

REPORT NUMBER: 214D-CAL-24-001

**SAFETY COMPLIANCE TESTING FOR FMVSS 214
SIDE IMPACT PROTECTION**

**KIA Corporation
2024 KIA Carnival
5 Door Minivan**

NHTSA No: C20244212

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



October 10, 2023

FINAL REPORT

**PREPARED FOR:
U. S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
ENFORCEMENT
OFFICE OF VEHICLE SAFETY COMPLIANCE
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WEST Bldg. (NEF-240)
WASHINGTON, D.C. 20590**

This final test report was prepared for the U.S. Department of Transportation, National Highway Traffic Safety Administration, in response to Contract Number 693JJ923D000043.

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Date: October 10, 2023

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Date: October 10, 2023

FINAL REPORT ACCEPTANCE BY OVSC:

Accepted by James A. Jones

Date: 10/10/2023

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No. 214D-CAL-24-001		2. Government Accession No.		3. Recipient's Catalog No.																																															
4. Title and Subtitle Final Report of 214P Compliance Test Side Impact Protection Testing of 2024 KIA Carnival 5 Door Minivan NHTSA No.: C20244212				5. Report Date October 10, 2023																																															
				6. Performing Organization Code CAL																																															
7. Author(s) Nicholas Marshall, Test Engineer Quinn Porzio, Test Engineer				8. Performing Organization Report No. CAL-DOT-2024-001																																															
9. Performing Organization Name and Address Calspan Corporation Transportation Test Operations P.O. Box 400 Buffalo, New York 14225				10. Work Unit No.																																															
				11. Contract or Grant No. 693JJ923D000043																																															
12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Administration Enforcement Office of Vehicle Safety Compliance 1200 New Jersey Ave., SE Washington, D.C. 20590				13. Type of Report and Period Covered: Final Test Report September 14, 2023 - October 10, 2023																																															
				14. Sponsoring Agency Code NEF-240																																															
15. Supplementary Notes																																																			
16. Abstract A 48/24 kph 90° Impact (Moving Deformable Barrier) Compliance Tests was conducted on the subject 2024 KIA Carnival 5 Door Minivan in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP-214D-09 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 14, 2023. The impact velocity of the Moving Deformable Barrier (MDB) was 53.12 kph, and the ambient temperature at the struck (driver side) of the target vehicle at the time of impact was 21°C. The target vehicle post-test maximum crush was 204 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>62.067</td> </tr> <tr> <td>Maximum Thoracic Rib Deflection</td> <td>mm</td> <td>44</td> <td>18.425</td> </tr> <tr> <td>Total Abdominal Force</td> <td>N</td> <td>2500</td> <td>302.008</td> </tr> <tr> <td>Pubic Symphysis Force</td> <td>N</td> <td>6000</td> <td>720.080</td> </tr> </tbody> </table> <table border="1"> <thead> <tr> <th rowspan="2">Measurement Description</th> <th colspan="3">Passenger ATD (SID-IIs)</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>68.748</td> </tr> <tr> <td>Lower Spine Resultant Acceleration</td> <td>G</td> <td>82</td> <td>48.409</td> </tr> <tr> <td>Maximum Thoracic Rib Deflection</td> <td>mm</td> <td>38</td> <td>13.565</td> </tr> <tr> <td>Maximum Abdominal Rib Deflection</td> <td>mm</td> <td>45</td> <td>1.032</td> </tr> </tbody> </table>						Measurement Description	Driver ATD (ES-2re)			Units	IARV	Result	Head Injury Criteria (HIC36)		1000	62.067	Maximum Thoracic Rib Deflection	mm	44	18.425	Total Abdominal Force	N	2500	302.008	Pubic Symphysis Force	N	6000	720.080	Measurement Description	Passenger ATD (SID-IIs)			Units	IARV	Result	Head Injury Criteria (HIC36)		1000	68.748	Lower Spine Resultant Acceleration	G	82	48.409	Maximum Thoracic Rib Deflection	mm	38	13.565	Maximum Abdominal Rib Deflection	mm	45	1.032
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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.																																																			
17. Key Words Compliance Testing Side Impact Protection MDB ES-2re SID-IIs				18. Distribution Statement <u>Copies of this report are available from:</u> 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																																															
19. Security Class. (of this report) UNCLASSIFIED		20. Security Class. (of this page) UNCLASSIFIED		21. No. of Pages 175	22. Price																																														

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SECTION 1

PURPOSE AND SUMMARY OF TEST

PURPOSE

This moving deformable barrier side impact test was conducted as part of the MY 2024 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 KIA Carnival 5 Door Minivan. The side impact test was conducted in accordance with the Office of Vehicle Safety Compliance's Laboratory Test Procedure, TP-214D-09 dated September 2012.

SUMMARY

A 2024 KIA Carnival 5 Door Minivan was impacted on the left side by a Moving Deformable Barrier (MDB) which was moving forward in a 27° crabbed position to the tow road guidance system at a velocity of 53.12 kph. The target vehicle was stationary and was positioned at an angle of 63° to the line of forward motion. The side impact test was conducted by the Calspan Corporation's Transportation Test Operations Center in Buffalo, New York on September 14, 2023. Pre-test and post-test photographs of the test vehicle, the MDB and the dummies are included in this report.

Test dummies were placed in the driver and left rear designated seating positions according to instructions specified in the OVSC Test Procedure, dated September 2012. The side impact event was documented by 9 cameras. Camera locations and other pertinent camera information are included in this report.

The ES2re male dummy was instrumented with triaxial accelerometer packs located in the head, three rib displacement transducers located in the chest, three load cells located in the abdomen and a load cell located in the pubic symphysis.

The SID-1Is female dummy was instrumented with triaxial accelerometer packs located in the head and the spine and load cells located in the pubic symphysis and acetabulum. A summary of each dummy's configuration and performance verification test data has been included in this report along with the dummy response traces.

Injury readings for the dummies were recorded as follows:

INJURY READINGS

ES-2re Injury Criteria	Units	Max. Allowable IARV	Measured Value	Pass/Fail
Head Injury Criteria (HIC36)		1000	62.067	Pass
Upper Rib Deflection	mm	44	8.153	Pass
Mid Rib Deflection	mm	44	11.468	Pass
Lower Rib Deflection	mm	44	18.425	Pass
Abdominal Load (front)	N		114.425	
Abdominal Load (mid)	N		147.118	
Abdominal Load (rear)	N		118.359	
Total Abdominal Force	N	2500	302.008	Pass
Pubic Symphysis Force	N	6000	720.080	Pass

INJURY READINGS

SIDIIIs Injury Criteria	Units	Max. Allowable IARV	Measured Value	Pass/Fail
Head Injury Criteria (HIC36)		1000	68.748	Pass
Lower Spine Resultant Acceleration	G	82	48.409	Pass
Acetabulum Force	N		2696.535	
Iliac Force	N		246.022	
Sum of Acetabular and Iliac	N	5525	2722.908	Pass

SECTION 2

OCCUPANT AND VEHICLE INFORMATION

This section contains information reporting for the following Data Sheets:

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DATA SHEET NO. 1
TEST VEHICLE INFORMATION AND OPTIONS

Test Vehicle: 2024 KIA Carnival 5 Door Minivan

NHTSA No.: C20244212

Test Facility: Calspan

Test Date: 09/14/2023

TEST VEHICLE INFORMATION AND OPTIONS

Make	KIA
Model	Carnival
Body Style	Minivan
VIN	KNDNB4H30R6337185
Body Color	Blue
Engine Displacement (L)	3.5
Type / No. Cylinders	V6
Engine Placement	Transverse
Transmission Type	Automatic
Transmission Speeds	8-Speed
Overdrive	Yes
Final Drive	Front Wheel Drive
Odometer Reading	45 miles

Anti-Lock Brakes (ABS)	Yes
All-Wheel Drive (AWD)	No
Traction Control System (TCS)	Yes
Electric Stability Control (ECS)	Yes
Curtain Airbags	Yes
Torso Airbags – Front Seats	Yes
Torso Airbags – Rear Seats	No
Combination/Head Torso Bag	No
Pelvic Airbag – Front Seats	No
Pelvic Airbag – Rear Seats	No
Knee Airbag – Driver	Yes
Knee Airbag – Front Passenger	No
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	No

DATA FROM CERTIFICATION LABEL

Manufactured By	KIA Corporation
Date of Manufacture	05/23
Vehicle Type	MPV

GVWR (kg)	2590
GVWR Front (kg)	1390
GVWR Rear (kg)	1480

VEHICLE SEATING AND WEIGHT CAPACITY DATA

Measured Parameter	Front	Rear	Third	Total
Type of Seats (Bench or Bucket)	Bucket	Bucket	Bench	
Designated Seating Capacity (DSC)	2	2	3	7
Capacity Weight (VCW) (kg)				525

DATA SHEET NO. 1 ... (CONTINUED)

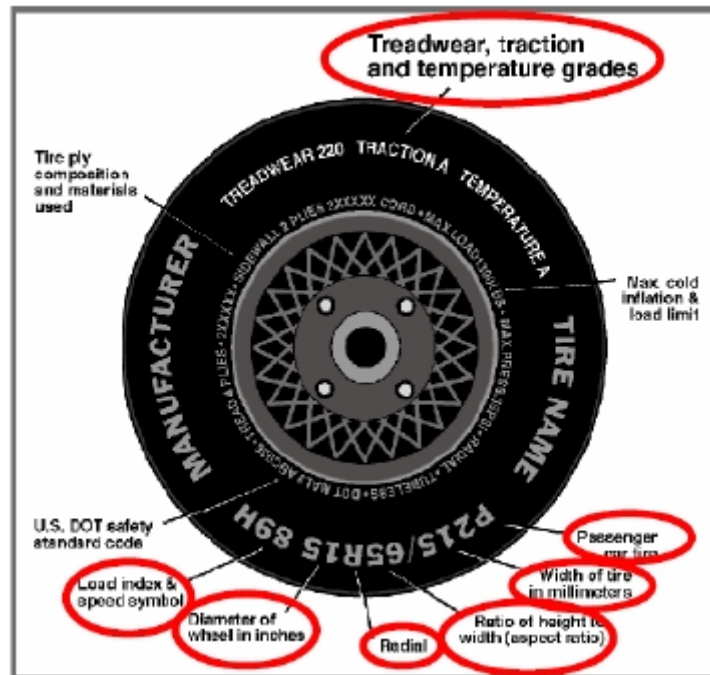
VEHICLE TIRE INFORMATION

Test Vehicle:	2024 KIA Carnival 5 Door Minivan
Test Facility:	Calspan

NHTSA No.: C20244212
Test Date: 09/14/2023

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)	255	255
Recommended Tire Size	235/65R17	235/65R17
Tire Sidewall	Front	Rear
Maximum Tire Pressure (kPa)	350	350
Tire Size on Vehicle	235/65R17	235/65R17
Tire Manufacturer Model	Nexen	Nexen
Tire Name	Roadian GTX	Roadian GTX
Tire Type	All Season	All Season
Tire Width	235	235
Aspect Ratio	65	65
Radial	Yes	Yes
Wheel Diameter	17	17
Load Index / Speed Symbol	104H	104H
Treadwear	600	600
Traction Grade	A	A
Temperature Grades	A	A

DATA SHEET NO. 2
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2024 KIA Carnival 5 Door Minivan

NHTSA No.: C20244212

Test Facility: Calspan

Test Date: 09/14/2023

TIRE PRESSURES

	Units	LF	RF	LR	RR
As Delivered	kPa	212	213	211	214
Tire Placard	kPa	255	255	255	255

TEST VEHICLE AXLE WEIGHTS

	Units	As Delivered (UVW)			Fully Loaded			As Tested		
		Front	Rear	Total	Front	Rear	Total	Front	Rear	Total
Left	kg	593	431		639	513		642	495	
Right	kg	564	441		570	486		574	489	
Ratio	%	57.0	43.0		54.7	45.3		55.3	44.7	
Totals	kg	1157	872	2029	1209	999	2208	1216	984	2200

TARGET TEST WEIGHT (TVTW) CALCULATION

Measured Parameter	Units	Value	
As Delivered Weight (UVW)	kg	2029	(A)
Weight of 2 P572 ATDs	kg	131	(B)
Rated Cargo / Luggage Weight (RCLW)	kg	48.72	(C)
Calculated Vehicle Target Weight (TVTW)	kg	2208.72	(A+B+C)

TEST VEHICLE ATTITUDES AND CG

Wheel Opening Location	Distance (grd to ref. point above wheel opening in mm)		Difference (mm)	Meets Requirement***
	Fully Loaded	As Tested		
Left Front	776	781	5	Yes
Right Front	783	782	1	Yes
Left Rear	783	786	3	Yes
Right Rear	793	790	3	Yes

***The "As Tested" vehicle attitude measurements must be equal to or within ± 10 mm of the "Fully Loaded" vehicle attitude measurements at each wheel well. Indicate "Yes" or "No" for "Meets Requirements".

MDB IMPACT POINT DATA

Measured Parameter	Distance (mm)	Met Requirement
Test Vehicle Wheelbase	3089	
Target Vertical Impact Reference Line Aft of Front Axle	508	Yes
Actual Impact Point Location (fore-aft, above - below)	+1 / -13	Yes

Note: Fore or above the target impact point is positive (+). Aft or below the target impact point is negative (-)

WEIGHT OF BALLAST AND VEHICLE COMPONENTS REMOVED TO MEET TVTW

Component Description	Weight (kg)
Trunk Carpeting	2
Jack	4
Rear Trim	11
Right Rear Glass	4
Ballast (if any)	5

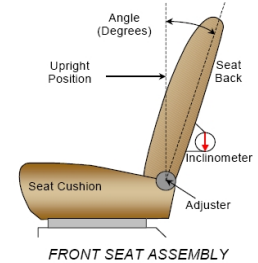
DATA SHEET NO. 3
SEAT AND SEAT BELT ANCHORAGE ADJUSTMENT DATA

Test Vehicle: 2024 KIA Carnival 5 Door Minivan
Test Facility: Calspan

NHTSA No.: C20244212
Test Date: 09/14/2023

SEAT BACK ANGLE ADJUSTMENT

The driver's seat back is positioned to the manufacturer's designated design angle. The front center and front passenger's seat backs are positioned in a similar manner as the driver's seat back. The struck side rear seat back is positioned such that the dummy's head is level. The rear center and non-struck side rear outboard seat backs are positioned in a similar manner as the struck-side rear seat back.



Seat	Total Seat Back Angle Range		Test Position from Most Upright	
	Degrees	Detents*	Degrees	Detents*
Driver Seat	63.8	33 (0-32)	4.9	12
Front Passenger Seat	63.8	33 (0-32)	4.9	12

SEAT POSITIONING

The driver's seat, front center seat (if applicable), and right front passenger's seat should be set to the mid-track, lowest, mid-angle position. The struck-side rear passenger's seat, rear center seat, and non-struck side rear passengers' seats should be set to the rear-most, lowest, mid-angle position

Seat	As Tested SCRL Angle (Mid) (°)	As Tested SCRP Height (mm)	SCRP Height Position	SCRP Height (mm)		
				Rearmost	Mid-Fore / Aft	Forward-Most
Driver Seat	12.8	18	Max	-	-	-
			Mid	-	-	-
			Min	12	18	23
Front Passenger Seat	Fixed	Fixed	Max			
			Mid			
			Min			

SEAT FORE / AFT POSITION

Seat	Total Fore / Aft Travel		Test Position from Forward most Position	
	mm	Detents*	mm	Detents*
Driver Seat	220	56 (0-55)	110	28
Front Passenger Seat	240	60 (0-59)	120	30

SEAT BELT ANCHORAGE ADJUSTMENT

Seat	Total # of Positions	Placed in Position #
Driver Seat	3 (0-2)	0 - Uppermost
Rear Seat	Fixed	Fixed

HEAD RESTRAINT ADJUSTMENT

Seat	Total # of Positions	Placed in Position #
Driver Seat	5 (0-4)	Uppermost
Rear Seat	4 (0-3)	Lowermost

DATA SHEET NO. 4
FUEL SYSTEMS AND STEERING WHEEL POSITION DATA

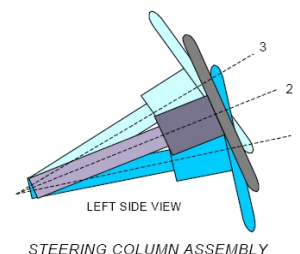
Test Vehicle: 2024 KIA Carnival 5 Door Minivan
 Test Facility: Calspan

NHTSA No.: C20244212
 Test Date: 09/14/2023

STEERING COLUMN ADJUSTMENT

Steering wheel and column adjustments are made so that the steering wheel hub is at the center of its geometric locus it describes when it moves through its full range of motion.

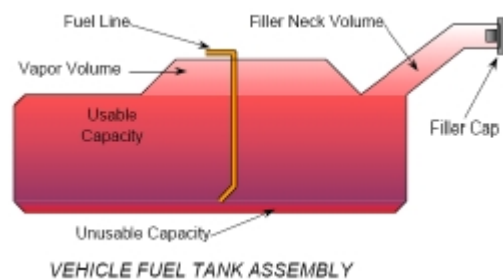
	Degrees	Fore / Aft Position (mm)
Lowermost - Position No. 1	23.8	
Geometric center - Position No. 2	26.3	
Uppermost - Position No. 3	28.8	
Telescoping Steering Wheel Travel		54
Test Position	26.4	27



FUEL PUMP

Describe the fuel pump type, details about how it operates, and the location of the fuel filler neck

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



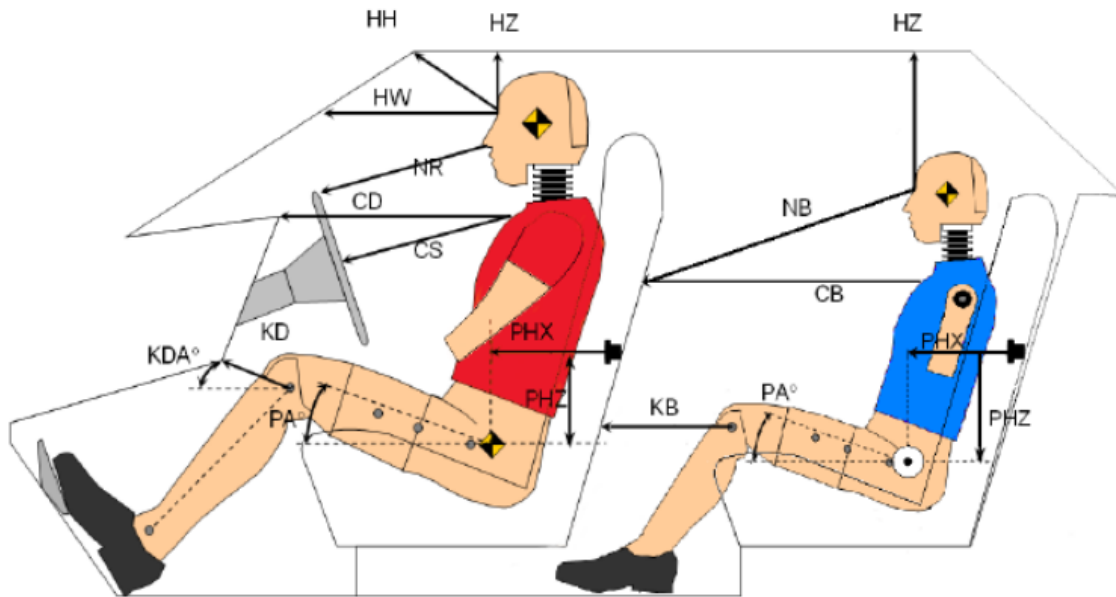
FUEL TANK CAPACITY

Description	Liters
Usable Capacity of - Form No.1	72
Usable Capacity of - Owner's Manual	72
92 - 94% of Usable Capacity	66.24 - 67.68
Actual Amount of Solvent Used in Test	66.88

DATA SHEET NO. 5
DUMMY LONGITUDINAL CLEARANCE DIMENSIONS

Test Vehicle: 2024 KIA Carnival 5 Door Minivan
 Test Facility: Calspan

NHTSA No.: C20244212
 Test Date: 09/14/2023



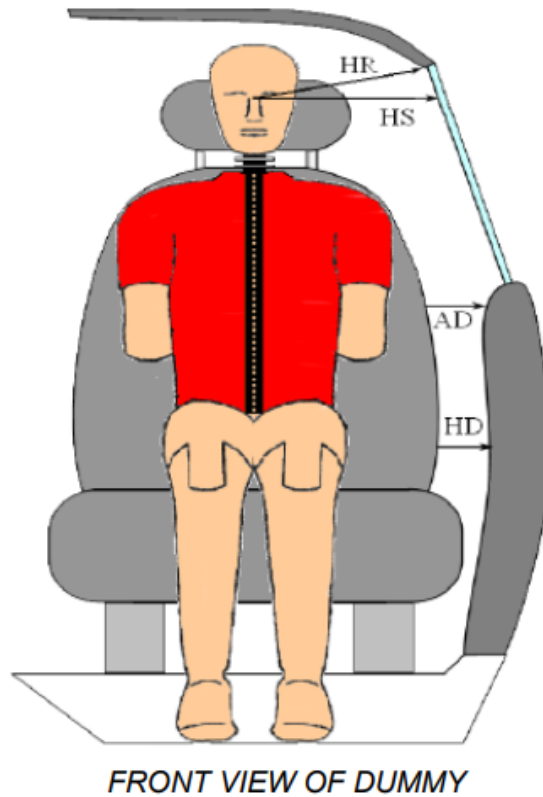
DUMMY LONGITUDINAL CLEARANCE DIMENSION INFORMATION

Code	Pass. Code	Description	ES2-re		SID-IIs	
			Length (mm)	Angle	Length (mm)	Angle
HH		Head to Header	504			
HW		Head to Windshield	733			
HZ	HZ	Head to Roof Liner	226		310	
NR	NB	Nose to Rim	499		588	
CD	CB	Chest to Dash	649		603	
CS		Chest to Steering Wheel	423			
KD(L) / KDA(L)°	KB(L) / KBA(L)°	Left Knee to Dash	225	22.3	344	18.0
KD(R) / KDA(R)°	KB(R) / KBA(R)°	Right Knee to Dash	192	13.5	343	14.8
PA°	PA°	Pelvic Tilt Angle (X-Axis)		23.4		19.6
PHX	PHX	Hip Point to Striker (X-Axis)	180		653	
PHZ	PHZ	Hip Point to Striker (Z-Axis)	228		88	

DATA SHEET NO. 6
DUMMY LATERAL CLEARANCE DIMENSIONS

Test Vehicle: 2024 KIA Carnival 5 Door Minivan
 Test Facility: Calspan

NHTSA No.: C20244212
 Test Date: 09/14/2023



FRONT VIEW OF DUMMY

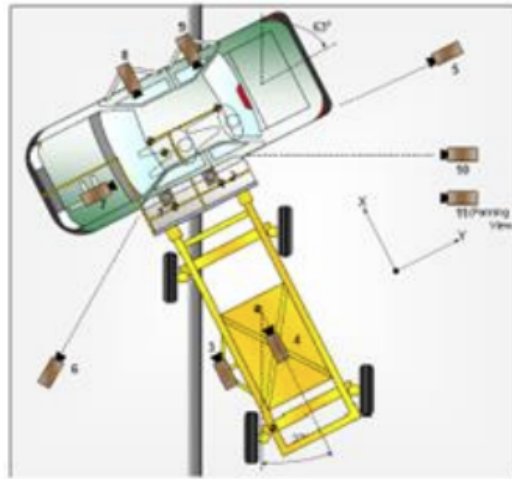
DUMMY LATERAL CLEARANCE DIMENSION INFORMATION

Code	Measurement Description	Units	Front Occupant	Rear Occupant
HR	Head to Side Header	mm	207	254
HS	Head to Side Window	mm	339	348
AD	Arm to Door	mm	125	154
HD	Hip Point to Door	mm	166	246

DATA SHEET NO. 7 **LOCATION OF CAMERAS**

Test Vehicle: 2024 KIA Carnival 5 Door Minivan
 Test Facility: Calspan

NHTSA No.: C20244212
 Test Date: 09/14/2023



CAMERA LOCATIONS AND DATA

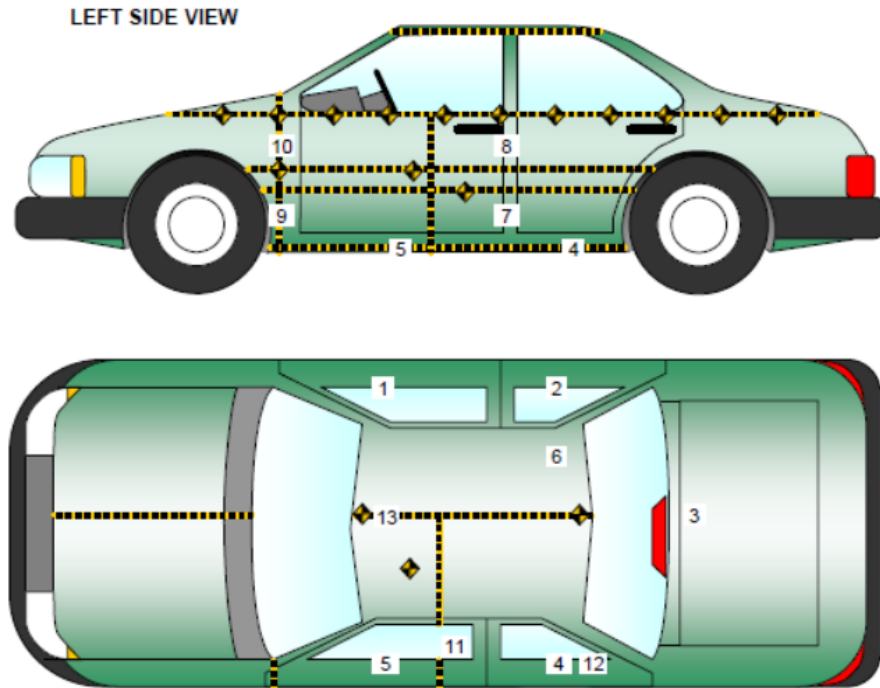
No.	Camera View	Location (mm)			Lens Length (mm)	Operating Frame Rate (fps)
		X	Y	Z		
1	Overhead Overall	410	0	-9220	12.5	60
2	Overhead Close-up	0	0	-9220	28	1000
3	Impact Point Close-up				25	1000
4	Centerline of Impact (MDB)				8	1000
5	Right Side View	376	9714	-1586	28	1000
6	Left Side View	-3867	-4922	-1552	24	1000
7	Front Seat Occupant-Frontal View (OB)				25	1000
8	Front Seat Occupant-Side View (OB)				12.5	1000
9	Rear Passenger-Side View (OB)				12.5	1000
10	Real-time Coverage				Zoom	30

Notes: *Reference: Impact Point projected to Ground*
 +X = To Front of MDB, +Y = To Right of MDB, +Z = Down

DATA SHEET NO. 8
TEST VEHICLE ACCELEROMETER LOCATIONS

Test Vehicle: 2024 KIA Carnival 5 Door Minivan
 Test Facility: Calspan

NHTSA No.: C20244212
 Test Date: 09/14/2023



TEST VEHICLE ACCELEROMETER LOCATIONS

No.	Accelerometer Location	Coordinates (mm)		
		X	Y	Z
1	Left (or Rt.) Sill at Front Seat	2810	12	-171
2	Left (or Rt.) Sill at Rear Seat	3211	748	48
3	Rear Floorpan Above Axle	2060	743	-13
4	Left (or Rt.) Sill at Front Door	3236	-751	53
5	Left (or Rt.) Sill at Rear Door	2083	-745	-9
6	Left (or Rt.) Rear Occ. Compartment	3722	-715	-183
7	Left (or Rt.) B-Post Lower	3683	-733	-694
8	Left (or Rt.) B-Post Middle	2669	-759	-282
9	Left (or Rt.) A-Post Lower	2639	-748	-650
10	Left (or Rt.) A-Post Middle	2874	-644	-8
11	Front Seat Track	1997	-663	-53
12	Rear Seat Track or Structure	2372	453	35
13	Vehicle CG	4289	149	-465

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

DATA SHEET NO. 9
TEST VEHICLE ACCELEROMETER DATA SUMMARY

Test Vehicle: 2024 Kia Carnival 5 Door Minivan
Test Facility: Calspan

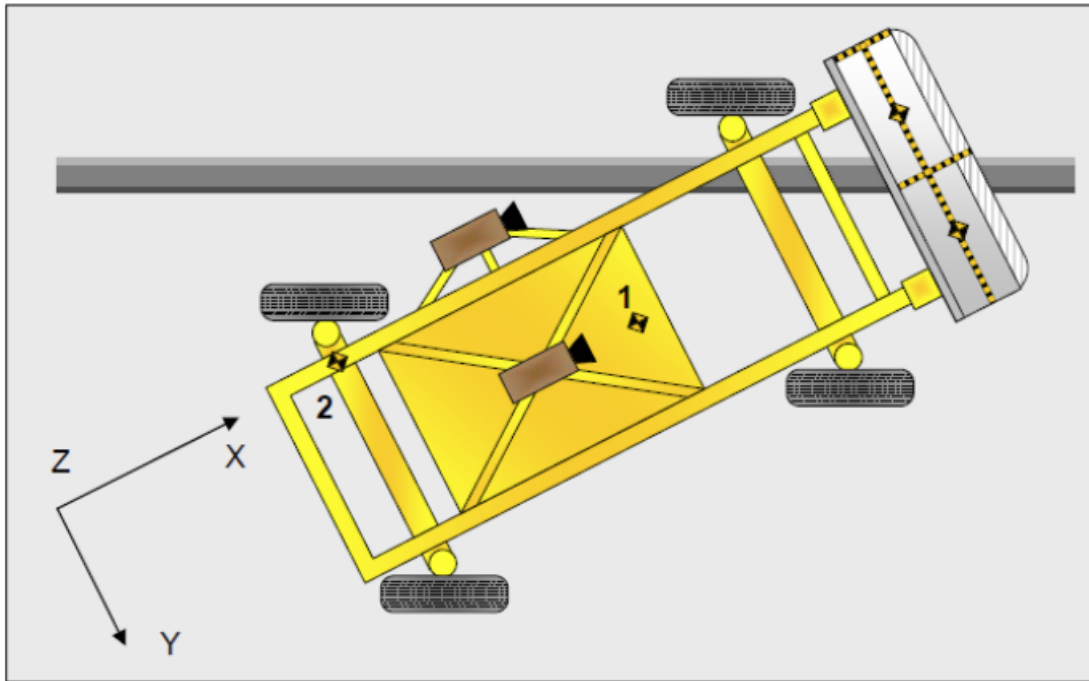
NHTSA No.: C20244212
Test Date: 09/14/2023

Loc. No	Description	Axes	Units	Peak Values (g's)			
				Max	Time (ms)	Min	Time (ms)
1	Right Sill at Front Seat	X	g	2.12	57.50	-5.15	15.65
	Right Sill at Front Seat	Y	g	21.55	8.50	-2.70	118.15
	Right Sill at Front Seat	Z	g	4.41	72.10	-11.58	10.95
	Right Sill at Front Seat Resultant	N/A	g	23.42	9.35	0.01	-9.70
2	Right Sill at Rear Seat	X	g	2.52	50.10	-5.39	19.40
	Right Sill at Rear Seat	Y	g	26.33	8.80	-3.26	117.55
	Right Sill at Rear Seat	Z	g	6.32	55.45	-11.19	24.30
	Right Sill at Rear Seat Resultant	N/A	g	26.62	8.80	0.01	-24.30
3	Rear Floor Pan Above Axle	X	g	3.71	42.00	-4.87	32.80
	Rear Floor Pan Above Axle	Y	g	20.01	7.90	-2.37	115.85
	Rear Floor Pan Above Axle	Z	g	6.89	37.45	-3.98	21.65
	Rear Floor Pan Above Axle Resultant	N/A	g	20.05	7.90	0.01	-34.25
4	Left Sill at Rear Door	Y	g	163.78	5.50	-87.45	25.35
5	Left Sill at Front Door	Y	g	45.16	6.40	-14.40	9.65
6	Right Rear Occ. Compartment	Y	g	22.06	7.25	-2.63	144.90
7	Left B-Post Lower	Y	g	114.93	5.50	-94.06	10.60
8	Left B-Post Middle	Y	g	88.44	5.10	-55.12	10.50
9	Left A-Post Lower	Y	g	49.67	70.15	-47.88	75.00
10	Left A-Post Middle	Y	g	44.54	26.45	-46.68	30.50
11	Front Seat Track	Y	g	30.70	23.90	-27.07	39.70
12	Rear Seat Track or Structure	Y	g	46.52	30.70	-6.31	35.75
13	Vehicle CG	X	g	4.32	56.10	-10.25	34.05
	Vehicle CG	Y	g	17.58	35.25	-4.07	78.75
	Vehicle CG	Z	g	10.81	18.05	-5.74	8.90
	Vehicle CG Resultant	N/A	g	20.56	34.85	0.01	-32.95

DATA SHEET NO. 10
MDB ACCELEROMETER LOCATIONS DATA SUMMARY

Test Vehicle: 2024 KIA Carnival 5 Door Minivan
 Test Facility: Calspan

NHTSA No.: C20244212
 Test Date: 09/14/2023



MDB ACCELEROMETER LOCATIONS

Loc No.	Description	Axes	Units	Peak Values (g's)			
				Max	Time (ms)	Min	Time (ms)
1	MDB CG	X	g	0.64	137.85	-18.66	31.35
		Y	g	0.77	80.30	-8.23	33.60
		Z	g	18.43	62.25	-15.35	80.60
		Resultant		24.57	33.15	24.57	205.55
2	MDB Rear	Y	g	1.27	103.90	-22.92	35.65
		Z	g	5.51	29.65	-3.38	59.10

DATA SHEET NO. 11
MDB SUMMARY OF RESULTS

Test Vehicle: 2024 KIA Carnival 5 Door Minivan
Test Facility: Calspan

NHTSA No.: C20244212
Test Date: 09/14/2023

MDB SPECIFICATIONS

Measurement Description	Requirement	Value
Overall Width of Framework Carriage	1241- 1261	1250
Overall Length Including Honeycomb Frame	4140 - 3990	4120
Wheelbase of Framework Carriage	2566 -2616	2600
CG Location of Front Axle		1120
MDB Front Axle Weight		764
MDB Rear Axle Weight		594
MDB Total Weight	1356.5 - 1365.5	1358

SPEED AND ANGLE AT IMPACT DATA

Measured Parameter	Units	Requirement	Value
Trap No. 1 Velocity (Primary)	km/h	52.1 - 53.7	53.12
Trap No. 2 Velocity (Redundant)	km/h	52.1 - 53.7	53.13
MDB CL to Target Vehicle CL	degrees	88.5 to 91.5	90.0

MAXIMUM STATIC CRUSH OF HONEYCOMB IMPACT FACE

Vertical Location			From Centerline		Maximum Crush (mm)
Row	Description	Height (mm)	Distance (mm)	Direction	
A	Center of Bumper	432	200	Right	192
B	Top of Bumper	533	300	Right	99
C	Mid-Level	686	200	Right	39
D	Top of Stack	813	800	Left	60

IMPACT POINT LOCATION DATA

Measured Parameter	Units	Tolerance	Value
Horizontal Offset (+ forward / - rearward)	mm	+/- 50	+1
Vertical Offset (- down / + up)	mm	+/- 20	-13

DATA SHEET NO. 12
DUMMY INJURY RESPONSE DATA
(Subpart U, ES-2re)

Test Vehicle: 2024 Kia Carnival 5 Door Minivan
Test Facility: Calspan

NHTSA No.: C20244212
Test Date: 09/14/2023

Dummy Serial No. D037

Description	Axes	Positive Direction		Negative Direction	
		MAX	TIME (ms)	MAX	TIME (ms)
HEAD ACCELERATION (g)					
Longitudinal	X	5.41	20.15	-12.39	26.25
Lateral	Y	34.14	27.60	-11.41	61.95
Vertical	Z	13.46	41.05	-6.60	68.55
Resultant	N/A	35.71	27.60		
HIC36 (t1, t2)	N/A	62.07		t1 = 19.40	t2 = 41.75
THORAX DEFLECTION (mm)					
Upper Rib	Y	8.15	47.80	-4.92	20.85
Middle Rib	Y	11.47	46.40	-2.12	20.90
Lower Rib	Y	18.43	47.70	0.00	9.55
ABDOMINAL FORCES (N)					
Front	Y	114.43	50.35	-44.81	14.25
Middle	Y	147.12	30.15	-6.96	12.55
Rear	Y	118.36	32.60	-4.60	252.85
SUM	N/A	302.01	38.65		
PELVIS FORCES (N)					
Pubic Symphysis	Y	62.09	76.45	-720.08	54.85

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

DATA SHEET NO. 13
DUMMY INJURY RESPONSE DATA
(Subpart V, SIDIIIs)

Test Vehicle: 2024 Kia Carnival 5 Door Minivan NHTSA No.: C20244212
Test Facility: Calspan Test Date: 09/14/2023

Dummy Serial No. 261

Description	Axes	Positive Direction		Negative Direction	
		MAX	TIME (ms)	MAX	TIME (ms)
HEAD ACCELERATION (g)					
Longitudinal	X	2.17	179.60	-10.90	59.95
Lateral	Y	22.99	75.20	-3.98	175.70
Vertical	Z	6.78	53.60	-2.87	119.90
Resultant	N/A	24.91	75.15		
HIC36 (t1, t2)	N/A	68.75		t1 = 56.05	t2 = 92.05
LOWER SPINE (g)					
Longitudinal	X	7.10	115.35	-22.60	55.95
Lateral	Y	42.13	56.30	-3.78	97.65
Vertical	Z	4.34	66.65	-8.24	57.25
Resultant	N/A	48.41	56.30	0.00	-30.95
PELVIS FORCES (N)					
Acetabular	Y	2696.54	51.15	-28.36	93.90
Iliac	Y	246.02	59.15	-172.43	47.20

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

DATA SHEET NO. 14
POST-TEST OBSERVATIONS

Test Vehicle: 2024 KIA Carnival 5 Door Minivan

NHTSA No.: C20244212

Test Facility: Calspan

Test Date: 09/14/2023

TEST DUMMY INFORMATION AND CONTACT POINTS

Dummy Body Part	Front Occupant	Rear Occupant
Head Contact	Side Header, Head Restraint, & Curtain Airbag	Head Restraint & Curtain Airbag
Upper Torso Contact	Seatback & Torso/Pelvic Airbag	None
Lower Torso Contact	Seatback & Torso/Pelvic Airbag	None
Left Knee Contact	Driver Door	Passenger Door
Right Knee Contact	Left Knee	Left Knee

POST-TEST DOOR PERFORMANCE

Description	Front	Rear
Left Side Doors	Jammed Shut	Jammed Shut
Right Side Doors	Closed & Operational	Closed & Operational
Hatch and Other Doors		Closed & Operational
Seat Movement	None	None
Seatback Failure	None	None

*Note: Description for door opening must be specific with the following three categories: Remained closed and operational, opened/unlatched during the crash, or jammed shut. Sometimes the door is jammed and unlatched. If the door cannot be opened, then note the door as jammed shut. If open, measurement must be taken for the width of the door opening (mm).

POST-TEST STRUCTURAL OBSERVATIONS

Critical Areas of Performance	Observations and Conclusions
Pillar Performance	B-Pillar Buckled
Sill Separation	None
Windshield Damage	None
Side Window Damage	Driver Window cracked throughout and the rear window shattered during impact event
Other Notable Effects	None

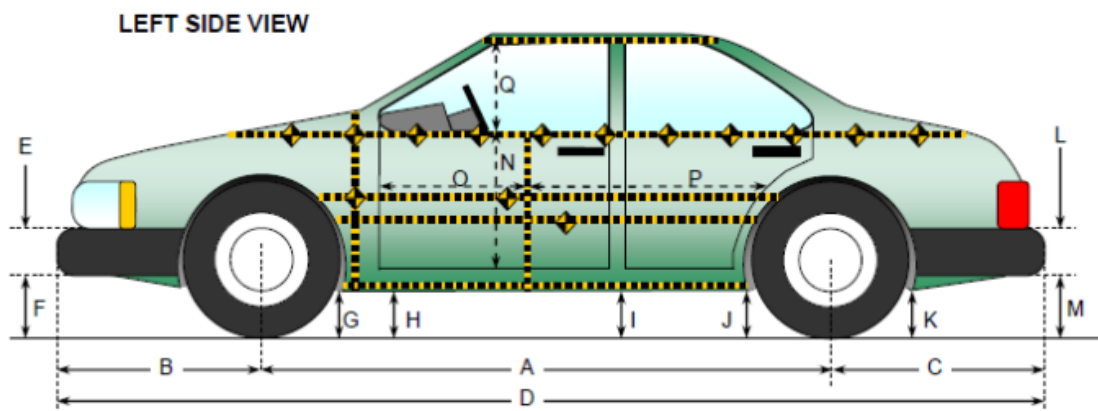
SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

Restraint Type	Front Occupant		Rear Occupant	
	Installed	Deployed	Installed	Deployed
Front Airbag	Yes	No	No	N/A
Side Torso Airbag	Yes	Yes	No	N/A
Head Airbag	No	N/A	No	N/A
Curtain Airbag	Yes	Yes	Yes	Yes
Seat Belt Pretensioner	Yes	Yes	No	N/A
Other	N/A	N/A	N/A	N/A

DATA SHEET NO. 15
TEST VEHICLE PROFILE MEASUREMENTS

Test Vehicle: 2024 KIA Carnival 5 Door Minivan
 Test Facility: Calspan

NHTSA No.: C20244212
 Test Date: 09/14/2023



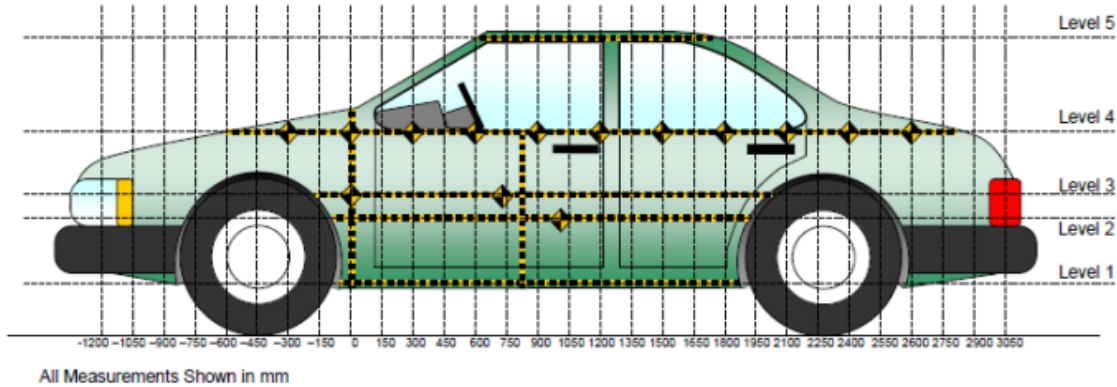
VEHICLE PRE- AND POST-TEST MEASUREMENT INFORMATION

Code.	Measurement Description	Pre-Test	Post-Test	Difference
A	Wheelbase	3089	3093	4
B	Front Axle to FSOV	937	932	-6
C	Rear Axle to RSOV	1128	1129	0
D	Total Vehicle Length at Centerline	5155	5154	-1
E	Front Bumper Thickness	164	164	0
F	Front Bumper Bottom to Ground	479	476	-3
G	Sill Height at Front Wheel Well	226	217	-9
H	Sill Height at Front Door Leading Edge	228	219	-9
I	Sill Height at B Pillar	230	219	-11
J1	Sill Height at Rear Wheel Well	234	235	1
J2	Pinch Weld Height at Rear Wheel Well	213	212	-1
K	Sill Height Aft of Rear Wheel Well	243	251	8
L	Rear Bumper Thickness	116	116	0
M	Rear Bumper Bottom to Ground	444	455	11
N	Sill Height to Window Bottom of Front Window Sill	917	939	21
O	Front Door Leading Edge to Impact CL	834	822	-12
P	Rear Door Trailing Edge to Impact CL	1486	1465	-21
Q	Front Window Opening	504	522	18
R	Right Side Length	5064	5063	-1
S	Left Side Length	5060	5059	-1
T	Vehicle Width at B-Pillars	1993	1880	-112

DATA SHEET NO.16 **TEST VEHICLE EXTERIOR CRUSH MEASUREMENTS**

Test Vehicle: 2024 KIA Carnival 5 Door Minivan
 Test Facility: Calspan

NHTSA No.: C20244212
 Test Date: 09/14/2023



MAXIMUM EXTERIOR CRUSH MEASUREMENTS

Level	Measurement Description	Units	Height Above Ground	Maximum Exterior Static Crush	Distance from Impact
1	Sill Top	mm	372	91	300
2	Occupant H-Point	mm	717	201	1500
3	Mid-Door	mm	331	204	1650
4	Window Sill	mm	1105	114	1650
5	Window Top	mm	1646	6	1050

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.17 **VEHICLE EXTERIOR CRUSH PROFILES**

Test Vehicle: 2024 KIA Carnival 5 Door Minivan

NHTSA No.: C20244212

Test Facility: Calspan

Test Date: 09/14/2023

EXTERIOR CRUSH MEASUREMENTS AT EACH LEVEL

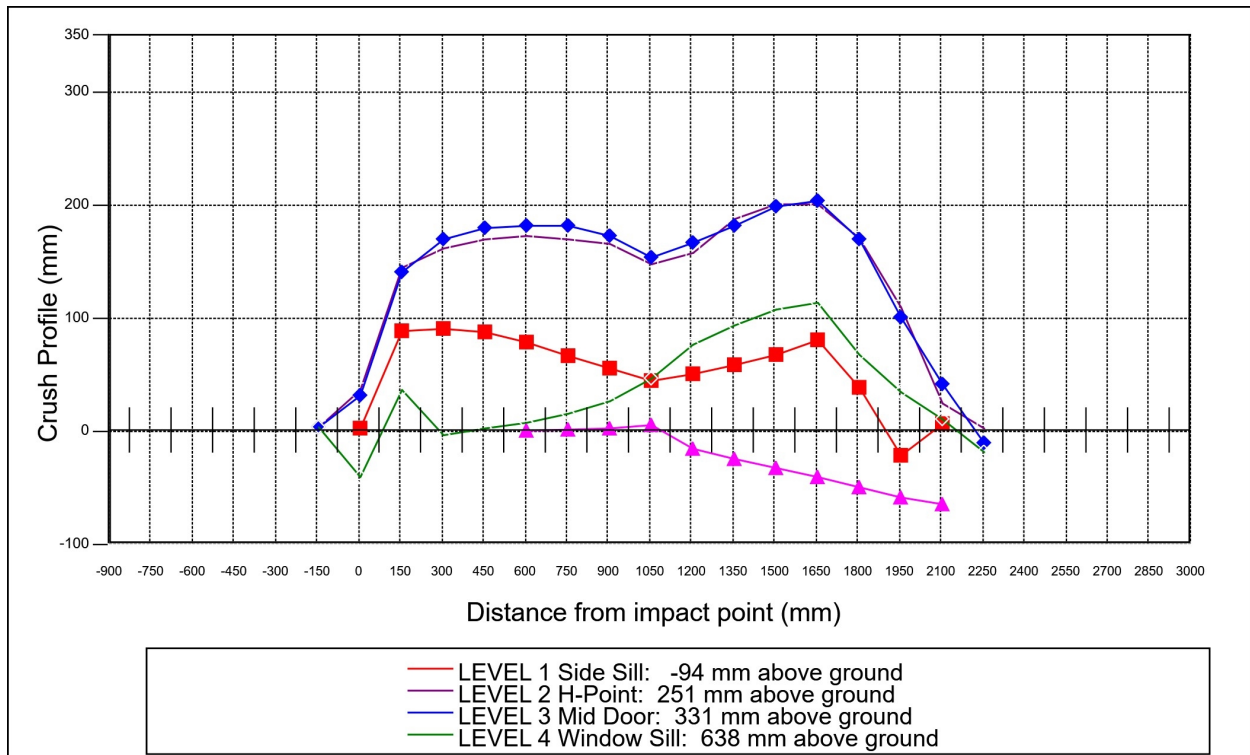
	Pre-Test					Post-Test					Difference				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
-900															
-750															
-600															
-450															
-300															
-150		1000	1001	889			996	997	885			4	4	4	
0	973	994	994	897		970	957	961	937		3	37	33	-40	
150	950	985	987	953		861	840	846	916		89	145	141	37	
300	950	980	987	912		859	818	817	915		91	162	170	-3	
450	954	980	987	917		866	810	807	914		88	170	180	3	
600	957	980	987	923	667	878	807	805	915	666	79	173	182	8	1
750	958	980	987	928	697	891	810	805	912	695	67	170	182	16	2
900	960	980	987	935	703	904	814	814	908	700	56	166	173	27	3
1050	962	980	987	940	708	917	832	833	893	702	45	148	154	47	6
1200	961	978	984	944	709	910	820	817	867	724	51	158	167	77	-15
1350	959	977	983	946	709	900	789	801	852	733	59	188	182	94	-24
1500	957	976	981	947	710	889	775	782	839	742	68	201	199	108	-32
1650	955	974	980	947	710	874	773	776	833	750	81	201	204	114	-40
1800	955	975	980	947	709	916	804	810	879	758	39	171	170	68	-49
1950	955	982	983	946	708	976	872	882	911	766	-21	110	101	35	-58
2100	965	993	990	944	707	958	968	948	933	771	7	25	42	11	-64
2250		994	996	939			991	1006	957			3	-10	-18	
2400															
2550															
2700															
2850															
3000															

NOTE: Pre-test measurements are taken when the vehicle is in the “As Tested” weight condition. Vehicle measurements forward of the vertical impact reference line are negative. The crush profile grid is established prior to the test based on an estimated impact point. The final distance from impact is determined after the final dummy positioning and the pole is aligned with the center of gravity of the dummy’s head.

DATA SHEET NO.17
TEST VEHICLE EXTERIOR CRUSH PROFILES (CONTINUED)

Test Vehicle: 2024 KIA Carnival 5 Door Minivan
Test Facility: Calspan

NHTSA No.: C20244212
Test Date: 09/14/2023

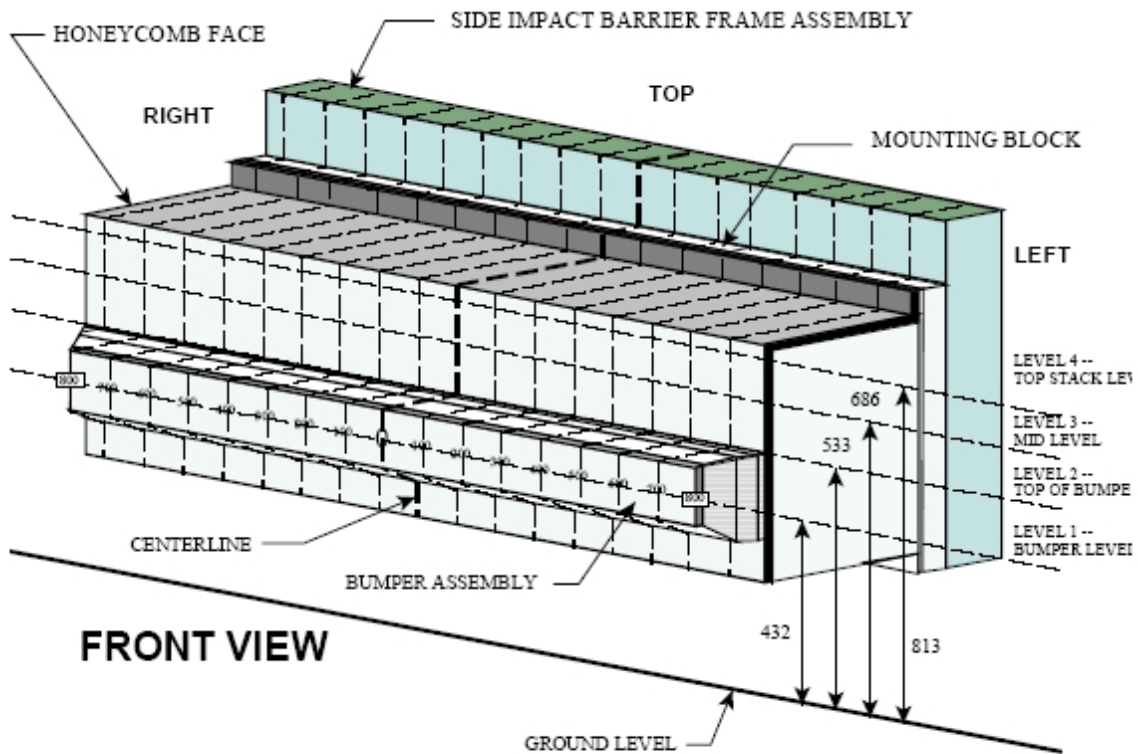


Vehicle Exterior Crush Measurements - Visual Representation

DATA SHEET NO.18 EXTERIOR STATIC CRUSH FOR IMPACT FACE

Test Vehicle: 2024 KIA Carnival 5 Door Minivan
Test Facility: Calspan

NHTSA No.: C20244212
Test Date: 09/14/2023



NOTE: Dimensions are shown in millimeters, mm

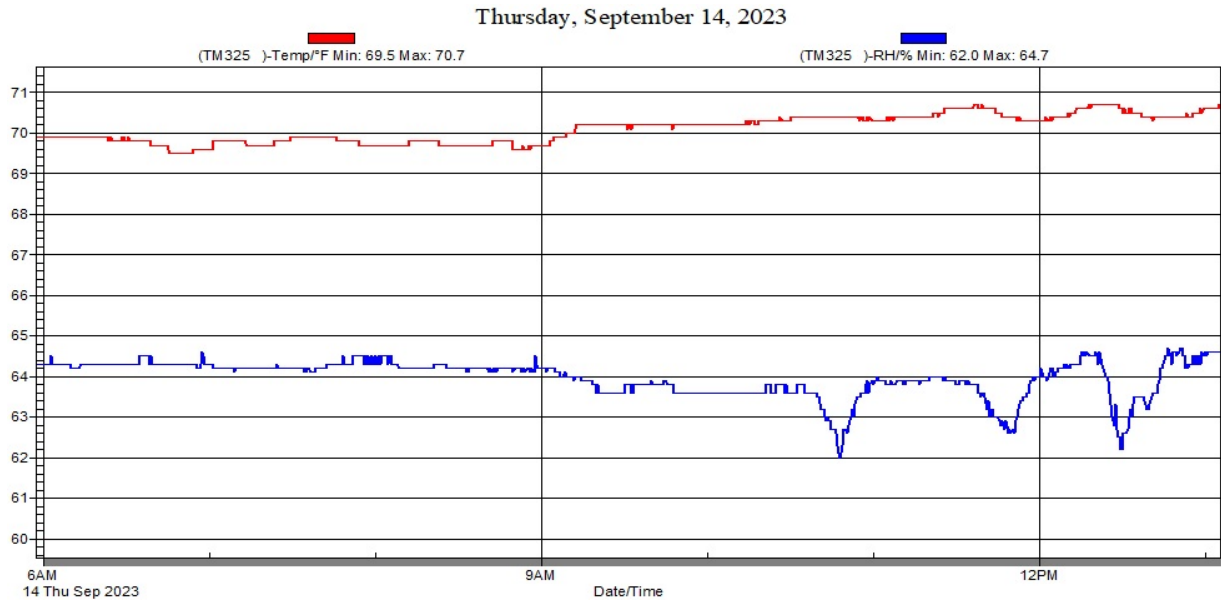
DEFORMABLE BARRIER STATIC CRUSH

Stack Level	Distance Right of Center								C/L	Distance Left of Center							
	800	700	600	500	400	300	200	100		100	200	300	400	500	600	700	800
1	164	162	164	167	170	177	192	167	159	167	192	177	170	167	164	162	164
2	85	89	92	94	97	99	97	86	79	86	97	99	97	94	92	89	85
3	22	11	7	6	8	11	39	39	17	39	39	11	8	6	7	11	22
4	31	3	-8	-5	0	7	28	45	22	45	28	7	0	-5	-8	3	31

DATA SHEET NO. 19
DUMMY / VEHICLE TEMPERATURE AND HUMIDITY STABILIZATION DATA

Test Vehicle: 2024 KIA Carnival 5 Door Minivan
Test Facility: Calspan

NHTSA No.: C20244212
Test Date: 09/14/2023



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

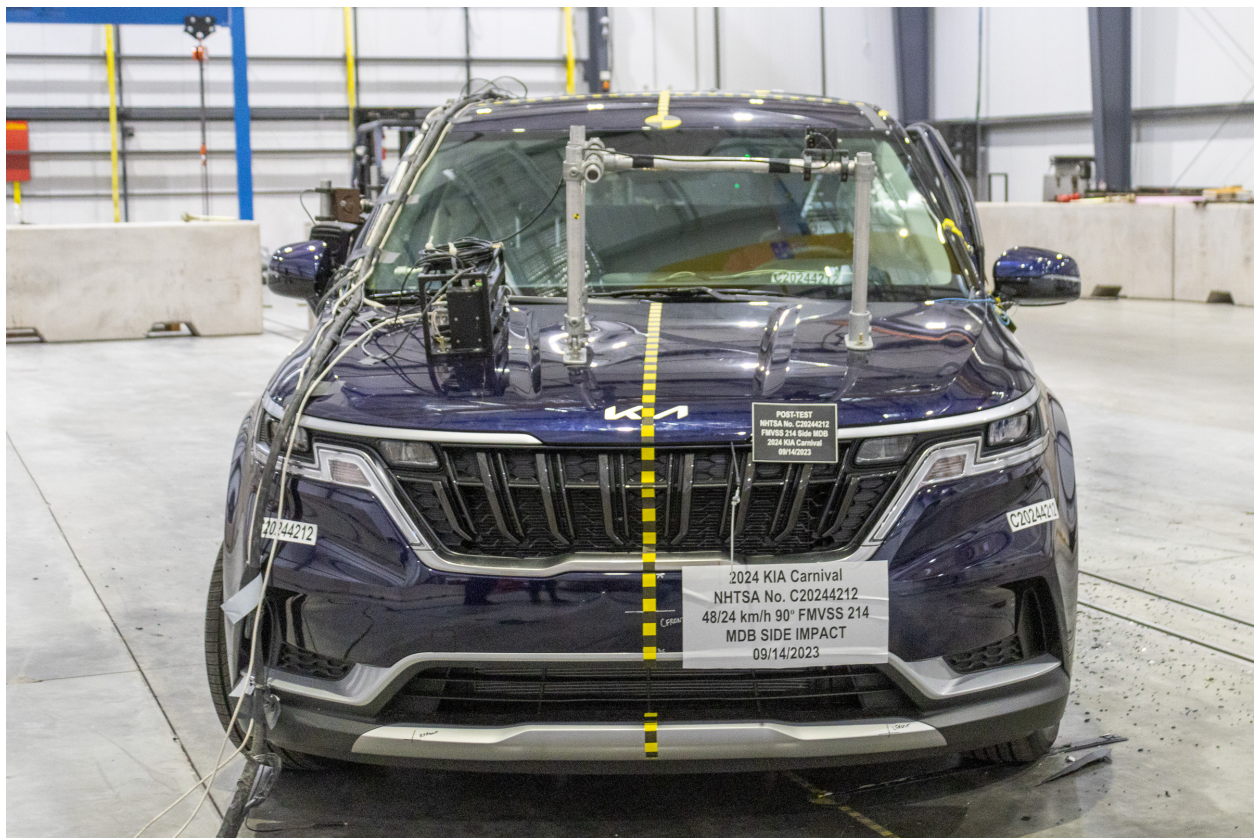


Figure A-2: Post-Test Frontal View of Test Vehicle



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 Frontal View of Impactor Face



Figure A-8: Post-Test Frontal View of Impactor Face



Figure A-9: Pre-Test Left Side View of Impactor Face



Figure A-10: Post-Test Left Side View of Impactor Face



Figure A-11: Pre-Test Right Side View of Impactor Face



Figure A-12: Post-Test Right Side View of Impactor Face



Figure A-13: Pre-Test Top View of Impactor Face



Figure A-14: Post-Test Top View of Impactor Face

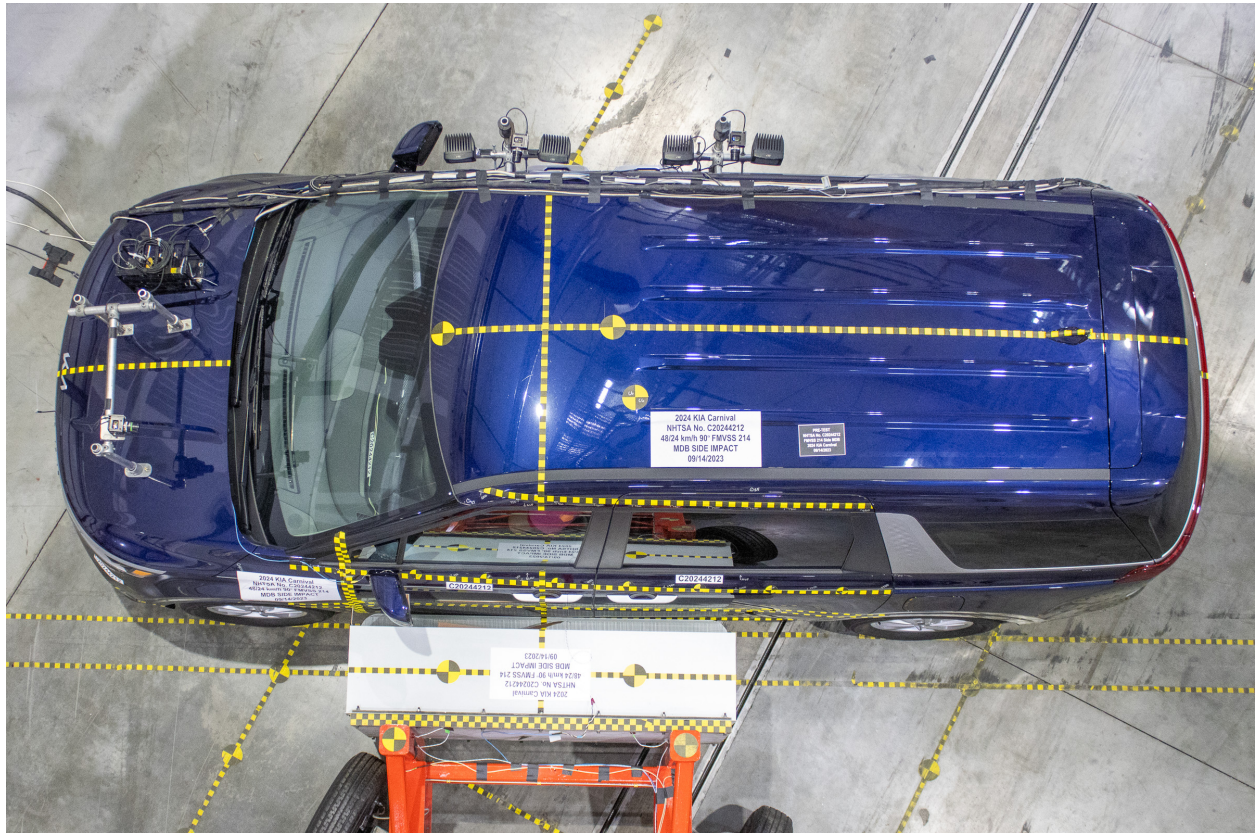


Figure A-15: Pre-Test Overhead View of MDB Positioned Against Impact Side of Test Vehicle at Impact Location



Figure A-16: Post-Test Overhead View of the MDB and Test Vehicle



Figure A-17: Pre-Test Front ES2-re in Final Seating Position (Door Open)



Figure A-18: Pre-Test Front ES2-re in Final Seating Position (Door Closed)



Figure A-19: Pre-Test Front ES2-re - Opposite Side View



Figure A-20: Post-Test Front ES2-re - Opposite Side View

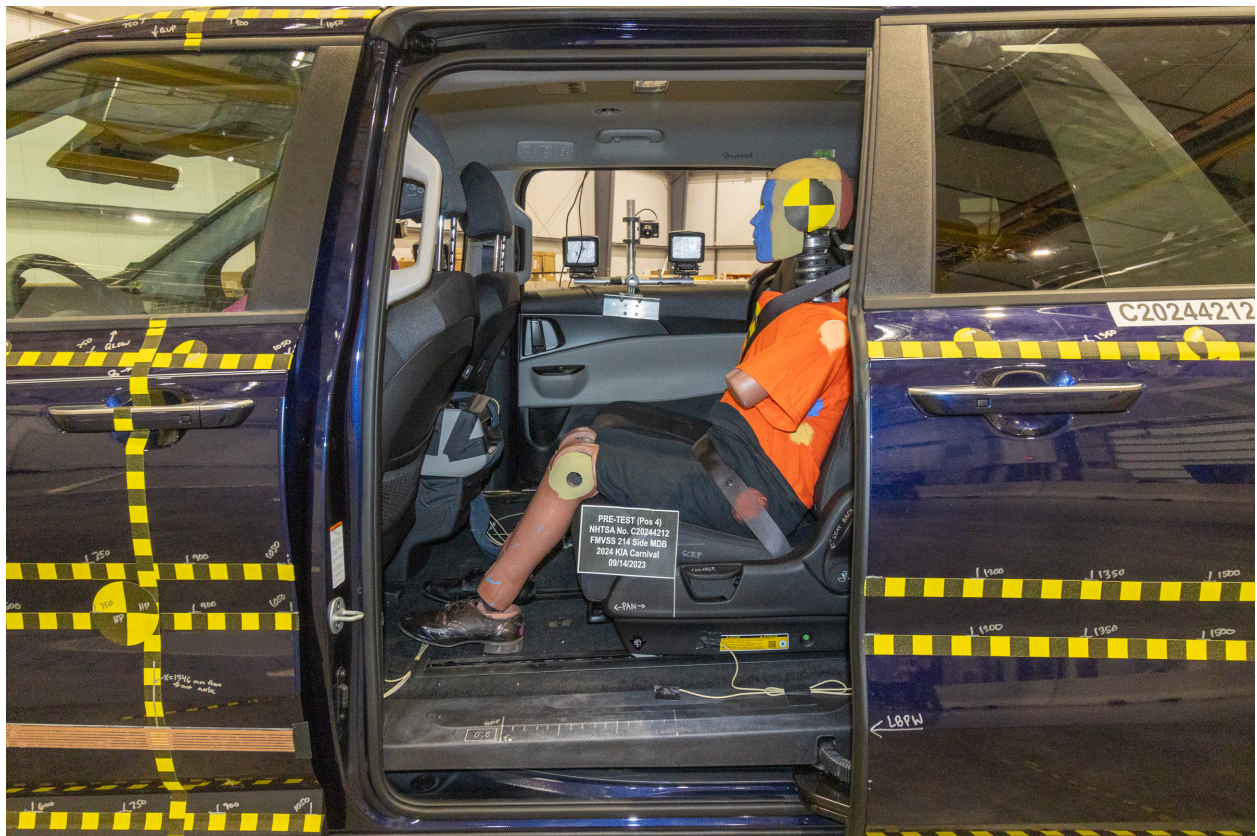


Figure A-21: Pre-Test Rear SID in Final Seating Position (Door Open)



Figure A-22: Pre-Test Rear SID in Final Seating Position (Door Closed)



Figure A-23: Pre-Test Rear SID - Opposite Side View



Figure A-24: Post-Test Rear SID - Opposite Side View



Figure A-25: T (0) - Impact Event



Figure A-26: Post-Test Close-up View of Impact Point Target



Figure A-27: Close-up View of Vehicle's Certification Label



Figure A-28: Post-Test Front Seat Occupant Area Showing Head & Torso Contact Regions



Figure A-29: Post-Test Rear Seat Occupant Area Showing Head & Torso Contact Regions

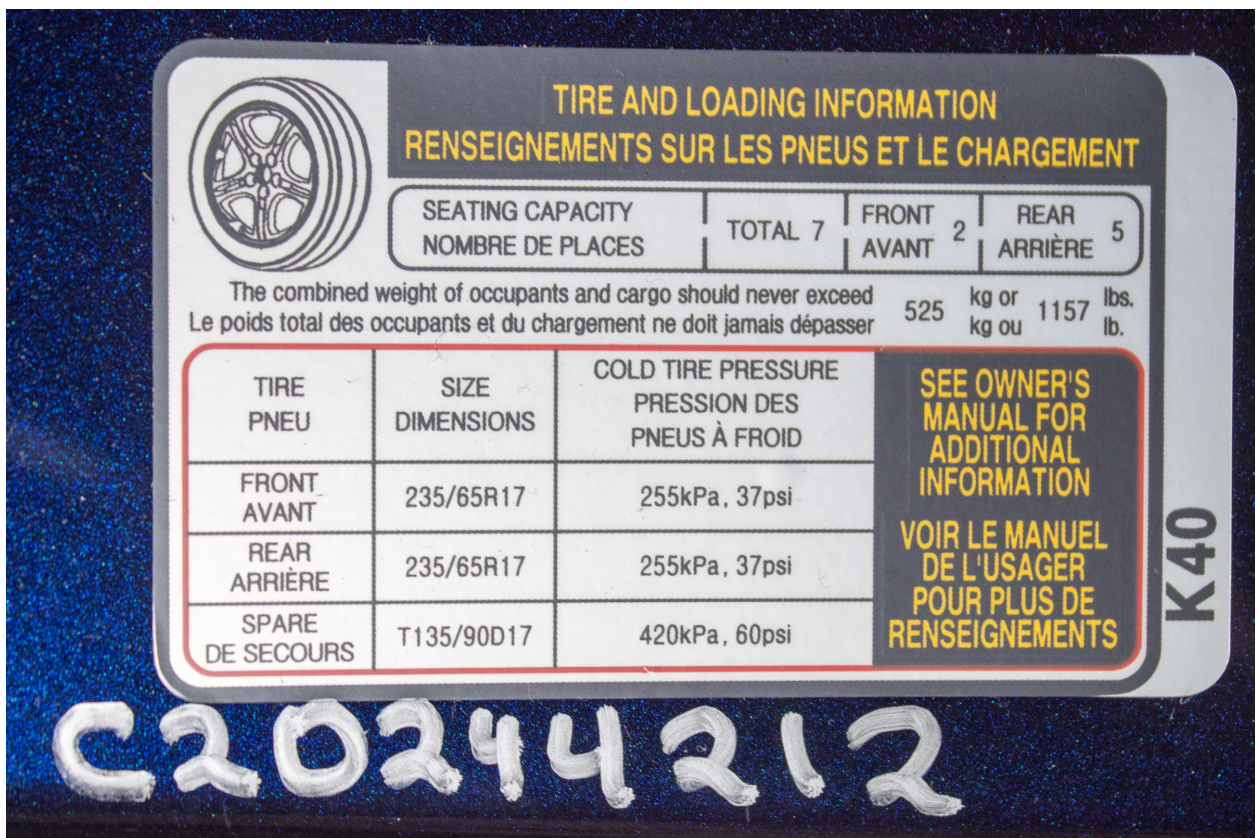


Figure A-30: Close-up View of Vehicle's Tire Placard

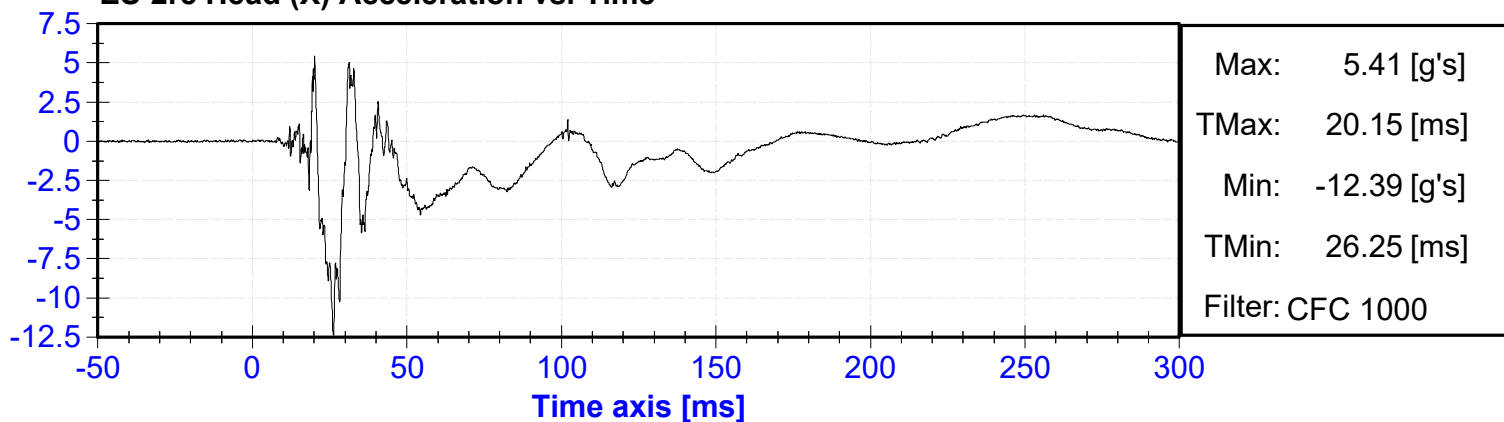
APPENDIX II

ES-2re DUMMY RESPONSE DATA TRACES

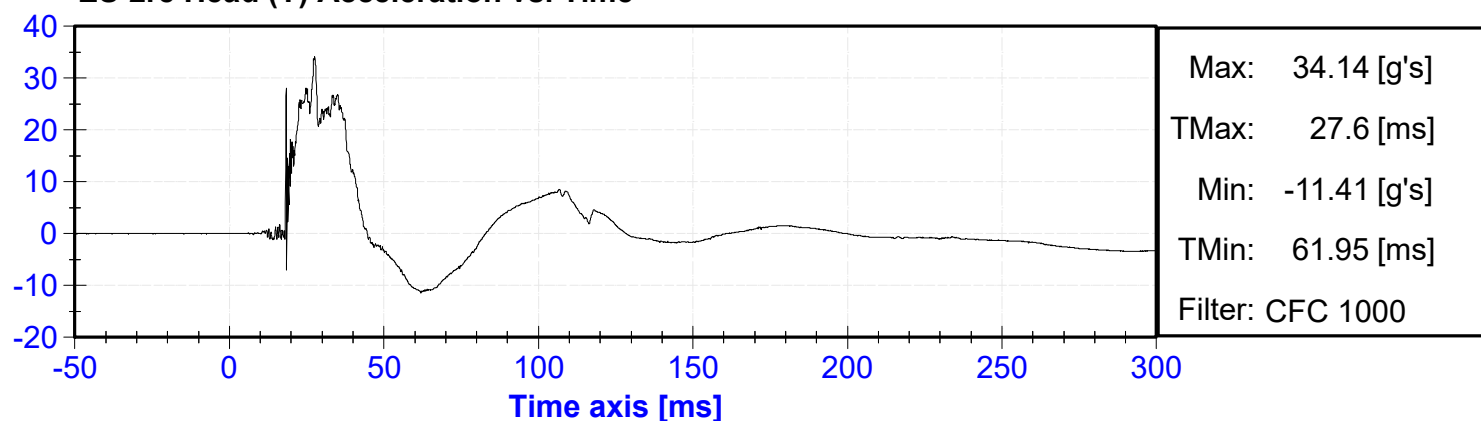
Table of Data Plots

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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 Middle Thorax Rib Deflection (Y) vs. Time	II-5
12	ES-2re Lower Thorax Rib Deflection Rate vs. Time	II-5
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17	ES-2re Sum of Abdomen Forces vs. Time	II-7
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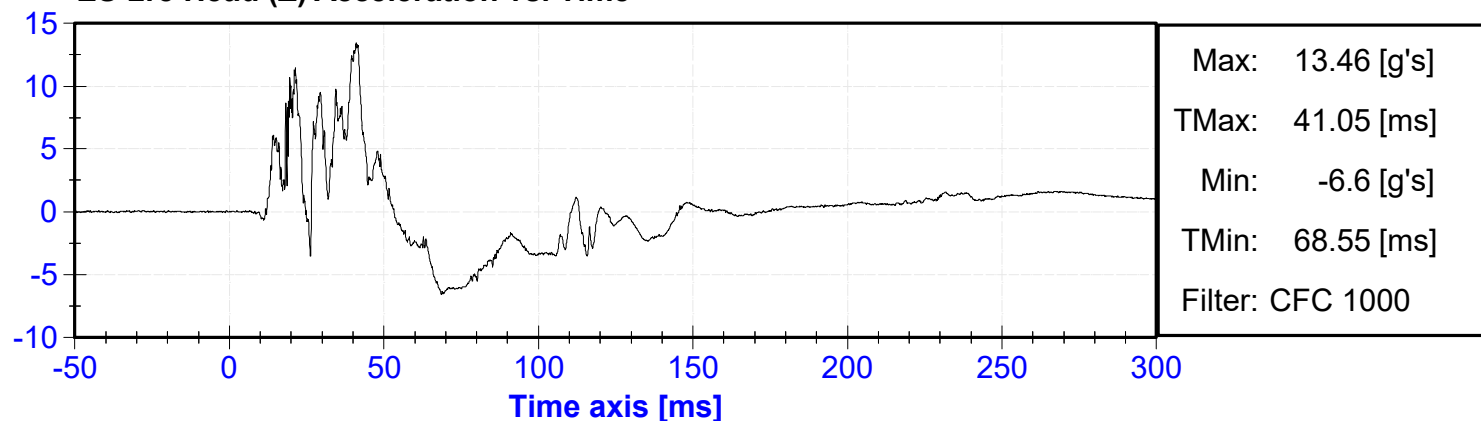
ES-2re Head (X) Acceleration vs. Time



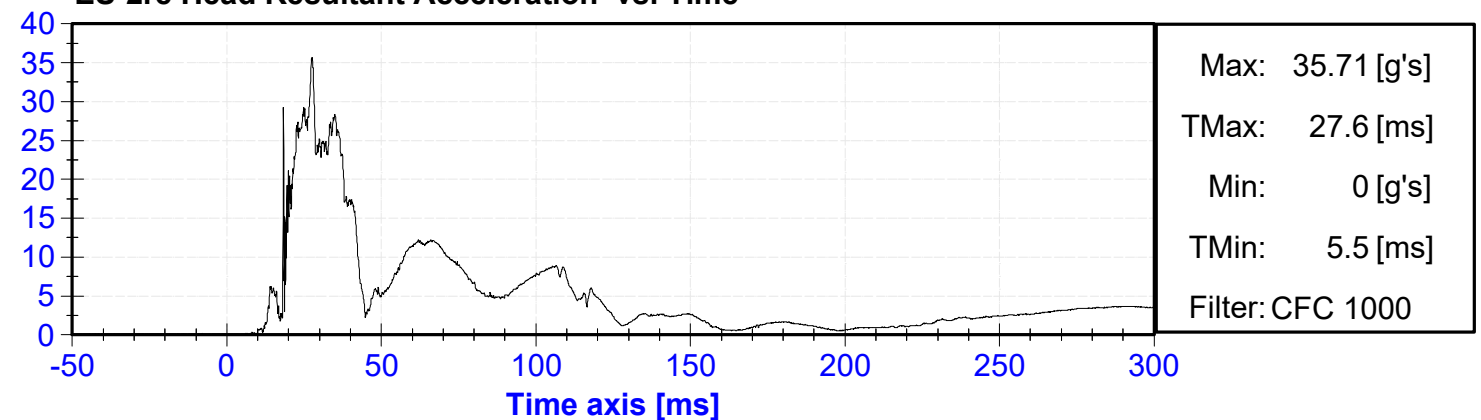
ES-2re Head (Y) Acceleration vs. Time



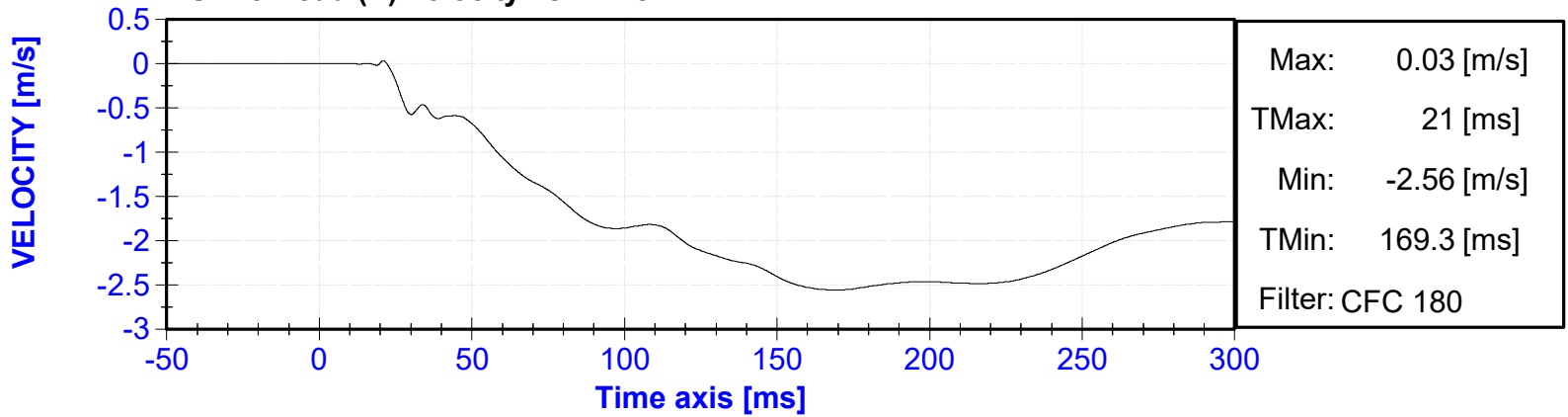
ES-2re Head (Z) Acceleration vs. Time



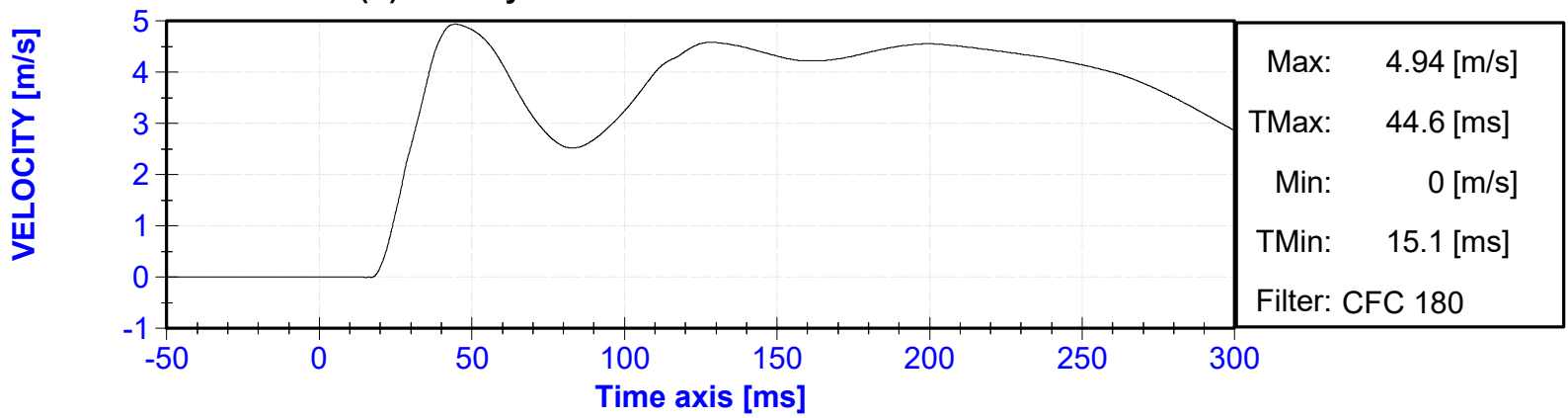
ES-2re Head Resultant Acceleration vs. Time



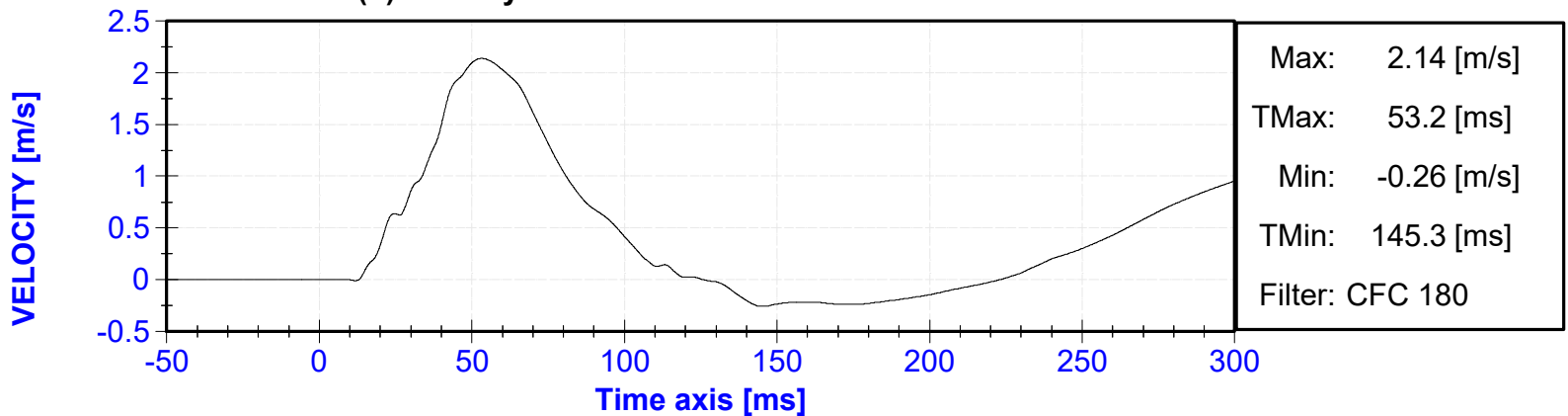
ES-2re Head (X) Velocity vs. Time



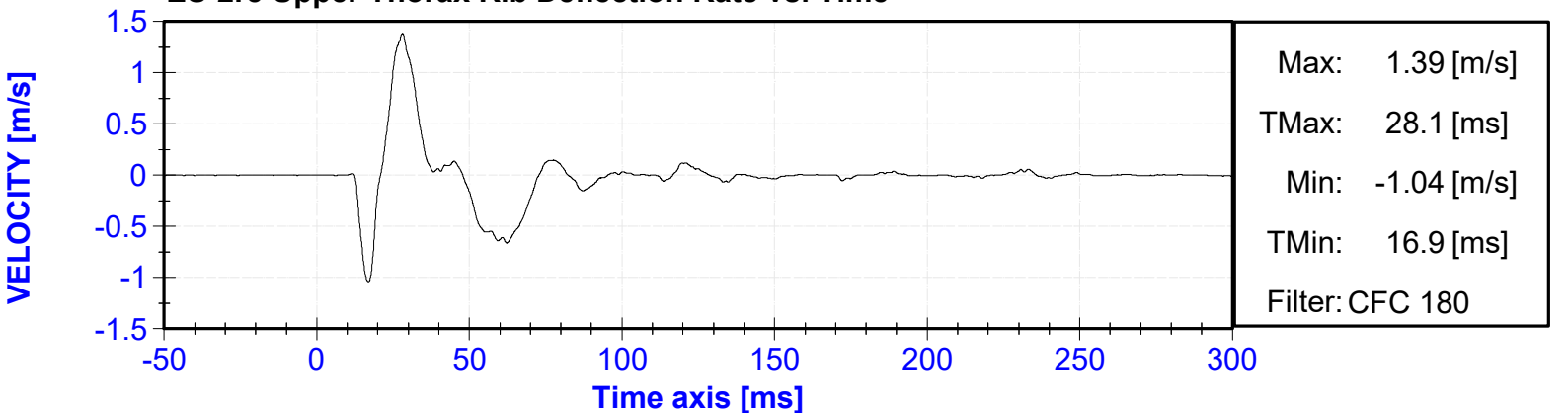
ES-2re Head (Y) Velocity vs. Time



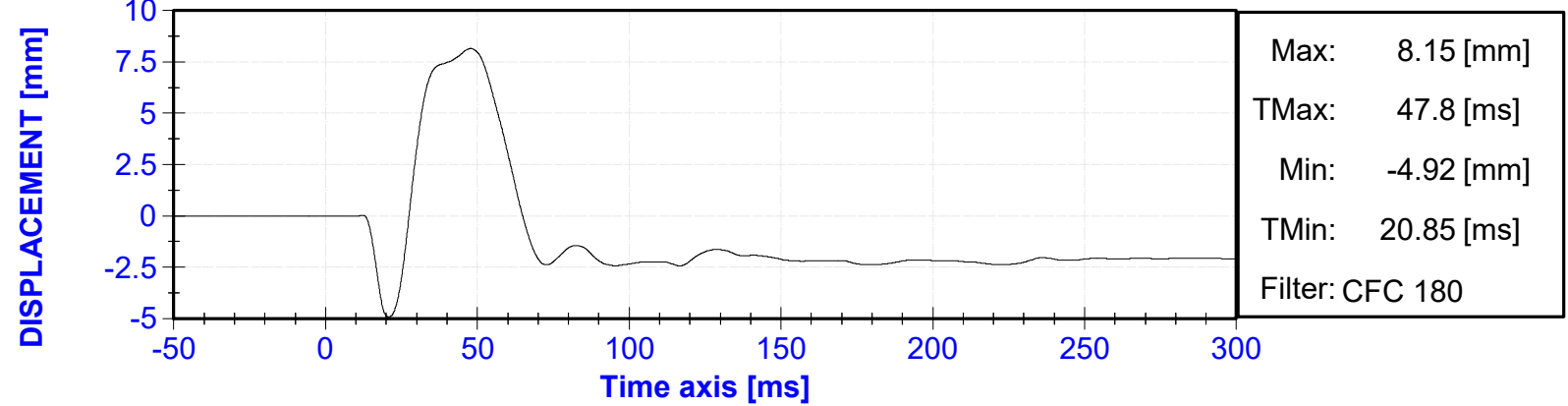
ES-2re Head (Z) Velocity vs. Time



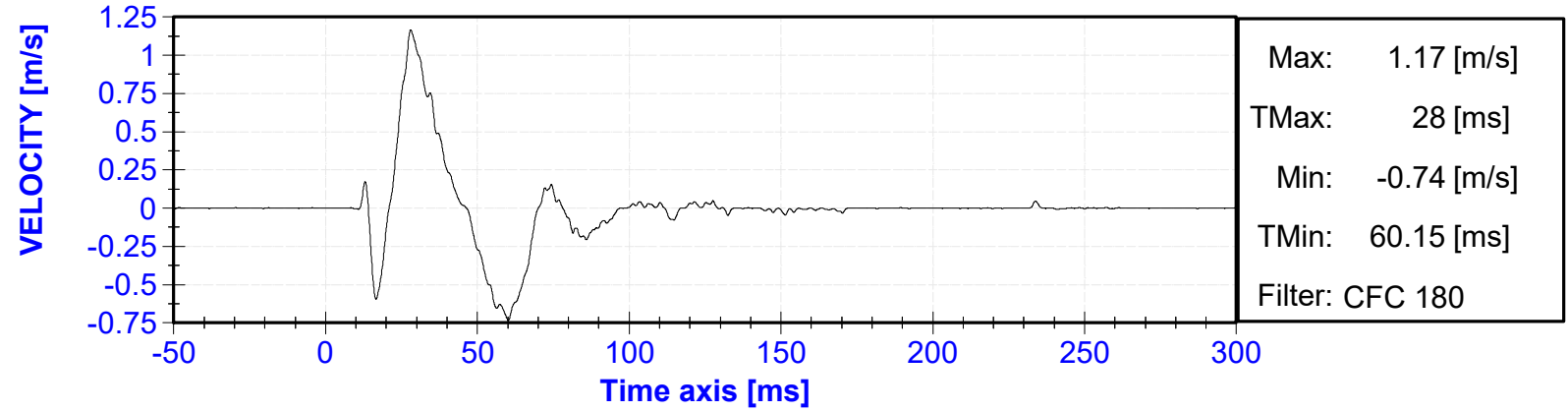
ES-2re Upper Thorax Rib Deflection Rate vs. Time



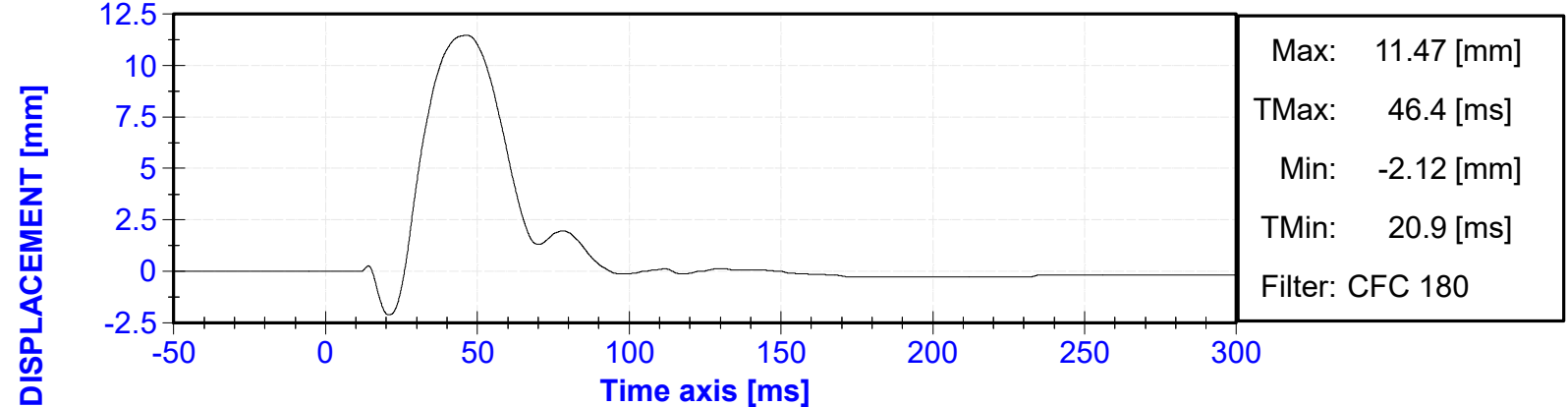
ES-2re Upper Thorax Rib Deflection (Y) vs. Time



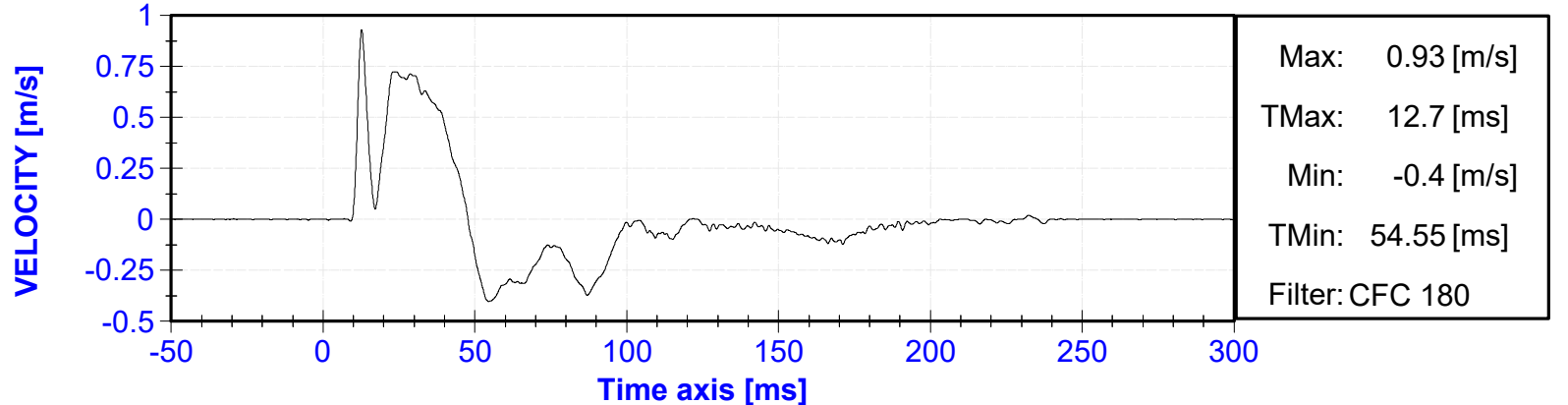
ES-2re Middle Thorax Rib Deflection Rate vs. Time



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

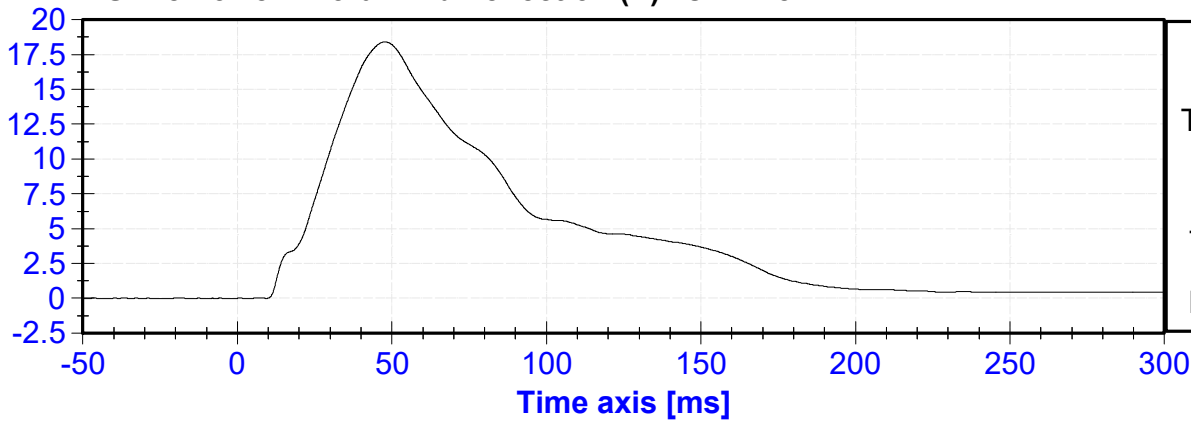


ES-2re Lower Thorax Rib Deflection Rate vs. Time



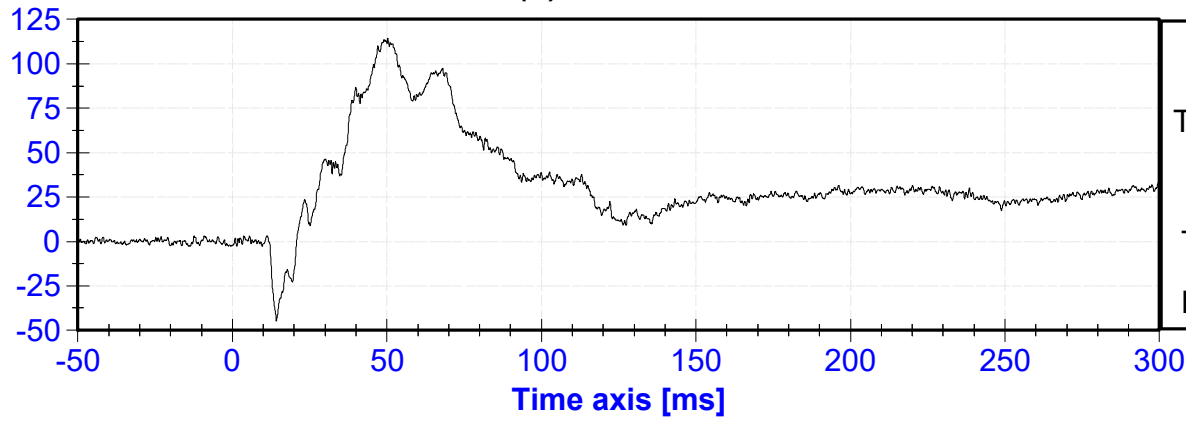
ES-2re Lower Thorax Rib Deflection (Y) vs. Time

DISPLACEMENT [mm]



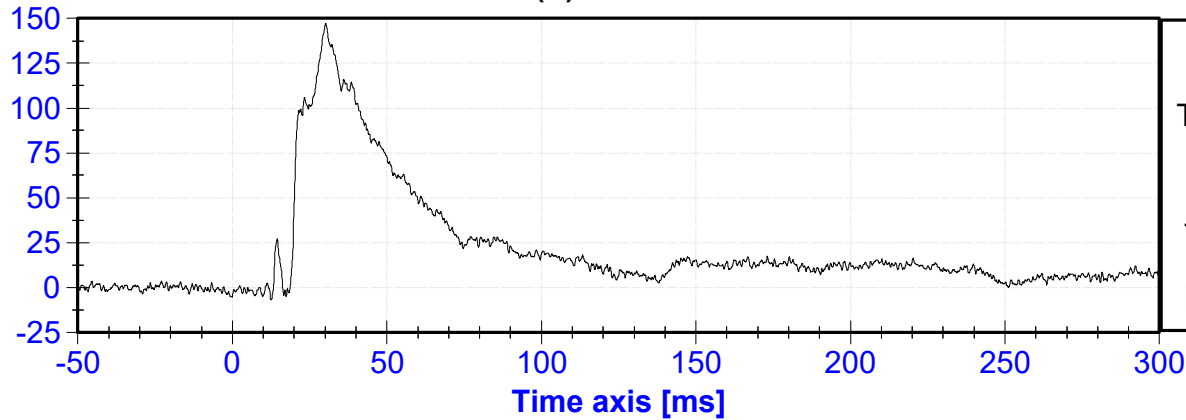
ES-2re Front Abdomen Force (Y) vs. Time

FORCE [N]



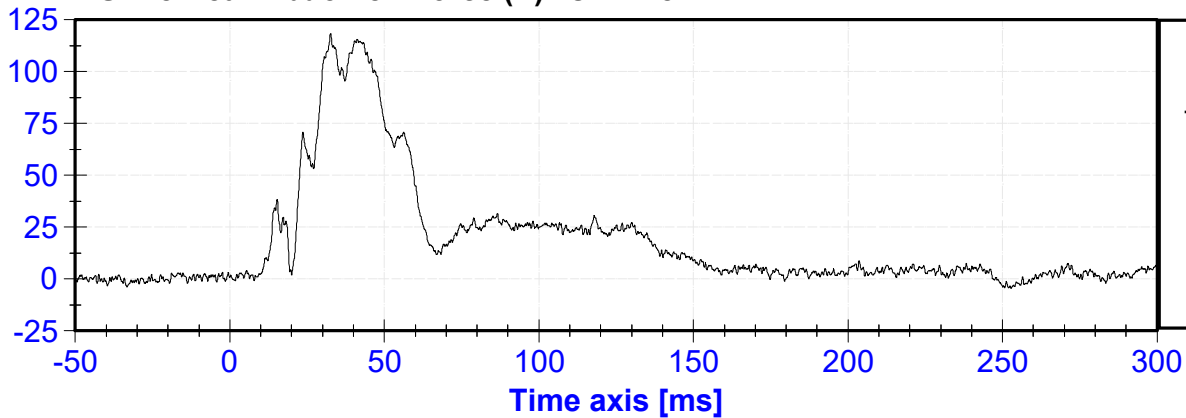
ES-2re Middle Abdomen Force (Y) vs. Time

FORCE [N]

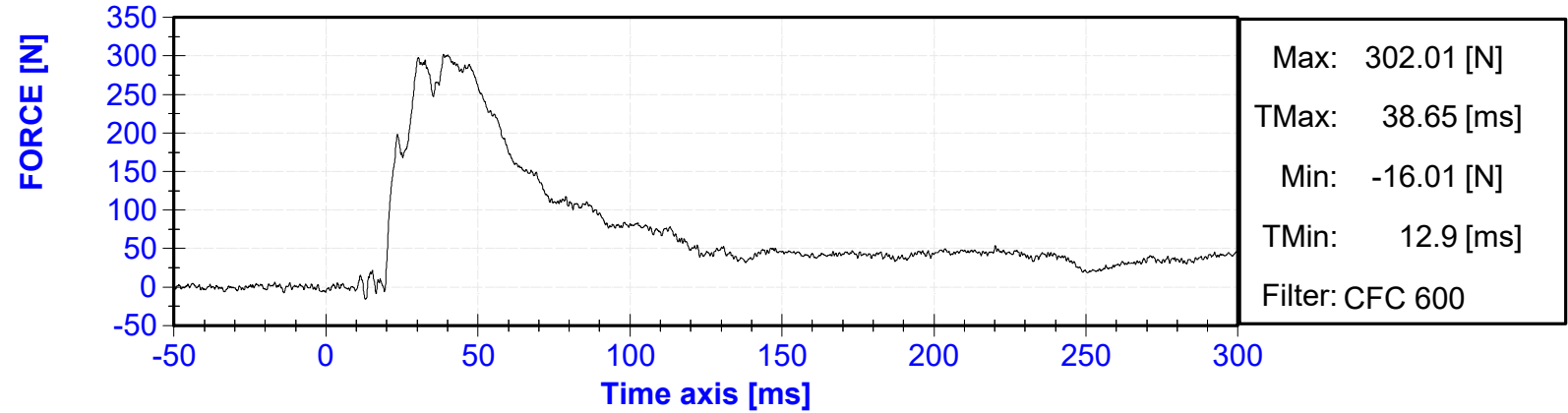


ES-2re Rear Abdomen Force (Y) vs. Time

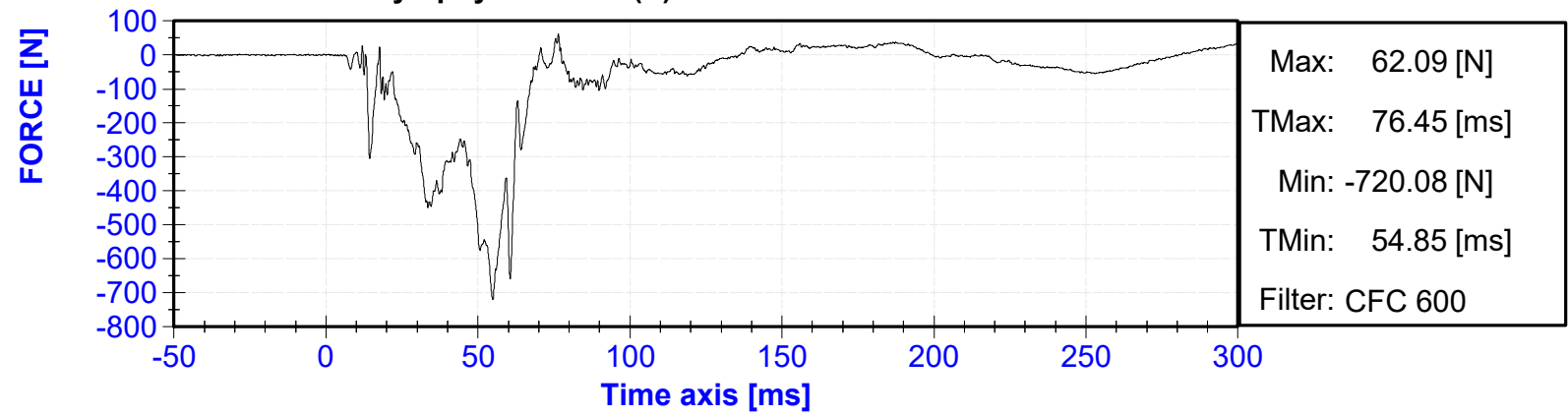
FORCE [N]



ES-2re Sum of Abdomen Forces vs. Time



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



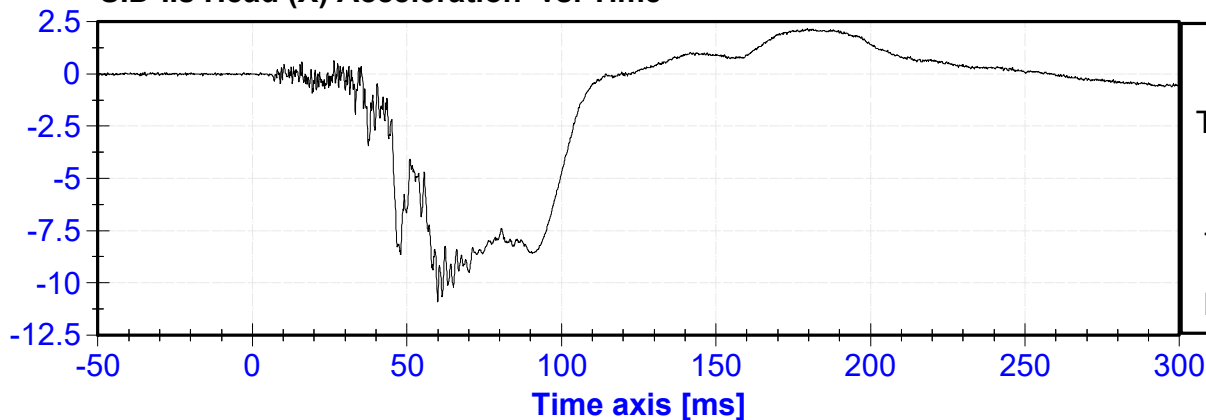
APPENDIX III

SID-IIs DUMMY RESPONSE DATA TRACES

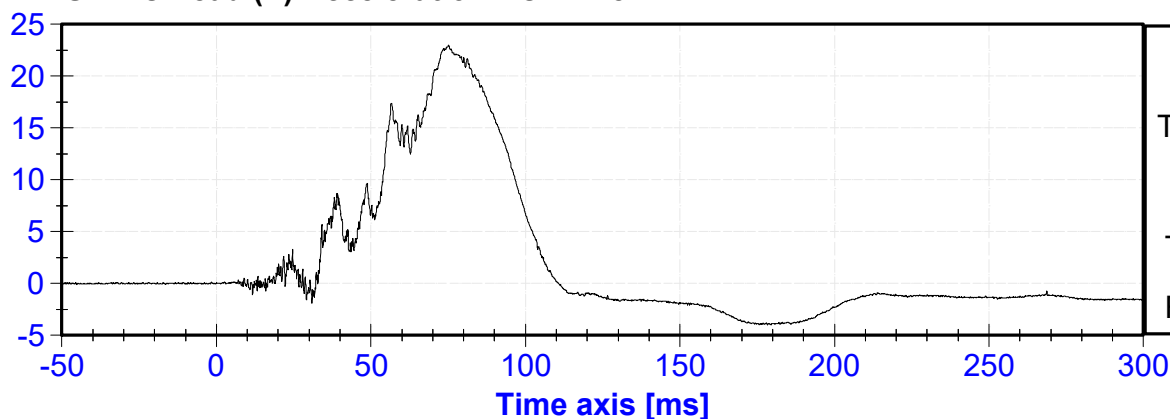
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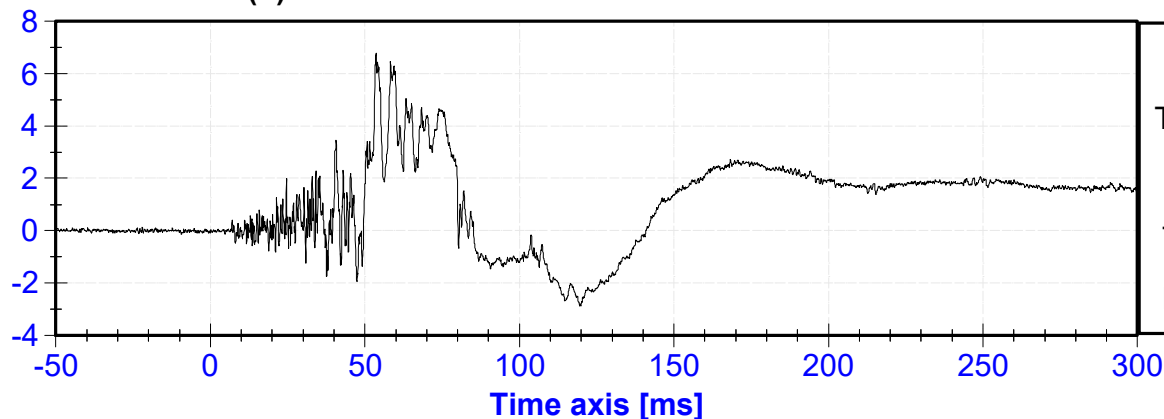
SID-IIs Head (X) Acceleration vs. Time



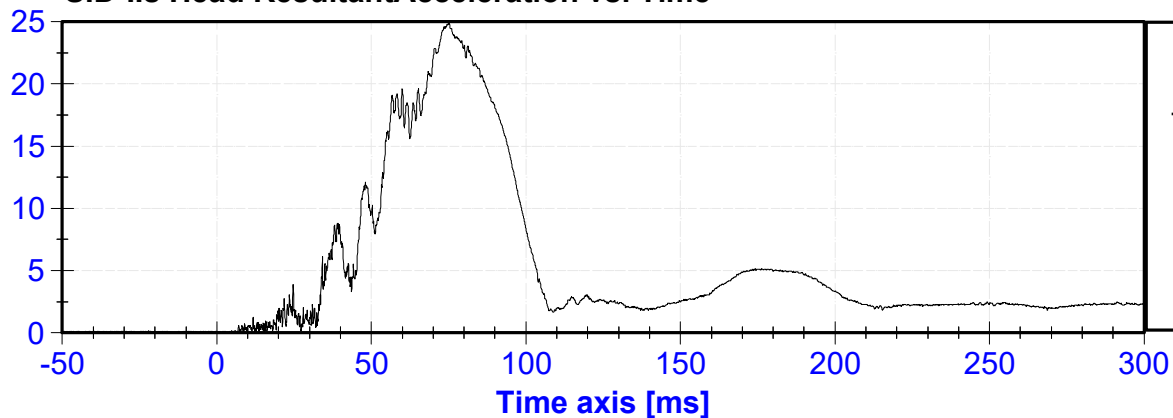
SID-IIs Head (Y) Acceleration vs. Time



SID-IIs Head (Z) Acceleration vs. Time

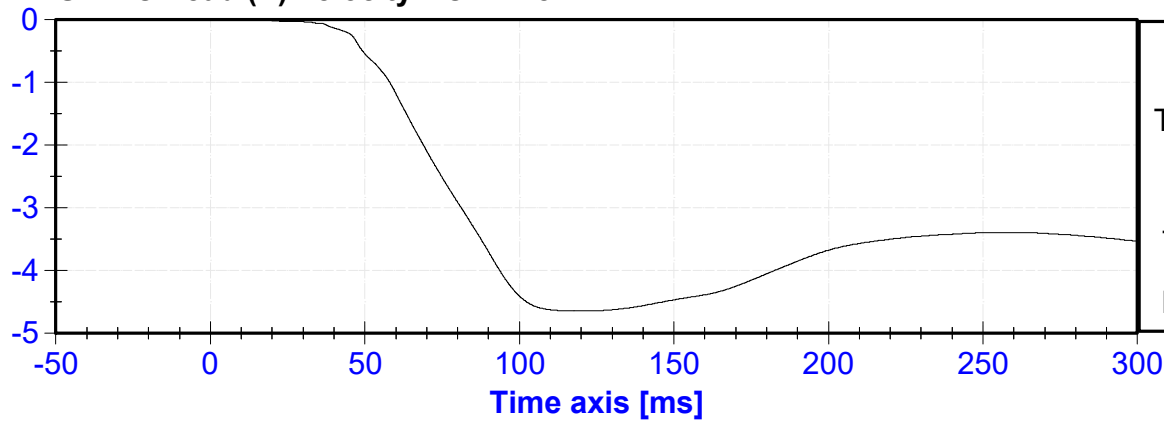


SID-IIs Head ResultantAcceleration vs. Time



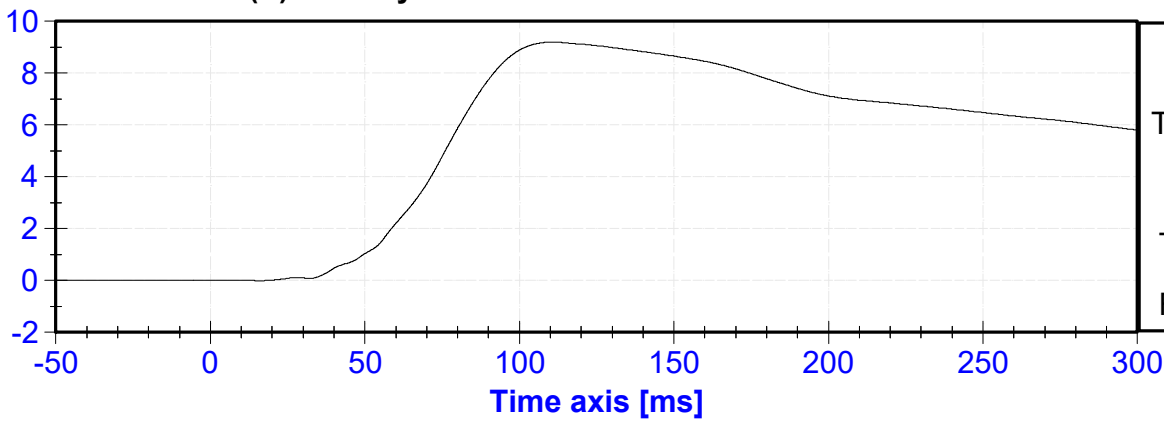
SID-IIs Head (X) Velocity vs. Time

VELOCITY [m/s]



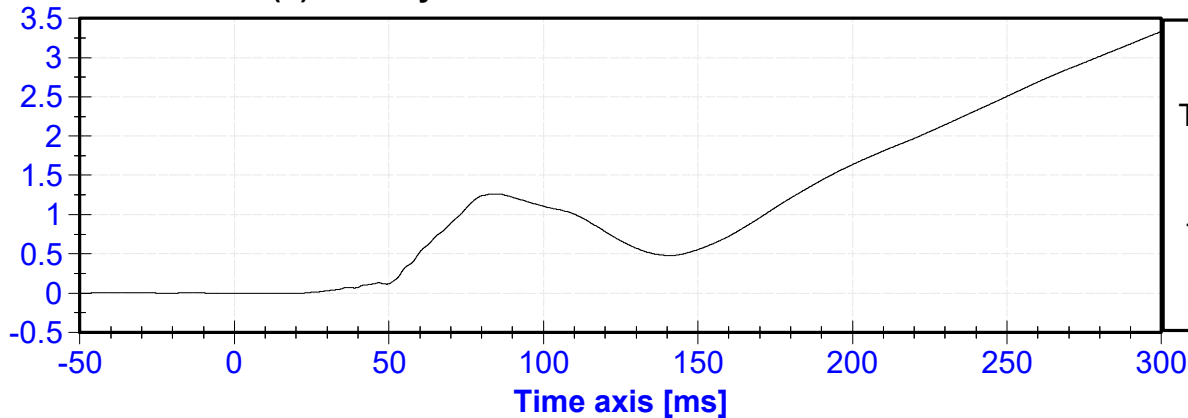
SID-IIs Head (Y) Velocity vs. Time

VELOCITY [m/s]



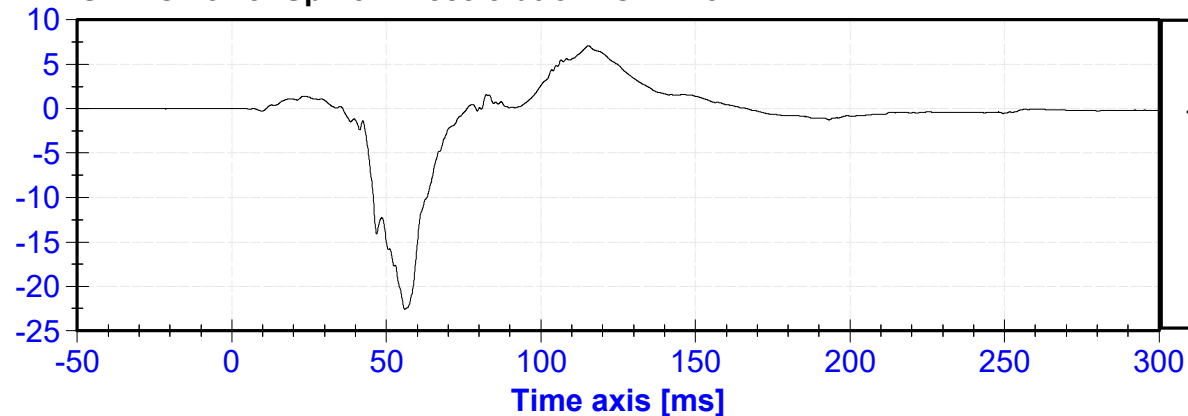
SID-IIs Head (Z) Velocity vs. Time

VELOCITY [m/s]

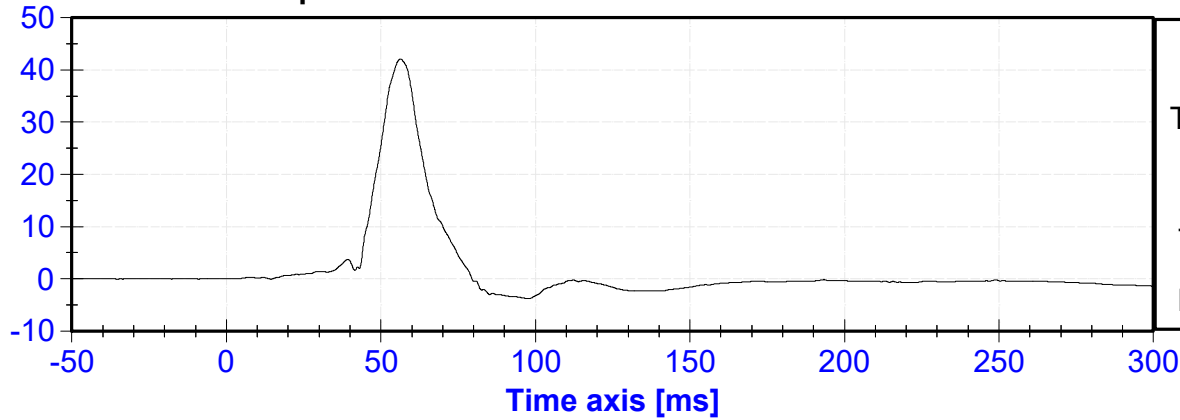


SID-IIs Lower Spine X Acceleration vs. Time

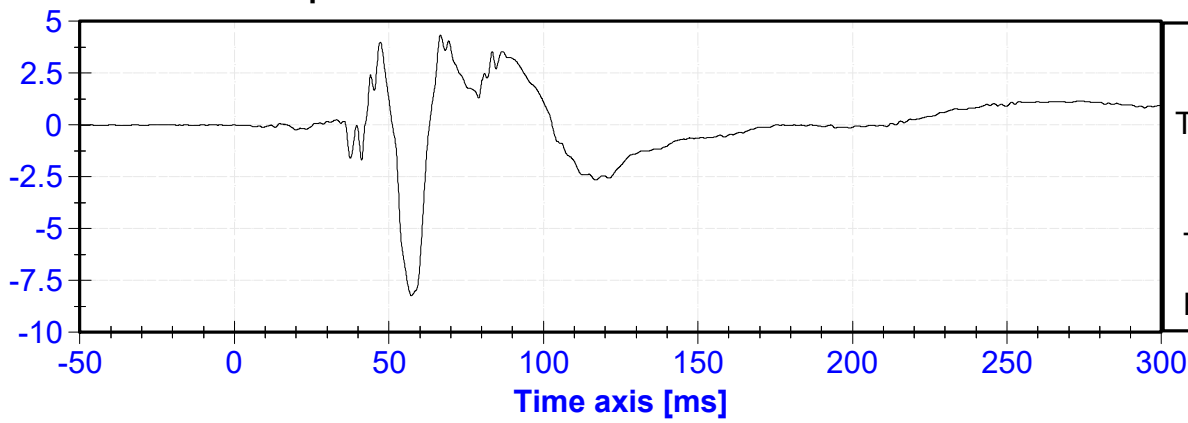
ACCELERATION [g's]



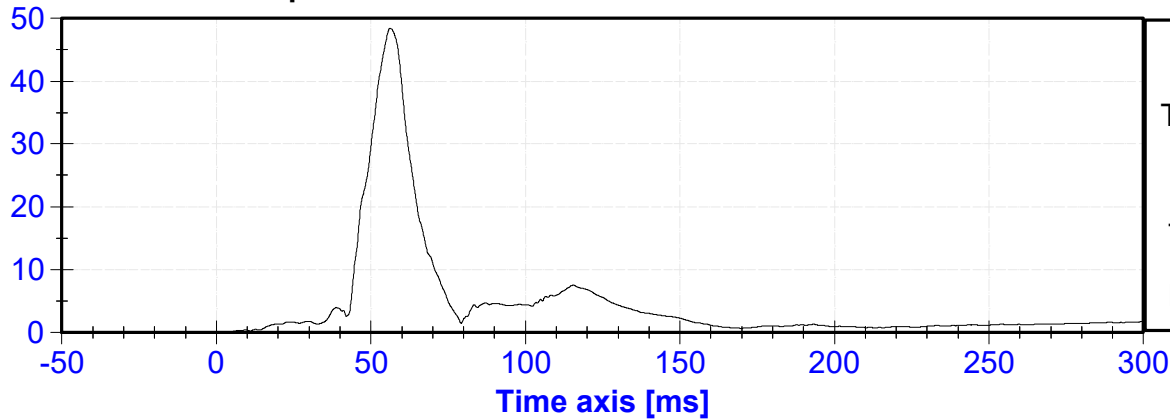
SID-IIs Lower Spine Y Acceleration vs. Time



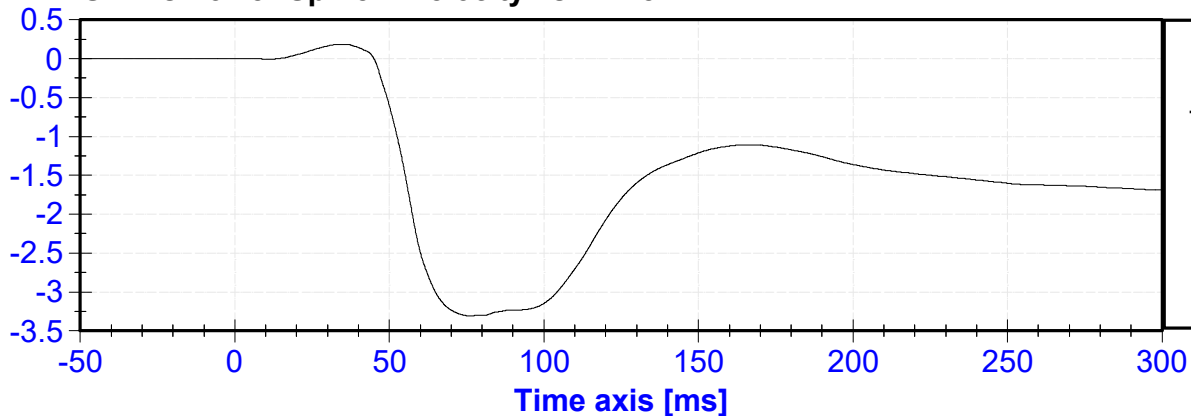
SID-IIs Lower Spine Z Acceleration vs. Time



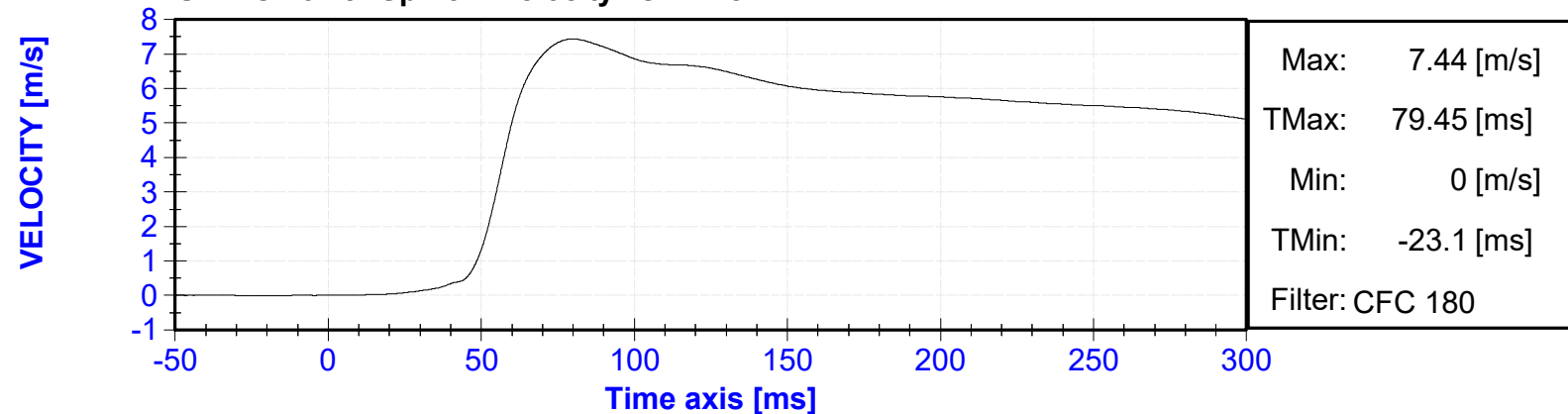
SID-IIs Lower Spine Resultant Acceleration vs. Time



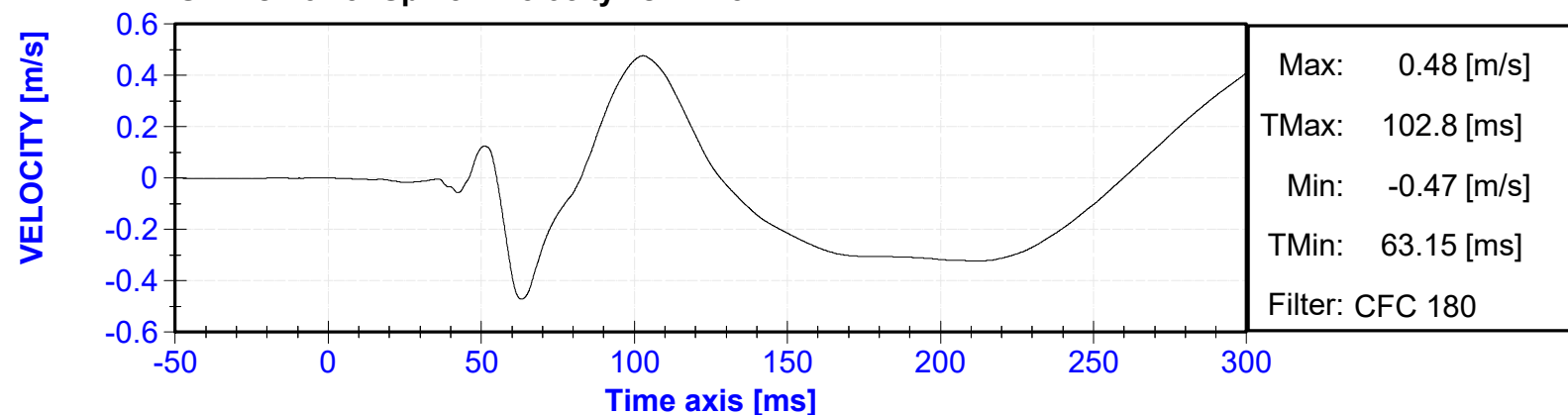
SID-IIs Lower Spine X Velocity vs. Time



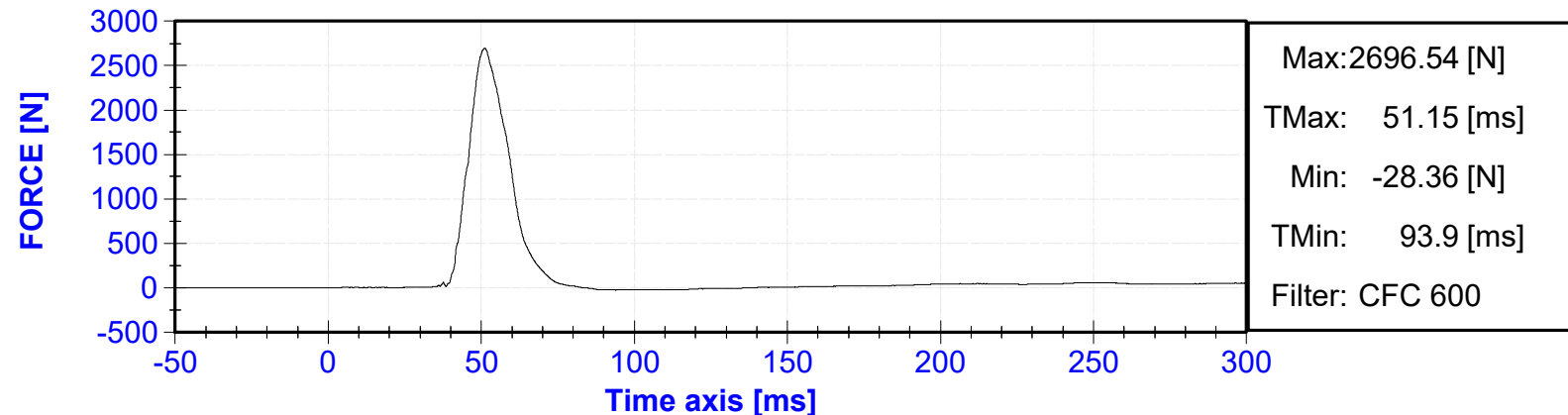
SID-IIs Lower Spine Y Velocity vs. Time



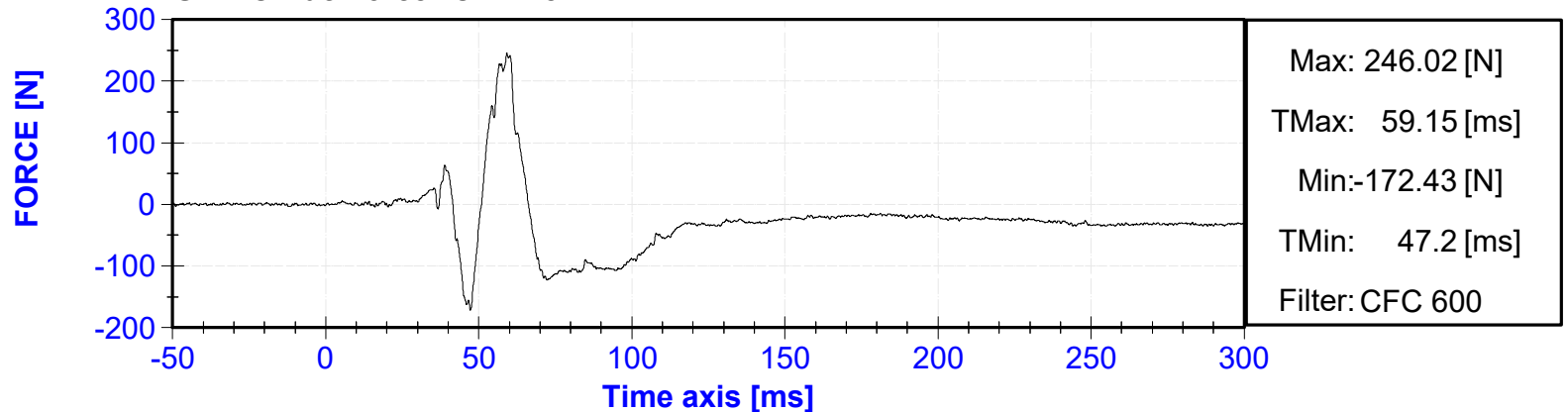
SID-IIs Lower Spine Z Velocity vs. Time



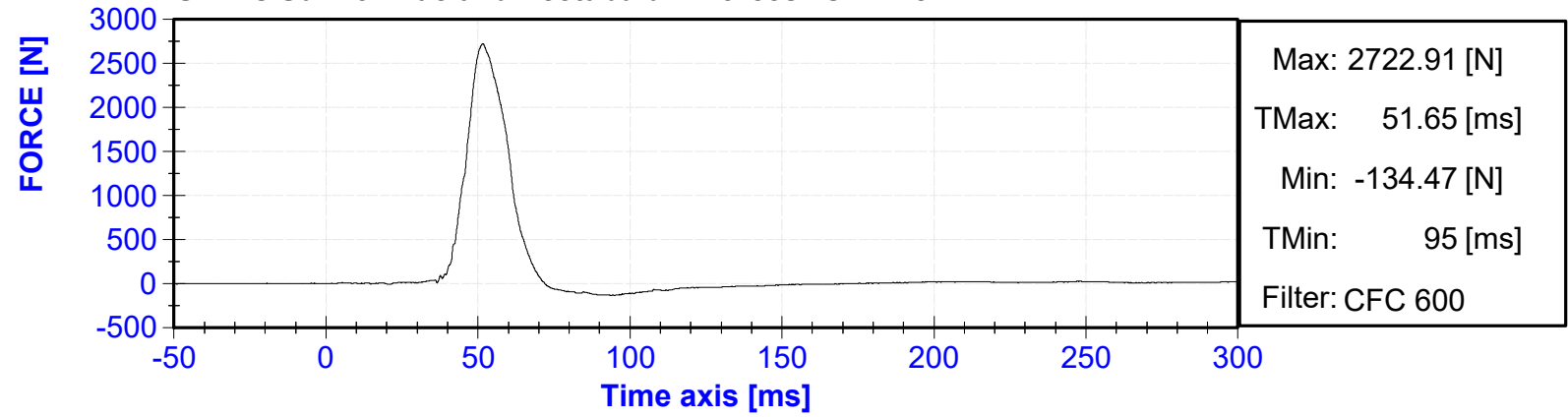
SID-IIs Acetabulum Force vs. Time



SID-IIs Iliac Force vs. Time



SID-IIs Sum of Iliac and Acetabulum Forces vs. Time



APPENDIX IV
VEHICLE AND MDB ACCELEROMETER RESPONSE
DATA

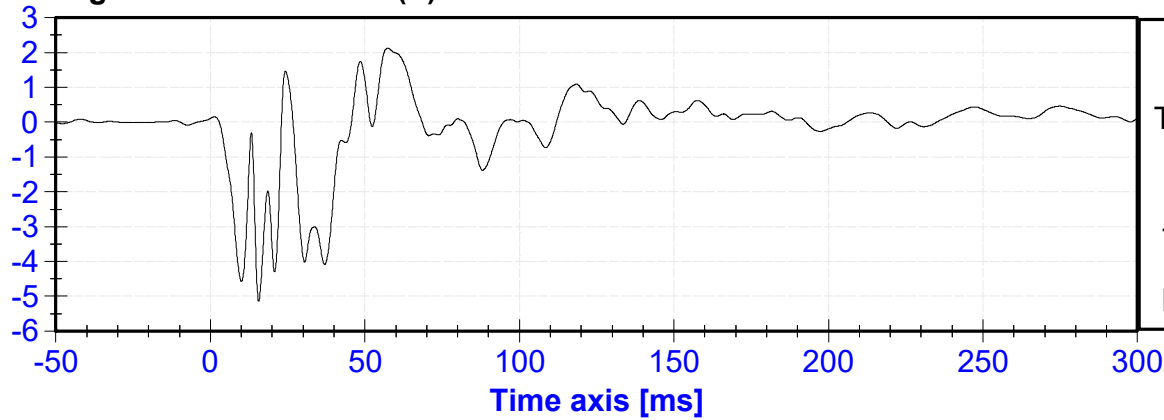
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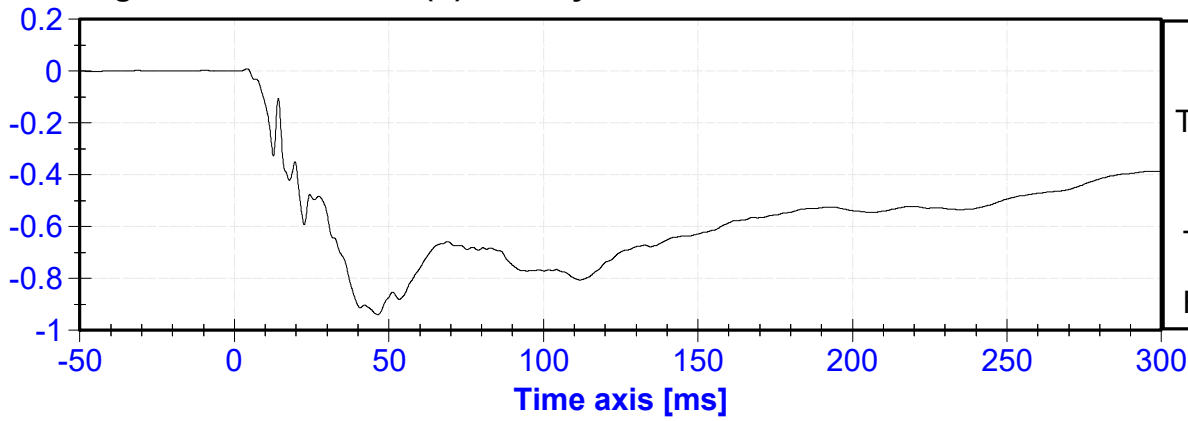
Right Sill at Front Seat (X) Acceleration vs. Time

ACCELERATION [g's]



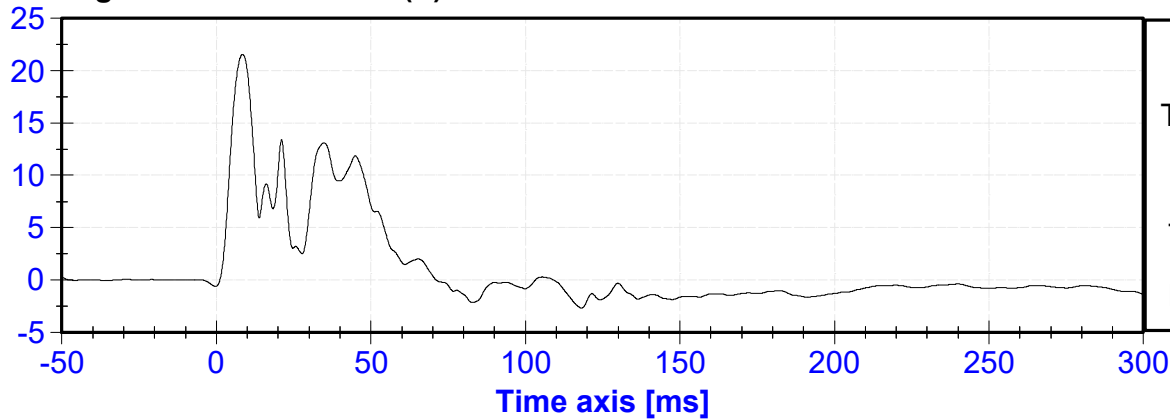
Right Sill at Front Seat (X) Velocity vs. Time

VELOCITY [m/s]



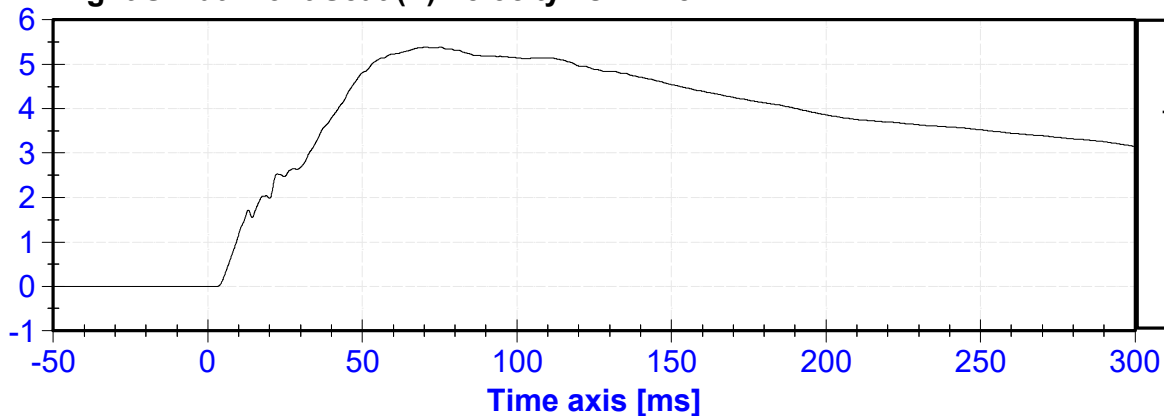
Right Sill at Front Seat (Y) Acceleration vs. Time

ACCELERATION [g's]

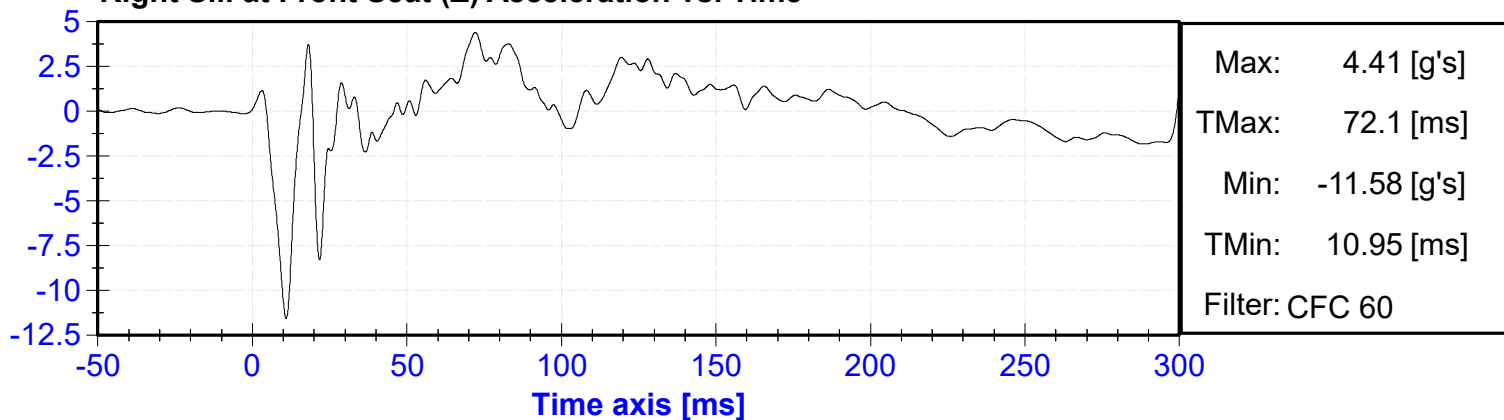


Right Sill at Front Seat (Y) Velocity vs. Time

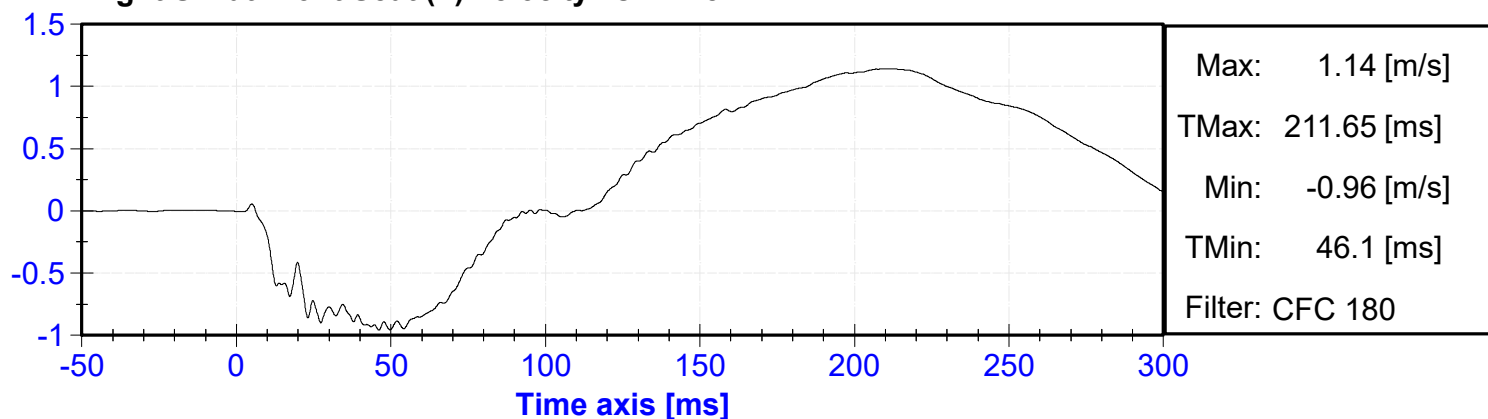
VELOCITY [m/s]



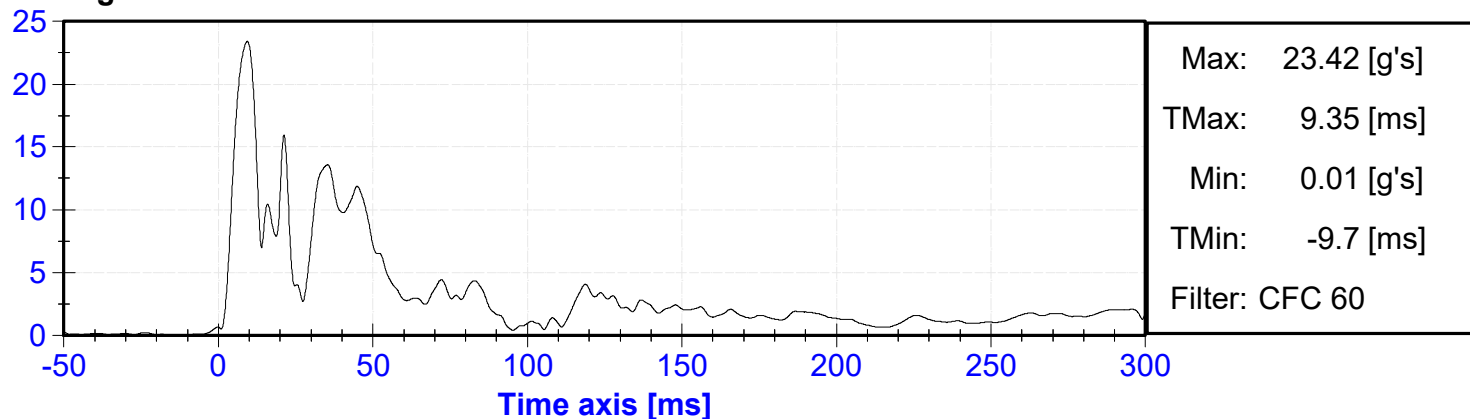
Right Sill at Front Seat (Z) Acceleration vs. Time



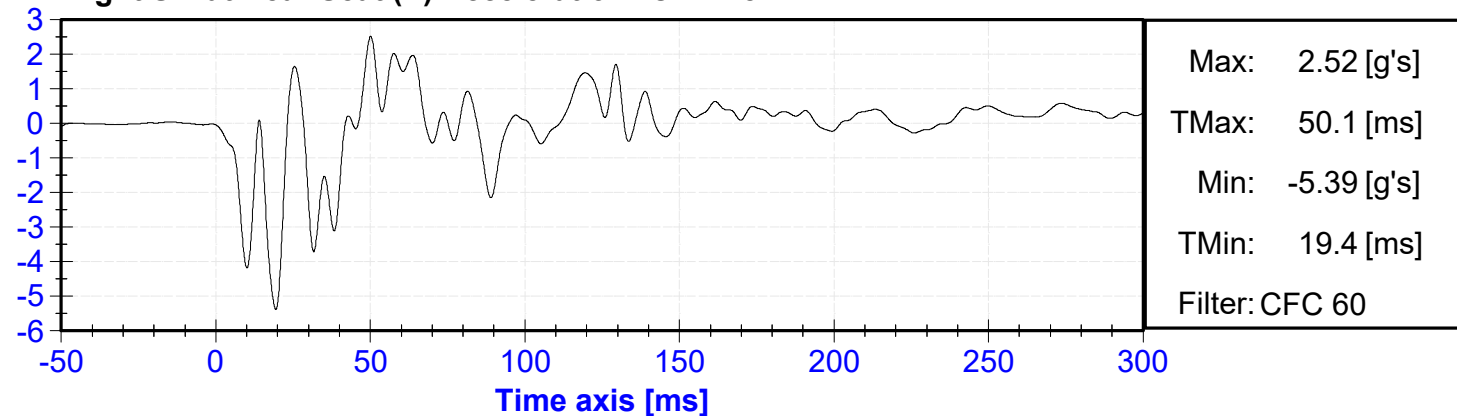
Right Sill at Front Seat (Z) Velocity vs. Time



Right Sill at Front Seat Resultant vs. Time

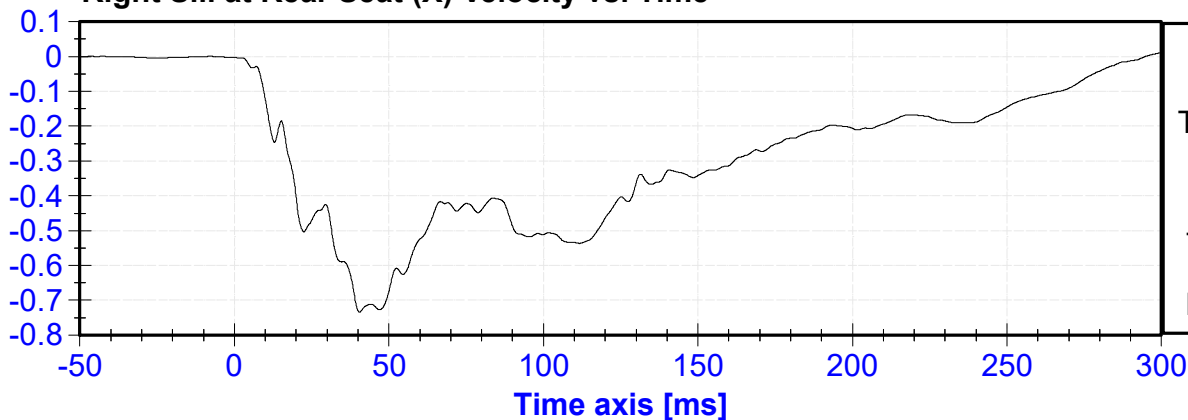


Right Sill at Rear Seat (X) Acceleration vs. Time



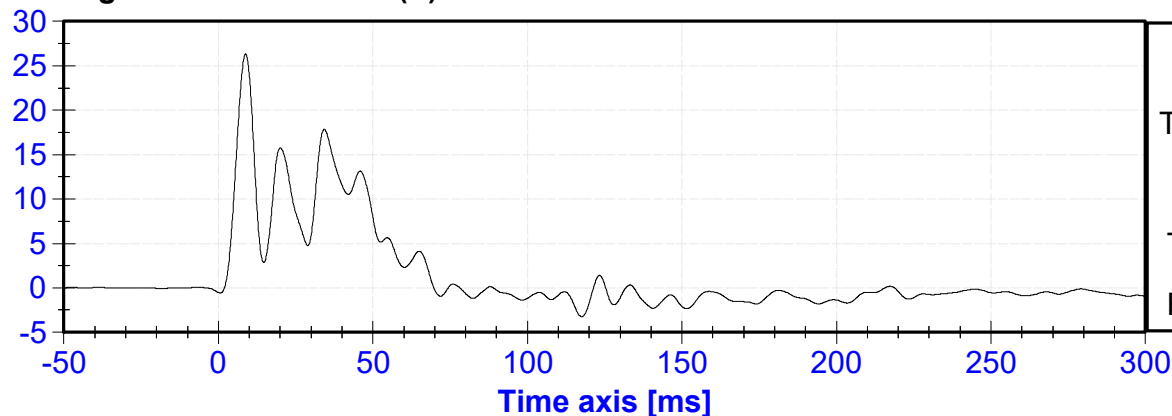
Right Sill at Rear Seat (X) Velocity vs. Time

VELOCITY [m/s]



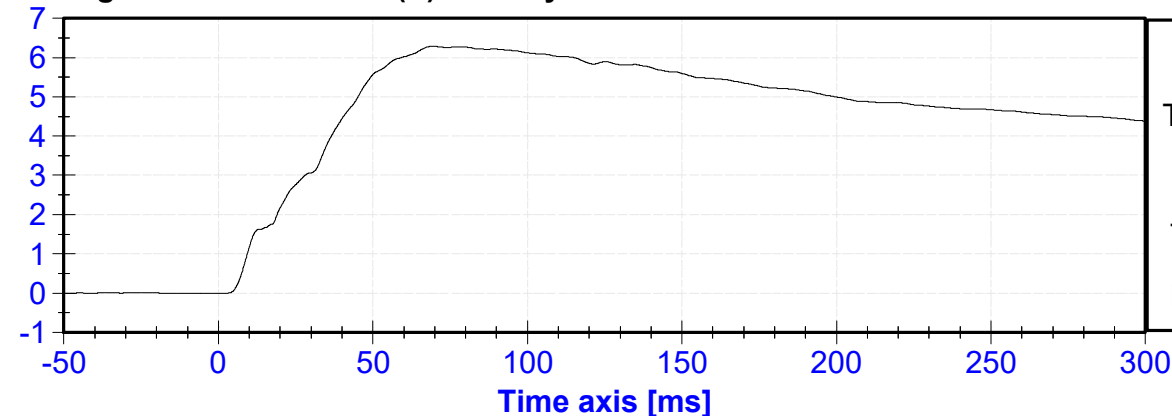
Right Sill at Rear Seat (Y) Acceleration vs. Time

ACCELERATION [g's]



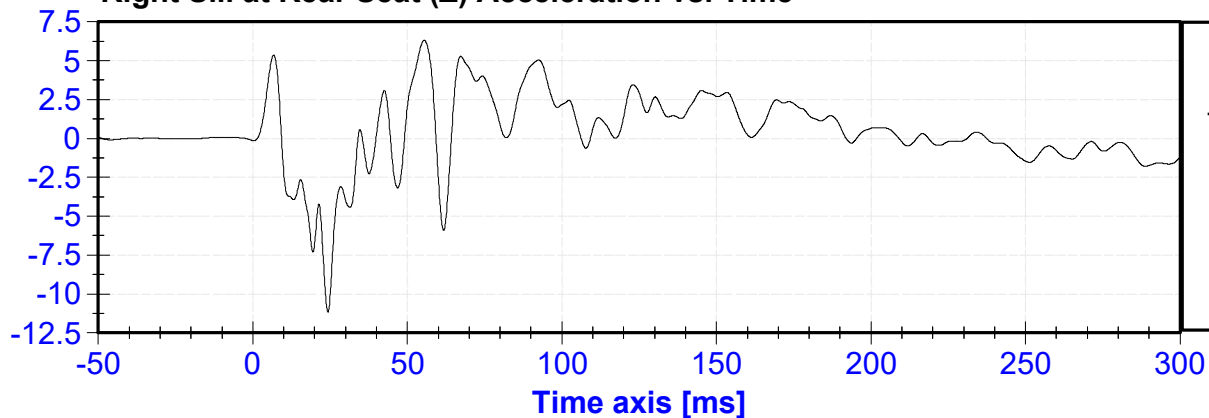
Right Sill at Rear Seat (Y) Velocity vs. Time

VELOCITY [m/s]



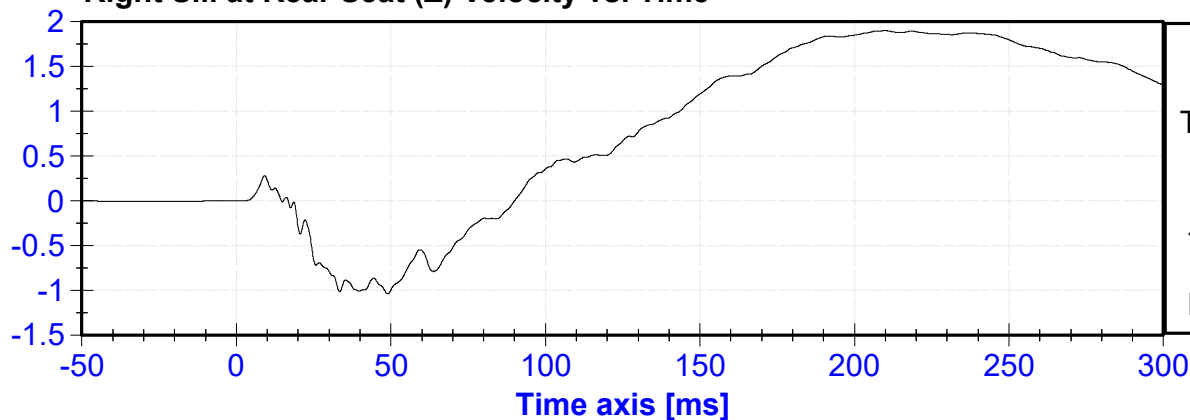
Right Sill at Rear Seat (Z) Acceleration vs. Time

ACCELERATION [g's]



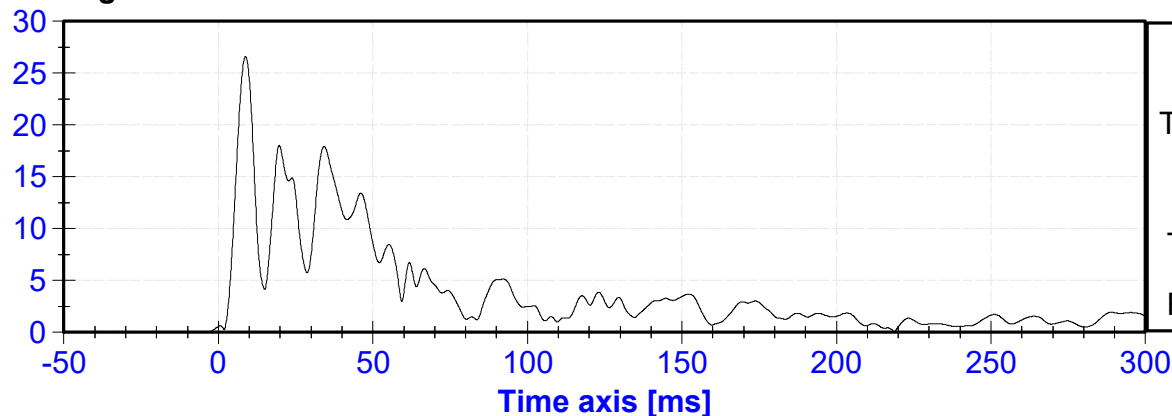
Right Sill at Rear Seat (Z) Velocity vs. Time

VELOCITY [m/s]



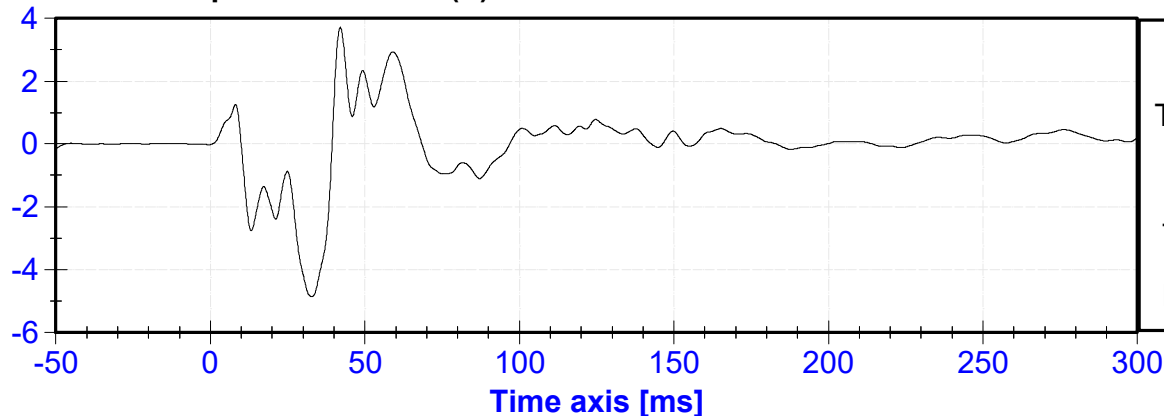
Right Sill at Rear Seat Resultant Acceleration vs. Time

ACCELERATION [g's]



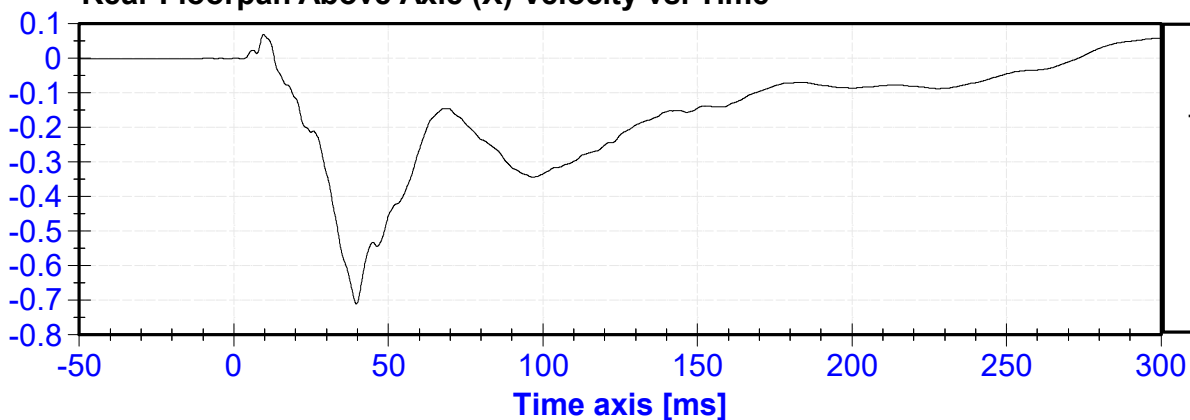
Rear Floorpan Above Axle (X) Acceleration vs. Time

ACCELERATION [g's]



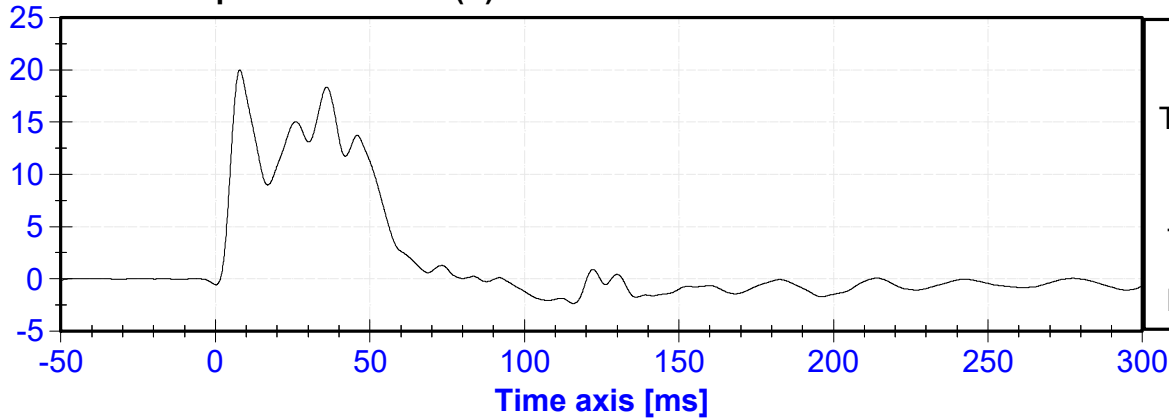
Rear Floorpan Above Axle (X) Velocity vs. Time

VELOCITY [m/s]



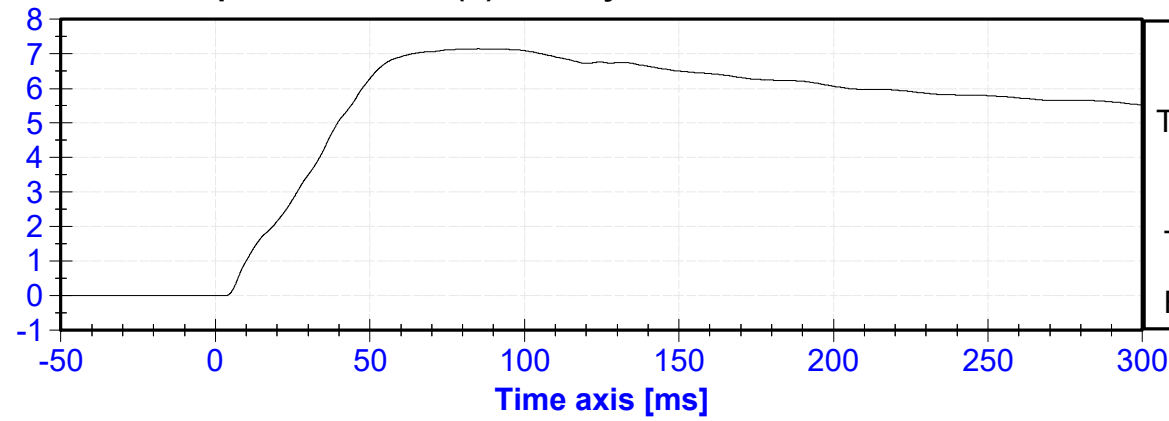
Rear Floorpan Above Axle (Y) Acceleration vs. Time

ACCELERATION [g's]



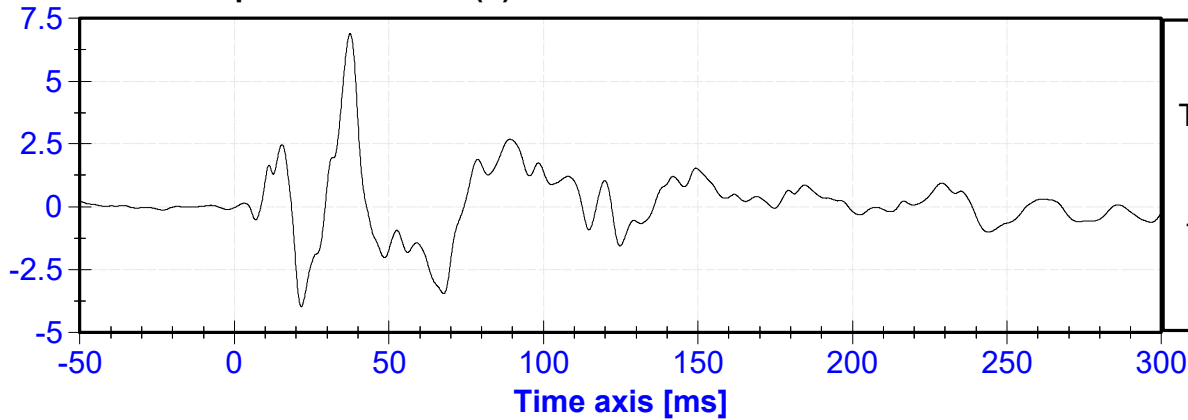
Rear Floorpan Above Axle (Y) Velocity vs. Time

VELOCITY [m/s]



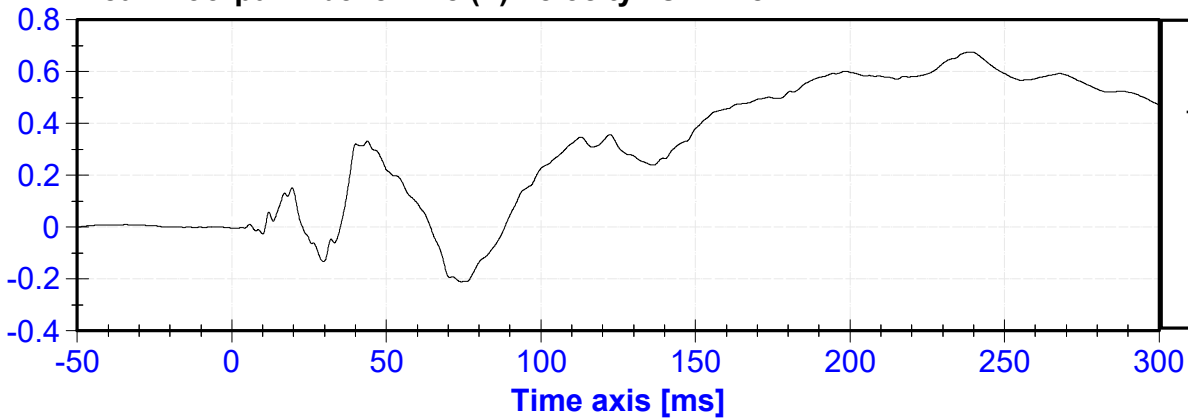
Rear Floorpan Above Axle (Z) Acceleration vs. Time

ACCELERATION [g's]

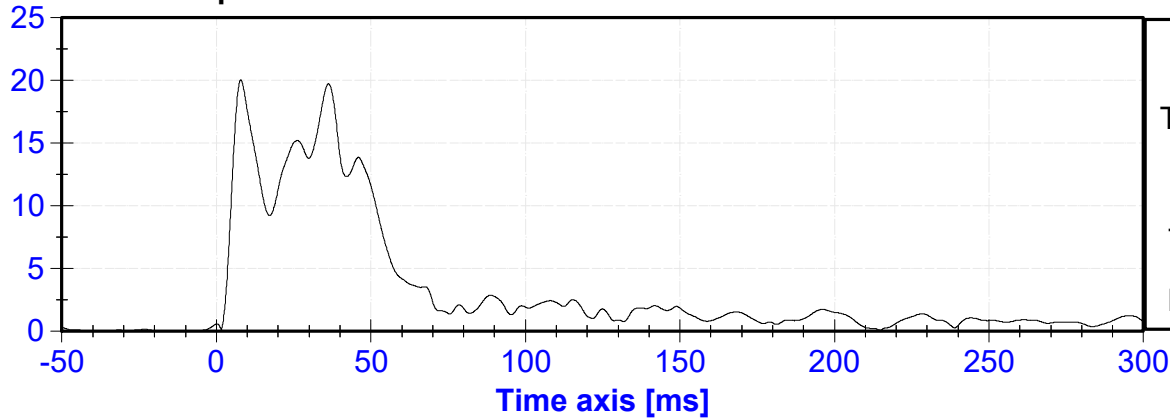


Rear Floorpan Above Axle (Z) Velocity vs. Time

VELOCITY [m/s]

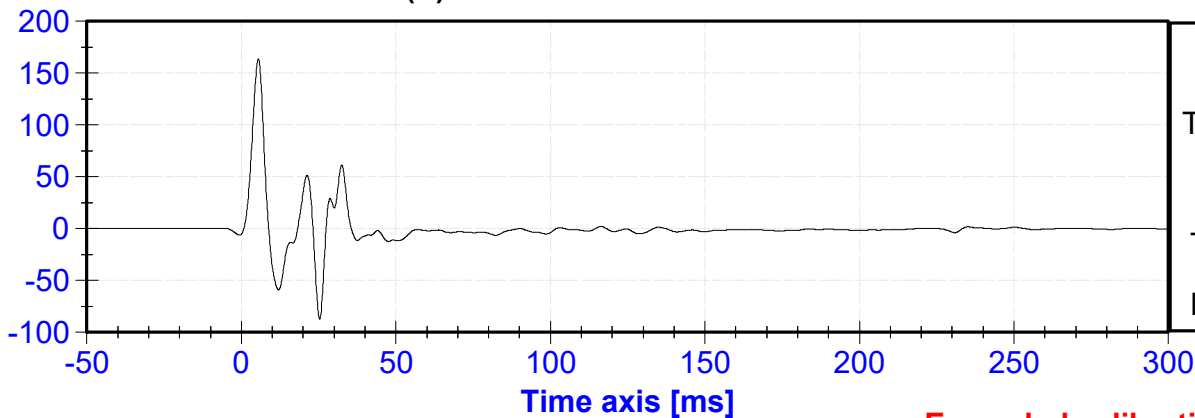


Rear Floorpan Above Axle Resultant Acceleration vs. Time



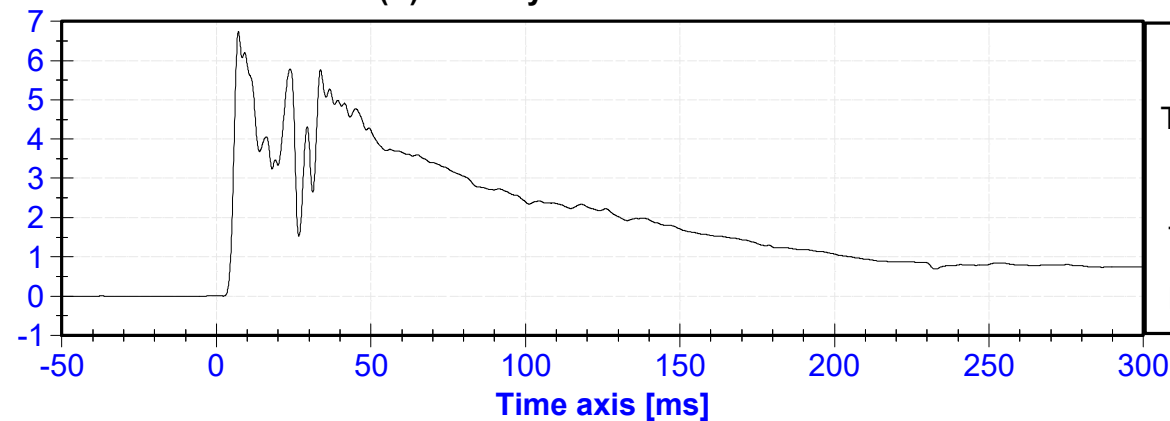
Exceeded calibration range at 25.3 ms

Left Sill at Rear Door (Y) Acceleration vs. Time

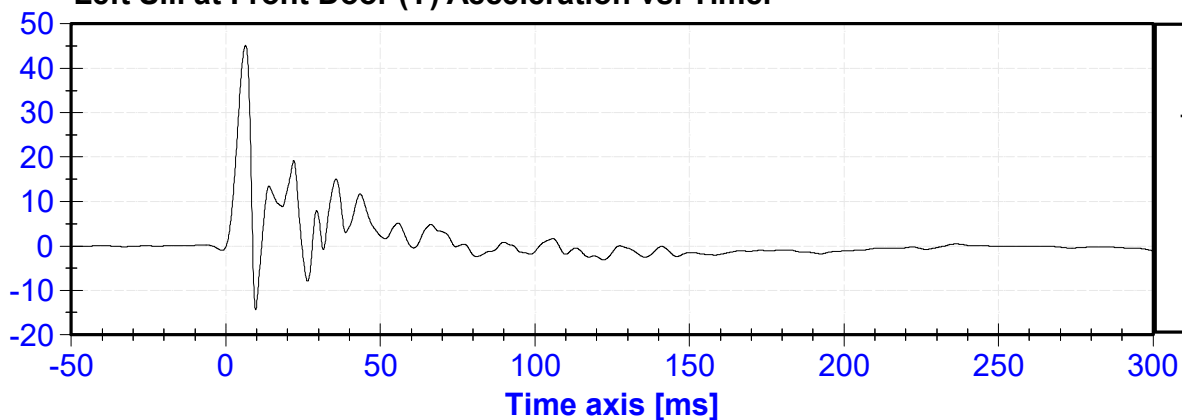


Exceeded calibration range at 25.3 ms

Left Sill at Rear Door (Y) Velocity vs. Time

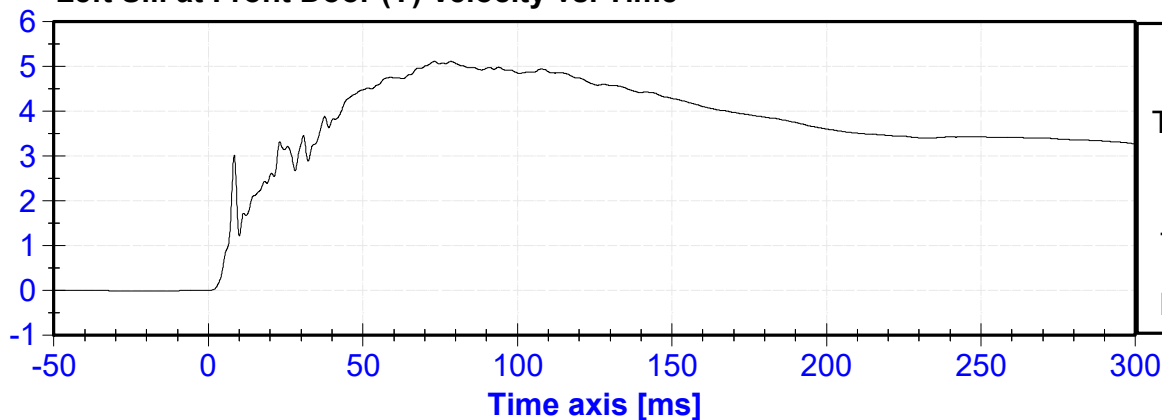


Left Sill at Front Door (Y) Acceleration vs. Time.



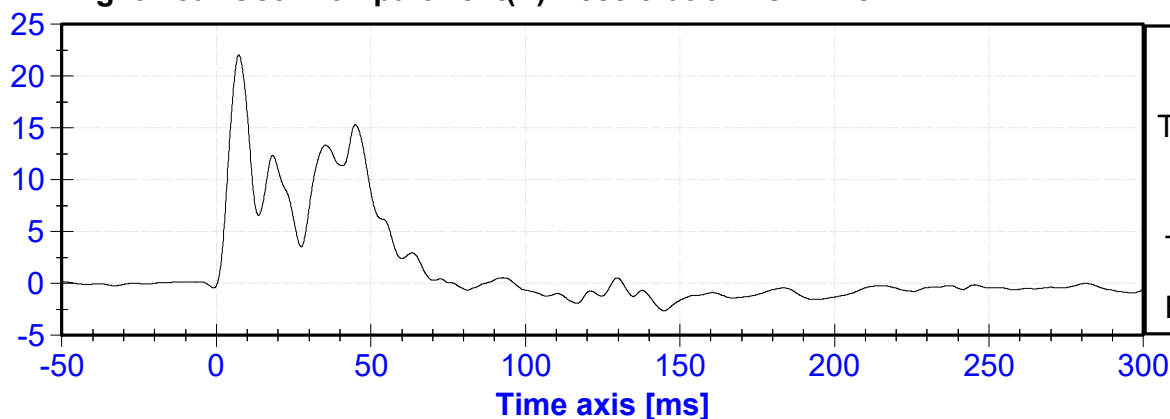
Left Sill at Front Door (Y) Velocity vs. Time

VELOCITY [m/s]



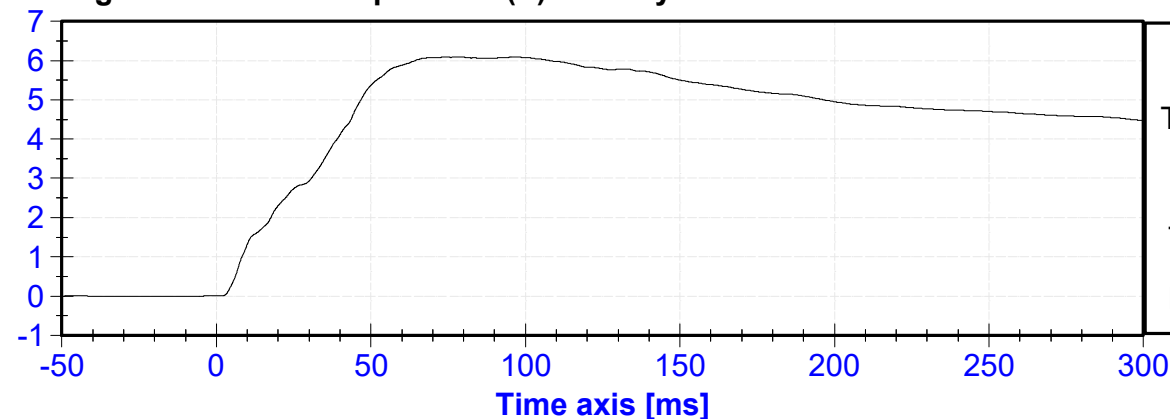
Right Rear Occ. Compartment(Y) Acceleration vs. Time

ACCELERATION [g's]



Right Rear Occ. Compartment(Y) Velocity vs. Time

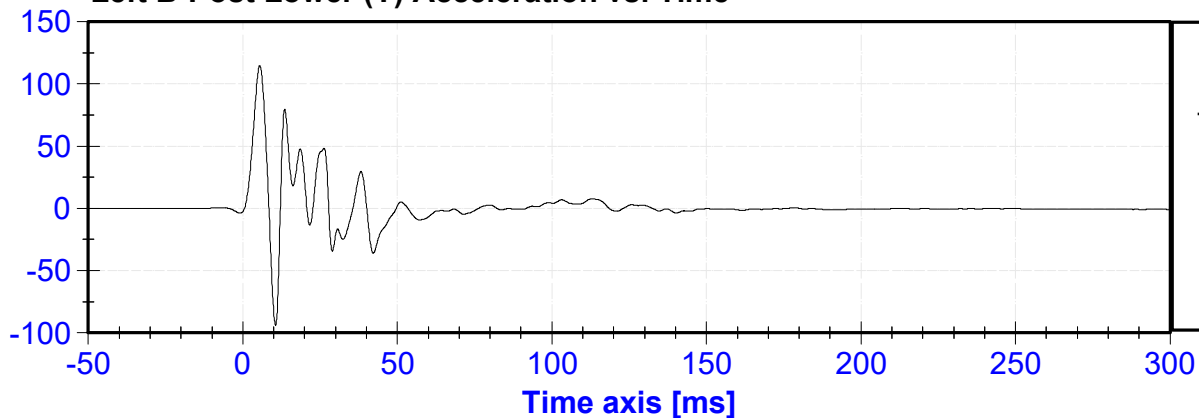
VELOCITY [m/s]



Exceeded calibration range at 10.4 ms 26.9 ms

Left B-Post Lower (Y) Acceleration vs. Time

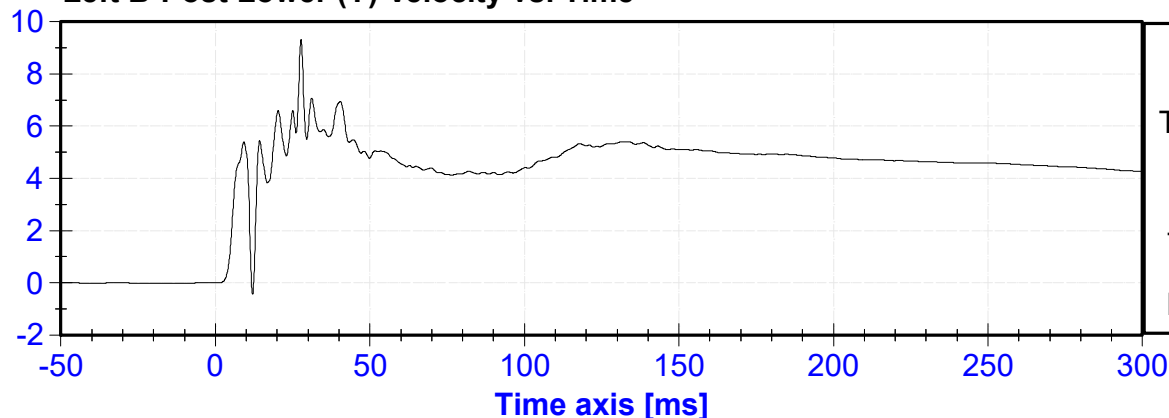
ACCELERATION [g's]



Exceeded calibration range at 10.4 ms 26.9 ms

Left B-Post Lower (Y) Velocity vs. Time

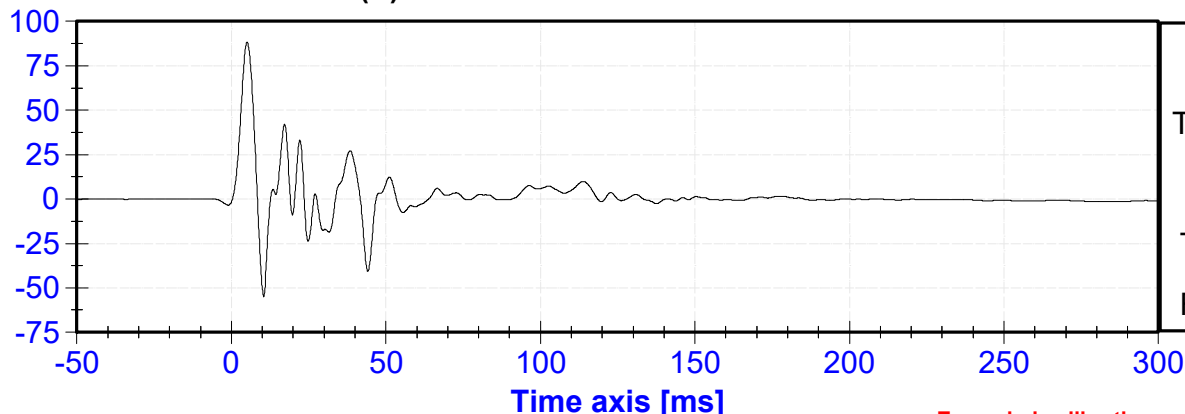
VELOCITY [m/s]



Exceeded calibration range and saturated at 10.6 ms

Left B-Post Middle (Y) Acceleration vs. Time

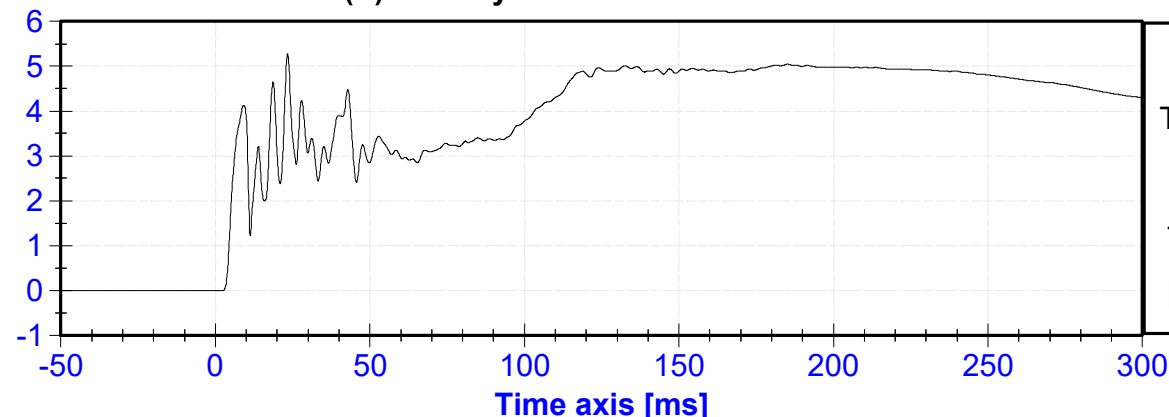
ACCELERATION [g's]



Exceeded calibration range and saturated at 10.6 ms

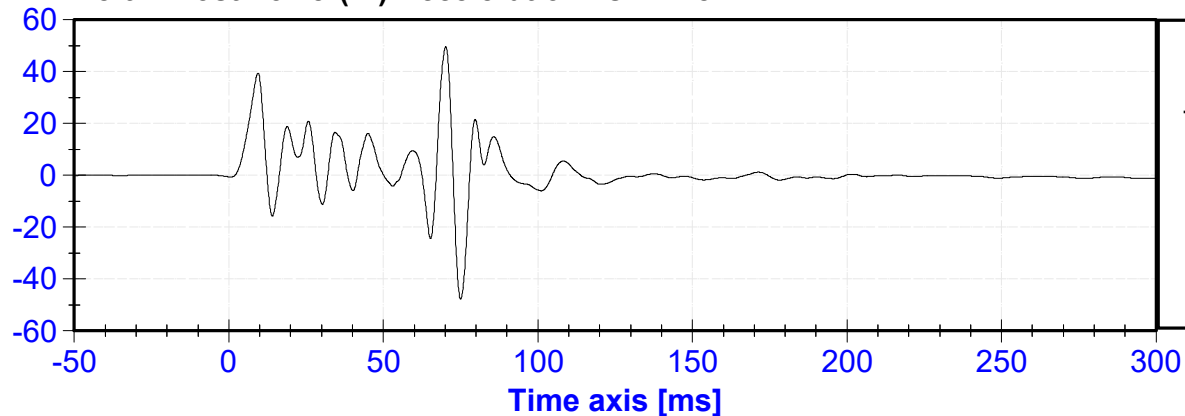
Left B-Post Middle (Y) Velocity vs. Time

VELOCITY [m/s]



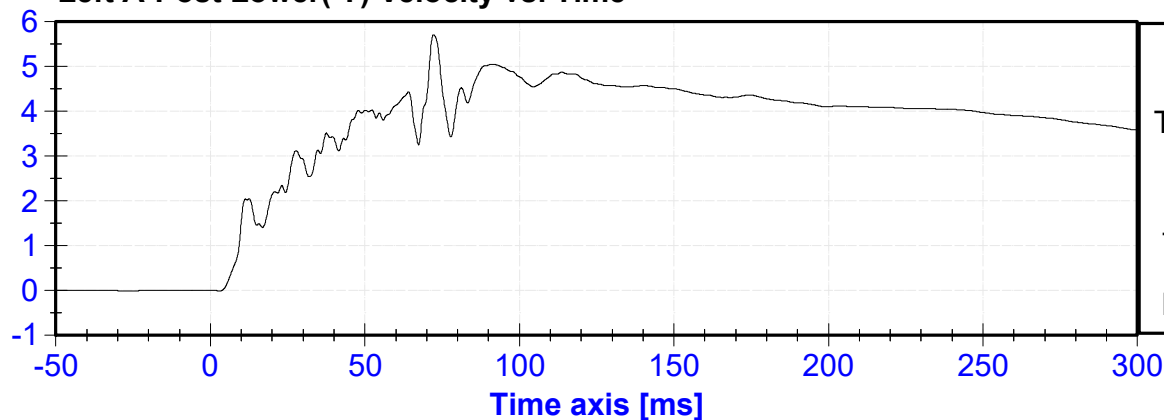
Left A-Post Lower (Y) Acceleration vs. Time

ACCELERATION [g's]



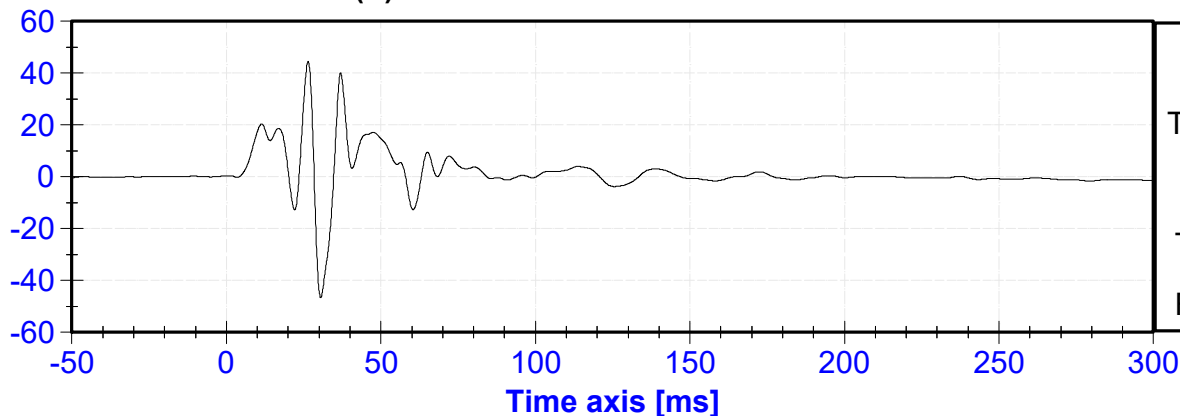
Left A-Post Lower (Y) Velocity vs. Time

VELOCITY [m/s]



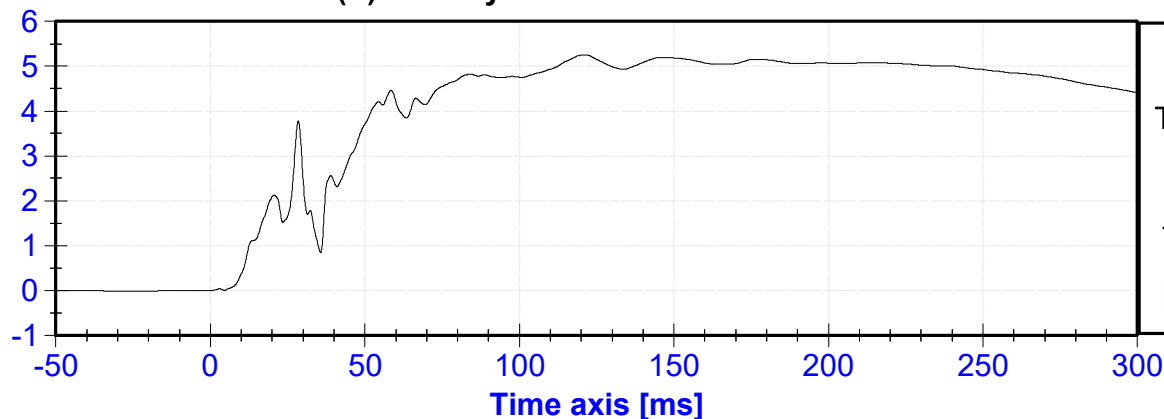
Left A-Post Middle (Y) Acceleration vs. Time

ACCELERATION [g's]



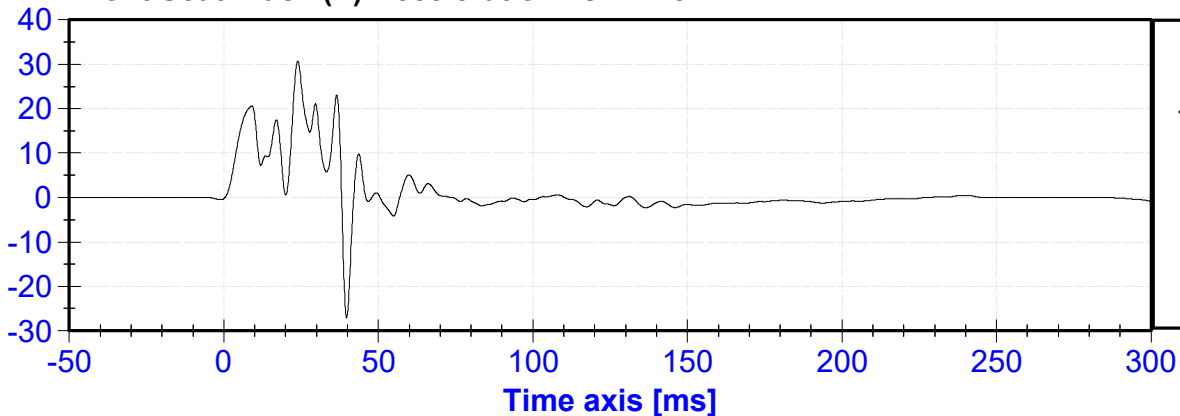
Left A-Post Middle (Y) Velocity vs. Time

VELOCITY [m/s]



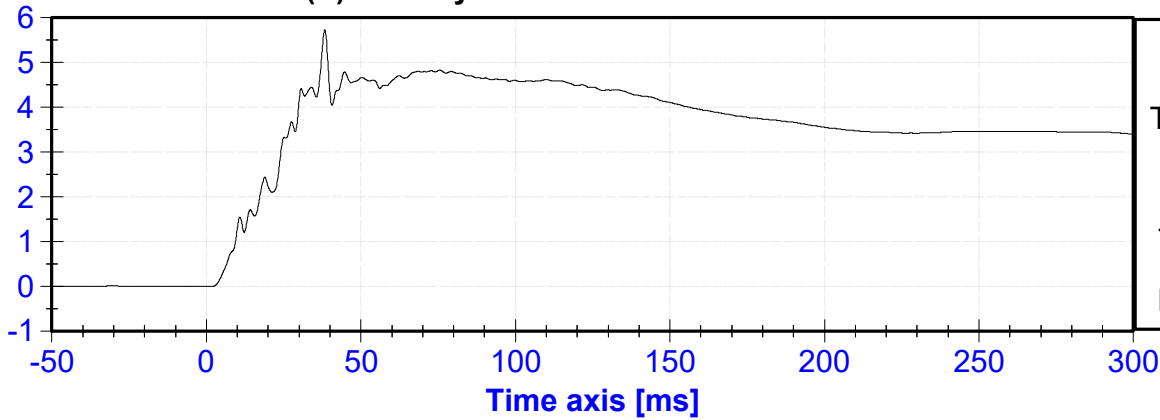
Front Seat Track (Y) Acceleration vs. Time

ACCELERATION [g's]



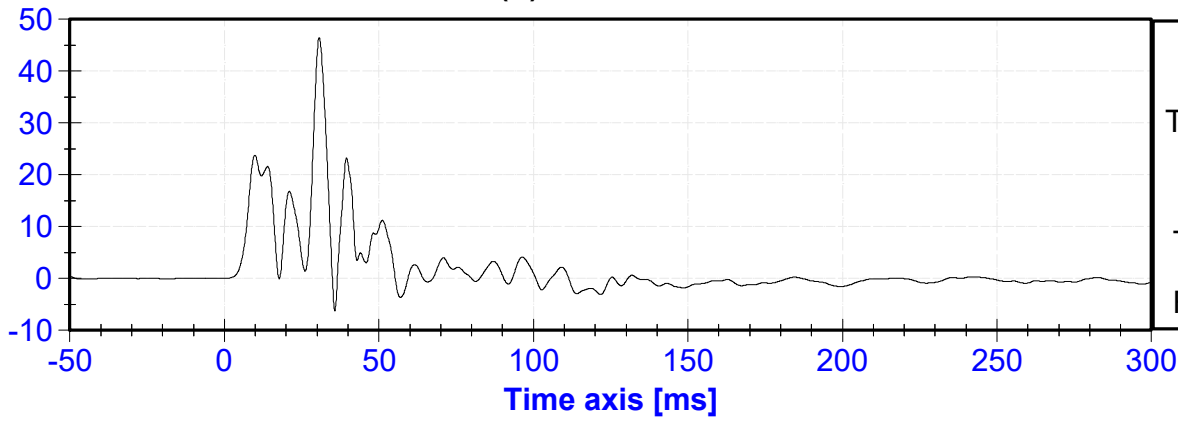
Front Seat Track (Y) Velocity vs. Time

VELOCITY [m/s]



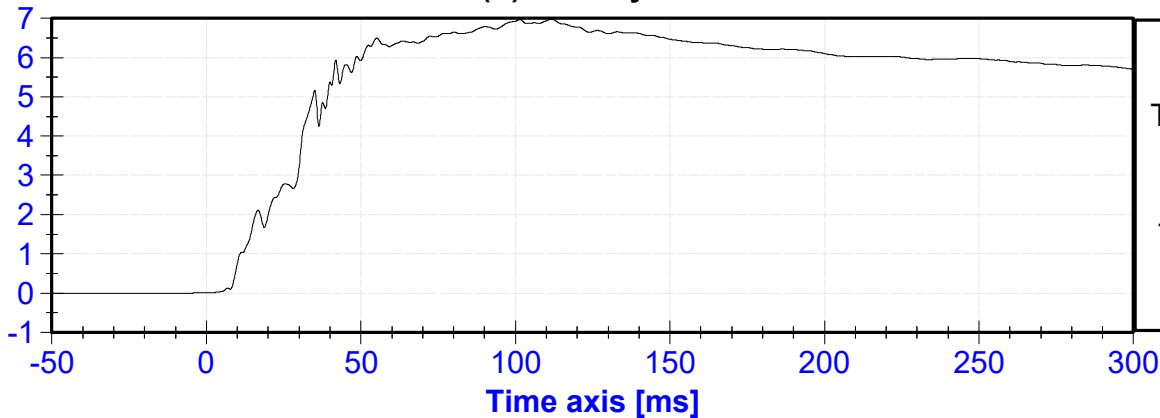
Rear Seat Track or Structure (Y) Acceleration vs. Time

ACCELERATION [g's]



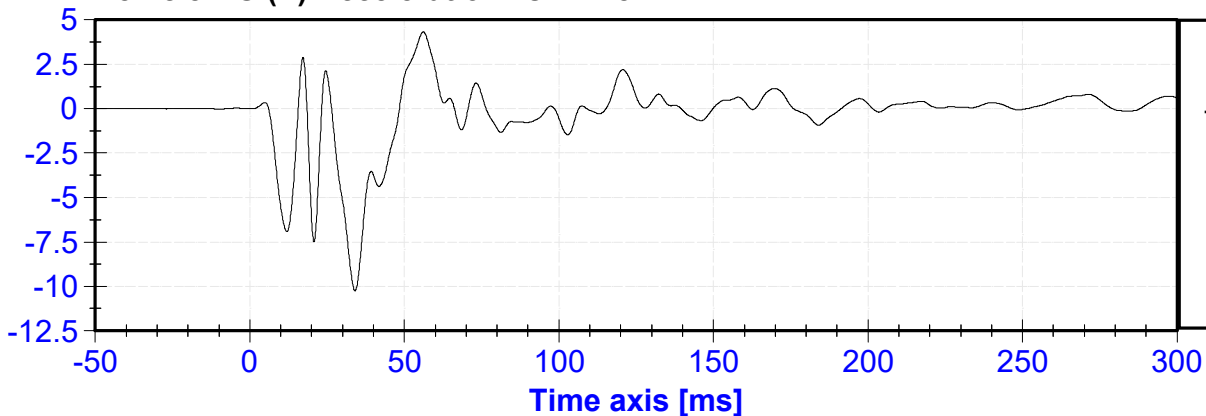
Rear Seat Track or Structure (Y) Velocity vs. Time

VELOCITY [m/s]

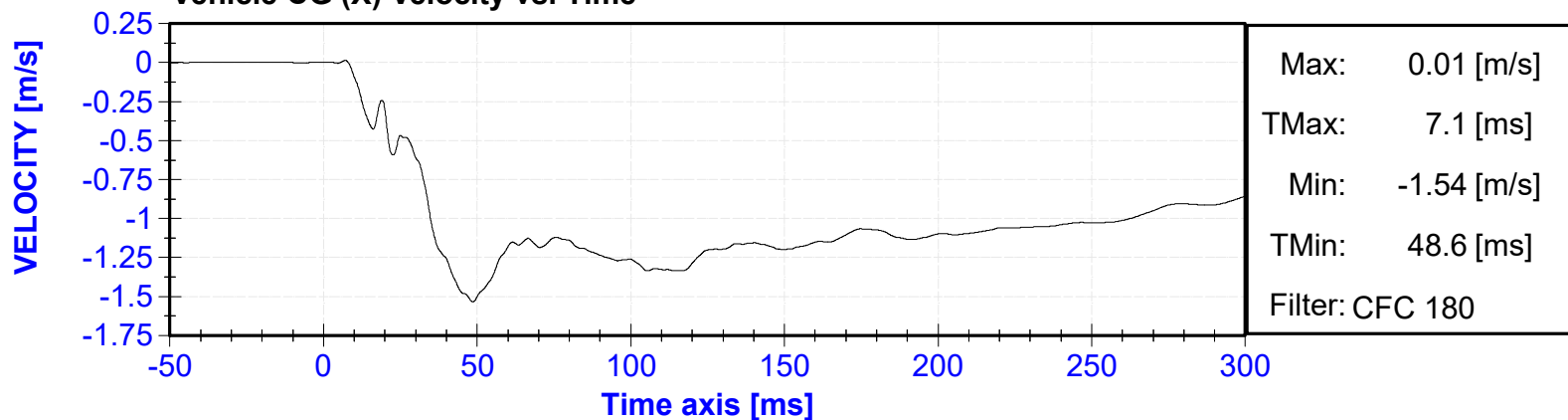


Vehicle CG (X) Acceleration vs. Time

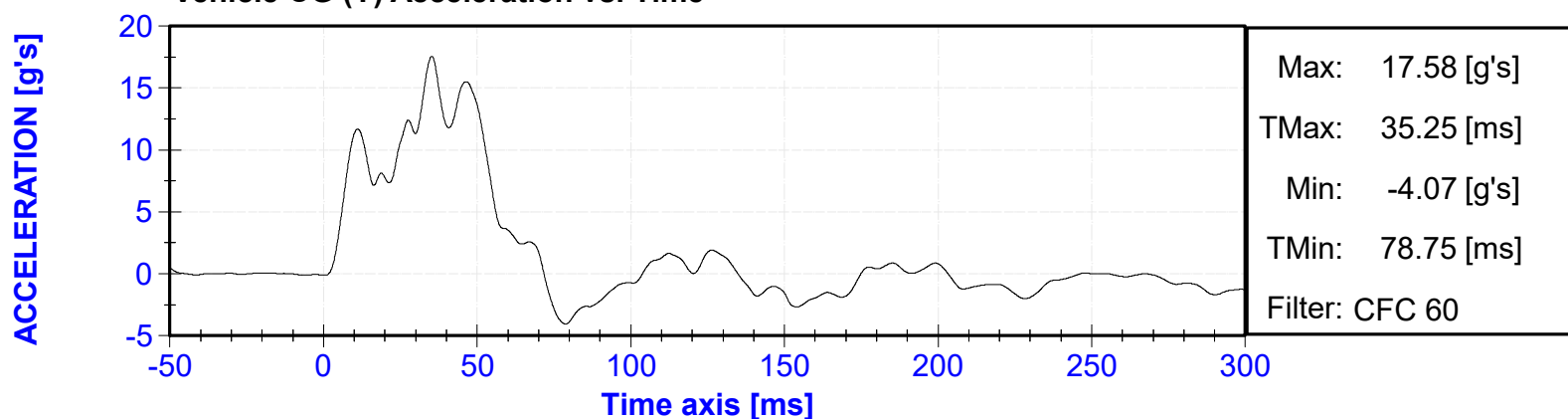
ACCELERATION [g's]



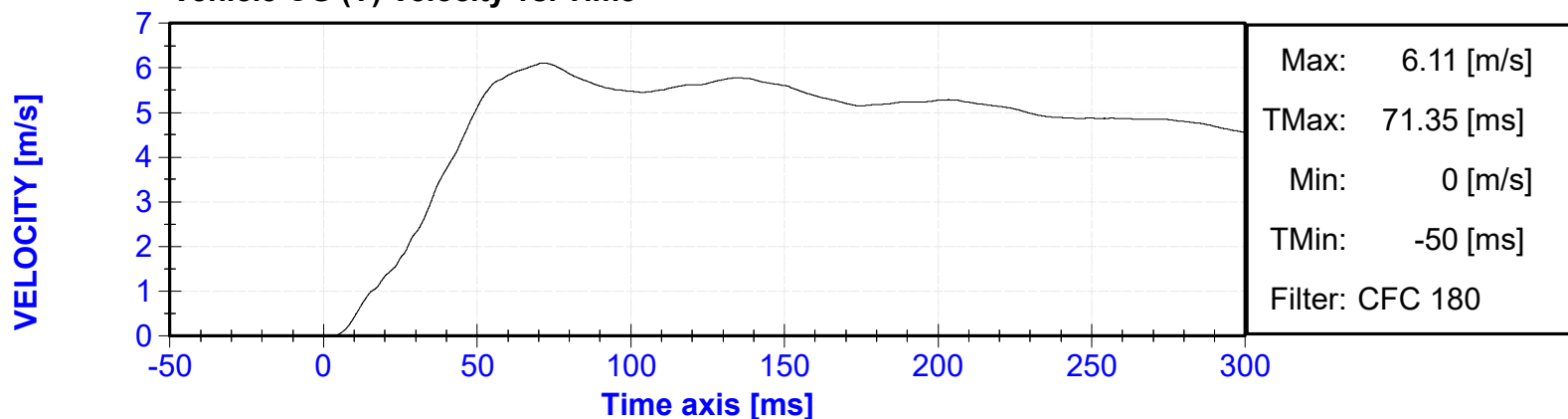
Vehicle CG (X) Velocity vs. Time



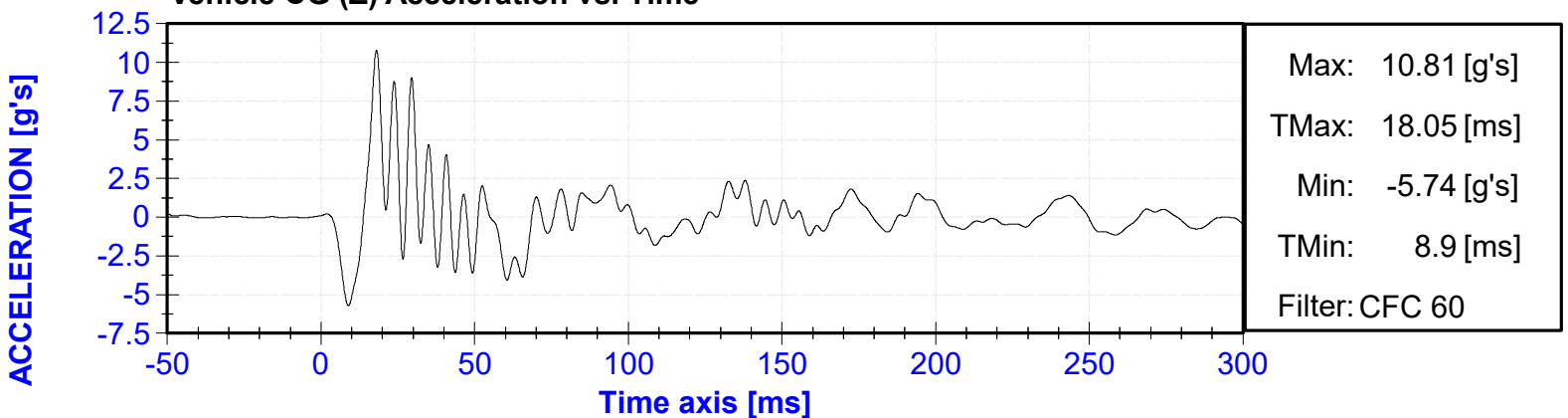
Vehicle CG (Y) Acceleration vs. Time



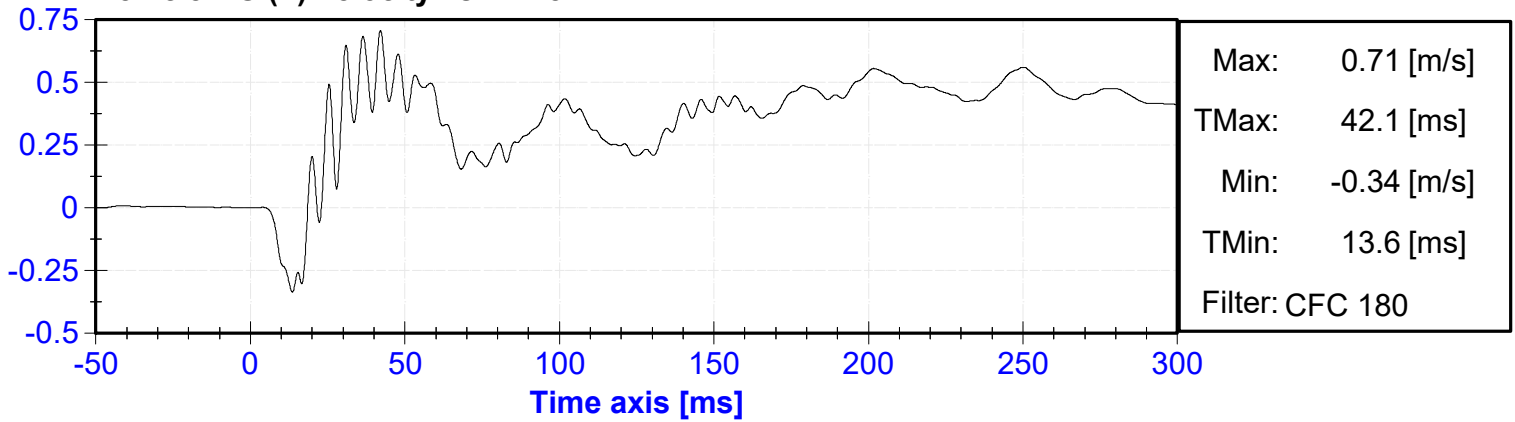
Vehicle CG (Y) Velocity vs. Time



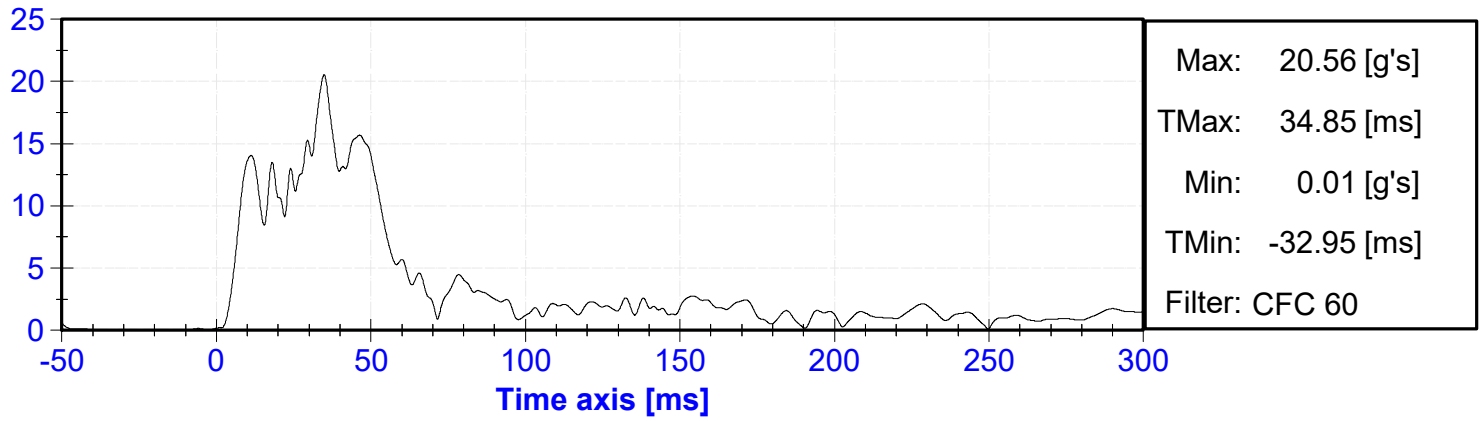
Vehicle CG (Z) Acceleration vs. Time



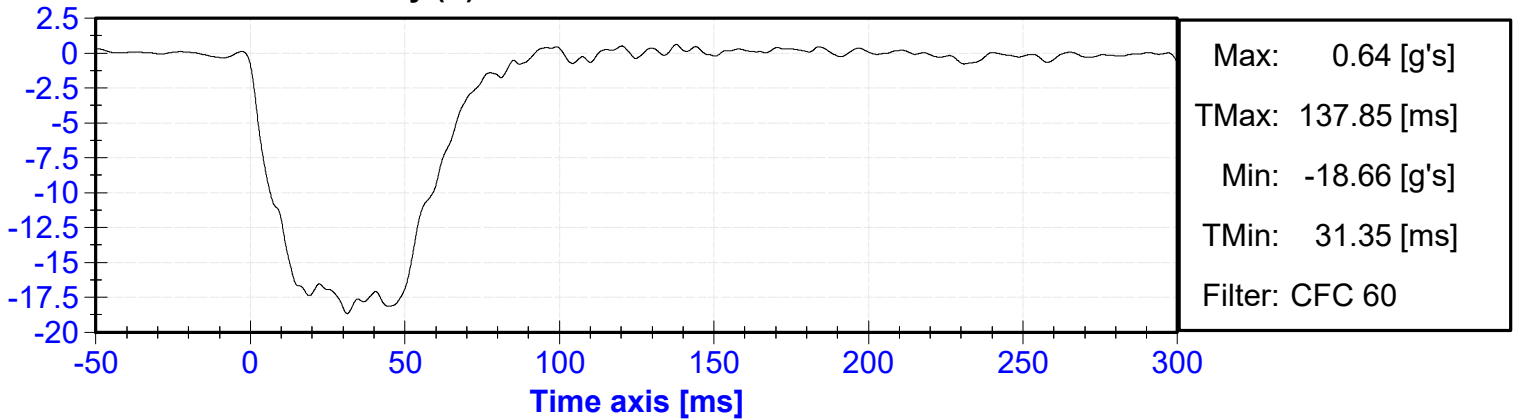
Vehicle CG (Z) Velocity vs. Time



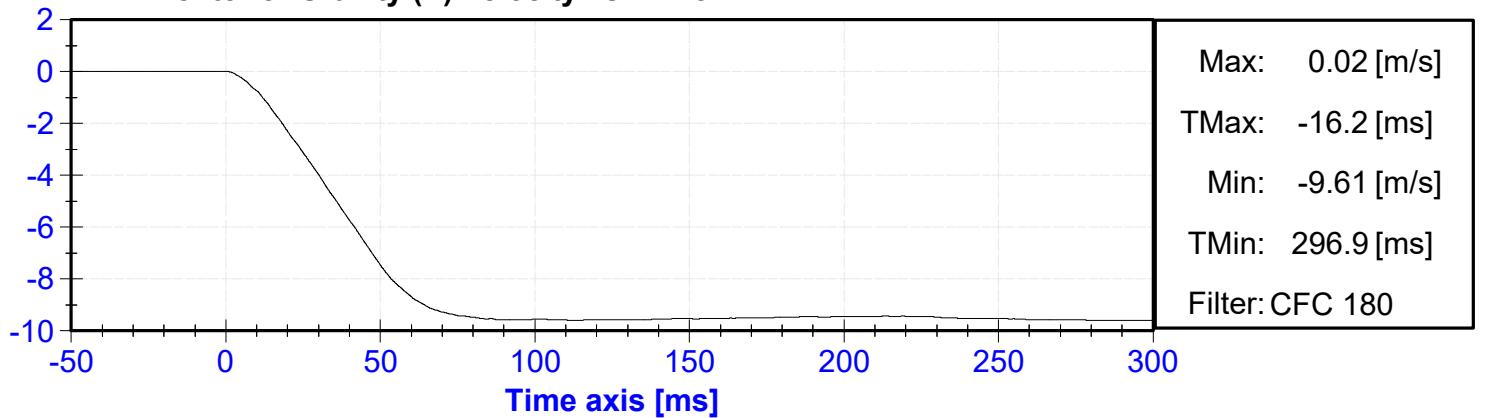
Vehicle CG Resultant Acceleration vs. Time



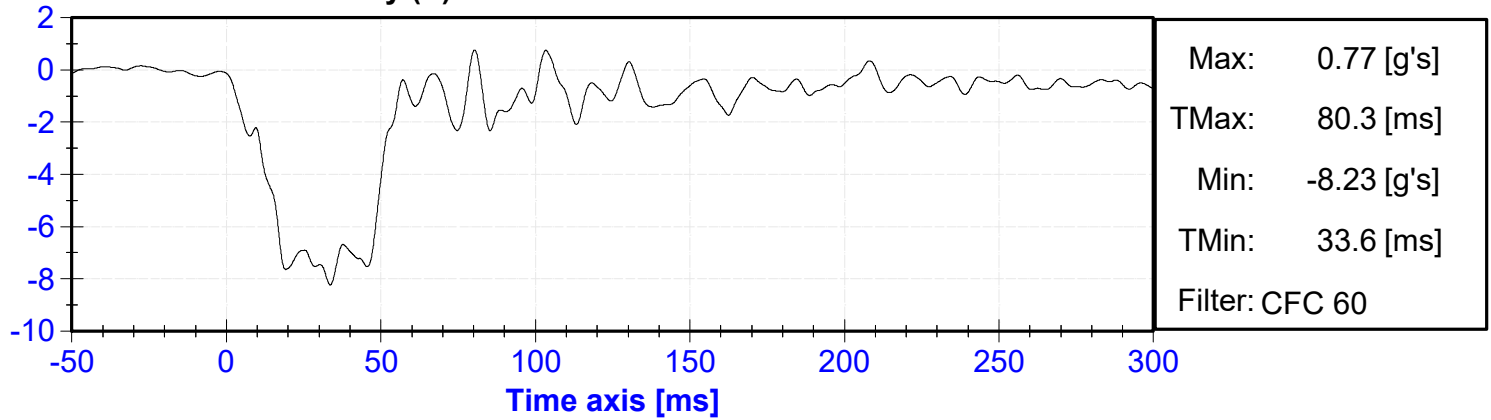
MDB Center of Gravity (X) Acceleration vs. Time



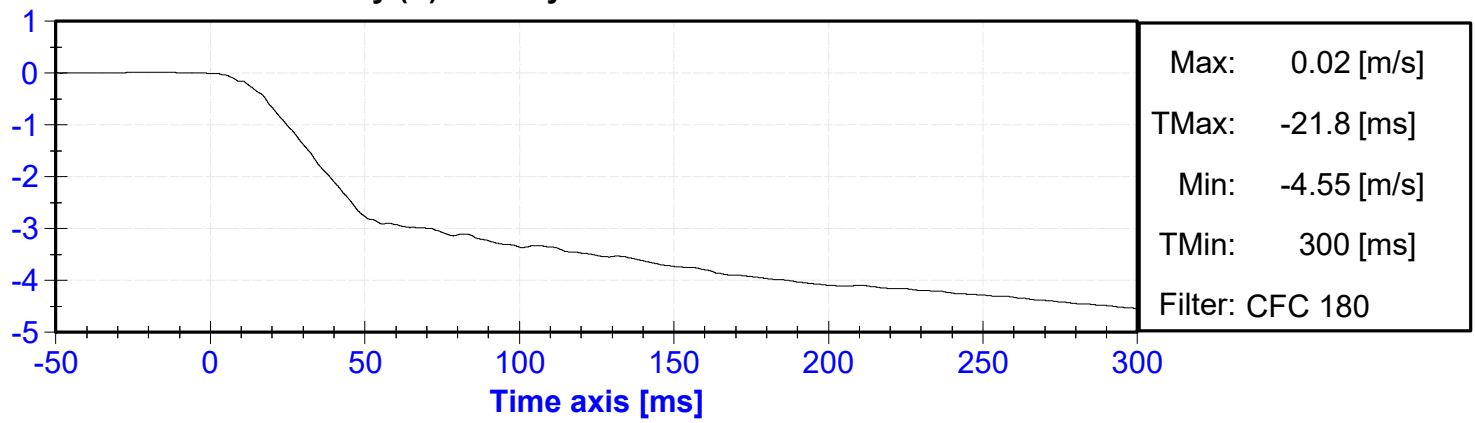
MDB Center of Gravity (X) Velocity vs. Time



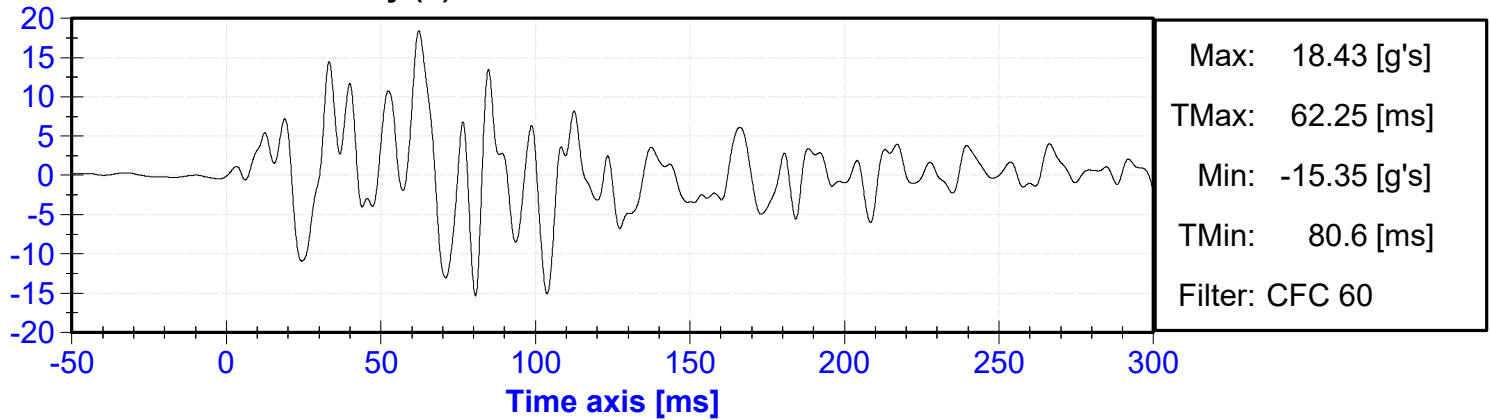
MDB Center of Gravity (Y) Acceleration vs. Time



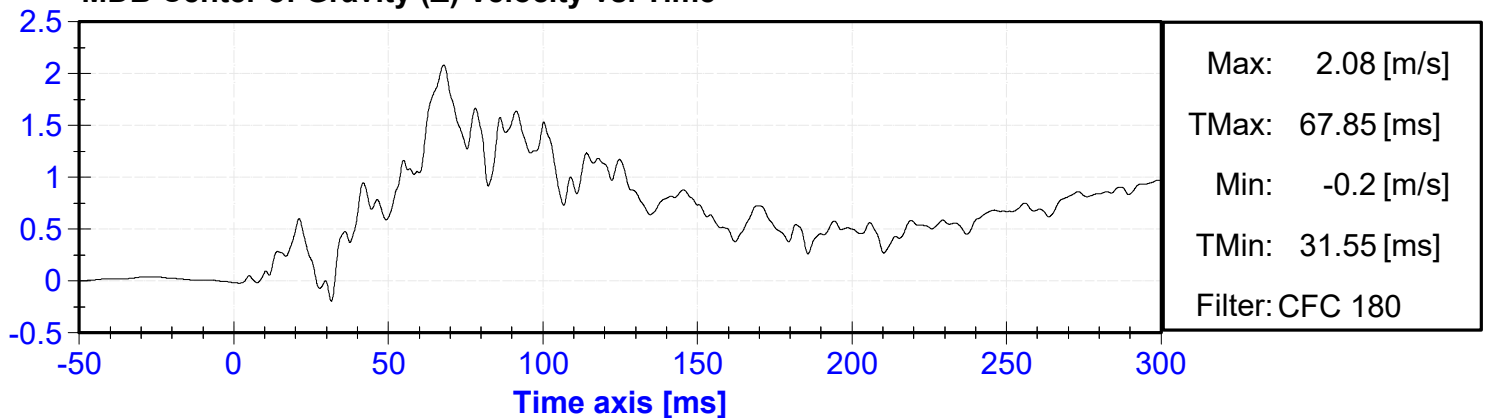
MDB Center of Gravity (Y) Velocity vs. Time



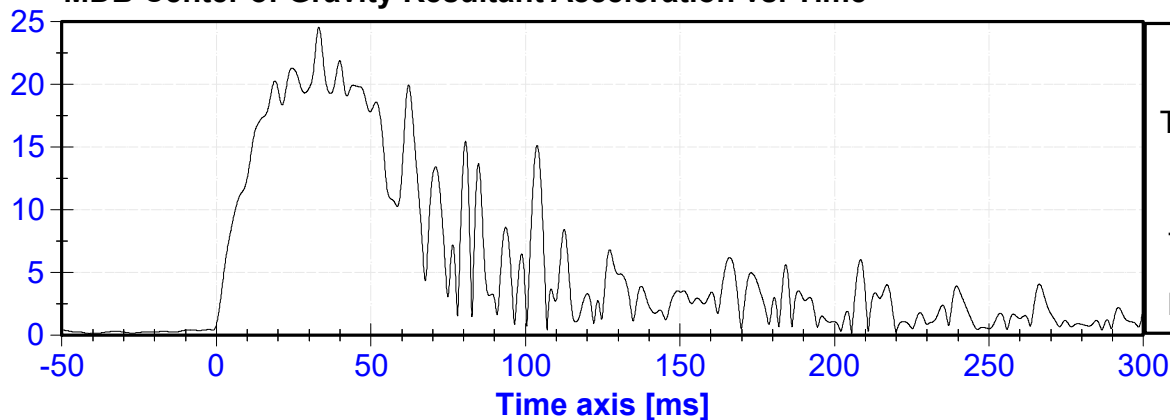
MDB Center of Gravity (Z) Acceleration vs. Time



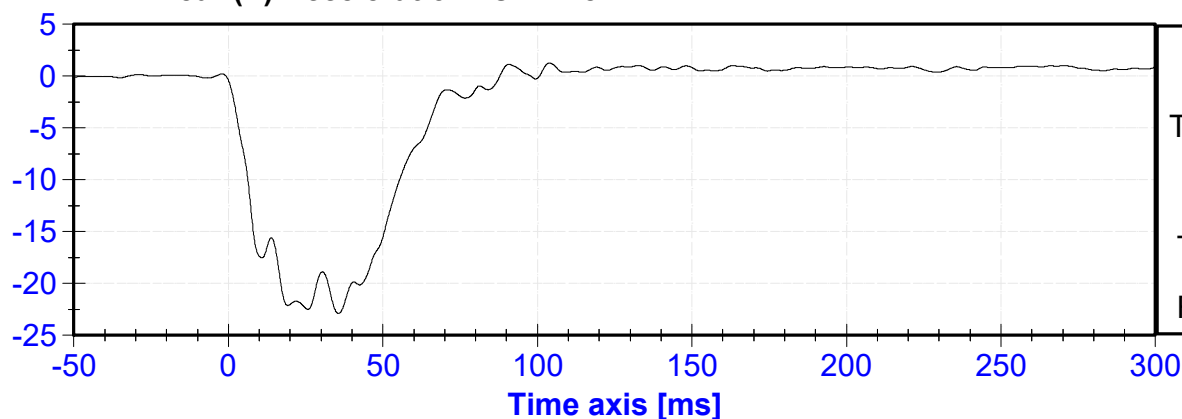
MDB Center of Gravity (Z) Velocity vs. Time



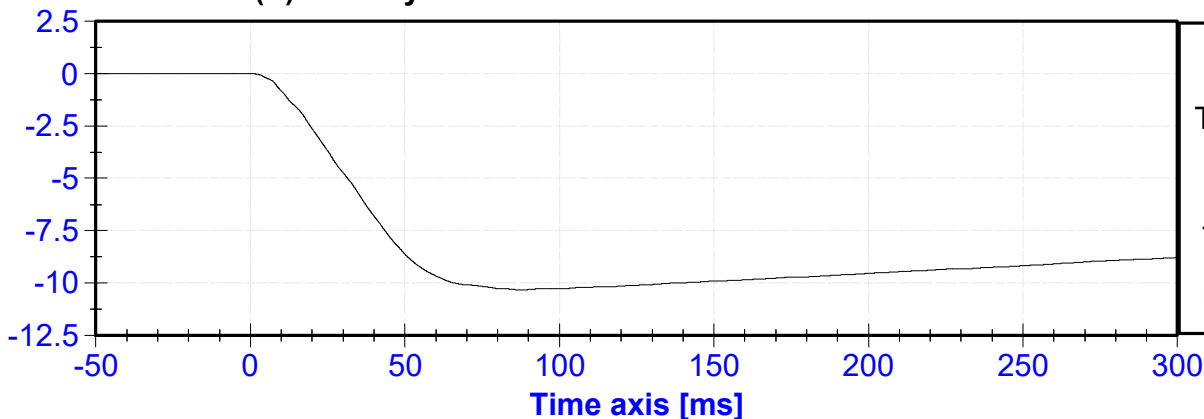
MDB Center of Gravity Resultant Acceleration vs. Time



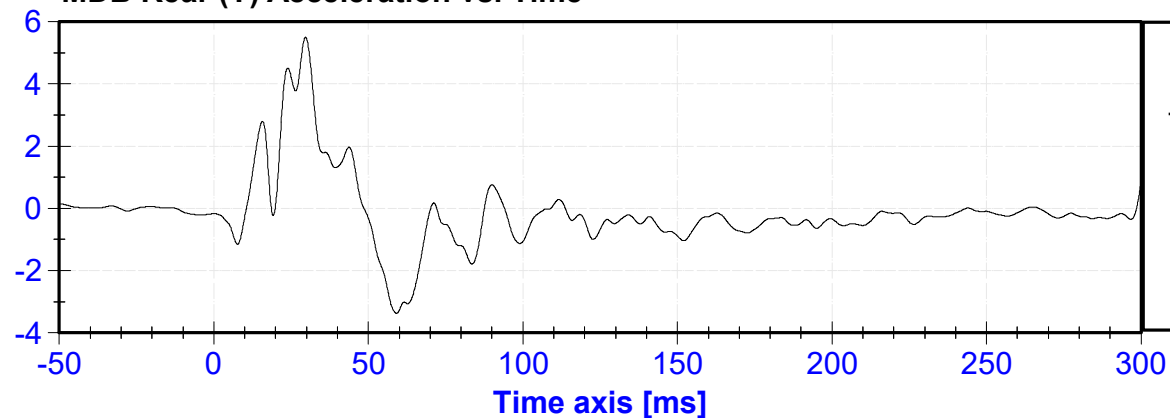
MDB Rear (X) Acceleration vs. Time

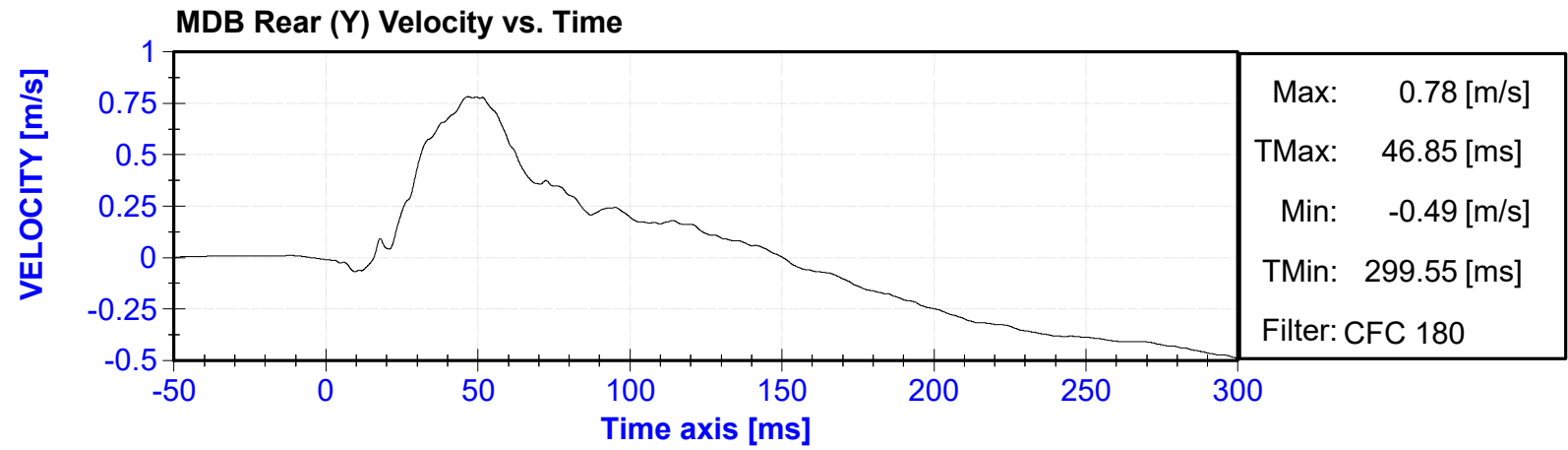


MDB Rear (X) Velocity vs. Time



MDB Rear (Y) Acceleration vs. Time





APPENDIX V

PRE-TEST ES-2re PERFORMANCE CALIBRATION TEST DATA

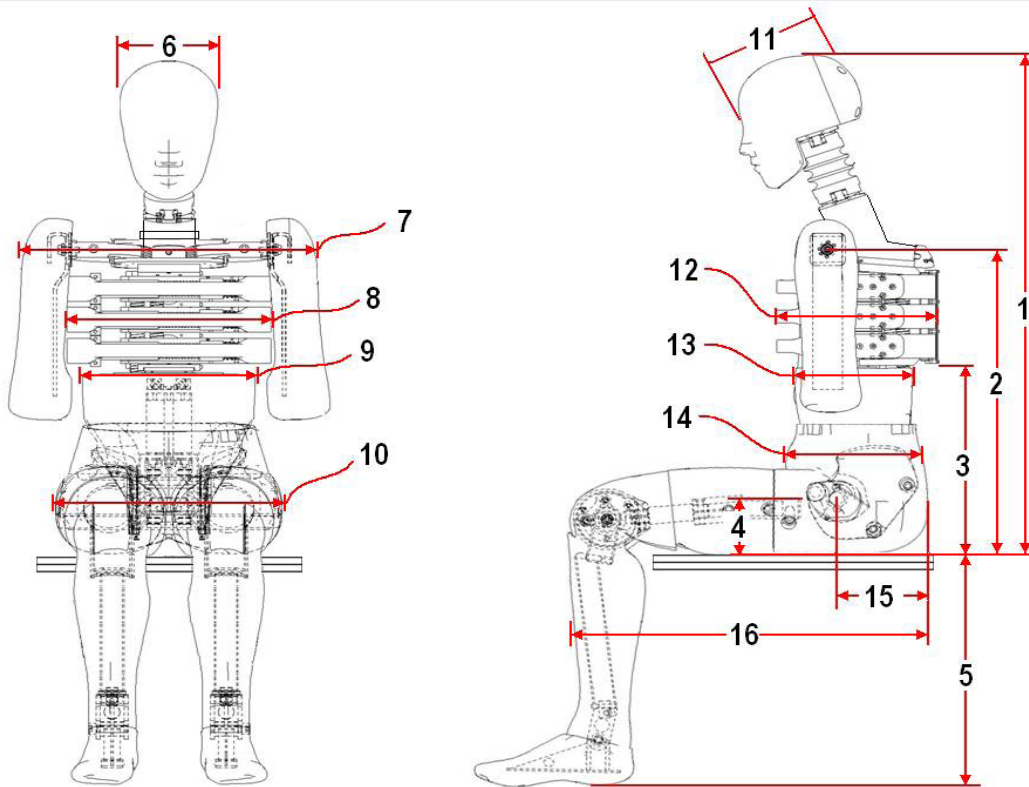


External Measurements - EuroSID-2re

Technician: K. Brogan

Date: 08/28/2023

Dummy Serial Number: D037



FRONT VIEW

SIDE VIEW

Dim. No.	Description	Specification (mm)		Result (mm)	Pass/Fail
1	Sitting Height	900	918	910	Pass
2	Seat to Shoulder Joint	558	572	564	Pass
3	Seat to Lower Face of Thoracic Spine Box	346	356	354	Pass
4	Seat to Hip Joint (center of bolt)	97	103	101	Pass
5	Sole to Seat, Sitting	333	451	423	Pass
6	Head Width	152	158	155	Pass
7	Shoulder/Arm Width	461	479	471	Pass
8	Thorax Width	322	332	329	Pass
9	Abdomen Width	273	287	282	Pass
10	Pelvis Lap Width	359	373	364	Pass
11	Head Depth	196	206	201	Pass
12	Thorax Depth	262	272	266	Pass
13	Abdomen Depth	194	204	199	Pass
14	Pelvis Depth	235	245	241	Pass
15	Back of Buttocks to Hip Joint (center of bolt)	150	160	154	Pass
16	Back of Buttocks to Front Knee	597	615	605	Pass

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

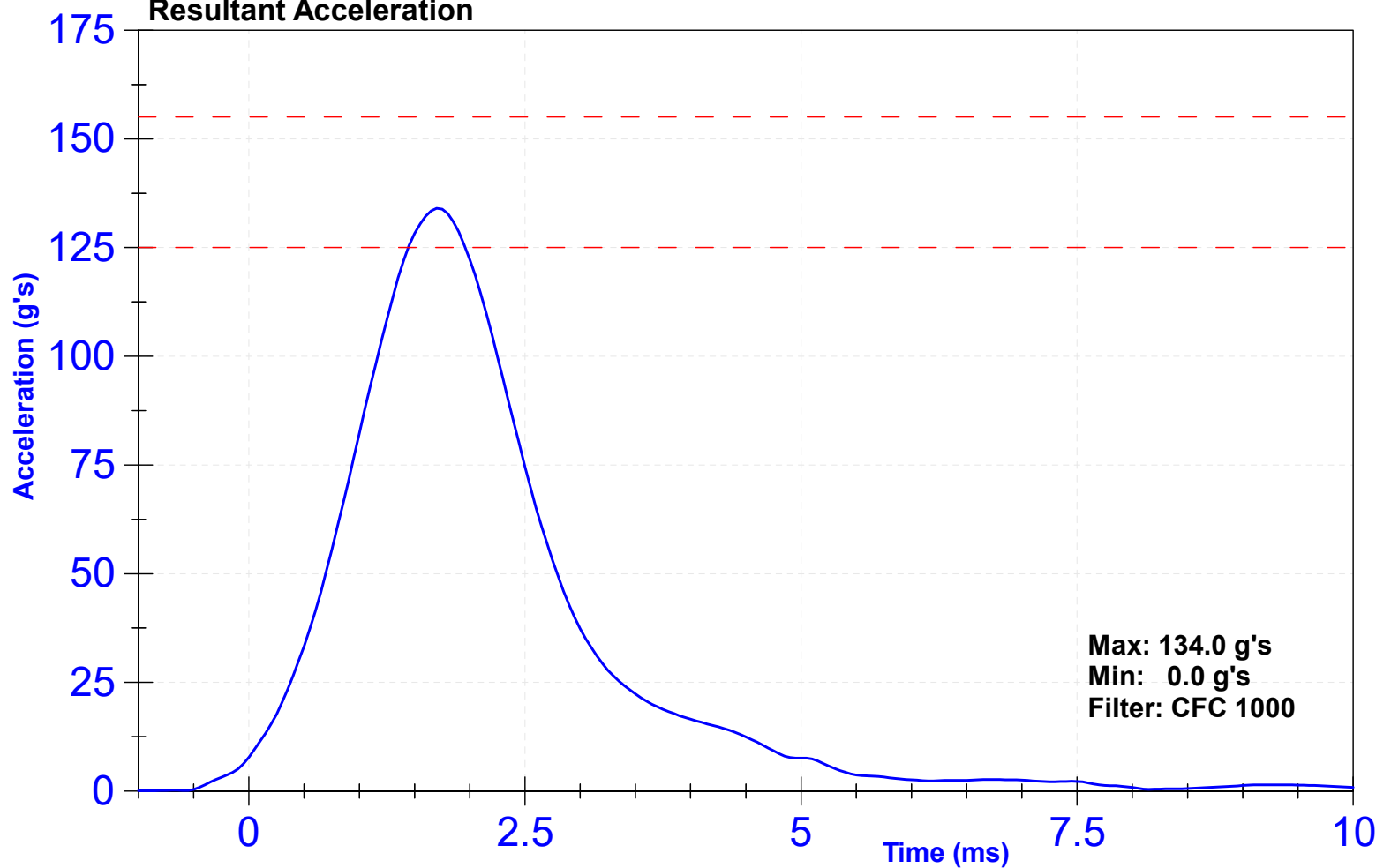
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.9	Pass
Humidity	10	70	%	59	Pass
Resultant Acceleration	125	155	g's	134.0	Pass
Oscillation	0	15	%	5.67	Pass
Fore-Aft Acceleration	-15	15	g's	6.5	Pass

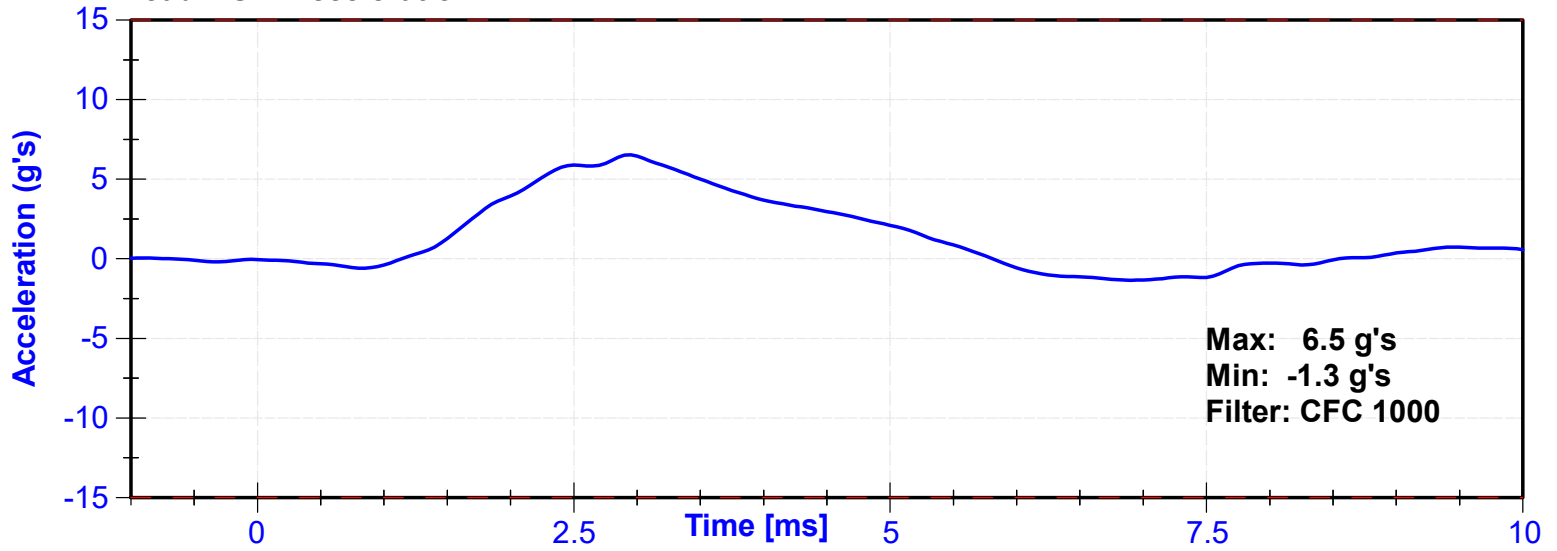
Transducer Calibrations

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

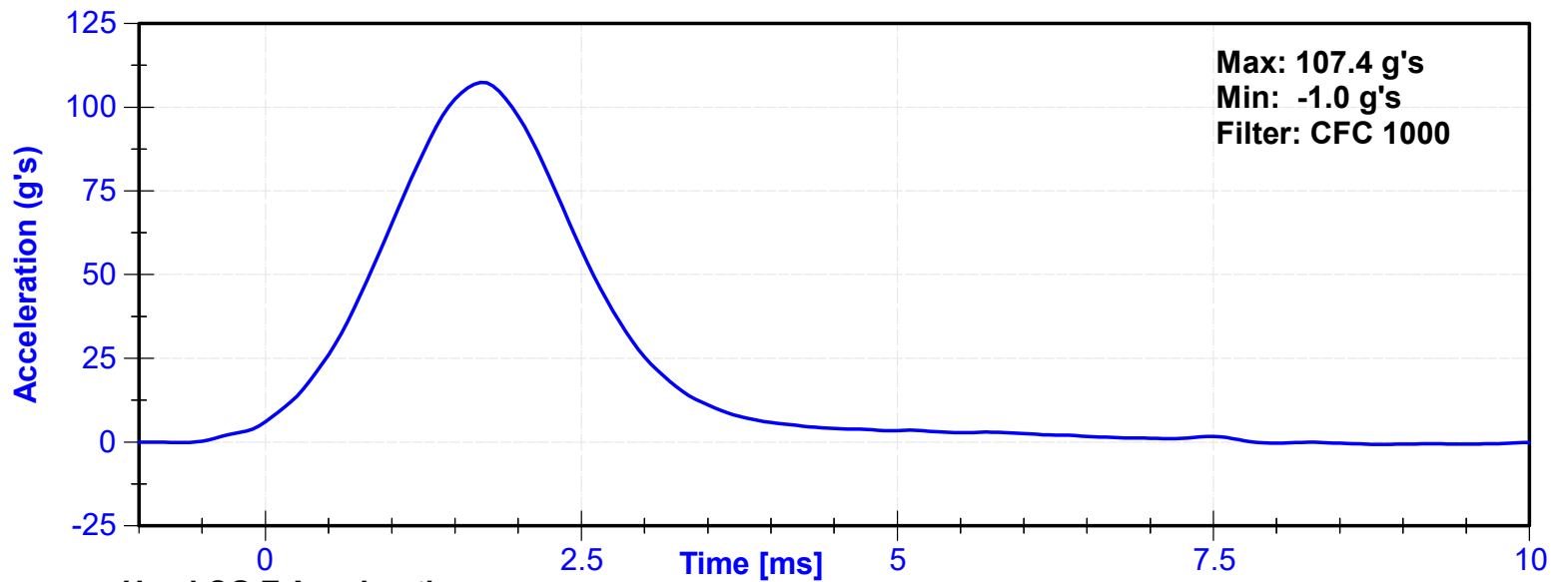
Resultant Acceleration



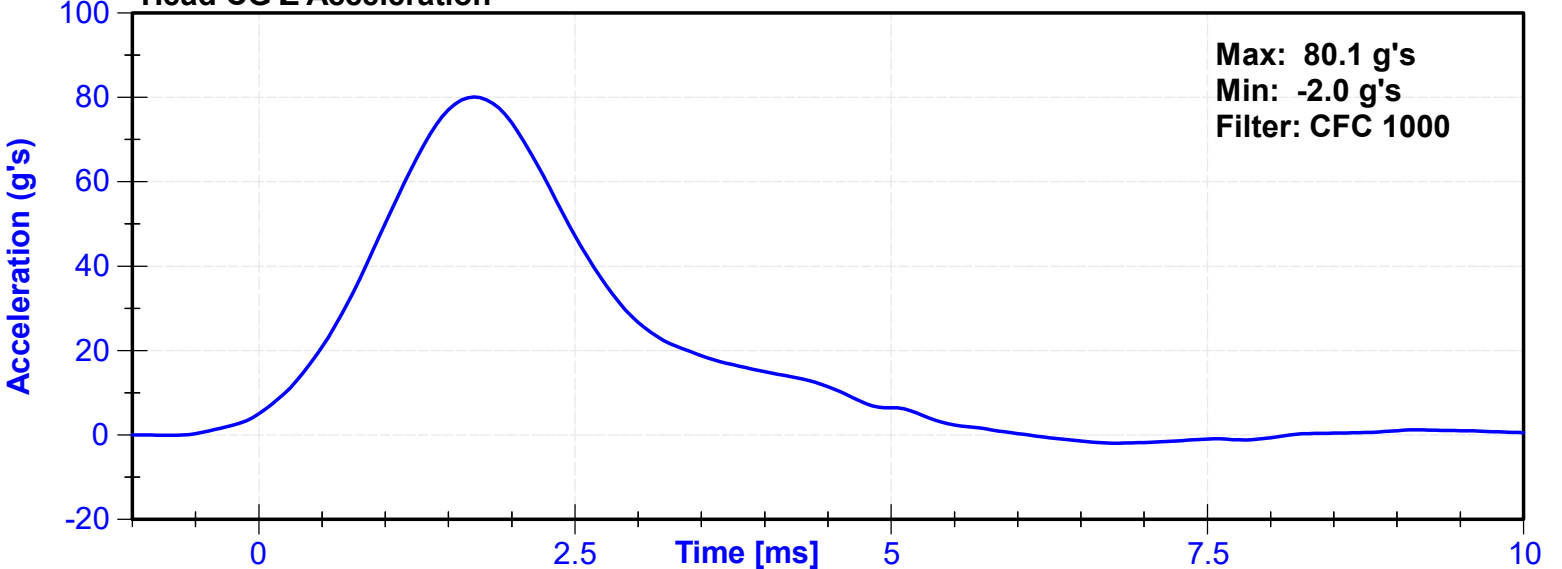
Head CG X Acceleration



Head CG Y Acceleration



Head CG Z Acceleration



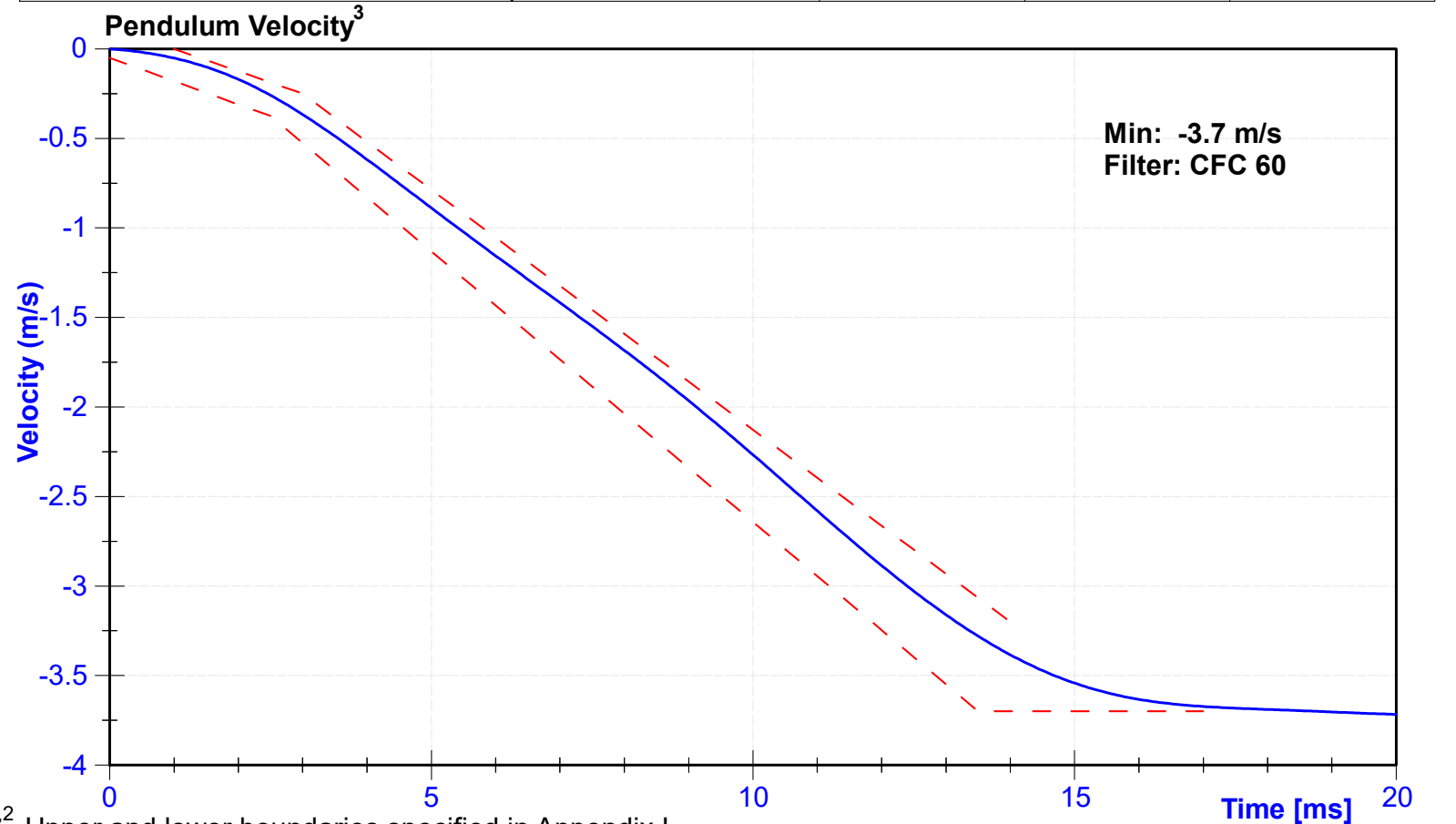
ATD Manufacturer	Denton	Test Technician	J. Miller
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

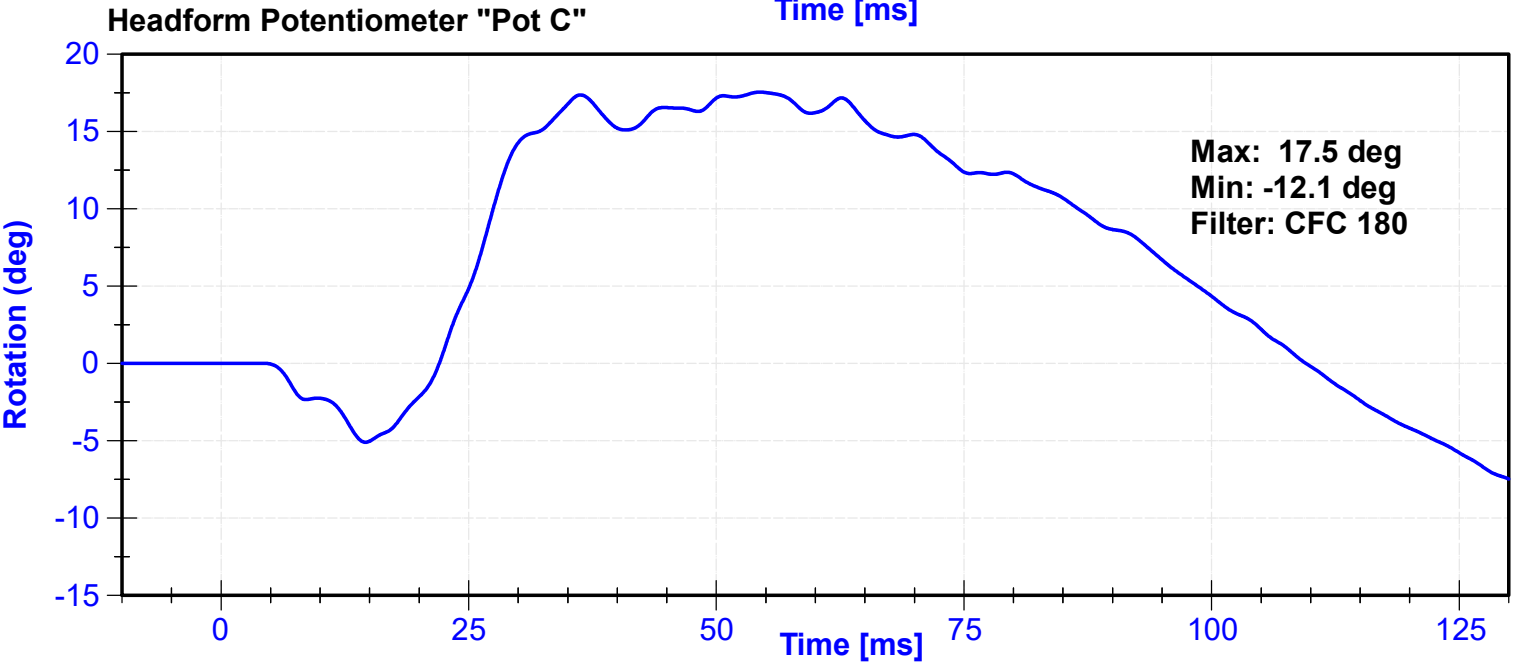
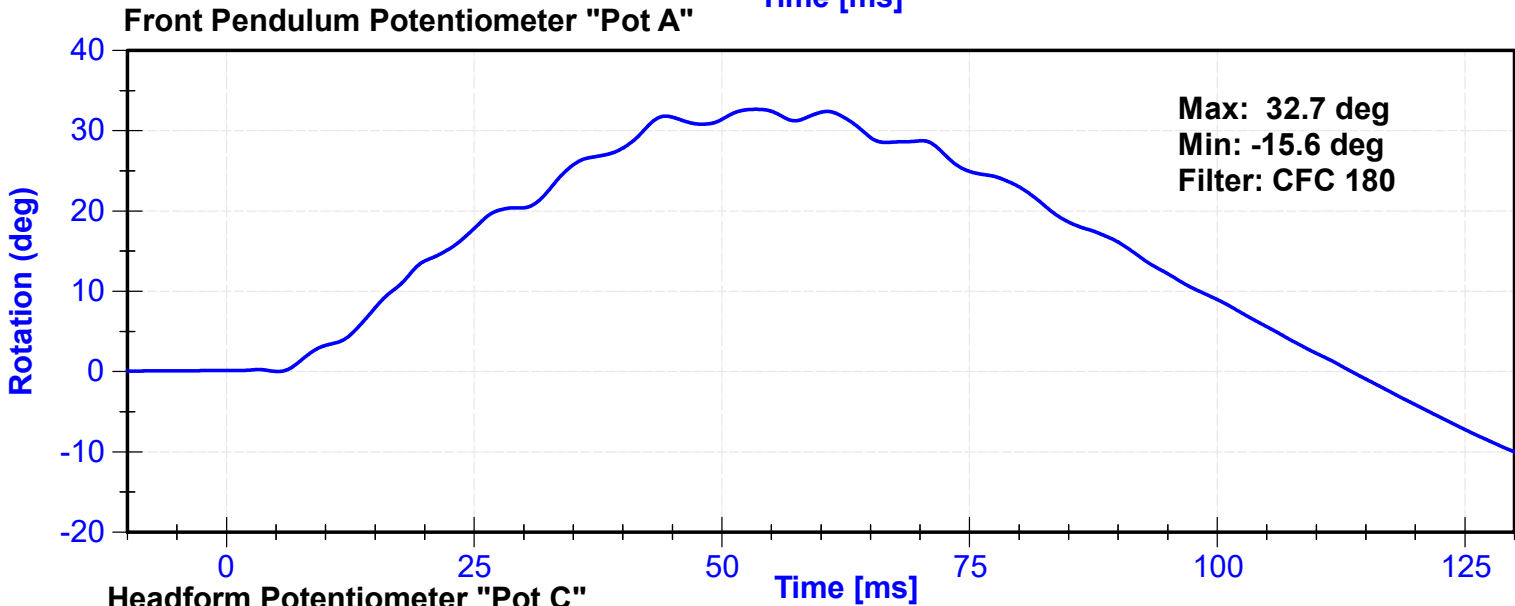
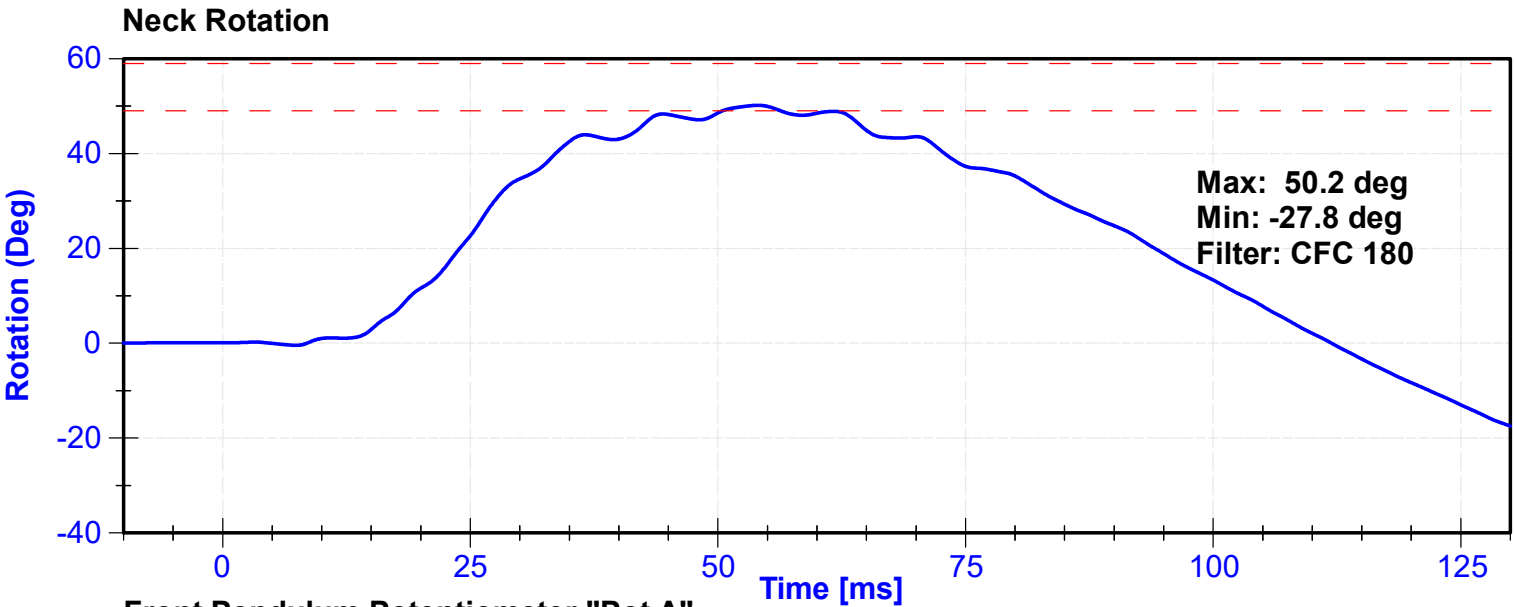
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.5	Pass
Humidity	10	70	%	65.6	Pass
Velocity	3.3	3.5	m/s	3.44	Pass
Lateral Neck Rotation	49	59	deg	50.2	Pass
Time at Maximum Rotation	54	66	ms	54.0	Pass
Time of Rotation Decay from Maximum	53	88	ms	58.0	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



Appendix I

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

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

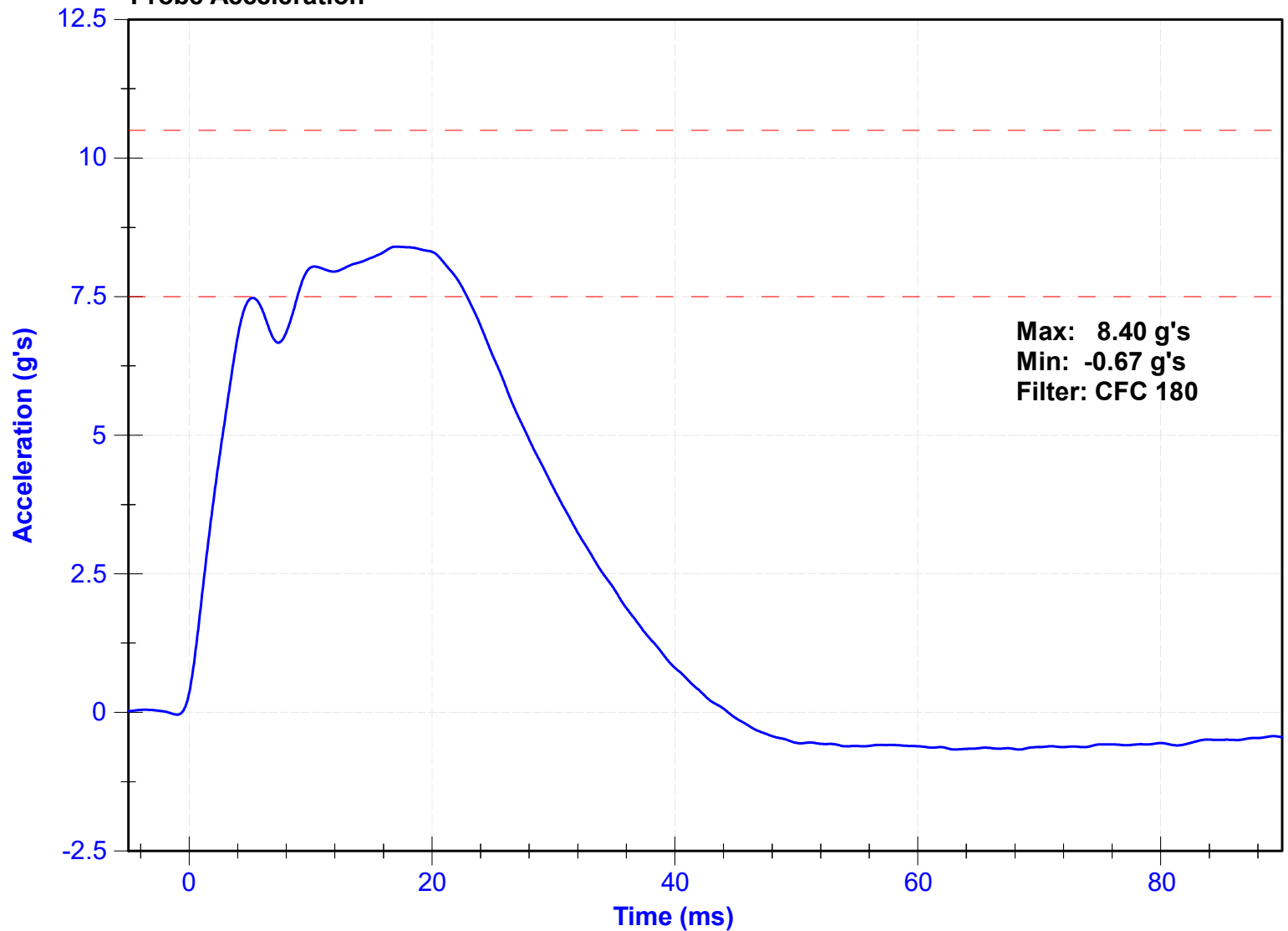
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.9	Pass
Humidity	10	70	%	54	Pass
Velocity	4.2	4.4	m/s	4.34	Pass
Probe Acceleration	7.5	10.5	g's	8.40	Pass

Transducer Calibrations

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

Probe Acceleration



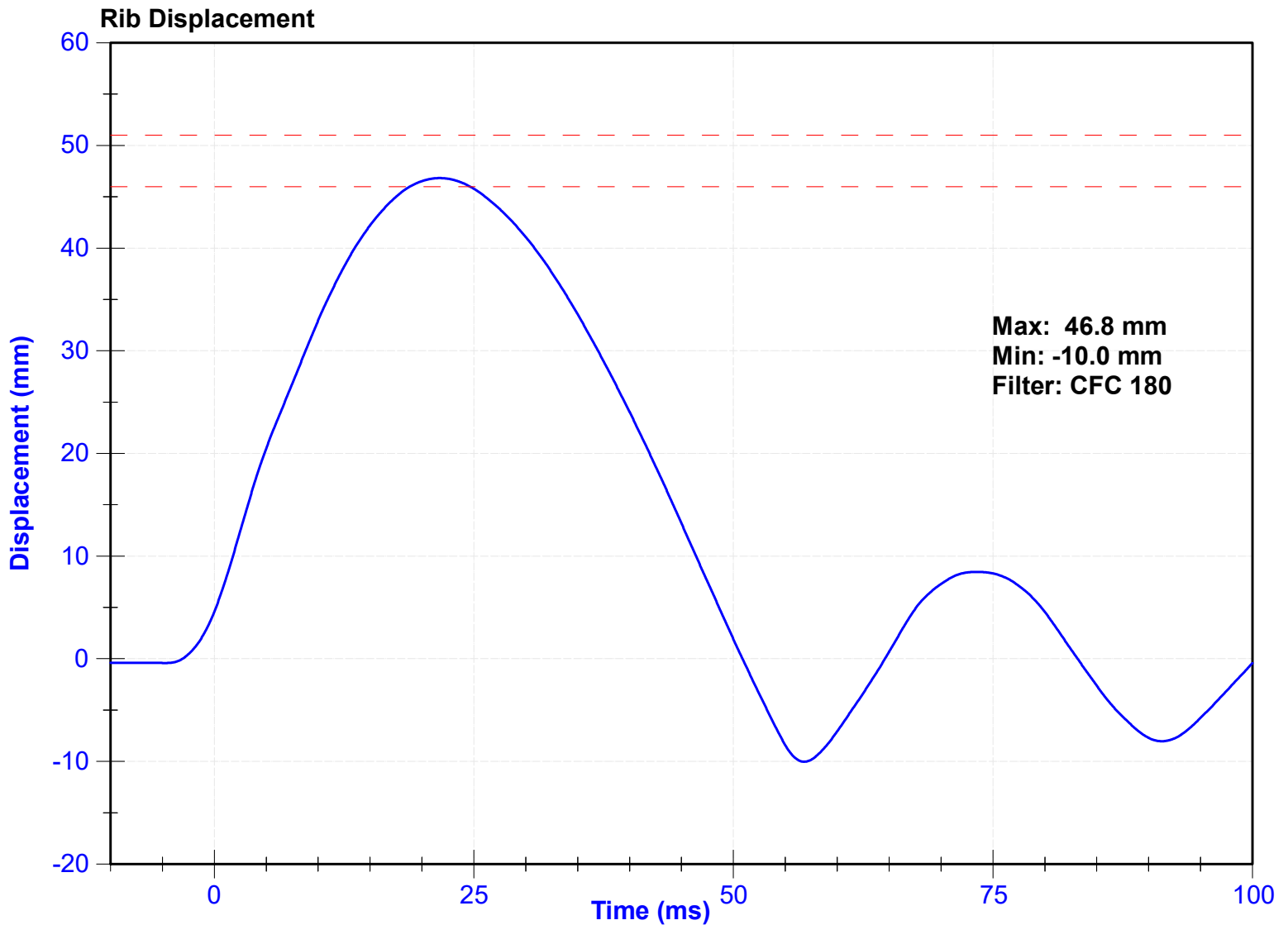
ATD Manufacturer	Denton	Test Technician	J.Miller
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.8	Pass
Humidity	10	70	%	44	Pass
Rib Displacement	46	51	mm	46.8	Pass

Transducer Calibrations

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



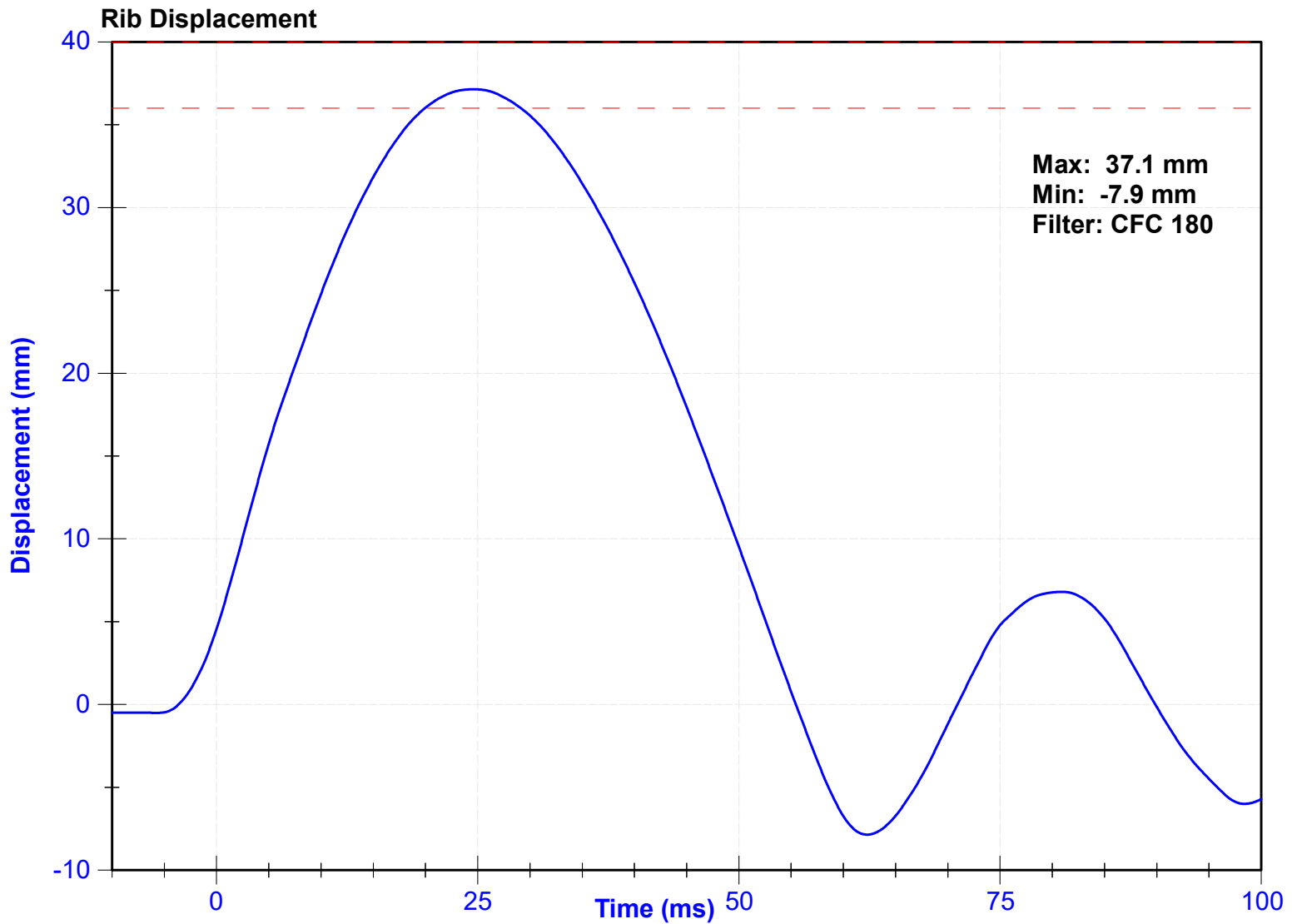
ATD Manufacturer	Denton	Test Technician	J.Miller
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.8	Pass
Humidity	10	70	%	44	Pass
Rib Displacement	36	40	mm	37.1	Pass

Transducer Calibrations

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



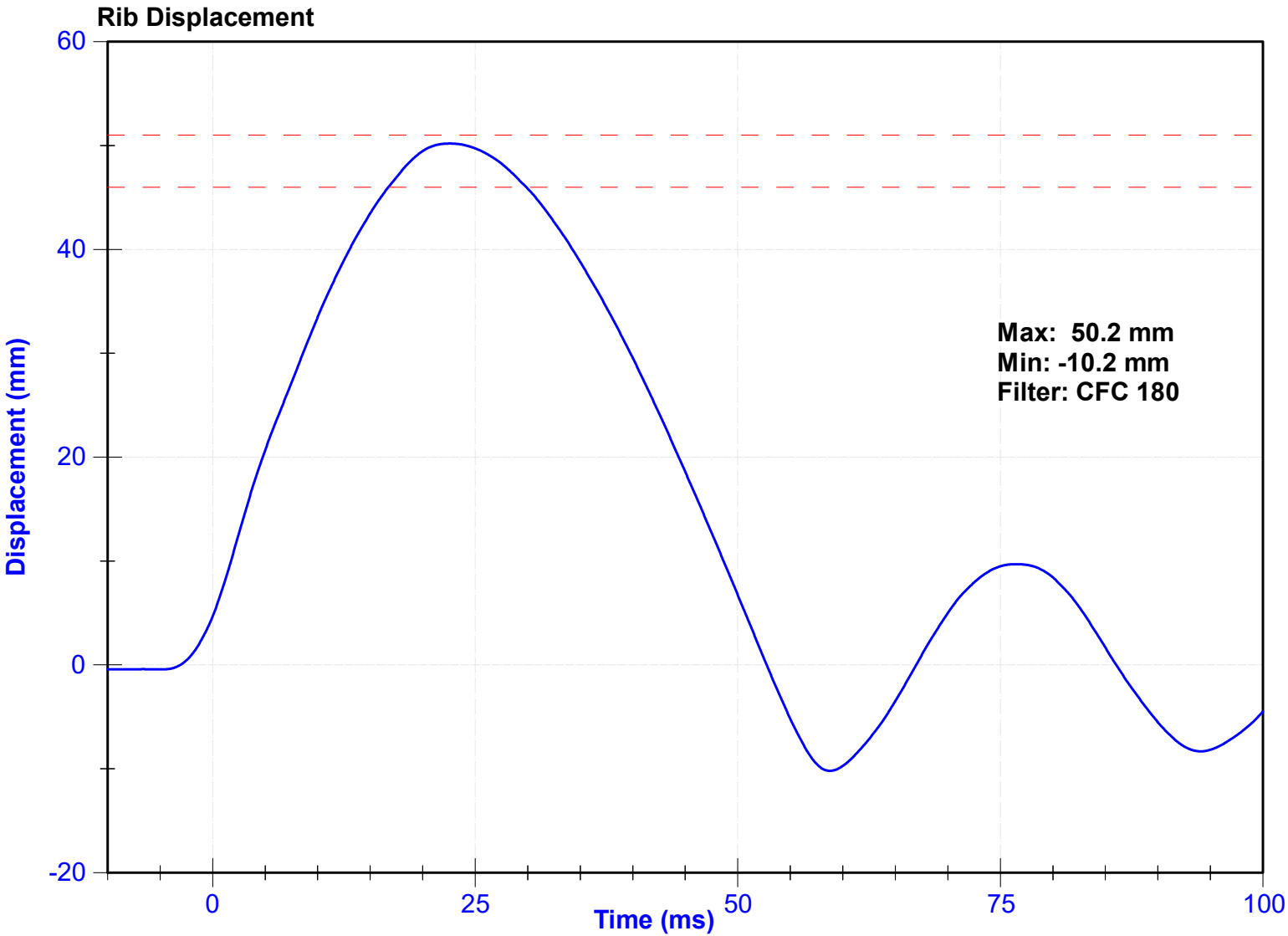
ATD Manufacturer	Denton	Test Technician	J.Miller
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.8	Pass
Humidity	10	70	%	43	Pass
Rib Displacement	46	51	mm	50.2	Pass

Transducer Calibrations

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



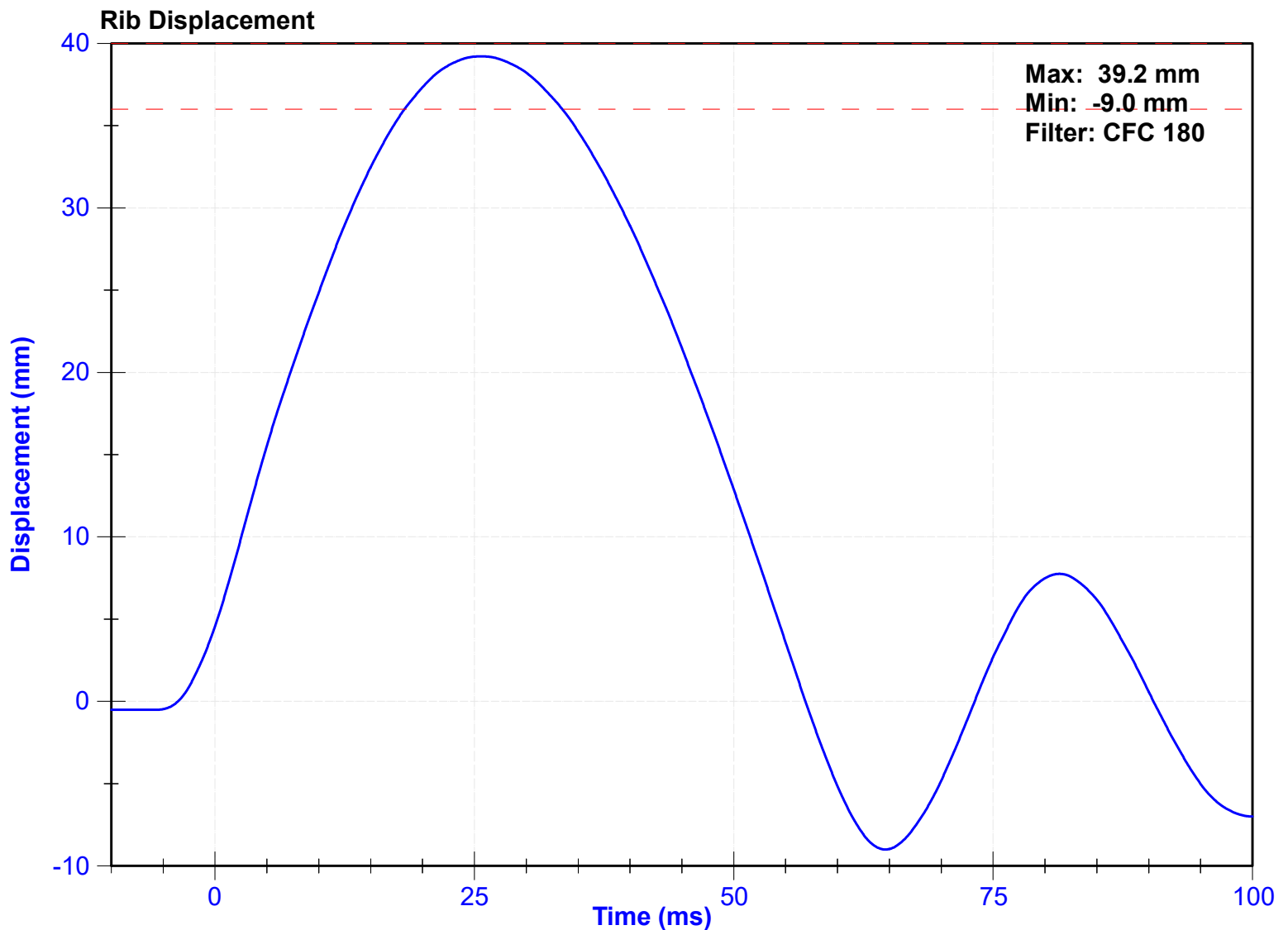
ATD Manufacturer	Denton	Test Technician	J.Miller
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.8	Pass
Humidity	10	70	%	43	Pass
Rib Displacement	36	40	mm	39.2	Pass

Transducer Calibrations

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



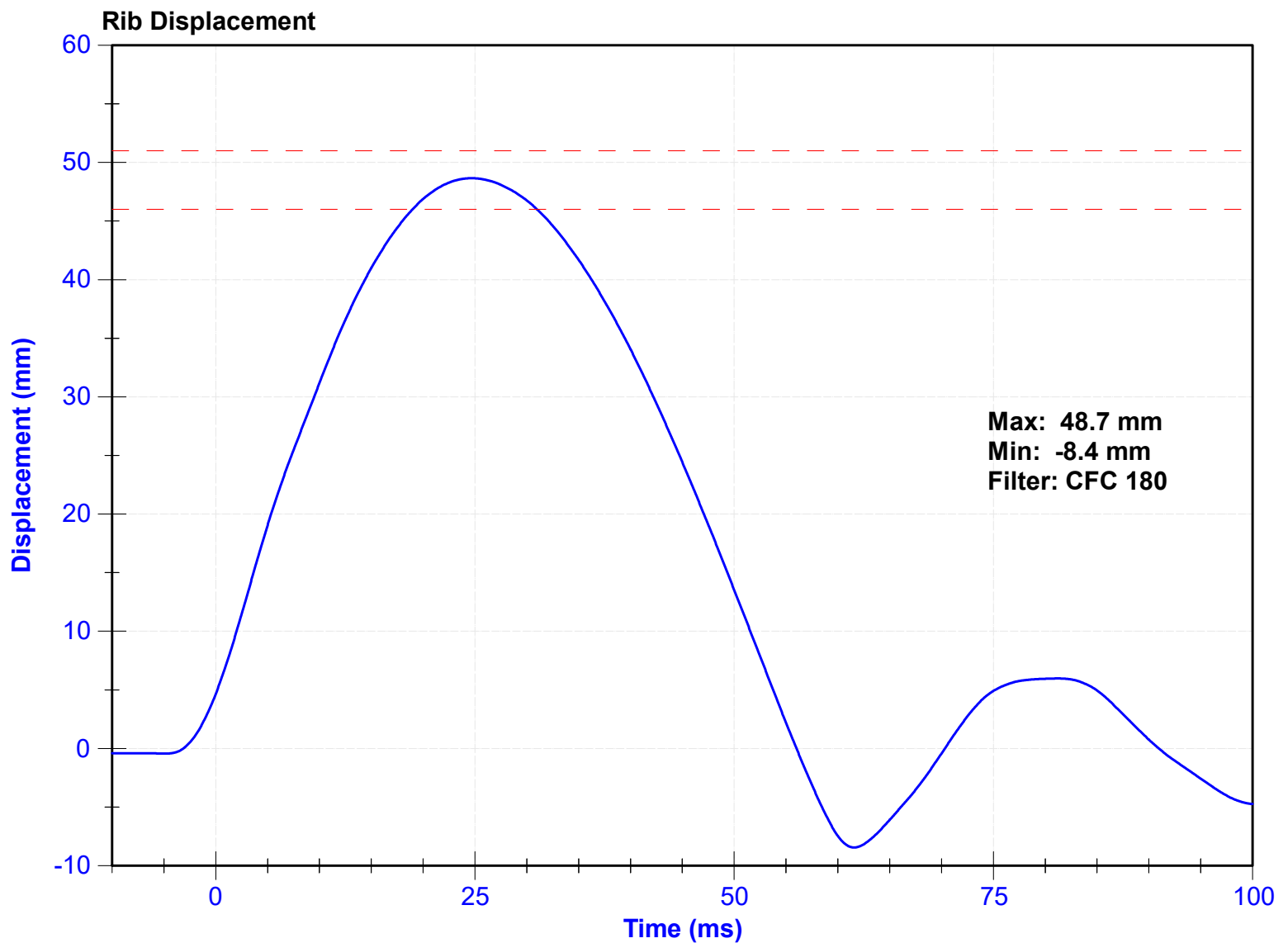
ATD Manufacturer	Denton	Test Technician	J.Miller
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.8	Pass
Humidity	10	70	%	43	Pass
Rib Displacement	46	51	mm	48.7	Pass

Transducer Calibrations

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



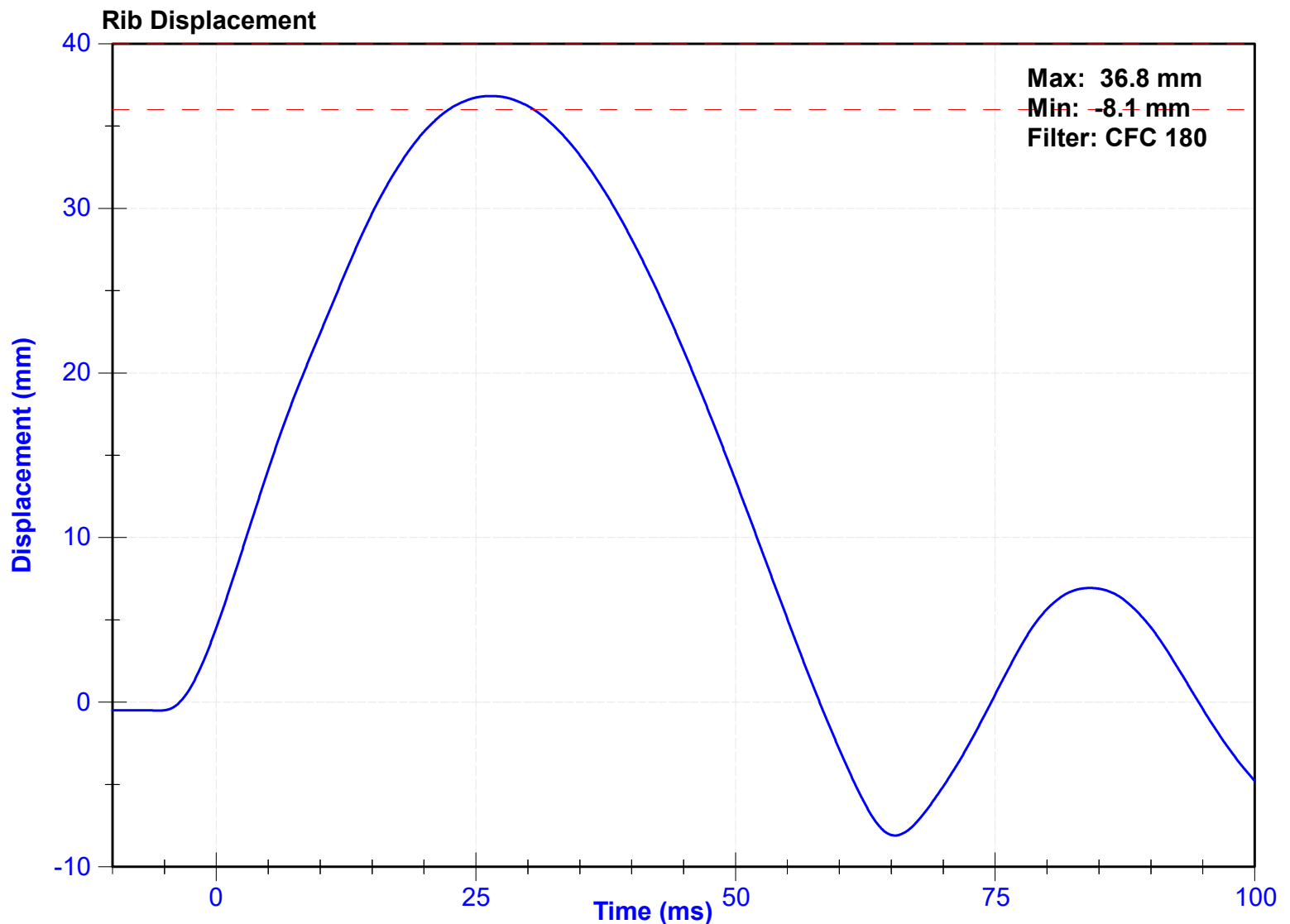
ATD Manufacturer	Denton	Test Technician	J.Miller
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.8	Pass
Humidity	10	70	%	43	Pass
Rib Displacement	36	40	mm	36.8	Pass

Transducer Calibrations

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



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

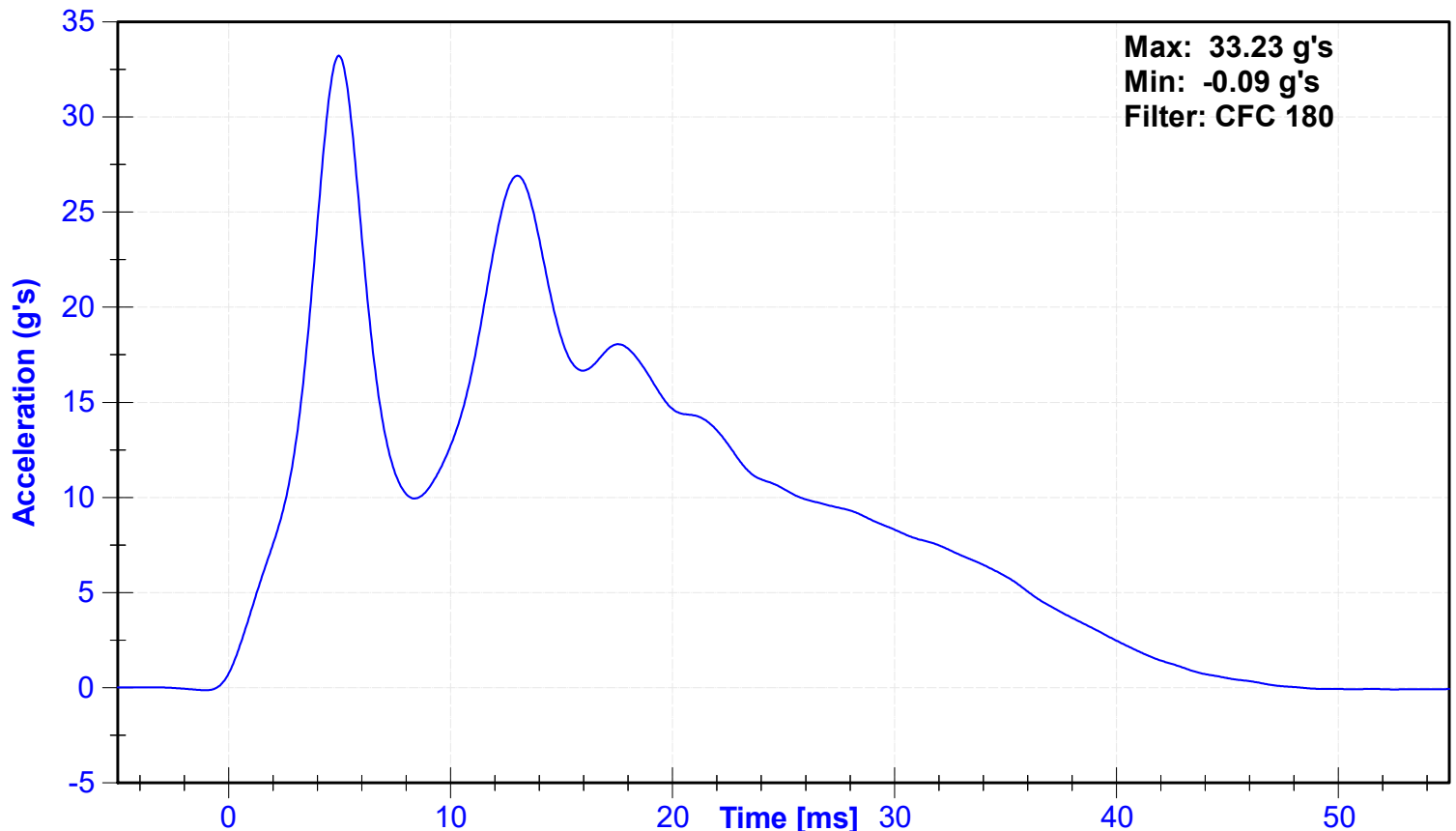
Results

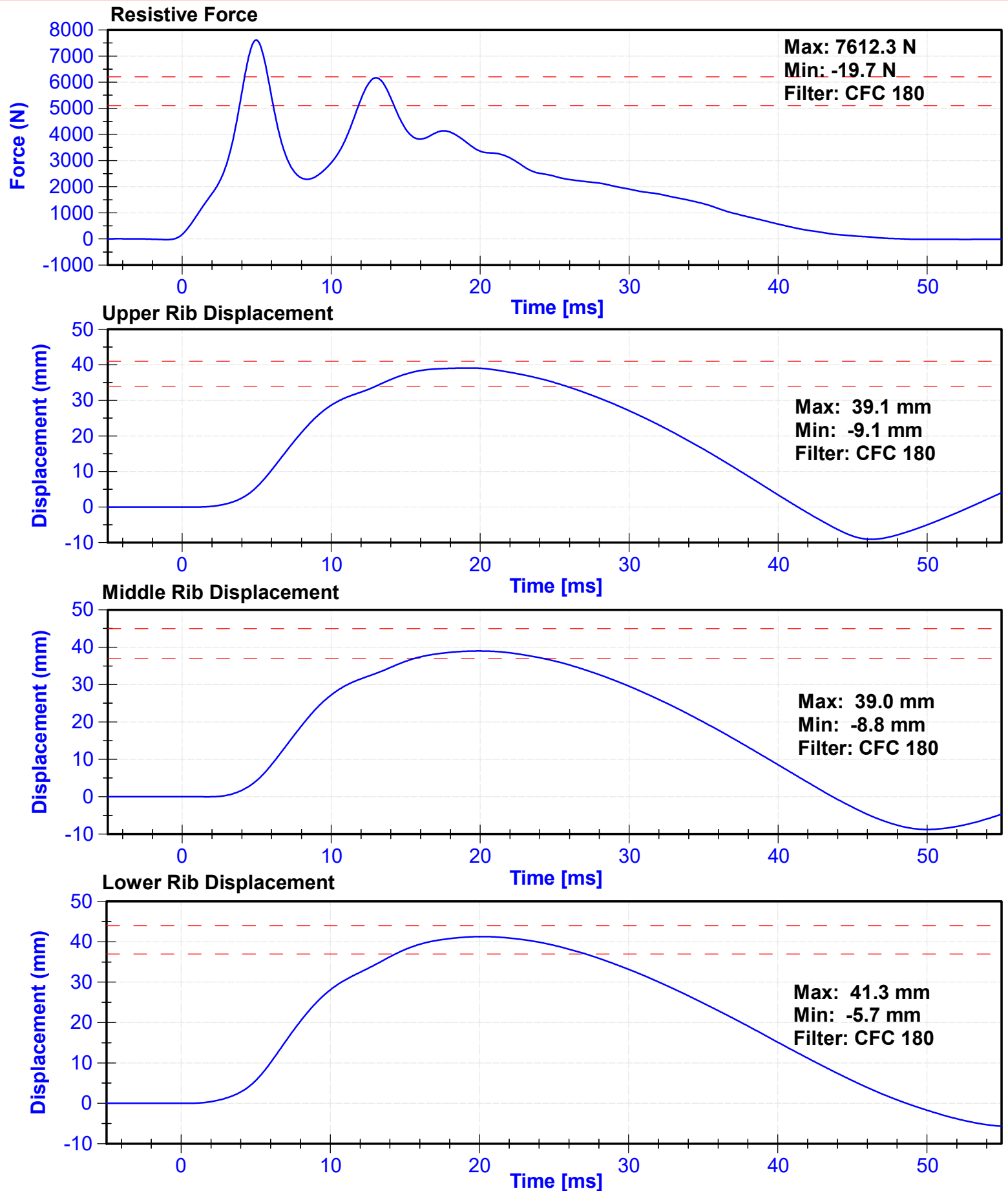
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.9	Pass
Humidity	10	70	%	54	Pass
Velocity	5.4	5.6	m/s	5.53	Pass
Resistive Force after 6ms	5100	6200	N	6167.8	Pass
Upper Thorax Rib Deflection	34	41	mm	39.1	Pass
Mid Thorax Rib Deflection	37	45	mm	39.0	Pass
Lower Thorax Rib Deflection	37	44	mm	41.3	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	0552-01	8/7/2023	2/5/2024
Middle Thorax Rib Potentiometer	Honeywell	807	8/7/2023	2/5/2024
Lower Thorax Rib Potentiometer	Honeywell	0552-03	8/7/2023	2/5/2024

Probe Acceleration





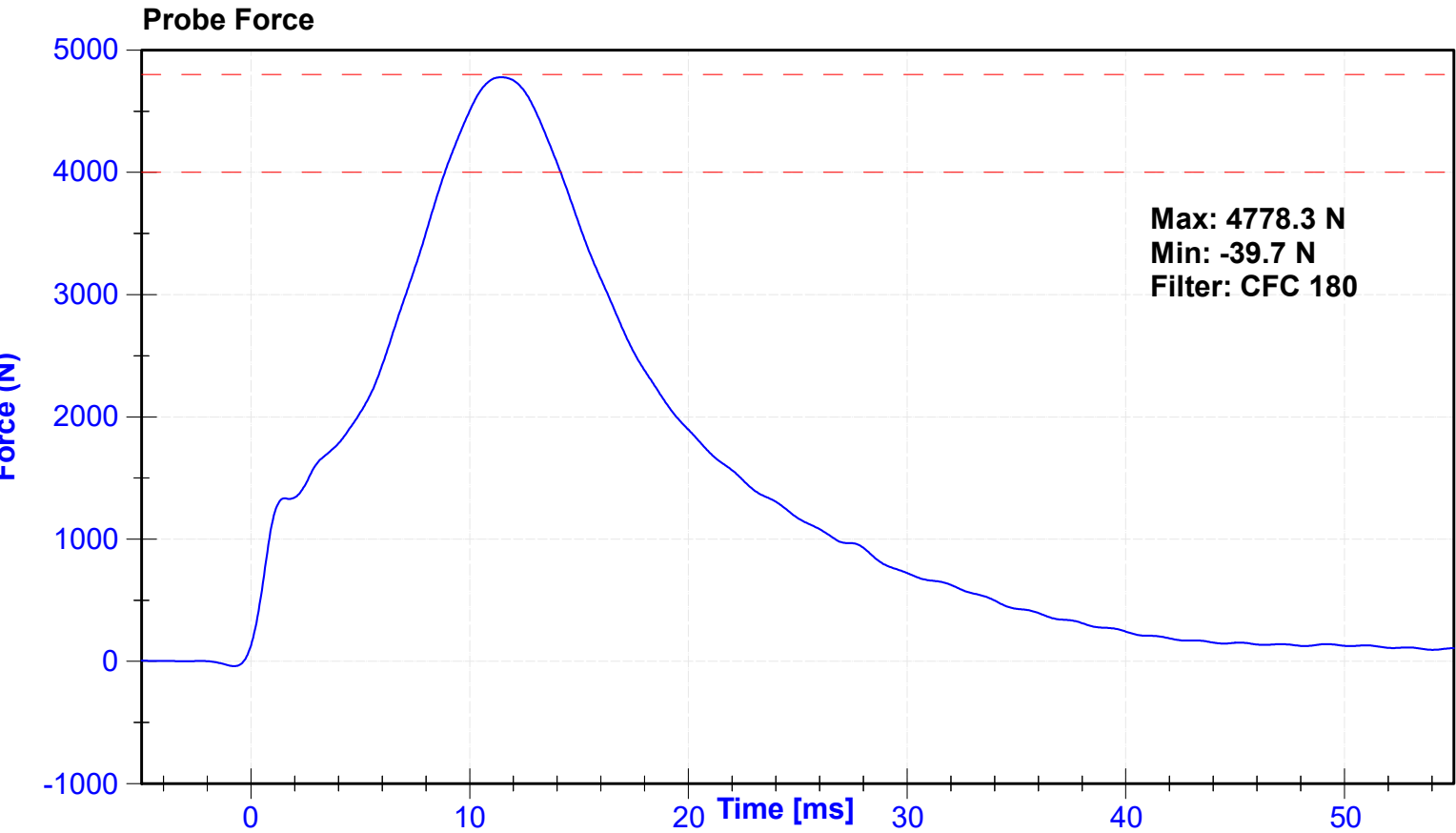
ATD Manufacturer	Denton	Test Technician	J. Miller
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

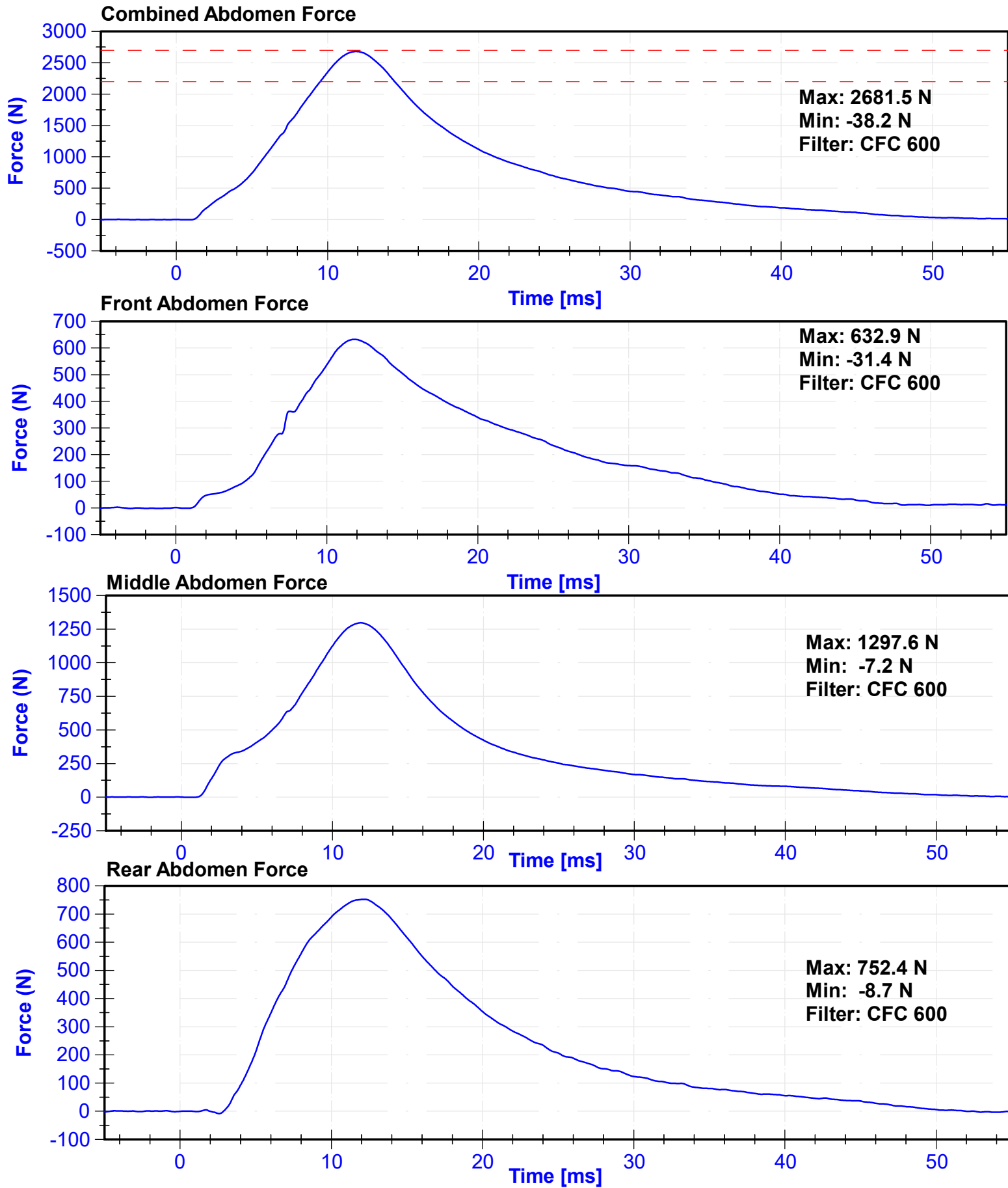
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.9	Pass
Humidity	10	70	%	54	Pass
Velocity	3.9	4.1	m/s	3.92	Pass
Combined Abdomen Force	2200	2700	N	2681.5	Pass
Time at Peak Abdomen Force	10.0	12.3	ms	11.90	Pass
Resistive Probe Force	4000	4800	N	4778.3	Pass
Time at Peak Resistive Force	10.6	13.0	ms	11.45	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	1440	8/8/2023	8/7/2024
Middle Abdomen Load Cell	Denton	1525	8/8/2023	8/7/2024
Rear Abdomen Load Cell	Denton	1528	8/8/2023	8/7/2024





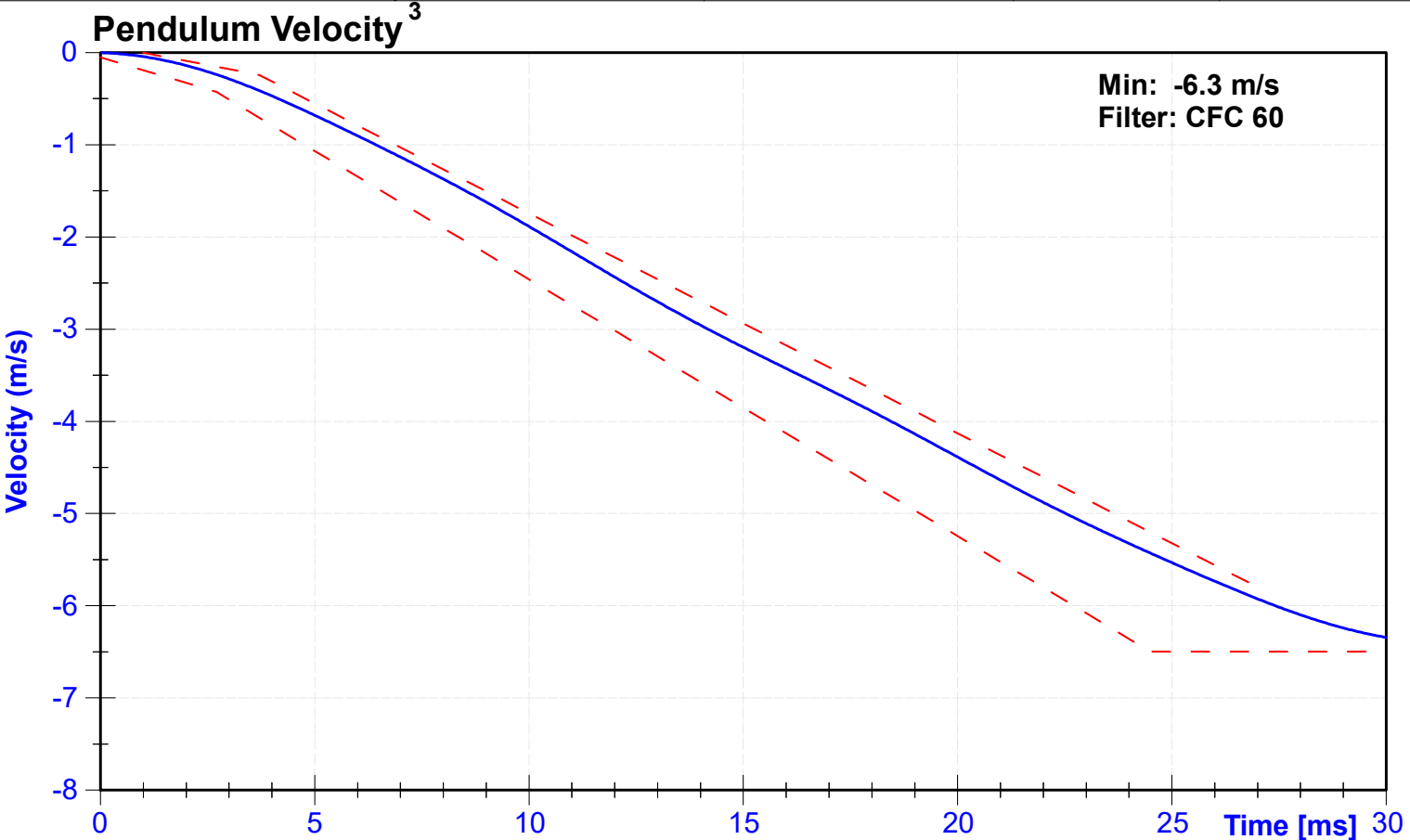
ATD Manufacturer	Denton	Test Technician	J. Miller
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

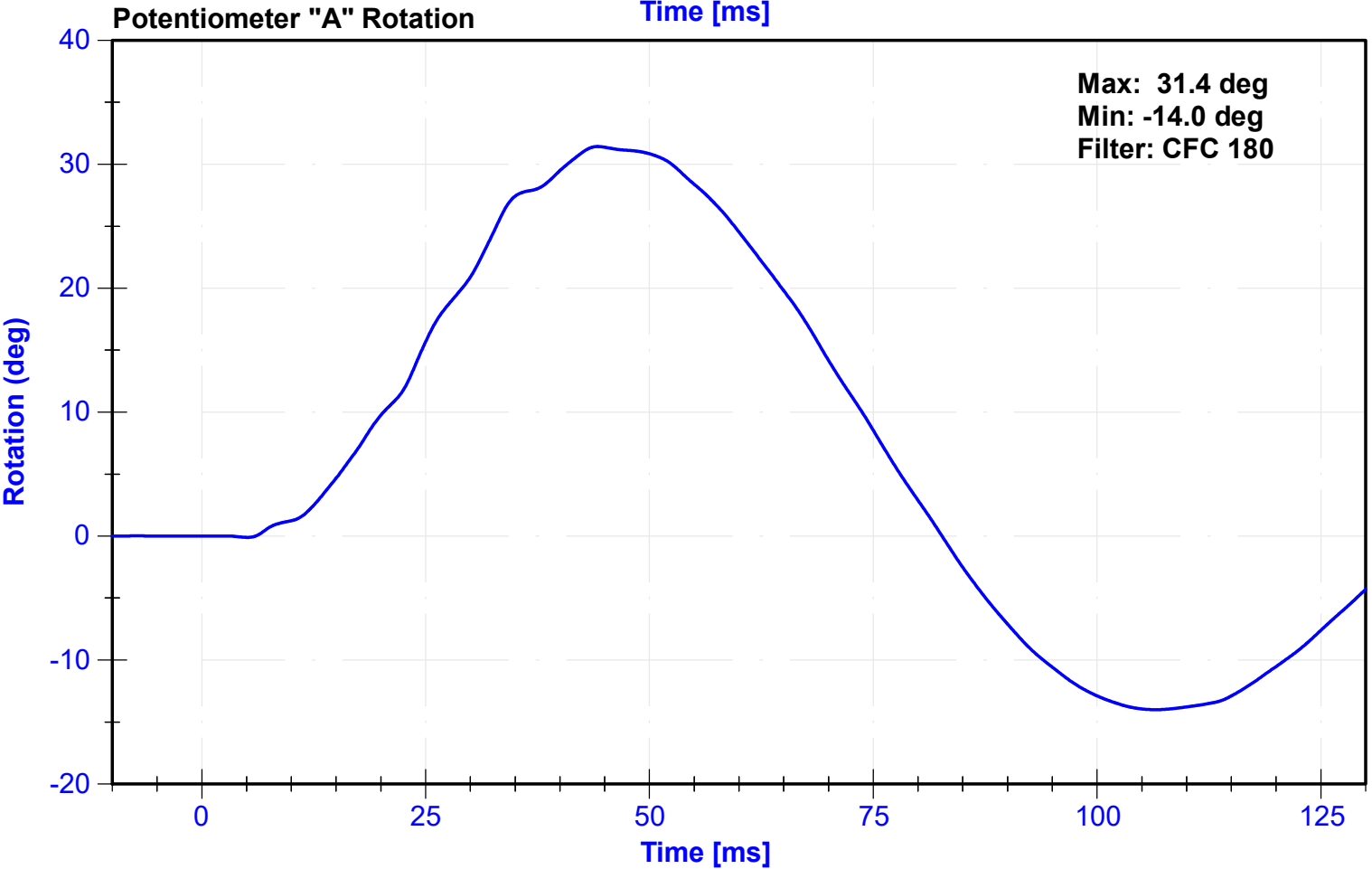
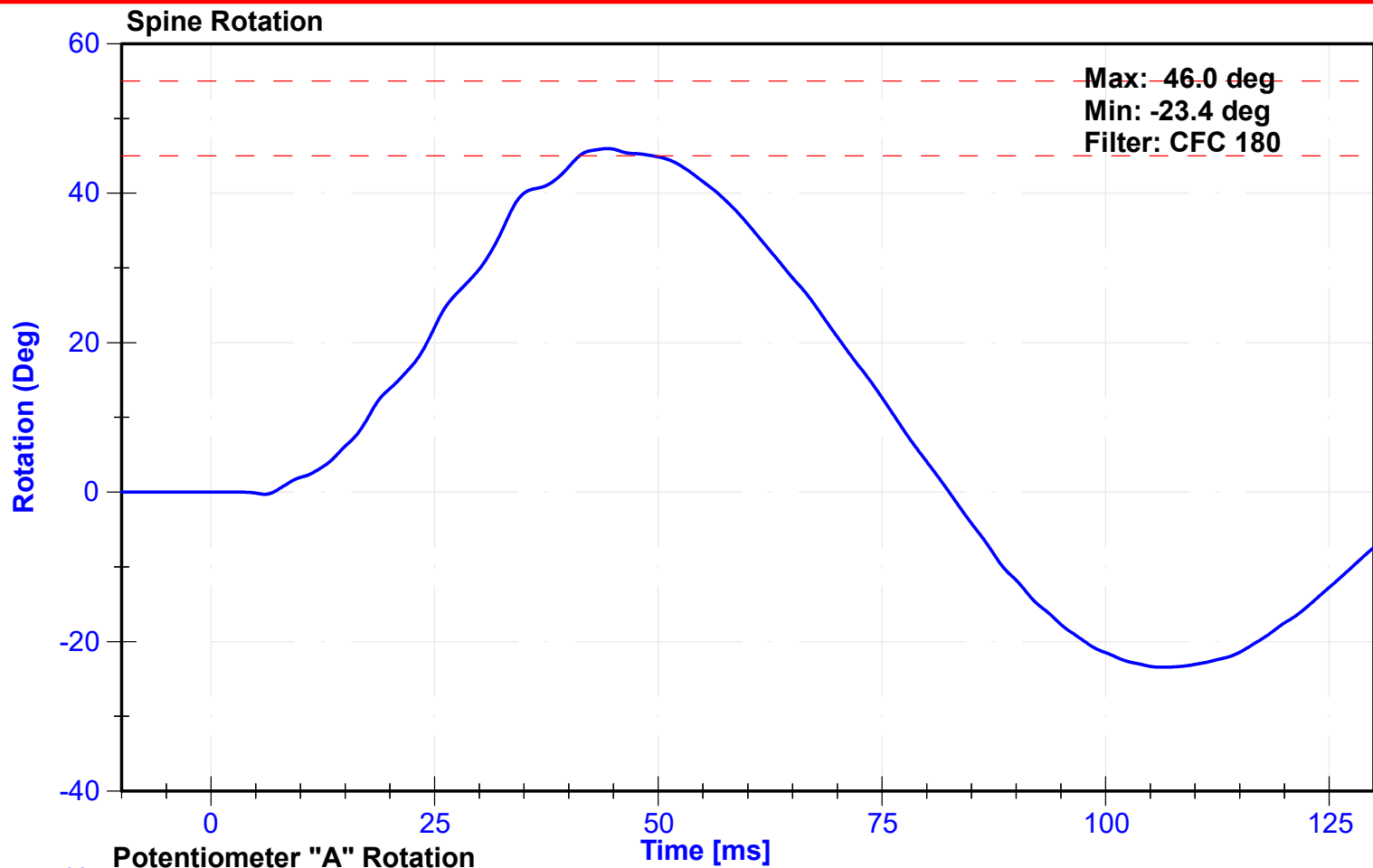
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.8	Pass
Humidity	10	70	%	64	Pass
Velocity	5.95	6.15	m/s	6.030	Pass
Lateral Spine Rotation	45	55	deg	46.0	Pass
Time at Maximum Rotation	39	53	ms	44.3	Pass
Time of Decay to Zero Degrees	37	57	ms	38.2	Pass
Pendulum Velocity Overall Corridor	Lower Boundary ¹	Upper Boundary ²	m/s	See Plot ³	Pass

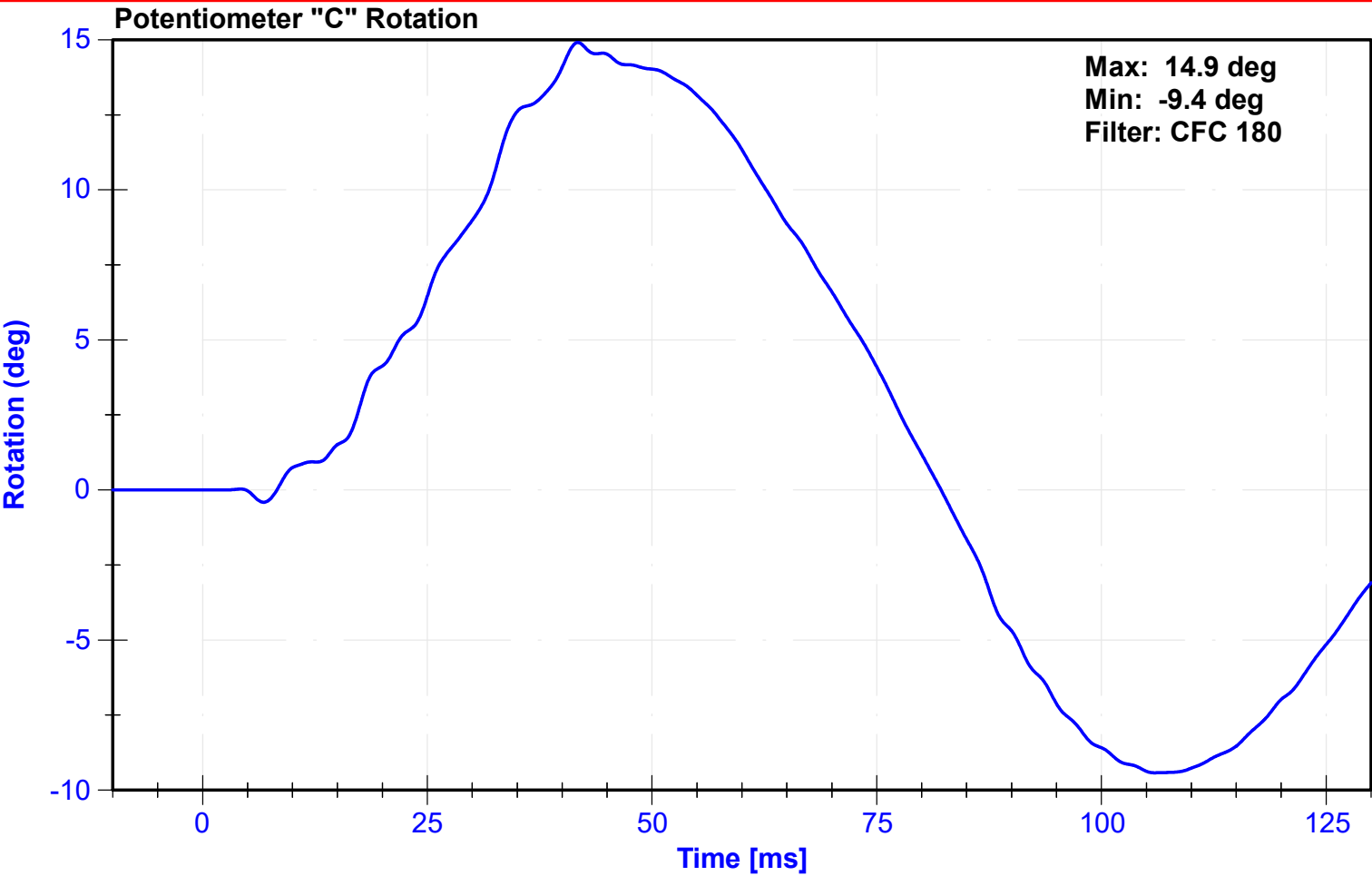
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	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 V-19





Appendix I

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

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

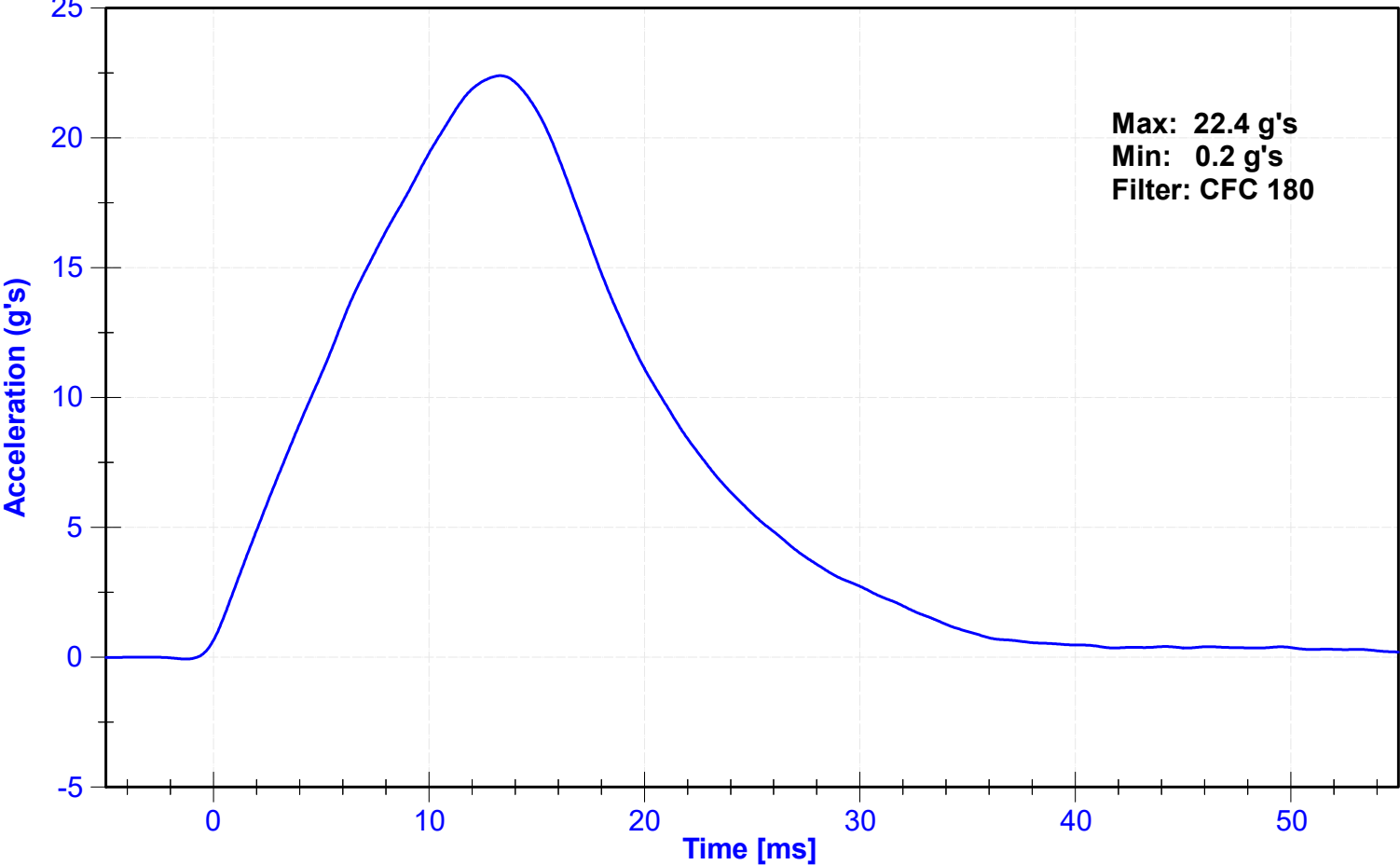
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.9	Pass
Humidity	10	70	%	54	Pass
Velocity	4.2	4.4	m/s	4.34	Pass
Resistive Force	4700	5400	N	5129.8	Pass
Time at Peak Resistive Force	11.8	16.1	ms	13.30	Pass
Pubic Force	-1590	-1230	N	-1579.9	Pass
Time at Peak Pubic Force	12.2	17.0	ms	12.80	Pass

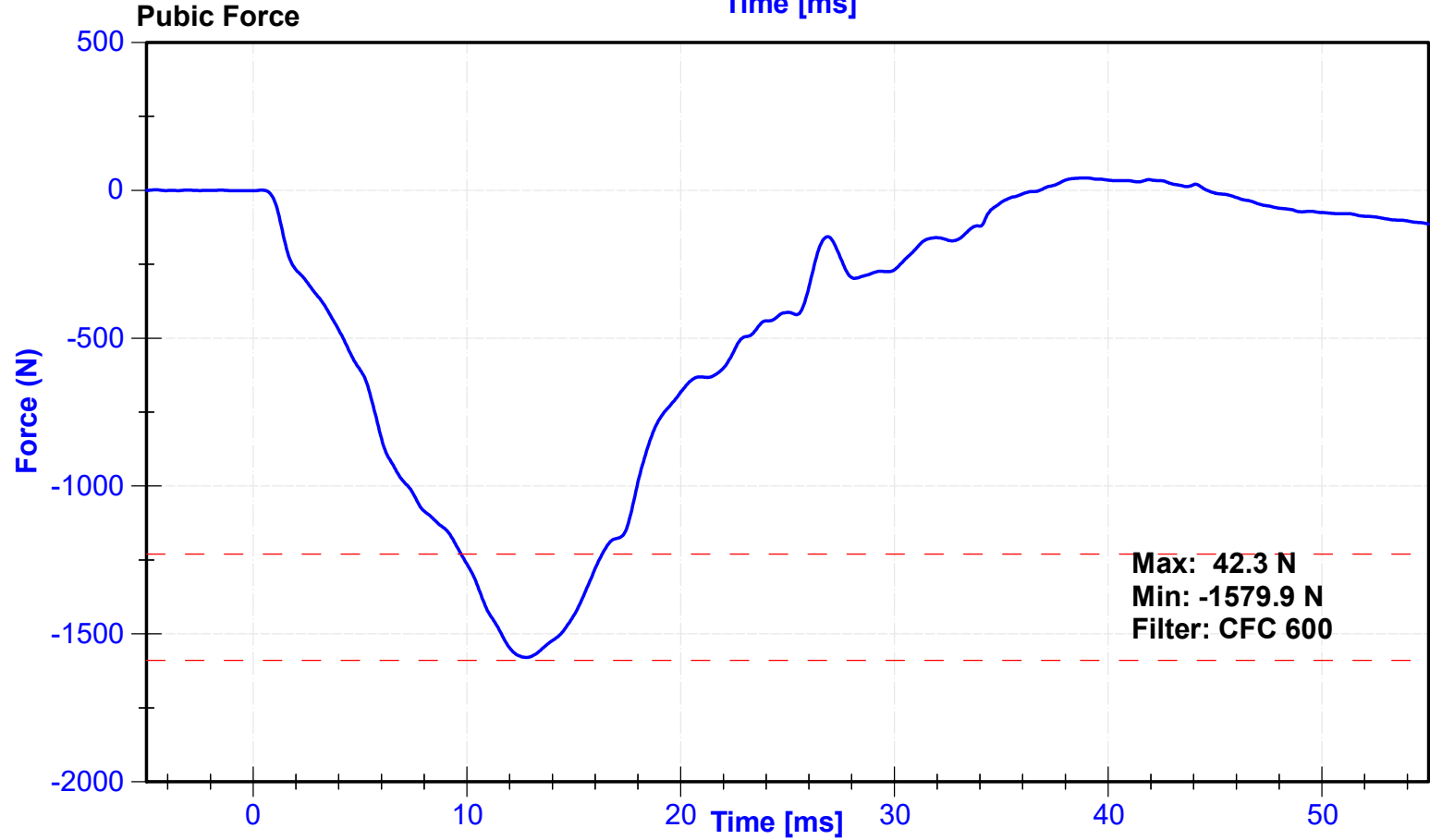
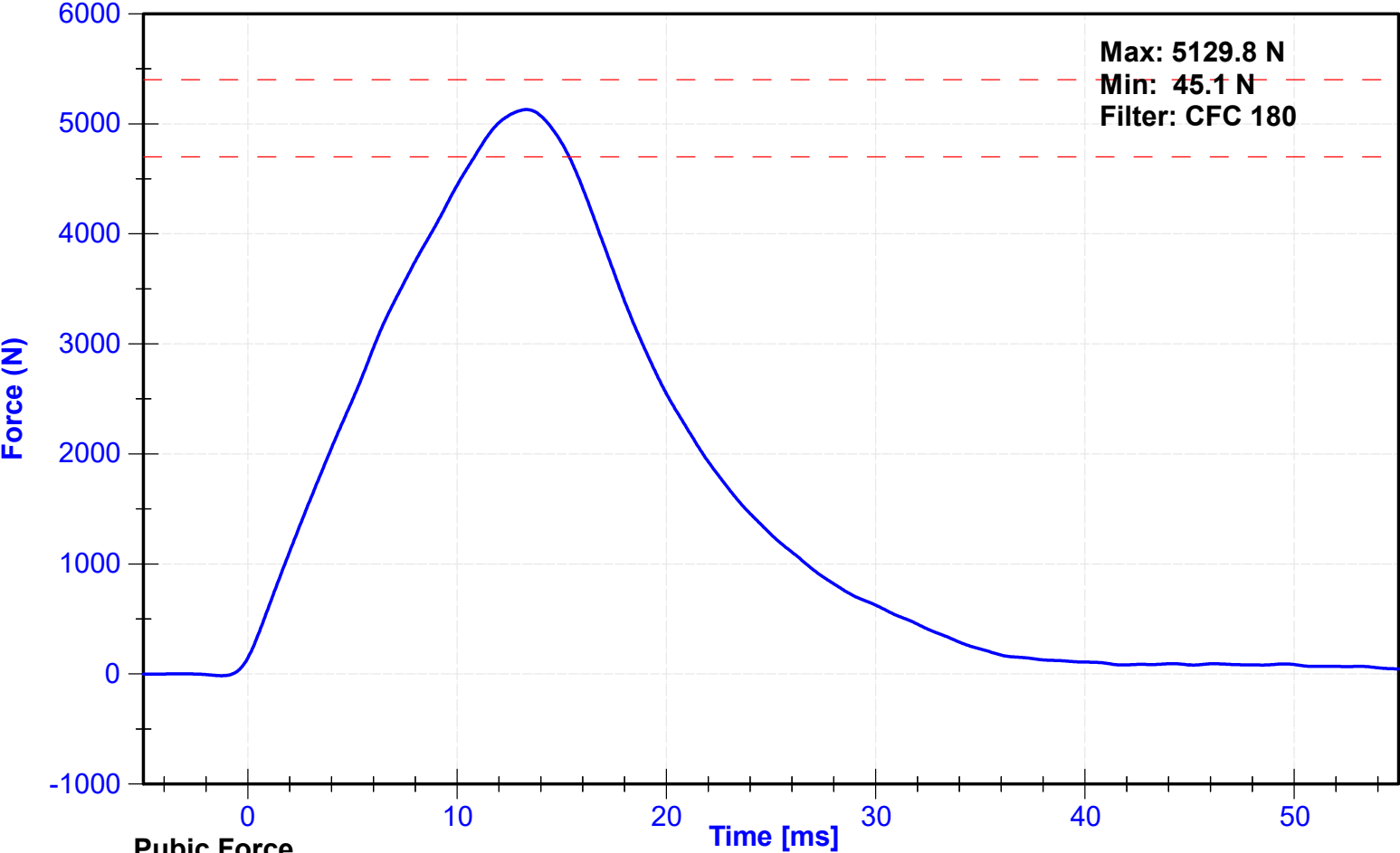
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	P51736	10/25/2022	10/25/2023
Pubic Load Cell	Denton	456-FY	8/8/2023	8/7/2024

Probe Acceleration



Resistive Force



POST-TEST
ES-2re PERFORMANCE CALIBRATION TEST DATA

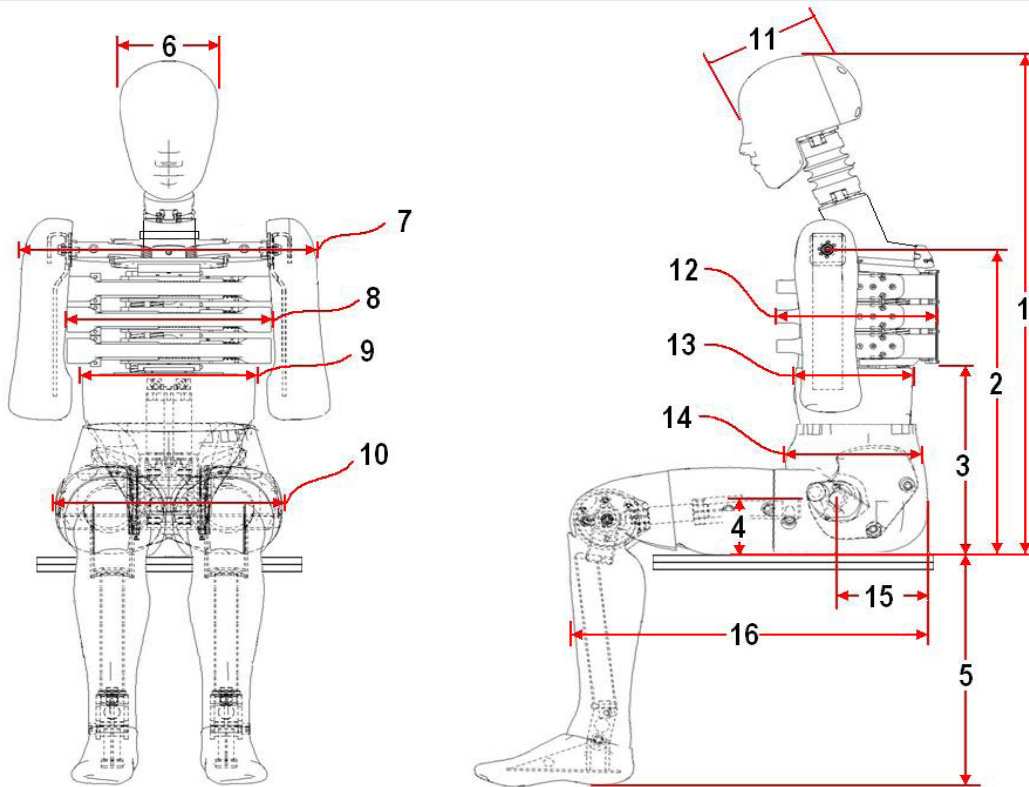


External Measurements - EuroSID-2re

Technician: K. Brogan

Date: 09/19/2023

Dummy Serial Number: D037



FRONT VIEW

SIDE VIEW

Dim. No.	Description	Specification (mm)		Result (mm)	Pass/Fail
1	Sitting Height	900	918	911	Pass
2	Seat to Shoulder Joint	558	572	564	Pass
3	Seat to Lower Face of Thoracic Spine Box	346	356	354	Pass
4	Seat to Hip Joint (center of bolt)	97	103	101	Pass
5	Sole to Seat, Sitting	333	451	422	Pass
6	Head Width	152	158	155	Pass
7	Shoulder/Arm Width	461	479	471	Pass
8	Thorax Width	322	332	329	Pass
9	Abdomen Width	273	287	281	Pass
10	Pelvis Lap Width	359	373	364	Pass
11	Head Depth	196	206	201	Pass
12	Thorax Depth	262	272	266	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	154	Pass
16	Back of Buttocks to Front Knee	597	615	605	Pass

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

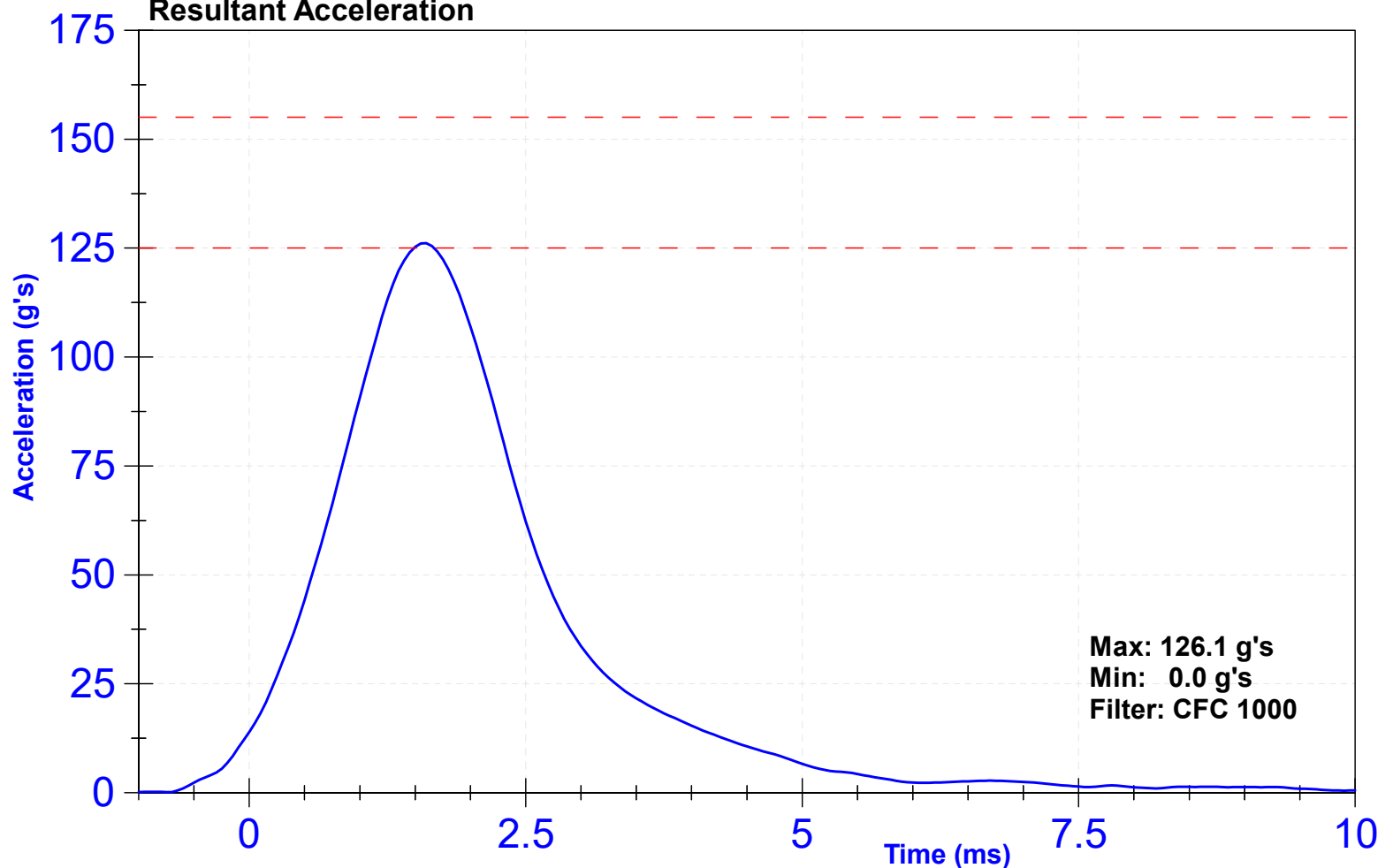
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.8	Pass
Humidity	10	70	%	53	Pass
Resultant Acceleration	125	155	g's	126.1	Pass
Oscillation	0	15	%	2.18	Pass
Fore-Aft Acceleration	-15	15	g's	6.5	Pass

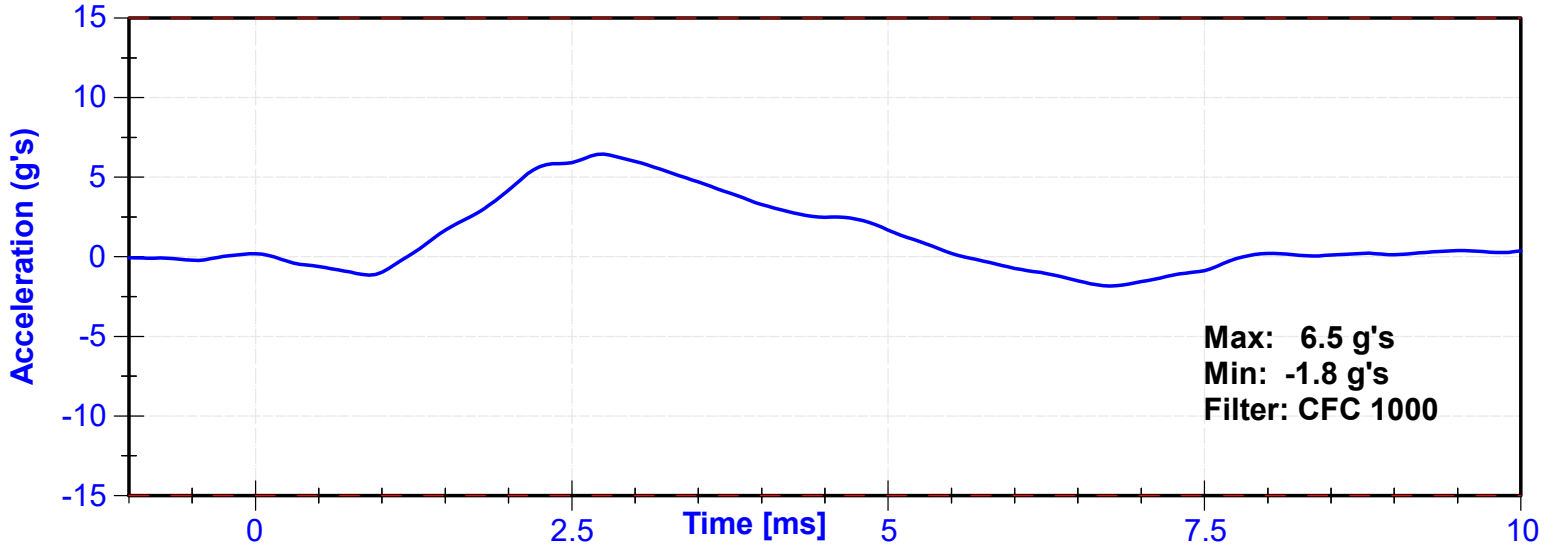
Transducer Calibrations

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

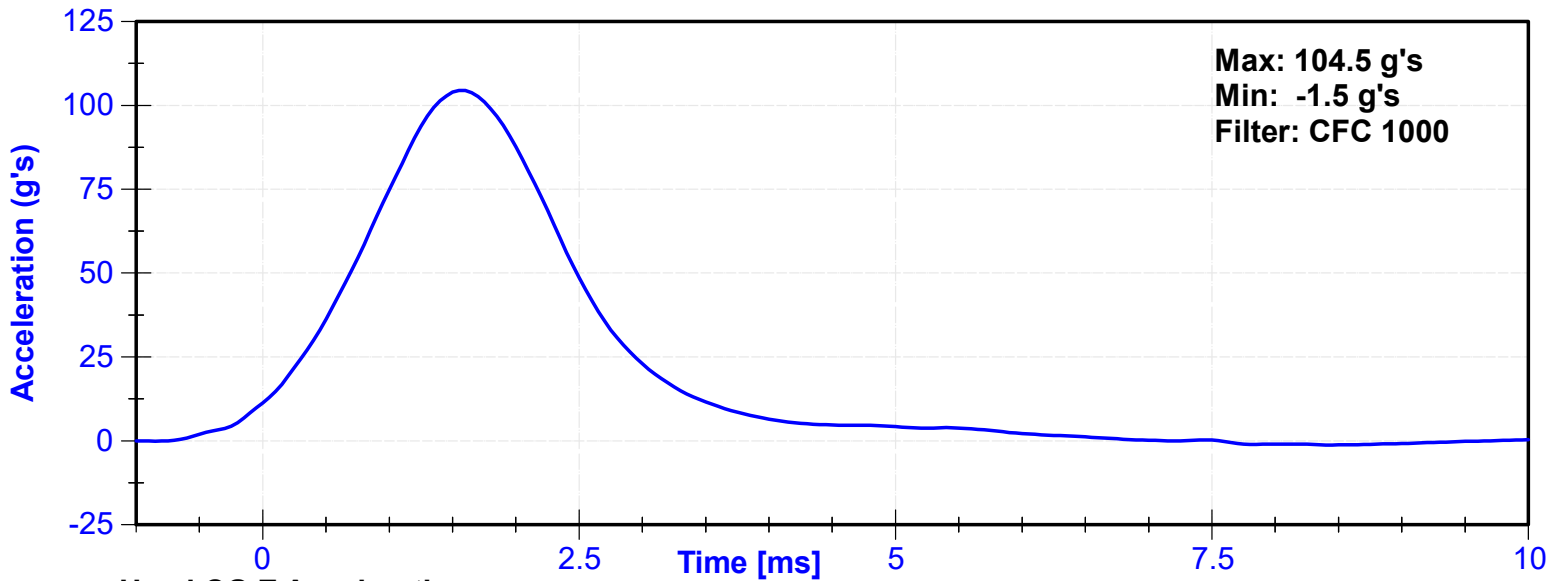
Resultant Acceleration



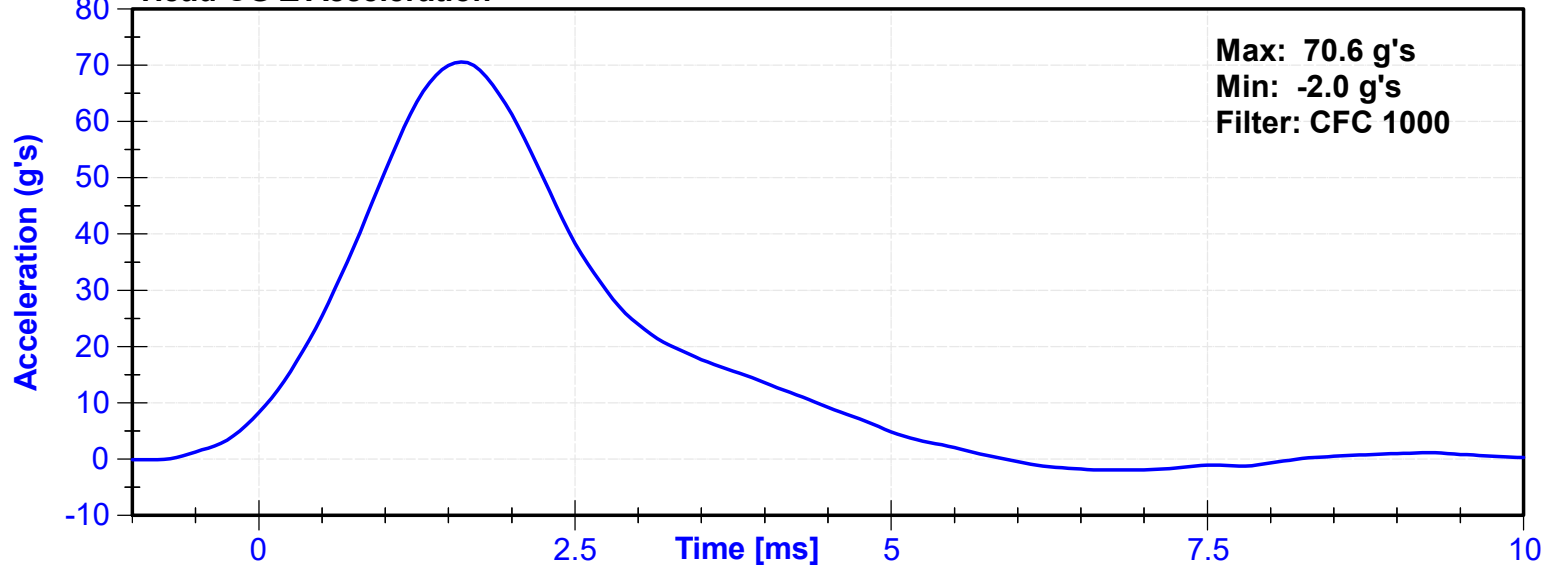
Head CG X Acceleration



Head CG Y Acceleration



Head CG Z Acceleration



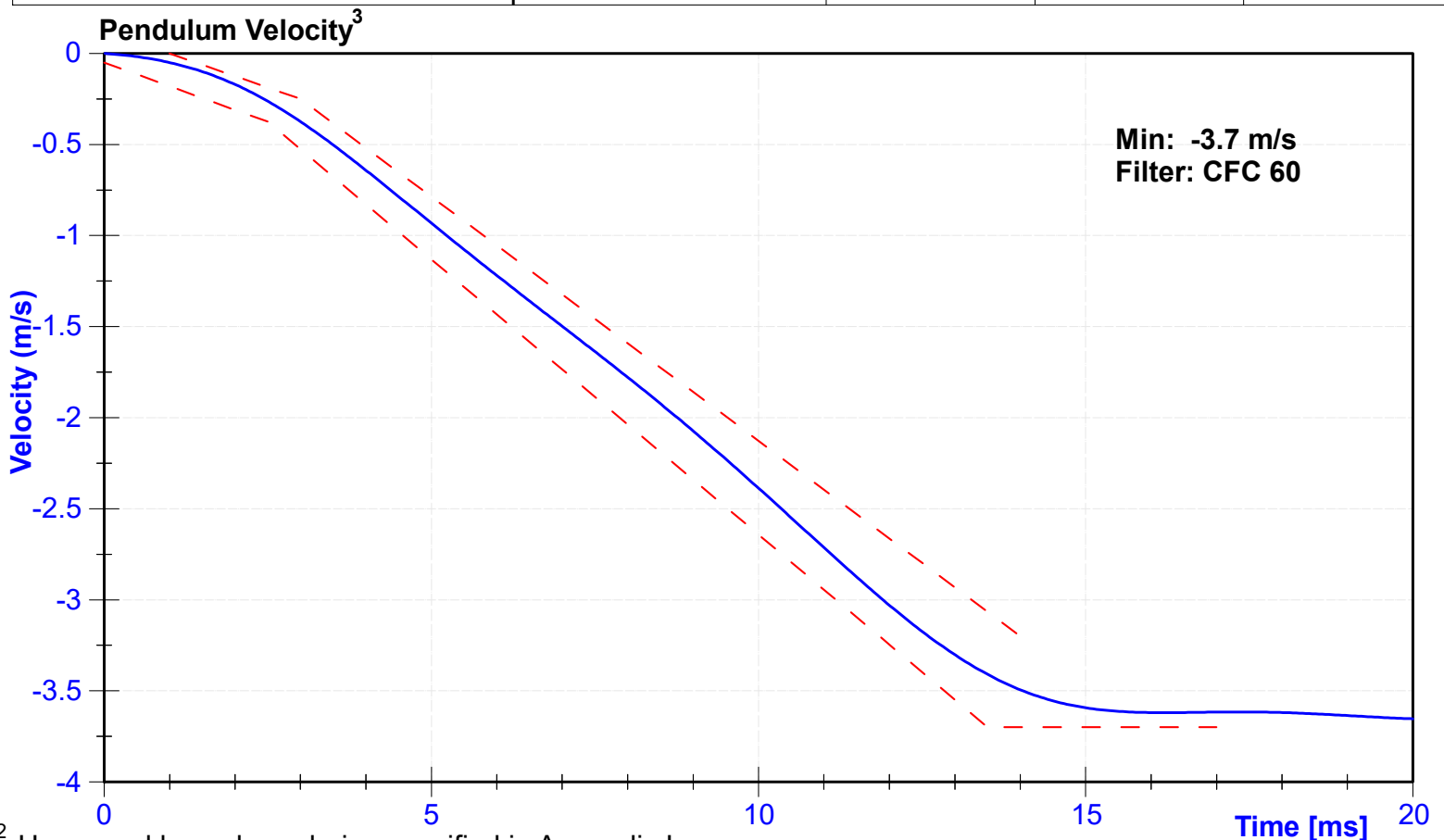
ATD Manufacturer	Denton	Test Technician	D. Sakona
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.8	Pass
Humidity	10	70	%	53	Pass
Velocity	3.3	3.5	m/s	3.43	Pass
Lateral Neck Rotation	49	59	deg	53.9	Pass
Time at Maximum Rotation	54	66	ms	61.3	Pass
Time of Rotation Decay from Maximum	53	88	ms	53.6	Pass
Pendulum Velocity Overall Corridor	Lower Boundary ¹	Upper Boundary ²	m/s	See Plot ³	Pass

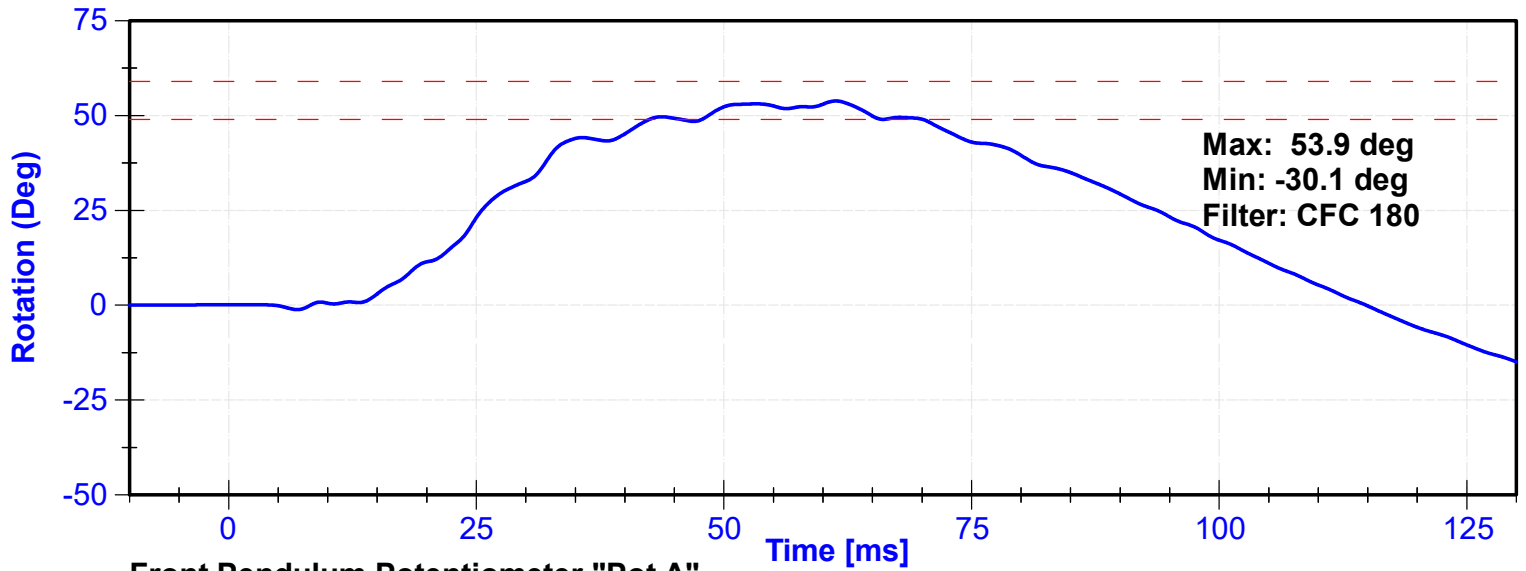
Transducer Calibrations

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

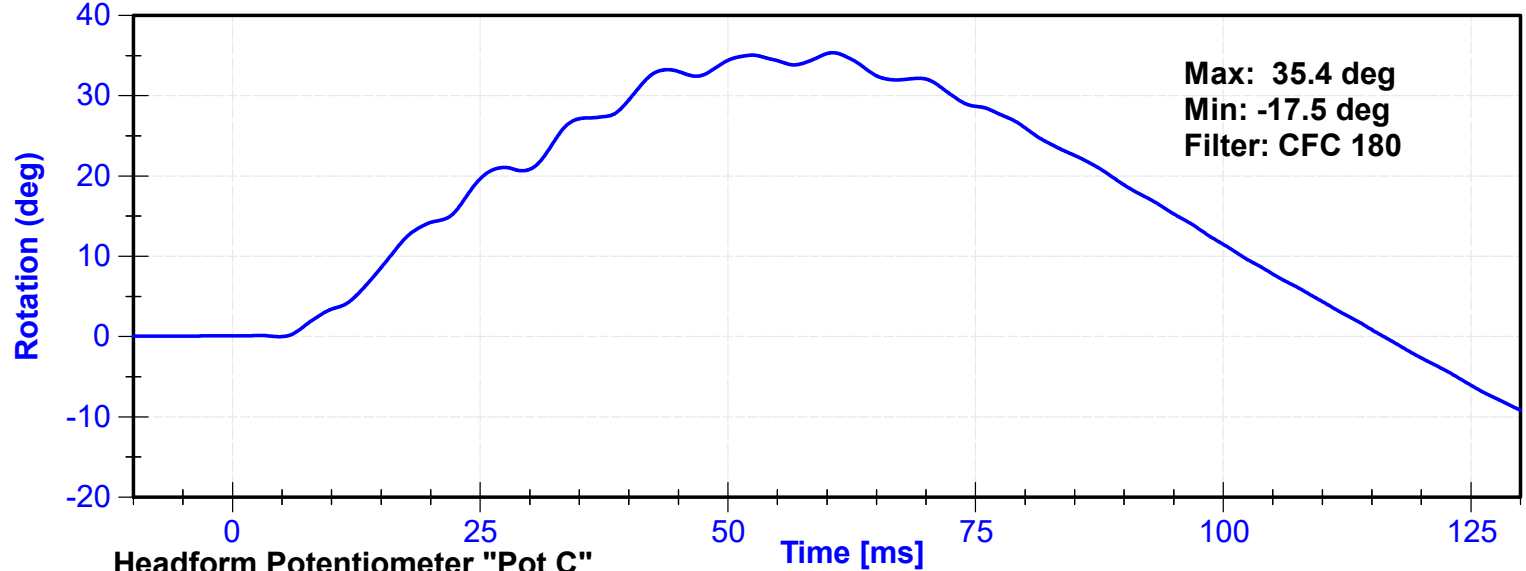


^{1,2} Upper and lower boundaries specified in Appendix I

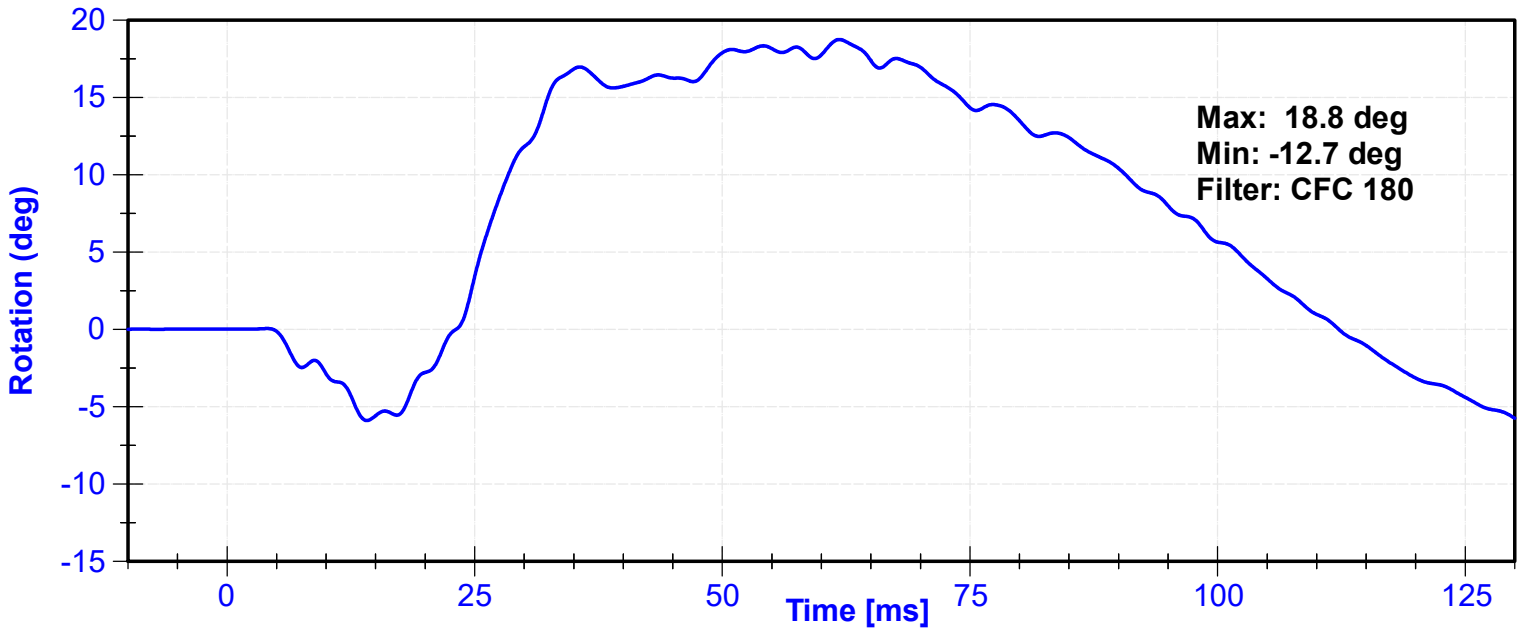
Neck Rotation



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

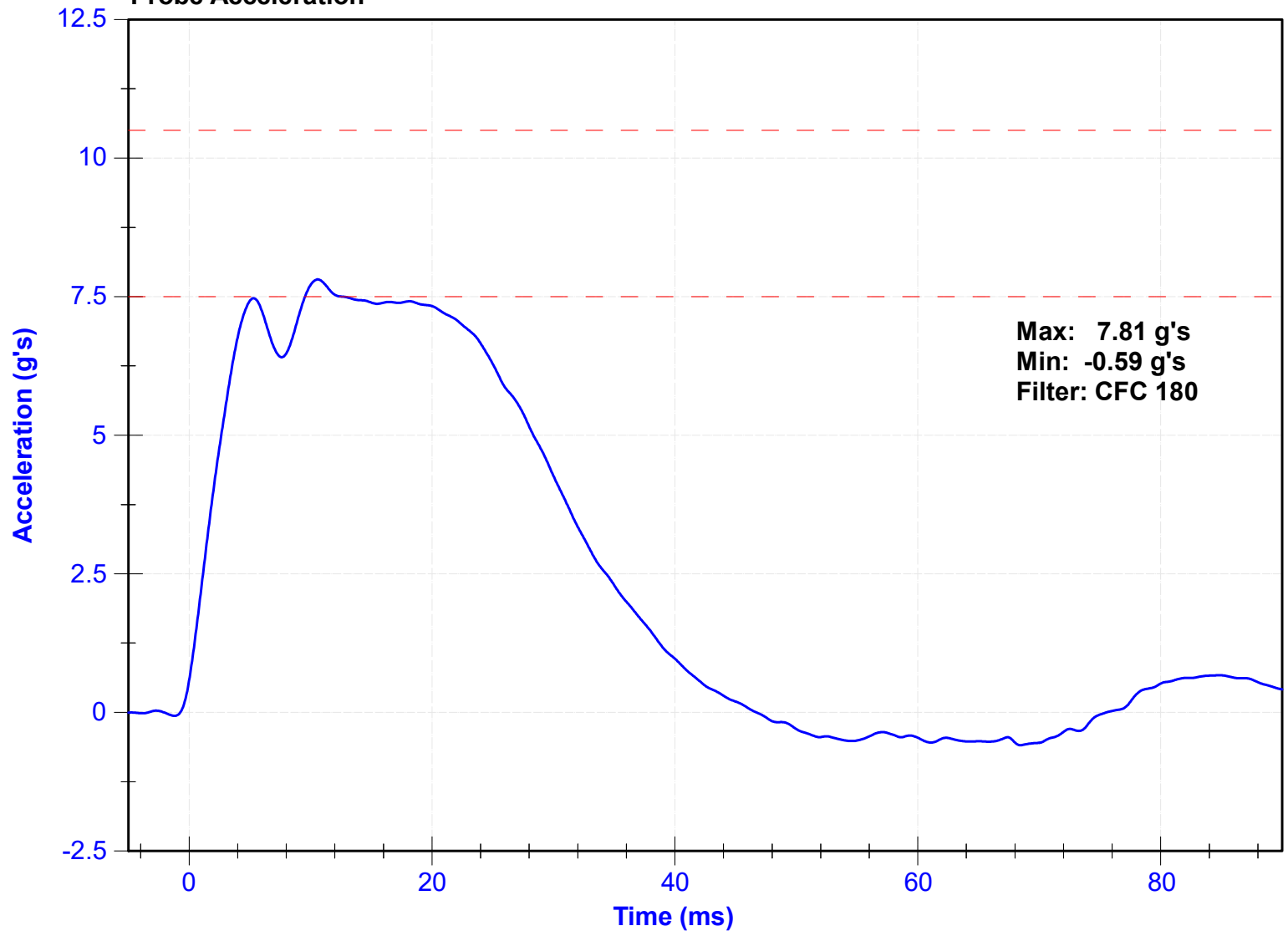
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.5	Pass
Humidity	10	70	%	47	Pass
Velocity	4.2	4.4	m/s	4.34	Pass
Probe Acceleration	7.5	10.5	g's	7.81	Pass

Transducer Calibrations

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

Probe Acceleration



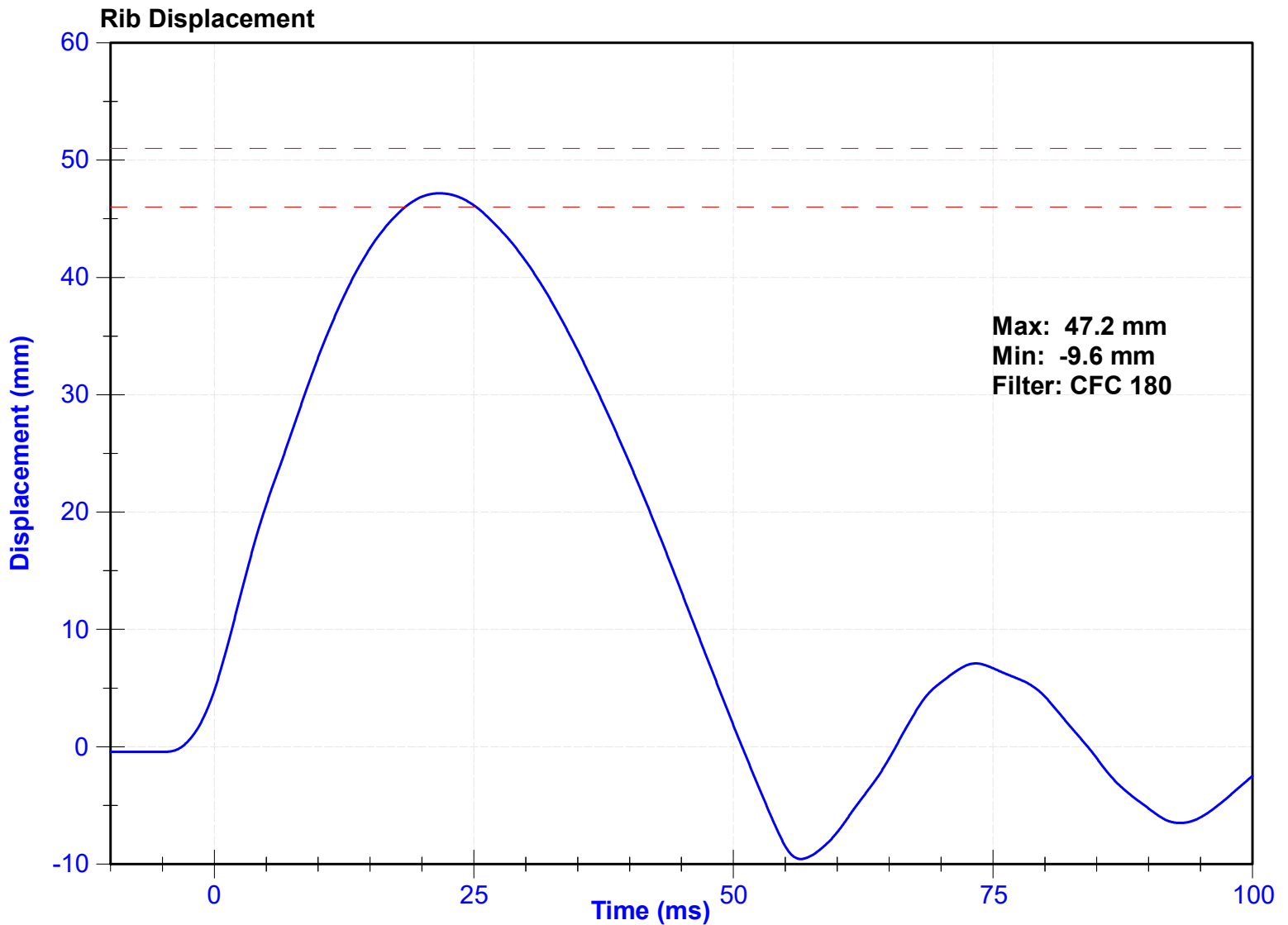
ATD Manufacturer	Denton	Test Technician	D. Sakona
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.8	Pass
Humidity	10	70	%	53	Pass
Rib Displacement	46	51	mm	47.2	Pass

Transducer Calibrations

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



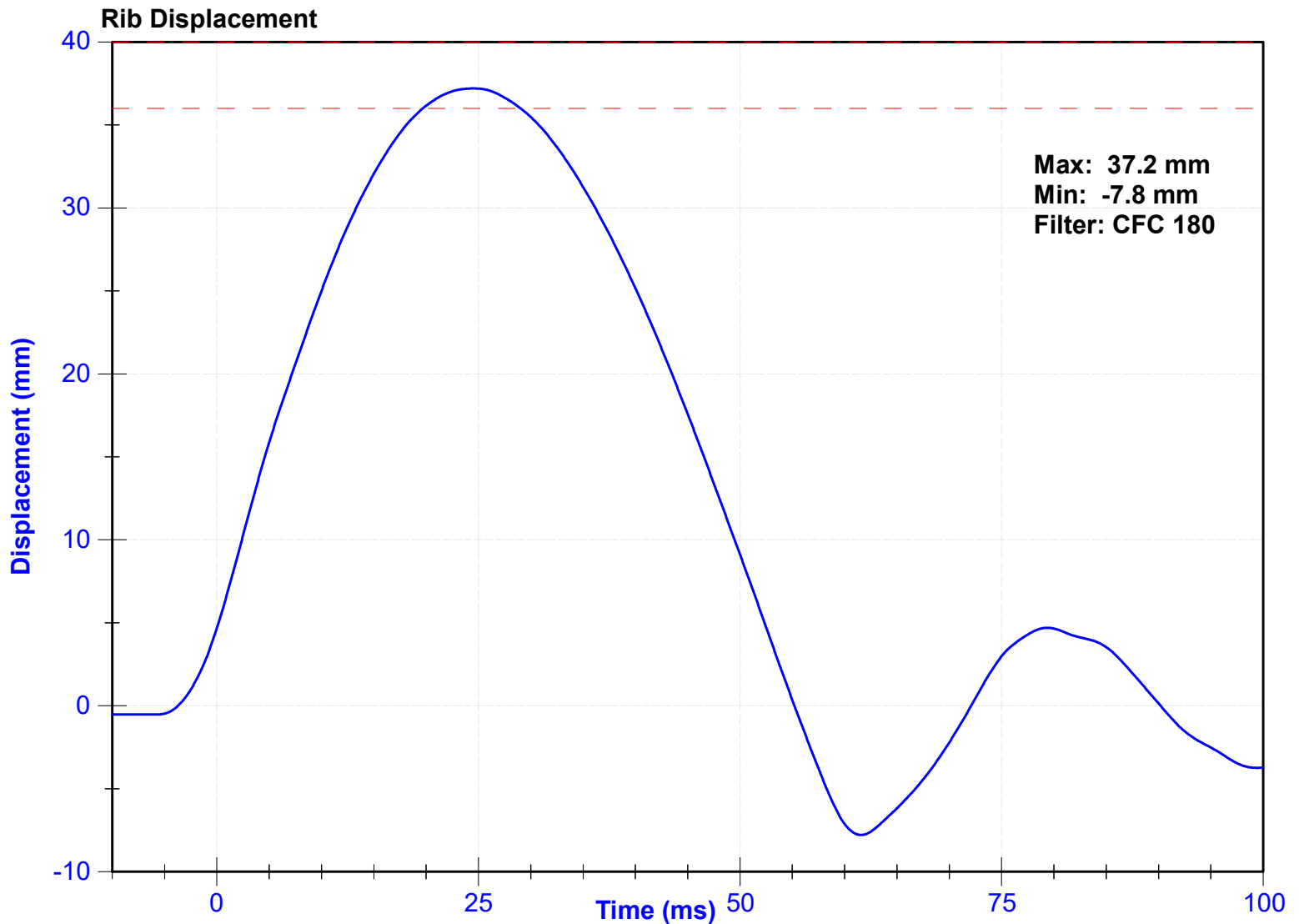
ATD Manufacturer	Denton	Test Technician	D. Sakona
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.8	Pass
Humidity	10	70	%	53	Pass
Rib Displacement	36	40	mm	37.2	Pass

Transducer Calibrations

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



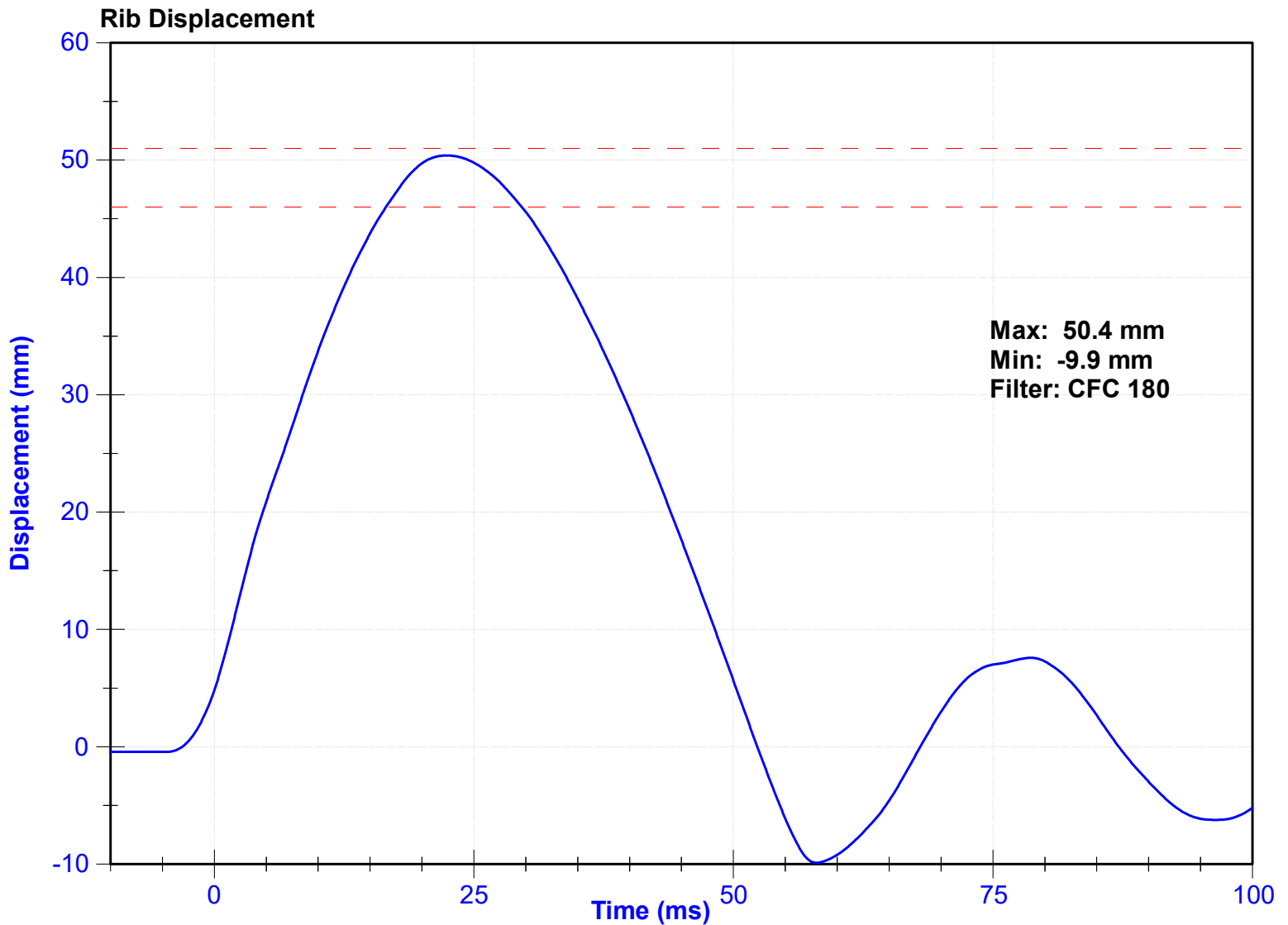
ATD Manufacturer	Denton	Test Technician	D. Sakona
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.8	Pass
Humidity	10	70	%	53	Pass
Rib Displacement	46	51	mm	50.4	Pass

Transducer Calibrations

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



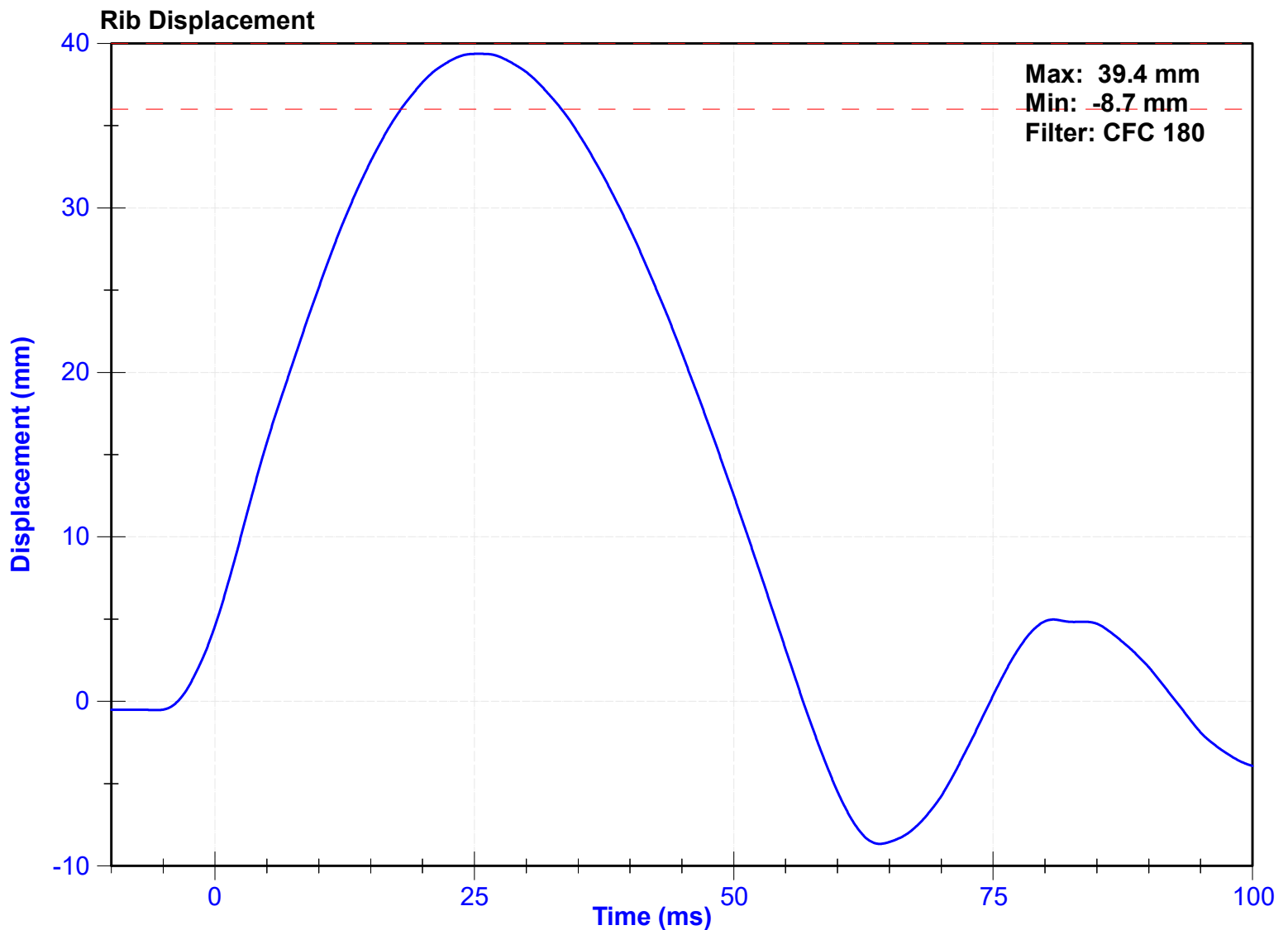
ATD Manufacturer	Denton	Test Technician	D. Sakona
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.8	Pass
Humidity	10	70	%	53	Pass
Rib Displacement	36	40	mm	39.4	Pass

Transducer Calibrations

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



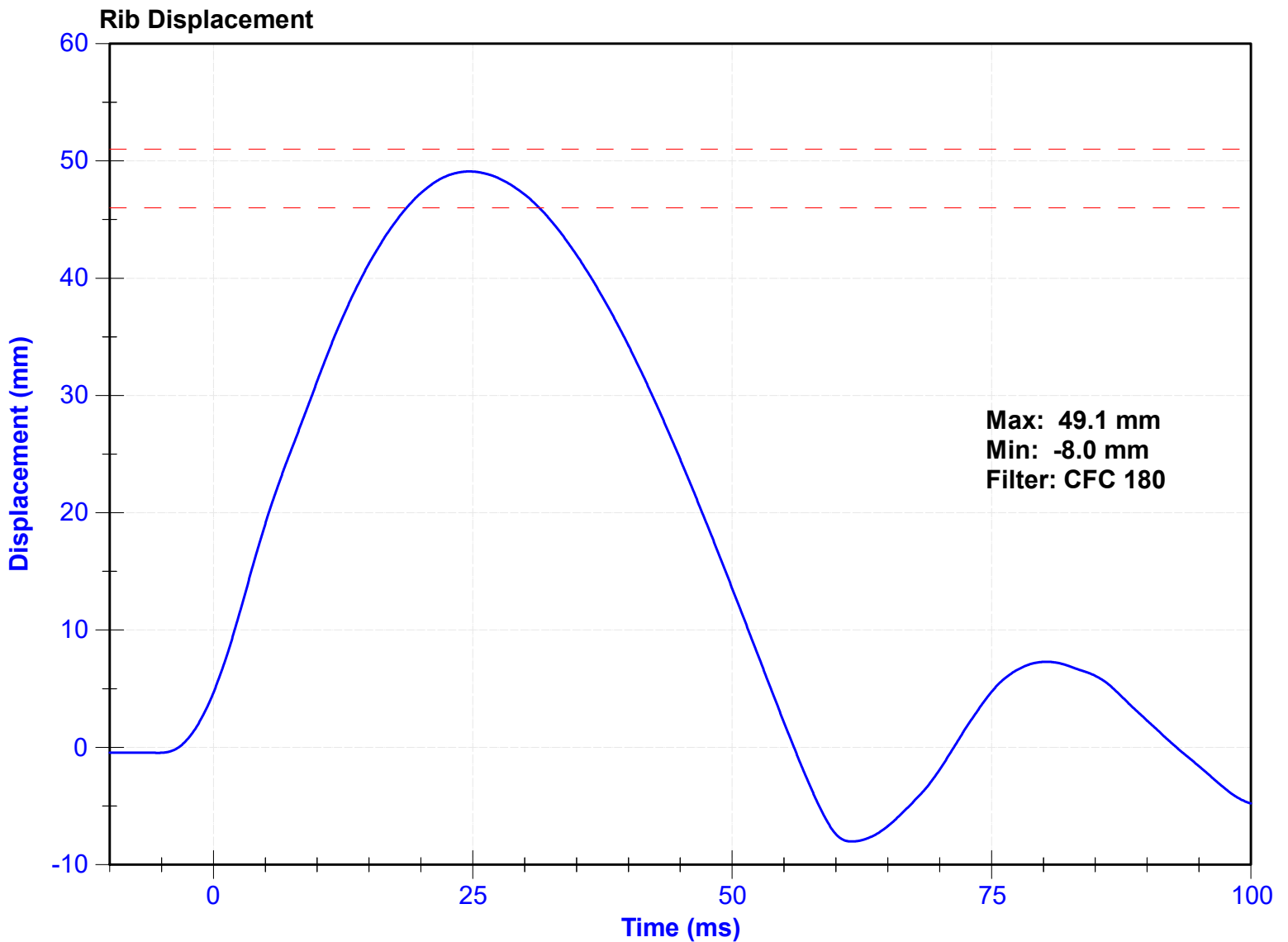
ATD Manufacturer	Denton	Test Technician	D. Sakona
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.8	Pass
Humidity	10	70	%	53	Pass
Rib Displacement	46	51	mm	49.1	Pass

Transducer Calibrations

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



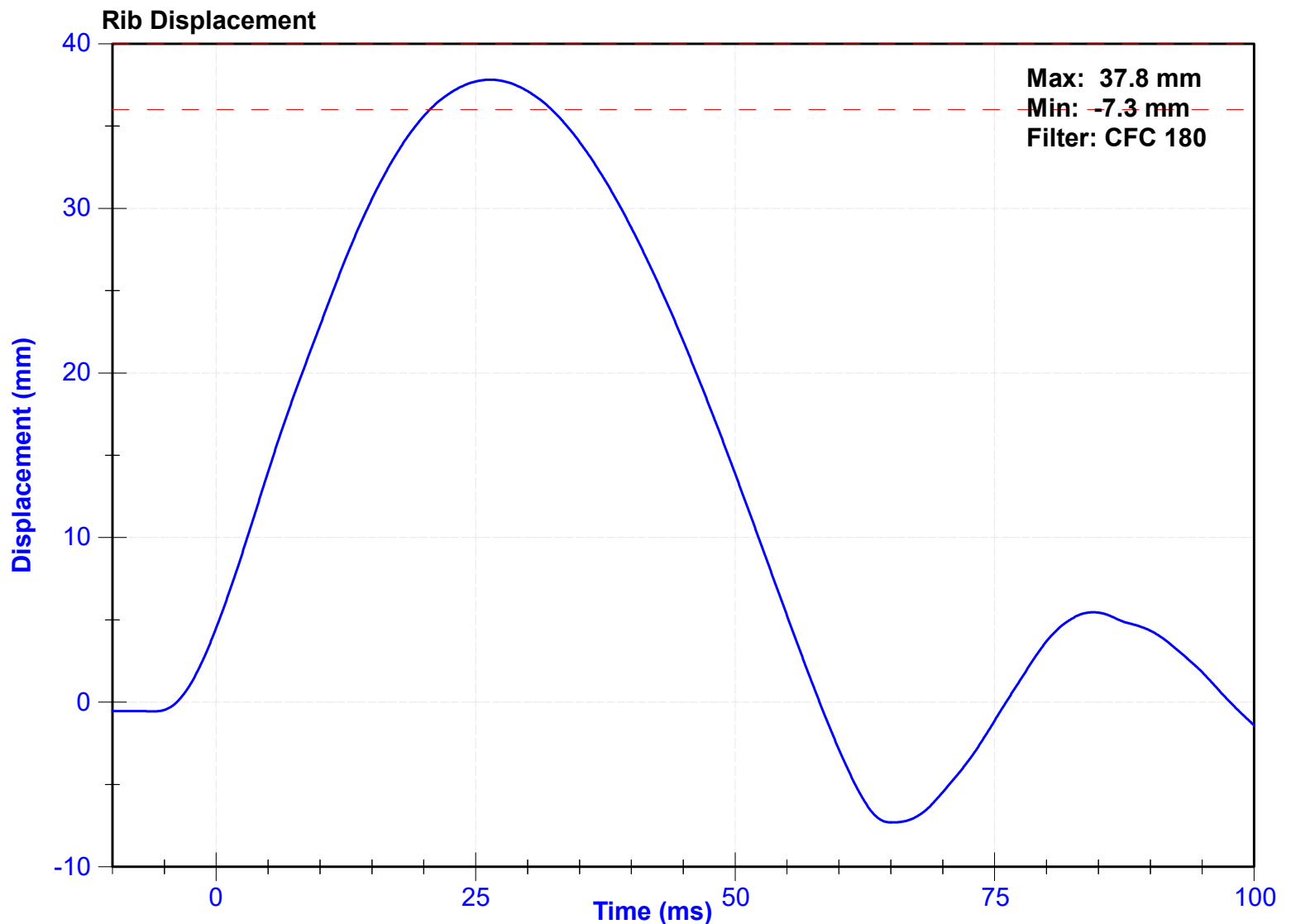
ATD Manufacturer	Denton	Test Technician	D. Sakona
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.8	Pass
Humidity	10	70	%	53	Pass
Rib Displacement	36	40	mm	37.8	Pass

Transducer Calibrations

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



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

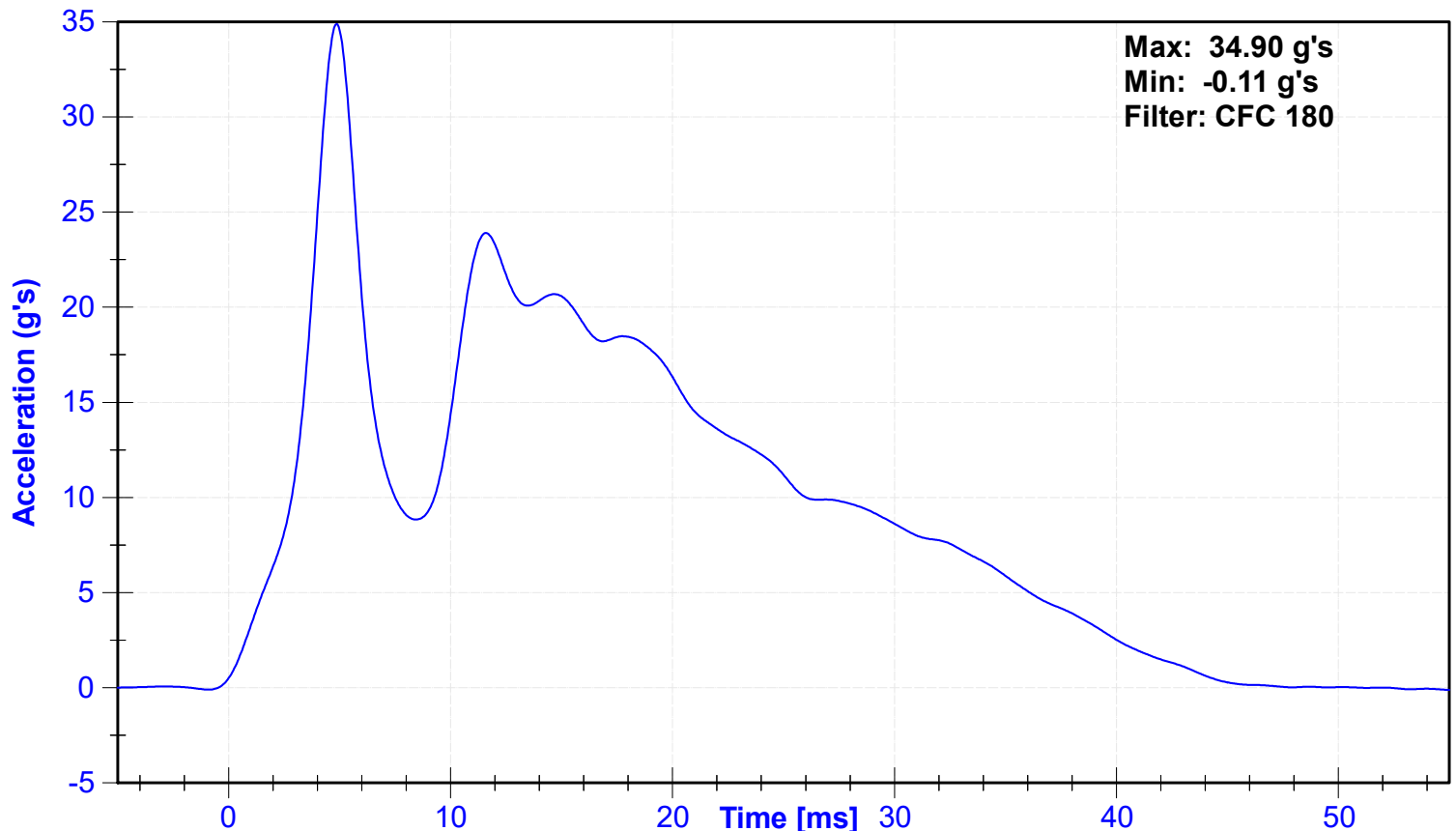
Results

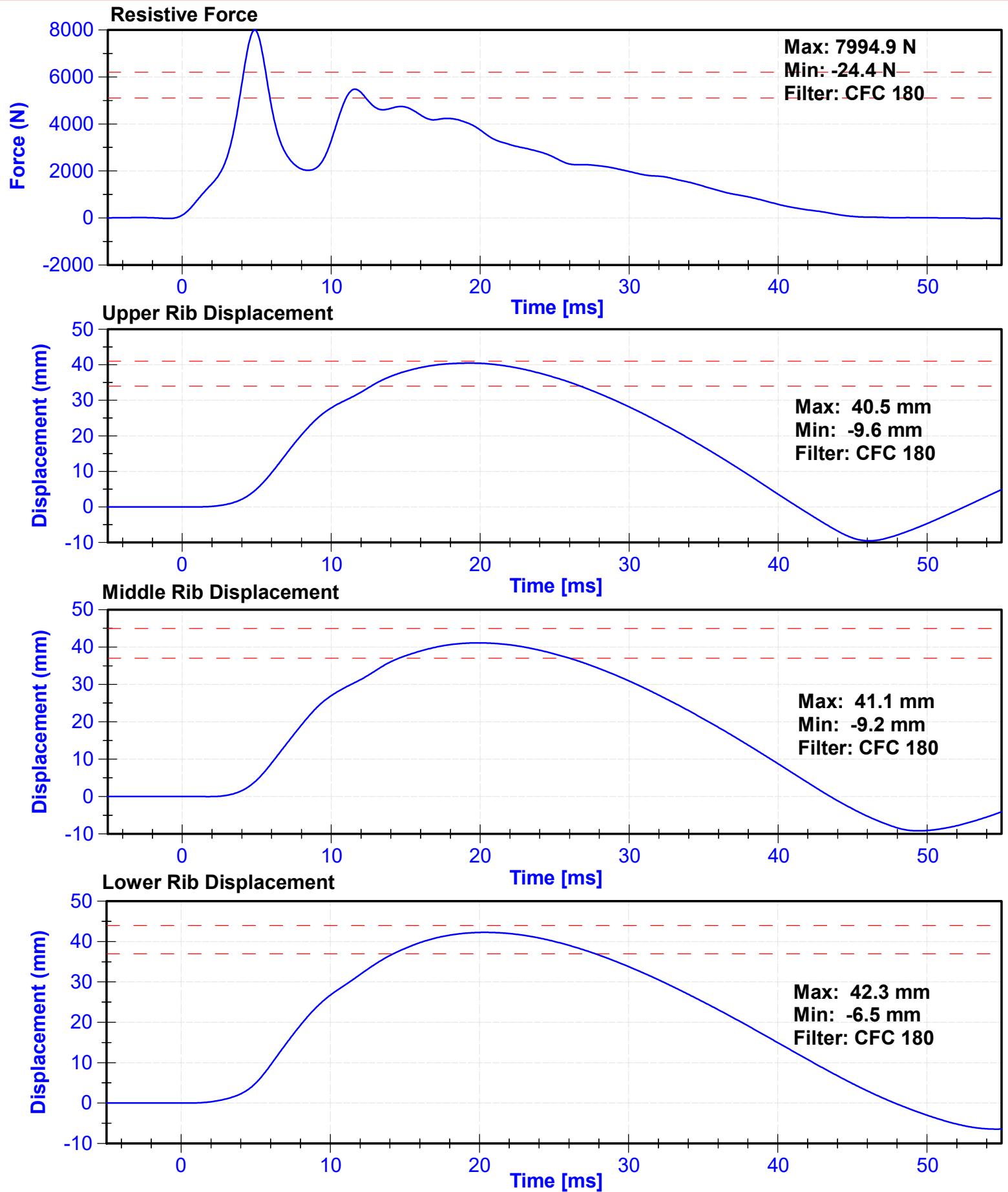
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.5	Pass
Humidity	10	70	%	47	Pass
Velocity	5.4	5.6	m/s	5.51	Pass
Resistive Force after 6ms	5100	6200	N	5476.4	Pass
Upper Thorax Rib Deflection	34	41	mm	40.5	Pass
Mid Thorax Rib Deflection	37	45	mm	41.1	Pass
Lower Thorax Rib Deflection	37	44	mm	42.3	Pass

Transducer Calibrations

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

Probe Acceleration





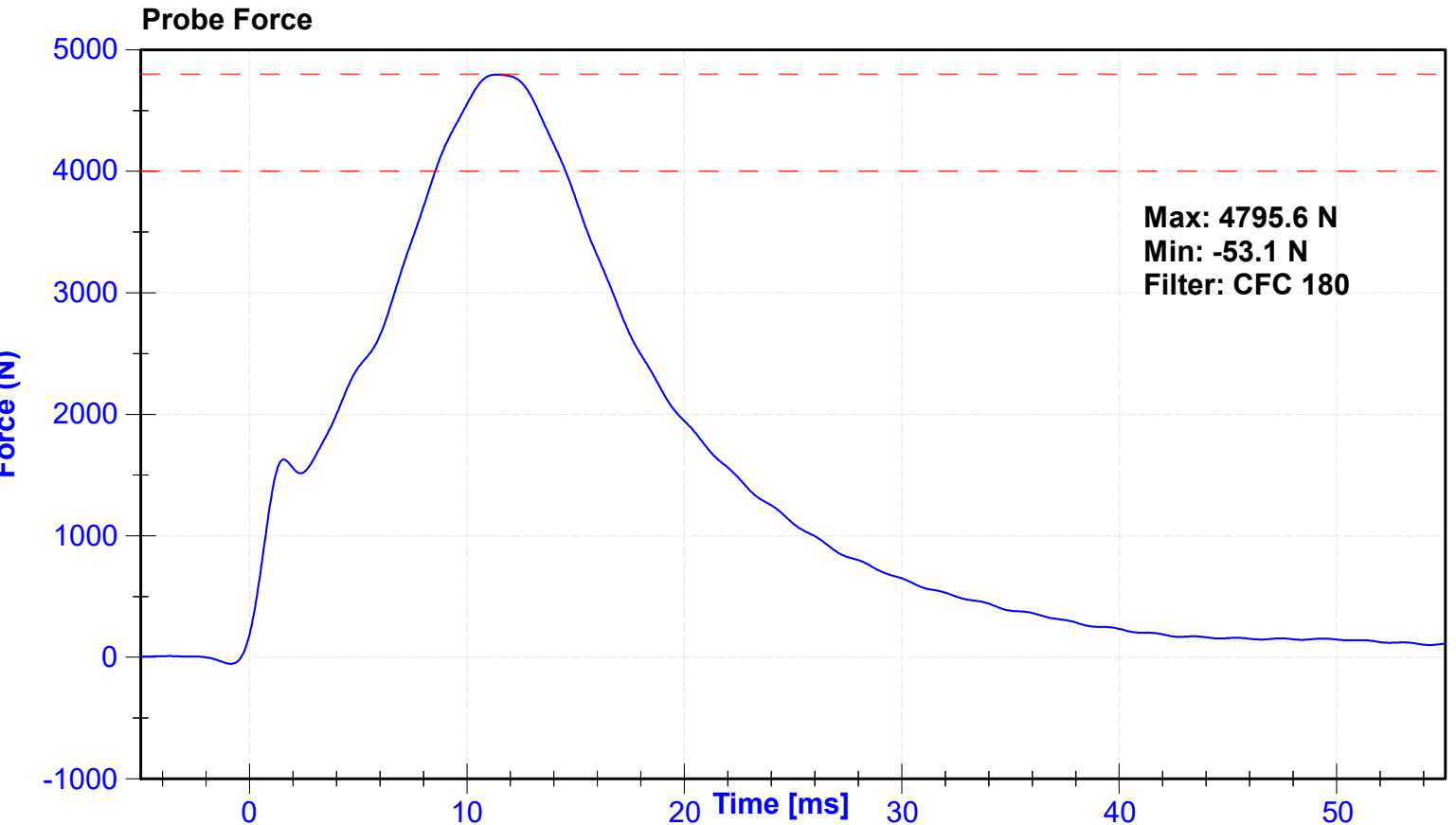
ATD Manufacturer	Denton	Test Technician	D. Sakona
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

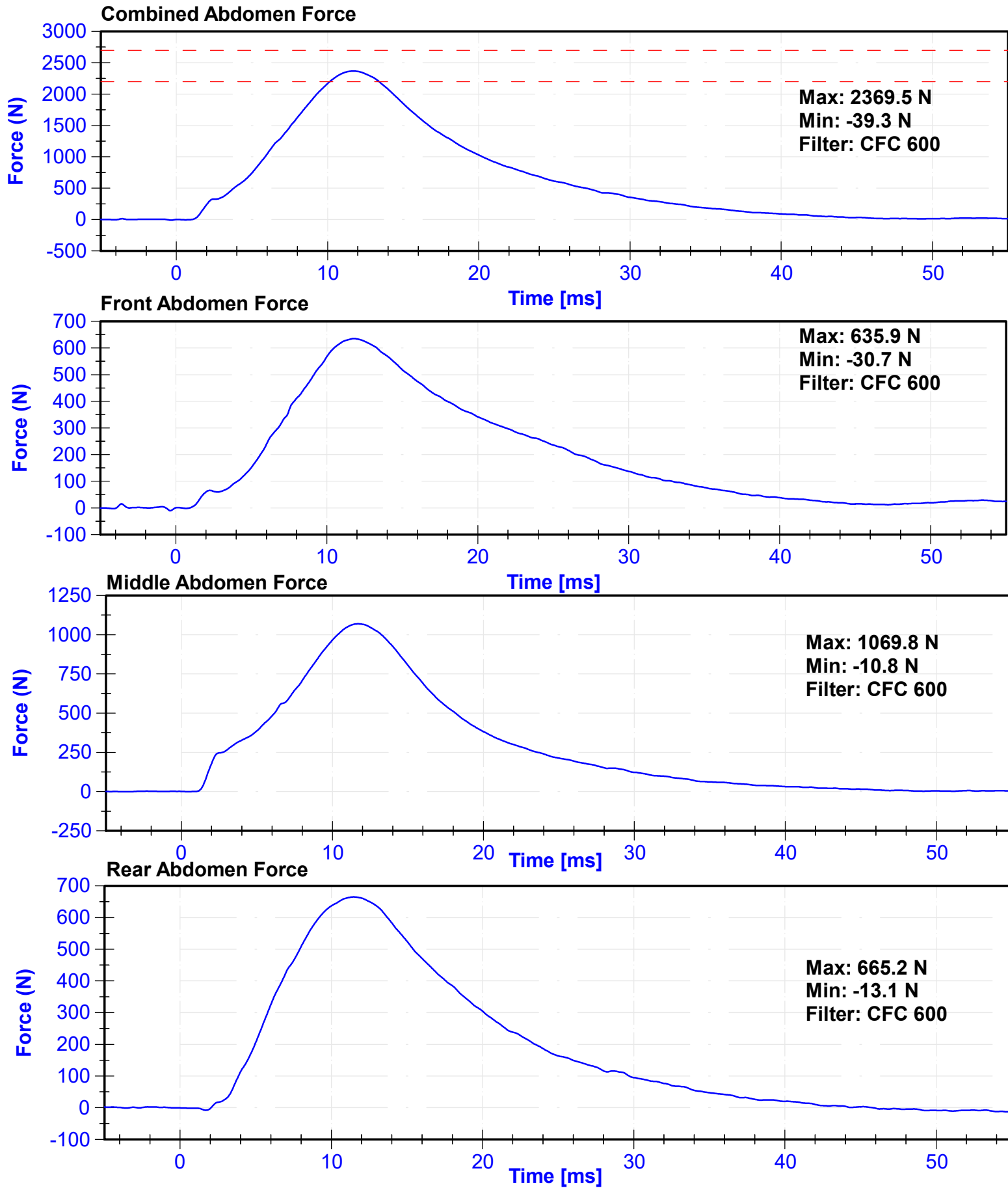
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.5	Pass
Humidity	10	70	%	47	Pass
Velocity	3.9	4.1	m/s	3.92	Pass
Combined Abdomen Force	2200	2700	N	2369.5	Pass
Time at Peak Abdomen Force	10.0	12.3	ms	11.70	Pass
Resistive Probe Force	4000	4800	N	4795.6	Pass
Time at Peak Resistive Force	10.6	13.0	ms	11.35	Pass

Transducer Calibrations

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





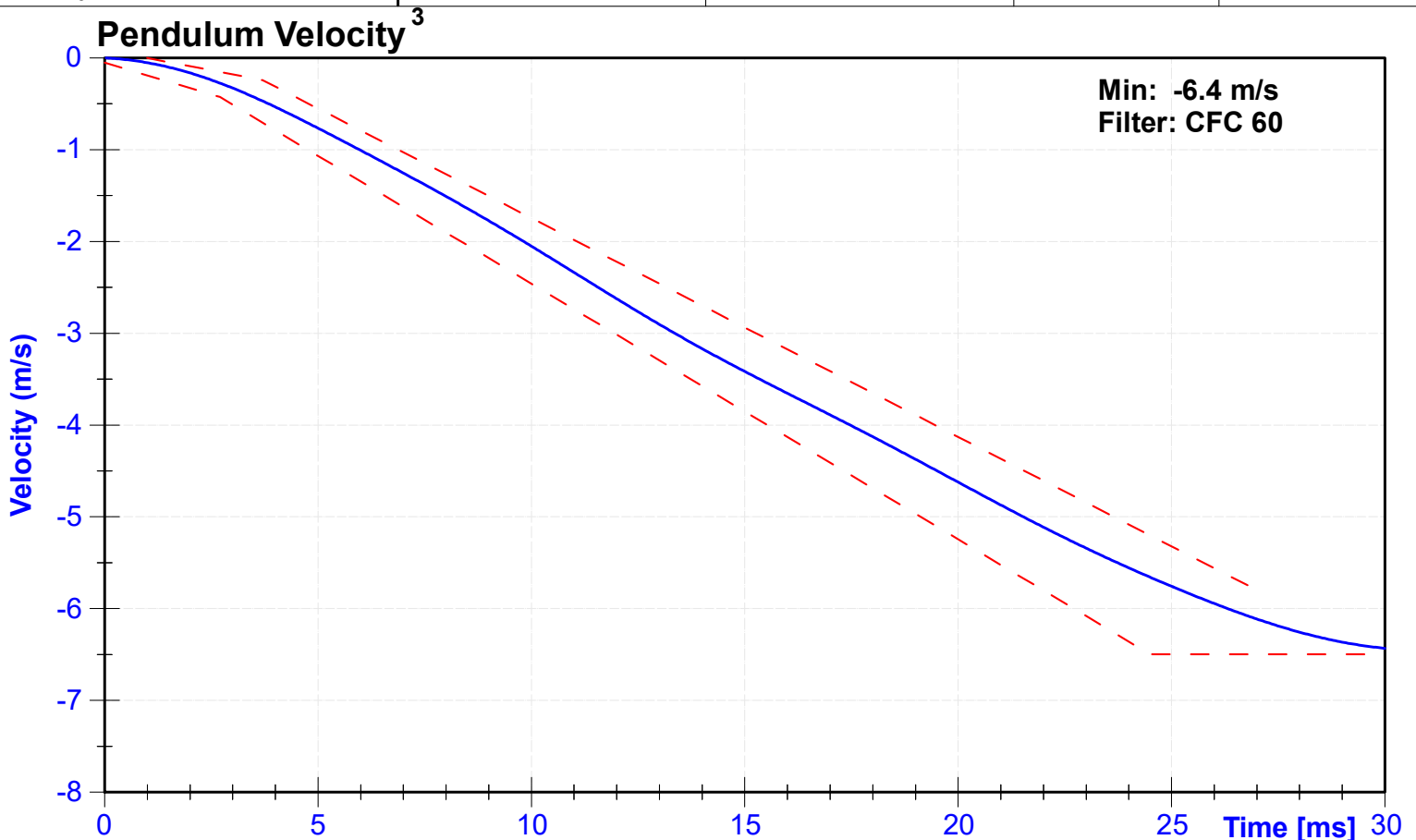
ATD Manufacturer	Denton	Test Technician	D. Sakona
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

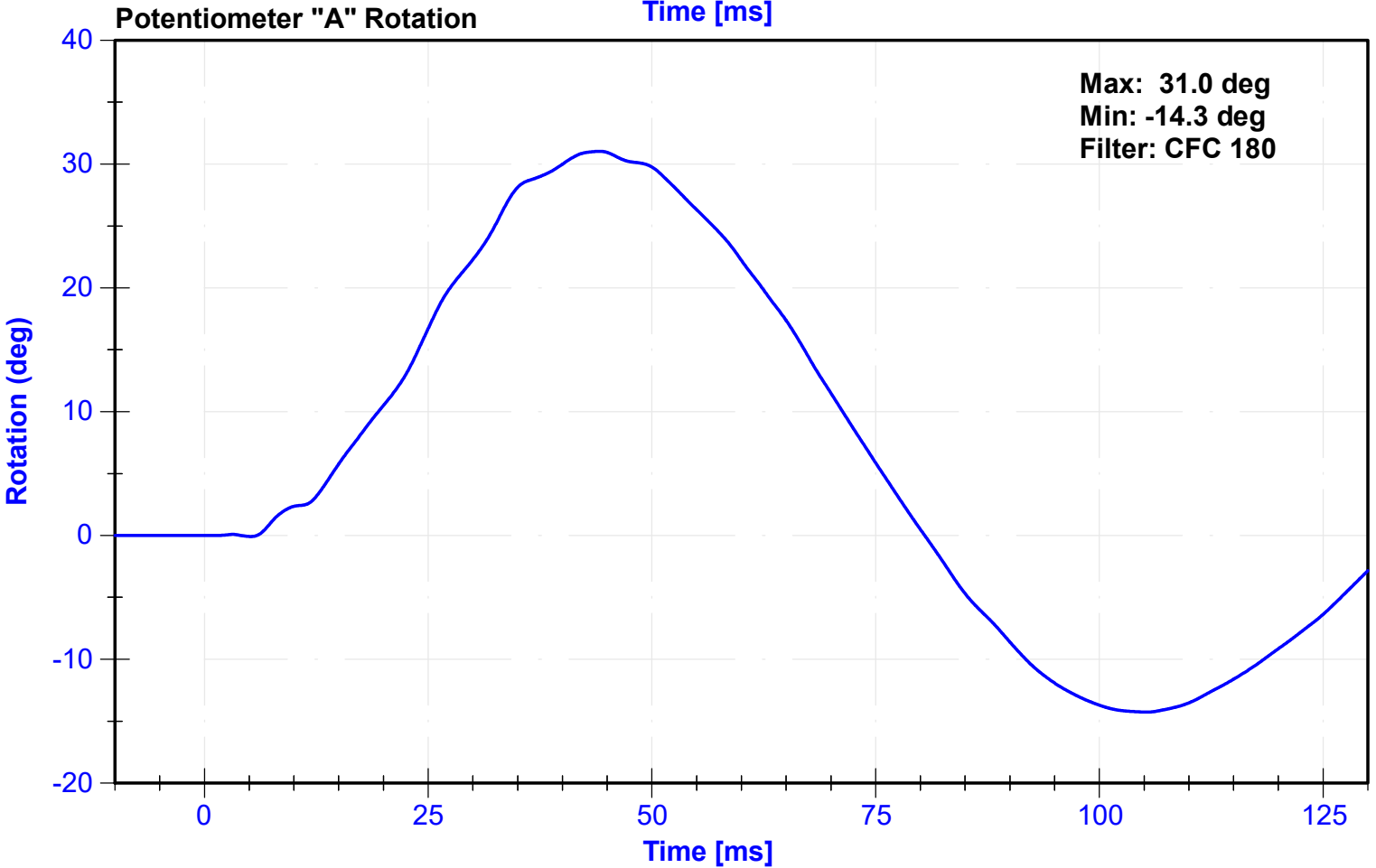
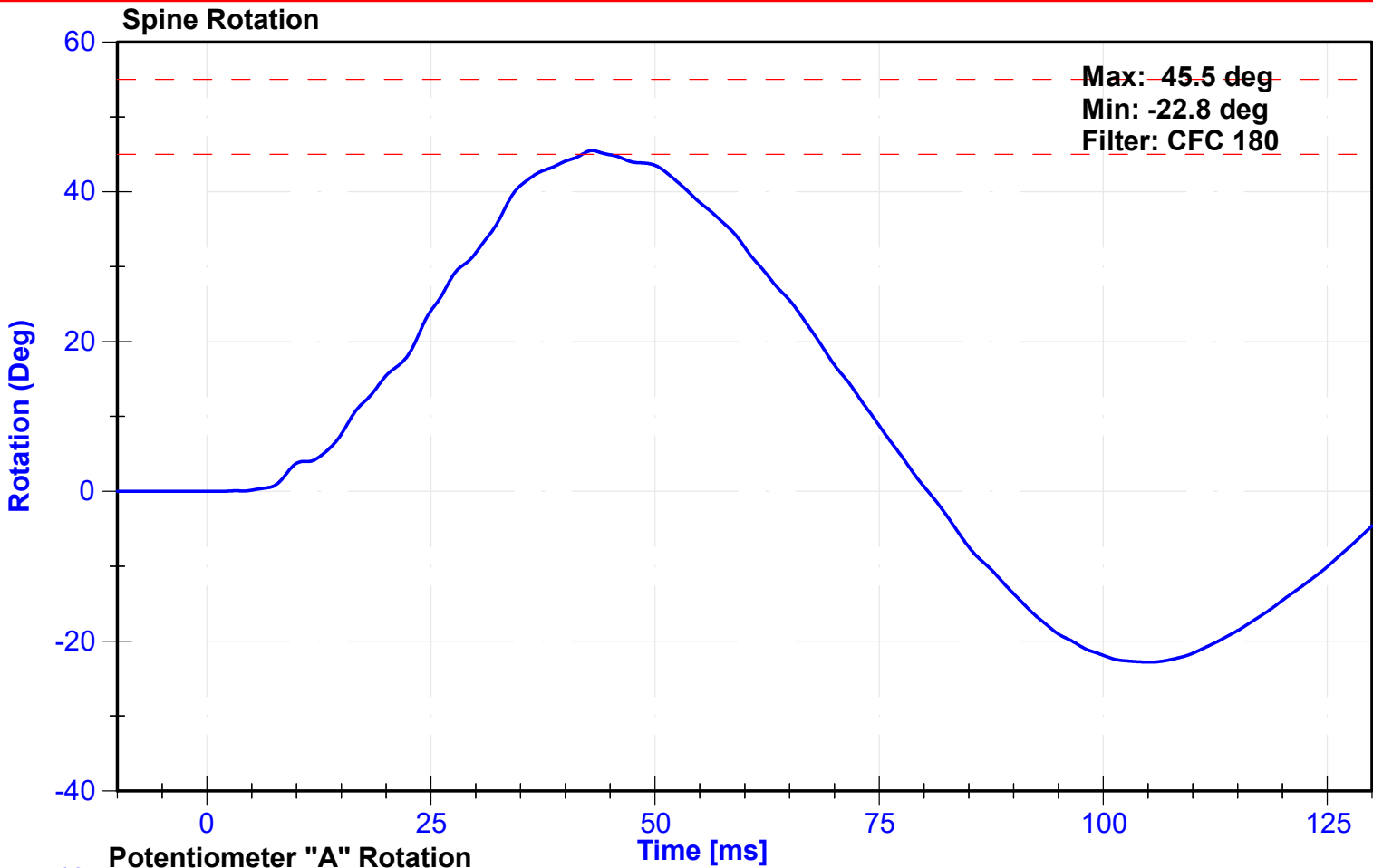
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.8	Pass
Humidity	10	70	%	53	Pass
Velocity	5.95	6.15	m/s	6.044	Pass
Lateral Spine Rotation	45	55	deg	45.5	Pass
Time at Maximum Rotation	39	53	ms	43.0	Pass
Time of Decay to Zero Degrees	37	57	ms	37.5	Pass
Pendulum Velocity Overall Corridor	Lower Boundary ¹	Upper Boundary ²	m/s	See Plot ³	Pass

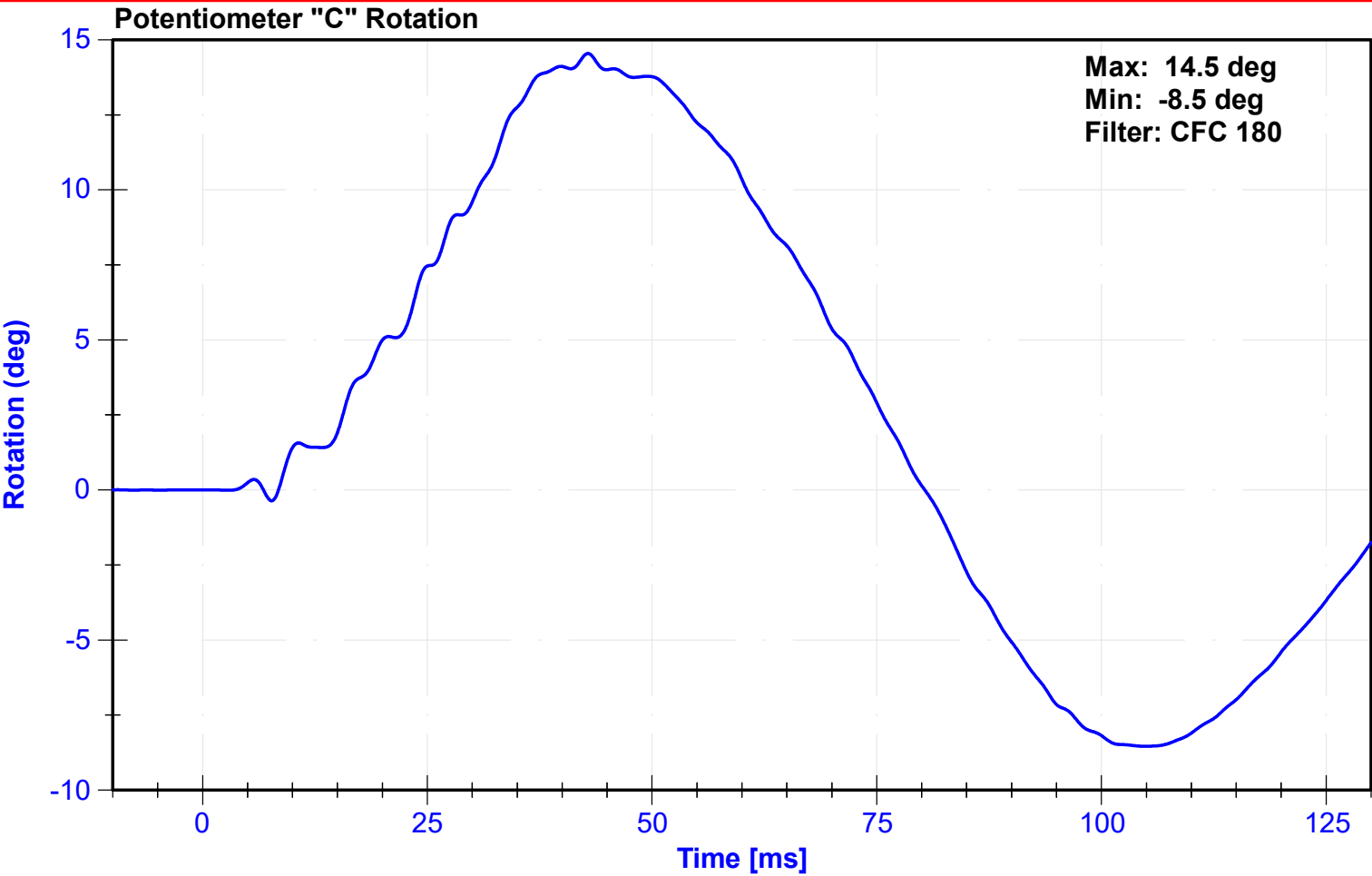
Transducer Calibrations

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 V-41





Appendix I

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

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

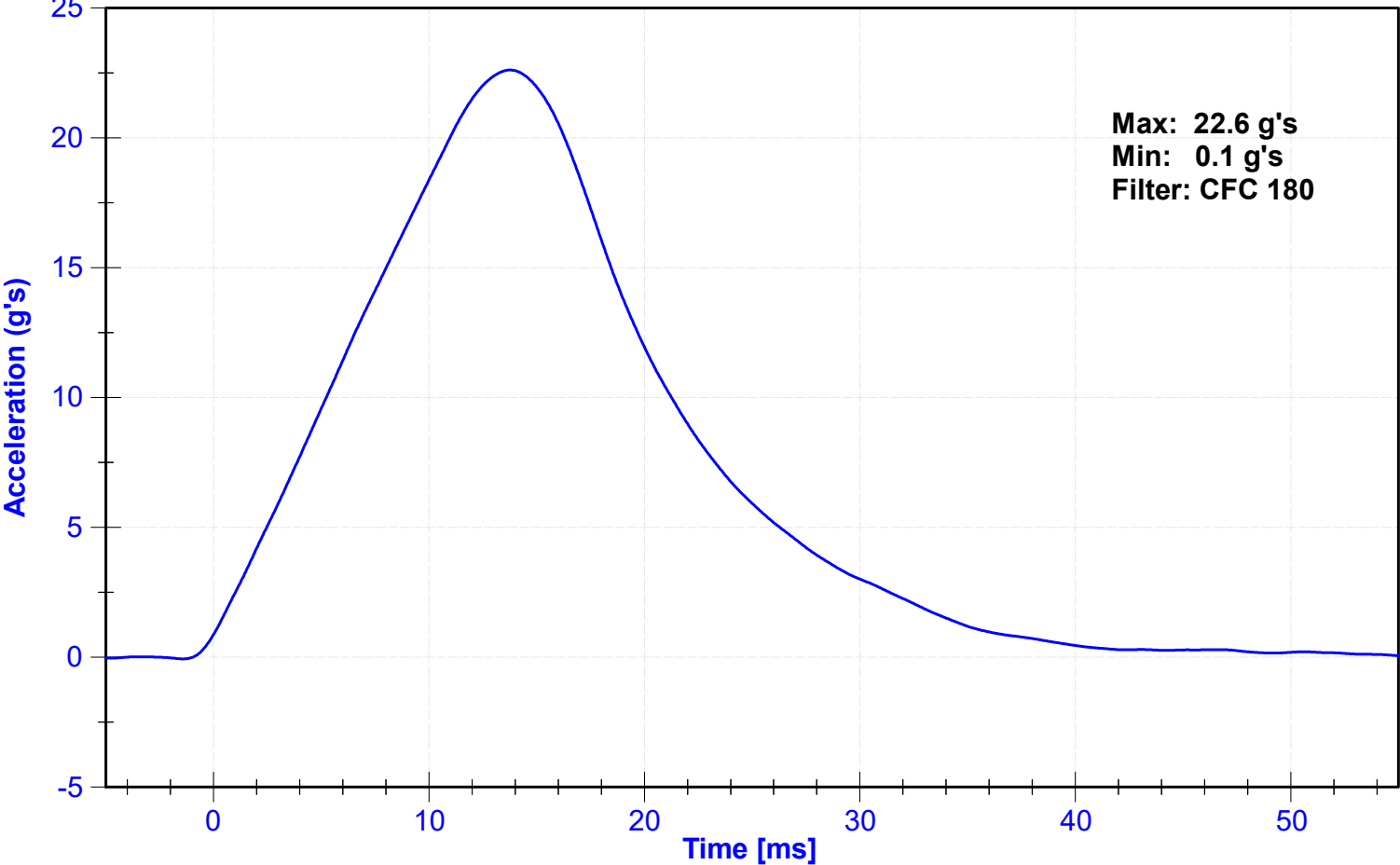
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.5	Pass
Humidity	10	70	%	47	Pass
Velocity	4.2	4.4	m/s	4.27	Pass
Resistive Force	4700	5400	N	5179.3	Pass
Time at Peak Resistive Force	11.8	16.1	ms	13.75	Pass
Pubic Force	-1590	-1230	N	-1558.6	Pass
Time at Peak Pubic Force	12.2	17.0	ms	14.40	Pass

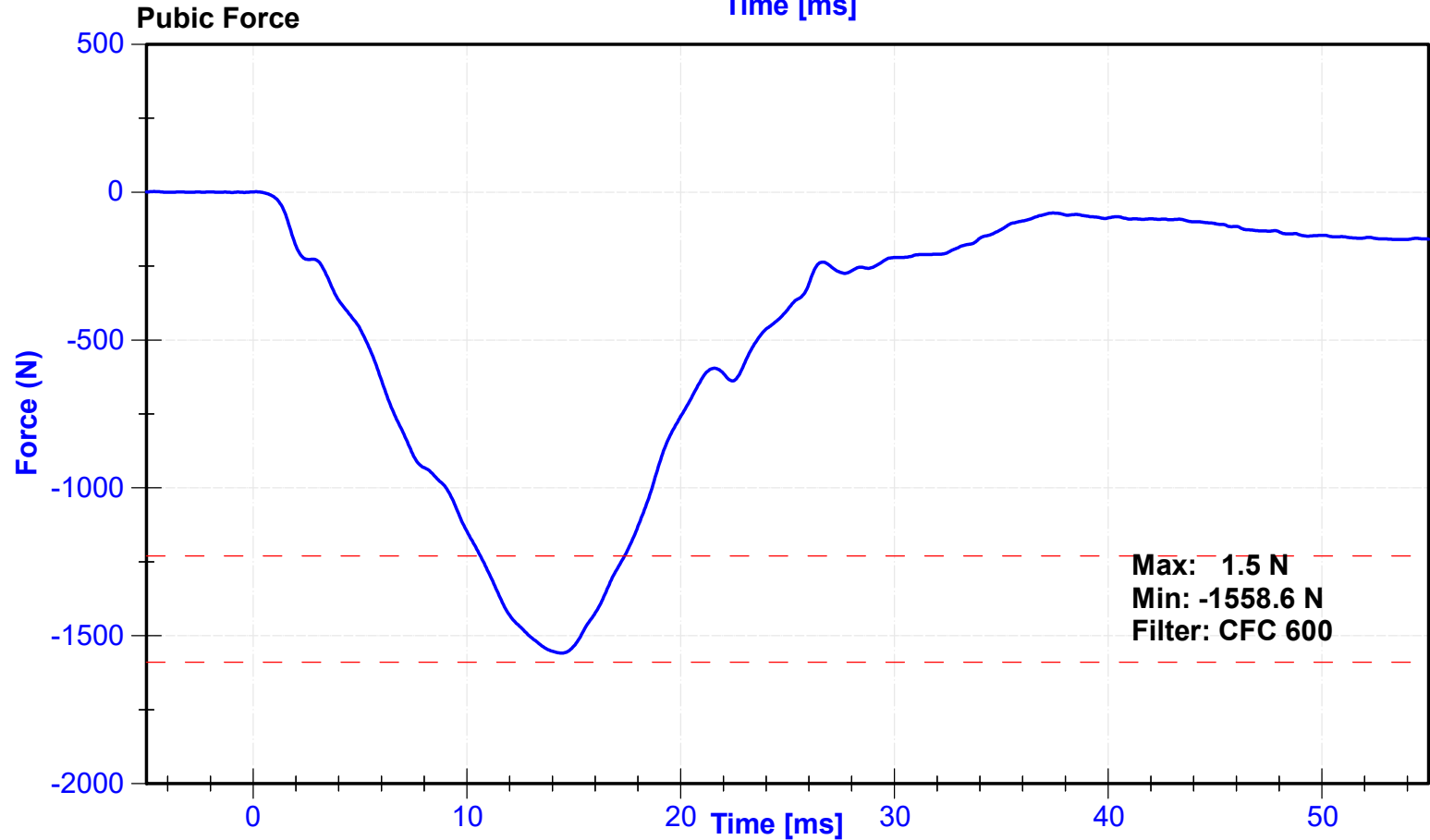
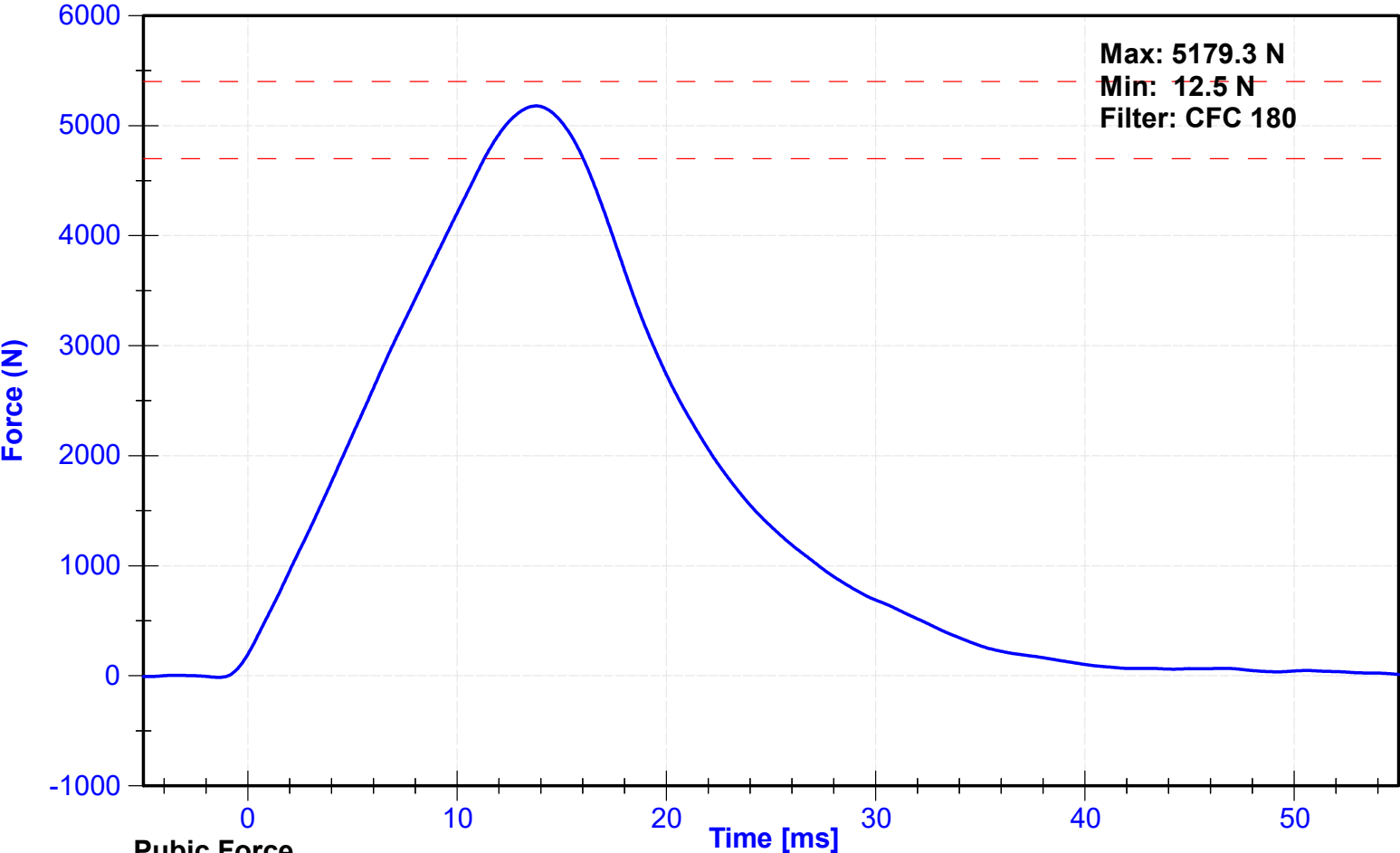
Transducer Calibrations

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

Probe Acceleration



Resistive Force



APPENDIX VI
SID-Is PERFORMANCE CALIBRATION TEST DATA

PRE-TEST
SID-IIs PERFORMANCE CALIBRATION TEST DATA

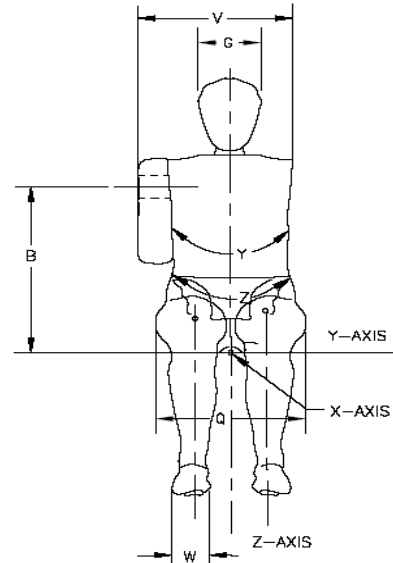
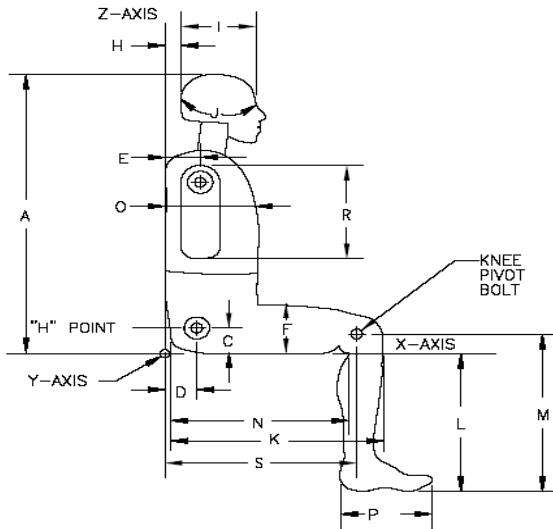


External Measurements - SID-IIs

Technician: K. Brogan

Date: 09/13/2023

Dummy Serial Number: 261



Symbol	Description	Specification (mm)		Result (mm)	Pass/Fail
A	Sitting Height	772	788	781	Pass
B	Shoulder Pivot Height	437	453	445	Pass
C	H-point Height	79	89	81	Pass
D	H-point from seatback	141	151	146	Pass
E	Shoulder Pivot from Backline	97	107	103	Pass
F	Thigh Clearance	119	135	128	Pass
G	Head Breadth	140	148	145	Pass
H	Head Back from Backline	40	46	43	Pass
I	Head Depth	178	188	181	Pass
J	Head Circumference	541	551	548	Pass
K	Buttock to Knee Length	514	540	532	Pass
L	Popliteal Height	343	369	354	Pass
M	Knee Pivot to floor height	392	409	401	Pass
N	Buttock Popliteal Length	416	442	431	Pass
O	Chest Depth w/o jacket	195	211	207	Pass
P	Foot Length	216	232	223	Pass
Q	Hip Breadth (w/pelvic plugs)	313	323	318	Pass
R	Arm Length	249	259	253	Pass
S	Knee Joint to seatback	477	493	483	Pass
V	Shoulder Width	341	357	350	Pass
W	Foot Width	78	94	84	Pass
Y	Chest Circumference w/jacket	851	881	871	Pass
Z	Waist Circumference	761	791	779	Pass

ATD Manufacturer	FTSS	Test Technician	Z.Schneider
ATD Serial Number	261	Laboratory Supervisor	C .Mantell

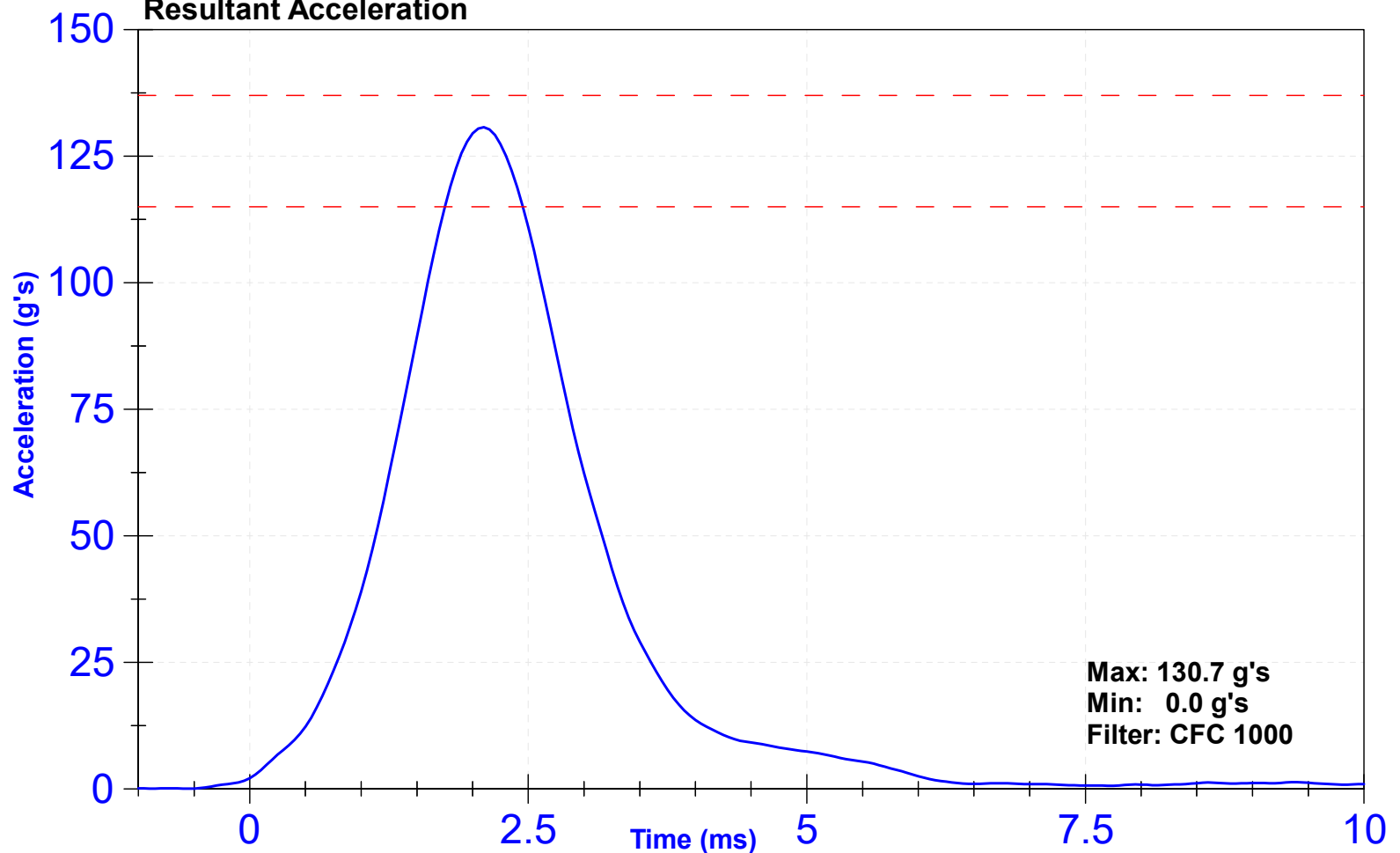
Results

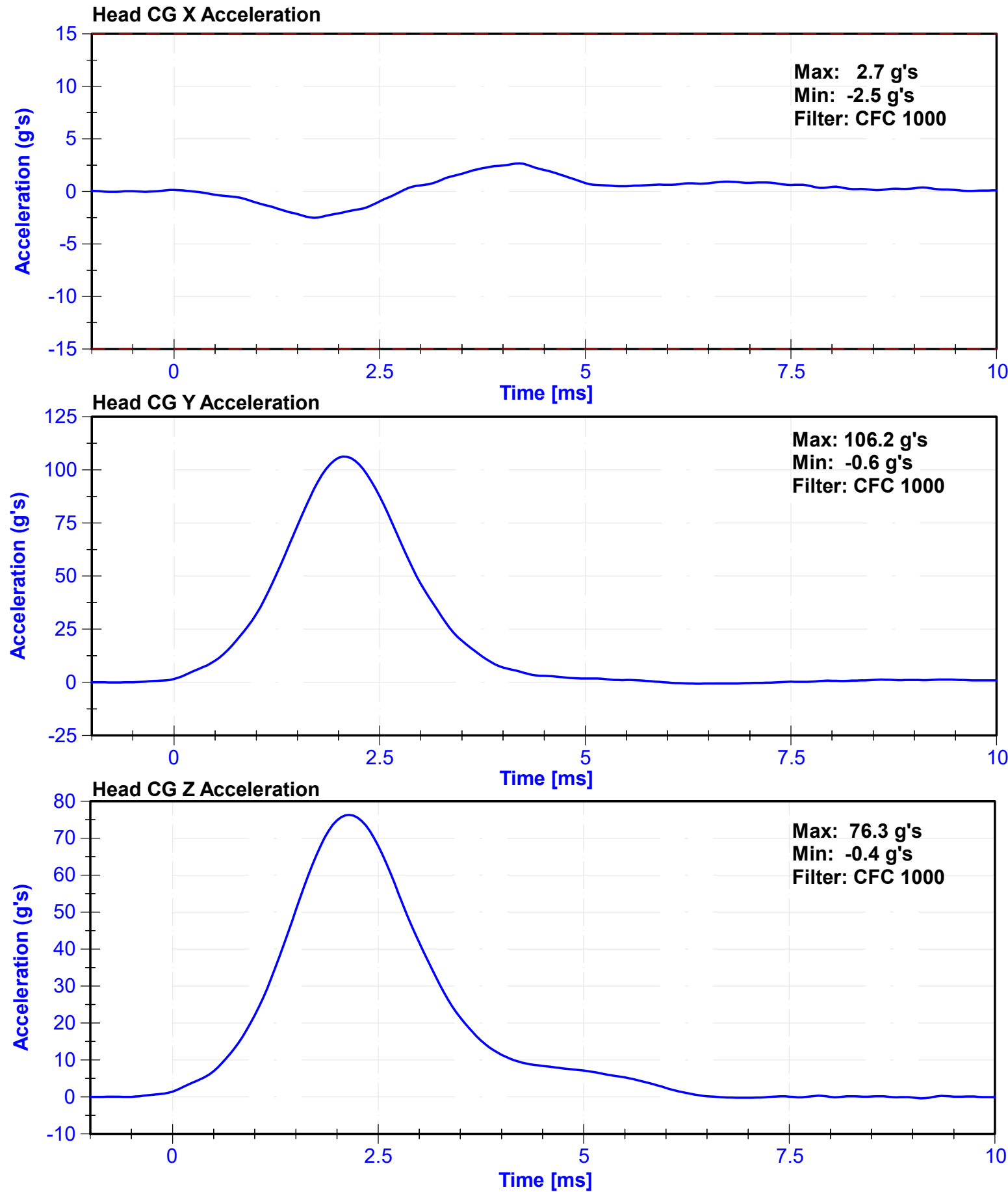
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.4	Pass
Humidity	10	70	%	64	Pass
Resultant Acceleration	115	137	g's	130.7	Pass
Oscillation	0	15	%	1.0	Pass
Fore-Aft Acceleration	-15	15	g's	2.7	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibratio Date	Calibratio Due Date
X Accelerometer	Endevco	P68067	6/22/2023	12/19/2023
Y Accelerometer	Endevco	P18567	6/22/2023	12/19/2023
Z Accelerometer	Endevco	P49163	6/22/2023	12/19/2023

Resultant Acceleration





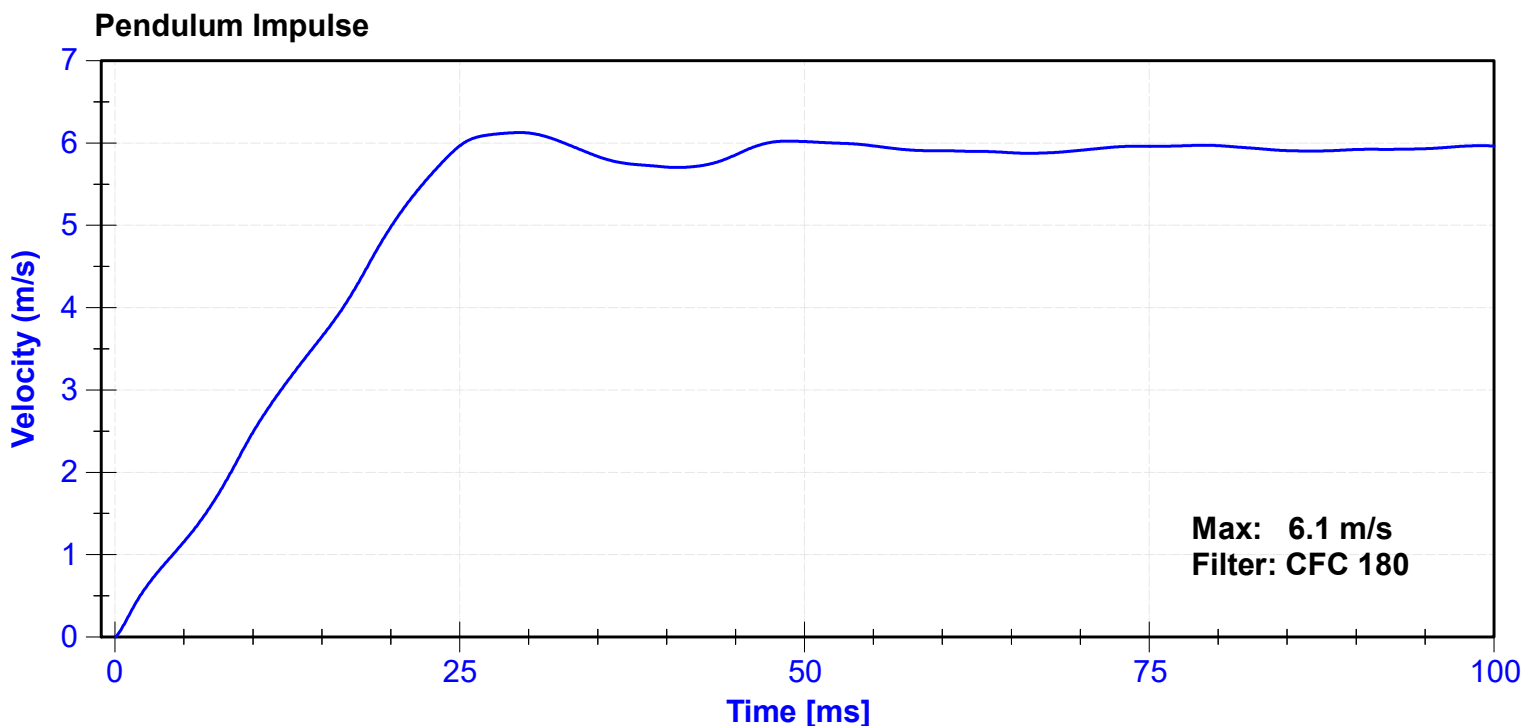
ATD Manufacturer	FTSS	Test Technician	Z.Schneider
ATD Serial Number	261	Laboratory Supervisor	C. Mantell

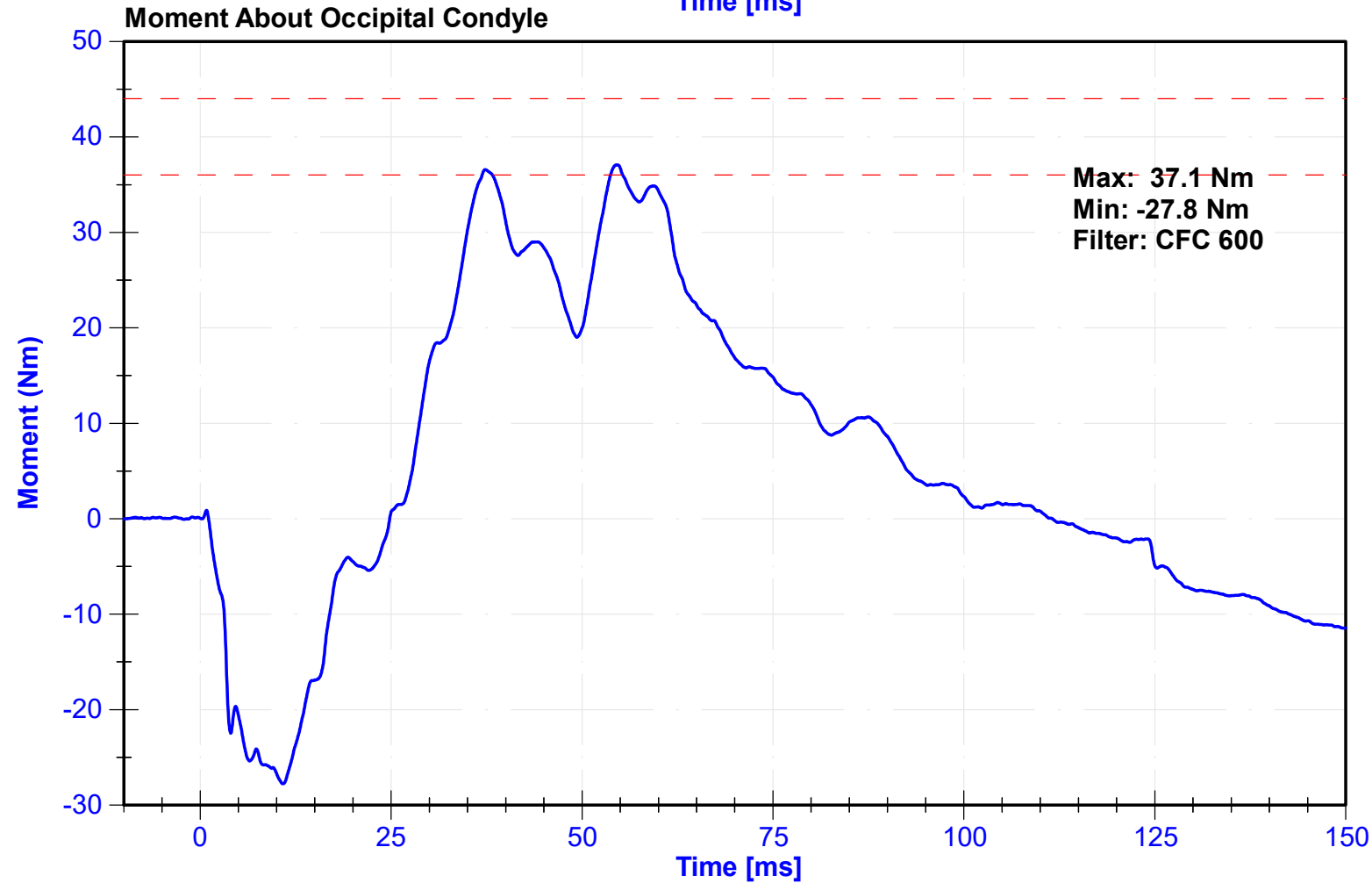
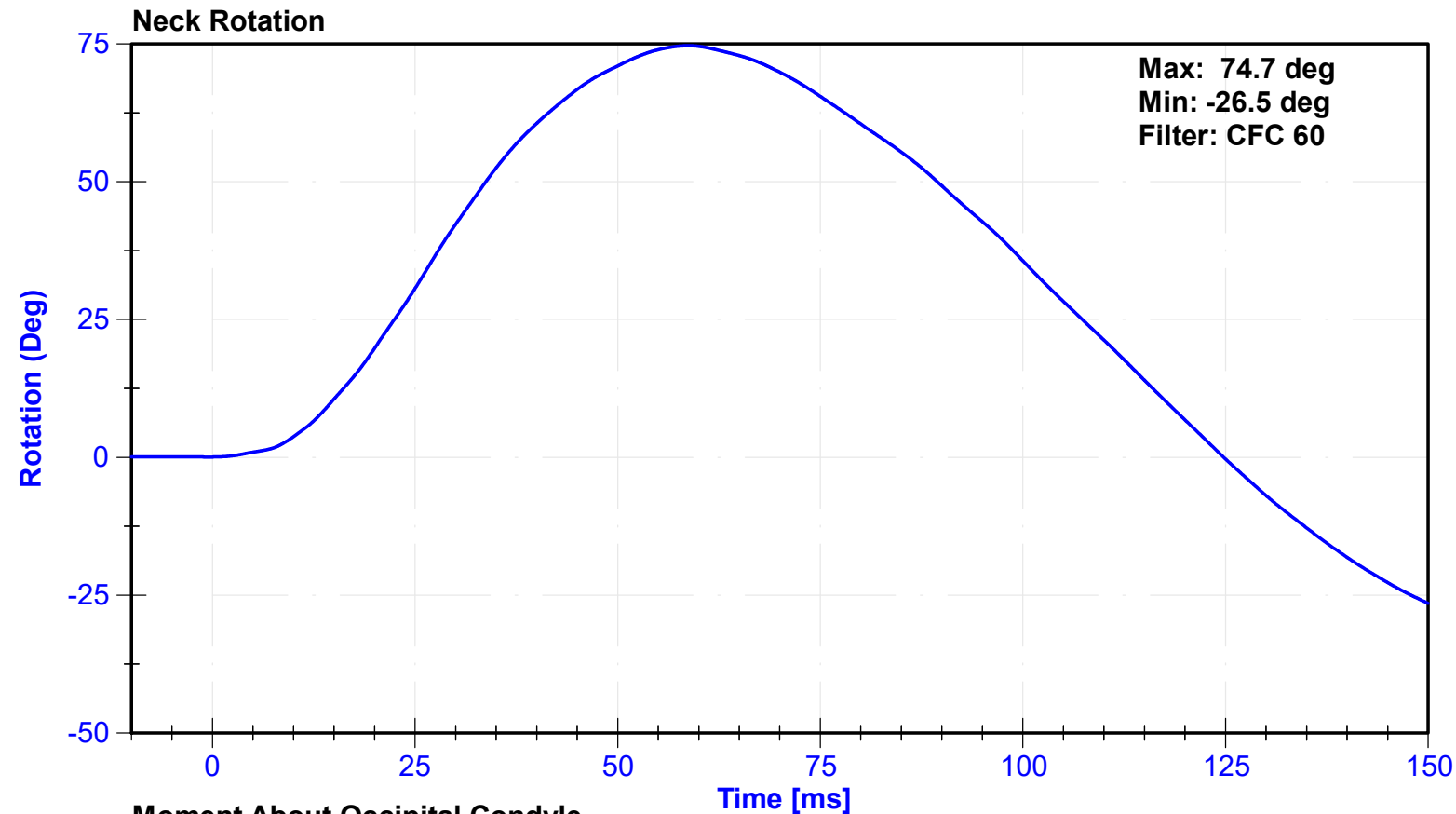
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.5	Pass
Humidity	10	70	%	61	Pass
Velocity	5.51	5.63	m/s	5.573	Pass
Pendulum Impulse at 10ms	2.2	2.8	m/s	2.49	Pass
Pendulum Impulse at 15ms	3.3	4.1	m/s	3.65	Pass
Pendulum Impulse at 20ms	4.4	5.4	m/s	4.98	Pass
Pendulum Impulse at 25ms	5.4	6.1	m/s	5.97	Pass
Pendulum Impulse from 25 to 100ms	5.5	6.2	m/s	6.13	Pass
Neck Rotation	71	81	deg	74.7	Pass
Time at Maximum Rotation	50	70	ms	58.7	Pass
Moment about the OC	36	44	Nm	37.1	Pass
Moment Decay to 0 Nm	102	126	ms	111.6	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	7231C-750	10/26/2022	10/26/2023
Pendulum Potentiometer	Servo	4961	11/11/2022	11/11/2023
Condyle Potentiometer	Servo	DS185	11/11/2022	11/11/2023
Upper Neck Load Cell	Denton	1716ATF_2184-FY	5/18/2023	5/17/2024





ATD Manufacturer	FTSS	Test Technician	C. Mantell
ATD Serial Number	261	Laboratory Supervisor	C. Mantell

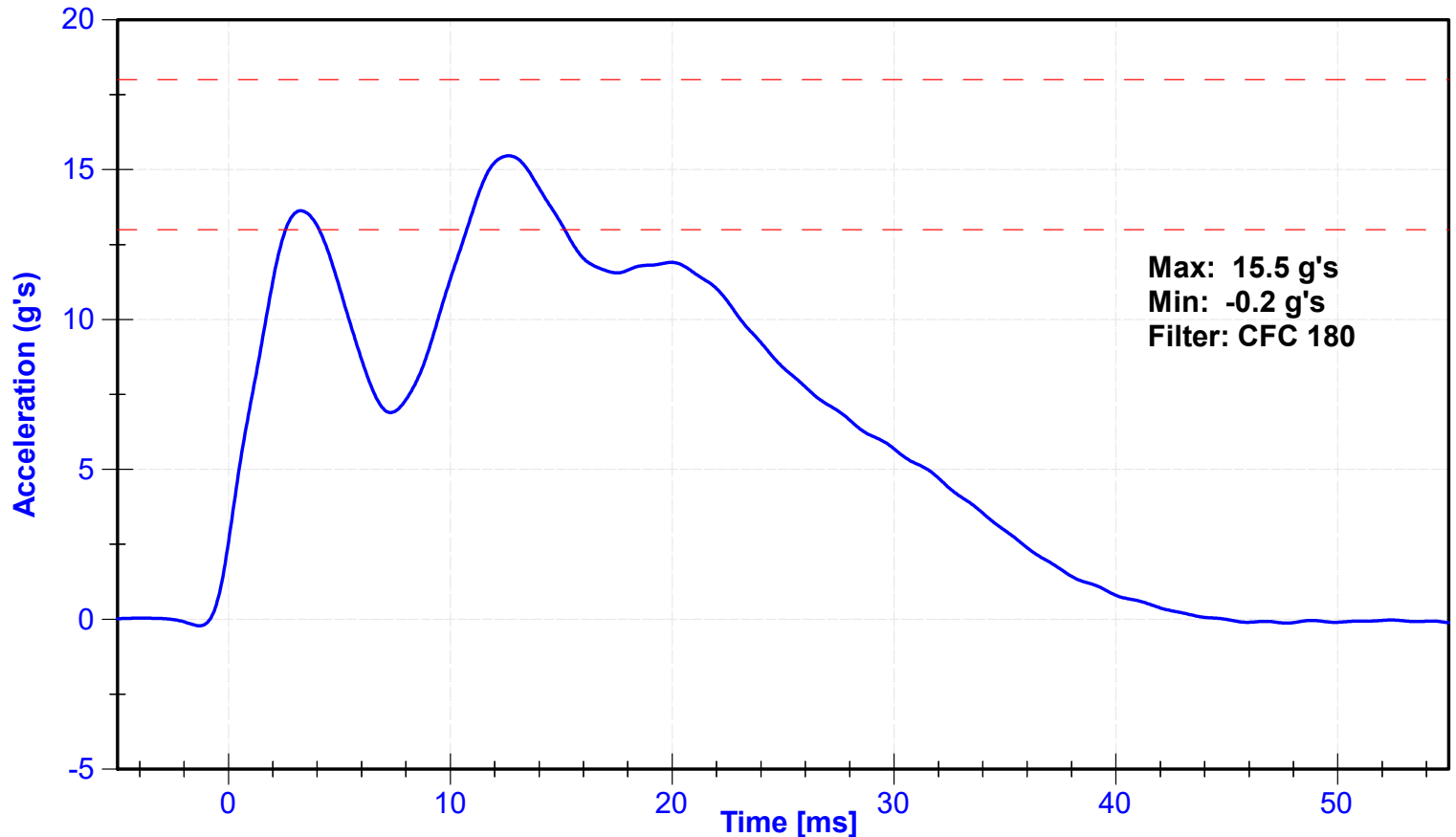
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.7	Pass
Humidity	10	70	%	51.0	Pass
Velocity	4.2	4.4	m/s	4.35	Pass
Probe Acceleration	13	18	g's	15.5	Pass
Shoulder Deflection	28	37	mm	33.9	Pass
Lateral Upper Spine Acceleration	17	22	g's	19.3	Pass

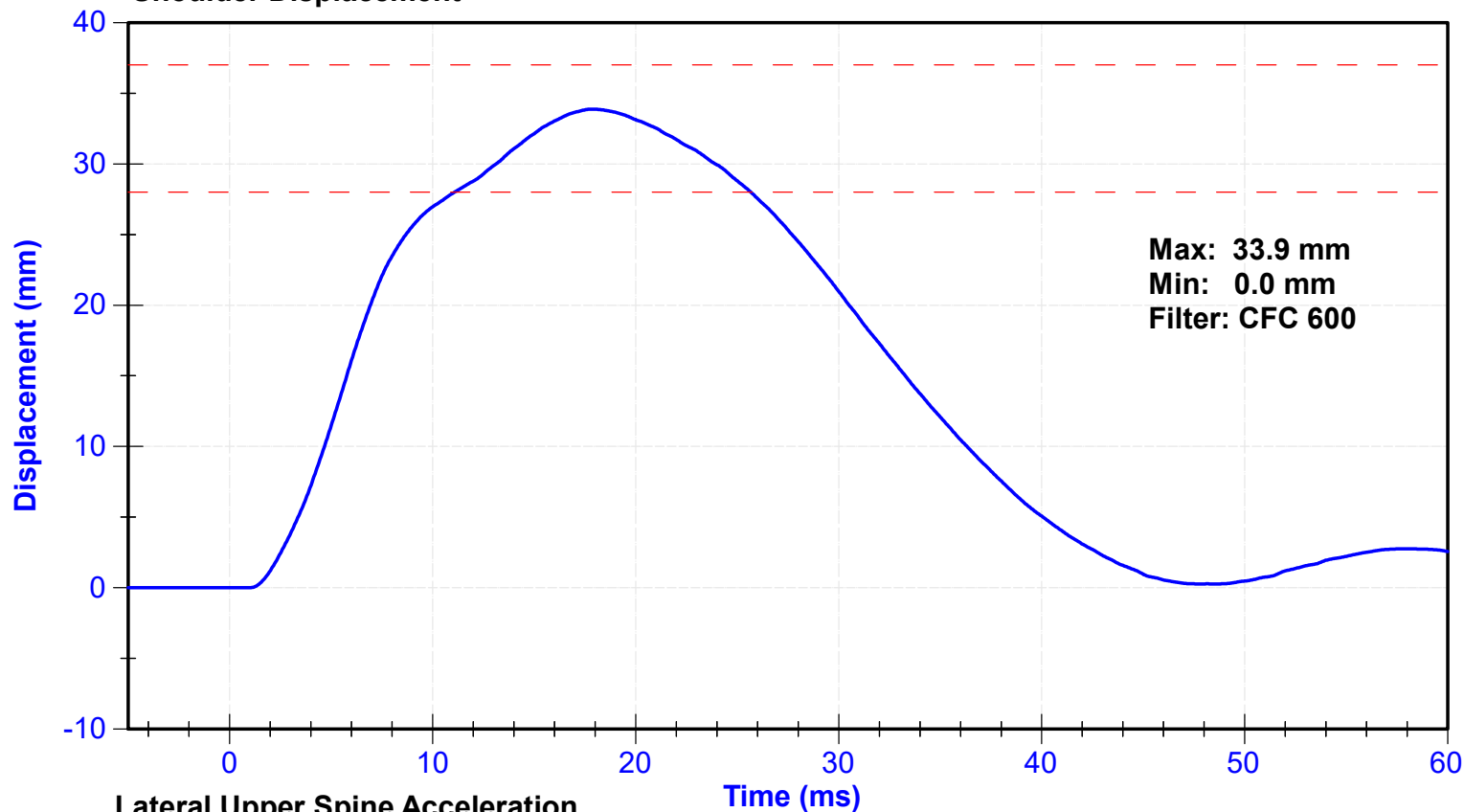
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	P51736	10/25/2022	10/25/2023
Shoulder Potentiometer	Servo	572GFE	6/22/2023	12/21/2023
Upper Spine Y Accelerometer	Endevco	P94678	6/22/2023	12/19/2023

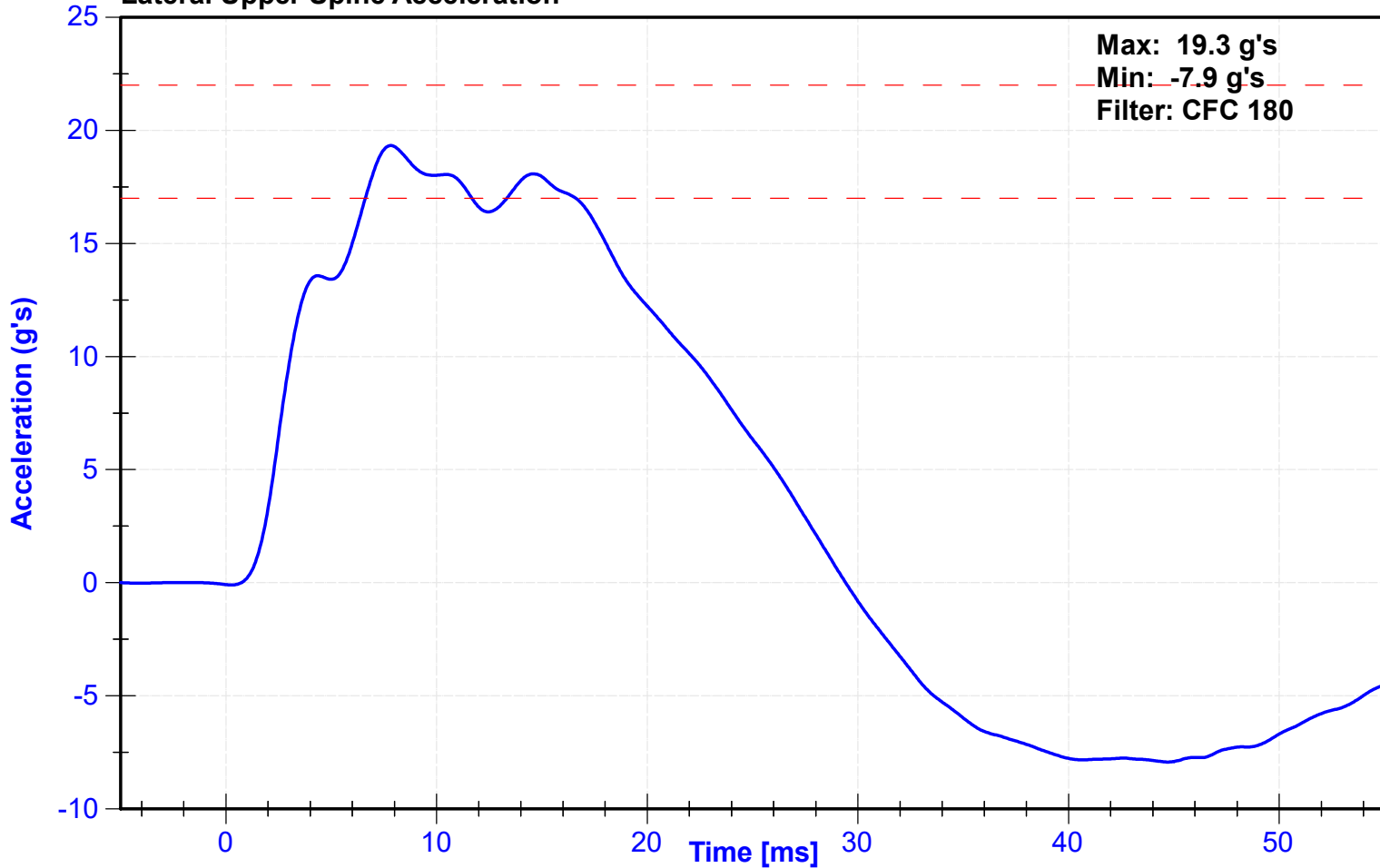
Probe Acceleration



Shoulder Displacement



Lateral Upper Spine Acceleration



ATD Manufacturer	FTSS	Test Technician	C. Mantell
ATD Serial Number	261	Laboratory Supervisor	C. Mantell

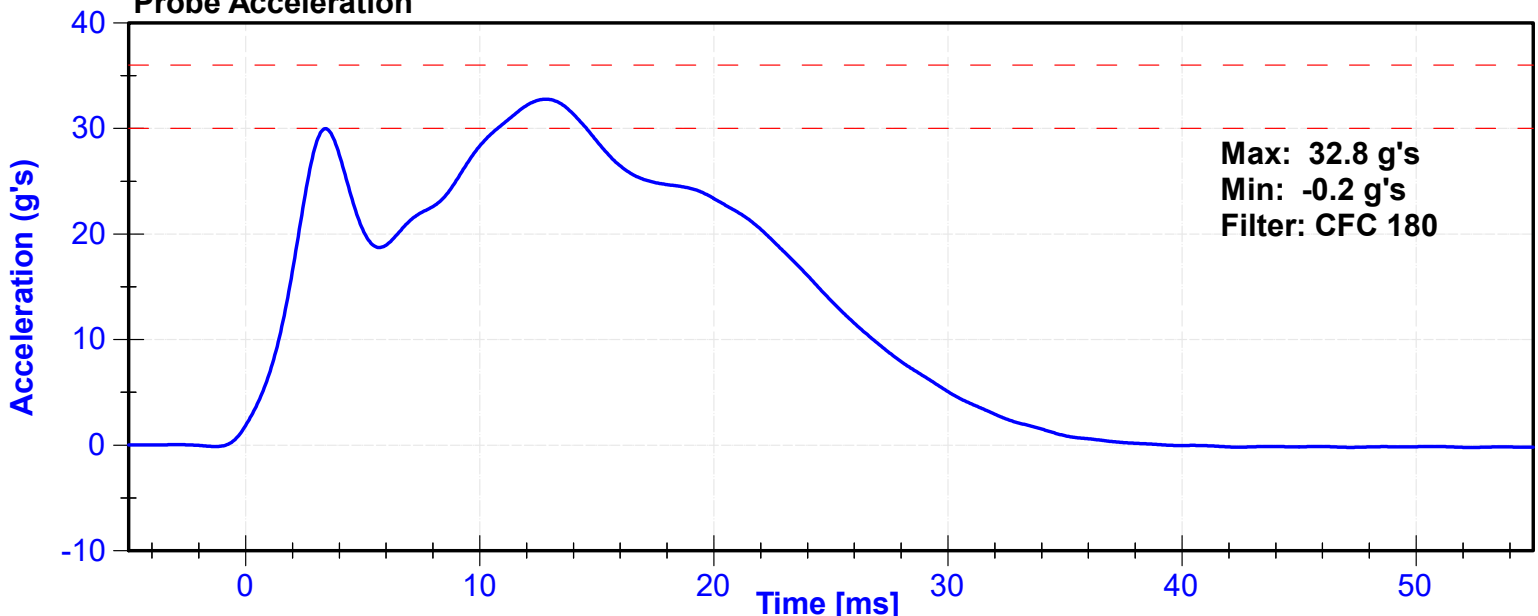
Results

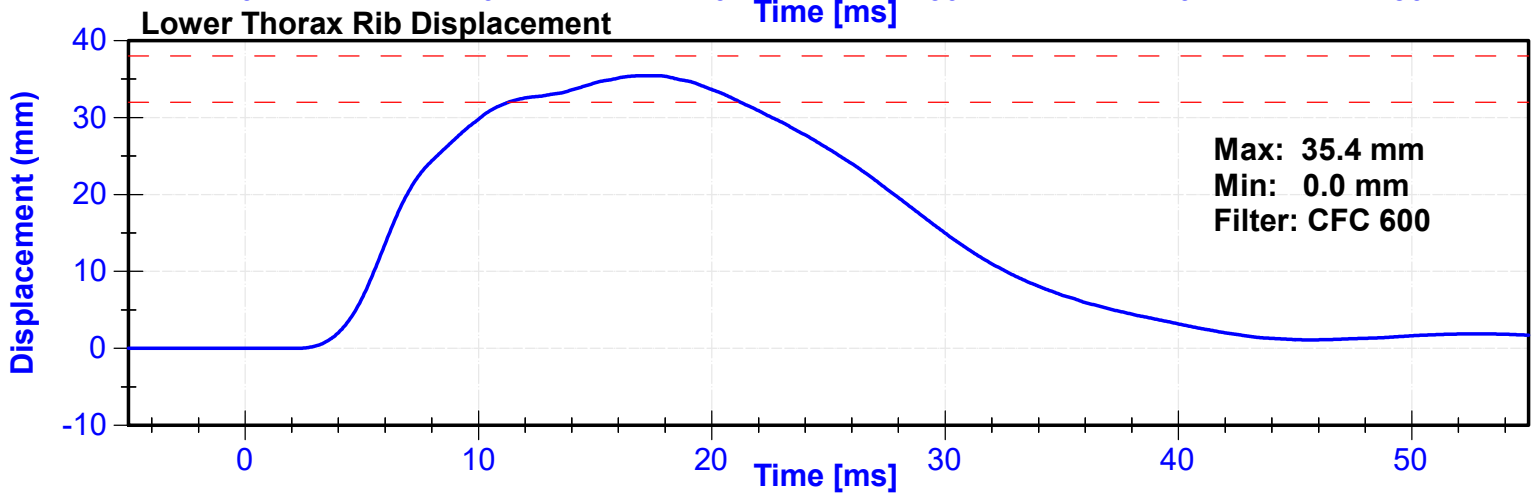
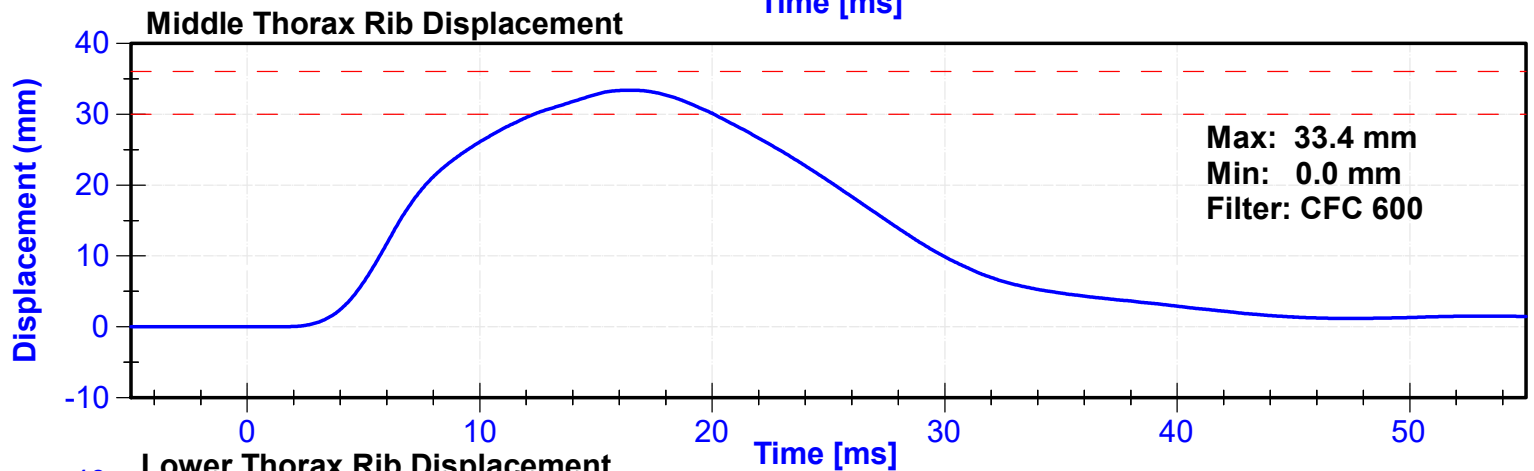
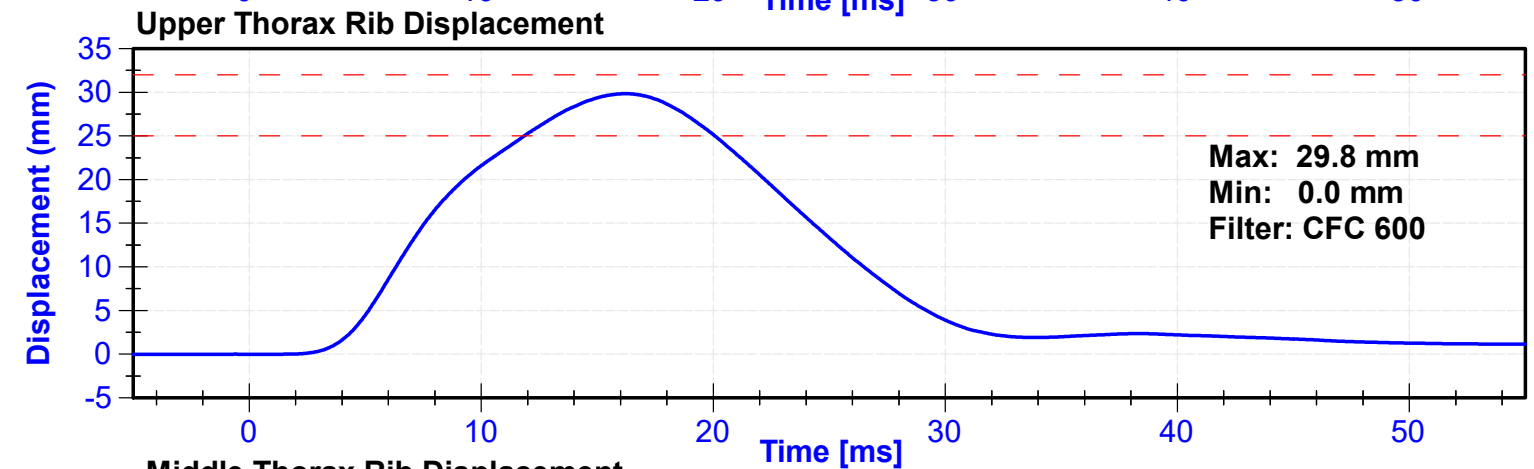
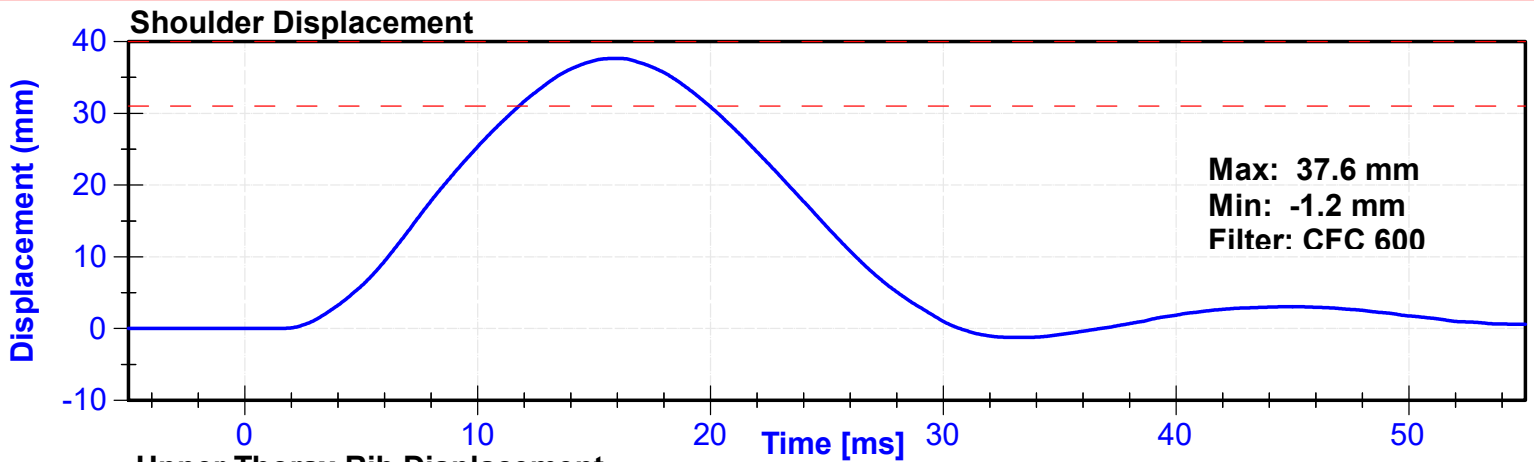
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.7	Pass
Humidity	10	70	%	51.0	Pass
Velocity	6.6	6.8	m/s	6.67	Pass
Probe Acceleration after 5 ms	30	36	g's	32.8	Pass
Lateral Upper Spine Acceleration	34	43	g's	38.5	Pass
Lateral Lower Spine Acceleration	29	37	g's	33.0	Pass
Shoulder Deflection	31	40	mm	37.6	Pass
Upper Thorax Rib Deflection	25	32	mm	29.8	Pass
Mid Thorax Rib Deflection	30	36	mm	33.4	Pass
Lower Thorax Rib Deflection	32	38	mm	35.4	Pass

Transducer Calibrations

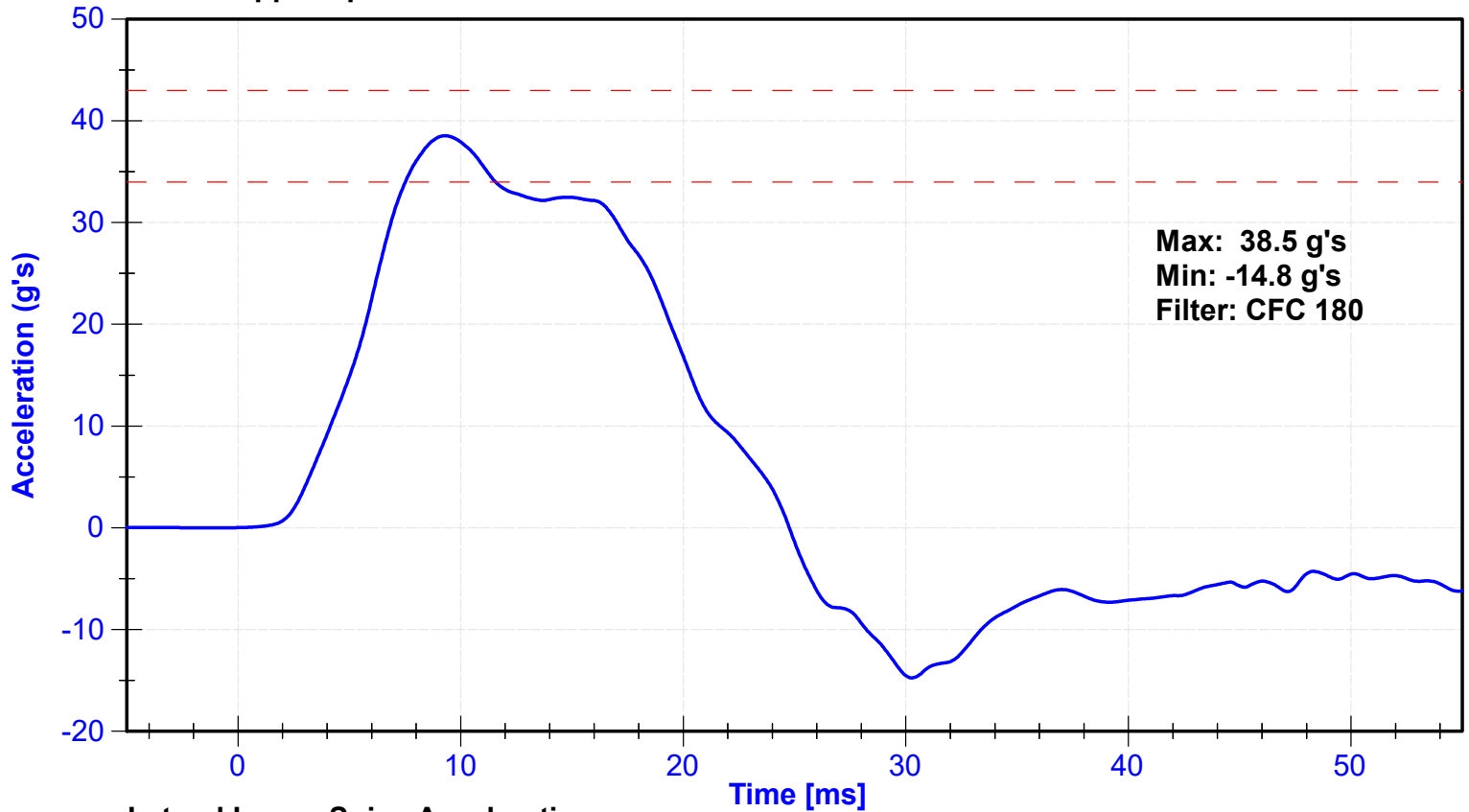
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	P51736	10/25/2022	10/25/2023
Upper Spine T1 Y Accelerometer	Endevco	P94678	6/22/2023	12/19/2023
Upper Spine T12 Y Accelerometer	Endevco	P58744	6/22/2023	12/19/2023
Shoulder Potentiometer	Servo	572GFE	6/22/2023	12/21/2023
Upper Thorax Rib Potentiometer	Servo	062GFE	6/22/2023	12/21/2023
Middle Thorax Rib Potentiometer	Servo	528GFE	6/22/2023	12/21/2023
Lower Thorax Rib Potentiometer	Servo	513GFE	6/22/2023	12/21/2023

Probe Acceleration

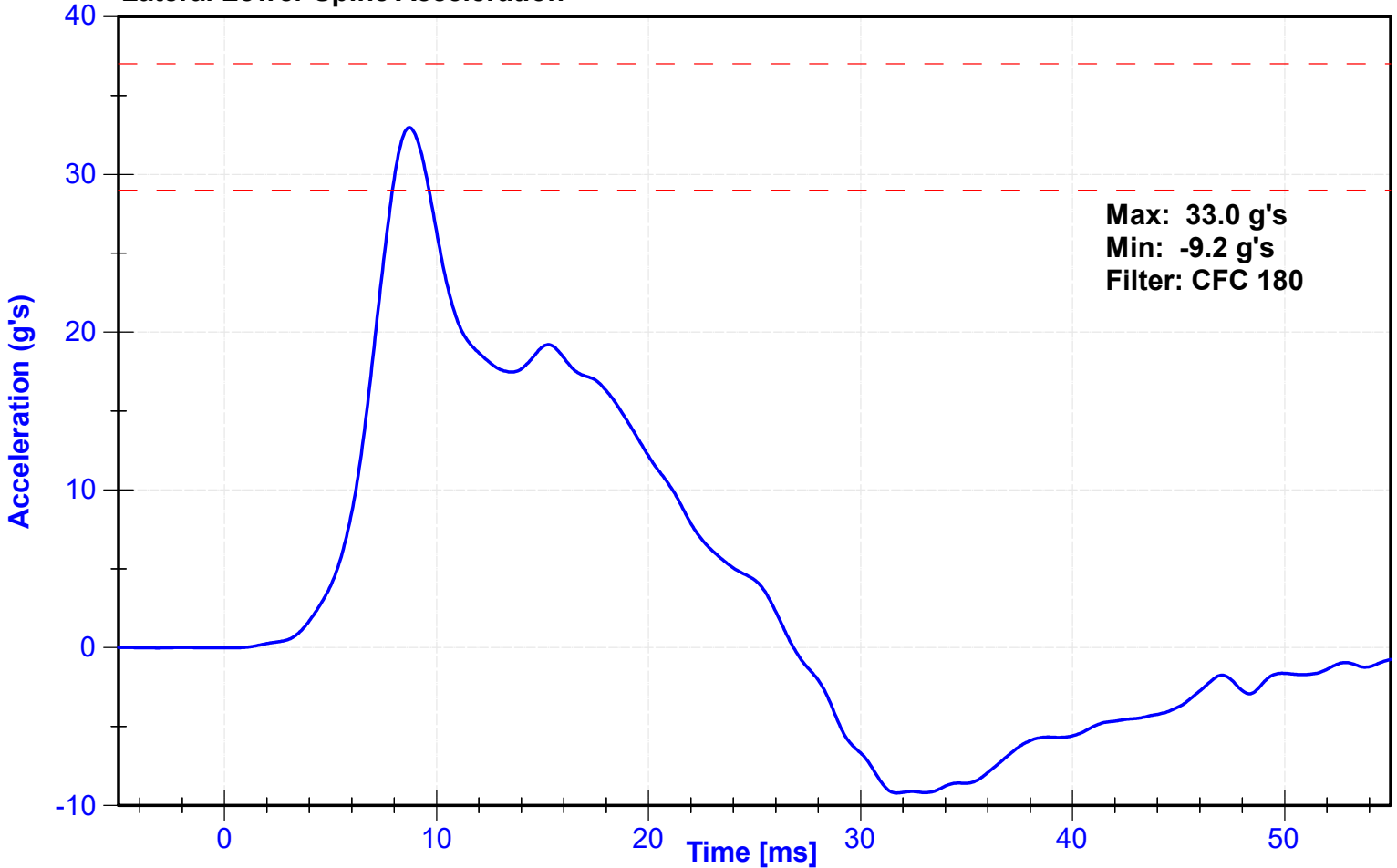




Lateral Upper Spine Acceleration



Lateral Lower Spine Acceleration



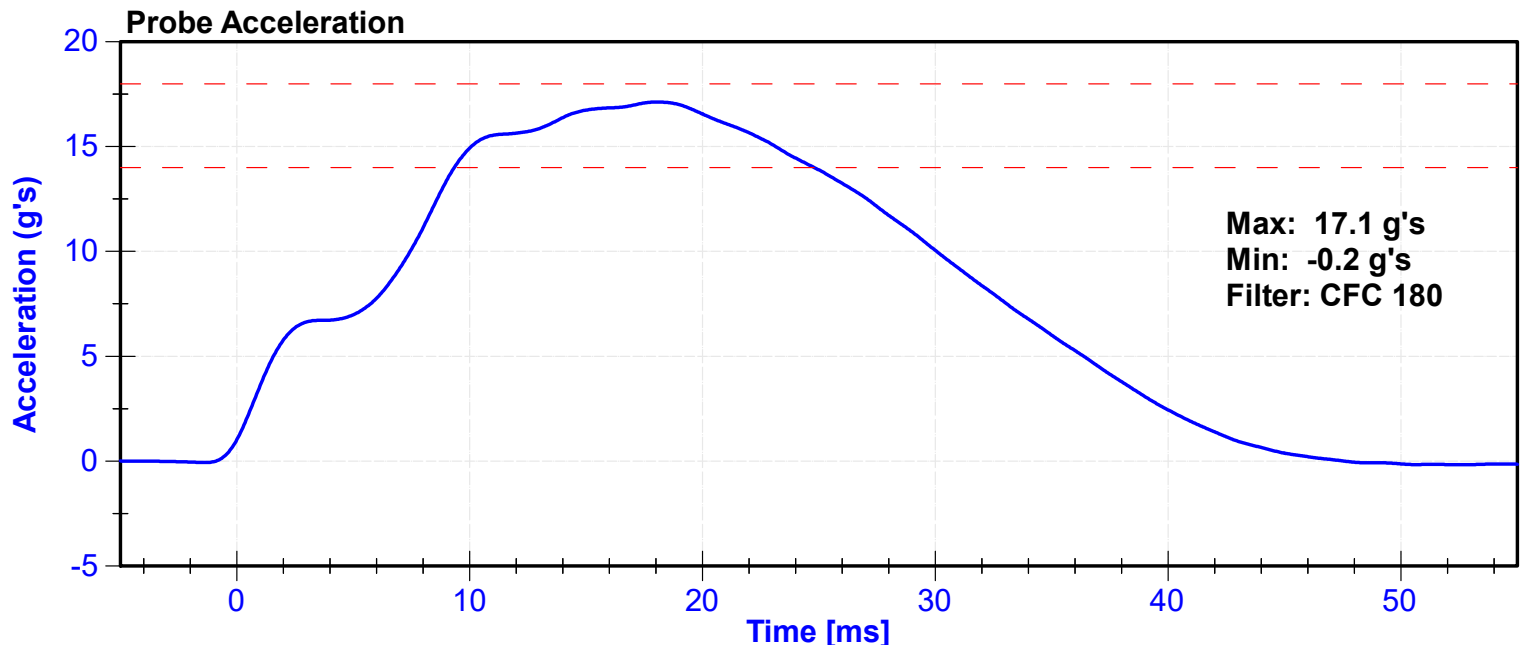
ATD Manufacturer	FTSS	Test Technician	C. Mantell
ATD Serial Number	261	Laboratory Supervisor	C. Mantell

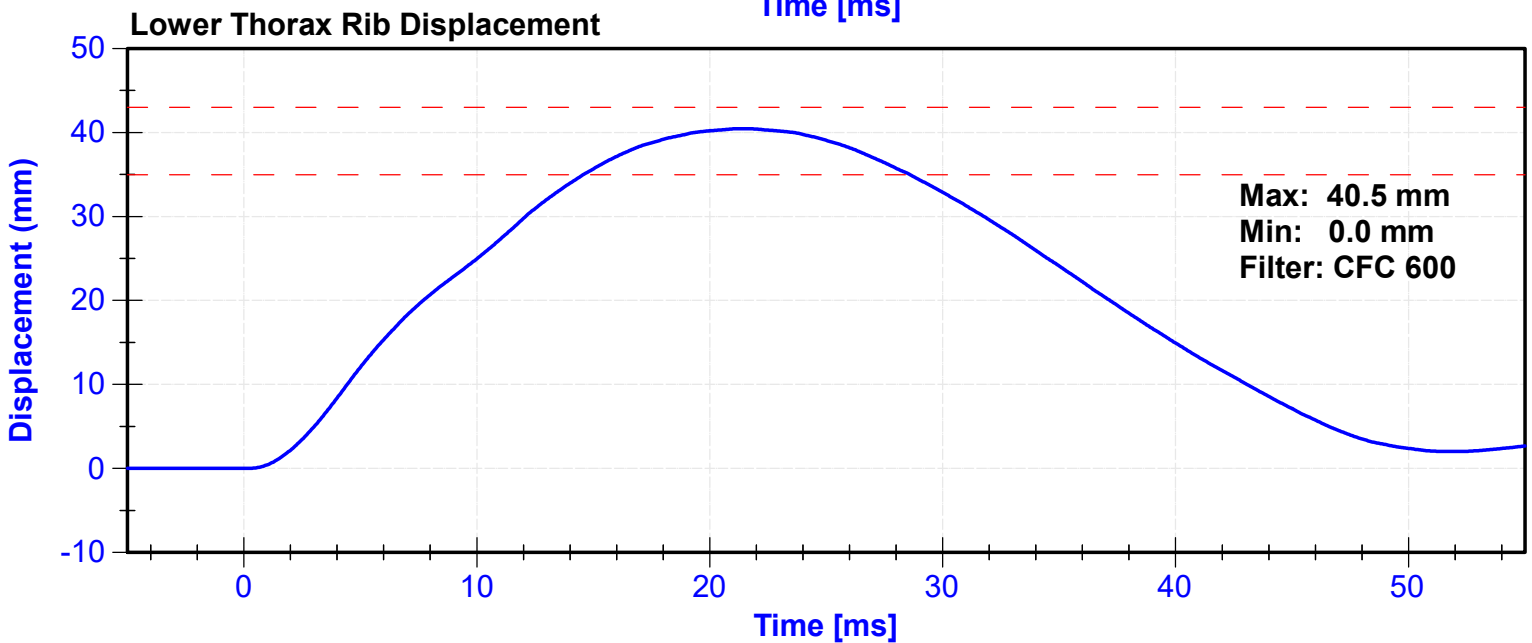
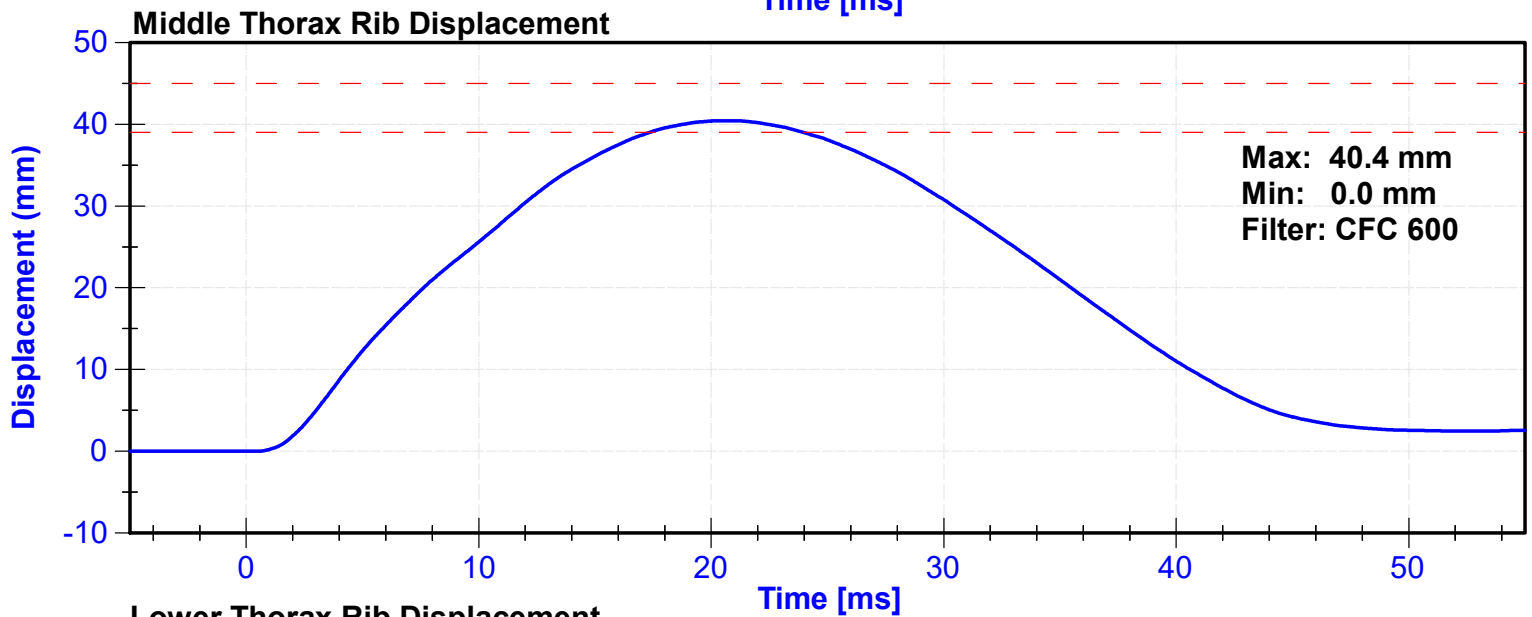
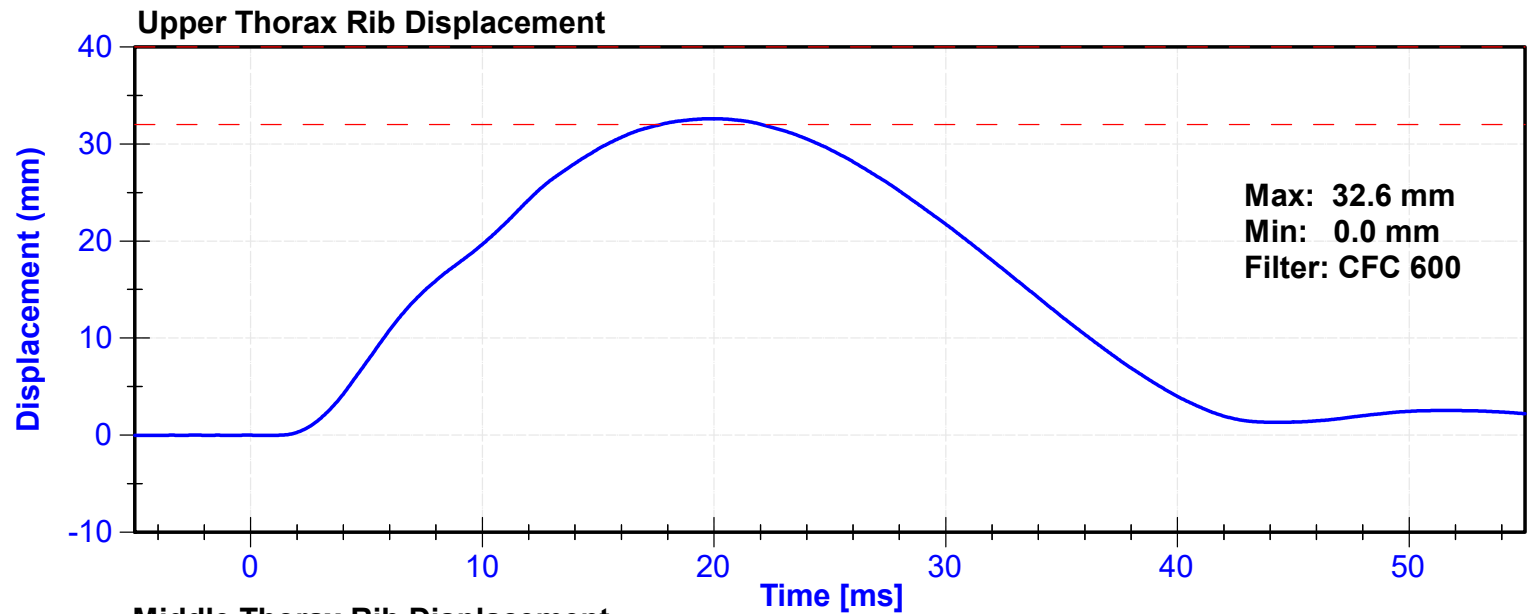
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.7	Pass
Humidity	10	70	%	51.0	Pass
Velocity	4.2	4.4	m/s	4.34	Pass
Probe Acceleration	14	18	g's	17.1	Pass
Lateral Upper Spine Acceleration	13	17	g's	16.0	Pass
Lateral Lower Spine Acceleration	7	11	g's	9.9	Pass
Upper Thorax Rib Deflection	32	40	mm	32.6	Pass
Middle Thorax Rib Deflection	39	45	mm	40.4	Pass
Lower Thorax Rib Deflection	35	43	mm	40.5	Pass

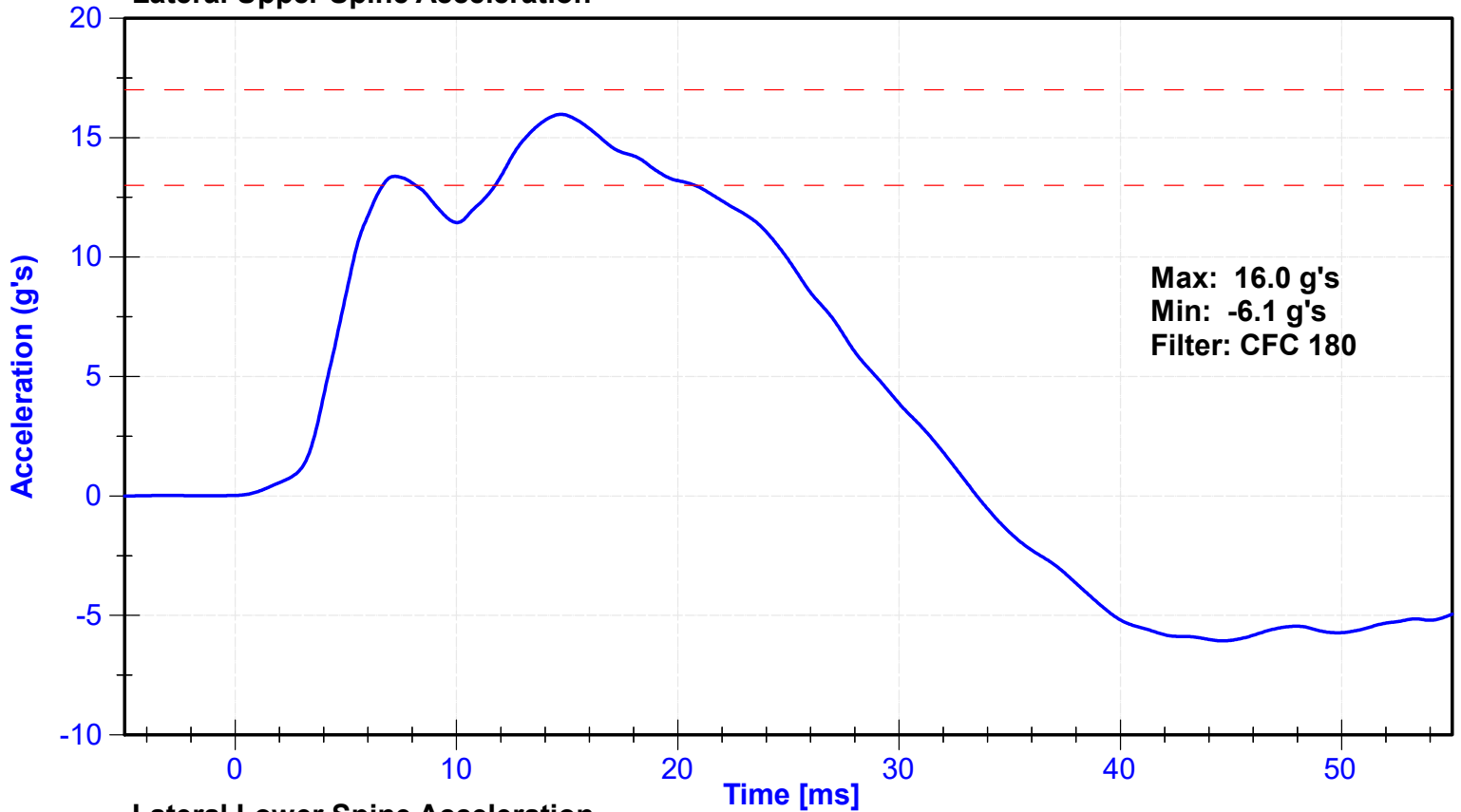
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	P51736	10/25/2022	10/25/2023
Upper Spine Y Accelerometer	Endevco	P94678	6/22/2023	12/19/2023
Lower Spine Y Accelerometer	Endevco	P58744	6/22/2023	12/19/2023
Upper Thorax Rib Potentiometer	Servo	062GFE	6/22/2023	12/21/2023
Middle Thorax Rib Potentiometer	Servo	528GFE	6/22/2023	12/21/2023
Lower Thorax Rib Potentiometer	Servo	513GFE	6/22/2023	12/21/2023

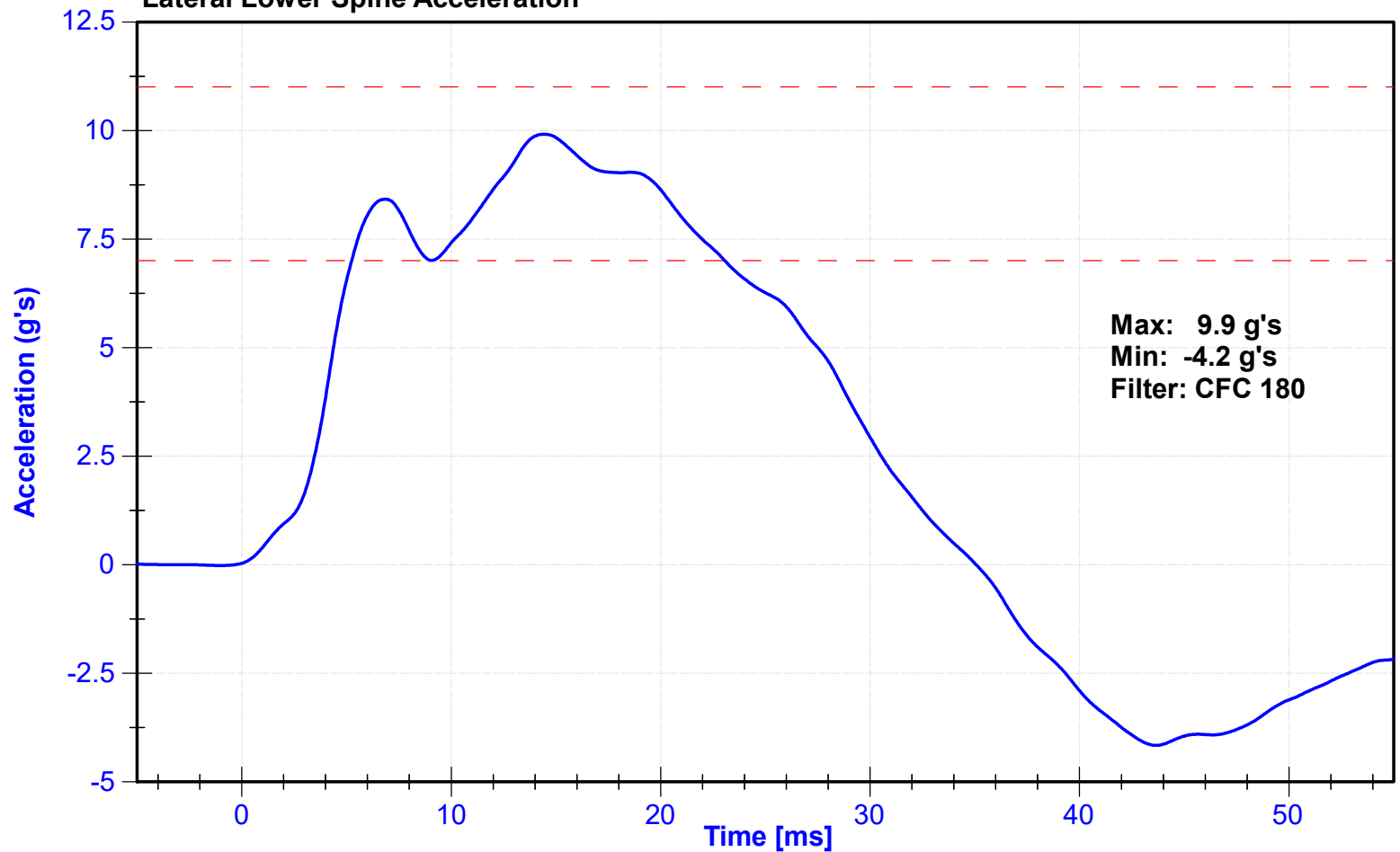




Lateral Upper Spine Acceleration



Lateral Lower Spine Acceleration



ATD Manufacturer	FTSS	Test Technician	C. Mantell
ATD Serial Number	261	Laboratory Supervisor	C. Mantell

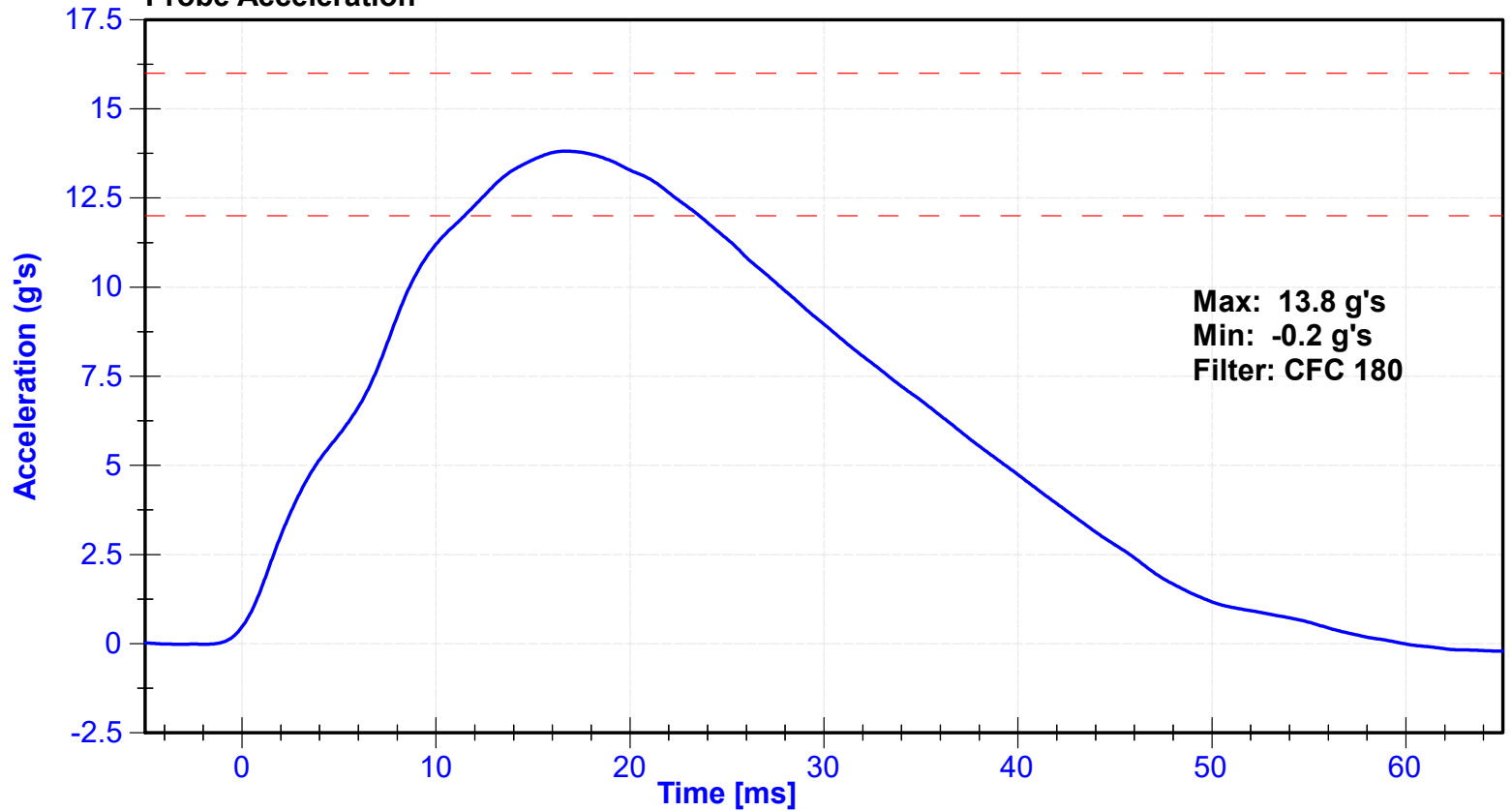
Results

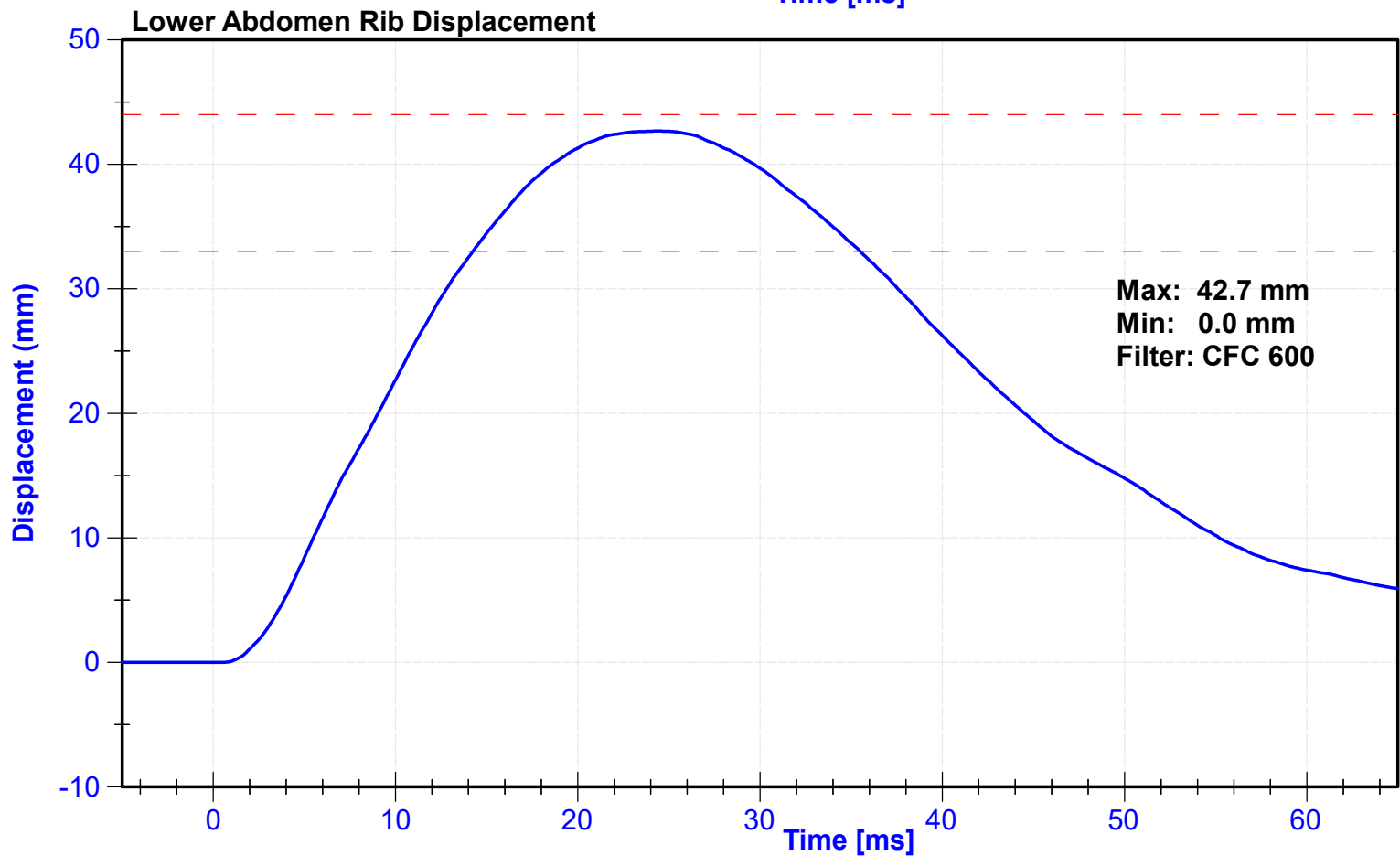
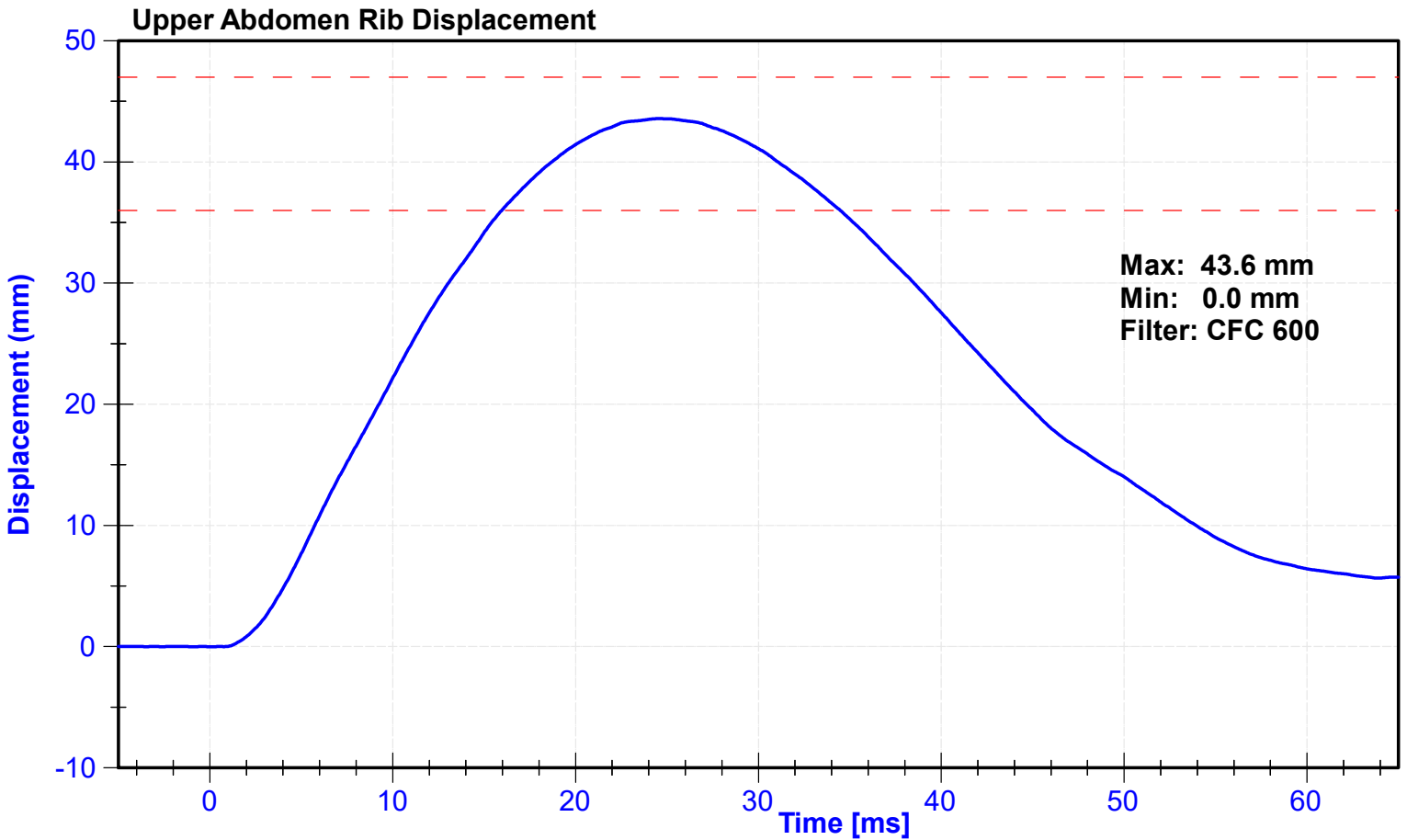
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.7	Pass
Humidity	10	70	%	51.0	Pass
Velocity	4.2	4.4	m/s	4.32	Pass
Probe Acceleration	12	16	g's	13.8	Pass
Lateral Lower Spine Acceleration	9	14	g's	10.1	Pass
Upper Abdomen Rib Deflection	36	47	mm	43.6	Pass
Lower Abdomen Rib Deflection	33	44	mm	42.7	Pass

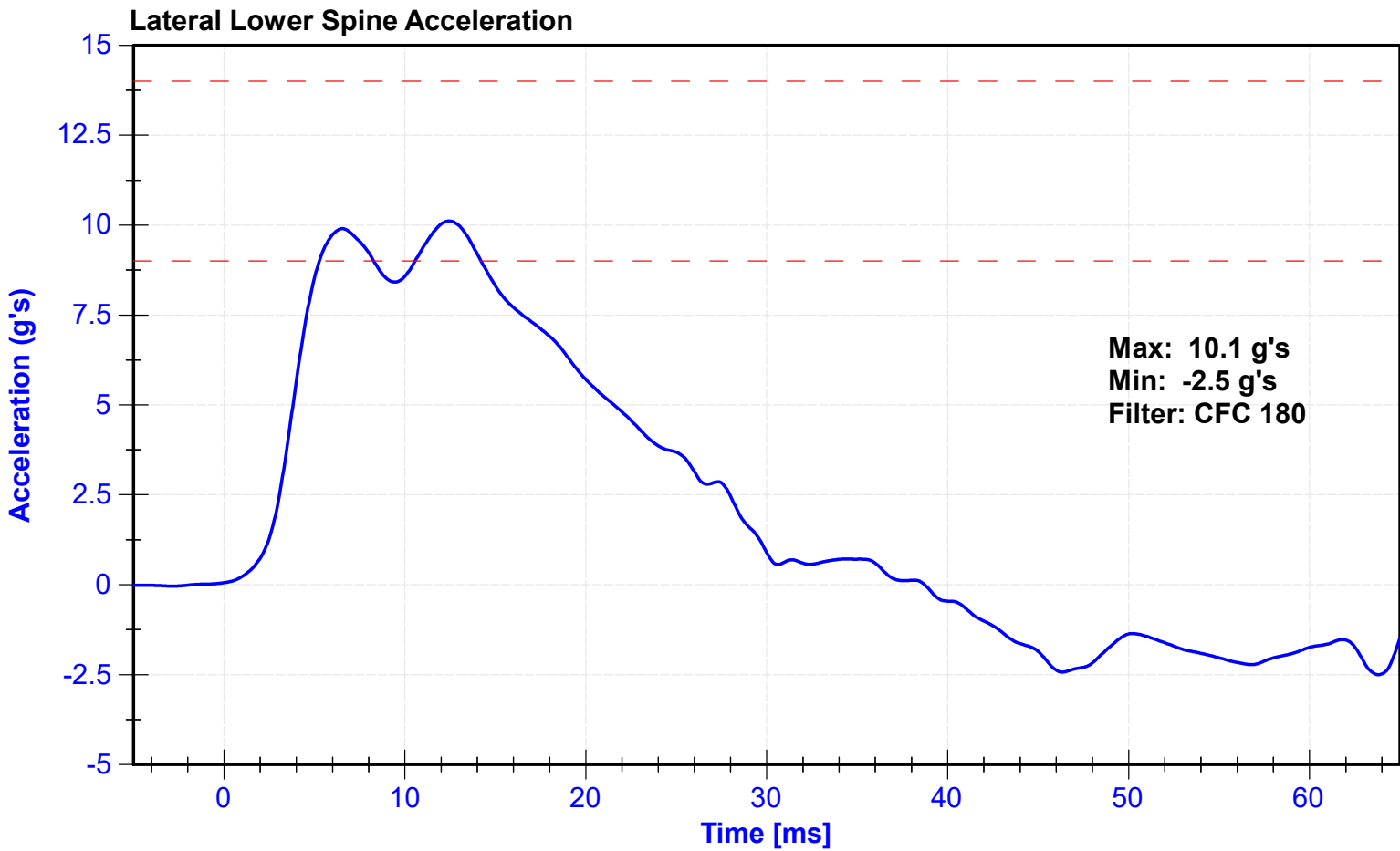
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Probe Accelerometer	Endevco	P51736	10/25/2022	10/25/2023
Lower Spine Y Accelerometer	Endevco	P58744	6/22/2023	12/19/2023
Upper Abdomen Rib Potentiometer	Servo	342GFE	6/22/2023	12/21/2023
Lower Abdomen Rib Potentiometer	Servo	512GFE	6/22/2023	12/21/2023

Probe Acceleration







ATD Manufacturer	FTSS	Test Technician	C. Mantell
ATD Serial Number	261	Laboratory Supervisor	C. Mantell

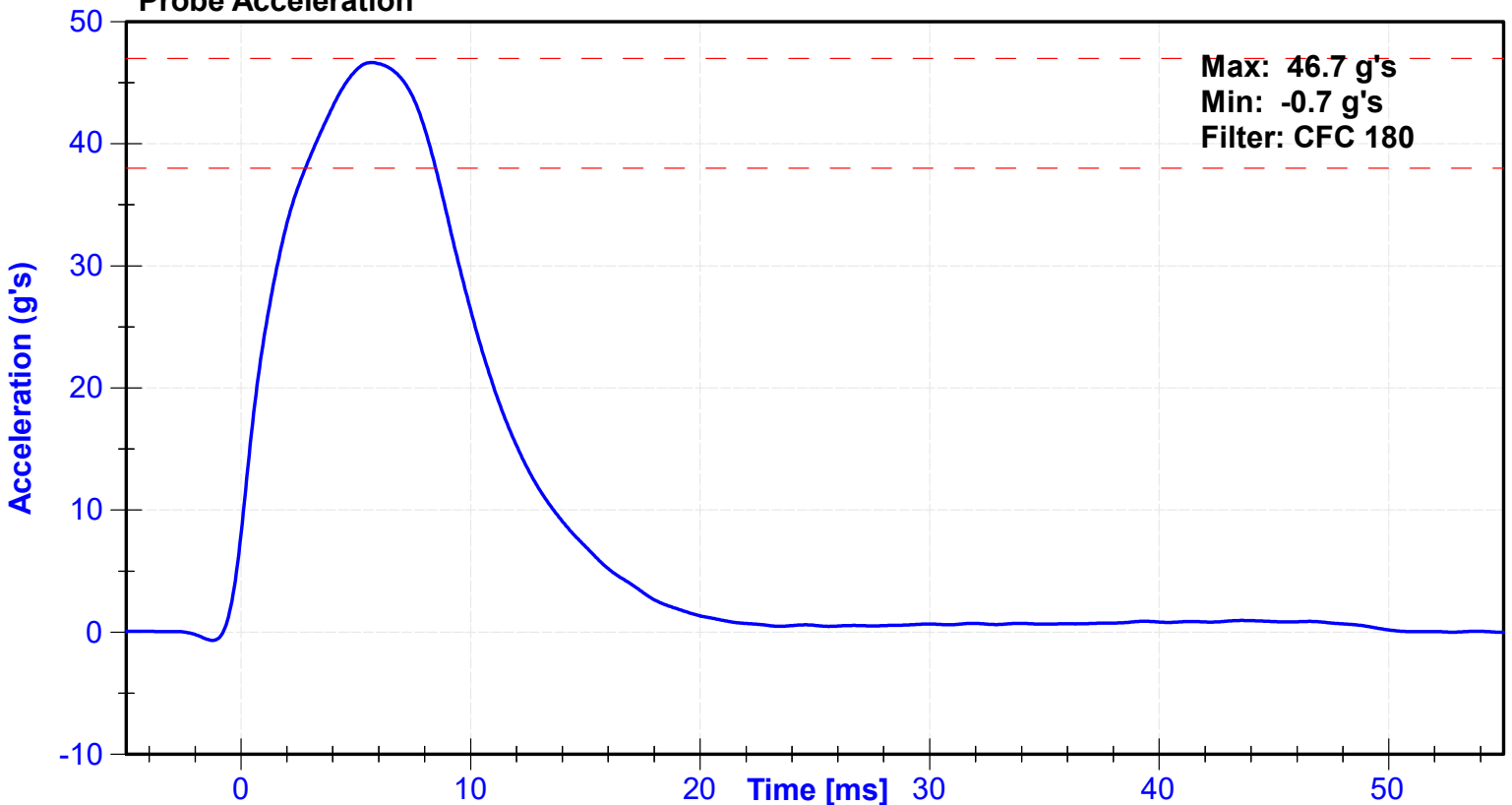
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.7	Pass
Humidity	10	70	%	51.0	Pass
Velocity	6.6	6.8	m/s	6.67	Pass
Probe Acceleration	38	47	g's	46.7	Pass
Lateral Pelvis Acceleration after 6ms	34	42	g's	41.4	Pass
Acetabulum Force	3600	4300	N	4143.6	Pass

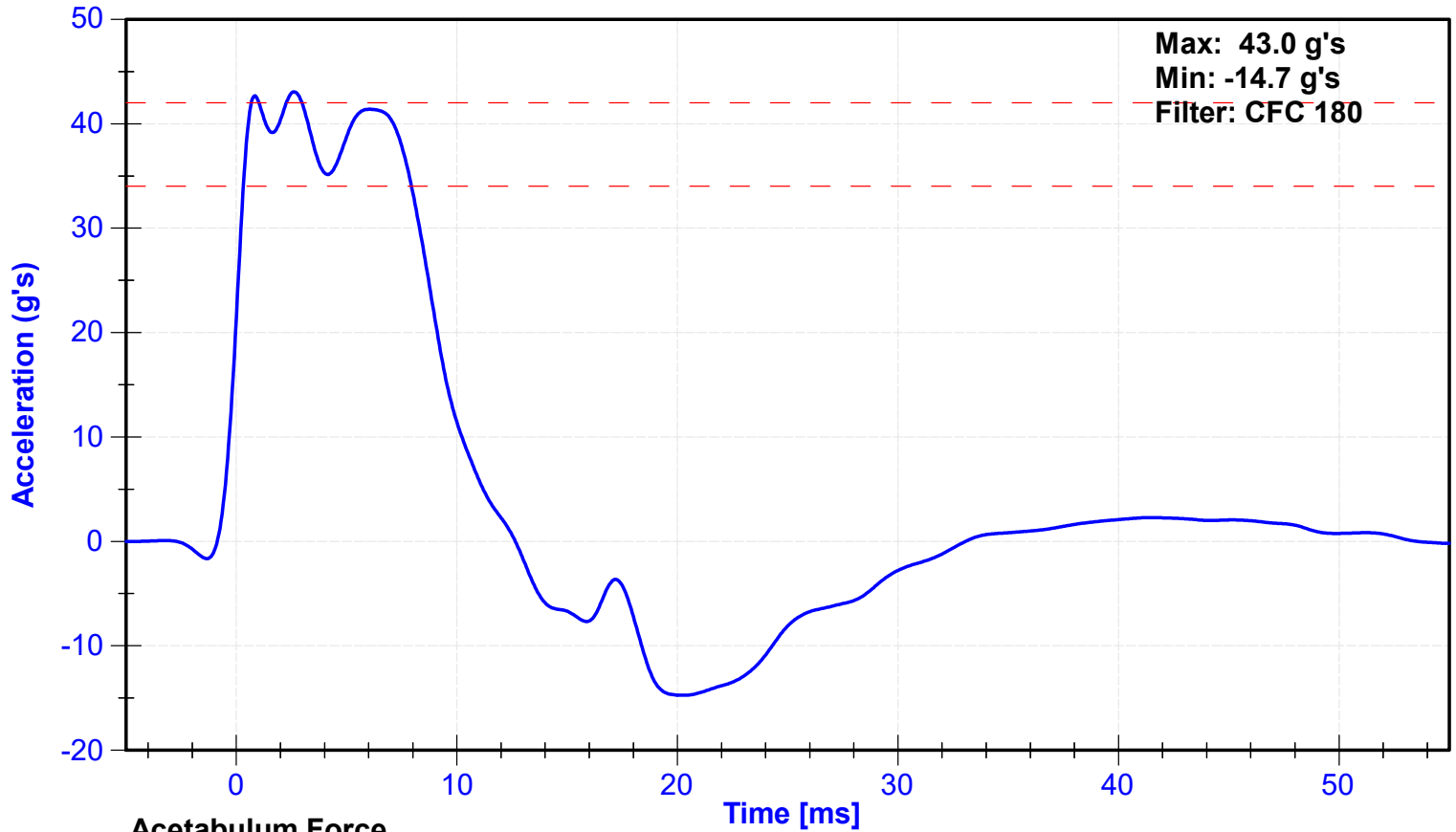
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	P51736	10/25/2022	10/25/2023
Pelvis Y Accelerometer	Endevco	T29392	7/27/2023	1/23/2024
Acetabulum Load Cell	Denton	267-FY	8/11/2022	8/11/2023
Certification Plug	SACO			N/A
Crash Test Plug	SACO			N/A

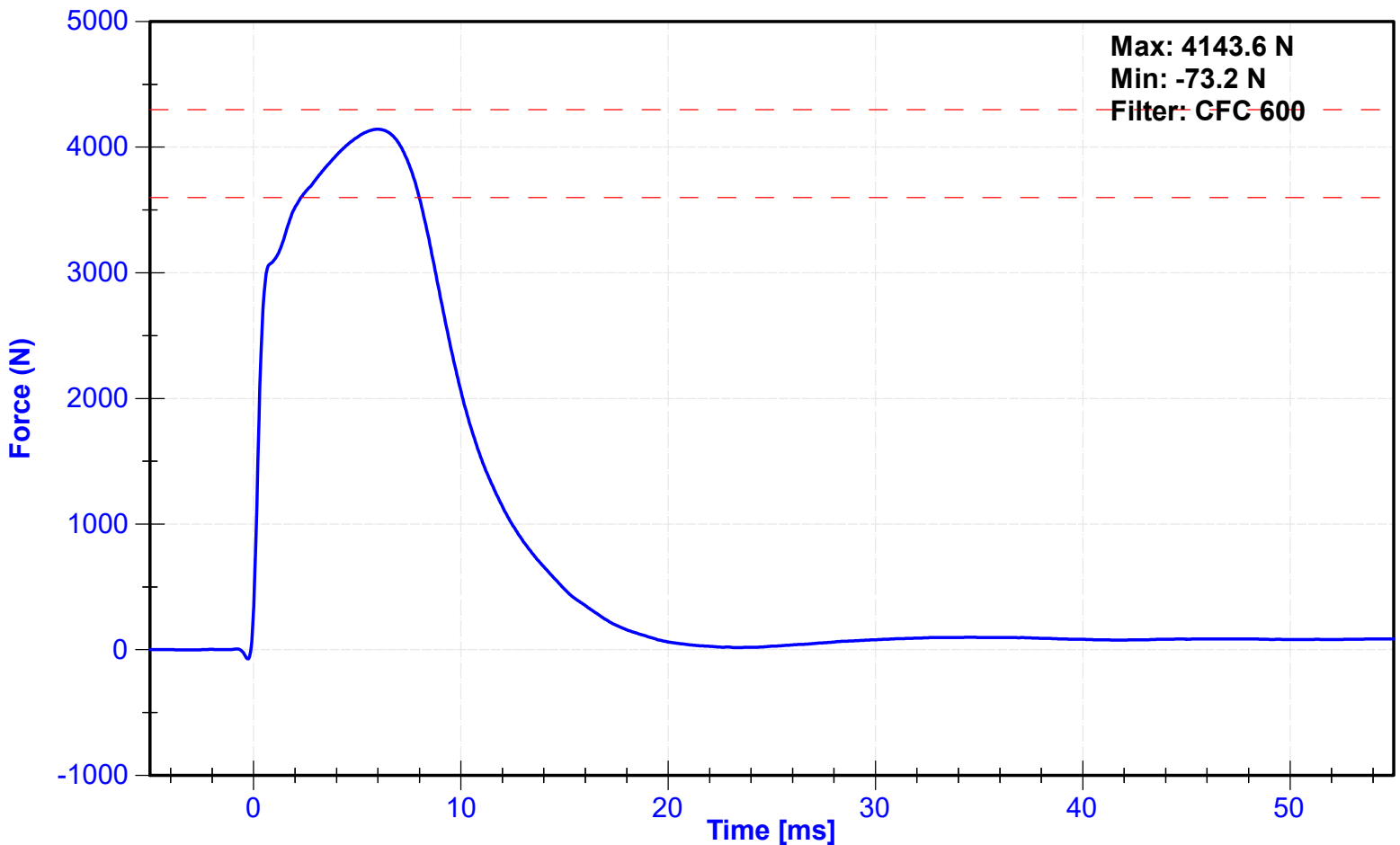
Probe Acceleration



Lateral Pelvis Acceleration



Acetabulum Force





SID-IIs Pelvis Plug Certification Test

Plug S/N 16574

Test Number 23358

Report Number 23415

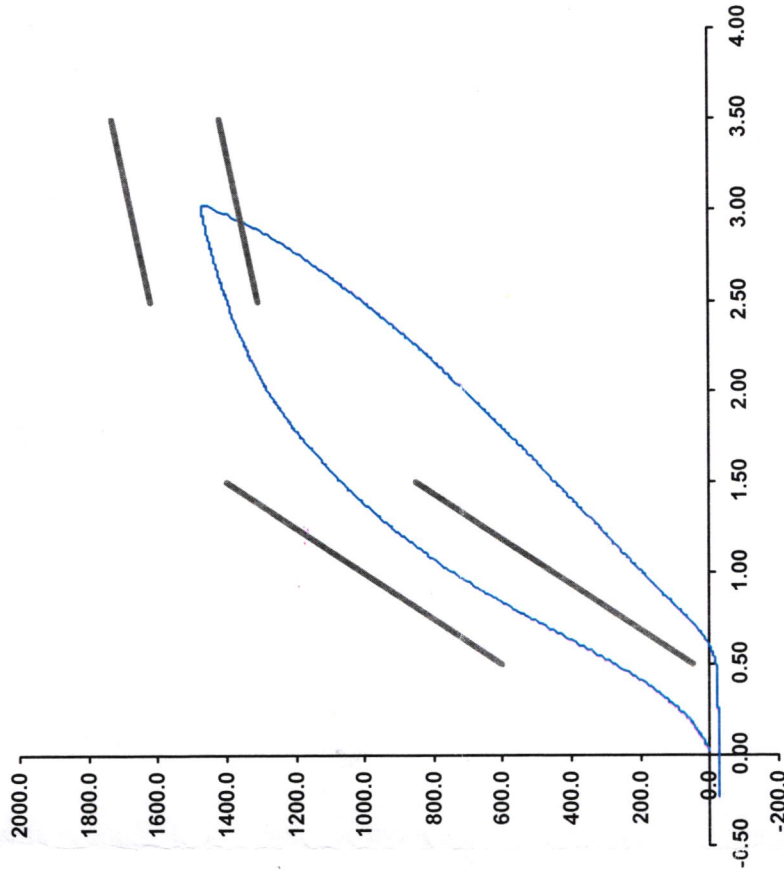
Test Date 7/19/2022 10:32:56 AM

Certification

9/13/23

261

Force (-N) vs Extension (-mm)



Test Results	Spec Min	Spec Max
Force @ 0.5 mm (N)	50	600
Force @ 1.5 mm (N)	850	1,400
Force @ 2.5 mm (N)	1,306	1,618
Force @ 3.0 mm (N)	1,361	1,673

Testing Machine STM-20 5965542

Load Cell S/N (FI360947), Units (LBS) 1000

Crosshead Speed (mm / min) or Rate 12.7

Extension or Position Measured by XHD_100 (XHD100)

Notes:

Operator

Part Number 180-4450

Template No 107

19-Jul-22
SACO Research

By: *DC* Date: *7/19/22*

SACO Research 41735 Elm St, #401 Murrieta, CA 92562 Tel 310-694-2082 FAX



NON-IMPACT

SID-IIs Pelvis Plug Certification Test

Plug S/N 15787

Test Number 20687

Report Number 20741

Test Date 10/15/2021 8:28:54 AM

Test Results	Spec Min	Spec Max
Force @ 0.5 mm (N)	50	600
Force @ 1.5 mm (N)	850	1,400
Force @ 2.5 mm (N)	1,306	1,618
Force @ 3.0 mm (N)	1,361	1,673

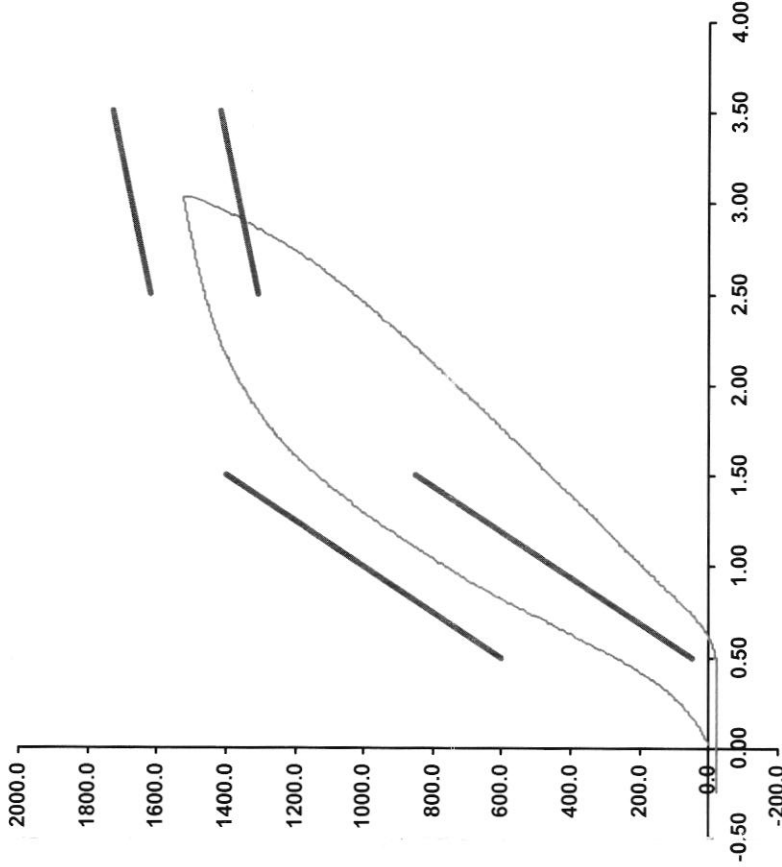
Testing Machine STM-20 5965542

Load Cell S/N (FI360947), Units (LBS) 1000

Crosshead Speed (mm / min) or Rate 12.7

Extension or Position Measured by XHD_100 (XHD100)

Notes:



Operator

Part Number 180-4450

Template No 107 15-Oct-21

SACO Research

By : DC Date : 10/15/21

SACO Research 41735 Elm St, #401 Murrieta, CA 92562 Tel 310-694-2082 FAX



IMPACT

SID-IIs Pelvis Plug Certification Test

Plug S/N 16410

Test Number 22979

Report Number 23037

Test Date 5/23/2022 10:01:18 AM

Test Results	Spec Min	Spec Max
Force @ 0.5 mm (N)	342	600
Force @ 1.5 mm (N)	1,217	1,400
Force @ 2.5 mm (N)	1,478	1,618
Force @ 3.0 mm (N)	1,527	1,673

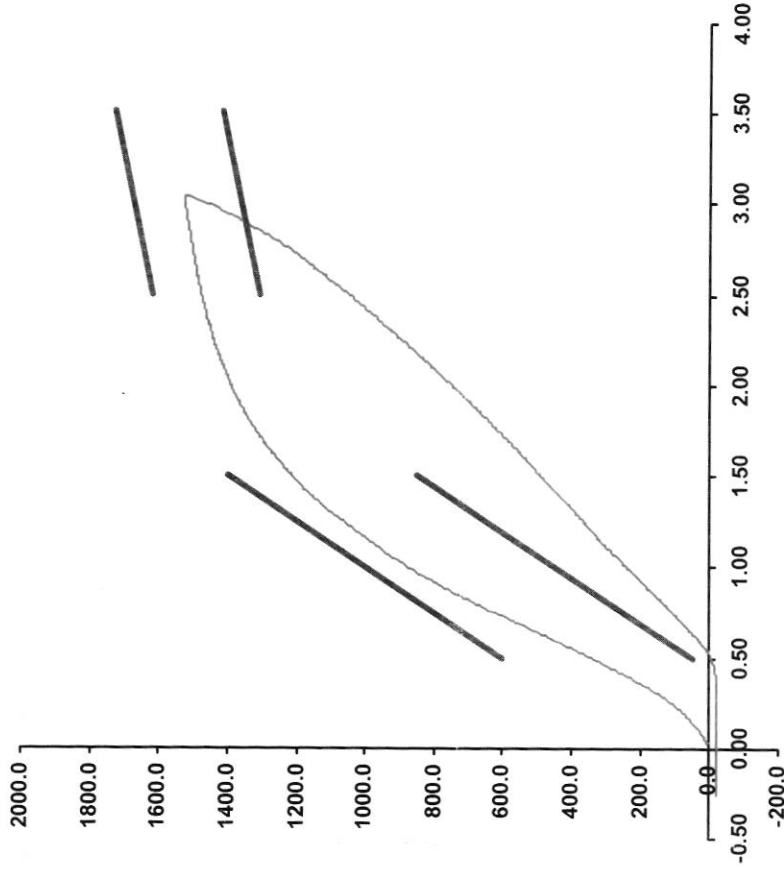
Testing Machine STM-20 5965542

Load Cell S/N (FI360947), Units (LBS) 1000

Crosshead Speed (mm / min) or Rate 12.7

Extension or Position Measured by XHD_100 (XHD100)

Notes:



Operator

Part Number 180-4450

Template No 107 23-May-22

SACO Research

By: DC Date: 5/23/2022

SACO Research 41735 Elm St, #401 Murrieta, CA 92562 Tel 310-694-2082 FAX

ATD Manufacturer	FTSS	Test Technician	C. Mantell
ATD Serial Number	261	Laboratory Supervisor	C. Mantell

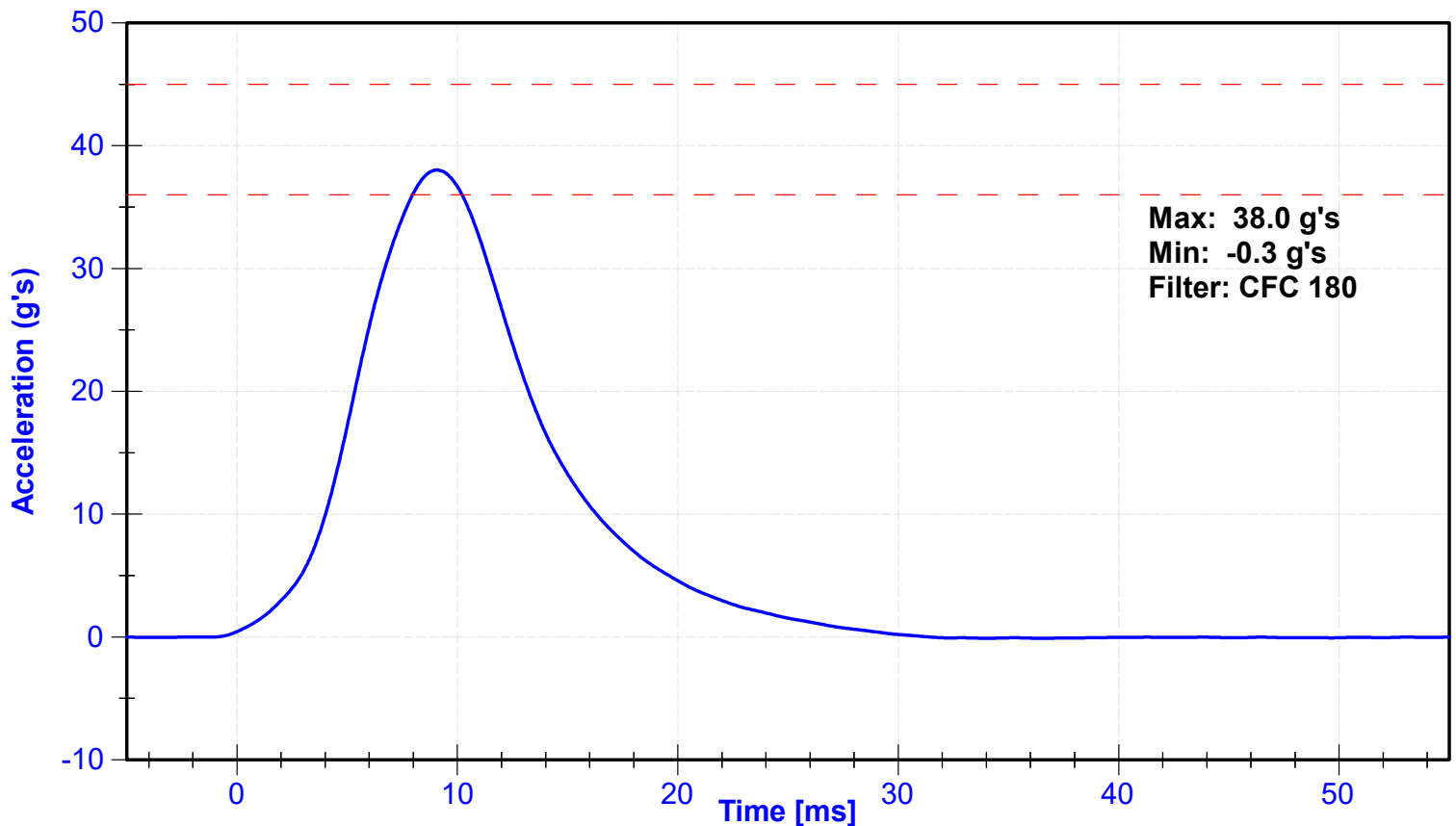
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.7	Pass
Humidity	10	70	%	51.0	Pass
Velocity	4.2	4.4	m/s	4.35	Pass
Probe Acceleration	36	45	g's	38.0	Pass
Lateral Pelvis Acceleration	28	39	g's	29.5	Pass
Iliac Force	4100	5100	N	4362.2	Pass

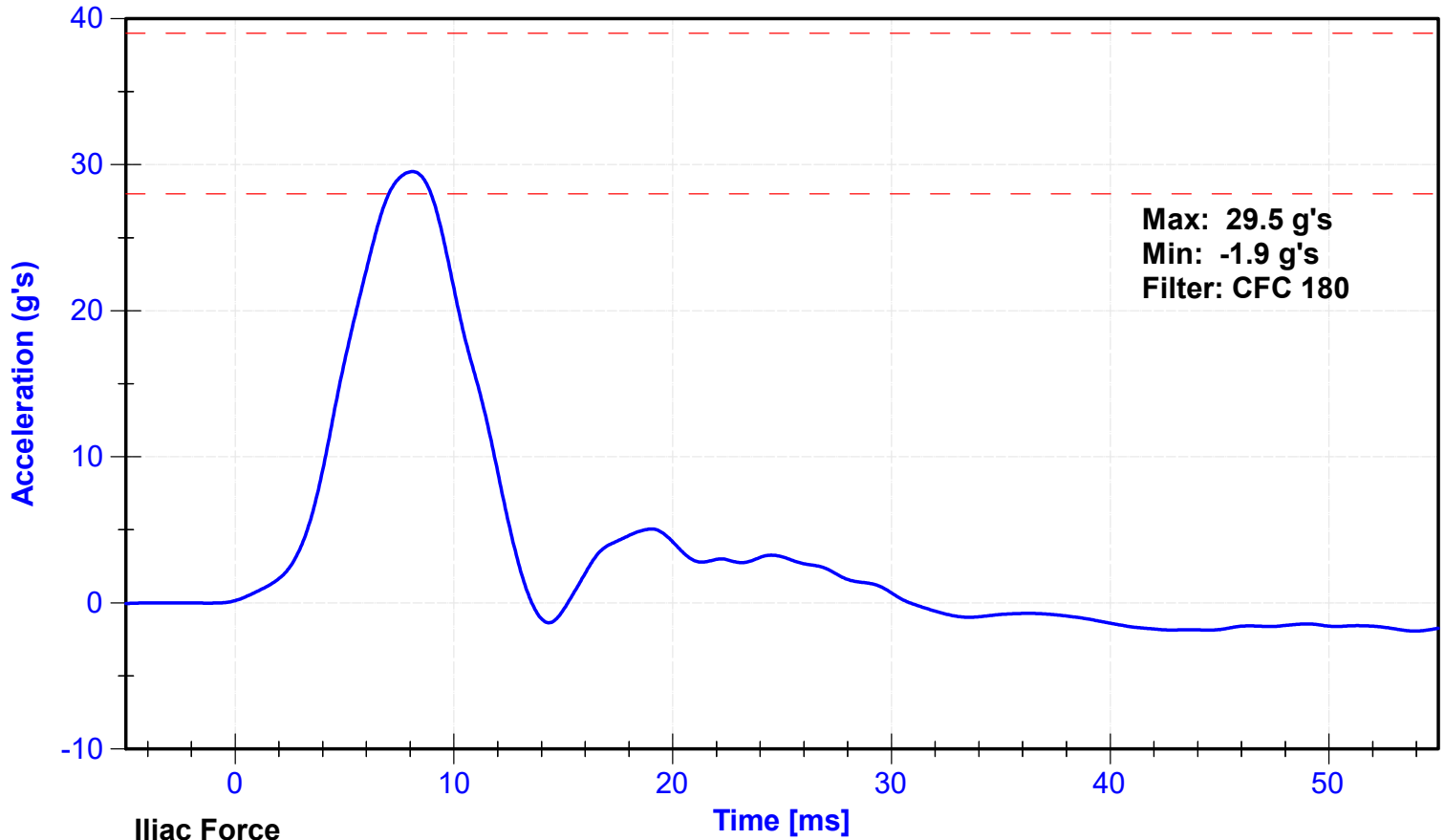
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	P51736	10/25/2022	10/25/2023
Pelvis Y Accelerometer	Endevco	T29392	7/27/2023	1/23/2024
Iliac Load Cell	Denton	321	9/25/2019	9/24/2020

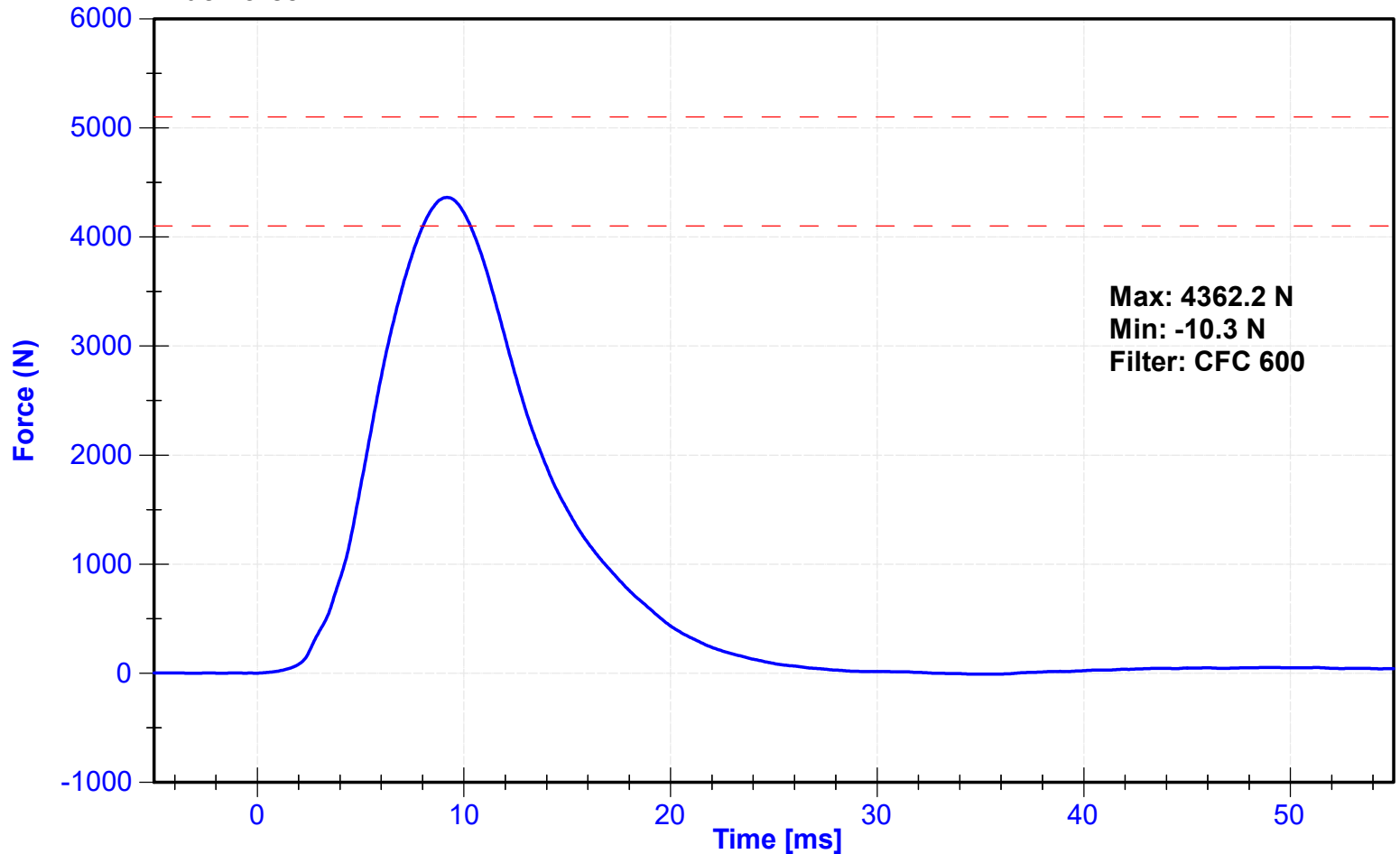
Probe Acceleration



Lateral Pelvis Acceleration



Iliac Force



**POST-TEST
SID-IIs PERFORMANCE CALIBRATION TEST DATA**

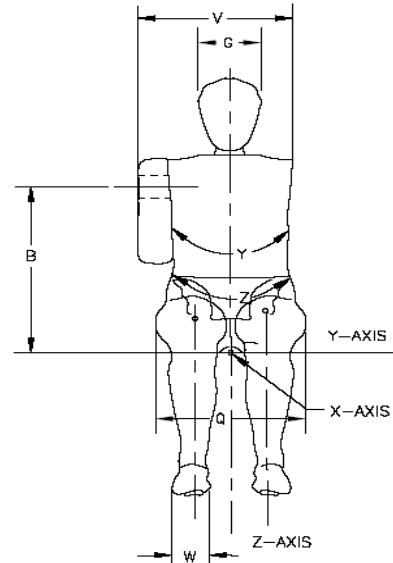
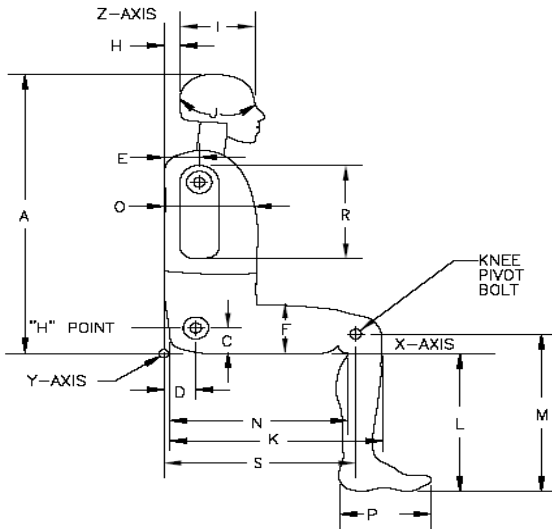


External Measurements - SID-IIs

Technician: K. Brogan

Date: 09/15/2023

Dummy Serial Number: 261



Symbol	Description	Specification (mm)		Result (mm)	Pass/Fail
A	Sitting Height	772	788	781	Pass
B	Shoulder Pivot Height	437	453	445	Pass
C	H-point Height	79	89	81	Pass
D	H-point from seatback	141	151	146	Pass
E	Shoulder Pivot from Backline	97	107	104	Pass
F	Thigh Clearance	119	135	128	Pass
G	Head Breadth	140	148	143	Pass
H	Head Back from Backline	40	46	43	Pass
I	Head Depth	178	188	180	Pass
J	Head Circumference	541	551	548	Pass
K	Buttock to Knee Length	514	540	530	Pass
L	Popliteal Height	343	369	354	Pass
M	Knee Pivot to floor height	392	409	400	Pass
N	Buttock Popliteal Length	416	442	431	Pass
O	Chest Depth w/o jacket	195	211	207	Pass
P	Foot Length	216	232	223	Pass
Q	Hip Breadth (w/pelvic plugs)	313	323	319	Pass
R	Arm Length	249	259	254	Pass
S	Knee Joint to seatback	477	493	483	Pass
V	Shoulder Width	341	357	350	Pass
W	Foot Width	78	94	84	Pass
Y	Chest Circumference w/jacket	851	881	871	Pass
Z	Waist Circumference	761	791	775	Pass

ATD Manufacturer	FTSS	Test Technician	C. Mantell
ATD Serial Number	261	Laboratory Supervisor	C. Mantell

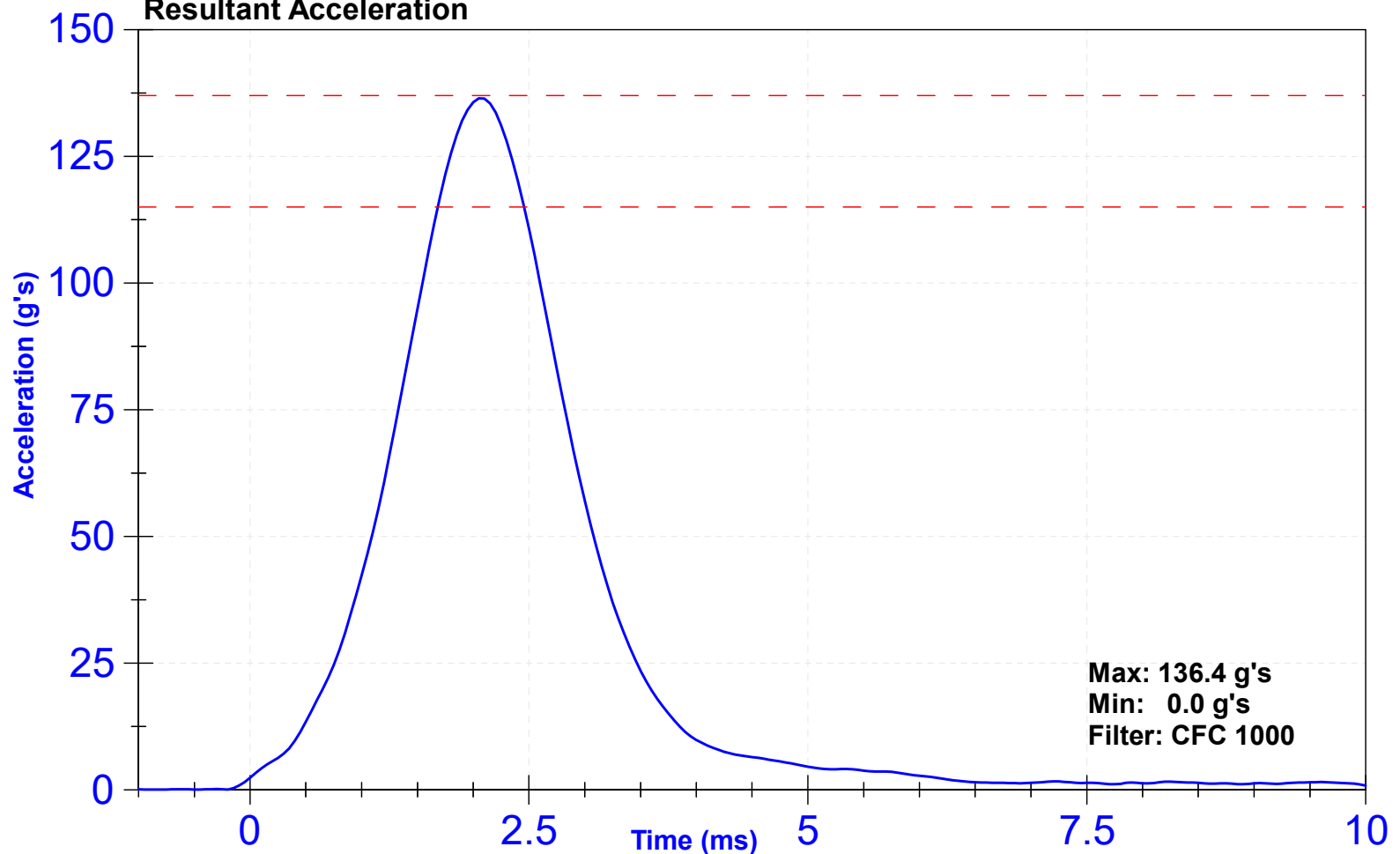
Results

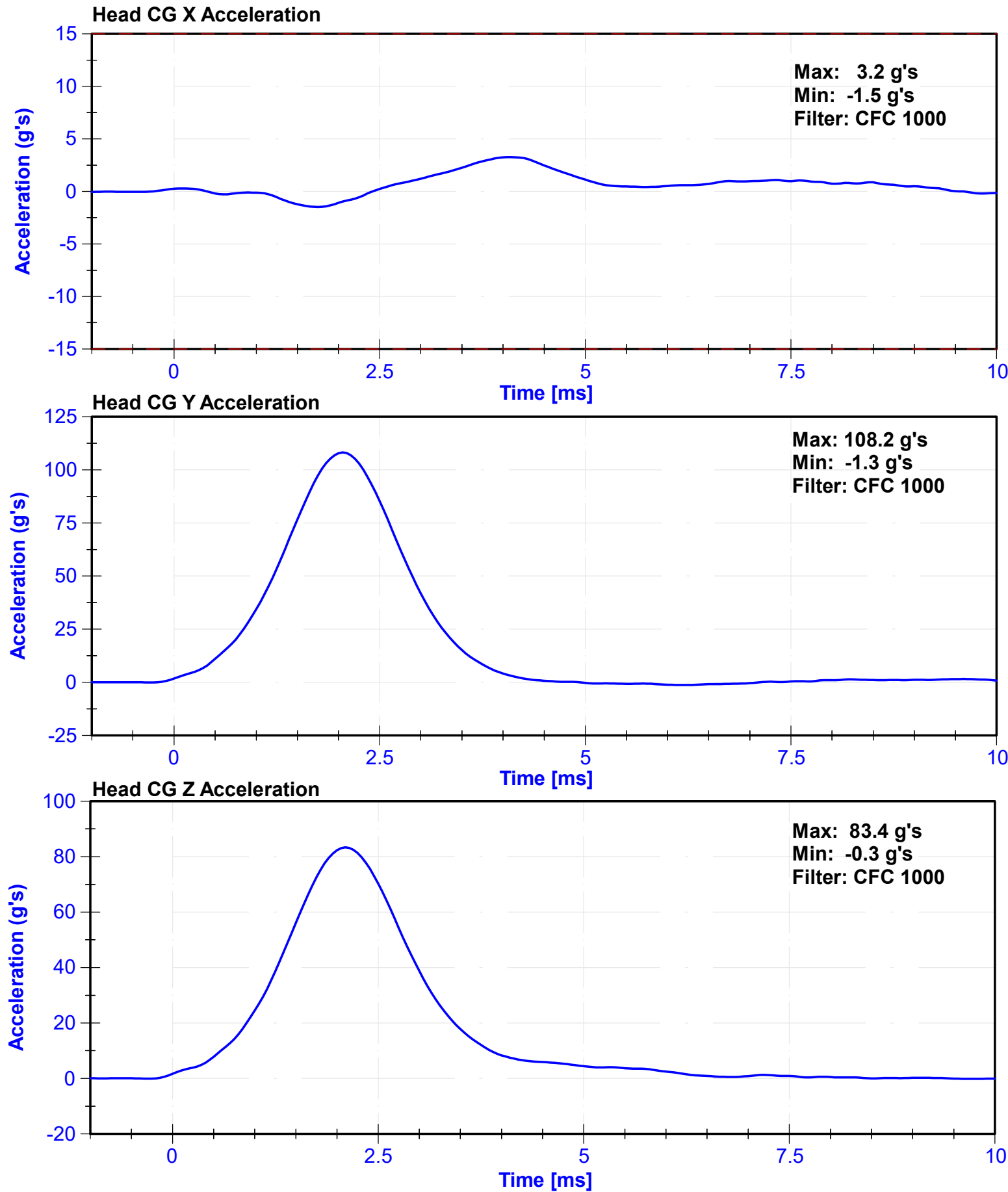
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.2	Pass
Humidity	10	70	%	43	Pass
Resultant Acceleration	115	137	g's	136.4	Pass
Oscillation	0	15	%	3.0	Pass
Fore-Aft Acceleration	-15	15	g's	3.2	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibratio Date	Calibratio Due Date
X Accelerometer	Endevco	P68067	6/22/2023	12/19/2023
Y Accelerometer	Endevco	P18567	6/22/2023	12/19/2023
Z Accelerometer	Endevco	P49163	6/22/2023	12/19/2023

Resultant Acceleration





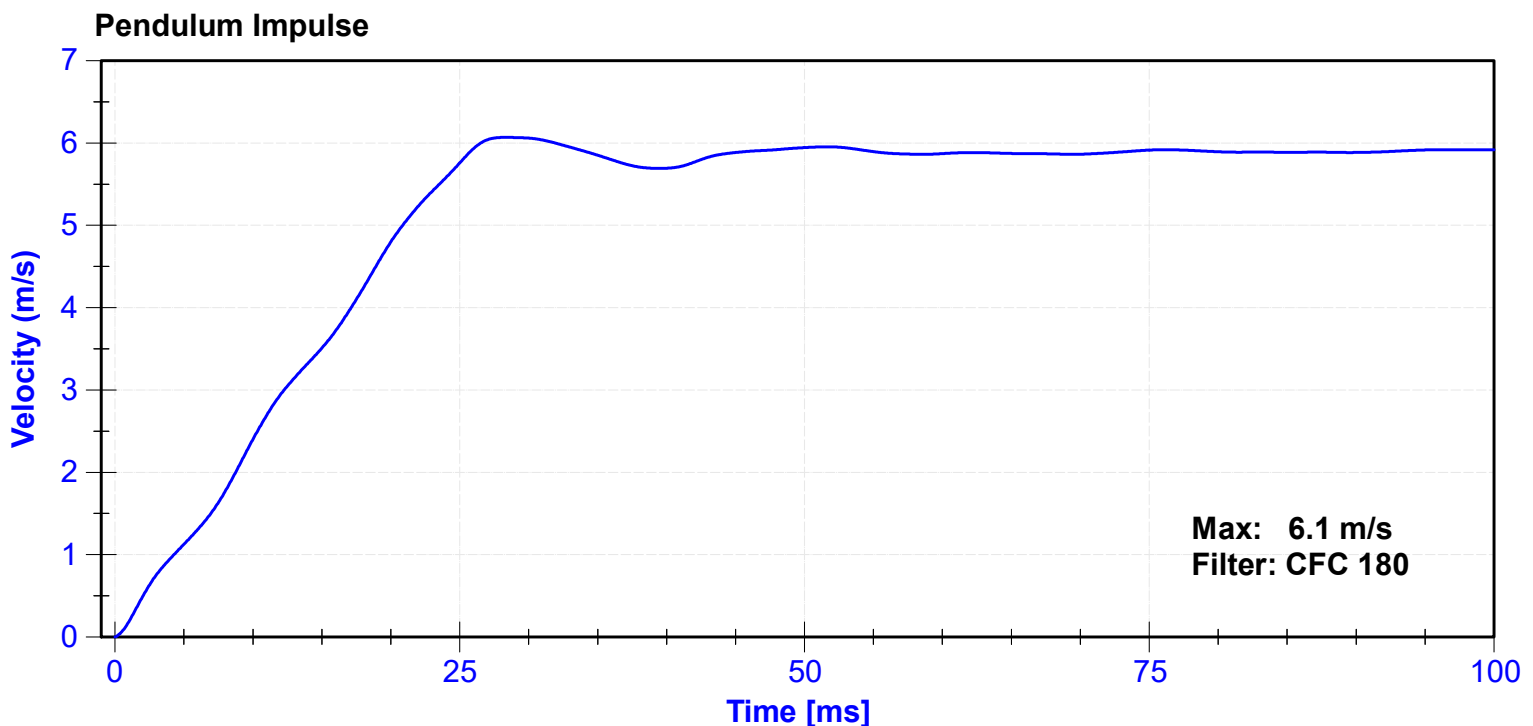
ATD Manufacturer	FTSS	Test Technician	C. Mantell
ATD Serial Number	261	Laboratory Supervisor	C. Mantell

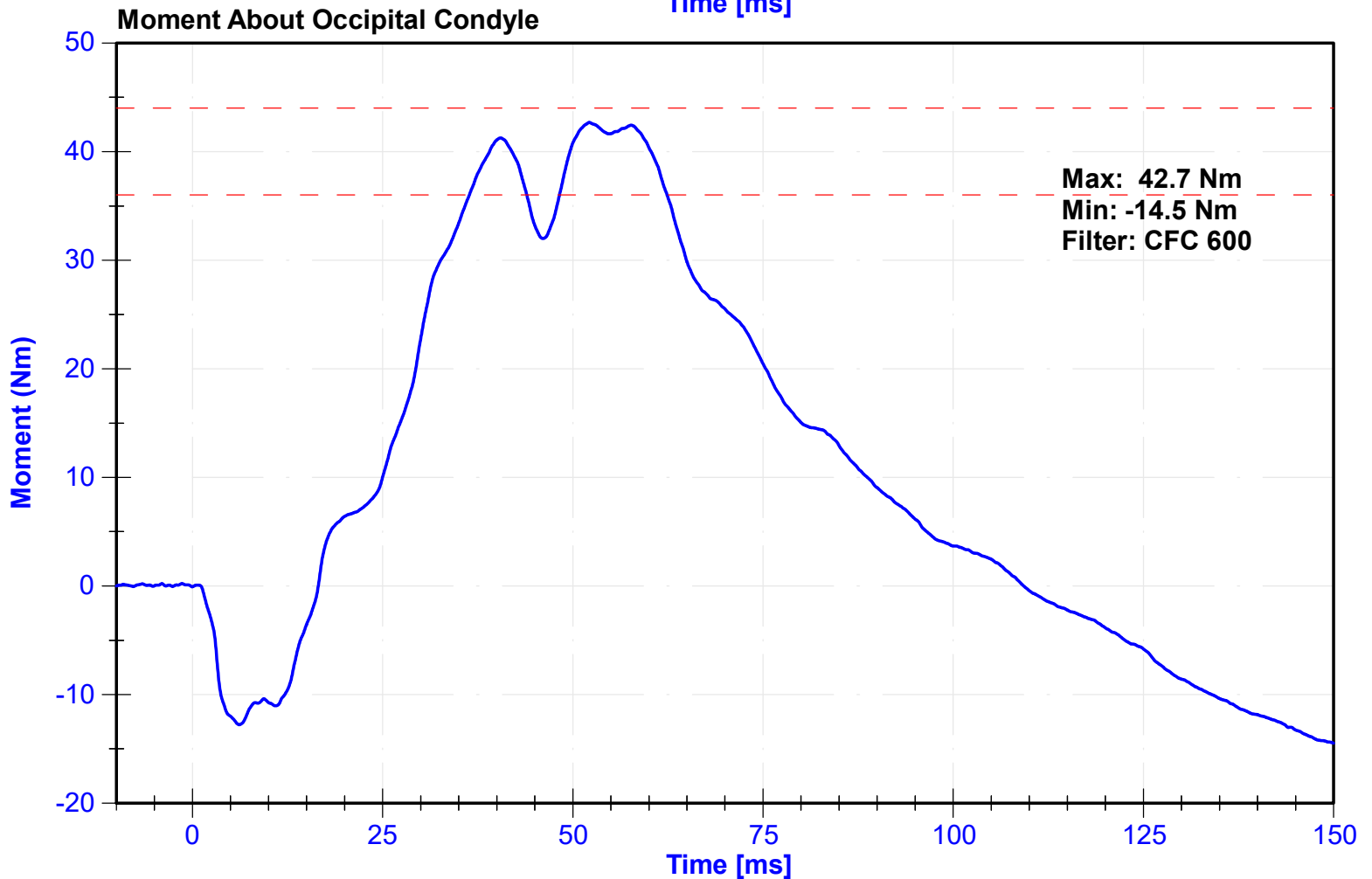
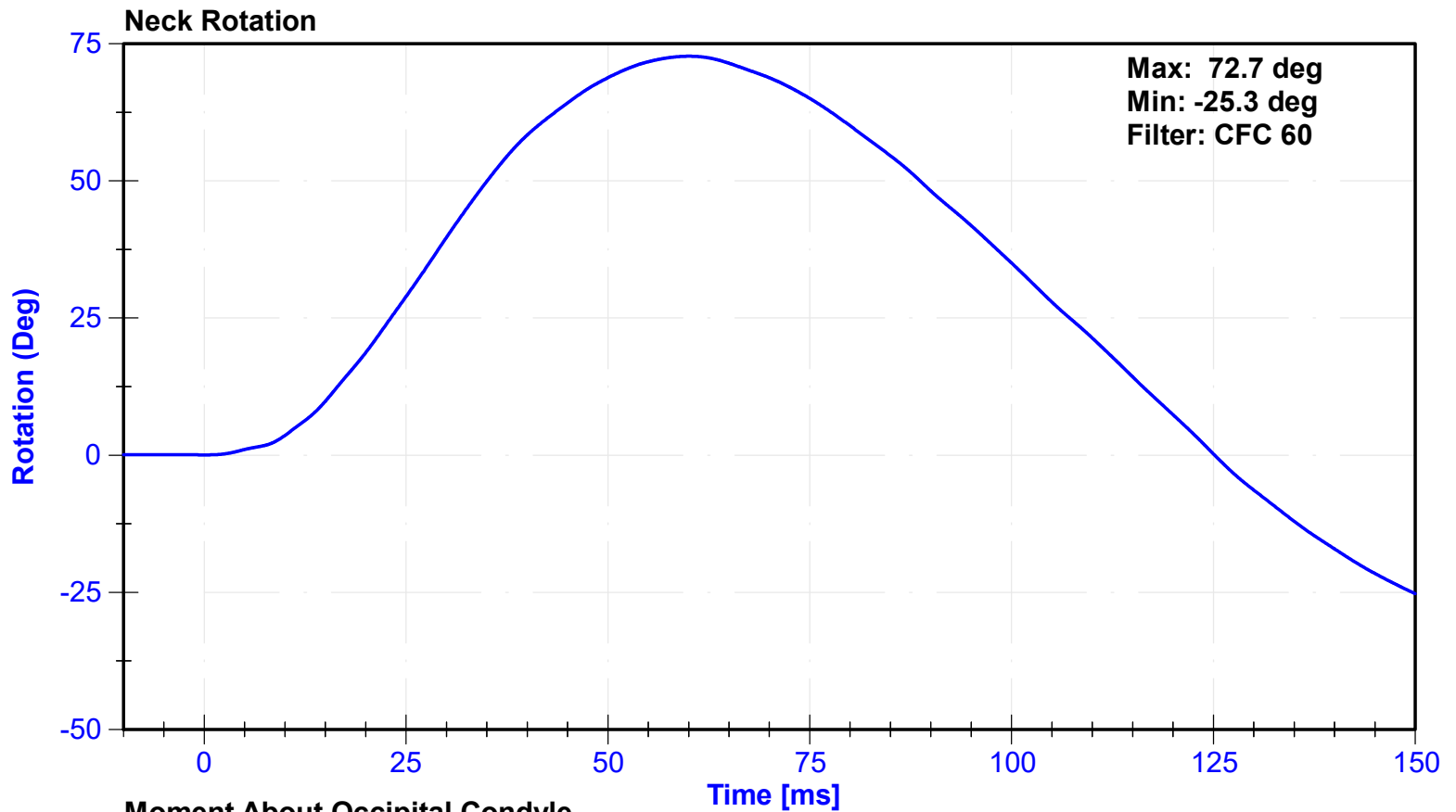
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.0	Pass
Humidity	10	70	%	42.0	Pass
Velocity	5.51	5.63	m/s	5.514	Pass
Pendulum Impulse at 10ms	2.2	2.8	m/s	2.40	Pass
Pendulum Impulse at 15ms	3.3	4.1	m/s	3.51	Pass
Pendulum Impulse at 20ms	4.4	5.4	m/s	4.80	Pass
Pendulum Impulse at 25ms	5.4	6.1	m/s	5.76	Pass
Pendulum Impulse from 25 to 100ms	5.5	6.2	m/s	6.07	Pass
Neck Rotation	71	81	deg	72.7	Pass
Time at Maximum Rotation	50	70	ms	60.0	Pass
Moment about the OC	36	44	Nm	42.7	Pass
Moment Decay to 0 Nm	102	126	ms	109.3	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	7231C-750	10/31/2022	10/31/2023
Pendulum Potentiometer	Servo	4961	11/11/2022	11/11/2023
Condyle Potentiometer	Servo	DS185	11/11/2022	11/11/2023
Upper Neck Load Cell	Denton	1716ATF_2184-FY	5/18/2023	5/17/2024





ATD Manufacturer	FTSS	Test Technician	C. Mantell
ATD Serial Number	261	Laboratory Supervisor	C. Mantell

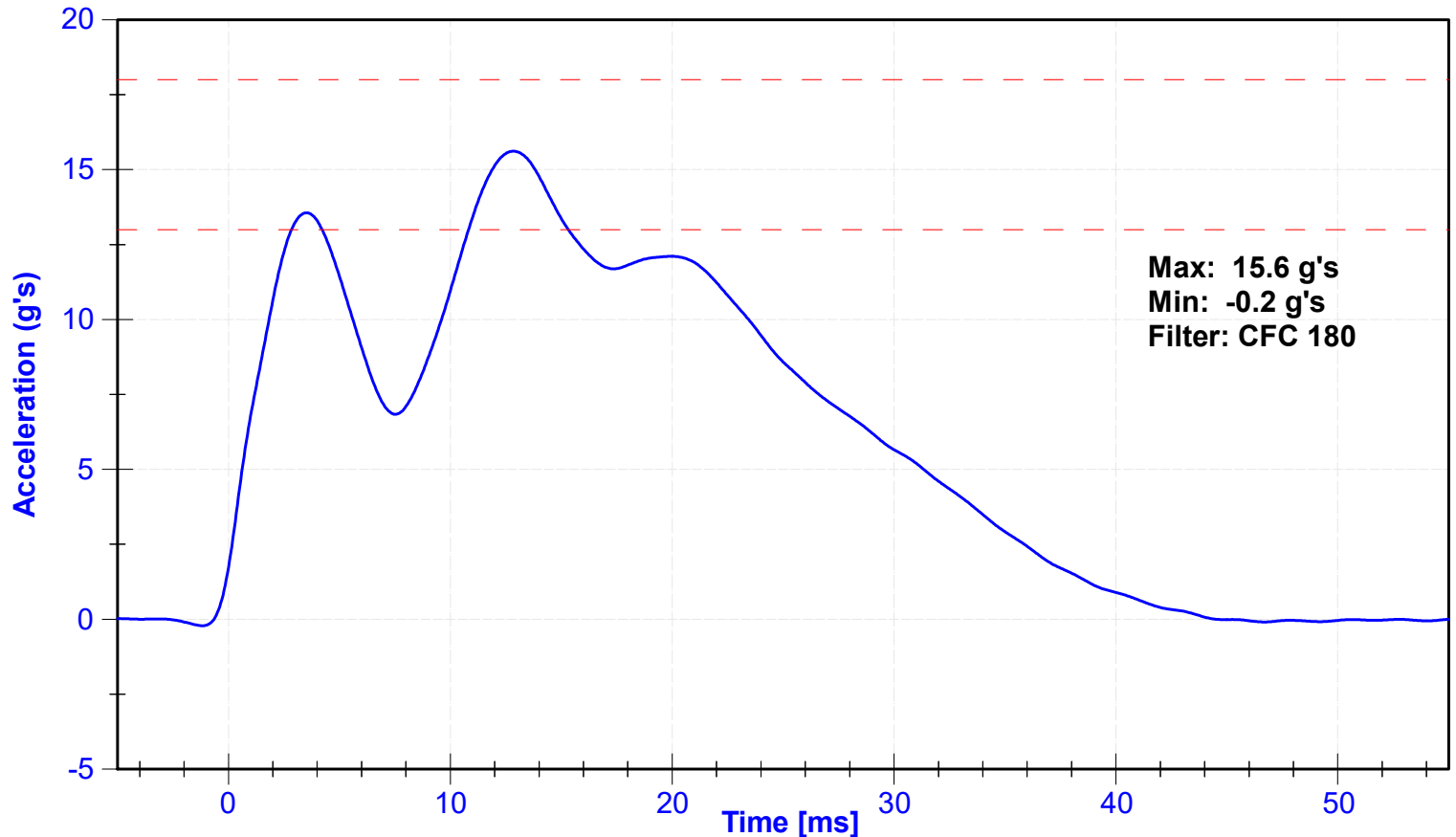
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.5	Pass
Humidity	10	70	%	45.0	Pass
Velocity	4.2	4.4	m/s	4.34	Pass
Probe Acceleration	13	18	g's	15.6	Pass
Shoulder Deflection	28	37	mm	33.9	Pass
Lateral Upper Spine Acceleration	17	22	g's	19.5	Pass

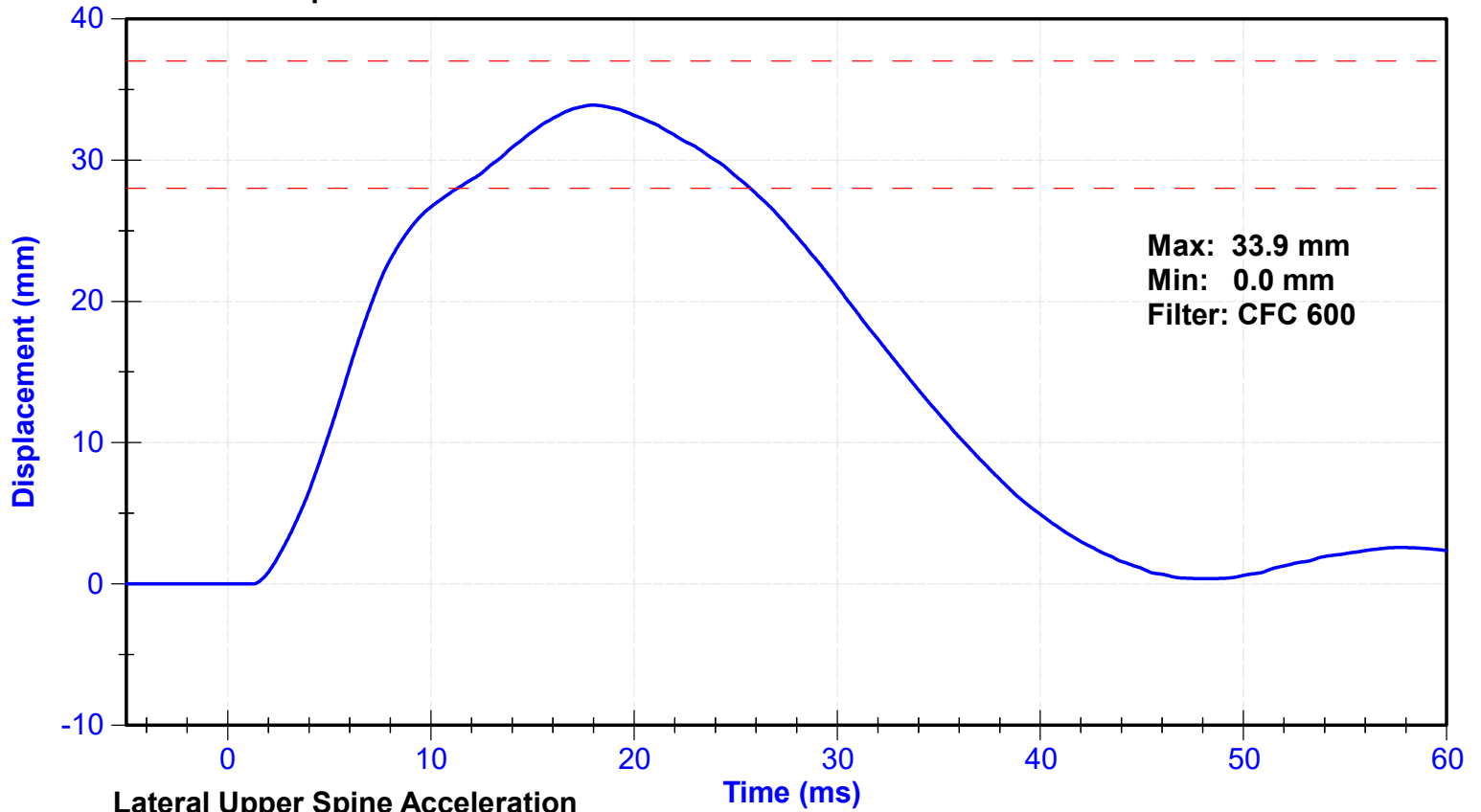
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	P51736	10/25/2022	10/25/2023
Shoulder Potentiometer	Servo	572GFE	6/22/2023	12/21/2023
Upper Spine Y Accelerometer	Endevco	P94678	6/22/2023	12/19/2023

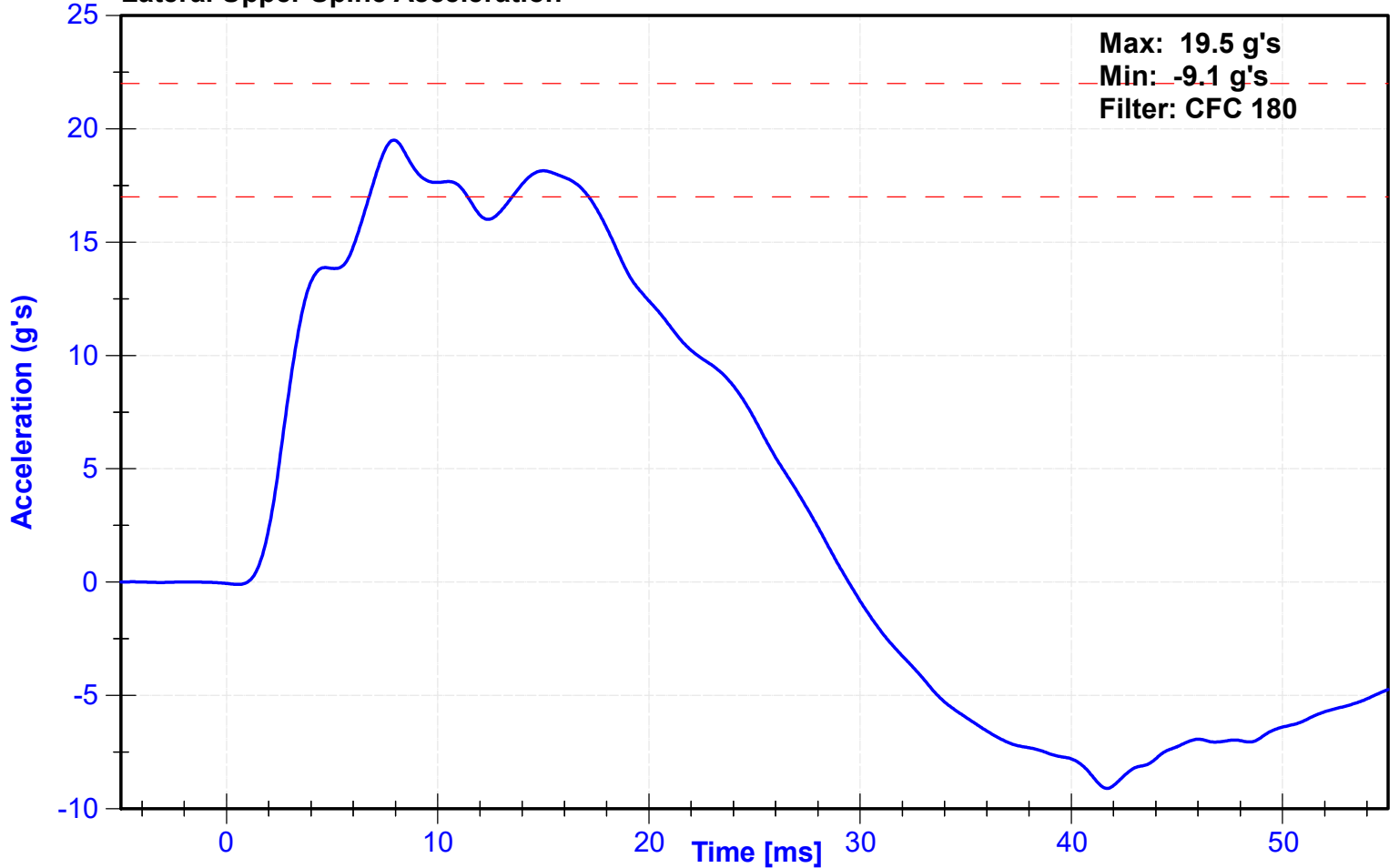
Probe Acceleration



Shoulder Displacement



Lateral Upper Spine Acceleration



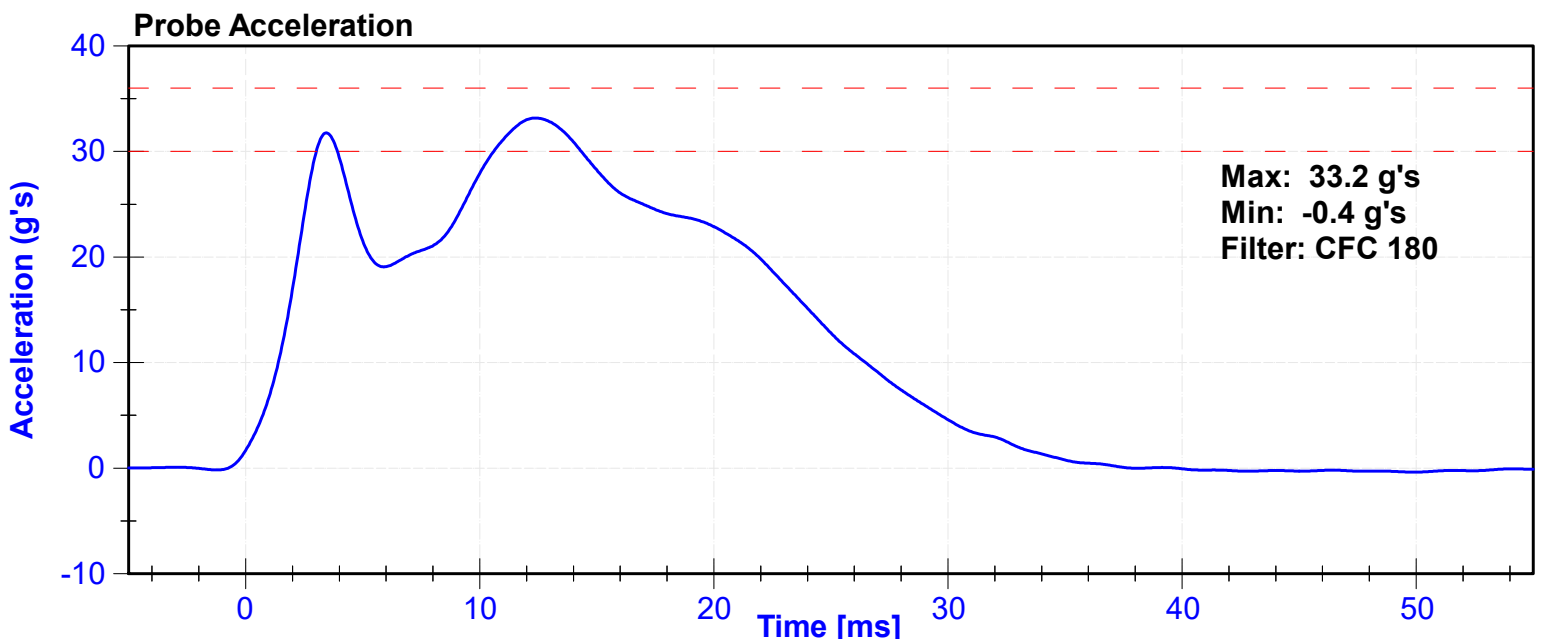
ATD Manufacturer	FTSS	Test Technician	C. Mantell
ATD Serial Number	261	Laboratory Supervisor	C. Mantell

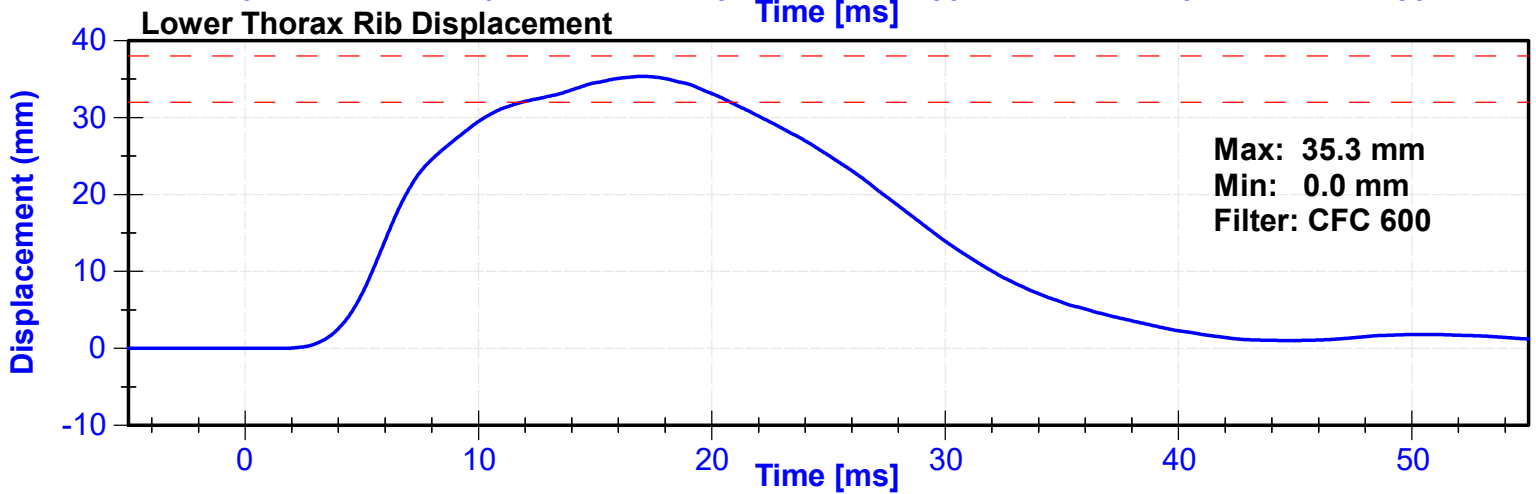
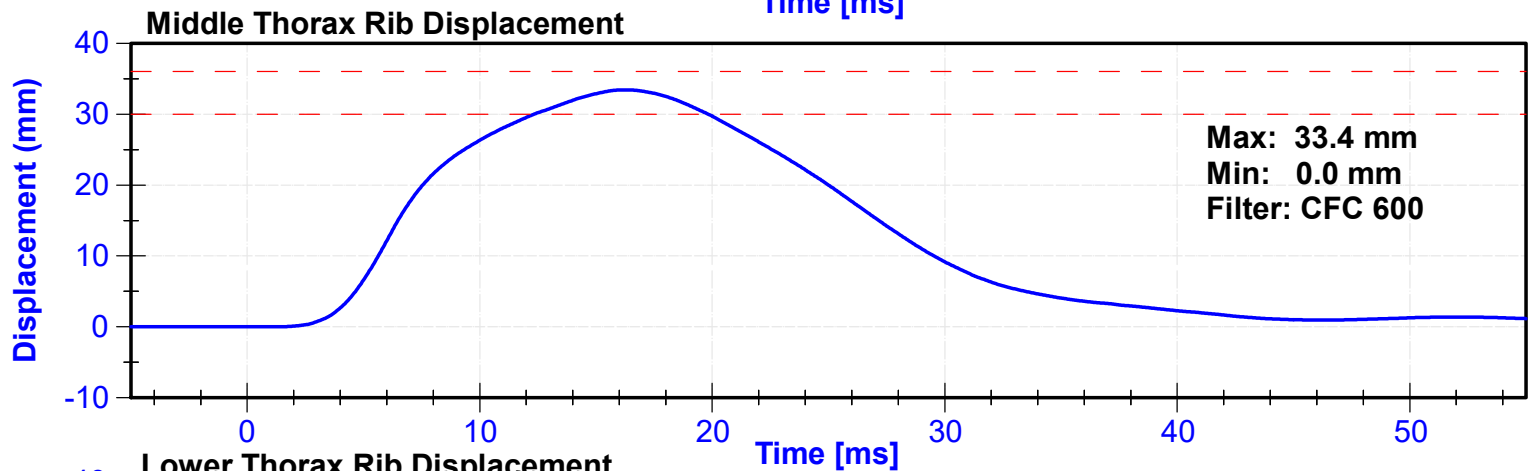
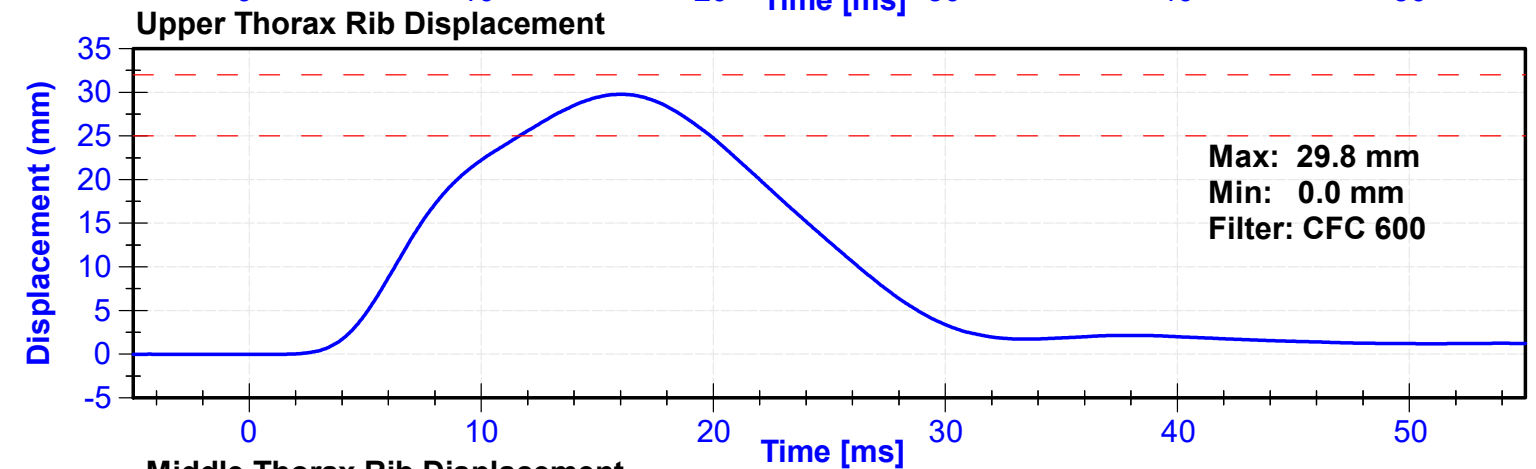
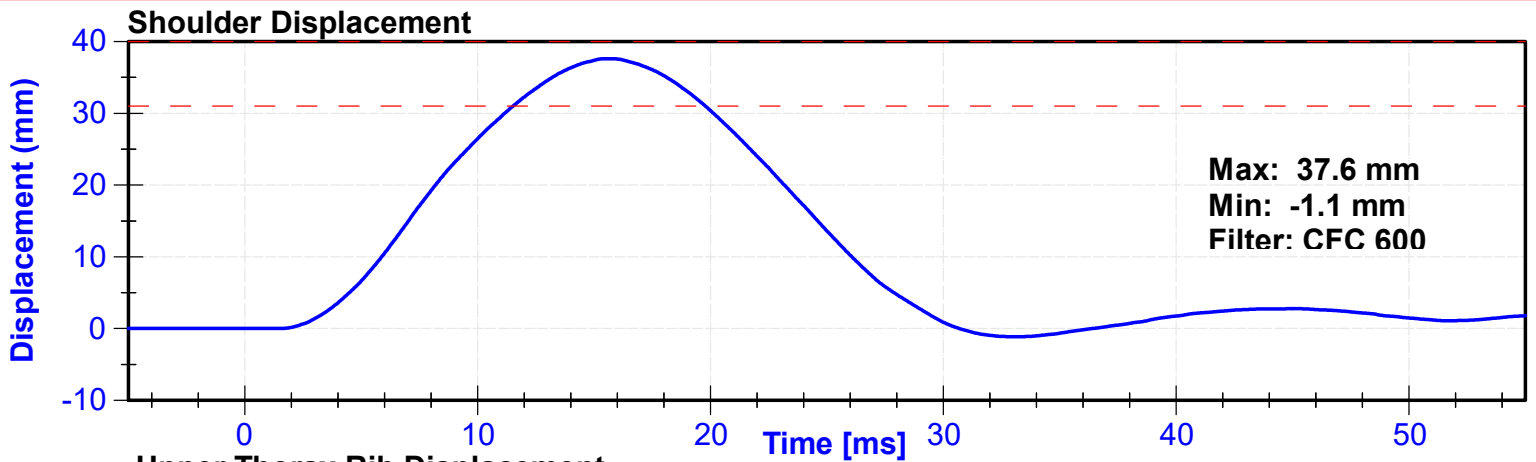
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.5	Pass
Humidity	10	70	%	45.0	Pass
Velocity	6.6	6.8	m/s	6.65	Pass
Probe Acceleration after 5 ms	30	36	g's	33.2	Pass
Lateral Upper Spine Acceleration	34	43	g's	38.9	Pass
Lateral Lower Spine Acceleration	29	37	g's	32.2	Pass
Shoulder Deflection	31	40	mm	37.6	Pass
Upper Thorax Rib Deflection	25	32	mm	29.8	Pass
Mid Thorax Rib Deflection	30	36	mm	33.4	Pass
Lower Thorax Rib Deflection	32	38	mm	35.3	Pass

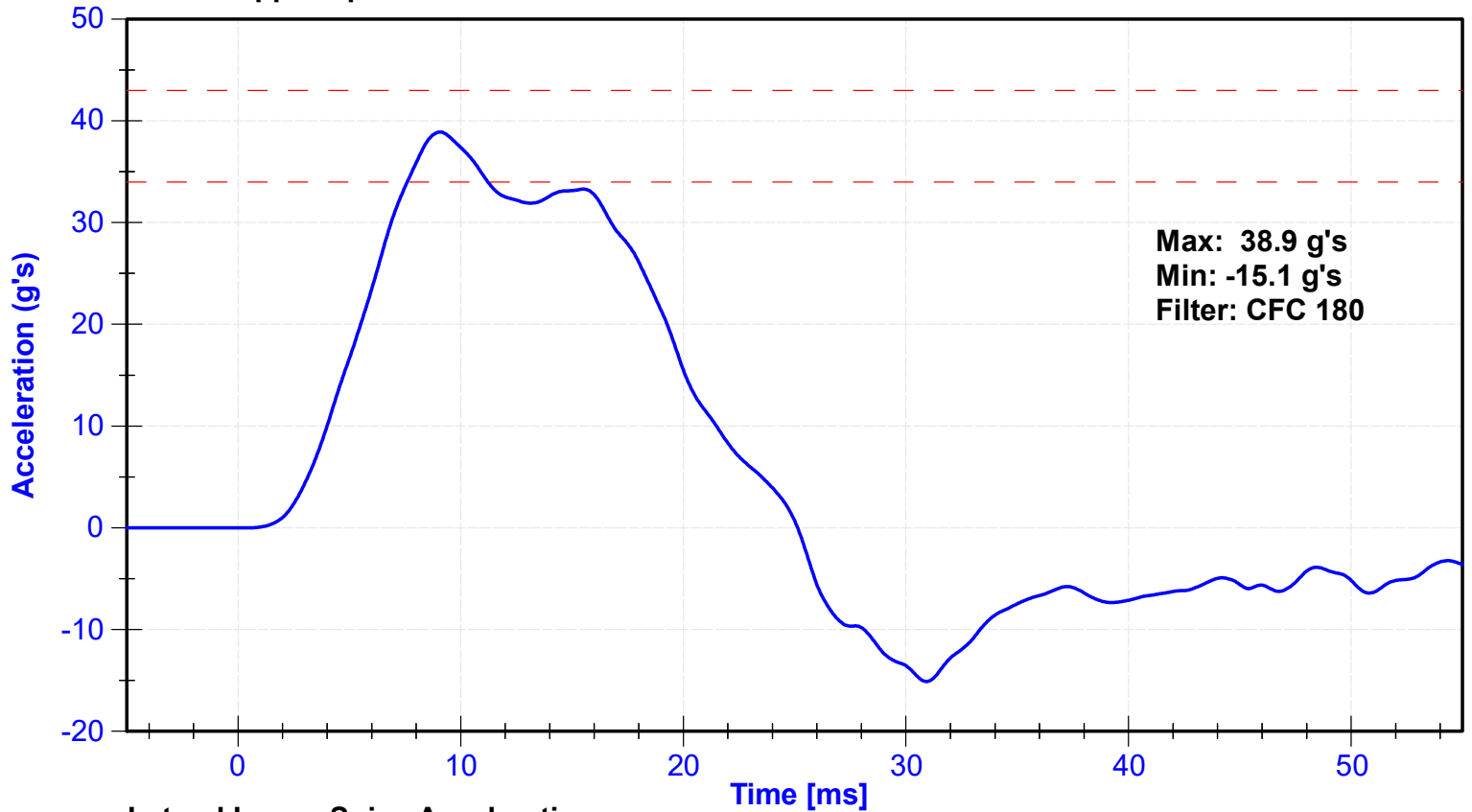
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	P51736	10/25/2022	10/25/2023
Upper Spine T1 Y Accelerometer	Endevco	P94678	6/22/2023	12/19/2023
Upper Spine T12 Y Accelerometer	Endevco	P58744	6/22/2023	12/19/2023
Shoulder Potentiometer	Servo	572GFE	6/22/2023	12/21/2023
Upper Thorax Rib Potentiometer	Servo	062GFE	6/22/2023	12/21/2023
Middle Thorax Rib Potentiometer	Servo	528GFE	6/22/2023	12/21/2023
Lower Thorax Rib Potentiometer	Servo	513GFE	6/22/2023	12/21/2023

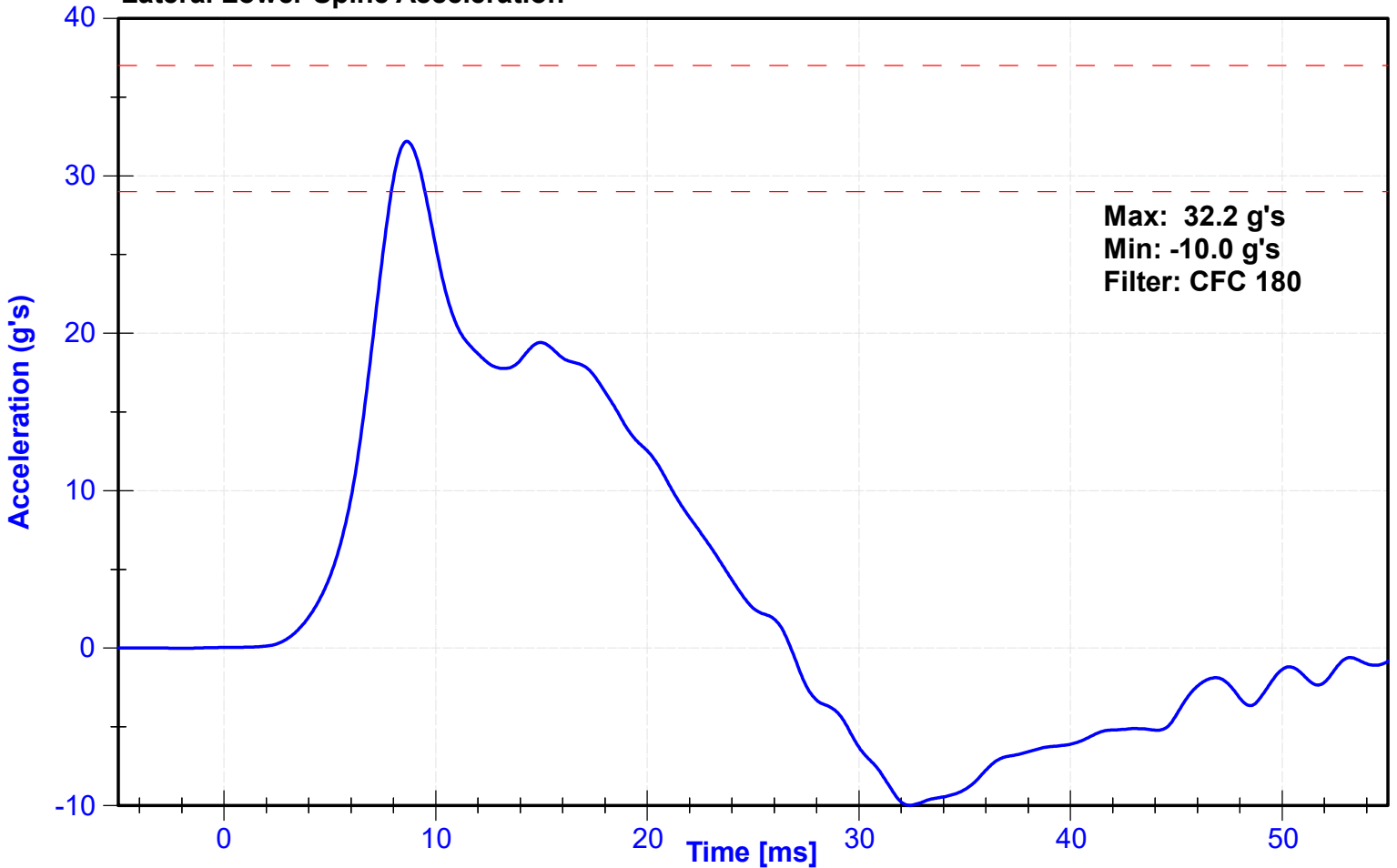




Lateral Upper Spine Acceleration



Lateral Lower Spine Acceleration



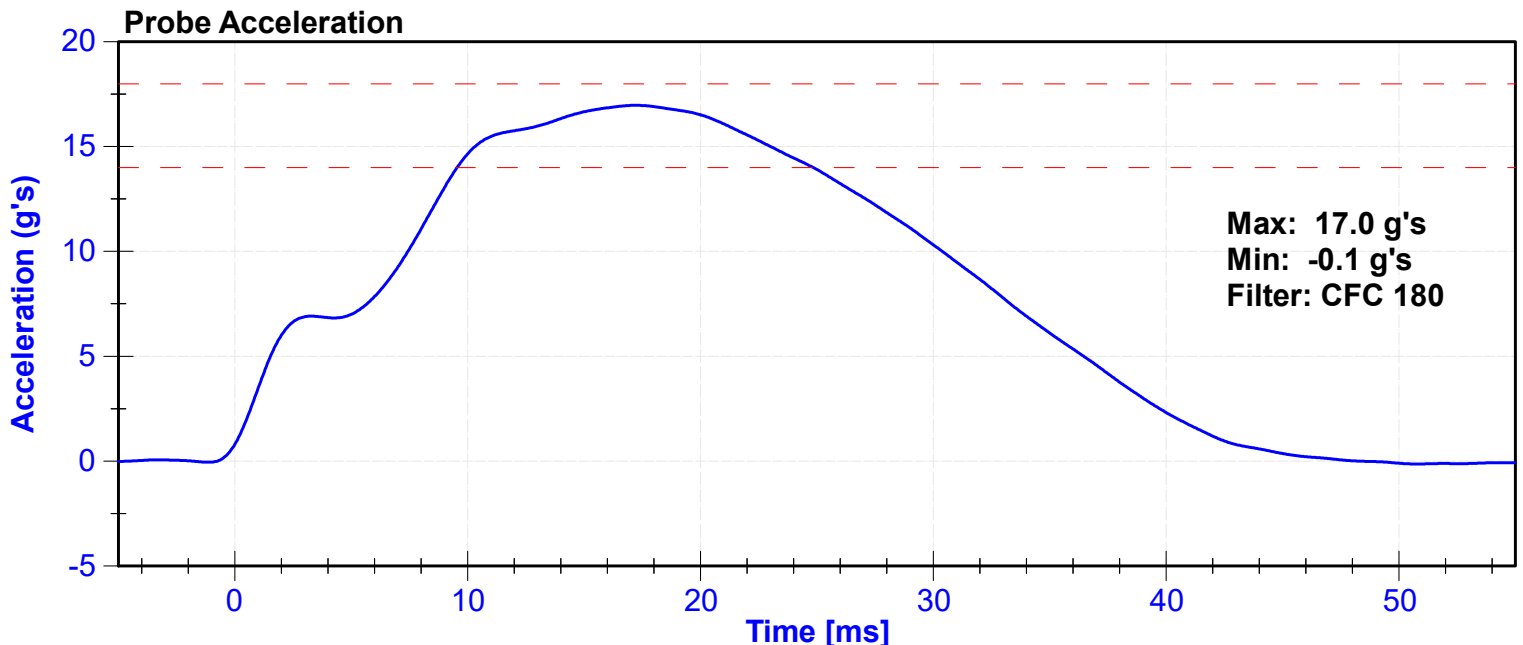
ATD Manufacturer	FTSS	Test Technician	C. Mantell
ATD Serial Number	261	Laboratory Supervisor	C. Mantell

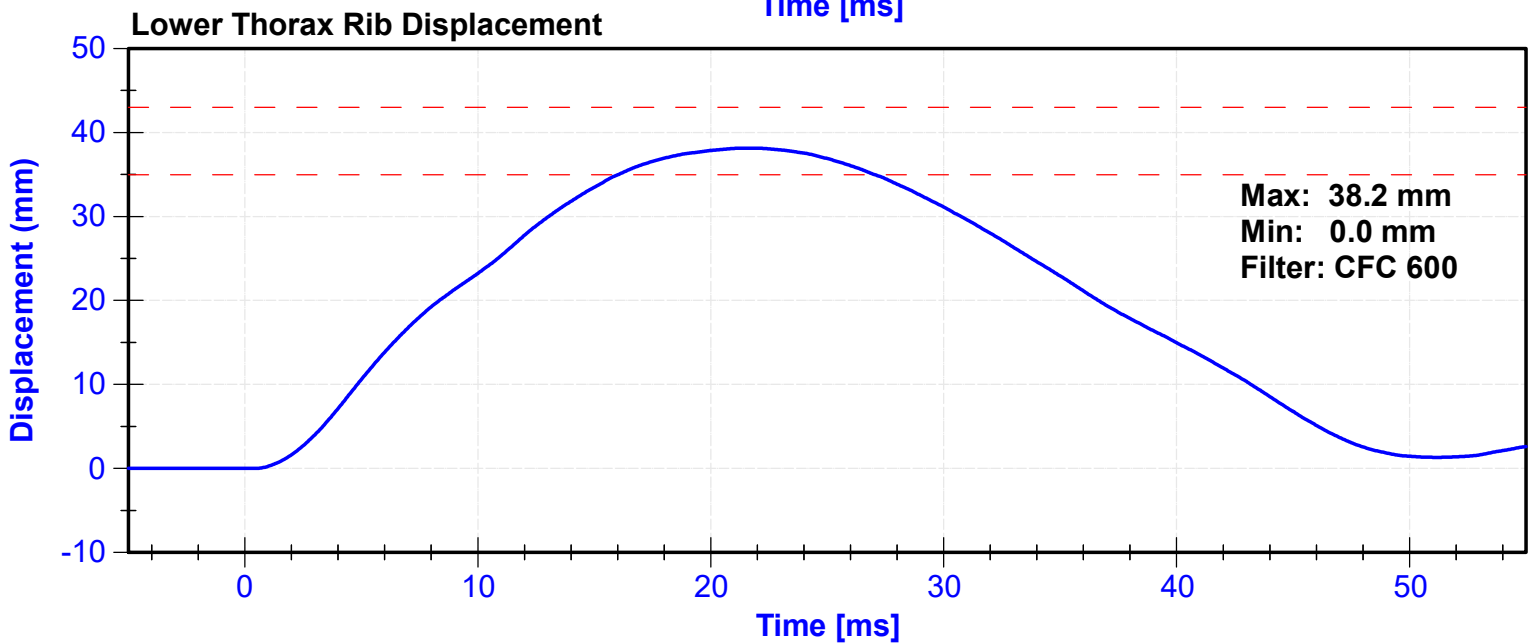
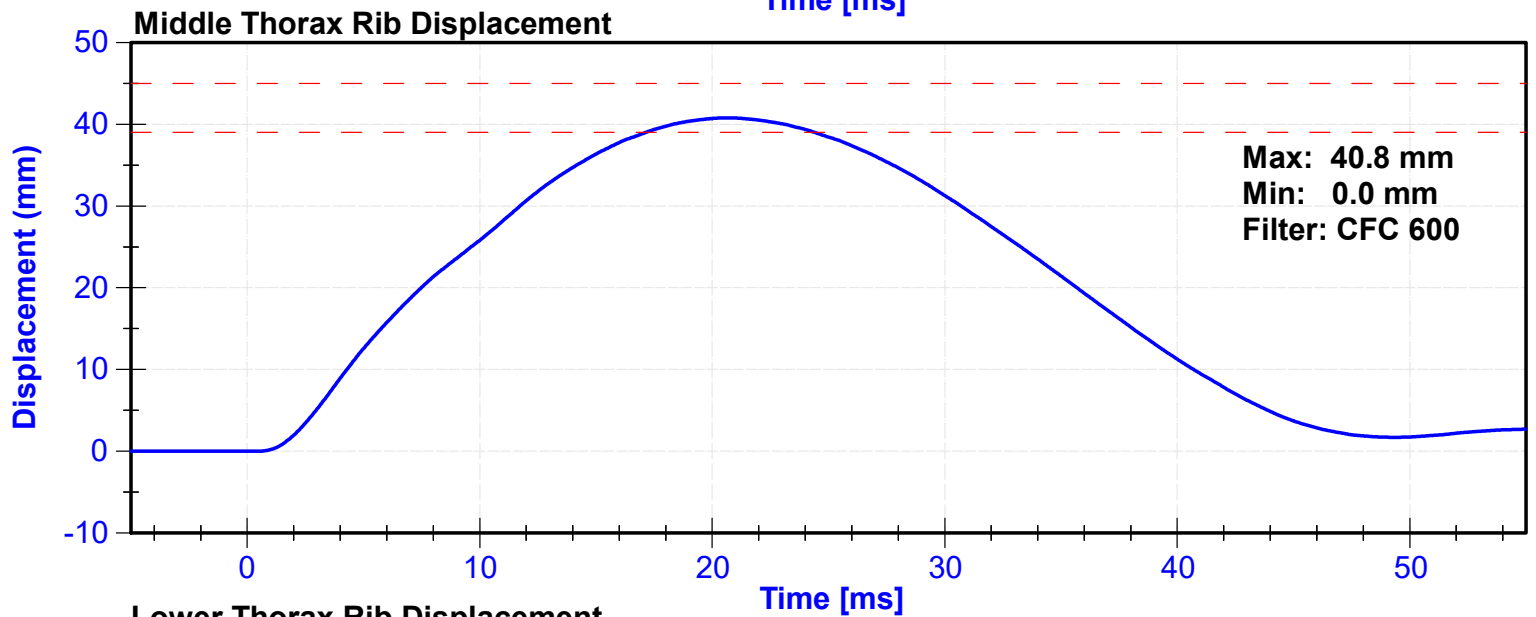
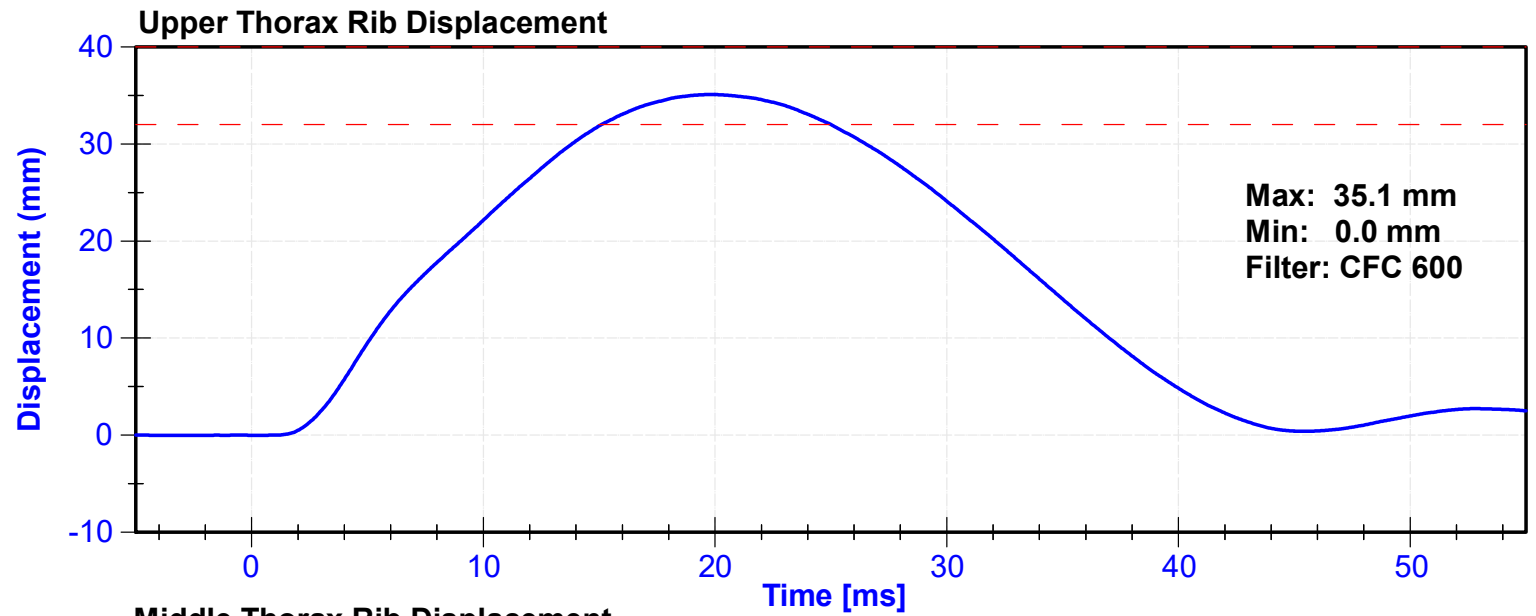
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.5	Pass
Humidity	10	70	%	45.0	Pass
Velocity	4.2	4.4	m/s	4.32	Pass
Probe Acceleration	14	18	g's	17.0	Pass
Lateral Upper Spine Acceleration	13	17	g's	15.9	Pass
Lateral Lower Spine Acceleration	7	11	g's	9.9	Pass
Upper Thorax Rib Deflection	32	40	mm	35.1	Pass
Middle Thorax Rib Deflection	39	45	mm	40.8	Pass
Lower Thorax Rib Deflection	35	43	mm	38.2	Pass

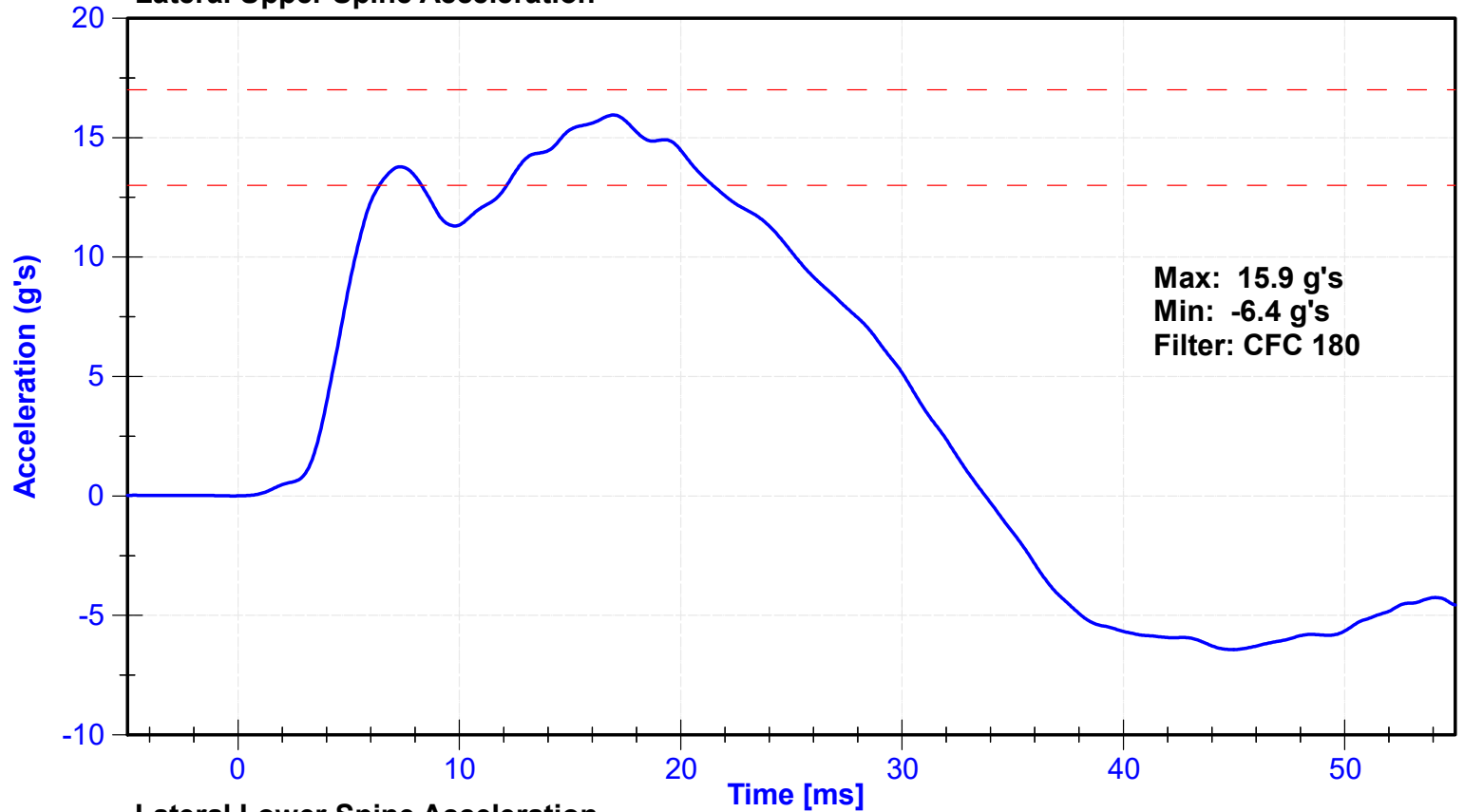
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	P51736	10/25/2022	10/25/2023
Upper Spine Y Accelerometer	Endevco	P94678	6/22/2023	12/19/2023
Lower Spine Y Accelerometer	Endevco	P58744	6/22/2023	12/19/2023
Upper Thorax Rib Potentiometer	Servo	062GFE	6/22/2023	12/21/2023
Middle Thorax Rib Potentiometer	Servo	528GFE	6/22/2023	12/21/2023
Lower Thorax Rib Potentiometer	Servo	513GFE	6/22/2023	12/21/2023

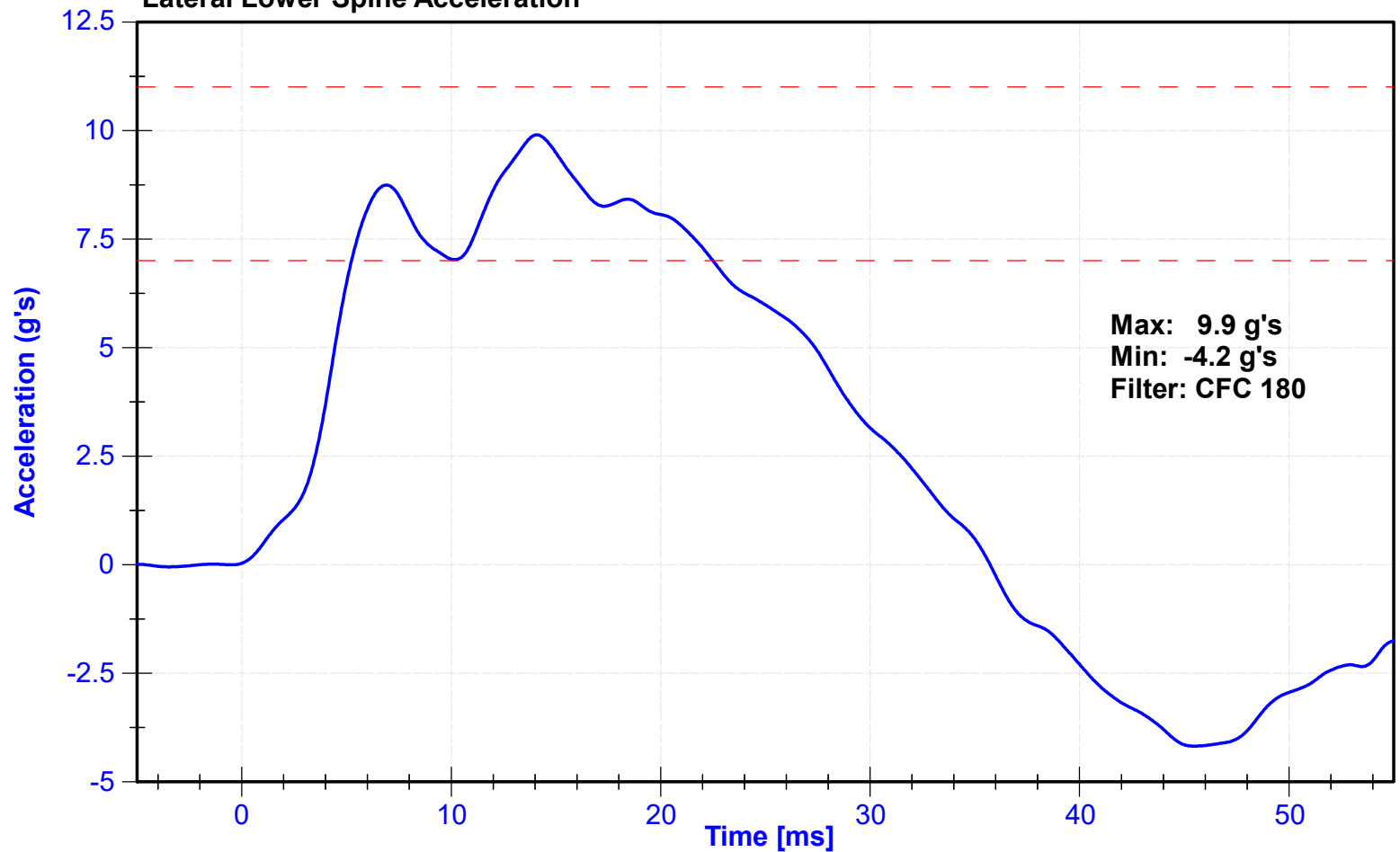




Lateral Upper Spine Acceleration



Lateral Lower Spine Acceleration



ATD Manufacturer	FTSS	Test Technician	C. Mantell
ATD Serial Number	261	Laboratory Supervisor	C. Mantell

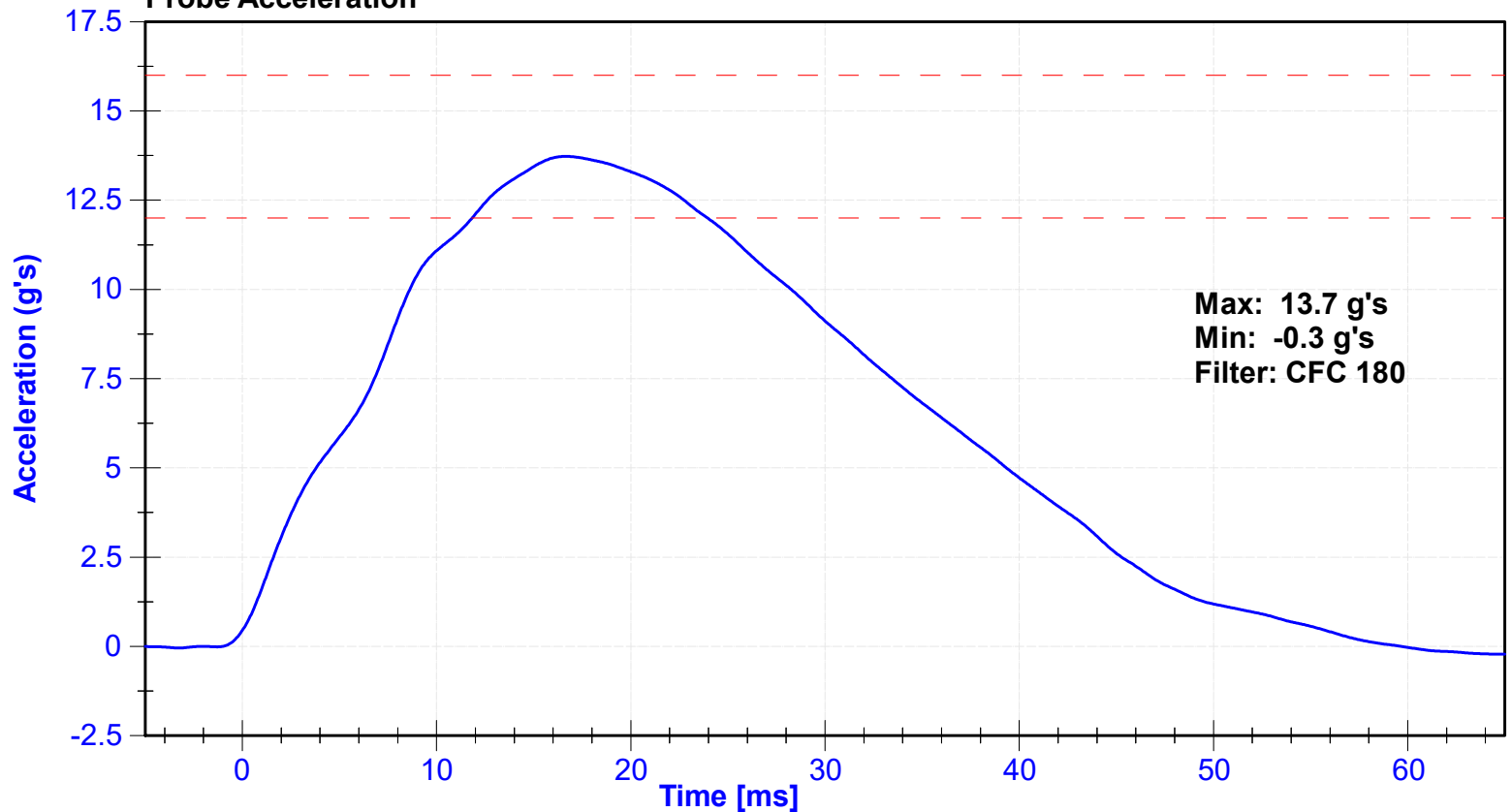
Results

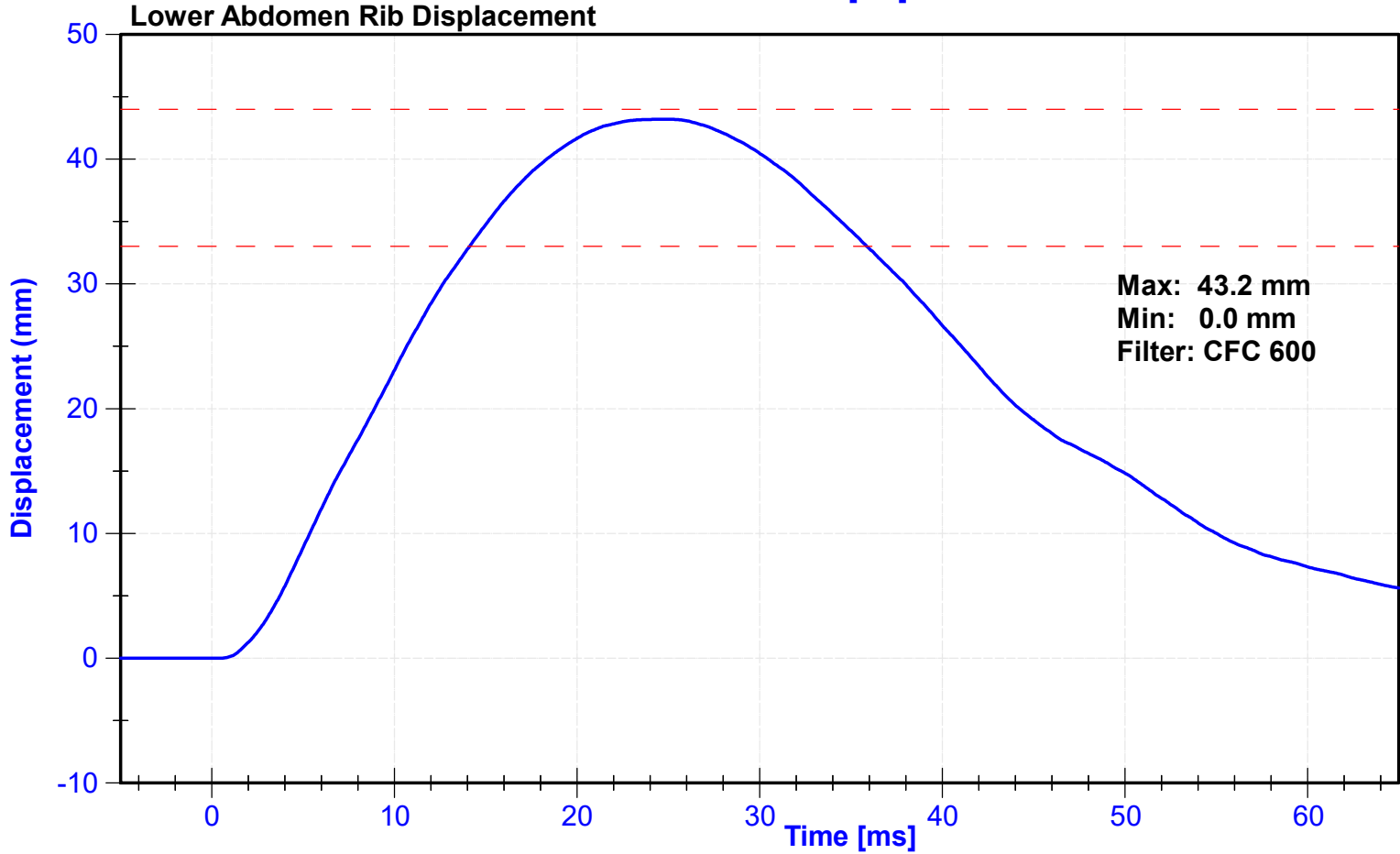
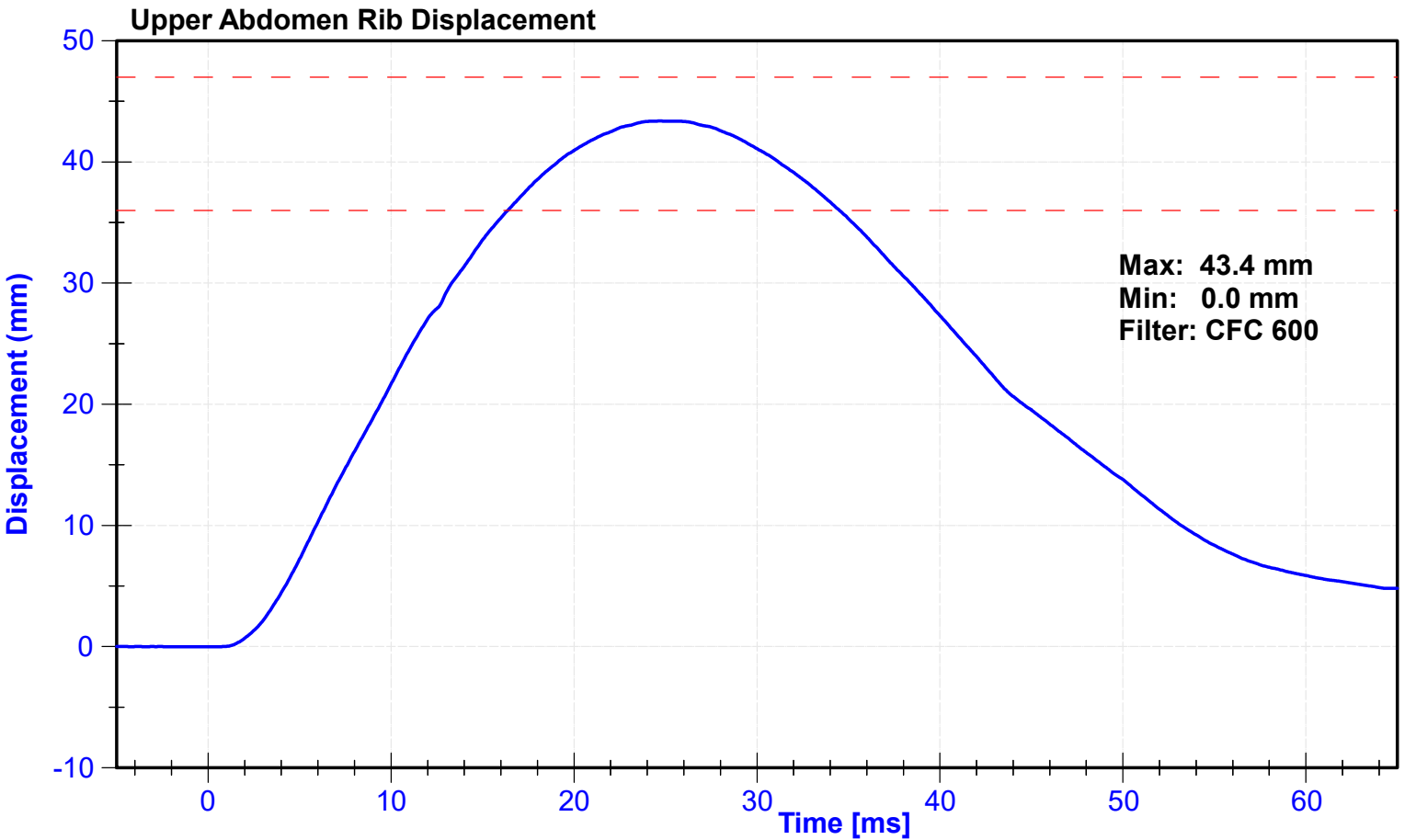
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.5	Pass
Humidity	10	70	%	45.0	Pass
Velocity	4.2	4.4	m/s	4.33	Pass
Probe Acceleration	12	16	g's	13.7	Pass
Lateral Lower Spine Acceleration	9	14	g's	10.1	Pass
Upper Abdomen Rib Deflection	36	47	mm	43.4	Pass
Lower Abdomen Rib Deflection	33	44	mm	43.2	Pass

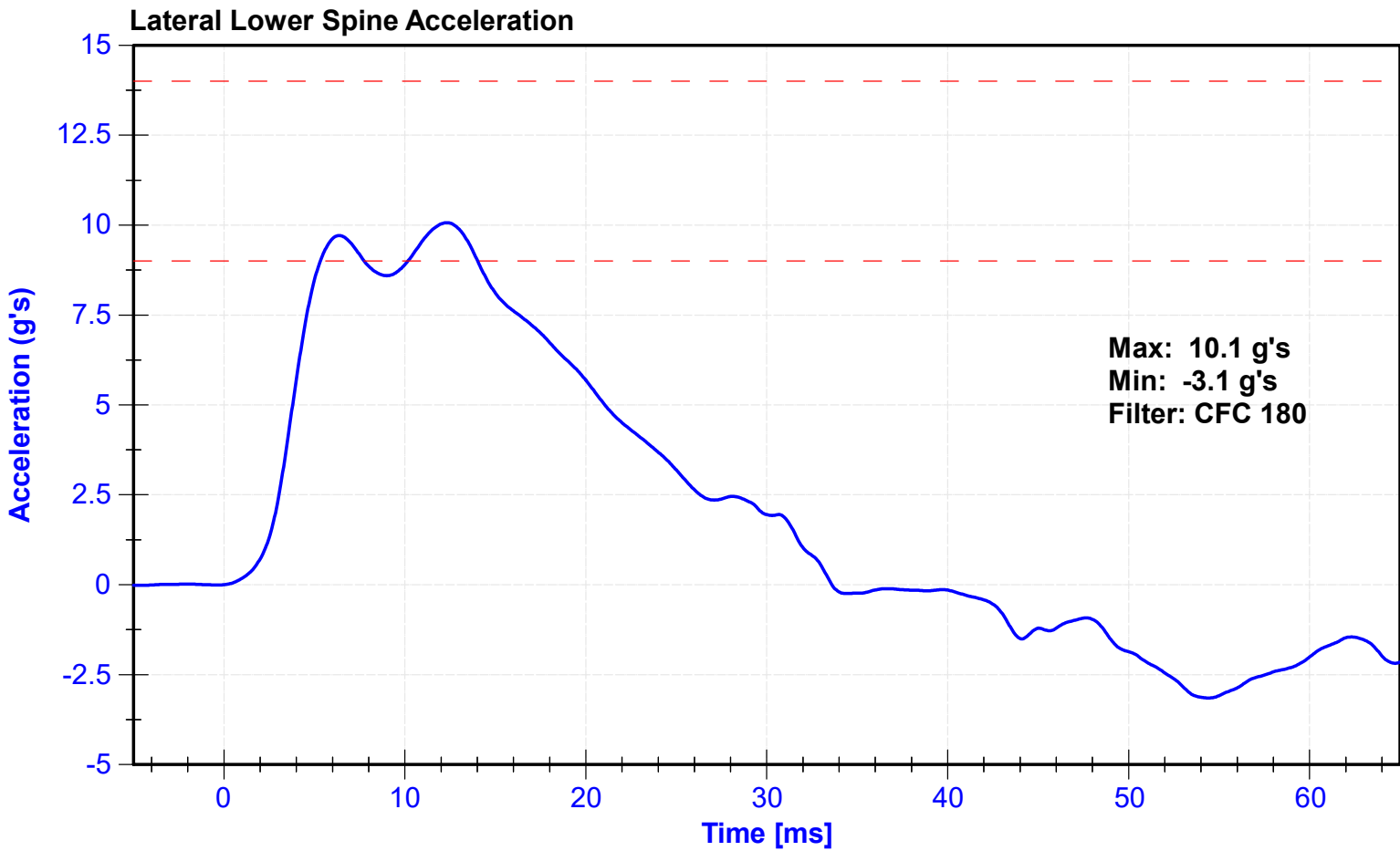
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Probe Accelerometer	Endevco	P51736	10/25/2022	10/25/2023
Lower Spine Y Accelerometer	Endevco	P58744	6/22/2023	12/19/2023
Upper Abdomen Rib Potentiometer	Servo	342GFE	6/22/2023	12/21/2023
Lower Abdomen Rib Potentiometer	Servo	512GFE	6/22/2023	12/21/2023

Probe Acceleration







ATD Manufacturer	FTSS	Test Technician	C. Mantell
ATD Serial Number	261	Laboratory Supervisor	C. Mantell

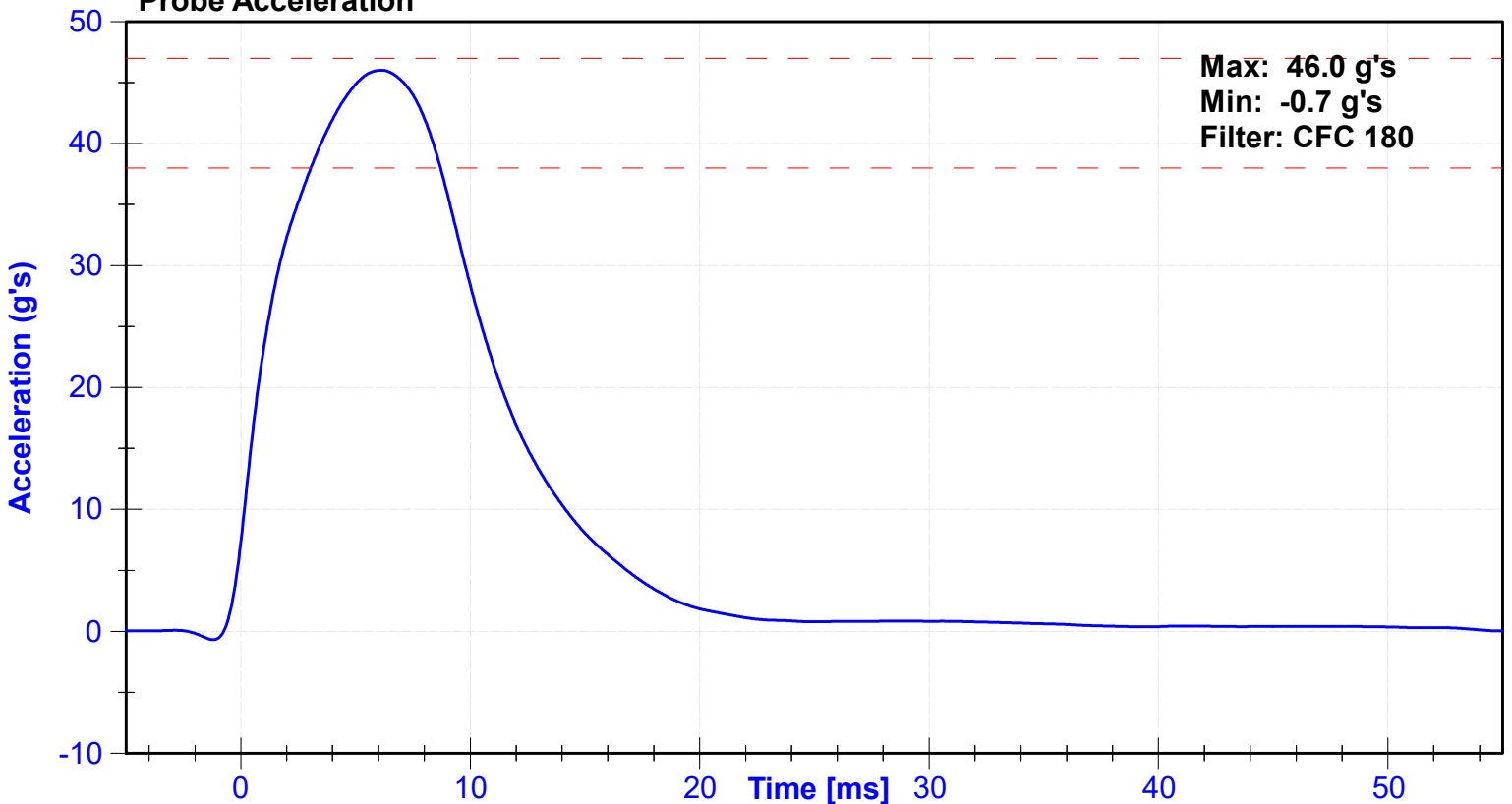
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.5	Pass
Humidity	10	70	%	45.0	Pass
Velocity	6.6	6.8	m/s	6.62	Pass
Probe Acceleration	38	47	g's	46.0	Pass
Lateral Pelvis Acceleration after 6ms	34	42	g's	41.0	Pass
Acetabulum Force	3600	4300	N	3937.9	Pass

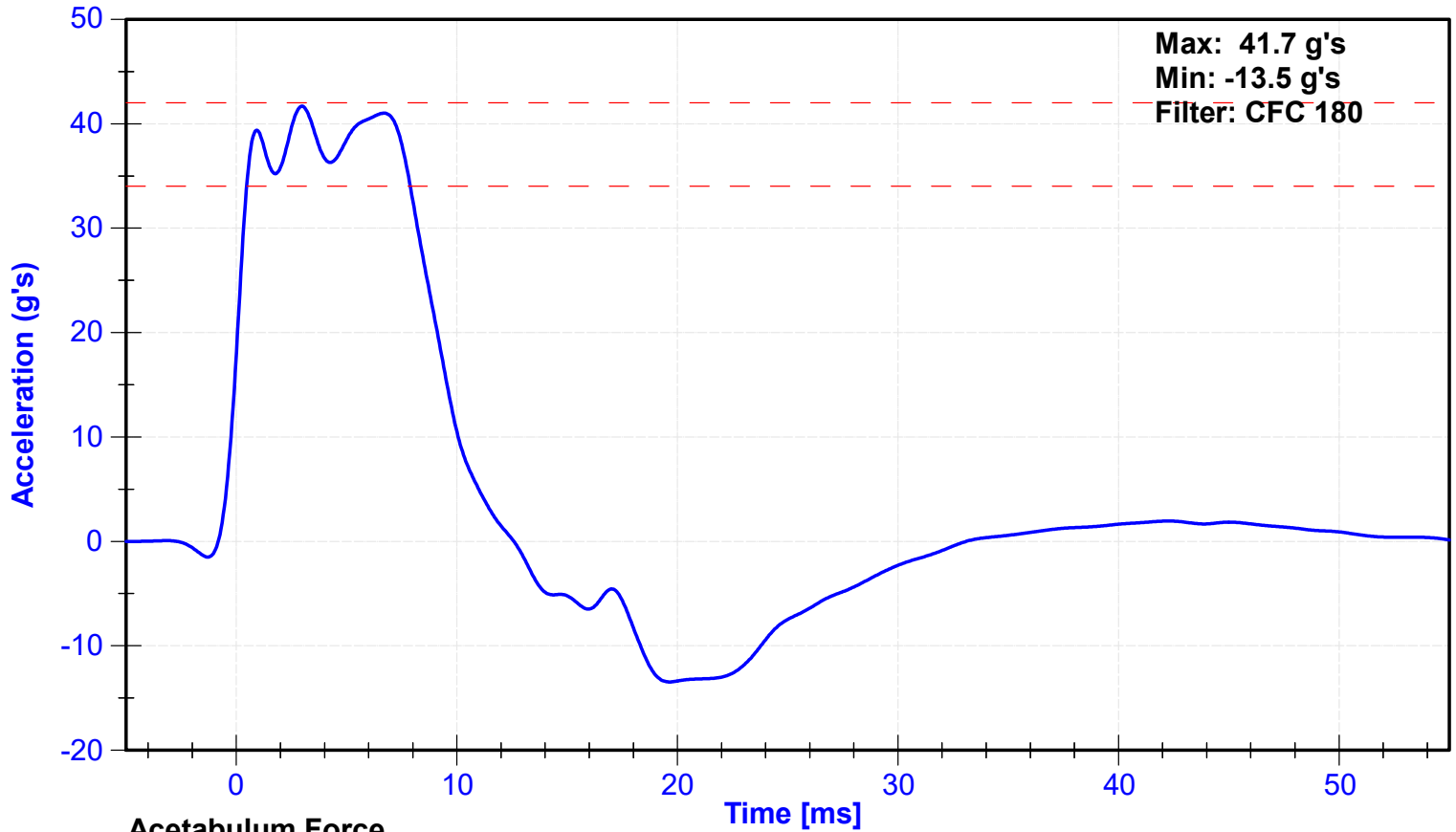
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	P51736	10/25/2022	10/25/2023
Pelvis Y Accelerometer	Endevco	T29392	7/27/2023	1/23/2024
Acetabulum Load Cell	Denton	267-FY	9/11/2023	9/10/2024
Certification Plug	SACO			N/A
Crash Test Plug	SACO			N/A

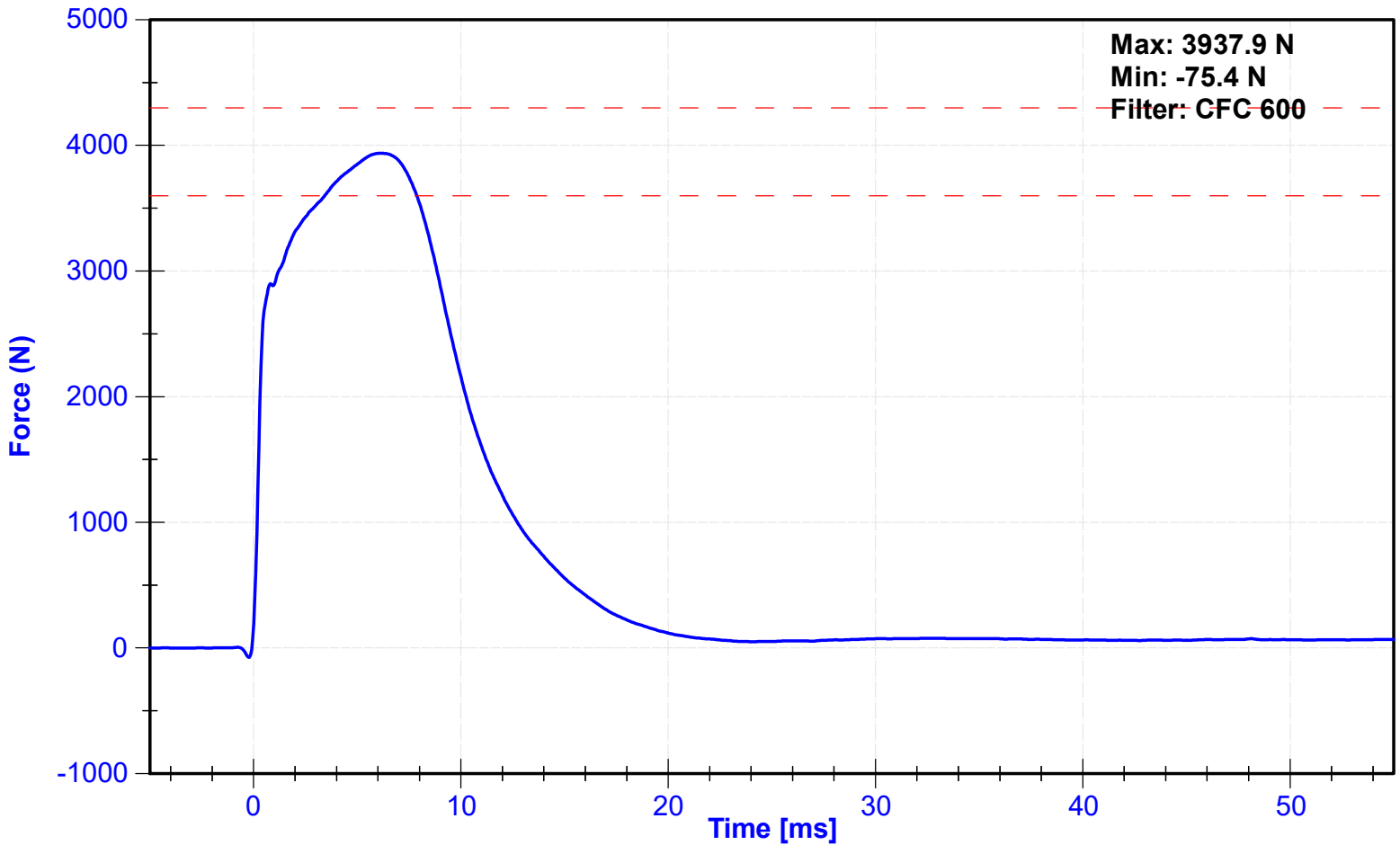
Probe Acceleration



Lateral Pelvis Acceleration



Acetabulum Force





SID-IIs Pelvis Plug Certification Test

Plug S/N 16637

Test Number 23404

Report Number 23461

Test Date 7/20/2022 1:25:22 PM

Test Results	Spec Min	Spec Max
Force @ 0.5 mm (N)	50	600
Force @ 1.5 mm (N)	850	1,400
Force @ 2.5 mm (N)	1,306	1,618
Force @ 3.0 mm (N)	1,361	1,673

Testing Machine STM-20 5965542

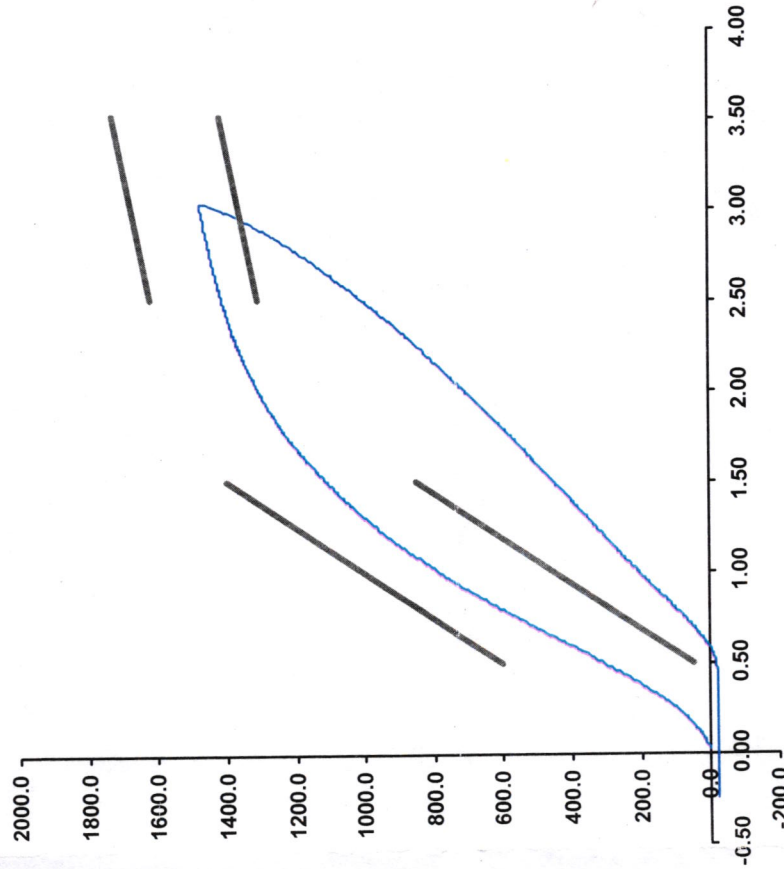
Load Cell S/N (FI360947), Units (LBS) 1000

Crosshead Speed (mm / min) or Rate 12.7

Extension or Position Measured by XHD_100 (XHD100)

Notes:

Force (-N) vs Extension (-mm)



Operator

Part Number 180-4450

Template No 107 20-Jul-22

SACO Research

By : DC Date : 7/20/22

SACO Research 41735 Elm St, #401 Murrieta, CA 92562 Tel 310-694-2082 FAX



CRASH

SID-IIs Pelvis Plug Certification Test

Plug S/N 16538

Test Number 23322

Report Number 23379

Test Date 7/15/2022 8:59:52 AM

Test Results	Spec Min	Spec Max
Force @ 0.5 mm (N)	50	600
Force @ 1.5 mm (N)	850	1,400
Force @ 2.5 mm (N)	1,306	1,618
Force @ 3.0 mm (N)	1,361	1,673

Testing Machine STM-20 5965542

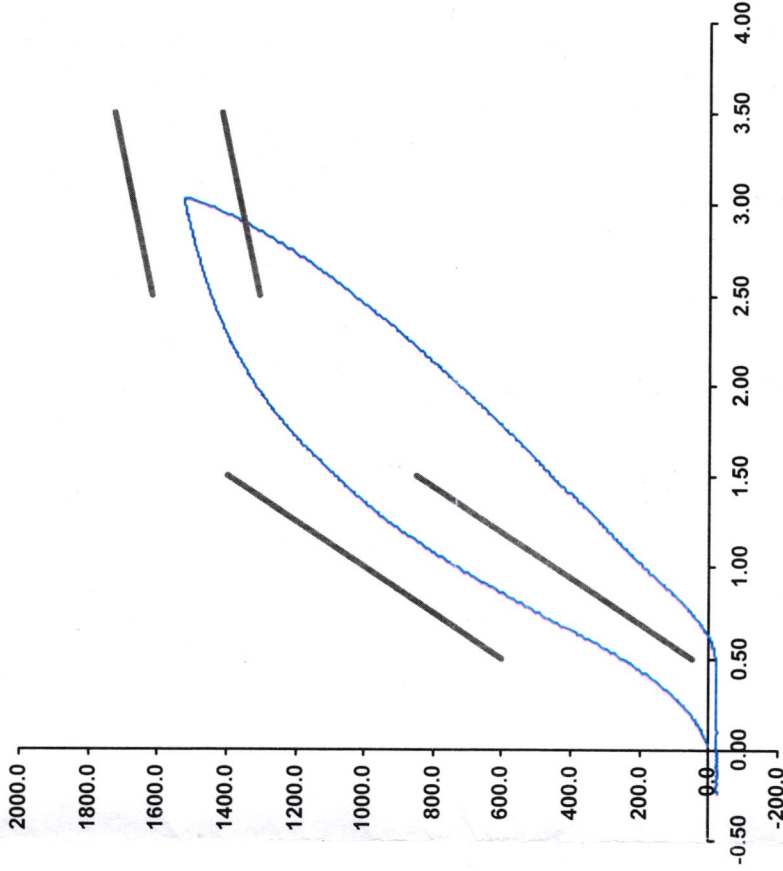
Load Cell S/N (FI360947), Units (LBS) 1000

Crosshead Speed (mm / min) or Rate 12.7

Extension or Position Measured by XHD_100 (XHD100)

Notes:

Force (-N) vs Extension (-mm)



Operator

Part Number 180-4450

Template No 107 15-Jul-22

SACO Research

By: DC Date: 7/15/22

SACO Research 41735 Elm St, #401 Murrieta, CA 92562 Tel 310-694-2082 FAX



SID-IIs Pelvis Plug Certification Test

Plug S/N 16415

Test Number 22984

Report Number 23042

Test Date 5/23/2022 10:18:13 AM

Test Results	Spec Min	Spec Max
Force @ 0.5 mm (N)	50	600
Force @ 1.5 mm (N)	850	1,400
Force @ 2.5 mm (N)	1,306	1,618
Force @ 3.0 mm (N)	1,361	1,673

Testing Machine STM-20 5965542

Load Cell S/N (FI360947), Units (LBS) 1000

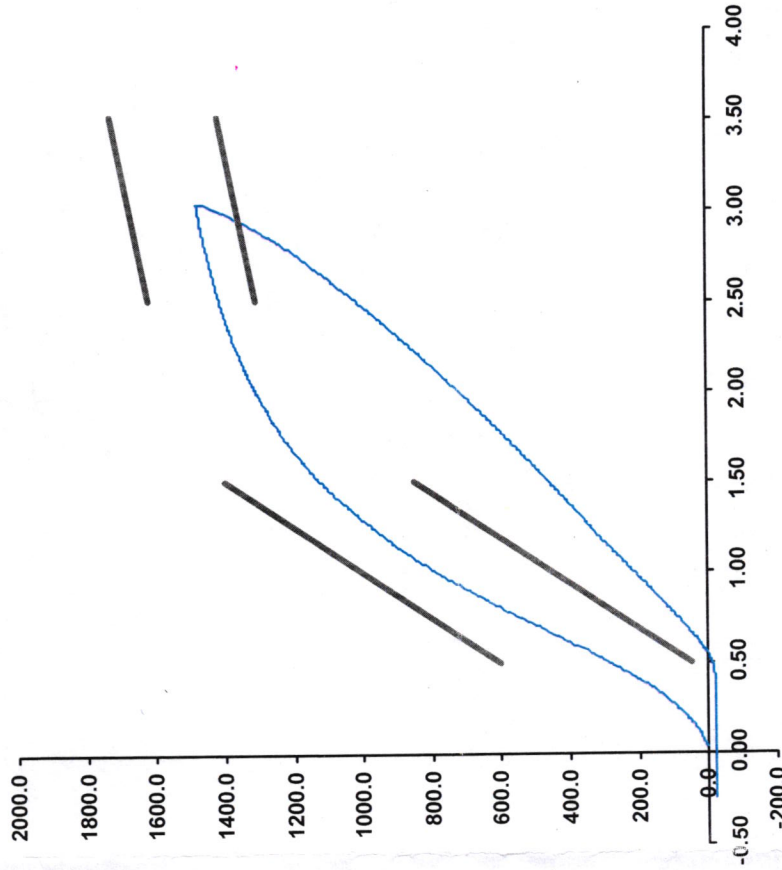
Crosshead Speed (mm / min) or Rate 12.7

Extension or Position Measured by XHD_100 (XHD100)

Notes:

Non-Impact

Force (-N) vs Extension (-mm)



Operator

Part Number 180-4450

Template No 107 23-May-22

SACO Research

By: DC

Date: 5/23/2022

SACO Research 41735 Elm St. #401 Murrieta, CA 92562 Tel 310-694-2082 FAX

ATD Manufacturer	FTSS	Test Technician	C. Mantell
ATD Serial Number	261	Laboratory Supervisor	C. Mantell

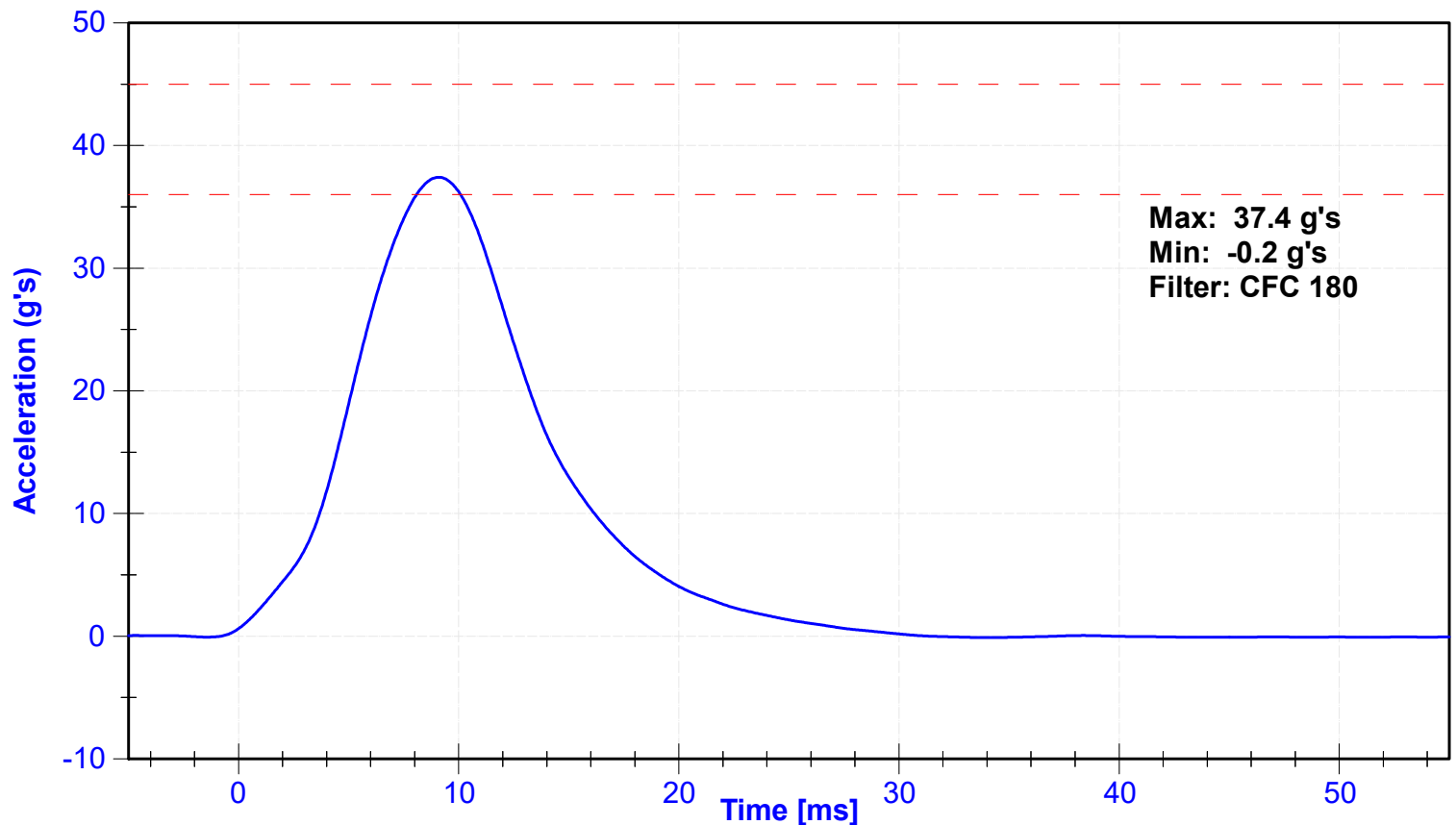
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.5	Pass
Humidity	10	70	%	45.0	Pass
Velocity	4.2	4.4	m/s	4.33	Pass
Probe Acceleration	36	45	g's	37.4	Pass
Lateral Pelvis Acceleration	28	39	g's	33.3	Pass
Iliac Force	4100	5100	N	4894.4	Pass

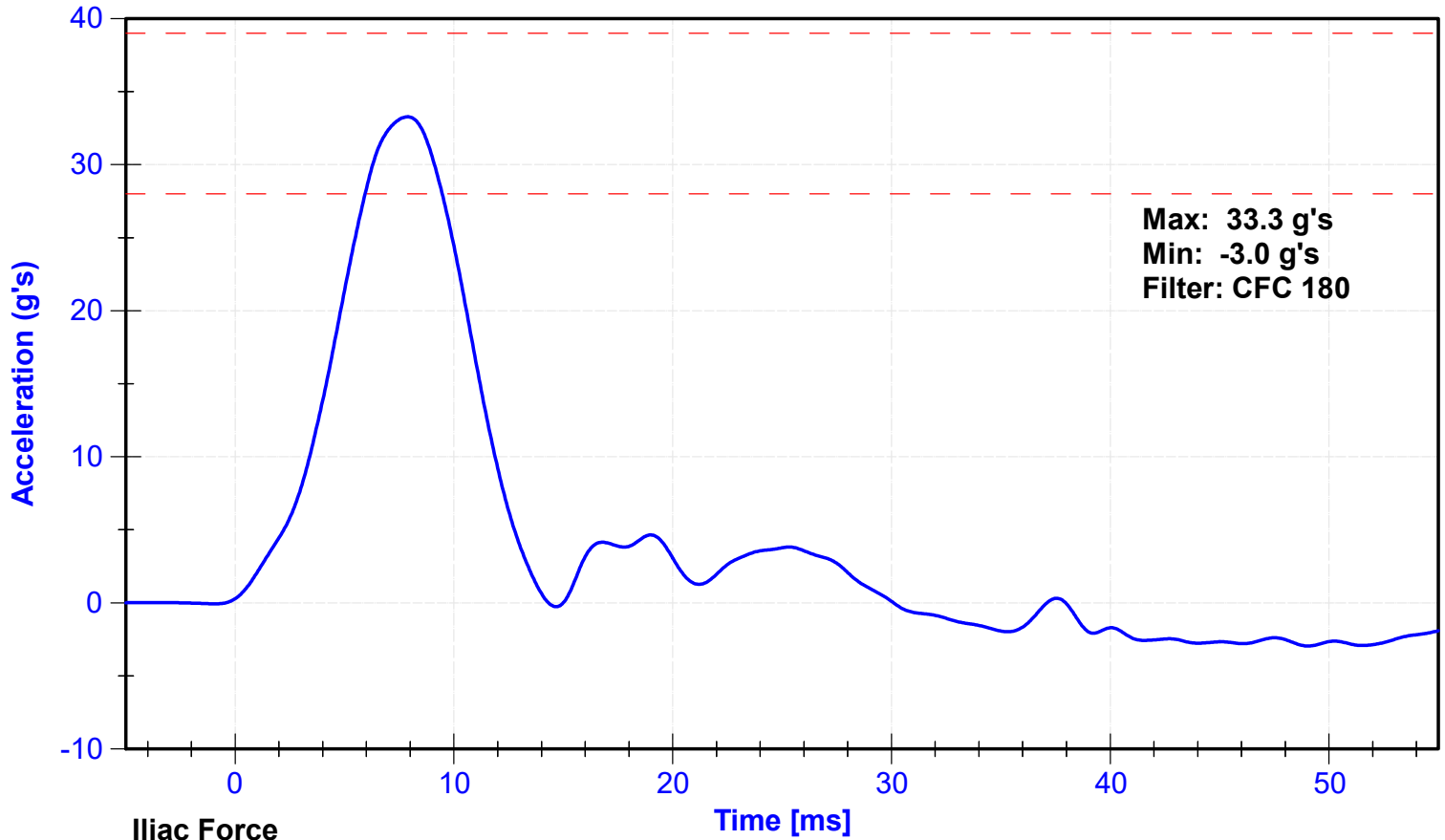
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	P51736	10/25/2022	10/25/2023
Pelvis Y Accelerometer	Endevco	T29392	7/27/2023	1/23/2024
Iliac Load Cell	Denton	321	9/11/2023	9/10/2024

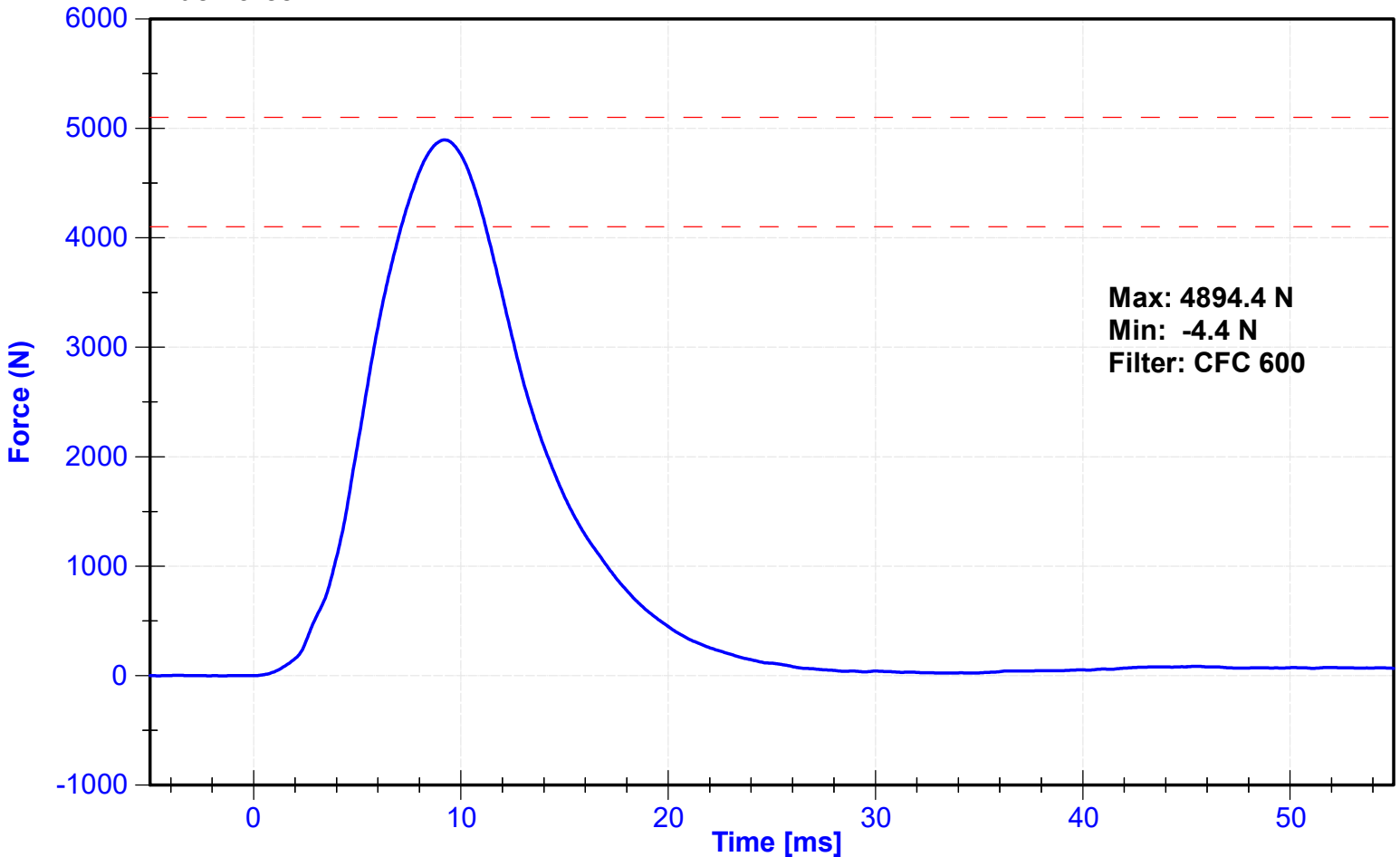
Probe Acceleration



Lateral Pelvis Acceleration



Iliac Force



APPENDIX VII

TEST EQUIPMENT AND INSTRUMENTATION CALIBRATION

TABLE 1 – Dummy Instrumentation (ES-2re)

			ES-2re S/N: D037		
			Serial Number	Manufacturer	Calibration Date
Head Accelerometers	Primary	X	T21724	Endevco	08/08/2023
		Y	T22281	Endevco	08/08/2023
		Z	T26050	Endevco	08/08/2023
	Redundant	X	T21682	Endevco	08/08/2023
		Y	T25989	Endevco	08/08/2023
		Z	T25864	Endevco	08/08/2023
Thorax Rib Displacement Potentiometers	Upper	Y	0552-01	Honeywell	08/07/2023
	Middle	Y	807	Honeywell	08/07/2023
	Lower	Y	0552-03	Honeywell	08/07/2023
Abdomen Load Cells	Forward	Y	1440	Denton	08/08/2023
	Middle	Y	1525	Denton	08/08/2023
	Rear	Y	1528	Denton	08/08/2023
Lower Spine Accelerometers (T12)		X	P71278	Endevco	08/08/2023
		Y	P49226	Endevco	08/30/2023
		Z	P50078	Endevco	08/30/2023
Pubic Symphysis Load Cell		Y	456-FY	Denton	08/08/2023

TABLE 2 – Dummy Instrumentation (SID-IIs)

				SID-IIs S/N: 261		
				Serial Number	Manufacturer	Calibration Date
Head Accelerometers		Primary	X	P68067	Endevco	06/22/2023
			Y	P18567	Endevco	06/22/2023
			Z	P49163	Endevco	06/22/2023
		Redundant	X	T26041	Endevco	06/22/2023
			Y	T22409	Endevco	06/22/2023
			Z	T26086	Endevco	06/22/2023
Displacement Potentiometers	Thoracic Rib	Upper	Y	062GFE	Servo	06/22/2023
		Middle	Y	528GFE	Servo	06/22/2023
		Lower	Y	513GFE	Servo	06/22/2023
	Abdominal Rib	Upper	Y	342GFE	Servo	06/22/2023
		Lower	Y	512GFE	Servo	06/22/2023
Lower Spine Accelerometers (T12)			X	T22340	Endevco	06/22/2023
			Y	P58744	Endevco	06/22/2023
			Z	T22124	Endevco	06/22/2023
Acetabulum Load Cell			Y	267-FY	Denton	09/11/2023
Iliac Wing Load Cell			Y	321	Denton	09/11/2023
Pelvis Plug (struck side)				13799	SACO	06/28/2023
Pelvis Plug (non-struck side)				14194	SACO	06/28/2023

TABLE 3 – Vehicle Instrumentation

Vehicle Instrumentation			Serial Number	Manufacturer	Calibration Date
1	Vehicle Center of Gravity	X	A400017	Measurement Specialties	08/02/2023
	Vehicle Center of Gravity	Y	A400767	Measurement Specialties	08/02/2023
	Vehicle Center of Gravity	Z	A405576	Measurement Specialties	08/02/2023
2	Right Sill at Front Seat	X	G22778	Endevco	08/04/2023
	Right Sill at Front Seat	Y	G22809	Endevco	08/17/2023
	Right Sill at Front Seat	Z	A335442	Measurement Specialties	08/04/2023
3	Right Sill at Rear Seat	X	G22717	Endevco	08/15/2023
	Right Sill at Rear Seat	Y	G22737	Endevco	08/15/2023
	Right Sill at Rear Seat	Z	G22738	Endevco	08/15/2023
4	Left Sill at Front Door	Y	A336636	Measurement Specialties	07/26/2023
5	Left Sill at Rear Door	Y	G22227	Endevco	08/02/2023
6	Left A-Post Lower	Y	G22391	Endevco	06/28/2023
7	Left A-Post Middle	Y	A373203	Measurement Specialties	06/01/2023
8	Left B-Post Lower	Y	A290929	Measurement Specialties	08/09/2023
9	Left B-Post Middle	Y	G22626	Endevco	08/09/2023
10	Front Seat Track	Y	G21395	Endevco	07/26/2023
11	Rear Seat Track or Structure	Y	G22195	Endevco	08/18/2023
12	Right Rear Occ. Compartment	Y	A315934	Measurement Specialties	08/18/2023
13	Engine Block	X	G22639	Endevco	07/05/2023
	Engine Block	Y	G22918	Endevco	07/05/2023
14	Rear Floorpan Above Axle	X	A431377	Measurement Specialties	05/22/2023
	Rear Floorpan Above Axle	Y	A431383	Measurement Specialties	05/22/2023
	Rear Floorpan Above Axle	Z	A398658	Measurement Specialties	08/18/2023

TABLE 4 – MDB Instrumentation

MDB Instrumentation		Serial Number	Manufacturer	Calibration Date
Vehicle CG Acceleration vs. Time	X	A352316	Measurement Specialties	05/10/2023
Vehicle CG Acceleration vs. Time	Y	A400754	Measurement Specialties	05/10/2023
Vehicle CG Velocity vs. Time	Y	Calculated	Measurement Specialties	05/10/2023
Vehicle CG Acceleration vs. Time	Z	A405578	Measurement Specialties	05/10/2023
Vehicle CG Velocity vs. Time	Z	Calculated	Measurement Specialties	05/10/2023
Vehicle CG Resultant Acceleration vs. Time	R	Calculated	Measurement Specialties	05/10/2023