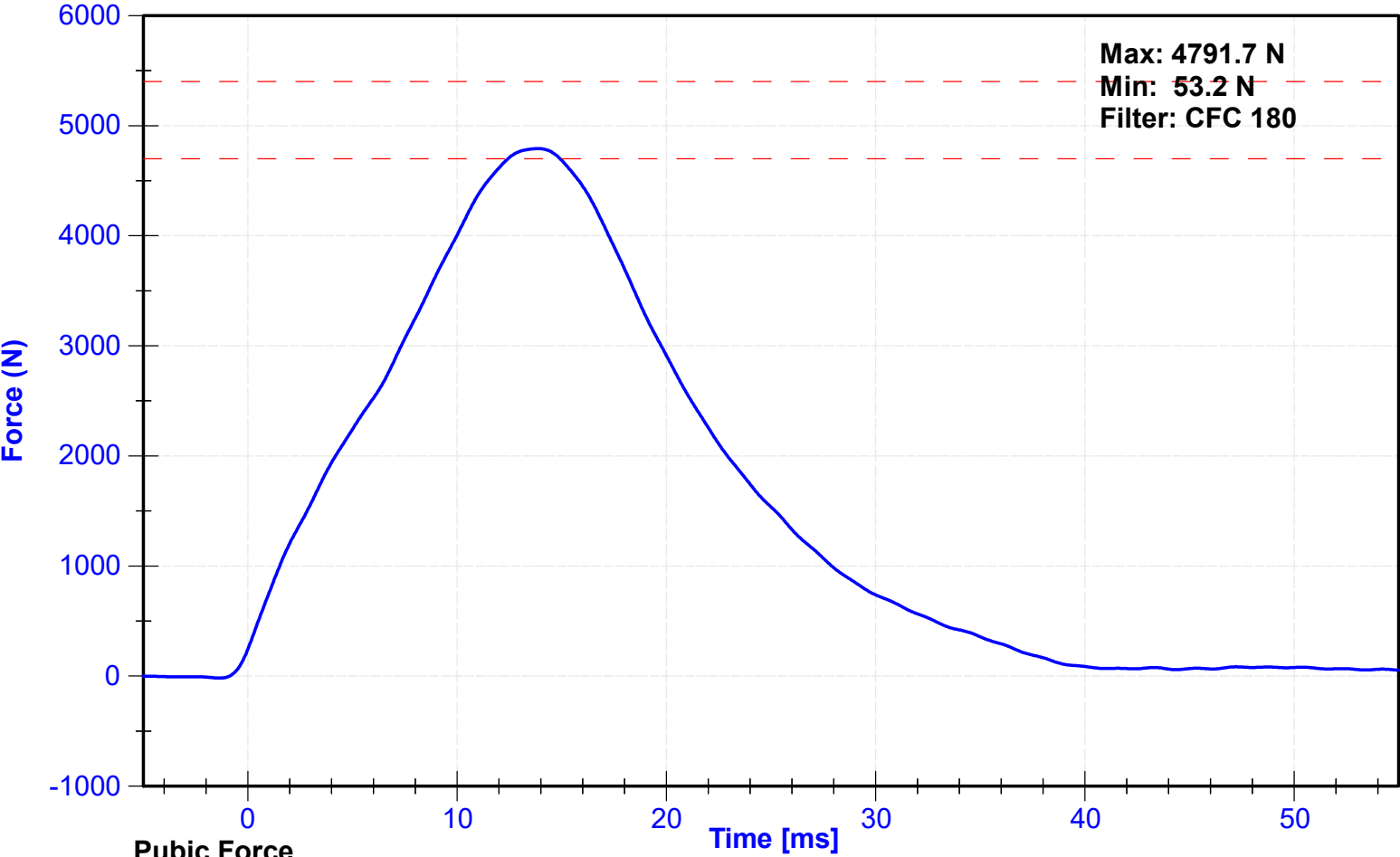
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	P51736	10/25/2022	10/25/2023
Pubic Load Cell	Denton	464-FY	8/15/2023	8/14/2024

Probe Acceleration



Resistive Force



APPENDIX V

TEST EQUIPMENT AND INSTRUMENTATION CALIBRATION DATA

Table 1 – Dummy Instrumentation (ES-2re)

			ES-2re S/N _DG5348_		
			Serial Number	Manufacturer	Calibration Date
Head Accelerometers	Primary	X	18613	Endevco	09/01/2023
		Y	18472	Endevco	09/01/2023
		Z	18663	Endevco	09/01/2023
	Redundant	X	18666	Endevco	09/01/2023
		Y	18664	Endevco	09/01/2023
		Z	18675	Endevco	09/01/2023
Thorax Rib Displacement Potentiometers	Upper	Y	268GFE	Honeywell	08/08/2023
	Middle	Y	269GFE	Honeywell	08/08/2023
	Lower	Y	270GFE	Honeywell	08/08/2023
Abdomen Load Cells	Forward	Y	1512	Denton	08/15/2023
	Middle	Y	1526	Denton	08/15/2023
	Rear	Y	1516	Denton	08/15/2023
Lower Spine Accelerometers (T12)		X	18478	Endevco	09/01/2023
		Y	18573	Endevco	09/01/2023
		Z	18662	Endevco	09/01/2023
Pubic Symphysis Load Cell		Y	464-FY	Denton	08/15/2023

Table 2 – Vehicle Instrumentation

Vehicle Instrumentation		Serial Number	Manufacturer	Calibration Date
Vehicle Center of Gravity	X	A280359	Measurement Specialties	05/03/2023
Vehicle Center of Gravity	Y	A315127	Measurement Specialties	05/03/2023
Vehicle Center of Gravity	Z	A413613	Measurement Specialties	05/03/2023
Left Floor Sill	Y	G22707	Endevco	06/21/2023
A-Pillar Sill	Y	G21387	Endevco	07/26/2023
A-Pillar Low	Y	A374299	Measurement Specialties	07/26/2023
A-Pillar Mid	Y	A301865	Measurement Specialties	06/17/2023
B-Pillar Sill	Y	A352403	Measurement Specialties	07/26/2023
B-Pillar Low	Y	G22689	Endevco	06/21/2023
B-Pillar Mid	Y	A283654	Measurement Specialties	08/09/2023
Driver Seat	Y	A370915	Measurement Specialties	08/16/2023
Engine Top	X	A290902	Measurement Specialties	08/07/2023
Engine Top	Y	A396642	Measurement Specialties	08/07/2023
Firewall	Y	A413611	Measurement Specialties	06/01/2023
Right Roof	Y	A428014	Measurement Specialties	07/26/2023
Right Floor Sill	Y	A284066	Measurement Specialties	07/05/2023
Rear Floorpan	X	A374343	Measurement Specialties	08/17/2023
Rear Floorpan	Y	A400007	Measurement Specialties	08/17/2023