REPORT NUMBER: SINCAP-CAL-24-008

NEW CAR ASSESSMENT PROGRAM (NCAP)
MOVING DEFORMABLE BARRIER SIDE IMPACT TEST

Hyundai Motor Manufacturing Alabama, LLC
2024 Hyundai Santa Cruz
4 Door Truck

NHTSA No: M20244207

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

December 17, 2024

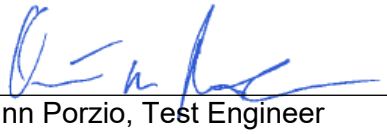
FINAL REPORT

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Prepared by:  Date: December 17, 2024

Quinn Porzio, Test Engineer

Approved by:  Date: December 17, 2024

Vanessa Hansen, Test Engineer

FINAL REPORT ACCEPTANCE BY OCWS:

_____

Division Chief, New Car Assessment Program
NHTSA, Office of Crashworthiness Standards

Date: _____

_____

COTR, New Car Assessment Program
NHTSA, Office of Crashworthiness Standards

Date: _____

TECHNICAL REPORT DOCUMENTATION PAGE

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15. Supplementary Notes		

16. Abstract

A 55/28, (61.90kph / 38.5 mph), 90° Moving Deformable Barrier NCAP Side Impact Test was conducted on the subject 2024 Hyundai Santa Cruz 4 Door Truck in accordance with the specifications of the Office of Crashworthiness Standards Side NCAP MDB Test Procedure for the generation of consumer information on vehicle side crash protection. This test was conducted at Calspan Corporation's Transportation Test Operations facility in Buffalo, New York on July 16, 2024.

The impact velocity of the Moving Deformable Barrier (MDB) was 62.12 km/h, and the ambient temperature at the struck (driver's) side of the target vehicle was 21°C. The target vehicle's maximum post-test static crush was 225 mm located at level 3. The test vehicle's occupant performance data is as follows:

Measurement Description	Driver ATD (ES-2re)		
	Units	IARV	Result
Head Injury Criteria (HIC36)		1000	37.292
Maximum Thorax Rib Deflection	mm	44	16.862
Total Abdominal Force	N	2500	383.236
Pubic Symphysis Force	N	6000	1094.409
Lower Spine (T12) Resultant Acceleration	G	82*	20.087
Measurement Description	**Passenger ATD (SID-IIs)**		
	Units	**IARV**	**Result**
Head Injury Criteria (HIC36)		1000	47.132
Maximum Thorax Rib Deflection	mm	38*	10.693
Lower Spine (T12) Resultant Acceleration	G	82	35.058
Total Pelvic Force (sum of acetabular and iliac forces)	N	5525	1410.387
Maximum Abdominal Rib Deflection	mm	45*	20.737

**Proposed IARV*

The two doors on the struck side of 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 New Car Assessment Program (NCAP) Side Impact MDB ES-2re SID-IIs	***18. Distribution Statement*** Copies of this report are available from: National Highway Traffic Safety Administration Technical Information Services Division 1200 New Jersey Ave. SE Washington, D.C. 20590

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SECTION 1

TEST PURPOSE AND PROCEDURE

This moving deformable barrier side impact test is part of the MY 2024 New Car Assessment Program Side Impact Test Program, sponsored by the National Highway Traffic Safety Administration (NHTSA), under contract number 693JJ920D000016. The purpose of this test is to generate comparative side impact performance in a 2024 Hyundai Santa Cruz 4 Door Truck. The side impact test was conducted in accordance with the Office of Crashworthiness Standard's Laboratory Test Procedure dated March 2020.

SECTION 2

SUMMARY OF TEST RESULTS

A 2024 Hyundai Santa Cruz 4 Door Truck was impacted on the left (driver's) 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 62.12 km/h. 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 July 16, 2024. Pre-test and post-test photographs of the test vehicle, the MDB and the dummies (ES-2re and SID-IIs) are included in this report.

Dummies were placed in the driver and left rear designated seating positions according to instructions specified in the OCWS Side Impact Laboratory Test Procedure, dated March 2020. The side impact event was documented by 9 high-speed and 2 real-time cameras. Camera locations are included in this report.

The Dummies were instrumented in the following manner:

DRIVER ATD (ES-2re)
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
Pubic symphysis y-axis load cell

PASSENGER ATD (SID-IIs)
Primary and redundant head CG tri-axial accelerometers
Chest upper rib, middle rib, and lower rib y-axis displacement potentiometers
Abdomen upper rib and lower rib y-axis displacement potentiometers
Lower spine (T12) tri-axial accelerometers
Acetabulum and iliac wing y-axis load cells

Appendix B contains the vehicle and dummy response data. Dummy configuration and performance verification data can be found in APPENDIX C of this report. Appendix D of this report contains the test equipment and instrumentation calibration data.

DUMMY INJURY VALUES

Measurement Description	Driver ATD (ES-2re)		
	Units	IARV	Result
Head Injury Criteria (HIC36)		1000	37.292
Maximum Thorax Rib Deflection	mm	44	16.862
Total Abdominal Force	N	2500	383.236
Pubic Symphysis Force	N	6000	1094.409
Lower Spine (T12) Resultant Acceleration	G	82*	20.087

Measurement Description	Passenger ATD (SID-IIs)		
	Units	IARV	Result
Head Injury Criteria (HIC36)		1000	47.132
Maximum Thorax Rib Deflection	mm	38*	10.693
Lower Spine (T12) Resultant Acceleration	G	82	35.058
Total Pelvic Force (sum of acetabular and iliac forces)	N	5525	1410.387
Maximum Abdominal Rib Deflection	mm	45*	20.737

**Proposed IARV*

SUPPLEMENTAL RESTRAINT INFORMATION

Restraint Type	Left Front (Driver) Occupant Location 1		Left Rear (Passenger) Occupant Location 4	
	Mounted	Deployed	Mounted	Deployed
Front Airbag	Yes	No		
Knee Airbag	No	N/A		
Side Airbag 1 - Curtain	Yes	Yes	Yes	Yes
Side Airbag 2 - Torso/Pelvis Airbag	Yes	Yes	Yes	Yes
Seat Belt Pretensioner	Yes	Yes	Yes	Yes
Seat Belt Load Limiter	Yes	Yes	Yes	Yes
Other				

GENERAL COMMENTS:

1. P1 serial number - F033
2. P4 serial number - 300

Data Anomalies:

The following channel was questionable for:

- Left B-Pillar Lower Y Acceleration, Exceeded calibration range at 11.8 ms 16 ms 22.8 ms
- Left B-Pillar Middle Y Acceleration, Exceeded calibration range and saturated at 12.1 ms
- Rear Left Passenger Head CG Redundant X Acceleration, Questionable data spike at 76.6ms 138.5ms
- MDB Rear Left Ax, Questionable data after 95.75 ms

SECTION 3

OCCUPANT AND VEHICLE INFORMATION

This section contains information reporting for the following Data Sheets:

Data Sheet No. 1 - General Test and Vehicle Parameter Data

Data Sheet No. 2 - Seat, Seat Belt, Steering Wheel Adjustment and Fuel Systems Data

Data Sheet No. 3 - Dummy Longitudinal Clearance Dimensions

Data Sheet No. 4 - Dummy Lateral Clearance Dimensions

Data Sheet No. 5 - Camera and Instrumentation Data

Data Sheet No. 6 - Test Vehicle Accelerometer Locations

Data Sheet No. 7- MDB Accelerometer Locations

Data Sheet No. 8 - Post-Test Observations

Data Sheet No. 9 - MDB Summary of Results

Data Sheet No. 10 - Test Vehicle Profile Measurements

Data Sheet No. 11 - Test Vehicle Exterior Crush Measurements

Data Sheet No. 12 - MDB Exterior Static Crush Measurements

Data Sheet No. 13 - Vehicle and MDB Damage Profile Distances

Data Sheet No. 14 - FMVSS No. 301 Static Rollover Results

Data Sheet No. 15 - Dummy / Vehicle Temperature and Humidity Stabilization Data

DATA SHEET NO. 1
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2024 Hyundai Santa Cruz 4 Door Truck
NHTSA No.: M20244207
Test Program: NCAP Side MDB Impact Test
Test Date: 07/16/2024

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA No.	M20244207
Model Year	2024
Make	Hyundai
Model	Santa Cruz
Body Style	Truck
VIN	5NTJB4DE1RH120466
Body Color	Hampton Gray
Odometer Reading (km/mi)	11 mi
Engine Displacement (L)	2.5
Type / No. Cylinders	I4
Engine Placement	Transverse
Transmission Type	Automatic
Transmission Speeds	8-Speed
Overdrive	Yes
Final Drive	Front Wheel Drive
Roof Rack	No
Sunroof / T-Top	No
Running Boards	No
Tilt Steering Wheel	Yes
Power Seats	Yes
Anti-Lock Brakes (ABS)	Yes

Traction Control System (TCS)	Yes
Auto-Leveling System	No
Automatic Door Locks (ADL)	Yes
Power Window Auto-Reverse	No
Other Optional Feature	N/A
Driver Front Airbag	Yes
Driver Curtain Airbag	Yes
Driver Head/Torso Airbag	No
Driver Torso Airbag	No
Driver Torso / Pelvis Airbag	Yes
Driver Pelvis Airbag	No
Driver Knee Airbag	No
Rear Pass. Curtain Airbag	Yes
Rear Pass. Head / Torso Airbag	No
Rear Pass. Torso Airbag	No
Rear Pass. Torso / Pelvis Airbag	Yes
Rear Pass. Pelvis Airbag	No
Driver Seat Belt Pretensioner	Yes
Rear Pass. Seat Belt Pretensioner	Yes
Driver Load Limiter	Yes
Rear Pass. Load Limiter	Yes
Other Safety Restraint	N/A

Does owner's manual provide instructions to turn off automatic door locks? No

DATA FROM CERTIFICATION LABEL

Manufactured By	Hyundai Motor Manufacturing Alabama, LLC
Date of Manufacture	May/06/24
Vehicle Type	Truck

GVWR (KG)	2475
GVWR Front (KG)	1200
GVWR Rear (KG)	1450

VEHICLE SEATING AND WEIGHT CAPACITY DATA

Measured Parameter	Front	Rear	Third	Total	
Designated Seating Capacity (DSC)	2	3	N/A	5	
Vehicle Capacity Weight (VCW) (kg)				640	(A)
DSC x 68.0 kg				340	(B)
Cargo Weight (RCLW) (kg)				136	

VEHICLE SEAT TYPE

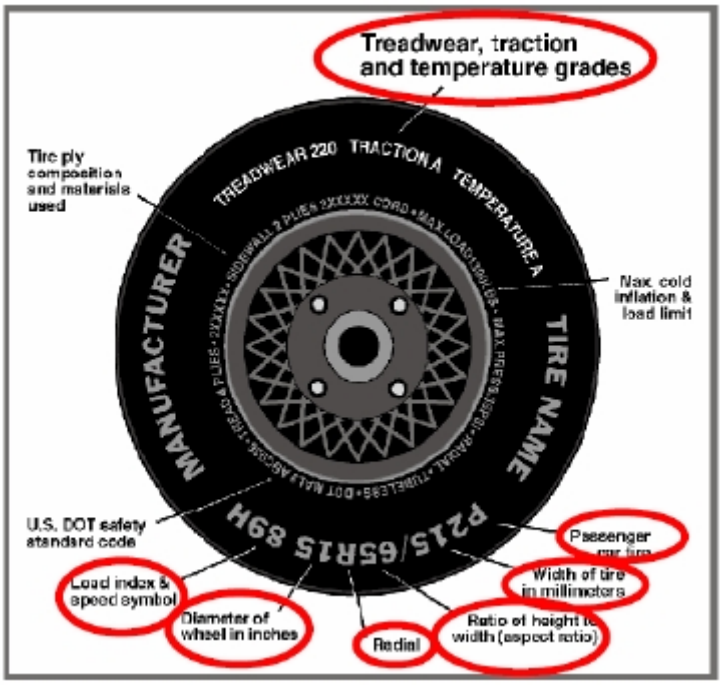
Seating Location	Type Of Seat Pan				Type Of Seat Back		
	Bucket	Bench	Split Bench	Contour	Fixed	Adjustable	
						W/ Lever	W/ Knob
Front	X						X
Rear or Second Row Seat			X		X		
Third Row Seat	N/A	N/A	N/A	N/A	N/A	N/A	N/A

DATA SHEET NO. 1 … (CONTINUED)
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle:	2024 Hyundai Santa Cruz 4 Door Truck	NHTSA No.:	M20244207
Test Program:	NCAP Side MDB Impact Test	Test Date:	07/16/2024

VEHICLE TIRE INFORMATION

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



TIRE SIDEWALL INFORMATION

Measured Parameter	Front	Rear
Maximum Tire Pressure (kPa)	350	350
Cold Pressure (kPa)	240	240
Recommended Tire Size	245/60R18	245/60R18
Tire Size on Vehicle	245/60R18	245/60R18
Tire Manufacturer	Kumho	Kumho
Tire Model	Crugen	Crugen
Treadwear	540	540
Traction	A	A
Temperature Grades	A	A
Tire Plies Sidewall	2 Polyester	2 Polyester
Tire Plies Body	2 Steel, 2 Polyester, 1 Polyamide	2 Steel, 2 Polyester, 1 Polyamide
Load Index / Speed Symbol	105H	105H
Tire Material	Rubber	Rubber
DOT Safety Code Left	000J8YA8E1824	000J8YA8E1824
DOT Safety Code Right	000J8YA8E1824	000J8YA8E1824

DATA SHEET NO. 1 … (CONTINUED)
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2024 Hyundai Santa Cruz 4 Door Truck
NHTSA No.: M20244207
Test Program: NCAP Side MDB Impact Test
Test Date: 07/16/2024

TIRE PRESSURES

	Units	LF	RF	LR	RR
As Delivered	kPa	217	220	214	219
Tire Placard	kPa	240	240	240	240
Owner's Manual	kPa	240	240	240	240
As Tested	kPa	240	240	240	240

MDB TIRE SPECIFICATIONS

	Units	Requirements	LF	RF	LR	RR
Tire Size		P205/75R15	P205/75R15	P205/75R15	P205/75R15	P205/75R15
Tire Pressure	kPa	200 ± 21	207	207	207	207

TEST VEHICLE WEIGHTS

	Units	As Delivered (UVW)			As Tested (ATW)			Fully Loaded		
		Front	Rear	Total	Front	Rear	Total	Front	Rear	Total
Left	kg	490	373		523	494		529	495	
Right	kg	485	356		498	447		501	445	
Ratio	%	57.2	42.8		52.0	48.0		52.3	47.7	
Totals	kg	975	729	1704	1021	941	1962	1030	940	1970

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value	
Total As Delivered Weight (UVW)	kg	1704	(A)
Actual Weight of 2 P572V (ES-2re and SID-IIs) ATDs Used	kg	127	(B)
Rated Cargo / Luggage Weight (RCLW)	kg	136	(C)
Calculated Vehicle Target Weight (TVTW)	kg	1967	(A+B+C)

Does the measured As Test Vehicle Weight lie within the required weight range

(i.e. Calculated Test Vehicle Target Weight – 4.5 kg to – 9 kg)? [X] **Yes** [ ] **No**

TEST VEHICLE ATTITUDES AND CG

Measurement Description	Units	As Tested	Fully Loaded	Meets Rqmt***
LF	mm	940	946	Yes
RF	mm	945	950	Yes
RR	mm	974	984	Yes
LR	mm	968	978	Yes
Vehicle CG (Aft of Front Axle)	mm	1435	1443	
Vehicle CG (Left (+) / Right (-) from Longitudinal Centerline)	mm	33	31	

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

Test height adjustable suspension setting, if applicable: N/A

DATA SHEET NO. 1 … (CONTINUED)
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle:	2024 Hyundai Santa Cruz 4 Door Truck	NHTSA No.:	M20244207
Test Program:	NCAP Side MDB Impact Test	Test Date:	07/16/2024

WEIGHT OF BALLAST AND VEHICLE COMPONENTS REMOVED TO MEET TVTW

Component Description	Weight (kg)
No Components Removed	0
Ballast / Equipment Added	63.5

TEST SURFACE MARKINGS

	Distance from 63° Impact Location Line (mm)
Fore 25 mm target	234
Aft 25 mm target	236
Pre-Impact Angle Line	235

Parallel Track Target	X Location (mm)	Y Location (mm)
A	0	0
B	2955	1555
C	2955	3355
D	0	3000

DATA SHEET NO. 2
SEAT, SEAT BELT, STEERING WHEEL ADJUSTMENT AND FUEL SYSTEMS DATA

Test Vehicle:	2024 Hyundai Santa Cruz 4 Door Truck	NHTSA No.:	M20244207
Test Program:	NCAP Side MDB Impact Test	Test Date:	07/16/2024

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 passenger's seats should be set to the rear-most, lowest, mid-angle position

SCRL ANGLE RANGE

Seat	SCRL(°)		
	Max	Min	Mid
Driver Seat	20.8	12.4	16.6
Front Passenger Seat	Fixed	Fixed	Fixed
Front Center Seat			
Struck Side Rear Seat	Fixed	Fixed	Fixed
Non-Struck Side Rear Seat	Fixed	Fixed	Fixed
Rear Center Seat	Fixed	Fixed	Fixed

SEAT HEIGHT AND ANGLE

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	16.6	9	Max	69	75	80
			Mid	36	41	47
			Min	3	9	15
Front Passenger Seat	Fixed	Fixed	Max			
			Mid			
			Min			
Front Center Seat*			Max			
			Mid			
			Min			
Struck Side Rear Seat	Fixed	Fixed	Max			
			Mid			
			Min			
Non-Struck Side Rear Seat	Fixed	Fixed	Max			
			Mid			
			Min			
Rear Center Seat*	Fixed	Fixed	Max			
			Mid			
			Min			

**If applicable*

DATA SHEET NO. 2 … (CONTINUED)
SEAT, SEAT BELT, STEERING WHEEL ADJUSTMENT AND FUEL SYSTEMS DATA

Test Vehicle:	2024 Hyundai Santa Cruz 4 Door Truck	NHTSA No.:	M20244207
Test Program:	NCAP Side MDB Impact Test	Test Date:	07/16/2024

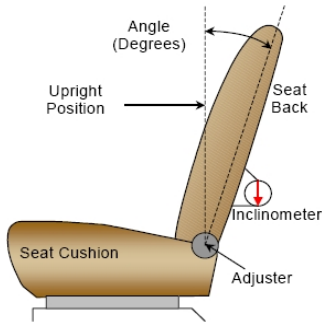
SEAT FORE / AFT POSITION

Seat	Total Fore / Aft Travel		Test Position from Forward most Position	
	mm	Detents*	mm	Detents*
Driver Seat	238	Power	119	Power
Front Passenger Seat	240	38 (0-37)	124	19
Front Center Seat				
Struck Side Rear Seat	Fixed	Fixed	Fixed	Fixed
Non-Struck Side Rear Seat	Fixed	Fixed	Fixed	Fixed
Rear Center Seat	Fixed	Fixed	Fixed	Fixed

if applicable

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.



FRONT SEAT ASSEMBLY

Seat	Total Seat Back Angle Range		Test Position from Most Upright	
	Degrees	Detents*	Degrees	Detents*
Driver Seat	64.2	Power	0.2	Power
Front Passenger Seat	59.7	31 (0-30)	0.5	7
Front Center Seat				
Struck Side Rear Seat	Fixed	Fixed	Fixed	Fixed
Non-Struck Side Rear Seat	Fixed	Fixed	Fixed	Fixed
Rear Center Seat	Fixed	Fixed	Fixed	Fixed

if applicable

DATA SHEET NO. 2 … (CONTINUED)
SEAT, SEAT BELT, STEERING WHEEL ADJUSTMENT AND FUEL SYSTEMS DATA

Test Vehicle:	2024 Hyundai Santa Cruz 4 Door Truck	NHTSA No.:	M20244207
Test Program:	NCAP Side MDB Impact Test	Test Date:	07/16/2024

SEAT BELT ANCHORAGE ADJUSTMENT

Seat belt anchorages are adjusted in accordance with the information provided by the manufacturer on Form No. 1. For this test zero is defined as the uppermost position.

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

HEAD RESTRAINT ADJUSTMENT

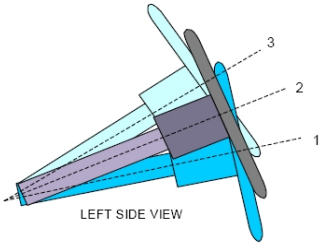
The driver's head restraint is adjusted to the highest and most full forward in-use position. The struck-side rear passenger's head restraint is adjusted to the lowest and most full forward in-use position.

Seat	Total # of Positions	Placed in Position #
Driver Seat	5 (0-4)	Uppermost
Rear Seat	3 (0-2)	Lowermost

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	22.8	
Geometric center - Position No. 2	25.2	
Uppermost - Position No. 3	27.6	
Telescoping Steering Wheel Travel		55
Test Position	25.2	27.5

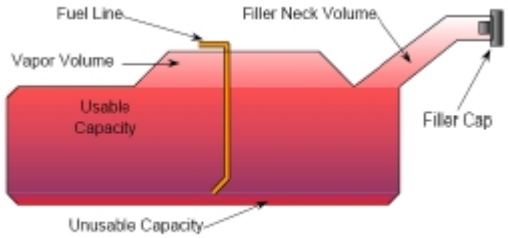


STEERING COLUMN ASSEMBLY

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 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

DATA SHEET NO. 2 … (CONTINUED)
SEAT, SEAT BELT, STEERING WHEEL ADJUSTMENT AND FUEL SYSTEMS DATA

Test Vehicle:	2024 Hyundai Santa Cruz 4 Door Truck	NHTSA No.:	M20244207
Test Program:	NCAP Side MDB Impact Test	Test Date:	07/16/2024

FUEL TANK CAPACITY

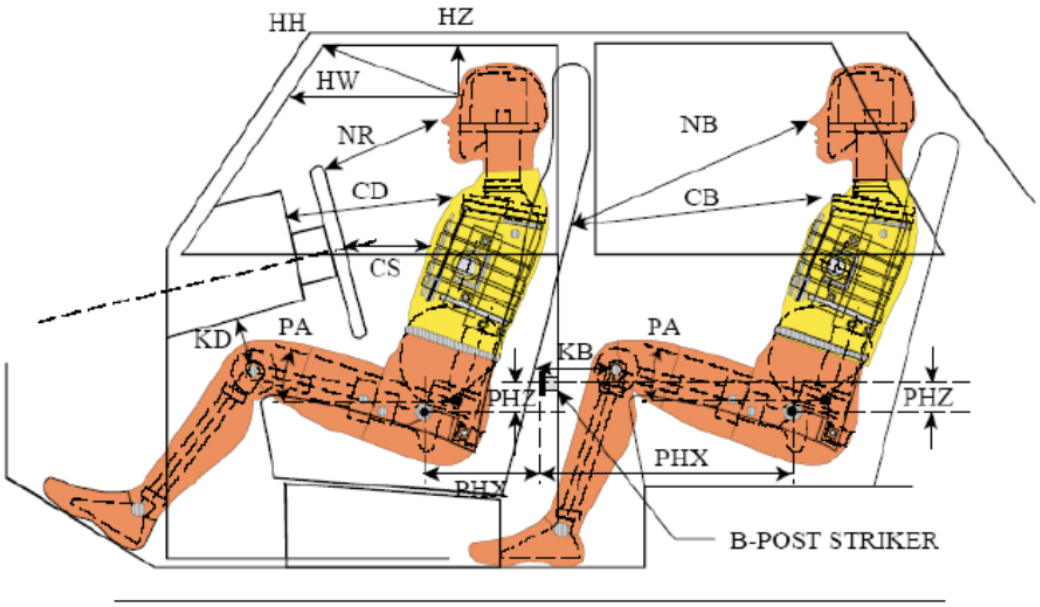
Description	Liters
Usable Capacity of “Standard Tank” (see Form No. 1)	67
Usable Capacity of “Optional Tank” (see Form No. 1)	N/A
Usable Capacity of “Standard Tank” (see Owner’s Manual)	67
Usable Capacity of “Optional Tank” (see Owner’s Manual)	N/A
93% of Usable Capacity	62.3
Actual Amount of Solvent Used in Test	62.3
1/3 of Usable Capacity	22.1

Is the Actual Amount of Solvent Used in the test equal to 93% ±1% of the Usable Capacity stated in Form No. 1? [X] **Yes** [ ] **No**

DATA SHEET NO. 3
DUMMY LONGITUDINAL CLEARANCE DIMENSIONS

Test Vehicle:	2024 Hyundai Santa Cruz 4 Door Truck	NHTSA No.:	M20244207
Test Program:	NCAP Side MDB Impact Test	Test Date:	07/16/2024

DUMMY LONGITUDINAL CLEARANCE DIMENSION INFORMATION



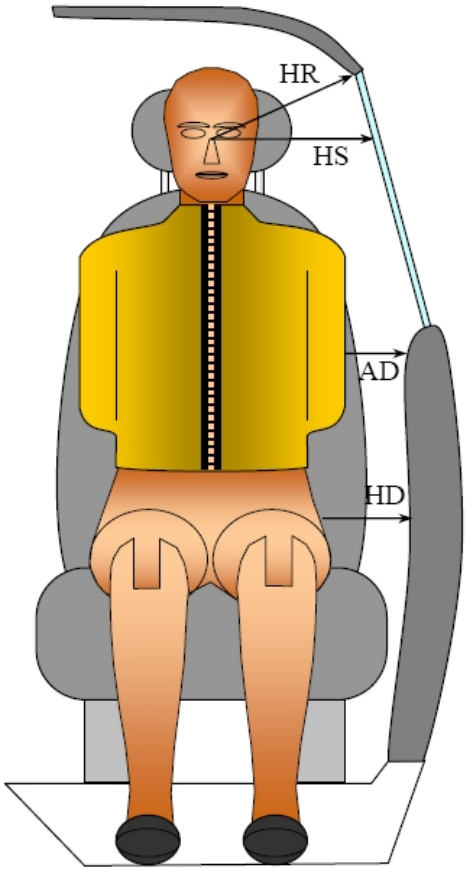
LEFT SIDE VIEW

NOTE: 2-DOOR VEHICLE SHOWN. REAR DUMMY PHX & PHZ MEASUREMENTS FOR A 4-DOOR VEHICLE WOULD USE THE C-POST STRIKER AS A REFERENCE POINT

Driver Code	Pass. Code	Description	Driver (Serial No. F033)		Left Rear Passenger (Serial No. 300)	
			Length (mm)	Angle (°)	Length (mm)	Angle (°)
HH		Header to Header	342			
HW		Header to Windshield	626			
HZ	HZ	Head to Roof Liner	200		320	
NR	NB	Nose to Rim/Seat Back	460		465	
CD	CB	Chest to Dash/Seat Back	623		455	
CS		Chest to Steering Wheel	405			
KD(L)/KDA(L)°	KB(L)/KBA(L)°	Left Knee to Dash/Seat Back	229	25.3	214	22.0
KD(R)/KDA(R)°	KB(R)/KBA(R)°	Right Knee to Dash/Seat Back	205	24.3	204	20.2
PAX°	PAX°	Pelvic Tilt Angle X		20.5		20.6
	PAY°	Pelvic Tilt Angle Y				0.1
PHX	PHX	Hip Point to Striker (X-Axis)	150		287	
PHZ	PHZ	Hip Point to Striker (Z-Axis)	207		228	

DATA SHEET NO. 4
DUMMY LATERAL CLEARANCE DIMENSIONS

Test Vehicle:	2024 Hyundai Santa Cruz 4 Door Truck	NHTSA No.:	M20244207
Test Program:	NCAP Side MDB Impact Test	Test Date:	07/16/2024



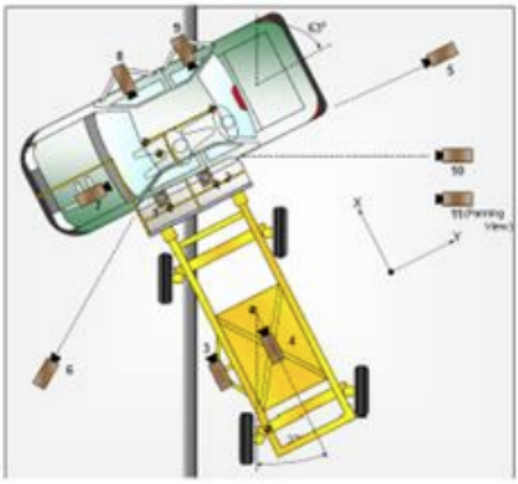
FRONT VIEW OF DUMMY

DUMMY LATERAL CLEARANCE DIMENSION INFORMATION

Code	Measurement Description	Units	Driver (Serial No. F033)	Left Rear Passenger (Serial No. 300)
HR	Head to Side Header	mm	208	291
HS	Head to Side Window	mm	340	390
AD	Arm to Door	mm	102	158
HD	Hip Point to Door	mm	174	227

DATA SHEET NO. 5
CAMERA AND INSTRUMENTATION DATA

Test Vehicle: 2024 Hyundai Santa Cruz 4 Door Truck
NHTSA No.: M20244207
Test Program: NCAP Side MDB Impact Test
Test Date: 07/16/2024



CAMERA LOCATIONS AND DATA

No.	Camera View	Location (mm)			Lens (mm)	Speed (fps)
		X	Y	Z		
1	Overhead Overall	0	792	-9220	12.5	1000
2	Overhead Close-up	0	0	-9220	28	1000
3	Left Impact Point (MDB)	-1470	0	-847	25	1000
4	Side Overall (MDB)	-1140	878	-1587	8	1000
5	Rear	270	8672	-1497	28	1000
6	Left Front	-3158	-4454	-1457	24	1000
7	Driver Front (OB)				25	1000
8	Driver Side (OB)				12.5	1000
9	Passenger Side (OB)				12.5	1000
10	Real-time Left Rear				Zoom	60
11	Real-time In Run				Zoom	60

Notes: *Reference: Impact Point projected to Ground*
+X = To Front of MDB, +Y = To Right of MDB, +Z = Down
** All measurements accurate to ± 6 mm.*

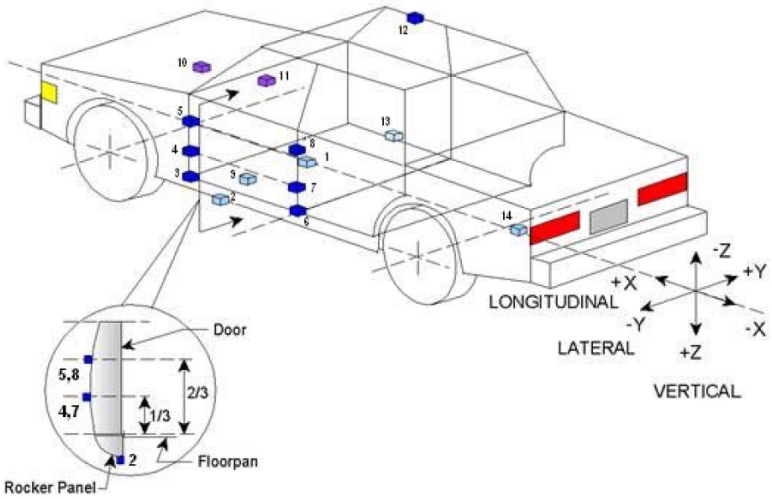
If applicable, explain why camera(s) did not operate as intended: All cameras operated as intended.

INSTRUMENTATION

Driver Dummy Channels	16
Passenger Dummy Channels	16
Vehicle Structure Accelerometers	23
MDB Accelerometers	7
Total	62

DATA SHEET NO. 6
TEST VEHICLE ACCELEROMETER LOCATIONS

Test Vehicle:	2024 Hyundai Santa Cruz 4 Door Truck	NHTSA No.:	M20244207
Test Program:	NCAP Side MDB Impact Test	Test Date:	07/16/2024



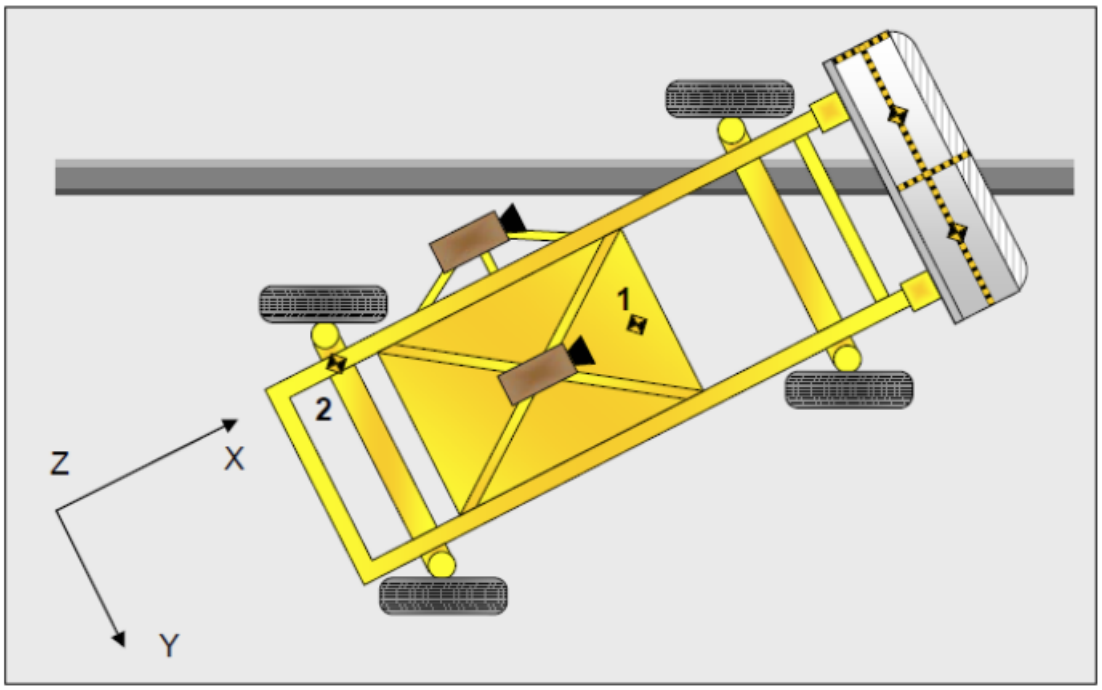
TEST VEHICLE ACCELEROMETER LOCATIONS

No.	Accelerometer Location	Coordinates (mm)		
		X	Y	Z
1	Vehicle CG	2455	4	-6
2	Right Sill at Front Seat	3206	672	-6
3	Right Sill at Rear Seat	2288	665	-15
4	Left Sill at Front Door	3198	-668	-5
5	Left Sill at Rear Door	2282	-668	-9
6	A-Post Lower	3607	-638	-185
7	A-Post Middle	3497	-656	-734
8	B-Post Lower	2537	-691	-203
9	B-Post Middle	2486	-669	-667
10	Front Seat Track	2769	-565	-51
11	Rear Seat Structure	1779	-612	-158
12	Rt. Rear Occ. Compartment	2519	416	78
13	Engine Block	4302	223	-485
14	Rear Above Axle	944	-2	-357

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

DATA SHEET NO. 7
MDB ACCELEROMETER LOCATIONS

Test Vehicle:	2024 Hyundai Santa Cruz 4 Door Truck	NHTSA No.:	M20244207
Test Program:	NCAP Side MDB Impact Test	Test Date:	07/16/2024



MDB ACCELEROMETER LOCATIONS

No.	Accelerometer Location	Coordinates (mm)		
		X	Y	Z
1	MDB CG	1859	0	-330
2	MDB Rear	386	-660	-660

Reference: *X – Face of MDB (+forward)*
Y – MDB centerline (+ to right)
Z – Ground plane (+down)

Width between left and right contact switches (mm): 1520

DATA SHEET NO. 8
POST-TEST OBSERVATIONS

Test Vehicle: 2024 Hyundai Santa Cruz 4 Door Truck | NHTSA No.: M20244207
Test Program: NCAP Side MDB Impact Test | Test Date: 07/16/2024

TEST DUMMY INFORMATION AND CONTACT POINTS

Description	Front Seat Dummy (ES-2re)	Rear Seat Dummy (SID-IIs)
Face	Curtain Airbag	Curtain Airbag
Top of Head	Curtain Airbag, Side Header	Curtain Airbag
Left Side of Head	Curtain Airbag	Curtain Airbag
Back of Head	Side Header, Head Restraint	Curtain Airbag, Head Restraint
Left Shoulder	Torso/Pelvis Airbag	Seatback & Torso/Pelvis Airbag
Upper Torso	Seatback & Torso/Pelvis Airbag	Seatback & Torso/Pelvis Airbag
Lower Torso	Seatback & Torso/Pelvis Airbag	Torso/Pelvis Airbag
Left Hip	Torso/Pelvis & Seat Pan	Torso/Pelvis Airbag
Left Knee	Driver Door	Passenger Door

POST-TEST DOOR PERFORMANCE

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

POST-TEST SEAT PERFORMANCE

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

POST-TEST STRUCTURAL OBSERVATIONS

Critical Areas of Performance	Observations and Conclusions
Pillar Performance	B-Pillar & C-Pillar Buckled
Sill Separation	None
Windshield Damage	None
Side Window Damage	None
Other Notable Effects	None

DATA SHEET NO. 8 … (CONTINUED)
POST-TEST OBSERVATIONS

Test Vehicle: 2024 Hyundai Santa Cruz 4 Door Truck | NHTSA No.: M20244207
Test Program: NCAP Side MDB Impact Test | Test Date: 07/16/2024

SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

Restraint Type	Struck Side Driver		Struck Side Rear Passenger	
	Mounted	Deployed	Mounted	Deployed
Front Airbag	Yes	No		
Knee Airbag	No	N/A		
Side Airbag 1 - Curtain	Yes	Yes	Yes	Yes
Side Airbag 2 - Torso/Pelvis Airbag	Yes	Yes	Yes	Yes
Seat Belt Pretensioner	Yes	Yes	Yes	Yes
Seat Belt Load Limiter	Yes	Yes	Yes	Yes
Other				

IMPACT POINT LOCATION DATA

Measured Parameter	Units	Tolerance	Value
Vehicle Wheel Base	mm		3008
Vertical Impact Reference Line (Aft of Front Axle - Intended Impact Point)	mm		508
Actual Impact Point (Aft of Frontal Axle)	mm		508
Horizontal Offset (+ forward / - rearward)	mm	+/- 50 of Intended Impact Point	0
Vertical Offset (+ down / - up)	mm	+/- 20 of Intended Impact Point	+1

DATA SHEET NO. 9
MDB SUMMARY OF RESULTS

Test Vehicle:	2024 Hyundai Santa Cruz 4 Door Truck	NHTSA No.:	M20244207
Test Program:	NCAP Side MDB Impact Test	Test Date:	07/16/2024

MDB SPECIFICATIONS

Measurement Description	Length (mm)
Overall Width of Framework Carriage	1250
Overall Length Including Honeycomb Frame	4120
Wheelbase of Framework Carriage	2591
CG Location of Front Axle	1122

MDB WEIGHTS

	Units	Front Axle	Rear Axle	Total
Left	kg	396	291.5	687.5
Right	kg	377.5	301	678.5
Ratio	%	56.6	43.4	100
Totals	kg	773.5	592.5	1366

SPEED AND ANGLE AT IMPACT DATA

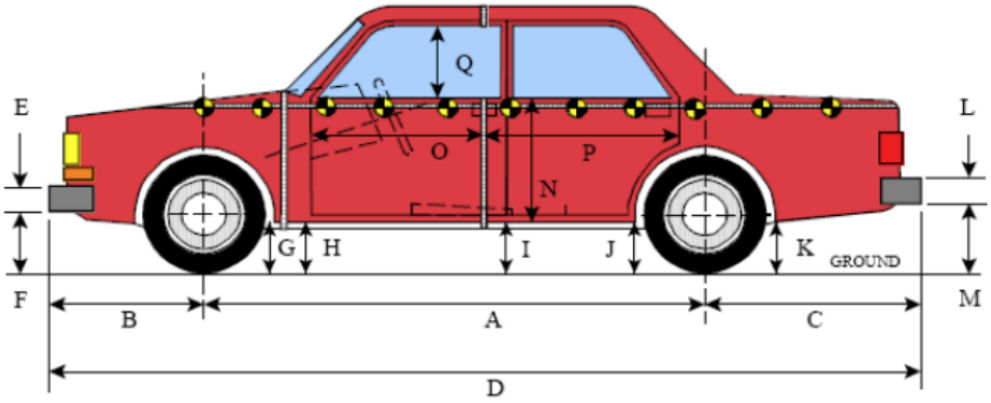
Measured Parameter	Units	Requirement	Value
Trap No. 1 Velocity (Primary)	km/h	61.10 to 62.70	62.12
Trap No. 2 Velocity (Redundant)	km/h	61.10 to 62.70	62.20
MDB CL to Target Vehicle CL	degrees	88.5 to 91.5	90.0
MDB Forward Line of Motion to Target Vehicle CL	degrees	62.5 to 63.5	63.0
MDB Crabbed angle to MDB Forward Line of Motion	degrees	26.0 to 28.0	27.0

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	800	Right	247
B	Top of Bumper	533	300	Right	142
C	Mid-Level	686	800	Left	113
D	Top of Stack	813	800	Left	143

DATA SHEET NO. 10
TEST VEHICLE PROFILE MEASUREMENTS

Test Vehicle:	2024 Hyundai Santa Cruz 4 Door Truck	NHTSA No.:	M20244207
Test Program:	NCAP Side MDB Impact Test	Test Date:	07/16/2024



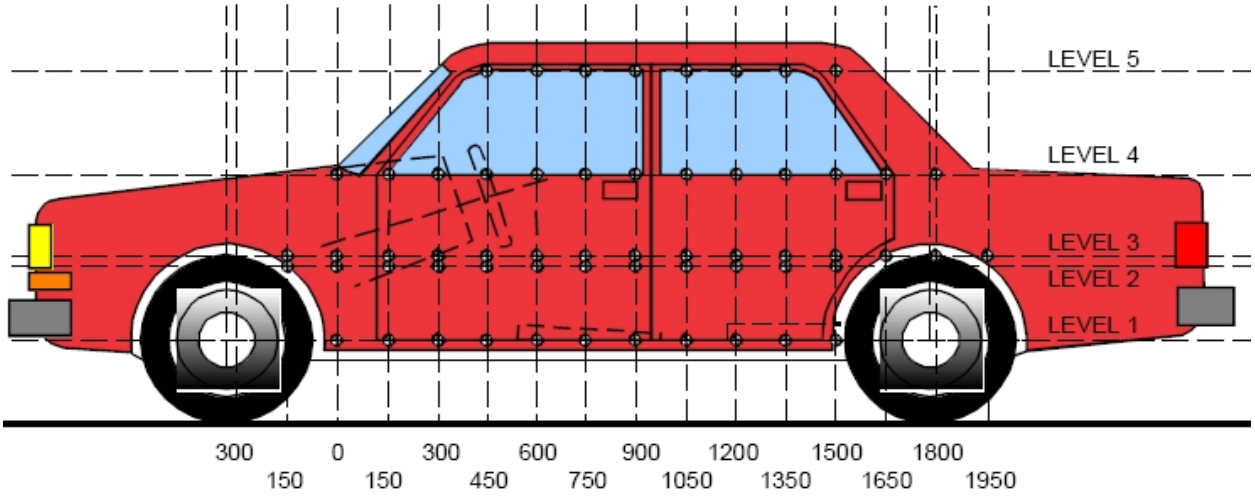
LEFT SIDE VIEW
All MEASUREMENTS IN (mm) WITH TOLERANCE OF ± 3mm

VEHICLE PRE- AND POST-TEST MEASUREMENT INFORMATION

Code.	Measurement Description	Pre-Test	Post-Test	Change
A	Wheelbase	3008	2979	-29
B	Front Axle to FSOV	890	919	29
C	Rear Axle to RSOV	1078	1077	-1
D	Total Length at Centerline	4976	4975	-1
E	Front Bumper Thickness	83	83	0
F	Front Bumper Bottom to Ground	502	510	8
G	Sill Height at Front Wheel Well	251	262	11
H	Sill Height at Front Door Leading Edge	277	290	13
I	Sill Height at B Pillar	282	283	1
J1	Sill Height at Rear Wheel Well	267	267	0
J2	Pinch Weld Height at Rear Wheel Well	266	268	2
K	Sill Height Aft of Rear Wheel Well	318	331	13
L	Rear Bumper Thickness	140	140	0
M	Rear Bumper Bottom to Ground	417	435	18
N	Sill Height to Bottom of Front Window Sill	909	814	-95
O	Front Door Leading Edge to Impact CL	822	812	-10
P	Rear Door Trailing Edge to Impact CL	1239	1209	-30
Q	Front Window Opening	393	387	-6
R	Right Side Length	4892	4890	-2
S	Left Side Length	4885	4882	-3
T	Maximum Vehicle Width	1839	1697	-142
U	Front Wheel Track Width	1646	1627	-19
V	Rear Wheel Track Width	1566	1648	82

DATA SHEET NO.11
TEST VEHICLE EXTERIOR CRUSH MEASUREMENTS

Test Vehicle:	2024 Hyundai Santa Cruz 4 Door Truck	NHTSA No.:	M20244207
Test Program:	NCAP Side MDB Impact Test	Test Date:	07/16/2024



LEFT SIDE VIEW

MAXIMUM EXTERIOR CRUSH MEASUREMENTS

Level	Measurement Description	Units	Height Above Ground	Maximum Exterior Static Crush	Distance from Impact
1	Sill Top	mm	437	139	1650
2	Driver H-Point	mm	694	216	1800
3	Mid-Door	mm	740	225	1800
4	Window Sill	mm	1101	83	1650
5	Window Top	mm	1612	4	1200

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.11 … (CONTINUED)
TEST VEHICLE EXTERIOR CRUSH MEASUREMENTS

Test Vehicle: 2024 Hyundai Santa Cruz 4 Door Truck NHTSA No.: M20244207
Test Program: NCAP Side MDB Impact Test Test Date: 07/16/2024

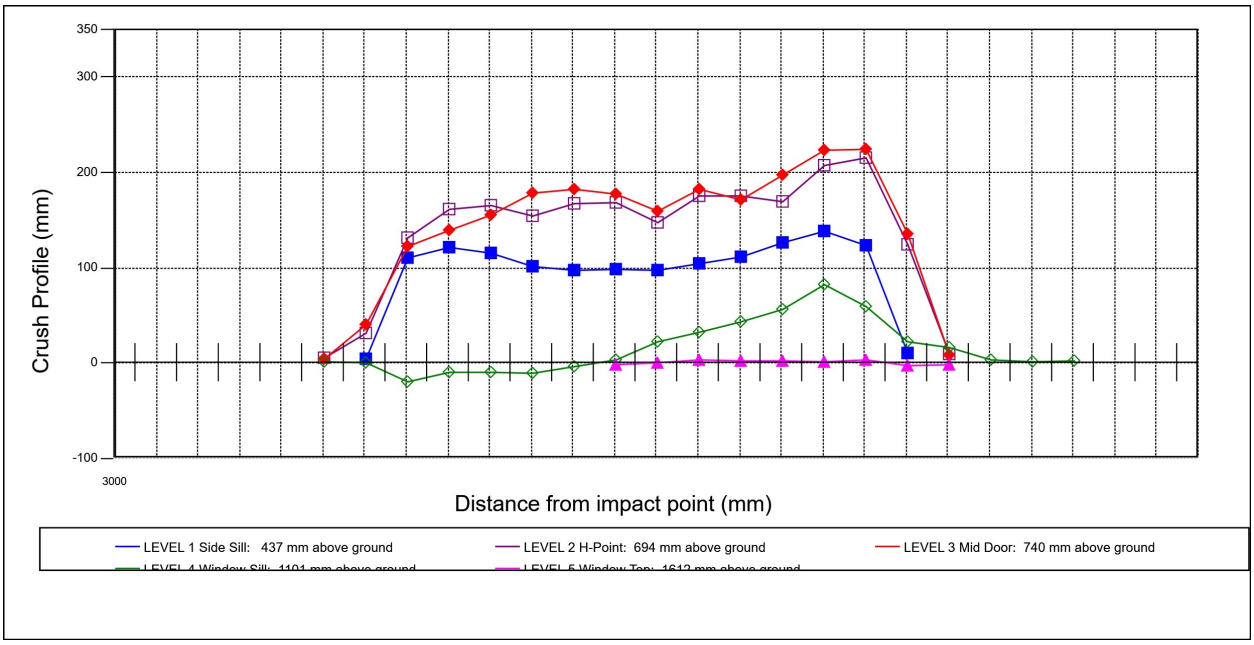
EXTERIOR CRUSH MEASUREMENTS AT EACH LEVEL

	Pre-Test					Post-Test					Crush				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
-900															
-750															
-600															
-450															
-300															
-150		941	950	821			935	945	819			6	5	2	
0	925	942	942	833		920	910	900	832		5	32	42	1	
150	925	932	931	840		814	800	808	859		111	132	123	-19	
300	923	923	924	847		801	761	784	856		122	162	140	-9	
450	916	917	919	845		800	751	763	854		116	166	156	-9	
600	905	914	918	851		803	759	739	861		102	155	179	-10	
750	904	913	917	860		806	745	734	863		98	168	183	-3	
900	904	913	917	869	623	805	744	739	865	624	99	169	178	4	-1
1050	903	913	917	874	629	805	765	757	851	628	98	148	160	23	1
1200	902	912	916	877	630	797	736	733	844	626	105	176	183	33	4
1350	901	911	915	881	629	789	735	743	837	626	112	176	172	44	3
1500	904	910	914	885	627	777	740	716	828	624	127	170	198	57	3
1650	906	909	912	885	624	767	701	688	802	622	139	208	224	83	2
1800	908	916	915	884	618	784	700	690	824	614	124	216	225	60	4
1950	910	937	935	882	606	899	812	799	859	608	11	125	136	23	-2
2100		937	947	879	589		927	938	862	590		10	9	17	-1
2250				878					874					4	
2400				880					878					2	
2550				885					882					3	
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.11 … (CONTINUED)
TEST VEHICLE EXTERIOR CRUSH MEASUREMENTS

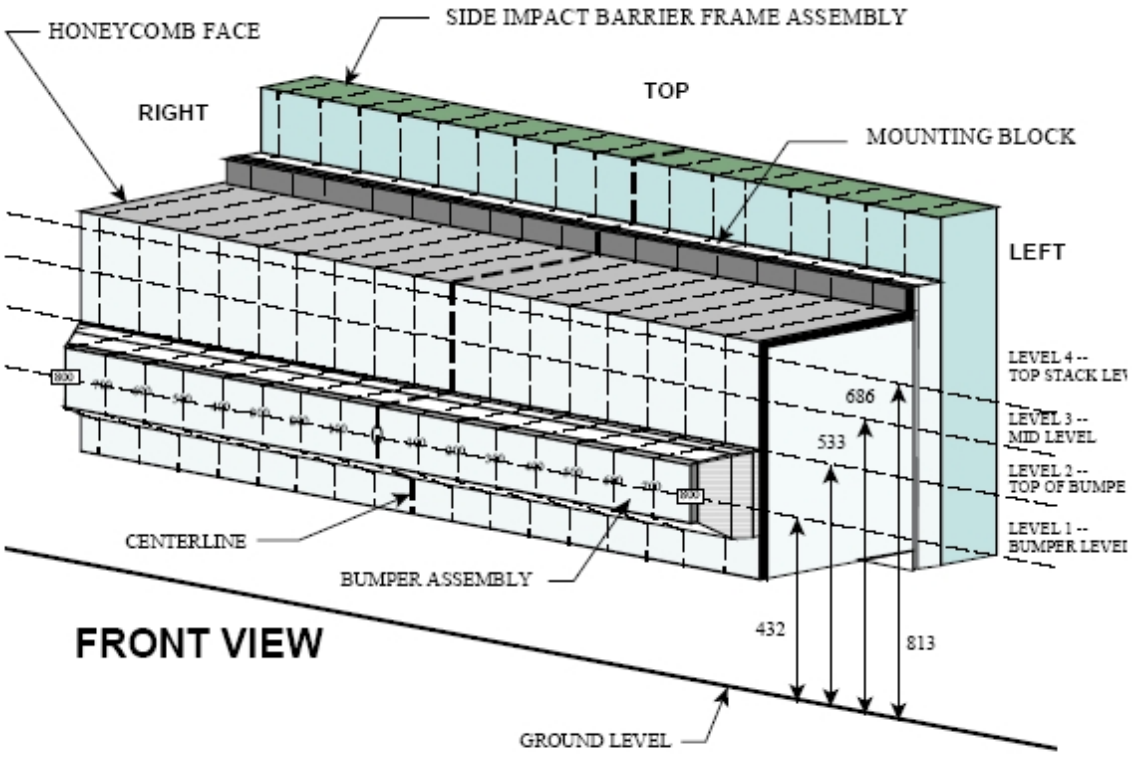
Test Vehicle:	2024 Hyundai Santa Cruz 4 Door Truck	NHTSA No.:	M20244207
Test Program:	NCAP Side MDB Impact Test	Test Date:	07/16/2024



Vehicle Exterior Crush Measurements - Visual Representation

DATA SHEET NO.12
MDB EXTERIOR STATIC CRUSH MEASUREMENTS

Test Vehicle:	2024 Hyundai Santa Cruz 4 Door Truck	NHTSA No.:	M20244207
Test Program:	NCAP Side MDB Impact Test	Test Date:	07/16/2024



NOTE: Dimensions are shown in millimeters, mm

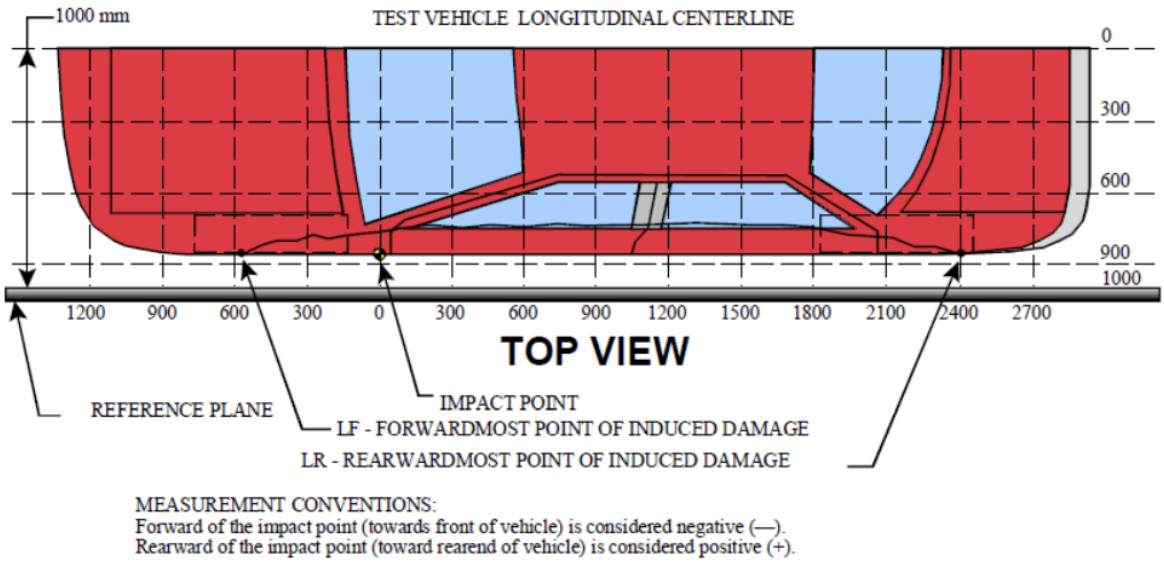
DEFORMABLE BARRIER STATIC CRUSH

Stack Level	Distance Right of Center								C/L	Distance Left of Center							
	800	700	600	500	400	300	200	100	0	100	200	300	400	500	600	700	800
1	247	245	243	241	241	241	239	238	239	236	234	233	231	229	229	227	230
2	131	132	134	130	128	142	133	136	136	125	127	116	116	114	112	111	112
3	69	62	69	82	74	72	96	91	92	64	59	55	55	57	67	85	113
4	77	55	44	50	61	81	97	122	110	88	90	80	76	81	90	111	143

DATA SHEET NO.13
VEHICLE AND MDB DAMAGE PROFILE DISTANCE

Test Vehicle:	2024 Hyundai Santa Cruz 4 Door Truck	NHTSA No.:	M20244207
Test Program:	NCAP Side MDB Impact Test	Test Date:	07/16/2024

For guidance regarding damage profile distance measurements, please refer to the latest version of the *NHTSA Test Reference Guide, Volume 1: Vehicle Tests.*



MEASUREMENT CONVENTIONS:
Forward of the impact point (towards front of vehicle) is considered negative (—).
Rearward of the impact point (toward rearend of vehicle) is considered positive (+).

VEHICLE DAMAGE PROFILE DISTANCES

DPD	Distance From Impact Point (mm)	Level	Post-Test (mm)	Pre-Test (mm)	Crush (mm)
1	-150	3	55	50	5
2	300	3	216	76	140
3	750	3	266	83	183
4	1200	3	267	84	183
5	1650	3	312	88	224
6	2100	3	62	53	9

MDB DAMAGE PROFILE DISTANCES

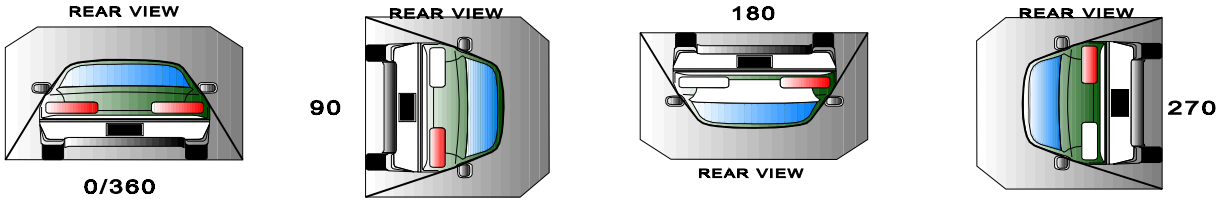
DPD	Distance From Center of MDB	Level	Post-Test (mm)	Pre-Test (mm)	Crush (mm)
1	800 mm left of center	1	275	505	-230
2	480 mm left of center	1	285	514	-229
3	160 mm left of center	1	279	514	-235
4	160 mm right of center	1	275	513	-238
5	480 mm right of center	1	272	513	-241
6	800 mm right of center	1	254	501	-247

DATA SHEET NO.14
FMVSS NO.301 STATIC ROLLOVER RESULTS

Test Vehicle:	2024 Hyundai Santa Cruz 4 Door Truck	NHTSA No.:	M20244207
Test Program:	NCAP Side MDB Impact Test	Test Date:	07/16/2024
Test Time:	12:09 PM	Temperature:	21 °C

A. From impact until vehicle motion ceases: 0 oz
(Maximum allowable is 1 oz.)
B. For the 5-minute period after motion ceases: 0 oz
(Maximum allowable is 5 oz.)
C. For the following 25 minutes: 0 oz
(Maximum allowable is 1 oz.)

D. Spillage Detail: No Spillage



ROLLOVER SOLVENT COLLECTION TIME TABLE IN SECONDS

Test Phase	Rotation Time	Hold Time	Total Time
0° to 90°	69	300	369
90° to 180°	72	300	372
180° to 270°	68	300	368
270° to 360°	67	300	367

FMVSS 301 SPILLAGE TABLE

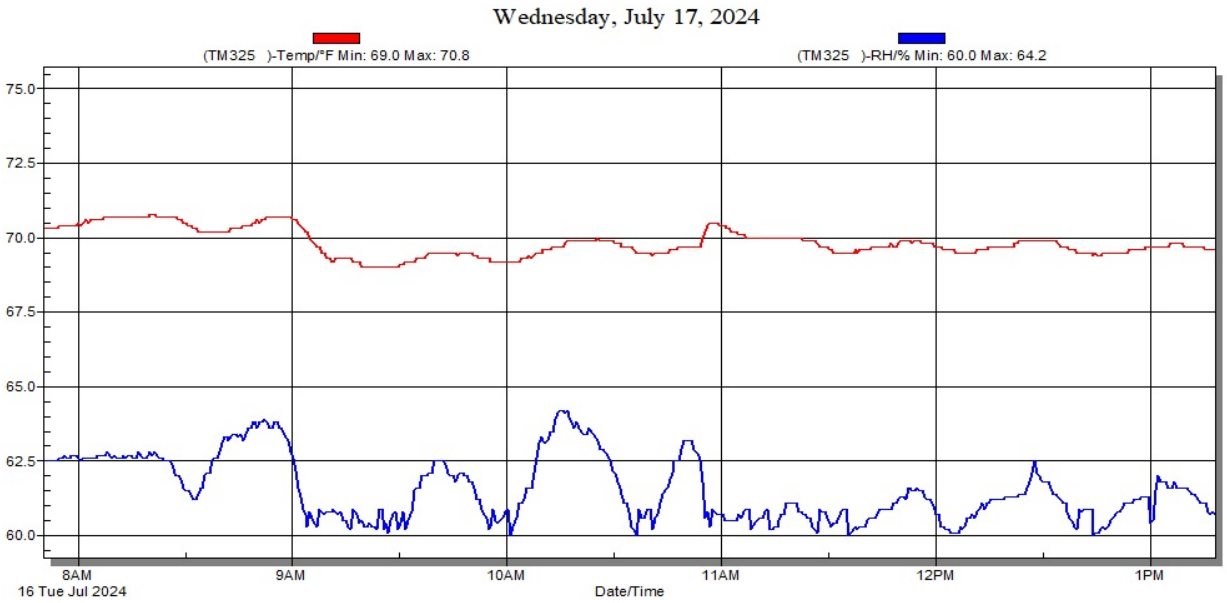
Test Phase	First 5 Minutes	Sixth Minute	Seventh Minute	Eighth Minute
0° to 90°	0	0	0	
90° to 180°	0	0	0	
180° to 270°	0	0	0	
270° to 360°	0	0	0	

SOLVENT SPILLAGE LOCATION TABLE

Test Phase	Spillage Location
0° to 90°	None
90° to 180°	None
180° to 270°	None
270° to 360°	None

DATA SHEET NO. 15
DUMMY / VEHICLE TEMPERATURE AND HUMIDITY STABILIZATION DATA

Test Vehicle:	2024 Hyundai Santa Cruz 4 Door Truck	NHTSA No.:	M20244207
Test Program:	NCAP Side MDB Impact Test	Test Date:	07/16/2024



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

APPENDIX A

PHOTOGRAPHS

TABLE OF PHOTOGRAPHS

Fig.	Description	Page
1	As-Delivered Right Front 3/4 View of Test Vehicle	A-5
2	As-Delivered Left Rear 3/4 View of Test Vehicle	A-5
3	Pre-Test Frontal View of Test Vehicle	A-6
4	Post-Test Frontal View of Test Vehicle	A-6
5	Pre-Test Left Front ¾ View of Test Vehicle	A-7
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7	Pre-Test Left Side View of Test Vehicle	A-8
8	Post-Test Left Side View of Test Vehicle	A-8
9	Pre-Test Left Rear ¾ View of Test Vehicle	A-9
10	Post-Test Left Rear ¾ View of Test Vehicle	A-9
11	Pre-Test Rear View of Test Vehicle	A-10
12	Post-Test Rear View of Test Vehicle	A-10
13	Pre-Test Right Side View of Test Vehicle	A-11
14	Post-Test Right Side View of Test Vehicle	A-11
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18	Pre-Test Right Side View of MDB Positioned Against Side of Test Vehicle	A-13
19	Pre-Test Close-Up View of Impact Point Target	A-14
20	Post-Test Close-up View of Impact Point Target	A-14
21	Pre-Test Left Front Door Latch Close-Up	A-15
22	Post-Test Left Front Door Latch Close-Up	A-15
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Figure A-1: As Delivered Right Front ¾ View of Test Vehicle



Figure A-2: As Delivered Left Rear ¾ View of Test Vehicle



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



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



Figure A-5: Pre-Test Left Front ¾ View of Test Vehicle



Figure A-6: Post-Test Left Front ¾ View of Test Vehicle

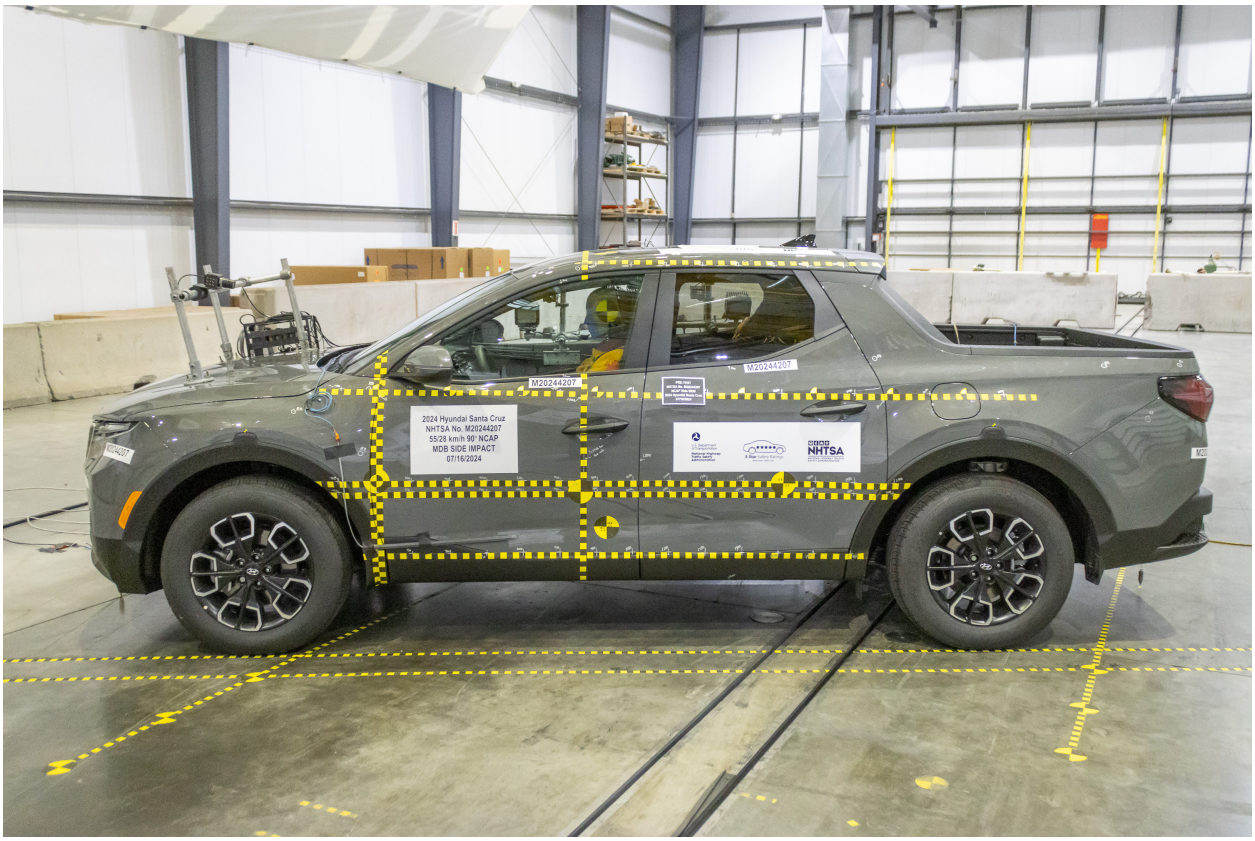


Figure A-7: Pre-Test Left Side View of Test Vehicle



Figure A-8: Post-Test Left Side View of Test Vehicle



Figure A-9: Pre-Test Left Rear ¾ View of Test Vehicle



Figure A-10: Post-Test Left Rear ¾ View of Test Vehicle



Figure A-11: Pre-Test Rear View of Test Vehicle



Figure A-12: Post-Test Rear View of Test Vehicle



Figure A-13: Pre-Test Right Side View of Test Vehicle



Figure A-14: Post-Test Right Side View of Test Vehicle

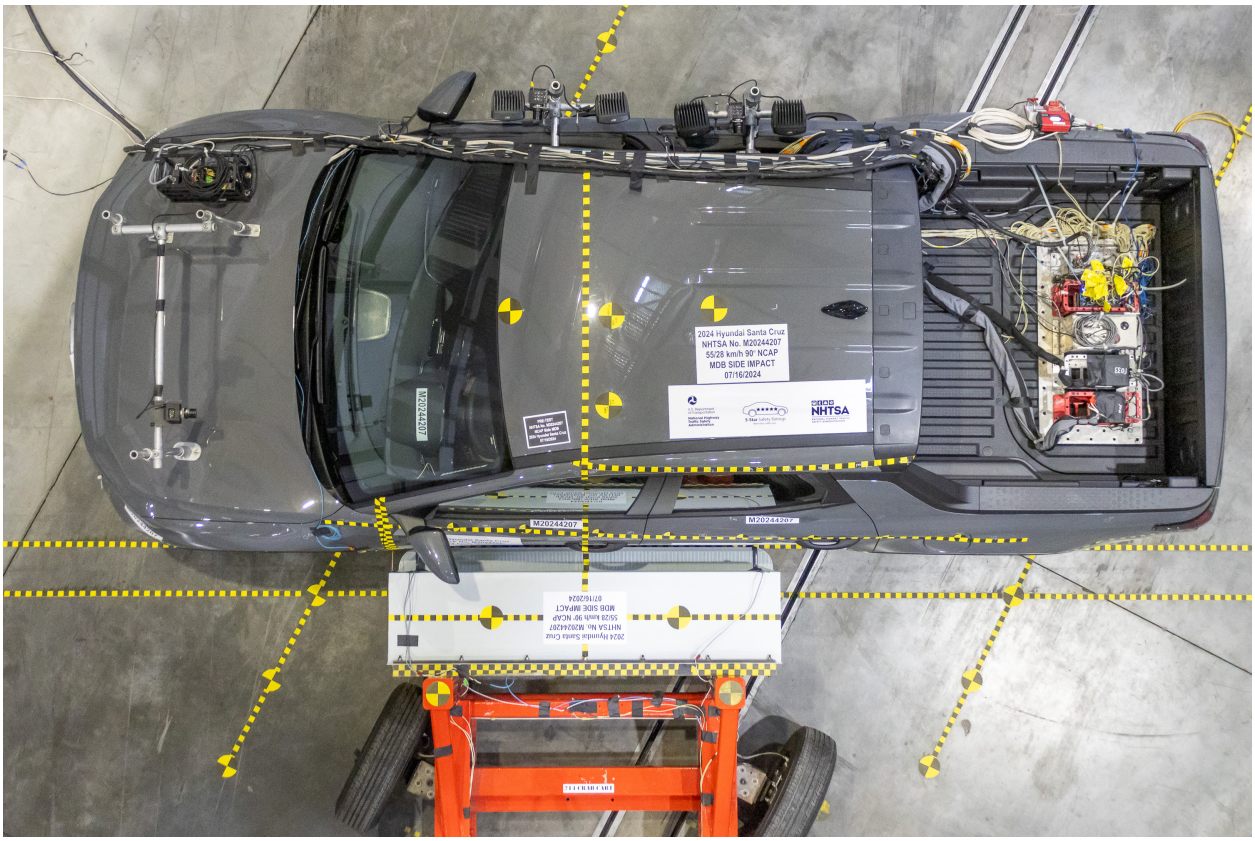


Figure A-15: Pre-Test Overhead View of Test Area

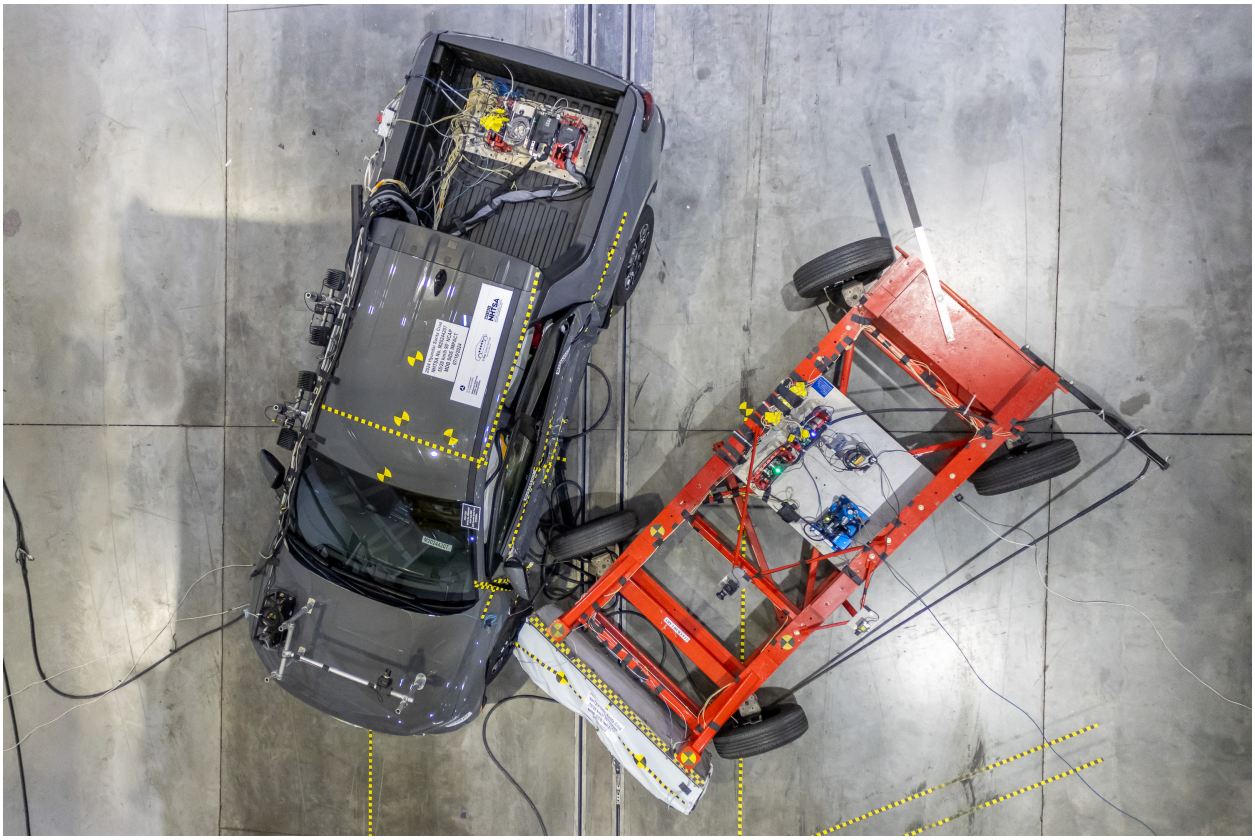


Figure A-16: Post-Test Overhead View of Test Area

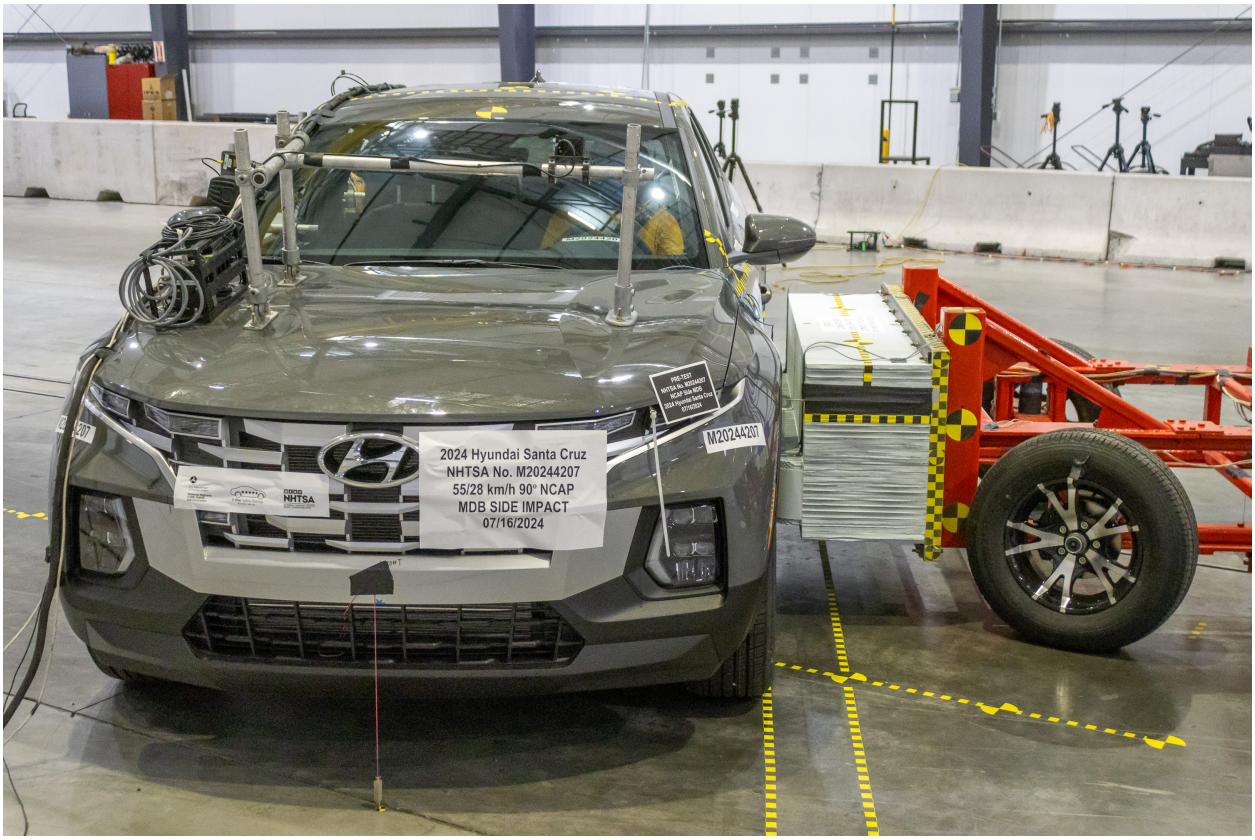


Figure A-17: Pre-Test Left Side View of MDB Positioned Against Side of Test Vehicle



Figure A-18: Pre-Test Right Side View of MDB Positioned Against Side of Test Vehicle



Figure A-19: Pre-Test Close-Up View of Impact Point Target



Figure A-20: Post-Test Close-up View of Impact Point Target

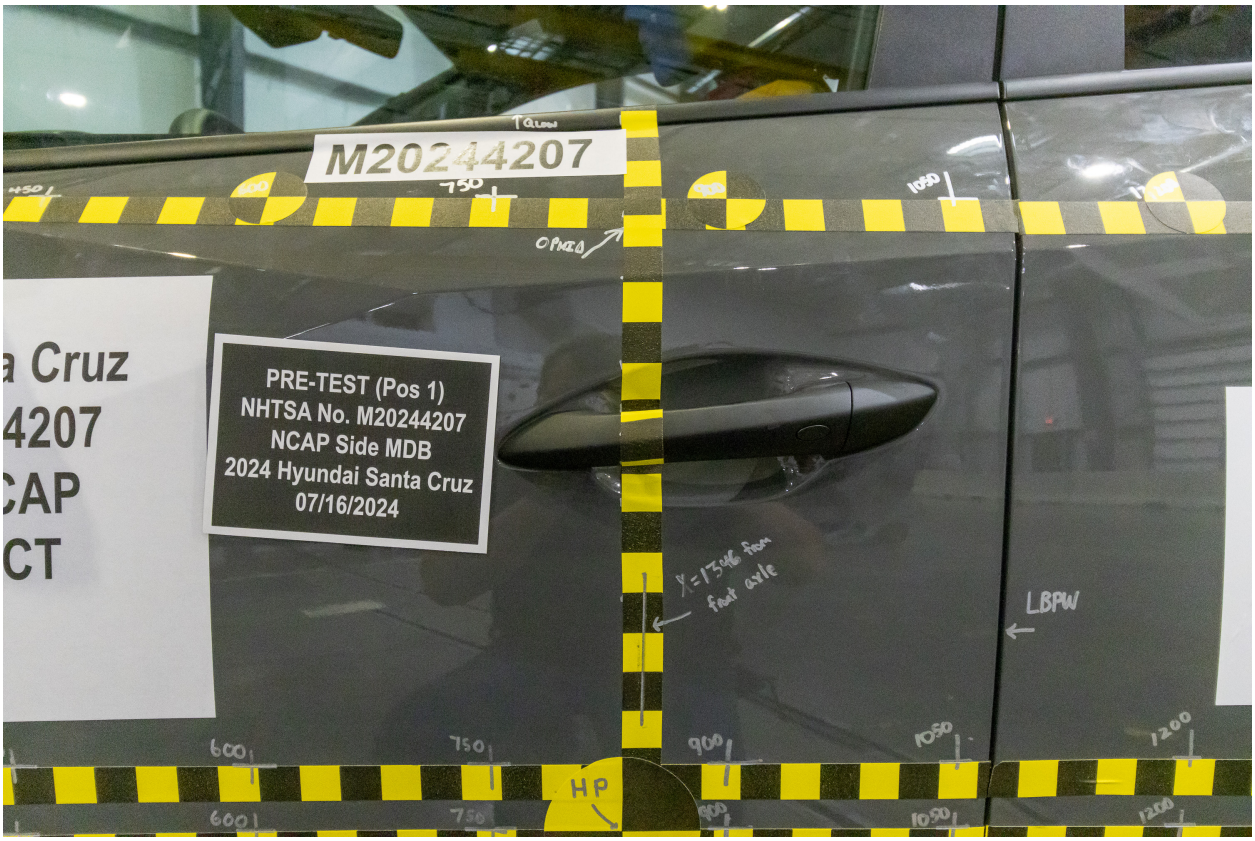


Figure A-21: Pre-Test Left Front Door Latch Close-Up



Figure A-22: Post-Test Left Front Door Latch Close-Up



Figure A-23: Pre-Test Left Rear Door Latch Close-Up



Figure A-24: Post-Test Left Rear Door Latch Close-Up



Figure A-25: Pre-Test Front Close-up View of Driver Dummy



Figure A-26: Post-Test Front Close-up View of Driver Dummy



Figure A-27: Pre-Test Left Side View of Driver Dummy Showing Belt and Chalking



Figure A-28: Pre-Test Left Side View of Driver Dummy Shoulder and Door Top View



Figure A-29: Post-Test Left Side View of Driver Dummy Shoulder and Door Top View



Figure A-30: Pre-Test Frontal View of Driver Seat Back Prior to Dummy Positioning



Figure A-31: Pre-Test Frontal View of Driver Dummy Head and Shoulders in Relation to Head Restraint



Figure A-32: Pre-Test Frontal View of Driver Seat Pan Prior to Dummy Positioning



Figure A-33: Pre-Test Overhead View of Driver Dummy Thighs on Seat Pan



Figure A-34: Pre-Test Placement of Driver Dummy's Feet



Figure A-35: Pre-Test View of Belt Anchorage for Driver Dummy



Figure A-36: Pre-Test Left Side View of Steering Wheel



Figure A-37: View of Disengaged Parking Brake



Figure A-38: Pre-Test View of Parking Brake



Figure A-39: Pre-Test Close-Up Left Side View of Driver Seat Track



Figure A-40: Pre-Test Close-Up Left Side View of Driver Seat Back

Photo Not Available

Figure A-41: Pre-Test Close-Up View of Driver Seat Back or Head Restraint



Figure A-42: Pre-Test Driver Dummy and Door Clearance View



Figure A-43: Post-Test Driver Dummy and Door Clearance View



Figure A-44: Pre-Test Right Side View of Driver Dummy and Front Seat of Occupant Compartment



Figure A-45: Post-Test Right Side View of Driver Dummy and Front Seat of Occupant Compartment



Figure A-46: Pre-Test Driver Inner Door Panel View



Figure A-47: Post-Test Driver Inner Door Panel View



Figure A-48: Post-Test Driver Dummy Close-Up Head Contact with Vehicle View

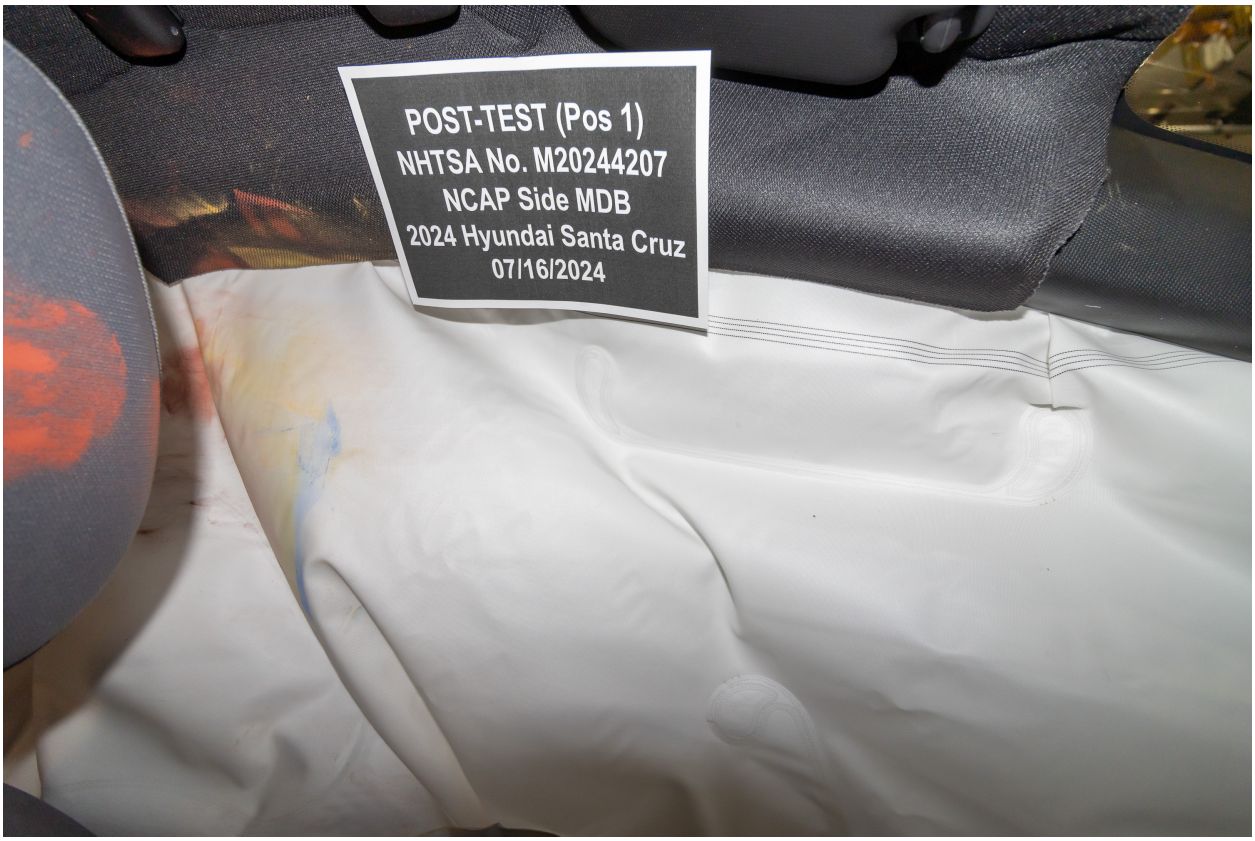


Figure A-49: Post-Test Driver Dummy Close-Up Head Contact with Side Air bag View



Figure A-50: Post-Test Driver Dummy Close-Up Torso Contact with Vehicle Interior View



Figure A-51: Post-Test Driver Dummy Close-Up Torso Contact with Side Air bag View

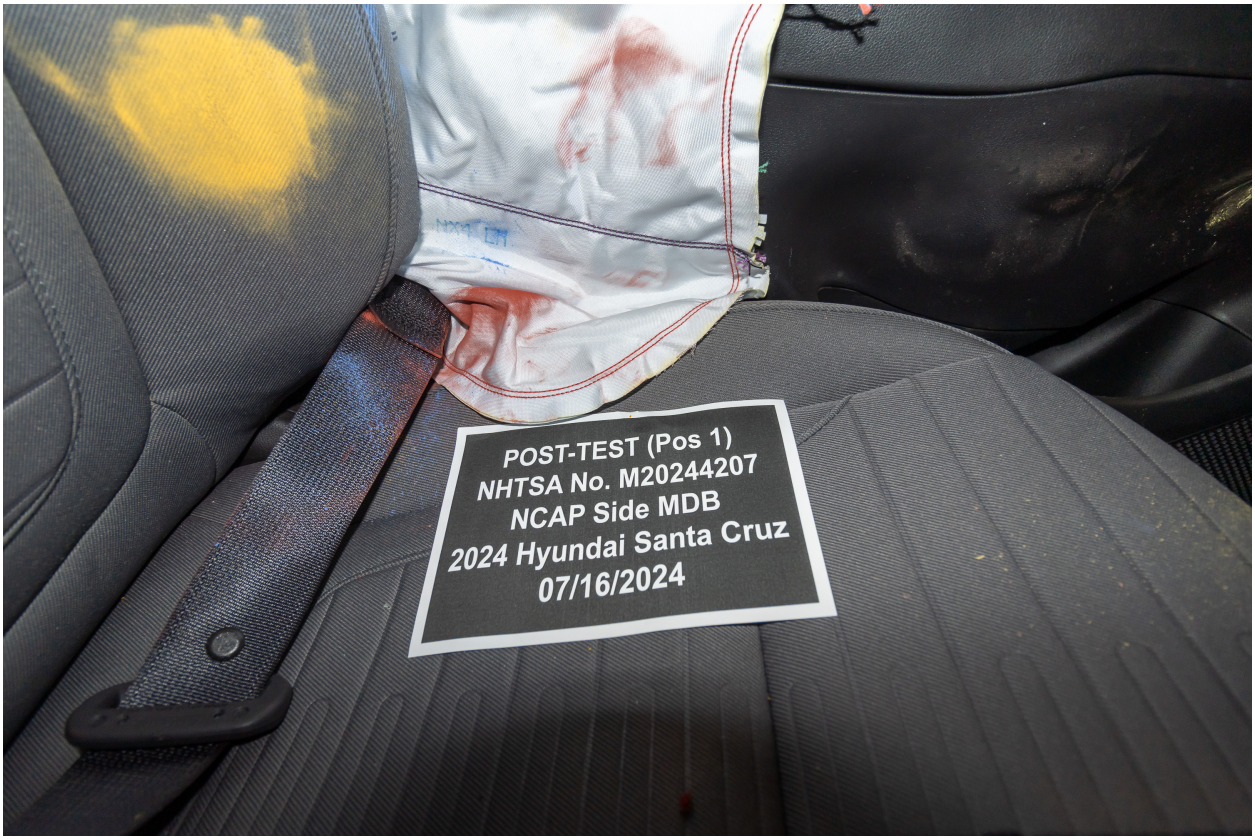


Figure A-52: Post-Test Driver Dummy Close-Up Pelvis Contact View

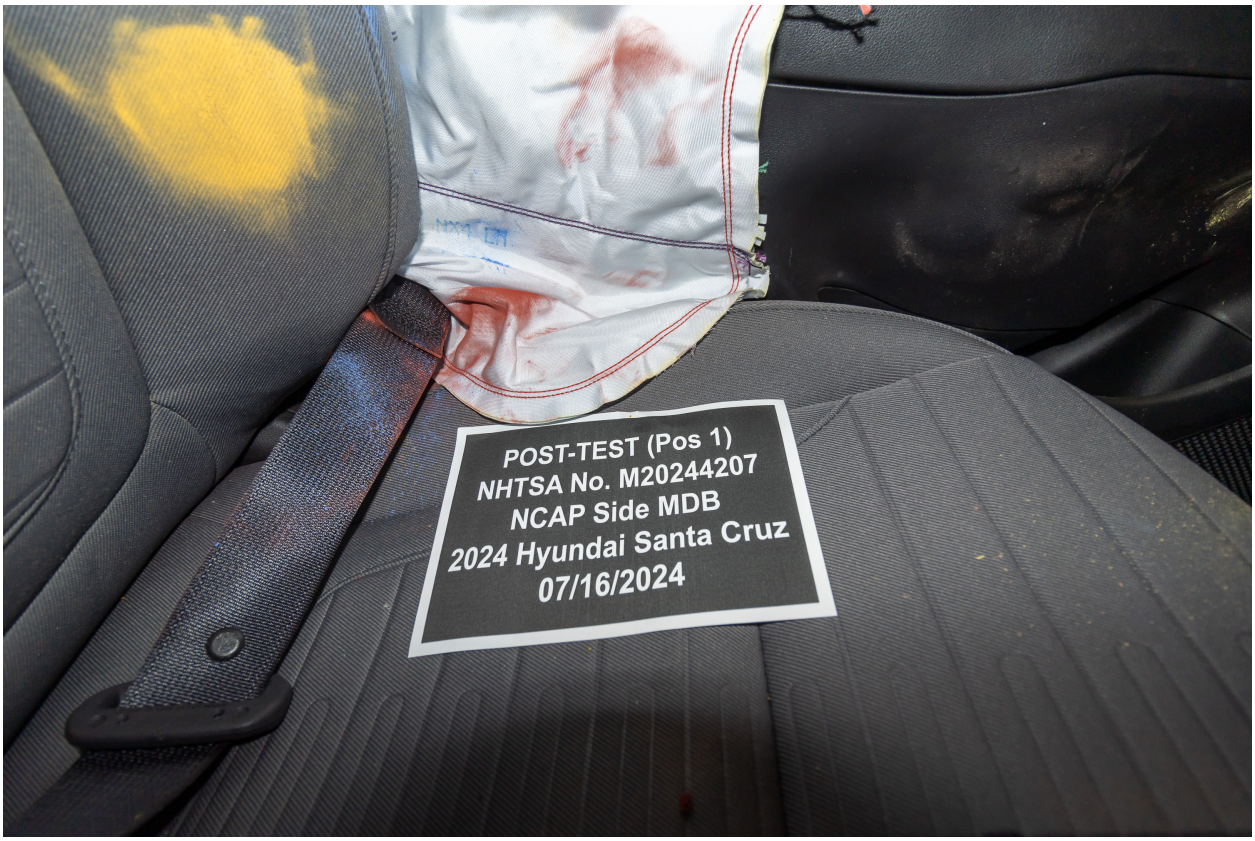


Figure A-53: Post-Test Driver Dummy Close-Up Pelvis Contact with Side Air bag View



Figure A-54: Post-Test Driver Dummy Close-Up Knee Contact View



Figure A-55: Pre-Test Left Side View of Rear Passenger Dummy Showing Belt and Chalking



Figure A-56: Pre-Test Left Side View of Rear Passenger Dummy Shoulder and Door Top View



Figure A-57: Post-Test Left Side View of Rear Passenger Dummy Shoulder and Door Top View



Figure A-58: Pre-Test Frontal View of Rear Passenger Seat Back Prior to Dummy Positioning

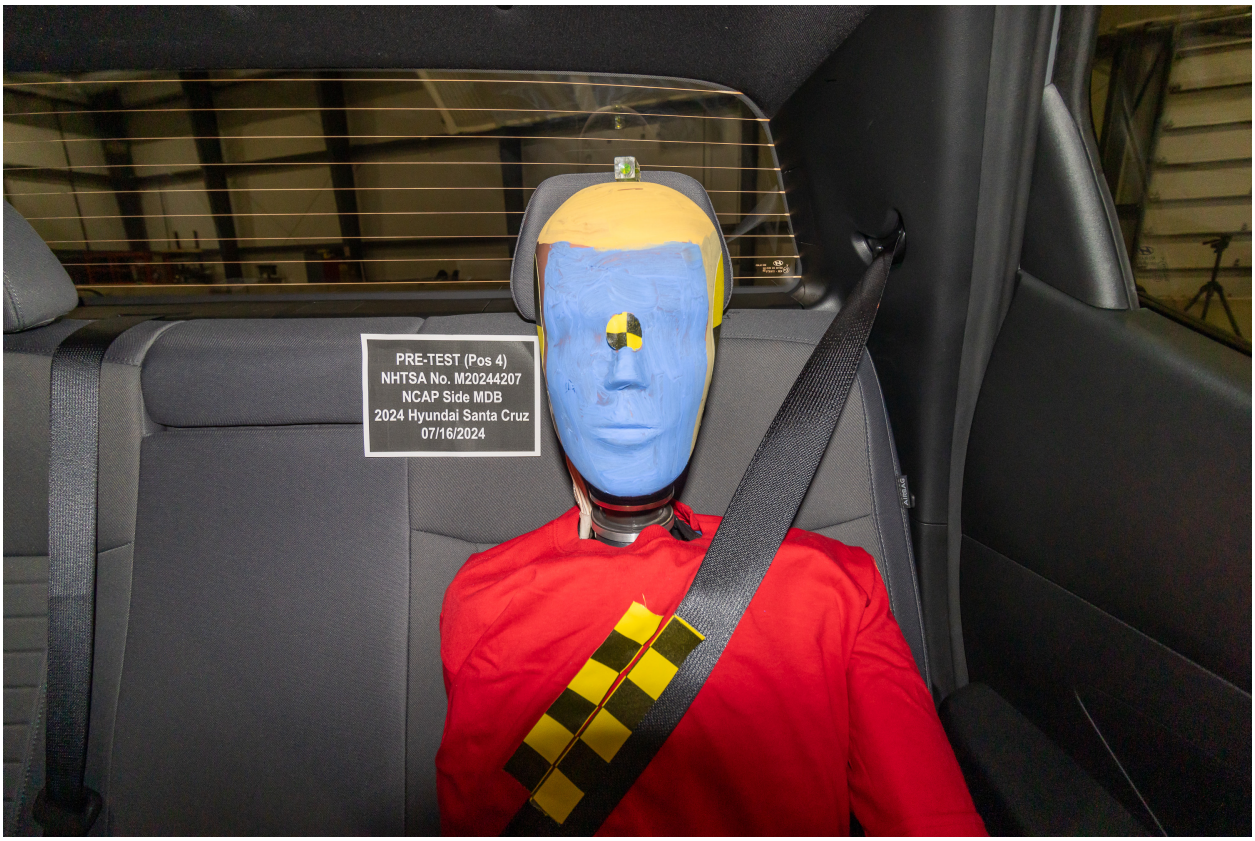


Figure A-59: Pre-Test Frontal View of Rear Passenger Dummy Head and Shoulders in Relation to Head Restraint



Figure A-60: Pre-Test Overhead View of Rear Passenger Seat Pan Prior to Dummy Positioning



Figure A-61: Pre-Test Overhead View of Rear Passenger Dummy Thighs on Seat Pan



Figure A-62: Pre-Test View of Rear Passenger Dummy's Neck Showing Position of Adjustable Neck Bracket



Figure A-63: Pre-Test View of Rear Passenger Dummy's Head Showing Dummy's Head is Level



Figure A-64: Pre-Test Placement of Rear Passenger Dummy's Feet



Figure A-65: Pre-Test View of Belt Anchorage for Rear Passenger Dummy



Figure A-66: Pre-Test Close-Up Left Side View of Rear Passenger Seat Track



Figure A-67: Pre-test Close-Up Left Side View of Rear Passenger Seat Back



Figure A-68: Pre-Test Close-Up View of Rear Passenger Seat Back or Head Restraint



Figure A-69: Pre-Test Rear Passenger Dummy and Door Clearance View



Figure A-70: Post-Test Rear Passenger Dummy and Door Clearance View



Figure A-71: Pre-Test Right Side View of Rear Passenger Dummy and Rear Seat Occupant Compartment



Figure A-72: Post-Test Right Side View of Rear Passenger Dummy and Rear Seat Occupant Compartment



Figure A-73: Pre-Test Rear Passenger Inner Door Panel View



Figure A-74: Post-Test Rear Passenger Inner Door Panel View Showing Rear Passenger Dummy Contact Locations



Figure A-75: Post-Test Rear Passenger Dummy Close-Up Head Contact with Vehicle View



Figure A-76: Post-Test Rear Passenger Dummy Close-Up Head Contact with Side Air bag View



Figure A-77: Post-Test Rear Passenger Dummy Close-Up Torso Contact with Vehicle Interior View



Figure A-78: Post-Test Rear Passenger Dummy Close-Up Torso Contact with Side Air bag View



Figure A-79: Post-Test Rear Passenger Dummy Close-Up Pelvis Contact View



Figure A-80: Post-Test Rear Passenger Dummy Close-Up Pelvis Contact with Side Air bag View



Figure A-81: Post-Test Rear Passenger Dummy Close-Up Knee Contact View



Figure A-82: Pre-Test View of Fuel Filler Cap or Fuel Filler Neck



Figure A-83: Post-Test View of Fuel Filler Cap or Fuel Filler Neck

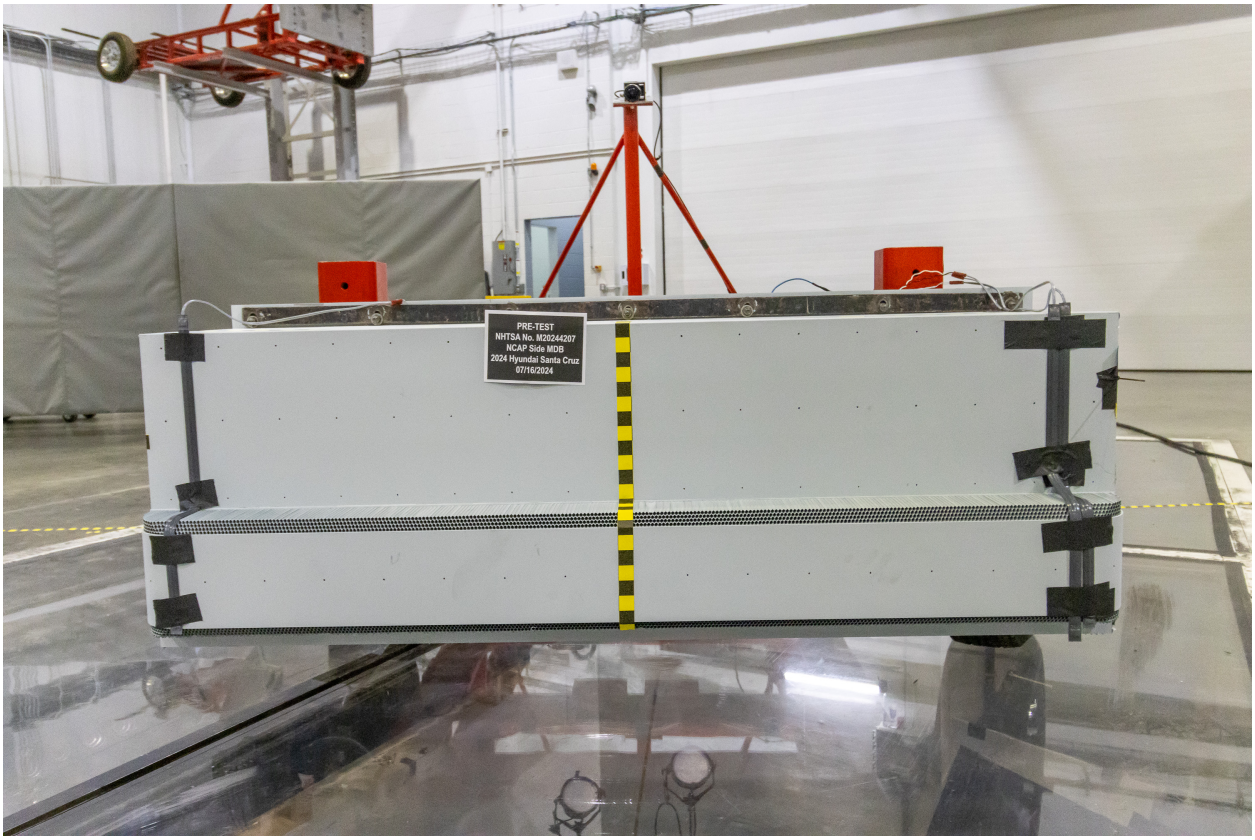


Figure A-84: Pre-Test Front View of MDB Impactor Face



Figure A-85: Post-Test Front View of MDB Impactor Face

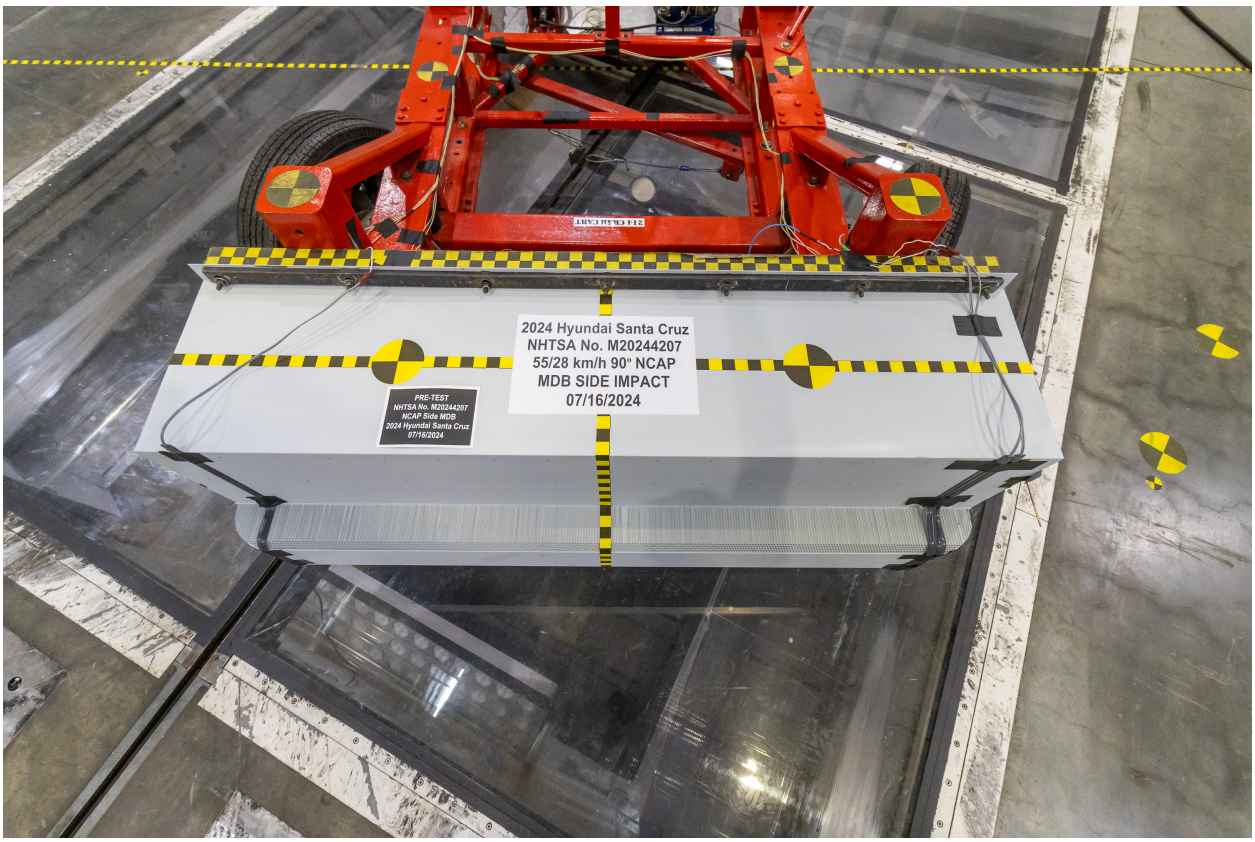


Figure A-86: Pre-Test Top View of MDB Impactor Face



Figure A-87: Post-Test Top View of MDB Impactor Face



Figure A-88: Pre-Test Left Side View of MDB Impactor Face



Figure A-89: Post-Test Left Side View of MDB Impactor Face



Figure A-90: Pre-Test Right Side View of MDB Impactor Face



Figure A-91: Post-Test Right Side View of MDB Impactor Face



Figure A-92: Close-Up View of Vehicle's Certification Label

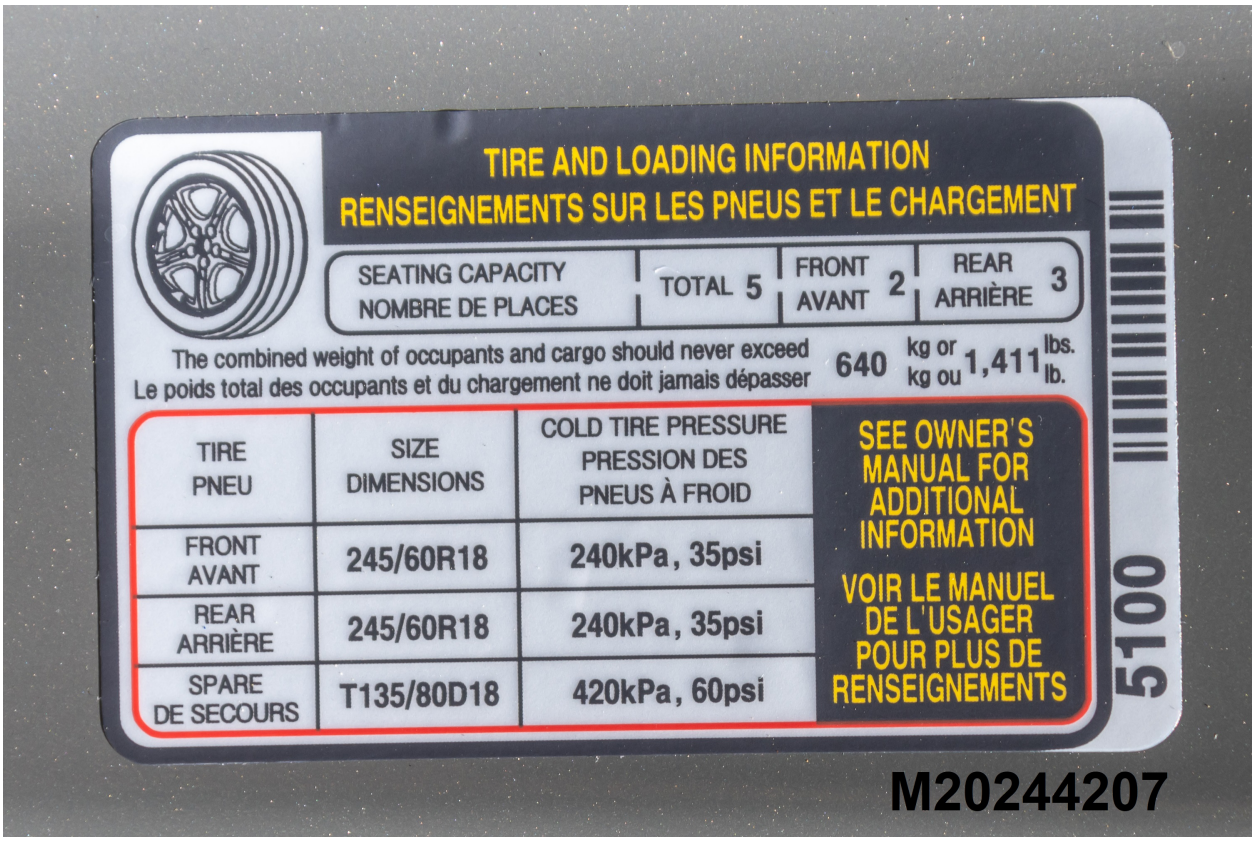


Figure A-93: Close-Up View of Vehicle's Tire Information Placard or Label

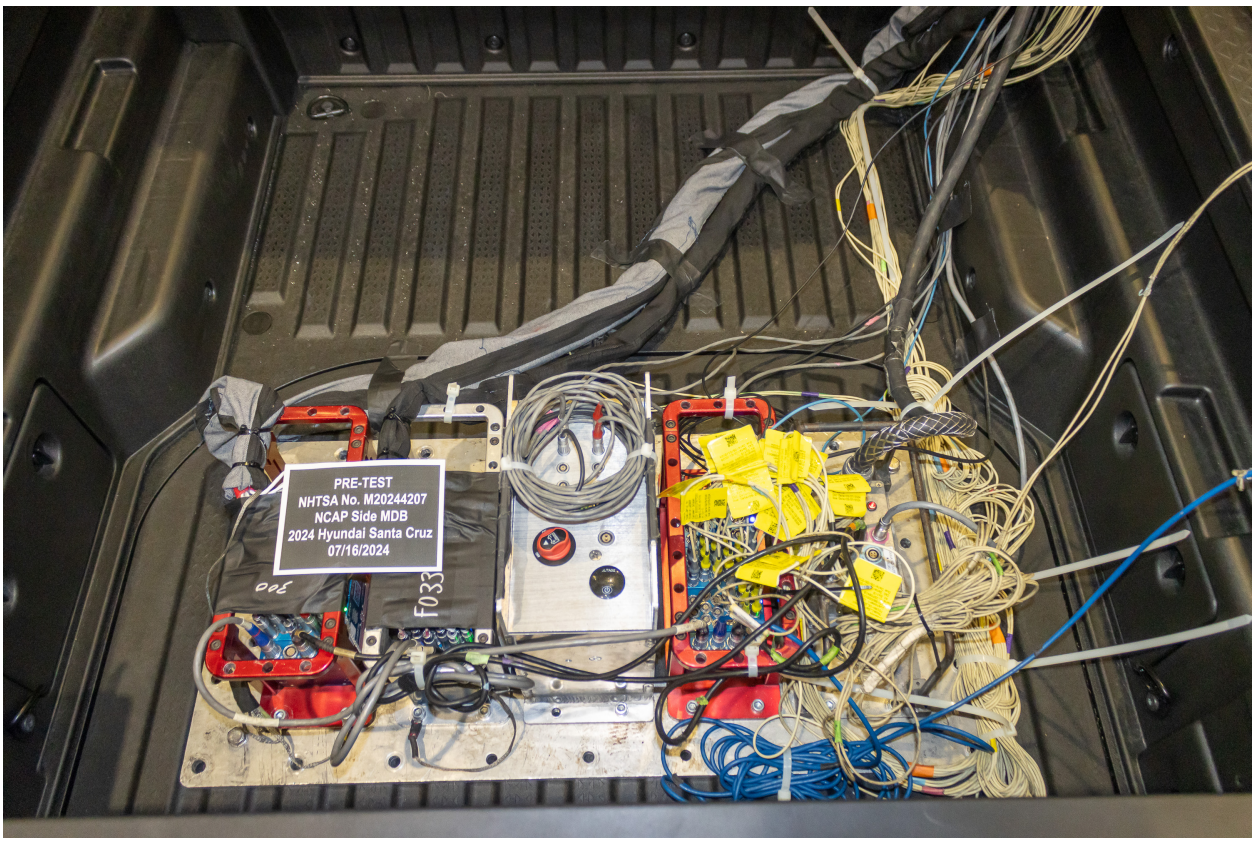


Figure A-94: Pre-Test Ballast View



Figure A-95: Post-Test Primary and Redundant Speed Trap Read-Out



Figure A-96: FMVSS No. 301 Static Rollover 0 Degrees

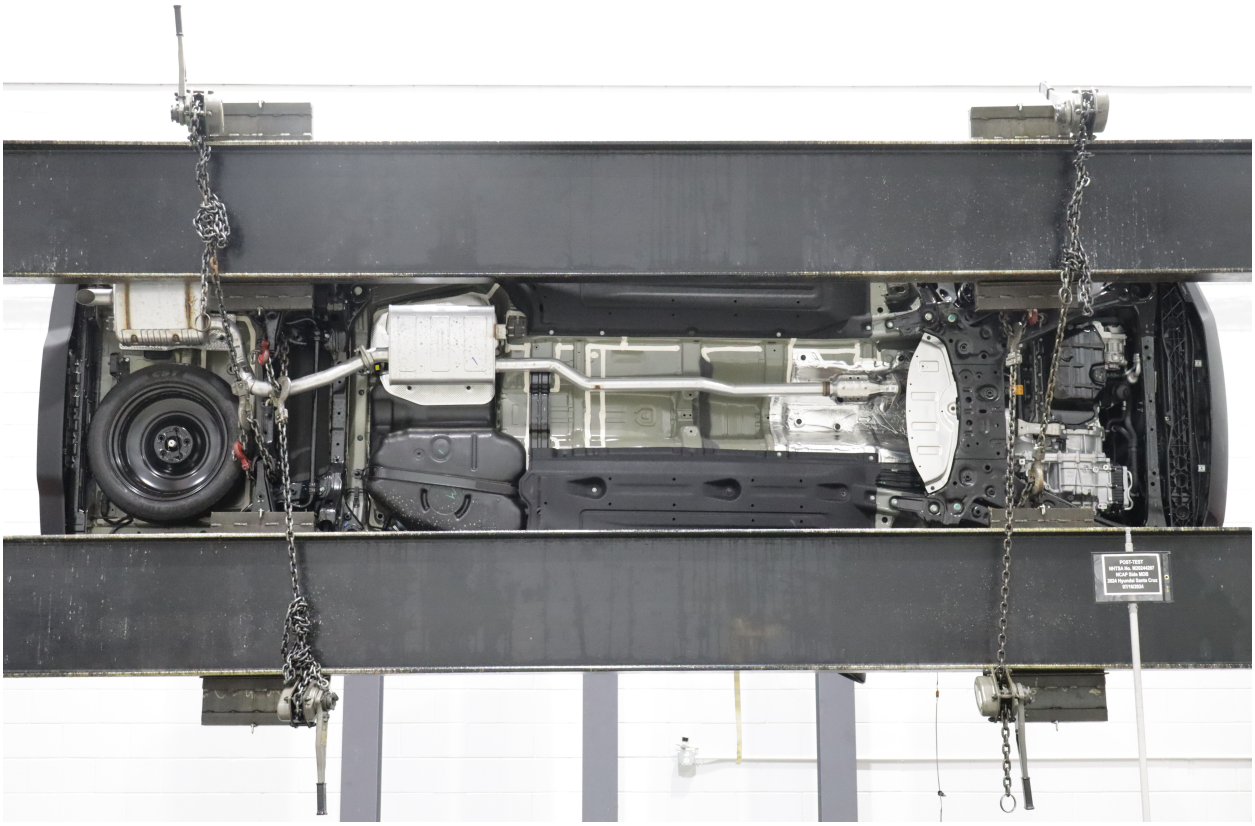


Figure A-97: FMVSS No. 301 Static Rollover 90 Degrees

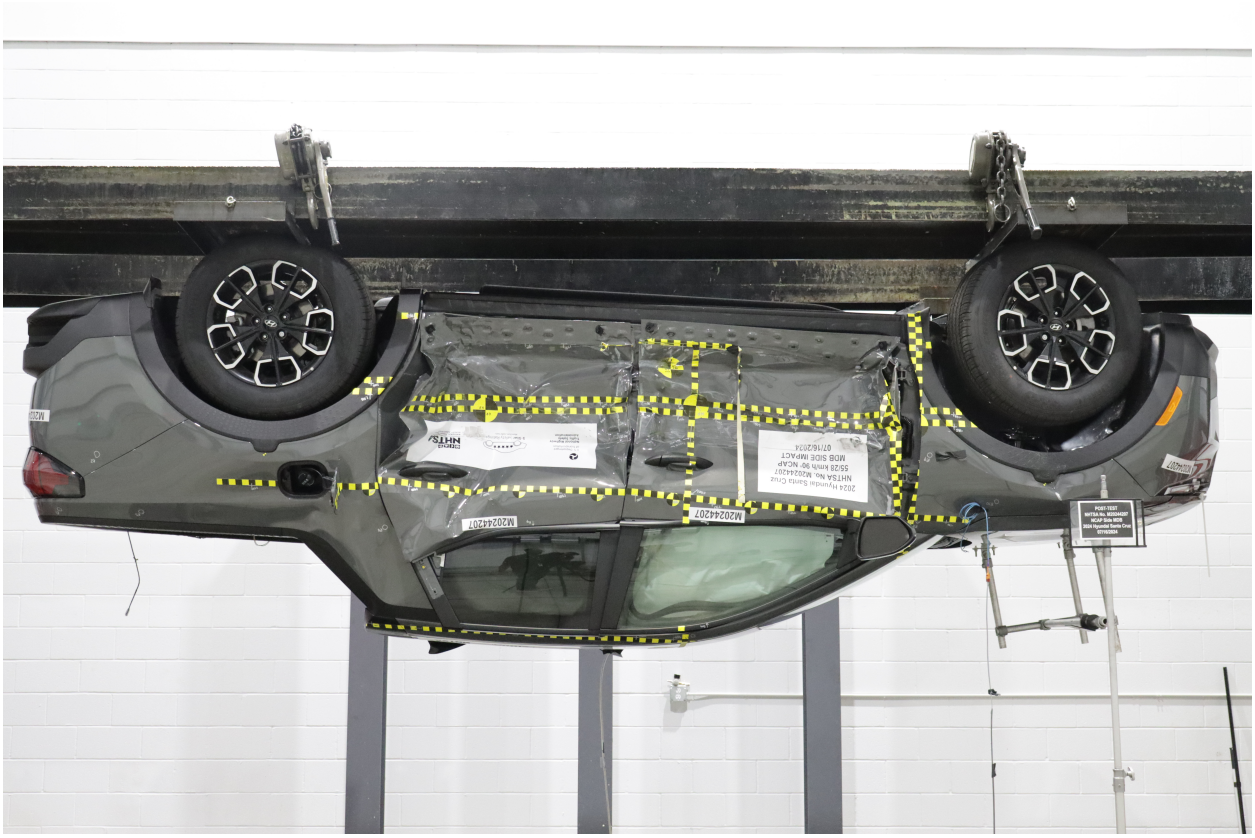


Figure A-98: FMVSS No. 301 Static Rollover 180 Degrees



Figure A-99: FMVSS No. 301 Static Rollover 270 Degrees



Figure A-100: FMVSS No. 301 Static Rollover 360 Degrees



Figure A-101: Impact Event

HYUNDAI

2024 SANTA CRUZ SEL FWD

SOLD TO: NY123 SHIPPED TO: NY123
MAGUIRE HYUNDAI
320 ELMIRA ROAD
ITHACA NY 14850

VIN: 5NTJB4DE1RH120466
MODEL: 90432F45
ENGINE: G4KNRK129272
PORT OF ENTRY: MA
EXTERIOR COLOR: HAMPTON GRAY
INTERIOR/SEAT COLOR: GRAY/GRAY
TRANSPORT: TRUCK
ACCESSORY WEIGHT: 11 lbs./ 5 kgs.
EMISSIONS: This vehicle is certified to meet emission requirements in all 50 states

GOVERNMENT 5-STAR SAFETY RATINGS

Overall Vehicle Score: Not Rated
Based on the combined rating of frontal, side and rollover.
Should ONLY be compared to other vehicles of similar size and weight.

Frontal Driver ★★★★★
Crash Passenger ★★★★★
Based on the risk of injury in a frontal impact.
Should ONLY be compared to other vehicles of similar size and weight.

Side Front seat: Not Rated
Crash Rear seat: Not Rated
Based on the risk of injury in a side impact.

Rollover ★★★★
Based on the risk of rollover in a single-vehicle crash.

Star ratings range from 1 to 5 stars (★★★★★) with 5 being the highest.
Source: National Highway Traffic Safety Administration (NHTSA).
www.safercar.gov or 1-888-327-4236

STANDARD FEATURES:

AMERICA'S BEST WARRANTY
5-year/60,000-mile New Vehicle Warranty*
10-year/100,000-mile Powertrain Warranty*
7-year/Unlimited-mile Anti-perforation Warranty*
3-year/36,000-mile Complimentary Maintenance*
5-year/Unlimited-mile Roadside Assistance
*Limited warranties, see dealer for details

ADVANCED SAFETY TECHNOLOGIES
Front, Front Side, & Side-Curtain Airbags w/ Rollover Sensors
Forward Collision-Avoidance Assist
Lane Keeping Assist; Lane Following Assist
Driver Attention Warning
Blind-Spot Collision-Avoidance Assist
Rear Cross-Traffic Collision-Avoidance Assist
Rearview Camera
Safe Exit Warning
Immobilizer

POWERTRAIN TECHNOLOGY
Smartstream 2.5L 4-cylinder Engine w/ GDI & MPI
8-speed Automatic Transmission w/ SHIFTRONIC®
Self-leveling Rear Suspension
Drive Mode Select

EXTERIOR
18" Alloy Wheels
Automatic LED Headlights
LED Daytime Running Lights
LED Taillights
Sheet Molded Composite Bed
Under Bed & Sidewall Storage Compartments
Rear Bumper Corner Steps

COMFORT & CONVENIENCE
Downhill Brake Control
Hillstart Assist Control
Dual Automatic Temperature Control
Proximity Key w/ Push Button Start
Remote Engine Start
Power Driver's Seat w/ Lumbar Support
Heated Front Seats
60/40 Flip-up Rear Seats w/ Storage Bin
4.2" Digital Cluster + Analog Gauges
Front USB Ports
Temporary Compact Spare Tire

MULTIMEDIA & CONNECTIVITY
8.0" Display Audio w/ AM/FM/HD Radio(TM)
SiriusXM® Radio w/ 90-day trial subscription;
Not Available in AK & HI
Android Auto(TM) & Apple CarPlay(R)
Bluelink® All-inclusive Connected Services (enrollment required)
Full Tank of Fuel

Manufacturer's Suggested Retail Price: $29,650.00

ADDED FEATURES:

*Carpeted Floor Mats	$210.00
*Cargo Net, Envelop	$55.00
*First Aid Kit	$30.00
*Mud Guards	$130.00
*Cargo Net, Bed	$80.00
*Wheel Locks	$70.00

Inland Freight & Handling : $1,375.00
Total Price : $31,600.00

Break out of the ordinary. With our one-of-a-kind Sport Adventure Vehicle, go time is all the time.

BlueLink

EPA DOT **Fuel Economy and Environment** — Gasoline Vehicle

Fuel Economy
23 MPG combined city/hwy
22 city 26 highway
4.3 gallons per 100 miles

Small SUVs range from 14 to 118 MPG.
The best vehicle rates 140 MPGe.

You spend **$2,000** more in fuel costs over 5 years compared to the average new vehicle.

Annual fuel cost **$2,350**

Fuel Economy & Greenhouse Gas Rating (tailpipe only): 5 (1–10, Best)
Smog Rating (tailpipe only): 5 (1–10, Best)

This vehicle emits 381 grams CO_2 per mile. The best emits 0 grams per mile (tailpipe only). Producing and distributing fuel also create emissions. learn more at fueleconomy.gov

Actual results will vary for many reasons, including driving conditions and how you drive and maintain your vehicle. The average new vehicle gets 28 MPG and costs $9,750 to fuel over 5 years. Cost estimates are based on 15,000 miles per year at $ 3.60 per gallon. MPGe is miles per gasoline gallon equivalent. Vehicle emissions are a significant cause of climate change and smog.

fueleconomy.gov
Calculate personalized estimates and compare vehicles

Smartphone QR Code

Manufacturer's suggested retail price includes manufacturer's recommended pre-delivery service. Gasoline license and title fees state and local taxes and dealer installed options and accessories are not included in the manufacturer's suggested retail price. This label has been affixed to this vehicle by Hyundai Motor America, pursuant to the requirements of 15 U.S.C. 1231 et seq. which prohibits its removal or alteration prior to delivery to the ultimate purchaser.

PARTS CONTENT INFORMATION
FOR VEHICLE IN THIS CARLINE:
U.S./CANADIAN PARTS CONTENT: 55 %
MAJOR SOURCES OF FOREIGN PARTS CONTENT: KOREA: 35 %

Note: Parts content does not include final assembly, distribution, or other non-parts costs.

FOR THIS VEHICLE:
FINAL ASSEMBLY POINT: MONTGOMERY, ALABAMA U.S.A.
COUNTRY OF ORIGIN:
ENGINE: U.S.A.
TRANSMISSION: U.S.A./KOREA

138 A 1

Figure A-102: Monroney Label

03

NOTICE

If you recline the seatback towards the front with the head restraint and seat cushion raised, the head restraint may come in contact with the sunvisor or other parts of the vehicle.

Front seat head restraints

The driver's and front passenger's seats are equipped with adjustable head restraint for the passengers safety and comfort.

Adjusting the height up and down

To raise the head restraint:

1. Pull it up to the desired position (1).

To lower the head restraint:

1. Push and hold the release button (2) on the head restraint support.
2. Lower the head restraint to the desired position (3).

3-13

Figure A-103: Driver Head Restraint Use and Adjustment Information from Vehicle Owner's Manual

03

Rear seat head restraint

The rear seats are equipped with head restraint in all the seating positions for the passenger's safety and comfort.

Removal/Reinstallation

To remove the head restraint:

1. Raise the head restraint as far as it can go.
2. Press the head restraint release button (1) while pulling the head restraint up (2).

To reinstall the head restraint:

1. Put the head restraint poles into the holes (3) while pressing the release button (1).
2. Adjust the head restraint to the appropriate height.

Adjusting the height up and down

To raise the head restraint:

1. Pull it up to the desired position (1).

To lower the head restraint:

1. Push and hold the release button (2) on the head restraint support.
2. Lower the head restraint to the desired position (3).

3-15

Figure A-104: Left Rear Passenger Head Restraint Use and Adjustment Information from Vehicle Owner's Manual

APPENDIX B
VEHICLE AND DUMMY RESPONSE DATA TRACES

Table of Data Plots
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The following additional dummy and vehicle response data can be obtained from the Research and Development section of the NHTSA website. The website can be found at www.NHTSA.gov

Additional Driver & Passenger Dummy Instrumentation Data

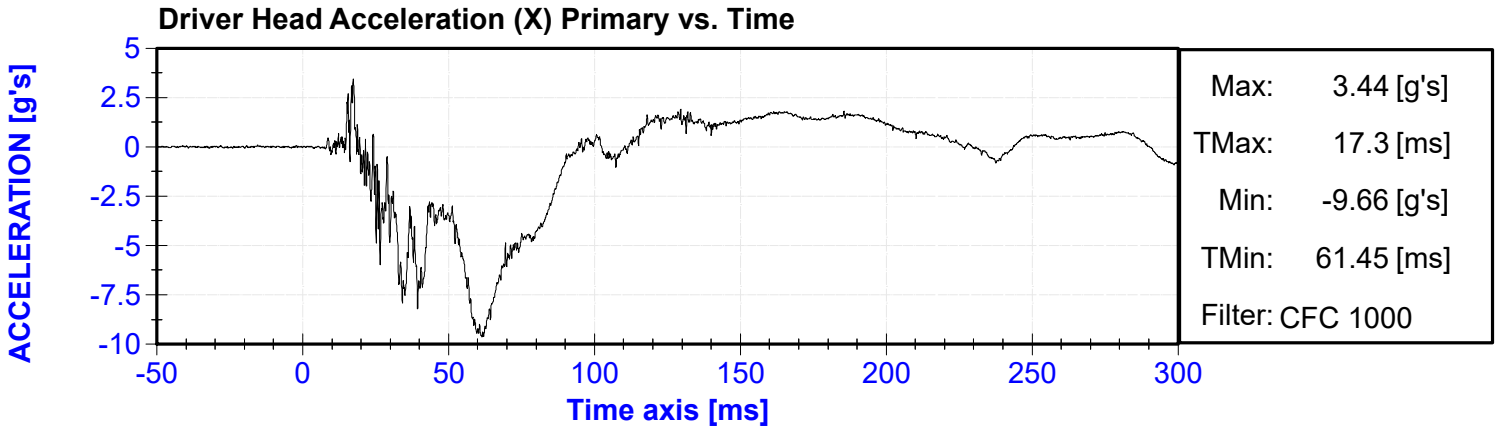
Driver Lower Spine T12 Acceleration (X)
Driver Lower Spine T12 Acceleration (Y)
Driver Lower Spine T12 Acceleration (Z)
Passenger Upper Thorax Rib Deflection (Y)
Passenger Middle Thorax Rib Deflection (Y)
Passenger Lower Thorax Rib Deflection (Y)
Passenger Upper Abdomen Rib Deflection (Y)
Passenger Lower Abdomen Rib Deflection (Y)
Driver Head Acceleration Redundant (X)
Driver Head Acceleration Redundant (Y)
Driver Head Acceleration Redundant (Z)
Passenger Head Acceleration Redundant (X)
Passenger Head Acceleration Redundant (Y)
Passenger Head Acceleration Redundant (Z)

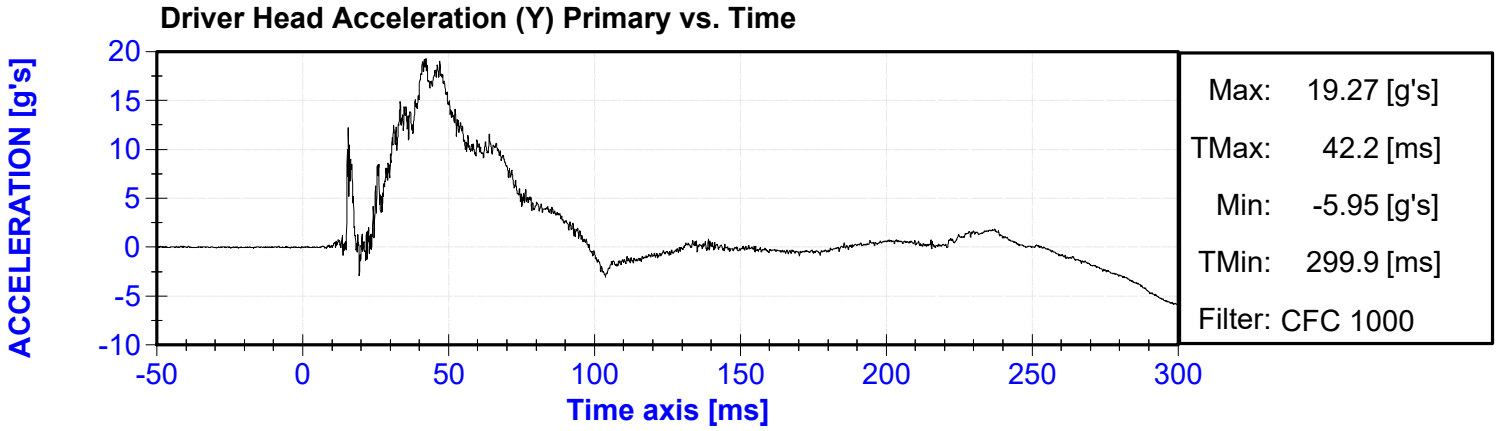
Vehicle Instrumentation Data

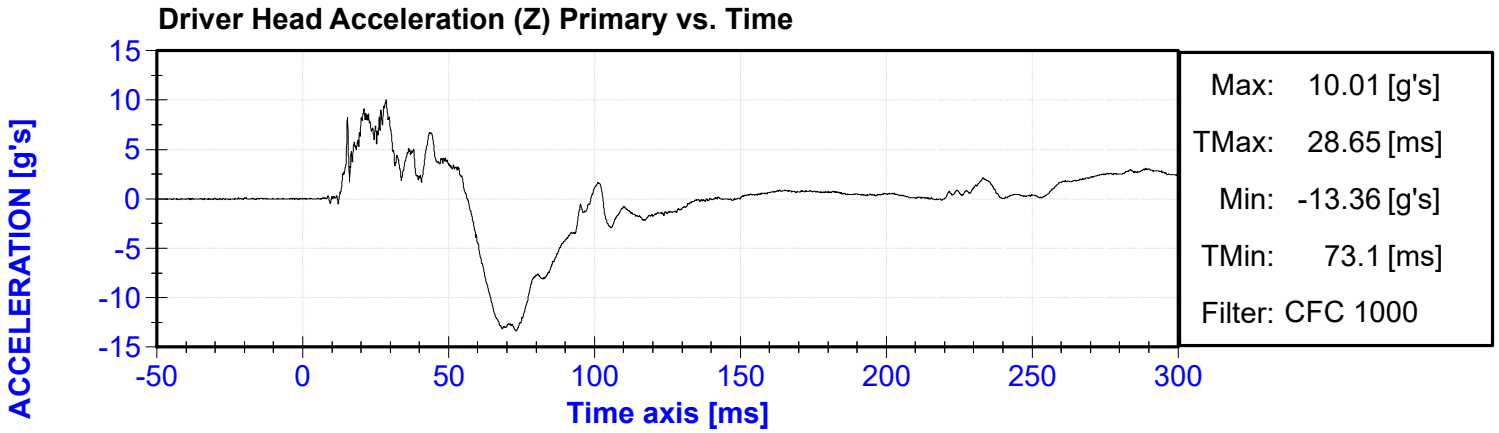
Vehicle Center of Gravity Acceleration (X)
Vehicle Center of Gravity Acceleration (Y)
Vehicle Center of Gravity Acceleration (Z)
Right Side Sill at Front Seat Acceleration (X)
Right Side Sill at Front Seat Acceleration (Y)
Right Side Sill at Front Seat Acceleration (Z)
Right Side Sill at Rear Seat Acceleration (X)
Right Side Sill at Rear Seat Acceleration (Y)
Right Side Sill at Rear Seat Acceleration (Z)
Left Side Sill at Front Seat Acceleration (Y)
Left Side Sill at Rear Seat Acceleration (Y)
Lower A-Post Acceleration (Y)
Middle A-Post Acceleration (Y)
Lower B-Post Acceleration (Y)
Middle B-Post Acceleration (Y)
Front Seat Track Acceleration (Y)
Rear Seat Structure Acceleration (Y)
Right Rear Occupant Compartment Acceleration (Y)
Engine Block (X)
Engine Block (Y)
Rear Floorpan Above Axle Acceleration (X)
Rear Floorpan Above Axle Acceleration (Y)
Rear Floorpan Above Axle Acceleration (Z)

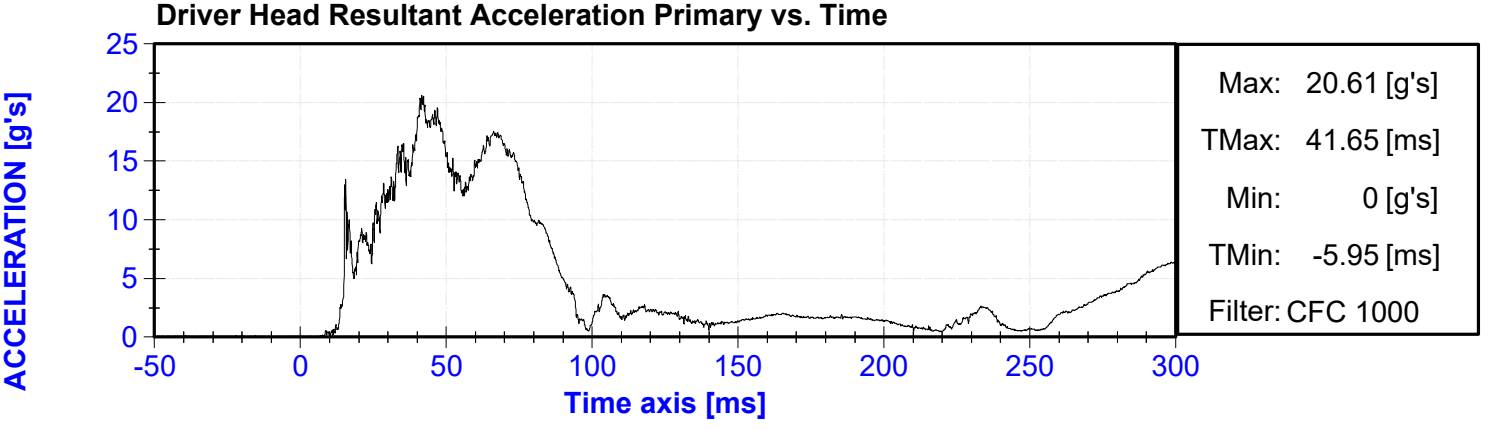
MDB Instrumentation Data

MDB Center of Gravity Acceleration (X)
MDB Center of Gravity Acceleration (Y)
MDB Center of Gravity Acceleration (Z)
MDB Rear Acceleration (X)
MDB Rear Acceleration (Y)
Left MDB Contact Switch
Right MDB Contact Switch

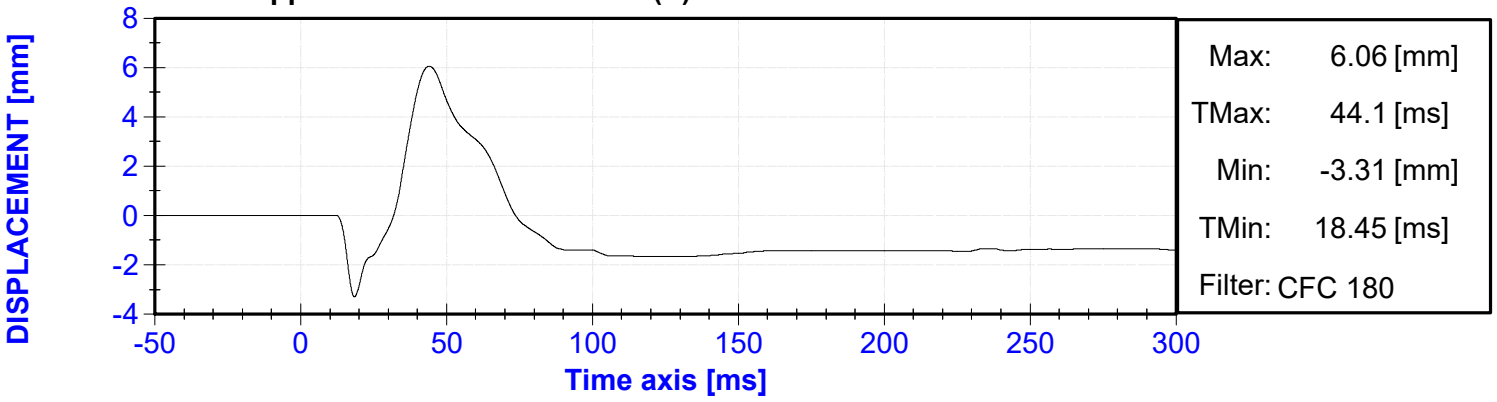

Driver Head Acceleration (X) Primary vs. Time
ACCELERATION [g's]
5
2.5
0
-2.5
-5
-7.5
-10
-50
0
50
100
150
200
250
300
Time axis [ms]
Max: 3.44 [g's]
TMax: 17.3 [ms]
Min: -9.66 [g's]
TMin: 61.45 [ms]
Filter: CFC 1000


Driver Head Acceleration (Y) Primary vs. Time
ACCELERATION [g's]
20
15
10
5
0
-5
-10
-50
0
50
100
150
200
250
300
Time axis [ms]
Max: 19.27 [g's]
TMax: 42.2 [ms]
Min: -5.95 [g's]
TMin: 299.9 [ms]
Filter: CFC 1000

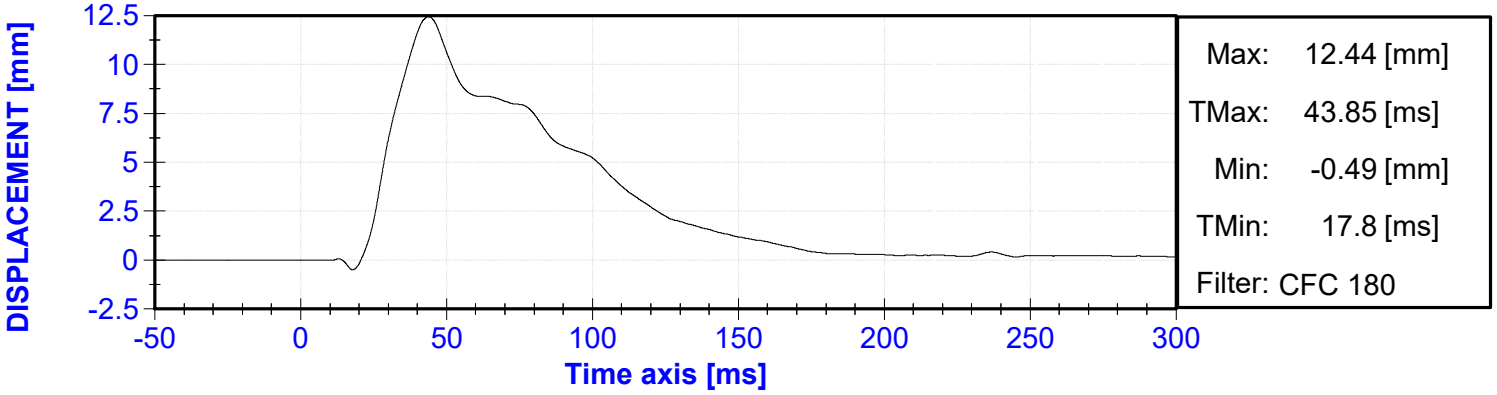

Driver Head Acceleration (Z) Primary vs. Time
ACCELERATION [g's]
15
10
5
0
-5
-10
-15
-50
0
50
100
150
200
250
300
Time axis [ms]
Max: 10.01 [g's]
TMax: 28.65 [ms]
Min: -13.36 [g's]
TMin: 73.1 [ms]
Filter: CFC 1000


Driver Head Resultant Acceleration Primary vs. Time
ACCELERATION [g's]
25
20
15
10
5
0
-50
0
50
100
150
200
250
300
Time axis [ms]
Max: 20.61 [g's]
TMax: 41.65 [ms]
Min: 0 [g's]
TMin: -5.95 [ms]
Filter: CFC 1000

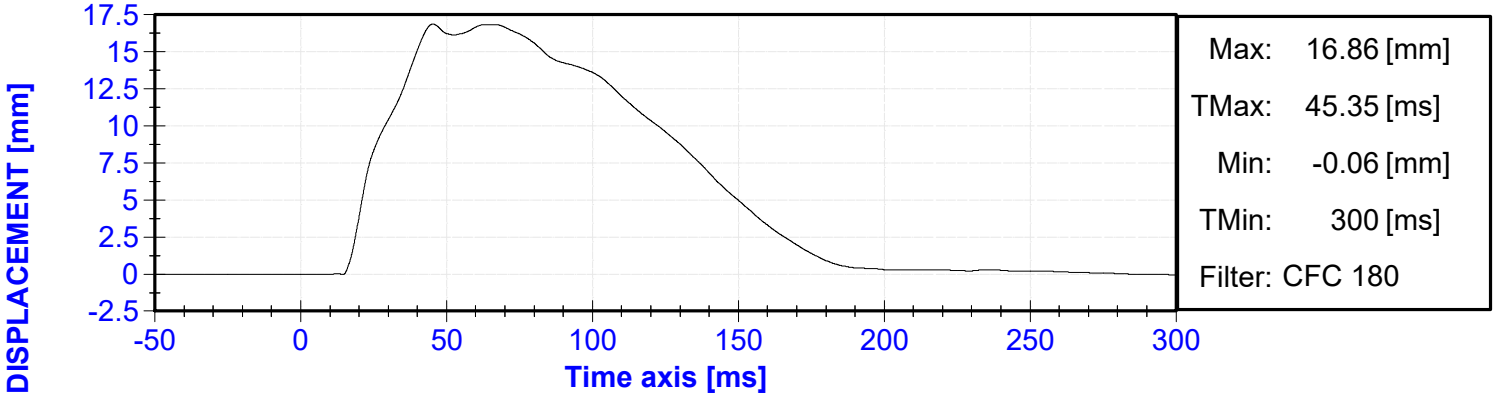
Driver Upper Thorax Rib Deflection (Y) vs. Time



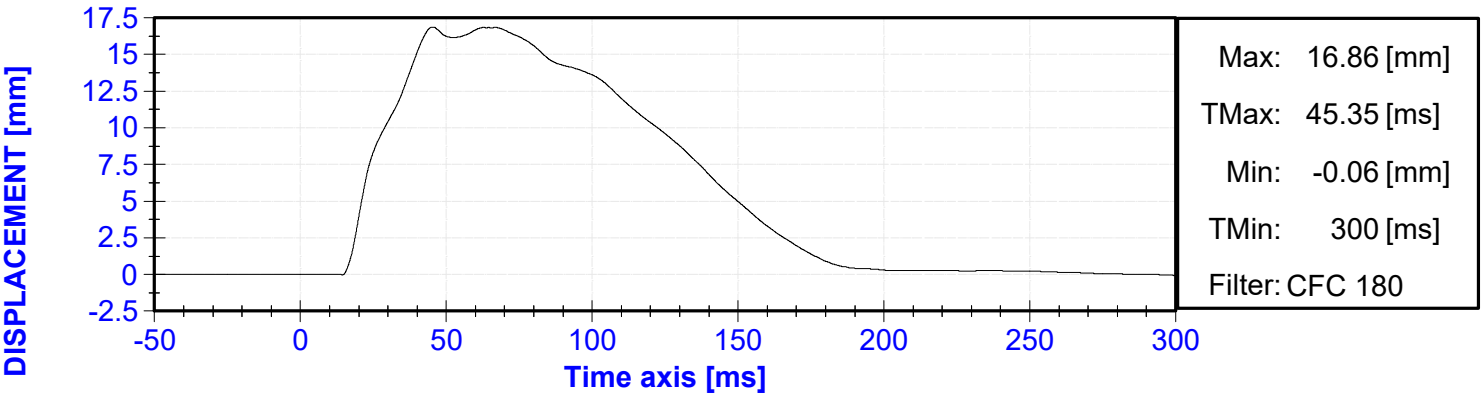
Driver Middle Thorax Rib Deflection (Y) vs. Time



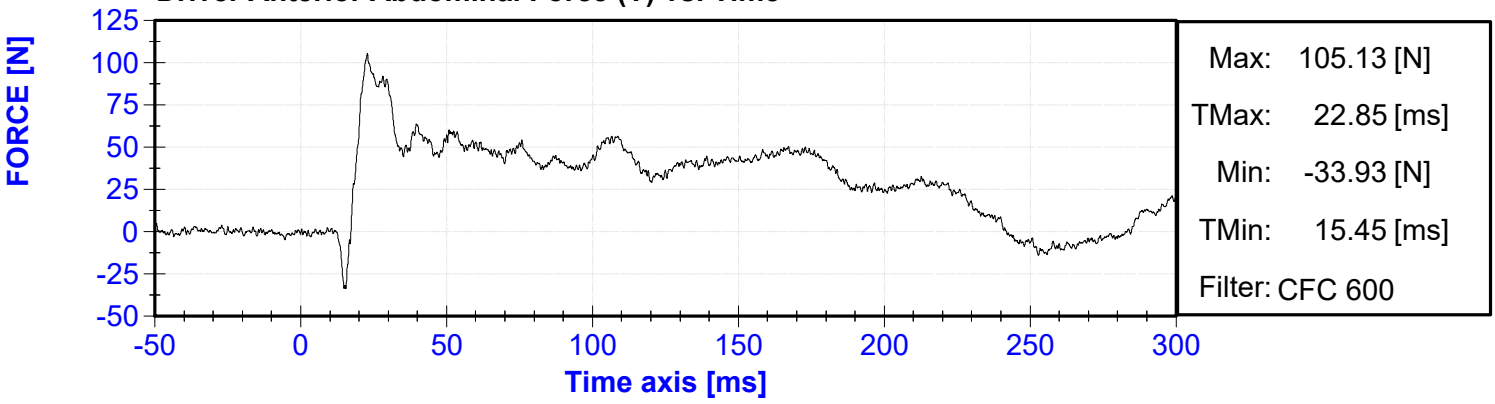
Driver Lower Thorax Rib Deflection (Y) vs. Time



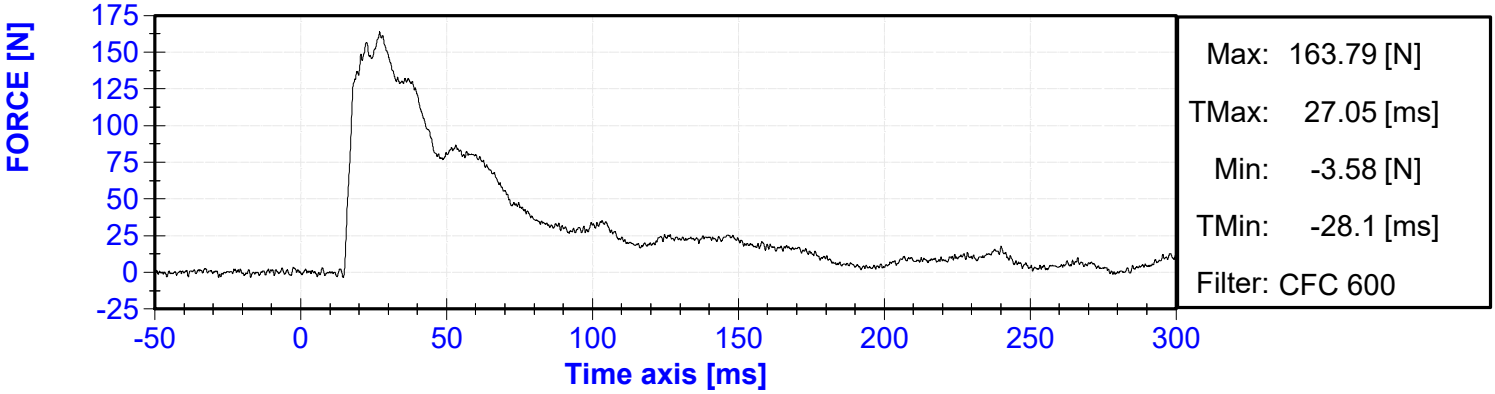
Driver Thorax Rib Deflection Maximum vs. Time



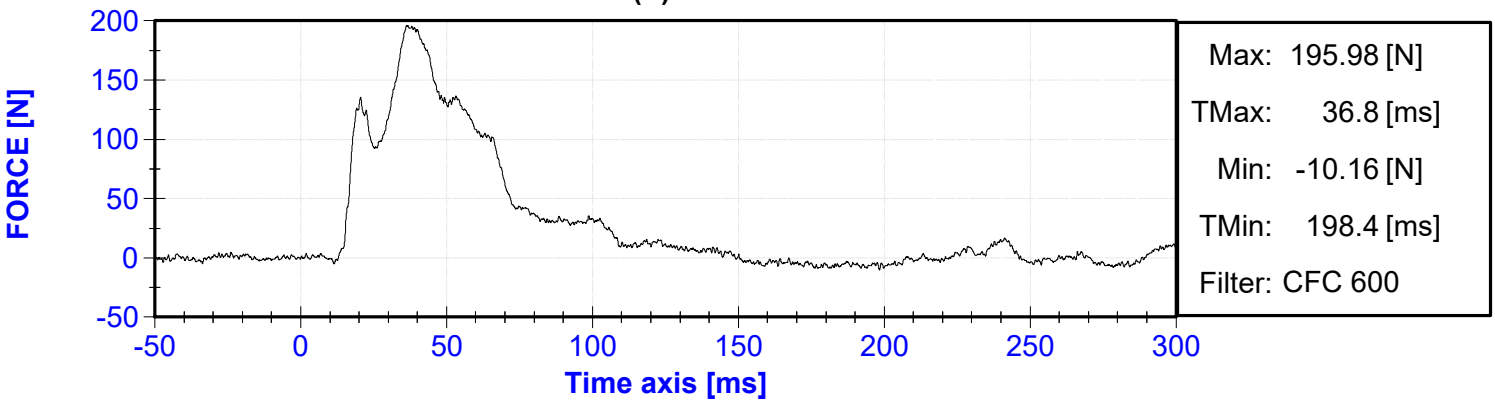
Driver Anterior Abdominal Force (Y) vs. Time



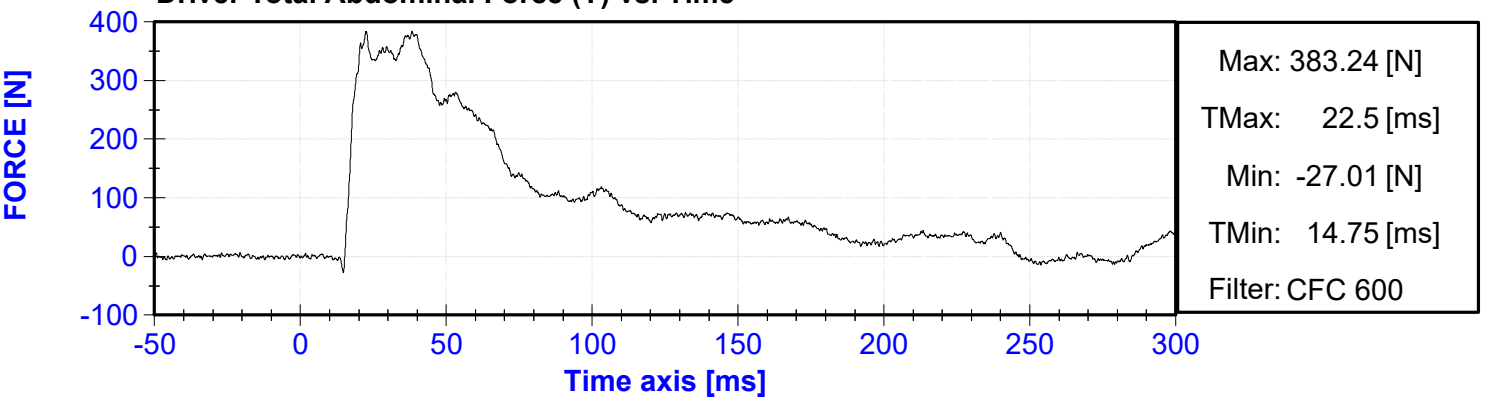
Driver Middle Abdominal Force (Y) vs. Time



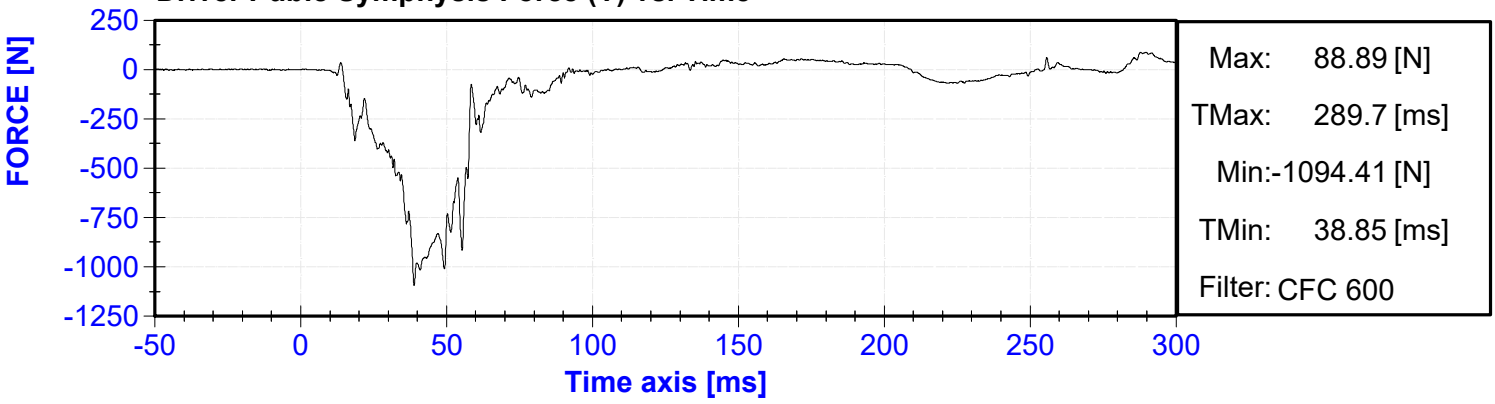
Driver Posterior Abdominal Force (Y) vs. Time



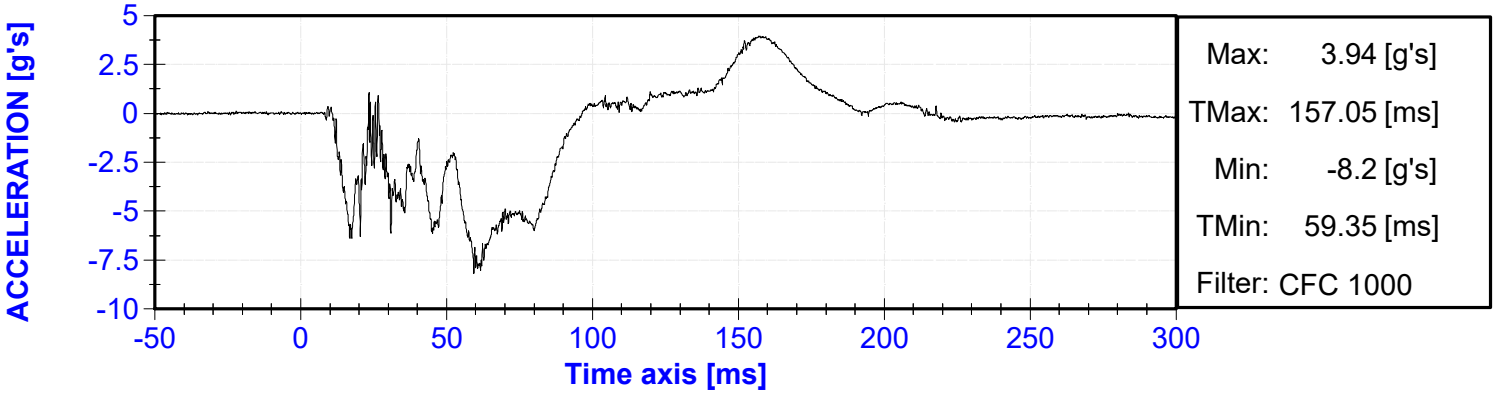
Driver Total Abdominal Force (Y) vs. Time



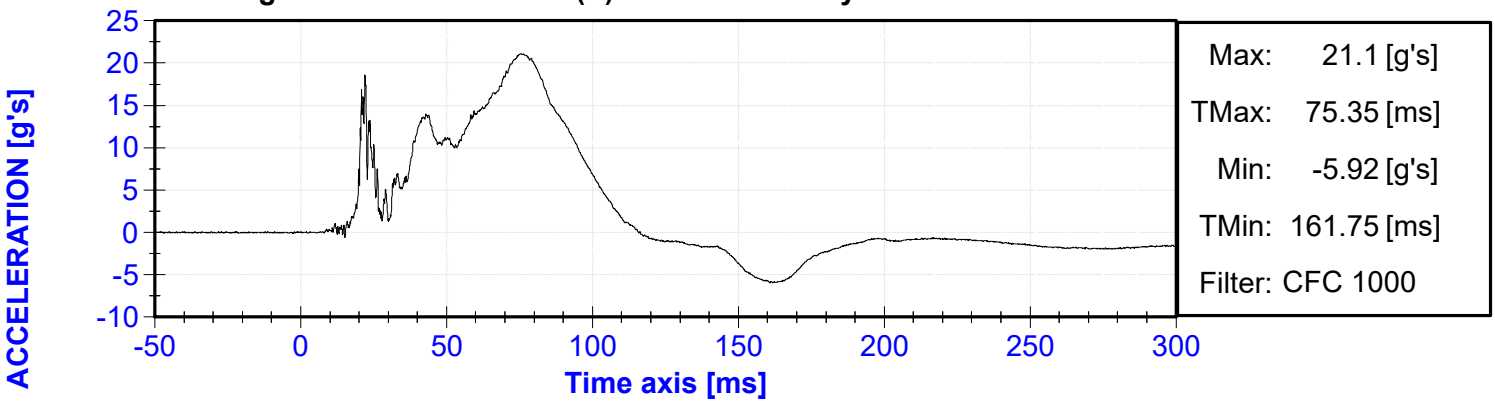
Driver Pubic Symphysis Force (Y) vs. Time



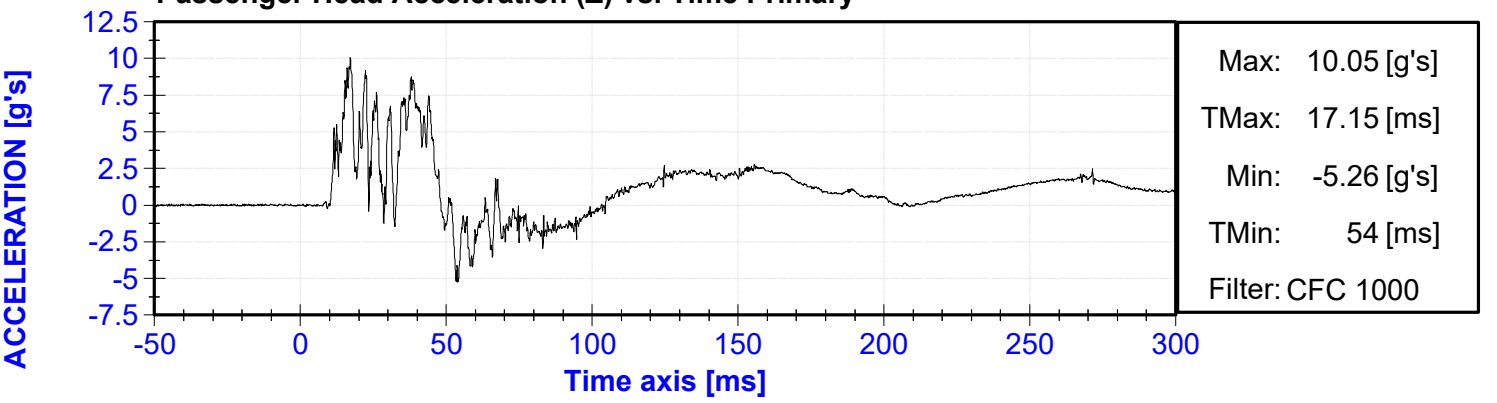
Passenger Head Acceleration (X) vs. Time Primary

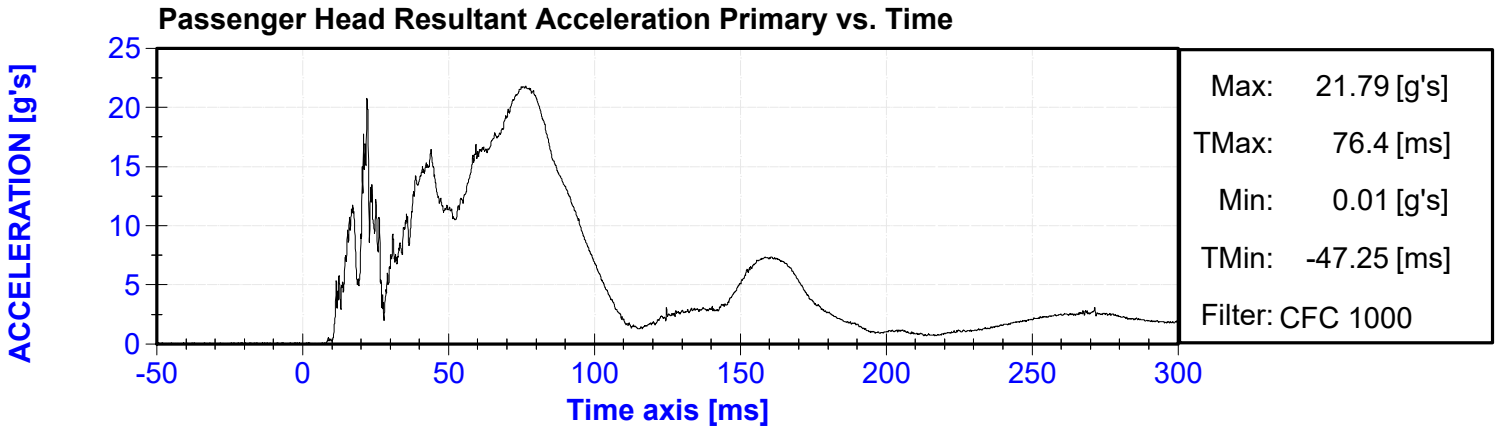


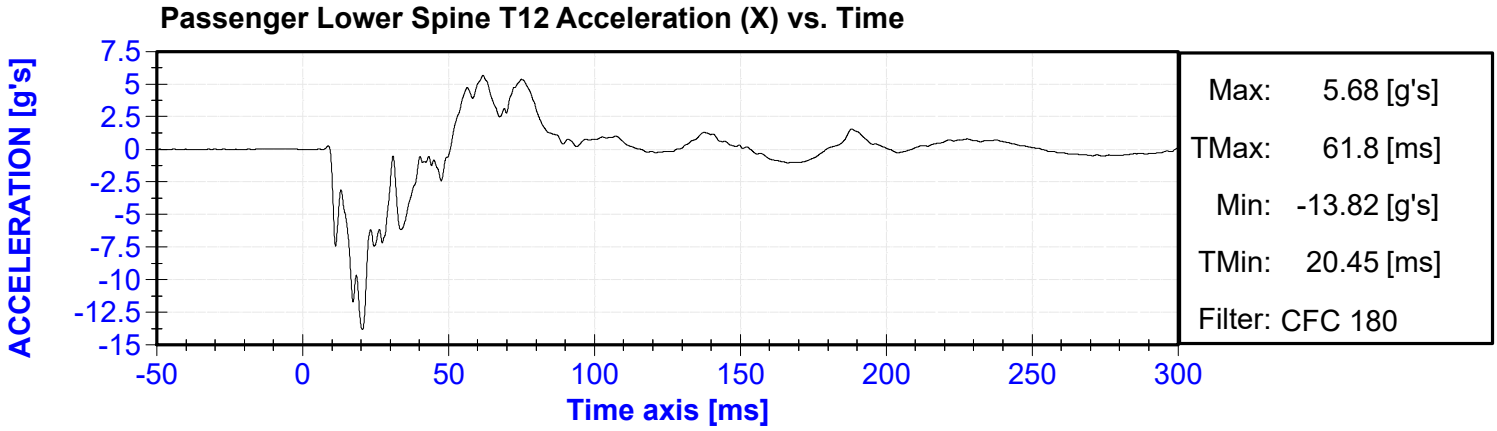
Passenger Head Acceleration (Y) vs. Time Primary

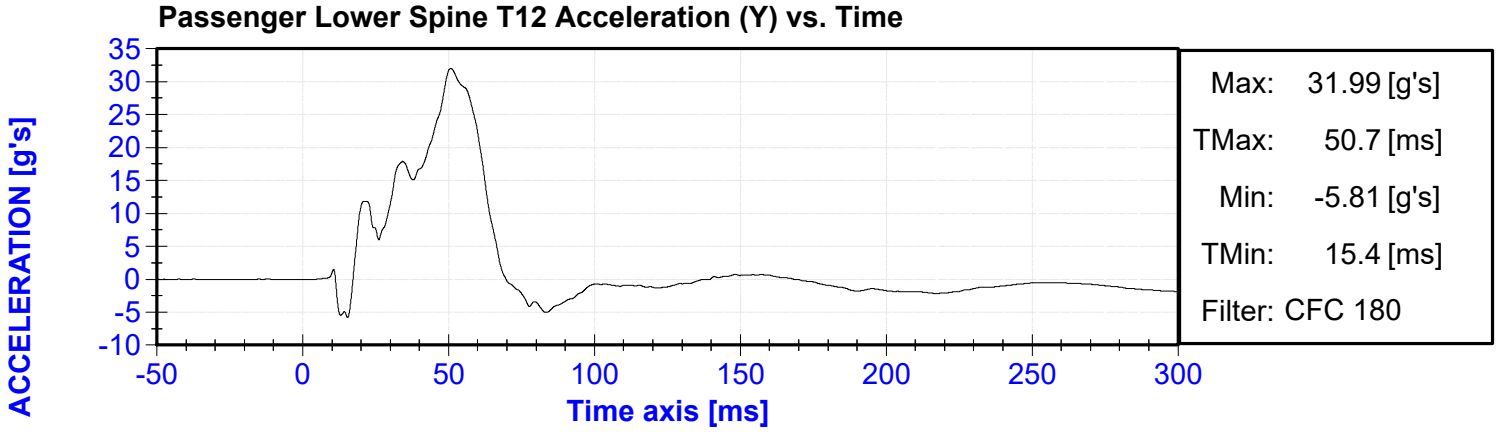


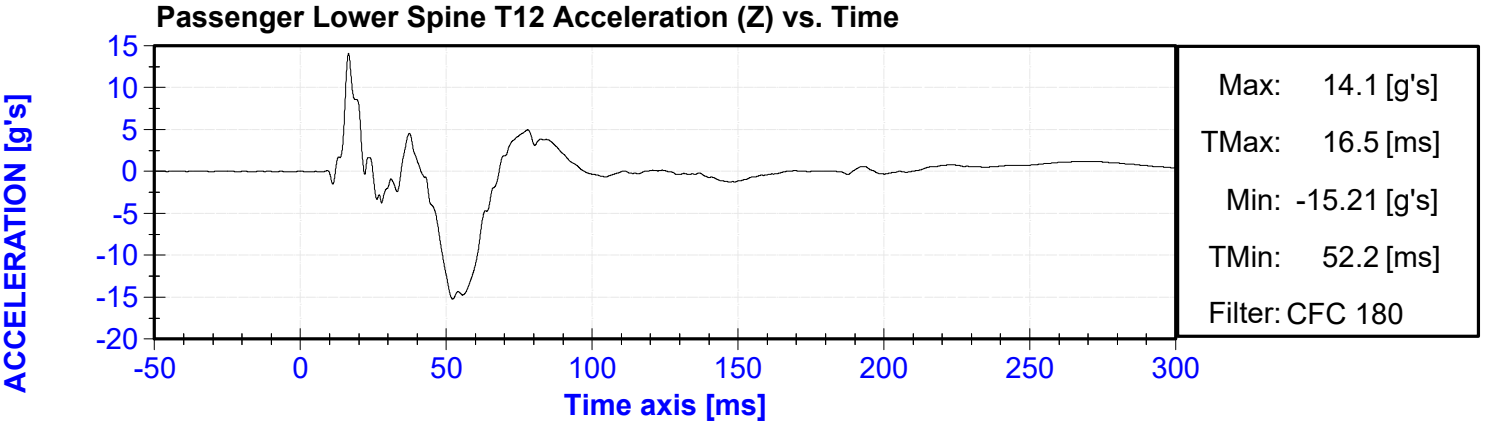
Passenger Head Acceleration (Z) vs. Time Primary



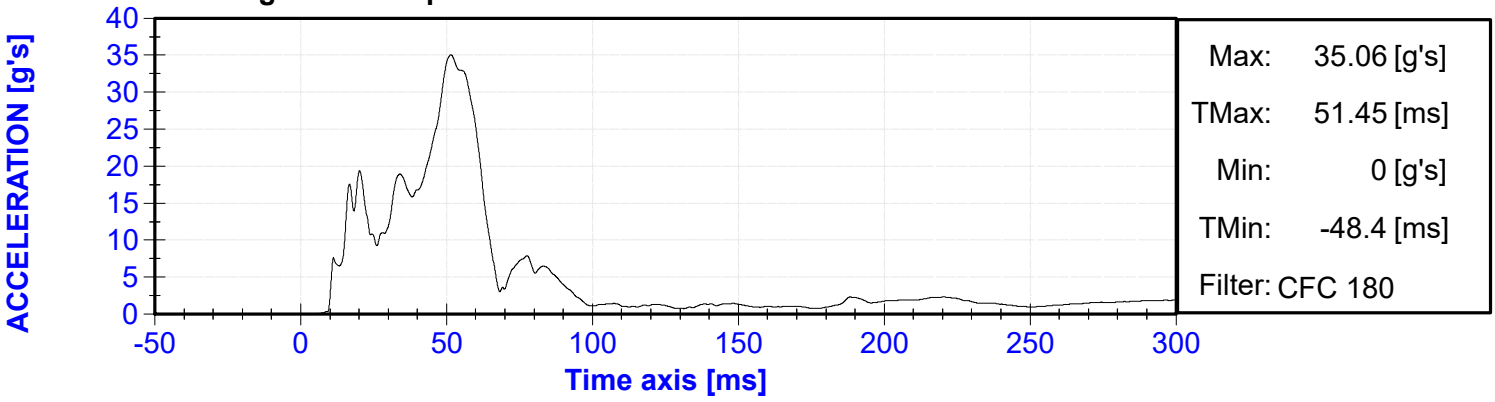

Passenger Head Resultant Acceleration Primary vs. Time
ACCELERATION [g's]
Time axis [ms]
Max: 21.79 [g's]
TMax: 76.4 [ms]
Min: 0.01 [g's]
TMin: -47.25 [ms]
Filter: CFC 1000


Passenger Lower Spine T12 Acceleration (X) vs. Time
ACCELERATION [g's]
Time axis [ms]
Max: 5.68 [g's]
TMax: 61.8 [ms]
Min: -13.82 [g's]
TMin: 20.45 [ms]
Filter: CFC 180

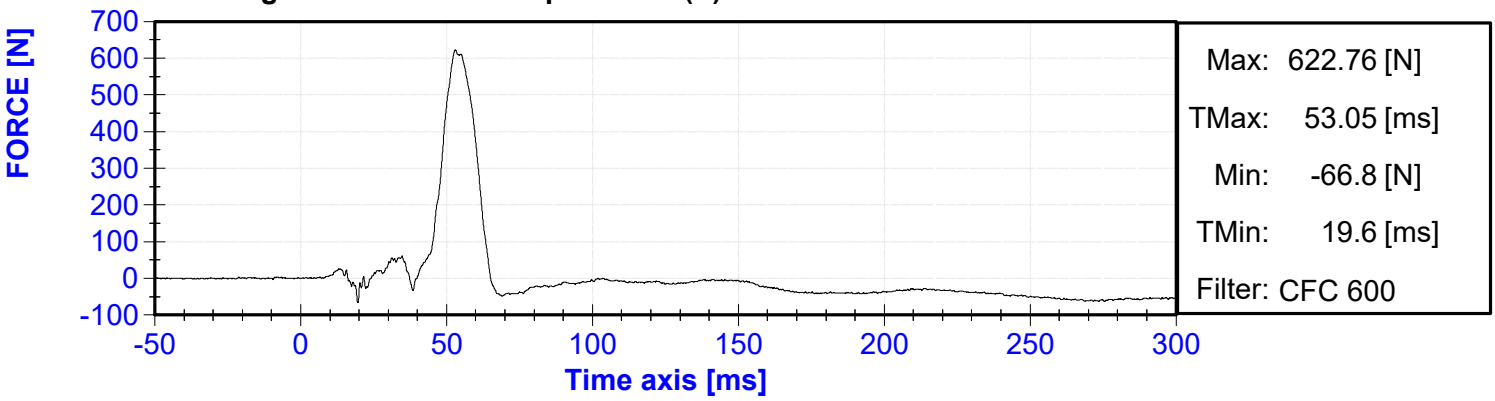

Passenger Lower Spine T12 Acceleration (Y) vs. Time
ACCELERATION [g's]
Time axis [ms]
Max: 31.99 [g's]
TMax: 50.7 [ms]
Min: -5.81 [g's]
TMin: 15.4 [ms]
Filter: CFC 180


Passenger Lower Spine T12 Acceleration (Z) vs. Time
ACCELERATION [g's]
Time axis [ms]
Max: 14.1 [g's]
TMax: 16.5 [ms]
Min: -15.21 [g's]
TMin: 52.2 [ms]
Filter: CFC 180

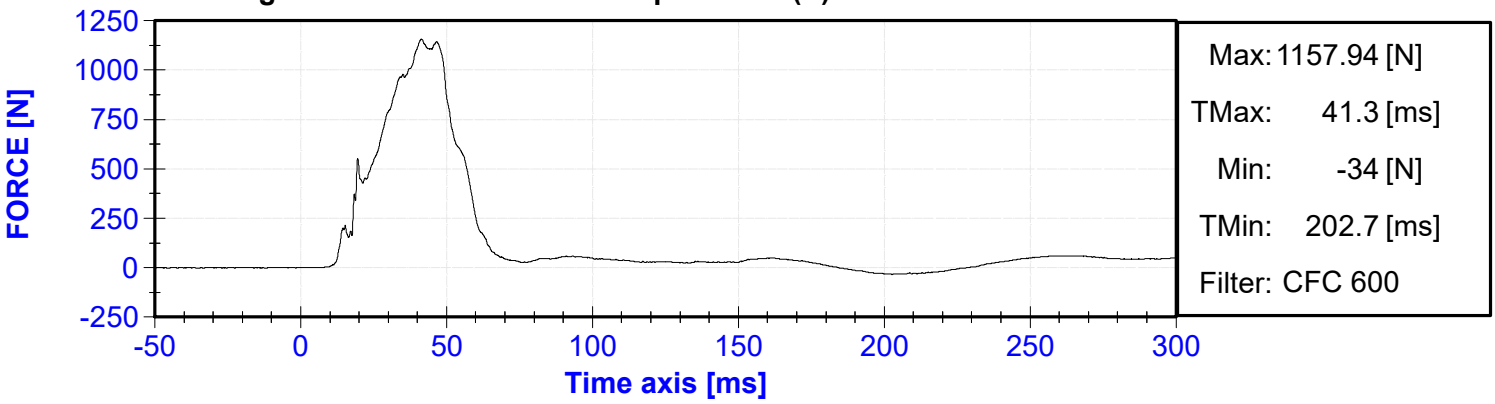
Passenger Lower Spine T12 Resultant Acceleration vs. Time



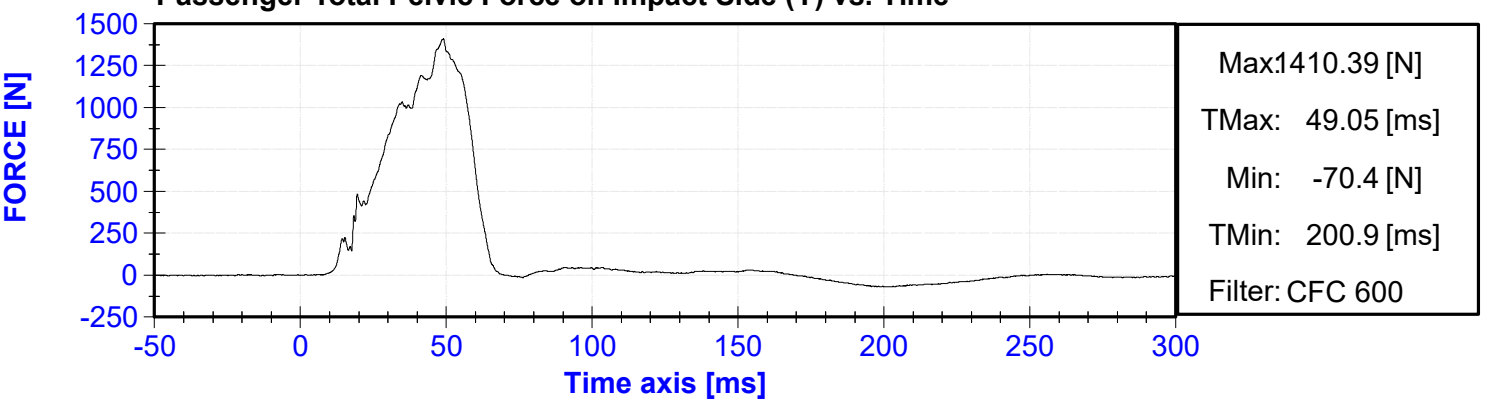
Passenger Iliac Force on Impact Side (Y) vs. Time



Passenger Acetabulum Force on Impact Side (Y) vs. Time



Passenger Total Pelvic Force on Impact Side (Y) vs. Time



APPENDIX C

DUMMY CONFIGURATION AND PERFORMANCE VERFICATION DATA

CALIBRATION TEST RESULTS

PRE-TEST

EUROSID 2 (ES-2RE) MALE – DRIVER ATD

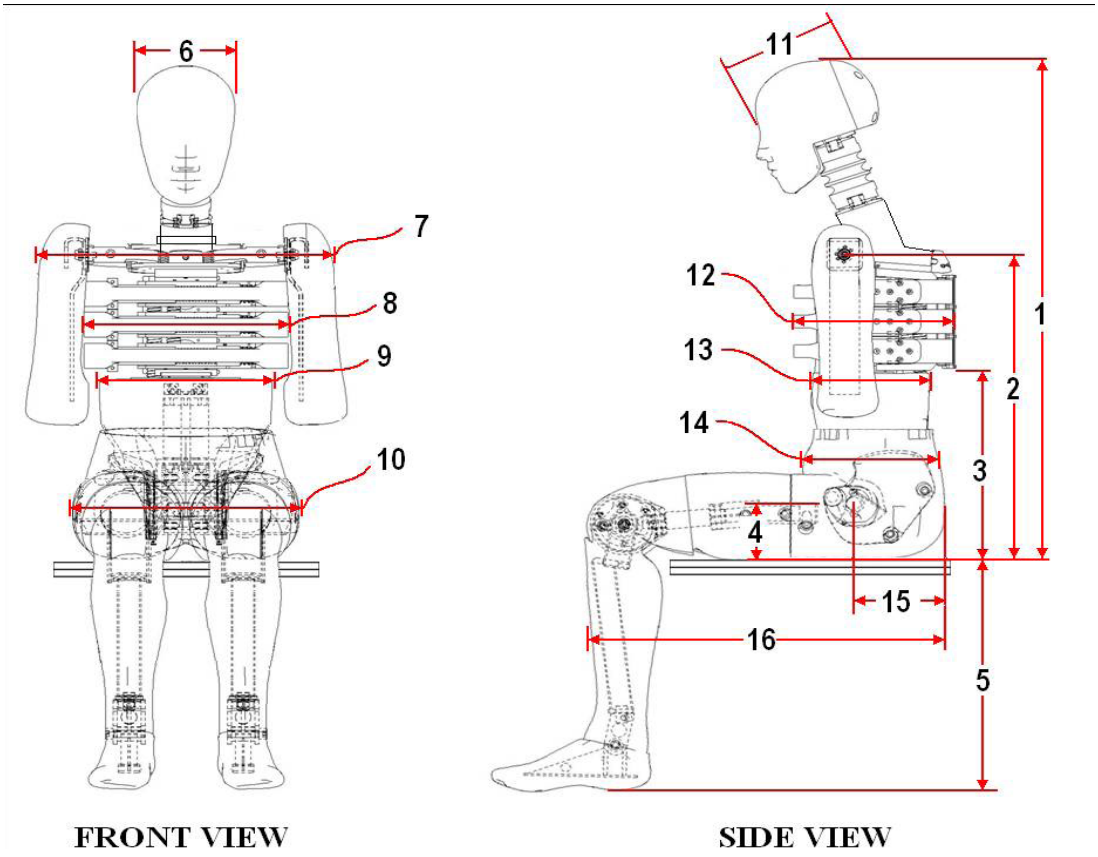
SERIAL NO:F033

(CONFIGURED FOR LEFT SIDE IMPACT)

External Measurements - EuroSID-2re

Technician: K. Brogan Date: 5/23/2024

Dummy Serial Number: F033



FRONT VIEW SIDE VIEW

Dim. No.	Description	Specification (mm)		Result (mm)	Pass/Fail
1	Sitting Height	900	918	914	Pass
2	Seat to Shoulder Joint	558	572	567	Pass
3	Seat to Lower Face of Thoracic Spine Box	346	356	354	Pass
4	Seat to Hip Joint (center of bolt)	97	103	99	Pass
5	Sole to Seat, Sitting	333	451	429	Pass
6	Head Width	152	158	155	Pass
7	Shoulder/Arm Width	461	479	472	Pass
8	Thorax Width	322	332	330	Pass
9	Abdomen Width	273	287	283	Pass
10	Pelvis Lap Width	359	373	370	Pass
11	Head Depth	196	206	201	Pass
12	Thorax Depth	262	272	269	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	611	Pass

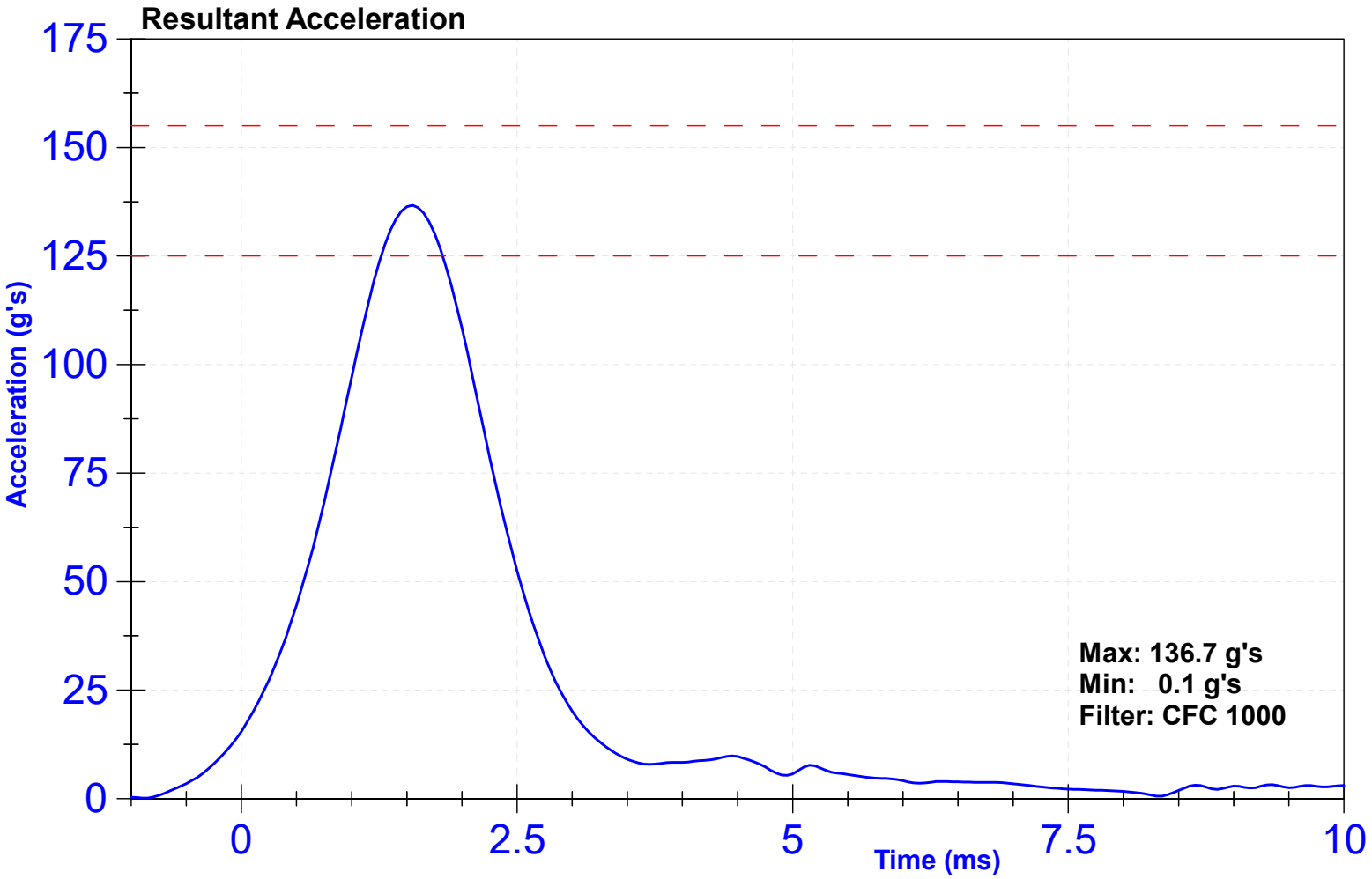
ATD Manufacturer	FTSS	Test Technician	D. Sakona
ATD Serial Number	F033	Laboratory Supervisor	C. Mantell

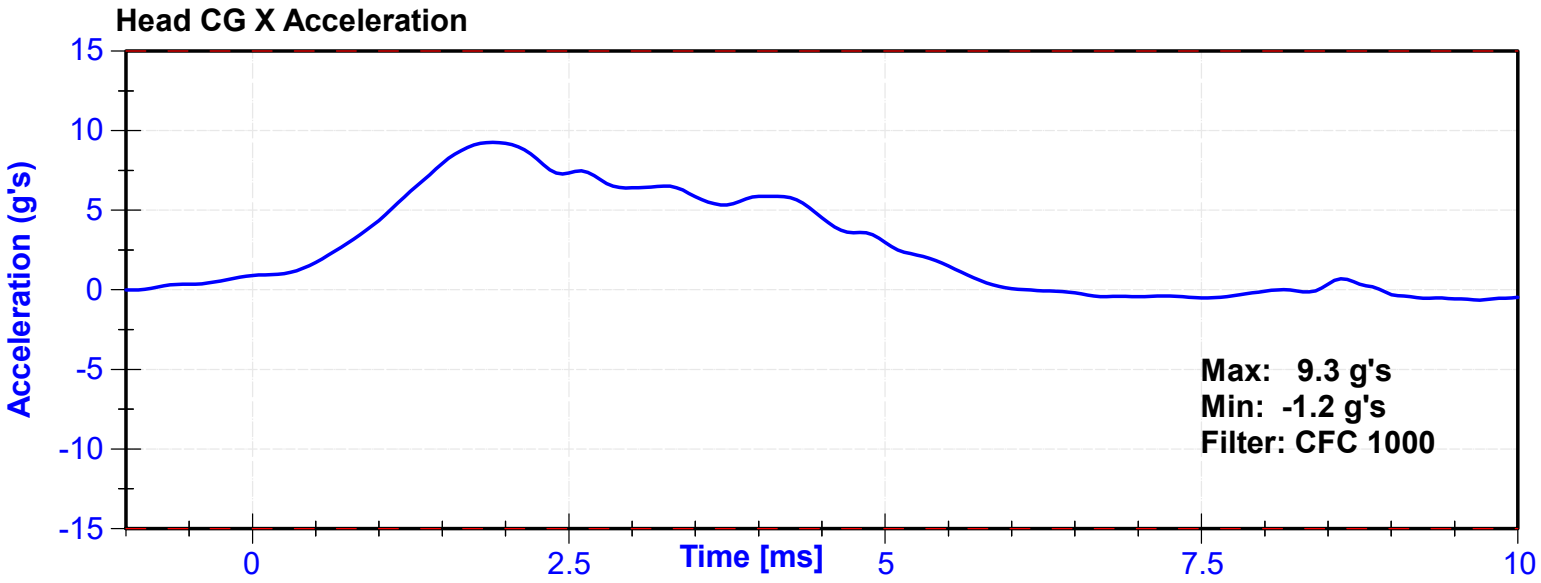
Results

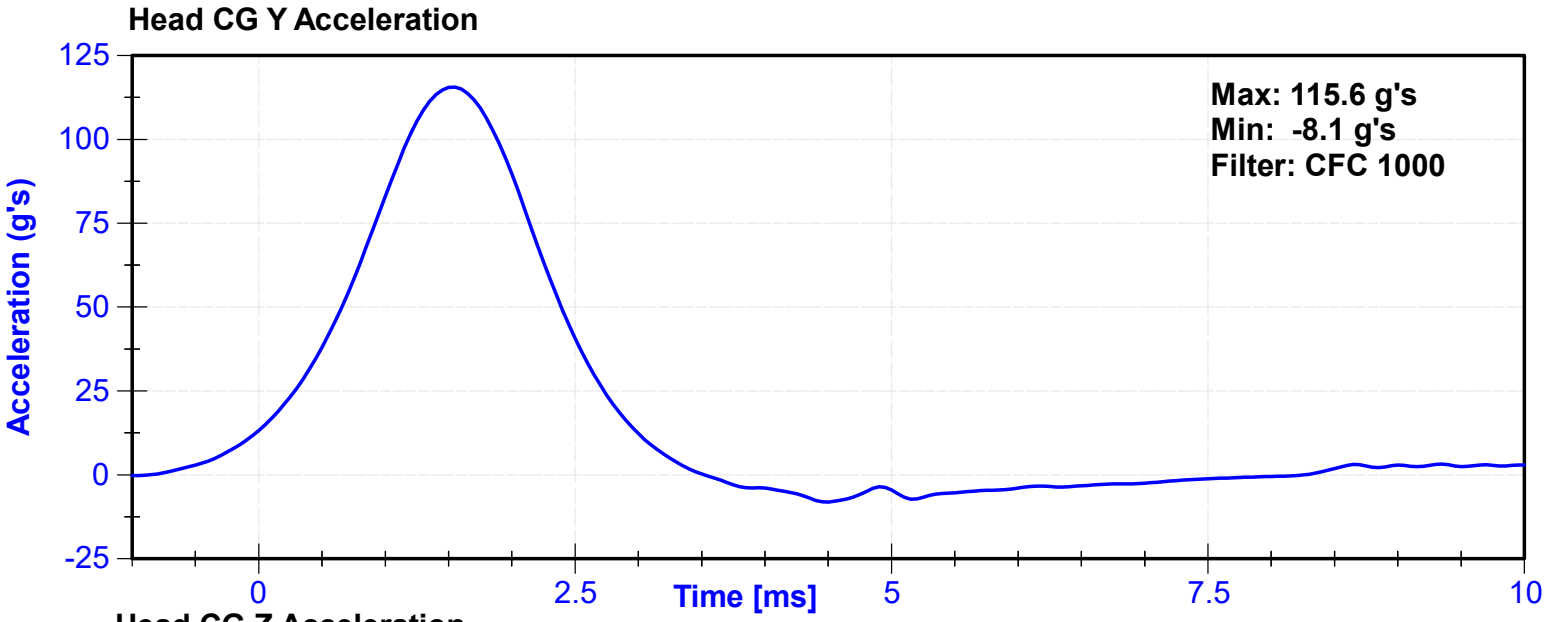
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.8	Pass
Humidity	10	70	%	56	Pass
Resultant Acceleration	125	155	g's	136.7	Pass
Oscillation	0	15	%	7.20	Pass
Fore-Aft Acceleration	-15	15	g's	9.3	Pass

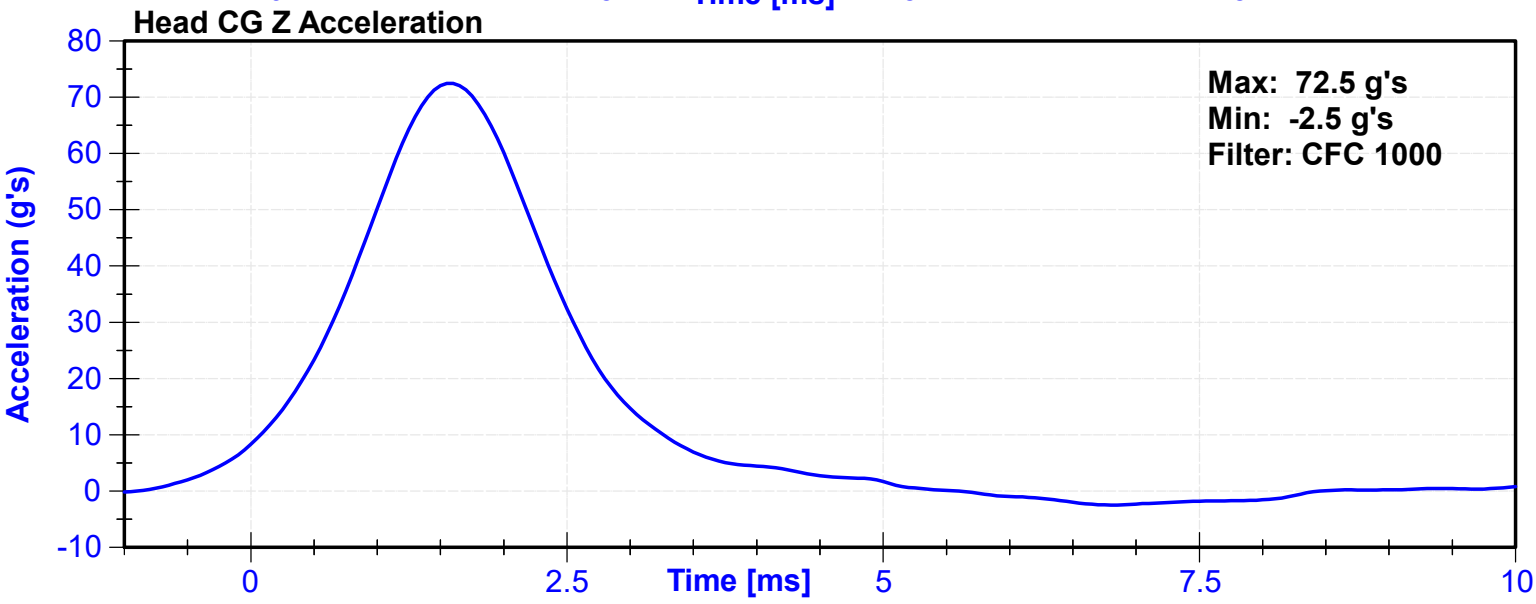
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	Endevco	P63861	5/6/2024	11/2/2024
Y Accelerometer	Endevco	P49216	5/6/2024	11/2/2024
Z Accelerometer	Endevco	P51303	5/6/2024	11/2/2024




Head CG X Acceleration
Acceleration (g's)
15
10
5
0
-5
-10
-15
0
2.5
5
7.5
10
Time [ms]
Max: 9.3 g's
Min: -1.2 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: 115.6 g's
Min: -8.1 g's
Filter: CFC 1000


Head CG Z Acceleration
Acceleration (g's)
80
70
60
50
40
30
20
10
0
-10
0
2.5
5
7.5
10
Time [ms]
Max: 72.5 g's
Min: -2.5 g's
Filter: CFC 1000

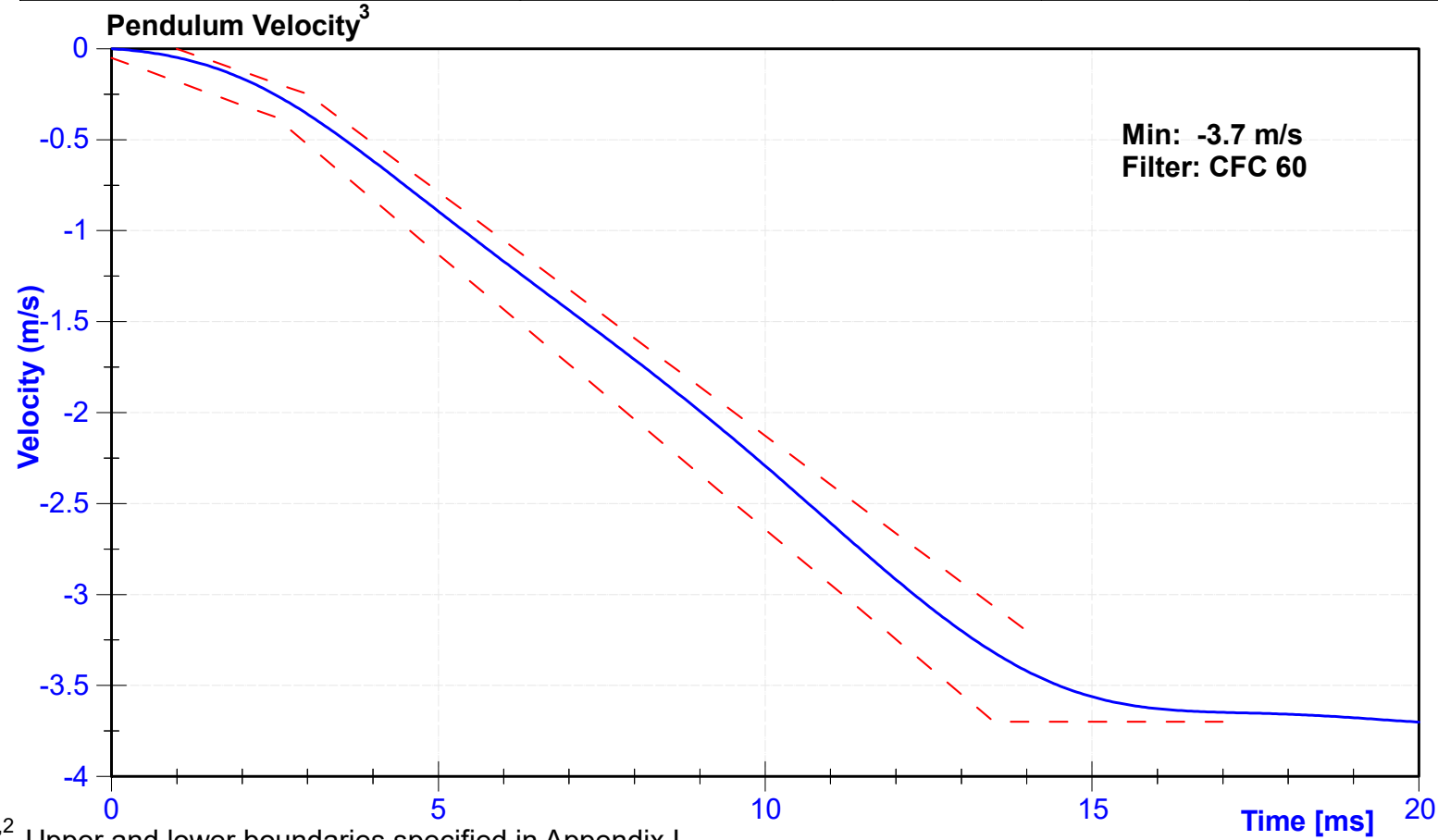
ATD Manufacturer	FTSS	Test Technician	D. Sakona
ATD Serial Number	F033	Laboratory Supervisor	C. Mantell

Results

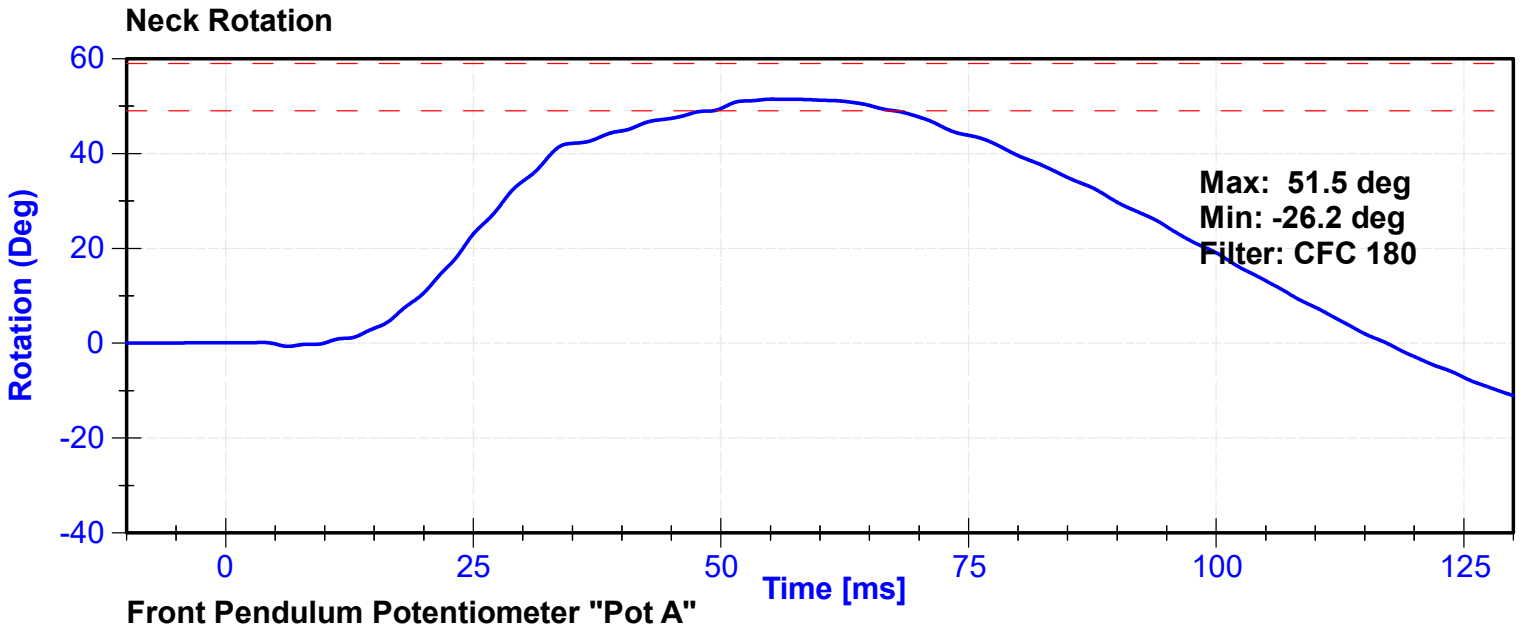
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.9	Pass
Humidity	10	70	%	49	Pass
Velocity	3.3	3.5	m/s	3.45	Pass
Lateral Neck Rotation	49	59	deg	51.5	Pass
Time at Maximum Rotation	54	66	ms	55.2	Pass
Time of Rotation Decay from Maximum	53	88	ms	62.1	Pass
Pendulum Velocity Overall Corridor	Lower Boundary[1]	Upper Boundary[2]	m/s	See Plot[3]	Pass

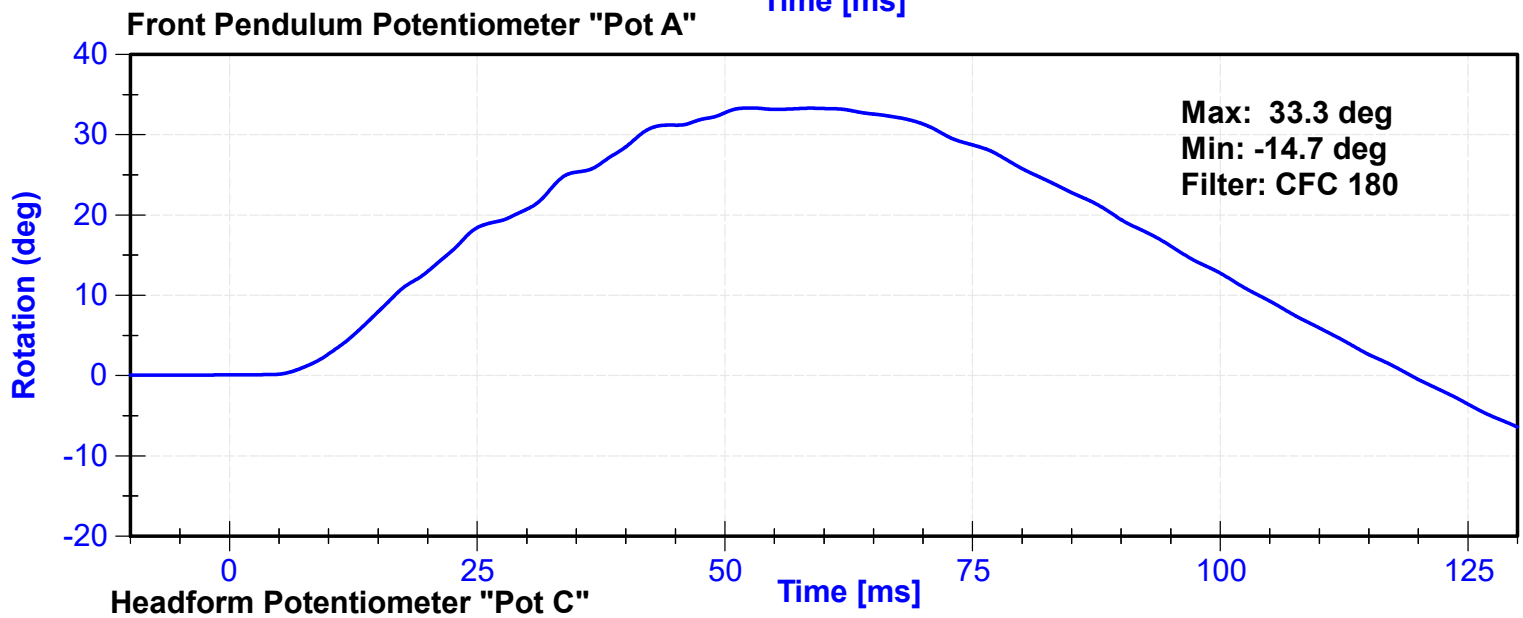
Transducer Calibrations

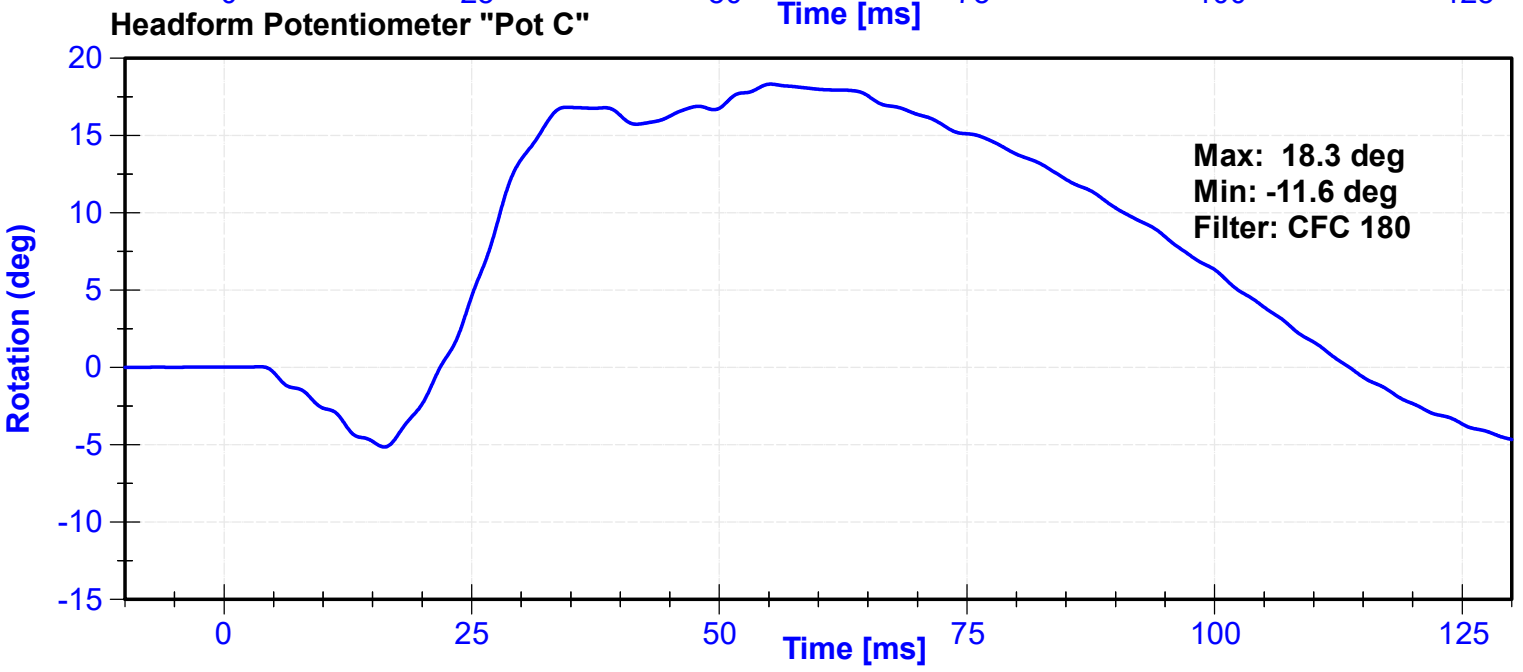
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	C16503	4/29/2024	10/26/2024
Front Pendulum Potentiometer	Sfernice	2247	12/5/2023	12/4/2024
Headform Potentiometer	Sfernice	095	9/29/2023	9/28/2024



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


Neck Rotation
Rotation (Deg)
60
40
20
0
-20
-40
0
25
50
75
100
125
Time [ms]
Max: 51.5 deg
Min: -26.2 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: 33.3 deg
Min: -14.7 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: 18.3 deg
Min: -11.6 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

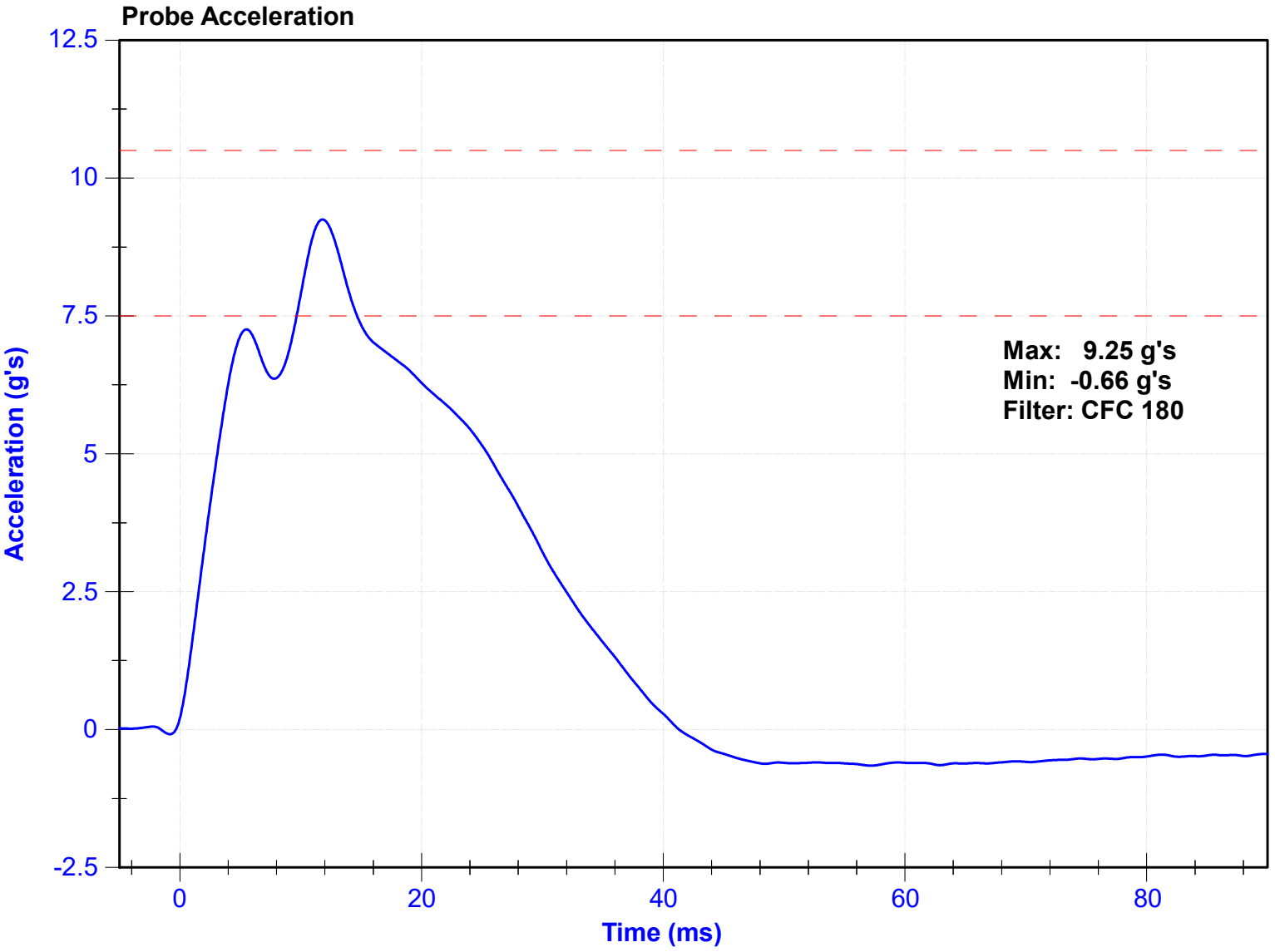
ATD Manufacturer	FTSS	Test Technician	D. Sakona
ATD Serial Number	F033	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.9	Pass
Humidity	10	70	%	49	Pass
Velocity	4.2	4.4	m/s	4.29	Pass
Probe Acceleration	7.5	10.5	g's	9.25	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Probe Accelerometer	Endevco	18619	3/29/2024	9/25/2024



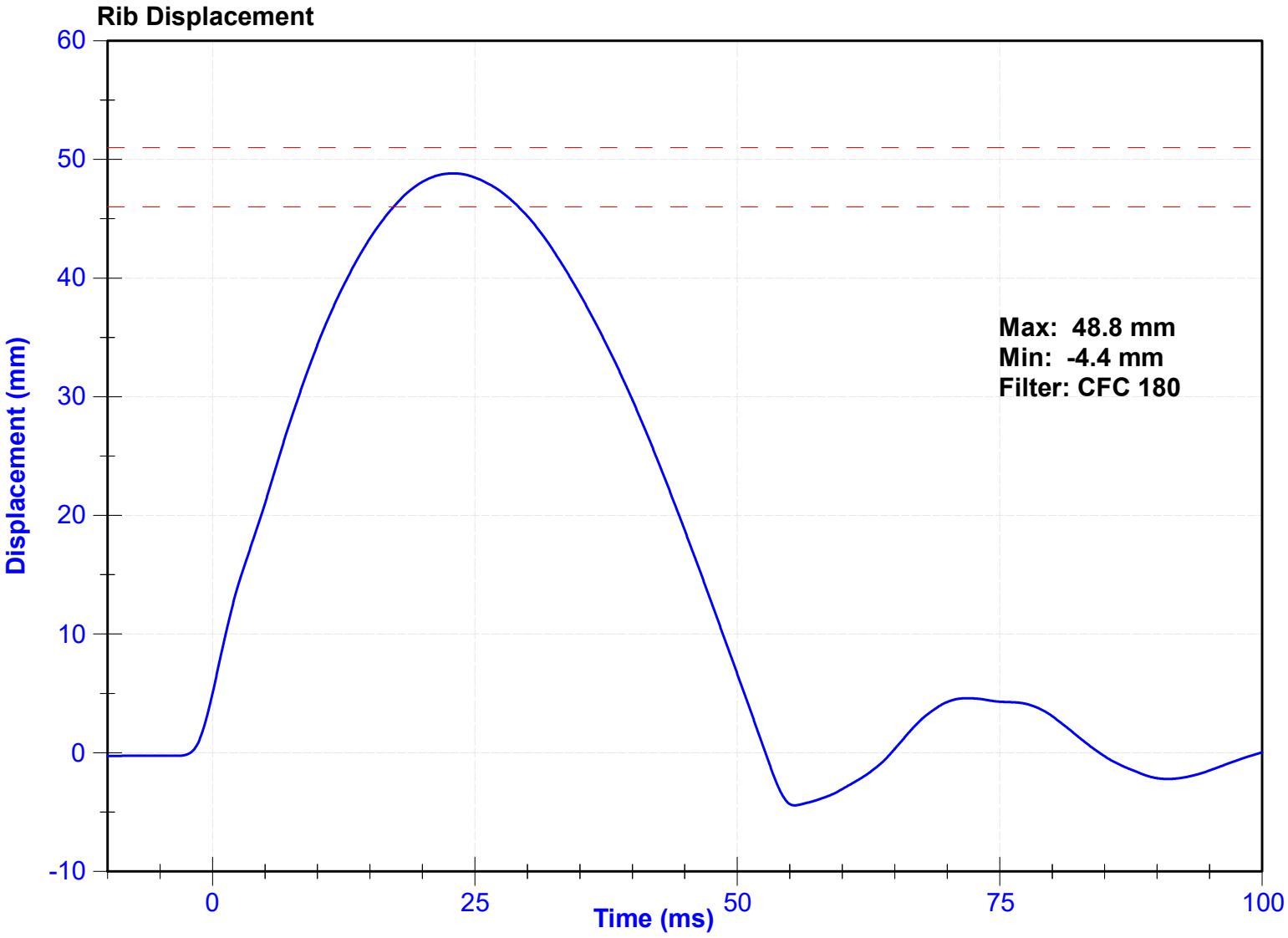
ATD Manufacturer	FTSS	Test Technician	D. Sakona
ATD Serial Number	F033	Laboratory Supervisor	C.Mantel

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.8	Pass
Humidity	10	70	%	56	Pass
Rib Displacement	46	51	mm	48.8	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	179GFE	5/6/2024	11/4/2024



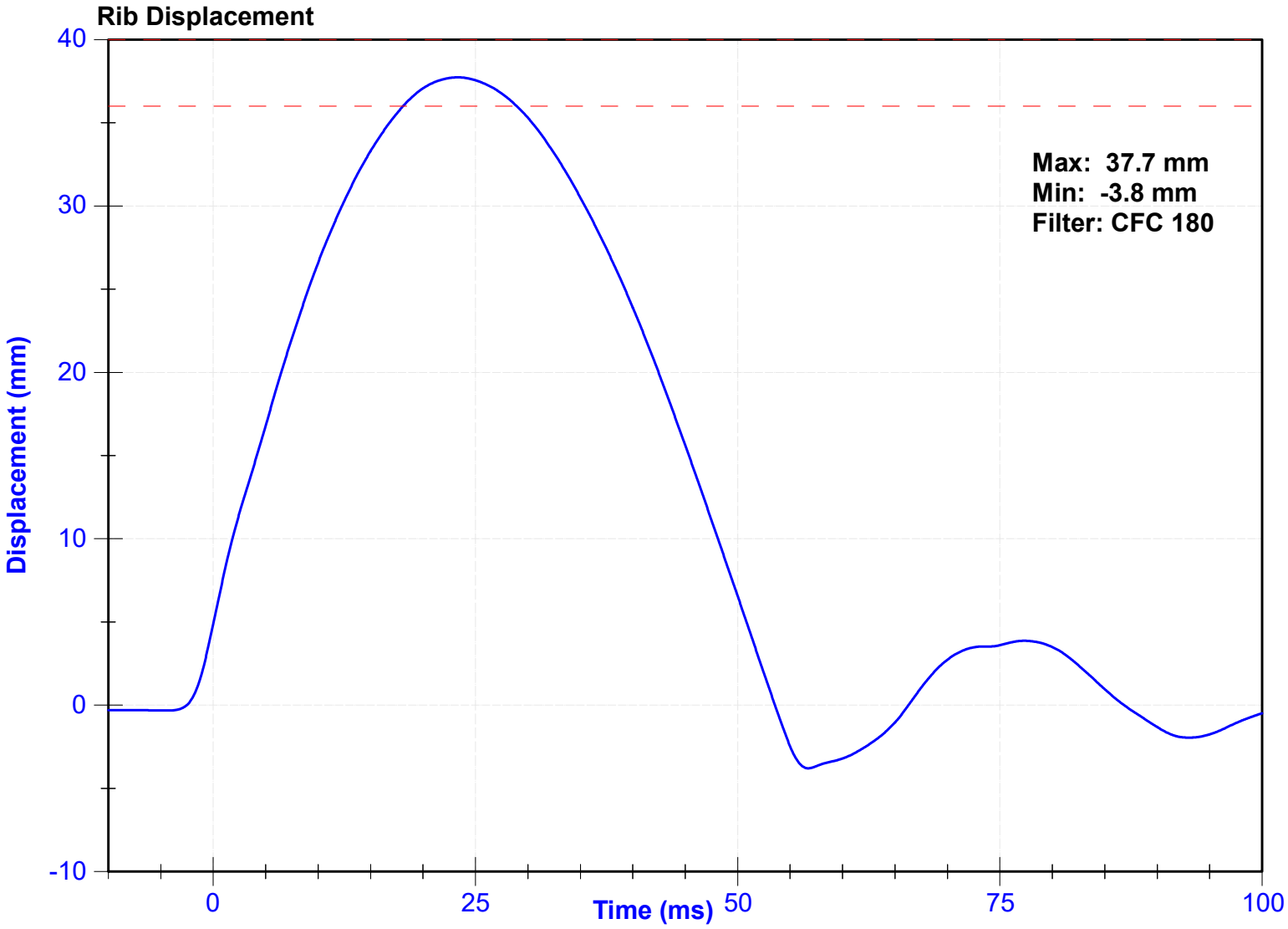
ATD Manufacturer	FTSS	Test Technician	D. Sakona
ATD Serial Number	F033	Laboratory Supervisor	C.Mantel

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.8	Pass
Humidity	10	70	%	56	Pass
Rib Displacement	36	40	mm	37.7	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	179GFE	5/6/2024	11/4/2024



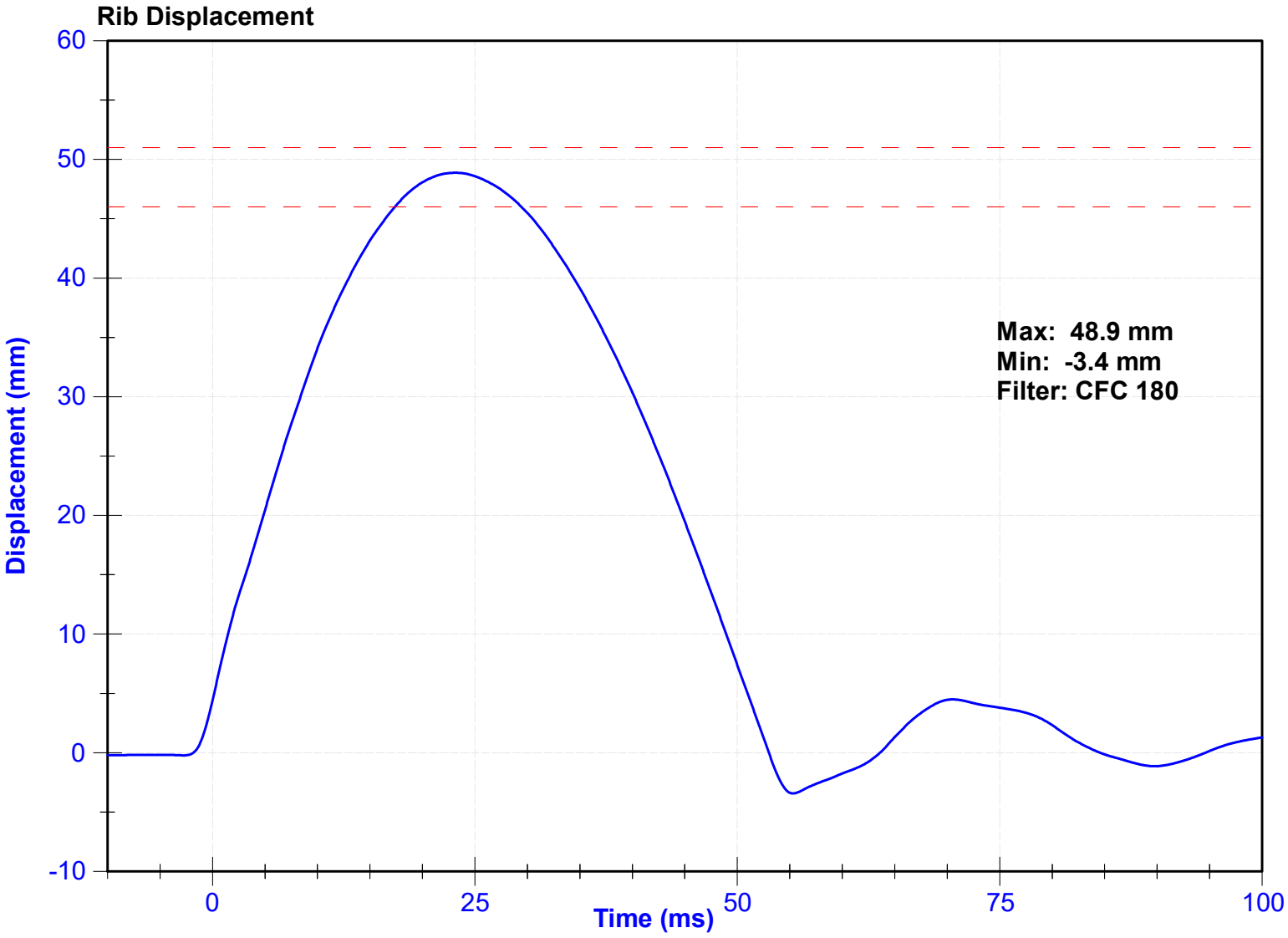
ATD Manufacturer	FTSS	Test Technician	D. Sakona
ATD Serial Number	F033	Laboratory Supervisor	C.Mantel

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.8	Pass
Humidity	10	70	%	56	Pass
Rib Displacement	46	51	mm	48.9	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	185GFE	5/6/2024	11/4/2024



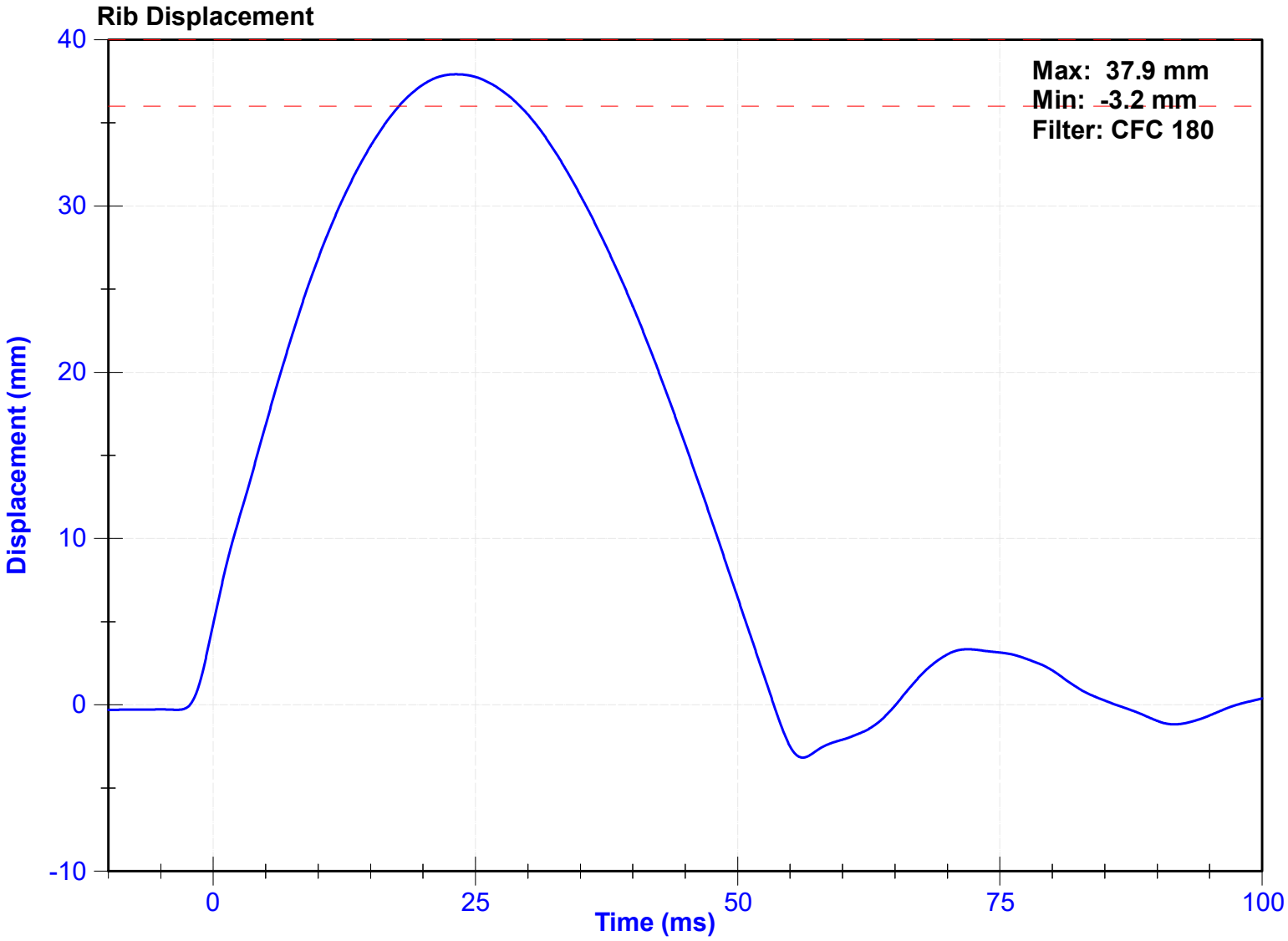
ATD Manufacturer	FTSS	Test Technician	D. Sakona
ATD Serial Number	F033	Laboratory Supervisor	C.Mantel

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.8	Pass
Humidity	10	70	%	56	Pass
Rib Displacement	36	40	mm	37.9	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	185GFE	5/6/2024	11/4/2024



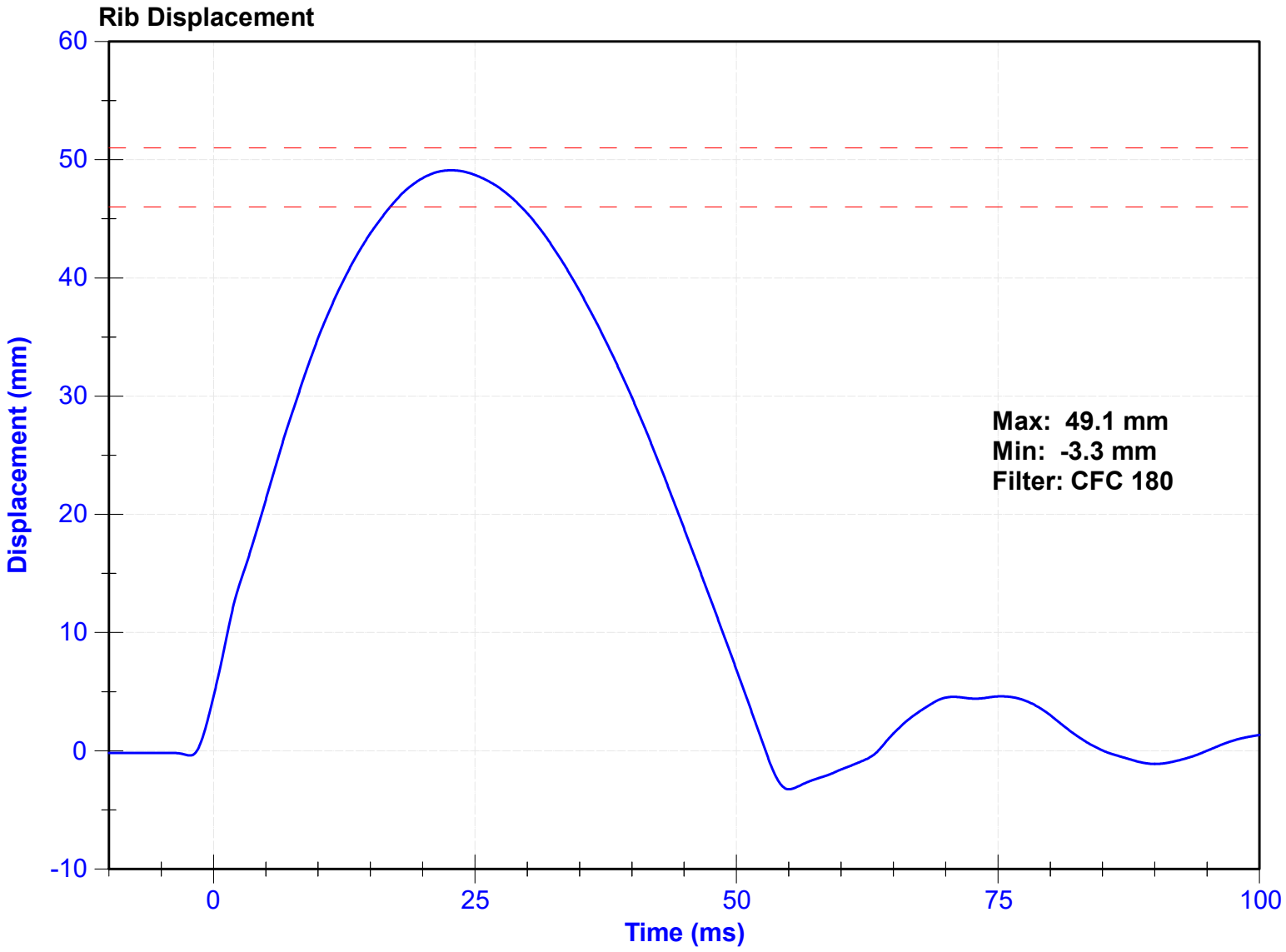
ATD Manufacturer	FTSS	Test Technician	D. Sakona
ATD Serial Number	F033	Laboratory Supervisor	C.Mantel

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.8	Pass
Humidity	10	70	%	56	Pass
Rib Displacement	46	51	mm	49.1	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	178GFE	5/6/2024	11/4/2024



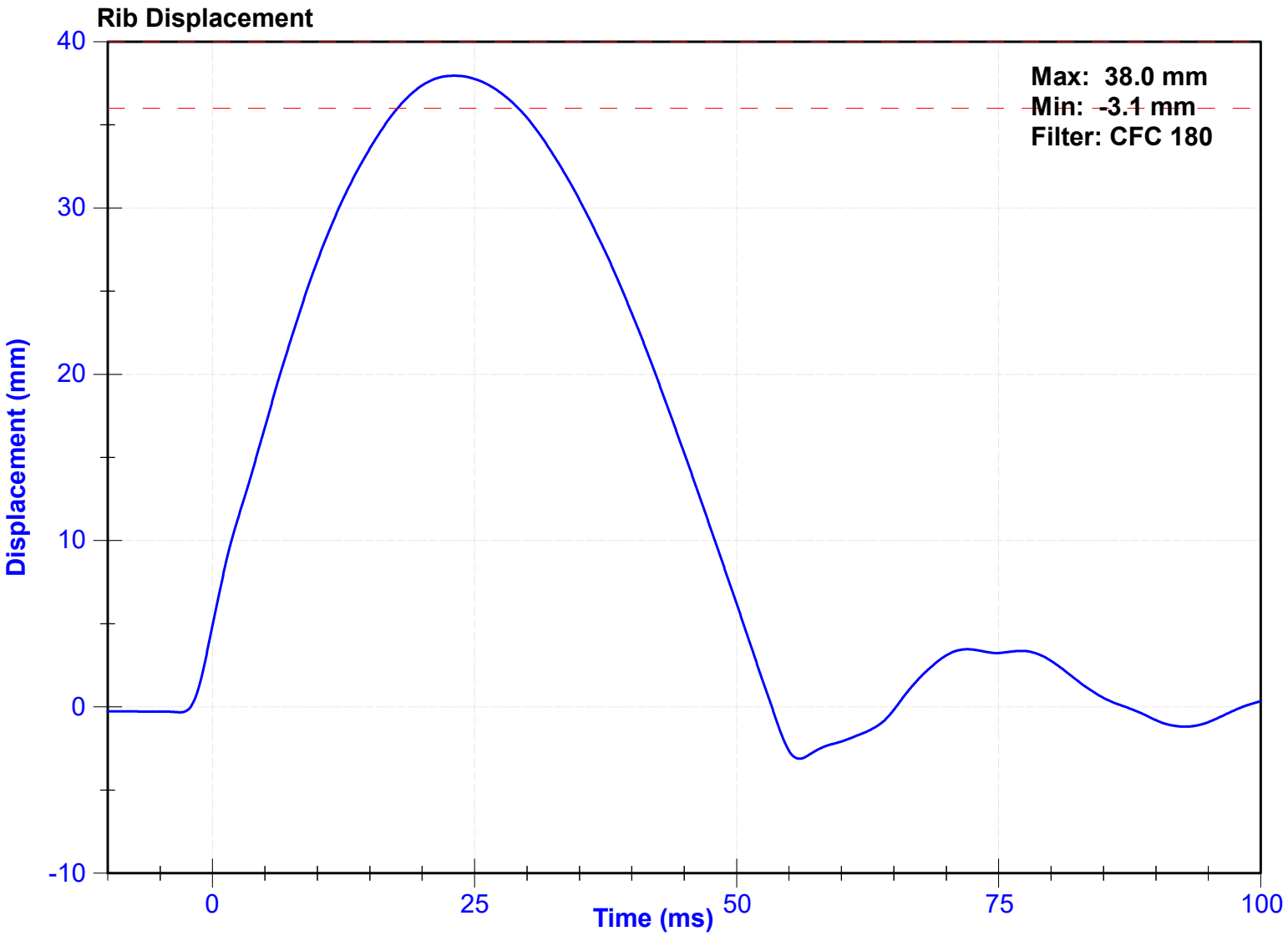
ATD Manufacturer	FTSS	Test Technician	D. Sakona
ATD Serial Number	F033	Laboratory Supervisor	C.Mantel

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.8	Pass
Humidity	10	70	%	56	Pass
Rib Displacement	36	40	mm	38.0	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	178GFE	5/6/2024	11/4/2024



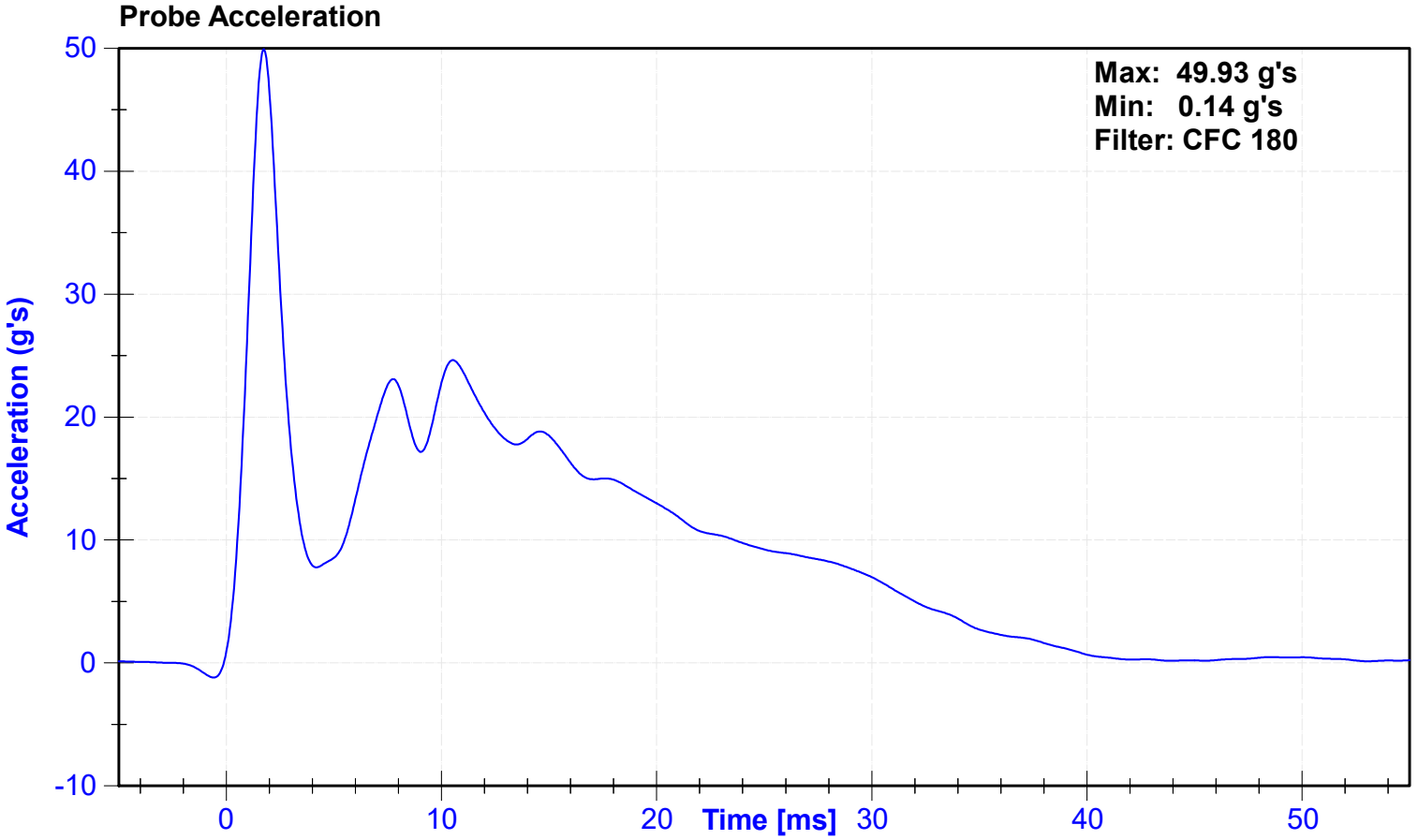
ATD Manufacturer	FTSS	Test Technician	D. Sakona
ATD Serial Number	F033	Laboratory Supervisor	C. Mantell

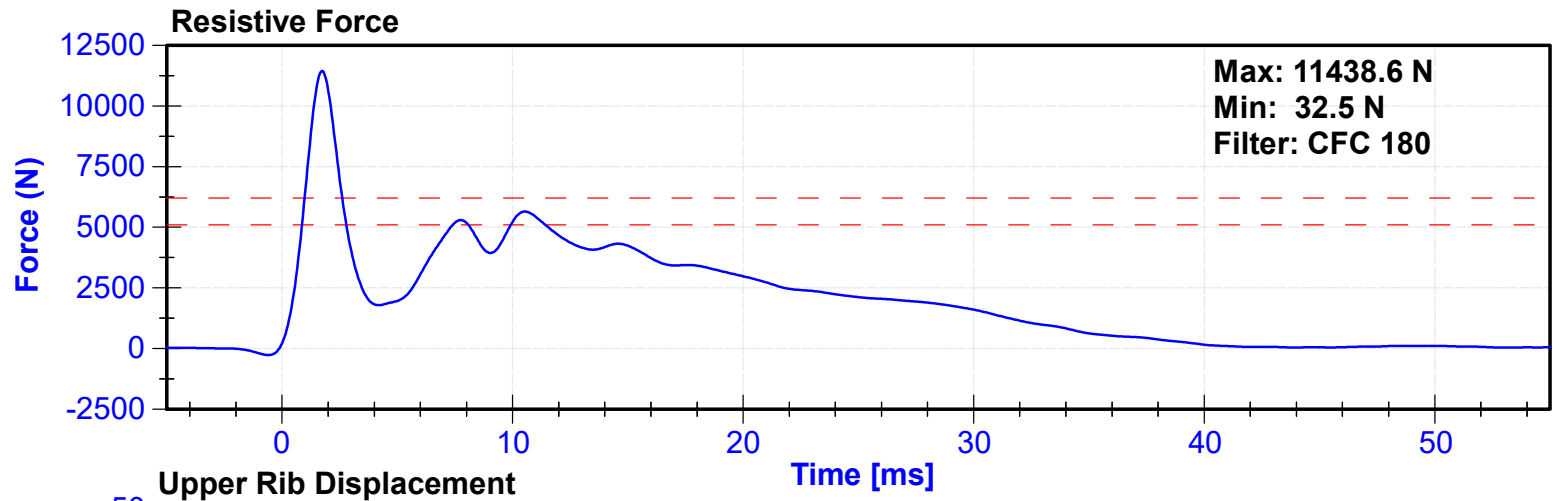
Results

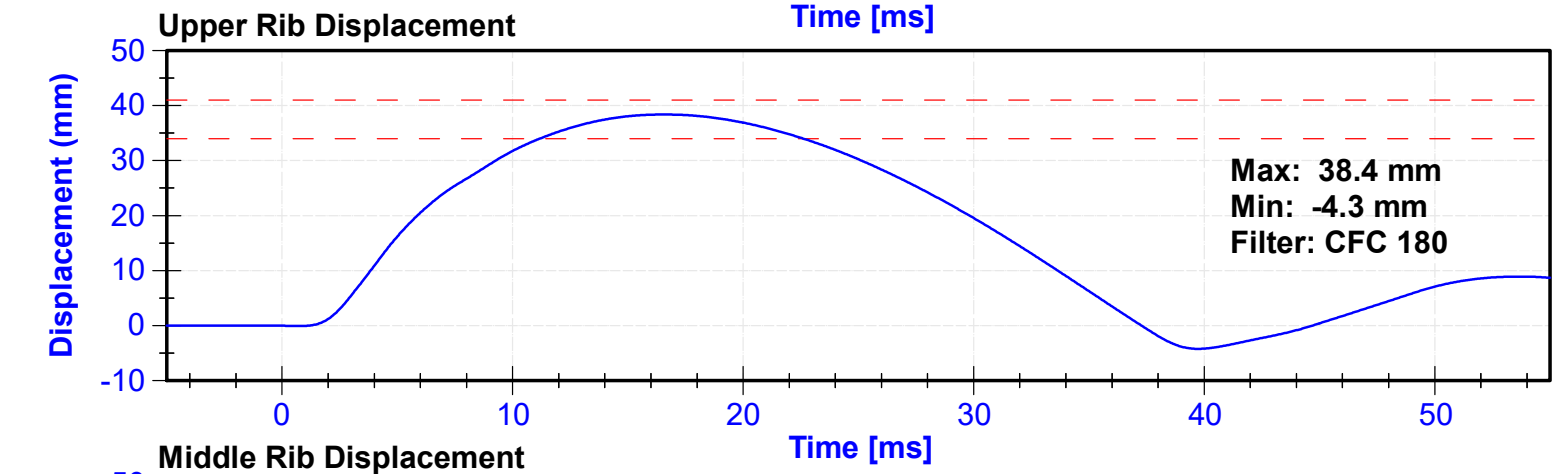
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.9	Pass
Humidity	10	70	%	49	Pass
Velocity	5.4	5.6	m/s	5.52	Pass
Resistive Force after 6ms	5100	6200	N	5643.9	Pass
Upper Thorax Rib Deflection	34	41	mm	38.4	Pass
Mid Thorax Rib Deflection	37	45	mm	42.2	Pass
Lower Thorax Rib Deflection	37	44	mm	41.2	Pass

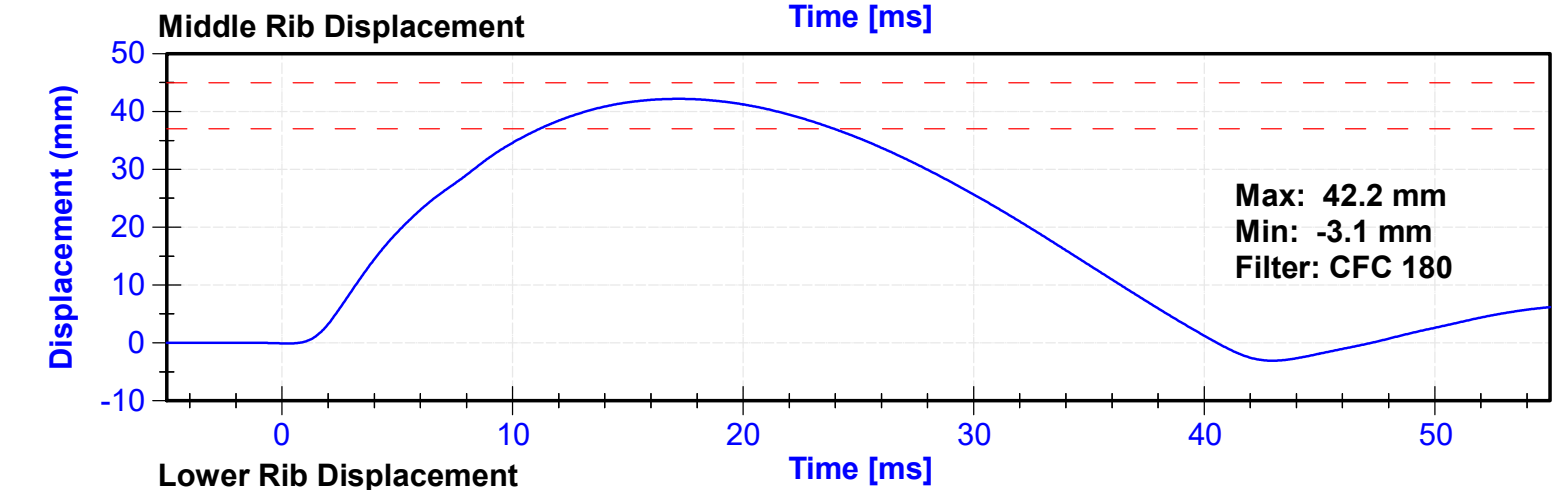
Transducer Calibrations

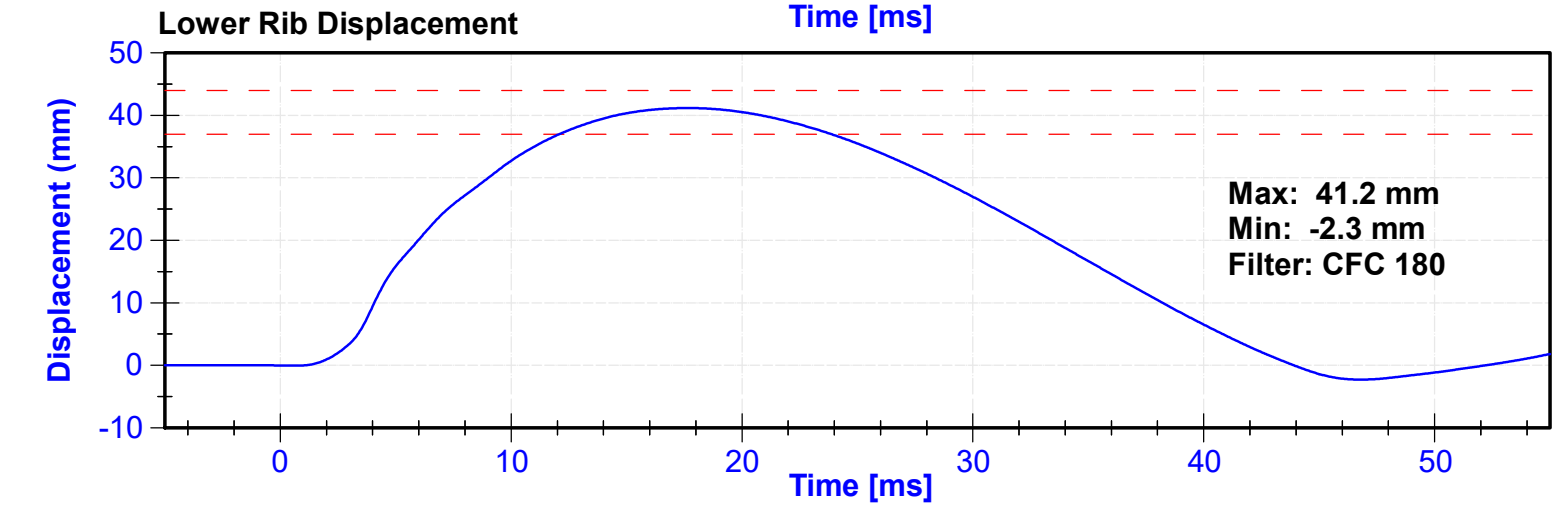
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Probe Accelerometer	Endevco	18619	3/29/2024	9/25/2024
Upper Thorax Rib Potentiometer	Honeywell	179GFE	5/6/2024	11/4/2024
Middle Thorax Rib Potentiometer	Honeywell	185GFE	5/6/2024	11/4/2024
Lower Thorax Rib Potentiometer	Honeywell	178GFE	5/6/2024	11/4/2024




Resistive Force
Force (N)
12500
10000
7500
5000
2500
0
-2500
0
10
20
30
40
50
Time [ms]
Max: 11438.6 N
Min: 32.5 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: 38.4 mm
Min: -4.3 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: -3.1 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: 41.2 mm
Min: -2.3 mm
Filter: CFC 180

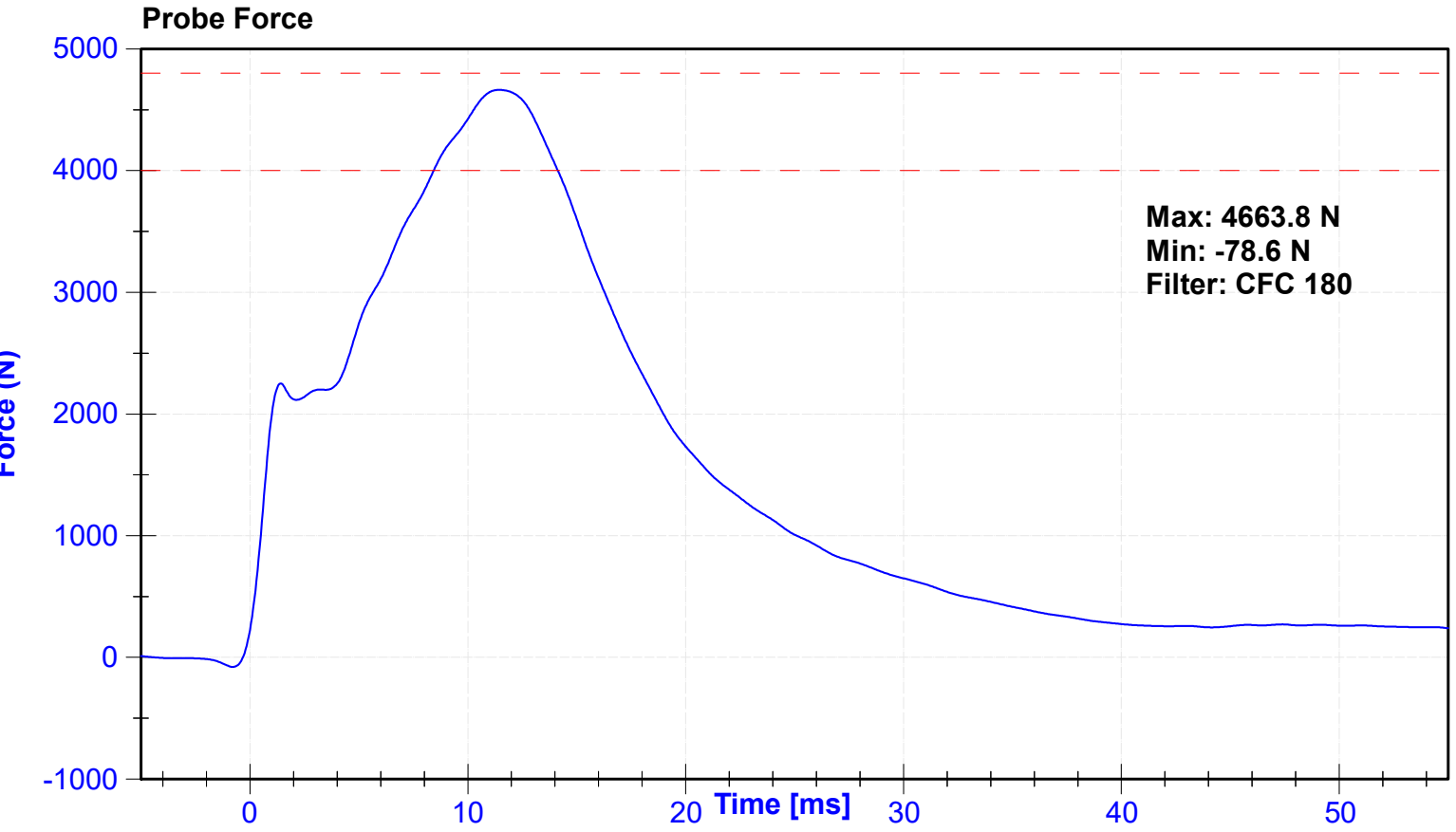
ATD Manufacturer	FTSS	Test Technician	D. Sakona
ATD Serial Number	F033	Laboratory Supervisor	C. Mantell

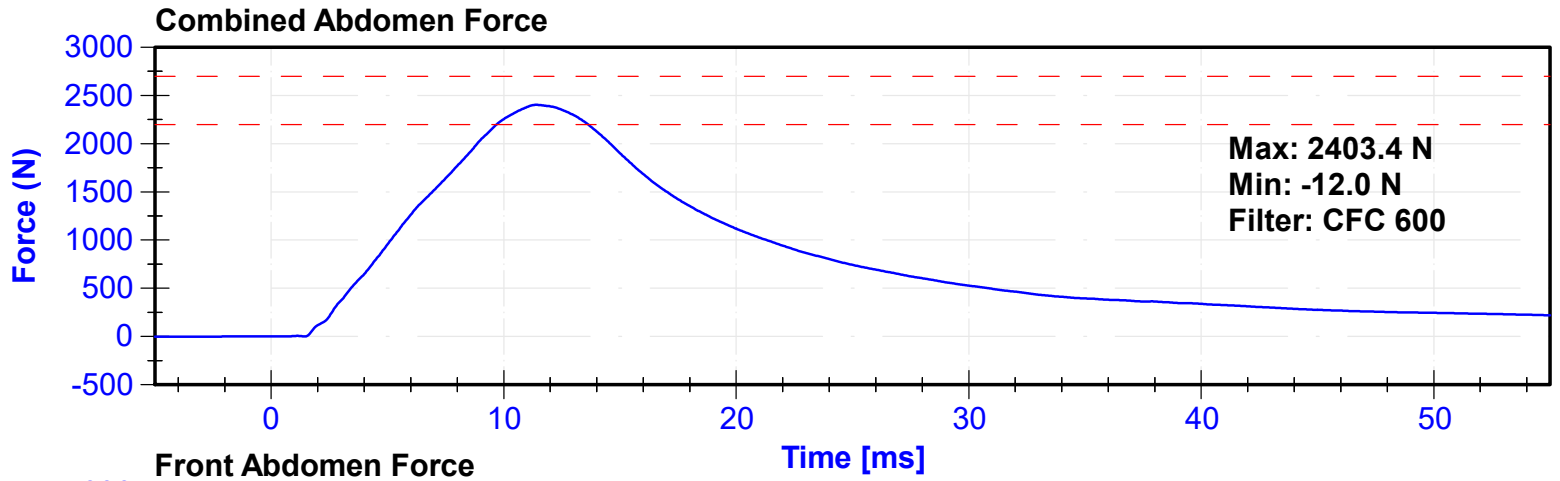
Results

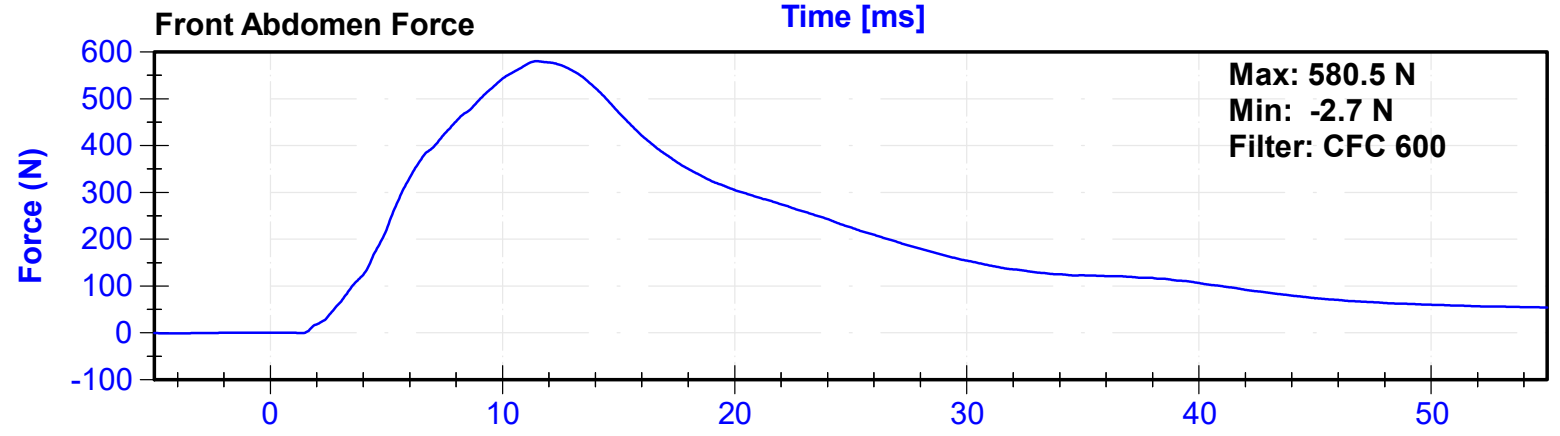
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.9	Pass
Humidity	10	70	%	49	Pass
Velocity	3.9	4.1	m/s	4.03	Pass
Combined Abdomen Force	2200	2700	N	2403.4	Pass
Time at Peak Abdomen Force	10.0	12.3	ms	11.40	Pass
Resistive Probe Force	4000	4800	N	4663.8	Pass
Time at Peak Resistive Force	10.6	13.0	ms	11.45	Pass

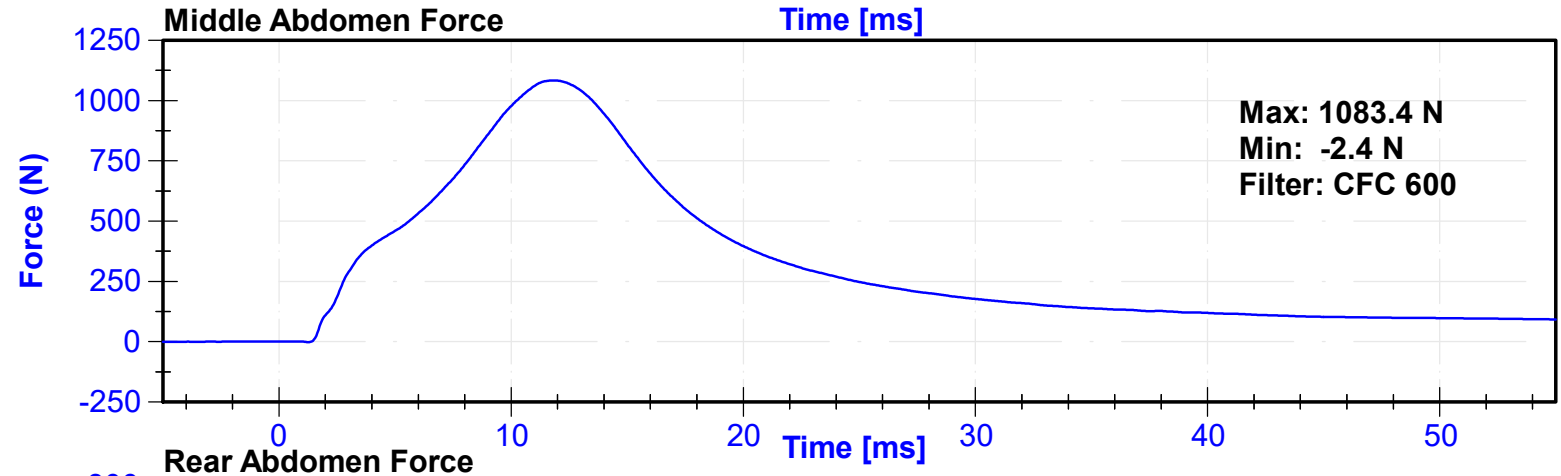
Transducer Calibrations

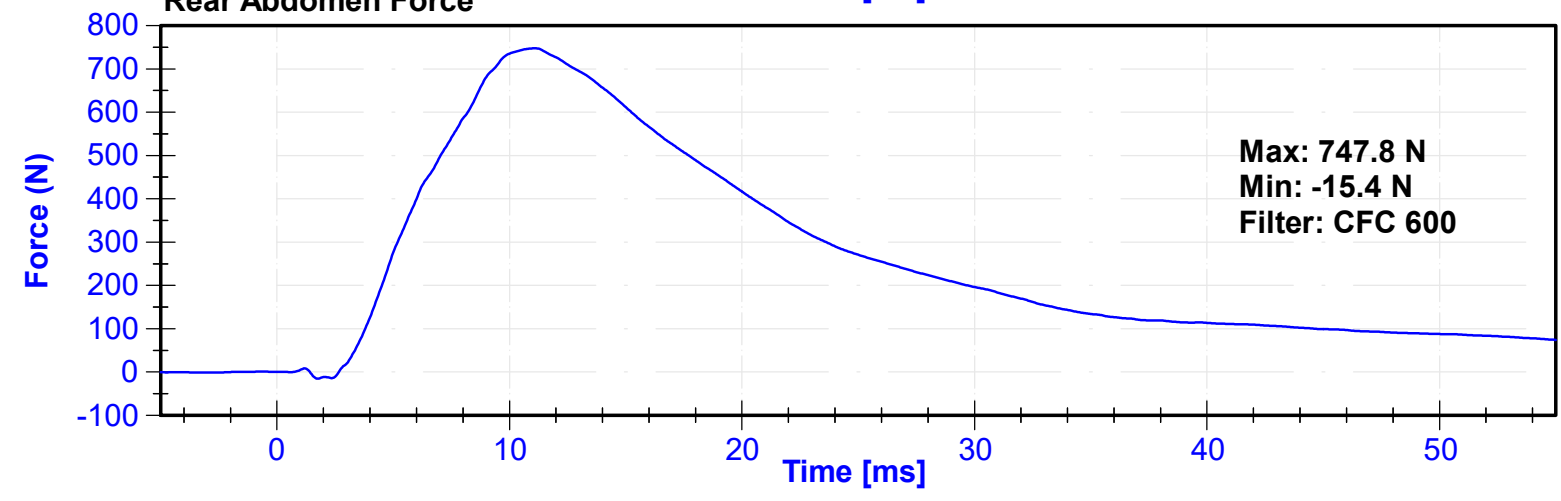
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18587	11/20/2023	11/19/2024
Front Abdomen Load Cell	Denton	1509	9/12/2023	9/11/2024
Middle Abdomen Load Cell	Denton	1508	9/12/2023	9/11/2024
Rear Abdomen Load Cell	Denton	1507	9/12/2023	9/11/2024




Combined Abdomen Force
Force (N)
Time [ms]
Max: 2403.4 N
Min: -12.0 N
Filter: CFC 600


Front Abdomen Force
Force (N)
Time [ms]
Max: 580.5 N
Min: -2.7 N
Filter: CFC 600


Middle Abdomen Force
Force (N)
Time [ms]
Max: 1083.4 N
Min: -2.4 N
Filter: CFC 600


Rear Abdomen Force
Force (N)
Time [ms]
Max: 747.8 N
Min: -15.4 N
Filter: CFC 600

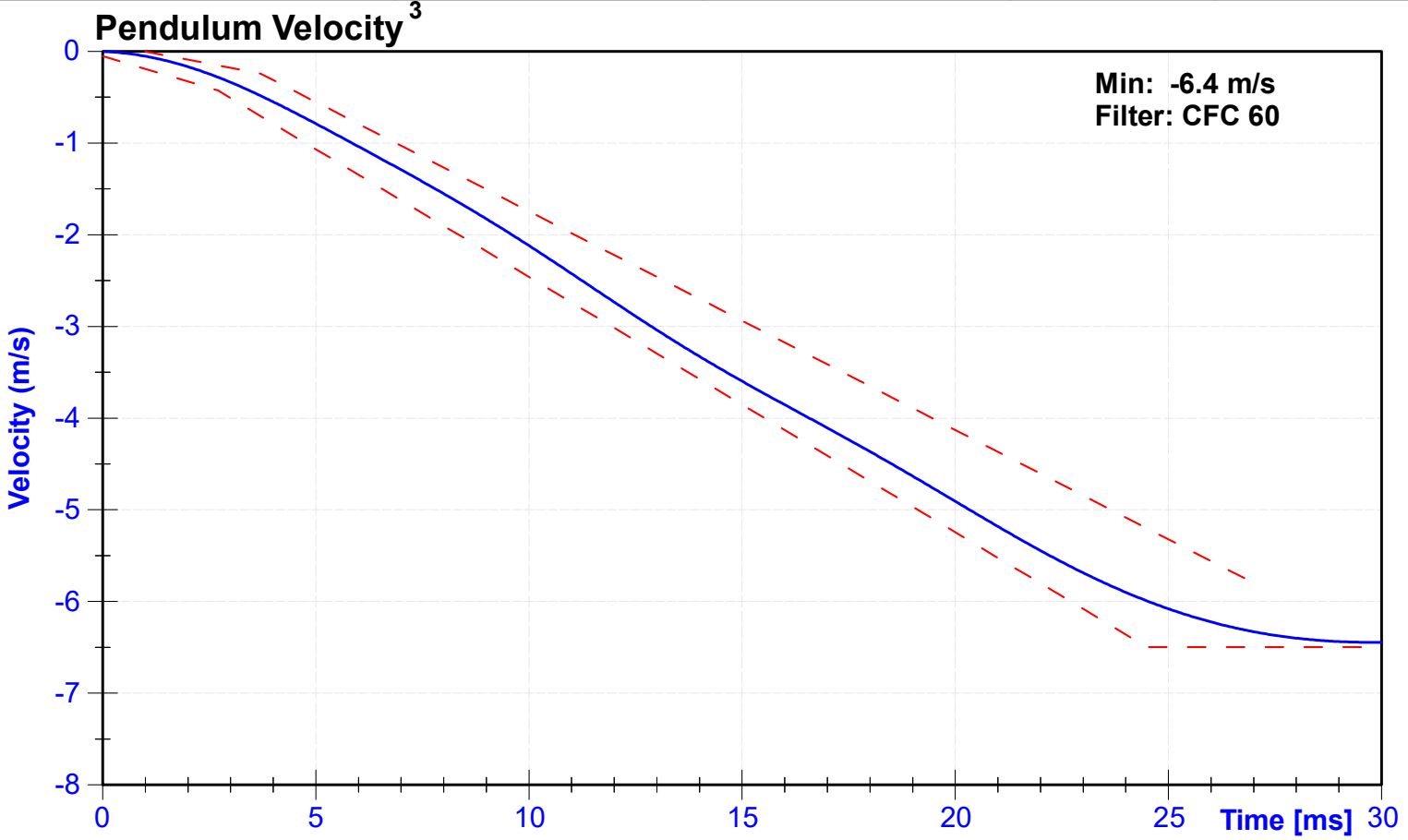
ATD Manufacturer	FTSS	Test Technician	D. Sakona
ATD Serial Number	F033	Laboratory Supervisor	C. Mantell

Results

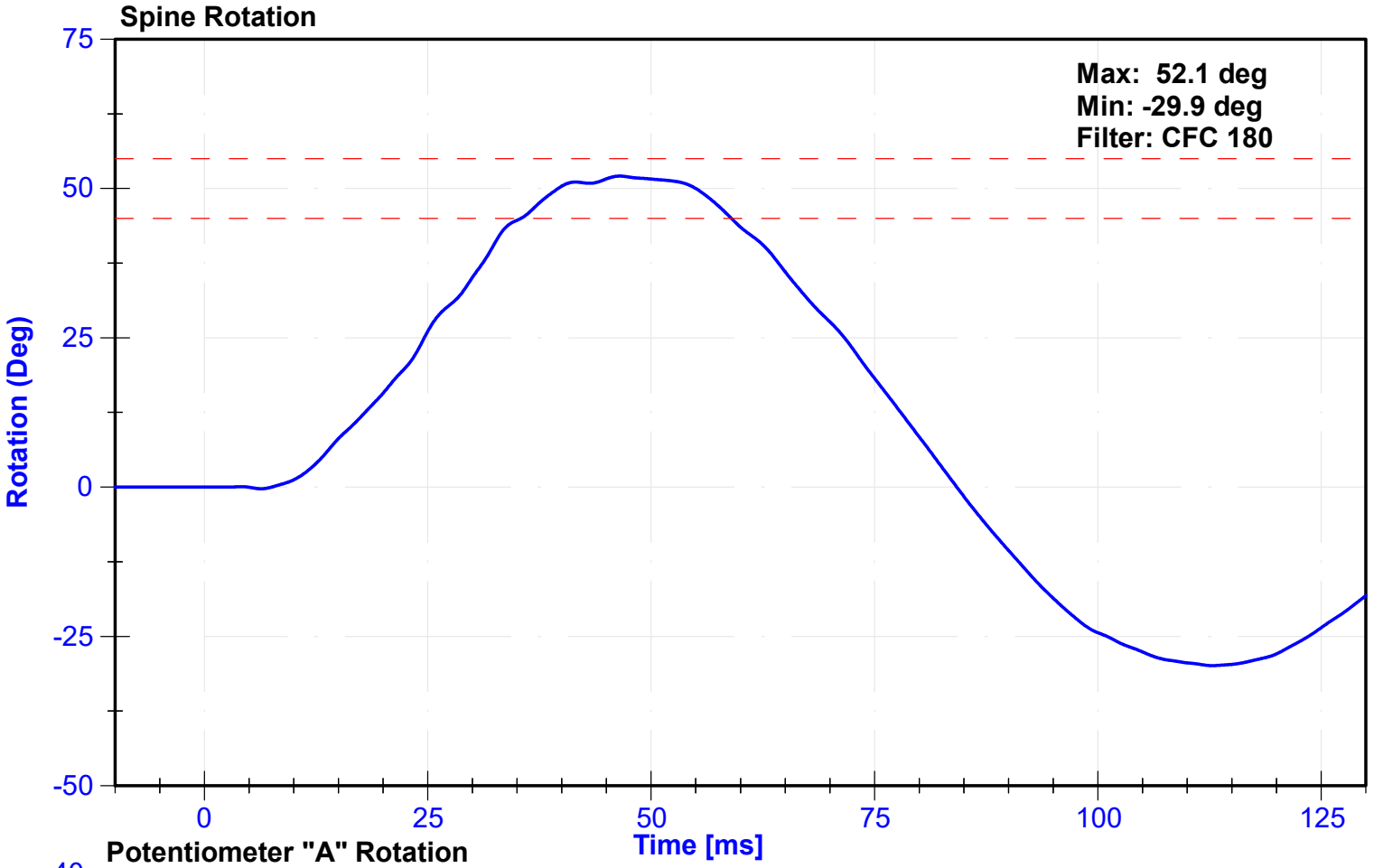
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.9	Pass
Humidity	10	70	%	49	Pass
Velocity	5.95	6.15	m/s	6.086	Pass
Lateral Spine Rotation	45	55	deg	52.1	Pass
Time at Maximum Rotation	39	53	ms	46.5	Pass
Time of Decay to Zero Degrees	37	57	ms	37.8	Pass
Pendulum Velocity Overall Corridor	Lower Boundary[1]	Upper Boundary[2]	m/s	See Plot[3]	Pass

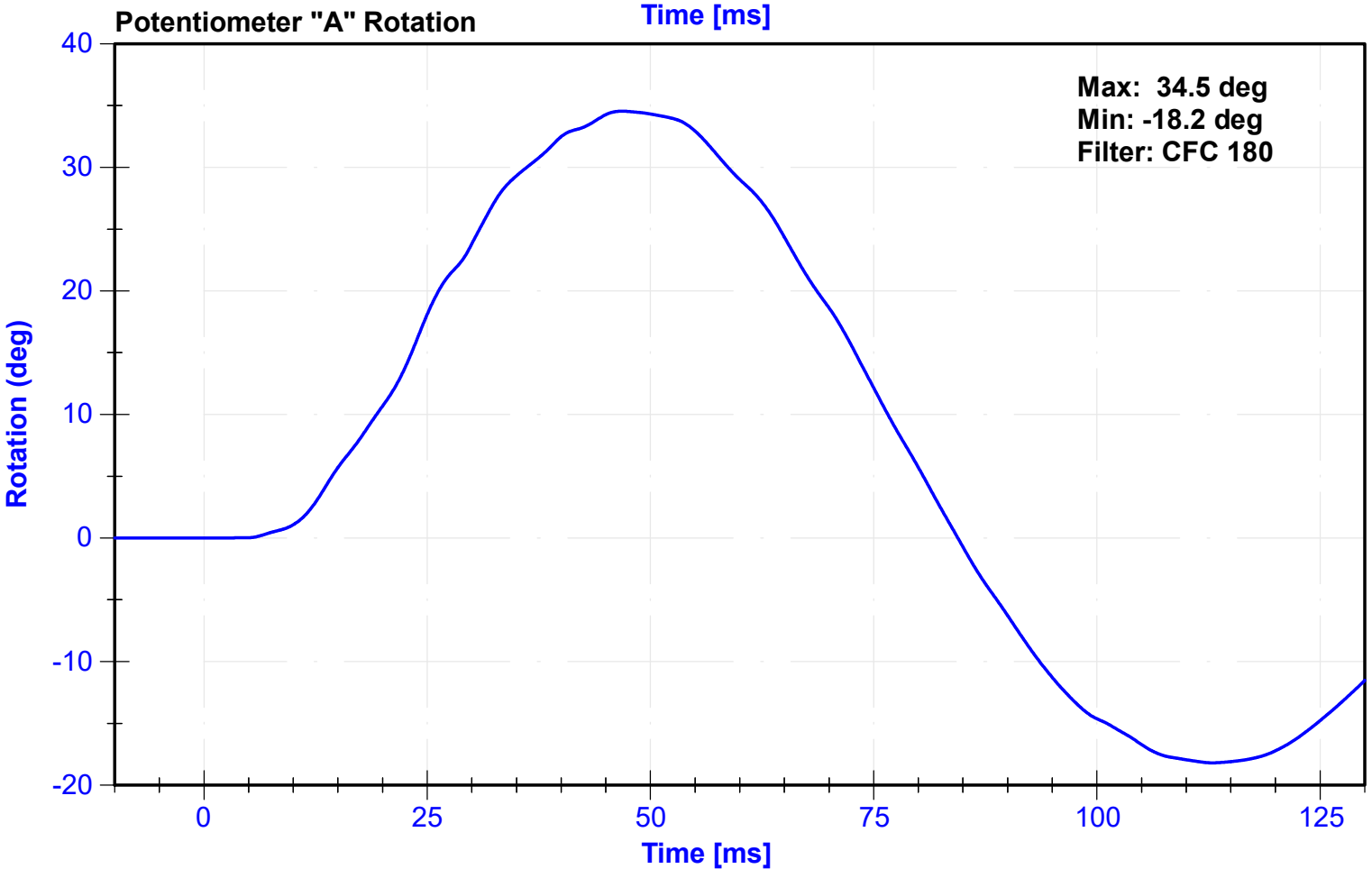
Transducer Calibrations

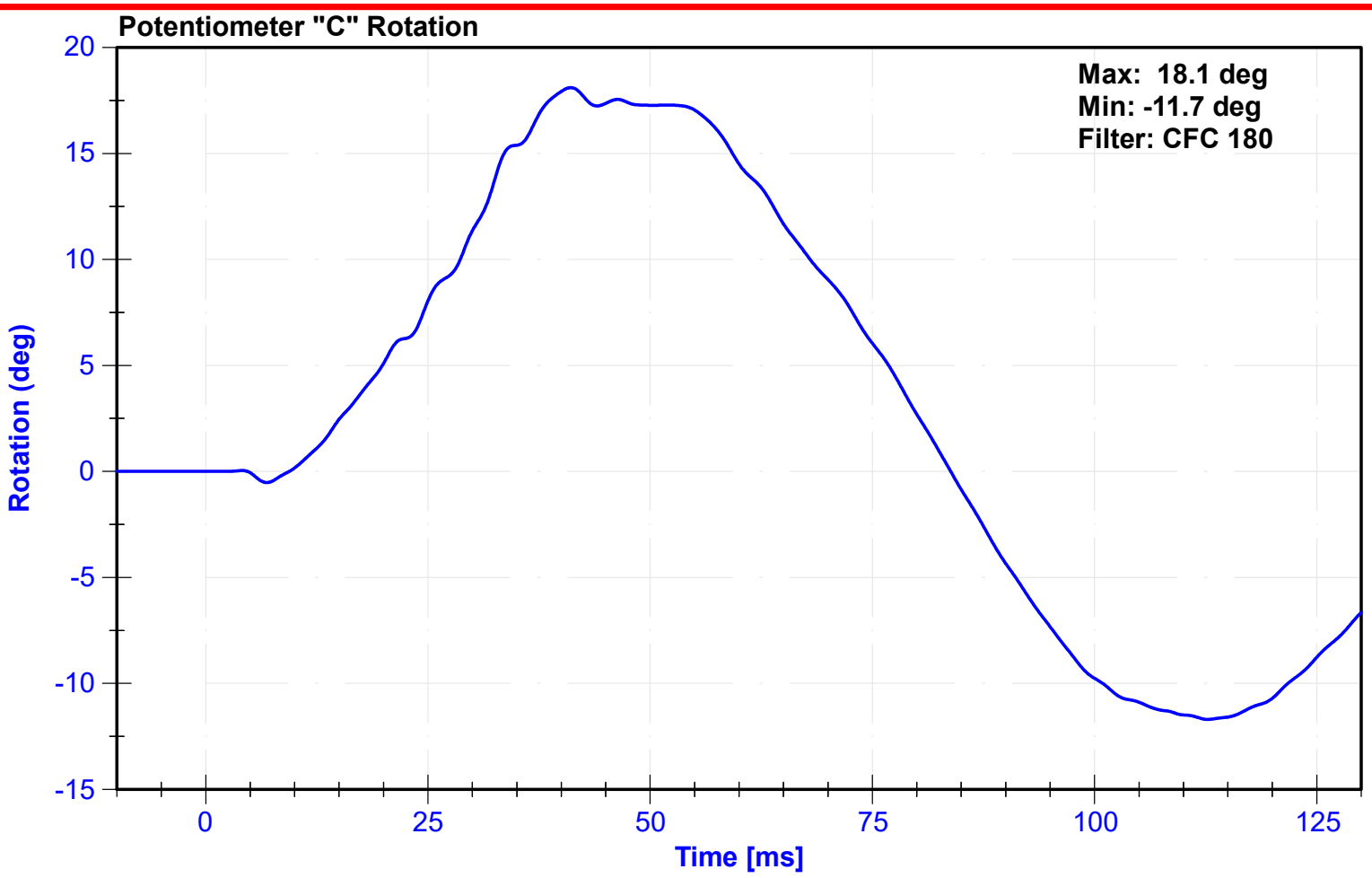
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	C16503	4/29/2024	10/26/2024
Pendulum "A" Potentiometer	Sfernice	2247	12/5/2023	12/4/2024
Condyle "B" Potentiometer	Sfernice	095	9/29/2023	9/28/2024



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


Spine Rotation
Max: 52.1 deg
Min: -29.9 deg
Filter: CFC 180
Rotation (Deg)
75
50
25
0
-25
-50
0
25
50
75
100
125
Time [ms]


Potentiometer "A" Rotation
Max: 34.5 deg
Min: -18.2 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

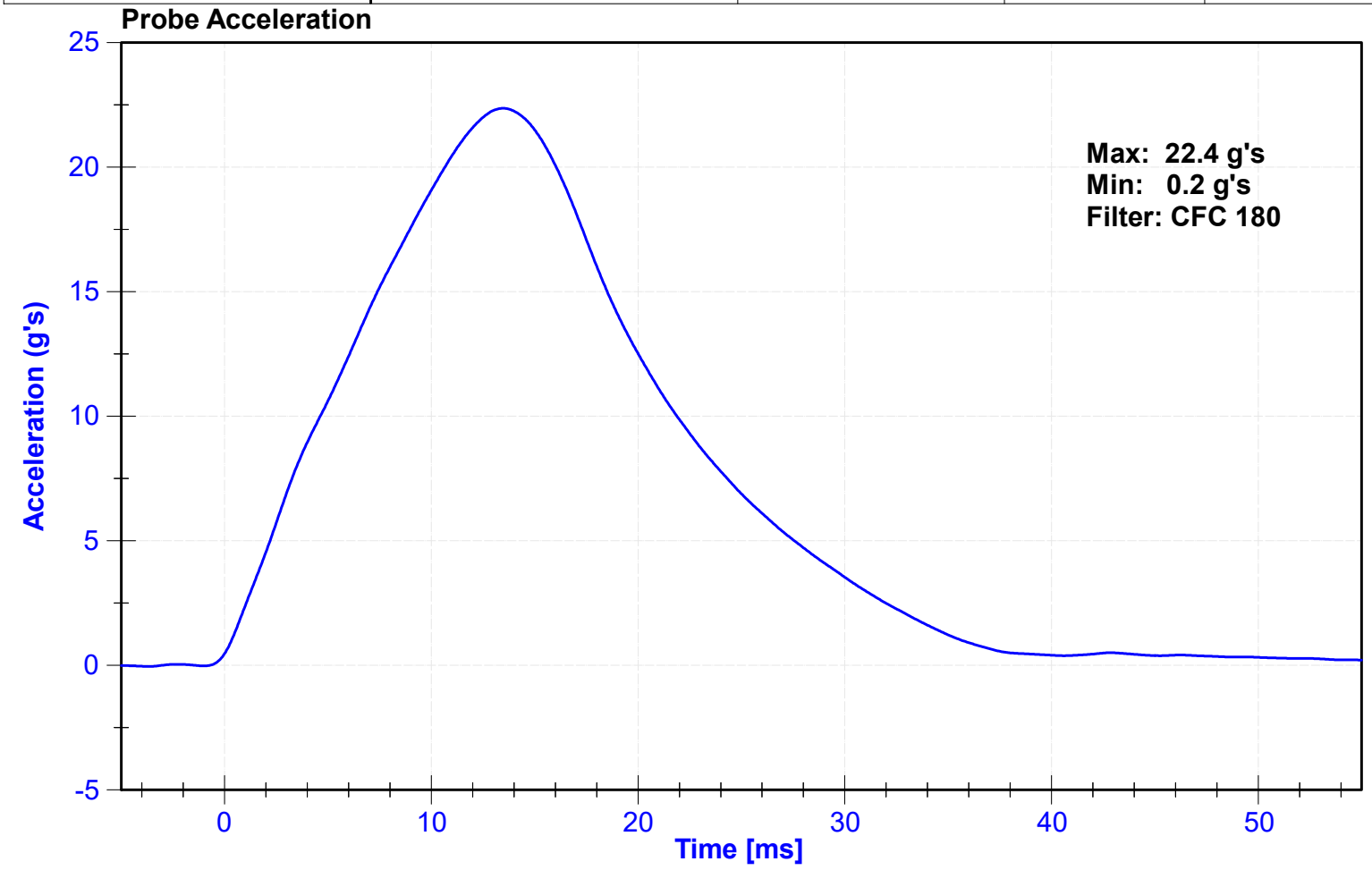
ATD Manufacturer	FTSS	Test Technician	D. Sakona
ATD Serial Number	F033	Laboratory Supervisor	C. Mantell

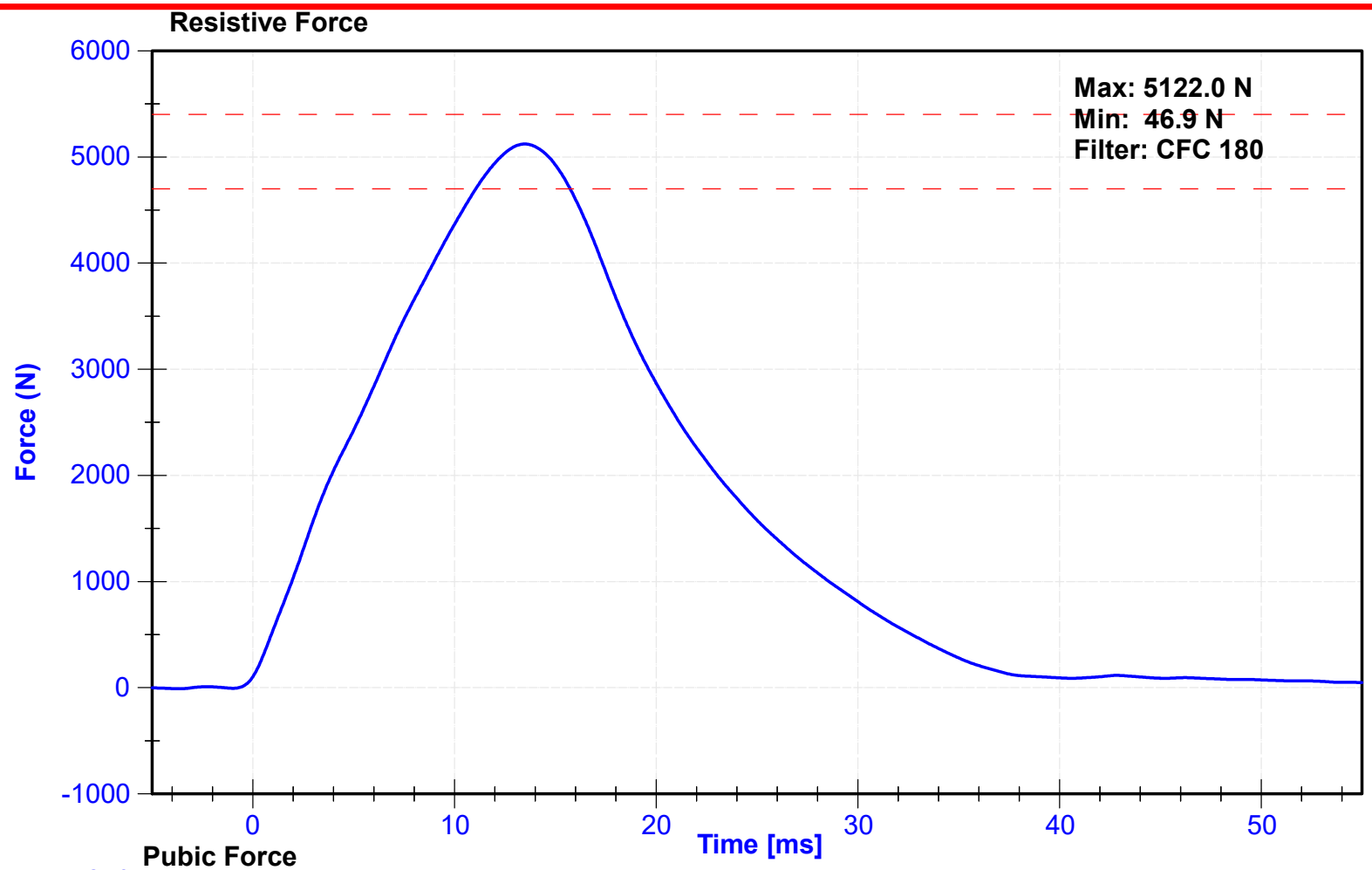
Results

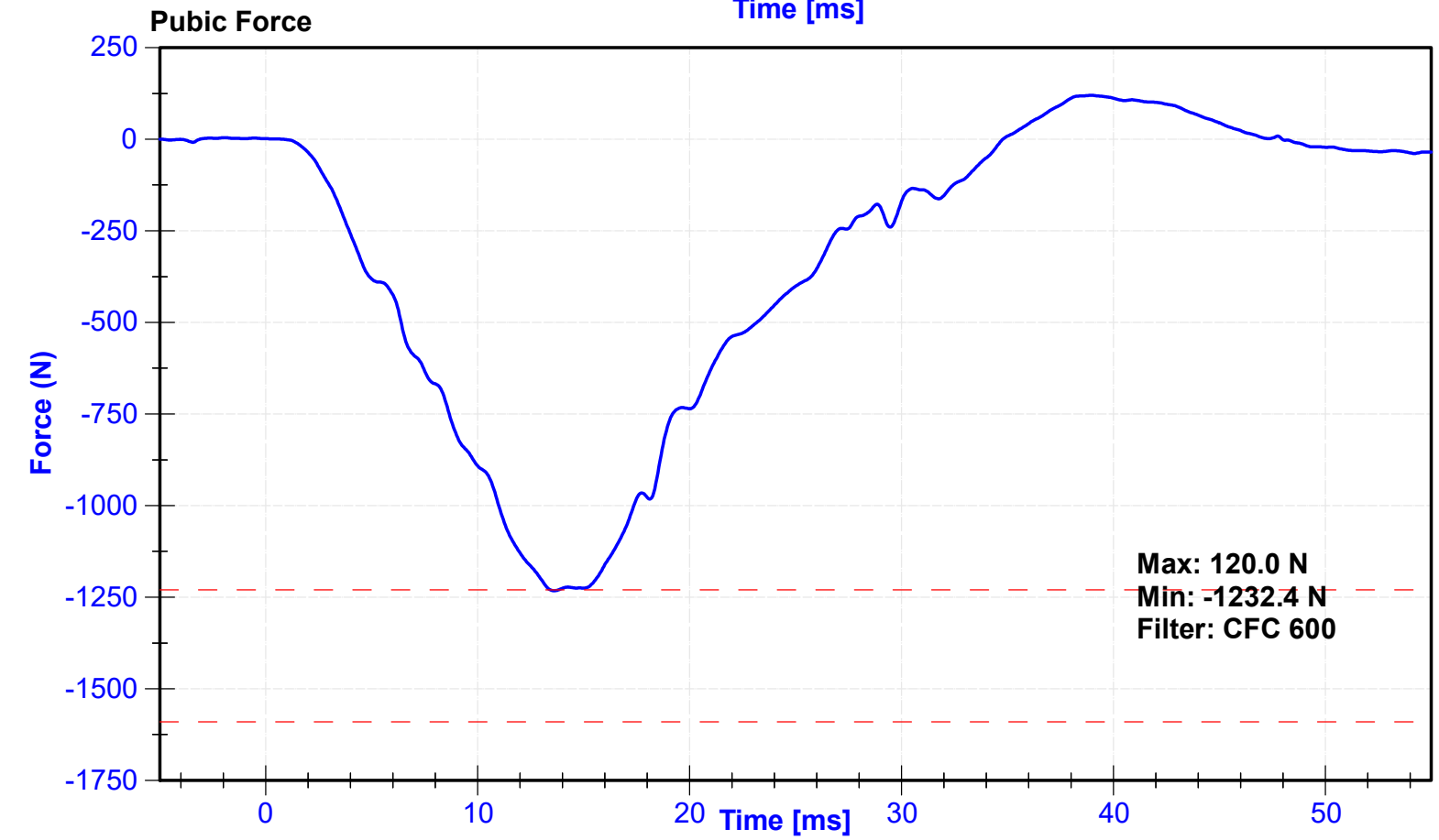
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.8	Pass
Humidity	10	70	%	48	Pass
Velocity	4.2	4.4	m/s	4.32	Pass
Resistive Force	4700	5400	N	5122.0	Pass
Time at Peak Resistive Force	11.8	16.1	ms	13.45	Pass
Pubic Force	-1590	-1230	N	-1232.4	Pass
Time at Peak Pubic Force	12.2	17.0	ms	13.60	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18587	11/20/2023	11/19/2024
Pubic Load Cell	Denton	459-FY	6/20/2023	6/19/2024




Resistive Force
Max: 5122.0 N
Min: 46.9 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: 120.0 N
Min: -1232.4 N
Filter: CFC 600
Force (N)
250
0
-250
-500
-750
-1000
-1250
-1500
-1750
0
10
20
30
40
50
Time [ms]

CALIBRATION TEST RESULTS

PRE-TEST

SID-IIS 5TH PERCENTILE FEMALE – PASSENGER ATD

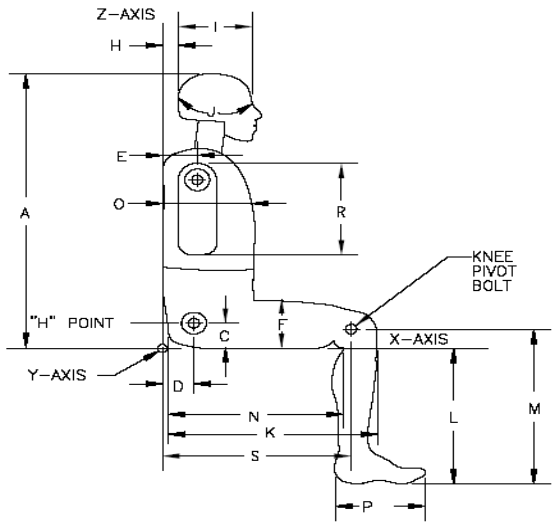
SERIAL NO:300

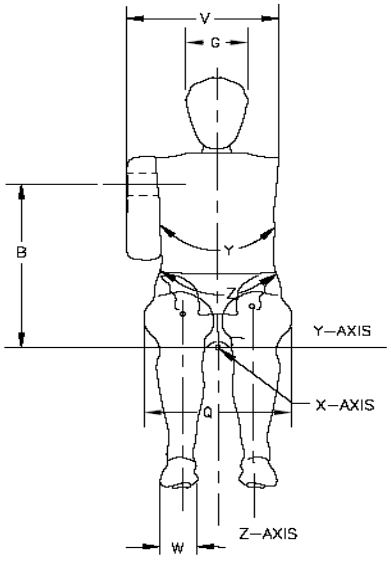
(CONFIGURED FOR LEFT SIDE IMPACT)

External Measurements - SID-IIs

Technician: K. Brogan Date: 5/28/2024

Dummy Serial Number: 300





Symbol	Description	Specification (mm)		Result (mm)	Pass/Fail
A	Sitting Height	772	788	782	Pass
B	Shoulder Pivot Height	437	453	446	Pass
C	H-point Height	79	89	84	Pass
D	H-point from seatback	141	151	146	Pass
E	Shoulder Pivot from Backline	97	107	98	Pass
F	Thigh Clearance	119	135	127	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	530	Pass
L	Popliteal Height	343	369	357	Pass
M	Knee Pivot to floor height	392	409	402	Pass
N	Buttock Popliteal Length	416	442	435	Pass
O	Chest Depth w/o jacket	195	211	199	Pass
P	Foot Length	216	232	225	Pass
Q	Hip Breadth (w/pelvic plugs)	313	323	319	Pass
R	Arm Length	249	259	255	Pass
S	Knee Joint to seatback	477	493	489	Pass
V	Shoulder Width	341	357	351	Pass
W	Foot Width	78	94	85	Pass
Y	Chest Circumference w/jacket	851	881	878	Pass
Z	Waist Circumference	761	791	780	Pass

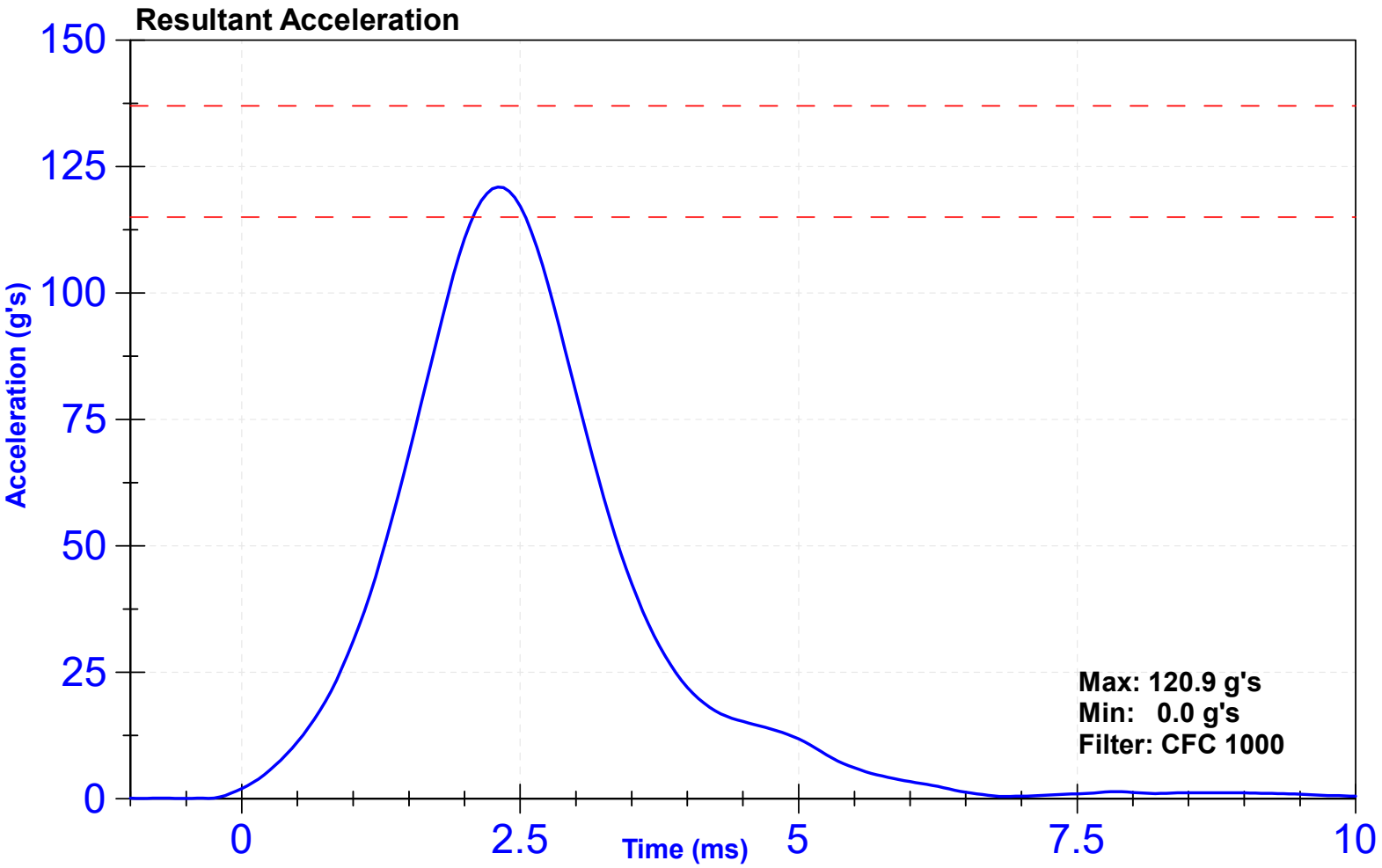
ATD Manufacturer	FTSS	Test Technician	D. Sakona
ATD Serial Number	300	Laboratory Supervisor	C. Mantell

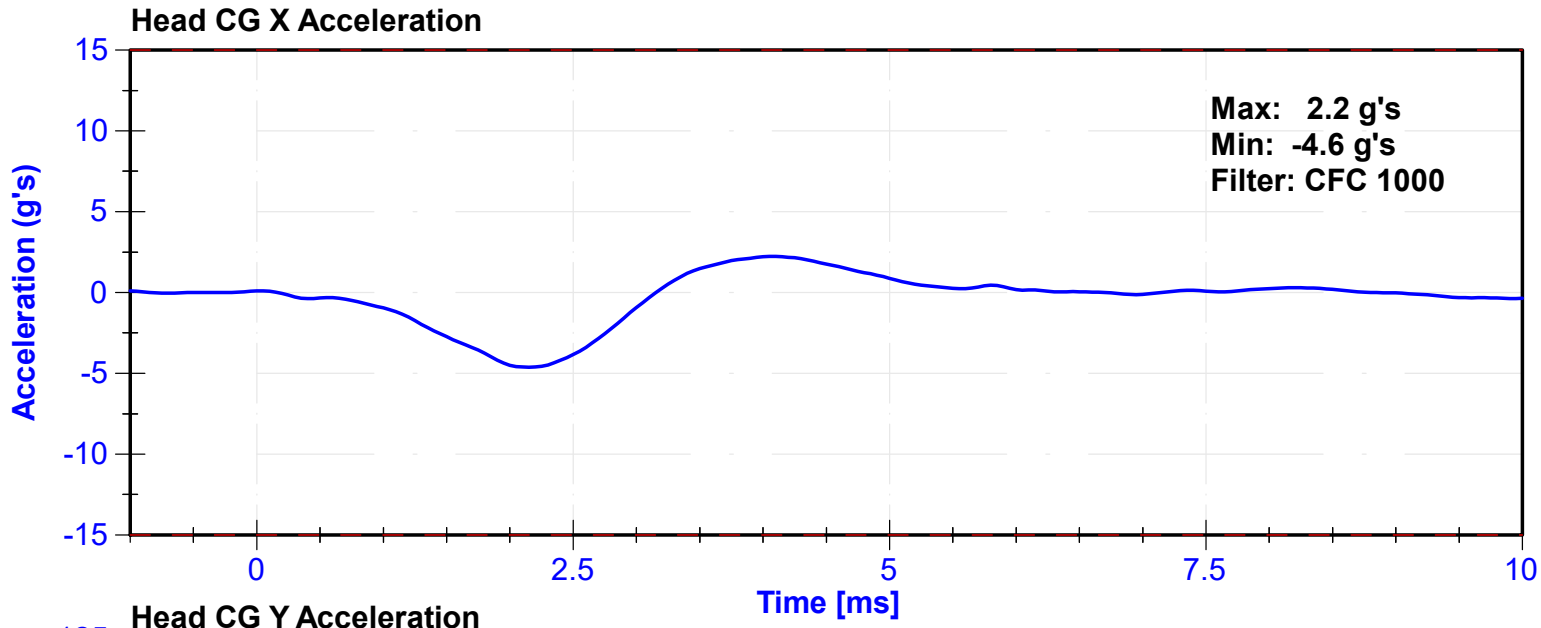
Results

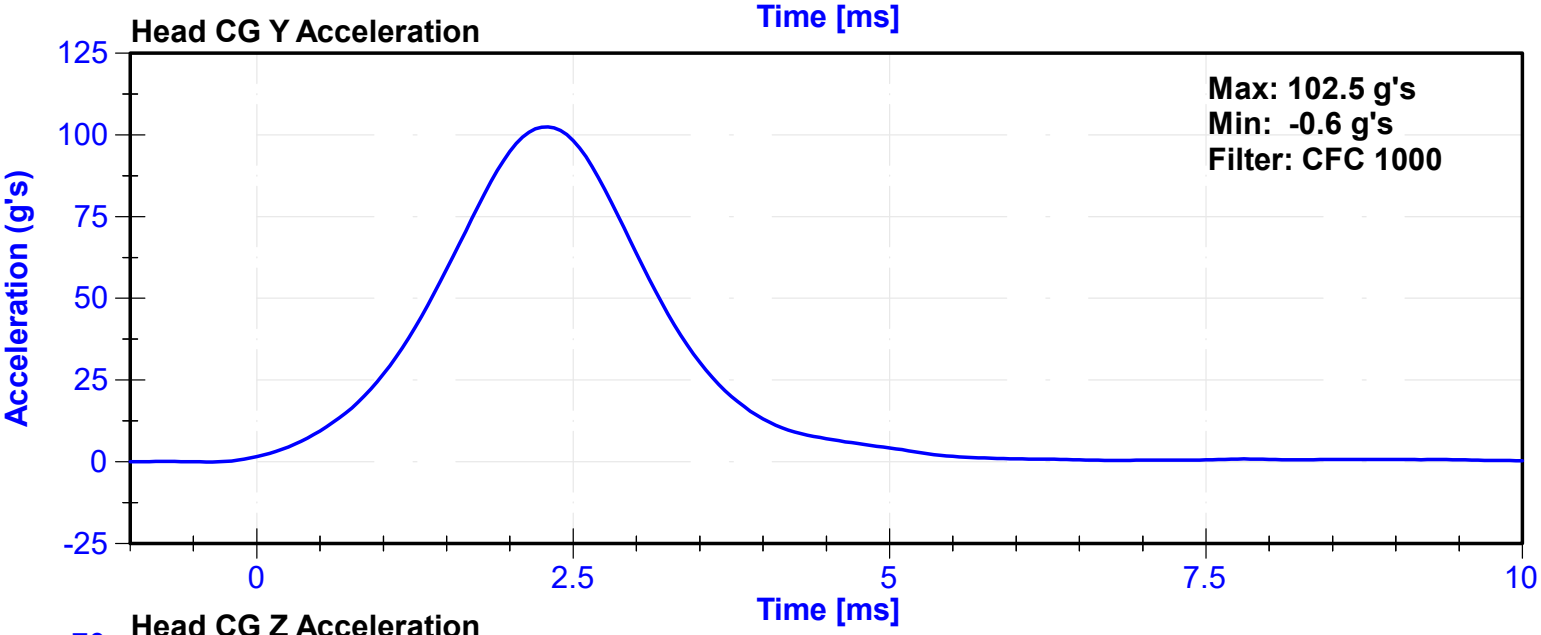
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.4	Pass
Humidity	10	70	%	51	Pass
Resultant Acceleration	115	137	g's	120.9	Pass
Oscillation	0	15	%	1.1	Pass
Fore-Aft Acceleration	-15	15	g's	-4.6	Pass

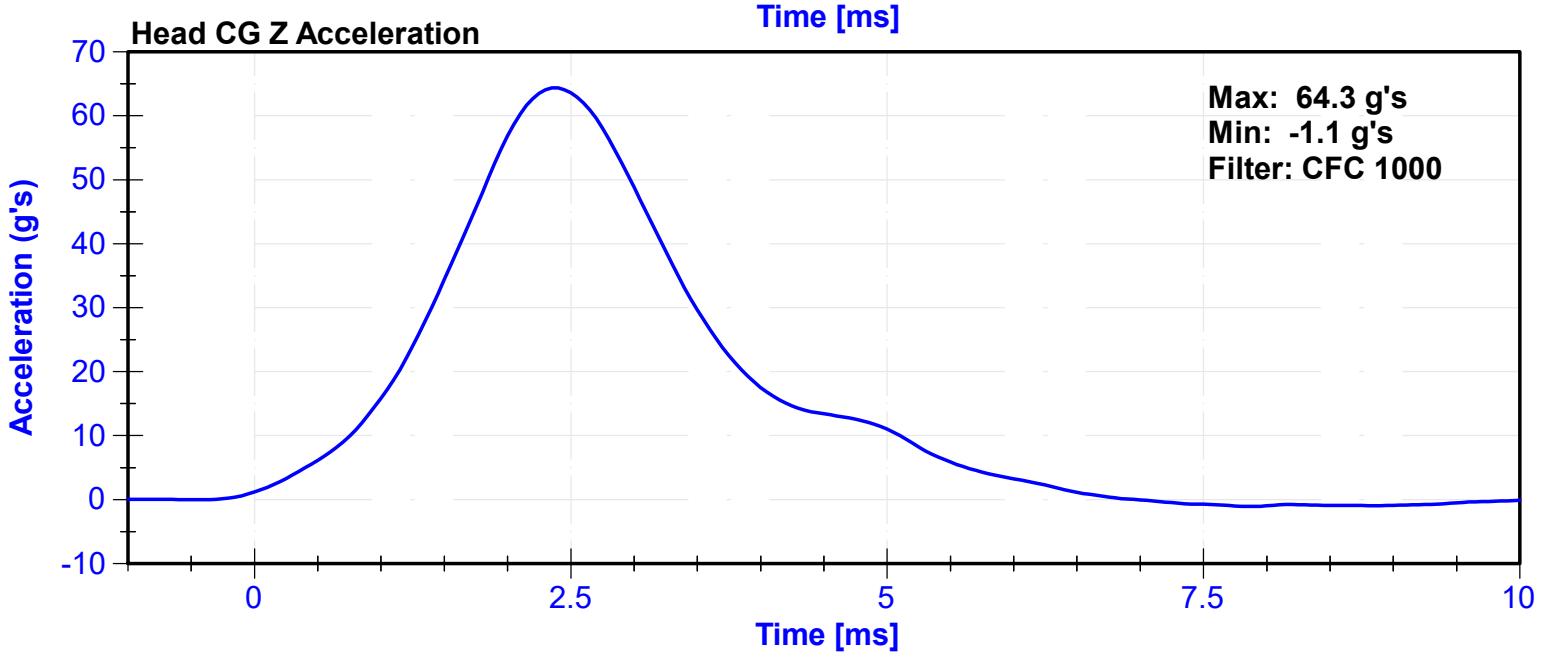
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibratio Date	Calibratio Due Date
X Accelerometer	Endevco	P59018	5/9/2024	11/5/2024
Y Accelerometer	Endevco	P79189	5/9/2024	11/5/2024
Z Accelerometer	Endevco	P79587	5/9/2024	11/5/2024




Head CG X Acceleration
Max: 2.2 g's
Min: -4.6 g's
Filter: CFC 1000
Acceleration (g's)
Time [ms]


Head CG Y Acceleration
Max: 102.5 g's
Min: -0.6 g's
Filter: CFC 1000
Acceleration (g's)
Time [ms]


Head CG Z Acceleration
Max: 64.3 g's
Min: -1.1 g's
Filter: CFC 1000
Acceleration (g's)
Time [ms]

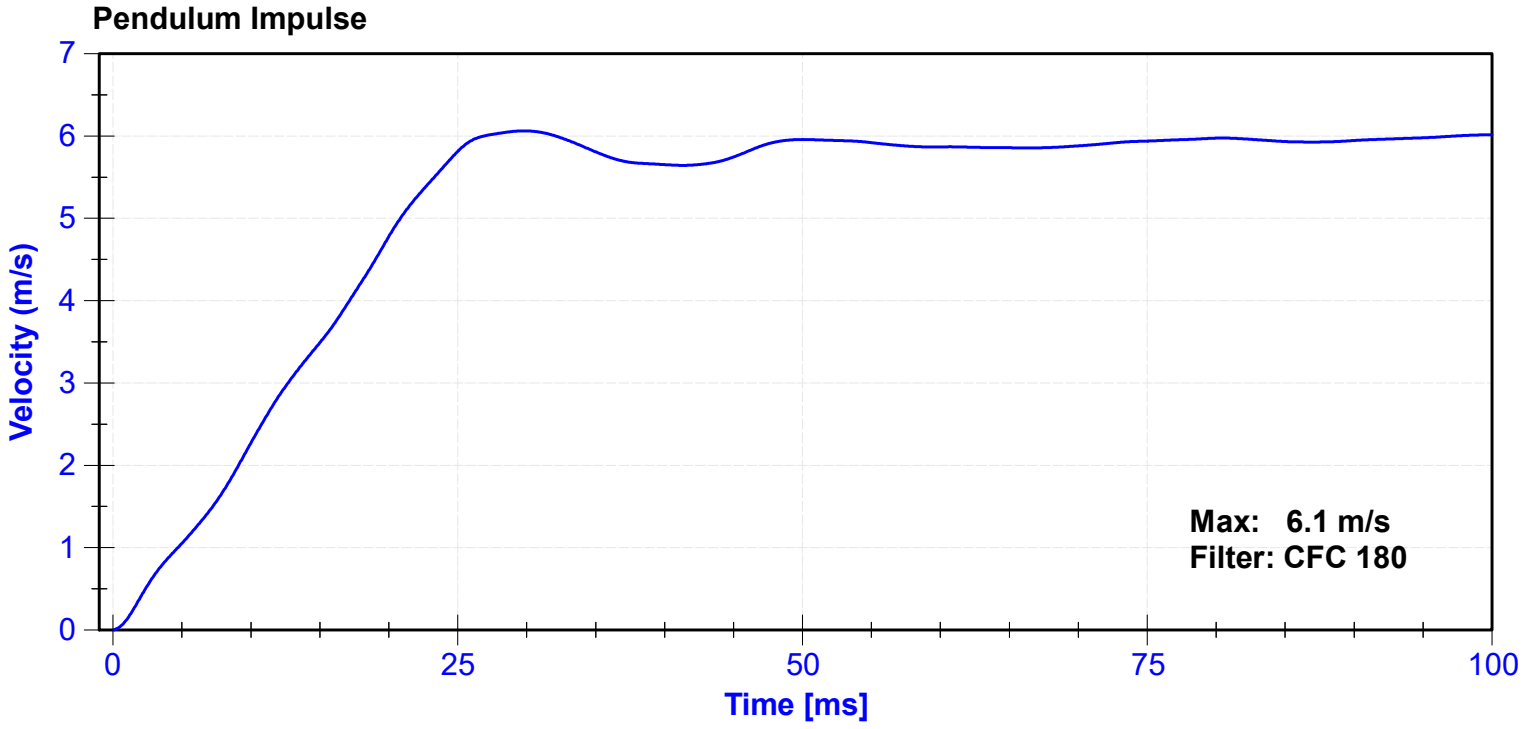
ATD Manufacturer	FTSS	Test Technician	D. Sakona
ATD Serial Number	300	Laboratory Supervisor	C. Mantell

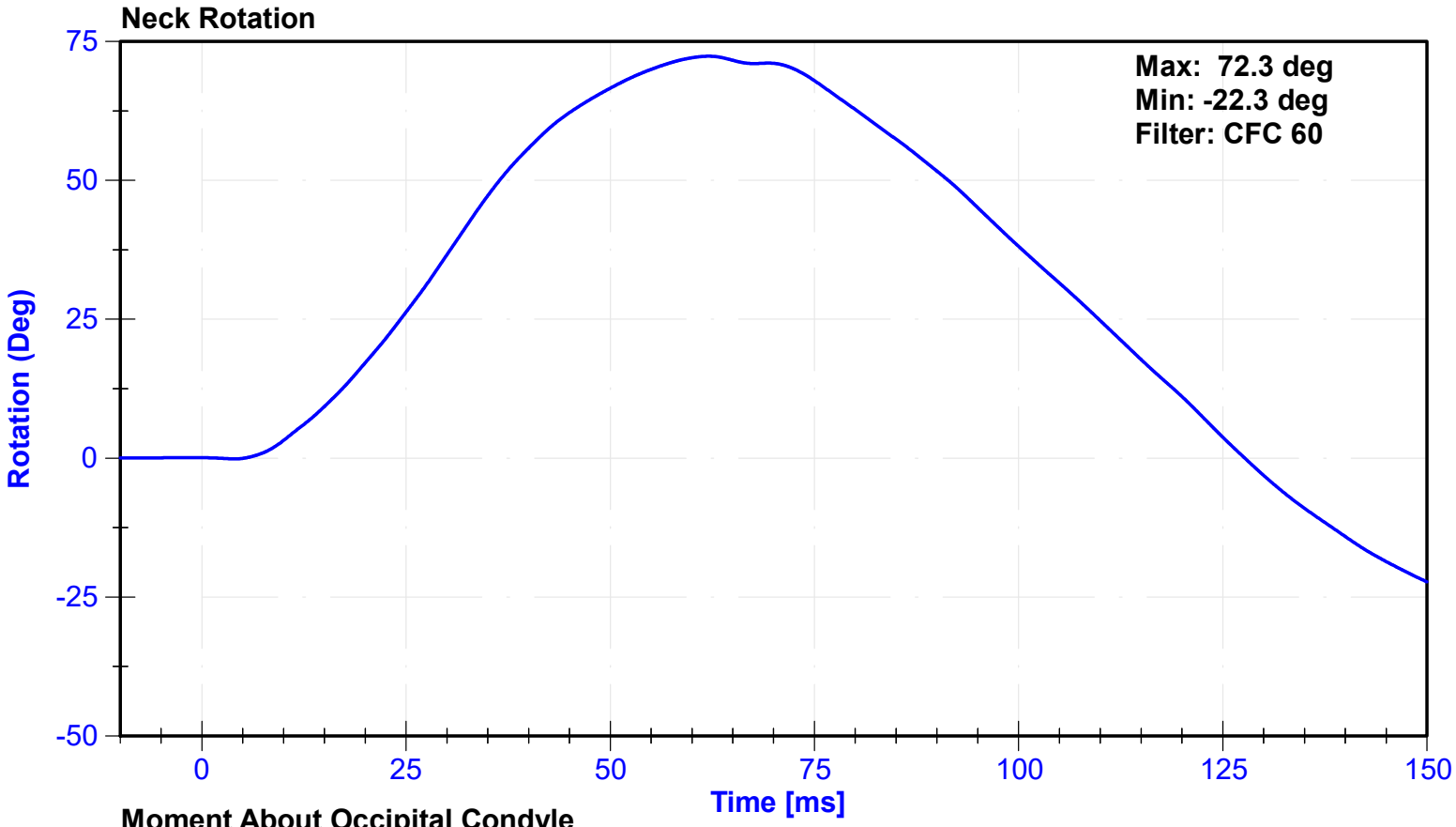
Results

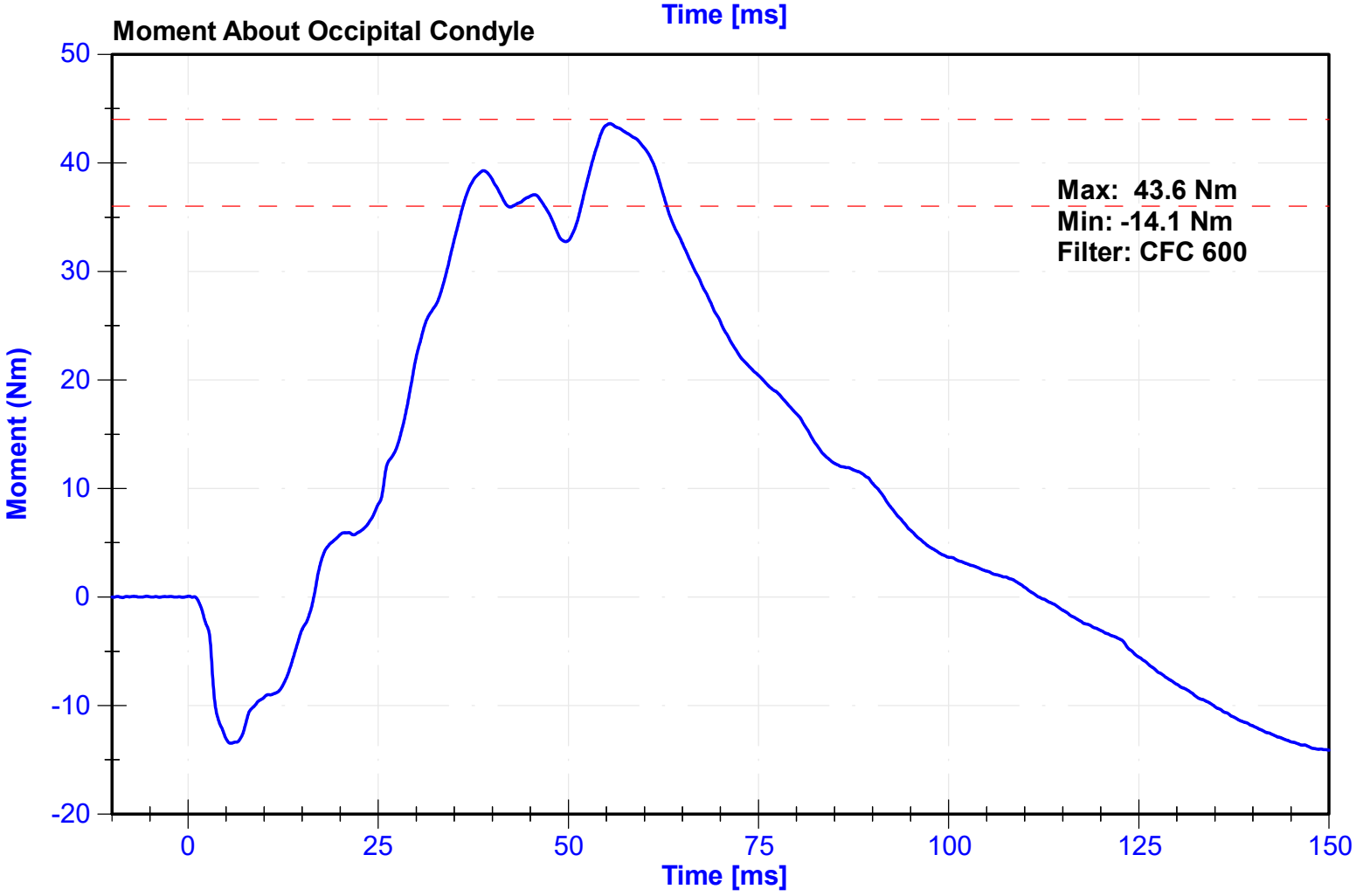
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.8	Pass
Humidity	10	70	%	52	Pass
Velocity	5.51	5.63	m/s	5.597	Pass
Pendulum Impulse at 10ms	2.2	2.8	m/s	2.27	Pass
Pendulum Impulse at 15ms	3.3	4.1	m/s	3.49	Pass
Pendulum Impulse at 20ms	4.4	5.4	m/s	4.78	Pass
Pendulum Impulse at 25ms	5.4	6.1	m/s	5.81	Pass
Pendulum Impulse from 25 to 100ms	5.5	6.2	m/s	6.06	Pass
Neck Rotation	71	81	deg	72.3	Pass
Time at Maximum Rotation	50	70	ms	62.1	Pass
Moment about the OC	36	44	Nm	43.6	Pass
Moment Decay to 0 Nm	102	126	ms	111.9	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	7231C-750	4/29/2024	10/26/2024
Pendulum Potentiometer	Servo	4961	10/2/2023	10/1/2024
Condyle Potentiometer	Servo	DS185	10/2/2023	10/1/2024
Upper Neck Load Cell	Denton	1716A_2187-FY	12/5/2023	12/4/2024




Neck Rotation
Max: 72.3 deg
Min: -22.3 deg
Filter: CFC 60
Rotation (Deg)
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]


Moment About Occipital Condyle
Max: 43.6 Nm
Min: -14.1 Nm
Filter: CFC 600
Moment (Nm)
50
40
30
20
10
0
-10
-20
0
25
50
75
100
125
150
Time [ms]

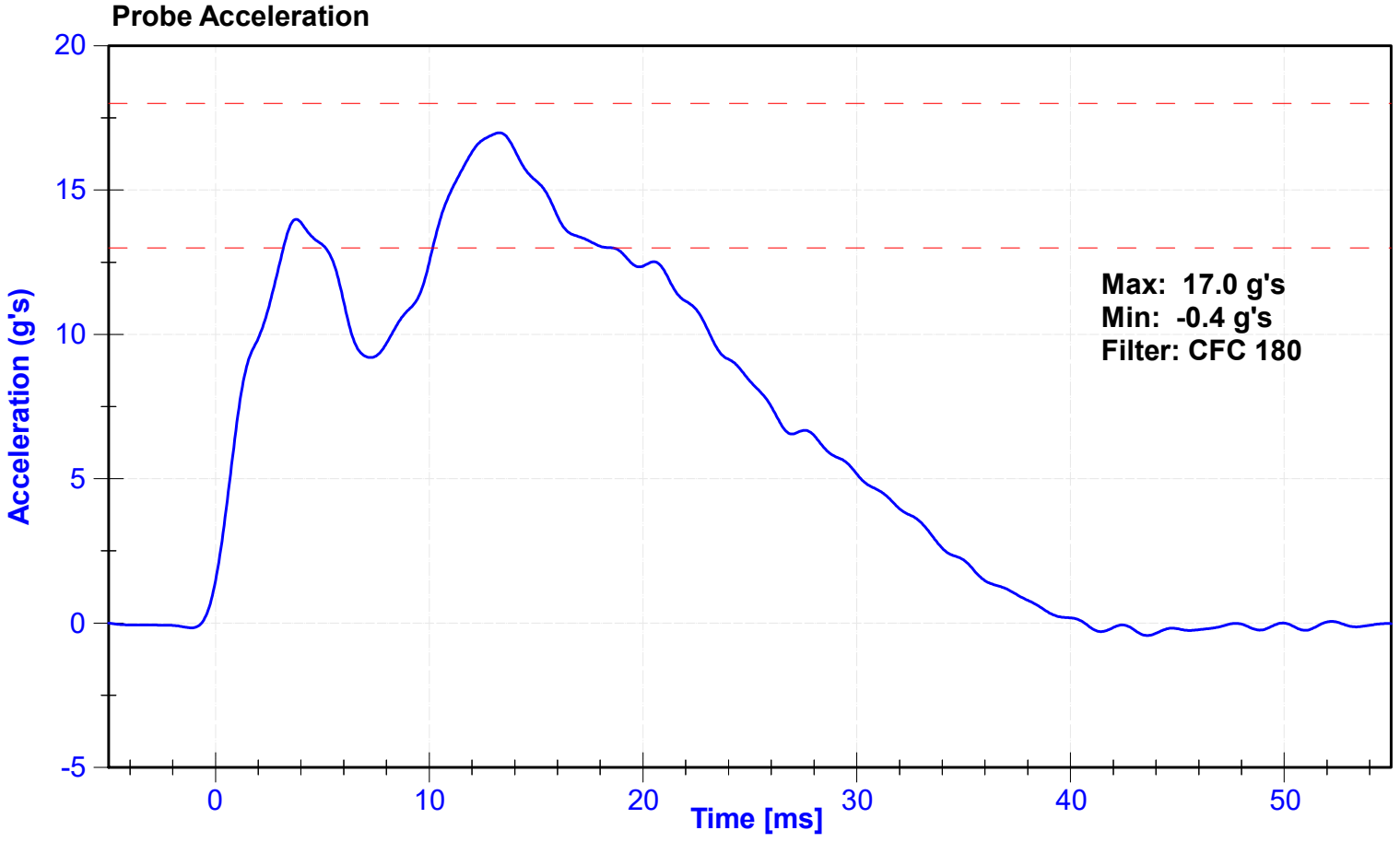
ATD Manufacturer	FTSS	Test Technician	D. Sakona
ATD Serial Number	300	Laboratory Supervisor	C. Mantell

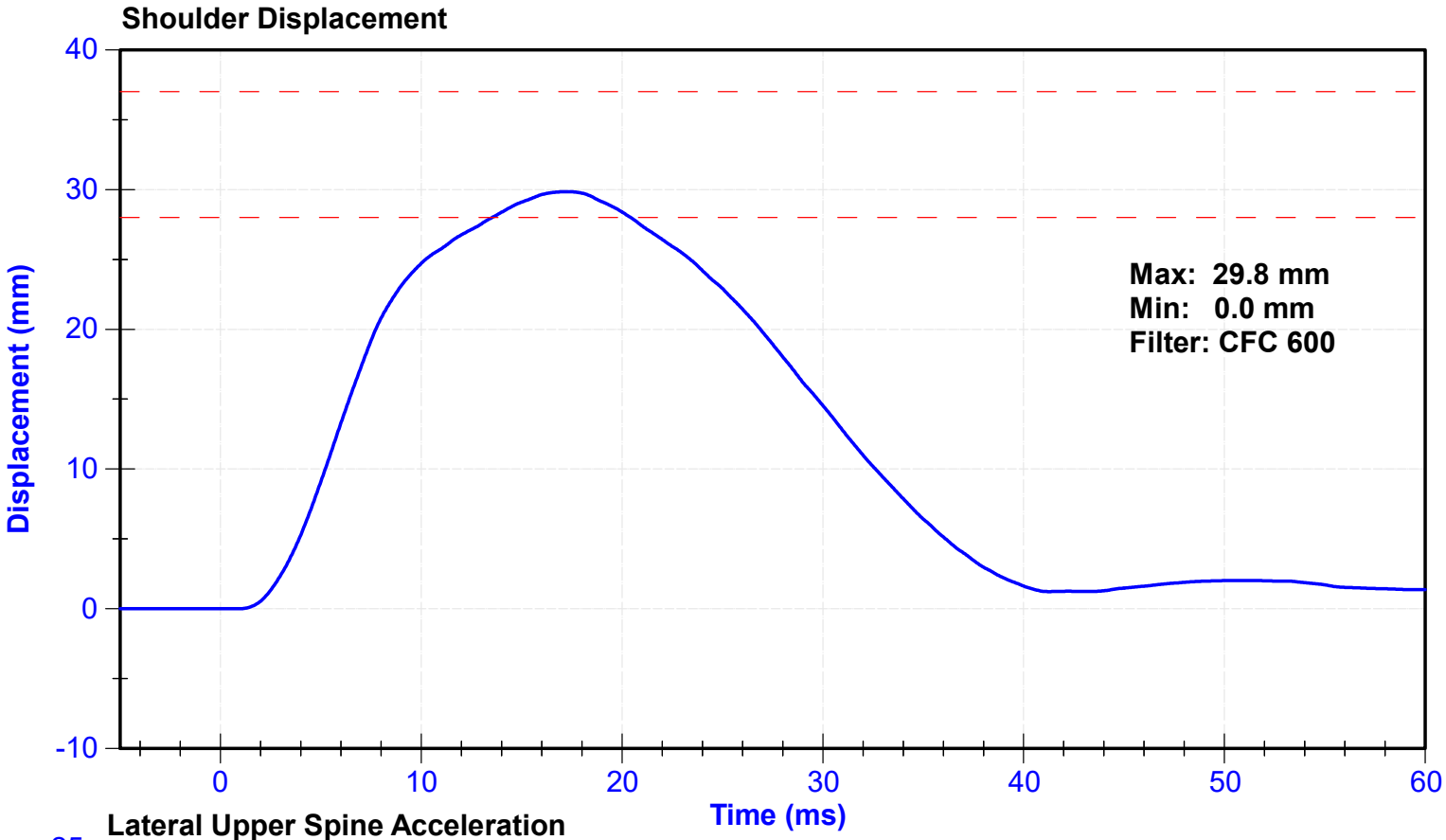
Results

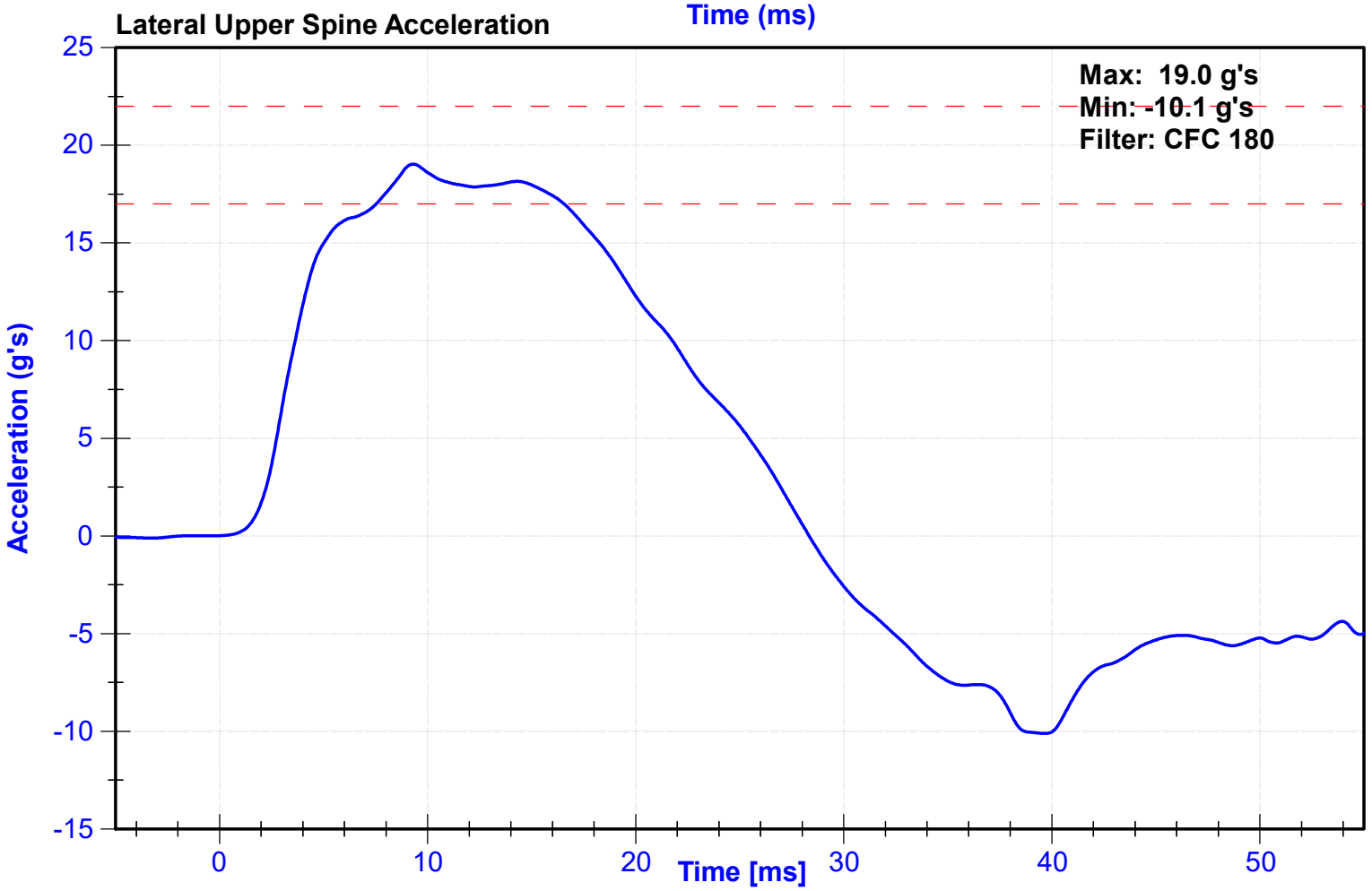
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.0	Pass
Humidity	10	70	%	46	Pass
Velocity	4.2	4.4	m/s	4.28	Pass
Probe Acceleration	13	18	g's	17.0	Pass
Shoulder Deflection	28	37	mm	29.8	Pass
Lateral Upper Spine Acceleration	17	22	g's	19.0	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18587	11/20/2023	11/19/2024
Shoulder Potentiometer	Servo	053GFE	5/9/2024	11/7/2024
Upper Spine Y Accelerometer	Endevco	T20880	5/9/2024	11/5/2024




Shoulder Displacement
Displacement (mm)
Time (ms)
Max: 29.8 mm
Min: 0.0 mm
Filter: CFC 600


Lateral Upper Spine Acceleration
Acceleration (g's)
Time [ms]
Max: 19.0 g's
Min: -10.1 g's
Filter: CFC 180

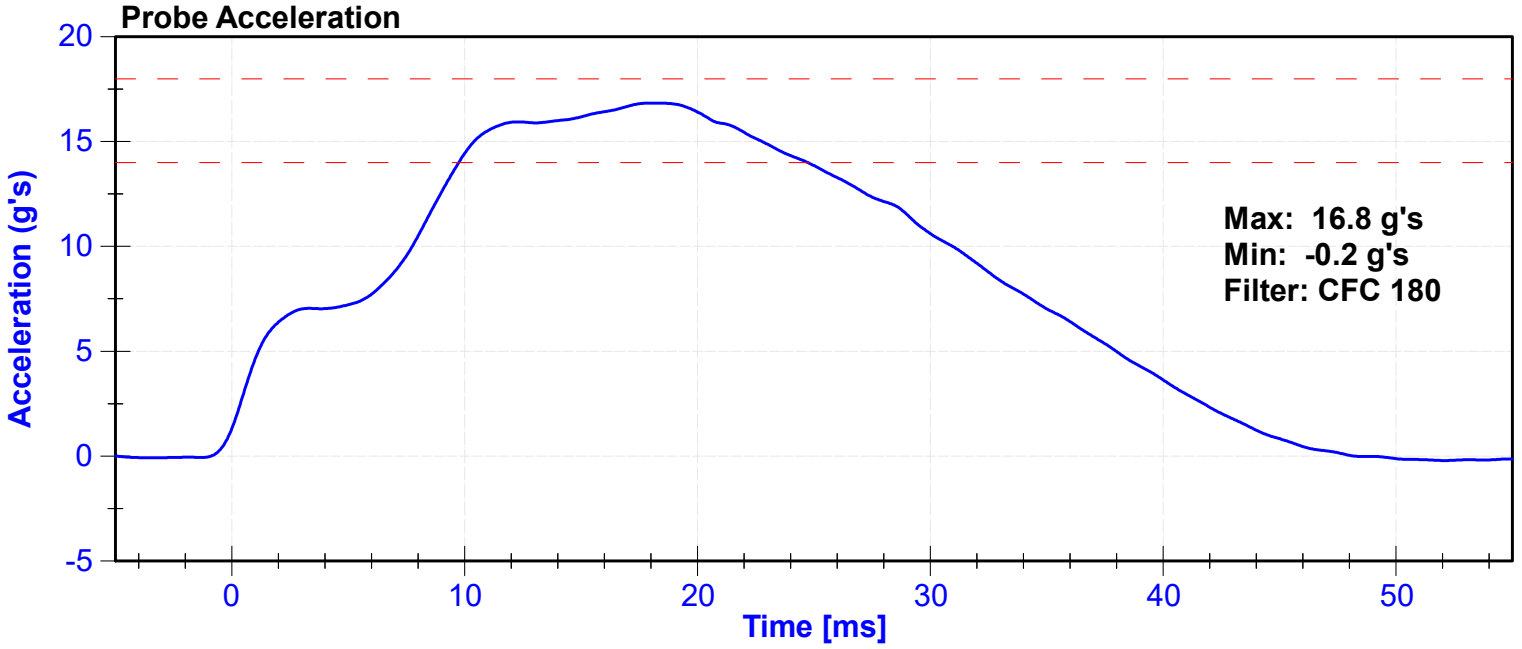
ATD Manufacturer	FTSS	Test Technician	D. Sakona
ATD Serial Number	300	Laboratory Supervisor	C. Mantell

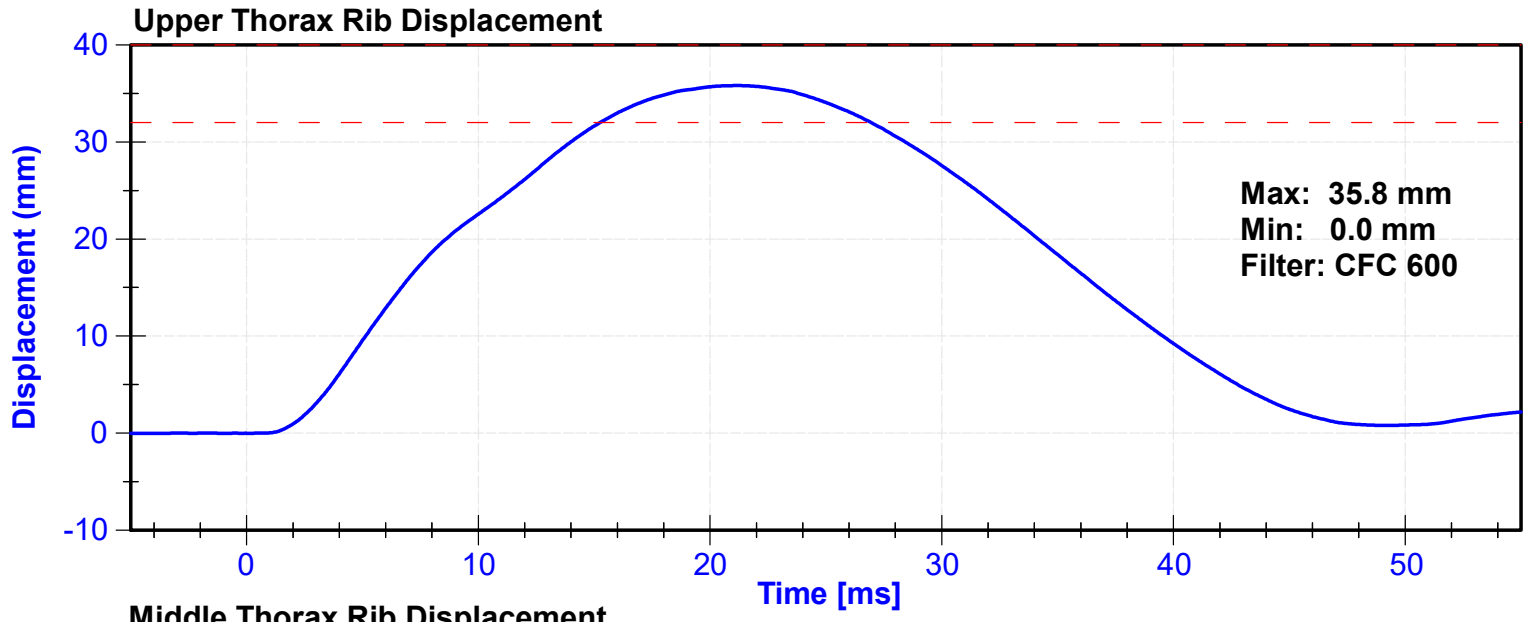
Results

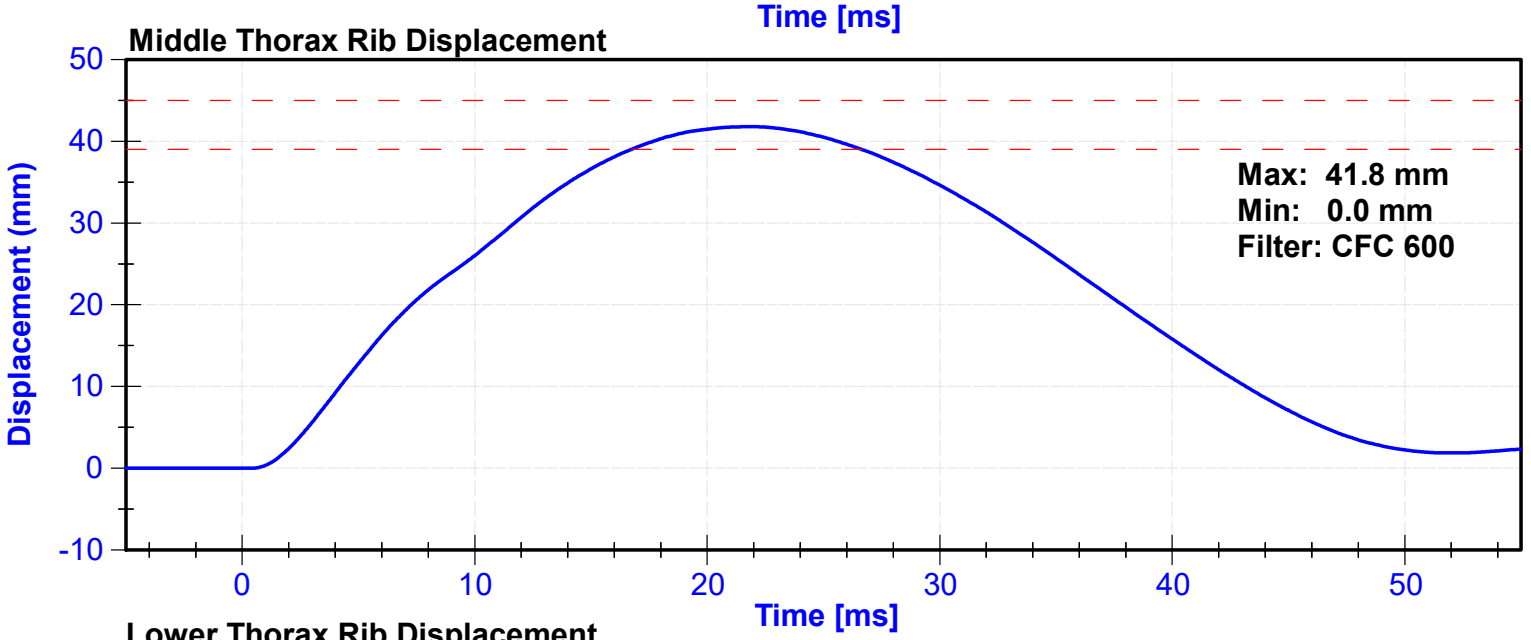
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.0	Pass
Humidity	10	70	%	46	Pass
Velocity	4.2	4.4	m/s	4.28	Pass
Probe Acceleration	14	18	g's	16.8	Pass
Lateral Upper Spine Acceleration	13	17	g's	15.1	Pass
Lateral Lower Spine Acceleration	7	11	g's	9.5	Pass
Upper Thorax Rib Deflection	32	40	mm	35.8	Pass
Middle Thorax Rib Deflection	39	45	mm	41.8	Pass
Lower Thorax Rib Deflection	35	43	mm	38.6	Pass

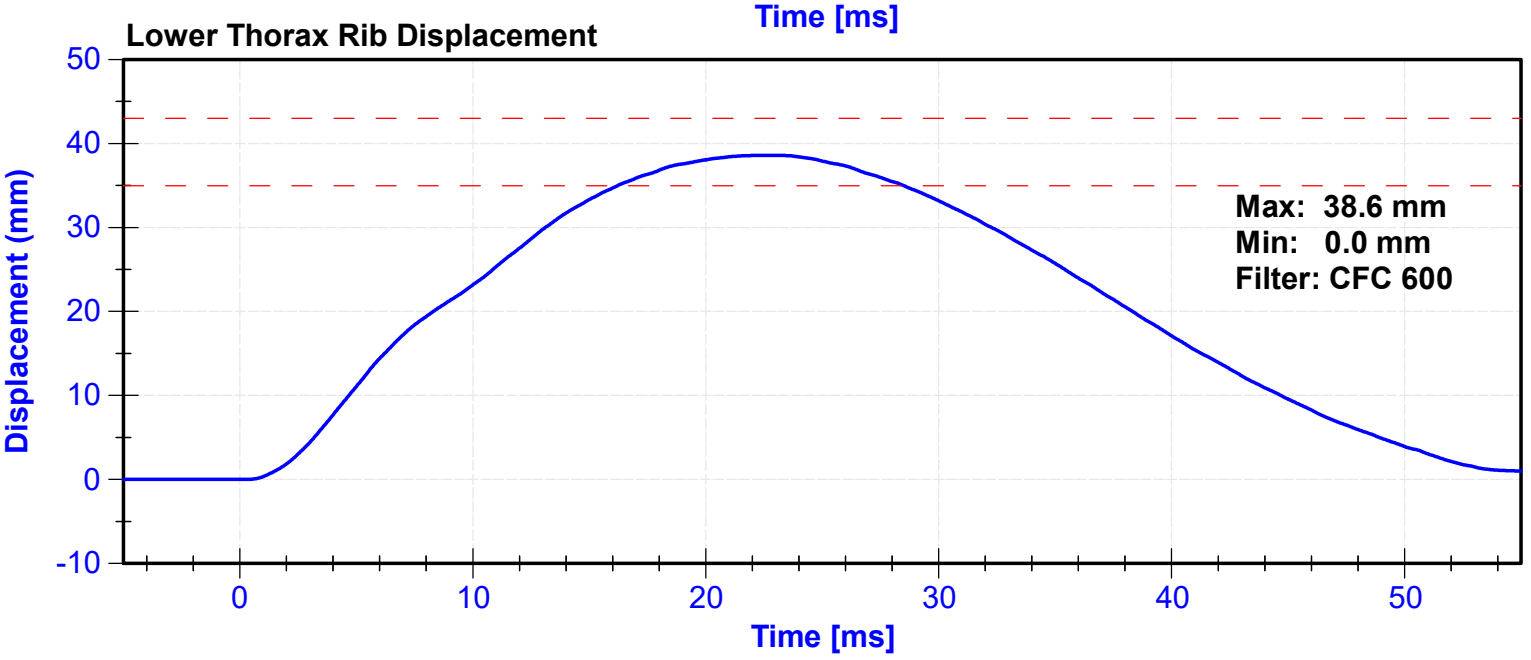
Transducer Calibrations

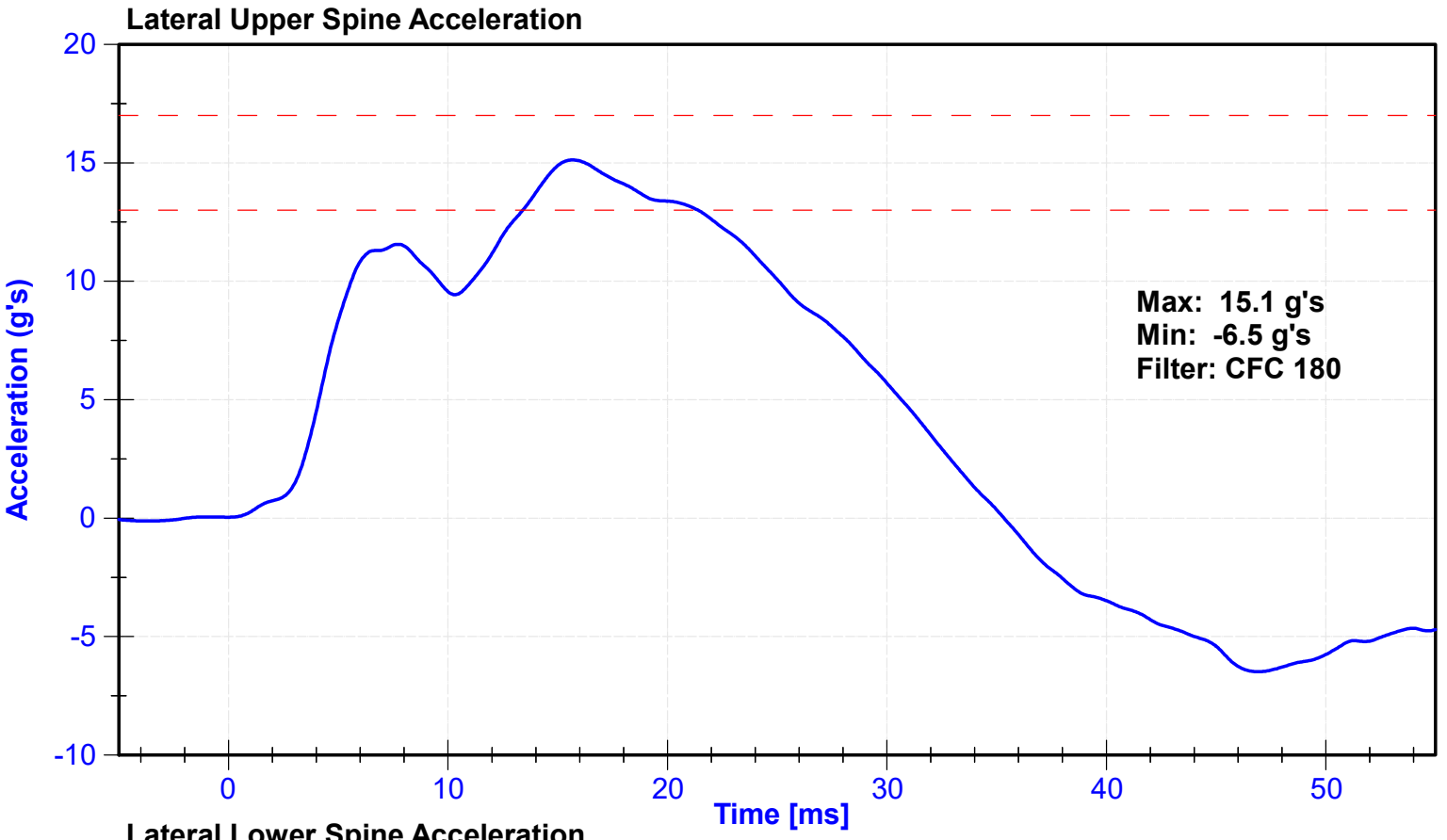
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18587	11/20/2023	11/19/2024
Upper Spine Y Accelerometer	Endevco	T20880	5/9/2024	11/5/2024
Lower Spine Y Accelerometer	Endevco	P52071	5/9/2024	11/5/2024
Upper Thorax Rib Potentiometer	Servo	2316GFE	5/9/2024	11/7/2024
Middle Thorax Rib Potentiometer	Servo	085GFE	5/9/2024	11/7/2024
Lower Thorax Rib Potentiometer	Servo	1156GFE	5/9/2024	11/7/2024

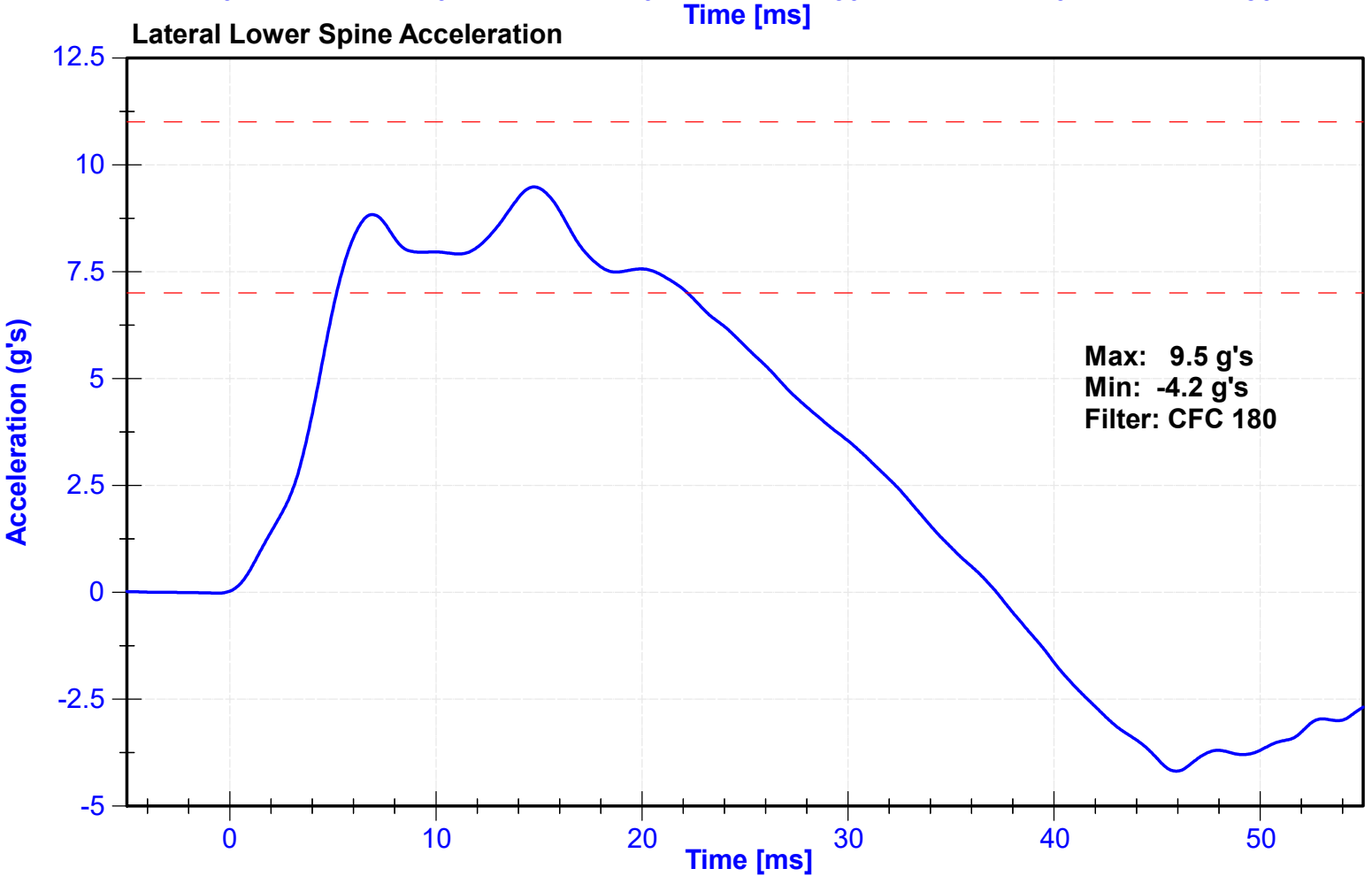



Upper Thorax Rib Displacement
Displacement (mm)
Time [ms]
Max: 35.8 mm
Min: 0.0 mm
Filter: CFC 600


Middle Thorax Rib Displacement
Displacement (mm)
Time [ms]
Max: 41.8 mm
Min: 0.0 mm
Filter: CFC 600


Lower Thorax Rib Displacement
Displacement (mm)
Time [ms]
Max: 38.6 mm
Min: 0.0 mm
Filter: CFC 600


Lateral Upper Spine Acceleration
Acceleration (g's)
Time [ms]
Max: 15.1 g's
Min: -6.5 g's
Filter: CFC 180


Lateral Lower Spine Acceleration
Acceleration (g's)
Time [ms]
Max: 9.5 g's
Min: -4.2 g's
Filter: CFC 180

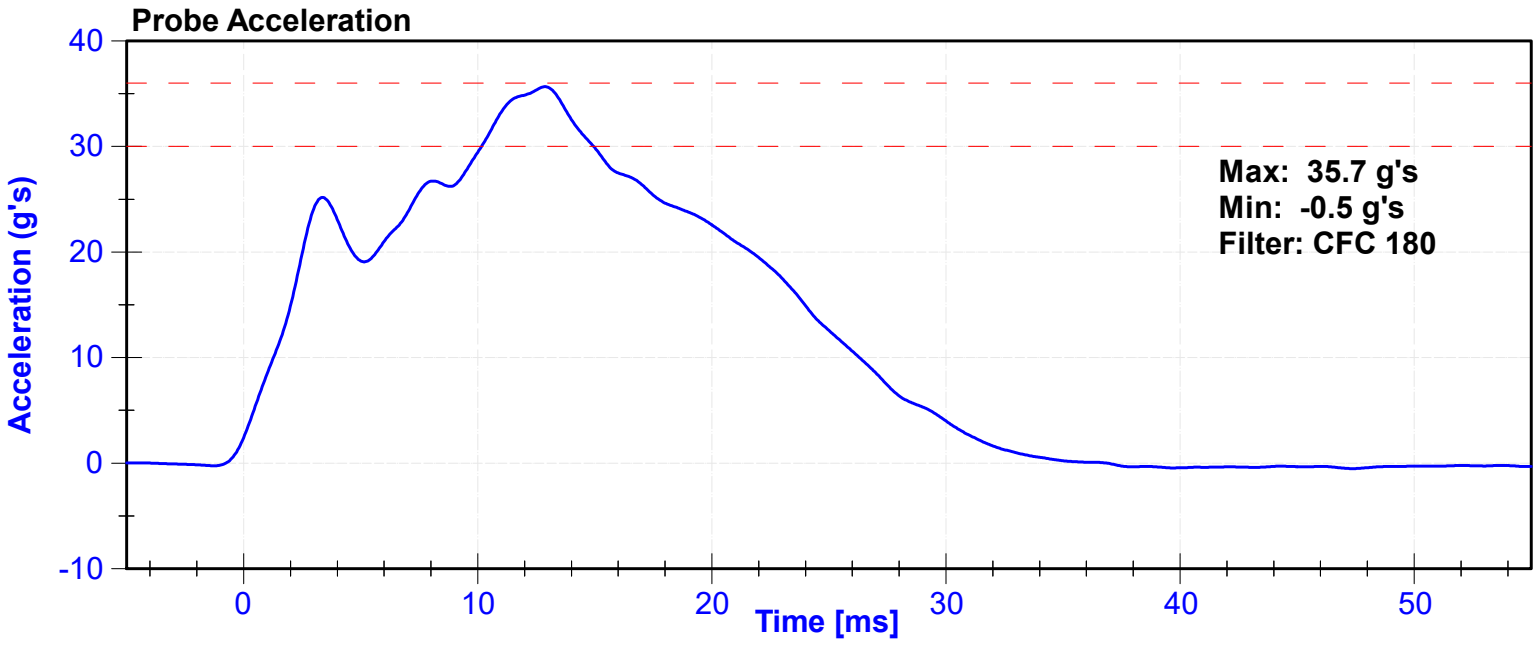
ATD Manufacturer	FTSS	Test Technician	D. Sakona
ATD Serial Number	300	Laboratory Supervisor	C. Mantell

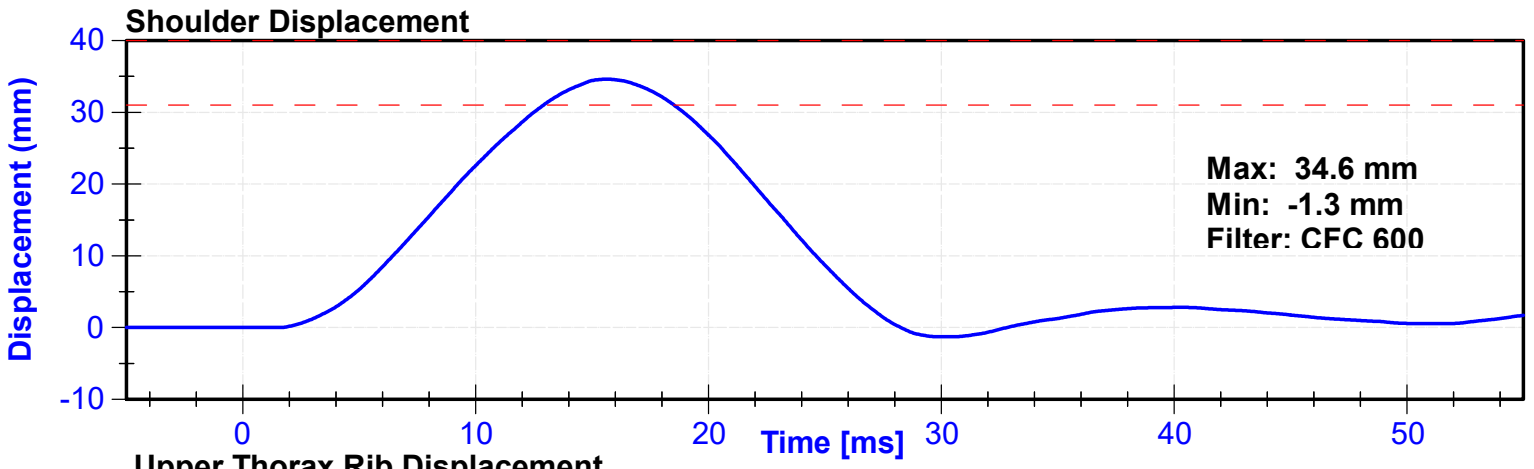
Results

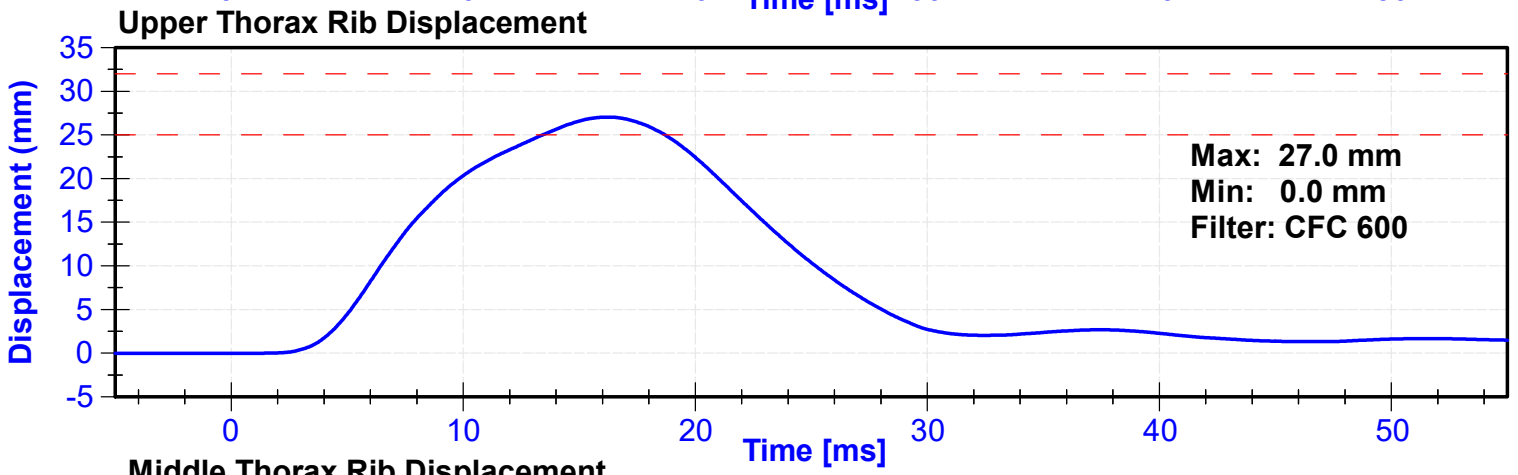
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.0	Pass
Humidity	10	70	%	46	Pass
Velocity	6.6	6.8	m/s	6.64	Pass
Probe Acceleration after 5 ms	30	36	g's	35.7	Pass
Lateral Upper Spine Acceleration	34	43	g's	36.2	Pass
Lateral Lower Spine Acceleration	29	37	g's	34.8	Pass
Shoulder Deflection	31	40	mm	34.6	Pass
Upper Thorax Rib Deflection	25	32	mm	27.0	Pass
Mid Thorax Rib Deflection	30	36	mm	30.6	Pass
Lower Thorax Rib Deflection	32	38	mm	32.6	Pass

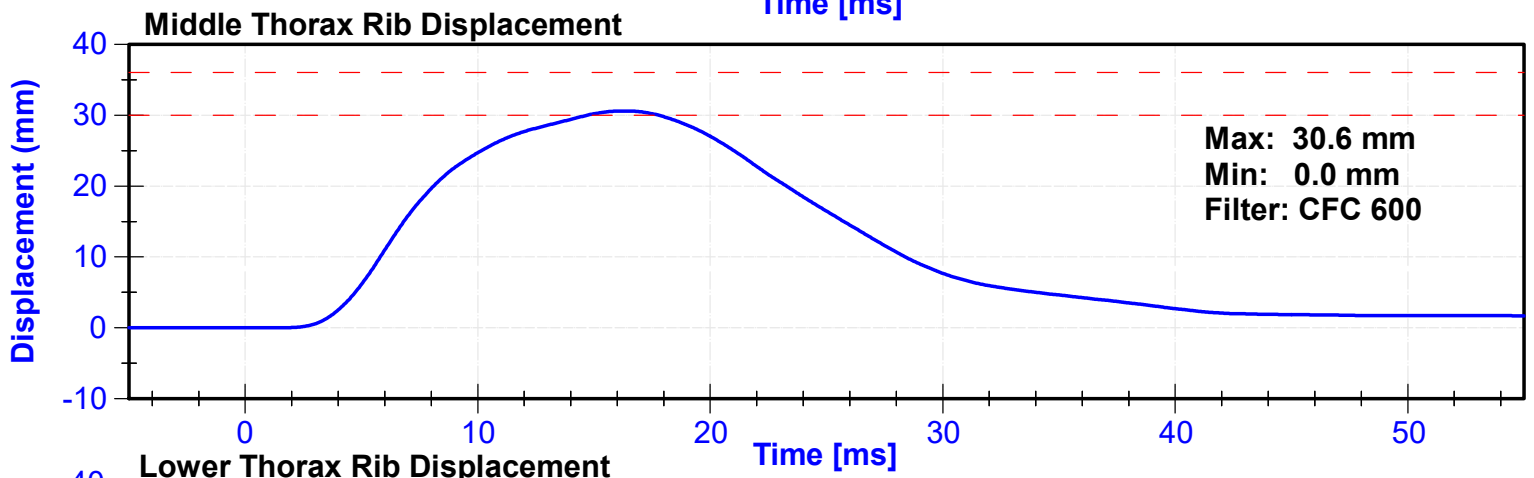
Transducer Calibrations

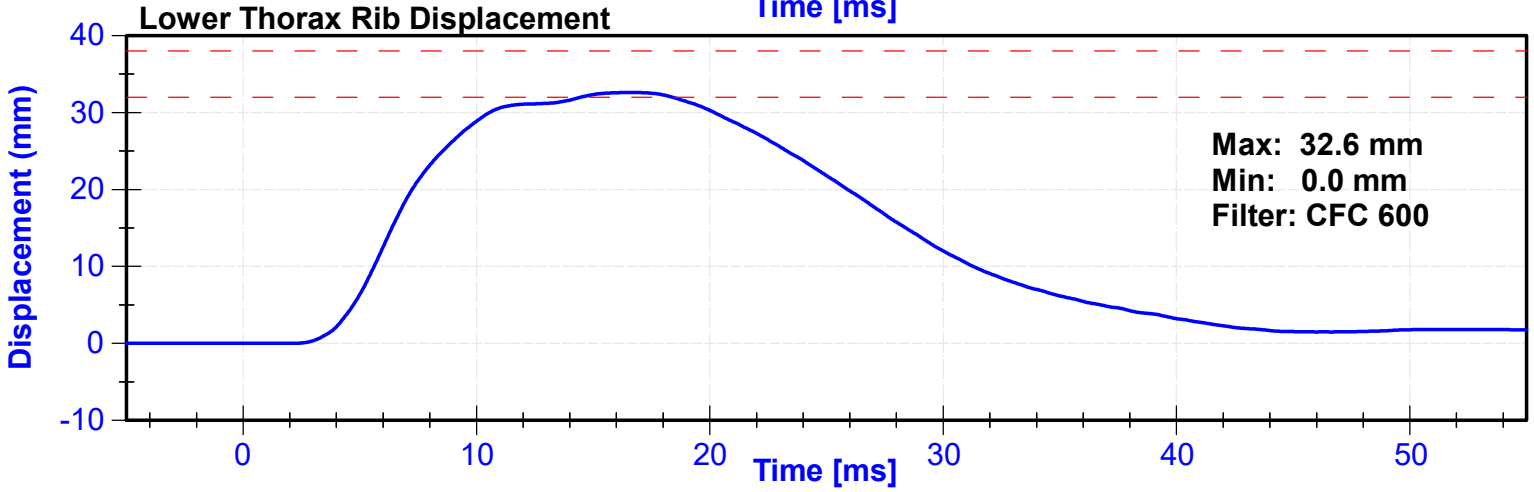
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18587	11/20/2023	11/19/2024
Upper Spine T1 Y Accelerometer	Endevco	T20880	5/9/2024	11/5/2024
Upper Spine T12 Y Accelerometer	Endevco	P52071	5/9/2024	11/5/2024
Shoulder Potentiometer	Servo	053GFE	5/9/2024	11/7/2024
Upper Thorax Rib Potentiometer	Servo	2316GFE	5/9/2024	11/7/2024
Middle Thorax Rib Potentiometer	Servo	085GFE	5/9/2024	11/7/2024
Lower Thorax Rib Potentiometer	Servo	1156GFE	5/9/2024	11/7/2024

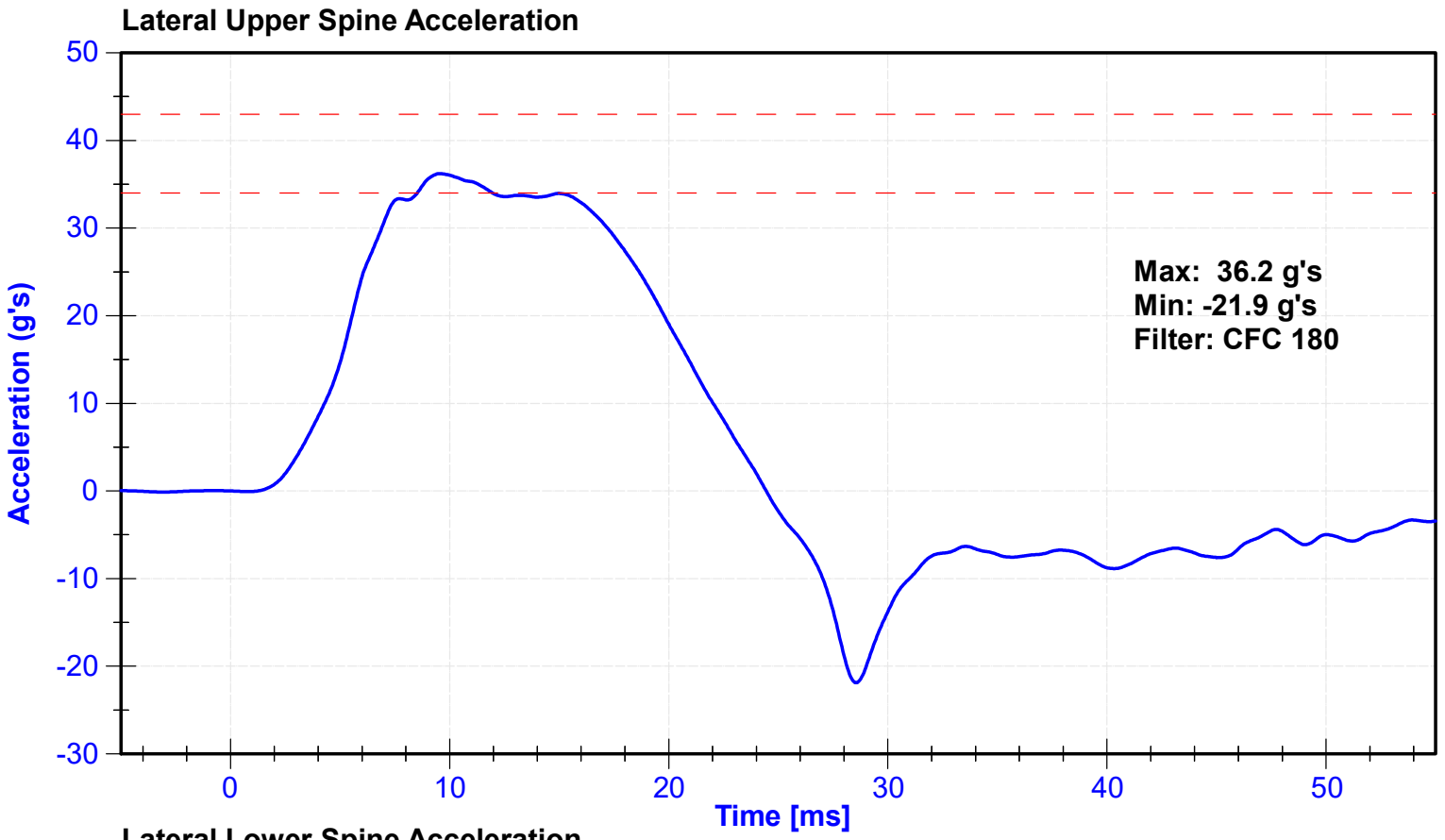


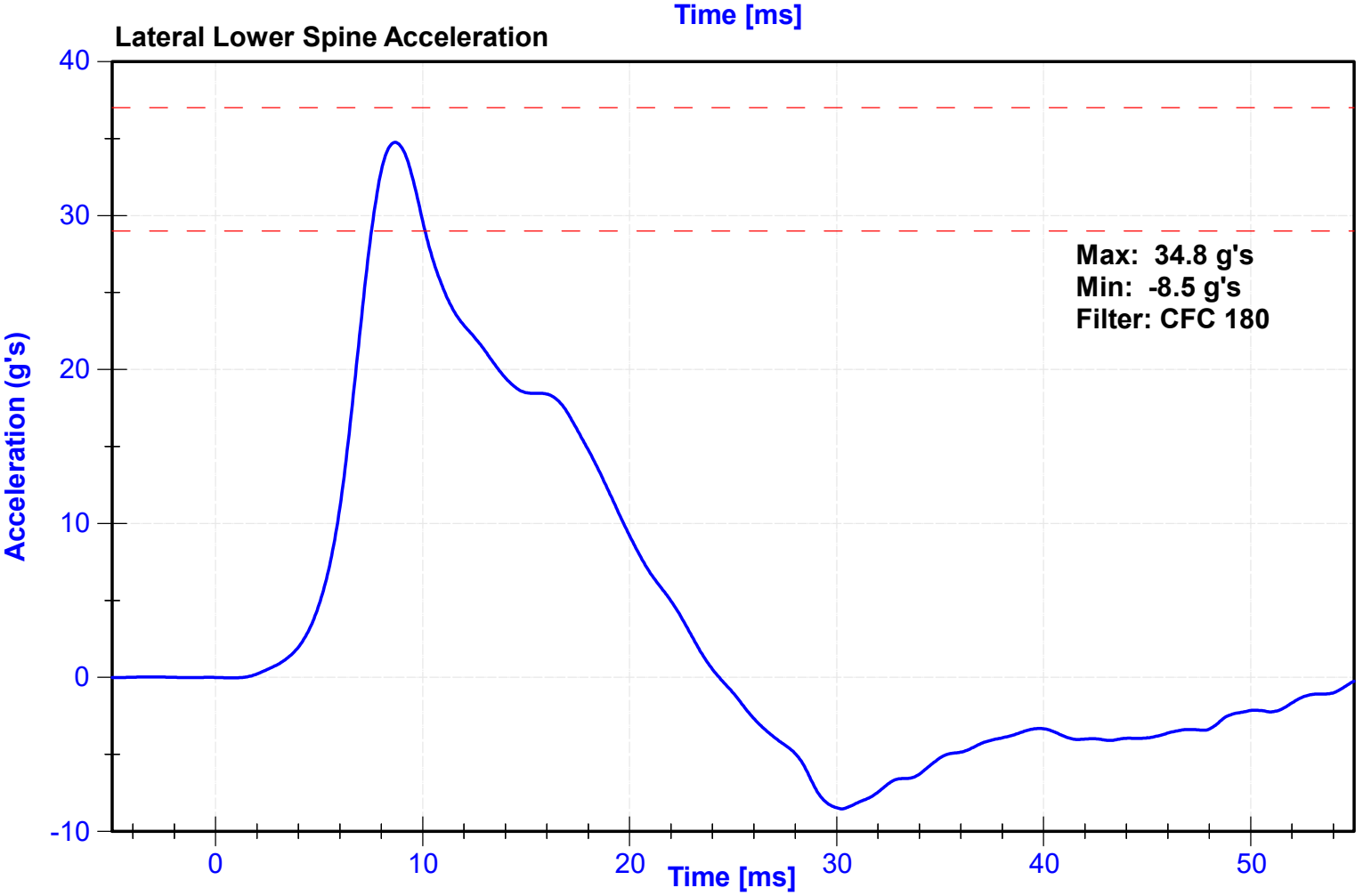

Shoulder Displacement
Displacement (mm)
Time [ms]
Max: 34.6 mm
Min: -1.3 mm
Filter: CFC 600


Upper Thorax Rib Displacement
Displacement (mm)
Time [ms]
Max: 27.0 mm
Min: 0.0 mm
Filter: CFC 600


Middle Thorax Rib Displacement
Displacement (mm)
Time [ms]
Max: 30.6 mm
Min: 0.0 mm
Filter: CFC 600


Lower Thorax Rib Displacement
Displacement (mm)
Time [ms]
Max: 32.6 mm
Min: 0.0 mm
Filter: CFC 600


Lateral Upper Spine Acceleration
Acceleration (g's)
50
40
30
20
10
0
-10
-20
-30
0
10
20
30
40
50
Time [ms]
Max: 36.2 g's
Min: -21.9 g's
Filter: CFC 180


Lateral Lower Spine Acceleration
Acceleration (g's)
40
30
20
10
0
-10
0
10
20
30
40
50
Time [ms]
Max: 34.8 g's
Min: -8.5 g's
Filter: CFC 180

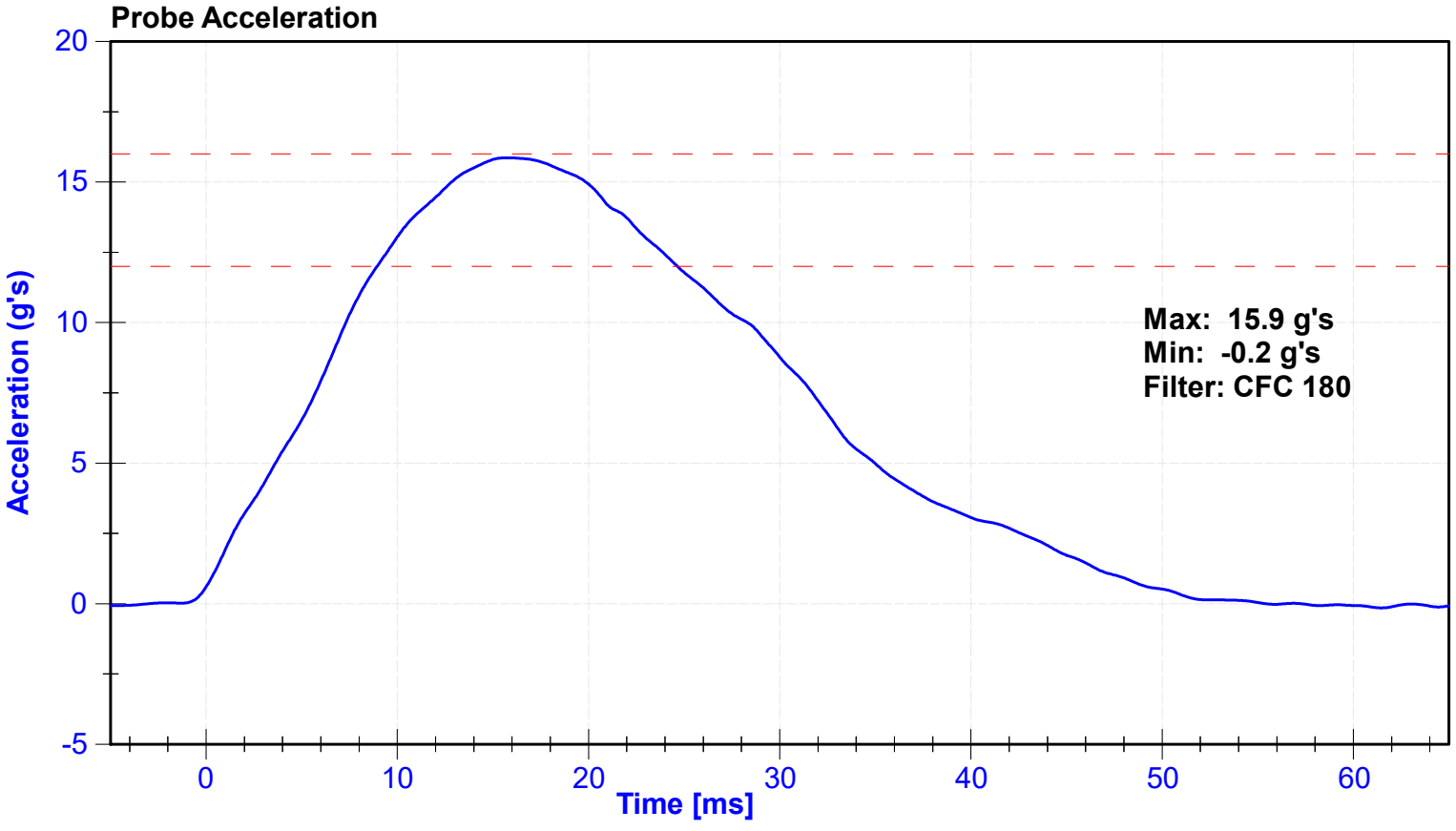
ATD Manufacturer	FTSS	Test Technician	D. Sakona
ATD Serial Number	300	Laboratory Supervisor	C. Mantell

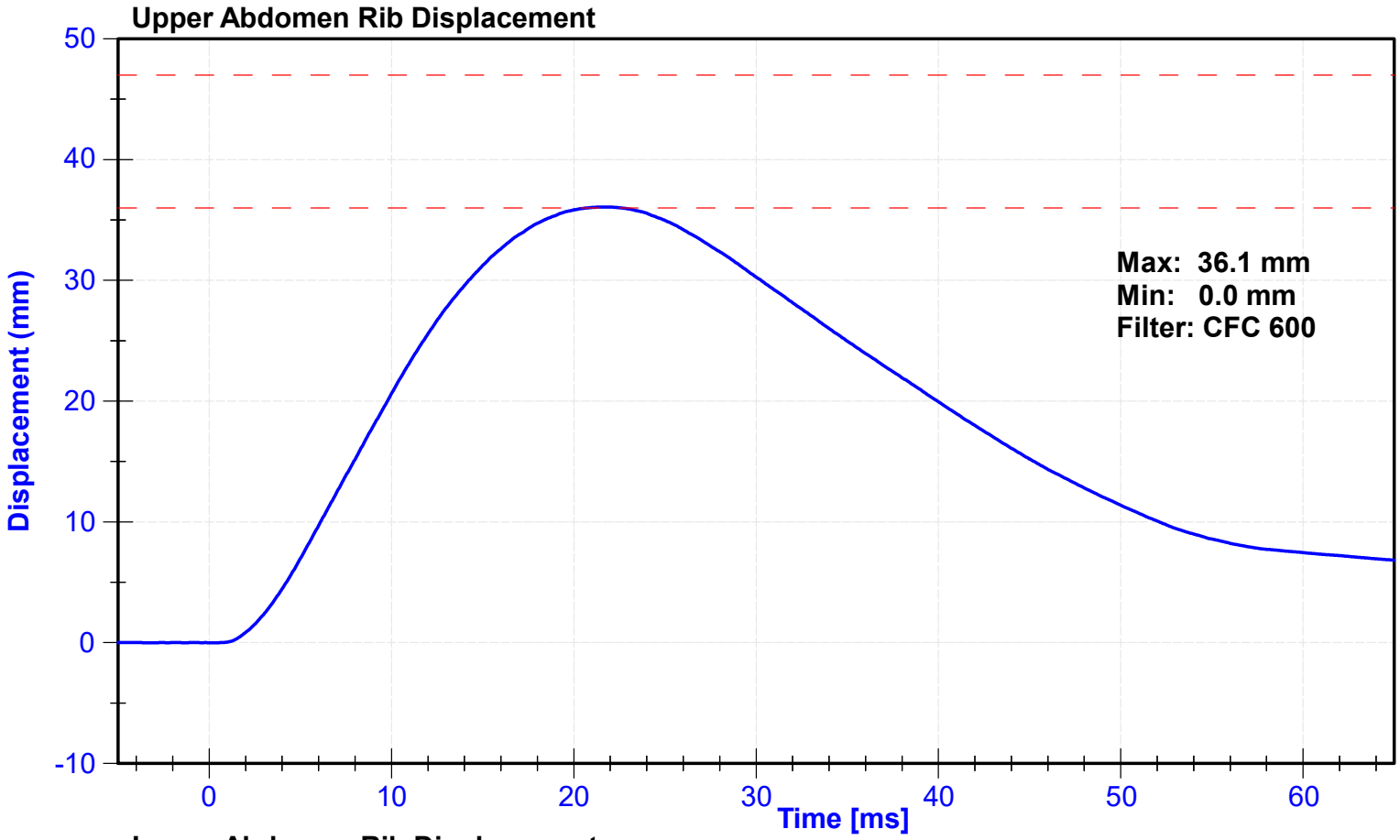
Results

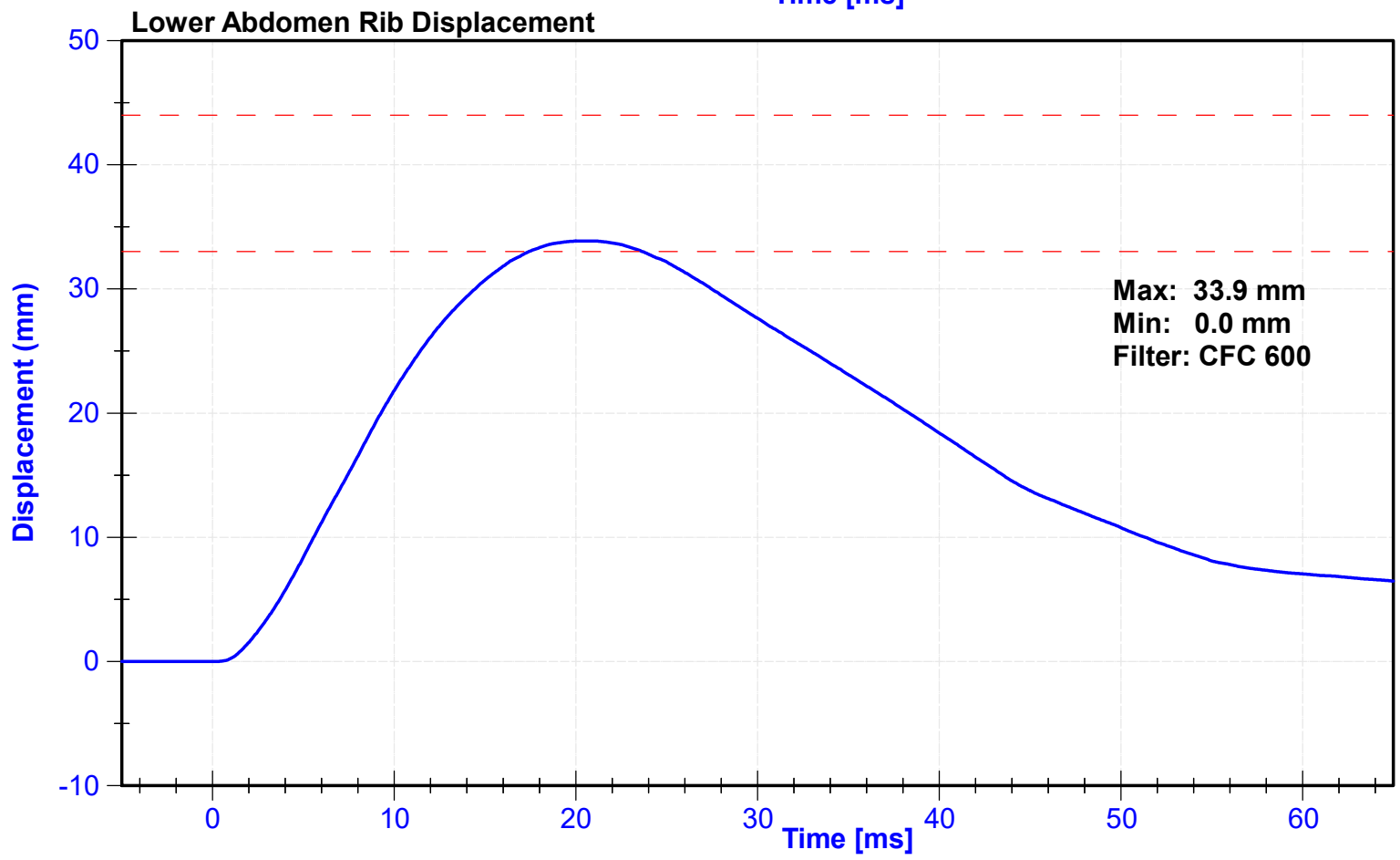
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.0	Pass
Humidity	10	70	%	46	Pass
Velocity	4.2	4.4	m/s	4.28	Pass
Probe Acceleration	12	16	g's	15.9	Pass
Lateral Lower Spine Acceleration	9	14	g's	12.5	Pass
Upper Abdomen Rib Deflection	36	47	mm	36.1	Pass
Lower Abdomen Rib Deflection	33	44	mm	33.9	Pass

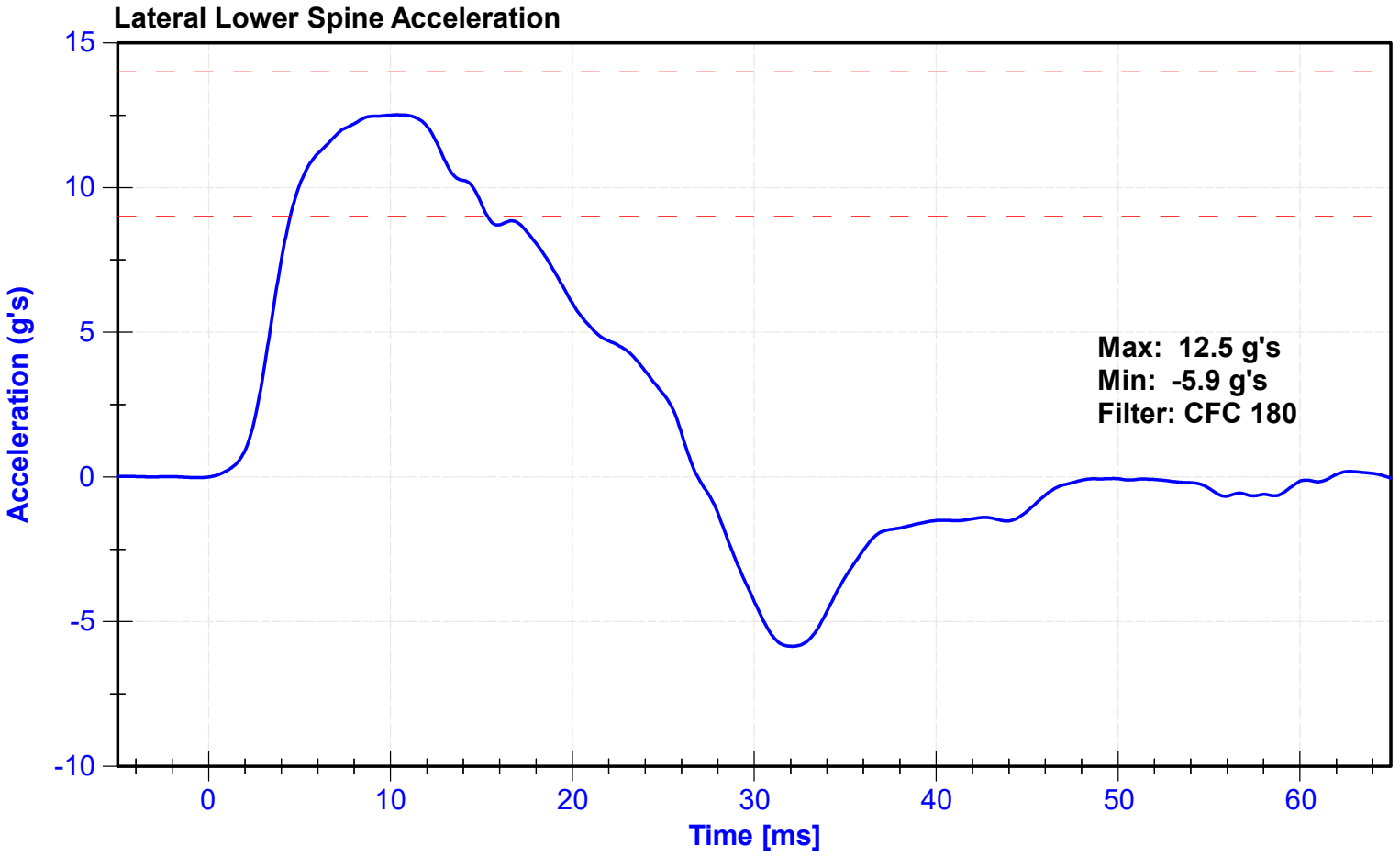
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Probe Accelerometer	Endevco	18587	11/20/2023	11/19/2024
Lower Spine Y Accelerometer	Endevco	P52071	5/9/2024	11/5/2024
Upper Abdomen Rib Potentiometer	Endevco	074GFE	5/28/2024	11/26/2024
Lower Abdomen Rib Potentiometer	Endevco	075GFE	5/9/2024	11/7/2024




Upper Abdomen Rib Displacement
Displacement (mm)
50
40
30
20
10
0
-10
0
10
20
30
40
50
60
Time [ms]
Max: 36.1 mm
Min: 0.0 mm
Filter: CFC 600


Lower Abdomen Rib Displacement
Displacement (mm)
50
40
30
20
10
0
-10
0
10
20
30
40
50
60
Time [ms]
Max: 33.9 mm
Min: 0.0 mm
Filter: CFC 600


Lateral Lower Spine Acceleration
Acceleration (g's)
15
10
5
0
-5
-10
0
10
20
30
40
50
60
Time [ms]
Max: 12.5 g's
Min: -5.9 g's
Filter: CFC 180

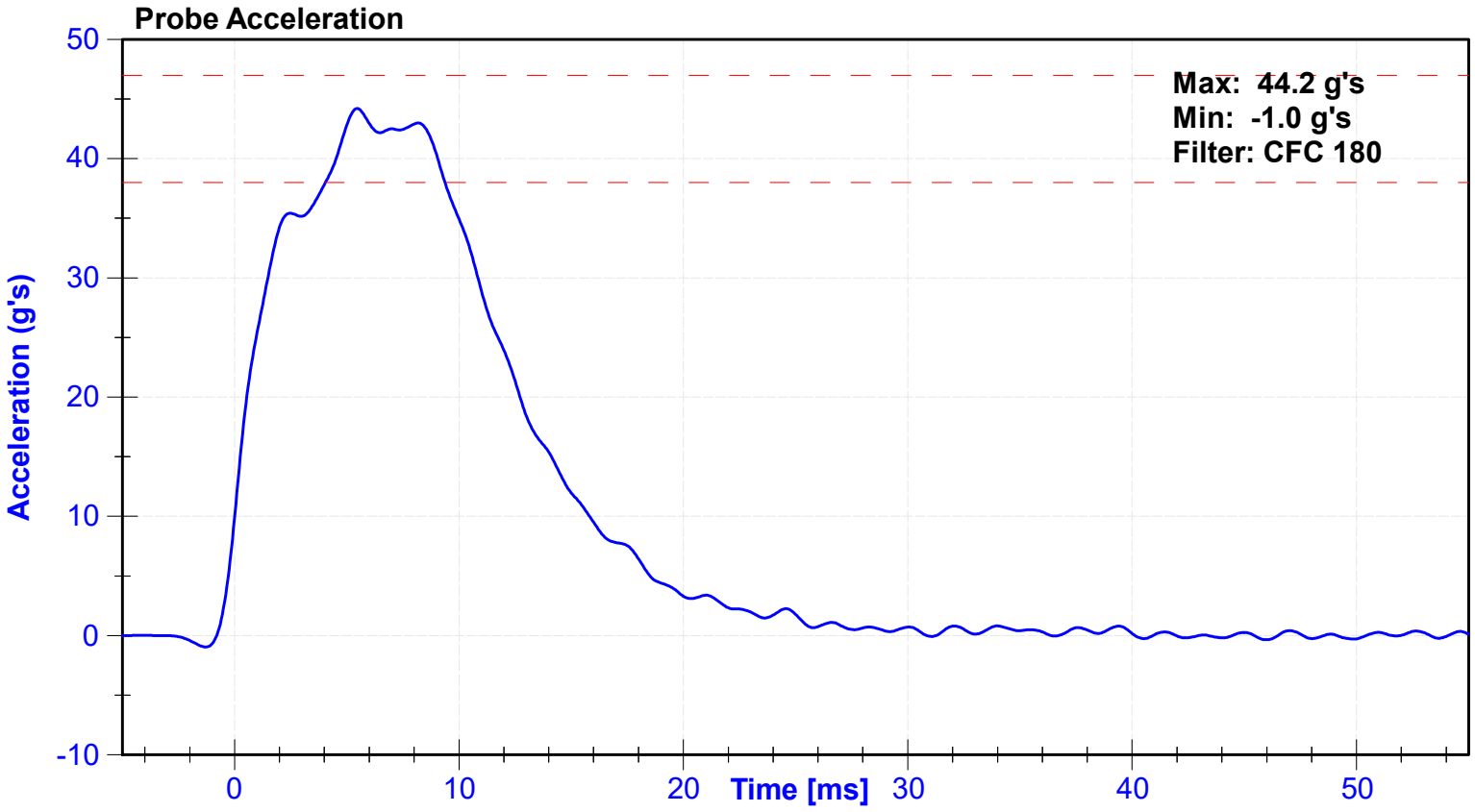
ATD Manufacturer	FTSS	Test Technician	D. Sakona
ATD Serial Number	300	Laboratory Supervisor	C. Mantell

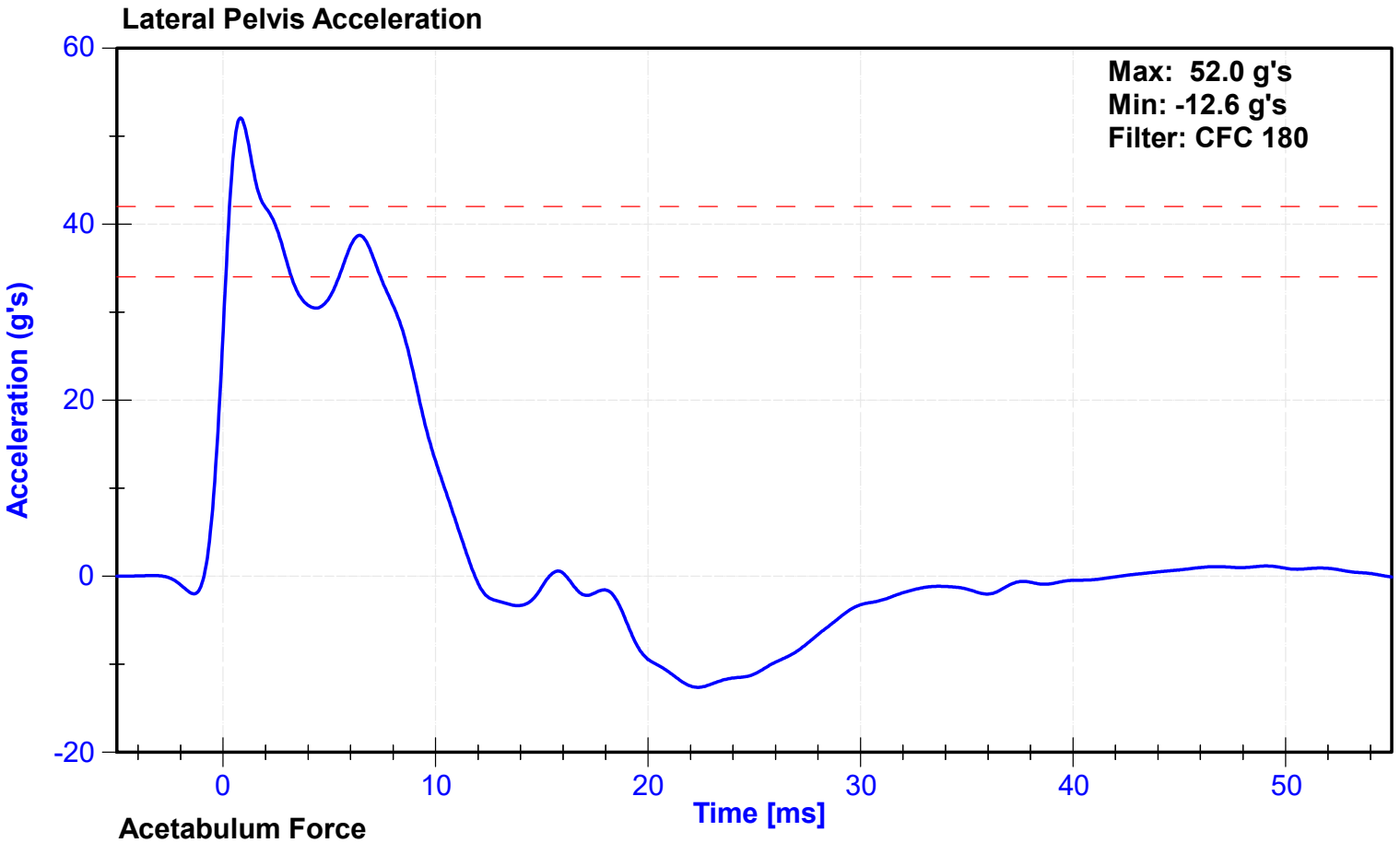
Results

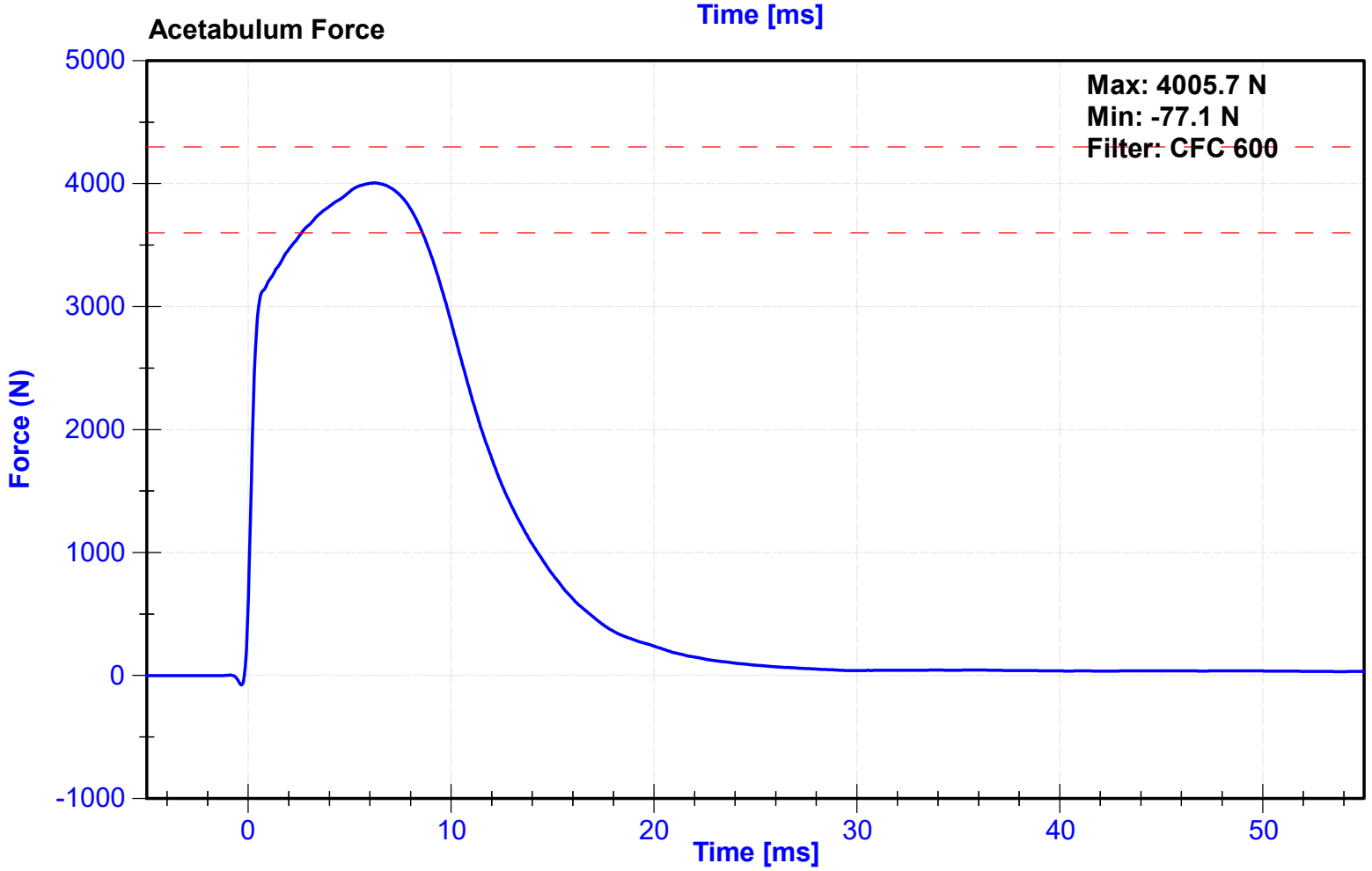
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.0	Pass
Humidity	10	70	%	46	Pass
Velocity	6.6	6.8	m/s	6.65	Pass
Probe Acceleration	38	47	g's	44.2	Pass
Lateral Pelvis Acceleration after 6ms	34	42	g's	38.7	Pass
Acetabulum Force	3600	4300	N	4005.7	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18587	11/20/2023	11/19/2024
Pelvis Y Accelerometer	Endevco	P51731	5/9/2024	11/5/2024
Acetabulum Load Cell	Denton	267-FY	9/11/2023	9/10/2024
Certification Plug	SACO			N/A
Crash Test Plug	SACO			N/A




Lateral Pelvis Acceleration
Max: 52.0 g's
Min: -12.6 g's
Filter: CFC 180
Acceleration (g's)
60
40
20
0
-20
0
10
20
30
40
50
Time [ms]


Acetabulum Force
Max: 4005.7 N
Min: -77.1 N
Filter: CFC 600
Force (N)
5000
4000
3000
2000
1000
0
-1000
0
10
20
30
40
50
Time [ms]

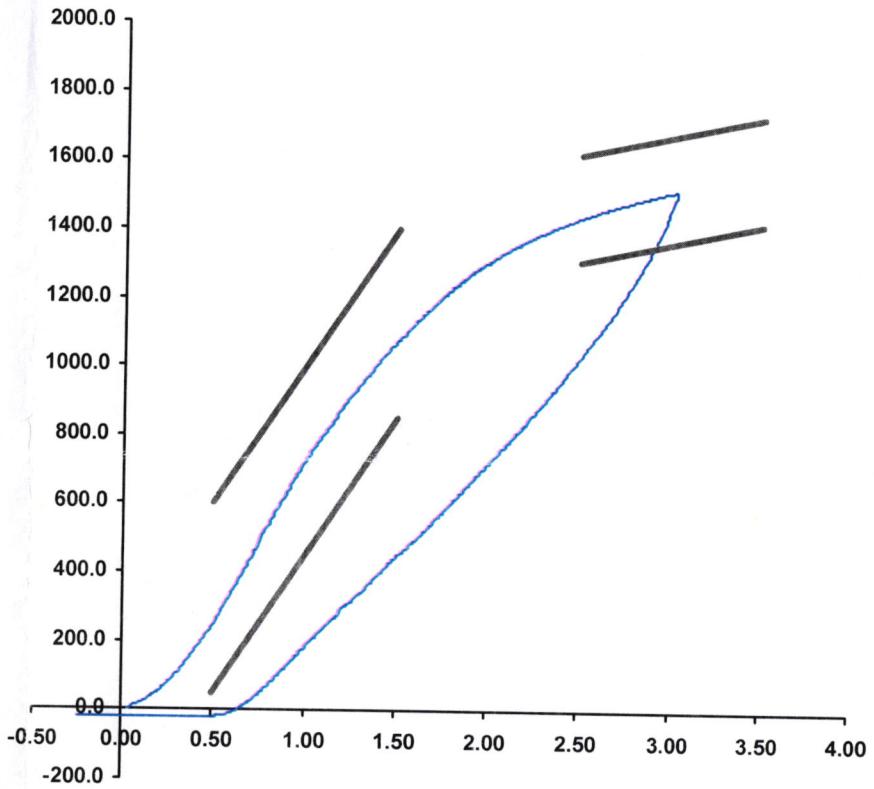
Cert 5/29/24

SID-IIs Pelvis Plug Certification Test

Plug S/N 16546
Test Number 23330
Report Number 23387
Test Date 7/15/2022 9:16:46 AM

	Test Results	Spec Min	Spec Max
Force @ 0.5 mm (N)	253	50	600
Force @ 1.5 mm (N)	1,074	850	1,400
Force @ 2.5 mm (N)	1,435	1,306	1,618
Force @ 3.0 mm (N)	1,512	1,361	1,673

Force (-N) vs Extension (-mm)



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-Jul-22
SACO Research

By : DC Date : 7/15/22

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

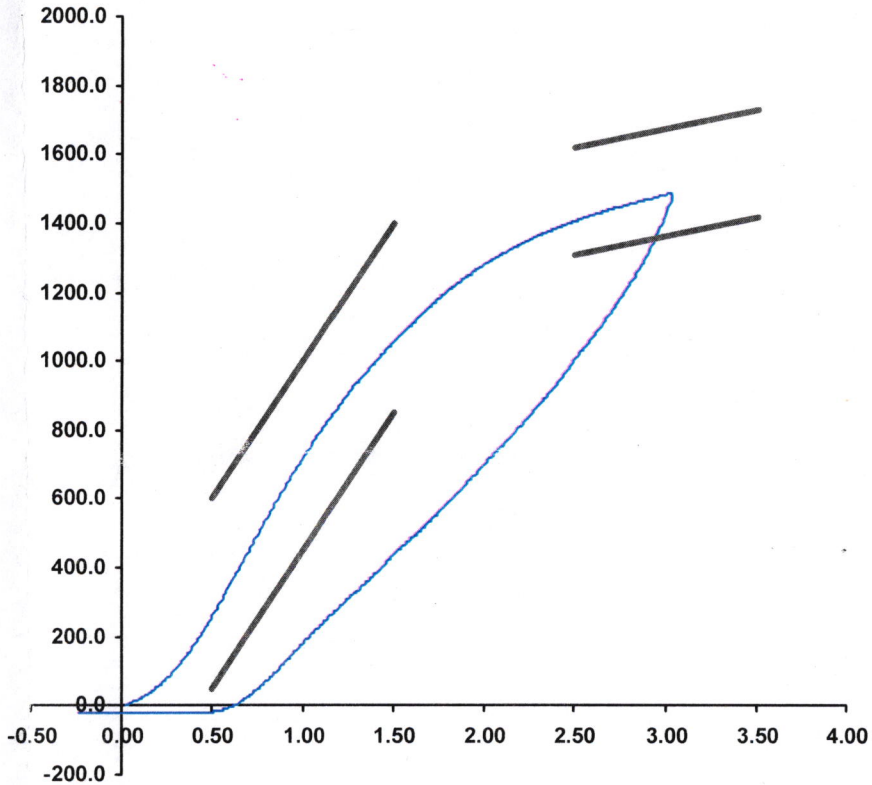
Crash 5/29/24

SID-IIs Pelvis Plug Certification Test

Plug S/N 16536
Test Number 23320
Report Number 23377
Test Date 7/15/2022 8:55:45 AM

	Test Results	Spec Min	Spec Max
Force @ 0.5 mm (N)	260	50	600
Force @ 1.5 mm (N)	1,060	850	1,400
Force @ 2.5 mm (N)	1,408	1,306	1,618
Force @ 3.0 mm (N)	1,483	1,361	1,673

Force (-N) vs Extension (-mm)



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-Jul-22
SACO Research

By : DC Date : 7/15/22

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

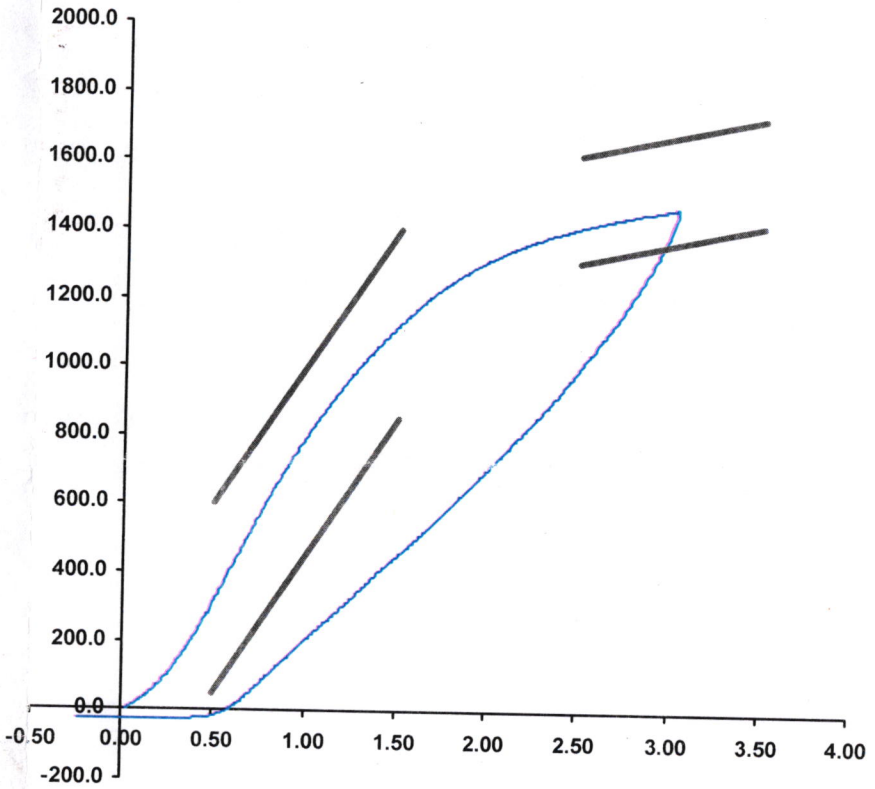
Non Impact
5/29/24

SID-IIs Pelvis Plug Certification Test

Plug S/N 16616
Test Number 23381
Report Number 23438
Test Date 7/20/2022 11:30:16 AM

	Test Results	Spec Min	Spec Max
Force @ 0.5 mm (N)	320	50	600
Force @ 1.5 mm (N)	1,122	850	1,400
Force @ 2.5 mm (N)	1,410	1,306	1,618
Force @ 3.0 mm (N)	1,465	1,361	1,673

Force (-N) vs Extension (-mm)



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 20-Jul-22
SACO Research

By : DC Date : 7/20/21

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

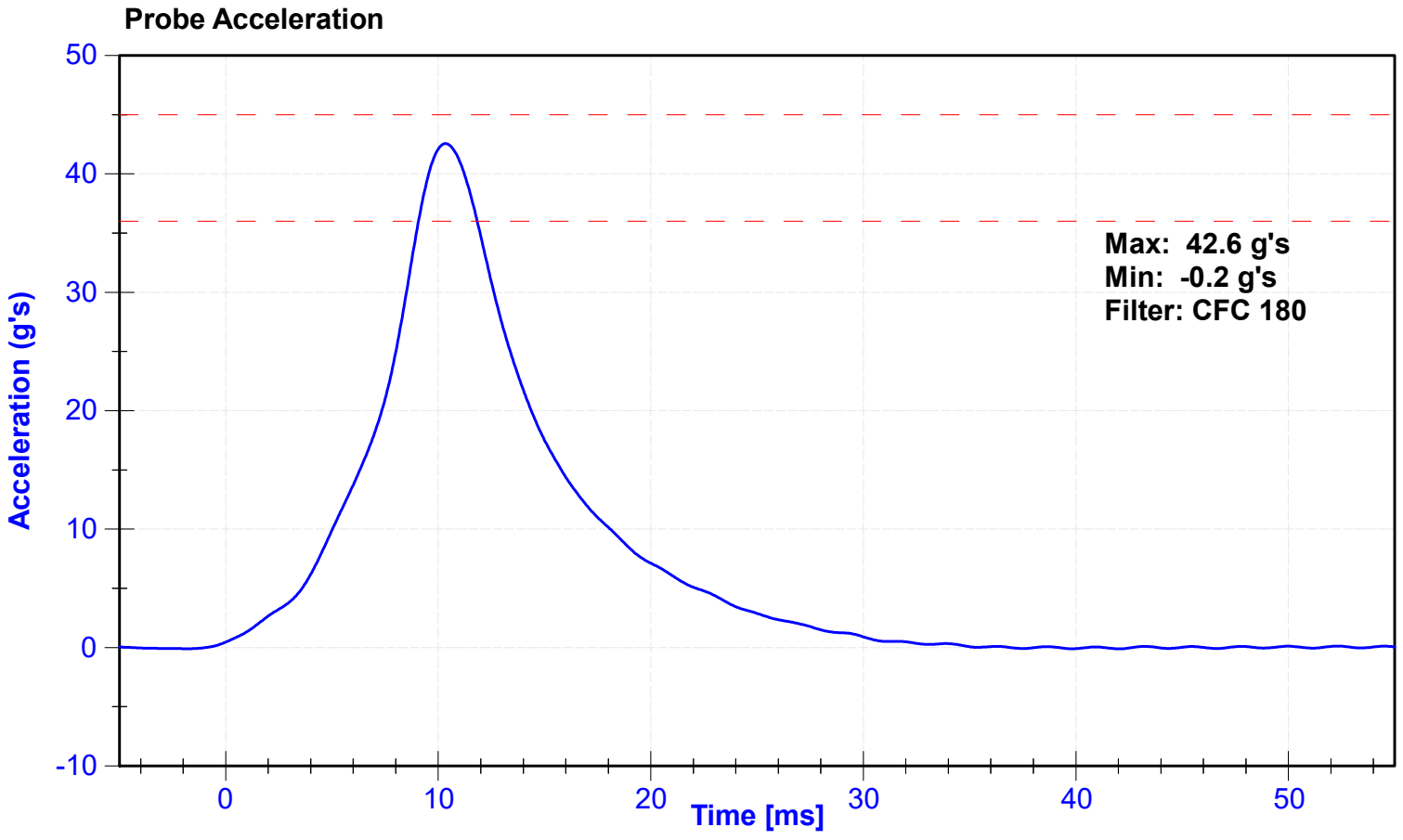
ATD Manufacturer	FTSS	Test Technician	D. Sakona
ATD Serial Number	300	Laboratory Supervisor	C. Mantell

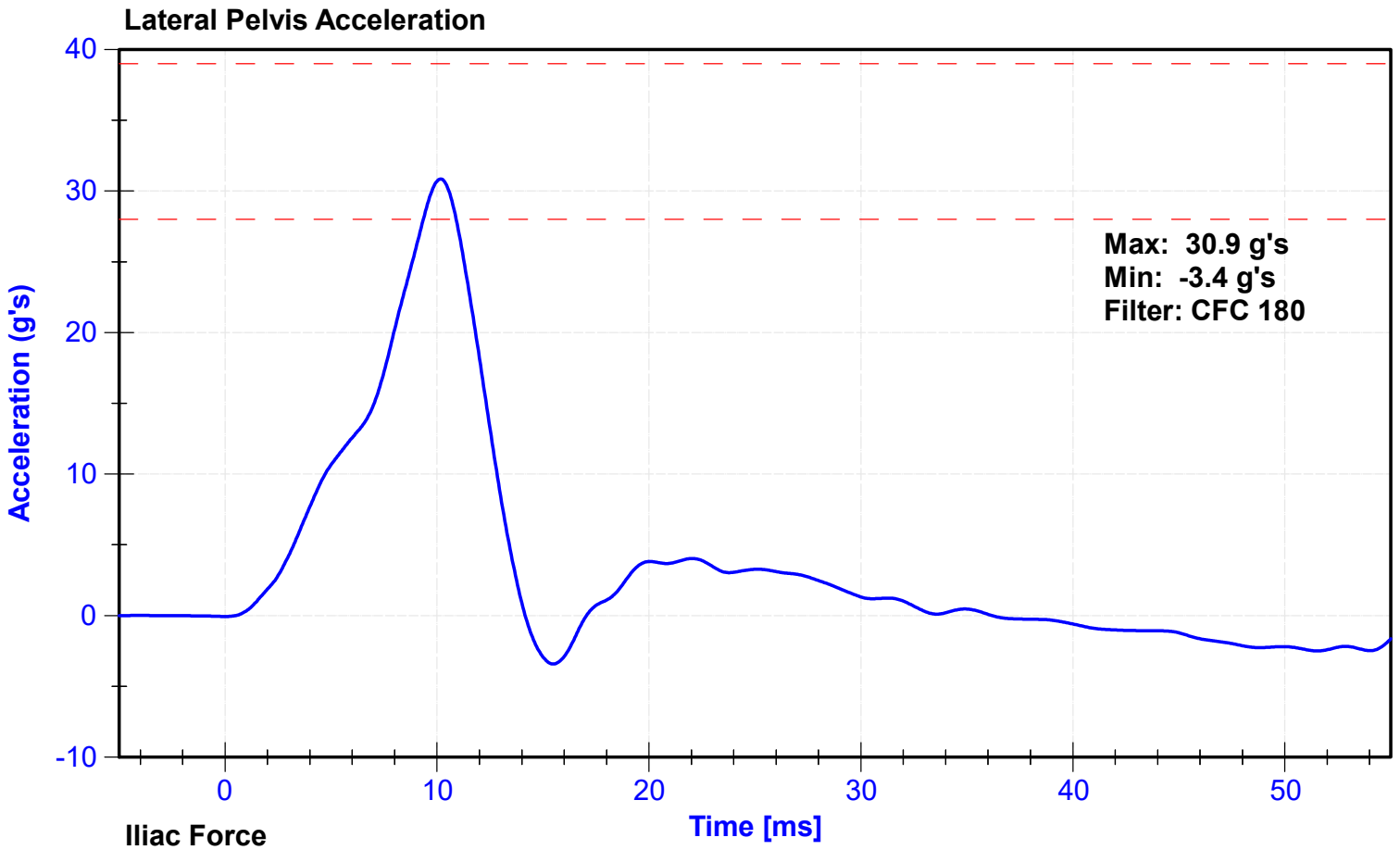
Results

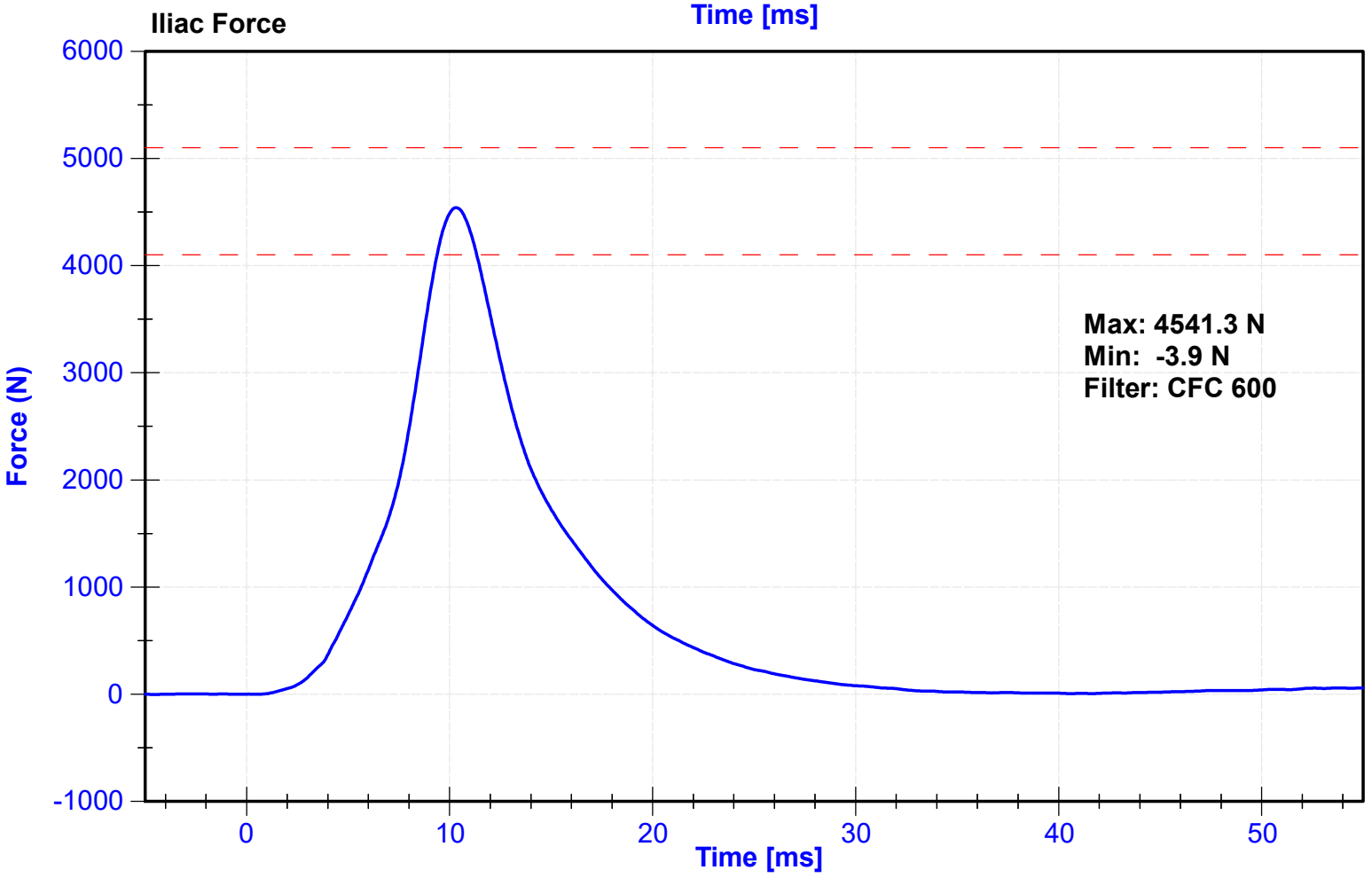
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.0	Pass
Humidity	10	70	%	46	Pass
Velocity	4.2	4.4	m/s	4.26	Pass
Probe Acceleration	36	45	g's	42.6	Pass
Lateral Pelvis Acceleration	28	39	g's	30.9	Pass
Iliac Force	4100	5100	N	4541.3	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18587	11/20/2023	11/19/2024
Pelvis Y Accelerometer	Endevco	P51731	5/9/2024	11/5/2024
Iliac Load Cell	Denton	321	9/11/2023	9/10/2024




Lateral Pelvis Acceleration
Acceleration (g's)
40
30
20
10
0
-10
0
10
20
30
40
50
Time [ms]
Max: 30.9 g's
Min: -3.4 g's
Filter: CFC 180


Iliac Force
Force (N)
6000
5000
4000
3000
2000
1000
0
-1000
0
10
20
30
40
50
Time [ms]
Max: 4541.3 N
Min: -3.9 N
Filter: CFC 600

CALIBRATION TEST RESULTS

POST-TEST

EUROSID 2 (ES-2RE) MALE – DRIVER ATD

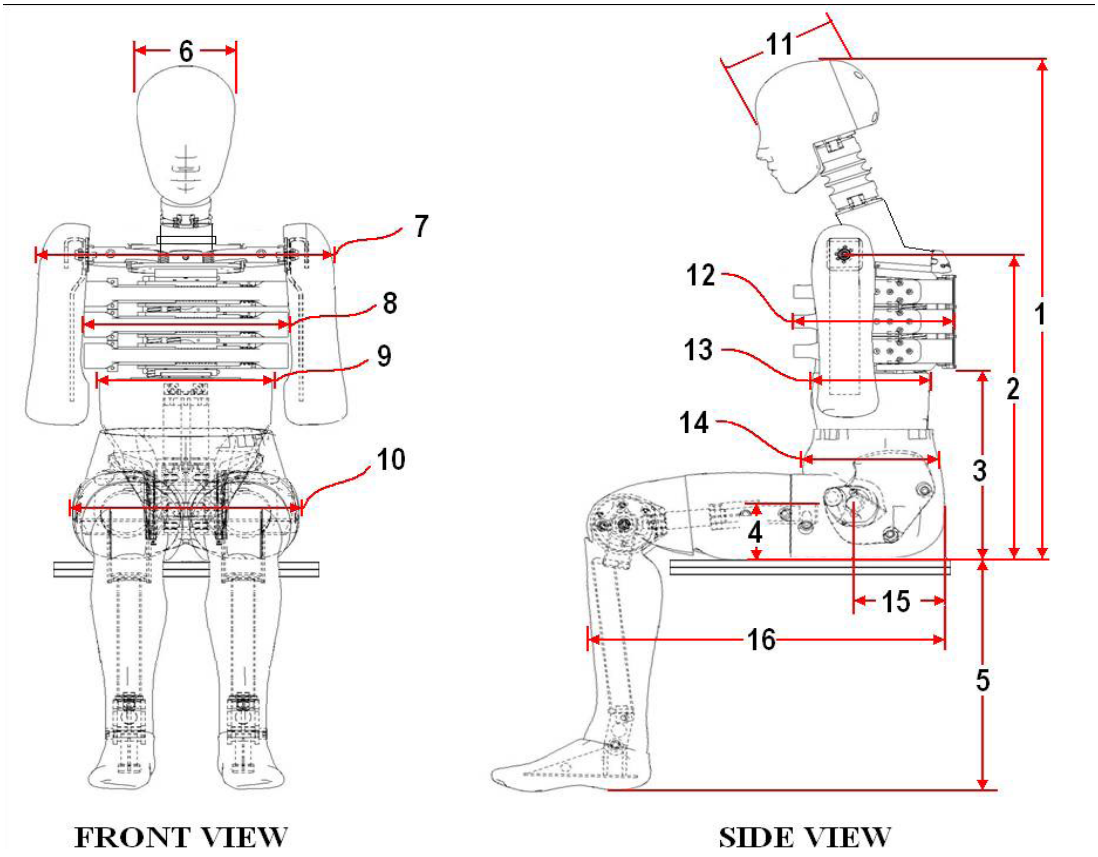
SERIAL NO:F033

(CONFIGURED FOR LEFT SIDE IMPACT)

External Measurements - EuroSID-2re

Technician: T. Roseman Date: 7/18/2024

Dummy Serial Number: F033



FRONT VIEW SIDE VIEW

Dim. No.	Description	Specification (mm)		Result (mm)	Pass/Fail
1	Sitting Height	900	918	915	Pass
2	Seat to Shoulder Joint	558	572	567	Pass
3	Seat to Lower Face of Thoracic Spine Box	346	356	352	Pass
4	Seat to Hip Joint (center of bolt)	97	103	99	Pass
5	Sole to Seat, Sitting	333	451	429	Pass
6	Head Width	152	158	156	Pass
7	Shoulder/Arm Width	461	479	472	Pass
8	Thorax Width	322	332	330	Pass
9	Abdomen Width	273	287	282	Pass
10	Pelvis Lap Width	359	373	370	Pass
11	Head Depth	196	206	200	Pass
12	Thorax Depth	262	272	269	Pass
13	Abdomen Depth	194	204	201	Pass
14	Pelvis Depth	235	245	241	Pass
15	Back of Buttocks to Hip Joint (center of bolt)	150	160	155	Pass
16	Back of Buttocks to Front Knee	597	615	611	Pass

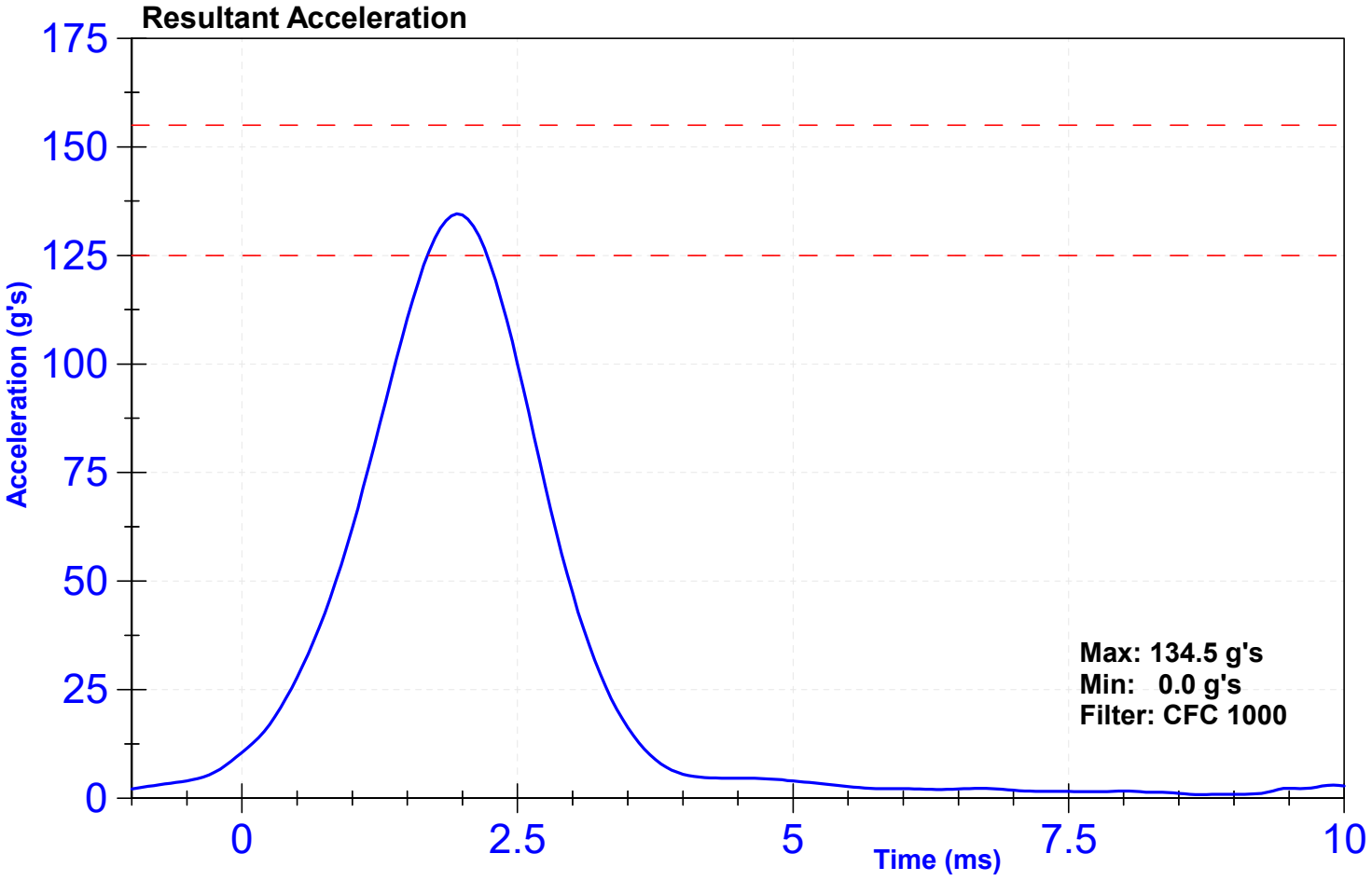
ATD Manufacturer	FTSS	Test Technician	J.Kinderman
ATD Serial Number	F033	Laboratory Supervisor	C. Mantell

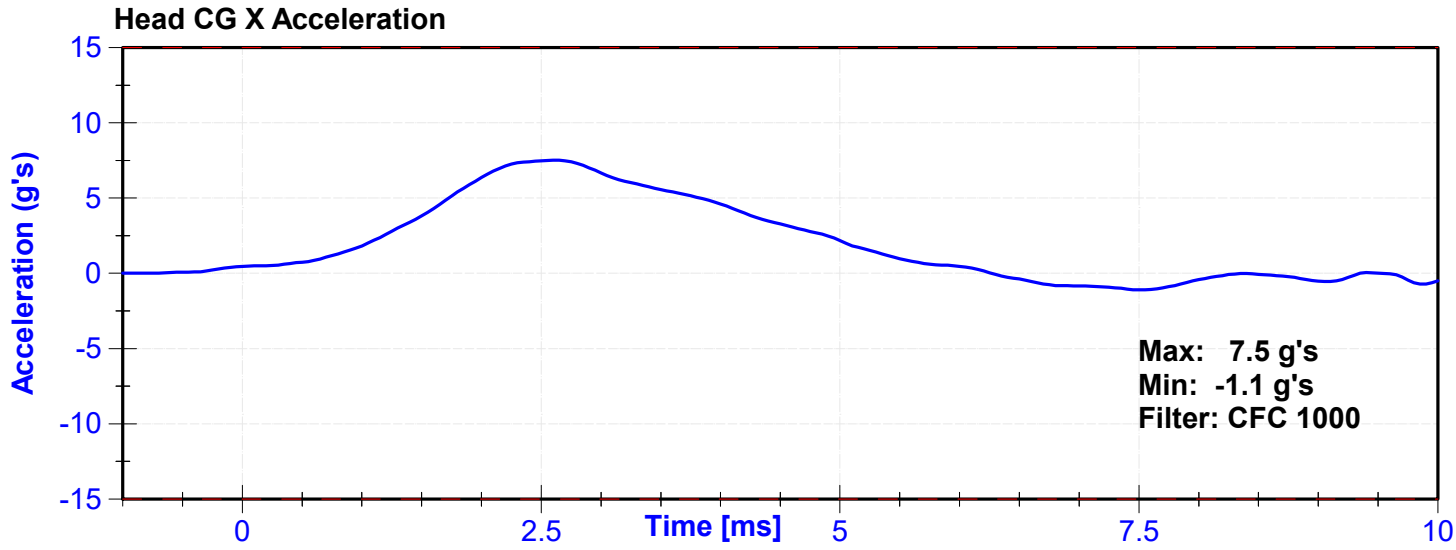
Results

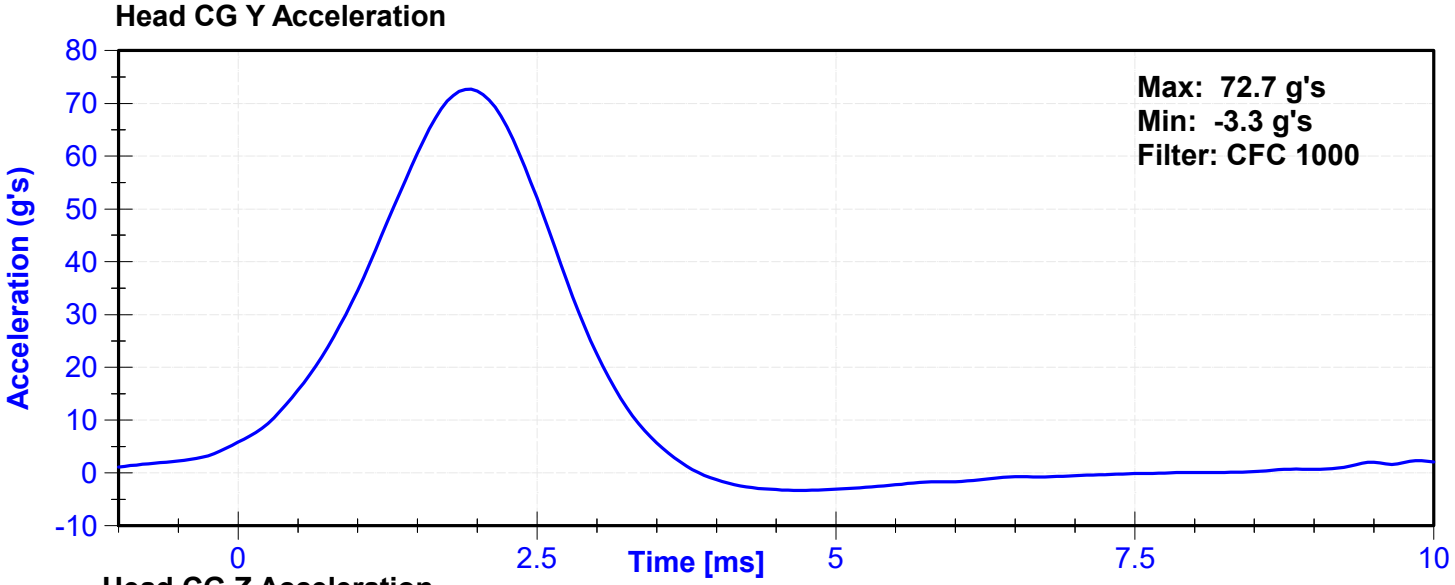
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21	Pass
Humidity	10	70	%	60	Pass
Resultant Acceleration	125	155	g's	134.5	Pass
Oscillation	0	15	%	2.45	Pass
Fore-Aft Acceleration	-15	15	g's	7.5	Pass

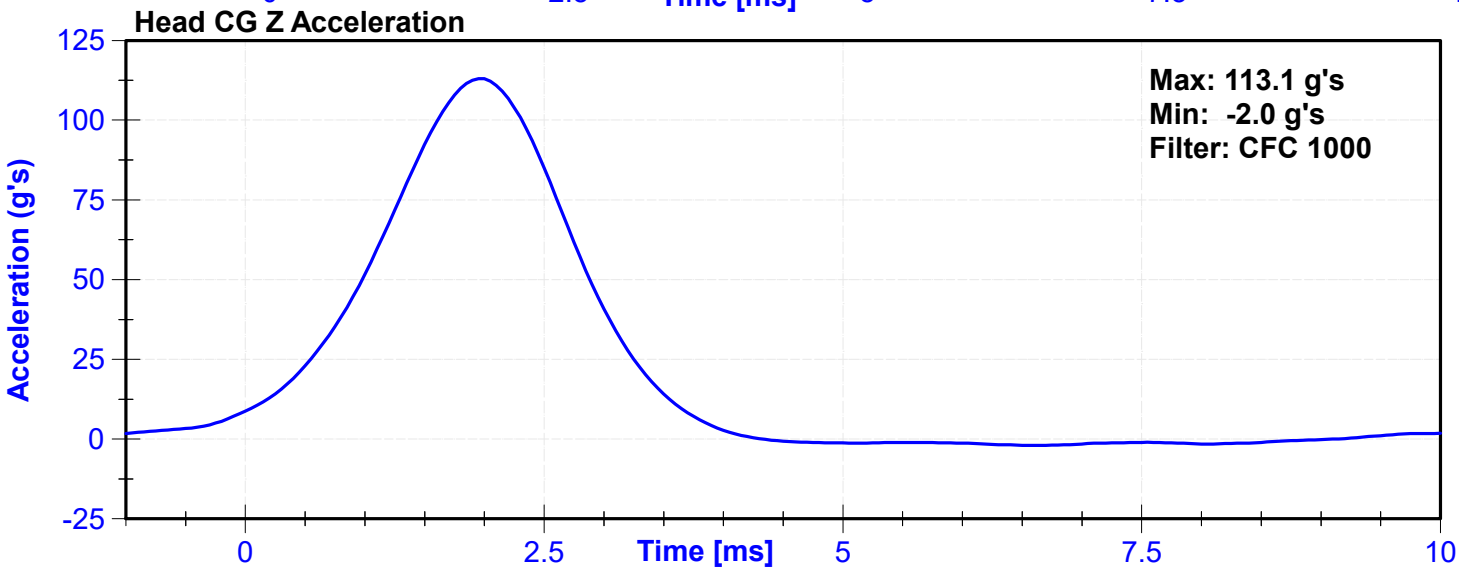
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	Endevco	P63861	5/6/2024	11/2/2024
Y Accelerometer	Endevco	P49216	5/6/2024	11/2/2024
Z Accelerometer	Endevco	P51303	5/6/2024	11/2/2024




Head CG X Acceleration
Acceleration (g's)
15
10
5
0
-5
-10
-15
0
2.5
Time [ms]
5
7.5
10
Max: 7.5 g's
Min: -1.1 g's
Filter: CFC 1000


Head CG Y Acceleration
Acceleration (g's)
80
70
60
50
40
30
20
10
0
-10
0
2.5
Time [ms]
5
7.5
10
Max: 72.7 g's
Min: -3.3 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: 113.1 g's
Min: -2.0 g's
Filter: CFC 1000

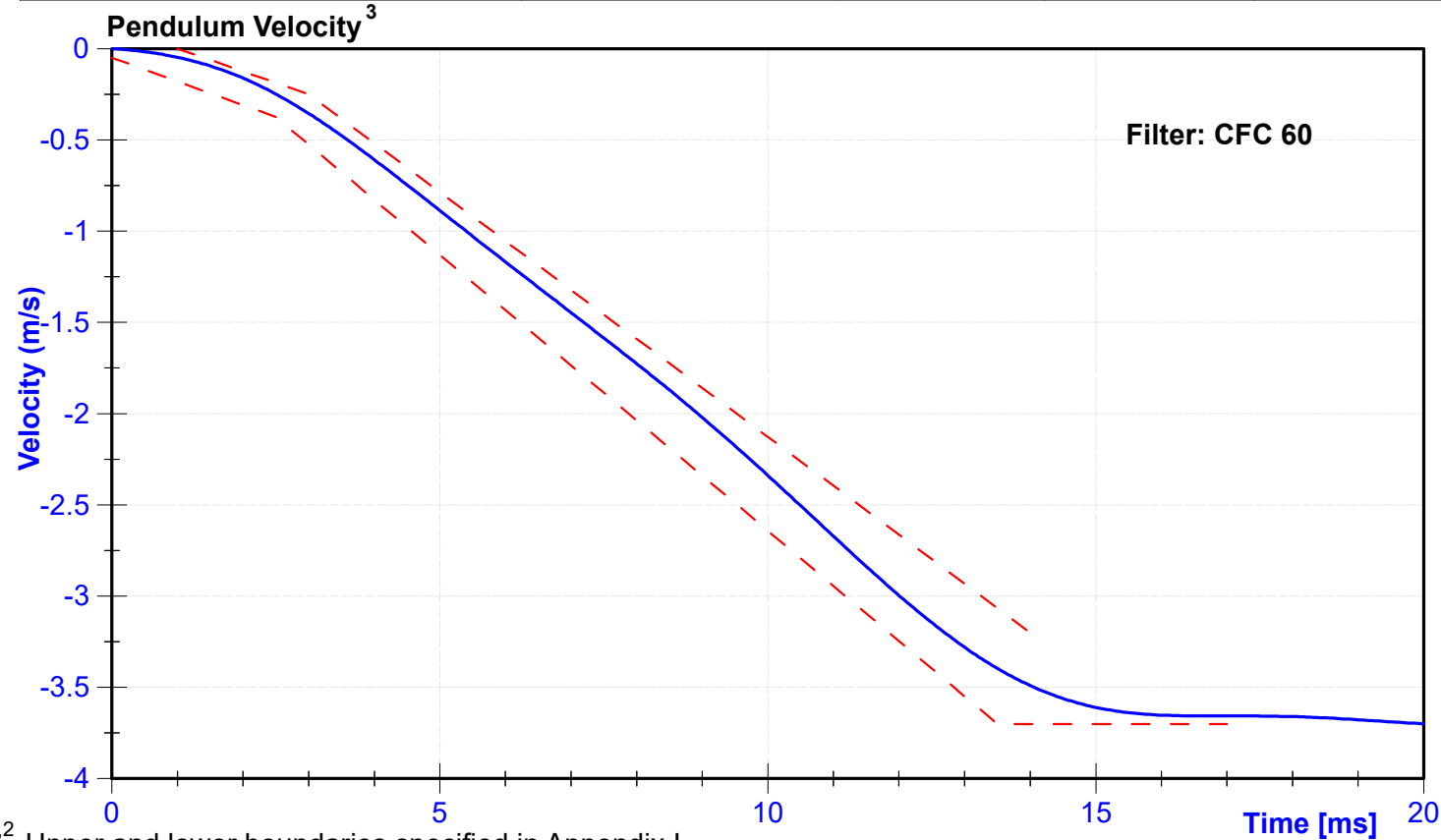
ATD Manufacturer	FTSS	Test Technician	J. Kinderman
ATD Serial Number	F033	Laboratory Supervisor	C. Mantell

Results

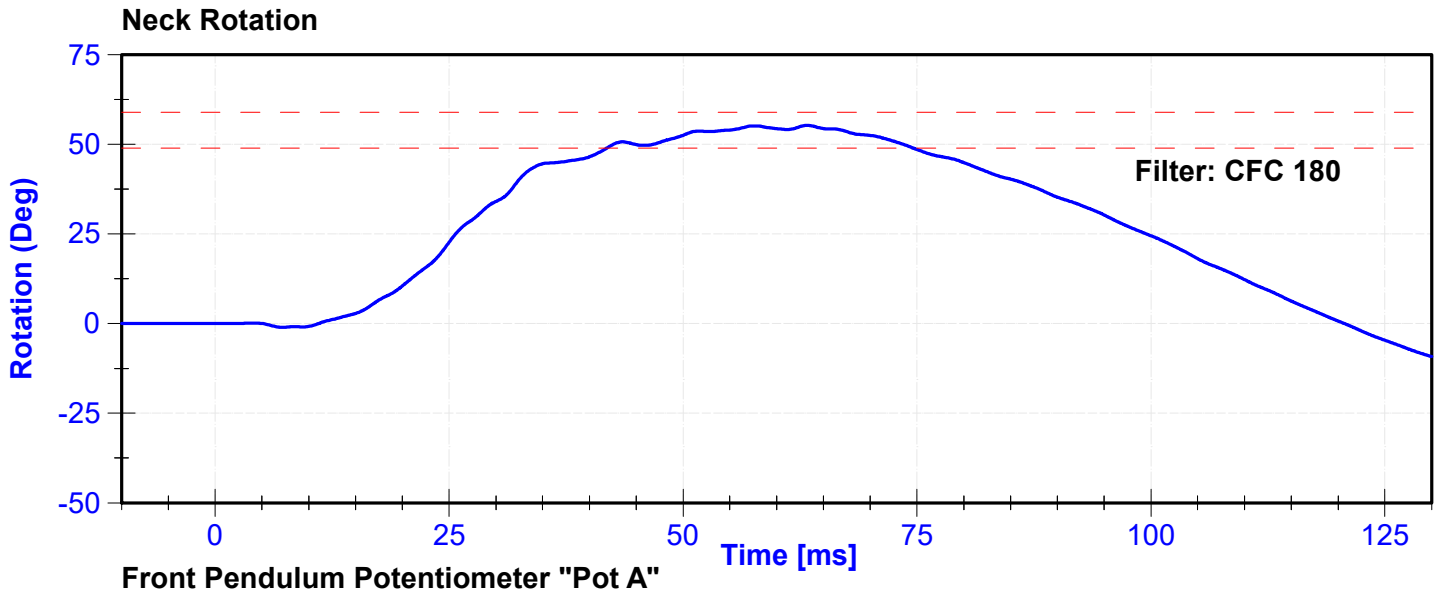
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.2	Pass
Humidity	10	70	%	57	Pass
Velocity	3.3	3.5	m/s	3.46	Pass
Lateral Neck Rotation	49	59	deg	55.3	Pass
Time at Maximum Rotation	54	66	ms	63.3	Pass
Time of Rotation Decay from Maximum	53	88	ms	57.5	Pass
Pendulum Velocity Overall Corridor	Lower Boundary[1]	Upper Boundary[2]	m/s	See Plot[3]	Pass

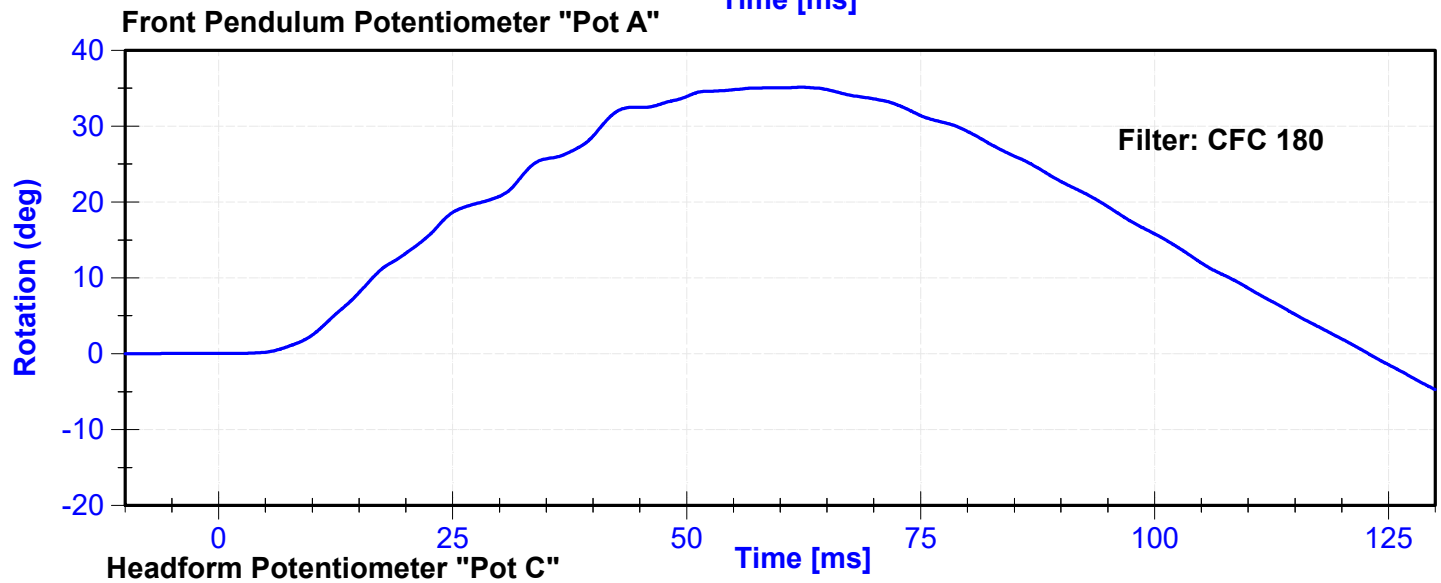
Transducer Calibrations

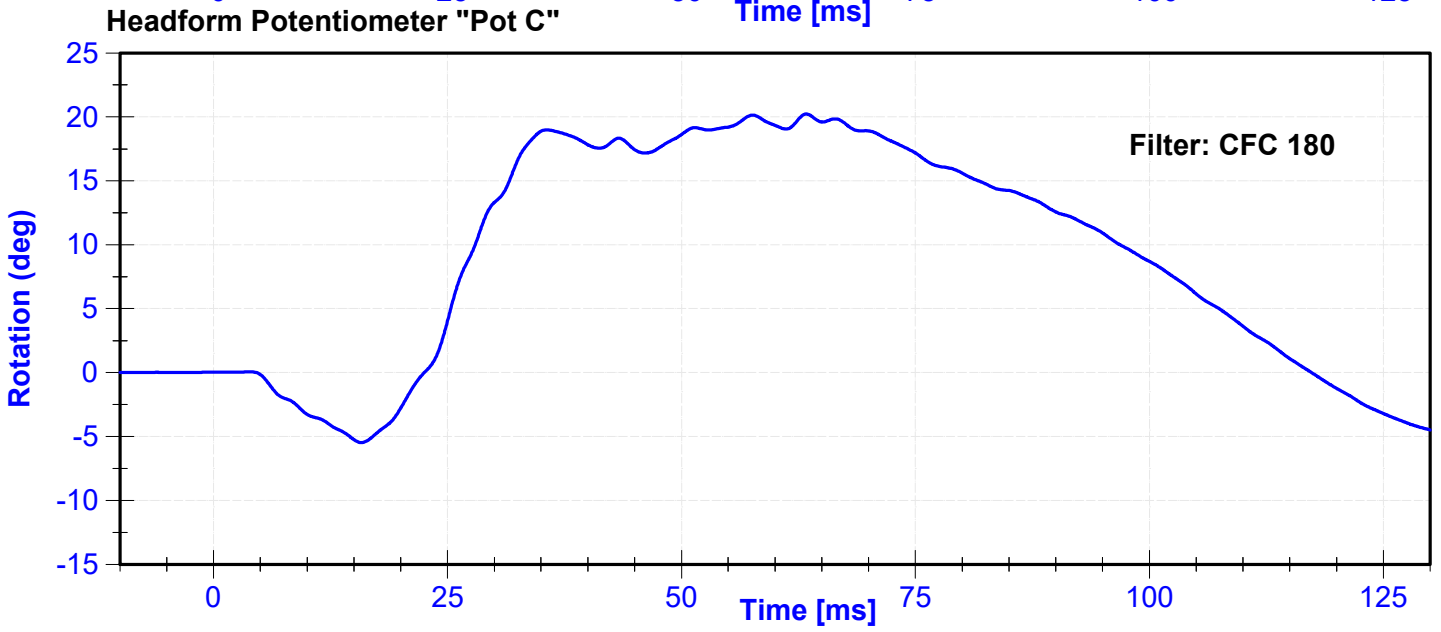
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	C16503	29-Apr-2024	26-Oct-2024
Front Pendulum Potentiometer	Sfernice	2247	05-Dec-2023	04-Dec-2024
Headform Potentiometer	Sfernice	095	29-Sep-2023	28-Sep-2024



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


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


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


Headform Potentiometer "Pot C"
Rotation (deg)
25
20
15
10
5
0
-5
-10
-15
Filter: CFC 180
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
3.0	-0.25	2.5	-0.375
14.0	-3.20	13.5	-3.7
		17.0	-3.7

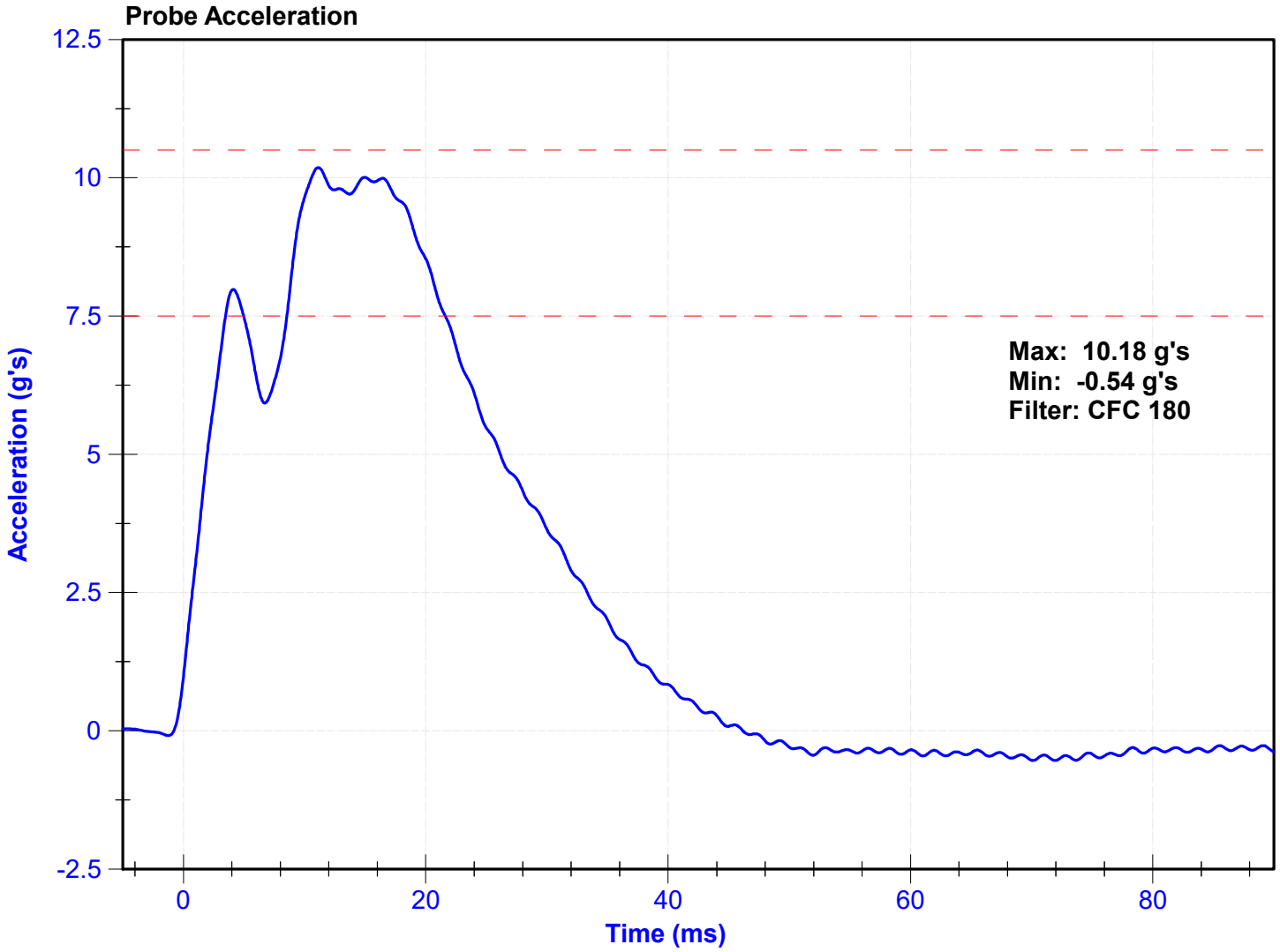
ATD Manufacturer	FTSS	Test Technician	J.Kinderman
ATD Serial Number	F033	Laboratory Supervisor	C. Mantell

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.4	Pass
Humidity	10	70	%	54	Pass
Velocity	4.2	4.4	m/s	4.26	Pass
Probe Acceleration	7.5	10.5	g's	10.18	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Probe Accelerometer	Endevco	18619	3/29/2024	9/25/2024



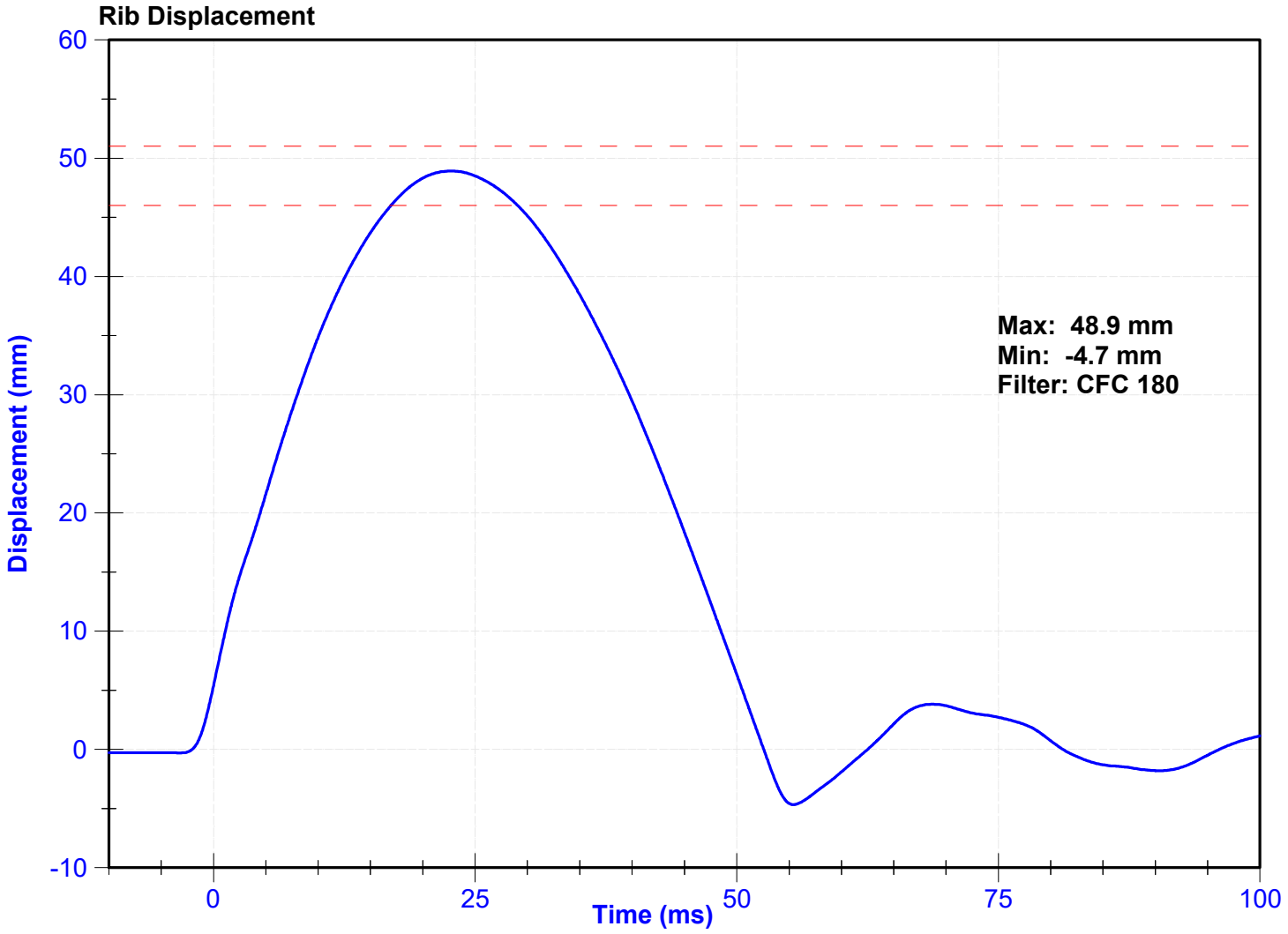
ATD Manufacturer	FTSS	Test Technician	J.Kinderman
ATD Serial Number	F033	Laboratory Supervisor	C.Mantel

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.2	Pass
Humidity	10	70	%	60	Pass
Rib Displacement	46	51	mm	48.9	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	179GFE	5/6/2024	11/4/2024



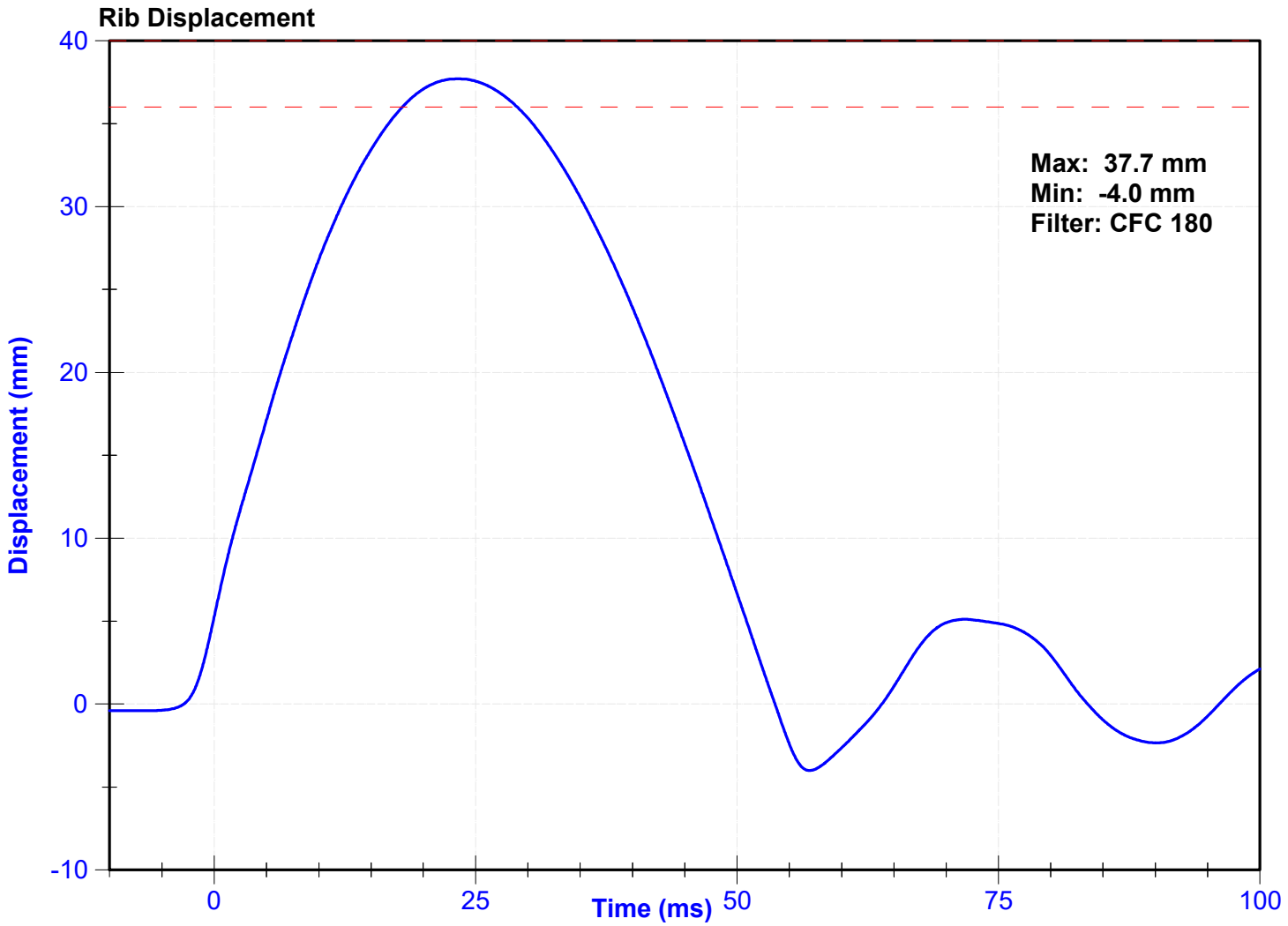
ATD Manufacturer	FTSS	Test Technician	J.Kinderman
ATD Serial Number	F033	Laboratory Supervisor	C.Mantel

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.2	Pass
Humidity	10	70	%	60	Pass
Rib Displacement	36	40	mm	37.7	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	179GFE	5/6/2024	11/4/2024



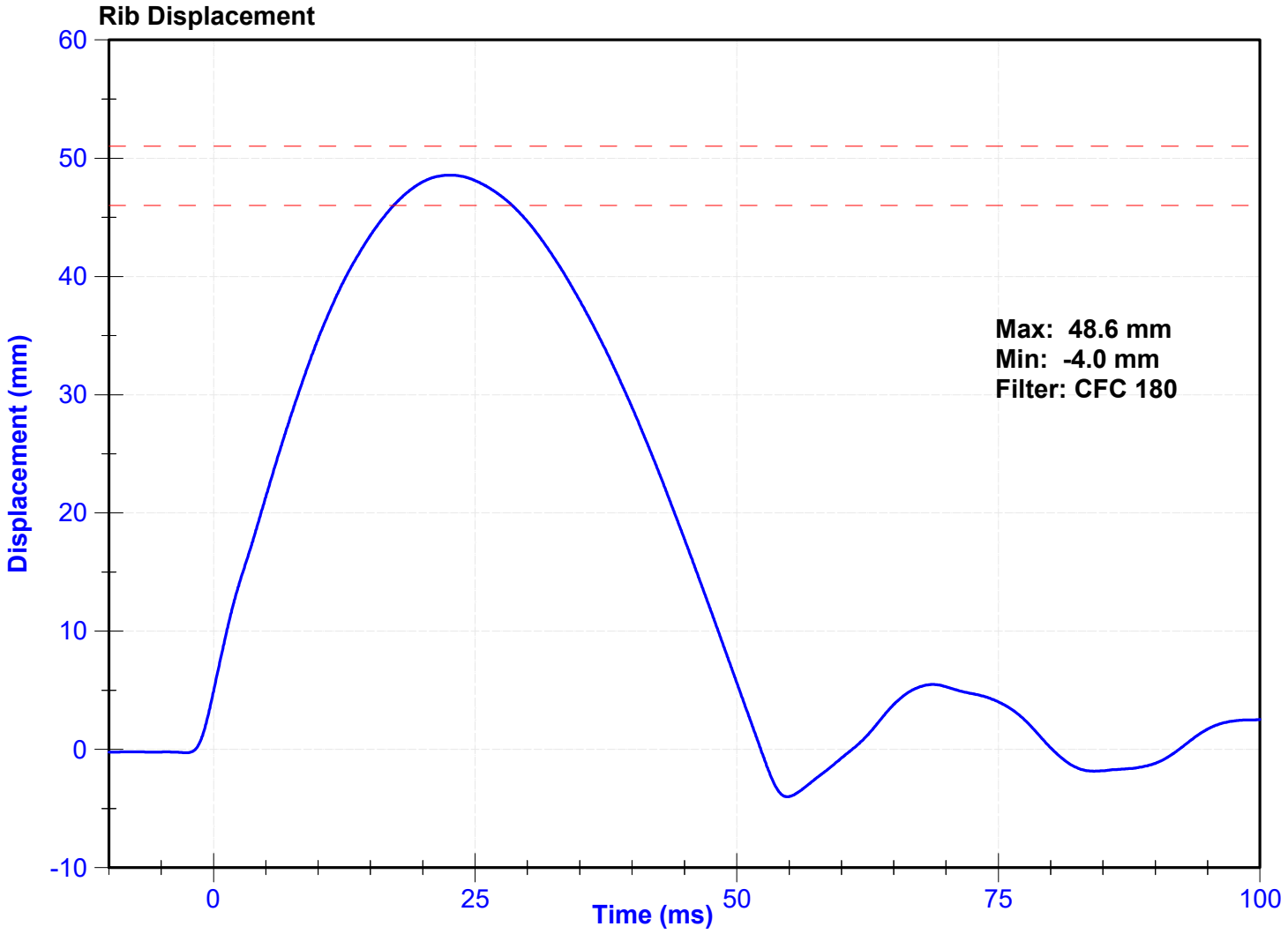
ATD Manufacturer	FTSS	Test Technician	J.Kinderman
ATD Serial Number	F033	Laboratory Supervisor	C.Mantel

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.2	Pass
Humidity	10	70	%	60	Pass
Rib Displacement	46	51	mm	48.6	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	185GFE	5/6/2024	11/4/2024



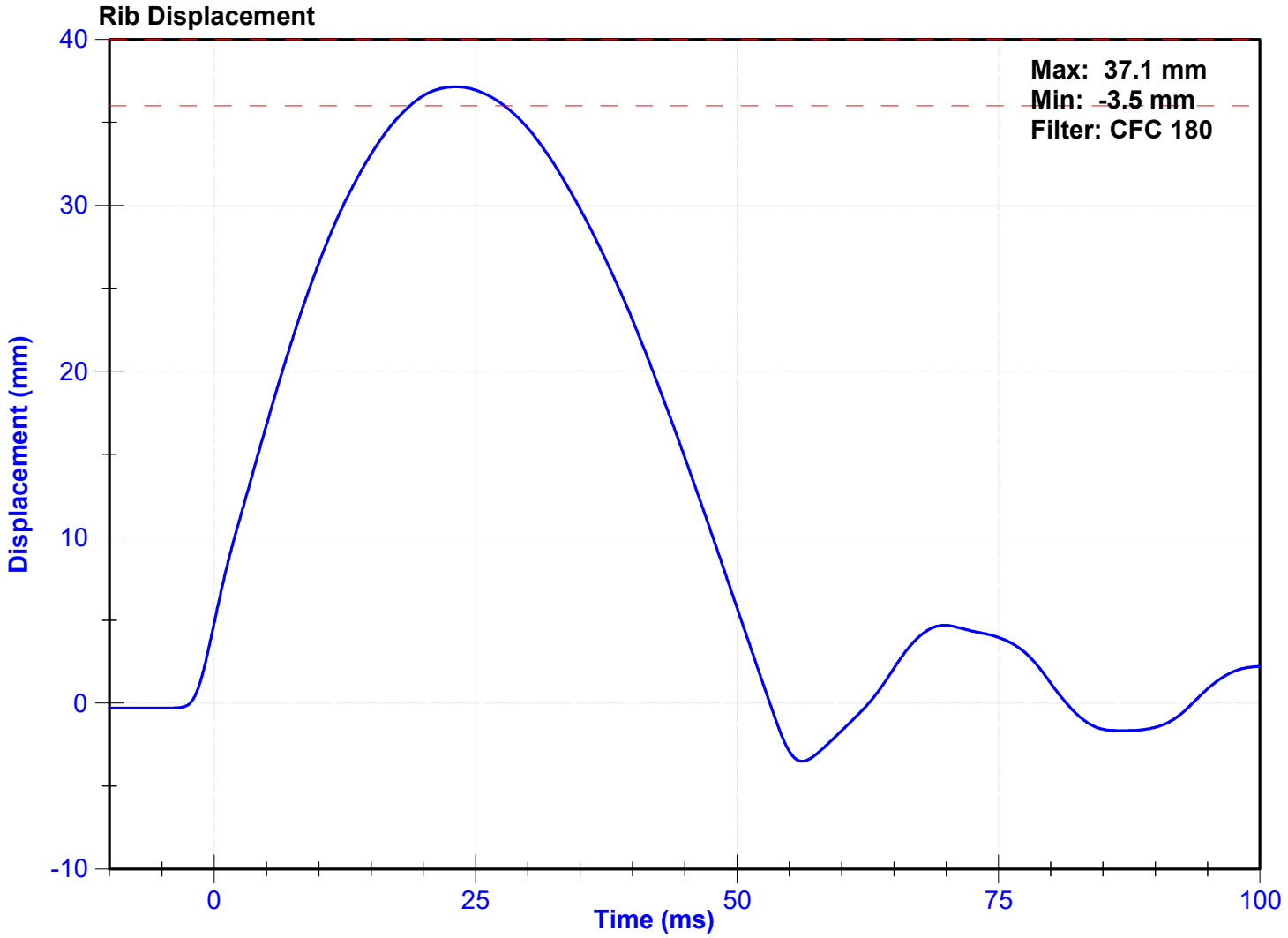
ATD Manufacturer	FTSS	Test Technician	J.Kinderman
ATD Serial Number	F033	Laboratory Supervisor	C.Mantel

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.2	Pass
Humidity	10	70	%	60	Pass
Rib Displacement	36	40	mm	37.1	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	185GFE	5/6/2024	11/4/2024



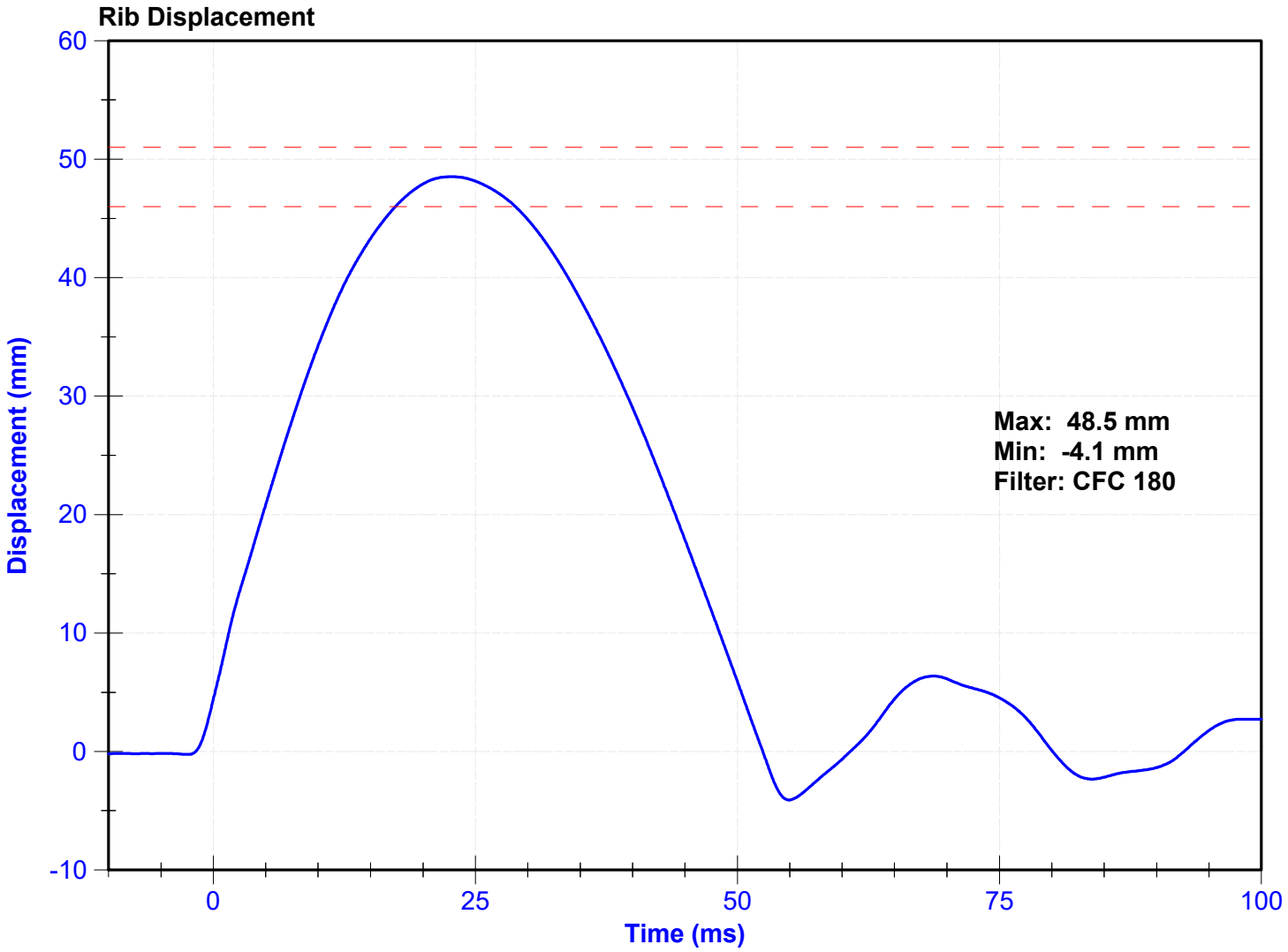
ATD Manufacturer	FTSS	Test Technician	J.Kinderman
ATD Serial Number	F033	Laboratory Supervisor	C.Mantel

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.2	Pass
Humidity	10	70	%	60	Pass
Rib Displacement	46	51	mm	48.5	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	178GFE	5/6/2024	11/4/2024



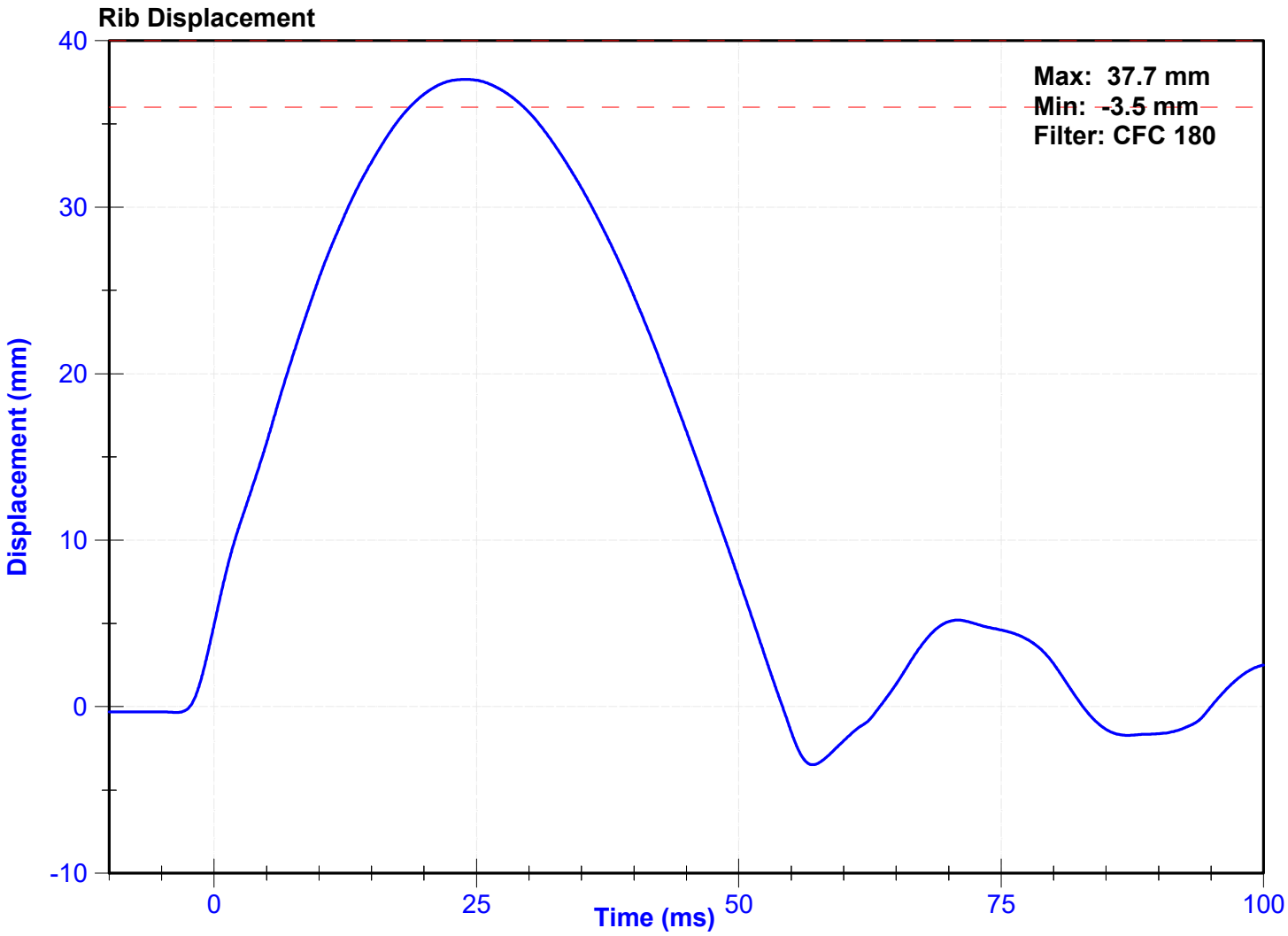
ATD Manufacturer	FTSS	Test Technician	J.Kinderman
ATD Serial Number	F033	Laboratory Supervisor	C.Mantel

Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.2	Pass
Humidity	10	70	%	60	Pass
Rib Displacement	36	40	mm	37.7	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Rib Potentiometer	Honeywell	178GFE	5/6/2024	11/4/2024



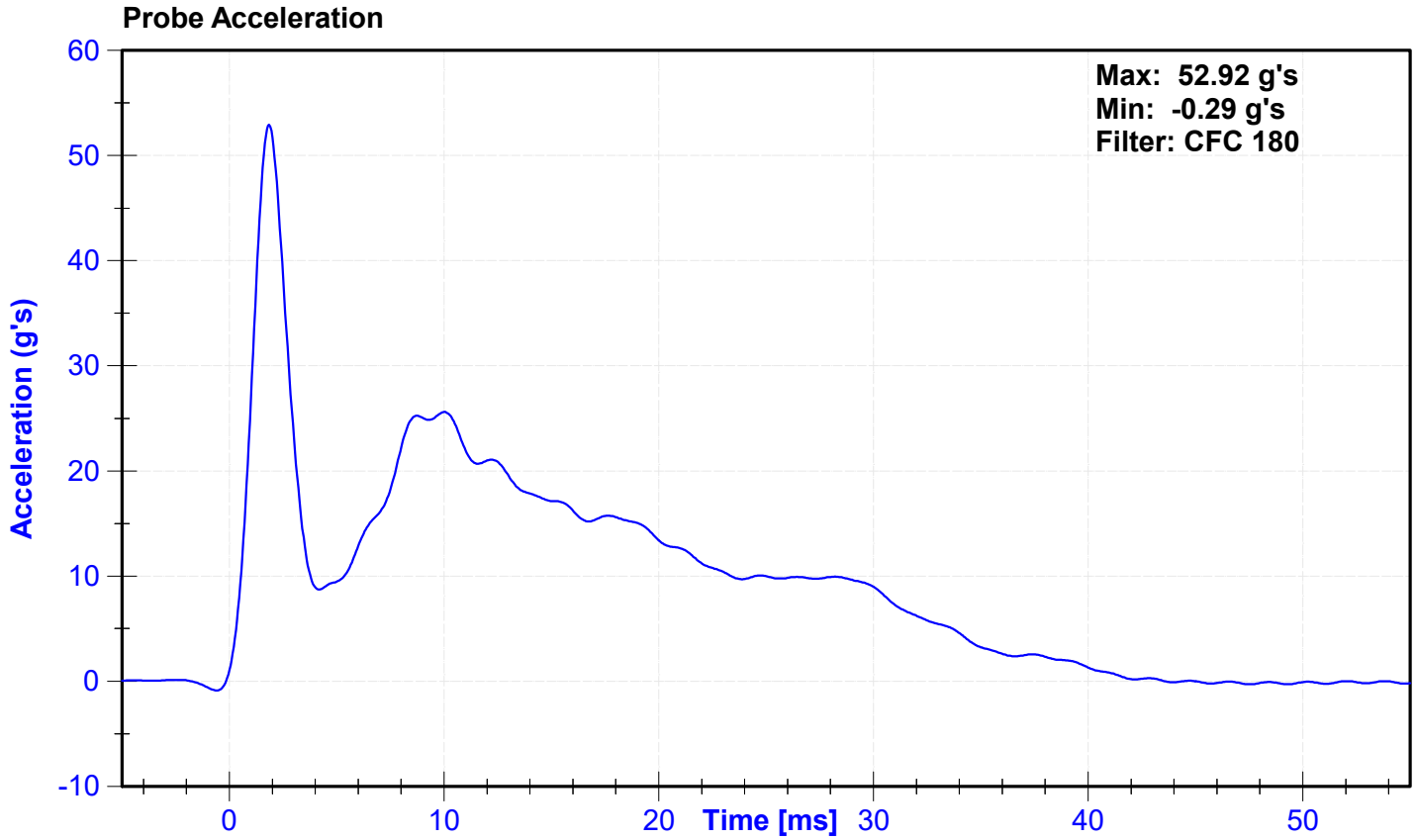
ATD Manufacturer	FTSS	Test Technician	J.Kinderman
ATD Serial Number	F033	Laboratory Supervisor	C. Mantell

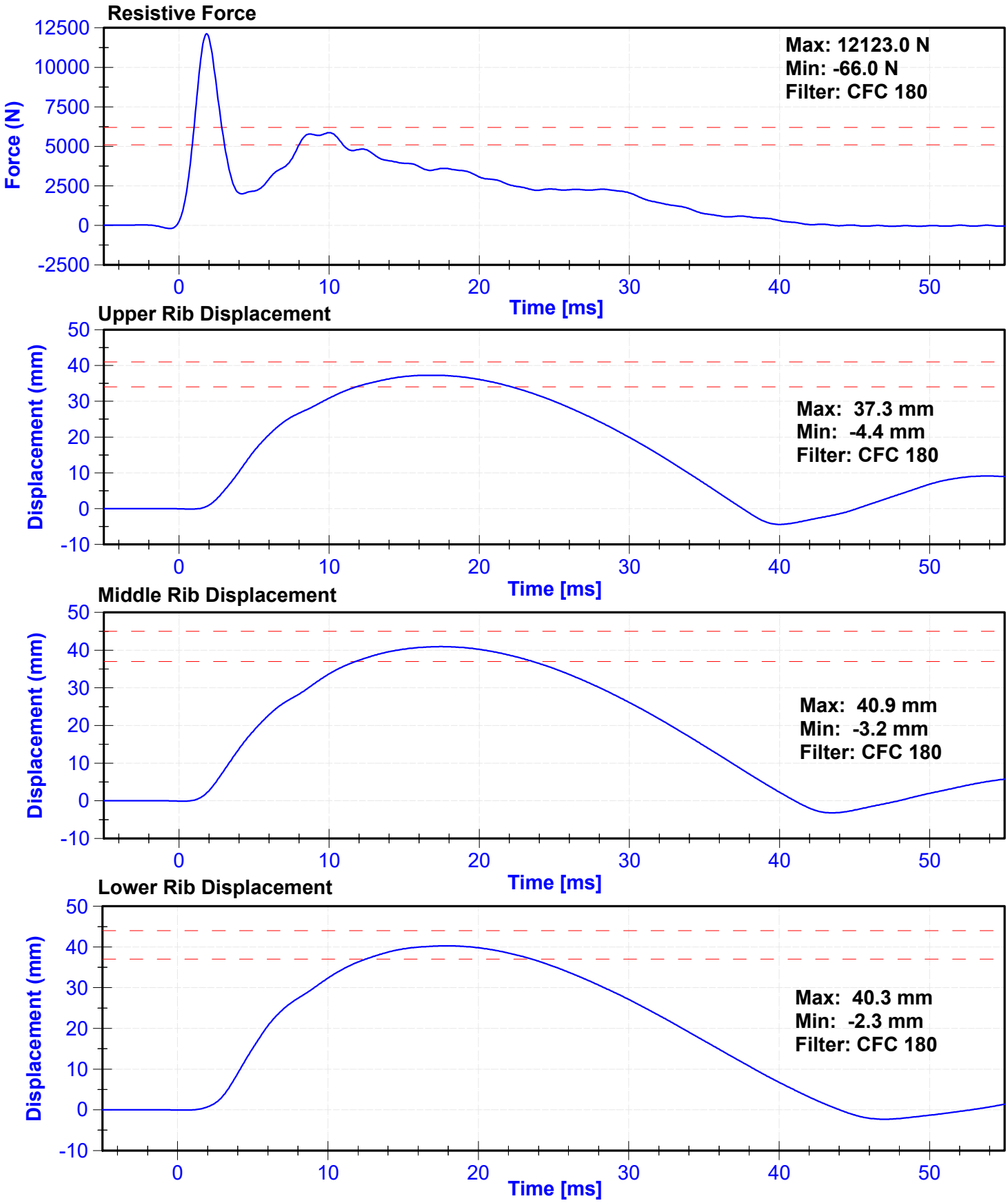
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.4	Pass
Humidity	10	70	%	54	Pass
Velocity	5.4	5.6	m/s	5.52	Pass
Resistive Force after 6ms	5100	6200	N	5865.9	Pass
Upper Thorax Rib Deflection	34	41	mm	37.3	Pass
Mid Thorax Rib Deflection	37	45	mm	40.9	Pass
Lower Thorax Rib Deflection	37	44	mm	40.3	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Probe Accelerometer	Endevco	18619	3/29/2024	9/25/2024
Upper Thorax Rib Potentiometer	Honeywell	179GFE	5/6/2024	11/4/2024
Middle Thorax Rib Potentiometer	Honeywell	185GFE	5/6/2024	11/4/2024
Lower Thorax Rib Potentiometer	Honeywell	178GFE	5/6/2024	11/4/2024




Resistive Force
Force (N)
12500
10000
7500
5000
2500
0
-2500
Max: 12123.0 N
Min: -66.0 N
Filter: CFC 180
0
10
20
30
40
50
Time [ms]
Upper Rib Displacement
Displacement (mm)
50
40
30
20
10
0
-10
Max: 37.3 mm
Min: -4.4 mm
Filter: CFC 180
Time [ms]
Middle Rib Displacement
Max: 40.9 mm
Min: -3.2 mm
Filter: CFC 180
Time [ms]
Lower Rib Displacement
Max: 40.3 mm
Min: -2.3 mm
Filter: CFC 180
Time [ms]

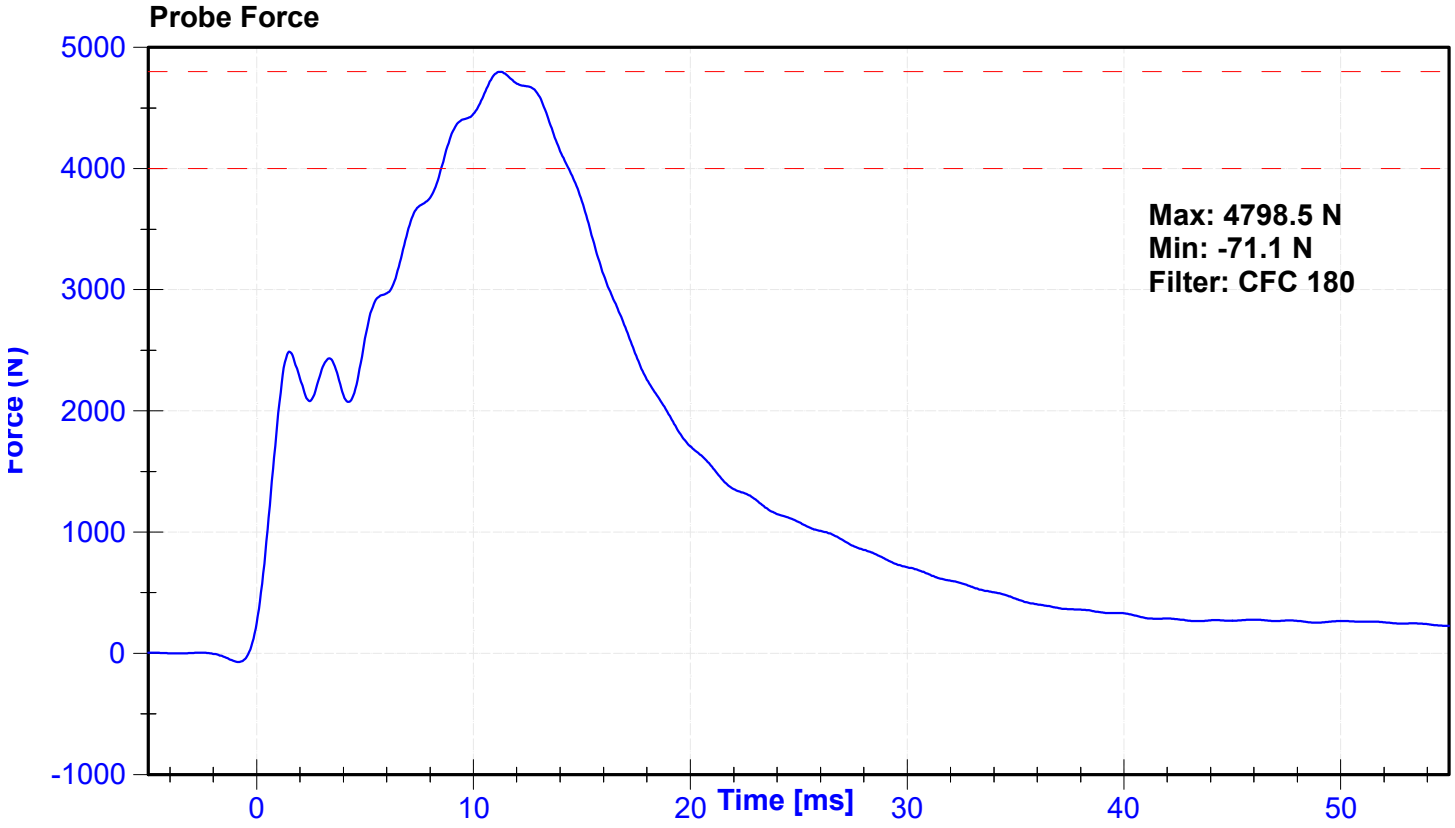
ATD Manufacturer	FTSS	Test Technician	J.Kinderman
ATD Serial Number	F033	Laboratory Supervisor	C. Mantell

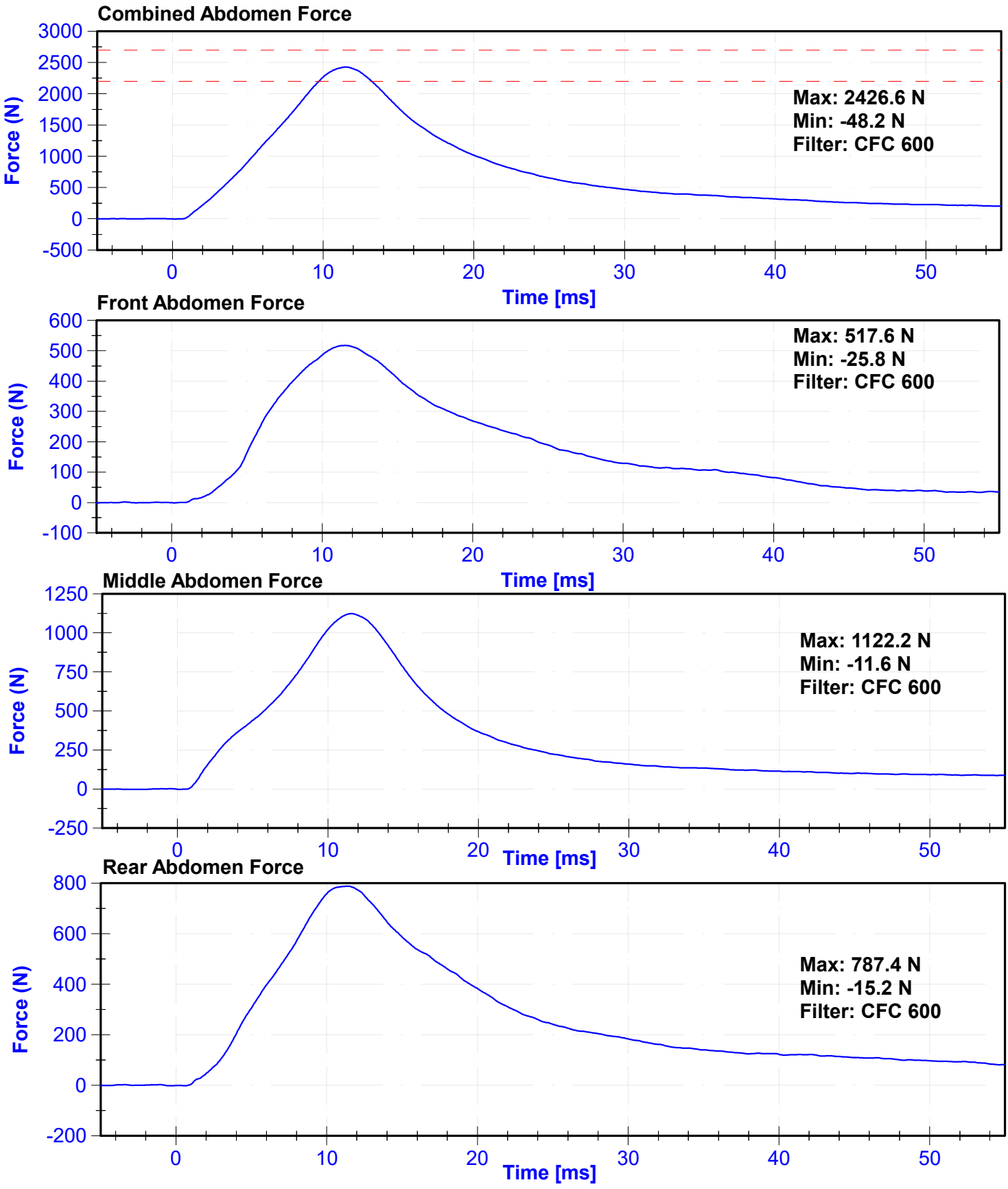
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.4	Pass
Humidity	10	70	%	54	Pass
Velocity	3.9	4.1	m/s	4.00	Pass
Combined Abdomen Force	2200	2700	N	2426.6	Pass
Time at Peak Abdomen Force	10.0	12.3	ms	11.50	Pass
Resistive Probe Force	4000	4800	N	4798.5	Pass
Time at Peak Resistive Force	10.6	13.0	ms	11.20	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18619	3/29/2024	9/25/2024
Front Abdomen Load Cell	Denton	1509	9/12/2023	9/11/2024
Middle Abdomen Load Cell	Denton	1508	9/12/2023	9/11/2024
Rear Abdomen Load Cell	Denton	1507	9/12/2023	9/11/2024




Combined Abdomen Force
Force (N)
Time [ms]
Max: 2426.6 N
Min: -48.2 N
Filter: CFC 600
Front Abdomen Force
Max: 517.6 N
Min: -25.8 N
Filter: CFC 600
Middle Abdomen Force
Max: 1122.2 N
Min: -11.6 N
Filter: CFC 600
Rear Abdomen Force
Max: 787.4 N
Min: -15.2 N
Filter: CFC 600

ATD Manufacturer	FTSS	Test Technician	J. Kinderman
ATD Serial Number	F033	Laboratory Supervisor	C. Mantell

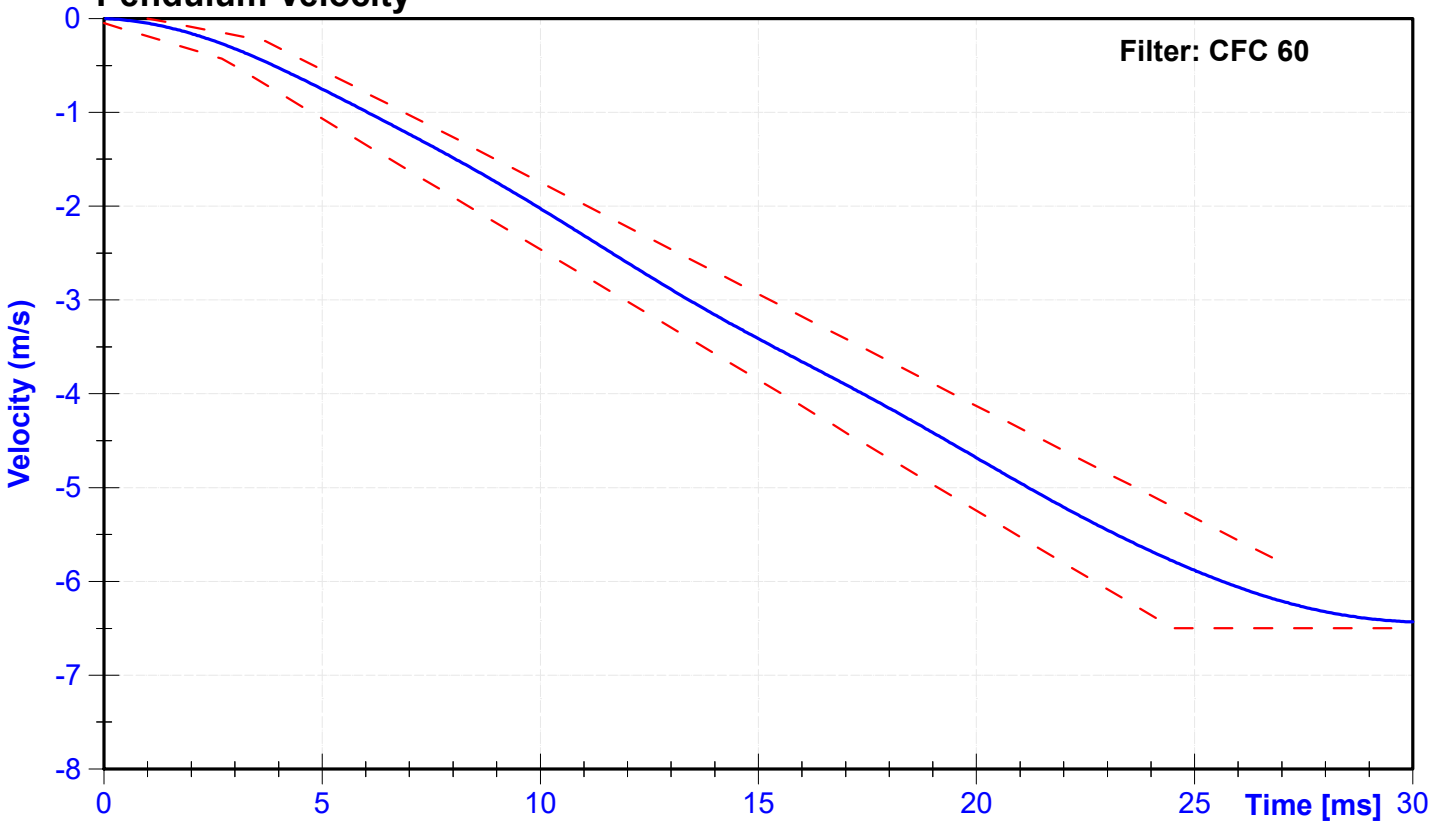
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.2	Pass
Humidity	10	70	%	57	Pass
Velocity	5.95	6.15	m/s	6.082	Pass
Lateral Spine Rotation	45	55	deg	48.4	Pass
Time at Maximum Rotation	39	53	ms	43.7	Pass
Time of Decay to Zero Degrees	37	57	ms	38.1	Pass
Pendulum Velocity Overall Corridor	Lower Boundary[1]	Upper Boundary[2]	m/s	See Plot[3]	Pass

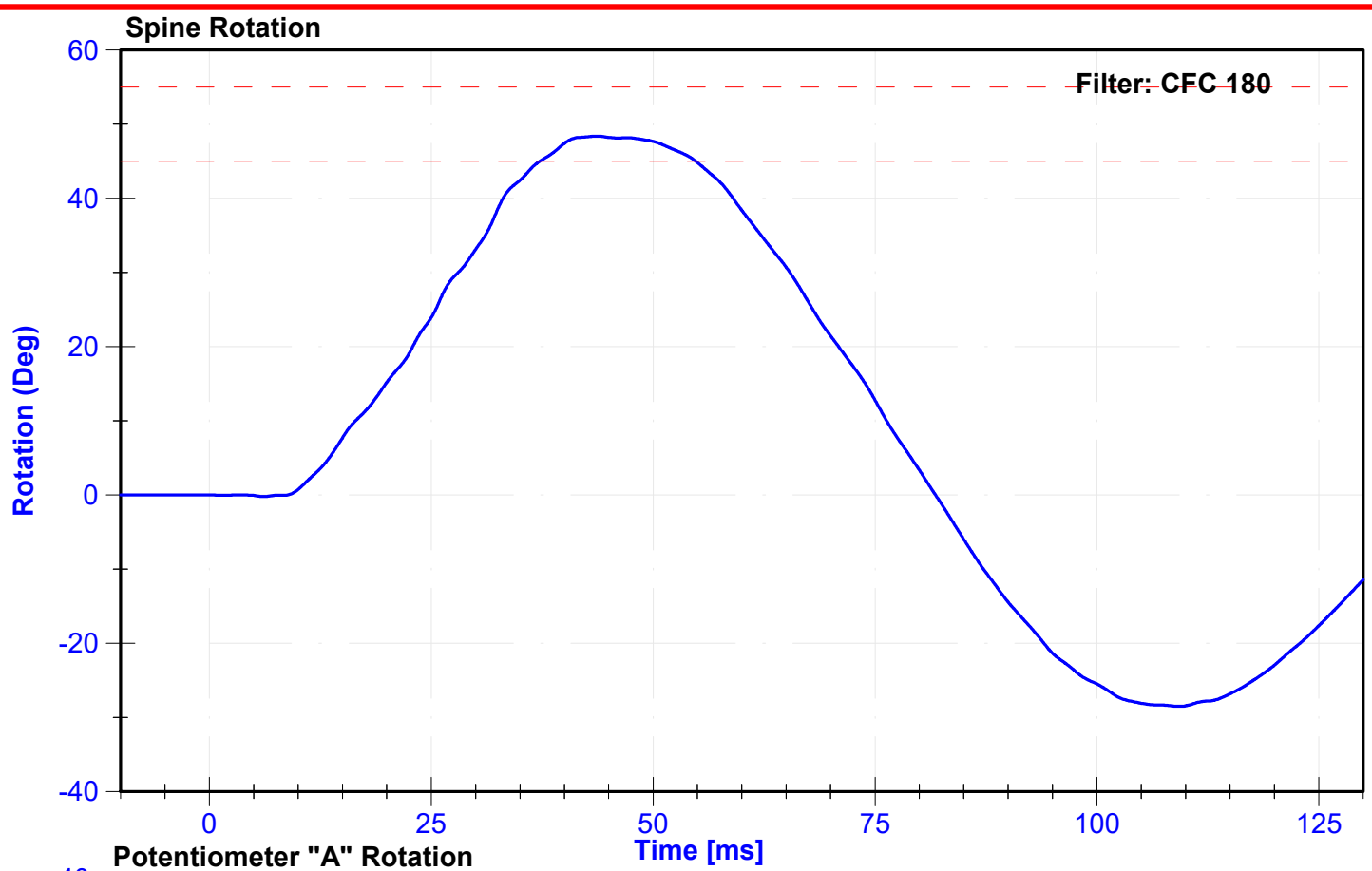
Transducer Calibrations

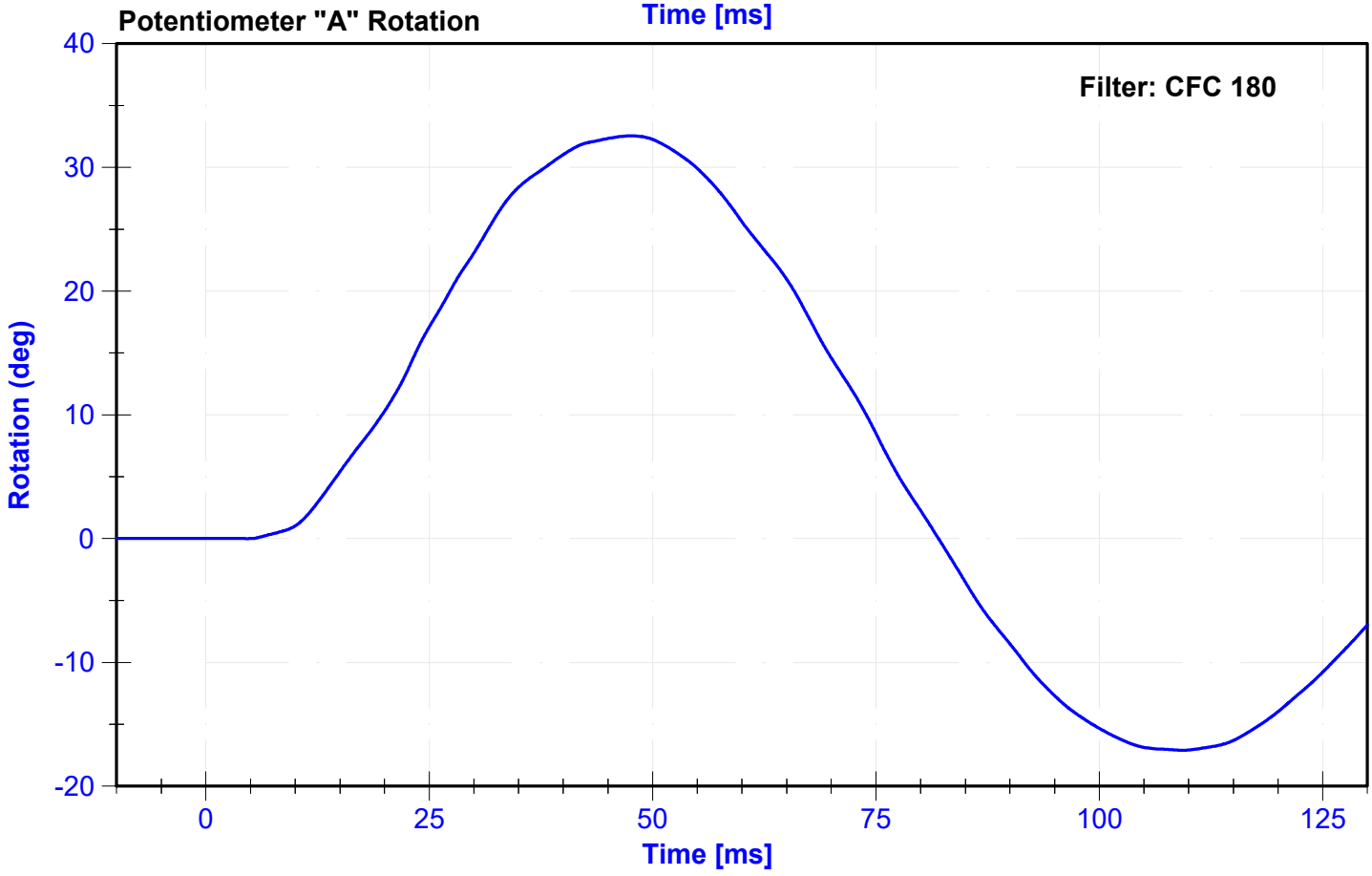
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	C16503	29-Apr-2024	26-Oct-2024
Pendulum "A" Potentiometer	Sfernice	2247	05-Dec-2023	04-Dec-2024
Condyle "B" Potentiometer	Sfernice	095	29-Sep-2023	28-Sep-2024

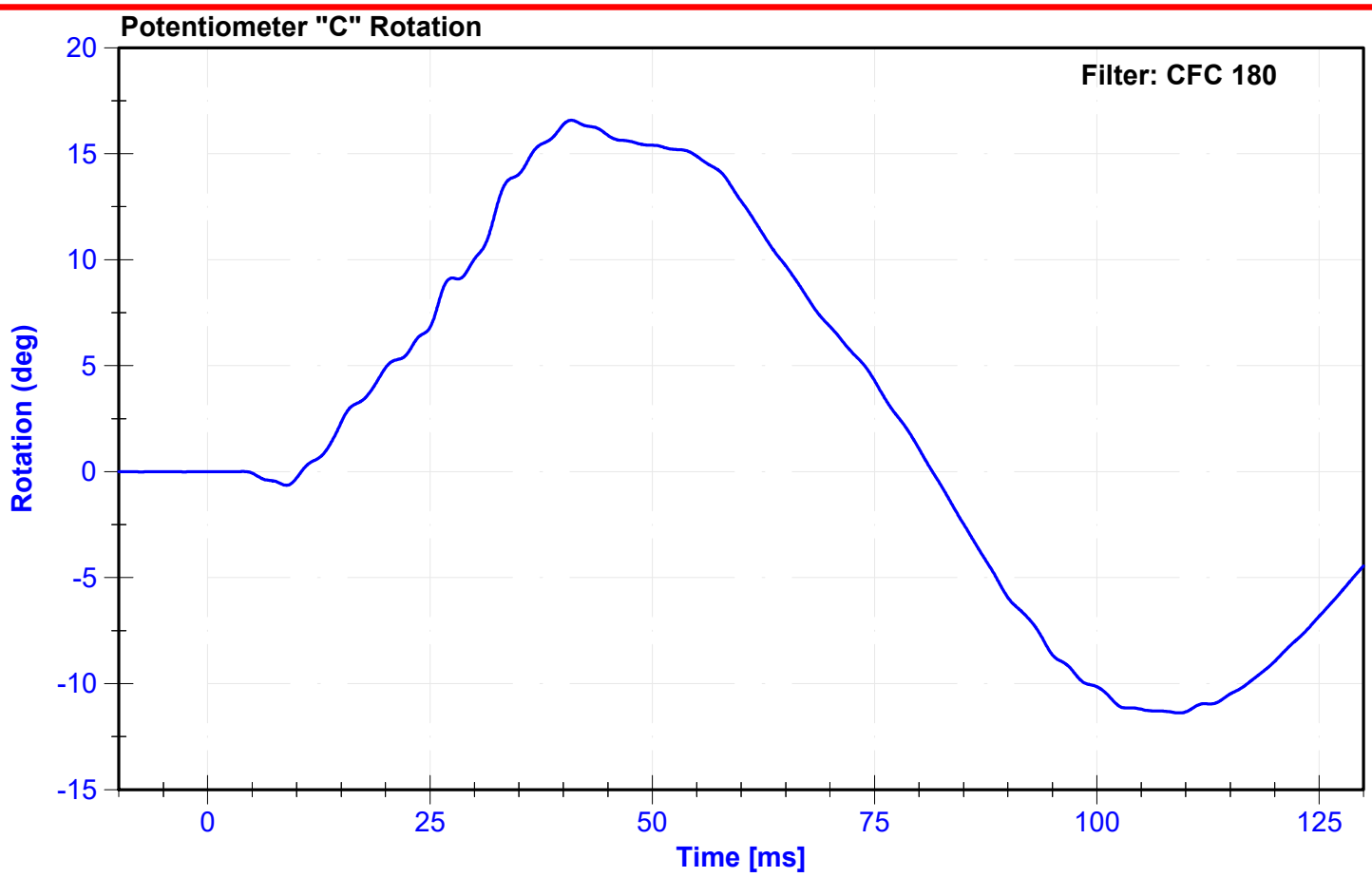
Pendulum Velocity[3]



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


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


Potentiometer "A" Rotation
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

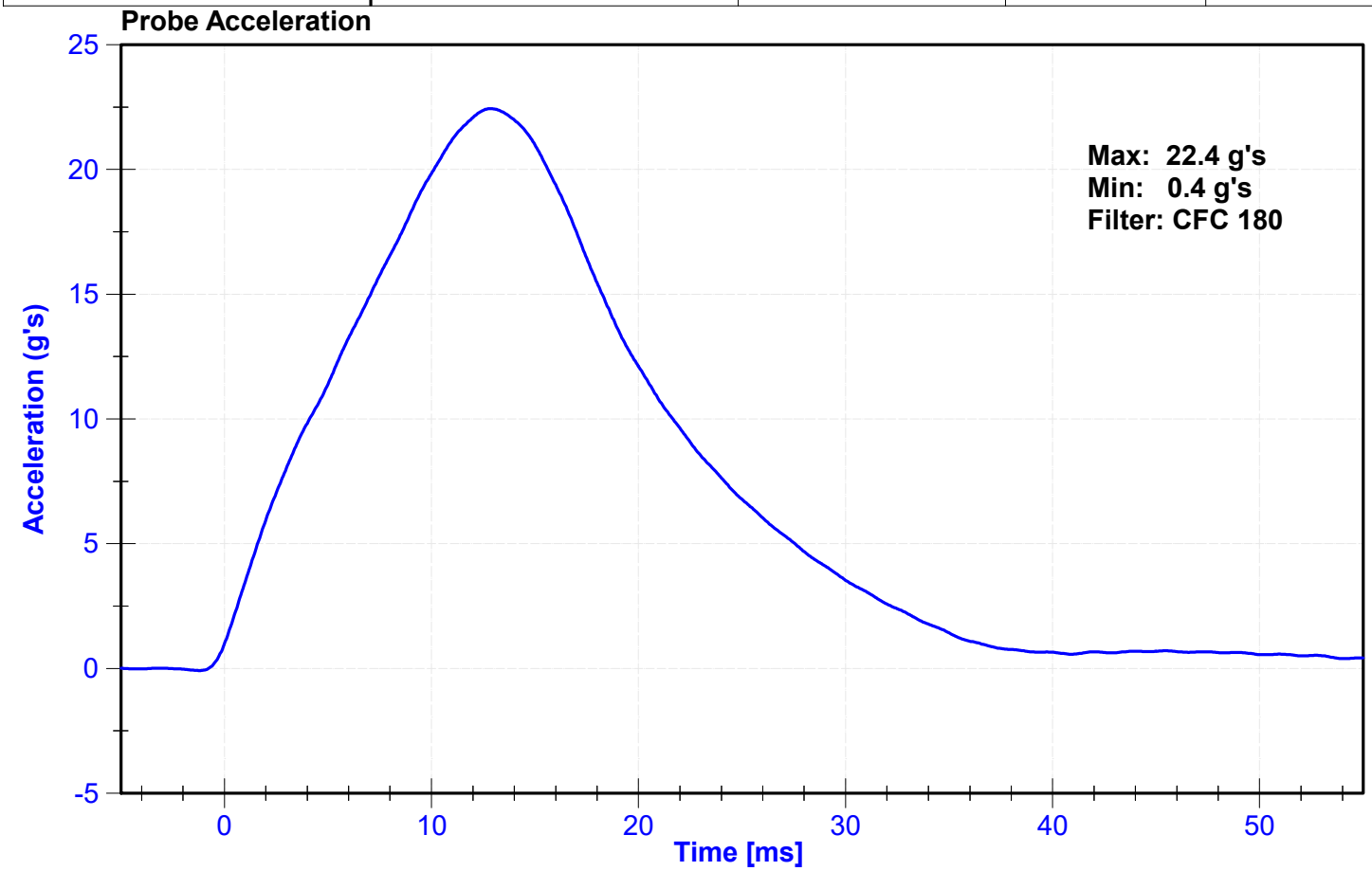
ATD Manufacturer	FTSS	Test Technician	J.Kinderman
ATD Serial Number	F033	Laboratory Supervisor	C. Mantell

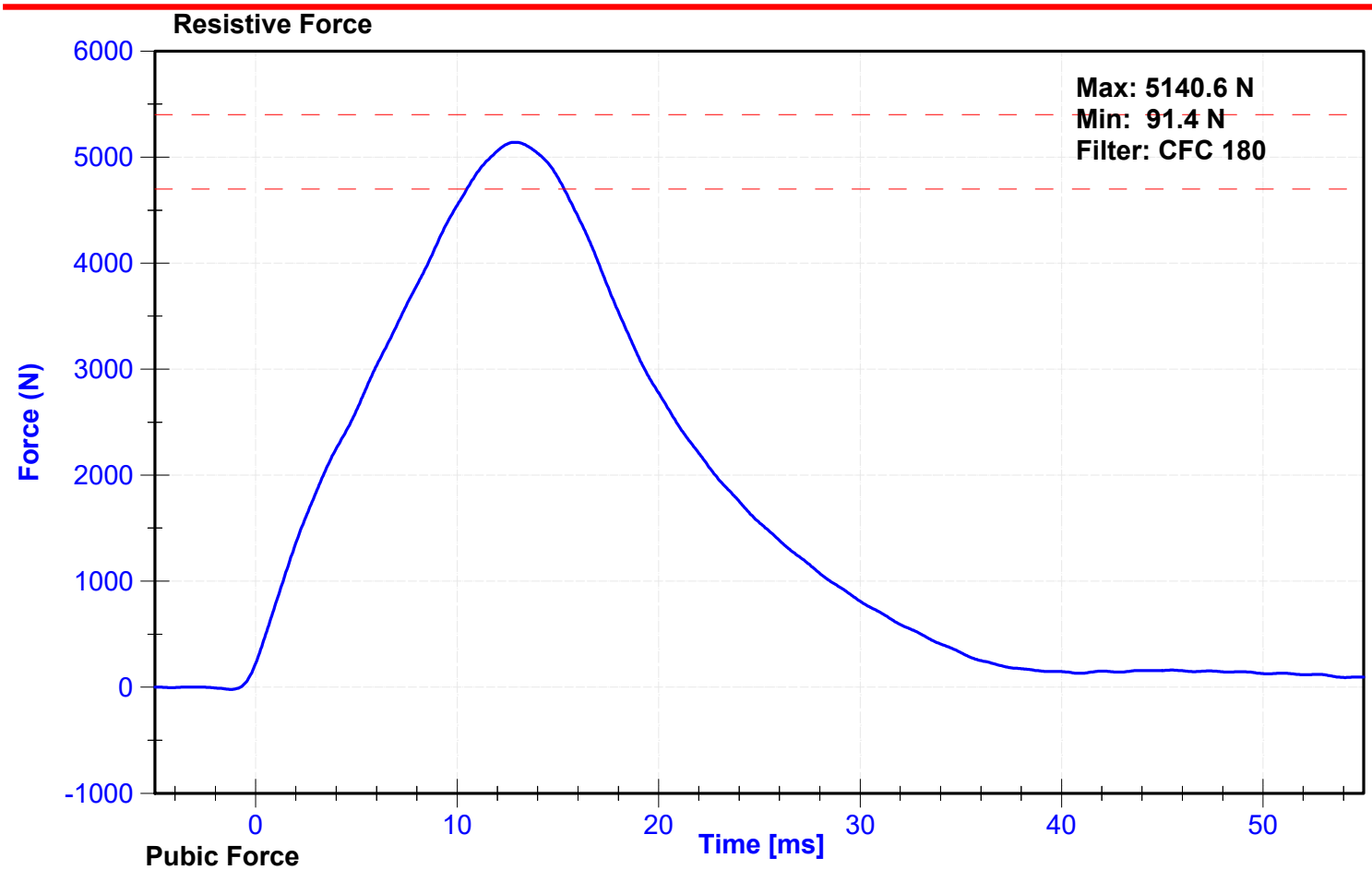
Results

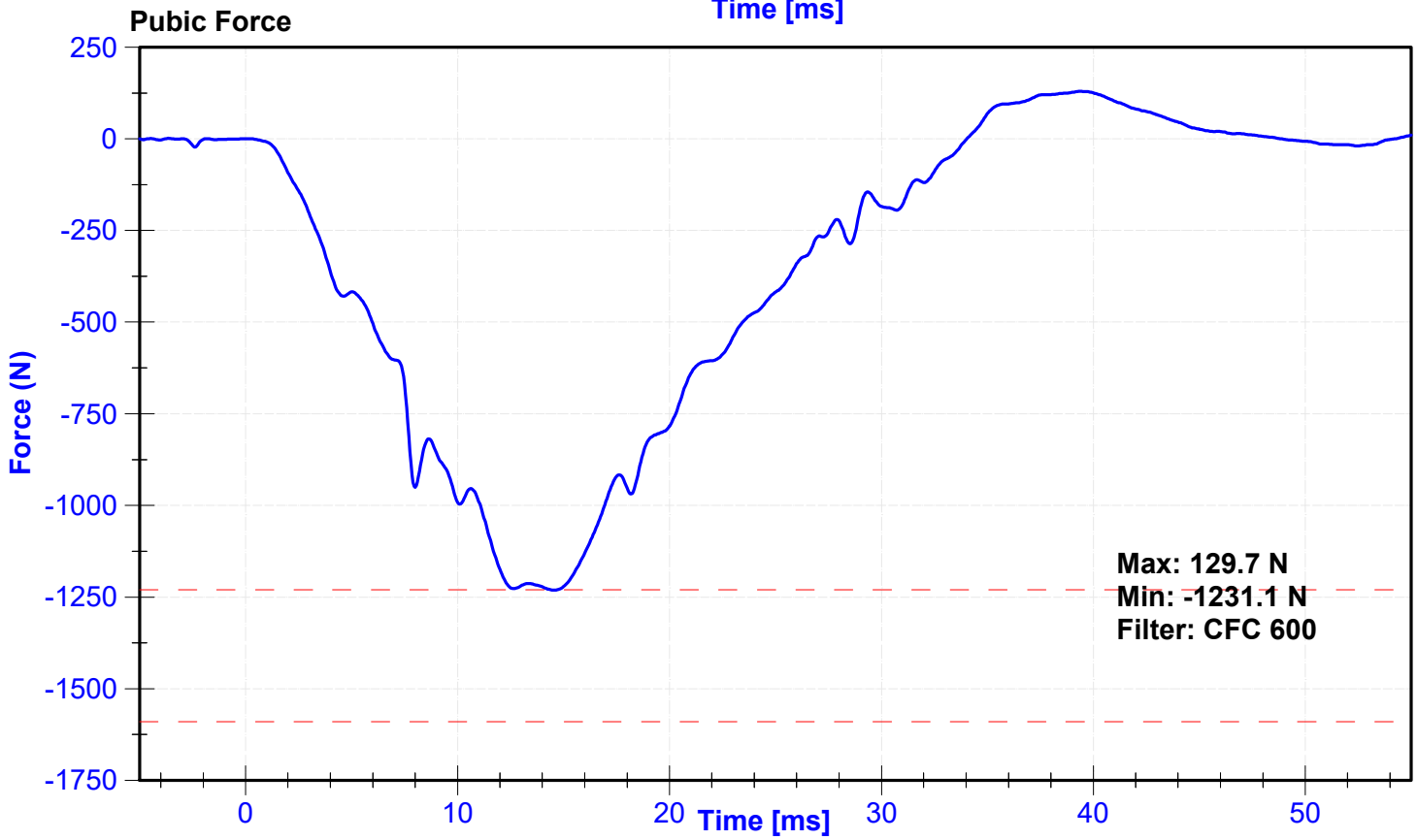
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.4	Pass
Humidity	10	70	%	54	Pass
Velocity	4.2	4.4	m/s	4.28	Pass
Resistive Force	4700	5400	N	5140.6	Pass
Time at Peak Resistive Force	11.8	16.1	ms	12.85	Pass
Pubic Force	-1590	-1230	N	-1231.1	Pass
Time at Peak Pubic Force	12.2	17.0	ms	14.55	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18619	3/29/2024	9/25/2024
Pubic Load Cell	Denton	458-FY	12/5/2023	12/4/2024




Resistive Force
Max: 5140.6 N
Min: 91.4 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: 129.7 N
Min: -1231.1 N
Filter: CFC 600
Force (N)
250
0
-250
-500
-750
-1000
-1250
-1500
-1750
0
10
20
30
40
50
Time [ms]

CALIBRATION TEST RESULTS

POST-TEST

SID-IIS 5TH PERCENTILE FEMALE – PASSENGER ATD

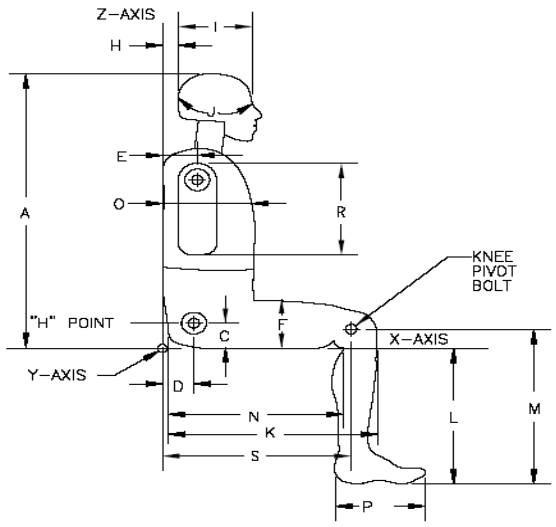
SERIAL NO:300

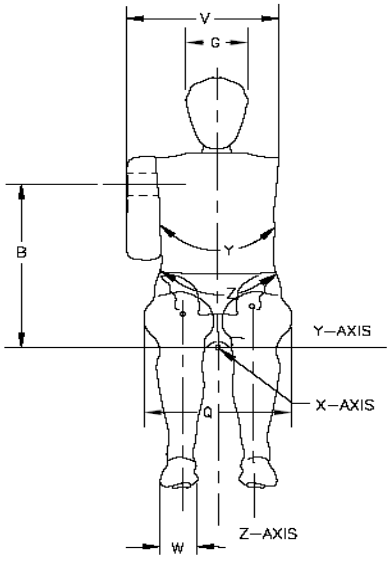
(CONFIGURED FOR LEFT SIDE IMPACT)

External Measurements - SID-IIs

Technician: T. Roseman Date: 7/18/2024

Dummy Serial Number: 300





Symbol	Description	Specification (mm)		Result (mm)	Pass/Fail
A	Sitting Height	772	788	781	Pass
B	Shoulder Pivot Height	437	453	446	Pass
C	H-point Height	79	89	84	Pass
D	H-point from seatback	141	151	145	Pass
E	Shoulder Pivot from Backline	97	107	98	Pass
F	Thigh Clearance	119	135	127	Pass
G	Head Breadth	140	148	144	Pass
H	Head Back from Backline	40	46	43	Pass
I	Head Depth	178	188	181	Pass
J	Head Circumference	541	551	550	Pass
K	Buttock to Knee Length	514	540	530	Pass
L	Popliteal Height	343	369	357	Pass
M	Knee Pivot to floor height	392	409	401	Pass
N	Buttock Popliteal Length	416	442	435	Pass
O	Chest Depth w/o jacket	195	211	199	Pass
P	Foot Length	216	232	224	Pass
Q	Hip Breadth (w/pelvic plugs)	313	323	319	Pass
R	Arm Length	249	259	255	Pass
S	Knee Joint to seatback	477	493	488	Pass
V	Shoulder Width	341	357	351	Pass
W	Foot Width	78	94	85	Pass
Y	Chest Circumference w/jacket	851	881	877	Pass
Z	Waist Circumference	761	791	780	Pass

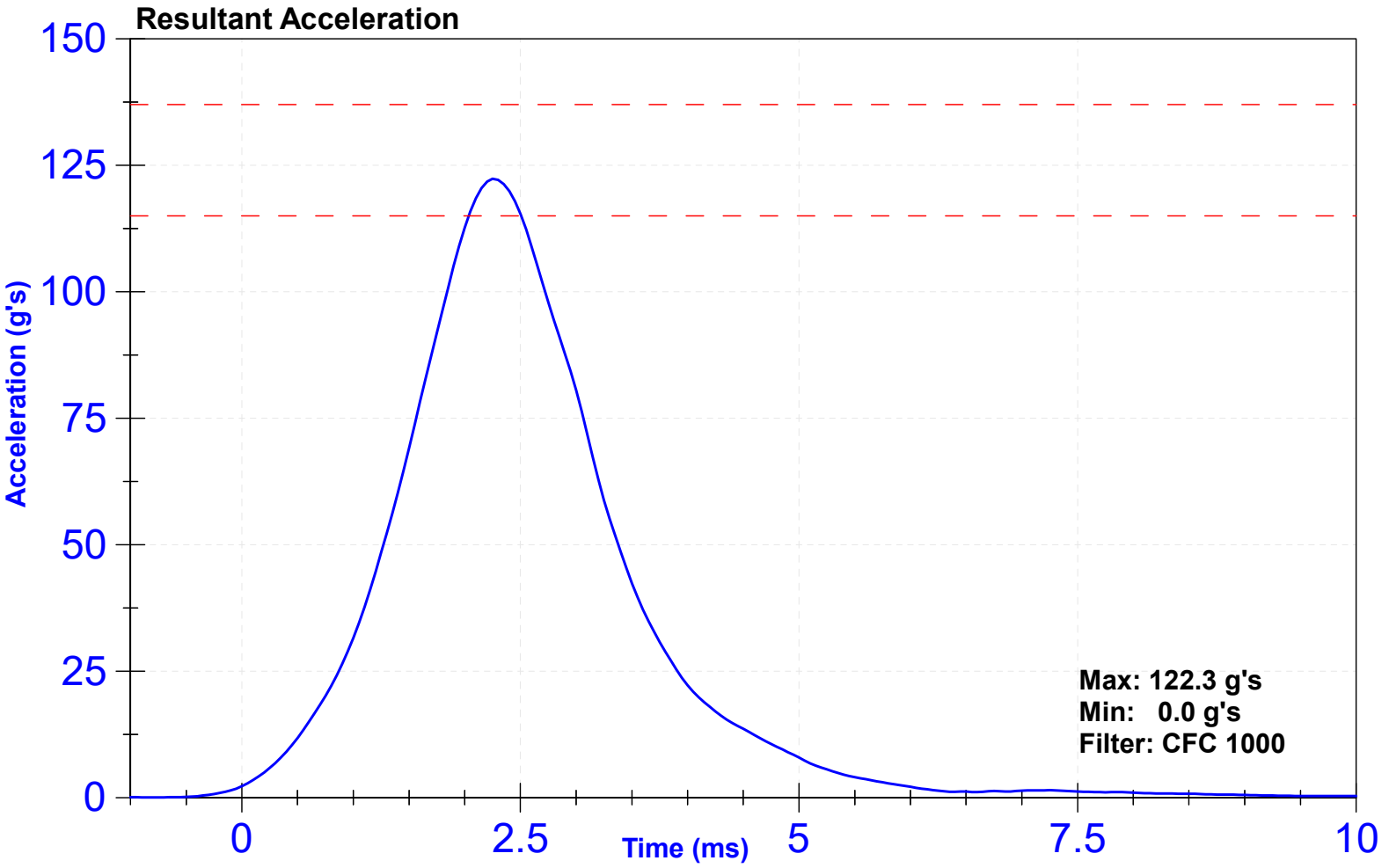
ATD Manufacturer	FTSS	Test Technician	J. Rios
ATD Serial Number	300	Laboratory Supervisor	C. Mantell

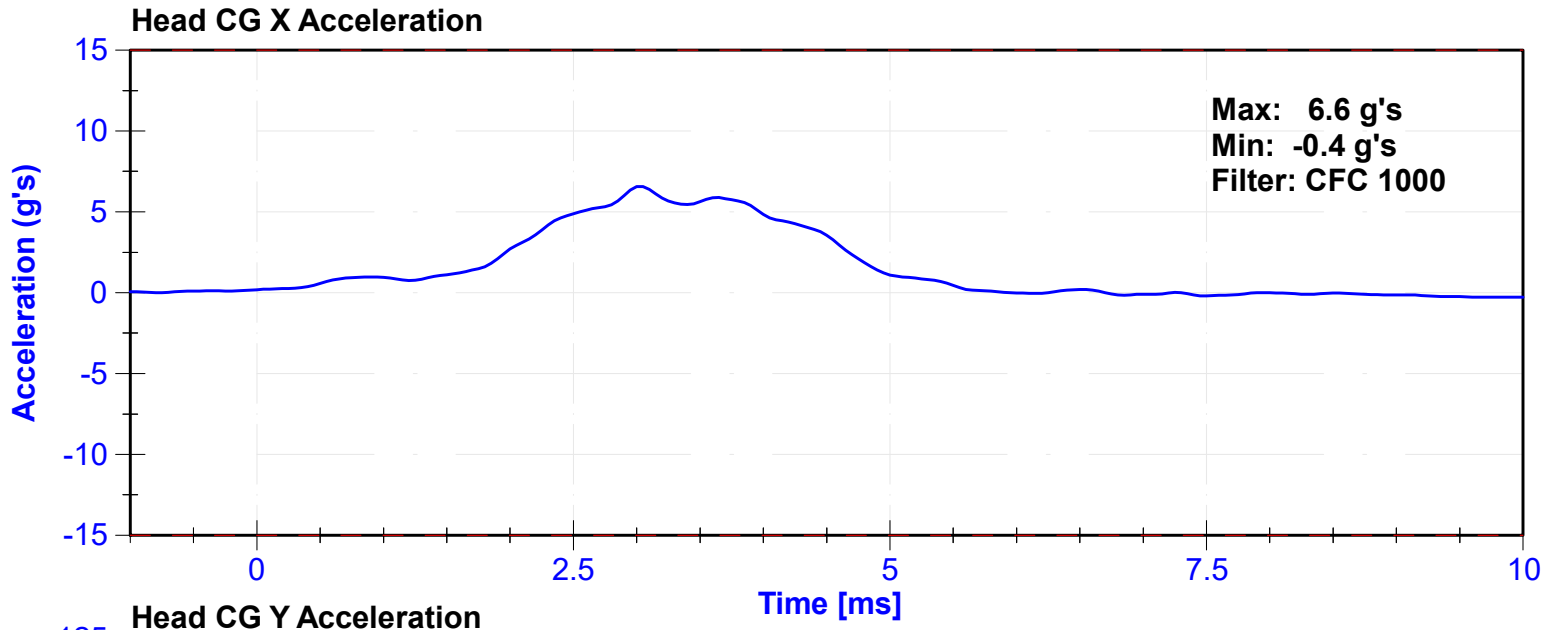
Results

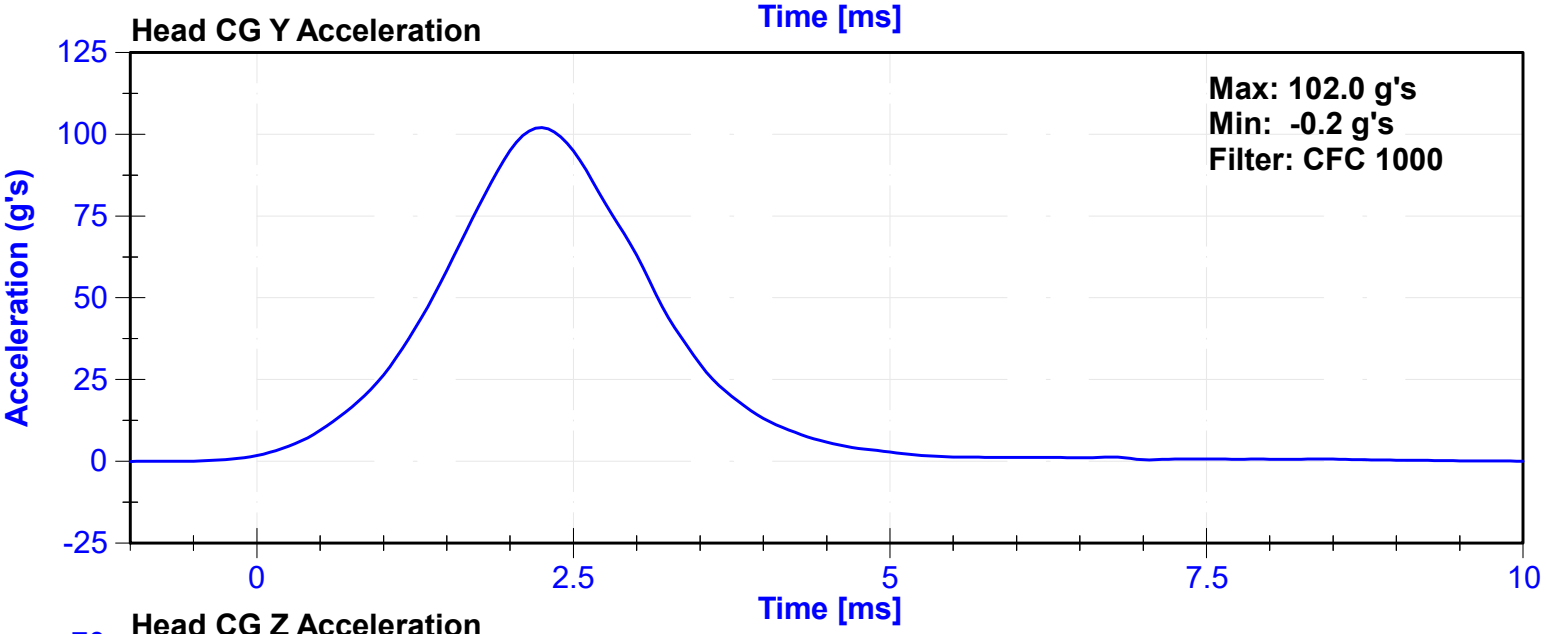
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.8	Pass
Humidity	10	70	%	51	Pass
Resultant Acceleration	115	137	g's	122.3	Pass
Oscillation	0	15	%	1.2	Pass
Fore-Aft Acceleration	-15	15	g's	6.6	Pass

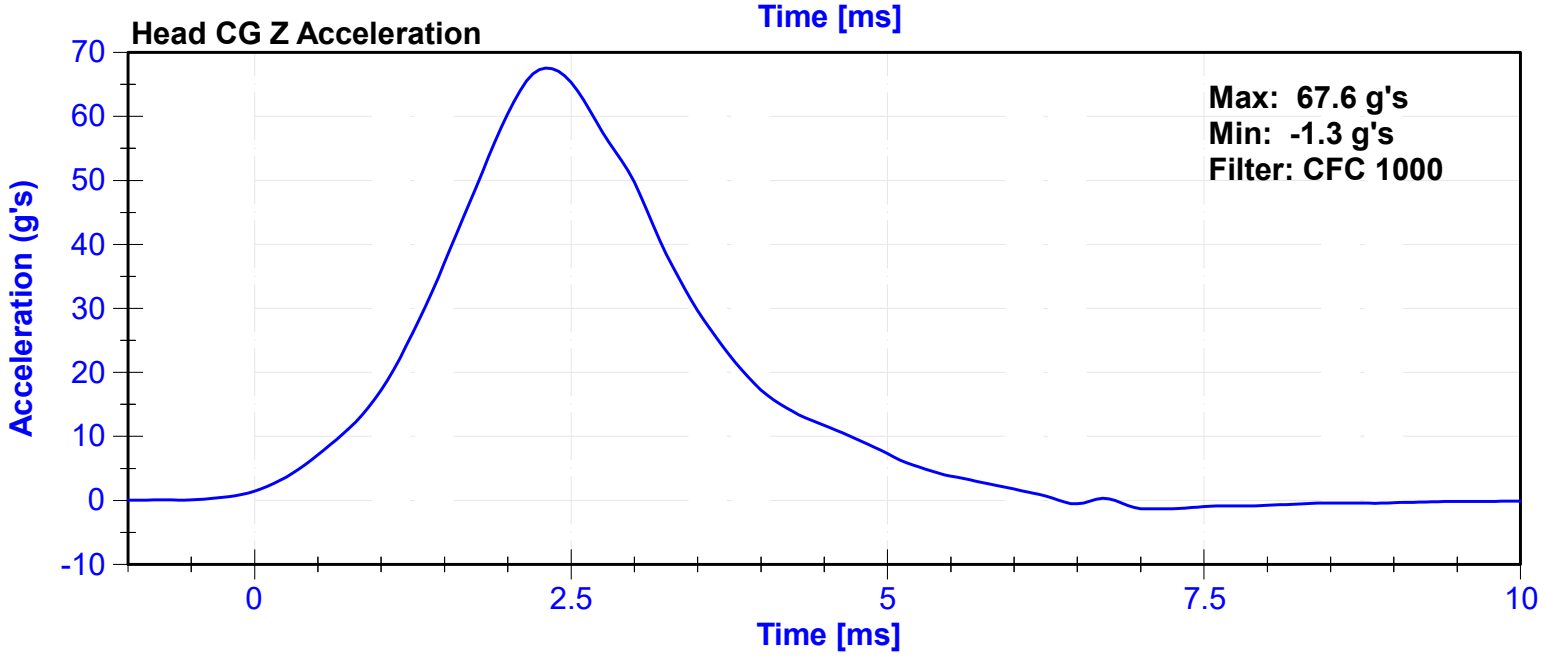
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibratio Date	Calibratio Due Date
X Accelerometer	Endevco	P59018	5/9/2024	11/5/2024
Y Accelerometer	Endevco	P79189	5/9/2024	11/5/2024
Z Accelerometer	Endevco	P79587	5/9/2024	11/5/2024




Head CG X Acceleration
Max: 6.6 g's
Min: -0.4 g's
Filter: CFC 1000
Acceleration (g's)
Time [ms]


Head CG Y Acceleration
Max: 102.0 g's
Min: -0.2 g's
Filter: CFC 1000
Acceleration (g's)
Time [ms]


Head CG Z Acceleration
Max: 67.6 g's
Min: -1.3 g's
Filter: CFC 1000
Acceleration (g's)
Time [ms]

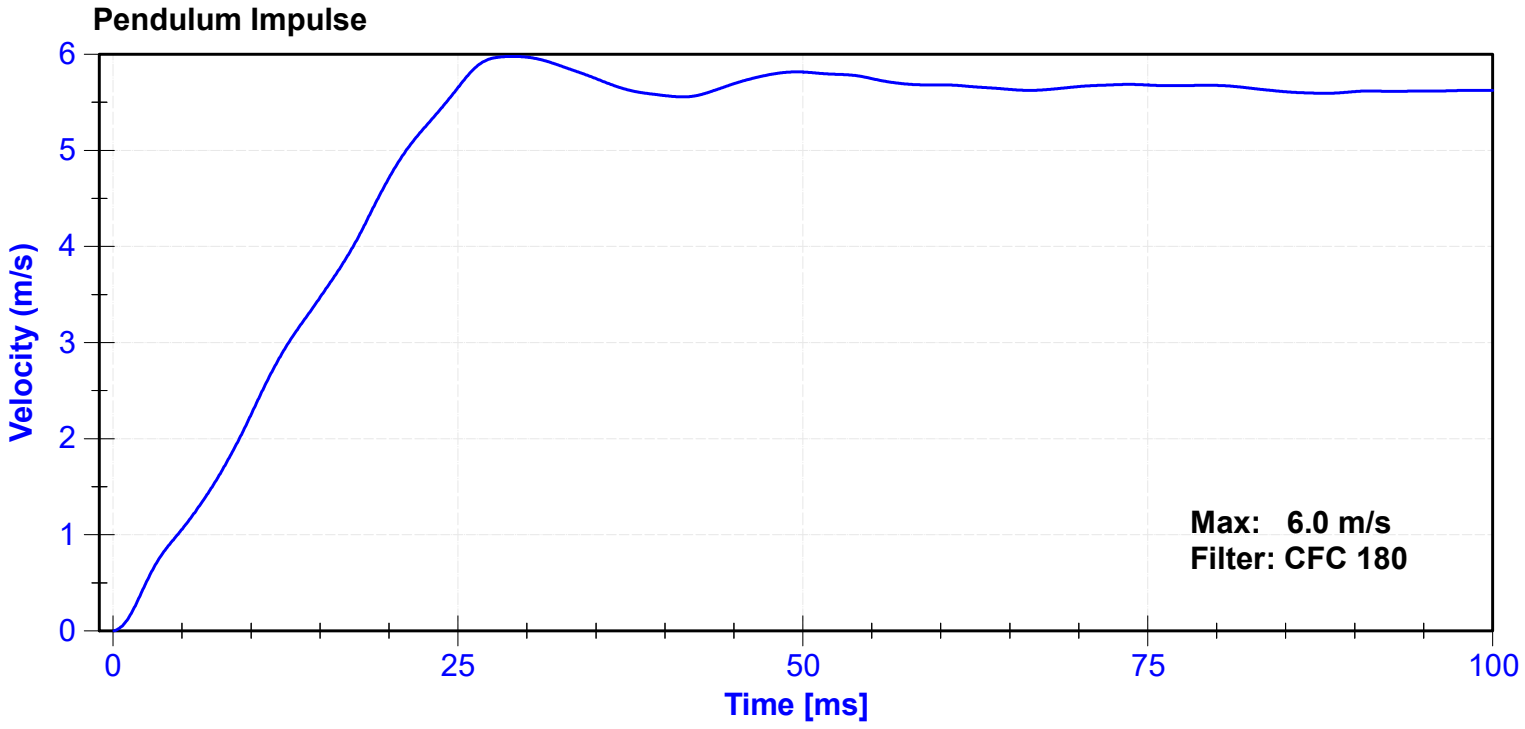
ATD Manufacturer	FTSS	Test Technician	J. Rios
ATD Serial Number	300	Laboratory Supervisor	C. Mantell

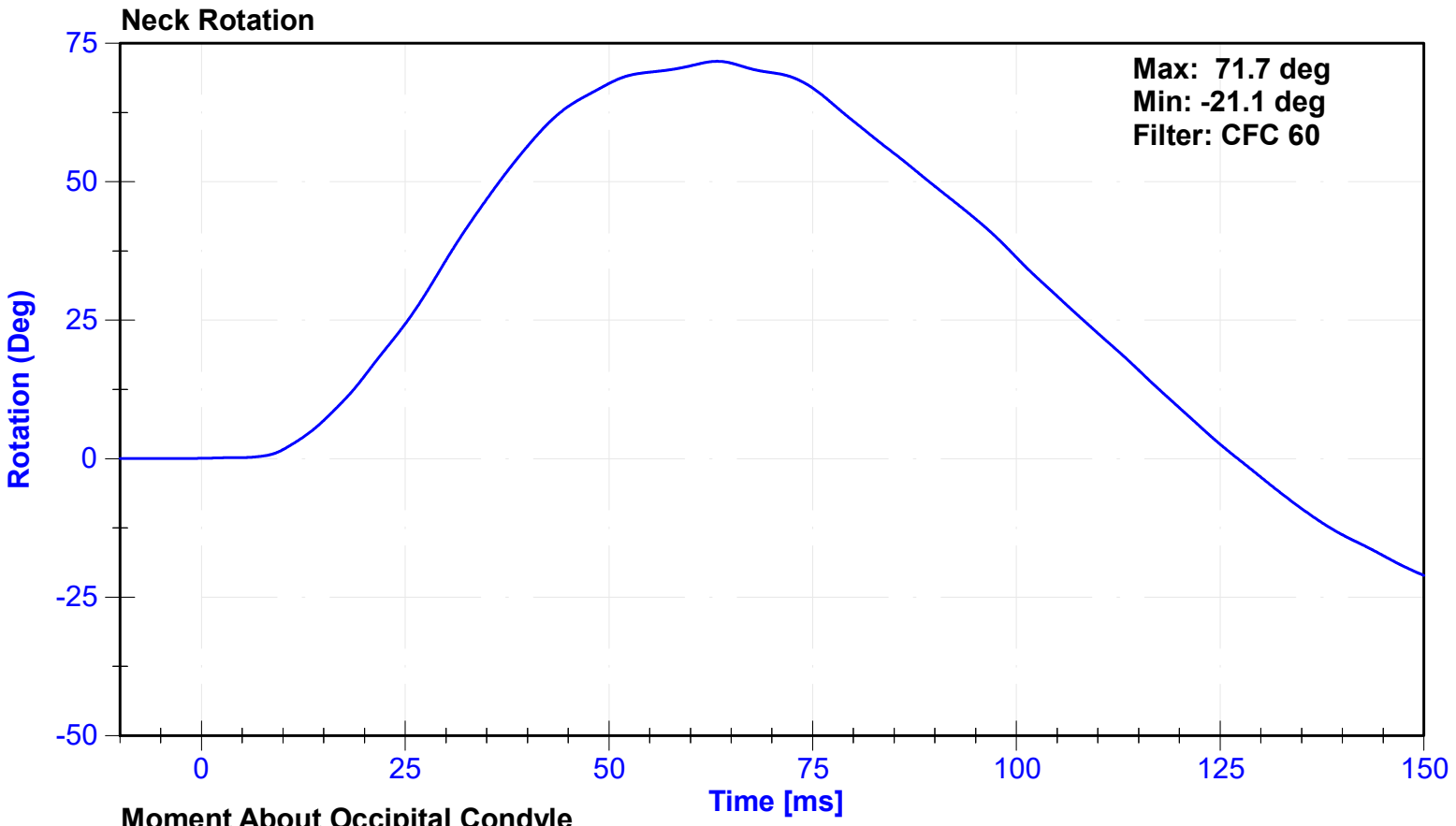
Results

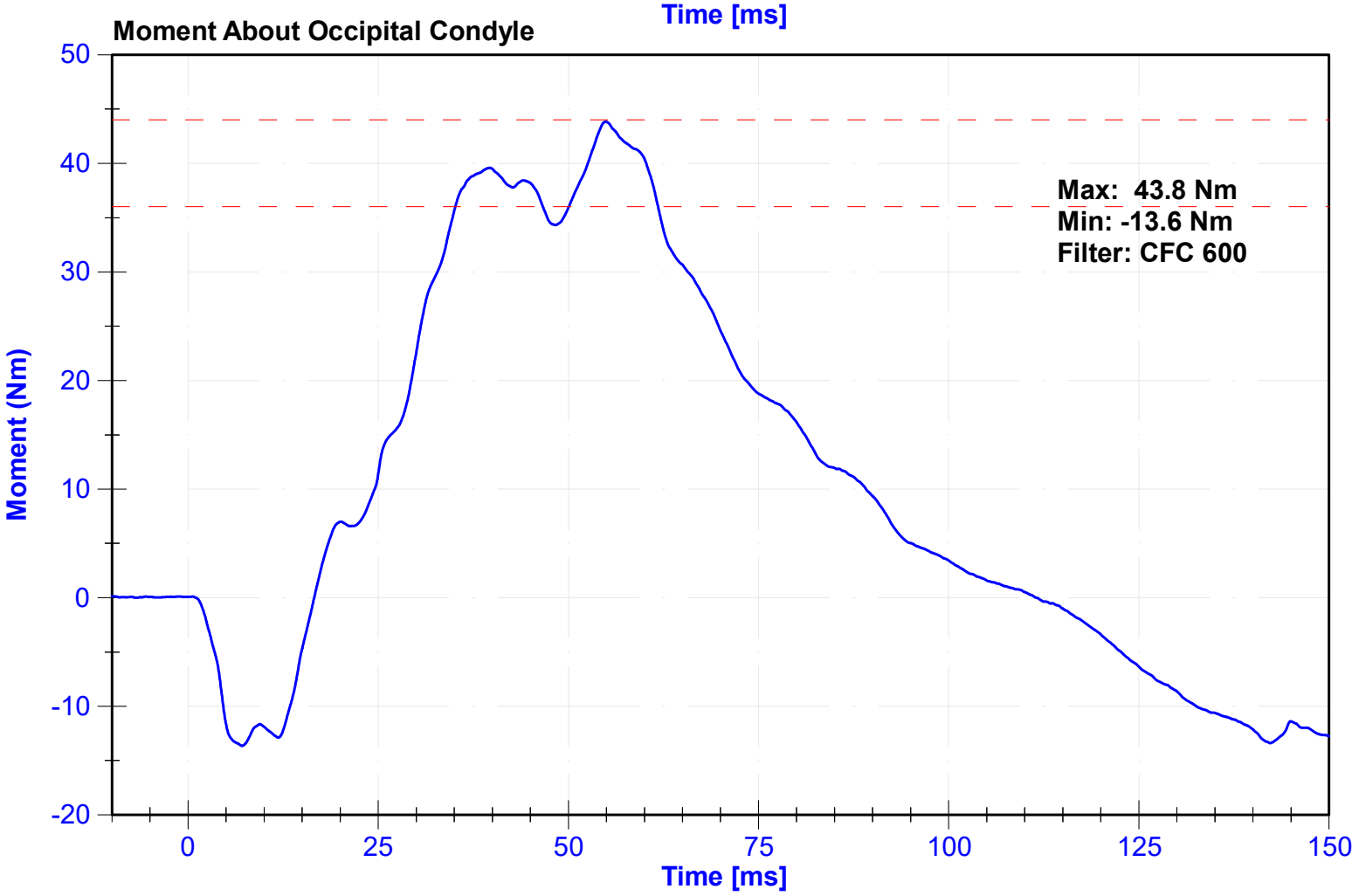
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	20.9	Pass
Humidity	10	70	%	59	Pass
Velocity	5.51	5.63	m/s	5.588	Pass
Pendulum Impulse at 10ms	2.2	2.8	m/s	2.25	Pass
Pendulum Impulse at 15ms	3.3	4.1	m/s	3.47	Pass
Pendulum Impulse at 20ms	4.4	5.4	m/s	4.71	Pass
Pendulum Impulse at 25ms	5.4	6.1	m/s	5.65	Pass
Pendulum Impulse from 25 to 100ms	5.5	6.2	m/s	5.98	Pass
Neck Rotation	71	81	deg	71.7	Pass
Time at Maximum Rotation	50	70	ms	63.3	Pass
Moment about the OC	36	44	Nm	43.8	Pass
Moment Decay to 0 Nm	102	126	ms	111.5	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	7231C-750	4/29/2024	10/26/2024
Pendulum Potentiometer	Servo	4961	10/2/2023	10/1/2024
Condyle Potentiometer	Servo	DS185	10/2/2023	10/1/2024
Upper Neck Load Cell	Denton	1716A_2187-FY	12/5/2023	12/4/2024




Neck Rotation
Max: 71.7 deg
Min: -21.1 deg
Filter: CFC 60
Rotation (Deg)
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]


Moment About Occipital Condyle
Max: 43.8 Nm
Min: -13.6 Nm
Filter: CFC 600
Moment (Nm)
50
40
30
20
10
0
-10
-20
0
25
50
75
100
125
150
Time [ms]

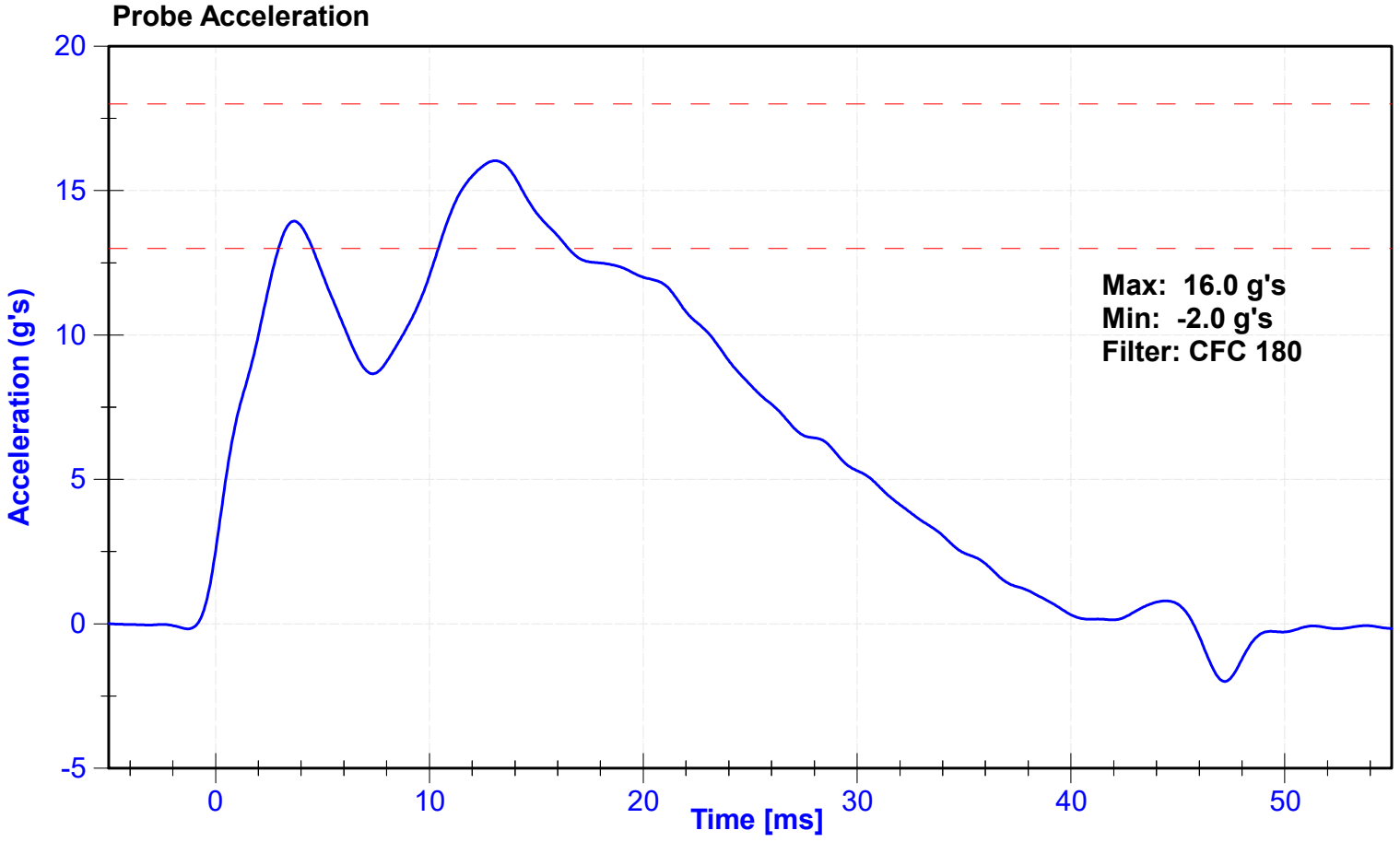
ATD Manufacturer	FTSS	Test Technician	J. Rios
ATD Serial Number	300	Laboratory Supervisor	C. Mantell

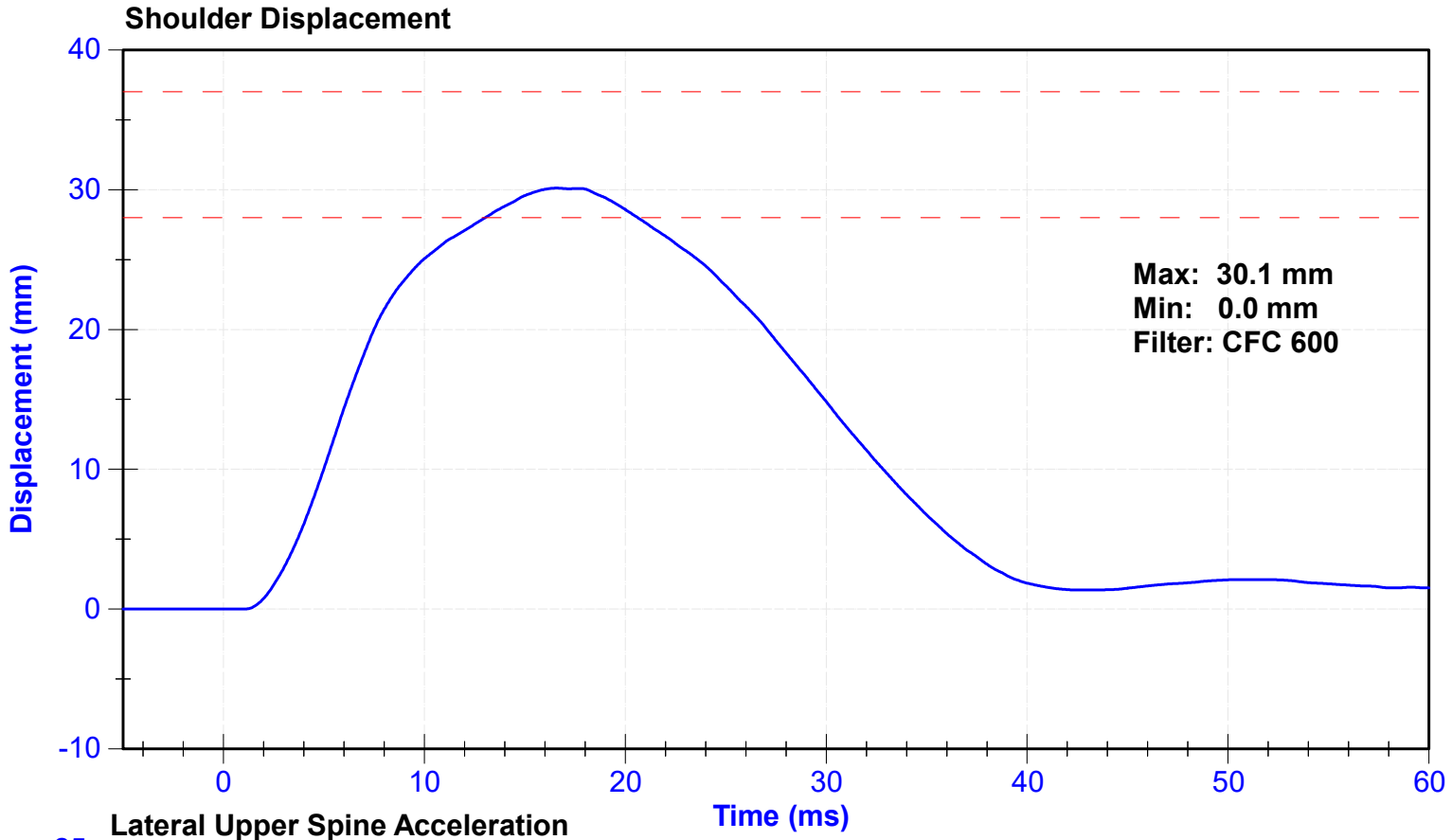
Results

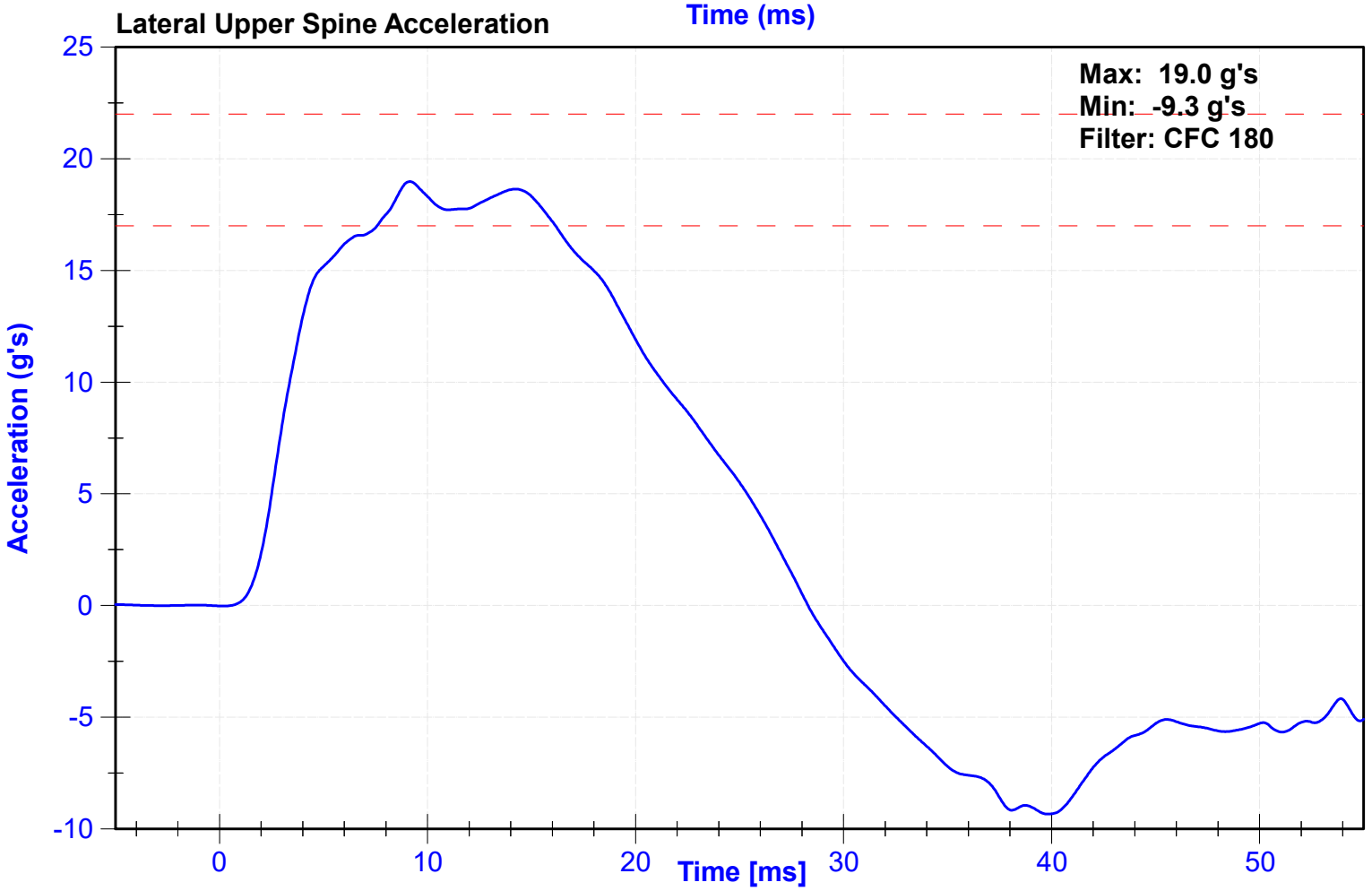
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.0	Pass
Humidity	10	70	%	57	Pass
Velocity	4.2	4.4	m/s	4.28	Pass
Probe Acceleration	13	18	g's	16.0	Pass
Shoulder Deflection	28	37	mm	30.1	Pass
Lateral Upper Spine Acceleration	17	22	g's	19.0	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18619	3/29/2024	9/25/2024
Shoulder Potentiometer	Servo	053GFE	5/9/2024	11/7/2024
Upper Spine Y Accelerometer	Endevco	T20880	5/9/2024	11/5/2024




Shoulder Displacement
Displacement (mm)
Time (ms)
Max: 30.1 mm
Min: 0.0 mm
Filter: CFC 600


Lateral Upper Spine Acceleration
Acceleration (g's)
Time [ms]
Max: 19.0 g's
Min: -9.3 g's
Filter: CFC 180

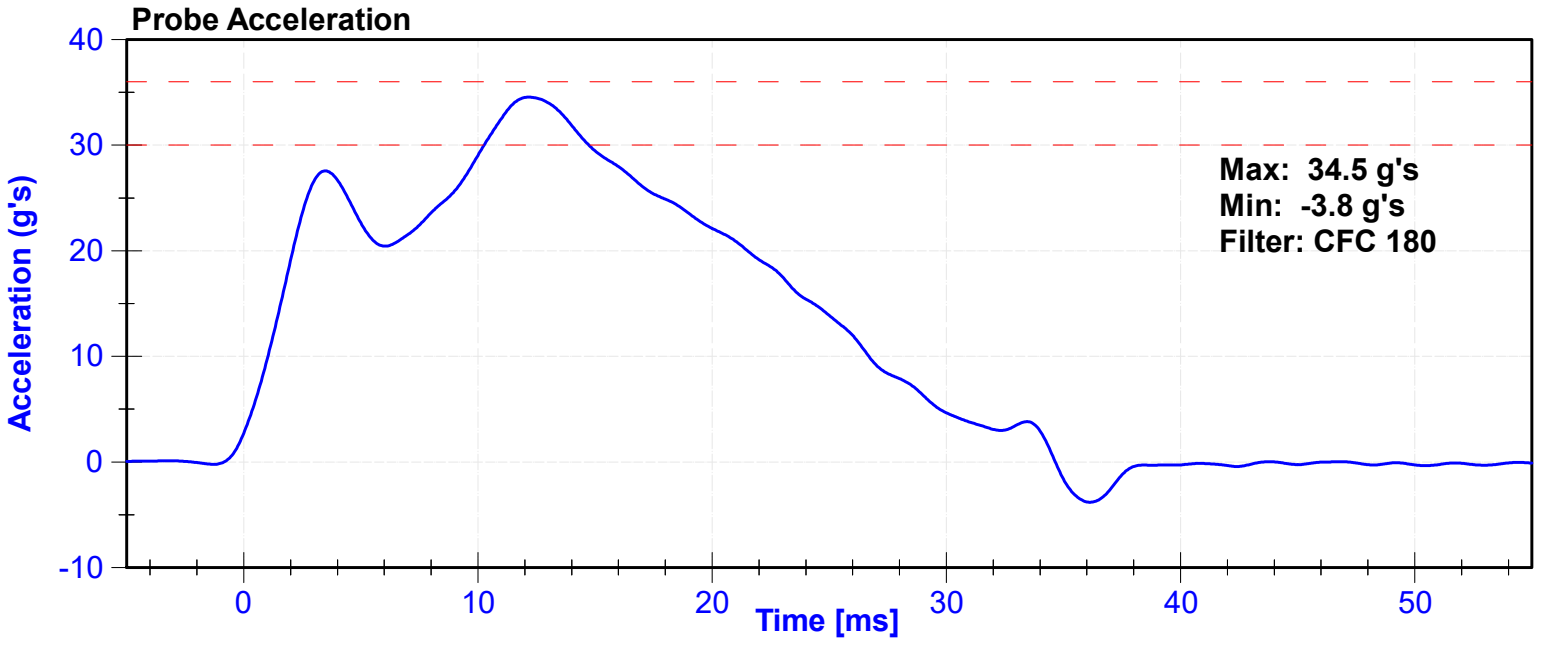
ATD Manufacturer	FTSS	Test Technician	J. Rios
ATD Serial Number	300	Laboratory Supervisor	C. Mantell

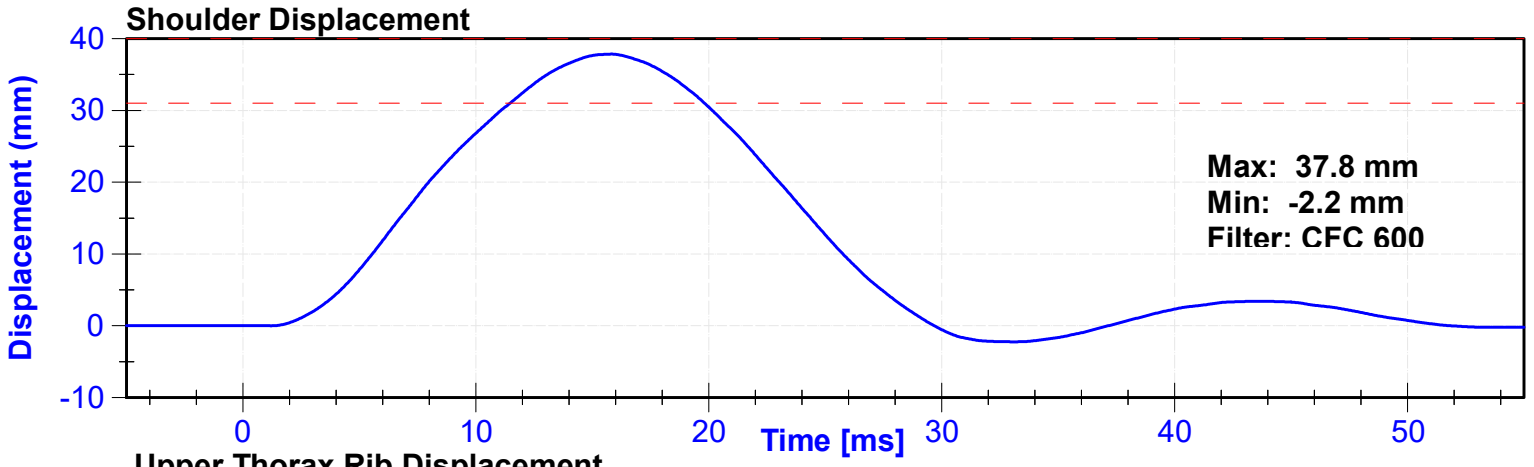
Results

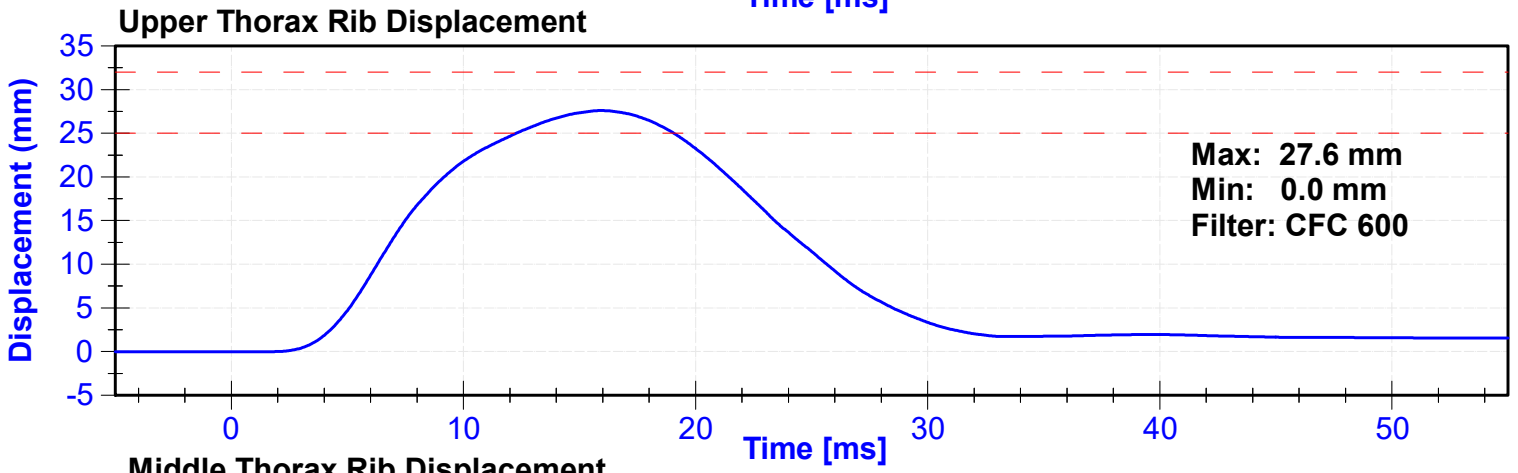
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.0	Pass
Humidity	10	70	%	57	Pass
Velocity	6.6	6.8	m/s	6.66	Pass
Probe Acceleration after 5 ms	30	36	g's	34.5	Pass
Lateral Upper Spine Acceleration	34	43	g's	35.5	Pass
Lateral Lower Spine Acceleration	29	37	g's	35.4	Pass
Shoulder Deflection	31	40	mm	37.8	Pass
Upper Thorax Rib Deflection	25	32	mm	27.6	Pass
Mid Thorax Rib Deflection	30	36	mm	30.3	Pass
Lower Thorax Rib Deflection	32	38	mm	32.2	Pass

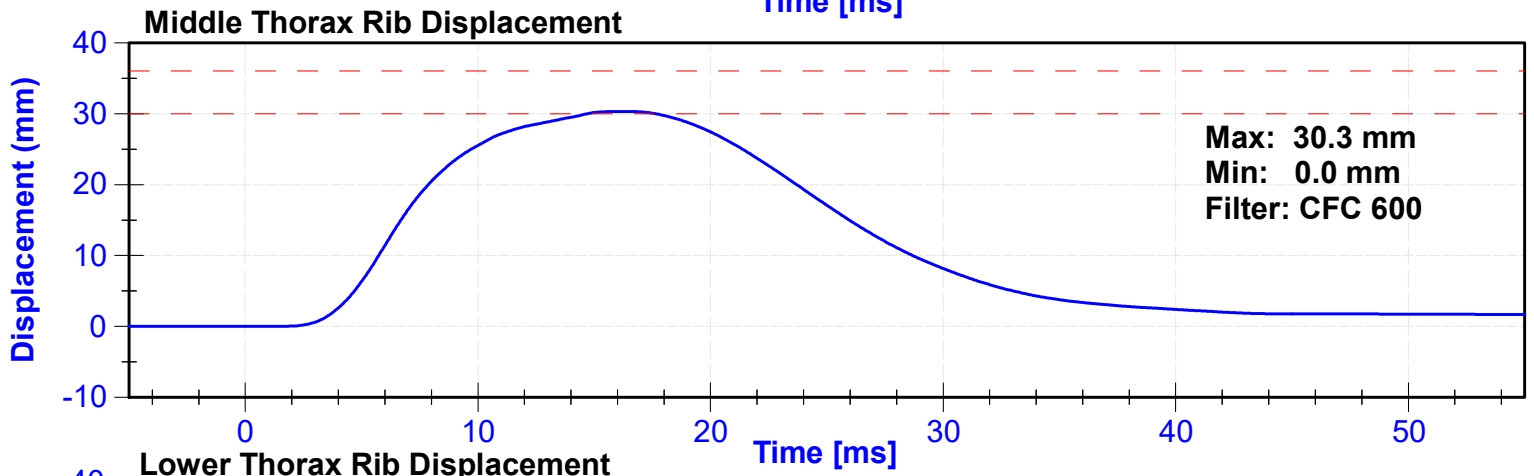
Transducer Calibrations

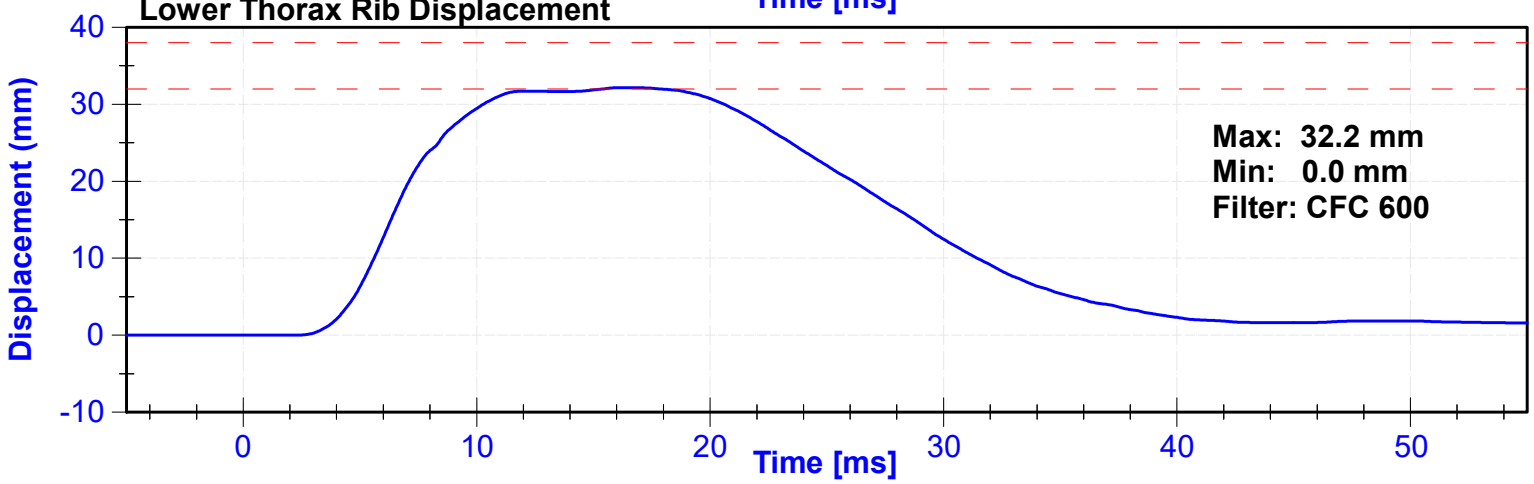
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18619	3/29/2024	9/25/2024
Upper Spine T1 Y Accelerometer	Endevco	T20880	5/9/2024	11/5/2024
Upper Spine T12 Y Accelerometer	Endevco	P52071	5/9/2024	11/5/2024
Shoulder Potentiometer	Servo	053GFE	5/9/2024	11/7/2024
Upper Thorax Rib Potentiometer	Servo	2316GFE	5/9/2024	11/7/2024
Middle Thorax Rib Potentiometer	Servo	085GFE	5/9/2024	11/7/2024
Lower Thorax Rib Potentiometer	Servo	1156GFE	5/9/2024	11/7/2024

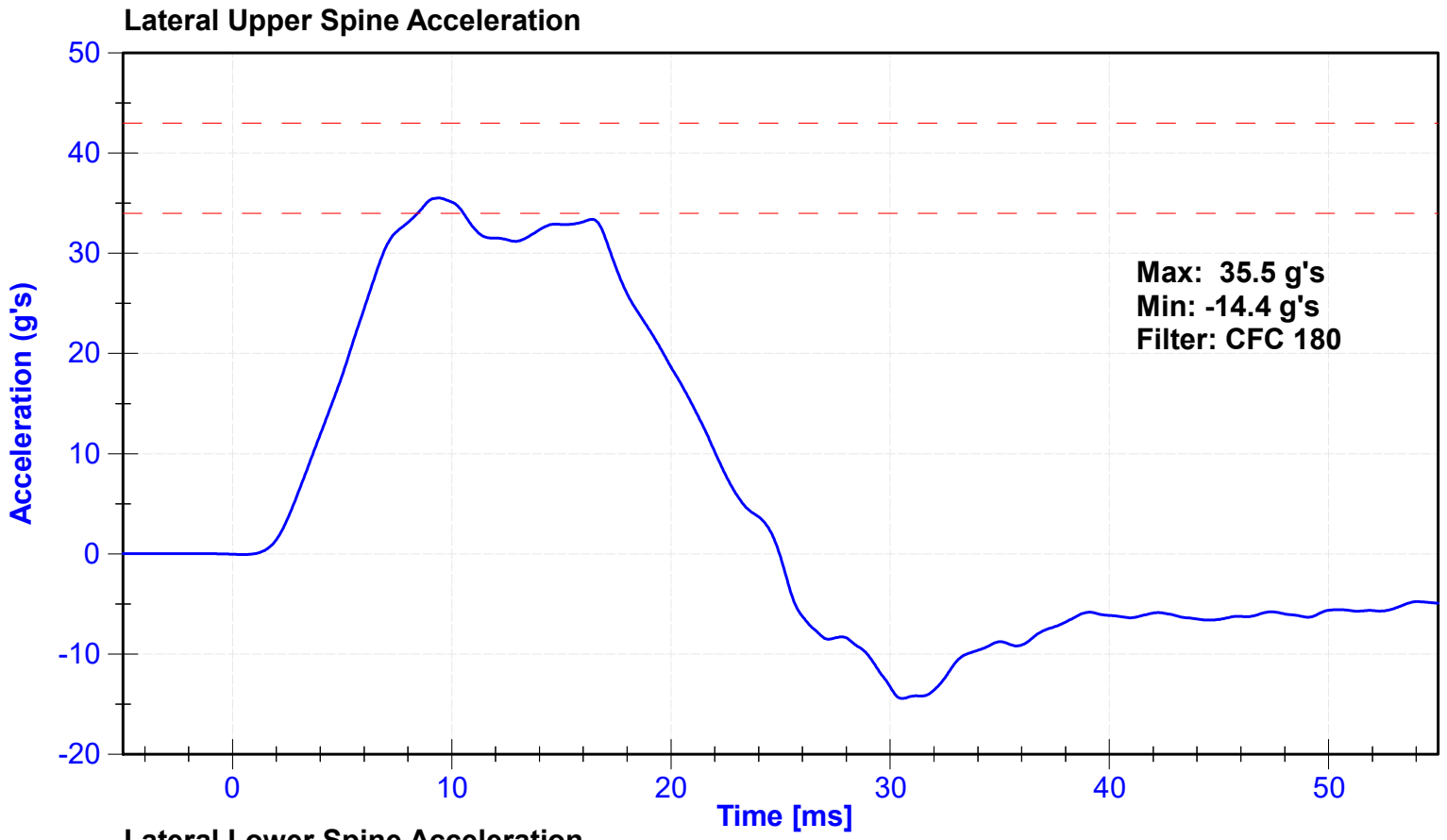


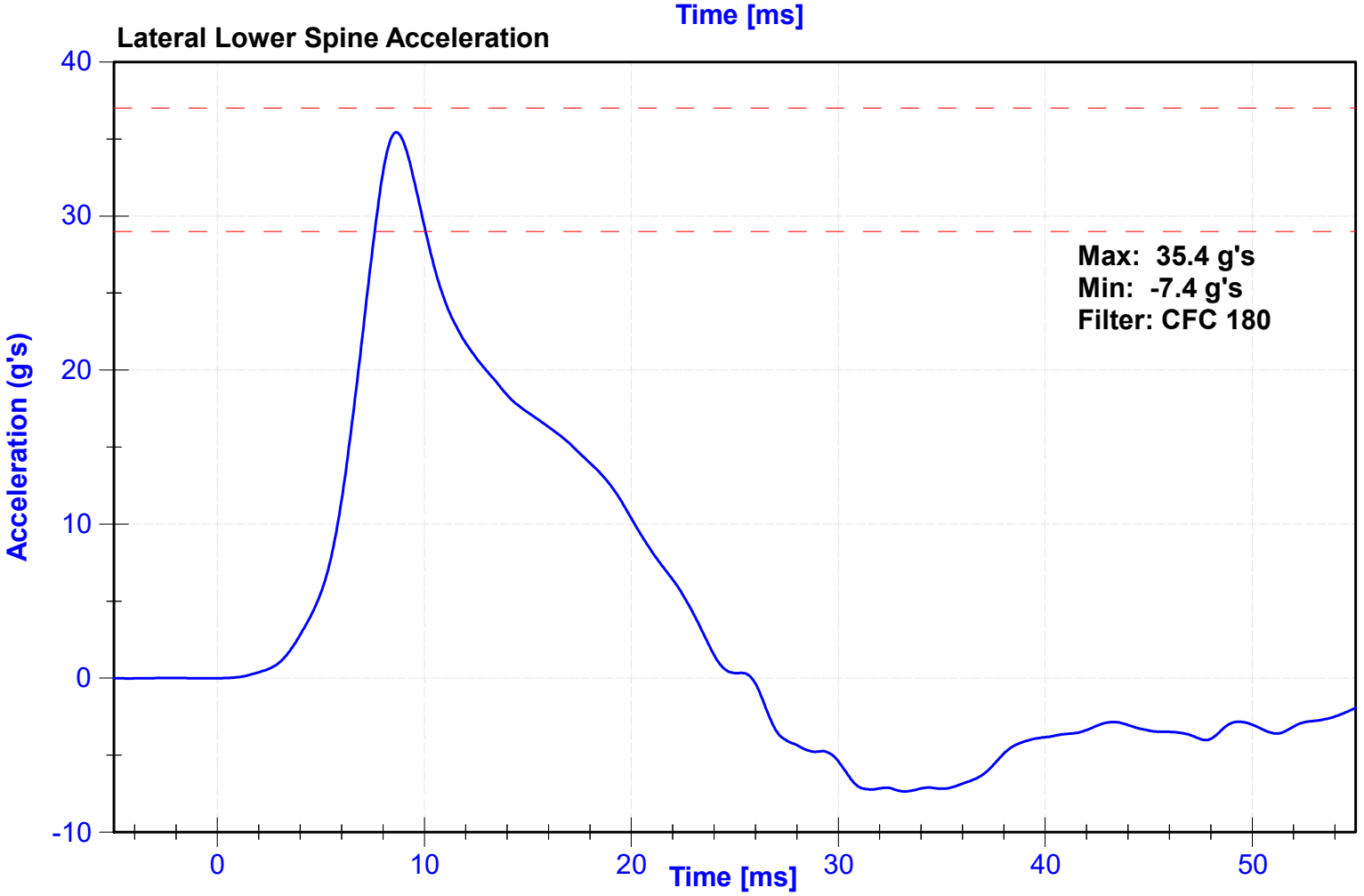

Shoulder Displacement
Displacement (mm)
Time [ms]
Max: 37.8 mm
Min: -2.2 mm
Filter: CFC 600


Upper Thorax Rib Displacement
Displacement (mm)
Time [ms]
Max: 27.6 mm
Min: 0.0 mm
Filter: CFC 600


Middle Thorax Rib Displacement
Displacement (mm)
Time [ms]
Max: 30.3 mm
Min: 0.0 mm
Filter: CFC 600


Lower Thorax Rib Displacement
Displacement (mm)
Time [ms]
Max: 32.2 mm
Min: 0.0 mm
Filter: CFC 600


Lateral Upper Spine Acceleration
Acceleration (g's)
Time [ms]
Max: 35.5 g's
Min: -14.4 g's
Filter: CFC 180


Lateral Lower Spine Acceleration
Acceleration (g's)
Time [ms]
Max: 35.4 g's
Min: -7.4 g's
Filter: CFC 180

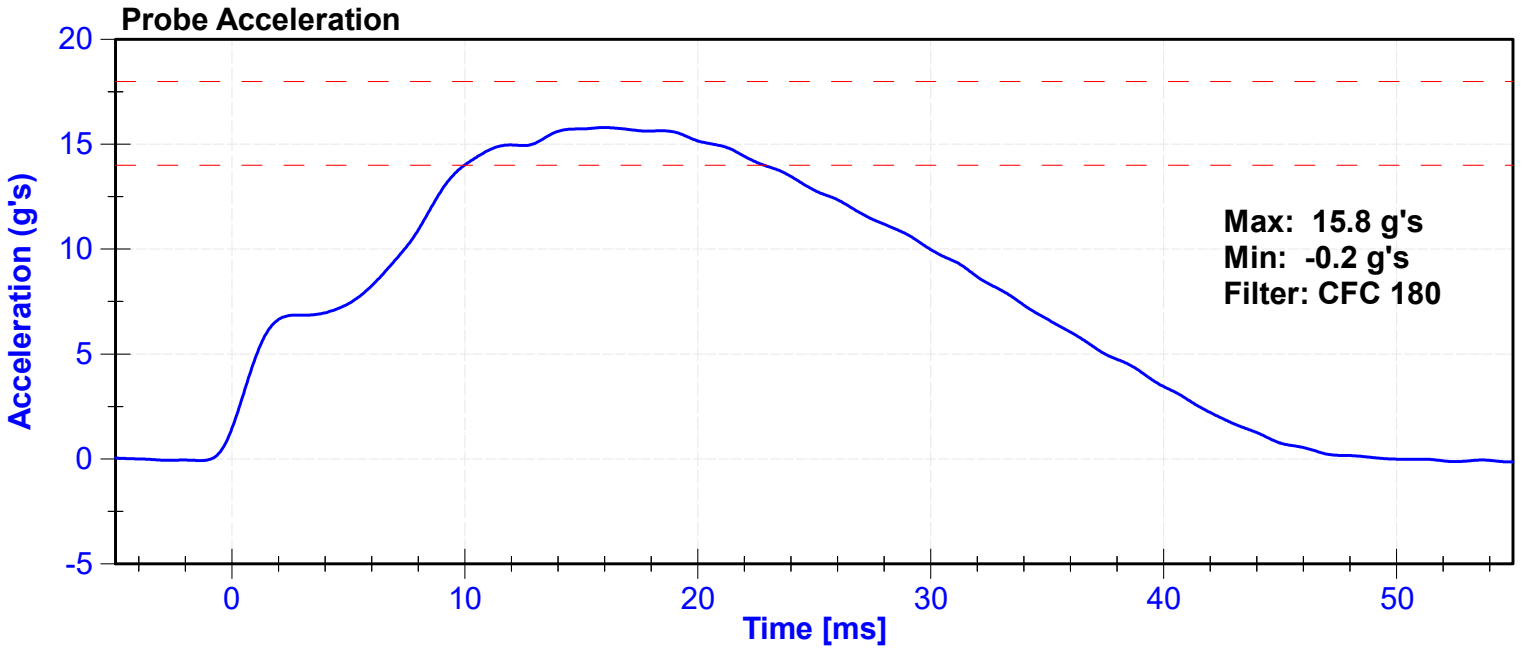
ATD Manufacturer	FTSS	Test Technician	J. Rios
ATD Serial Number	300	Laboratory Supervisor	C. Mantell

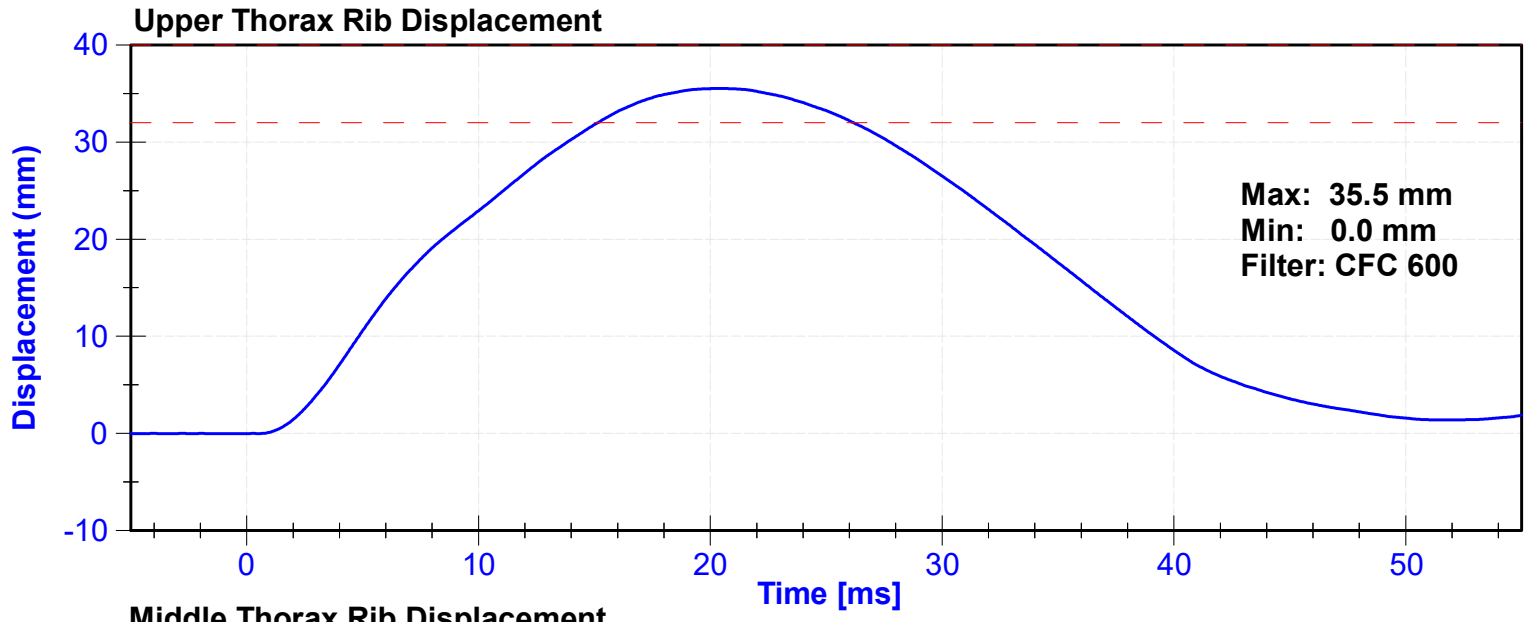
Results

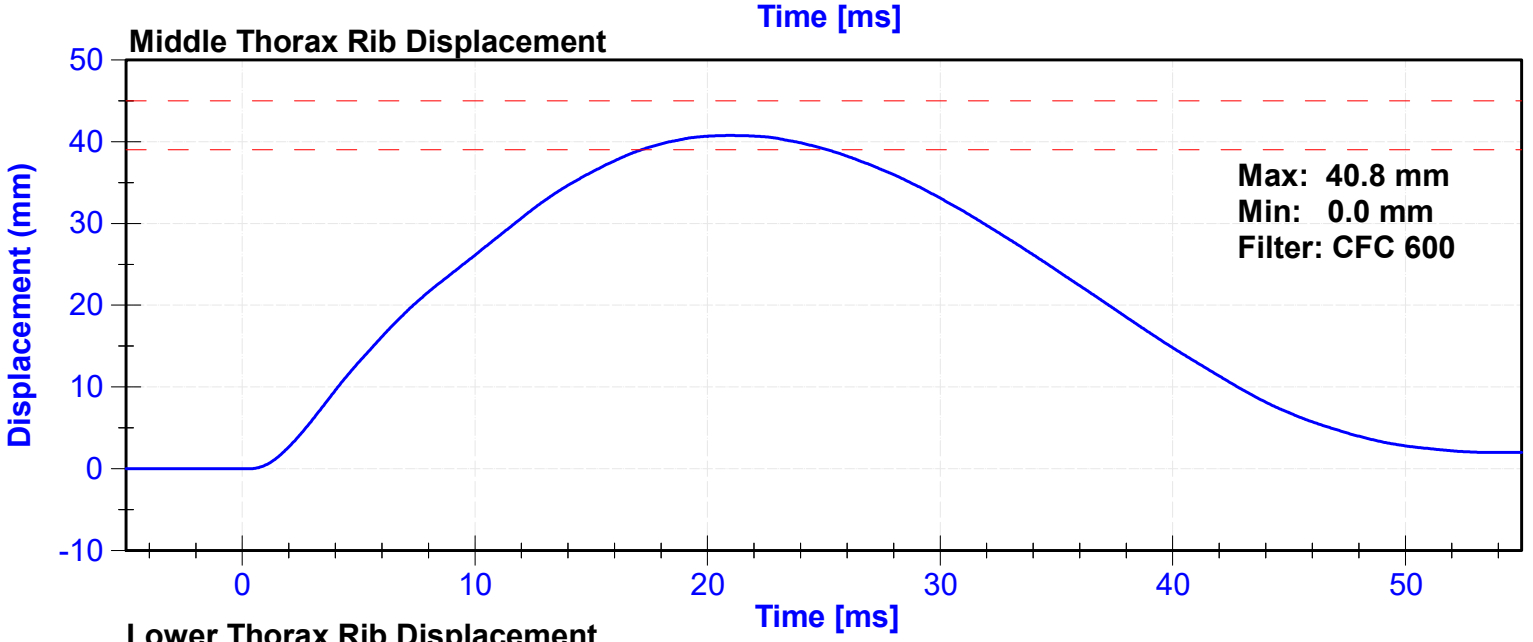
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.0	Pass
Humidity	10	70	%	57	Pass
Velocity	4.2	4.4	m/s	4.29	Pass
Probe Acceleration	14	18	g's	15.8	Pass
Lateral Upper Spine Acceleration	13	17	g's	14.0	Pass
Lateral Lower Spine Acceleration	7	11	g's	8.5	Pass
Upper Thorax Rib Deflection	32	40	mm	35.5	Pass
Middle Thorax Rib Deflection	39	45	mm	40.8	Pass
Lower Thorax Rib Deflection	35	43	mm	36.6	Pass

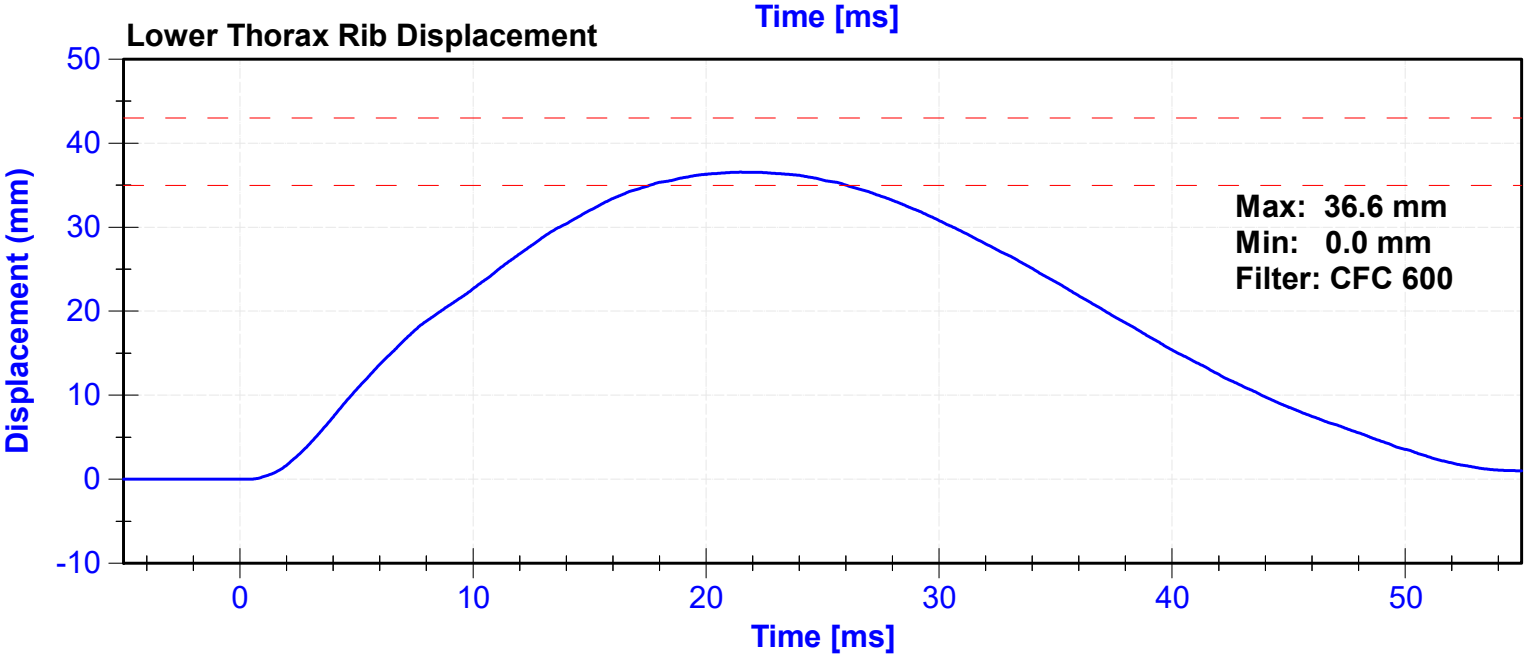
Transducer Calibrations

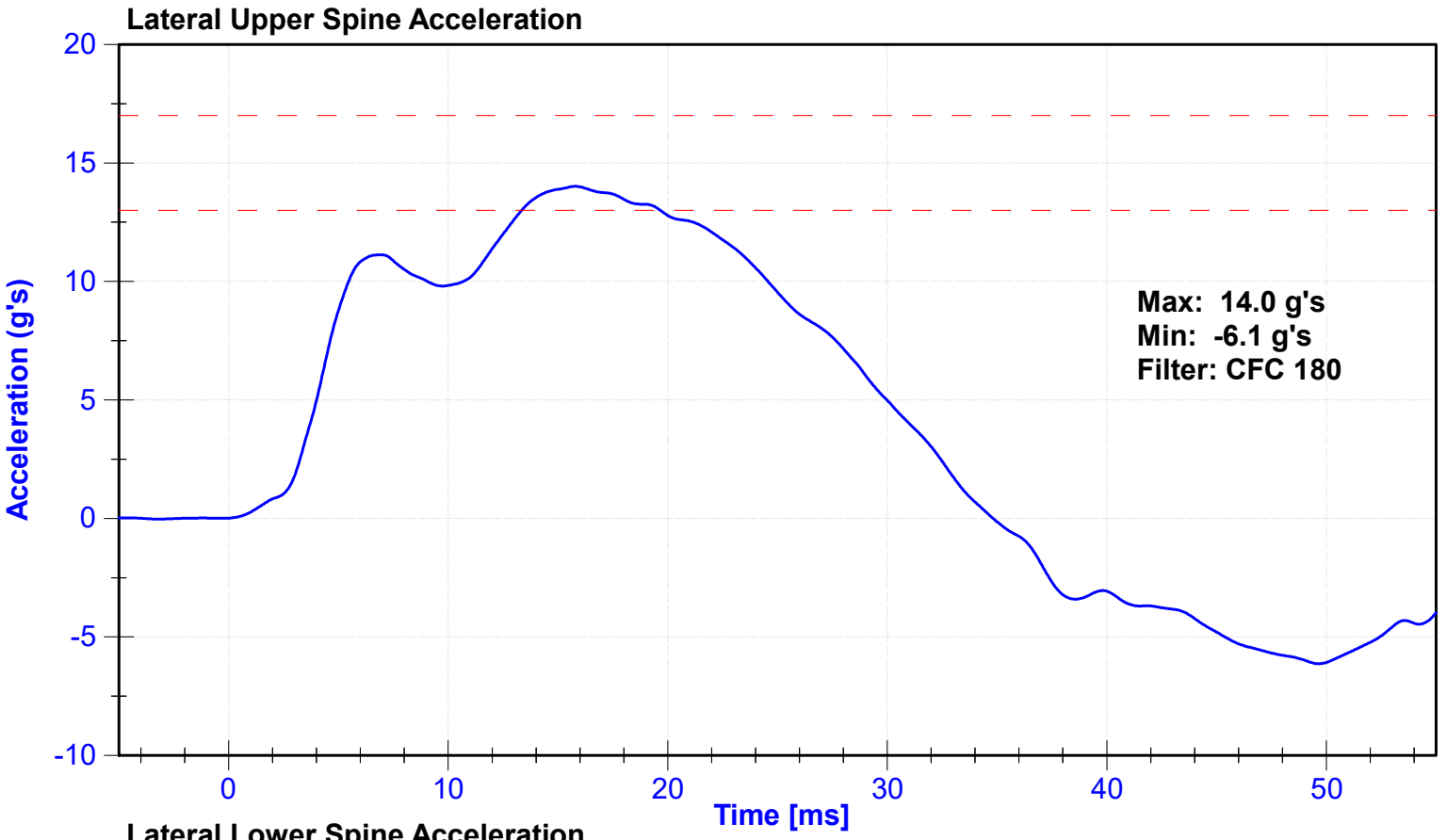
Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18619	3/29/2024	9/25/2024
Upper Spine Y Accelerometer	Endevco	T20880	5/9/2024	11/5/2024
Lower Spine Y Accelerometer	Endevco	P52071	5/9/2024	11/5/2024
Upper Thorax Rib Potentiometer	Servo	2316GFE	5/9/2024	11/7/2024
Middle Thorax Rib Potentiometer	Servo	085GFE	5/9/2024	11/7/2024
Lower Thorax Rib Potentiometer	Servo	1156GFE	5/9/2024	11/7/2024

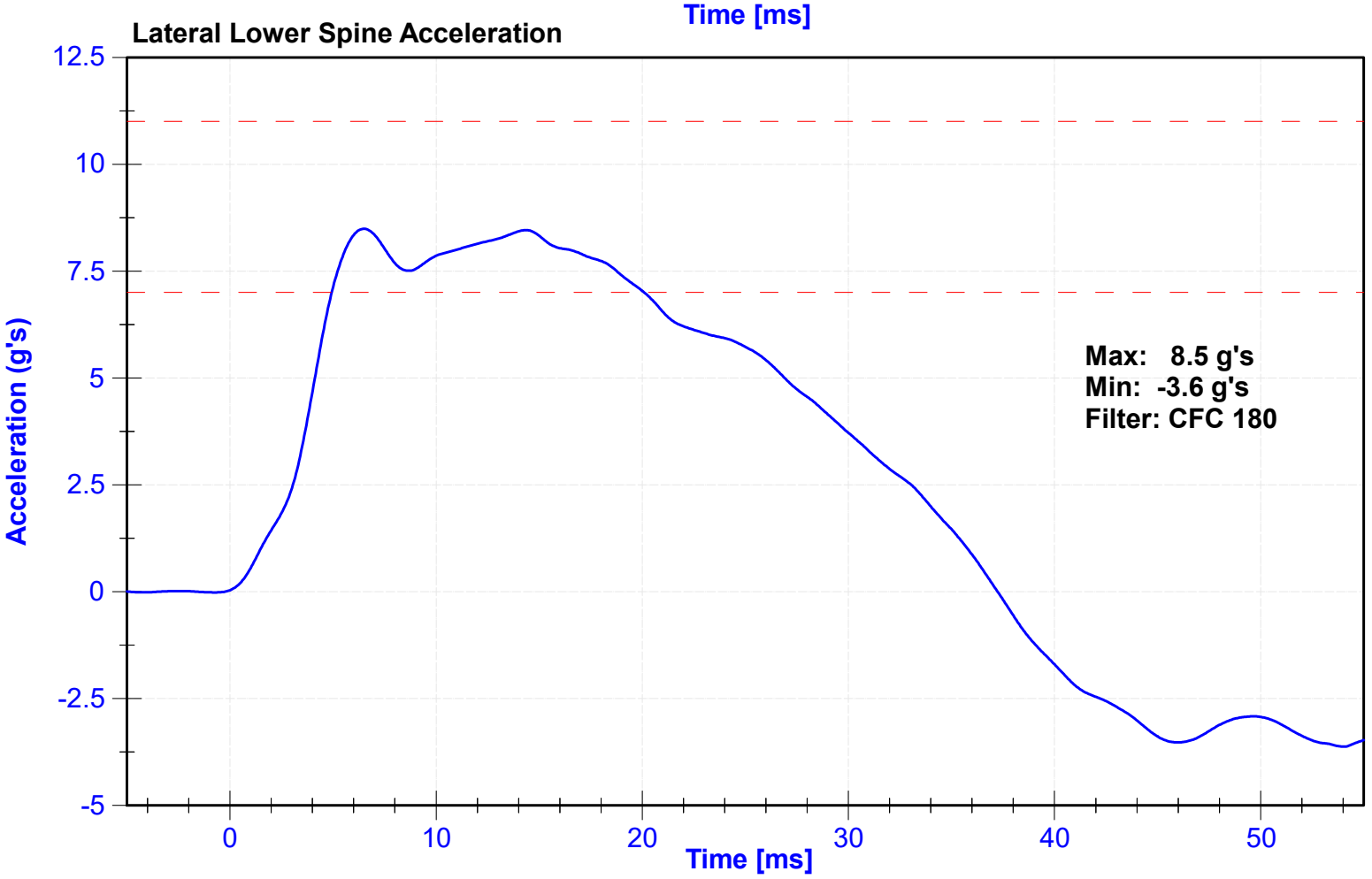



Upper Thorax Rib Displacement
Displacement (mm)
Time [ms]
Max: 35.5 mm
Min: 0.0 mm
Filter: CFC 600


Middle Thorax Rib Displacement
Displacement (mm)
Time [ms]
Max: 40.8 mm
Min: 0.0 mm
Filter: CFC 600


Lower Thorax Rib Displacement
Displacement (mm)
Time [ms]
Max: 36.6 mm
Min: 0.0 mm
Filter: CFC 600


Lateral Upper Spine Acceleration
Acceleration (g's)
20
15
10
5
0
-5
-10
0
10
20
30
40
50
Time [ms]
Max: 14.0 g's
Min: -6.1 g's
Filter: CFC 180


Lateral Lower Spine Acceleration
Acceleration (g's)
12.5
10
7.5
5
2.5
0
-2.5
-5
0
10
20
30
40
50
Time [ms]
Max: 8.5 g's
Min: -3.6 g's
Filter: CFC 180

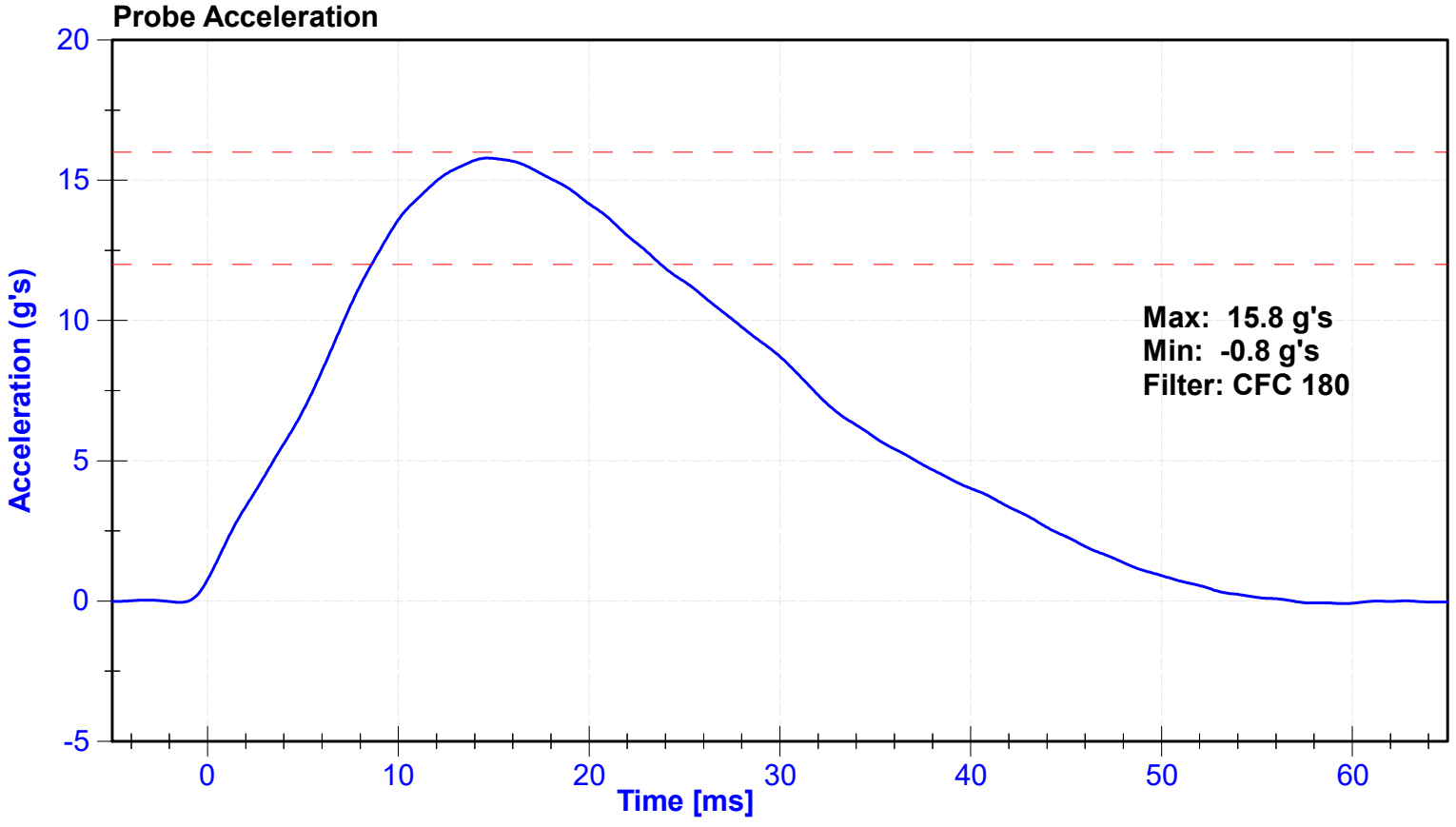
ATD Manufacturer	FTSS	Test Technician	J. Rios
ATD Serial Number	300	Laboratory Supervisor	C. Mantell

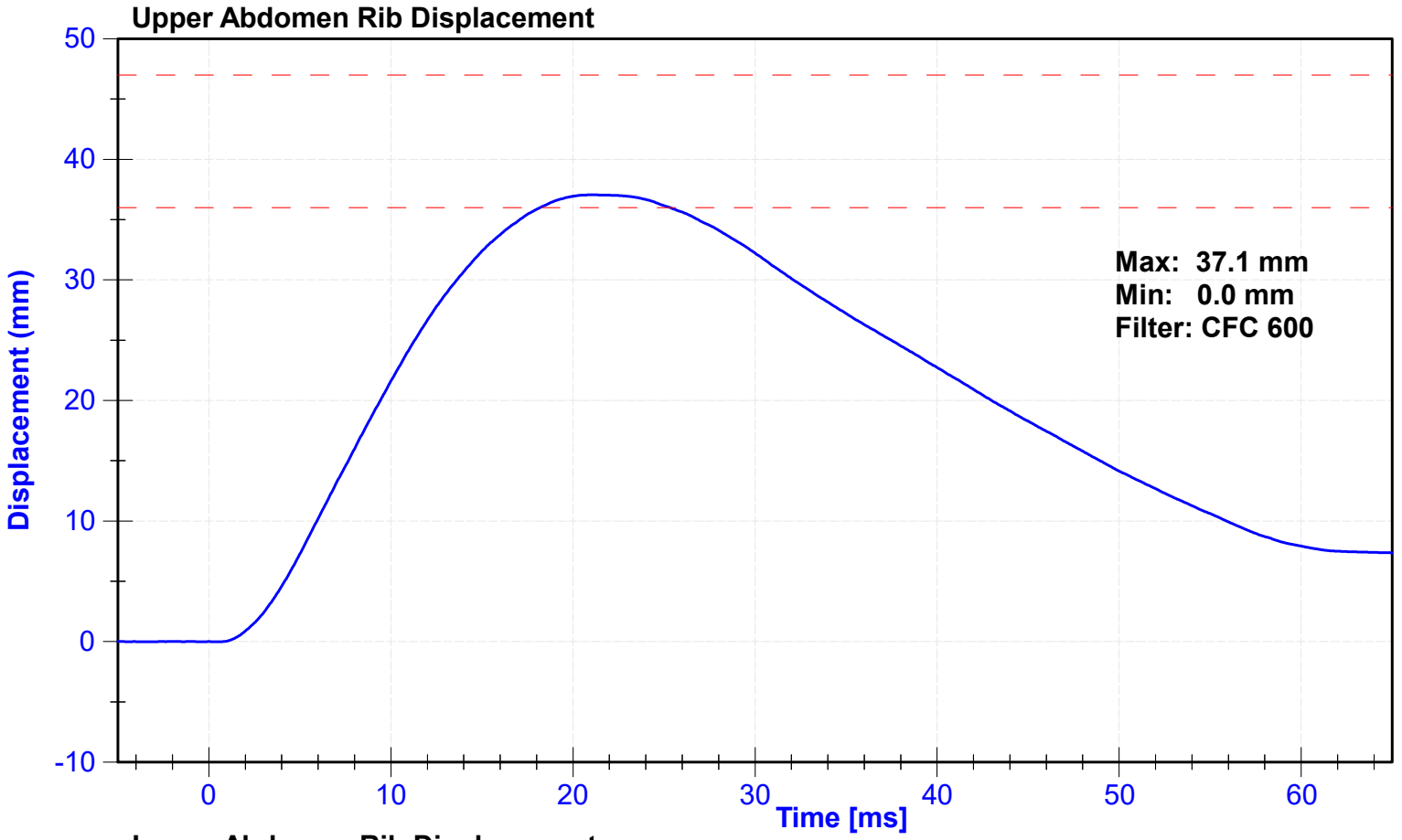
Results

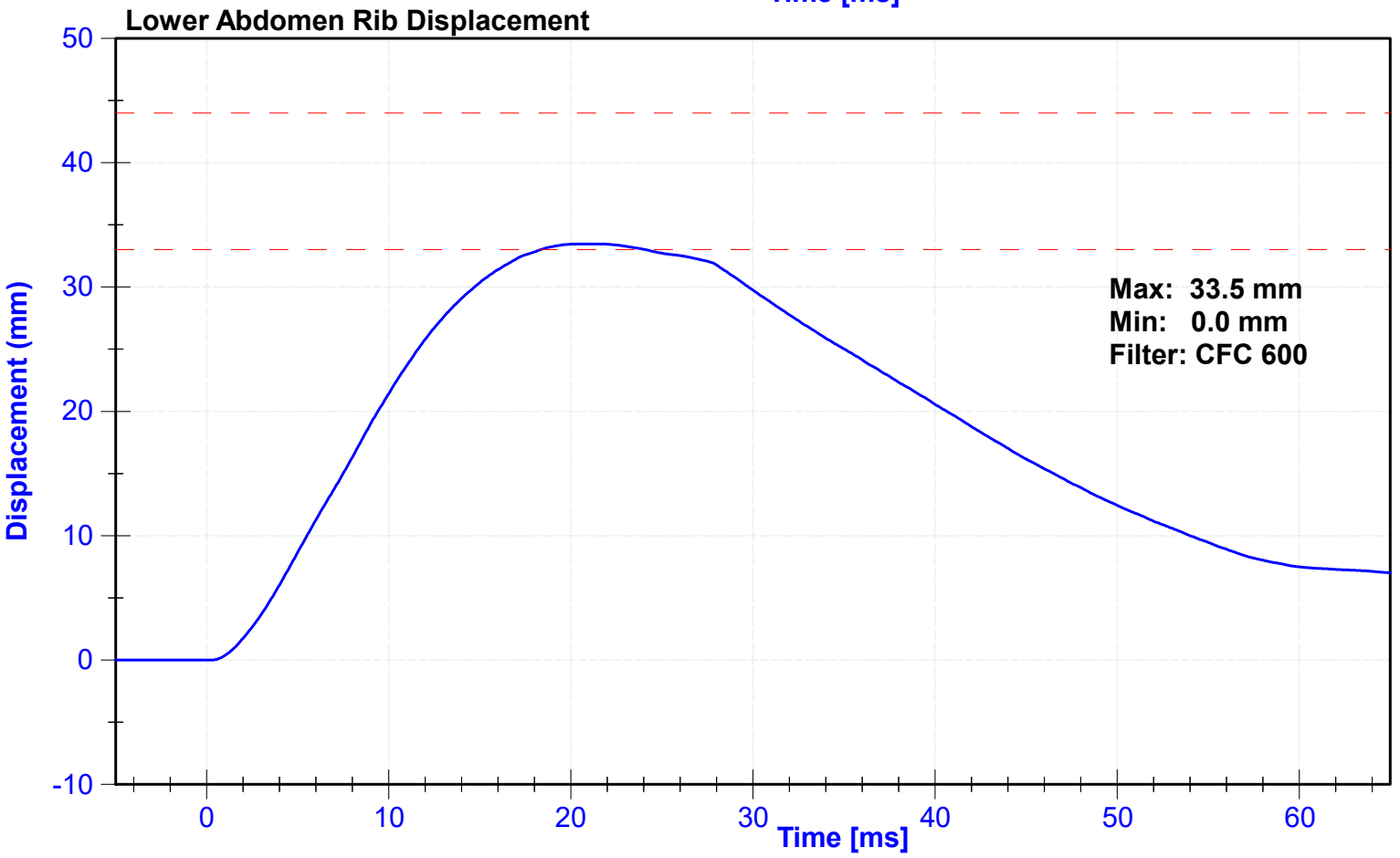
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.0	Pass
Humidity	10	70	%	57	Pass
Velocity	4.2	4.4	m/s	4.28	Pass
Probe Acceleration	12	16	g's	15.8	Pass
Lateral Lower Spine Acceleration	9	14	g's	11.8	Pass
Upper Abdomen Rib Deflection	36	47	mm	37.1	Pass
Lower Abdomen Rib Deflection	33	44	mm	33.5	Pass

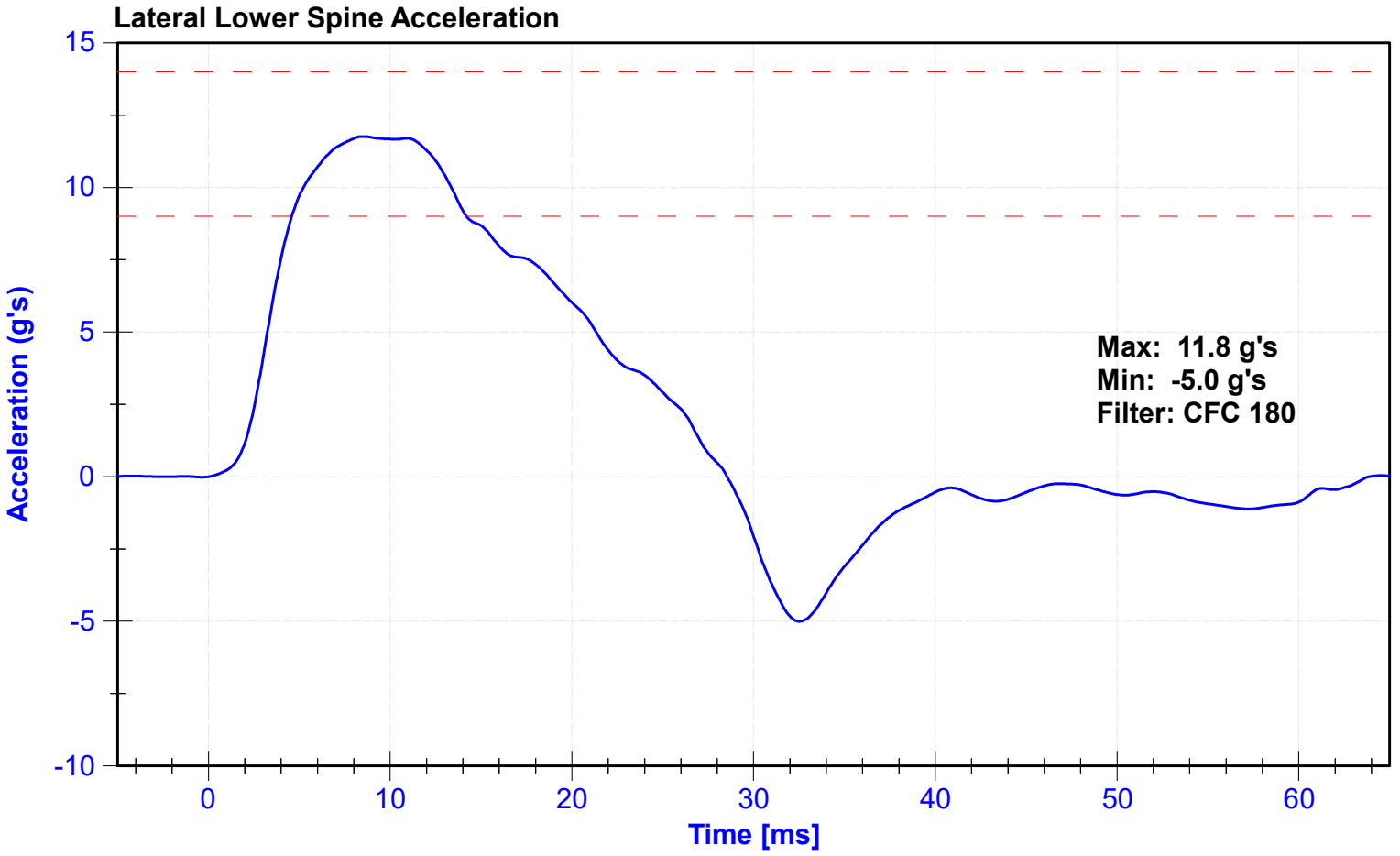
Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Probe Accelerometer	Endevco	18619	3/29/2024	9/25/2024
Lower Spine Y Accelerometer	Endevco	P52071	5/9/2024	11/5/2024
Upper Abdomen Rib Potentiometer	Servo	074GFE	5/9/2024	11/5/2024
Lower Abdomen Rib Potentiometer	Servo	075GFE	5/9/2024	11/5/2024




Upper Abdomen Rib Displacement
Displacement (mm)
50
40
30
20
10
0
-10
0
10
20
30
40
50
60
Time [ms]
Max: 37.1 mm
Min: 0.0 mm
Filter: CFC 600


Lower Abdomen Rib Displacement
Displacement (mm)
50
40
30
20
10
0
-10
0
10
20
30
40
50
60
Time [ms]
Max: 33.5 mm
Min: 0.0 mm
Filter: CFC 600


Lateral Lower Spine Acceleration
Acceleration (g's)
15
10
5
0
-5
-10
0
10
20
30
40
50
60
Time [ms]
Max: 11.8 g's
Min: -5.0 g's
Filter: CFC 180

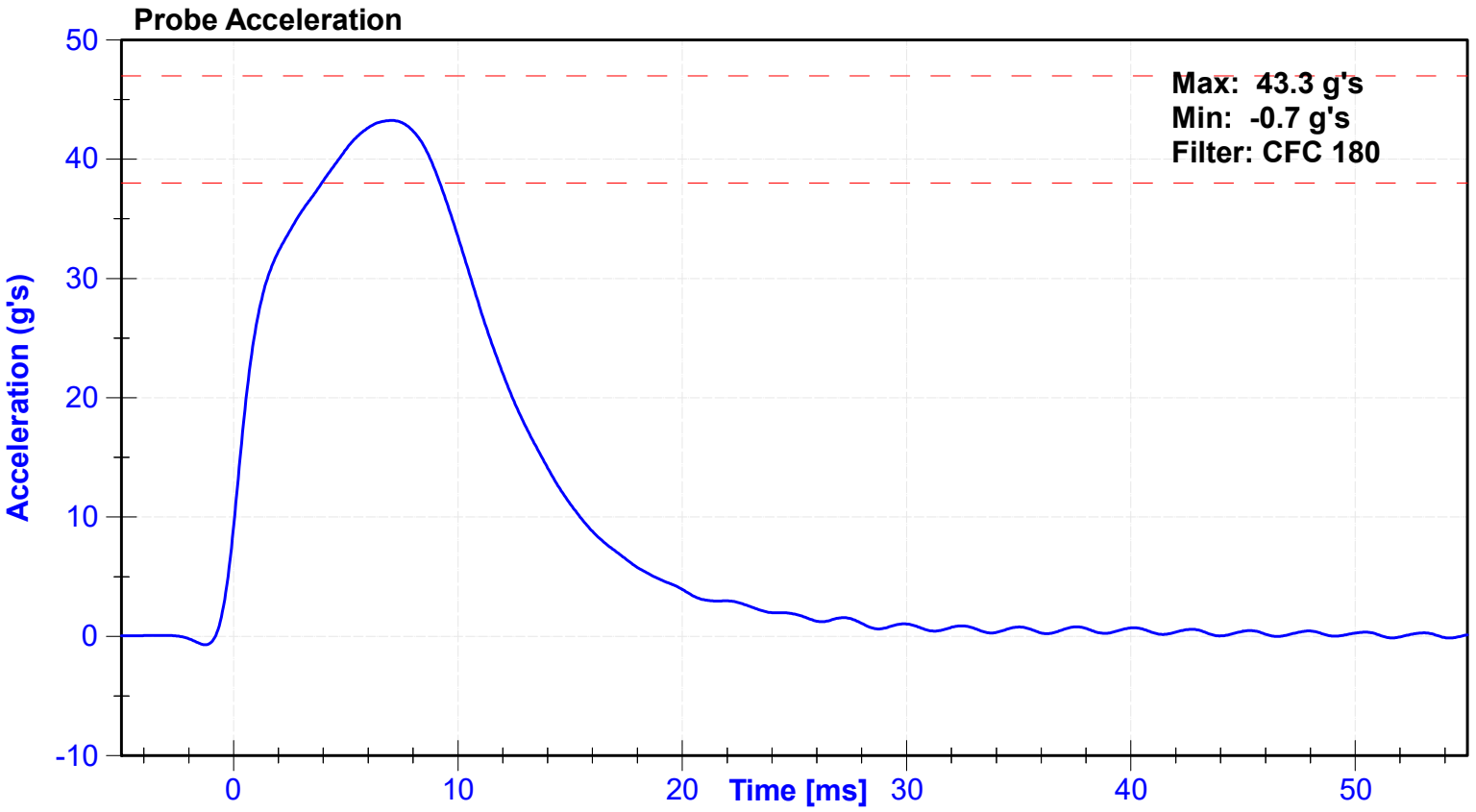
ATD Manufacturer	FTSS	Test Technician	J. Rios
ATD Serial Number	300	Laboratory Supervisor	C. Mantell

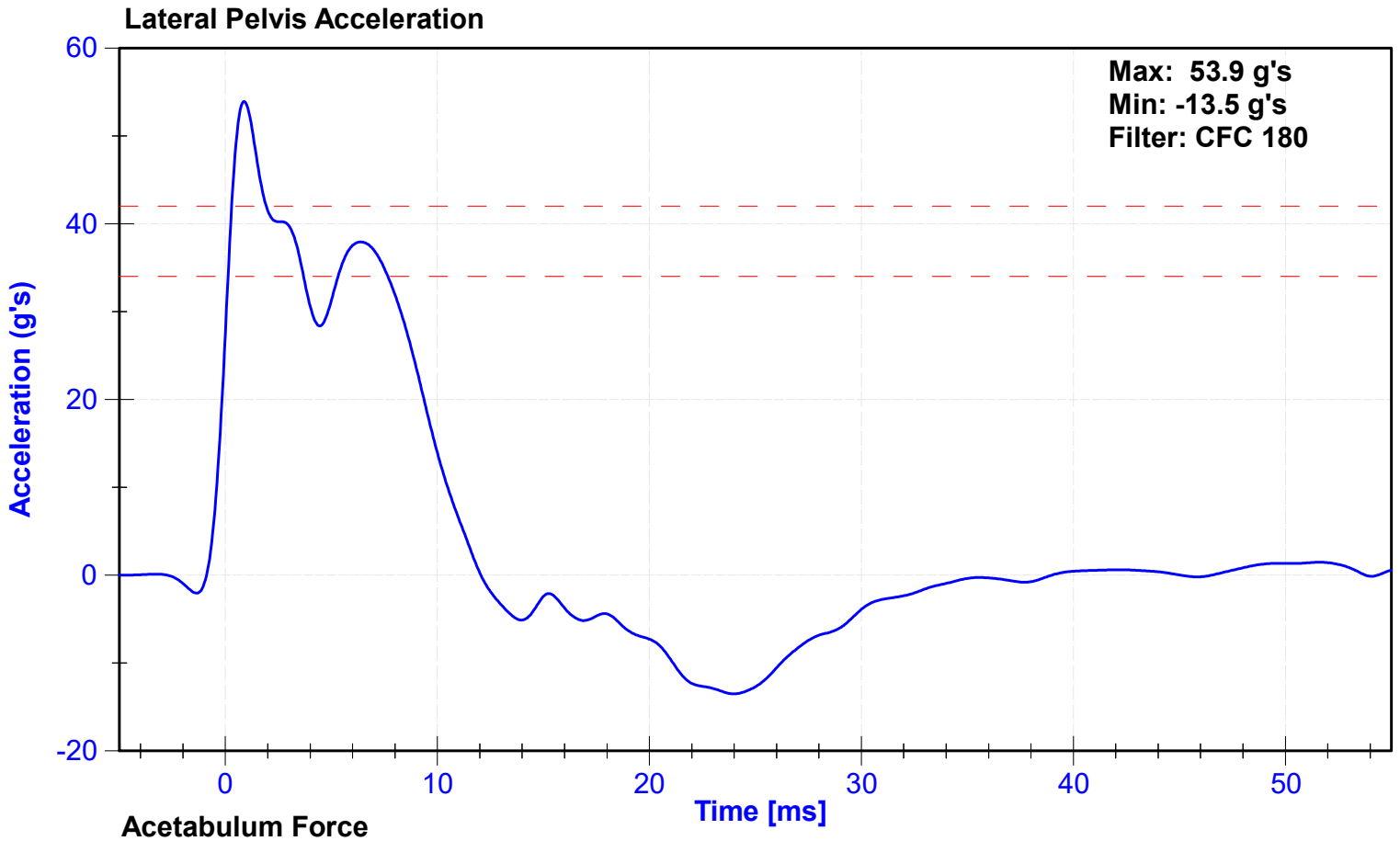
Results

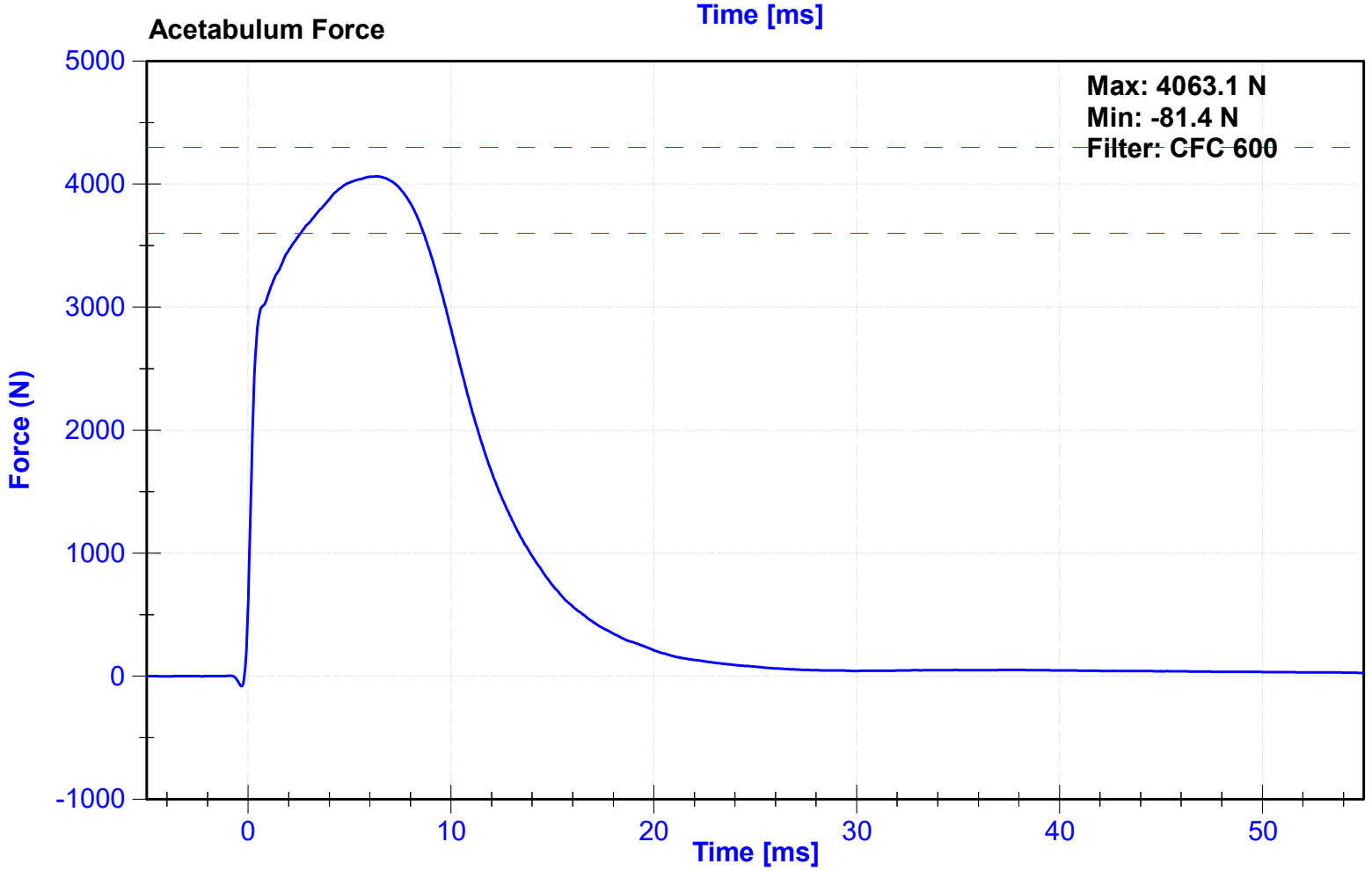
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.0	Pass
Humidity	10	70	%	57	Pass
Velocity	6.6	6.8	m/s	6.66	Pass
Probe Acceleration	38	47	g's	43.3	Pass
Lateral Pelvis Acceleration after 6ms	34	42	g's	37.9	Pass
Acetabulum Force	3600	4300	N	4063.1	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18619	3/29/2024	9/25/2024
Pelvis Y Accelerometer	Endevco	P51731	5/9/2024	11/5/2024
Acetabulum Load Cell	Denton	267-FY	9/11/2023	9/10/2024
Certification Plug	SACO			N/A
Crash Test Plug	SACO			N/A




Lateral Pelvis Acceleration
Max: 53.9 g's
Min: -13.5 g's
Filter: CFC 180
Acceleration (g's)
60
40
20
0
-20
0
10
20
30
40
50
Time [ms]


Acetabulum Force
Max: 4063.1 N
Min: -81.4 N
Filter: CFC 600
Force (N)
5000
4000
3000
2000
1000
0
-1000
0
10
20
30
40
50
Time [ms]

SACO RESEARCH

SID-IIs Pelvis Plug Certification Test

Plug S/N 16341
Test Number 22908
Report Number 22965
Test Date 5/20/2022 12:00:36 PM

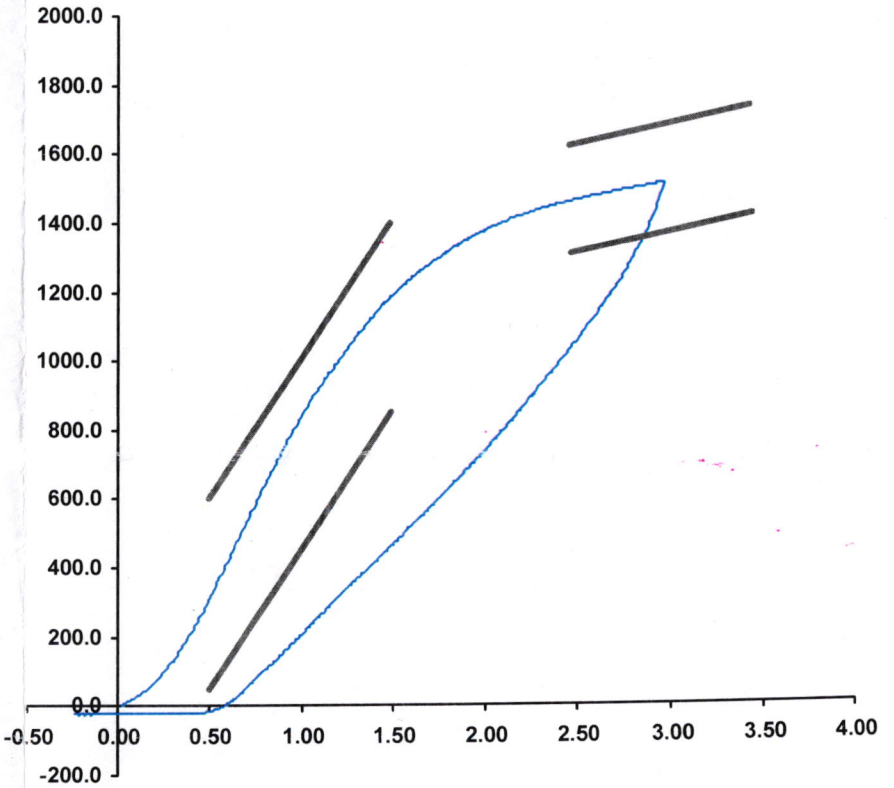
	Test Results	Spec Min	Spec Max
Force @ 0.5 mm (N)	317	50	600
Force @ 1.5 mm (N)	1,184	850	1,400
Force @ 2.5 mm (N)	1,458	1,306	1,618
Force @ 3.0 mm (N)	1,509	1,361	1,673

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:
Cert Plug 07/18/2024 300

Force (-N) vs Extension (-mm)



Operator

Part Number 180-4450

Template No 107 20-May-22
SACO Research

By : DC Date : 5/20/2022

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

C-90

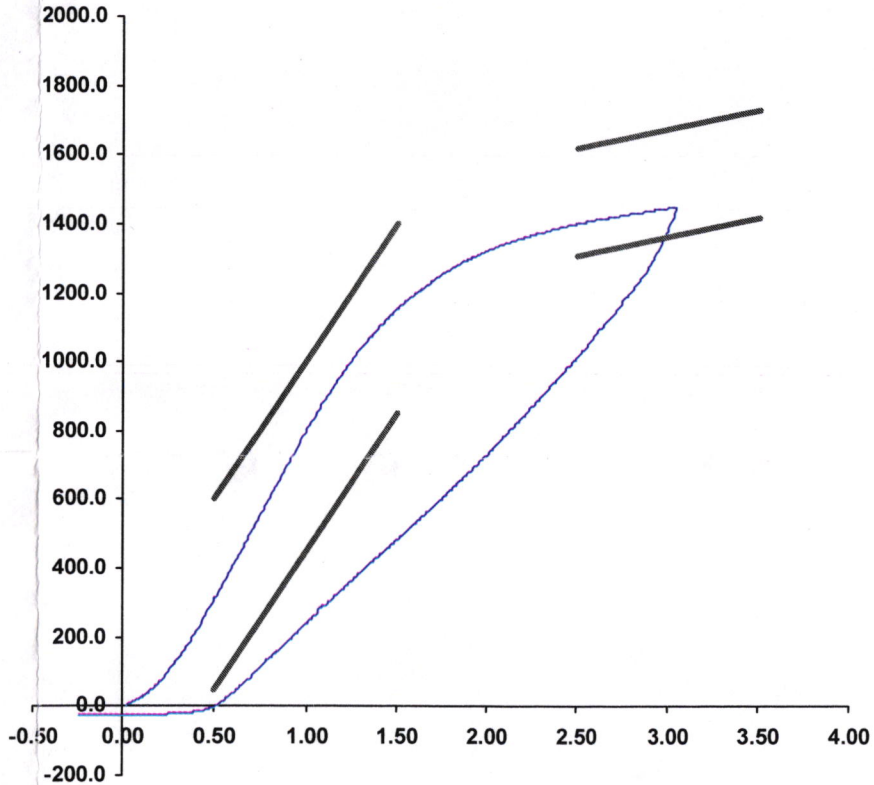
SACO RESEARCH

SID-IIs Pelvis Plug Certification Test

Plug S/N 14156
Test Number 14194
Report Number 14239
Test Date 6/28/2020 12:26:06 PM

	Test Results	Spec Min	Spec Max
Force @ 0.5 mm (N)	316.32	50.00	600.00
Force @ 1.5 mm (N)	1,148.80	850.00	1,400.00
Force @ 2.5 mm (N)	1,398.65	1,306.00	1,618.00
Force @ 3.0 mm (N)	1,444.84	1,361.00	1,673.00

Force (-N) vs Extension (-mm)



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:
IMPACT 300 7/19/24

Operator

Part Number 180-4450

Template No 107 28-Jun-20
SACO Research

By : D. Co Date : 6-28-2020

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

C-91

SACO RESEARCH

SID-IIs Pelvis Plug Certification Test

Plug S/N 14168
Test Number 14206
Report Number 14251
Test Date 6/28/2020 12:44:18 PM

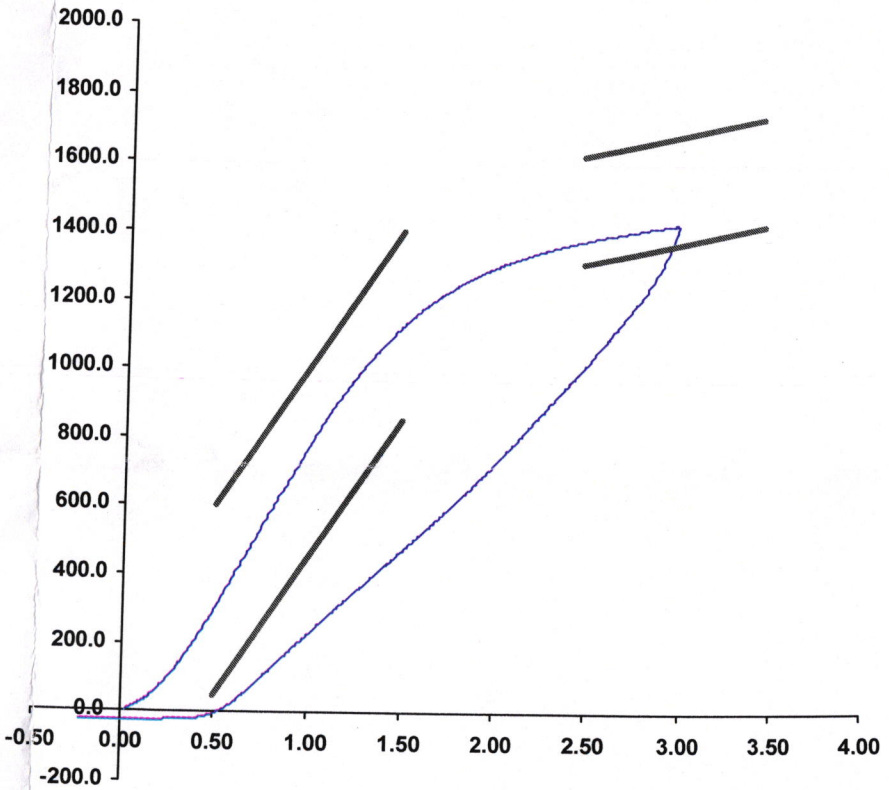
	Test Results	Spec Min	Spec Max
Force @ 0.5 mm (N)	312.37	50.00	600.00
Force @ 1.5 mm (N)	1,124.07	850.00	1,400.00
Force @ 2.5 mm (N)	1,373.07	1,306.00	1,618.00
Force @ 3.0 mm (N)	1,419.26	1,361.00	1,673.00

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:
NOW-IMPACT 7/19/24 300

Force (-N) vs Extension (-mm)



Operator

Part Number 180-4450

Template No 107 28-Jun-20
SACO Research

By : D.C. Date : 6-28-2021

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

C-92

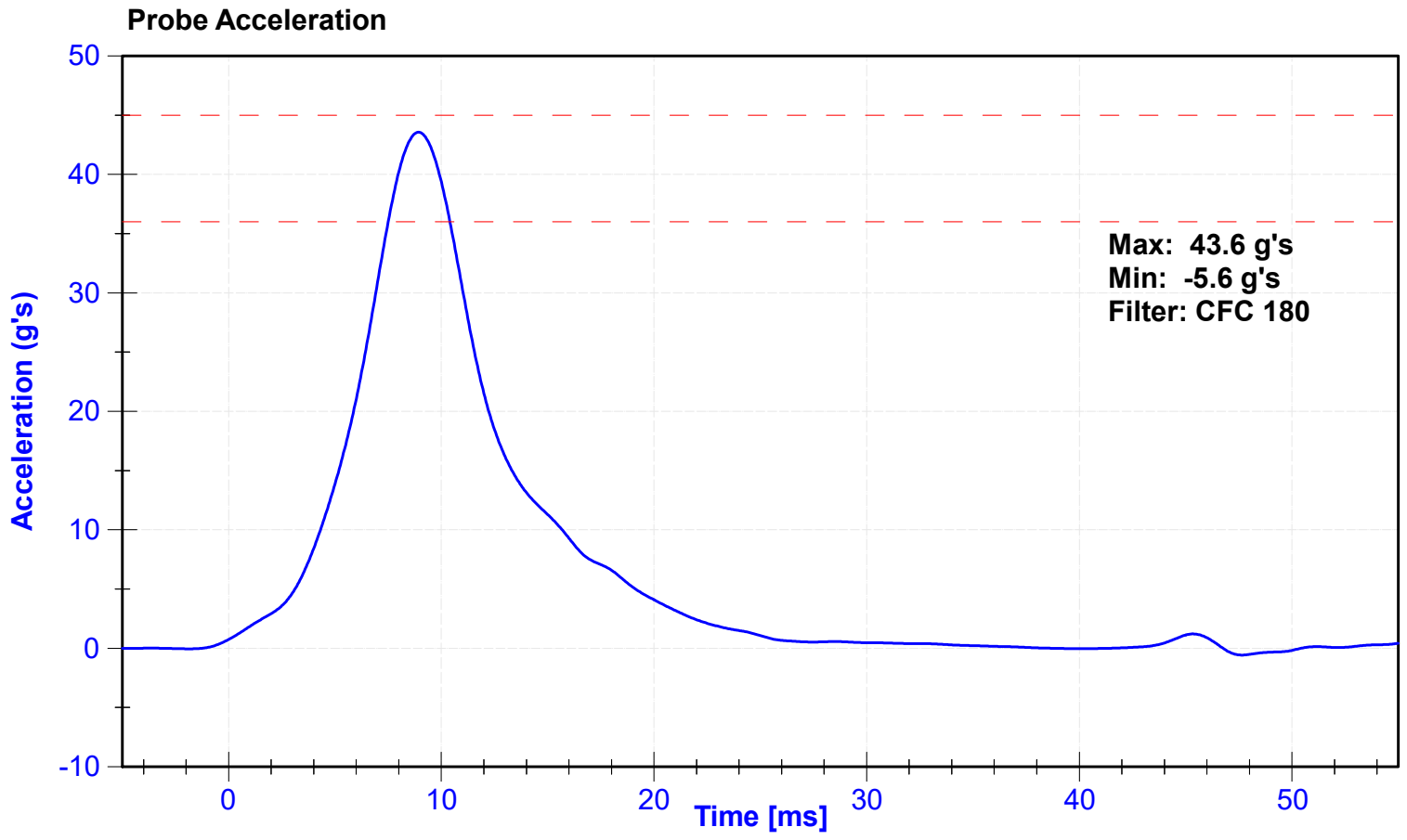
ATD Manufacturer	FTSS	Test Technician	J. Rios
ATD Serial Number	300	Laboratory Supervisor	C. Mantell

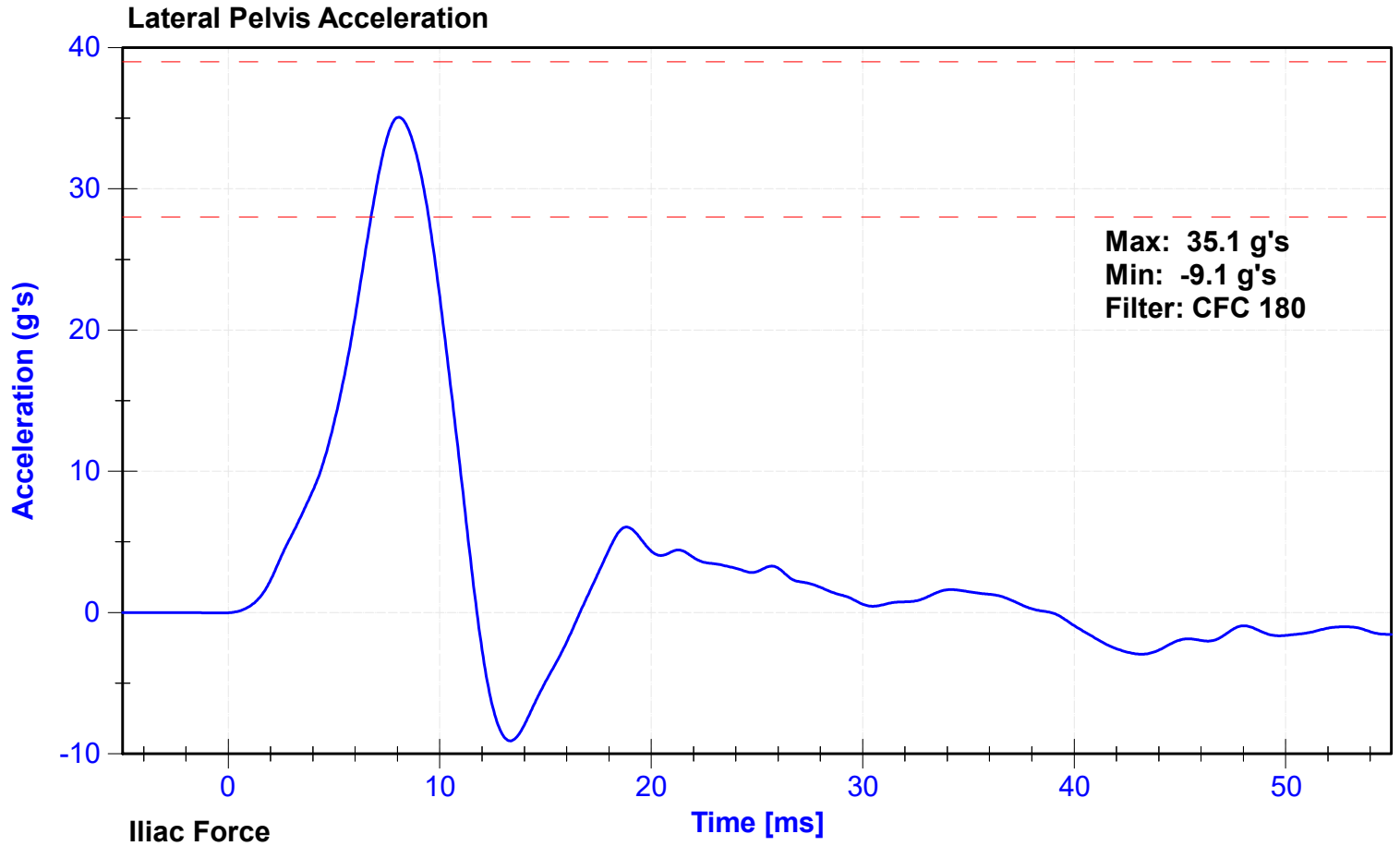
Results

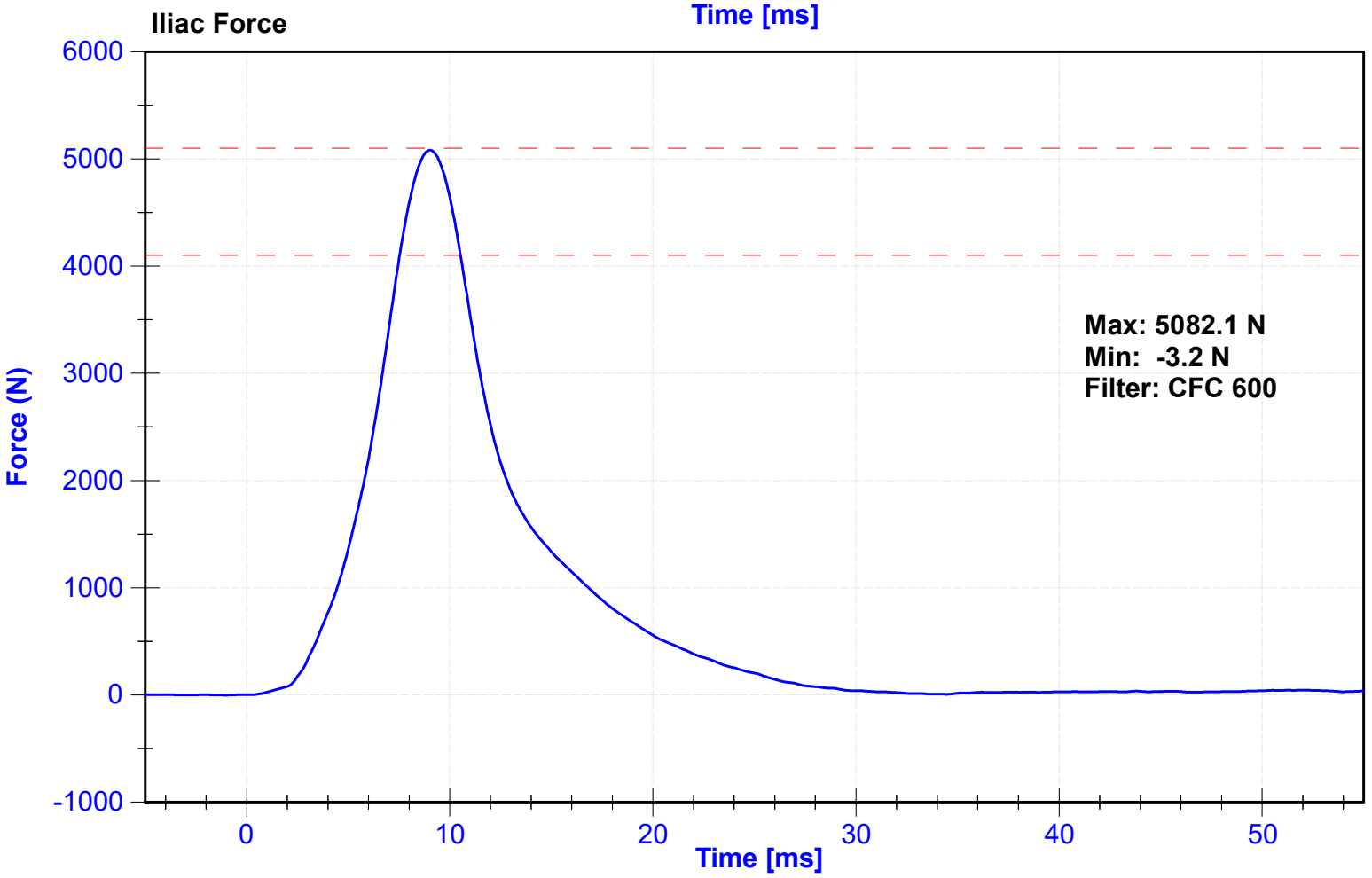
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	ºC	21.0	Pass
Humidity	10	70	%	57	Pass
Velocity	4.2	4.4	m/s	4.28	Pass
Probe Acceleration	36	45	g's	43.6	Pass
Lateral Pelvis Acceleration	28	39	g's	35.1	Pass
Iliac Force	4100	5100	N	5082.1	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	Endevco	18619	3/29/2024	9/25/2024
Pelvis Y Accelerometer	Endevco	P51731	5/9/2024	11/5/2024
Iliac Load Cell	Denton	321	9/11/2023	9/10/2024




Lateral Pelvis Acceleration
Acceleration (g's)
40
30
20
10
0
-10
0
10
20
30
40
50
Time [ms]
Max: 35.1 g's
Min: -9.1 g's
Filter: CFC 180


Iliac Force
Force (N)
6000
5000
4000
3000
2000
1000
0
-1000
0
10
20
30
40
50
Time [ms]
Max: 5082.1 N
Min: -3.2 N
Filter: CFC 600

APPENDIX D

TEST EQUIPMENT AND INSTRUMENTATION CALIBRATION DATA

TABLE 1 – Dummy Instrumentation (ES-2re)

			ES-2re S/N _F033__		
			Serial Number	**Manufacturer**	**Calibration Date**
Head Accelerometers	Primary	X	P63861	Endevco	05/06/2024
		Y	P49216	Endevco	05/06/2024
		Z	P51303	Endevco	05/06/2024
	Redundant	X	P58868	Endevco	05/06/2024
		Y	P59020	Endevco	05/06/2024
		Z	P52132	Endevco	05/06/2024
Thorax Rib Displacement Potentiometers	Upper	Y	179GFE	Honeywell	05/06/2024
	Middle	Y	185GFE	Honeywell	05/06/2024
	Lower	Y	178GFE	Honeywell	05/06/2024
Abdomen Load Cells	Forward	Y	1509	Denton	09/12/2023
	Middle	Y	1508	Denton	09/12/2023
	Rear	Y	1507	Denton	09/12/2023
Lower Spine Accelerometers (T12)		X	P35790	Endevco	05/06/2024
		Y	T31029	Endevco	05/06/2024
		Z	P52033	Endevco	05/06/2024
Pubic Symphysis Load Cell		Y	458-FY	Denton	12/05/2023

TABLE 2 – Dummy Instrumentation (SID-IIs)

				SID-IIs S/N __300__		
				Serial Number	**Manufacturer**	**Calibration Date**
Head Accelerometers		Primary	X	P59018	Endevco	05/09/2024
			Y	P79189	Endevco	05/09/2024
			Z	P79587	Endevco	05/09/2024
		Redundant	X	P68057	Endevco	05/09/2024
			Y	P58986	Endevco	05/09/2024
			Z	P52025	Endevco	05/09/2024
Displacement Potentiometers	Thoracic Rib	Upper	Y	2316GFE	Servo	05/09/2024
		Middle	Y	085GFE	Servo	05/09/2024
		Lower	Y	1156GFE	Servo	05/09/2024
	Abdominal Rib	Upper	Y	074GFE	Servo	05/28/2024
		Lower	Y	075GFE	Servo	05/09/2024
Lower Spine Accelerometers (T12)			X	P64003	Endevco	05/09/2024
			Y	P52071	Endevco	05/09/2024
			Z	P17283	Endevco	05/09/2024
Acetabulum Load Cell			Y	267-FY	Denton	09/11/2023
Iliac Wing Load Cell			Y	321	Denton	09/11/2023
Pelvis Plug (struck side)				16536	SACO	07/15/2022
Pelvis Plug (non-struck side)				16616	SACO	07/20/2022

TABLE 3 – Vehicle Instrumentation

Vehicle Instrumentation			Serial Number	Manufacturer	Calibration Date
1	Vehicle Center of Gravity	X	G23870	Endevco	03/21/2024
	Vehicle Center of Gravity	Y	G24019	Endevco	03/21/2024
	Vehicle Center of Gravity	Z	G24203	Endevco	03/21/2024
2	Right Sill at Front Seat	X	G23641	Endevco	03/27/2024
	Right Sill at Front Seat	Y	G23644	Endevco	03/27/2024
	Right Sill at Front Seat	Z	G23645	Endevco	03/27/2024
3	Right Sill at Rear Seat	X	A400765	Measurement Specialties	03/27/2024
	Right Sill at Rear Seat	Y	A405613	Measurement Specialties	03/27/2024
	Right Sill at Rear Seat	Z	A405630	Measurement Specialties	03/27/2024
4	Left Sill at Front Door	Y	G25278	Endevco	03/02/2024
5	Left Sill at Rear Door	Y	G22807	Endevco	04/05/2024
6	Left A-Post Lower	Y	A350949	Measurement Specialties	04/23/2024
7	Left A-Post Middle	Y	G25392	Endevco	04/01/2024
8	Left B-Post Lower	Y	A370897	Measurement Specialties	04/15/2024
9	Left B-Post Middle	Y	G23690	Endevco	03/21/2024
10	Front Seat Track	Y	G25533	Endevco	04/27/2024
11	Rear Seat Track or Structure	Y	G22231	Endevco	05/03/2024
12	Right Rear Occ. Compartment	Y	G22923	Endevco	04/05/2024
13	Engine Block	X	G23829	Endevco	06/05/2024
	Engine Block	Y	G23836	Endevco	06/05/2024
14	Rear Floorpan Above Axle	X	A398324	Measurement Specialties	03/21/2024
	Rear Floorpan Above Axle	Y	A398332	Measurement Specialties	03/21/2024
	Rear Floorpan Above Axle	Z	A400004	Measurement Specialties	03/21/2024

TABLE 4 – MDB Instrumentation

MDB Instrumentation		Serial Number	Manufacturer	Calibration Date
MDB Center of Gravity	X	A315905	Measurement Specialties	02/16/2024
MDB Center of Gravity	Y	A315970	Measurement Specialties	02/16/2024
MDB Center of Gravity	Z	A335459	Measurement Specialties	02/16/2024
Left Frame at Rear Axle Centerline	X	G23642	Endevco	02/05/2024
Left Frame at Rear Axle Centerline	Y	G23646	Endevco	02/05/2024