REPORT NUMBER: 214P-CAL-23-006

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

Bayerische Motoren Werke AG
2023 BMW X1 xDrive28i
5 Door SUV

NHTSA No: C20234101

PREPARED BY:
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June 8, 2023

FINAL REPORT

PREPARED FOR:
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NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
ENFORCEMENT
OFFICE OF VEHICLE SAFETY COMPLIANCE
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Prepared by: _____ Date: June 8, 2023
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FINAL REPORT ACCEPTANCE BY OVSC:

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Date: 2023.06.20 11:23:54 -04'00'
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Date: _____

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7. Author(s) Quinn Porzio, Test Engineer Matthew Pronko, Senior Test Engineer	***8. Performing Organization Report No.*** CAL-DOT-2023-006
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15. Supplementary Notes

16. Abstract

A 31.00 km/h (19.3 mph), 285° oblique compliance test was conducted on the subject 2023 BMW X1 xDrive28i 5 Door SUV in accordance with the specifications of the Office of Vehicle Safety Compliance TP-214P-01 for the determination of FMVSS No.214 Side Impact Protection compliance. This test was conducted at Calspan Corporation's Transportation Test Operations facility in Buffalo, New York on May 30, 2023.

The impact velocity of the vehicle was 30.97 km/h, and the ambient temperature at the struck (passenger's) side of the target vehicle was 21°C. The target vehicle's maximum post-test static crush was 327 mm located at level 3. The test vehicle's occupant performance data is as follows:

Measurement Description	Front Passenger ATD (ES-2re)		
	Units	IARV	Result
Head Injury Criteria (HIC36)		1000	338.760
Maximum Thoracic Rib Deflection	mm	44	30.319
Total Abdominal Force	N	2500	950.543
Pubic Symphysis Force	N	6000	2034.827

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 hte side impact event.

17. Key Words	***18. Distribution Statement***
Compliance Testing Side Impact Protection Pole Test ES-2re SID-IIs	Copies of this report are available from: National Highway Traffic Safety Administration Technical Information Services (TIS) Room E12-100 East Bldg. 1200 New Jersey Ave. Washington, D.C. 20590 Telephone No. (202) 366-2588

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Form DOT F1700.7 (8-72)

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SECTION 1

PURPOSE AND SUMMARY OF TEST

PURPOSE

This side impact test was conducted as part of the FY 2023 FMVSS 214 Side Impact Protection Compliance Test Program, sponsored by the National Highway Traffic Safety Administration (NHTSA), under Contract No. DTNH22-17-D-00078. The purpose of this test was to evaluate side impact protection in a 2023 BMW X1 xDrive28i 5 Door SUV. The side impact test was conducted in accordance with the Office of Vehicle Safety Compliance's Laboratory Test Procedure, TP-214P-01 dated September 2012.

SUMMARY

A rigid pole side impact test was conducted on a 2023 BMW X1 xDrive28i 5 Door SUV. The subject vehicle was towed into the rigid pole at an angle of 285° and a velocity of 30.97 km/h. The test was conducted by Calspan Corporation's Transportation Test Operations facility in Buffalo, New York on May 30, 2023. Pre-test and post-test photographs of the test vehicle and side impact dummy (ES2re) are included in Appendix I of this report.

One Part 572U (ES2re) dummy was placed in the front passenger designated seating position according to instructions specified in the TP-214P-01 Test Procedure, dated September 2012. The side impact event was documented by nine High Speed Cameras and one real time camera.

The ES2re male dummy was instrumented accordingly:

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

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

Injury readings for the ES2re dummy were recorded as follows:

INJURY READINGS

Measurement Description	Front Passenger ATD (ES2re)		
	Units	IARV	Result
Head Injury Criteria (HIC36)		1000	338.760
Upper Rib Deflection	mm	44	30.319
Mid Rib Deflection	mm	44	25.653
Lower Rib Deflection	mm	44	26.573
Abdominal Load (front)	N		344.504
Abdominal Load (mid)	N		256.579
Abdominal Load (rear)	N		377.256
Total Abdominal Force	N	2500	950.543
Pubic Symphysis Force	N	6000	2034.827

SECTION 2

OCCUPANT AND VEHICLE INFORMATION

This section contains information reporting for the following Data Sheets:

DATA SHEET NO. 1
TEST VEHICLE INFORMATION AND OPTIONS

Test Vehicle:	2023 BMW X1 xDrive28i 5 Door SUV	NHTSA No.:	C20234101
Test Facility:	Calspan	Test Date:	05/30/2023

TEST VEHICLE INFORMATION AND OPTIONS

Make	BMW
Model	X1 xDrive28i
Body Style	5 Door SUV
VIN	WBX73EF04P5W51965
Body Color	Green
Engine Displacement (L)	2.0
Type / No. Cylinders	I4
Engine Placement	Transverse
Transmission Type	Automatic
Transmission Speeds	7-speed
Overdrive	Yes
Final Drive	AWD
Odometer Reading (mi)	16 mi

Anti-Lock Brakes (ABS)	Yes
All-Wheel Drive (AWD)	Yes
Traction Control System (TCS)	Yes
Electric Stability Control (ECS)	Yes
Curtain Airbags	Yes
Pelvis/Torso Airbags – Front Seats	Yes
Pelvis/Torso Airbags – Rear Seats	Yes
Combination/Head Torso Bag	No
Pelvic Airbag – Front Seats	No
Pelvis Airbag – Rear Seats	No
Knee Airbag – Driver	Yes
Knee Airbag – Front Passenger	Yes
Seat Belt Pretensioners – Front Seats	Yes
Seat Belt Pretensioners – Rear Seats	Yes
Seat Belt Load Limiter – Front Seats	Yes
Seat Belt Load Limiter – Rear Seats	Yes
Tire Pressure Monitoring System (TPMS)	Yes
Tilt Steering Wheel	Yes
Automatic Door Locks (ADL)	Yes
Power Window Auto-reverse	Yes
Power Seats	Yes
Other Safety Restraint	N/A

DATA FROM CERTIFICATION LABEL

Manufactured By	Bayerische Motoren Werke AG
Date of Manufacture	02/23
Vehicle Type	MPV

GVWR (kg)	2200
GVWR Front (kg)	1155
GVWR Rear (kg)	1145

VEHICLE SEATING AND WEIGHT CAPACITY DATA

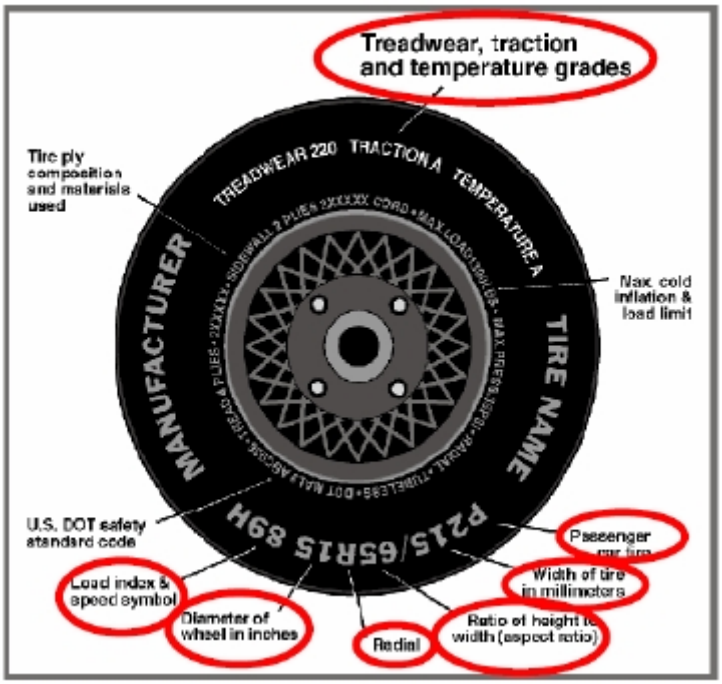
Measured Parameter	Front	Rear	Third	Total
Type of Seats (Bench or Bucket)	Bucket	Split Bench	N/A	
Designated Seating Capacity (DSC)	2	3	N/A	5
Capacity Weight (VCW) (kg)				451
Cargo Weight (RCLW) (kg)				110.8

DATA SHEET NO. 2
VEHICLE TIRE INFORMATION

Test Vehicle:	2023 BMW X1 xDrive28i 5 Door SUV	NHTSA No.:	C20234101
Test Facility:	Calspan	Test Date:	05/30/2023

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)	240	220
Recommended Tire Size	225/55R18	225/55R18
Tire Sidewall	**Front**	**Rear**
Maximum Tire Pressure (kPa)	340	340
Tire Size on Vehicle	225/55R18	225/55R18
Tire Manufacturer Model	Hankook	Hankook
Tire Name	Ventus S1	Ventus S1
Tire Type	All Season	All Season
Tire Width	225	225
Aspect Ratio	55	55
Radial	Yes	Yes
Wheel Diameter	18	18
Load Index / Speed Symbol	N/A	N/A
Treadwear	620	620
Traction Grade	A	A
Temperature Grades	BB	BB

DATA SHEET NO. 3
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2023 BMW X1 xDrive28i 5 Door SUV NHTSA No.: C20234101
Test Facility: Calspan Test Date: 05/30/2023

TIRE PRESSURES

	Units	LF	RF	LR	RR
As Delivered	kPa	255	235	232	236
Tire Placard	kPa	240	240	220	220

TEST VEHICLE AXLE WEIGHTS

	Units	As Delivered (UVW)			Fully Loaded			As Tested		
		Front	Rear	Total	Front	Rear	Total	Front	Rear	Total
Left	kg	490.5	355.0		511.0	413.0		493.5	437.5	
Right	kg	471.5	376.0		488.0	474.0		495.5	451.5	
Ratio	%	56.8	43.2		53.0	47.0		52.7	47.3	
Totals	kg	962.0	731.0	1693.0	999.0	887.0	1886.0	989.0	889.0	1878.0

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value	
Total As Delivered Weight (UVW)	kg	1693.0	(A)
Weight of Test Dummy	kg	81.0	(B)
Rated Cargo / Luggage Weight (RCLW)	kg	110.8	(C)
Calculated Vehicle Target Weight (TVTW)	kg	1884.8	(A+B+C)

TEST VEHICLE ATTITUDES AND CG

Measurement Description	Units	As Delivered	Fully Loaded	As Tested
Driver Door Sill Angle	Deg	+0.50	+1.00	+0.55
Front Passenger Sill Angle	Deg	+1.00	+0.80	+0.80
Front Bumper-Line Angle	Deg	-0.10	+0.25	0.00
Rear Bumper-Line Angle	Deg	-0.10	-0.10	-0.10

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

CALCULATION OF VERTICAL IMPACT REFFERENCE LINE

Measured Parameter	Units	Value
Test Vehicle Wheelbase	mm	2687
Vertical Impact Reference Line Aft of Front Axle	mm	1330

WEIGHT OF BALLAST AND VEHICLE COMPONENTS REMOVED TO MEET TVTW

Component Description	Weight (kg)
Trunk Carpeting	10.5
Spare Tire	13.0
Jack	3.5
Privacy Cover Trim	1
Front Bumper Fascia	10.5
Ballast (if any)	83.5

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

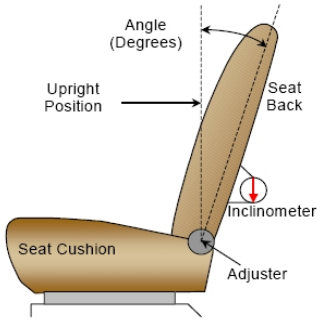
Test Vehicle:	2023 BMW X1 xDrive28i 5 Door SUV	NHTSA No.:	C20234101
Test Facility:	Calspan	Test Date:	05/30/2023

SEAT BACK ANGLE ADJUSTMENT

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

	Units	Seat Back Angle
Driver Seat	deg	18.1
Front Passenger Seat	deg	18.2

**Measurement taken on seatback*



FRONT SEAT ASSEMBLY

SEAT HEIGHT AND ANGLE

Seat	As Tested SCRL Angle (Mid) (º)	SCRP Height Position	SCRP Height (mm)		
			Rearmost	Mid-Fore / Aft	Forward-Most
Driver Seat	16.8	Max	50	54	62
		Mid	28	34	42
		Min	6	13	22
Front Passenger Seat	16.0	Max	51	60	68
		Mid	29	38	46
		Min	7	15	23

SEAT FORE / AFT POSITION

Seat	Total Fore / Aft Travel		Placed in Position #	
	mm	Detents	mm	Detents
Driver Seat	240	Power	120	Power
Front Passenger Seat	249	Power	125	Power

SEAT BELT ANCHORAGE ADJUSTMENT

Seat	Total # of Positions	Placed in Position #
Front Passenger Seat	Fixed	Fixed

HEAD RESTRAINT ADJUSTMENT

Seat	Total # of Positions	Placed in Position #
Front Passenger Seat	5 (0-4)	Uppermost

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

Test Vehicle:	2023 BMW X1 xDrive28i 5 Door SUV	NHTSA No.:	C20234101
Test Facility:	Calspan	Test Date:	05/30/2023

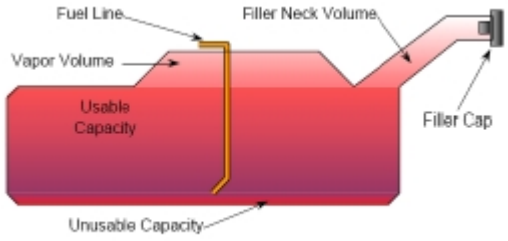
FUEL TANK CAPACITY

Description	Liters
Usable Capacity of (Form No.1)	54.0
Usable Capacity of (Owner's Manual)	54.0
92 - 94% of Usable Capacity	49.7 - 50.8
Actual Amount of Solvent Used in Test	49.9

FUEL PUMP

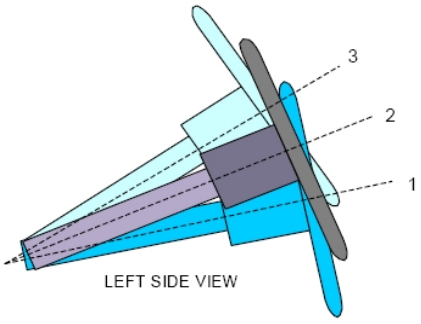
Describe the operation of the fuel pump.

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



VEHICLE FUEL TANK ASSEMBLY

STEERING COLUMN POSITIONS

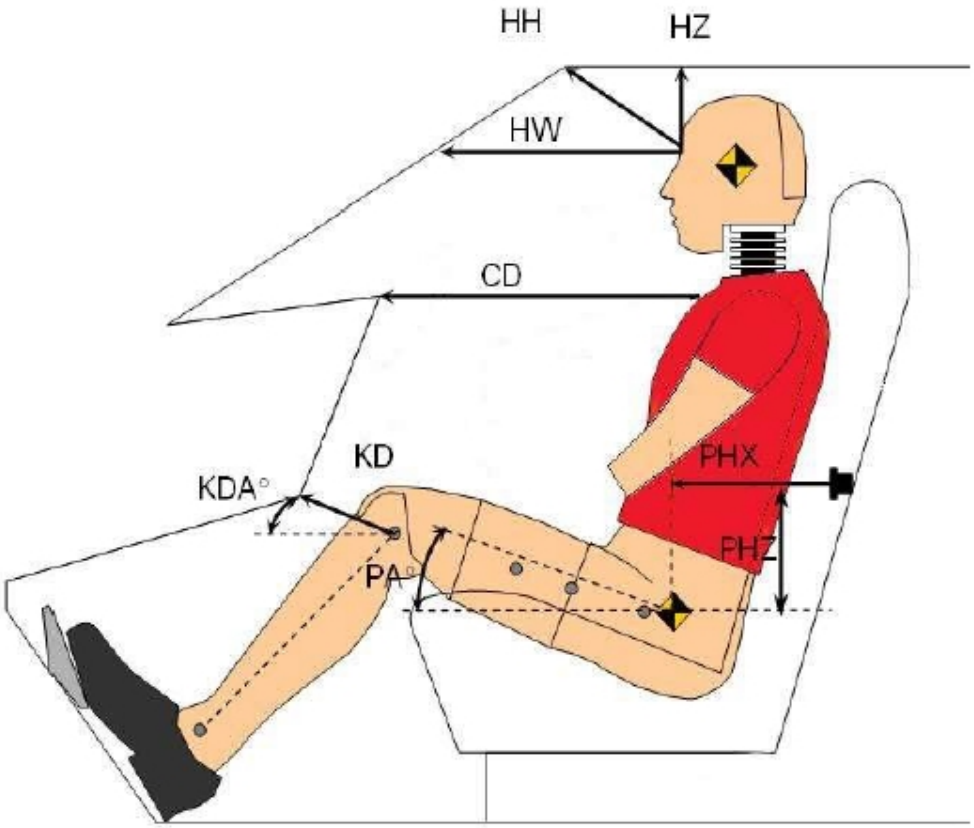


STEERING COLUMN ASSEMBLY

	Degrees	Fore / Aft Position (mm)
Lowermost - Position No. 1	23.2	
Geometric center - Position No. 2	25.5	
Uppermost - Position No. 3	27.8	
Telescoping Steering Wheel Travel		60
Test Position		30

DATA SHEET NO. 6
DUMMY LONGITUDINAL CLEARANCE DIMENSIONS

Test Vehicle:	2023 BMW X1 xDrive28i 5 Door SUV	NHTSA No.:	C20234101
Test Facility:	Calspan	Test Date:	05/30/2023

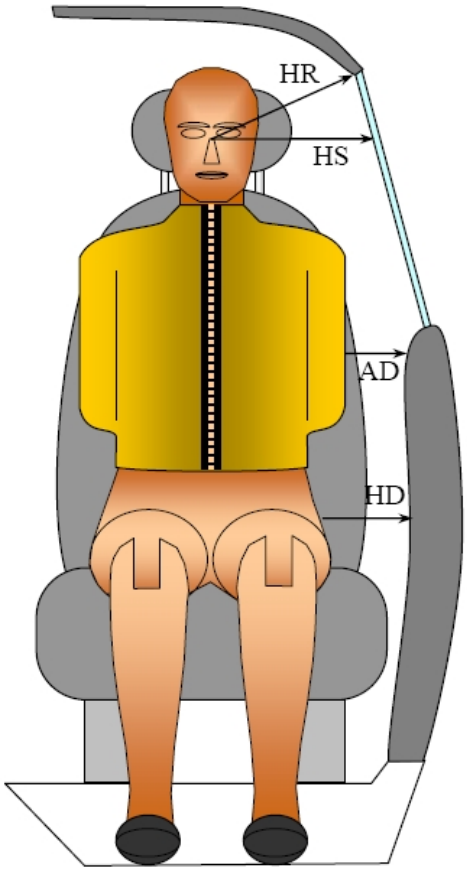


DUMMY LONGITUDINAL CLEARANCE DIMENSION INFORMATION

Driver Code	Description	Front Passenger	
		Length (mm)	Angle (°)
HH	Head to Header	409	
HW	Head to Windshield	658	
HZ	Head to Roof Liner	228	
NR	Nose to Dash	638	
CD	Chest to Dash	557	
KD(L) / KDA(L)◦	Left Knee to Dash	231	29.2
KD(R) / KDA(R)◦	Right Knee to Dash	226	32.5
PAX◦	Pelvic Tilt Angle (Y-Axis)		24.1
PAY◦	Pelvic Tilt Angle (Y-Axis)		1.1
PHX	Hip Point to Striker (X-Axis)	122	
PHZ	Hip Point to Striker (Z-Axis)	177	

DATA SHEET NO. 7
DUMMY LATERAL CLEARANCE DIMENSIONS

Test Vehicle:	2023 BMW X1 xDrive28i 5 Door SUV	NHTSA No.:	C20234101
Test Facility:	Calspan	Test Date:	05/30/2023



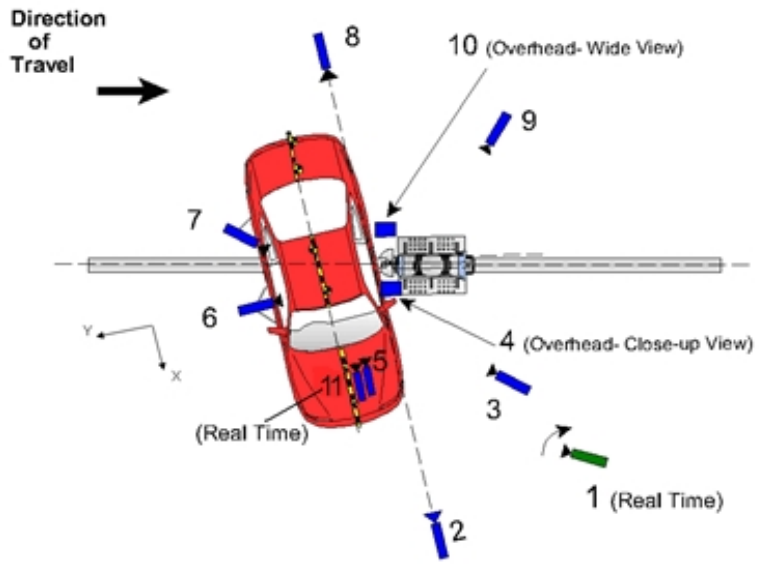
FRONT VIEW OF DUMMY

DUMMY LATERAL CLEARANCE DIMENSION INFORMATION

Code	Measurement Description	Units	Front Passenger
HR	Head to Side Header	mm	230
HS	Head to Side Window	mm	365
AD	Arm to Door	mm	100
HD	H-Point to Door	mm	148

DATA SHEET NO. 8
LOCATION OF CAMERAS

Test Vehicle:	2023 BMW X1 xDrive28i 5 Door SUV	NHTSA No.:	C20234101
Test Facility:	Calspan	Test Date:	05/30/2023



CAMERA LOCATIONS AND DATA

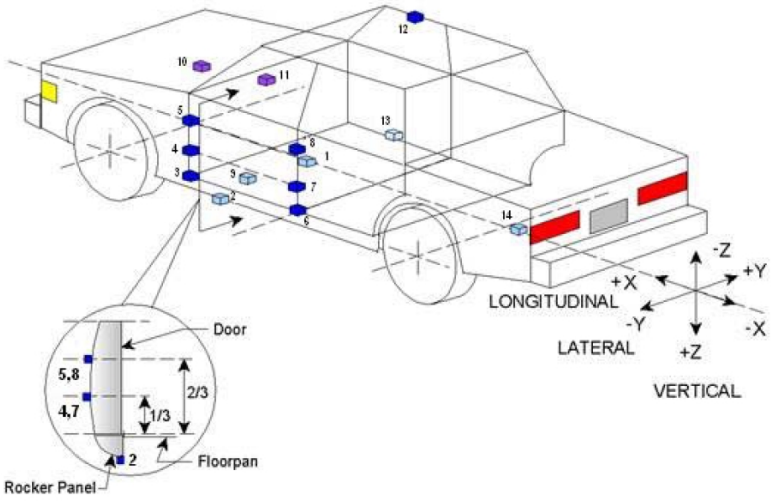
CAMERA LOCATIONS AND DATA

No.	Camera View	Coordinates (mm)			Lens Length (mm)	Operating Frame Rate (fps)
		X	Y	Z		
1	Real-time (24 - 30 fps) pan view of impact				Zoom	60
2	Front ground level - impact view	6954	0	-1545	28	1000
3	Impact side 45º - forward pole view	5653	-1377	-1562	24	1000
4	Overhead Close-up view of impact	0	0	-9375	28	1000
5	Onboard - dummy front view				25	1000
6	Onboard - dummy side view				12.5	1000
7	Onboard - dummy rear oblique view				12.5	1000
8	Rear ground level - impact view	-7528	0	-1453	28	1000
9	Impact side 45º - rearward pole view	-4725	-3375	-1592	24	1000
10	Overhead wide - view of impact	0	0	-9375	12.5	1000

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

DATA SHEET NO. 9
TEST VEHICLE ACCELEROMETER LOCATIONS

Test Vehicle:	2023 BMW X1 xDrive28i 5 Door SUV	NHTSA No.:	C20234101
Test Facility:	Calspan	Test Date:	05/30/2023



TEST VEHICLE ACCELEROMETER LOCATIONS

No.	Accelerometer Location	Coordinates (mm)		
		X	Y	Z
1	Vehicle CG	2314	4	-21
2	Left Floor Sill	2589	662	111
3	A-Pillar Sill	3101	561	126
4	A-Pillar Low	3186	560	-86
5	A-Pillar Mid	2984	630	-554
6	B-Pillar Sill	2126	667	66
7	B-Pillar Low	2066	665	-266
8	B-Pillar Mid	2006	650	-553
9	Seat	2352	548	93
10	Engine	3785	115	-348
11	Firewall	3434	137	-303
12	Roof	1878	-576	-1078
13	Right Floor Sill	2569	-662	110
14	Rear Deck	1032	-50	-73

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

DATA SHEET NO. 10
TEST VEHICLE ACCELEROMETER DATA SUMMARY

Test Vehicle: 2023 BMW X1 xDrive28i 5 Door SUV NHTSA No.: C20234101
Test Facility: Calspan Test Date: 05/30/2023

Loc. No	Description	Axes	Units	Positive Direction		Negative Direction	
				Max	Time (ms)	Max	Time (ms)
1	Vehicle CG	X	g	9.48	39.25	-14.86	44.80
	Vehicle CG	Y	g	9.35	42.80	-46.76	32.85
	Vehicle CG	Z	g	32.99	25.25	-29.04	47.40
	Vehicle CG Resultant	N/A	g	48.31	32.55	0.02	-15.20
2	Floor Sill (Left)	Y	g	1.10	176.30	-19.06	42.95
3	A Pillar Sill	Y	g	18.69	39.35	-32.34	50.95
4	A Pillar Low	Y	g	29.79	65.25	-63.74	74.10
5	A Pillar Mid	Y	g	17.44	18.80	-37.21	15.30
6	B Pillar Sill	Y	g	66.67	14.55	-188.86	17.60
7	B Pillar Low	Y	g	170.29	9.30	-235.03	13.40
8	B Pillar Mid	Y	g	92.83	13.40	-104.23	19.85
9	Seat	Y	g	6.80	35.40	-46.68	19.35
10	Engine Top	X	g	4.16	79.85	-18.70	34.75
	Engine Top	Y	g	5.72	38.85	-23.55	53.85
11	Firewall	Y	g	1.13	156.50	-16.55	43.60
12	Roof	Y	g	17.57	54.25	-41.62	40.10
13	Floor Sill (Right)	Y	g	21.95	9.55	-51.35	17.30
14	Rear Deck	X	g	4.09	84.65	-8.60	55.90
	Rear Deck	Y	g	1.55	164.80	-17.96	49.00

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

Test Vehicle: 2023 BMW X1 xDrive28i 5 Door SUV NHTSA No.: C20234101
Test Facility: Calspan Test Date: 05/30/2023

Dummy Serial No. D037

Description	Axes	Positive Direction		Negative Direction	
		MAX	TIME (ms)	MAX	TIME (ms)
HEAD ACCELERATION (g)					
Longitudinal	X	6.80	105.00	-12.86	48.10
Lateral	Y	15.81	105.95	-51.33	65.30
Vertical	Z	17.99	45.80	-4.72	157.25
Resultant	N/A	52.53	65.30		
HIC36 (t1, t2)	N/A	338.76		**t1 =** 44.30	**t2 =** 79.10
THORAX DEFLECTION (mm)					
Upper Rib	Y	30.32	53.00	-6.71	23.55
Middle Rib	Y	25.65	52.65	-2.87	86.20
Lower Rib	Y	26.57	56.80	-1.62	83.55
ABDOMINAL FORCES (N)					
Front	Y	344.50	42.55	-6.68	15.20
Middle	Y	256.58	42.40	-8.68	127.80
Rear	Y	377.26	46.75	-14.94	171.05
SUM	N/A	950.54	45.35		
PELVIS FORCES (N)					
Pubic Symphysis	Y	92.16	154.20	-2034.83	61.75

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

DATA SHEET NO. 12
POST-TEST OBSERVATIONS

Test Vehicle:	2023 BMW X1 xDrive28i 5 Door SUV	NHTSA No.:	C20234101
Test Facility:	Calspan	Test Date:	05/30/2023

IMPACT POINT DATA

Measured Parameter		Units	Value
Vertical Impact Ref Line	- Aft of Front Axle, Intended Impact Pt	mm	1330
Actual Impact Point	- Aft of Front Axle	mm	1333
Difference		mm	3

TEST DUMMY INFORMATION AND CONTACT POINTS

Dummy Body Part	Front Passenger Seat Dummy (ES2re)
Face Contact	Curtain Airbag
Top of Head Contact	Curtain Airbag
Right Side of Head Contact	Curtain Airbag
Back of Head Contact	Curtain Airbag & Head Restraint
Right Shoulder Contact	Door Trim
Upper Torso Contact	Seat Back & Torso/Pelvis Airbag
Lower Torso Contact	Seat Back
Right Knee Contact	Door Trim
Right Hip Contact	Door Trim, Torso/Pelvis Airbag, and Seat Pan

POST-TEST DOOR PERFORMANCE

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

POST-TEST SEAT PERFORMANCE

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

POST-TEST STRUCTURAL OBSERVATIONS

Critical Areas of Performance	Observations and Conclusions
Pillar Performance	B-Pillar and C-Pillar Buckled
Sill Separation	None
Windshield Damage	Separation along struck side A-Pillar and cracked throughout
Side Window Damage	Passenger window shattered and fell out
Other Notable Effects	Sunroof shattered and fell out; Passenger seatback reclined due to button being depressed after impact event

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

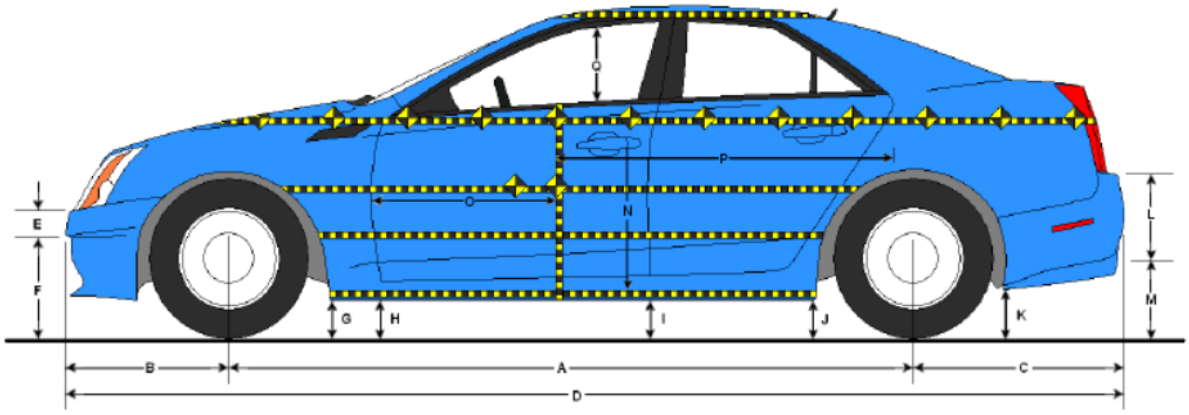
Test Vehicle:	2023 BMW X1 xDrive28i 5 Door SUV	NHTSA No.:	C20234101
Test Facility:	Calspan	Test Date:	05/30/2023

SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

Restraint Type	Struck Side Front Occupant	
	Mounted	Deployed
Front Airbag	Yes	No
Knee Airbag	Yes	No
Side Airbag 1 - Curtain AIrbag	Yes	Yes
Side Airbag 2 - Torso/Pelvis Airbag	Yes	Yes
Seat Belt Pretensioner	Yes	Yes
Seat Belt Load Limiter	Yes	Yes
Other		

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

Test Vehicle:	2023 BMW X1 xDrive28i 5 Door SUV	NHTSA No.:	C20234101
Test Facility:	Calspan	Test Date:	05/30/2023



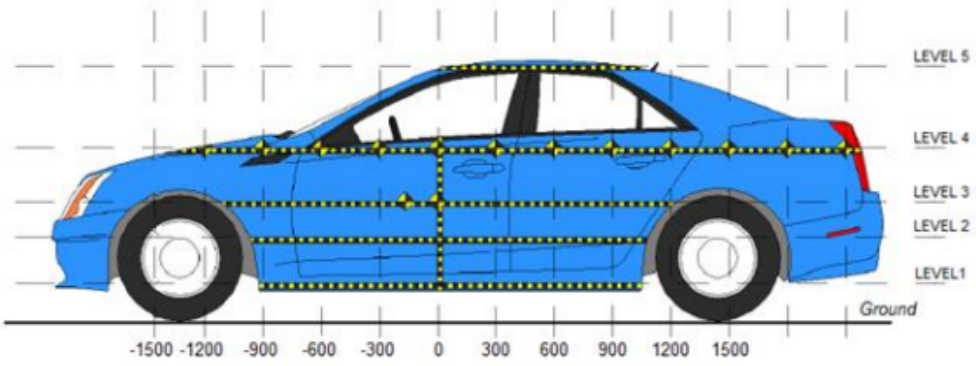
LEFT SIDE VIEW

VEHICLE PRE- AND POST-TEST MEASUREMENT INFORMATION

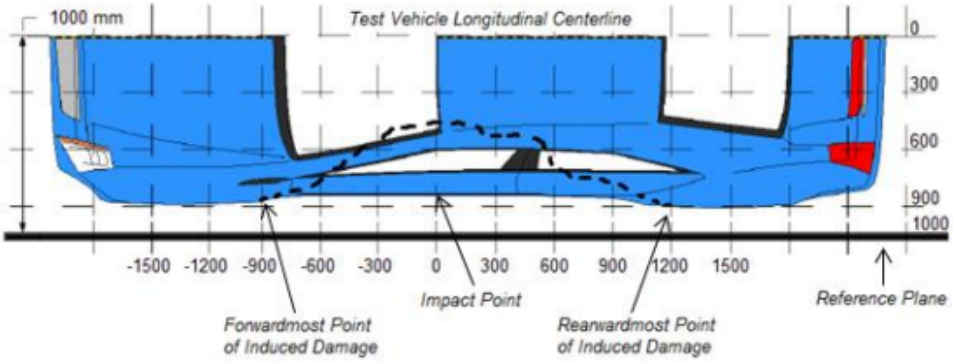
No.	Measurement Description	Pre-Test	Post-Test	Difference
A	Vehicle Wheelbase	2687	2703	-16
B	Front Axle to FSOV	845	802	44
C	Rear Axle to RSOV	935	932	3
D	Total Vehicle Length at Centerline	4467	4436	30
E	Front Bumper Thickness	124	124	0
F	Front Bumper Bottom to Ground	459	472	-13
G	Sill Height at Front Wheel Well	212	222	-10
H	Sill Height at Front Door Leading Edge	211	219	-8
I	Sill Height at B Pillar	235	223	12
J1	Sill Height at Rear Wheel Well	217	236	-19
J2	Pinch Weld Height at Rear Wheel Well	224	236	-12
K	Sill Height Aft of Rear Wheel Well	282	277	5
L	Rear Bumper Thickness	134	134	0
M	Rear Bumper Bottom to Ground	411	404	7
N	Sill Height to Window Bottom Sill	893	904	-11
O	Front Door Leading Edge to Impact CL	813	752	61
P	Rear Door Trailing Edge to Impact CL	1184	1108	76
Q	Front Window Opening	398	397	1
R	Right Side Length	4393	4341	51
S	Left Side Length	4397	4382	15
T	Vehicle Width at B-Pillars	1820	1682	138

DATA SHEET NO. 14
TEST VEHICLE EXTERIOR CRUSH MEASUREMENTS

Test Vehicle:	2023 BMW X1 xDrive28i 5 Door SUV	NHTSA No.:	C20234101
Test Facility:	Calspan	Test Date:	05/30/2023



Left Side View



Overhead View

MAXIMUM EXTERIOR CRUSH MEASUREMENTS

Level	Measurement Description	Units	Height Above Ground	Maximum Exterior Static Crush	Distance from Impact
1	Sill Top	mm	318	264	0
2	Occupant H-Point	mm	657	318	0
3	Mid-Door	mm	742	327	0
4	Window Sill	mm	1054	298	0
5	Window Top	mm	1578	107	0

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

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

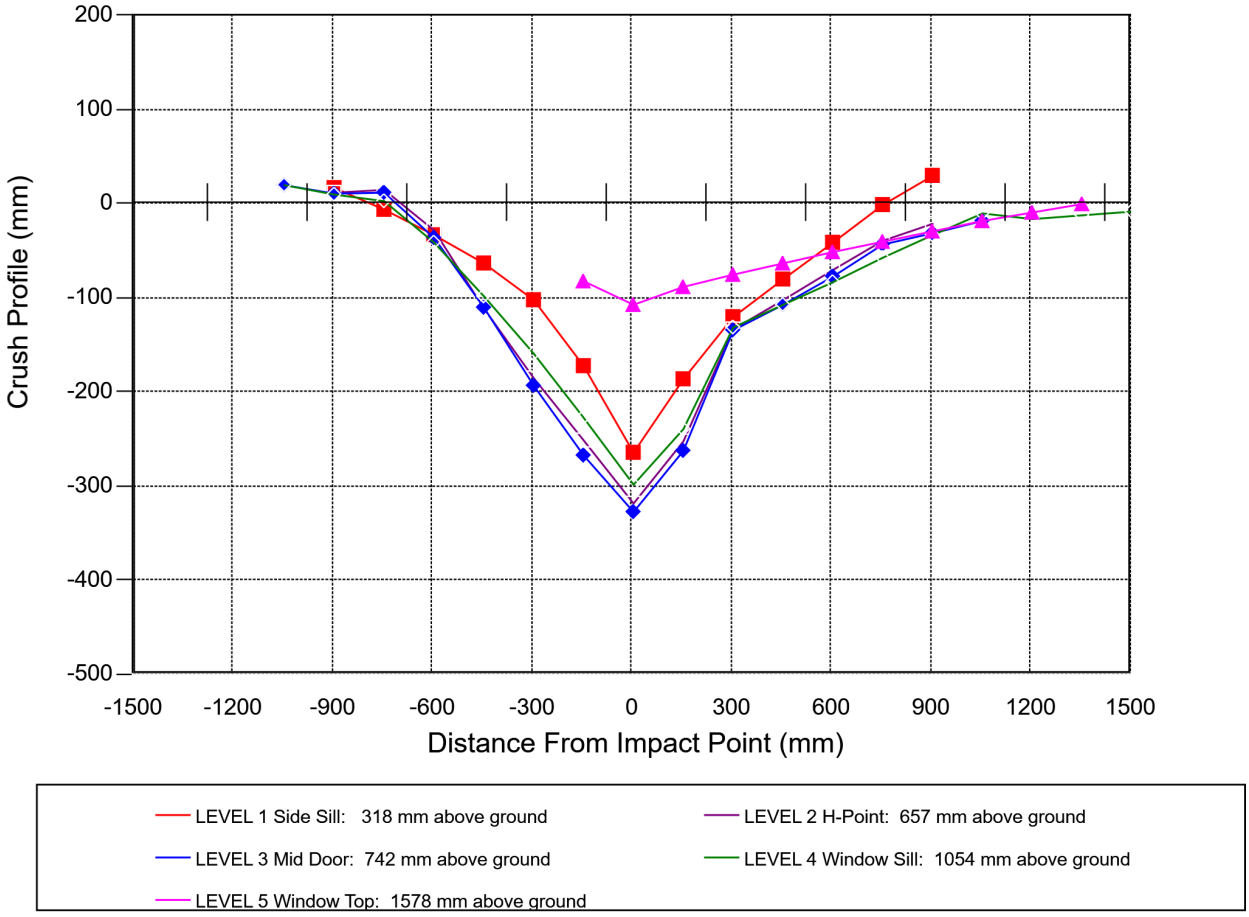
Test Vehicle: 2023 BMW X1 xDrive28i 5 Door SUV
NHTSA No.: C20234101
Test Facility: Calspan
Test Date: 05/30/2023

EXTERIOR CRUSH MEASUREMENTS AT EACH LEVEL

	Pre-Test					Post-Test					Difference				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
-1500															
-1350															
-1200															
-1050			-911	-803				-931	-823				20	20	
-900	-884	-904	-910	-812		-901	-916	-921	-822		17	12	11	10	
-750	-869	-905	-904	-822		-863	-920	-916	-825		-6	15	12	3	
-600	-864	-901	-903	-833		-831	-873	-867	-792		-33	-28	-36	-41	
-450	-860	-899	-904	-844		-797	-788	-794	-746		-63	-111	-110	-98	
-300	-857	-900	-905	-853		-755	-715	-712	-694		-102	-185	-193	-159	
-150	-855	-900	-906	-862	-624	-683	-649	-639	-635	-542	-172	-251	-267	-227	-82
0	-853	-901	-906	-868	-632	-589	-583	-579	-570	-525	-264	-318	-327	-298	-107
150	-852	-900	-906	-875	-634	-666	-648	-644	-636	-546	-186	-252	-262	-239	-88
300	-852	-901	-905	-880	-635	-732	-768	-771	-749	-560	-120	-133	-134	-131	-75
450	-859	-901	-905	-883	-634	-779	-799	-798	-776	-571	-80	-102	-107	-107	-63
600	-866	-901	-906	-882	-631	-825	-831	-829	-799	-580	-41	-70	-77	-83	-51
750	-868	-904	-908	-880	-626	-867	-865	-865	-823	-586	-1	-39	-43	-57	-40
900	-873	-904	-912	-879	-619	-903	-883	-881	-846	-590	30	-21	-31	-33	-29
1050			-911	-877	-607			-893	-867	-589			-18	-10	-18
1200				-874	-589				-858	-580				-16	-9
1350				-870	-552				-858	-552				-12	0
1500				-862					-854					-8	

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

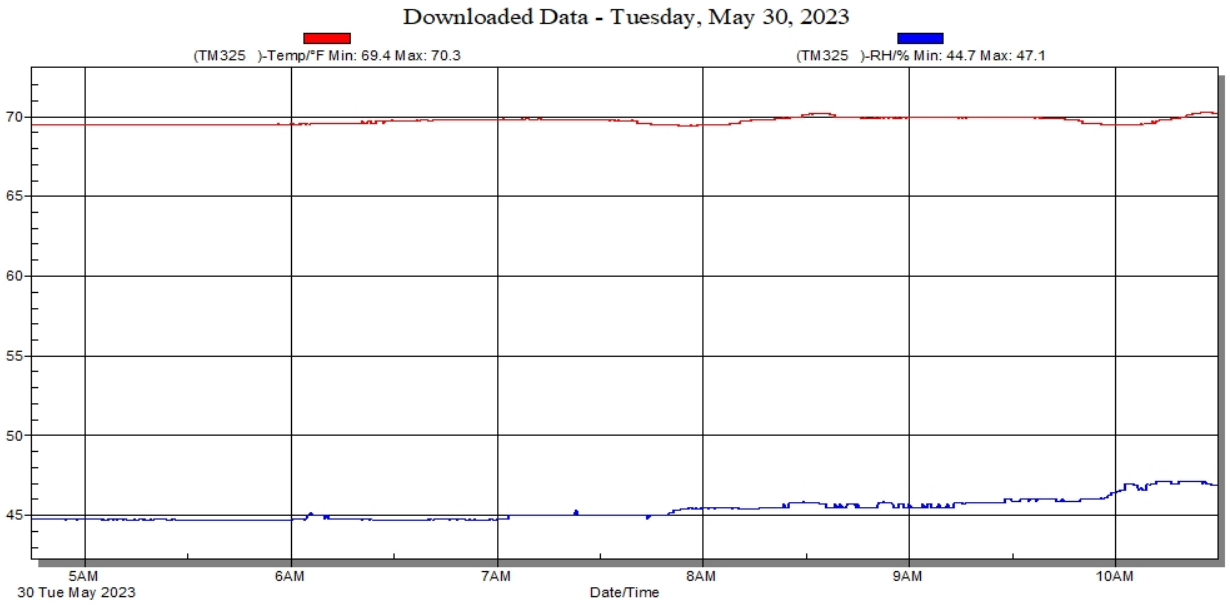
Test Vehicle:	2023 BMW X1 xDrive28i 5 Door SUV	NHTSA No.:	C20234101
Test Facility:	Calspan	Test Date:	05/30/2023



Vehicle Exterior Crush Measurements - Visual Representation

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

Test Vehicle:	2023 BMW X1 xDrive28i 5 Door SUV	NHTSA No.:	C20234101
Test Facility:	Calspan	Test Date:	05/30/2023



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

APPENDIX I

PHOTOGRAPHS

TABLE OF PHOTOGRAPHS

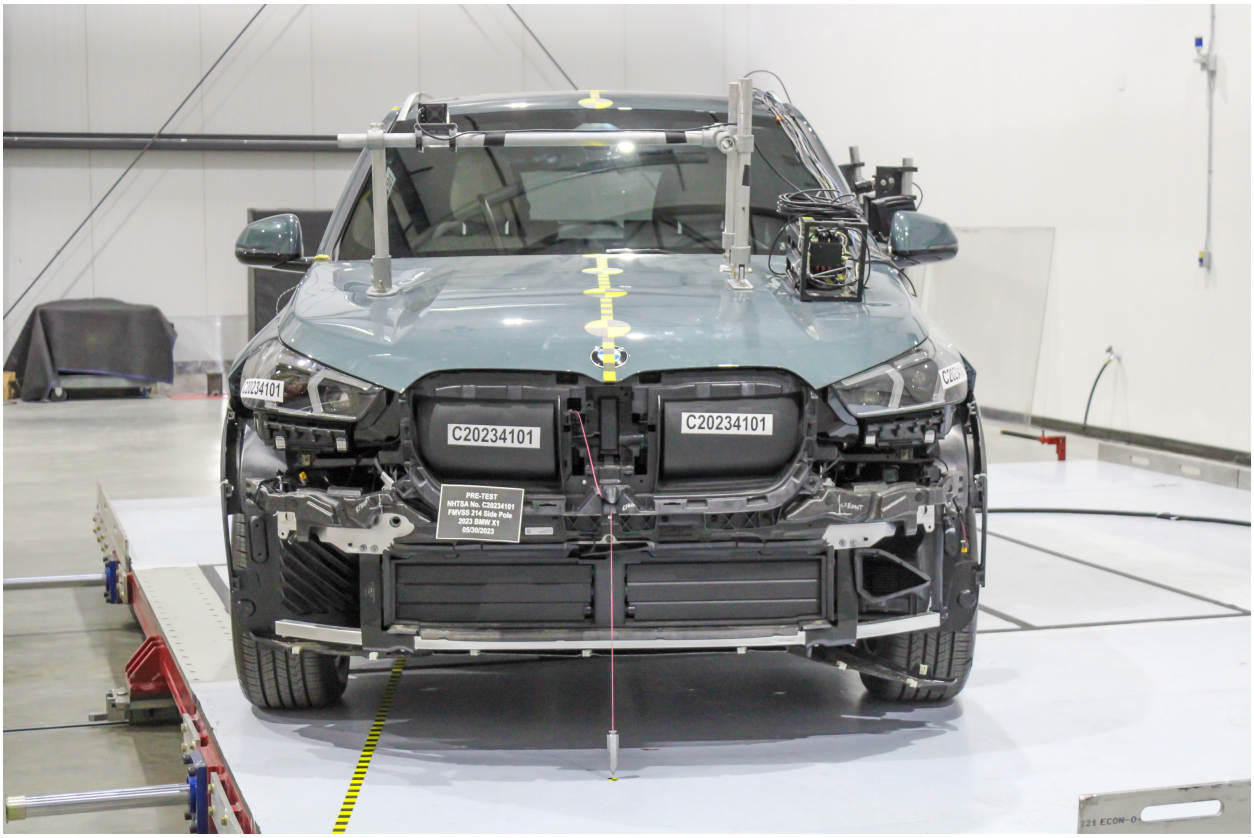


Figure A-1: Pre-Test Frontal View of Test Vehicle

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

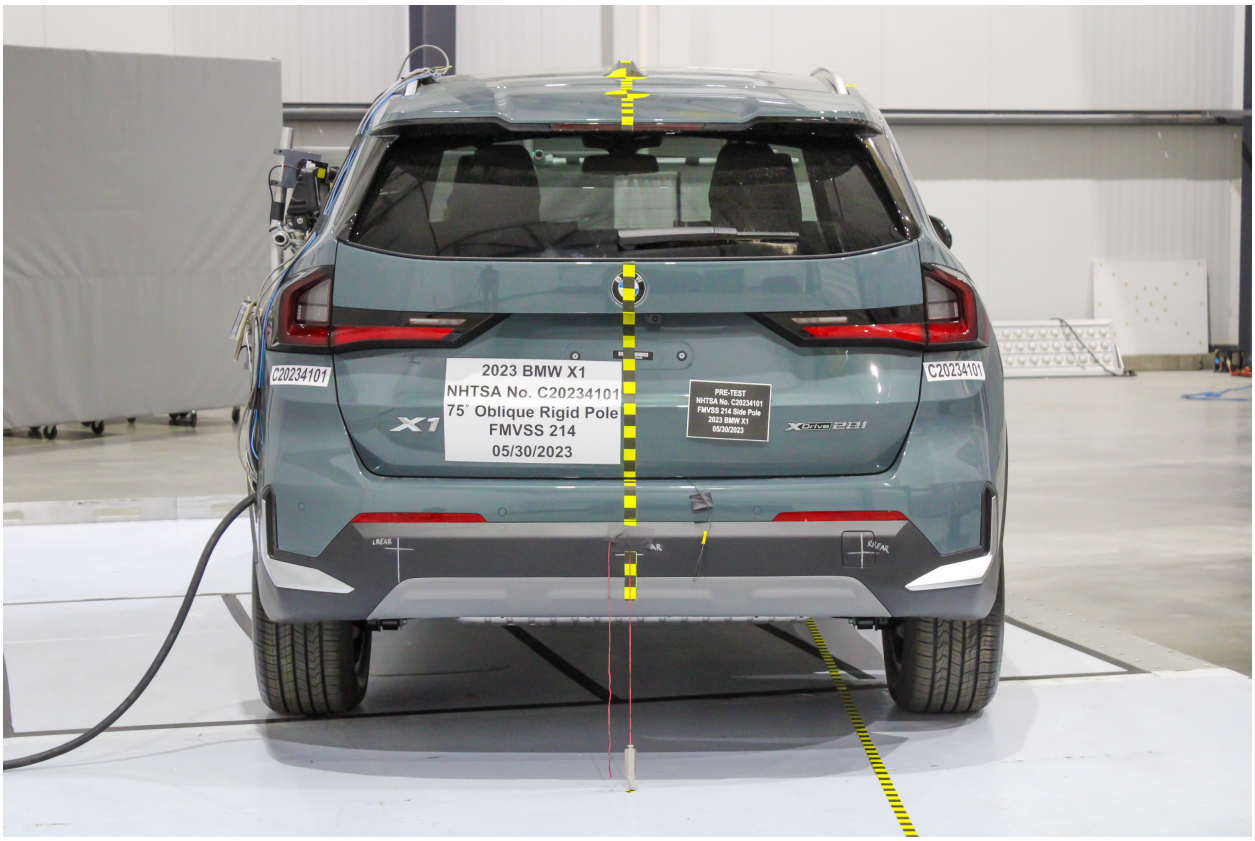


Figure A-3: Pre-Test Rear View of Test Vehicle

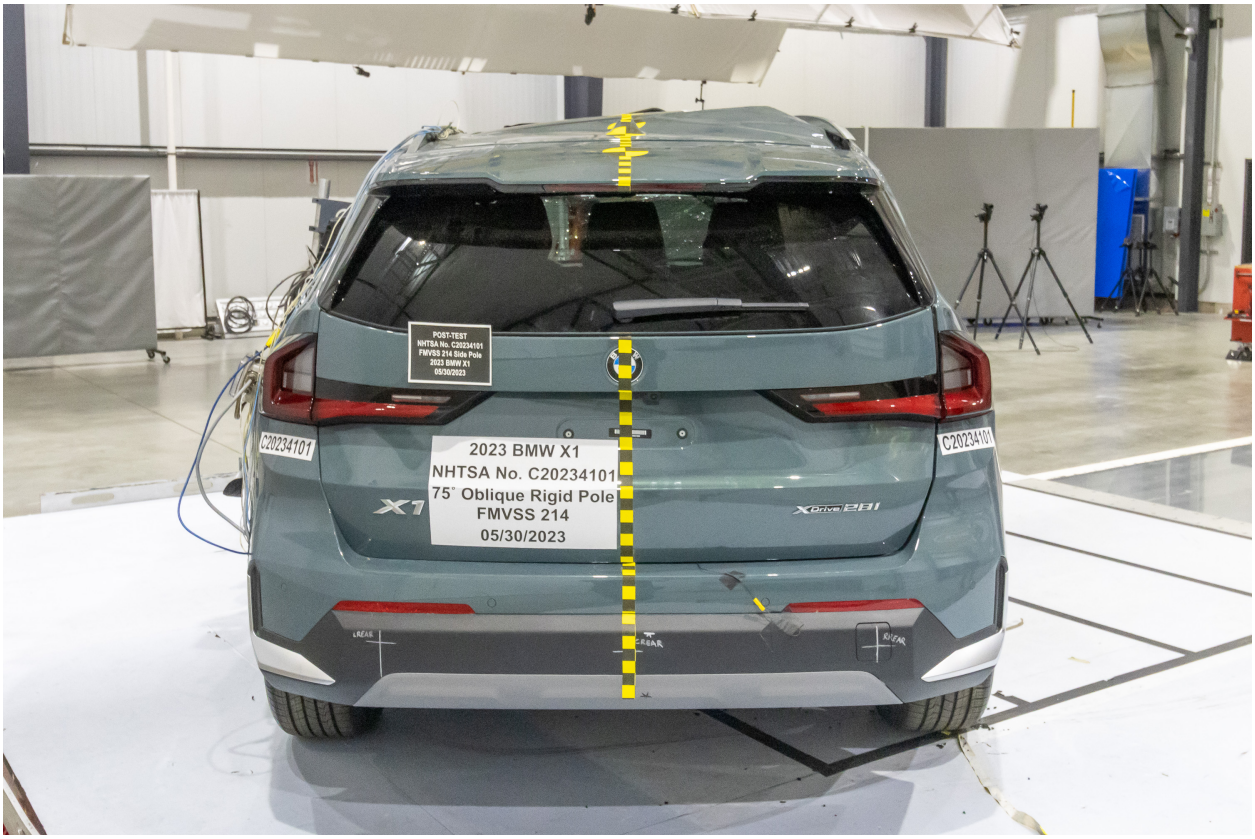


Figure A-4: Post-Test Rear View of Test Vehicle

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

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

Figure A-7: Pre-Test Right ¾ Front View of Vehicle and Pole

Figure A-8: Pre-Test Right ¾ Rear View of Vehicle and Pole

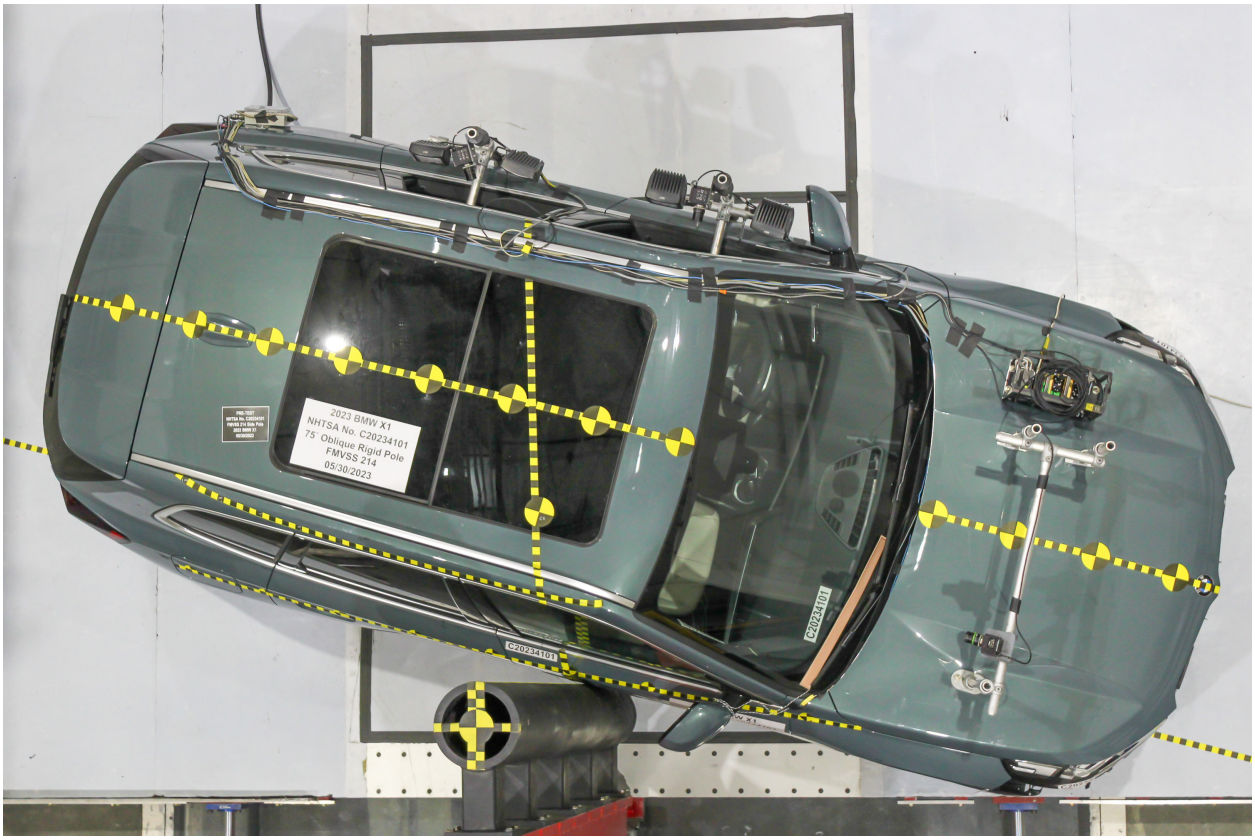


Figure A-9: Pre-Test Overhead View of Test Vehicle

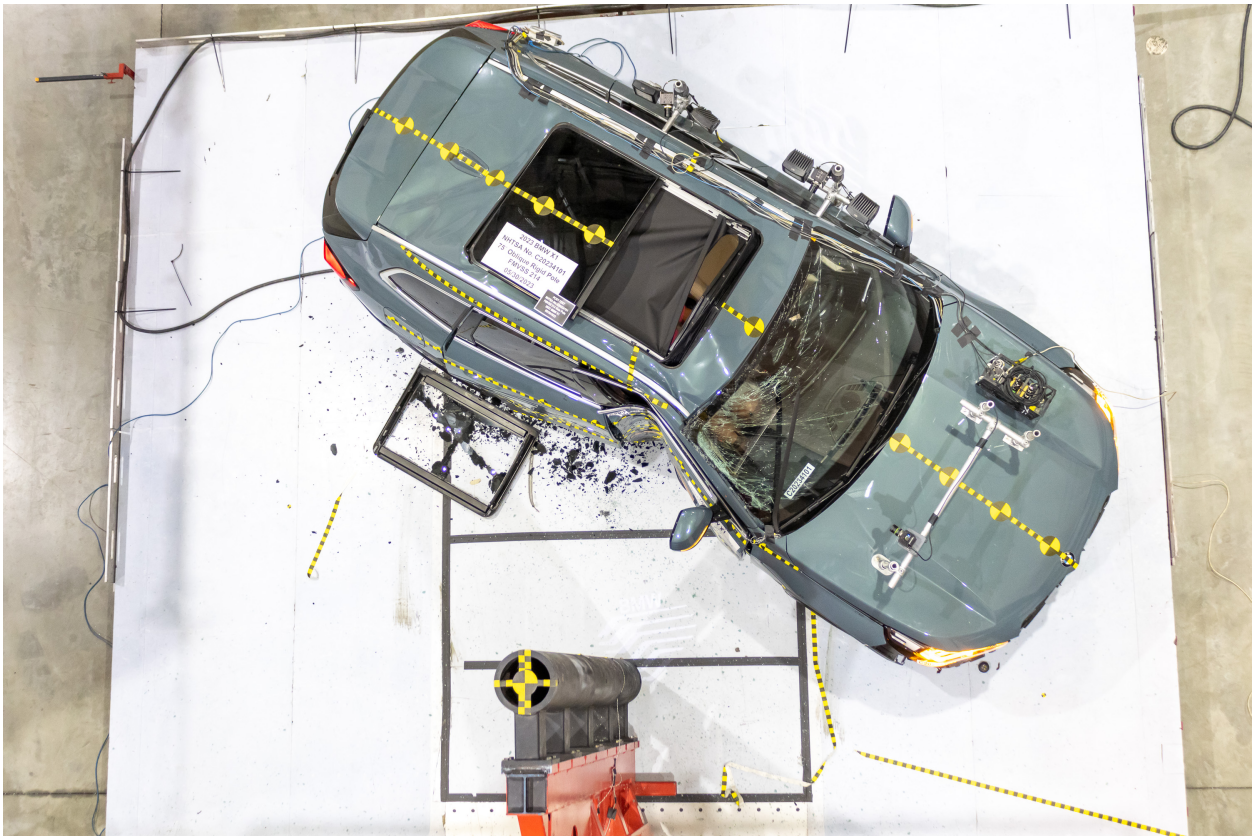


Figure A-10: Post-Test Overhead View of Test Vehicle

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

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

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

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

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

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

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

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

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

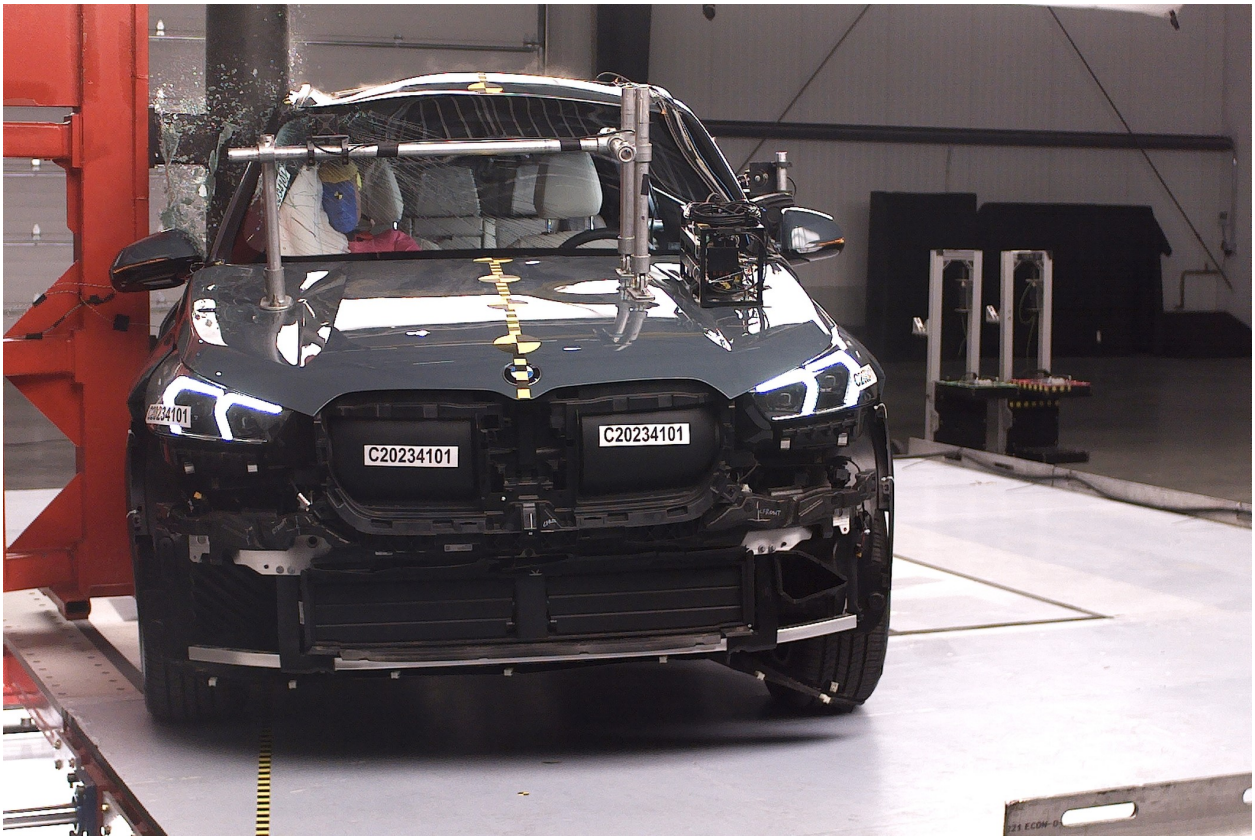


Figure A-20: Impact Event

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

Figure A-22: Post-Test ¾ Front View of Impact Zone

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

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

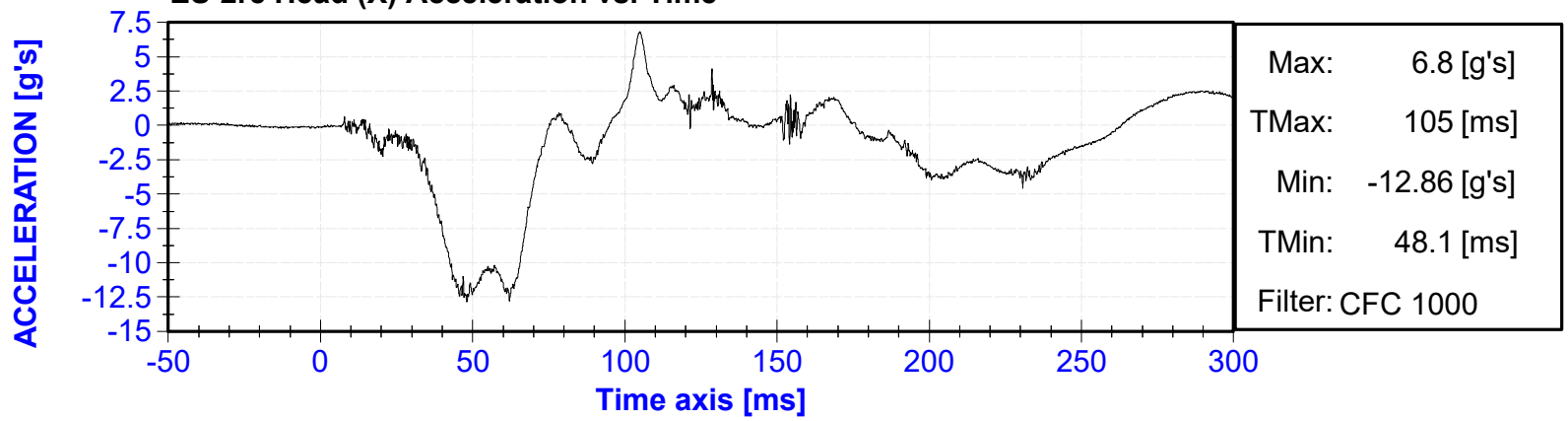
Figure A-25: Close-Up View of Vehicle's Certification Label

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

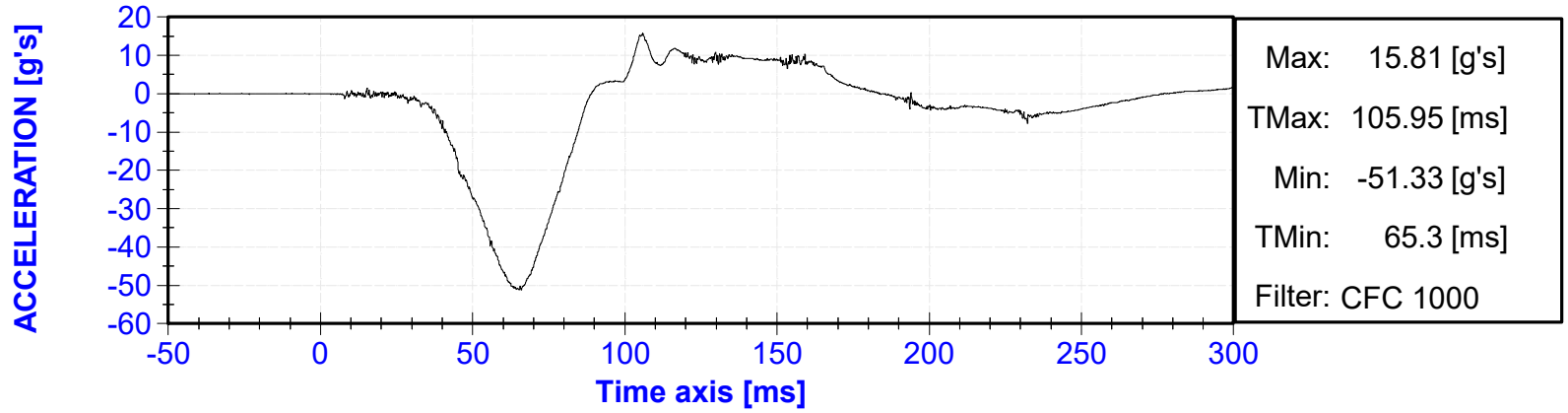
APPENDIX II
ES-2re DUMMY RESPONSE DATA TRACES

Table of Data Plots

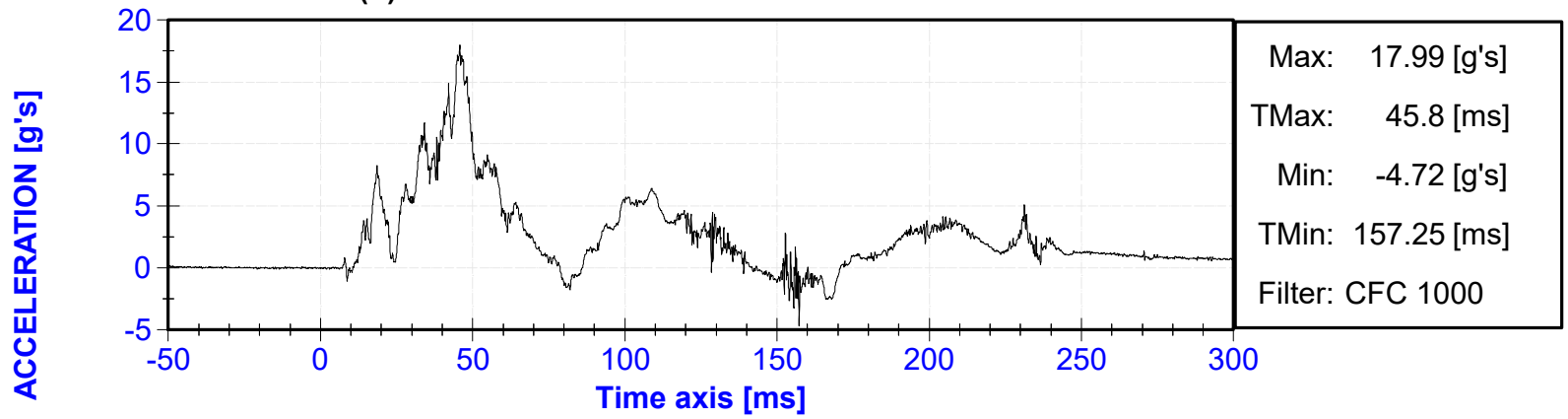
ES-2re Head (X) Acceleration vs. Time



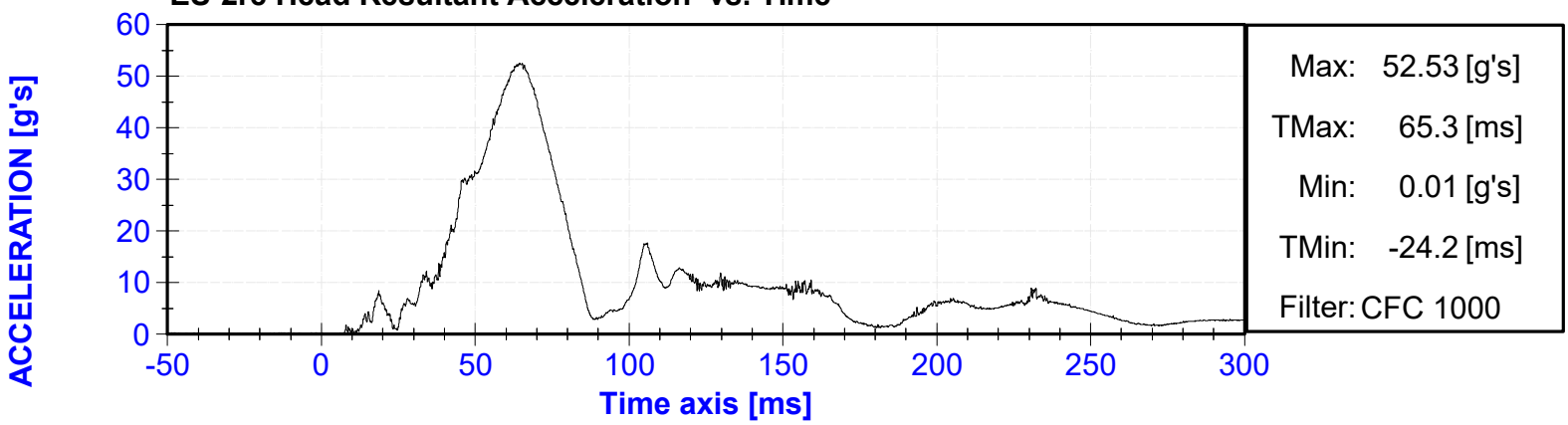
ES-2re Head (Y) Acceleration vs. Time



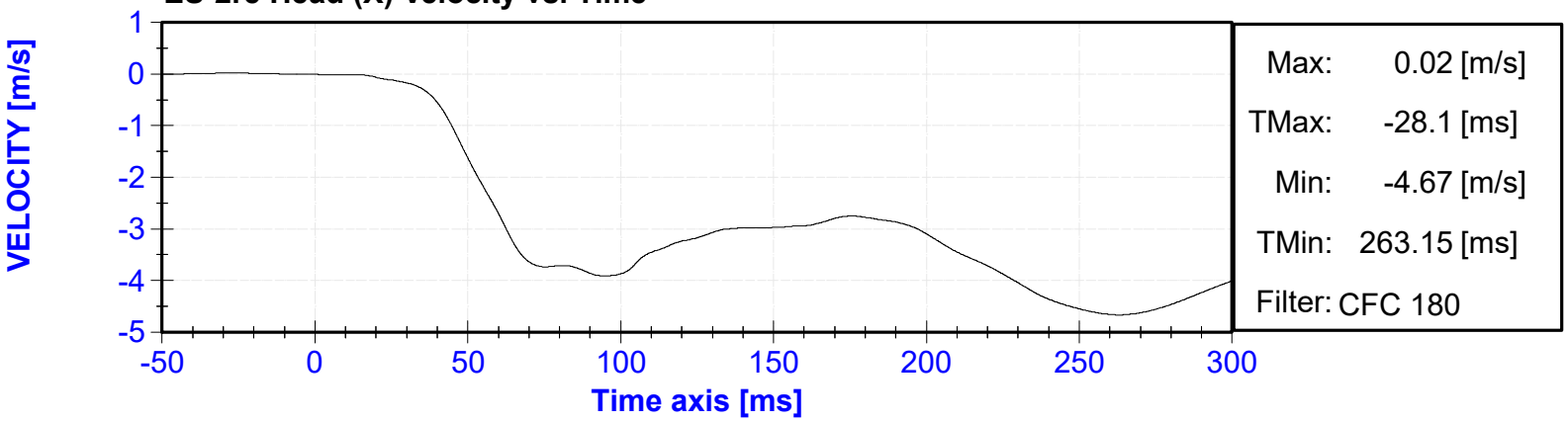
ES-2re Head (Z) Acceleration vs. Time



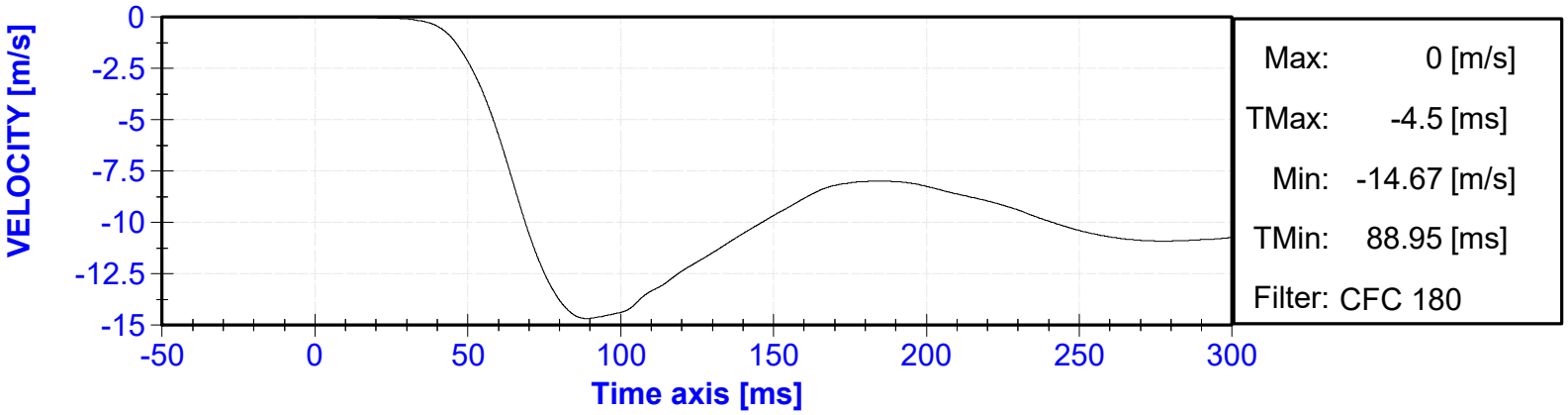
ES-2re Head Resultant Acceleration vs. Time



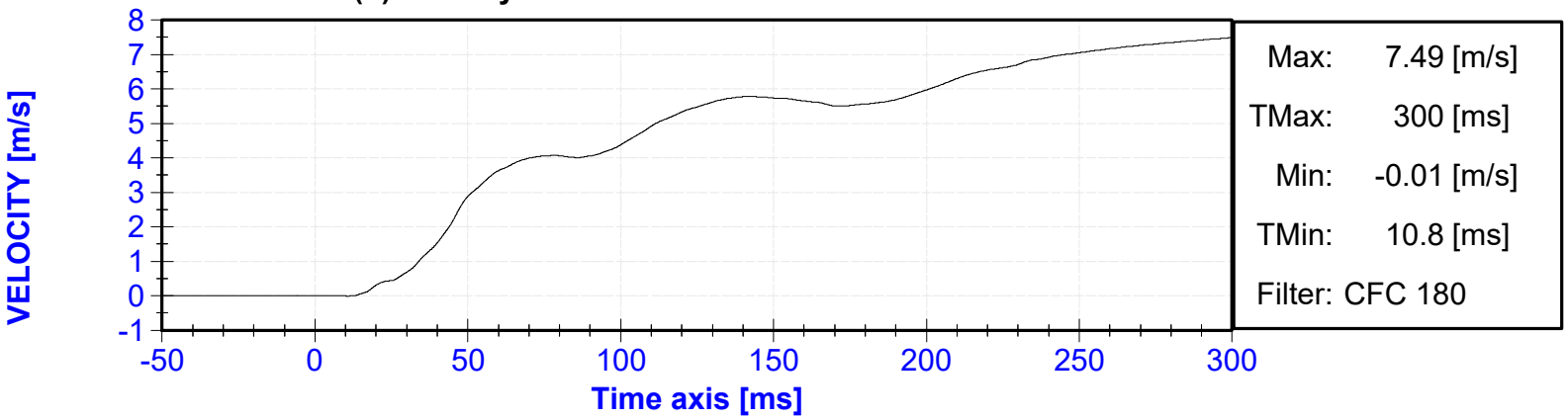
ES-2re Head (X) Velocity vs. Time



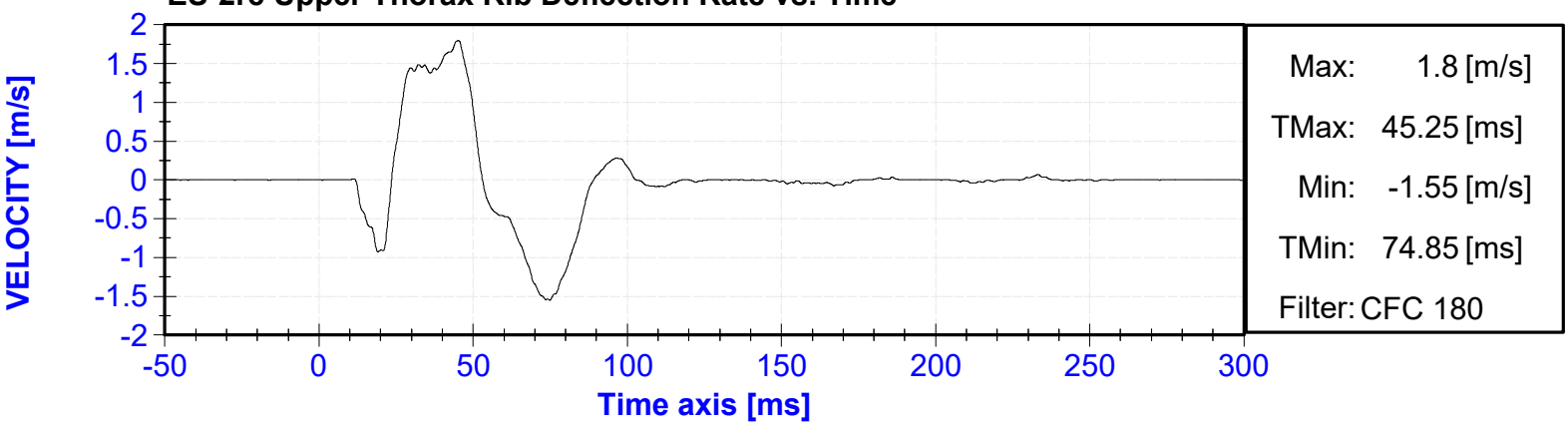
ES-2re Head (Y) Velocity vs. Time



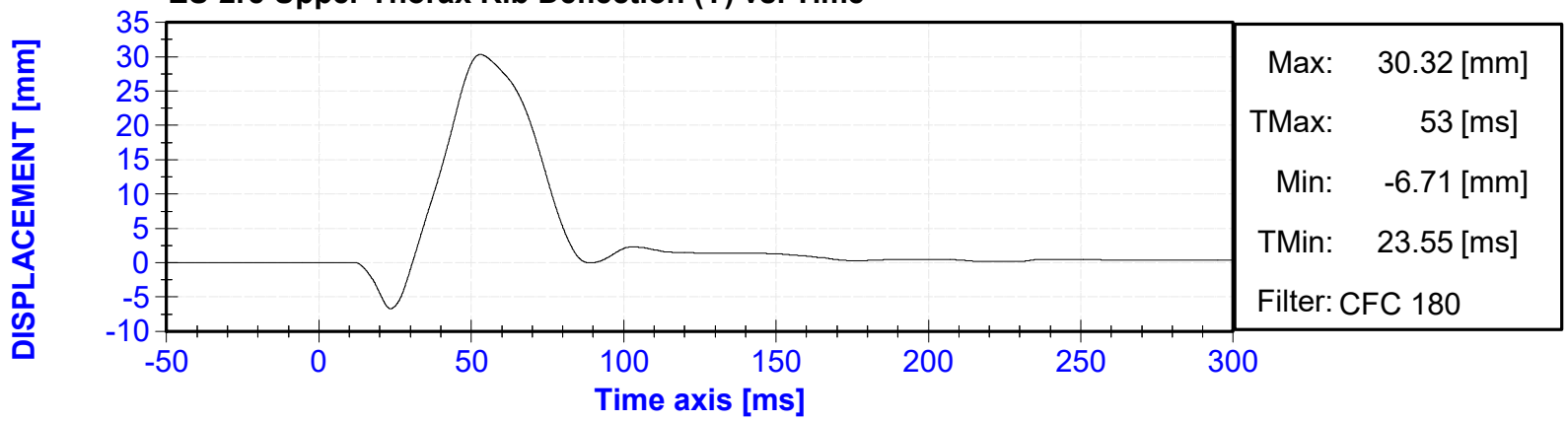
ES-2re Head (Z) Velocity vs. Time



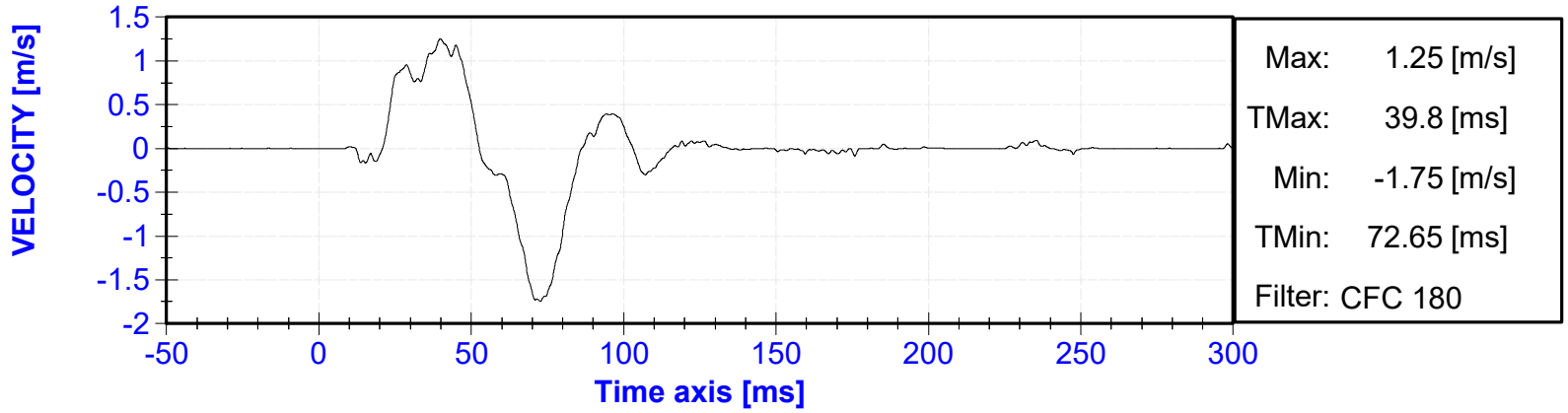
ES-2re Upper Thorax Rib Deflection Rate vs. Time



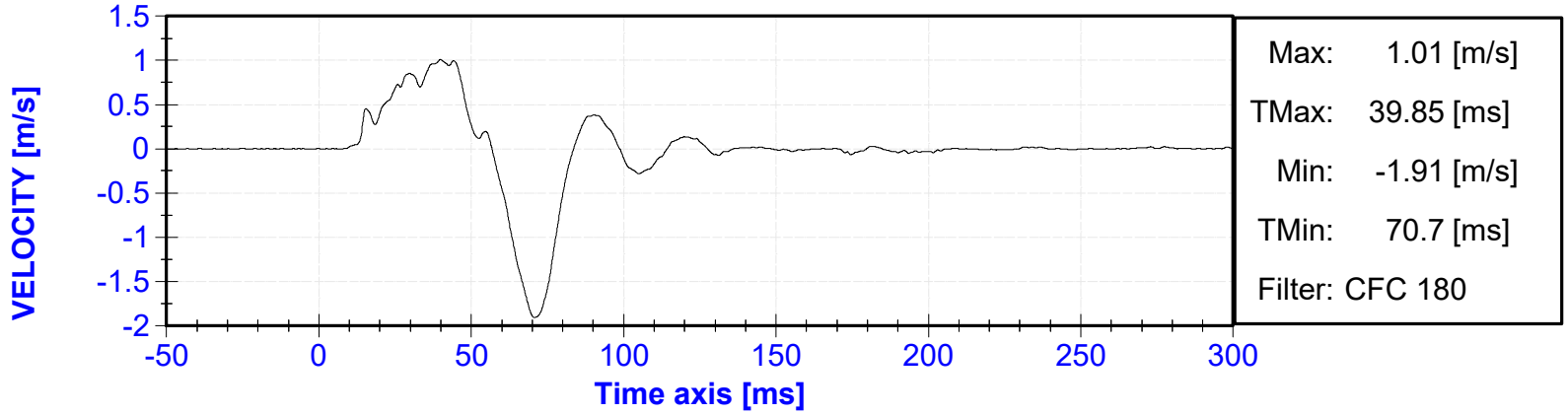
ES-2re Upper Thorax Rib Deflection (Y) vs. Time



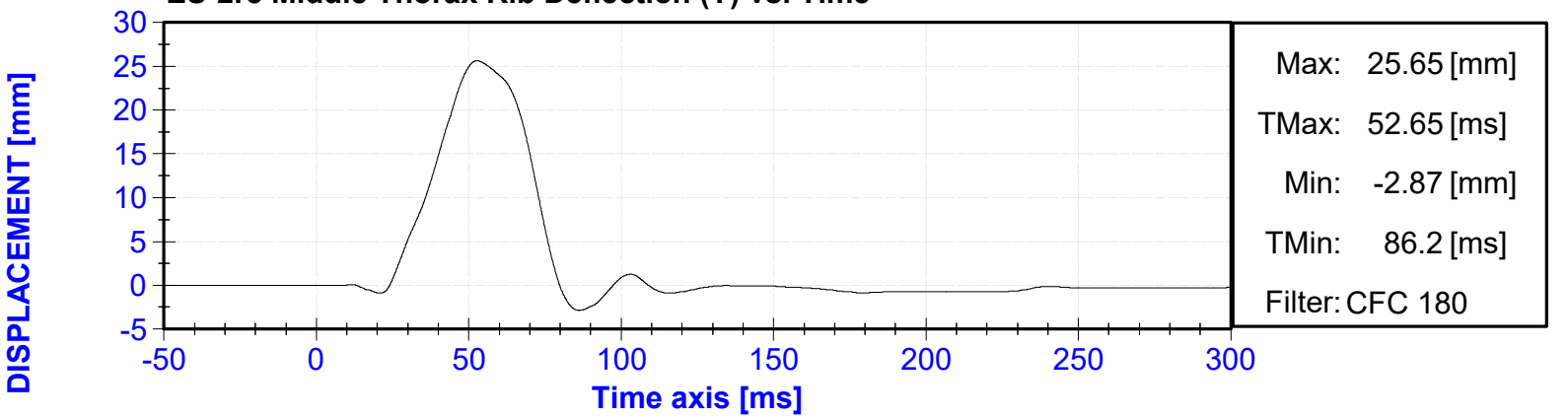
ES-2re Middle Thorax Rib Deflection Rate vs. Time



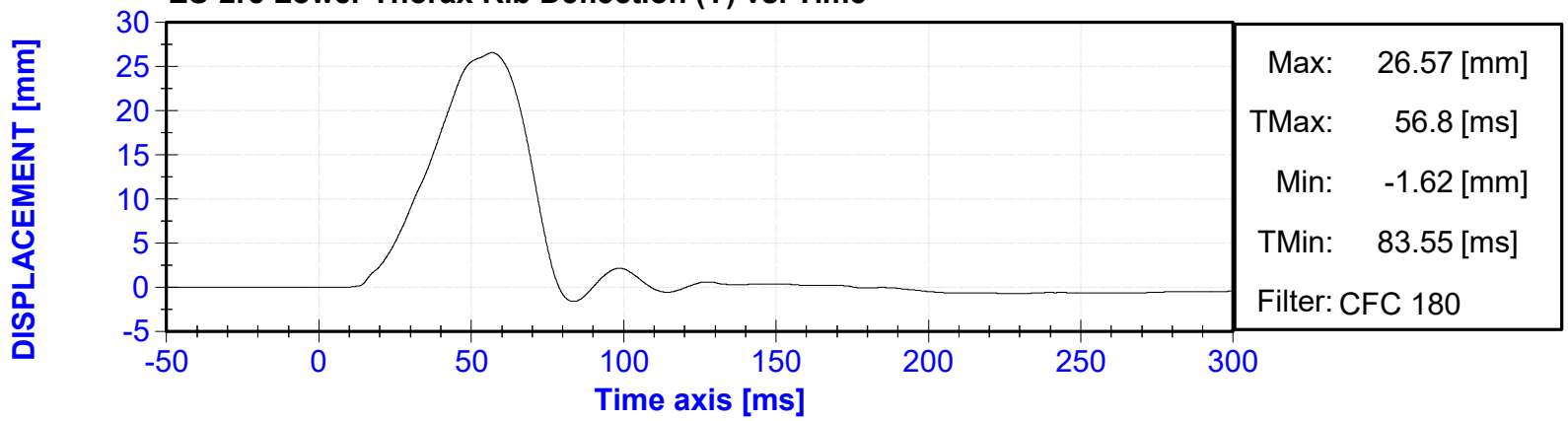
ES-2re Lower Thorax Rib Deflection Rate vs. Time



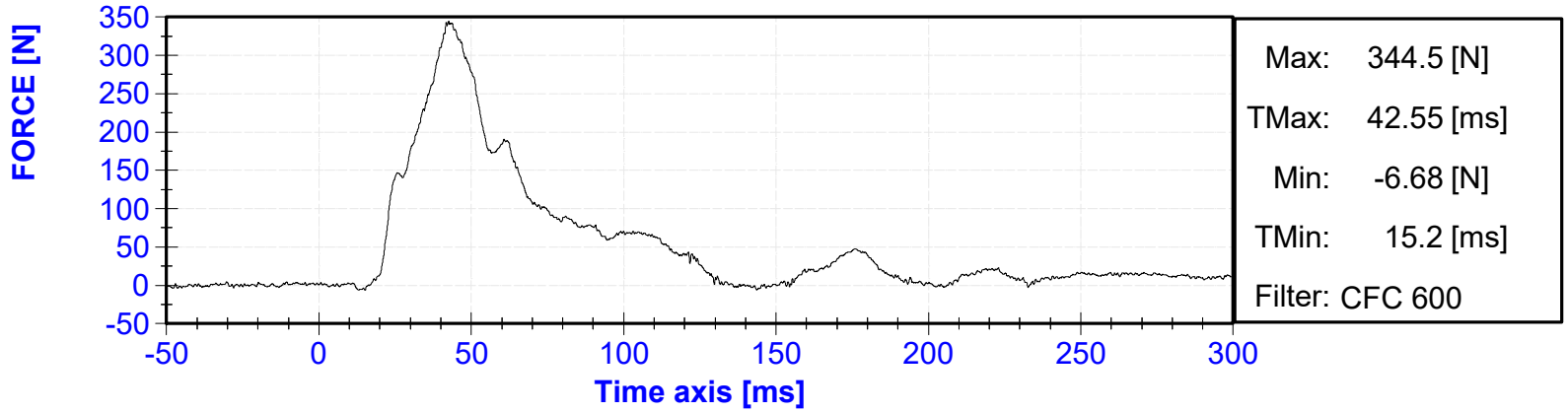
ES-2re Middle Thorax Rib Deflection (Y) vs. Time



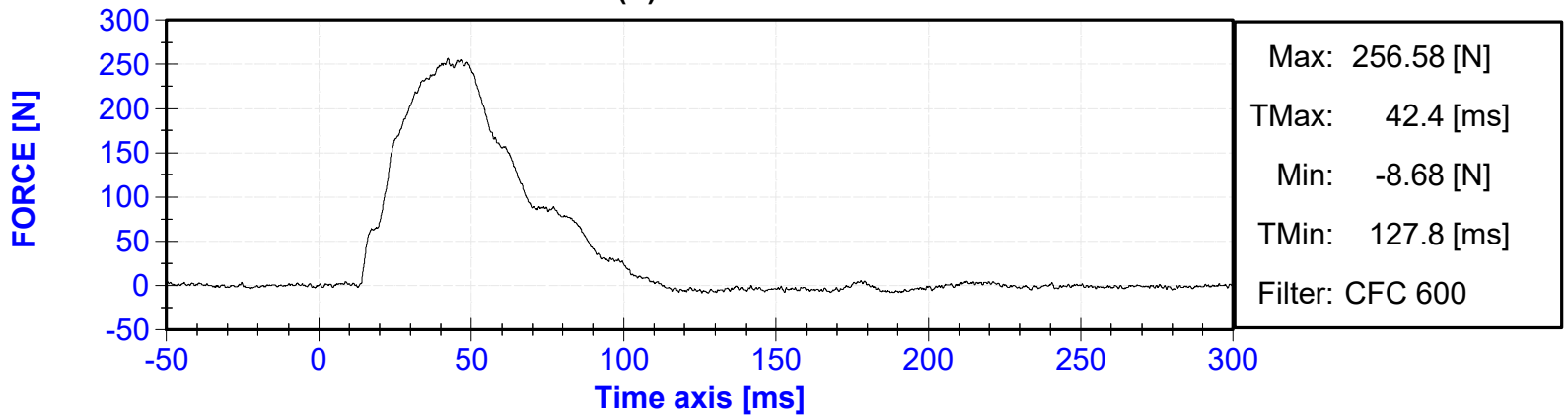
ES-2re Lower Thorax Rib Deflection (Y) vs. Time



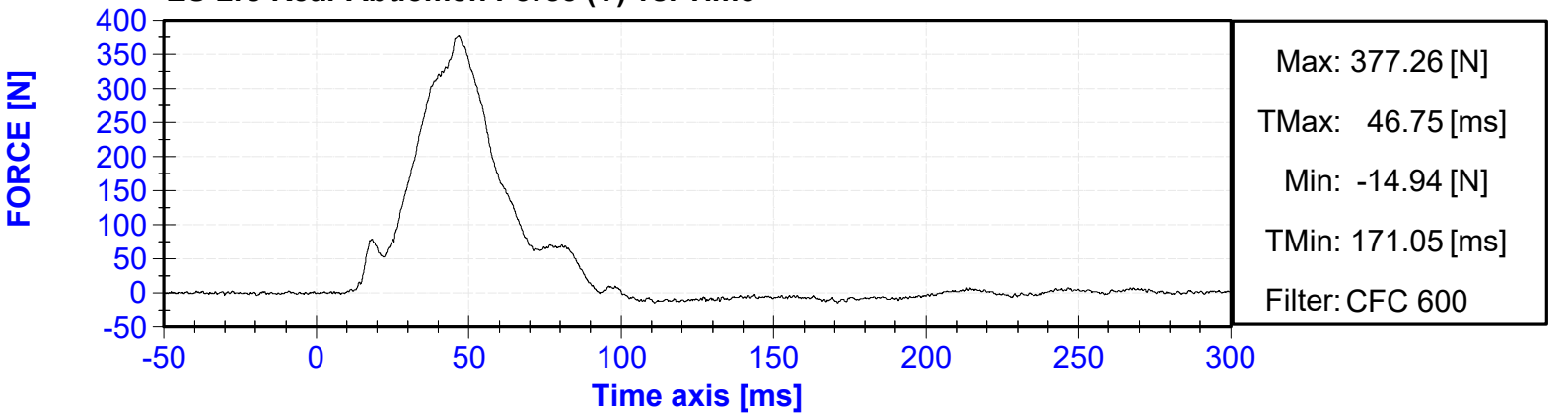
ES-2re Front Abdomen Force (Y) vs. Time

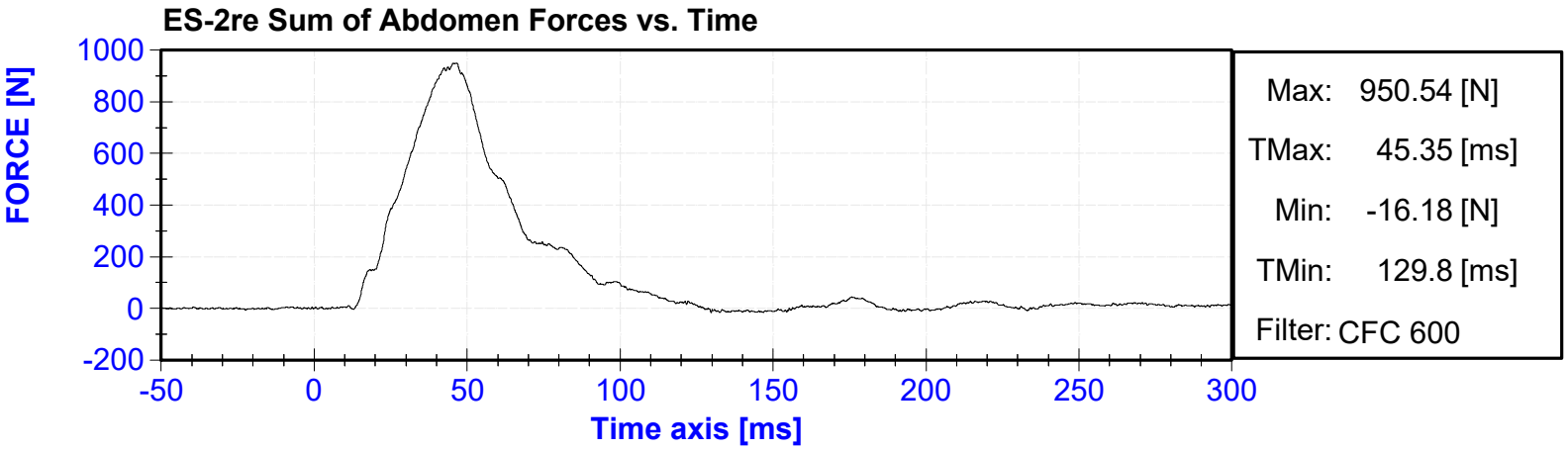


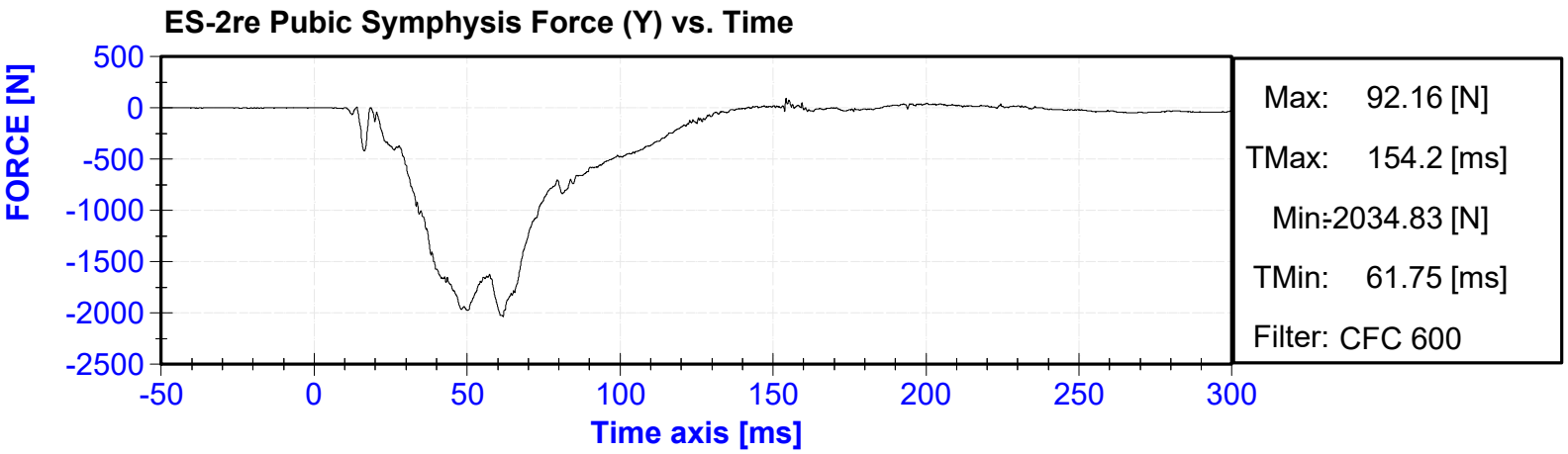
ES-2re Middle Abdomen Force (Y) vs. Time



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



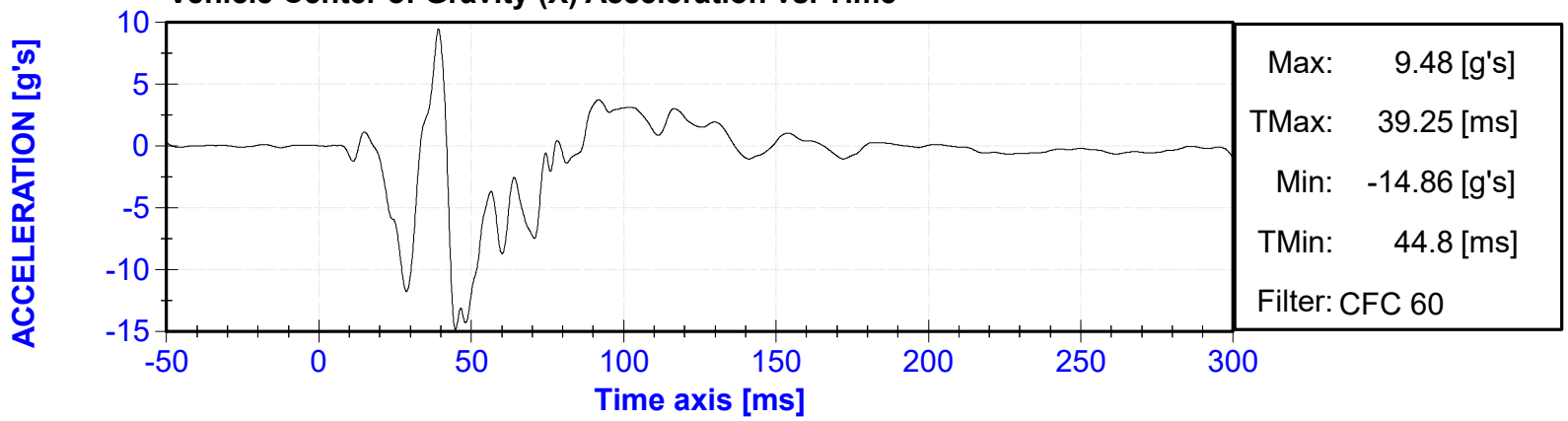

ES-2re Sum of Abdomen Forces vs. Time
FORCE [N]
1000
800
600
400
200
0
-200
-50
0
50
100
150
200
250
300
Time axis [ms]
Max: 950.54 [N]
TMax: 45.35 [ms]
Min: -16.18 [N]
TMin: 129.8 [ms]
Filter: CFC 600


ES-2re Pubic Symphysis Force (Y) vs. Time
FORCE [N]
500
0
-500
-1000
-1500
-2000
-2500
-50
0
50
100
150
200
250
300
Time axis [ms]
Max: 92.16 [N]
TMax: 154.2 [ms]
Min: -2034.83 [N]
TMin: 61.75 [ms]
Filter: CFC 600

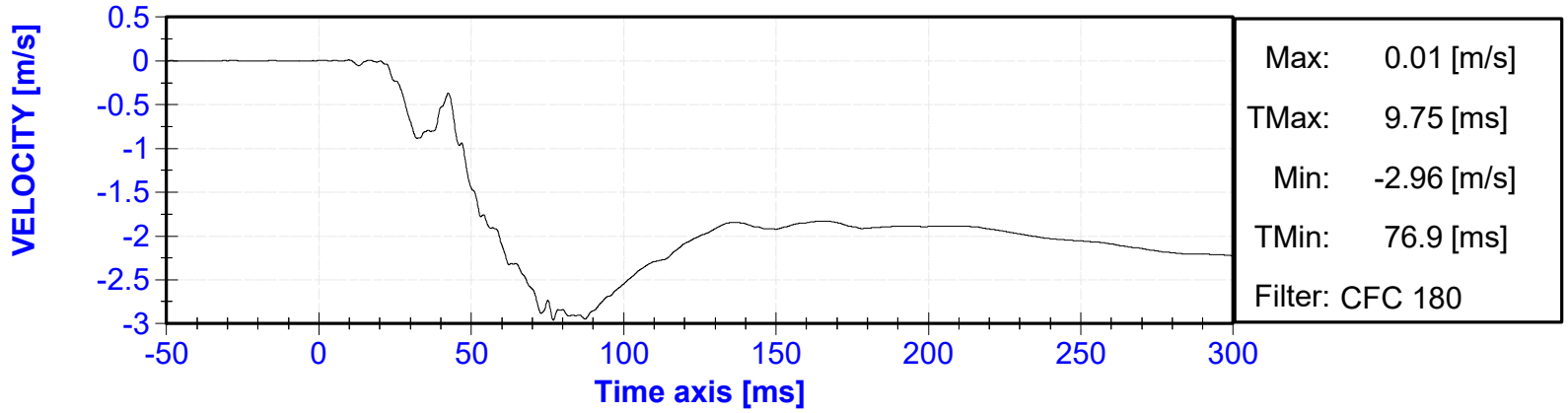
APPENDIX III
VEHICLE ACCELEROMETER RESPONSE DATA

Table of Data Plots

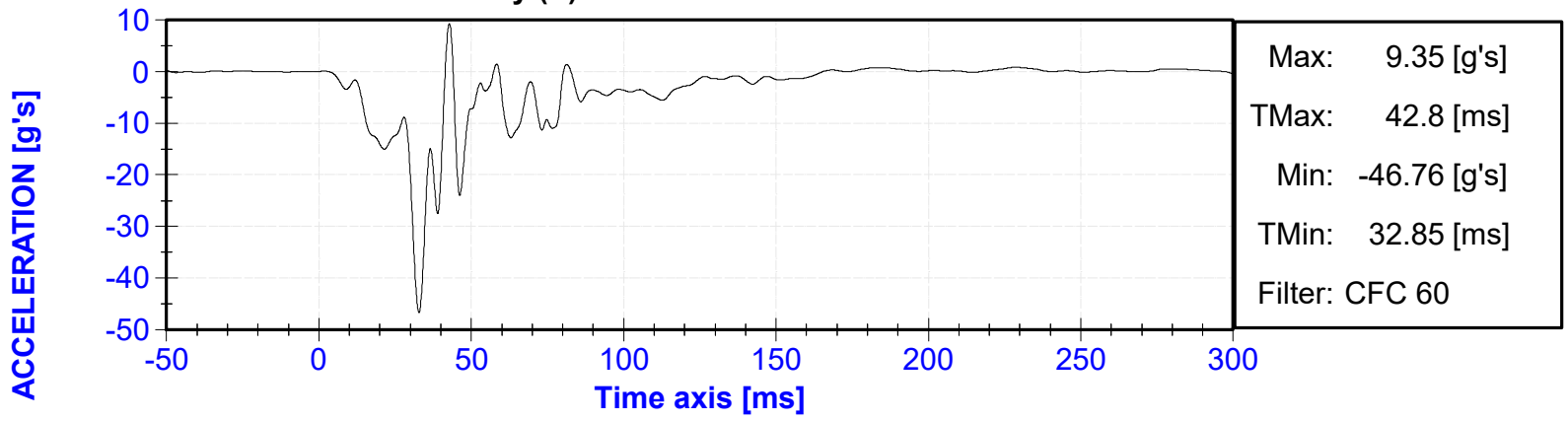
Vehicle Center of Gravity (X) Acceleration vs. Time



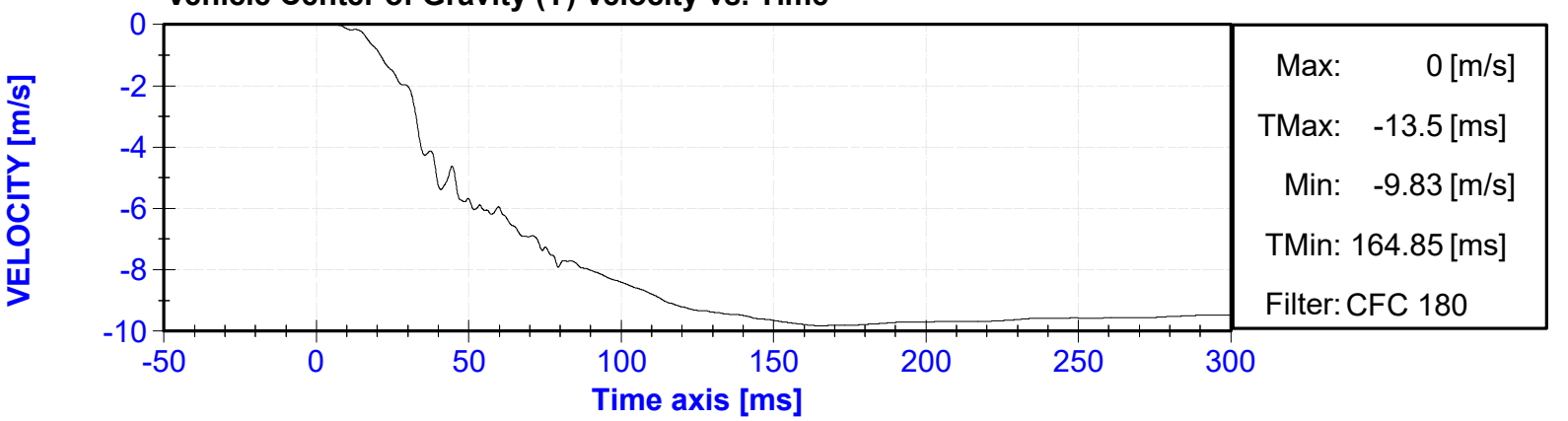
Vehicle Center of Gravity (X) Velocity vs. Time



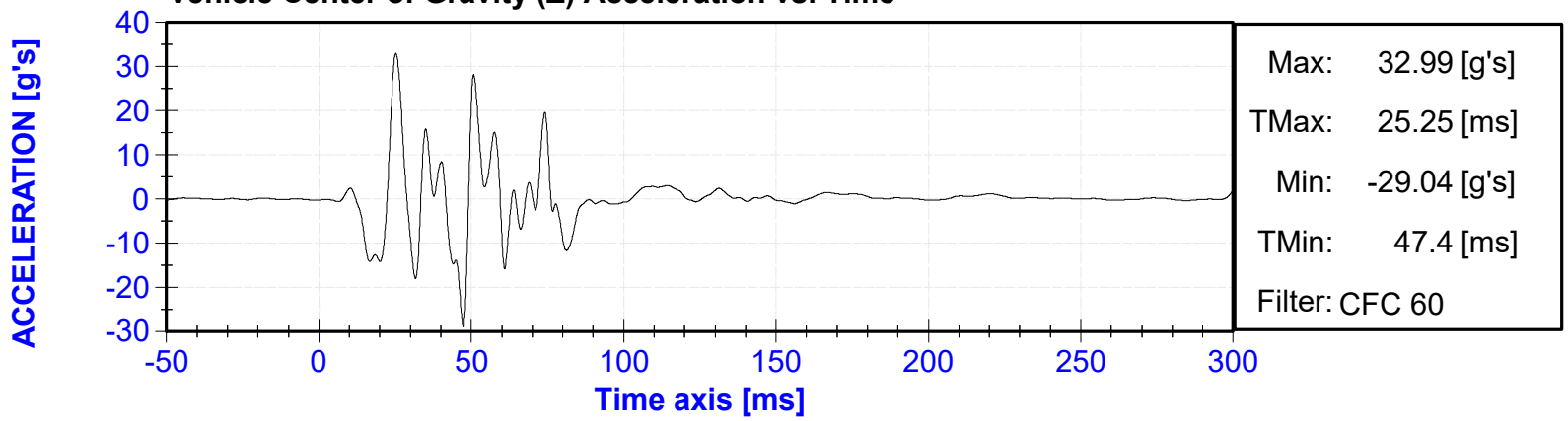
Vehicle Center of Gravity (Y) Acceleration vs. Time



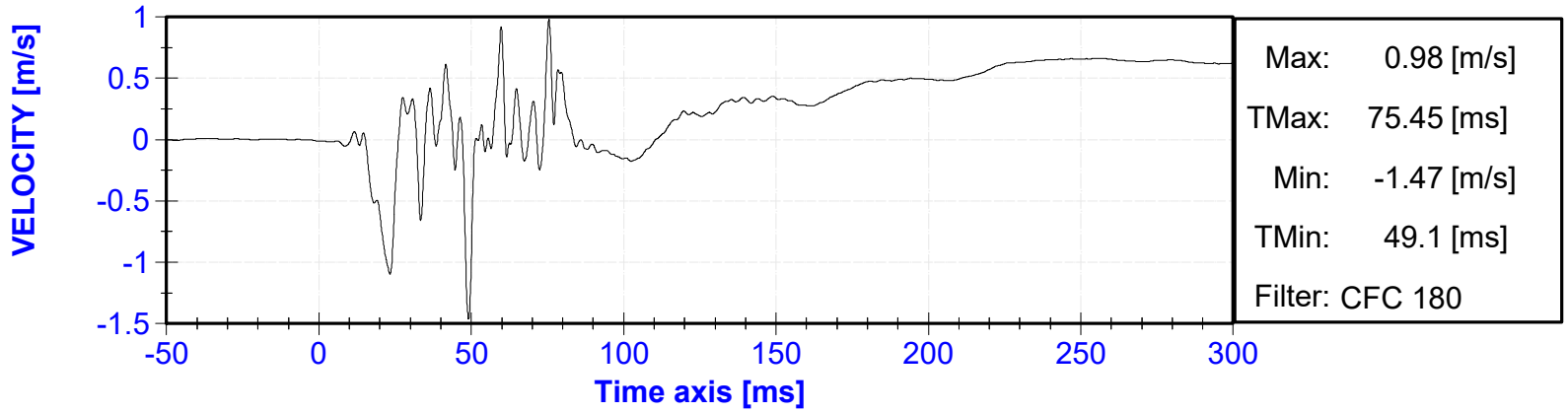
Vehicle Center of Gravity (Y) Velocity vs. Time



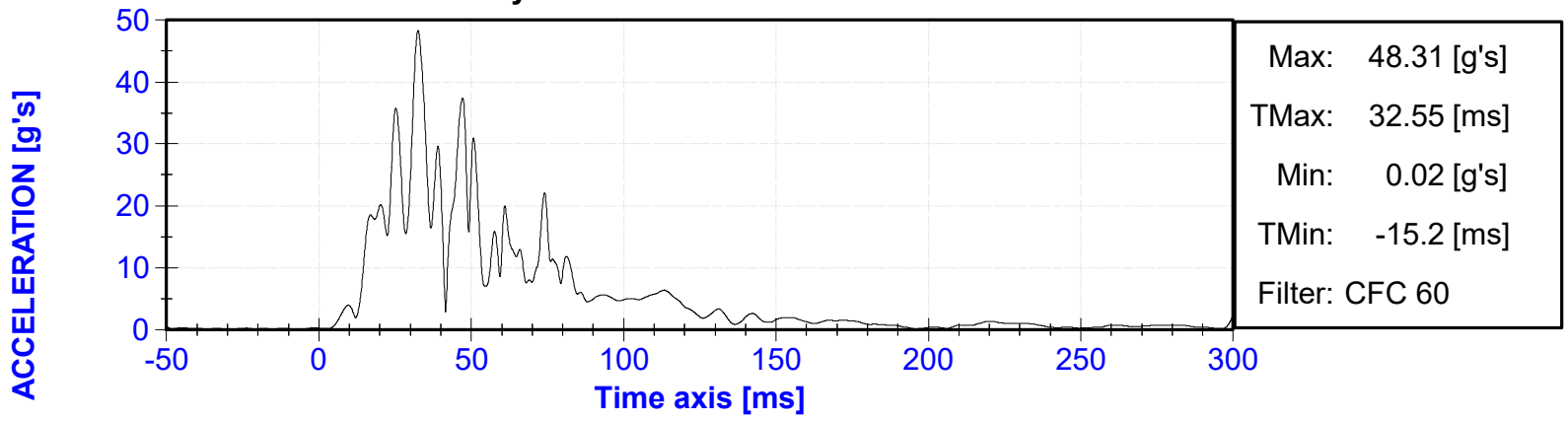
Vehicle Center of Gravity (Z) Acceleration vs. Time



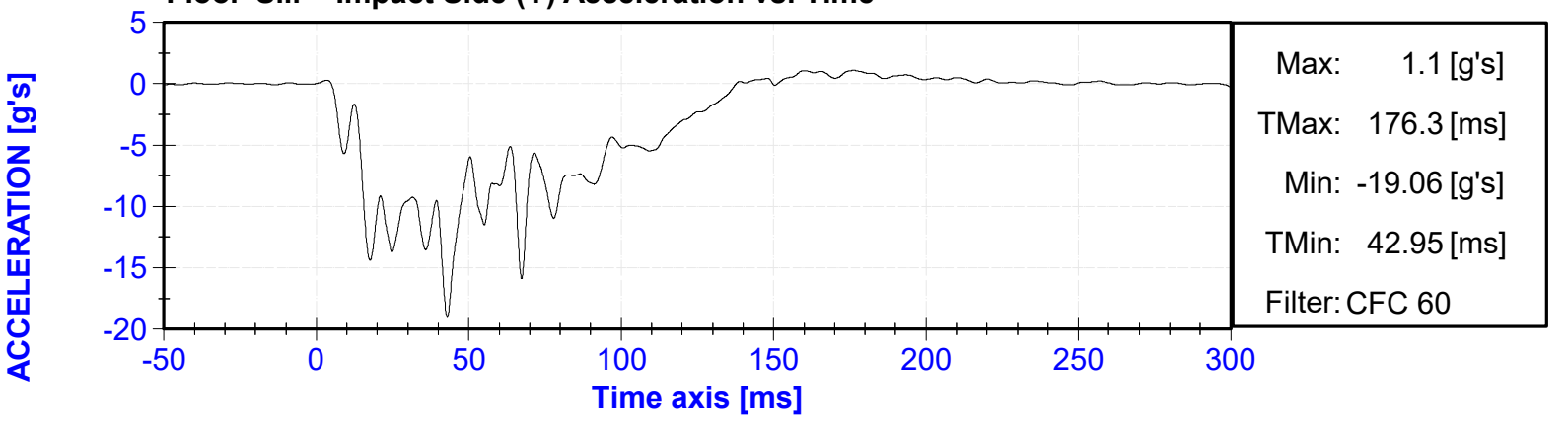
Vehicle Center of Gravity (Z) Velocity vs. Time



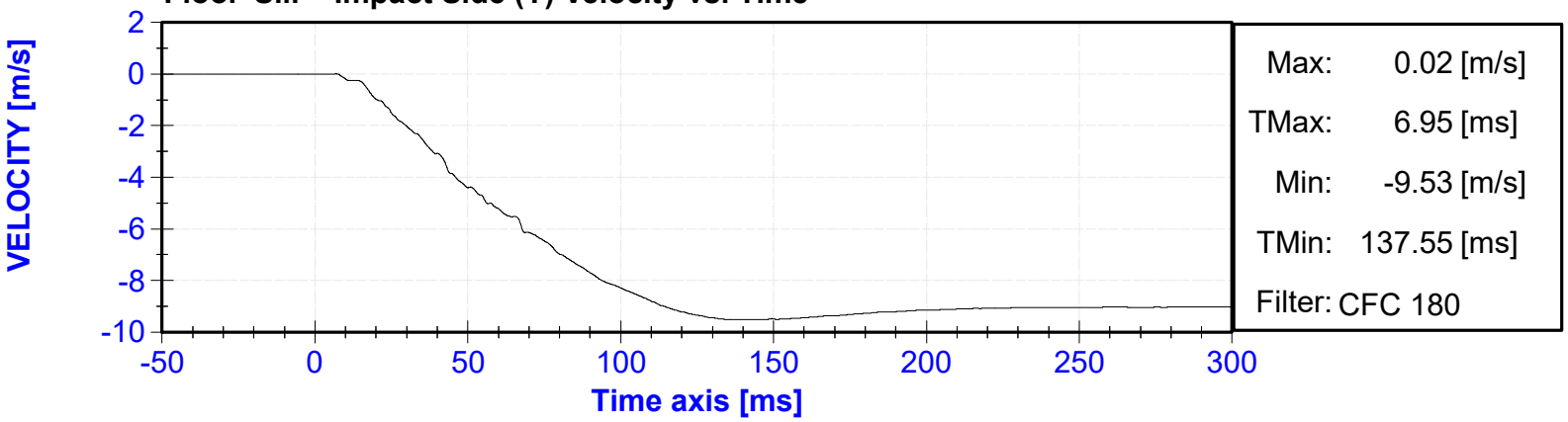
Vehicle Center of Gravity Resultant Acceleration vs. Time



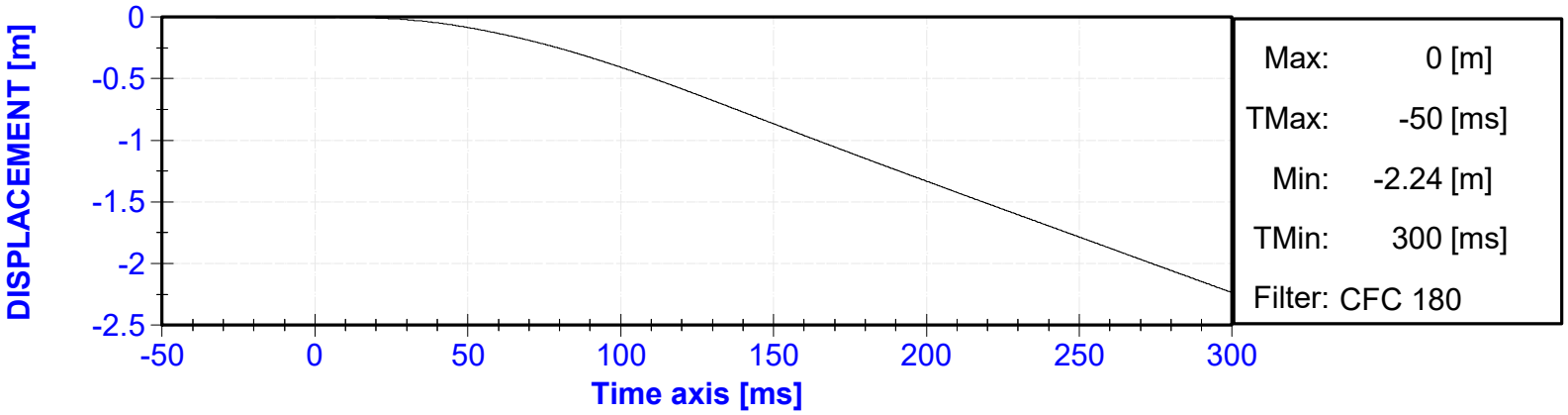
Floor Sill – Impact Side (Y) Acceleration vs. Time



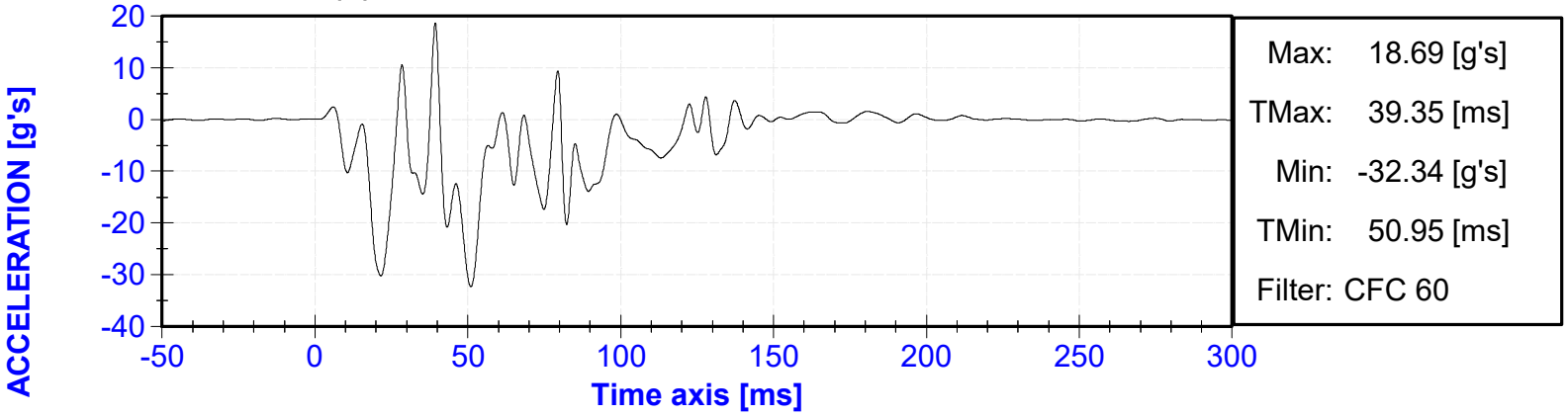
Floor Sill – Impact Side (Y) Velocity vs. Time



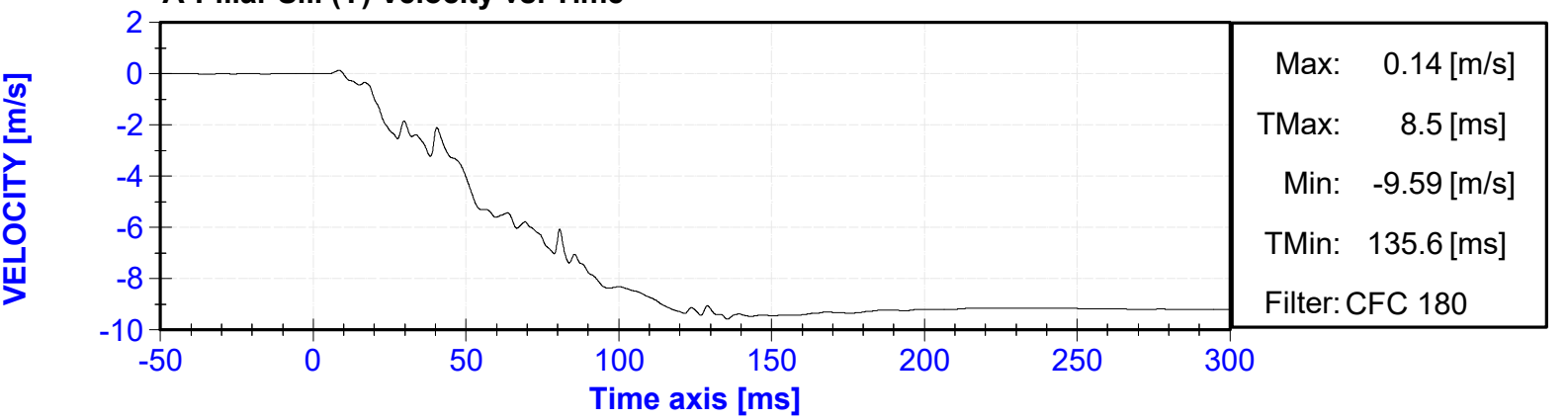
Floor Sill – Impact Side (Y) Displacement vs. Time

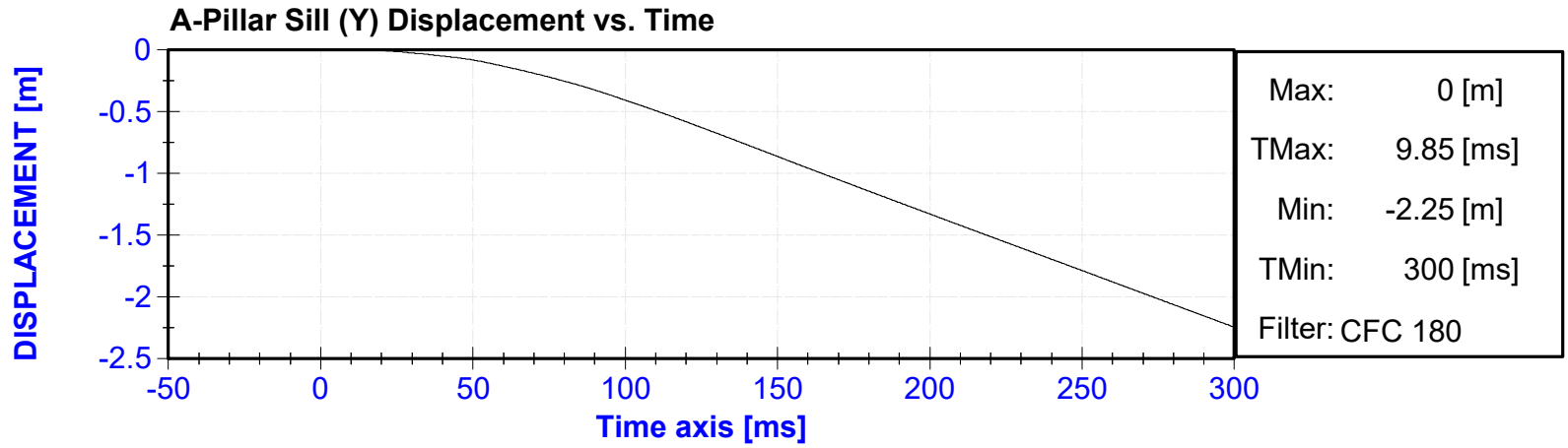


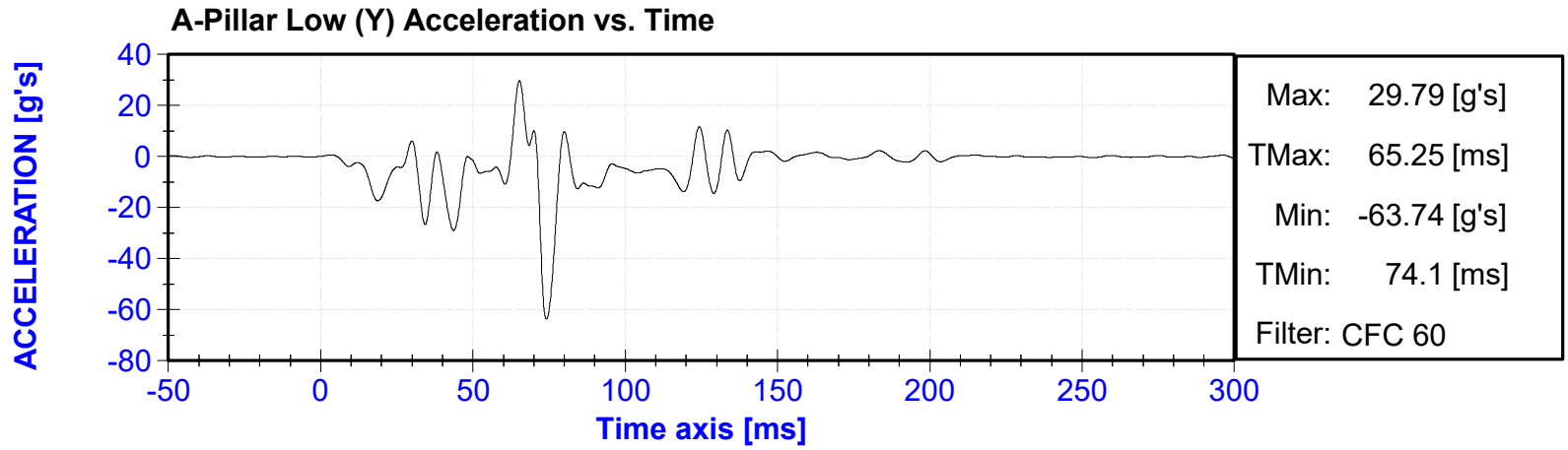
A-Pillar Sill (Y) Acceleration vs. Time

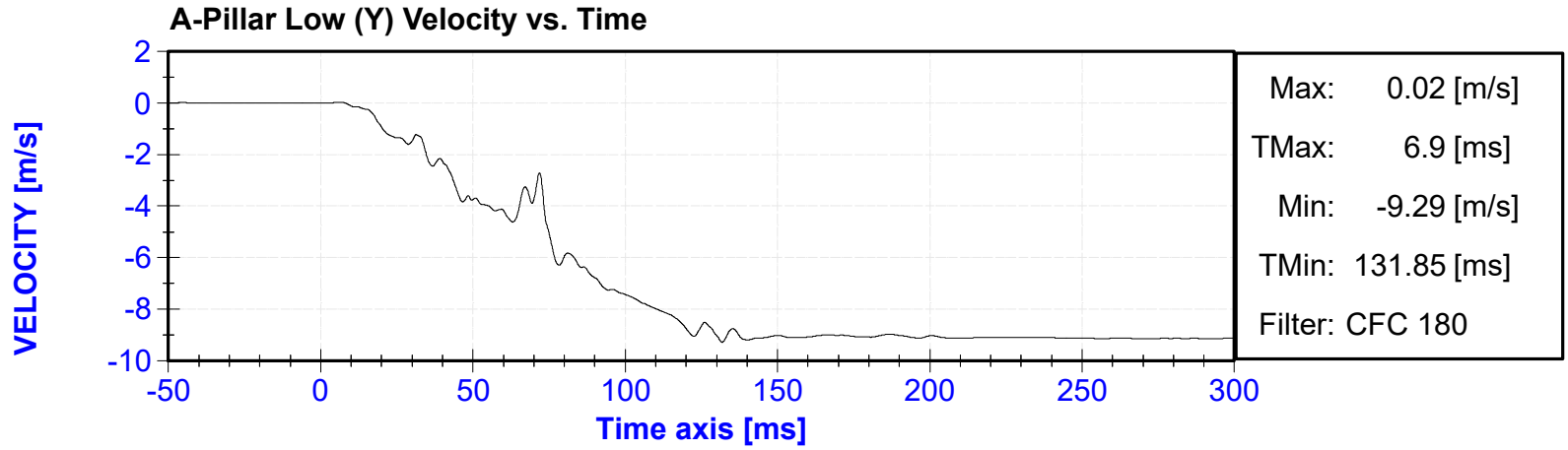


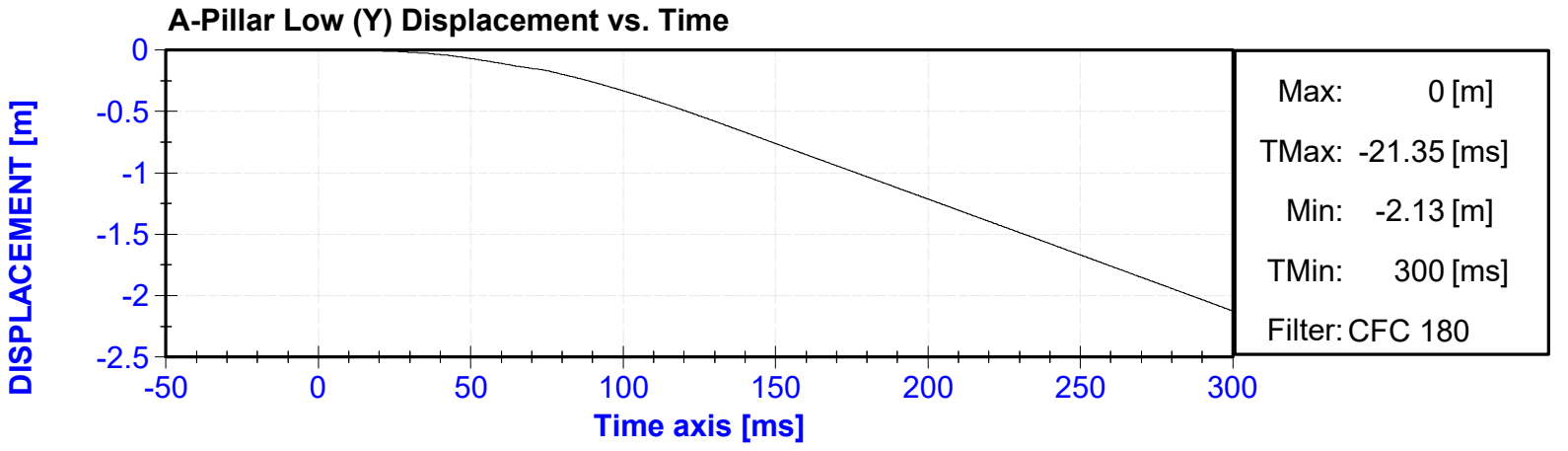
A-Pillar Sill (Y) Velocity vs. Time

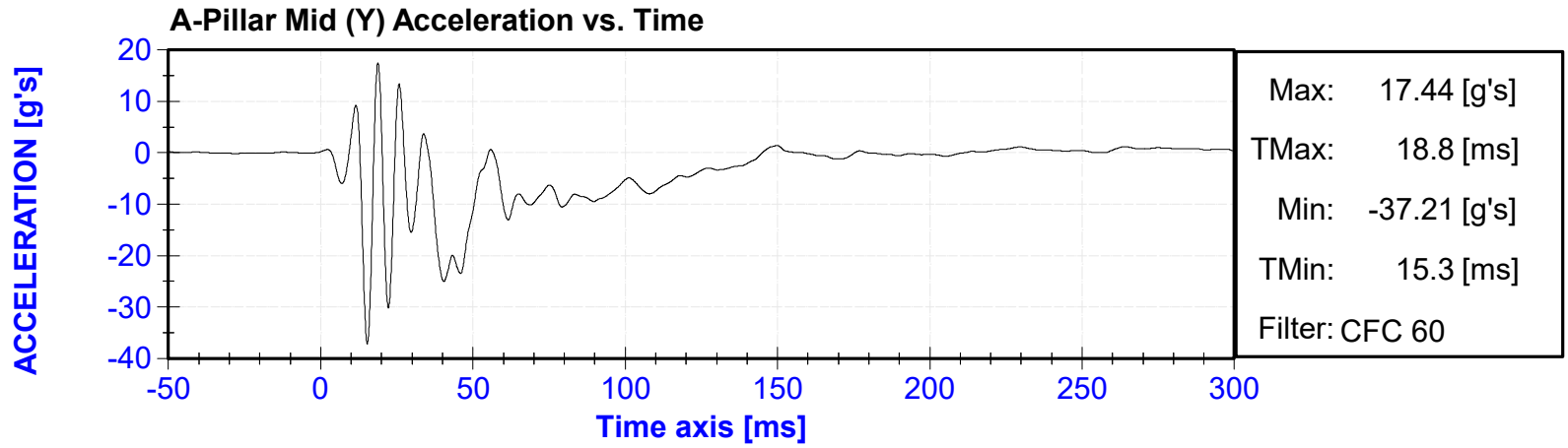


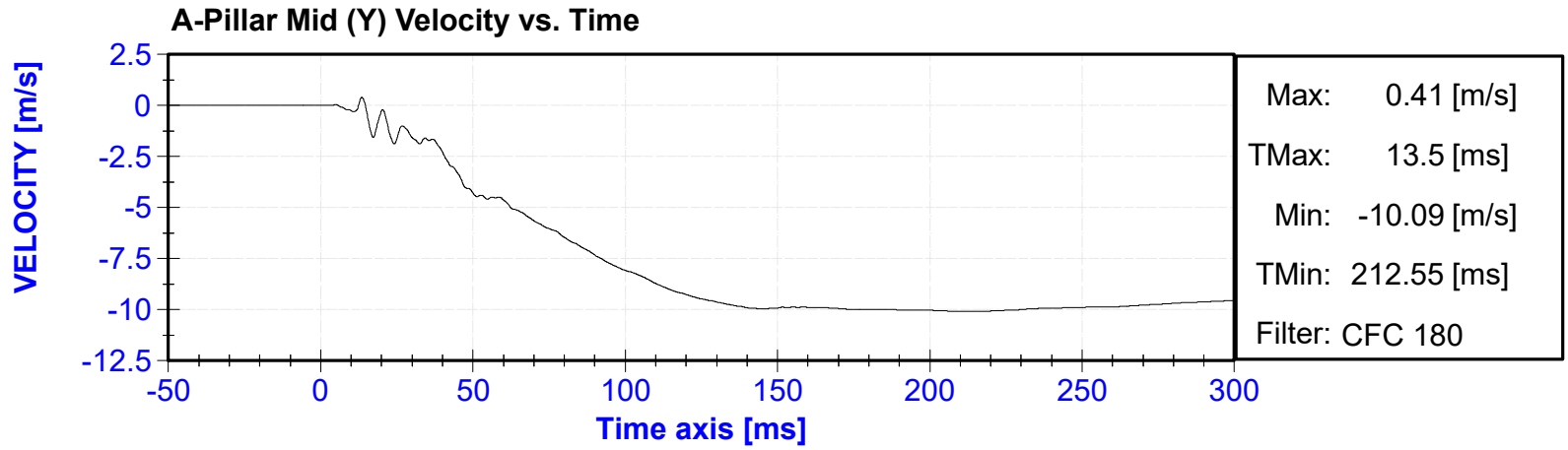

A-Pillar Sill (Y) Displacement vs. Time
DISPLACEMENT [m]
0
-0.5
-1
-1.5
-2
-2.5
-50
0
50
100
150
200
250
300
Time axis [ms]
Max: 0 [m]
TMax: 9.85 [ms]
Min: -2.25 [m]
TMin: 300 [ms]
Filter: CFC 180

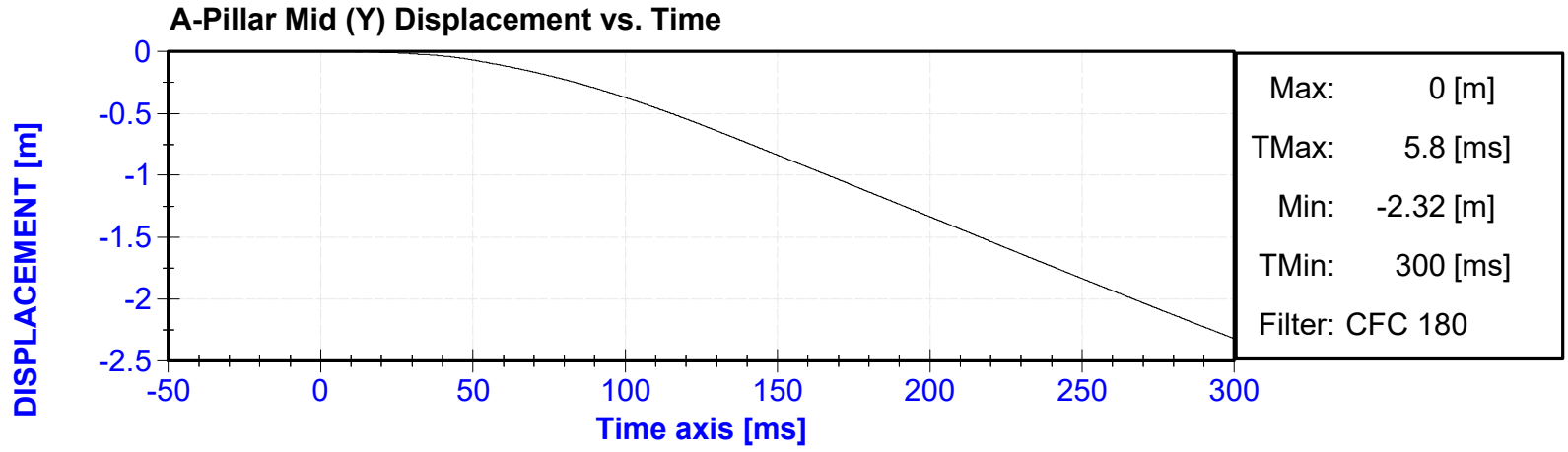

A-Pillar Low (Y) Acceleration vs. Time
ACCELERATION [g's]
40
20
0
-20
-40
-60
-80
-50
0
50
100
150
200
250
300
Time axis [ms]
Max: 29.79 [g's]
TMax: 65.25 [ms]
Min: -63.74 [g's]
TMin: 74.1 [ms]
Filter: CFC 60


A-Pillar Low (Y) Velocity vs. Time
VELOCITY [m/s]
2
0
-2
-4
-6
-8
-10
-50
0
50
100
150
200
250
300
Time axis [ms]
Max: 0.02 [m/s]
TMax: 6.9 [ms]
Min: -9.29 [m/s]
TMin: 131.85 [ms]
Filter: CFC 180

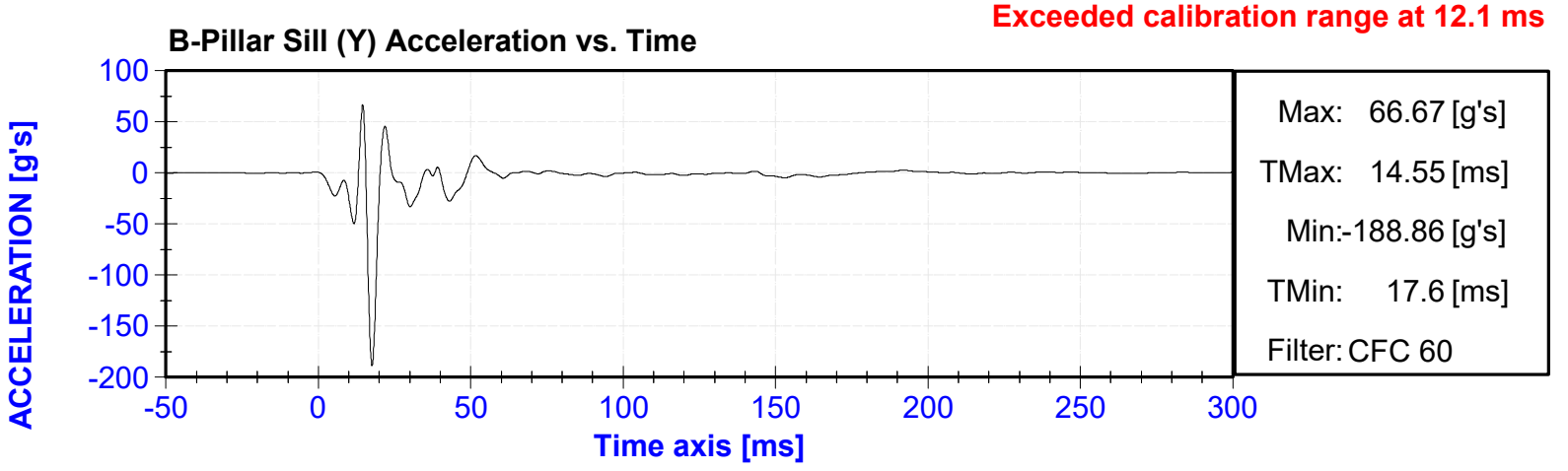

A-Pillar Low (Y) Displacement vs. Time
DISPLACEMENT [m]
0
-0.5
-1
-1.5
-2
-2.5
-50
0
50
100
150
200
250
300
Time axis [ms]
Max: 0 [m]
TMax: -21.35 [ms]
Min: -2.13 [m]
TMin: 300 [ms]
Filter: CFC 180



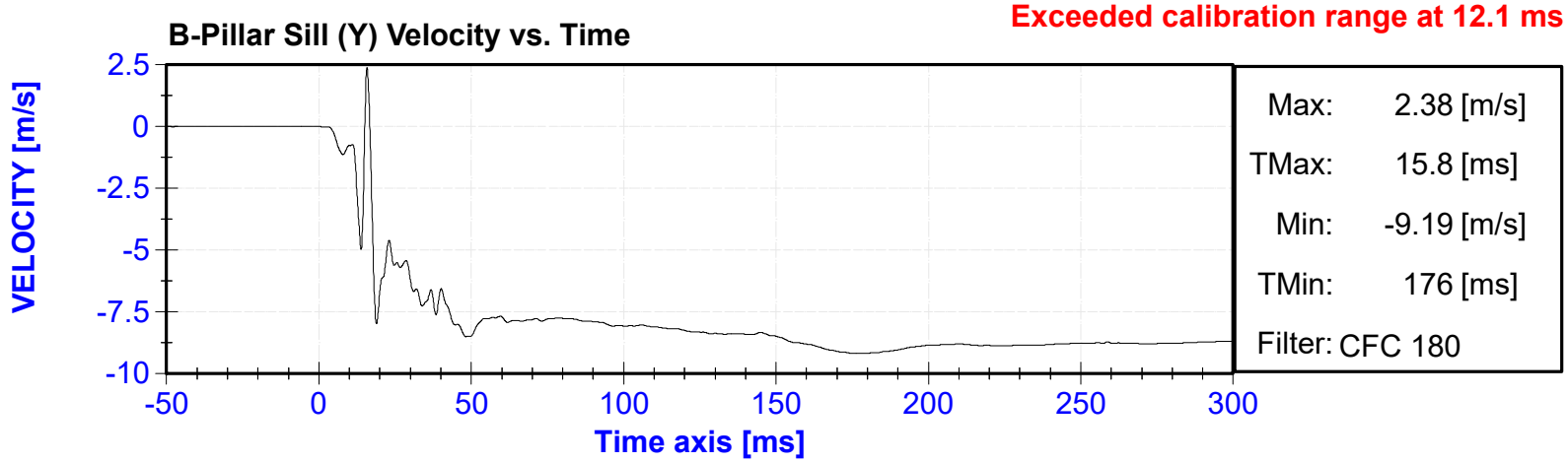




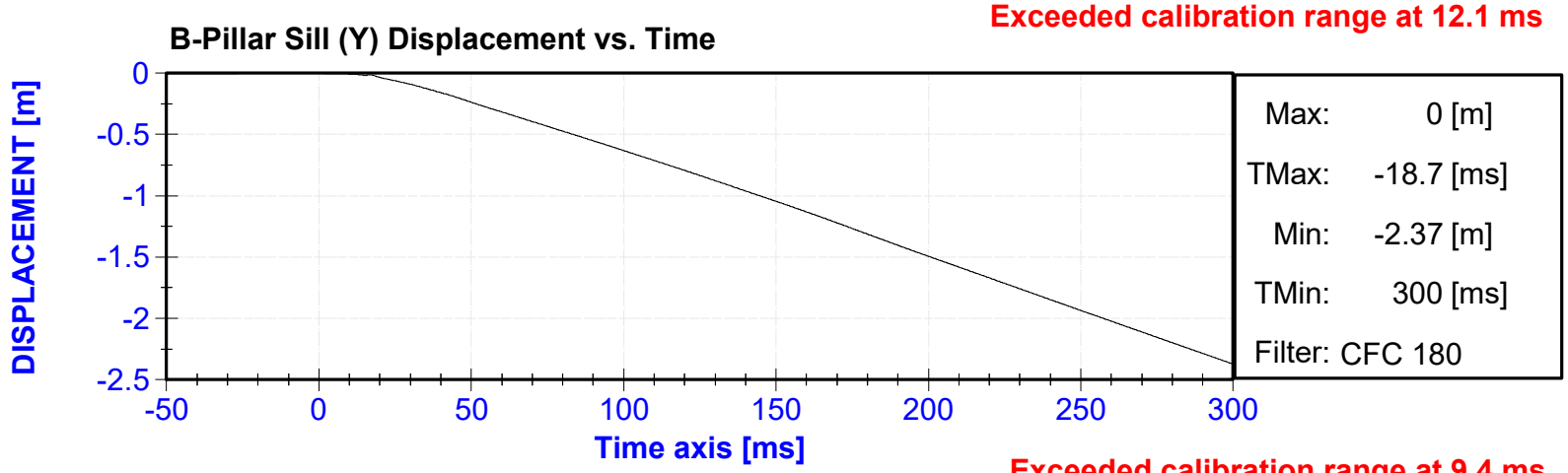
Exceeded calibration range at 12.1 ms



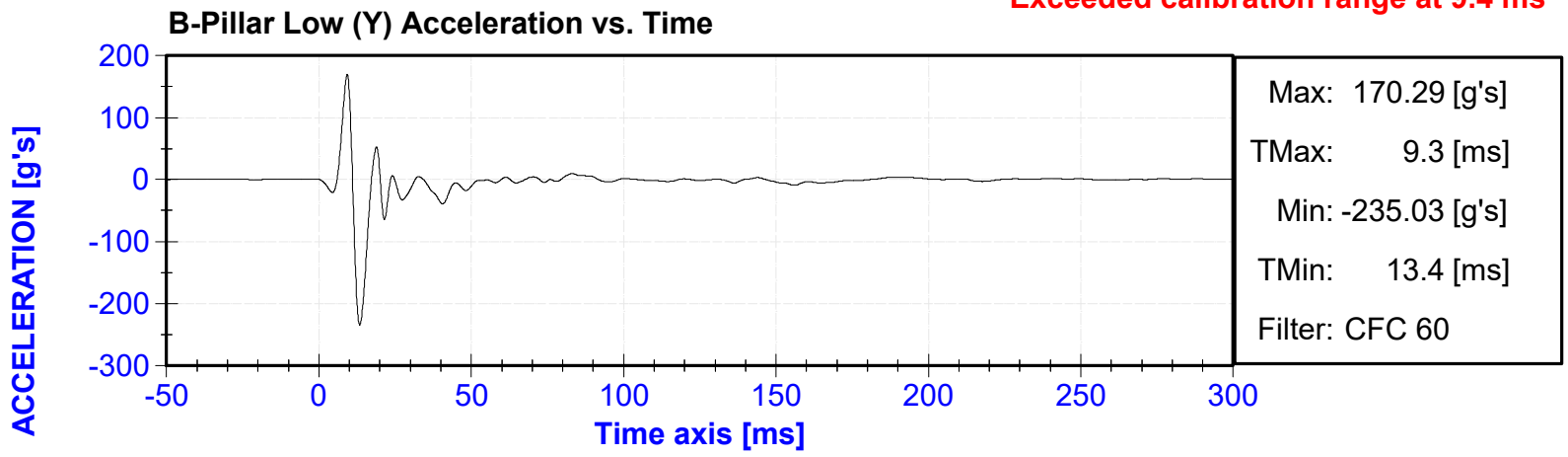
Exceeded calibration range at 12.1 ms



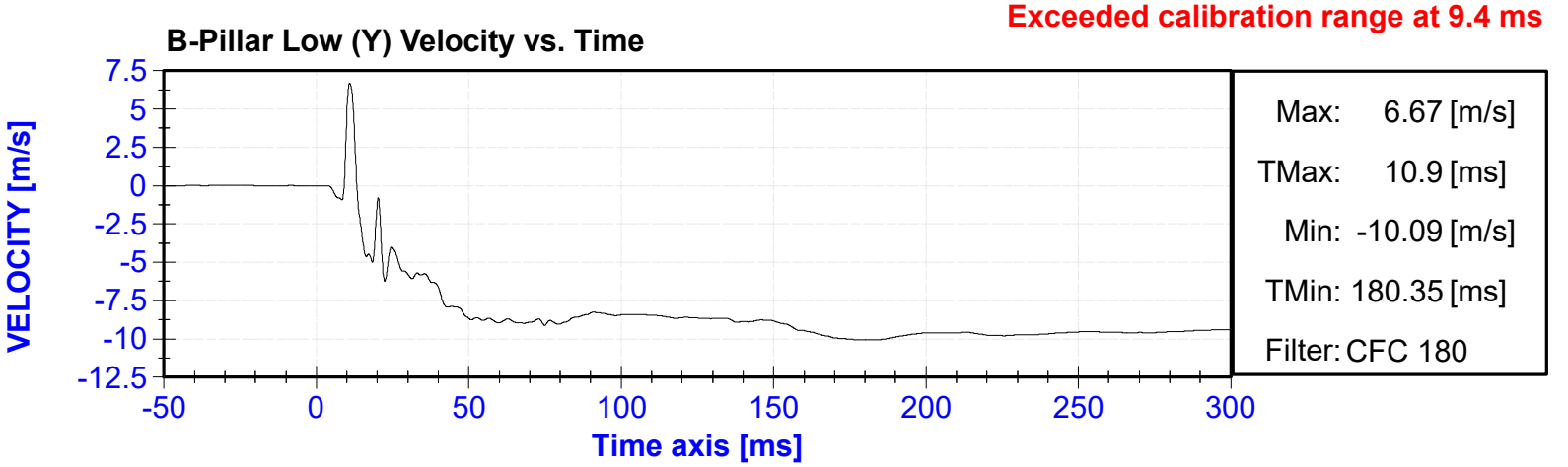
Exceeded calibration range at 12.1 ms



Exceeded calibration range at 9.4 ms

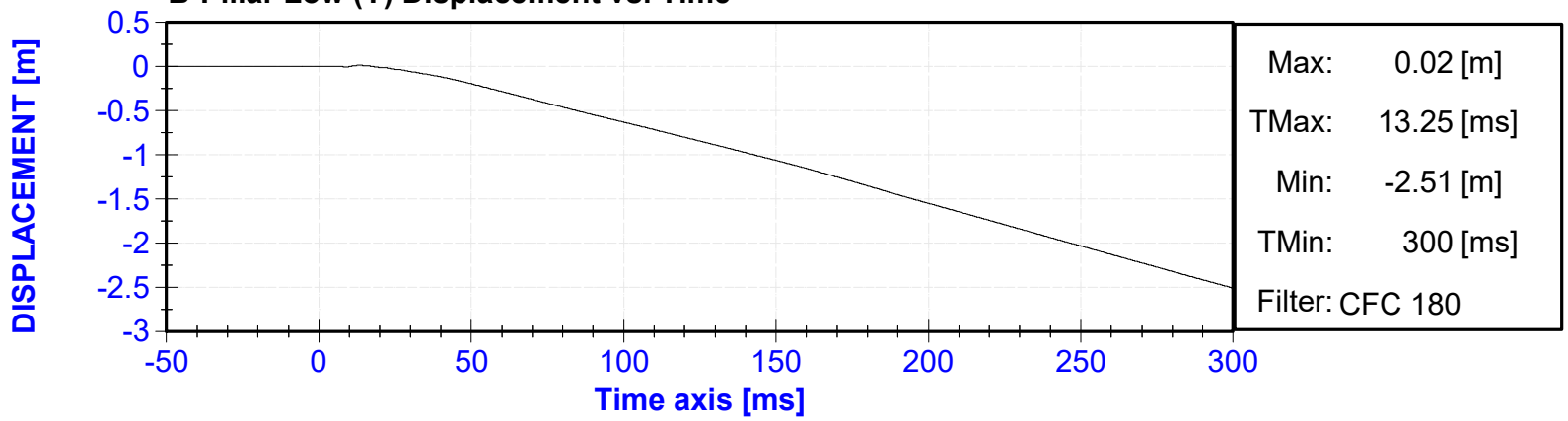


Exceeded calibration range at 9.4 ms



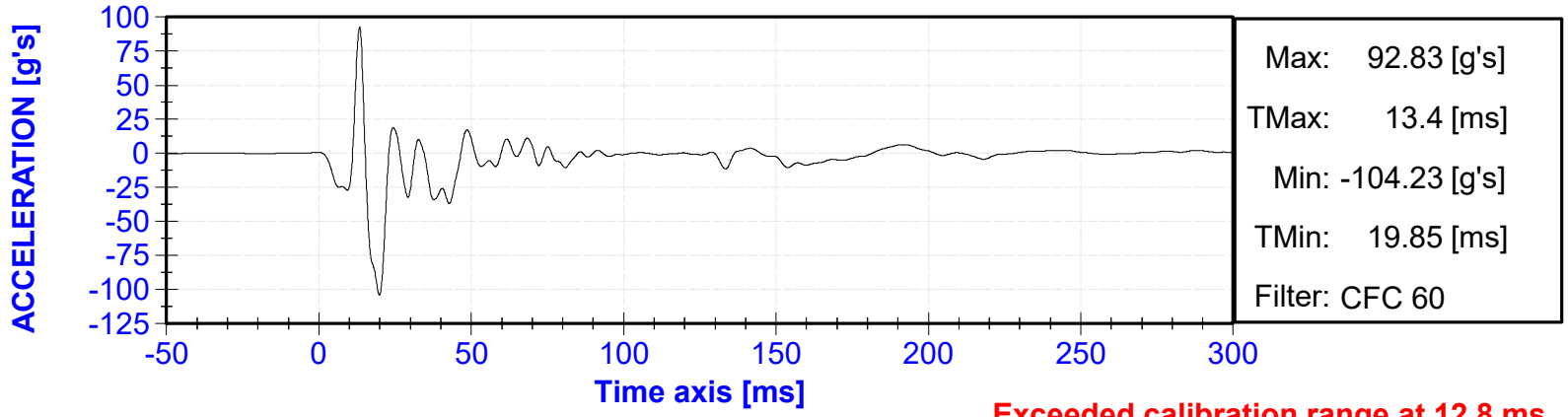
Exceeded calibration range at 9.4 ms

B-Pillar Low (Y) Displacement vs. Time



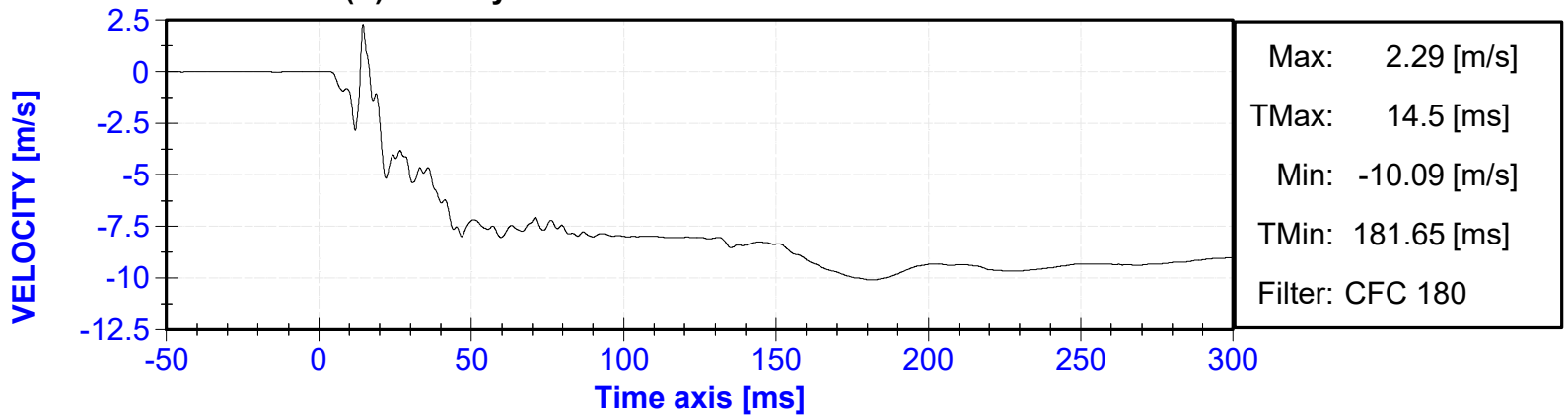
Exceeded calibration range at 12.8 ms

B-Pillar Mid (Y) Acceleration vs. Time



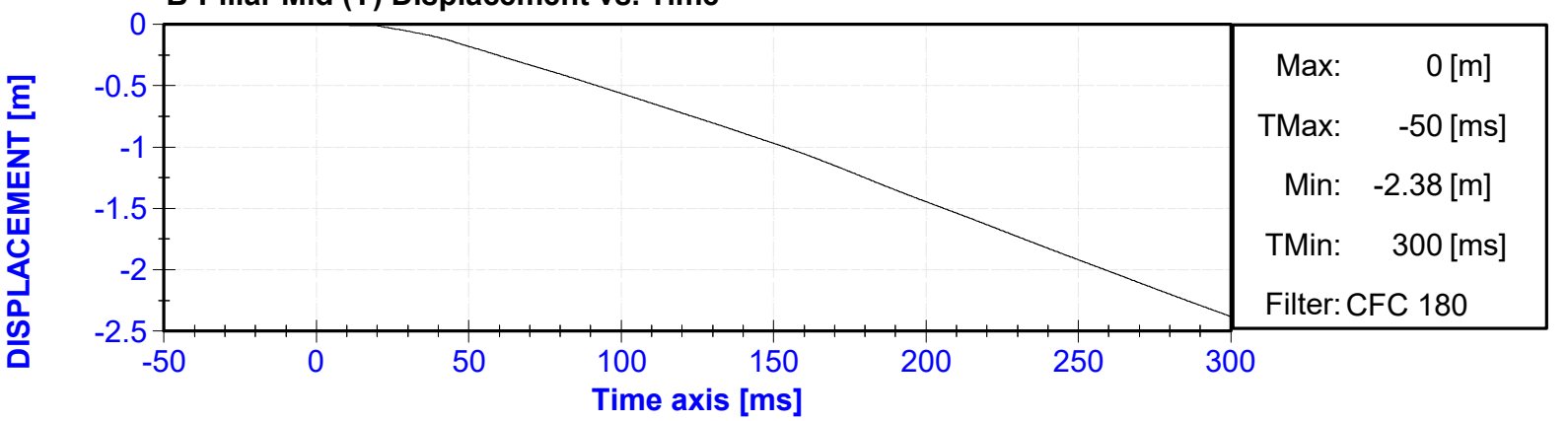
Exceeded calibration range at 12.8 ms

B-Pillar Mid (Y) Velocity vs. Time

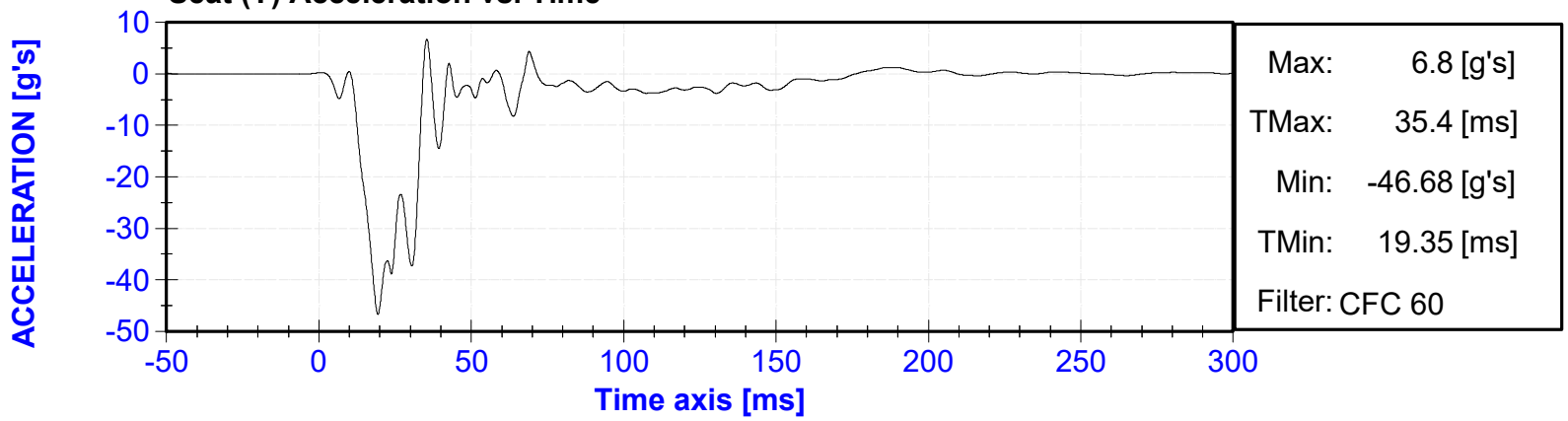


Exceeded calibration range at 12.8 ms

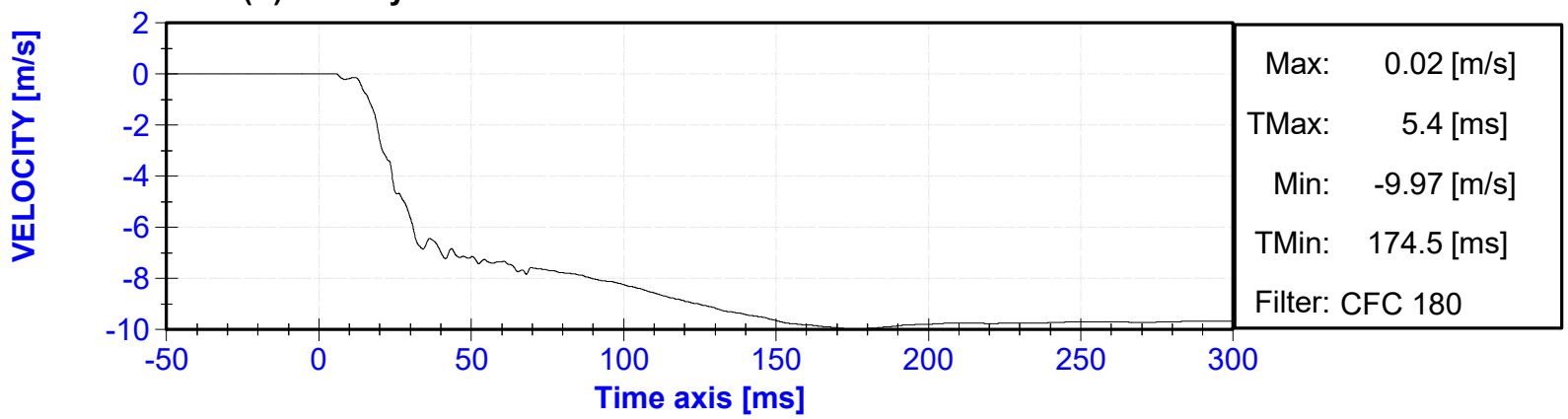
B-Pillar Mid (Y) Displacement vs. Time



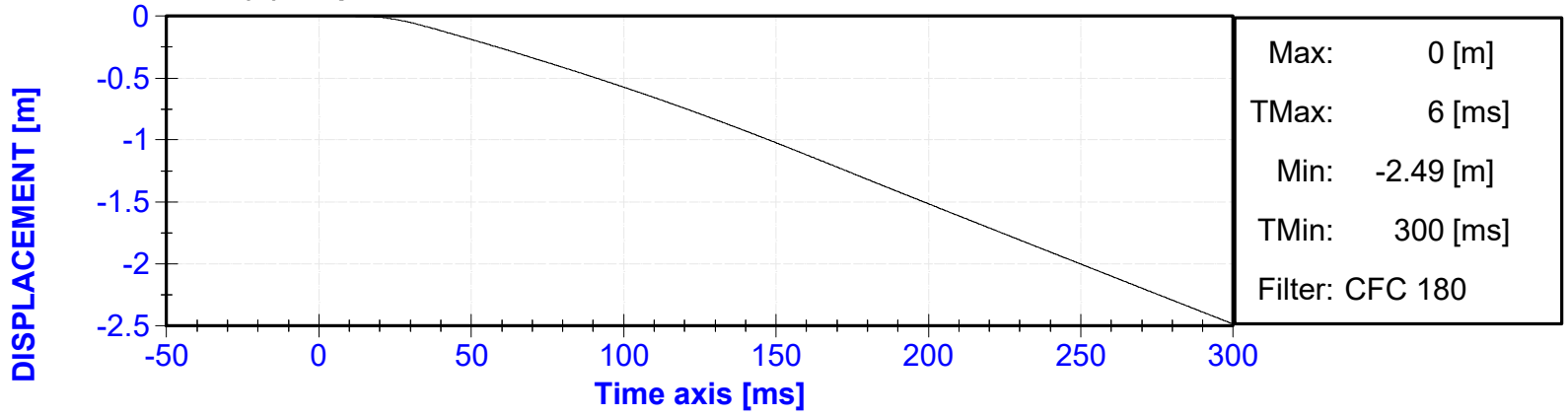
Seat (Y) Acceleration vs. Time



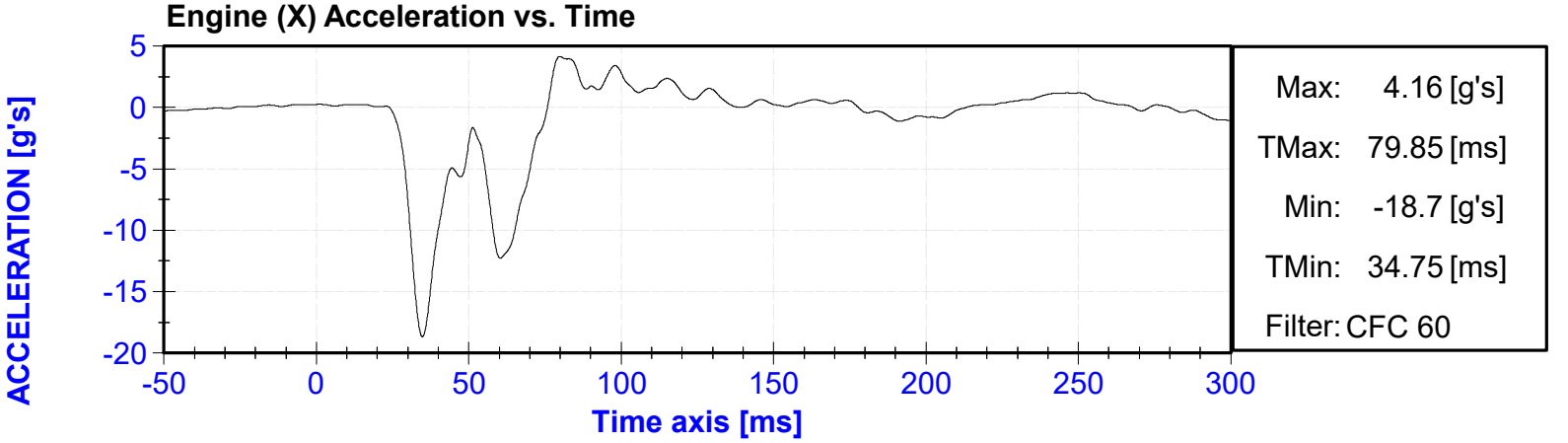
Seat (Y) Velocity vs. Time



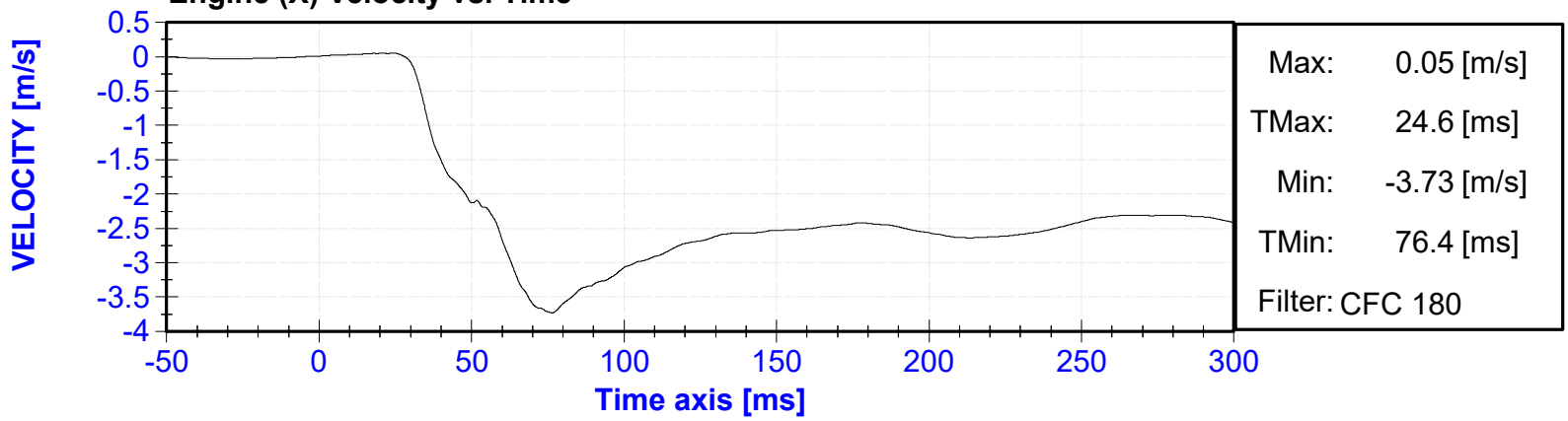
Seat (Y) Displacement vs. Time



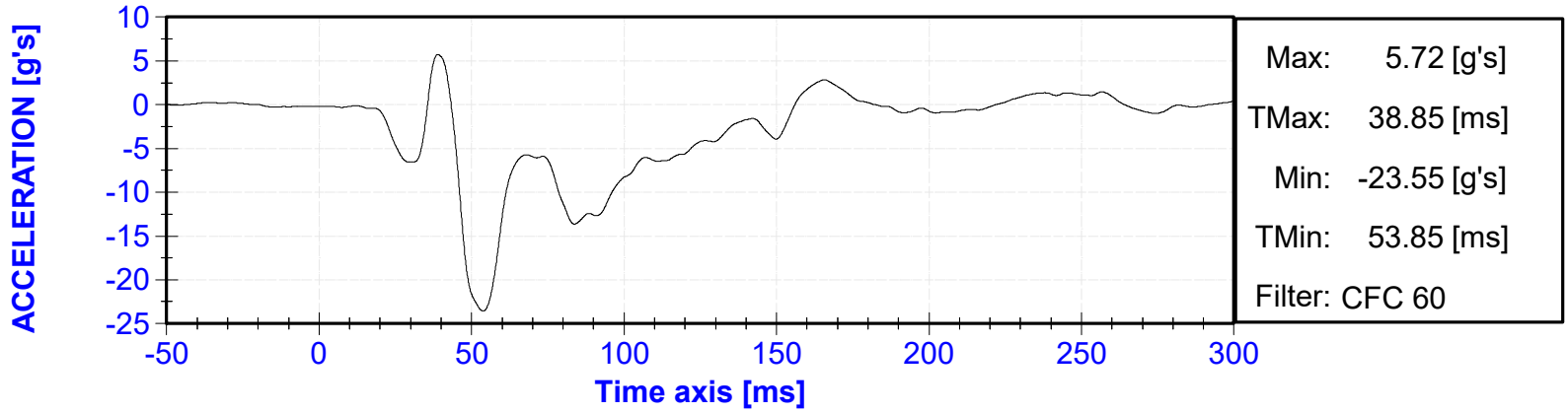
Engine (X) Acceleration vs. Time



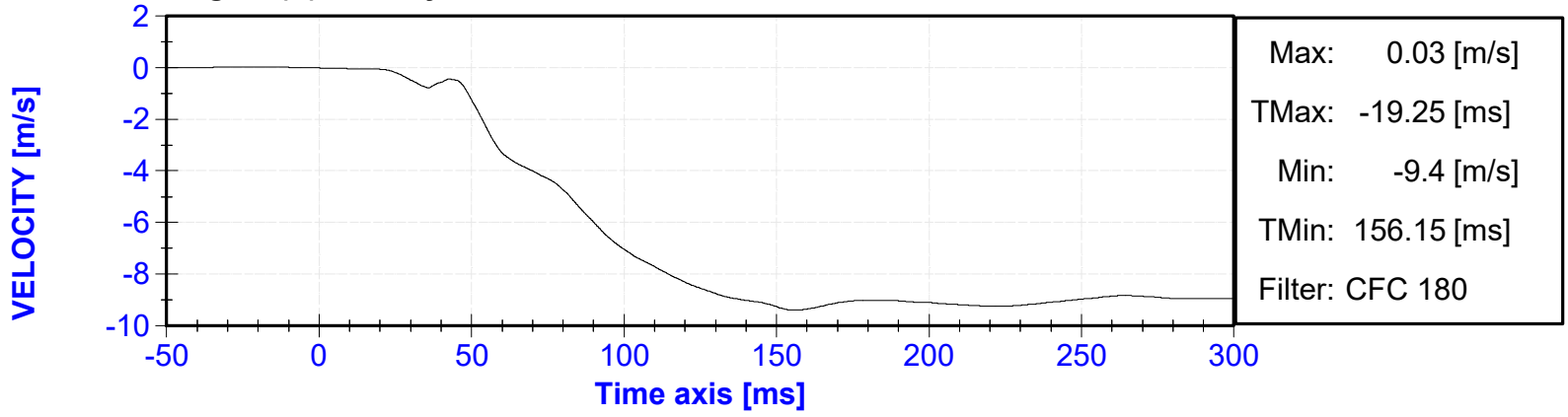
Engine (X) Velocity vs. Time



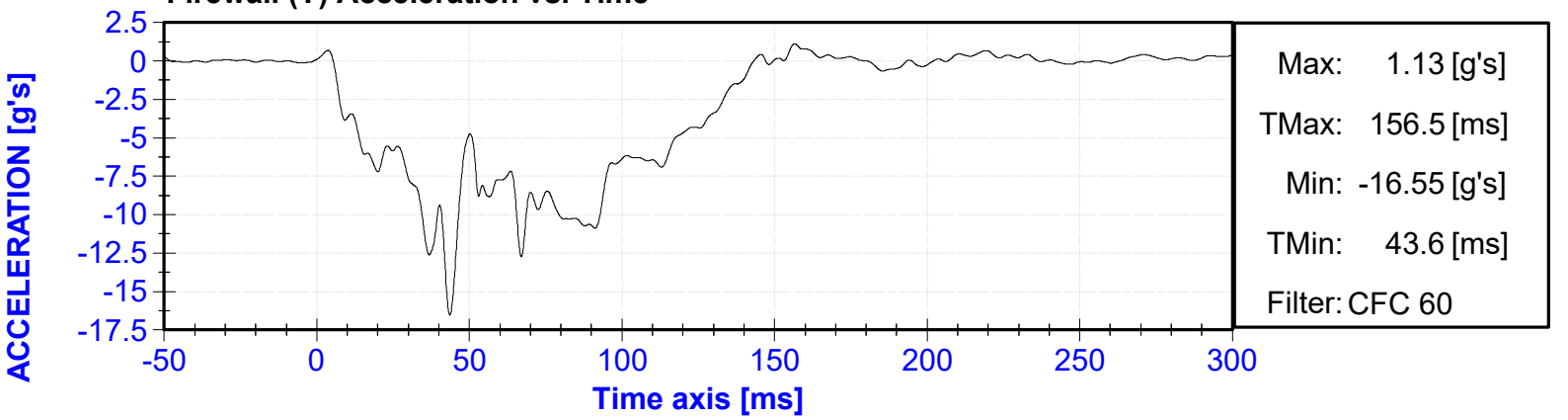
Engine (Y) Acceleration vs. Time



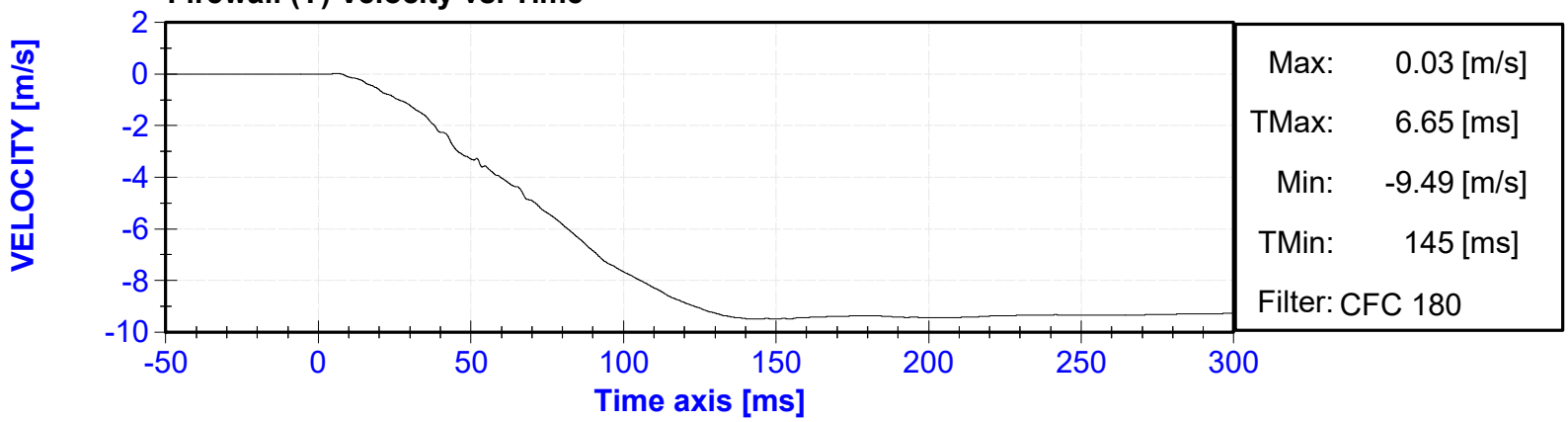
Engine (Y) Velocity vs. Time



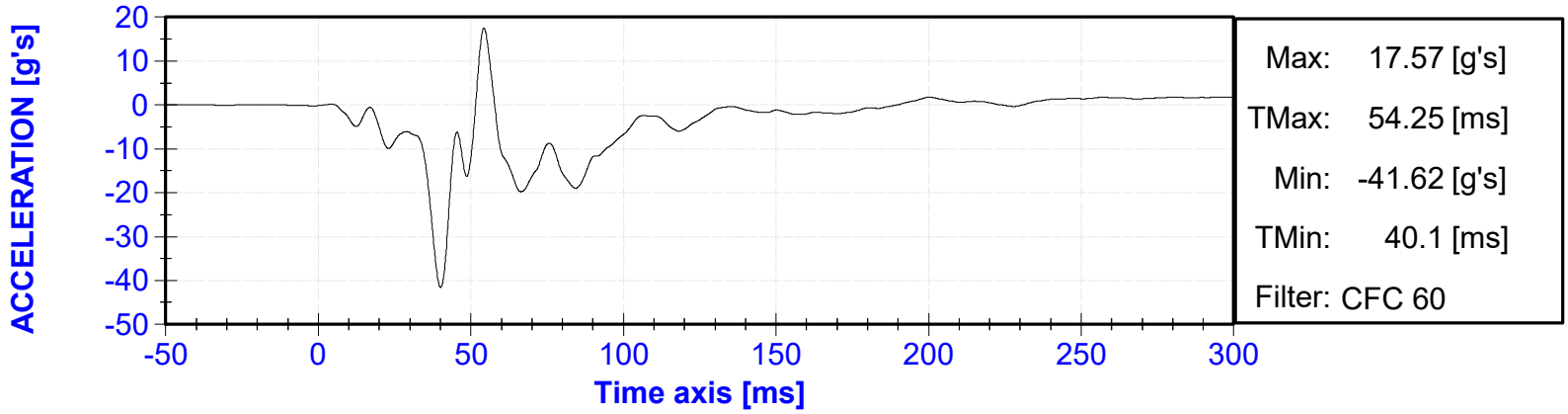
Firewall (Y) Acceleration vs. Time



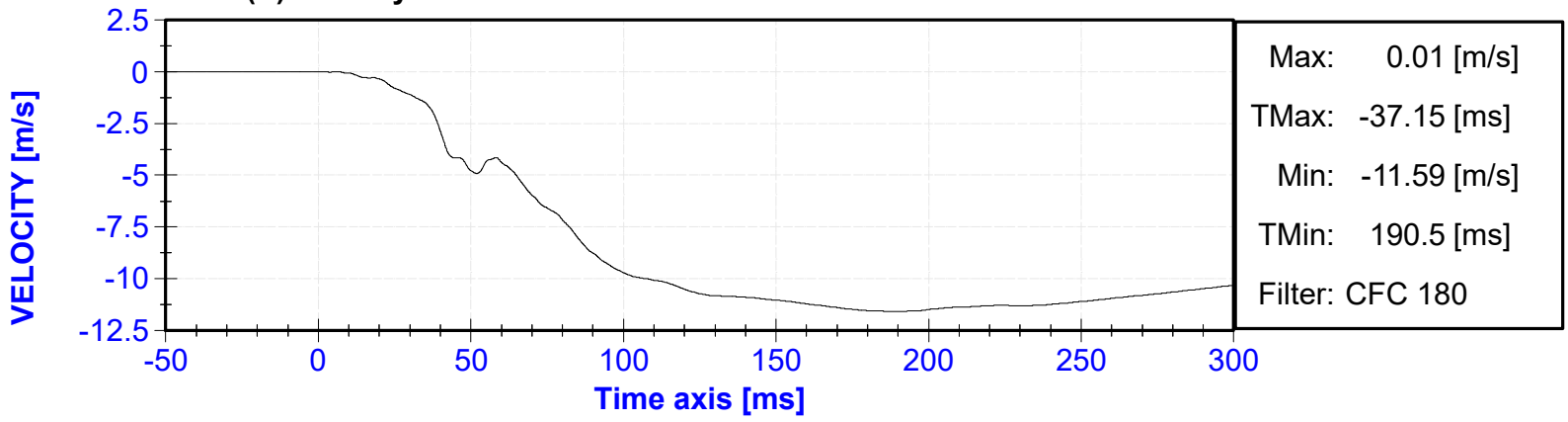
Firewall (Y) Velocity vs. Time



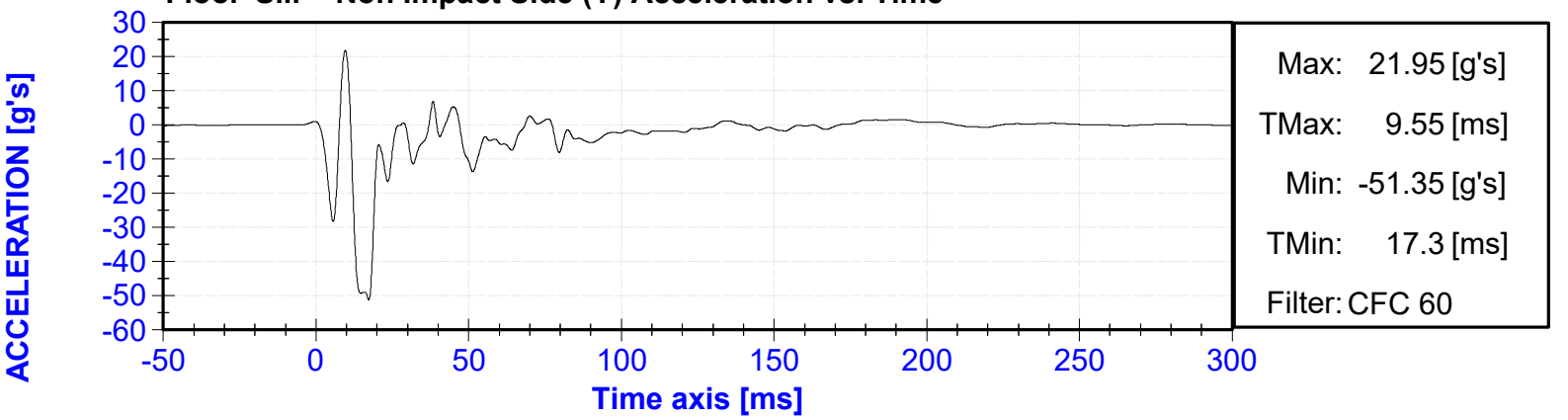
Roof (Y) Acceleration vs. Time



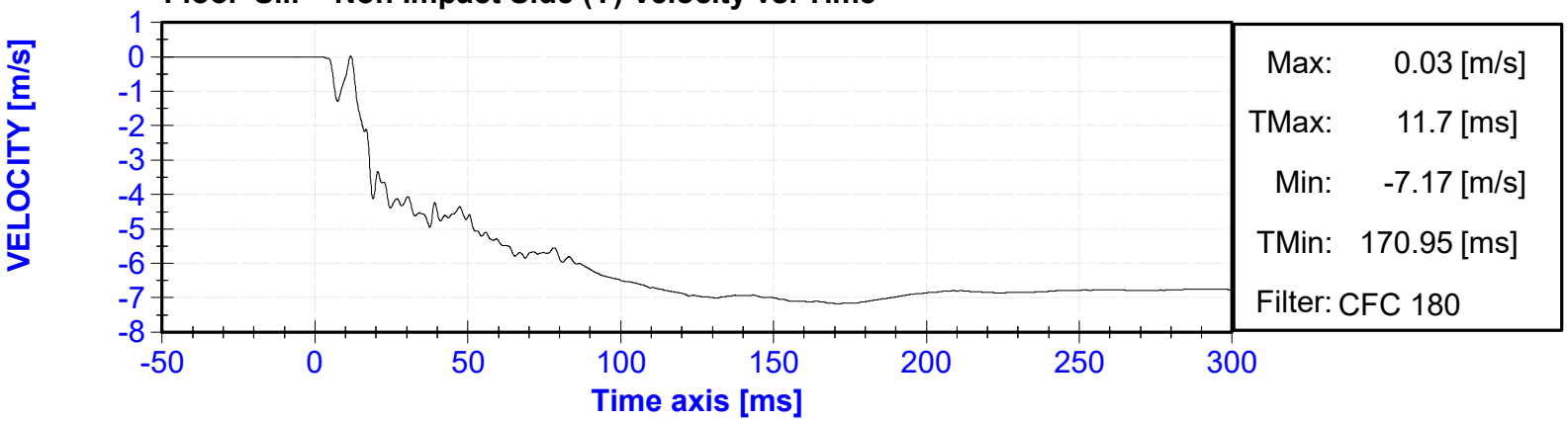
Roof (Y) Velocity vs. Time



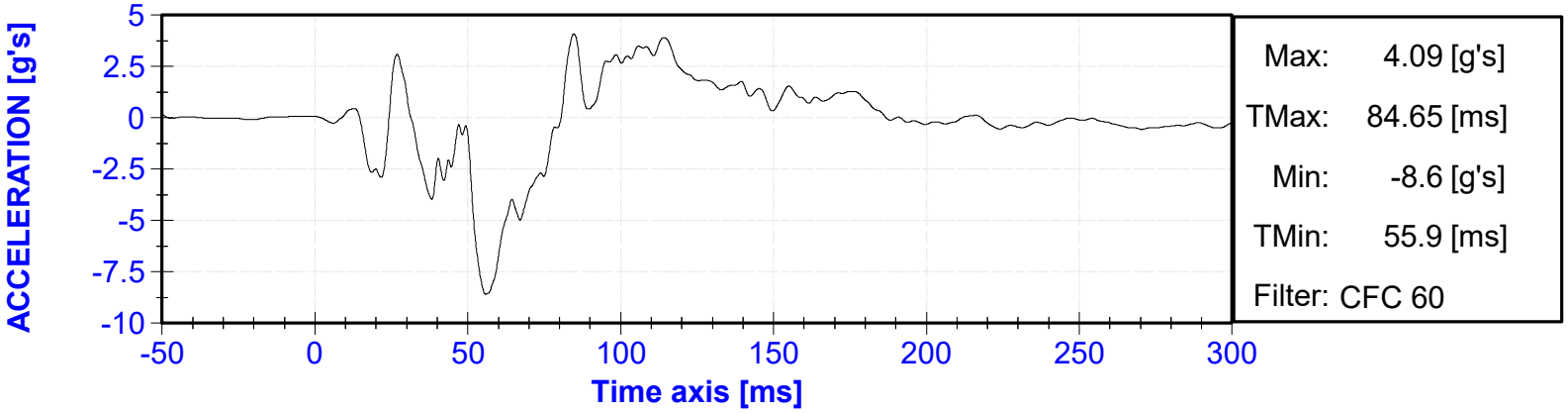
Floor Sill – Non Impact Side (Y) Acceleration vs. Time



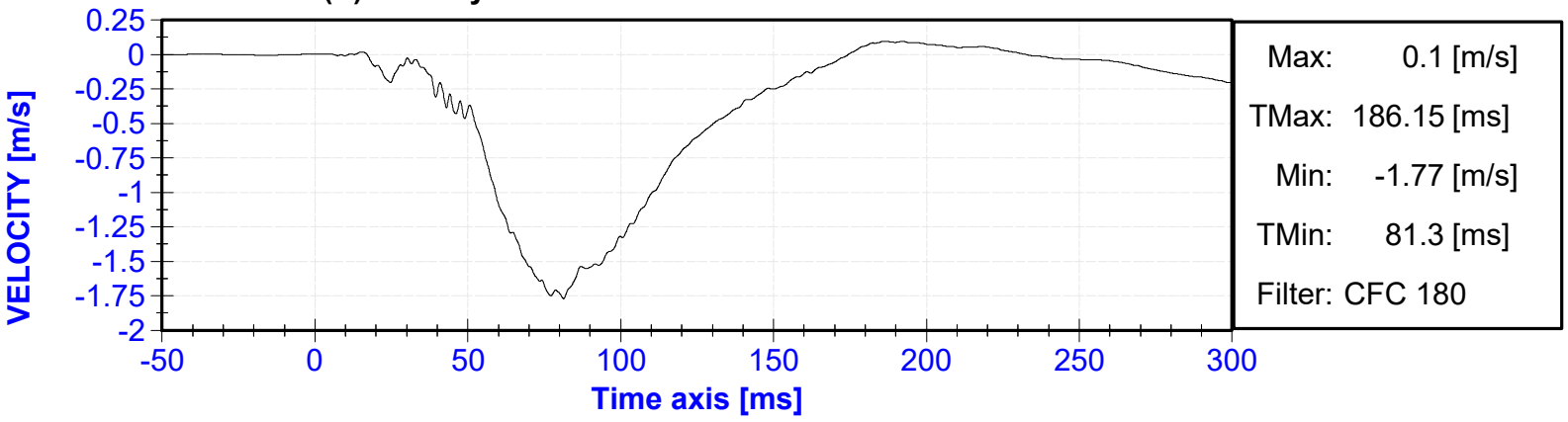
Floor Sill – Non Impact Side (Y) Velocity vs. Time



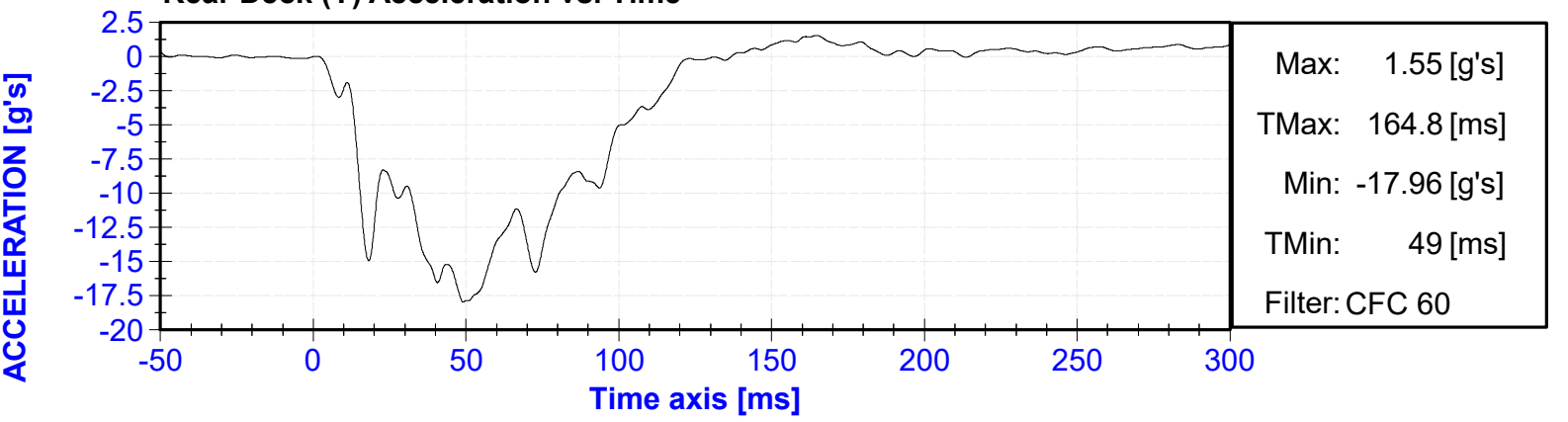
Rear Deck (X) Acceleration vs. Time

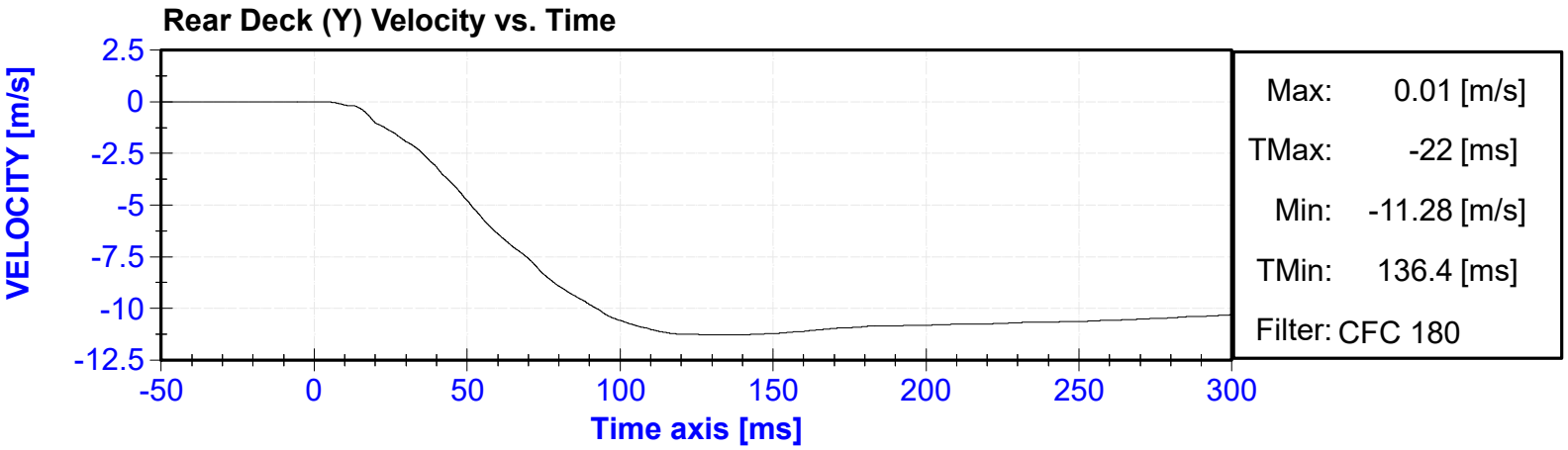


Rear Deck (X) Velocity vs. Time



Rear Deck (Y) Acceleration vs. Time




Rear Deck (Y) Velocity vs. Time
VELOCITY [m/s]
2.5
0
-2.5
-5
-7.5
-10
-12.5
-50
0
50
100
150
200
250
300
Time axis [ms]
Max: 0.01 [m/s]
TMax: -22 [ms]
Min: -11.28 [m/s]
TMin: 136.4 [ms]
Filter: CFC 180

APPENDIX IV

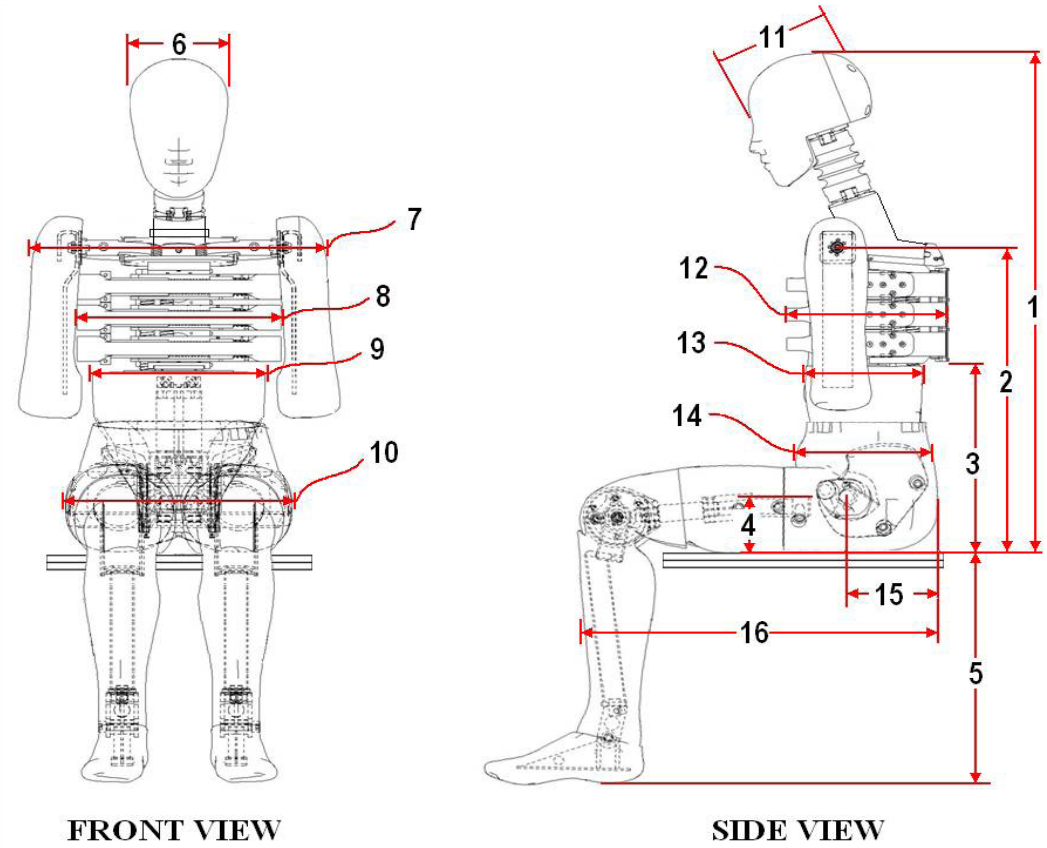
PRE-TEST DUMMY PERFORMANCE CALIBRATION TEST DATA

(Subpart U, ES-2re)

External Measurements - EuroSID-2re

Technician: K. Brogan Date: 05/02/2023

Dummy Serial Number: D037



FRONT VIEW SIDE VIEW

Dim. No.	Description	Specification (mm)		Result (mm)	Pass/Fail
1	Sitting Height	900	918	913	Pass
2	Seat to Shoulder Joint	558	572	564	Pass
3	Seat to Lower Face of Thoracic Spine Box	346	356	352	Pass
4	Seat to Hip Joint (center of bolt)	97	103	103	Pass
5	Sole to Seat, Sitting	333	451	421	Pass
6	Head Width	152	158	155	Pass
7	Shoulder/Arm Width	461	479	472	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	199	Pass
12	Thorax Depth	262	272	268	Pass
13	Abdomen Depth	194	204	200	Pass
14	Pelvis Depth	235	245	240	Pass
15	Back of Buttocks to Hip Joint (center of bolt)	150	160	154	Pass
16	Back of Buttocks to Front Knee	597	615	604	Pass

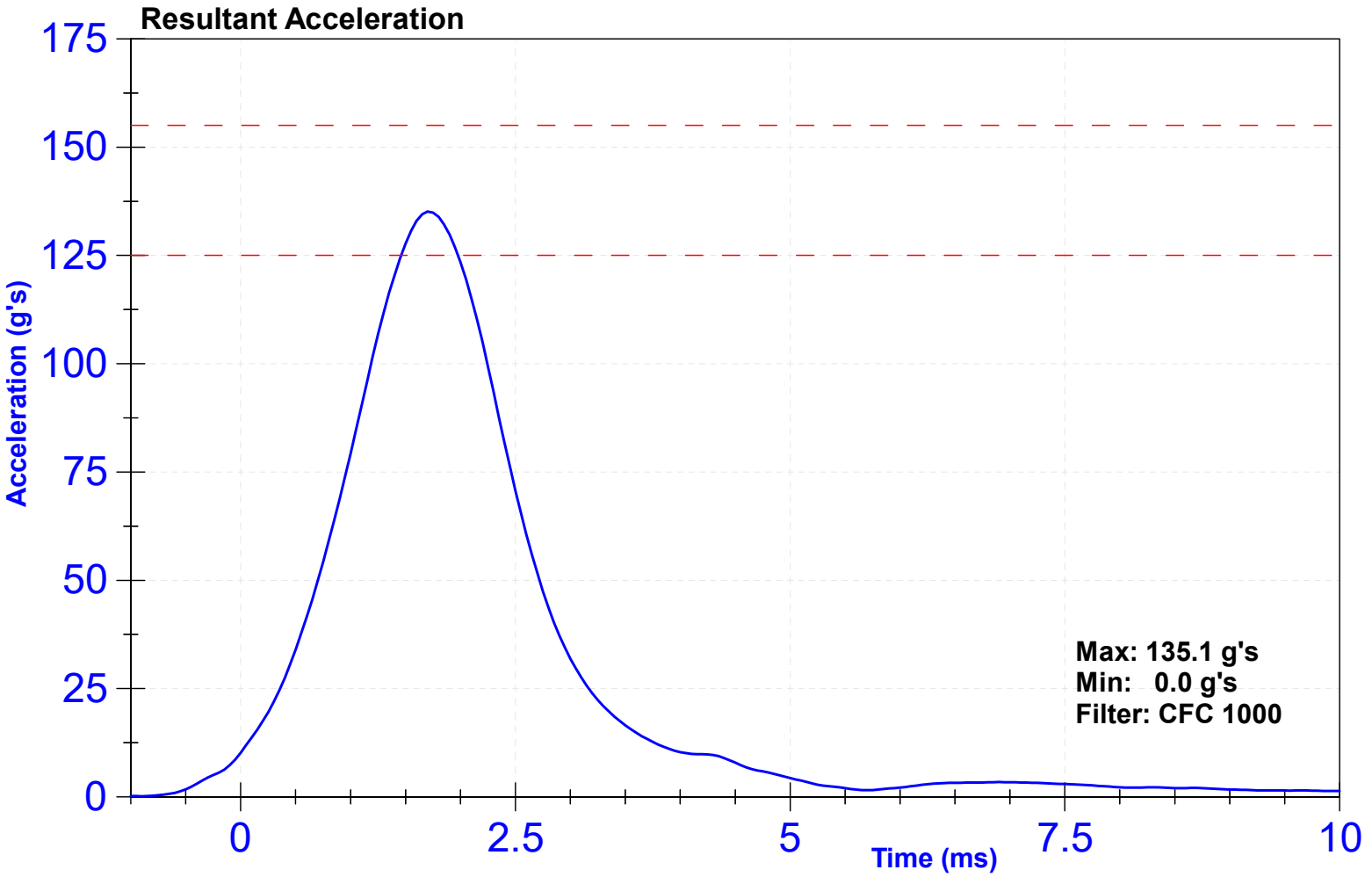
ATD Manufacturer	Denton	Test Technician	T. Roseman
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

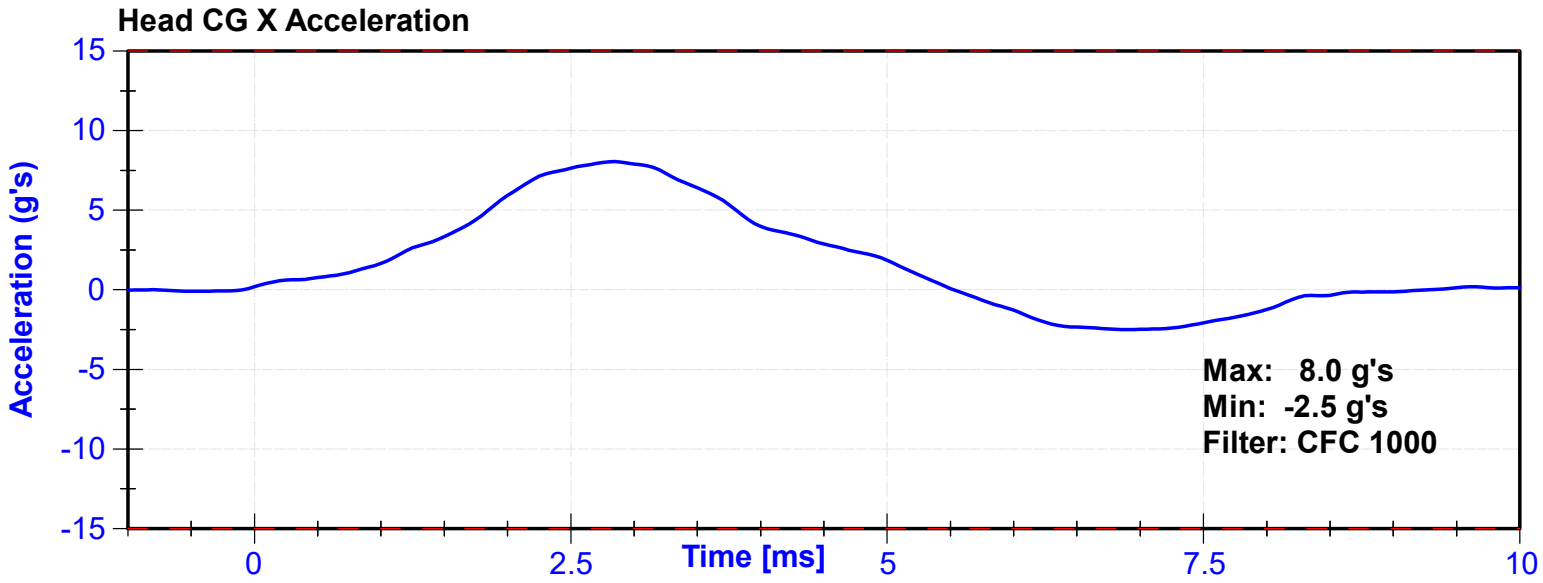
Results

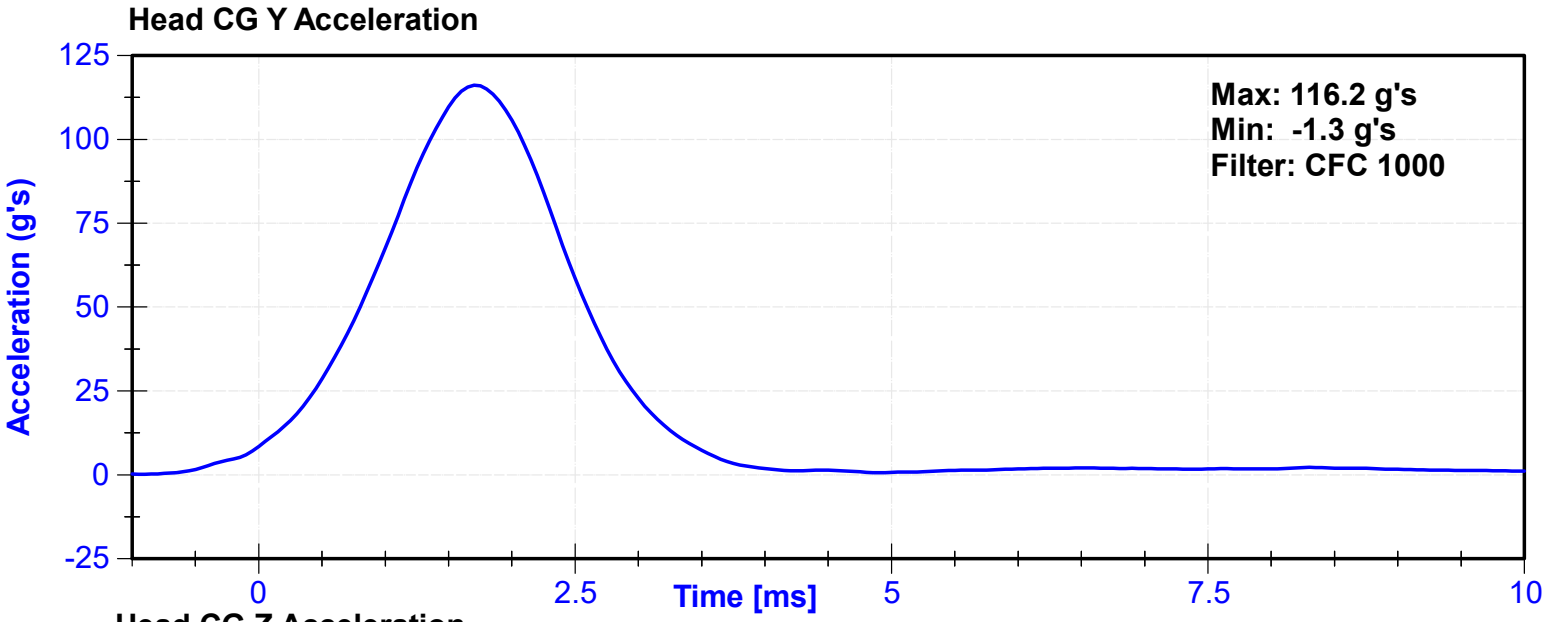
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.8	Pass
Humidity	10	70	%	20.5	Pass
Resultant Acceleration	125	155	g's	135.1	Pass
Oscillation	0	15	%	2.51	Pass
Fore-Aft Acceleration	-15	15	g's	8.0	Pass

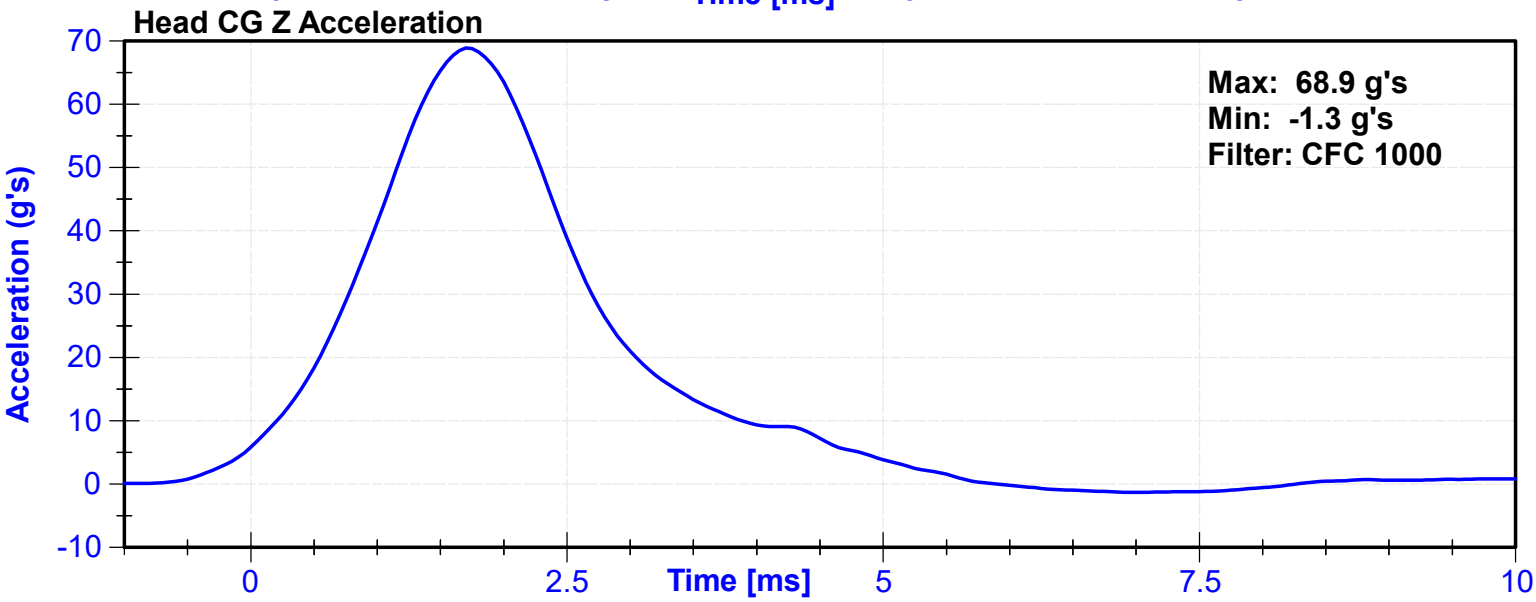
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	Endevco	T21724	2/27/2023	8/26/2023
Y Accelerometer	Endevco	T22281	2/27/2023	8/26/2023
Z Accelerometer	Endevco	T26050	2/27/2023	8/26/2023




Head CG X Acceleration
Acceleration (g's)
15
10
5
0
-5
-10
-15
0
2.5
5
7.5
10
Time [ms]
Max: 8.0 g's
Min: -2.5 g's
Filter: CFC 1000


Head CG Y Acceleration
Acceleration (g's)
125
100
75
50
25
0
-25
0
2.5
5
7.5
10
Time [ms]
Max: 116.2 g's
Min: -1.3 g's
Filter: CFC 1000


Head CG Z Acceleration
Acceleration (g's)
70
60
50
40
30
20
10
0
-10
0
2.5
5
7.5
10
Time [ms]
Max: 68.9 g's
Min: -1.3 g's
Filter: CFC 1000

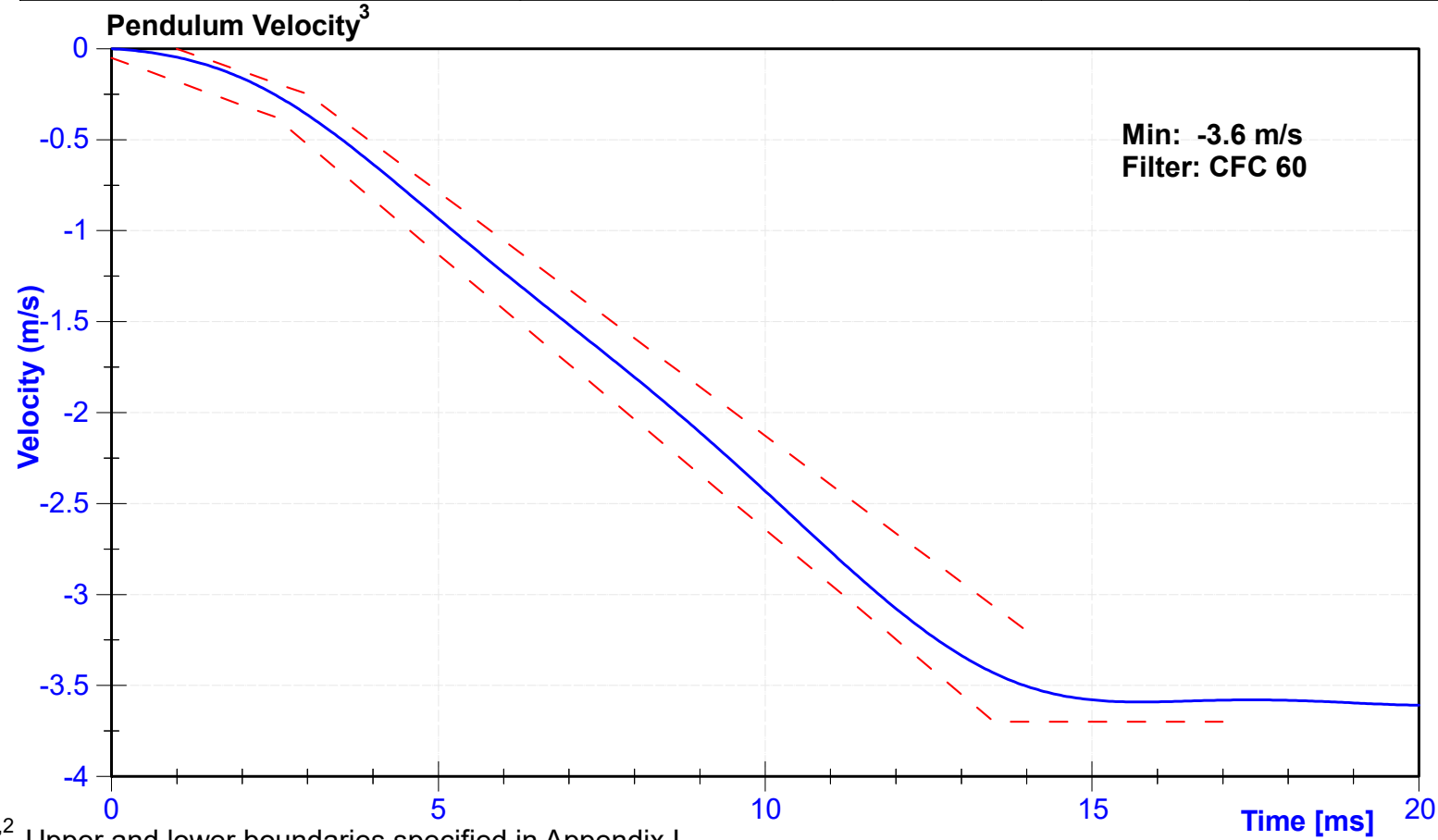
ATD Manufacturer	Denton	Test Technician	T. Roseman
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

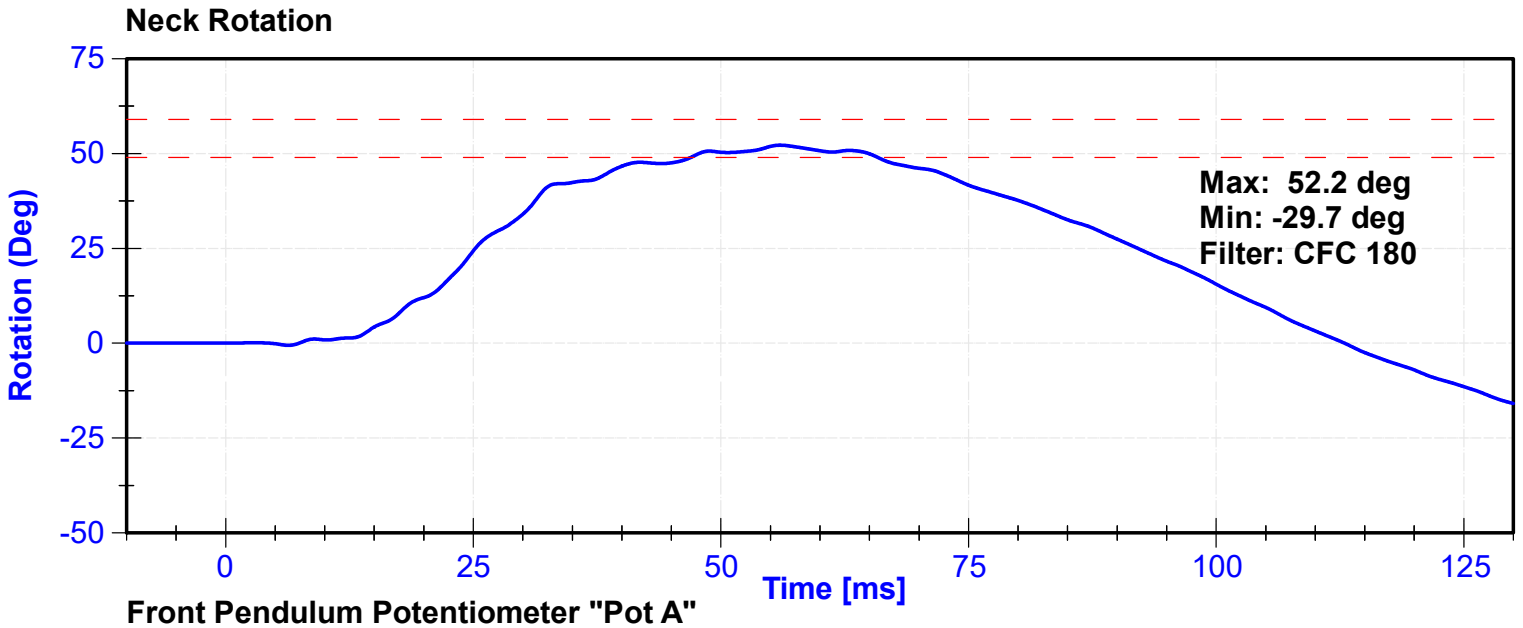
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.1	Pass
Humidity	10	70	%	31.5	Pass
Velocity	3.3	3.5	m/s	3.37	Pass
Lateral Neck Rotation	49	59	deg	52.2	Pass
Time at Maximum Rotation	54	66	ms	56.0	Pass
Time of Rotation Decay from Maximum	53	88	ms	57.1	Pass
Pendulum Velocity Overall Corridor	Lower Boundary[1]	Upper Boundary[2]	m/s	See Plot[3]	Pass

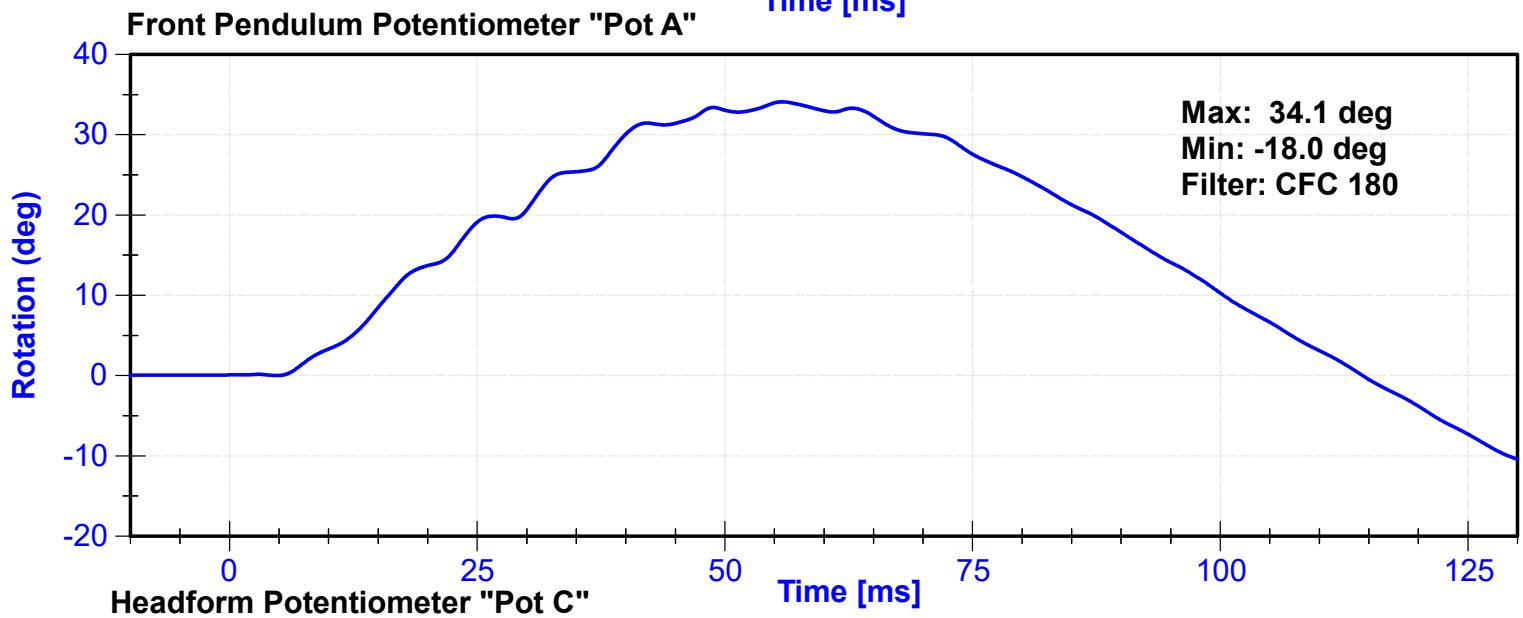
Transducer Calibrations

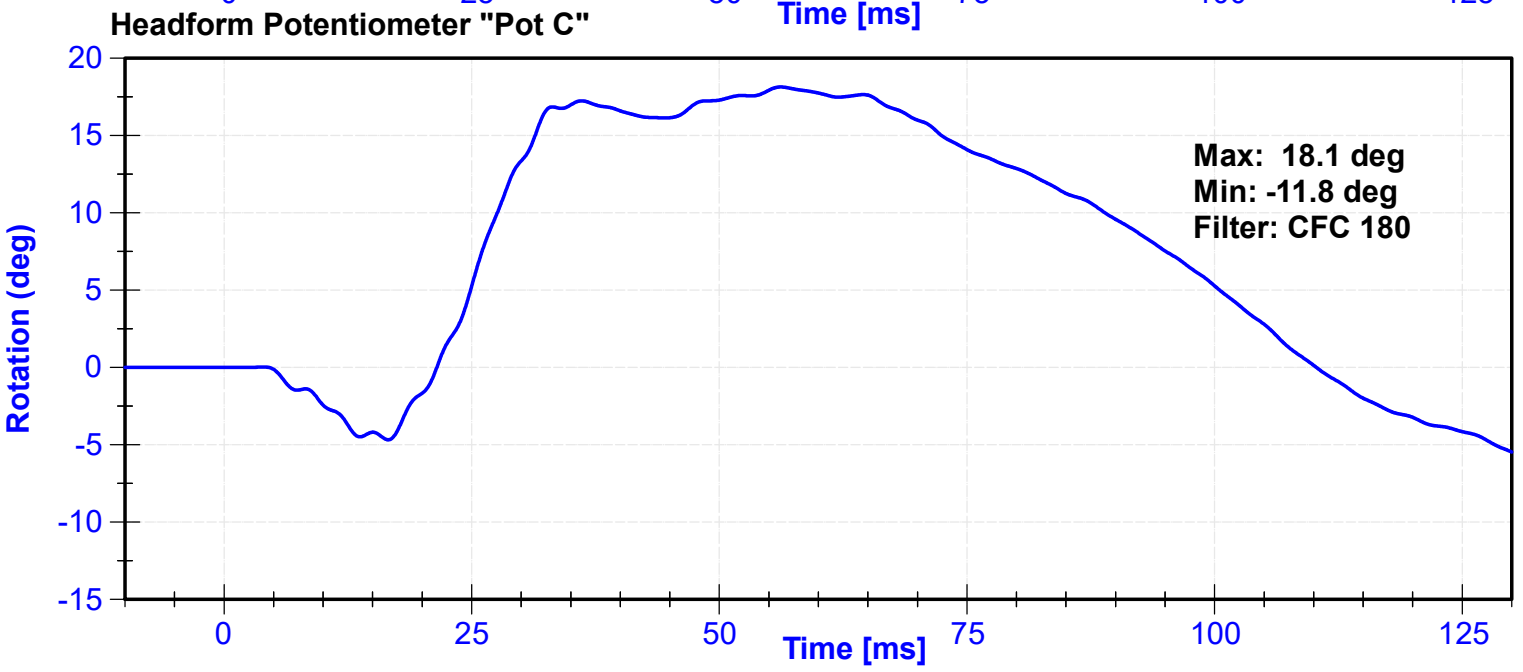
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	C16503	10/26/2022	10/26/2023
Front Pendulum Potentiometer	Sfernice	094	10/5/2022	10/5/2023
Headform Potentiometer	Sfernice	095	10/5/2022	10/5/2023



[1,2] Upper and lower boundaries specified in Appendix I


Neck Rotation
Rotation (Deg)
75
50
25
0
-25
-50
0
25
50
75
100
125
Time [ms]
Max: 52.2 deg
Min: -29.7 deg
Filter: CFC 180


Front Pendulum Potentiometer "Pot A"
Rotation (deg)
40
30
20
10
0
-10
-20
0
25
50
75
100
125
Time [ms]
Max: 34.1 deg
Min: -18.0 deg
Filter: CFC 180


Headform Potentiometer "Pot C"
Rotation (deg)
20
15
10
5
0
-5
-10
-15
0
25
50
75
100
125
Time [ms]
Max: 18.1 deg
Min: -11.8 deg
Filter: CFC 180

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

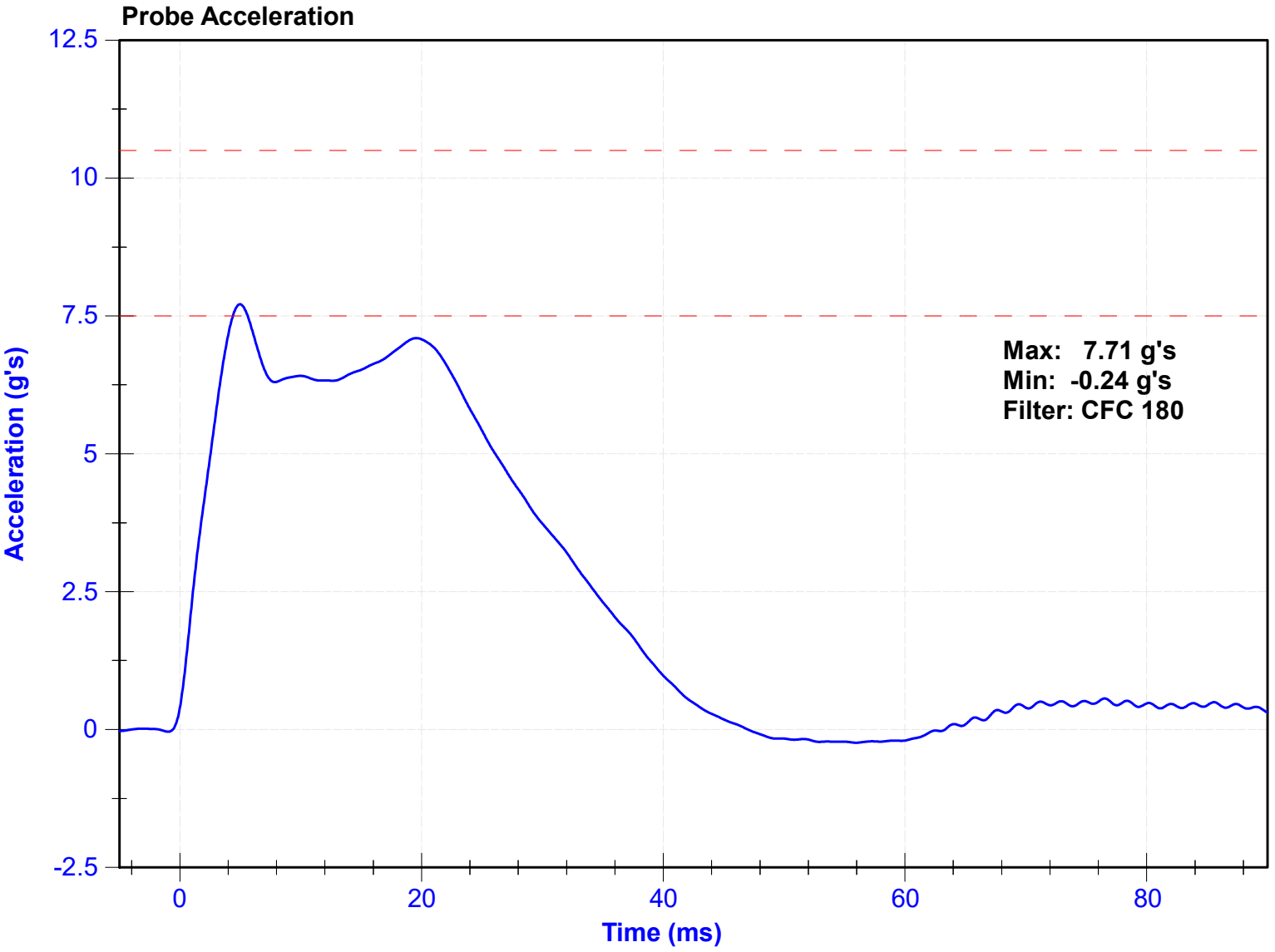
ATD Manufacturer	Denton	Test Technician	C. Mantell
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.7	Pass
Humidity	10	70	%	33.3	Pass
Velocity	4.2	4.4	m/s	4.35	Pass
Probe Acceleration	7.5	10.5	g's	7.71	Pass

Transducer Calibrations

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



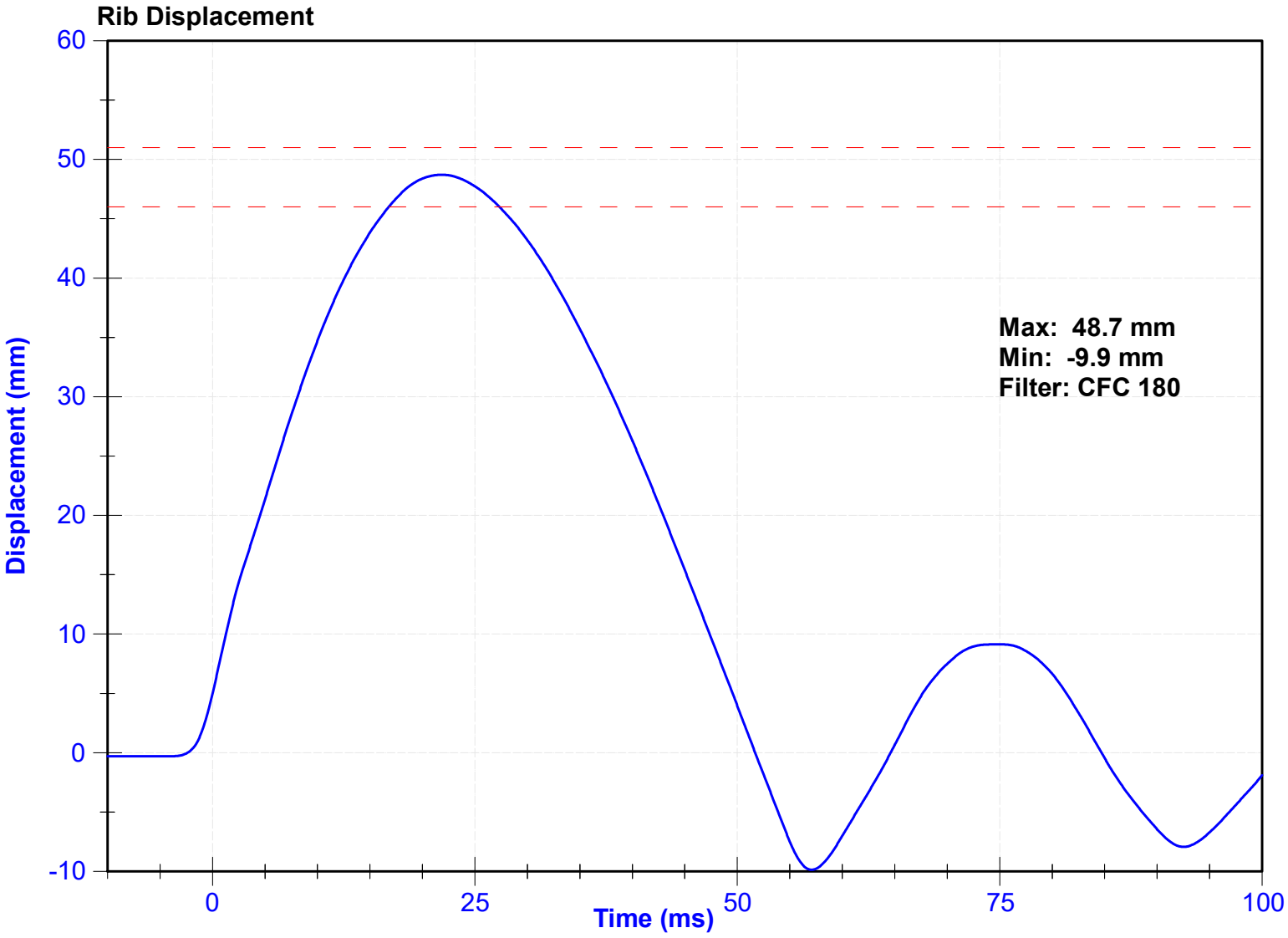
ATD Manufacturer	Denton	Test Technician	T. Roseman
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.8	Pass
Humidity	10	70	%	20.5	Pass
Rib Displacement	46	51	mm	48.7	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	DS-0552-01	2/27/2023	8/28/2023



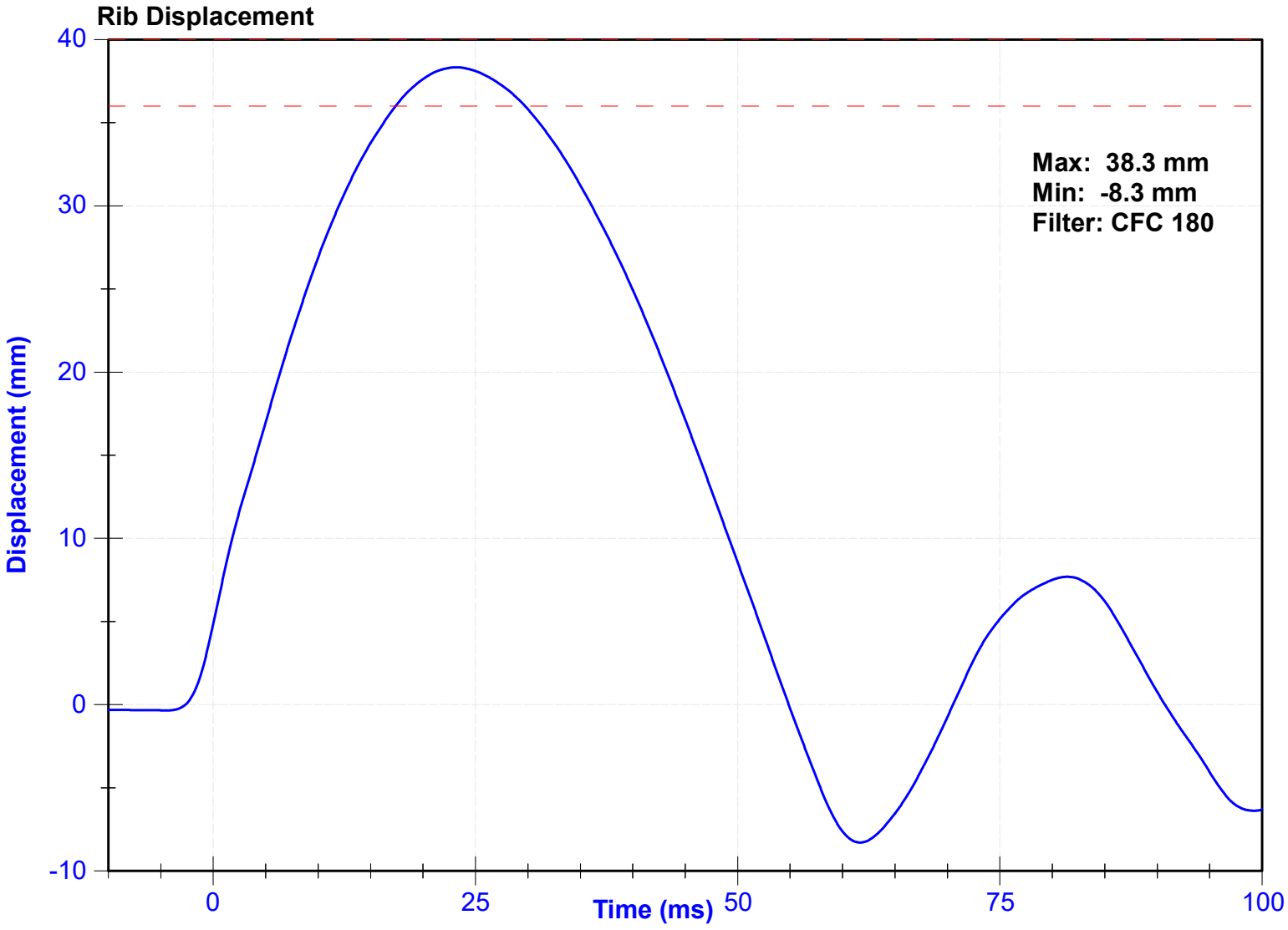
ATD Manufacturer	Denton	Test Technician	T. Roseman
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.8	Pass
Humidity	10	70	%	20.5	Pass
Rib Displacement	36	40	mm	38.3	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	DS-0552-01	2/27/2023	8/28/2023



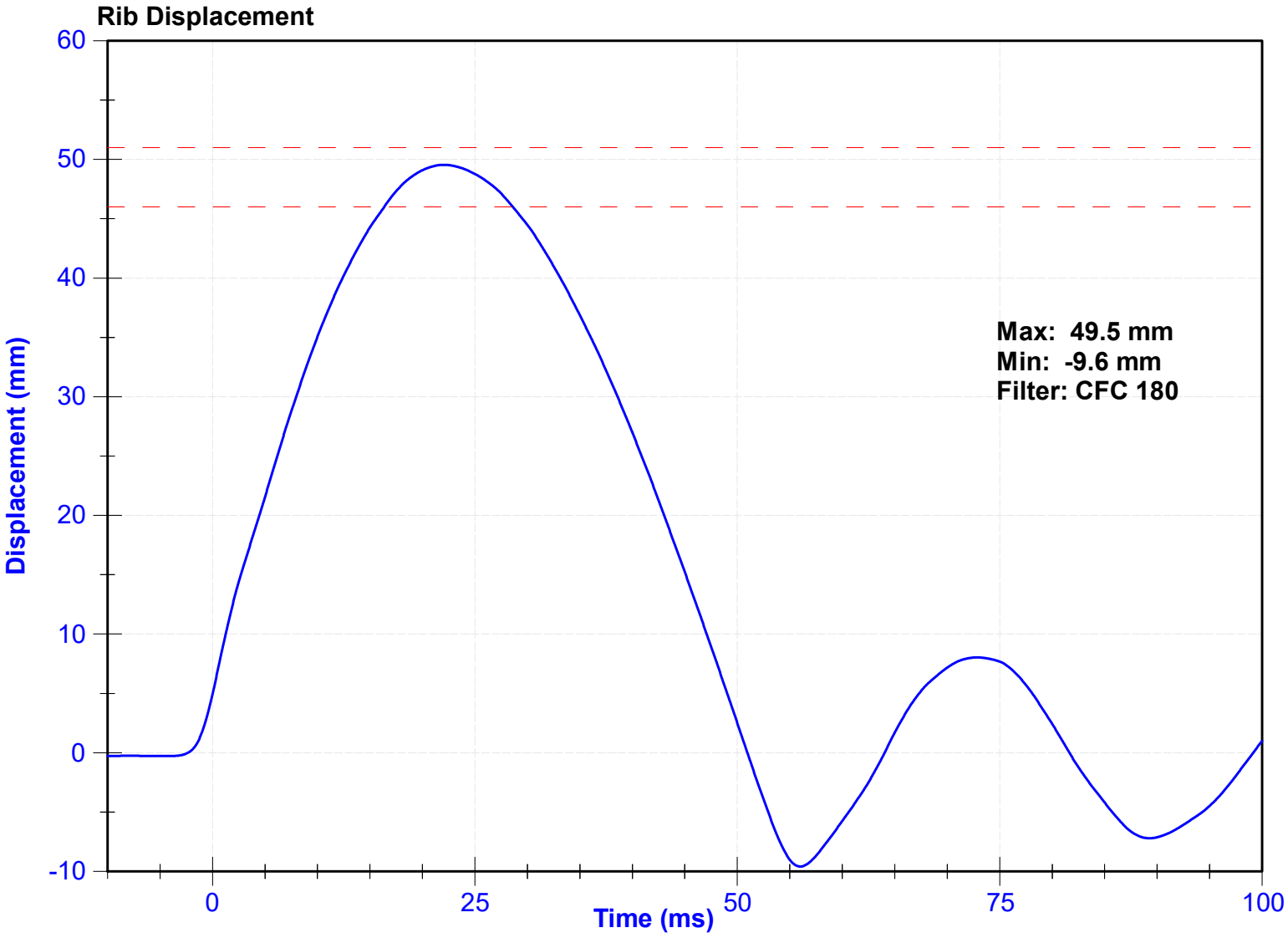
ATD Manufacturer	Denton	Test Technician	T. Roseman
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.8	Pass
Humidity	10	70	%	20.5	Pass
Rib Displacement	46	51	mm	49.5	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	DS-807	2/27/2023	8/28/2023



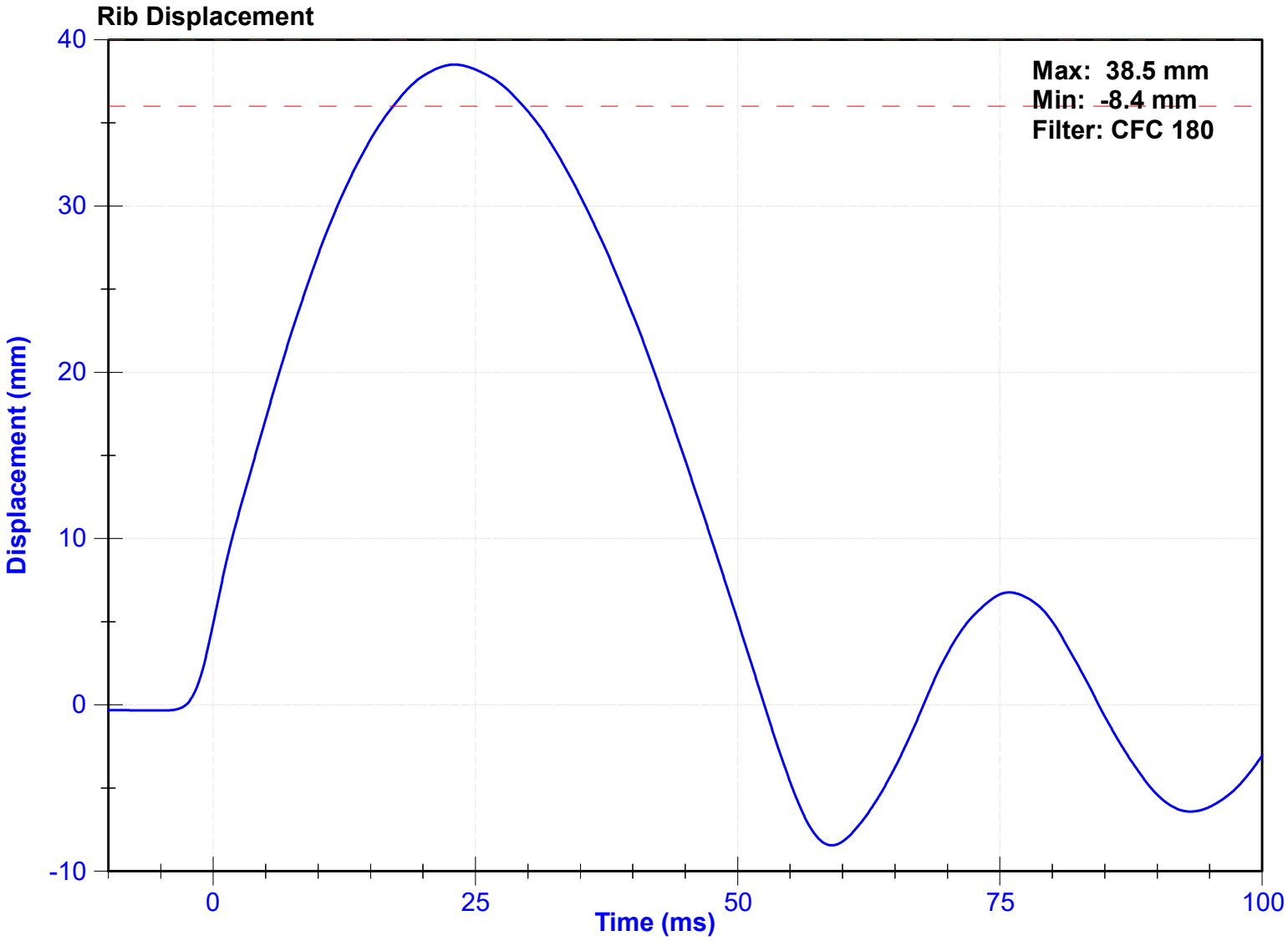
ATD Manufacturer	Denton	Test Technician	T. Roseman
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.8	Pass
Humidity	10	70	%	20.5	Pass
Rib Displacement	36	40	mm	38.5	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	DS-807	2/27/2023	8/28/2023



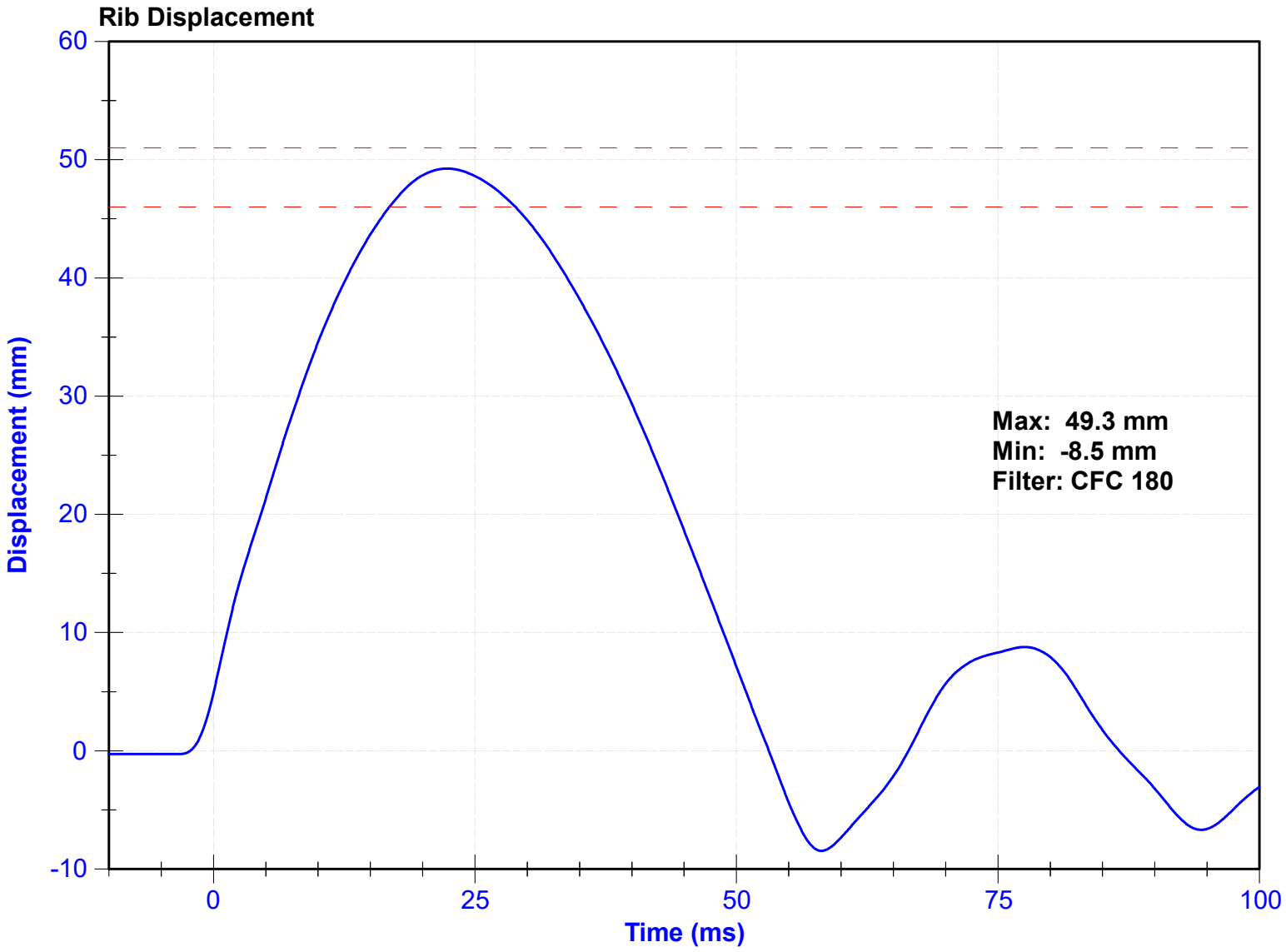
ATD Manufacturer	Denton	Test Technician	T. Roseman
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.8	Pass
Humidity	10	70	%	20.5	Pass
Rib Displacement	46	51	mm	49.3	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	DS-0552-03	2/27/2023	8/28/2023



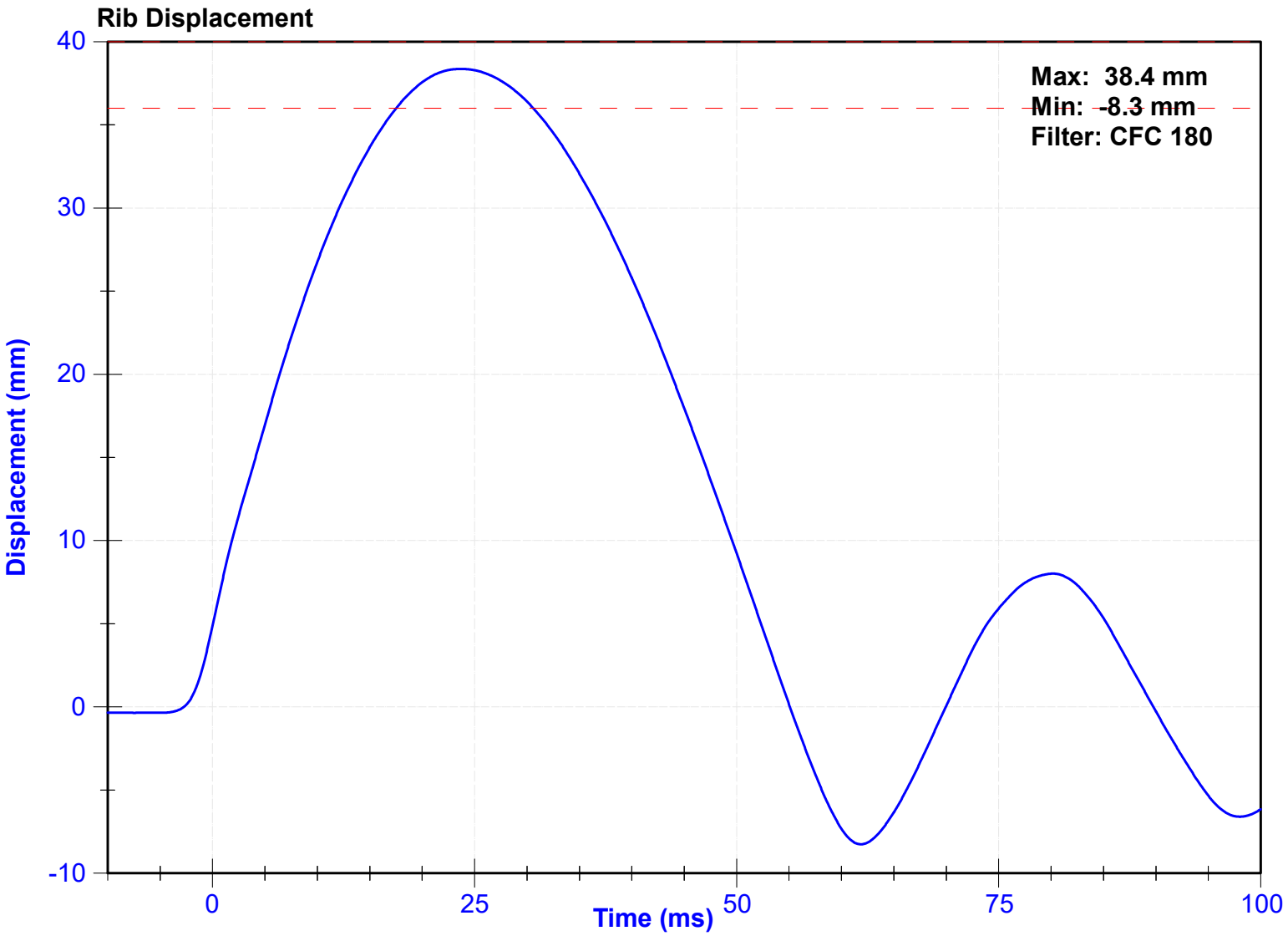
ATD Manufacturer	Denton	Test Technician	T. Roseman
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.8	Pass
Humidity	10	70	%	20.5	Pass
Rib Displacement	36	40	mm	38.4	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	DS-0552-03	2/27/2023	8/28/2023



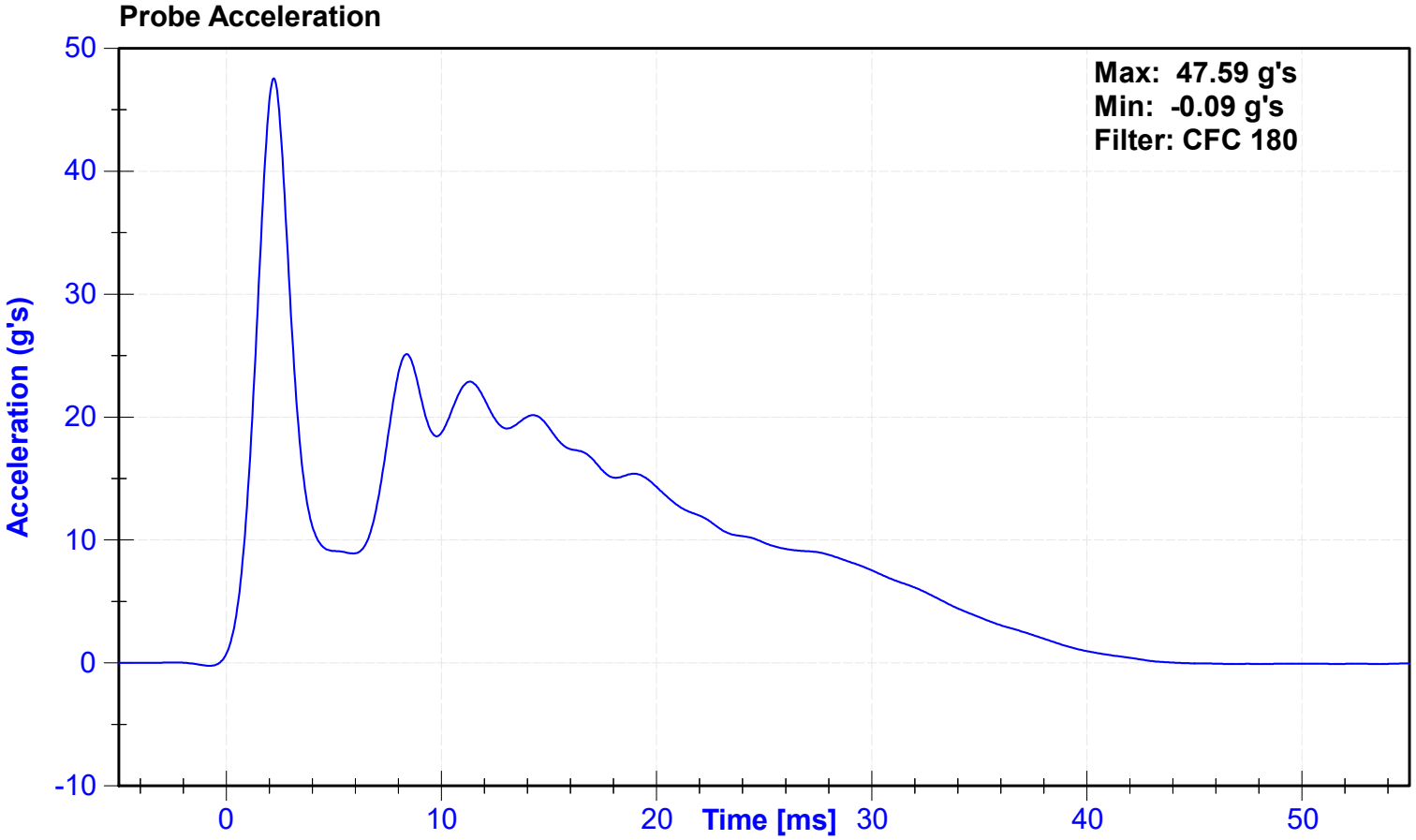
ATD Manufacturer	Denton	Test Technician	C. Mantell
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

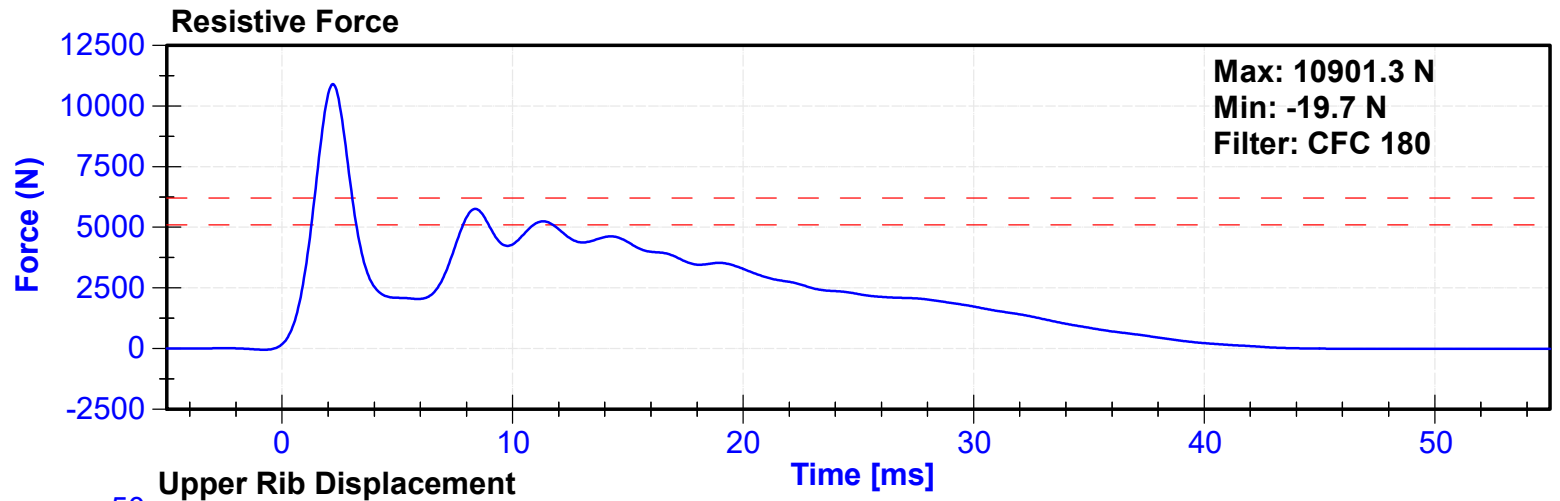
Results

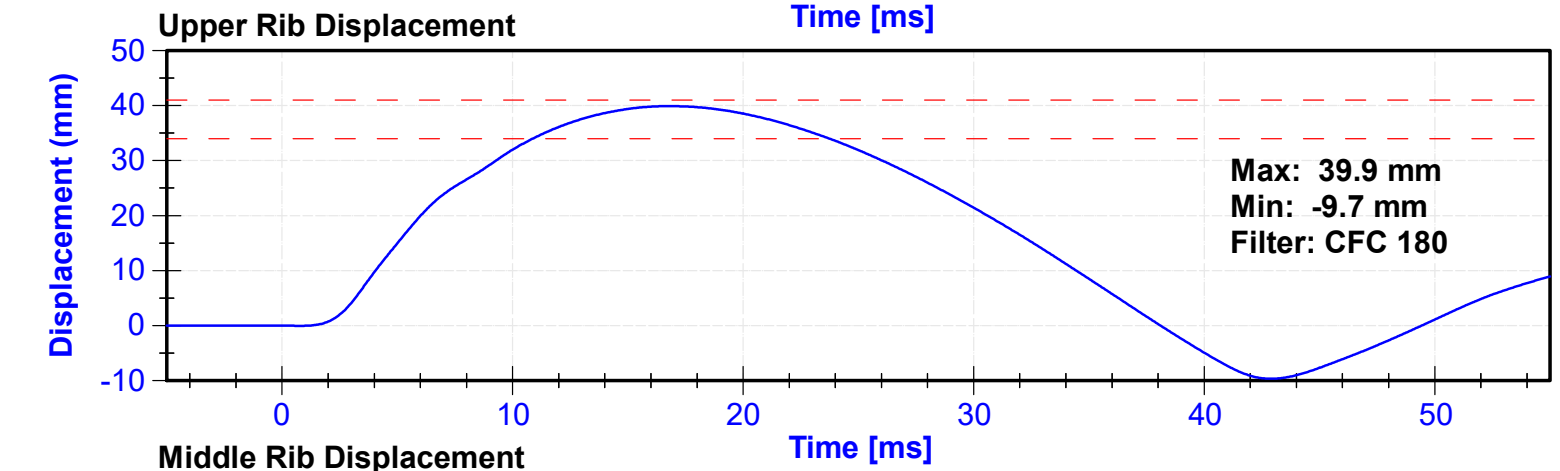
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.7	Pass
Humidity	10	70	%	33.3	Pass
Velocity	5.4	5.6	m/s	5.53	Pass
Resistive Force after 6ms	5100	6200	N	5756.3	Pass
Upper Thorax Rib Deflection	34	41	mm	39.9	Pass
Mid Thorax Rib Deflection	37	45	mm	42.2	Pass
Lower Thorax Rib Deflection	37	44	mm	42.7	Pass

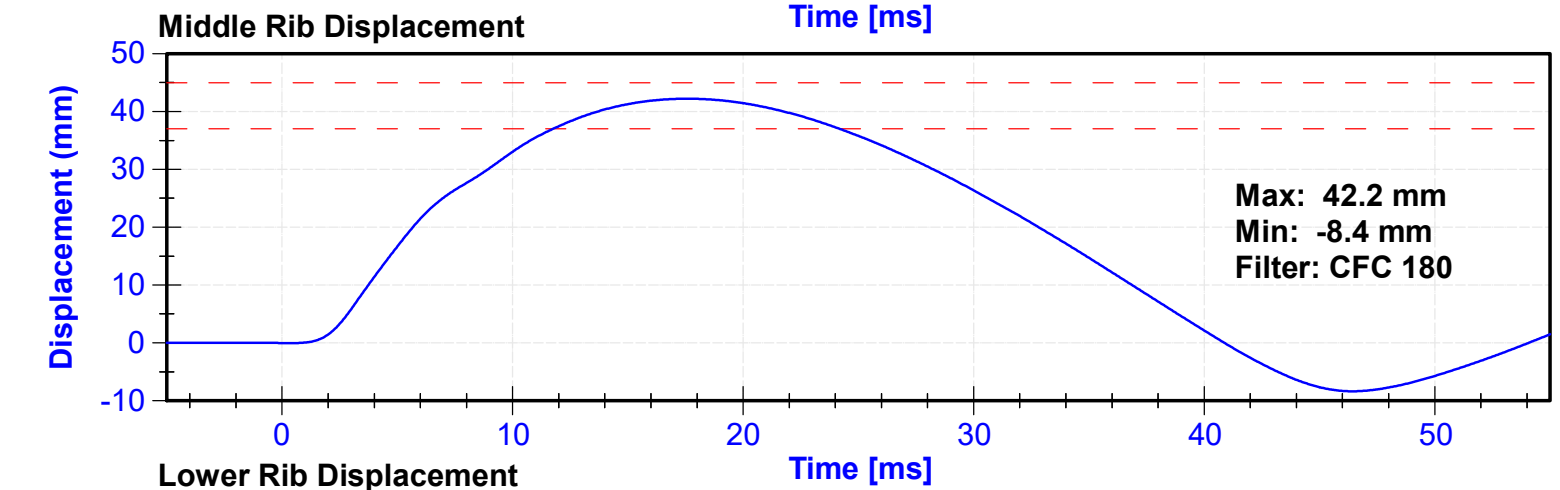
Transducer Calibrations

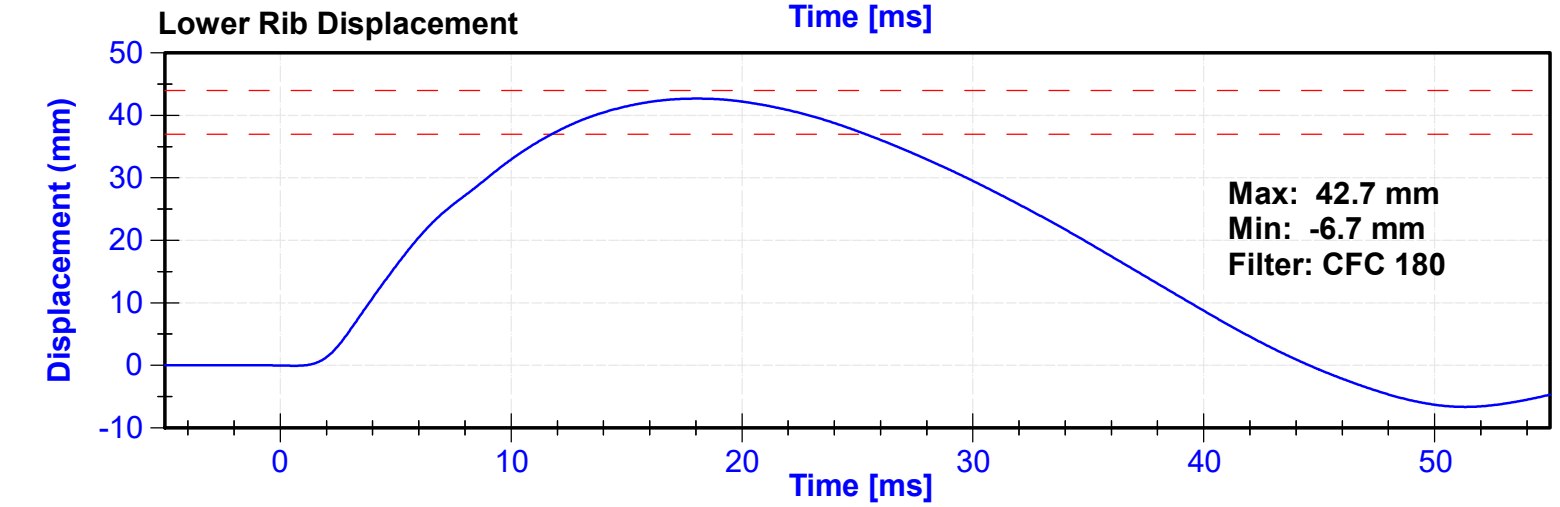
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Probe Accelerometer	Endevco	P51736	10/25/2022	10/25/2023
Upper Thorax Rib Potentiometer	Honeywell	DS-0552-01	2/27/2023	8/28/2023
Middle Thorax Rib Potentiometer	Honeywell	DS-807	2/27/2023	8/28/2023
Lower Thorax Rib Potentiometer	Honeywell	DS-0552-03	2/27/2023	8/28/2023




Resistive Force
Force (N)
12500
10000
7500
5000
2500
0
-2500
0
10
20
30
40
50
Time [ms]
Max: 10901.3 N
Min: -19.7 N
Filter: CFC 180


Upper Rib Displacement
Displacement (mm)
50
40
30
20
10
0
-10
0
10
20
30
40
50
Time [ms]
Max: 39.9 mm
Min: -9.7 mm
Filter: CFC 180


Middle Rib Displacement
Displacement (mm)
50
40
30
20
10
0
-10
0
10
20
30
40
50
Time [ms]
Max: 42.2 mm
Min: -8.4 mm
Filter: CFC 180


Lower Rib Displacement
Displacement (mm)
50
40
30
20
10
0
-10
0
10
20
30
40
50
Time [ms]
Max: 42.7 mm
Min: -6.7 mm
Filter: CFC 180

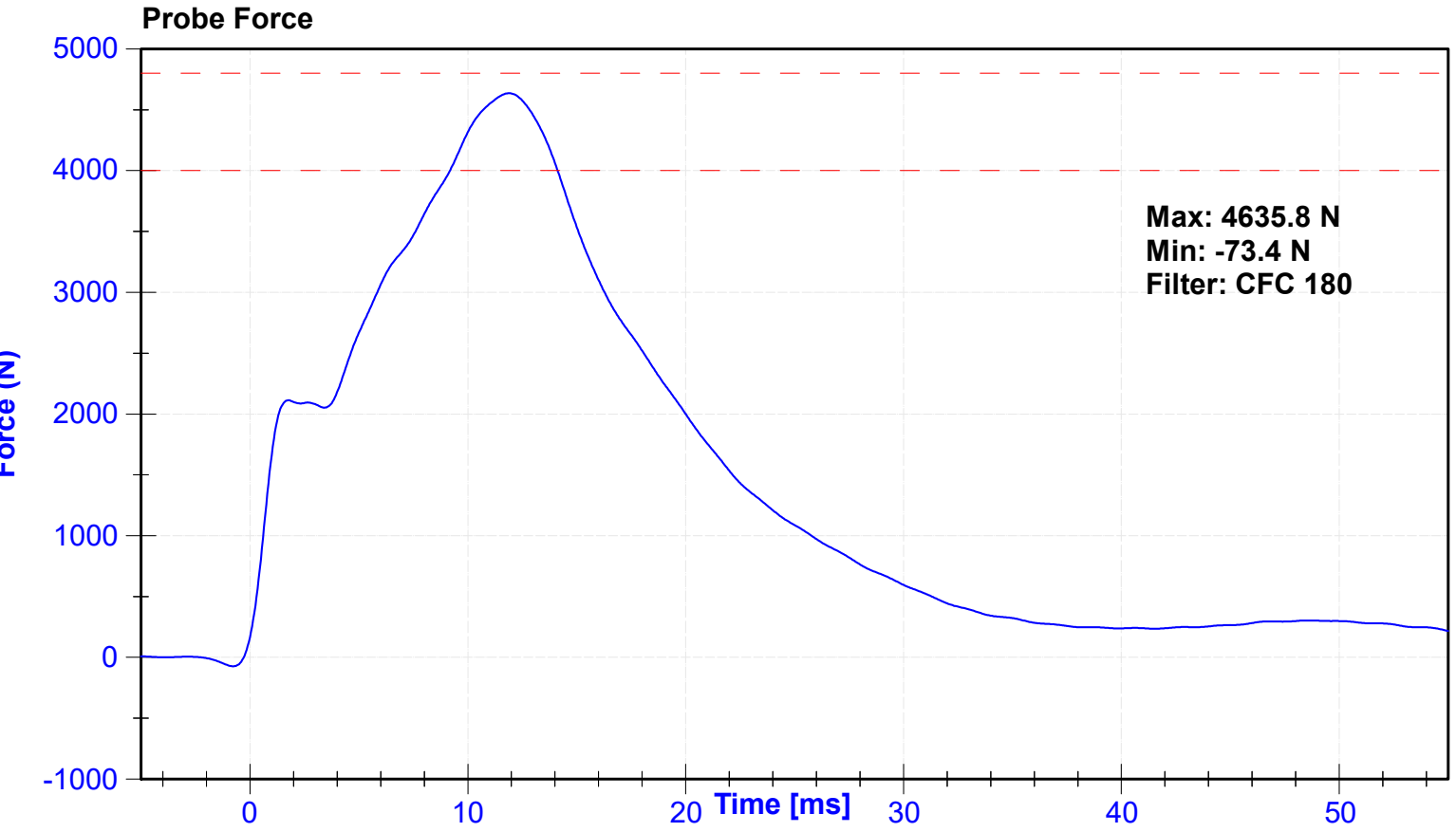
ATD Manufacturer	Denton	Test Technician	C. Mantell
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

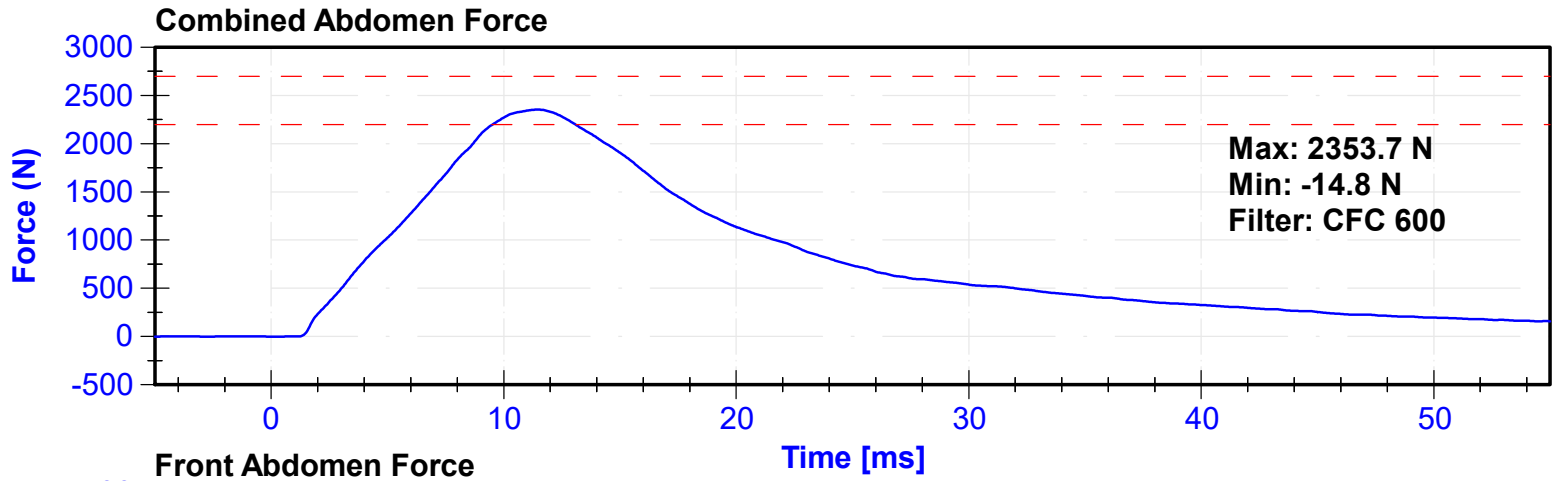
Results

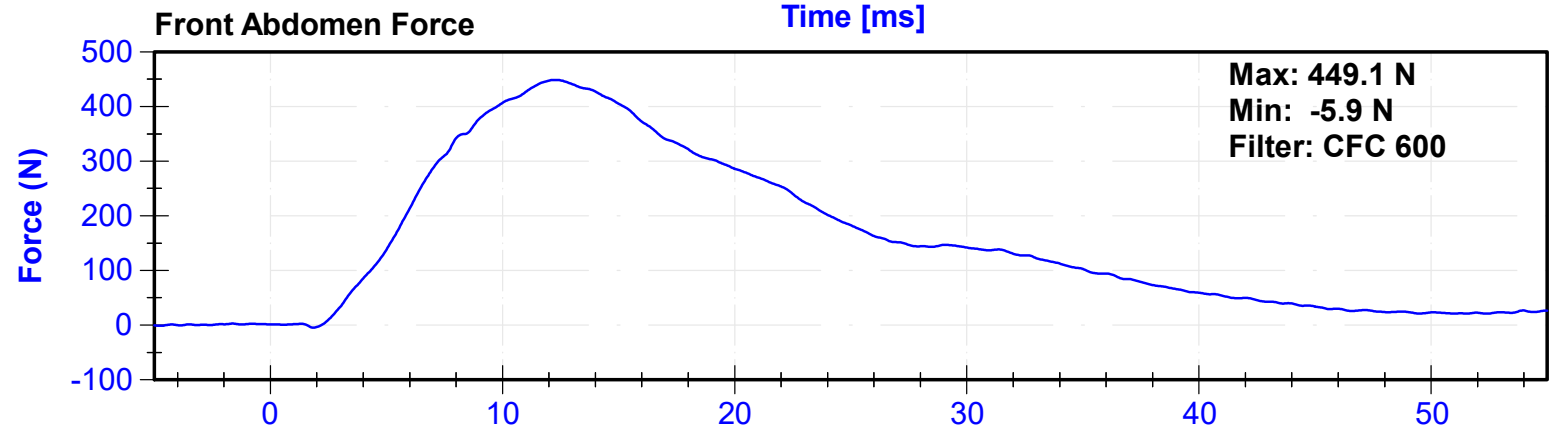
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.7	Pass
Humidity	10	70	%	33.3	Pass
Velocity	3.9	4.1	m/s	4.04	Pass
Combined Abdomen Force	2200	2700	N	2353.7	Pass
Time at Peak Abdomen Force	10.0	12.3	ms	11.45	Pass
Resistive Probe Force	4000	4800	N	4635.8	Pass
Time at Peak Resistive Force	10.6	13.0	ms	11.90	Pass

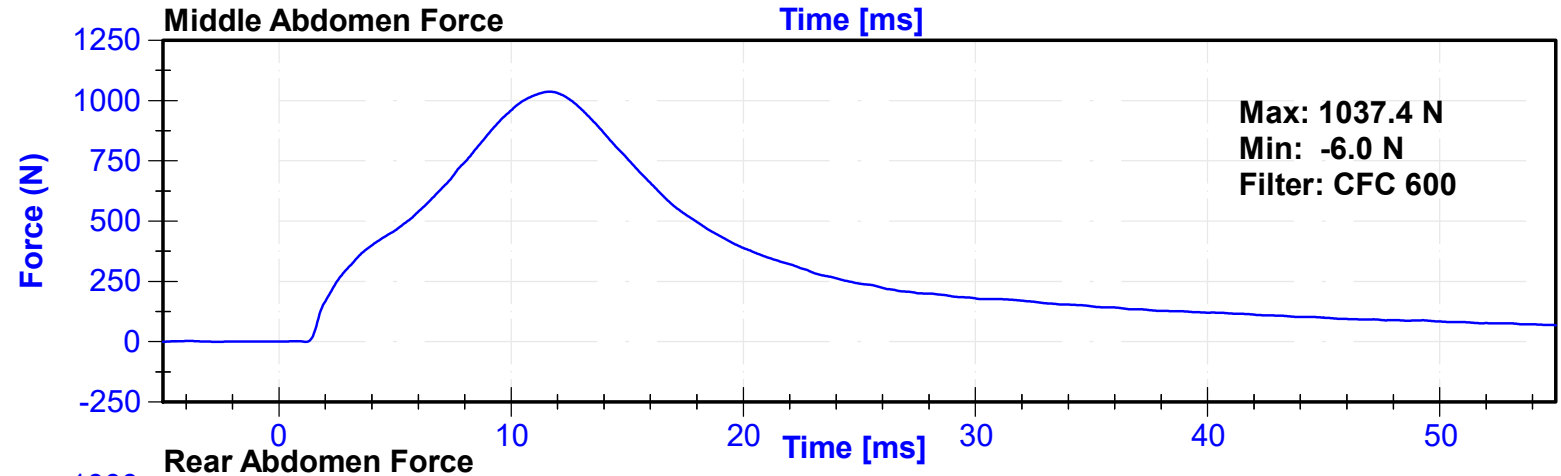
Transducer Calibrations

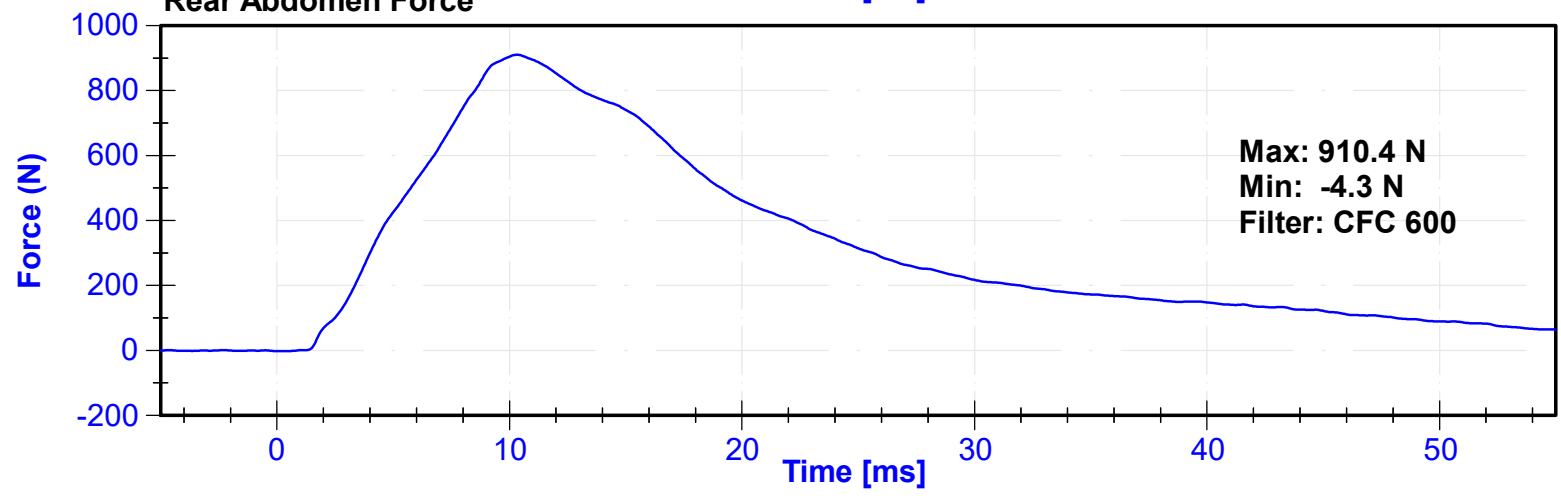
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	P51736	10/25/2022	10/25/2023
Front Abdomen Load Cell	Denton	1440	8/12/2022	8/12/2023
Middle Abdomen Load Cell	Denton	1525	8/12/2022	8/12/2023
Rear Abdomen Load Cell	Denton	1528	8/12/2022	8/12/2023




Combined Abdomen Force
Force (N)
Time [ms]
Max: 2353.7 N
Min: -14.8 N
Filter: CFC 600


Front Abdomen Force
Force (N)
Time [ms]
Max: 449.1 N
Min: -5.9 N
Filter: CFC 600


Middle Abdomen Force
Force (N)
Time [ms]
Max: 1037.4 N
Min: -6.0 N
Filter: CFC 600


Rear Abdomen Force
Force (N)
Time [ms]
Max: 910.4 N
Min: -4.3 N
Filter: CFC 600

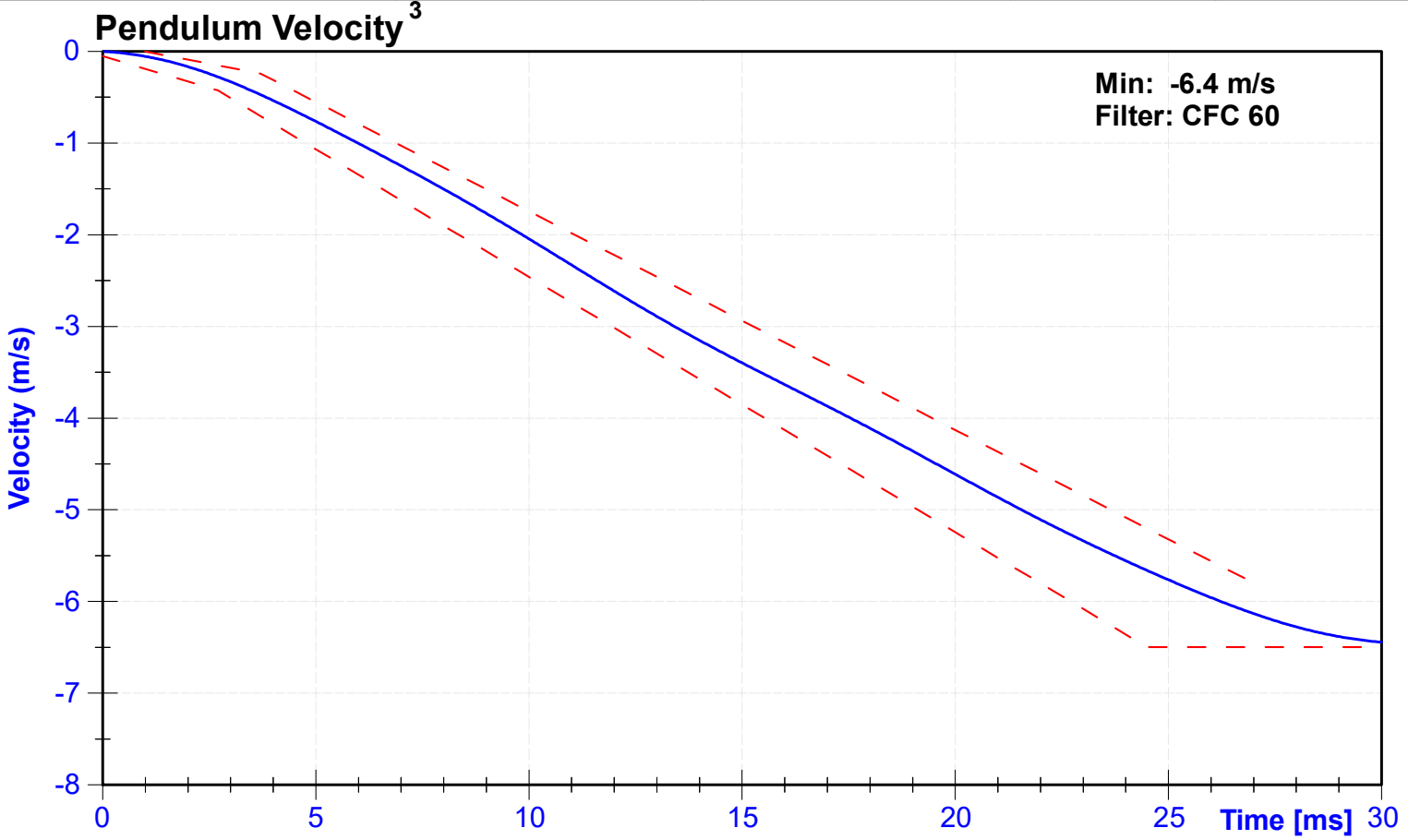
ATD Manufacturer	Denton	Test Technician	T. Roseman
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

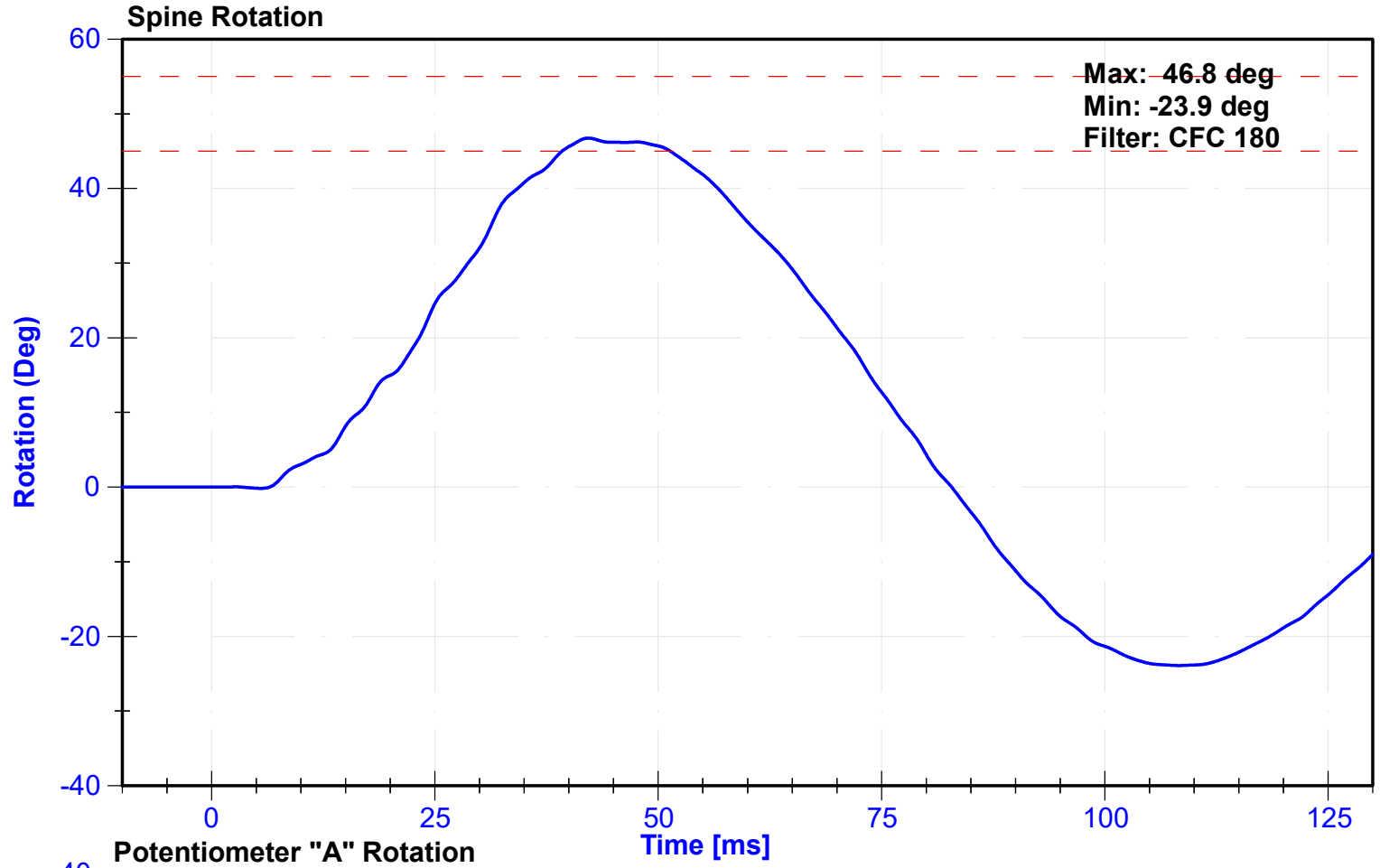
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.1	Pass
Humidity	10	70	%	31.5	Pass
Velocity	5.95	6.15	m/s	6.048	Pass
Lateral Spine Rotation	45	55	deg	46.8	Pass
Time at Maximum Rotation	39	53	ms	42.1	Pass
Time of Decay to Zero Degrees	37	57	ms	40.7	Pass
Pendulum Velocity Overall Corridor	Lower Boundary[1]	Upper Boundary[2]	m/s	See Plot[3]	Pass

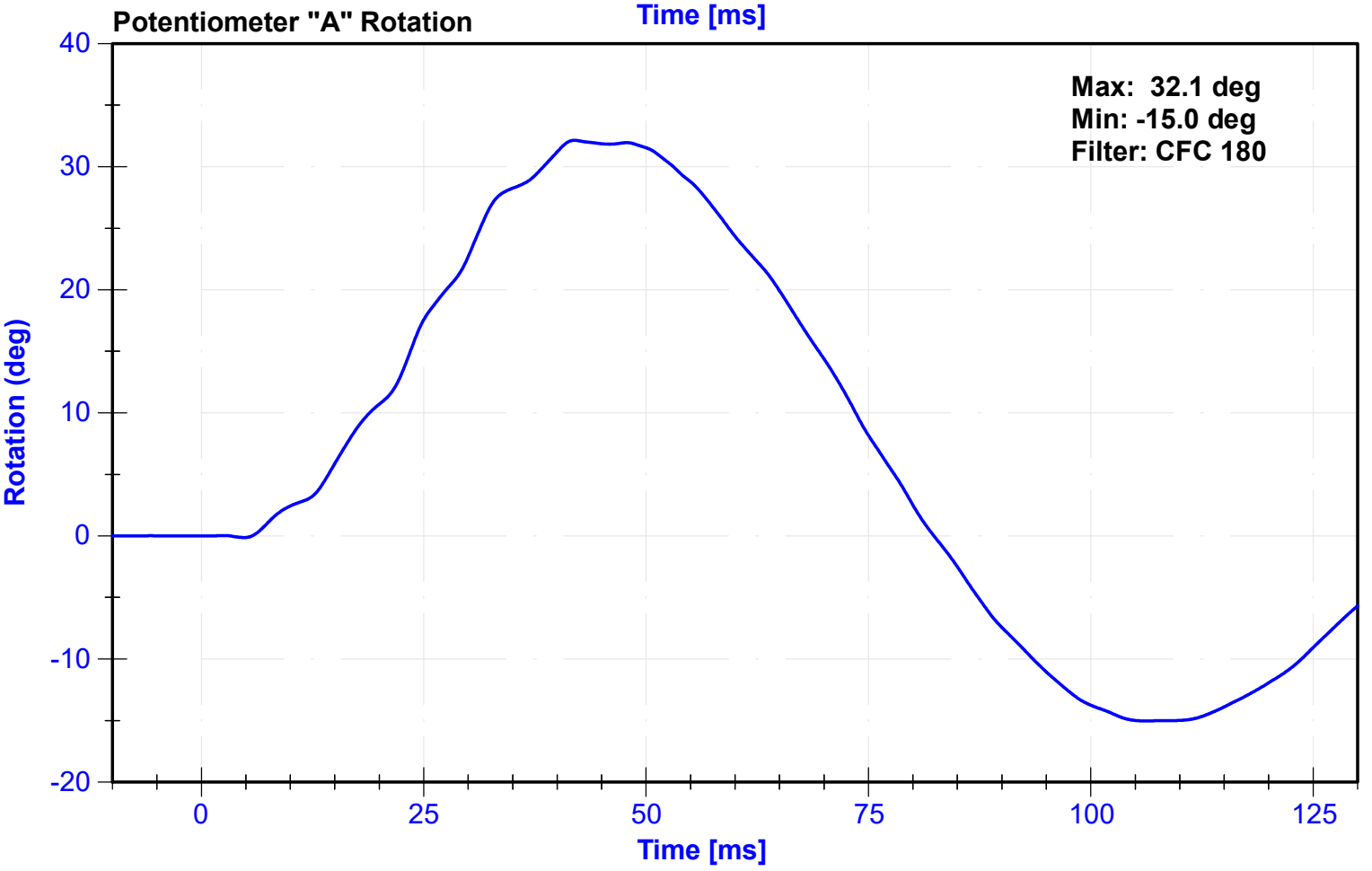
Transducer Calibrations

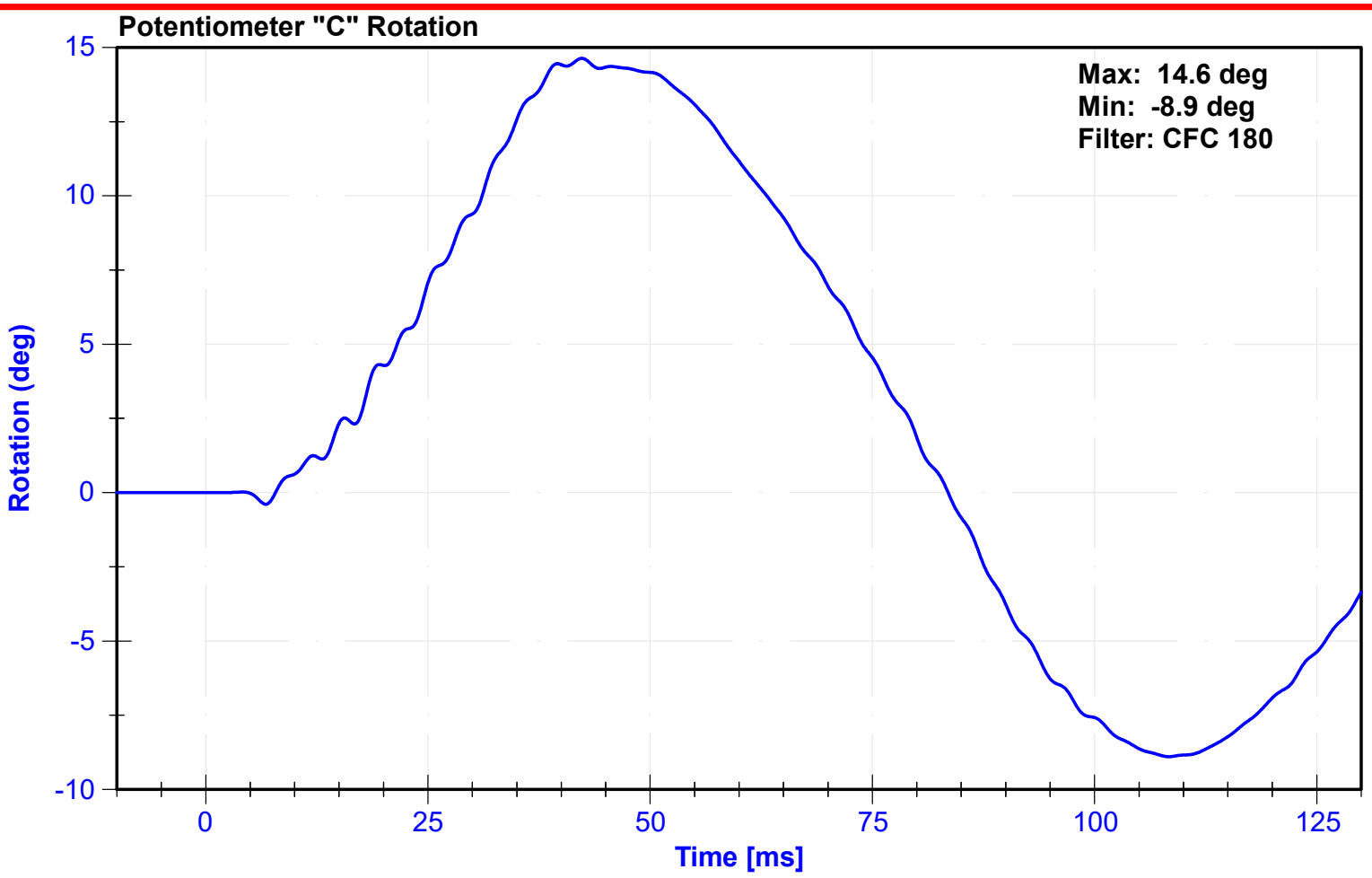
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	C16503	10/26/2022	10/26/2023
Pendulum "A" Potentiometer	Sfernice	094	10/5/2022	10/5/2023
Condyle "B" Potentiometer	Sfernice	095	10/5/2022	10/5/2023



[1,2] Upper and lower boundaries specified in Appendix I


Spine Rotation
Max: 46.8 deg
Min: -23.9 deg
Filter: CFC 180
Rotation (Deg)
60
40
20
0
-20
-40
0
25
50
75
100
125
Time [ms]


Potentiometer "A" Rotation
Max: 32.1 deg
Min: -15.0 deg
Filter: CFC 180
Rotation (deg)
40
30
20
10
0
-10
-20
0
25
50
75
100
125
Time [ms]



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

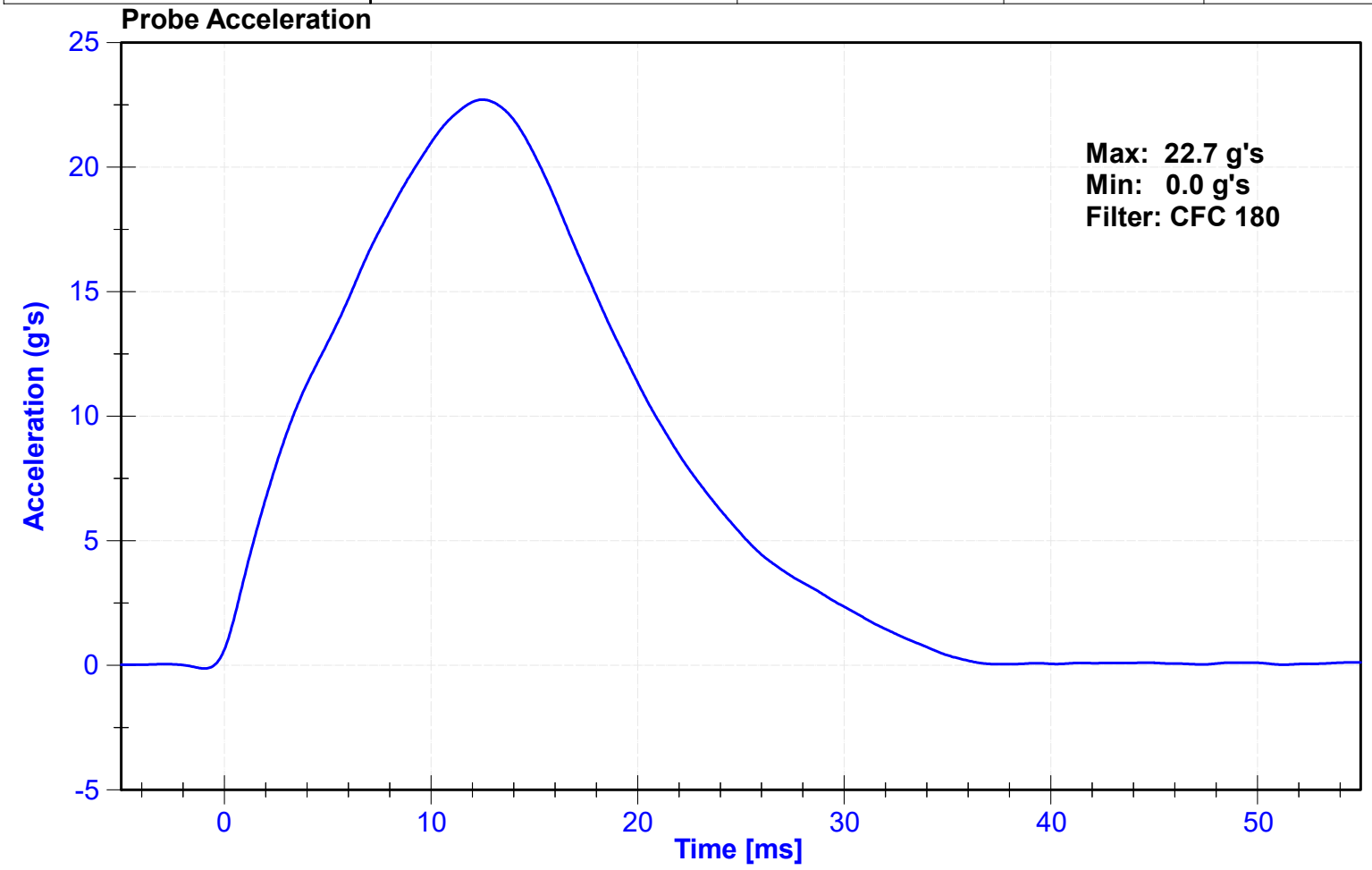
ATD Manufacturer	Denton	Test Technician	C. Mantell
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

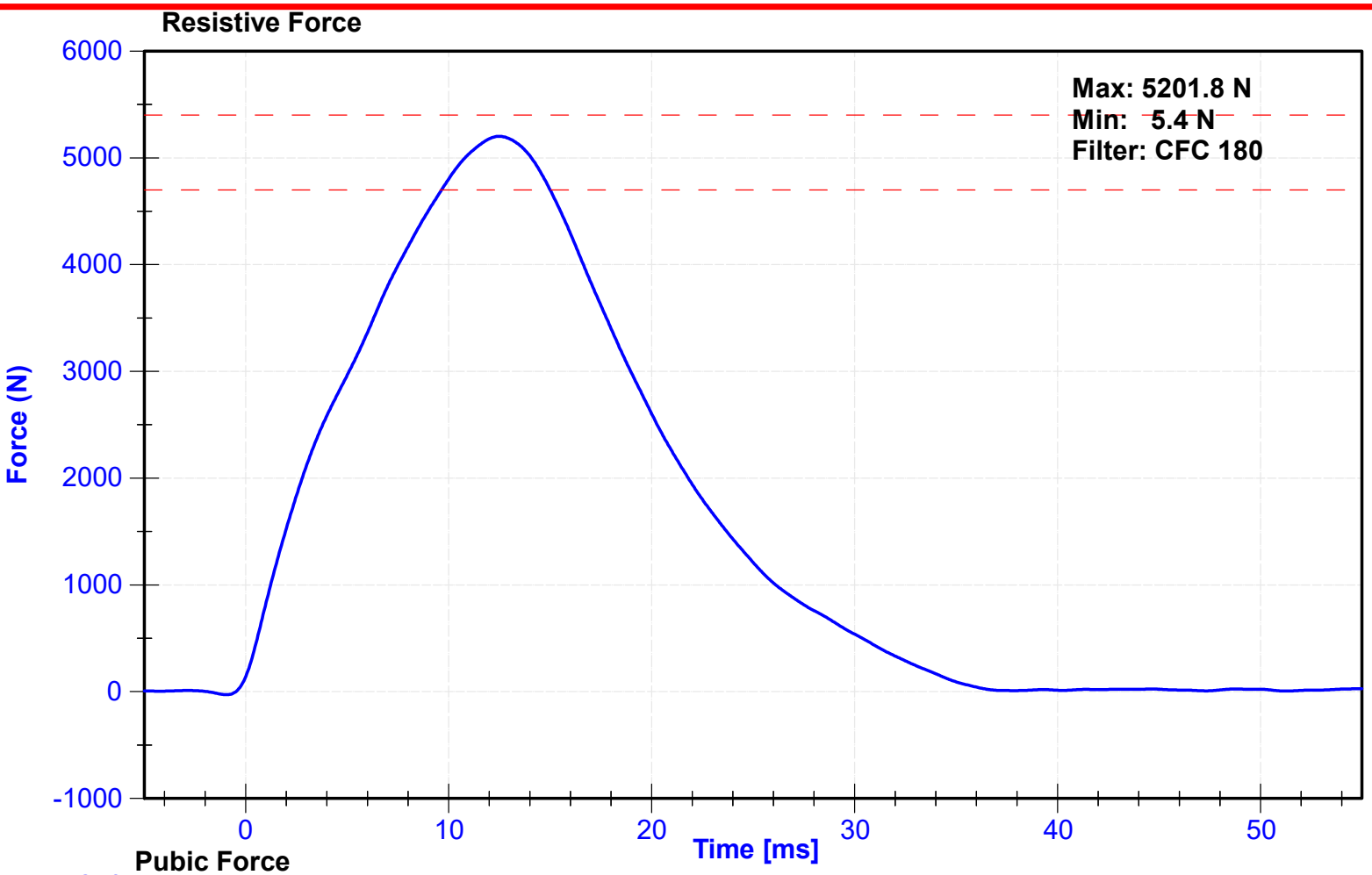
Results

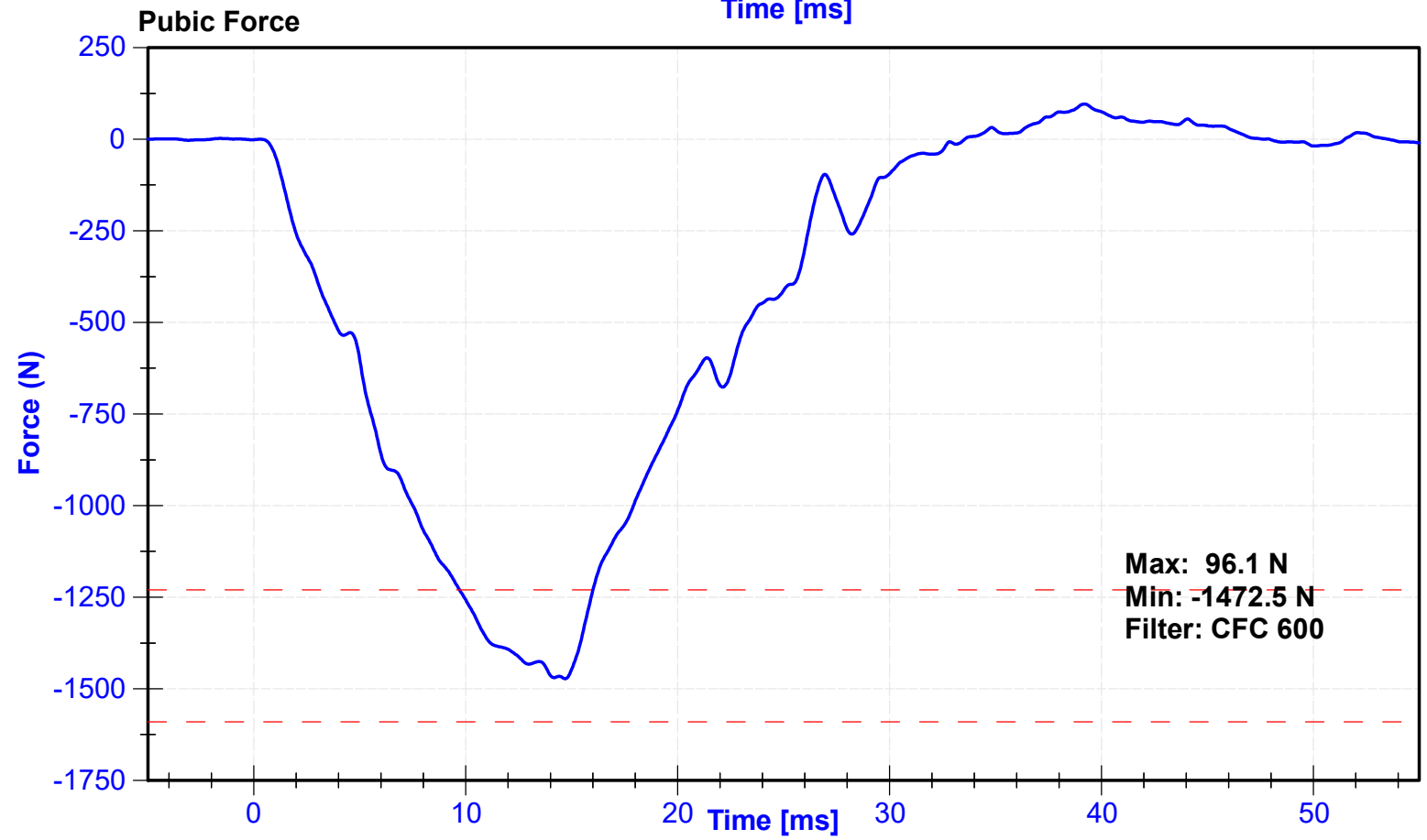
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.7	Pass
Humidity	10	70	%	33.3	Pass
Velocity	4.2	4.4	m/s	4.35	Pass
Resistive Force	4700	5400	N	5201.8	Pass
Time at Peak Resistive Force	11.8	16.1	ms	12.50	Pass
Pubic Force	-1590	-1230	N	-1472.5	Pass
Time at Peak Pubic Force	12.2	17.0	ms	14.70	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		8/12/2022	8/12/2023




Resistive Force
Max: 5201.8 N
Min: 5.4 N
Filter: CFC 180
Force (N)
6000
5000
4000
3000
2000
1000
0
-1000
0
10
20
30
40
50
Time [ms]

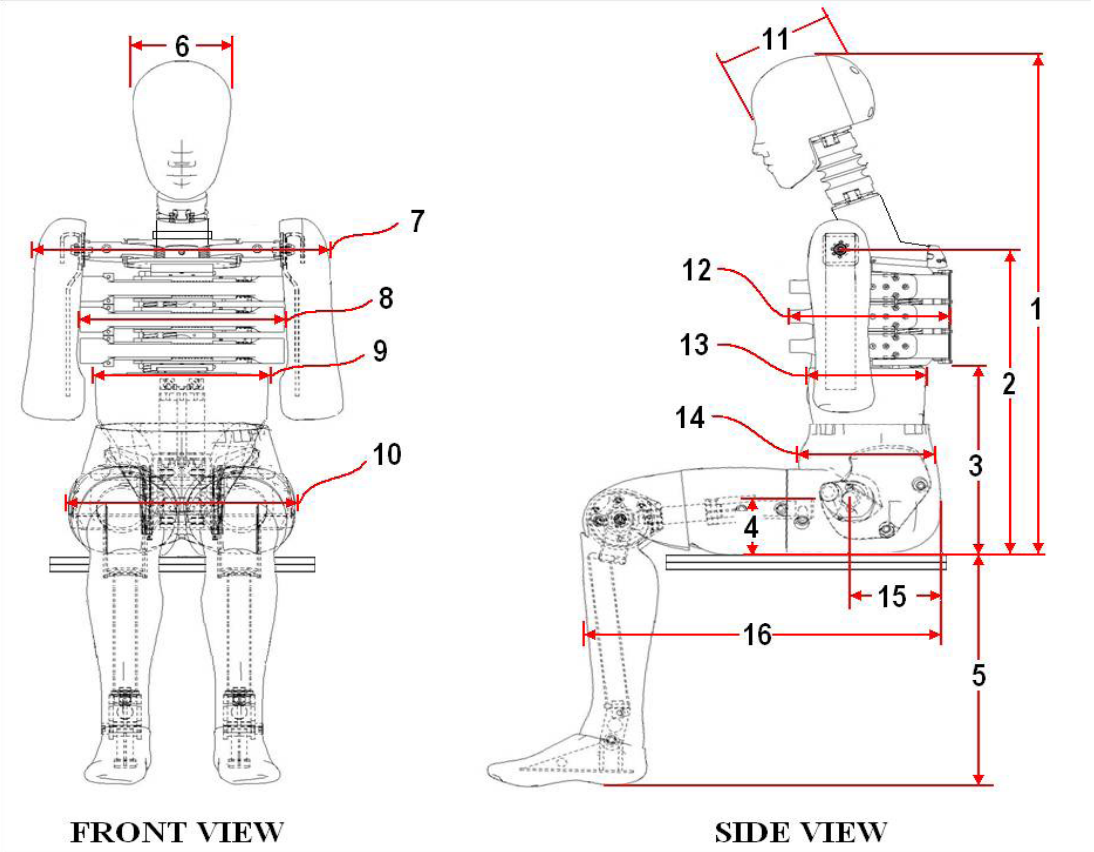

Pubic Force
Max: 96.1 N
Min: -1472.5 N
Filter: CFC 600
Force (N)
250
0
-250
-500
-750
-1000
-1250
-1500
-1750
0
10
20
30
40
50
Time [ms]

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

External Measurements - EuroSID-2re

Technician: K. Brogan Date: 06/01/2023

Dummy Serial Number: D037



FRONT VIEW SIDE VIEW

Dim. No.	Description	Specification (mm)		Result (mm)	Pass/Fail
1	Sitting Height	900	918	912	Pass
2	Seat to Shoulder Joint	558	572	564	Pass
3	Seat to Lower Face of Thoracic Spine Box	346	356	352	Pass
4	Seat to Hip Joint (center of bolt)	97	103	101	Pass
5	Sole to Seat, Sitting	333	451	421	Pass
6	Head Width	152	158	155	Pass
7	Shoulder/Arm Width	461	479	470	Pass
8	Thorax Width	322	332	329	Pass
9	Abdomen Width	273	287	280	Pass
10	Pelvis Lap Width	359	373	364	Pass
11	Head Depth	196	206	199	Pass
12	Thorax Depth	262	272	266	Pass
13	Abdomen Depth	194	204	200	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

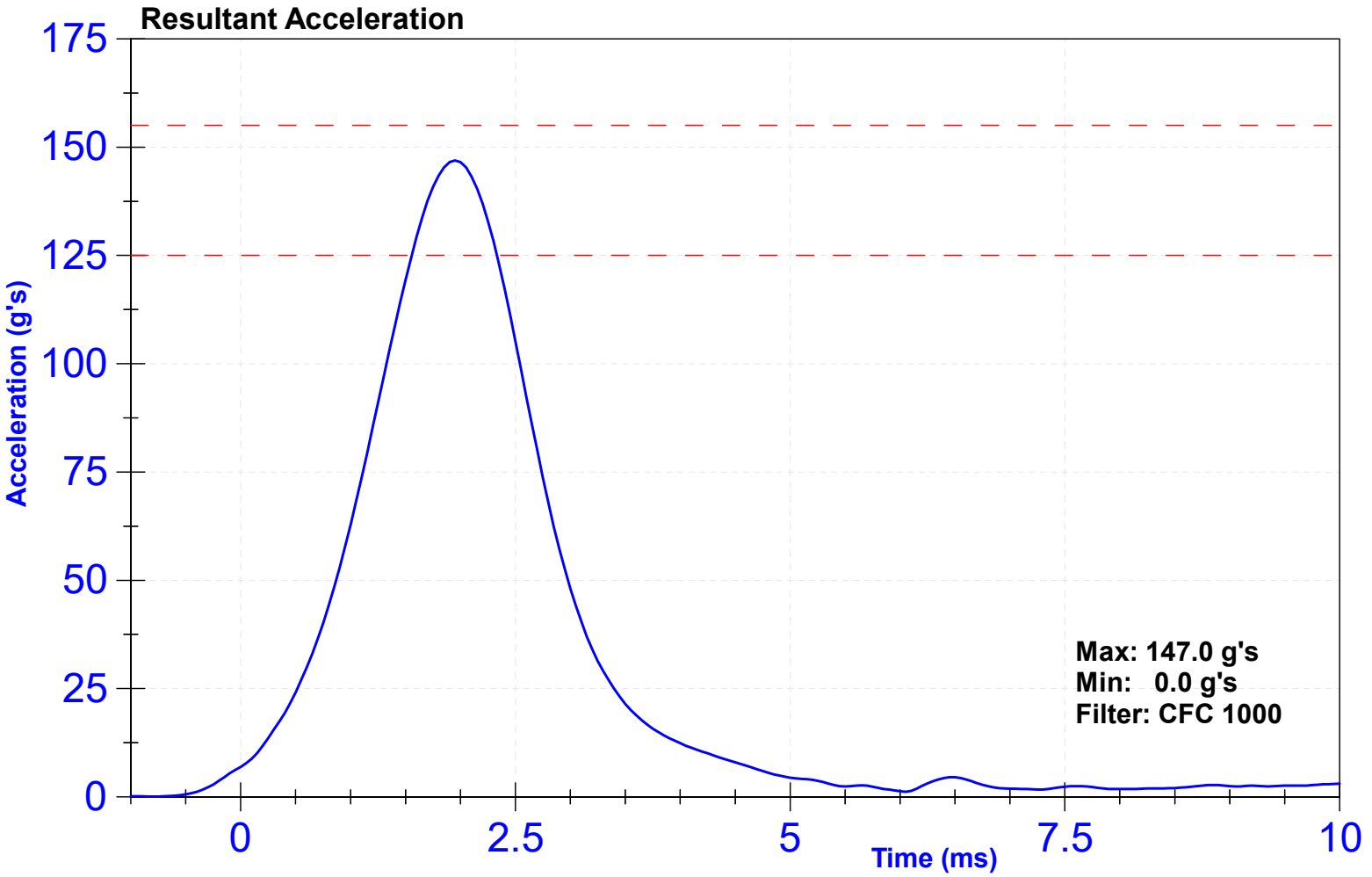
ATD Manufacturer	Denton	Test Technician	Z.Schneider
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

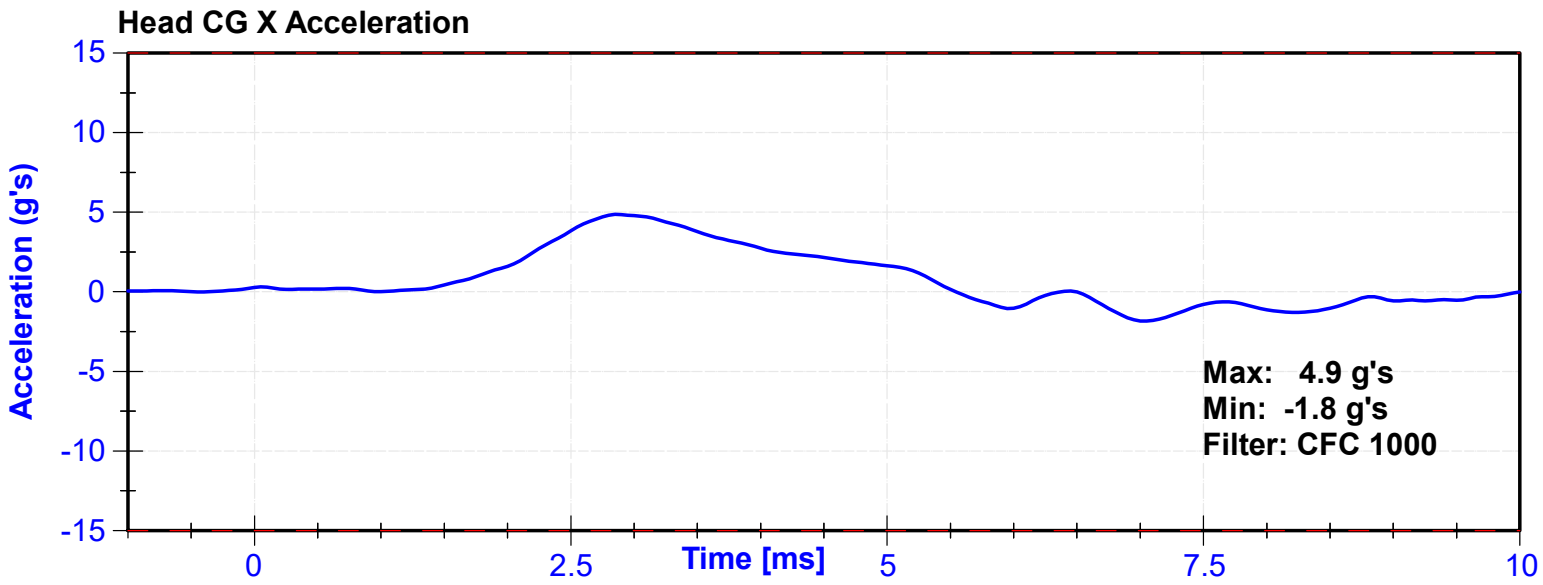
Results

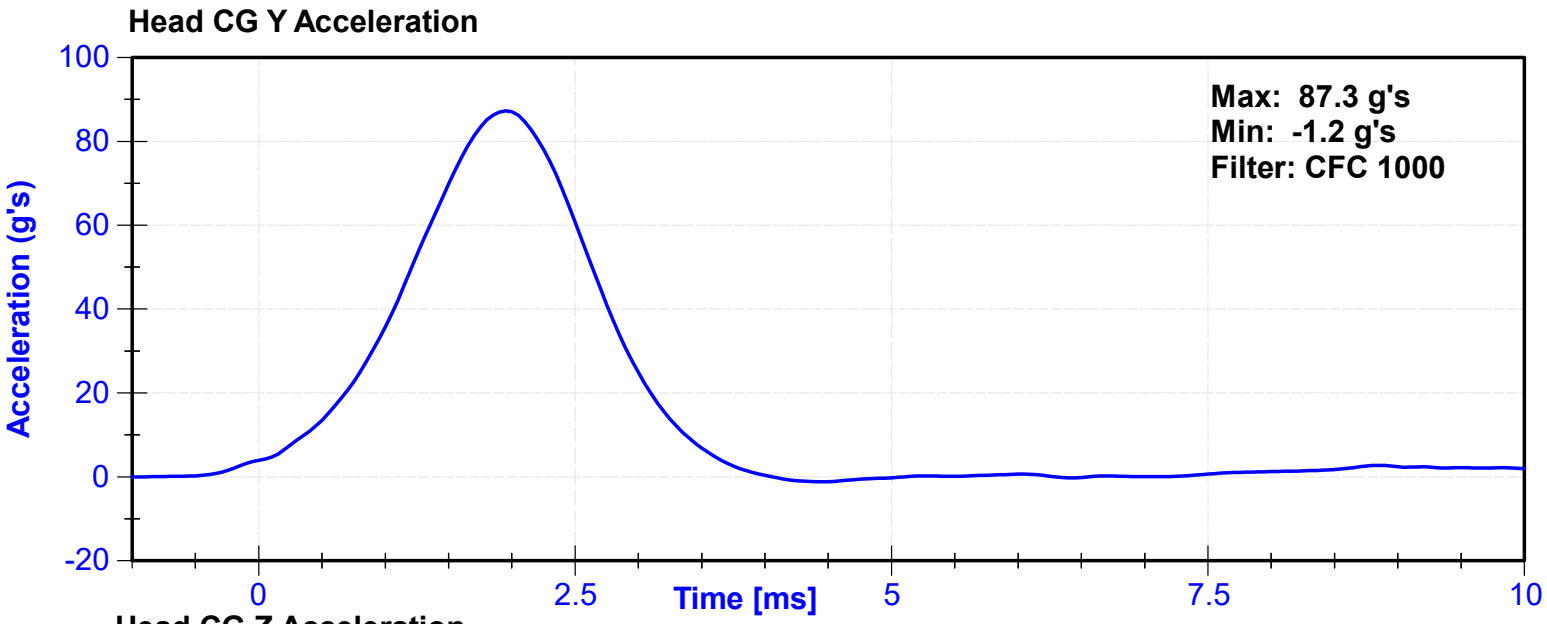
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.5	Pass
Humidity	10	70	%	48	Pass
Resultant Acceleration	125	155	g's	147.0	Pass
Oscillation	0	15	%	3.10	Pass
Fore-Aft Acceleration	-15	15	g's	4.9	Pass

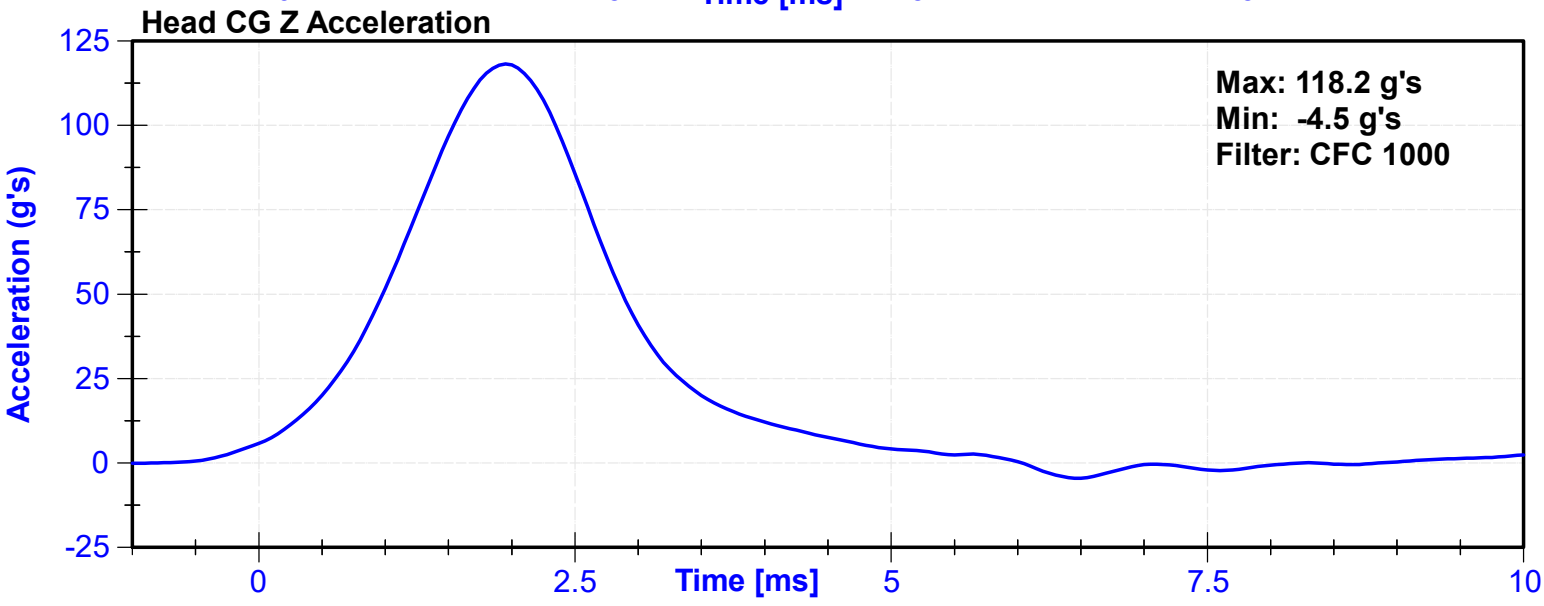
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	Endevco	T21724	2/27/2023	8/26/2023
Y Accelerometer	Endevco	T22281	2/27/2023	8/26/2023
Z Accelerometer	Endevco	T26050	2/27/2023	8/26/2023




Head CG X Acceleration
Acceleration (g's)
15
10
5
0
-5
-10
-15
0
2.5
Time [ms]
5
7.5
10
Max: 4.9 g's
Min: -1.8 g's
Filter: CFC 1000


Head CG Y Acceleration
Acceleration (g's)
100
80
60
40
20
0
-20
0
2.5
Time [ms]
5
7.5
10
Max: 87.3 g's
Min: -1.2 g's
Filter: CFC 1000


Head CG Z Acceleration
Acceleration (g's)
125
100
75
50
25
0
-25
0
2.5
Time [ms]
5
7.5
10
Max: 118.2 g's
Min: -4.5 g's
Filter: CFC 1000

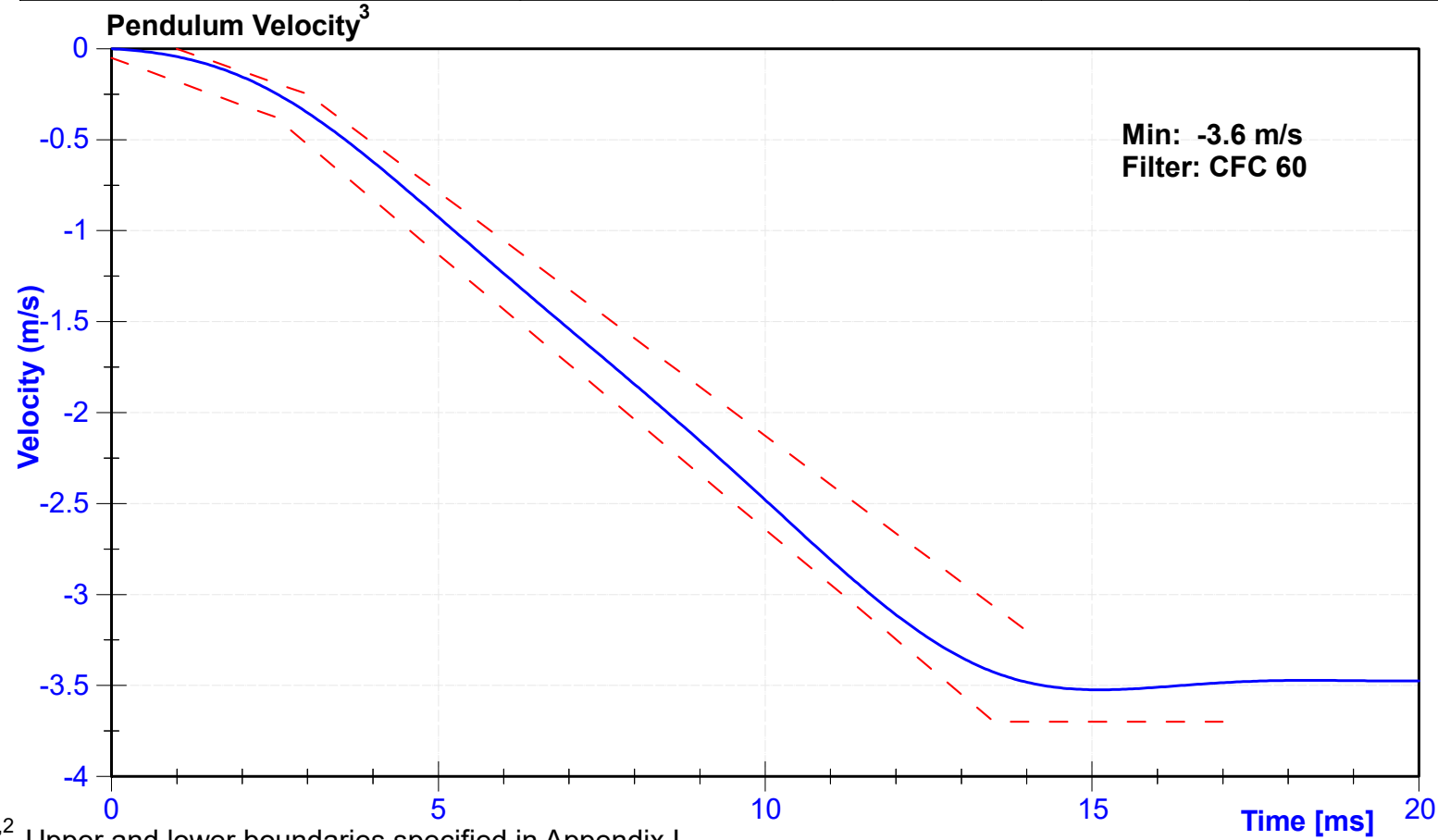
ATD Manufacturer	Denton	Test Technician	D. Sakona
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

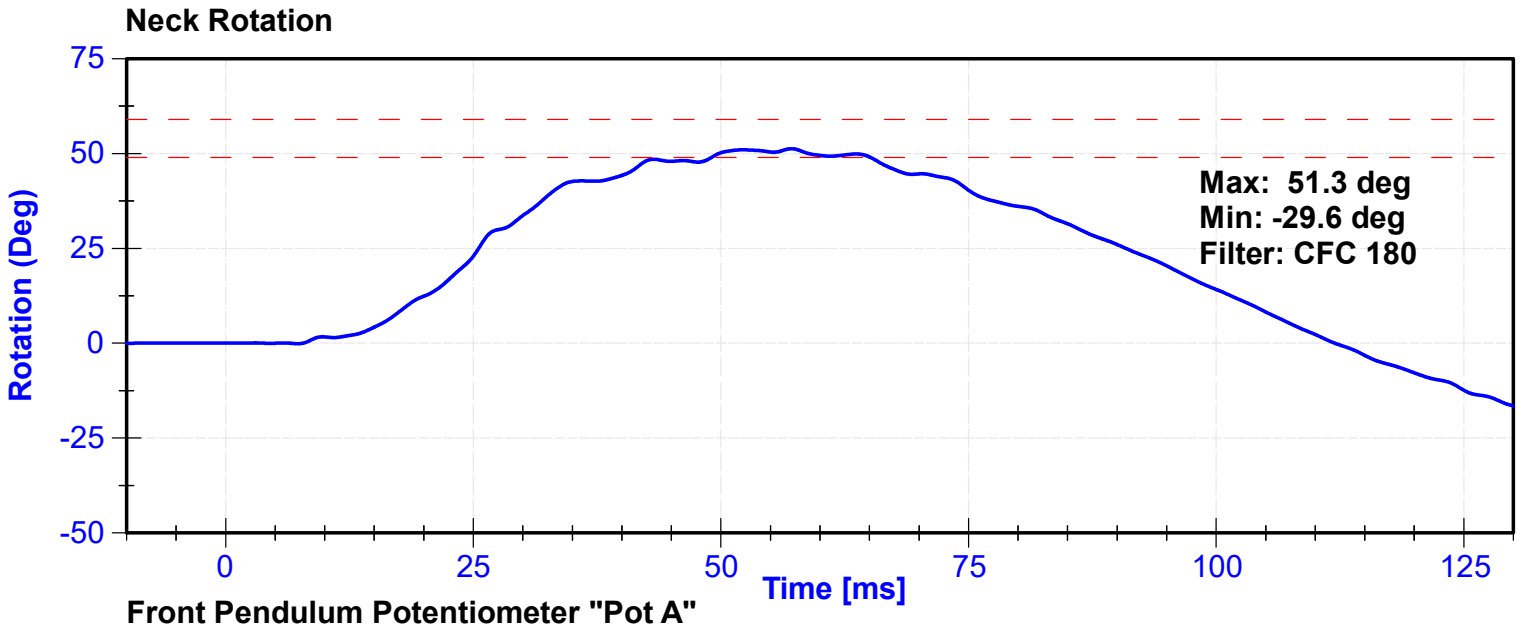
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.8	Pass
Humidity	10	70	%	47.5	Pass
Velocity	3.3	3.5	m/s	3.31	Pass
Lateral Neck Rotation	49	59	deg	51.3	Pass
Time at Maximum Rotation	54	66	ms	57.1	Pass
Time of Rotation Decay from Maximum	53	88	ms	54.9	Pass
Pendulum Velocity Overall Corridor	Lower Boundary[1]	Upper Boundary[2]	m/s	See Plot[3]	Pass

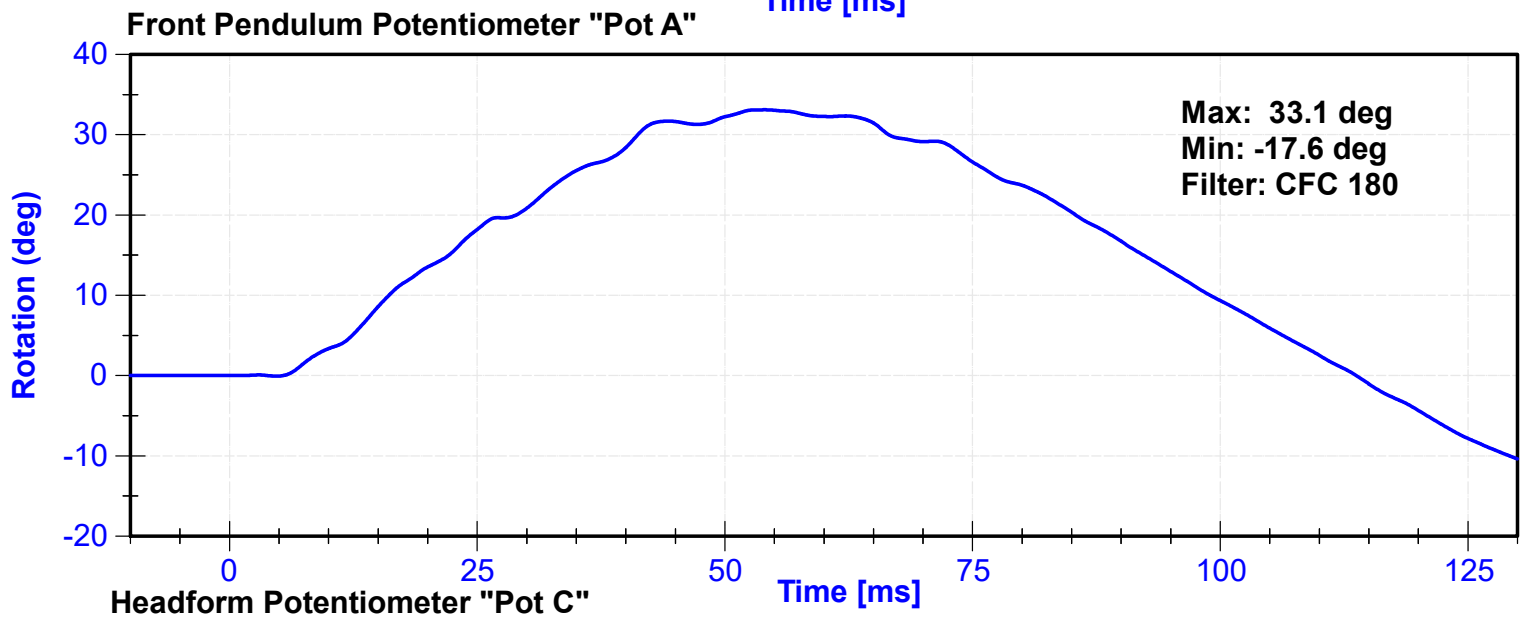
Transducer Calibrations

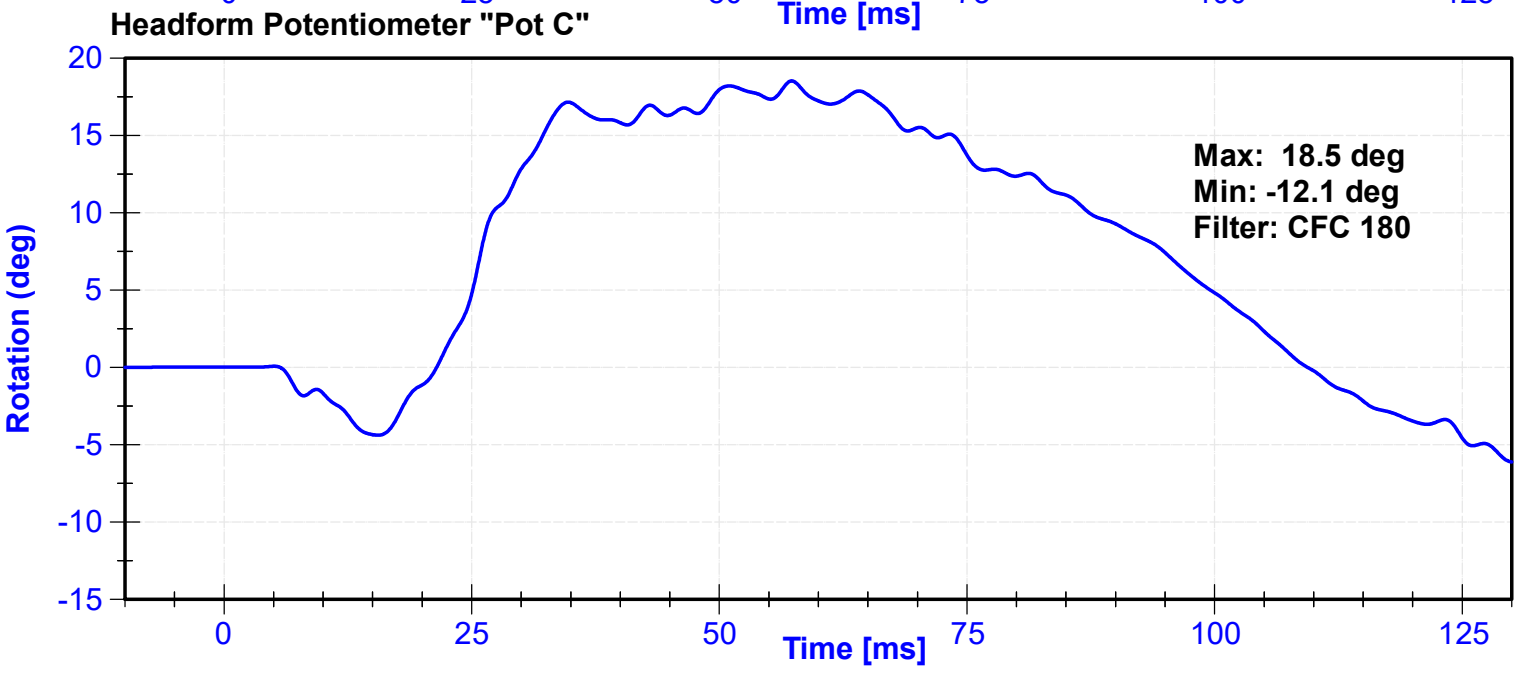
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	C16503	10/26/2022	10/26/2023
Front Pendulum Potentiometer	Sfernice	094	10/5/2022	10/5/2023
Headform Potentiometer	Sfernice	095	10/5/2022	10/5/2023



[1,2] Upper and lower boundaries specified in Appendix I


Neck Rotation
Rotation (Deg)
Time [ms]
Max: 51.3 deg
Min: -29.6 deg
Filter: CFC 180


Front Pendulum Potentiometer "Pot A"
Rotation (deg)
Time [ms]
Max: 33.1 deg
Min: -17.6 deg
Filter: CFC 180


Headform Potentiometer "Pot C"
Rotation (deg)
Time [ms]
Max: 18.5 deg
Min: -12.1 deg
Filter: CFC 180

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

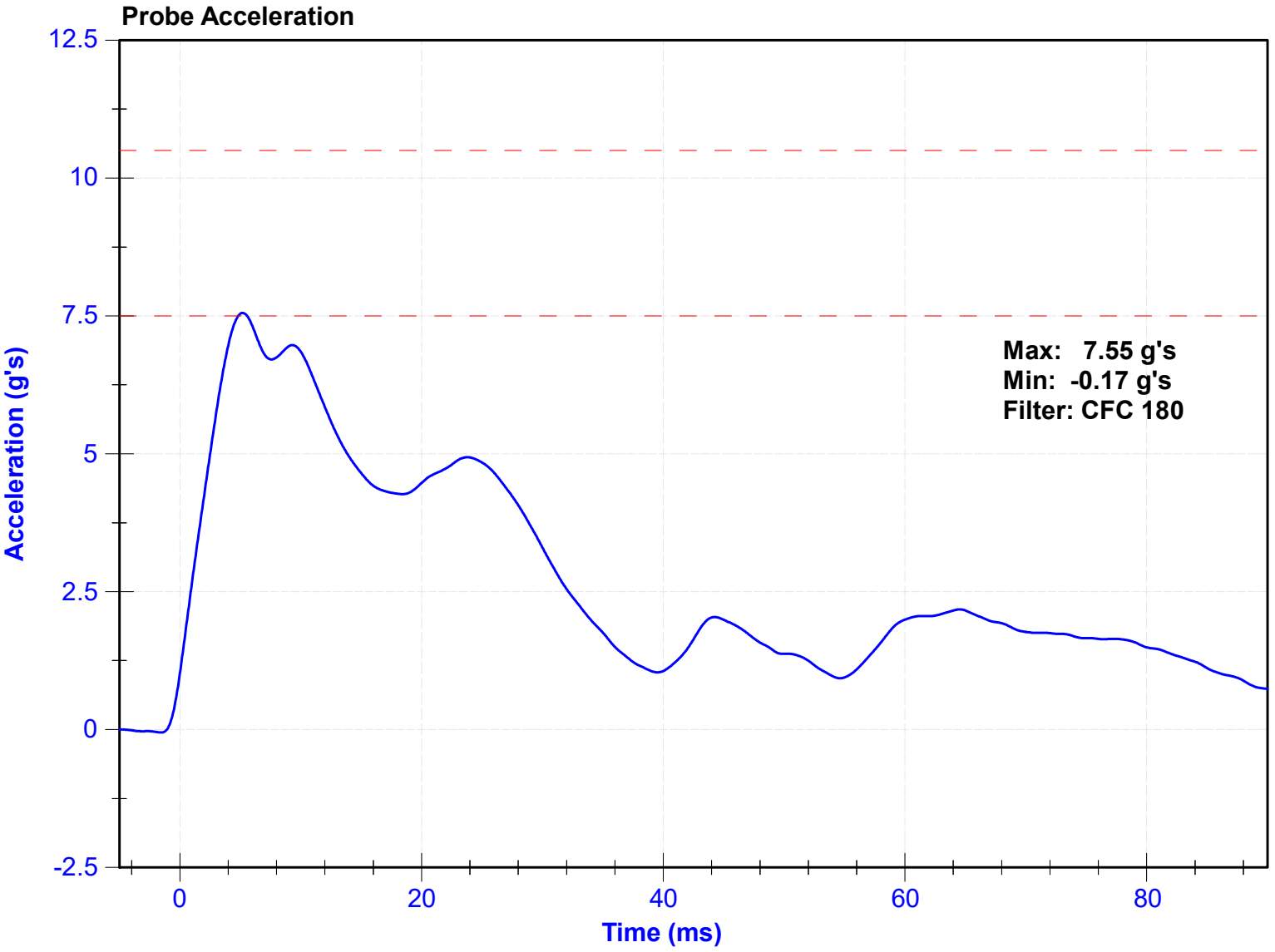
ATD Manufacturer	Denton	Test Technician	Z.Schneider
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.5	Pass
Humidity	10	70	%	49	Pass
Velocity	4.2	4.4	m/s	4.34	Pass
Probe Acceleration	7.5	10.5	g's	7.55	Pass

Transducer Calibrations

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



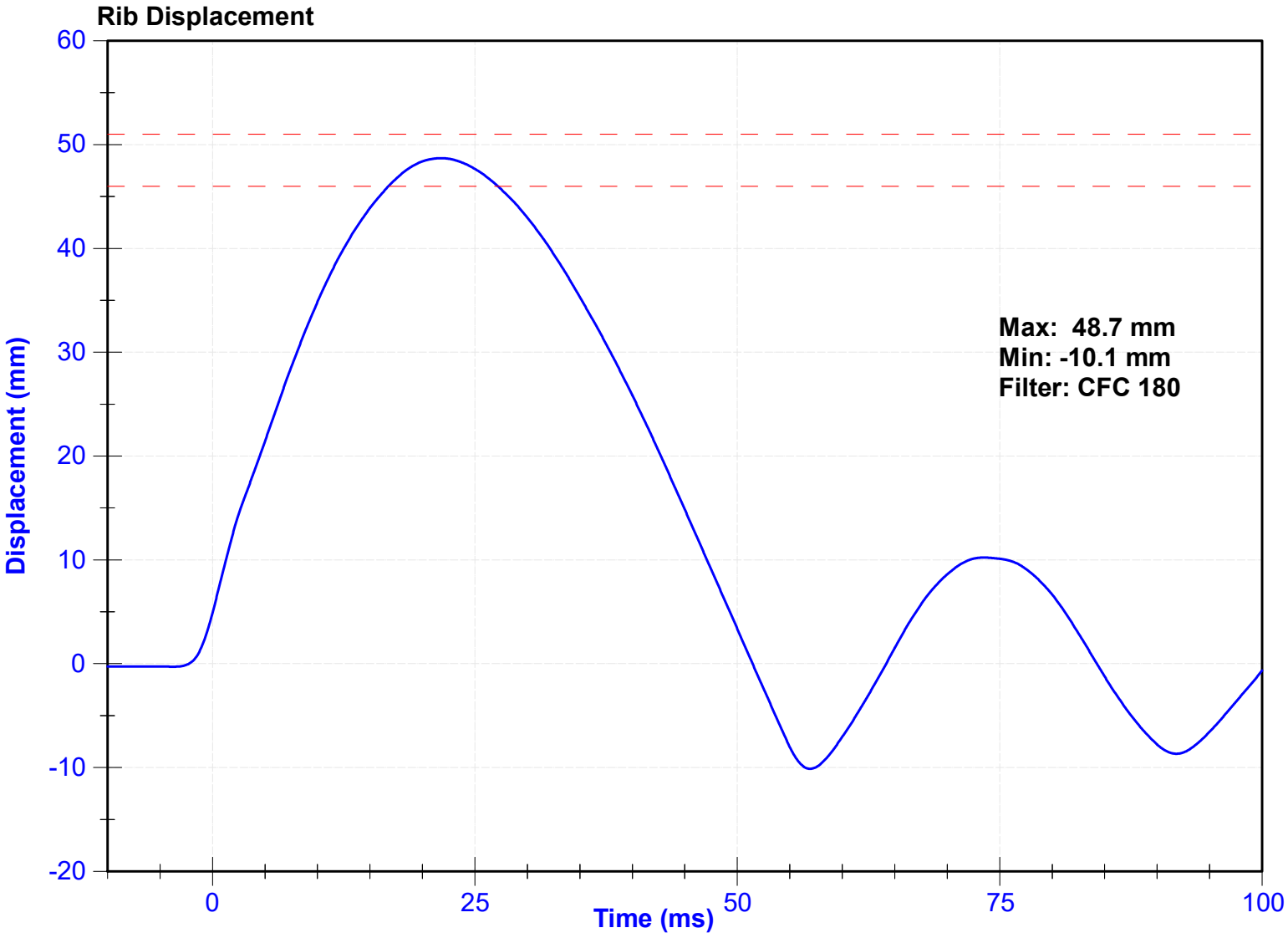
ATD Manufacturer	Denton	Test Technician	Z.Schneider
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.8	Pass
Humidity	10	70	%	48	Pass
Rib Displacement	46	51	mm	48.7	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	DS-0552-01	2/27/2023	8/28/2023



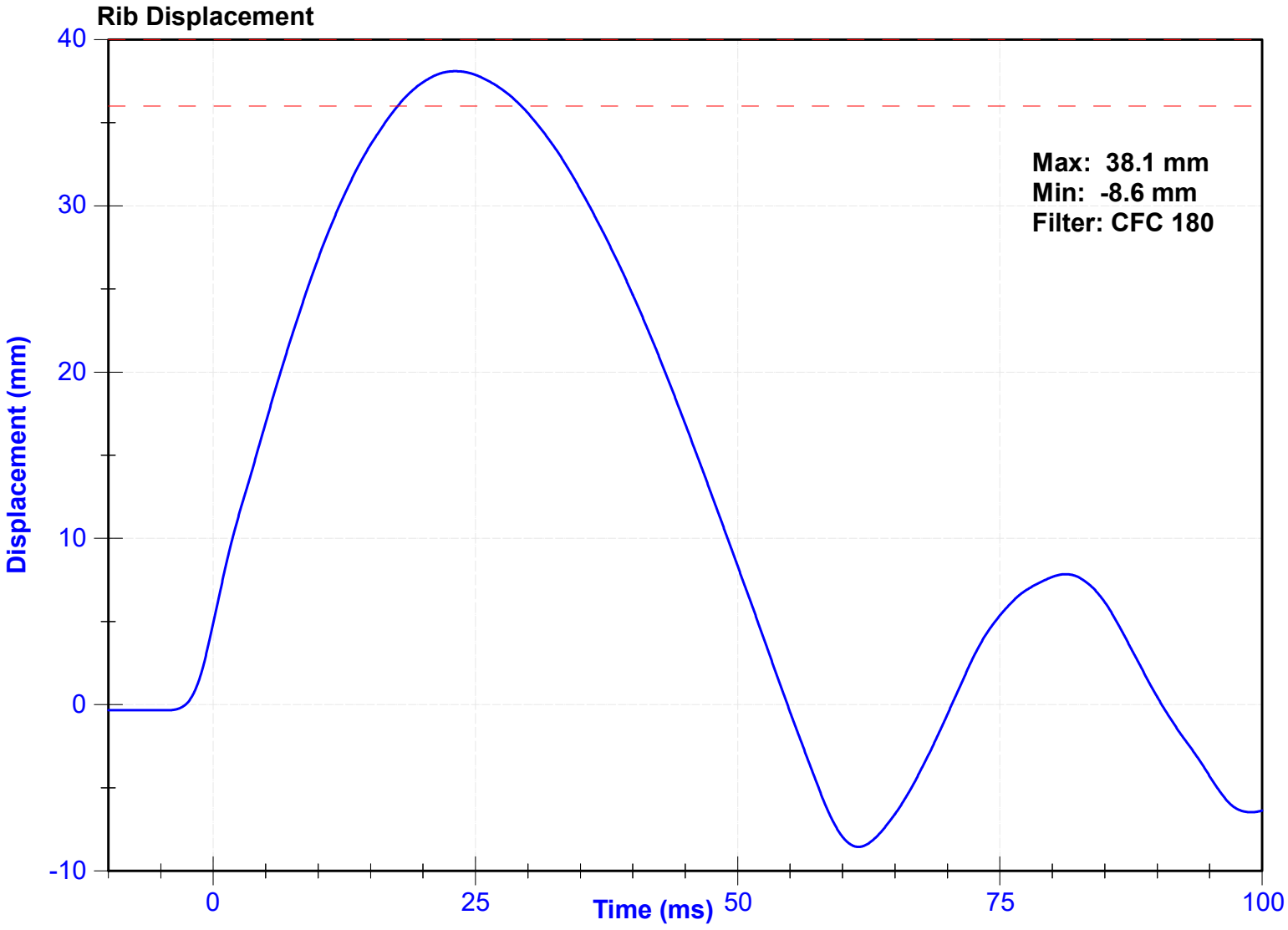
ATD Manufacturer	Denton	Test Technician	Z.Schneider
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.8	Pass
Humidity	10	70	%	48	Pass
Rib Displacement	36	40	mm	38.1	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	DS-0552-01	2/27/2023	8/28/2023



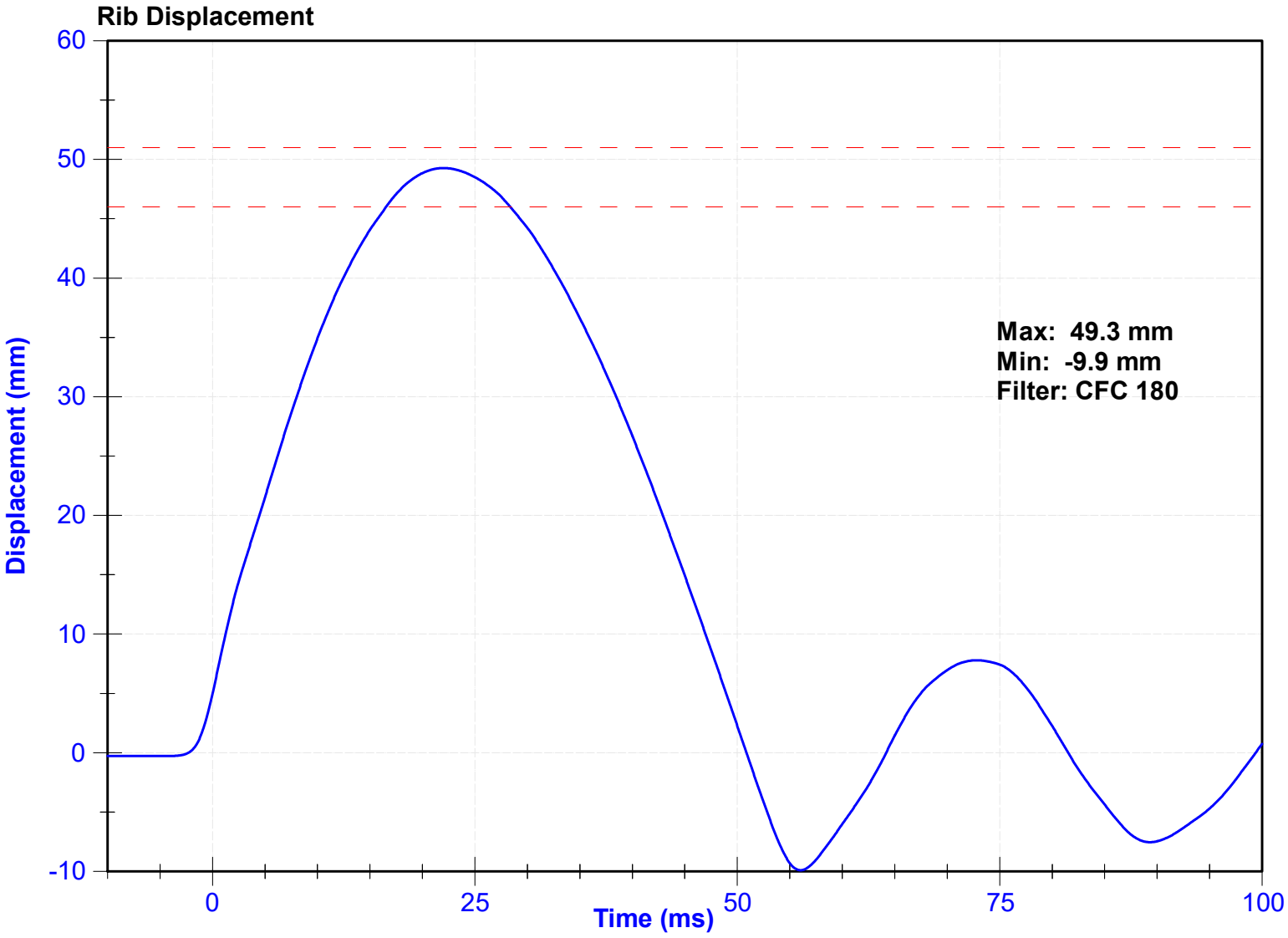
ATD Manufacturer	Denton	Test Technician	Z.Schneider
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.8	Pass
Humidity	10	70	%	48	Pass
Rib Displacement	46	51	mm	49.3	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	DS-807	2/27/2023	8/28/2023



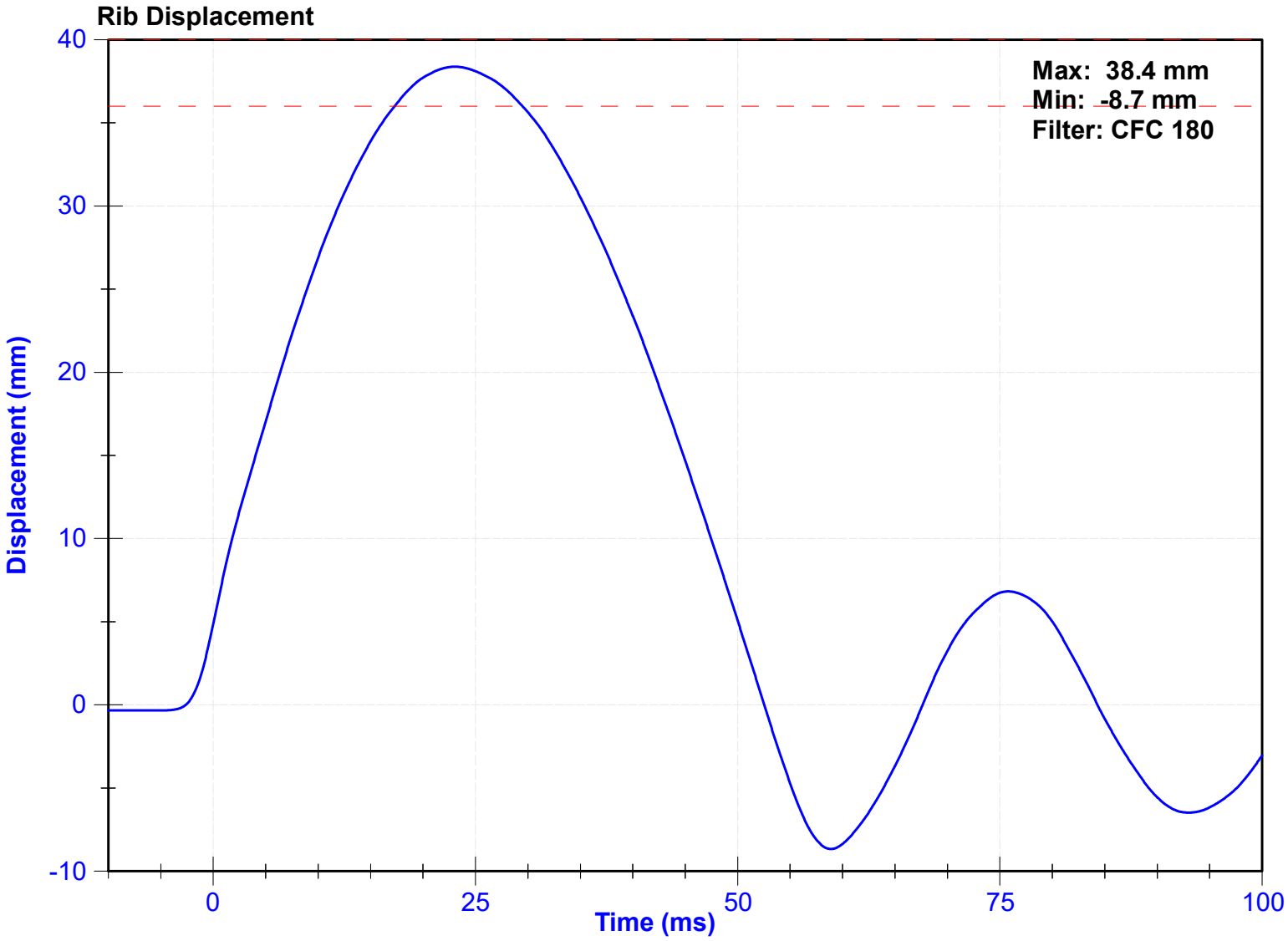
ATD Manufacturer	Denton	Test Technician	Z.Schneider
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.8	Pass
Humidity	10	70	%	48	Pass
Rib Displacement	36	40	mm	38.4	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	DS-807	2/27/2023	8/28/2023



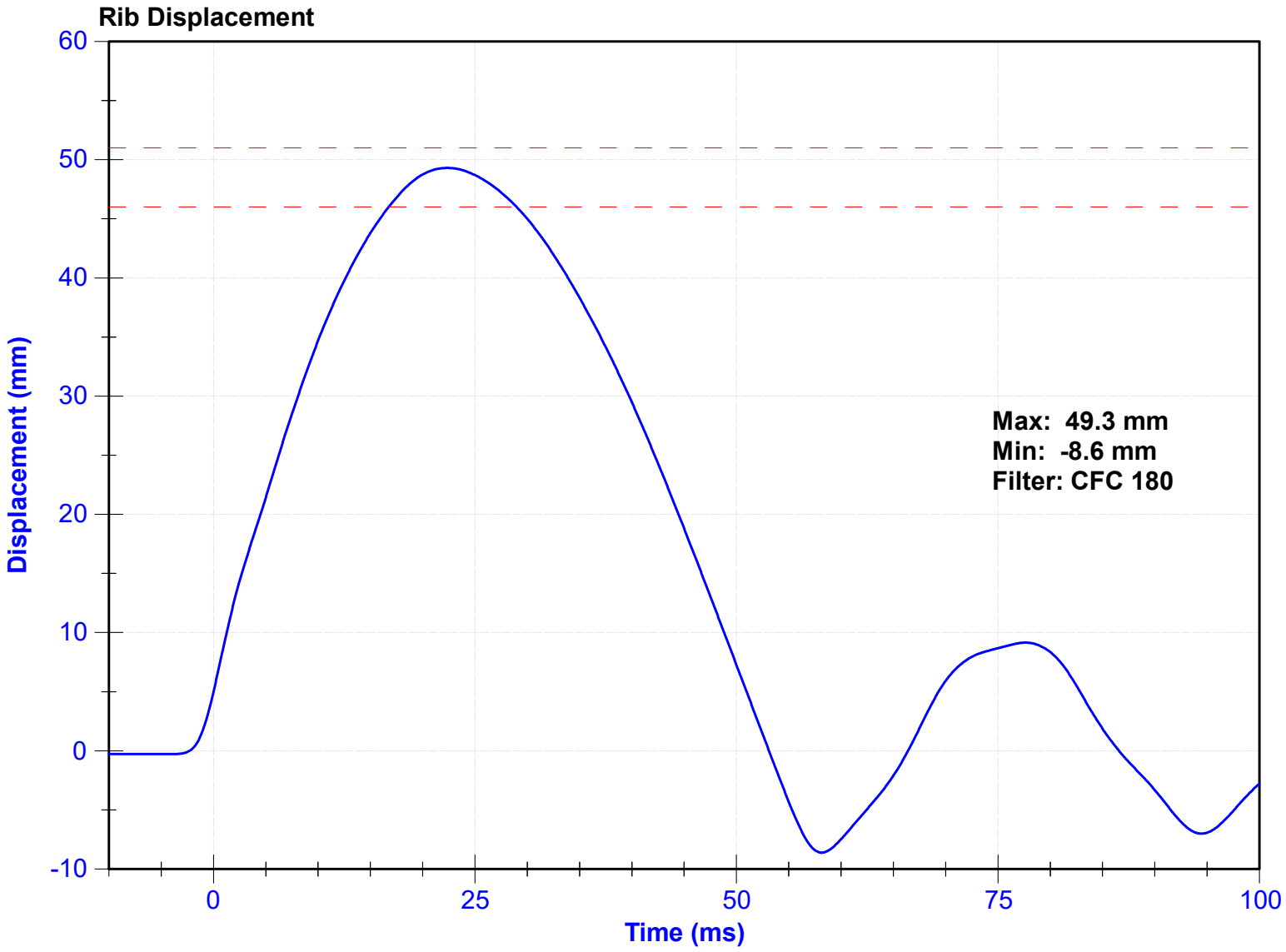
ATD Manufacturer	Denton	Test Technician	Z.Schneider
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.8	Pass
Humidity	10	70	%	48	Pass
Rib Displacement	46	51	mm	49.3	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	DS-0552-03	2/27/2023	8/28/2023



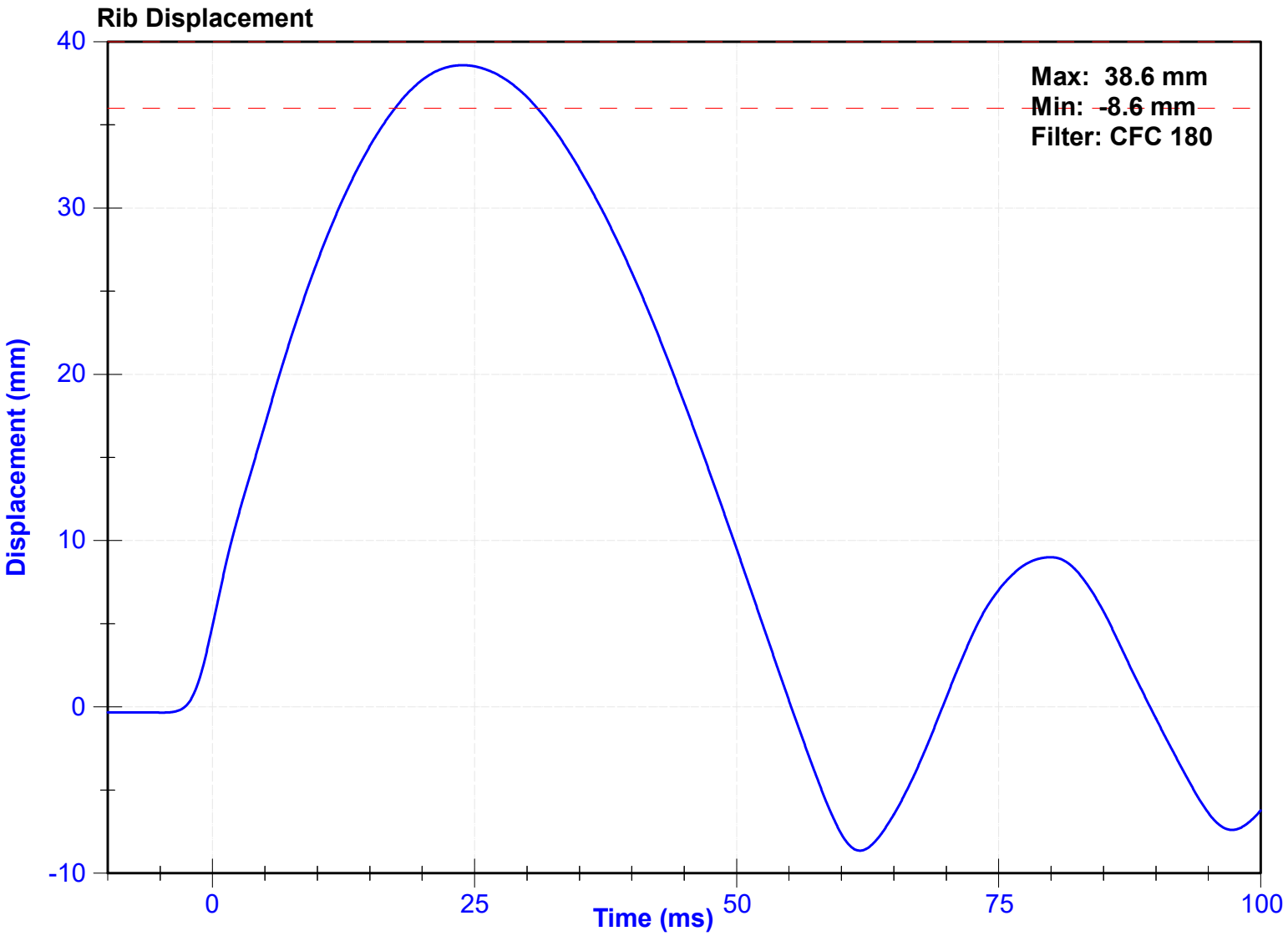
ATD Manufacturer	Denton	Test Technician	Z.Schneider
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.8	Pass
Humidity	10	70	%	48	Pass
Rib Displacement	36	40	mm	38.6	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	DS-0552-03	2/27/2023	8/28/2023



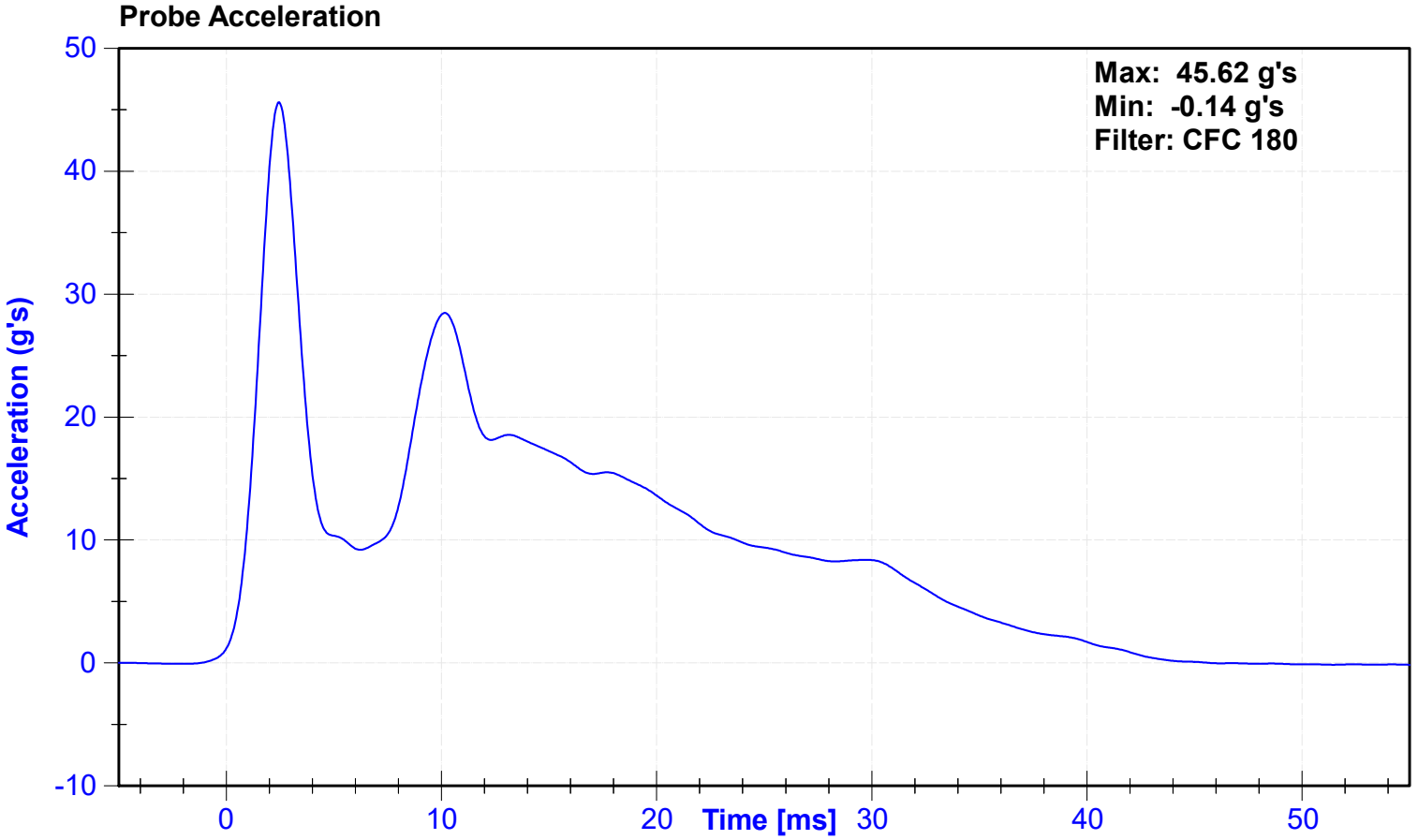
ATD Manufacturer	Denton	Test Technician	Z.Schneider
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

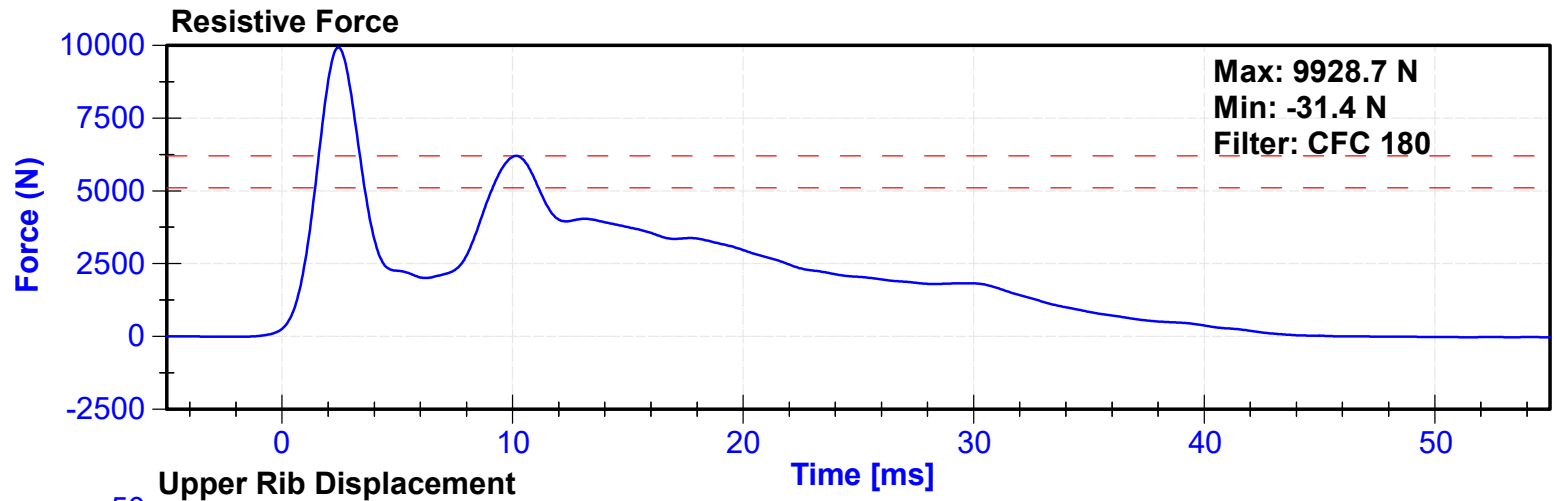
Results

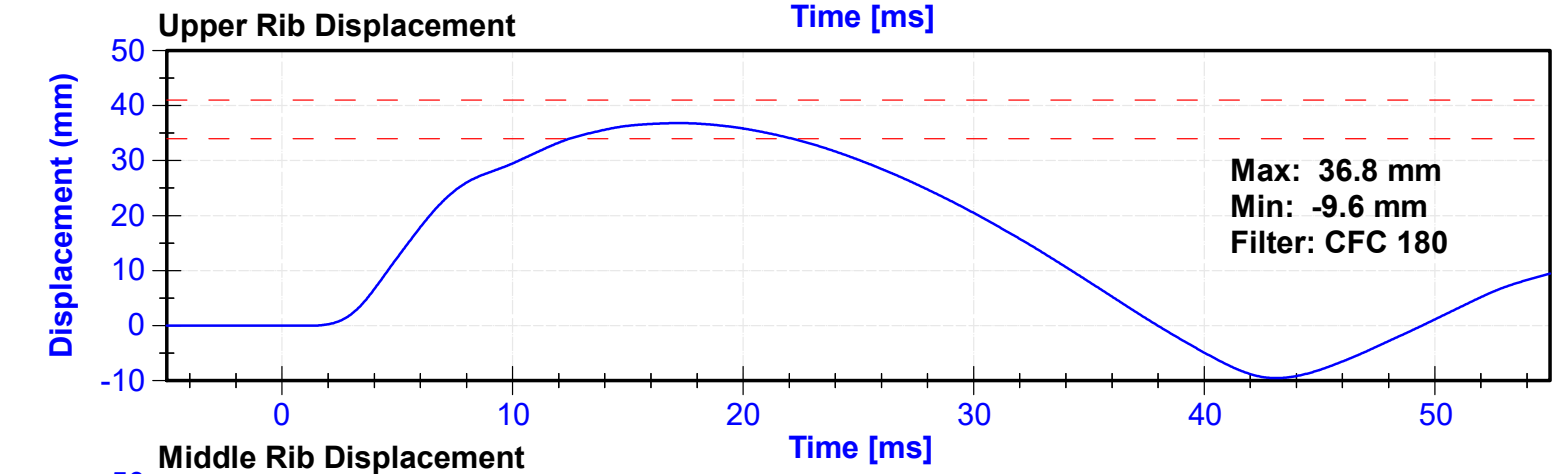
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.5	Pass
Humidity	10	70	%	49	Pass
Velocity	5.4	5.6	m/s	5.54	Pass
Resistive Force after 6ms	5100	6200	N	6198.7	Pass
Upper Thorax Rib Deflection	34	41	mm	36.8	Pass
Mid Thorax Rib Deflection	37	45	mm	40.8	Pass
Lower Thorax Rib Deflection	37	44	mm	42.4	Pass

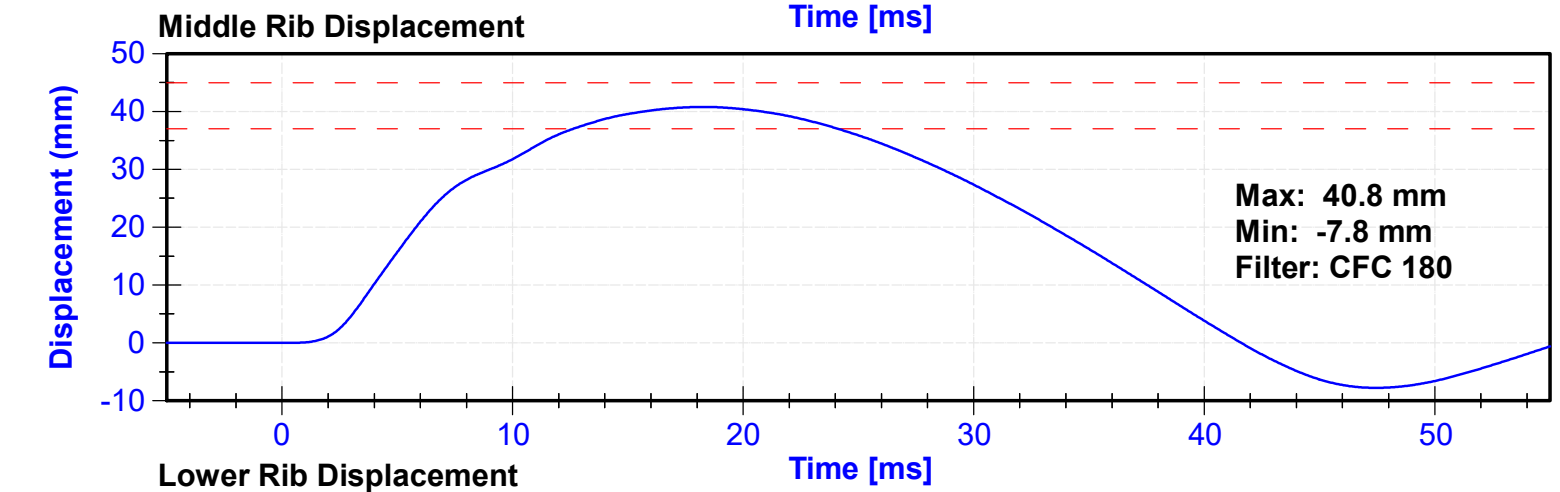
Transducer Calibrations

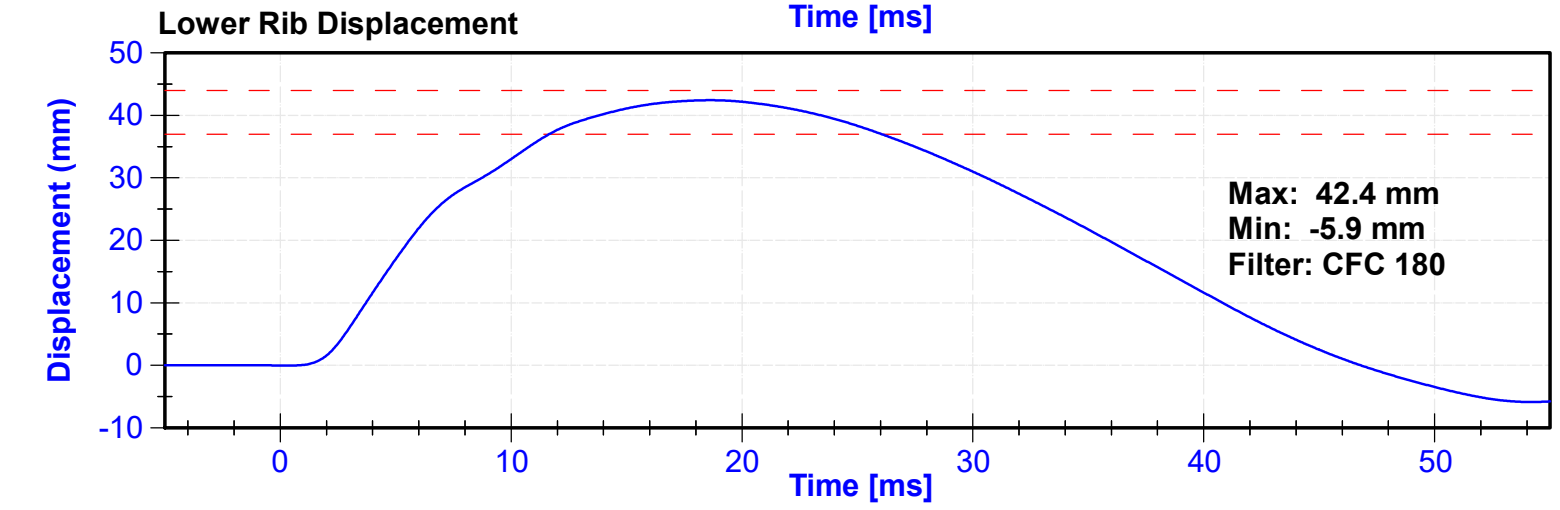
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Probe Accelerometer	Endevco	18546	11/19/2022	11/18/2023
Upper Thorax Rib Potentiometer	Honeywell	DS-0552-01	2/27/2023	8/28/2023
Middle Thorax Rib Potentiometer	Honeywell	DS-807	2/27/2023	8/28/2023
Lower Thorax Rib Potentiometer	Honeywell	DS-0552-03	2/27/2023	8/28/2023




Resistive Force
Max: 9928.7 N
Min: -31.4 N
Filter: CFC 180
Force (N)
10000
7500
5000
2500
0
-2500
0
10
20
30
40
50
Time [ms]


Upper Rib Displacement
Max: 36.8 mm
Min: -9.6 mm
Filter: CFC 180
Displacement (mm)
50
40
30
20
10
0
-10
0
10
20
30
40
50
Time [ms]


Middle Rib Displacement
Max: 40.8 mm
Min: -7.8 mm
Filter: CFC 180
Displacement (mm)
50
40
30
20
10
0
-10
0
10
20
30
40
50
Time [ms]


Lower Rib Displacement
Max: 42.4 mm
Min: -5.9 mm
Filter: CFC 180
Displacement (mm)
50
40
30
20
10
0
-10
0
10
20
30
40
50
Time [ms]

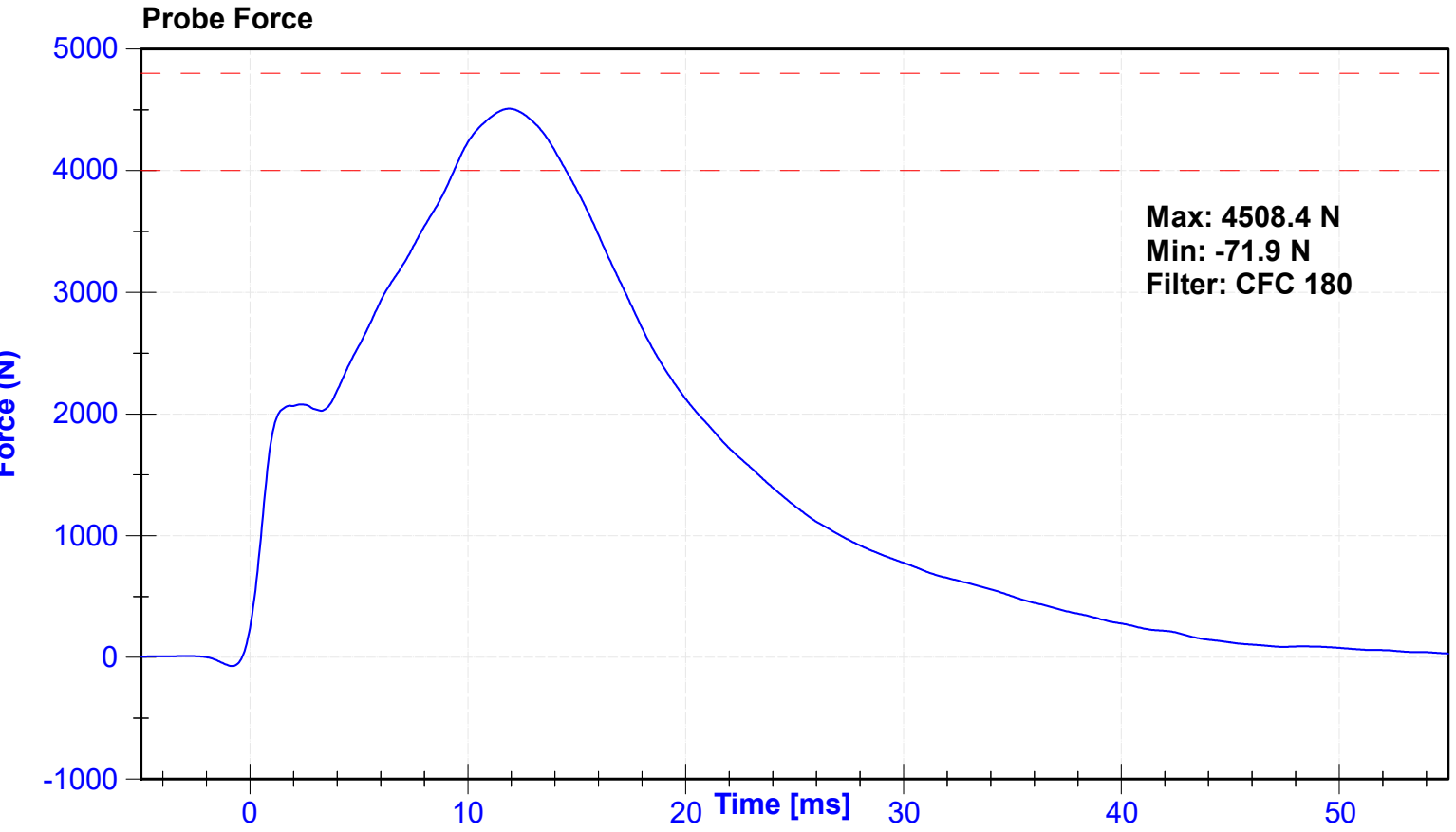
ATD Manufacturer	Denton	Test Technician	Z.Schneider
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

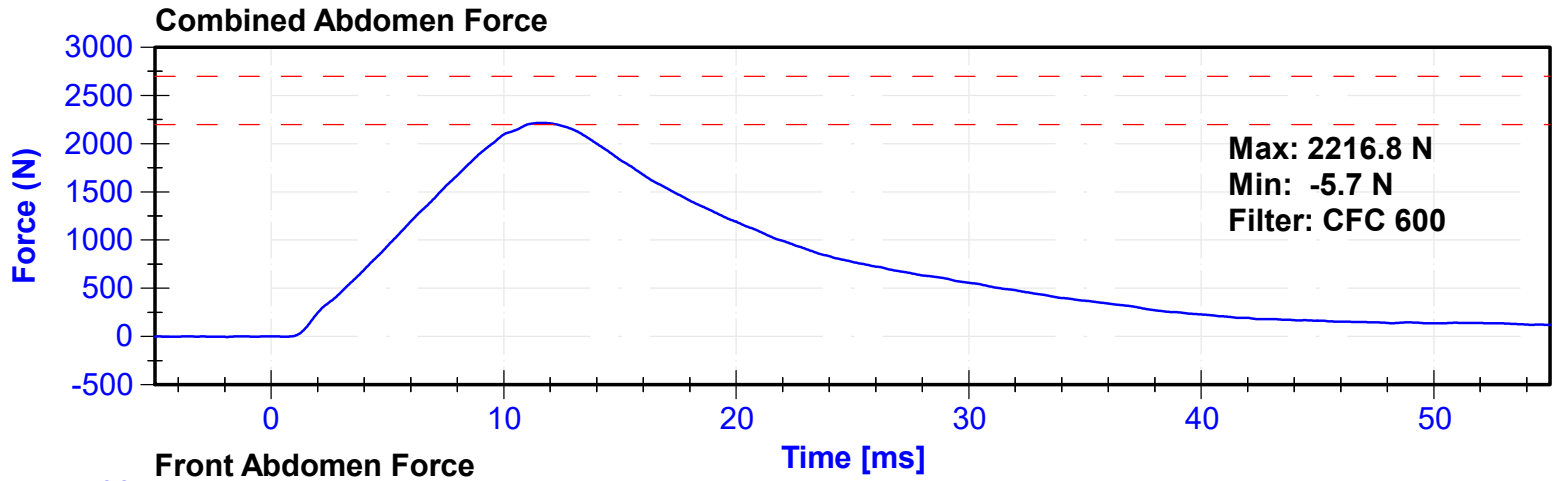
Results

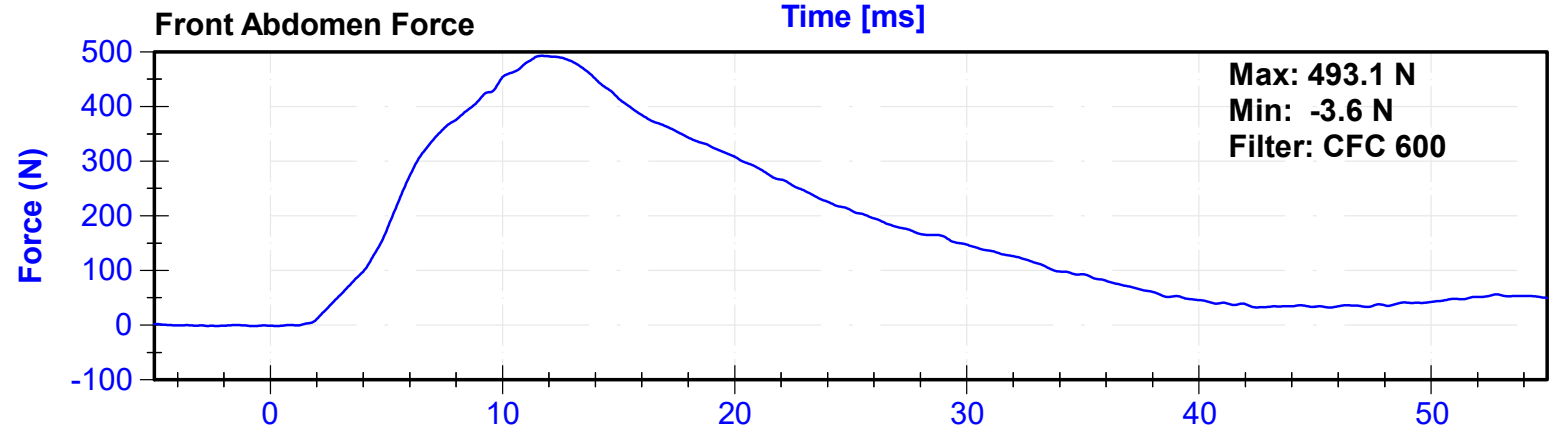
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.5	Pass
Humidity	10	70	%	49	Pass
Velocity	3.9	4.1	m/s	4.02	Pass
Combined Abdomen Force	2200	2700	N	2216.8	Pass
Time at Peak Abdomen Force	10.0	12.3	ms	11.65	Pass
Resistive Probe Force	4000	4800	N	4508.4	Pass
Time at Peak Resistive Force	10.6	13.0	ms	11.90	Pass

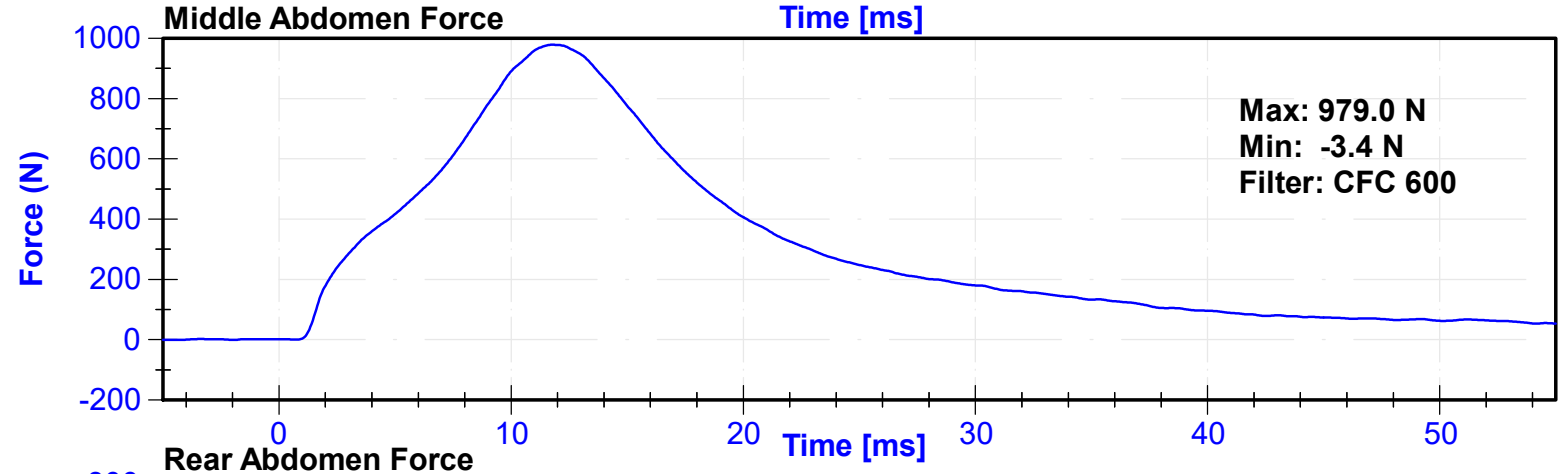
Transducer Calibrations

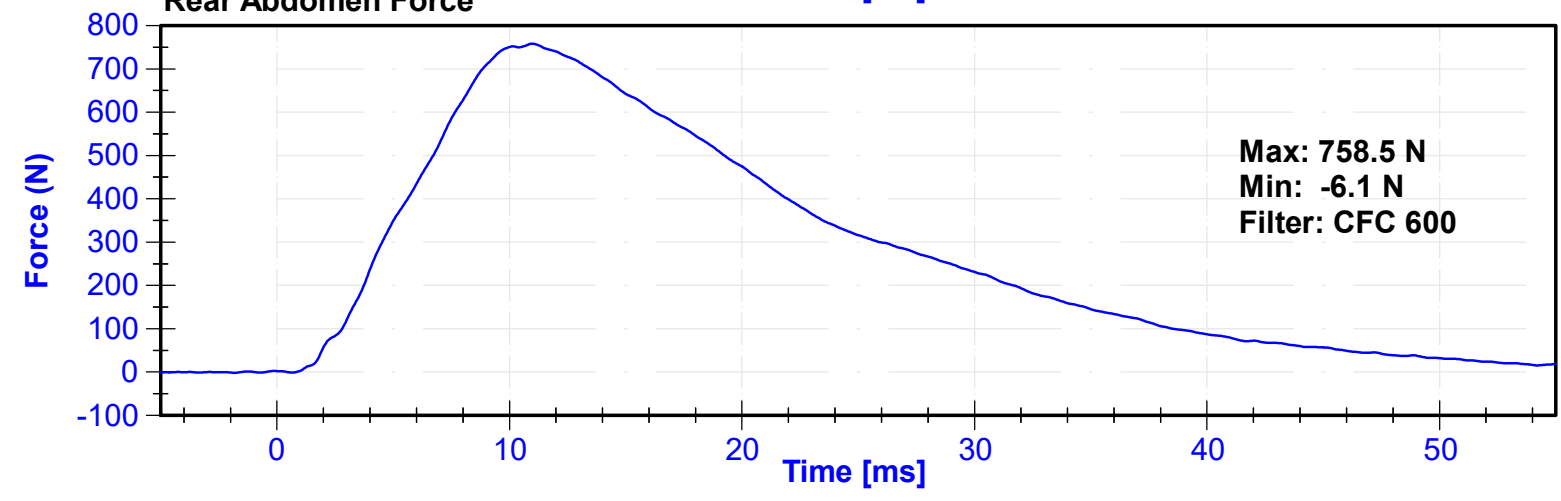
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18546	11/19/2022	11/18/2023
Front Abdomen Load Cell	Denton	1440	8/12/2022	8/12/2023
Middle Abdomen Load Cell	Denton	1525	8/12/2022	8/12/2023
Rear Abdomen Load Cell	Denton	1528	8/12/2022	8/12/2023




Combined Abdomen Force
Force (N)
Time [ms]
Max: 2216.8 N
Min: -5.7 N
Filter: CFC 600


Front Abdomen Force
Force (N)
Time [ms]
Max: 493.1 N
Min: -3.6 N
Filter: CFC 600


Middle Abdomen Force
Force (N)
Time [ms]
Max: 979.0 N
Min: -3.4 N
Filter: CFC 600


Rear Abdomen Force
Force (N)
Time [ms]
Max: 758.5 N
Min: -6.1 N
Filter: CFC 600

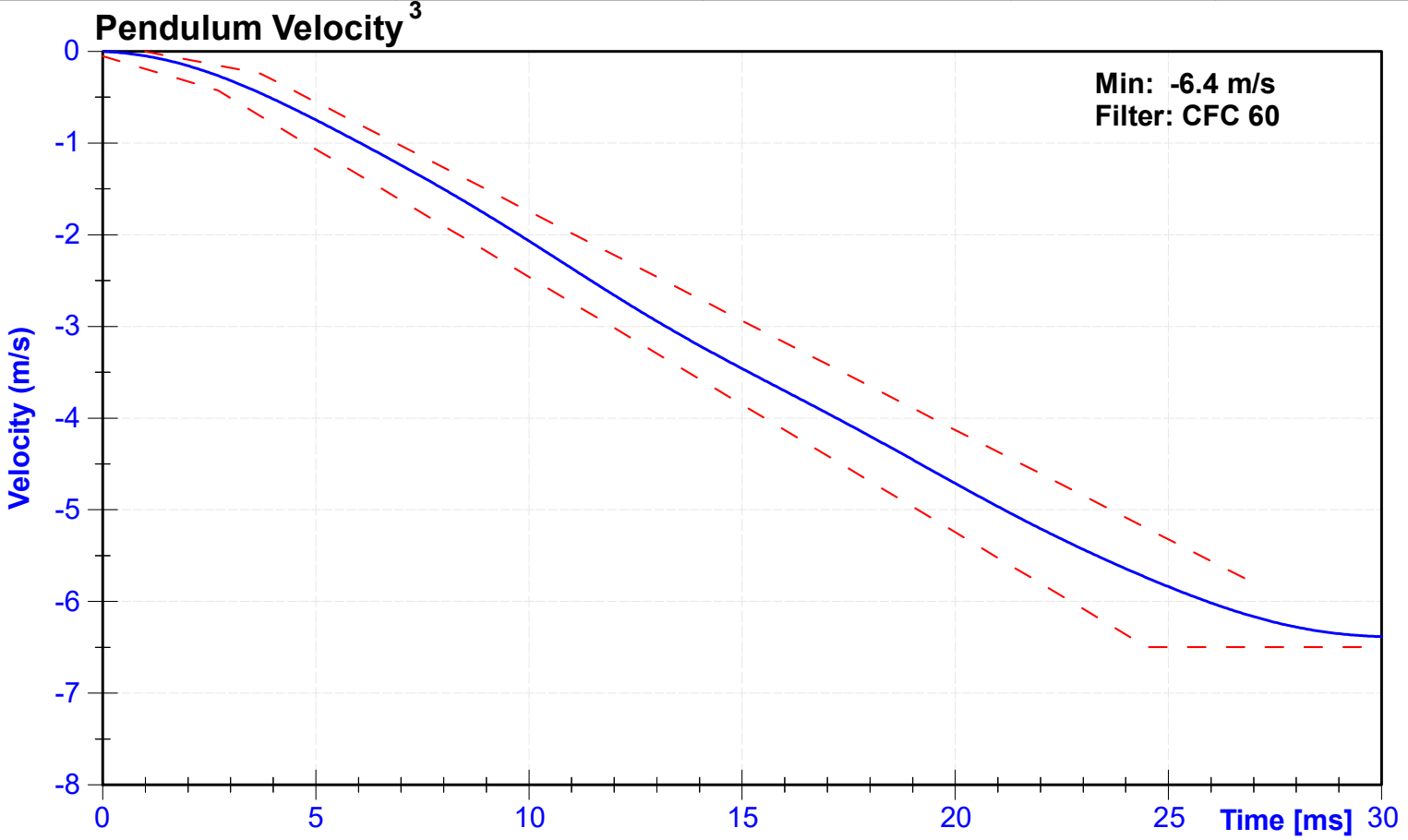
ATD Manufacturer	Denton	Test Technician	D. Sakona
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

Results

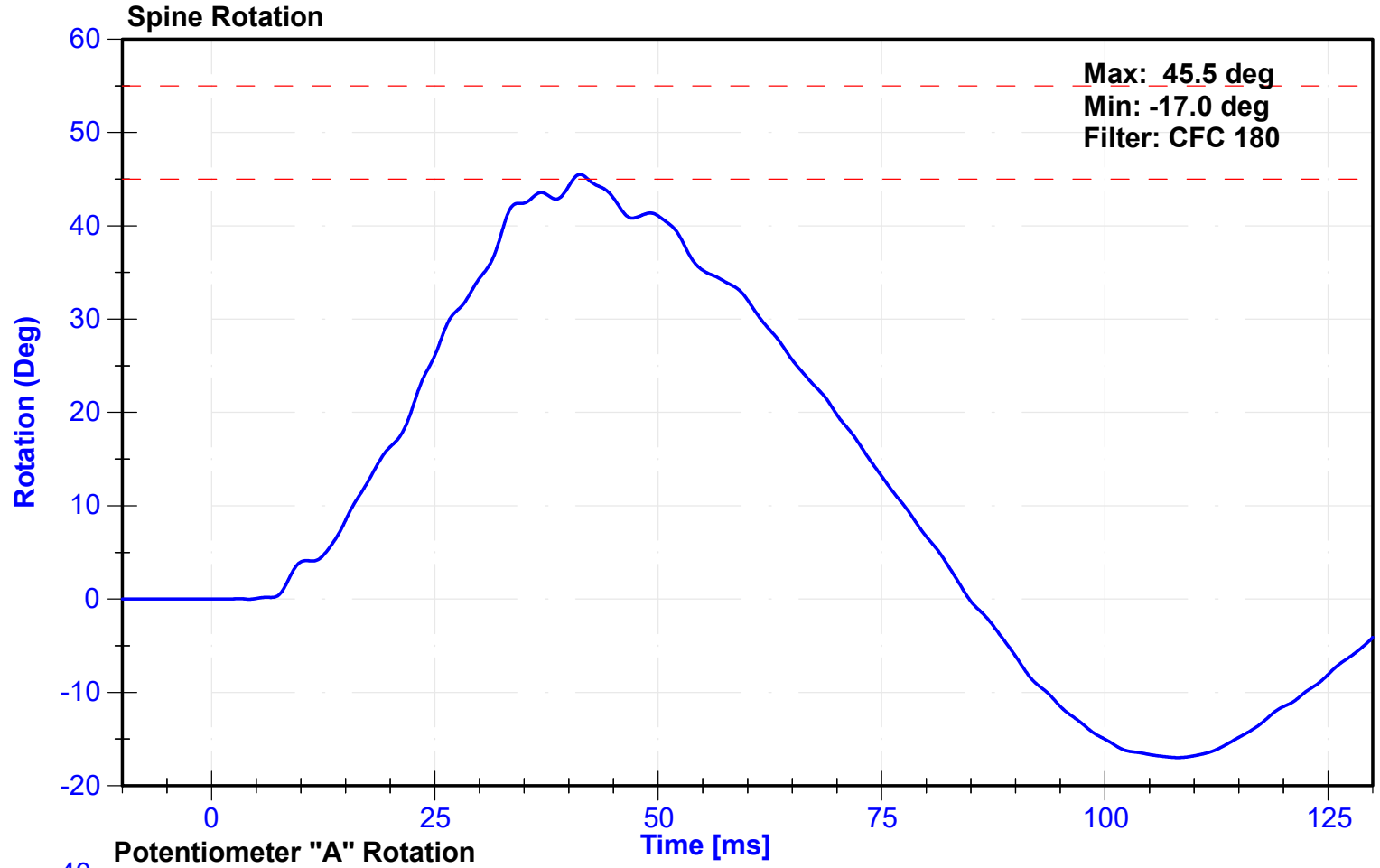
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.8	Pass
Humidity	10	70	%	47.5	Pass
Velocity	5.95	6.15	m/s	5.962	Pass
Lateral Spine Rotation	45	55	deg	45.5	Pass
Time at Maximum Rotation	39	53	ms	41.2	Pass
Time of Decay to Zero Degrees	37	57	ms	43.6	Pass
Pendulum Velocity Overall Corridor	Lower Boundary[1]	Upper Boundary[2]	m/s	See Plot[3]	Pass

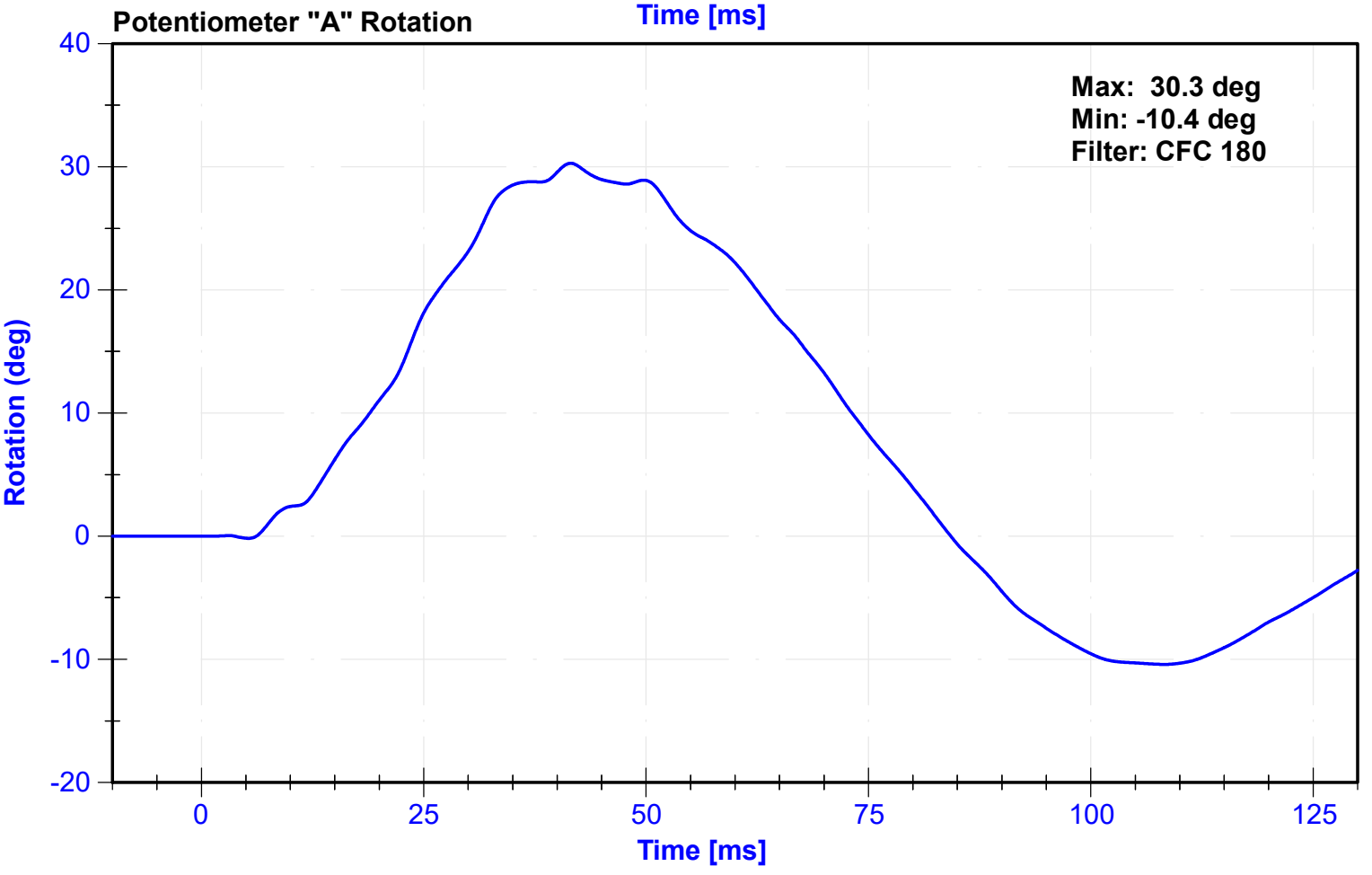
Transducer Calibrations

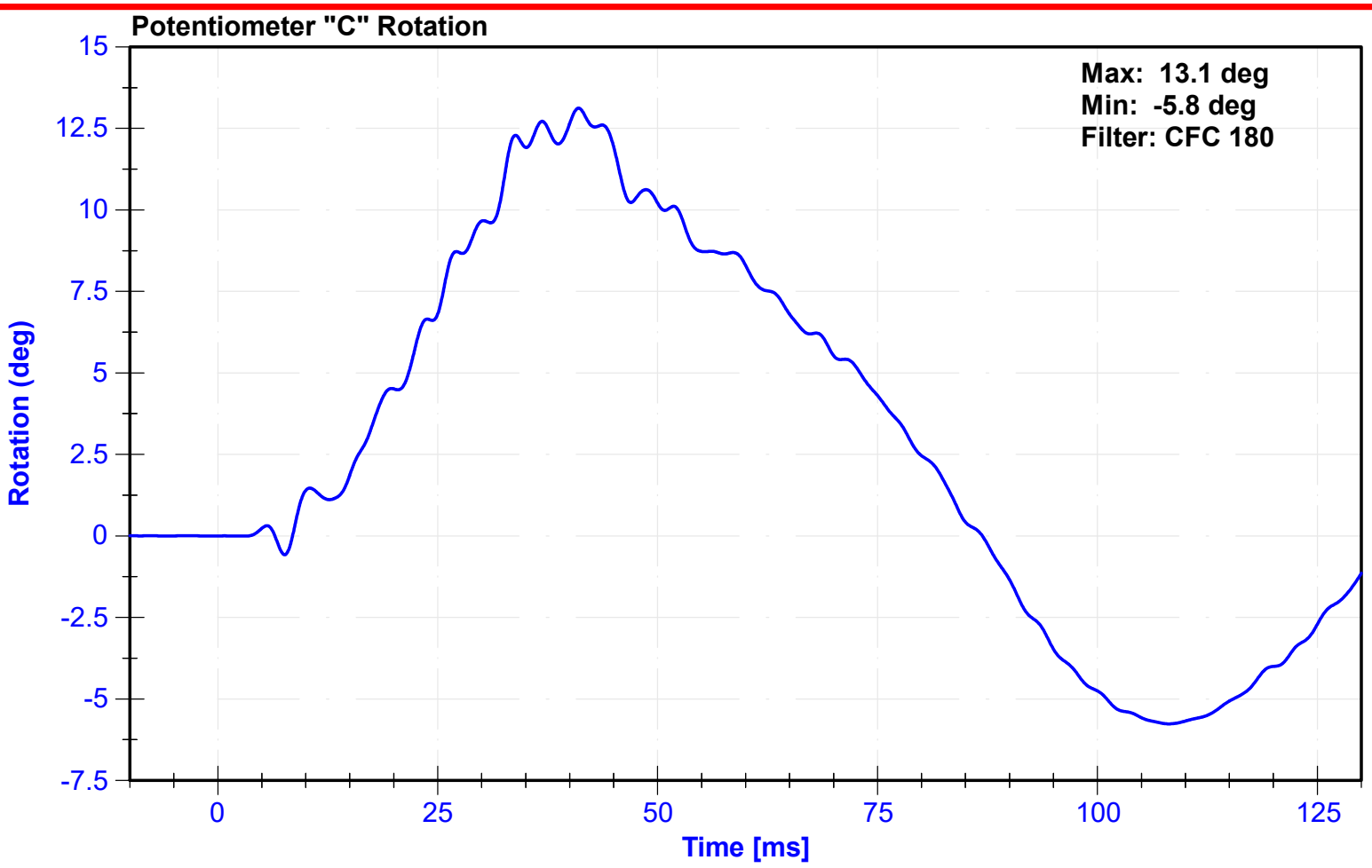
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	C16503	10/26/2022	10/26/2023
Pendulum "A" Potentiometer	Sfernice	094	10/5/2022	10/5/2023
Condyle "B" Potentiometer	Sfernice	095	10/5/2022	10/5/2023



[1,2] Upper and lower boundaries specified in Appendix I


Spine Rotation
Max: 45.5 deg
Min: -17.0 deg
Filter: CFC 180
Rotation (Deg)
60
50
40
30
20
10
0
-10
-20
0
25
50
75
100
125
Time [ms]


Potentiometer "A" Rotation
Max: 30.3 deg
Min: -10.4 deg
Filter: CFC 180
Rotation (deg)
40
30
20
10
0
-10
-20
0
25
50
75
100
125
Time [ms]



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

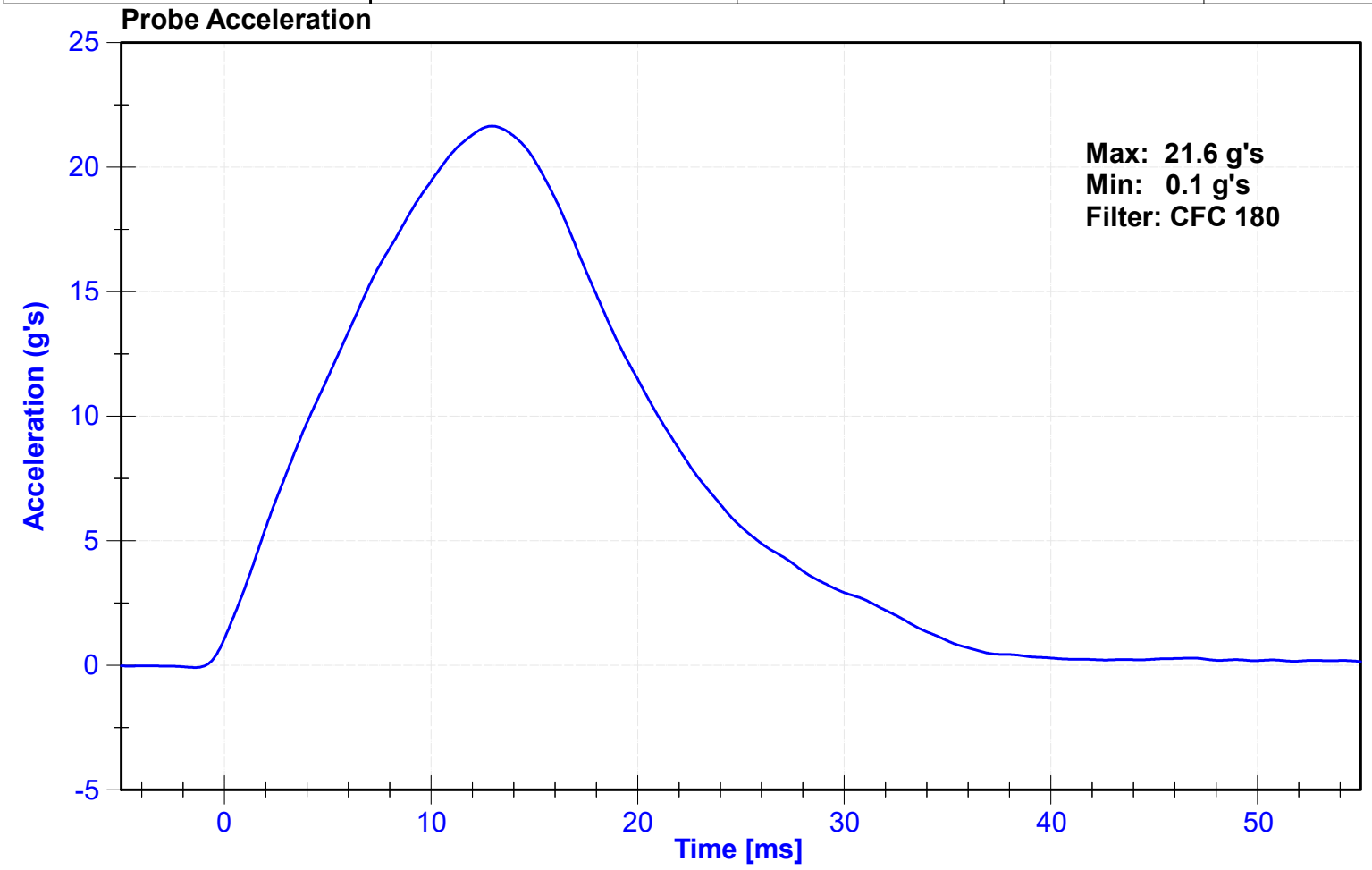
ATD Manufacturer	Denton	Test Technician	Z.Schneider
ATD Serial Number	D037	Laboratory Supervisor	C. Mantell

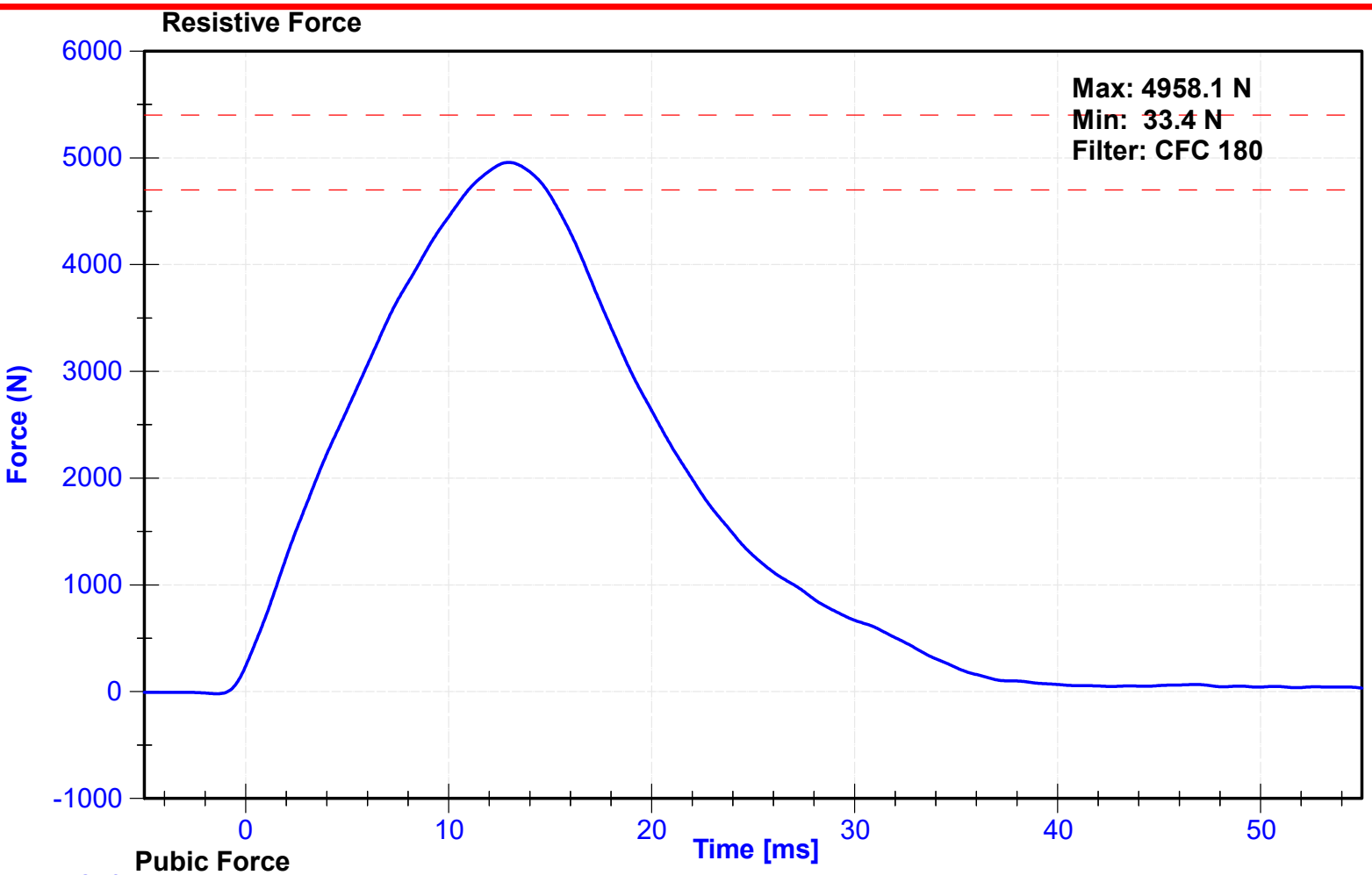
Results

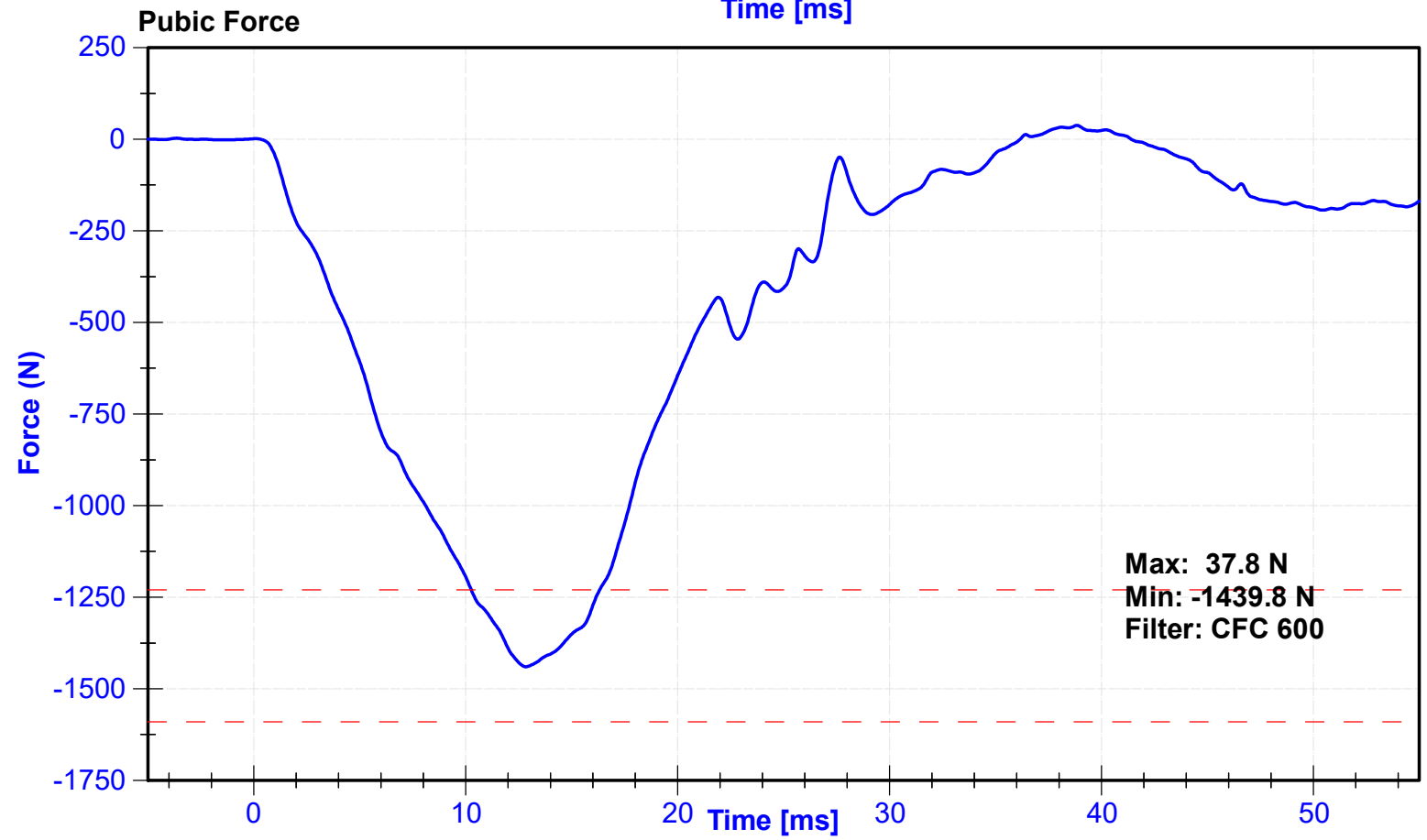
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.5	Pass
Humidity	10	70	%	49	Pass
Velocity	4.2	4.4	m/s	4.33	Pass
Resistive Force	4700	5400	N	4958.1	Pass
Time at Peak Resistive Force	11.8	16.1	ms	12.95	Pass
Pubic Force	-1590	-1230	N	-1439.8	Pass
Time at Peak Pubic Force	12.2	17.0	ms	12.85	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		8/12/2022	8/12/2023




Resistive Force
Max: 4958.1 N
Min: 33.4 N
Filter: CFC 180
Force (N)
6000
5000
4000
3000
2000
1000
0
-1000
0
10
20
30
40
50
Time [ms]


Pubic Force
Max: 37.8 N
Min: -1439.8 N
Filter: CFC 600
Force (N)
250
0
-250
-500
-750
-1000
-1250
-1500
-1750
0
10
20
30
40
50
Time [ms]

APPENDIX V

TEST EQUIPMENT AND INSTRUMENTATION CALIBRATION DATA

Table 1 – Dummy Instrumentation (ES-2re)

			ES-2re S/N _D037__		
			Serial Number	**Manufacturer**	**Calibration Date**
Head Accelerometers	Primary	X	T21724	Endevco	2/27/2023
		Y	T22281	Endevco	2/27/2023
		Z	T26050	Endevco	2/27/2023
	Redundant	X	T21682	Endevco	2/27/2023
		Y	T25989	Endevco	2/27/2023
		Z	T25864	Endevco	2/27/2023
Thorax Rib Displacement Potentiometers	Upper	Y	DS-0552-01	Honeywell	2/27/2023
	Middle	Y	DS-807	Honeywell	2/27/2023
	Lower	Y	DS-0552-03	Honeywell	2/27/2023
Abdomen Load Cells	Forward	Y	1440	Denton	8/12/2022
	Middle	Y	1525	Denton	8/12/2022
	Rear	Y	1528	Denton	8/12/2022
Lower Spine Accelerometers (T12)		X	P71278	Endevco	2/27/2023
		Y	P71276	Endevco	2/27/2023
		Z	T23573	Endevco	2/27/2023
Pubic Symphysis Load Cell		Y	3096JFL-456-FY	Denton	8/12/2022

Table 2 – Vehicle Instrumentation

Vehicle Instrumentation		**Serial Number**	**Manufacturer**	**Calibration Date**
Vehicle Center of Gravity	X	A413617	Measurement Specialties	4/10/2023
Vehicle Center of Gravity	Y	G22586	Endevco	4/10/2023
Vehicle Center of Gravity	Z	G22605	Endevco	4/10/2023
Left Floor Sill	Y	G22441	Endevco	3/9/2023
A-Pillar Sill	Y	G22915	Endevco	2/25/2023
A-Pillar Low	Y	A428028	Measurement Specialties	3/17/2023
A-Pillar Mid	Y	A428014	Measurement Specialties	1/3/2023
B-Pillar Sill	Y	A405577	Measurement Specialties	2/25/2023
B-Pillar Low	Y	A290938	Measurement Specialties	2/27/2023
B-Pillar Mid	Y	G22115	Endevco	3/23/2023
Driver Seat	Y	G22798	Endevco	2/6/2023
Engine Top	X	A280853	Measurement Specialties	1/4/2023
Engine Top	Y	A315715	Measurement Specialties	1/4/2023
Firewall	Y	A284233	Measurement Specialties	3/23/2023
Right Roof	Y	G22227	Endevco	1/20/2023
Right Floor Sill	Y	G22649	Endevco	4/11/2023
Rear Floorpan	X	A335451	Measurement Specialties	1/12/2023
Rear Floorpan	Y	A350980	Measurement Specialties	2/9/2023