

**REPORT NUMBER: 214P-CAL-24-009**

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

**Volvo Car Corporation  
2024 Volvo S60 Recharge  
4 Door Sedan**

**NHTSA No: C20245900**

**PREPARED BY:  
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P.O. BOX 400  
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**March 21, 2024**

**FINAL REPORT**

**PREPARED FOR:  
U. S. DEPARTMENT OF TRANSPORTATION  
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION  
ENFORCEMENT  
OFFICE OF VEHICLE SAFETY COMPLIANCE  
1200 NEW JERSEY AVE. S.E.  
WASHINGTON, D.C. 20590**

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Date: 3/22/2024

**TECHNICAL REPORT DOCUMENTATION PAGE**

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				<b>14. Sponsoring Agency Code</b> NEF-240																								
<b>15. Supplementary Notes</b>																												
<b>16. Abstract</b> A 31.00 km/h (19.3 mph), 75° oblique compliance test was conducted on the subject 2024 Volvo S60 Recharge 4 Door Sedan 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 February 29, 2024.  The impact velocity of the vehicle was 30.93 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 318 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>325.195</td> </tr> <tr> <td>Maximum Thoracic Rib Deflection</td> <td>mm</td> <td>44</td> <td>30.039</td> </tr> <tr> <td>Total Abdominal Force</td> <td>N</td> <td>2500</td> <td>1071.423</td> </tr> <tr> <td>Pubic Symphysis Force</td> <td>N</td> <td>6000</td> <td>2240.863</td> </tr> </tbody> </table>						Measurement Description	Driver ATD (ES-2re)			Units	IARV	Result	Head Injury Criteria (HIC36)		1000	325.195	Maximum Thoracic Rib Deflection	mm	44	30.039	Total Abdominal Force	N	2500	1071.423	Pubic Symphysis Force	N	6000	2240.863
Measurement Description	Driver ATD (ES-2re)																											
	Units	IARV	Result																									
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Maximum Thoracic Rib Deflection	mm	44	30.039																									
Total Abdominal Force	N	2500	1071.423																									
Pubic Symphysis Force	N	6000	2240.863																									
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.																												
<b>17. Key Words</b> Compliance Testing Side Impact Protection Pole Test ES-2re SID-IIs				<b>18. Distribution Statement</b> 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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## 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 Volvo S60 Recharge 4 Door Sedan. 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 Volvo S60 Recharge 4 Door Sedan. The subject vehicle was towed into the rigid pole at an angle of 75° and a velocity of 30.93 km/h. The test was conducted by Calspan Corporation's Transportation Test Operations facility in Buffalo, New York on February 29, 2024. 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	325.195
Upper Rib Deflection	mm	44	27.957
Mid Rib Deflection	mm	44	23.480
Lower Rib Deflection	mm	44	30.039
Abdominal Load (front)	N		272.871
Abdominal Load (mid)	N		363.105
Abdominal Load (rear)	N		507.920
Total Abdominal Force	N	2500	1071.423
Pubic Symphysis Force	N	6000	2240.863

## 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 Volvo S60 Recharge 4 Door Sedan  
 Test Facility: Calspan

NHTSA No.: C20245900  
 Test Date: 02/29/2024

**TEST VEHICLE INFORMATION AND OPTIONS**

Make	Volvo	Anti-Lock Brakes (ABS)	Yes
Model	S60 Recharge	All-Wheel Drive (AWD)	Yes
Body Style	Sedan	Traction Control System (TCS)	Yes
VIN	7JRH60FL9RG294040	Electric Stability Control (ECS)	Yes
Body Color	Black	Curtain Airbags	Yes
Engine Displacement (L)	2.0	Torso Airbags – Front Seats	Yes
Type / No. Cylinders	I4	Torso Airbags – Rear Seats	No
Engine Placement	Transverse	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	No
Odometer Reading (mi)	669	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	No
		Power Seats	Yes
		Other Safety Restraint	N/A

**DATA FROM CERTIFICATION LABEL**

Manufactured By	Volvo Car Corporation	GVWR (kg)	2499
Date of Manufacture	08/23	GVWR Front (kg)	1032
Vehicle Type	Passenger Car	GVWR Rear (kg)	1300

**VEHICLE SEATING AND WEIGHT CAPACITY DATA**

Measured Parameter	Front	Rear	Third	Total
Type of Seats (Bench or Bucket)	2	3	N/A	5
Designated Seating Capacity (DSC)				405
Capacity Weight (VCW) (kg)				340.2
Cargo Weight (RCLW) (kg)				64.8



**DATA SHEET NO. 3  
GENERAL TEST AND VEHICLE PARAMETER DATA**

Test Vehicle: 2024 Volvo S60 Recharge 4 Door Sedan  
 Test Facility: Calspan

NHTSA No.: C20245900  
 Test Date: 02/29/2024

**TIRE PRESSURES**

	Units	LF	RF	LR	RR
As Delivered	kPa	261	254	278	271
Tire Placard	kPa	270	270	270	270

**TEST VEHICLE WEIGHTS**

	Units	As Delivered (UVW)			Fully Loaded			As Tested		
		Front	Rear	Total	Front	Rear	Total	Front	Rear	Total
Left	kg	561.5	461.0		586.5	527.0		592	506.5	
Right	kg	542.0	450.5		550.0	498.0		562.5	492.5	
Ratio	%	54.8	45.2		52.6	47.4		53.6	46.4	
Totals	kg	1103.5	911.5	2015	1136.5	1025.5	2162	1154.5	999	2153.5

**TARGET TEST WEIGHT CALCULATION**

Measured Parameter	Units	Value	
Total As Delivered Weight (UVW)	kg	2015	(A)
Weight of Test Dummy	kg	81	(B)
Rated Cargo / Luggage Weight (RCLW)	kg	64.8	(C)
Calculated Vehicle Target Weight (TVT <sub>W</sub> )	kg	2160.8	(A+B+C)

**TEST VEHICLE ATTITUDES AND CG**

Measurement Description	Units	As Delivered	Fully Loaded	As Tested
Driver Door Sill Angle	Deg	+0.45	+0.05	+0.30
Front Passenger Sill Angle	Deg	+0.55	+0.35	+0.35
Front Bumper-Line Angle	Deg	0.00	0.00	0.00
Rear Bumper-Line Angle	Deg	+1.55	+1.35	+1.35

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	2874
Vertical Impact Reference Line Aft of Front Axle	mm	1524

**WEIGHT OF BALLAST AND VEHICLE COMPONENTS REMOVED TO MEET TVT<sub>W</sub>**

Component Description	Weight (kg)
Trunk Carpeting	7.5
Jack	5
Ballast (if any)	0

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

Test Vehicle: 2024 Volvo S60 Recharge 4 Door Sedan  
 Test Facility: Calspan

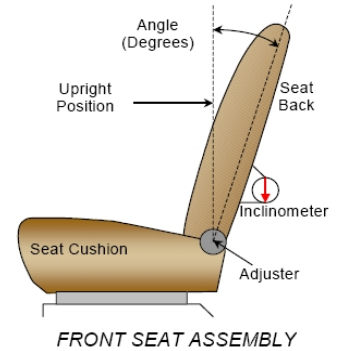
NHTSA No.: C20245900  
 Test Date: 02/29/2024

**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	23.3
Front Passenger Seat	Degrees	23.5

\*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	18.1	Max	57	70	85
		Mid	29	43	57
		Min	2	16	29
Front Passenger Seat	18.2	Max	56	70	84
		Mid	28	42	56
		Min	2	15	28

**SEAT FORE / AFT POSITION**

Seat	Total Fore / Aft Travel		Placed in Position #	
	mm	Detents*	mm	Detents*
Driver Seat	263	Power	131.5	Power
Front Passenger Seat	263	Power	131.5	Power

**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	Fixed	Fixed

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

Test Vehicle: 2024 Volvo S60 Recharge 4 Door Sedan  
 Test Facility: Calspan

NHTSA No.: C20245900  
 Test Date: 02/29/2024

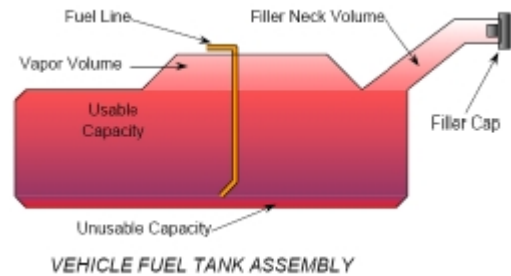
**FUEL TANK CAPACITY DATA**

Description	Liters
Usable Capacity of (Form No.1)	60
Usable Capacity of (Owner's Manual)	60
92 - 94% of Usable Capacity	55.2 - 56.4
Actual Amount of Solvent Used in Test	56

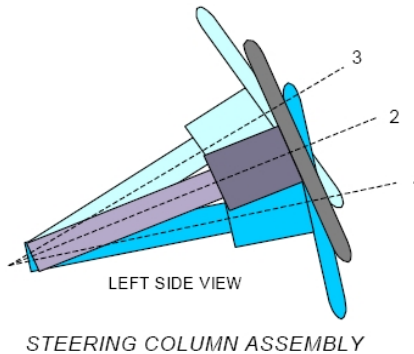
**FUEL PUMP**

*Describe the operation of the fuel pump.*

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



**STEERING COLUMN POSITIONS**

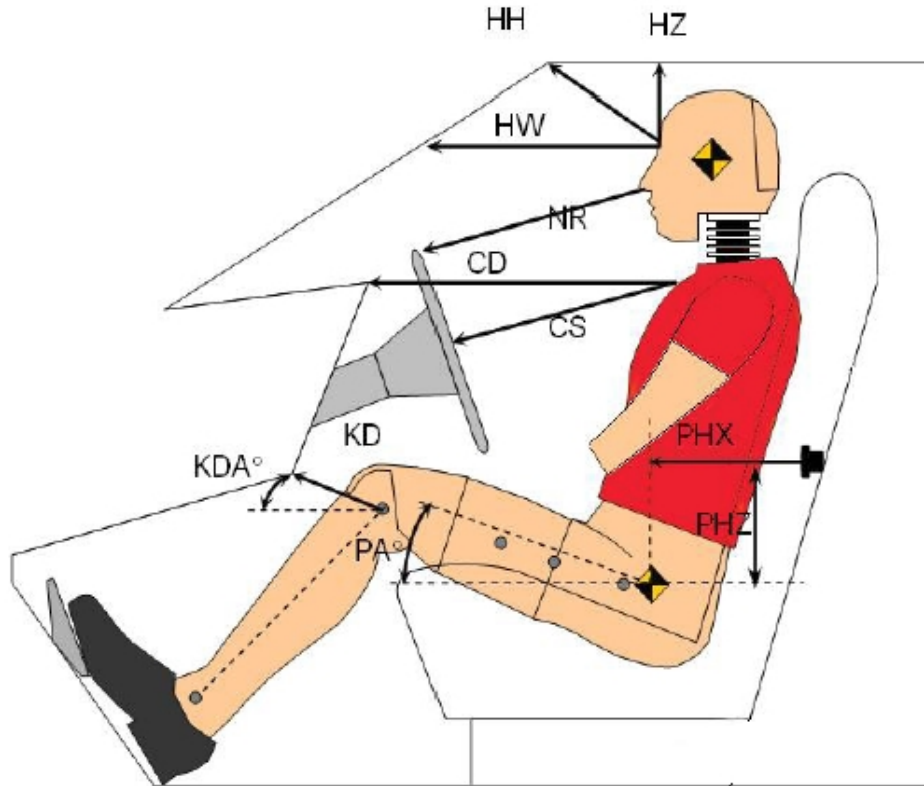


	Degrees	Fore / Aft Position (mm)
Lowermost - Position No. 1	16.6	
Geometric center - Position No. 2	19.6	
Uppermost - Position No. 3	22.6	
Telescoping Steering Wheel Travel		66
Test Position	19.5	33

**DATA SHEET NO. 6**  
**DUMMY LONGITUDINAL CLEARANCE DIMENSIONS**

Test Vehicle: 2024 Volvo S60 Recharge 4 Door Sedan  
Test Facility: Calspan

NHTSA No.: C20245900  
Test Date: 02/29/2024



**Left Side View**

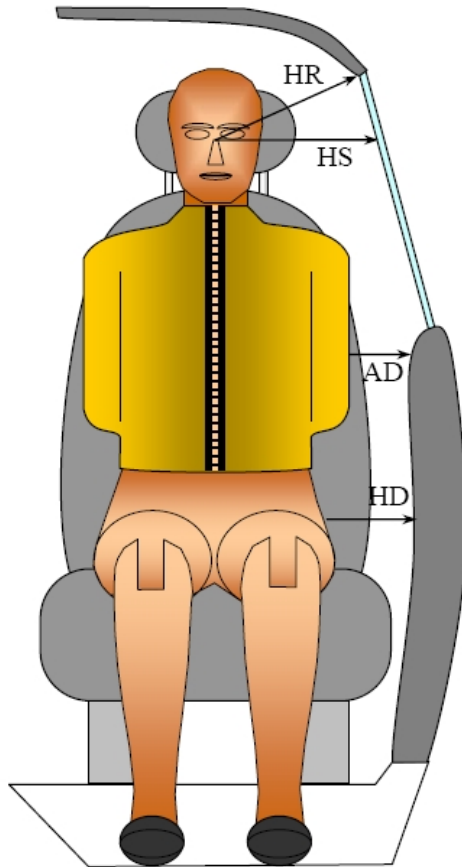
**DUMMY LONGITUDINAL CLEARANCE DIMENSION INFORMATION**

Driver Code	Description	Driver	
		Length (mm)	Angle (°)
HH	Head to Header	426	
HW	Head to Windshield	721	
HZ	Head to Roof Liner	155	
NR	Nose to Rim	470	
CD	Chest to Dash	600	
CS	Chest to Steering Wheel	399	
KD(L) / KDA(L)°	Left Knee to Dash	213	42.4
KD(R) / KDA(R)°	Right Knee to Dash	214	35.6
PAX°	Pelvic Tilt Angle (X-Axis)		-0.5
PAY°	Pelvic Tilt Angle (Y-Axis)		27.8
PHX	Hip Point to Striker (X-Axis)	159	
PHZ	Hip Point to Striker (Z-Axis)	216	

**DATA SHEET NO. 7  
DUMMY LATERAL CLEARANCE DIMENSIONS**

Test Vehicle: 2024 Volvo S60 Recharge 4 Door Sedan  
 Test Facility: Calspan

NHTSA No.: C20245900  
 Test Date: 02/29/2024



*FRONT VIEW OF DUMMY*

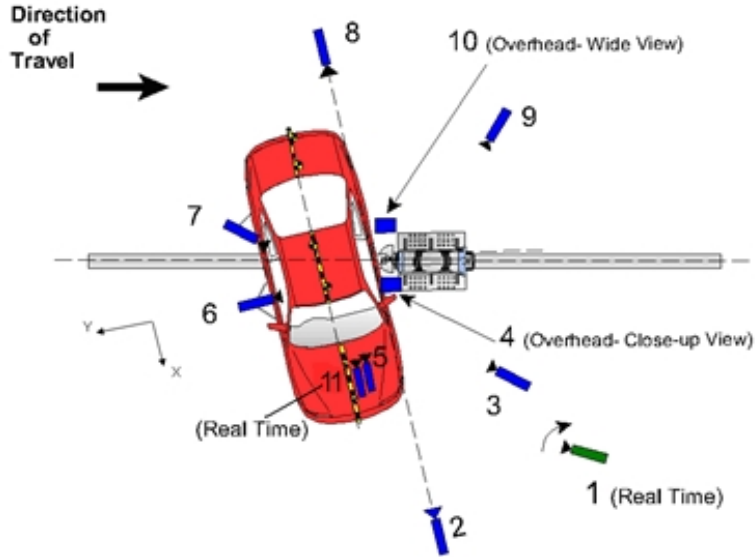
**DUMMY LATERAL CLEARANCE DIMENSION INFORMATION**

Code	Measurement Description	Units	Driver
HR	Head to Side Header	mm	185
HS	Head to Side Window	mm	334
AD	Arm to Door	mm	87
HD	H-Point to Door	mm	153

**DATA SHEET NO. 8  
LOCATION OF CAMERA**

Test Vehicle: 2024 Volvo S60 Recharge 4 Door Sedan  
 Test Facility: Calspan

NHTSA No.: C20245900  
 Test Date: 02/29/2024



**CAMERA LOCATIONS AND DATA**

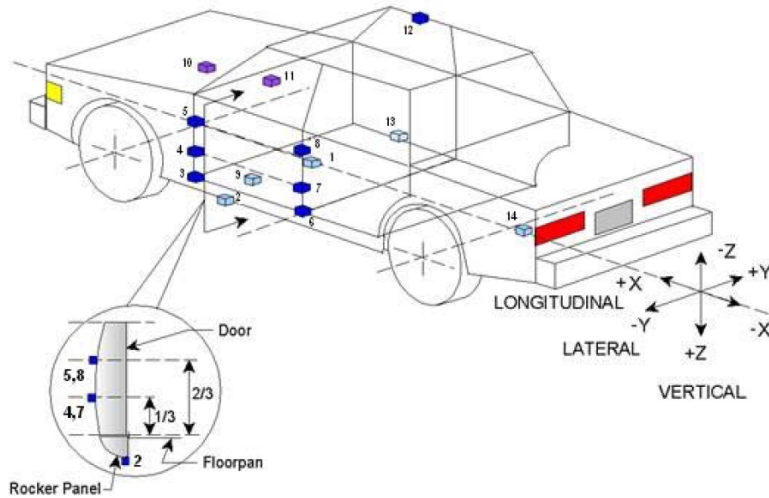
No.	Camera View	Coordinates (mm)			Lens Length (mm)	Operating Frame Rate (fps)
		X	Y	Z		
1	Real-time (24 - 30 fps) pan view of impact				Zoom	60
2	Front ground level - impact view	0	7990	-1450	28	1000
3	Impact side 45° - forward pole view	950	5100	-1425	24	1000
4	Overhead Close-up view of impact	0	0	-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	-8750	-1435	28	1000
9	Impact side 45° - rearward pole view	3950	-3850	-1525	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 Volvo S60 Recharge 4 Door Sedan  
Test Facility: Calspan

NHTSA No.: C20245900  
Test Date: 02/29/2024



**TEST VEHICLE ACCELEROMETER LOCATIONS**

No.	Accelerometer Location	Coordinates (mm)		
		X	Y	Z
1	Vehicle CG	2568	27	-284
2	Left Floor Sill	2798	-678	40
3	A-Pillar Sill	3194	-661	-5
4	A-Pillar Low	3214	-660	-147
5	A-Pillar Mid	3138	-642	-597
6	B-Pillar Sill	2242	-685	41
7	B-Pillar Low	2177	-696	-264
8	B-Pillar Mid	2140	-631	-568
9	Seat	2452	-564	117
10	Engine	4103	283	-405
11	Firewall	3685	246	-328
12	Roof	1990	570	-1011
13	Right Floor Sill	2830	681	48
14	Rear Deck	879	-11	-28

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 Volvo S60 Recharge 4 Door Sedan  
 Test Facility: Calspan

NHTSA No.: C20245900  
 Test Date: 02/29/2024

Loc. No	Description	Axes	Units	Positive Direction		Negative Direction	
				Max	Time (ms)	Max	Time (ms)
1	Vehicle CG	X	g	5.88	91.85	-13.64	46.30
	Vehicle CG	Y	g	33.55	42.40	-12.15	88.25
	Vehicle CG	Z	g	18.96	41.65	-11.22	34.95
	Vehicle CG Resultant	N/A	g	38.97	42.30	0.03	-22.00
2	Floor Sill (Left)	Y	g	43.40	13.75	-33.40	57.15
3	A Pillar Sill	Y	g	26.85	17.25	-31.82	20.70
4	A Pillar Low	Y	g	17.17	34.15	-8.47	18.35
5	A Pillar Mid	Y	g	24.84	28.65	-13.15	63.05
6	B Pillar Sill	Y	g	52.55	24.55	-31.20	20.30
7	B Pillar Low	Y	g	395.34	13.40	-130.52	18.10
8	B Pillar Mid	Y	g	72.85	16.20	-24.83	23.55
9	Seat	Y	g	49.92	31.40	-24.75	35.85
10	Engine Top	X	g	2.88	150.45	-11.23	50.25
	Engine Top	Y	g	17.07	55.40	-5.49	218.00
11	Firewall	Y	g	14.05	48.40	-1.14	192.95
12	Roof	Y	g	31.93	46.35	-2.29	300.00
13	Floor Sill (Right)	Y	g	30.12	37.15	-3.25	55.35
14	Rear Deck	X	g	3.43	140.00	-6.43	62.80
	Rear Deck	Y	g	17.46	52.60	-1.57	221.95

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

Test Vehicle: 2024 Volvo S60 Recharge 4 Door Sedan NHTSA No.: C20245900  
 Test Facility: Calspan Test Date: 02/29/2024

**Dummy Serial No. DG5348**

Description	Axes	Positive Direction		Negative Direction	
		MAX	TIME (ms)	MAX	TIME (ms)
<b>HEAD ACCELERATION (g)</b>					
Longitudinal	X	6.55	81.10	-16.46	51.25
Lateral	Y	51.61	53.95	-17.30	81.50
Vertical	Z	9.53	99.80	-8.62	55.15
Resultant	N/A	54.03	54.10		
HIC36 (t1, t2)	N/A	325.19		t1 =40.05	t2 =63.90
<b>THORAX DEFLECTION (mm)</b>					
Upper Rib	Y	27.96	60.90	-0.97	21.85
Middle Rib	Y	23.48	59.75	0.00	9.45
Lower Rib	Y	30.04	57.80	0.00	-33.95
<b>ABDOMINAL FORCES (N)</b>					
Front	Y	272.87	99.20	-21.22	17.05
Middle	Y	363.10	50.55	-3.50	-41.90
Rear	Y	507.92	51.25	-11.38	163.35
SUM	N/A	1071.42	50.45		
<b>PELVIS FORCES (N)</b>					
Pubic Symphysis	Y	3.64	3.60	-2240.86	93.05

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

**DATA SHEET NO. 12  
POST-TEST OBSERVATIONS**

Test Vehicle: 2024 Volvo S60 Recharge 4 Door Sedan  
 Test Facility: Calspan

NHTSA No.: C20245900  
 Test Date: 02/29/2024

**IMPACT POINT DATA**

Measured Parameter	Units	Value
Vertical Impact Ref Line - Aft of Front Axle, Intended Impact Pt	mm	1524
Actual Impact Point - Aft of Front Axle	mm	1527
Difference	mm	3

**TEST DUMMY INFORMATION AND CONTACT POINTS**

Dummy Body Part	Driver Seat Dummy (ES2-re)
Head Contact	Curtain Airbag, Side Header & Headrest
Upper Torso Contact	Torso/Pelvis Airbag & Seatback
Lower Torso Contact	Torso/Pelvis Airbag & Seatback
Left Knee Contact	Driver Door Trim
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	A-Pillar & B-pillar buckled
Sill Separation	290 mm of separation at struck side rear door
Windshield Damage	Cracked throughout
Side Window Damage	Driver window shattered & fell out
Other Notable Effects	None

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

Test Vehicle: 2024 Volvo S60 Recharge 4 Door Sedan  
 Test Facility: Calspan

NHTSA No.: C20245900  
 Test Date: 02/29/2024

**SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION**

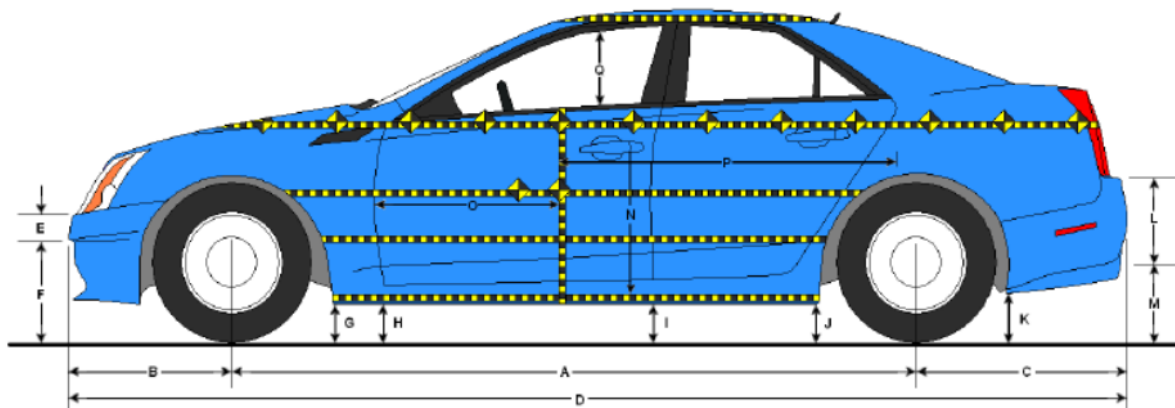
Restraint Type	Struck Side Front Occupant	
	Mounted	Deployed
Front Airbag	Yes	No
Knee Airbag	Yes	No
Head Airbag*	Yes	Yes
Side Airbag 2 - Torso/Pelvis Airbag	Yes	Yes
Seat Belt Pretensioner	Yes	Yes
Seat Belt Load Limiter	Yes	Yes
Other	N/A	N/A

\*Head Airbag was a Curtain Airbag

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

Test Vehicle: 2024 Volvo S60 Recharge 4 Door Sedan  
Test Facility: Calspan

NHTSA No.: C20245900  
Test Date: 02/29/2024



**LEFT SIDE VIEW**

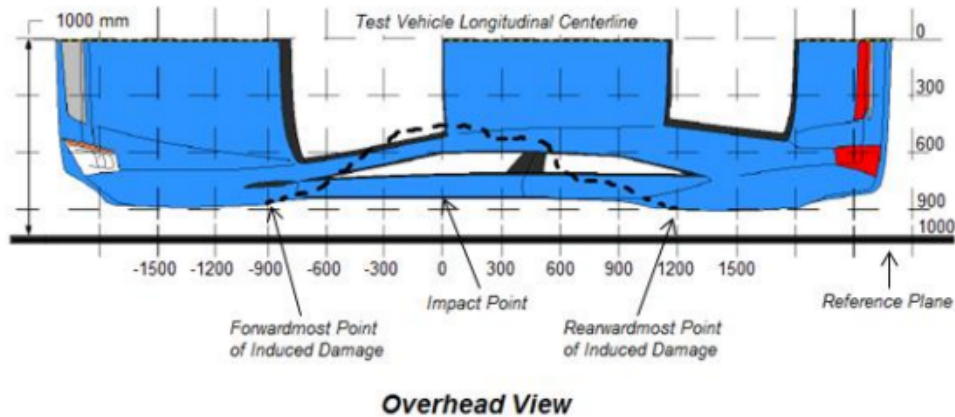
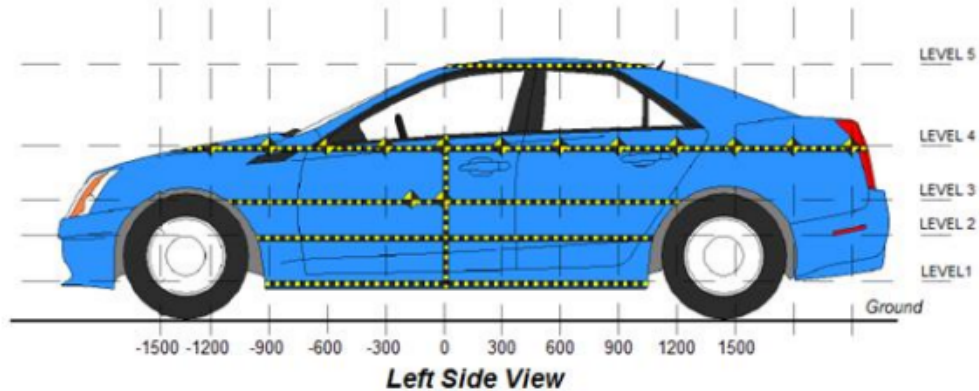
**VEHICLE PRE- AND POST-TEST MEASUREMENT INFORMATION**

No.	Measurement Description	Pre-Test	Post-Test	Difference
A	Vehicle Wheelbase	2874	2782	-92
B	Front Axle to FSOV	853	914	61
C	Rear Axle to RSOV	1052	1048	-4
D	Total Vehicle Length at Centerline	4778	4743	-35
E	Front Bumper Thickness	205	205	0
F	Front Bumper Bottom to Ground	361	357	-4
G	Sill Height at Front Wheel Well	152	157	5
H	Sill Height at Front Door Leading Edge	154	163	9
I	Sill Height at B Pillar	167	141	-26
J1	Sill Height at Rear Wheel Well	164	158	-6
J2	Pinch Weld Height at Rear Wheel Well	162	190	28
K	Sill Height Aft of Rear Wheel Well	216	220	4
L	Rear Bumper Thickness	135	135	0
M	Rear Bumper Bottom to Ground	452	448	-4
N	Sill Height to Window Bottom Sill	703	682	-21
O	Front Door Leading Edge to Impact CL	866	801	-65
P	Rear Door Trailing Edge to Impact CL	1178	1122	-56
Q	Front Window Opening	383	379	-4
R	Right Side Length	4688	4678	-10
S	Left Side Length	4686	4629	-56
T	Vehicle Width at B-Pillars	1855	1677	-178

**DATA SHEET NO. 14**  
**TEST VEHICLE EXTERIOR CRUSH MEASUREMENTS**

Test Vehicle: 2024 Volvo S60 Recharge 4 Door Sedan  
 Test Facility: Calspan

NHTSA No.: C20245900  
 Test Date: 02/29/2024



**MAXIMUM EXTERIOR CRUSH MEASUREMENTS**

Level	Measurement Description	Units	Height Above Ground	Maximum Exterior Static Crush	Distance from Impact
1	Sill Top	mm	318	301	0
2	Occupant H-Point	mm	490	297	0
3	Mid-Door	mm	644	318	0
4	Window Sill	mm	913	279	0
5	Window Top	mm	1378	67	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: 2024 Volvo S60 Recharge 4 Door Sedan  
 Test Facility: Calspan

NHTSA No.: C20245900  
 Test Date: 02/29/2024

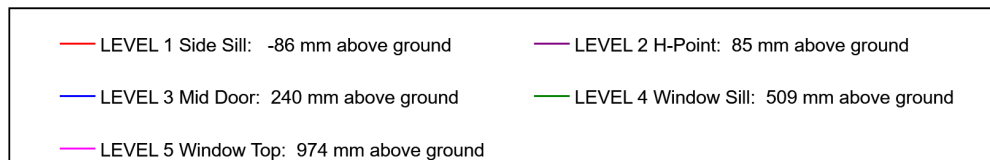
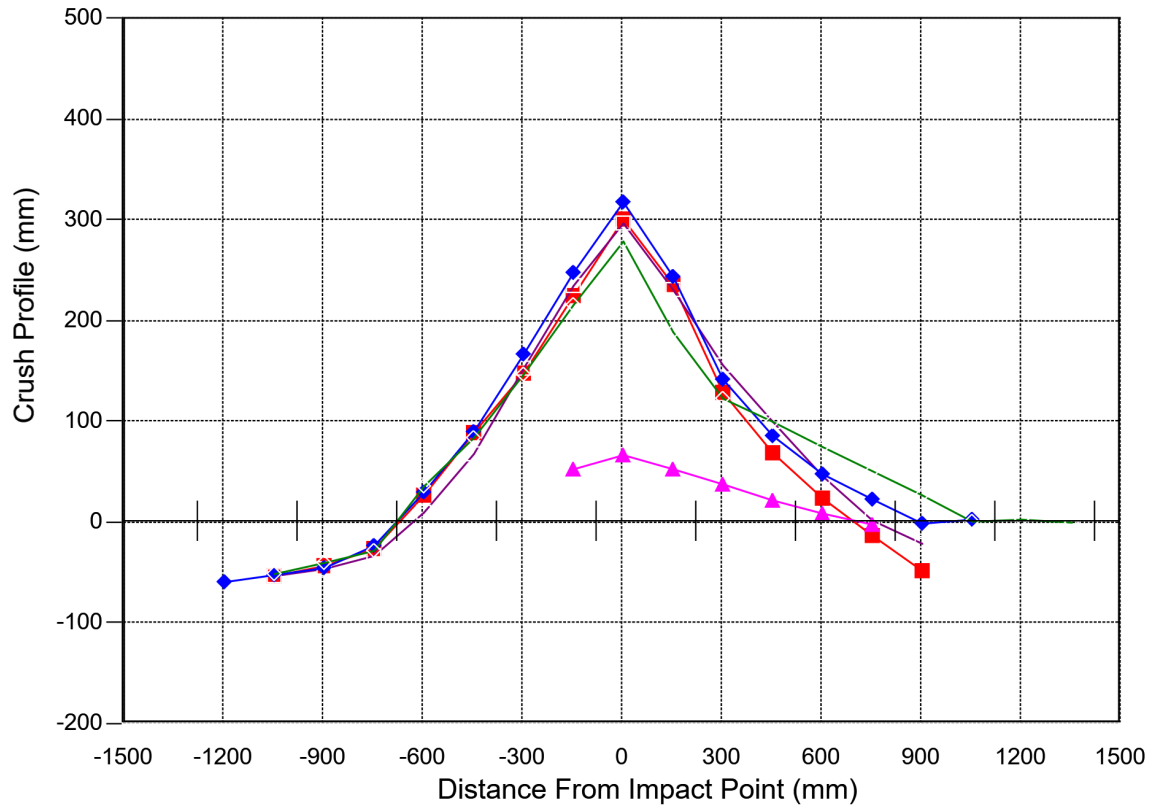
**EXTERIOR CRUSH MEASUREMENTS AT EACH LEVEL**

	Pre-Test					Post-Test					Difference				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
-1500															
-1350															
-1200			917					976					-59		
-1050	906	910	908	811		959	963	960	862		-53	-53	-52	-51	
-900	906	898	907	823		949	944	952	863		-43	-46	-45	-40	
-750	908	895	909	827		934	928	932	855		-26	-33	-23	-28	
-600	909	895	911	868		882	885	881	832		27	10	30	36	
-450	911	895	912	839		822	827	822	755		89	68	90	84	
-300	912	895	913	845		764	742	746	698		148	153	167	147	
-150	911	895	912	850	584	686	660	664	634	531	225	235	248	216	53
0	910	897	910	854	594	609	600	592	575	527	301	297	318	279	67
150	908	898	909	856	597	672	667	665	667	544	236	231	244	189	53
300	903	897	905	856	596	774	741	763	733	558	129	156	142	123	38
450	898	897	902	856	593	829	797	816	756	571	69	100	86	100	22
600	894	897	899	855	589	870	851	851	780	580	24	46	48	75	9
750	890	898	900	854	577	903	896	877	803	579	-13	2	23	51	-2
900	892	908	907	851		940	929	908	824		-48	-21	-1	27	
1050			919	846				916	845				3	1	
1200				840					837					3	
1350				832					832					0	
1500															

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

Test Vehicle: 2024 Volvo S60 Recharge 4 Door Sedan  
 Test Facility: Calspan

NHTSA No.: C20245900  
 Test Date: 02/29/2024



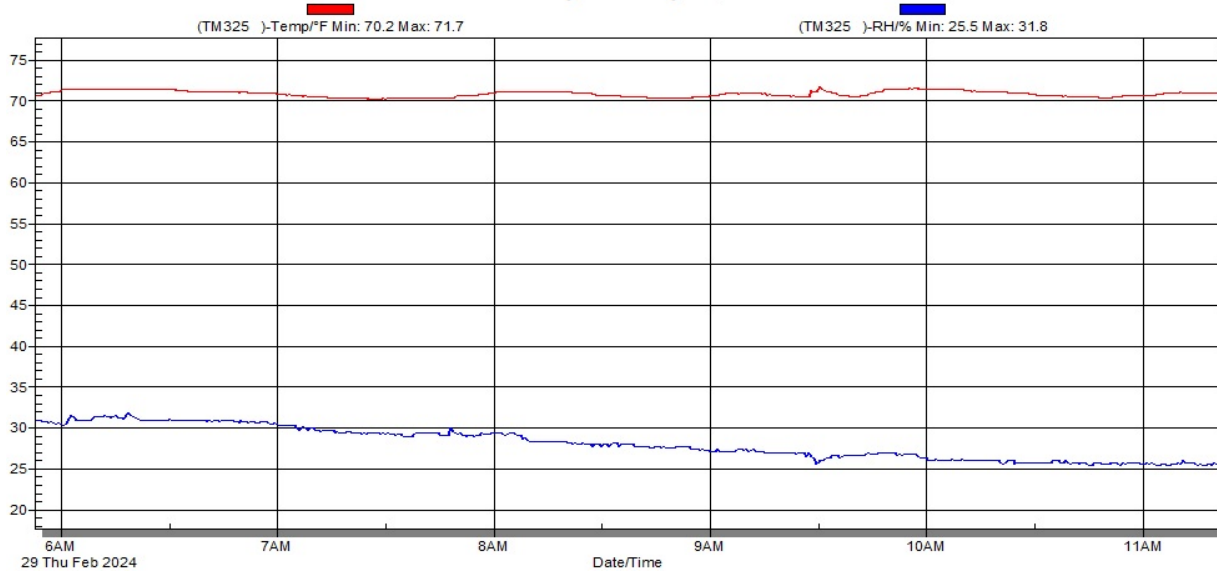
**Vehicle Exterior Crush Measurements - Visual Representation**

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

Test Vehicle: 2024 Volvo S60 Recharge 4 Door Sedan  
Test Facility: Calspan

NHTSA No.: C20245900  
Test Date: 02/29/2024

Thursday, February 29, 2024

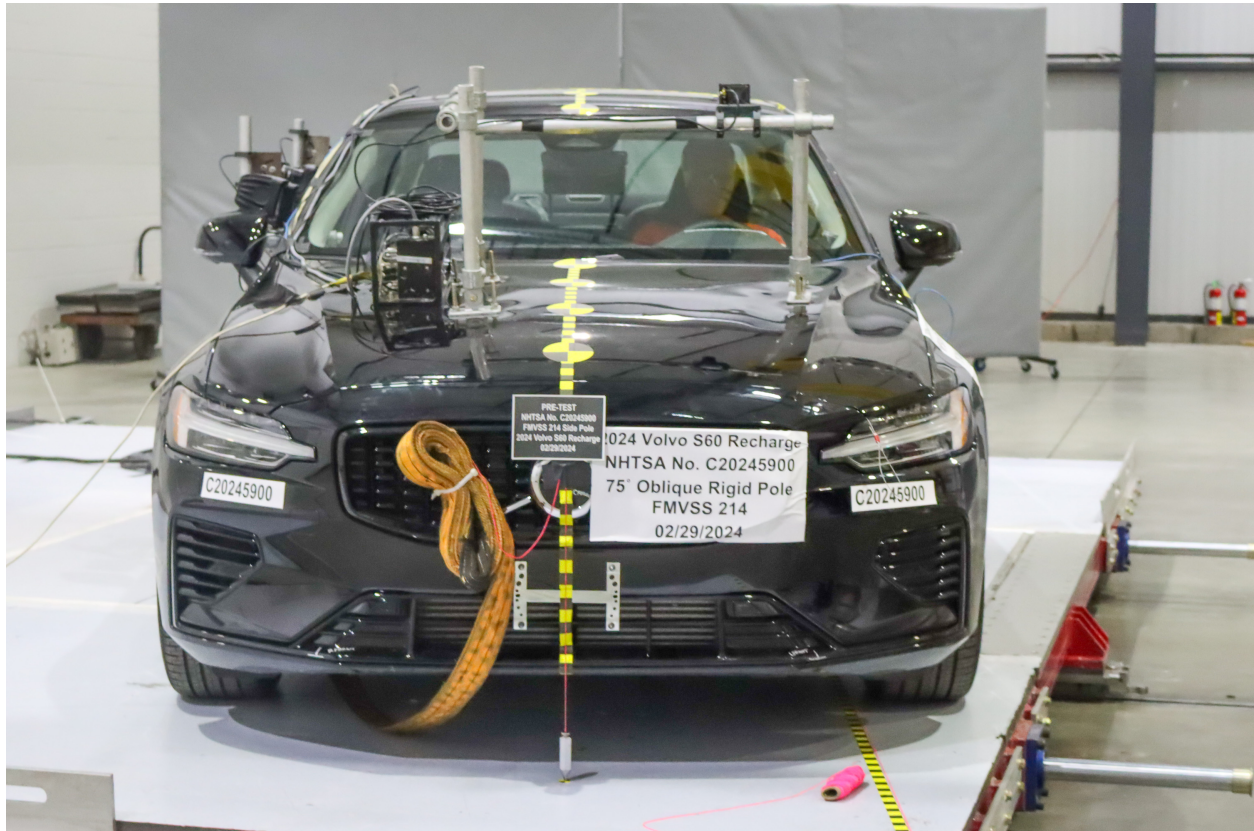


***Temperature and Humidity Stabilization Chart/Data for Dummies and Test Vehicle***

**APPENDIX I**  
**PHOTOGRAPHS**

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**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**



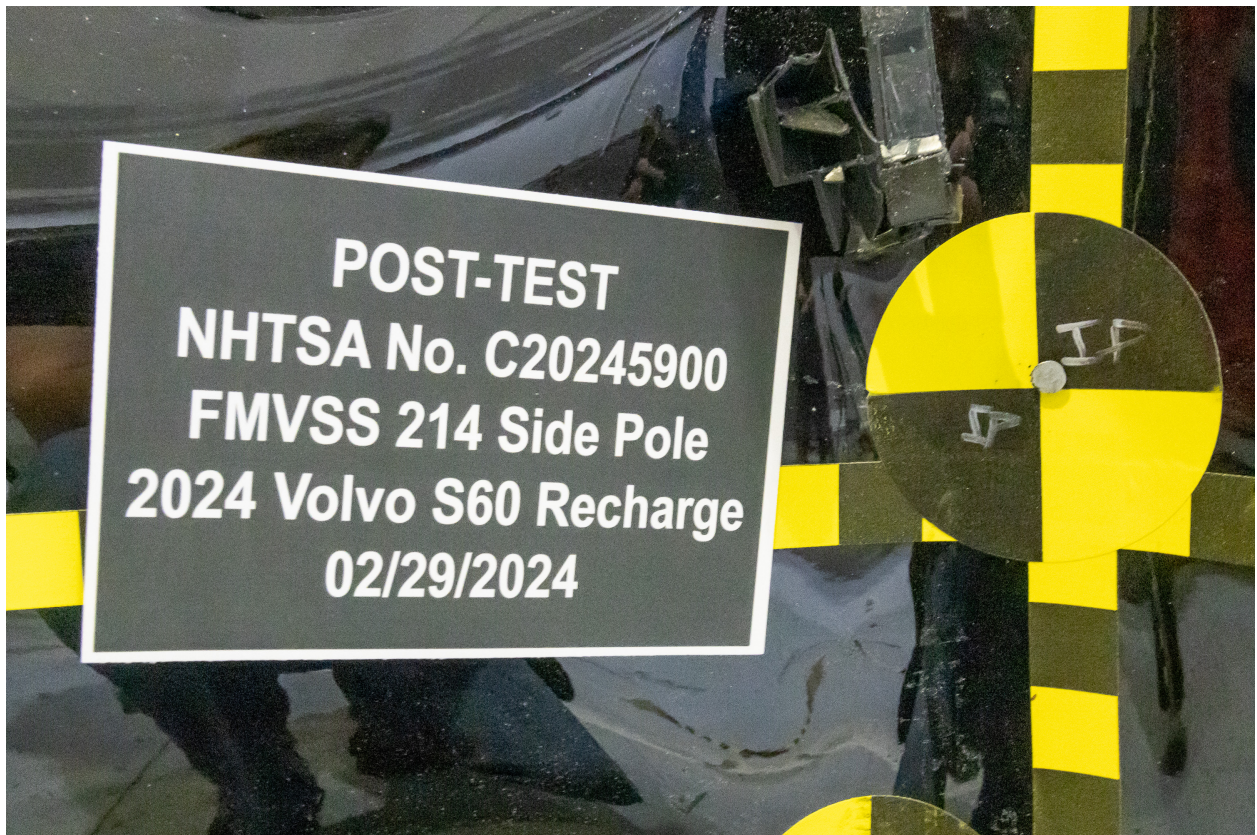
**Figure A-21: Post-Test Impact Zone Close-Up View**



**Figure A-22: Post-Test 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**

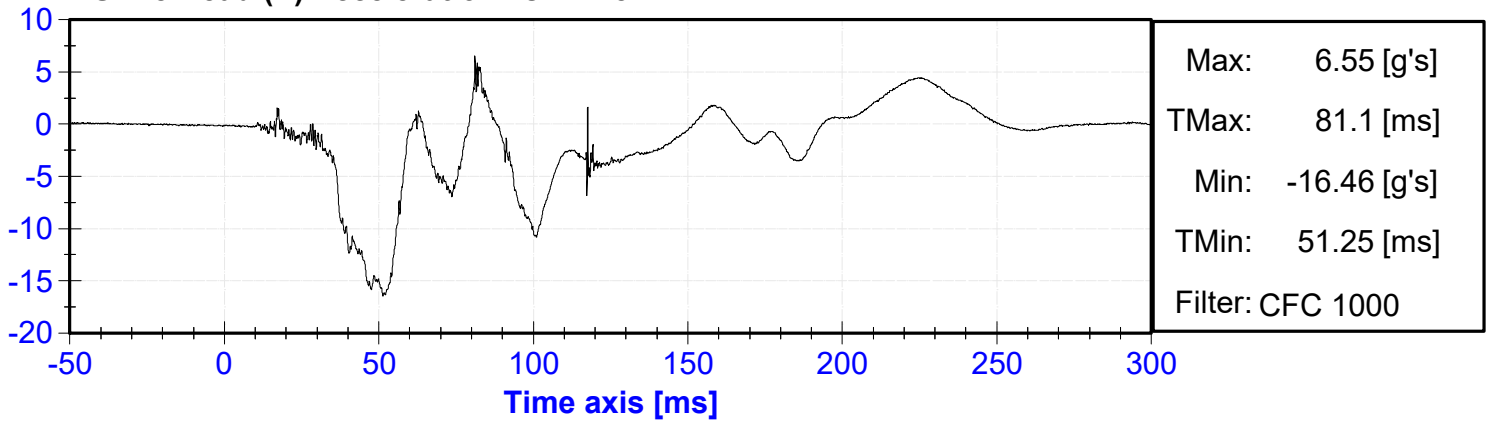


**APPENDIX II**  
**ES-2re DUMMY RESPONSE DATA TRACES**

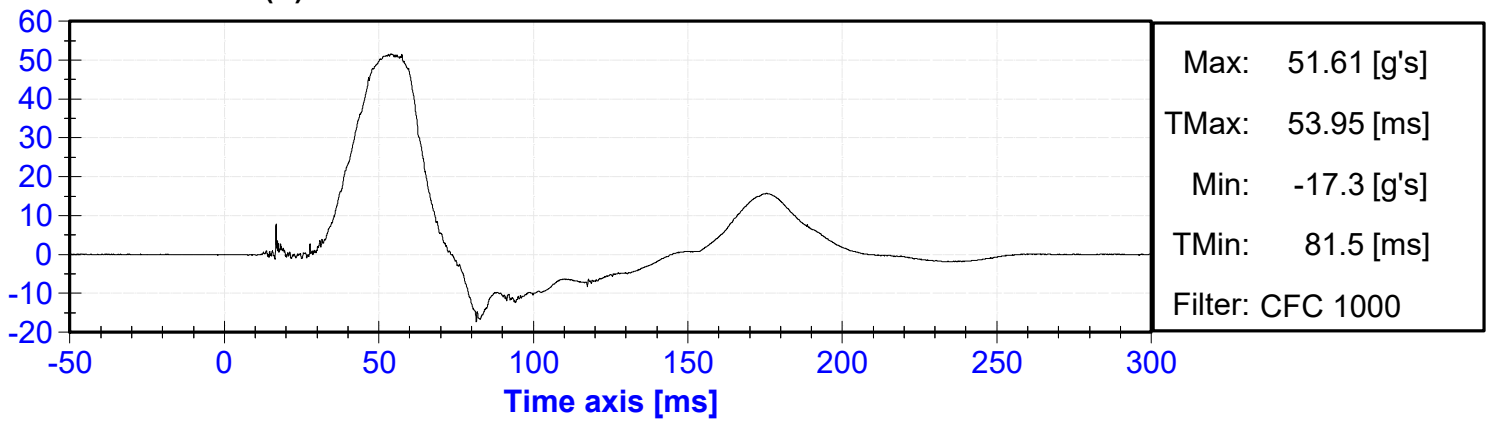
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10	ES-2re Middle Thorax Rib Deflection Rate vs. Time	II-5
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17	ES-2re Sum of Abdomen Forces vs. Time	II-7
18	ES-2re Pubic Symphysis Force (Y) vs. Time	II-7

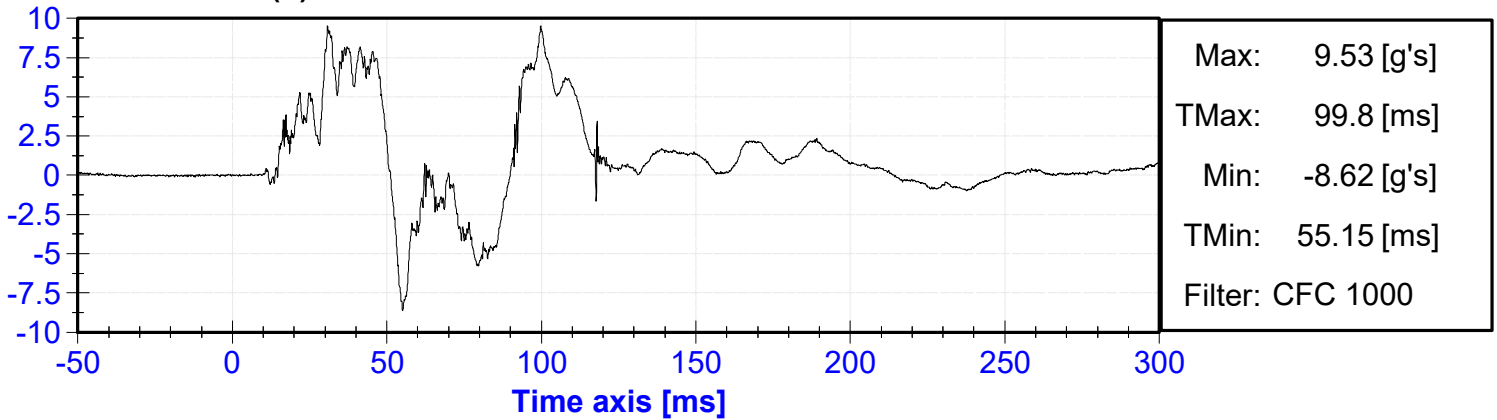
ES-2re Head (X) Acceleration vs. Time



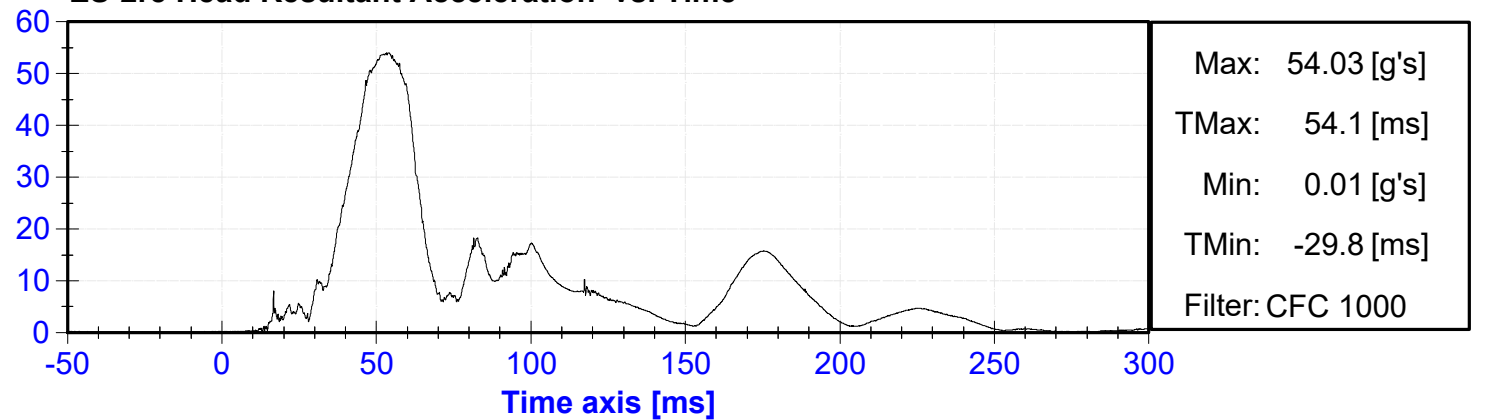
ES-2re Head (Y) Acceleration vs. Time



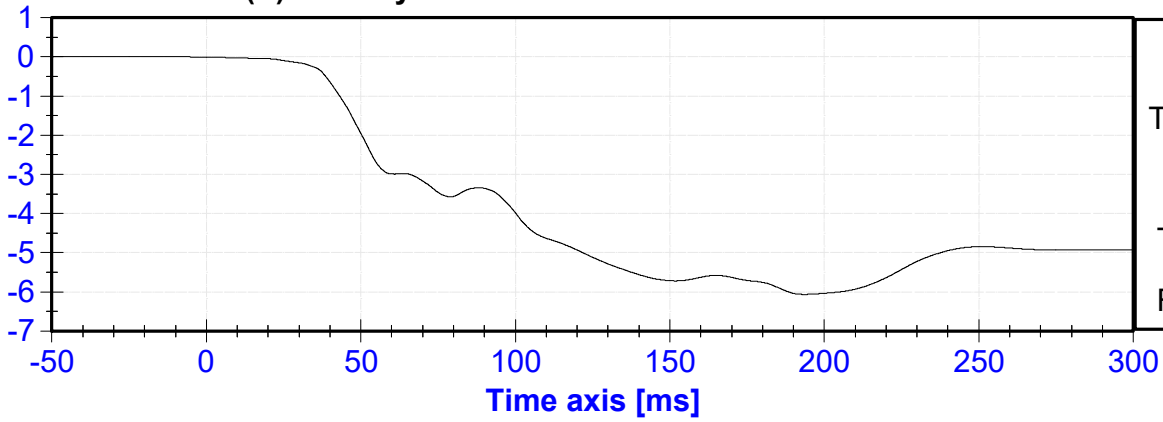
ES-2re Head (Z) Acceleration vs. Time



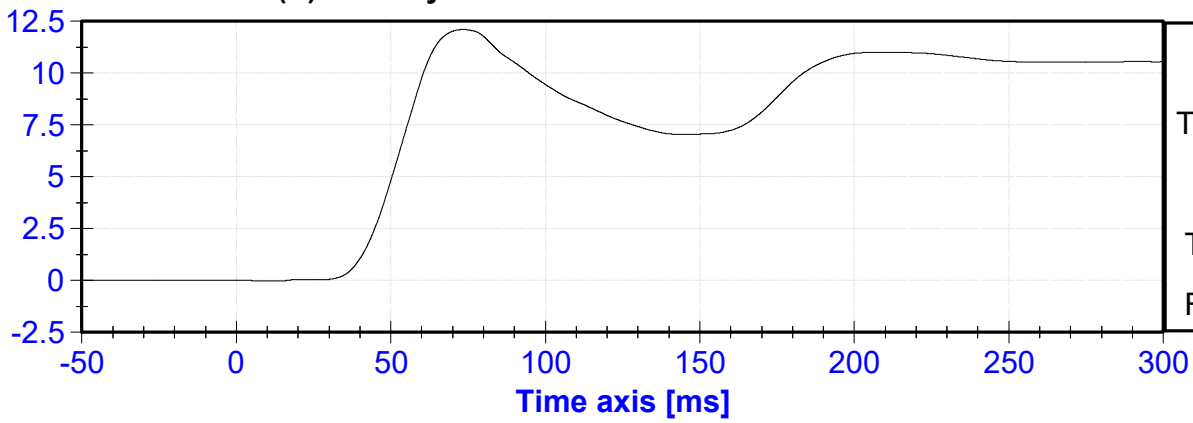
ES-2re Head Resultant Acceleration vs. Time



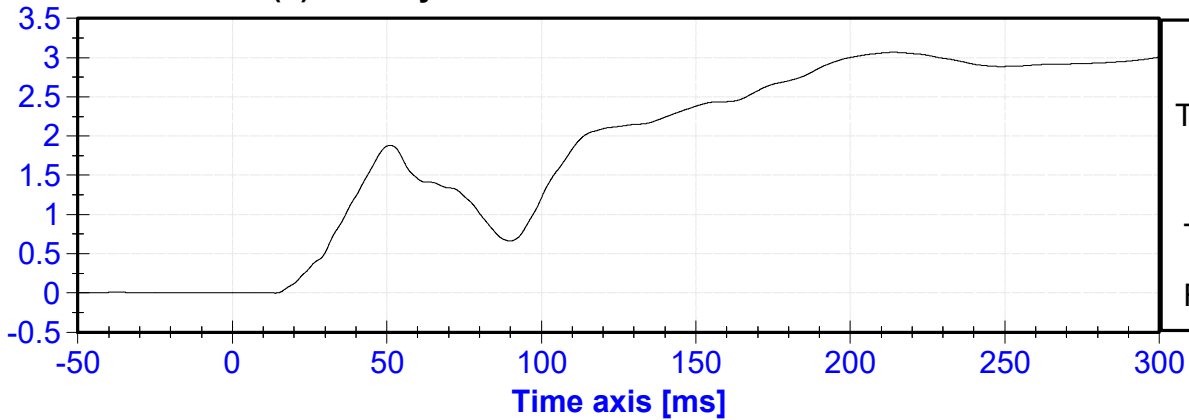
ES-2re Head (X) Velocity vs. Time



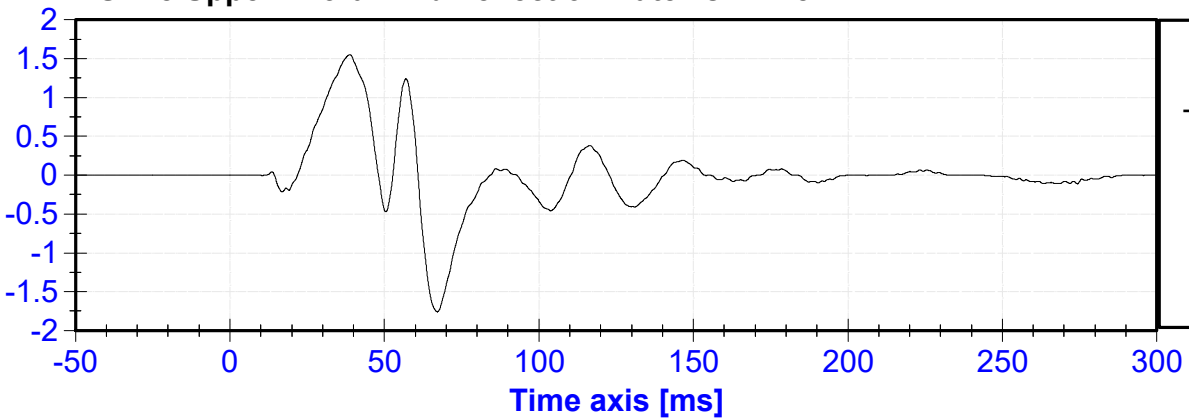
ES-2re Head (Y) Velocity vs. Time



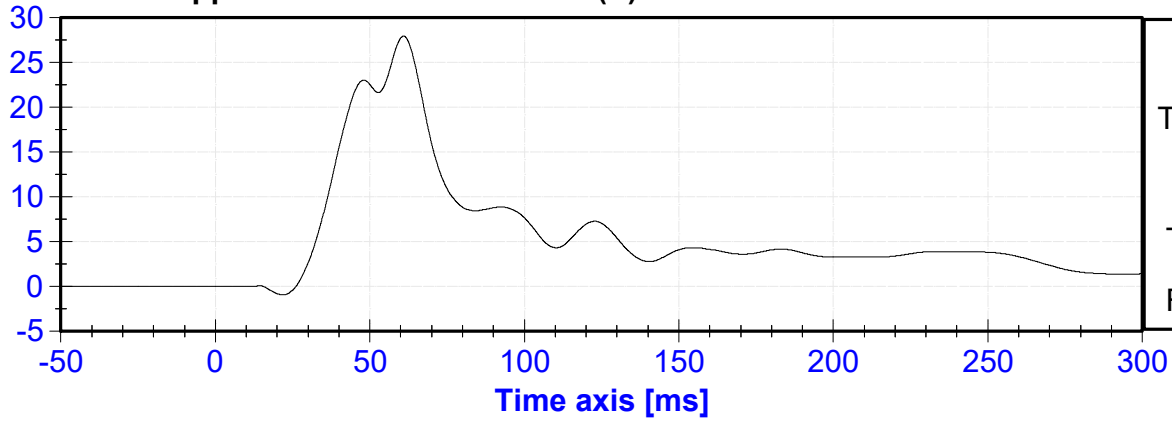
ES-2re Head (Z) Velocity vs. Time



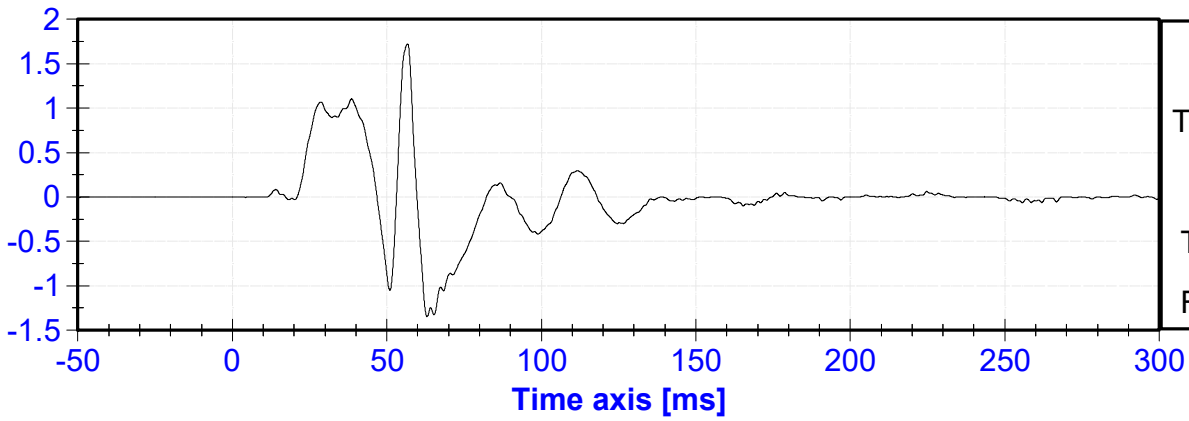
ES-2re Upper Thorax Rib Deflection Rate vs. Time



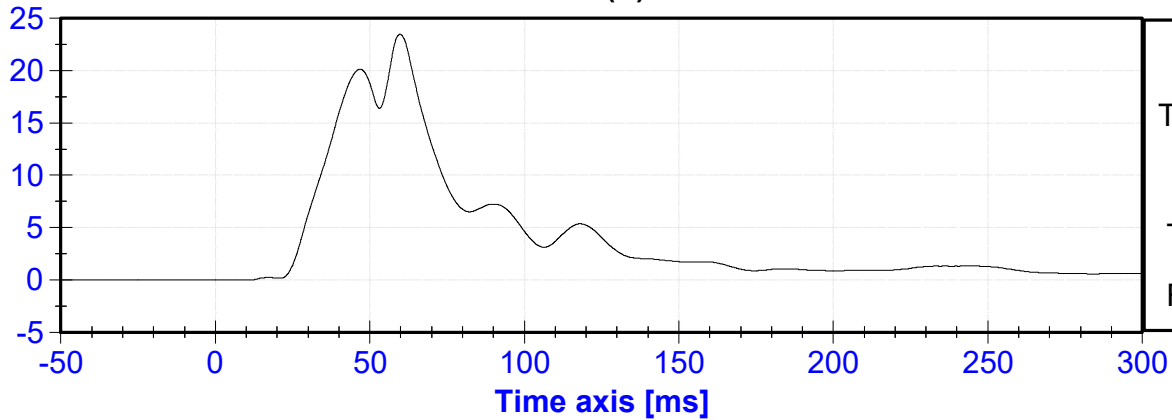
ES-2re Upper Thorax Rib Deflection (Y) vs. Time



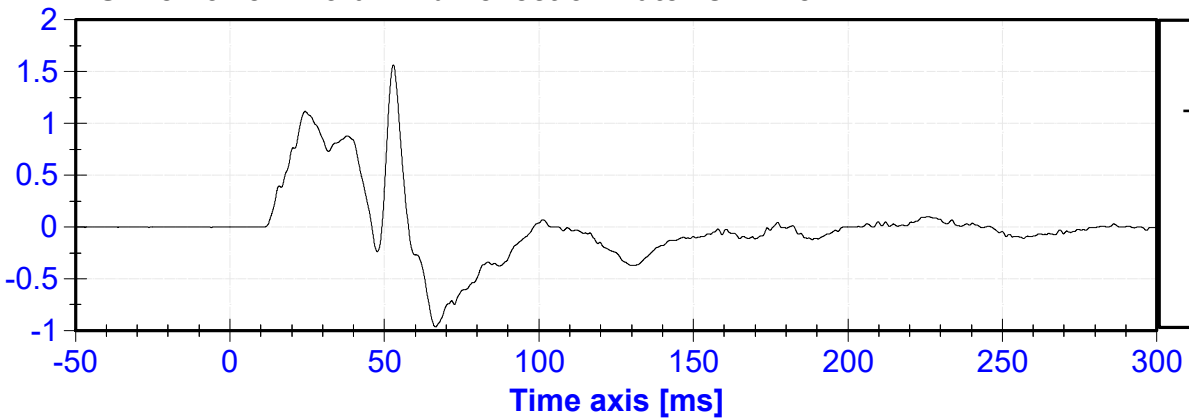
ES-2re Middle Thorax Rib Deflection Rate vs. Time



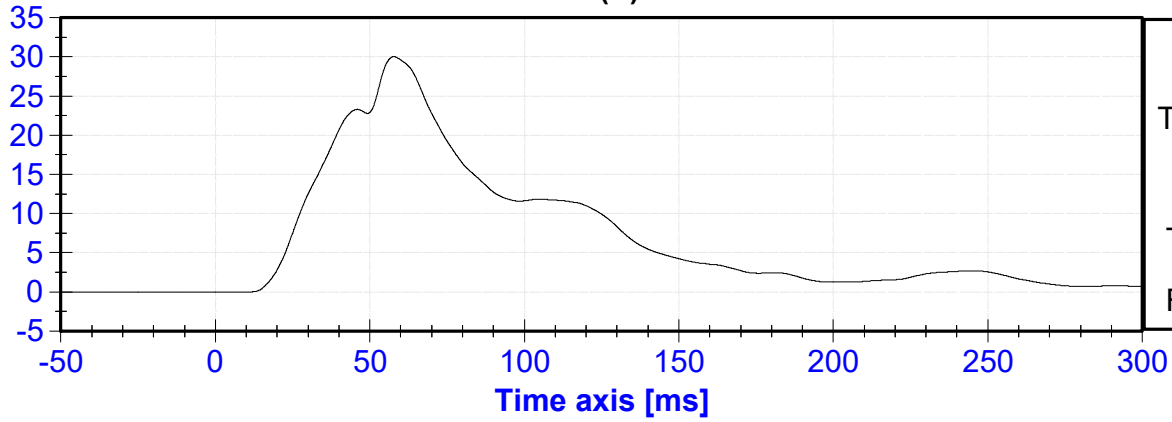
ES-2re Middle Thorax Rib Deflection (Y) vs. Time



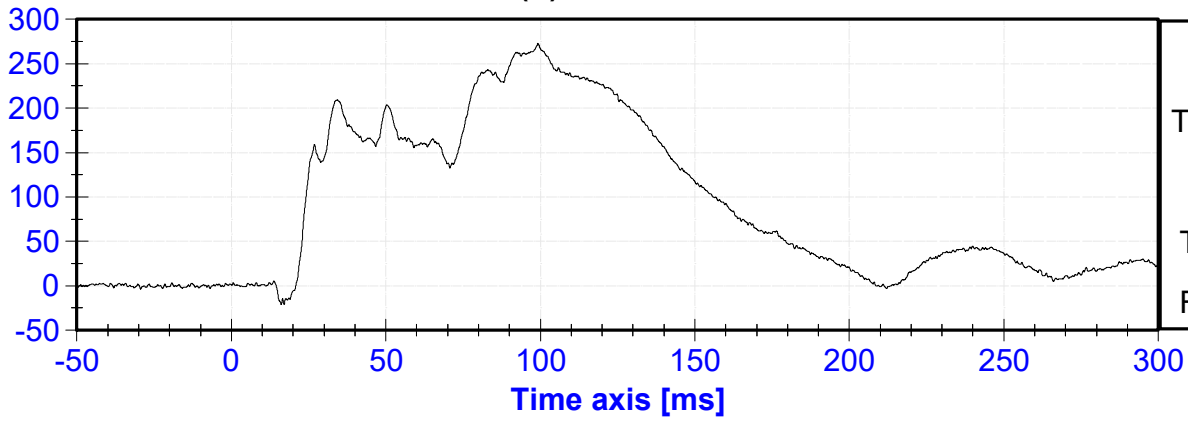
ES-2re Lower Thorax Rib Deflection Rate vs. Time



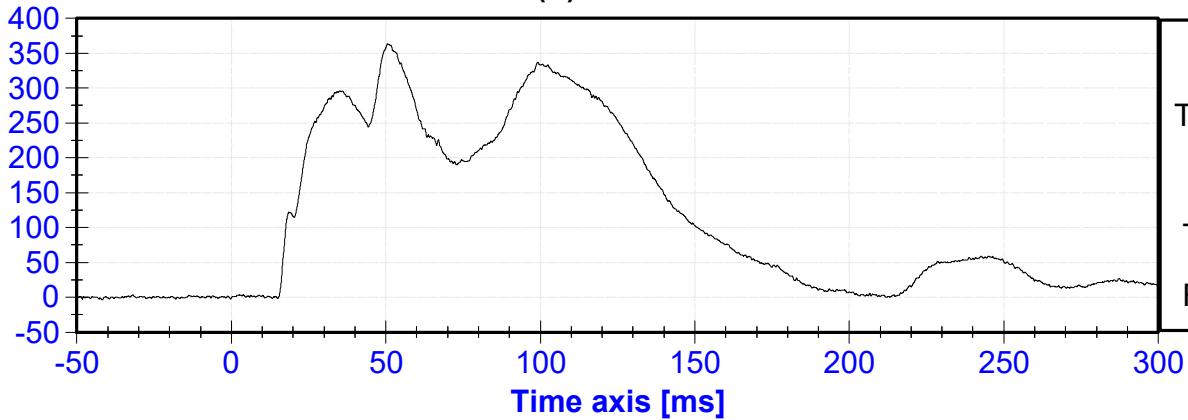
ES-2re Lower Thorax Rib Deflection (Y) vs. Time



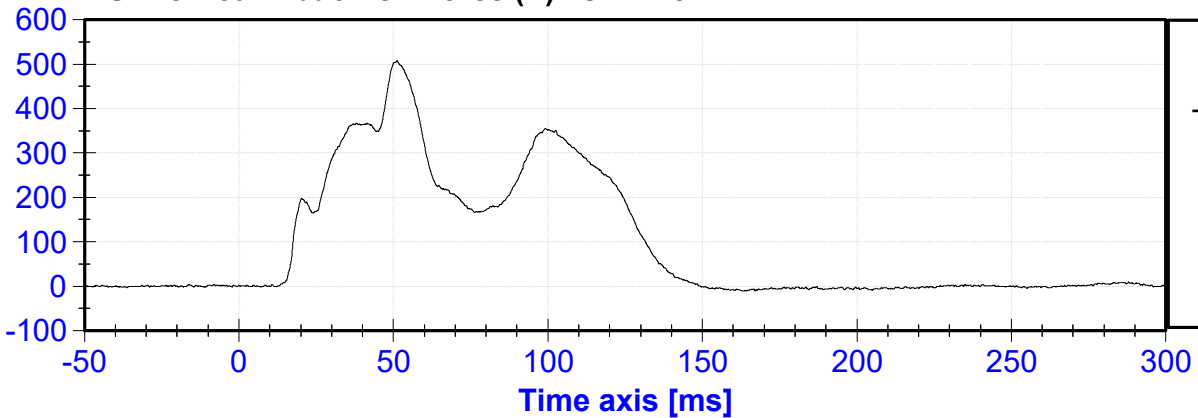
ES-2re Front Abdomen Force (Y) vs. Time



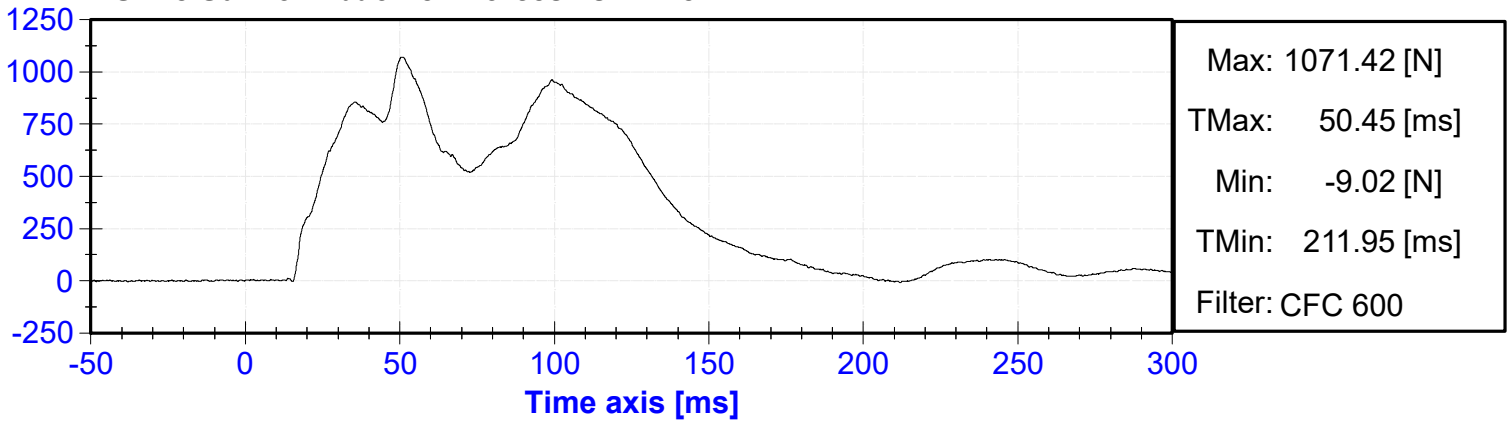
ES-2re Middle Abdomen Force (Y) vs. Time



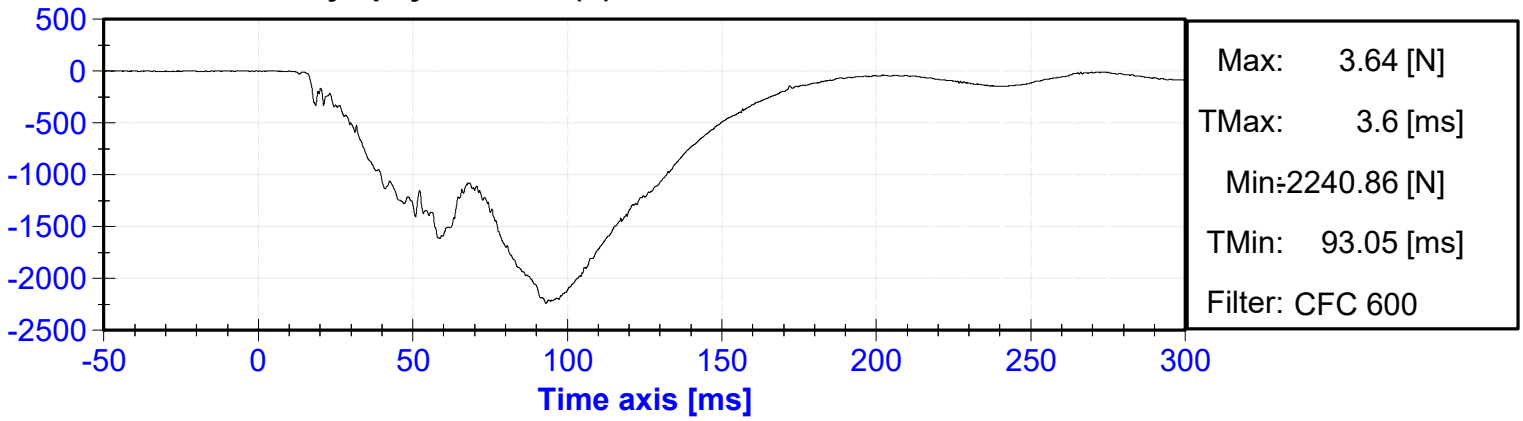
ES-2re Rear Abdomen Force (Y) vs. Time



ES-2re Sum of Abdomen Forces vs. Time



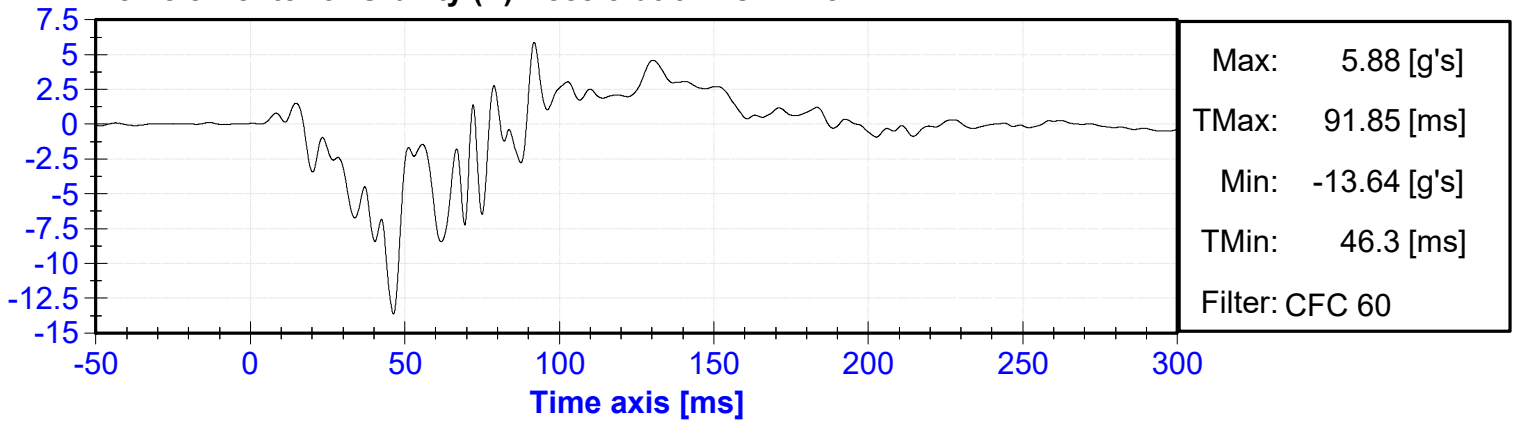
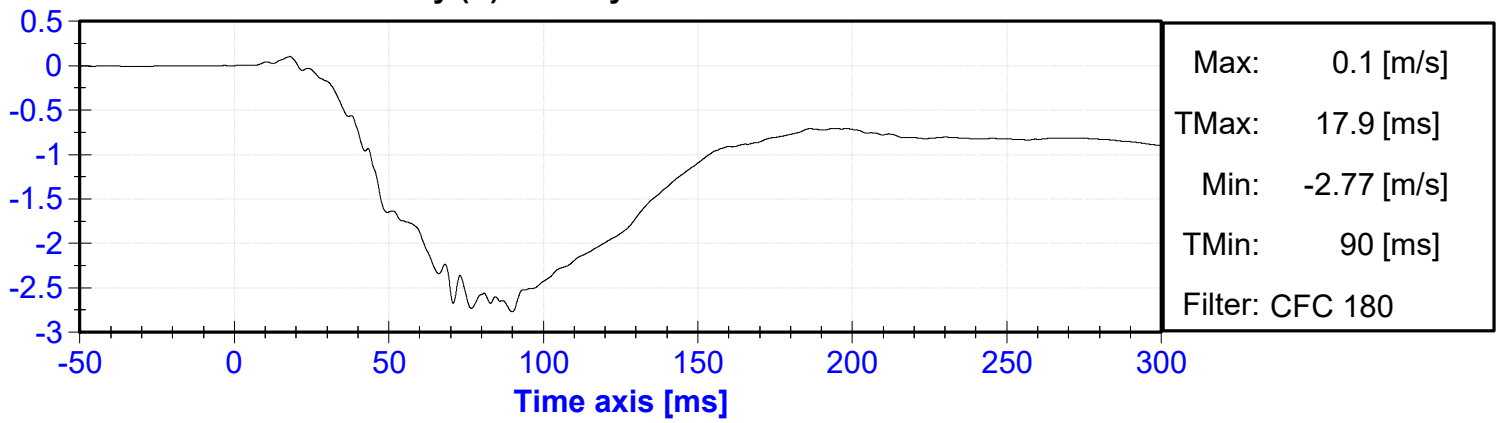
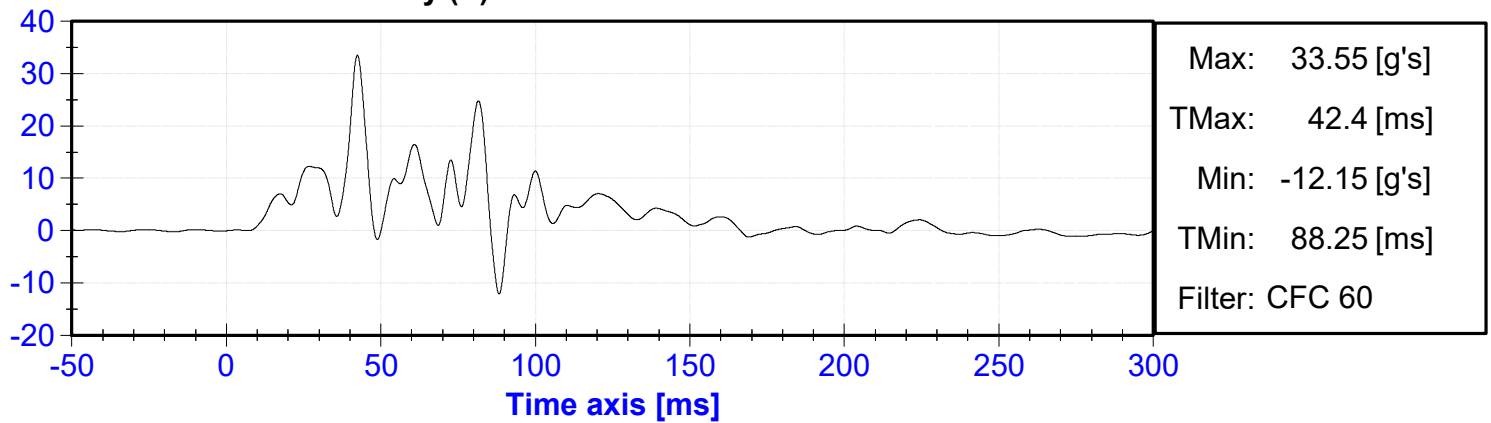
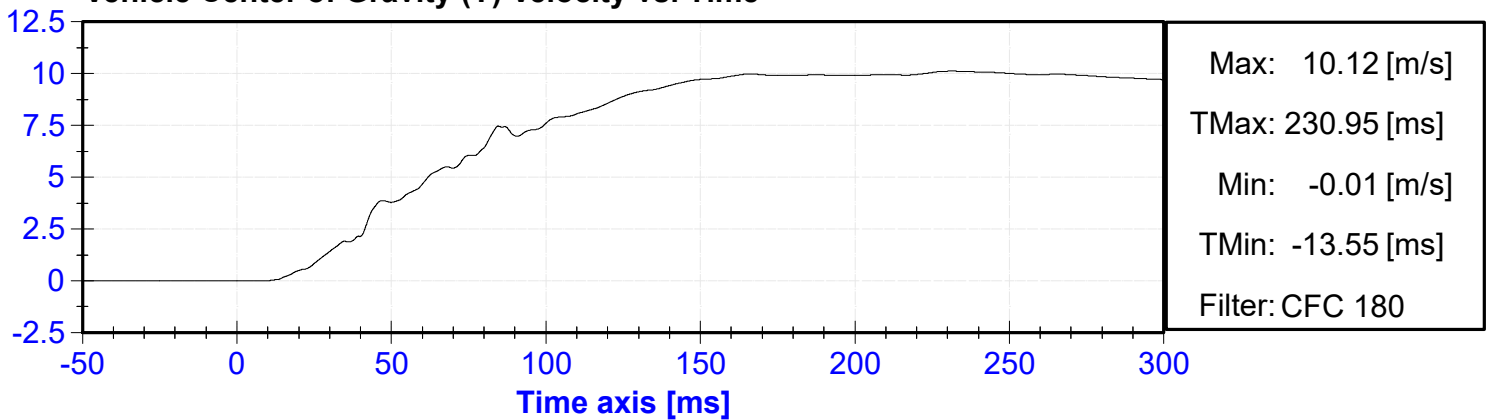
ES-2re Pubic Symphysis Force (Y) vs. Time

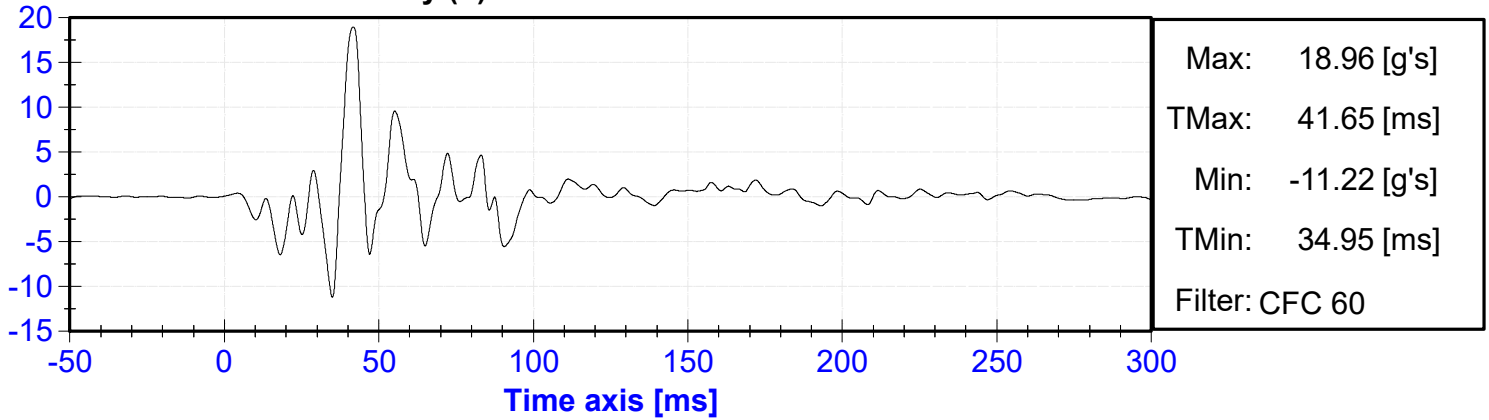
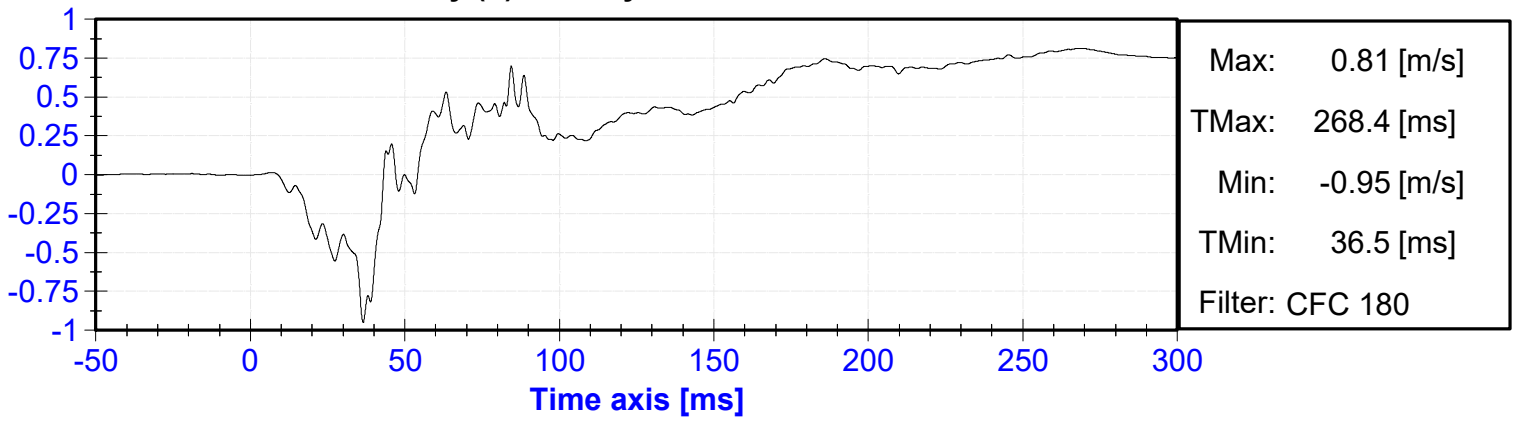
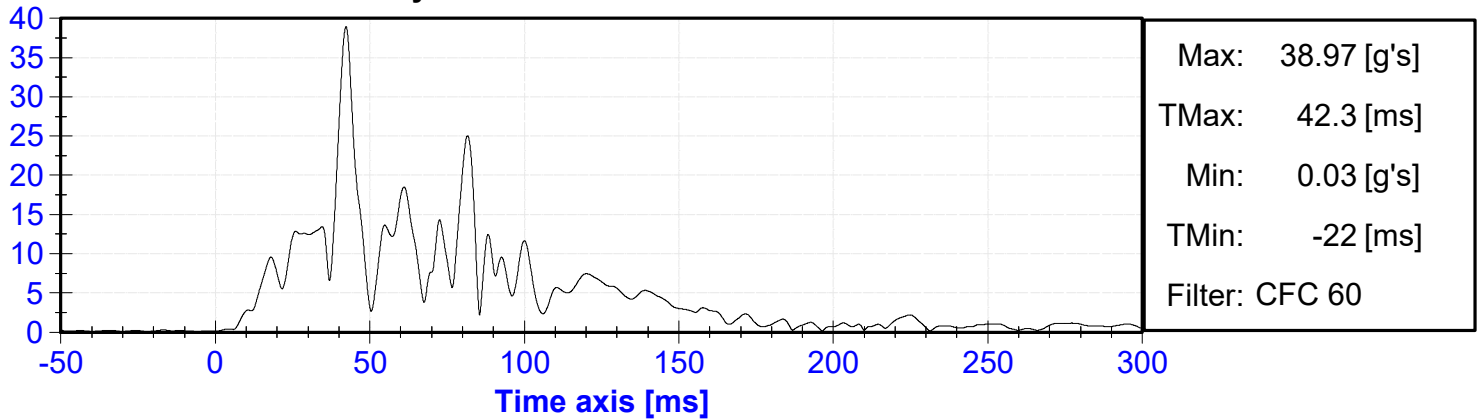
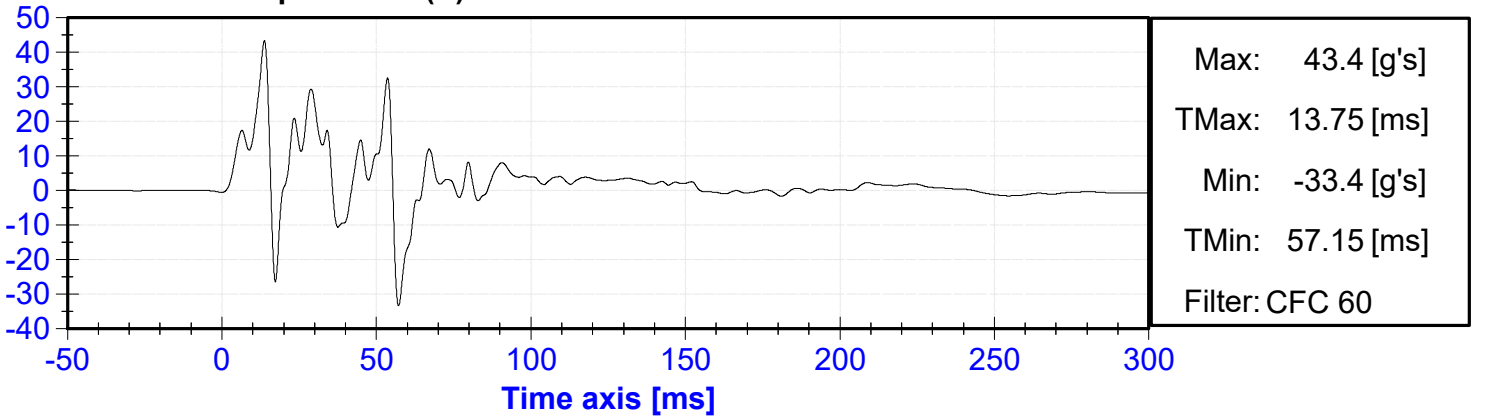


**APPENDIX III**  
**VEHICLE ACCELEROMETER RESPONSE DATA**

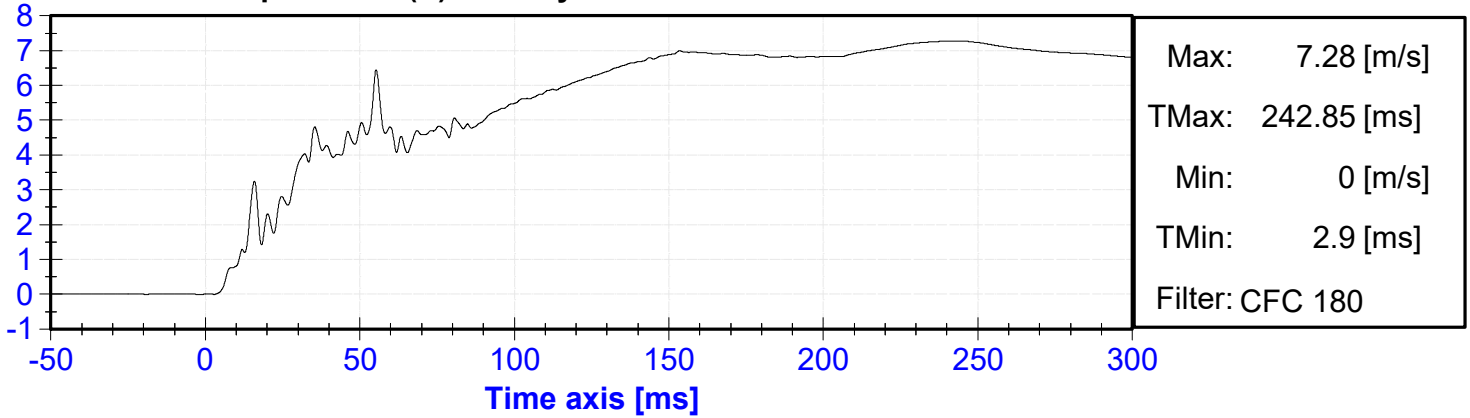
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24	B-Pillar Low (Y) Velocity vs. Time	III-8
25	B-Pillar Low (Y) Displacement vs. Time	III-9
26	B-Pillar Mid (Y) Acceleration vs. Time	III-9
27	B-Pillar Mid (Y) Velocity vs. Time	III-9
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30	Seat (Y) 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

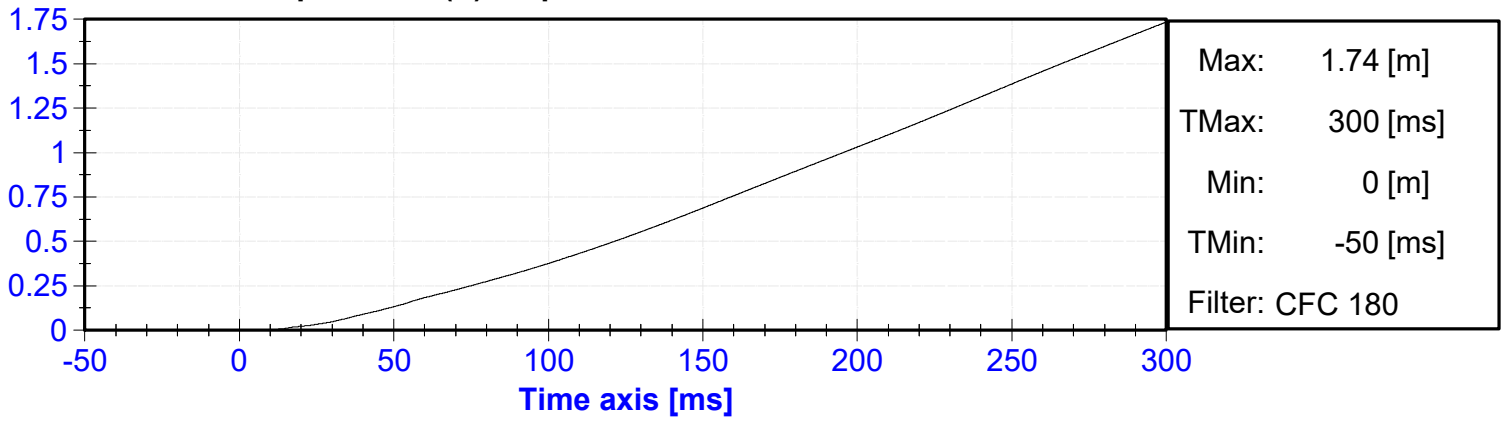
**Vehicle Center of Gravity (X) Acceleration vs. Time****Vehicle Center of Gravity (X) Velocity vs. Time****Vehicle Center of Gravity (Y) Acceleration vs. Time****Vehicle Center of Gravity (Y) Velocity vs. Time**

**Vehicle Center of Gravity (Z) Acceleration vs. Time****Vehicle Center of Gravity (Z) Velocity vs. Time****Vehicle Center of Gravity Resultant Acceleration vs. Time****Floor Sill – Impact Side (Y) Acceleration vs. Time**

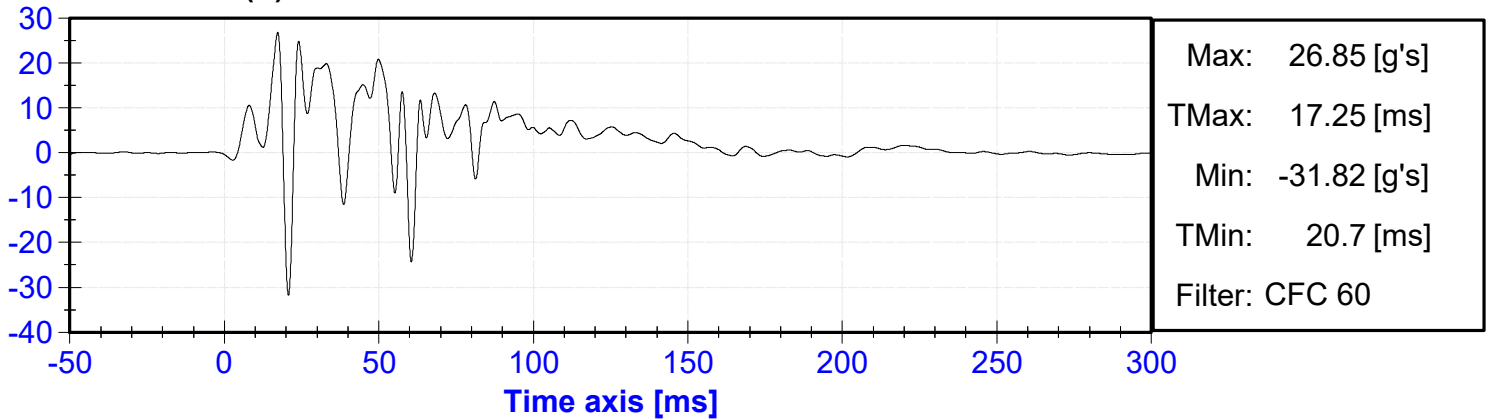
Floor Sill – Impact Side (Y) Velocity vs. Time



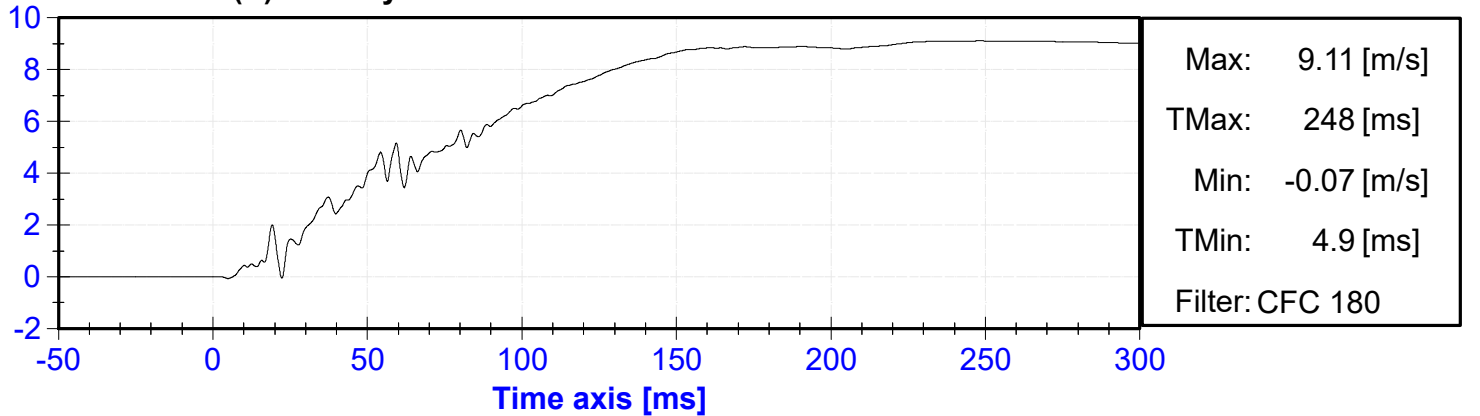
Floor Sill – Impact Side (Y) Displacement vs. Time

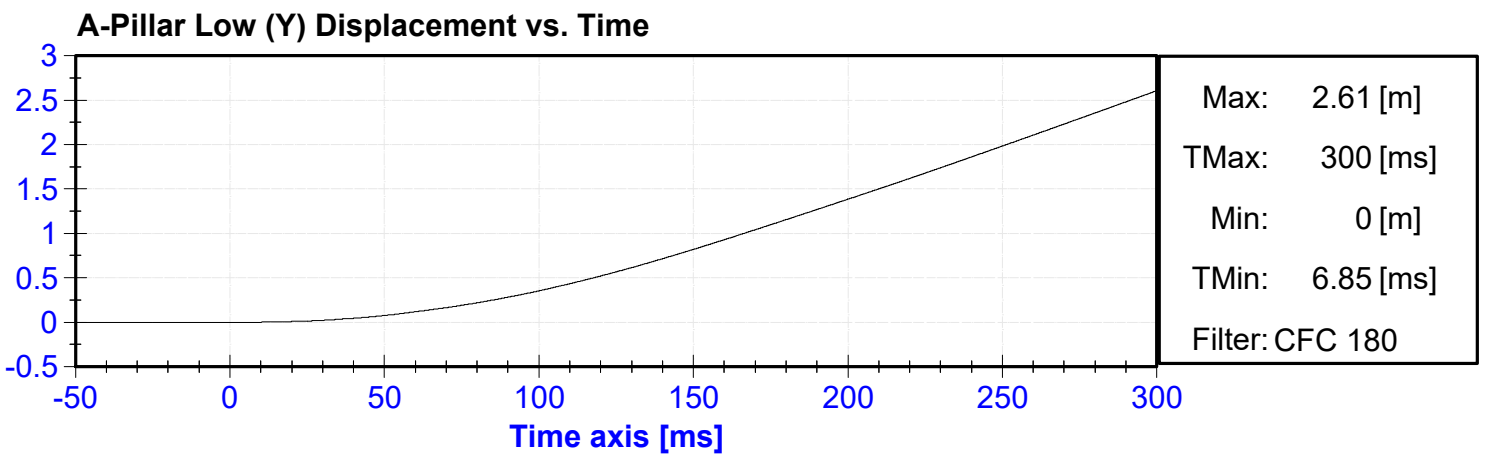
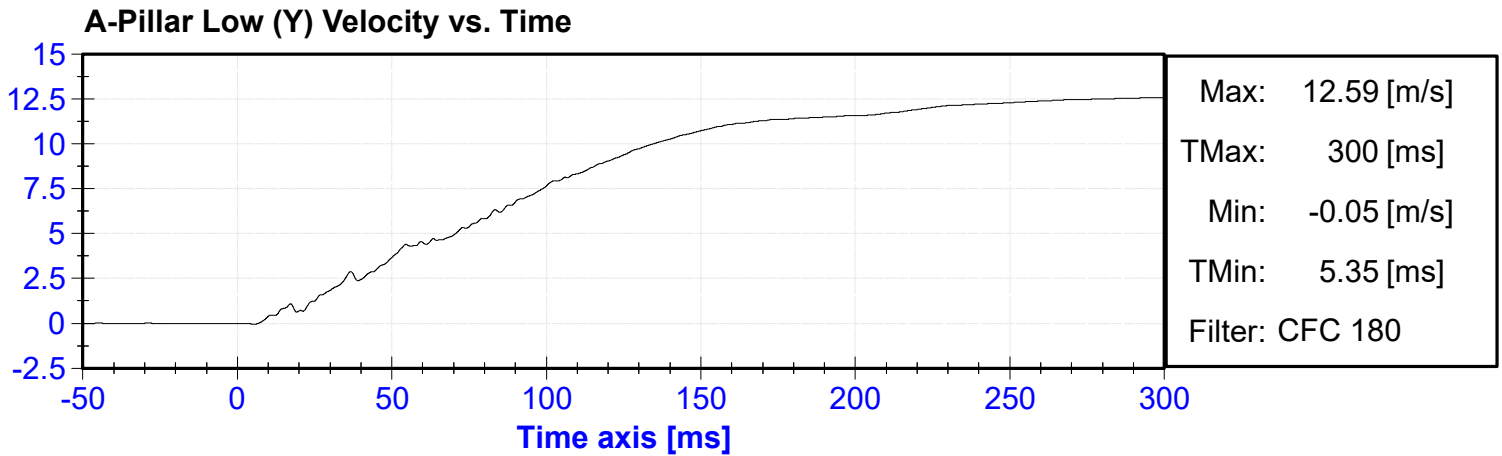
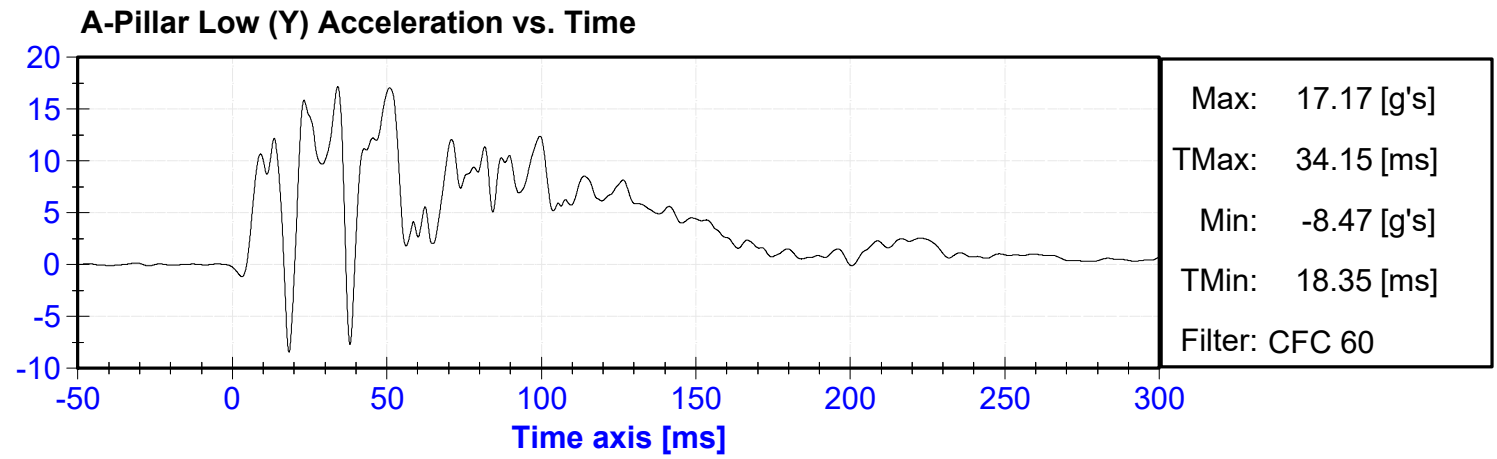
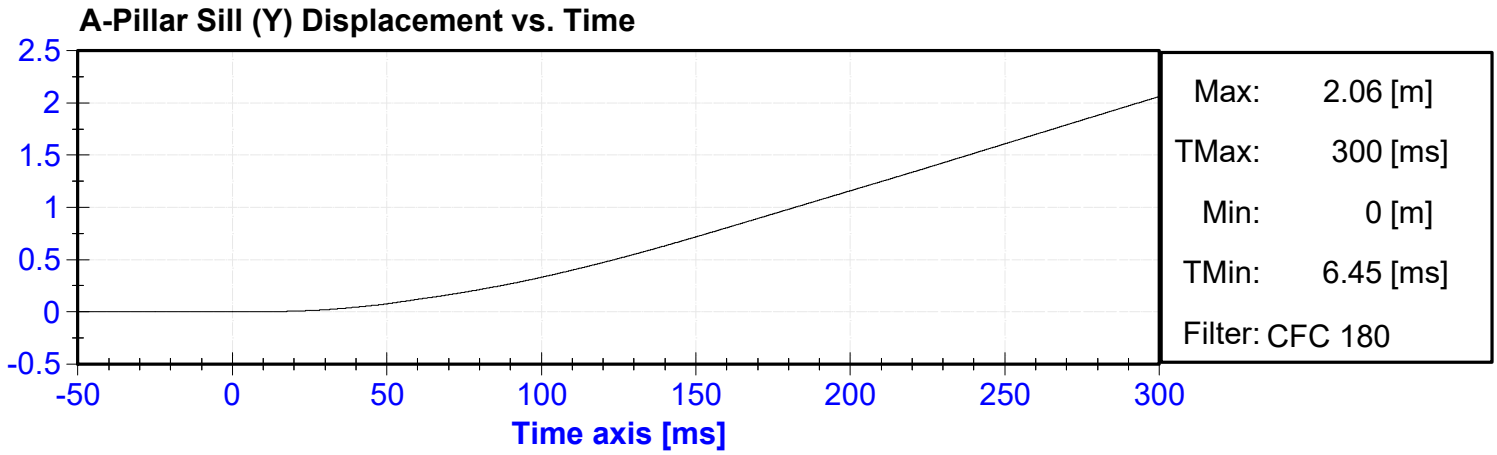


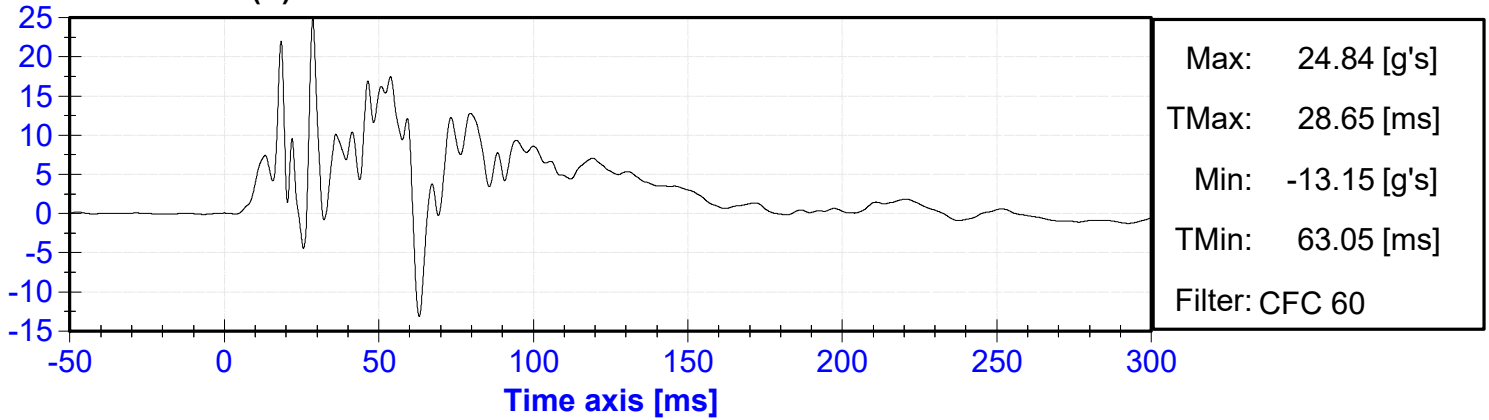
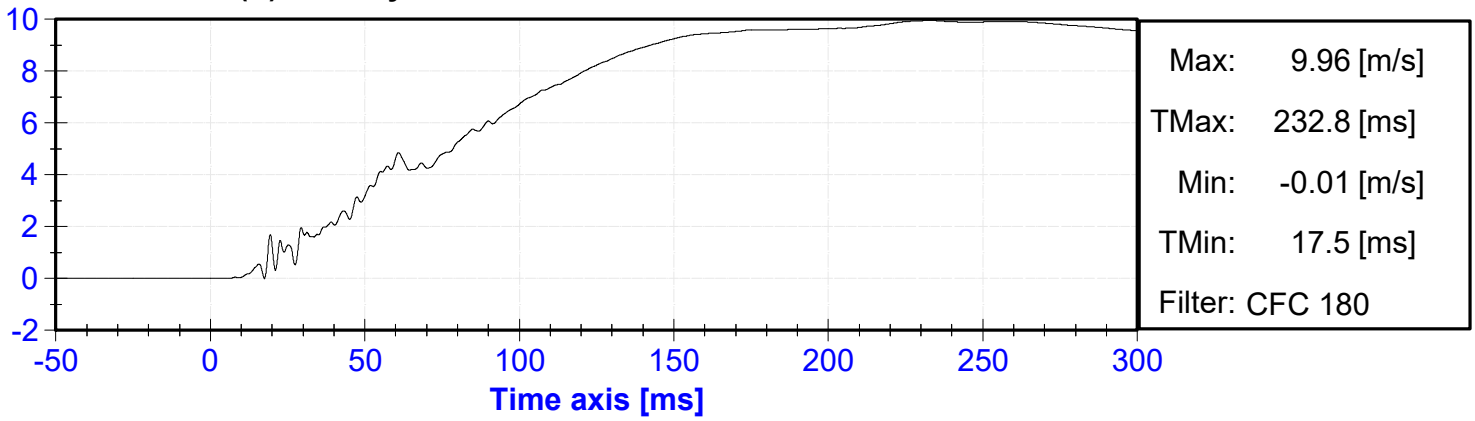
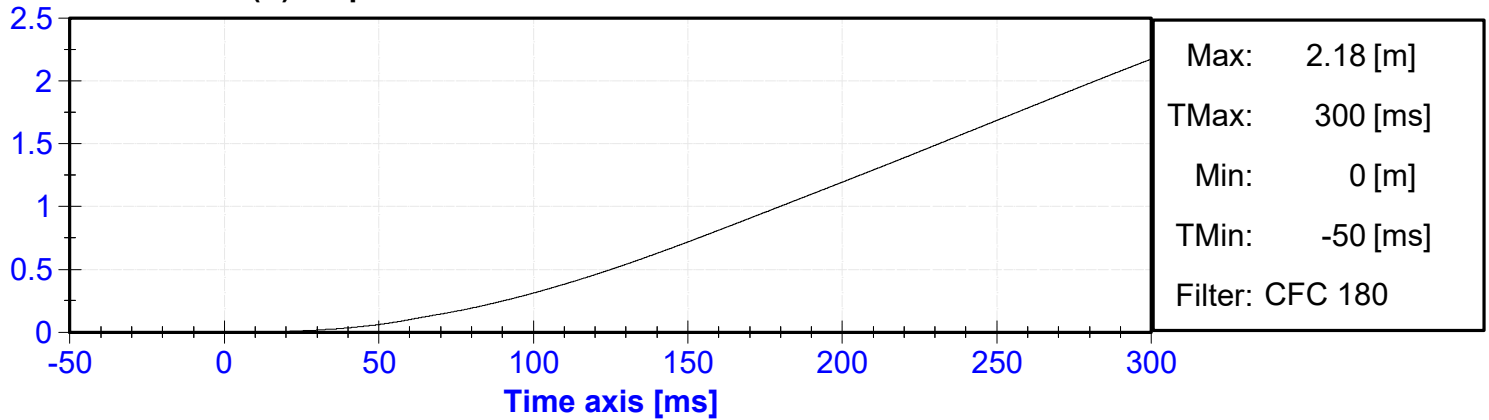
A-Pillar Sill (Y) Acceleration vs. Time



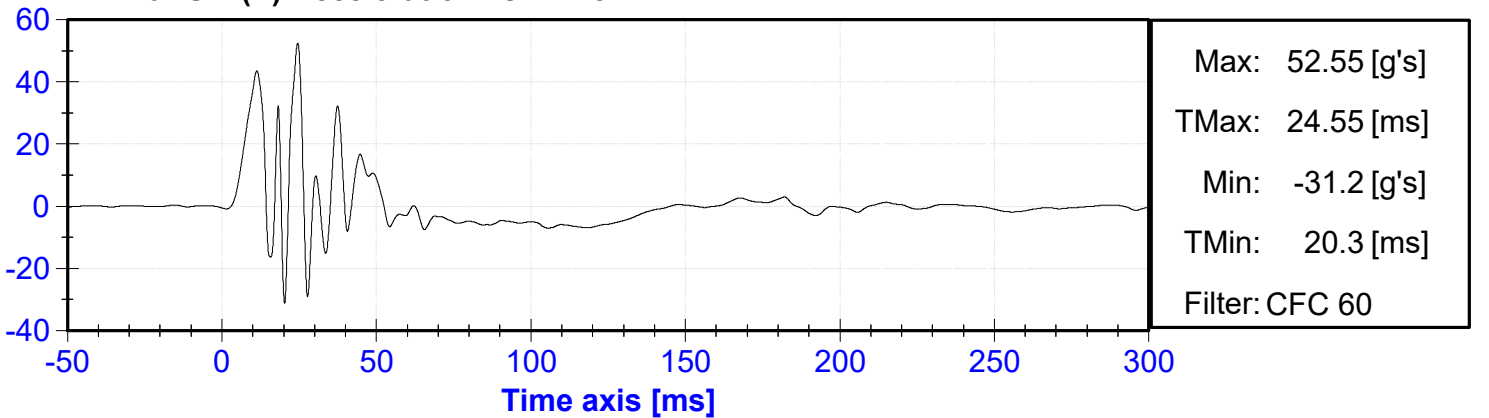
A-Pillar Sill (Y) Velocity vs. Time





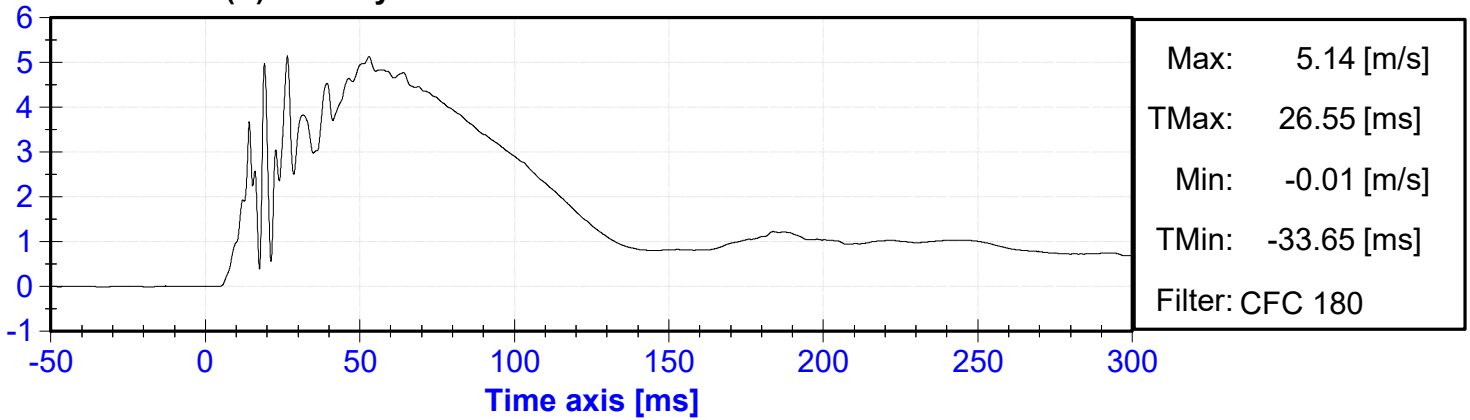
**A-Pillar Mid (Y) Acceleration vs. Time****A-Pillar Mid (Y) Velocity vs. Time****A-Pillar Mid (Y) Displacement vs. Time**

Exceeded calibration range and saturated at 13.2 ms

**B-Pillar Sill (Y) Acceleration vs. Time**

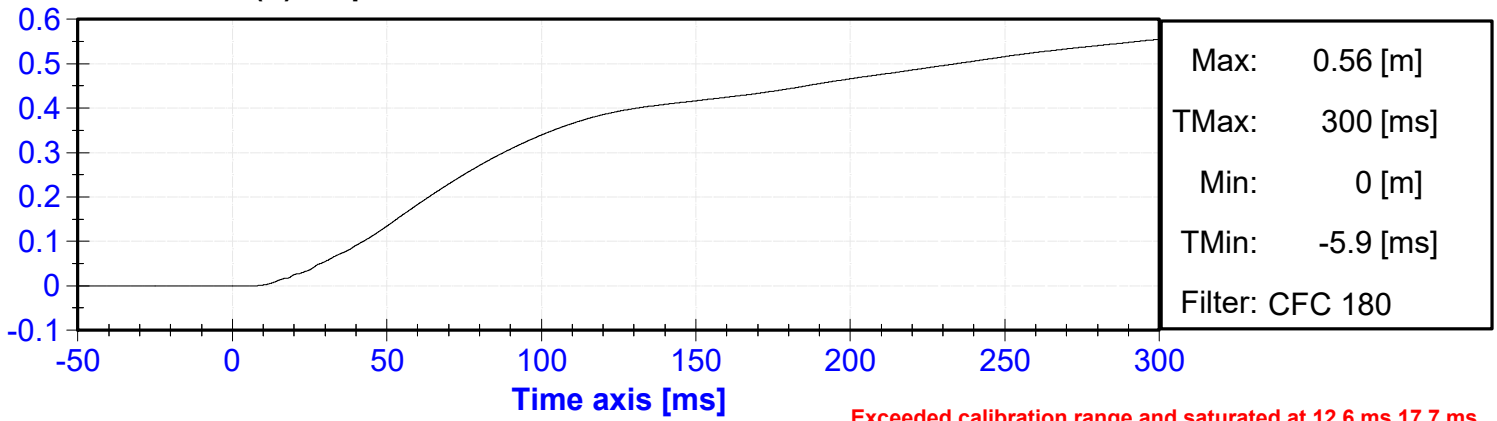
Exceeded calibration range and saturated at 13.2 ms

B-Pillar Sill (Y) Velocity vs. Time



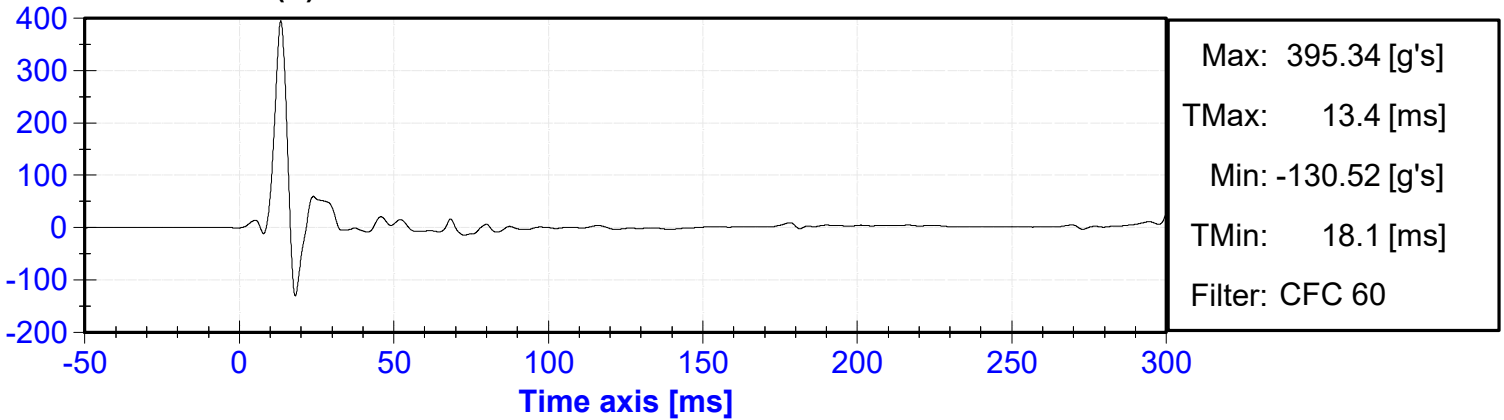
Exceeded calibration range and saturated at 13.2 ms

B-Pillar Sill (Y) Displacement vs. Time



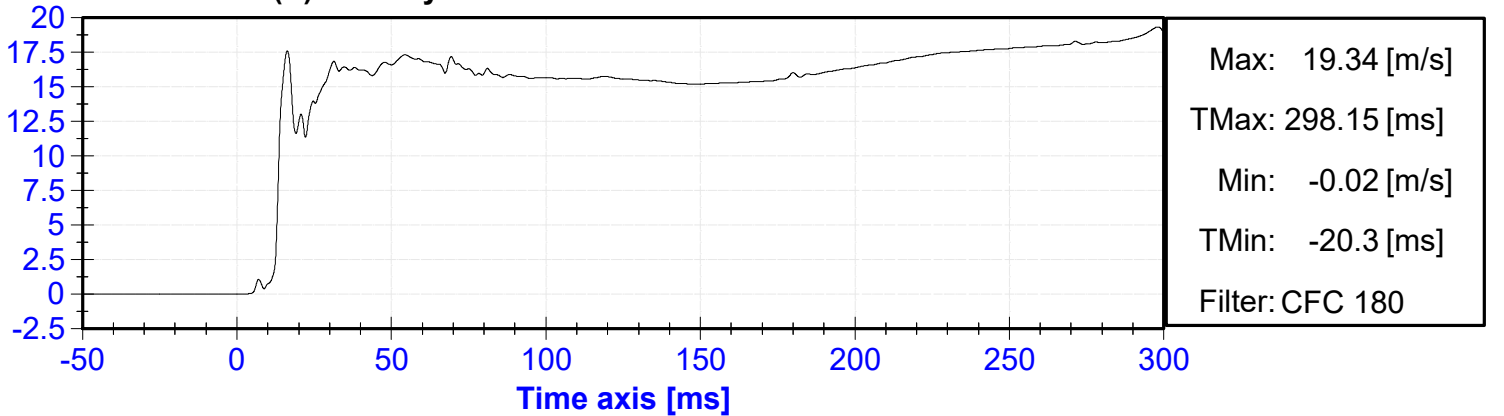
Exceeded calibration range and saturated at 12.6 ms 17.7 ms

B-Pillar Low (Y) Acceleration vs. Time



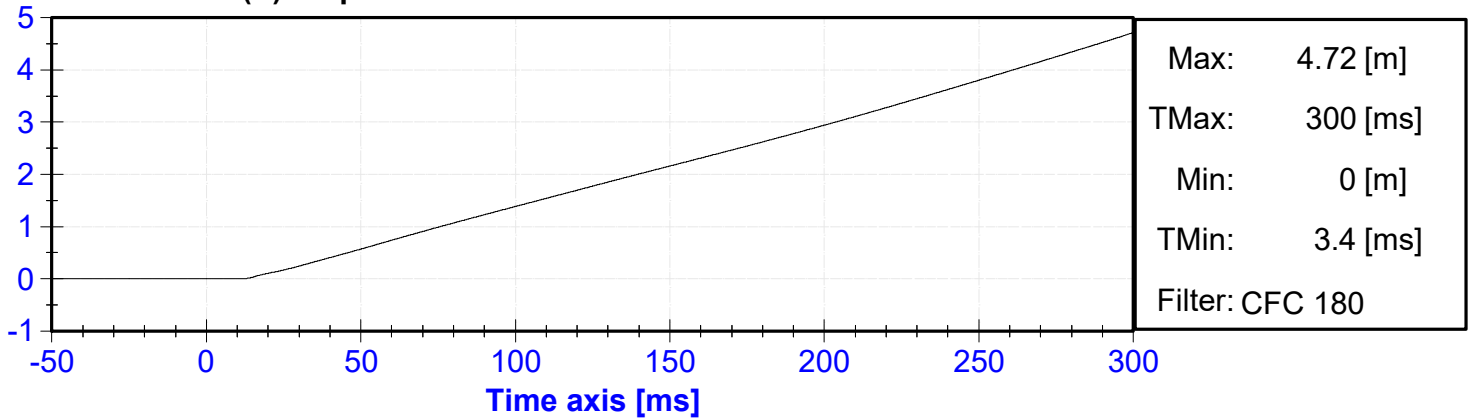
Exceeded calibration range and saturated at 12.6 ms 17.7 ms

B-Pillar Low (Y) Velocity vs. Time



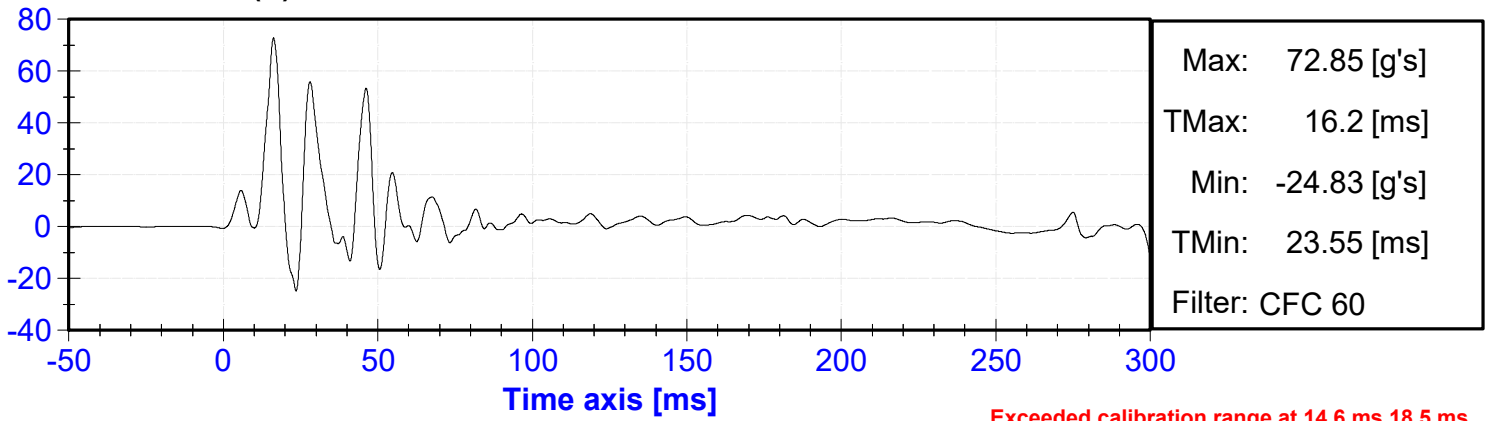
Exceeded calibration range and saturated at 12.6 ms 17.7 ms

B-Pillar Low (Y) Displacement vs. Time



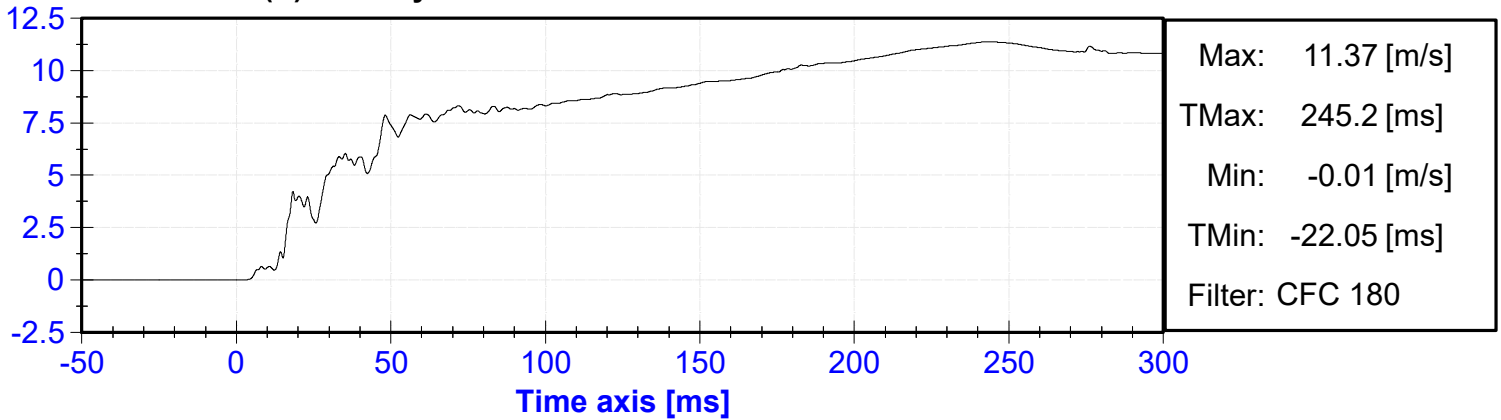
Exceeded calibration range at 14.6 ms 18.5 ms

B-Pillar Mid (Y) Acceleration vs. Time



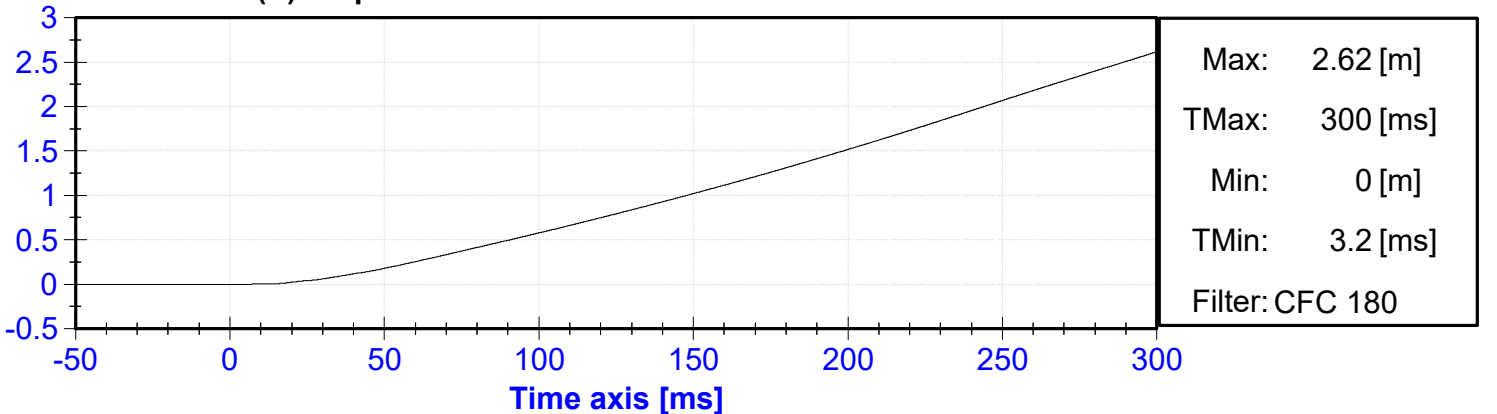
Exceeded calibration range at 14.6 ms 18.5 ms

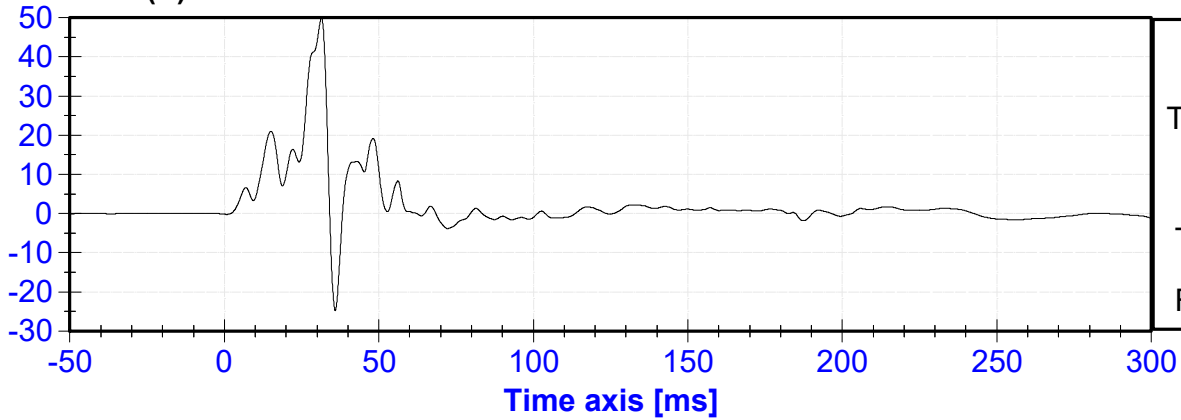
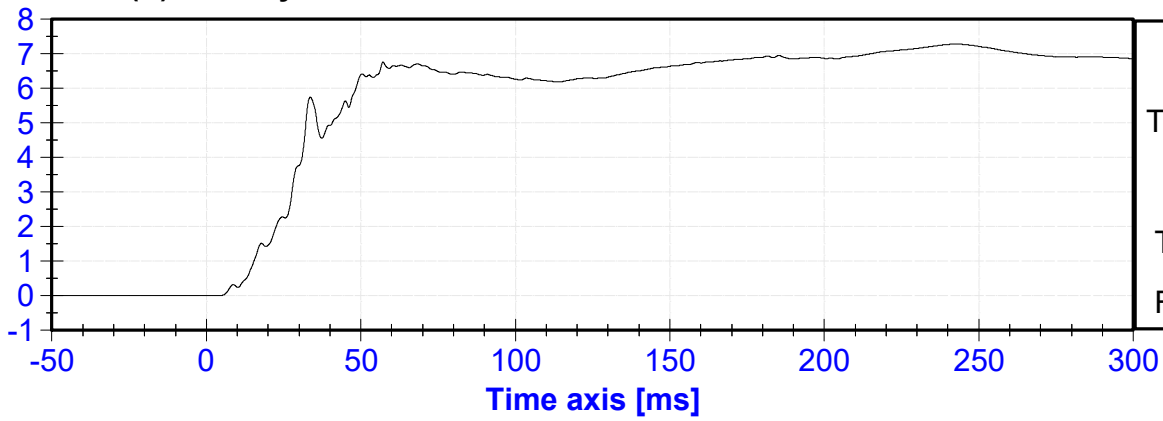
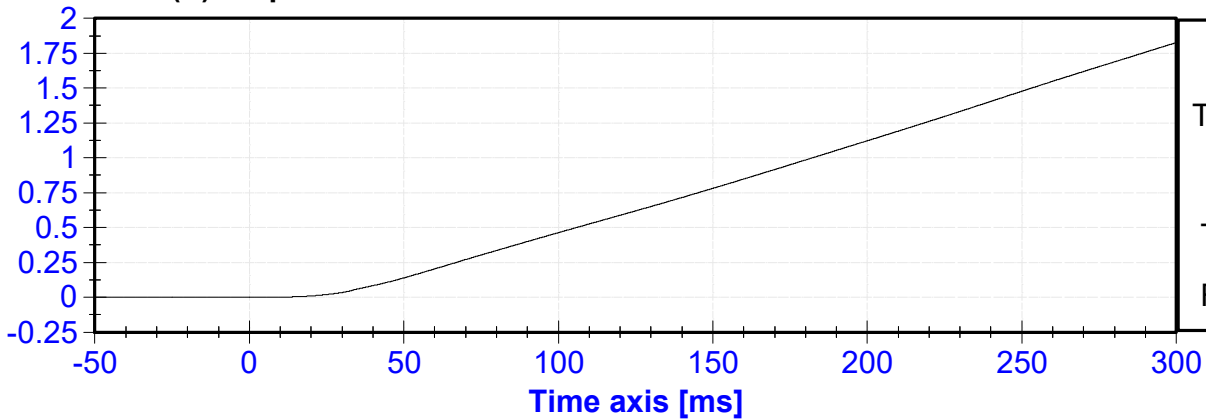
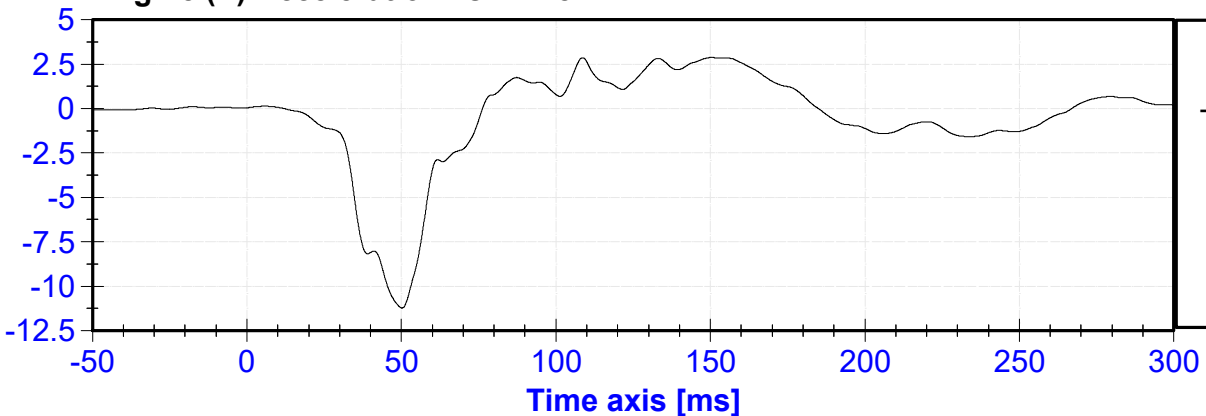
B-Pillar Mid (Y) Velocity vs. Time

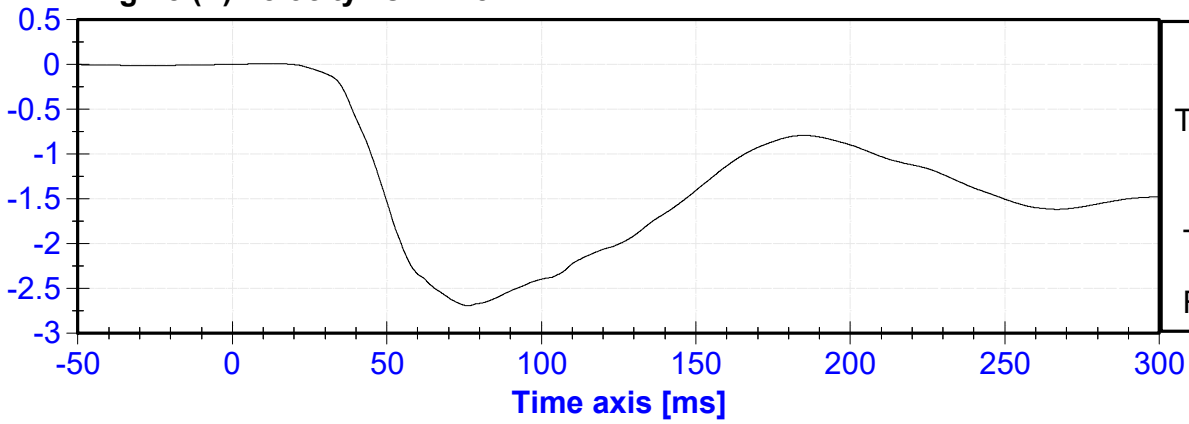
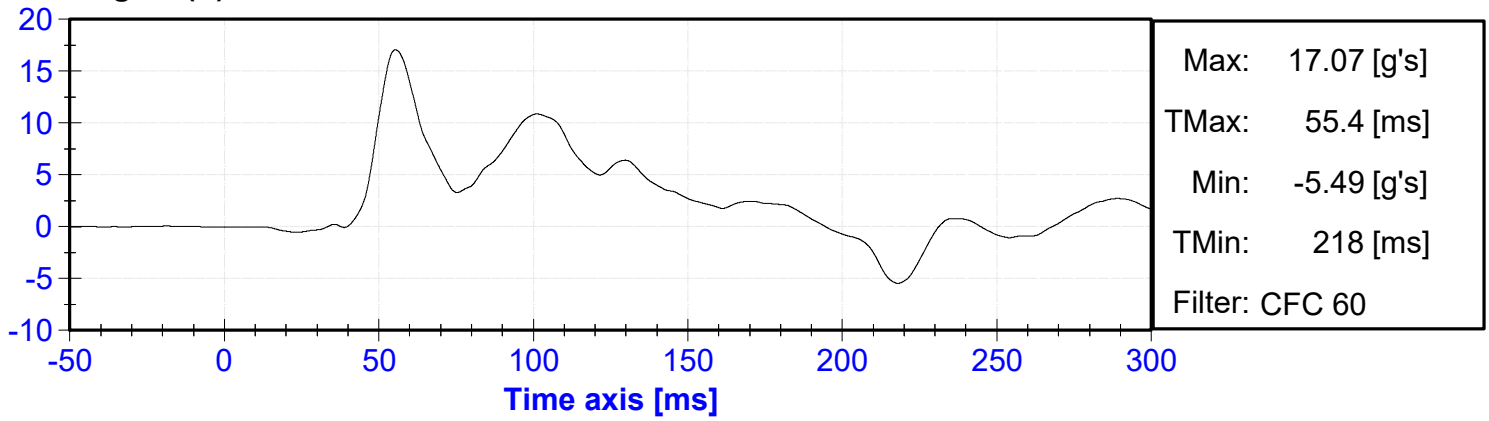
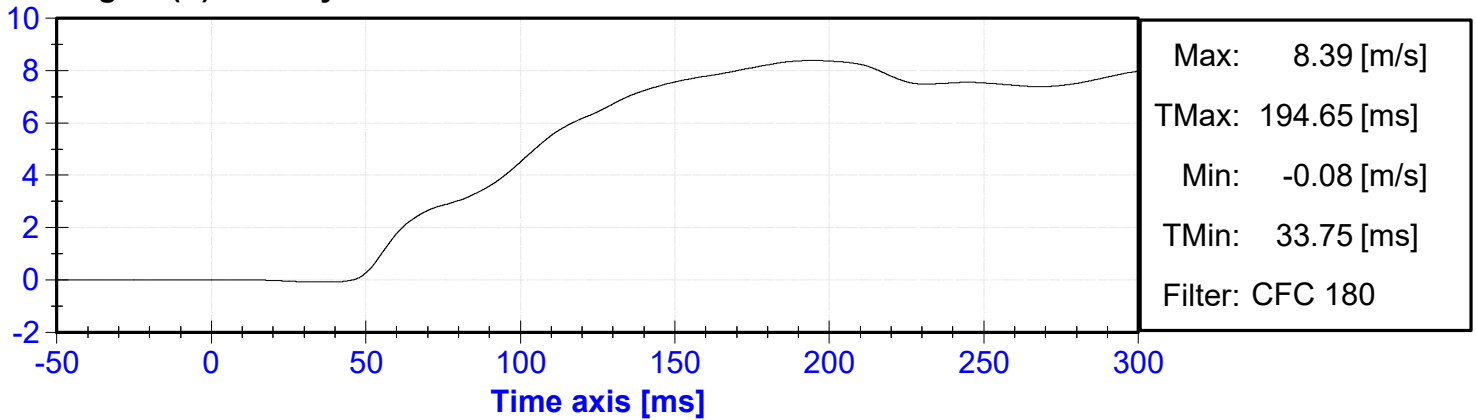
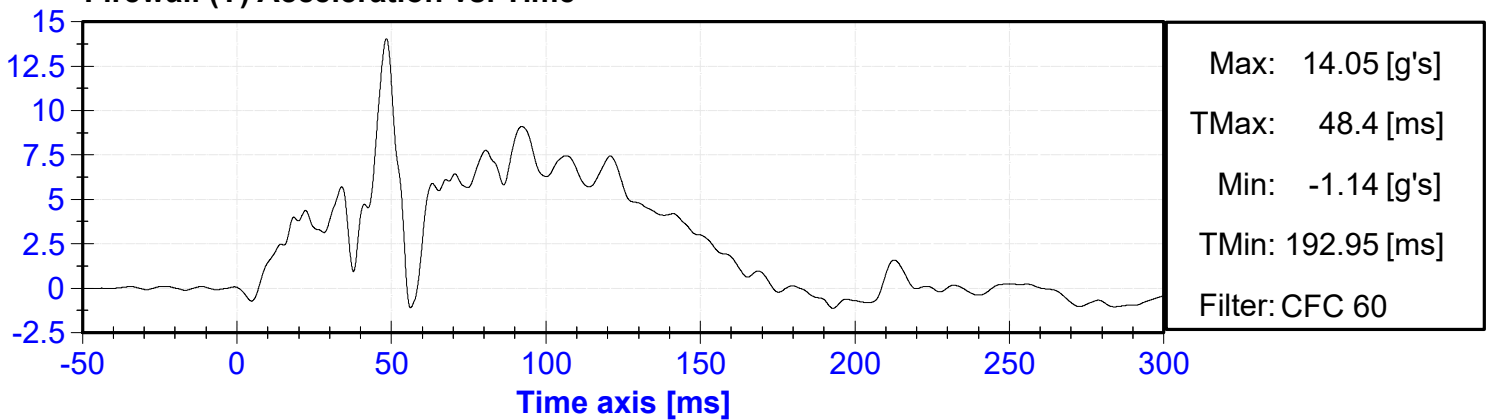


Exceeded calibration range at 14.6 ms 18.5 ms

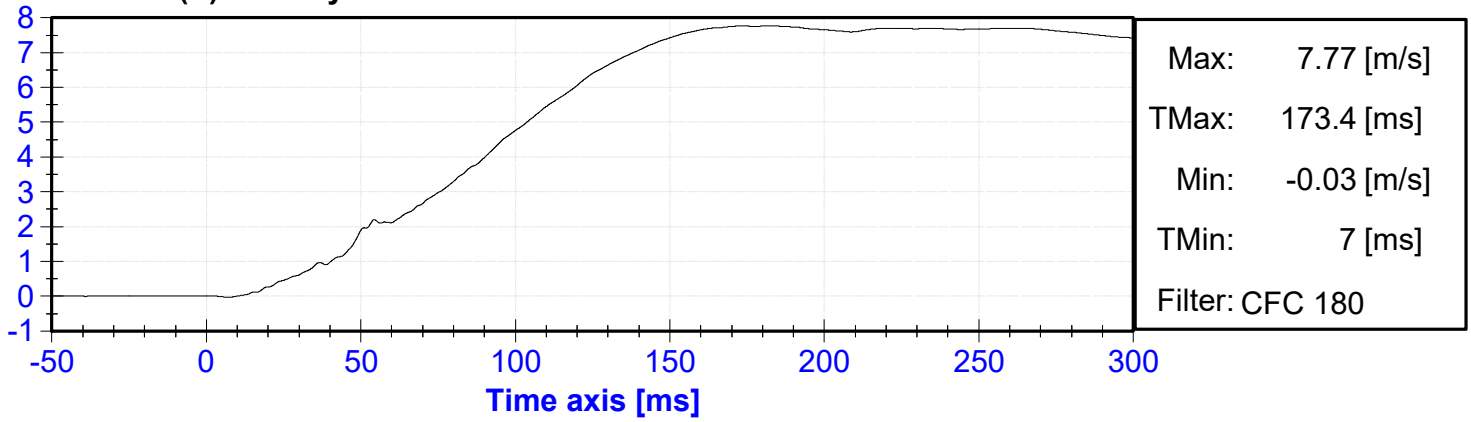
B-Pillar Mid (Y) Displacement vs. Time



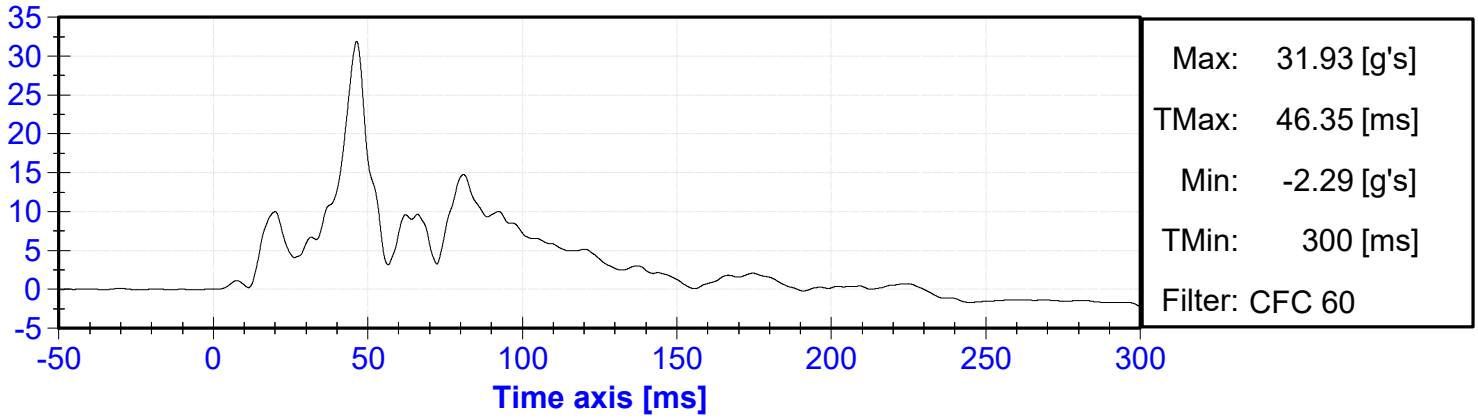
**Seat (Y) Acceleration vs. Time****Seat (Y) Velocity vs. Time****Seat (Y) Displacement vs. Time****Engine (X) Acceleration vs. Time**

**Engine (X) Velocity vs. Time****Engine (Y) Acceleration vs. Time****Engine (Y) Velocity vs. Time****Firewall (Y) Acceleration vs. Time**

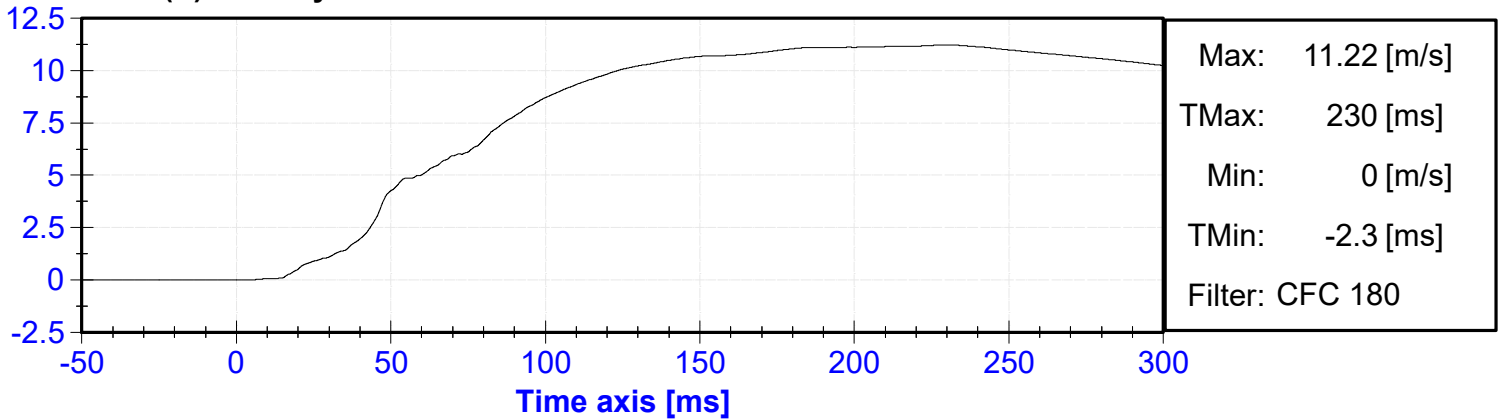
Firewall (Y) Velocity vs. Time



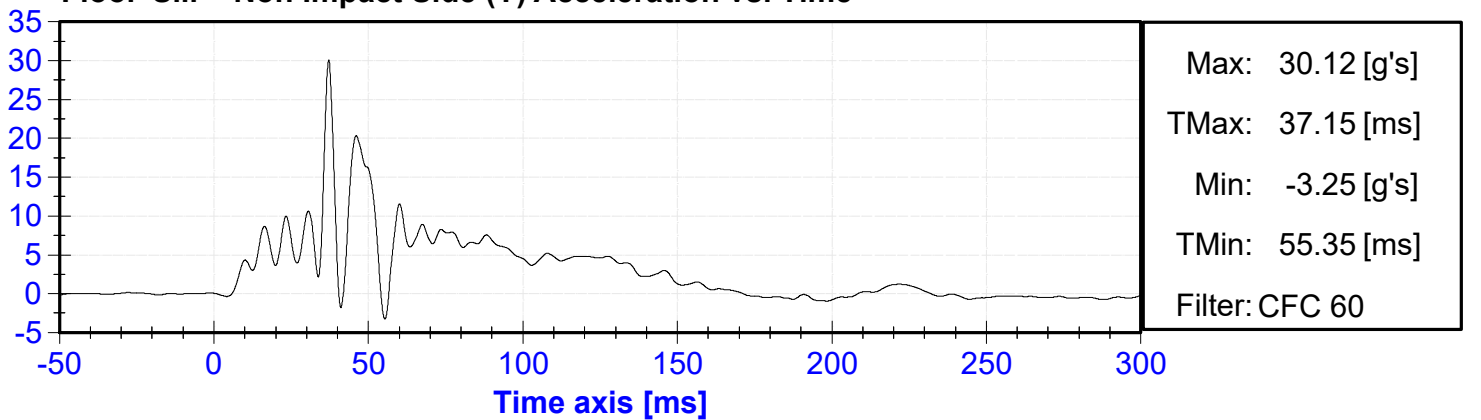
Roof (Y) Acceleration vs. Time



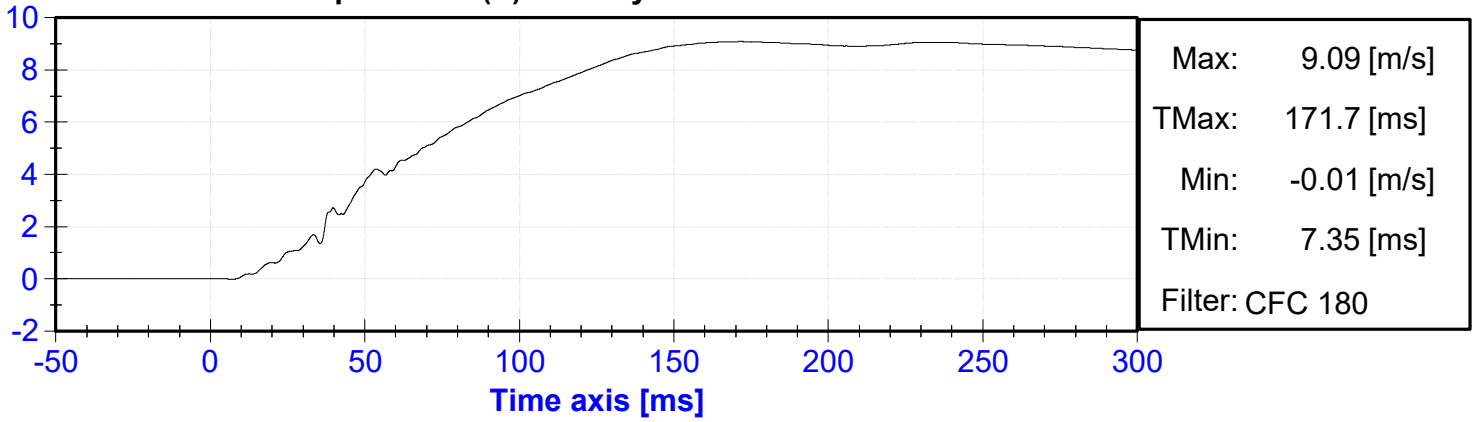
Roof (Y) Velocity vs. Time



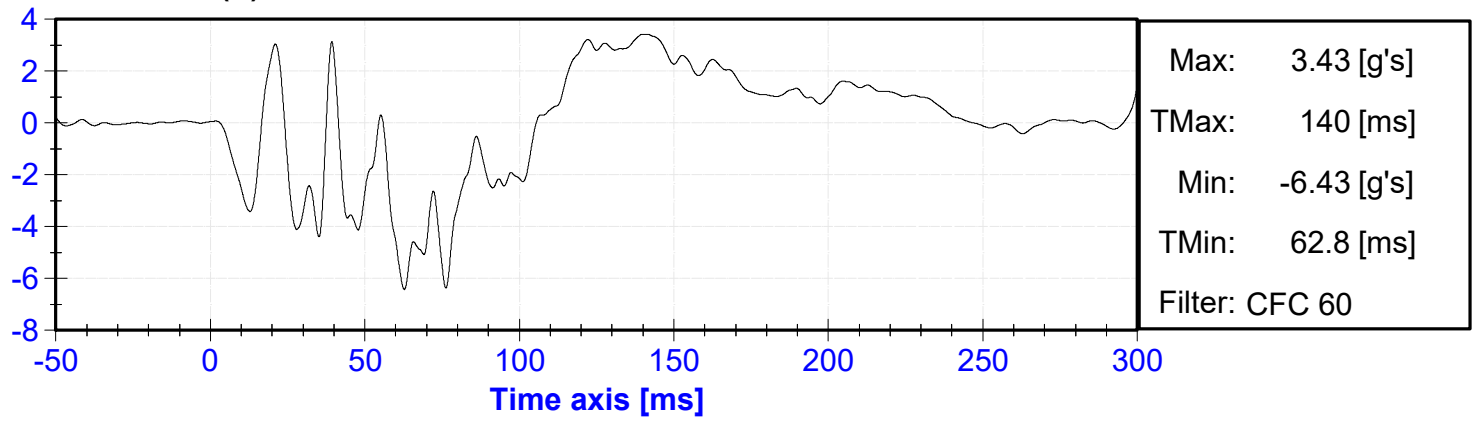
Floor Sill – Non Impact Side (Y) Acceleration vs. Time



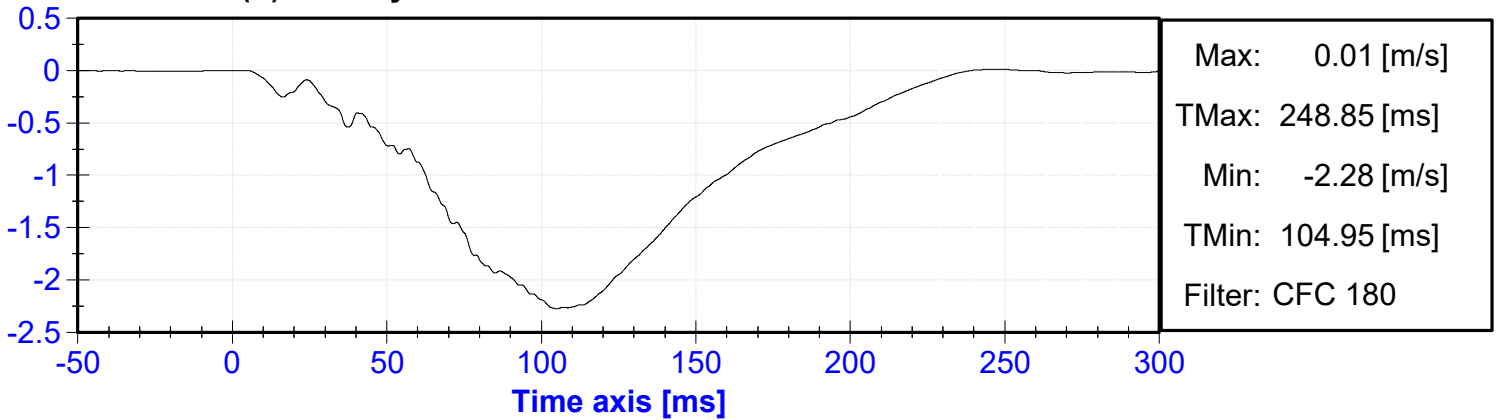
Floor Sill – Non Impact Side (Y) Velocity vs. Time



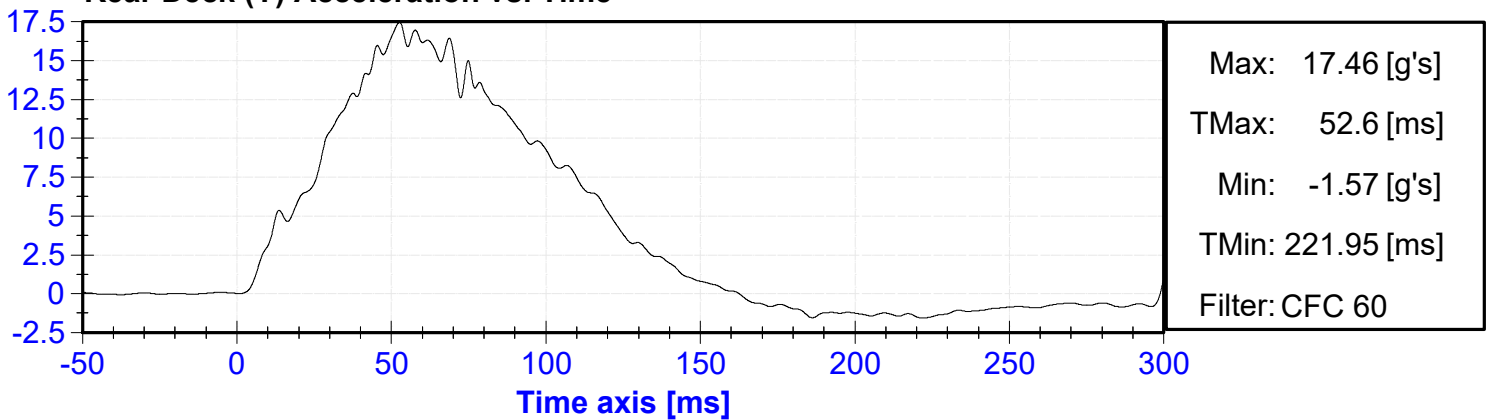
Rear Deck (X) Acceleration vs. Time



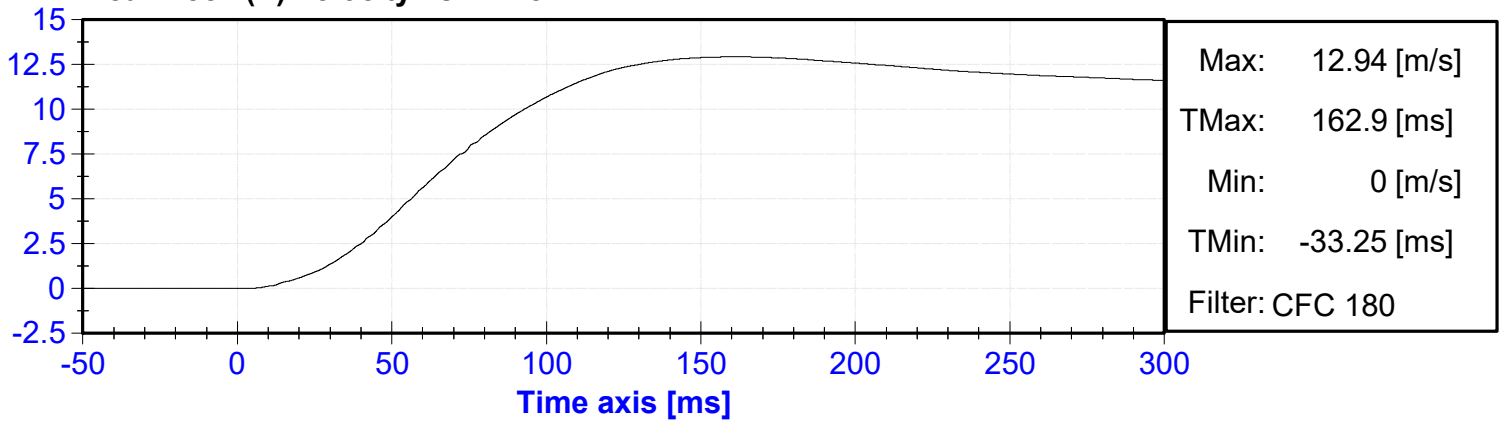
Rear Deck (X) Velocity vs. Time



Rear Deck (Y) Acceleration vs. Time



Rear Deck (Y) Velocity vs. Time



**APPENDIX IV**

**PRE-TEST DUMMY PERFORMANCE CALIBRATION TEST DATA**

**(Subpart U, ES-2re)**

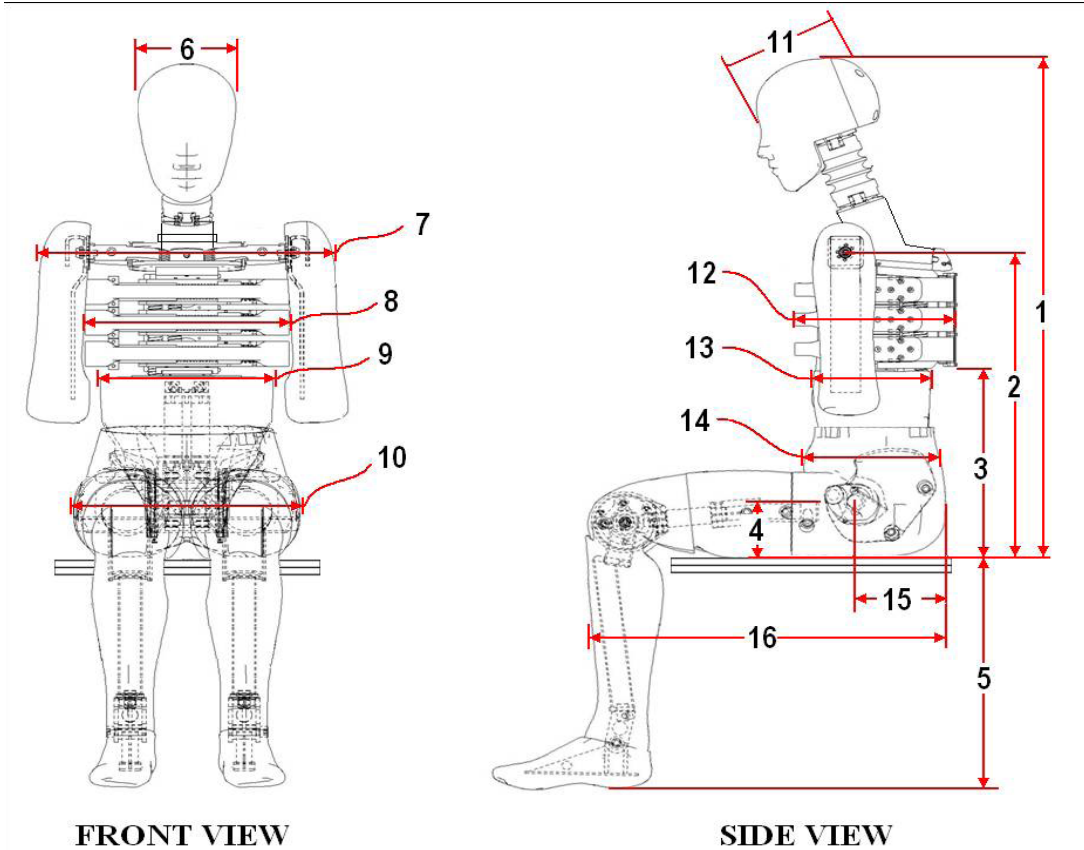


External Measurements - EuroSID-2re

Technician: K. Brogan

Date: 02/14/2024

Dummy Serial Number: DG5348



Dim. No.	Description	Specification (mm)		Result (mm)	Pass/Fail
1	Sitting Height	900	918	915	Pass
2	Seat to Shoulder Joint	558	572	568	Pass
3	Seat to Lower Face of Thoracic Spine Box	346	356	351	Pass
4	Seat to Hip Joint (center of bolt)	97	103	102	Pass
5	Sole to Seat, Sitting	333	451	415	Pass
6	Head Width	152	158	156	Pass
7	Shoulder/Arm Width	461	479	472	Pass
8	Thorax Width	322	332	327	Pass
9	Abdomen Width	273	287	281	Pass
10	Pelvis Lap Width	359	373	368	Pass
11	Head Depth	196	206	200	Pass
12	Thorax Depth	262	272	268	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	155	Pass
16	Back of Buttocks to Front Knee	597	615	605	Pass

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

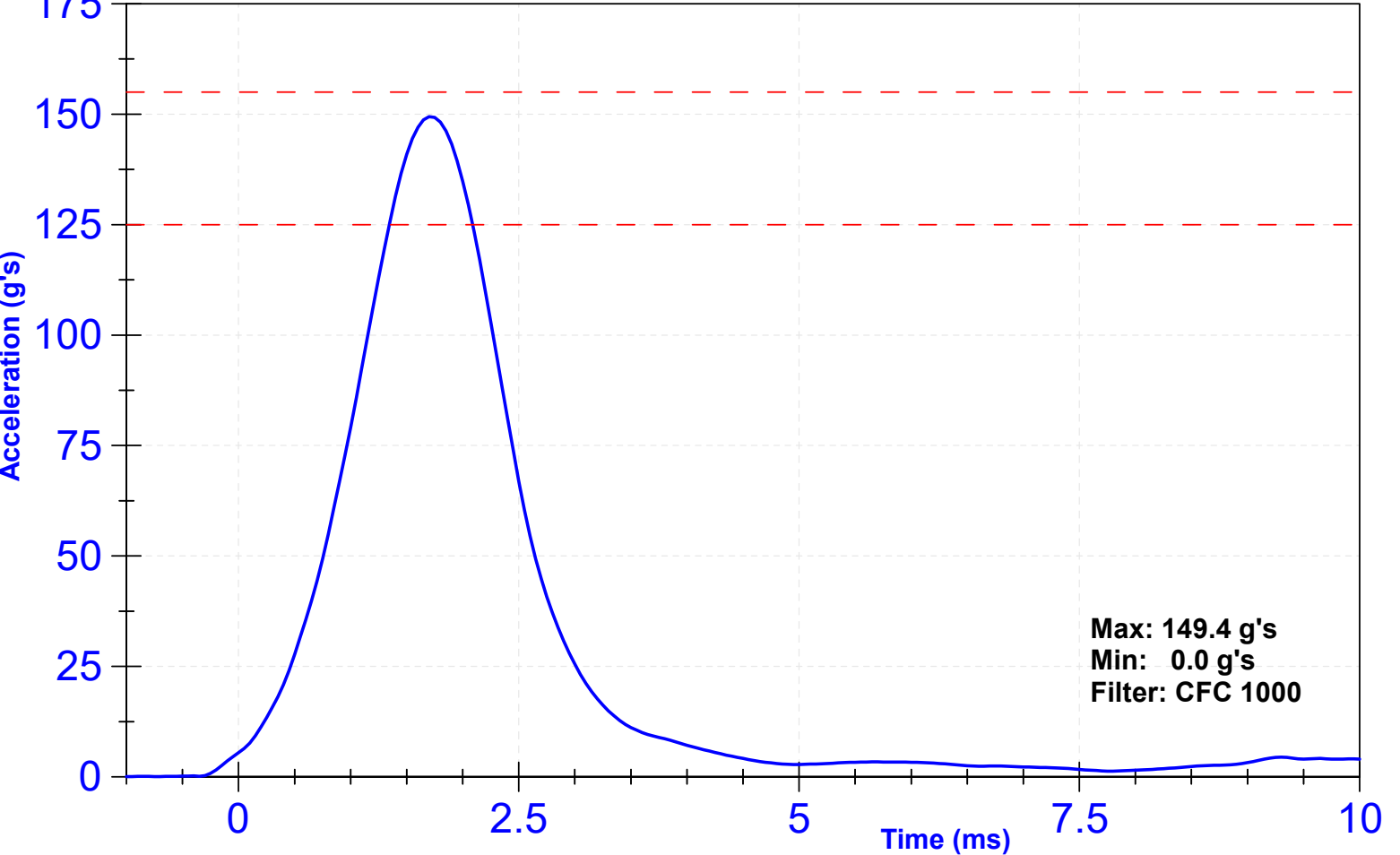
**Results**

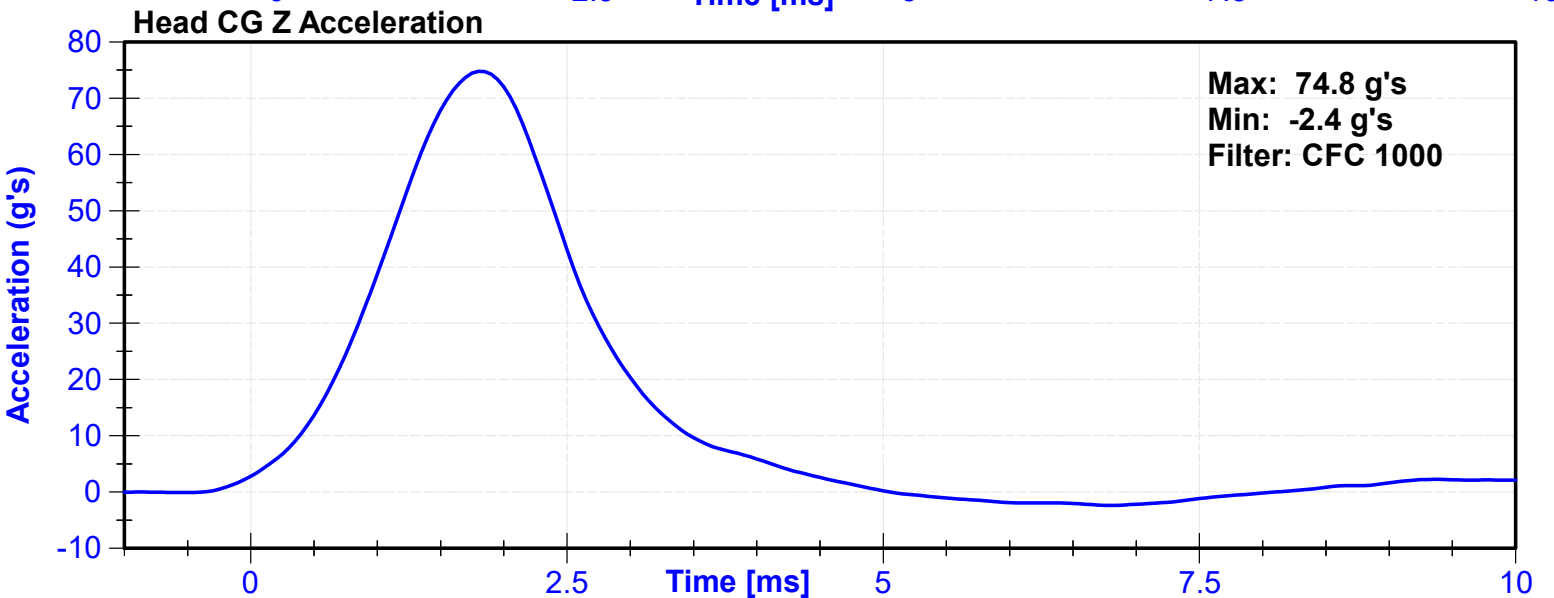
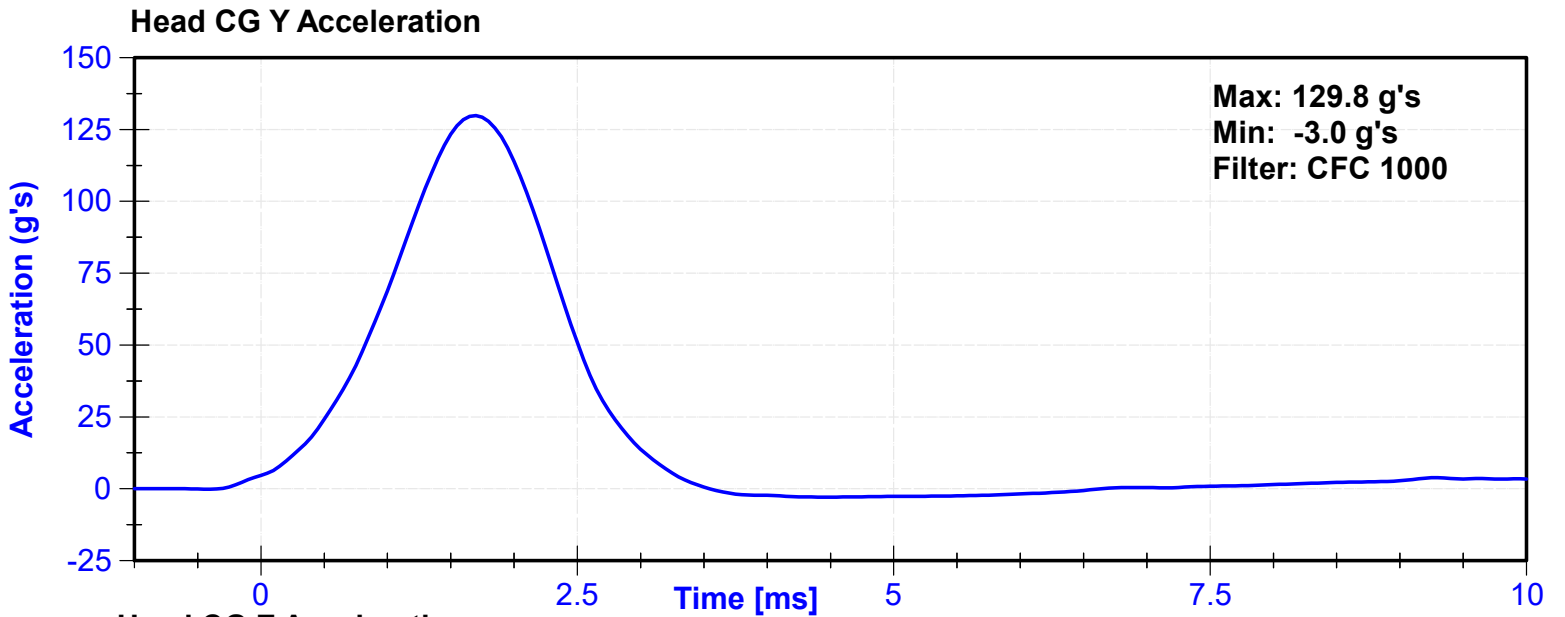
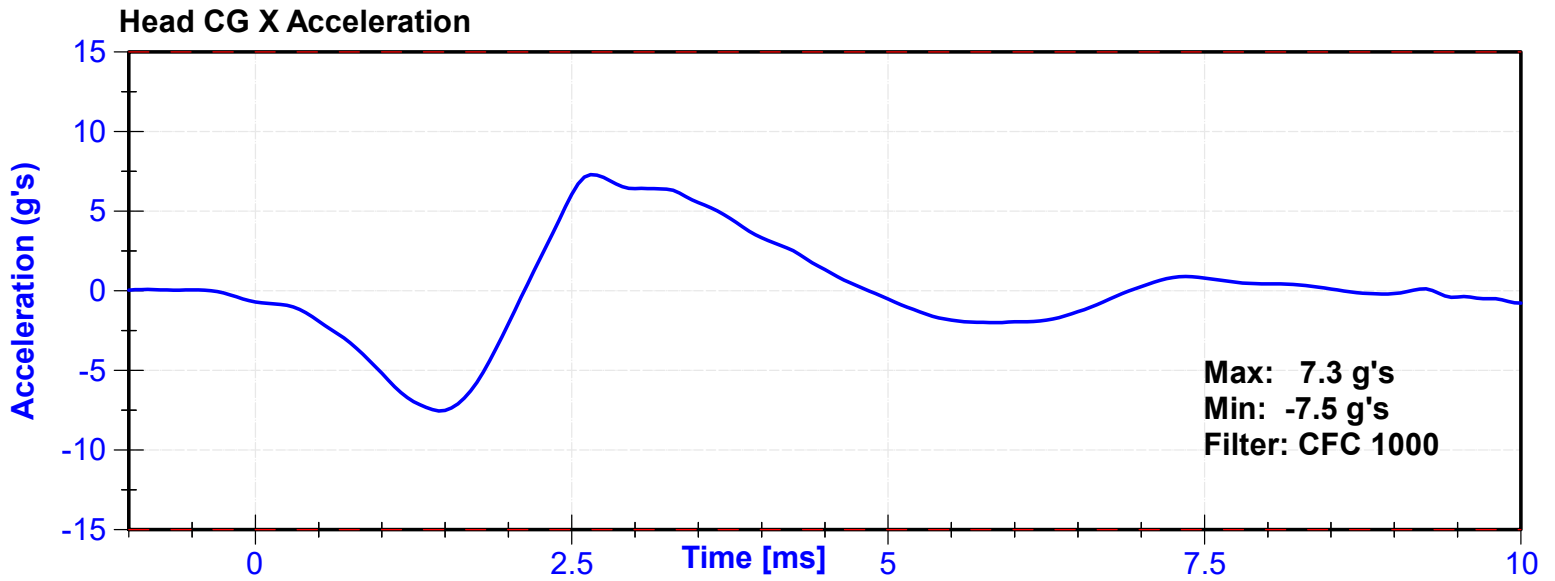
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.6	Pass
Humidity	10	70	%	30	Pass
Resultant Acceleration	125	155	g's	149.4	Pass
Oscillation	0	15	%	2.98	Pass
Fore-Aft Acceleration	-15	15	g's	-7.5	Pass

**Transducer Calibrations**

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	Endevco	18666	2/8/2024	8/6/2024
Y Accelerometer	Endevco	18664	2/8/2024	8/6/2024
Z Accelerometer	Endevco	18675	2/7/2024	8/5/2024

**Resultant Acceleration**





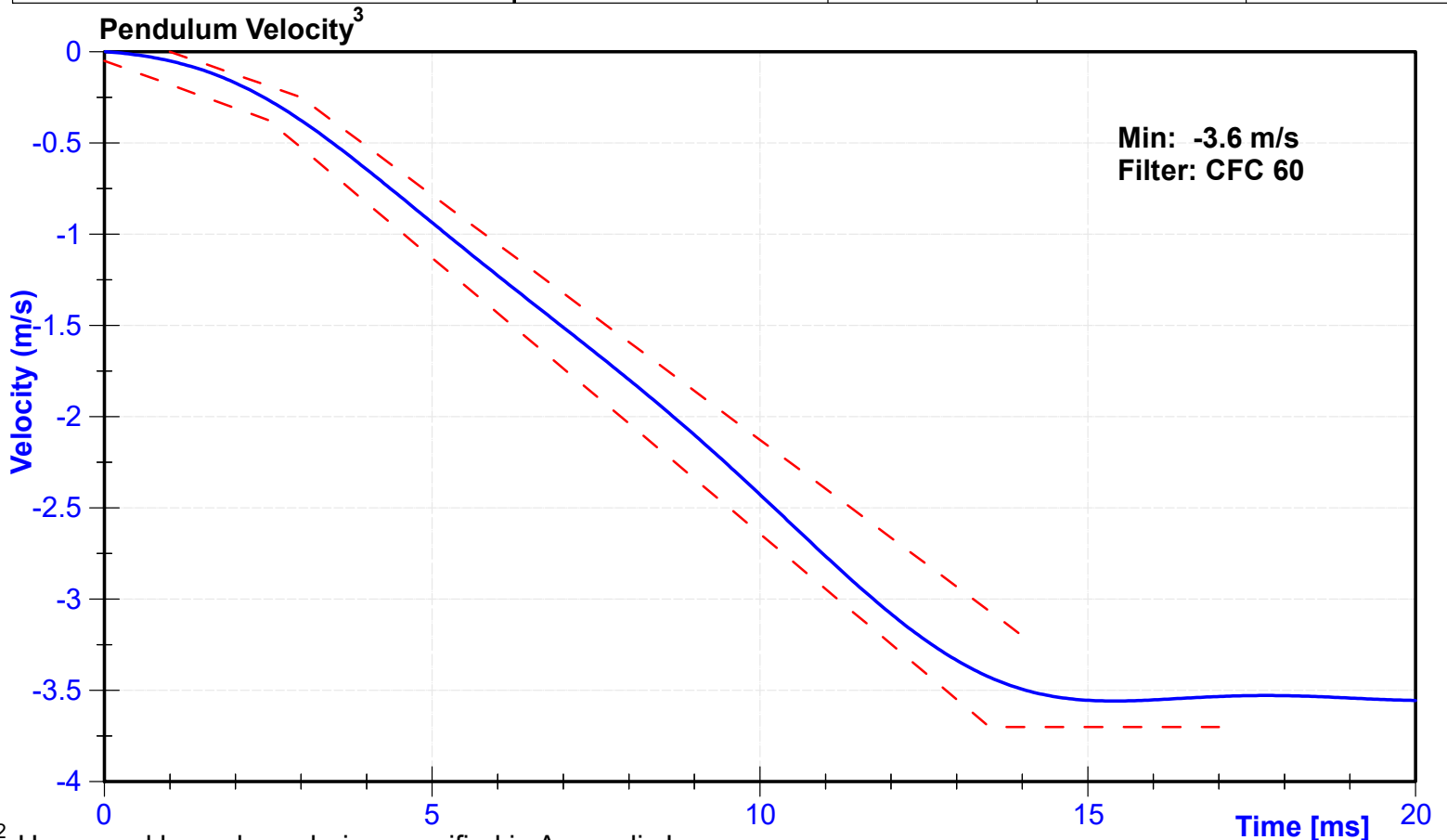
ATD Manufacturer	FTSS	Test Technician	T. Roseman
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantell

**Results**

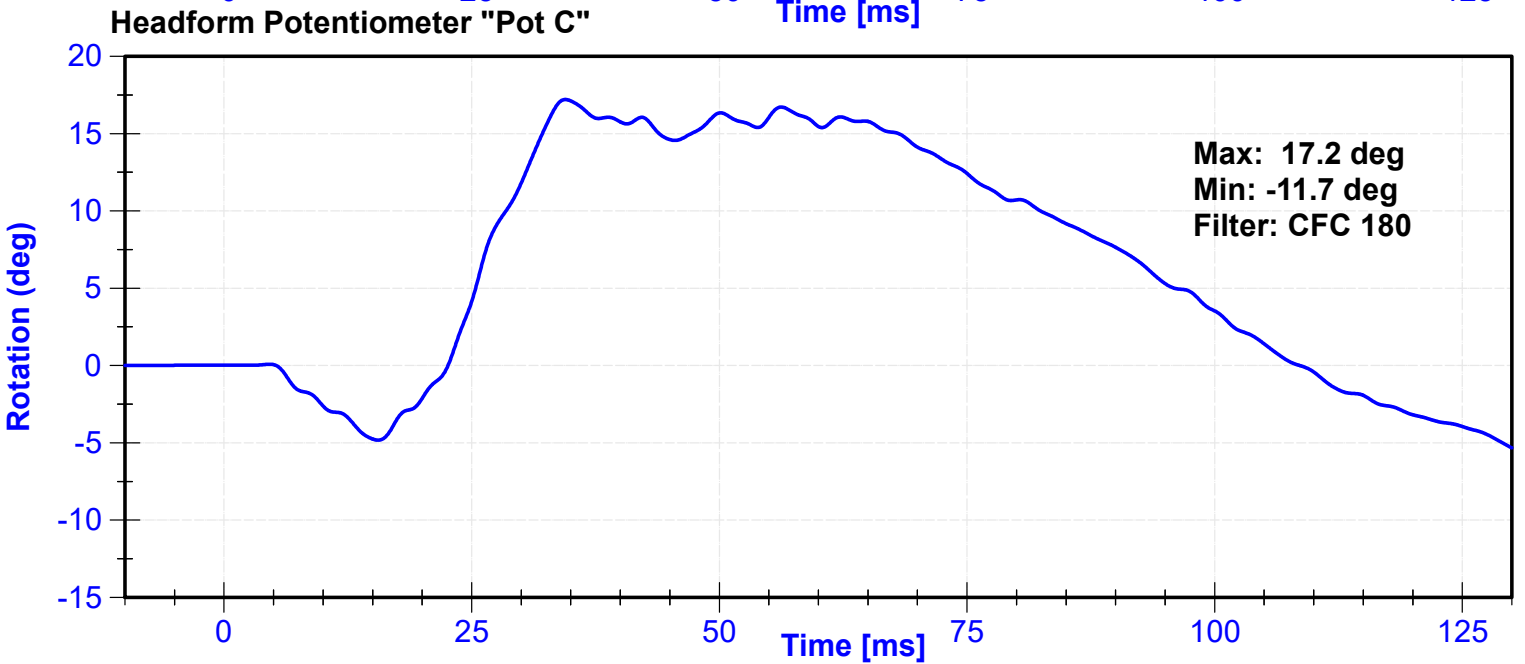
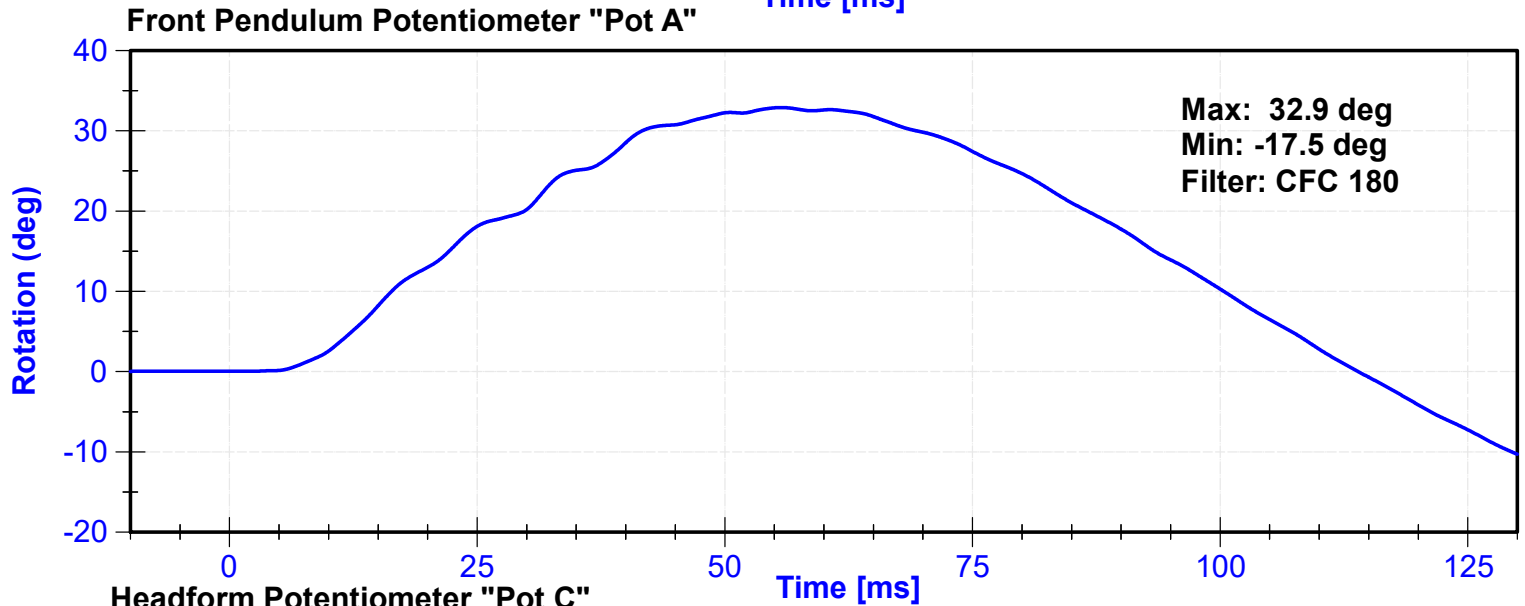
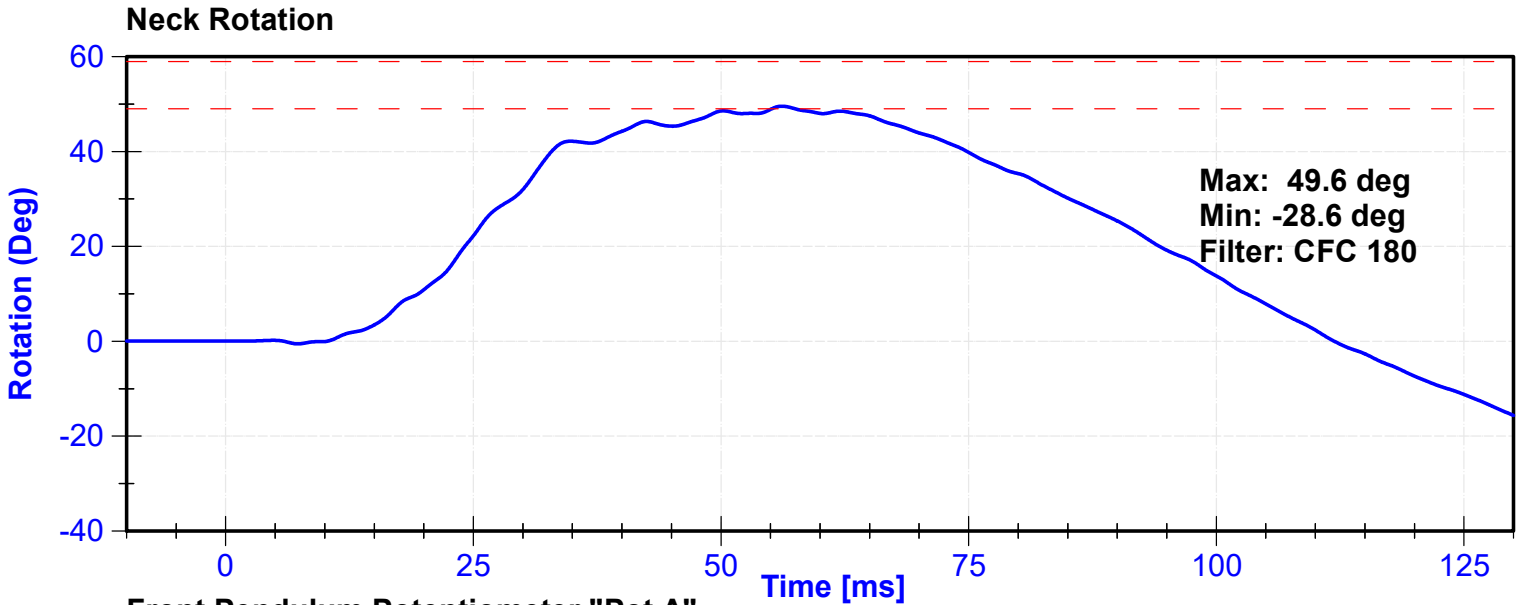
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.9	Pass
Humidity	10	70	%	29	Pass
Velocity	3.3	3.5	m/s	3.36	Pass
Lateral Neck Rotation	49	59	deg	49.6	Pass
Time at Maximum Rotation	54	66	ms	56.2	Pass
Time of Rotation Decay from Maximum	53	88	ms	55.8	Pass
Pendulum Velocity Overall Corridor	Lower Boundary <sup>1</sup>	Upper Boundary <sup>2</sup>	m/s	See Plot <sup>3</sup>	Pass

**Transducer Calibrations**

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	C16503	10/31/2023	4/28/2024
Front Pendulum Potentiometer	Sfernice	2247	12/5/2023	12/4/2024
Headform Potentiometer	Sfernice	095	9/29/2023	9/28/2024



<sup>1,2</sup> Upper and lower boundaries specified in Appendix I



## Appendix I

<sup>2</sup> Upper Boundary Corridor		<sup>1</sup> 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

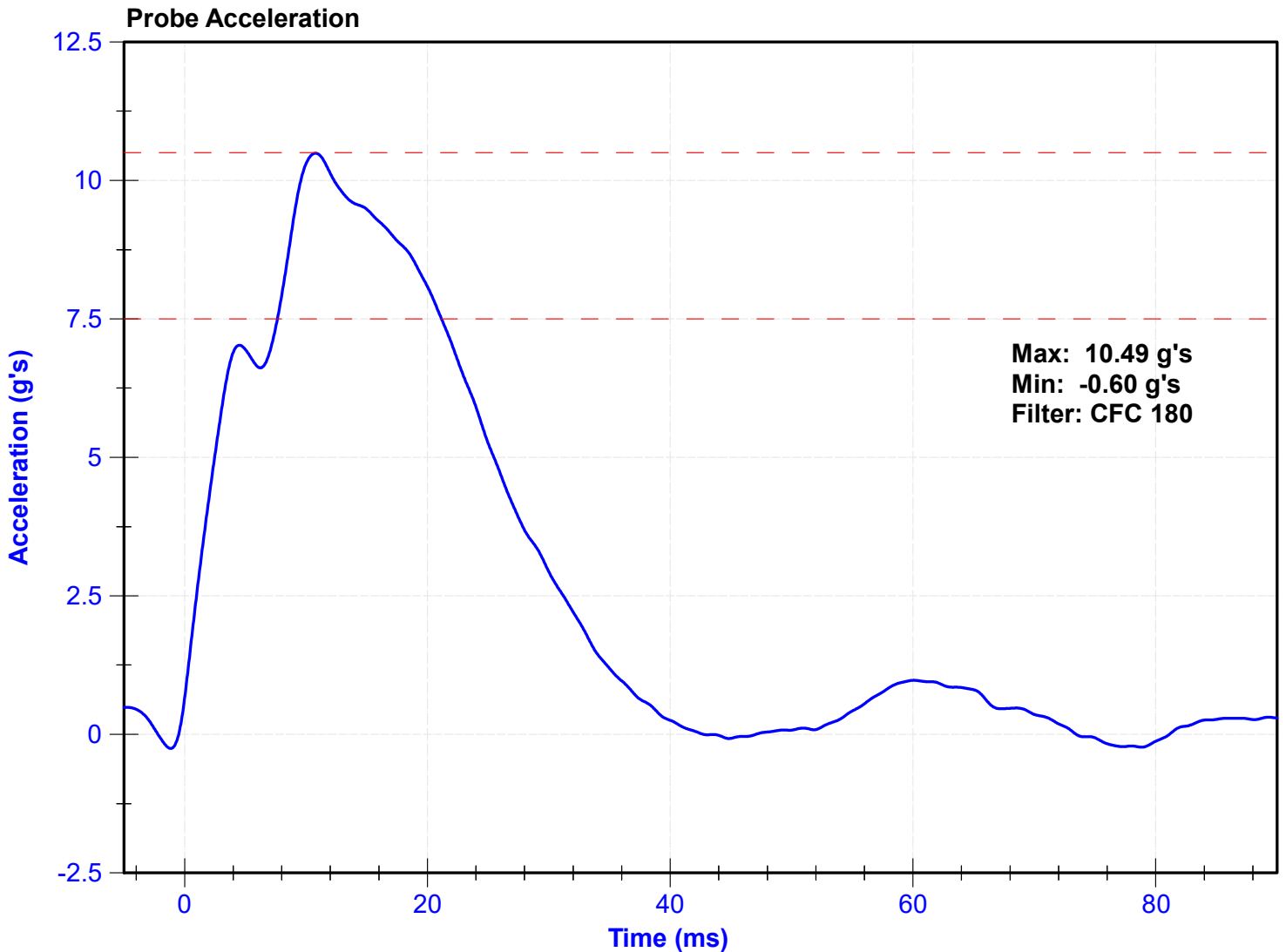
ATD Manufacturer	FTSS	Test Technician	J.Rios
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantell

**Results**

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.0	Pass
Humidity	10	70	%	18	Pass
Velocity	4.2	4.4	m/s	4.31	Pass
Probe Acceleration	7.5	10.5	g's	10.49	Pass

**Transducer Calibrations**

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Probe Accelerometer	Endevco	18619	9/29/2023	3/27/2024



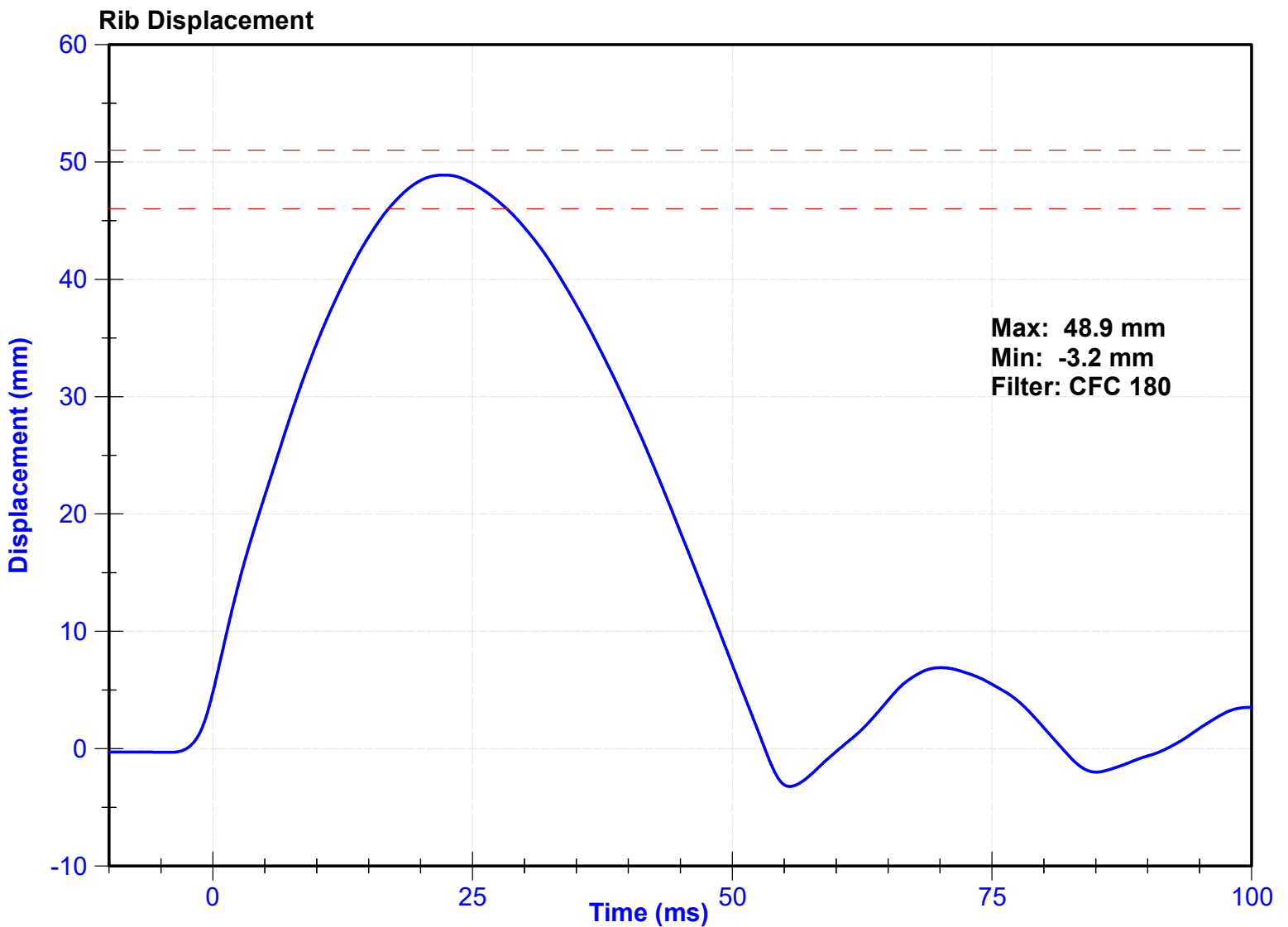
ATD Manufacturer	FTSS	Test Technician	T. Roseman
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantel

**Results**

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.6	Pass
Humidity	10	70	%	22.2	Pass
Rib Displacement	46	51	mm	48.9	Pass

**Transducer Calibrations**

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



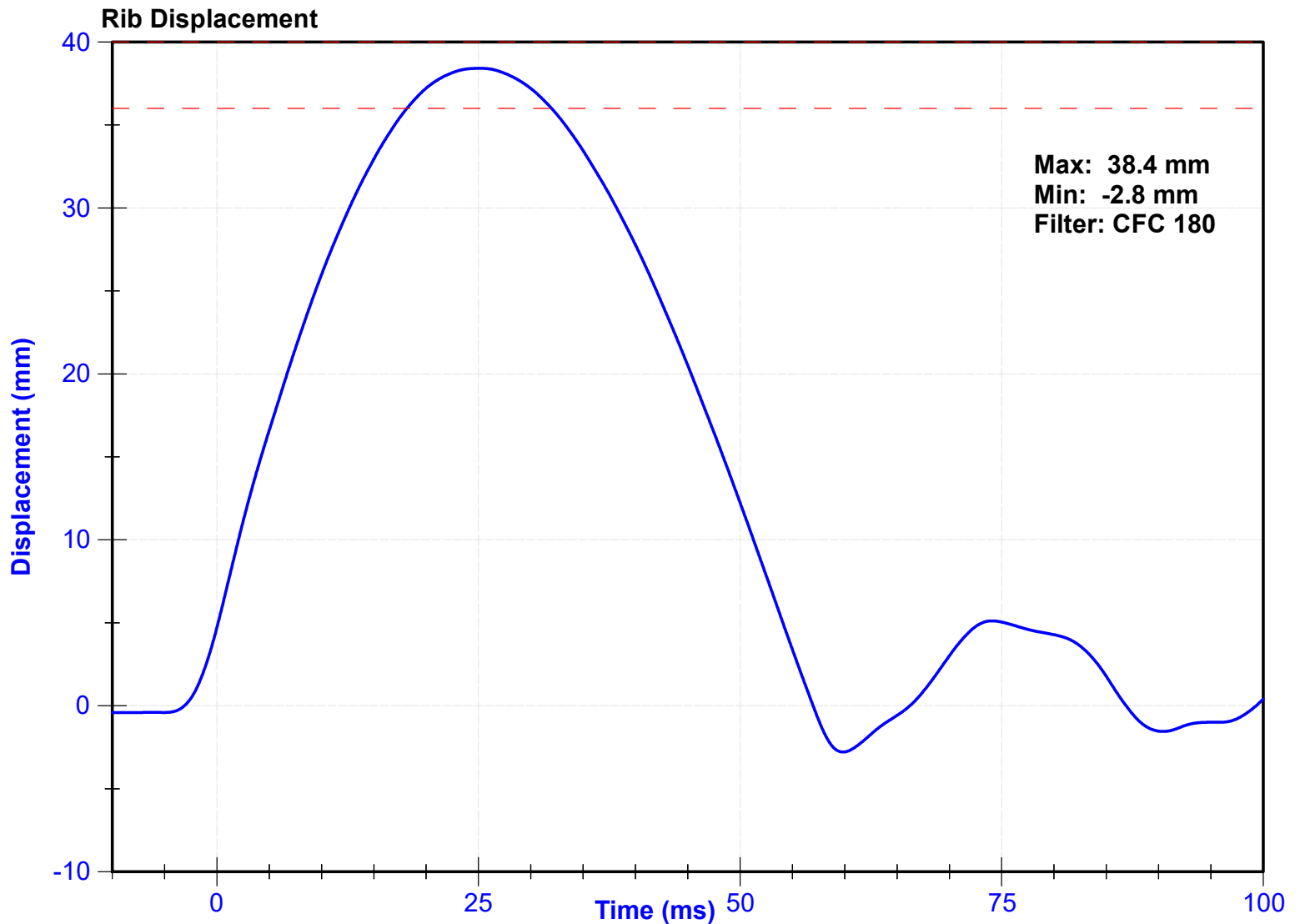
ATD Manufacturer	FTSS	Test Technician	T. Roseman
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantel

**Results**

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.6	Pass
Humidity	10	70	%	22.2	Pass
Rib Displacement	36	40	mm	38.4	Pass

**Transducer Calibrations**

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



ATD Manufacturer	FTSS	Test Technician	T. Roseman
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	%	22.2	Pass
Rib Displacement	46	51	mm	49.1	Pass

**Transducer Calibrations**

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



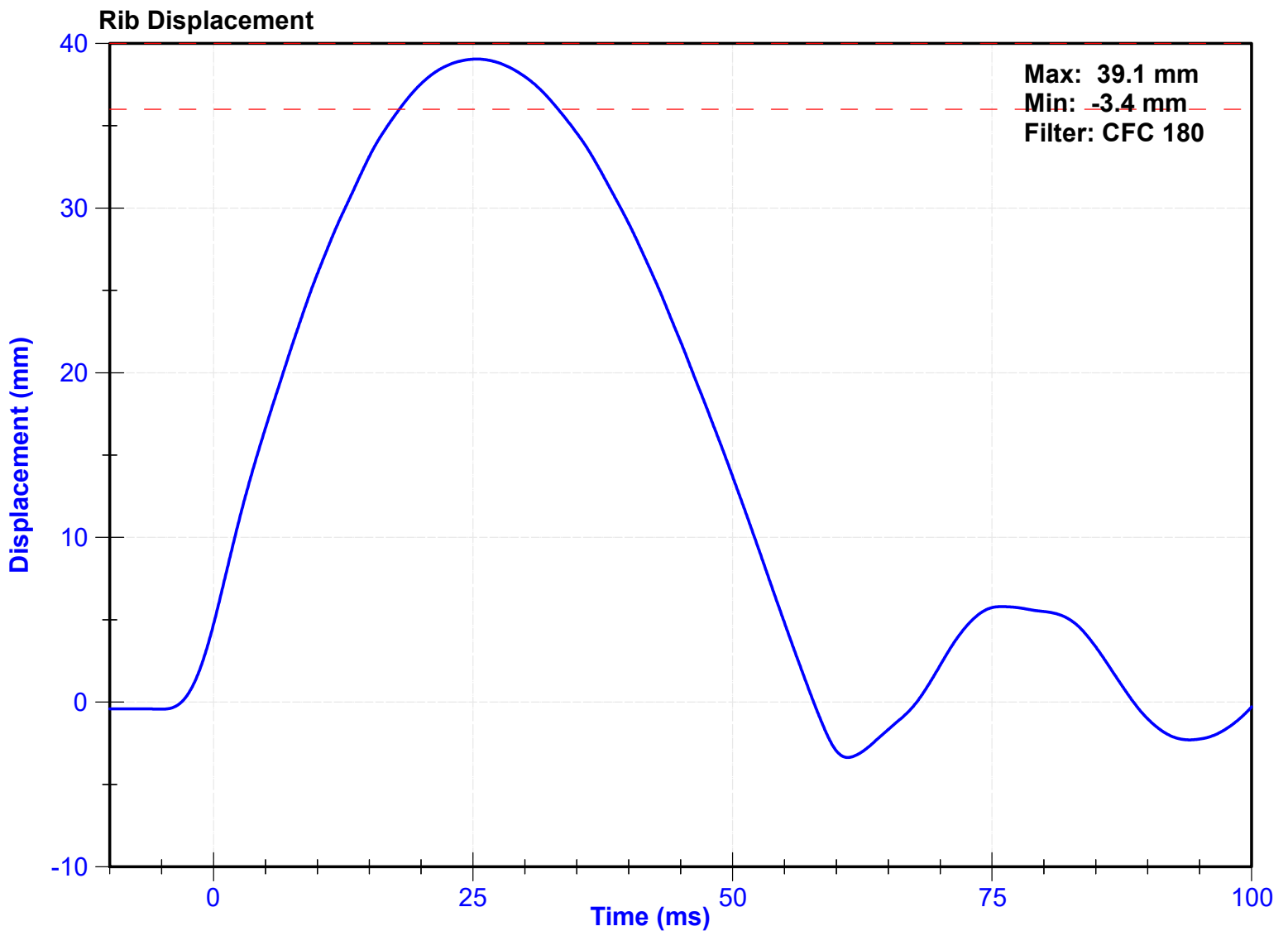
ATD Manufacturer	FTSS	Test Technician	T. Roseman
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantel

**Results**

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.6	Pass
Humidity	10	70	%	22.2	Pass
Rib Displacement	36	40	mm	39.1	Pass

**Transducer Calibrations**

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



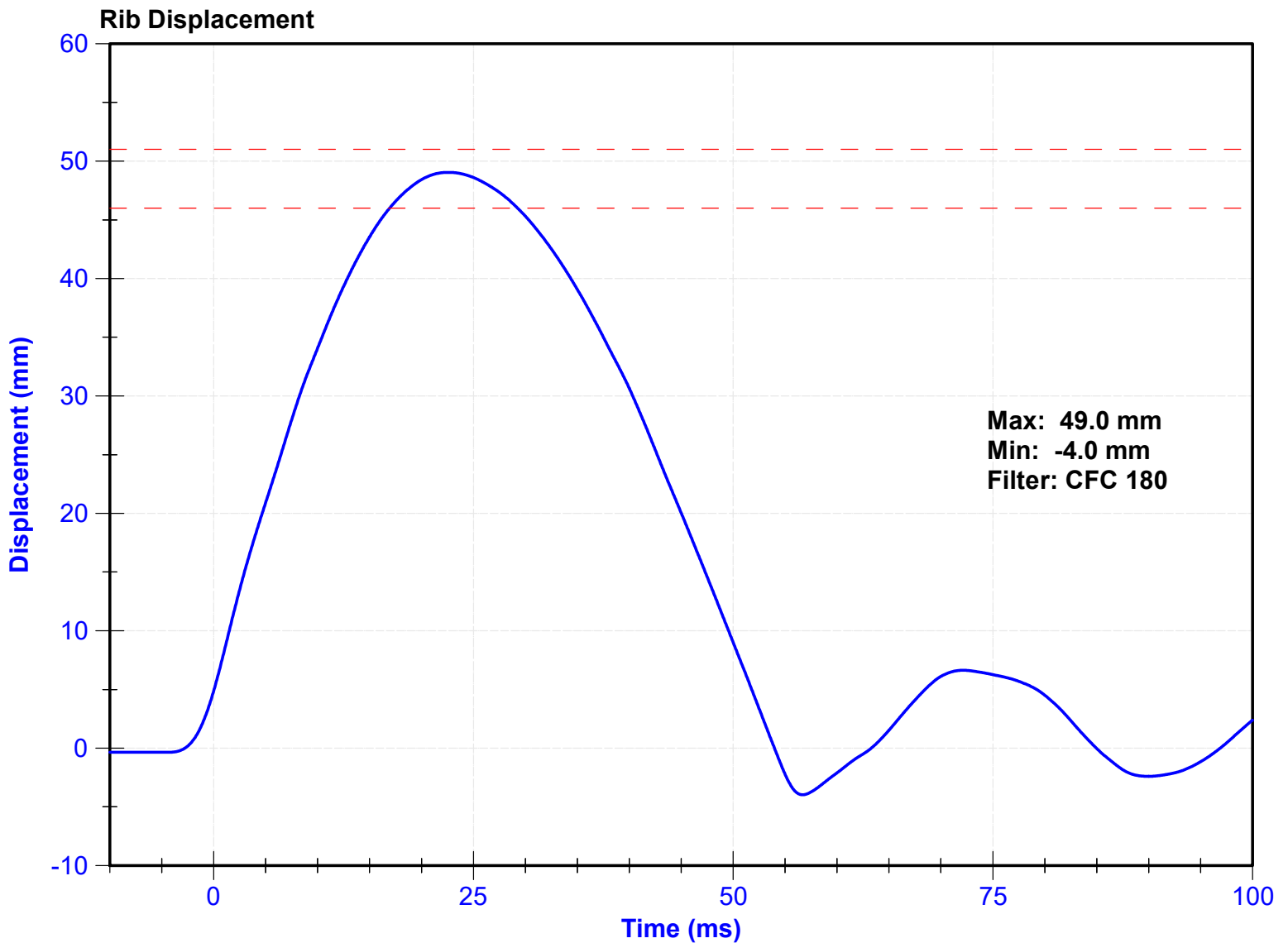
ATD Manufacturer	FTSS	Test Technician	T. Roseman
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantel

**Results**

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.6	Pass
Humidity	10	70	%	22.2	Pass
Rib Displacement	46	51	mm	49.0	Pass

**Transducer Calibrations**

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



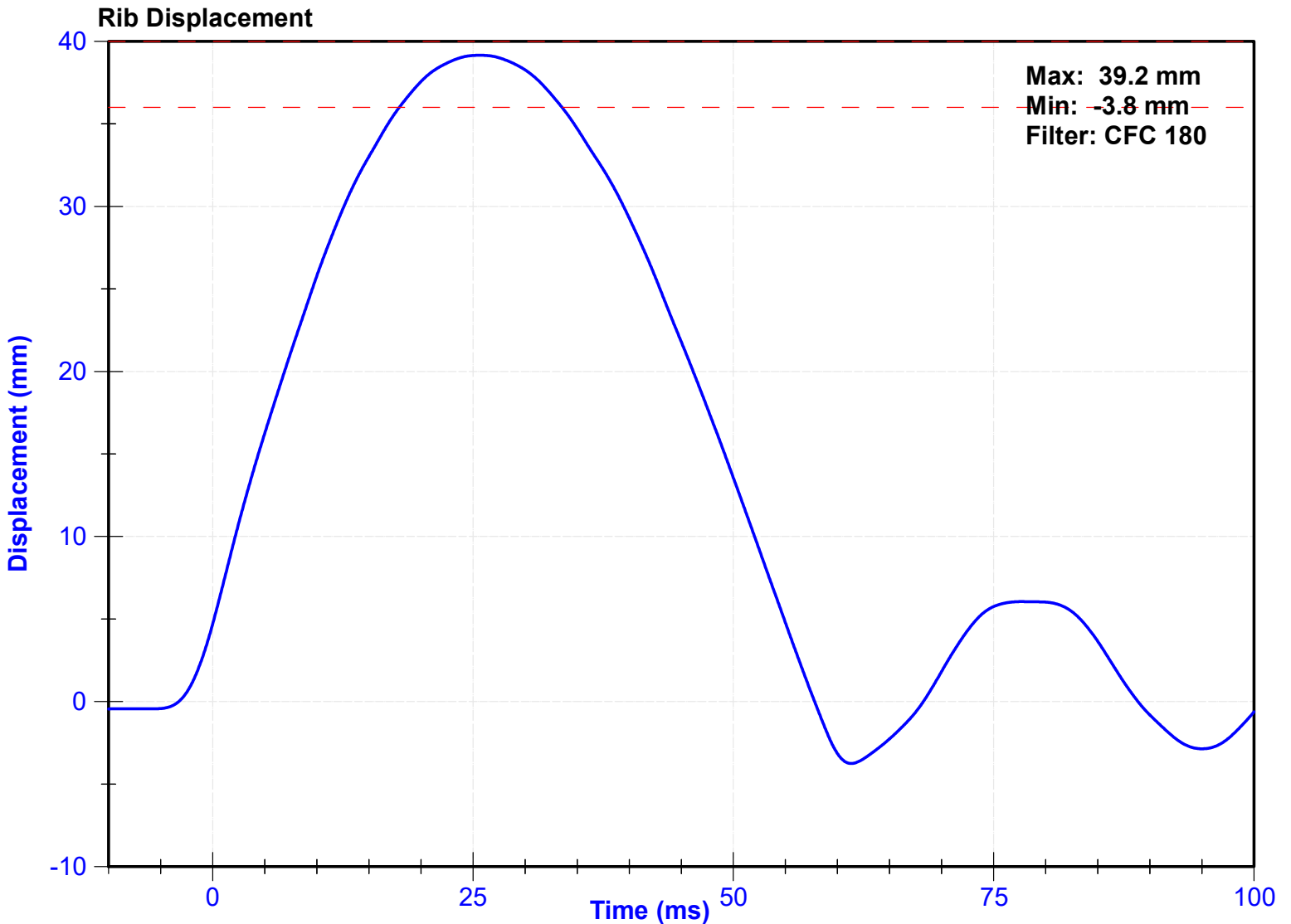
ATD Manufacturer	FTSS	Test Technician	T. Roseman
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantel

**Results**

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.6	Pass
Humidity	10	70	%	22.2	Pass
Rib Displacement	36	40	mm	39.2	Pass

**Transducer Calibrations**

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



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

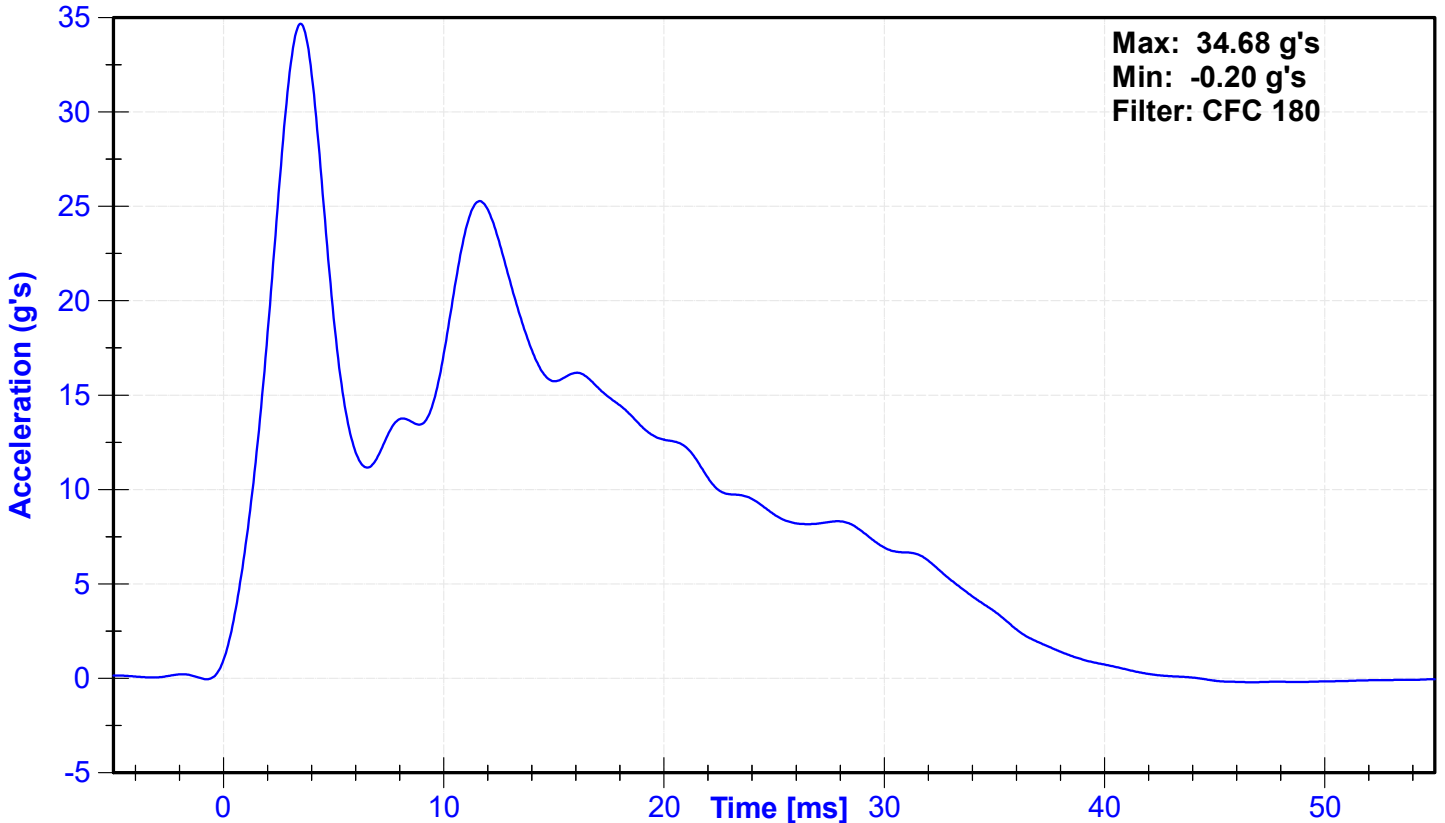
**Results**

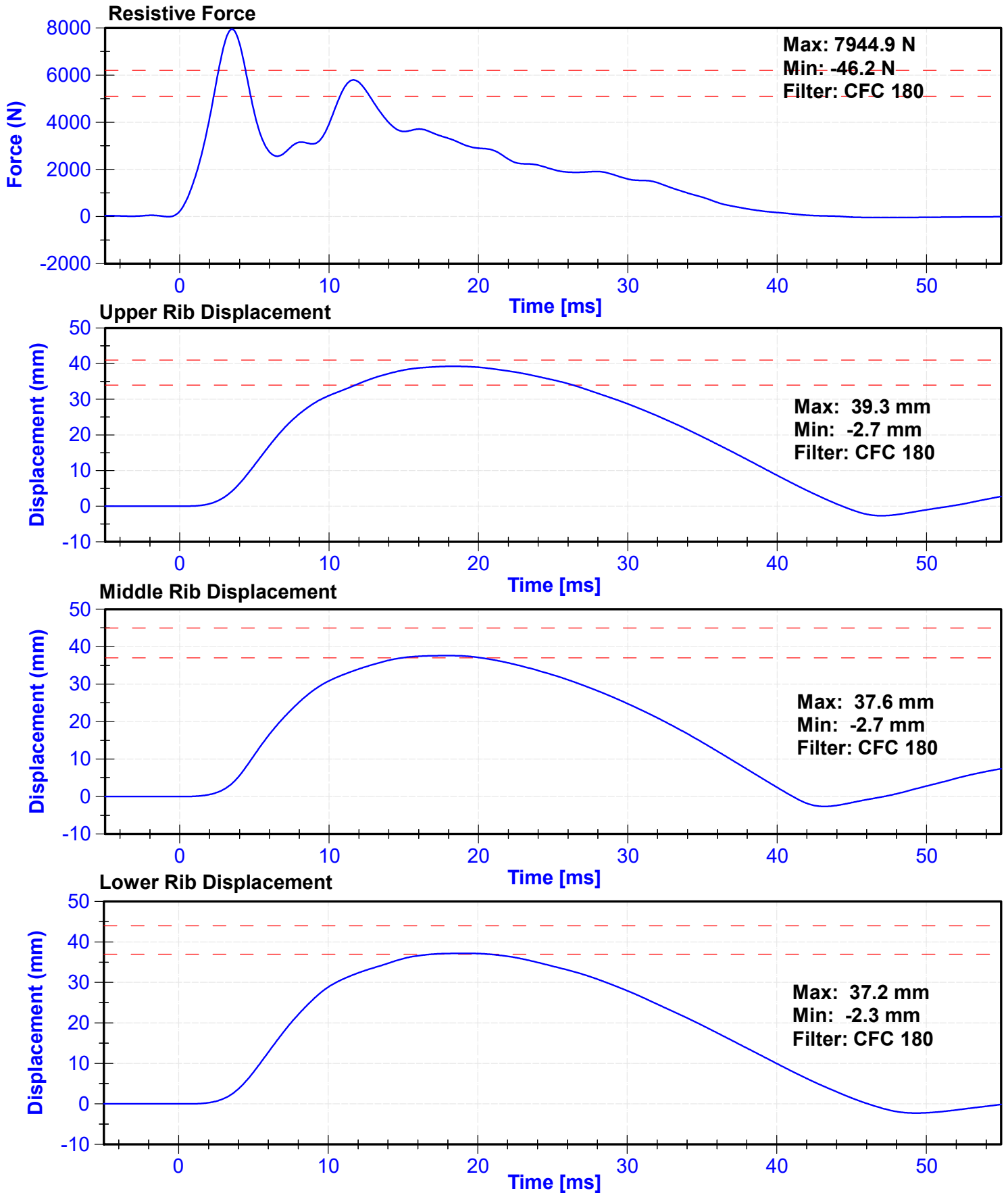
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.0	Pass
Humidity	10	70	%	18	Pass
Velocity	5.4	5.6	m/s	5.53	Pass
Resistive Force after 6ms	5100	6200	N	5791.3	Pass
Upper Thorax Rib Deflection	34	41	mm	39.3	Pass
Mid Thorax Rib Deflection	37	45	mm	37.6	Pass
Lower Thorax Rib Deflection	37	44	mm	37.2	Pass

**Transducer Calibrations**

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Probe Accelerometer	Endevco	18619	9/29/2023	3/27/2024
Upper Thorax Rib Potentiometer	Honeywell	269GFE	2/8/2024	8/8/2024
Middle Thorax Rib Potentiometer	Honeywell	268GFE	2/8/2024	8/8/2024
Lower Thorax Rib Potentiometer	Honeywell	270GFE	2/8/2024	8/8/2024

**Probe Acceleration**





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

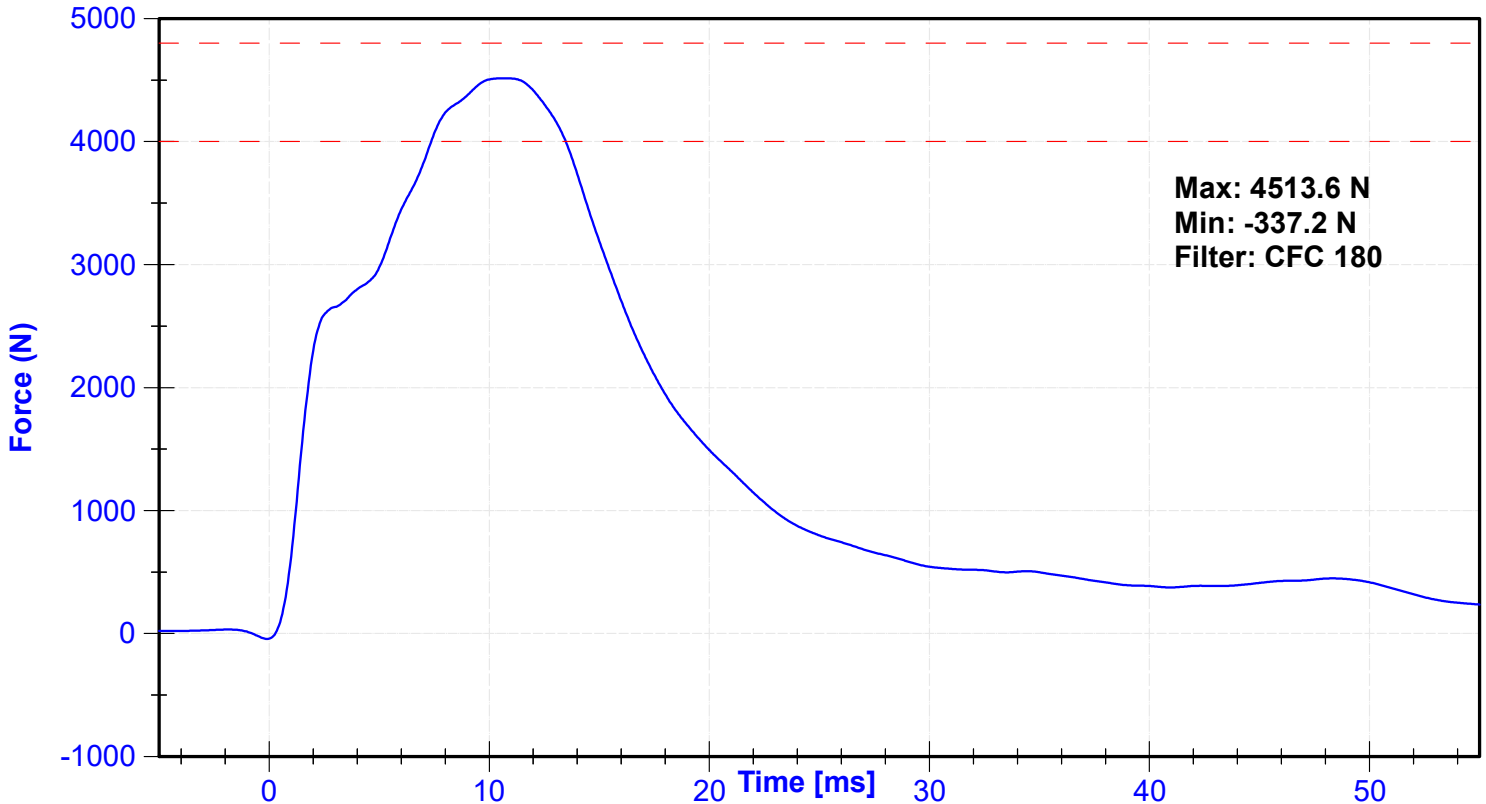
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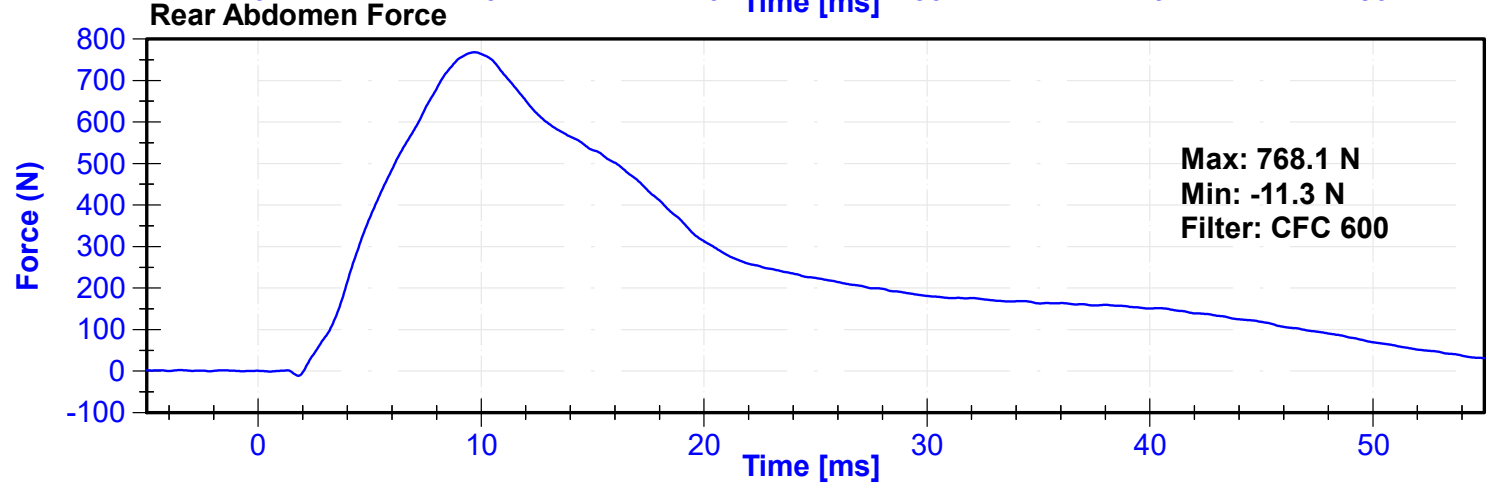
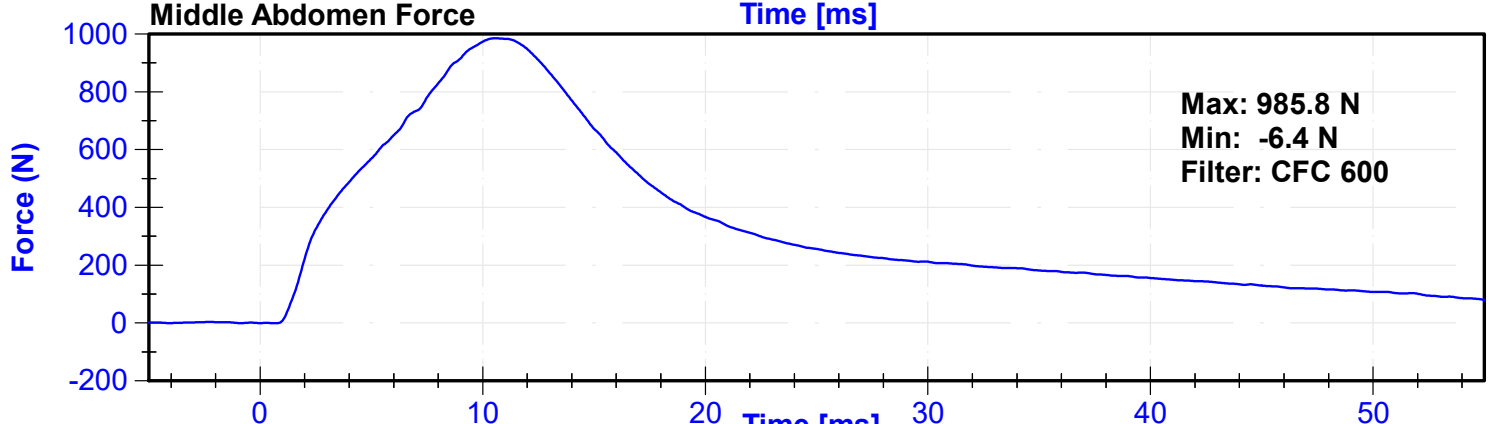
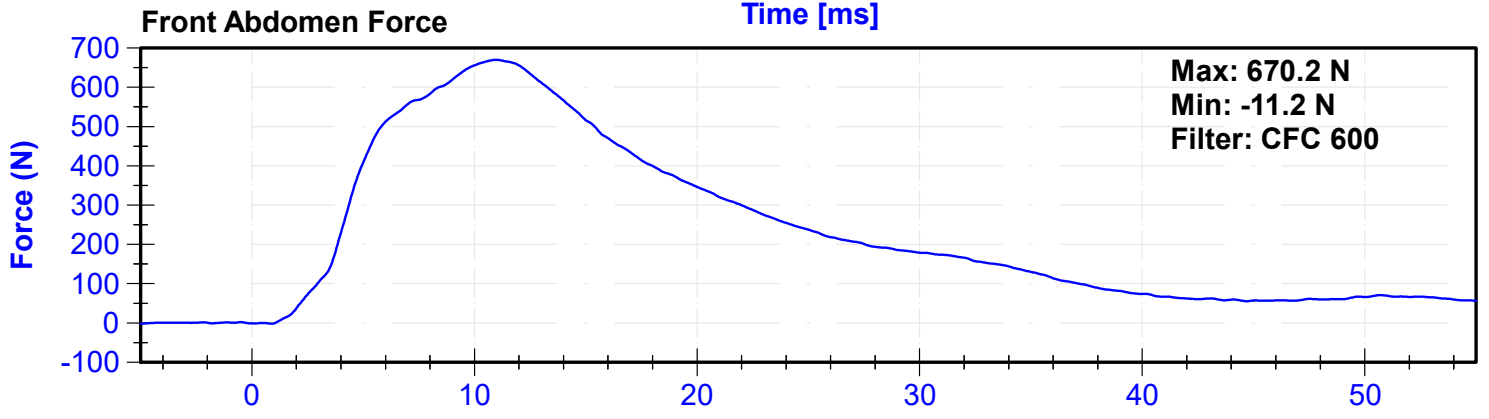
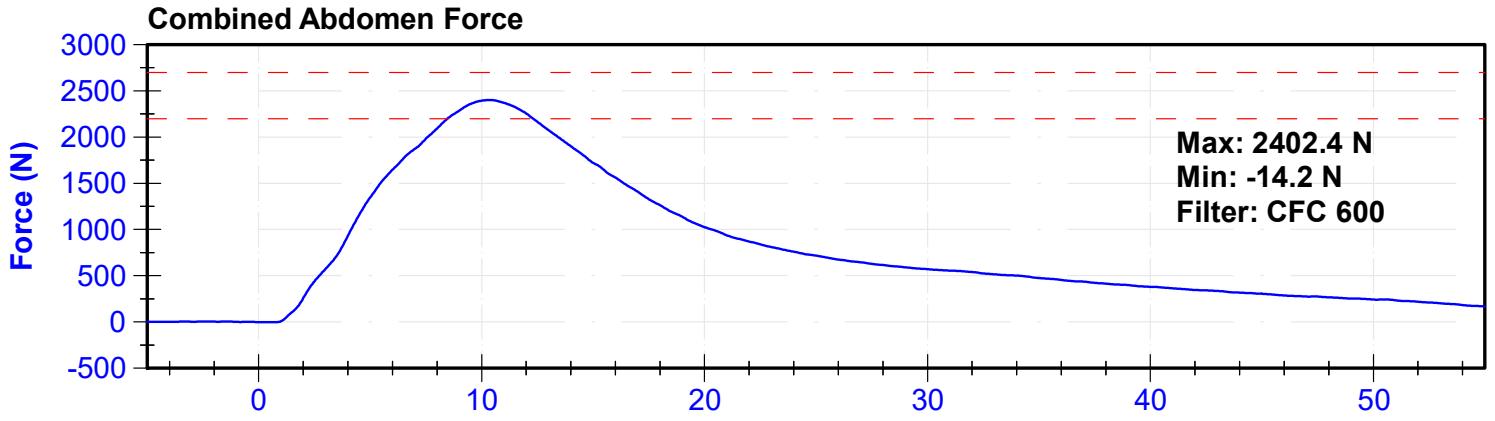
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.0	Pass
Humidity	10	70	%	18	Pass
Velocity	3.9	4.1	m/s	4.04	Pass
Combined Abdomen Force	2200	2700	N	2402.4	Pass
Time at Peak Abdomen Force	10.0	12.3	ms	10.35	Pass
Resistive Probe Force	4000	4800	N	4513.6	Pass
Time at Peak Resistive Force	10.6	13.0	ms	10.70	Pass

**Transducer Calibrations**

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18619	9/29/2023	3/27/2024
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

**Probe Force**





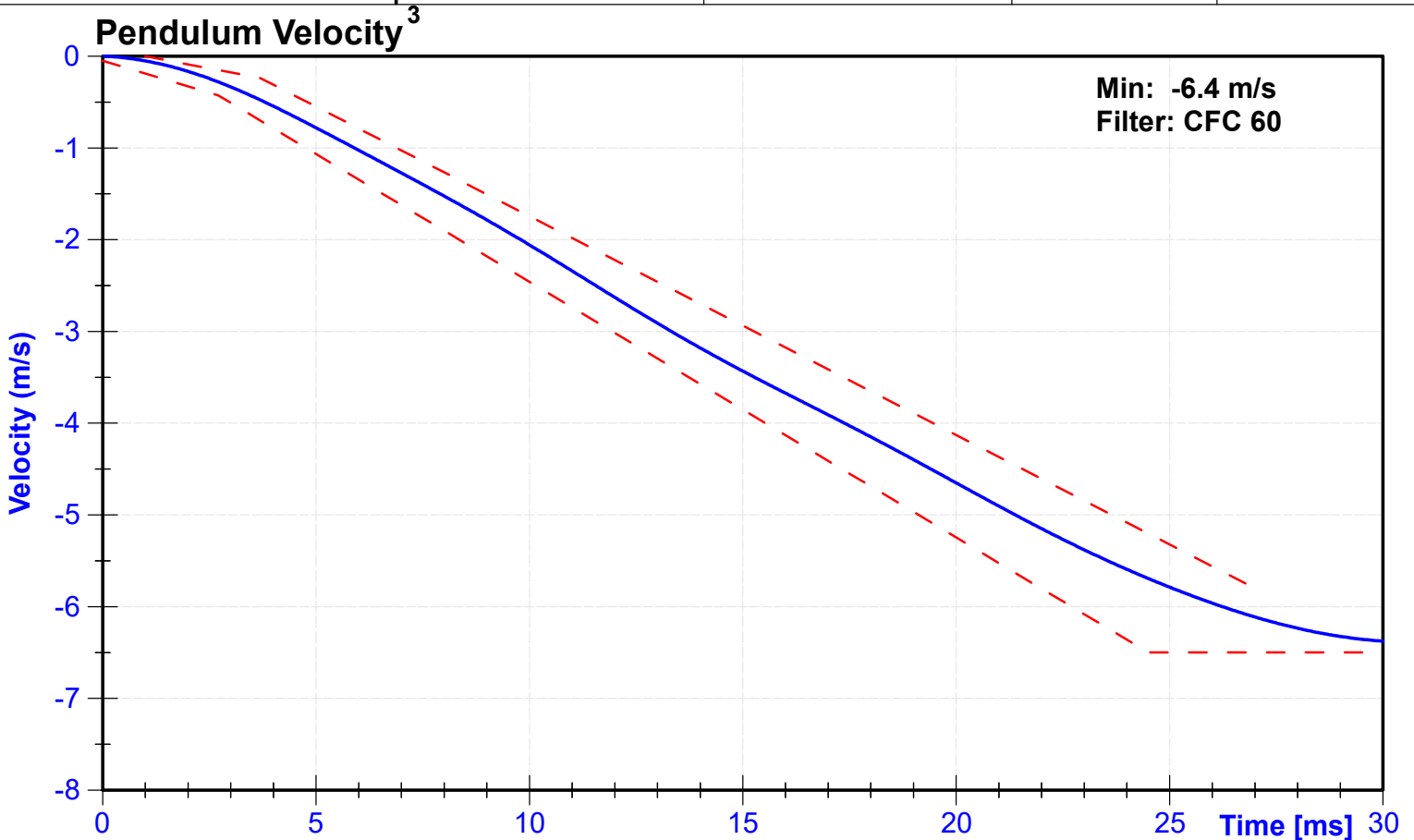
ATD Manufacturer	FTSS	Test Technician	T. Roseman
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantell

**Results**

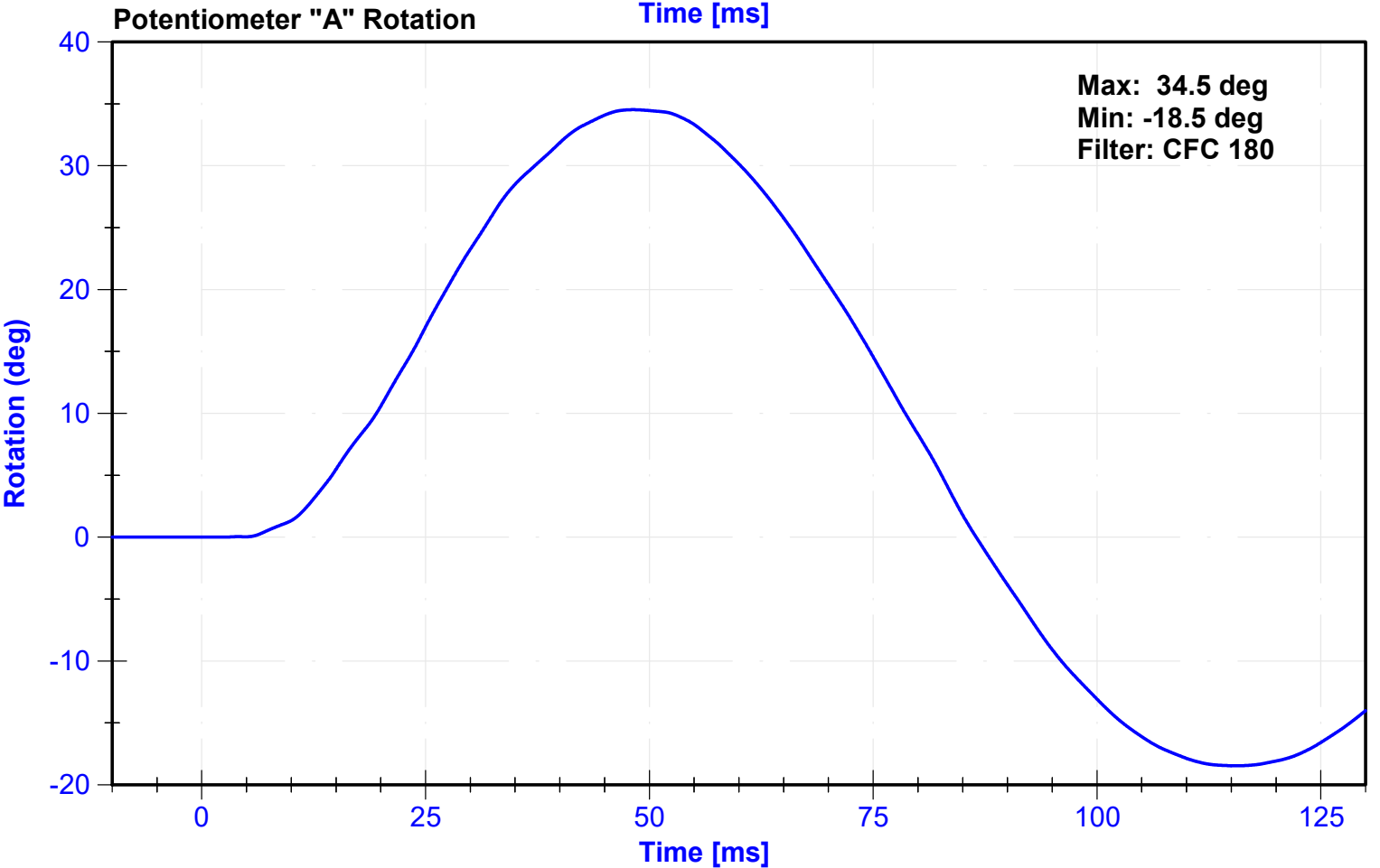
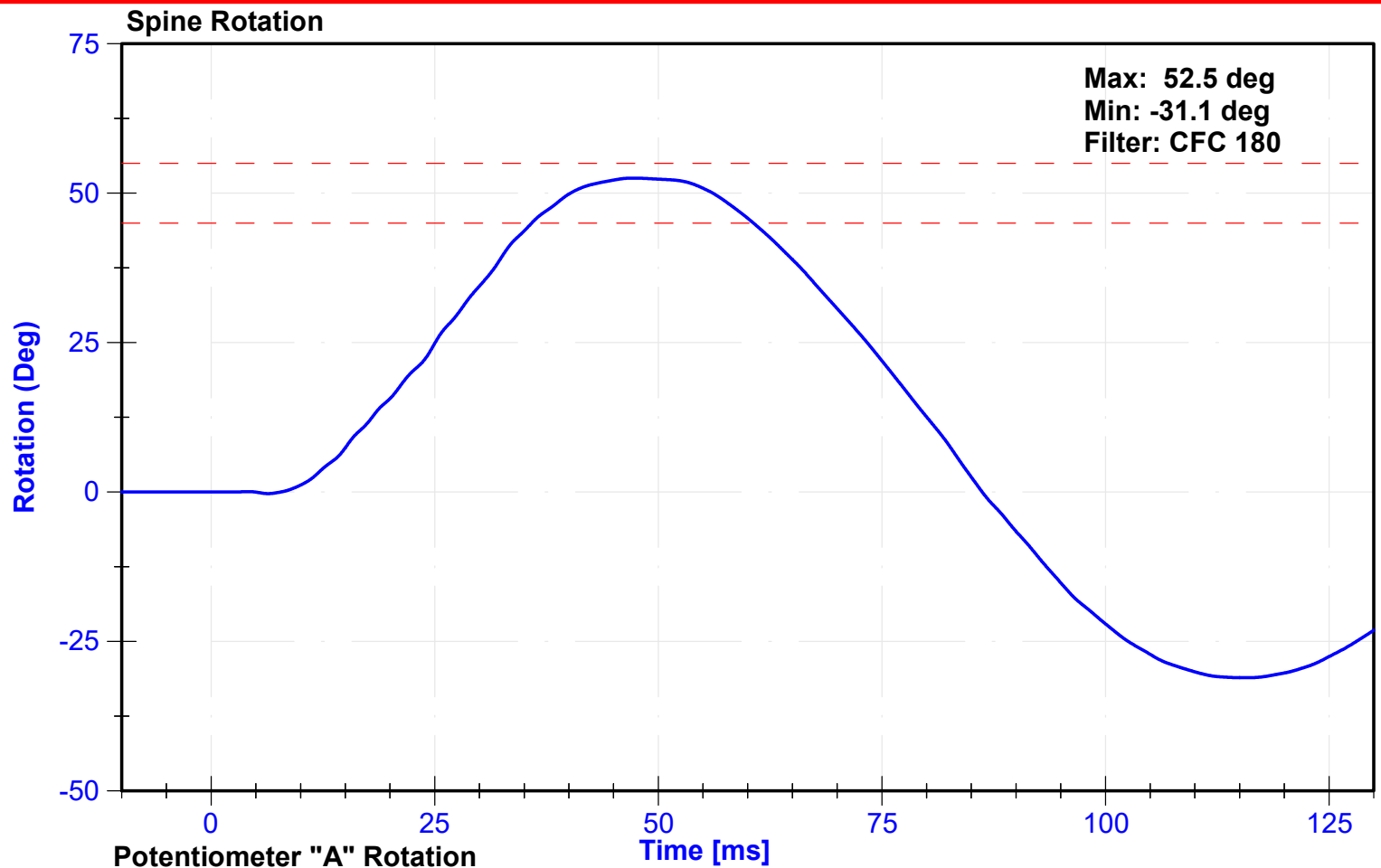
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.9	Pass
Humidity	10	70	%	29	Pass
Velocity	5.95	6.15	m/s	5.962	Pass
Lateral Spine Rotation	45	55	deg	52.5	Pass
Time at Maximum Rotation	39	53	ms	47.1	Pass
Time of Decay to Zero Degrees	37	57	ms	39.2	Pass
Pendulum Velocity Overall Corridor	Lower Boundary <sup>1</sup>	Upper Boundary <sup>2</sup>	m/s	See Plot <sup>3</sup>	Pass

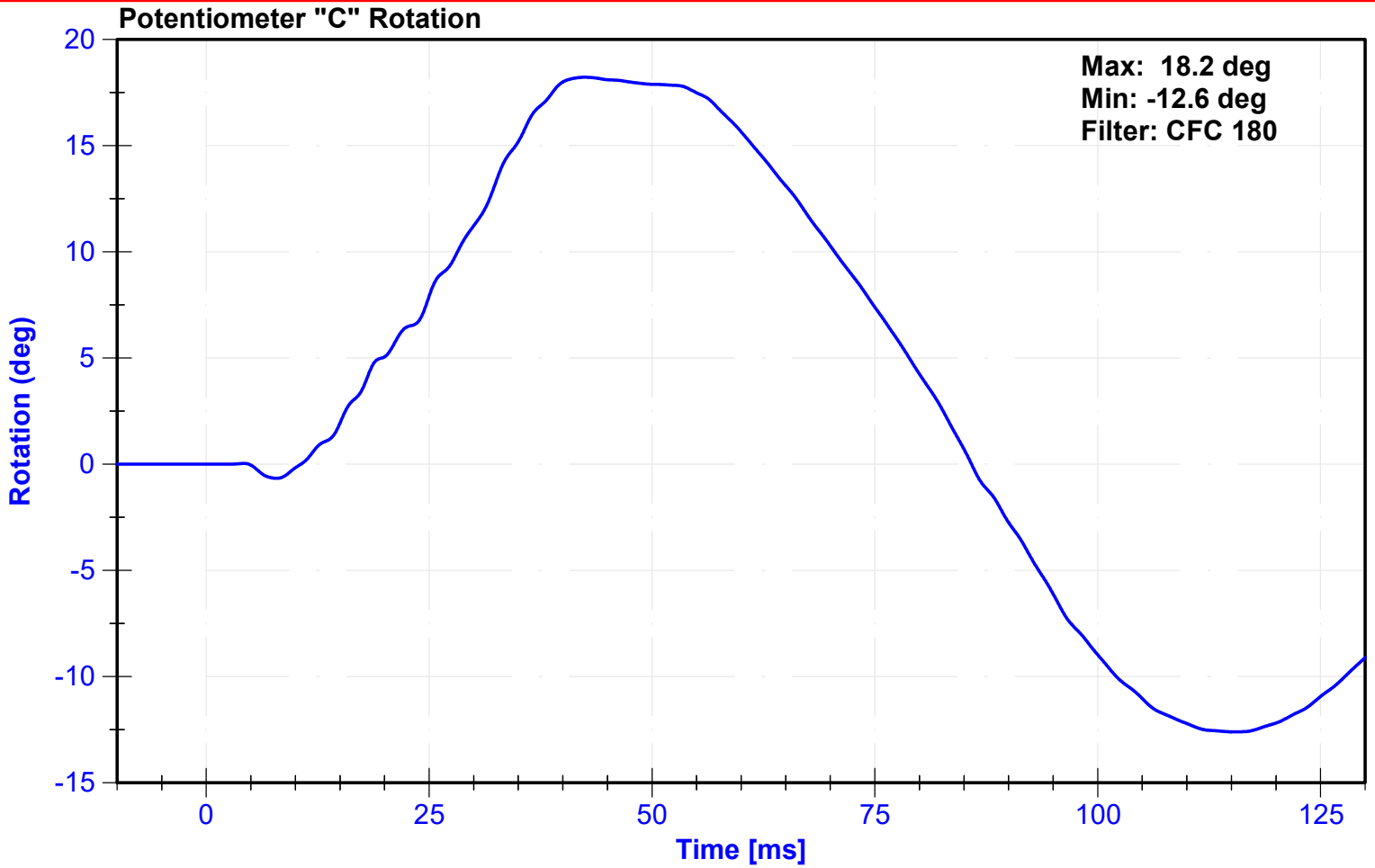
**Transducer Calibrations**

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	C16503	10/31/2023	4/28/2024
Pendulum "A" Potentiometer	Sfernice	2247	12/5/2023	12/4/2024
Condyle "B" Potentiometer	Sfernice	095	9/29/2023	9/28/2024



<sup>1,2</sup> Upper and lower boundaries specified in Appendix I IV-19





## Appendix I

<sup>2</sup> Upper Boundary Corridor		<sup>1</sup> 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

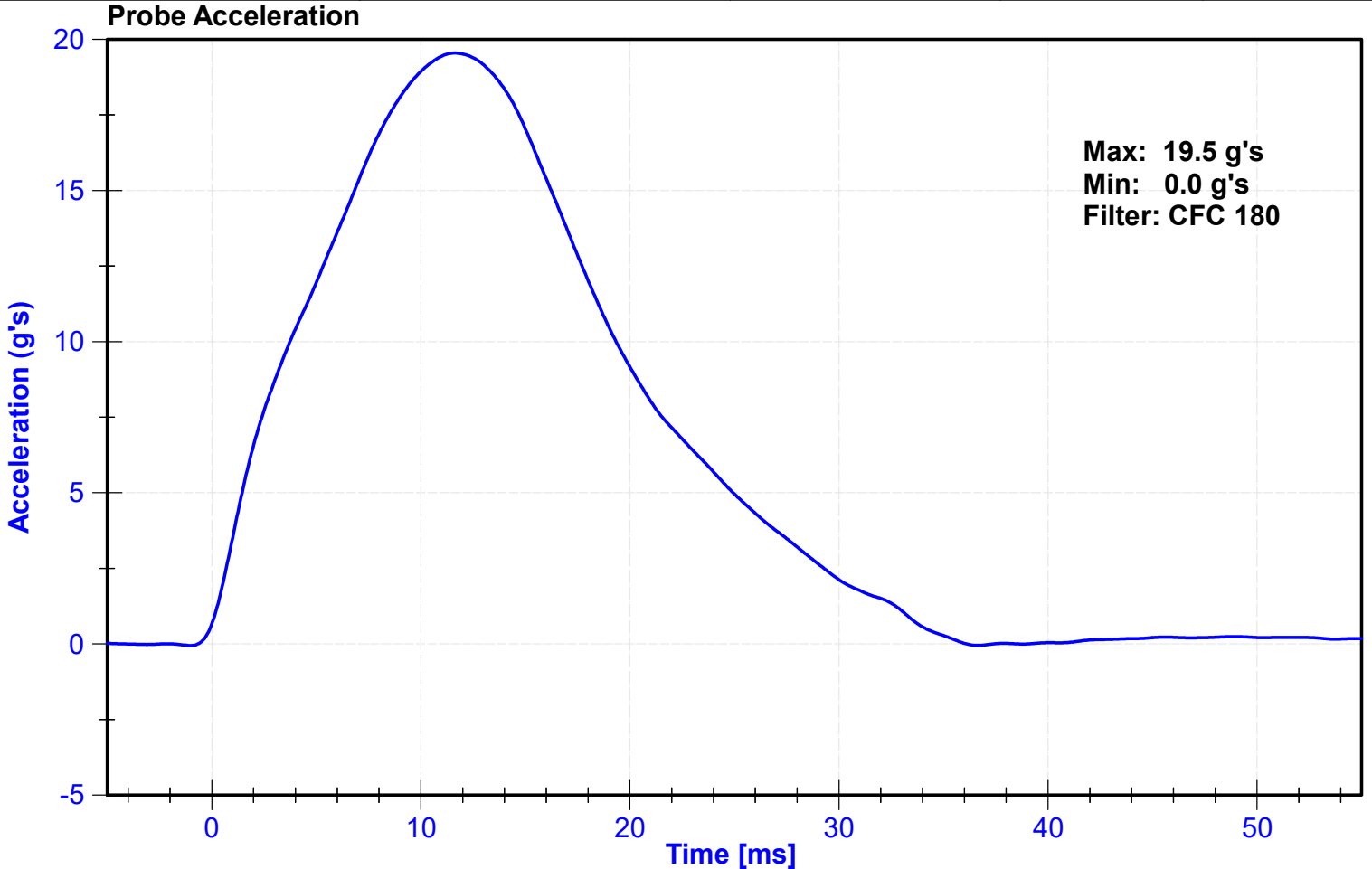
ATD Manufacturer	FTSS	Test Technician	J.Rios
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantell

**Results**

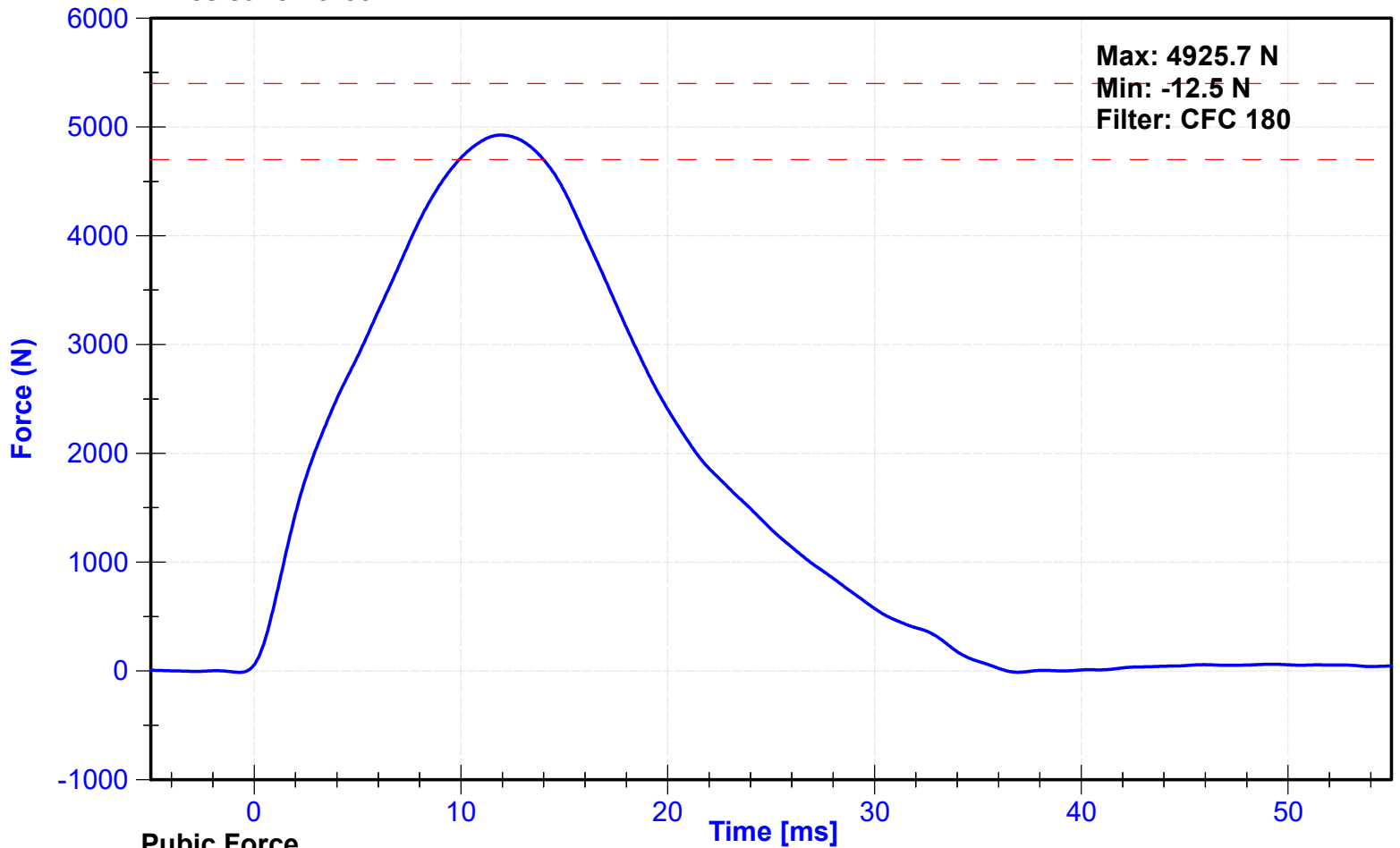
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.0	Pass
Humidity	10	70	%	18	Pass
Velocity	4.2	4.4	m/s	4.29	Pass
Resistive Force	4700	5400	N	4925.7	Pass
Time at Peak Resistive Force	11.8	16.1	ms	11.90	Pass
Pubic Force	-1590	-1230	N	-1286.0	Pass
Time at Peak Pubic Force	12.2	17.0	ms	12.45	Pass

**Transducer Calibrations**

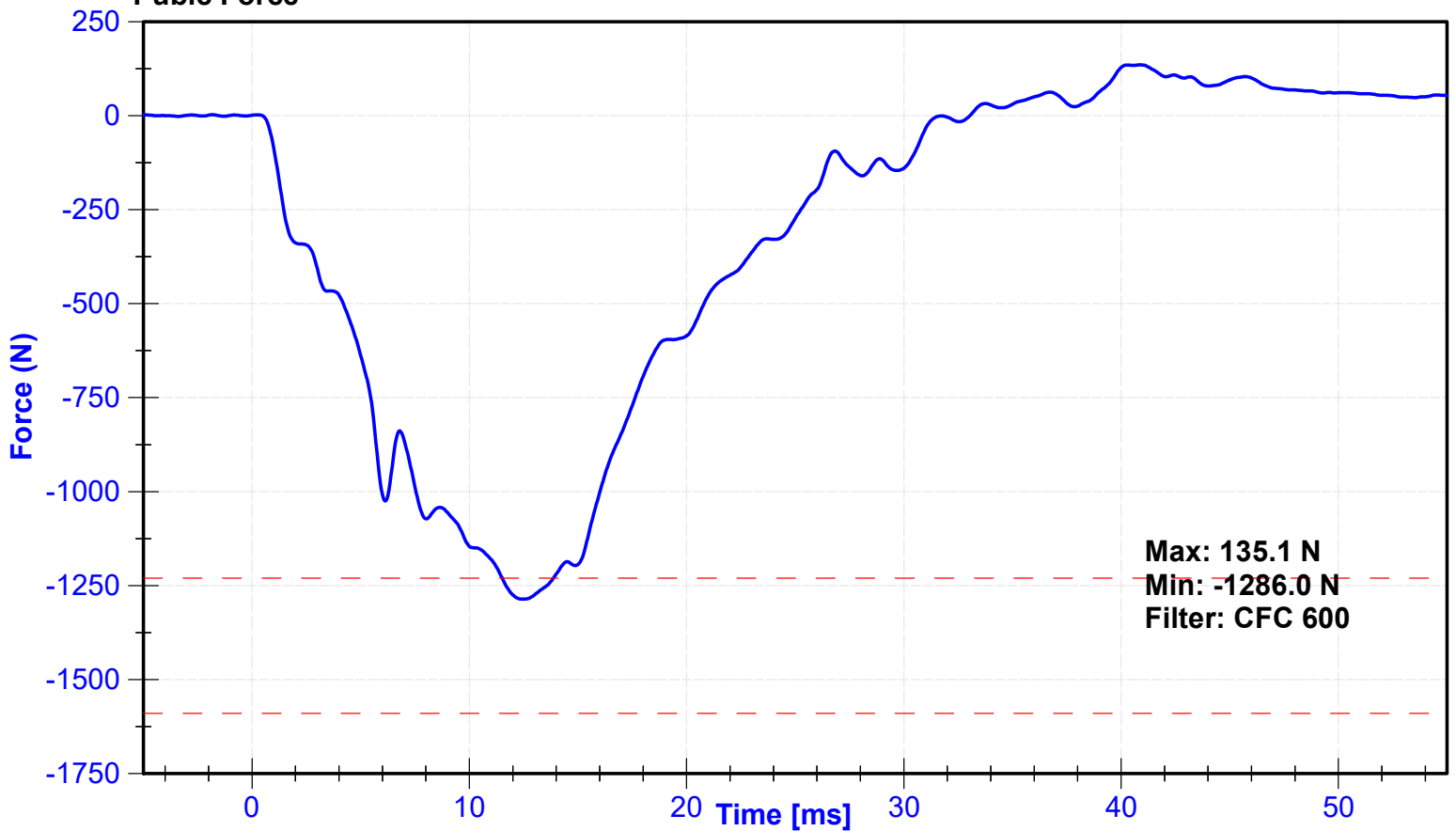
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18619	9/29/2023	3/27/2024
Pubic Load Cell	Denton	464-FY	8/15/2023	8/14/2024



Resistive Force



Pubic Force



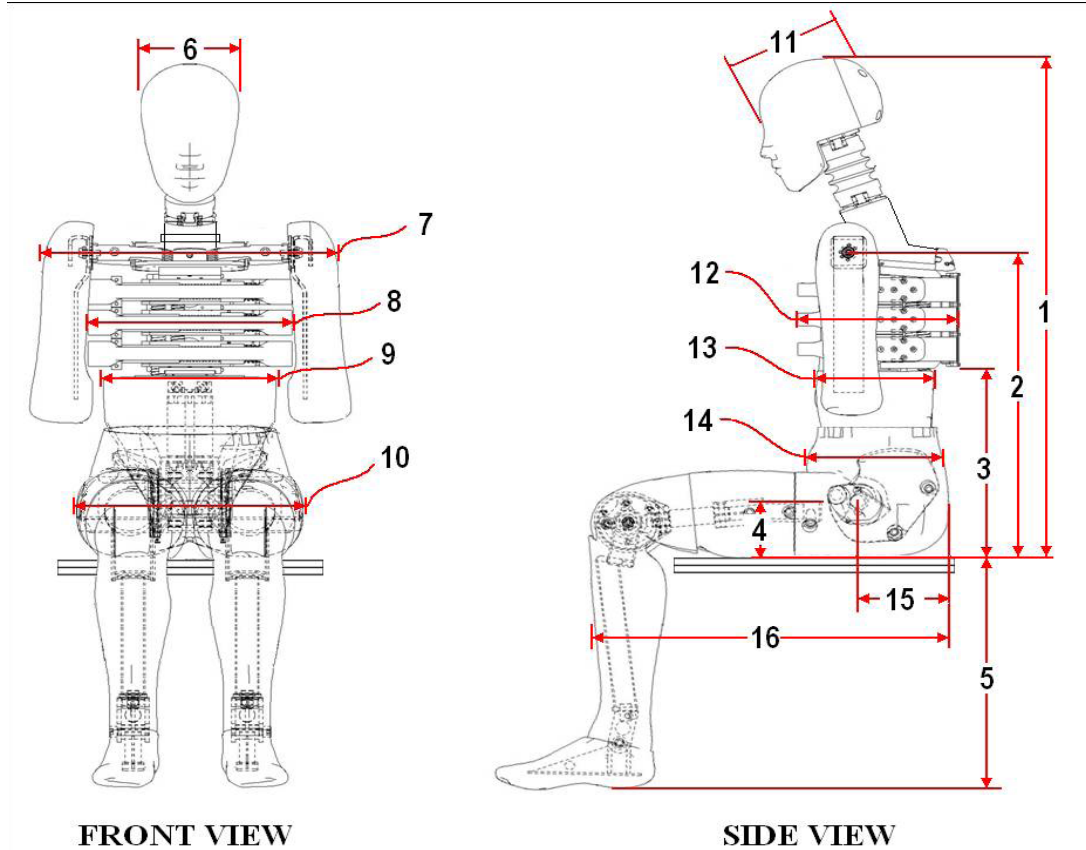
**POST-TEST DUMMY PERFORMANCE CALIBRATION TEST DATA**  
**(Subpart U, ES-2re)**

External Measurements - EuroSID-2re

Technician: K. Brogan

Date: 03/05/2024

Dummy Serial Number: DG5348



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	327	Pass
9	Abdomen Width	273	287	281	Pass
10	Pelvis Lap Width	359	373	367	Pass
11	Head Depth	196	206	200	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	J. Rios
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantell

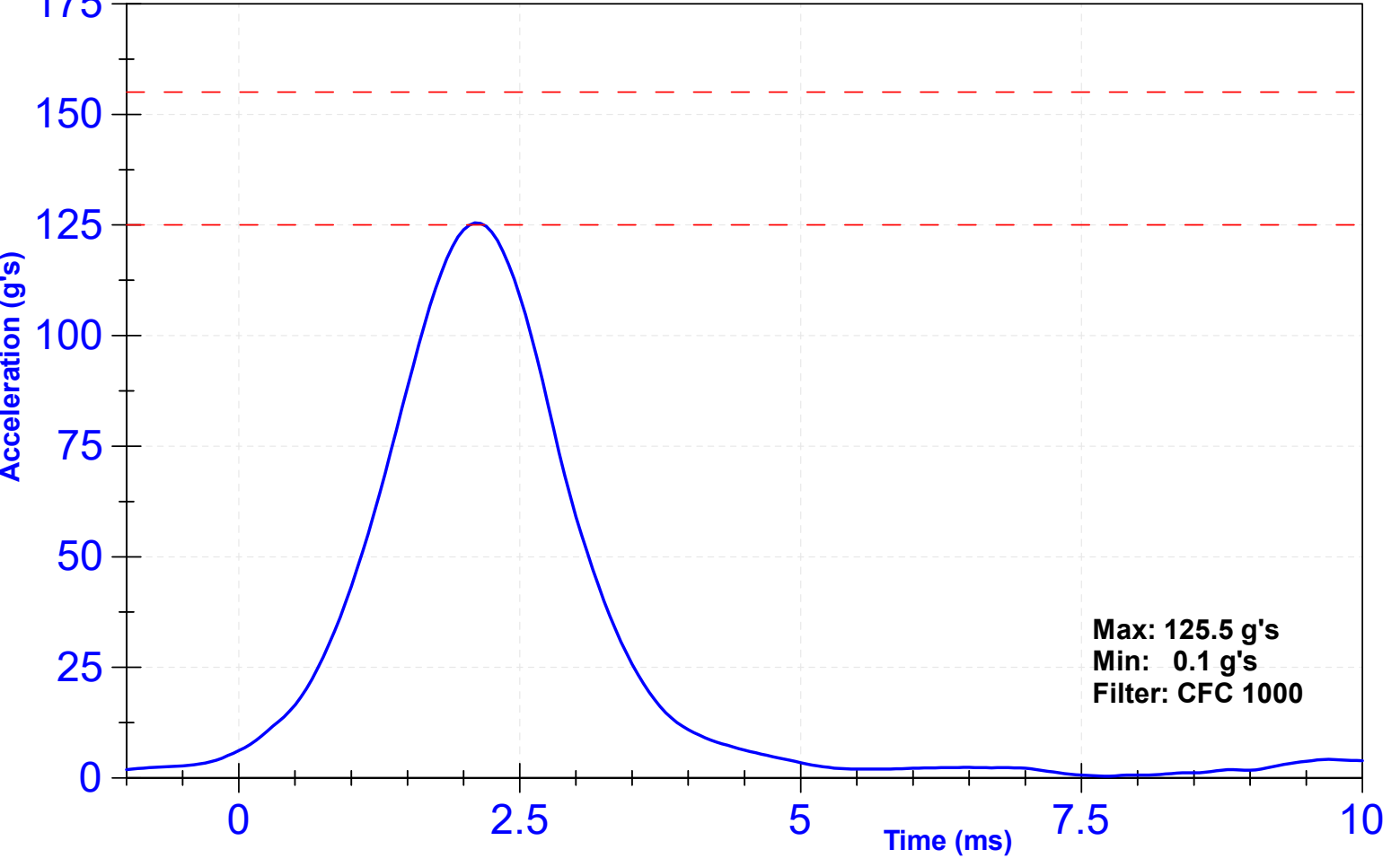
**Results**

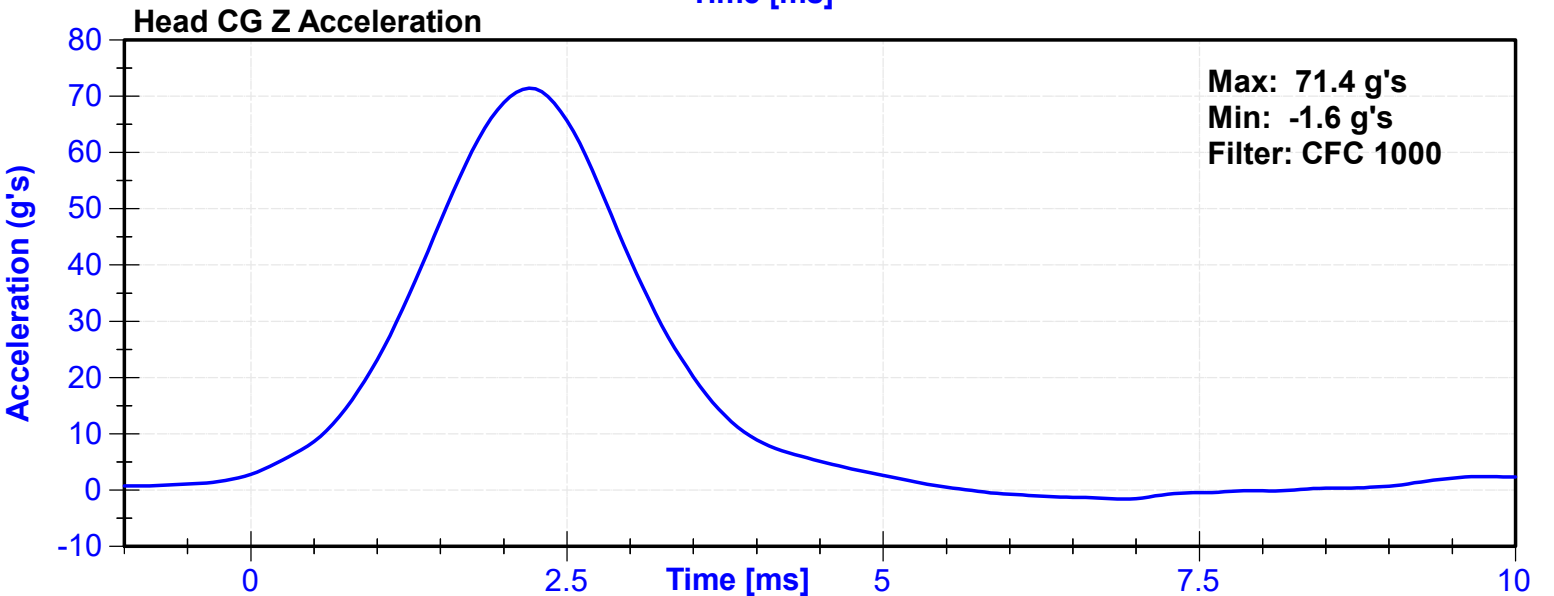
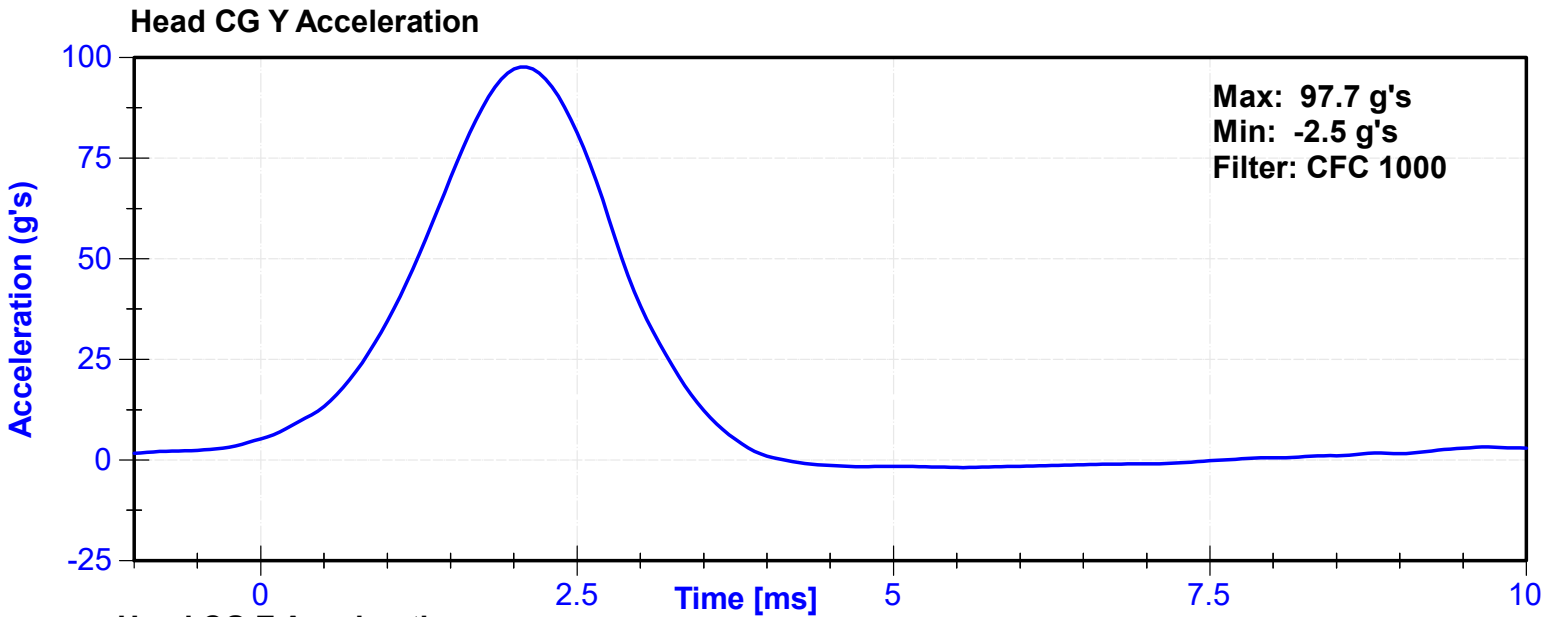
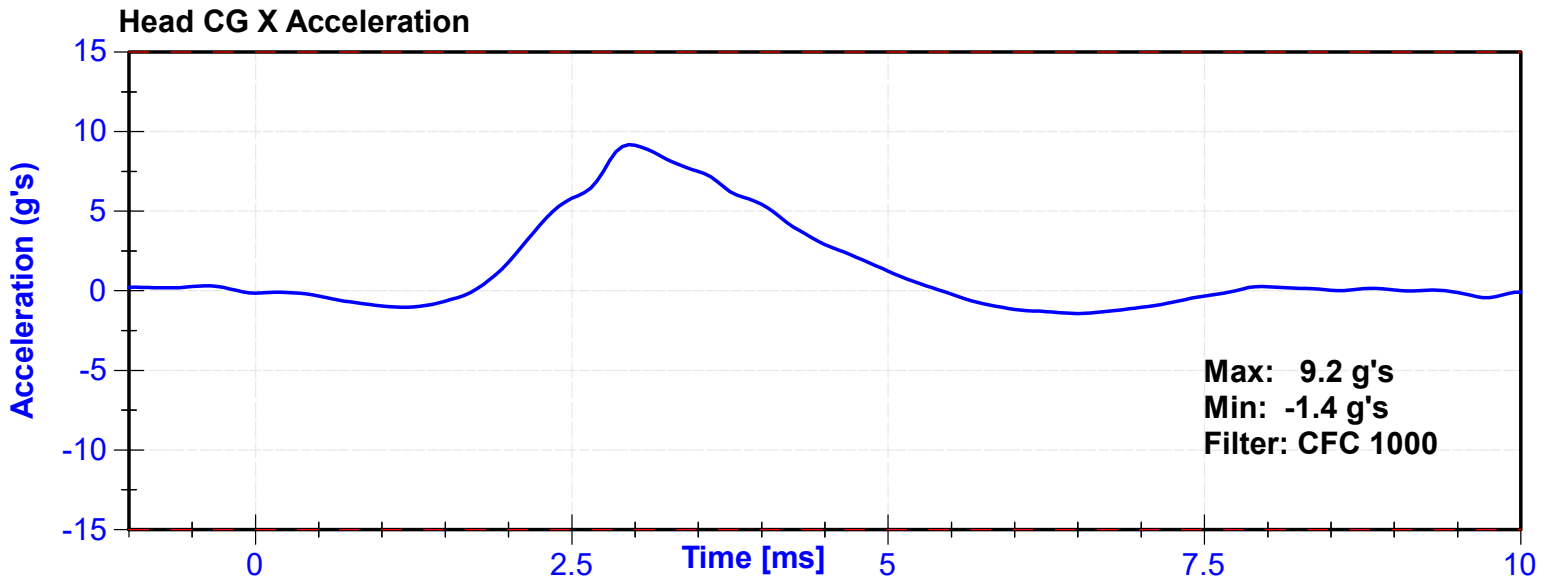
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.3	Pass
Humidity	10	70	%	27	Pass
Resultant Acceleration	125	155	g's	125.5	Pass
Oscillation	0	15	%	3.35	Pass
Fore-Aft Acceleration	-15	15	g's	9.2	Pass

**Transducer Calibrations**

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	Endevco	18613	2/8/2024	8/6/2024
Y Accelerometer	Endevco	18472	2/8/2024	8/6/2024
Z Accelerometer	Endevco	18663	2/8/2024	8/6/2024

**Resultant Acceleration**





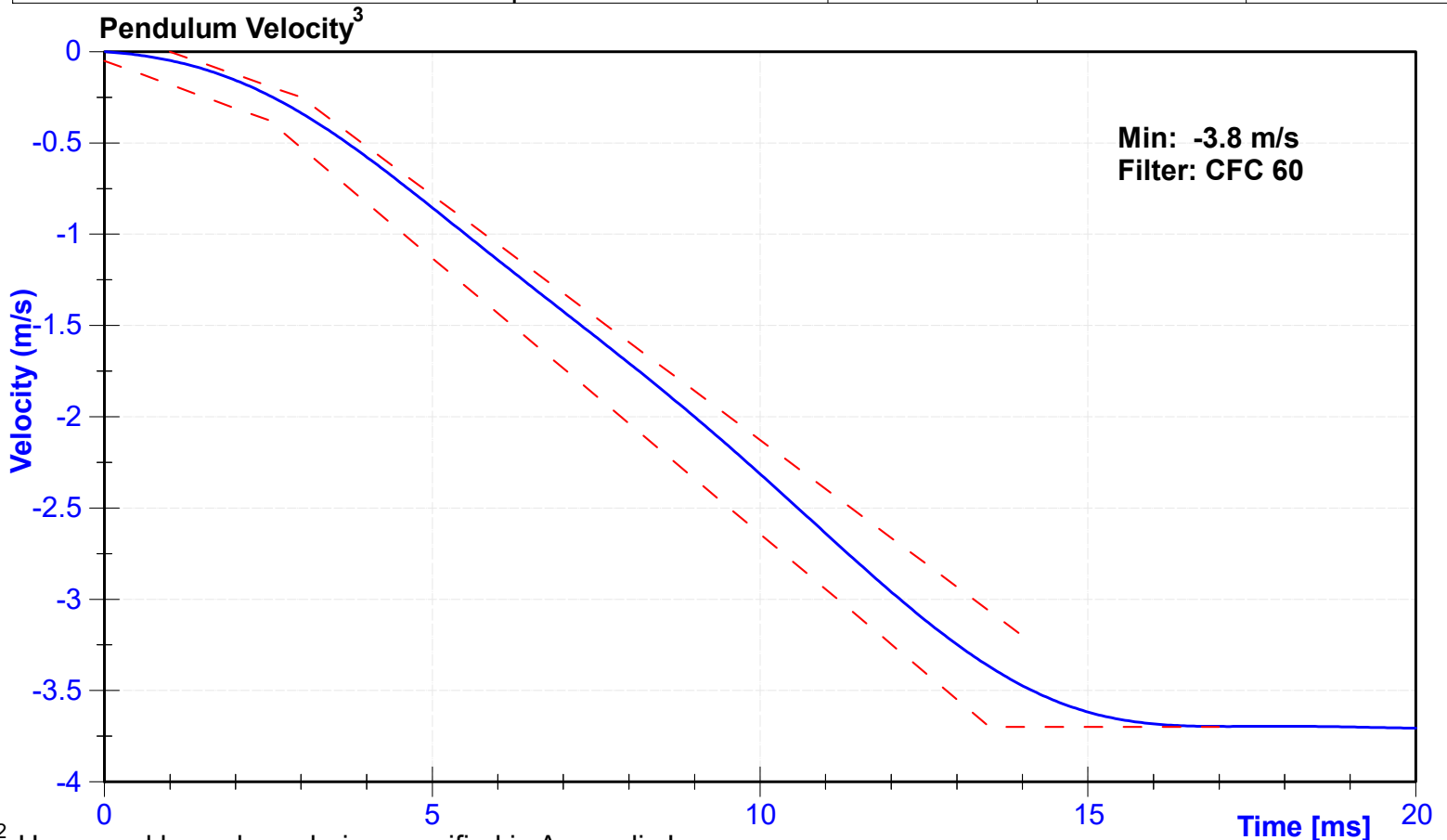
ATD Manufacturer	FTSS	Test Technician	J. Rios
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantell

**Results**

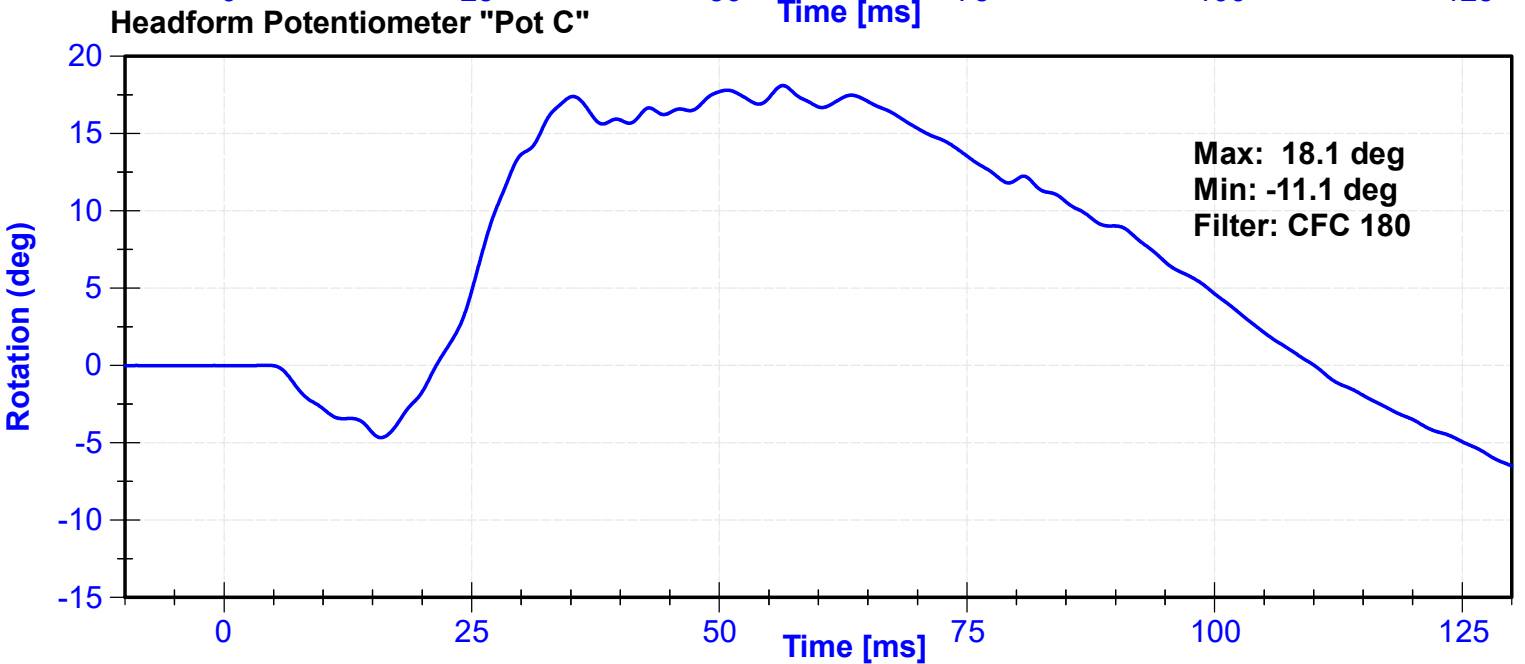
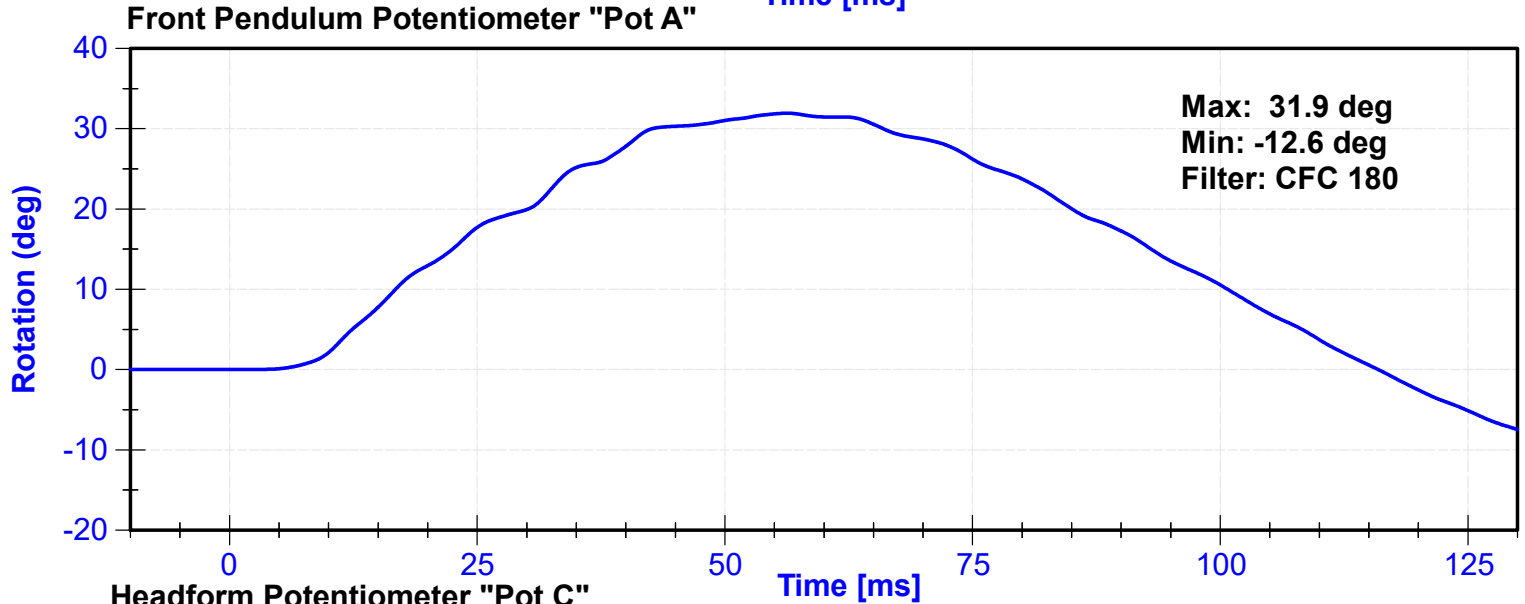
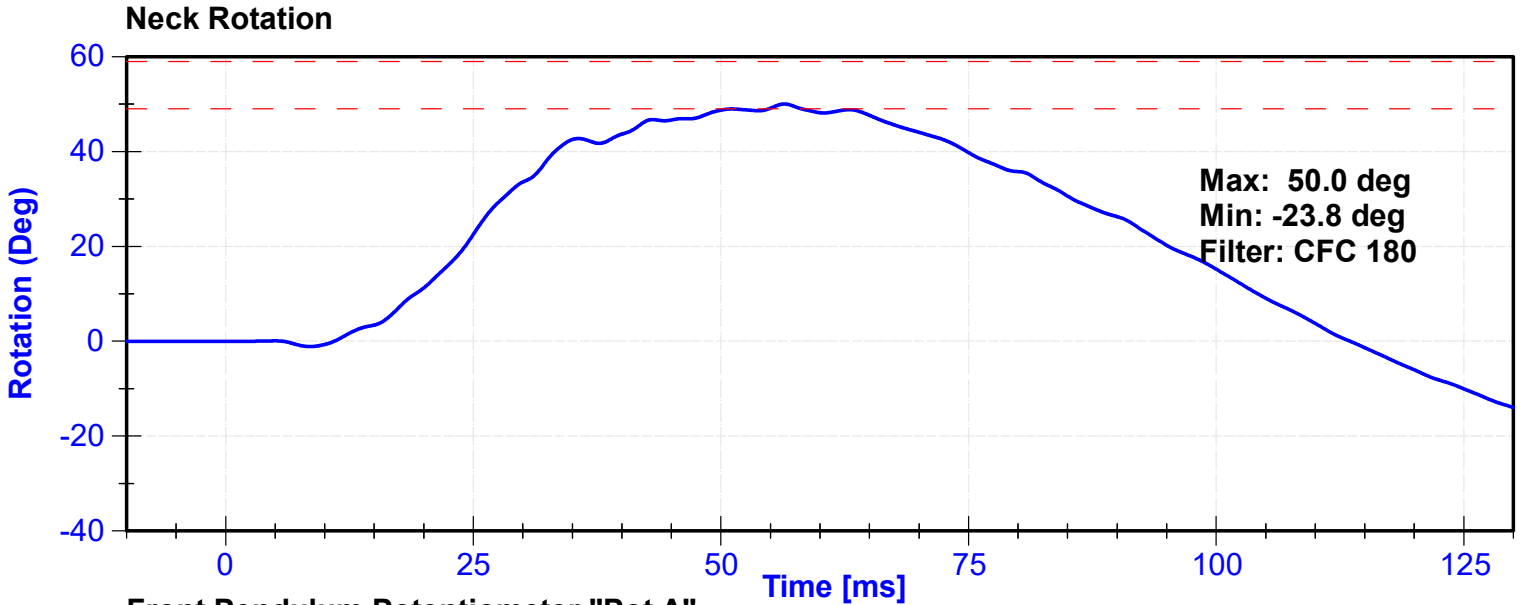
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	22.1	Pass
Humidity	10	70	%	40	Pass
Velocity	3.3	3.5	m/s	3.47	Pass
Lateral Neck Rotation	49	59	deg	50.0	Pass
Time at Maximum Rotation	54	66	ms	56.4	Pass
Time of Rotation Decay from Maximum	53	88	ms	57.1	Pass
Pendulum Velocity Overall Corridor	Lower Boundary <sup>1</sup>	Upper Boundary <sup>2</sup>	m/s	See Plot <sup>3</sup>	Pass

**Transducer Calibrations**

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	C16503	10/31/2023	4/28/2024
Front Pendulum Potentiometer	Sfernice	2247	12/5/2023	12/4/2024
Headform Potentiometer	Sfernice	095	9/29/2023	9/28/2024



<sup>1,2</sup> Upper and lower boundaries specified in Appendix I



## Appendix I

<sup>2</sup> Upper Boundary Corridor		<sup>1</sup> 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.Rios
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantell

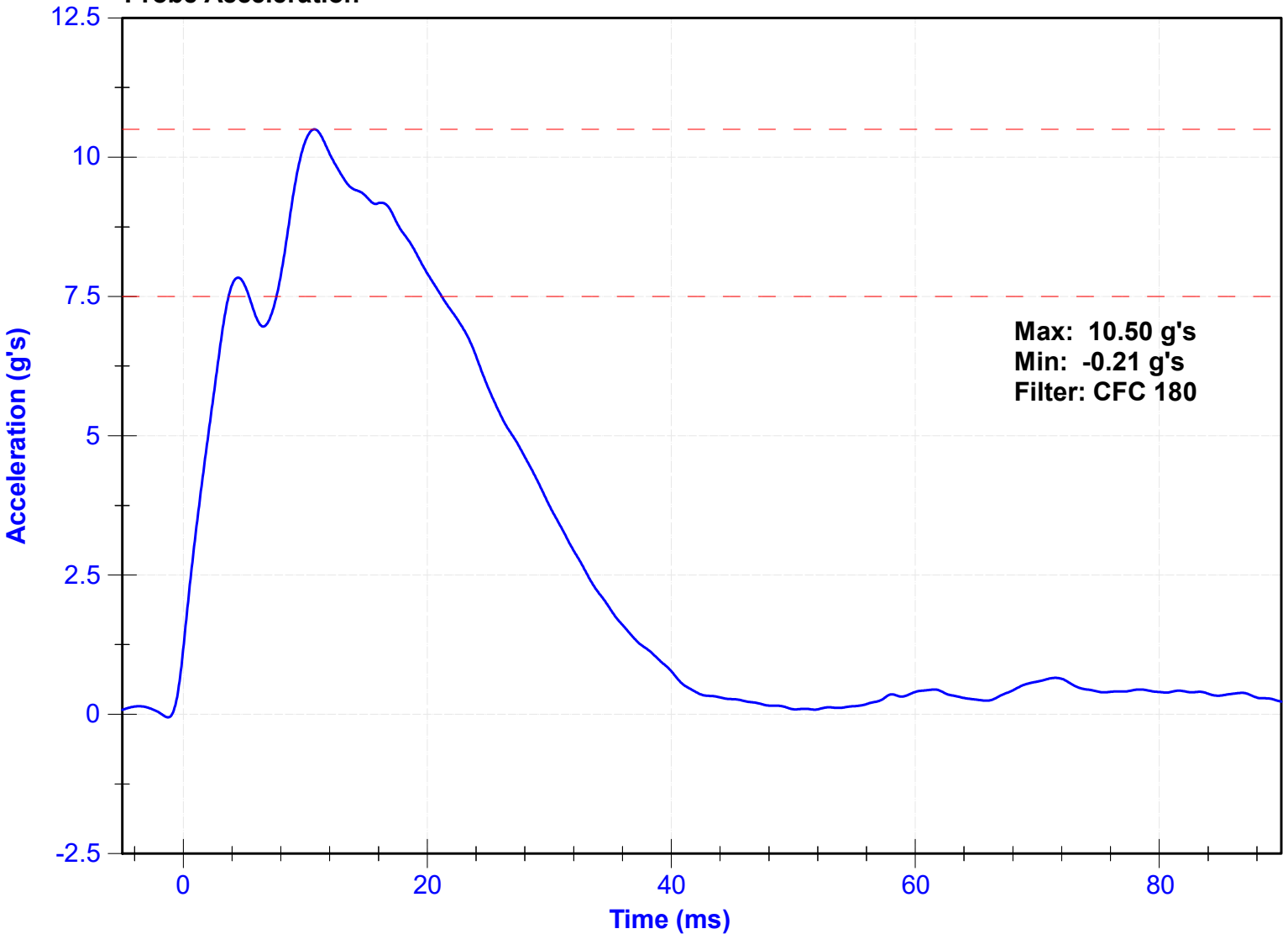
**Results**

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.5	Pass
Humidity	10	70	%	18	Pass
Velocity	4.2	4.4	m/s	4.29	Pass
Probe Acceleration	7.5	10.5	g's	10.50	Pass

**Transducer Calibrations**

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

**Probe Acceleration**



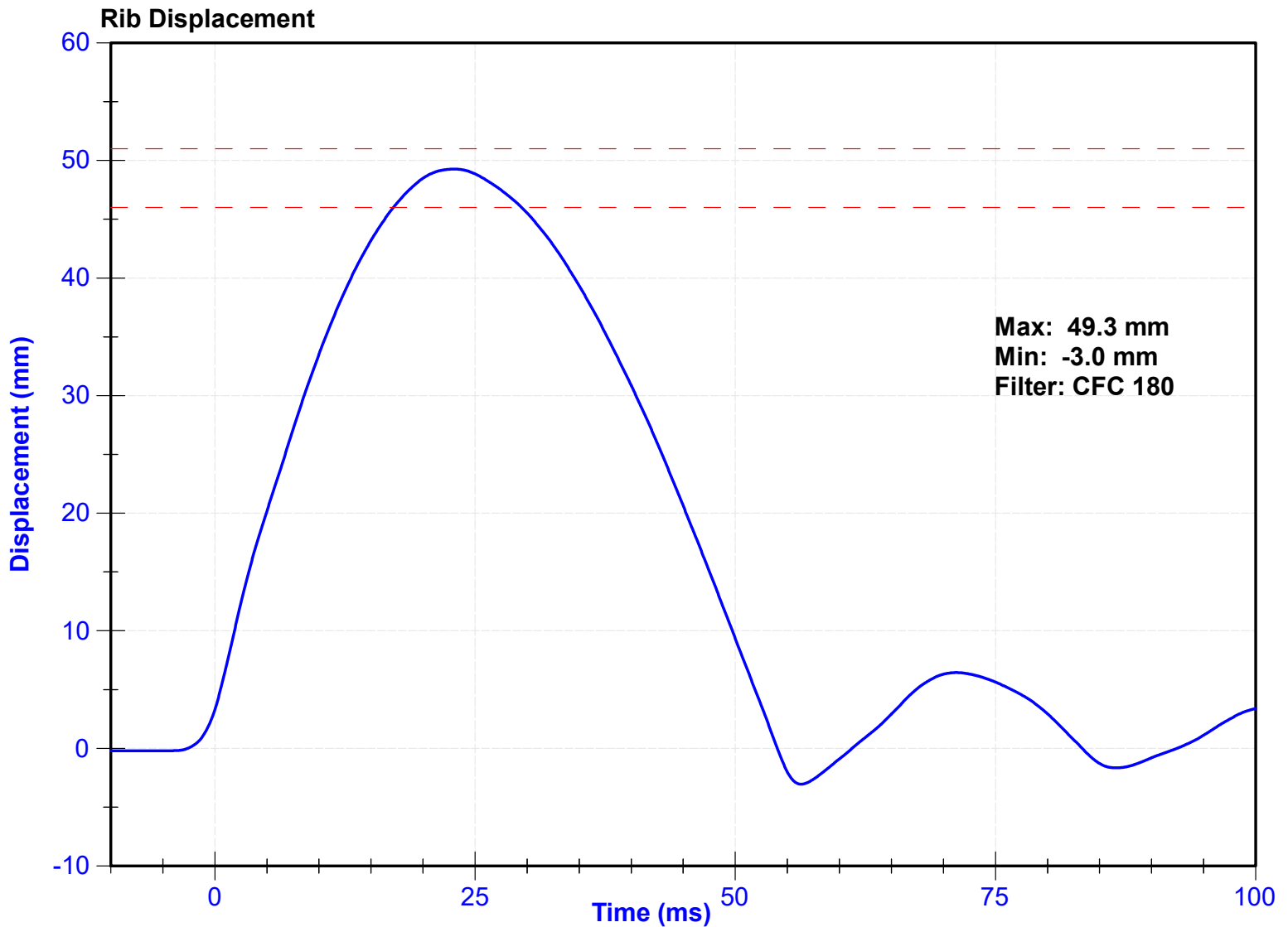
ATD Manufacturer	FTSS	Test Technician	T. Roseman
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantel

**Results**

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.9	Pass
Humidity	10	70	%	39	Pass
Rib Displacement	46	51	mm	49.3	Pass

**Transducer Calibrations**

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



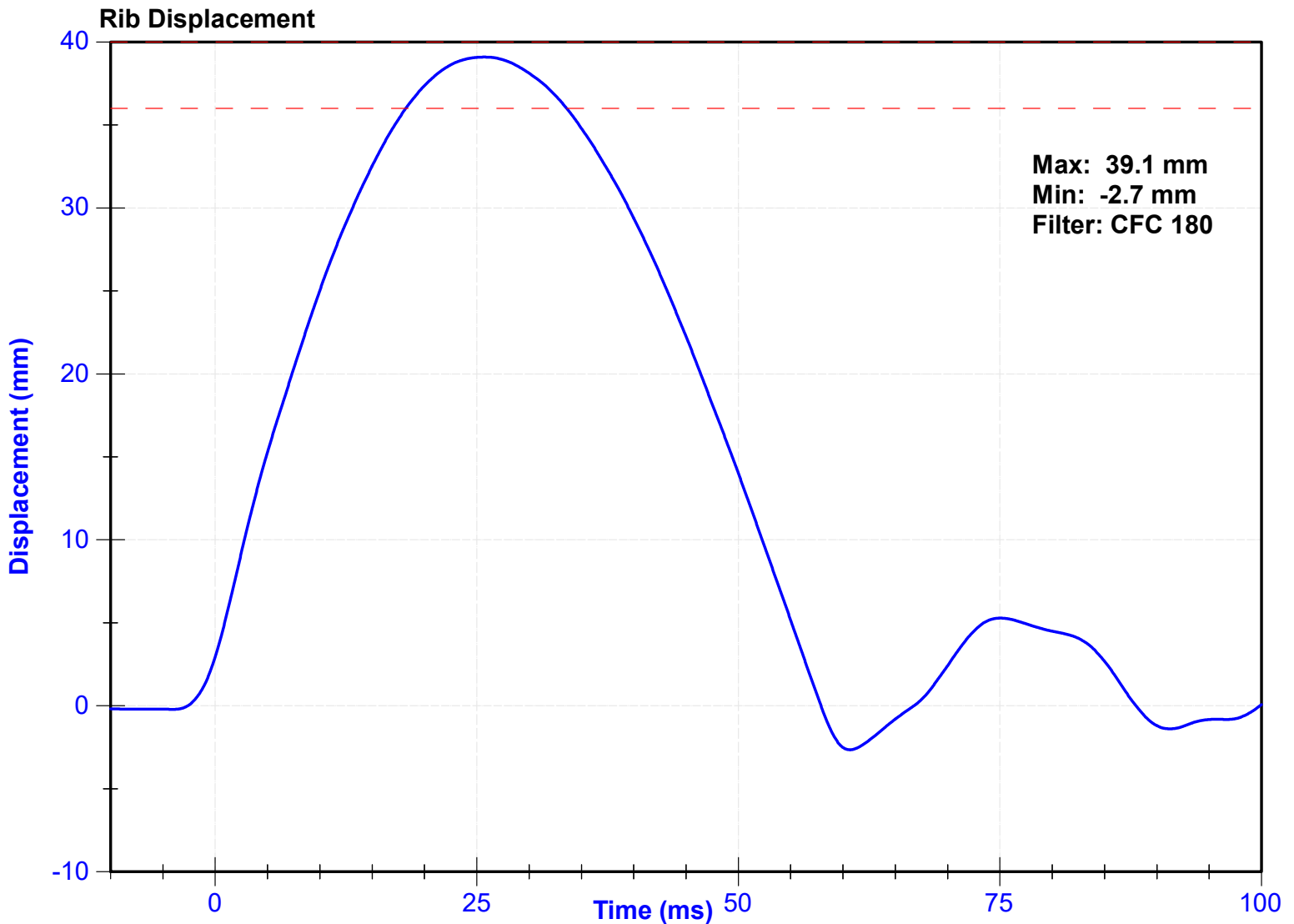
ATD Manufacturer	FTSS	Test Technician	T. Roseman
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantel

**Results**

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.9	Pass
Humidity	10	70	%	39	Pass
Rib Displacement	36	40	mm	39.1	Pass

**Transducer Calibrations**

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



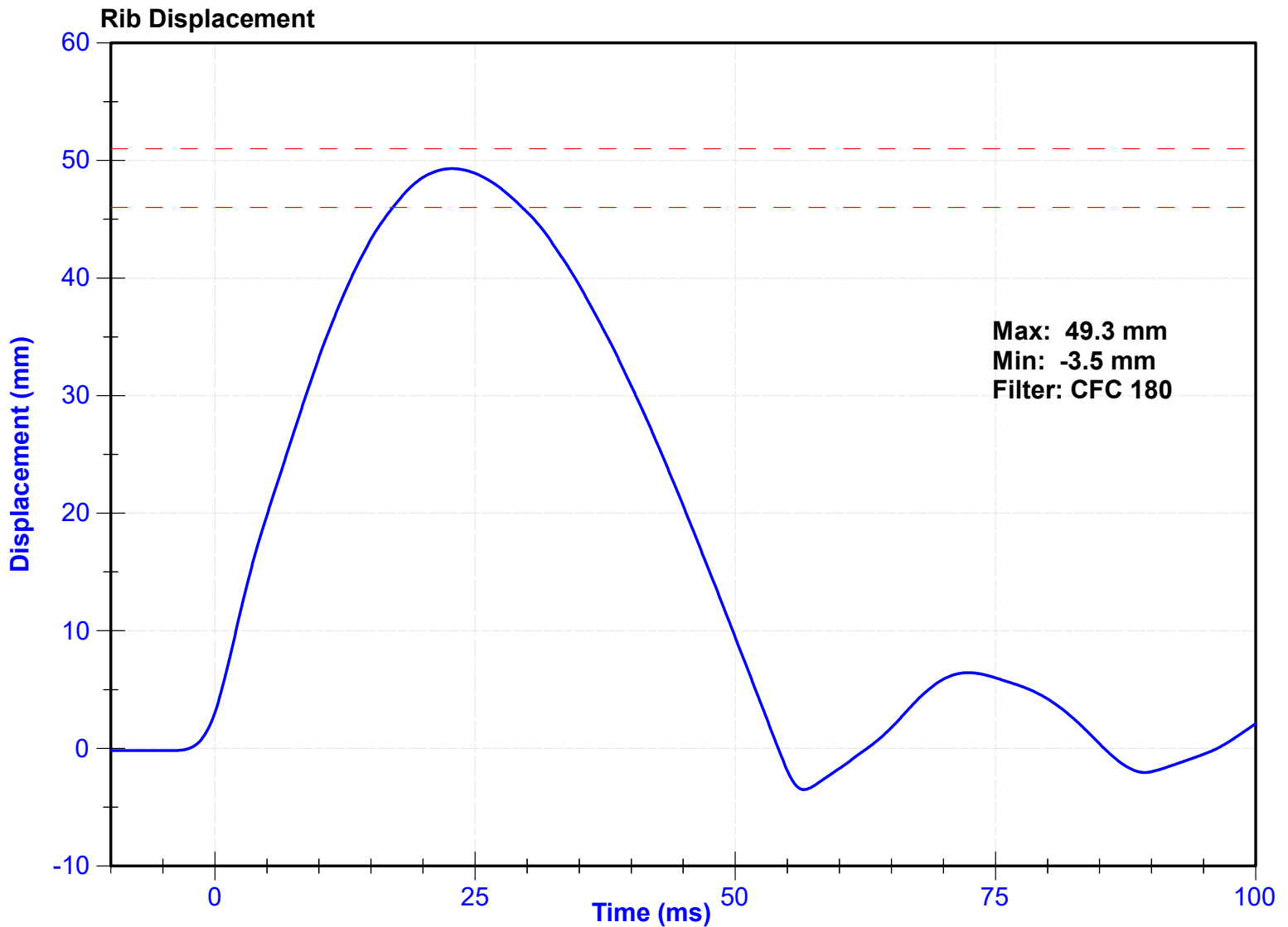
ATD Manufacturer	FTSS	Test Technician	J. Rios
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantel

**Results**

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.9	Pass
Humidity	10	70	%	39	Pass
Rib Displacement	46	51	mm	49.3	Pass

**Transducer Calibrations**

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



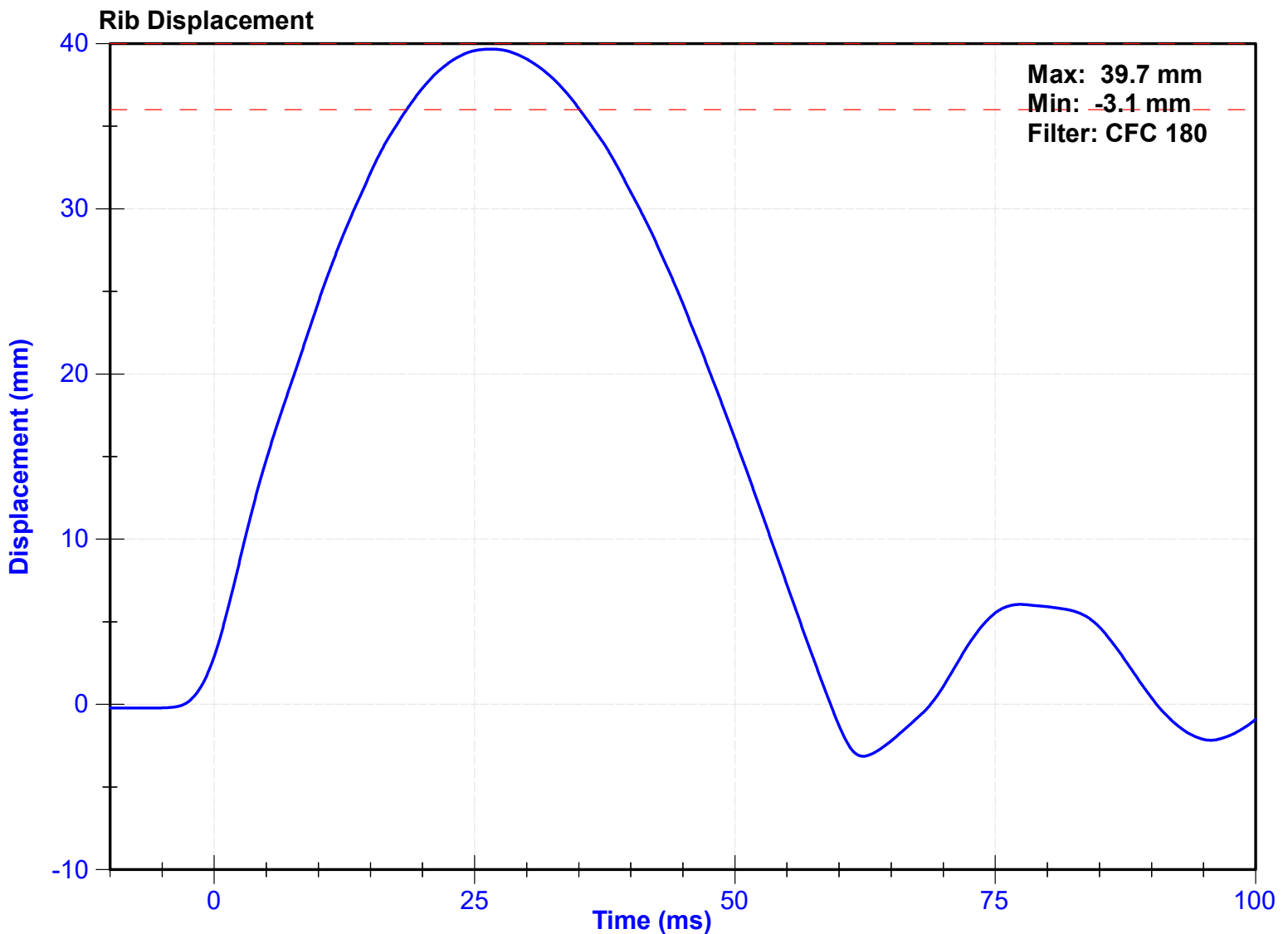
ATD Manufacturer	FTSS	Test Technician	T. Roseman
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantel

**Results**

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.9	Pass
Humidity	10	70	%	39	Pass
Rib Displacement	36	40	mm	39.7	Pass

**Transducer Calibrations**

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



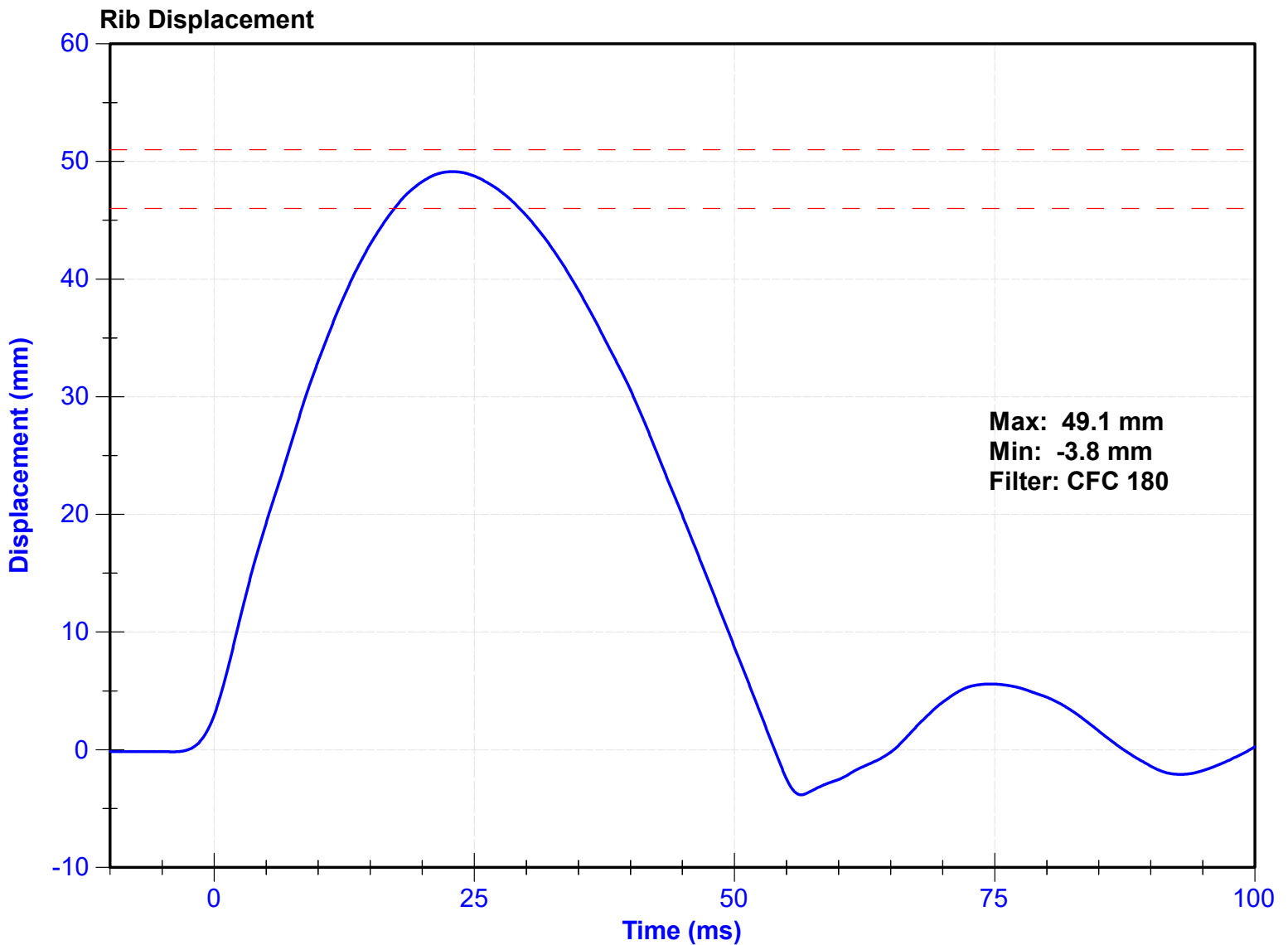
ATD Manufacturer	FTSS	Test Technician	T. Roseman
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantel

**Results**

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.9	Pass
Humidity	10	70	%	39	Pass
Rib Displacement	46	51	mm	49.1	Pass

**Transducer Calibrations**

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



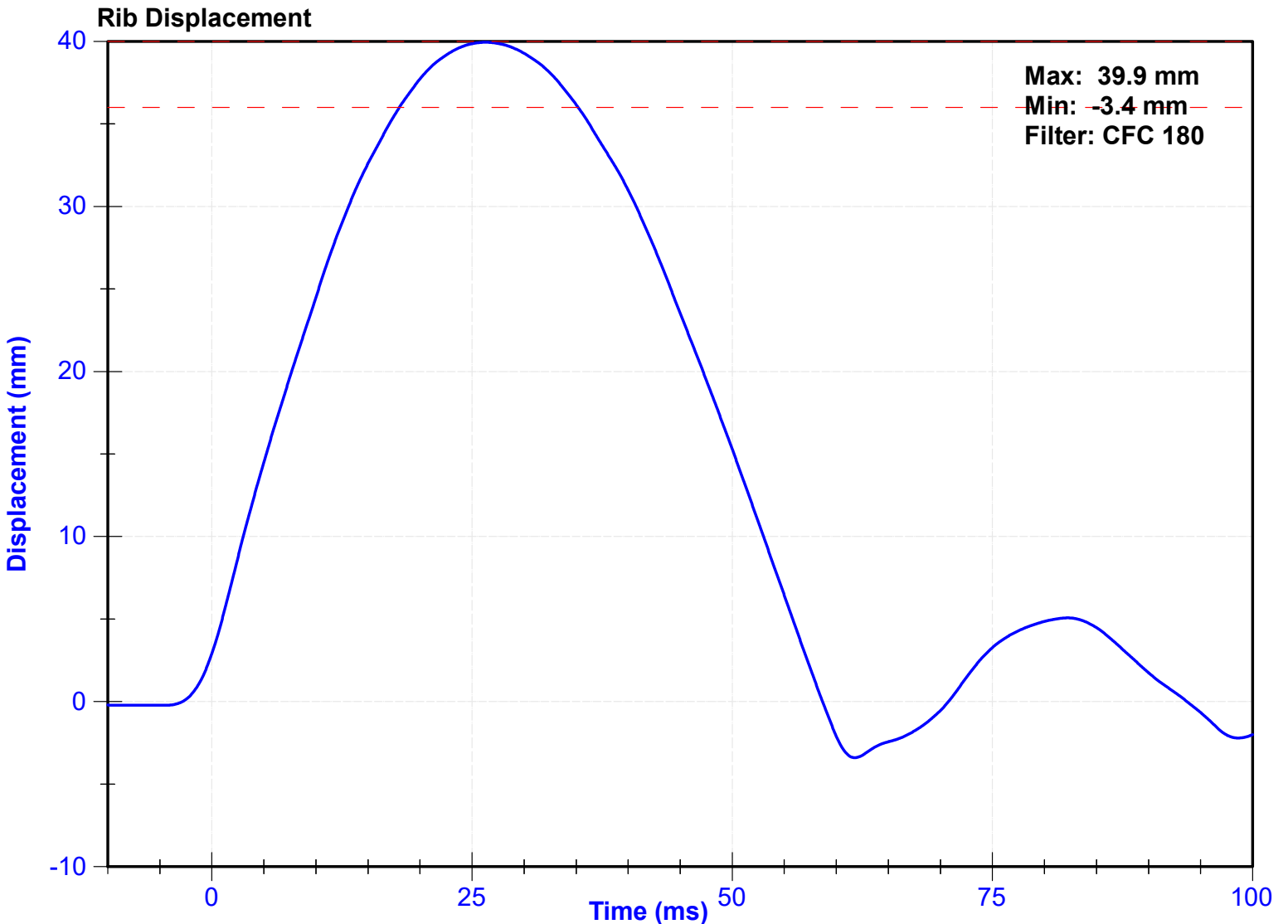
ATD Manufacturer	FTSS	Test Technician	T. Roseman
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantel

**Results**

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.9	Pass
Humidity	10	70	%	39	Pass
Rib Displacement	36	40	mm	39.9	Pass

**Transducer Calibrations**

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



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

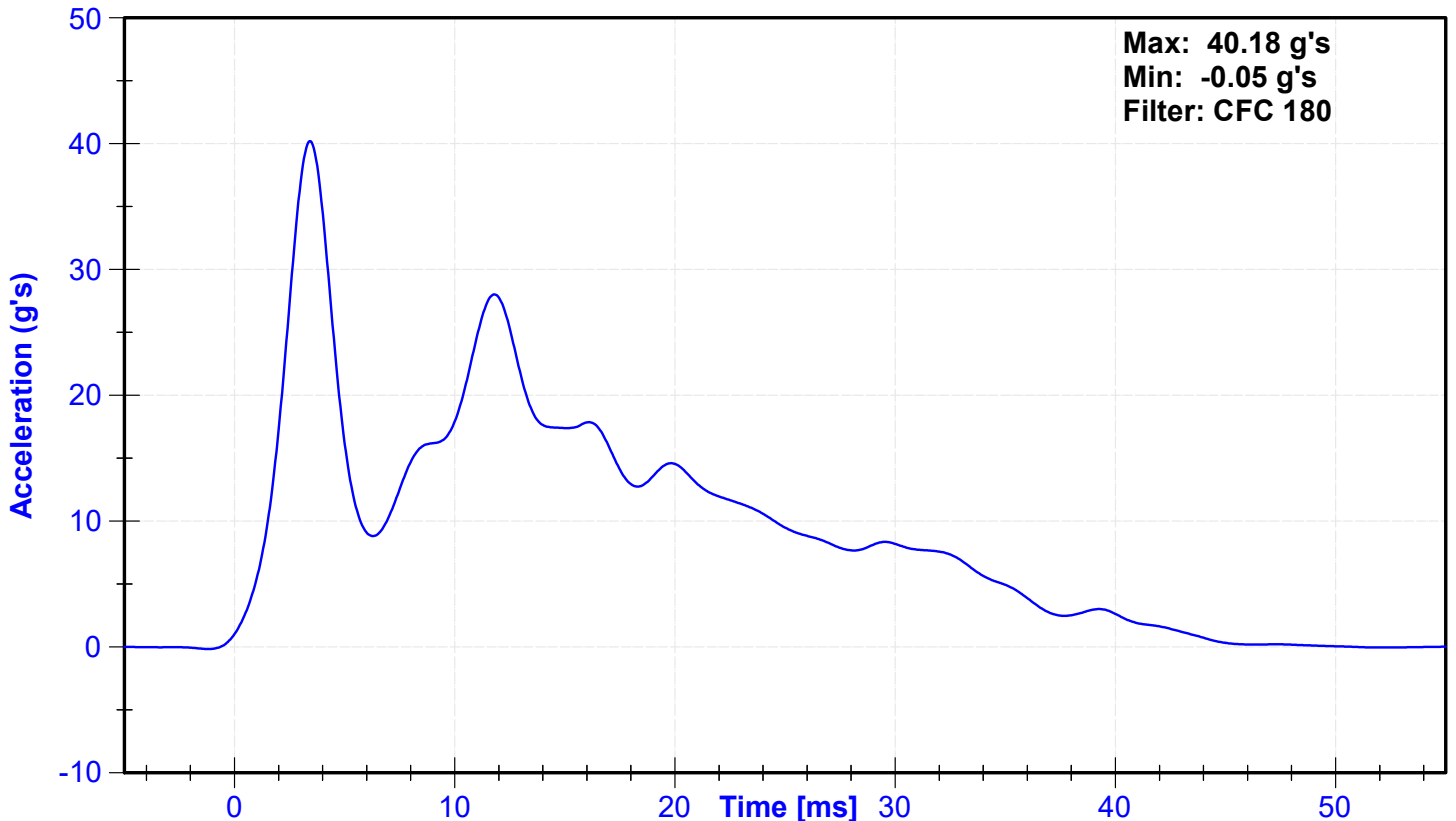
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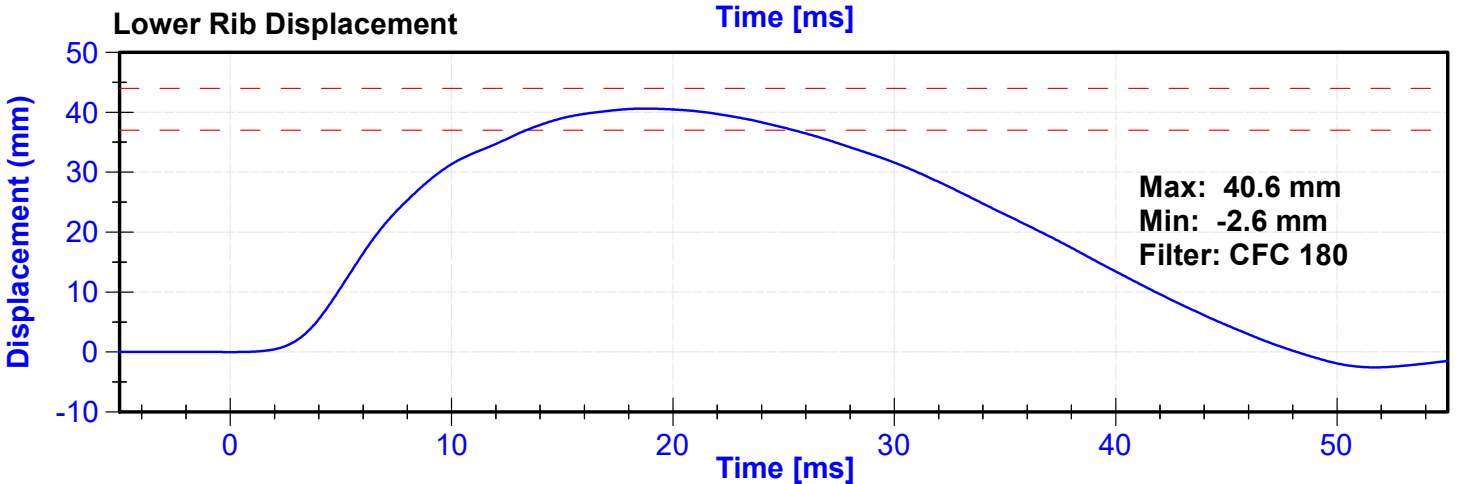
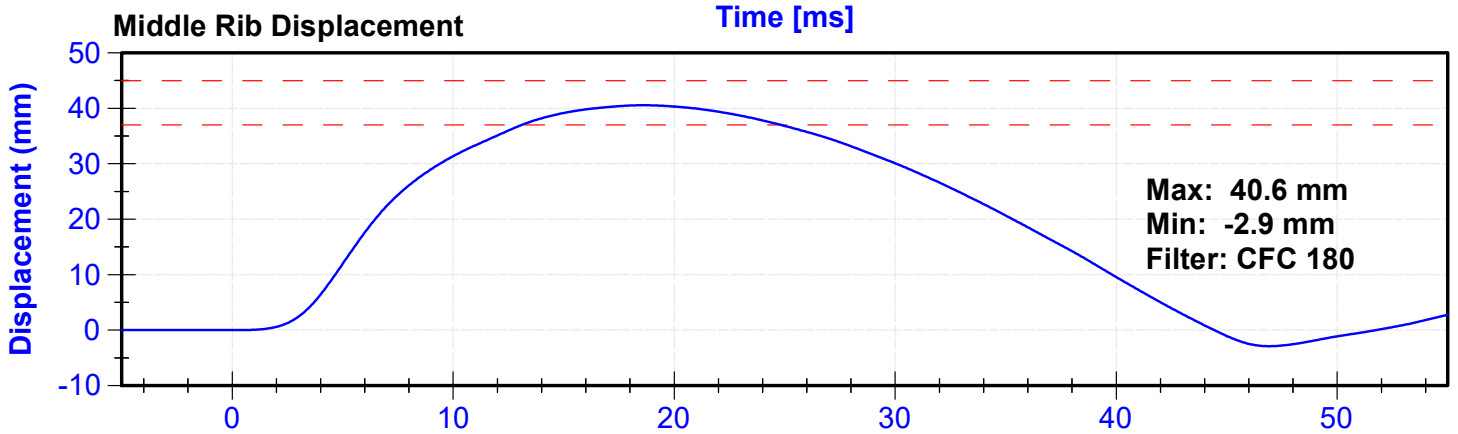
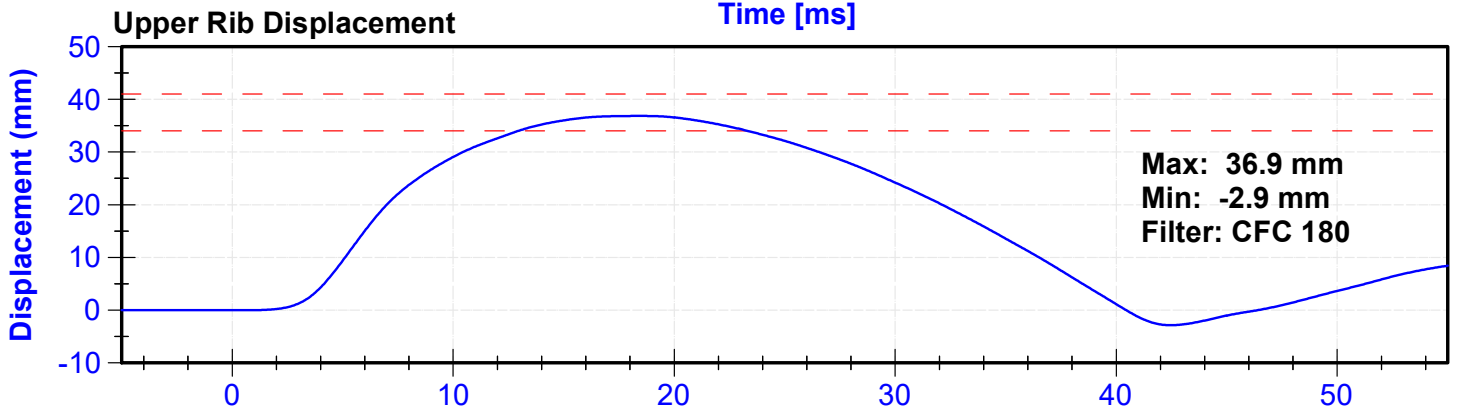
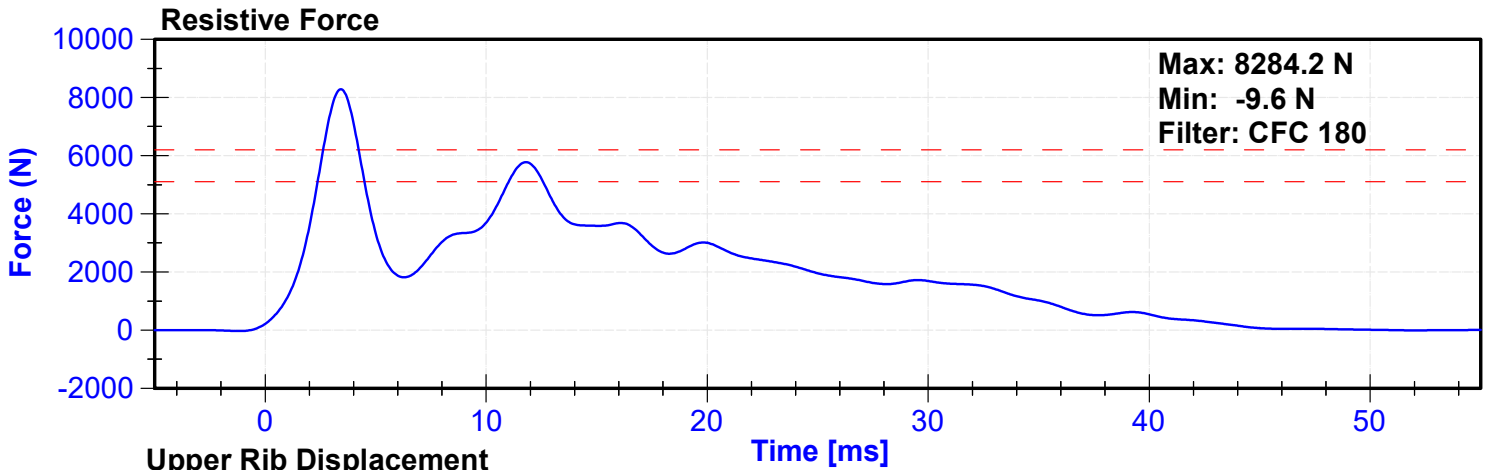
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.5	Pass
Humidity	10	70	%	18	Pass
Velocity	5.4	5.6	m/s	5.52	Pass
Resistive Force after 6ms	5100	6200	N	5775.7	Pass
Upper Thorax Rib Deflection	34	41	mm	36.9	Pass
Mid Thorax Rib Deflection	37	45	mm	40.6	Pass
Lower Thorax Rib Deflection	37	44	mm	40.6	Pass

**Transducer Calibrations**

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Probe Accelerometer	Endevco	18587	11/20/2023	11/19/2024
Upper Thorax Rib Potentiometer	Honeywell	268GFE	2/8/2024	8/8/2024
Middle Thorax Rib Potentiometer	Honeywell	269GFE	2/8/2024	8/8/2024
Lower Thorax Rib Potentiometer	Honeywell	270GFE	2/8/2024	8/8/2024

**Probe Acceleration**





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

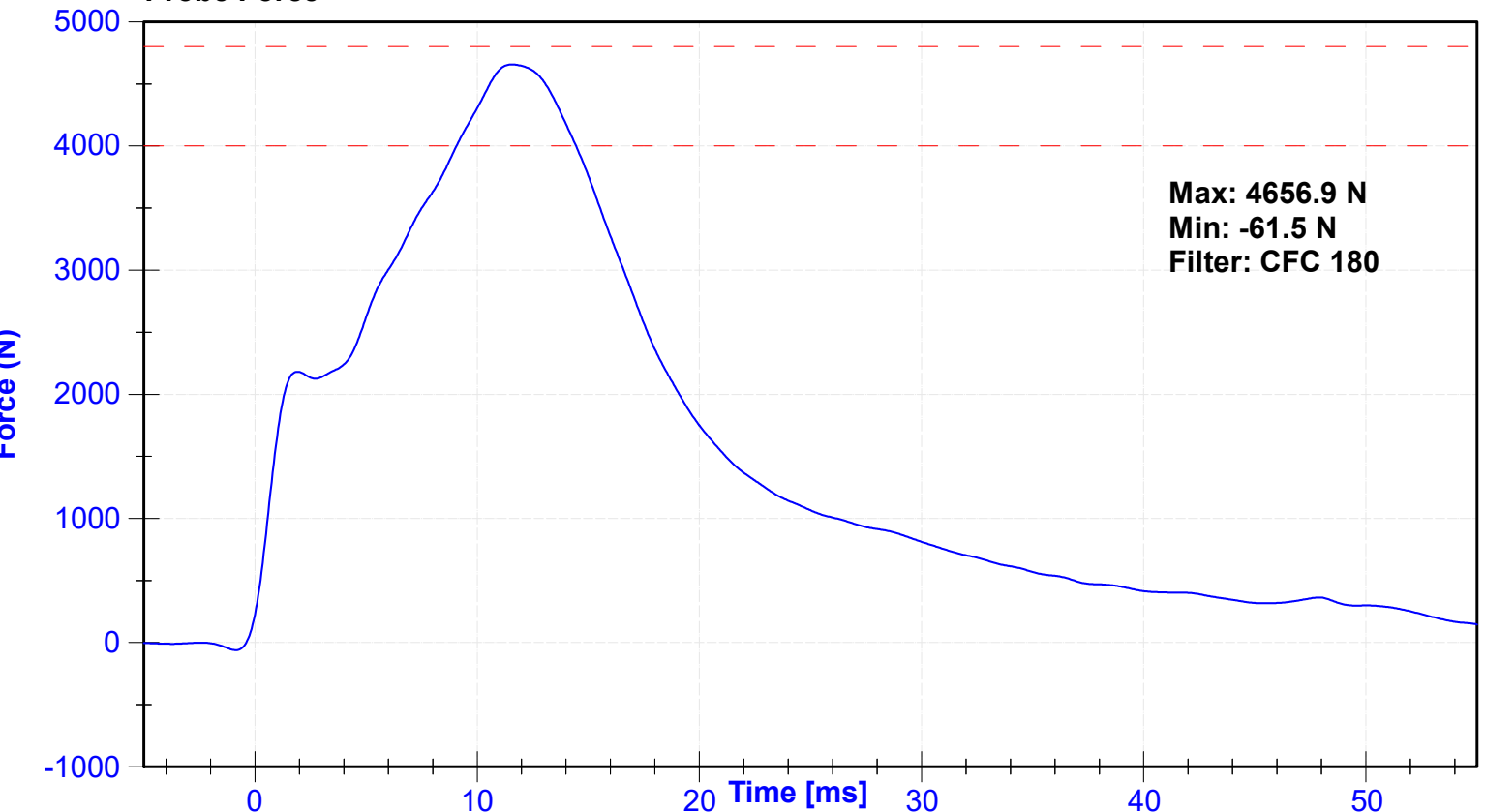
**Results**

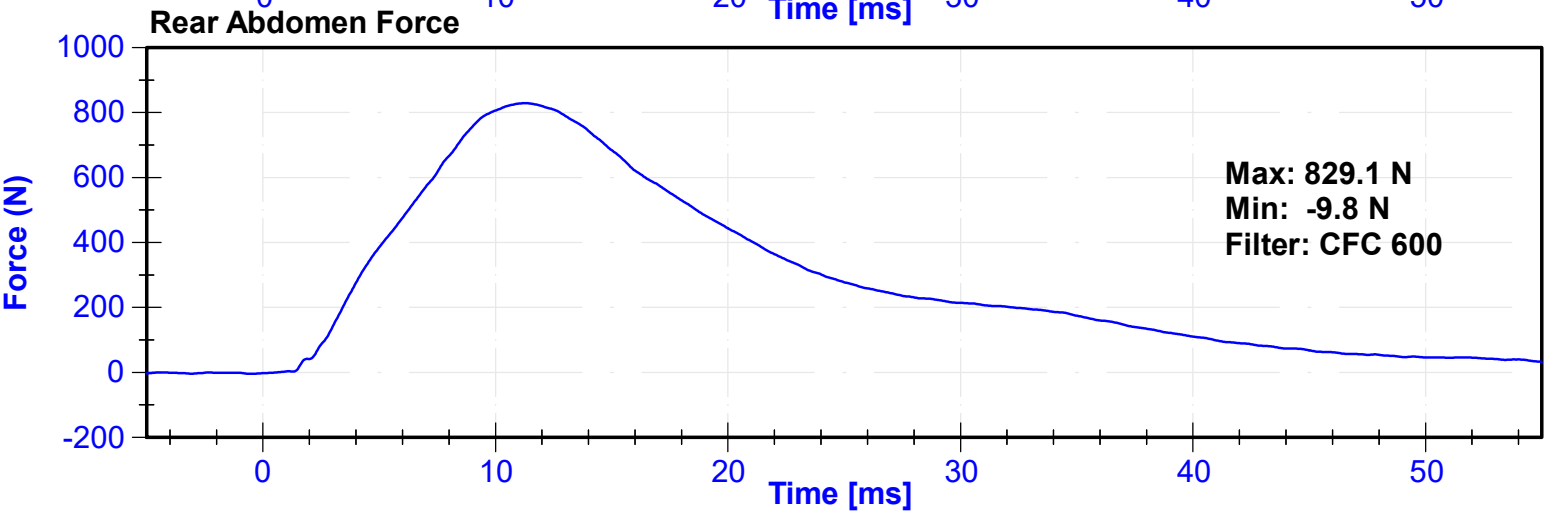
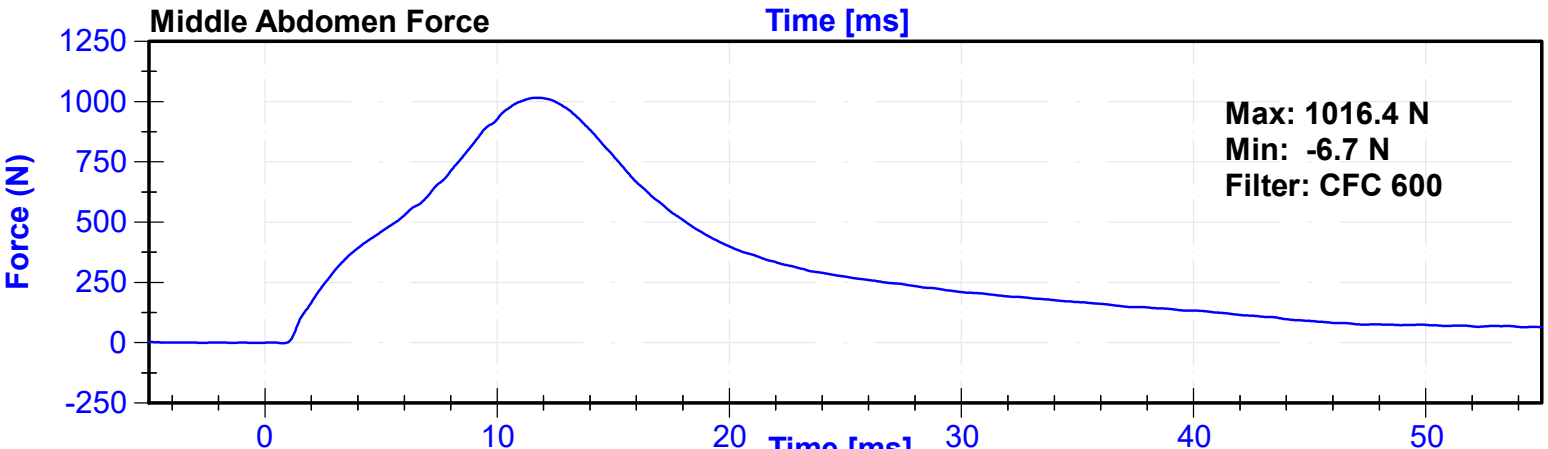
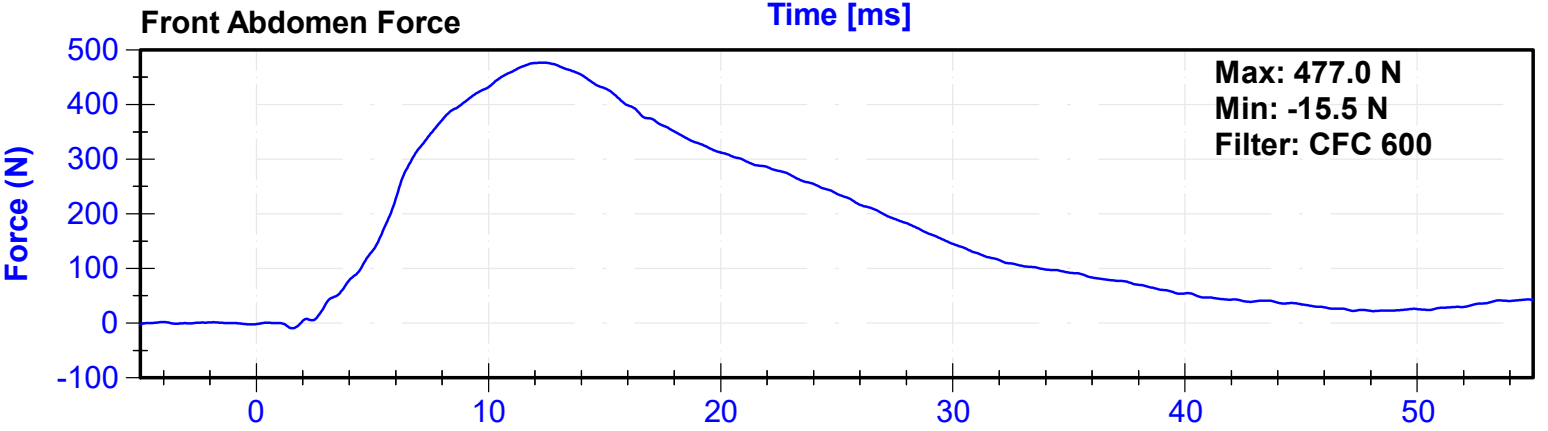
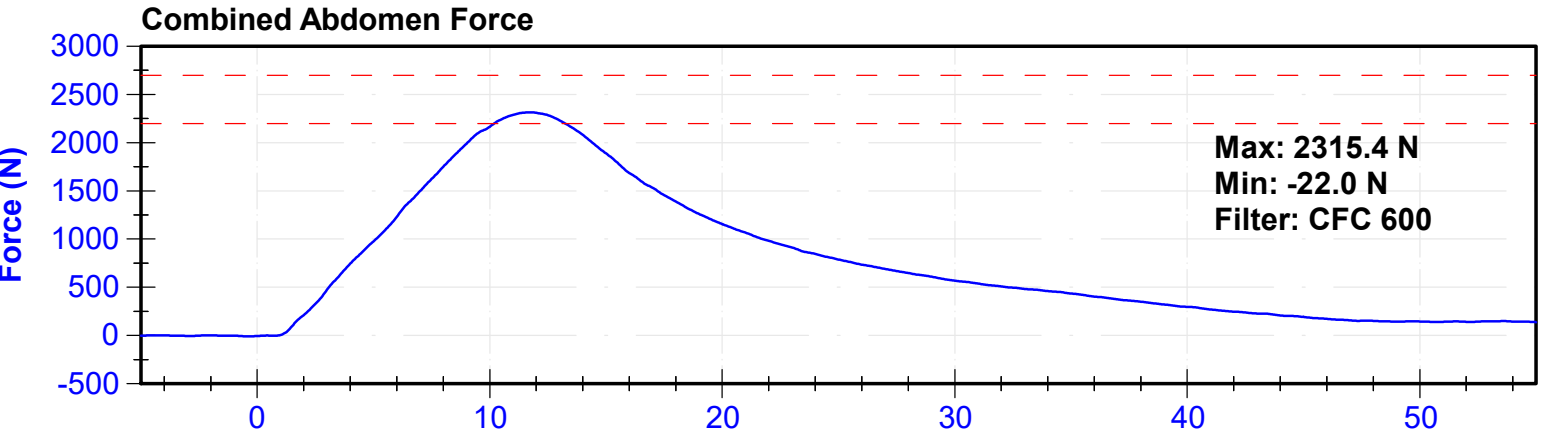
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.5	Pass
Humidity	10	70	%	18	Pass
Velocity	3.9	4.1	m/s	4.02	Pass
Combined Abdomen Force	2200	2700	N	2315.4	Pass
Time at Peak Abdomen Force	10.0	12.3	ms	11.75	Pass
Resistive Probe Force	4000	4800	N	4656.9	Pass
Time at Peak Resistive Force	10.6	13.0	ms	11.55	Pass

**Transducer Calibrations**

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

**Probe Force**





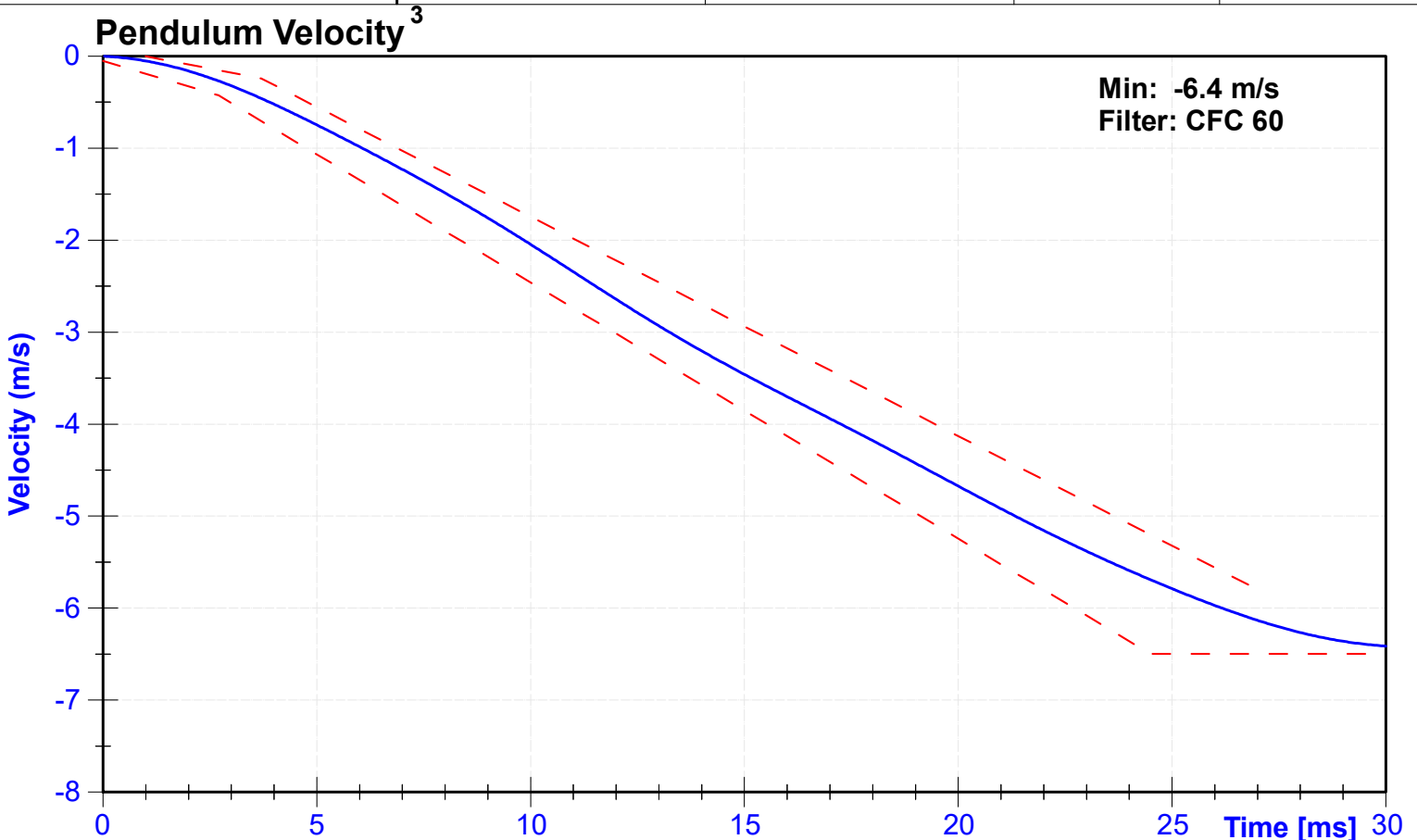
ATD Manufacturer	FTSS	Test Technician	J. Rios
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantell

**Results**

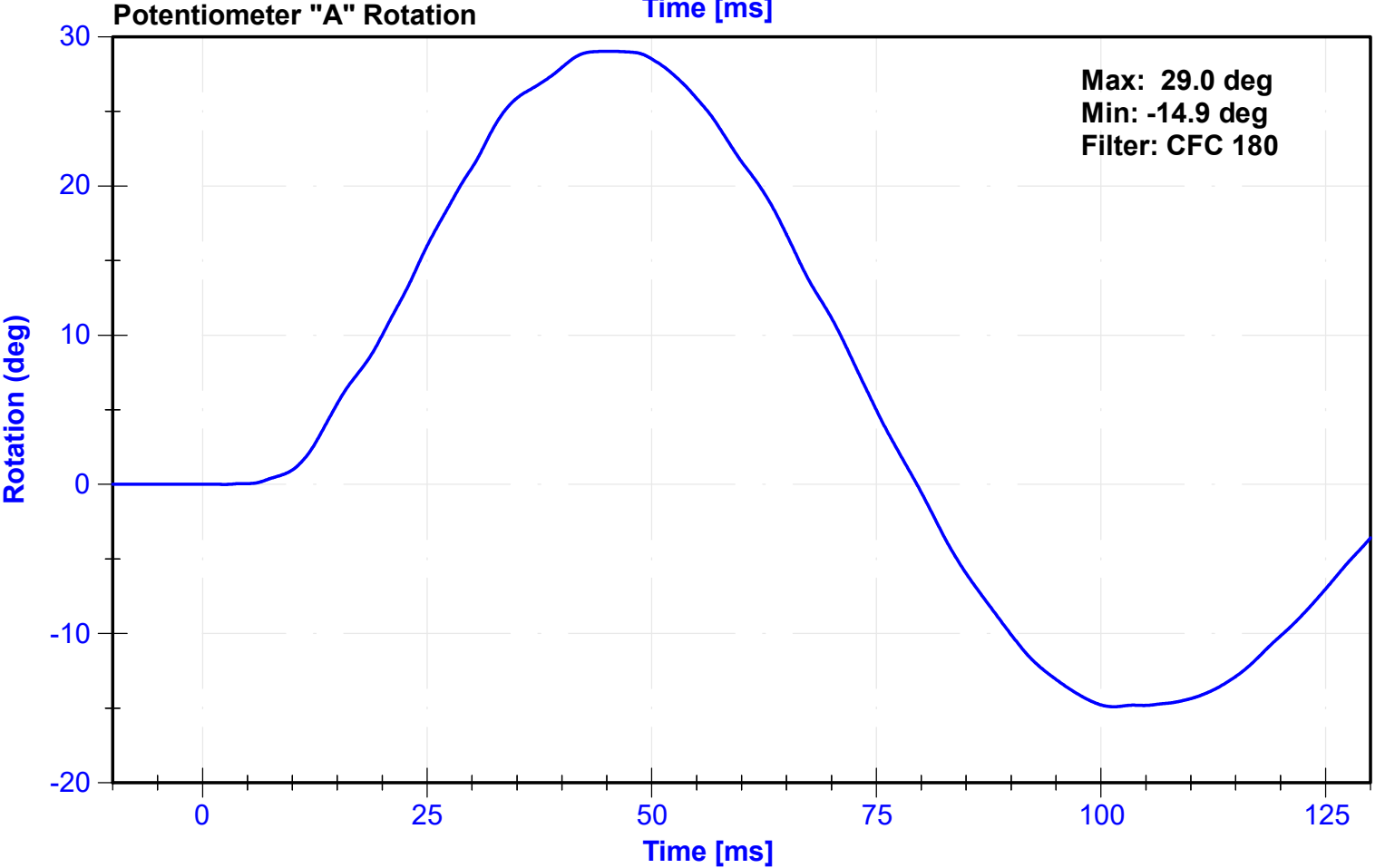
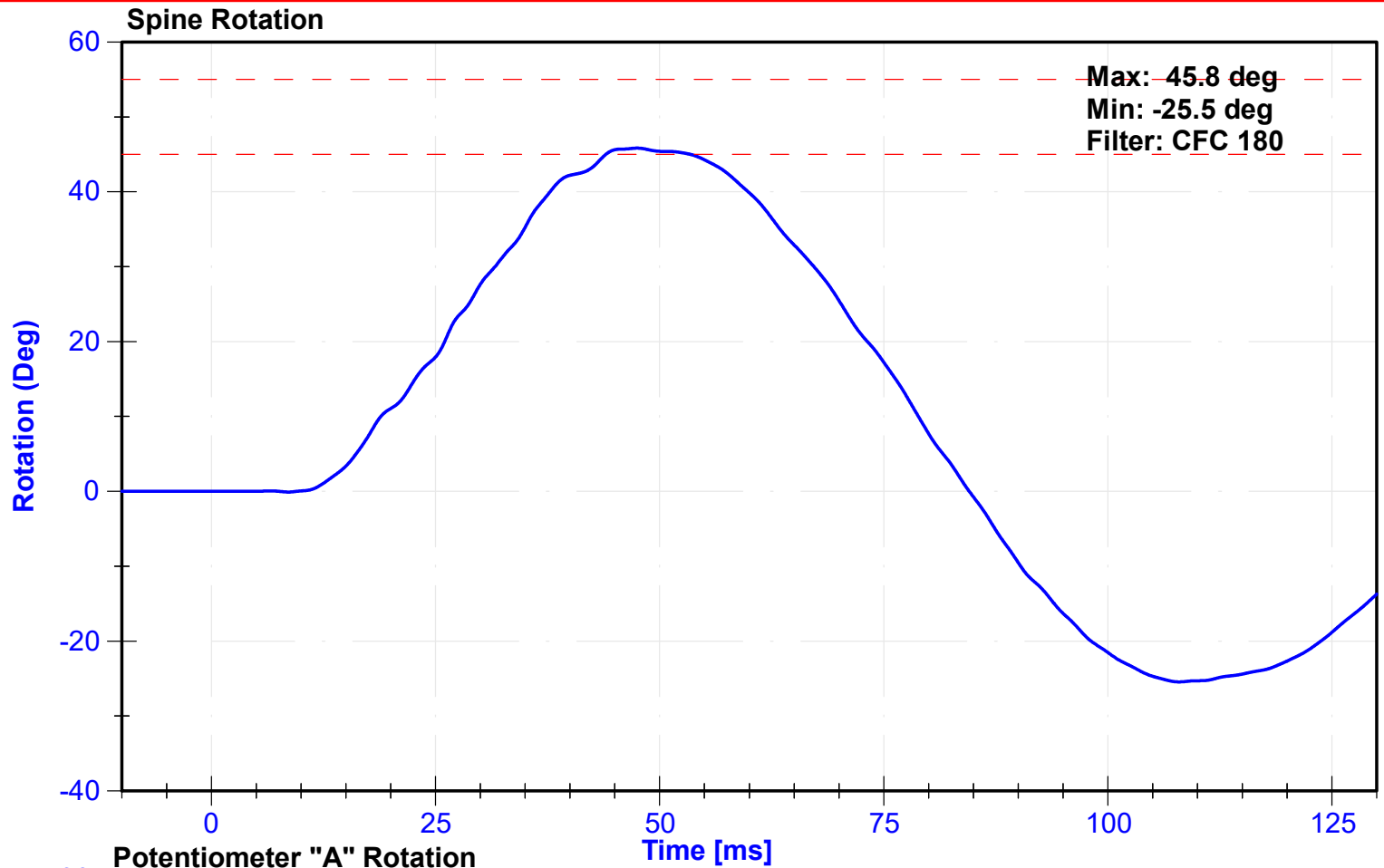
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.2	Pass
Humidity	10	70	%	37	Pass
Velocity	5.95	6.15	m/s	5.994	Pass
Lateral Spine Rotation	45	55	deg	45.8	Pass
Time at Maximum Rotation	39	53	ms	47.5	Pass
Time of Decay to Zero Degrees	37	57	ms	37.1	Pass
Pendulum Velocity Overall Corridor	Lower Boundary <sup>1</sup>	Upper Boundary <sup>2</sup>	m/s	See Plot <sup>3</sup>	Pass

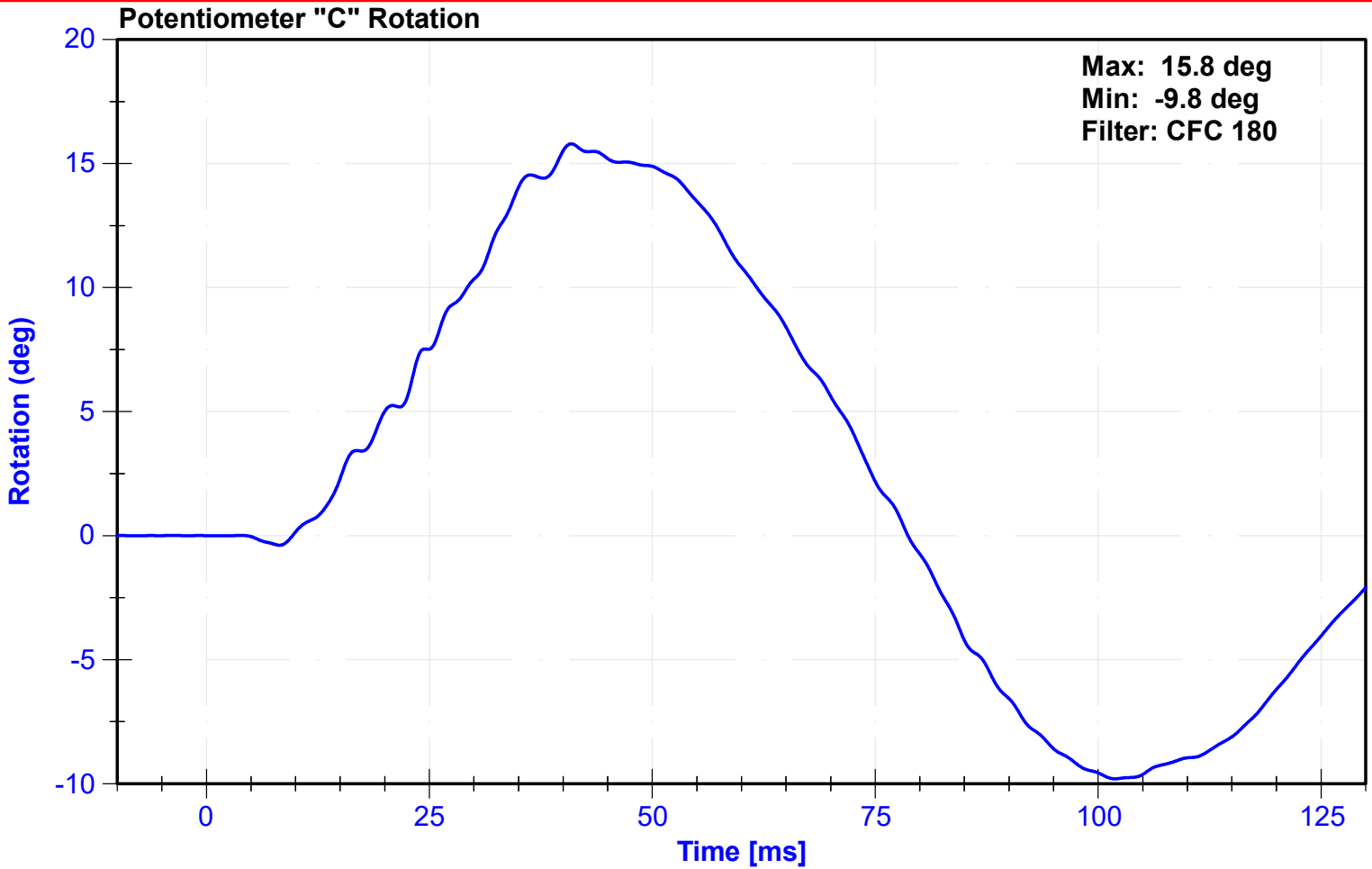
**Transducer Calibrations**

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	C16503	10/31/2023	4/28/2024
Pendulum "A" Potentiometer	Sfernice	2247	12/5/2023	12/4/2024
Condyle "B" Potentiometer	Sfernice	095	9/29/2023	9/28/2024



<sup>1,2</sup> Upper and lower boundaries specified in Appendix I IV-42





## Appendix I

<sup>2</sup> Upper Boundary Corridor		<sup>1</sup> 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

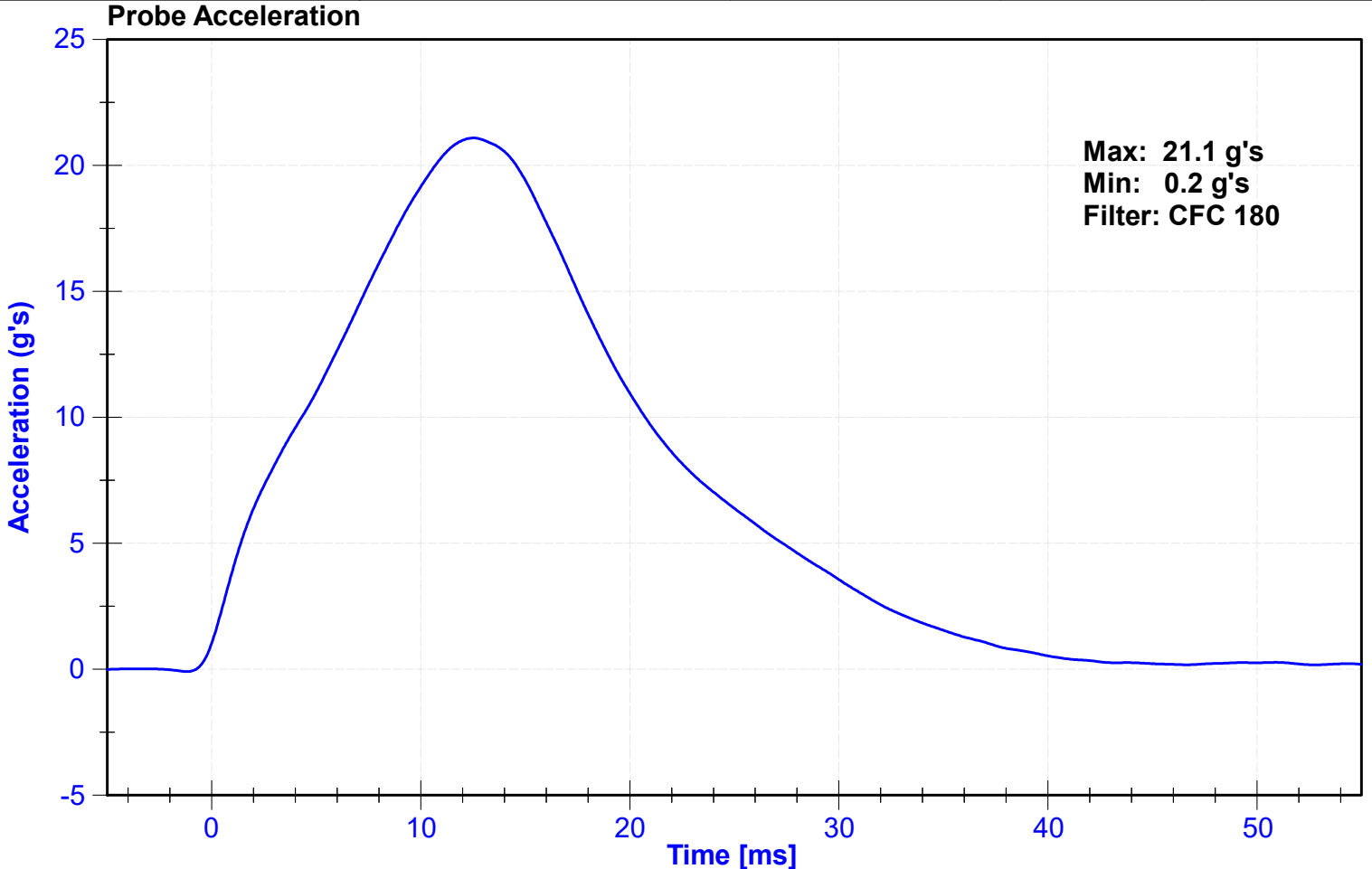
ATD Manufacturer	FTSS	Test Technician	J.Rios
ATD Serial Number	DG5348	Laboratory Supervisor	C. Mantell

**Results**

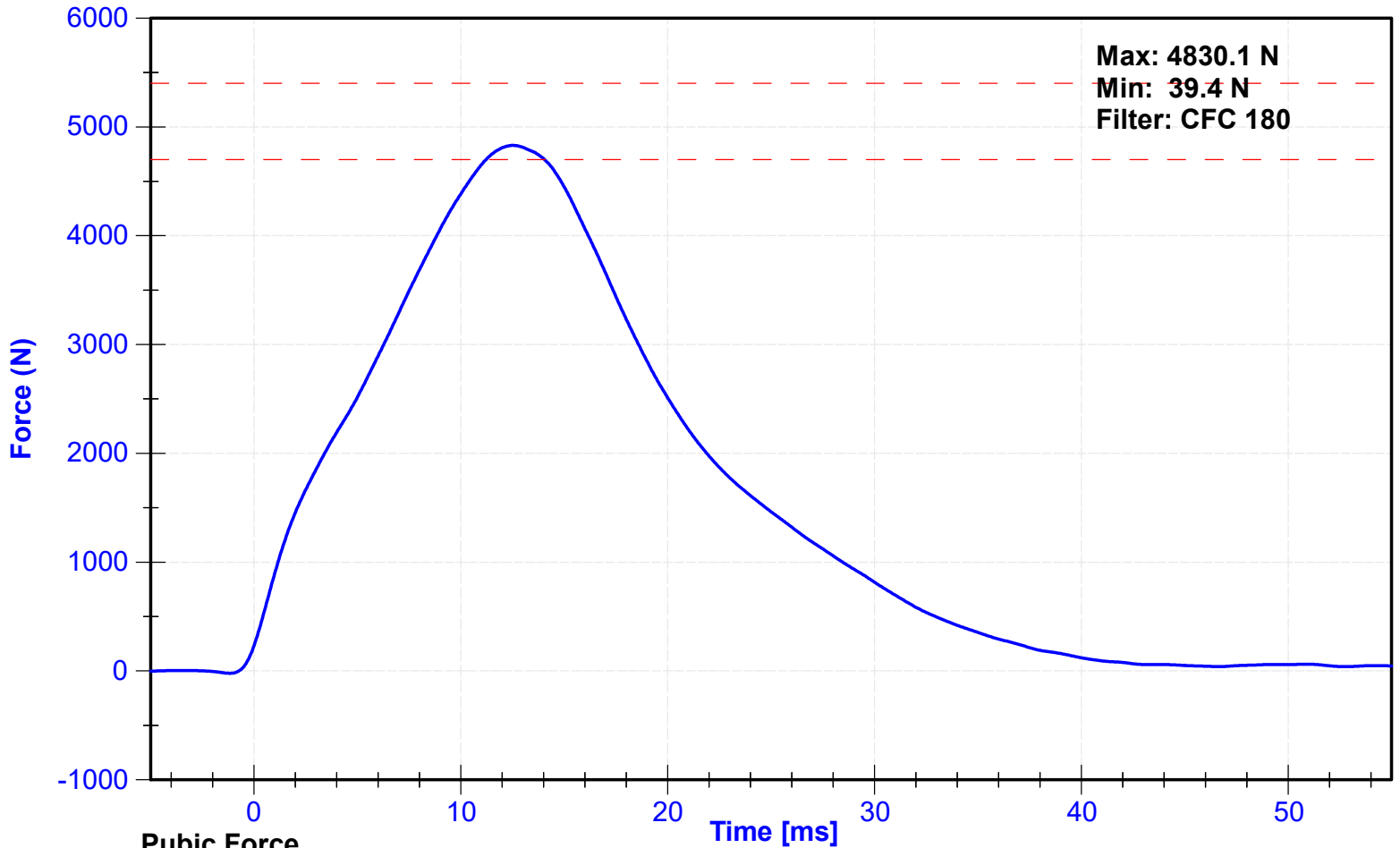
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.5	Pass
Humidity	10	70	%	18	Pass
Velocity	4.2	4.4	m/s	4.27	Pass
Resistive Force	4700	5400	N	4830.1	Pass
Time at Peak Resistive Force	11.8	16.1	ms	12.50	Pass
Pubic Force	-1590	-1230	N	-1234.5	Pass
Time at Peak Pubic Force	12.2	17.0	ms	14.55	Pass

**Transducer Calibrations**

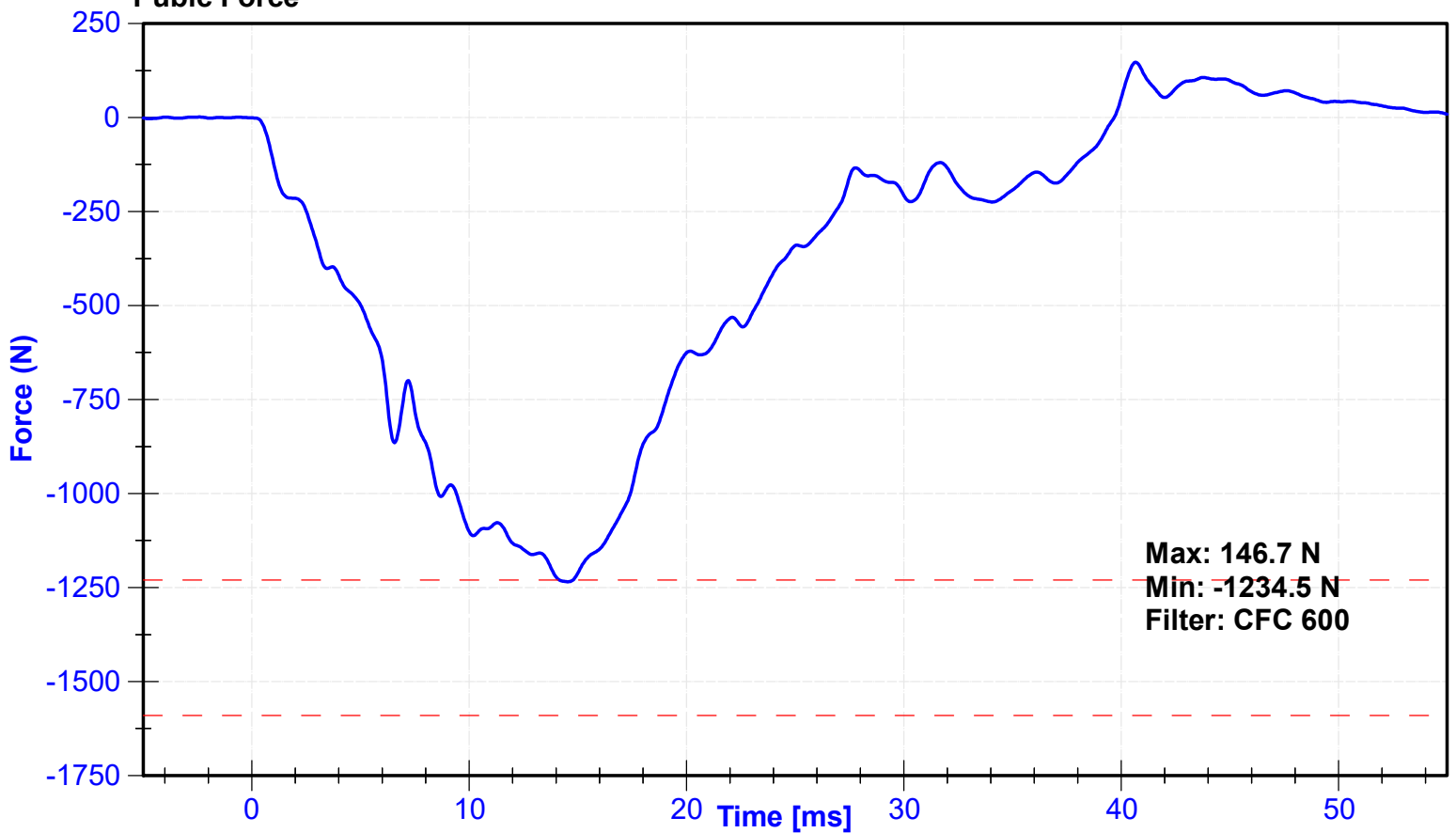
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18587	11/20/2023	11/19/2024
Pubic Load Cell	Denton	464-FY	8/15/2023	8/14/2024



### Resistive Force



### Pubic 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	02/08/2024
		Y	18472	Endevco	02/08/2024
		Z	18663	Endevco	02/08/2024
	Redundant	X	18666	Endevco	02/08/2024
		Y	18664	Endevco	02/08/2024
		Z	18675	Endevco	02/07/2024
Thorax Rib Displacement Potentiometers	Upper	Y	268GFE	Honeywell	02/08/2024
	Middle	Y	269GFE	Honeywell	02/08/2024
	Lower	Y	270GFE	Honeywell	02/08/2024
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	18524	Endevco	02/08/2024
		Y	18573	Endevco	02/07/2024
		Z	18657	Endevco	02/08/2024
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	G23636	Endevco	10/14/2023
Vehicle Center of Gravity	Y	G23639	Endevco	10/14/2023
Vehicle Center of Gravity	Z	G23640	Endevco	10/14/2023
Left Floor Sill	Y	G24976	Endevco	01/09/2024
A-Pillar Sill	Y	G24989	Endevco	01/09/2024
A-Pillar Low	Y	G24980	Endevco	01/09/2024
A-Pillar Mid	Y	G24990	Endevco	01/09/2024
B-Pillar Sill	Y	G24978	Endevco	01/09/2024
B-Pillar Low	Y	G24973	Endevco	01/09/2024
B-Pillar Mid	Y	G24971	Endevco	01/10/2024
Driver Seat	Y	G24633	Endevco	11/29/2023
Engine Top	X	G22413	Endevco	10/26/2023
Engine Top	Y	G22608	Endevco	10/26/2023
Firewall	Y	G24987	Endevco	01/09/2024
Right Roof	Y	G24977	Endevco	01/09/2024
Right Floor Sill	Y	G24960	Endevco	01/09/2024
Rear Floorpan	X	G22637	Endevco	10/31/2023
Rear Floorpan	Y	G22917	Endevco	10/31/2023