FMVSS 208

Research Flat Frontal Barrier Test

Unbelted at 25 mph

GM KOREA COMPANY

2020 Buick Encore GX

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FINAL REPORT

Prepared For:
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16. Abstract

A 40.20 km/h (25 mph), frontal rigid barrier impact test was conducted on a 2020 Buick Encore GX based on the specifications of the Office of Crashworthiness Standards Laboratory Procedure for NCAP Full Frontal Rigid Barrier Impact Testing (May 2018) and FMVSS 208 (September 2012) test procedures. This test was conducted to obtain data related to FMVSS Nos. 208, 212, 219 (partial), performance. The test was conducted at the Transportation Research Center Inc. in East Liberty, Ohio on November 15, 2022.

The impact velocity was 40.16 km/h, and the ambient temperature at the barrier face at the time of impact was 21° C. The target vehicle post-test maximum crush was 268 millimeters at vehicle center line. The test vehicle's performance is as follows:

Measurement Description	Units	Driver THOR-05F	Passenger THOR-05F
Head Injury Criteria (HIC15)	N/A	32	66
Brain Injury Criteria (BrIC)	N/A	0.42	0.52
Peak Neck Tension	N	457.7	312.2
Peak Neck Compression	mm	-375.0	-795.4
Peak Chest Deflection	mm	36.1	36.7
Peak Resultant Acetabulum Force	N	2575.5	1717.1
Peak Femur Force	N	-4314.8	-2796.6
Peak Upper Tibia Index	N	0.45	0.65

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40.20 km/h (25 mph) Full Frontal Rigid Barrier Impact Test New Car Assessment Program (NCAP) FMVSS 208 THOR-05F	Copies of this report are available from: National Highway Traffic Safety Administration Technical Information Services Division 1200 New Jersey Ave, SE Washington, DC 20590

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SECTION 1 PURPOSE AND SUMMARY OF THE TEST

PURPOSE

This 40.20 km/h frontal barrier impact test is part of the frontal research crash test program. It was conducted for the National Highway Traffic Safety Administration's (NHTSA) under 693JJ918D000019 by Transportation Research Center Inc. The purpose of this test was to evaluate the repeatability, reproducibility, and durability of the THOR 05F ATD in a test series looking at 3 vehicle platforms.

The test was conducted using NHTSA's Procedure for NCAP Full Frontal Rigid Barrier Impact Testing (dated May 2018) and NHTSA's FMVSS No.208, (dated September 2012) as a guidelines. THOR-05F ATDs were used instead of the Hybrid III 50th and Hybrid III 5th percentile ATDs listed in the test procedures."

SUMMARY

A frontal rigid barrier was impacted by a 2020 Buick Encore GX at a velocity of 40.16 km/h. The test was performed at Transportation Research Center, Inc. on November 15, 2022. Pre- and post-test photographs of the vehicle and dummies can be found in Appendix A.

One real-time camera and 16 high-speed cameras were used to document the frontal barrier impact event. Camera locations and other pertinent camera information can be found in this report.

Two THOR-05F anthropomorphic test devices (ATDs) were positioned in both the driver and right front vehicle seats following a NHTSA supplied draft seating procedure. This draft procedure was used for this test series and can be found in Appendix F.

Both ATDs were fully instrumented with head, chest, spine and pelvis tri-axial accelerometers, chest displacement IR-TRACCs, upper neck transducers, abdomen pressure transducers, femur load cells, and lower leg instrumentation.

The driver (position 1) ATD (Serial No. EV0674), and the right-front passenger (position 2) ATD (Serial No. EU3430) were qualified (using draft procedures developed by NHTSA) prior to the first and fourth tests of the series. Certification details, along with instrumentation calibration data, are found in Appendix D & E of this report.

The 253 channels of data were recorded on an on-board data acquisition system at 20,000 samples per second and processed as specified in SAE J211/1MAR 95. Appendix B contains the vehicle and dummy response data traces.

There was 100.0 percent windshield retention and no intrusion into the protected zone of the windshield during the event.

The maximum static crush of the vehicle was 268 mm and both the driver and passenger side doors remained closed during the impact event and were operable after the impact.

Additional research vehicle measurements and data sheets can be found in Appendix F.

The driver's visible contact points were as follows: front airbag and knee airbag. The passenger's visible contact points were as follows: front airbag and knee airbag.

The occupant data is summarized below:

ATD Position	Driver (THOR-05F)		Passenger (THOR-05F)	
HIC_{15}	32		66	
BrIC	0.42		0.52	
Peak Neck Tension (N)	457.7		312.2	
Peak Neck Compression (N)	-375.0		-795.4	
Chest Deflection (mm)	36.1		36.7	
Acetabulum Force (N)	2575.5		1717.1	
Peak Femur Force (N)	**Left**	-2824.9	**Left**	-2796.6
	Right	-4314.8	**Right**	-13.6
Upper Tibia Index (N)	**Left**	0.45	**Left**	0.48
	Right	0.41	**Right**	0.65

TEST COMMENTS:

DATA ACQUISITION EXPLANATIONS

DRIVER T1 X ACCELERATION; Questionable data spike at 55.0 ms

DRIVER T1 Y ACCELERATION; Questionable data spike at 55.0 ms

DRIVER T1 Z ACCELERATION; Questionable data spike at 55.0 ms

TABLE 1 THOR-05F INSTRUMENTATION DATA
Driver Dummy Serial Number: EV0674

Location		Positive Direction		Negative Direction	
		Max.	Time (ms)	Max.	Time (ms)
Head Acceleration (g)	X	29.32	220.30	-24.48	65.00
	Y	8.31	222.90	-6.70	35.40
	Z	14.98	128.25	-6.18	53.25
	R	30.58	222.60		
Head Angular Rate (deg/sec)	X	128.07	266.40	-195.41	121.30
	Y	290.83	214.95	-1287.61	124.25
	Z	260.96	94.65	-146.67	137.85
Front Neck Spring Load Cell Force (N)	Z	86.37	44.75	-97.42	93.30
Front Neck Spring Load Cell Force (N)	Z	317.52	176.95	-56.74	48.45
Occipital Condyle Rotary Potentiometer (deg)	Y	20.45	102.20	-9.56	239.10
Upper Neck Force (N)	X	618.08	98.90	-347.42	177.05
	Y	41.45	80.70	-36.66	92.20
	Z	457.67	62.25	-375.04	226.85
Upper Neck Moment (Nm)	X	3.61	295.35	-4.86	80.65
	Y	14.87	71.10	-3.40	52.50
	Z	1.27	47.10	-4.40	102.75
Lower Neck Force (N)	X	399.88	71.00	-186.05	237.20
	Y	83.52	79.35	-33.03	64.25
	Z	451.36	62.25	-434.21	227.30
Lower Neck Moment (Nm)	X	5.06	288.55	-3.85	47.75
	Y	22.26	161.10	-41.11	93.15
	Z	1.55	53.75	-3.23	296.50
T1 Acceleration (g)	X	---[1]	---[1]	---[1]	---[1]
	Y	---[1]	---[1]	---[1]	---[1]
	Z	---[1]	---[1]	---[1]	---[1]
	R	---[1]	---[1]		
Left Clavicle Force (N)	X	60.32	83.40	-50.41	52.70
	Z	14.03	239.85	-102.84	78.95
	X	31.59	98.25	-249.06	72.10
	Z	22.16	173.95	-433.92	78.40
Left Upper Thorax IR-TRACC		0.13	100.25	0.07	10.65
Left Upper Thorax Rotary Potentiometer	Y	0.31	291.55	-15.24	74.05
	Z	-14.19	75.85	-16.08	168.15
Right Upper Thorax IR-TRACC		0.14	99.60	0.08	286.20
Right Upper Thorax Rotary Potentiometer	Y	17.55	75.50	0.47	290.10
	Z	17.40	94.25	12.79	214.40

[1]See data acquisition explanation

TABLE 1 THOR-05F INSTRUMENTATION DATA (CONT'D)
Driver Dummy Serial Number: EV0674

Location		Positive Direction		Negative Direction	
		Max.	Time (ms)	Max.	Time (ms)
T8 Acceleration (g)	X	3.27	240.60	-31.42	76.85
	Y	2.36	62.25	-7.04	73.40
	Z	3.93	99.20	-14.74	76.85
	R	34.90	76.70		
Thoracic Spine (Nm)	X	9.83	73.60	-8.20	61.30
	Y	26.76	115.35	-34.89	76.85
Left Lower Thorax IR-TRACC (V)		0.15	70.40	0.07	35.40
Left Lower Thorax Rotary Potentiometer (mm)	Y	7.36	92.25	-1.28	64.70
	Z	15.69	172.90	13.22	40.20
Right Lower Thorax IR-TRACC (V)		0.17	70.65	0.08	32.75
Right Lower Thorax Rotary Potentiometer (mm)	Y	2.59	66.40	-6.51	93.80
	Z	-12.45	172.50	-17.81	98.75
Left Abdomen Pressure Sensor (bar)		0.29	95.15	0.14	157.00
Right Abdomen Pressure Sensor (bar)		1.98	94.20	1.80	110.00
Left A.S.I.S. Load Cell Force (N)	X	82.90	73.55	-27.17	227.35
Left A.S.I.S. Load Cell Moment (Nm)	Y	0.20	81.30	-0.36	98.45
Right A.S.I.S. Load Cell Force (N)	X	108.52	70.75	-21.40	228.65
Right A.S.I.S. Load Cell Moment (Nm)	Y	0.50	122.15	-0.51	58.75
Left Acetabulum Force (N)	X	1121.56	80.95	-428.22	203.55
	Y	132.52	230.20	-277.82	85.70
	Z	134.14	227.25	-899.73	87.50
Right Acetabulum Force (N)	X	2393.40	72.25	-270.26	253.10
	Y	117.81	33.30	-579.38	71.20
	Z	1044.61	83.70	-105.87	36.85
Pelvis Accelerometer (g)	X	4.60	227.55	-44.44	71.00
	Y	8.23	82.20	-15.03	59.60
	Z	3.09	227.90	-18.65	71.20
	R	49.04	71.05		
Pelvis Angular Rate (deg/sec)	X	126.66	77.20	-124.70	89.35
	Y	86.37	282.75	-1050.08	84.95
	Z	355.39	72.40	-285.19	56.20
Left Femur Force (N)	X	337.42	84.80	-338.78	35.95
	Y	151.78	54.95	-142.69	228.85
	Z	308.98	226.95	-2824.91	76.10

TABLE 1 THOR-05F INSTRUMENTATION DATA (CONT'D)
Driver Dummy Serial Number: EV0674

Location		Positive Direction		Negative Direction	
		Max.	Time (ms)	Max.	Time (ms)
Left Femur Moment (Nm)	X	17.08	82.65	-14.90	54.15
	Y	47.66	93.90	-16.44	76.20
	Z	15.06	139.10	-10.04	76.45
Left Knee Slider Potentiometer (mm)	X	0.89	227.40	-4.96	34.50
5-Channel Left Upper Tibia Force (N)	X	337.58	46.70	-198.90	55.90
	Y	79.06	40.25	-132.34	70.80
	Z	159.16	194.50	-1492.02	82.05
5-Channel Left Upper Tibia Moment (Nm)	X	13.39	141.25	-17.70	73.95
	Y	50.94	32.90	-35.77	76.65
Left Lower Tibia Force (N)	X	298.56	32.90	-236.13	72.50
	Y	87.75	70.80	-55.91	40.75
	Z	77.60	177.75	-2101.87	49.75
Left Lower Tibia Moment (Nm)	X	7.63	88.05	-13.45	48.65
	Y	23.29	32.50	-27.29	72.75
Left Achilles Force (N)	Z	98.78	282.35	-2.72	35.35
Left Tibia Accelerometer (g)	X	15.59	55.90	-78.97	46.20
	Y	30.33	45.85	-28.11	65.30
Left Ankle Rotary Potentiometer (deg)	X	5.60	65.25	-4.37	264.50
	Y	9.72	284.60	-31.23	224.50
	Z	1.39	139.50	-1.81	215.50
Left Foot Accelerometer (g)	X	25.04	191.00	-108.54	44.55
	Y	45.41	44.50	-42.11	46.35
	Z	85.12	44.00	-215.53	44.55
	R	245.50	44.55		
Right Femur Force (N)	X	397.69	63.20	-290.75	37.80
	Y	67.43	31.40	-206.93	74.75
	Z	344.78	252.60	-4314.78	71.40
Right Femur Moment (Nm)	X	18.40	36.30	-34.44	71.40
	Y	41.53	95.95	-50.67	72.85
	Z	7.91	220.90	-22.75	103.20
Right Knee Slider Potentiometer (mm)	X	0.23	235.90	-4.13	71.75
5-Channel Right Upper Tibia Force (N)	X	266.71	229.60	-304.96	72.20
	Y	110.89	25.10	-58.72	32.75
	Z	139.20	252.25	-1216.76	61.65
5-Channel Right Upper Tibia Moment (Nm)	X	11.92	25.05	-20.92	65.40
	Y	46.37	36.70	-23.54	79.95

TABLE 1 THOR-05F INSTRUMENTATION DATA (CONT'D)
Driver Dummy Serial Number: EV0674

Location		Positive Direction		Negative Direction	
		Max.	Time (ms)	Max.	Time (ms)
Right Lower Tibia Force (N)	X	276.83	36.00	-271.56	76.60
	Y	91.36	97.90	-97.30	25.25
	Z	132.34	251.75	-2164.26	58.90
Right Lower Tibia Moment (Nm)	X	7.18	26.50	-11.23	72.85
	Y	24.32	36.15	-16.56	230.00
Right Achilles Force (N)	Z	271.10	75.15	-18.87	246.40
Right Tibia Accelerometer (g)	X	15.07	25.00	-69.55	48.45
	Y	37.14	24.05	-29.09	30.30
Right Ankle Rotary Potentiometer (deg)	X	20.10	104.00	-1.53	206.30
	Y	23.45	74.00	-35.19	266.50
	Z	20.16	170.15	6.62	27.35
Right Foot Accelerometer (g)	X	18.14	225.00	-68.51	48.20
	Y	39.32	48.55	-19.22	48.25
	Z	60.14	35.30	-78.10	49.10
	R	88.43	50.35		

<u>Positive Direction</u>

Longitudinal	Forward
Lateral	Rightward
Vertical	Downward

<u>Negative Direction</u>

Longitudinal	Rearward
Lateral	Leftward
Vertical	Upward

TABLE 2 THOR-05F INSTRUMENTATION DATA
Passenger Dummy Serial Number: EU3430

Location		Positive Direction		Negative Direction	
		Max.	Time (ms)	Max.	Time (ms)
Head Acceleration (g)	X	20.70	247.05	-30.74	93.85
	Y	3.35	34.15	-7.84	85.60
	Z	15.53	85.00	-9.36	59.40
	R	30.96	93.85		
Head Angular Rate (deg/sec)	X	143.87	77.80	-327.53	92.85
	Y	476.80	85.80	-1570.60	165.65
	Z	263.91	141.60	-430.42	95.40
Front Neck Spring Load Cell Force (N)	Z	435.98	107.40	-225.46	57.60
Front Neck Spring Load Cell Force (N)	Z	225.76	283.75	-155.99	71.65
Occipital Condyle Rotary Potentiometer (deg)	Y	6.26	206.75	-18.37	85.55
Upper Neck Force (N)	X	1208.03	97.55	-237.08	289.30
	Y	101.83	99.30	-121.84	84.15
	Z	312.16	66.85	-795.36	93.70
Upper Neck Moment (Nm)	X	6.26	64.75	-3.81	88.25
	Y	27.39	80.15	-6.83	116.00
	Z	4.87	93.65	-1.18	242.55
Lower Neck Force (N)	X	569.97	84.30	-154.68	105.30
	Y	97.10	98.10	-94.07	77.35
	Z	297.83	166.75	-939.10	93.70
Lower Neck Moment (Nm)	X	8.77	58.65	-9.69	83.15
	Y	15.93	296.80	-62.87	84.45
	Z	4.55	85.70	-1.29	243.25
T1 Acceleration (g)	X	1.62	258.10	-28.67	91.80
	Y	11.93	84.90	-4.68	63.80
	Z	29.03	93.60	-9.78	62.95
	R	40.56	92.10		
Right Clavicle Force (N)	X	32.54	66.50	-27.39	82.35
	Z	38.43	98.90	-16.53	66.40
	X	34.31	66.00	-87.39	83.45
	Z	15.42	90.85	-48.79	80.55
Left A.S.I.S. Load Cell Force (N)	X	68.42	60.00	-21.55	168.15
Left A.S.I.S. Load Cell Moment (Nm)	Y	0.44	93.65	-0.30	193.25
Right A.S.I.S. Load Cell Force (N)	X	69.06	49.70	-33.74	168.10
Right A.S.I.S. Load Cell Moment (Nm)	Y	0.35	54.65	-0.56	79.75
Left Upper Thorax IR-TRACC		0.13	86.25	0.08	52.40
Left Upper Thorax Rotary Potentiometer	Y	-2.08	265.05	-19.89	88.95
	Z	-10.87	224.10	-14.02	101.95

TABLE 2 THOR-05F INSTRUMENTATION DATA (CONT'D)
Passenger Dummy Serial Number: EU3430

Location		Positive Direction		Negative Direction	
		Max.	Time (ms)	Max.	Time (ms)
Right Upper Thorax IR-TRACC		0.14	93.75	0.09	46.20
Right Upper Thorax Rotary Potentiometer	Y	19.57	83.40	2.90	267.10
	Z	15.61	89.10	13.73	56.05
T8 Acceleration (g)	X	2.49	199.60	-39.95	83.55
	Y	7.05	76.60	-2.09	109.10
	Z	12.69	98.35	-14.32	61.50
	R	40.61	83.50		
Thoracic Spine (Nm)	X	6.84	219.15	-19.44	68.10
	Y	18.50	125.25	-44.23	86.85
Left Lower Thorax IR-TRACC (V)		0.11	84.55	0.06	128.40
Left Lower Thorax Rotary Potentiometer (mm)	Y	15.39	129.45	7.90	81.15
	Z	12.52	101.75	8.82	131.65
Right Lower Thorax IR-TRACC (V)		0.09	84.70	0.05	54.90
Right Lower Thorax Rotary Potentiometer (mm)	Y	-6.01	80.75	-13.85	130.75
	Z	-11.77	45.60	-15.91	83.25
Left Abdomen Pressure Sensor (bar)		0.21	70.30	0.08	35.75
Right Abdomen Pressure Sensor (bar)		0.65	65.90	0.49	107.85
Left Acetabulum Force (N)	X	1167.22	63.10	-328.91	173.45
	Y	10.71	46.55	-1128.34	62.80
	Z	167.41	37.55	-921.34	78.05
Right Acetabulum Force (N)	X	309.20	170.10	-1477.83	49.85
	Y	216.56	75.40	-312.95	36.65
	Z	1369.65	91.55	-78.93	28.70
Pelvis Accelerometer (g)	X	4.09	167.15	-36.65	80.75
	Y	12.23	59.90	-5.64	30.85
	Z	7.60	98.10	-18.53	66.75
	R	37.06	80.75		
Pelvis Angular Rate (deg/sec)	X	96.37	206.70	-261.79	63.75
	Y	84.37	254.35	-1253.40	78.25
	Z	549.78	49.85	-209.50	77.30
Left Femur Force (N)	X	353.34	78.05	-143.35	35.65
	Y	88.54	172.70	-371.22	60.70
	Z	377.44	177.15	-2796.62	63.05
Left Femur Moment (Nm)	X	31.82	36.00	-25.69	52.30
	Y	31.94	95.75	-13.61	80.50
	Z	13.21	198.80	-13.58	41.30
Left Knee Slider Potentiometer (mm)	X	0.04	23.30	-4.44	63.15

TABLE 2 THOR-05F INSTRUMENTATION DATA (CONT'D)
Passenger Dummy Serial Number: EU3430

Location		Positive Direction		Negative Direction	
		Max.	Time (ms)	Max.	Time (ms)
Right Femur Force (N)	X	503.02	75.65	-355.79	34.85
	Y	139.73	72.65	-375.92	46.20
	Z	362.36	168.40	-2411.86	49.40
Right Femur Moment (Nm)	X	26.68	44.80	-29.34	71.25
	Y	73.54	95.95	-12.93	59.10
	Z	5.77	210.75	-59.38	88.30
Right Knee Slider Potentiometer (mm)	X	0.20	203.65	-6.05	50.05
Left Upper Tibia Force (N)	X	297.83	174.65	-186.45	29.55
	Y	59.87	177.25	-225.59	25.25
	Z	270.98	160.75	-1010.87	66.65
Left Upper Tibia Moment (Nm)	X	25.64	174.00	-36.22	52.40
	Y	22.52	104.05	-47.32	73.55
Left Achilles Force (N)	Z	57.18	299.20	-1.85	230.55
Left Lower Tibia Force (N)	X	155.80	29.45	-311.33	73.75
	Y	180.56	52.80	-120.77	173.60
	Z	175.30	32.60	-1215.51	67.05
Left Lower Tibia Moment (Nm)	X	15.48	190.10	-28.49	52.10
	Y	12.58	30.35	-40.10	73.70
Left Tibia Accelerometer (g)	X	23.11	25.40	-55.84	51.25
	Y	26.09	25.70	-62.61	23.50
Left Ankle Rotary Potentiometer (deg)	X	9.38	190.55	-11.00	268.15
	Y	6.05	300.00	-26.09	202.10
	Z	10.74	162.50	-4.19	22.30
Left Foot Accelerometer (g)	X	18.22	35.50	-88.08	47.65
	Y	38.22	35.30	-46.07	25.90
	Z	51.23	35.50	-55.67	26.00
	R	88.46	47.65		
Right Upper Tibia Force (N)	X	159.23	180.40	-346.90	31.25
	Y	138.24	87.05	-122.34	47.00
	Z	221.73	184.80	-1218.45	47.25
Right Upper Tibia Moment (Nm)	X	13.06	208.95	-55.40	88.80
	Y	57.18	31.30	-22.95	75.30
Right Achilles Force (N)	Z	70.67	101.60	-2.09	32.50
Right Lower Tibia Force (N)	X	397.28	31.15	-111.18	75.45
	Y	385.89	84.15	-62.06	30.45
	Z	119.26	200.55	-1906.59	47.35

TABLE 2 THOR-05F INSTRUMENTATION DATA (CONT'D)
Passenger Dummy Serial Number: EU3430

Location		Positive Direction		Negative Direction	
		Max.	Time (ms)	Max.	Time (ms)
Right Lower Tibia Moment (Nm)	X	34.64	64.20	-31.76	46.95
	Y	27.06	101.55	-12.70	76.05
Right Tibia Accelerometer (g)	X	23.63	46.85	-29.56	62.45
	Y	7.21	175.60	-54.95	45.85
Right Ankle Rotary Potentiometer (deg)	X	49.80	68.20	-5.63	193.25
	Y	2.39	98.10	-25.72	203.75
	Z	19.61	184.50	1.95	53.85
Right Foot Accelerometer (g)	X	13.44	167.75	-54.05	44.00
	Y	31.13	43.05	-38.06	58.20
	Z	65.88	36.30	-156.51	44.10
	R	165.13	44.10		

Positive Direction		Negative Direction	
Longitudinal	Forward	Longitudinal	Rearward
Lateral	Rightward	Lateral	Leftward
Vertical	Downward	Vertical	Upward

SECTION 2 OCCUPANT AND VEHICLE INFORMATION / DATA SHEETS

DATA SHEET NO. 1 - GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2020 Buick Encore GX
Test Program: THOR-05 Durability Evaluation Test Date: 11/15/2022

TEST VEHICLE INFORMATION

NHTSA No.	
Model Year	2020
Make	Buick
Model	Encore GX
Body Style	MPV
VIN	KL4MMGSL8LB099014
Body Color	Grey
Odometer Reading (km/mi)	17234 mi.
Engine Displacement (L)	1.3
Type/No. Cylinders	Inline/3
Engine Placement	Front
Transmission Type	Automatic
Transmission Speeds	9
Overdrive	No
Final Drive	AWD
Roof Rack	Yes
Sunroof/T-Top	No
Running Boards	No
Tilt Steering Wheel	Yes
Power Seats	Yes
Anti-Lock Brakes (ABS)	Yes
Automatic Door Locks (ADLs)	Yes

TEST VEHICLE OPTIONS

Traction Control System (TCS)	Yes
Power Steering	Yes
Power Window Auto-Reverse	No
Driver Frontal 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	Yes
Front Pass. Frontal Airbag	Yes
Front Pass. Curtain Airbag	Yes
Front Pass. Head/Torso Airbag	No
Front Pass. Torso Airbag	No
Front Pass. Torso/Pelvis Airbag	Yes
Front Pass. Pelvis Airbag	No
Front Pass. Knee Airbag	Yes
Driver Pretensioner	Yes
Driver Load Limiter	Yes
Front Pass. Pretensioner	Yes
Front Pass. Load Limiter	Yes
Other:	No

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

DATA FROM CERTIFICATION LABEL

Manufactured by	GM KOREA COMPANY
Date of Manufacture	01/20

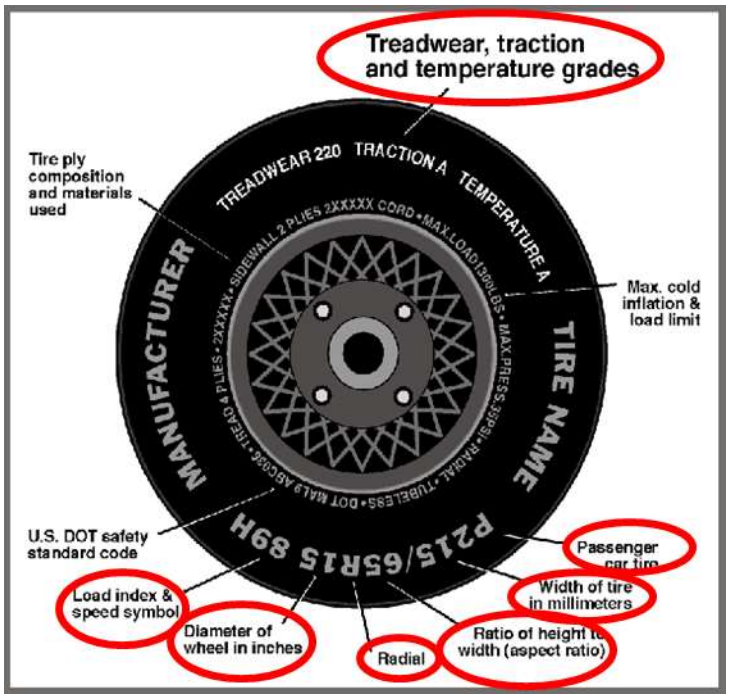
GVWR (LB)	4409
GAWR Front (LB)	2336
GAWR Rear (LB)	2336

VEHICLE SEATING AND WEIGHT CAPACITY

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Split Bench	N/A	
Number of Occupants	2	3	N/A	5
Capacity Wt. (VCW) (kg)				428.0
Cargo Wt. (RCLW) (kg)				88.0

DATA SHEET NO. 1 - GENERAL TEST AND VEHICLE PARAMETER DATA (CONT'D)

Test Vehicle: 2020 Buick Encore GX
Test Program: THOR-05 Durability Evaluation Test Date: 11/15/2022



DATA FROM TIRE PLACARD

Measured Parameter	Front	Rear
Maximum Tire Pressure (kPa)	350	350
Cold / Test Pressure (kPa)	240	240
Recommended Tire Size	225/55R18 H	225/55R18 H
Tire Size on Vehicle	225/55R18 H	225/55R18 H
Tire Manufacturer	Hankook	Hankook
Tire Model	Kinergy GT	Kinergy GT
Treadwear	700	700
Traction Grade	B	B
Temperature Grade	A	A
Tire Plies Sidewall	2	2
Tire Plies Body	5	5
Load Index/Speed Symbol	98H	98H
Tire Material	Polyester/Nylon/Steel	Polyester/Nylon/Steel
DOT Safety Code Right	1T700 1B H0 5219	1T700 1B H0 5219
DOT Safety Code Left	1T700 1B H0 5219	1T700 1B H0 5219

DATA SHEET NO. 1 - GENERAL TEST AND VEHICLE PARAMETER DATA (CONT'D)

Test Vehicle: 2020 Buick Encore GX
Test Program: THOR-05 Durability Evaluation Test Date: 11/15/2022

TEST VEHICLE WEIGHTS

	Units	As Delivered (UVW) (Axle)			As Tested (ATW) (Axle)		
		Front	Rear	Total	Front	Rear	Total
Left	kg	466.0	314.8		491.6	382.0	
Right	kg	445.0	298.4		462.0	370.0	
Ratio	%	59.8	40.2		55.9	44.1	
Totals	kg	911.0	613.2	1524.2	953.6	752.0	1705.6

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value
Total Delivered Weight (UVW)	kg	1524.2
Weight of 1 THOR-05 ATD (49.0 kg)	kg	98.0
Rated Cargo/Luggage Weight (RCLW)	kg	88.0
Vehicle Target Weight (TVTW)	kg	1710.2

TEST VEHICLE ATTITUDES AND CG

	Units	LF	RF	LR	RR	CG (aft of front)
As Delivered	mm	793	797	800	807	1042
As Tested	mm	784	791	774	771	1142
Post Test	mm	N/A	N/A	772	775	

GENERAL TEST VEHICLE DATA

Measurement Description	Units	Value
Test Vehicle Wheel Base	mm	2590
Total Vehicle Length at Left Side	mm	4120
Total Vehicle Length at Centerline	mm	4350
Total Vehicle Length at Right Side	mm	4120
Weight of Ballast in Cargo Area	kg	20.4
Weight of Vehicle Components Removed	kg	0.0
Amount of Stoddard Solvent in Fuel Tank	liters	0.0

LIST OF COMPONENTS REMOVED TO MEET TEST WEIGHT: None

DATA SHEET NO. 1 - GENERAL TEST AND VEHICLE PARAMETER DATA (CONT'D)

Test Vehicle: 2020 Buick Encore GX

Test Program: THOR-05 Durability Evaluation Test Date: 11/15/2022

TARGET VEHICLE STRUCTURAL MEASUREMENT

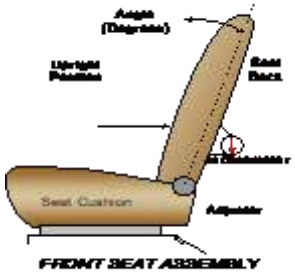
	Elements	Descriptions	Pre-Test (mm)
1	Total Length	Total length of the vehicle bumper to bumper	4350
2	Total Width	Widest part of the vehicle excluding mirrors	1809
3	Bumper Top Height	Height from ground	605
4	Bumper Bottom Height	Height from ground	529
5	Longitudinal Member Top Height	Bumper beam top to ground	610
6	Distance Between Longitudinal Members	Distance between bumper beam mounts	962
7	Longitudinal Member Width	Bumper beam width	100
8	Engine Top Height	Top of engine to ground	918
9	Engine Bottom Height	Bottom of engine to ground	220
10	Engine and Gearbox Width	Engine width	750
11	Front Bumper-Engine Distance	Front of front bumper to leading edge of engine	507
12	Front Shock Absorber Fixing Height	Shock mount (Under hood) to ground	951
13	Bonnet Leading Edge Height	Height of the leading edge of hood to ground	960
14	Front Shock Absorber Fixing Width	Width between shock mounts	1171
15	Front Bumper – Front Axle Distance	leading edge of bumper to front axle	918
16	Front Axle – A-Pillar Distance	Front axle to A pillar	560
17	A-Pillar – B-Pillar Distance	Distance between A and B pillars	980
18	B-Pillar – Rear Axle Distance	B Pillar to rear axle	1080
19	B-Pillar – C-Pillar Distance	Distance between B and C pillars	900
20	Roof Sill Bottom Height	Bottom of roof Sill to ground (door frame top)	1510
21	Roof Sill Top Height	Top of roof Sill to ground (edge of the roof where it rolls into roof)	1586
22	Floor Sill Bottom Height	Sill bottom to ground	401
23	Floor Sill Top Height	Sill top to ground	450

DATA SHEET NO. 2 - SEAT ADJUSTMENT, FUEL SYSTEM AND STEERING WHEEL DATA

Test Vehicle: 2020 Buick Encore GX
Test Program: THOR-05 Durability Evaluation Test Date: 11/15/2022

NORMAL DESIGN RIDING POSITION

Measure at the head rest post



	Degree
Driver Seat back angle:	8.0
Passenger Seat back angle:	7.8

SEAT FORE/AFT POSITIONS

Seat was placed at mid-angle and measured in the full forward and full rearward position. The driver SCRL angle is 16.0 degrees and the passenger SCRL is 16.55. The driver seatback angle is 8.0 degrees and the passenger seatback angle is 7.8 degrees measured from the head rest Post.

	Total Fore/Aft Travel	Placed in Position No.
Driver Seat	258	0
Passenger Seat	260	0

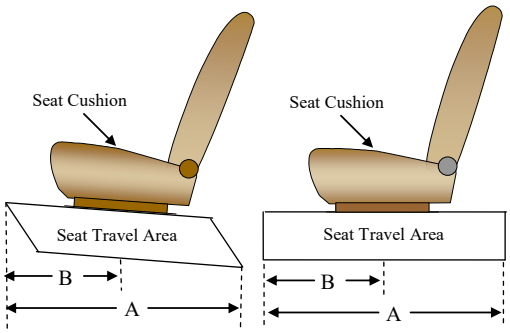
SEAT BELT UPPER ANCHORAGE

Describe the method of positioning seat belt upper anchorages.

Driver: Uppermost, Positioned according to Form 1

Passenger: Uppermost, Positioned according to Form 1

	Total No. of Positions	Placed in Position No.
Driver Seat	4	0, Full Up
Passenger Seat	4	0, Full Up



DATA SHEET NO. 2 - SEAT ADJUSTMENT, FUEL SYSTEM AND STE.2ERING WHEEL DATA (CONT'D)

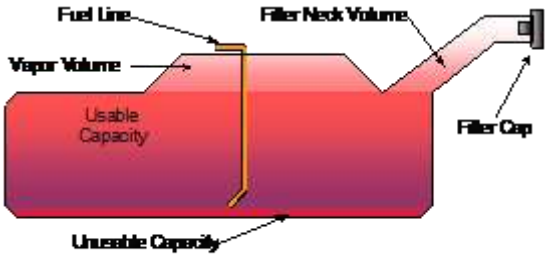
Test Vehicle: 2020 Buick Encore GX
Test Program: THOR-05 Durability Evaluation Test Date: 11/15/2022

FUEL TANK CAPACITY

	Liters
Usable Capacity of "Standard Tank"	50.0
Usable Capacity of "Optional Tank"	N/A
92%-94% of Usable Capacity	46.0-47.0
Actual Amount of Solvent Used	0.0
1/3 of Usable Capacity	16.7

Describe the fuel system - what type of fuel pump, details about how it operates, etc.

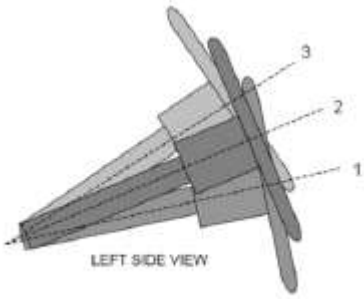
When engine is running



VEHICLE FUEL TANK ASSEMBLY

STEERING COLUMN ADJUSTMENT

Steering wheel and column adjustments are made so that the steering wheel hub is at the geometric center of the locus it describes when moved through its full range of motion. Describe how this measurement was taken.



STEERING COLUMN ASSEMBLY

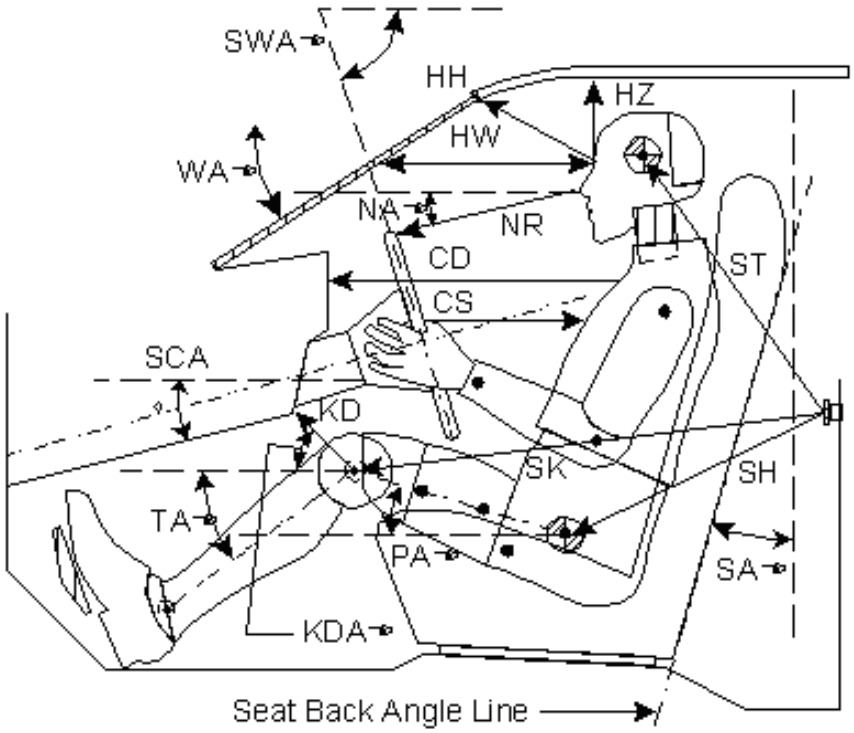
The fuel pump would activate when the ignition key is turned to the 'On/Run' position. When the working pressure of fuel system is achieved; the pump will turn off. In AWD vehicle, fuel suction pump in sub-chamber of the fuel tank is activated only in condition of engine running

STEERING COLUMN POSITIONS

	Degrees	Fore/Aft Position (mm)
Lowermost Position No. 1	21.9	0
Geometric Center Position No. 2	23.9	23
Uppermost Position No. 3	25.9	47
Telescoping Steering Wheel Travel		47
Test Position	23.9	23

DATA SHEET NO. 3 - DUMMY LONGITUDINAL CLEARANCE DIMENSIONS

Test Vehicle: 2020 Buick Encore GX
Test Program: THOR-05 Durability Evaluation Test Date: 11/15/2022

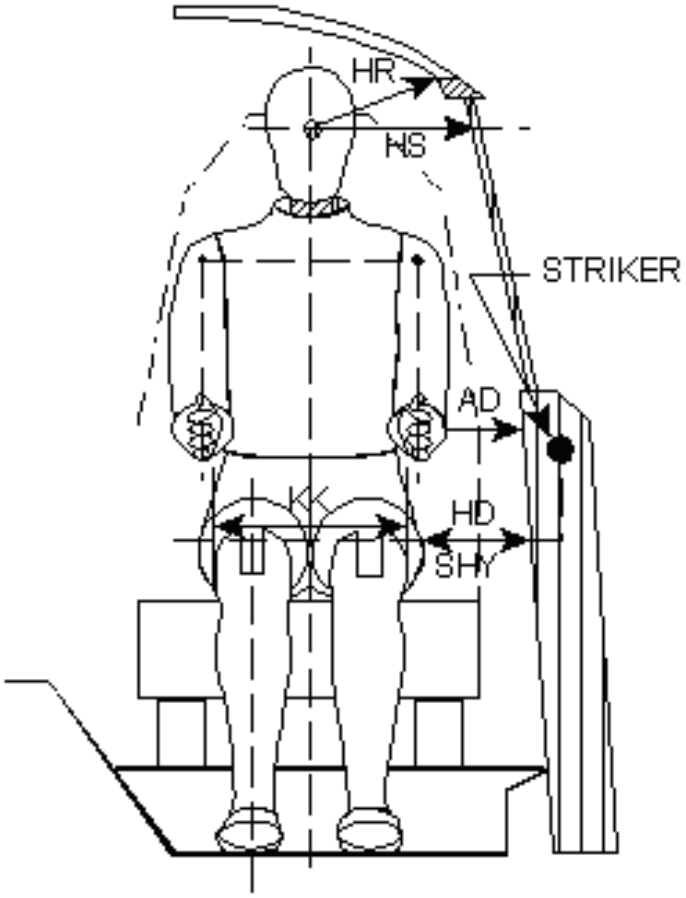


Code	Measurement Description	Driver		Passenger	
		Length (mm)	Angle (°)	Length (mm)	Angle (°)
WAº	Windshield Angle		58.6		58.7
SWAº	Steering Wheel Angle		23.9		
SCAº	Steering Column Angle		66.1		
SAº	Seat Back Angle (on head rest post)		8.0		7.8
HZ	Head to Roof (Z)	247		246	
HH	Head to Header	367		361	
HW	Head to Windshield	710		708	
NR	Nose to Rim	358			
CD	Chest to Dash	849		763	
CS	Chest to Steering Hub	268			
RA	Rim to Abdomen	126			
KDL	Left Knee to Dash	114	15.6	86	27.6
KDR	Right Knee to Dash	116	3.5	87	42.2
PAº	Pelvic Angle		20.5		18.2
TAº	Tibia Angle		62.6		72.4
SK	Striker to Knee	642	0.7	662	0.2
ST	Striker to Head	547	-79.0	546	-78.4
SH	Striker to H-Point	275	10.2	297	8.8

Measurements taken with CMM

DATA SHEET NO. 4 - DUMMY LATERAL CLEARANCE DIMENSIONS

Test Vehicle: 2020 Buick Encore GX
Test Program: THOR-05 Durability Evaluation Test Date: 11/15/2022

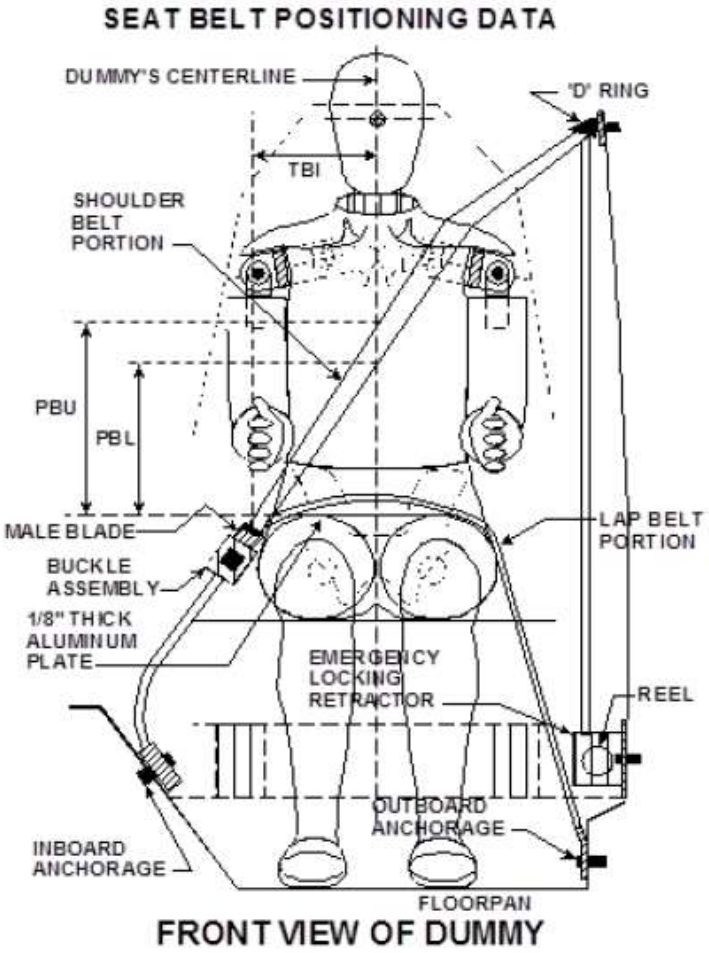


Code	Description	Axis	Units	Driver		Passenger	
AD	Arm to Door		mm	53		78	
HD	H-Point to Door		mm	75		73	
HR	Head to Side Header		mm	286		272	
HS	Head to Side Window		mm	371		375	
KK	Knee to Knee		mm	222		212	
SHY	Striker to H-Point (Y Direction)		mm	189		187	
HLHL	Heel to Heel		mm	286		214	
Tilt Sensor	Head	X, Y	Deg	-0.1	0.1	-0.4	-0.7
	Upper Thorax (T01)	X, Y	Deg	-1.0	-5.9	-1.0	-3.9
	Mid Thorax (T06)	X, Y	Deg	-1.1	24.5	-0.4	26.7
	Lower Thorax (T12)	X, Y	Deg	-1.5	15.7	-0.3	17.4
	Pelvis	X, Y	Deg	-0.8	21.3	0.6	21.5

Measurements taken with CMM

DATA SHEET NO. 5 - SEAT BELT POSITIONING DATA

Test Vehicle: 2020 Buick Encore GX
Test Program: THOR-05 Durability Evaluation Test Date: 11/15/2022



SEAT BELT POSITIONING MEASUREMENTS

Measurement Description	Units	Driver	Passenger
PBU – Top surface of reference to belt upper edge	mm	---[1]	---[1]
PBL – Top surface of reference to belt lower edge	mm	---[1]	---[1]

BELT LENGTH DATA

Measurement Description	Units	Driver	Passenger
Shoulder belt length as measured on ATD	mm	---[1]	---[1]
Lap belt length as measured on ATD	mm	---[1]	---[1]
Remainder of belt on reel	mm	---[1]	---[1]
Total belt length for continuous webbing systems	mm	---[1]	---[1]

[1] Unbelted measurements not applicable

TABLE 3 SEATING TABLE

Test Vehicle: 2020 Buick Encore GX

Test Program: THOR-05 Durability Evaluation Test Date: 11/15/2022

Driver THOR 5th Seating Worksheet

Vehicle	2020 Buick Encore GX	**Technician**	J. Fultz
VIN #	KL4MMGSL8LB099014	**Position**	Front Left
ATD	EV0674	**Date**	11/15/2022
SEATING #	1		

SCRL Angle			**THOR Tilt Sensors**		X	Y
	Max	20.2	Head	0°±2	-0.1	0.1
	Min -	11.8	Upper	0°±2	-1.0	-5.9
	Difference	8.4	Mid	0°±2	-1.1	24.5
	/2	4.2	Lower	0°±2	-1.5	15.7
	Min +	4.2	Pelvis	0°±2	-0.8	21.3
	Mid Angle	16				

Seat Back Angle @ HR post	8	**Headrest Adjustment (for-aft, pivot)**	FULL DOWN / FULL REAR
Seat Back Angle With 2' Level	N/A	**Seat position**	MID HEIGHT / MID ANGLE /FULL FORWARD
Seat Fore/Aft Position			

Pelvis Angle	THOR 5th 20° +/-2.5°	Manual Inclinometer	20.5

	FARO Measrurements On Vehicle Before Seating and Instrumentation							
	Measurements From Striker							
Name	**Meas X**	**Meas Y**	**Meas Z**	**X-DISTANCE**	**Y-DISTANCE**	**Z-DISTANCE**	**3D Distance**	**Deg**
Striker to Bumper	2009.840	-765.313	-241.620					
SBU (Appendix E)	-36.430	2.499	-12.619					
SBL -(Appendix E)	-30.400	0.996	22.749					
STRIKER (Center) -(Appendix E)	0.000	0.000	0.000					
FOSB - (Appendix E)	385.680	213.583	325.236					
FISB- (Appendix E)	385.060	639.900	323.599					
ROSB- (Appendix E)	-9.300	213.902	317.512					
RISB- (Appendix E)	-29.910	640.231	314.964					
S0- (Appendix E)	485.197	423.099	-288.668					
CLAP - (Appendix F)	945.410	593.983	326.691					
Floor Pan Point - (Appendix F)	944.942	593.373	396.227					
Brake Pedal - (Appendix F)	938.270	444.097	243.288					
Left Lower IP - (Appendix F)	736.170	273.558	-54.348					
Right Lower IP - (Appendix F)	734.610	571.421	-55.437					
Upper IP - (Appendix F)	675.410	271.763	-190.256					
Parking Brake - (Appendix F)	N/A	N/A	N/A					
Footrest - (Appendix F)	1013.350	195.900	242.799					
TP Outboard - (Appendix F)	1140.160	295.833	240.607					
TP Center - (Appendix F)	1259.610	442.527	240.308					
TP Inboard - (Appendix F)	1168.280	593.125	242.759					
PEDAL REFERENCE POINT (PRP) - (Appendix E)	944.942	593.373	396.227					
Heel Point Reference Line - (Appendix E)	830.840	596.386	400.044					
Gas Pedal Right Upper - (Appendix F)	1030.630	612.360	238.260					
Gas Pedal Right Lower - (Appendix F)	944.920	611.778	325.098					
Gas Pedal Left Upper - (Appendix F)	1033.050	575.449	237.932					
Gas Pedal Left Lower - (Appendix F)	945.910	574.383	324.958					
Brake Pedal Right Upper - (Appendix F)	954.820	495.579	224.707					
Brake Pedal Right Lower - (Appendix F)	927.300	490.202	267.758					
Brake Pedal Left Upper - (Appendix F)	955.090	393.251	225.691					
Brake Pedal Left Lower - (Appendix F)	927.060	398.560	268.430					
TS - (Appendix F)	552.620	421.650	-444.169					
BS - (Appendix F)	409.077	423.691	-135.662					
SC1 - (Appendix F)	683.450	333.924	-164.279					
Seat Centerline Point	140.050	427.047	100.284					
SCRP- Full Forward - (Appendix E)	535.880	217.353	62.474					
SCRP- Full Rearward- (Appendix E)	276.900	216.767	59.178					
Door Sill (Frame) Point 1 Driver Side- (Appendix F)	865.690	43.937	244.425					
Door Sill (Frame) Point 2 Driver Side- (Appendix F)	870.840	43.202	167.762					
Door Sill (Frame) Point 3 Driver Side- (Appendix F)	870.940	44.027	92.252					
Door Sill (Frame) Point 4 Driver Side- (Appendix F)	867.390	53.648	-207.465					
Door Sill (Frame) Point 5 Driver Side- (Appendix F)	865.440	57.223	-281.558					
Door Sill (Frame) Point 6 Driver Side- (Appendix F)	857.850	66.089	-356.555					
Door Sill (Frame) Point 7 Driver Side- (Appendix F)	97.010	45.371	244.848					
Door Sill (Frame) Point 8 Driver Side- (Appendix F)	-32.800	49.905	-206.499					
Center of Front Wheel (Driver Side)- (Appendix F)	1422.886	-95.745	444.209					
Center of Rear Wheel (Driver Side)- (Appendix F)	-1172.122	-102.059	432.274					
CG Accelerometer	521.970	863.407	325.091					
Footwell Accelerometer	1133.660	339.289	249.321					
DoorSill Accelerometer	-353.160	73.797	349.642					
Cross Member Accelerometer	-445.910	537.168	160.879					

NOTES:

TABLE 3 SEATING TABLE (CONT'D)

	FARO Measurements Taken Once Seating is Complete							
	Measurements From Striker							
Name	**Meas X**	**Meas Y**	**Meas Z**	**X-DISTANCE**	**Y-DISTANCE**	**Z-DISTANCE**	**3D Distance**	**Deg**
RHCG	105.913	493.402	-537.673					
LHCG	103.972	344.407	-537.221					
RIGHT EYE	196.231	440.300	-530.321					
LEFT EYE	195.570	393.377	-530.720					
NS	197.564	417.434	-530.250					
RIGHT CHEEK	194.659	441.988	-491.368					
LEFT CHEEK	193.953	393.928	-492.429					
TN	197.546	418.702	-492.508					
UC	197.029	419.159	-454.735					
TC	191.672	419.553	-413.427					
C1	209.527	419.829	-287.804					
C2	217.472	423.364	-287.532					
C3	283.078	424.245	-135.799					
SHT L	75.113	276.388	-346.554					
SHT R	75.108	557.762	-359.876					
E1	233.393	170.395	-96.602					
LEFT WRIST	424.457	217.817	-210.662					
RIGHT WRIST	401.468	610.891	-215.599					
P1	205.612	149.042	-7.042					
H-POINT	270.938	189.153	48.860					
H-POINT (2)	271.718	245.939	48.069					
OK	642.301	282.832	7.833					
IK	646.792	504.408	9.957					
OA	797.813	276.464	307.337					
IA	828.036	559.202	287.629					
OH	756.707	310.479	416.511					
IH	831.765	585.784	405.980					
OUTBOARD TOE	978.866	327.730	307.607					
INBOARD TOE	996.774	591.713	215.645					
OP	-78.111	324.797	-435.932					
TOP CENTER SHOULDER BELT	N/A	N/A	N/A					
BOTTOM CENTER SHOULDER BELT	N/A	N/A	N/A					
TOP CENTER LAP BELT	N/A	N/A	N/A					
BOTTOM CENTER LAP BELT	N/A	N/A	N/A					
CENTER OF BELT AT D-RING	-159.378	170.920	-552.609					
DRIVER SCRP - FINAL TEST POSITION	529.757	223.995	73.961					
	Measurements to be taken once Dummy is seated and measured							
Name	**Meas X**	**Meas Y**	**Meas Z**	**X-DISTANCE**	**Y-DISTANCE**	**Z-DISTANCE**	**3D Distance**	**Deg**
R	198.300	417.515	-776.765					
H	500.281	418.047	-738.014					
W1	907.339	416.863	-530.915					
W1 OUTSIDE	924.749	418.035	-529.861					
W2 OUTSIDE	1198.880	416.289	-362.720					
D1	670.655	420.146	-423.979					
D2	751.730	282.857	-22.762					
D3	762.751	503.070	2.879					
HRP	197.677	193.997	-709.181					
HSP	198.089	46.703	-530.710					
ADP	234.182	117.592	-95.987					
HDP	271.414	114.615	47.900					
	Measurements calculated using points collected from the FARO arm							
Name	**Meas X**	**Meas Y**	**Meas Z**	**X-DISTANCE**	**Y-DISTANCE**	**Z-DISTANCE**	**3D Distance**	**Deg**
HZ						247		
HH							367	
HW				710				
NR							358	
CD							849	
CS				268				
CBS				126				
IKD							116	
OKD							114	
HR							286	
HS					371			
AD					53			
HD					75			
HLHL							286	
KK							222	
SH							334	
HRA - (Inclonometer measurement deg)								8.0
H-POINT TOOL ANGLE								40.6
TORSO ANGLE								15.9
WINDSHIELD ANGLE								58.6
Distance A (From Point 1 to 7)				769				
Distance B (from Point 4 to 8)				900				
Wheelbase (From center of front tire to rear tire) Driver Side				2595				

NOTES:

TABLE 3 SEATING TABLE (CONT'D)

Passenger THOR 5th Seating Worksheet

Vehicle	2020 Buick Encore GX	**Technician**	J. Fultz
VIN #	KL4MMGSL8LB099014	**Position**	Front Right
ATD	EU3430	**Date**	11/15/2022
SEATING #	2		

SCRL Angle		
	Max	21.7
	Min -	11.4
	Difference	10.3
	/2	5.15
	Min +	5.15
	Mid Angle	16.55

THOR Tilt Sensors		X	Y
Head	0°±2	-0.4	-0.7
T1	0°±2	-1.0	-3.9
T6	0°±2	-0.4	26.7
T12	0°±2	-0.3	17.4
Pelvis	0°±2	0.6	21.5

Seat Back Angle @ HR post	7.8	**Headrest Adjustment (for-aft, pivot)**	FULL DOWN / FULL REAR
Seat Back Angle With 2' Level	N/A	**Seat position**	MID HEIGHT / MID ANGLE /FULL FORWARD
Seat Fore/Aft Position			

Pelvis Angle	THOR 5th 20° +/-2.5°	Manual Inclinometer	18.2

	Measurements From Striker							
Name	**Meas X**	**Meas Y**	**Meas Z**	**X-DISTANCE**	**Y-DISTANCE**	**Z-DISTANCE**	**3D Distance**	**Deg**
Striker to Bumper	**2006.580**	**766.436**	**-248.562**					
SBU (Appendix E)	**-36.180**	**-4.024**	**-11.312**					
SBL -(Appendix E)	**-30.390**	**-0.376**	**23.931**					
STRIKER (Center) -(Appendix E)	**0.000**	**0.000**	**0.000**					
FOSB - (Appendix E)	**384.870**	**-213.678**	**330.826**					
FISB- (Appendix E)	**384.250**	**-640.024**	**331.141**					
ROSB- (Appendix E)	**-7.690**	**-210.323**	**322.073**					
RISB- (Appendix E)	**-32.140**	**-638.293**	**321.077**					
Upper IP - (Appendix F)	**681.790**	**-278.200**	**-160.450**					
Left Lower IP - (Appendix F)	**734.060**	**-577.755**	**-46.700**					
Right Lower IP - (Appendix F)	**732.390**	**-279.085**	**-47.848**					
TP Inboard - (Appendix F)	**1165.010**	**-580.476**	**251.433**					
TP Outboard - (Appendix F)	**1128.280**	**-280.188**	**253.377**					
TP Center - (Appendix F)	**1158.810**	**-431.193**	**254.768**					
Footrest - (Appendix F)	**1059.400**	**-179.930**	**253.588**					
Door Sill (Frame) Point 1 Pass. Side- (Appendix F)	**865.710**	**-42.846**	**249.925**					
Door Sill (Frame) Point 2 Pass. Side- (Appendix F)	**870.640**	**-43.112**	**169.819**					
Door Sill (Frame) Point 3 Pass. Side- (Appendix F)	**871.050**	**-44.013**	**99.896**					
Door Sill (Frame) Point 4 Pass. Side- (Appendix F)	**868.950**	**-54.024**	**-198.580**					
Door Sill (Frame) Point 5 Pass. Side- (Appendix F)	**866.030**	**-58.987**	**-274.614**					
Door Sill (Frame) Point 6 Pass. Side- (Appendix F)	**860.050**	**-67.580**	**-349.894**					
Door Sill (Frame) Point 7 Pass. Side- (Appendix F)	**99.690**	**-44.538**	**250.559**					
Door Sill (Frame) Point 8 Pass. Side- (Appendix F)	**-30.060**	**-51.123**	**-199.582**					
Seat Centerline Point	**151.090**	**-429.944**	**101.532**					
Floor line	**720.270**	**-430.142**	**429.345**					
SCRP- Full Forward- (Appendix E)	**519.550**	**-220.150**	**68.905**					
SCRP- Full Rearward- (Appendix E)	**259.930**	**-219.414**	**65.740**					
Center of Front Wheel (Passenger Side)- (Appendix F)	**1422.111**	**97.180**	**450.519**					
Center of Rear Wheel (Passenger Side)- (Appendix F)	**-1168.862**	**105.912**	**437.854**					
Footwell Accelerometer	**1127.020**	**-347.054**	**254.653**					
DoorSill Accelerometer	**-349.190**	**-74.595**	**352.111**					
Cross Member Accelerometer	**-450.380**	**-447.943**	**164.875**					

NOTES:

TABLE 3 SEATING TABLE (CONT'D)

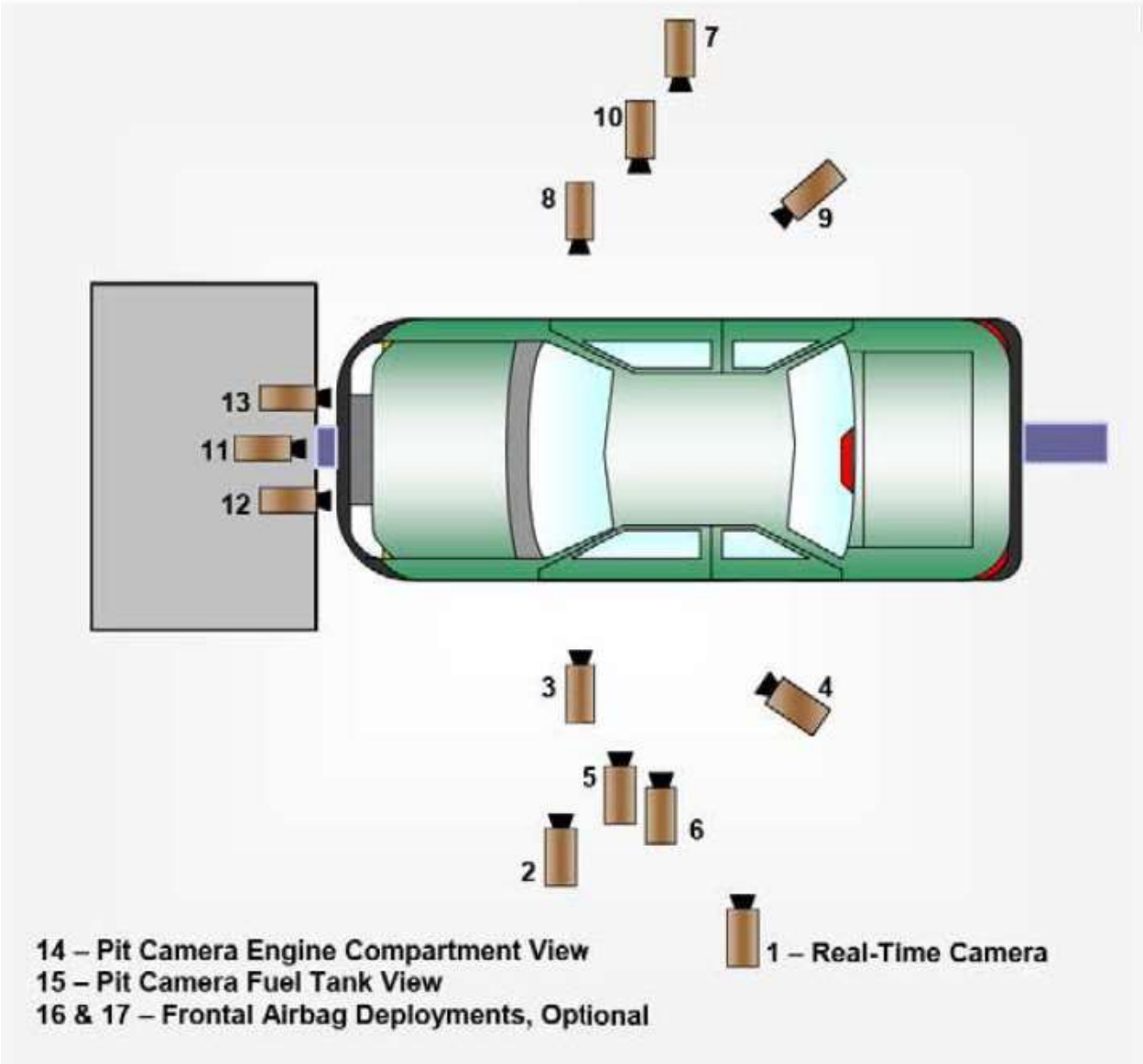
	Measurements From Striker							
Name	**Meas X**	**Meas Y**	**Meas Z**	**X-DISTANCE**	**Y-DISTANCE**	**Z-DISTANCE**	**3D Distance**	**Deg**
ATD Measurements to be taken once Dummy is placed in vehicle								
RHDCG	110.308	-357.387	-535.039					
LHDCG	109.843	-504.815	-533.291					
RIGHT EYE	200.442	-407.707	-526.245					
LEFT EYE	200.194	-456.135	-526.675					
NS	202.422	-431.999	-524.889					
RIGHT CHEEK	198.810	-406.278	-489.205					
LEFT CHEEK	199.448	-453.062	-485.737					
TN	202.479	-430.534	-487.483					
UC	201.708	-431.508	-450.893					
TC	195.524	-429.376	-410.805					
C1	219.729	-429.898	-285.501					
SHT L	76.862	-569.183	-343.763					
SHT R	80.500	-285.976	-349.809					
E1	193.442	-192.587	-74.467					
LEFT WRIST	438.807	-608.609	-42.056					
RIGHT WRIST	409.749	-225.850	-9.165					
P1	228.426	-145.722	-10.776					
H-POINT	293.845	-187.397	45.588					
H-POINT (2)	294.421	-246.927	45.044					
OK	662.402	-287.055	2.194					
IK	662.264	-498.697	4.333					
OA	763.558	-257.361	320.504					
IA	768.995	-493.391	324.812					
OH	706.882	-294.625	423.197					
IH	706.372	-509.123	423.667					
OUTBOARD TOE	957.047	-294.233	355.411					
INBOARD TOE	951.180	-515.162	358.879					
OP	-71.699	-339.933	-447.758					
TOP CENTER OF SHOULDER BELT	N/A	N/A	N/A					
BOTTOM CENTER OF SHOULDER BELT	N/A	N/A	N/A					
TOP CENTER LAP BELT	N/A	N/A	N/A					
BOTTOM CENTER OF LAP BELT	N/A	N/A	N/A					
CENTER OF BELT AT D-RING	-164.032	-170.278	-550.120					
PASSENGER SCRP - FINAL TEST POSITION	518.757	-218.744	71.175					
Name	**Meas X**	**Meas Y**	**Meas Z**	**X-DISTANCE**	**Y-DISTANCE**	**Z-DISTANCE**	**3D Distance**	**Deg**
Measurements to be taken on Dummy is seated and measured								
R	202.913	-431.066	-771.239					
H	499.875	-431.651	-729.612					
W1	910.634	-431.842	-525.473					
W1 OUTSIDE	925.495	-431.907	-525.687					
W2 OUTSIDE	1196.710	-432.599	-360.632					
D1	681.082	-427.762	-156.625					
D2	726.911	-286.747	-56.386					
D3	738.355	-499.945	-35.451					
HRP	203.253	-221.698	-697.807					
HSP	203.043	-56.529	-525.444					
ADP	193.818	-114.925	-74.210					
HDP	294.493	-114.103	45.548					
Name	**Meas X**	**Meas Y**	**Meas Z**	**X-DISTANCE**	**Y-DISTANCE**	**Z-DISTANCE**	**3D Distance**	**Deg**
Measurements calculated using points collected from the FARO arm								
HZ						246		
HH							361	
HW				708				
CD							763	
IKD							86	
OKD							87	
HR							272	
HS					375			
AD					78			
HD					73			
HLHL							214	
KK							212	
SH							351	
HRA - (Inclonometer measurement deg)								7.8
H-POINT TOOL ANGLE								40.7
TORSO ANGLE								17.6
WINDSHIELD ANGLE								58.7
Distance D (From Point 1 to 7)				766				
Distance E (from Point 4 to 8)				899				
Wheelbase (From center of front tire to rear tire) - Passenger Side				2803				

NOTES:

DATA SHEET NO. 6 - HIGH SPEED CAMERA LOCATIONS AND DATA

Test Vehicle: 2020 Buick Encore GX
Test Program: THOR-05 Durability Evaluation Test Date: 11/15/2022

CAMERA POSITIONS FOR FRONTAL IMPACTS



DATA SHEET NO. 6 - HIGH SPEED CAMERA LOCATIONS AND DATA (CONT'D)

Test Vehicle: 2020 Buick Encore GX
Test Program: THOR-05 Durability Evaluation Test Date: 11/15/2022

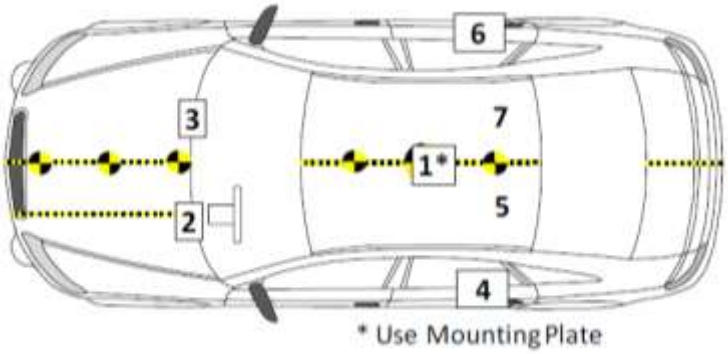
CAMERA LOCATIONS

No.	Camera View	Location (mm)			Lens (mm)	Frame Speed (fps)
		X	Y	Z		
1	REAL-TIME LEFT OVERALL	-1550	-4440	-1432	Zoom	30
2	LEFT OVERALL	-1450	-4440	-1432	8.5	1000
3	DRIVER CLOSE-UP	2059	-4465	-1493	50	1000
4	LEFT FRONT HALF	-853	-4514	-1383	25	1000
5	LEFT ANGLE	-3218	-2280	-1640	20	1000
6	STEERING COLUMN	-3134	-3696	-1507	50	1000
7	RIGHT OVERALL	-1731	-4391	-1524	8.5	1000
8	PASSENGER CLOSE-UP	-2134	4330	-1501	50	1000
9	RIGHT FRONT HALF	-901	4372	-1467	25	1000
10	RIGHT ANGLE	-3160	3696	-1619	20	1000
11	WINDSHIELD	-379	0	-2610	20	1000
12	DRIVER WINDSHIELD	-380	-652	-2601	25	1000
13	PASSENGER WINDSHIELD	-380	480	-2590	25	1000
14	PIT FRONT	-875	0	3020	20	1000
15	PIT REAR	-3105	0	3050	20	1000
16	DRIVER ONBOARD (FOOTWELL)				8.5	500
17	PASSENGER ONBOARD (FOOTWELL)				8.5	500

Reference Points: +X – forward of impact plane
+Y – right of monorail center
+Z – into ground

DATA SHEET NO. 7 - VEHICLE ACCELEROMETER DATA

Test Vehicle: 2020 Buick Encore GX
Test Program: THOR-05 Durability Evaluation Test Date: 11/15/2022



VEHICLE ACCELEROMETER PRE-TEST LOCATIONS

Location		Coordinates (mm)			Positive Direction		Negative Direction	
		X	Y	Z	Max	Time (ms)	Max	Time (ms)
1	Vehicle CG	2532	98	83				
	Longitudinal (g)				2.05	132.05	-42.92	25.75
	Lateral (g)				7.93	34.10	-7.89	53.55
	Vertical (g)				15.18	27.05	-17.80	43.45
	Resultant (g)				44.49	25.90		
2	Driver Floor Pan	3144	-426	8				
	Longitudinal (g)				2.01	126.05	-51.64	25.50
	Lateral (g)				11.17	56.05	-14.97	43.00
	Vertical (g)				15.51	32.25	-17.12	42.75
	Resultant (g)				51.78	25.50		
3	Passenger Floor Pan	3134	419	6				
	Longitudinal (g)				27.53	37.05	-43.47	24.90
	Lateral (g)				12.35	38.60	-7.96	30.60
	Vertical (g)				19.62	38.05	-12.41	42.25
	Resultant (g)				45.75	31.85		
4	Door Sill Left Rear	1657	-692	108				
	Longitudinal (g)				2.22	126.75	-37.27	26.40
5	Door Sill Right Rear	1657	692	104				
	Longitudinal (g)				1.88	126.05	-36.04	26.05
6	Left Rear Seat Crossmember	1564	-228	-81				
	Longitudinal (g)				6.71	149.20	-41.79	27.60
	Vertical (g)				12.57	26.70	-21.66	64.45
7	Right Rear Seat Crossmember	1556	318	-84				
	Longitudinal (g)				2.68	125.70	-35.34	27.30
	Vertical (g)				13.74	26.10	-14.88	62.65

Reference point:

X – Rear Surface of Vehicle (+ forward)

Y – Vehicle Centerline (+ to right)

Z – Ground Plane (+ down)

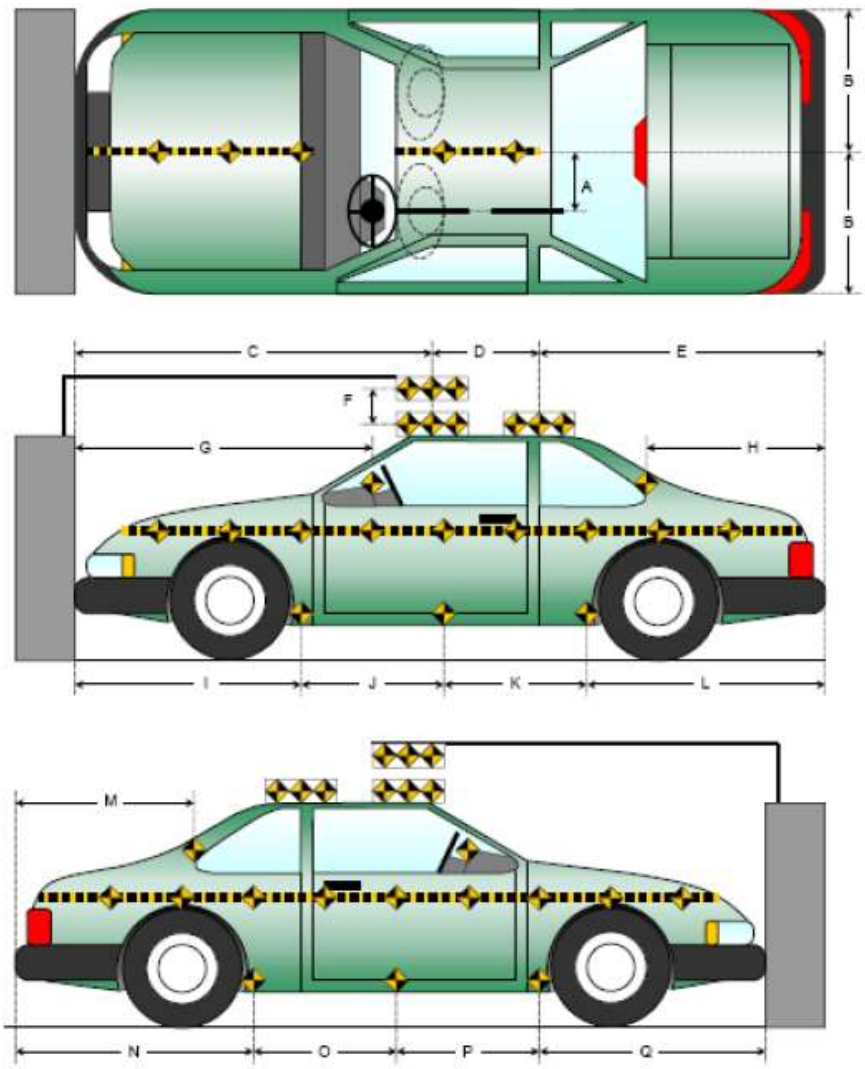
Reference Appendix F for measurement description

DATA SHEET NO. 8 - PHOTOGRAPHIC REFERENCE TARGET LOCATIONS

Test Vehicle: 2020 Buick Encore GX
Test Program: THOR-05 Durability Evaluation Test Date: 11/15/2022

Item	Value
A	350
B	905
C	2402
D	600
E	1383
F	245
G	1680
H	1065
I	1390
J	830
K	830
L	1300
M	1055
N	1300
O	830
P	830
Q	1390

All units in millimeters



DATA SHEET NO. 9 - TEST VEHICLE SUMMARY OF RESULTS

Test Vehicle: 2020 Buick Encore GX
Test Program: THOR-05 Durability Evaluation Test Date: 11/15/2022

INSTRUMENTATION

Instrumentation	Number of Channels Collected
Driver Dummy Accelerometers	115
Passenger Dummy Accelerometers	115
Vehicle Structure Accelerometers	15
Total	245

CAMERA COVERAGE

Type of Camera	Number Used in this Test
High-Speed Vehicle Onboard	2
High-Speed Offboard	14
Real-Time Panning	1
Total	17

DATA SHEET NO. 10 - POST-TEST OBSERVATIONS

Test Vehicle: 2020 Buick Encore GX
Test Program: THOR-05 Durability Evaluation Test Date: 11/15/2022

TEST DUMMY INFORMATION AND CONTACT LOCATIONS

Description	Driver	Passenger
Dummy Type / Serial No.	THOR-05 / EV0674	THOR-05 / EV3430
Head Contact	Front airbag	Front airbag
Upper Torso Contact	Front airbag	Front airbag
Lower Torso Contact	Front airbag	Front airbag
Left Knee Contact	Knee airbag	Knee airbag
Right Knee Contact	Knee airbag	Knee airbag

DOOR OPENING, TRUNK OPENING, AND SEAT TRACK INFORMATION

Description	Driver	Passenger	Other
Locked/Unlocked Doors**	Unlocked	Unlocked	
Front Door Opening**	No	No	
Rear Door Opening**	No	No	
Trunk/Hatch/Tailgate Opening**			No
Seat Track Shift (mm) **	No	No	
Seat Back Movement from Initial Position**	No	No	

**NOTE: Indicate “No”, “N/A, or “Yes”, and if “Yes”, describe

POST- OTHER VEHICLE POST-TEST OBSERVATIONS

Critical Areas of Performance	Observations
Windshield Damage	Cracked at airbag
Window Damage	None
Other Notable Effects	None

VEHICLE REBOUND FROM BARRIER

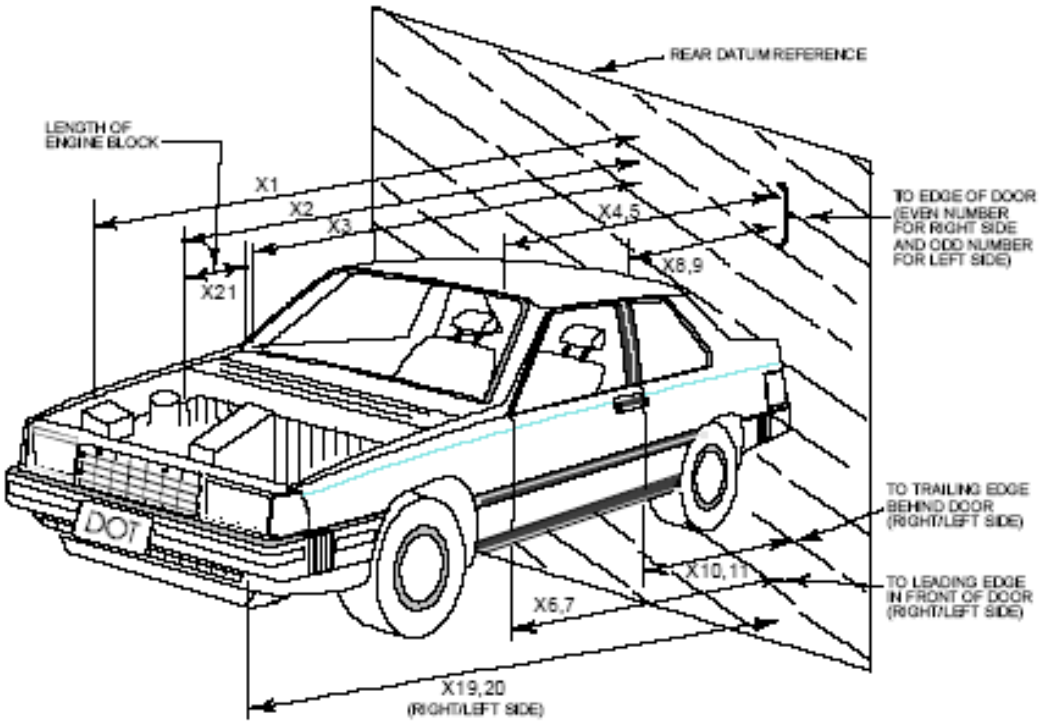
Measured Parameter	Units	Value
Left Side	mm	1342
Center	mm	1305
Right Side	mm	1349
Average	mm	1332

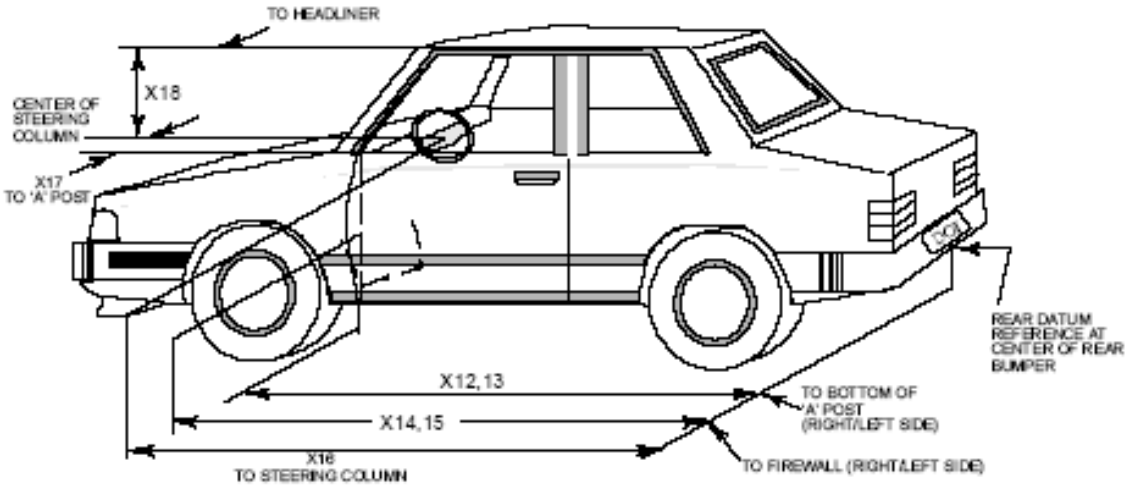
SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

Restraint Type	Driver (Occupant 1)		Passenger (Occupant 2)	
	Installed	Deployed	Installed	Deployed
Front Airbag	Yes	Yes	Yes	Yes
Torso/Pelvis Side Airbag	Yes	No	Yes	No
Curtain Side Airbag	Yes	No	Yes	No
Knee Airbag	Yes	Yes	Yes	Yes
Seat Belt Pretensioner	Yes	No	Yes	No
Seat Belt Load Limiter	Yes	No	Yes	No
Seat Belt Buckle Pretensioner	No	N/A	No	N/A
Other	No	N/A	No	N/A

DATA SHEET NO. 11 - VEHICLE PROFILE MEASUREMENTS

Test Vehicle: 2020 Buick Encore GX
Test Program: THOR-05 Durability Evaluation Test Date: 11/15/2022





DATA SHEET NO. 11 - VEHICLE PROFILE MEASUREMENTS (CONT'D)

Test Vehicle: 2020 Buick Encore GX
Test Program: THOR-05 Durability Evaluation Test Date: 11/15/2022

No.	Measurement Description	Pre-Test	Post-Test	Difference
1	Total Length of Vehicle at Centerline	4350	4082	268
2	Rear Surface of Vehicle (RSOV) to Front of Engine	3840	3762	78
3	RSOV to Firewall	3440	3422	18
4	RSOV to Upper Leading Edge of Right Door	2900	2909	-9
5	RSOV to Upper Leading Edge of Left Door	2900	2900	0
6	RSOV to Lower Leading Edge of Right Door	2895	2898	-3
7	RSOV to Lower Leading Edge of Left Door	2900	2895	5
8	RSOV to Upper Trailing Edge of Right Door	1912	1919	-7
9	RSOV to Upper Trailing Edge of Left Door	1915	1915	0
10	RSOV to Lower Trailing Edge of Right Door	1960	1966	-6
11	RSOV to Lower Trailing Edge of Left Door	1965	1965	0
12	RSOV to Bottom of "A" Post-of Right Side	2880	2882	-2
13	RSOV to Bottom of "A" Post-of Left Side	2880	2885	-5
14	RSOV to Firewall, Right Side	3405	3420	-15
15	RSOV to Firewall, Left Side	3405	3401	4
16	RSOV to Steering Column	2475	2647	-172
17	Center of Steering Column to "A" Post	325	340	-15
18	Center of Steering Column to Headliner	450	460	-10
19	RSOV to Right Side of Front Bumper	4120	4020	100
20	RSOV to Left Side of Front Bumper	4120	3977	143
21	Length of Engine Block	500	500	0
RD	RSOV to Right Side of Dash Panel	2735	2738	-3
CD	RSOV to Center of Dash Panel	2785	2782	3
LD	RSOV to Left Side of Dash Panel	2740	2740	0

All Dimensions in mm

DATA SHEET NO. 12 - ACCIDENT INVESTIGATION DIVISION DATA

Test Vehicle: 2020 Buick Encore GX
Test Program: THOR-05 Durability Evaluation Test Date: 11/15/2022

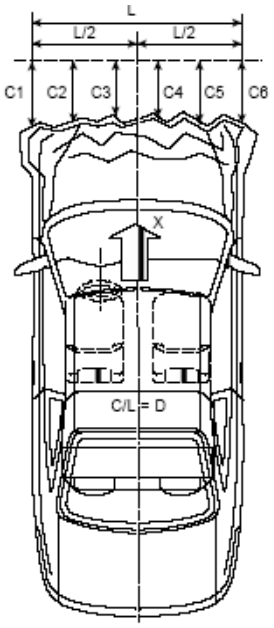
VEHICLE INFORMATION

VIN: KL4MMGSL8LB099014
Vehicle Size Category: MPV

Wheelbase: 2590
Test Weight (kg): 1705.6

ACCELEROMETER DATA

Accelerometer Locations: As listed on Page 15 of this report.
Cal. Procedure/Interval: TRC procedure / 6 month interval
Integration Algorithm: Trapezoidal
Linearity: > 99%
Impact Velocity (km/h): 40.16
Velocity Change (km/h): 49.43
Time of Separation (ms): 121



CRUSH PROFILE

Collision Deformation Classification: 12FDEW2
Midpoint of Damage: Centerline
Damage Region Length (mm): 1524
Impact Mode: Frontal

No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
C1	Crush zone 1 at left side	mm	4120	3977	143
C2	Crush zone 2 at left side	mm	4252	4037	215
C3	Crush zone 3 at left side	mm	4330	4075	255
C4	Crush zone 4 at right side	mm	4330	4088	242
C5	Crush zone 5 at right side	mm	4252	4035	217
C6	Crush zone 6 at right side	mm	4120	4020	100
L	C1 to C6	mm	1524	1500	24

DATA SHEET NO. 13 - VEHICLE INTRUSION MEASUREMENTS

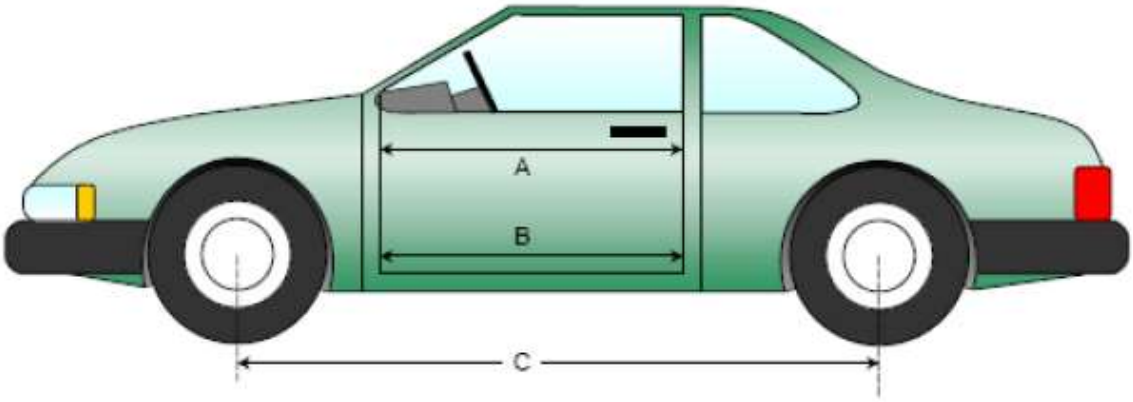
Test Vehicle: 2020 Buick Encore GX
Test Program: THOR-05 Durability Evaluation Test Date: 11/15/2022

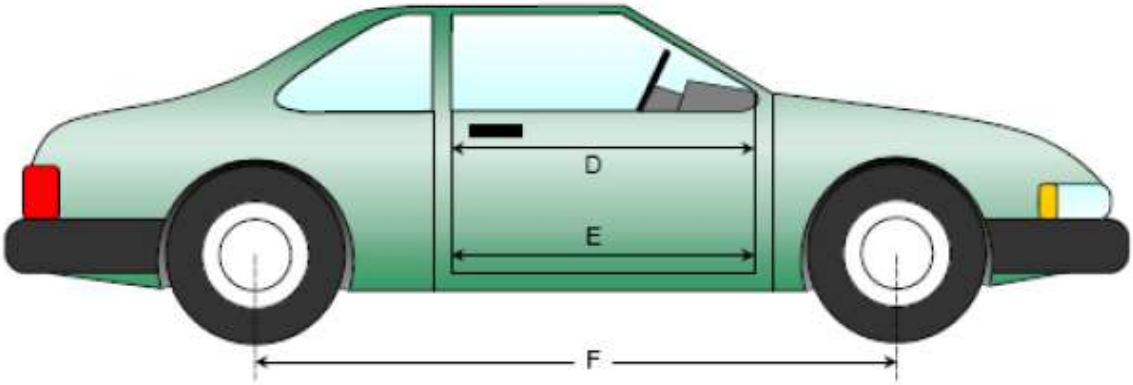
DOOR OPENING WIDTH

No.	Description	Units	Pre-Test	Post-Test	Difference
A	Left Side Upper	mm	935	946	-11
B	Left Side Lower	mm	850	850	0
D	Right Side Upper	mm	935	940	-5
E	Right Side Lower	mm	850	860	-10

WHEELBASE MEASUREMENTS

No.	Description	Units	Pre-Test	Post-Test	Difference
C	Left Side Wheelbase	mm	2590	2520	70
F	Right Side Wheelbase	mm	2590	2520	70





[1] Front suspension damaged and wheels fell off measurements not available

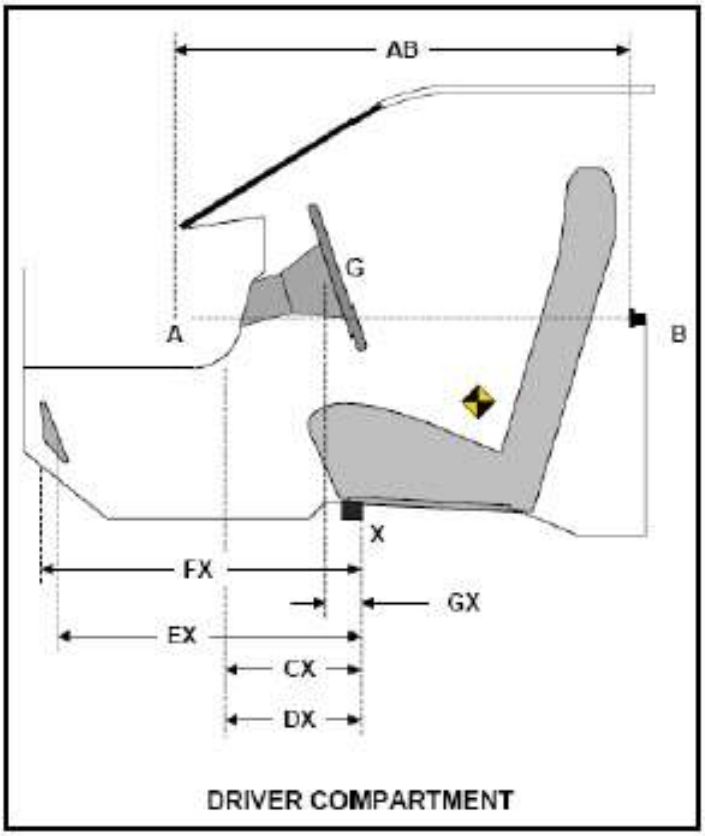
DATA SHEET NO. 13 - VEHICLE INTRUSION MEASUREMENTS (CONT'D)

Test Vehicle: 2020 Buick Encore GX
Test Program: THOR-05 Durability Evaluation Test Date: 11/15/2022

DRIVER COMPARTMENT INTRUSION

Item	Description	Units	Pre-Test	Post-Test	Difference
AB	Door Opening (Inside Window Jam)	mm	935	935	0
CX	Left Knee Bolster to X	mm	335	340	-5
DX	Right Knee Bolster to X	mm	335	390	-55
EX	Brake Pedal to X	mm	560	537	23
FX	Foot Rest to X	mm	580	566	14
GX	Center of Steering Column Wheel Hub to X	mm	65	156	-91

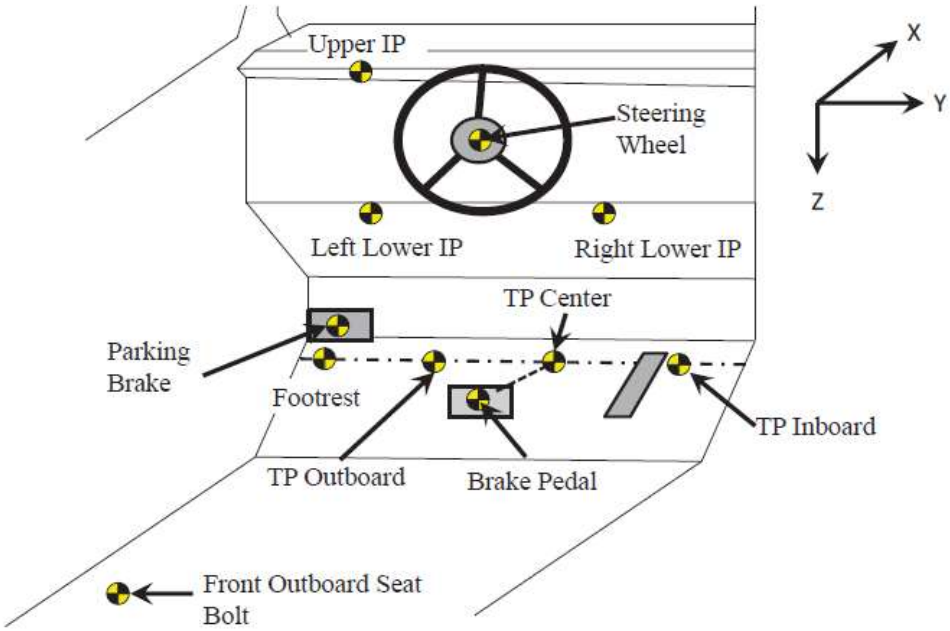
X = Front of Seat Track (Stationary)



DATA SHEET NO. 13 VEHICLE INTRUSION MEASUREMENTS (CONT'D)

Test Vehicle: 2020 Buick Encore GX
Test Program: THOR-05 Durability Evaluation Test Date: 11/15/2022

DRIVER FLOOR PAN MEASUREMENTS



Intrusion Location	Pre-Test (mm)			Post-Test (mm)			Difference (mm)		
	X	Y	Z	X	Y	Z	X	Y	Z
Steering Wheel	2495	-342	-530	2563	-336	-515	-68	-6	-15
Left Lower IP	2746	-492	-296	2757	-486	-298	-11	-6	2
Right Lower IP	2744	-194	-297	2756	-189	-298	-12	-5	1
Upper IP	2685	-494	-432	2691	-486	-432	-6	-8	0
Parking Brake Pedal Point	---[1]	---[1]	---[1]	---[1]	---[1]	---[1]	---[1]	---[1]	---[1]
TP Footrest	3023	-569	1	3023	-562	2	0	-7	-1
TP Outboard	3150	-469	-1	3144	-461	-6	6	-8	5
TP Center	3269	-323	-1	3263	-323	-6	6	0	5
TP Inboard	3178	-172	1	3167	-167	-3	11	-5	4

Reference point:

+X – From the rear of the vehicle to the front of the vehicle
+Y – From the left side of the vehicle to the right side of the vehicle
+Z – From the top of the vehicle to the bottom of the vehicle

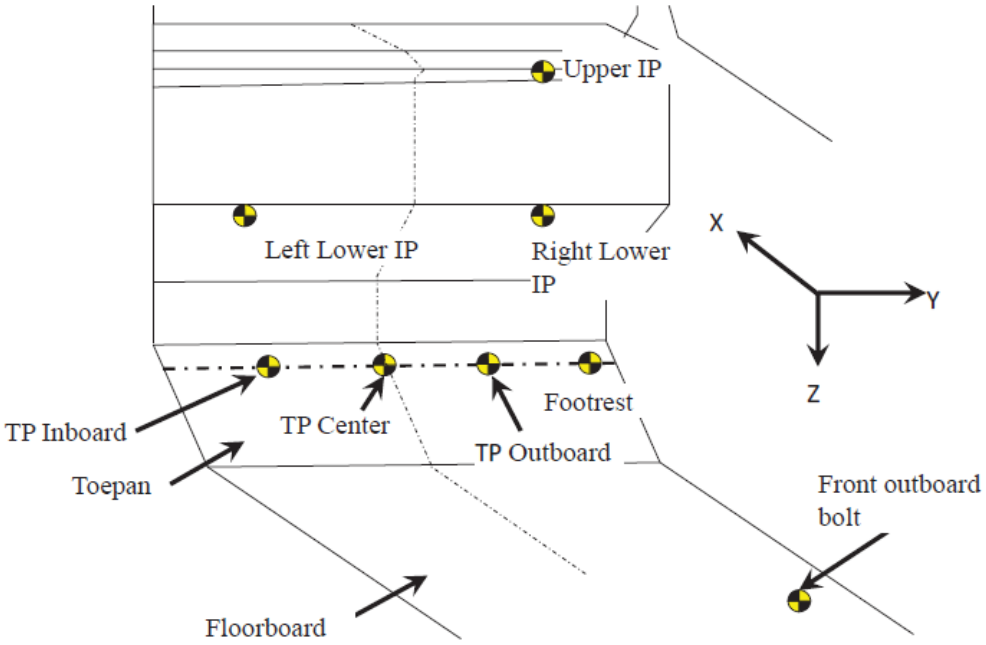
Reference Appendix F for measurement description

[1] Measurement not recorded

DATA SHEET NO. 13 VEHICLE INTRUSION MEASUREMENTS (CONT'D)

Test Vehicle: 2020 Buick Encore GX
Test Program: THOR-05 Durability Evaluation Test Date: 11/15/2022

PASSENGER FLOOR PAN MEASUREMENTS



Intrusion Location	Pre-Test (mm)			Post-Test (mm)			Difference (mm)		
	X	Y	Z	X	Y	Z	X	Y	Z
Left Lower IP	2741	189	-295	2748	190	-301	-7	-1	6
Right Lower IP	2739	487	-296	2743	488	-300	-4	-1	4
Upper IP	2688	488	-409	2690	489	-412	-2	-1	3
TP Footrest	3066	587	5	3059	587	0	7	0	5
TP Outboard	3135	486	5	3162	336	0	-27	150	5
TP Center	3165	335	6	3128	485	-2	37	-150	8
TP Inboard	3172	186	3	3168	188	-2	4	-2	5

Reference point:

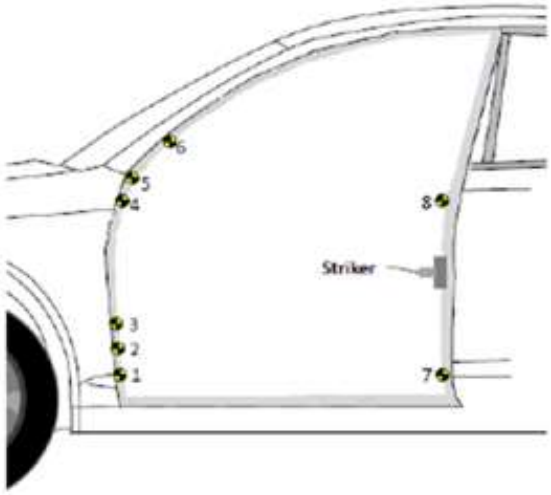
+X – From the rear of the vehicle to the front of the vehicle
+Y – From the left side of the vehicle to the right side of the vehicle
+Z – From the top of the vehicle to the bottom of the vehicle

Reference Appendix F for measurement description

DATA SHEET NO. 13 VEHICLE INTRUSION MEASUREMENTS (CONT'D)

Test Vehicle: 2020 Buick Encore GX
Test Program: THOR-05 Durability Evaluation Test Date: 11/15/2022

DRIVER SIDE DOOR SILL INTRUSIONS



Point	Pre-Test			Post-Test			Difference		
	X	Y	Z	X	Y	Z	X	Y	Z
1	2876	-721	3	2874	-715	2	2	-6	1
2	2881	-722	-74	2880	-717	-73	1	-5	-1
3	2881	-721	-149	2880	-716	-150	1	-5	1
4	2877	-712	-449	2877	-709	-450	0	-3	1
5	2875	-708	-523	2875	-706	-523	0	-2	0
6	2868	-699	-598	2867	-697	-598	1	-2	0
7	2107	-720	3	2105	-717	4	2	-3	-1
8	1977	-715	-448	1977	-713	-447	0	-2	-1

Reference point: Taken inside the door sill

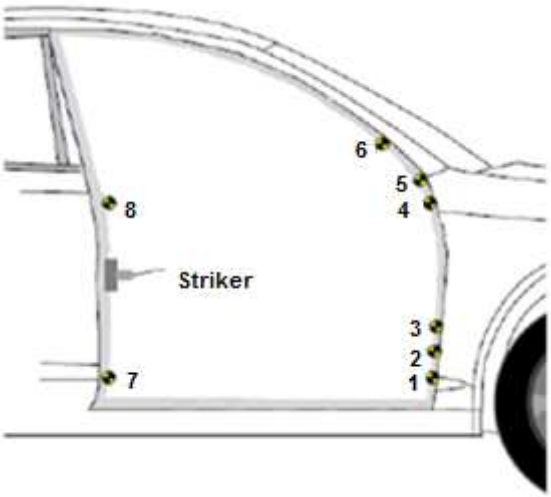
+X – From the rear of the vehicle to the front of the vehicle
+Y – From the left side of the vehicle to the right side of the vehicle
+Z – From the top of the vehicle to the bottom of the vehicle

Reference Appendix F for measurement description

DATA SHEET NO. 13 VEHICLE INTRUSION MEASUREMENTS (CONT'D)

Test Vehicle: 2020 Buick Encore GX
Test Program: THOR-05 Durability Evaluation Test Date: 11/15/2022

PASSENGER SIDE DOOR SILL INTRUSIONS



Point	Pre-Test			Post-Test			Difference		
	X	Y	Z	X	Y	Z	X	Y	Z
1	2872	724	1	2872	725	-1	0	-1	2
2	2877	723	-79	2876	724	-79	1	-1	0
3	2878	722	-149	2878	724	-151	0	-2	2
4	2876	712	-447	2875	714	-449	1	-2	2
5	2873	707	-523	2872	709	-525	1	-2	2
6	2867	699	-598	2867	701	-600	0	-2	2
7	2106	722	2	2108	724	3	-2	-2	-1
8	2872	724	1	1977	717	-448	0	-2	0

Reference point: Taken inside the door sill

+X – From the rear of the vehicle to the front of the vehicle
+Y – From the left side of the vehicle to the right side of the vehicle
+Z – From the top of the vehicle to the bottom of the vehicle

Reference Appendix F for measurement description

DATA SHEET NO. 14 - SUMMARY OF INDICANT FMVSS 212 AND FMVSS 219 (PARTIAL) DATA

Test Vehicle: 2020 Buick Encore GX
Test Program: THOR-05 Durability Evaluation Test Date: 11/15/2022

Please provide windshield mounting details.

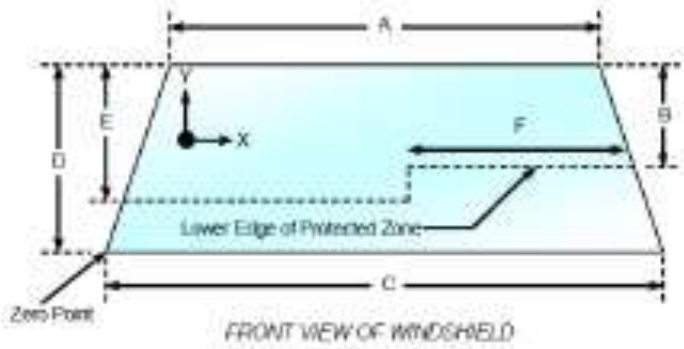
The standard requires that the post-test retention measurement be a minimum of 75% of the pre-test total periphery measurement for vehicle not equipped with occupant passive restraint and 50% for each side of the windshield for vehicle which are equipped with occupant passive restraints.

Temperature of windshield molding during test: 17.3°C

WINDSHIELD PERIPHERY MEASUREMENTS

Measurement	Pre-Test (mm)	Post-Test (mm)	% Retention
Left Side	2108	2108	100.0
Right Side	2108	2108	100.0
Total	4216	4216	100.0

Item	Units	Value
A	mm	1204
B	mm	435
C	mm	1432
D	mm	790
E	mm	488
F	mm	465



AREAS OF PROTECTED ZONE FAILURES

A. Provide coordinates of the area that the protected zone was penetrated more than .25 inches by a vehicle component other than one that is normally in contact with the windshield.

X	Y
NA	NA
NA	NA
NA	NA
NA	NA

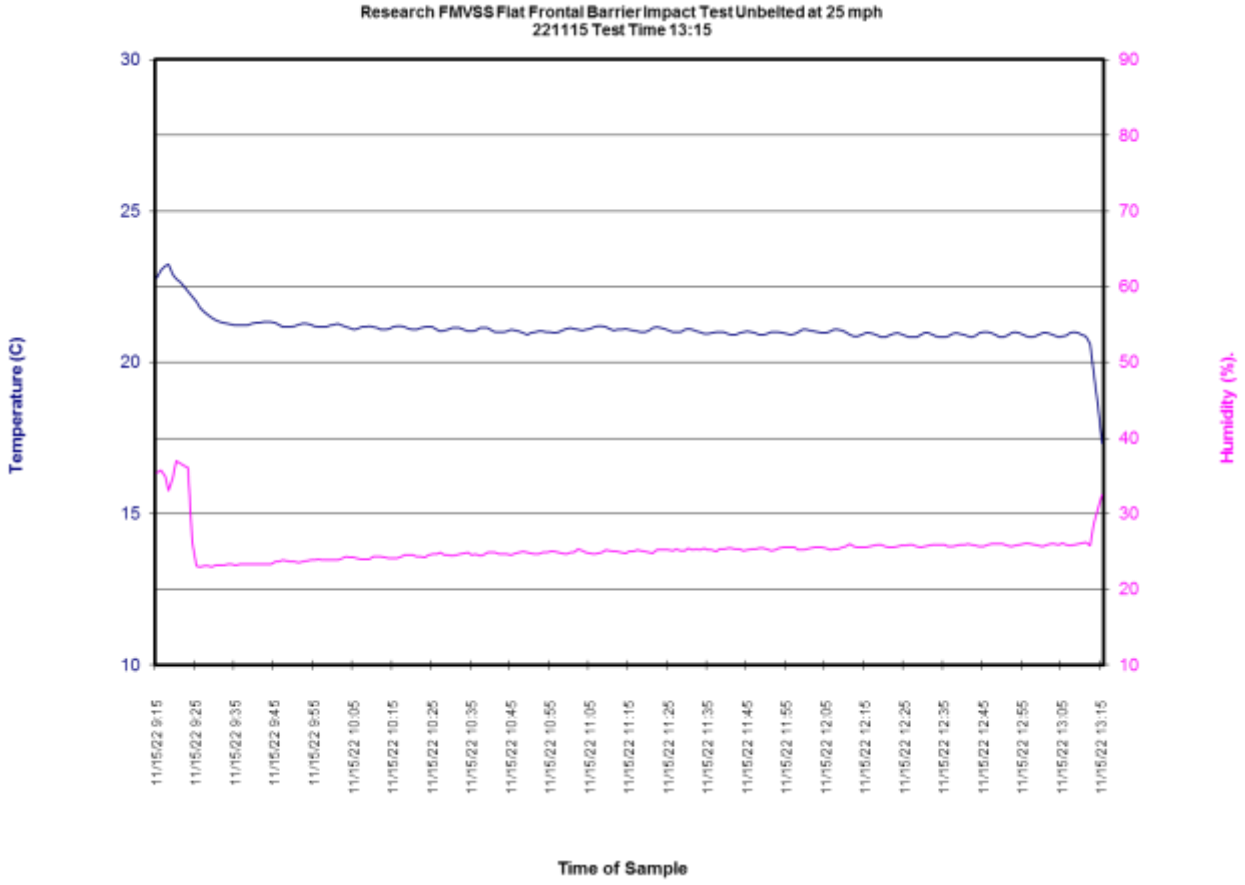
B. The inner surface of the windshield was penetrated by the hood support beneath the protected zone.

X	Y
NA	NA
NA	NA
NA	NA
NA	NA

DATA SHEET NO. 15 - DUMMY/VEHICLE TEMPERATURE STABILIZATION

Test Vehicle: 2020 Buick Encore GX

Test Program: THOR-05 Durability Evaluation Test Date: 11/15/2022



APPENDIX A

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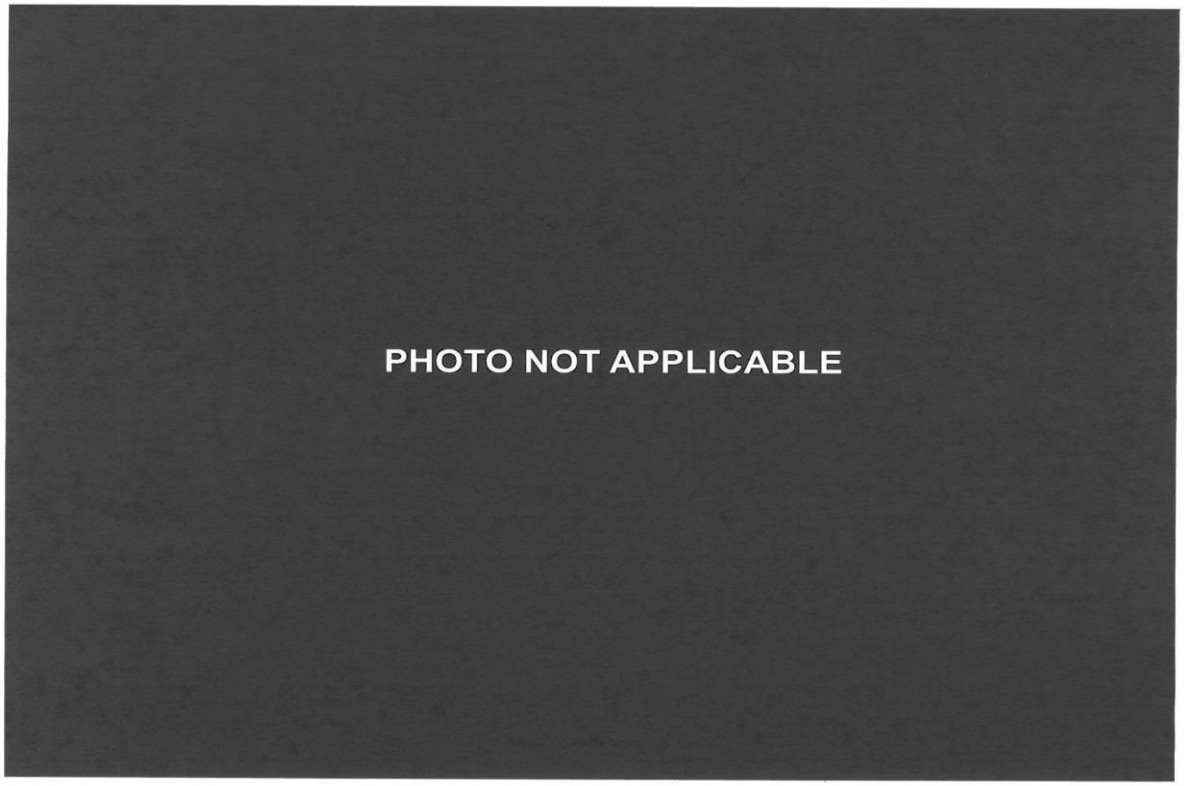
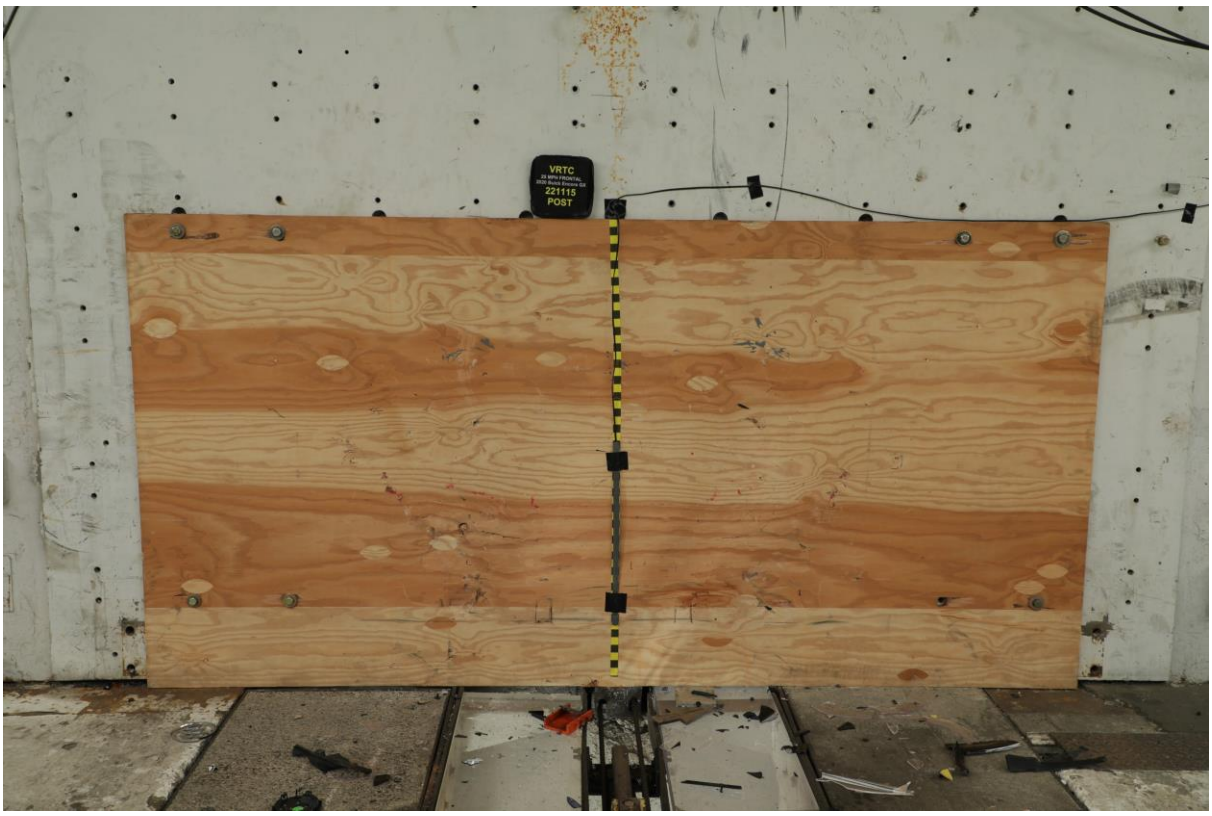


001 Load Cell Location

002 Pre-Test Flat Wall



003 Post-Test Flat Wall

004 Manufacturer's Label

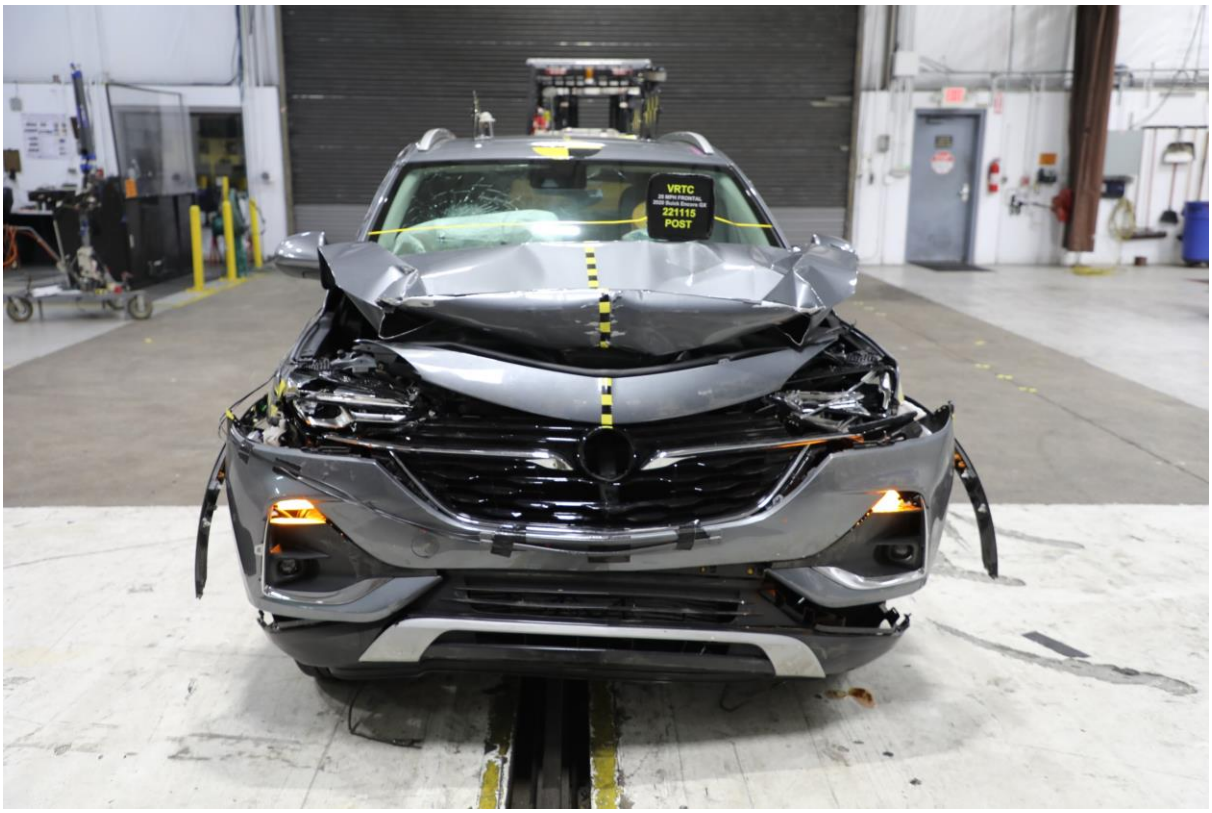
005 Tire Placard

Intentionally Left Blank

006 2022 Buick Encore GXFrontal As Delivered

007 Left Rear 3-4 View, as Received

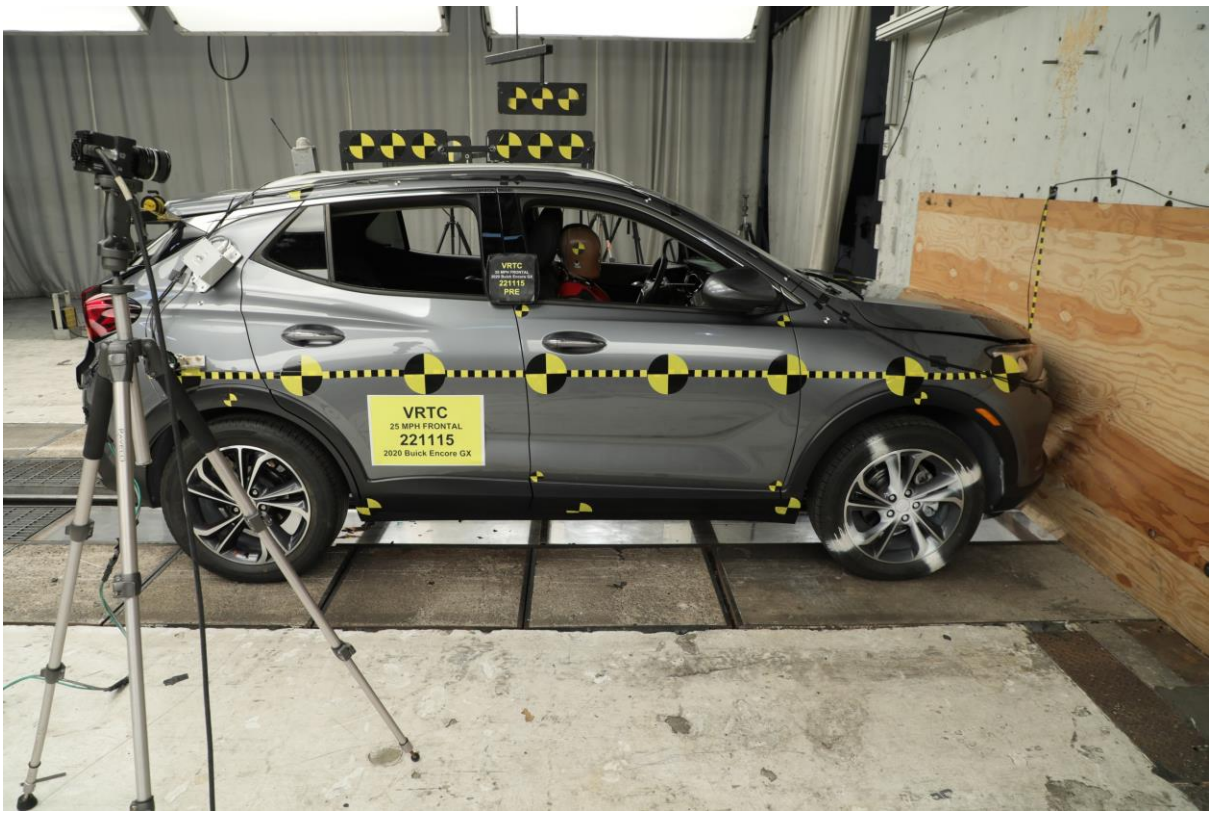
008 Pre-Test Front View of Test Vehicle



009 Post-Test Front View of Test Vehicle

010 Pre-Test Left View of Test Vehicle

011 Post-Test Left View of Test Vehicle



012 Pre-Test Right View of Test Vehicle

013 Post-Test Right View of Test Vehicle

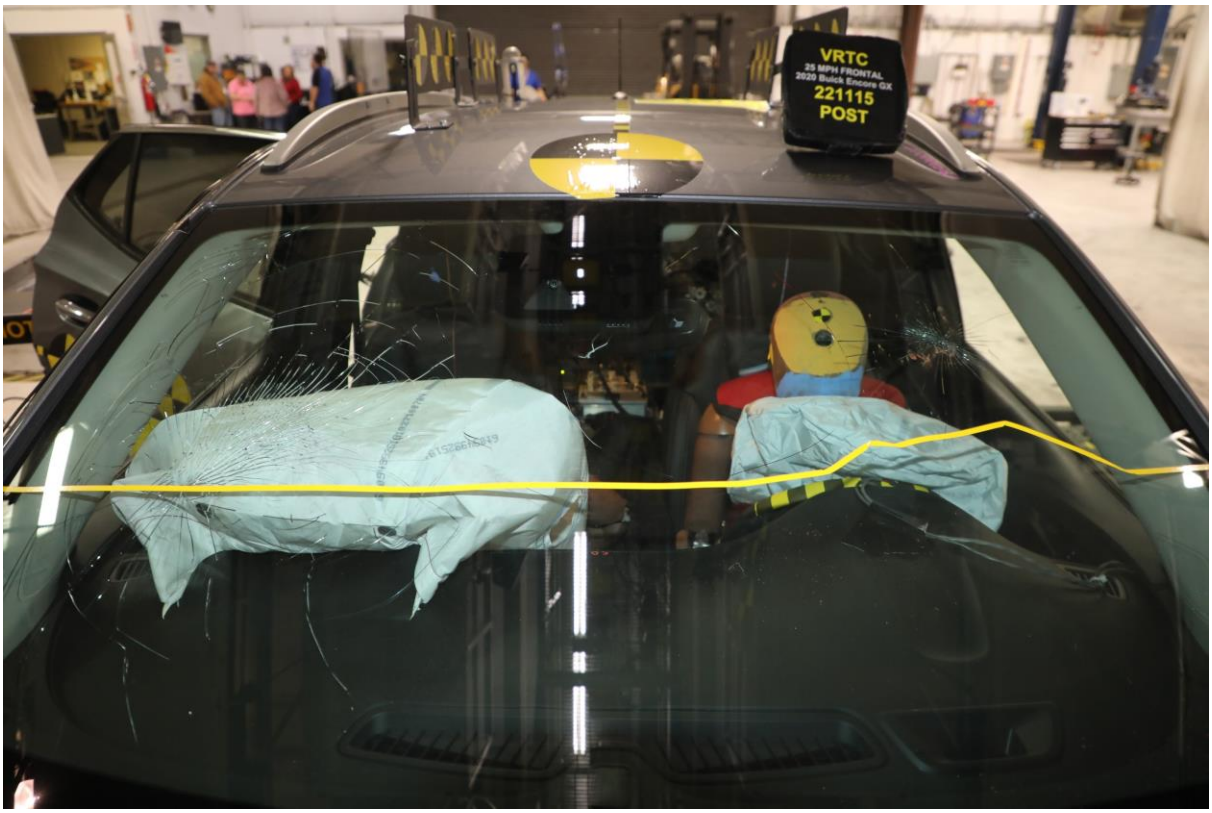
014 Pre-Test Right Front 3-4 View

015 Post-Test Right Front 3-4 View

016 Pre-Test Left Rear 3-4 View

017 Post-Test Left Rear 3-4 View

018 Pre-Test Windshield View



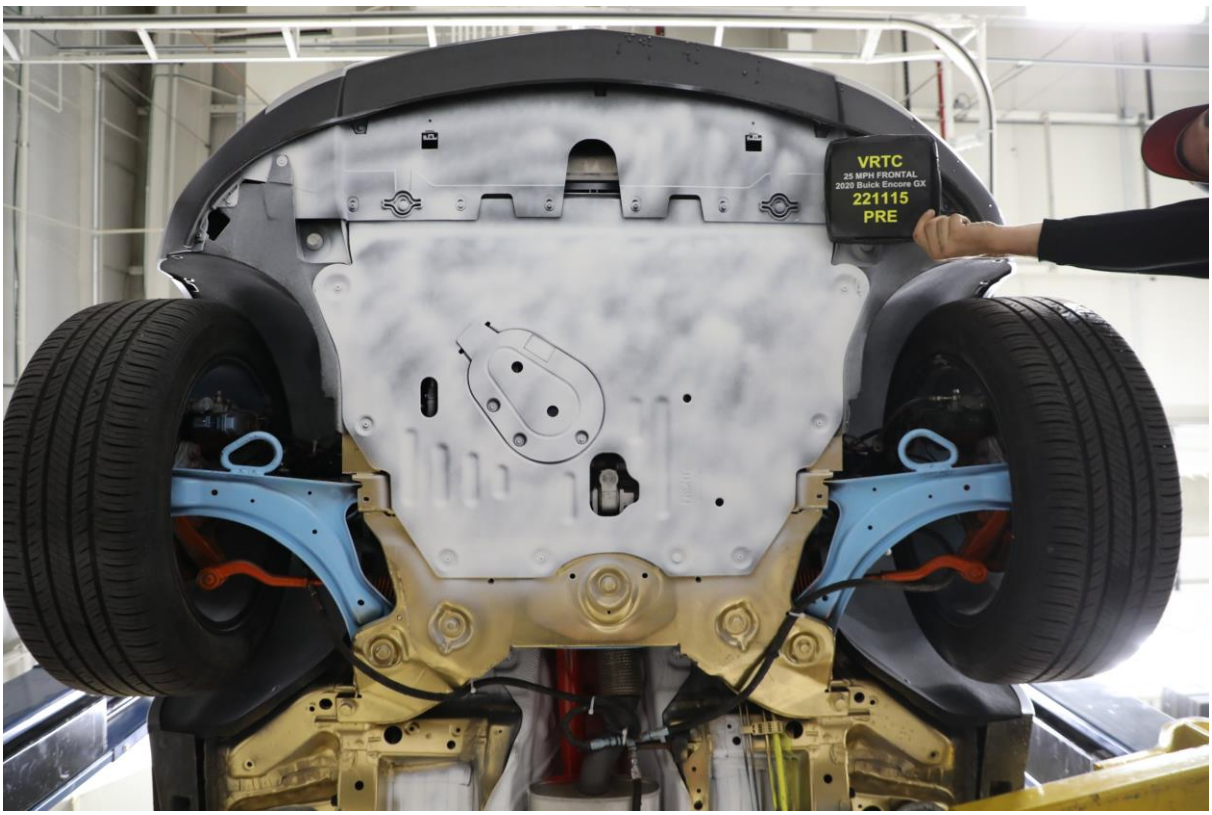
019 Post-Test Windshield View

020 Pre-Test Engine Compartment View

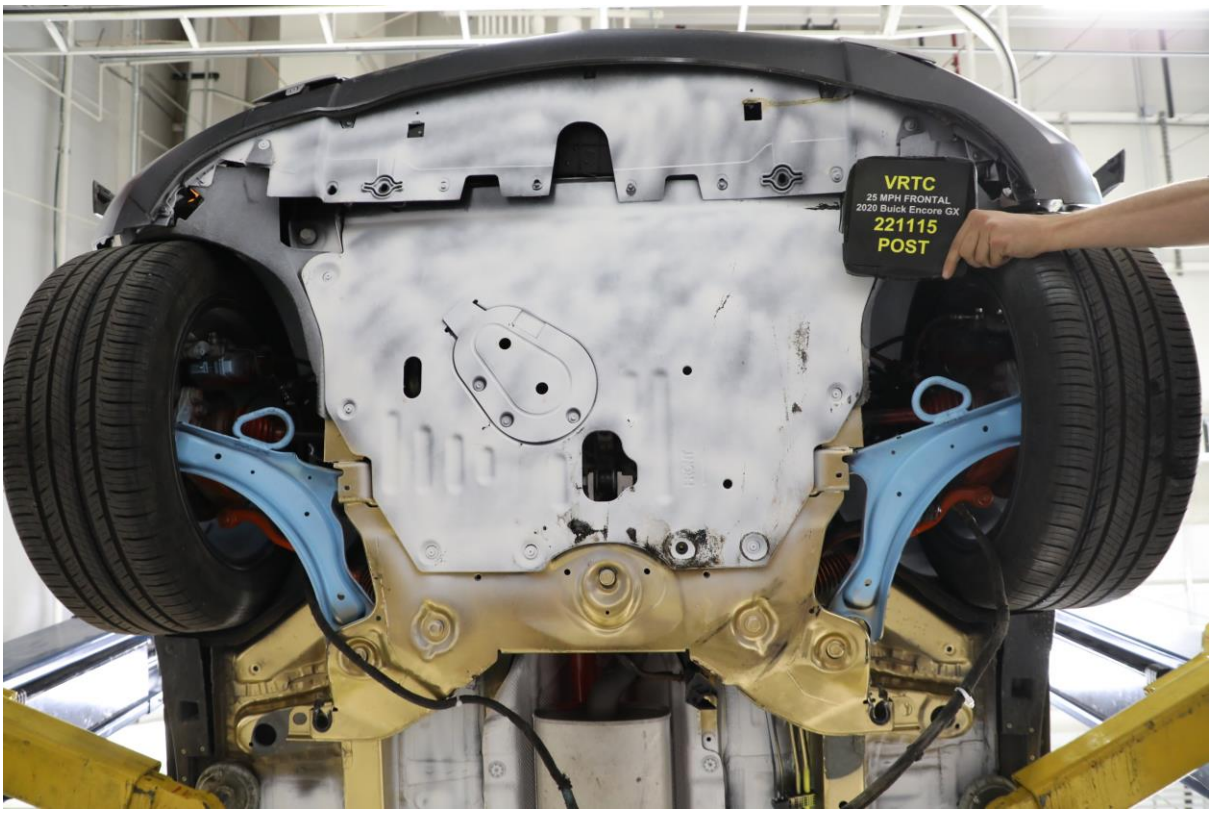
021 Post-Test Engine Compartment View

022 Pre-Test Fuel Filler Cap View

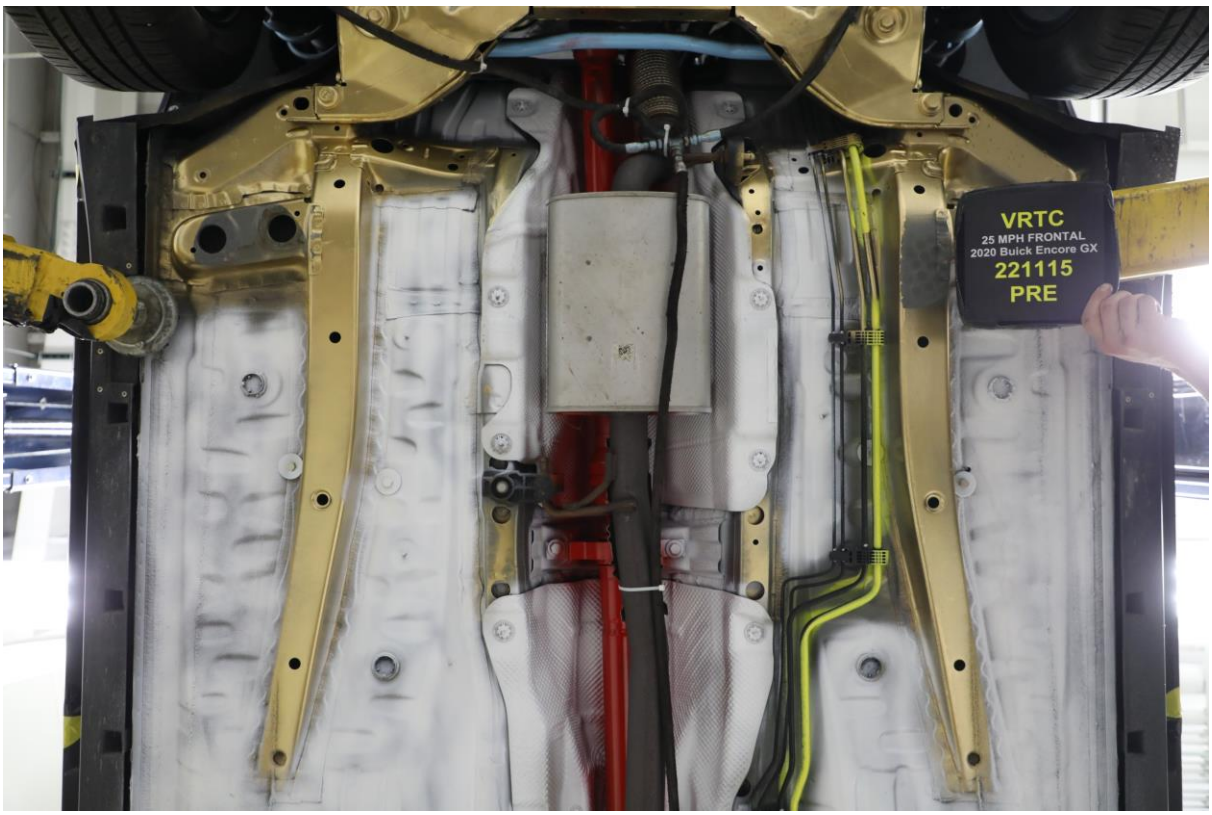
023 Post-Test Fuel Filler Cap View



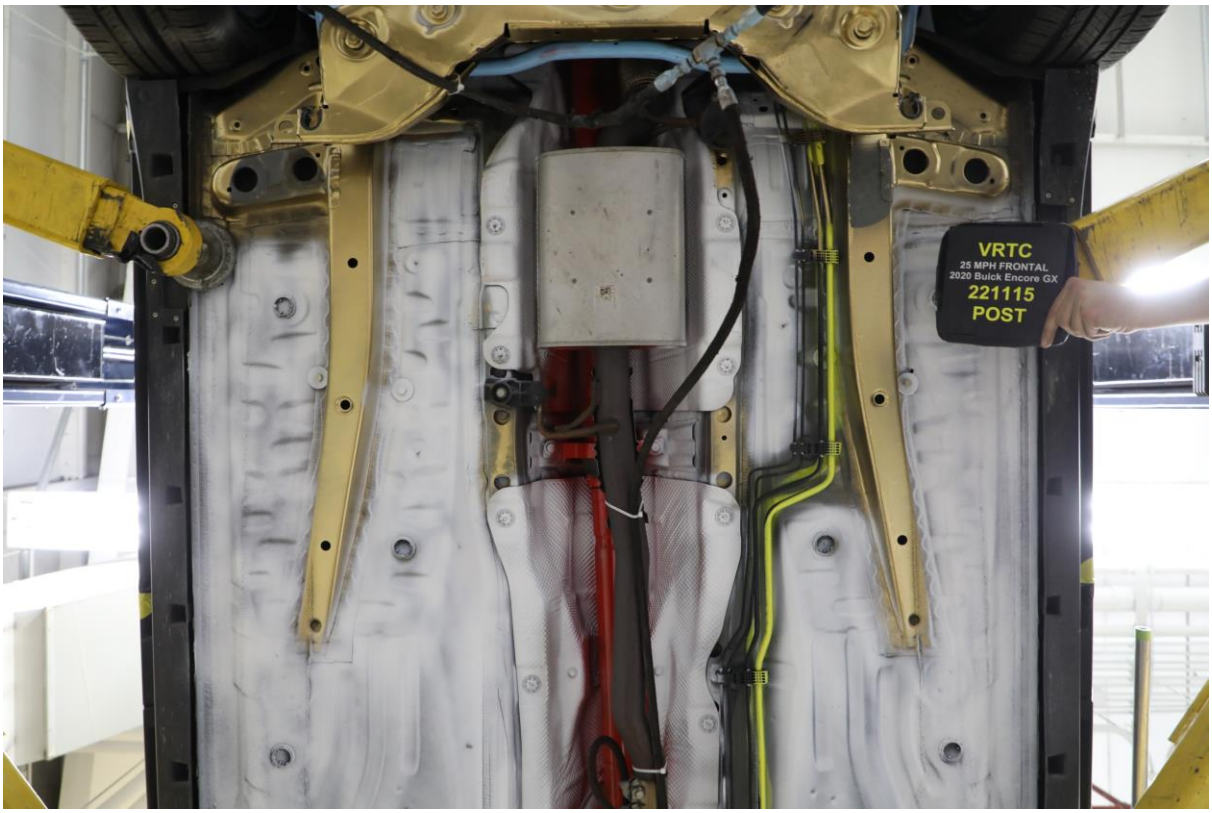
024 Pre-Test Front Underbody View



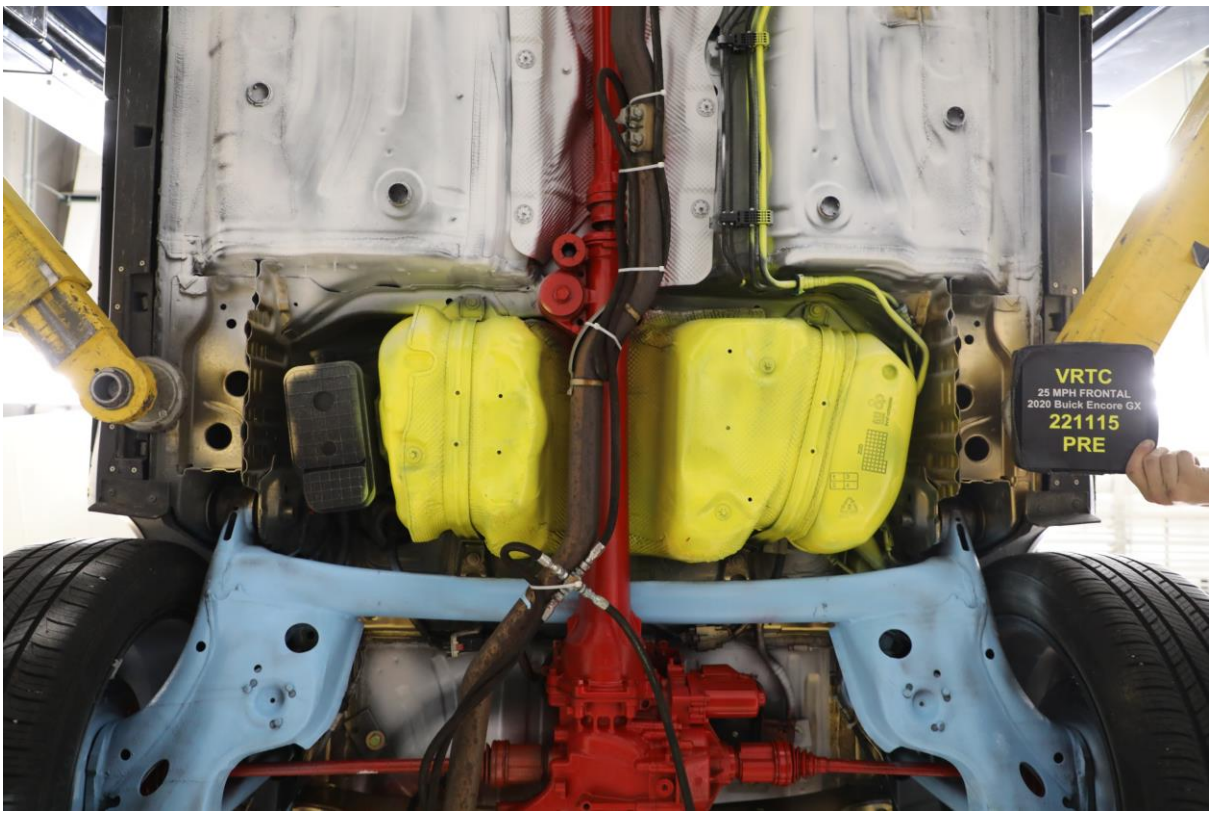
025 Post-Test Front Underbody View



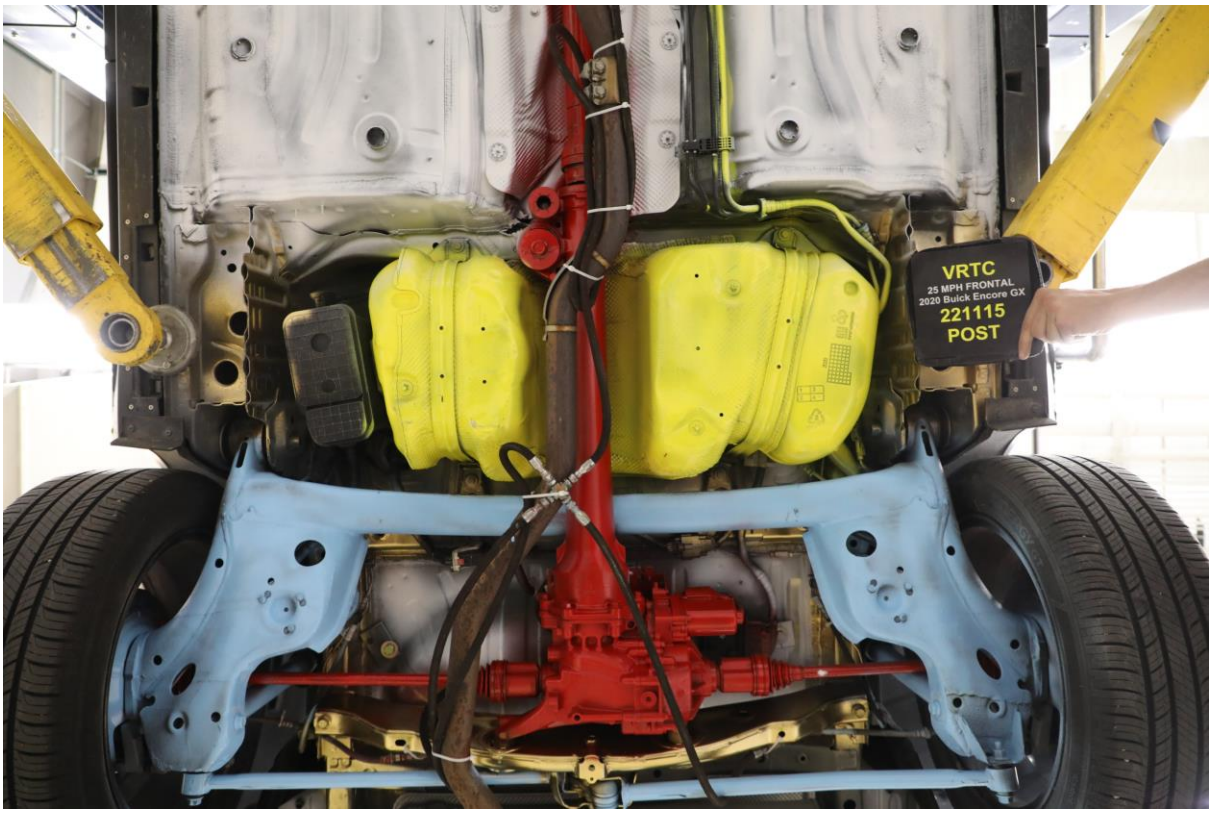
025a Pre-Test Mid Front Underbody View



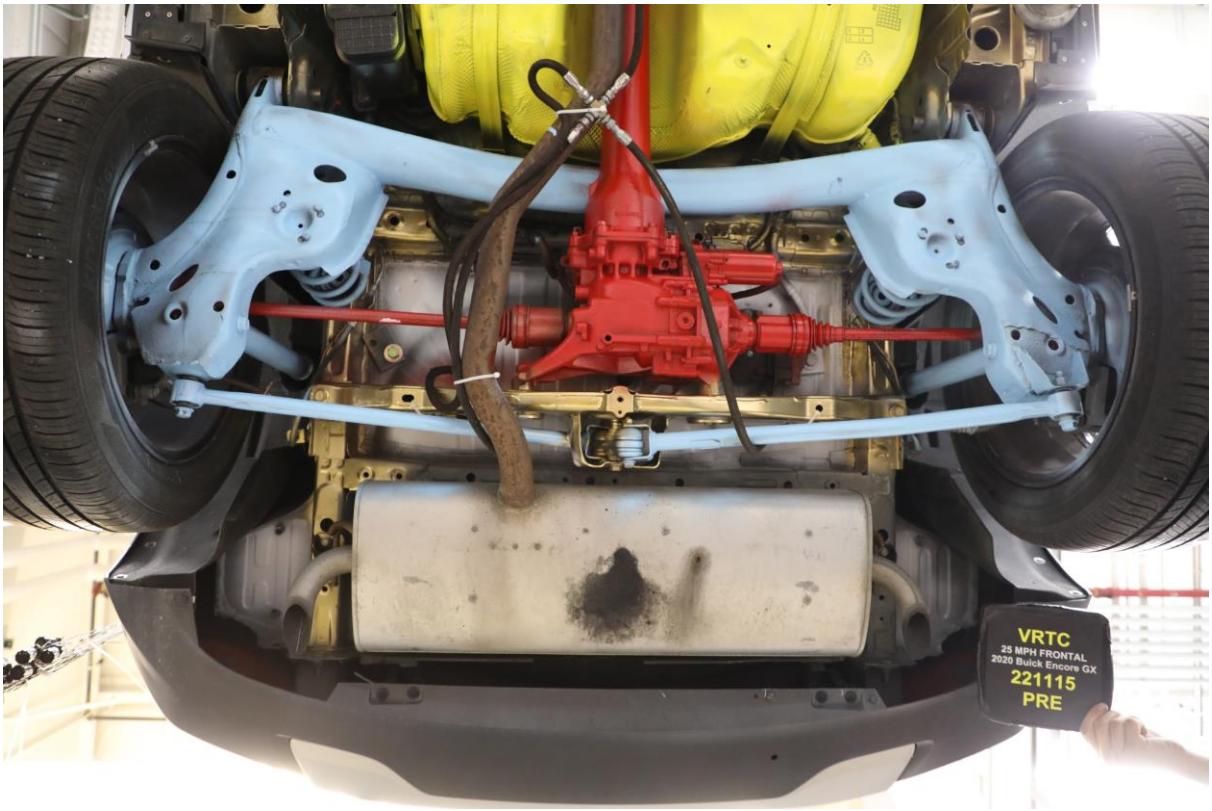
025b Post-Test Mid Front Underbody View



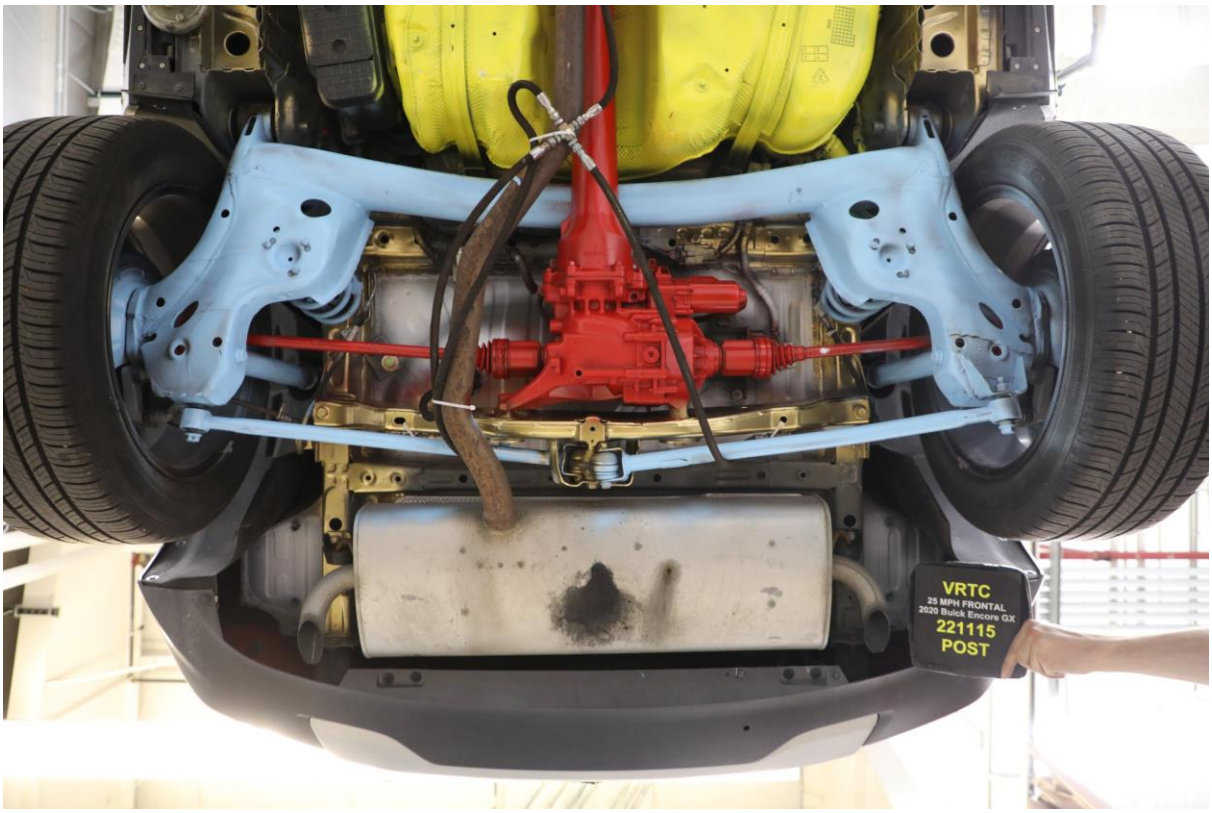
025c Pre-Test Mid Rear Underbody View



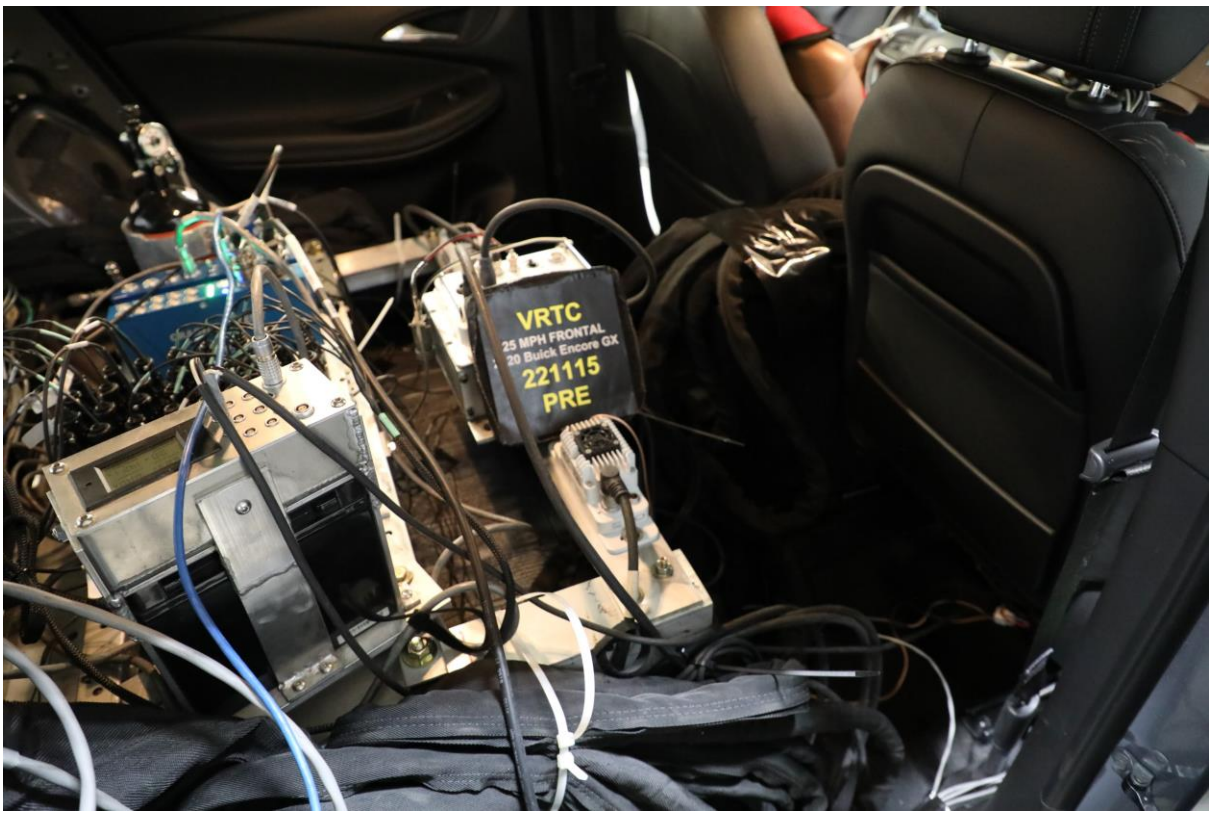
025d Post-Test Mid Rear Underbody View



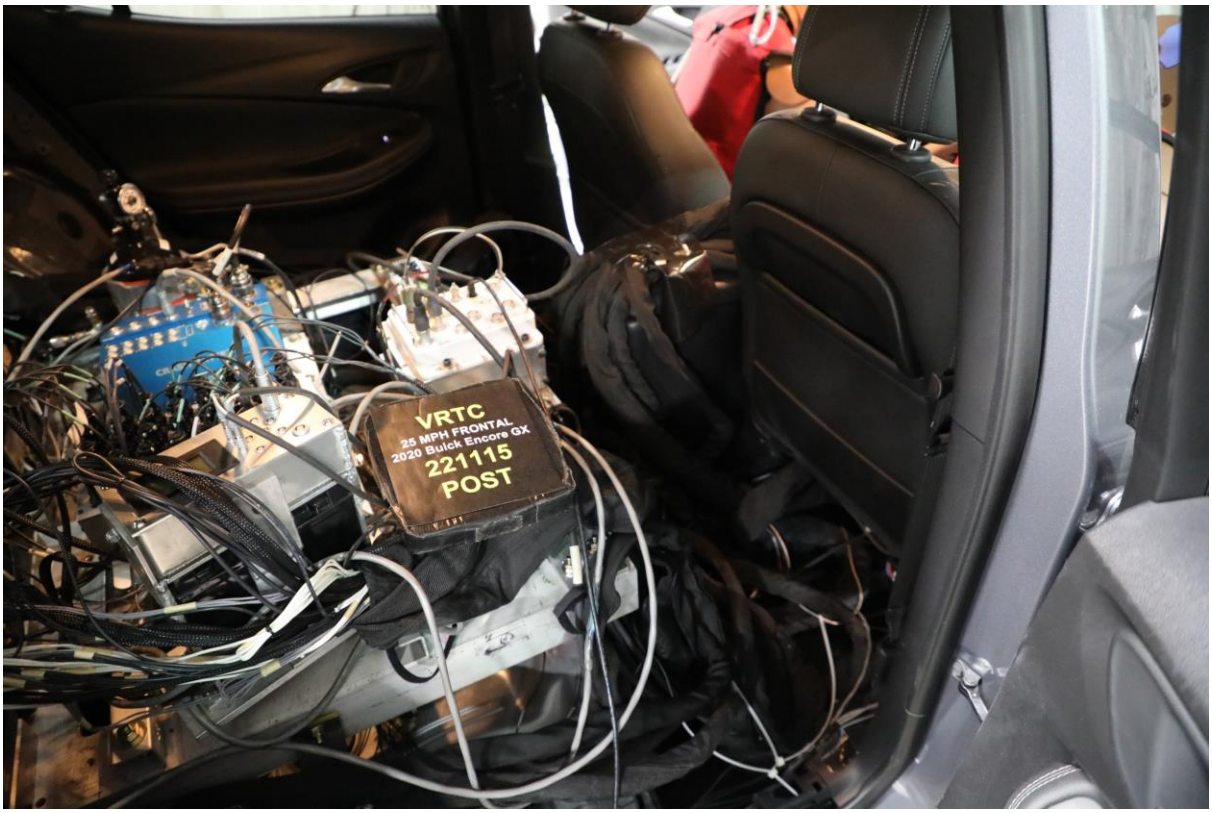
026 Pre-Test Rear Underbody View



027 Post-Test Rear Underbody View

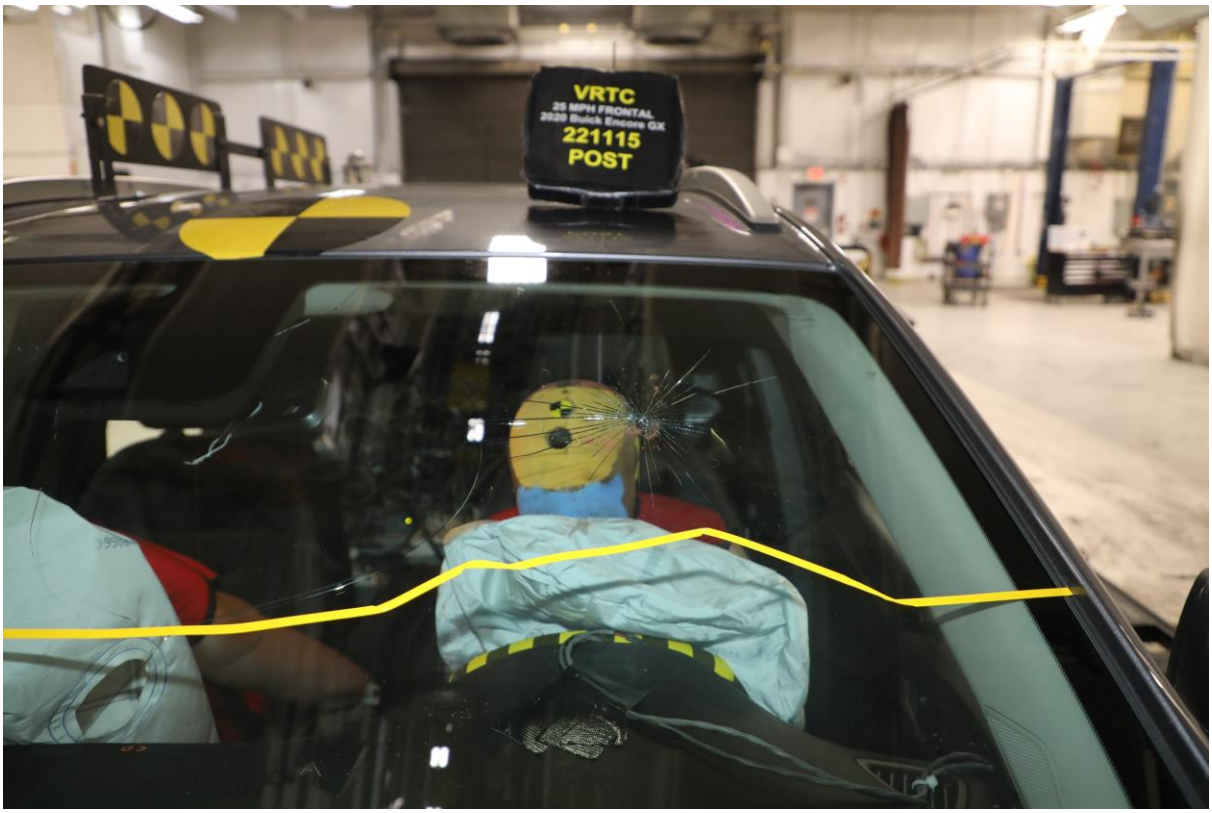


028 Pre-Test Dummy Cable Routing



029 Post-Test Dummy Cable Routing

030 Pre-Test Driver Dummy Front View

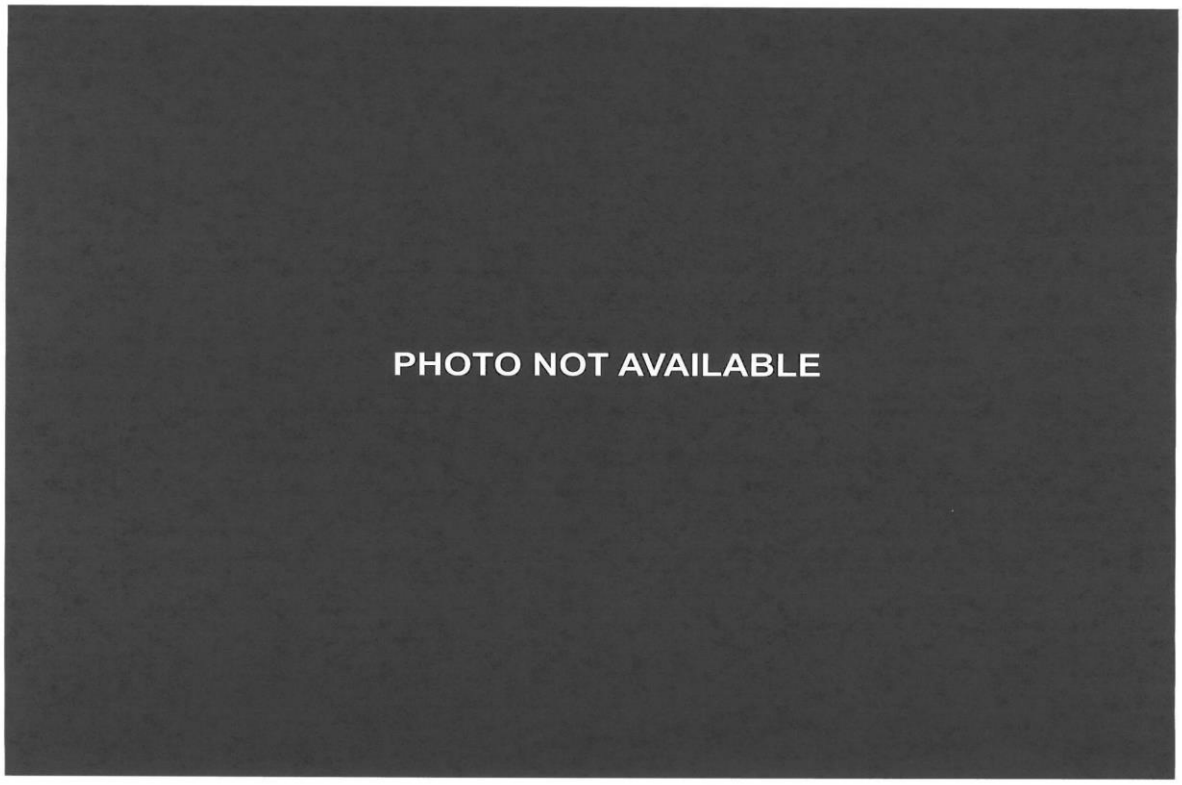


031 Post-Test Driver Dummy Front View

032 Pre-Test Driver Dummy Window View

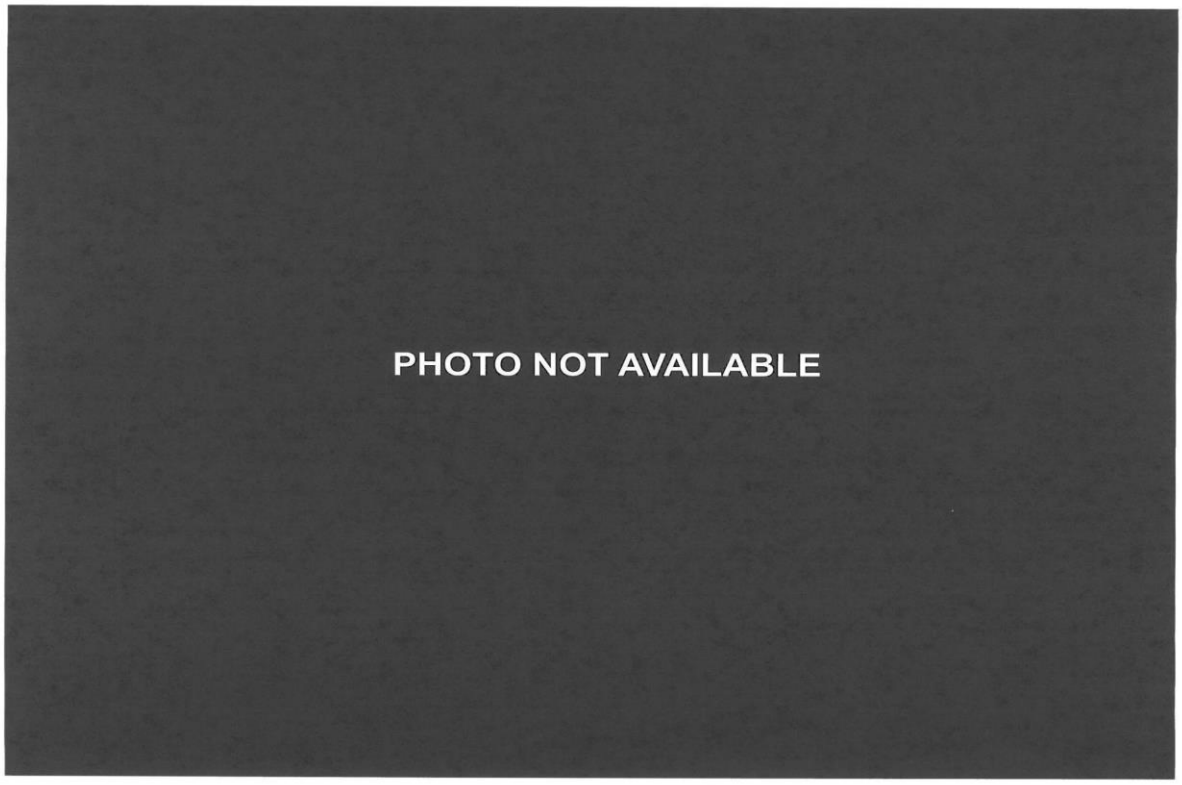
033 Post-Test Driver Dummy Window View

034 Pre-Test Driver Dummy and Vehicle Interior View

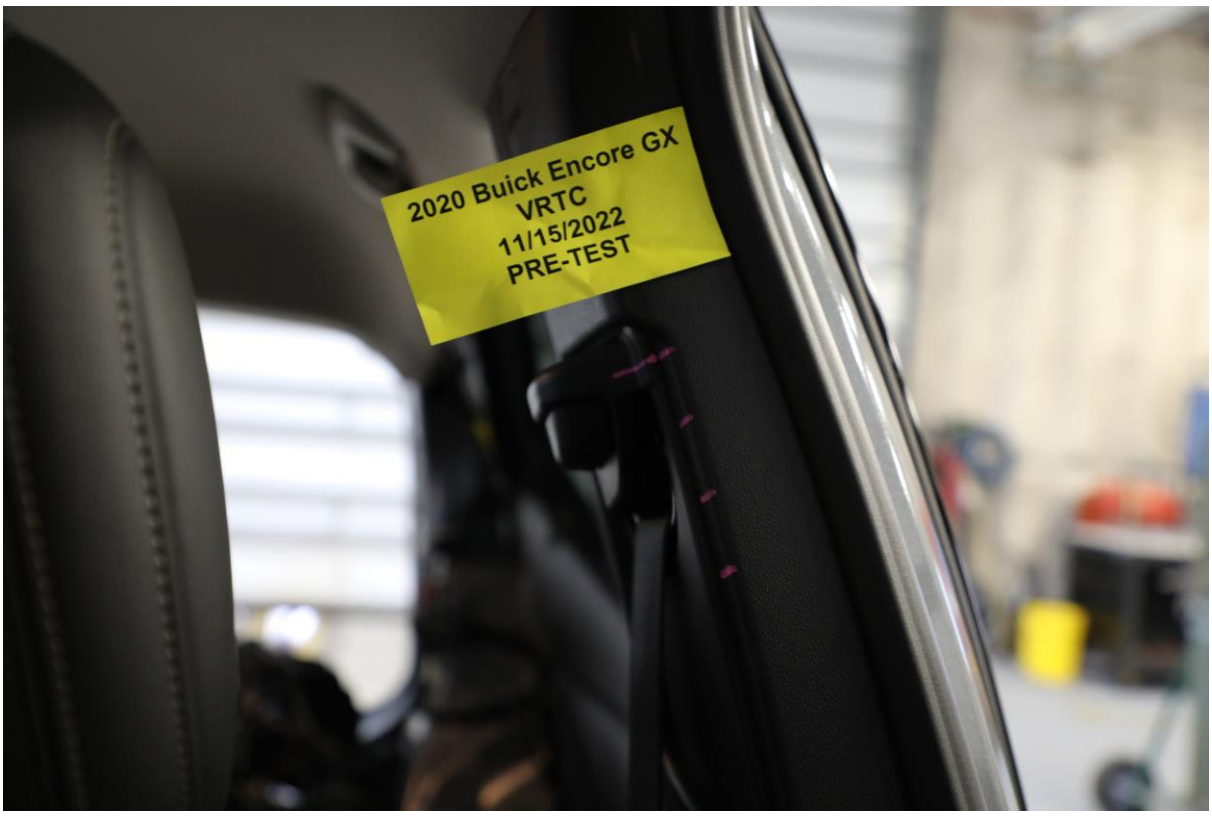


035 Post-Test Driver Dummy and Vehicle Interior View

036 Pre-Test Driver's Seat Fore-Aft Markings



037 Post-Test Driver's Seat Fore-Aft Markings

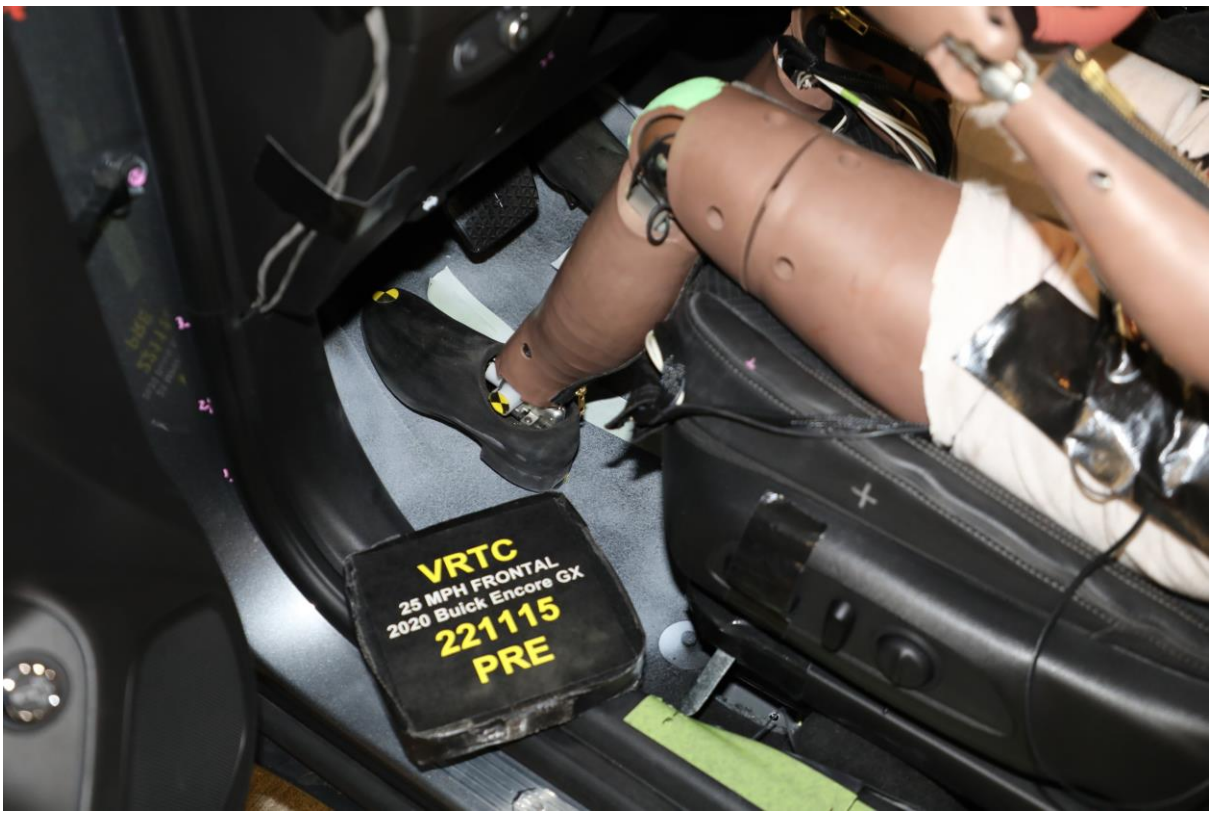


038 Pre-Test View of Belt Anchorage for Driver Dummy

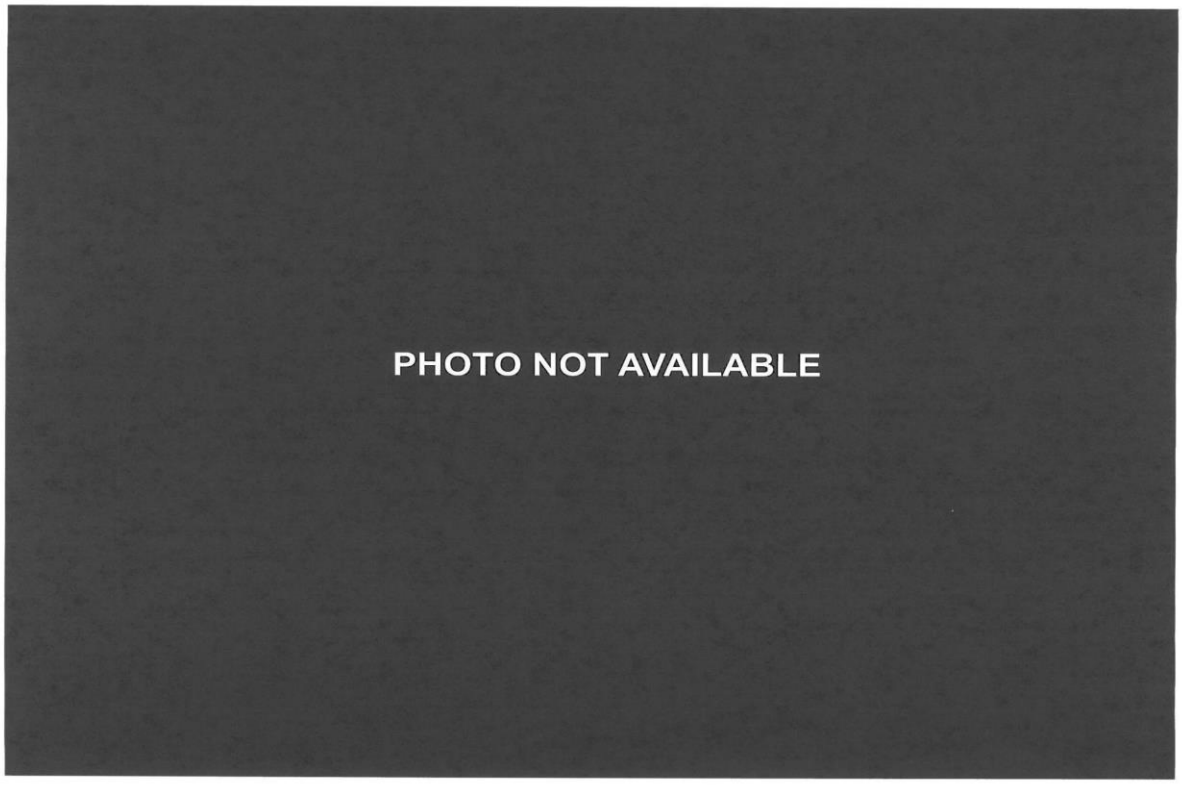
039 Post-Test View of Belt Anchorage for Driver Dummy

040 Pre-Test View of Belt Buckle and Latch Plate for Driver Dummy

041 Post-Test View of Belt Buckle and Latch Plate for Driver Dummy



042 Pre-Test Driver Dummy Feet



043 Post-Test Driver Dummy Feet

044 Pre-Test Driver's Side Knee Bolster

045 Post-Test Driver's Side Knee Bolster

046 Pre-Test Driver's Side Floorpan

047 Post-Test Driver's Side Floorpan

048 Post-Test Driver Dummy Face

049 Post-Test Driver Dummy Contact with Airbag

050 Post-Test Driver Dummy Contact with Headrest

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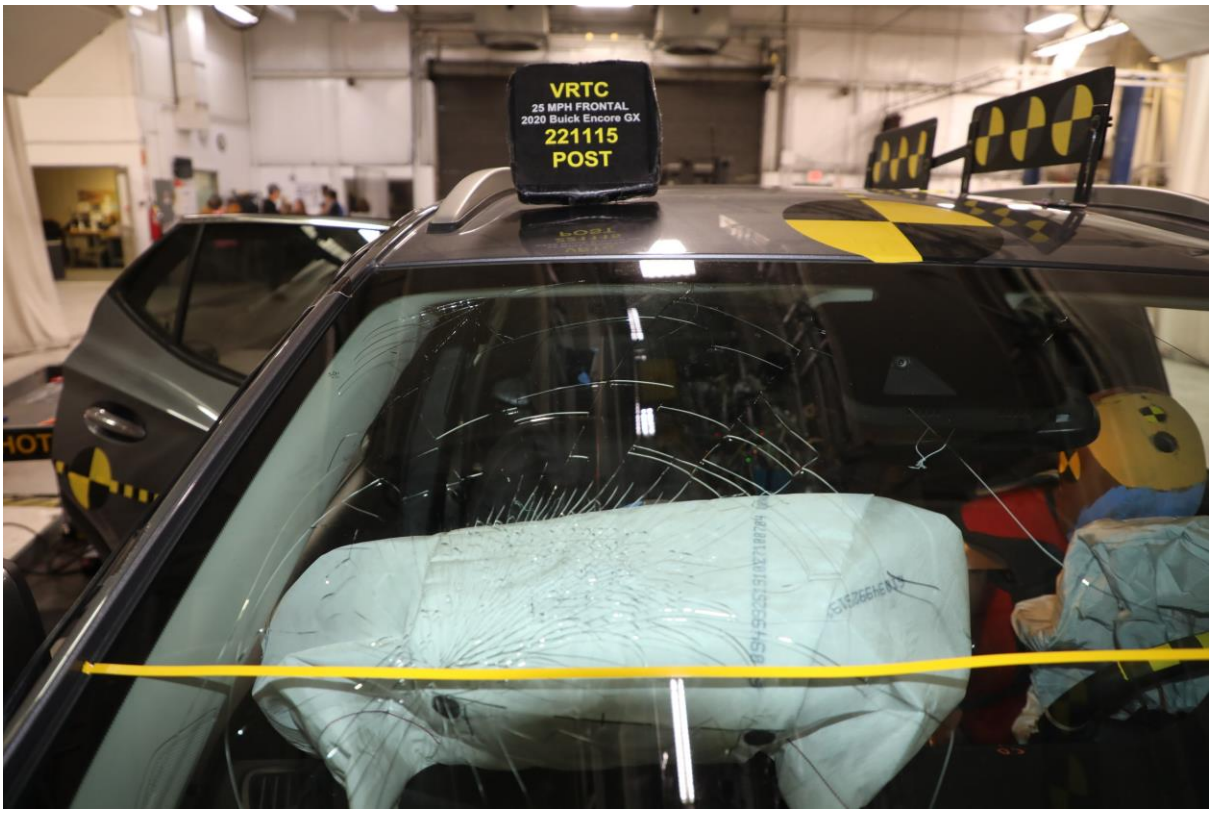
051 Pre-Test View of the Steering Wheel

052 Post-Test View of the Steering Wheel

53 Pre-Test Passenger Dummy Front View



054 Post-Test Passeger Dummy Front View

055 Pre-Test Passenger Dummy Window View

056 Post-Test Passenger Dummy Window View

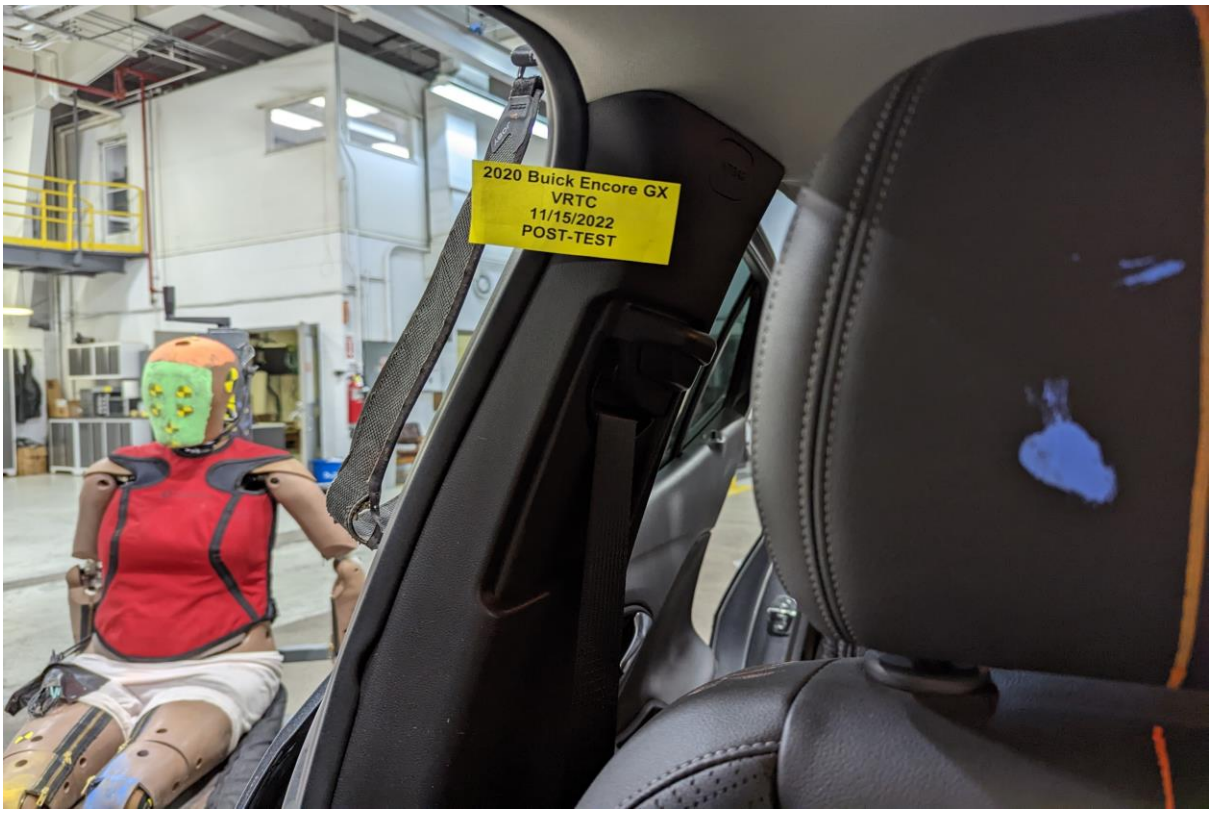
057 Pre-Test Passenger Dummy and Vehicle Interior View

058 Post-Test Passenger Dummy and Vehicle Interior View

059 Pre-Test Passenger's Seat Fore-Aft Markings

060 Post-Test Passenger's Seat Fore-Aft Markings

061 Pre-Test View of Belt Anchorage for Passenger Dummy



062 Post-Test View of Belt Anchorage for Passenger Dummy

063 Pre-Test View of Belt Buckle and Latch Plate for Passenger Dummy

064 Post-Test View of Belt Buckle and Latch Plate for Passenger Dummy

065 Pre-Test Passenger Dummy Feet

066 Post-Test Passenger Dummy Feet

067 Pre-Test Passenger's Side Knee Bolster

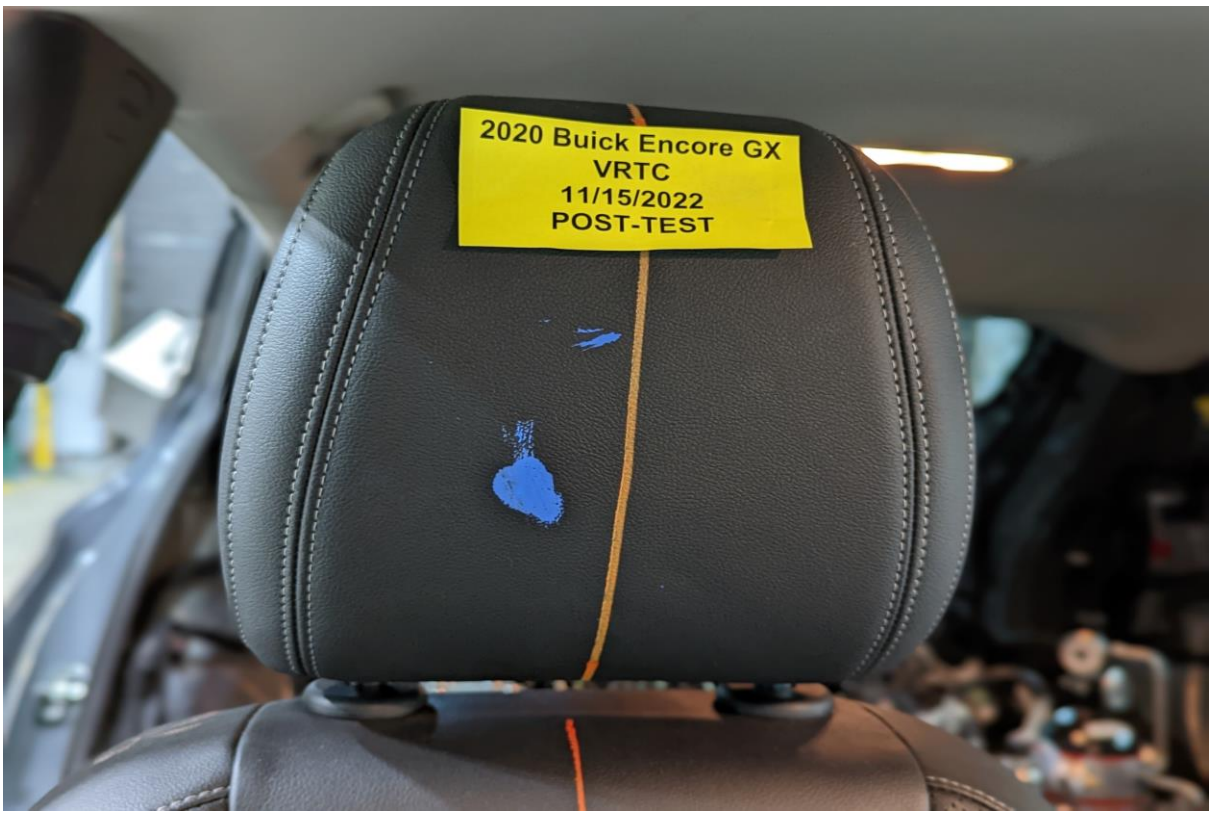
068 Post-Test Passenger's Side Knee Bolster

069 Pre-Test Passenger's Side Floorpan

070 Post-Test Passenger's Side Floorpan

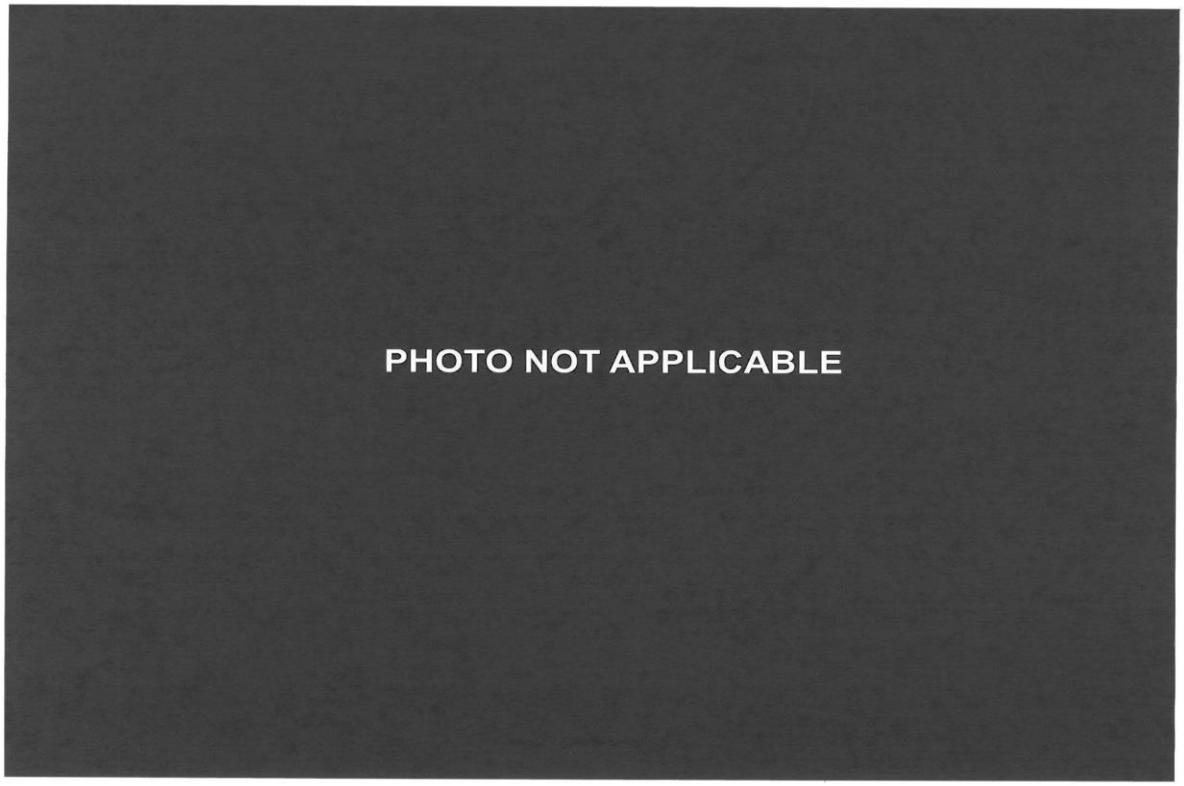
071 Post-Test Passenger Dummy Face

072 Post-Test Passenger Dummy Contact with Airbag

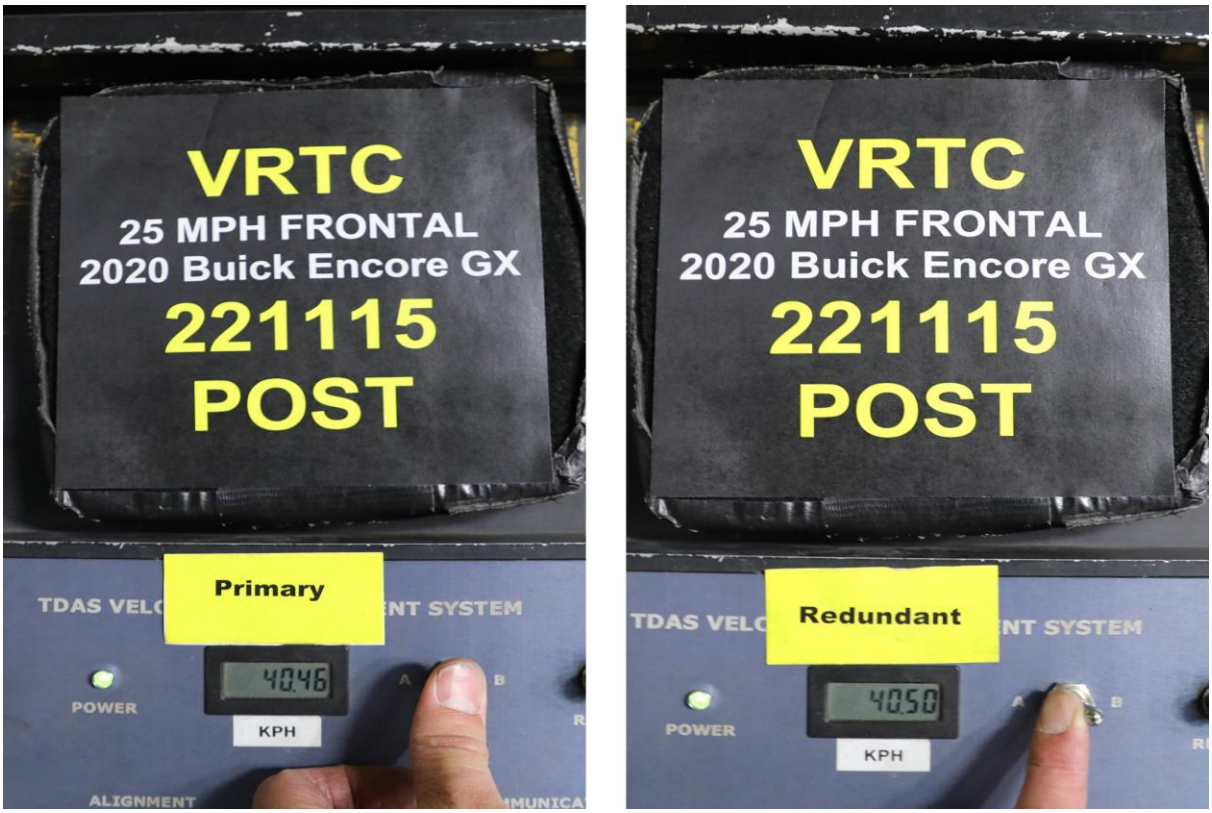


073 Post-Test Passenger Dummy Contact with Headrest

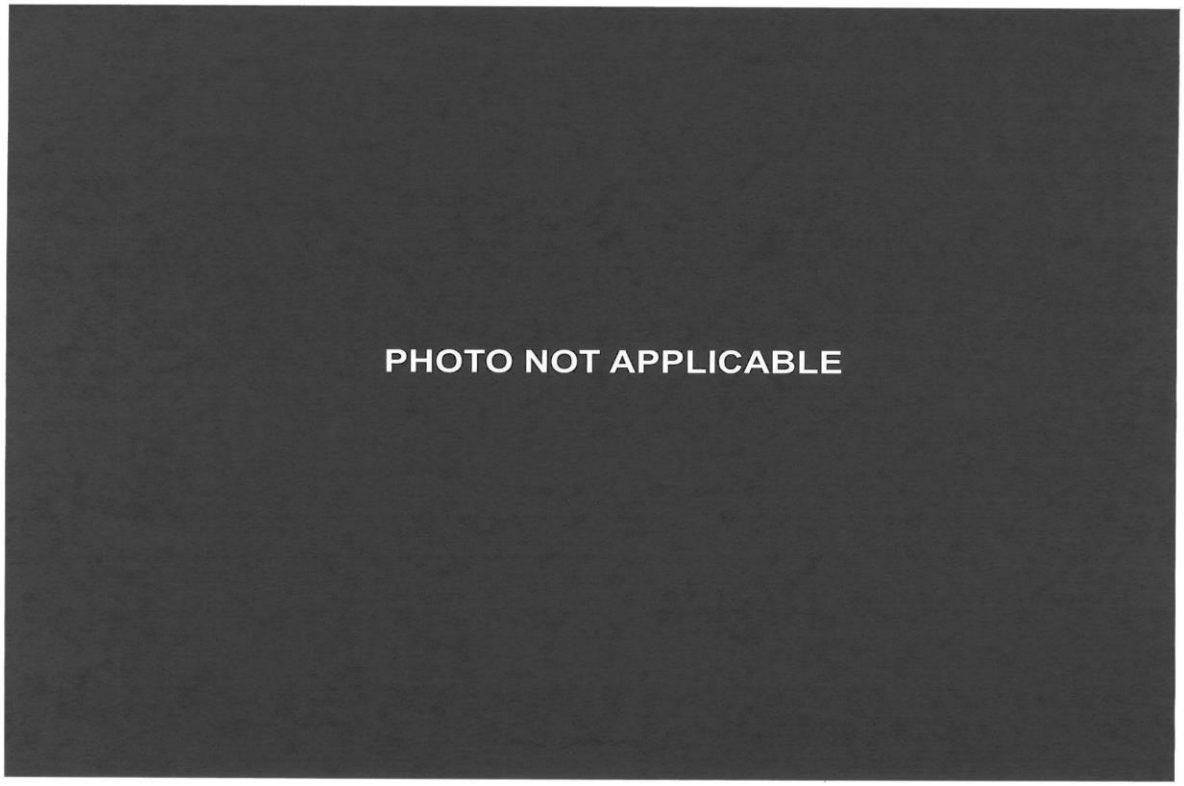
074 Photograph of Ballast Installed in Vehicle



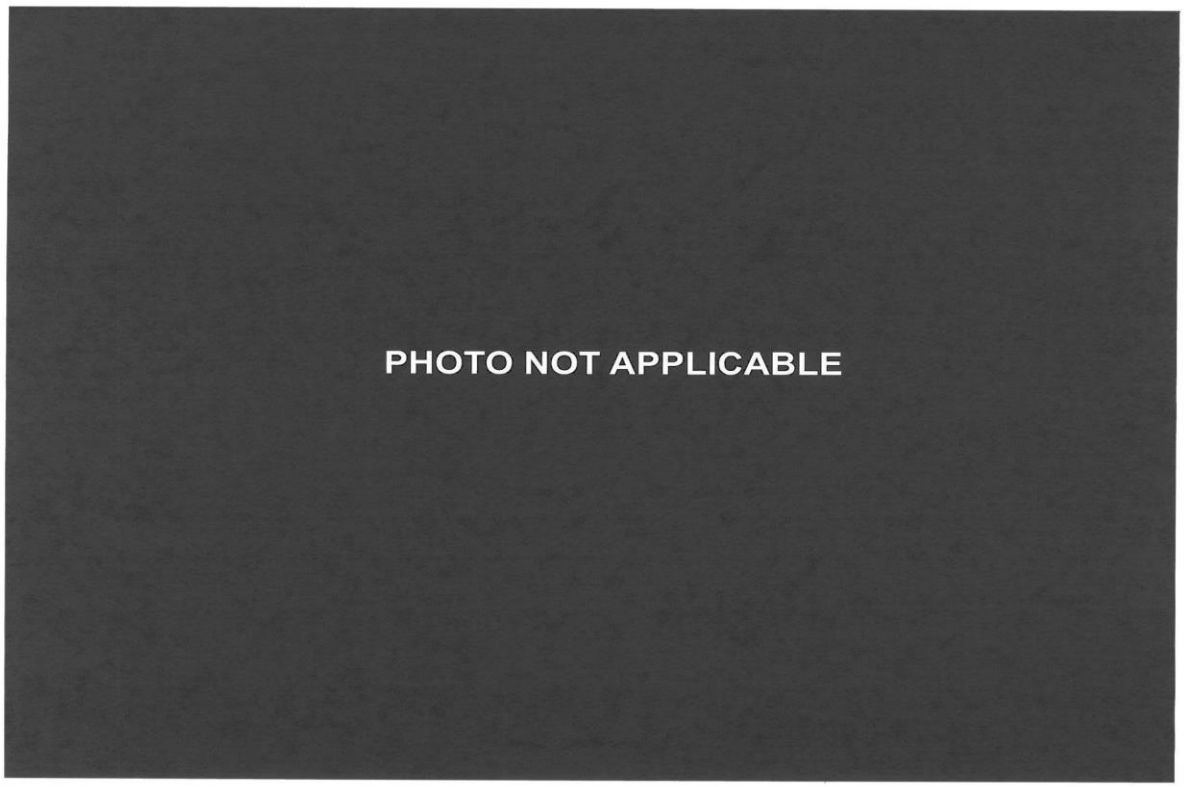
075 Post-Test Stoddard Spillage Location View



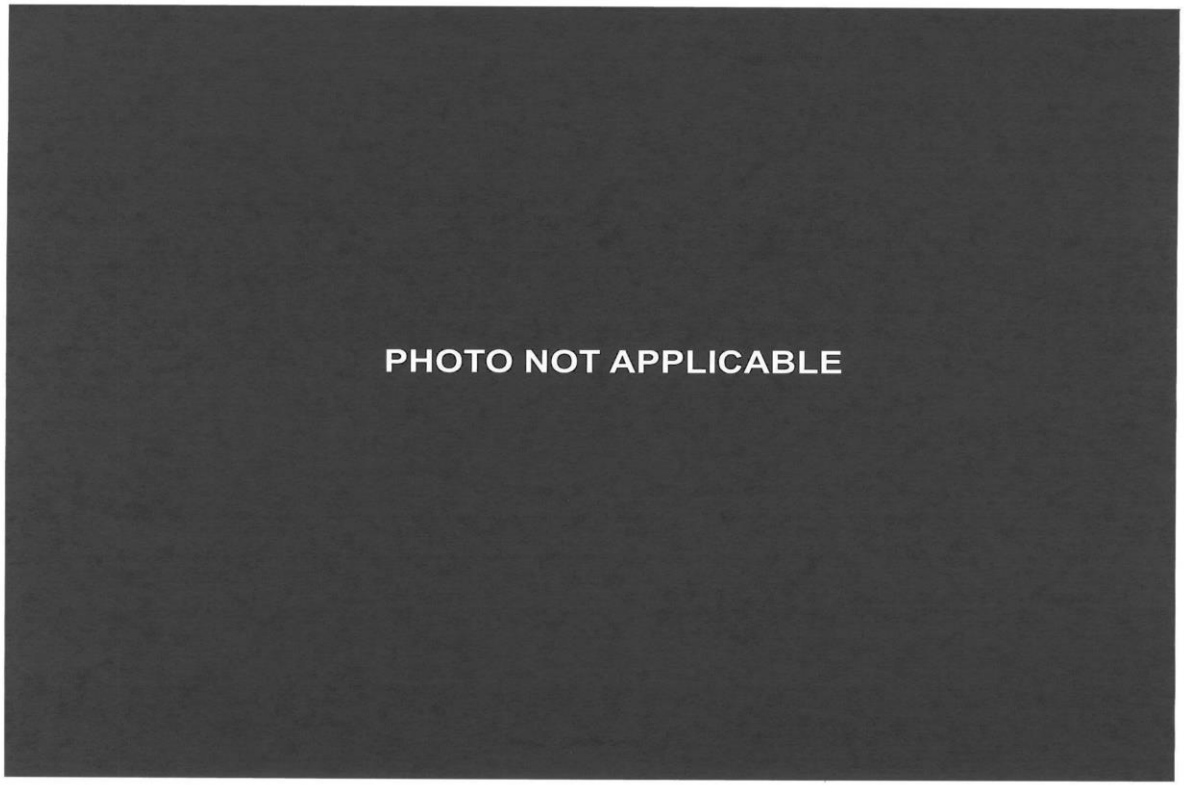
076 Post-Test Speed Trap Read out



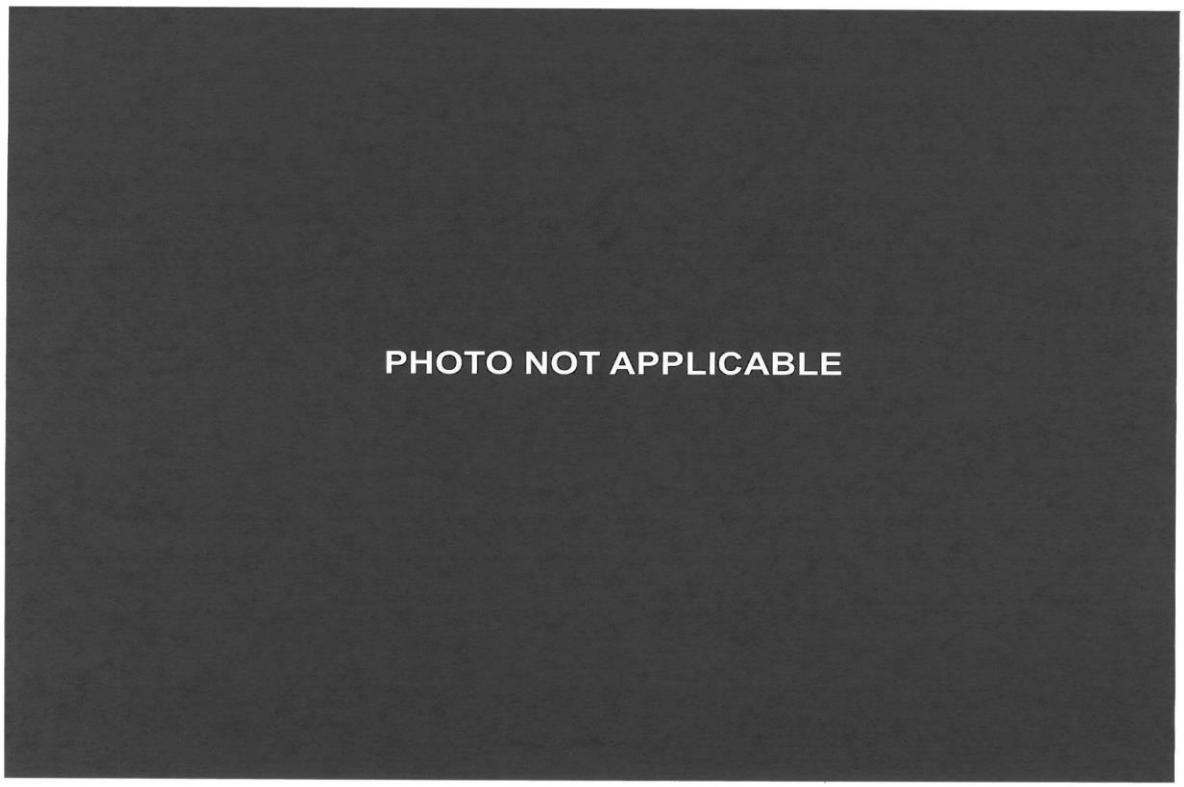
077 Vehicle at 0º on Static Rollover Device



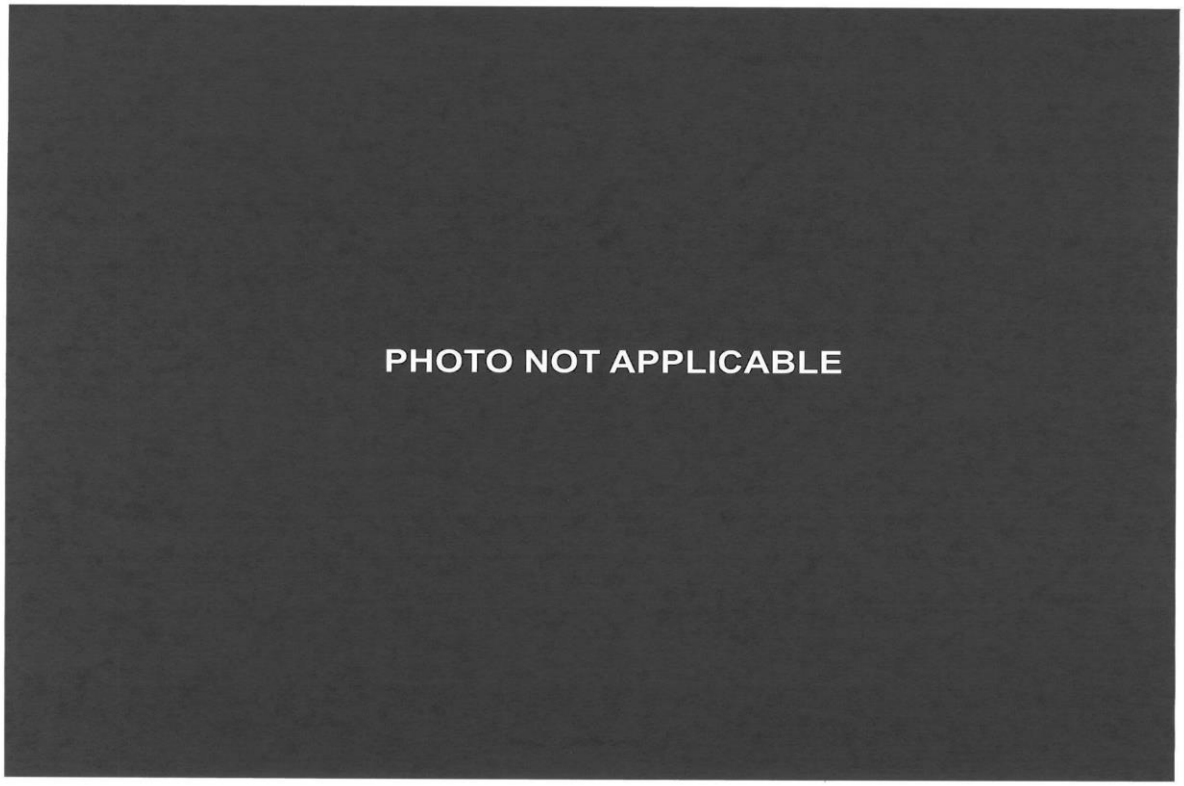
078 Vehicle at 90º on Static Rollover Device



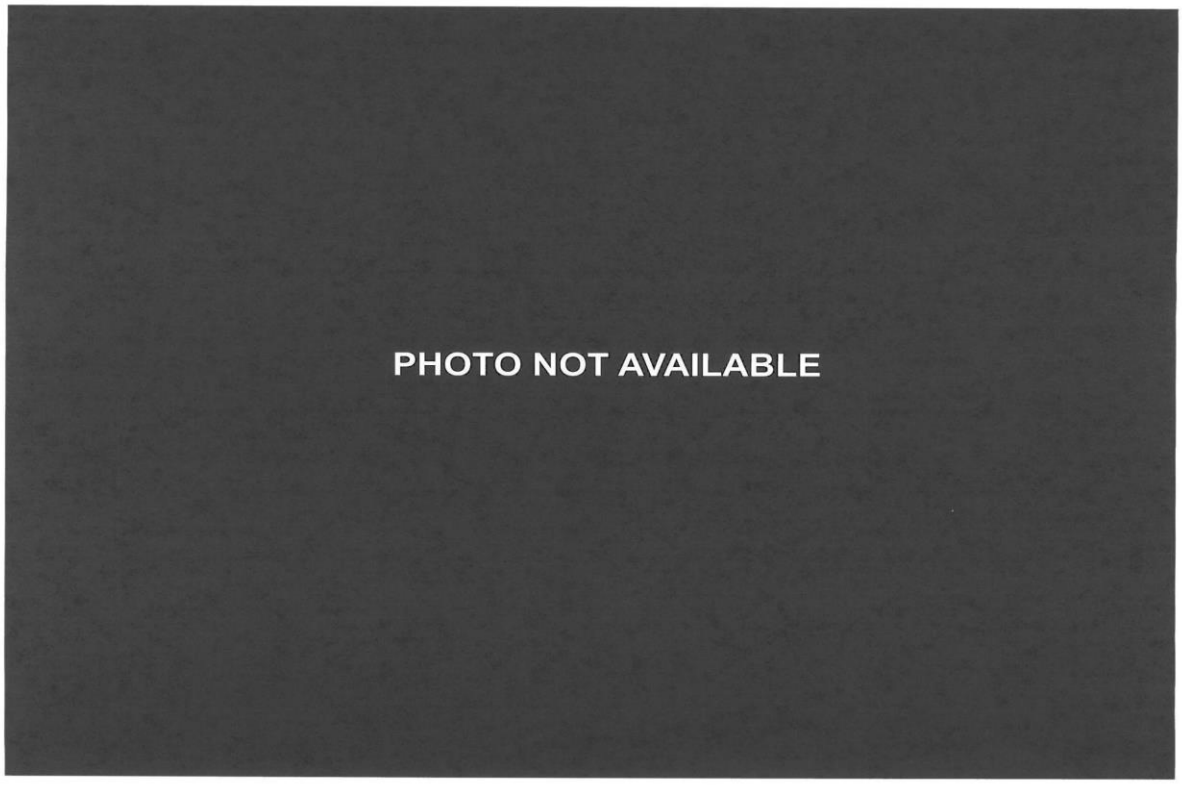
079 Vehicle at 180º on Static Rollover Device



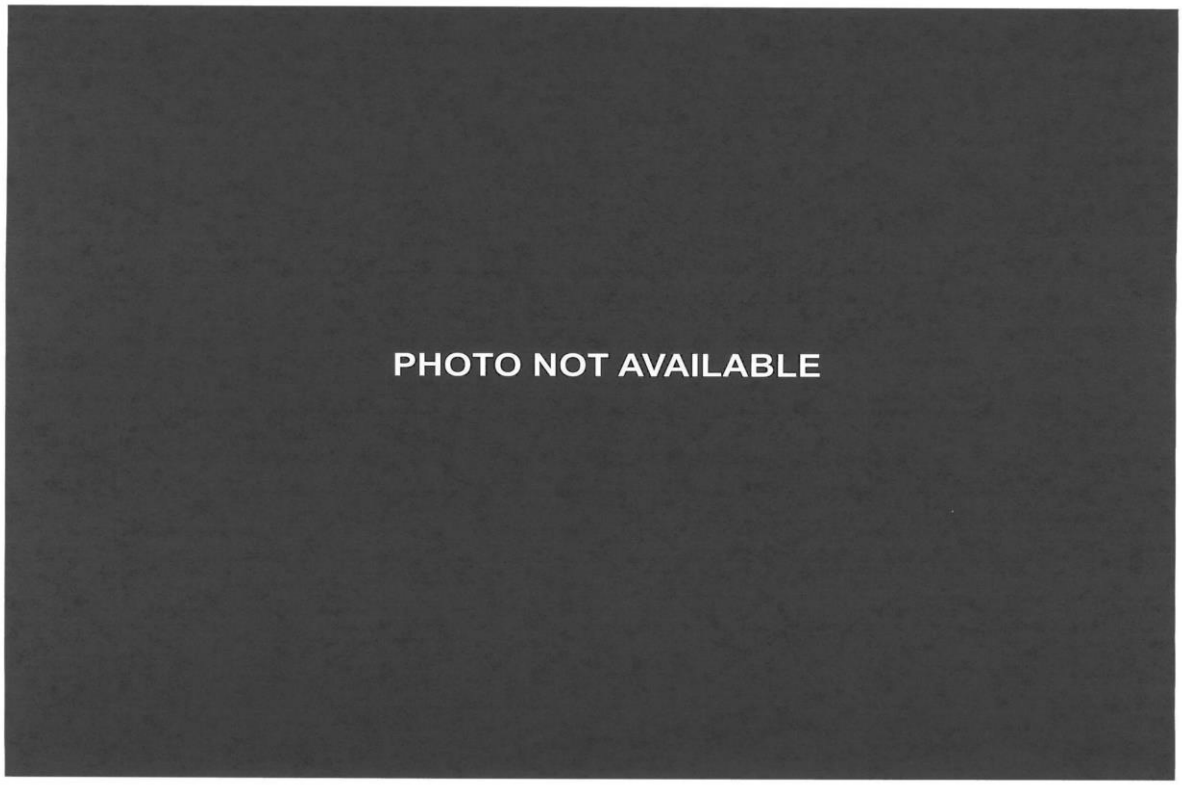
080 Vehicle at 270º on Static Rollover Device



081 Vehicle at 360º on Static Rollover Device



082 2022 Buick Encore GX Frontal Impact Event



083 Monroney Label Photograph

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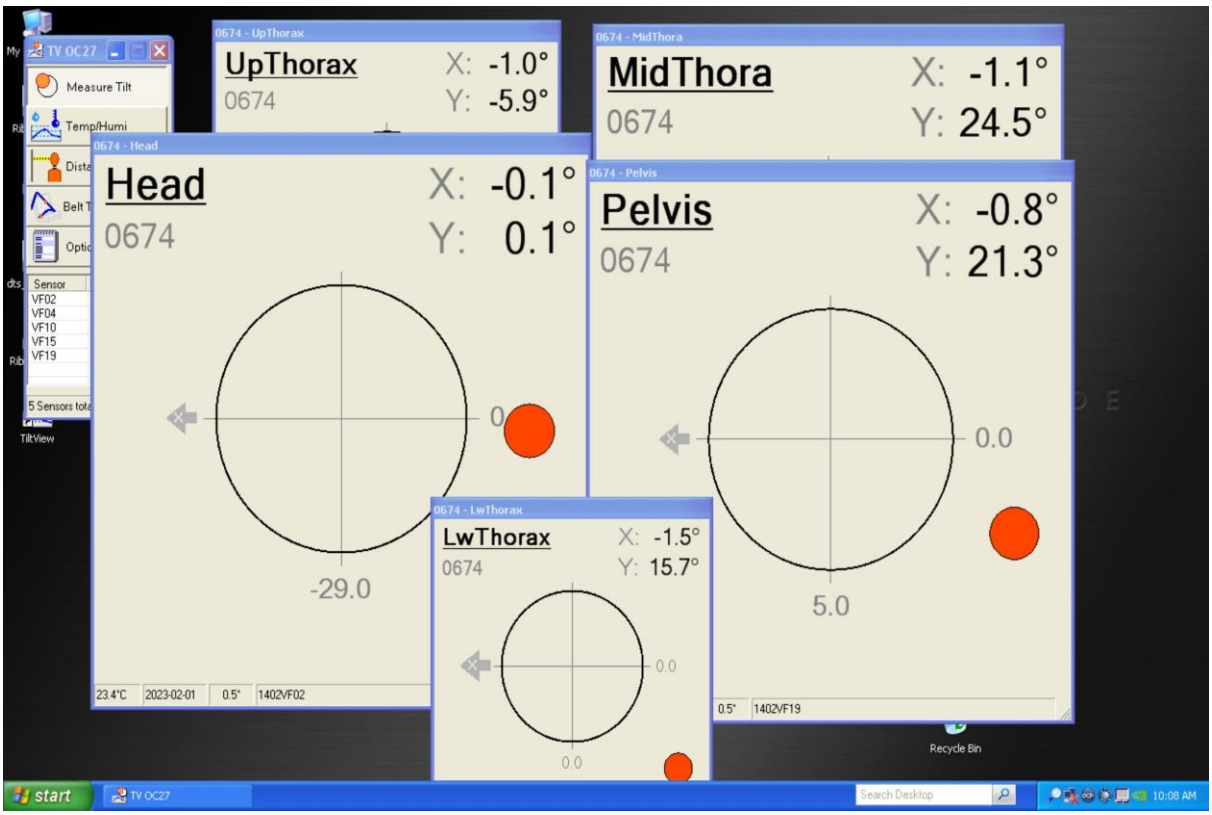
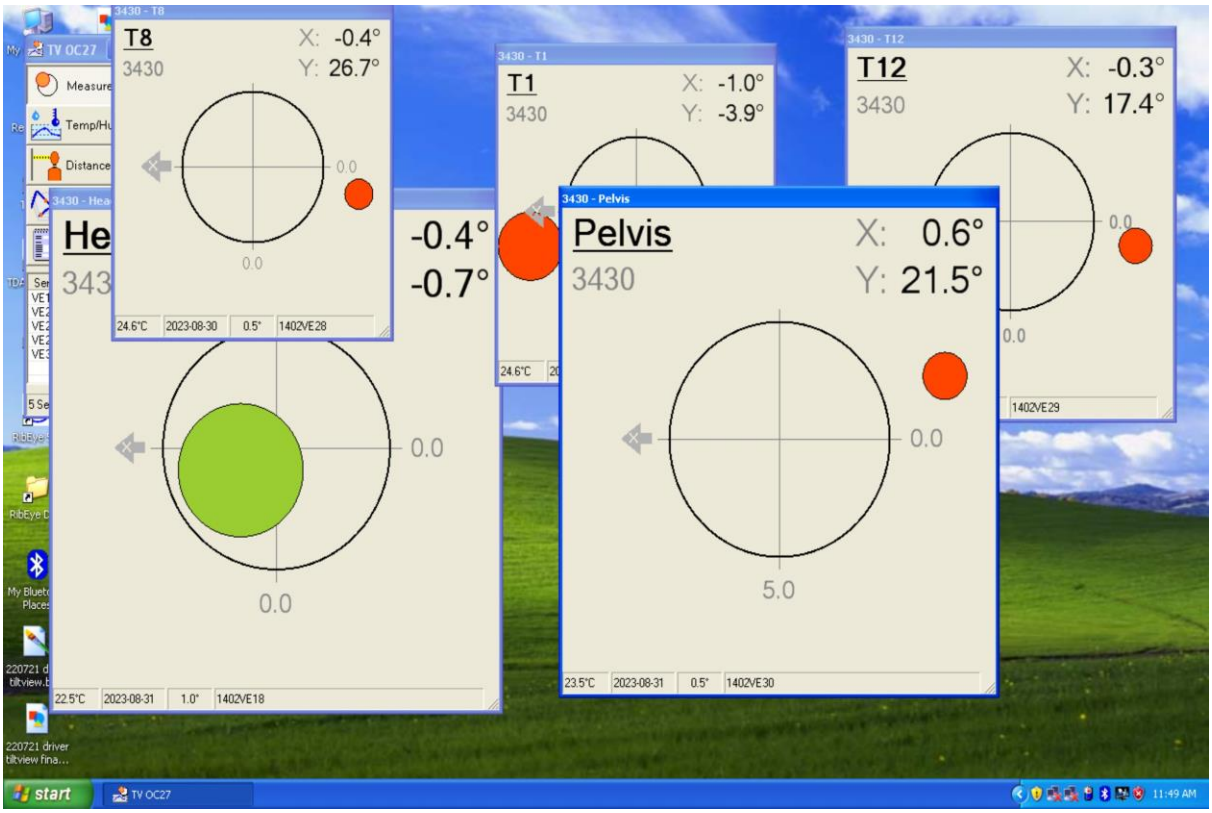


084 Driver THOR-05 Pre-Test Tilt Sensor View



085 Passenger THOR-05 Pre-Test Tilt Sensor View

APPENDIX B

VEHICLE AND DUMMY RESPONSE DATA PLOTS

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7	Head Z Angular Rate Sensor	B-11
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12	Upper Neck Load Cell Force Y	B-13
13	Upper Neck Load Cell Force Z	B-13
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45	Left Lower Thorax Z Rotary Potentiometer	**B-23**
46	Right Lower Thorax IR-TRACC	**B-24**
47	Right Lower Thorax Y Rotary Potentiometer	**B-24**
48	Right Lower Thorax Z Rotary Potentiometer	**B-24**
49	Left Abdomen Pressure Sensor	**B-25**
50	Right Abdomen Pressure Sensor	**B-25**
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53	Right A.S.I.S. Load Cell Force X	**B-26**
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55	Left Acetabulum Load Cell Force X	**B-27**
56	Left Acetabulum Load Cell Force Y	**B-27**
57	Left Acetabulum Load Cell Force Z	**B-27**
58	Right Acetabulum Load Cell Force X	**B-28**
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60	Right Acetabulum Load Cell Force Z	**B-28**
61	Pelvis X Accelerometer	**B-29**
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67	Pelvis Z Angular Rate Sensor	**B-30**
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69	Left Femur Load Cell Force Y	**B-31**
70	Left Femur Load Cell Force Z	**B-31**
71	Left Femur Load Cell Moment X	**B-32**
72	Left Femur Load Cell Moment Y	**B-32**
73	Left Femur Load Cell Moment Z	**B-32**
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75	5-Channel Left Upper Tibia Load Cell Force X	**B-33**
76	5-Channel Left Upper Tibia Load Cell Force Y	**B-33**
77	5-Channel Left Upper Tibia Load Cell Force Z	**B-33**
78	5-Channel Left Upper Tibia Load Cell Moment X	**B-34**
79	5-Channel Left Upper Tibia Load Cell Moment Y	**B-34**
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81	Left Lower Tibia Load Cell Force Y	**B-35**
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87	Left Tibia Y Accelerometer	**B-37**
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90	Left Ankle Z Rotary Potentiometer	**B-38**
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98	Right Femur Load Cell Moment X	**B-41**
99	Right Femur Load Cell Moment Y	**B-41**
100	Right Femur Load Cell Moment Z	**B-41**
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102	5-Channel Right Upper Tibia Load Cell Force X	**B-42**
103	5-Channel Right Upper Tibia Load Cell Force Y	**B-42**
104	5-Channel Right Upper Tibia Load Cell Force Z	**B-42**
105	5-Channel Right Upper Tibia Load Cell Moment X	**B-43**
106	5-Channel Right Upper Tibia Load Cell Moment Y	**B-43**
107	Right Lower Tibia Load Cell Force X	**B-44**
108	Right Lower Tibia Load Cell Force Y	**B-44**
109	Right Lower Tibia Load Cell Force Z	**B-44**
110	Right Lower Tibia Load Cell Moment X	**B-45**
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133	Upper Neck Force Y	**B-52**
134	Upper Neck Force Z	**B-52**
135	Upper Neck Moment X	**B-53**
136	Upper Neck Moment Y	**B-53**
137	Upper Neck Moment Z	**B-53**
138	Lower Neck Force X	**B-54**
139	Lower Neck Force Y	**B-54**
140	Lower Neck Force Z	**B-54**
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142	Lower Neck Moment Y	**B-55**
143	Lower Neck Moment Z	**B-55**
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146	T1 Linear Acceleration Z	**B-56**
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150	Right Clavicle Force X	**B-57**
151	Right Clavicle Force Z	**B-57**
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153	Left A.S.I.S. Moment Y	**B-58**
154	Right A.S.I.S. Force X	**B-58**
155	Right A.S.I.S. Moment Y	**B-58**
156	Upper Left Thorax Displacement X	**B-59**
157	Upper Left Thorax Angular Displacement Y	**B-59**
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173	Lower Right Thorax Angular Displacement Z	**B-64**
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177	Left Acetabulum Force Y	**B-66**
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190	Left Femur Force Y	**B-70**
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198	Right Femur Force Z	**B-72**
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214	Left Tibia Linear Acceleration X	**B-77**
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217	Left Ankle Angular Displacement Y	**B-78**
218	Left Ankle Angular Displacement Z	**B-78**
219	Left Foot Linear Acceleration X	**B-79**
220	Left Foot Linear Acceleration Y	**B-79**
221	Left Foot Linear Acceleration Z	**B-79**
222	Left Foot Linear Acceleration Resultant	**B-79**
223	Right Upper Tibia Force X	**B-80**
224	Right Upper Tibia Force Y	**B-80**
225	Right Upper Tibia Force Z	**B-80**
226	Right Upper Tibia Moment X	**B-81**
227	Right Upper Tibia Moment Y	**B-81**
228	Right Achilles Force Z	**B-81**
229	Right Lower Tibia Force X	**B-82**
230	Right Lower Tibia Force Y	**B-82**
231	Right Lower Tibia Force Z	**B-82**
232	Right Lower Tibia Moment X	**B-83**
233	Right Lower Tibia Moment Y	**B-83**
234	Right Tibia Linear Acceleration X	**B-83**
235	Right Tibia Linear Acceleration Y	**B-83**
236	Right Ankle Angular Displacement X	**B-84**
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268	Passenger Knee Airbag	**B-92**
269	Driver Chest Left Upper Dx	**B-93**
270	Driver Chest Left Upper Dy	**B-93**
271	Driver Chest Left Upper Dz	**B-93**
272	Driver Chest Left Upper Resultant	**B-93**
273	Driver Chest Right Upper Dx	**B-94**
274	Driver Chest Right Upper Dy	**B-94**
275	Driver Chest Right Upper Dz	**B-94**
276	Driver Chest Right Upper Resultant	**B-94**
277	Driver Chest Left Lower Dx	**B-95**
278	Driver Chest Left Lower Dy	**B-95**
279	Driver Chest Left Lower Dz	**B-95**
280	Driver Chest Left Lower Resultant	**B-95**
281	Driver Chest Right Lower Dx	**B-96**
282	Driver Chest Right Lower Dy	**B-96**
283	Driver Chest Right Lower Dz	**B-96**
284	Driver Chest Right Lower Resultant	**B-96**
285	Passenger Chest Left Upper Dx	**B-97**
286	Passenger Chest Left Upper Dy	**B-97**
287	Passenger Chest Left Upper Dz	**B-97**
288	Passenger Chest Left Upper Resultant	**B-97**

TABLE OF DATA PLOTS, CONTINUED

No.	List of Data Plots Provided in the Test Report	Page
289	Passenger Chest Right Upper Dx	**B-98**
290	Passenger Chest Right Upper Dy	**B-98**
291	Passenger Chest Right Upper Dz	**B-98**
292	Passenger Chest Right Upper Resultant	**B-98**
293	Passenger Chest Left Lower Dx	**B-99**
294	Passenger Chest Left Lower Dy	**B-99**
295	Passenger Chest Left Lower Dz	**B-99**
296	Passenger Chest Left Lower Resultant	**B-99**
297	Passenger Chest Right Lower Dx	**B-100**
298	Passenger Chest Right Lower Dy	**B-100**
299	Passenger Chest Right Lower Dz	**B-100**
300	Passenger Chest Right Lower Resultant	**B-100**

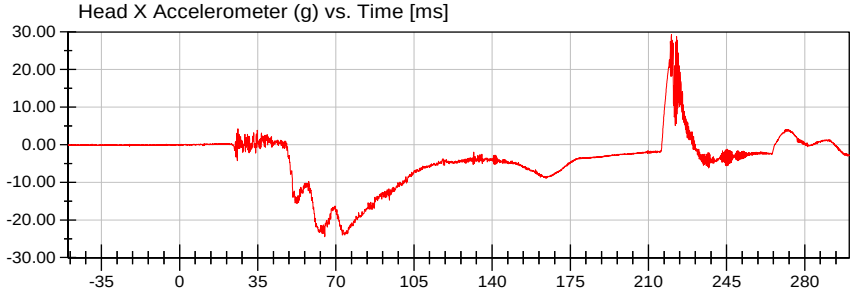
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Head X Accelerometer (g) vs. Time [ms]



<Max>

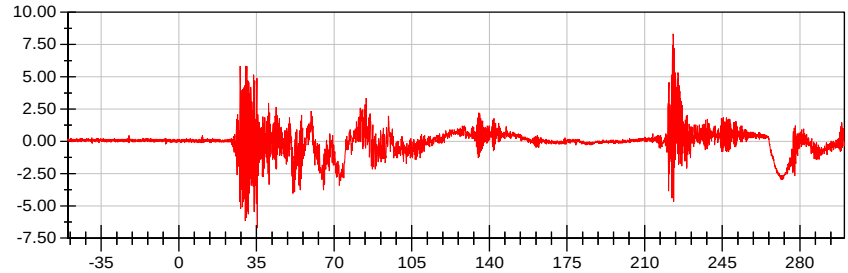
29.32 g at 220.30 ms

<Min>

-24.48 g at 65.00 ms

CFC_1000

Head Y Accelerometer (g) vs. Time [ms]



<Max>

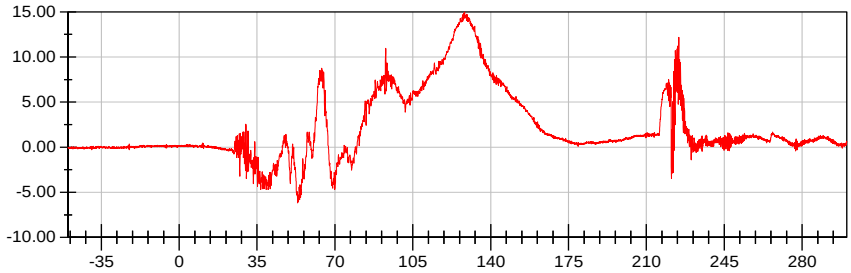
8.31 g at 222.90 ms

<Min>

-6.70 g at 35.40 ms

CFC_1000

Head Z Accelerometer (g) vs. Time [ms]



<Max>

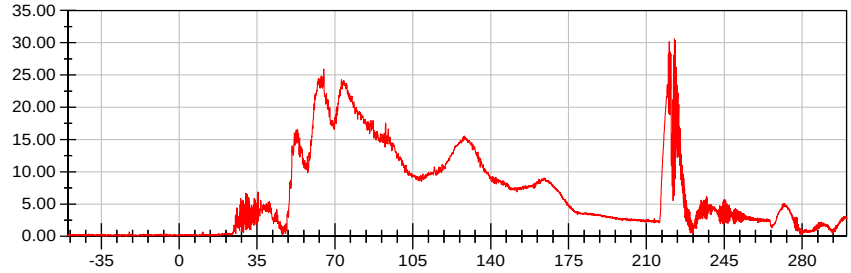
14.98 g at 128.25 ms

<Min>

-6.18 g at 53.25 ms

CFC_1000

Head Resultant (g) vs. Time [ms]



<Max>

30.58 g at 222.60 ms

<Min>

0.04 g at -45.80 ms

CFC_1000

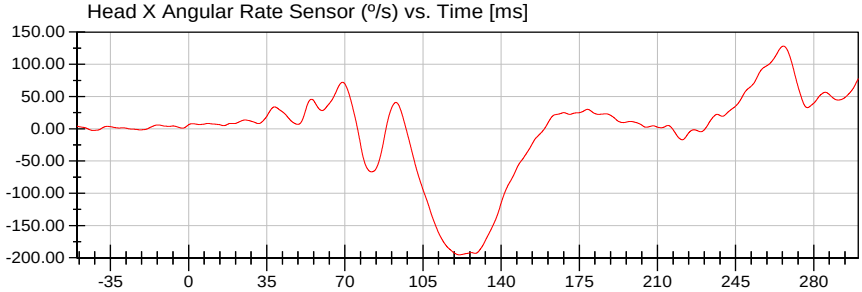
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Head X Angular Rate Sensor (º/s) vs. Time [ms]



<Max>

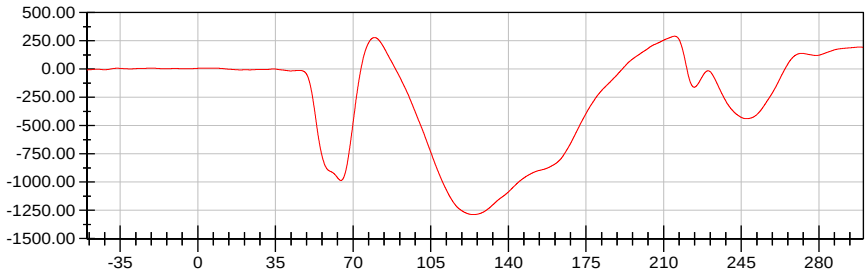
128.07 º/s at 266.40 ms

<Min>

-195.41 º/s at 121.30 ms

CFC_60

Head Y Angular Rate Sensor (º/s) vs. Time [ms]



<Max>

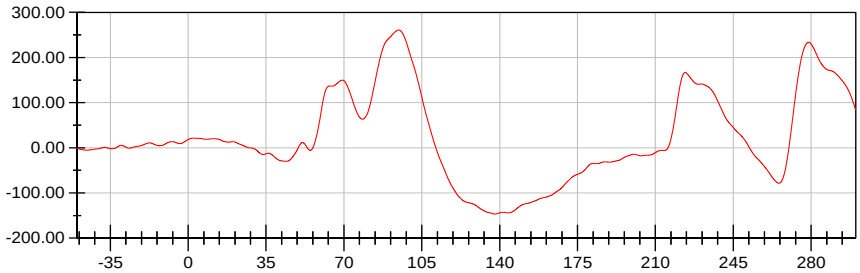
290.83 º/s at 214.95 ms

<Min>

-1,287.61 º/s at 124.25 ms

CFC_60

Head Z Angular Rate Sensor (º/s) vs. Time [ms]



<Max>

260.96 º/s at 94.65 ms

<Min>

-146.67 º/s at 137.85 ms

CFC_60

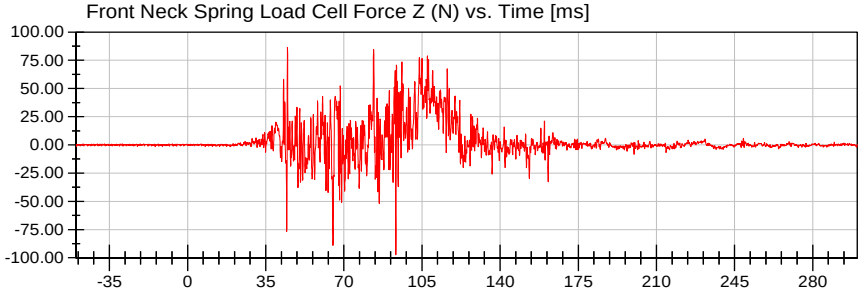
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Front Neck Spring Load Cell Force Z (N) vs. Time [ms]



<Max>

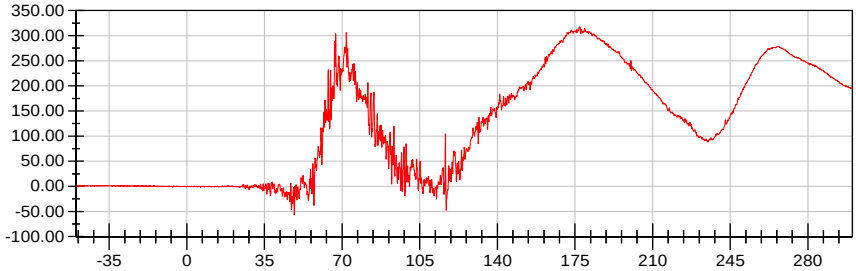
86.37 N at 44.75 ms

<Min>

-97.42 N at 93.30 ms

CFC_1000

Rear Neck Spring Load Cell Force Z (N) vs. Time [ms]



<Max>

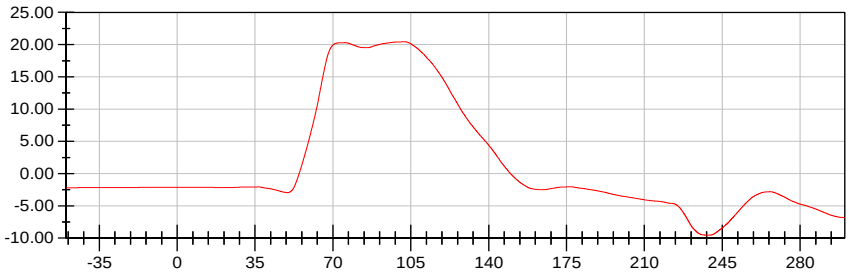
317.52 N at 176.95 ms

<Min>

-56.74 N at 48.45 ms

CFC_1000

Occipital Condyle Rotary Potentiometer (º) vs. Time [ms]



<Max>

20.45 º at 102.20 ms

<Min>

-9.56 º at 239.10 ms

CFC_180

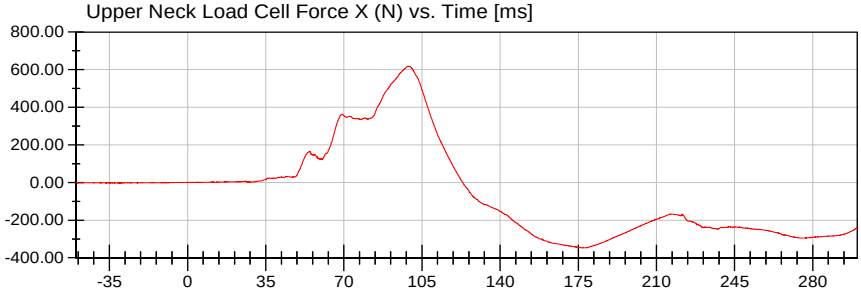
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Upper Neck Load Cell Force X (N) vs. Time [ms]



<Max>

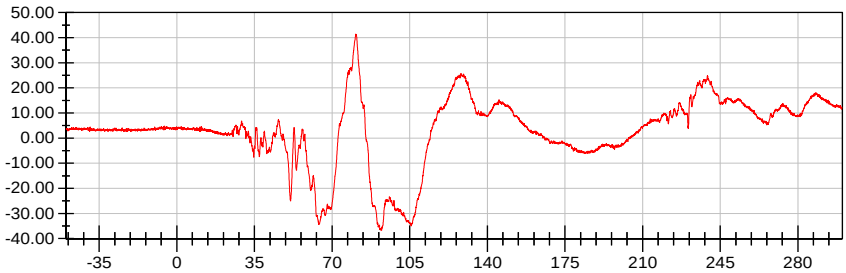
618.08 N at 98.90 ms

<Min>

-347.42 N at 177.05 ms

CFC_1000

Upper Neck Load Cell Force Y (N) vs. Time [ms]



<Max>

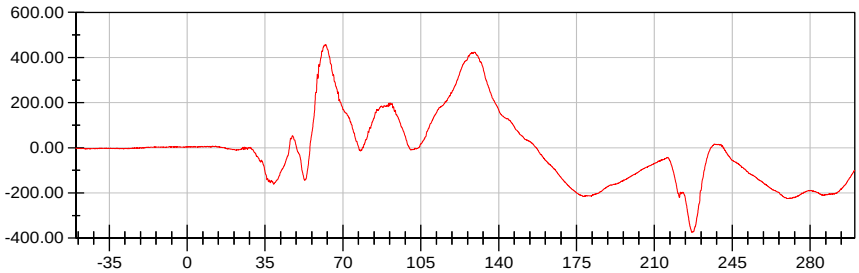
41.45 N at 80.70 ms

<Min>

-36.66 N at 92.20 ms

CFC_1000

Upper Neck Load Cell Force Z (N) vs. Time [ms]



<Max>

457.67 N at 62.25 ms

<Min>

-375.04 N at 226.85 ms

CFC_1000

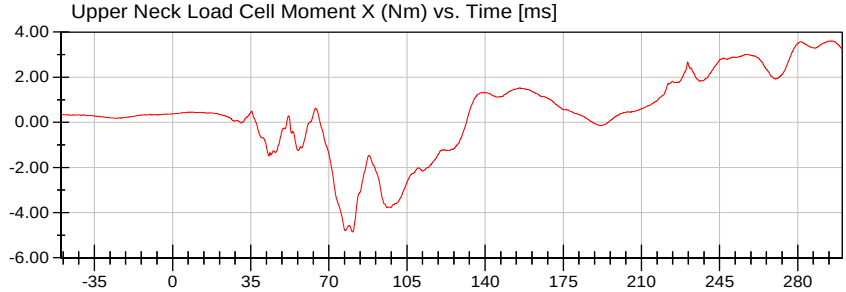
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Upper Neck Load Cell Moment X (Nm) vs. Time [ms]



<Max>

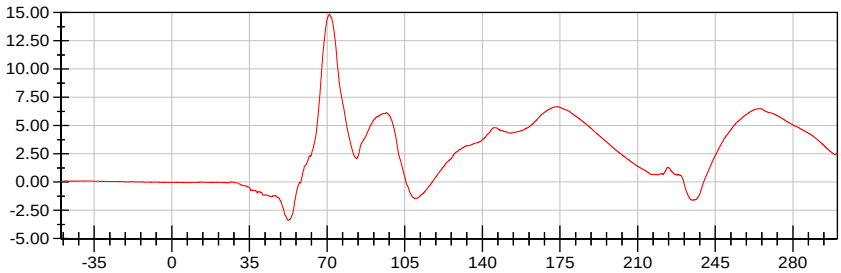
3.61 Nm at 295.35 ms

<Min>

-4.86 Nm at 80.65 ms

CFC_600

Upper Neck Load Cell Moment Y (Nm) vs. Time [ms]



<Max>

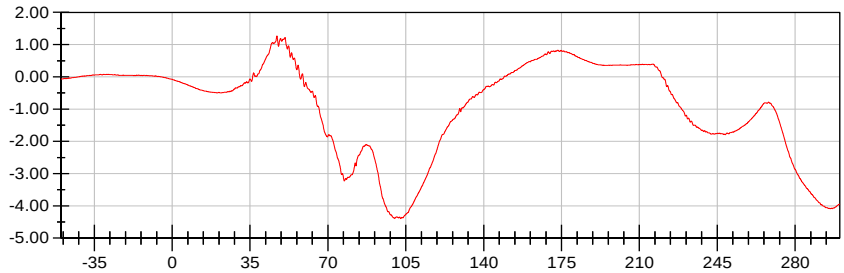
14.86 Nm at 71.10 ms

<Min>

-3.40 Nm at 52.50 ms

CFC_600

Upper Neck Load Cell Moment Z (Nm) vs. Time [ms]



<Max>

1.27 Nm at 47.10 ms

<Min>

-4.40 Nm at 102.75 ms

CFC_600

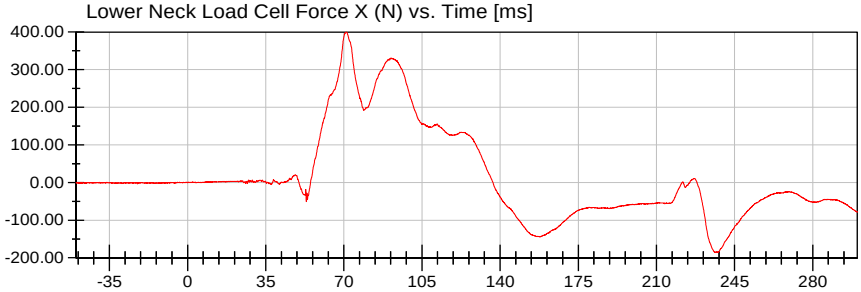
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Lower Neck Load Cell Force X (N) vs. Time [ms]



<Max>

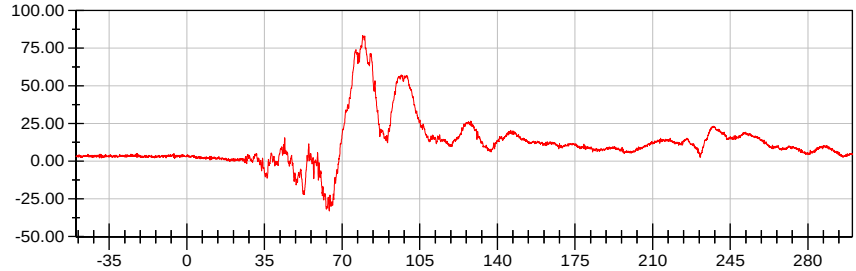
399.87 N at 71.00 ms

<Min>

-186.05 N at 237.20 ms

CFC_1000

Lower Neck Load Cell Force Y (N) vs. Time [ms]



<Max>

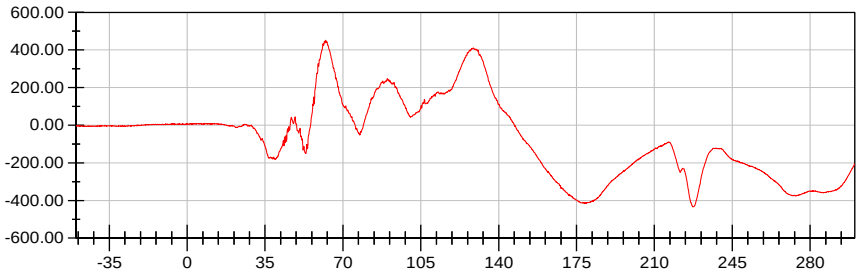
83.52 N at 79.35 ms

<Min>

-33.03 N at 64.25 ms

CFC_1000

Lower Neck Load Cell Force Z (N) vs. Time [ms]



<Max>

451.36 N at 62.25 ms

<Min>

-434.21 N at 227.30 ms

CFC_1000

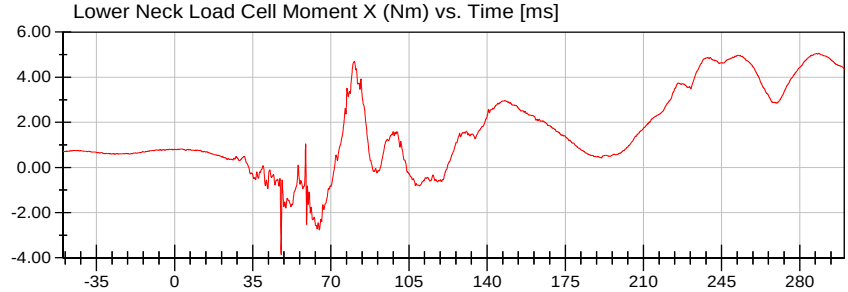
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Lower Neck Load Cell Moment X (Nm) vs. Time [ms]



<Max>

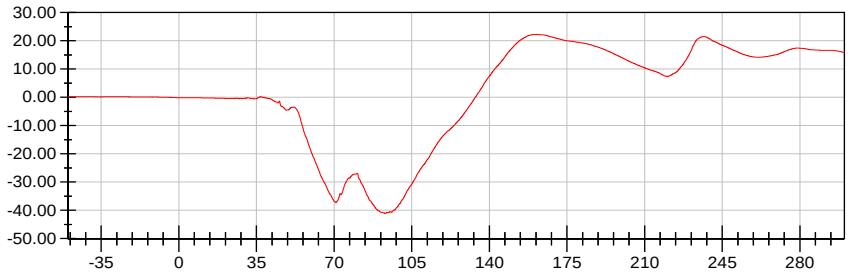
5.06 Nm at 288.55 ms

<Min>

-3.85 Nm at 47.75 ms

CFC_600

Lower Neck Load Cell Moment Y (Nm) vs. Time [ms]



<Max>

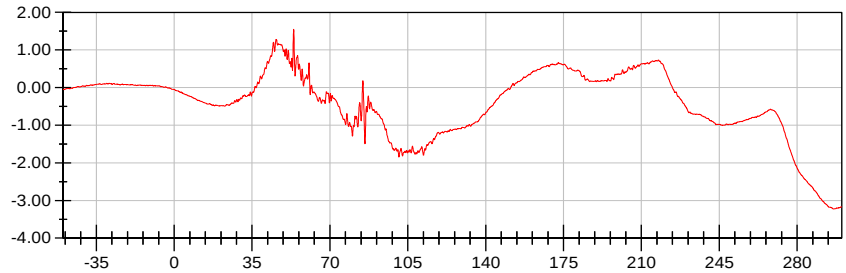
22.26 Nm at 161.10 ms

<Min>

-41.11 Nm at 93.15 ms

CFC_600

Lower Neck Load Cell Moment Z (Nm) vs. Time [ms]



<Max>

1.55 Nm at 53.75 ms

<Min>

-3.23 Nm at 296.50 ms

CFC_600

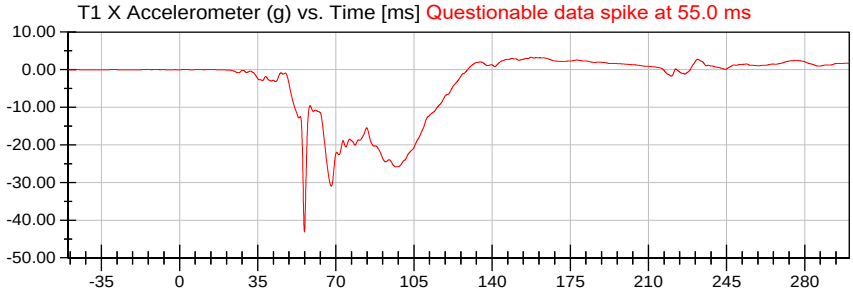
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

T1 X Accelerometer (g) vs. Time [ms] Questionable data spike at 55.0 ms



<Max>

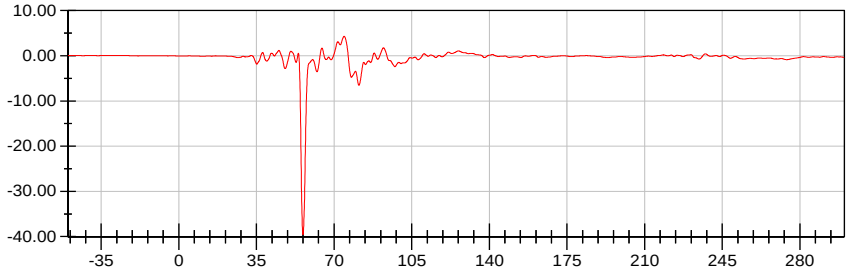
3.29 g at 157.45 ms

<Min>

-43.12 g at 55.95 ms

CFC_180

T1 Y Accelerometer (g) vs. Time [ms] Questionable data spike at 55.0 ms



<Max>

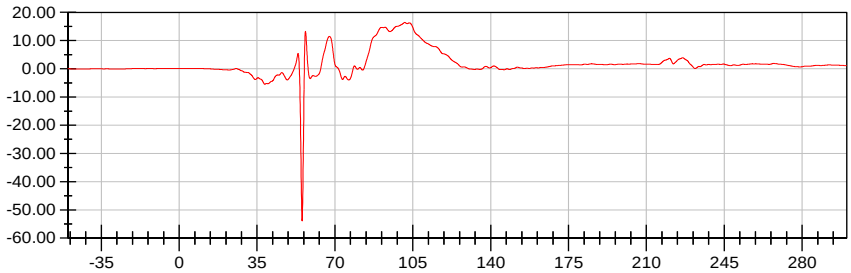
4.32 g at 74.55 ms

<Min>

-39.58 g at 55.95 ms

CFC_180

T1 Z Accelerometer (g) vs. Time [ms] Questionable data spike at 55.0 ms



<Max>

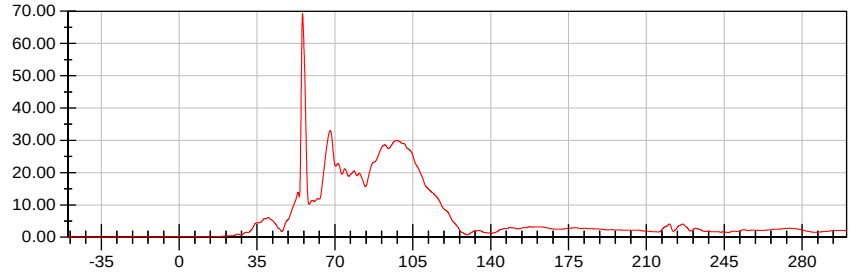
16.40 g at 101.35 ms

<Min>

-53.89 g at 55.25 ms

CFC_180

T1 Accelerometer Resultant (g) vs. Time [ms]



<Max>

69.27 g at 55.45 ms

<Min>

0.05 g at -39.50 ms

CFC_180

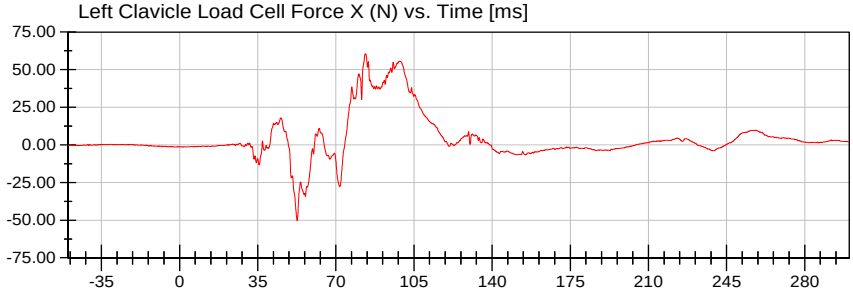
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Left Clavicle Load Cell Force X (N) vs. Time [ms]



<Max>

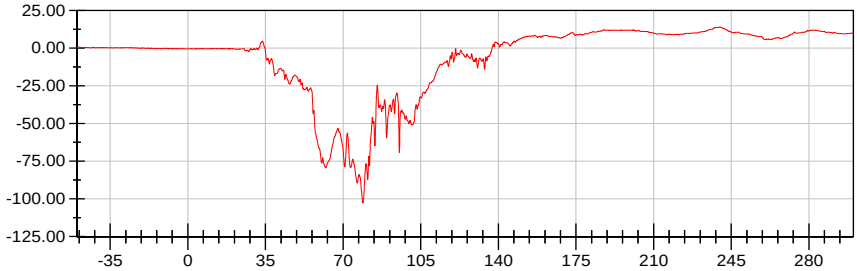
60.32 N at 83.40 ms

<Min>

-50.41 N at 52.70 ms

CFC_600

Left Clavicle Load Cell Force Z (N) vs. Time [ms]



<Max>

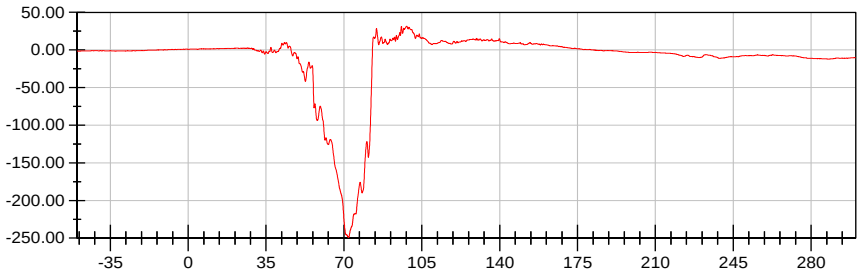
14.03 N at 239.85 ms

<Min>

-102.84 N at 78.95 ms

CFC_600

Left Clavicle Load Cell Force X (N) vs. Time [ms]



<Max>

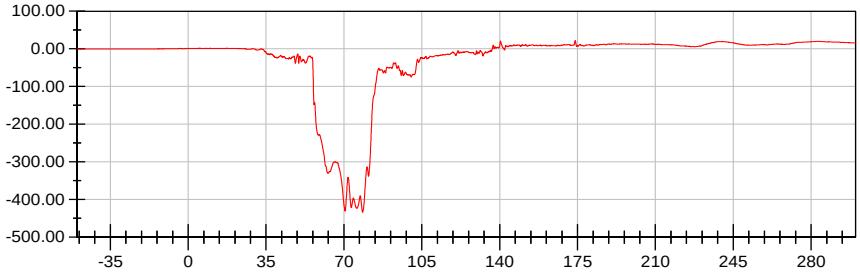
31.59 N at 98.25 ms

<Min>

-249.06 N at 72.10 ms

CFC_600

Left Clavicle Load Cell Force Z (N) vs. Time [ms]



<Max>

22.15 N at 173.95 ms

<Min>

-433.92 N at 78.40 ms

CFC_600

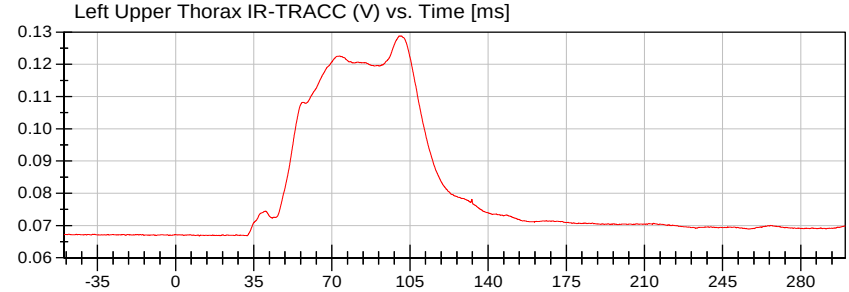
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Left Upper Thorax IR-TRACC (V) vs. Time [ms]



<Max>

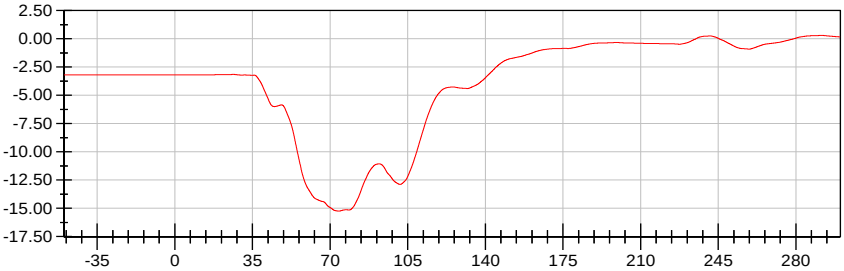
0.13 V at 100.25 ms

<Min>

0.07 V at 10.65 ms

CFC_600

Left Upper Thorax Y Rotary Potentiometer (º) vs. Time [ms]



<Max>

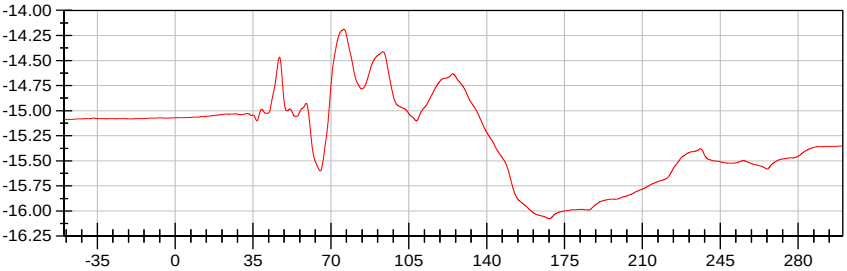
0.31 º at 291.55 ms

<Min>

-15.24 º at 74.05 ms

CFC_180

Left Upper Thorax Z Rotary Potentiometer (º) vs. Time [ms]



<Max>

-14.19 º at 75.85 ms

<Min>

-16.08 º at 168.15 ms

CFC_180

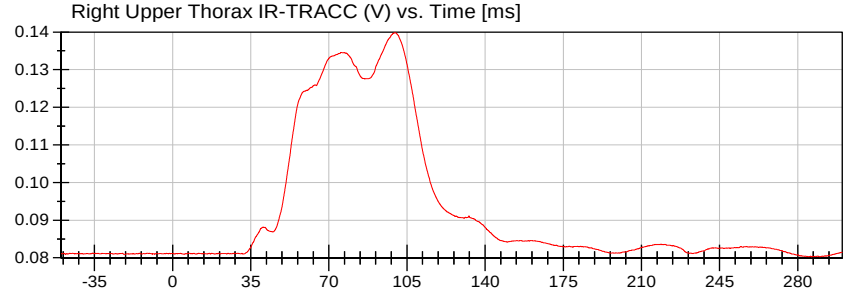
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Right Upper Thorax IR-TRACC (V) vs. Time [ms]



<Max>

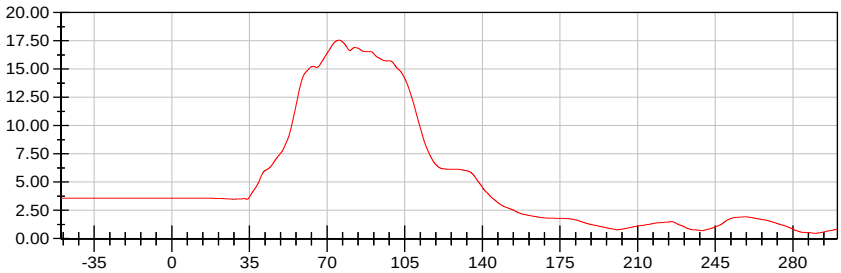
0.14 V at 99.60 ms

<Min>

0.08 V at 286.20 ms

CFC_600

Right Upper Thorax Y Rotary Potentiometer (º) vs. Time [ms]



<Max>

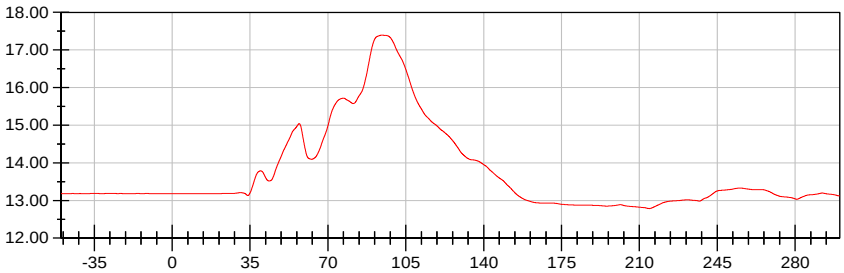
17.55 º at 75.50 ms

<Min>

0.47 º at 290.10 ms

CFC_180

Right Upper Thorax Z Rotary Potentiometer (º) vs. Time [ms]



<Max>

17.40 º at 94.25 ms

<Min>

12.78 º at 214.40 ms

CFC_180

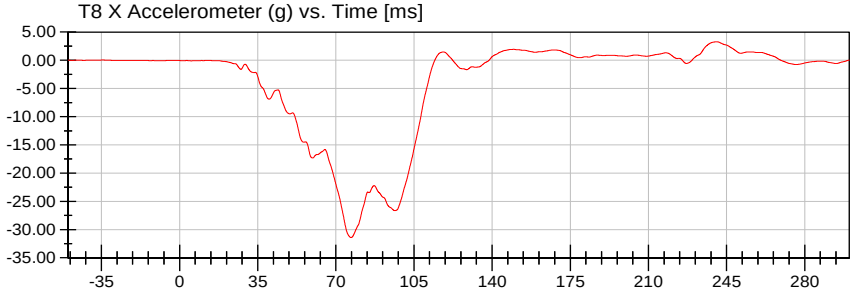
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

T8 X Accelerometer (g) vs. Time [ms]



<Max>

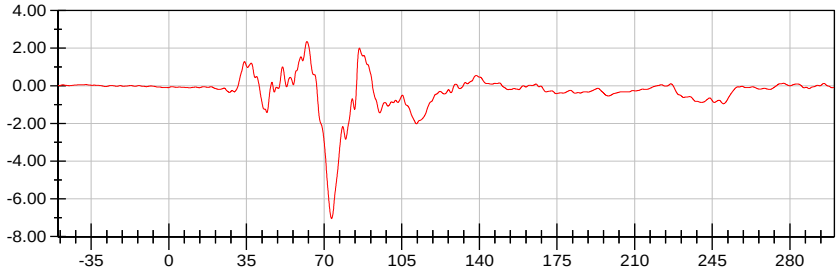
3.27 g at 240.60 ms

<Min>

-31.42 g at 76.85 ms

CFC_180

T8 Y Accelerometer (g) vs. Time [ms]



<Max>

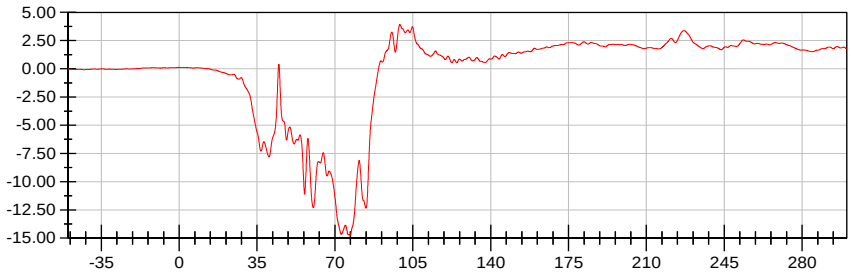
2.36 g at 62.25 ms

<Min>

-7.04 g at 73.40 ms

CFC_180

T8 Z Accelerometer (g) vs. Time [ms]



<Max>

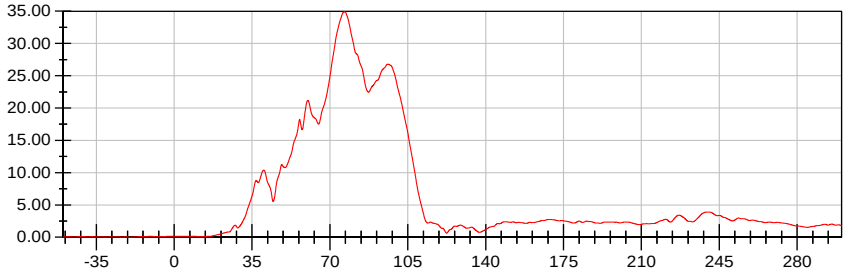
3.92 g at 99.20 ms

<Min>

-14.74 g at 76.85 ms

CFC_180

T8 Accelerometer Resultant (g) vs. Time [ms]



<Max>

34.90 g at 76.70 ms

<Min>

0.02 g at -22.95 ms

CFC_180

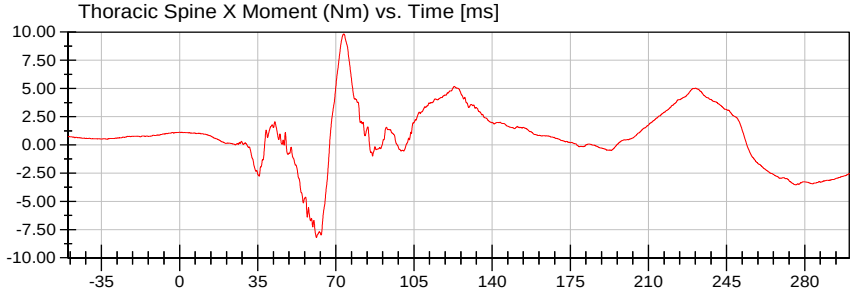
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Thoracic Spine X Moment (Nm) vs. Time [ms]



<Max>

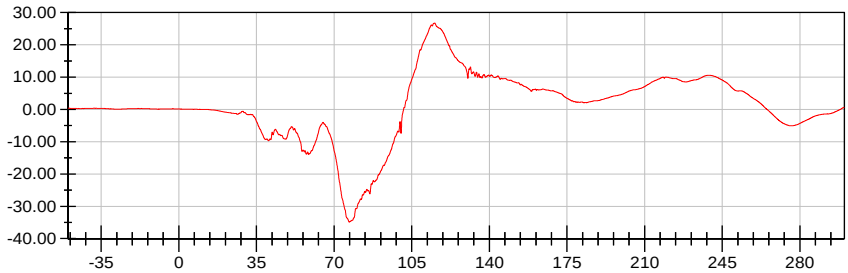
9.83 Nm at 73.60 ms

<Min>

-8.20 Nm at 61.30 ms

CFC_600

Thoracic Spine Y Moment (Nm) vs. Time [ms]



<Max>

26.75 Nm at 115.35 ms

<Min>

-34.89 Nm at 76.85 ms

CFC_600

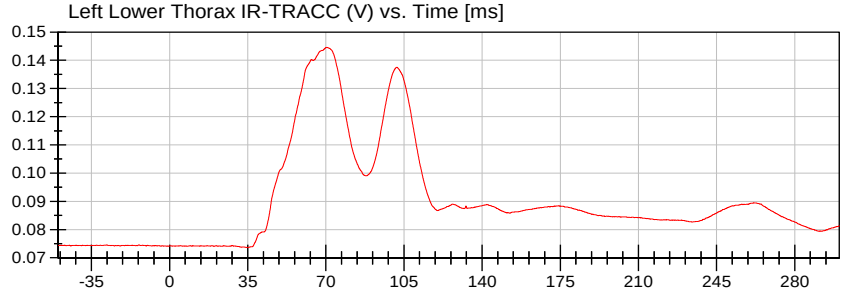
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Left Lower Thorax IR-TRACC (V) vs. Time [ms]



<Max>

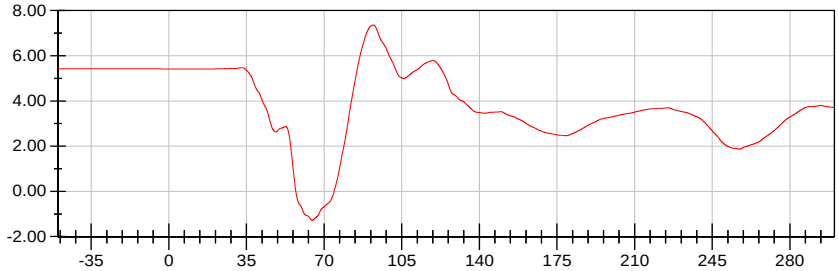
0.14 V at 70.40 ms

<Min>

0.07 V at 35.40 ms

CFC_600

Left Lower Thorax Y Rotary Potentiometer (º) vs. Time [ms]



<Max>

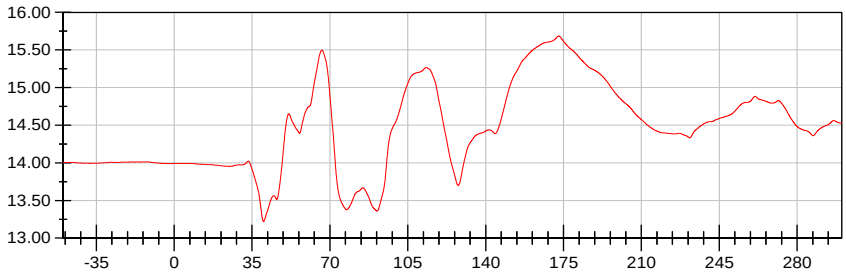
7.36 º at 92.25 ms

<Min>

-1.28 º at 64.70 ms

CFC_180

Left Lower Thorax Z Rotary Potentiometer (º) vs. Time [ms]



<Max>

15.69 º at 172.90 ms

<Min>

13.22 º at 40.20 ms

CFC_180

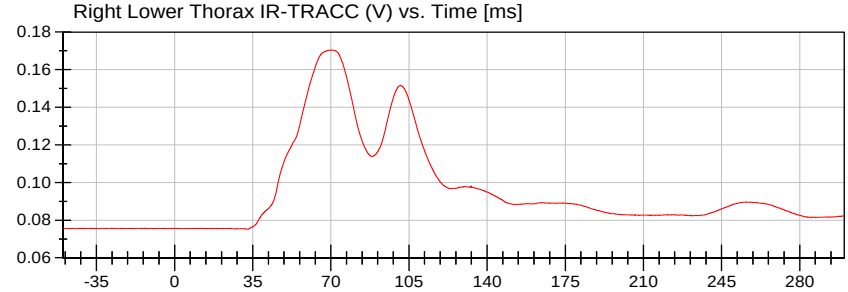
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Right Lower Thorax IR-TRACC (V) vs. Time [ms]



<Max>

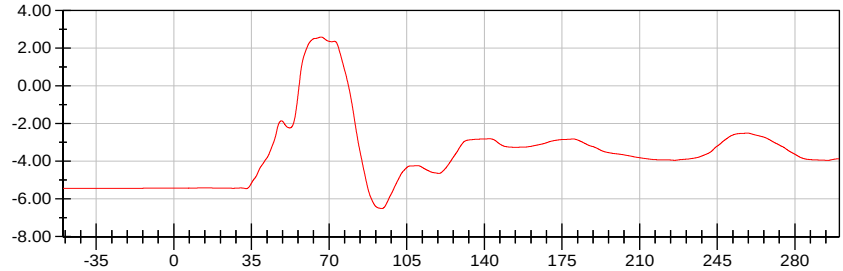
0.17 V at 70.65 ms

<Min>

0.08 V at 32.75 ms

CFC_600

Right Lower Thorax Y Rotary Potentiometer (º) vs. Time [ms]



<Max>

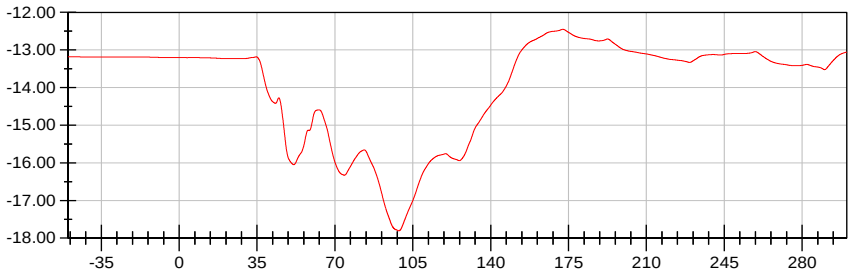
2.59 º at 66.40 ms

<Min>

-6.51 º at 93.80 ms

CFC_180

Right Lower Thorax Z Rotary Potentiometer (º) vs. Time [ms]



<Max>

-12.45 º at 172.50 ms

<Min>

-17.81 º at 98.75 ms

CFC_180

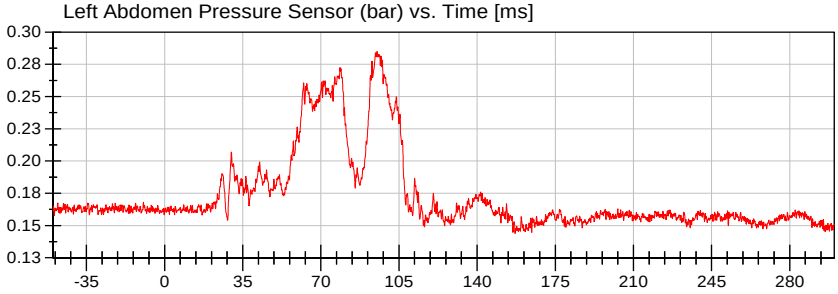
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Left Abdomen Pressure Sensor (bar) vs. Time [ms]



<Max>

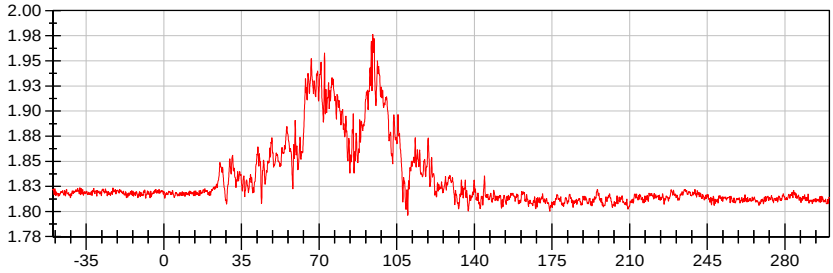
0.28 bar at 95.15 ms

<Min>

0.14 bar at 157.00 ms

CFC_1000

Right Abdomen Pressure Sensor (bar) vs. Time [ms]



<Max>

1.98 bar at 94.20 ms

<Min>

1.80 bar at 110.00 ms

CFC_1000

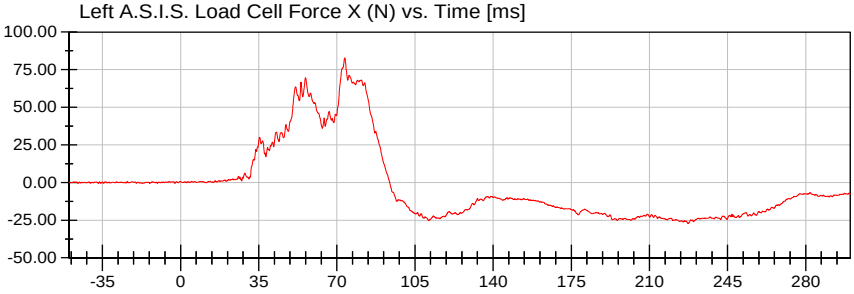
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Left A.S.I.S. Load Cell Force X (N) vs. Time [ms]



<Max>

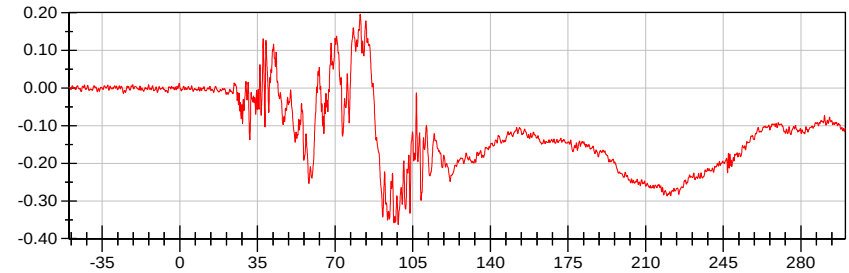
82.90 N at 73.55 ms

<Min>

-27.17 N at 227.35 ms

CFC_600

Left A.S.I.S. Load Cell Moment Y (Nm) vs. Time [ms]



<Max>

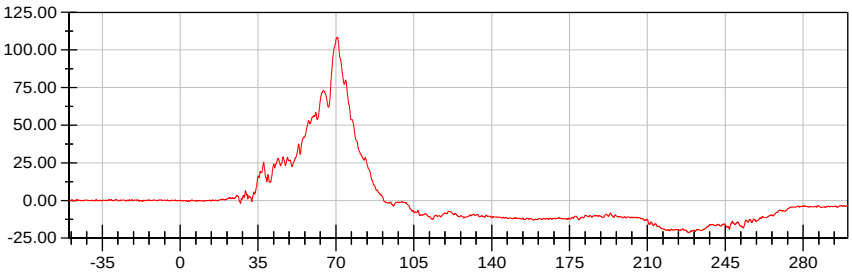
0.20 Nm at 81.30 ms

<Min>

-0.36 Nm at 98.45 ms

CFC_600

Right A.S.I.S. Load Cell Force X (N) vs. Time [ms]



<Max>

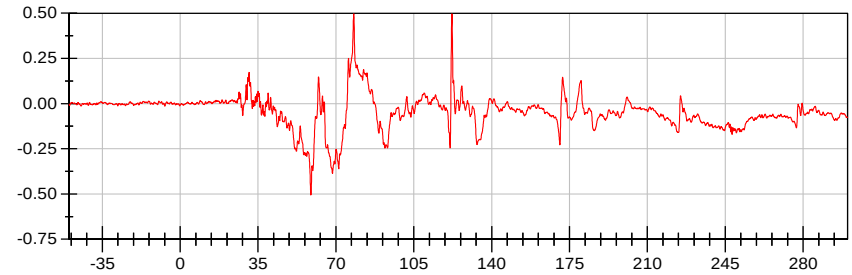
108.52 N at 70.75 ms

<Min>

-21.39 N at 228.65 ms

CFC_600

Right A.S.I.S. Load Cell Moment Y (Nm) vs. Time [ms]



<Max>

0.50 Nm at 122.15 ms

<Min>

-0.51 Nm at 58.75 ms

CFC_600

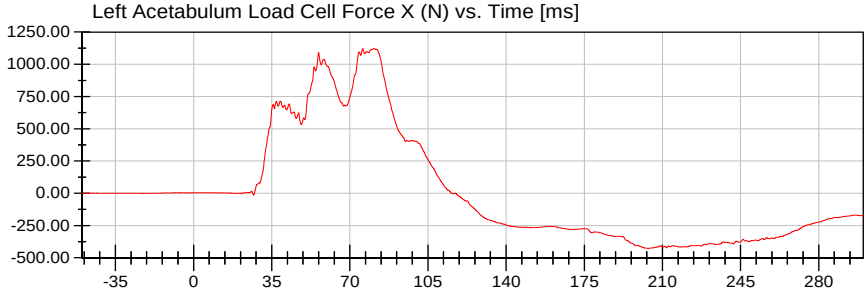
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Left Acetabulum Load Cell Force X (N) vs. Time [ms]



<Max>

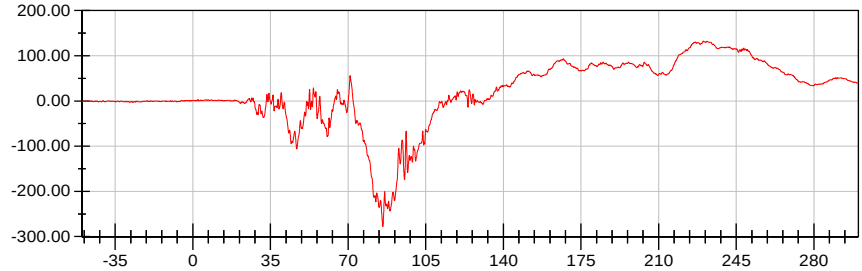
1,121.56 N at 80.95 ms

<Min>

-428.22 N at 203.55 ms

CFC_600

Left Acetabulum Load Cell Force Y (N) vs. Time [ms]



<Max>

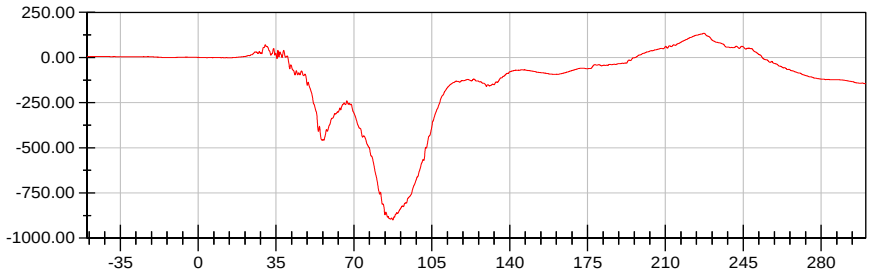
132.52 N at 230.20 ms

<Min>

-277.82 N at 85.70 ms

CFC_600

Left Acetabulum Load Cell Force Z (N) vs. Time [ms]



<Max>

134.14 N at 227.25 ms

<Min>

-899.72 N at 87.50 ms

CFC_600

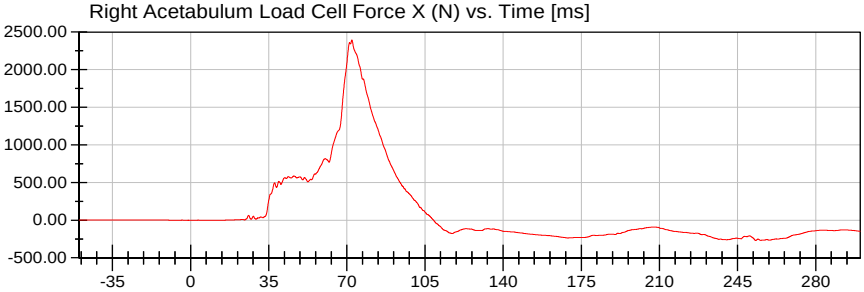
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Right Acetabulum Load Cell Force X (N) vs. Time [ms]



<Max>

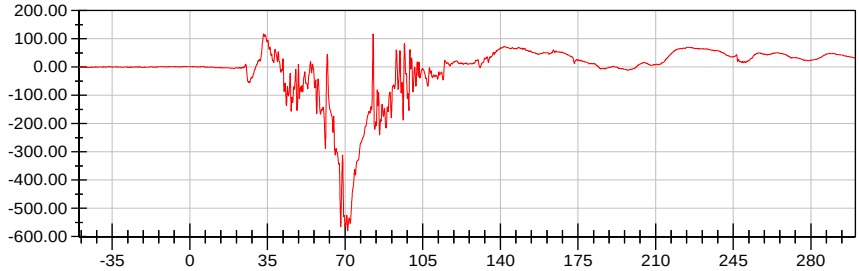
2,393.40 N at 72.25 ms

<Min>

-270.26 N at 253.10 ms

CFC_600

Right Acetabulum Load Cell Force Y (N) vs. Time [ms]



<Max>

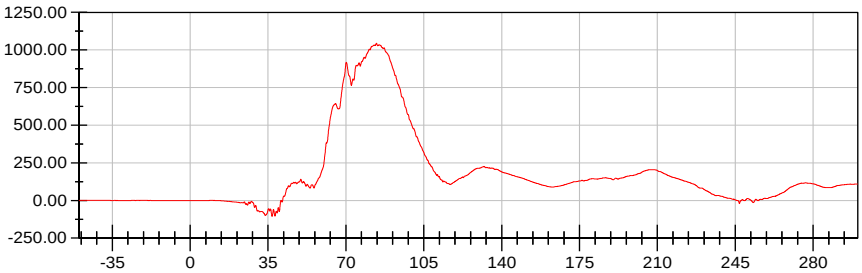
117.81 N at 33.30 ms

<Min>

-579.38 N at 71.20 ms

CFC_600

Right Acetabulum Load Cell Force Z (N) vs. Time [ms]



<Max>

1,044.61 N at 83.70 ms

<Min>

-105.87 N at 36.85 ms

CFC_600

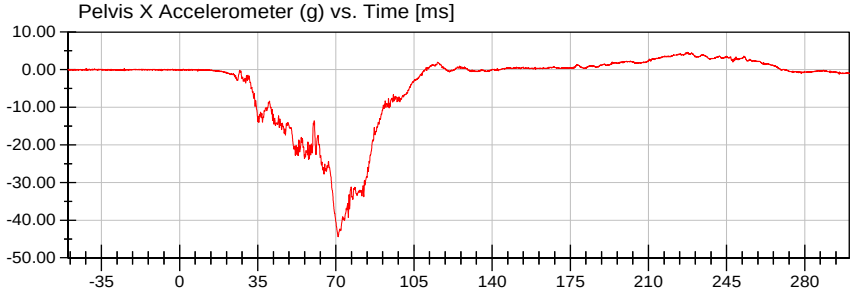
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Pelvis X Accelerometer (g) vs. Time [ms]



<Max>

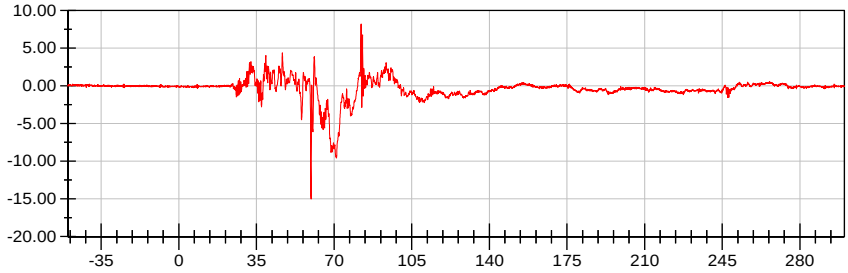
4.60 g at 227.55 ms

<Min>

-44.44 g at 71.00 ms

CFC_1000

Pelvis Y Accelerometer (g) vs. Time [ms]



<Max>

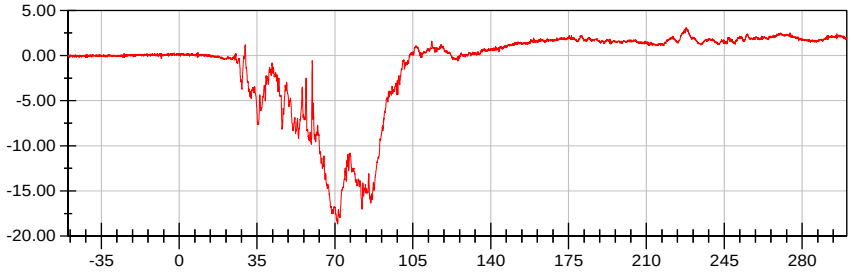
8.23 g at 82.20 ms

<Min>

-15.03 g at 59.60 ms

CFC_1000

Pelvis Z Accelerometer (g) vs. Time [ms]



<Max>

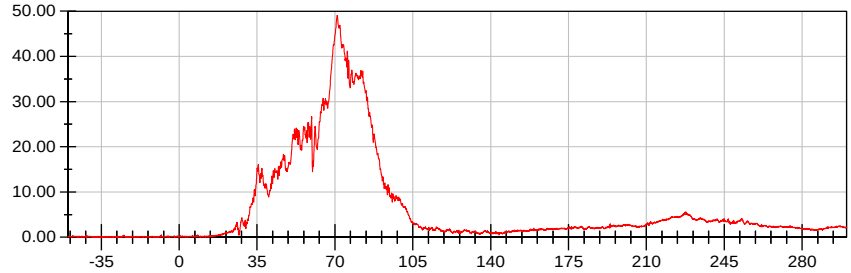
3.09 g at 227.90 ms

<Min>

-18.65 g at 71.20 ms

CFC_1000

Pelvis Accelerometer Resultant (g) vs. Time [ms]



<Max>

49.04 g at 71.05 ms

<Min>

0.03 g at -45.50 ms

CFC_1000

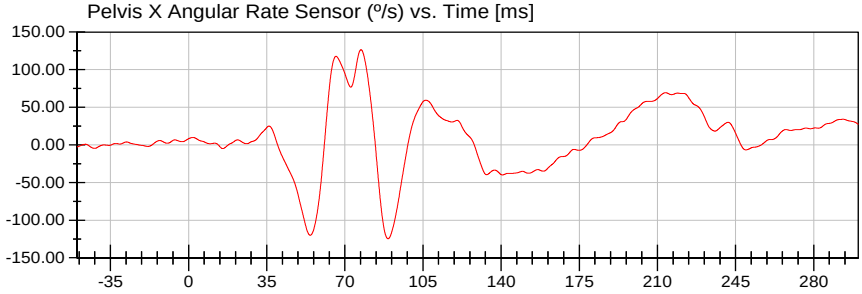
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Pelvis X Angular Rate Sensor (º/s) vs. Time [ms]



<Max>

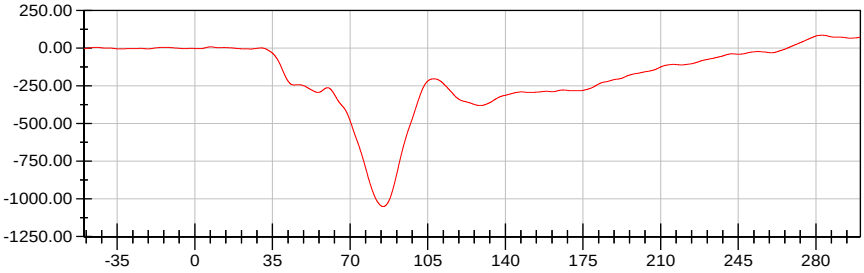
126.66 º/s at 77.20 ms

<Min>

-124.70 º/s at 89.35 ms

CFC_60

Pelvis Y Angular Rate Sensor (º/s) vs. Time [ms]



<Max>

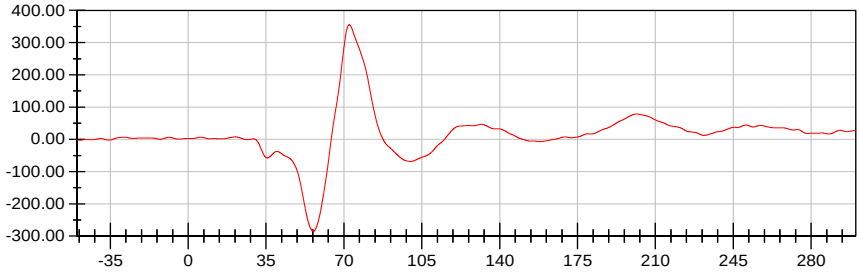
86.37 º/s at 282.75 ms

<Min>

-1,050.08 º/s at 84.95 ms

CFC_60

Pelvis Z Angular Rate Sensor (º/s) vs. Time [ms]



<Max>

355.39 º/s at 72.40 ms

<Min>

-285.19 º/s at 56.20 ms

CFC_60

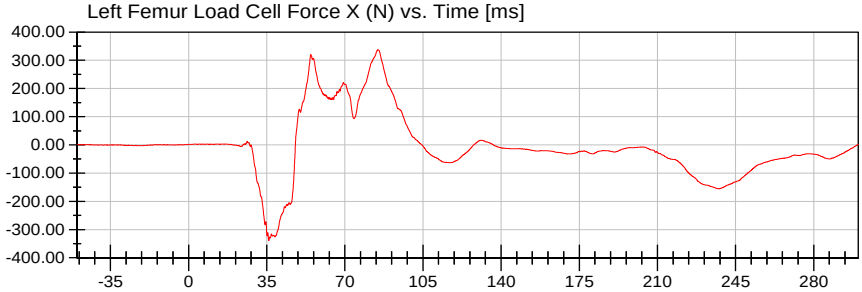
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Left Femur Load Cell Force X (N) vs. Time [ms]



<Max>

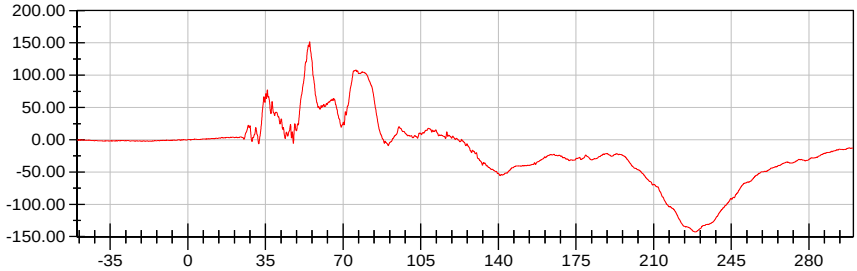
337.42 N at 84.80 ms

<Min>

-338.78 N at 35.95 ms

CFC_600

Left Femur Load Cell Force Y (N) vs. Time [ms]



<Max>

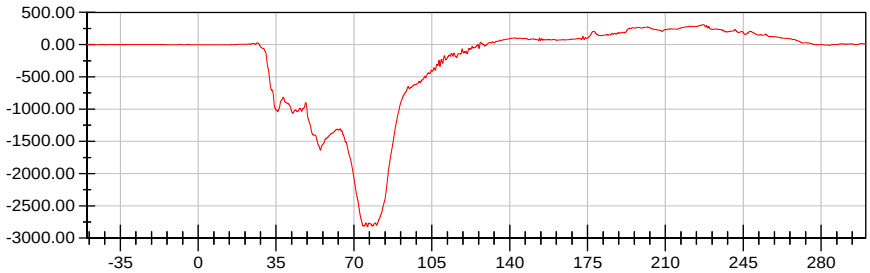
151.78 N at 54.95 ms

<Min>

-142.69 N at 228.85 ms

CFC_600

Left Femur Load Cell Force Z (N) vs. Time [ms]



<Max>

308.98 N at 226.95 ms

<Min>

-2,824.91 N at 76.10 ms

CFC_600

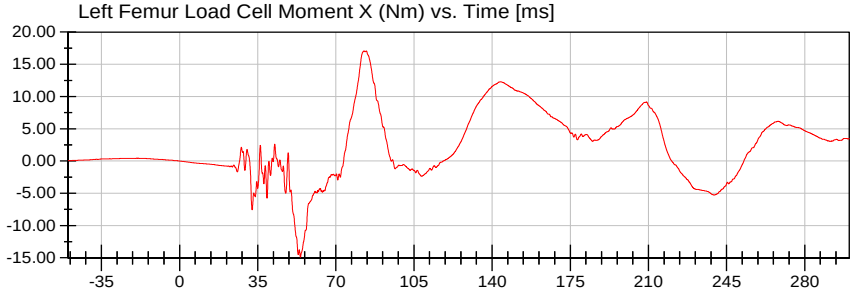
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Left Femur Load Cell Moment X (Nm) vs. Time [ms]



<Max>

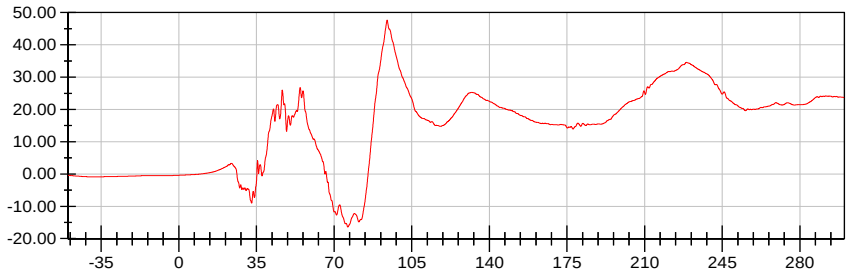
17.08 Nm at 82.65 ms

<Min>

-14.90 Nm at 54.15 ms

CFC_600

Left Femur Load Cell Moment Y (Nm) vs. Time [ms]



<Max>

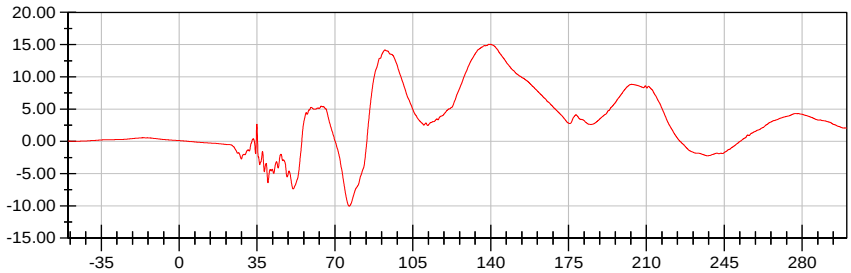
47.66 Nm at 93.90 ms

<Min>

-16.44 Nm at 76.20 ms

CFC_600

Left Femur Load Cell Moment Z (Nm) vs. Time [ms]



<Max>

15.06 Nm at 139.10 ms

<Min>

-10.04 Nm at 76.45 ms

CFC_600

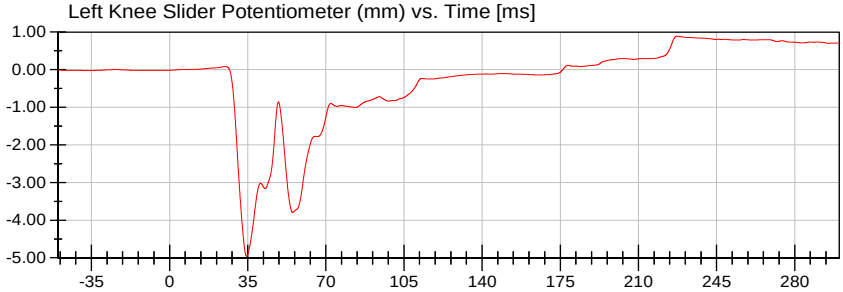
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Left Knee Slider Potentiometer (mm) vs. Time [ms]



<Max>

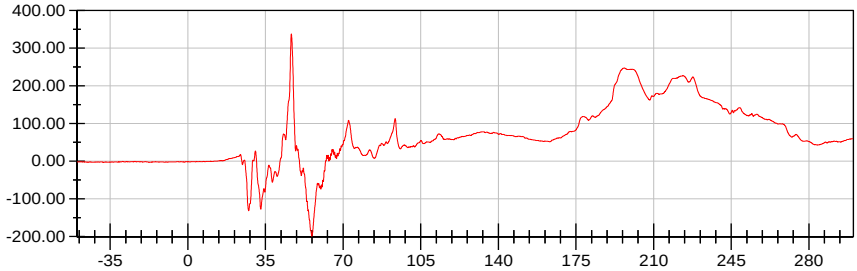
0.89 mm at 227.40 ms

<Min>

-4.96 mm at 34.50 ms

CFC_180

5-Channel Left Upper Tibia Load Cell Force X (N) vs. Time [ms]



<Max>

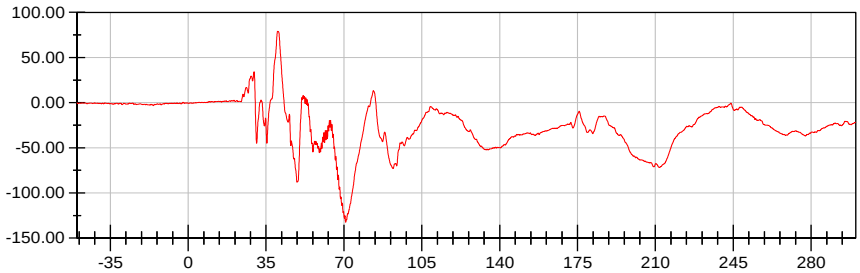
337.58 N at 46.70 ms

<Min>

-198.90 N at 55.90 ms

CFC_600

5-Channel Left Upper Tibia Load Cell Force Y (N) vs. Time [ms]



<Max>

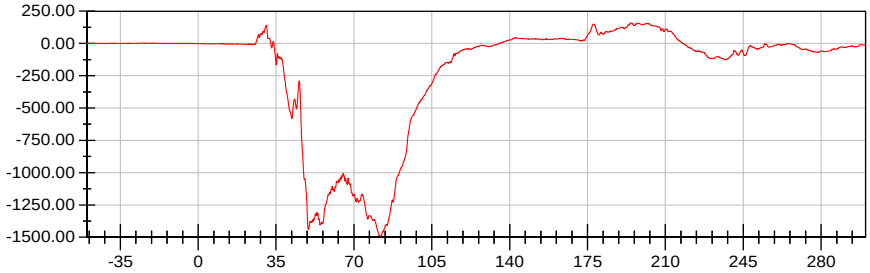
79.06 N at 40.25 ms

<Min>

-132.34 N at 70.80 ms

CFC_600

5-Channel Left Upper Tibia Load Cell Force Z (N) vs. Time [ms]



<Max>

159.16 N at 194.50 ms

<Min>

-1,492.01 N at 82.05 ms

CFC_600

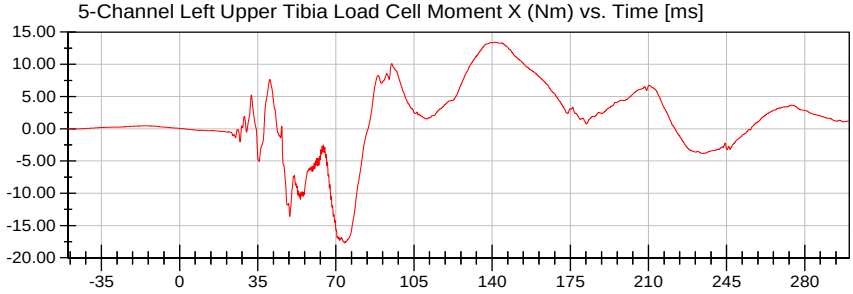
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

5-Channel Left Upper Tibia Load Cell Moment X (Nm) vs. Time [ms]



<Max>

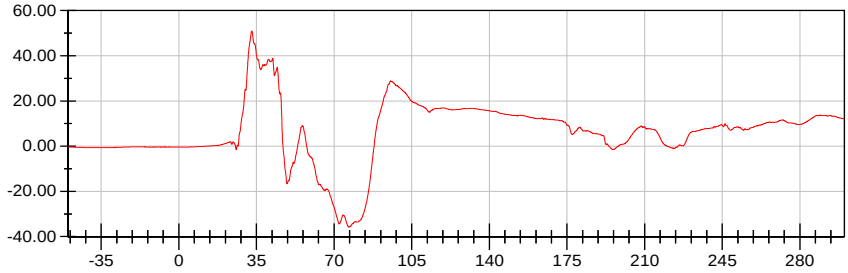
13.39 Nm at 141.25 ms

<Min>

-17.70 Nm at 73.95 ms

CFC_600

5-Channel Left Upper Tibia Load Cell Moment Y (Nm) vs. Time [ms]



<Max>

50.94 Nm at 32.90 ms

<Min>

-35.77 Nm at 76.65 ms

CFC_600

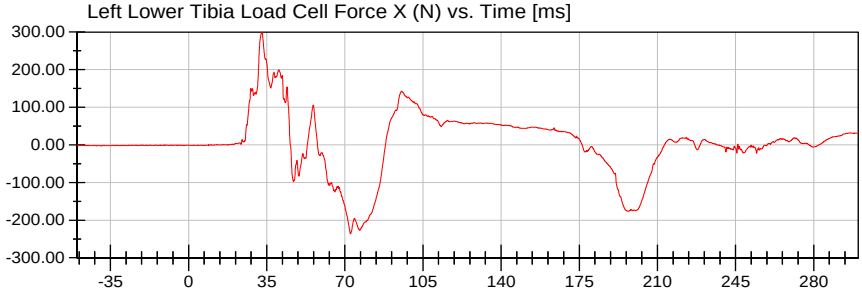
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Left Lower Tibia Load Cell Force X (N) vs. Time [ms]



<Max>

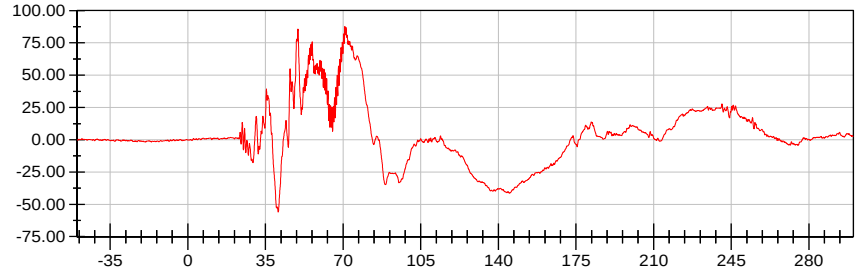
298.56 N at 32.90 ms

<Min>

-236.13 N at 72.50 ms

CFC_600

Left Lower Tibia Load Cell Force Y (N) vs. Time [ms]



<Max>

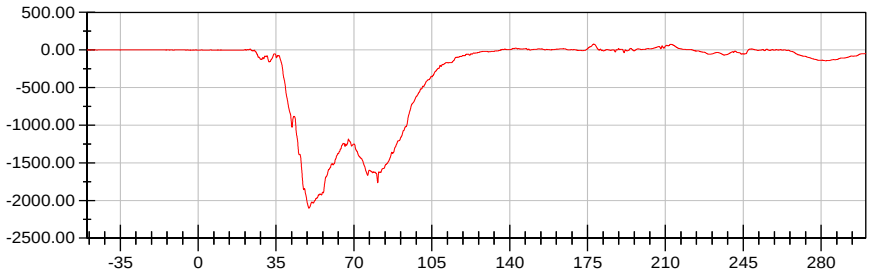
87.75 N at 70.80 ms

<Min>

-55.91 N at 40.75 ms

CFC_600

Left Lower Tibia Load Cell Force Z (N) vs. Time [ms]



<Max>

77.60 N at 177.75 ms

<Min>

-2,101.87 N at 49.75 ms

CFC_600

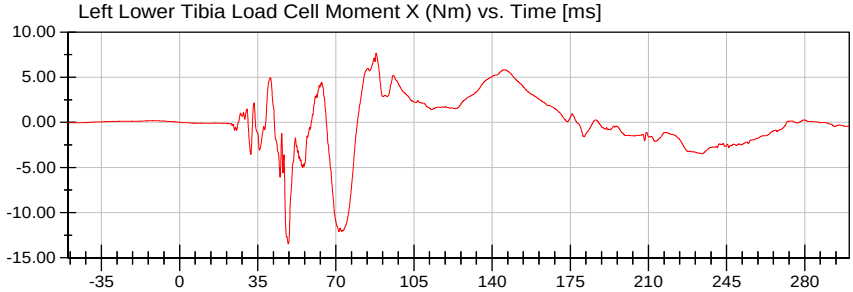
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Left Lower Tibia Load Cell Moment X (Nm) vs. Time [ms]



<Max>

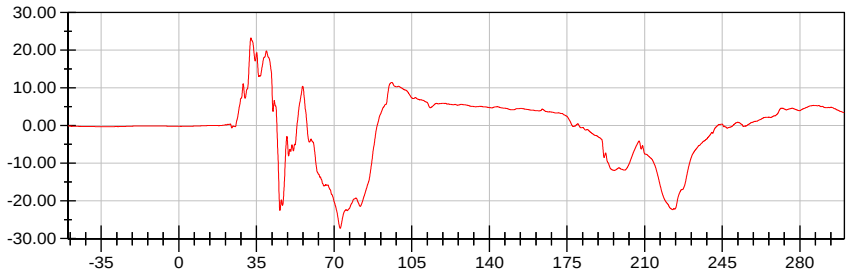
7.63 Nm at 88.05 ms

<Min>

-13.45 Nm at 48.65 ms

CFC_600

Left Lower Tibia Load Cell Moment Y (Nm) vs. Time [ms]



<Max>

23.28 Nm at 32.50 ms

<Min>

-27.29 Nm at 72.75 ms

CFC_600

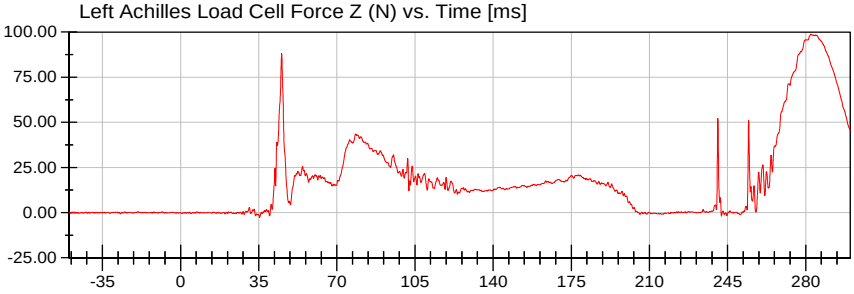
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Left Achilles Load Cell Force Z (N) vs. Time [ms]



<Max>

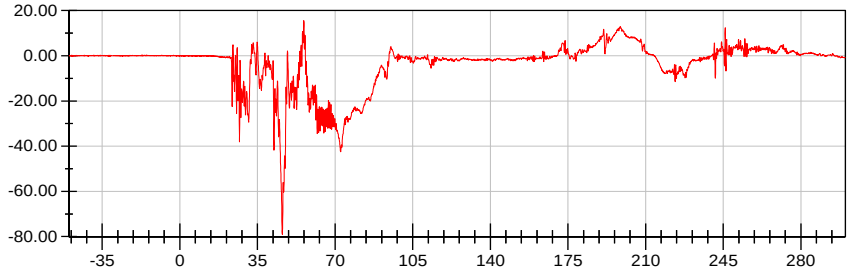
98.78 N at 282.35 ms

<Min>

-2.72 N at 35.35 ms

CFC_600

Left Tibia X Accelerometer (g) vs. Time [ms]



<Max>

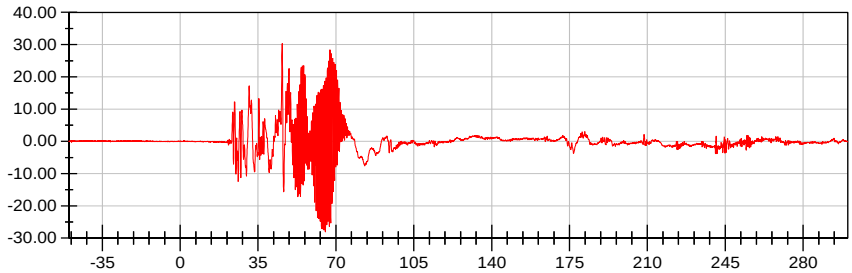
15.59 g at 55.90 ms

<Min>

-78.97 g at 46.20 ms

CFC_1000

Left Tibia Y Accelerometer (g) vs. Time [ms]



<Max>

30.33 g at 45.85 ms

<Min>

-28.11 g at 65.30 ms

CFC_1000

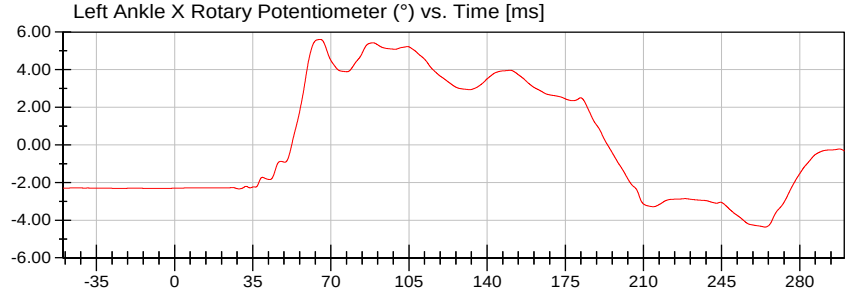
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Left Ankle X Rotary Potentiometer (°) vs. Time [ms]



<Max>

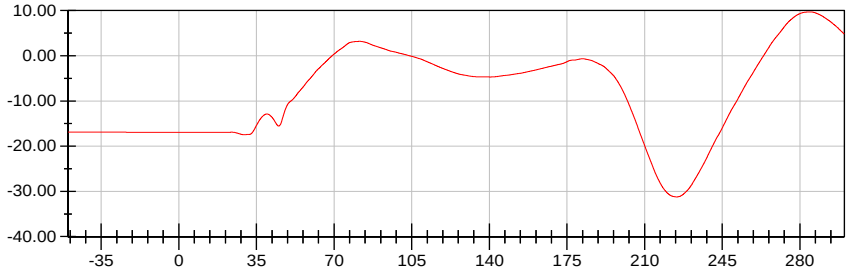
5.60 ° at 65.25 ms

<Min>

-4.37 ° at 264.50 ms

CFC_180

Left Ankle Y Rotary Potentiometer (°) vs. Time [ms]



<Max>

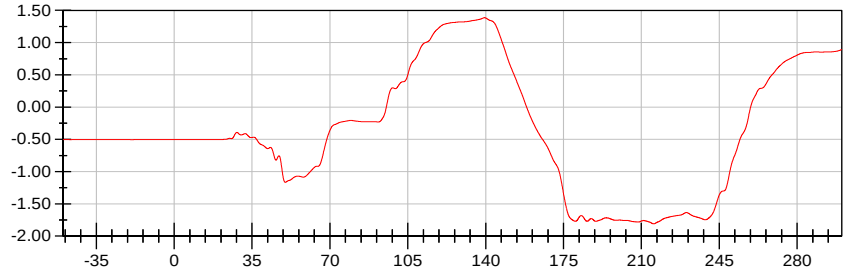
9.72 ° at 284.60 ms

<Min>

-31.23 ° at 224.50 ms

CFC_180

Left Ankle Z Rotary Potentiometer (°) vs. Time [ms]



<Max>

1.39 ° at 139.50 ms

<Min>

-1.81 ° at 215.50 ms

CFC_180

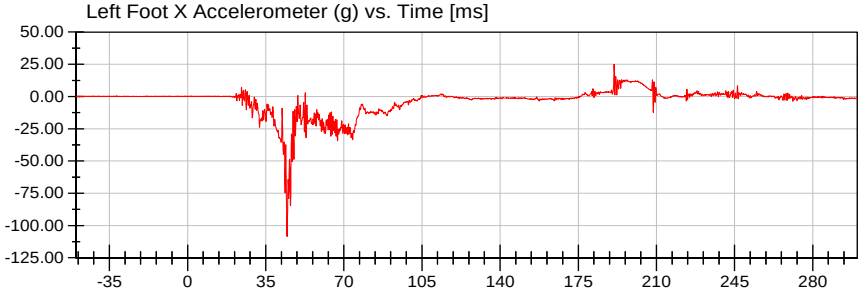
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Left Foot X Accelerometer (g) vs. Time [ms]



<Max>

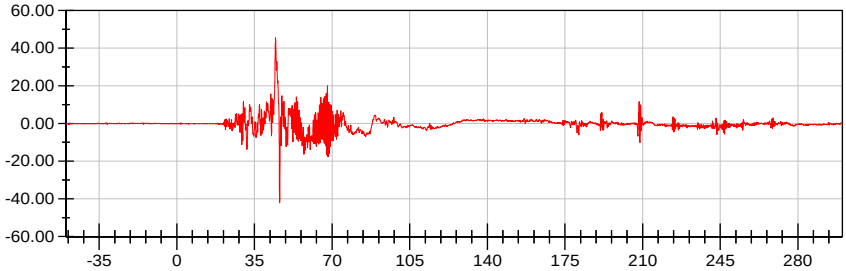
25.04 g at 191.00 ms

<Min>

-108.54 g at 44.55 ms

CFC_1000

Left Foot Y Accelerometer (g) vs. Time [ms]



<Max>

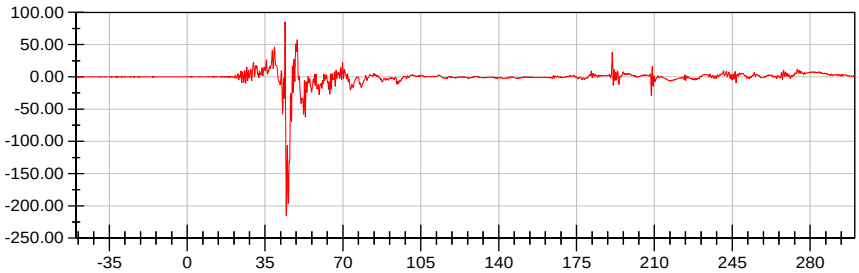
45.41 g at 44.50 ms

<Min>

-42.11 g at 46.35 ms

CFC_1000

Left Foot Z Accelerometer (g) vs. Time [ms]



<Max>

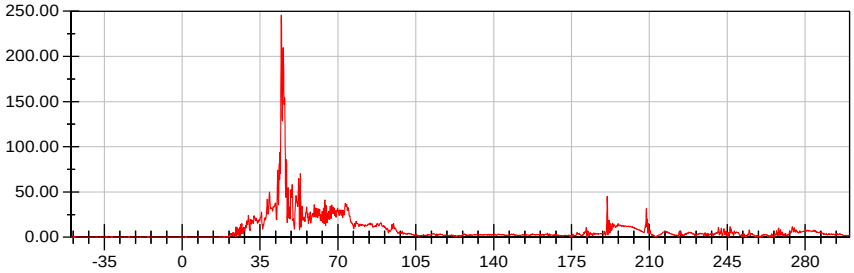
85.12 g at 44.00 ms

<Min>

-215.53 g at 44.55 ms

CFC_1000

Left Foot Accelerometer Resultant (g) vs. Time [ms]



<Max>

245.50 g at 44.55 ms

<Min>

0.04 g at -49.40 ms

CFC_1000

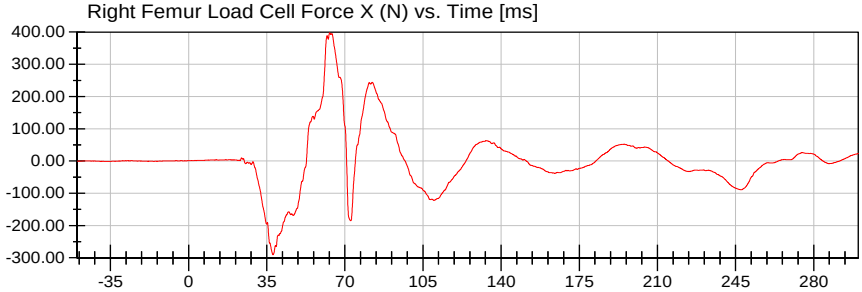
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Right Femur Load Cell Force X (N) vs. Time [ms]



<Max>

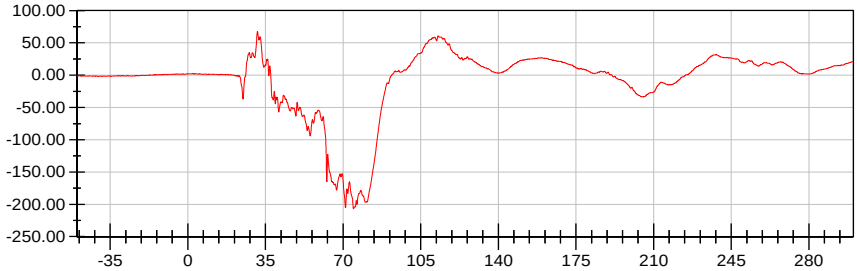
397.69 N at 63.20 ms

<Min>

-290.75 N at 37.80 ms

CFC_600

Right Femur Load Cell Force Y (N) vs. Time [ms]



<Max>

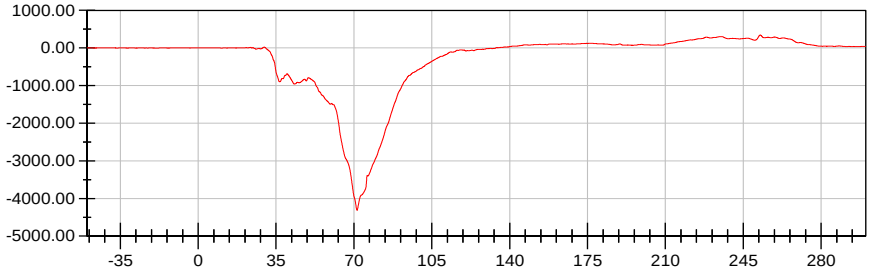
67.43 N at 31.40 ms

<Min>

-206.93 N at 74.75 ms

CFC_600

Right Femur Load Cell Force Z (N) vs. Time [ms]



<Max>

344.78 N at 252.60 ms

<Min>

-4,314.77 N at 71.40 ms

CFC_600

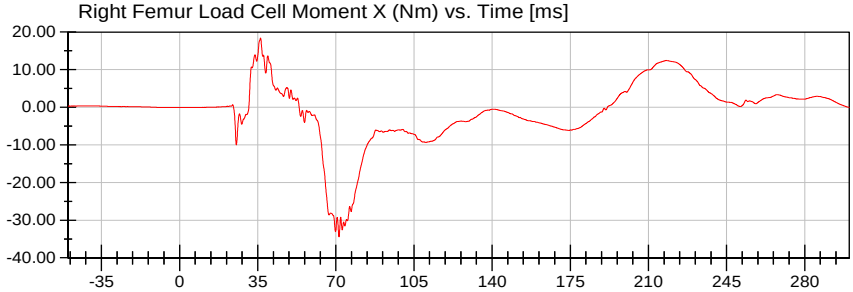
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Right Femur Load Cell Moment X (Nm) vs. Time [ms]



<Max>

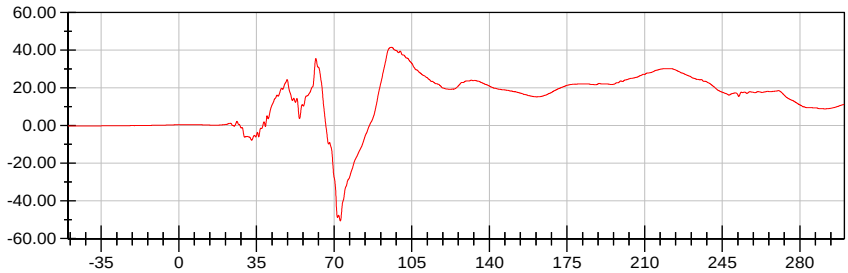
18.40 Nm at 36.30 ms

<Min>

-34.44 Nm at 71.40 ms

CFC_600

Right Femur Load Cell Moment Y (Nm) vs. Time [ms]



<Max>

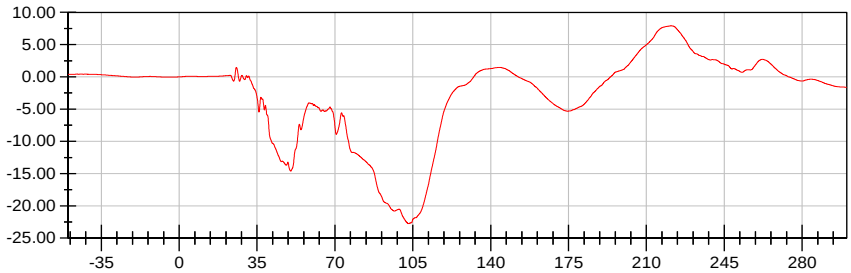
41.53 Nm at 95.95 ms

<Min>

-50.67 Nm at 72.85 ms

CFC_600

Right Femur Load Cell Moment Z (Nm) vs. Time [ms]



<Max>

7.91 Nm at 220.90 ms

<Min>

-22.75 Nm at 103.20 ms

CFC_600

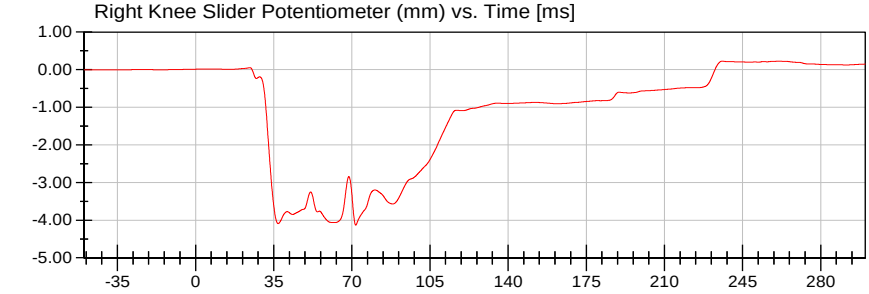
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Right Knee Slider Potentiometer (mm) vs. Time [ms]



<Max>

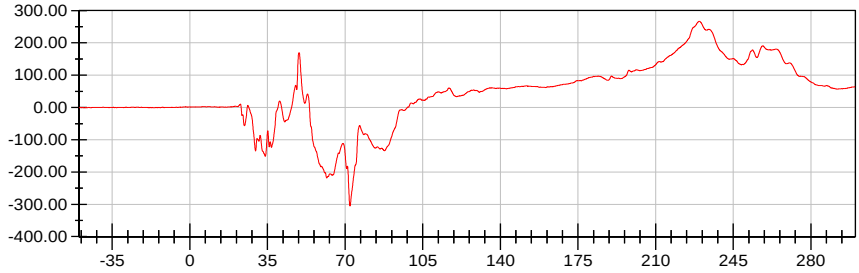
0.23 mm at 235.90 ms

<Min>

-4.13 mm at 71.75 ms

CFC_180

5-Channel Right Upper Tibia Load Cell Force X (N) vs. Time [ms]



<Max>

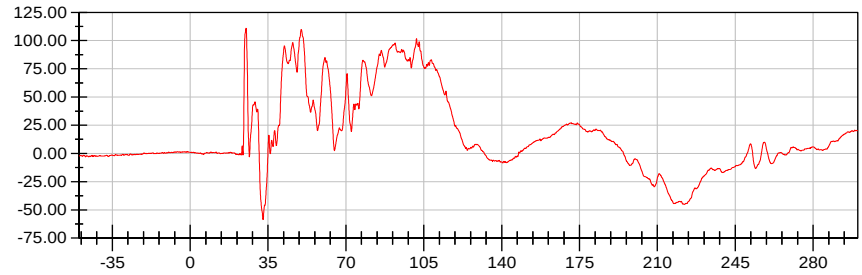
266.71 N at 229.60 ms

<Min>

-304.96 N at 72.20 ms

CFC_600

5-Channel Right Upper Tibia Load Cell Force Y (N) vs. Time [ms]



<Max>

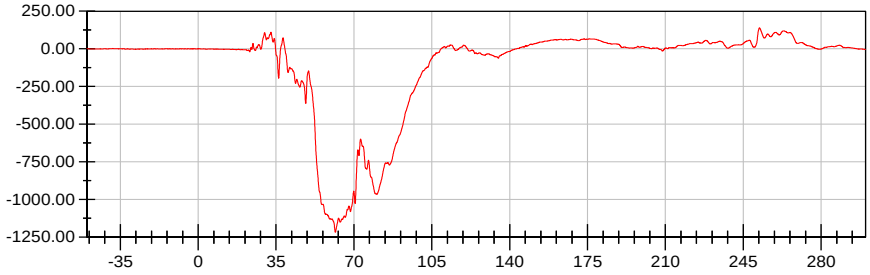
110.89 N at 25.10 ms

<Min>

-58.72 N at 32.75 ms

CFC_600

5-Channel Right Upper Tibia Load Cell Force Z (N) vs. Time [ms]



<Max>

139.20 N at 252.25 ms

<Min>

-1,216.76 N at 61.65 ms

CFC_600

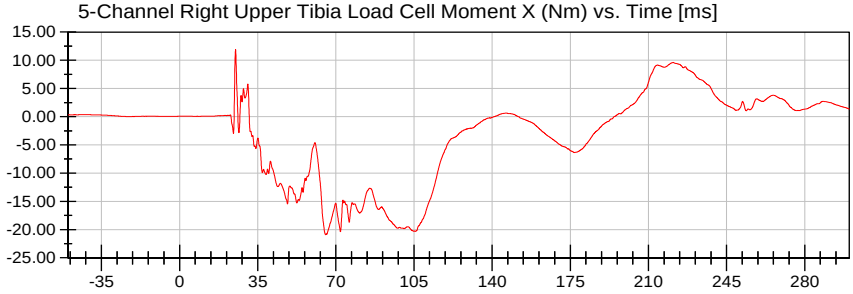
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

5-Channel Right Upper Tibia Load Cell Moment X (Nm) vs. Time [ms]



<Max>

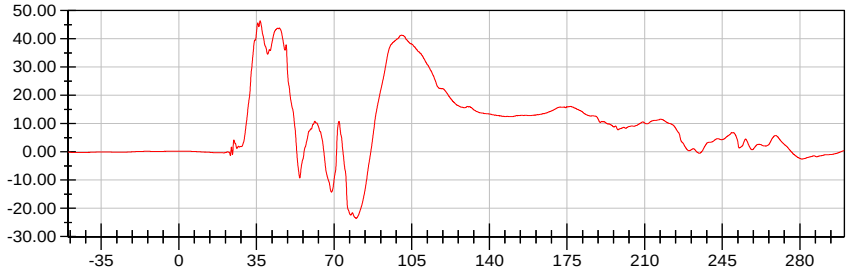
11.92 Nm at 25.05 ms

<Min>

-20.92 Nm at 65.40 ms

CFC_600

5-Channel Right Upper Tibia Load Cell Moment Y (Nm) vs. Time [ms]



<Max>

46.37 Nm at 36.70 ms

<Min>

-23.54 Nm at 79.95 ms

CFC_600

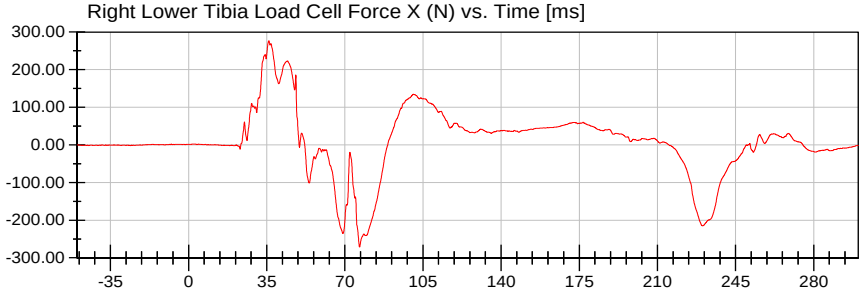
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Right Lower Tibia Load Cell Force X (N) vs. Time [ms]



<Max>

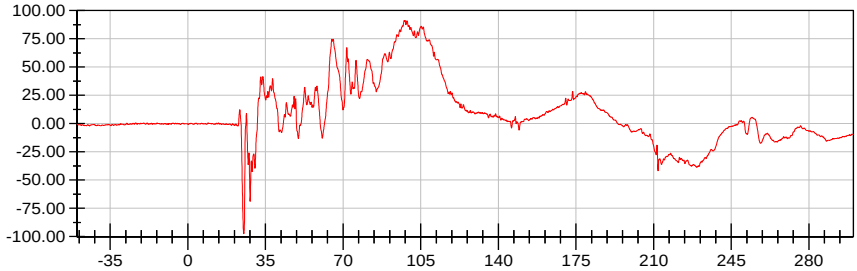
276.83 N at 36.00 ms

<Min>

-271.56 N at 76.60 ms

CFC_600

Right Lower Tibia Load Cell Force Y (N) vs. Time [ms]



<Max>

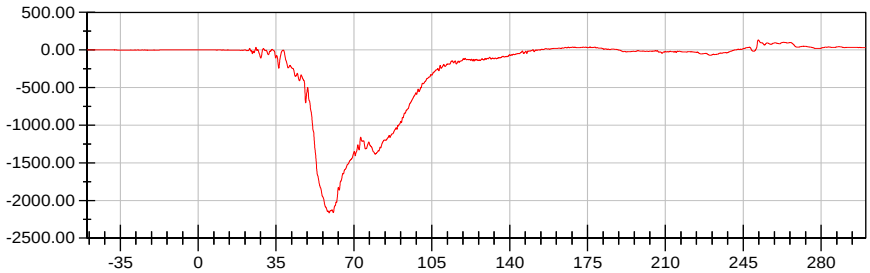
91.36 N at 97.90 ms

<Min>

-97.30 N at 25.25 ms

CFC_600

Right Lower Tibia Load Cell Force Z (N) vs. Time [ms]



<Max>

132.34 N at 251.75 ms

<Min>

-2,164.26 N at 58.90 ms

CFC_600

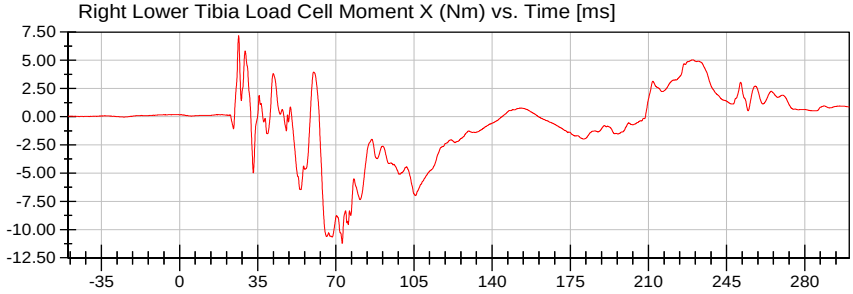
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Right Lower Tibia Load Cell Moment X (Nm) vs. Time [ms]



<Max>

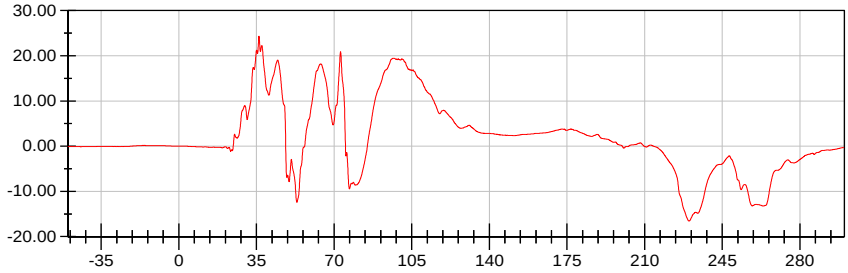
7.18 Nm at 26.50 ms

<Min>

-11.23 Nm at 72.85 ms

CFC_600

Right Lower Tibia Load Cell Moment Y (Nm) vs. Time [ms]



<Max>

24.32 Nm at 36.15 ms

<Min>

-16.56 Nm at 230.00 ms

CFC_600

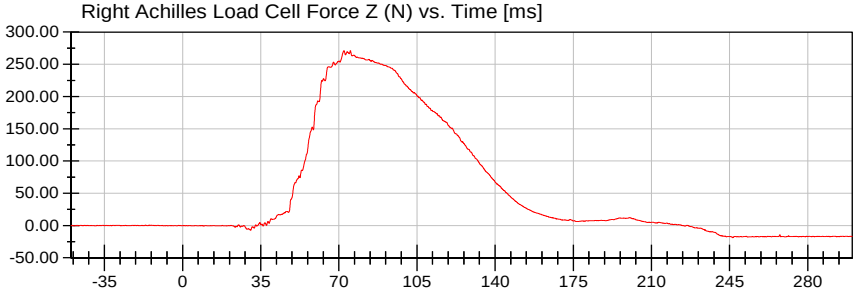
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Right Achilles Load Cell Force Z (N) vs. Time [ms]



<Max>

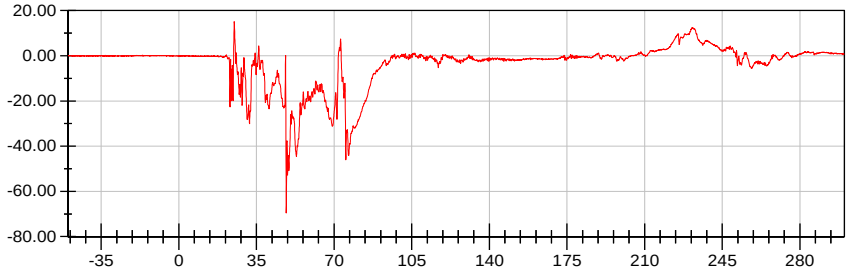
271.10 N at 75.15 ms

<Min>

-18.87 N at 246.40 ms

CFC_600

Right Tibia X Accelerometer (g) vs. Time [ms]



<Max>

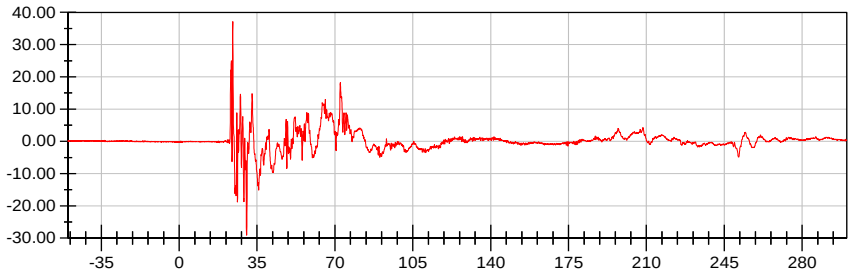
15.07 g at 25.00 ms

<Min>

-69.55 g at 48.45 ms

CFC_1000

Right Tibia Y Accelerometer (g) vs. Time [ms]



<Max>

37.14 g at 24.05 ms

<Min>

-29.09 g at 30.30 ms

CFC_1000

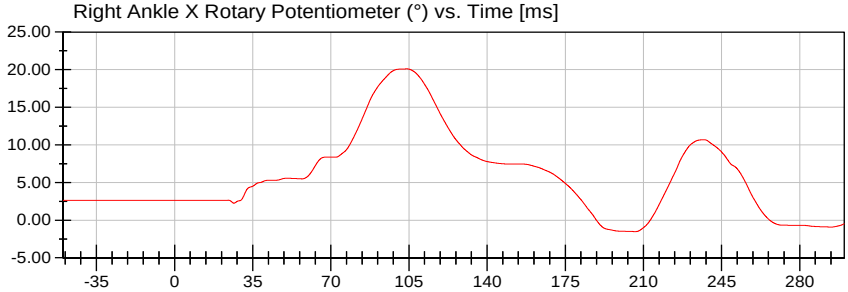
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Right Ankle X Rotary Potentiometer (°) vs. Time [ms]



<Max>

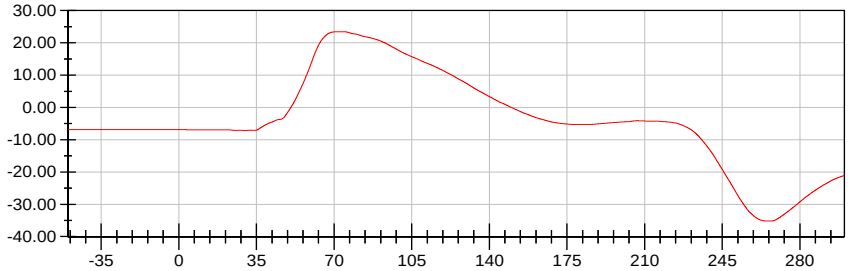
20.10 ° at 104.00 ms

<Min>

-1.53 ° at 206.30 ms

CFC_180

Right Ankle Y Rotary Potentiometer (°) vs. Time [ms]



<Max>

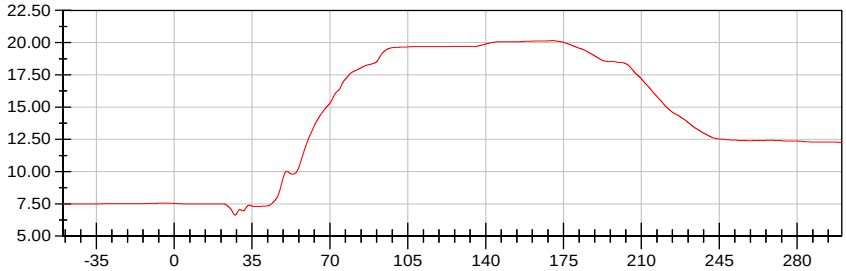
23.45 ° at 74.00 ms

<Min>

-35.19 ° at 266.50 ms

CFC_180

Right Ankle Z Rotary Potentiometer (°) vs. Time [ms]



<Max>

20.16 ° at 170.15 ms

<Min>

6.62 ° at 27.35 ms

CFC_180

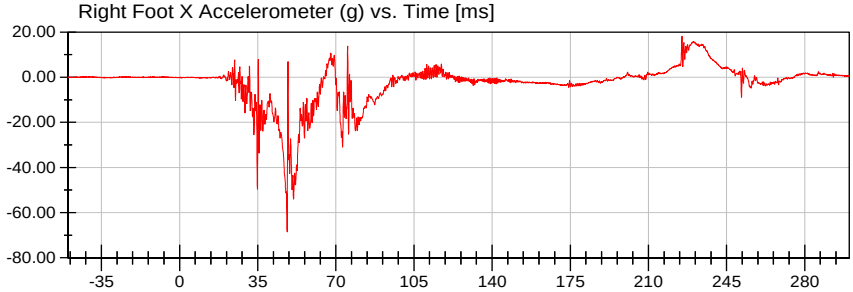
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Right Foot X Accelerometer (g) vs. Time [ms]



<Max>

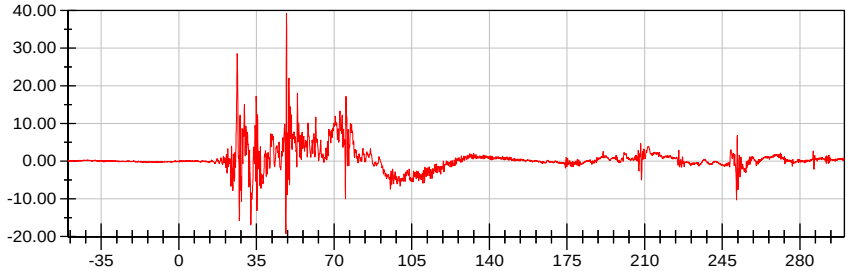
18.14 g at 225.00 ms

<Min>

-68.51 g at 48.20 ms

CFC_1000

Right Foot Y Accelerometer (g) vs. Time [ms]



<Max>

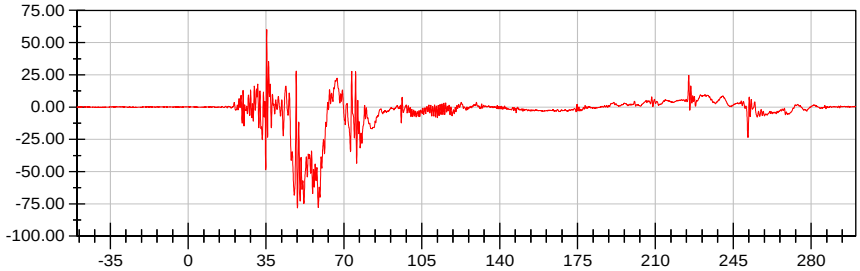
39.32 g at 48.55 ms

<Min>

-19.22 g at 48.25 ms

CFC_1000

Right Foot Z Accelerometer (g) vs. Time [ms]



<Max>

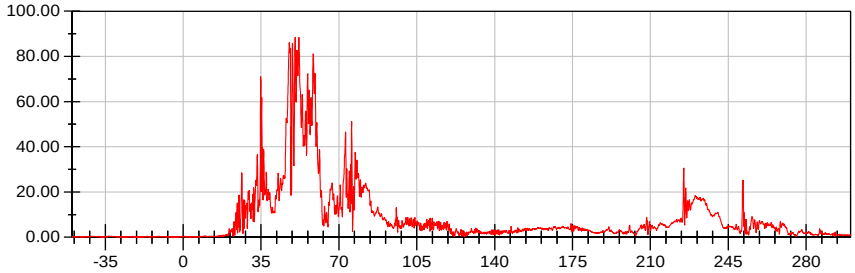
60.14 g at 35.30 ms

<Min>

-78.10 g at 49.10 ms

CFC_1000

Right Foot Accelerometer Resultant (g) vs. Time [ms]



<Max>

88.43 g at 50.35 ms

<Min>

0.04 g at -36.65 ms

CFC_1000

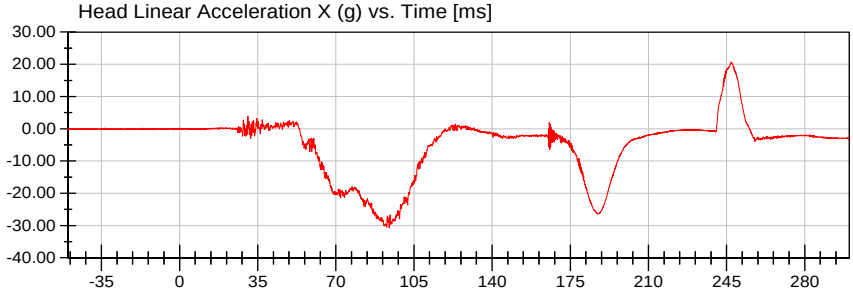
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Head Linear Acceleration X (g) vs. Time [ms]



<Max>

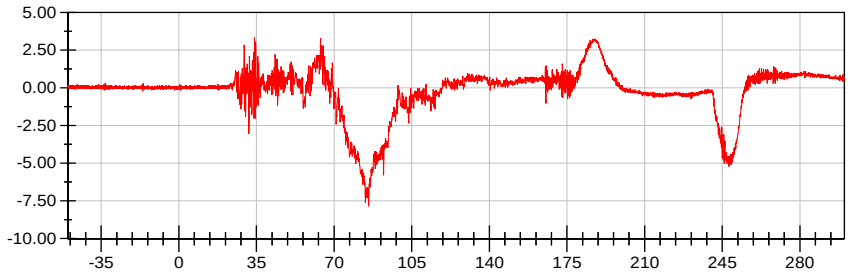
20.70 g at 247.05 ms

<Min>

-30.74 g at 93.85 ms

CFC_1000

Head Linear Acceleration Y (g) vs. Time [ms]



<Max>

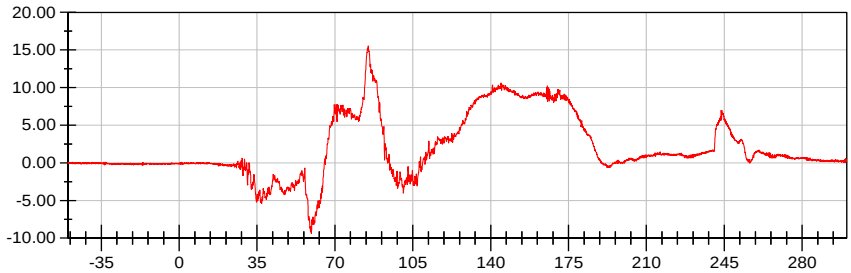
3.35 g at 34.15 ms

<Min>

-7.84 g at 85.60 ms

CFC_1000

Head Linear Acceleration Z (g) vs. Time [ms]



<Max>

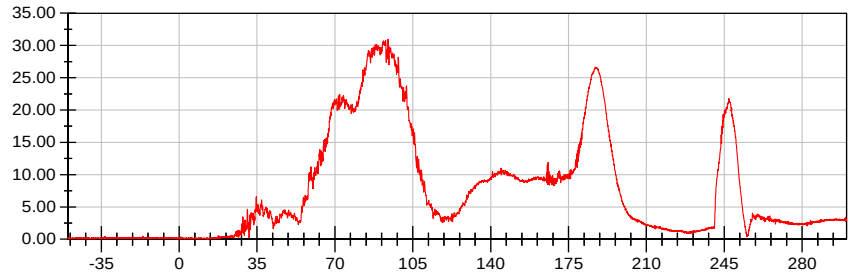
15.53 g at 85.00 ms

<Min>

-9.36 g at 59.40 ms

CFC_1000

Head Linear Acceleration Resultant (g) vs. Time [ms]



<Max>

30.96 g at 93.85 ms

<Min>

0.04 g at -49.60 ms

CFC_1000

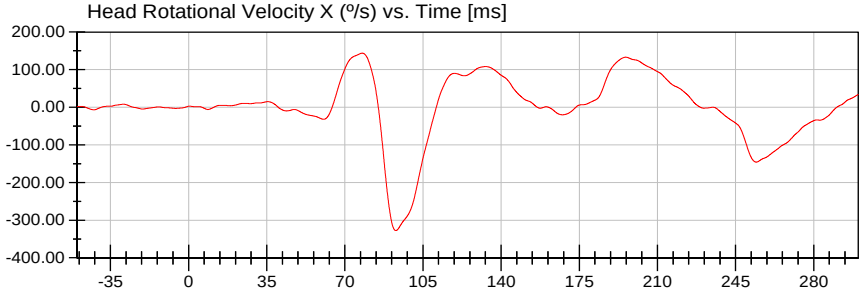
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Head Rotational Velocity X (º/s) vs. Time [ms]



<Max>

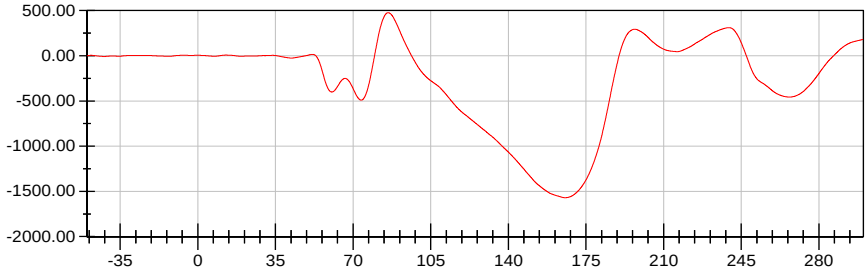
143.87 º/s at 77.80 ms

<Min>

-327.53 º/s at 92.85 ms

CFC_60

Head Rotational Velocity Y (º/s) vs. Time [ms]



<Max>

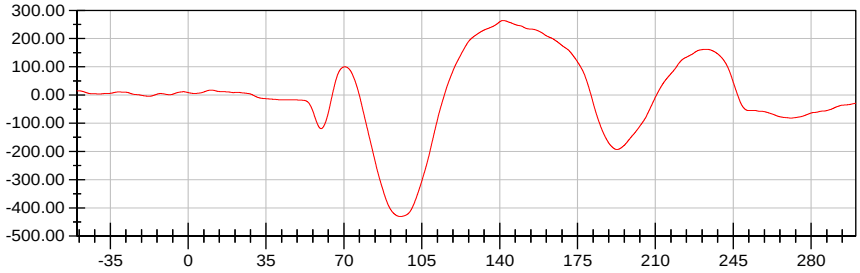
476.80 º/s at 85.80 ms

<Min>

-1,570.60 º/s at 165.65 ms

CFC_60

Head Rotational Velocity Z (º/s) vs. Time [ms]



<Max>

263.91 º/s at 141.60 ms

<Min>

-430.42 º/s at 95.40 ms

CFC_60

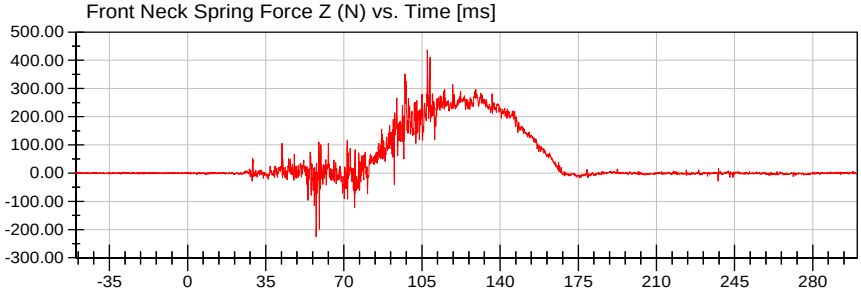
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Front Neck Spring Force Z (N) vs. Time [ms]



<Max>

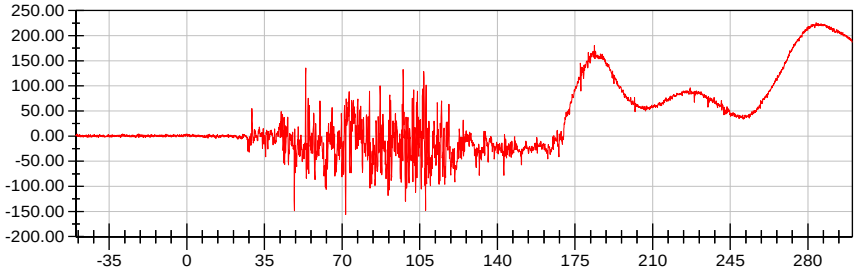
435.98 N at 107.40 ms

<Min>

-225.46 N at 57.60 ms

CFC_1000

Rear Neck Spring Force Z (N) vs. Time [ms]



<Max>

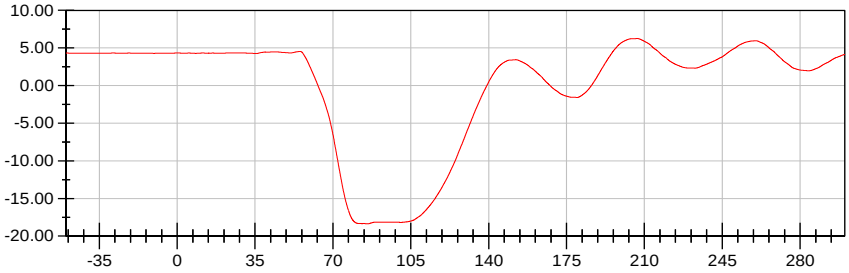
225.76 N at 283.75 ms

<Min>

-155.99 N at 71.65 ms

CFC_1000

Occipital Condyle Angular Displacement Y (º) vs. Time [ms]



<Max>

6.26 º at 206.75 ms

<Min>

-18.37 º at 85.55 ms

CFC_180

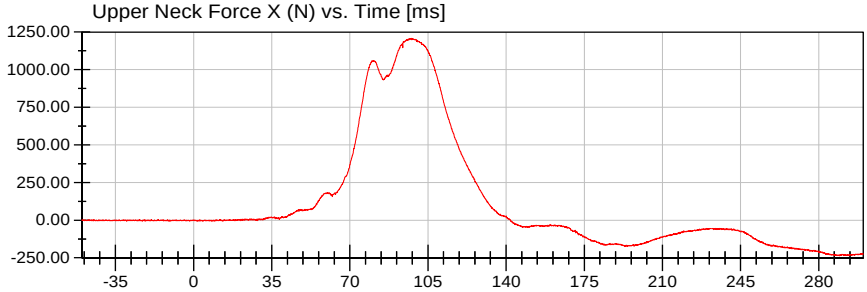
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Upper Neck Force X (N) vs. Time [ms]



<Max>

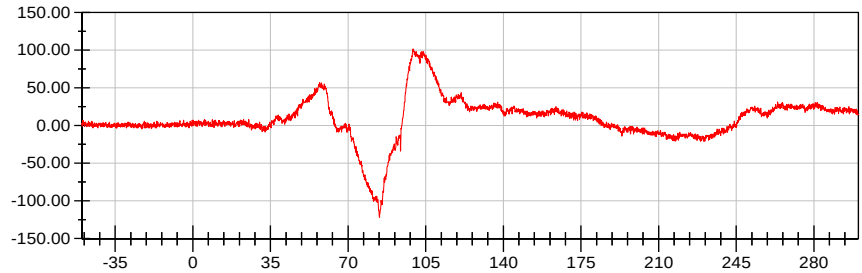
1,208.03 N at 97.55 ms

<Min>

-237.07 N at 289.30 ms

CFC_1000

Upper Neck Force Y (N) vs. Time [ms]



<Max>

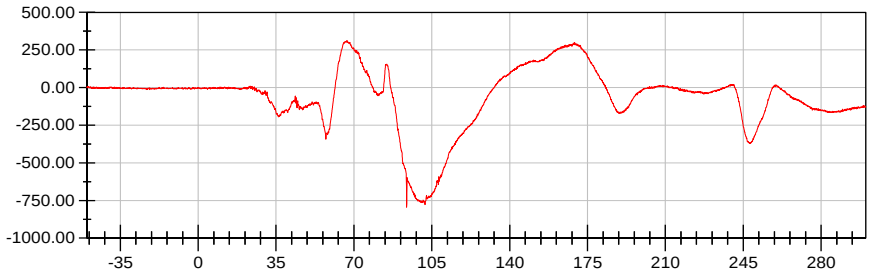
101.83 N at 99.30 ms

<Min>

-121.84 N at 84.15 ms

CFC_1000

Upper Neck Force Z (N) vs. Time [ms]



<Max>

312.16 N at 66.85 ms

<Min>

-795.36 N at 93.70 ms

CFC_1000

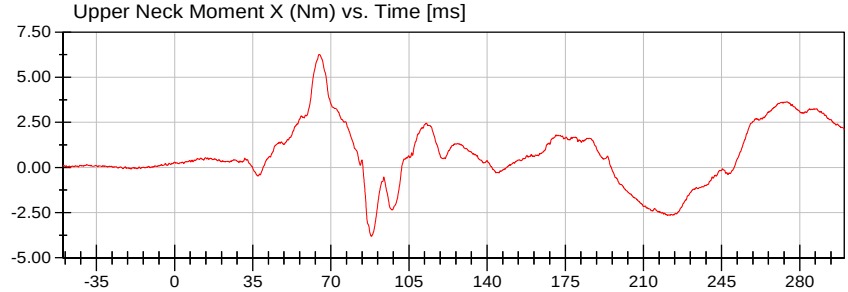
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Upper Neck Moment X (Nm) vs. Time [ms]



<Max>

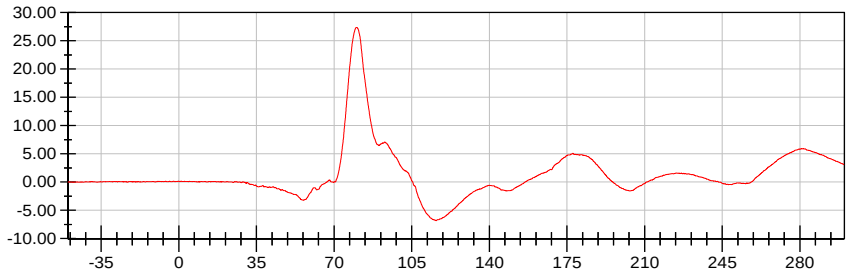
6.26 Nm at 64.75 ms

<Min>

-3.81 Nm at 88.25 ms

CFC_600

Upper Neck Moment Y (Nm) vs. Time [ms]



<Max>

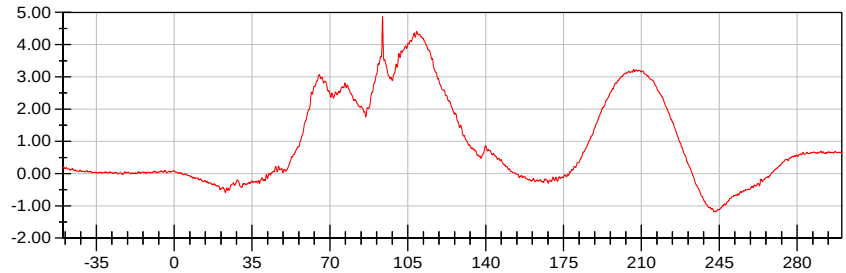
27.39 Nm at 80.15 ms

<Min>

-6.83 Nm at 116.00 ms

CFC_600

Upper Neck Moment Z (Nm) vs. Time [ms]



<Max>

4.87 Nm at 93.65 ms

<Min>

-1.18 Nm at 242.55 ms

CFC_600

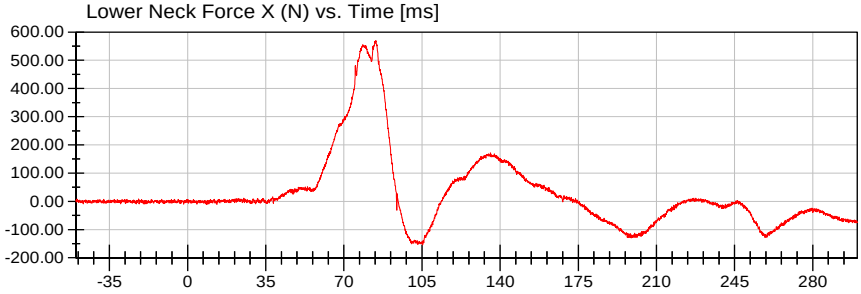
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Lower Neck Force X (N) vs. Time [ms]



<Max>

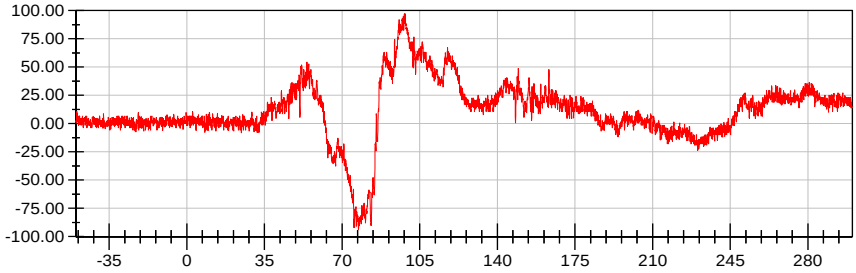
569.97 N at 84.30 ms

<Min>

-154.68 N at 105.30 ms

CFC_1000

Lower Neck Force Y (N) vs. Time [ms]



<Max>

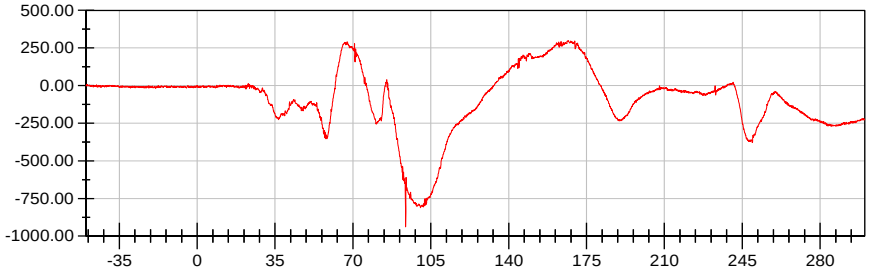
97.10 N at 98.10 ms

<Min>

-94.07 N at 77.35 ms

CFC_1000

Lower Neck Force Z (N) vs. Time [ms]



<Max>

297.83 N at 166.75 ms

<Min>

-939.10 N at 93.70 ms

CFC_1000

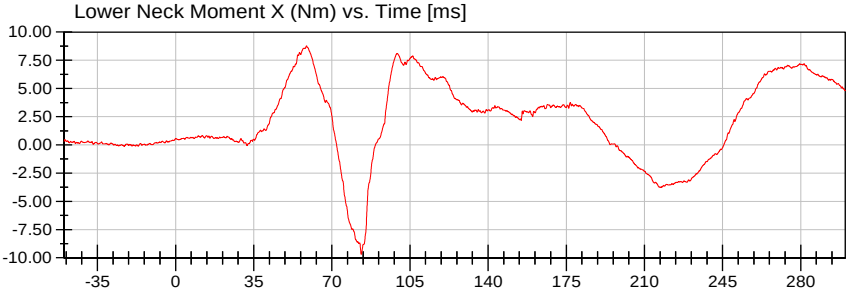
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Lower Neck Moment X (Nm) vs. Time [ms]



<Max>

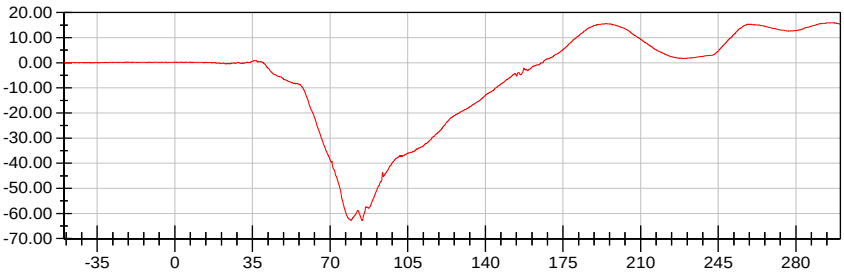
8.77 Nm at 58.65 ms

<Min>

-9.68 Nm at 83.15 ms

CFC_600

Lower Neck Moment Y (Nm) vs. Time [ms]



<Max>

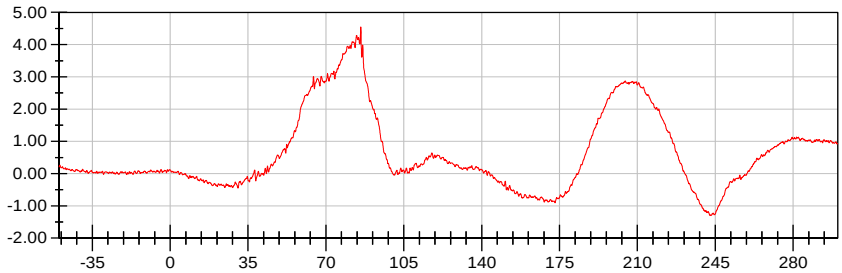
15.93 Nm at 296.80 ms

<Min>

-62.87 Nm at 84.45 ms

CFC_600

Lower Neck Moment Z (Nm) vs. Time [ms]



<Max>

4.55 Nm at 85.70 ms

<Min>

-1.29 Nm at 243.25 ms

CFC_600

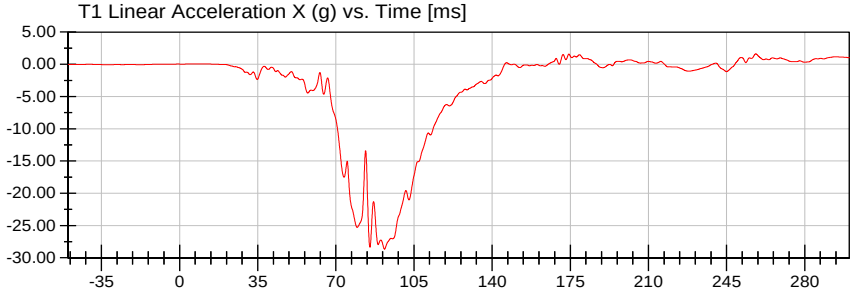
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

T1 Linear Acceleration X (g) vs. Time [ms]



<Max>

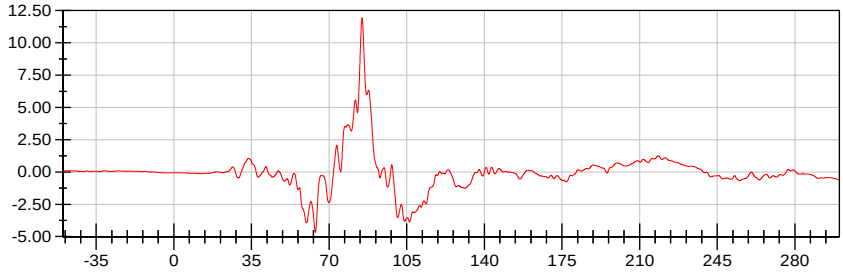
1.62 g at 258.10 ms

<Min>

-28.66 g at 91.80 ms

CFC_180

T1 Linear Acceleration Y (g) vs. Time [ms]



<Max>

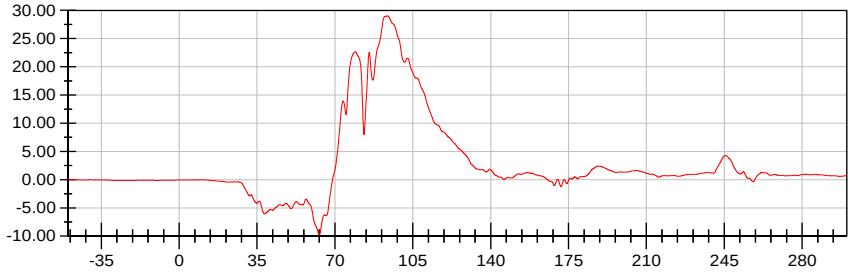
11.93 g at 84.90 ms

<Min>

-4.68 g at 63.80 ms

CFC_180

T1 Linear Acceleration Z (g) vs. Time [ms]



<Max>

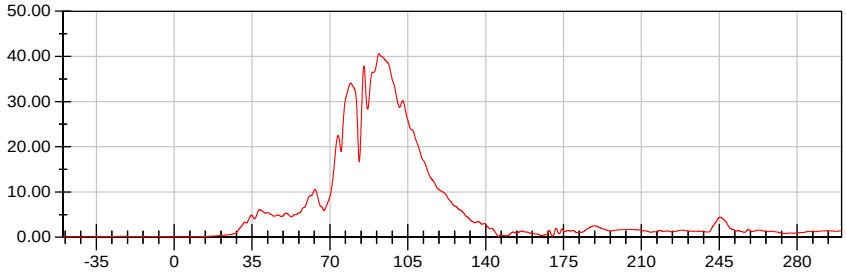
29.03 g at 93.60 ms

<Min>

-9.78 g at 62.95 ms

CFC_180

T1 Linear Acceleration Resultant (g) vs. Time [ms]



<Max>

40.56 g at 92.10 ms

<Min>

0.05 g at -41.00 ms

CFC_180

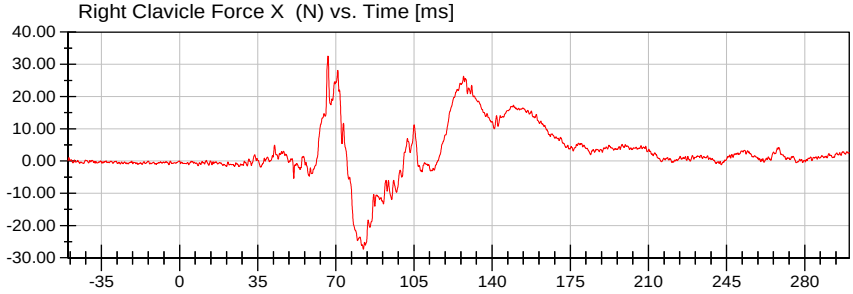
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Right Clavicle Force X (N) vs. Time [ms]



<Max>

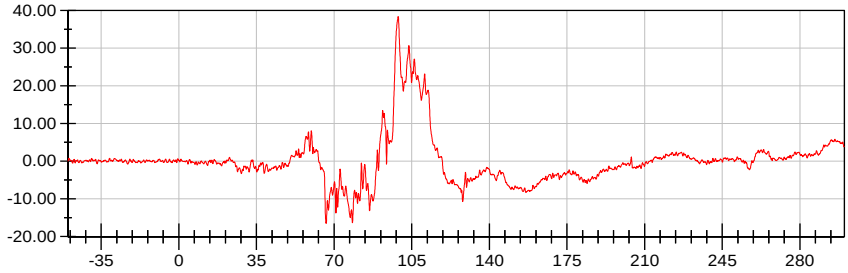
32.54 N at 66.50 ms

<Min>

-27.39 N at 82.35 ms

CFC_600

Right Clavicle Force Z (N) vs. Time [ms]



<Max>

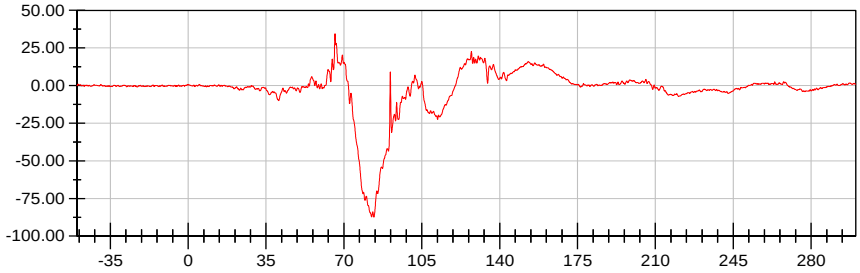
38.43 N at 98.90 ms

<Min>

-16.53 N at 66.40 ms

CFC_600

Right Clavicle Force X (N) vs. Time [ms]



<Max>

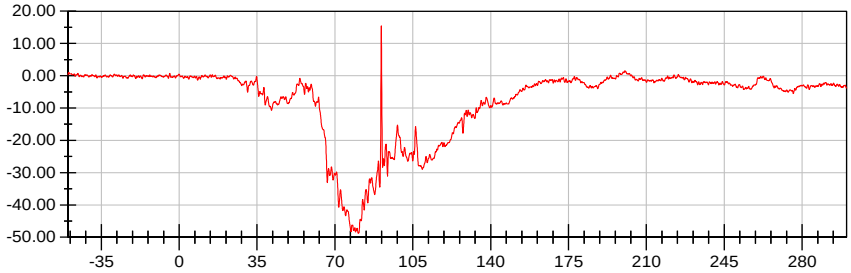
34.31 N at 66.00 ms

<Min>

-87.39 N at 83.45 ms

CFC_600

Right Clavicle Force Z (N) vs. Time [ms]



<Max>

15.41 N at 90.85 ms

<Min>

-48.79 N at 80.55 ms

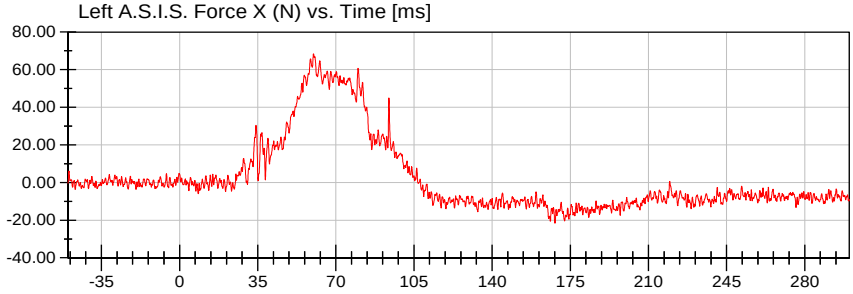
CFC_600

VRTC

Test Date: 11/15/2022

Test Lab: CTF
Test Number: 221115 ()

Left A.S.I.S. Force X (N) vs. Time [ms]



<Max>

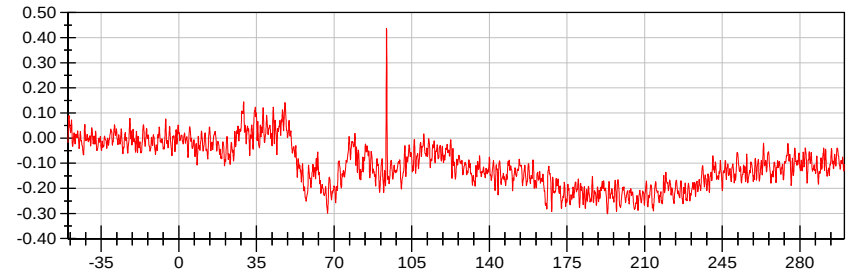
68.42 N at 60.00 ms

<Min>

-21.55 N at 168.15 ms

CFC_600

Left A.S.I.S. Moment Y (Nm) vs. Time [ms]



<Max>

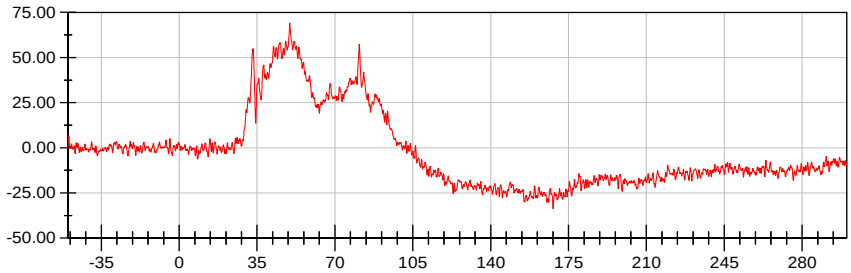
0.44 Nm at 93.65 ms

<Min>

-0.30 Nm at 193.25 ms

CFC_600

Right A.S.I.S. Force X (N) vs. Time [ms]



<Max>

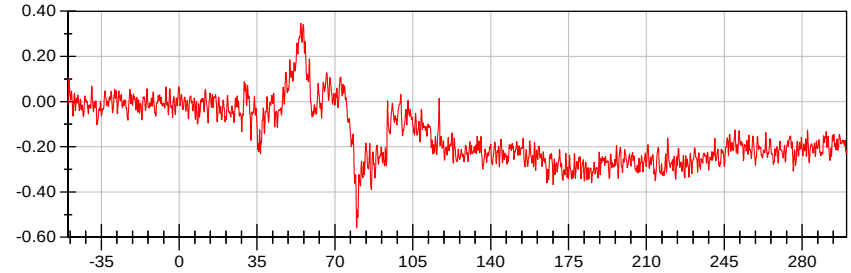
69.05 N at 49.70 ms

<Min>

-33.74 N at 168.10 ms

CFC_600

Right A.S.I.S. Moment Y (Nm) vs. Time [ms]



<Max>

0.35 Nm at 54.65 ms

<Min>

-0.56 Nm at 79.75 ms

CFC_600

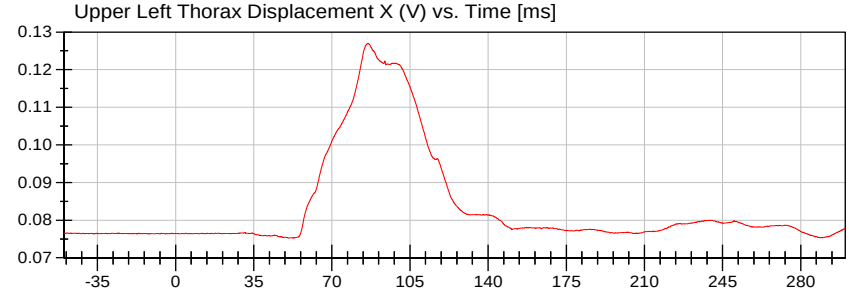
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Upper Left Thorax Displacement X (V) vs. Time [ms]



<Max>

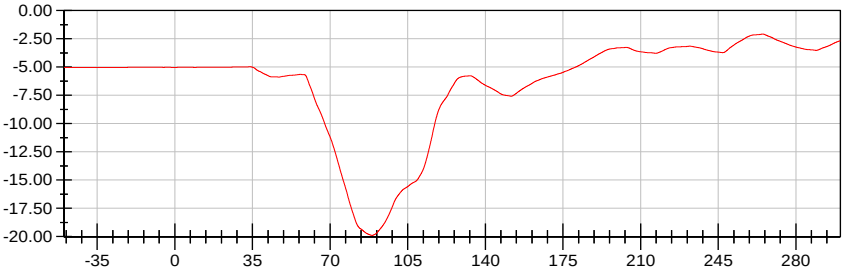
0.13 V at 86.25 ms

<Min>

0.08 V at 52.40 ms

CFC_600

Upper Left Thorax Angular Displacement Y (º) vs. Time [ms]



<Max>

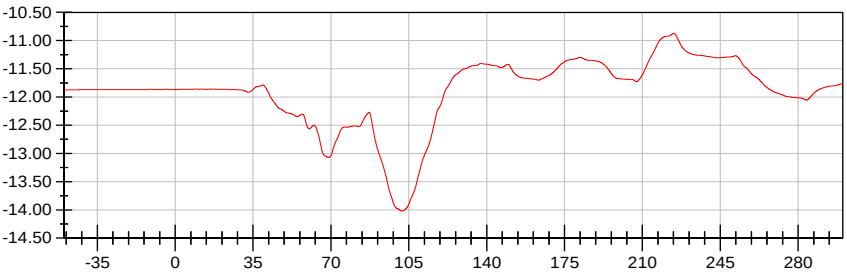
-2.08 º at 265.05 ms

<Min>

-19.89 º at 88.95 ms

CFC_180

Upper Left Thorax Angular Displacement Z (º) vs. Time [ms]



<Max>

-10.87 º at 224.10 ms

<Min>

-14.02 º at 101.95 ms

CFC_180

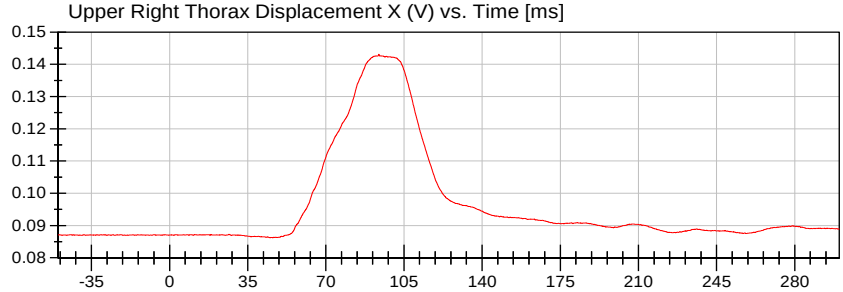
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Upper Right Thorax Displacement X (V) vs. Time [ms]



<Max>

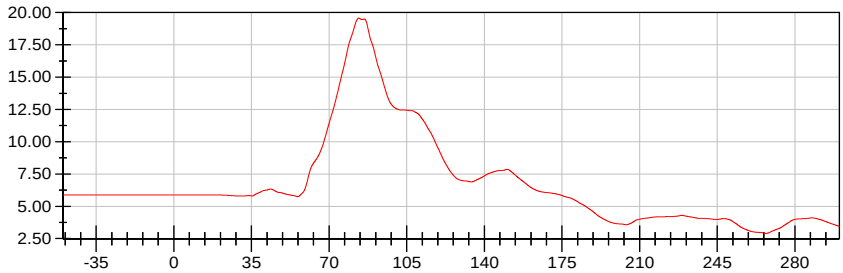
0.14 V at 93.75 ms

<Min>

0.09 V at 46.20 ms

CFC_600

Upper Right Thorax Angular Displacement Y (º) vs. Time [ms]



<Max>

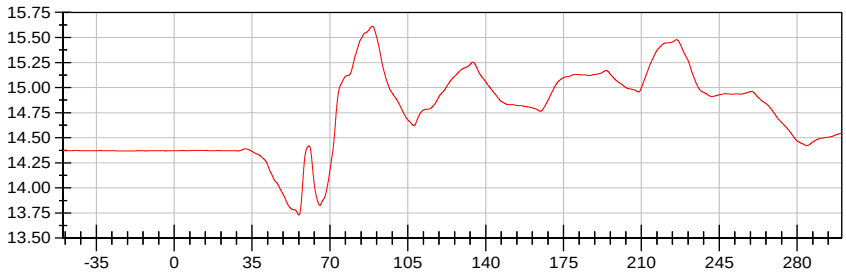
19.57 º at 83.40 ms

<Min>

2.90 º at 267.10 ms

CFC_180

Upper Right Thorax Angular Displacement Z (º) vs. Time [ms]



<Max>

15.61 º at 89.10 ms

<Min>

13.73 º at 56.05 ms

CFC_180

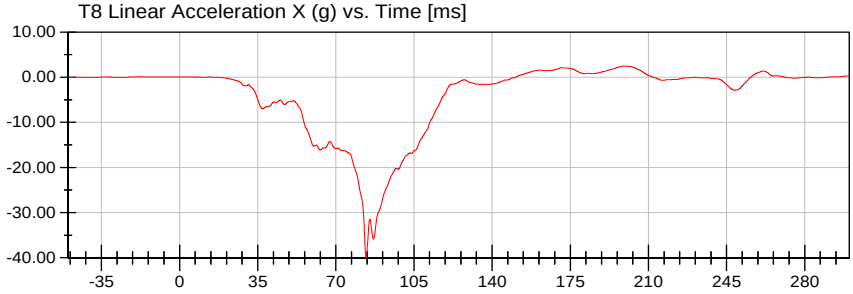
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

T8 Linear Acceleration X (g) vs. Time [ms]



<Max>

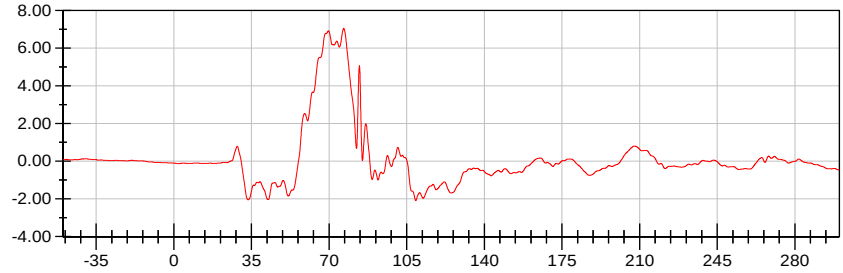
2.49 g at 199.60 ms

<Min>

-39.95 g at 83.55 ms

CFC_180

T8 Linear Acceleration Y (g) vs. Time [ms]



<Max>

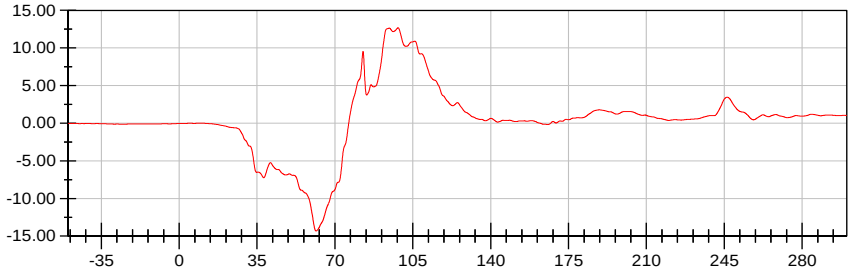
7.05 g at 76.60 ms

<Min>

-2.09 g at 109.10 ms

CFC_180

T8 Linear Acceleration Z (g) vs. Time [ms]



<Max>

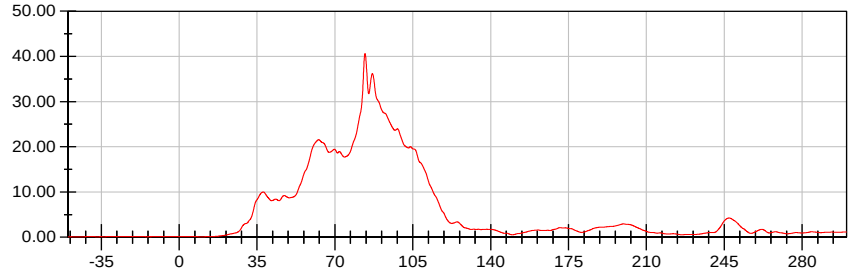
12.69 g at 98.35 ms

<Min>

-14.32 g at 61.50 ms

CFC_180

T8 Linear Acceleration Resultant (g) vs. Time [ms]



<Max>

40.61 g at 83.50 ms

<Min>

0.09 g at -46.35 ms

CFC_180

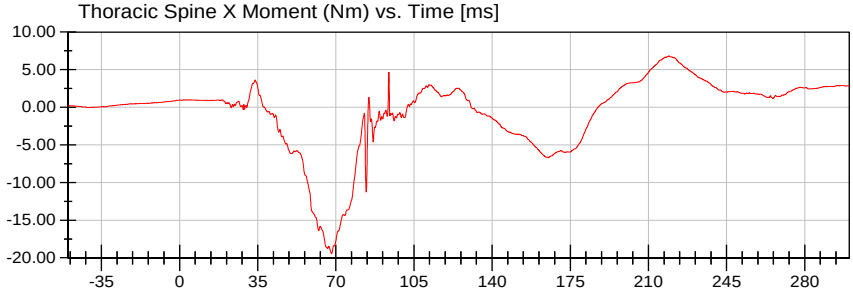
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Thoracic Spine X Moment (Nm) vs. Time [ms]



<Max>

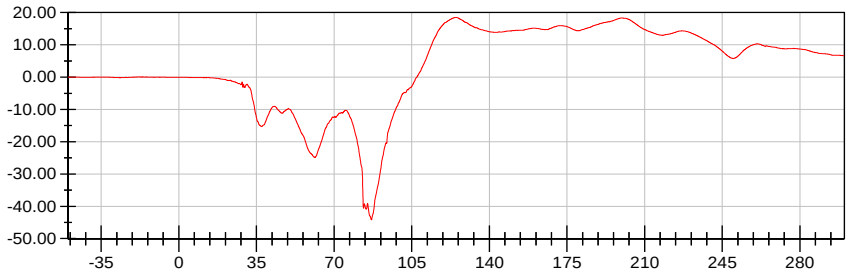
6.84 Nm at 219.15 ms

<Min>

-19.44 Nm at 68.10 ms

CFC_600

Thoracic Spine Y Moment (Nm) vs. Time [ms]



<Max>

18.50 Nm at 125.25 ms

<Min>

-44.23 Nm at 86.85 ms

CFC_600

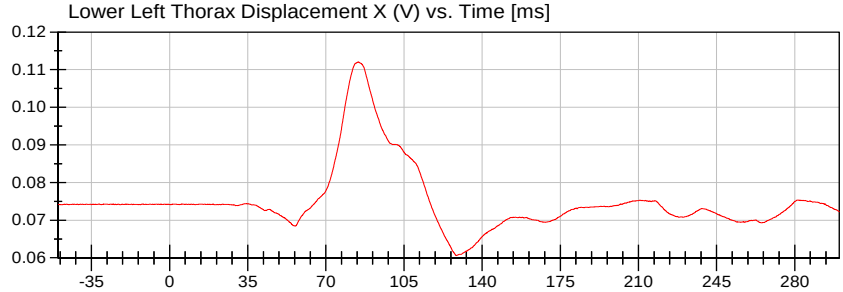
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Lower Left Thorax Displacement X (V) vs. Time [ms]



<Max>

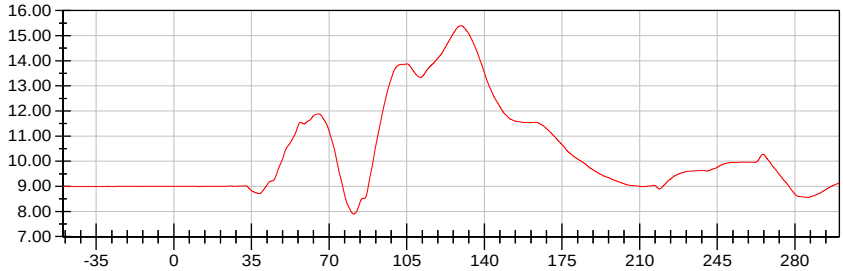
0.11 V at 84.55 ms

<Min>

0.06 V at 128.40 ms

CFC_600

Lower Left Thorax Angular Displacement Y (º) vs. Time [ms]



<Max>

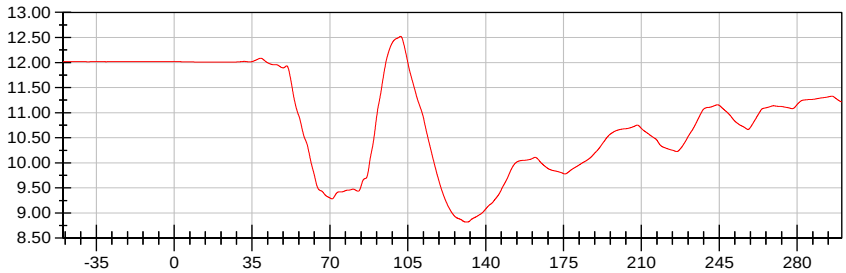
15.39 º at 129.45 ms

<Min>

7.90 º at 81.15 ms

CFC_180

Lower Left Thorax Angular Displacement Z (º) vs. Time [ms]



<Max>

12.52 º at 101.75 ms

<Min>

8.82 º at 131.65 ms

CFC_180

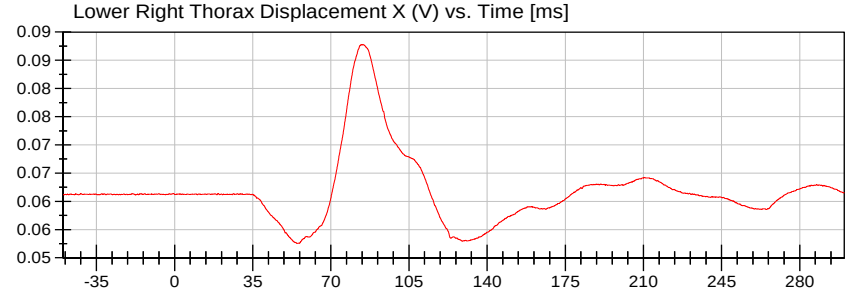
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Lower Right Thorax Displacement X (V) vs. Time [ms]



<Max>

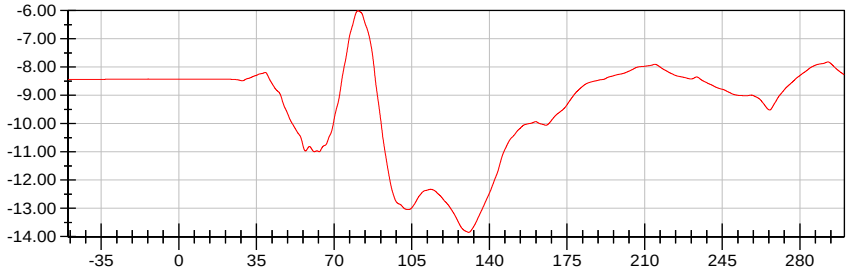
0.09 V at 84.70 ms

<Min>

0.05 V at 54.90 ms

CFC_600

Lower Right Thorax Angular Displacement Y (º) vs. Time [ms]



<Max>

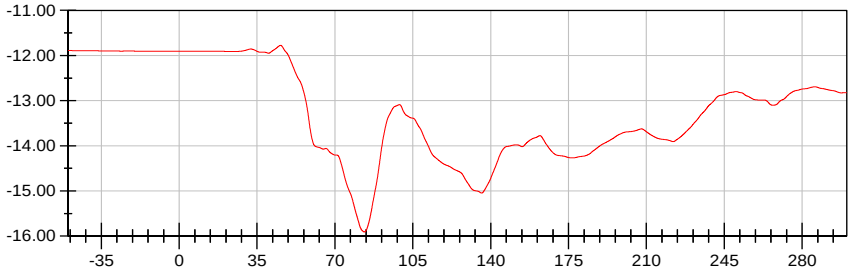
-6.01 º at 80.75 ms

<Min>

-13.85 º at 130.75 ms

CFC_180

Lower Right Thorax Angular Displacement Z (º) vs. Time [ms]



<Max>

-11.77 º at 45.60 ms

<Min>

-15.91 º at 83.25 ms

CFC_180

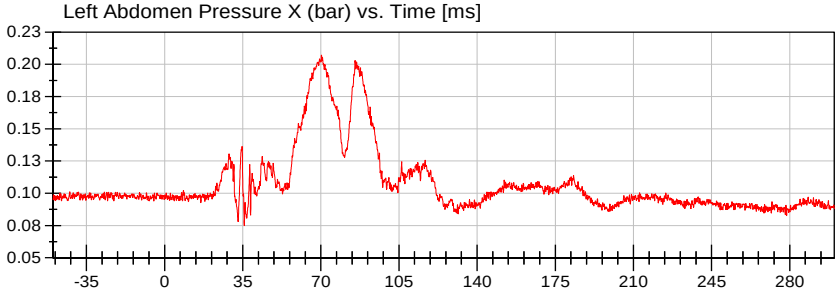
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Left Abdomen Pressure X (bar) vs. Time [ms]



<Max>

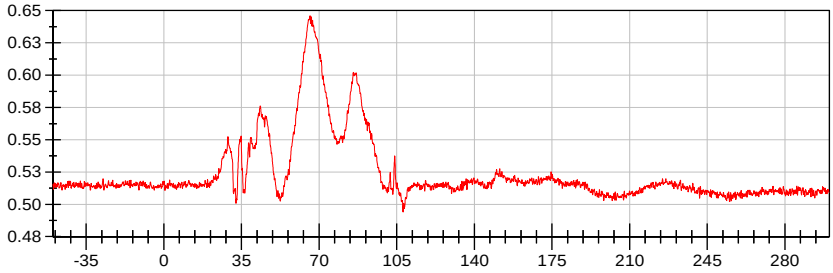
0.21 bar at 70.30 ms

<Min>

0.07 bar at 35.75 ms

CFC_1000

Right Abdomen Pressure X (bar) vs. Time [ms]



<Max>

0.65 bar at 65.90 ms

<Min>

0.49 bar at 107.85 ms

CFC_1000

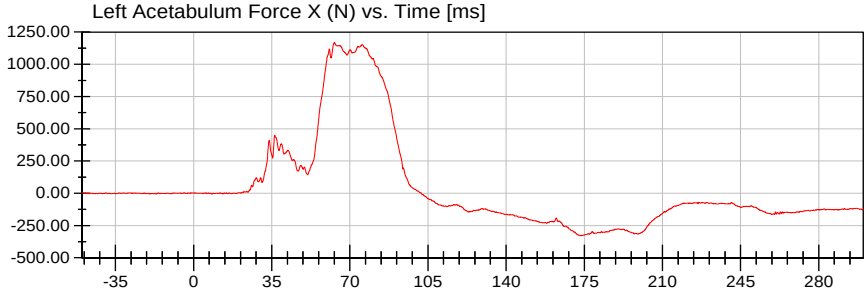
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Left Acetabulum Force X (N) vs. Time [ms]



<Max>

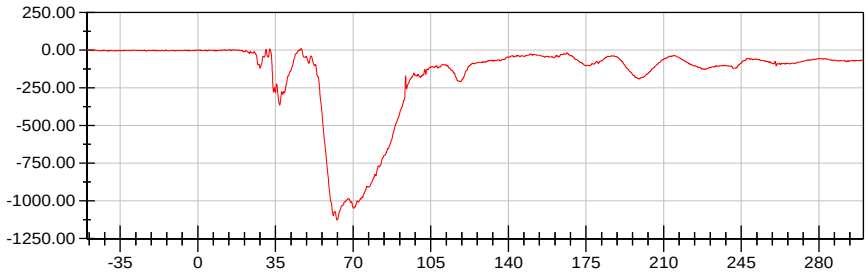
1,167.22 N at 63.10 ms

<Min>

-328.91 N at 173.45 ms

CFC_600

Left Acetabulum Force Y (N) vs. Time [ms]



<Max>

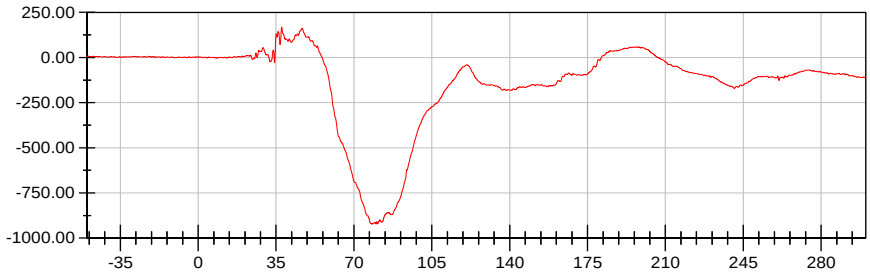
10.71 N at 46.55 ms

<Min>

-1,128.34 N at 62.80 ms

CFC_600

Left Acetabulum Force Z (N) vs. Time [ms]



<Max>

167.41 N at 37.55 ms

<Min>

-921.34 N at 78.05 ms

CFC_600

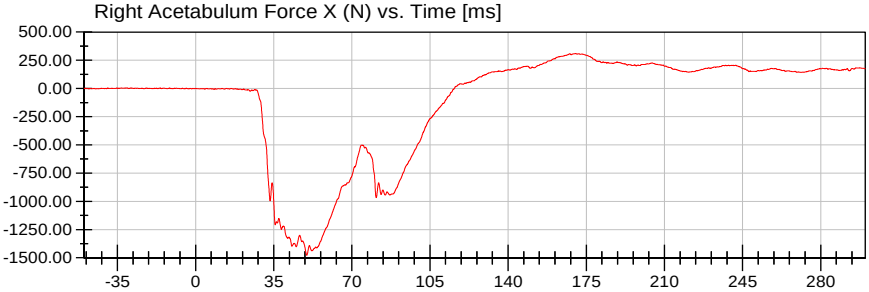
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Right Acetabulum Force X (N) vs. Time [ms]



<Max>

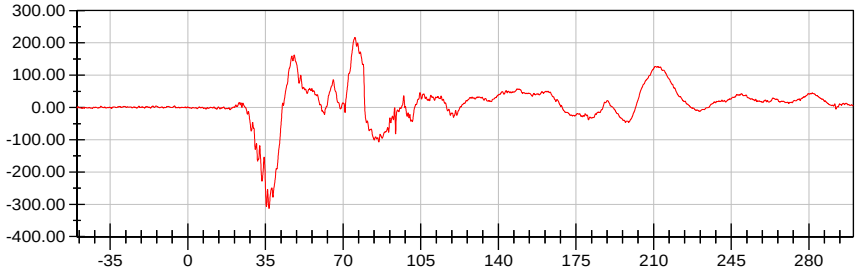
309.20 N at 170.10 ms

<Min>

-1,477.83 N at 49.85 ms

CFC_600

Right Acetabulum Force Y (N) vs. Time [ms]



<Max>

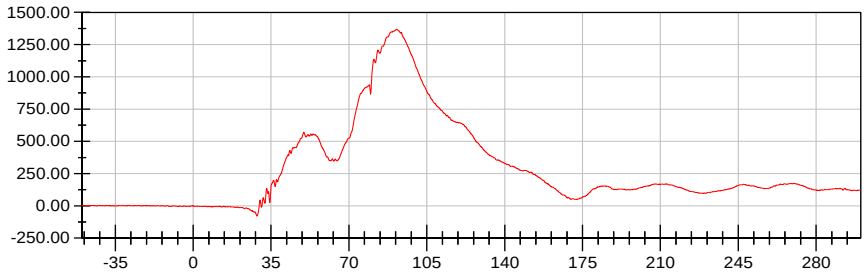
216.56 N at 75.40 ms

<Min>

-312.95 N at 36.65 ms

CFC_600

Right Acetabulum Force Z (N) vs. Time [ms]



<Max>

1,369.65 N at 91.55 ms

<Min>

-78.93 N at 28.70 ms

CFC_600

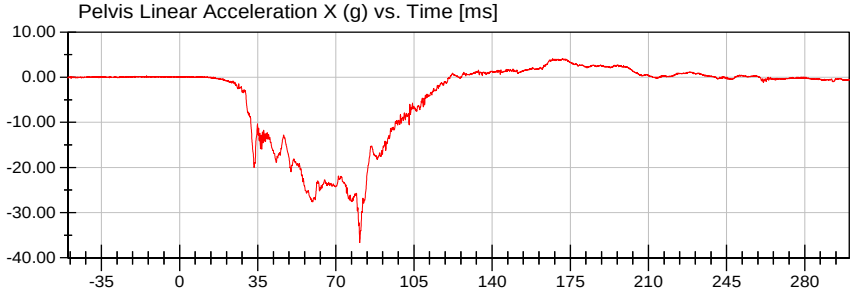
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Pelvis Linear Acceleration X (g) vs. Time [ms]



<Max>

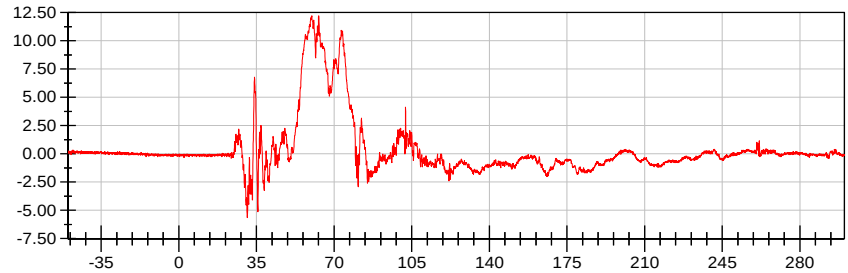
4.08 g at 167.15 ms

<Min>

-36.65 g at 80.75 ms

CFC_1000

Pelvis Linear Acceleration Y (g) vs. Time [ms]



<Max>

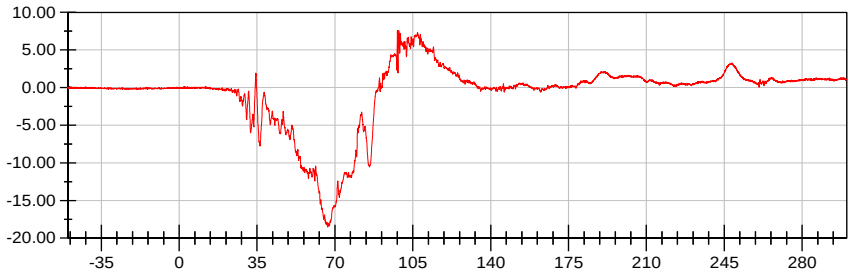
12.23 g at 59.90 ms

<Min>

-5.64 g at 30.85 ms

CFC_1000

Pelvis Linear Acceleration Z (g) vs. Time [ms]



<Max>

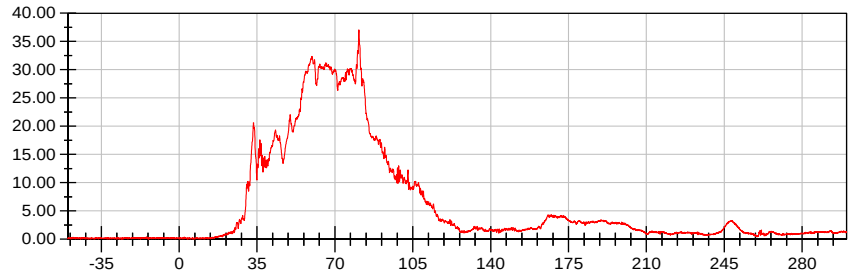
7.60 g at 98.10 ms

<Min>

-18.53 g at 66.75 ms

CFC_1000

Pelvis Linear Acceleration Resultant (g) vs. Time [ms]



<Max>

37.06 g at 80.75 ms

<Min>

0.03 g at -44.30 ms

CFC_1000

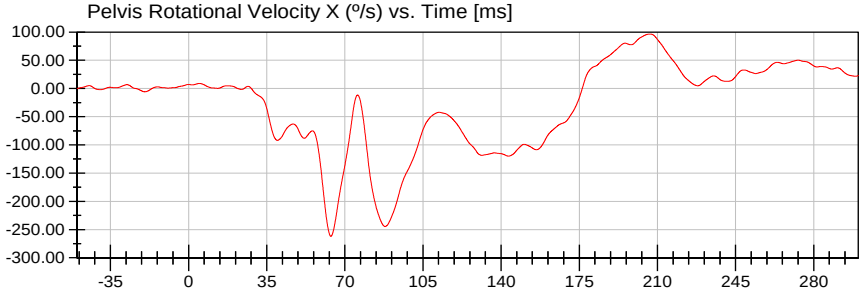
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Pelvis Rotational Velocity X (º/s) vs. Time [ms]



<Max>

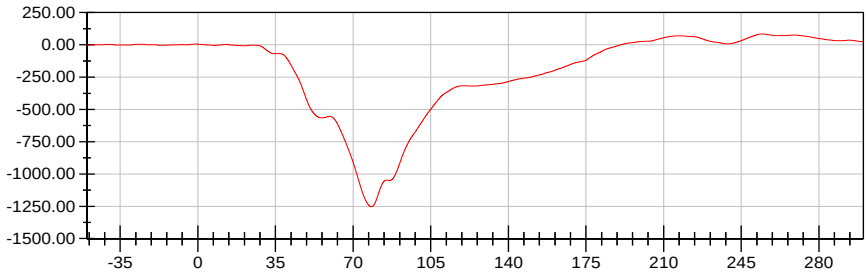
96.37 º/s at 206.70 ms

<Min>

-261.79 º/s at 63.75 ms

CFC_60

Pelvis Rotational Velocity Y (º/s) vs. Time [ms]



<Max>

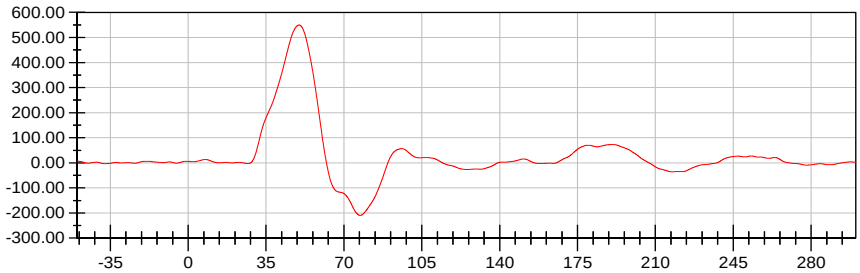
84.37 º/s at 254.35 ms

<Min>

-1,253.40 º/s at 78.25 ms

CFC_60

Pelvis Rotational Velocity Z (º/s) vs. Time [ms]



<Max>

549.78 º/s at 49.85 ms

<Min>

-209.50 º/s at 77.30 ms

CFC_60

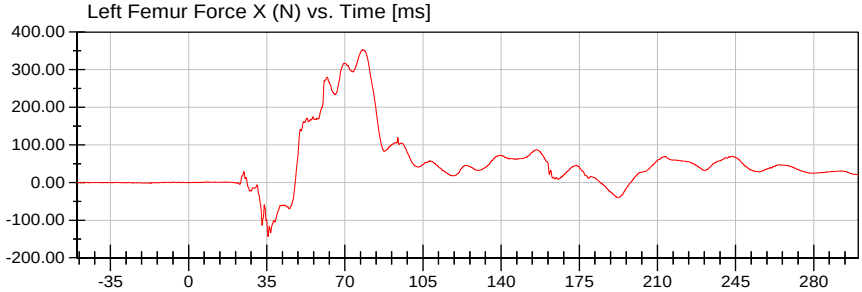
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Left Femur Force X (N) vs. Time [ms]



<Max>

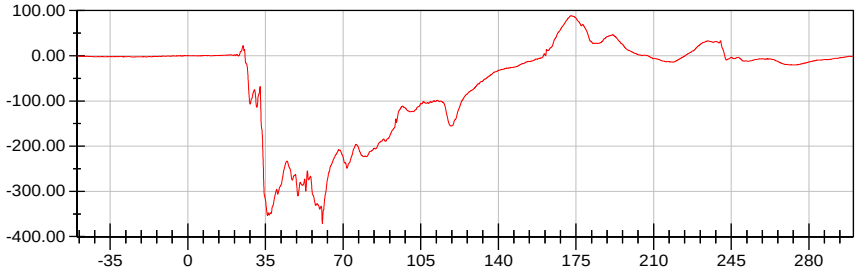
353.34 N at 78.05 ms

<Min>

-143.34 N at 35.65 ms

CFC_600

Left Femur Force Y (N) vs. Time [ms]



<Max>

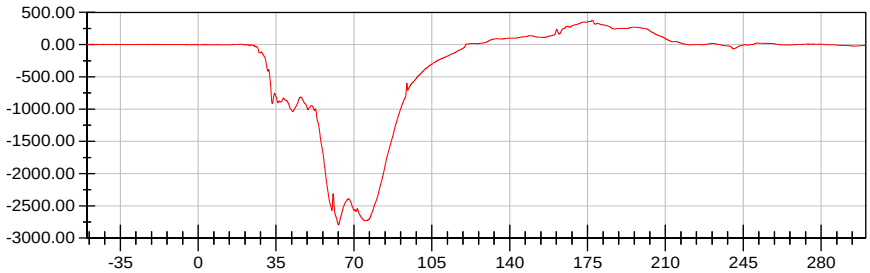
88.54 N at 172.70 ms

<Min>

-371.22 N at 60.70 ms

CFC_600

Left Femur Force Z (N) vs. Time [ms]



<Max>

377.44 N at 177.15 ms

<Min>

-2,796.62 N at 63.05 ms

CFC_600

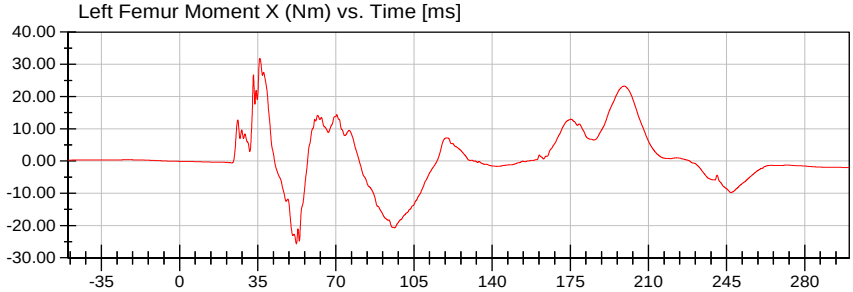
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Left Femur Moment X (Nm) vs. Time [ms]



<Max>

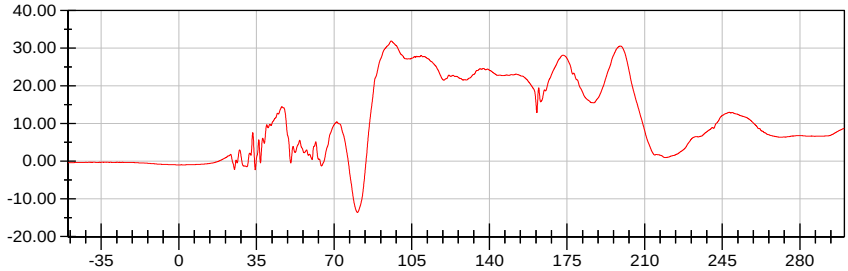
31.82 Nm at 36.00 ms

<Min>

-25.69 Nm at 52.30 ms

CFC_600

Left Femur Moment Y (Nm) vs. Time [ms]



<Max>

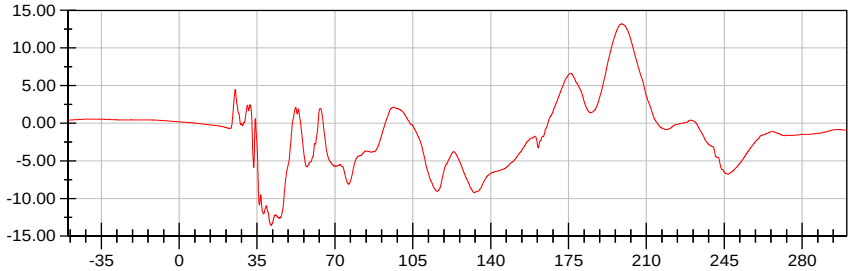
31.94 Nm at 95.75 ms

<Min>

-13.61 Nm at 80.50 ms

CFC_600

Left Femur Moment Z (Nm) vs. Time [ms]



<Max>

13.21 Nm at 198.80 ms

<Min>

-13.58 Nm at 41.30 ms

CFC_600

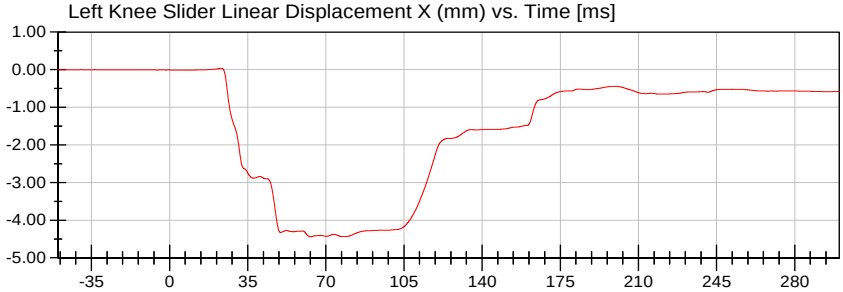
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Left Knee Slider Linear Displacement X (mm) vs. Time [ms]



<Max>

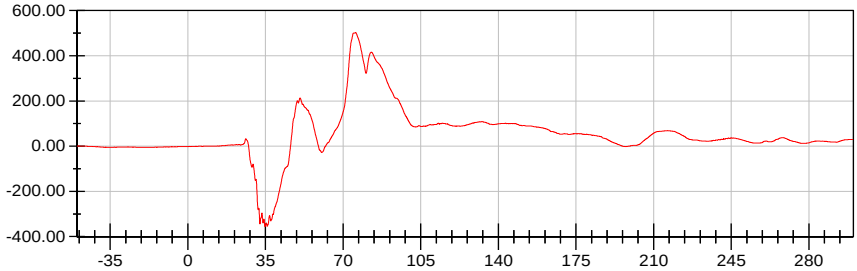
0.04 mm at 23.30 ms

<Min>

-4.44 mm at 63.15 ms

CFC_180

Right Femur Force X (N) vs. Time [ms]



<Max>

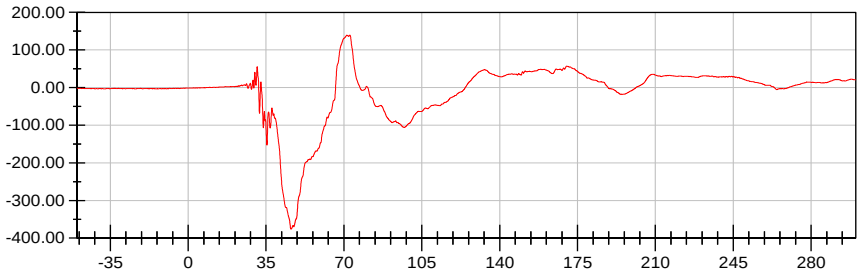
503.02 N at 75.65 ms

<Min>

-355.79 N at 34.85 ms

CFC_600

Right Femur Force Y (N) vs. Time [ms]



<Max>

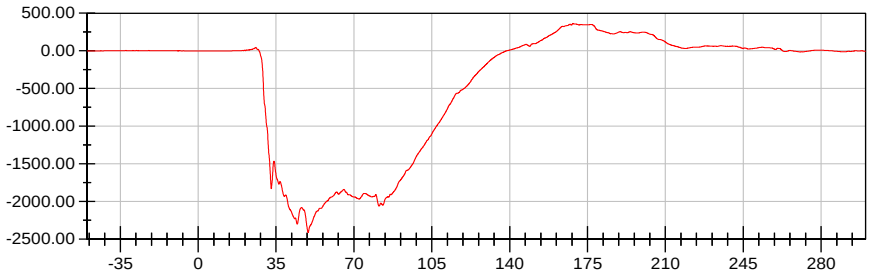
139.73 N at 72.65 ms

<Min>

-375.92 N at 46.20 ms

CFC_600

Right Femur Force Z (N) vs. Time [ms]



<Max>

362.36 N at 168.40 ms

<Min>

-2,411.86 N at 49.40 ms

CFC_600

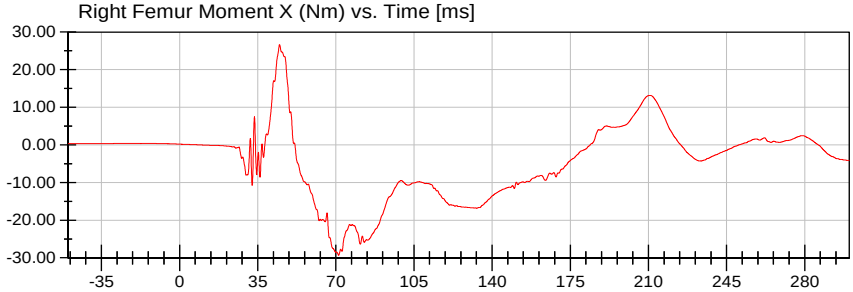
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Right Femur Moment X (Nm) vs. Time [ms]



<Max>

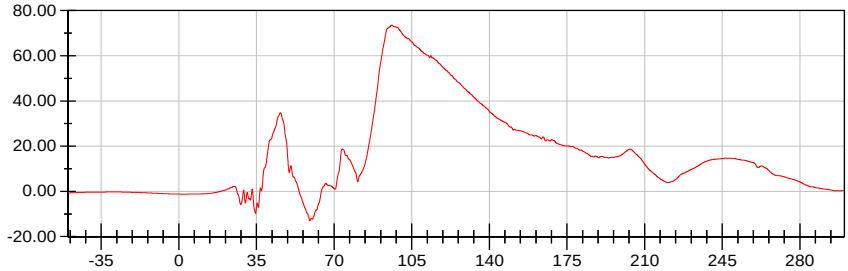
26.68 Nm at 44.80 ms

<Min>

-29.34 Nm at 71.25 ms

CFC_600

Right Femur Moment Y (Nm) vs. Time [ms]



<Max>

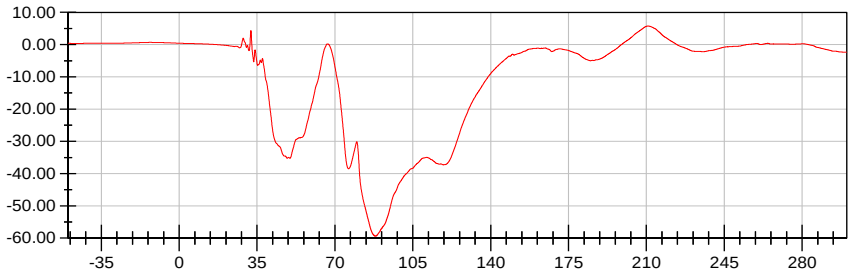
73.54 Nm at 95.95 ms

<Min>

-12.93 Nm at 59.10 ms

CFC_600

Right Femur Moment Z (Nm) vs. Time [ms]



<Max>

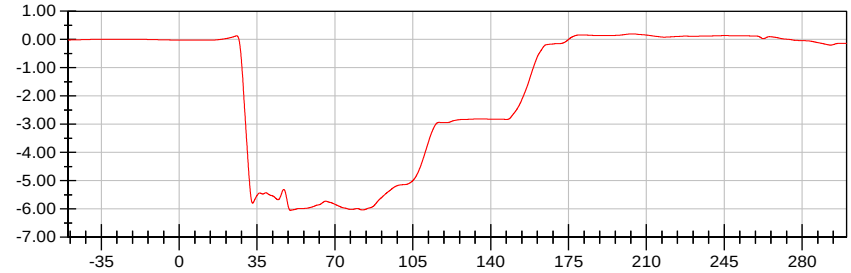
5.77 Nm at 210.75 ms

<Min>

-59.38 Nm at 88.30 ms

CFC_600

Right Knee Slider Linear Displacement X (mm) vs. Time [ms]



<Max>

0.20 mm at 203.65 ms

<Min>

-6.05 mm at 50.05 ms

CFC_180

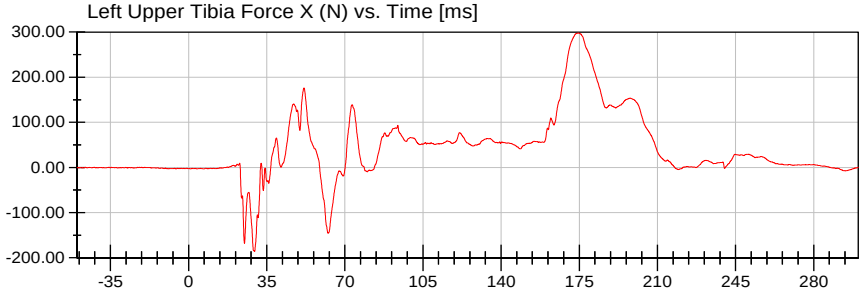
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Left Upper Tibia Force X (N) vs. Time [ms]



<Max>

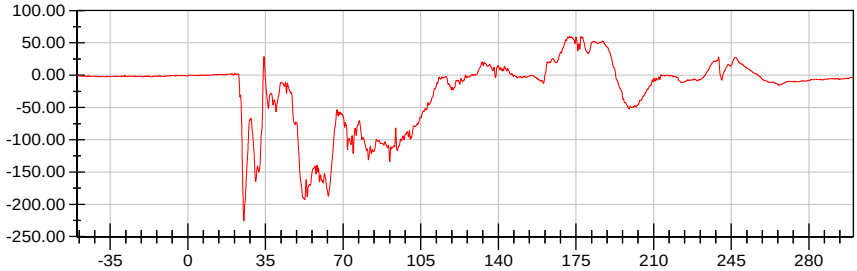
297.83 N at 174.65 ms

<Min>

-186.45 N at 29.55 ms

CFC_600

Left Upper Tibia Force Y (N) vs. Time [ms]



<Max>

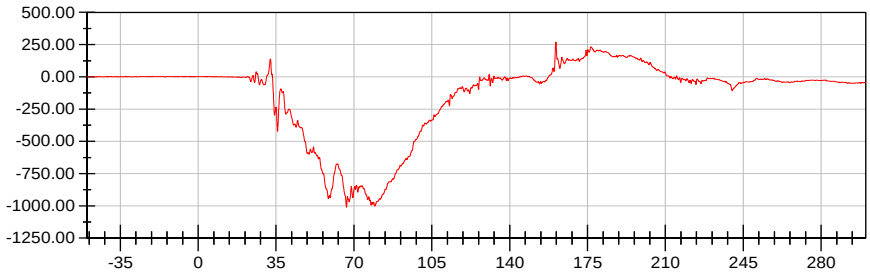
59.87 N at 177.25 ms

<Min>

-225.59 N at 25.25 ms

CFC_600

Left Upper Tibia Force Z (N) vs. Time [ms]



<Max>

270.98 N at 160.75 ms

<Min>

-1,010.86 N at 66.65 ms

CFC_600

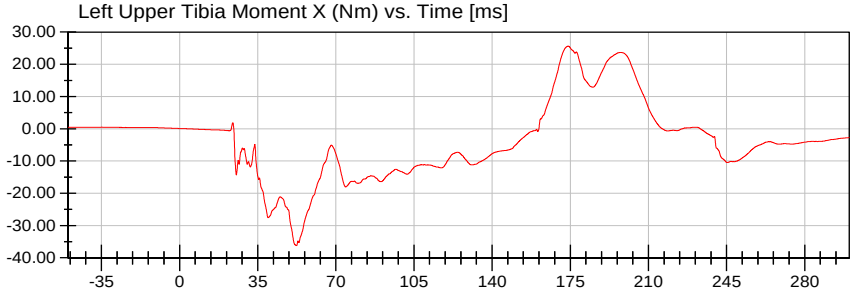
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Left Upper Tibia Moment X (Nm) vs. Time [ms]



<Max>

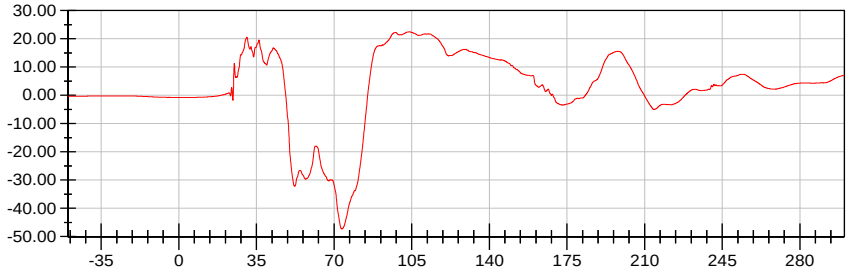
25.64 Nm at 174.00 ms

<Min>

-36.22 Nm at 52.40 ms

CFC_600

Left Upper Tibia Moment Y (Nm) vs. Time [ms]



<Max>

22.52 Nm at 104.05 ms

<Min>

-47.32 Nm at 73.55 ms

CFC_600

Left Achilles Force Z (N) vs. Time [ms]

<Max>

57.18 N at 299.20 ms

<Min>

-1.85 N at 230.55 ms

CFC_600

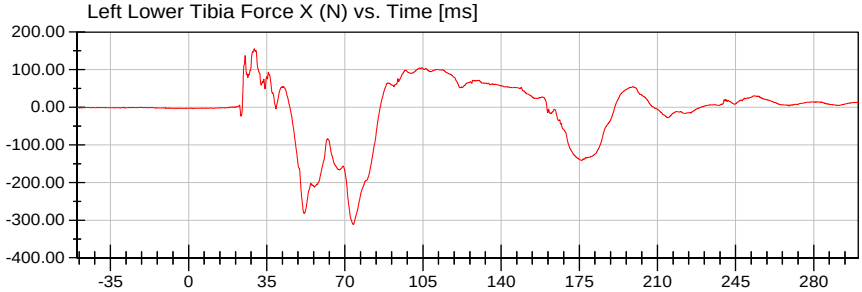
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Left Lower Tibia Force X (N) vs. Time [ms]



<Max>

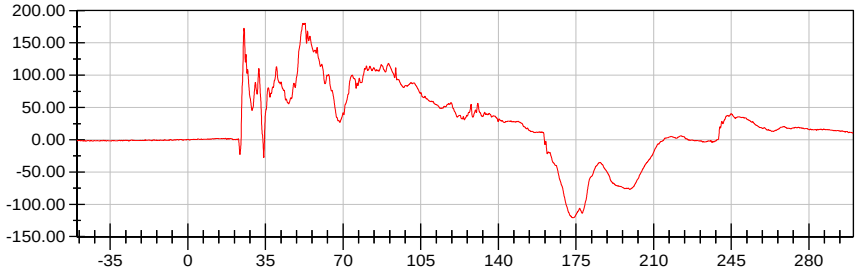
155.80 N at 29.45 ms

<Min>

-311.33 N at 73.75 ms

CFC_600

Left Lower Tibia Force Y (N) vs. Time [ms]



<Max>

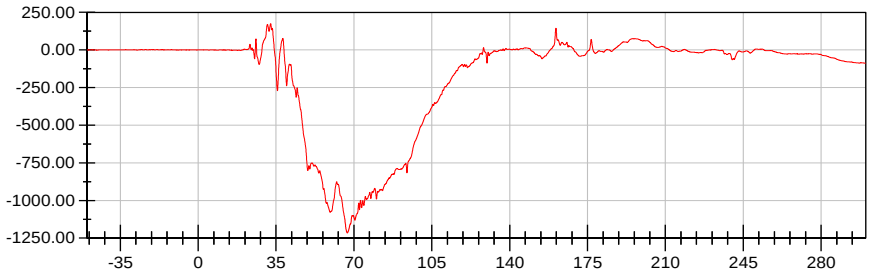
180.56 N at 52.80 ms

<Min>

-120.77 N at 173.60 ms

CFC_600

Left Lower Tibia Force Z (N) vs. Time [ms]



<Max>

175.30 N at 32.60 ms

<Min>

-1,215.51 N at 67.05 ms

CFC_600

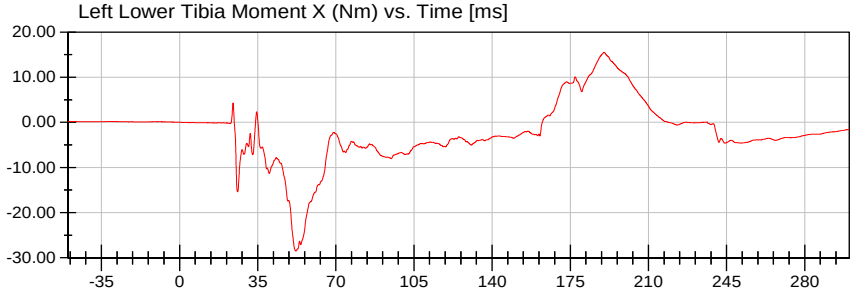
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Left Lower Tibia Moment X (Nm) vs. Time [ms]



<Max>

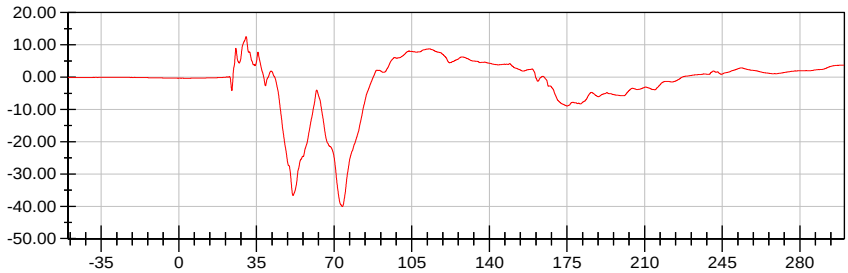
15.48 Nm at 190.10 ms

<Min>

-28.49 Nm at 52.10 ms

CFC_600

Left Lower Tibia Moment Y (Nm) vs. Time [ms]



<Max>

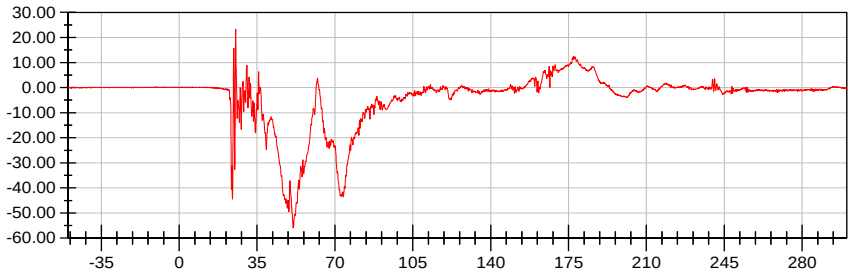
12.58 Nm at 30.35 ms

<Min>

-40.10 Nm at 73.70 ms

CFC_600

Left Tibia Linear Acceleration X (g) vs. Time [ms]



<Max>

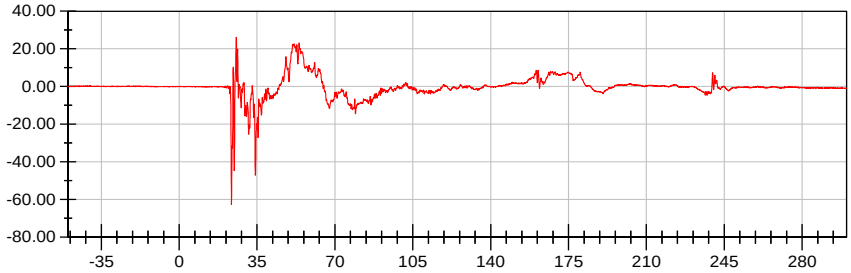
23.11 g at 25.40 ms

<Min>

-55.84 g at 51.25 ms

CFC_1000

Left Tibia Linear Acceleration Y (g) vs. Time [ms]



<Max>

26.09 g at 25.70 ms

<Min>

-62.61 g at 23.50 ms

CFC_1000

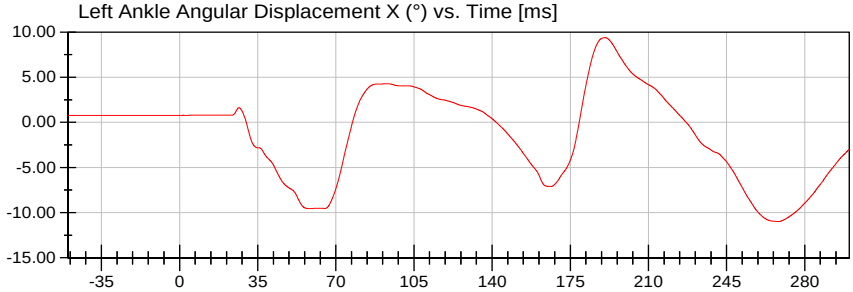
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Left Ankle Angular Displacement X (°) vs. Time [ms]



<Max>

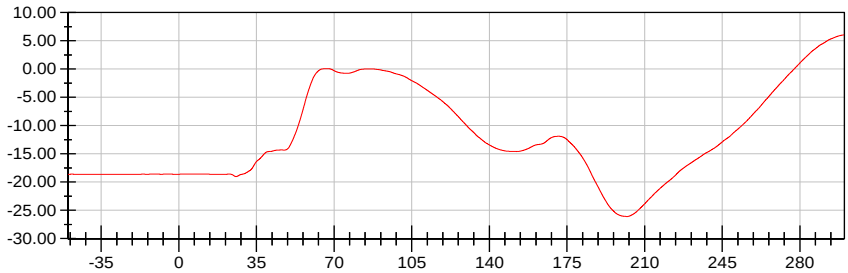
9.38 ° at 190.55 ms

<Min>

-11.00 ° at 268.15 ms

CFC_180

Left Ankle Angular Displacement Y (°) vs. Time [ms]



<Max>

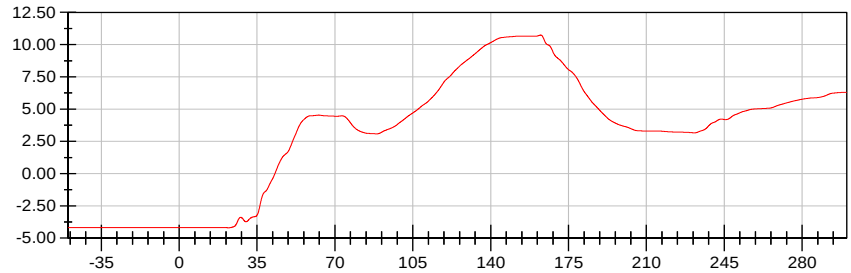
6.05 ° at 300.00 ms

<Min>

-26.09 ° at 202.10 ms

CFC_180

Left Ankle Angular Displacement Z (°) vs. Time [ms]



<Max>

10.74 ° at 162.50 ms

<Min>

-4.19 ° at 22.30 ms

CFC_180

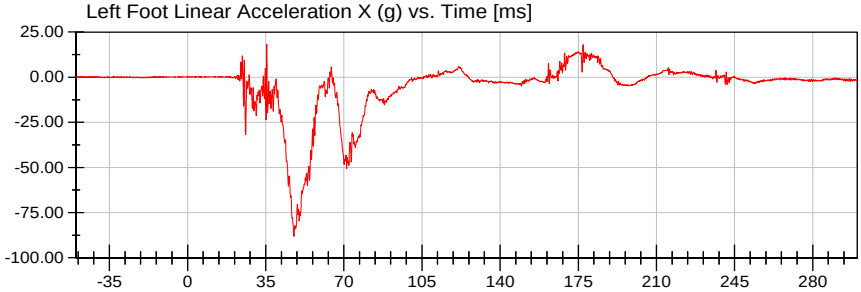
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Left Foot Linear Acceleration X (g) vs. Time [ms]



<Max>

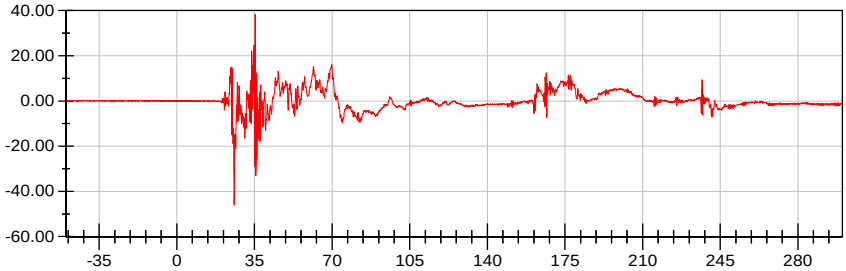
18.22 g at 35.50 ms

<Min>

-88.08 g at 47.65 ms

CFC_1000

Left Foot Linear Acceleration Y (g) vs. Time [ms]



<Max>

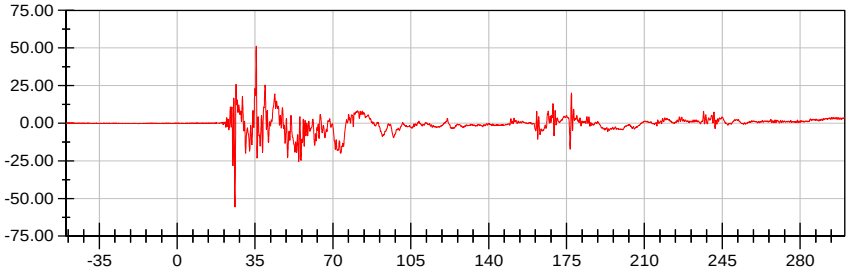
38.22 g at 35.30 ms

<Min>

-46.07 g at 25.90 ms

CFC_1000

Left Foot Linear Acceleration Z (g) vs. Time [ms]



<Max>

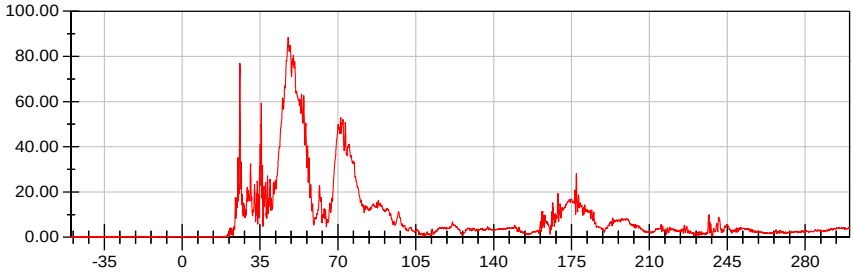
51.23 g at 35.50 ms

<Min>

-55.66 g at 26.00 ms

CFC_1000

Left Foot Linear Acceleration Resultant (g) vs. Time [ms]



<Max>

88.46 g at 47.65 ms

<Min>

0.03 g at -49.10 ms

CFC_1000

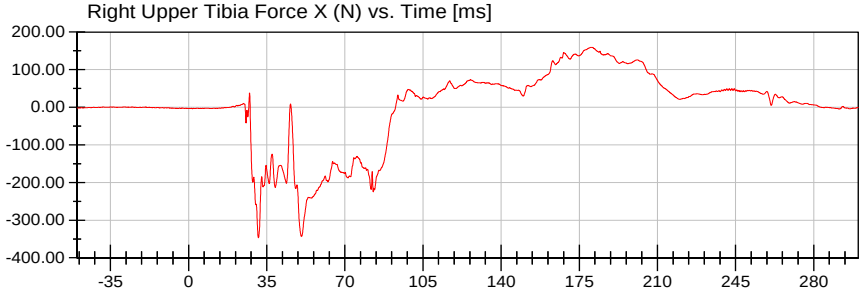
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Right Upper Tibia Force X (N) vs. Time [ms]



<Max>

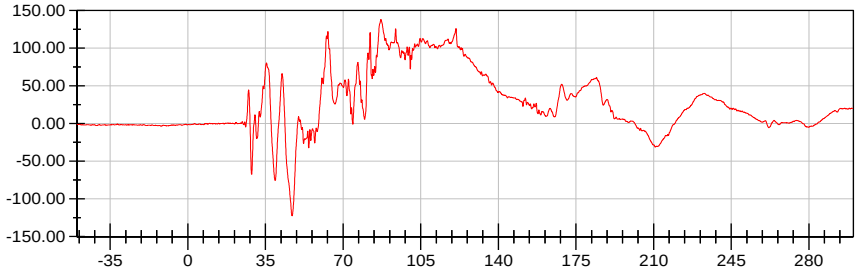
159.23 N at 180.40 ms

<Min>

-346.90 N at 31.25 ms

CFC_600

Right Upper Tibia Force Y (N) vs. Time [ms]



<Max>

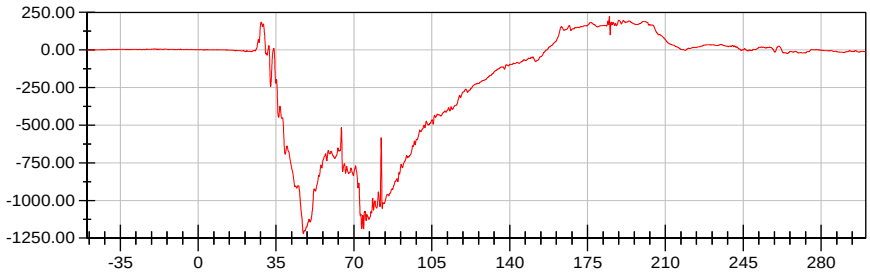
138.24 N at 87.05 ms

<Min>

-122.34 N at 47.00 ms

CFC_600

Right Upper Tibia Force Z (N) vs. Time [ms]



<Max>

221.73 N at 184.80 ms

<Min>

-1,218.45 N at 47.25 ms

CFC_600

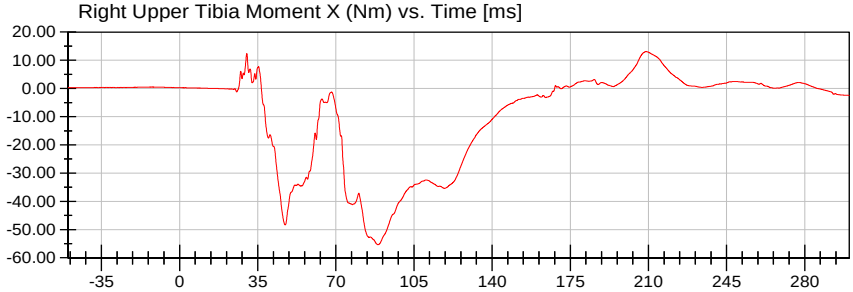
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Right Upper Tibia Moment X (Nm) vs. Time [ms]



<Max>

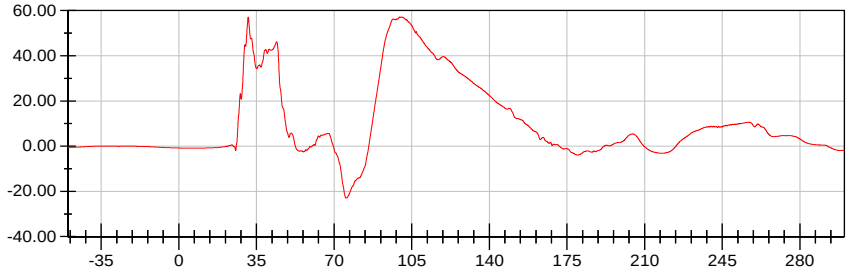
13.06 Nm at 208.95 ms

<Min>

-55.40 Nm at 88.80 ms

CFC_600

Right Upper Tibia Moment Y (Nm) vs. Time [ms]



<Max>

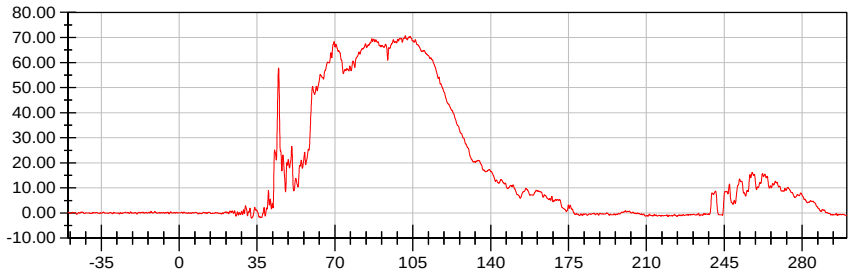
57.18 Nm at 31.30 ms

<Min>

-22.95 Nm at 75.30 ms

CFC_600

Right Achilles Force Z (N) vs. Time [ms]



<Max>

70.67 N at 101.60 ms

<Min>

-2.08 N at 32.50 ms

CFC_600

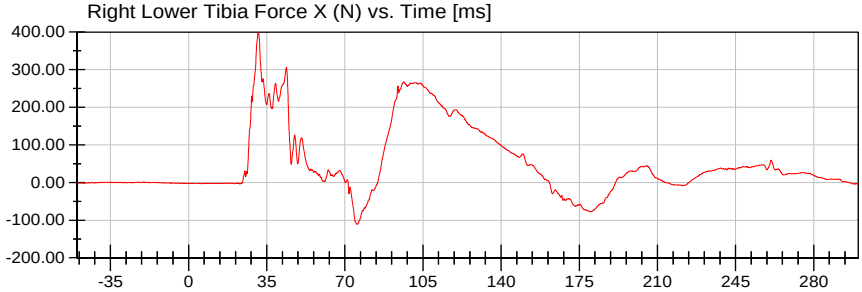
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Right Lower Tibia Force X (N) vs. Time [ms]



<Max>

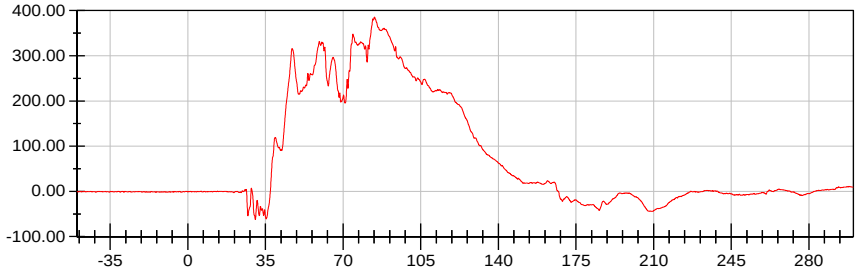
397.28 N at 31.15 ms

<Min>

-111.18 N at 75.45 ms

CFC_600

Right Lower Tibia Force Y (N) vs. Time [ms]



<Max>

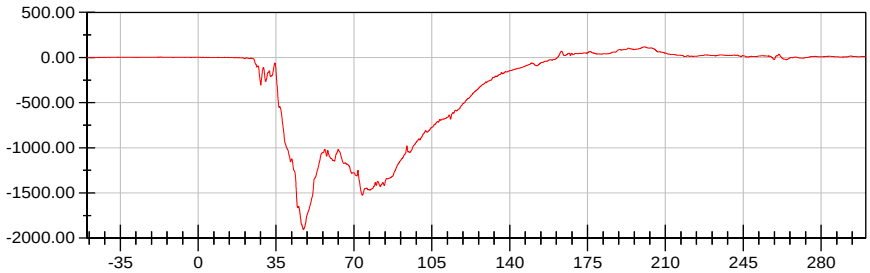
385.89 N at 84.15 ms

<Min>

-62.06 N at 30.45 ms

CFC_600

Right Lower Tibia Force Z (N) vs. Time [ms]



<Max>

119.26 N at 200.55 ms

<Min>

-1,906.58 N at 47.35 ms

CFC_600

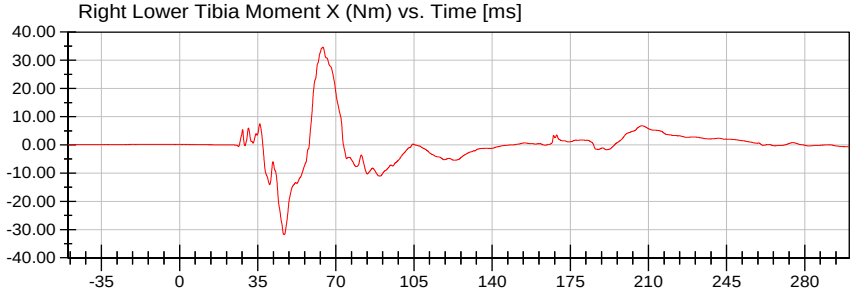
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Right Lower Tibia Moment X (Nm) vs. Time [ms]



<Max>

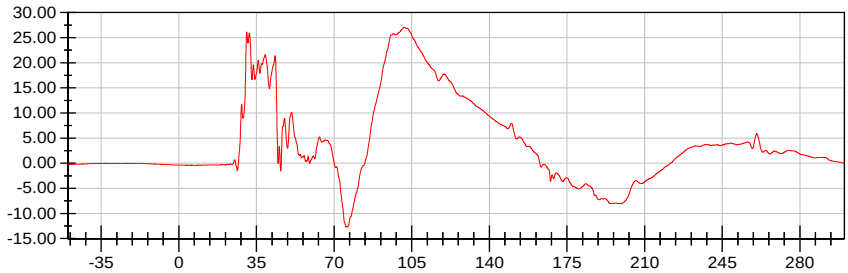
34.64 Nm at 64.20 ms

<Min>

-31.75 Nm at 46.95 ms

CFC_600

Right Lower Tibia Moment Y (Nm) vs. Time [ms]



<Max>

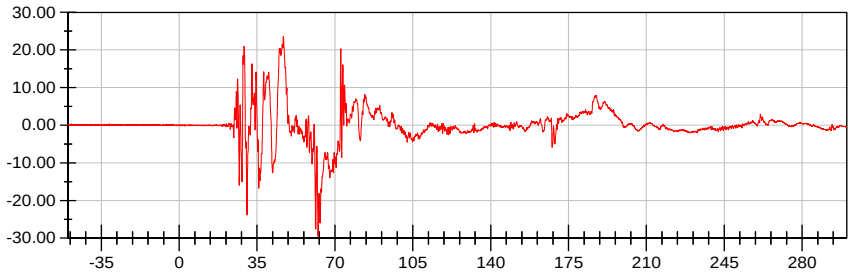
27.06 Nm at 101.55 ms

<Min>

-12.70 Nm at 76.05 ms

CFC_600

Right Tibia Linear Acceleration X (g) vs. Time [ms]



<Max>

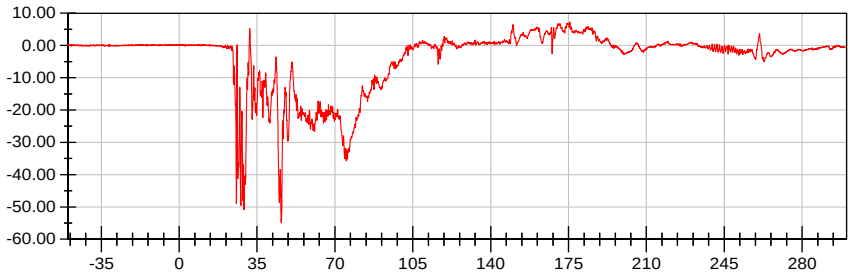
23.63 g at 46.85 ms

<Min>

-29.56 g at 62.45 ms

CFC_1000

Right Tibia Linear Acceleration Y (g) vs. Time [ms]



<Max>

7.21 g at 175.60 ms

<Min>

-54.95 g at 45.85 ms

CFC_1000

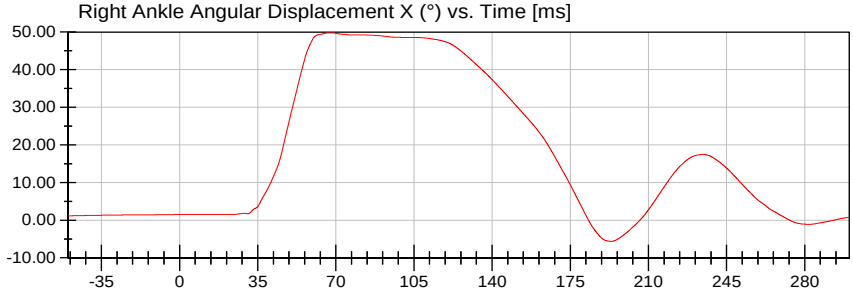
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Right Ankle Angular Displacement X (°) vs. Time [ms]



<Max>

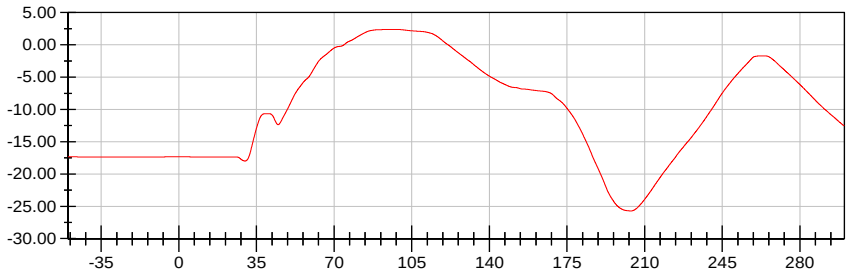
49.79 ° at 68.20 ms

<Min>

-5.63 ° at 193.25 ms

CFC_180

Right Ankle Angular Displacement Y (°) vs. Time [ms]



<Max>

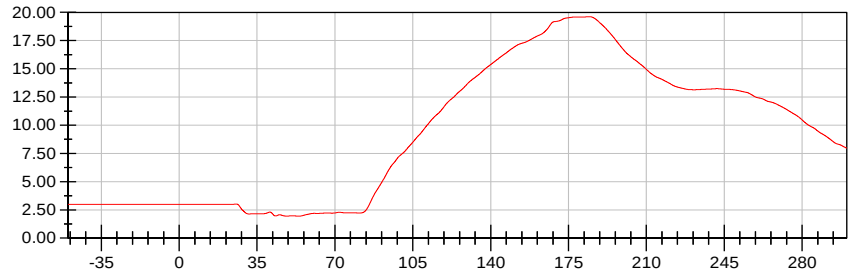
2.39 ° at 98.10 ms

<Min>

-25.72 ° at 203.75 ms

CFC_180

Right Ankle Angular Displacement Z (°) vs. Time [ms]



<Max>

19.61 ° at 184.50 ms

<Min>

1.95 ° at 53.85 ms

CFC_180

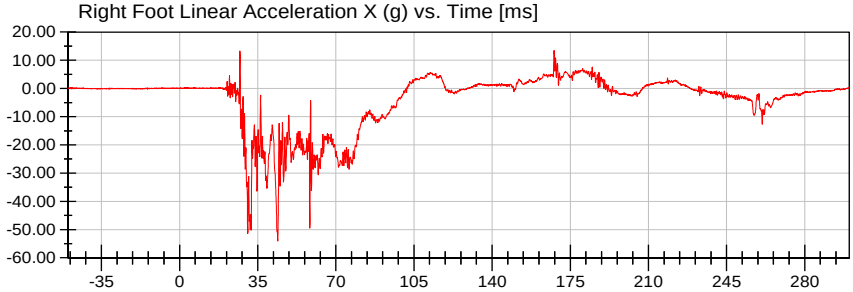
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Right Foot Linear Acceleration X (g) vs. Time [ms]



<Max>

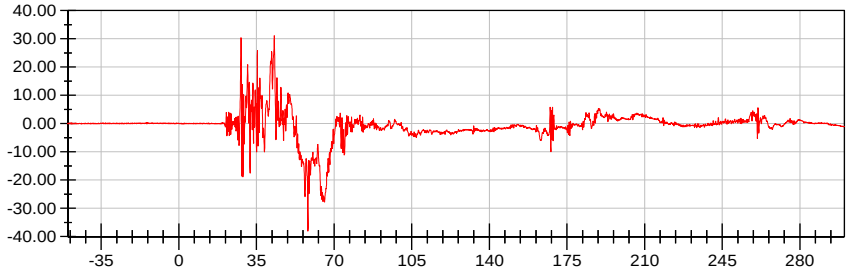
13.44 g at 167.75 ms

<Min>

-54.05 g at 44.00 ms

CFC_1000

Right Foot Linear Acceleration Y (g) vs. Time [ms]



<Max>

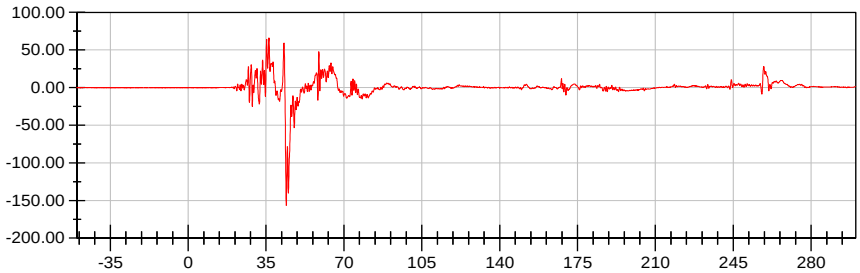
31.13 g at 43.05 ms

<Min>

-38.06 g at 58.20 ms

CFC_1000

Right Foot Linear Acceleration Z (g) vs. Time [ms]



<Max>

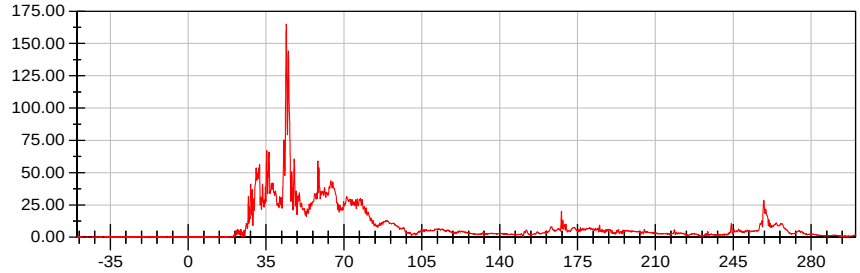
65.88 g at 36.30 ms

<Min>

-156.51 g at 44.10 ms

CFC_1000

Right Foot Linear Acceleration Resultant (g) vs. Time [ms]



<Max>

165.13 g at 44.10 ms

<Min>

0.04 g at -41.10 ms

CFC_1000

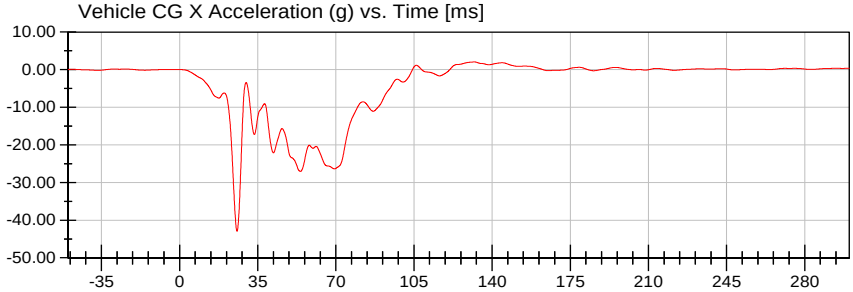
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Vehicle CG X Acceleration (g) vs. Time [ms]



<Max>

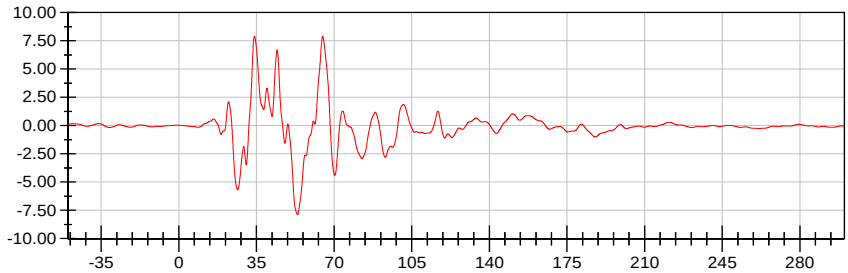
2.05 g at 132.05 ms

<Min>

-42.92 g at 25.75 ms

CFC_60

Vehicle CG Y Acceleration (g) vs. Time [ms]



<Max>

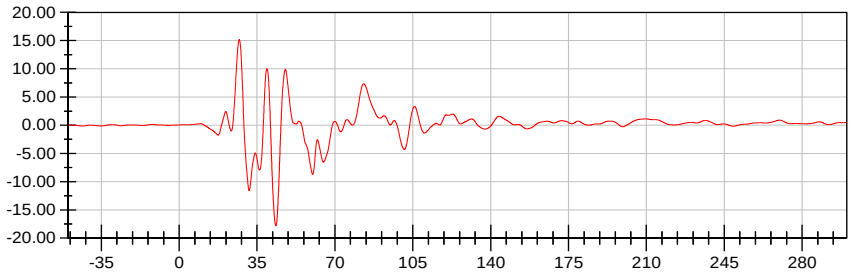
7.93 g at 34.10 ms

<Min>

-7.89 g at 53.55 ms

CFC_60

Vehicle CG Z Acceleration (g) vs. Time [ms]



<Max>

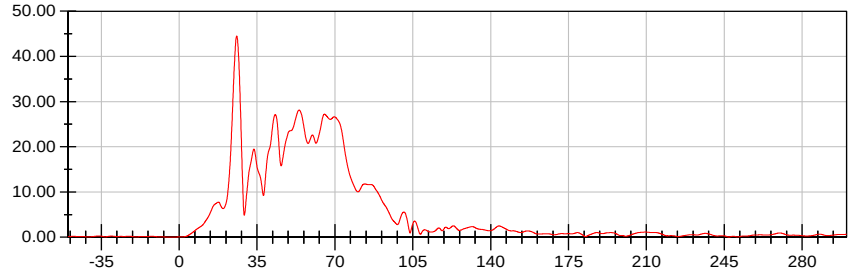
15.18 g at 27.05 ms

<Min>

-17.80 g at 43.45 ms

CFC_60

Vehicle CG Acceleration Resultant (g) vs. Time [ms]



<Max>

44.49 g at 25.90 ms

<Min>

0.02 g at -3.00 ms

CFC_60

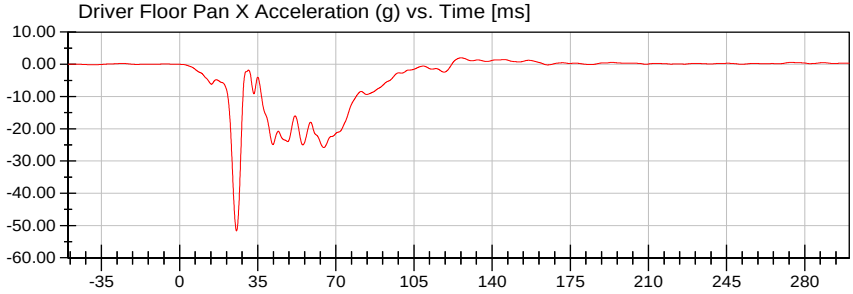
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Driver Floor Pan X Acceleration (g) vs. Time [ms]



<Max>

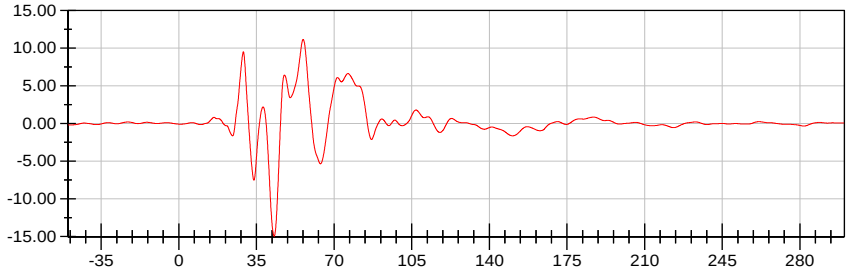
2.01 g at 126.05 ms

<Min>

-51.64 g at 25.50 ms

CFC_60

Driver Floor Pan Y Acceleration (g) vs. Time [ms]



<Max>

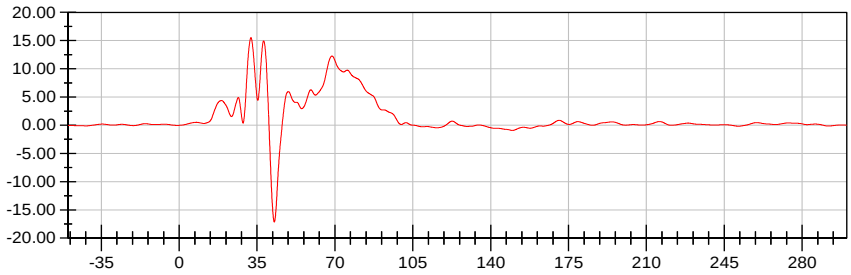
11.17 g at 56.05 ms

<Min>

-14.96 g at 43.00 ms

CFC_60

Driver Floor Pan Z Acceleration (g) vs. Time [ms]



<Max>

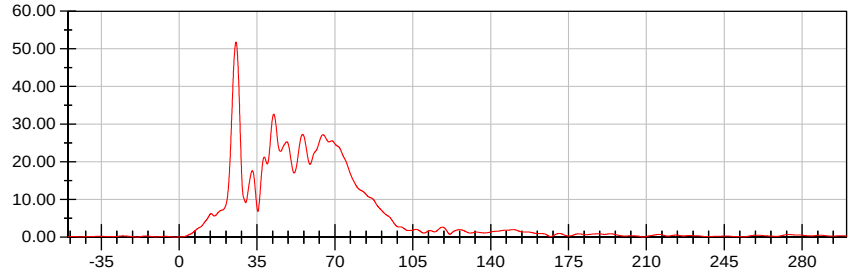
15.51 g at 32.25 ms

<Min>

-17.12 g at 42.75 ms

CFC_60

Driver Floor Pan Acceleration Resultant (g) vs. Time [ms]



<Max>

51.78 g at 25.50 ms

<Min>

0.01 g at -2.20 ms

CFC_60

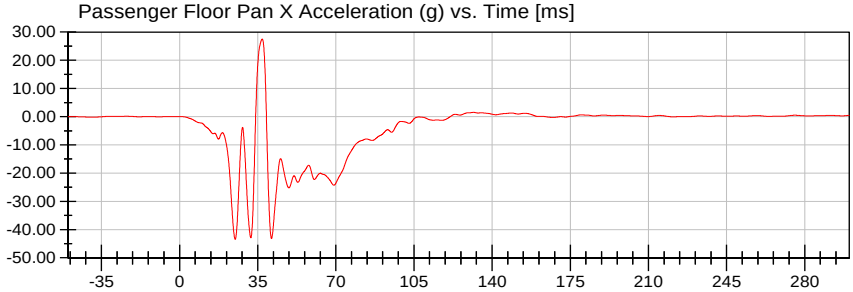
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Passenger Floor Pan X Acceleration (g) vs. Time [ms]



<Max>

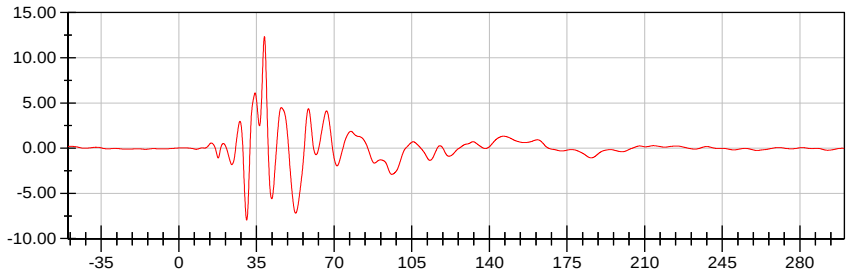
27.53 g at 37.05 ms

<Min>

-43.47 g at 24.90 ms

CFC_60

Passenger Floor Pan Y Acceleration (g) vs. Time [ms]



<Max>

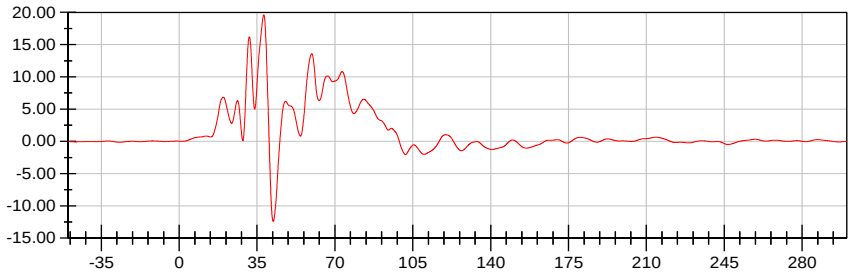
12.35 g at 38.60 ms

<Min>

-7.96 g at 30.60 ms

CFC_60

Passenger Floor Pan Z Acceleration (g) vs. Time [ms]



<Max>

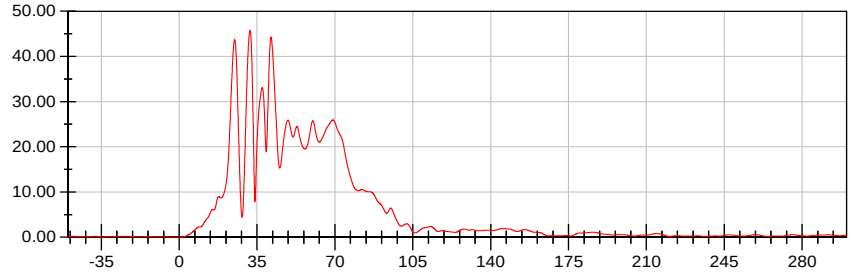
19.62 g at 38.05 ms

<Min>

-12.41 g at 42.25 ms

CFC_60

Passenger Floor Pan Acceleration Resultant (g) vs. Time [ms]



<Max>

45.75 g at 31.85 ms

<Min>

0.02 g at -34.20 ms

CFC_60

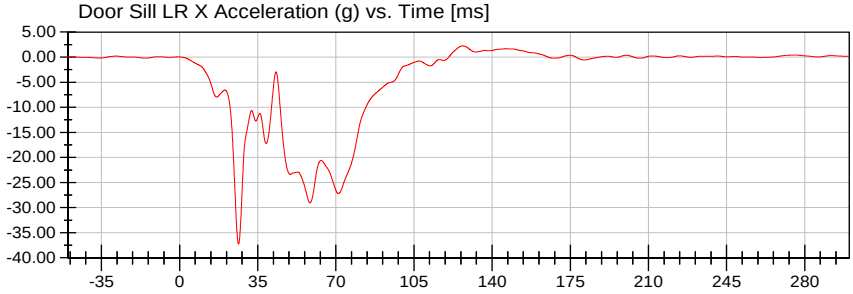
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Door Sill LR X Acceleration (g) vs. Time [ms]



<Max>

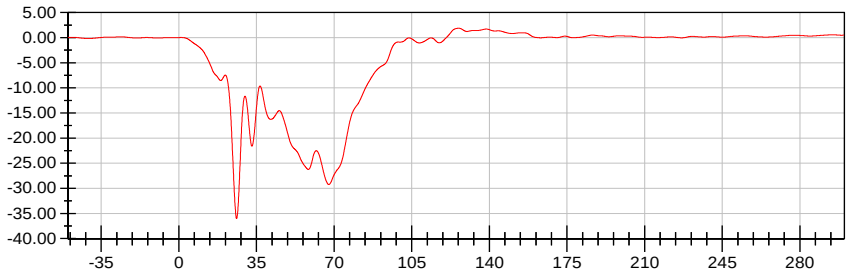
2.22 g at 126.75 ms

<Min>

-37.27 g at 26.40 ms

CFC_60

Door Sill RR X Acceleration (g) vs. Time [ms]



<Max>

1.88 g at 126.05 ms

<Min>

-36.04 g at 26.05 ms

CFC_60

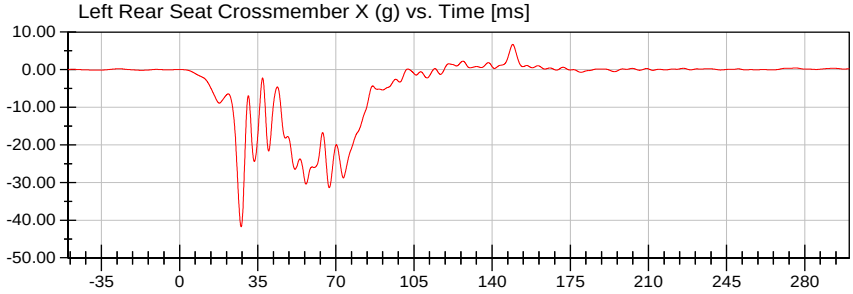
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Left Rear Seat Crossmember X (g) vs. Time [ms]



<Max>

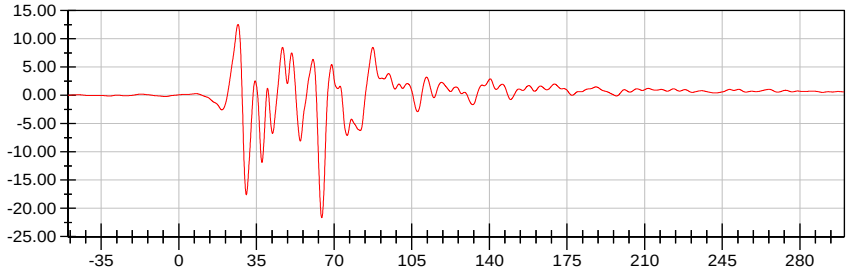
6.71 g at 149.20 ms

<Min>

-41.79 g at 27.60 ms

CFC_60

Left Rear Seat Crossmember Z (g) vs. Time [ms]



<Max>

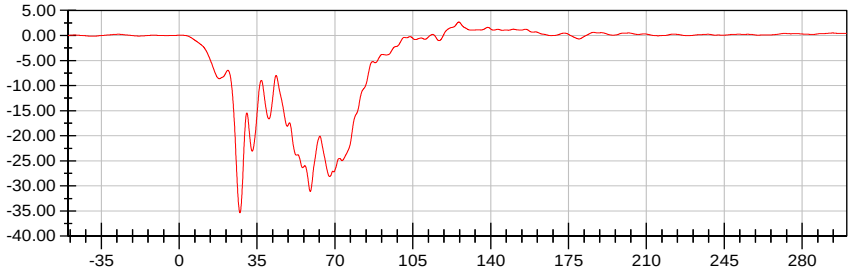
12.57 g at 26.70 ms

<Min>

-21.66 g at 64.45 ms

CFC_60

Right Rear Seat Crossmember X (g) vs. Time [ms]



<Max>

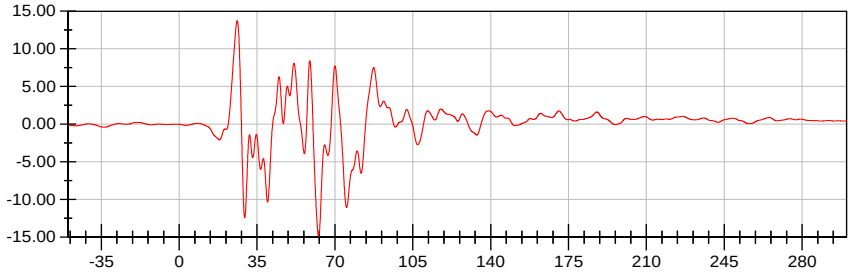
2.68 g at 125.70 ms

<Min>

-35.34 g at 27.30 ms

CFC_60

Right Rear Seat Crossmember Z (g) vs. Time [ms]



<Max>

13.74 g at 26.10 ms

<Min>

-14.88 g at 62.65 ms

CFC_60

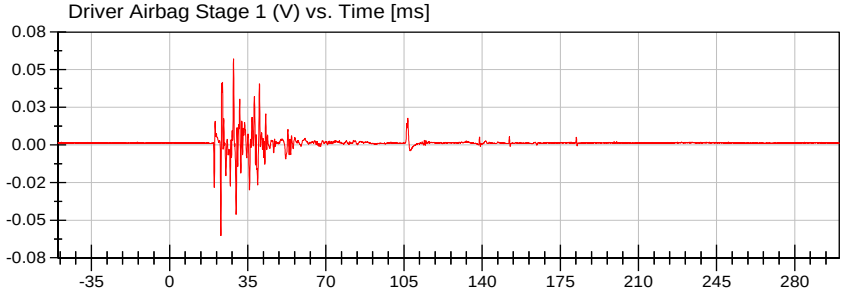
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Driver Airbag Stage 1 (V) vs. Time [ms]



<Max>

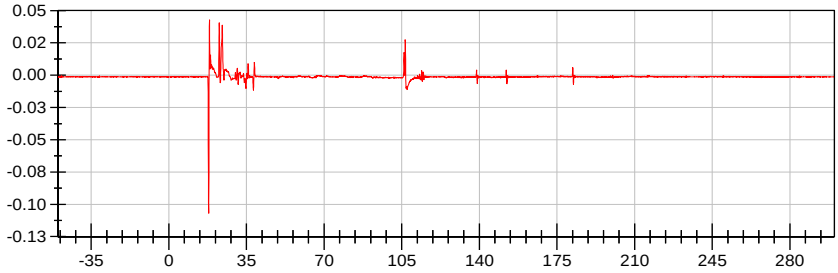
0.06 V at 28.65 ms

<Min>

-0.06 V at 23.00 ms

Unfiltered

Driver Airbag Stage 2 (V) vs. Time [ms]



<Max>

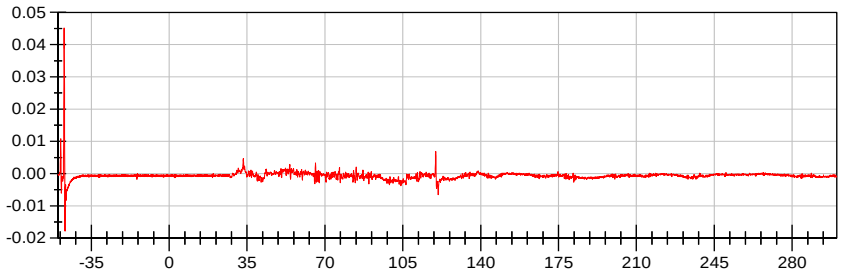
0.04 V at 18.30 ms

<Min>

-0.11 V at 17.95 ms

Unfiltered

Driver Seat Airbag (V) vs. Time [ms]



<Max>

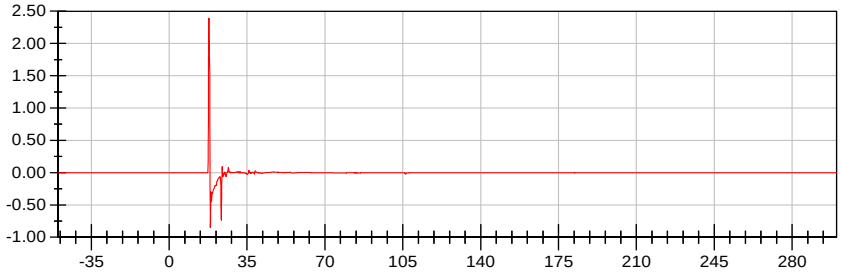
0.05 V at -47.20 ms

<Min>

-0.02 V at -46.80 ms

Unfiltered

Driver Knee Airbag (V) vs. Time [ms]



<Max>

2.39 V at 17.85 ms

<Min>

-0.85 V at 18.55 ms

Unfiltered

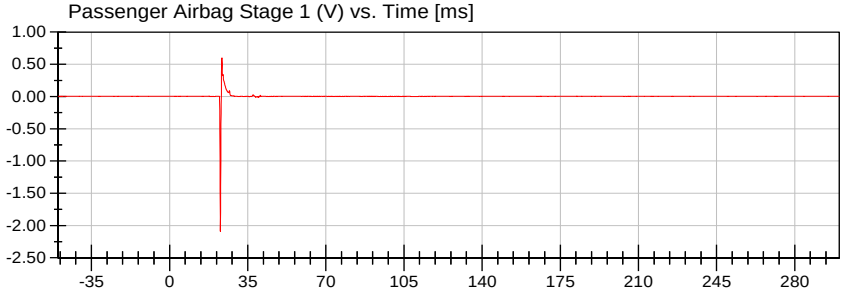
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Passenger Airbag Stage 1 (V) vs. Time [ms]



<Max>

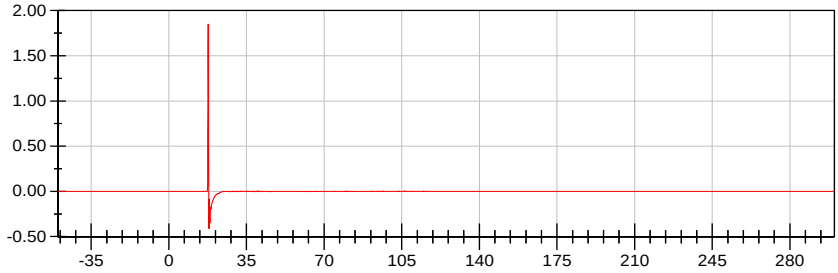
0.60 V at 23.45 ms

<Min>

-2.09 V at 22.75 ms

Unfiltered

Passenger Airbag Stage 2 (V) vs. Time [ms]



<Max>

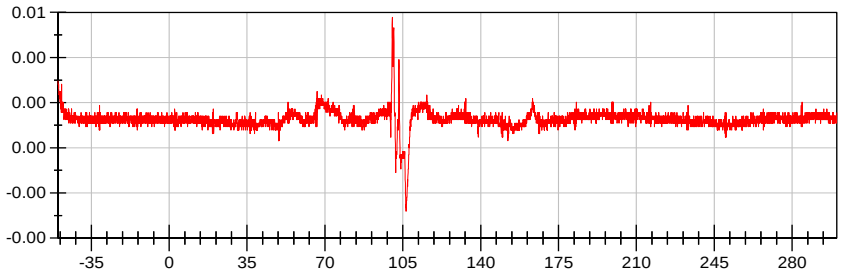
1.85 V at 17.75 ms

<Min>

-0.41 V at 18.05 ms

Unfiltered

Passenger Seat Airbag (V) vs. Time [ms]



<Max>

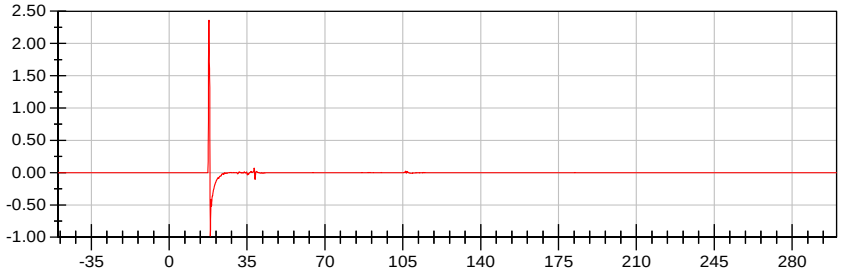
0.01 V at 100.30 ms

<Min>

0.00 V at 106.45 ms

Unfiltered

Passenger Knee Airbag (V) vs. Time [ms]



<Max>

2.36 V at 17.85 ms

<Min>

-0.98 V at 18.55 ms

Unfiltered

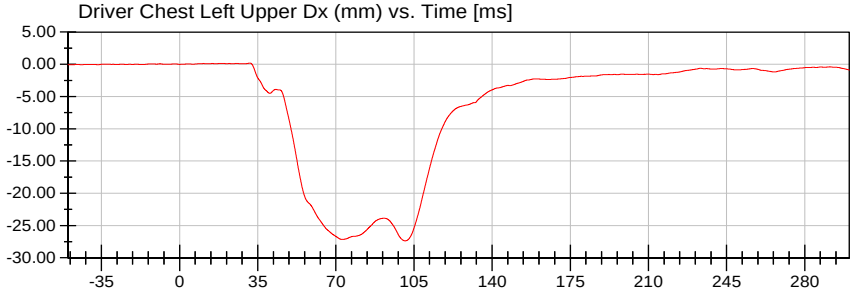
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Driver Chest Left Upper Dx (mm) vs. Time [ms]



<Max>

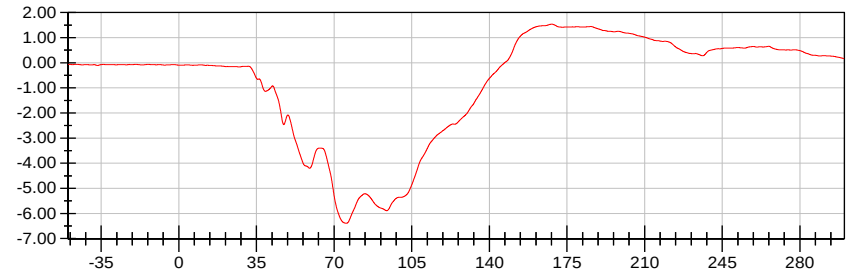
0.18 mm at 31.55 ms

<Min>

-27.37 mm at 101.10 ms

CFC_1000

Driver Chest Left Upper Dy (mm) vs. Time [ms]



<Max>

1.54 mm at 168.15 ms

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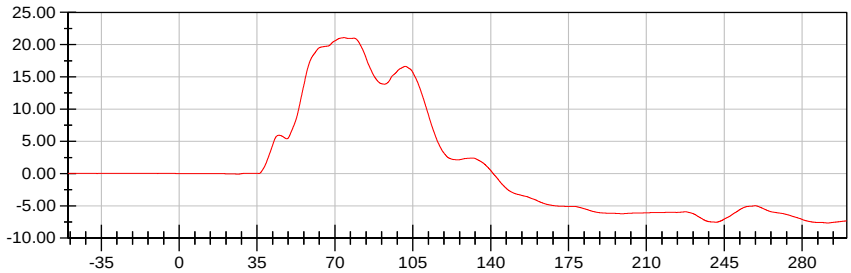
-6.39 mm at 75.55 ms

CFC_1000

Driver Chest Left Upper Dz (mm) vs. Time [ms]



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21.07 mm at 74.15 ms

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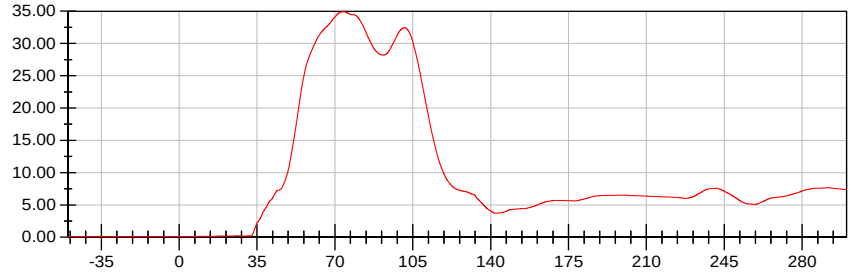
-7.65 mm at 291.50 ms

CFC_1000

Driver Chest Left Upper Resultant (mm) vs. Time [ms]



<Max>

34.92 mm at 73.85 ms

<Min>

0.07 mm at -46.00 ms

CFC_1000

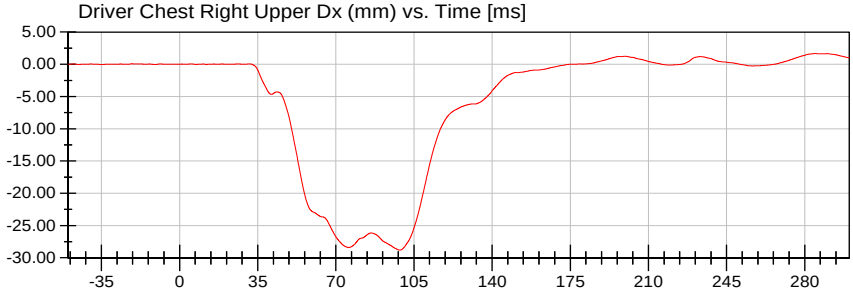
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Driver Chest Right Upper Dx (mm) vs. Time [ms]



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1.65 mm at 284.70 ms

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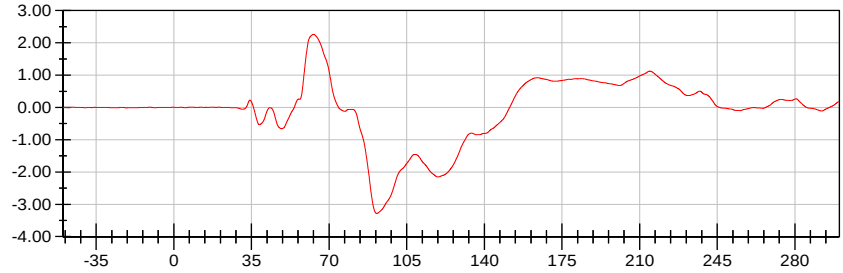
-28.81 mm at 98.60 ms

CFC_1000

Driver Chest Right Upper Dy (mm) vs. Time [ms]



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2.27 mm at 63.05 ms

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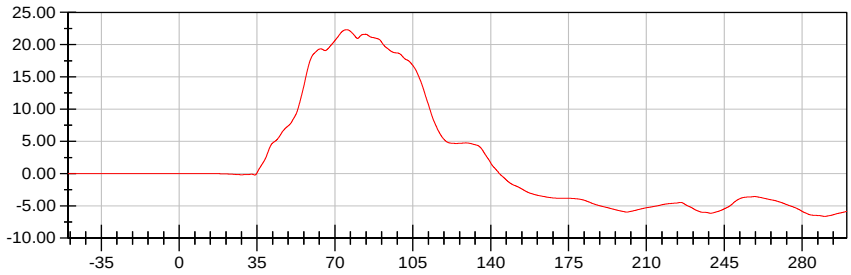
-3.28 mm at 91.50 ms

CFC_1000

Driver Chest Right Upper Dz (mm) vs. Time [ms]



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22.30 mm at 75.35 ms

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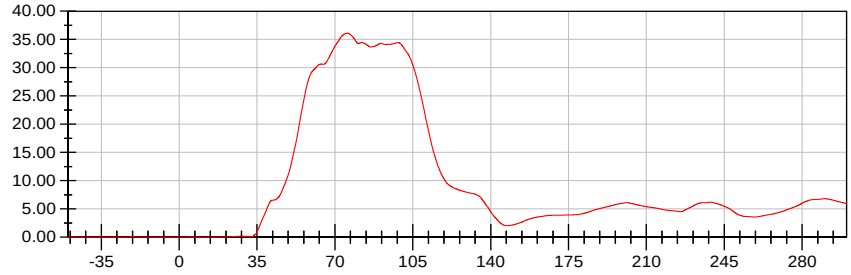
-6.63 mm at 290.10 ms

CFC_1000

Driver Chest Right Upper Resultant (mm) vs. Time [ms]



<Max>

36.10 mm at 75.60 ms

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0.00 mm at -12.20 ms

CFC_1000

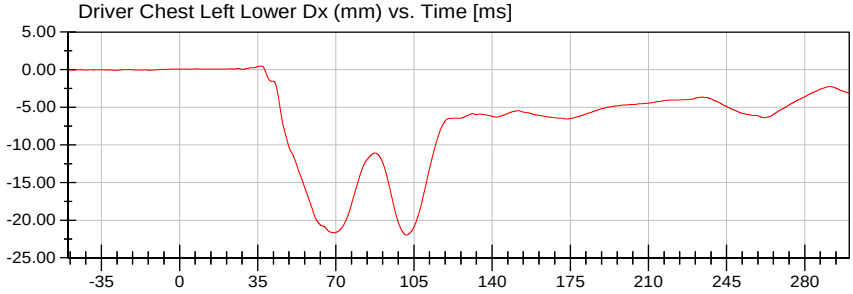
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Driver Chest Left Lower Dx (mm) vs. Time [ms]



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0.49 mm at 36.70 ms

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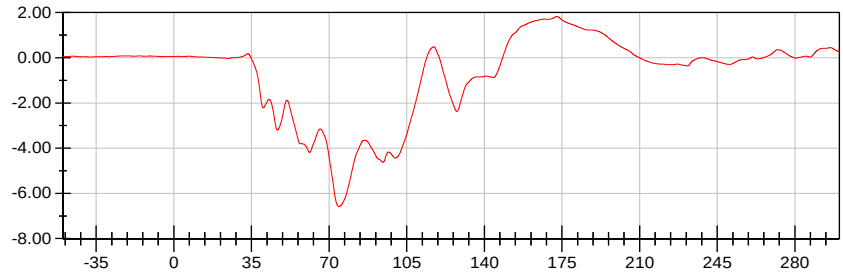
-21.99 mm at 101.60 ms

CFC_1000

Driver Chest Left Lower Dy (mm) vs. Time [ms]



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1.83 mm at 172.80 ms

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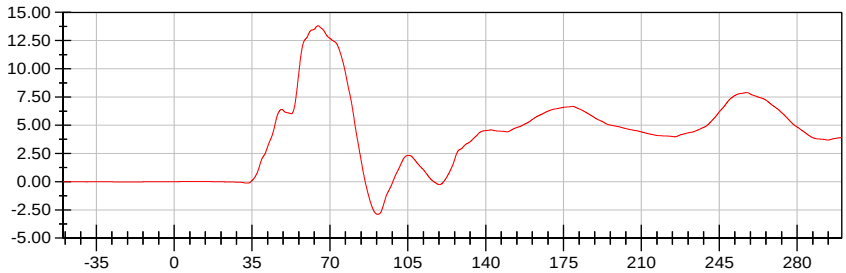
-6.58 mm at 74.45 ms

CFC_1000

Driver Chest Left Lower Dz (mm) vs. Time [ms]



<Max>

13.81 mm at 64.65 ms

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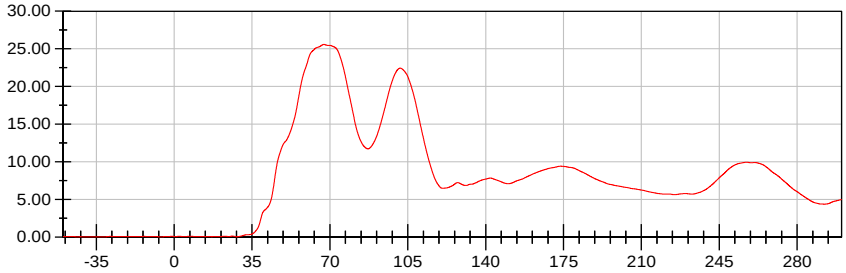
-2.89 mm at 91.45 ms

CFC_1000

Driver Chest Left Lower Resultant (mm) vs. Time [ms]



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25.58 mm at 67.30 ms

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0.05 mm at -39.70 ms

CFC_1000

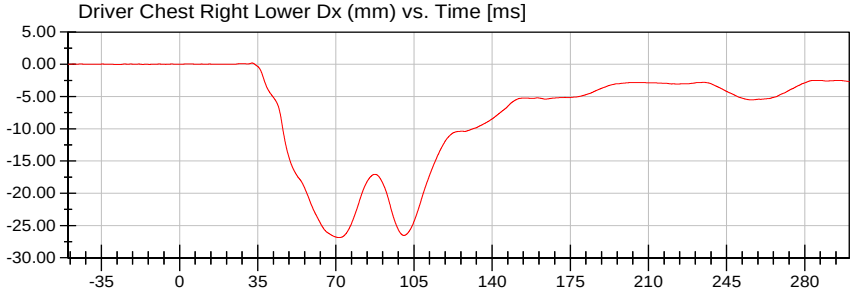
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Driver Chest Right Lower Dx (mm) vs. Time [ms]



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0.19 mm at 32.55 ms

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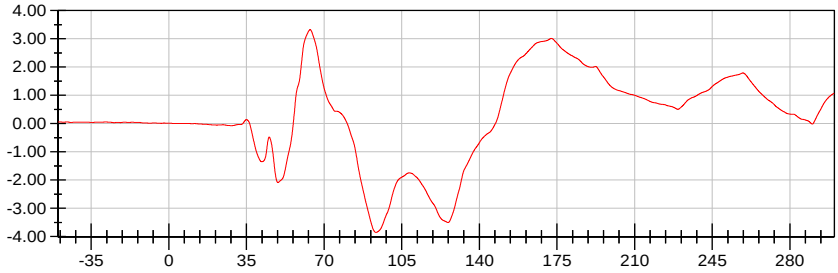
CFC_1000

Driver Chest Right Lower Dy (mm) vs. Time [ms]



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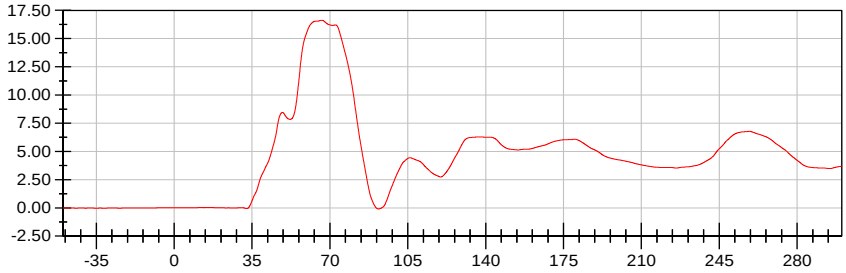
-3.85 mm at 93.40 ms

CFC_1000

Driver Chest Right Lower Dz (mm) vs. Time [ms]



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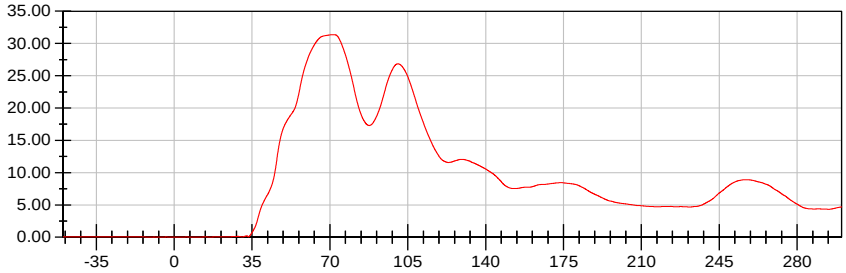
CFC_1000

Driver Chest Right Lower Resultant (mm) vs. Time [ms]



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0.02 mm at -1.45 ms

CFC_1000

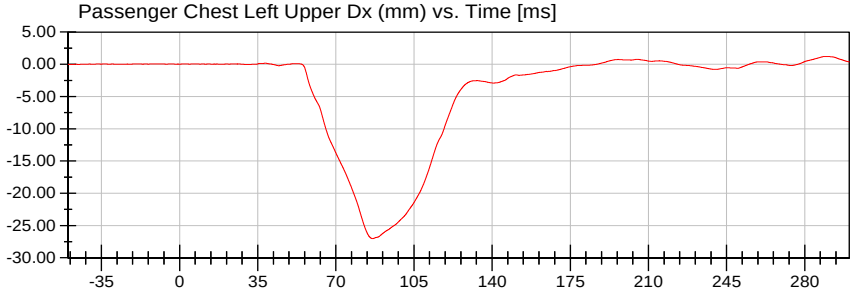
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Passenger Chest Left Upper Dx (mm) vs. Time [ms]



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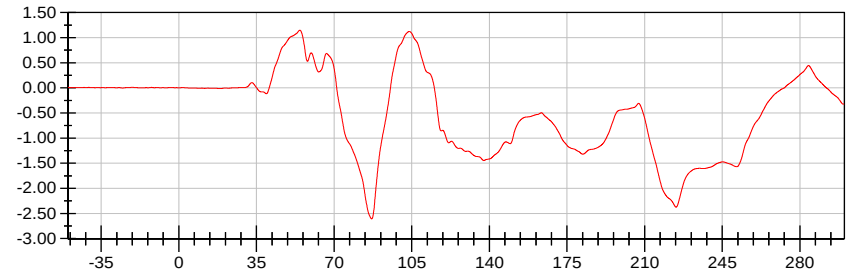
-27.03 mm at 86.45 ms

CFC_1000

Passenger Chest Left Upper Dy (mm) vs. Time [ms]



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1.15 mm at 54.55 ms

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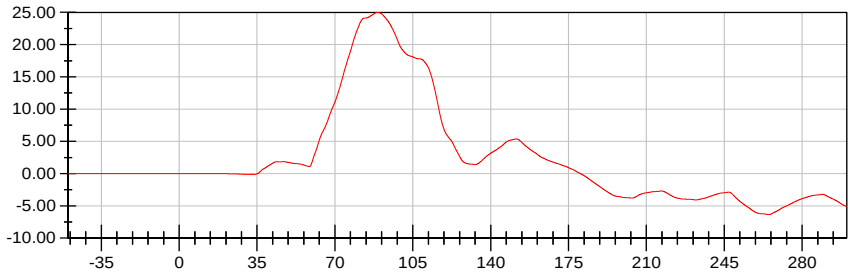
-2.61 mm at 86.95 ms

CFC_1000

Passenger Chest Left Upper Dz (mm) vs. Time [ms]



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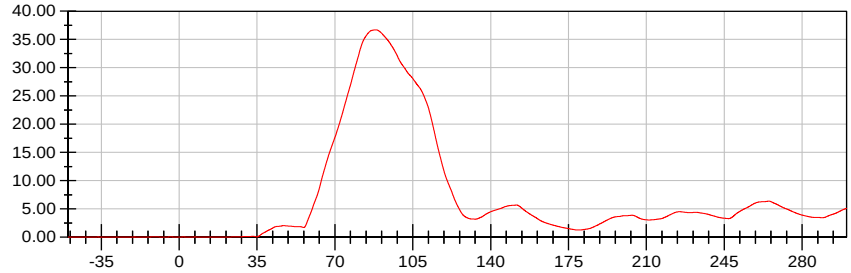
-6.36 mm at 265.05 ms

CFC_1000

Passenger Chest Left Upper Resultant (mm) vs. Time [ms]



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36.70 mm at 88.50 ms

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0.00 mm at -25.15 ms

CFC_1000

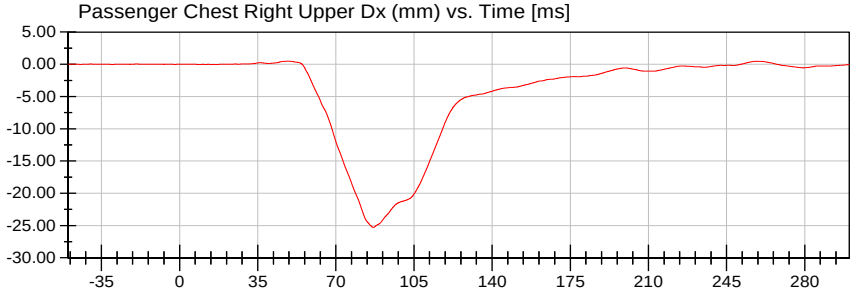
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Passenger Chest Right Upper Dx (mm) vs. Time [ms]



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0.49 mm at 48.45 ms

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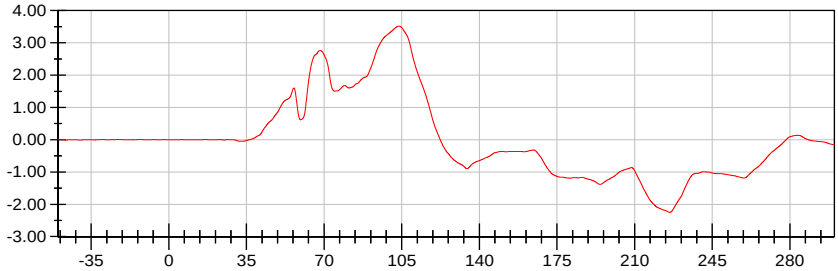
-25.30 mm at 86.75 ms

CFC_1000

Passenger Chest Right Upper Dy (mm) vs. Time [ms]



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3.52 mm at 103.70 ms

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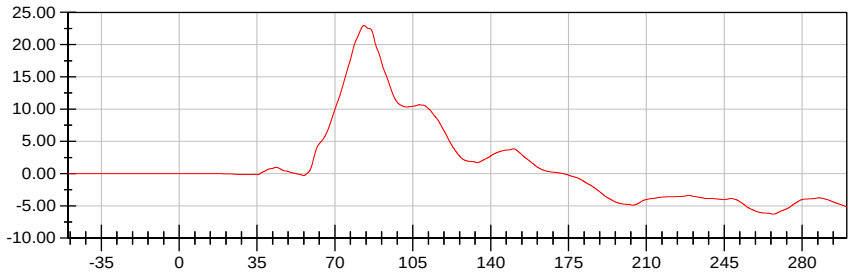
-2.25 mm at 225.75 ms

CFC_1000

Passenger Chest Right Upper Dz (mm) vs. Time [ms]



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22.96 mm at 83.05 ms

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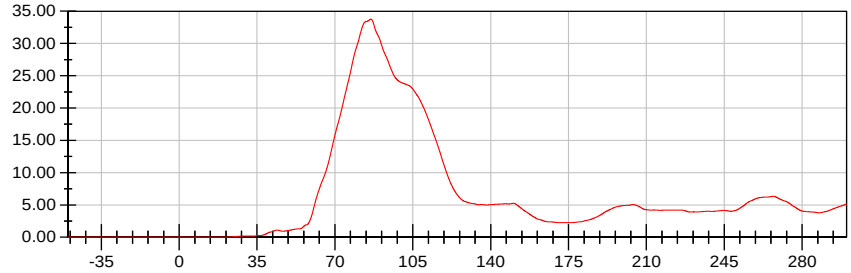
-6.29 mm at 267.10 ms

CFC_1000

Passenger Chest Right Upper Resultant (mm) vs. Time [ms]



<Max>

33.77 mm at 86.15 ms

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0.00 mm at -42.90 ms

CFC_1000

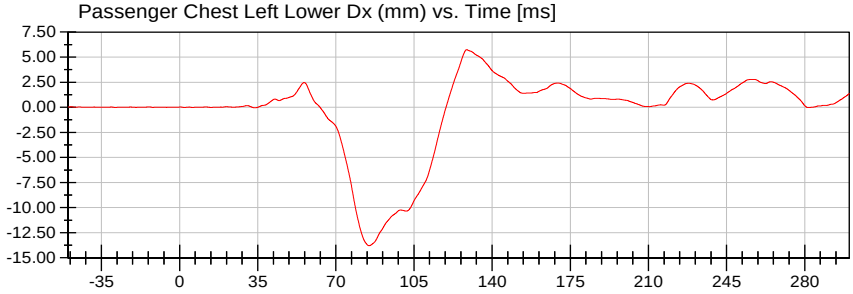
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Passenger Chest Left Lower Dx (mm) vs. Time [ms]



<Max>

5.74 mm at 128.60 ms

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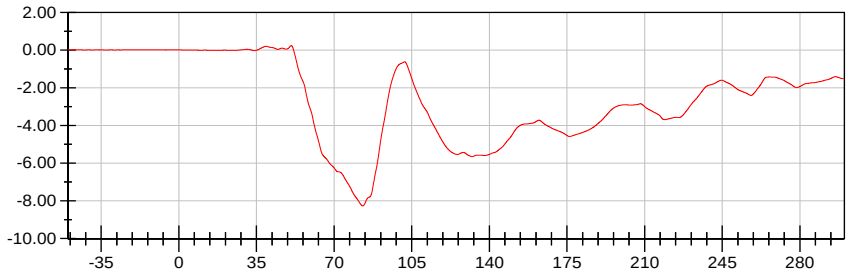
-13.79 mm at 84.90 ms

CFC_1000

Passenger Chest Left Lower Dy (mm) vs. Time [ms]



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0.25 mm at 50.70 ms

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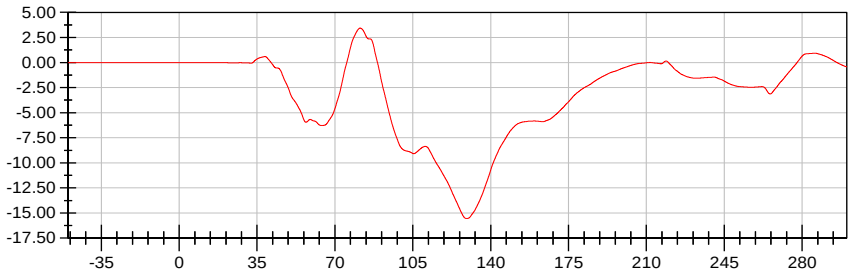
-8.27 mm at 82.95 ms

CFC_1000

Passenger Chest Left Lower Dz (mm) vs. Time [ms]



<Max>

3.43 mm at 81.35 ms

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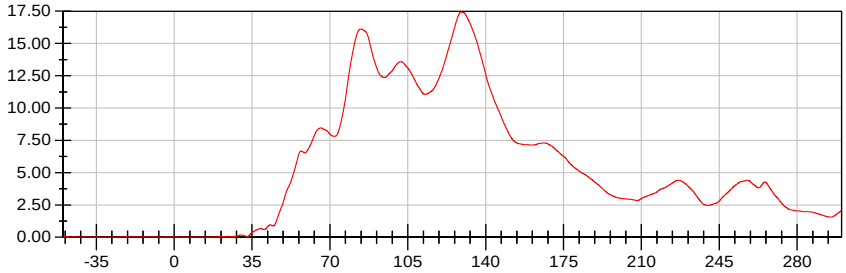
-15.54 mm at 129.20 ms

CFC_1000

Passenger Chest Left Lower Resultant (mm) vs. Time [ms]



<Max>

17.43 mm at 129.05 ms

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0.01 mm at 10.25 ms

CFC_1000

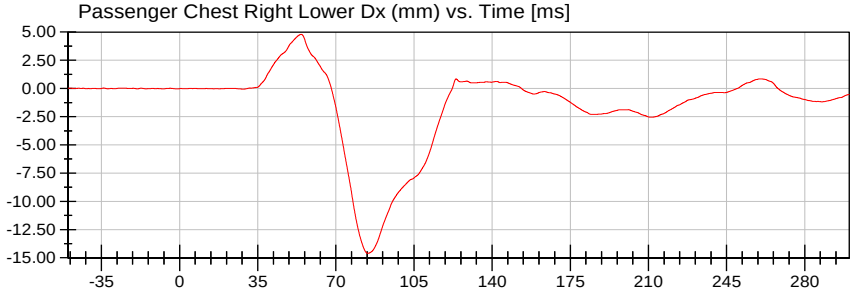
VRTC

Test Date: 11/15/2022

Test Lab: CTF

Test Number: 221115 ()

Passenger Chest Right Lower Dx (mm) vs. Time [ms]



<Max>

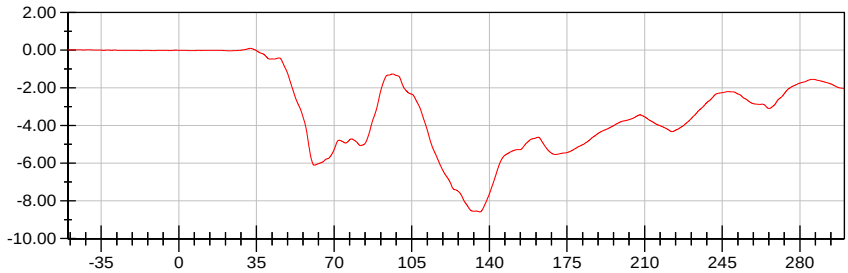
4.79 mm at 54.50 ms

<Min>

-14.61 mm at 84.40 ms

CFC_1000

Passenger Chest Right Lower Dy (mm) vs. Time [ms]



<Max>

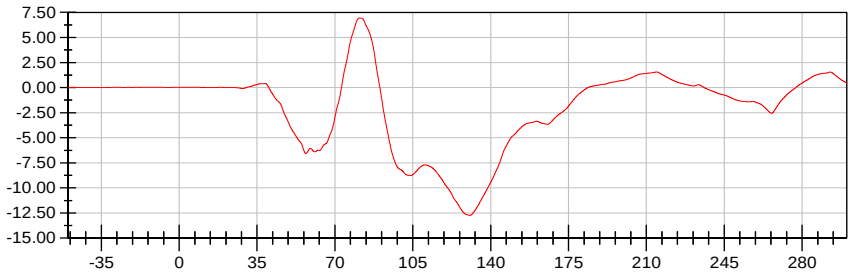
0.10 mm at 32.30 ms

<Min>

-8.58 mm at 135.75 ms

CFC_1000

Passenger Chest Right Lower Dz (mm) vs. Time [ms]



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6.93 mm at 81.10 ms

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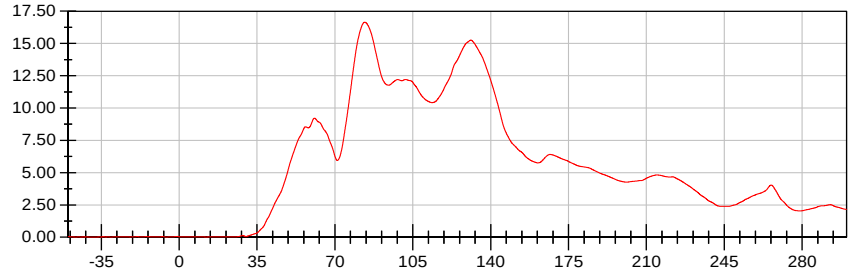
-12.73 mm at 130.70 ms

CFC_1000

Passenger Chest Right Lower Resultant (mm) vs. Time [ms]



<Max>

16.65 mm at 83.40 ms

<Min>

0.01 mm at -35.00 ms

CFC_1000

APPENDIX C

THOR 05 QUALIFICATION PROCEDURE

THOR-05F QUALIFICATION PROCEDURE

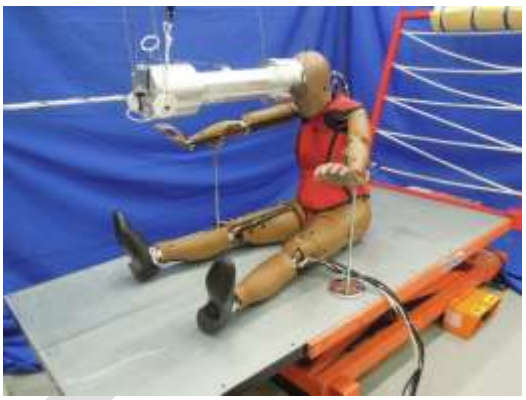
DRAFT

Qualification Procedure Background

Qualification tests were performed on the THOR-05Fs to ensure the repeatability of the ATDs' responses throughout the crash series and to help flag potential damage as a result of the severe loading. Qualification tests were performed prior to all crash tests, at mid-series (after the 3 belted crashes and before the 3 unbelted), and after all 6 crashes. The procedures for the qualification tests performed on the ATDs are provided here for reference, along with the time-history plots of relevant data channels. ***These procedures are drafts and anticipated to change in the future.*** Qualification corridors for the collected data are still under development and are not provided.

DRAFT

1 HEAD QUALIFICATION



1.1 Description

The head qualification test is a dynamic test performed to examine the force-time and acceleration-time characteristics of the head when impacted on the forehead with a 19.2 kg rigid impactor at 2.00 m/s.

1.2 Materials

- Fully-assembled THOR-05F ATD (474-0000)
- Impactor 19.2 ± 0.02 kg (42.3 ± 0.05 lb) in mass, including instrumentation, rigid attachments and the mass of the lower 1/3 of the suspension cables. The test probe is a 152.40 ± 0.3 mm (6.00 ± 0.01 in) diameter rigid cylinder. The impacting surface has a flat, right angle face with an edge radius of 12.7 ± 0.3 mm (0.50 ± 0.01 in).

1.3 Instrumentation

- Instrumentation to measure impact force (accelerometer on impactor)
- Instrumentation to measure the impact velocity
- Head center of gravity tri-axial accelerometers (SA572-S4)
- A dual-axis tilt sensor (SA572-S44) attached to head accelerometer mounting plate assembly (474-1031) to measure initial angle about “X” and “Y” axes
- A dual-axis tilt sensor (SA572-S44) attached to the pelvis to measure initial angle about “X” and “Y” axes

1.4 Pre-Test Procedures

1.4.1 Soak the ATD in a controlled environment with a temperature of 20.6 to 22.2 °C (69 to 72 °F) and a relative humidity from 10 to 70% for at least 4 hours prior to a test. The test environment should have the same temperature and humidity requirements as the soak environment.

1.4.2 Set the lower thoracic spine (LTS) pitch change joint to the **slouched** position.

1.4.3 Set the neck pitch change joint to the **neutral** position.

1.5 Test Procedure

1.5.1 Install the THOR-05F Jacket (474-3800).

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1.5.2 Seat the dummy on a horizontal surface (±0.5°) with no back support, with all limbs extended horizontally and forward parallel to the midsagittal plane. The midsagittal plane shall be vertical within ±1 degree (Figure 1-1).

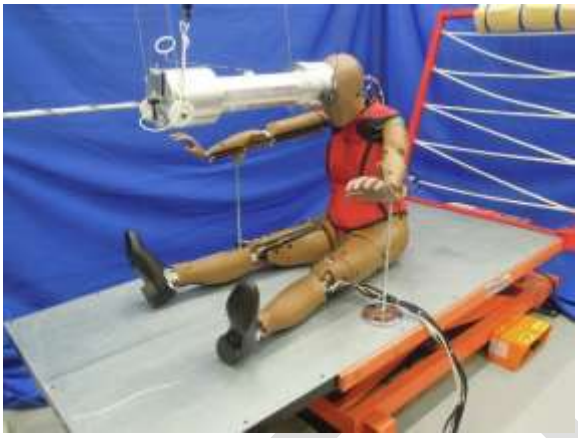

Figure 1-1. Initial setup for head qualification test.

1.5.3 Support the forearms in a fully-extended orientation, palmside of the hands down, with hands angled upwards to minimize interference with the arm supports (Figure 1-1). The inability to hold this position indicates that the arm and shoulder joint torques are not set properly.

1.5.4 Set the pelvis so that the angle measured by the pelvis tilt sensor is 0 ± 0.5° in the X-axis and 8 ± 1° in the Y-axis.

1.5.5 Set the head so that the angle measured by the head CG tilt sensor is 0 ± 0.5° in the X-axis and -29 ± 1° in the Y-axis (Figure 1-2).

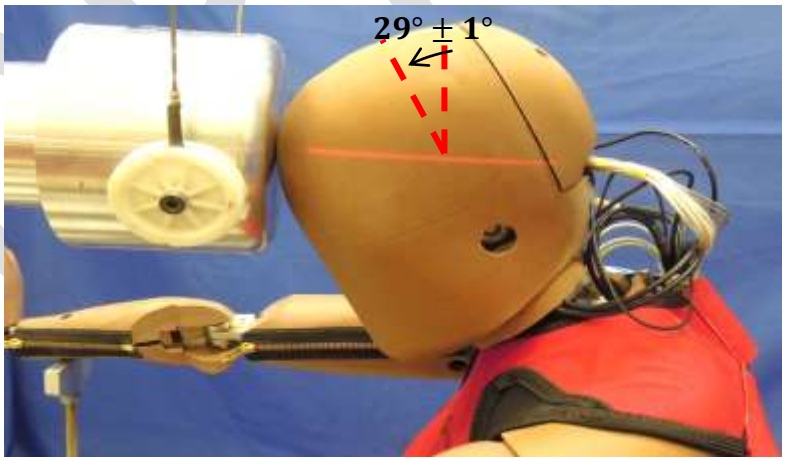

Figure 1-2. Angle of head and alignment with impactor.

1.5.6 Position the dummy so that the head is just touching the impactor face (Figure 1-2) when the probe is at its lowest position (at rest). The dummy should be seated so that the centerline of the probe axis aligns with the dummy's midsagittal plane.

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1.5.7 Adjust the table height or impactor height so that the center of the impactor face is aligned with the head center of gravity as indicated by a notch on the side of the head skin. A removable pointer (threaded into the centerline of the pendulum with approximately 30mm protruding) or laser will aid this process (Figure 1-3). Remove the pointer tool when this step has been completed.

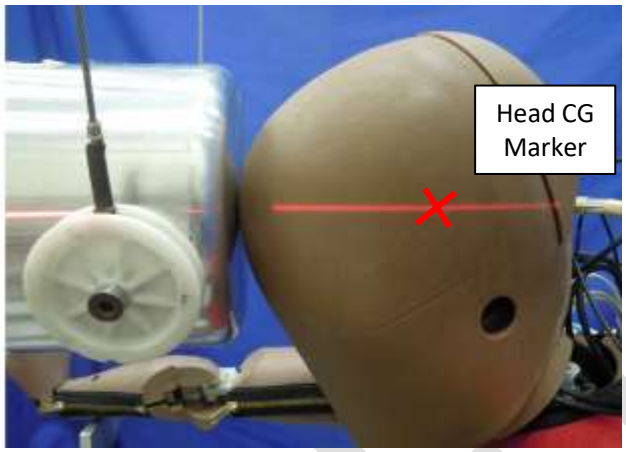

Figure 1-3. Vertical height set up during head impact test

1.5.8 The probe at rest should just be contacting the face. If it is not, carefully adjust the dummy position relative to the probe while maintaining setup angles for impact position.

1.5.9 The motion of the impactor should be constrained so that there is no significant lateral, vertical, or rotational movement.

1.5.10 Record the "as measured (AM)" channels listed in Table 1-2 in accordance with SAE J211-1.

1.5.11 Confirm the test setup parameters illustrated in Table 1-1.

Table 1-1. Head Impact Test Setup Parameters

Parameter	Setting
Lower Thoracic Spine (LTS) Pitch Change Setting	Slouched
Neck Pitch Change Setting	Neutral
Tilt Sensor Reading: Head	X = 0 ± 0.5°; Y = -29° ± 1°
Tilt Sensor Reading: Pelvis	X = 0 ± 0.5º; Y = 8 ± 1º
Wait Time Between Tests	At Least 60 Minutes

1.5.12 Ensure that at least 60 minutes have passed since the last test on the head or face.

1.5.13 Conduct the test at an impact velocity of 2.00 ± 0.05 m/s.

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1.6 Data Processing

1.6.1 Perform bias removal of the measured (unfiltered) channels listed in the "Required Measurement Channels" (Table 1-2) by subtracting the average value of the data samples over the period between (0.050 s) and (0.010 s) prior to contact.

1.6.2 Filter channels based on the CFC filter classes listed in Table 1-2.

1.6.3 Calculate time-history of impact force at the contact interface:

$F_{IMP}(t) = m_{IMP} \cdot a_{IMP}(t)$ where,

$F_{IMP}(t)$ = calculated force time-history at contact interface

m_{IMP} = mass of the impactor

$a_{IMP}(t)$ = measured acceleration time-history of impactor

1.6.4 Calculate head CG resultant acceleration:

$$HDCG_R(t) = \sqrt{HDCG_X^2 + HDCG_Y^2 + HDCG_Z^2}$$

Where:

$HDCG_R(t)$ = time history of head CG resultant acceleration

$HDCG_x(t)$ = time history of head X resultant acceleration

$HDCG_y(t)$ = time history of head Y resultant acceleration

$HDCG_z(t)$ = time history of head Z resultant acceleration

Table 1-2. Required Measurement Channels for the Head Impact Test

Channel Description	CFC	ISO-MME Code	AXIS	DASTAT	SENATT	SENTYP	YUNITS
Probe Accelerometer	180	T0SENSMI0000ACXC	XG	AM	PEND	AC	G'S
Probe Force	N/A	T0SENSMI0000FOXC	XG	CM	PEND	PP	NWT
Head CG Accelerometer, X-axis	1000	D0HEAD0000TFACXA	XL	AM	HDCG	AC	G'S
Head CG Accelerometer, Y-axis	1000	D0HEAD0000TFACYA	YL	AM	HDCG	AC	G'S
Head CG Accelerometer, Z-axis	1000	D0HEAD0000TFACZA	ZL	AM	HDCG	AC	G'S
Head CG Resultant Accelerometer	N/A	D0HEAD0000TFACRA	RS	CM	HDCG	PP	G'S

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2 FACE QUALIFICATION

2.1 Description

The face qualification test examines facial impact response to loading by a rigid 152.4 mm diameter circular disk attached to a 10.70 kg impactor at a velocity of 6.73 m/s.

2.2 Materials

- Fully-assembled THOR-05F ATD (474-0000)
- Impactor 10.70 ± 0.02 kg (23.59 ± 0.05 lb) in mass, including instrumentation, rigid attachments and the mass of the lower 1/3 of the suspension cables. The test probe is a 152.40 ± 0.3 mm (6.0 ± 0.01 in) diameter rigid cylinder. The impacting surface must have a flat, right angle face with an edge radius of 12.7 ± 0.3 mm (0.50 ± 0.01 in).

2.3 Instrumentation

- Instrumentation to measure impact force (accelerometer on impactor)
- Instrumentation to measure the impact velocity
- Head center of gravity tri-axial accelerometers (SA572-S4)
- A dual-axis tilt sensor (SA572-S44) attached to head accelerometer mounting plate assembly (474-1031) to measure initial angle about "X" and "Y" axes
- A dual-axis tilt sensor (SA572-S44) attached to the pelvis to measure initial angle about "X" and "Y" axes

2.4 Pre-Test Procedures

2.4.1 Soak the ATD in a controlled environment with a temperature of 20.6 to 22.2 °C (69 to 72 °F) and a relative humidity from 10 to 70% for at least 4 hours prior to a test. The test environment should have the same temperature and humidity requirements as the soak environment.

2.4.2 Set the lower thoracic spine (LTS) pitch change joint to the **erect** position.

2.4.3 Set the neck pitch change joint to the **neutral** position.

2.5 Test Procedure

2.5.1 Seat the dummy on a horizontal surface (±0.5°) with no back support, with all limbs extended horizontally and forward parallel to the midsagittal plane. The midsagittal plane shall be vertical within ±1 degree (Figure 2-1).

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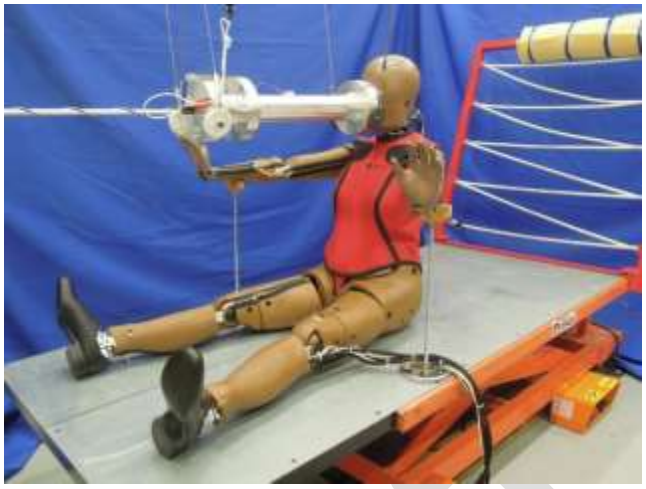

Figure 2-1. Initial setup for the face disk impact test.

2.5.2 Support the forearms in a fully-extended orientation, palmside of the hands down, with hands angled upwards to minimize interference with the arm supports (Figure 2-1). The inability to hold this position indicates that the arm and shoulder joint torques are not set properly.

2.5.3 Set the pelvis so that the angle measured by the pelvis tilt sensor is 0 ± 0.5° in the X-axis and 7± 1° in the Y-axis.

2.5.4 Set the head so that the angle measured by the head CG tilt sensor is 0 ± 0.5° in the X-axis and 0 ± 1° in the Y-axis.

2.5.5 Position the dummy so that the face is just touching the probe when the probe is at its lowest position (at rest). The dummy should be seated so that the centerline of the probe axis aligns with the dummy's midsagittal plane.

2.5.6 Adjust the table height or impactor height so that the center of the impact face is aligned 61.8 mm below the head CG marker (Figure 2-2). A removable pointer (threaded into the centerline of the pendulum with approximately 30mm protruding) or laser will aid this process.

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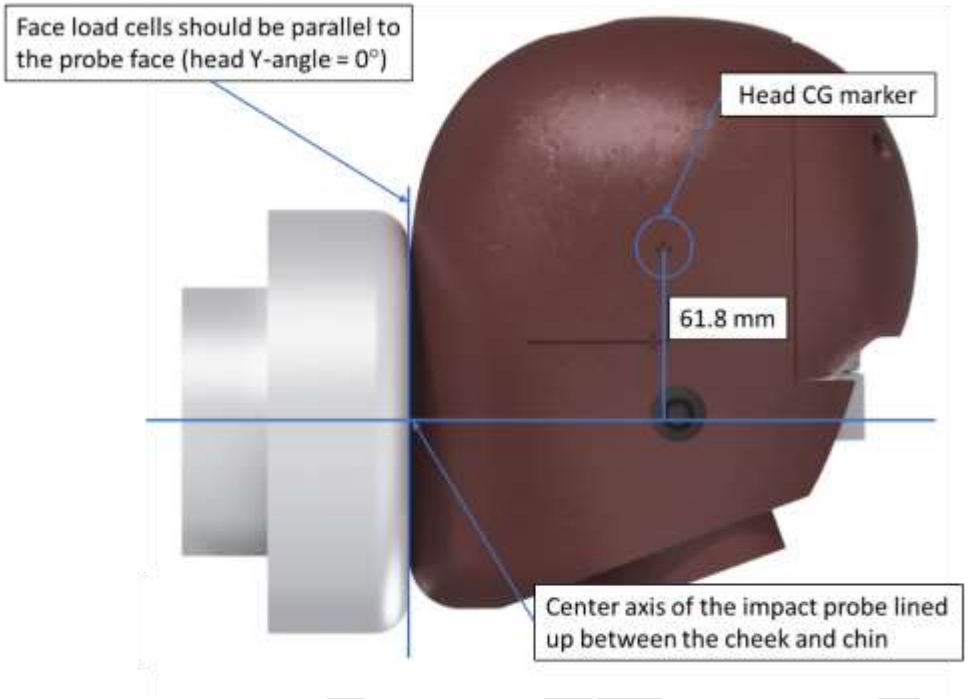

Figure 2-2. Positioning the center of the impact face to align impactor.

2.5.7 If used, remove the pointer by unthreading from the centerline of the impactor. The probe at rest should just be contacting the face. If it is not, carefully adjust the dummy position relative to the probe while maintaining setup angles for impact position.

2.5.8 The motion of the impactor should be constrained so that there is no significant lateral, vertical, or rotational movement.

2.5.9 Record the "as measured (AM)" channels listed in Table 2-2 in accordance with SAE J211-1.

2.5.10 Confirm the test setup parameters illustrated in Table 2-1.

Table 2-1. Face Rigid Disk Impact Test Setup Parameters

Parameter	Setting
Lower Thoracic Spine (LTS) Pitch Change Setting	Erect
Neck Pitch Change Setting	Neutral
Tilt Sensor Reading: Head	X = 0 ± 0.5º; Y = 0 ± 1º
Tilt Sensor Reading: Pelvis	X = 0 ± 0.5º; Y = 7 ± 1º
Wait Time Between Tests	At Least 30 mins

2.5.11 Conduct the test at a velocity of 6.73 ± 0.05 m/s.

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2.6 Data Processing

2.6.1 Perform bias removal of the measured (unfiltered) channels listed in the "Required Measurement Channels" (Table 2-2) by subtracting the average value of the data samples over the period between (.050 s) and (.010 s) prior to contact.

2.6.2 Filter channels based on the CFC filter classes listed in Table 2-2.

2.6.3 Calculate time-history of impact force at the contact interface:

$F_{IMP}(t) = m_{IMP} \cdot a_{IMP}(t)$ where,

$F_{IMP}(t)$ = calculated force time-history at contact interface

m_{IMP} = mass of the impactor

$a_{IMP}(t)$ = measured acceleration time-history of impactor

2.6.4 Calculate head CG resultant acceleration:

$$HDCG_R(t) = \sqrt{HDCG_X^2 + HDCG_Y^2 + HDCG_Z^2}$$

Where:

$HDCG_R(t) = \text{time} - \text{history of head CG resultant acceleration}$

$HDCG_X = \text{time} - \text{history of head acceleration}, \text{X} - \text{axis}$

$HDCG_Y = \text{time} - \text{history of head acceleration}, \text{Y} - \text{axis}$

$HDCG_Z = \text{time} - \text{history of head acceleration}, \text{Z} - \text{axis}$

Table 2-2. Required Measurement Channels for Face Qualification

Channel Description	CFC	ISO-MME Code	AXIS	DASTAT	SENATT	SENTYP	YUNITS
Probe Accelerometer	180	T0SENSMI0000ACXC	XG	AM	PEND	AC	G'S
Probe Force	N/A	T0SENSMI0000FOXC	XG	CM	PEND	PP	NWT
Head CG Accelerometer, X-axis	1000	D0HEAD0000TFACXA	XL	AM	HDCG	AC	G'S
Head CG Accelerometer, Y-axis	1000	D0HEAD0000TFACYA	YL	AM	HDCG	AC	G'S
Head CG Accelerometer, Z-axis	1000	D0HEAD0000TFACZA	ZL	AM	HDCG	AC	G'S
Head CG Resultant Acceleration	N/A	D0HEAD0000TFACRA	RS	CM	HDCG	PP	G'S

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3 NECK QUALIFICATION

3.1 Summary

There are six procedures used to qualify the THOR-05F neck performance. Using a torsion fixture, a torsion test is conducted in the left and right directions to assess the response of the neck in rotation about its Z-axis. Flexion and extension tests resemble the Hybrid III 5th Percentile Female head-neck pendulum test defined in CFR Title 49, Part 572, Subpart O with 152.4 mm (6 in) aluminum honeycomb used to decelerate the pendulum. The flexion and extension tests assess the neck performance in forward and rearward bending about the local Y-axis. The neck is also tested in a lateral mode resembling the SID-IIsD head-neck lateral pendulum test defined in CFR Title 49, Part 572, Subpart V using 76.2 mm (3 in) aluminum honeycomb for pendulum deceleration. The lateral tests assess the neck performance in the left and right directions about the local X-axis. Logistically, the neck should be qualified in the torsion tests first, followed by the flexion, extension, and lateral tests.

3.2 Description

The neck qualification tests are dynamic tests performed to examine the moment, force, rotation, and angular velocity characteristics of the neck in torsion, frontal flexion, extension, and lateral flexion. The pendulum is decelerated from 5.00 m/s (frontal flexion, extension) or 3.40 m/s (torsion, lateral flexion) during contact with aluminum honeycomb.

3.3 Materials

- THOR-05F ATD head and neck assembly (474-1000 and 474-2000), including all neck spring hardware
- Head-neck pendulum (as defined in CFR Title 49, §572.33(c)3).
- Neck mounting plate with 10° offset (TF-200-2357) to attach the lower neck load cell to the pendulum (Figure 3-1).

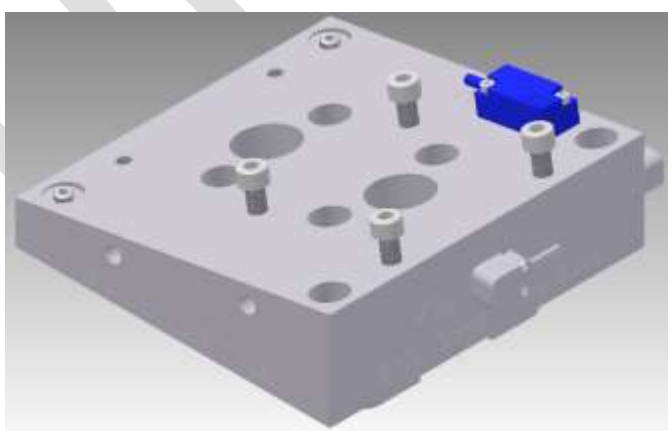

Figure 3-1. Neck mounting plate with 10° offset (TF-200-2357).

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- 152.4 mm (6 in) deep aluminum honeycomb[1] used for decelerating the pendulum in flexion and extension modes.
- 76.2 mm (3 in) deep aluminum honeycomb used for decelerating the pendulum in lateral and torsion modes.
- Neck torsion fixture (DL472-1000) with upper and lower neck THOR-05F adaptors (Figure 3-2).

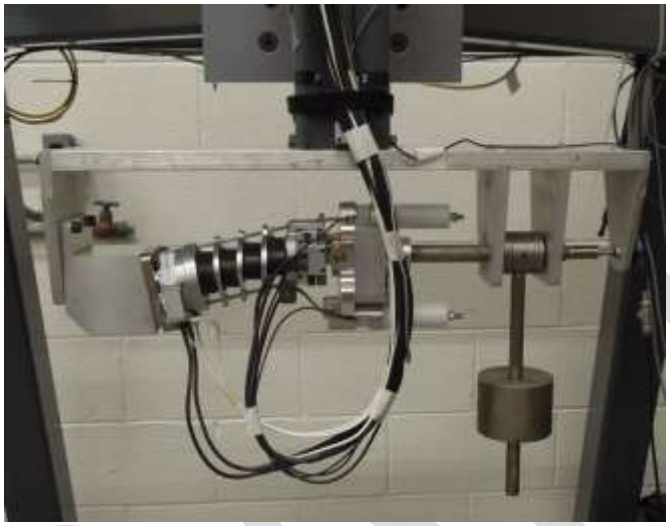

Figure 3-2. Neck torsion fixture with THOR-05F adaptors

3.4 Instrumentation

- Pendulum accelerometer
- Instrumentation to measure impact velocity
- Instrumentation to determine Time Zero (T_0)
- Upper neck 6-axis load cell (SA572-S105)
- 3 Angular Rate Sensors (ARS) in the head (X, Y, Z) (SA572-S58)
- Rotational potentiometer on neck torsion fixture (SA572-S51)
- Pendulum Angular Rate Sensor (ARS).
    - Mount the ARS to a surface on the pendulum arm that is perpendicular to the plane of motion of the pendulum's longitudinal axis, such that the rotational velocity about the global Y-axis is recorded (
    - Figure 3-3. Installation of ARS on pendulum.). Set the polarity of the pendulum ARS such that the rotation of the pendulum towards the honeycomb decelerator results in a positive angular velocity before impact.

[1] Length and width of the honeycomb may be varied to achieve the required deceleration pulse.

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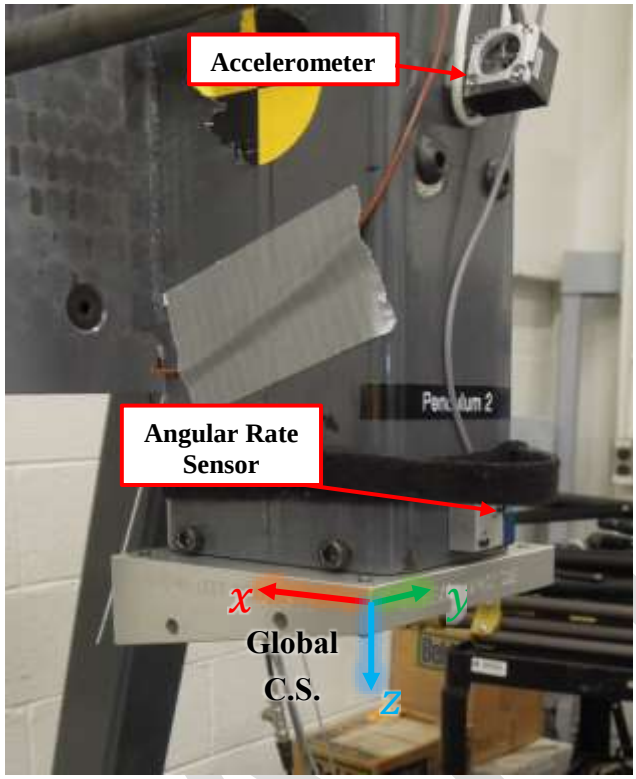

Figure 3-3. Installation of ARS on pendulum.

3.5 Pre-Test Neck Setup Procedure

Before the neck qualification procedures are performed, the neck spring towers must be properly installed, adjusted, and locked in place using jam nuts at the top of the front and rear towers (Figure 3-4). *Once the spring tower adjustment has been made and neck qualification tests have been performed, do not adjust the spring towers again or new neck qualification tests must be performed.*

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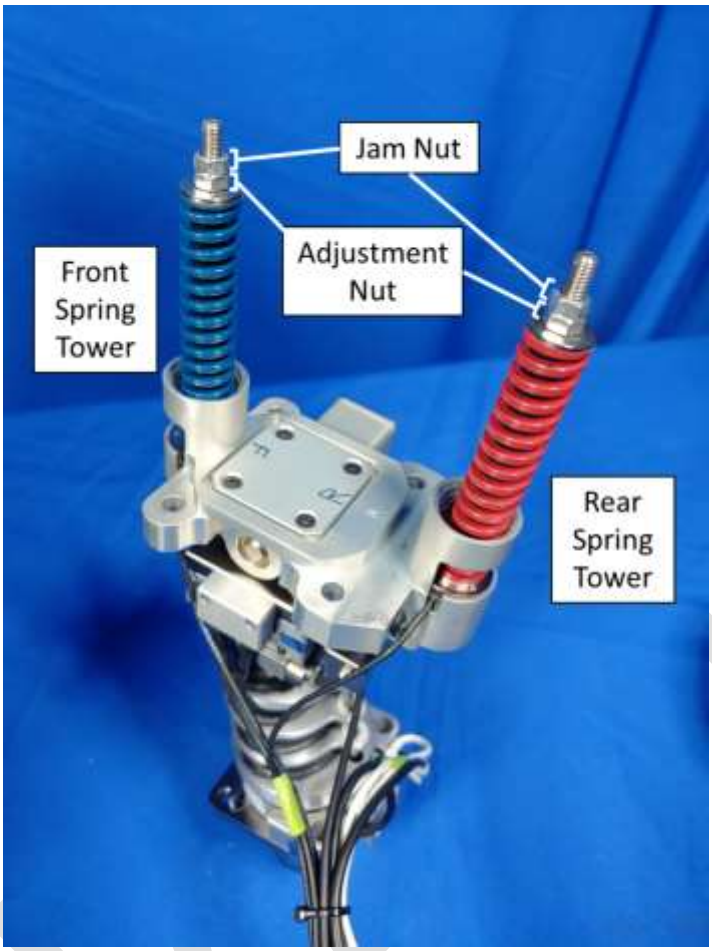

Figure 3-4. Neck spring tower jam nut configuration.

3.5.1 Remove the neck/head assembly (including the lower neck load cell) from the torso by removing the four M5 X 0.8 X 16 mm SHCS (two anterior and two posterior) that hold the base of the lower neck load cell to the torso (Figure 3-5).

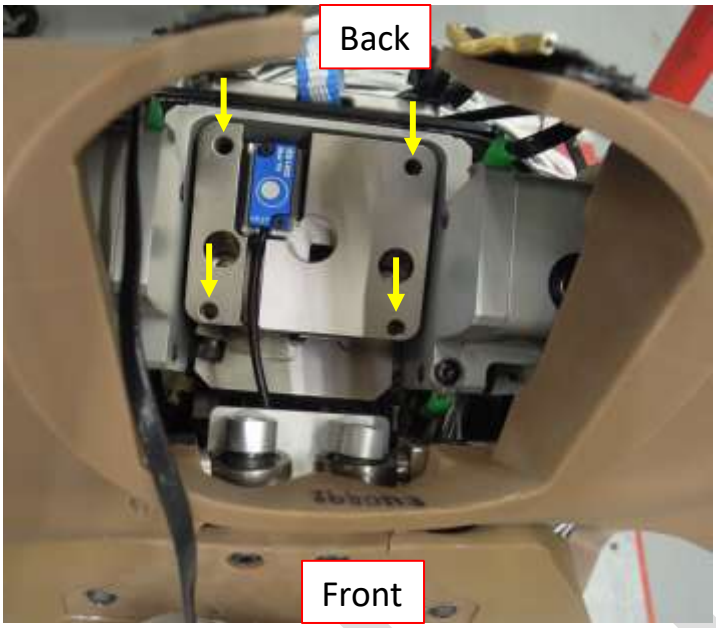

Figure 3-5. Removal of bolts that attach neck to torso.

3.5.2 Uninstall the Skull Cap and Cap Skin (474-1020 and 474-1025) by removing the four M6 X 1 X 20 mm LHCS attaching it to the skull assembly (Figure 3-6).

Figure 3-6. Uninstall the Skull Cap and Cap Skin (474-1020 and 474-1025).

3.5.3 Remove the Head Skin (474-1008) from the skull by first spreading the posterior portion away from the groove at the rear of the skull assembly, then pulling the top of the head skin forward and down (Figure 3-7).

Figure 3-7. Remove the Head Skin (474-1008).

3.5.4 Remove the four M6 X 1 X 25 LG. SHCS at the bottom of the head/neck platform assembly (474-2300) to disconnect the head from the neck (Figure 3-8). Separate the head and neck by pulling the neck away from the head in a direction parallel to the neck column until the front spring tower is completely outside of the skull.

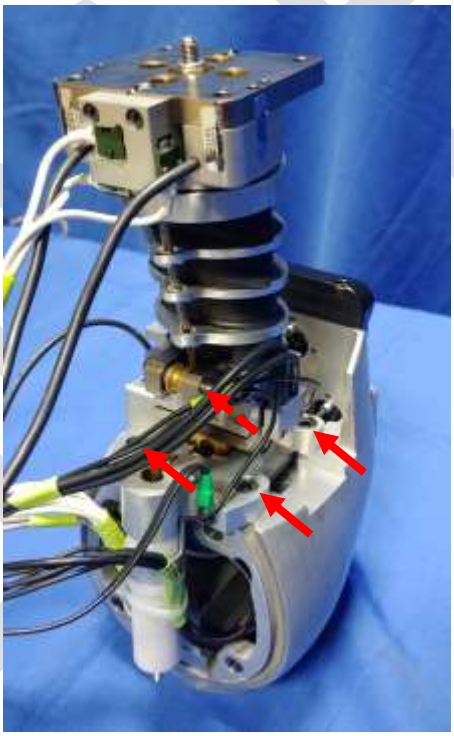

Figure 3-8. Remove the head from the neck by removing four M6 x 25 LG. SHCS from the bottom of the head/neck platform assembly (474-2300).

Figure 3-9. THOR-05F Neck Assembly.

3.5.5 Remove the front and rear spring tubes (474-2303) by unscrewing by hand from the head/neck mounting platform (Figure 3-10).

Figure 3-10. Remove the front and rear spring tubes (474-2303).

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3.5.6 Loosen the M5 x 0.8 thin profile jam and adjustment nuts from the top of the front and rear spring cables (Figure 3-11). Remove the stop assembly (474-2115) by removing four M3 x 0.5 x 8 LG FHCS from the head/neck mounting platform (474-2302) (circled in red in Figure 3-11). The head/neck mounting platform (474-2302) is free to rotate about the occipital condyle.

Figure 3-11. Remove the M5 x 0.8 thin profile jam nuts from the top of the front and rear spring cables.

3.5.7 Attach the lower neck load cell (474-2325) to the 10° neck mounting plate (TF-200-2357) with four M5 X 0.8 X 16mm SHCS (Figure 3-12). Clamp the neck mounting plate clamped to a rigid, flat horizontal surface. Adjust and stabilize the neck mounting plate so an inclinometer reads 10.0 ± 0.2° about the Y-axis and 0 ± 0.5° about the X-axis.

Figure 3-12. Install neck lower load cell (474-2325) to neck mounting plate. Clamp neck mounting plate to rigid, flat surface.

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3.5.8 Remove the Occipital Condyle Potentiometer (SA572-S114) and Rotary Potentiometer Housing (474-2013) by loosening the set screw (M3 X 0.5 X 3 SSS) from the OC pin and then removing the top two M3 X 0.5 X 35 LG. BHCS SS from the OC potentiometer housing and remove the OC pot with housing from the neck (Figure 3-13).

Figure 3-13. Remove the top two M3 X 0.5 X 35 LG. BHCS SS from the OC potentiometer housing and remove the OC pot with housing from the neck .

3.5.9 Manipulate the neck bend and adjust the head/neck mounting platform (474-2302) until an inclinometer at the upper neck plate and on the top surface of the Head/Neck Mounting Platform are reading 0 ± 0.2° about the Y-axis and 0 ± 0.5° about the X-axis (Figure 3-14). The Upper Neck Tilt Sensor (SA572-S44) can be used instead of an inclinometer (Figure 3-15). Gently tighten the front and rear M5 x 0.8 adjustment nuts to temporarily hold mounting platform orientation. NOTE: Make sure neck bend is stable before continuing.

Figure 3-14. Inclinometer placement on top surface of Head/Neck Mounting Platform (474-2302) (left) and placement on upper neck plate (right).

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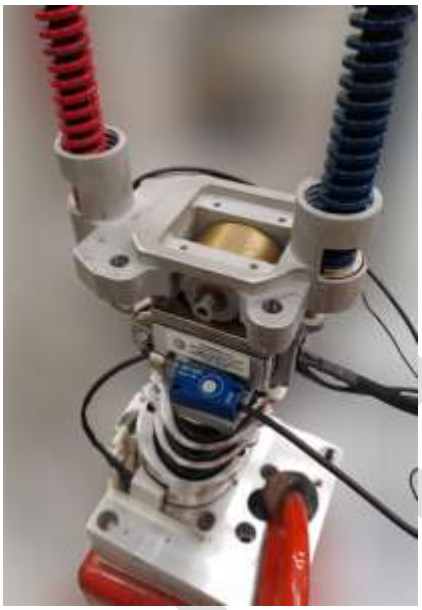

Figure 3-15. Measuring angle using Upper Neck Tilt Sensor.

3.5.10 Insert the Flexion/Extension Stop Assembly (474-2115) into the head/neck mounting platform and secure with four M3 X 0.5 X 8 FHCS (Figure 3-16). The front and rear nodding blocks are the same shape so the orientation does not matter.

Figure 3-16. Insert the Flexion/Extension Stop Assembly (474-2115) into the head/neck mounting platform

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3.5.11 Ensure that the springs are properly seated on the front and rear neck cables (Figure 3-17).

Figure 3-17. Rear spring properly seated against spring load cell.

3.5.12 With zero compression on the front and rear neck cable load cells, acquire voltages for the front and rear skull spring load cells. ***NOTE*****:** *Load cells must have no applied pressure before balancing or else the output will be unintentionally offset.*

3.5.13 Gently tighten the front and rear M5 X 0.8 adjustment nuts evenly until they both have 0.5-1.5 lbs (2.2-6.7 N) of applied force.

3.5.14 Reinstall front and rear M5 x 0.8 jam nuts to lock adjustment nut position. **NOTE:** Adjustment nut may move while jamming. Confirm that applied compression on both spring load cells is 0.5-1.5lbs (2.2-6.7N) with the head and neck Y-axis tilts still at 0 ± 0.2°.

3.5.15 Remove the neck assembly from the 10° Neck Mounting Platform (TF-200-2357) and reinstall the spring tubes (474-2303).

3.5.16 Remove upper neck plate tilt sensor if used.

3.5.17 Reinstall Occiptial Condyle Rotary Potentiometer (SA572-S114).

3.5.18 Once the neck cables are adjusted as above, the neck is ready for qualification testing. The cables must not be adjusted <u>after</u> qualification testing as this may invalidate the qualification results.

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3.6 Neck Test Data Zero Setting, Offset Calculation, Velocity Calculation

Follow these procedures to set time zero, remove offset, and calculate velocity from the neck test data.

3.6.1 Filter the pendulum acceleration at CFC1000.

3.6.2 Perform bias removal of the pendulum acceleration by subtracting the average value of the data samples over the period between (.050 s) and (.010 s) prior to contacting the honeycomb.

3.6.3 Time zero (t_0) is defined as the time when the first data sample where the bias removed pendulum acceleration from Step 3.6.2 exceeds 5 g. If this results in a time shift from the original DAS-recorded time, apply this time shift to all measured channels listed in the "Required Measurement Channels" table for the respective neck test mode.

3.6.4 Perform bias removal of the remaining measured channels listed in the "Required Measurement Channels" for the respective neck test mode by subtracting the average value of the data samples over the period between (.050 s) and (.010 s) prior to time zero (t_0).

3.6.5 Filter the data for all measured channels listed in the "Required Measurement Channels" table for the respective neck test mode.

3.6.6 Integrate the pendulum acceleration (CFC1000) from t_0 to the end of the sample period to obtain pendulum velocity.

$$Pendulum\ Velocity(t) = \int_{t_0}^{t_f} Pend\ Accel\ (t)dt$$

Where:

$Pendulum\ Velocity(t) = \text{time} - \text{history of pendulum impact velocity}$

$Pend\ Accel(t) = \text{time} - \text{history of pendulum acceleration}$

$t_0 = \text{first time point for calculation (see3.6.3 above)}$

$t_f = \text{final time point for collected data}$

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3.7 Neck Torsion Test

3.7.1 Neck Torsion Test Procedure

3.7.1.1 Soak the head and neck assembly in a controlled environment with a temperature of 20.6 to 22.2 °C (69 to 72 °F) and a relative humidity from 10 to 70% for at least 4 hours prior to a test. The test environment should have the same temperature and humidity requirements as the soak environment.

3.7.1.2 Install the 76.2 mm (3") aluminum honeycomb to meet the pendulum pulse specified in Table 3-2 for an impact velocity of 3.40 ± 0.05 m/s. Ensure that the contact area of the aluminum honeycomb engages the impactor plate on the pendulum upon impact.

3.7.1.3 Ensure that the Pre-Test Neck Setup Procedure (See Section 3.5) has been carried out.

3.7.1.4 Mount the angular rate sensor (ARS, SA572-S58) on top of the upper neck mounting adapter (DL472-1170) at the edge opposite the front spring tower recess, as shown in Figure 3-18.

3.7.1.5 Install the upper neck mounting adapter (DL472-1170) to the neck using four M6 X 1 X 14 mm SHCS. The semi-circular recess is oriented towards the front of the neck next to the front spring tower. This will locate the ARS closest to the rear spring tower (Figure 3-18).

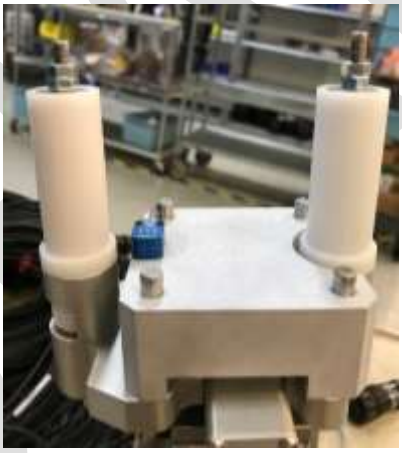

Figure 3-18. Angular rate sensor installation on upper neck mounting adapter (DL472-1170).

3.7.1.6 Attach the lower neck load cell to the lower neck mounting adaptor using four M5 X 0.8 X 16 mm SHCS (Figure 3-19). Attach the end plate assembly (DL472-1130) to the neck mounting adaptor as shown in Figure 3-19. Orient the neck so that the bottom surface is parallel to the top surface of the upper neck mounting adaptor and the front spring tower is facing the locator pins.

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Figure 3-19. Neck with lower neck mounting adaptor and end plate assembly (DL472-1130) installed.

3.7.1.7 Mount the neck torsion fixture (DL472-1000) to the bottom of the neck pendulum using four ¼-20 x 5/8" SHCS (Figure 3-20). Orient the long axis of the torsion fixture top plate (DL472-1110) perpendicular to the direction of motion of the pendulum (Figure 3-21).

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Figure 3-20. Attachment of torsion fixture to neck pendulum.

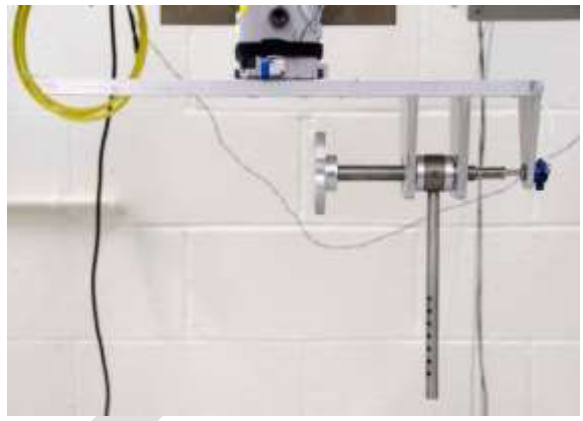

Figure 3-21. Long axis of torsion fixture top plate (DL572-1110) perpendicular to motion of neck pendulum.

3.7.1.8 Install the neck into the fixture by aligning the locator pins on the end plate assembly into the end of the torsion fixture top plate (Figure 3-22). Orient the neck so that the rear spring tower faces the ground.

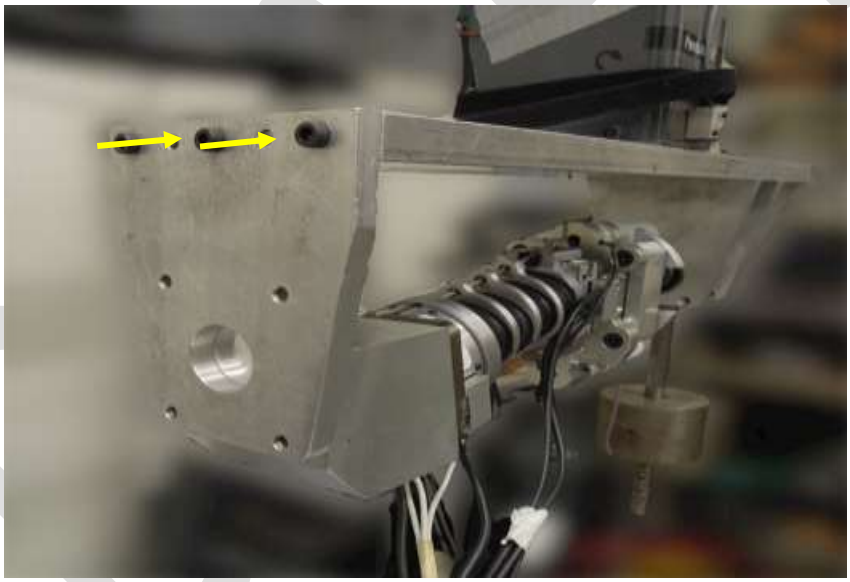

Figure 3-22. Alignment of locator pins with end plate of neck torsion fixture.

3.7.1.9 While positioning the end plate assembly in Step 3.7.1.8, simultaneously align the neck mounting adapter locator pins into the neck attachment plate (DL472-1151) (Figure 3-23 and Figure 3-24).

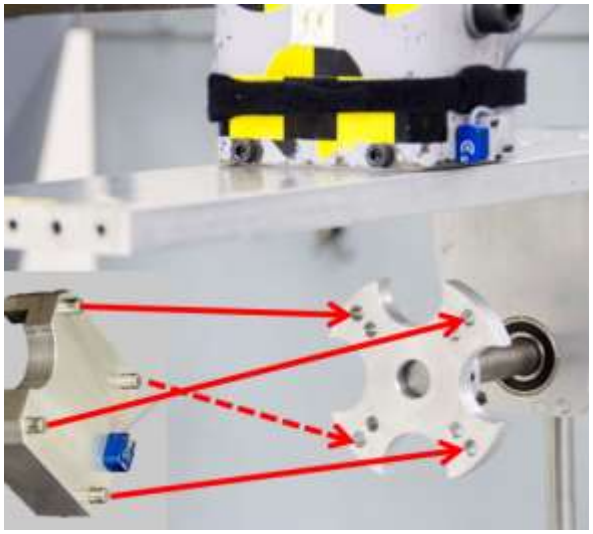

Figure 3-23. Alignment of neck mounting adapter locator pins with neck attachment plate locator holes.

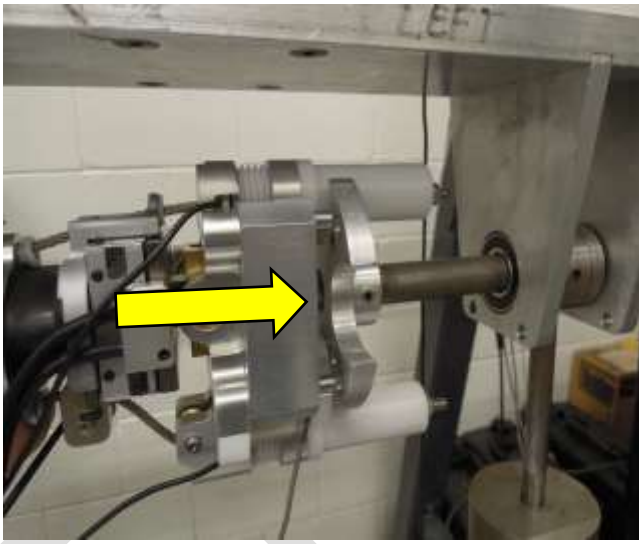

Figure 3-24. Installation of neck assembly into the torsion fixture.

3.7.1.10 Once the locator pins have been placed within the locator holes, install the three #10-24 X 1" SHCS through the end plate assembly into the top plate to secure the neck into the fixture (Figure 3-25).

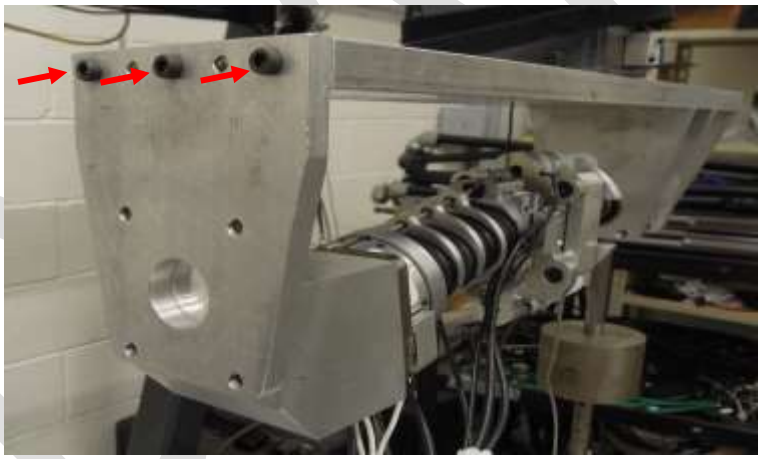

Figure 3-25. Attachment of end place to secure the neck into the torsion fixture.

3.7.1.11 Tape and route the cables so they do not interfere with the neck during the test. Leave at least 30 centimeters (12 inches) of slack in the bundle of wires from the upper neck (upper neck load cell, OC potentiometer, ARS, and spring tower load cells) so that the cables do not become taut when the neck is twisted about the Z-axis (Figure 3-26). No slack is necessary in the lower neck bundle, but ensure that the wires are secured to the neck torsion fixture and do not interfere with rotation of the neck.

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Figure 3-26. Tape wiring to minimize interference during test.

3.7.1.12 Slide the 1.5 ± 0.05 kg pendulum weight onto the pendulum rod. Position the weight so that the 10-24 x 1 ½" SHCS can be installed through the weight into the second hole from the top of the rod. This corresponds to 140 mm from the centerline of the shaft assembly (Figure 3-27).

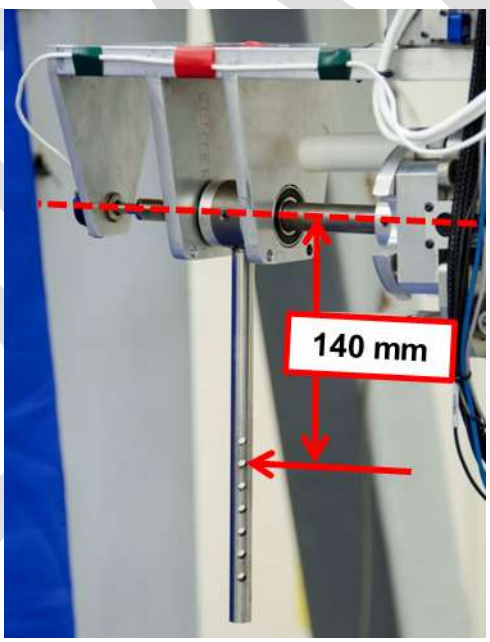

Figure 3-27. Pendulum rod hole position.

3.7.1.13 Record the "as measured (AM)" channels listed in Table 3-1 in accordance with SAE J211-1. Determine the time of initial contact between the striker and the honeycomb. A contact switch or a change in pendulum acceleration may be used; ensure that at least 50 milliseconds of data are recorded before contact.

3.7.1.14 Ensure that at least 30 minutes have passed since the last test involving the neck.

3.7.1.15 Release the pendulum from a height to generate a 3.40 ± 0.05 m/s velocity at impact.

3.7.1.16 The procedure and pictures above describe the left neck torsion test (Figure 3-29). To conduct the right neck torsion test (Figure 3-28), remove the four ¼-20 x 5/8" SHCS attaching the neck torsion fixture to the bottom of the neck pendulum, rotate the fixture 180° about the pendulum z-axis, and reinstall the four ¼-20 x 5/8" SHCS (Figure 3-20). Repeat Steps 3.7.1.13 through 3.7.1.15.

Figure 3-28. Torsion test for twist to the right .

Figure 3-29. Torsion test for twist to the left.

3.7.2 Torsion Data Processing

3.7.2.1 Follow the procedures in Section 3.6 Neck Test Data Zero Setting, Offset Calculation.

Table 3-1. Required Measurement Channels for the Neck Torsion Test

Channel Description	CFC	ISO-MME Code	AXIS	DASTAT	SENATT	SENTYP	YUNITS
Pendulum Accelerometer, X-axis	1000	T0SENSMI0000ACXA	XG	AM	PEND	AC	G'S
Pendulum Velocity, X-axis	N/A	T0SENSMI0000VAXD	XG	CM	PEND	PP	MPS
Upper Neck Moment, Z-axis	600	D0NECKUP00TFMOZB	ZL	AM	NEKU	LC	NWM
Upper Neck Angular Velocity, Z-axis (ARS)	60	D0NECKUP00TFAVZD	ZL	AM	NEKU	AV	DPS
Neck Fixture Rotation	60	T0SENSMI0000ANZD	ZL	AM	PEND	AD	DEG

3.7.3 Torsion Test Input Specification

The pendulum pulse must be within the ranges indicated in Table 3-2.

Table 3-2. Pendulum Pulse for Neck Torsion Qualification Test

Parameter	Units	Specification	
		Min.	Max.
Pendulum velocity at 7 ms after T0	m/s	0.93	1.13
Pendulum velocity at 14 ms after T0	m/s	1.87	2.29
Pendulum velocity at 21 ms after T0	m/s	2.80	3.43

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3.8 Neck Frontal Flexion Test

3.8.1 Neck Frontal Test Procedure

3.8.1.1 Soak the head and neck assembly in a controlled environment with a temperature of 20.6 to 22.2 °C (69 to 72 °F) and a relative humidity from 10 to 70% for at least 4 hours prior to a test. The test environment should have the same temperature and humidity requirements as the soak environment.

3.8.1.2 Attach the head assembly (474-1000) to the neck assembly. The front neck spring tower should slide into the skull. Install four M6 X 1 X 25 mm SHCS at the bottom of the head/neck mounting platform to secure the head to the neck (Figure 3-30) and torque to 12.0 N-m (8.9 ft-lbf).

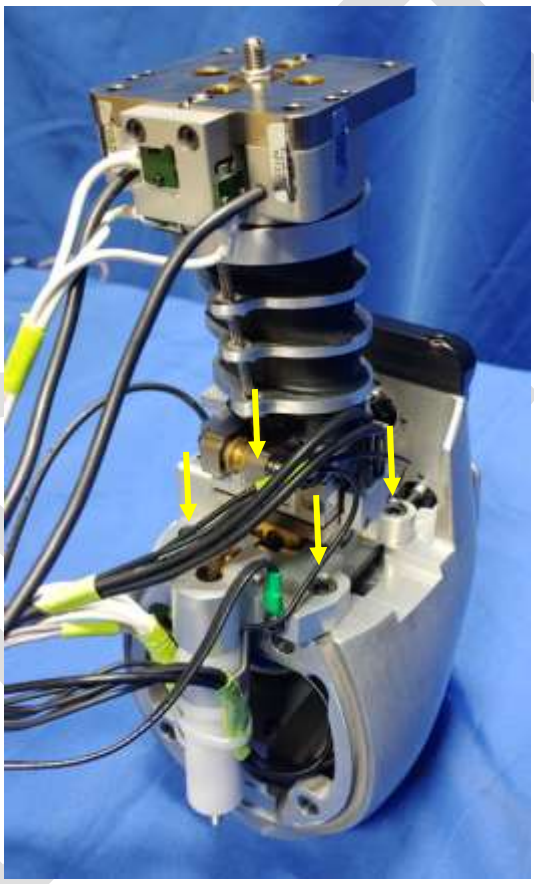

Figure 3-30. Install 4 M6 SHCS to connect the head to the neck.

3.8.1.3 Ensure that the face insert (474-1401) is positioned in the head skin assembly (474-1008). Install the head skin assembly by positioning it in front of and below the skull and moving it over the skull in an up-and-back motion until the head skin posterior flaps are positioned along the posterior groove of the skull. Install the skull cap and cap skin (474-1020 and 474-1025) using four M6 X 1 X 20 mm LHCS torqued to 20.3 N-m (15.0 ft-lbf), ensuring the wire bundles are positioned in both recesses of the skull cap.

3.8.1.4 Install the 152.4 mm (6 in) aluminum honeycomb[2] to meet the pendulum pulse specified in Table 3-4 for an impact velocity of 5.00 ± 0.05 m/s. Ensure that the contact area of the aluminum honeycomb covers the impactor plate on the pendulum upon impact.

3.8.1.5 Attach the neck mounting plate (TF-200-2357) to the bottom of the pendulum arm such that the thickest side of the wedge is facing away from the direction of impact. Mount the bottom of the neck assembly rigidly to the neck mounting plate (TF-200-2357) using four M6 X 1 X 25 mm SHCS torqued to 20.3 N-m (15.0 ft-lbf) such that the front edge of the lower neck is aligned with the leading edge of the pendulum arm (forehead facing the direction of impact). For the frontal flexion test, the neck is placed such that the midsagittal plane of the head is vertical (±0.5°) and coincides with the plane of motion of the pendulum's longitudinal axis, with the positive longitudinal axis of the head coordinate system pointing in the direction of travel of the pendulum (Figure 3-31).

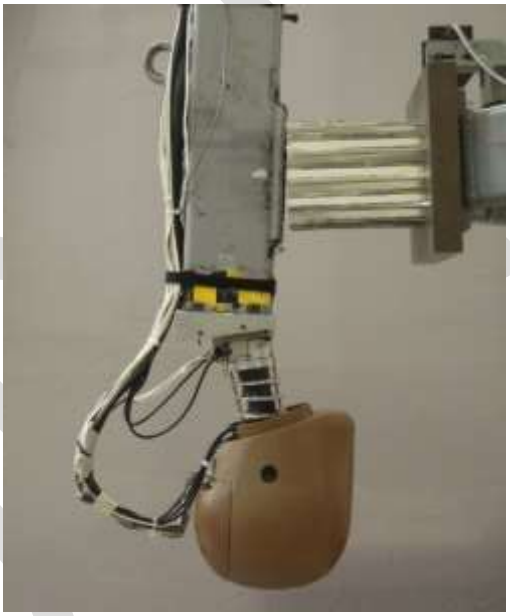

Figure 3-31. Head-neck assembly orientation for neck flexion tests.

3.8.1.6 Record the "as measured (AM)" channels listed in Table 3-3 in accordance with SAE J211-1. Determine the time of first contact between the striker and the honeycomb. A contact switch or a change in pendulum acceleration may be used; ensure that at least 50 milliseconds of data are recorded before contact.

3.8.1.7 Ensure that at least 30 minutes have passed since the last neck qualification test.

3.8.1.8 Release the pendulum from a height to generate a 5.00 ± 0.05 m/s velocity at impact.

[2] As a starting point, use the same aluminum honeycomb configuration used in the Hybrid III 5th neck flexion test.

3.8.2 Neck Frontal Flexion Data Processing

3.8.2.1 Follow the procedures in Section 3.6 Neck Test Data Zero Setting, Offset Calculation.

3.8.2.2 Confirm that the polarity of the pendulum ARS is set such that the angular velocity of the pendulum as it falls towards the decelerator is positive.

3.8.2.3 Calculate the head rotation angle relative to the pendulum. Begin integration at time zero:

$$Head\ Rotation(t) = \int_{t_0}^{t_f} -\omega_{y,head}(t) - \omega_{y,pendulum}(t)dt$$

Where:

$Head\ Rotation(t) = \text{time} - \text{history of head Y rotation}$

$\omega_{y,head}(t) = \text{time} - \text{history of head Y angular velocity}$

$\omega_{y,pendulum}(t) = \text{time} - \text{history of pendulum Yangular velocity}$

$t_0 = \text{first time point for calculation (see 3.6.3)}$

$t_f = \text{final time point for collected data}$

Table 3-3. Required Measurement Channels for the Neck Flexion Test

Channel Description	CFC	ISO-MME Code	AXIS	DASTAT	SENATT	SENTYP	YUNITS
Pendulum Accelerometer, X-axis	1000	T0SENSMI0000ACXA	XG	AM	PEND	AC	G'S
Pendulum Velocity, X-axis	N/A	T0SENSMI0000VAXD	XG	CM	PEND	PP	MPS
Upper Neck Force, Z-axis	1000	D0NECKUP00TFFOZA	ZL	AM	NEKU	LC	NWT
Upper Neck Moment, Y-axis	600	D0NECKUP00TFMOYB	YL	AM	NEKU	LC	NWM
Head Angular Velocity, Y-axis (ARS)	60	D0HEAD0000TFAVYD	YL	AM	HDCG	AV	DPS
Pendulum Angular Velocity (ARS)	60	T0SENSMI00TFAVYD	YG	AM	PEND	AV	DPS
Head Rotation (relative to pendulum)	N/A	D0HEAD0000TFANYD	YL	CM	HDCG	PP	DEG

3.8.3 Neck Frontal Flexion Input Specification

The pendulum pulse must achieve a velocity time-history that meets all three of the requirements in Table 3-4.

Table 3-4. Neck Flexion Input Requirements

Parameter	Units	Specification	
		Min.	Max.
Pendulum velocity at 8 ms after T0	m/s	1.56	1.91
Pendulum velocity at 16 ms after T0	m/s	3.11	3.80
Pendulum velocity at 24 ms after T0	m/s	4.41	5.39

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3.9 Neck Extension Test

3.9.1 Neck Extension Test Procedure

3.9.1.1 Soak the head and neck assembly in a controlled environment with a temperature of 20.6 to 22.2 °C (69 to 72 °F) and a relative humidity from 10 to 70% for at least 4 hours prior to a test. The test environment should have the same temperature and humidity requirements as the soak environment.

3.9.1.2 If the head and neck assembly is already installed from a previous neck extension, flexion, or lateral flexion test, proceed to the next step. Otherwise, follow the instructions provided in Steps 3.8.1.2 and 3.8.1.3 to assemble the head and neck.

3.9.1.3 Install the 152.4 mm (6 in) size aluminum honeycomb[3] to meet the pendulum pulse specified in Table 3-6 for an impact velocity of 5.00 ± 0.05 m/s. Ensure that the contact area of the aluminum honeycomb covers the impactor plate on the pendulum upon impact.

3.9.1.4 Attach the neck mounting plate to the bottom of the pendulum arm such that the thickest side of the wedge is facing towards the direction of impact. Mount the bottom of the neck assembly rigidly to the neck mounting plate using four M6 X 1 X 25 mm SHCS torqued to 20.3 N-m (15.0 ft-lbf) such that the rear edge of the lower neck is aligned with the leading edge of the pendulum arm. For the extension test, the neck is placed such that the midsagittal plane of the head is vertical (±0.5°) and coincides with the plane of motion of the pendulum's longitudinal axis, with the positive longitudinal axis of the head pointing opposite the direction of travel of the pendulum (Figure 3-32).

Figure 3-32. Mounting the head-neck assembly for neck extension tests.

[3] Size and width may vary to meet the pulse velocity specification

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3.9.1.5 Record the "as measured (AM)" channels listed in Table 3-5 in accordance with SAE J211. Determine the time of first contact between the striker and the honeycomb. A contact switch or a change in pendulum acceleration may be used; ensure that at least 50 milliseconds of data are recorded before contact.

3.9.1.6 Ensure that at least 30 minutes have passed since the last neck qualification test.

3.9.1.7 Release the pendulum from a height to generate a 5.00 ± 0.05 m/s velocity at impact.

3.9.2 Neck Extension Data Processing

3.9.2.1 Follow the procedures in Section 3.6 Neck Test Data Zero Setting, Offset Calculation.

3.9.2.2 Confirm that the polarity of the pendulum ARS is set such that the angular velocity of the pendulum as it falls towards the decelerator is positive.

3.9.2.3 Calculate the head rotation angle relative to the pendulum:

$$Head\ Rotation(t) = \int_{t_0}^{t_f} \omega_{y,head}(t) - \omega_{y,pendulum}(t)dt$$

Where:

$Head\ Rotation(t) = \text{time} - \text{history of head Y rotation}$

$\omega_{y,head}(t) = \text{time} - \text{history of head Y angular velocity}$

$\omega_{y,pendulum}(t) = \text{time} - \text{history of pendulum Y angular velocity}$

$t_0 = \text{first time point for calculation (see 3.6.3)}$

$t_f = \text{final time point for collected data}$

Table 3-5. Required Measurement Channels for the Neck Extension Test

Channel Description	CFC	ISO-MME Code	AXIS	DASTAT	SENATT	SENTYP	YUNITS
Pendulum Accelerometer, X-axis	1000	T0SENSMI0000ACXA	XG	AM	PEND	AC	G'S
Pendulum Velocity, X-axis	N/A	T0SENSMI0000VAXD	XG	CM	PEND	PP	MPS
Upper Neck Force, Z-axis	1000	DONECKUP00TFFOZA	ZL	AM	NEKU	LC	NWT
Upper Neck Moment, Y-axis	600	D0NECKUP00TFMOYB	YL	AM	NEKU	LC	NWM
Head Angular Velocity, Y-axis (ARS)	60	D0HEAD0000TFAVYD	YL	AM	HDCG	AV	DPS
Pendulum Angular Velocity (ARS)	60	T0SENSMI00TFAVYD	YG	AM	PEND	AV	DPS
Head Rotation (relative to pendulum)	N/A	D0HEAD0000TFANYD	YL	CM	HDCG	PP	DEG

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3.9.3 Neck Extension Input Specification

The pendulum pulse must be within the ranges indicated in Table 3-6.

Table 3-6. Pendulum Pulse for Neck Extension Qualification Test

Parameter	Units	Specification	
		Min.	Max.
Pendulum velocity at 8 ms after T0	m/s	1.58	1.93
Pendulum velocity at 16 ms after T0	m/s	3.18	3.88
Pendulum velocity at 24 ms after T0	m/s	4.49	5.48

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3.10 Neck Lateral Flexion Test

3.10.1 Neck Lateral Flexion Test Procedure

3.10.1.1 Soak the head and neck assembly in a controlled environment with a temperature of 20.6 to 22.2 °C (69 to 72 °F) and a relative humidity from 10 to 70% for at least 4 hours prior to a test. The test environment should have the same temperature and humidity requirements as the soak environment.

3.10.1.2 If the head and neck assembly is already installed from a previous neck extension, flexion, or lateral flexion test, proceed to the next step. Otherwise, follow the instructions provided in Steps 3.8.1.2 and 3.8.1.3 to assemble the head and neck.

3.10.1.3 Install the 76.2 mm (3 in) size aluminum honeycomb[4] to meet the pendulum pulse specified in Table 3-8 for an impact velocity of 3.40 ± 0.05 m/s. Ensure that the contact area of the aluminum honeycomb covers the impactor plate on the pendulum upon impact.

3.10.1.4 Attach the neck mounting plate to the bottom of the pendulum arm such that the thickest side of the wedge is facing 90° ± 0.5° from the direction of impact. Mount the bottom of the neck assembly rigidly to the neck mounting plate using four M6 x 1 x 25 mm SHCS torqued to 20.3 N-m (15.0 ft-lbf) such that the rear edge of the lower neck is aligned with the thickest side of the wedge. For the lateral flexion test, the neck is placed such that the midsagittal plane of the head is vertical and anterior-posterior direction of the assembly is pointing 90 ± 0.5° from the direction of travel of the pendulum. The occipital condyle should be aligned with the longitudinal centerline of the pendulum arm. The neck is tested in both left and right lateral modes (Figure 3-33 and Figure 3-34).

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[4] Size and width may vary to meet the pulse velocity specification

Neck Lateral Flexion, Left

Figure 3-33. Left neck lateral flexion setup.

Neck Lateral Flexion, Right

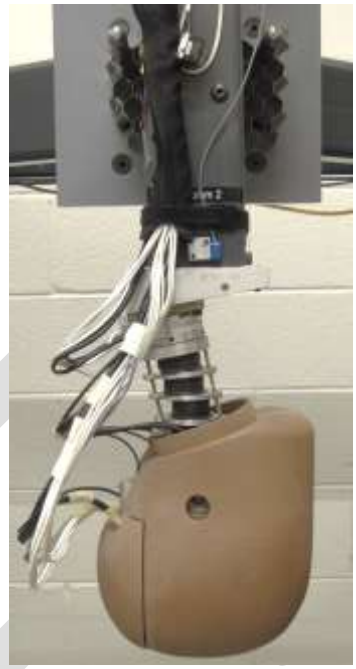

Figure 3-34. Right neck lateral flexion setup.

3.10.1.5 Record the "as measured (AM)" channels listed in Table 3-7 in accordance with SAE-J211-1. Determine the time of first contact between the striker and the honeycomb. A contact switch or a change in pendulum acceleration may be used; ensure that at least 50 milliseconds of data are recorded before contact.

3.10.1.6 Ensure that at least 30 minutes have passed since the last neck qualification test.

3.10.1.7 Release the pendulum from a height to generate a 3.40 ± 0.05 m/s velocity at impact.

3.10.1.8 Repeat Section 3.10 for the opposite direction of loading.

3.10.2 <u>Neck Lateral Flexion Data Processing</u>

3.10.2.1 Follow the procedures in Section 3.6 Neck Test Data Zero Setting, Offset Calculation.

3.10.2.2 Confirm that the polarity of the pendulum ARS is set such that the angular velocity of the pendulum as it falls towards the decelerator is positive.

3.10.2.3 Calculate the head rotation angle relative to the pendulum:

$$Left: Head\ Rotation(t) = \int_{t_0}^{t} -\omega_{x,head}(t) - \omega_{y,pendulum}(t)dt$$

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$$Right: Head\ Rotation(t) = \int_{t_0}^{t} \omega_{x,head}(t) - \omega_{y,pendulum}(t)dt$$

Where:

$Head\ Rotation\ (t) = \text{time} - \text{history of Head Y Rotation}$

$\omega_{x,head}(t) = \text{time} - \text{history of Head X Angular Velocity}$

$\omega_{y,pendulum}(t) = \text{time} - \text{history of Pendulum Y Angular Velocity}$

$t_0 = \text{first time point for calculation (see 3.6.3)}$

$t_f = \text{final time point for collected data}$

Table 3-7. Required Measurement Channels for the Neck Lateral Flexion Test

Channel Description	CFC	ISO-MME Code	AXIS	DASTAT	SENATT	SENTYP	YUNITS
Pendulum Accelerometer, X-axis	1000	T0SENSMI0000ACXA	XG	AM	PEND	AC	G'S
Pendulum Velocity, X-axis	N/A	T0SENSMI0000VAXD	XG	CM	PEND	PP	MPS
Upper Neck Moment, X-axis	600	D0NECKUP00TFMOXB	XL	AM	NEKU	LC	NWM
Head Angular Velocity, X-axis (ARS)	60	D0HEAD0000TFAVXD	XL	AM	HDCG	AV	DPS
Pendulum Angular Velocity (ARS)	60	T0SENSMI00TFAVYD	YG	AM	PEND	AV	DPS
Head Rotation (relative to pendulum)	N/A	D0HEAD0000TFANXD	XL	CM	HDCG	PP	DEG

3.10.3 Neck Lateral Flexion Input Specification

The pendulum pulse must be within the ranges indicated in Table 3-8.

Table 3-8. Pendulum Pulse for Neck Lateral Flexion Qualification Test

Parameter	Units	Specification	
		Min.	Max.
Pendulum velocity at 5 ms after T0	m/s	0.91	1.11
Pendulum velocity at 10 ms after T0	m/s	1.89	2.31
Pendulum velocity at 15 ms after T0	m/s	2.75	3.36

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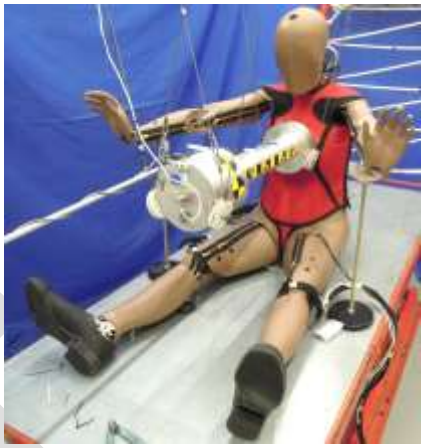
4 UPPER THORAX QUALIFICATION



4.1 Description

The upper thorax qualification test is a dynamic test performed to examine the resultant deflection and corresponding force of the upper thorax when impacted at mid-sternum with a 13.97 kg rigid impactor at 4.30 m/s.

4.2 Materials

- Fully-assembled THOR-05F ATD (474-0000)
- Impactor 13.97 ± 0.2 kg (30.8 ± 0.5 lb) in mass, including instrumentation, rigid attachments and the mass of the lower 1/3 of the suspension cables, as specified in Part 572[5]. The test probe is a 152.4 ± 0.25 mm (6.00 ± 0.01 in) diameter rigid cylinder. The impacting surface has a flat, right angle face with an edge radius of 12.7 ± 0.3 mm (0.5 ± 0.01 in).

4.3 Instrumentation

- Instrumentation to measure impact force (accelerometer on impactor)
- Instrumentation to measure the impact velocity
- A dual-axis tilt sensor (SA572-S44) on the thoracic spine (T8) to measure initial angles about "X" and "Y" axes
- A dual-axis tilt sensor (SA572-S44) attached to the pelvis to measure initial angle about "X" and "Y" axes
- 3-D IR-TRACC assemblies in the upper left (474-3550) and upper right thorax (474-3560), installed as shown in 474-3000.

4.4 Pre-Test Procedures

4.4.1 Soak the ATD in a controlled environment with a temperature of 20.6 to 22.2 °C (69 to 72 °F) and a relative humidity from 10 to 70% for at least 4 hours prior to a test. The test environment should have the same temperature and humidity requirements as the soak environment.

4.4.2 Set the lower thoracic spine (LTS) pitch change joint to the **slouched**.

4.4.3 Set the neck pitch change joint to the **neutral** position.

4.4.4 Set the arm and shoulder joint torques to 1g.

[5] Code of Federal Regulations, Anthropomorphic Test Devices, Title 49, §572.137(a).

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4.5 Test Procedure

4.5.1 Seat the dummy on a horizontal surface (±0.5°) with no back support, with all limbs extended horizontally and forward parallel to the midsagittal plane. The midsagittal plane shall be vertical within ±1 degree.

4.5.2 If the jacket is installed, unzip the left and right shoulder and left and right torso zippers to expose the rib cage. If the jacket is not installed, position the crotch strap in place under the pelvis so that later jacket installation does not change torso position.

4.5.3 Support the forearms in a fully-extended orientation, palmside of the hands down, with hands angled upwards to minimize interference with the arm supports. The inability to hold this position indicates that the arm and shoulder joint torques are not set properly.

4.5.4 Set the pelvis so that the angle measured by the pelvis tilt sensor (SA572-S44) is 0 ± 0.5° in the X-axis and 11 ± 1° in the Y-axis.

4.5.5 Position the thorax so that the T8 tilt sensor (SA572-S44) reads 0 ± 1° in the Y-axis and 0 ± 0.5° laterally (about the X-axis).

4.5.6 Adjust the table height or impactor height so that the center of the impact face is at the vertical level of the center of the third rib anteriorly, as indicated by the attachment bolts of the left and right upper thorax IR-TRACC assemblies (Figure 4-1).

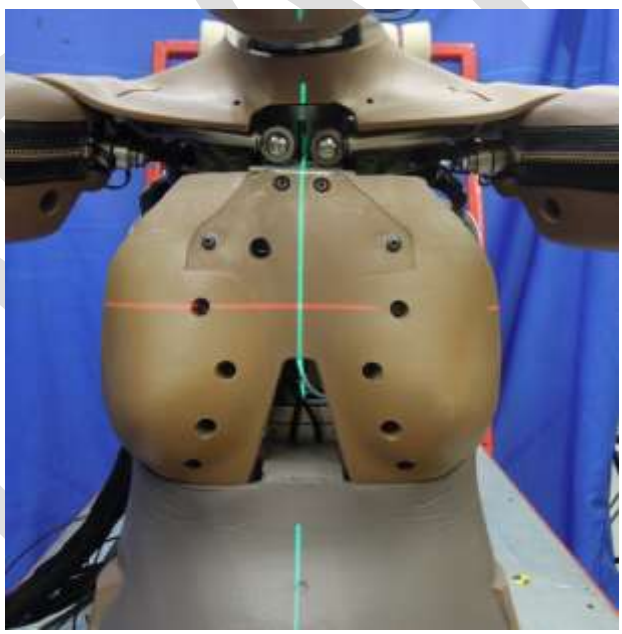

Figure 4-1. Vertical and lateral alignment of impact location.

4.5.7 Align the vertical centerline of the probe with the midsagittal plane of the dummy (Figure 4-1). The midsagittal plane can be visualized using the center of the bottom face load cell detent on the head skin, the midpoint between the IR-TRACC attachment bolts, the umbilicus detent on the abdomen, and the pelvis flesh at the pubic symphysis.

4.5.8 Carefully reinstall the dummy's jacket by zipping the sides and shoulders of the jacket.

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4.5.9 Position the dummy so the chest is barely touching the impact probe when the probe is at rest.

4.5.10 The motion of the impactor should be constrained so that there is no significant lateral, vertical, or rotational movement.

4.5.11 Record the "as measured (AM)" channels listed in Table 4-2 in accordance with SAE J211-1.

4.5.12 Confirm the test setup parameters illustrated in Table 4-1.

Table 4-1. Upper Thorax Qualification Setup Parameters

Parameter	Setting
Lower Thoracic Spine (LTS) Pitch Change Setting	Slouched
Neck Pitch Change Setting	Neutral
Tilt Sensor Reading: T8	X = 0 ± 0.5º; Y = 0 ± 1º
Tilt Sensor Reading: Pelvis	X = 0 ± 0.5º; Y = 11 ± 1º
Wait Time Between Tests	At Least 30 Minutes

4.5.13 Ensure that at least 30 minutes have passed since the last upper thorax or lower thorax test on this ATD.

4.5.14 Conduct the test at an impact velocity of 4.30 ± 0.05 m/s.

4.6 Data Processing

4.6.1 With the exception of IR-TRACCs and associated potentiometer channels, perform bias removal of the measured (unfiltered) channels listed in the "Required Measurement Channels" (Table 4-2) by subtracting the average value of the data samples over the period between (.050 s) and (.010 s) prior to contact.

4.6.2 Filter channels based on the CFC filter classes listed in Table 4-2. Do not filter the raw IR-TRACC voltage, as this will be filtered at CFC 180 after it is linearized and scaled during Step 4.6.4.

4.6.3 Calculate time-history of impact force at the contact interface:

$$F_{IMP}(t) = m_{IMP} \cdot a_{IMP}(t) \quad \text{where,}$$

$F_{IMP}(t)$ = calculated force time-history at contact interface

m_{IMP} = mass of the impactor

$a_{IMP}(t)$ = measured acceleration time-history of impactor

4.6.4 Calculate the upper thorax X-axis, Y-axis, and Z-axis deflections in the *local spine coordinate system*.

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4.6.5 Calculate the upper left and upper right resultant thorax deflections in the *local spine coordinate system* (upper thoracic spine (UTS)).

$$UPTH_{DR}(t) = \sqrt{D_X^2 + D_Y^2 + D_Z^2}$$

Where:

$UPTH_{DR}(t) = \text{time} - \text{history of upper thorax resultant deflection (L or R)}$

$D_X = \text{time} - \text{history of upper thorax X deflection (L or R)}$

$D_Y = \text{time} - \text{history of upper thorax Y deflection (L or R)}$

$D_Z = \text{time} - \text{history of upper thorax Z deflection (L or R)}$

4.6.6 Calculate the absolute value of the difference between the maximum left and maximum right resultant deflections in the *local coordinate system* (UTS).

Table 4-2. Required Measurement Channels for the Upper Thorax Qualification Test

Channel Description	CFC	ISO-MME Code	AXIS	DASTAT	SENATT	SENTYP	YUNITS
Upper left IR-TRACC tube	N/A	D0CHSTLEUPTFVO00	NA	AM	CHLU	DS	VOL
Upper left Y-axis rotational potentiometer	180	D0CHSTLEUPTFANYC	YL	AM	CHLU	AD	DEG
Upper left Z-axis rotational potentiometer	180	D0CHSTLEUPTFANZC	ZL	AM	CHLU	AD	DEG
Upper right IR-TRACC tube	N/A	D0CHSTRIUPTFVO00	NA	AM	CHRU	DS	VOL
Upper right Y-axis rotational potentiometer	180	D0CHSTRIUPTFANYC	YL	AM	CHRU	AD	DEG
Upper right Z-axis rotational potentiometer	180	D0CHSTRIUPTFANZC	ZL	AM	CHRU	AD	DEG
Probe Accelerometer	180	T0SENSMI0000ACXC	XG	AM	PEND	AC	G'S
Probe Force	N/A	T0SENSMI0000FOXC	XG	CM	PEND	PP	NWT
Upper left X-axis deflection WRT UTS	N/A	D0CHSTLEUPTFDSXC	XL	CM	CHLU	PP	MM
Upper left Y-axis deflection WRT UTS	N/A	D0CHSTLEUPTFDSYC	XL	CM	CHLU	PP	MM
Upper left Z-axis deflection WRT UTS	N/A	D0CHSTLEUPTFDSZC	XL	CM	CHLU	PP	MM
Upper right X-axis deflection WRT UTS	N/A	D0CHSTRIUPTFDSXC	XL	CM	CHRU	PP	MM
Upper right Y-axis deflection WRT UTS	N/A	D0CHSTRIUPTFDSYC	XL	CM	CHRU	PP	MM
Upper right Z-axis deflection WRT UTS	N/A	D0CHSTRIUPTFDSZC	XL	CM	CHRU	PP	MM
Upper left resultant deflection WRT UTS	N/A	D0CHSTLEUPTFDSRC	NA	CM	CHLU	PP	MM
Upper right resultant deflection WRT UTS	N/A	D0CHSTRIUPTFDSRC	NA	CM	CHRU	PP	MM

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5 LOWER THORAX QUALIFICATION

5.1 Description

The lower thorax qualification test is a dynamic test performed to examine the resultant deflection and corresponding force of the lower thorax when impacted with a 13.97 kg rigid impactor at 4.30 m/s. This test is carried out on both the left and right lower rib cage locations.

5.2 Materials

- Fully-assembled THOR-05F ATD (474-0000)
- Impactor 13.97 ± 0.2 kg (30.8 ± 0.5 lb) in mass, including instrumentation, rigid attachments and the mass of the lower 1/3 of the suspension cables, as specified in Part 572[6]. The test probe is a 152.4 ± 0.25 mm (6.00 ± 0.01 in) diameter rigid cylinder. The impacting surface has a flat, right angle face with an edge radius of 12.7 ± 0.3 mm (0.5 ± 0.01 in).

5.3 Instrumentation

- Instrumentation to measure impact force (accelerometer on impactor)
- Instrumentation to measure the impact velocity
- A dual-axis tilt sensor (SA572-S44) on the thoracic spine (T8) to measure initial angles about "X" and "Y" axes
- A dual-axis tilt sensor (SA572-S44) attached to the pelvis to measure initial angle about "X" and "Y" axes
- 3-D IR-TRACC assemblies in the lower left (474-3580) and lower right thorax (474-3570), installed as shown in 474-3000.

5.4 Pre-Test Procedures

5.4.1 Soak the ATD in a controlled environment with a temperature of 20.6 to 22.2 °C (69 to 72 °F) and a relative humidity from 10 to 70% for at least 4 hours prior to a test. The test environment should have the same temperature and humidity requirements as the soak environment.

5.4.2 Set the lower thoracic spine (LTS) pitch change joint to the **slouched** position.

5.4.3 Set the neck pitch change joint to the **neutral** position.

[6] Code of Federal Regulations, Anthropomorphic Test Devices, Title 49, §572.137(a).

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5.4.4 Set the arm and shoulder joint torques to 1g.

5.5 Test Procedure

5.5.1 Seat the dummy on a horizontal surface (±0.5°) with no back support, with all limbs extended horizontally and forward parallel to the midsagittal plane. The midsagittal plane shall be vertical within ± 1 degree (Figure 5-1).

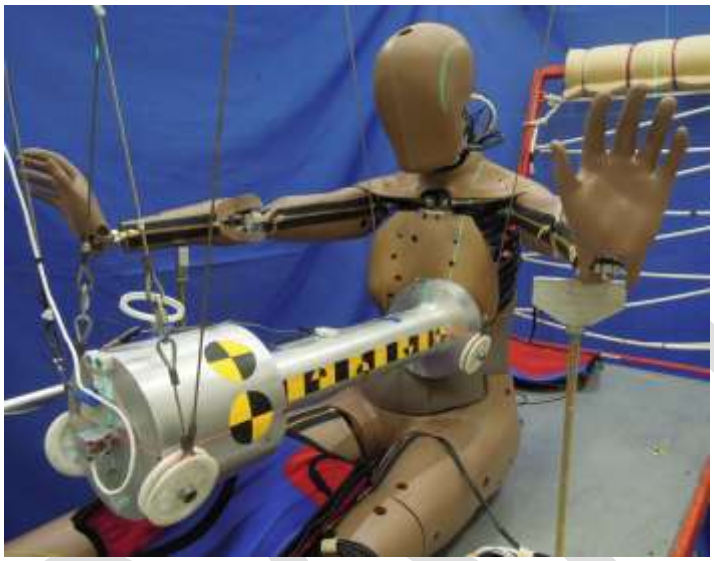

Figure 5-1. Initial setup for the lower thorax qualification test.

5.5.2 If the jacket is installed, unzip the left and right shoulder and left and right torso zippers to expose the rib cage. If the jacket is not installed, position the crotch strap in place under the pelvis so that later jacket installation does not affect positioning.

5.5.3 Support the forearms in a fully-extended orientation, palmside of the hands down, with hands angled upwards to minimize interference with the arm supports (Figure 5-1). The inability to hold this position indicates that the arm and shoulder joint torques are not set properly.

5.5.4 Set the pelvis so that the angle measured by the pelvis tilt sensor is 0 ± 0.5° in the X-axis and 11 ± 1° in the Y-axis.

5.5.5 Position the thorax so that the T8 tilt sensor (SA572-S44) reads 0 ± 0.5° in the X-axis and 0 ± 0.5° in the Y-axis.

5.5.6 Adjust the table height or impactor height so that the center of the impact face is at the vertical level of the center of the sixth rib anteriorly, as indicated by the attachment bolt of the lower left or right thorax IR-TRACC assembly (Figure 5-2).

5.5.7 Align the impactor face with the center of the left or right lower thorax IR-TRACC bolt. A removable pointer (threaded into the centerline of the pendulum with approximately 30mm protruding) or laser will aid this process (Figure 5-2). Remove the pointer tool when this step has been completed.

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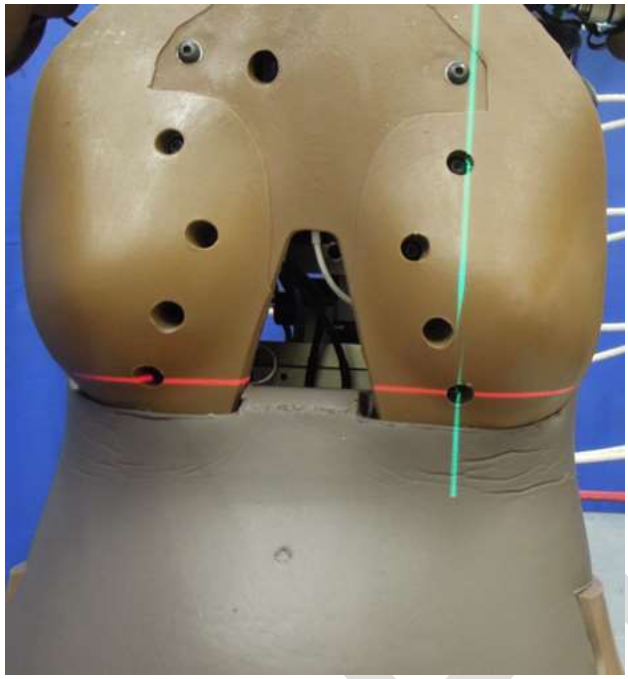

Figure 5-2. Alignment of impact location using laser.

5.5.8 Carefully reinstall the dummy's jacket by zipping the sides and shoulders of the jacket.

5.5.9 Position the ATD so the thorax is just barely touching the impact probe when the probe is at rest (Figure 5-3).

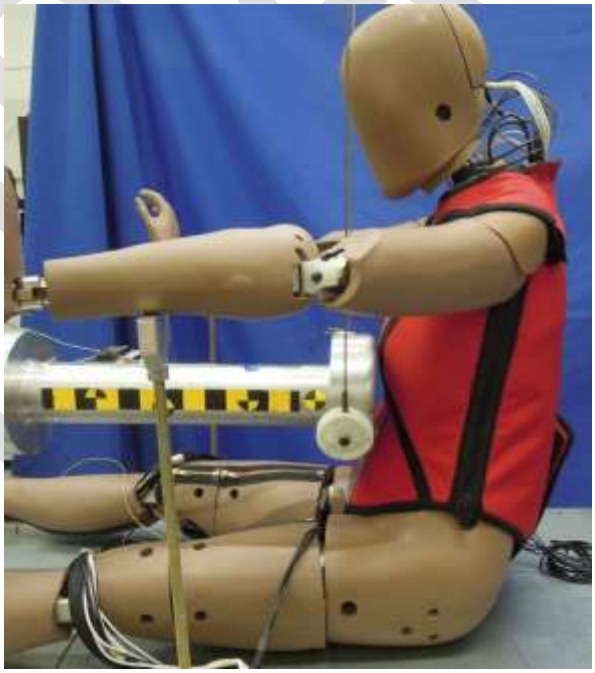

Figure 5-3. Lower thorax impact with jacket.

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5.5.10 Align the frontal (coronal) plane of the dummy perpendicular to the impact direction. A right-angled guide placed behind the dummy's pelvis and aligned perpendicular to the line of impact may facilitate the process.

5.5.11 Remove the right-angled guide, if used.

5.5.12 Constrain the motion of the impactor so that there is no significant lateral, vertical, or rotational movement.

5.5.13 Record the "as measured (AM)" channels listed in Table 5-2 (for left impacts) or Table 5-3 (for right impacts) in accordance with SAE J211-1.

5.5.14 Confirm the test setup parameters illustrated in Table 5-1.

Table 5-1. Lower Thorax Qualification Setup Parameters

Parameter	Setting
Lower Thoracic Spine (LTS) Pitch Change Setting	Slouched
Neck Pitch Change Setting	Neutral
Tilt Sensor Reading: T8	X = 0 ± 0.5º; Y = 0 ± 0.5º
Tilt Sensor Reading: Pelvis	X = 0 ± 0.5º; Y = 11 ± 1º
Wait Time Between Tests	At Least 30 Minutes

5.5.15 Ensure that at least 30 minutes have passed since the last upper thorax, lower thorax, or abdomen test on this ATD.

5.5.16 Conduct the test at an impact velocity of 4.30 ± 0.05 m/s.

5.5.17 Repeat 5.5 for the opposite side of the lower thorax.

5.6 Data Processing

5.6.1 With the exception of IR-TRACCs and associated potentiometer channels, perform bias removal of the measured (unfiltered) channels listed in the "Required Measurement Channels" (Table 5-2) by subtracting the average value of the data samples over the period between (.050 s) and (.010 s) prior to contact.

5.6.2 Filter channels based on CFC filter classes listed in Table 5-2 (for left impacts) or Table 5-3 (for right impacts). Do not filter the raw IR-TRACC voltage, as this will be filtered at CFC 180 after it is linearized and scaled during Step 5.6.4.

5.6.3 Calculate time-history of impact force at the contact interface:

$$F_{IMP}(t) = m_{IMP} \cdot a_{IMP}(t) \quad \text{where,}$$

$F_{IMP}(t)$ = calculated force time-history at contact interface

m_{IMP} = mass of the impactor

$a_{IMP}(t)$ = measured acceleration time-history of impactor

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5.6.4 Calculate the lower left and lower right X-axis, Y-axis, and Z-axis thoracic deflections in the *local spine coordinate system* (lower thoracic spine (LTS)).

5.6.5 Calculate the lower left or lower right resultant thorax deflections in the *local spine coordinate system* (lower thoracic spine (LTS) coordinate system).

$$LOTH_{DR}(t) = \sqrt{D_X^2 + D_Y^2 + D_Z^2}$$

Where:

$LOTH_{DR}(t) = \text{time} - \text{history of lower thorax resultant deflection (L or R)}$

$D_X = \text{time} - \text{history of lower thorax X deflection (L or R)}$

$D_Y = \text{time} - \text{history of lower thorax Y deflection (L or R)}$

$D_Z = \text{time} - \text{history of lower thorax Z deflection (L or R)}$

Table 5-2. Required Measurement Channels for the Lower Left Thorax Qualification Test

Channel Description	CFC	ISO-MME Code	AXIS	DASTAT	SENATT	SENTYP	YUNITS
Lower left IR-TRACC tube	N/A	D0CHSTLELOTFVO00	NA	AM	CHLL	DS	VOL
Lower left Y-axis rotational potentiometer	180	D0CHSTLELOTFANYC	YL	AM	CHLL	AD	DEG
Lower left Z-axis rotational potentiometer	180	D0CHSTLELOTFANZC	ZL	AM	CHLL	AD	DEG
Probe Accelerometer	180	T0SENSMI0000ACXC	XG	AM	PEND	AC	G'S
Probe Force	N/A	T0SENSMI0000FOXC	XG	CM	PEND	PP	NWT
Lower left X-axis deflection WRT LTS	N/A	D0CHSTLELOTFDSXC	XL	CM	CHLL	PP	MM
Lower left Y-axis deflection WRT LTS	N/A	D0CHSTLELOTFDSYC	YL	CM	CHLL	PP	MM
Lower left Z-axis deflection WRT LTS	N/A	D0CHSTLELOTFDSZC	ZL	CM	CHLL	PP	MM
Lower left resultant deflection WRT LTS	N/A	D0CHSTLELOTFDSRC	NA	CM	CHLL	PP	MM

Table 5-3. Required Measurement Channels for the Lower Right Thorax Qualification Test

Channel Description	CFC	ISO-MME Code	AXIS	DASTAT	SENATT	SENTYP	YUNITS
Lower right IR-TRACC tube	N/A	D0CHSTRILOTFVO00	NA	AM	CHRL	DS	VOL
Lower right Y-axis rotational potentiometer	180	D0CHSTRILOTFANYC	YL	AM	CHRL	AD	DEG
Lower right Z-axis rotational potentiometer	180	D0CHSTRILOTFANZC	ZL	AM	CHRL	AD	DEG
Pendulum Accelerometer	180	T0SENSMI0000ACXC	XG	AM	PEND	AC	G'S
Pendulum Force	N/A	T0SENSMI0000FOXC	XG	CM	PEND	PP	NWT
Lower right X-axis deflection WRT LTS	N/A	D0CHSTRILOTFDSXC	XL	CM	CHRL	PP	MM
Lower right Y-axis deflection WRT LTS	N/A	D0CHSTRILOTFDSYC	YL	CM	CHRL	PP	MM
Lower right Z-axis deflection WRT LTS	N/A	D0CHSTRILOTFDSZC	ZL	CM	CHRL	PP	MM
Lower right resultant deflection WRT LTS	N/A	D0CHSTRILOTFDSRC	NA	CM	CHRL	PP	MM

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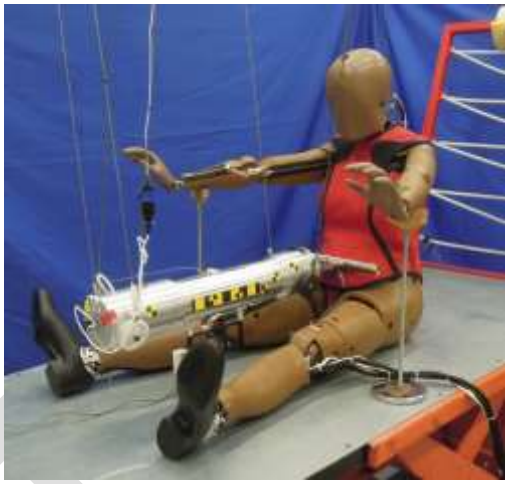
6 LOWER ABDOMEN QUALIFICATION



6.1 Description

The lower abdomen qualification test is a dynamic test performed to examine the deflection and corresponding force of the abdomen when impacted with a 16.00 kg rigid impactor (utilizing a cylindrical, horizontally-oriented rigid bar impactor face) at 6.10 m/s.

6.2 Materials

- Fully assembled THOR-05F ATD (474-0000)
- Impactor 16.00 ± 0.02 kg (35.25 ± 0.05 lb) in mass, including cylindrical rigid bar, instrumentation, rigid attachments and the mass of the lower 1/3 of the suspension cables. The cylindrical, horizontally-oriented rigid lower abdomen bar attached to the test probe (DL472-3000) has a diameter of 25 mm edge and is 300 mm long.

6.3 Instrumentation

- Instrumentation to measure impact force (accelerometer on impactor)
- Instrumentation to measure the impact velocity
- A dual-axis tilt sensor (SA572-S44) on the thoracic spine (T12) to measure initial angles about “X” and “Y” axes
- A dual-axis tilt sensor (SA572-S44) attached to the pelvis to measure initial angle about “X” and “Y” axes
- Abdomen Twin Pressure sensor (SA572-S162) in the lower left and lower right abdomen to measure abdominal pressure

6.4 Pre-Test Procedures

6.4.1 Soak the ATD in a controlled environment with a temperature of 20.6 to 22.2 °C (69 to 72 °F) and a relative humidity from 10 to 70% for at least 4 hours prior to a test. The test environment should have the same temperature and humidity requirements as the soak environment.

6.4.2 Set the lower thoracic spine (LTS) pitch change joint to the **slouched** position.

6.4.3 Set the neck pitch change joint to the **neutral** position.

6.4.4 Set the arm and shoulder joint torques to 1g.

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6.5 Test Procedure

6.5.1 Seat the dummy on a horizontal surface (±0.5°) with no back support, with all limbs extended horizontally and forward parallel to the midsagittal plane. The midsagittal plane shall be vertical within ±1 degree (Figure 6-1).

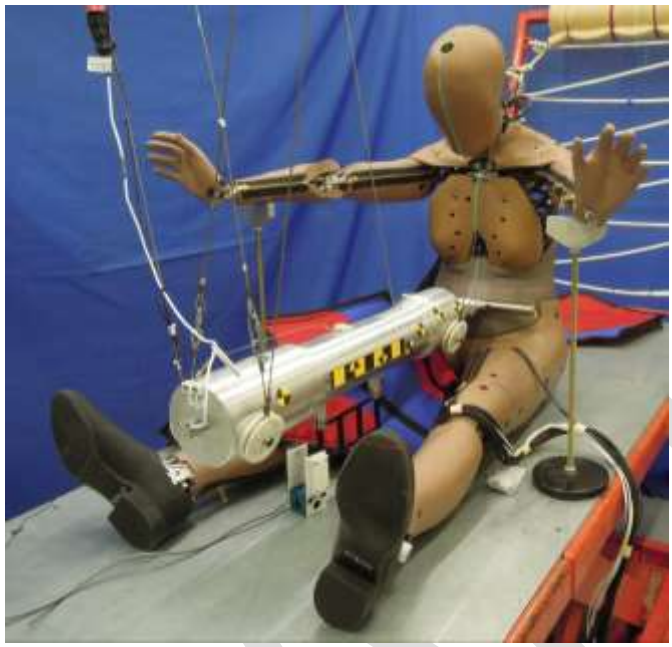

Figure 6-1. Initial setup for lower abdomen impact test.

6.5.2 If the jacket is installed, unzip the left and right shoulder and left and right torso zippers to expose the rib cage. If the jacket is not installed, position the crotch strap in place under the pelvis so that later jacket installation does not affect positioning.

6.5.3 Support the forearms in a fully-extended orientation, palmside of the hands down, with hands angled upwards to minimize interference with the arm supports (Figure 6-1). The inability to hold this position indicates that the arm and shoulder joint torques are not set properly.

6.5.4 Position the pelvis so that the pelvis tilt sensor (SA572-S44) reads 8 ± 1° (rearward tilt about the Y-axis) and 0 ± 0.5° laterally (about the X-axis).

6.5.5 Position the thorax so that the T12 tilt sensor (SA572-S44) reads 8 ± 1° (rearward tilt about the Y-axis) and 0 ± 0.5° laterally (about the X-axis).

6.5.6 Align the vertical centerline of the probe with the midsagittal plane of the ATD (Figure 6-1). The midsagittal plane can be visualized using the center of the bottom face load cell detent on the head skin, the midpoint between the IR-TRACC attachment bolts, the umbilicus detent on the abdomen, and the pelvis flesh at the pubic symphysis.

6.5.7 Adjust the table height or impactor height so that the vertical center of the impact face is 20.7 ± 1.0 mm below the umbilicus detent (Figure 6-2 and Figure 6-3).

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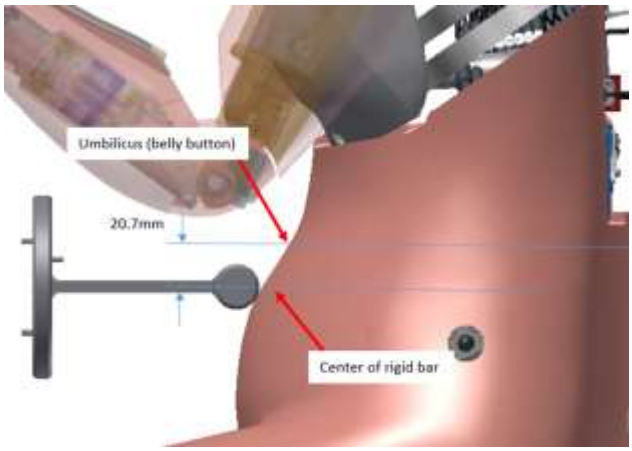

Figure 6-2. Lower abdomen impact loaction

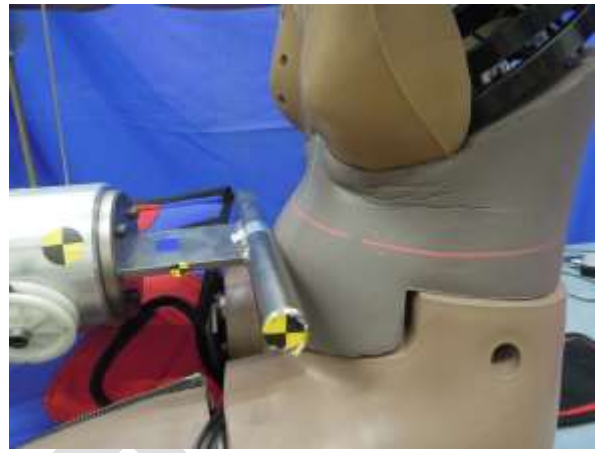

Figure 6-3. Vertical alignment of impact location using laser.

6.5.8 Carefully reinstall the dummy's jacket by zipping the sides and shoulders of the jacket.

6.5.9 Position the dummy so the abdomen is just touching the impact probe when the probe is at rest.

6.5.10 The motion of the impactor should be constrained so that there is no significant lateral, vertical, or rotational movement. Ensure that the impactor bar is level, 0° ± 0.5°.

6.5.11 Record the "as measured (AM)" channels listed in Table 6-2 in accordance with SAE J211-1. The pre-event bias of the abdomen pressure sensors must not be removed at any time during data collection.

6.5.12 Confirm the test setup parameters illustrated in Table 6-1.

Table 6-1. Lower Abdomen Impact Test Setup Parameters

Parameter	Setting
Lower Thoracic Spine (LTS) Pitch Change Setting	Slouched
Neck Pitch Change Setting	Neutral
Tilt Sensor Reading: T12	X = 0 ± 0.5º; Y = 10 ± 1º
Tilt Sensor Reading: Pelvis	X = 0 ± 0.5º; Y = 8 ± 1º
Wait Time Between Tests	At Least 30 Minutes

6.5.13 Ensure that at least 30 minutes have passed since the last lower thorax or lower abdomen test on this ATD.

6.5.14 Conduct the test at an impact velocity of 6.10 ± 0.05 m/s.

6.6 Data Processing

6.6.1 Perform bias removal of the measured (unfiltered) channels listed in the "Required Measurement Channels" (Table 6-2) by subtracting the average value of the data samples over the period between (.050 s) and (.010 s) prior to contact.

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6.6.2 Filter channels based on the CFC filter classes listed in Table 6-2.

6.6.3 Calculate time-history of impact force at the contact interface:

$$F_{IMP}(t) = m_{IMP} \cdot a_{IMP}(t)$$ where,

$F_{IMP}(t)$ = calculated force time-history at contact interface

m_{IMP} = mass of the impactor

$a_{IMP}(t)$ = measured acceleration time-history of impactor

6.6.4 Calculate the absolute value of the difference between the maximum left and right abdomen pressures.

Table 6-2. Required Measurement Channels for the Lower Abdomen Qualification Test

Channel Description	CFC	ISO-MME Code	AXIS	DASTAT	SENATT	SENTYP	YUNITS
Pendulum Accelerometer	600	T0SENSMI0000ACXB	XG	AM	PEND	AC	G'S
Pendulum Force	N/A	T0SENSMI0000FOXB	XG	CM	PEND	PP	NWT
Left abdomen pressure	600	D0ABDOLE00TFPR0B	XL	CM	ABDL	PP	KPA
Right abdomen presssure	600	D0ABDORI00TFPR0B	XL	CM	ABDR	PP	KPA

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7 UPPER LEG QUALIFICATION

7.1 Description

The upper leg qualification test is a dynamic test performed to examine the response of the femur to axial impacts at the knee using a 7.26 kg rigid impactor at 3.3 m/s.

7.2 Materials

- Fully-assembled THOR-05F ATD (474-0000)
- Impactor 7.26 ± 0.02 kg (16.0 ± 0.04 lb) in mass, including instrumentation, rigid attachments and the mass of the lower 1/3 of the suspension cables. The test probe is a 76.2 ± 0.2 mm (3.00 ± 0.01 in) diameter rigid cylinder. The impacting surface has a flat, right angle face with an edge radius of 0.5 ± 0.2 mm (0.02 ± 0.01 in).

7.3 Instrumentation

- Instrumentation to measure impact force (accelerometer on impactor)
- Instrumentation to measure the impact velocity
- Acetabulum load cell (SA572-S108, S109)
- Femur load cell (SA572-S63)
- A dual-axis tilt sensor (SA572-S44) attached to the pelvis to measure initial angle about "X" and "Y" axes

7.4 Pre-Test Procedures

7.4.1 Soak the ATD in a controlled environment with a temperature of 20.6 to 22.2 °C (69 to 72 °F) and a relative humidity from 10 to 70% for at least 4 hours prior to a test. The test environment should have the same temperature and humidity requirements as the soak environment.

7.4.2 Set the lower thoracic spine (LTS) pitch change joint to the **slouched** position.

7.4.3 Set the neck pitch change joint to the **neutral**.

7.4.4 Adjust the knee torque settings according to 1g.

7.5 Test Procedure

7.5.1 Seat the dummy on a horizontal surface (±0.5°) with back support, with femurs extended horizontally and forward parallel to the midsagittal plane and lower legs extended vertically and downward parallel to the vertical plane (Figure 7-1). The midsagittal plane shall be vertical within ±1 degree.

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Figure 7-1. Initial setup for the upper leg qualification test.

7.5.2 Position the arms along the side of the body (Figure 7-1).

7.5.3 Set the pelvis so that the angle measured by the pelvis tilt sensor is 0 ± 0.5° in the X-axis and 5 ±1° in the Y-axis.

7.5.4 With the lower legs positioned over the front edge of the seating surface, measure the angle of the line between the center of the knee joint and the centerline of the femur shaft, which is visible through the gap between the thigh and pelvis flesh (Figure 7-2 and Figure 7-3), using a straight edge with an inclinometer or using a laser level. Place support shims under the thigh in order to level the centerline of the femur shaft in the horizontal plane (±0.5°).

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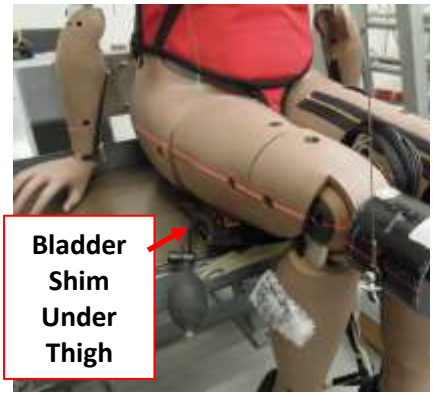

Figure 7-2. Location of shim used to level upper leg in horizontal plane.

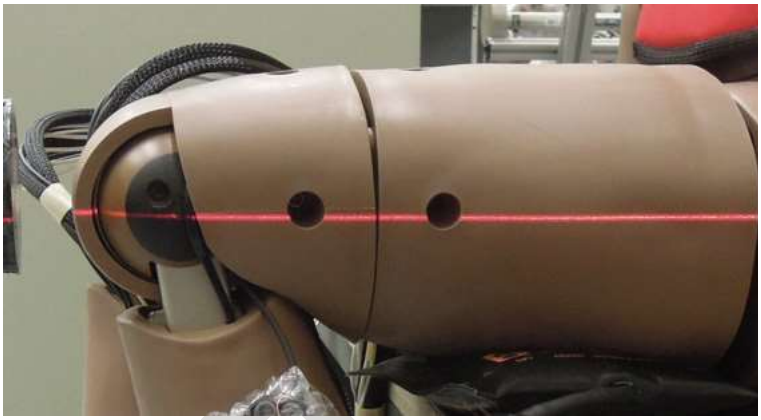

Figure 7-3. Horizontal alignment of knee and femur using laser level.

7.5.5 Position the tibia at an angle of 10 ± 1° (in flexion, such that the ankle is behind the knee), as measured at the anterior aspect of the knee clevis (474-5517;Figure 7-4). The distance between the posterior surface of the tibia and the leading edge of the test seat shall be no less than 25 mm.

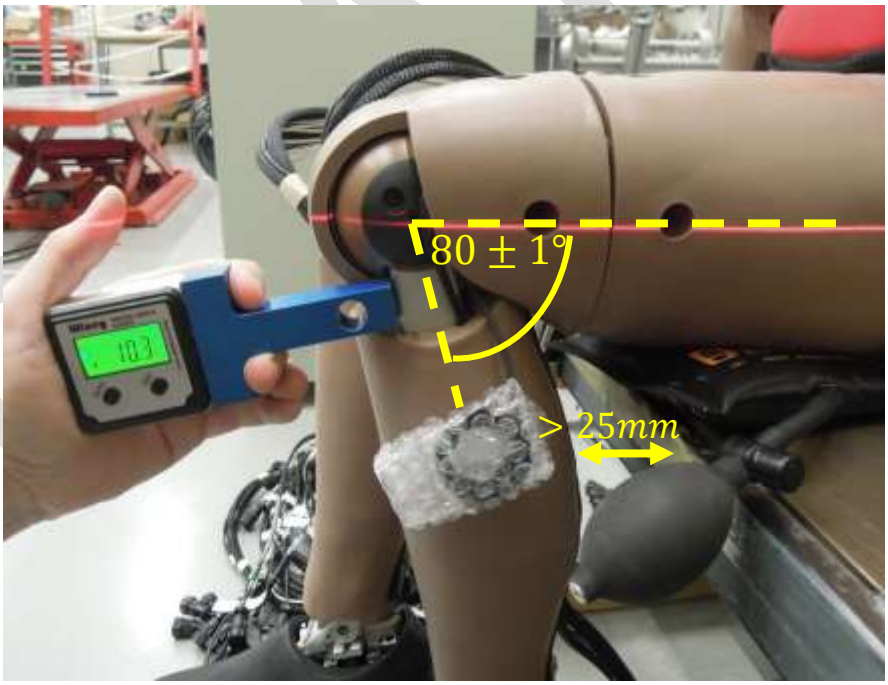

Figure 7-4. Lower leg angle measurement

7.5.6 Ensure the ATD is square against the backer plate.

7.5.7 Align the impact probe so that at the point of contact is the center of the probe face which is centered on the surface of the knee and the longitudinal centerline of the probe is collinear within 0.5° of the longitudinal centerline of the femur load cell (Figure 7-5).

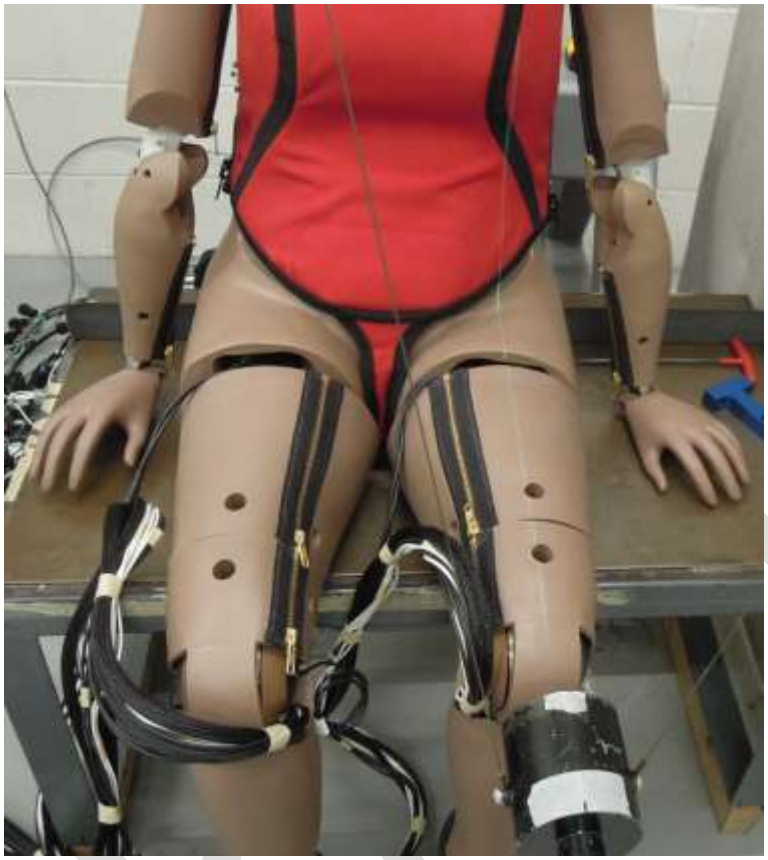

Figure 7-5. Lateral alignment of the probe.

7.5.8 Position the foot and lower leg such that the center of the ankle X-axis potentiometer is in the same vertical plane as the femur centerline. This can be accomplished by aligning the centerline of the probe with the centerline of the lower leg through the ankle (Figure 7-6).

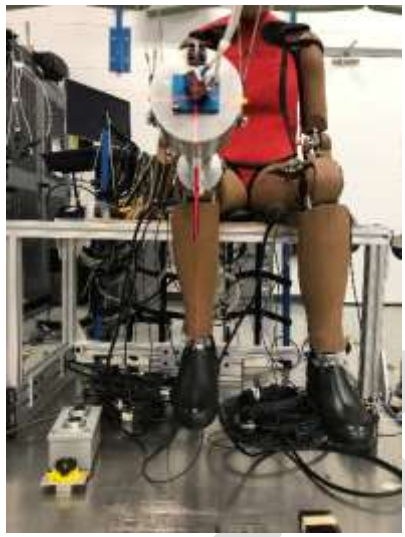

Figure 7-6. Orient lower leg along centerline.

7.5.9 At the point of contact, the longitudinal centerline of the impact probe must be within 0.5° of horizontal.

7.5.10 Position the dummy so the knee is just touching the impact probe when the probe is at rest.

7.5.11 Constrain the motion of the impactor so that there is no significant lateral, vertical, or rotational movement.

7.5.12 Record the "as measured (AM)" channels listed in Table 7-2 (for left impacts) and Table 7-3 (for right impacts) in accordance with SAE J211-1.

7.5.13 Confirm the test setup parameters illustrated in Table 7-1.

Table 7-1. Seated Knee Impact Test Setup Parameters

Parameter	Setting
Lower Thoracic Spine (LTS) Pitch Change Setting	Slouched
Neck Pitch Change Setting	Neutral
Tilt Sensor Reading: Pelvis	X = 0 ± 0.5º; Y = 5 ± 1º
Wait Time Between Tests	At Least 30 Minutes

7.5.14 Ensure that at least 30 minutes have passed since the last upper leg qualification test.

7.5.15 Conduct the test at a velocity of 3.30 ± 0.05 m/s.

7.5.16 Repeat Section 7.5 for the opposite upper leg.

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7.6 Data Processing

7.6.1 Perform bias removal of the measured (unfiltered) channels listed in the "Required Measurement Channels" (Table 7-2 for left impacts and Table 7-3 for right impacts) by subtracting the average value of the data samples over the period between (.050 s) and (.010 s) prior to contact.

7.6.2 Filter channels based on the CFC filter classes listed in Table 7-2 (for left impacts) and Table 7-3 (for right impacts).

7.6.3 Calculate time-history of impact force at the contact interface:

$F_{IMP}(t) = m_{IMP} \cdot a_{IMP}(t)$ where,

$F_{IMP}(t)$ = calculated force time-history at contact interface

m_{IMP} = mass of the impactor

$a_{IMP}(t)$ = measured acceleration time-history of impactor

7.6.4 Calculate resultant acetabulum force:

$PVA_{FR}(t) = \sqrt{PVA_{FX}^2 + PVA_{FY}^2 + PVA_{FZ}^2}$ where,

$PVA_{FR}(t) = \text{time} - \text{history of acetabulum resultant force (L or R)}$

$PVA_{FX} = \text{time} - \text{history of acetabulum X force (L or R)}$

$PVA_{FY} = \text{time} - \text{history of acetabulum Y force (L or R)}$

$PVA_{FZ} = \text{time} - \text{history of acetabulum Z force (L or R)}$

Table 7-2. Required Measurement Channels for the Left Upper Leg Qualification Test

Channel Description	CFC	ISO-MME Code	AXIS	DASTAT	SENATT	SENTYP	YUNITS
Probe Accelerometer	600	T0SENSMI0000ACXB	XG	AM	PEND	AC	G'S
Probe Force	N/A	T0SENSMI0000FOXB	XG	CM	PEND	PP	NWT
Left Femur Force, Z-axis	600	DOFEMRLE00TFFOZB	ZL	AM	FMRL	LC	NWT
Left Acetabulum Force, X-axis	600	D0ACTBLE00TFFOXB	XL	AM	PVAL	LC	NWT
Left Acetabulum Force, Y-axis	600	D0ACTBLE00TFFOYB	YL	AM	PVAL	LC	NWT
Left Acetabulum Force, Z-axis	600	D0ACTBLE00TFFOZB	ZL	AM	PVAL	LC	NWT
Left Acetabulum Force, Resultant	N/A	D0ACTBLE00TFFORB	RS	CM	PVAL	PP	NWT

Table 7-3. Required Measurement Channels for the Right Upper Leg Qualification Test

Channel Description	CFC	ISO-MME Code	AXIS	DASTAT	SENATT	SENTYP	YUNITS
Probe Accelerometer	600	T0SENSMI0000ACXB	XG	AM	PEND	AC	G'S
Probe Force	N/A	T0SENSMI0000FOXB	XG	CM	PEND	PP	NWT
Right Femur Force, Z-axis	600	DOFEMRRI00TFFOZB	ZL	AM	FMRR	LC	NWT
Right Acetabulum Force, X-axis	600	D0ACTBRI00TFFOXB	XL	AM	PVAR	LC	NWT
Right Acetabulum Force, Y-axis	600	D0ACTBRI00TFFOYB	YL	AM	PVAR	LC	NWT
Right Acetabulum Force, Z-axis	600	D0ACTBRI00TFFOZB	ZL	AM	PVAR	LC	NWT
Right Acetabulum Force, Resultant	N/A	D0ACTBRI00TFFORB	RS	CM	PVAR	PP	NWT

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8 KNEE QUALIFICATION

8.1 Description

The knee qualification test is a dynamic test performed to examine the force-time and force-deflection of the tibia with respect to the femur at the knee joint; the knee joint is impacted with a 7.26 kg rigid impactor at 2.15 m/s.

8.2 Materials

- THOR-05F ATD knee assembly (474-5300)
- Impactor 7.26 ± 0.02 kg (16.0 ± 0.04 lb) in mass, including instrumentation, rigid attachments and the mass of the lower 1/3 of the suspension cables. The test probe is a 76.2 ± 0.2 mm (3.00 ± 0.01 in) diameter rigid cylinder. The impacting surface has a flat, right angle face with an edge radius of 0.5 ± 0.2 mm (0.02 ± 0.01 in).
- Knee slider load distribution bracket assembly (TH-474-4100)

8.3 Instrumentation

- Instrumentation to measure the impact velocity
- THOR-05F femur load cell (SA572-S63)
- Knee slider string potentiometer (SA572-S90)

8.4 Pre-Test Procedures

8.4.1 Soak the ATD in a controlled environment with a temperature of 20.6 to 22.2 °C (69 to 72 °F) and a relative humidity from 10 to 70% for at least 4 hours prior to a test. The test environment should have the same temperature and humidity requirements as the soak environment.

8.5 Test Procedure

8.5.1 Mount the THOR-05F femur load cell (SA572-S63) to a rigid surface using four modified M6 BHSS and torque to 10.0 N-m (7.4 ft-lbf).

8.5.2 Orient the inboard/outboard knee slider assembly (474-5380) such that motion along the knee slider track is horizontal, parallel to the long axis of the femur load cell. Install the knee slider load distribution bracket (TH-474-4100) to the inboard and outboard slider assemblies in the orientation shown in Figure 8-1 using four M4 x 0.7 FHCS on each side and torque to 2.5 N-m (2.1 ft-lbf). Note that the knee slider distribution bracket is installed perpendicular to the orientation of the knee clevis in the fully-assembled, seated dummy.

8.5.3 Once the knee slider load distribution bracket is installed, set the torque on the modified M8 shoulder bolt to 5 N-m (3.7 ft-lbf) (Figure 8-1).

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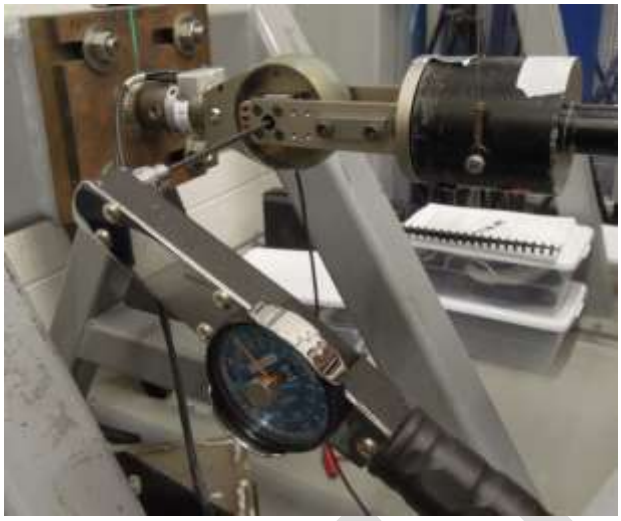

Figure 8-1. Knee joint bolt torque setting.

8.5.4 Adjust the position of the impact probe such that the angle between the probe's longitudinal centerline and the centerline of the femur load cell is less than 2 degrees. laser level positioned between the centerline of the knee and the centerline of the probe both laterally (Figure 8-2) and on the top surface of the probe/knee (Figure 8-3) will aid in this process.

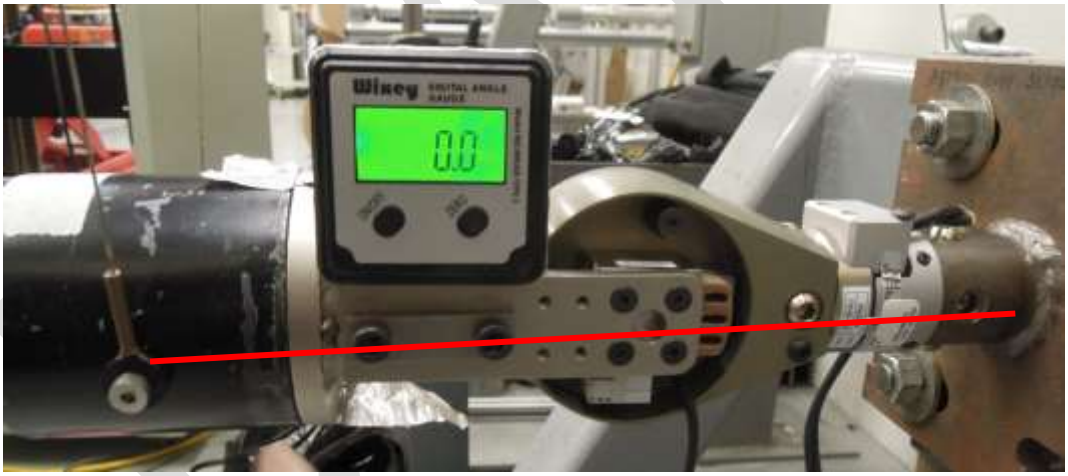

Figure 8-2. Vertical alignment of impact location.

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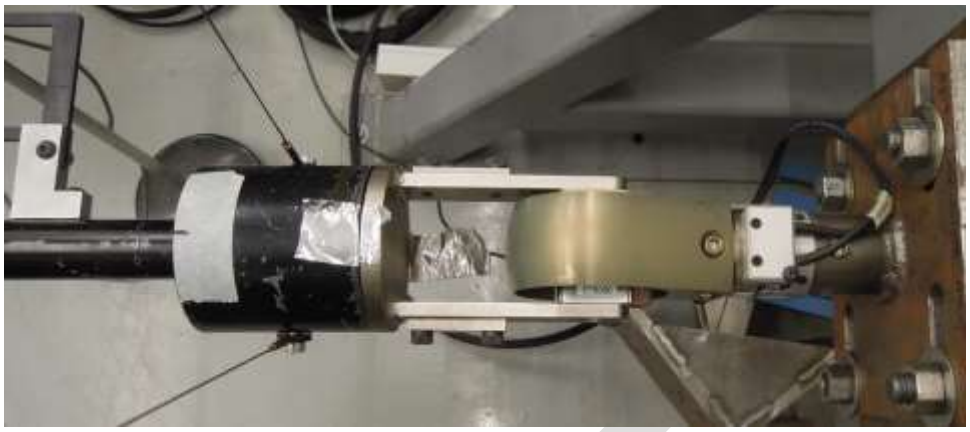

Figure 8-3. Lateral alignment of impact location.

8.5.5 After alignment, confirm that the knee slider load distribution bracket is just touching the impact probe when the probe is at rest.

8.5.6 The motion of the impactor should be constrained so that there is no significant lateral, vertical, or rotational movement at the time of contact between the test probe face and the load distribution bracket.

8.5.7 Record the "as measured (AM)" channels listed in Table 8-1 (for left impacts) or Table 8-2 (for right impacts) in accordance with SAE J211-1.

8.5.8 Ensure that at least 30 minutes have passed since the last test on the upper leg or knee.

8.5.9 Conduct the test at a velocity of 2.15 ± 0.05 m/s.

8.5.10 Repeat Section 8.5 for the opposite knee.

8.6 Data Processing

8.6.1 Perform bias removal of the measured (unfiltered) channels listed in the "Required Measurement Channels" (Table 8-1 for left impacts or Table 8-2 for right impacts) by subtracting the average value of the data samples over the period between (.050 s) and (.010 s) prior to contact.

8.6.2 Filter channels based on the CFC filter classes listed in Table 8-1 (for left impacts) or Table 8-2 (for right impacts).

Table 8-1. Required Measurement Channels for the Left Knee Qualification Test

Channel Description	CFC	ISO-MME Code	AXIS	DASTAT	SENATT	SENTYP	YUNITS
Left Femur Force, Z-axis	180	D0FEMRLE00TFFOZC	ZL	AM	FMRL	LC	NWT
Left Knee Slider Deflection	180	D0KNSLLE00TFDSXC	XL	AM	KNEL	DS	MM

Table 8-2. Required Measurement Channels for the Right Knee Qualification Test

Channel Description	CFC	ISO-MME Code	AXIS	DASTAT	SENATT	SENTYP	YUNITS
Right Femur Force, Z-axis	180	D0FEMRRI00TFFOZC	ZL	AM	FMRR	LC	NWT
Right Knee Slider Deflection	180	D0KNSLRI00TFDSXC	XL	AM	KNER	DS	MM

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9 ANKLE INVERSION AND EVERSION QUALIFICATION

9.1 Description

The inversion and eversion ankle qualification tests are dynamic tests performed to examine the moment and rotational characteristics of the ankle when impacted with a 3.00 kg rigid impactor at 2.00 m/s to elicit inversion or eversion.

The ankle qualification consists of two impacts (one each for inversion and eversion) to a padded bracket which is temporarily attached to the ankle in place of the molded shoe. The bracket is attached such that the line of impact is offset from the longitudinal axis of the tibia, and the resulting motion of the foot exercises the inversion and eversion properties of the ankle assembly. The leg is held rigidly such that the X-Z plane of the foot and lower leg are horizontal. The impact surface of the bracket is covered with PTFE padding to reduce noise transmission through the bracket into the ankle and load cell.

9.2 Materials

- THOR-05F ATD lower leg (474-5500-1 or 474-5500-2)
- NHTSA Dynamic Impactor (TLX-9000-013) 3.00 ± 0.02 kg (6.61 ± 0.04 lb) in *effective* mass, which includes the mass of instrumentation, ballast, impactor face (TLX-9000-006), and a portion of the mass of the pendulum arm (TLX-9000-007) including the distal mass welded to the tube and 1/3 of the mass of the tube itself. The pendulum arm is mounted to a rigid shaft which is pivoted on low friction ball bearings. The impact surface is a rigid semi-cylinder 63.5 ± 2.5 mm in diameter and 88.9 ± 3.5 mm in length, oriented in a horizontal plane perpendicular to the direction of impact.
- Dynamic inversion/eversion bracket (TH-1603-0675)
- Rigid fixture for eversion and inversion testing

9.3 Instrumentation

- Instrumentation to measure the impact velocity
- THOR-05F lower tibia load cell (SA572-S104)
- X-axis ankle potentiometer (SA572-S114)
- Y-axis ankle potentiometer (SA572-S114)
- Z-axis ankle potentiometer (SA572-S114)

9.4 Pre-Test Procedures

9.4.1 Soak the ATD in a controlled environment with a temperature of 20.6 to 22.2 °C (69 to 72 °F) and a relative humidity from 10 to 70% for at least 4 hours prior to a test. The test environment should have the same temperature and humidity requirements as the soak environment.

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9.4.2 Confirm that the outputs of the individual ankle potentiometers when the ankle is held in a known orientation referred to as the zero position: zero degrees plantar-/dorsi-flexion (Y-axis), zero degrees inversion/eversion (X-axis), and zero degrees internal/external rotation (Z-axis).

9.5 Test Procedure

9.5.1 Remove the Tibia Skin (474-5520) and the two M5 X 0.8 X 12 BHCS which attach the Tibia Guard (474-5518) to the lower leg assembly (Figure 9-1). Also remove the four M6 X 1 X 16 LG. SHCS that attach the Knee Clevis (474-5517-1,2) to the Tibia Assembly (474-5507-1,2).

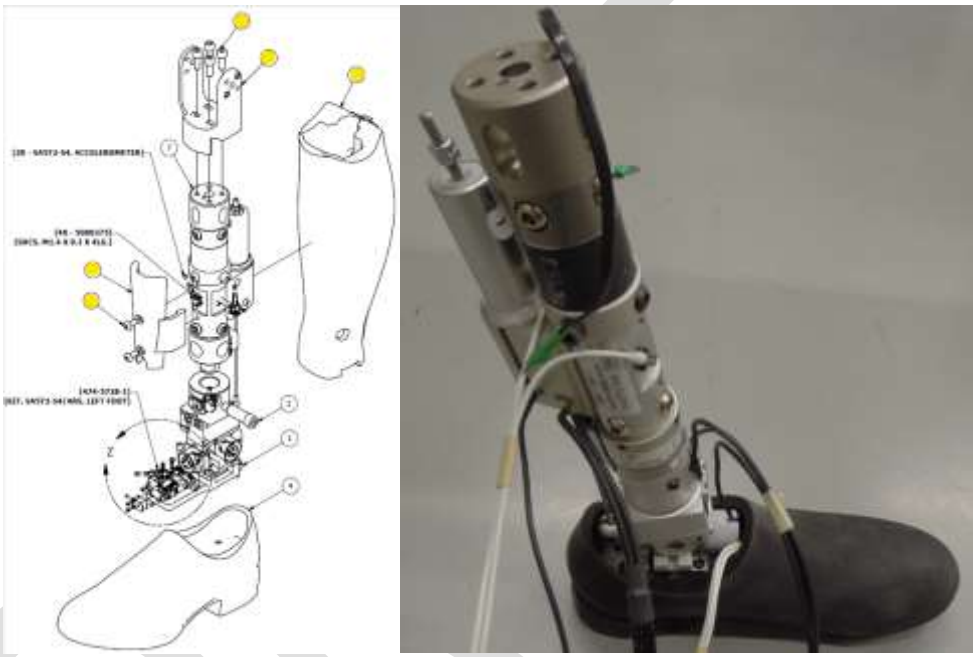

Figure 9-1. Remove tibia guard (474-5518) and knee clevis(474-5517).

9.5.2 Remove the four M4 X 0.7 xX12 LHCS (two per side) which attach the Lower Achilles spring housing to the rear of the lower tibia shaft (474-5540) (Figure 9-2). Remove the M3 X 0.5 X 12 SHCS in the Achilles Cable Retainer (474-5828) and remove the Achilles Cable (474-5530) from behind the Achilles Cable Retainer (474-5828) (Figure 9-3).

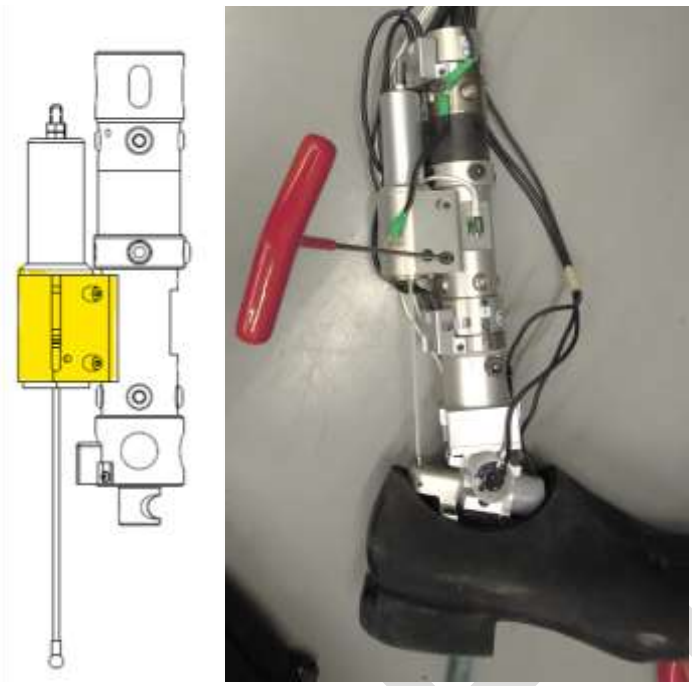

Figure 9-2. Remove Achilles spring tube assembly.

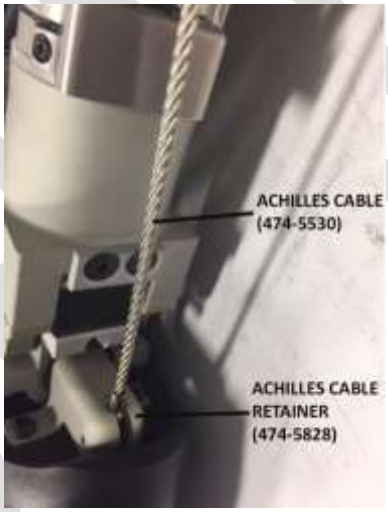

Figure 9-3. Slide the Achilles Cable (474-5530) out of the Achilles Cable Retainer (474-5828).

9.5.3 Remove the four M4 X 16 SHCS which attach the molded shoe (474-5903) to the ankle (Figure 9-4).

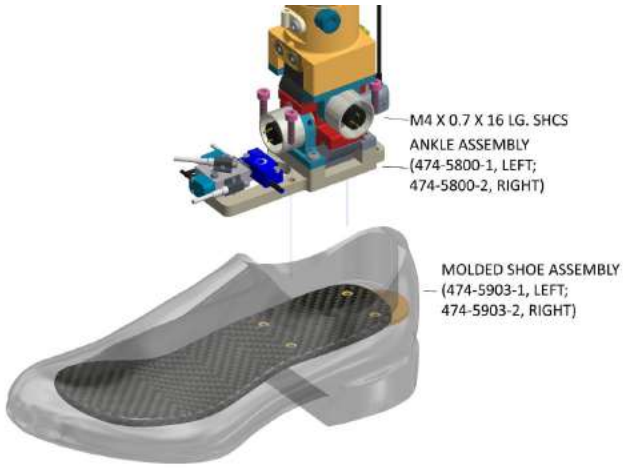

Figure 9-4. Remove the molded shoe (474-5903).

9.5.4 Remove the tibia compliant element assembly (474-5508) from the lower tibia shaft (474-5540) by removing the tibia plunger pins (474-5512), M6 X 1 X 10 FHCS, and M6 X 1 X 10 BHCS (Figure 9-5).

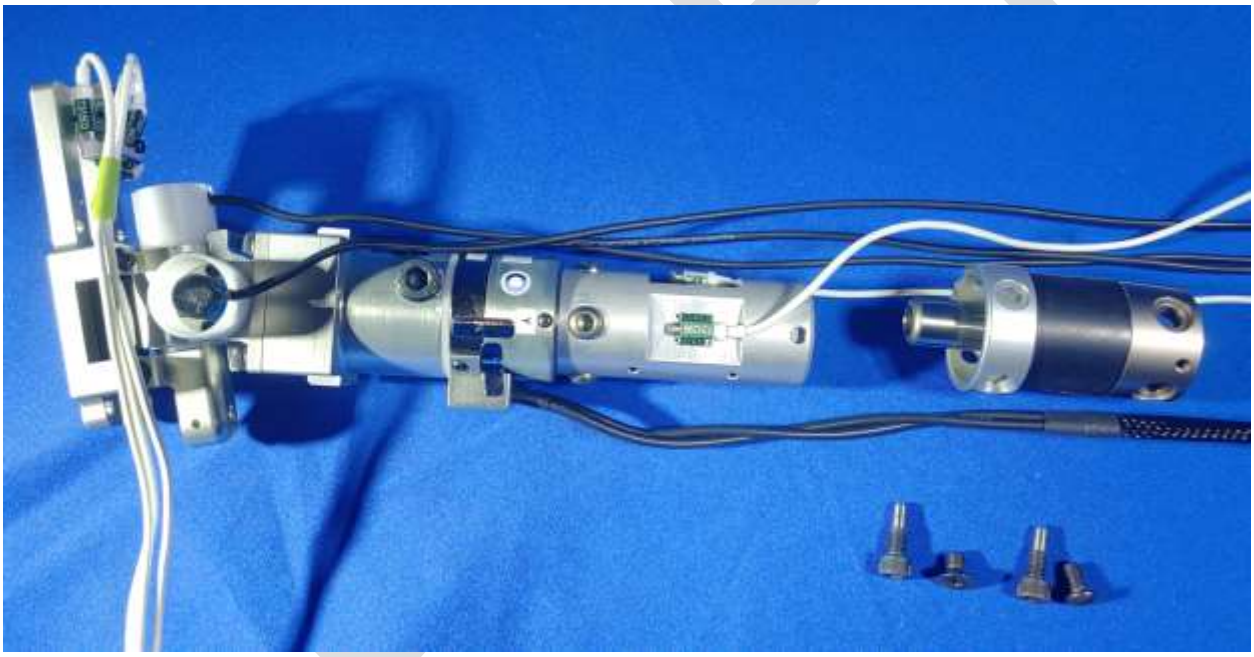

Figure 9-5. Remove the tibia compliant element assembly (474-5508) from the lower tibia shaft (474-5540).

9.5.5 Mount the rigid fixture for eversion and inversion testing. The remainder of the procedural instructions in this Section are written for the left leg inversion test. The setup for left leg eversion tests follows the same procedures as inversion, except that the orientation is rotated 180° about its longitudinal axis (Figure 9-6). Right leg tests for both inversion and eversion are mounted in the opposite directions of their respective left leg tests.

9.5.6 Remove one W50-61042 modified BHSS that attaches the lower tibia shaft (474-5540) to the lower tibia load cell (Right leg eversion test or left leg inversion test remove lateral bolt). Mount the ankle assembly to the rigid fixture using four modified M6 x 1 x 20 FHCS with torque set to 10.0 ± 2.5 N-m (7.4 ± 1.8 ft-lbf) such that the X-Z plane of the foot and lower leg are horizontal (Figure 9-6).

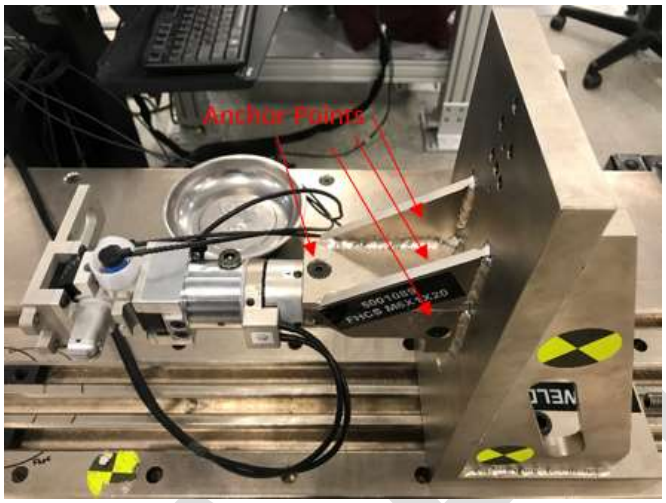

Figure 9-6. Lower (left) leg mounted to bracket for eversion test.

9.5.7 Attach the dynamic inversion/eversion bracket (TH-1603-0675-PR; Figure 9-7) in place of the molded shoe (474-5903) to the bottom (inferior) side of the ankle using four M4 x 0.7 x 20 mm SHCS torqued to 20.3 ± 2.5 N-m (15.0 ± 1.8 ft-lbf).

Figure 9-7. Dynamic inversion/eversion bracket (TH-1603-0675-PR).

9.5.8 Using the zero offset values collected when zeroing the ankle pots, position the ankle Y axis and Z axis rotations to 0° ± 0.5°.

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9.5.9 Adjust the position of the impactor such that the longitudinal centerline of the pendulum arm and the struck surface of the inversion/eversion bracket are vertical at impact, within ±0.5°, the center of the impactor is in line with the center of the inversion/eversion bracket, and the point of impact is 110.0 ± 2.5 mm (4.33 ± 0.1 in) above the ankle X-axis pivot point (Figure 9-8).

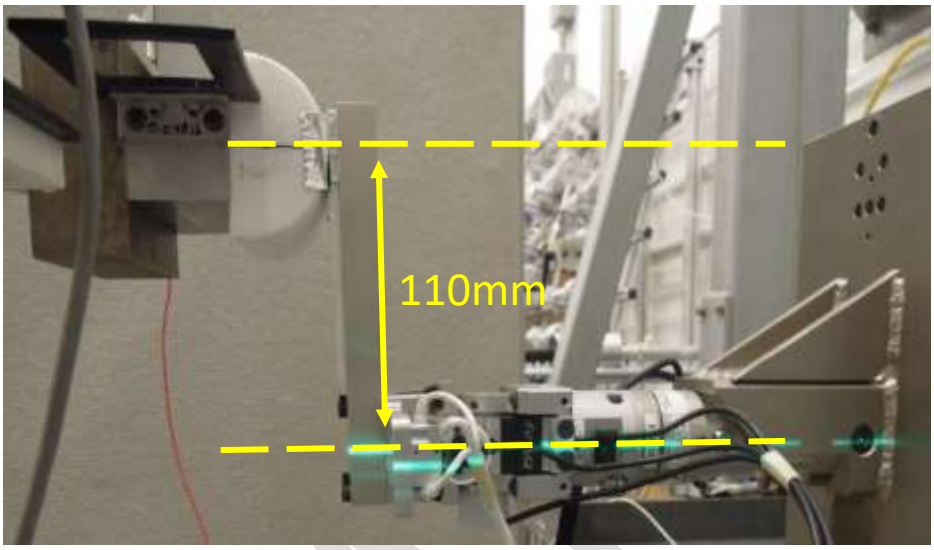

Figure 9-8. Set impact location for left inversion (or right eversion) test.

9.5.10 Record the "as measured (AM)" channels listed in Table 9-1 (for left impacts) or Table 9-2 (for right impacts) in accordance with SAE J211-1.

9.5.11 Ensure that at least 30 minutes have passed since the last test on the lower leg.

9.5.12 Release the pendulum and allow it to fall freely from a height to achieve an impact velocity of 2.00 ± 0.05 m/s (6.56 ± 0.15 ft/s).

9.5.13 To perform an eversion test, rotate the lower leg 180° about its longitudinal axis. Remove one W50-61042 modified BHSS that attaches the lower tibia shaft (474-5540) to the lower tibia load cell (lateral or medial depending on left or right leg).Remove the dynamic inversion/eversion bracket (TH-1603-0675-PR) from the ankle assembly by uninstalling the four M4 X 0.7 X 20 mm SHCS. Rotate the bracket 180 degrees about the longitudinal axis of the tibia and reinstall using four M4 X 0.7 X 20 mm SHCS torqued to 20.3 ± 2.5 N-m (15.0 ± 1.8 ft-lbf). Follow the same procedures as described in Section 9.4.1 for inversion.

9.6 Data Processing

9.6.1 With the exception of the ankle rotational potentiometer channel, perform bias removal of the measured (unfiltered) channels listed in the "Required Measurement Channels" (Table 9-1 for left impacts or Table 9-2 for right impacts) by subtracting the average value of the data samples over the period between (.050 s) and (.010 s) prior to contact.

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9.6.2 Filter channels based on the CFC filter classes listed in Table 9-1 (for left impacts) or Table 9-2 (for right impacts).

9.6.3 Calculate ankle resistive moment:

Left: $$M_{ANKL}(t) = M_{x_{TBLL}} + \left[0.1014m \times F_{y_{TBLL}}\right]$$

Right: $$M_{ANKR}(t) = M_{x_{TBLR}} + \left[0.1014m \times F_{y_{TBLR}}\right]$$

Where:

$M_{ANK[LR]} =$ time − history of calculated ankle resistive moment [L or R]

$M_{x_{TBL[LR]}} =$ measured X moment time history measured at the lower [L or R] tibia load cell

$F_{y_{TBL[LR]}} =$ measured Y force time history measured at the lower [L or R] tibia load cell

Table 9-1. Required Measurement Channels for the Left Ankle Qualification Test

Channel Description	CFC	ISO-MME Code	AXIS	DASTAT	SENATT	SENTYP	YUNITS
Left Lower Tibia Shear Force, Y-axis	600	D0TIBILELOTFFOYB	YL	AM	TBLL	LC	NWT
Left Lower Tibia Axial Force, Z-axis	600	D0TIBILELOTFFOZB	ZL	AM	TBLL	LC	NWT
Left Lower Tibia Moment, X-axis	600	D0TIBILELOTFMOXB	XL	AM	TBLL	LC	NWM
Left Ankle Rotation, X-axis	180	D0ANKLLE00TFANXC	XL	AM	ANKL	AD	DEG
Left Ankle Resistive Moment	N/A	D0ANKLLE00TFMOXB	XL	CM	ANKL	PP	NWM

Table 9-2. Required Measurement Channels for the Right Ankle Qualification Test

Channel Description	CFC	ISO-MME Code	AXIS	DASTAT	SENATT	SENTYP	YUNITS
Right Lower Tibia Shear Force, Y-axis	600	D0TIBIRILOTFFOYB	YL	AM	TBRL	LC	NWT
Right Lower Tibia Axial Force, Z-axis	600	D0TIBIRILOTFFOZB	ZL	AM	TBRL	LC	NWT
Right Lower Tibia Moment, X-axis	600	D0TIBIRILOTFMOXB	XL	AM	TBRL	LC	NWM
Right Ankle Rotation, X-axis	180	D0ANKLRI00TFANXC	XL	AM	ANKR	AD	DEG
Right Ankle Resistive Moment	N/A	D0ANKLRI00TFMOXB	XL	CM	ANKR	PP	NWM

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10 BALL OF FOOT QUALIFICATION

10.1 Description

The ball of foot qualification test is a dynamic test performed to examine the force, moment, and rotational characteristics of the ankle when impacted with a 7.45 kg rigid impactor at 2.00 m/s to elicit dorsiflexion.

10.2 Materials

- THOR-05F ATD lower leg (474-5500-1 or 474-5500-2)
- NHTSA Dynamic Impactor (TLX-9000-013) 8.52 ± 0.02 kg (11.02 ± 0.04 lb) in *effective* mass, which includes the mass of instrumentation, ballast, impactor face (TLX-9000-006), and a portion of the mass of the pendulum arm (TLX-9000-007) including the distal mass welded to the tube and 1/3 of the mass of the tube itself. The pendulum arm is mounted to a rigid shaft which is pivoted on low friction ball bearings. The impact surface is a rigid semi-cylinder 63.5 ± 2.5 mm in diameter and 88.9 ± 3.5 mm in length, oriented in a horizontal plane perpendicular to the direction of impact.
- Rigid fixture for ball of foot testing

10.3 Instrumentation

- Instrumentation to measure the impact velocity
- THOR-05F lower tibia load cell (SA572-S104)
- X-axis ankle potentiometer (SA572-114)
- Y-axis ankle potentiometer (SA572-114)
- Z-axis ankle potentiometer (SA572-114)
- Achilles cable load cell (SA572-S126)

10.4 Pre-Test Procedures

10.4.1 Soak the ATD in a controlled environment with a temperature of 20.6 to 22.2 °C (69 to 72 °F) and a relative humidity from 10 to 70% for at least 4 hours prior to a test. The test environment should have the same temperature and humidity requirements as the soak environment.

10.4.2 Confirm that the outputs of the individual ankle potentiometers when the ankle is held in a known orientation referred to as the zero position: zero degrees plantar-/dorsi-flexion (Y-axis), zero degrees inversion/eversion (X-axis), and zero degrees internal/external rotation (Z-axis).

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10.5 Test Procedure

10.5.1 If necessary, remove the tibia skin (474-5520) and the two M5 X 0.8 X 12 BHCS which attach the tibia guard (474-5518) to the lower leg assembly. Remove the tibia compliant element assembly (474-5508) at the lower flange joint by removing the two modified M6 plunger pin bolts (474-5512), the M6 X 1 X 10 BHCS, and M6 X 1 X 10 FHCS.

10.5.2 Remove the front W50-61042 modified BHSS that attaches the lower tibia (474-5540) shaft to the lower tiba load cell in order to mount the leg to the rigid fixture. Mount the lower leg to the rigid fixture such that the Y-Z plane of the lower leg is horizontal and the toes are pointing upward using four M6 X 1 X 20 FHCS (Figure 10-1).

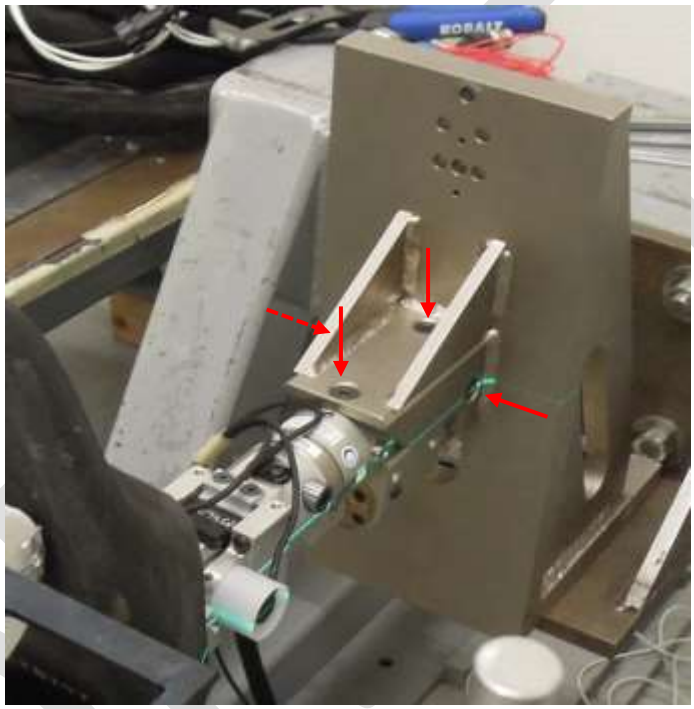

Figure 10-1. Mount the lower leg to the rigid fixture.

10.5.3 Using the zero offset values collected while zeroing the pots, position the ankle X-axis and Z-axis rotations to 0° ± 0.5°.

10.5.4 Adjust the position of the impactor so that the longitudinal centerline of the pendulum am is vertical at impact, within ±0.5°, amd the point of impact is 110 ± 1 mm (4.33 ± 0.04 in) above the ankle Y-axis pivot point (Figure 10-2).

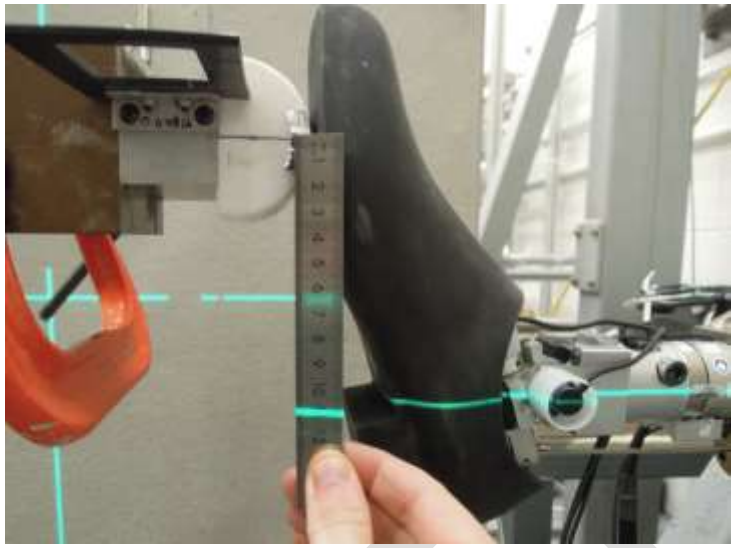

Figure 10-2. Ball of foot setup.

10.5.5 Record the "as measured (AM)" channels listed in Table 10-1 (for left impacts) or Table 10-2 (for right impacts) in accordance with SAE J211-1.

10.5.6 Ensure that at least 30 minutes have passed since the last test on the lower leg.

10.5.7 Release the pendulum and allow it to fall freely from a height to achieve an impact velocity of 2.00 ± 0.05 m/s (6.56 ± 0.15 ft/s).

10.5.8 Repeat Section 10.5 for the opposite leg.

10.6 Data Processing

10.6.1 With the exception of the ankle rotational potentiometer channel, perform bias removal of the measured (unfiltered) channels listed in the "Required Measurement Channels" (Table 10-1 for left impacts and Table 10-2 for right impacts) by subtracting the average value of the data samples over the period between (.050 s) and (.010 s) prior to contact.

10.6.2 Filter channels based on the CFC filter classes listed in Table 10-1 (for left impacts) or Table 10-2 (for right impacts).

10.6.3 Calculate ankle resistive moment:

Left: $$M_{ANKL} = M_{y_{TBLL}} - \left[0.0864m \times F_{x_{TBLL}}\right]$$

Right: $$M_{ANKR} = M_{y_{TBLR}} - \left[0.0864m \times F_{x_{TBLR}}\right]$$

Where:

$M_{ANK[LR]} =$ calculated ankle resistive moment [left or right] time history

$M_{y_{TBL[LR]}} =$ measured Y moment time history measured at the lower [L or R] tibia load cell

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$F_{x_{TBL[LR]}} =$ measured X force time history measured at the lower [L or R] tibia load cell

Table 10-1. Required Measurement Channels for the Left BOF Qualification Test

Channel Description	CFC	ISO-MME Code	AXIS	DASTAT	SENATT	SENTYP	YUNITS
Left Lower Tibia Shear Force, X-axis	600	D0TIBILELOTFFOXB	XL	AM	TBLL	LC	NWT
Left Lower Tibia Axial Force, Z-axis	600	D0TIBILELOTFFOZB	ZL	AM	TBLL	LC	NWT
Left Lower Tibia Moment, Y-axis	600	D0TIBILELOTFMOYB	YL	AM	TBLL	LC	NWM
Left Ankle Rotation, Y-axis	180	D0ANKLLE00TFANYC	YL	AM	ANKL	AD	DEG
Left Ankle Resistive Moment	N/A	D0ANKLLE00TFMOYB	YL	CM	ANKL	PP	NWM

Table 10-2. Required Measurement Channels for the Right BOF Qualification Test

Channel Description	CFC	ISO-MME Code	AXIS	DASTAT	SENATT	SENTYP	YUNITS
Right Lower Tibia Shear Force, X-axis	600	D0TIBIRILOTFFOXB	XL	AM	TBRL	LC	NWT
Right Lower Tibia Axial Force, Z-axis	600	D0TIBIRILOTFFOZB	ZL	AM	TBRL	LC	NWT
Right Lower Tibia Moment, Y-axis	600	D0TIBIRILOTFMOYB	YL	AM	TBRL	LC	NWM
Right Ankle Rotation, Y-axis	180	D0ANKLRI00TFANYC	YL	AM	ANKR	AD	DEG
Right Ankle Resistive Moment	N/A	D0ANKLRI00TFMOYB	YL	CM	ANKR	PP	NWM

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11 HEEL QUALIFICATION

11.1 Description

The heel qualification test is a dynamic test performed to examine the force-time response of the heel when impacted with a 3.00 kg rigid impactor at 4.00 m/s.

11.2 Materials

- THOR-05F ATD lower leg (474-5500-1 or 474-5500-2)
- NHTSA Dynamic Impactor (TLX-9000-013) 3.00 ± 0.02 kg (6.61 ± 0.04 lb) in *effective* mass, which includes the mass of instrumentation, ballast, impactor face (TLX-9000-006), and a portion of the mass of the pendulum arm (TLX-9000-007) including the distal mass welded to the tube and 1/3 of the mass of the tube itself. The pendulum arm is mounted to a rigid shaft which is pivoted on low friction ball bearings. The impact surface is a rigid semi-cylinder 63.5 ± 2.5 mm in diameter and 88.9 ± 3.5 mm in length, oriented in a horizontal plane perpendicular to the direction of impact.
- Ankle external positioning bracket (TLX-9000-016M)
- Rigid fixture for heel of foot testing

11.3 Instrumentation

- Pendulum accelerometer
- Instrumentation to measure the impact velocity
- THOR-05F lower tibia load cell (SA572-S104)
- X-axis ankle potentiometer (SA572-114)
- Y-axis ankle potentiometer (SA572-114)
- Z-axis ankle potentiometer (SA572-114)

11.4 Pre-Test Procedures

11.4.1 Soak the ATD in a controlled environment with a temperature of 20.6 to 22.2 °C (69 to 72 °F) and a relative humidity from 10 to 70% for at least 4 hours prior to a test. The test environment should have the same temperature and humidity requirements as the soak environment.

11.4.2 Confirm that the outputs of the individual ankle potentiometers when the ankle is held in a known orientation referred to as the <u>zero position</u>: zero degrees plantar-/dorsi-flexion (Y-axis), zero degrees inversion/eversion (X-axis), and zero degrees internal/external rotation (Z-axis).

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11.5 Test Procedure

11.5.1 Remove the tibia skin (474-5520), the two M5 X 0.8 X 12 BHCS which attach the shin guard (474-5518) to the lower leg assembly, and the four M6 X 1 X 16 SHCS which attach the knee clevis to the lower leg assembly (474-5517) (Figure 11-1, highlighted in yellow).

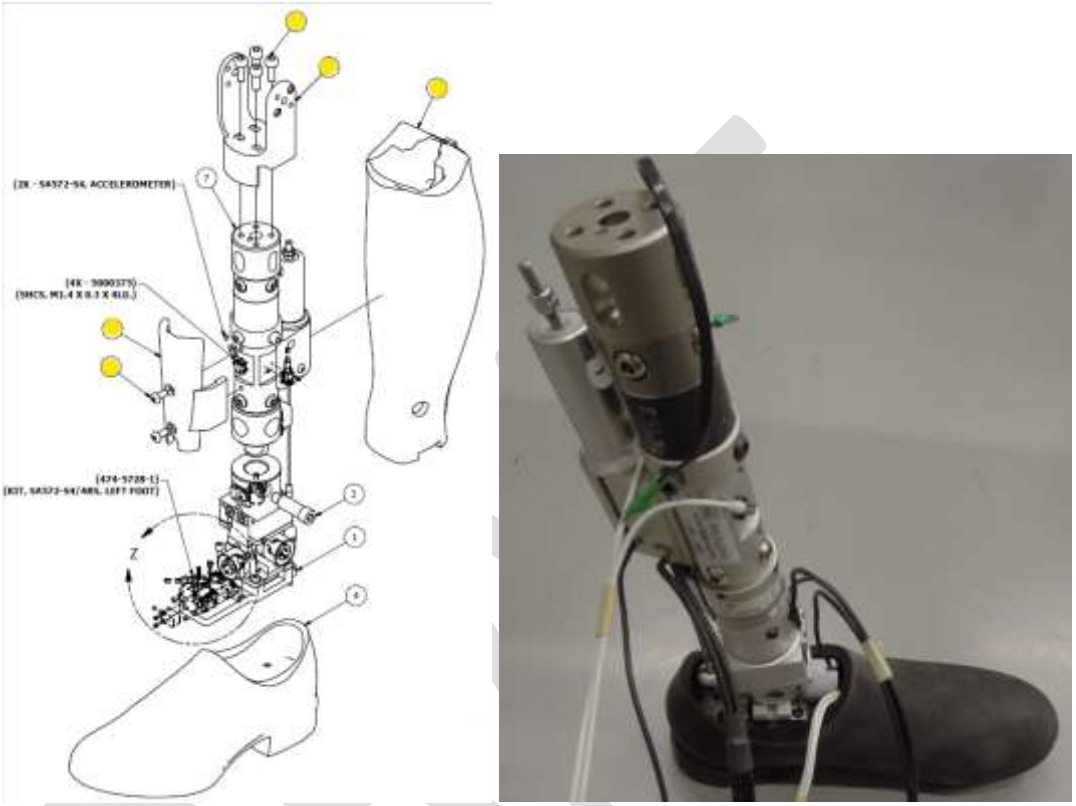

Figure 11-1. Remove tibia guard (474-5518) and knee clevis (474-5517).

11.5.2 Remove the four modified M6 BHSS which attach the upper tibia load cell (SA572-S103) to the tibia compliant bushing (474-5508). Replace with the structural replacement (Figure 11-2).

Figure 11-2. Assembly of lower leg for Heel of Foot testing.

11.5.3 Mount the leg to the rigid fixture with the toe pointing upward (Figure 11-3) using four M6 X 16 SHCS and torque to 10.0 ± 2.5 N-m (7.4 ± 1.8 ft-lbf). Verify the leg is horizontal by placing a level on the flat area used for mounting an accelerometer on the X-axis of the lower tibia shaft.

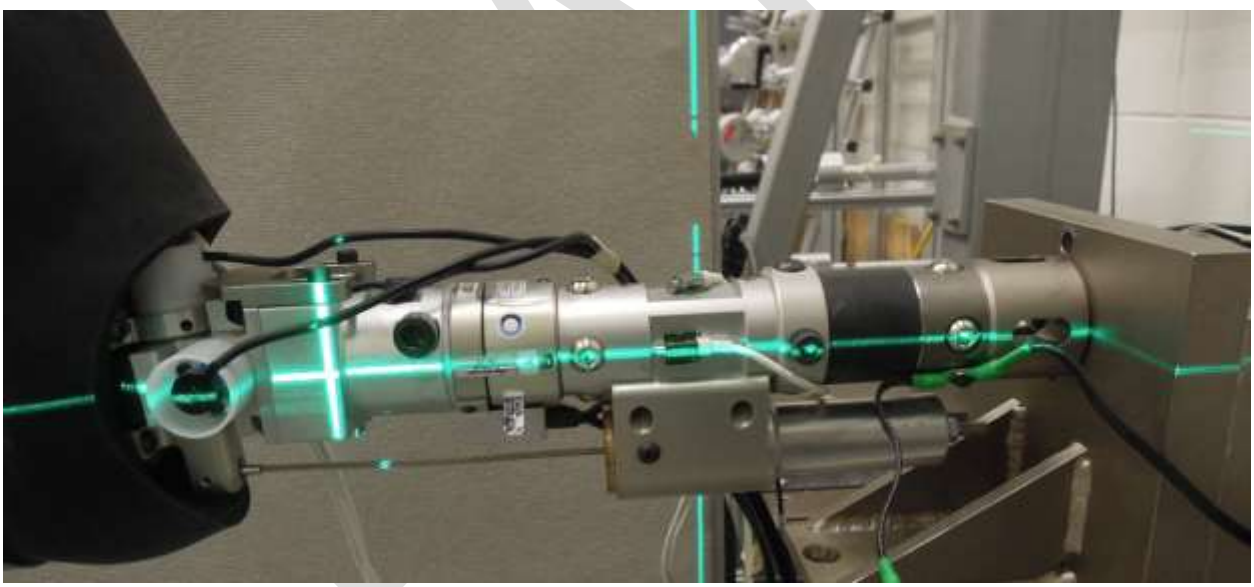

Figure 11-3. Install lower leg to rigid fixture and level for heel impact test.

11.5.4 Using the zero offset values collected in Section **Error! Reference source not found.**, orient the foot at 0° ± 0.5° dorsiflexion/plantarflexion and inversion/eversion and Z-axis rotation. Use the external positioning bracket (TLX-9000-016M) to hold the ankle in the proper orientation (Figure 11-4).

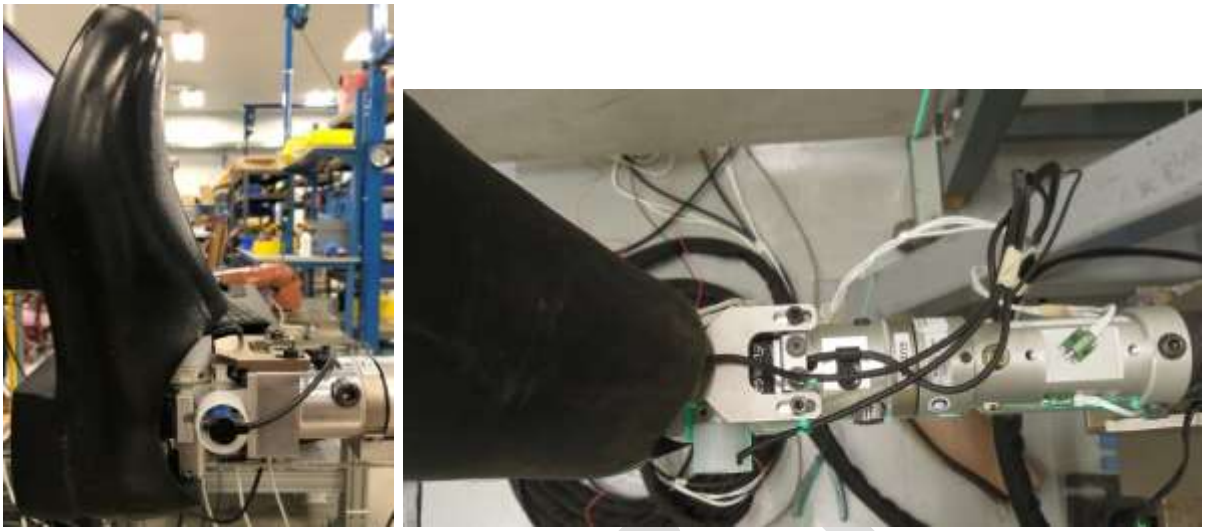

Figure 11-4. Install external positioning bracket for heel impact test.

11.5.5 Adjust the position of the impactor so that the longitudinal centerline of the pendulum arm is vertical at impact, within ±0.5°, and the point of impact is aligned with the longitudinal axis of the tibia within ±1 mm (±0.04 in) (Figure 11-5). The longitudinal axis of the tibia is defined as the horizontal line crossing the centers of the ankle Y-axis pivot point, plunger retaining bolt (474-5512), and the modified BHSC (W50-61042) attaching the tibia compliant bushing assembly to the rigid fixture.

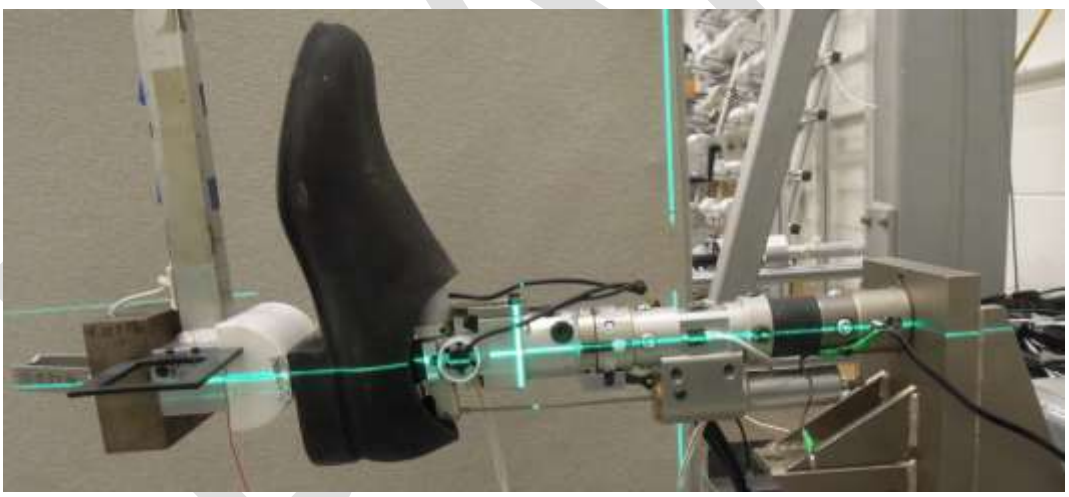

Figure 11-5. Alignment of the impactor for heel impact test.

11.5.6 Record the "as measured (AM)" channels listed in Table 11-1 (for left impacts) or Table 11-2 (for right impacts) in accordance with SAE J211-1.

11.5.7 Ensure that at least 30 minutes have passed since the last test on the lower leg.

11.5.8 Release the pendulum and allow it to fall freely from a height to achieve an impact velocity of 4.00 ± 0.05 m/s (13.10 ± 0.15 ft/s).

11.5.9 Repeat Section 11.4.2 for the opposite leg.

11.6 Data Processing

11.6.1 Perform bias removal of the measured (unfiltered) channels listed in the "Required Measurement Channels" (Table 11-1 for left impacts or Table 11-2 for right impacts) by subtracting the average value of the data samples over the period between (.050 s) and (.010 s) prior to contact.

11.6.2 Filter channels based on the CFC filter classes listed in Table 11-1 (for left impacts) or Table 11-2 (for right impacts).

11.6.3 Calculate time-history of impact force at the contact interface (see Section **Error! Reference source not found.**).

Table 11-1. Required Measurement Channels for the Left Heel Qualification Test

Channel Description	CFC	ISO-MME Code	AXIS	DASTAT	SENATT	SENTYP	YUNITS
Left Lower Tibia Axial Force, Z-axis	600	D0TIBILELOTFFOZB	ZL	AM	TBLL	LC	NWT
Pendulum Accelerometer	600	T0SENSMI0000ACXB	XG	AM	PEND	AC	G'S
Pendulum Force	N/A	T0SENSMI0000FOXB	XG	CM	PEND	PP	NWT

Table 11-2. Required Measurement Channels for the Right Heel Qualification Test

Channel Description	CFC	ISO-MME Code	AXIS	DASTAT	SENATT	SENTYP	YUNITS
Right Lower Tibia Axial Force, Z-axis	600	D0TIBIRILOTFFOZB	ZL	AM	TBRL	LC	NWT
Pendulum Accelerometer	600	T0SENSMI0000ACXB	XG	AM	PEND	AC	G'S
Pendulum Force	N/A	T0SENSMI0000FOXB	XG	CM	PEND	PP	NWT

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APPENDIX D
DUMMY QUALIFICATION

THOR-05F Head Impact Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Head Skin: EV3766

Test ID: 220614-9
Test Date: 6/14/2022
Test Time: 3:53 PM

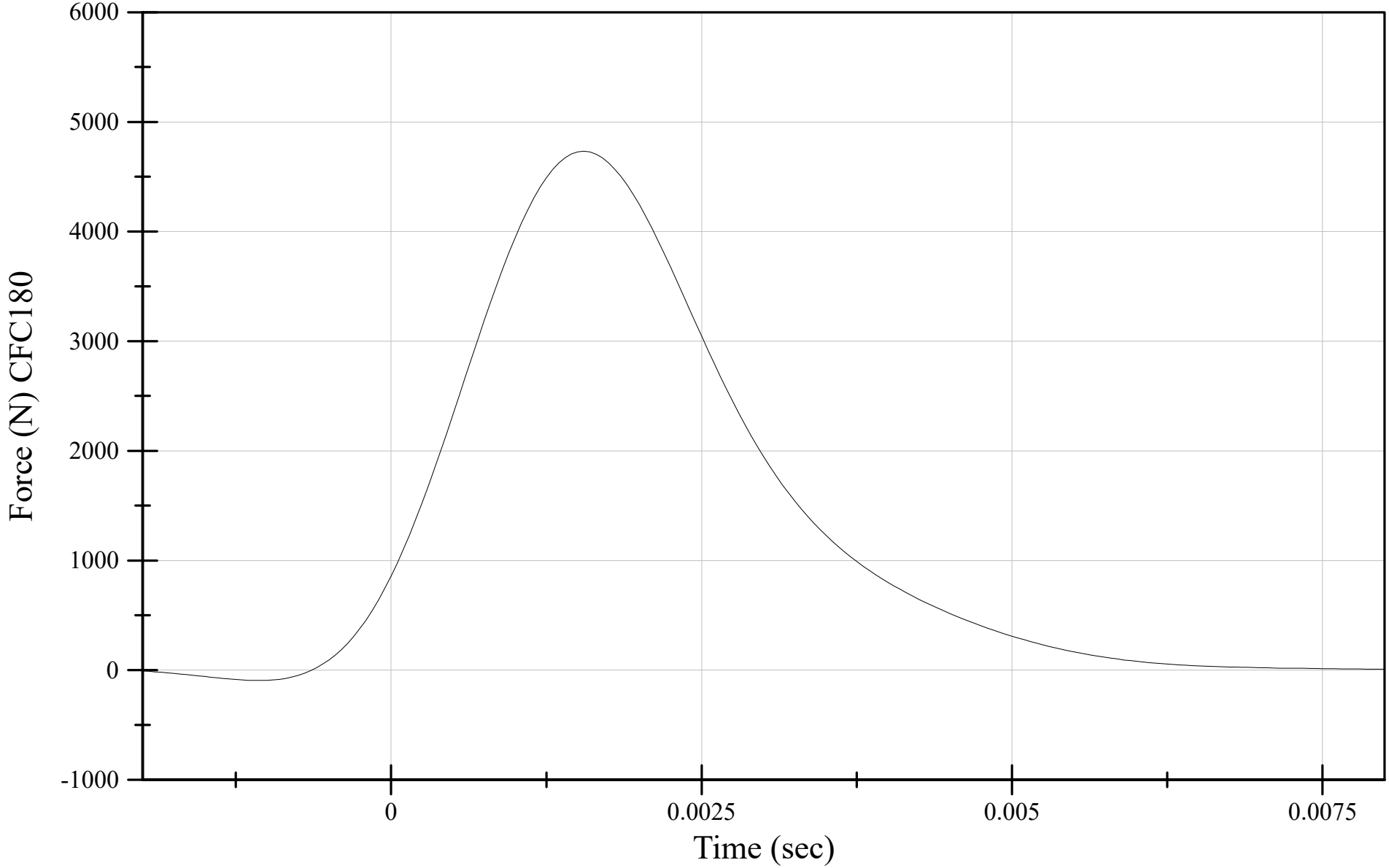
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.5	Pass
Test Humidity (%)	10 - 70	55	Pass
Test Velocity (m/s)	1.95 - 2.05	2.01	Pass
Peak Probe Force (N)		4733	
Peak Head CG Resultant Acceleration (g)		136	

* THOR-05F Qualification Manual - March 2022

File Name: 220614-9 processed
Software Version: 2.8

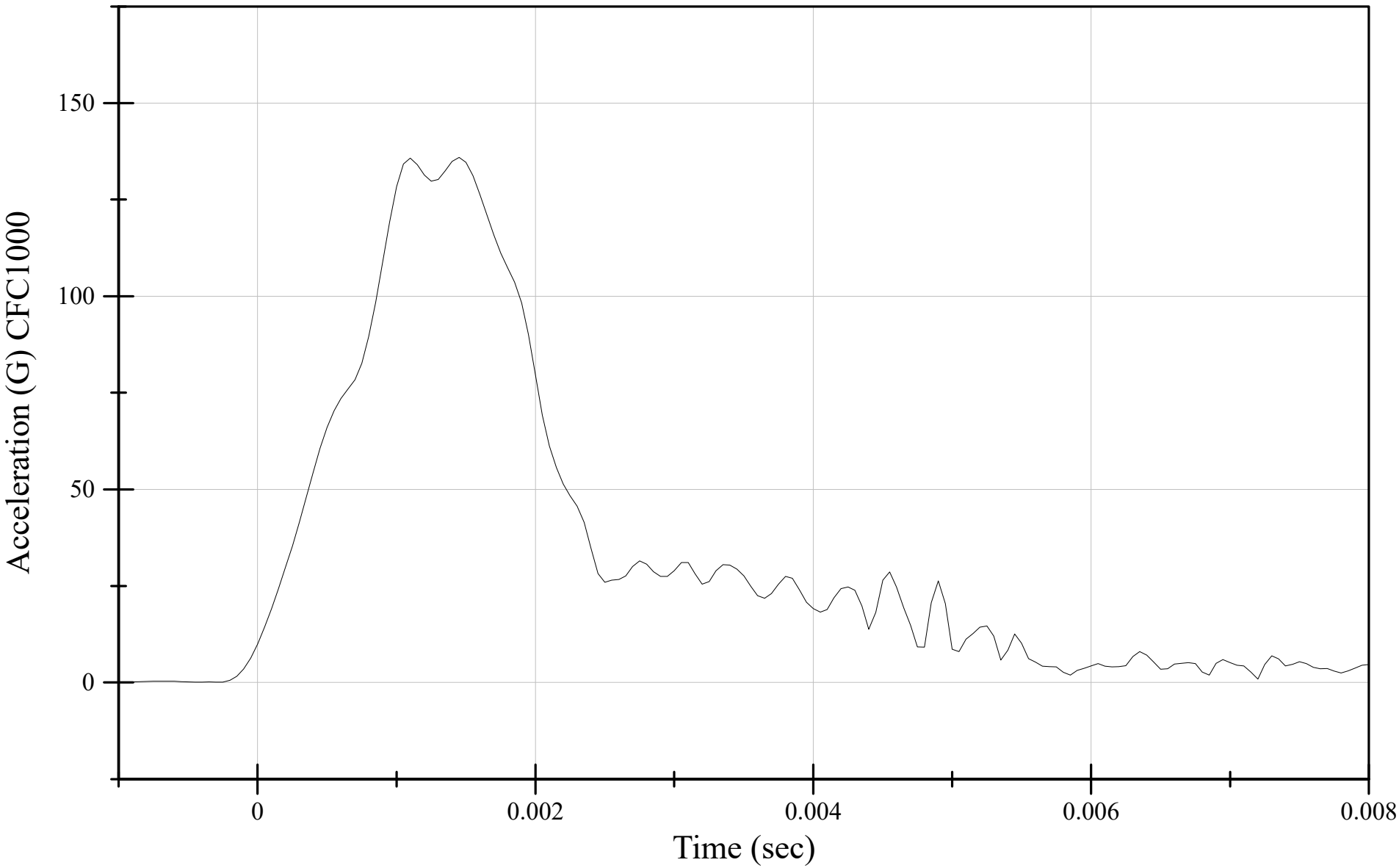
THOR-05F Head Impact Qualification
Probe Force
Dummy Serial Number: EV0674



File Name: 220614-9 processed

6/14/2022 3:53 PM

THOR-05F Head Impact Qualification
Head CG Resultant Acceleration
Dummy Serial Number: EV0674



File Name: 220614-9 processed

6/14/2022 3:53 PM

THOR-05F Face Disk Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components

Head Skin: EV3766

Face Foam: EV0769

Test ID: 220615-2

Test Date: 6/15/2022

Test Time: 8:36 AM

Test Results

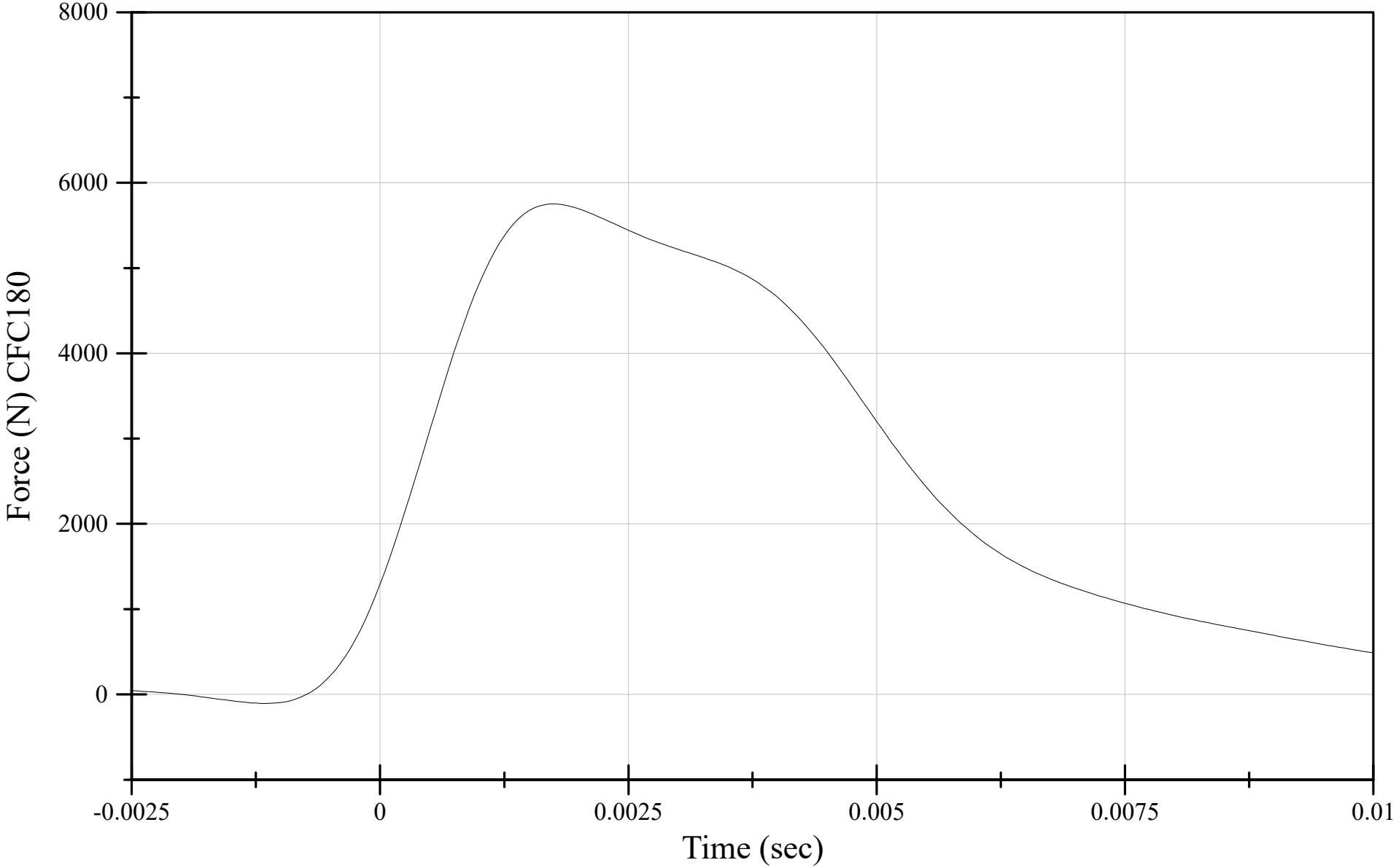
Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.2	Pass
Test Humidity (%)	10 - 70	52	Pass
Test Velocity (m/s)	6.68 - 6.78	6.69	Pass
Peak Probe Force (N)		5753	
Peak Head CG Resultant Acceleration prior to 2 ms (g)		160	
Peak Head CG Resultant Acceleration after to 2 ms (g)		147	

* THOR-05F Qualification Manual - March 2022

File Name: 220615-2 processed

Software Version: 2.8

THOR-05F Face Disk Qualification
Probe Force
Dummy Serial Number: EV0674



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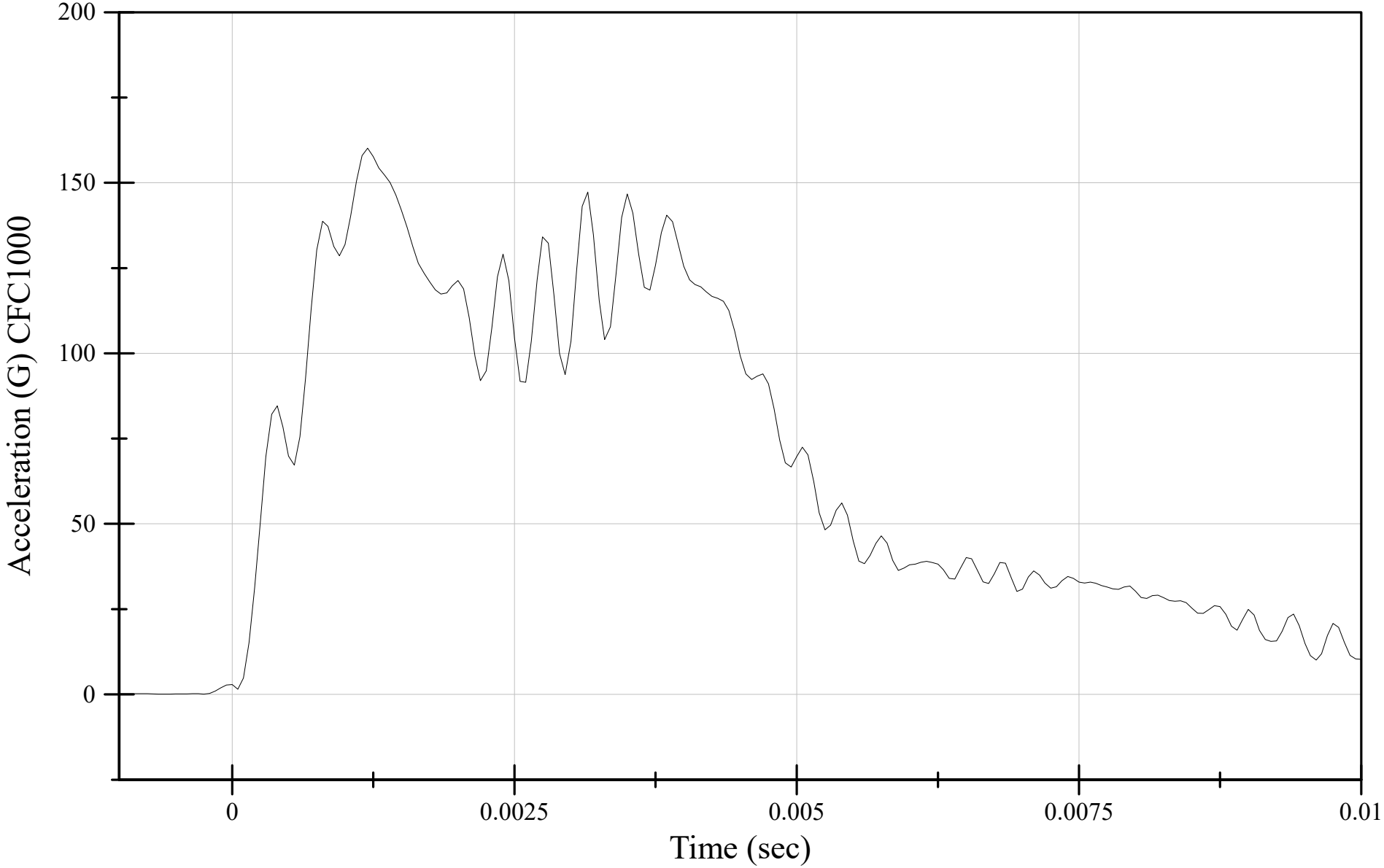
6/15/2022 8:36 AM

THOR-05F Face Disk Qualification
Head CG Resultant Acceleration
Dummy Serial Number: EV0674



File Name: 220615-2 processed

6/15/2022 8:36 AM

THOR-05F Neck Left Torsion Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Neck Serial Number: EV1357
O.C. Stop Assembly Serial Number: DML0002
O.C. Cam Serial Number: DML0003

Test ID: 220607-8
Test Date: 6/7/2022
Test Time: 10:55 AM

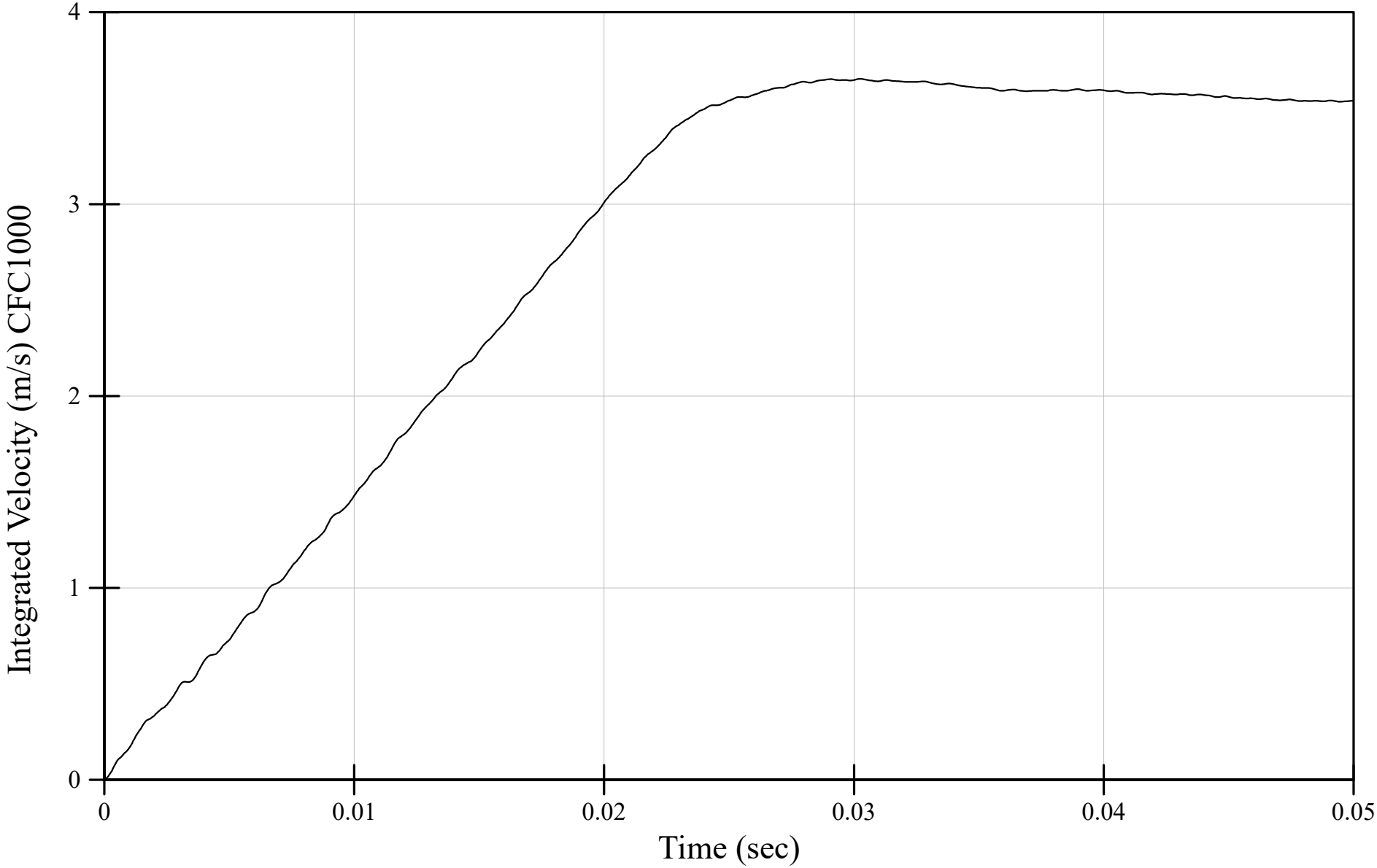
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.4	Pass
Test Humidity (%)	10 - 70	67	Pass
Test Velocity (m/s)	3.35 - 3.45	3.40	Pass
Pendulum Velocity at 10 ms (m/s)		1.03	
Pendulum Velocity at 15 ms (m/s)		2.11	
Pendulum Velocity at 20 ms (m/s)		3.15	
Peak Upper Neck Mz (Nm)		20.3	
Peak Neck Fixture Rotation (deg)		-51.4	
Peak Upper Neck Angular Velocity Z (deg/sec)		-1291.3	

* THOR-05F Qualification Manual - March 2022

File Name: 220607-8 processed
Software Version: 2.8

THOR-05F Neck Left Torsion Qualification
Pendulum Pulse
Neck Serial Number: EV1357



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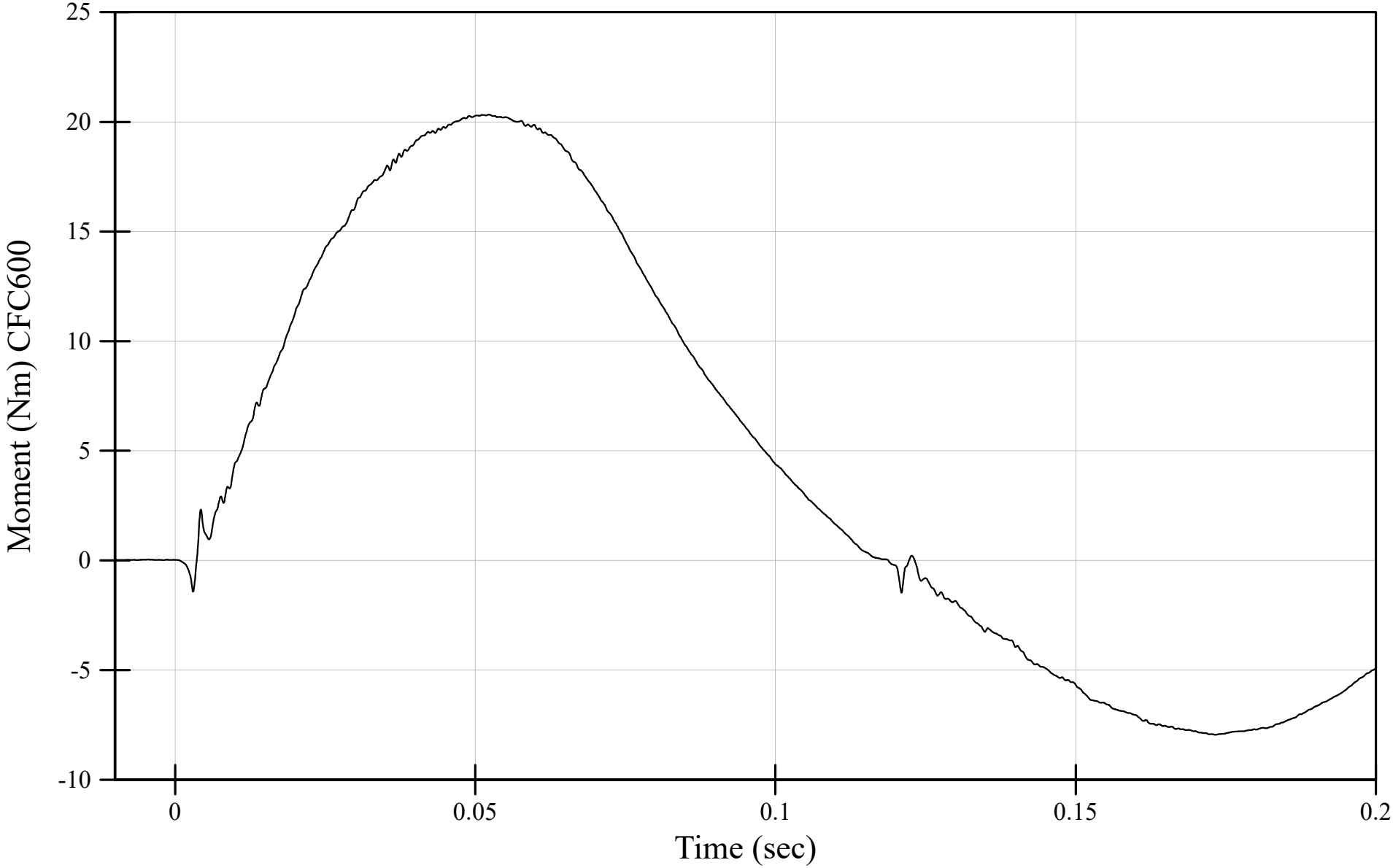
6/7/2022 10:55 AM

THOR-05F Neck Left Torsion Qualification
Z-Moment as Measured
Neck Serial Number: EV1357



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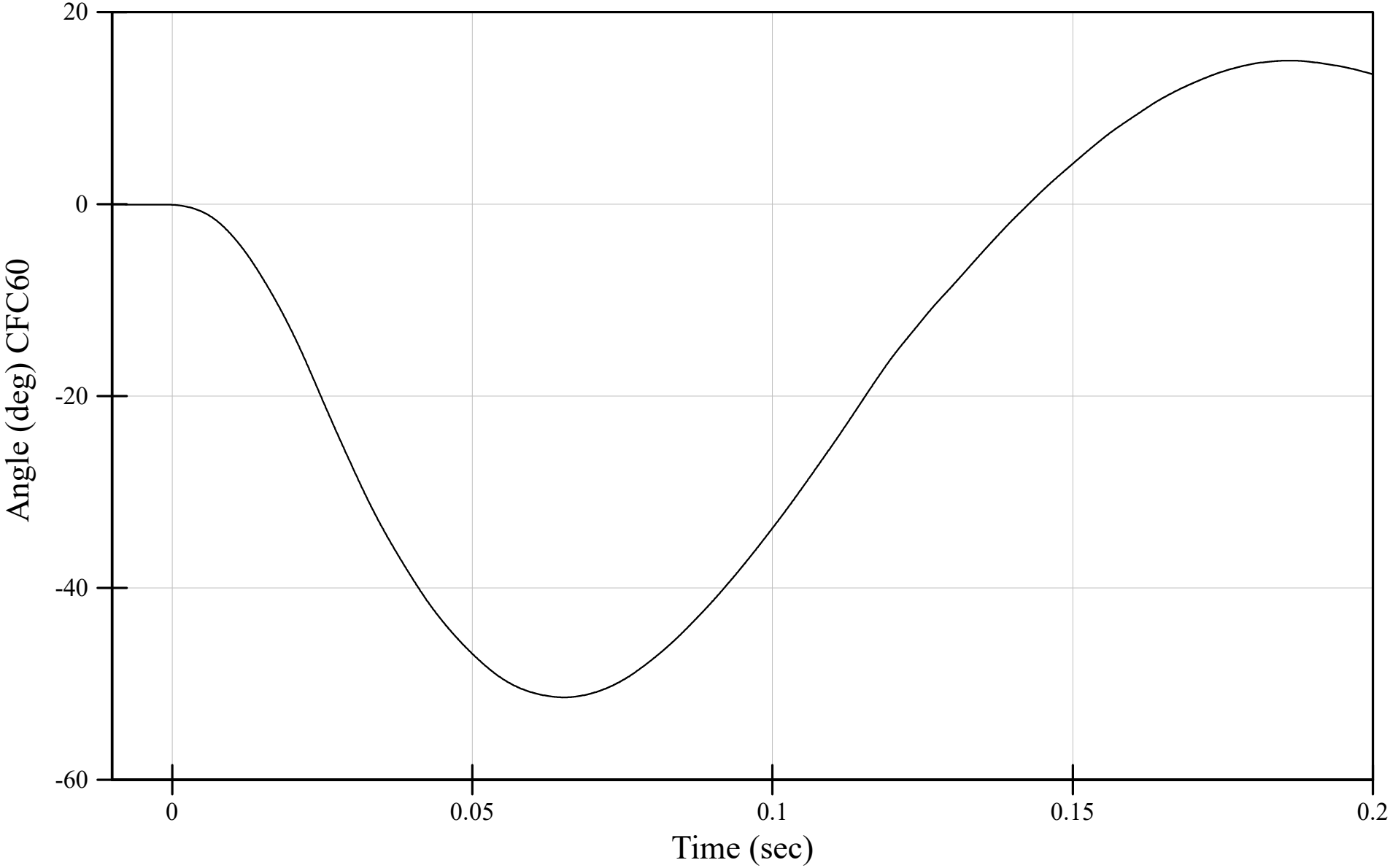
6/7/2022 10:55 AM

THOR-05F Neck Left Torsion Qualification
Neck Fixture Rotation
Neck Serial Number: EV1357



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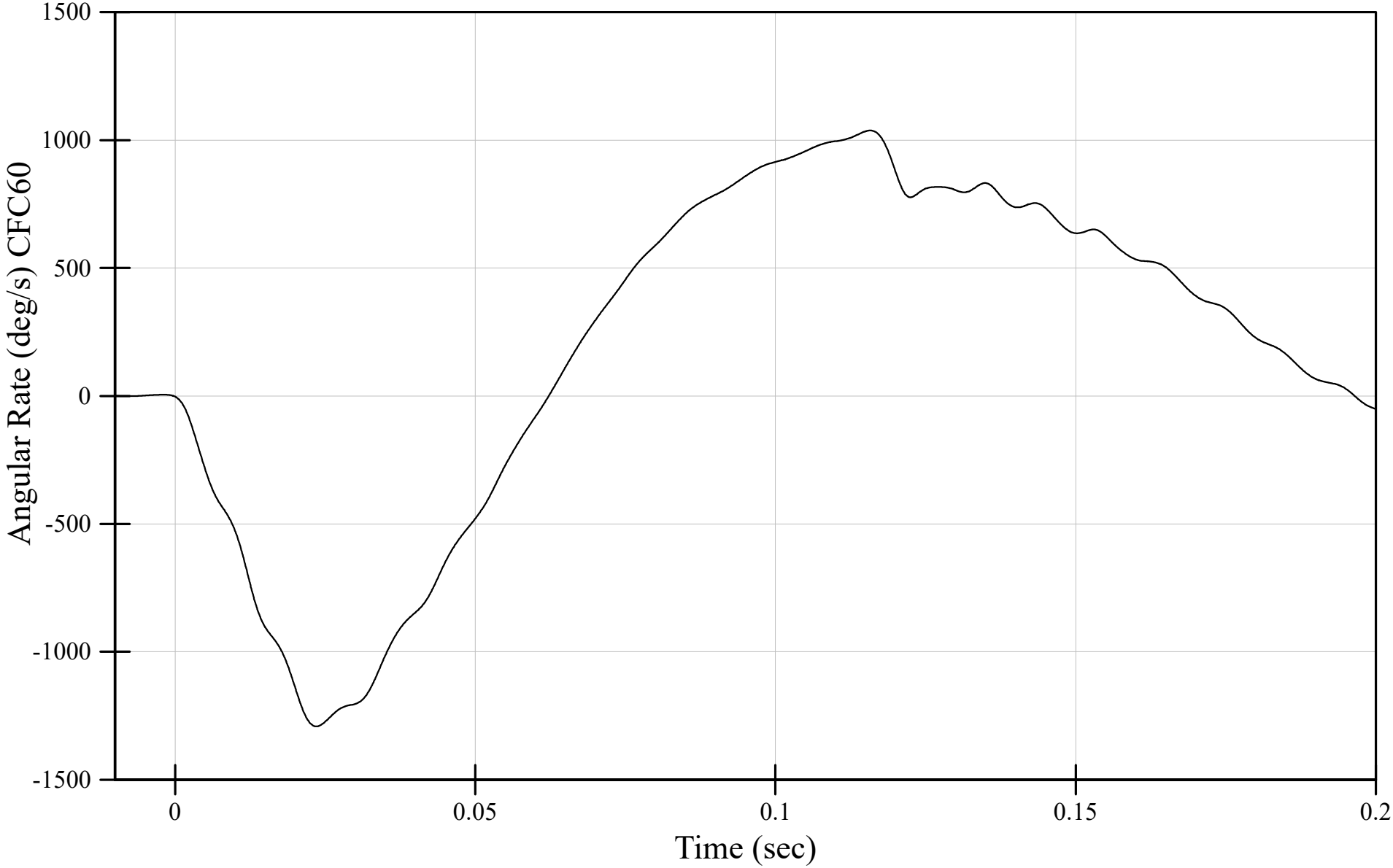
6/7/2022 10:55 AM

THOR-05F Neck Left Torsion Qualification
Peak Angular Rate
Neck Serial Number: EV1357



File Name: 220607-8 processed

6/7/2022 10:55 AM

THOR-05F Neck Right Torsion Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Neck Serial Number: EV1357
O.C. Stop Assembly: DML0002
O.C. Cam: DML0003

Test ID: 220607-5
Test Date: 6/7/2022
Test Time: 10:10 AM

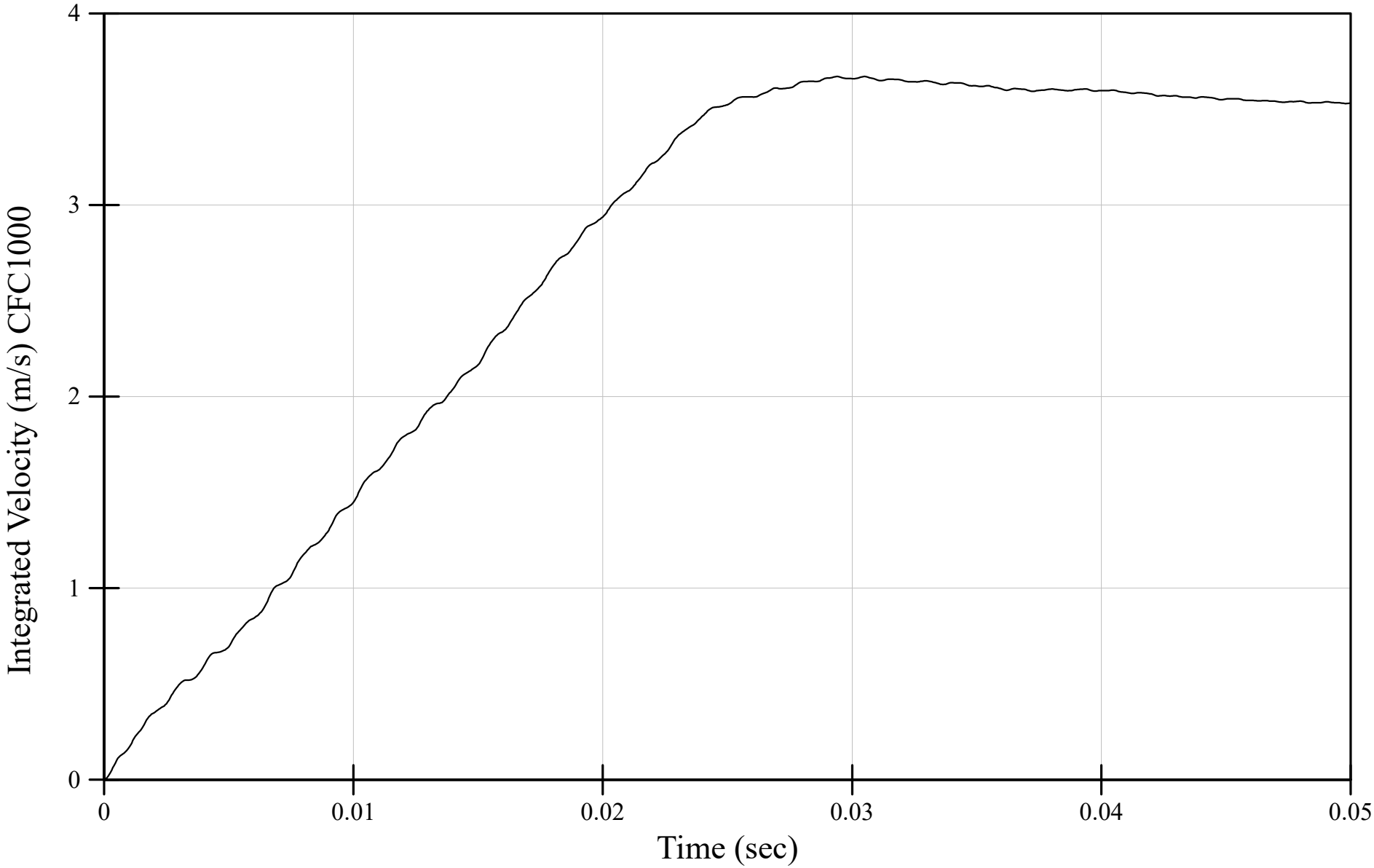
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	20.8	Pass
Test Humidity (%)	10 - 70	68	Pass
Test Velocity (m/s)	3.35 - 3.45	3.40	Pass
Pendulum Velocity at 7 ms (m/s)		1.02	
Pendulum Velocity at 14 ms (m/s)		2.04	
Pendulum Velocity at 21 ms (m/s)		3.07	
Peak Upper Neck Mz (Nm)		-20.6	
Peak Neck Fixture Rotation (deg)		50.9	
Peak Upper Neck Angular Velocity Z (deg/sec)		1274.1	

* THOR-05F Qualification Manual - March 2022

File Name: 220607-5 processed
Software Version: 2.8

THOR-05F Neck Right Torsion Qualification
Pendulum Pulse
Neck Serial Number: EV1357



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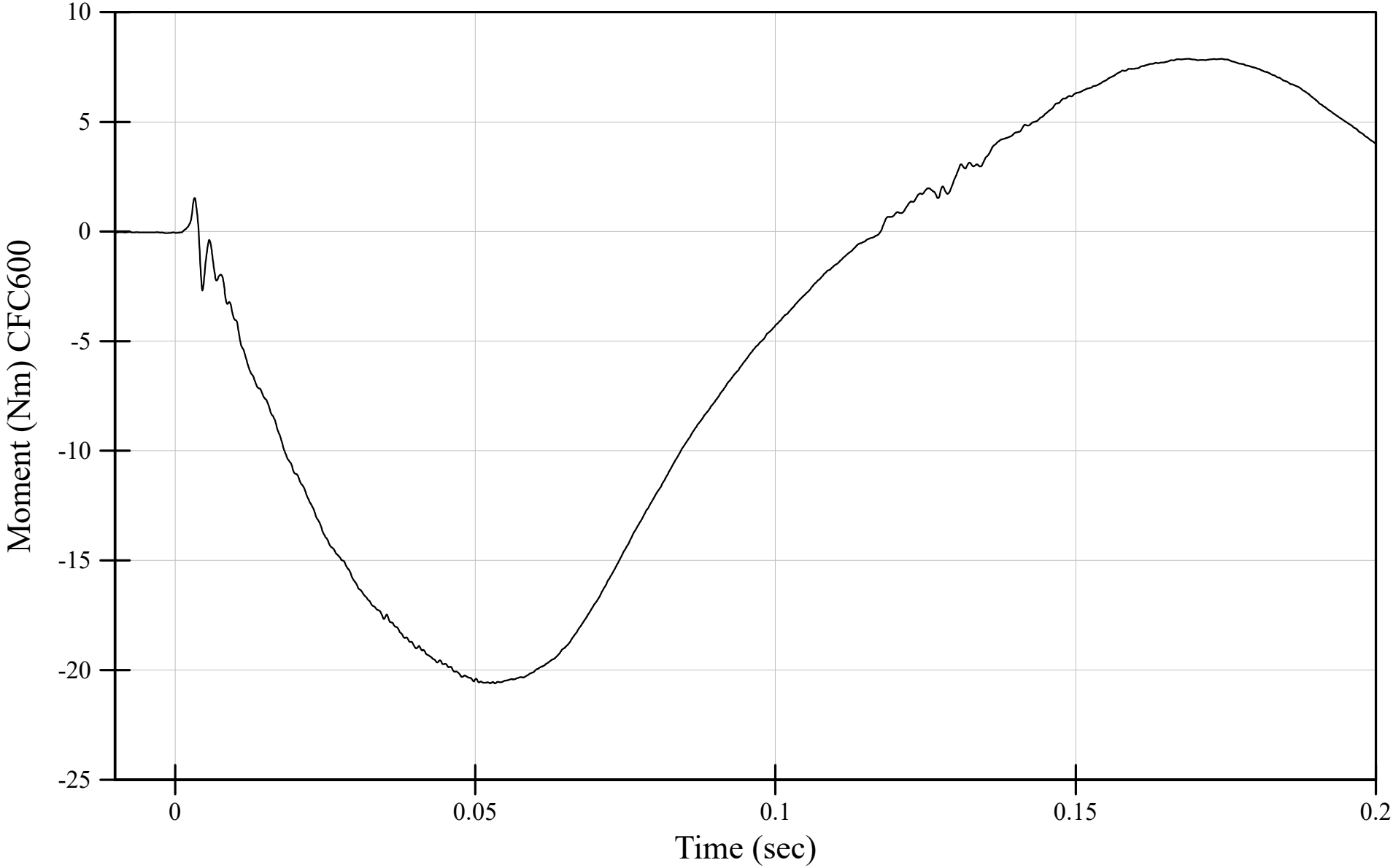
THOR-05F Neck Right Torsion Qualification
Z-Moment as Measured
Neck Serial Number: EV1357



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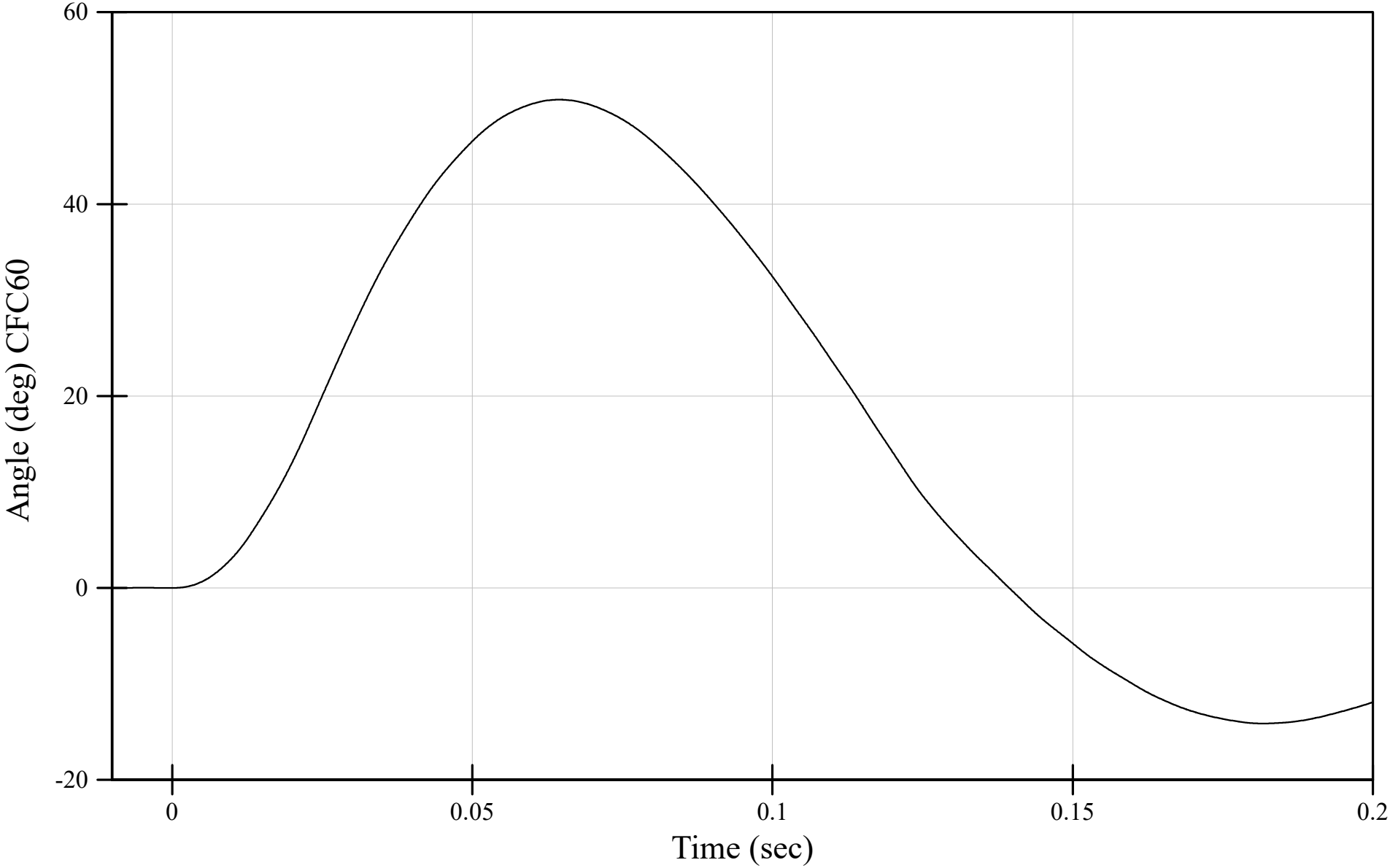
THOR-05F Neck Right Torsion Qualification
Neck Fixture Rotation
Neck Serial Number: EV1357



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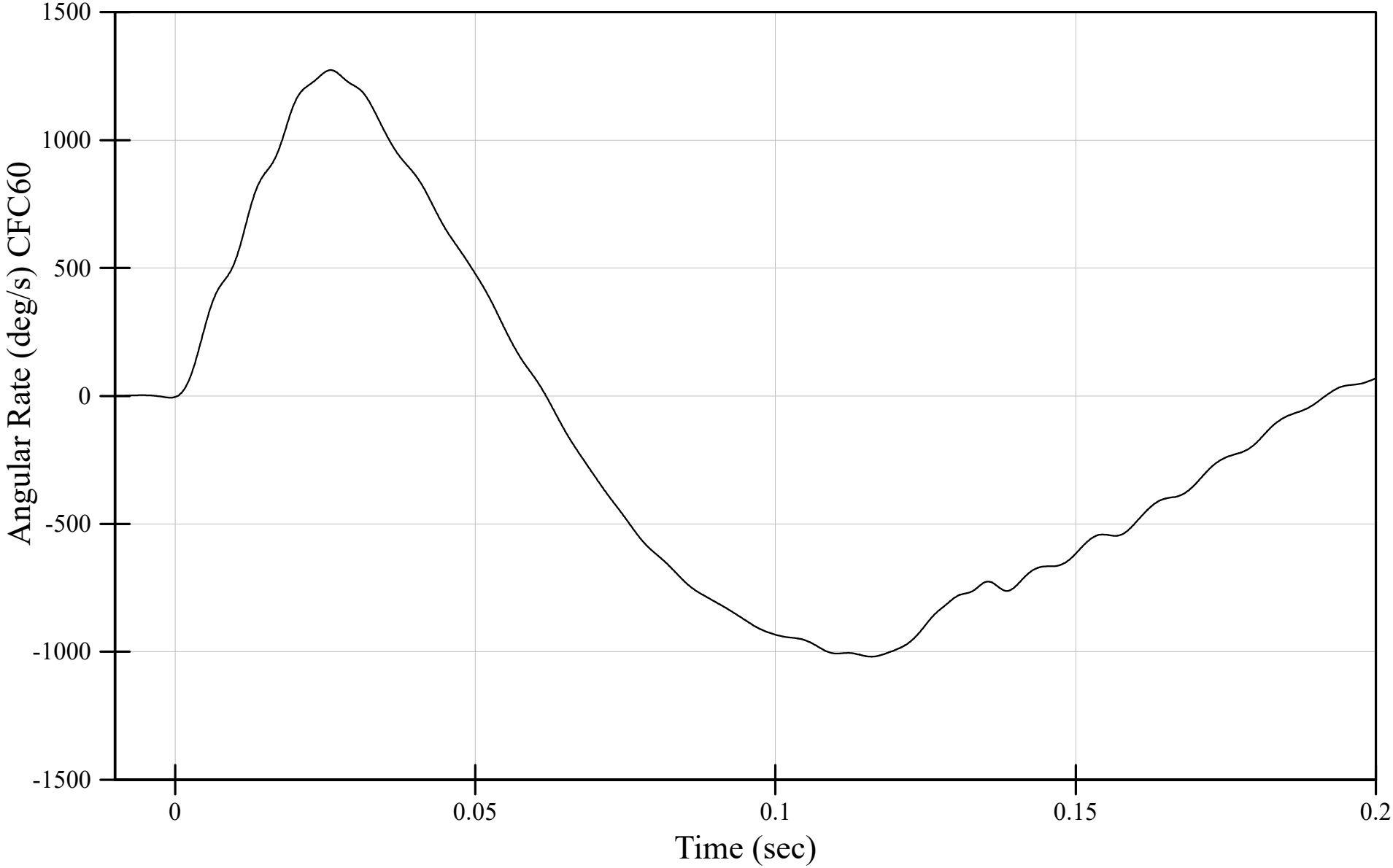
THOR-05F Neck Right Torsion Qualification
Peak Angular Rate
Neck Serial Number: EV1357



File Name: 220607-5 processed

6/7/2022 10:10 AM

THOR-05F Neck Front Flexion Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Neck Serial Number: EV1357
O.C. Stop Assembly: DML00002
O.C. Cam: DML00003

Test ID: 220608-1
Test Date: 6/8/2022
Test Time: 6:54 AM

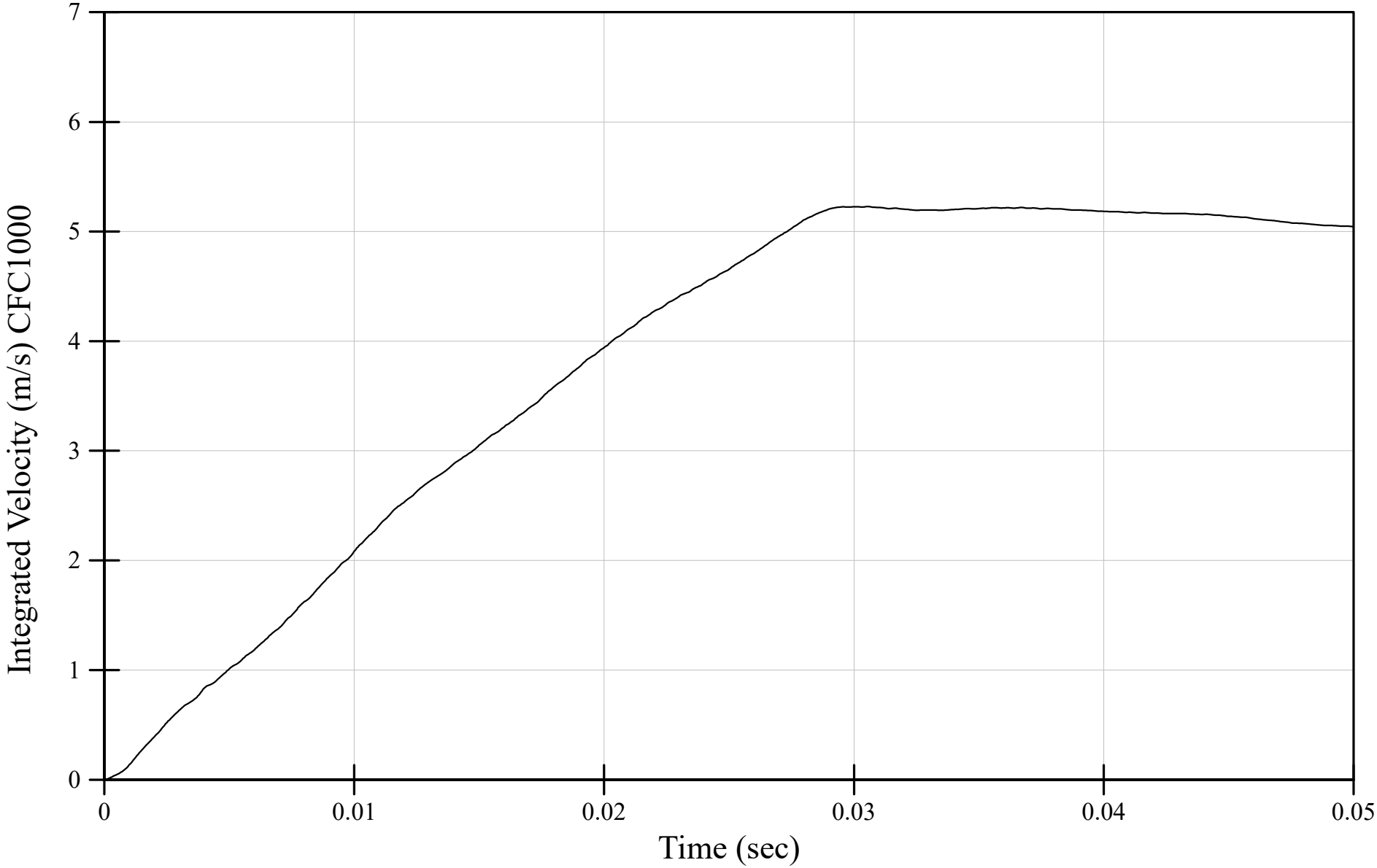
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	20.9	Pass
Test Humidity (%)	10 - 70	53	Pass
Test Velocity (m/s)	4.95 - 5.05	4.99	Pass
Pendulum Velocity at 8 ms (m/s)		1.62	
Pendulum Velocity at 16 ms (m/s)		3.22	
Pendulum Velocity at 24 ms (m/s)		4.53	
Peak Upper Neck My (Nm)		21.2	
Peak Upper Neck Fz prior to 40 ms (N)		761	
Peak Head Angular Velocity Y (deg/sec)		-22998	
Peak Head Rotation (deg)		-690.1	

* THOR-05F Qualification Manual - March 2022

File Name: 220608-1 processed
Software Version: 2.8

THOR-05F Neck Flexion Qualification
Pendulum Pulse
Neck Serial Number: EV1357



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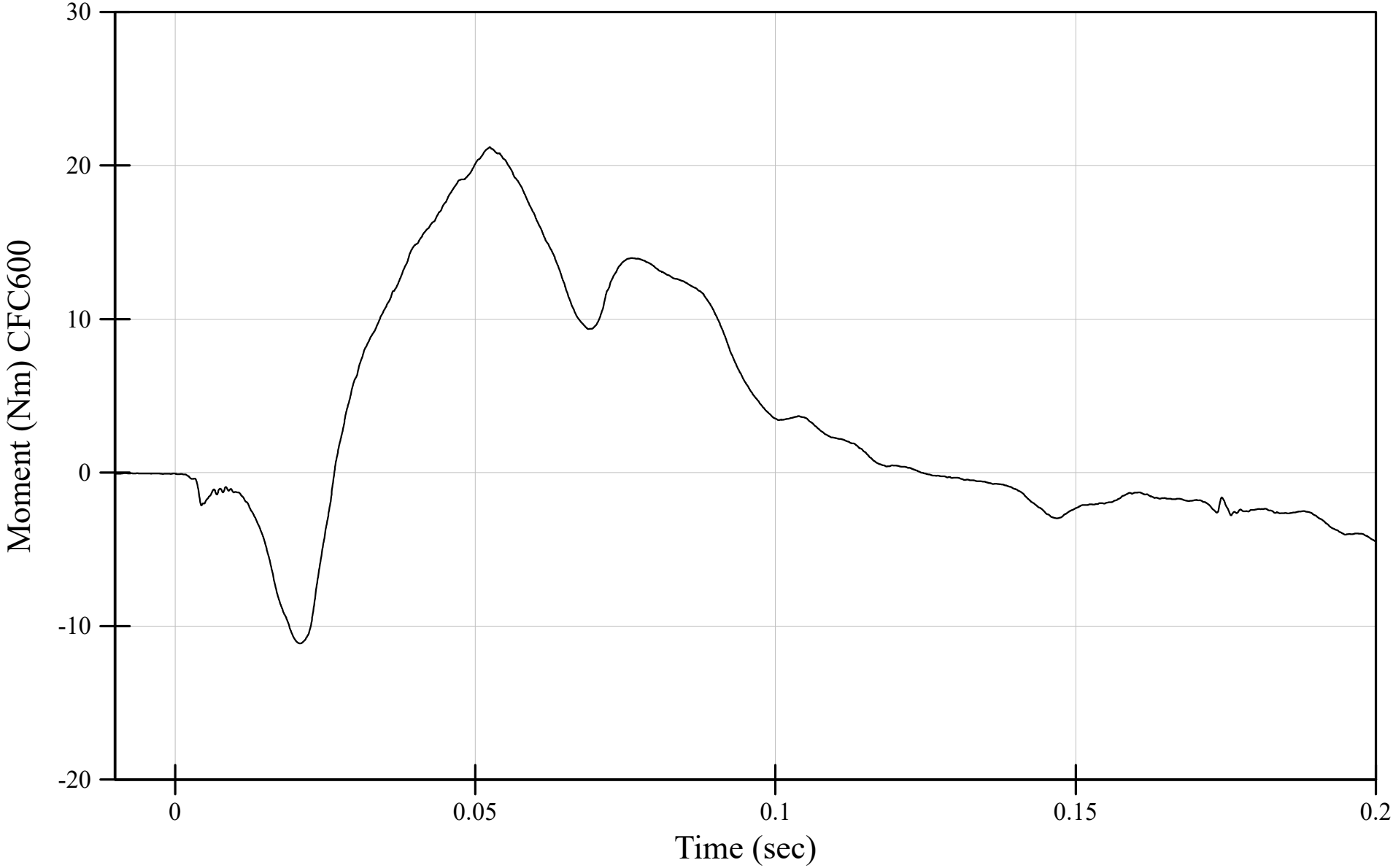
THOR-05F Neck Flexion Qualification
Y-Moment as Measured
Neck Serial Number: EV1357



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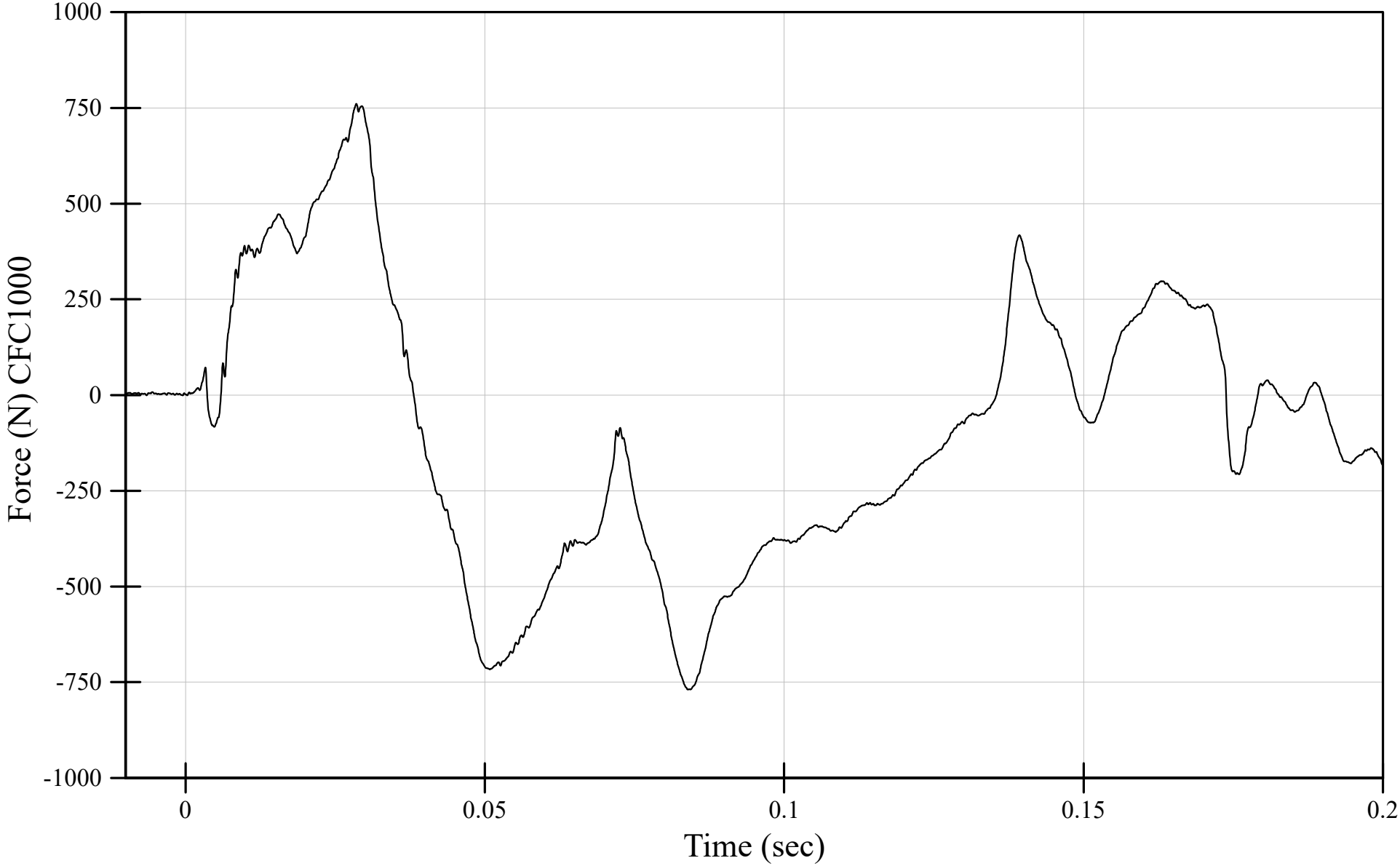
THOR-05F Neck Flexion Qualification
Z-Force as Measured
Neck Serial Number: EV1357



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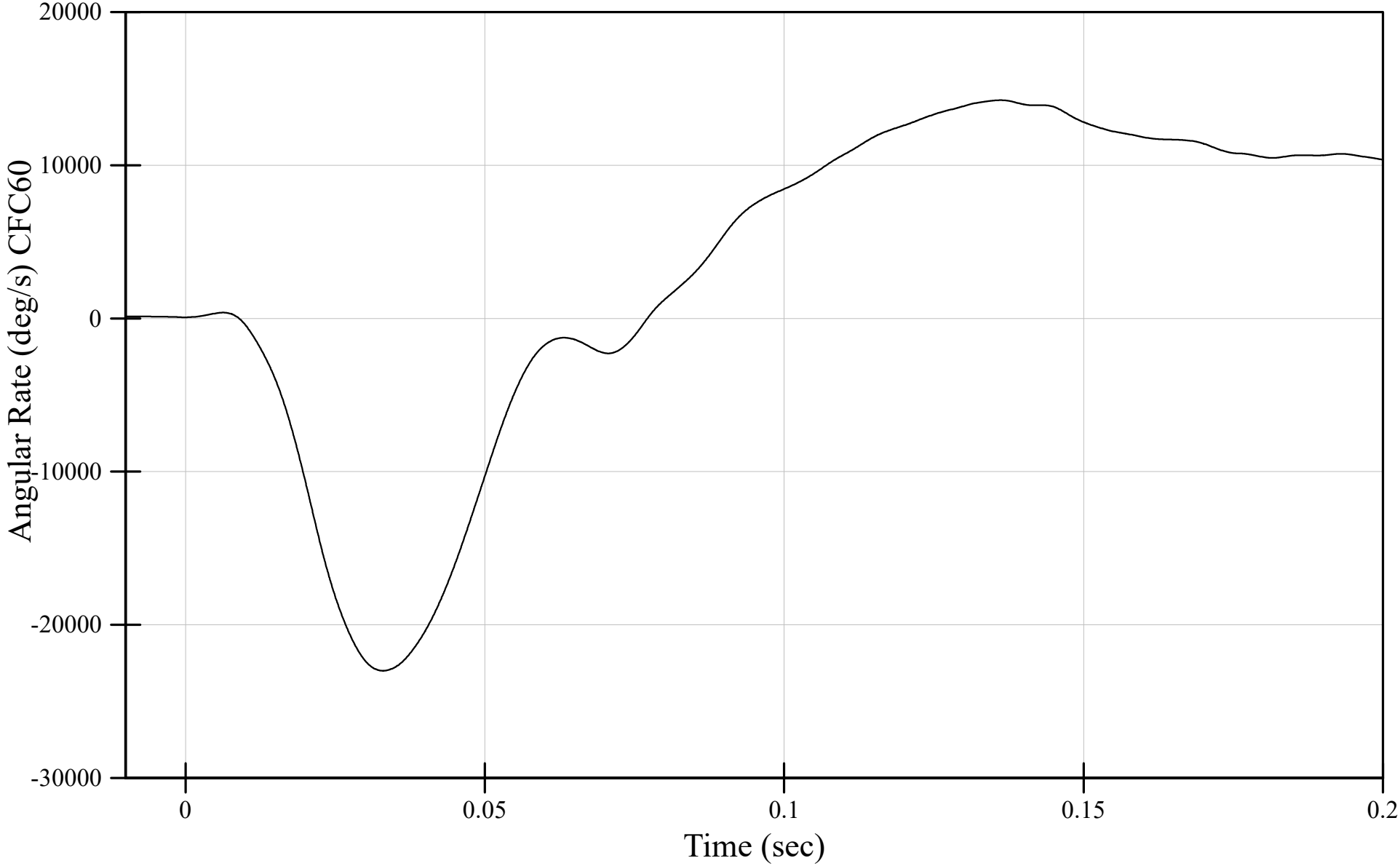
6/8/2022 6:54 AM

THOR-05F Neck Flexion Qualification
Peak Angular Rate
Neck Serial Number: EV1357



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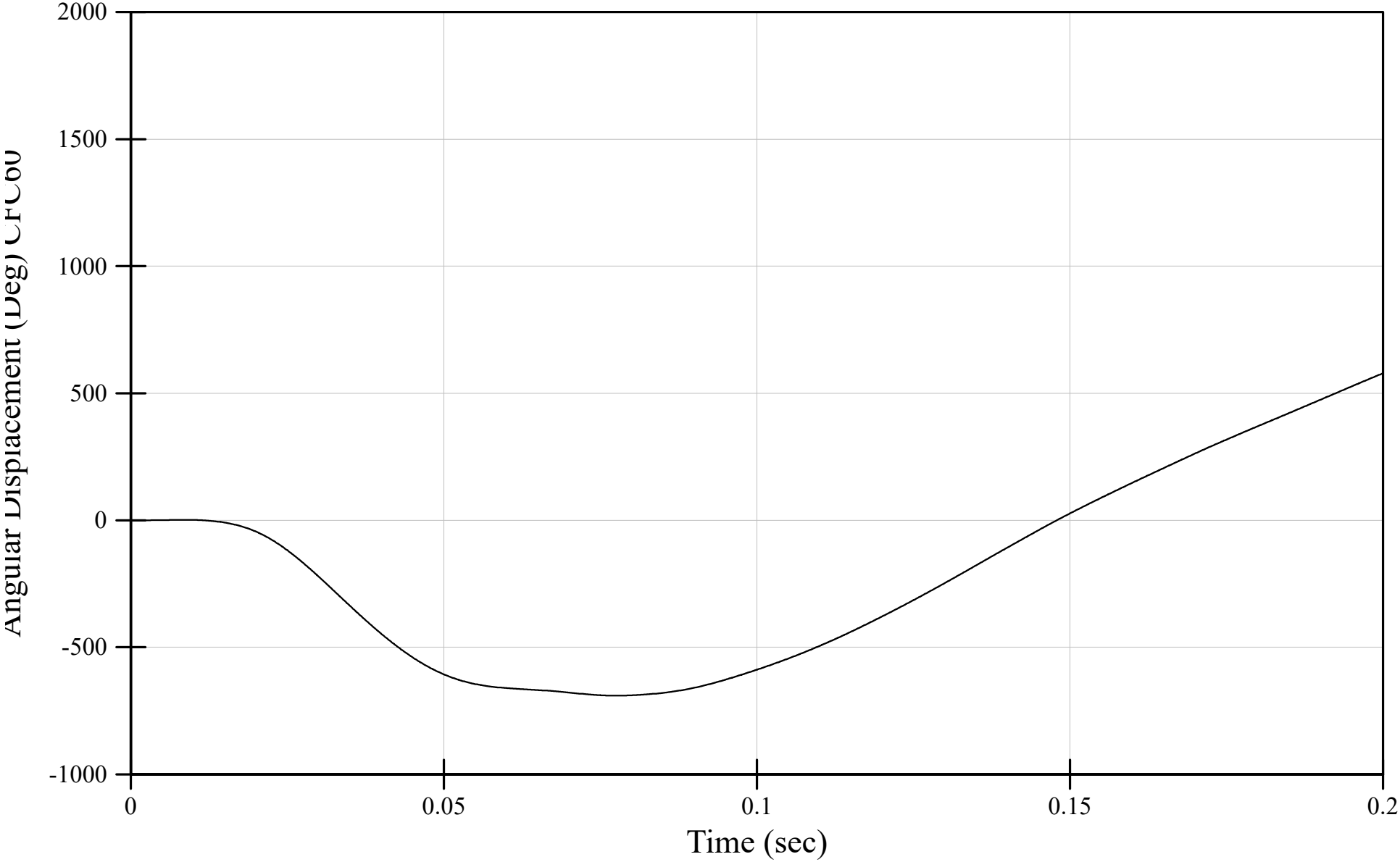
6/8/2022 6:54 AM

THOR-05F Neck Flexion Qualification
Neck Rotation
Neck Serial Number: EV1357



File Name: 220608-1 processed

6/8/2022 6:54 AM

THOR-05F Neck Extension Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components	Test ID: 220608-9
Neck Serial Number: EV1357	Test Date: 6/8/2022
O.C. Stop Assembly: DML00002	Test Time: 12:46 PM
O.C. Cam: DML00003	

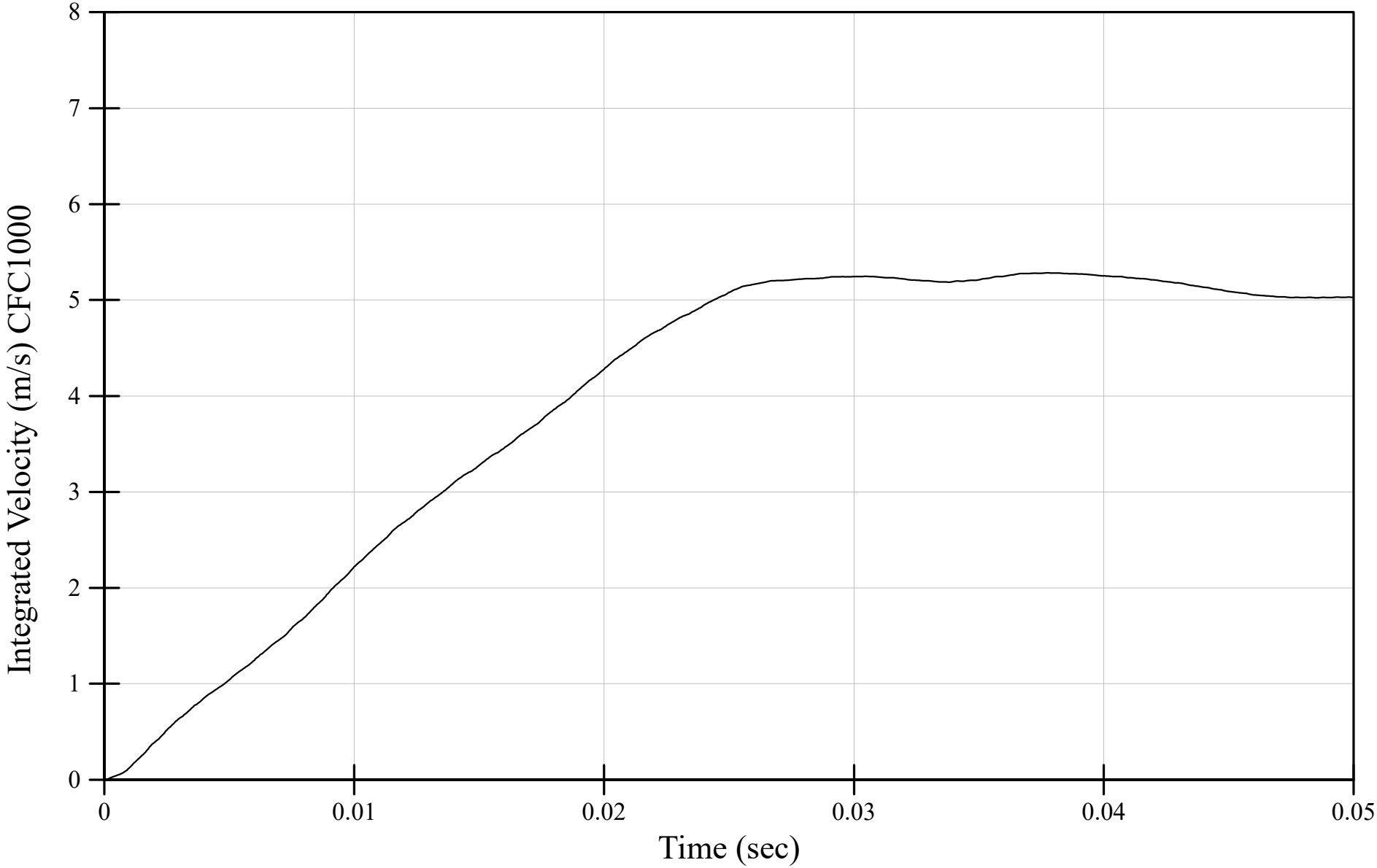
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.7	Pass
Test Humidity (%)	10 - 70	57	Pass
Test Velocity (m/s)	4.95 - 5.05	5.00	Pass
Pendulum Velocity at 8 ms (m/s)		1.69	
Pendulum Velocity at 16 ms (m/s)		3.46	
Pendulum Velocity at 24 ms (m/s)		4.95	
Peak Upper Neck My (Nm)		-16.9	
Peak Upper Neck Fz (N)		-1649	
Peak Head Angular Velocity Y (deg/sec)		2433	
Peak Head Rotation (deg)		84.9	

* THOR-05F Qualification Manual - March 2022

File Name: 220608-9 processed

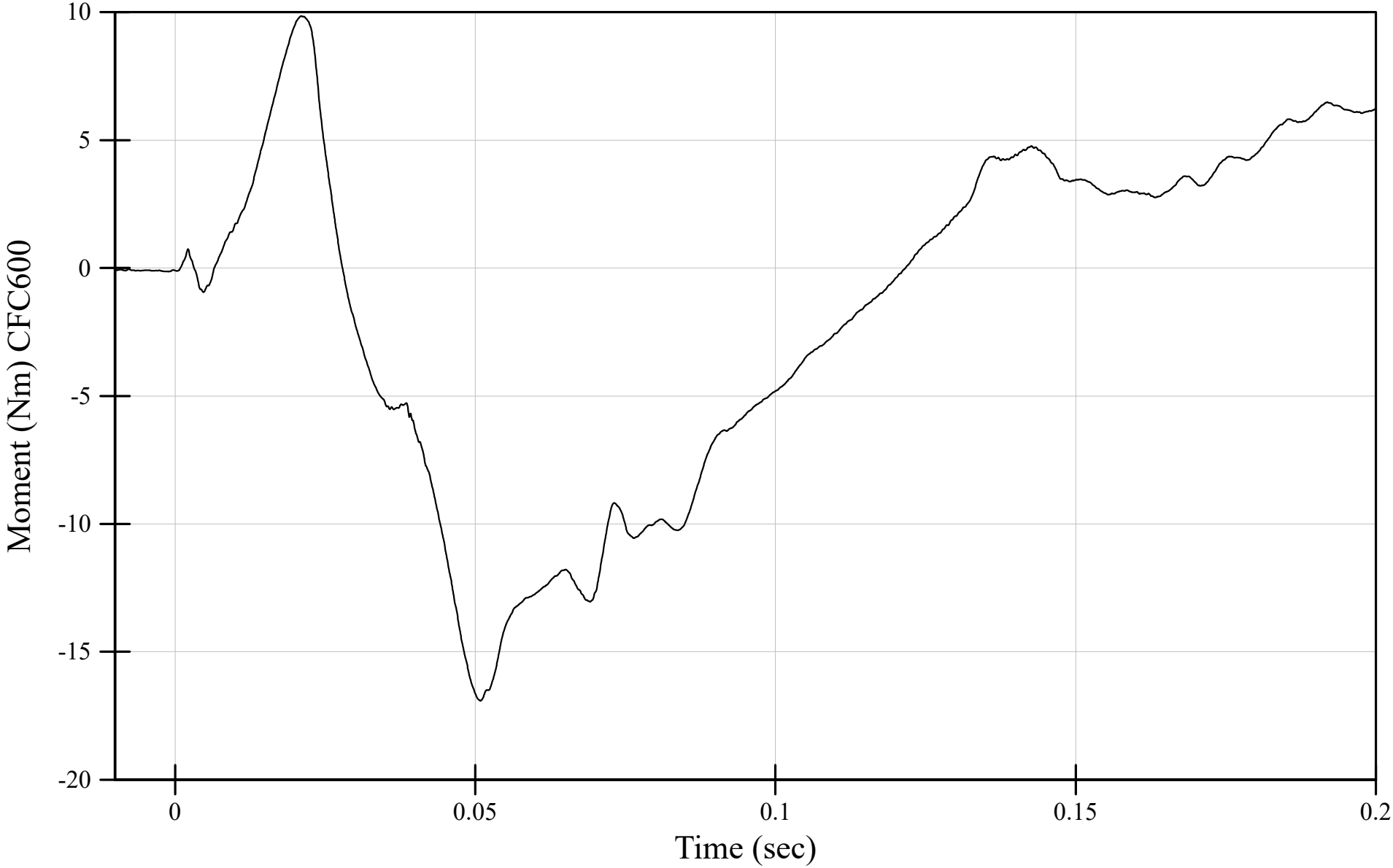
THOR-05F Neck Extension Qualification
Probe Acceleration
Neck Serial Number: EV1357



File Name: 220608-9 processed

6/8/2022 12:46 PM

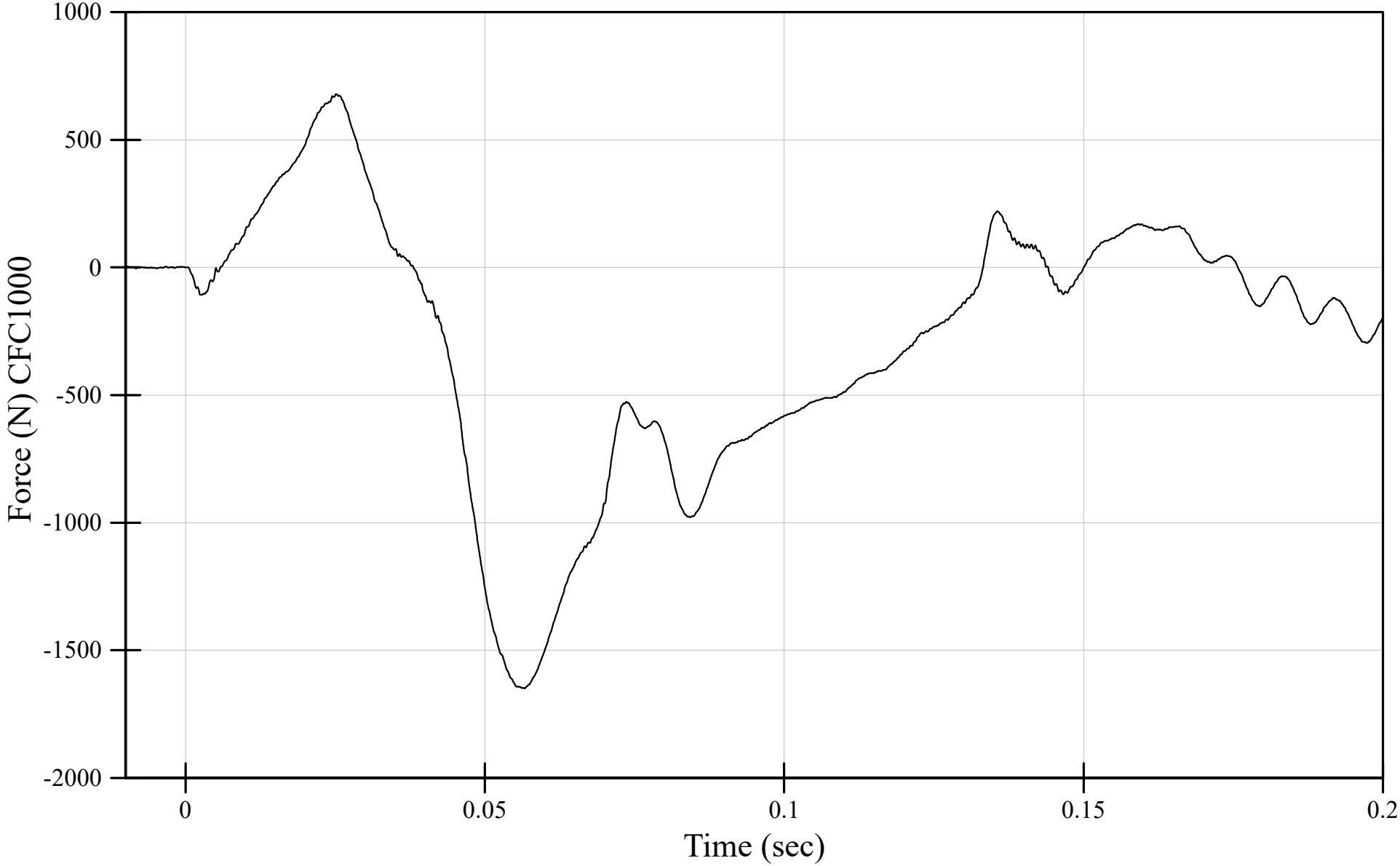
THOR-05F Neck Extension Qualification
Y-Moment as Measured
Neck Serial Number: EV1357



File Name: 220608-9 processed

6/8/2022 12:46 PM

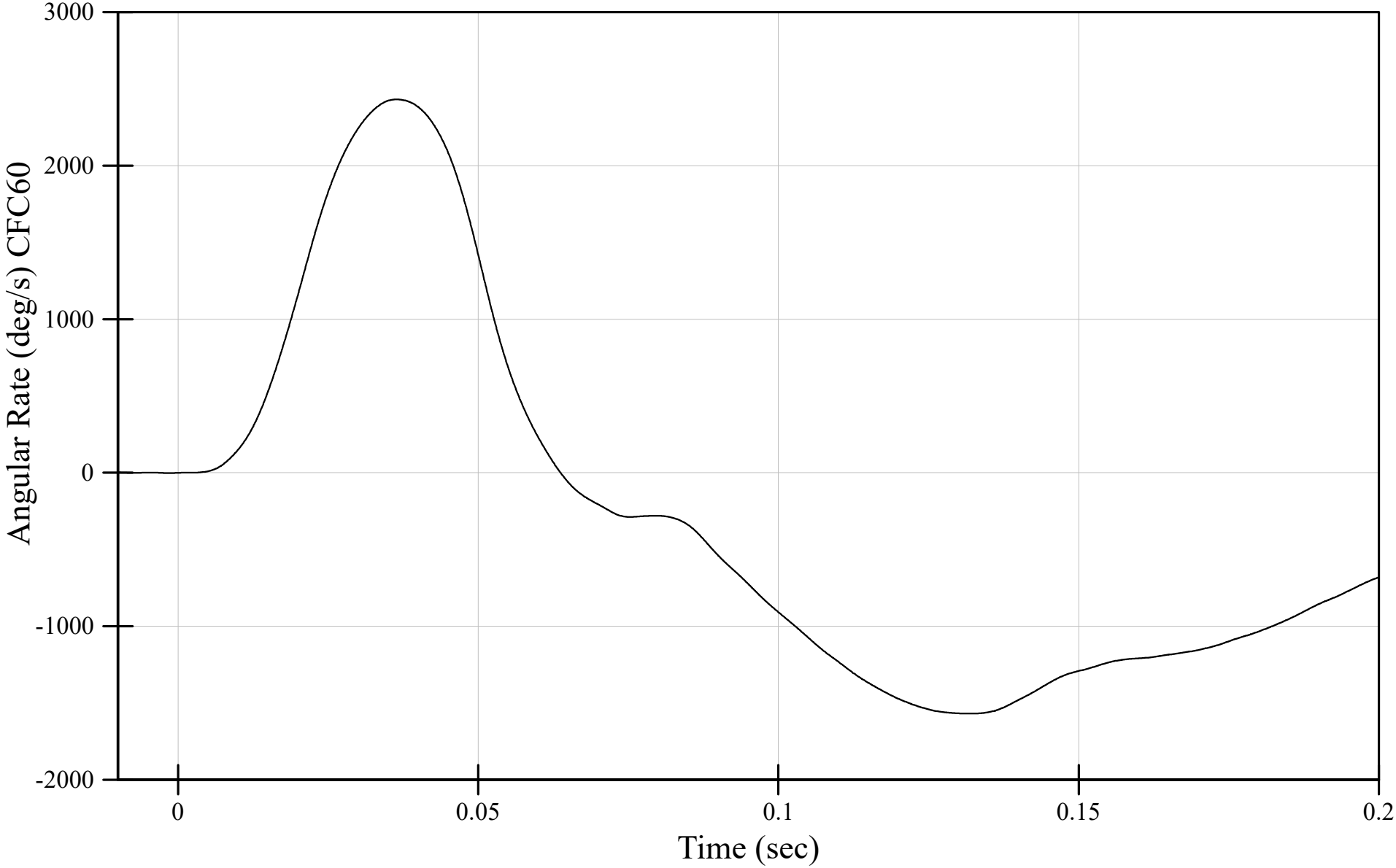
THOR-05F Neck Extension Qualification
Z-Force as Measured
Neck Serial Number: EV1357



File Name: 220608-9 processed

6/8/2022 12:46 PM

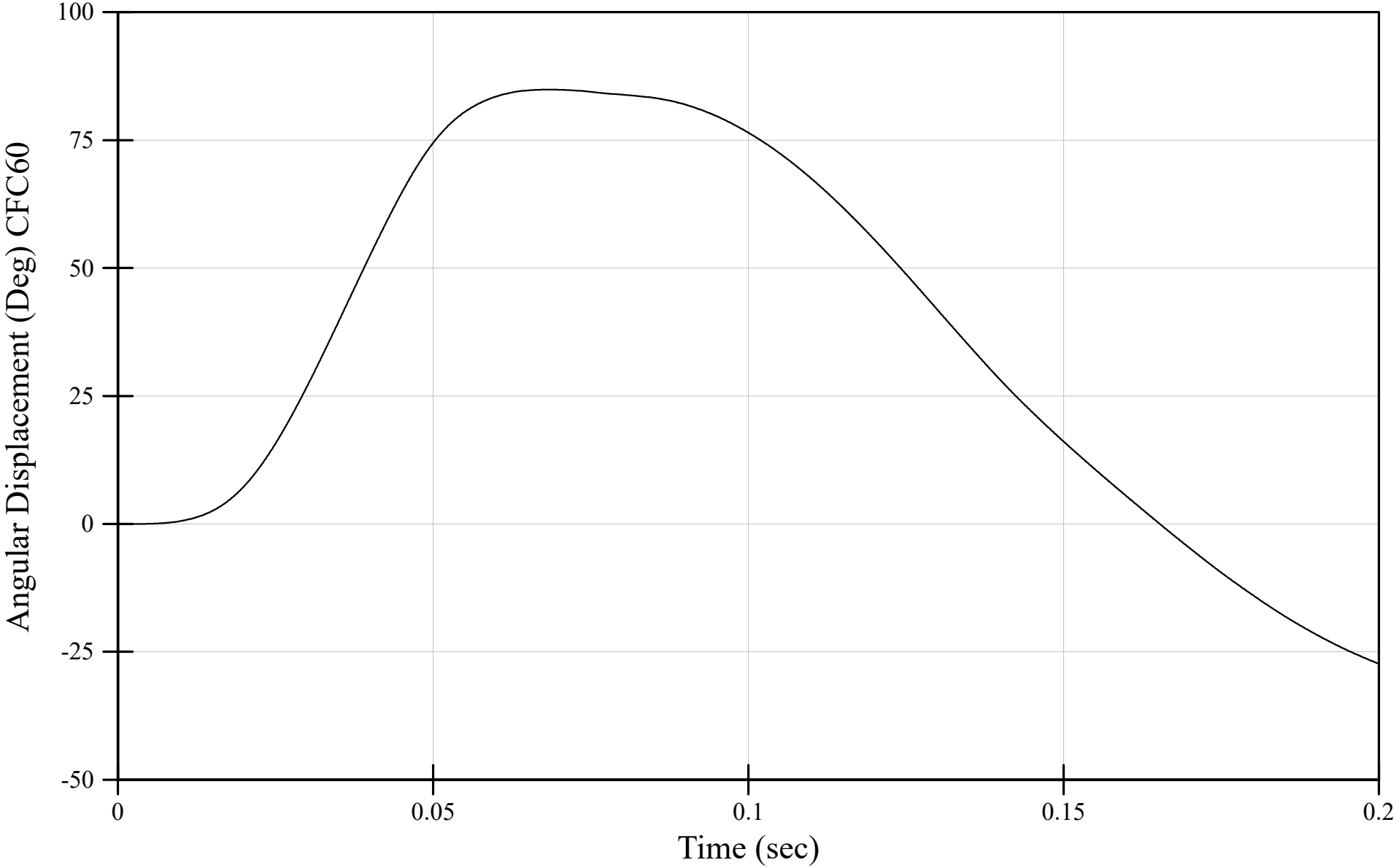
THOR-05F Neck Extension Qualification
Peak Head Angular Rate
Neck Serial Number: EV1357



File Name: 220608-9 processed

6/8/2022 12:46 PM

THOR-05F Neck Extension Qualification
Neck Rotation
Neck Serial Number: EV1357



File Name: 220608-9 processed

6/8/2022 12:46 PM

THOR-05F Neck Left Lateral Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Neck Serial Number: EV1357
O.C. Stop Assembly Serial Number: DML00002
O.C. Cam Serial Number: DML00003

Test ID: 220608-13
Test Date: 6/8/2022
Test Time: 3:46 PM

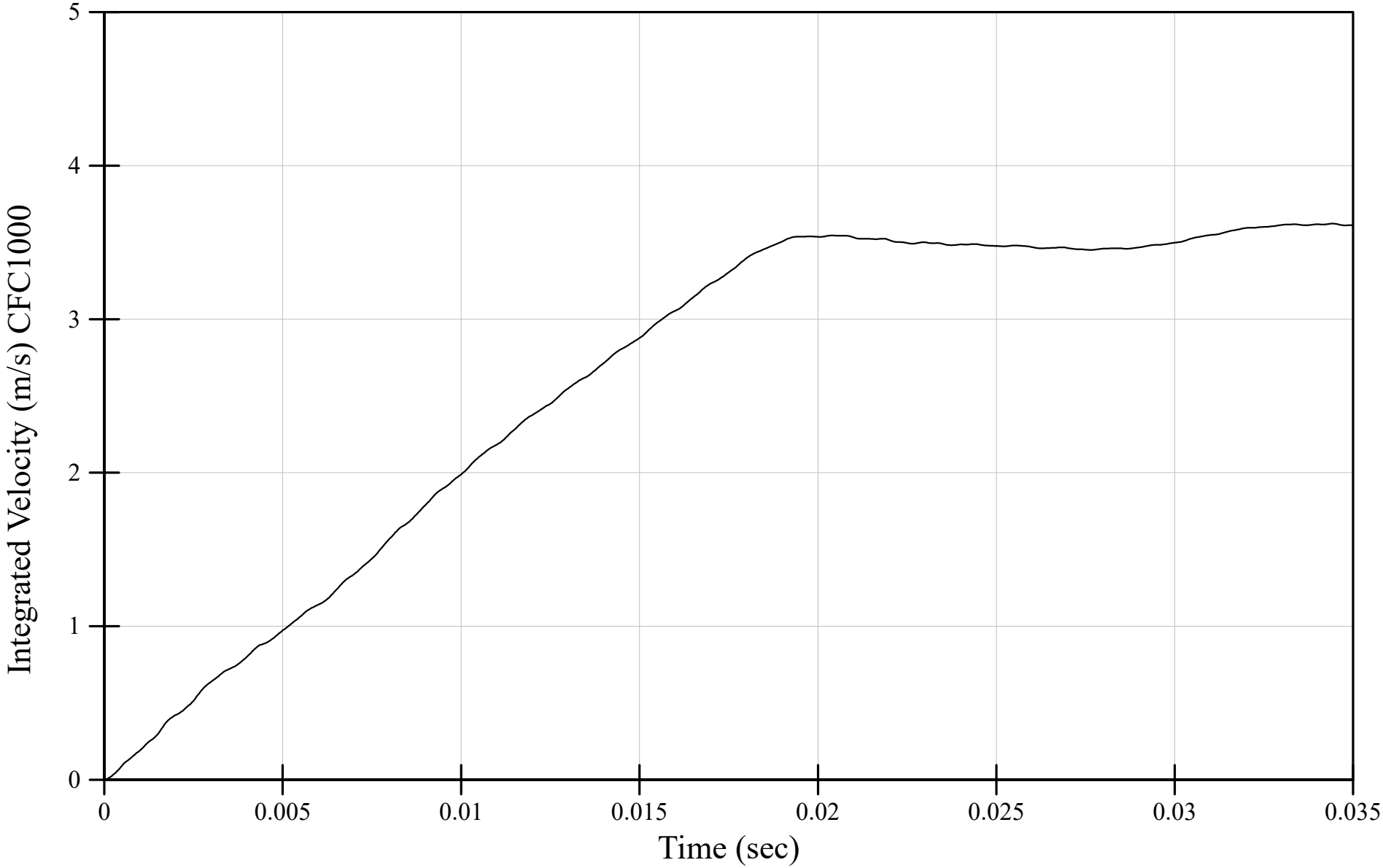
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.0	Pass
Test Humidity (%)	10 - 70	62	Pass
Test Velocity (m/s)	3.35 - 3.45	3.39	Pass
Pendulum Velocity at 5 ms (m/s)		0.97	
Pendulum Velocity at 10 ms (m/s)		1.99	
Pendulum Velocity at 15 ms (m/s)		2.88	
Peak Upper Neck Mx after 40 ms (N)		28.9	
Peak Head Angular Velocity X (deg/sec)		-1330.3	
Peak Head Rotation (deg)		-51.3	

* THOR-05F Qualification Manual - March 2022

File Name: 220608-13 processed
Software Version: 2.8

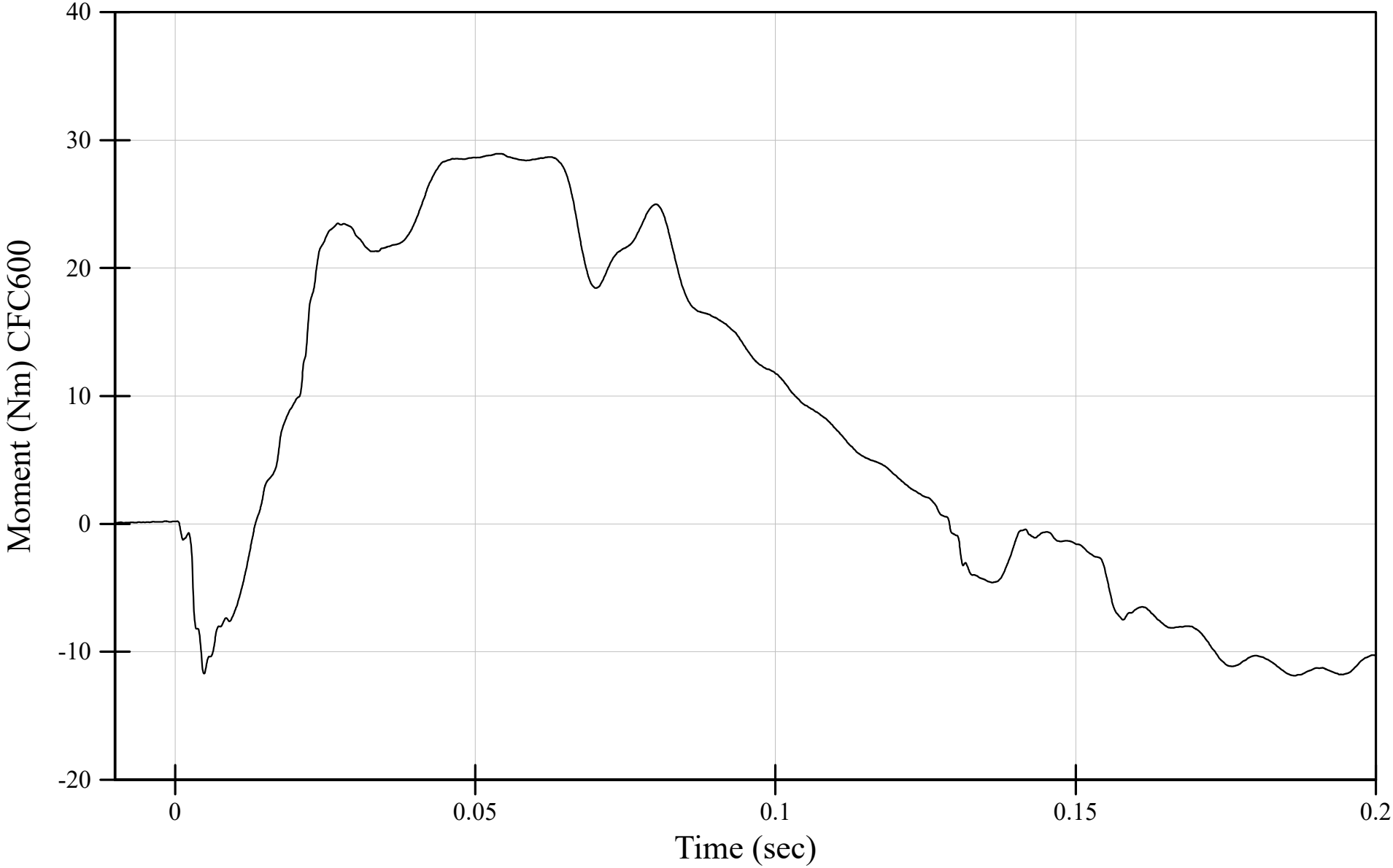
THOR-05F Neck Left Lateral Qualification
Pendulum Pulse
Serial Number: EV1357



File Name: 220608-13 processed

6/8/2022 3:46 PM

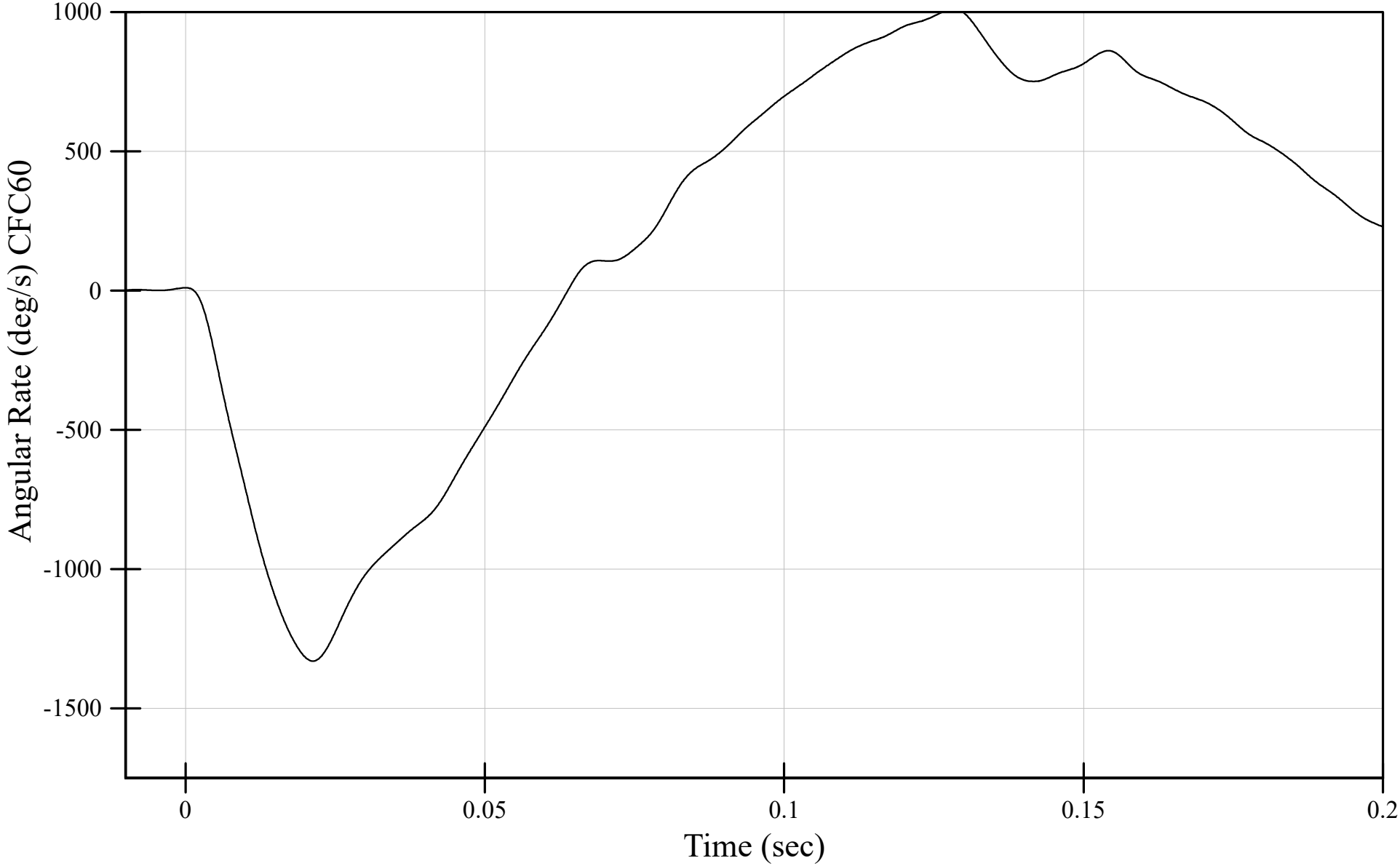
THOR-05F Neck Left Lateral Qualification
X-Moment as Measured
Serial Number: EV1357



File Name: 220608-13 processed

6/8/2022 3:46 PM

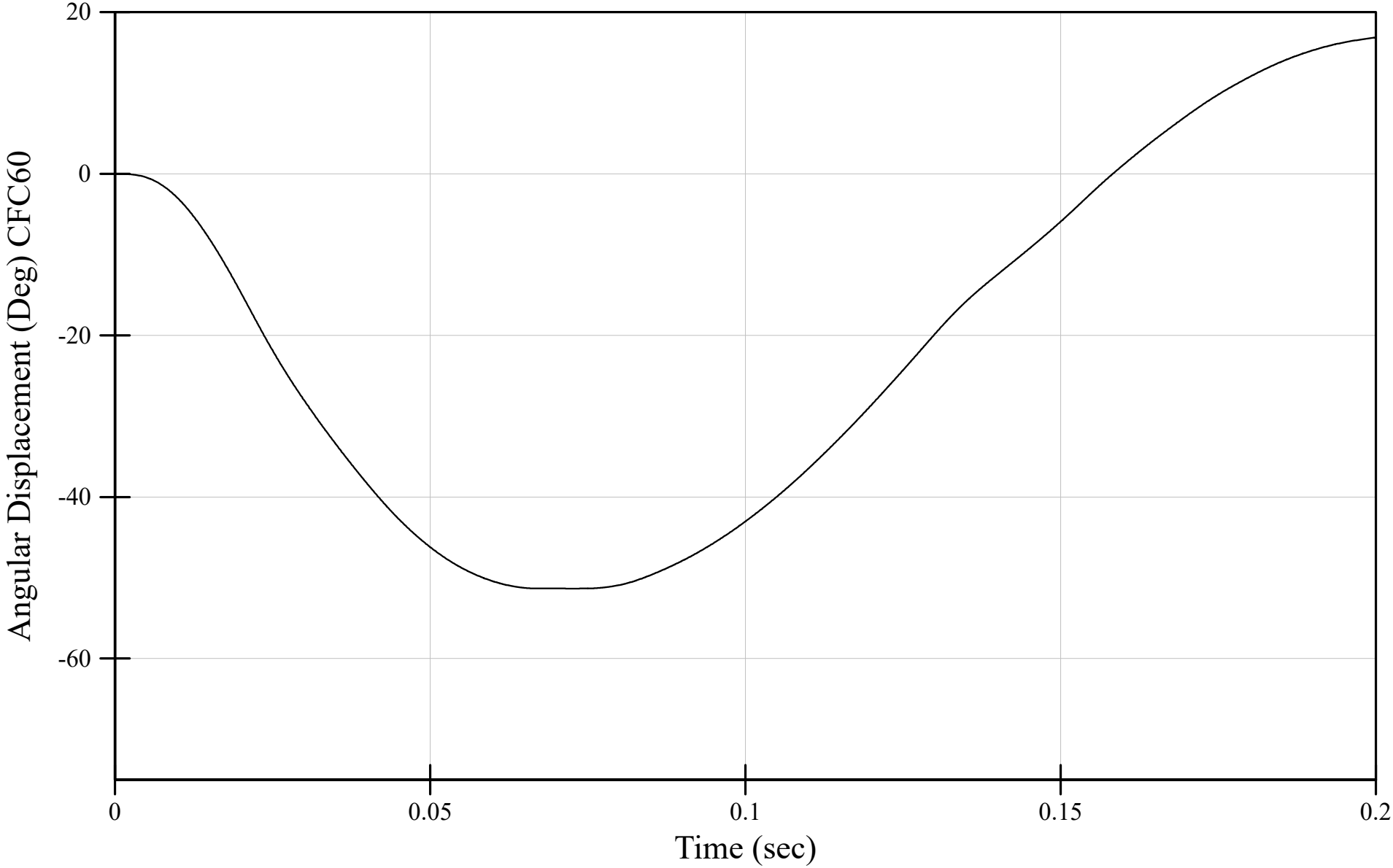
THOR-05F Neck Left Lateral Qualification
Peak Angular Rate
Serial Number: EV1357



File Name: 220608-13 processed

6/8/2022 3:46 PM

THOR-05F Neck Left Lateral Qualification
Neck Rotation
Serial Number: EV1357



File Name: 220608-13 processed

6/8/2022 3:46 PM

THOR-05F Neck Right Lateral Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Neck Serial Number: EV1357
O.C. Stop Assembly Serial Number: DML00002
O.C. Cam Serial Number: DML00003

Test ID: 220608-14
Test Date: 6/8/2022
Test Time: 4:42 PM

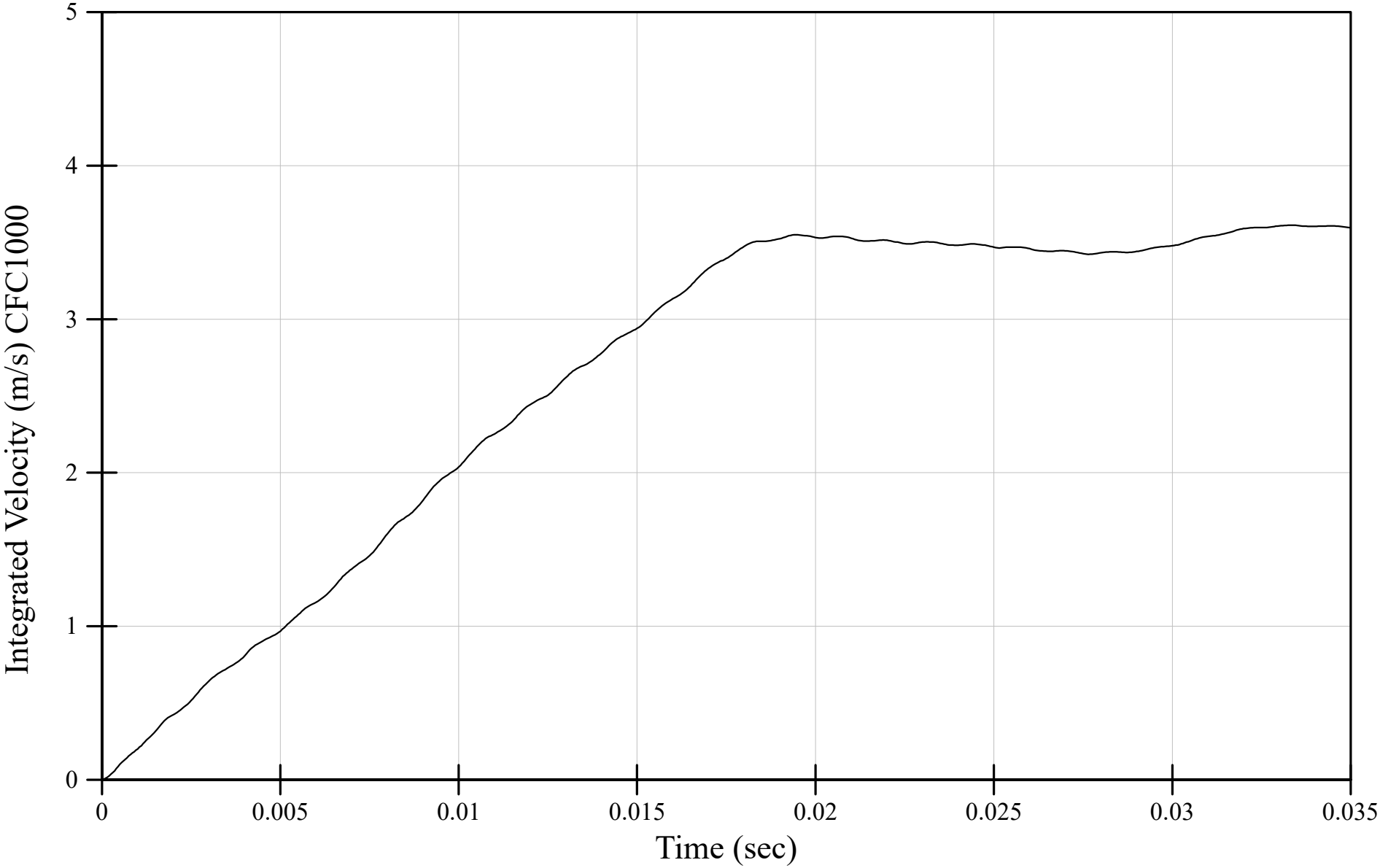
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.2	Pass
Test Humidity (%)	10 - 70	62	Pass
Test Velocity (m/s)	3.35 - 3.45	3.39	Pass
Pendulum Velocity at 5 ms (m/s)		0.97	
Pendulum Velocity at 10 ms (m/s)		2.04	
Pendulum Velocity at 15 ms (m/s)		2.94	
Peak Upper Neck Mx after 40 ms (N)		-29.7	
Peak Head Angular Velocity X (deg/sec)		1376.0	
Peak Head Rotation (deg)		51.2	

* THOR-05F Qualification Manual - March 2022

File Name: 220608-14 processed
Software Version: 2.8

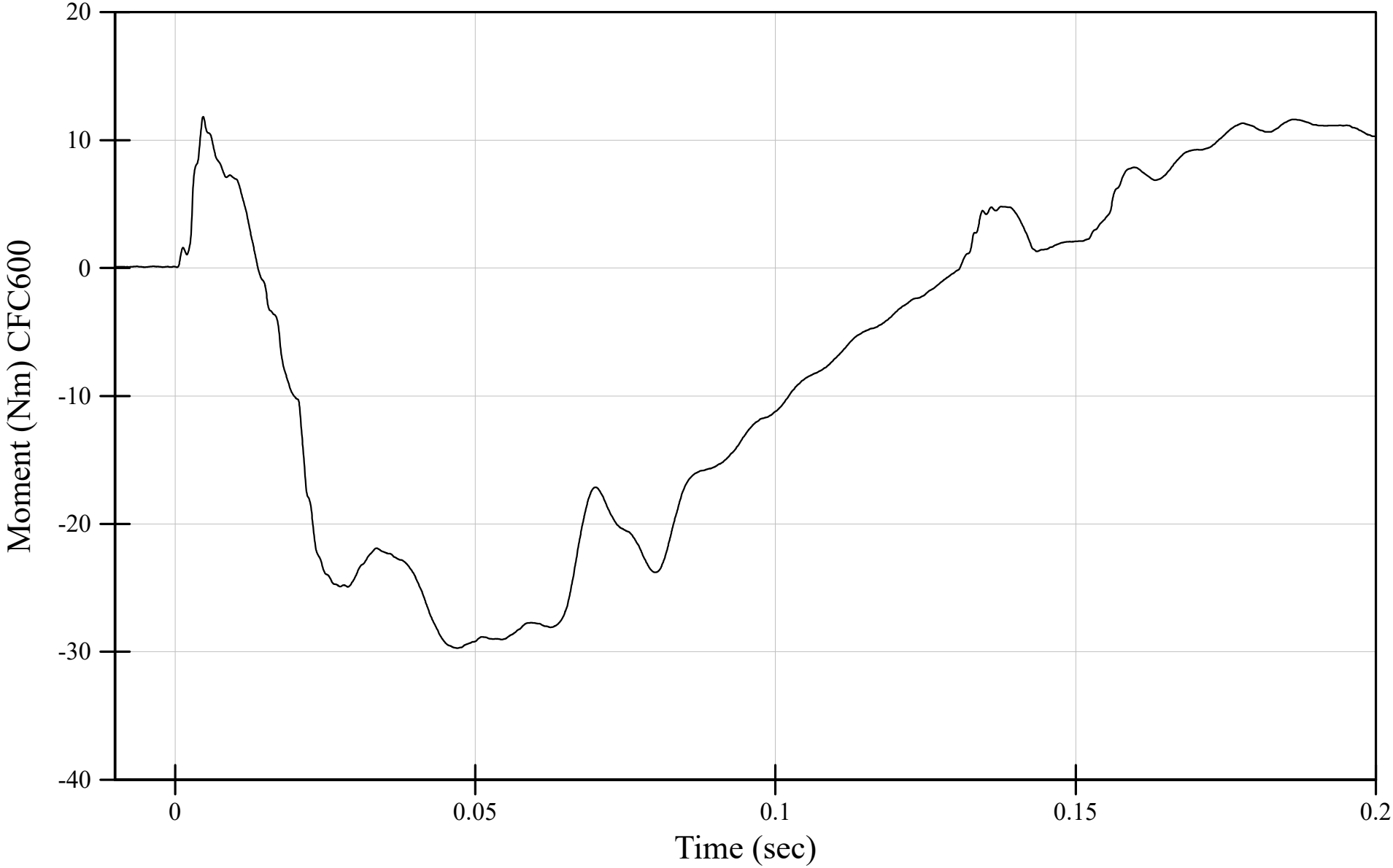
THOR-05F Neck Right Lateral Qualification
Pendulum Pulse
Neck Serial Number: EV1357



File Name: 220608-14 processed

6/8/2022 4:42 PM

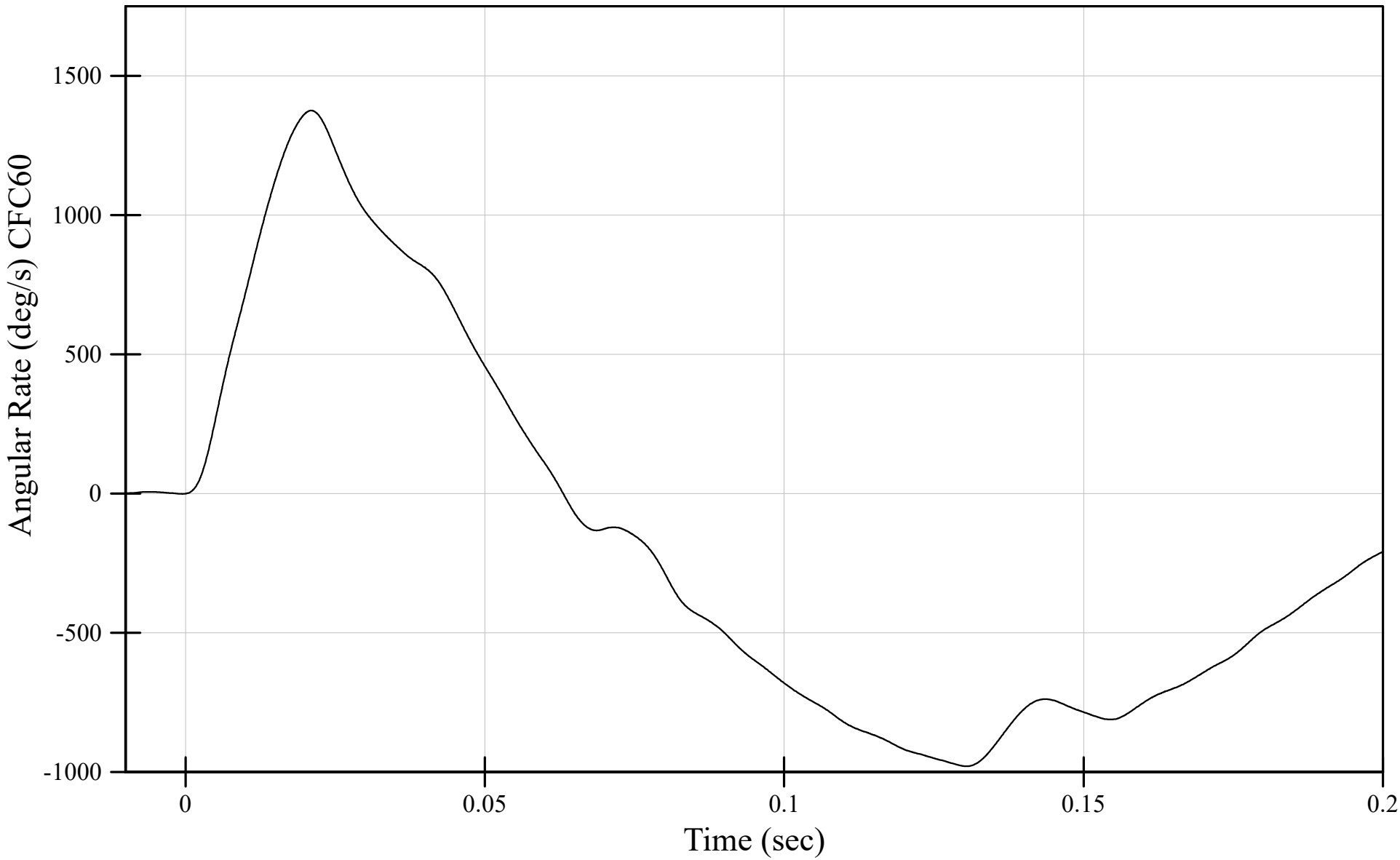
THOR-05F Neck Right Lateral Qualification
X-Moment as Measured
Neck Serial Number: EV1357



File Name: 220608-14 processed

6/8/2022 4:42 PM

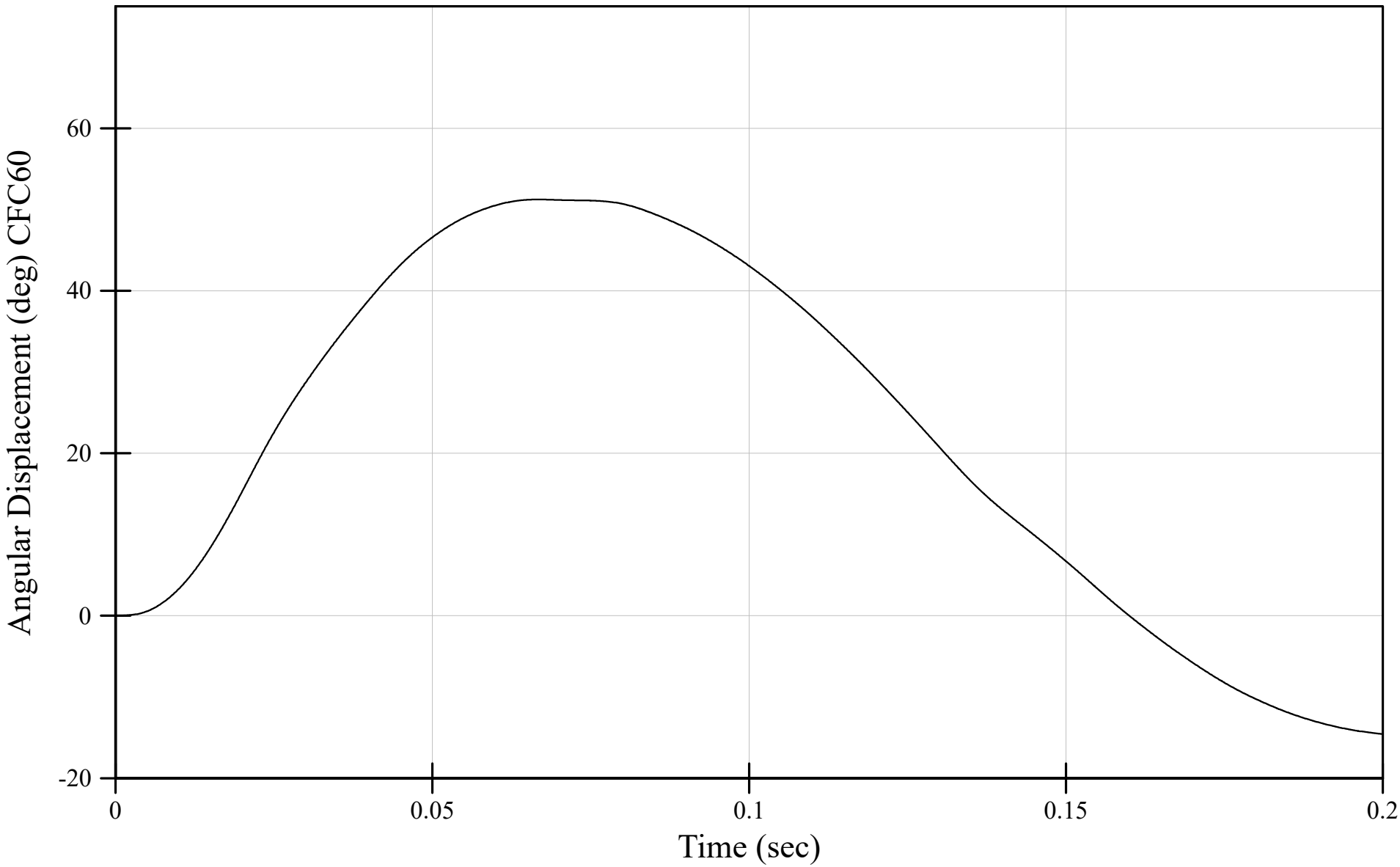
THOR-05F Neck Right Lateral Qualification
Peak Angular Rate
Neck Serial Number: EV1357



File Name: 220608-14 processed

6/8/2022 4:42 PM

THOR-05F Neck Right Lateral Qualification
Neck Rotation
Neck Serial Number: EV1357



File Name: 220608-14 processed

6/8/2022 4:42 PM

THOR-05F Upper Thorax Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components

Rib 1 Serial Number: EU8361
Rib 2 Serial Number: EU8362
Rib 3 Serial Number: EU8363
Rib 4 Serial Number: EL6732
Rib 5 Serial Number: EU8364
Rib 6 Serial Number: EL6737
Rib 7 Serial Number: EL6736

Test ID: 220615-3
Test Date: 6/15/2022
Test Time: 1:39 PM

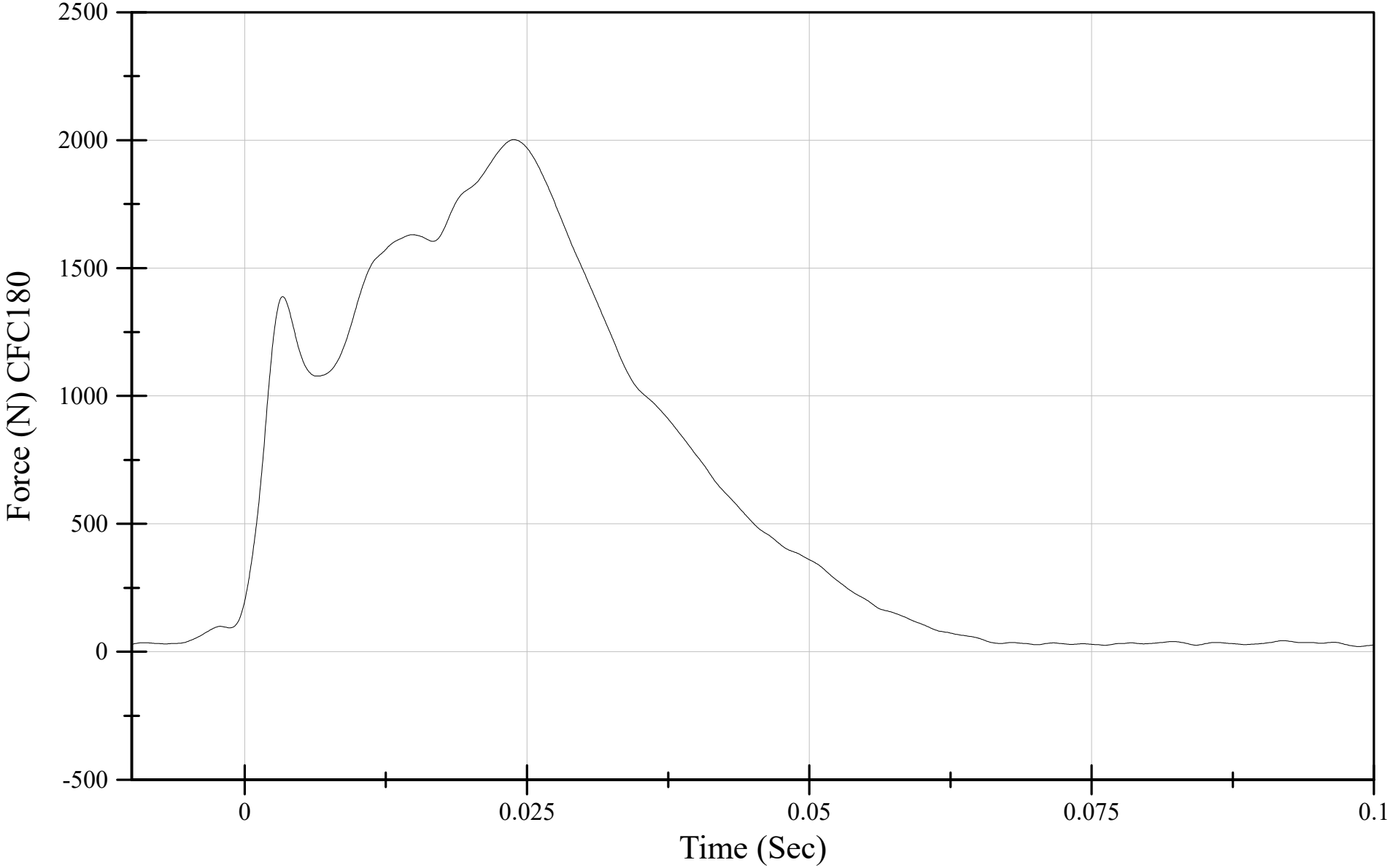
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.3	Pass
Test Humidity (%)	10 - 70	53	Pass
Test Velocity (m/s)	4.25 - 4.35	4.27	Pass
Peak Probe Force (N)		2002	
Peak Upper Left Resultant Deflection (mm)		45.4	
Peak Upper Right Resultant Deflection (mm)		45.0	
Difference Between Peak Left & Right Resultant Deflections (mm)		0.4	
Force at Left Peak Resultant Deflection (N)		1842	
Force at Right Peak Resultant Deflection (N)		1866	

* THOR-05F Qualification Manual - March 2022

File Name: 220615-3 processed

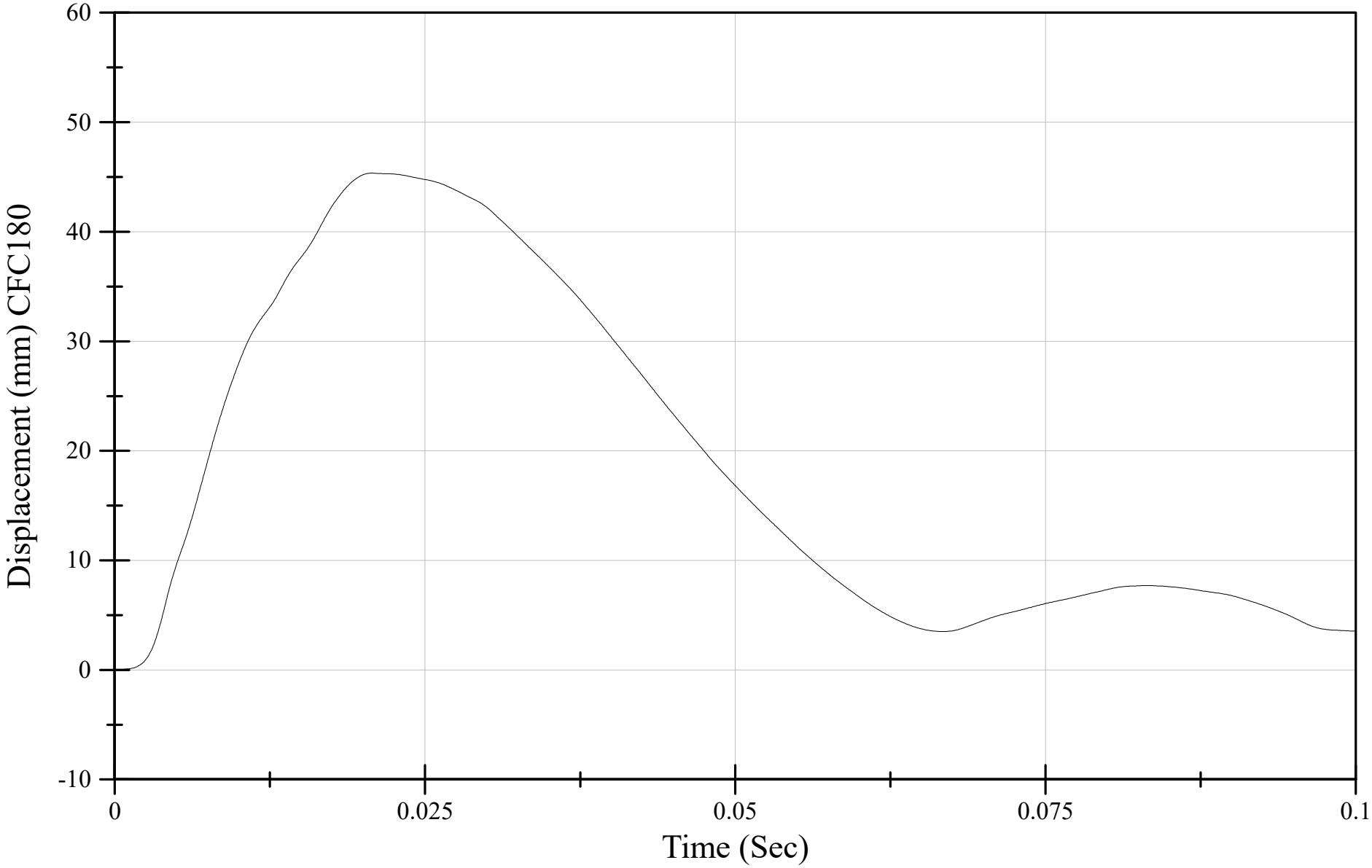
THOR-05F Upper Thorax Qualification
Probe Force
Dummy Serial Number: EV0674



File Name: 220615-3 processed

6/15/2022 1:39 PM

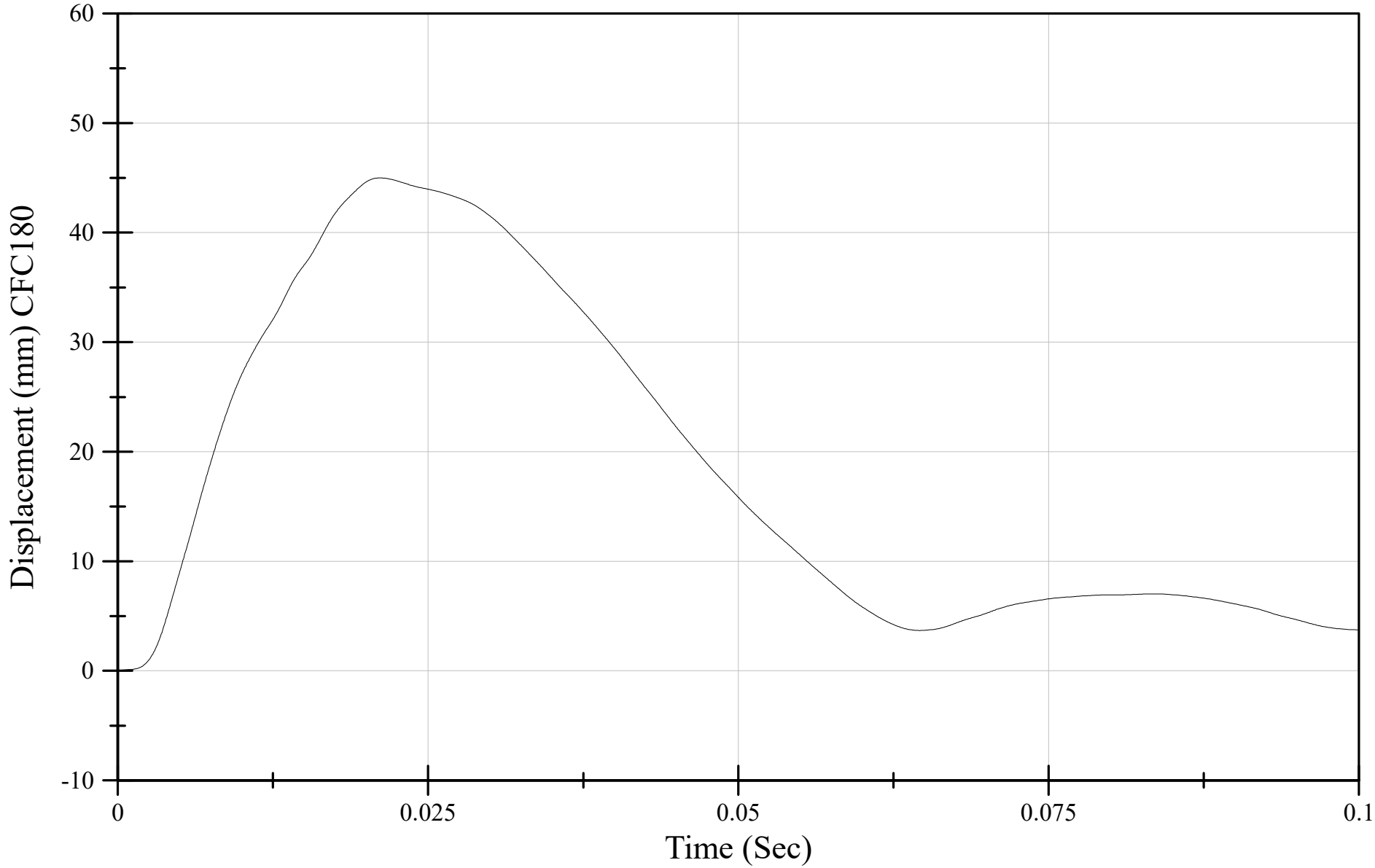
THOR-05F Upper Thorax Qualification
Left Resultant Deflection
Dummy Serial Number: EV0674



File Name: 220615-3 processed

6/15/2022 1:39 PM

THOR-05F Upper Thorax Qualification
Right Resultant Deflection
Dummy Serial Number: EV0674



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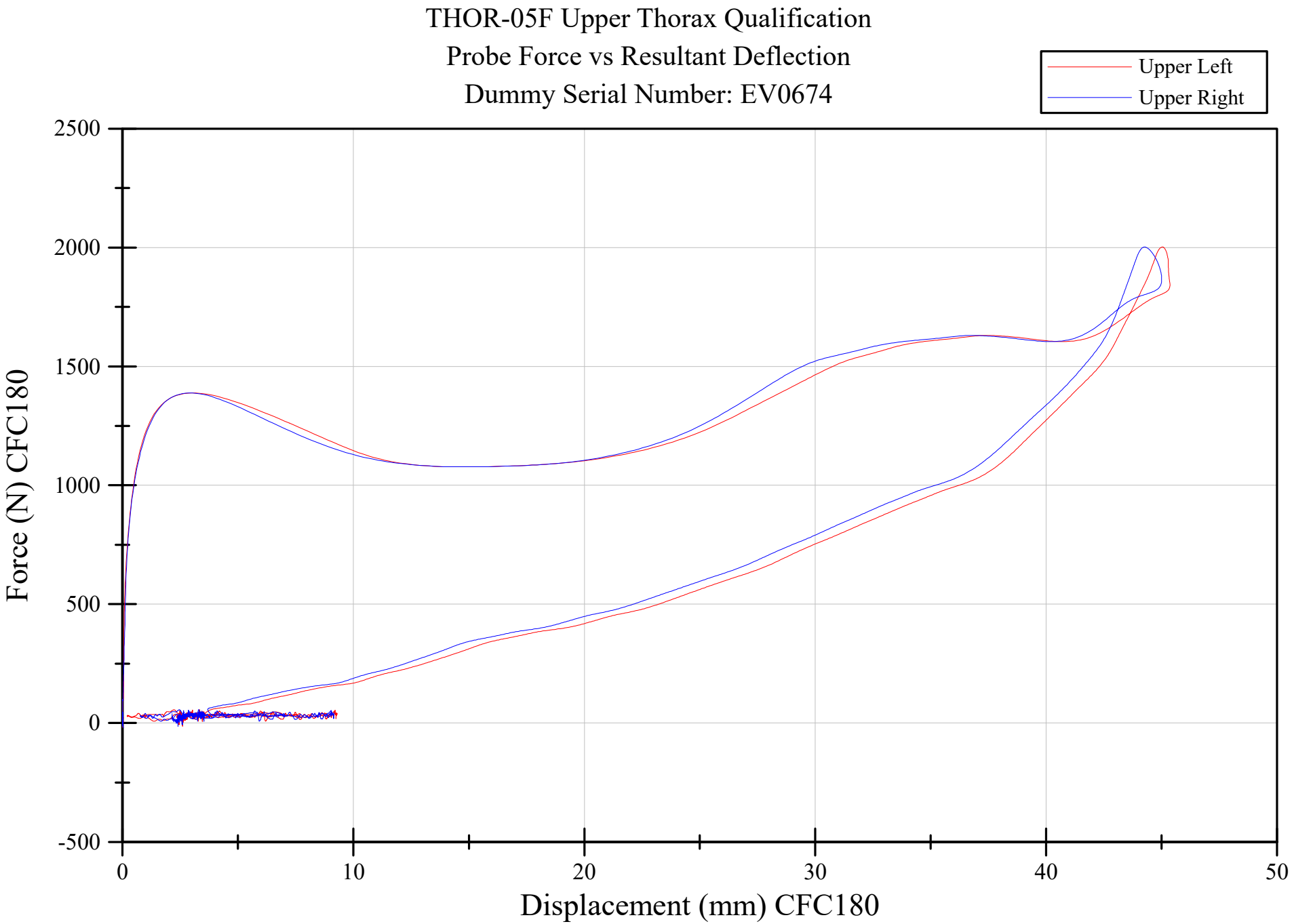
6/15/2022 1:39 PM



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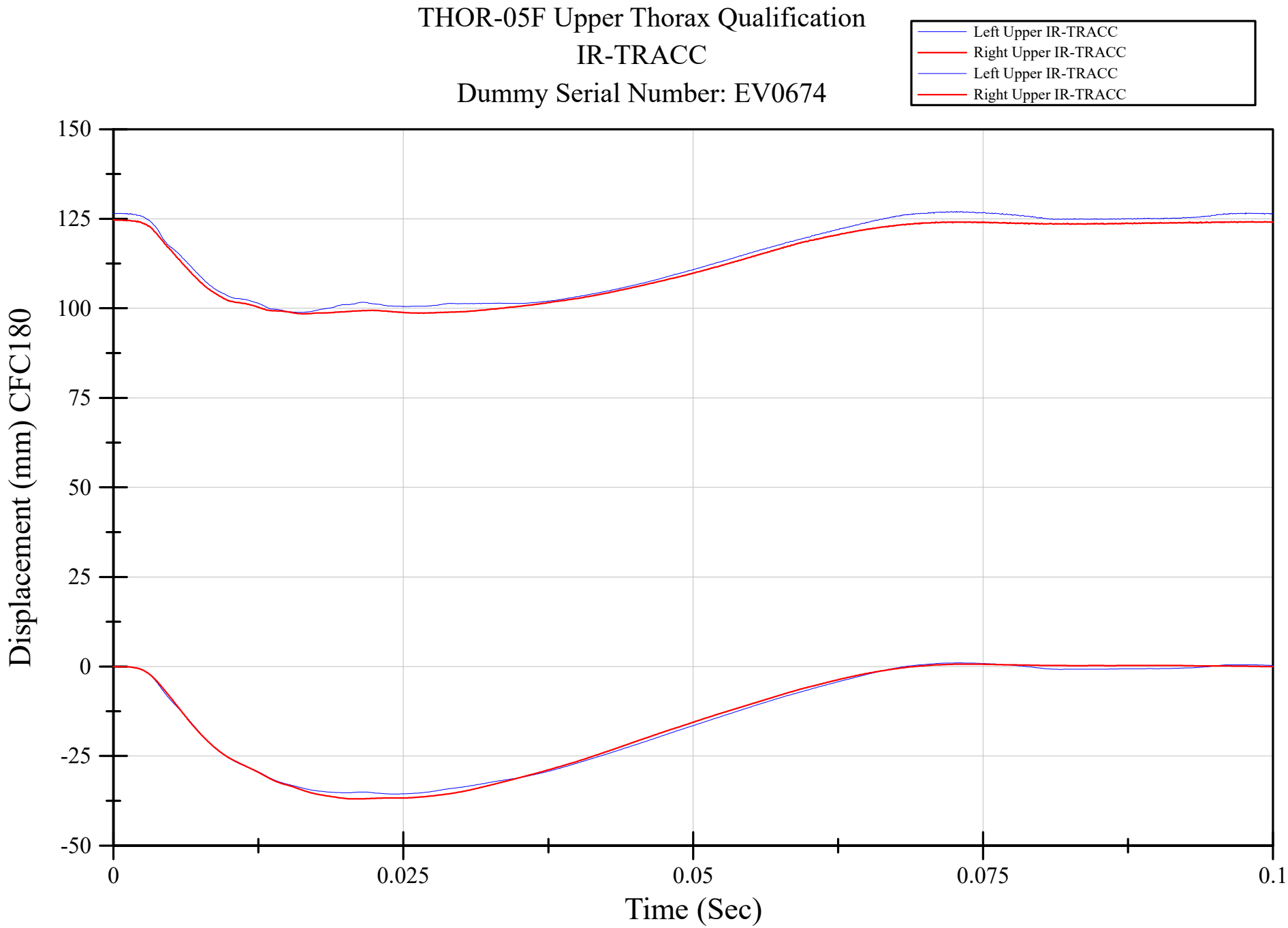
6/15/2022 1:39 PM



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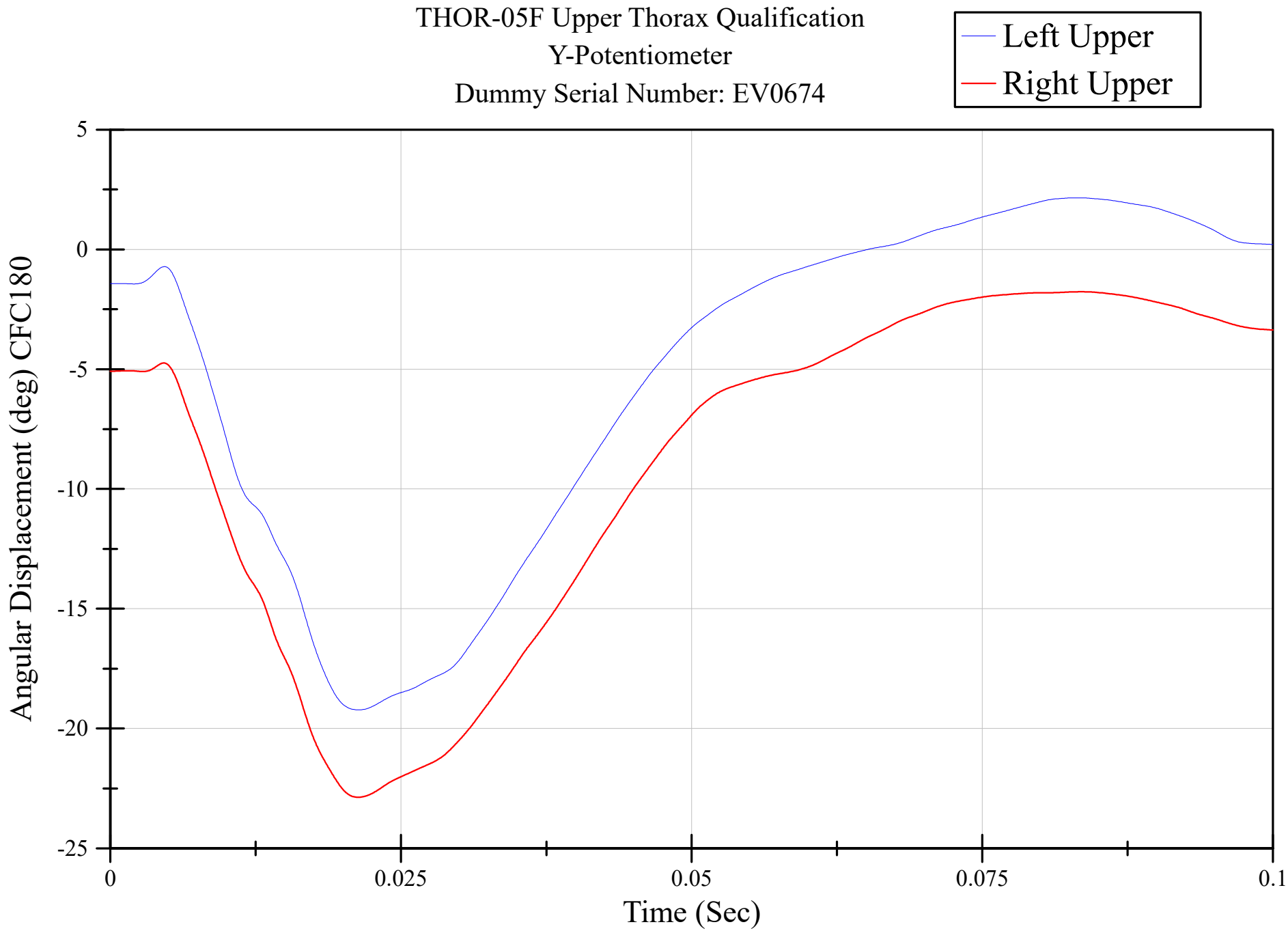
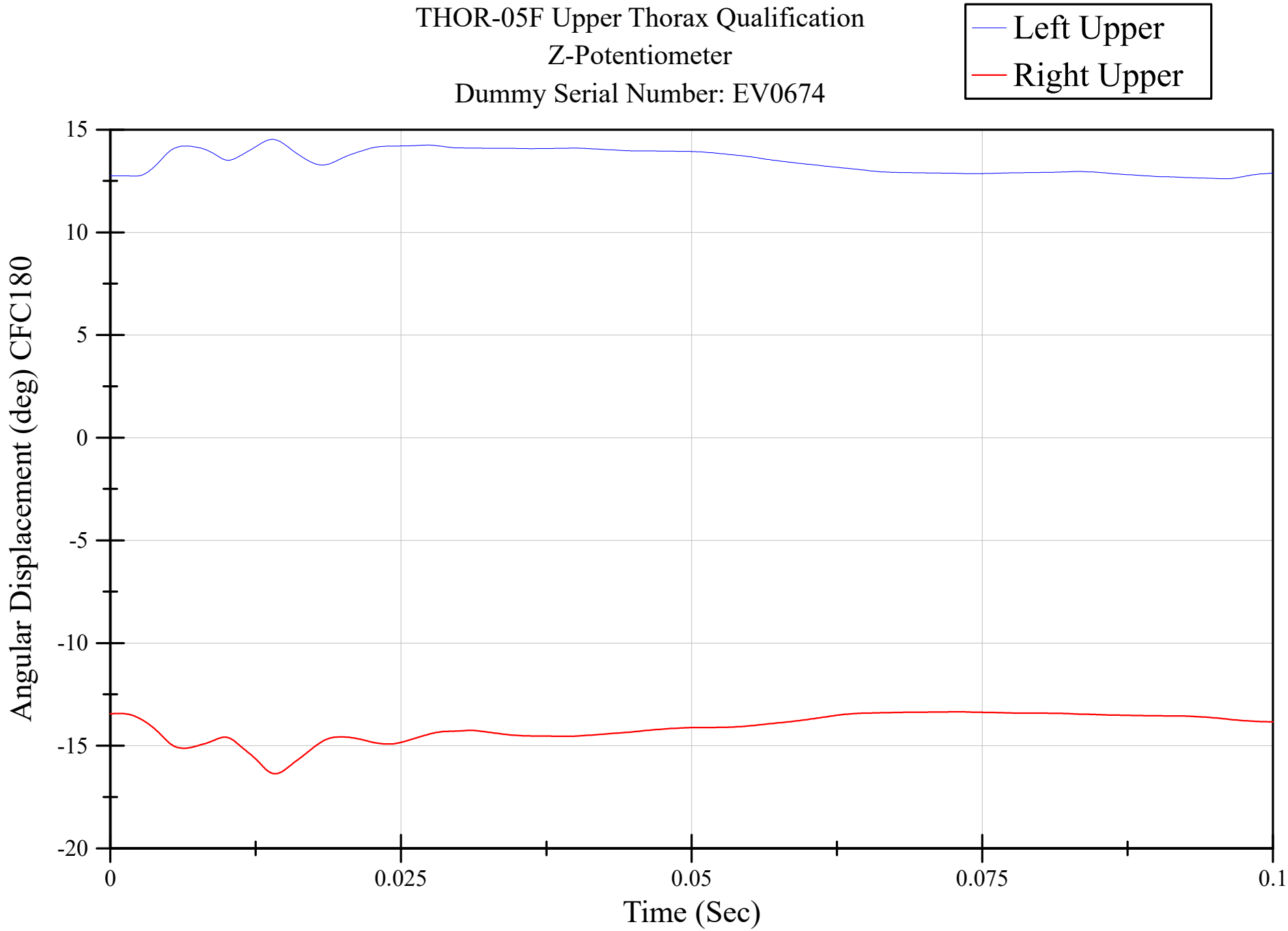
6/15/2022 1:39 PM



File Name: 220615-3 processed

6/15/2022 1:39 PM



File Name: 220615-3 processed

6/15/2022 1:39 PM

THOR-05F Lower Left Thorax Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components

Rib 1 Serial Number: EU8361
Rib 2 Serial Number: EU8362
Rib 3 Serial Number: EU8363
Rib 4 Serial Number: EL6732
Rib 5 Serial Number: EU8364
Rib 6 Serial Number: EL6737
Rib 7 Serial Number: EL6736

Test ID: 220616-1
Test Date: 6/16/2022
Test Time: 8:46 AM

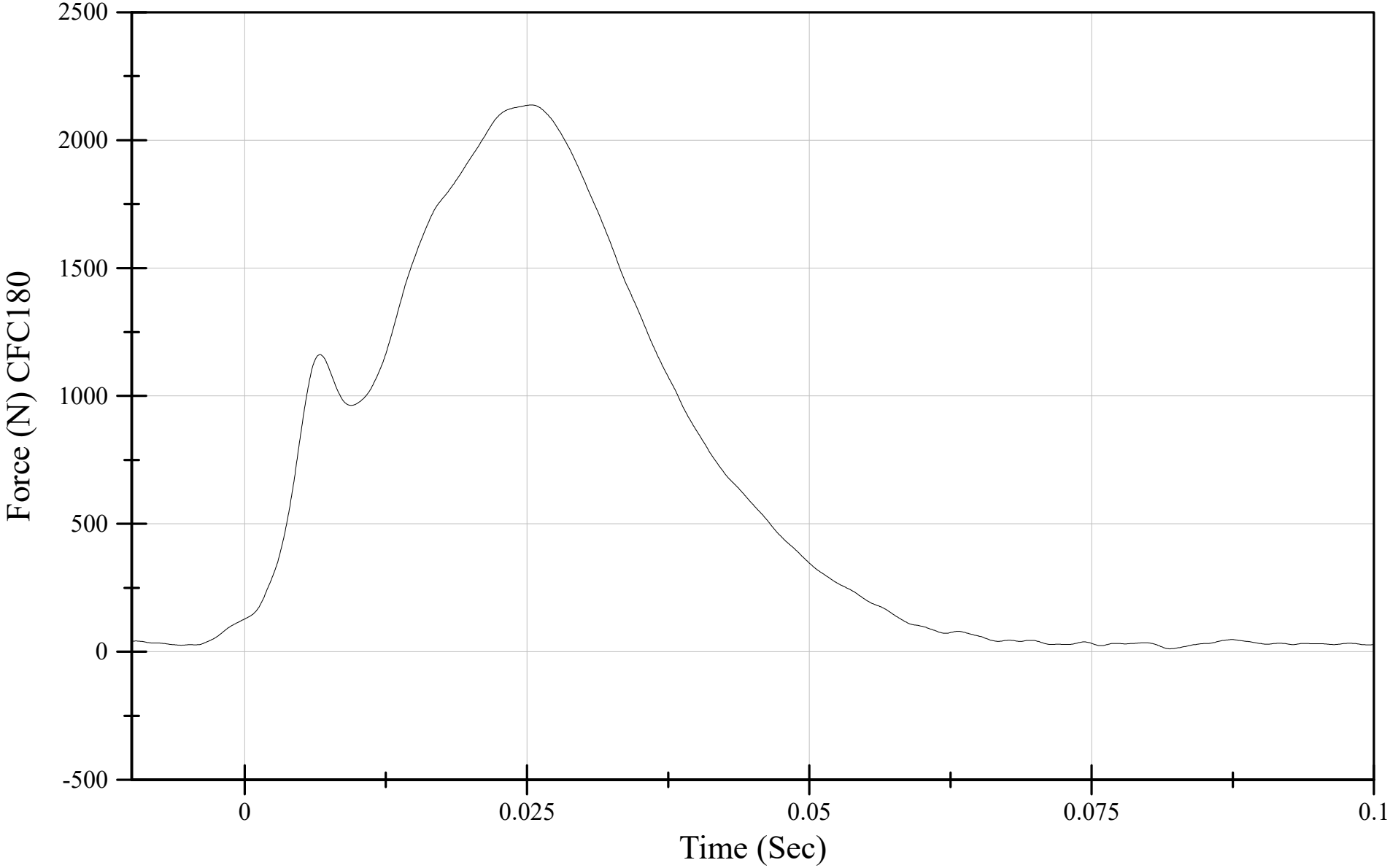
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.5	Pass
Test Humidity (%)	10 - 70	52	Pass
Test Velocity (m/s)	4.25 - 4.35	4.26	Pass
Peak Probe Force (N)		2138	
Left Resultant Deflection at Peak Force (mm)		51.7	

* THOR-05F Qualification Manual - March 2022

File Name: 220616-1 processed
Software Version: 2.8

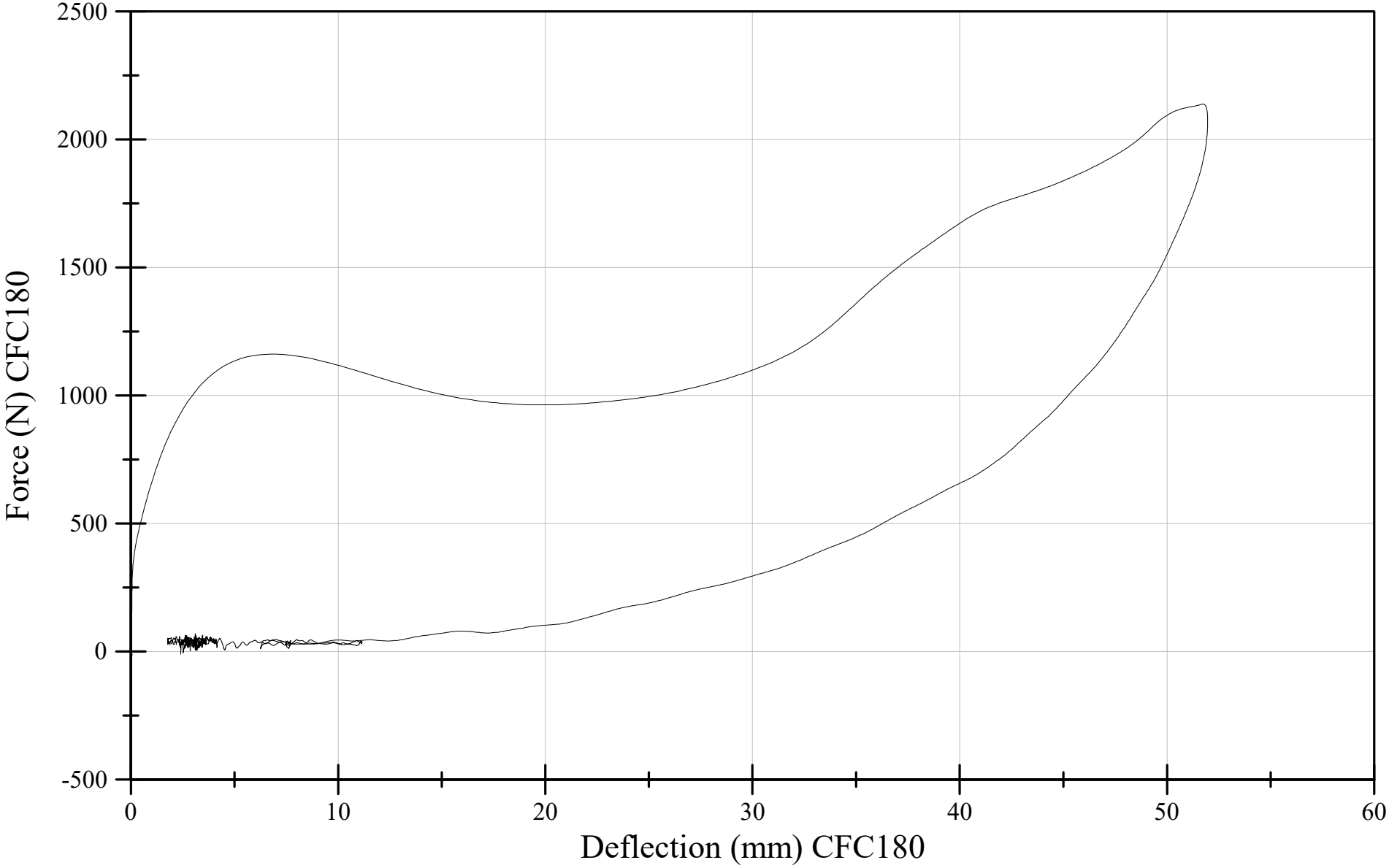
THOR-05F Lower Left Thorax Qualification
Peak Probe Force
Serial Number: EV0674



File Name: 220616-1 processed

6/16/2022 8:46 AM

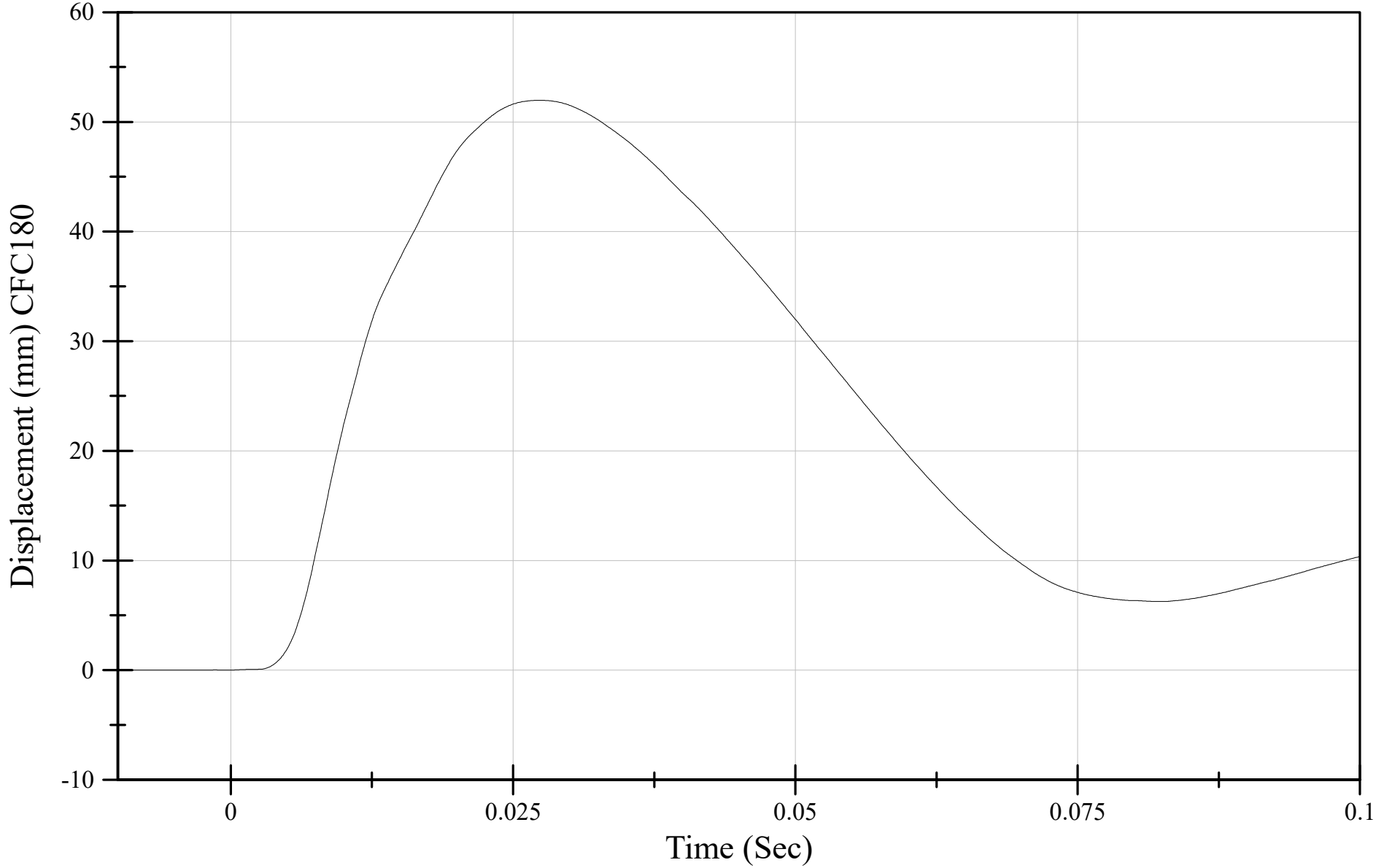
THOR-05F Lower Left Thorax Qualification
Probe Force vs Left Resultant Deflection
Serial Number: EV0674



File Name: 220616-1 processed

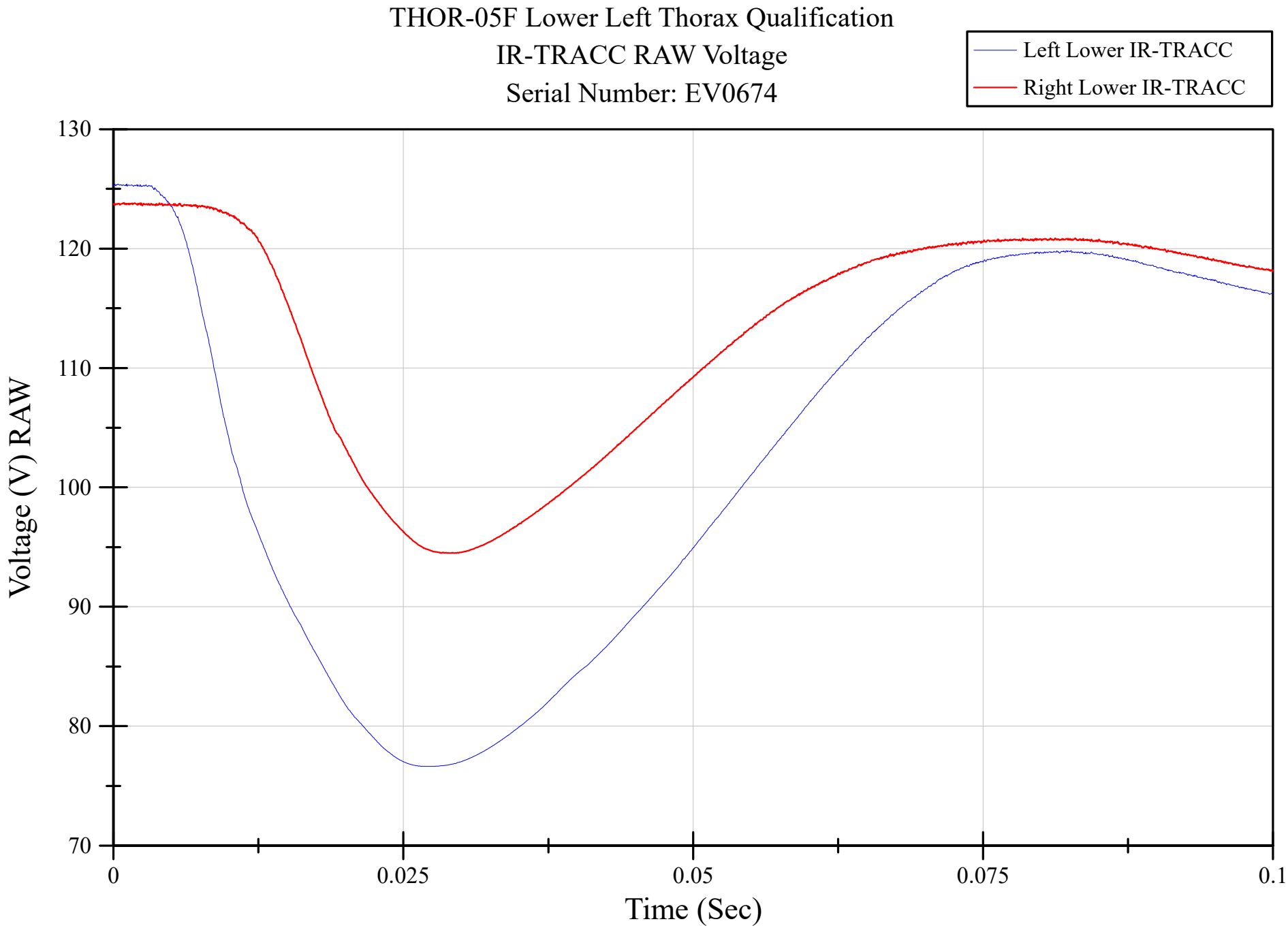
6/16/2022 8:46 AM

THOR-05F Lower Left Thorax Qualification
Left Resultant Deflection
Serial Number: EV0674



File Name: 220616-1 processed

6/16/2022 8:46 AM



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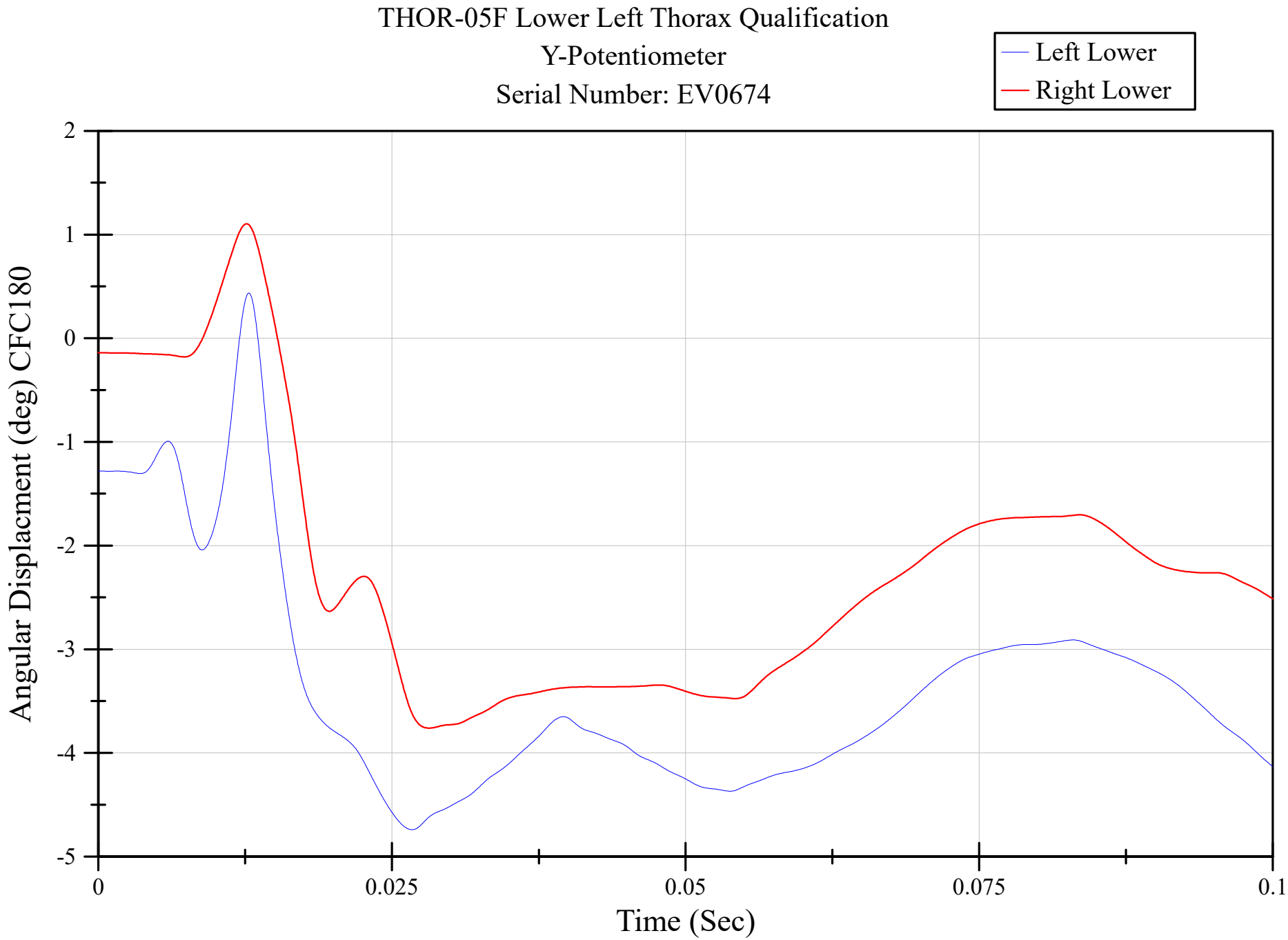
6/16/2022 8:46 AM



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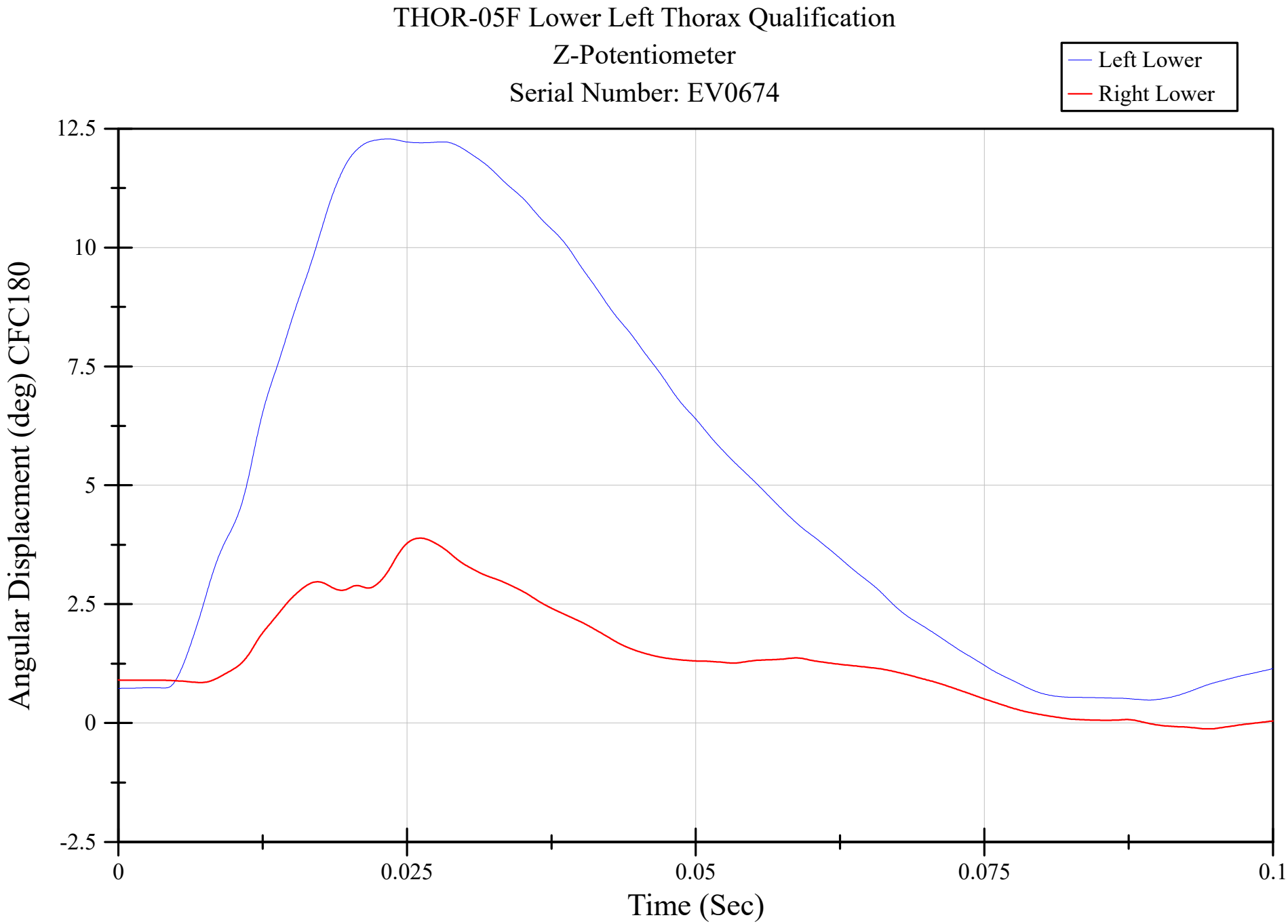
6/16/2022 8:46 AM



File Name: 220616-1 processed

6/16/2022 8:46 AM

THOR-05F Lower Right Thorax Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components

Rib 1 Serial Number: EU8361
Rib 2 Serial Number: EU8362
Rib 3 Serial Number: EU8363
Rib 4 Serial Number: EL6732
Rib 5 Serial Number: EU8364
Rib 6 Serial Number: EL6737
Rib 7 Serial Number: EL6736

Test ID: 220616-3
Test Date: 6/16/2022
Test Time: 10:57 AM

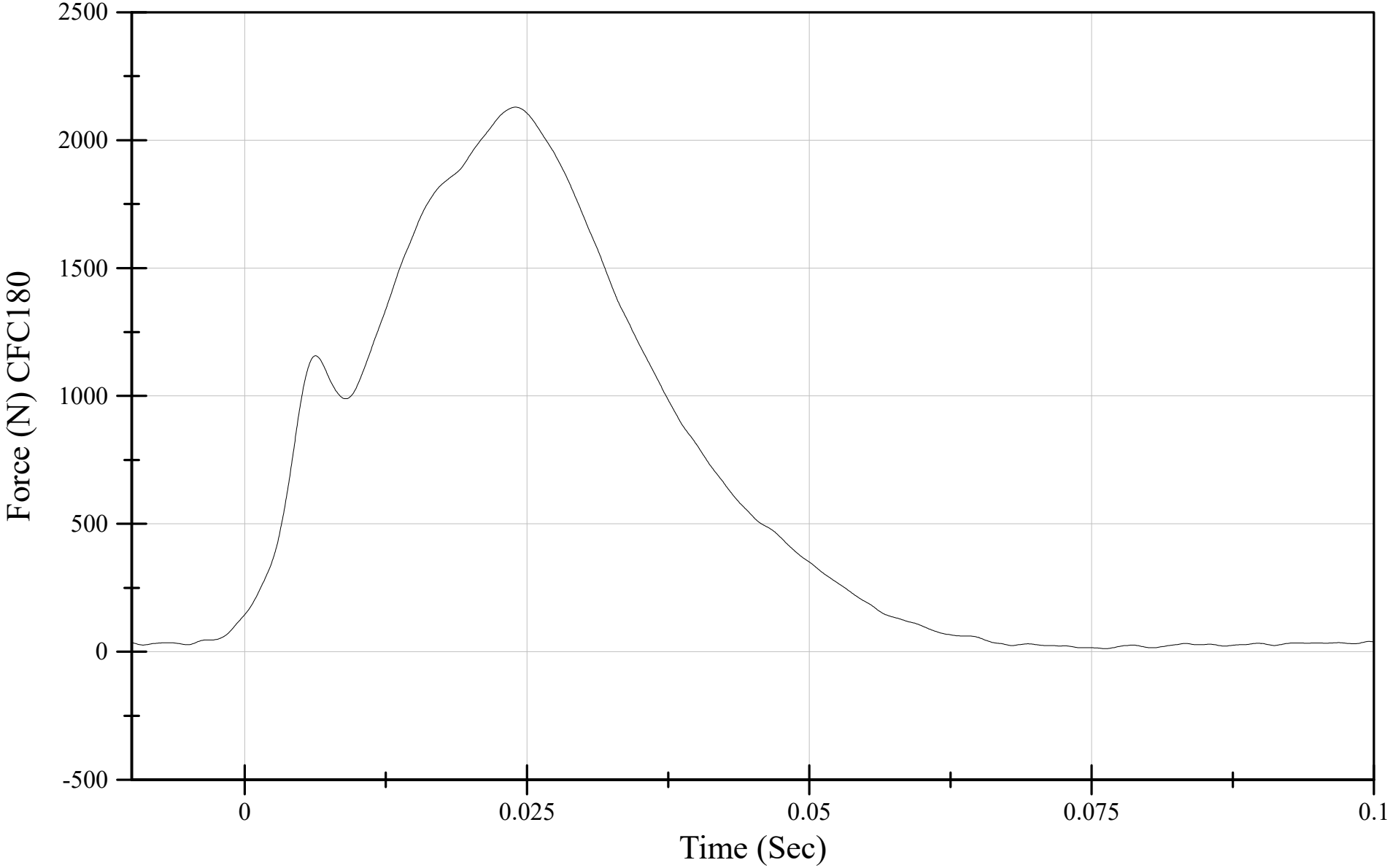
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.4	Pass
Test Humidity (%)	10 - 70	53	Pass
Test Velocity (m/s)	4.25 - 4.35	4.27	Pass
Peak Probe Force (N)		2129	
Right Resultant Deflection at Peak Force (mm)		48.3	

* THOR-05F Qualification Manual - March 2022

File Name: 220616-3 processed
Software Version: 2.8

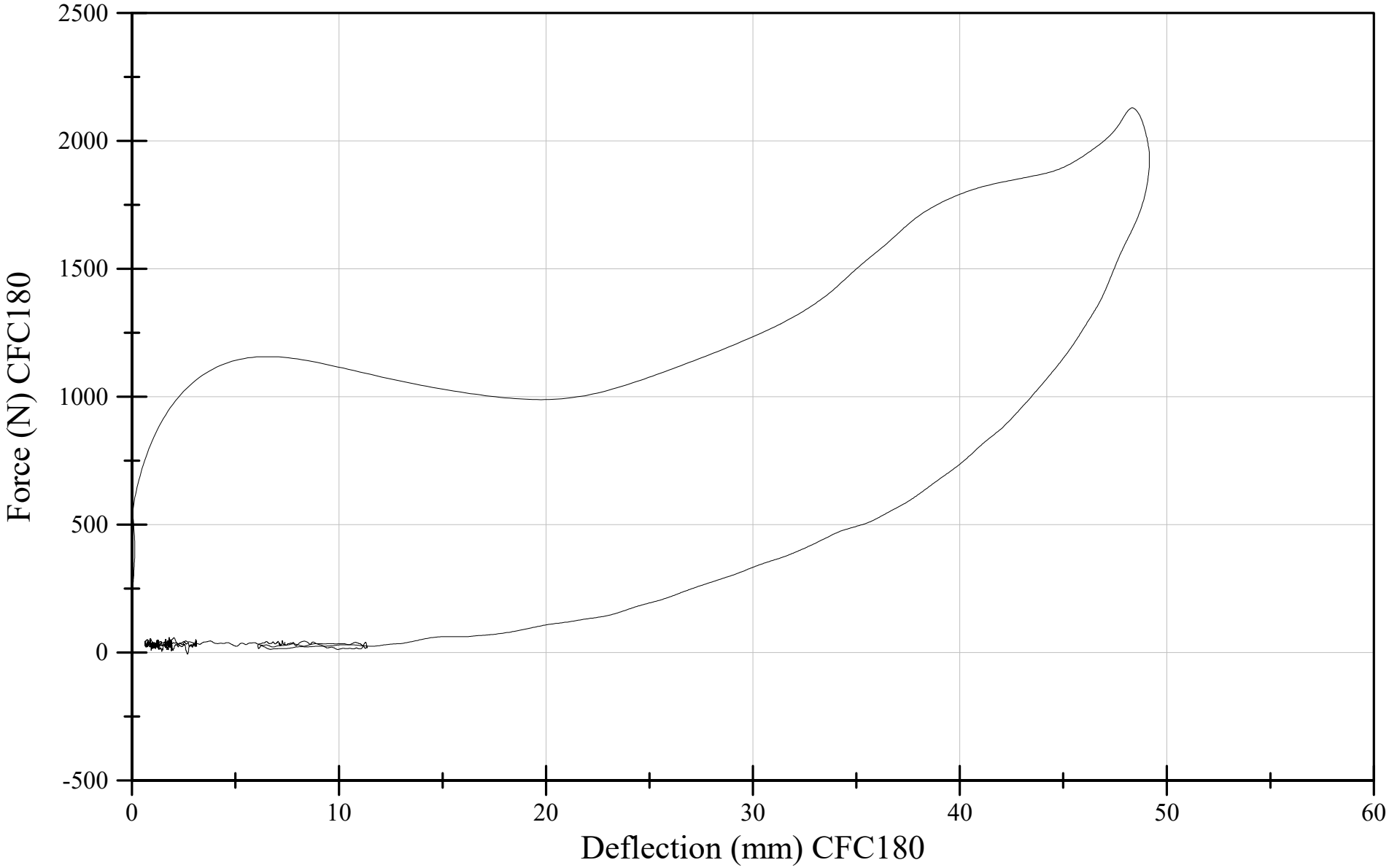
THOR-05F Lower Right Thorax Qualification
Peak Probe Force
Serial Number: EV0674



File Name: 220616-3 processed

6/16/2022 10:57 AM

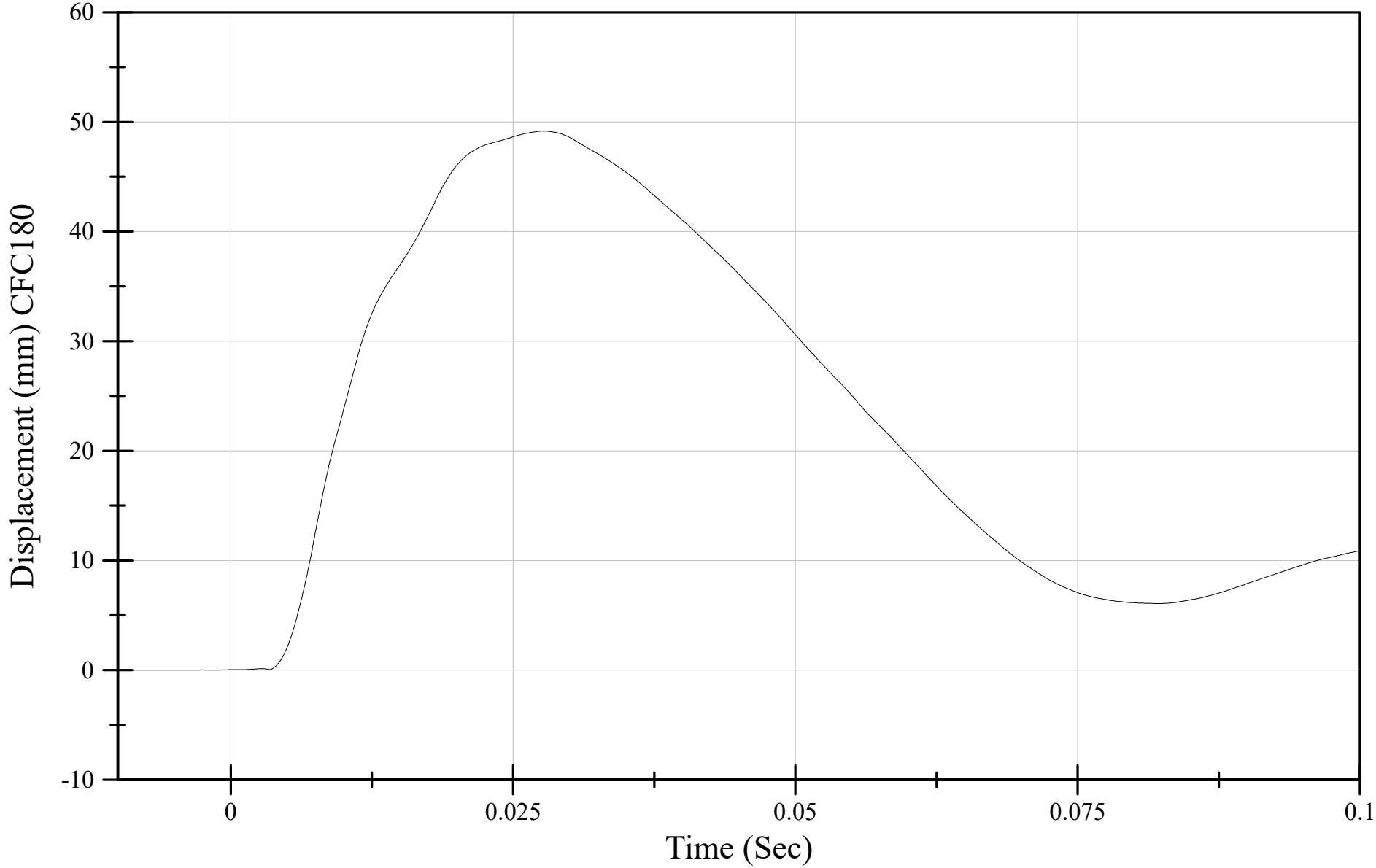
THOR-05F Lower Right Thorax Qualification
Probe Force vs Right Resultant Deflection
Serial Number: EV0674



File Name: 220616-3 processed

6/16/2022 10:57 AM

THOR-05F Lower Right Thorax Qualification
Right Resultant Deflection
Serial Number: EV0674



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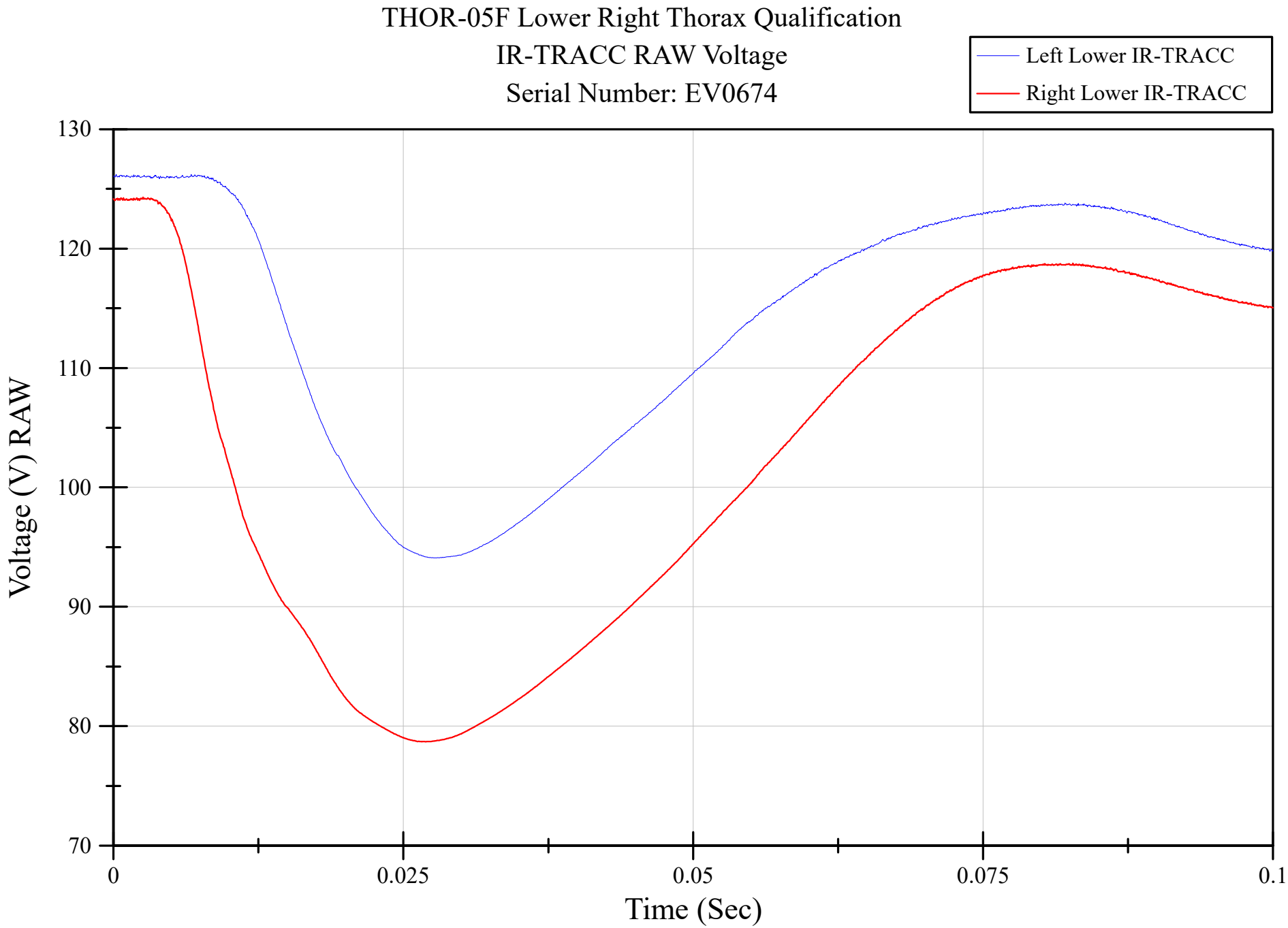
6/16/2022 10:57 AM



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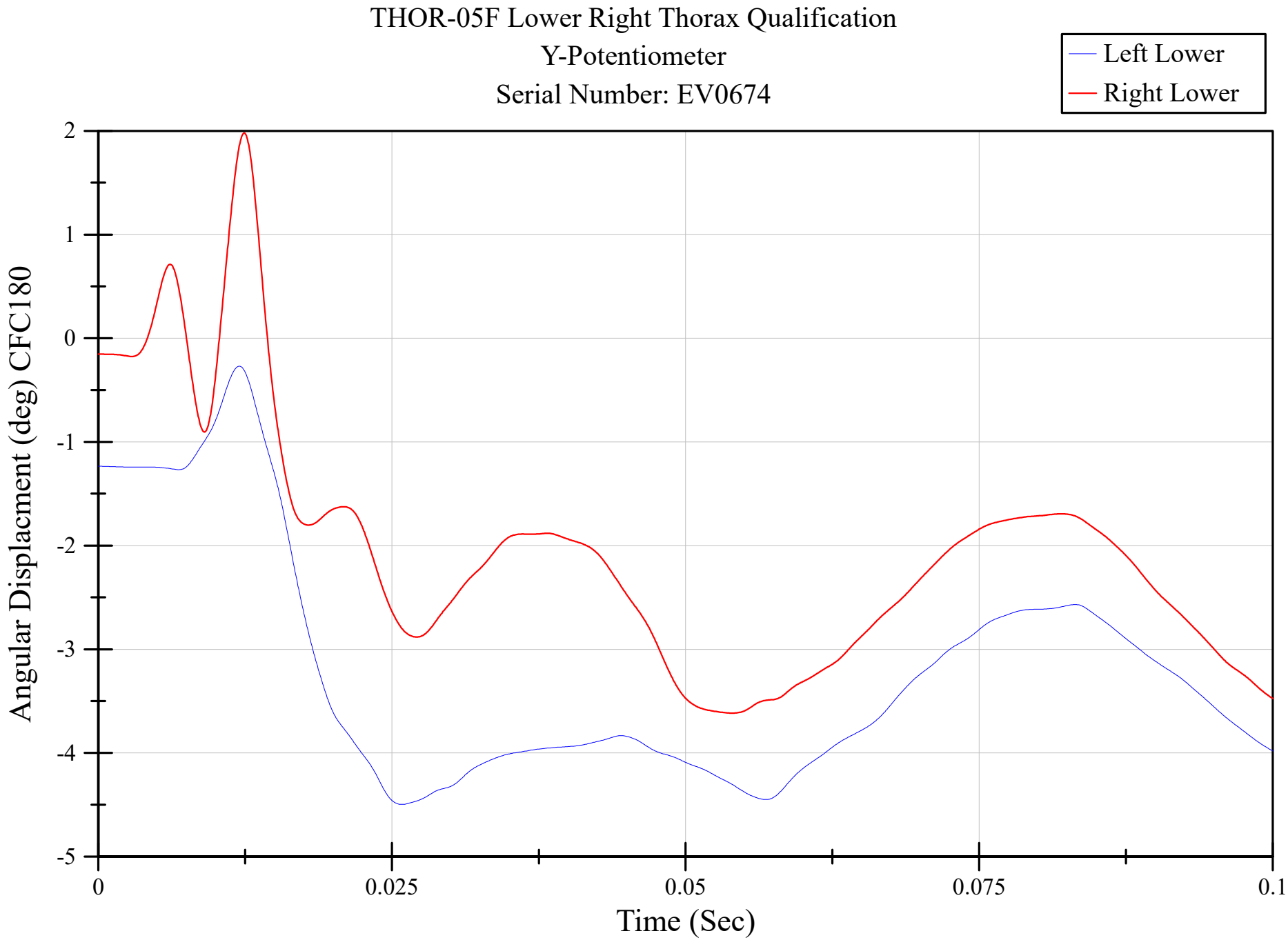
6/16/2022 10:57 AM



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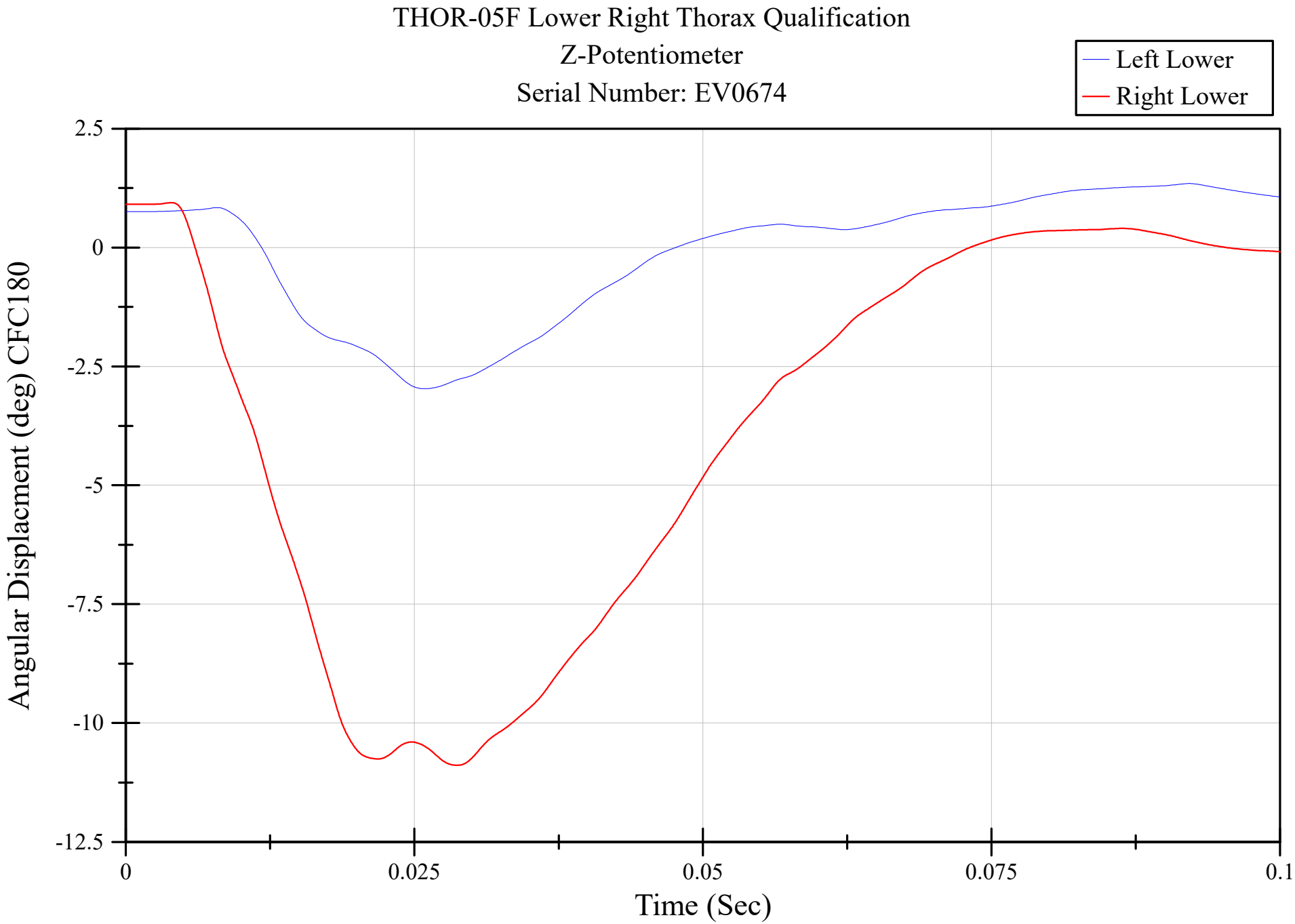
6/16/2022 10:57 AM



File Name: 220616-3 processed

6/16/2022 10:57 AM

THOR-05F Lower Abdomen Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components

Abdomen Foam: EV1098

Test ID: 220616-15
Test Date: 6/16/2022
Test Time: 1:45 PM

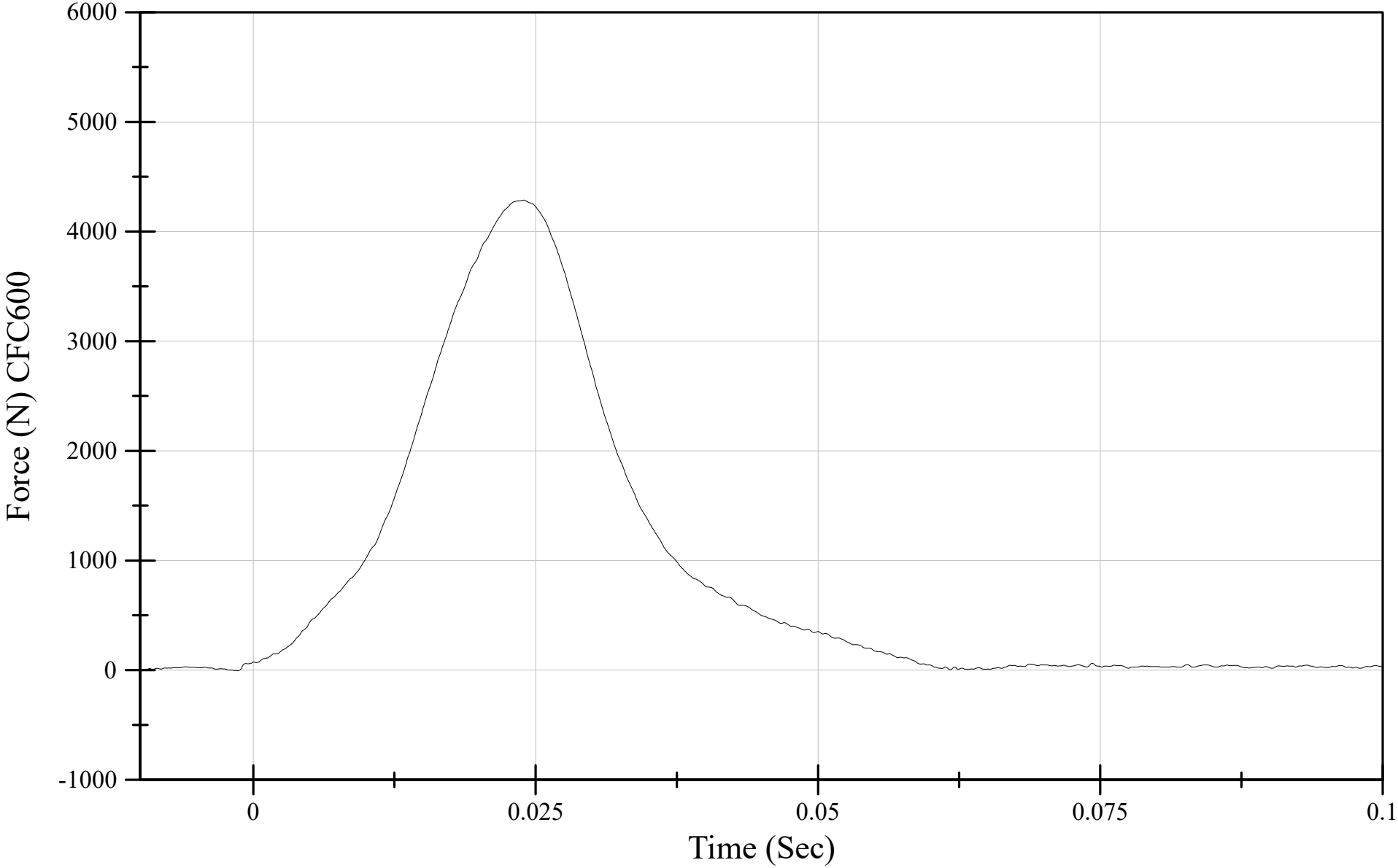
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.5	Pass
Test Humidity (%)	10 - 70	55	Pass
Test Velocity (m/s)	6.05 - 6.15	6.10	Pass
Peak Probe Force (N)		4287	
Peak Left Abdomen Pressure (kPa)		150	
Peak Right Abdomen Pressure (kPa)		161	
Difference between Left and Right Pressure (kPa)		11	

* THOR-05F Qualification Manual - March 2022

File Name: 220616-15 processed
Software Version: 2.8

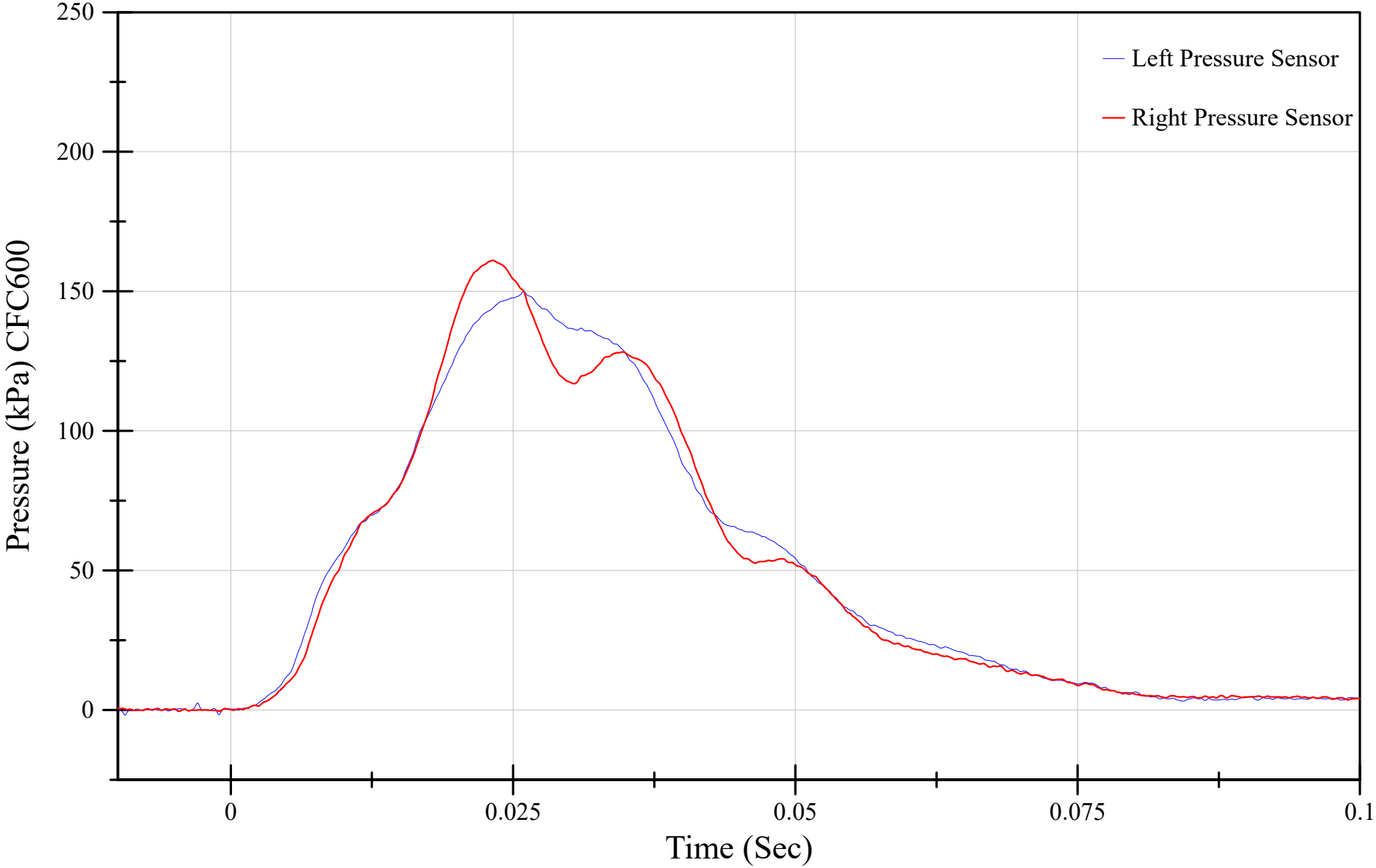
THOR-05F Lower Abdomen Qualification
Peak Probe Force
Serial Number: EV0674



File Name: 220616-15 processed

6/16/2022 1:45 PM

THOR-05F Lower Abdomen Qualification
Abdomen Pressure Sensors
Serial Number: EV0674



File Name: 220616-15 processed

6/16/2022 1:45 PM

THOR-05F Left Upper Leg Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Compression Element: EV0593
Left Thigh Flesh: EV3102

Test ID: 220616-16
Test Date: 6/16/2022
Test Time: 5:14 PM

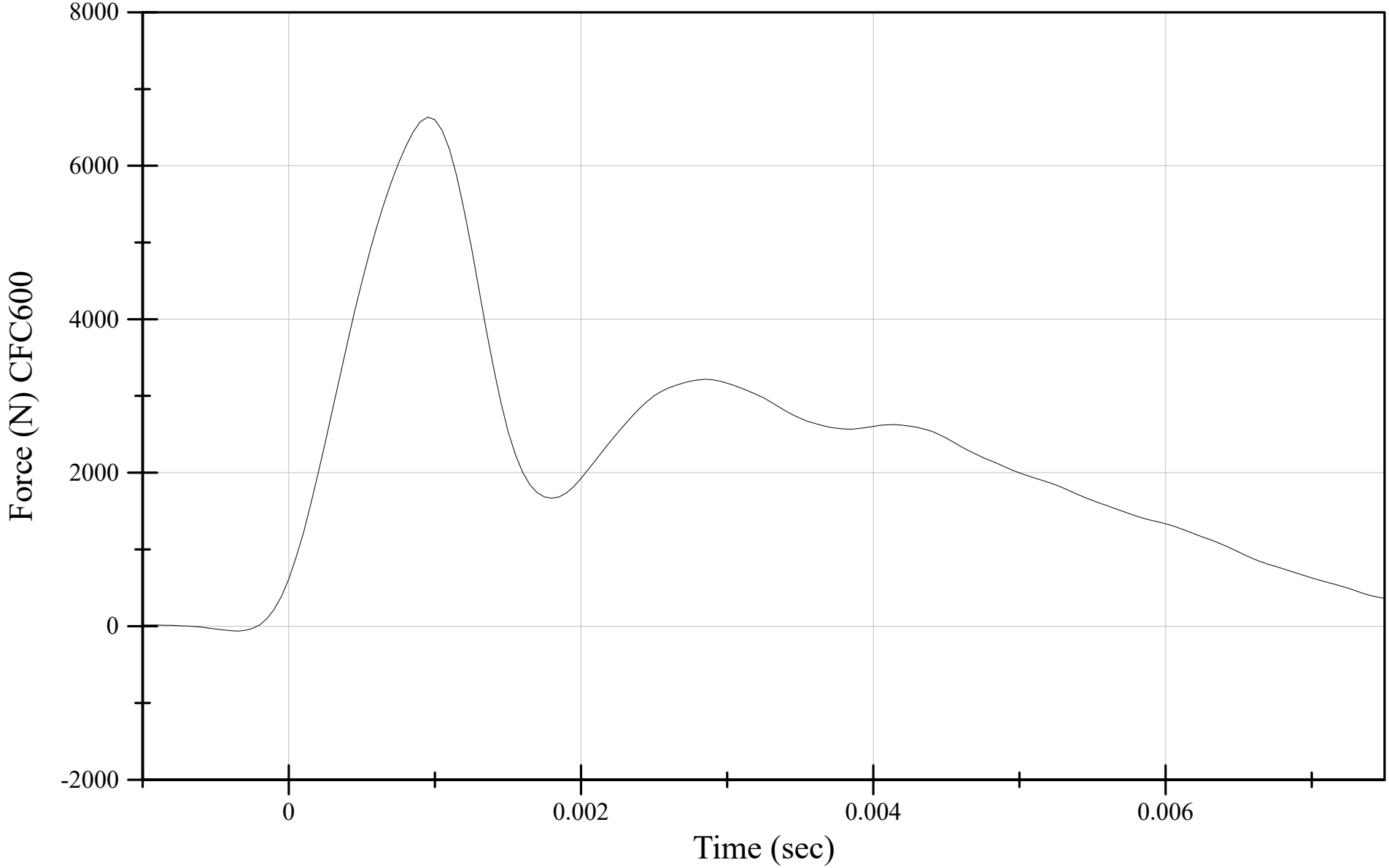
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.5	Pass
Test Humidity (%)	10 - 70	54	Pass
Test Velocity (m/s)		3.28	Pass
Peak Probe Force (N)		6634.3	
Peak Femur Force (N)		-3733.8	
Peak Resultant Acetabulum Force (N)		1575.5	

* THOR-05F Qualification Manual - March 2022

File Name: 220616-16 processed

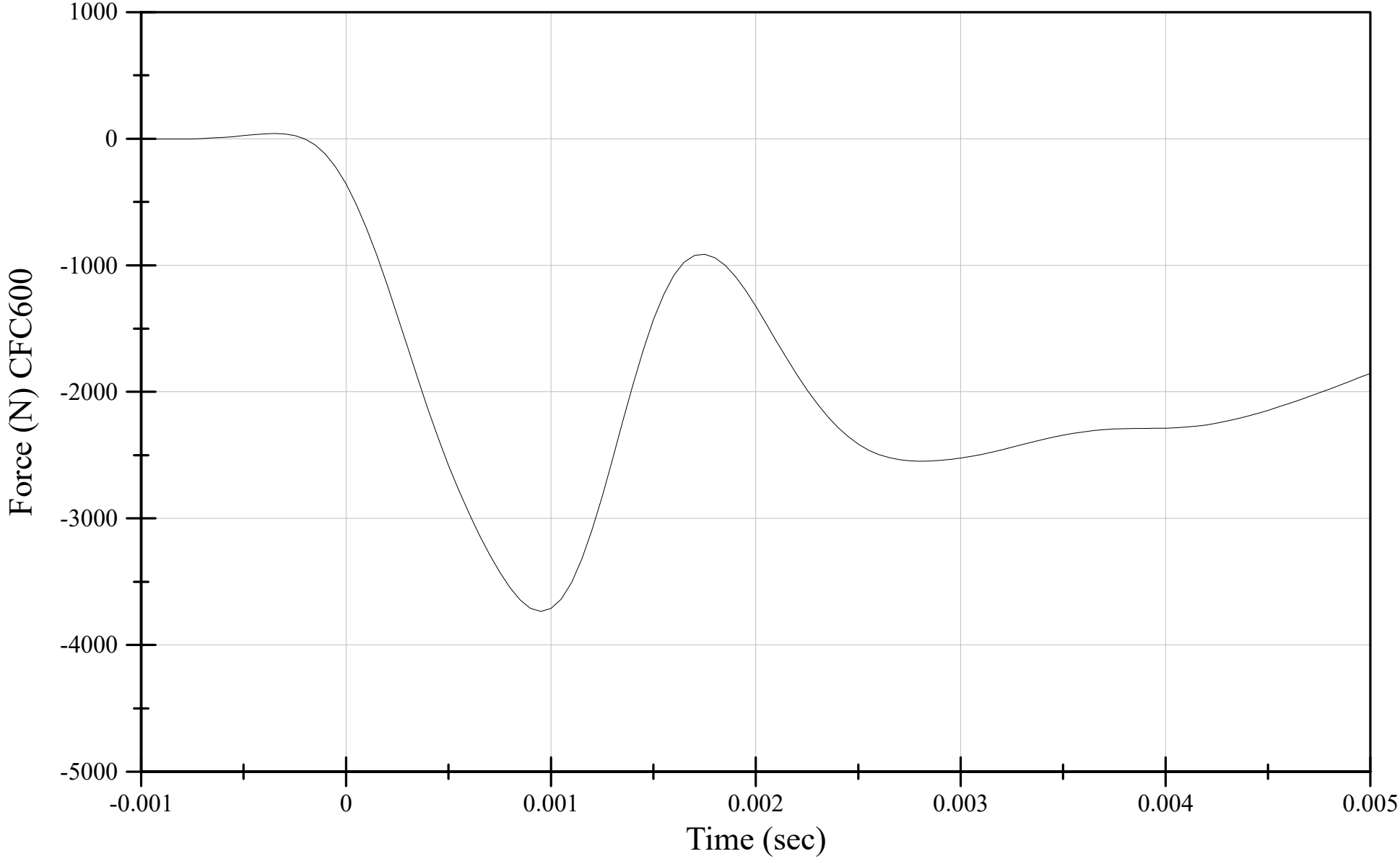
THOR-05F Left Upper Leg Qualification
Probe Force
Serial Number: EV0674



File Name: 220616-16 processed

6/16/2022 5:14 PM

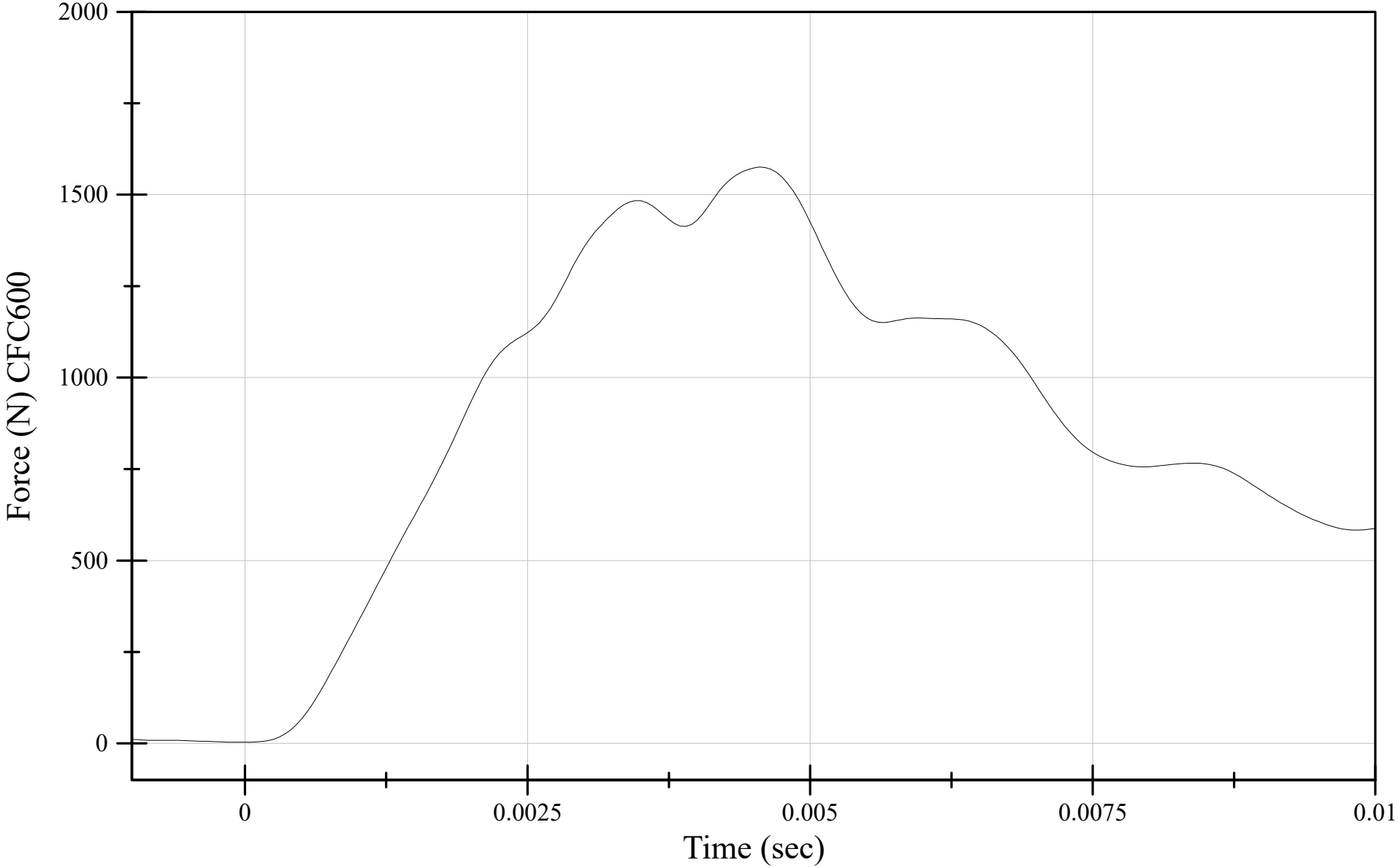
THOR-05F Left Upper Leg Qualification
Femur Z-Force
Serial Number: EV0674



File Name: 220616-16 processed

6/16/2022 5:14 PM

THOR-05F Left Upper Leg Qualification
Peak Acetabulum Resultant Force
Serial Number: EV0674



File Name: 220616-16 processed

6/16/2022 5:14 PM

THOR-05F Left Knee Qualification
Test Results Summary

Dummy Serial Number: EV0674

Test ID: 220622-3
Test Date: 6/22/2022
Test Time: 1:30 PM

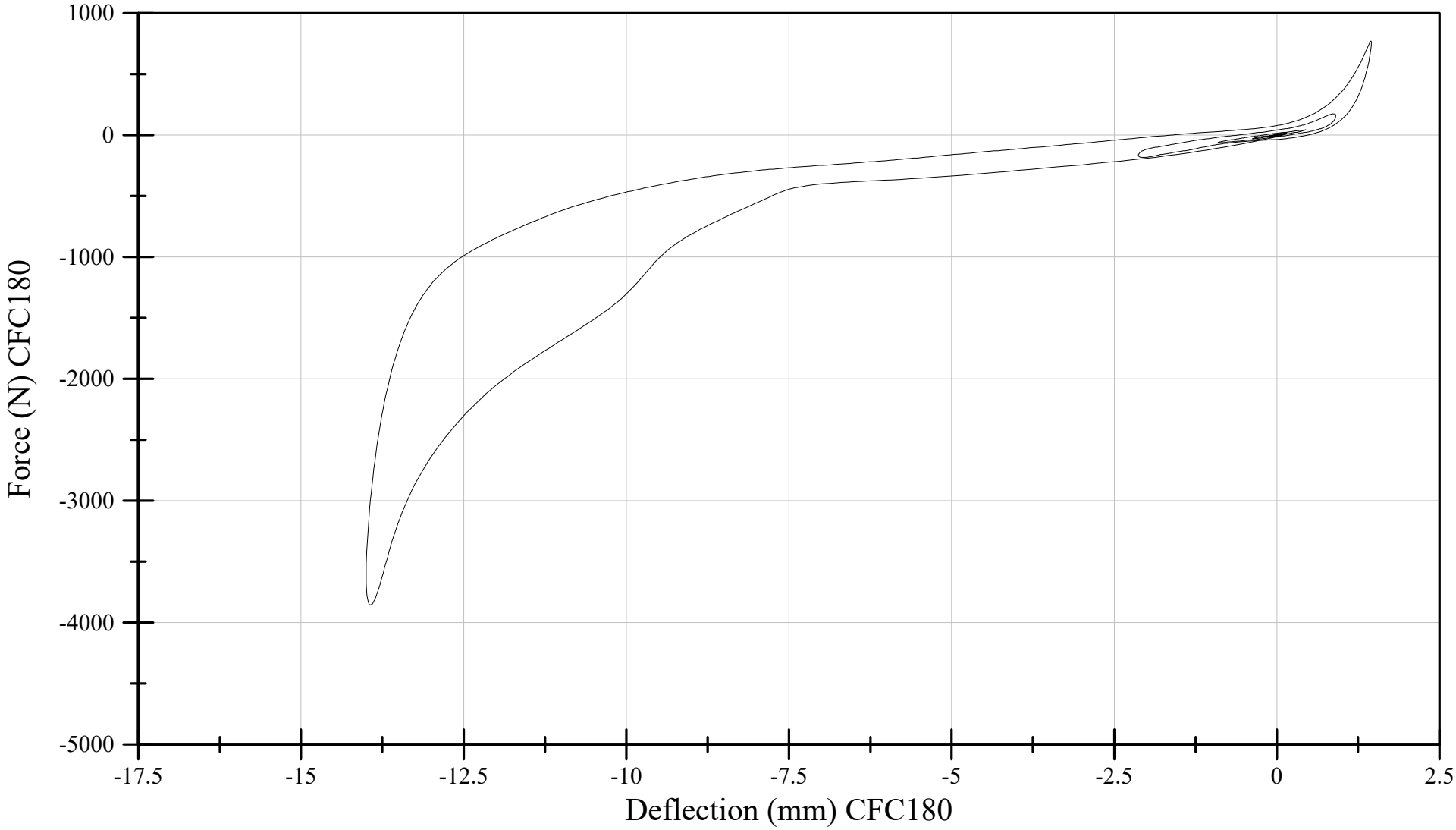
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.5	Pass
Test Humidity (%)	10 - 70	49	Pass
Test Velocity (m/s)	2.10 - 2.20	2.17	Pass
Peak Femur Fz (N)		-3855.1	
Knee Deflection at Peak Femur Force (N)		-14.0	

* THOR-05F Qualification Manual - March 2022

File Name: 220622-3 processed
Software Version: 2.8

THOR-05F Left Knee Qualification
Peak Deflection at Peak Force
Serial Number: EV0674

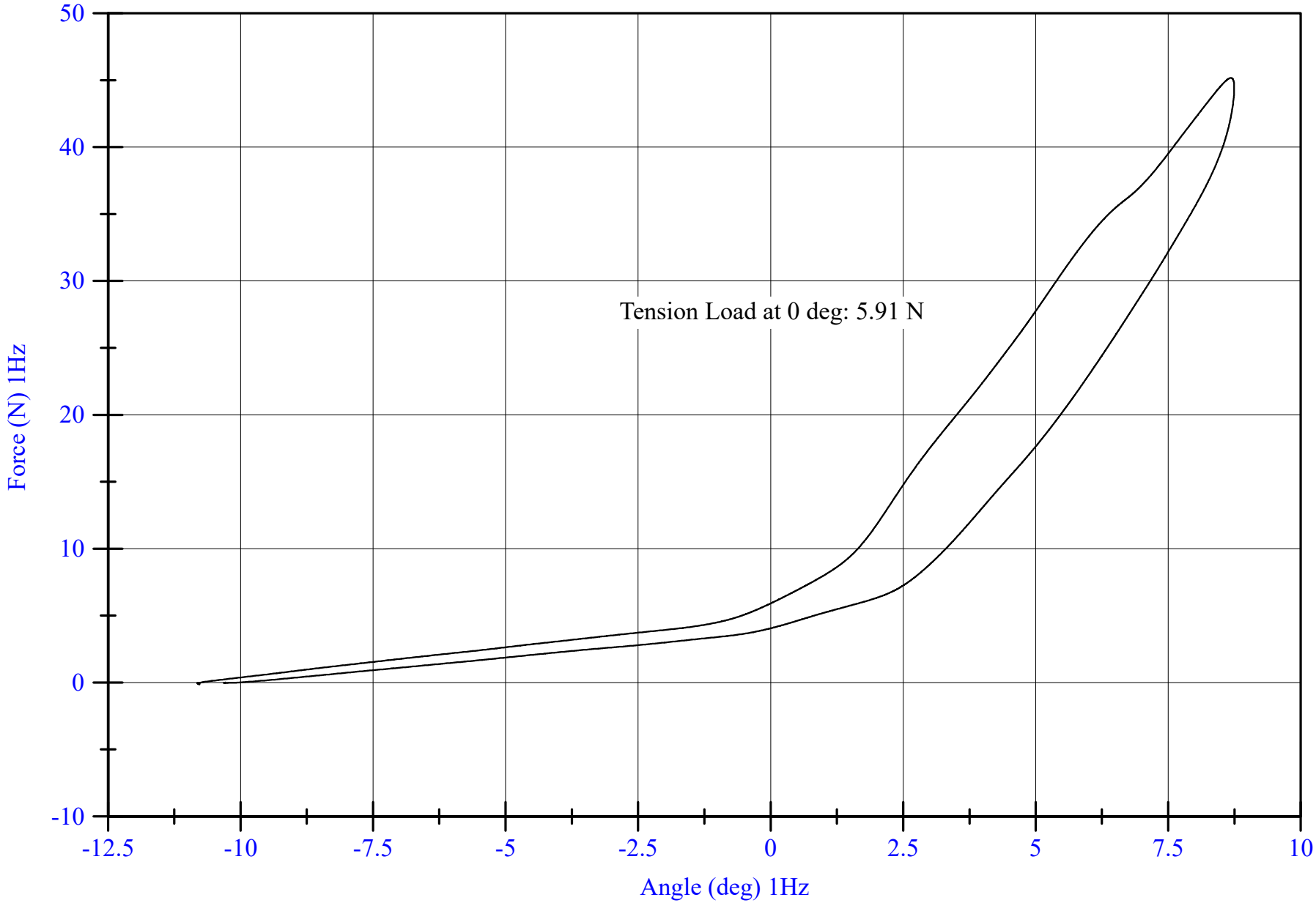


File Name: 220622-3 processed

6/22/2022 1:30 PM

Test Temperature: 21° C
Relative Humidity: 46%

THOR-05F Left Leg Achilles Qualification
Force vs Rotation
Leg Serial Number: EV0674



Data file: 220713-2 processed

THOR-05F Left Ball of Foot Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components

Left Ankle: EV4000

Dorsiflexion Stop: EV3717

Test ID: 220713-7

Test Date: 7/13/2022

Test Time: 1:40 PM

Test Results

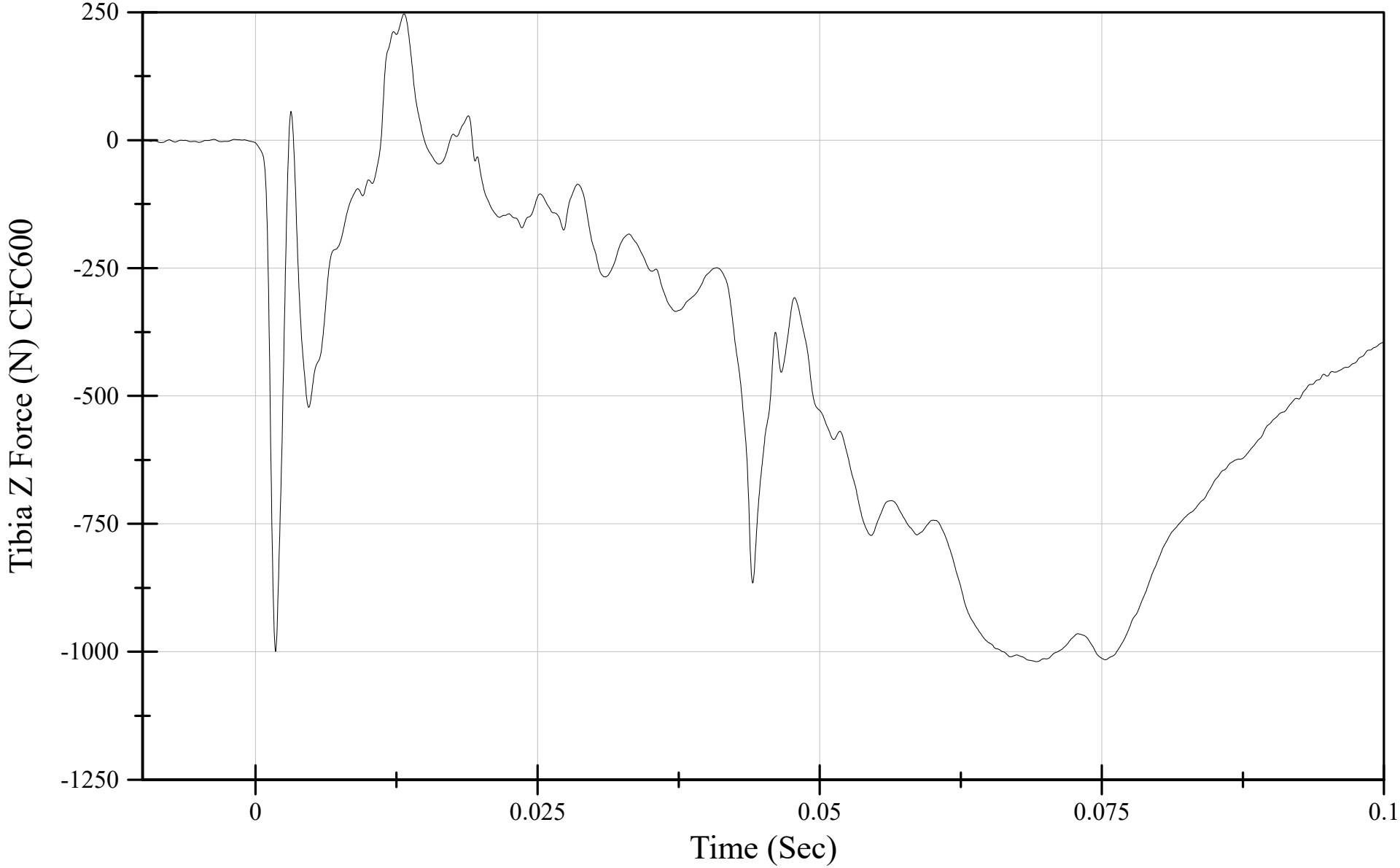
Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.0	Pass
Test Humidity (%)	10 - 70	47	Pass
Test Velocity (m/s)	1.95 - 2.05	1.96	Pass
Peak Lower Tibia Fz after 10 ms (N)		-1019.2	
Peak Ankle Resistive Moment (Nm)		54.5	
Peak Ankle Y-axis Rotation (deg)		31.5	

* THOR-05F Qualification Manual - March 2022

File Name: 220713-7 processed

Software Version: 2.8

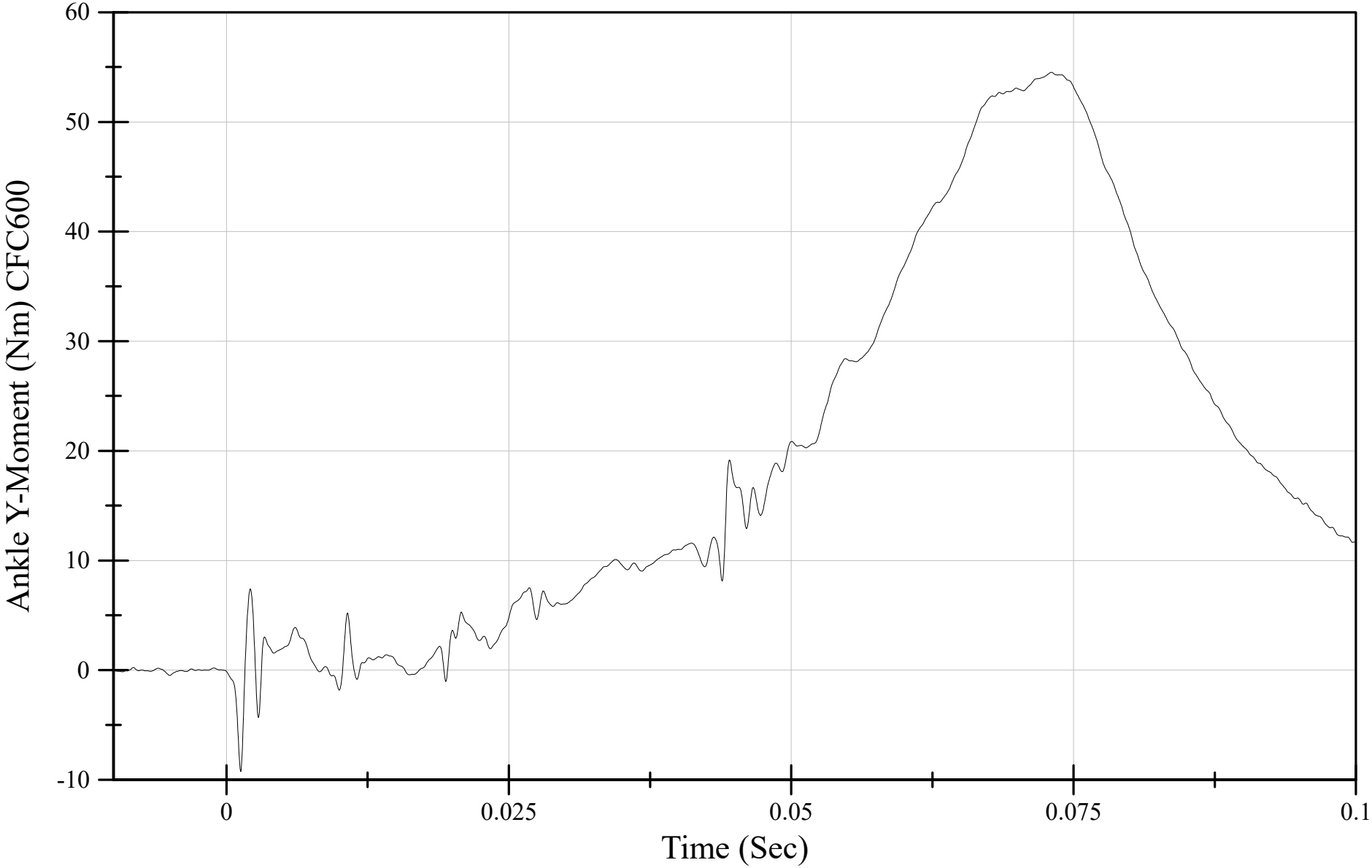
THOR-05F Left Ball of Foot Qualification
Lower Tibia Fz
Serial Number: EV0674



File Name: 220713-7 processed

7/13/2022 1:40 PM

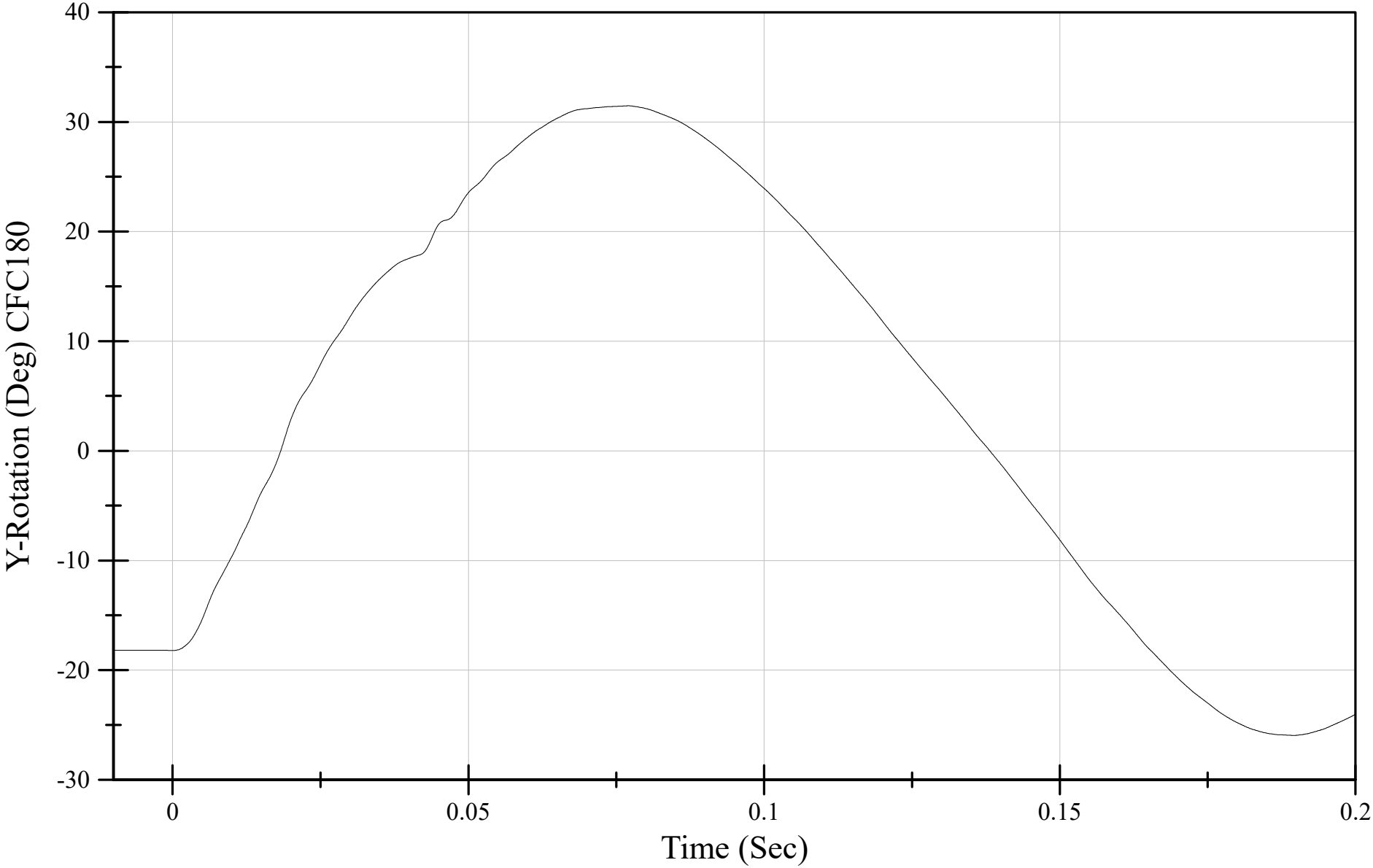
THOR-05F Left Ball of Foot Qualification
Ankle Y-Moment
Serial Number: EV0674



File Name: 220713-7 processed

7/13/2022 1:40 PM

THOR-05F Left Ball of Foot Qualification
Ankle Y-Rotation
Serial Number: EV0674



File Name: 220713-7 processed

7/13/2022 1:40 PM

THOR-05F Left Foot Inversion Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components	Test ID: 220713-8
Ankle Serial: EV4000	Test Date: 7/13/2022
Inversion Stop Assembly: ET9530	Test Time: 2:12 PM

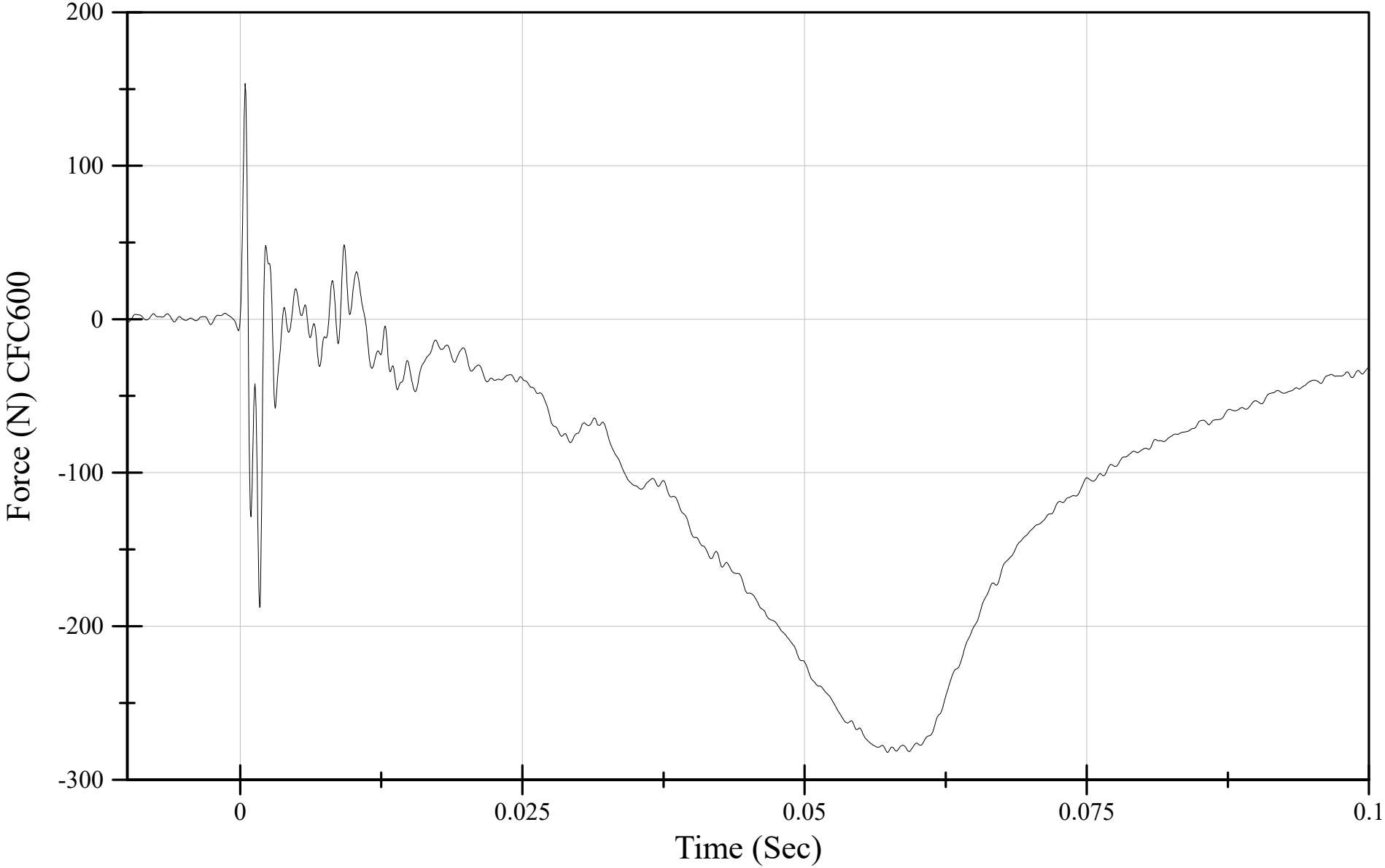
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.1	Pass
Test Humidity (%)	10 - 70	46	Pass
Test Velocity (m/s)	1.95 - 2.05	2.02	Pass
Peak Lower Tibia Fz		-282.2	
Peak Ankle X-axis Resistive Moment		-31.0	
Peak Ankle X-axis Rotation		-44.7	

* THOR-05F Qualification Manual - March 2022

File Name: 220713-8 processed
Software Version: 2.8

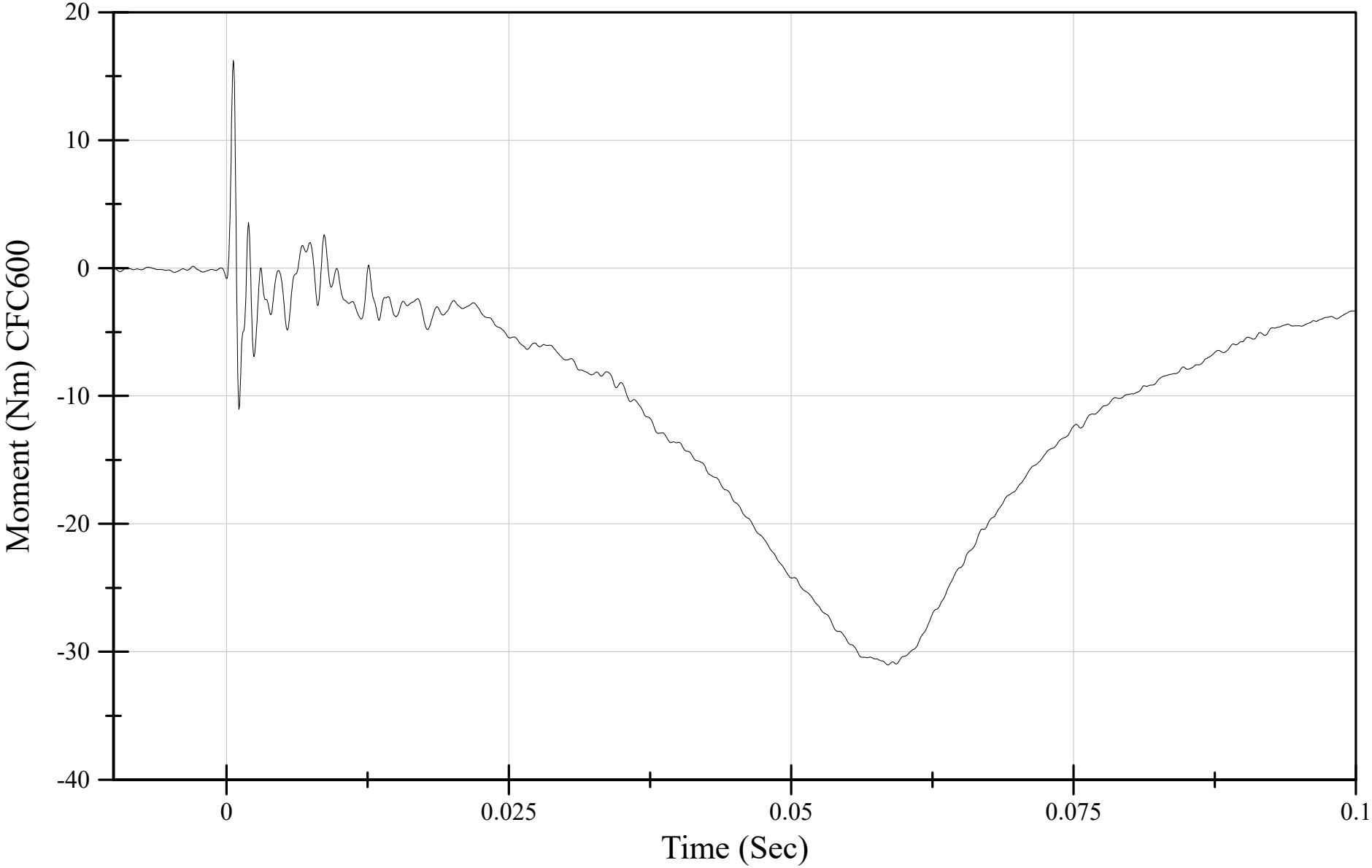
THOR-05F Left Foot Inversion Qualification
Tibia Load - Force Z
Ankle Serial Number: EV4000



File Name: 220713-8 processed

7/13/2022 2:12 PM

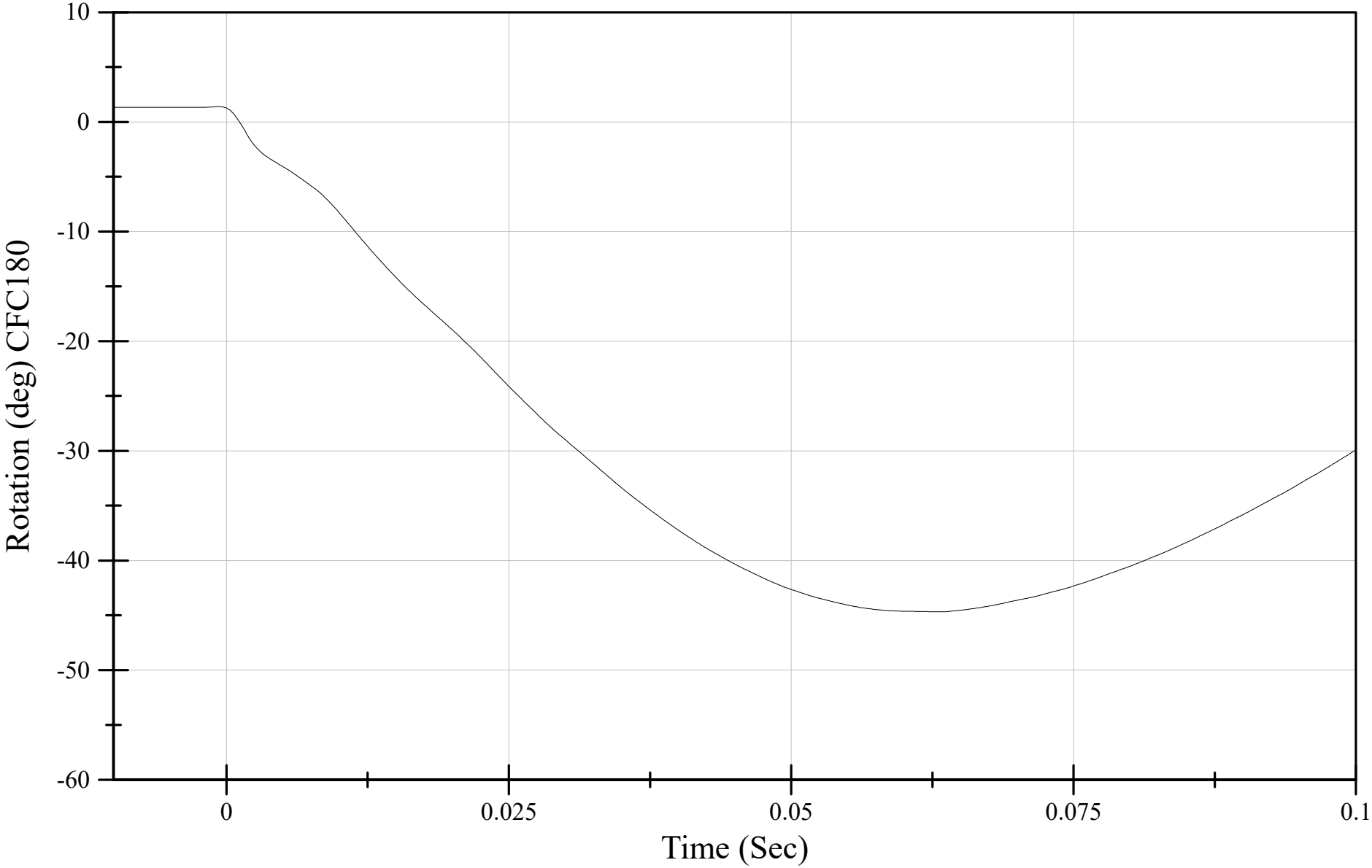
THOR-05F Left Foot Inversion Qualification
Ankle Moment - X axis
Ankle Serial Number: EV4000



File Name: 220713-8 processed

7/13/2022 2:12 PM

THOR-05F Left Foot Inversion Qualification
Ankle X-Rotation
Ankle Serial Number: EV4000



File Name: 220713-8 processed

7/13/2022 2:12 PM

THOR-05F Left Foot Eversion Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components	Test ID: 220713-10
Ankle Serial: EV4000	Test Date: 7/13/2022
Eversion Stop Assembly: EU9453	Test Time: 3:22 PM

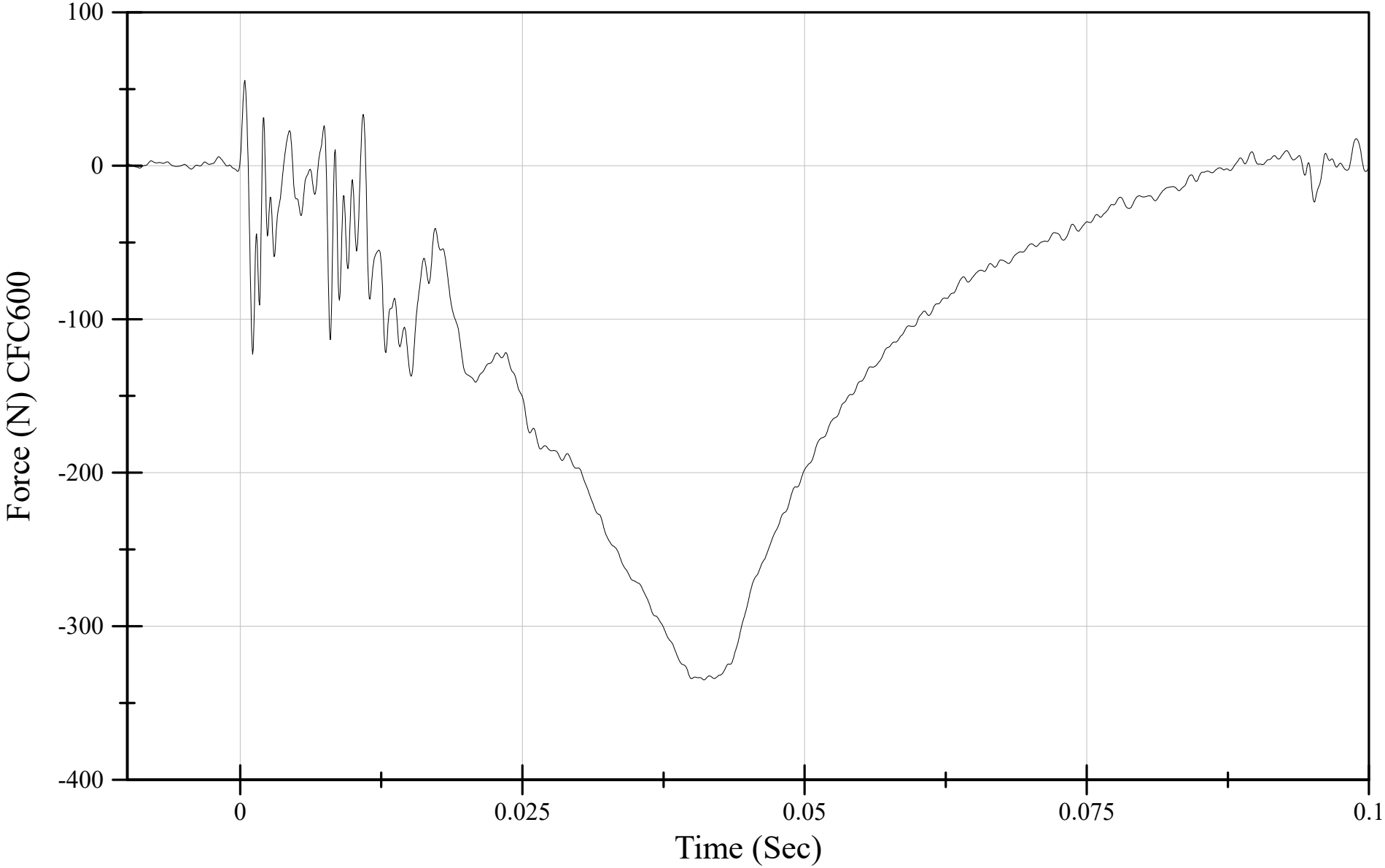
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.2	Pass
Test Humidity (%)	10 - 70	47	Pass
Test Velocity (m/s)	1.95 - 2.05	2.04	Pass
Peak Lower Tibia Fz		-335.0	
Peak Ankle X-axis Resistive Moment		32.0	
Peak Ankle X-axis Rotation		28.8	

* THOR-05F Qualification Manual - March 2022

File Name: 220713-10 processed
Software Version: 2.8

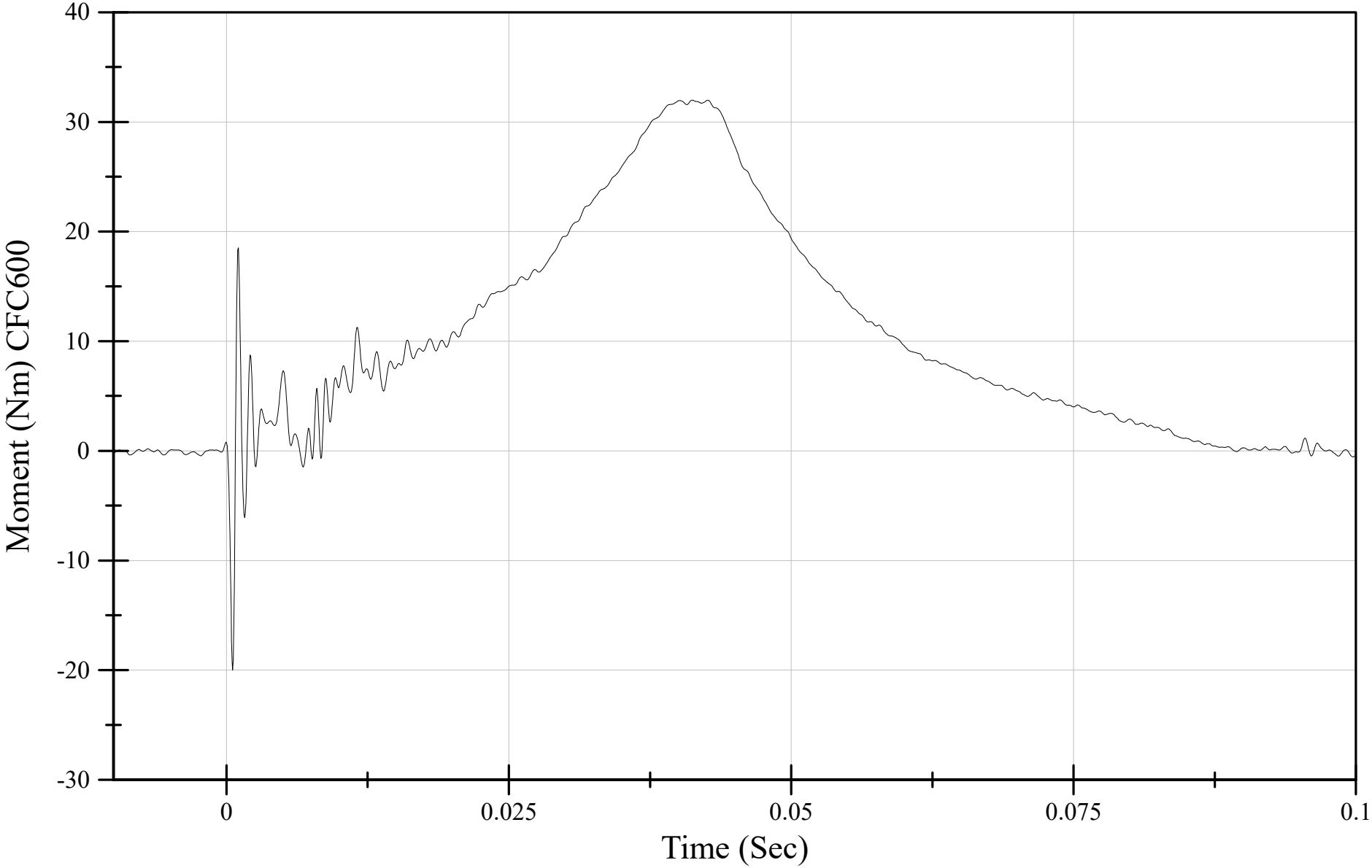
THOR-05F Left Foot Eversion Qualification
Tibia Load - Force Z
Ankle Serial Number: EV4000



File Name: 220713-10 processed

7/13/2022 3:22 PM

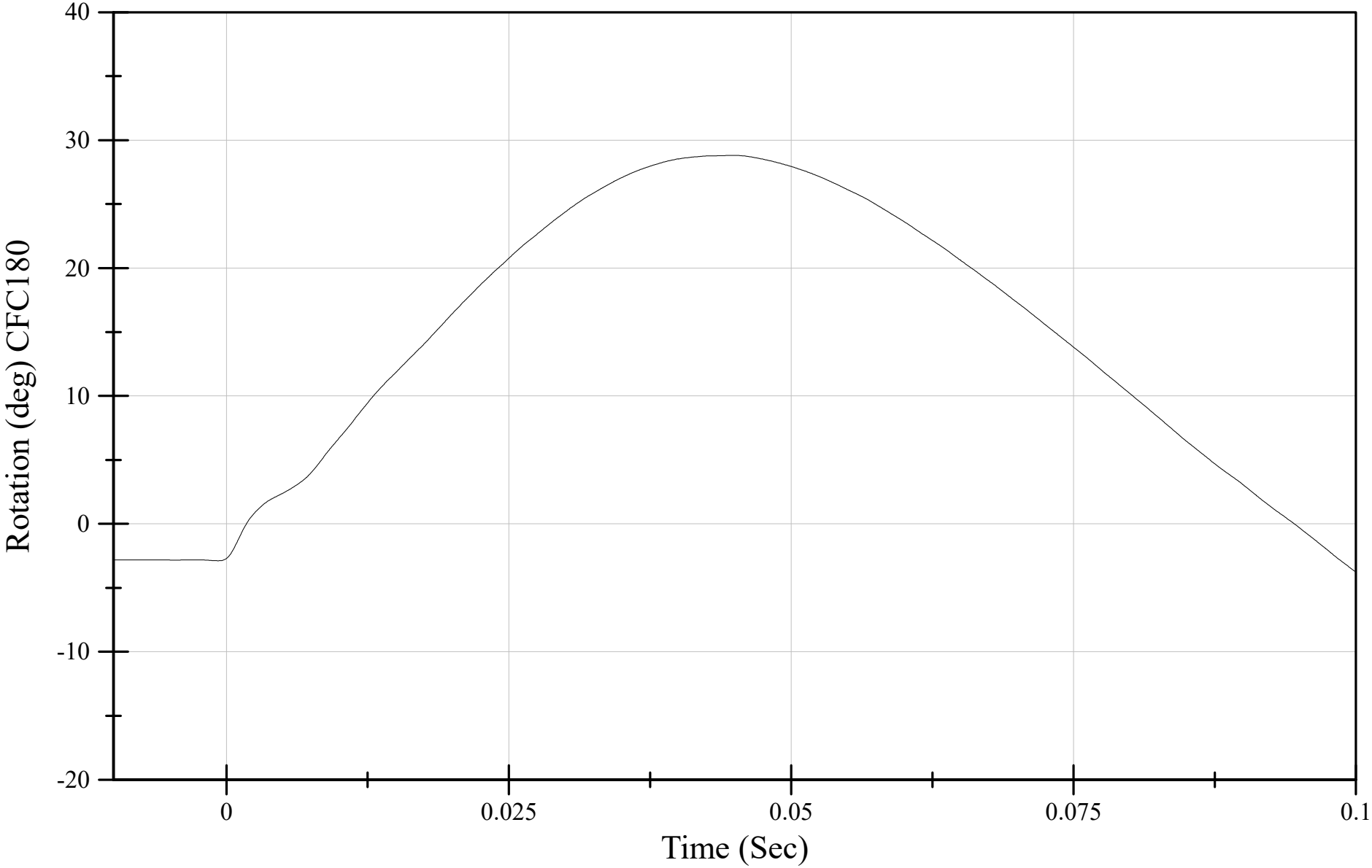
THOR-05F Left Foot Eversion Qualification
Ankle Moment - X axis
Ankle Serial Number: EV4000



File Name: 220713-10 processed

7/13/2022 3:22 PM

THOR-05F Left Foot Eversion Qualification
Ankle X-Rotation
Ankle Serial Number: EV4000



File Name: 220713-10 processed

7/13/2022 3:22 PM

THOR-05F Left Heel Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Left Ankle: EV4000

Test ID: 220713-13
Test Date: 7/13/2022
Test Time: 4:10 PM

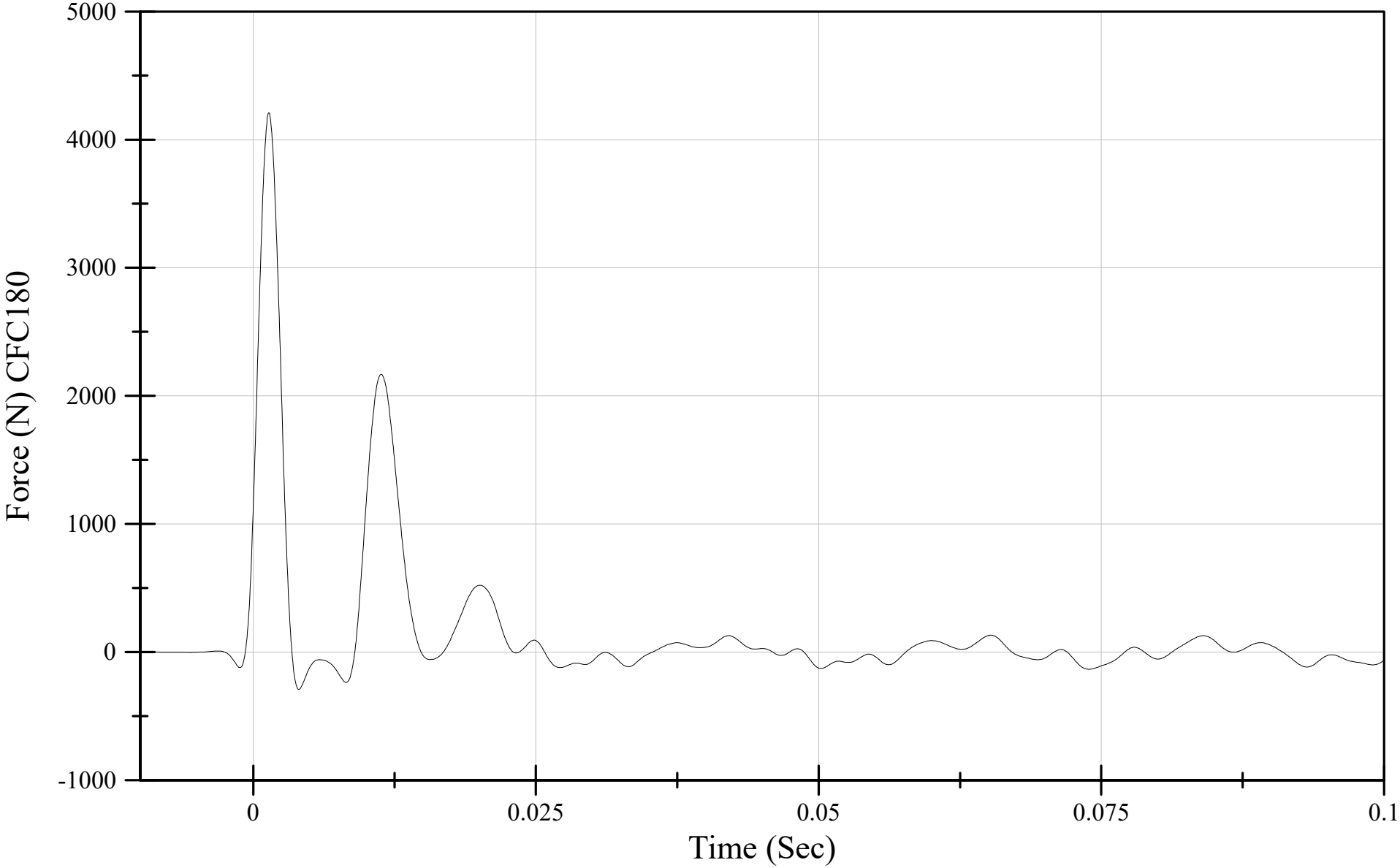
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.2	Pass
Test Humidity (%)	10 - 70	47	Pass
Test Velocity (m/s)	3.95 - 4.05	3.99	Pass
Probe Force (N)		4210.4	
Peak Lower Tibia Fz (N)		-2132.5	

* THOR-05F Qualification Manual - March 2022

File Name: 220713-13 processed
Software Version: 2.8

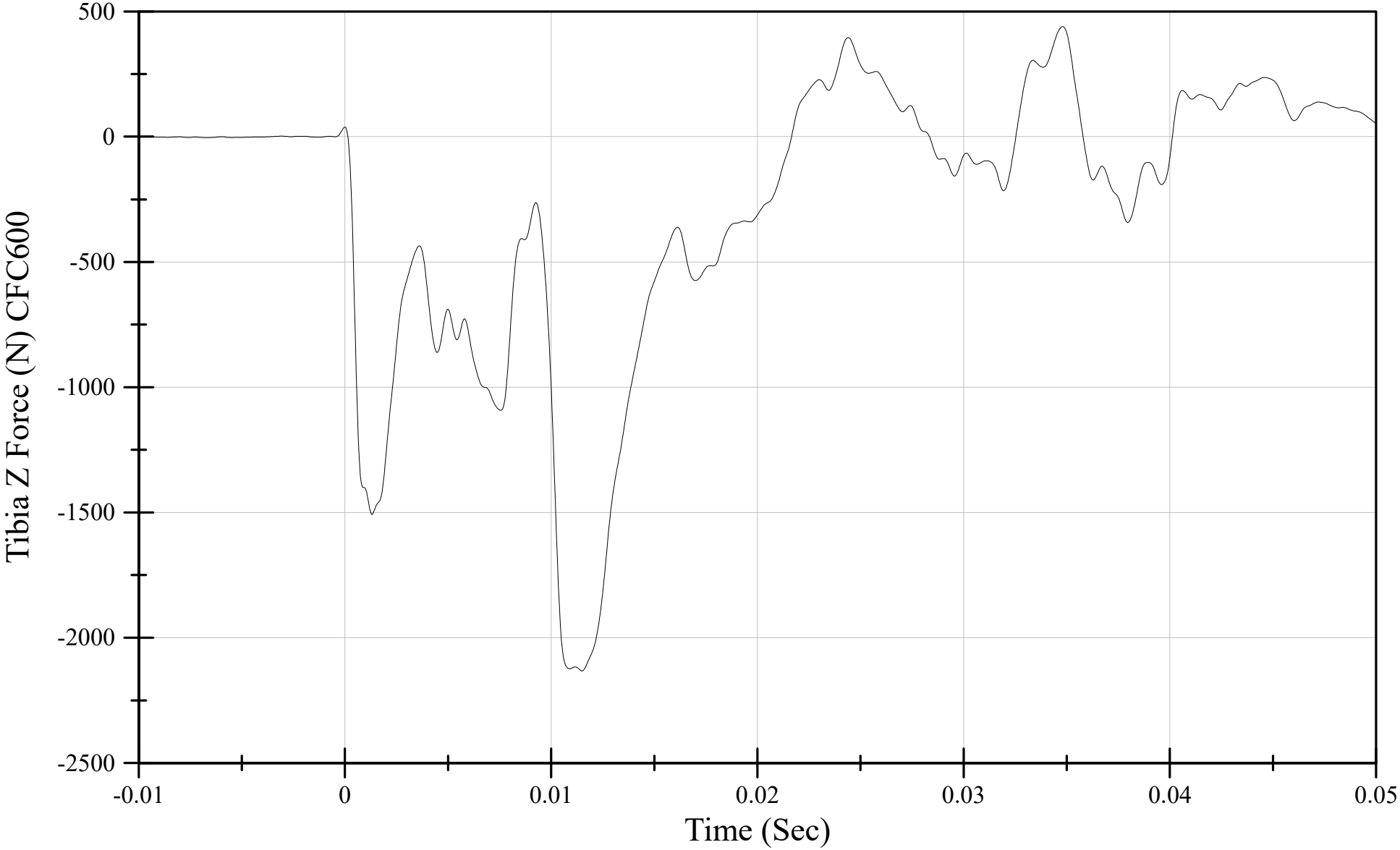
THOR-05F Left Heel Qualification
Probe Force
Dummy Serial Number: EV0674



File Name: 220713-13 processed

7/13/2022 4:10 PM

THOR-05F Left Heel Qualification
Tibia Load
Serial Number: EV0674



File Name: 220713-13 processed

7/13/2022 4:10 PM

THOR-05F Right Upper Leg Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Compression Element: EV0619
Right Thigh Flesh: EV0939

Test ID: 220621-1
Test Date: 6/21/2022
Test Time: 11:03 AM

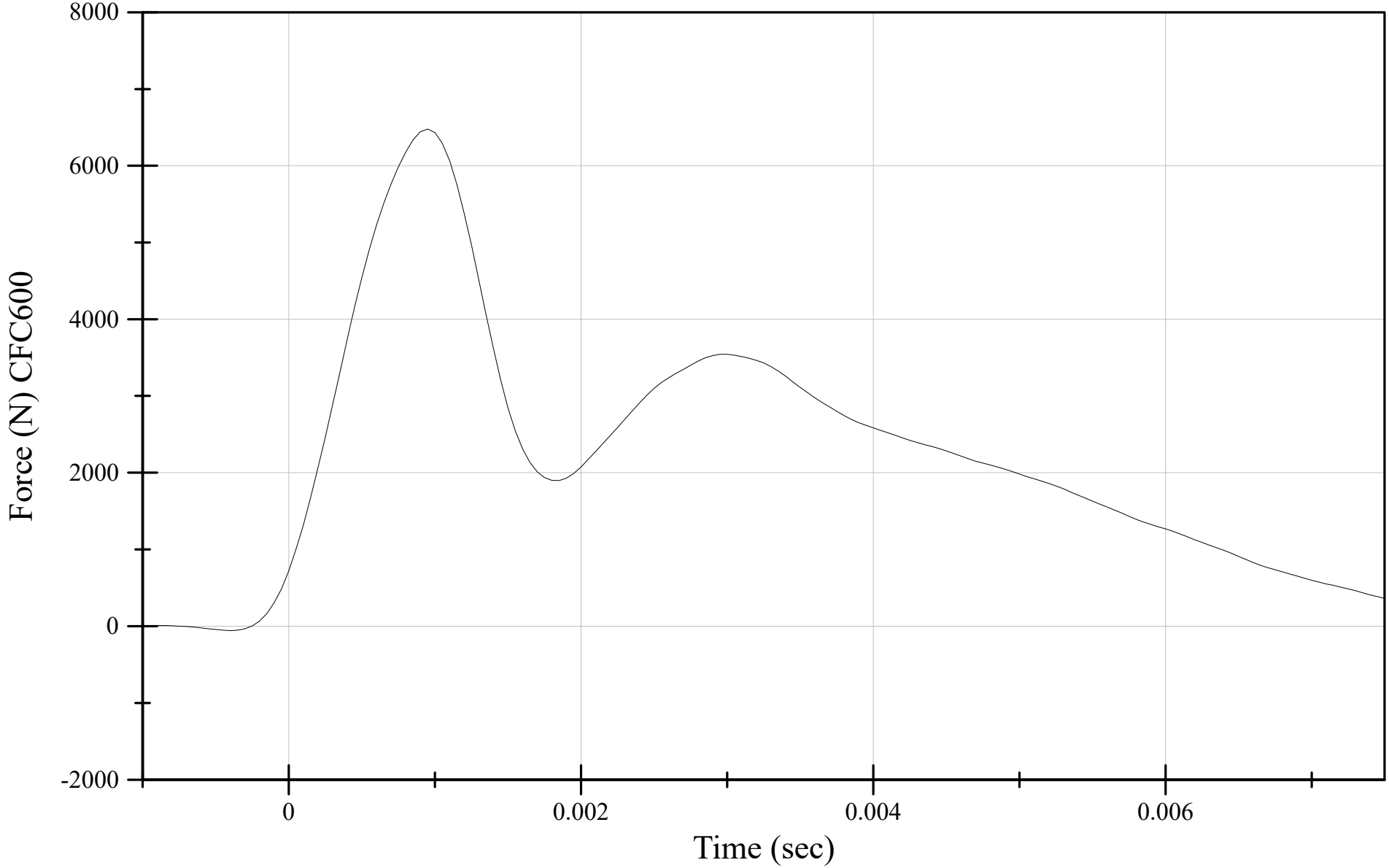
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.1	Pass
Test Humidity (%)	10 - 70	46	Pass
Test Velocity (m/s)	3.25 - 3.35	3.27	Pass
Peak Probe Force (N)		6480	
Peak Femur Force (N)		-3849	
Peak Resultant Acetabulum Force (N)		1700	

* THOR-05F Qualification Manual - March 2022

File Name: 220621-1 processed

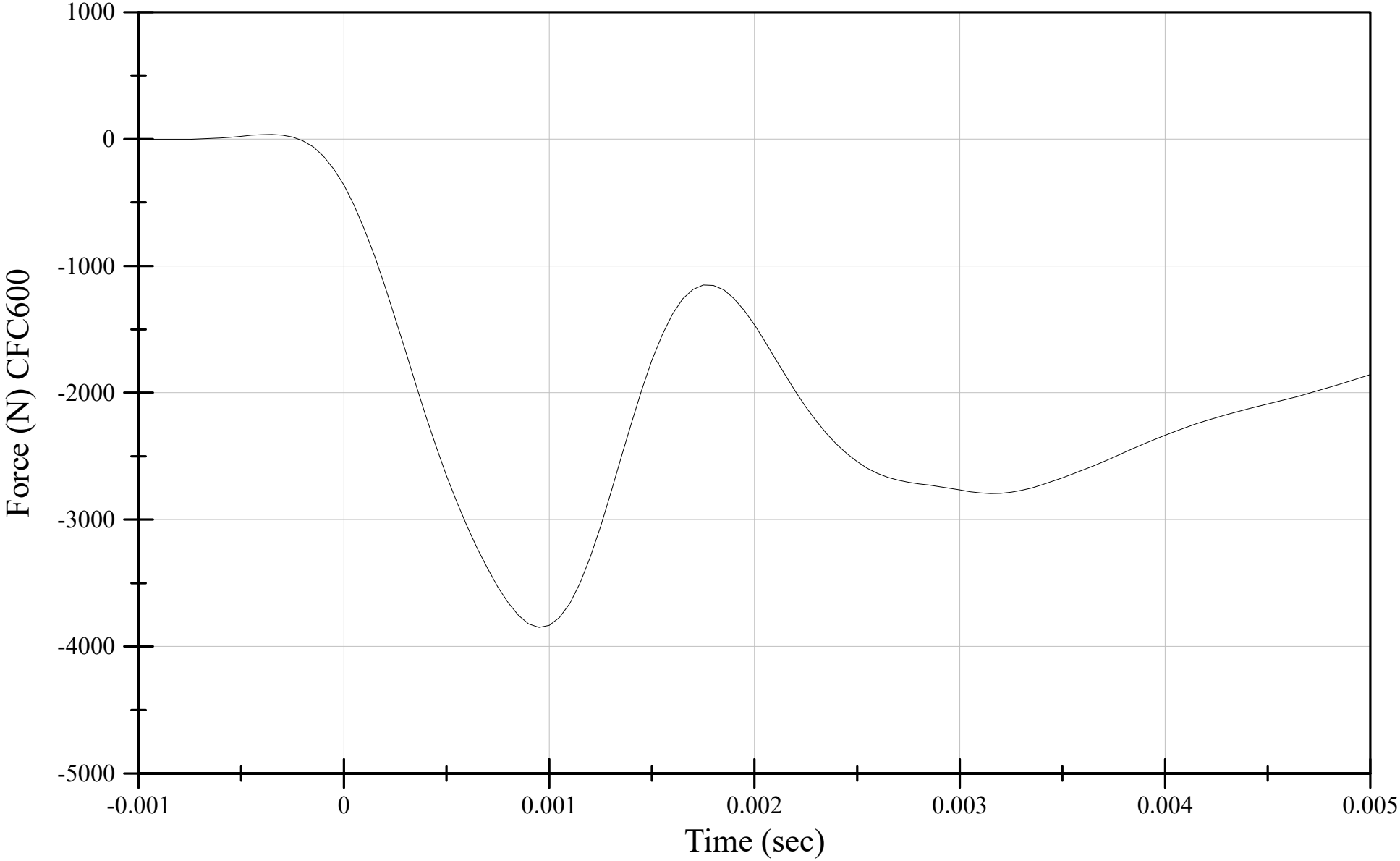
THOR-05F Right Upper Leg Qualification
Probe Force
Serial Number: EV0674



File Name: 220621-1 processed

6/21/2022 11:03 AM

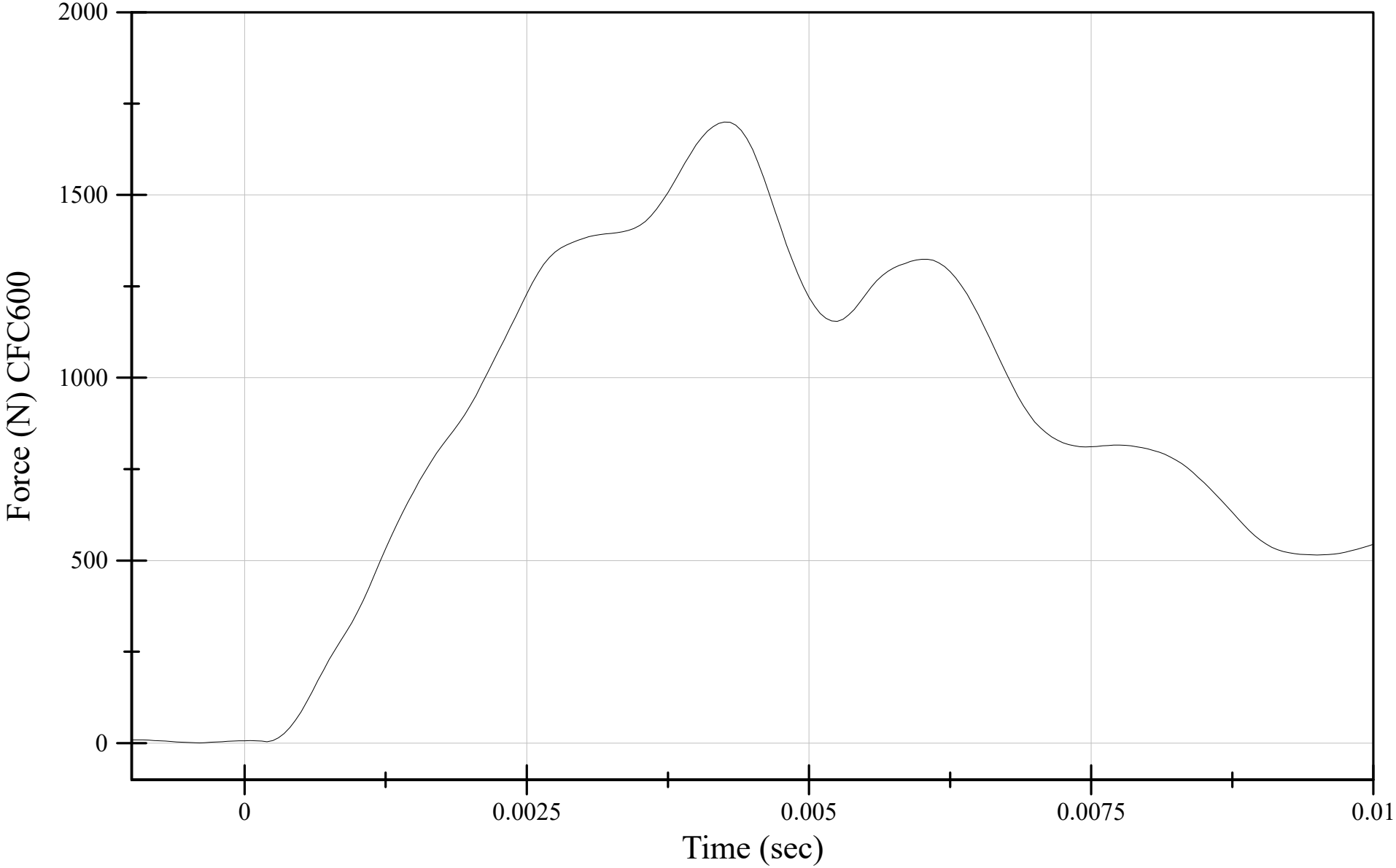
THOR-05F Right Upper Leg Qualification
Femur Z-Force
Serial Number: EV0674



File Name: 220621-1 processed

6/21/2022 11:03 AM

THOR-05F Right Upper Leg Qualification
Peak Acetabulum Resultant Force
Serial Number: EV0674



File Name: 220621-1 processed

6/21/2022 11:03 AM

THOR-05F Right Knee Qualification
Test Results Summary

Dummy Serial Number: EV0674

Test ID: 220706-1
Test Date: 7/6/2022
Test Time: 1:55 PM

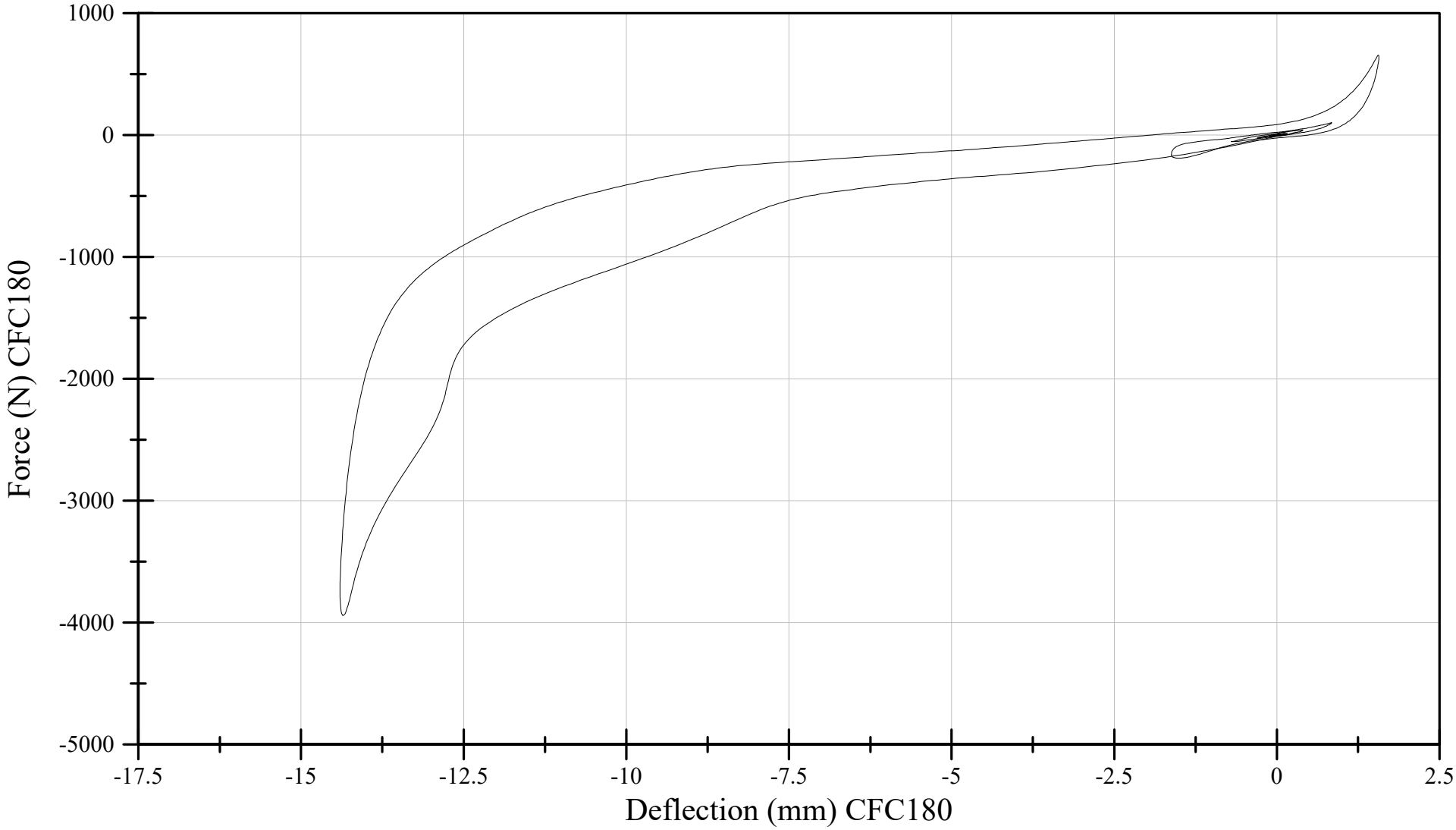
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.0	Pass
Test Humidity (%)	10 - 70	48	Pass
Test Velocity (m/s)	2.10 - 2.20	2.19	Pass
Peak Femur Fz (N)		-3942.0	
Knee Deflection at Peak Femur Force (N)		-14.4	

* THOR-05F Qualification Manual - March 2022

File Name: 220706-1 processed
Software Version: 2.8

THOR-05F Right Knee Qualification
Peak Deflection at Peak Force
Serial Number: EV0674

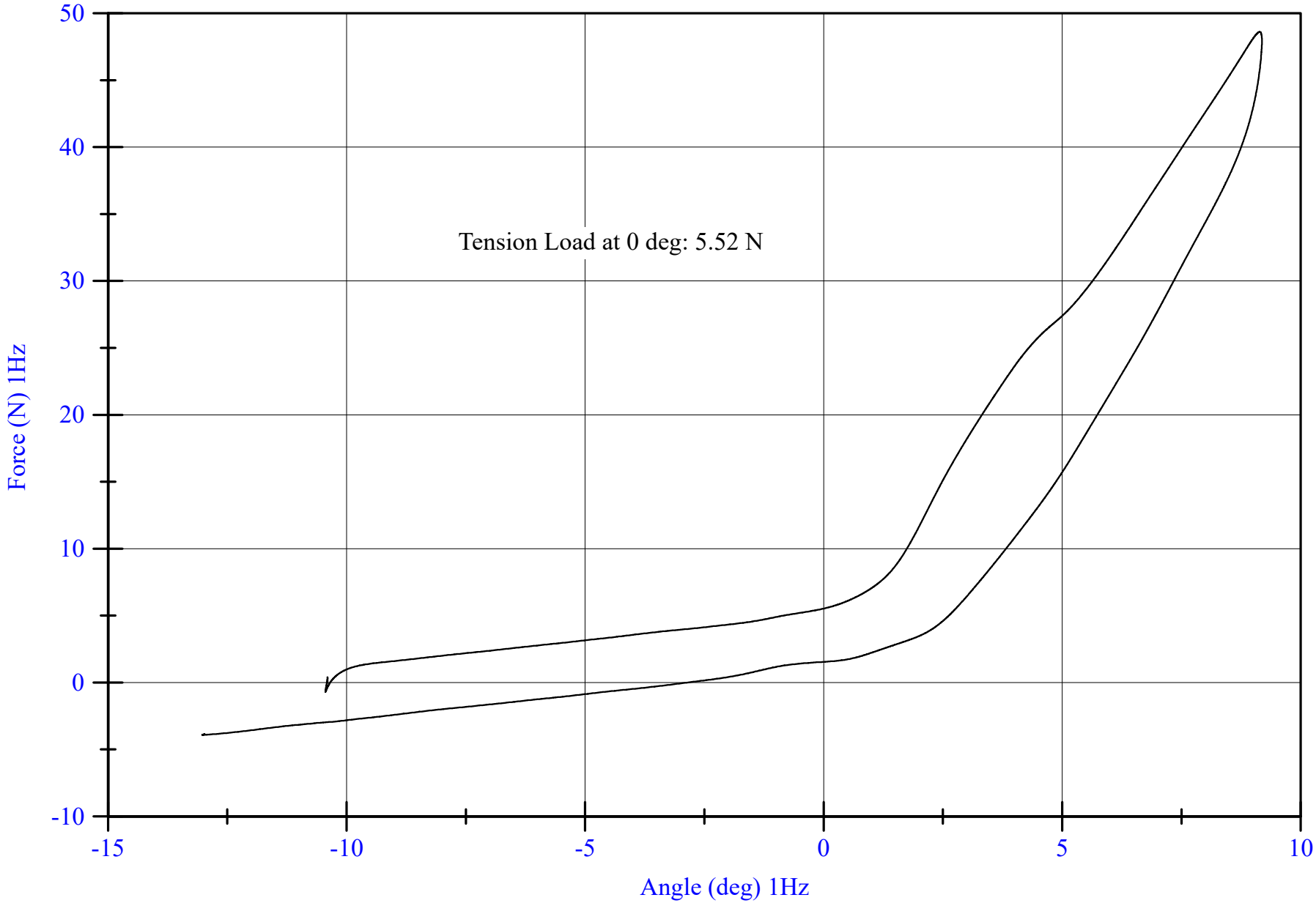


File Name: 220706-1 processed

7/6/2022 1:55 PM

Test Temperature: 21.2° C
Relative Humidity: 47%

THOR-05F Right Achilles Tension Qualification
Force vs Rotation
Leg Serial Number: EV4210



Test ID: 220712-9 processed

THOR-05F Right Ball of Foot Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Left Ankle: EV4210
Dorsiflexion Stop: EU1417

Test ID: 220712-10
Test Date: 7/12/2022
Test Time: 12:38 PM

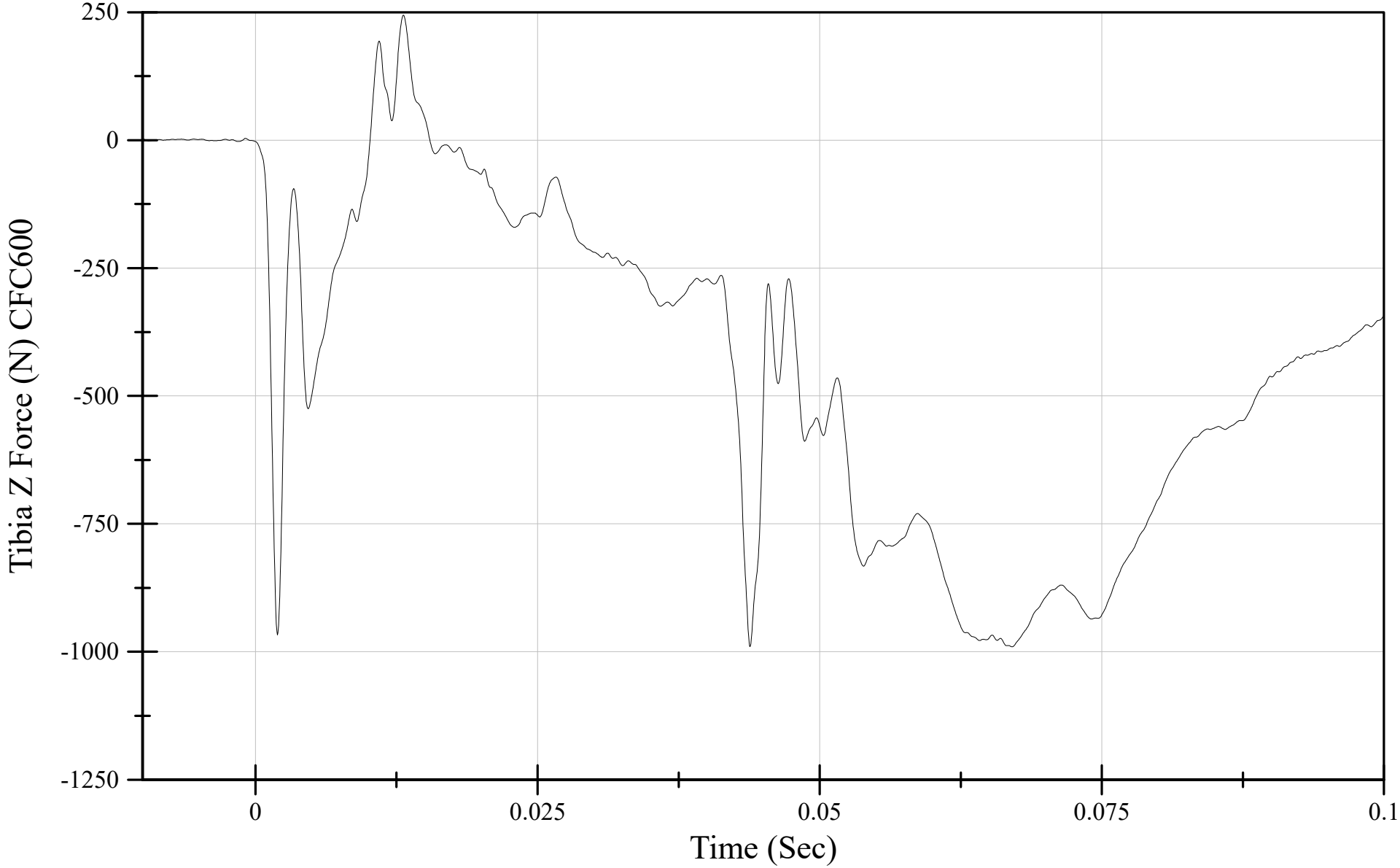
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.1	Pass
Test Humidity (%)	10 - 70	47	Pass
Test Velocity (m/s)	1.95 - 2.05	1.97	Pass
Peak Lower Tibia Fz after 10 ms (N)		-990.3	
Peak Ankle Resistive Moment (Nm)		51.1	
Peak Ankle Y-axis Rotation (deg)		30.6	

* THOR-05F Qualification Manual - March 2022

File Name: 220712-10 processed
Software Version: 2.8

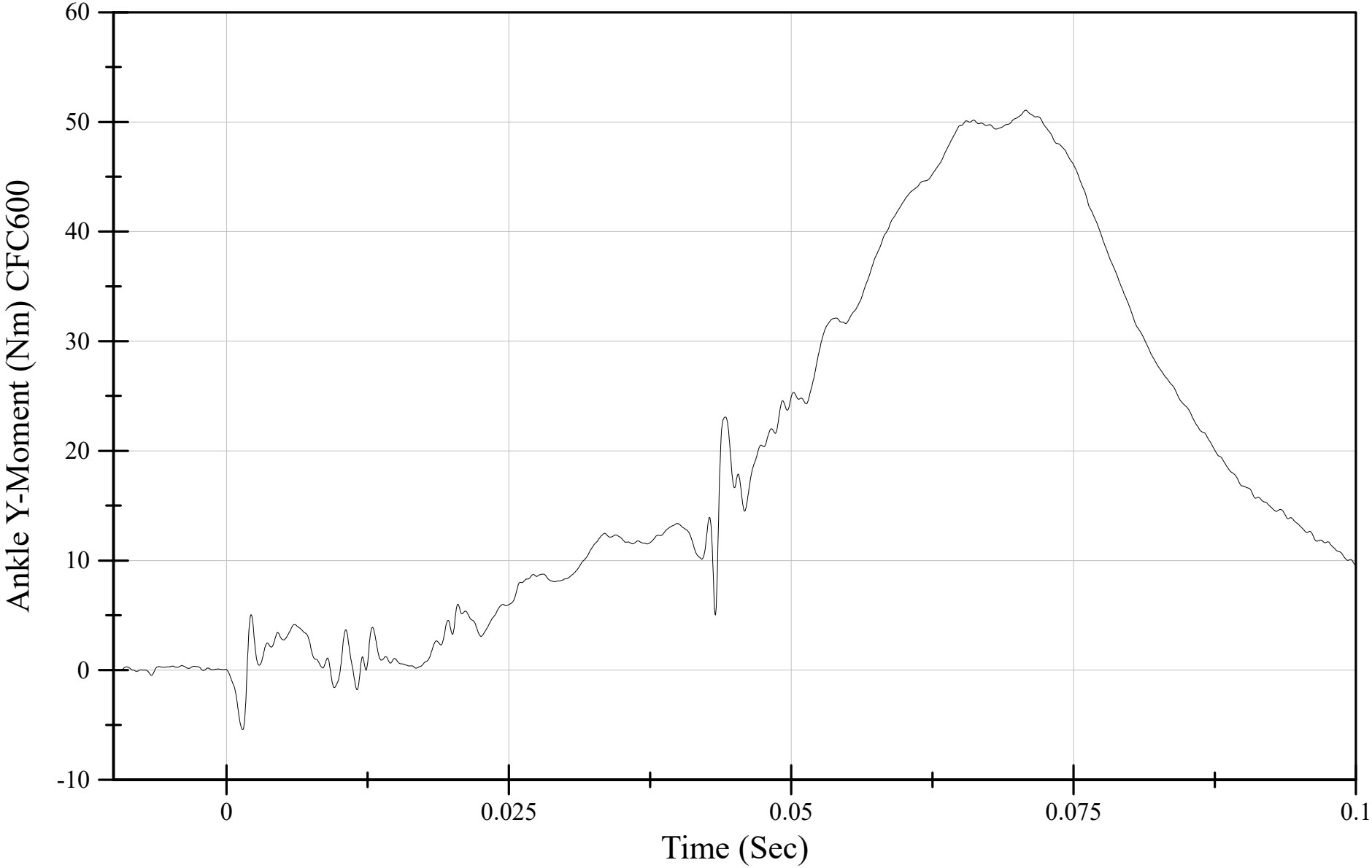
THOR-05F Right Ball of Foot Qualification
Lower Tibia Fz
Serial Number: EV0674



File Name: 220712-10 processed

7/12/2022 12:38 PM

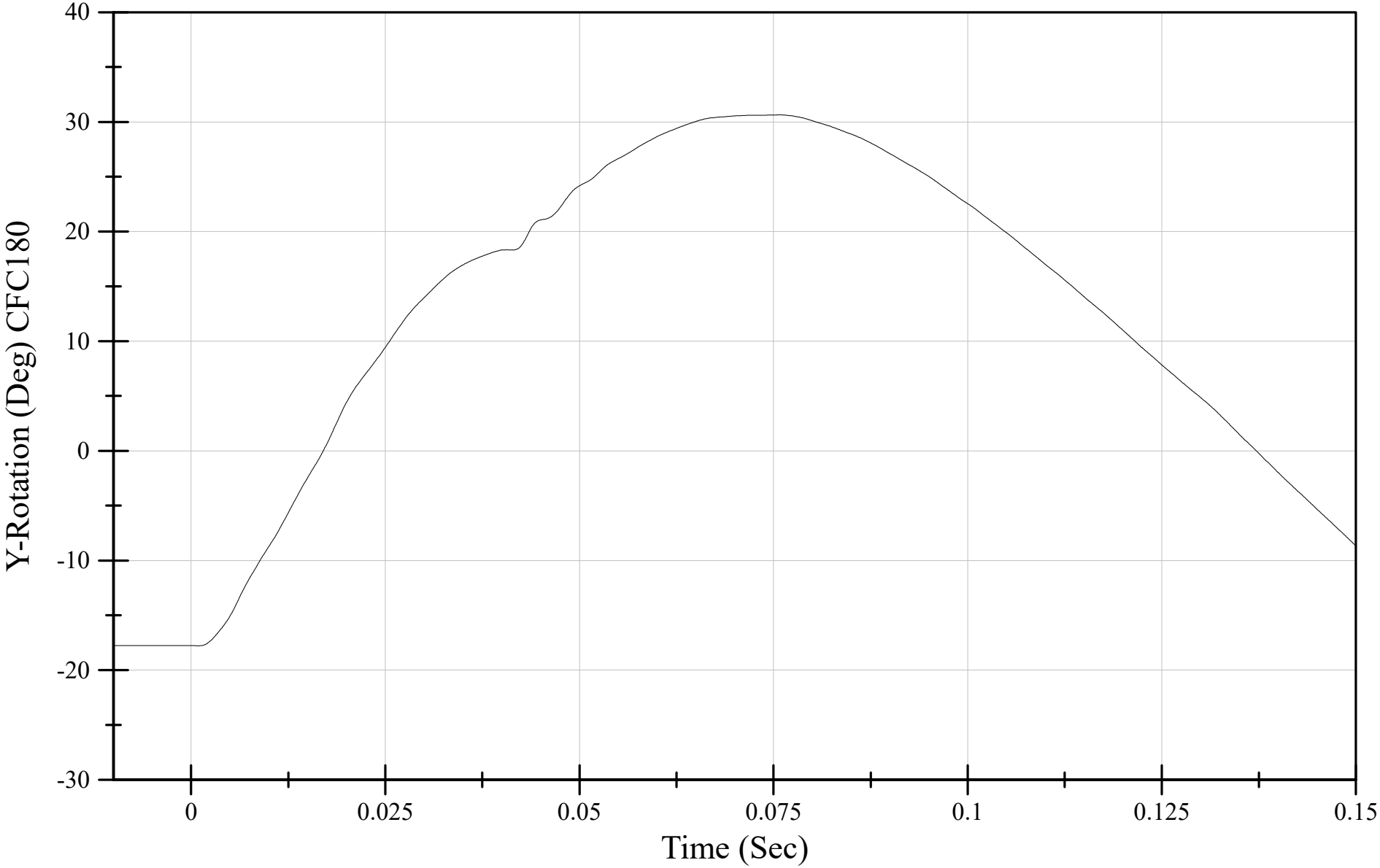
THOR-05F Right Ball of Foot Qualification
Ankle Y-Moment
Serial Number: EV0674



File Name: 220712-10 processed

7/12/2022 12:38 PM

THOR-05F Right Ball of Foot Qualification
Ankle Y-Rotation
Serial Number: EV0674



File Name: 220712-10 processed

7/12/2022 12:38 PM

THOR-05F Right Foot Inversion Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components	Test ID: 220712-14
Ankle Serial: EV4210	Test Date: 7/12/2022
Inversion Stop Assembly: EU9791	Test Time: 4:13 PM

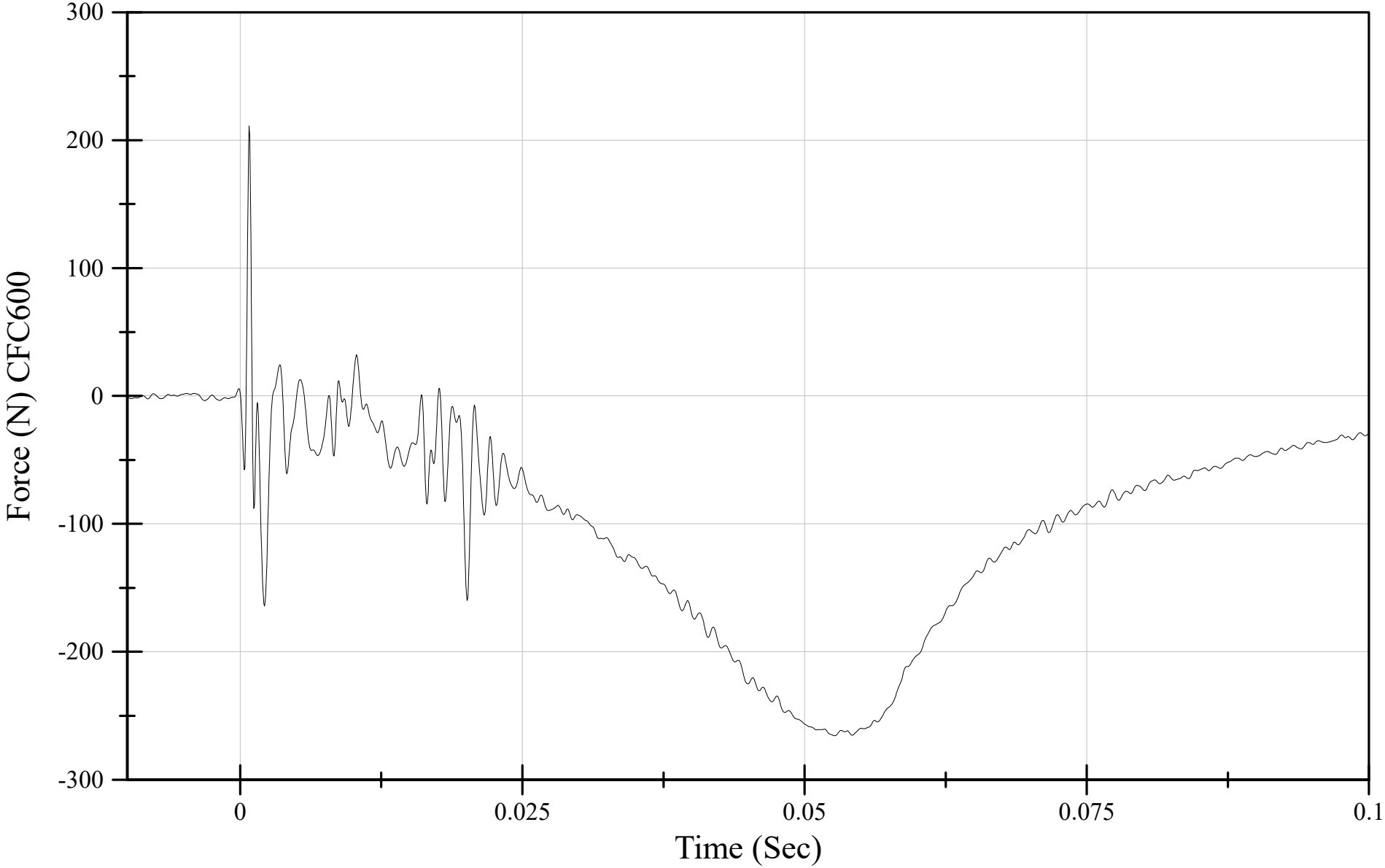
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.3	Pass
Test Humidity (%)	10 - 70	47	Pass
Test Velocity (m/s)	1.95 - 2.05	2.05	Pass
Peak Lower Tibia Fz		-265.7	
Peak Ankle X-axis Resistive Moment		28.3	
Peak Ankle X-axis Rotation		43.7	

* THOR-05F Qualification Manual - March 2022

File Name: 220712-14 processed
Software Version: 2.8

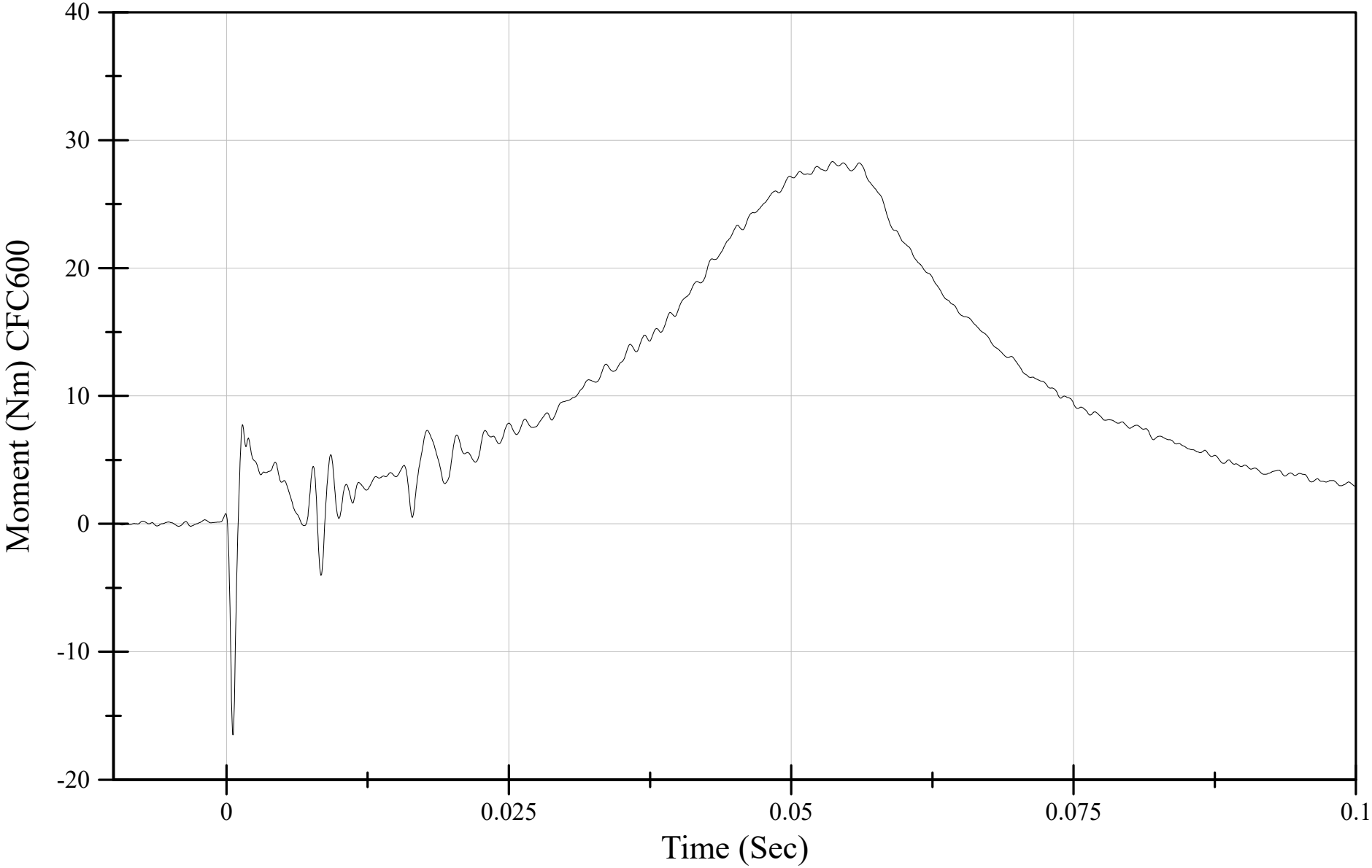
THOR-05F Right Foot Inversion Qualification
Tibia Load - Force Z
Ankle Serial Number: EV4210



File Name: 220712-14 processed

7/12/2022 4:13 PM

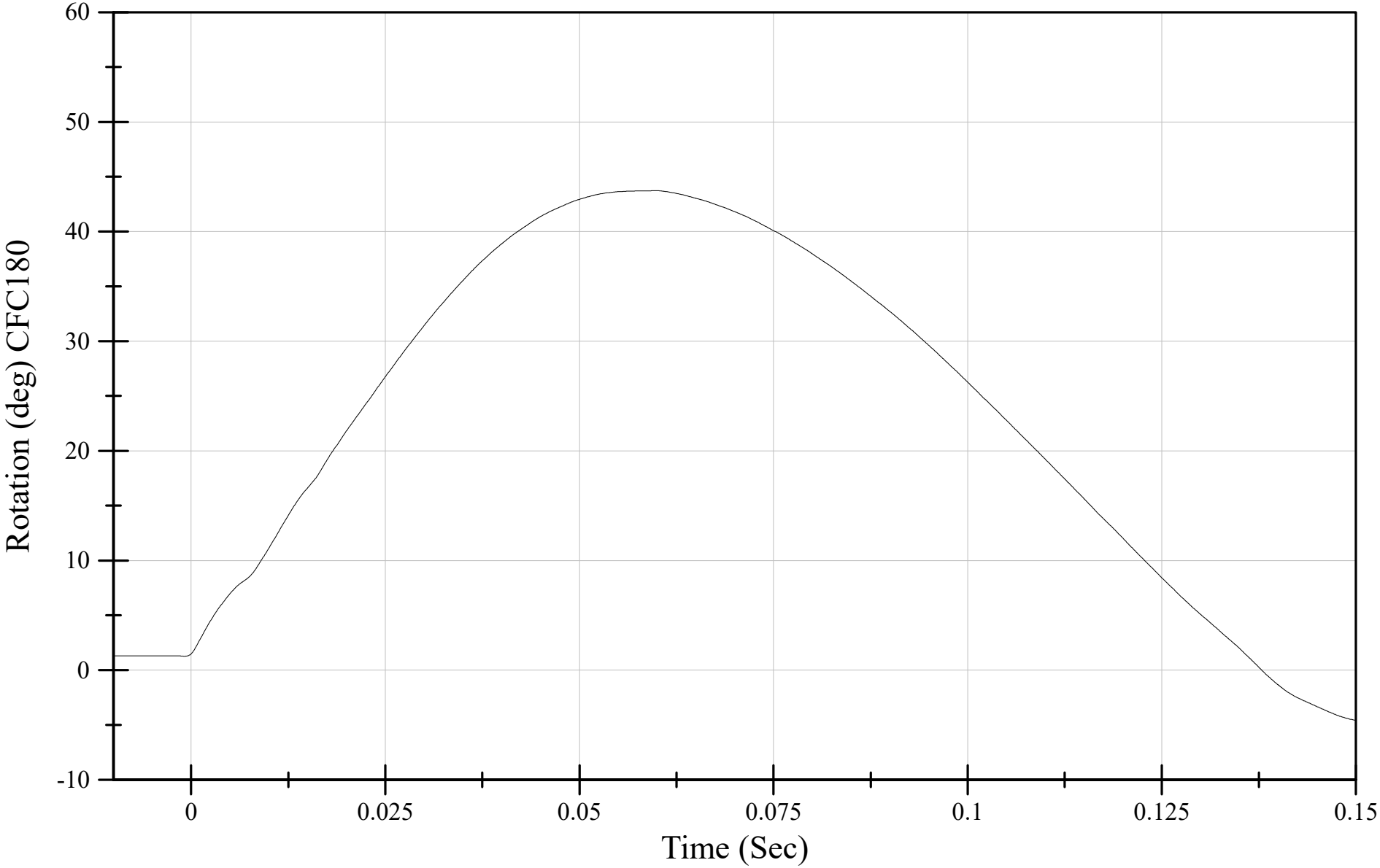
THOR-05F Right Foot Inversion Qualification
Ankle Moment - X axis
Ankle Serial Number: EV4210



File Name: 220712-14 processed

7/12/2022 4:13 PM

THOR-05F Right Foot Inversion Qualification
Ankle X-Rotation
Ankle Serial Number: EV4210



File Name: 220712-14 processed

7/12/2022 4:13 PM

THOR-05F Right Foot Eversion Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components	Test ID: 220712-11
Ankle Serial: EV4210	Test Date: 7/12/2022
Eversion Stop Assembly: EV3439	Test Time: 3:03 PM

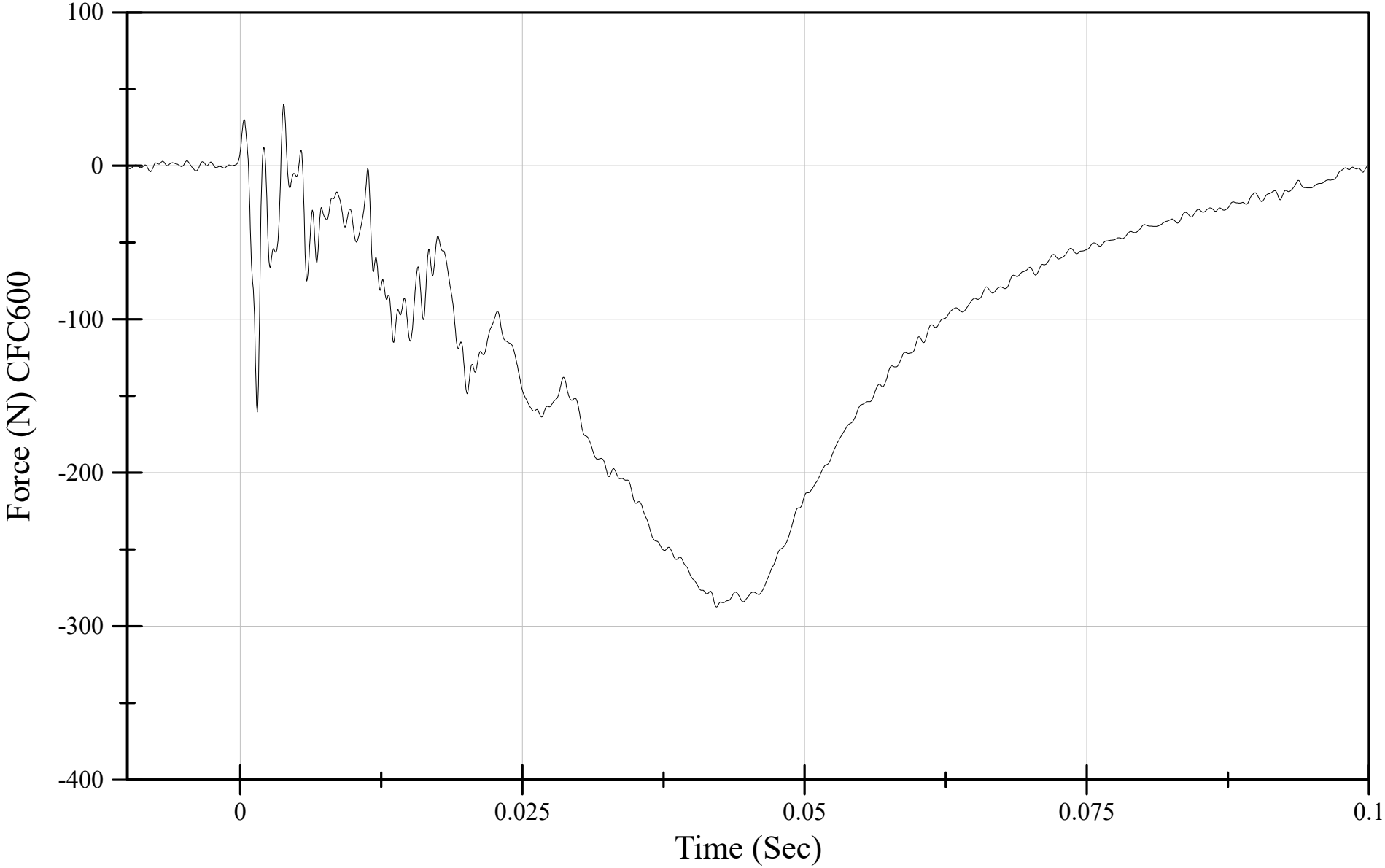
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.1	Pass
Test Humidity (%)	10 - 70	46	Pass
Test Velocity (m/s)	1.95 - 2.05	2.03	Pass
Peak Lower Tibia Fz		-287.5	
Peak Ankle X-axis Resistive Moment		-27.6	
Peak Ankle X-axis Rotation		-33.0	

* THOR-05F Qualification Manual - March 2022

File Name: 220712-11 processed
Software Version: 2.8

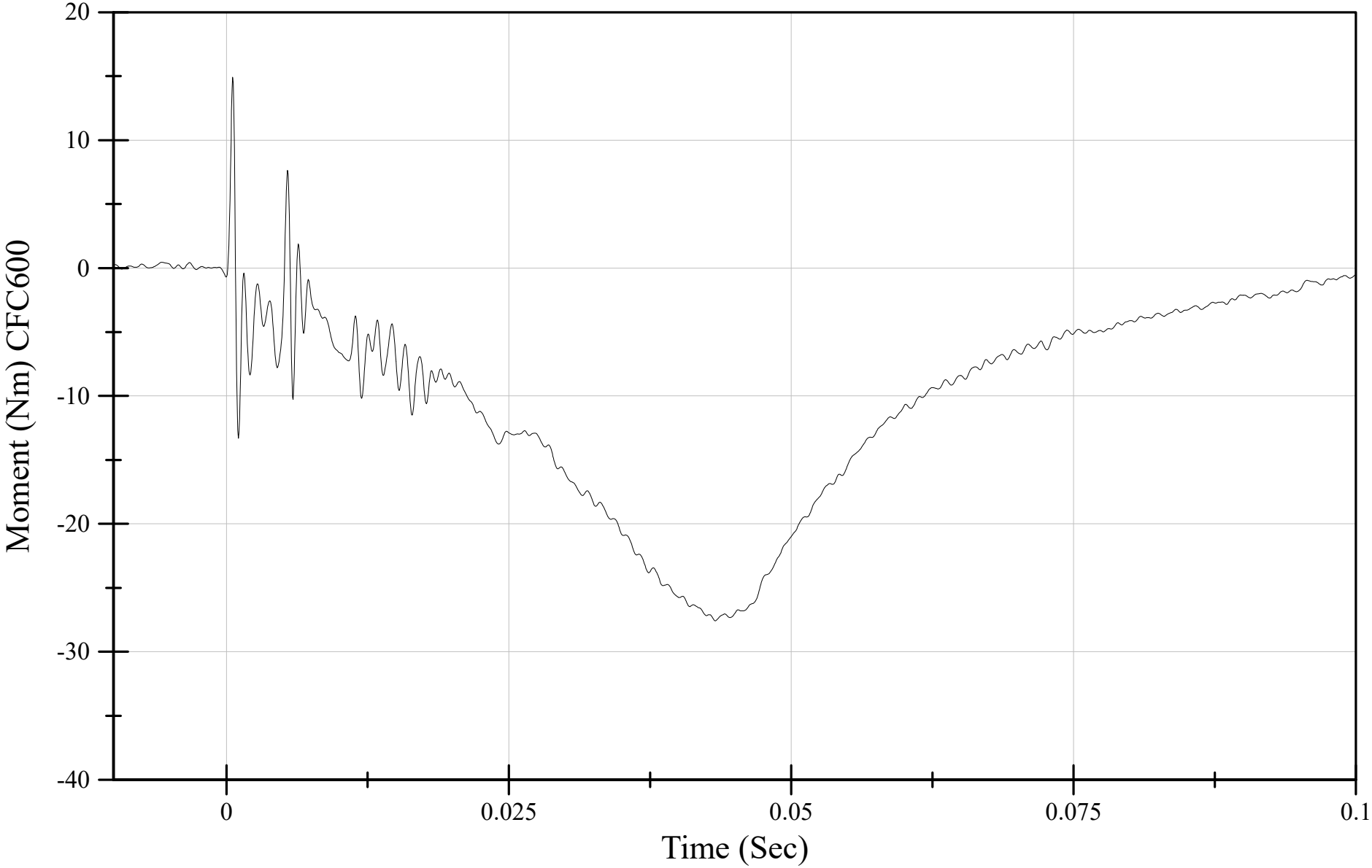
THOR-05F Right Foot Eversion Qualification
Tibia Load - Force Z
Ankle Serial Number: EV4210



File Name: 220712-11 processed

7/12/2022 3:03 PM

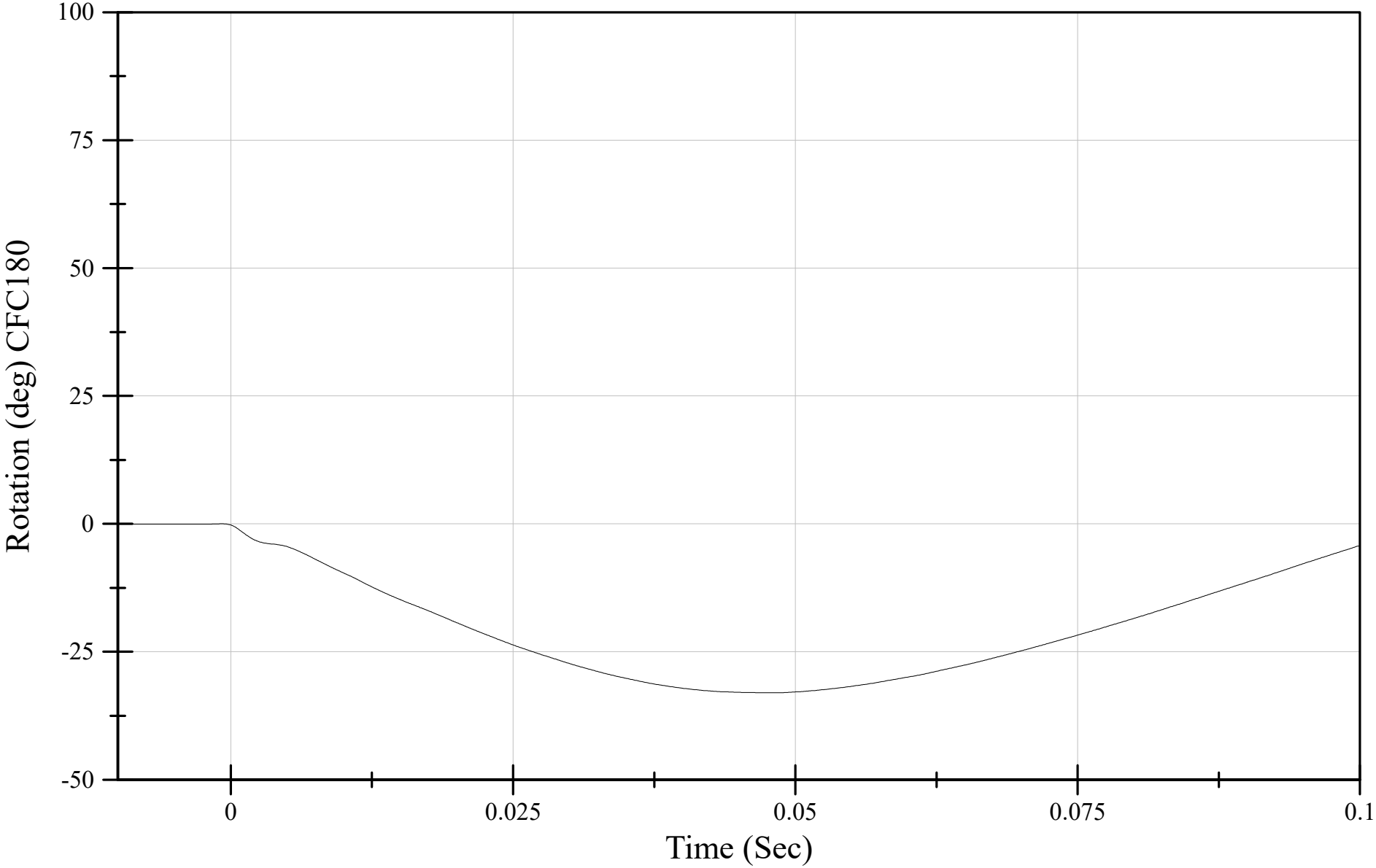
THOR-05F Right Foot Eversion Qualification
Ankle Moment - X axis
Ankle Serial Number: EV4210



File Name: 220712-11 processed

7/12/2022 3:03 PM

THOR-05F Right Foot Eversion Qualification
Ankle X-Rotation
Ankle Serial Number: EV4210



File Name: 220712-11 processed

7/12/2022 3:03 PM

THOR-05F Right Heel Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Right Ankle: EV4210

Test ID: 220712-15
Test Date: 7/12/2022
Test Time: 4:36 PM

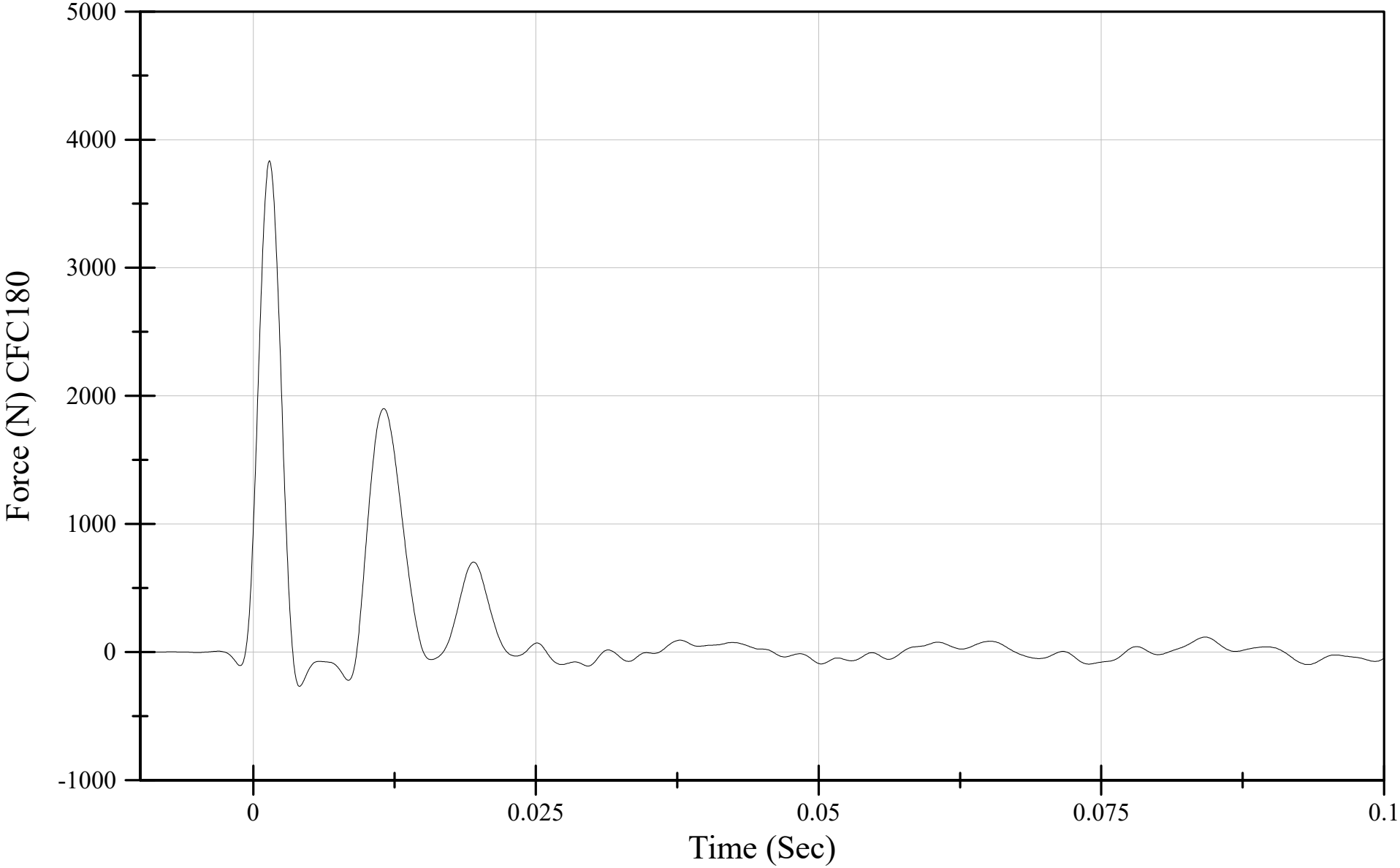
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.3	Pass
Test Humidity (%)	10 - 70	47	Pass
Test Velocity (m/s)	3.95 - 4.05	3.99	Pass
Probe Force (N)		3835.4	
Peak Lower Tibia Fz (N)		-2035.7	

* THOR-05F Qualification Manual - March 2022

File Name: 220712-15 processed
Software Version: 2.8

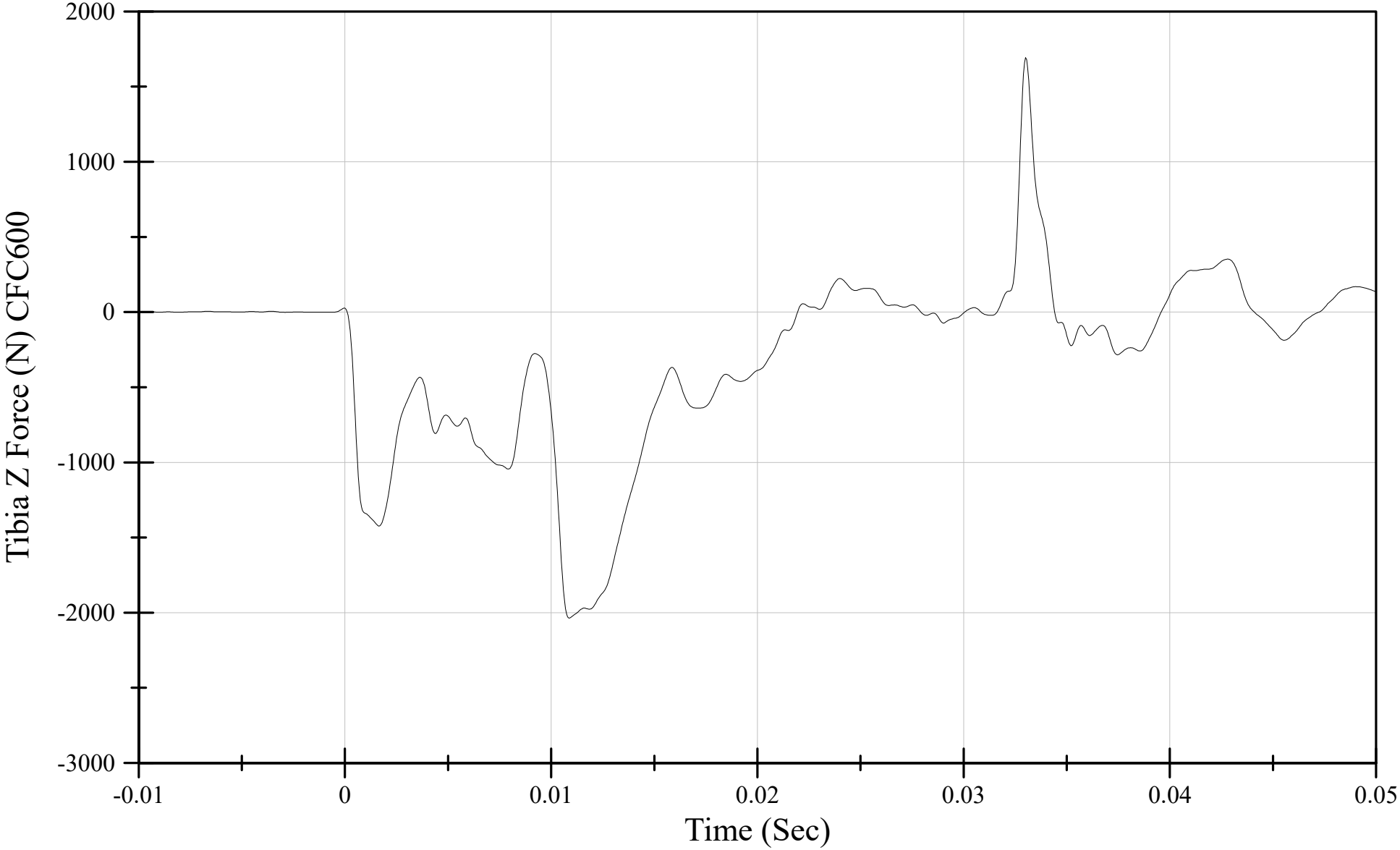
THOR-05F Right Heel Qualification
Probe Force
Dummy Serial Number: EV0674



File Name: 220712-15 processed

7/12/2022 4:36 PM

THOR-05F Right Heel Qualification
Tibia Load
Serial Number: EV0674



File Name: 220712-15 processed

7/12/2022 4:36 PM

THOR-05F Head Impact Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Head Skin: EV3771

Test ID: 220926-10
Test Date: 9/26/2022
Test Time: 3:34 PM

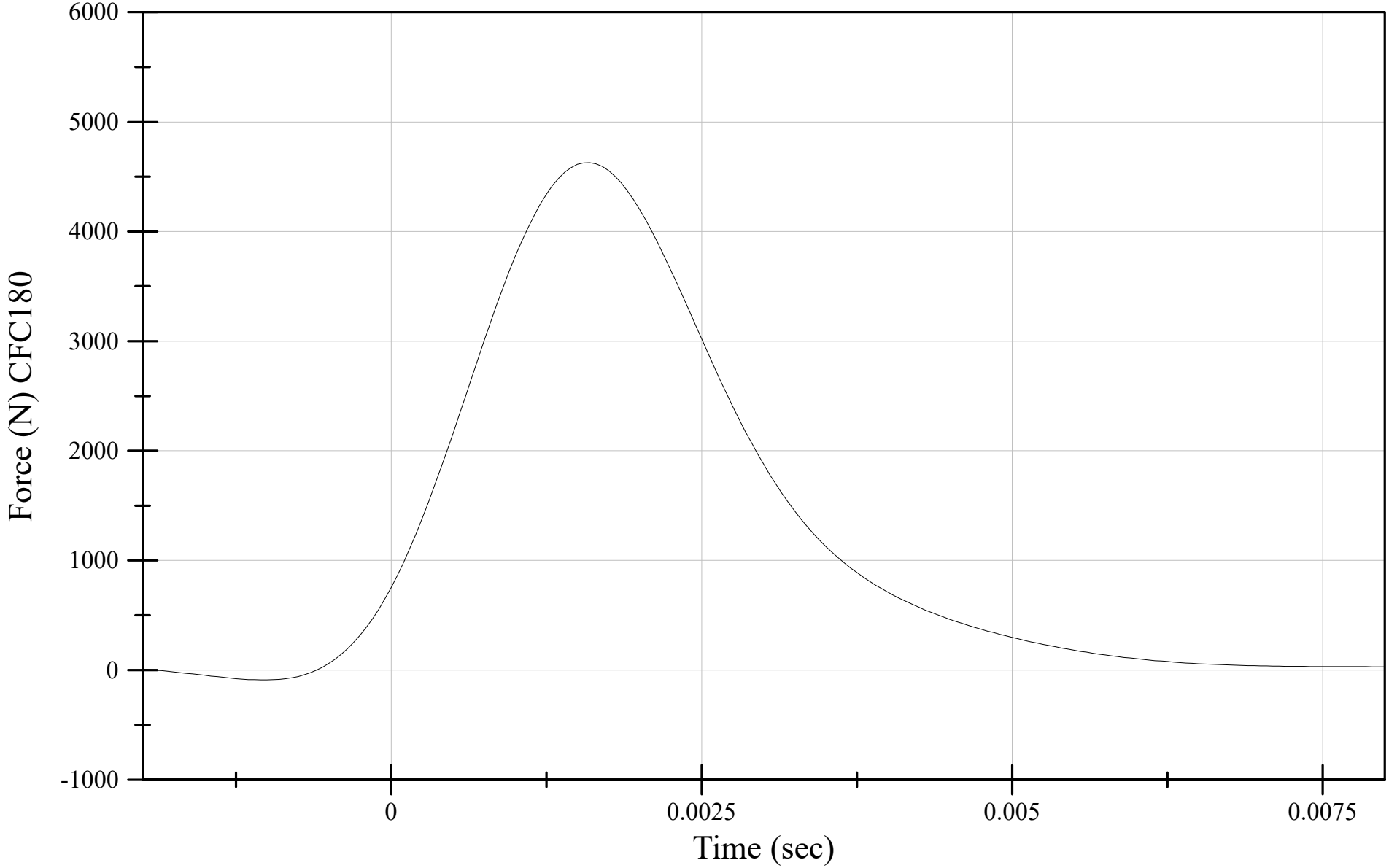
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.3	Pass
Test Humidity (%)	10 - 70	44.4	Pass
Test Velocity (m/s)	1.95 - 2.05	2.00	Pass
Peak Probe Force (N)		4629	
Peak Head CG Resultant Acceleration (g)		143	

* THOR-05F Qualification Manual - July 2022

File Name: 220926-10 processed
Software Version: 2.8

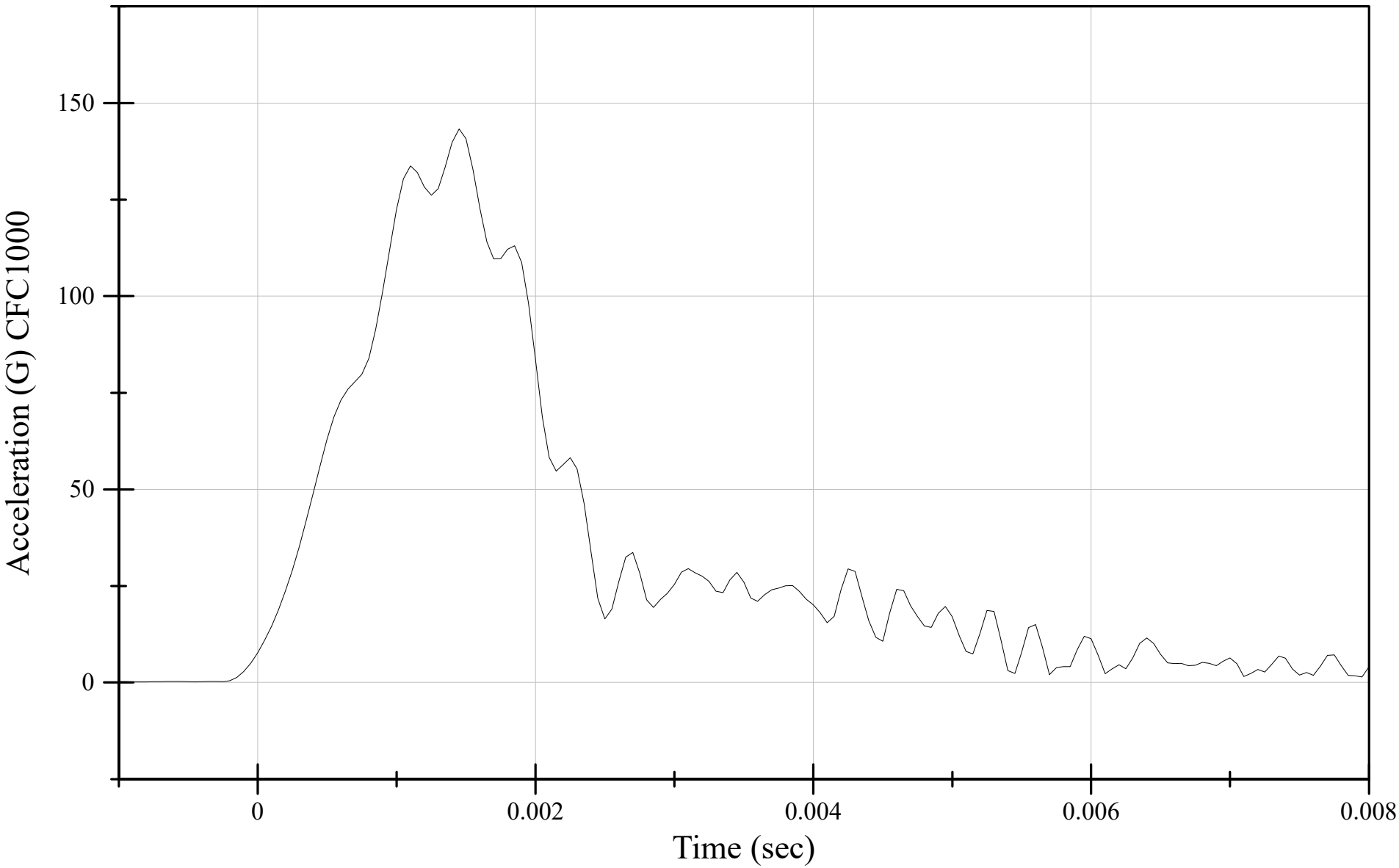
THOR-05F Head Impact Qualification
Probe Force
Dummy Serial Number: EV0674



File Name: 220926-10 processed

9/26/2022 3:34 PM

THOR-05F Head Impact Qualification
Head CG Resultant Acceleration
Dummy Serial Number: EV0674



File Name: 220926-10 processed

9/26/2022 3:34 PM

THOR-05F Face Disk Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components

Head Skin: EV3766

Face Foam: EV0769

Test ID: 220920-7

Test Date: 9/20/2022

Test Time: 4:38 PM

Test Results

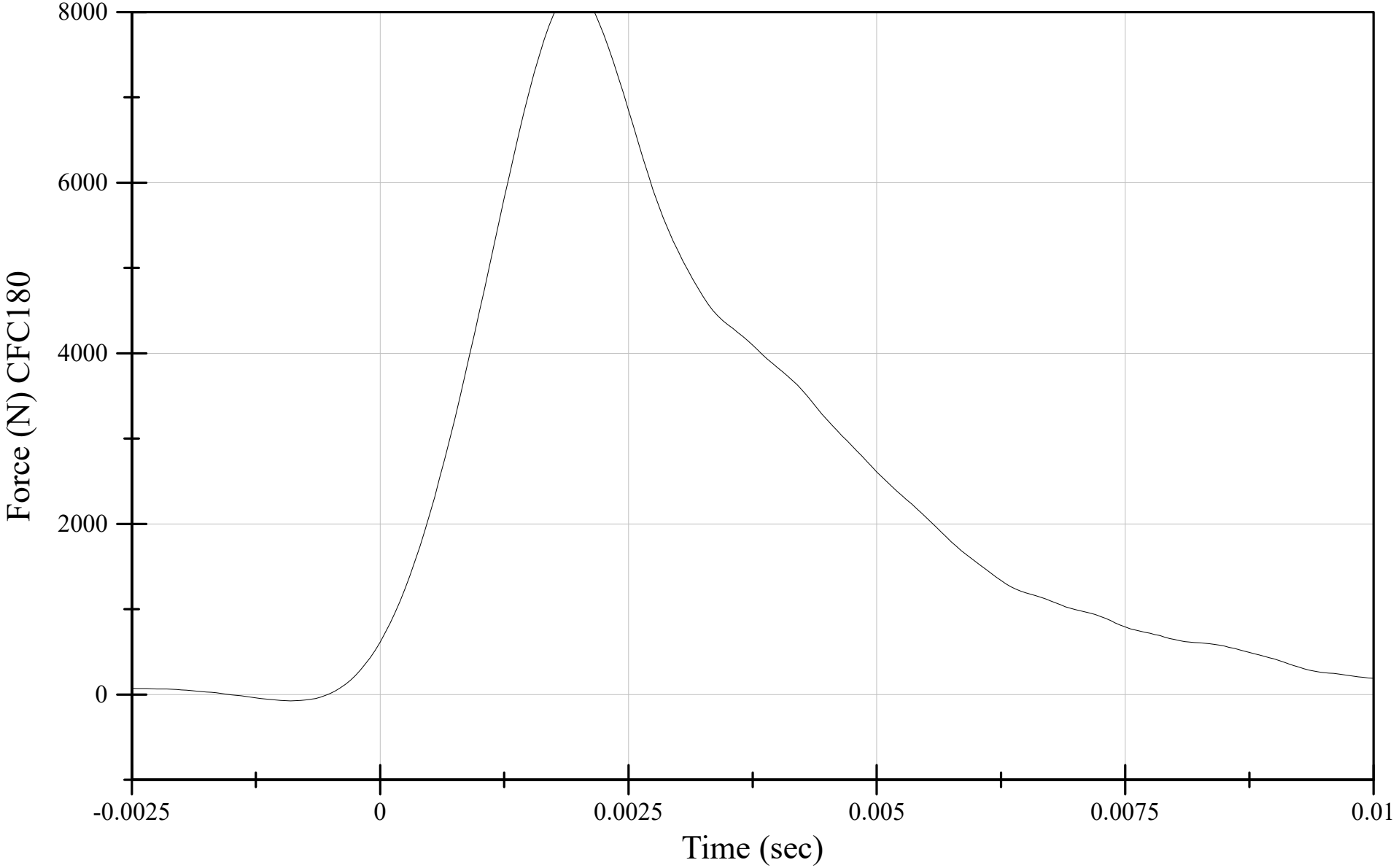
Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.6	Pass
Test Humidity (%)	10 - 70	63.8	Pass
Test Velocity (m/s)	6.68 - 6.78	6.73	Pass
Peak Probe Force (N)		8258	
Peak Head CG Resultant Acceleration prior to 2 ms (g)		763	
Peak Head CG Resultant Acceleration after to 2 ms (g)		749	

* THOR-05F Qualification Manual - July 2022

File Name: 220920-7 processed

Software Version: 2.8

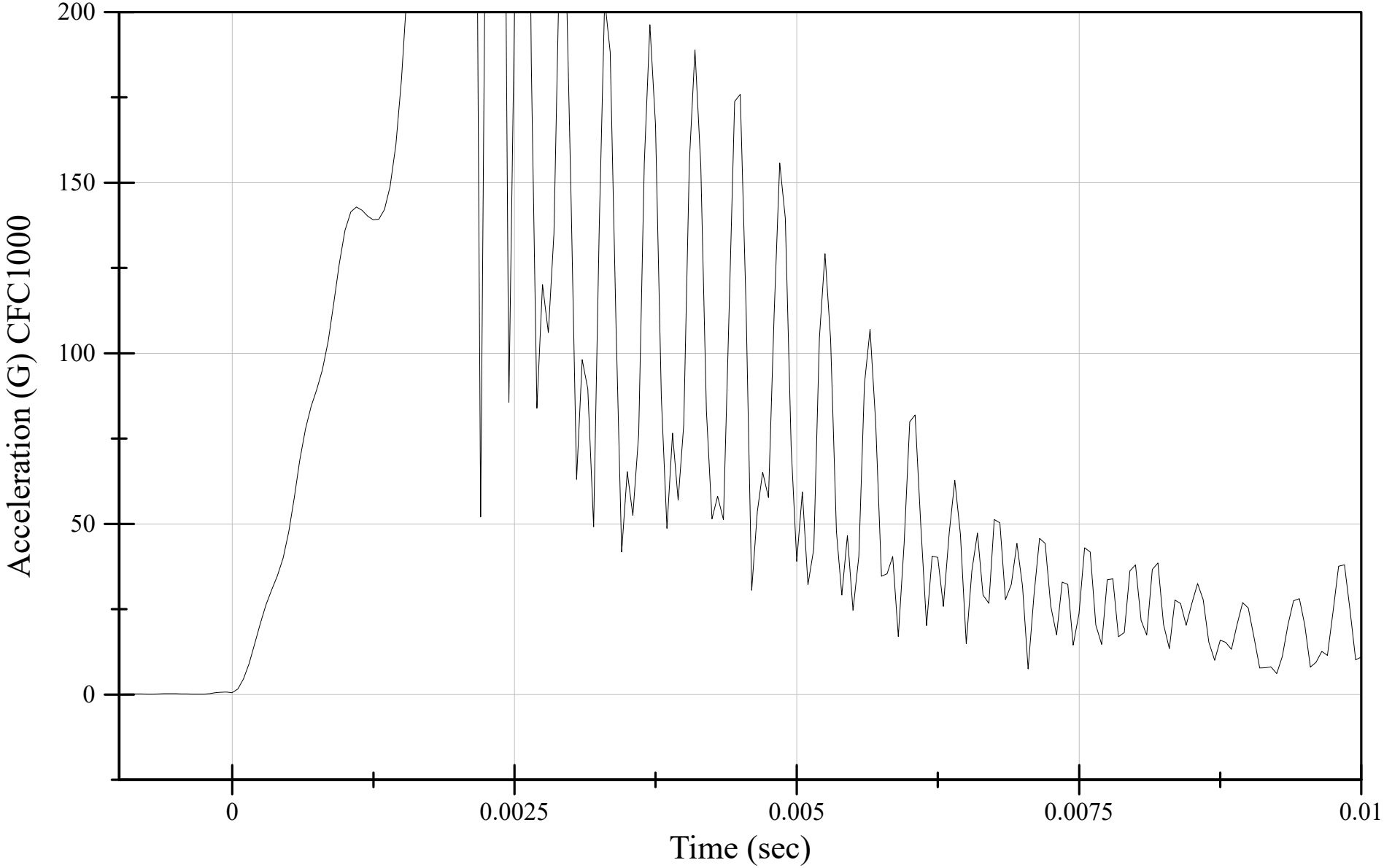
THOR-05F Face Disk Qualification
Probe Force
Dummy Serial Number: EV0674



File Name: 220920-7 processed

9/20/2022 4:38 PM

THOR-05F Face Disk Qualification
Head CG Resultant Acceleration
Dummy Serial Number: EV0674



File Name: 220920-7 processed

9/20/2022 4:38 PM

THOR-05F Neck Extension Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components	Test ID: 220914-5
Neck Serial Number: EV1357	Test Date: 9/14/2022
O.C. Stop Assembly:	Test Time: 3:48 PM
O.C. Cam:	

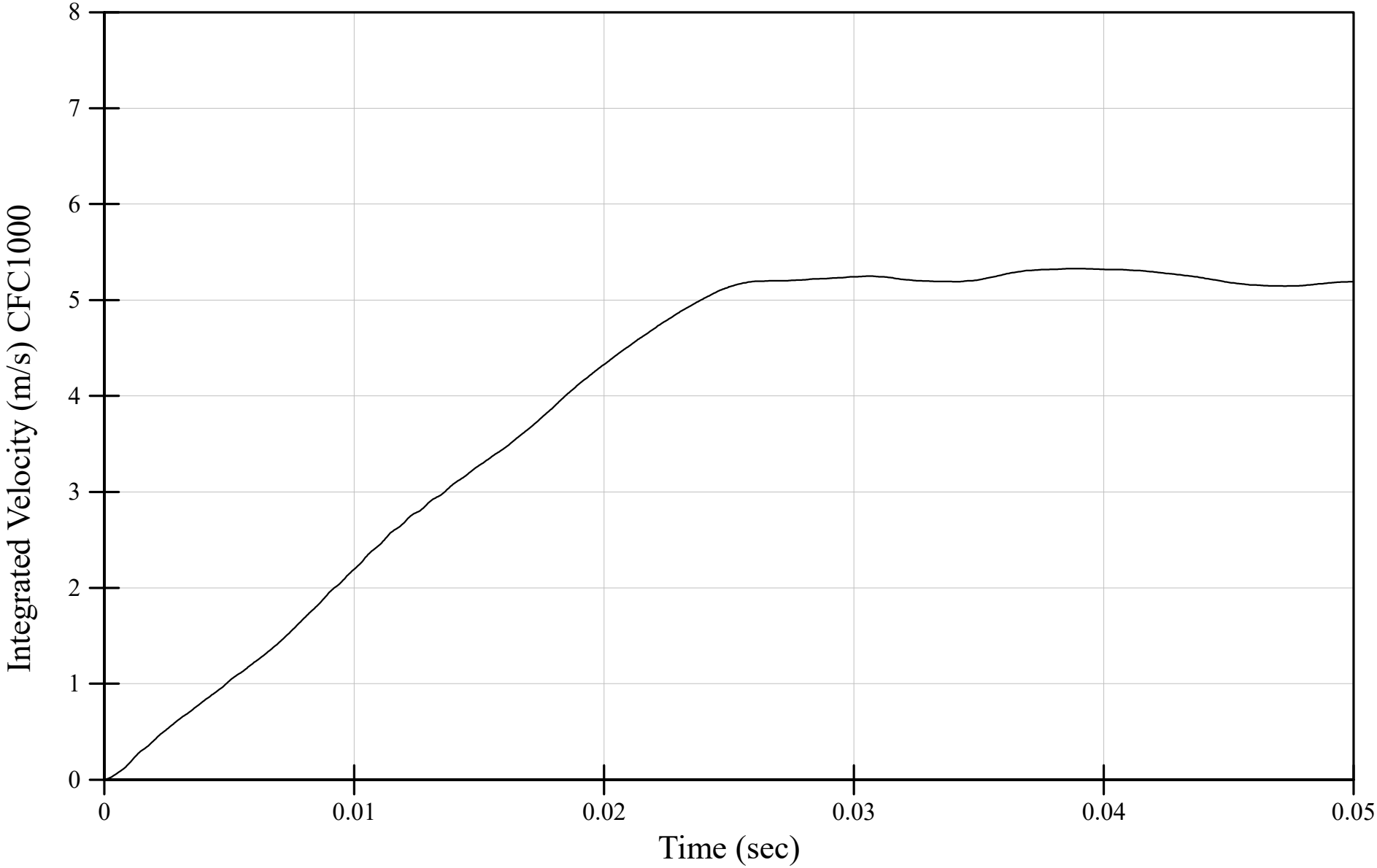
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.9	Pass
Test Humidity (%)	10 - 70	62	Pass
Test Velocity (m/s)	4.95 - 5.05	4.98	Pass
Pendulum Velocity at 8 ms (m/s)		1.69	
Pendulum Velocity at 16 ms (m/s)		3.45	
Pendulum Velocity at 24 ms (m/s)		5.02	
Peak Upper Neck My (Nm)		-19.3	
Peak Upper Neck Fz (N)		-1452	
Peak Head Angular Velocity Y (deg/sec)		2431	
Peak Head Rotation (deg)		87.1	

* THOR-05F Qualification Manual - July 2022

File Name: 220914-5 processed

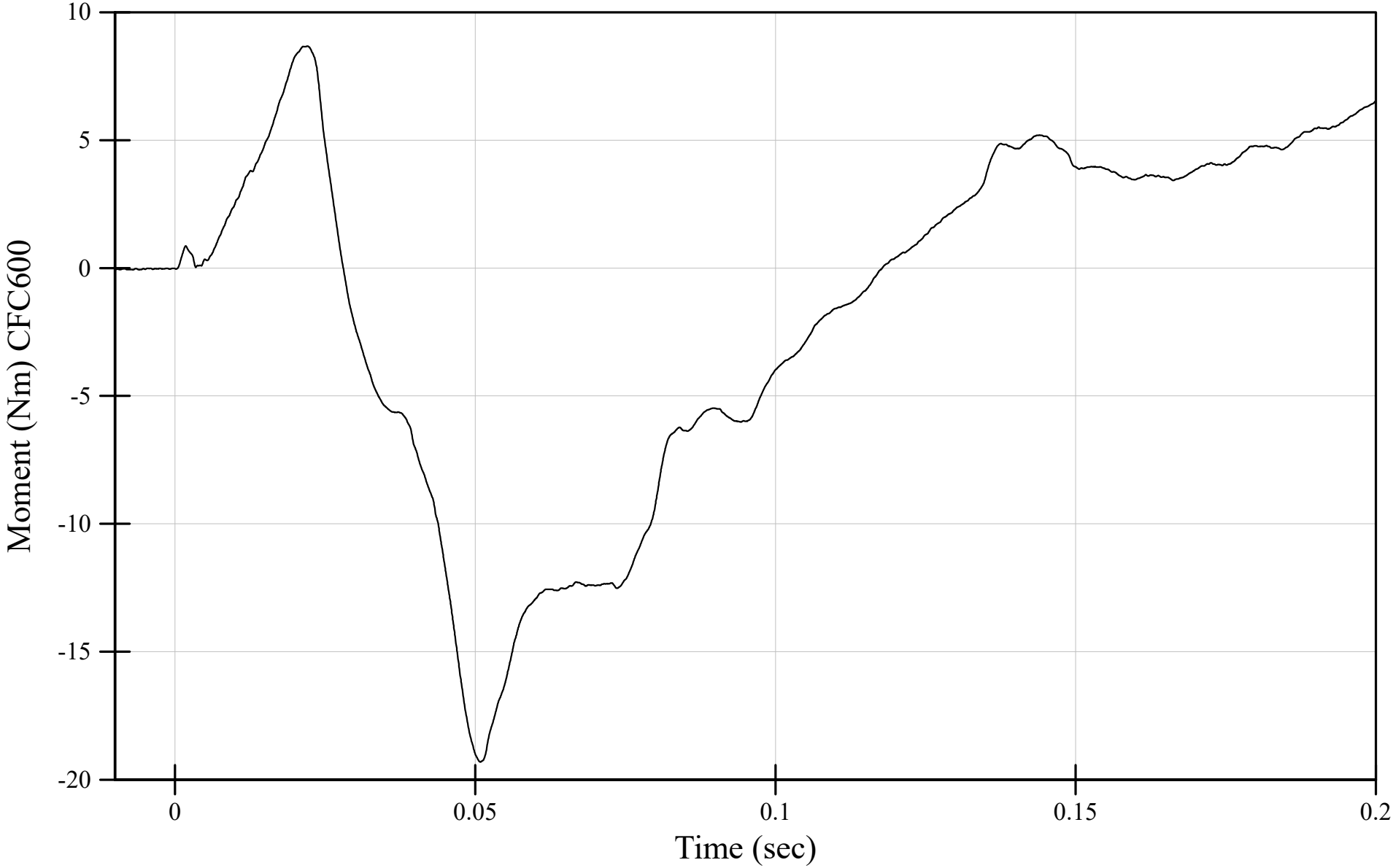
THOR-05F Neck Extension Qualification
Probe Acceleration
Neck Serial Number: EV1357



File Name: 220914-5 processed

9/14/2022 3:48 PM

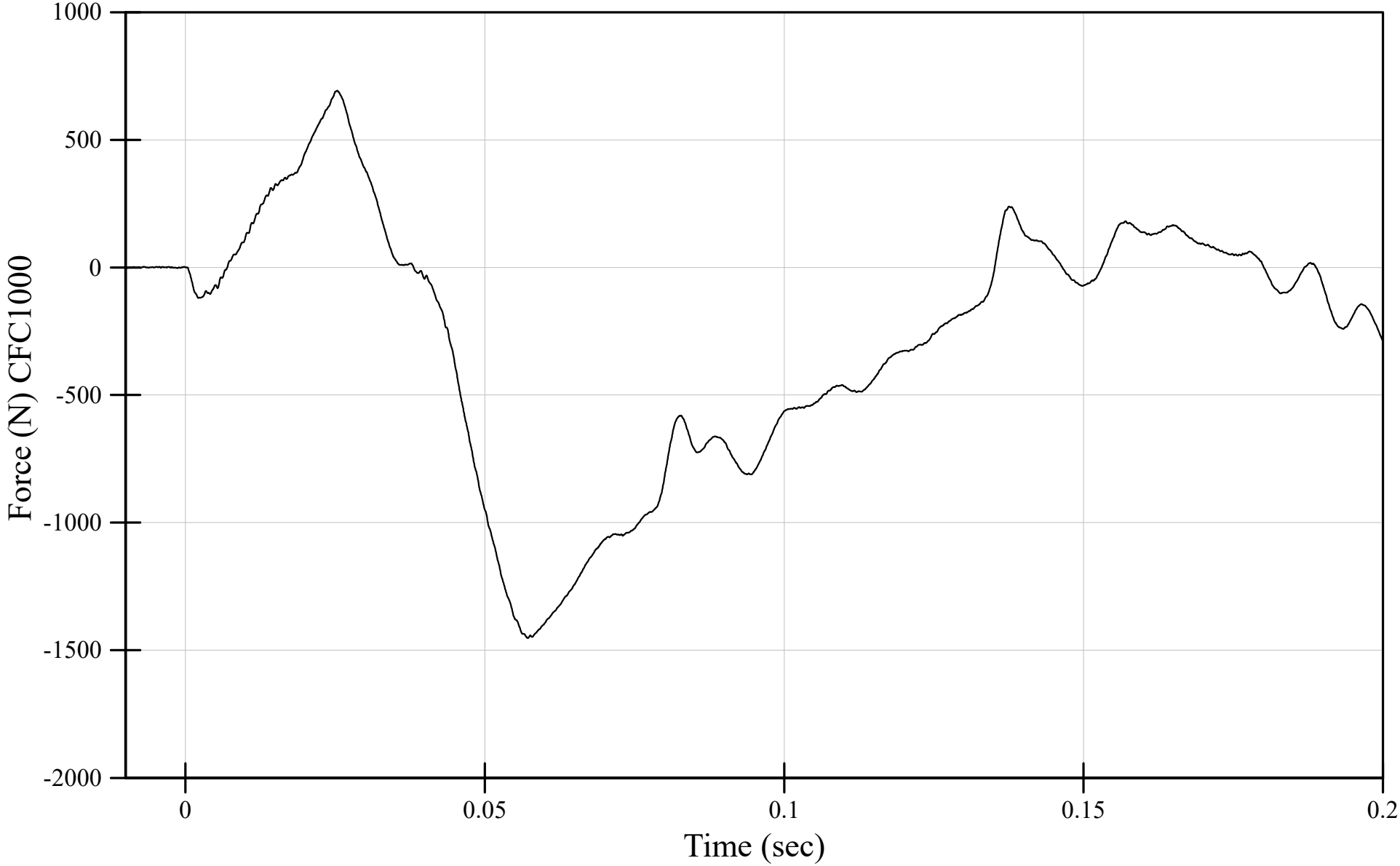
THOR-05F Neck Extension Qualification
Y-Moment as Measured
Neck Serial Number: EV1357



File Name: 220914-5 processed

9/14/2022 3:48 PM

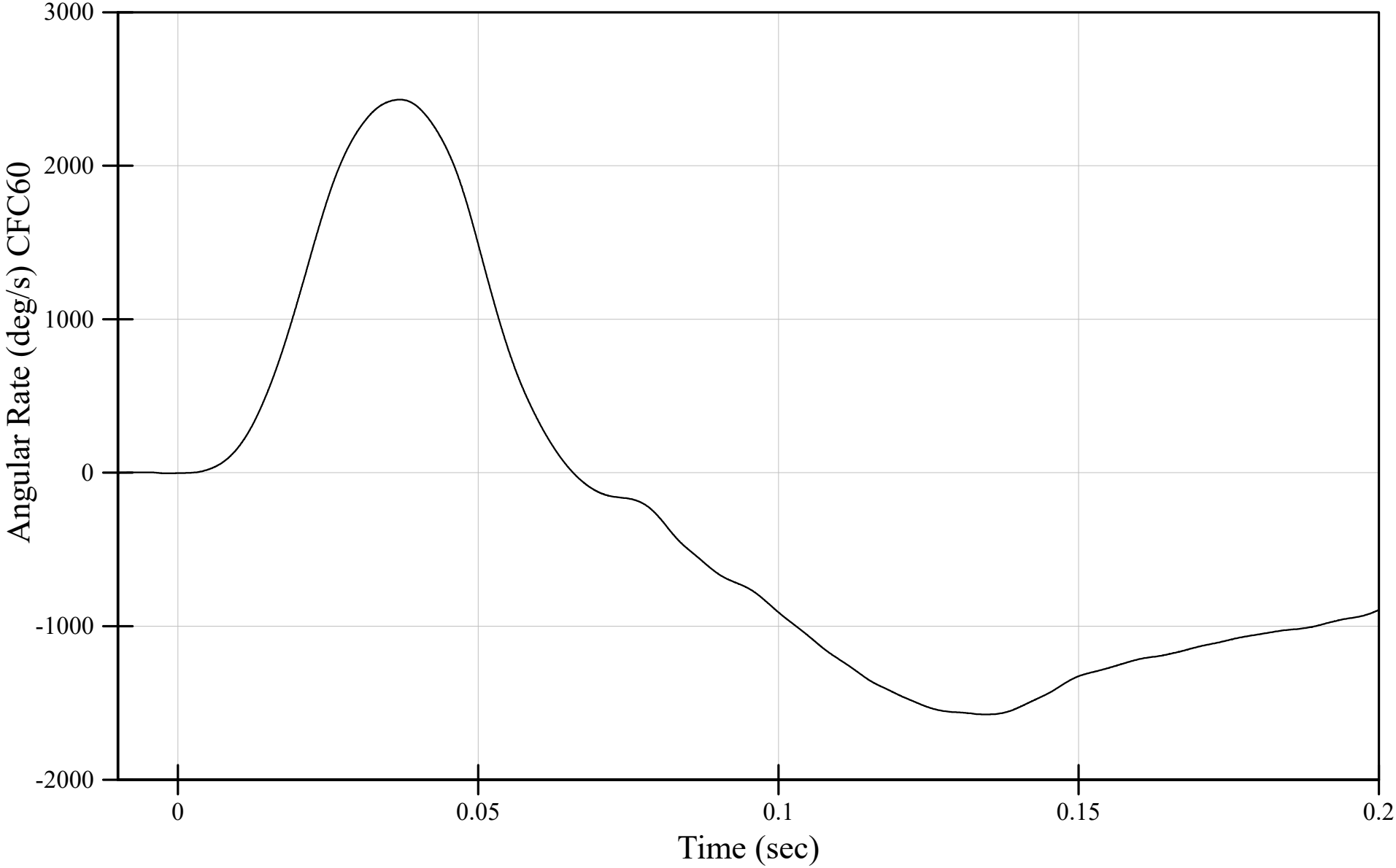
THOR-05F Neck Extension Qualification
Z-Force as Measured
Neck Serial Number: EV1357



File Name: 220914-5 processed

9/14/2022 3:48 PM

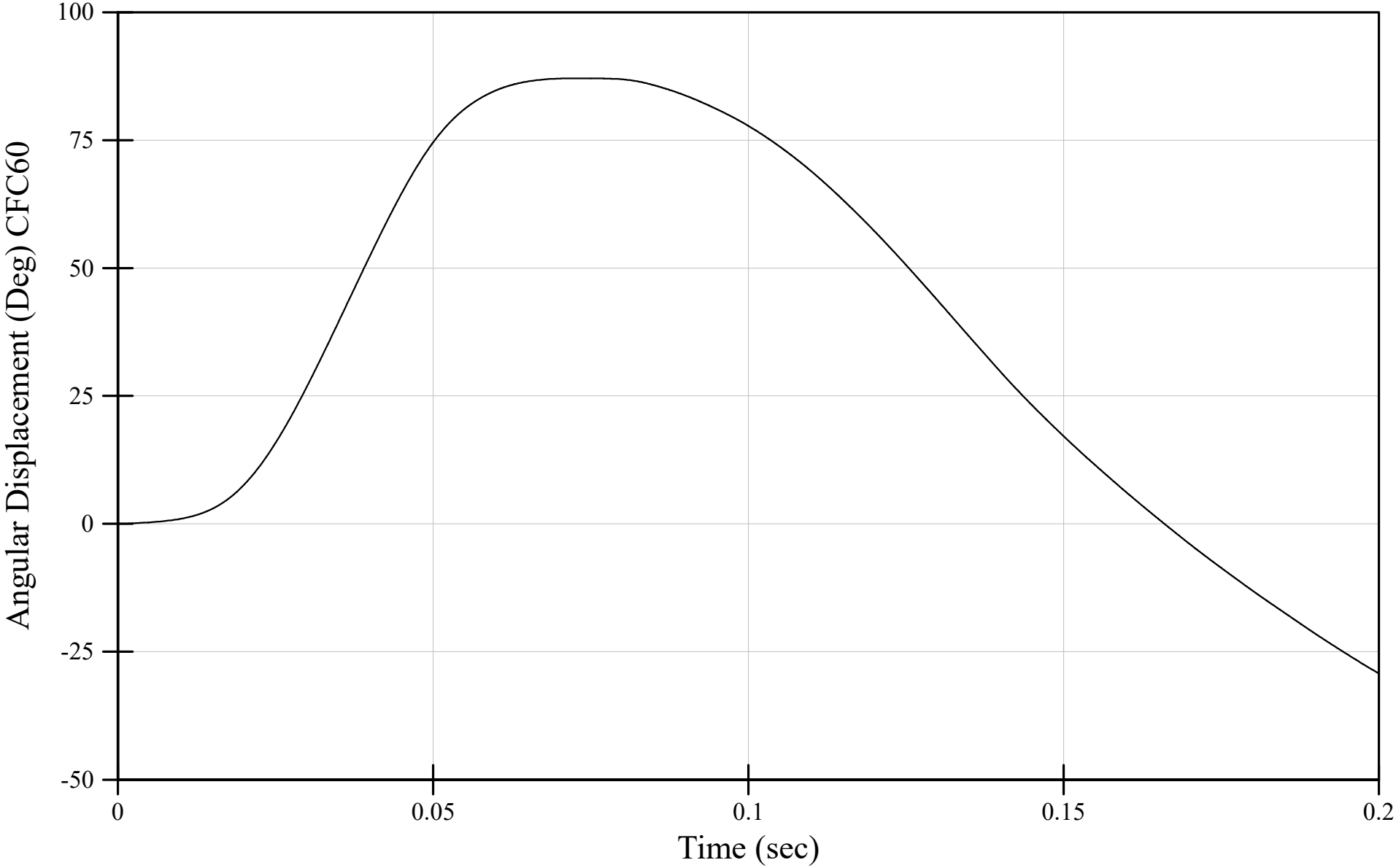
THOR-05F Neck Extension Qualification
Peak Head Angular Rate
Neck Serial Number: EV1357



File Name: 220914-5 processed

9/14/2022 3:48 PM

THOR-05F Neck Extension Qualification
Neck Rotation
Neck Serial Number: EV1357



File Name: 220914-5 processed

9/14/2022 3:48 PM

THOR-05F Neck Front Flexion Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Neck Serial Number: EV1357
O.C. Stop Assembly:
O.C. Cam:

Test ID: 220914-11
Test Date: 9/14/2022
Test Time: 5:18 PM

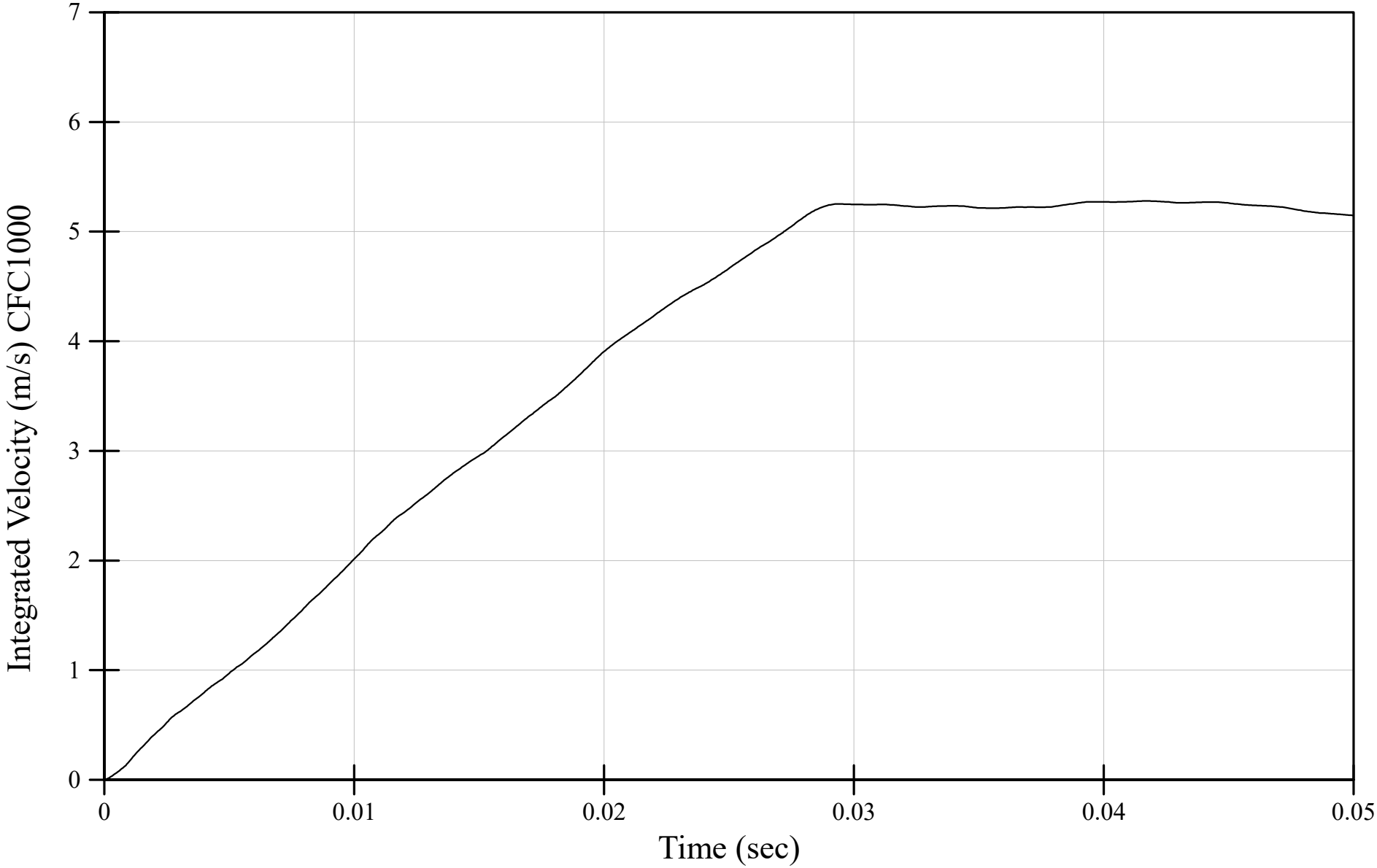
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.8	Pass
Test Humidity (%)	10 - 70	63	Pass
Test Velocity (m/s)	4.95 - 5.05	5.01	Pass
Pendulum Velocity at 8 ms (m/s)		1.57	
Pendulum Velocity at 16 ms (m/s)		3.13	
Pendulum Velocity at 24 ms (m/s)		4.52	
Peak Upper Neck My (Nm)		17.6	
Peak Upper Neck Fz prior to 40 ms (N)		726	
Peak Head Angular Velocity Y (deg/sec)		-2059	
Peak Head Rotation (deg)		-78.9	

* THOR-05F Qualification Manual - July 2022

File Name: 220914-11 processed
Software Version: 2.8

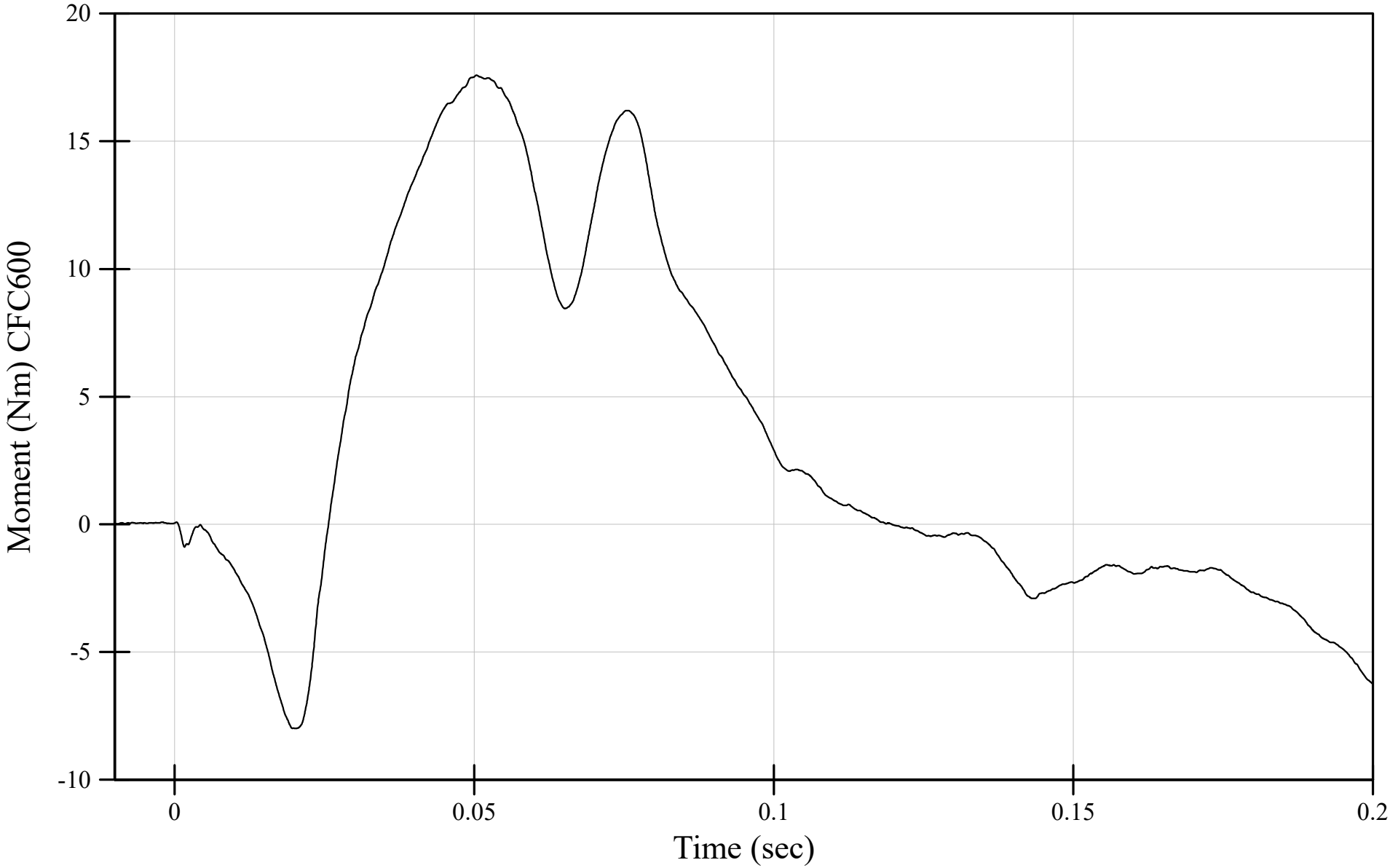
THOR-05F Neck Flexion Qualification
Pendulum Pulse
Neck Serial Number: EV1357



File Name: 220914-11 processed

9/14/2022 5:18 PM

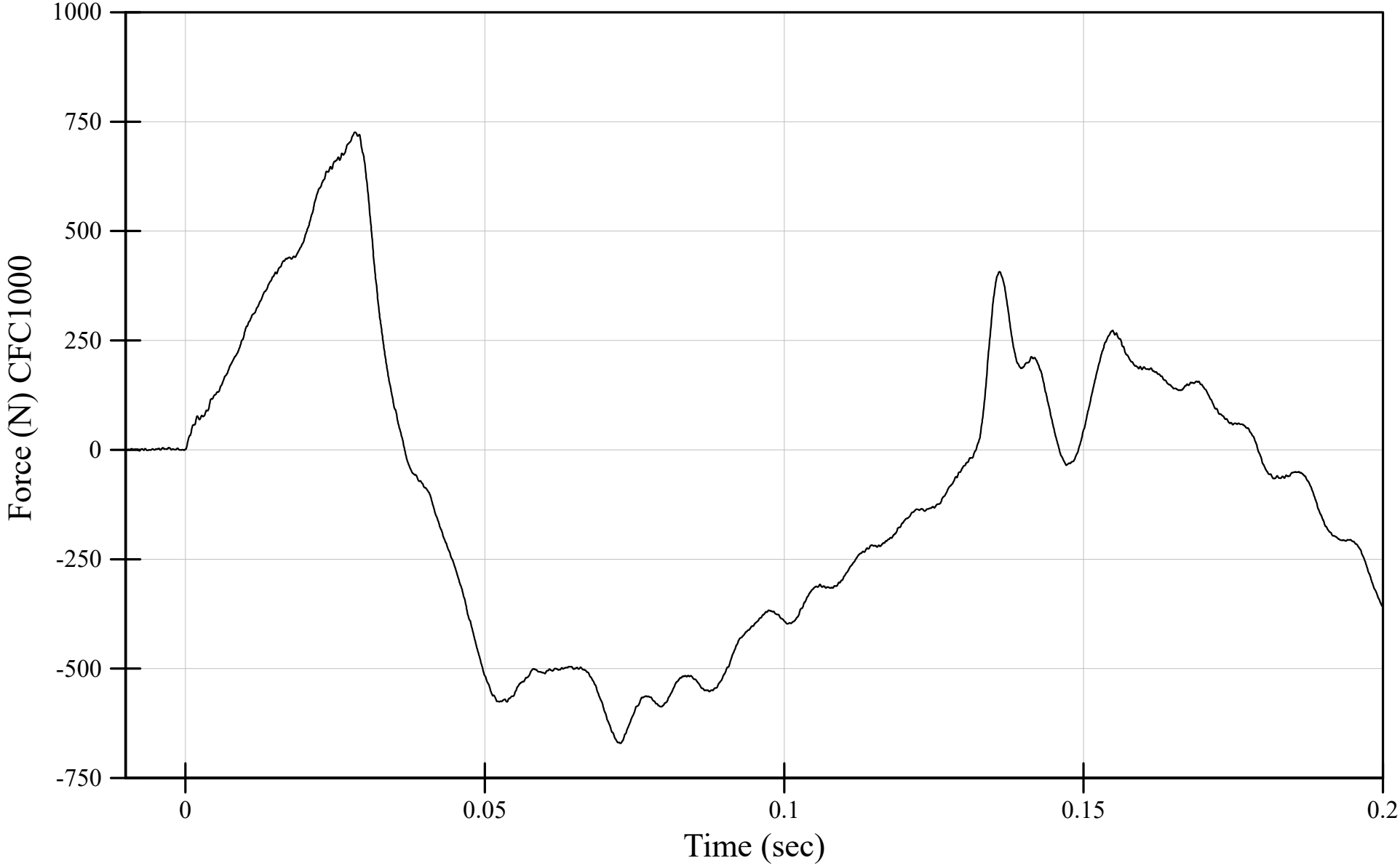
THOR-05F Neck Flexion Qualification
Y-Moment as Measured
Neck Serial Number: EV1357



File Name: 220914-11 processed

9/14/2022 5:18 PM

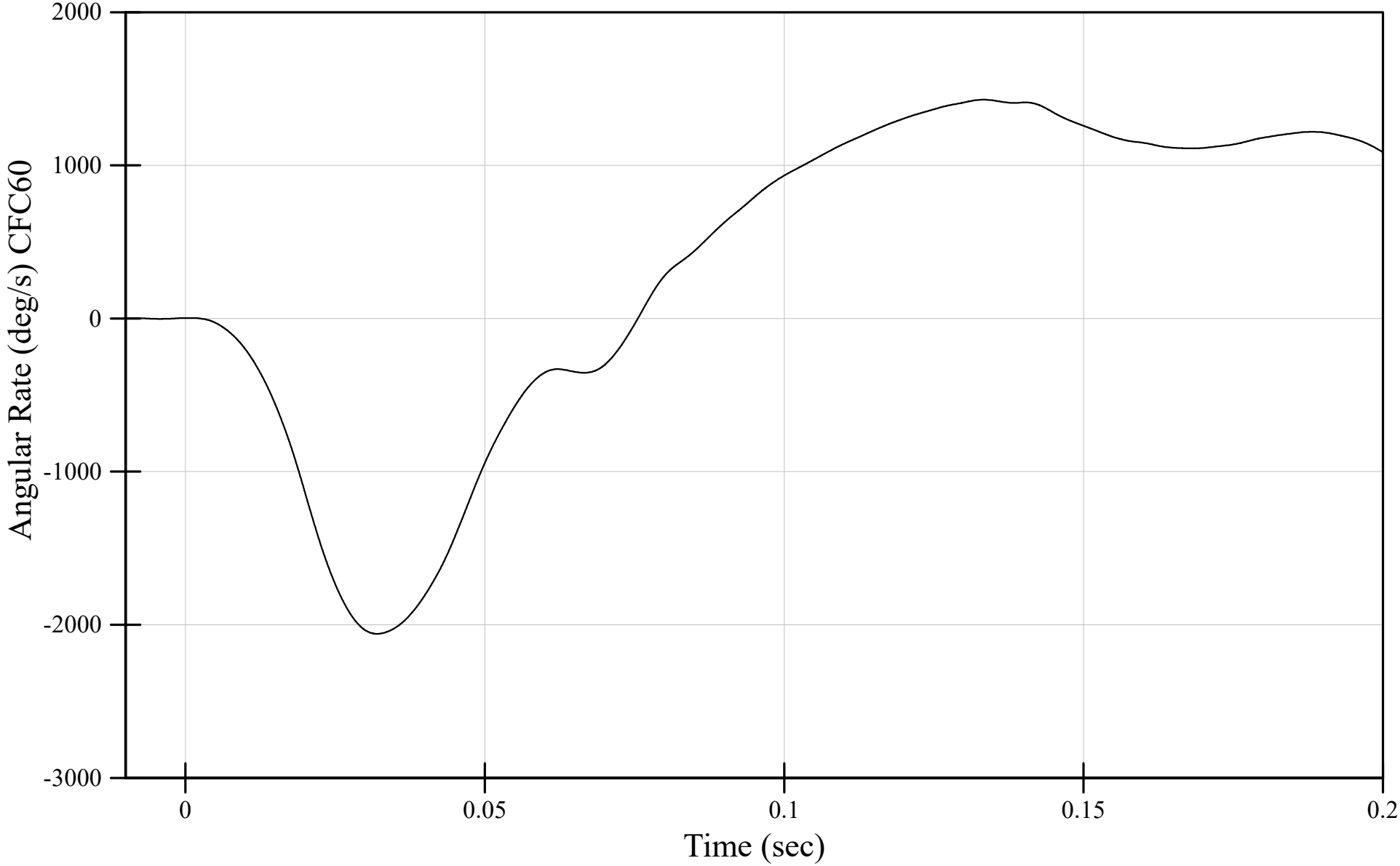
THOR-05F Neck Flexion Qualification
Z-Force as Measured
Neck Serial Number: EV1357



File Name: 220914-11 processed

9/14/2022 5:18 PM

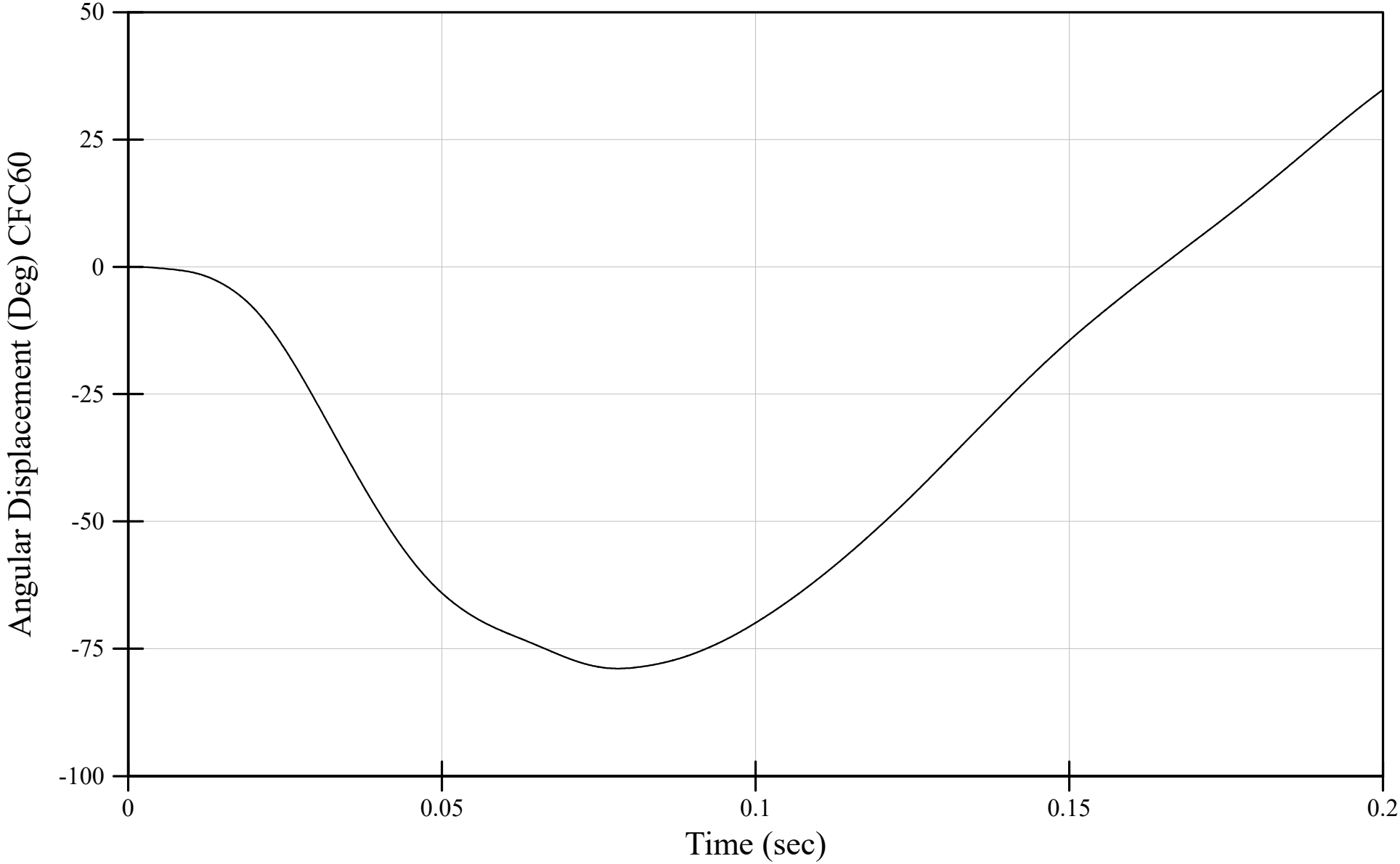
THOR-05F Neck Flexion Qualification
Peak Angular Rate
Neck Serial Number: EV1357



File Name: 220914-11 processed

9/14/2022 5:18 PM

THOR-05F Neck Flexion Qualification
Neck Rotation
Neck Serial Number: EV1357



File Name: 220914-11 processed

9/14/2022 5:18 PM

THOR-05F Neck Left Lateral Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Neck Serial Number: EV1357
O.C. Stop Assembly Serial Number:
O.C. Cam Serial Number:

Test ID: 220915-4
Test Date: 9/15/2022
Test Time: 8:15 AM

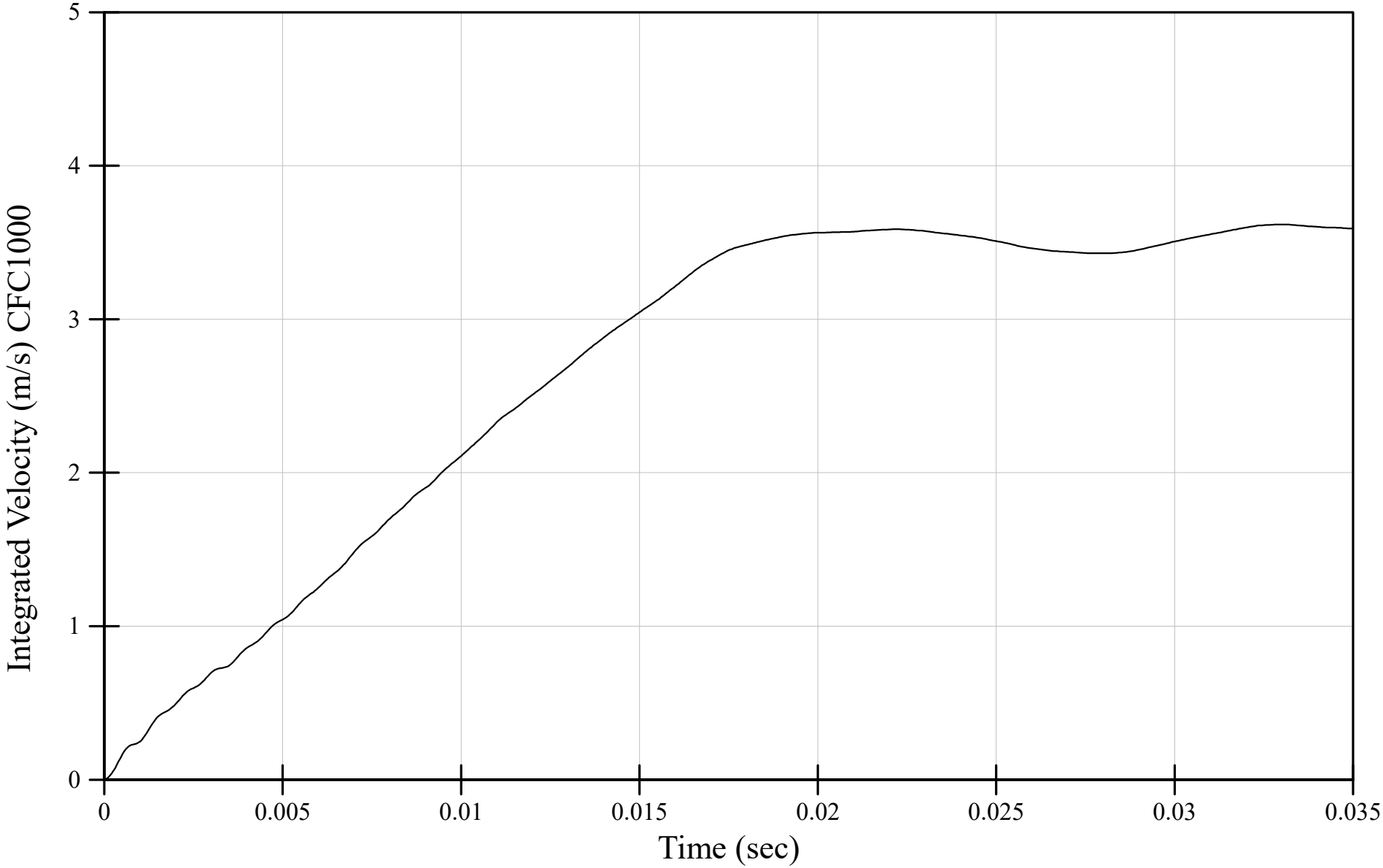
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.9	Pass
Test Humidity (%)	10 - 70	56	Pass
Test Velocity (m/s)	3.35 - 3.45	3.39	Pass
Pendulum Velocity at 5 ms (m/s)		1.04	
Pendulum Velocity at 10 ms (m/s)		2.11	
Pendulum Velocity at 15 ms (m/s)		3.05	
Peak Upper Neck Mx after 40 ms (N)		29.9	
Peak Head Angular Velocity X (deg/sec)		-1307.5	
Peak Head Rotation (deg)		-50.1	

* THOR-05F Qualification Manual - July 2022

File Name: 220915-4 processed
Software Version: 2.8

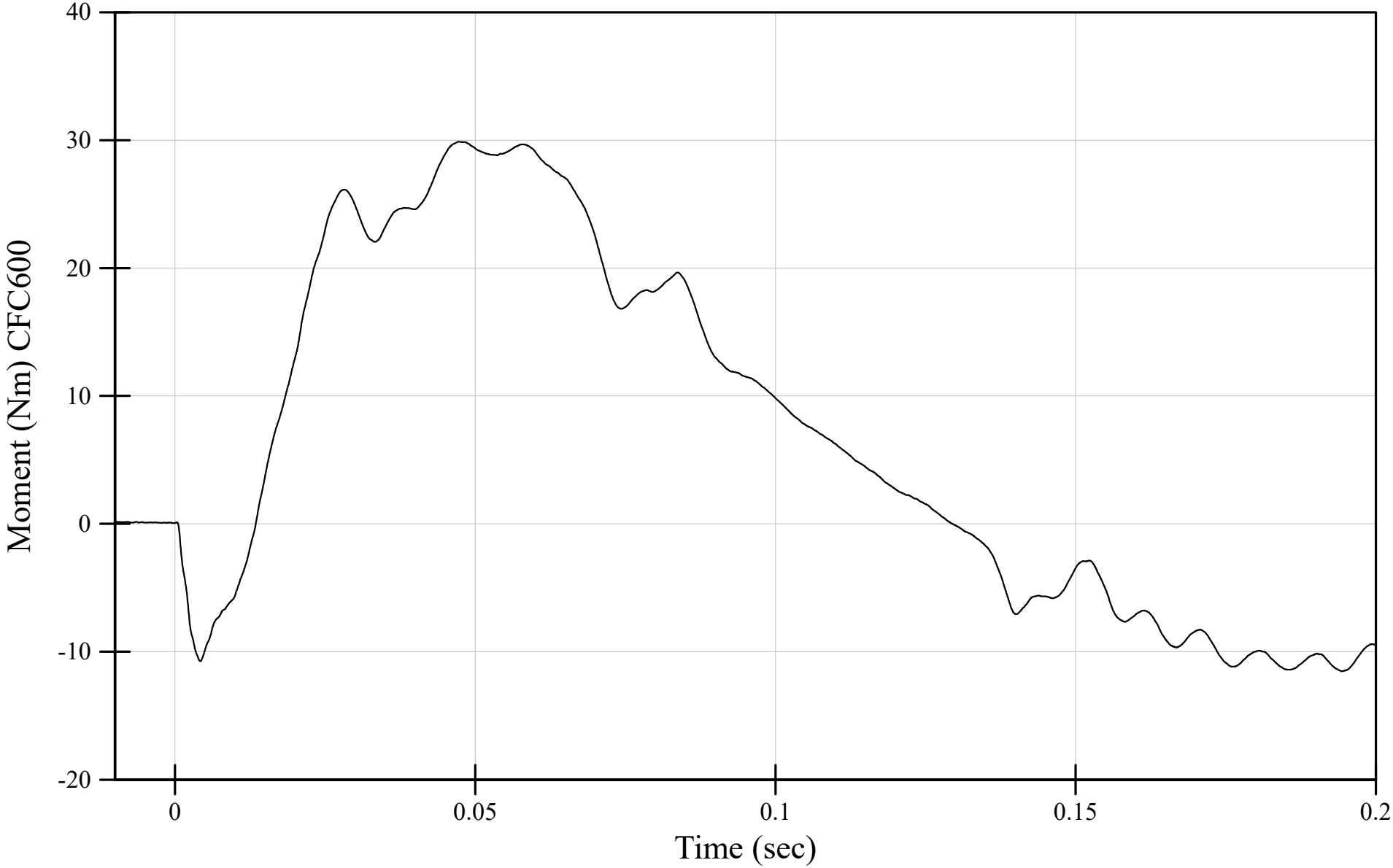
THOR-05F Neck Left Lateral Qualification
Pendulum Pulse
Serial Number: EV1357



File Name: 220915-4 processed

9/15/2022 8:15 AM

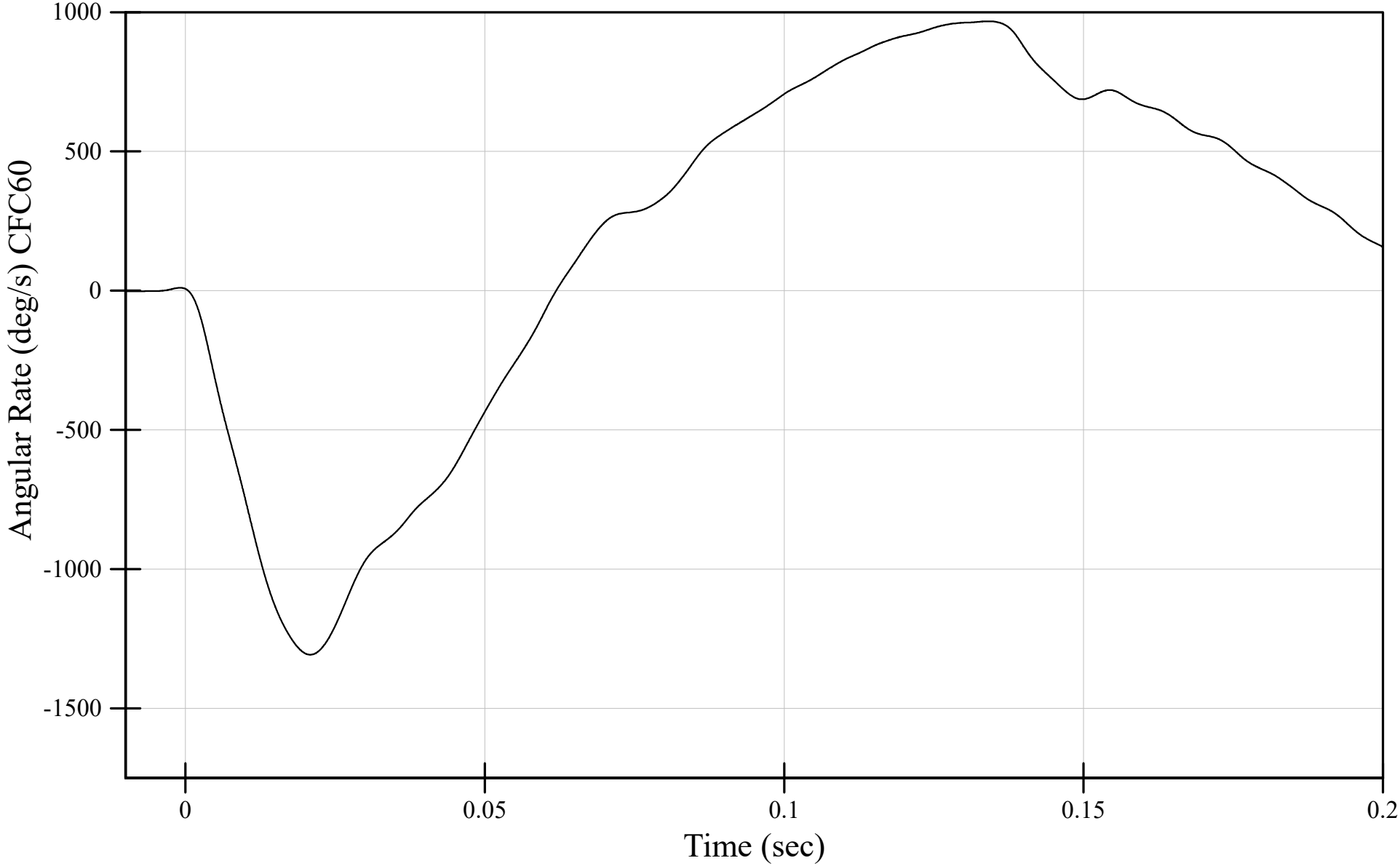
THOR-05F Neck Left Lateral Qualification
X-Moment as Measured
Serial Number: EV1357



File Name: 220915-4 processed

9/15/2022 8:15 AM

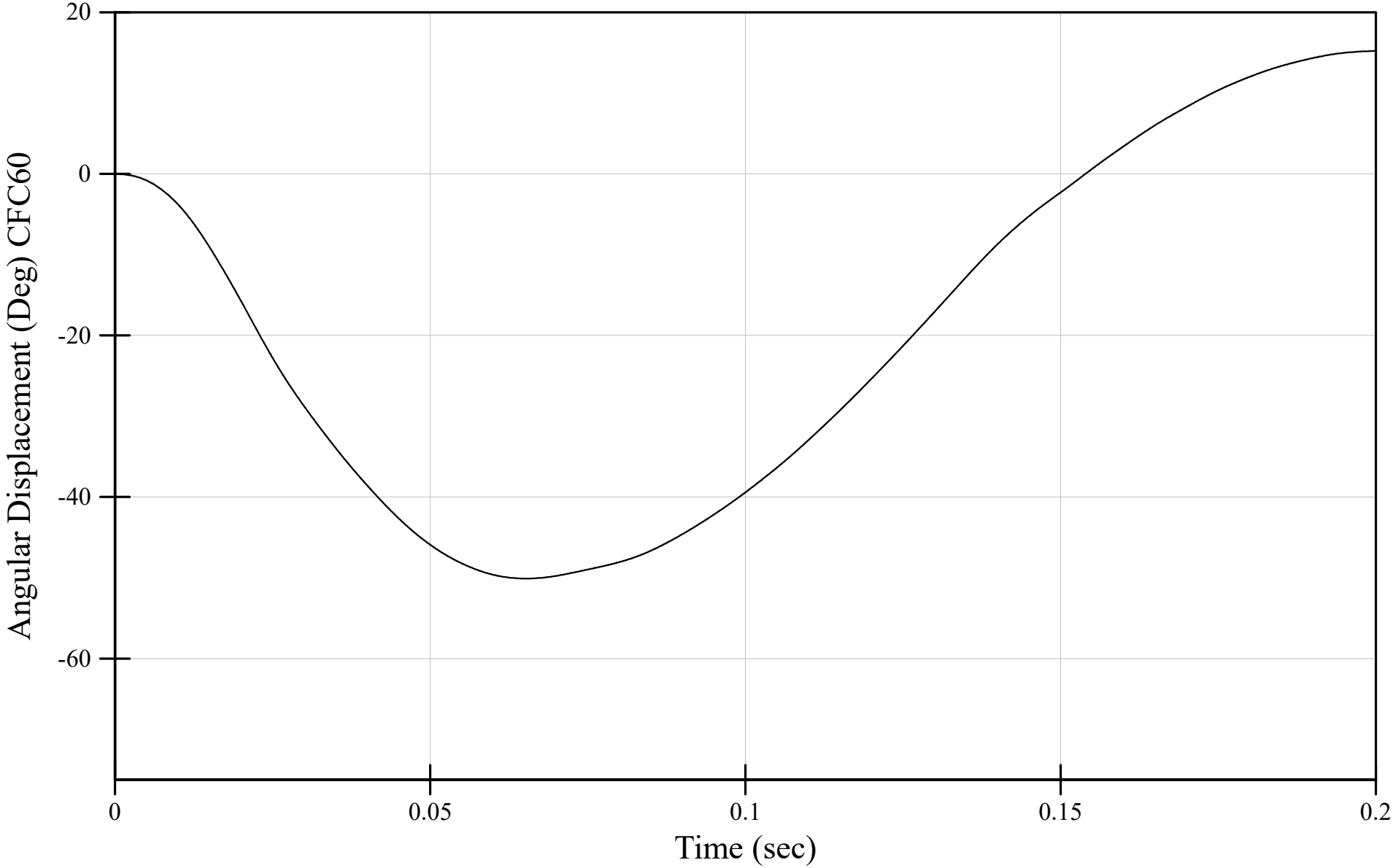
THOR-05F Neck Left Lateral Qualification
Peak Angular Rate
Serial Number: EV1357



File Name: 220915-4 processed

9/15/2022 8:15 AM

THOR-05F Neck Left Lateral Qualification
Neck Rotation
Serial Number: EV1357



File Name: 220915-4 processed

9/15/2022 8:15 AM

THOR-05F Neck Right Lateral Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Neck Serial Number: EV1357
O.C. Stop Assembly Serial Number:
O.C. Cam Serial Number:

Test ID: 220915-5
Test Date: 9/15/2022
Test Time: 8:47 AM

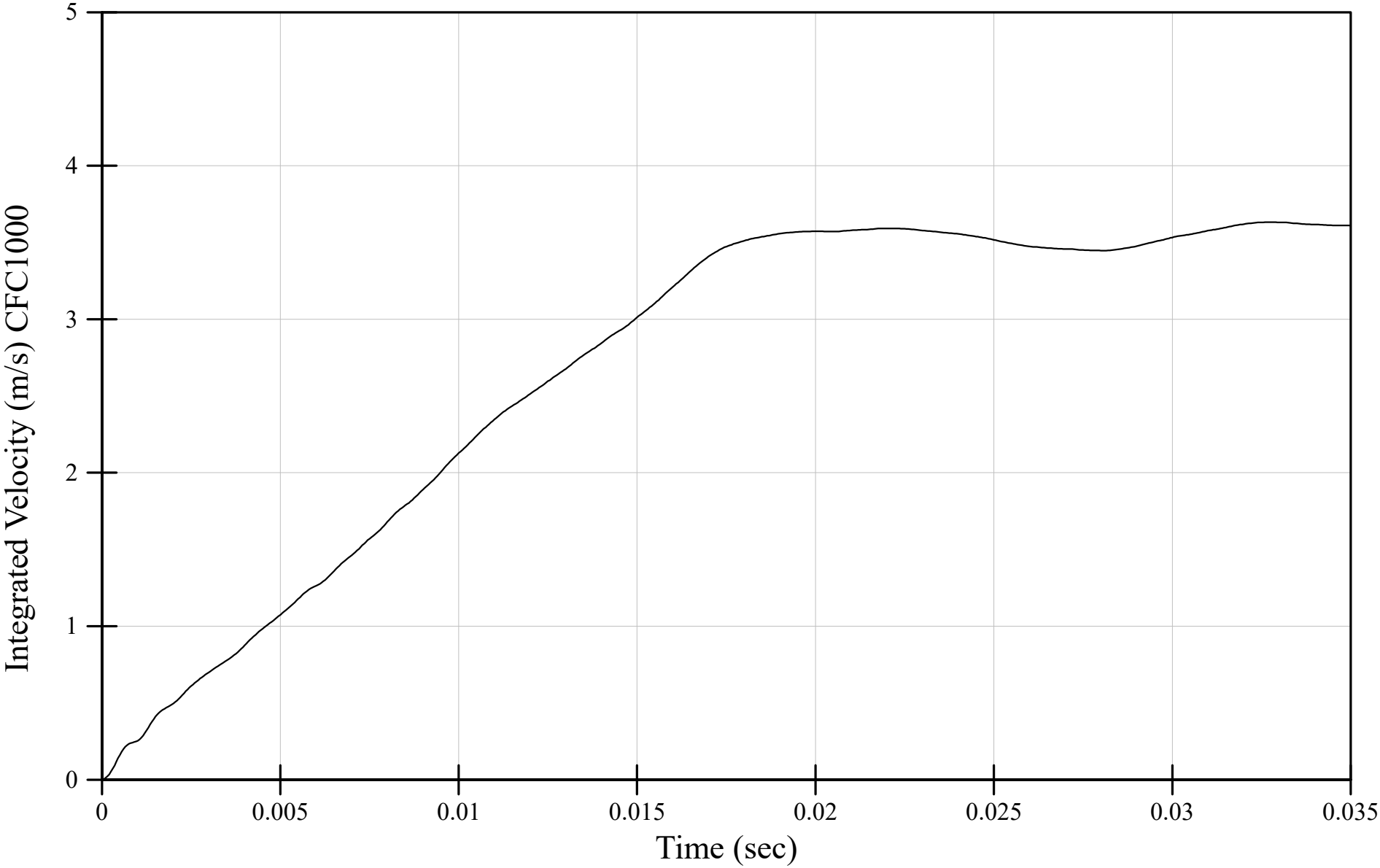
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	22.0	Pass
Test Humidity (%)	10 - 70	55	Pass
Test Velocity (m/s)	3.35 - 3.45	3.40	Pass
Pendulum Velocity at 5 ms (m/s)		1.08	
Pendulum Velocity at 10 ms (m/s)		2.13	
Pendulum Velocity at 15 ms (m/s)		3.01	
Peak Upper Neck Mx after 40 ms (N)		-29.8	
Peak Head Angular Velocity X (deg/sec)		1321.2	
Peak Head Rotation (deg)		51.8	

* THOR-05F Qualification Manual - July 2022

File Name: 220915-5 processed
Software Version: 2.8

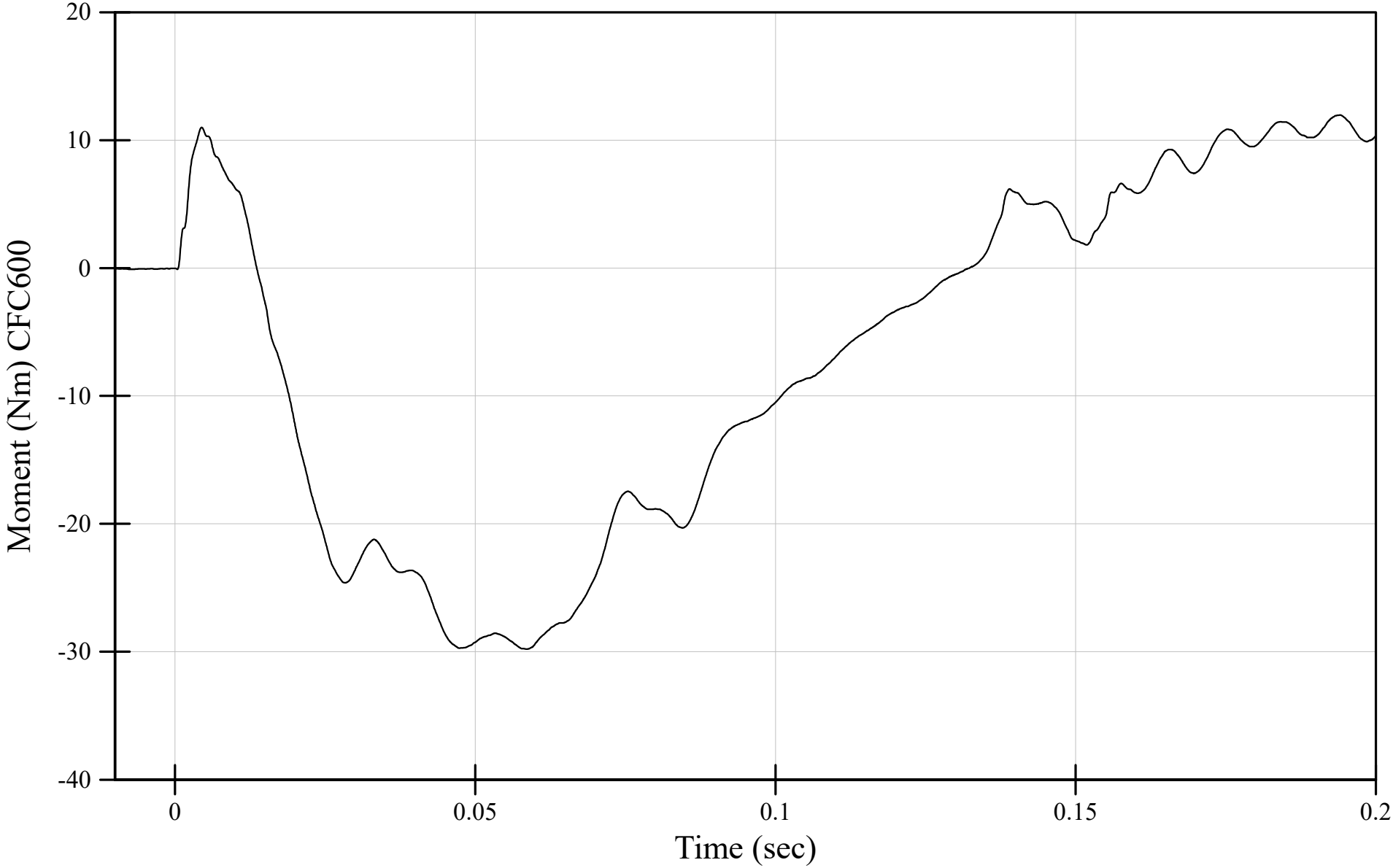
THOR-05F Neck Right Lateral Qualification
Pendulum Pulse
Neck Serial Number: EV1357



File Name: 220915-5 processed

9/15/2022 8:47 AM

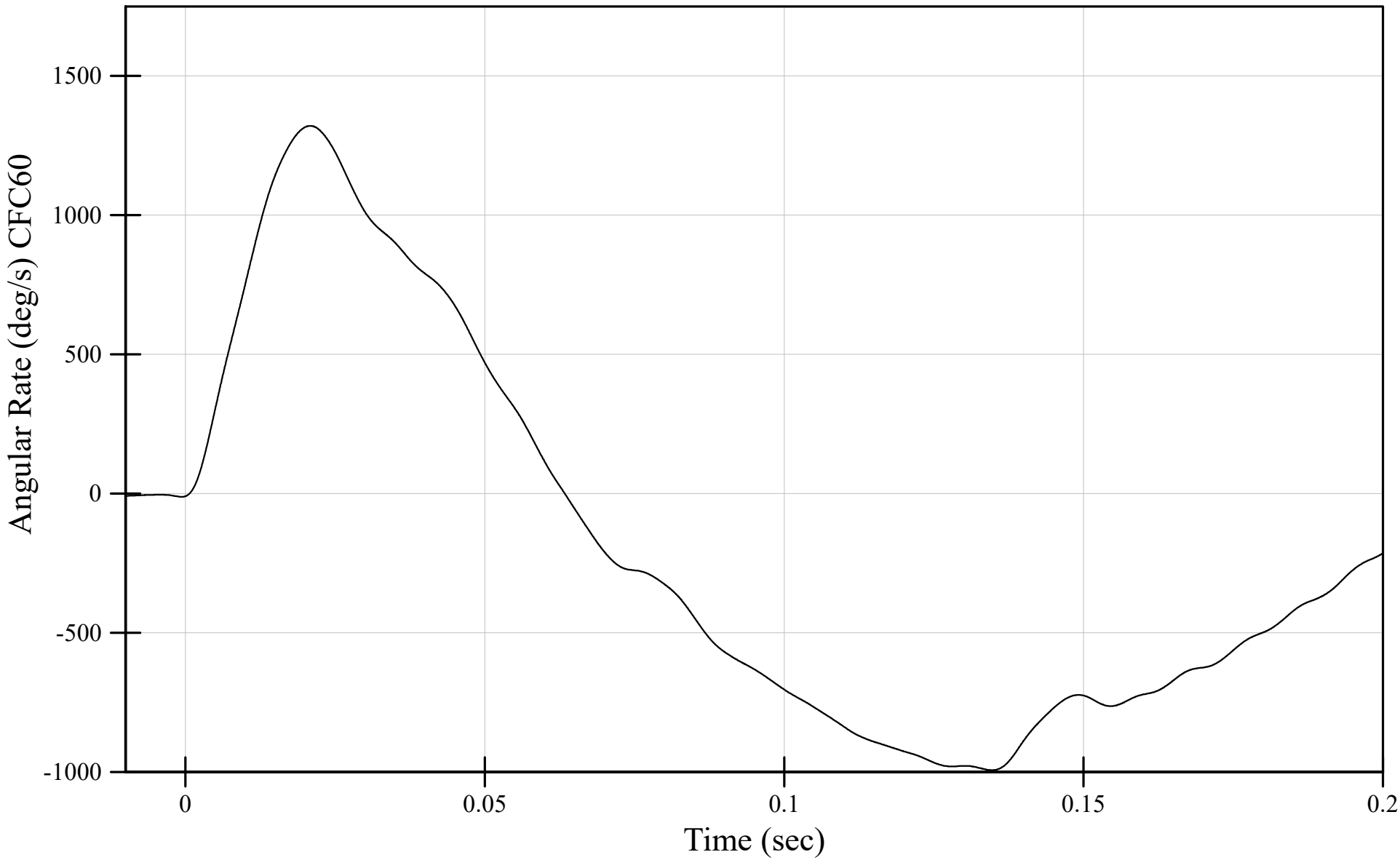
THOR-05F Neck Right Lateral Qualification
X-Moment as Measured
Neck Serial Number: EV1357



File Name: 220915-5 processed

9/15/2022 8:47 AM

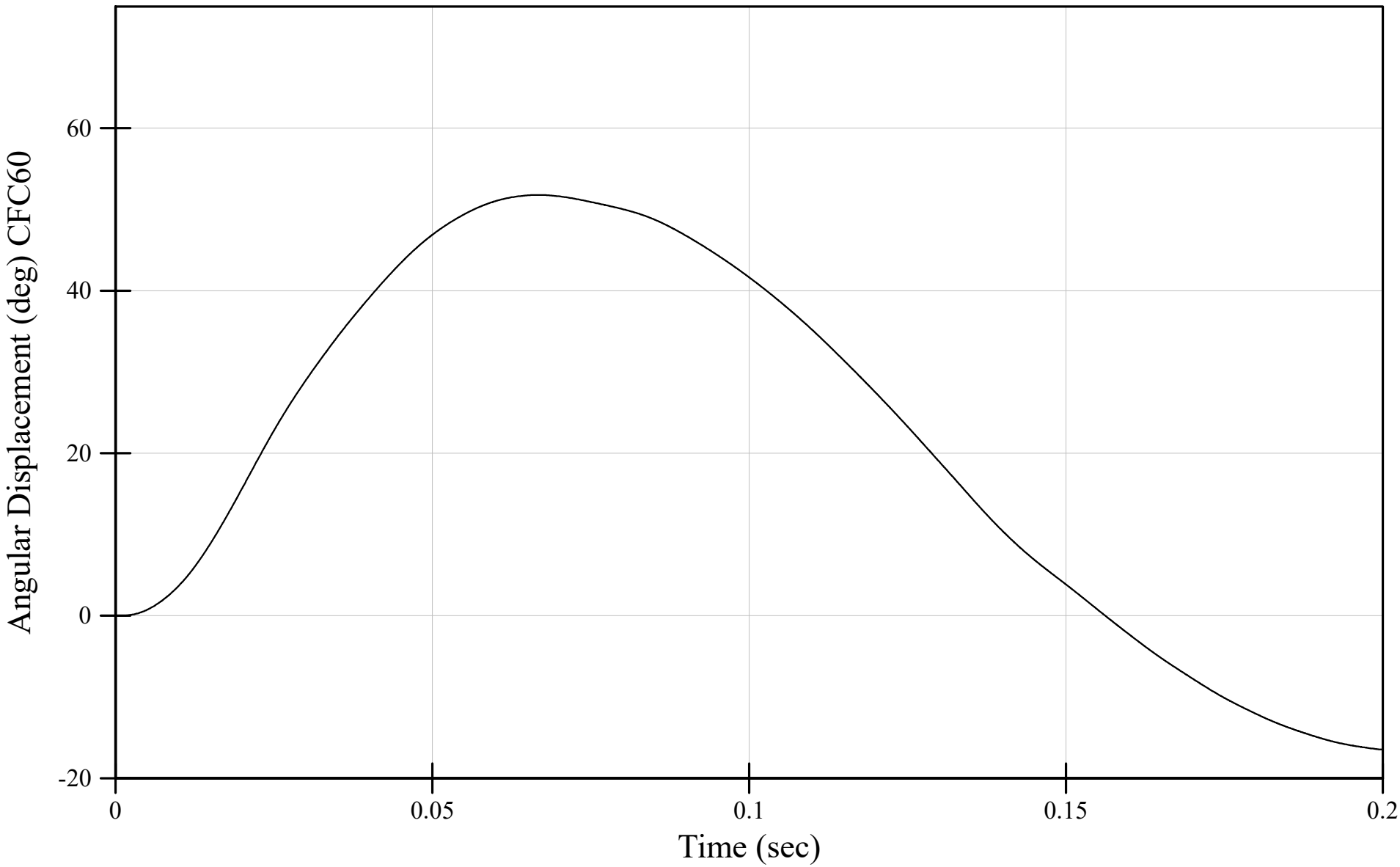
THOR-05F Neck Right Lateral Qualification
Peak Angular Rate
Neck Serial Number: EV1357



File Name: 220915-5 processed

9/15/2022 8:47 AM

THOR-05F Neck Right Lateral Qualification
Neck Rotation
Neck Serial Number: EV1357



File Name: 220915-5 processed

9/15/2022 8:47 AM

THOR-05F Neck Left Torsion Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Neck Serial Number: EV1357
O.C. Stop Assembly Serial Number:
O.C. Cam Serial Number:

Test ID: 220915-11
Test Date: 9/15/2022
Test Time: 11:11 AM

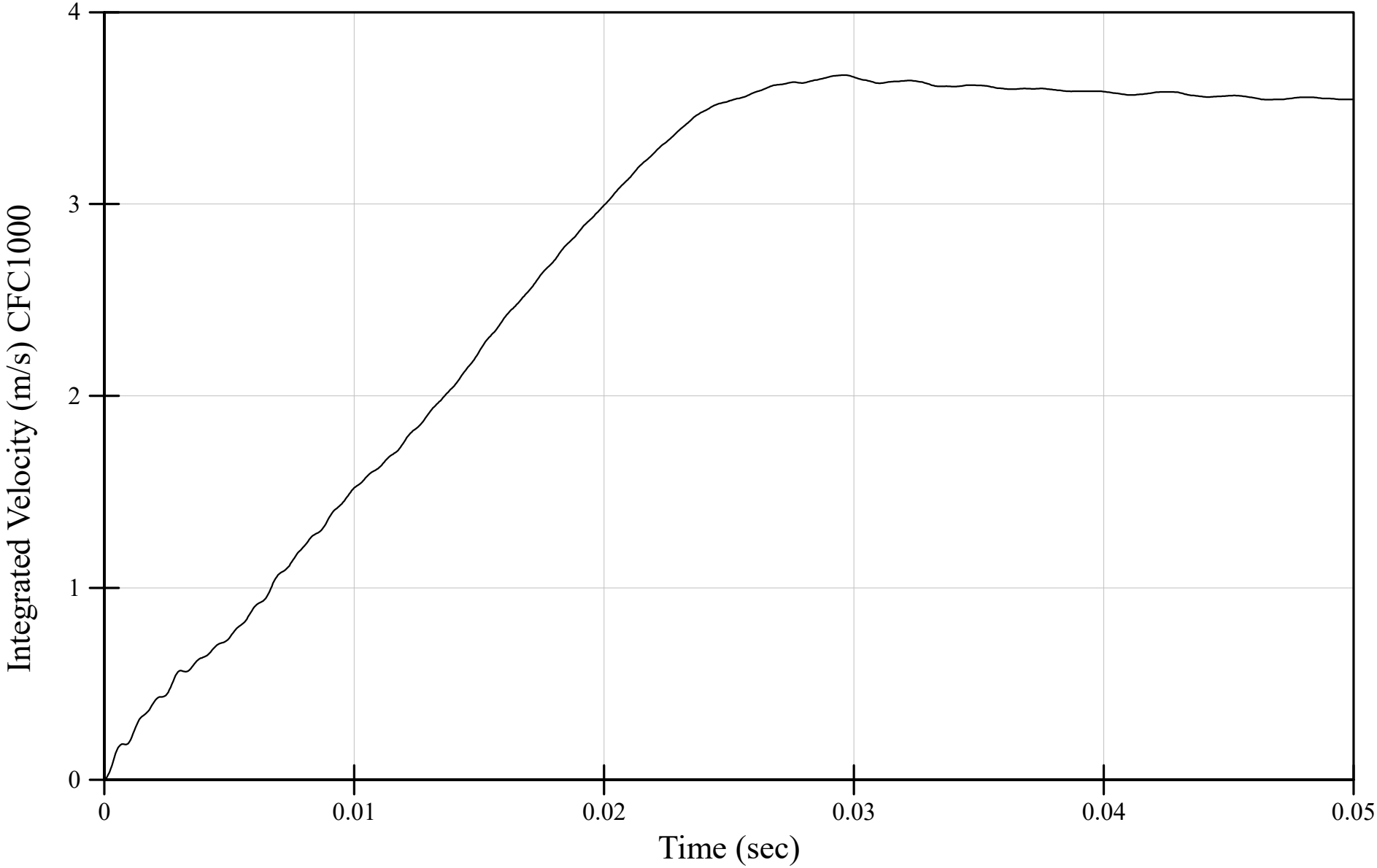
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.9	Pass
Test Humidity (%)	10 - 70	57	Pass
Test Velocity (m/s)	3.35 - 3.45	3.38	Pass
Pendulum Velocity at 10 ms (m/s)		1.07	
Pendulum Velocity at 15 ms (m/s)		2.05	
Pendulum Velocity at 20 ms (m/s)		3.13	
Peak Upper Neck Mz (Nm)		19.8	
Peak Neck Fixture Rotation (deg)		-50.2	
Peak Upper Neck Angular Velocity Z (deg/sec)		-1256.2	

* THOR-05F Qualification Manual - July 2022

File Name: 220915-11 processed
Software Version: 2.8

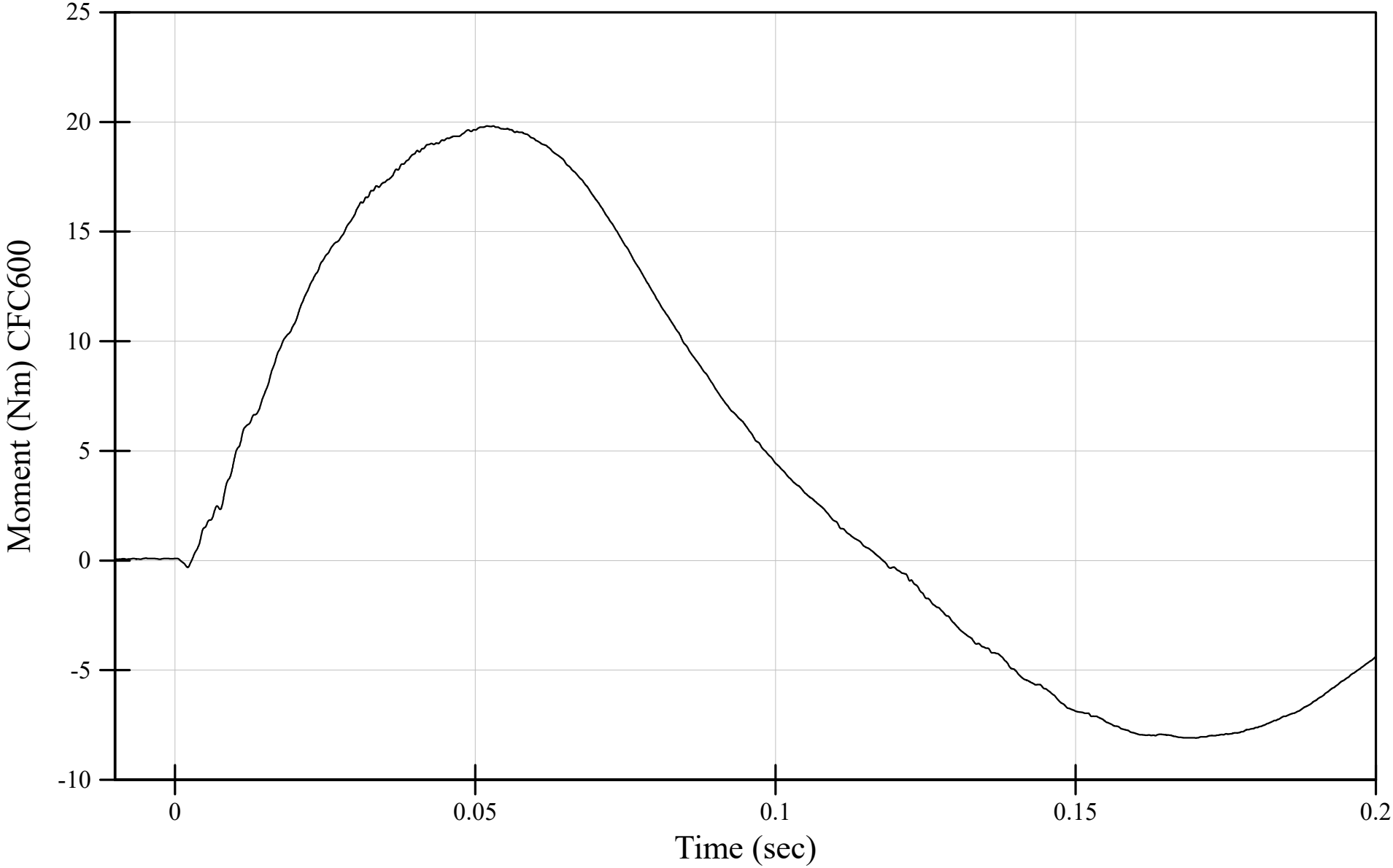
THOR-05F Neck Left Torsion Qualification
Pendulum Pulse
Neck Serial Number: EV1357



File Name: 220915-11 processed

9/15/2022 11:11 AM

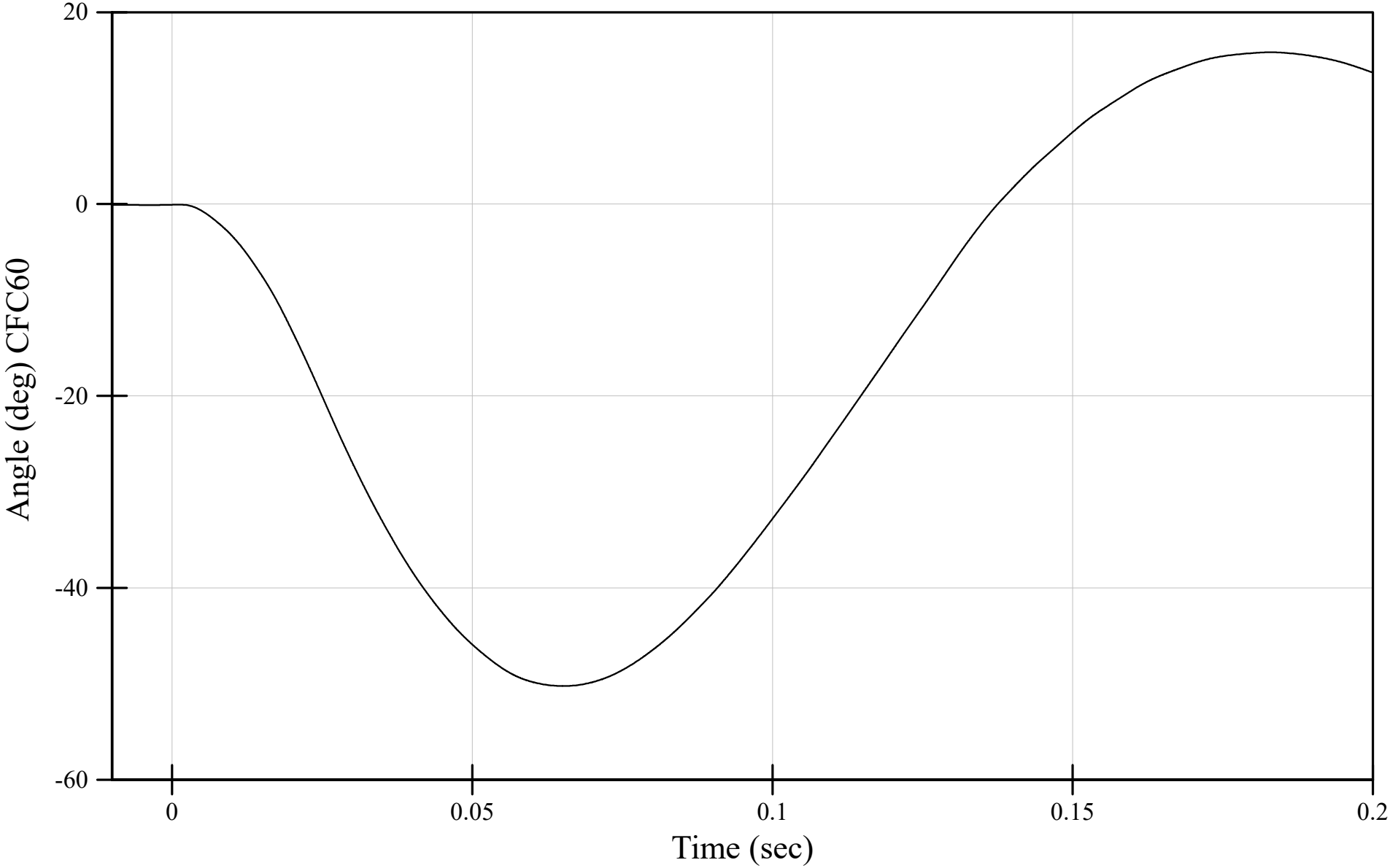
THOR-05F Neck Left Torsion Qualification
Z-Moment as Measured
Neck Serial Number: EV1357



File Name: 220915-11 processed

9/15/2022 11:11 AM

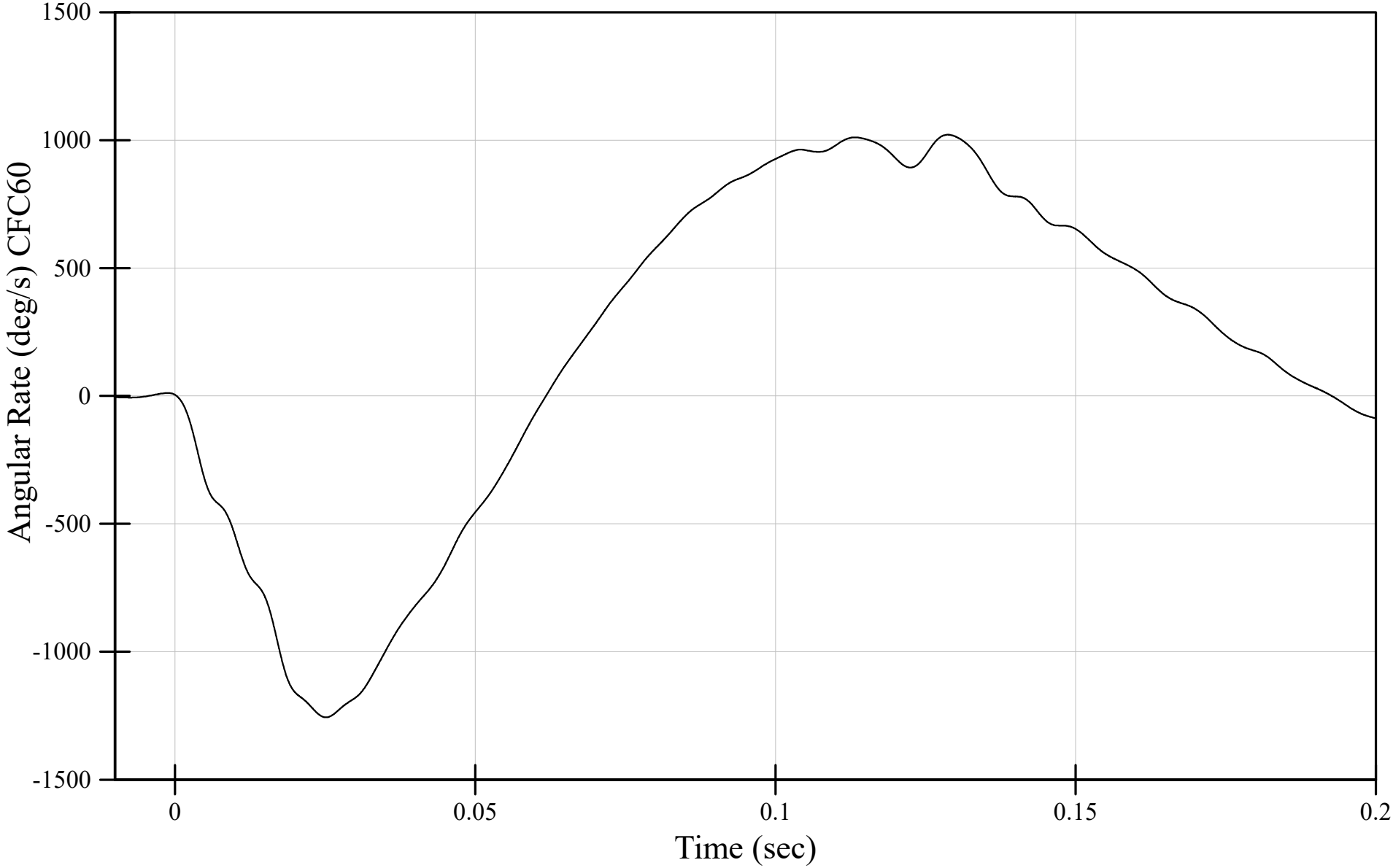
THOR-05F Neck Left Torsion Qualification
Neck Fixture Rotation
Neck Serial Number: EV1357



File Name: 220915-11 processed

9/15/2022 11:11 AM

THOR-05F Neck Left Torsion Qualification
Peak Angular Rate
Neck Serial Number: EV1357



File Name: 220915-11 processed

9/15/2022 11:11 AM

THOR-05F Neck Right Torsion Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Neck Serial Number: EV1357
O.C. Stop Assembly:
O.C. Cam:

Test ID: 220915-12
Test Date: 9/15/2022
Test Time: 12:55 PM

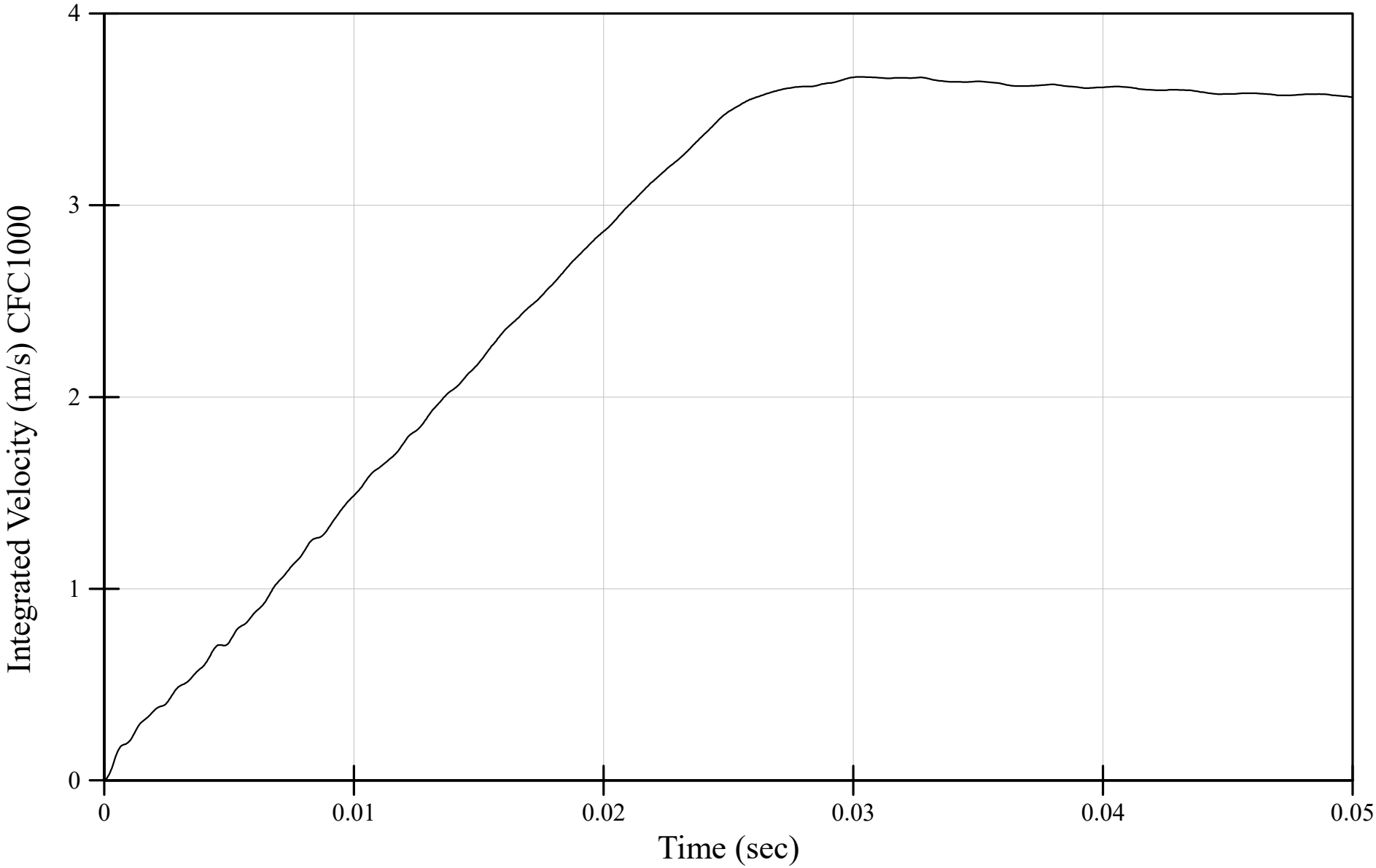
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.7	Pass
Test Humidity (%)	10 - 70	59	Pass
Test Velocity (m/s)	3.35 - 3.45	3.38	Pass
Pendulum Velocity at 7 ms (m/s)		1.04	
Pendulum Velocity at 14 ms (m/s)		2.04	
Pendulum Velocity at 21 ms (m/s)		3.00	
Peak Upper Neck Mz (Nm)		-20.0	
Peak Neck Fixture Rotation (deg)		49.8	
Peak Upper Neck Angular Velocity Z (deg/sec)		1224.3	

* THOR-05F Qualification Manual - July 2022

File Name: 220915-12 processed
Software Version: 2.8

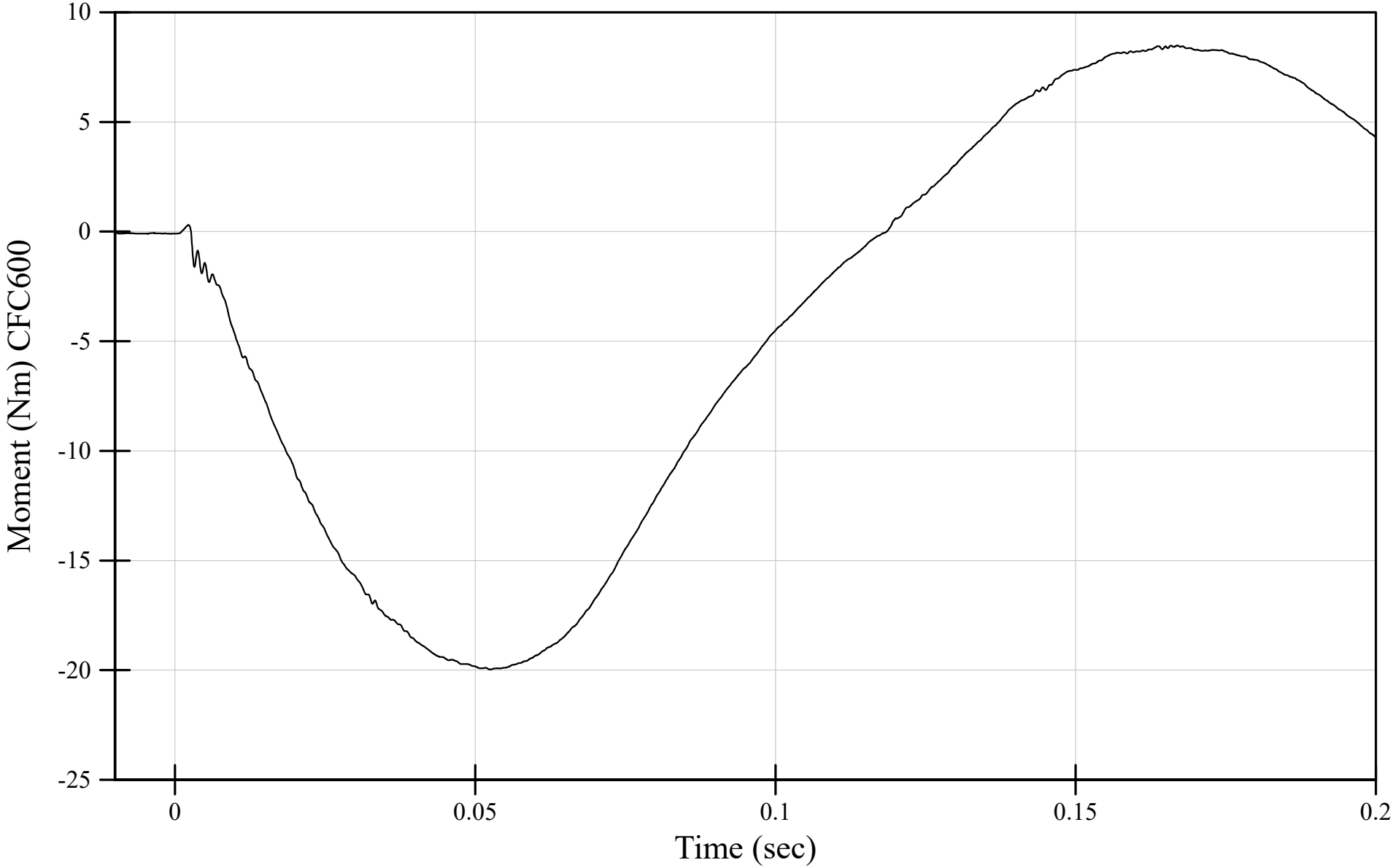
THOR-05F Neck Right Torsion Qualification
Pendulum Pulse
Neck Serial Number: EV1357



File Name: 220915-12 processed

9/15/2022 12:55 PM

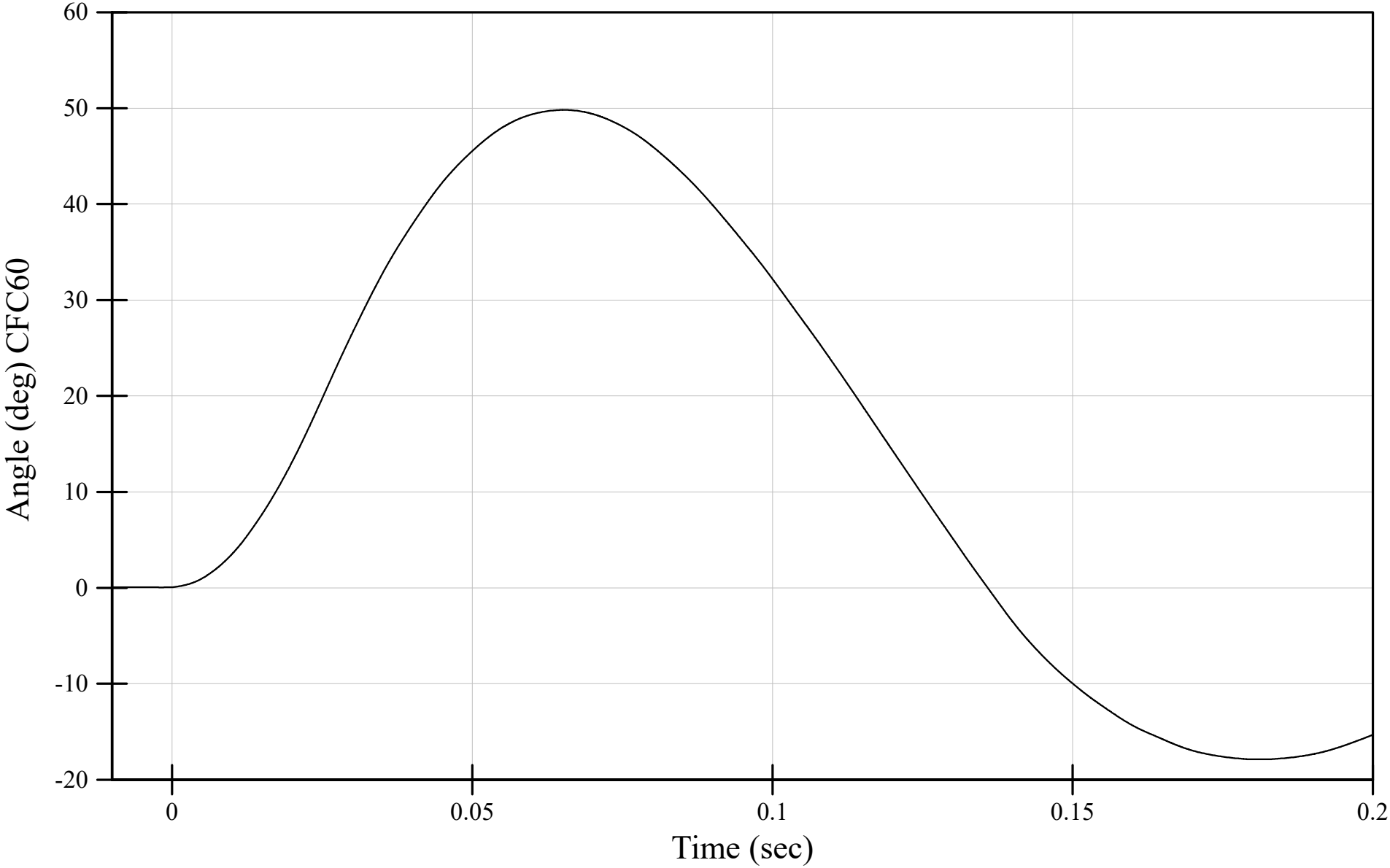
THOR-05F Neck Right Torsion Qualification
Z-Moment as Measured
Neck Serial Number: EV1357



File Name: 220915-12 processed

9/15/2022 12:55 PM

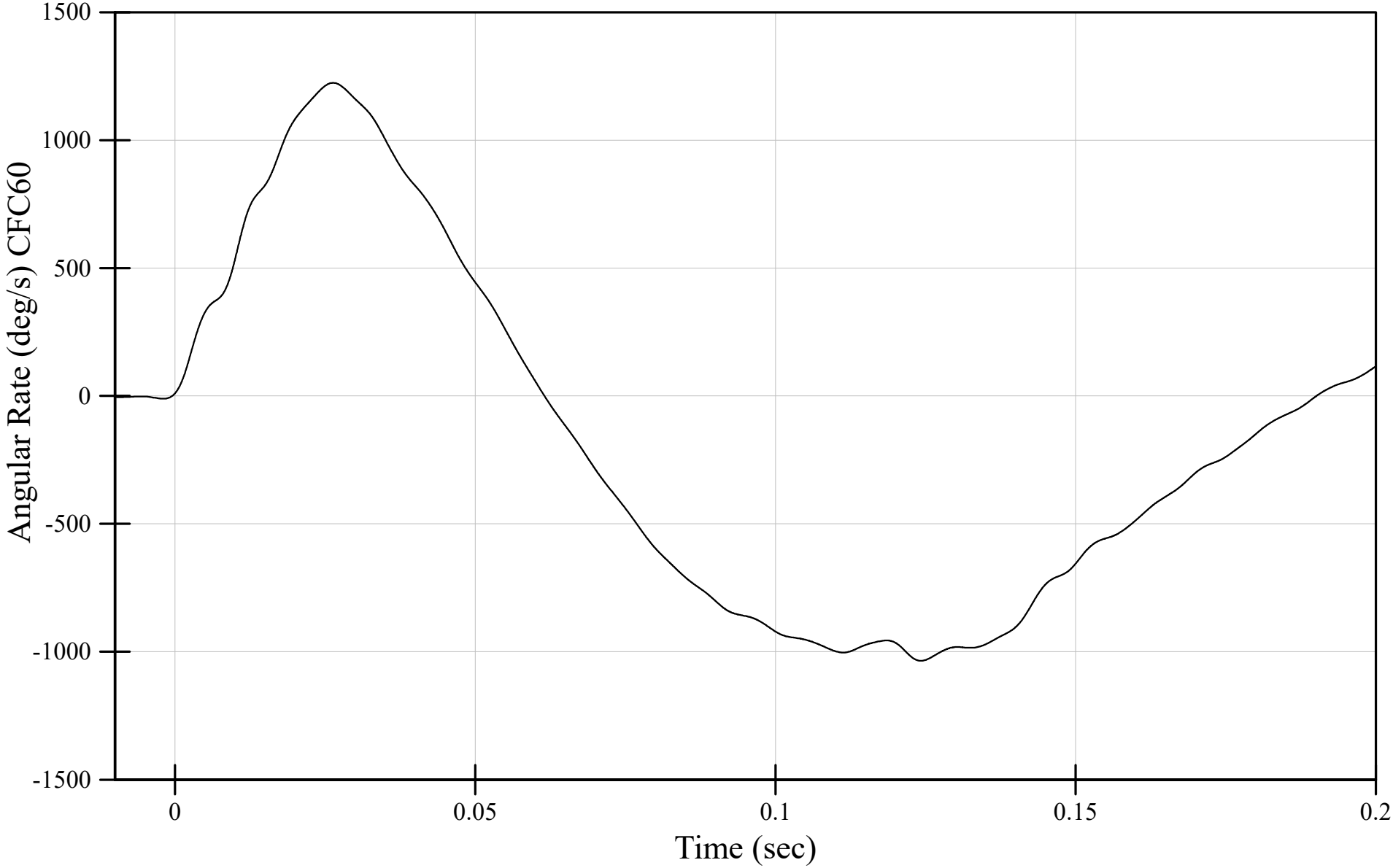
THOR-05F Neck Right Torsion Qualification
Neck Fixture Rotation
Neck Serial Number: EV1357



File Name: 220915-12 processed

9/15/2022 12:55 PM

THOR-05F Neck Right Torsion Qualification
Peak Angular Rate
Neck Serial Number: EV1357



File Name: 220915-12 processed

9/15/2022 12:55 PM

THOR-05F Upper Thorax Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components

Rib 1 Serial Number: EU8361
Rib 2 Serial Number: EU8362
Rib 3 Serial Number: EU8363
Rib 4 Serial Number: EL6732
Rib 5 Serial Number: EU8364
Rib 6 Serial Number: EL6737
Rib 7 Serial Number: EL6736

Test ID: 221005-4
Test Date: 10/5/2022
Test Time: 9:53 AM

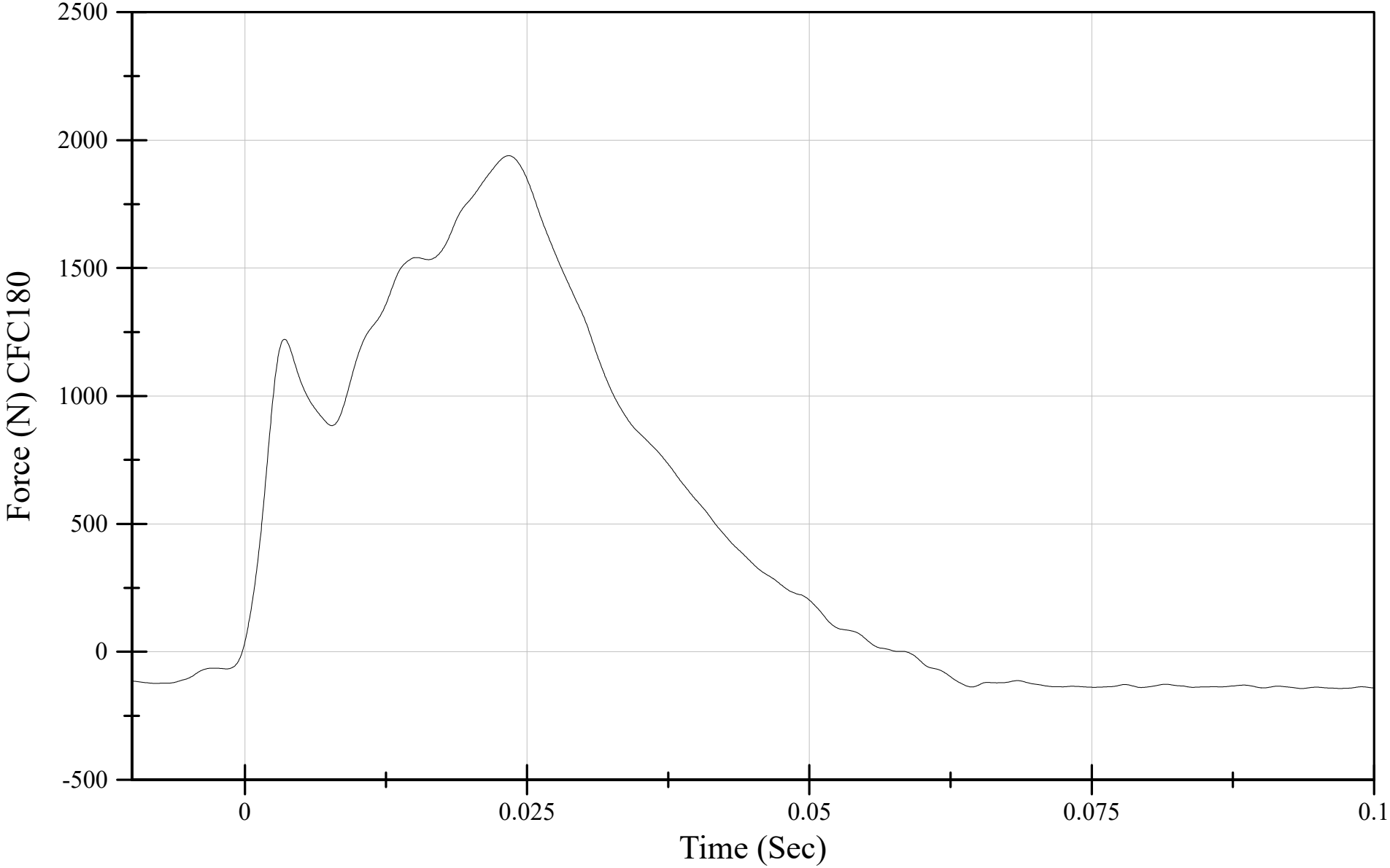
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.3	Pass
Test Humidity (%)	10 - 70	39	Pass
Test Velocity (m/s)	4.25 - 4.35	4.31	Pass
Peak Probe Force (N)		1940	
Peak Upper Left Resultant Deflection (mm)		46.3	
Peak Upper Right Resultant Deflection (mm)		43.9	
Difference Between Peak Left & Right Resultant Deflections (mm)		2.5	
Force at Left Peak Resultant Deflection (N)		1846	
Force at Right Peak Resultant Deflection (N)		1849	

* THOR-05F Qualification Manual - July 2022

File Name: 221005-4 processed

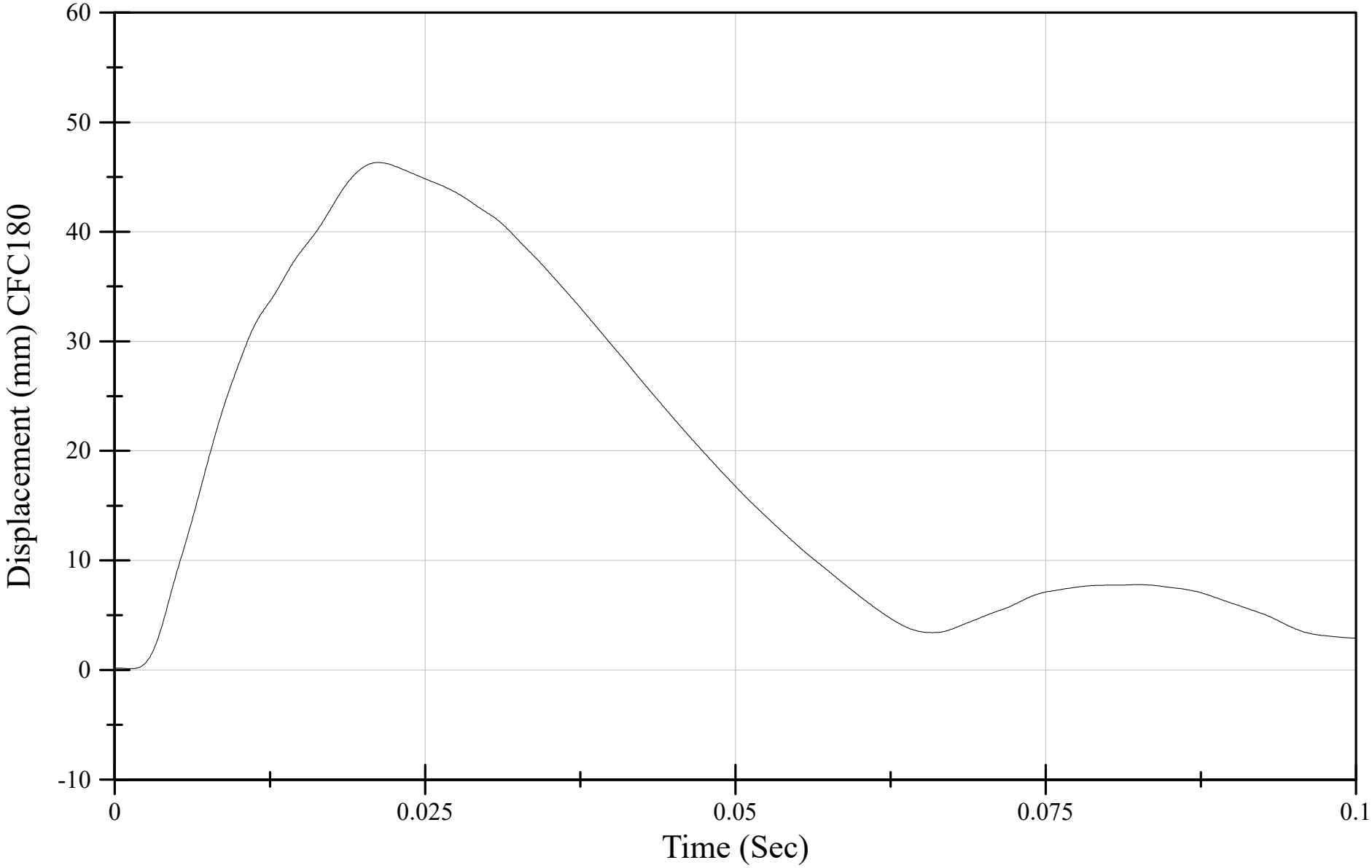
THOR-05F Upper Thorax Qualification
Probe Force
Dummy Serial Number: EV0674



File Name: 221005-4 processed

10/5/2022 9:53 AM

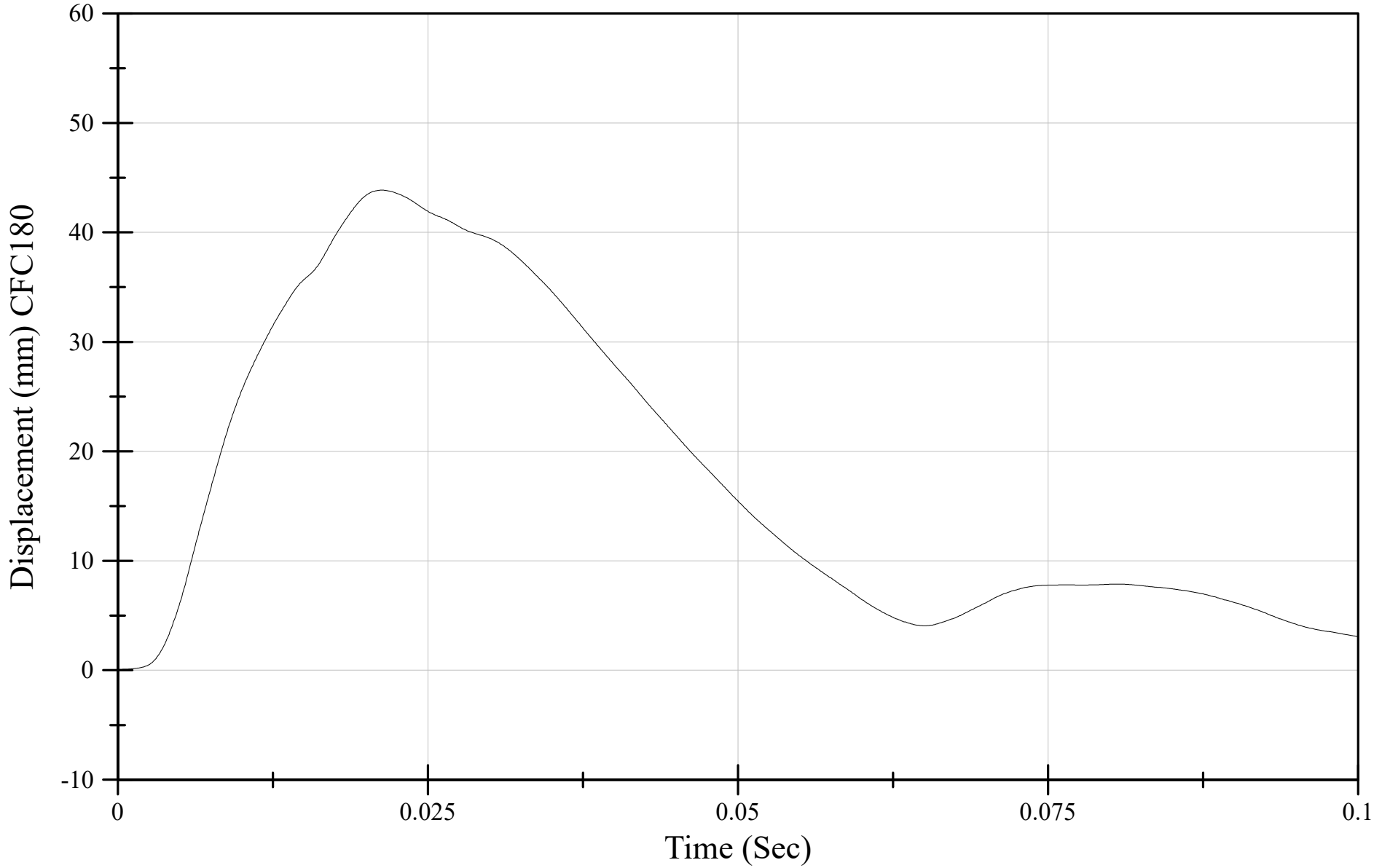
THOR-05F Upper Thorax Qualification
Left Resultant Deflection
Dummy Serial Number: EV0674



File Name: 221005-4 processed

10/5/2022 9:53 AM

THOR-05F Upper Thorax Qualification
Right Resultant Deflection
Dummy Serial Number: EV0674



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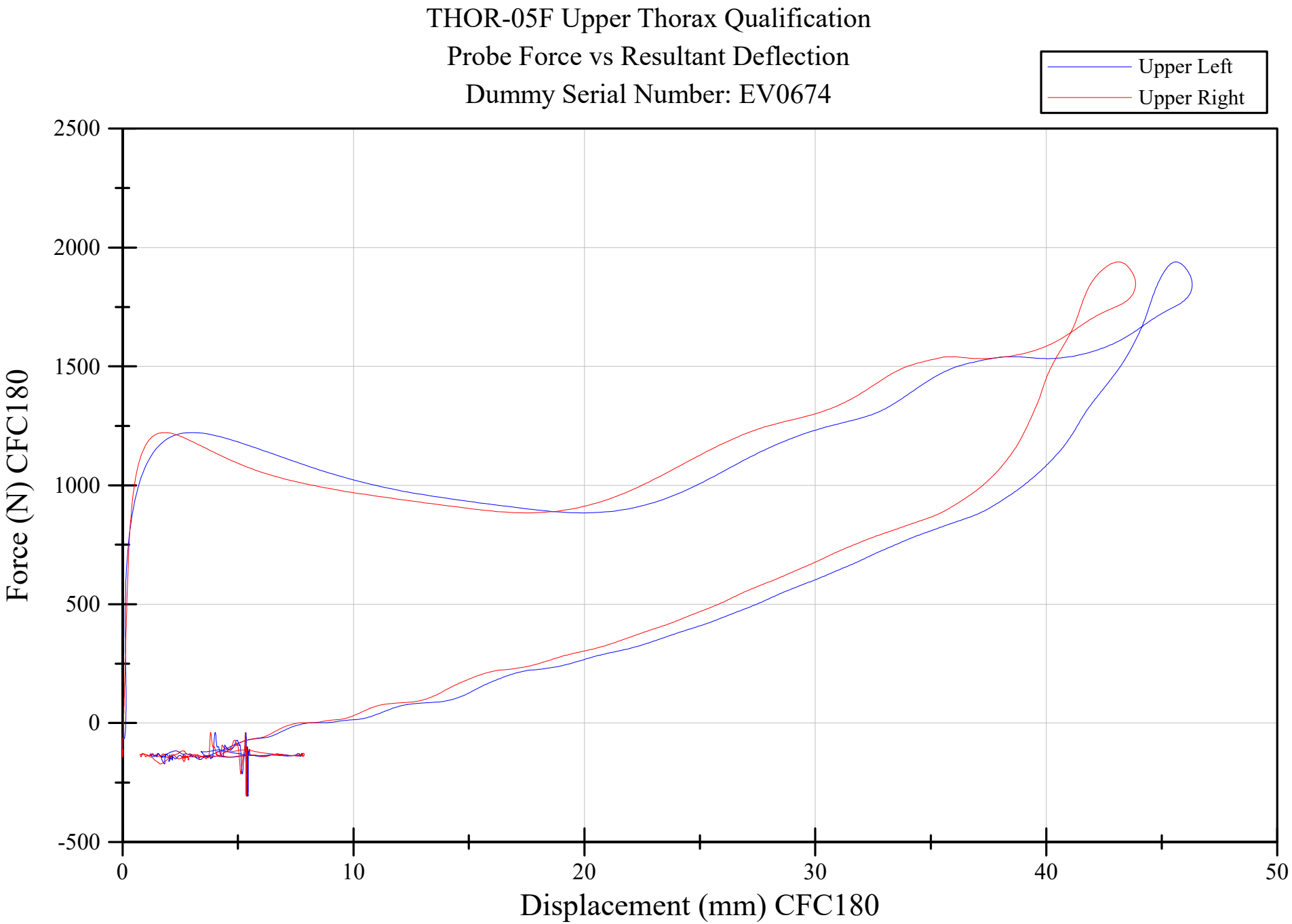
10/5/2022 9:53 AM



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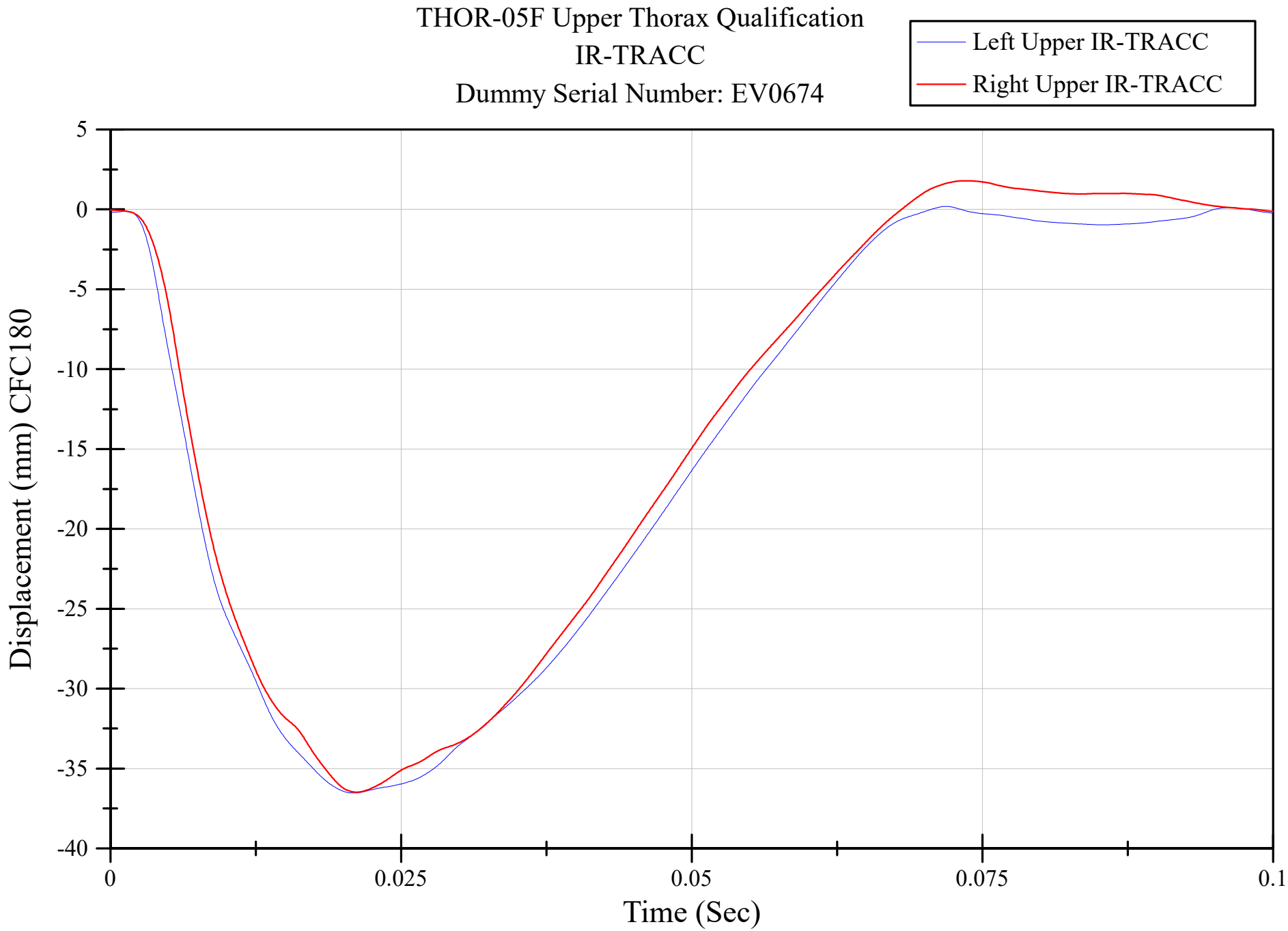
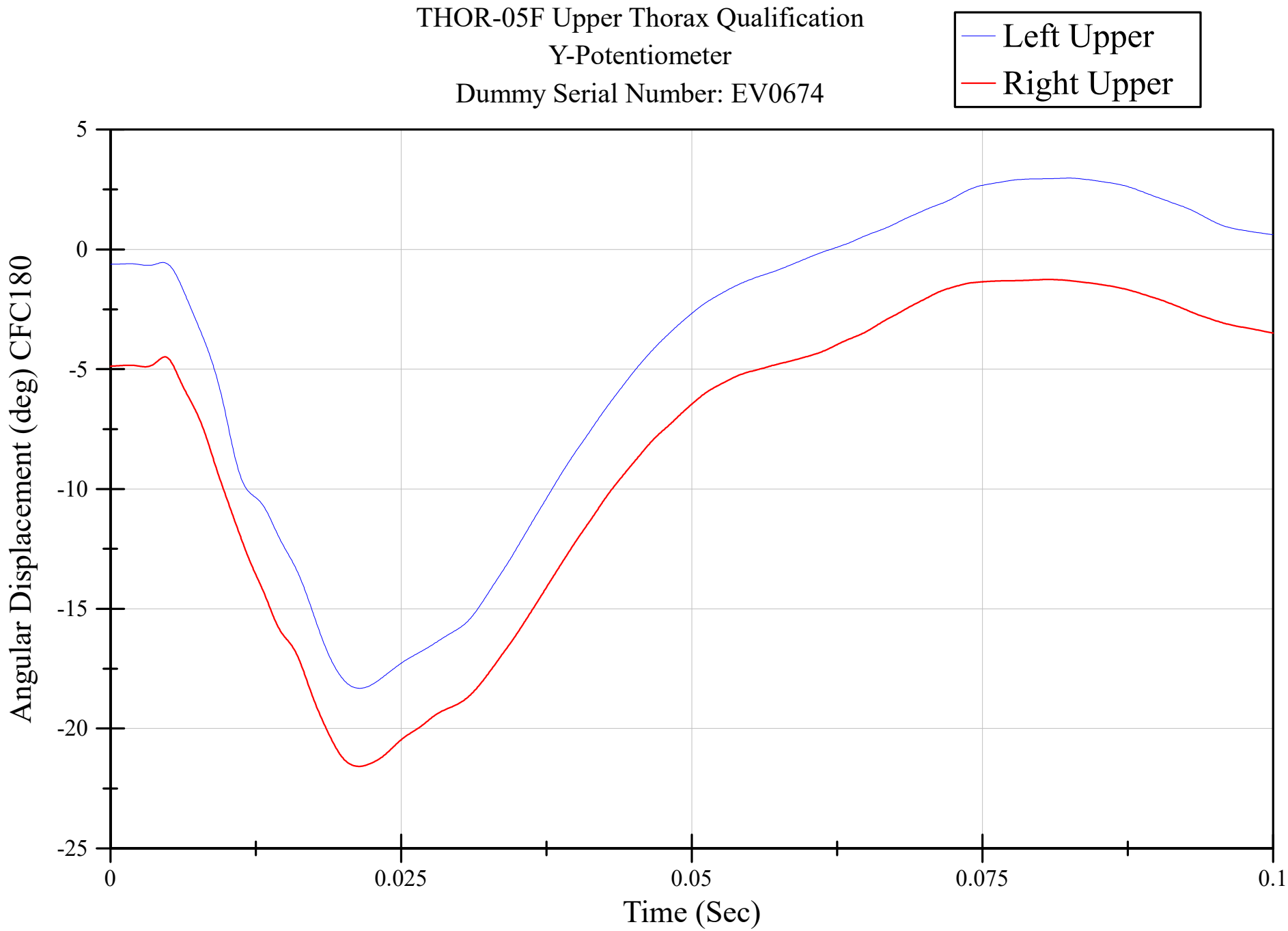
10/5/2022 9:53 AM



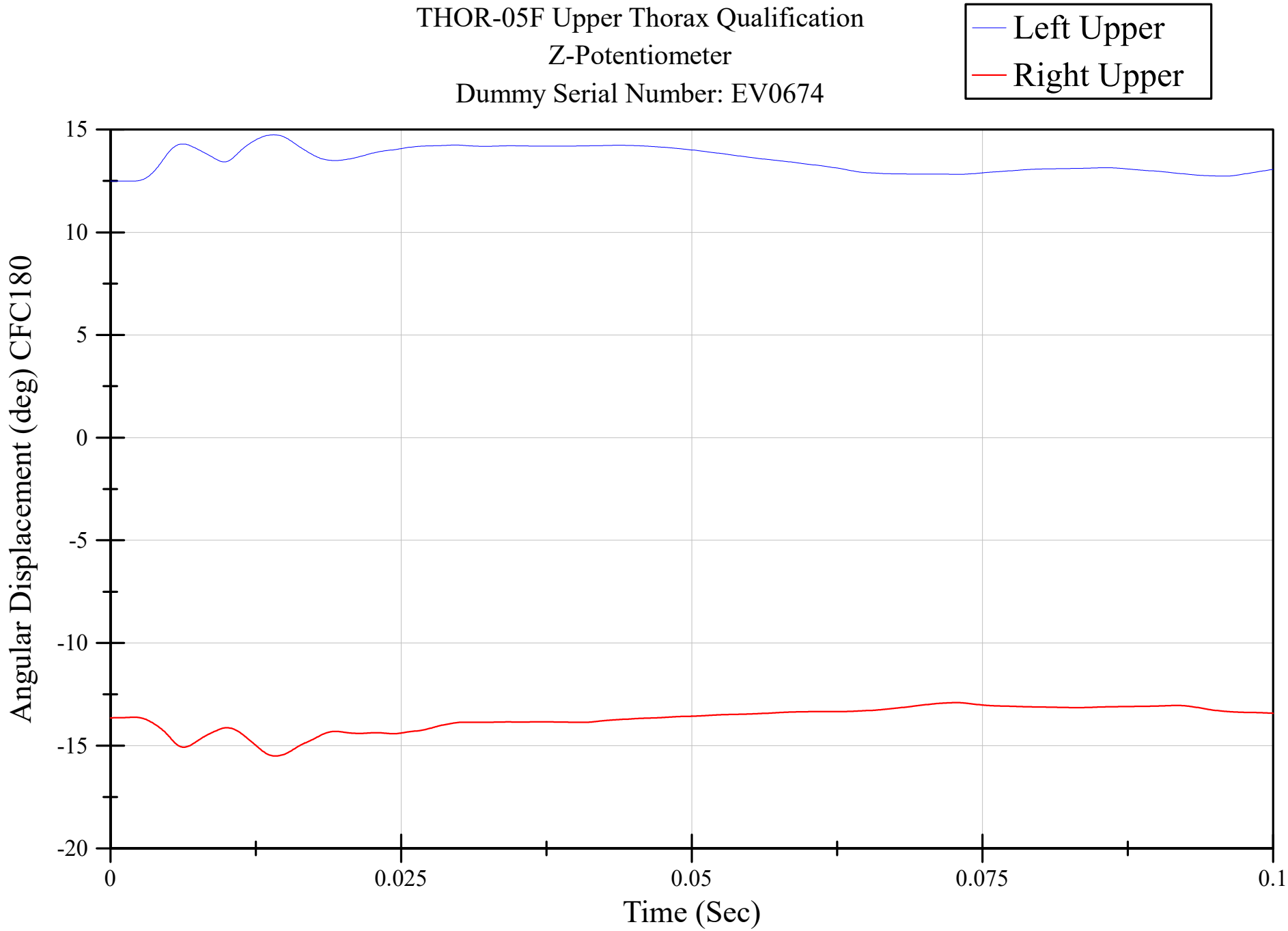
File Name: 221005-4 processed

10/5/2022 9:53 AM



File Name: 221005-4 processed

10/5/2022 9:53 AM



File Name: 221005-4 processed

10/5/2022 9:53 AM

THOR-05F Lower Left Thorax Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components

Rib 1 Serial Number: EU8361
Rib 2 Serial Number: EU8362
Rib 3 Serial Number: EU8363
Rib 4 Serial Number: EL6732
Rib 5 Serial Number: EU8364
Rib 6 Serial Number: EL6737
Rib 7 Serial Number: EL6736

Test ID: 221005-5
Test Date: 10/5/2022
Test Time: 10:36 AM

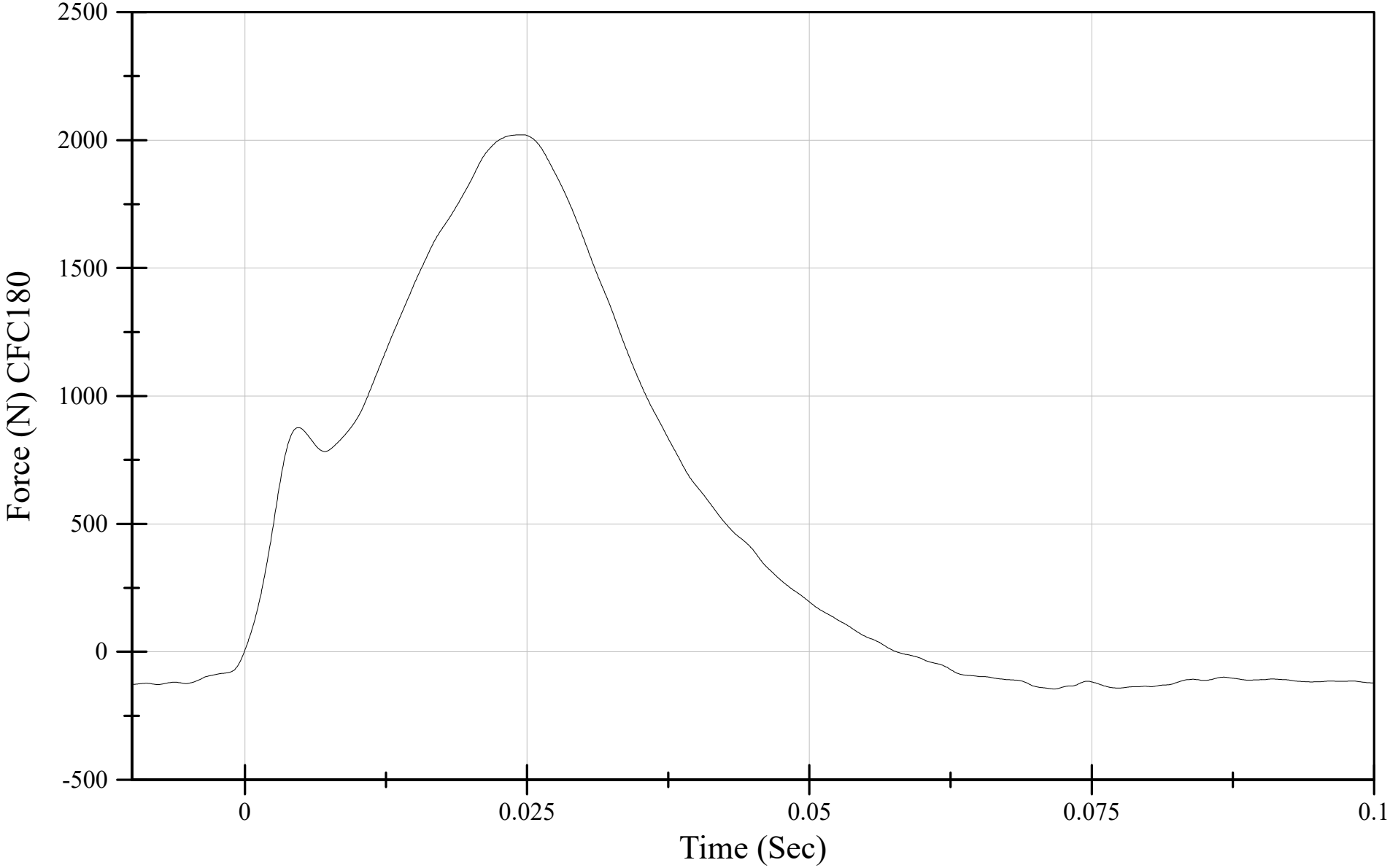
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.3	Pass
Test Humidity (%)	10 - 70	38	Pass
Test Velocity (m/s)	4.25 - 4.35	4.30	Pass
Peak Probe Force (N)		2021	
Left Resultant Deflection at Peak Force (mm)		51.5	

* THOR-05F Qualification Manual - July 2022

File Name: 221005-5 processed
Software Version: 2.8

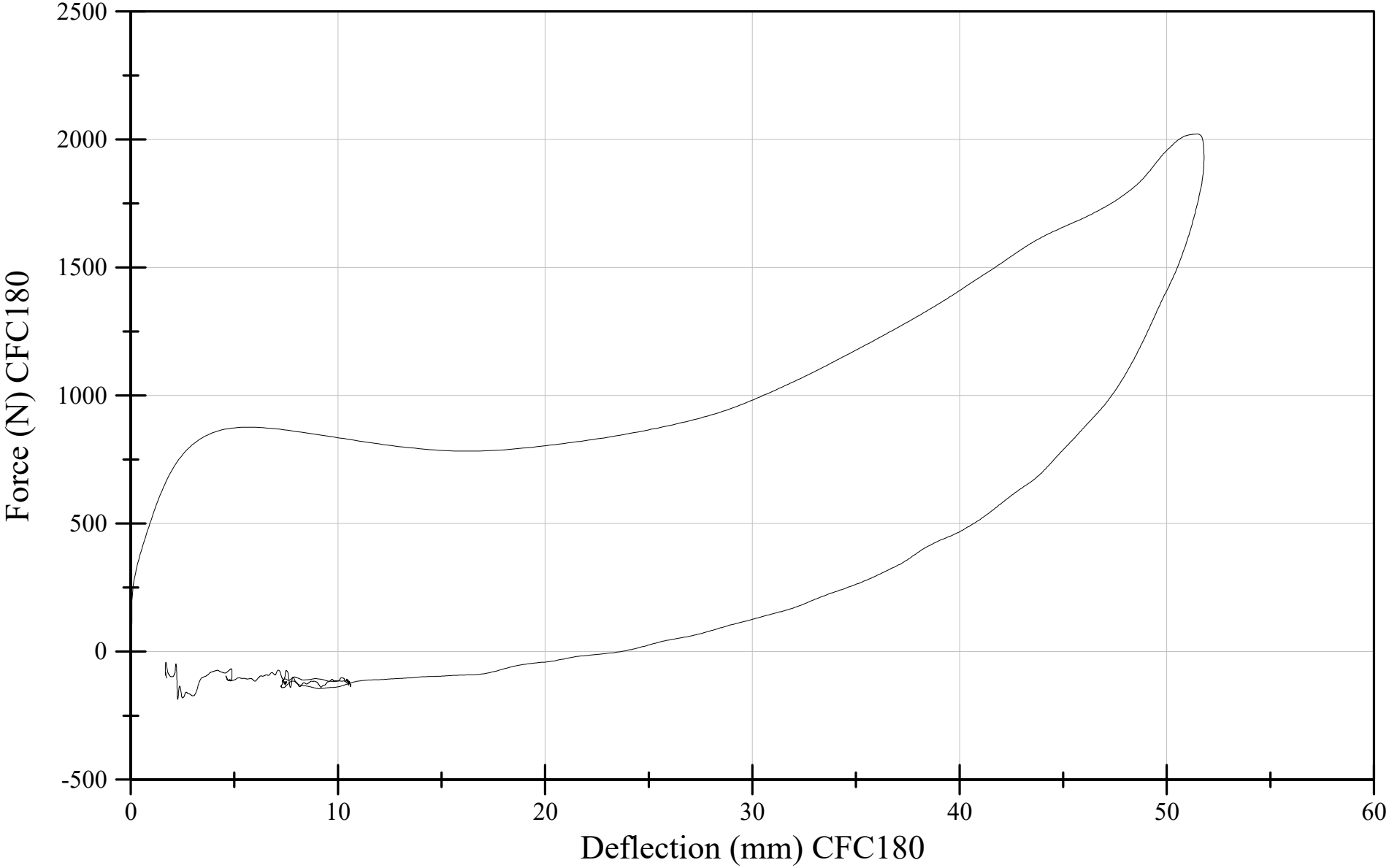
THOR-05F Lower Left Thorax Qualification
Peak Probe Force
Serial Number: EV0674



File Name: 221005-5 processed

10/5/2022 10:36 AM

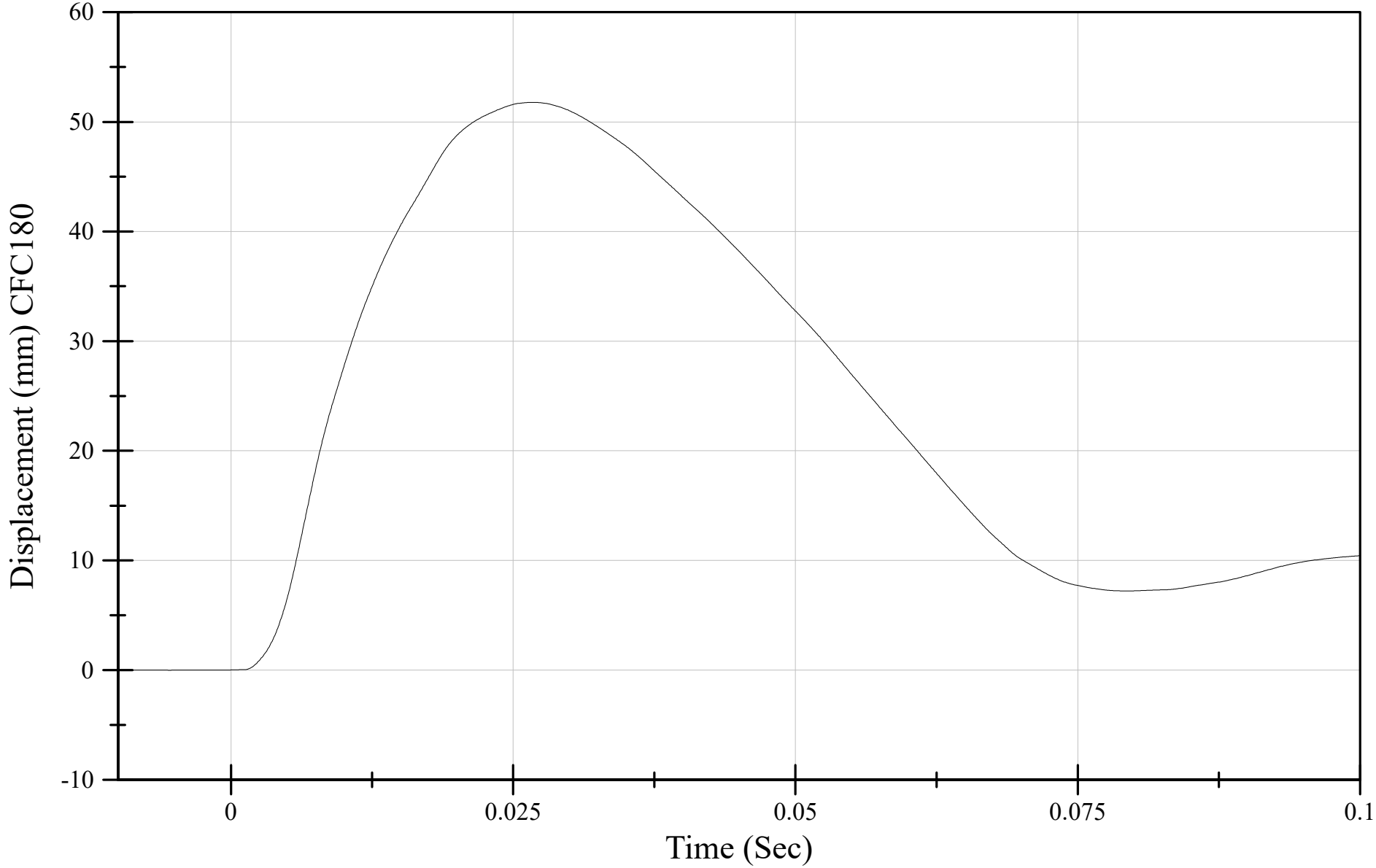
THOR-05F Lower Left Thorax Qualification
Probe Force vs Left Resultant Deflection
Serial Number: EV0674



File Name: 221005-5 processed

10/5/2022 10:36 AM

THOR-05F Lower Left Thorax Qualification
Left Resultant Deflection
Serial Number: EV0674



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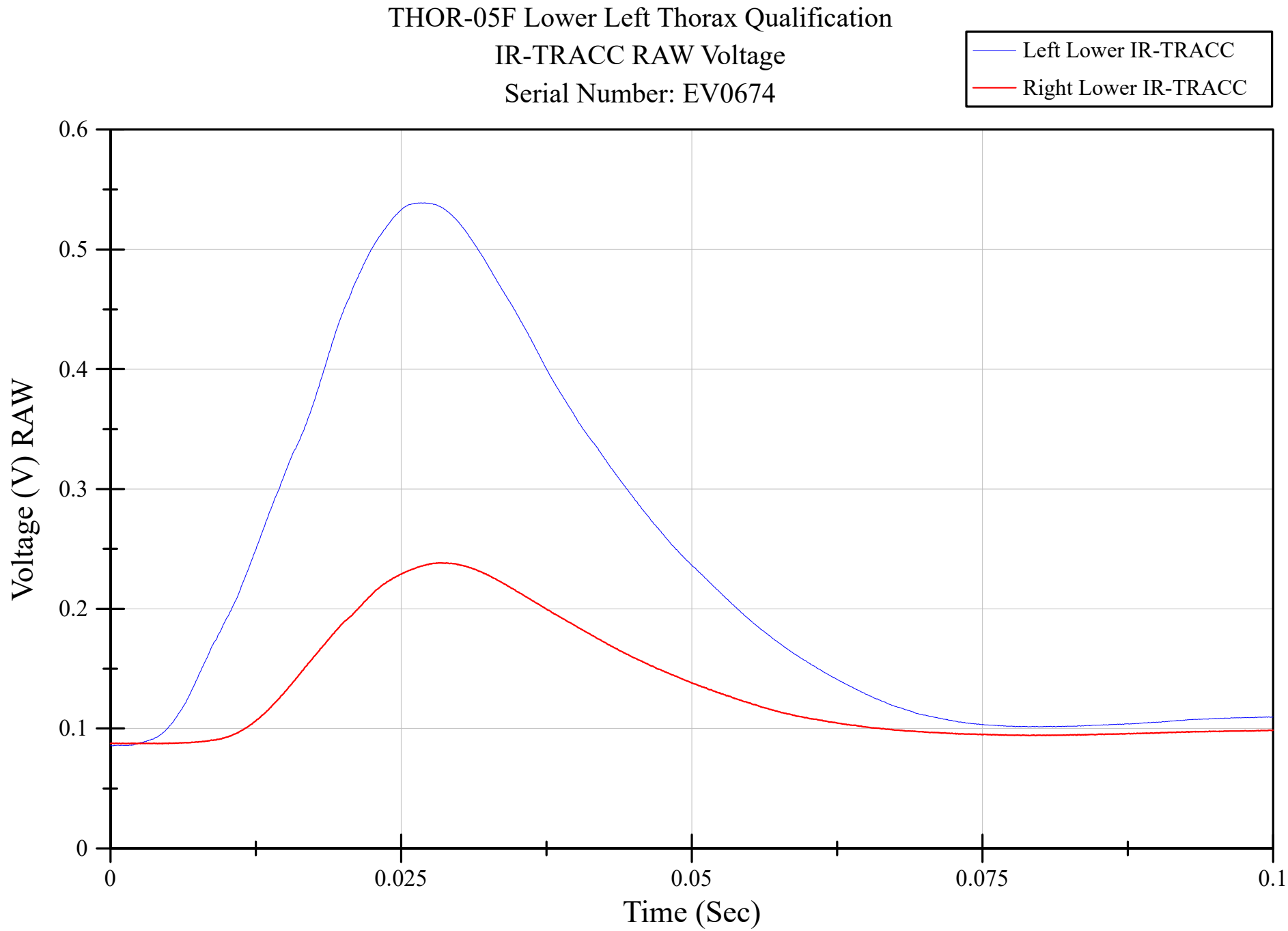
10/5/2022 10:36 AM



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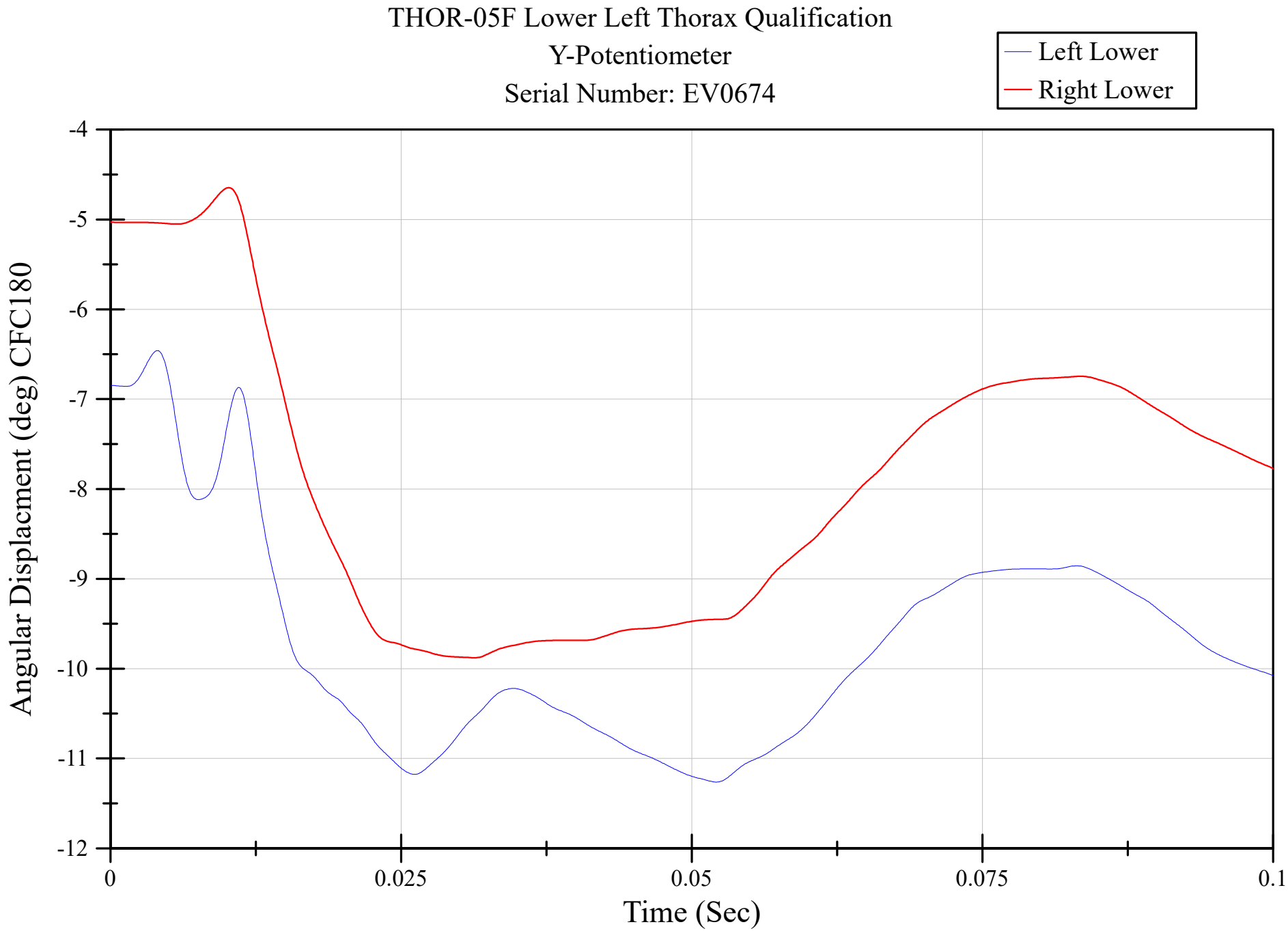

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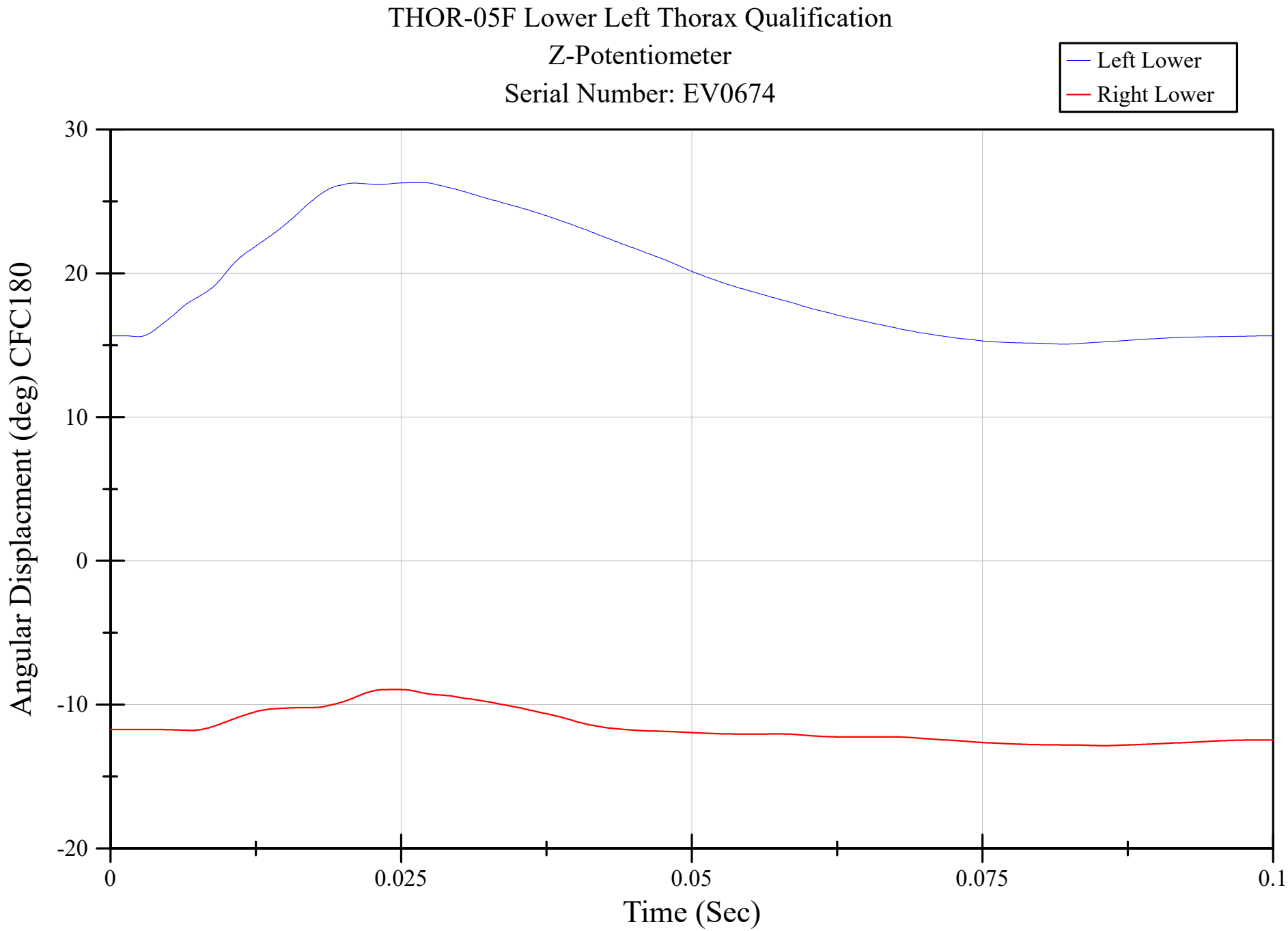
10/5/2022 10:36 AM



File Name: 221005-5 processed

10/5/2022 10:36 AM

THOR-05F Lower Right Thorax Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components

Rib 1 Serial Number: EU8361
Rib 2 Serial Number: EU8362
Rib 3 Serial Number: EU8363
Rib 4 Serial Number: EL6732
Rib 5 Serial Number: EU8364
Rib 6 Serial Number: EL6737
Rib 7 Serial Number: EL6736

Test ID: 221005-7
Test Date: 10/5/2022
Test Time: 2:16 PM

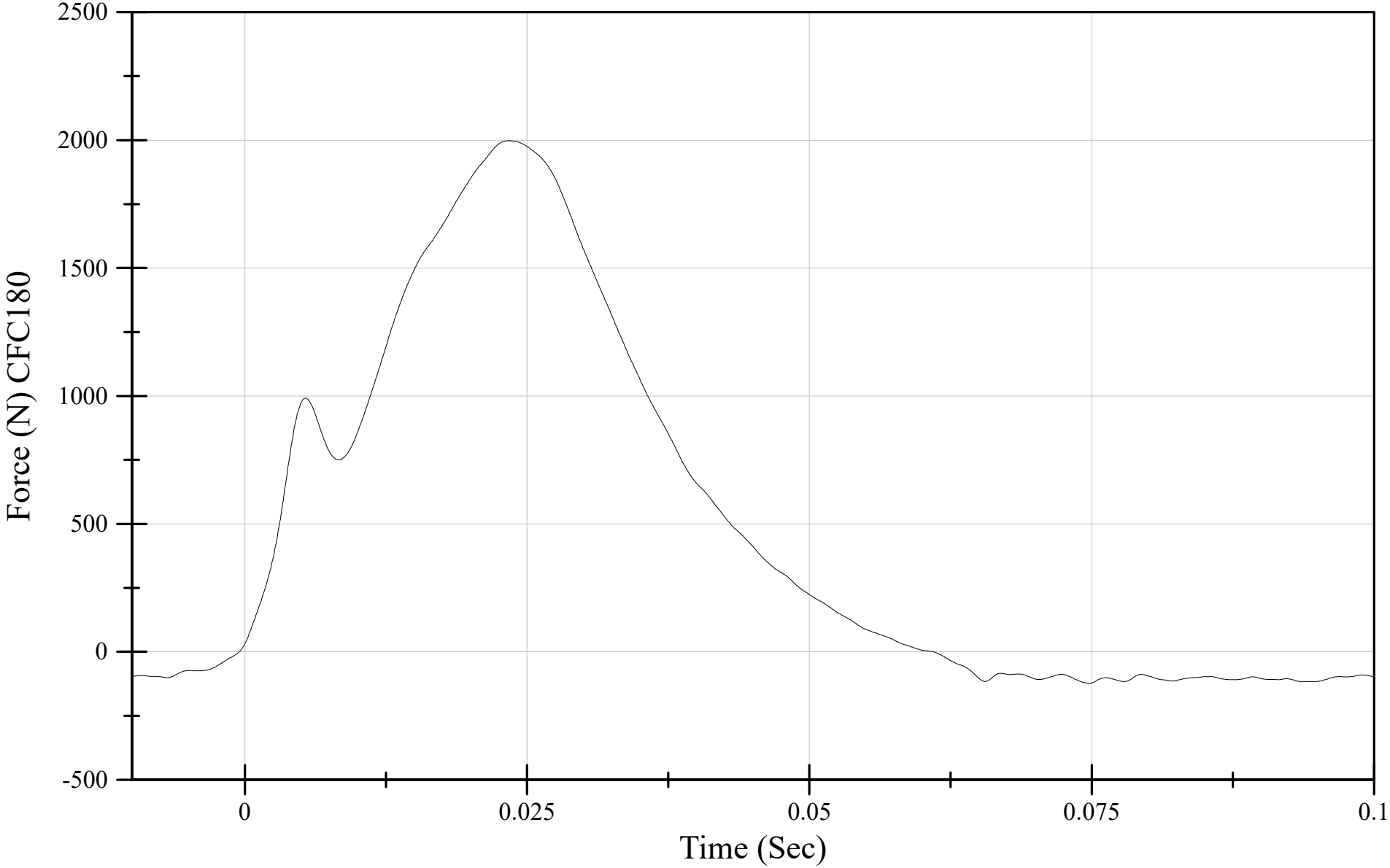
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.5	Pass
Test Humidity (%)	10 - 70	43	Pass
Test Velocity (m/s)	4.25 - 4.35	4.31	Pass
Peak Probe Force (N)		1998	
Right Resultant Deflection at Peak Force (mm)		50.1	

* THOR-05F Qualification Manual - July 2022

File Name: 221005-7 processed
Software Version: 2.8

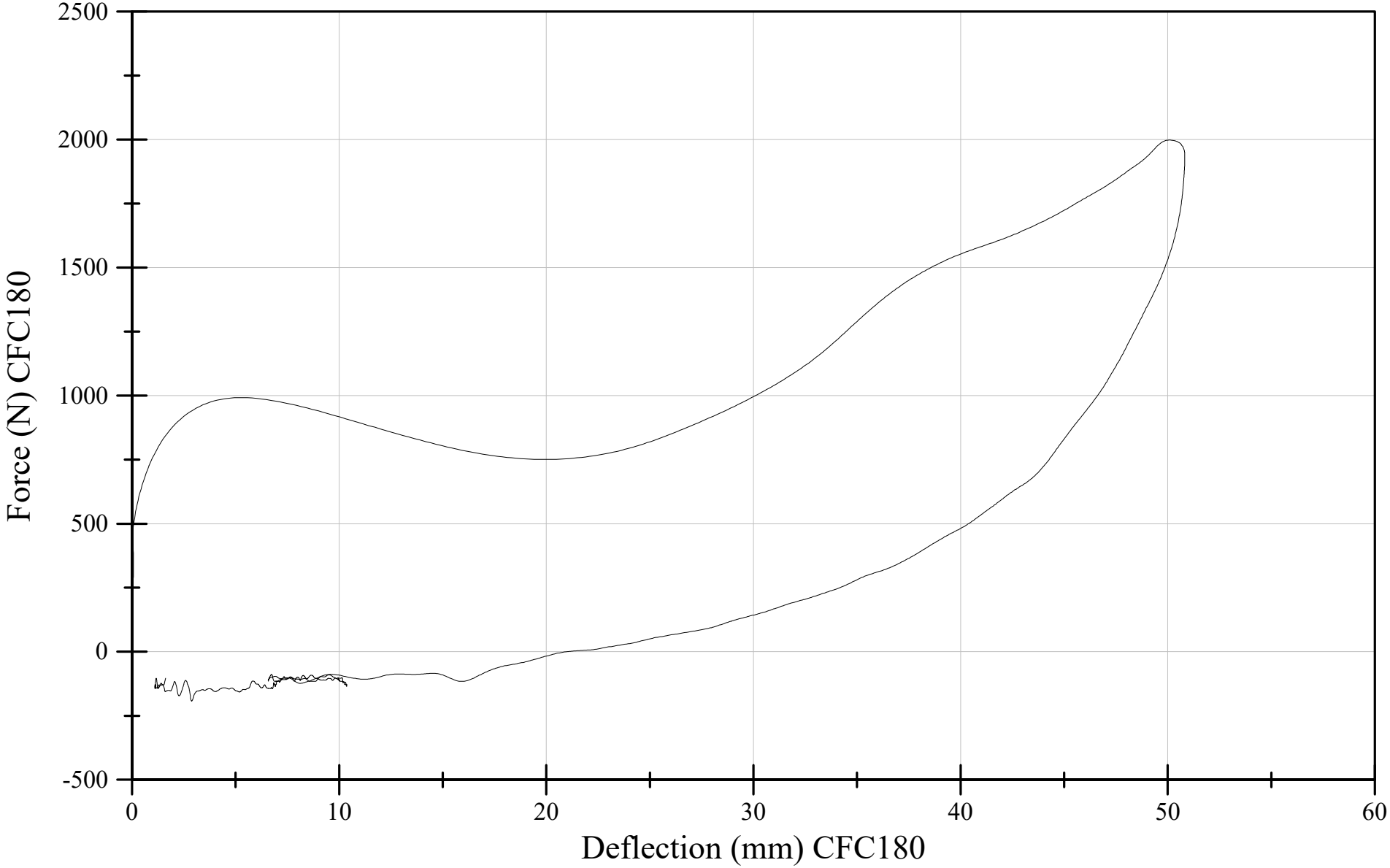
THOR-05F Lower Right Thorax Qualification
Peak Probe Force
Serial Number: EV0674



File Name: 221005-7 processed

10/5/2022 2:16 PM

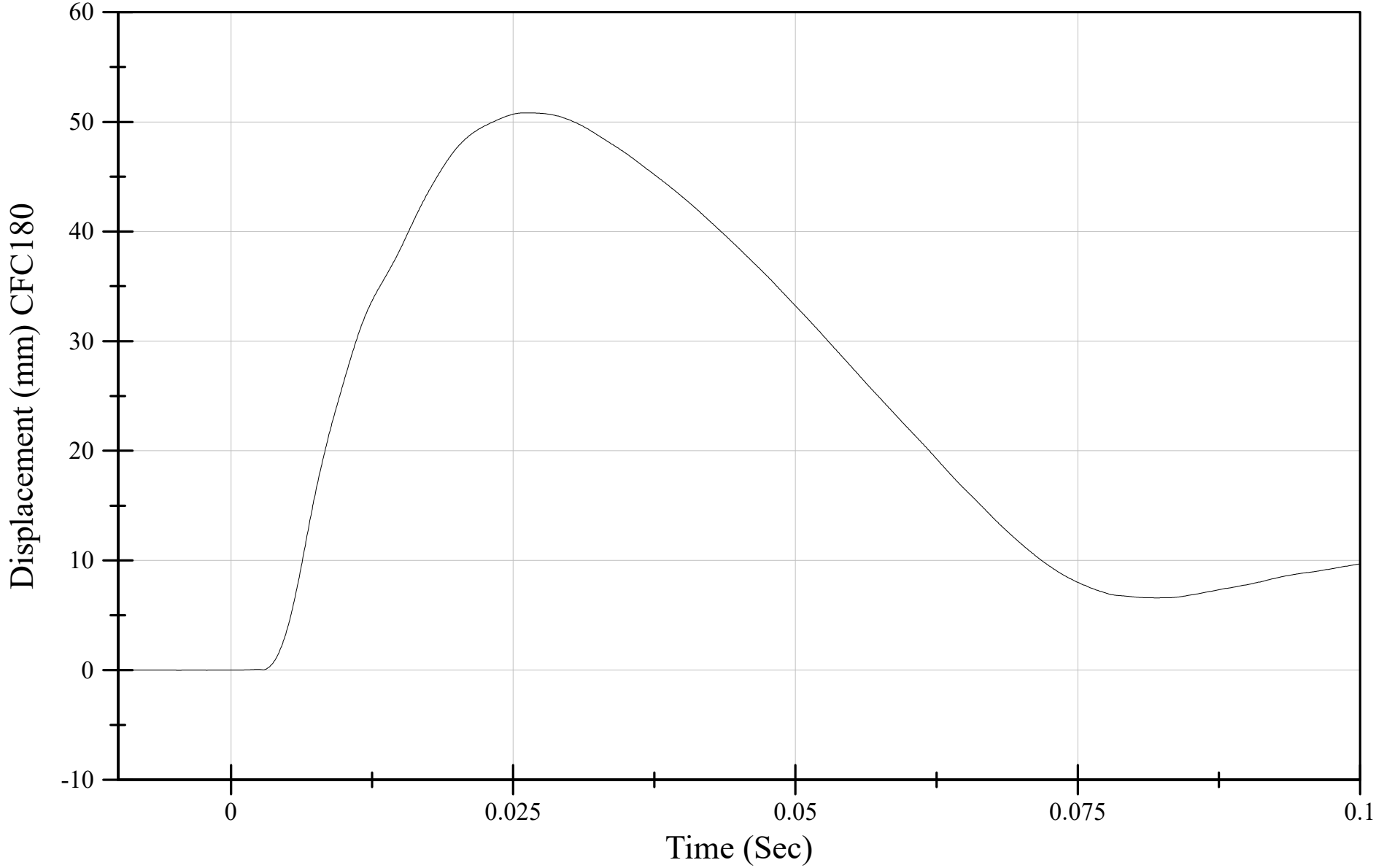
THOR-05F Lower Right Thorax Qualification
Probe Force vs Right Resultant Deflection
Serial Number: EV0674



File Name: 221005-7 processed

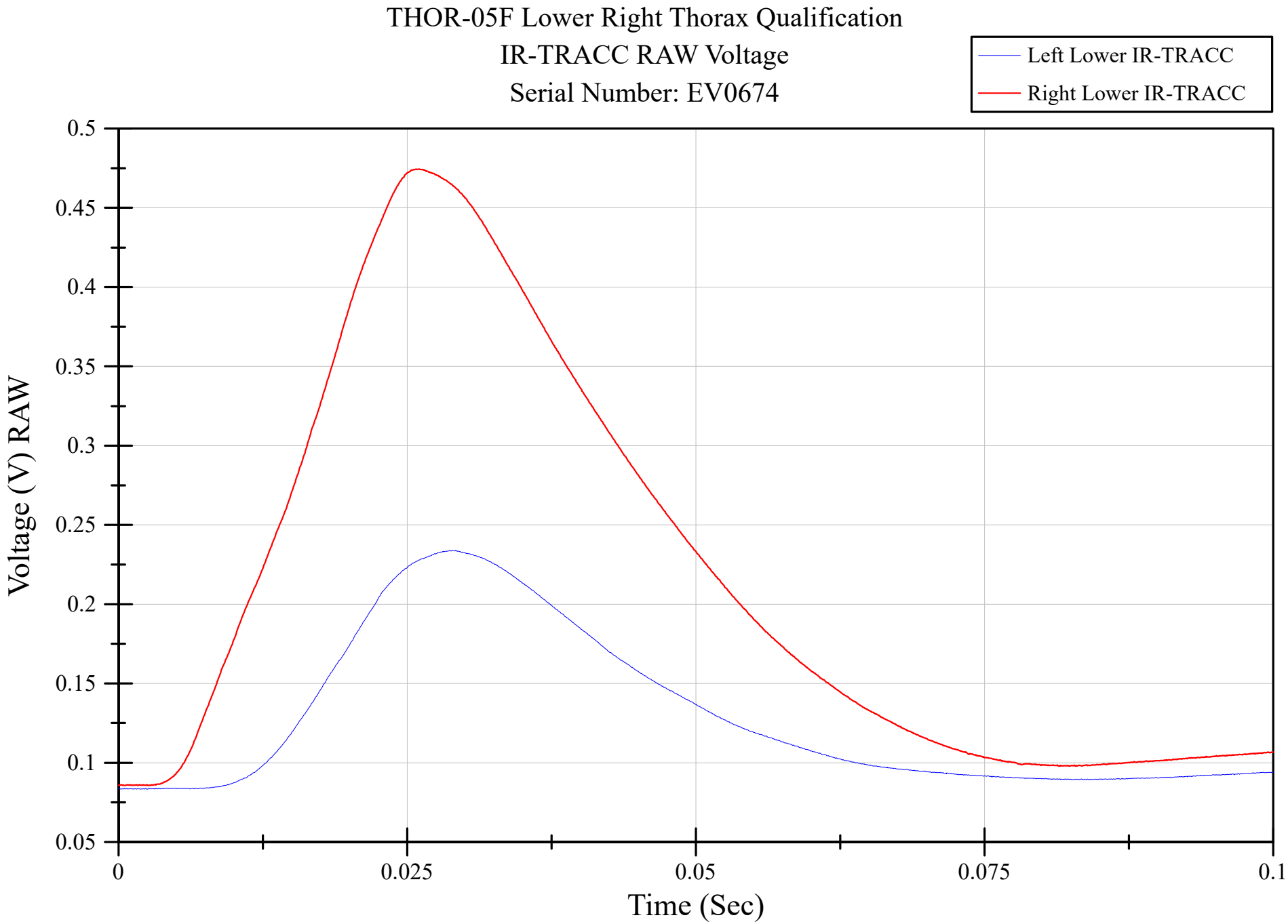
10/5/2022 2:16 PM

THOR-05F Lower Right Thorax Qualification
Right Resultant Deflection
Serial Number: EV0674



File Name: 221005-7 processed

10/5/2022 2:16 PM



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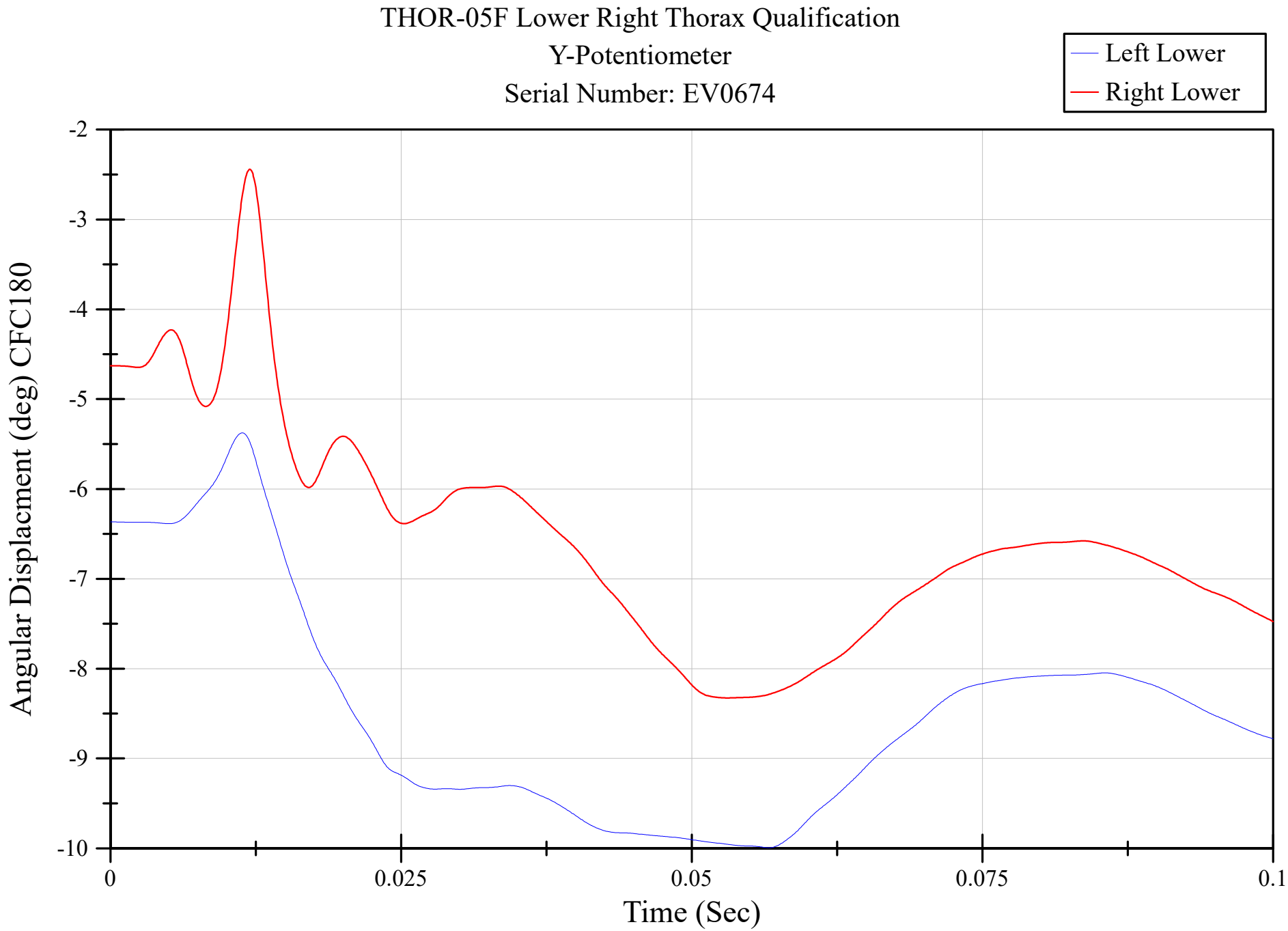

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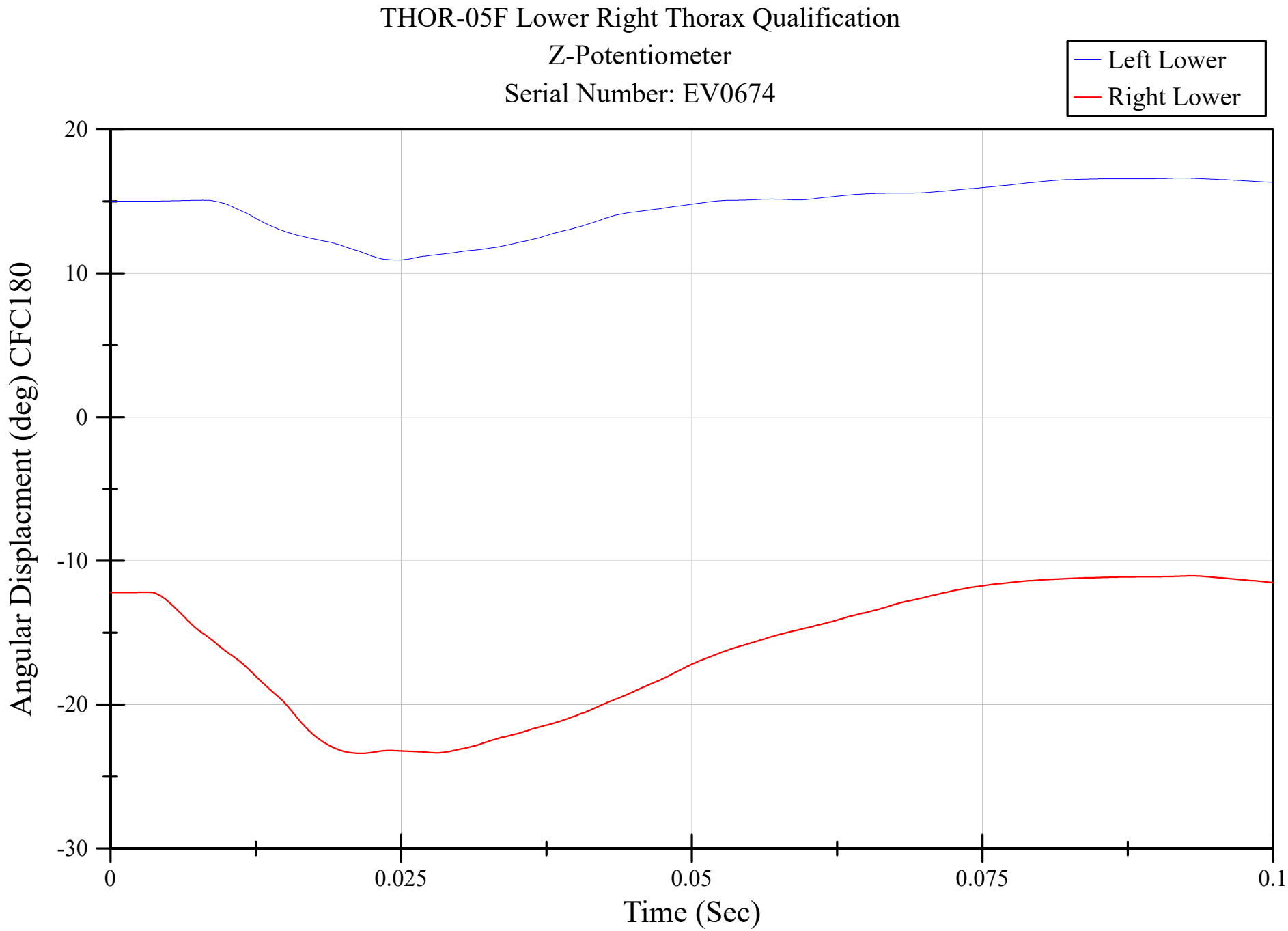
10/5/2022 2:16 PM



File Name: 221005-7 processed

10/5/2022 2:16 PM

THOR-05F Lower Abdomen Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components

Abdomen Foam: EV1098

Test ID: 221004-22
Test Date: 10/4/2022
Test Time: 3:43 PM

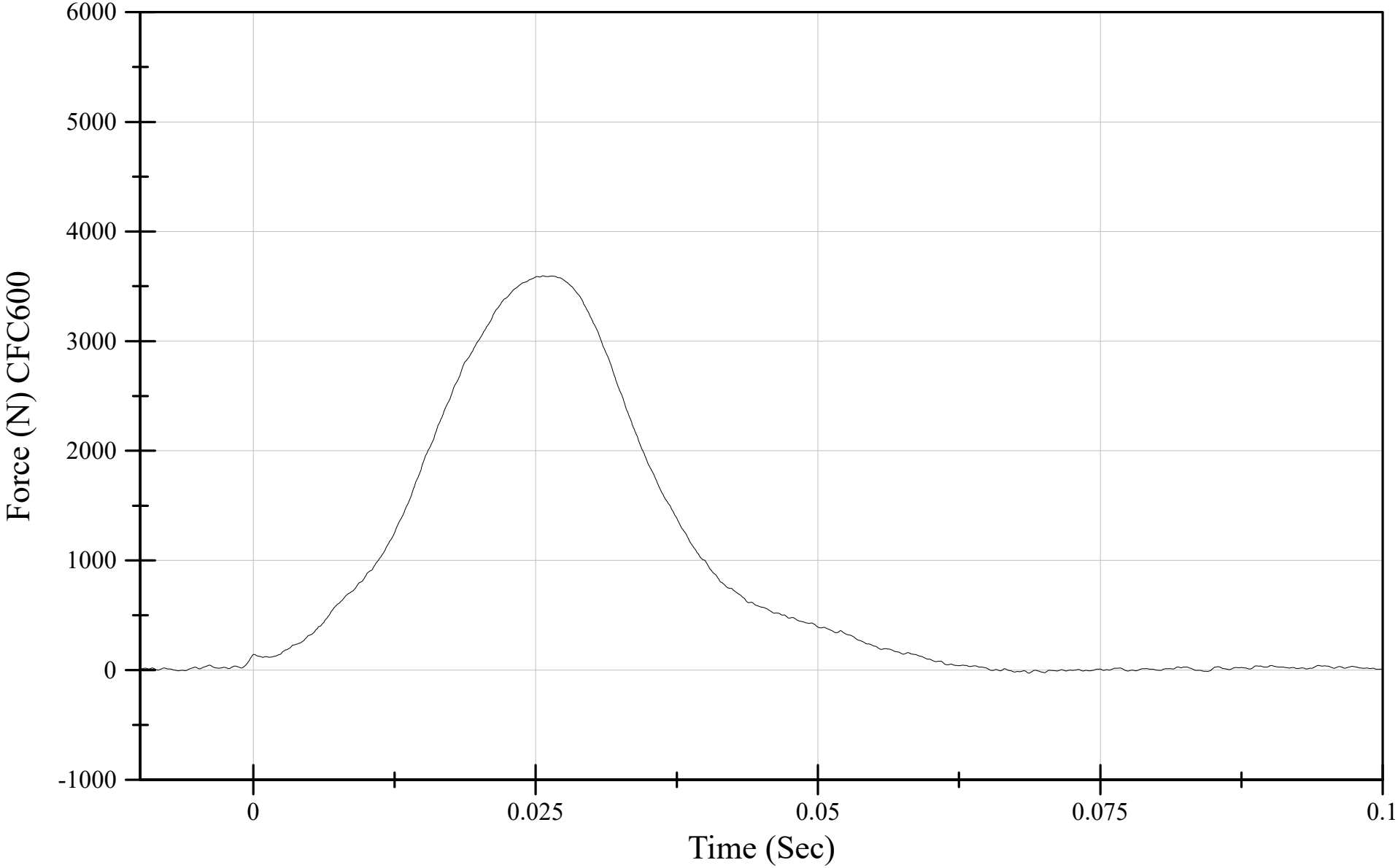
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.0	Pass
Test Humidity (%)	10 - 70	43	Pass
Test Velocity (m/s)	6.05 - 6.15	6.11	Pass
Peak Probe Force (N)		3597	
Peak Left Abdomen Pressure (kPa)		134	
Peak Right Abdomen Pressure (kPa)		146	
Difference between Left and Right Pressure (kPa)		12	

* THOR-05F Qualification Manual - July 2022

File Name: 221004-22 processed
Software Version: 2.8

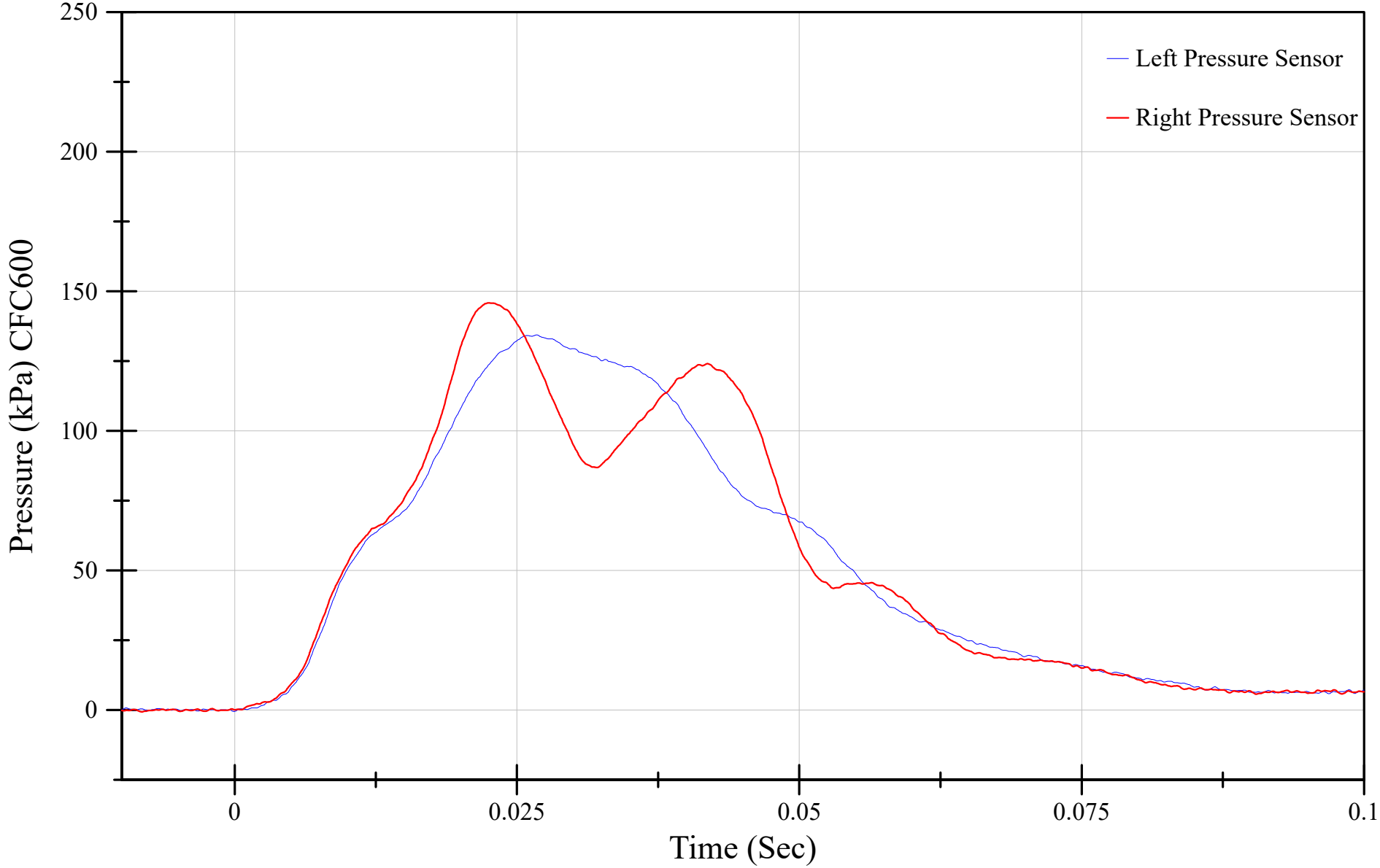
THOR-05F Lower Abdomen Qualification
Peak Probe Force
Serial Number: EV0674



File Name: 221004-22 processed

10/4/2022 3:43 PM

THOR-05F Lower Abdomen Qualification
Abdomen Pressure Sensors
Serial Number: EV0674



File Name: 221004-22 processed

10/4/2022 3:43 PM

THOR-05F Left Upper Leg Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Compression Element: EV0593
Left Thigh Flesh: EV3102

Test ID: 220927-2
Test Date: 9/27/2022
Test Time: 8:37 AM

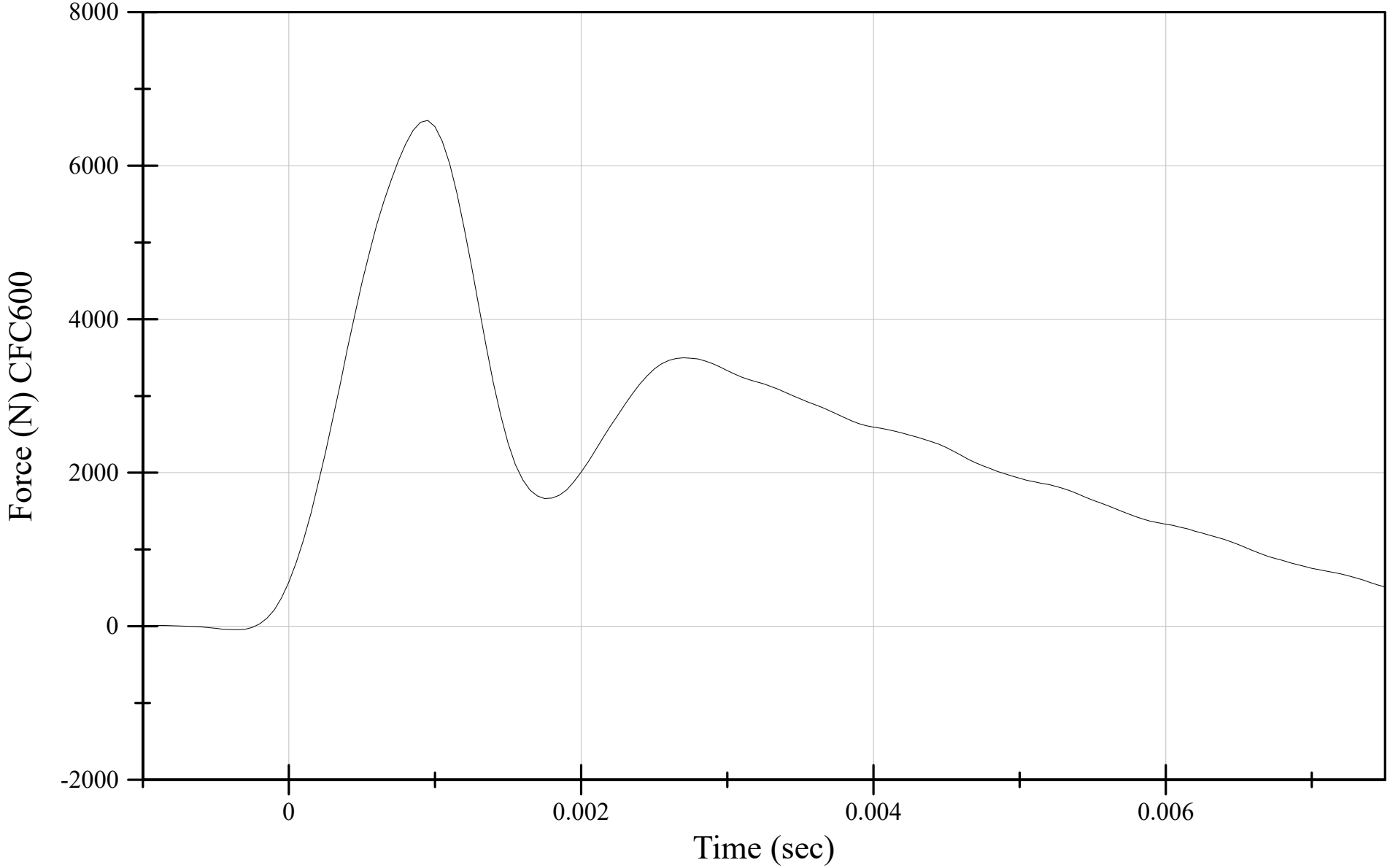
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.0	Pass
Test Humidity (%)	10 - 70	42.8	Pass
Test Velocity (m/s)	3.25 - 3.35	3.29	Pass
Peak Probe Force (N)		6590.2	
Peak Femur Force (N)		-3790.4	
Peak Resultant Acetabulum Force (N)		1560.0	

* THOR-05F Qualification Manual - July 2022

File Name: 220927-2 processed

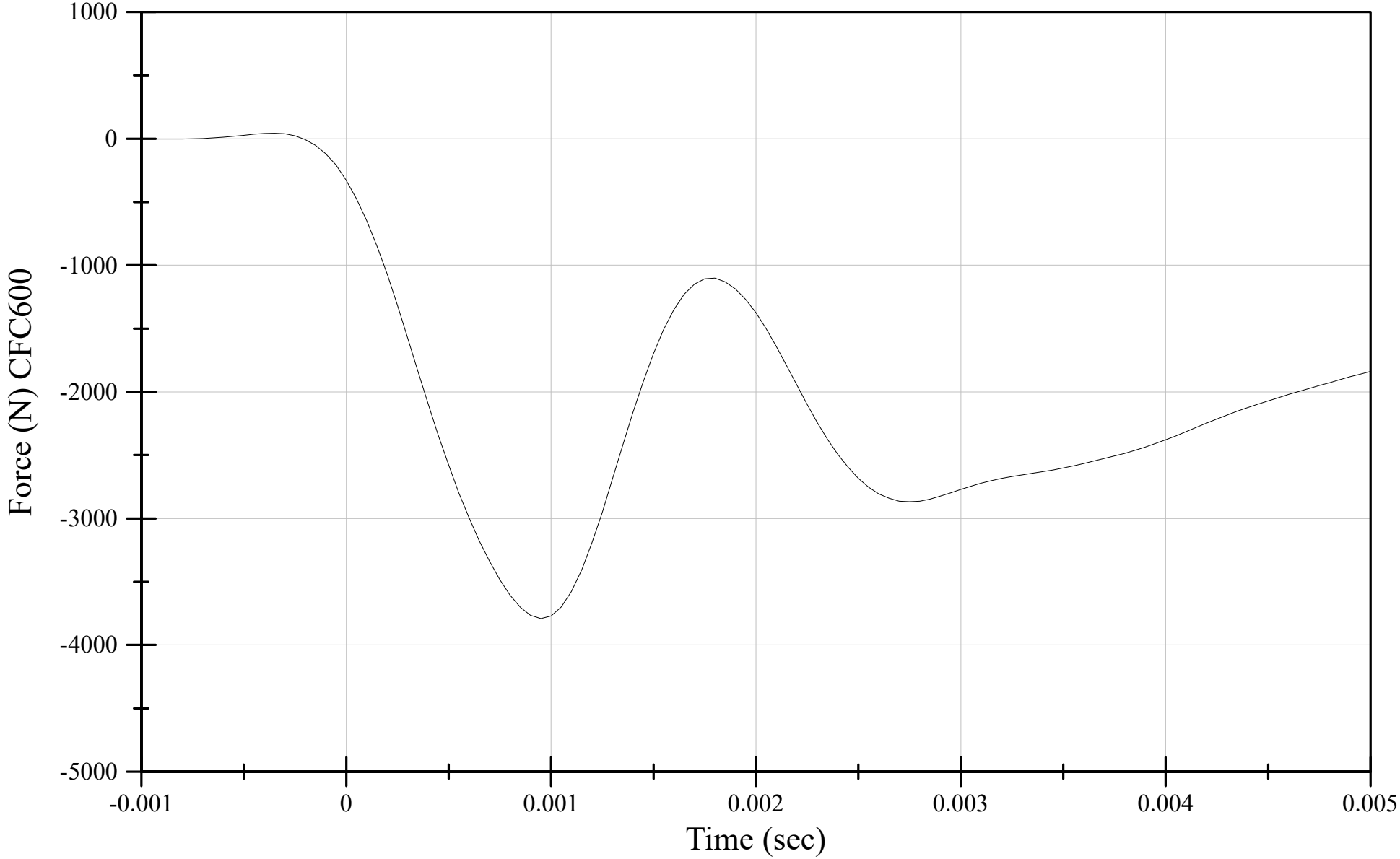
THOR-05F Left Upper Leg Qualification
Probe Force
Serial Number: EV0674



File Name: 220927-2 processed

9/27/2022 8:37 AM

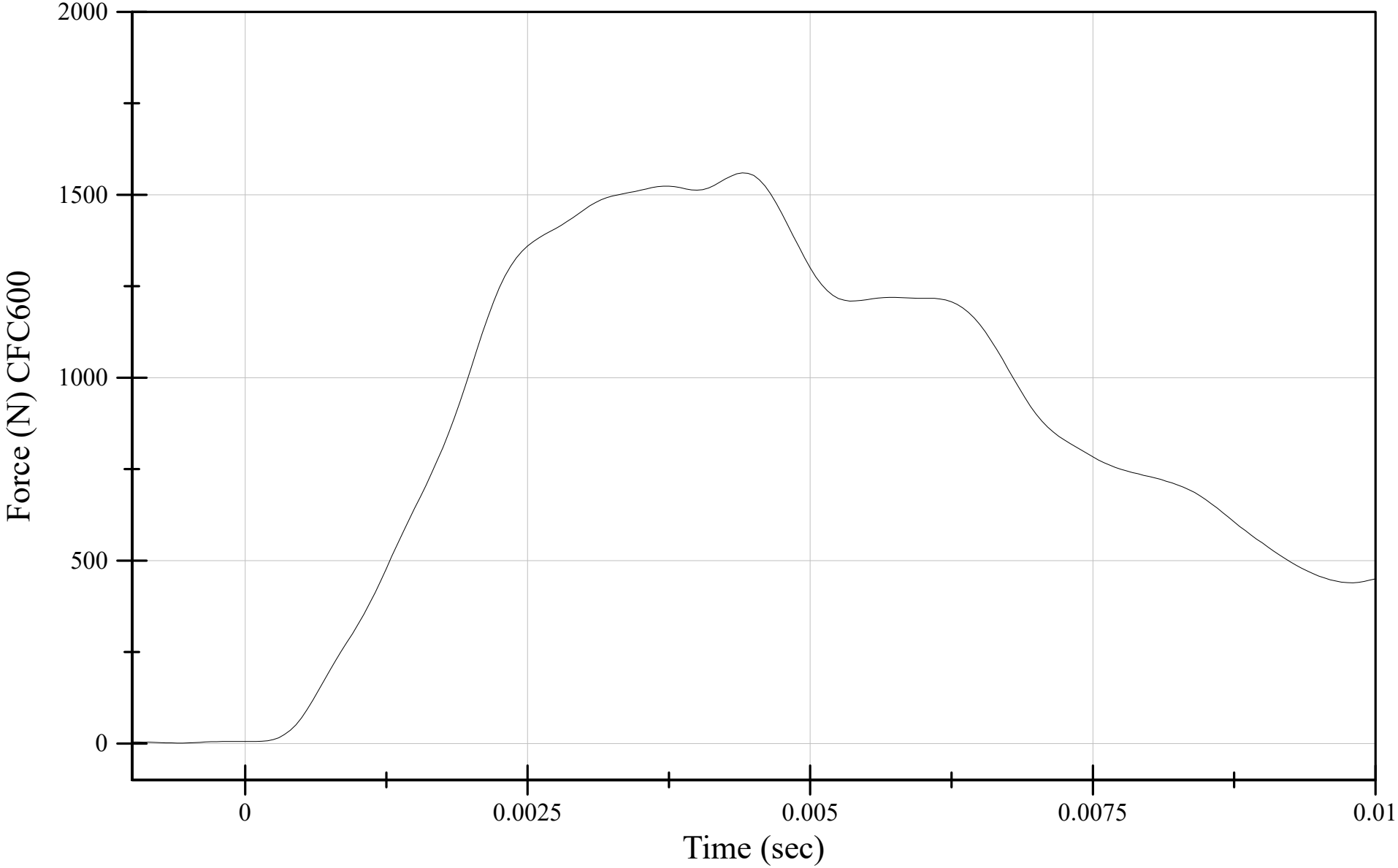
THOR-05F Left Upper Leg Qualification
Femur Z-Force
Serial Number: EV0674



File Name: 220927-2 processed

9/27/2022 8:37 AM

THOR-05F Left Upper Leg Qualification
Peak Acetabulum Resultant Force
Serial Number: EV0674



File Name: 220927-2 processed

9/27/2022 8:37 AM

THOR-05F Left Knee Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Left Knee Slider: EV0858

Test ID: 220928-2
Test Date: 9/28/2022
Test Time: 10:25 AM

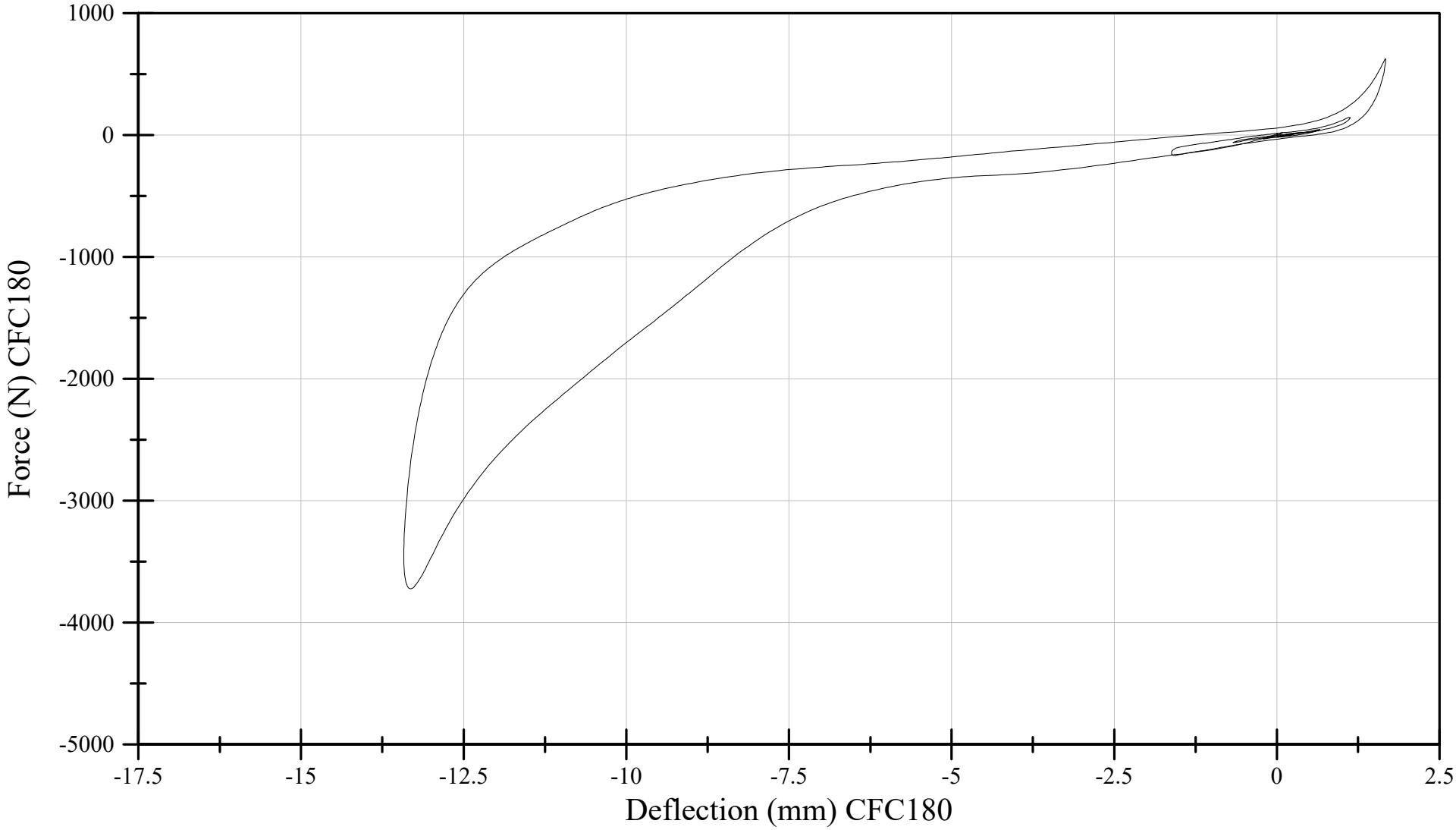
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.0	Pass
Test Humidity (%)	10 - 70	42.5	Pass
Test Velocity (m/s)	2.10 - 2.20	2.18	Pass
Peak Femur Fz (N)		-3721.8	
Knee Deflection at Peak Femur Force (N)		-13.4	

* THOR-05F Qualification Manual - July 2022

File Name: 220928-2 processed
Software Version: 2.8

THOR-05F Left Knee Qualification
Peak Deflection at Peak Force
Serial Number: EV0674



File Name: 220928-2 processed

9/28/2022 10:25 AM

THOR-05F Left Achilles Tension Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Left Ankle Assembly: EV4000

Test ID: 220929-2
Test Date: 9/29/2022
Test Time: 10:21 AM

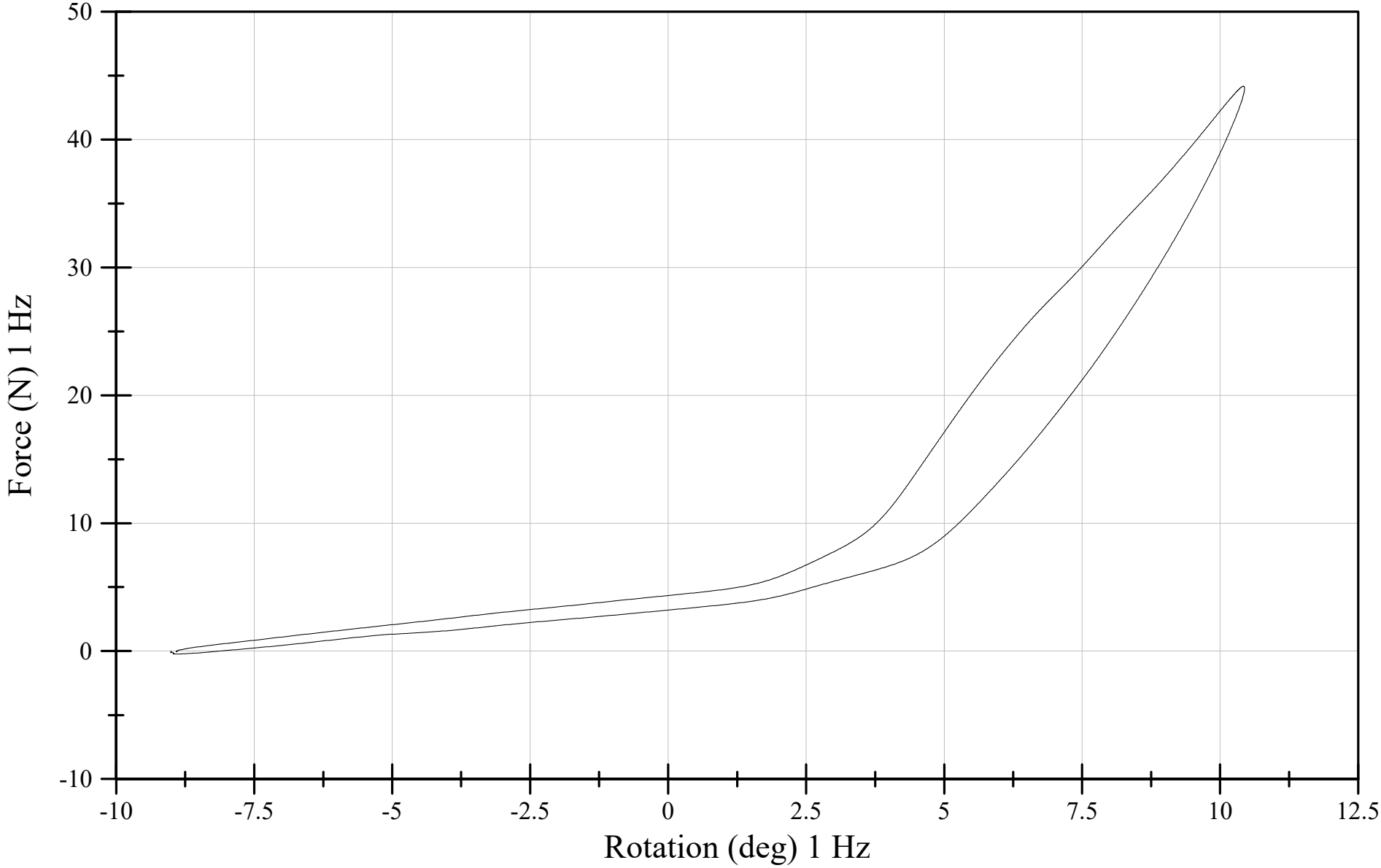
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.1	Pass
Test Humidity (%)	10 - 70	41.5	Pass
Force at 0° Y Rotation (N)		4	

* THOR-05F Qualification Manual - July 2022

File Name: 220929-2 processed
Software Version: 2.8

THOR-05F Left Achilles Tension Qualification
Force vs Rotation
Ankle Serial Number: EV4000



File Name: 220929-2 processed

9/29/2022 10:21 AM

THOR-05F Left Ball of Foot Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Left Ankle: EV4000
Dorsiflexion Stop: EU1417

Test ID: 221004-12
Test Date: 10/4/2022
Test Time: 12:31 PM

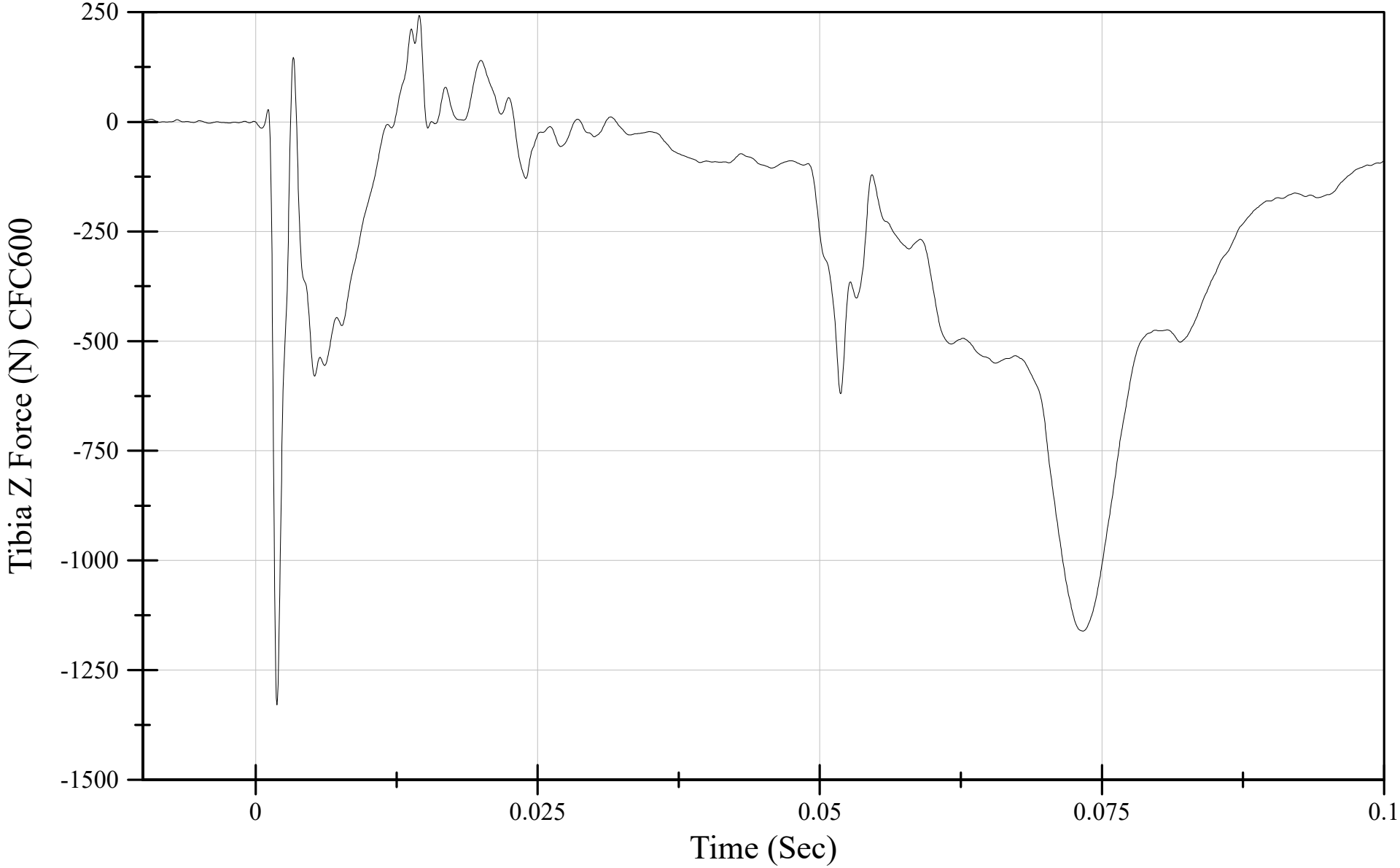
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.1	Pass
Test Humidity (%)	10 - 70	46.7	Pass
Test Velocity (m/s)	1.95 - 2.05	1.96	Pass
Peak Lower Tibia Fz after 10 ms (N)		-1160.8	
Peak Ankle Resistive Moment (Nm)		64.0	
Peak Ankle Y-axis Rotation (deg)		34.7	

* THOR-05F Qualification Manual - July 2022

File Name: 221004-12 processed
Software Version: 2.8

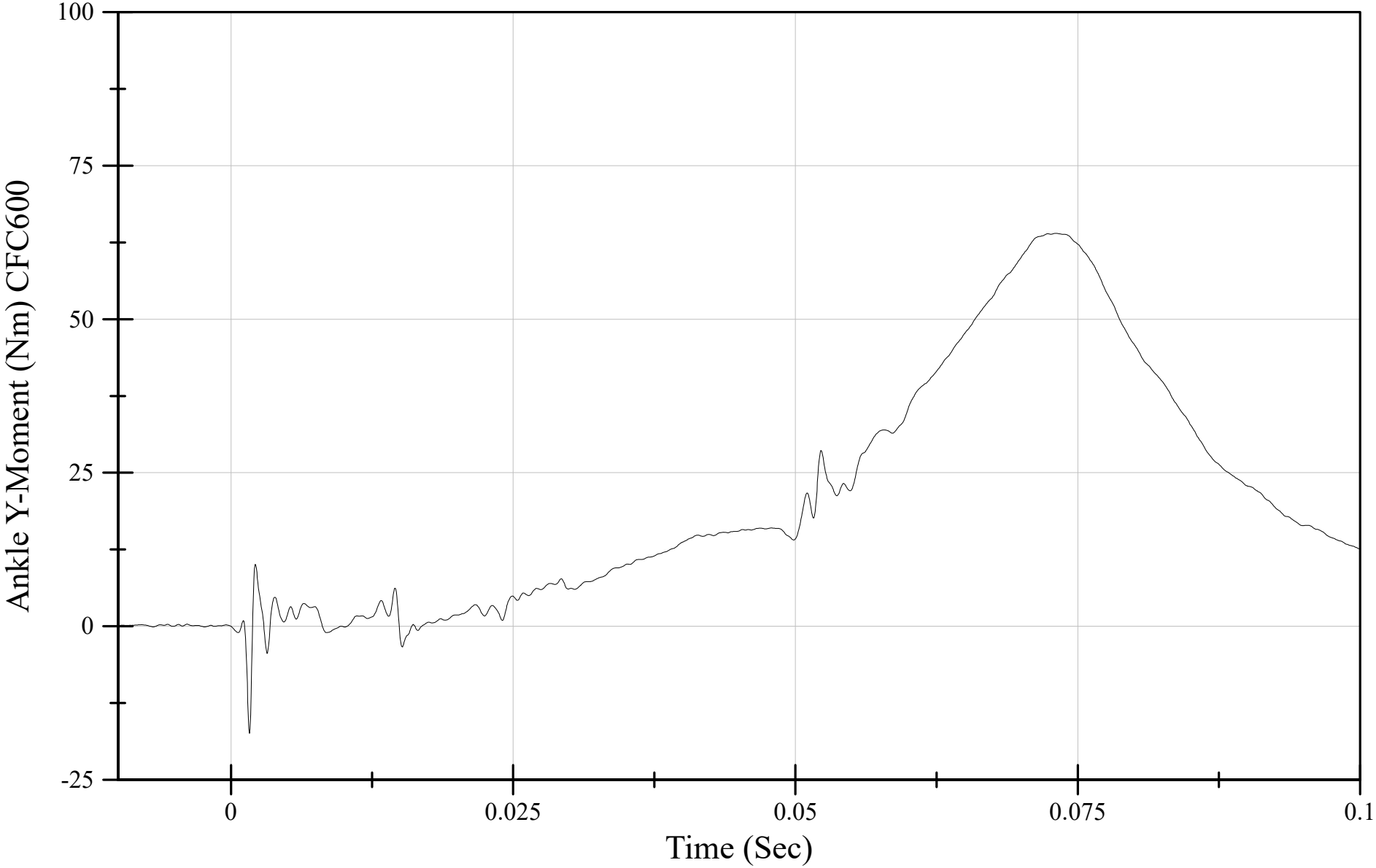
THOR-05F Left Ball of Foot Qualification
Lower Tibia Fz
Serial Number: EV0674



File Name: 221004-12 processed

10/4/2022 12:31 PM

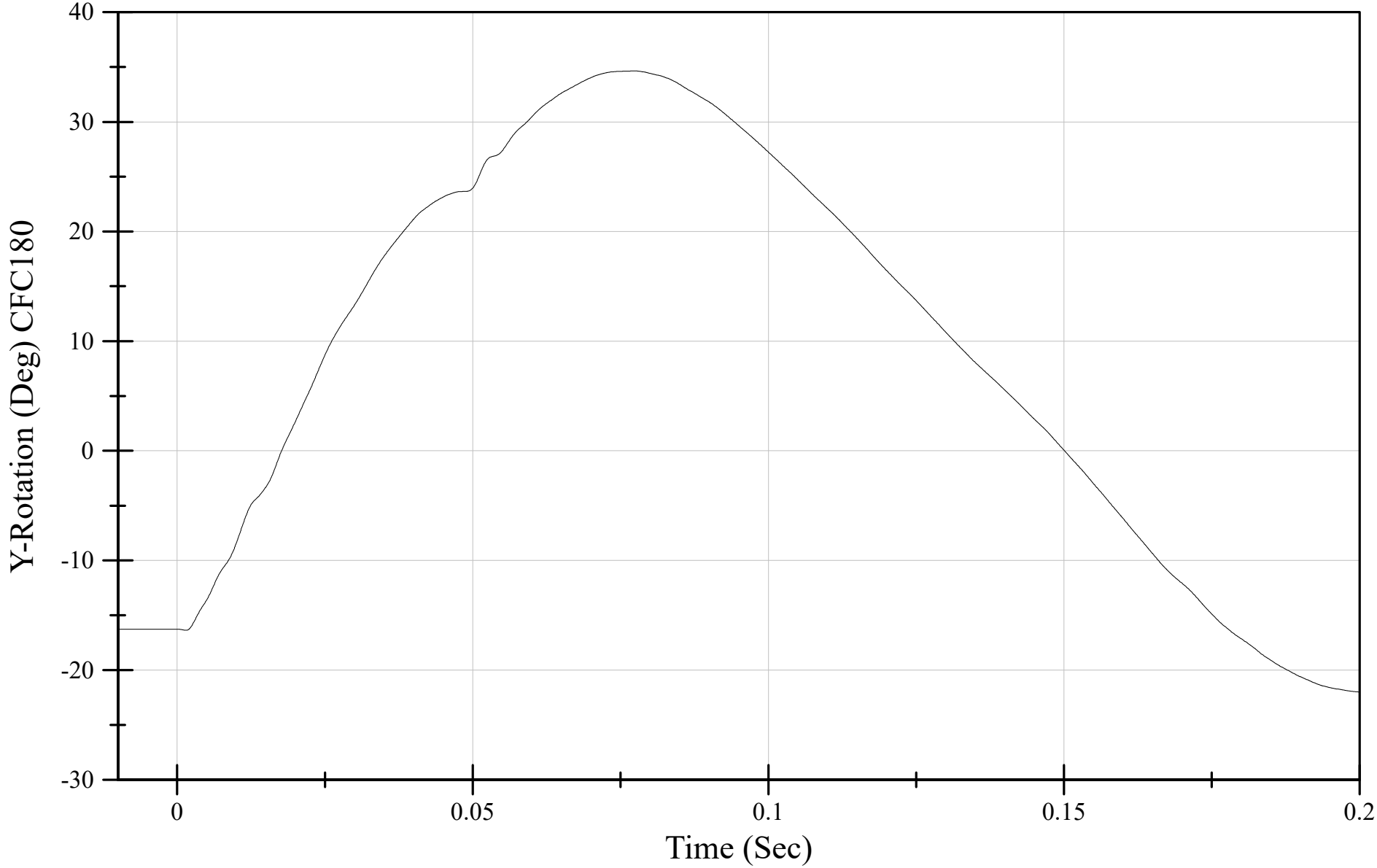
THOR-05F Left Ball of Foot Qualification
Ankle Y-Moment
Serial Number: EV0674



File Name: 221004-12 processed

10/4/2022 12:31 PM

THOR-05F Left Ball of Foot Qualification
Ankle Y-Rotation
Serial Number: EV0674



File Name: 221004-12 processed

10/4/2022 12:31 PM

THOR-05F Left Foot Inversion Qualification
Test Results Summary

Dummy Serial Number: EV0647

Tested Components	Test ID: 221003-2
Ankle Serial: EV4000	Test Date: 10/3/2022
Inversion Stop Assembly: ET9530	Test Time: 7:41 AM

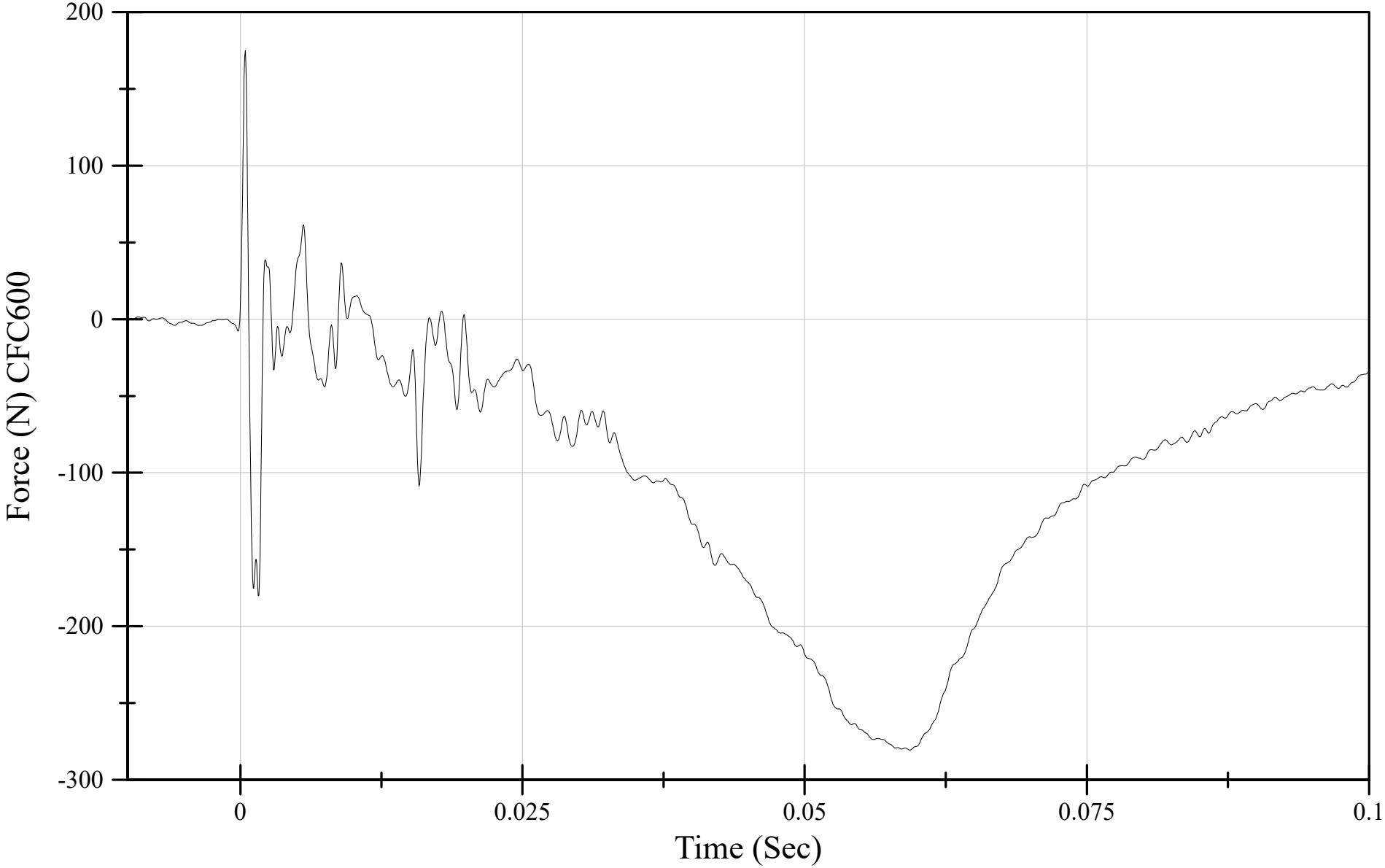
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	20.9	Pass
Test Humidity (%)	10 - 70	41.7	Pass
Test Velocity (m/s)	1.95 - 2.05	1.99	Pass
Peak Lower Tibia Fz		-280.7	
Peak Ankle X-axis Resistive Moment		-29.7	
Peak Ankle X-axis Rotation		-43.0	

* THOR-05F Qualification Manual - July 2022

File Name: 221003-2 processed
Software Version: 2.8

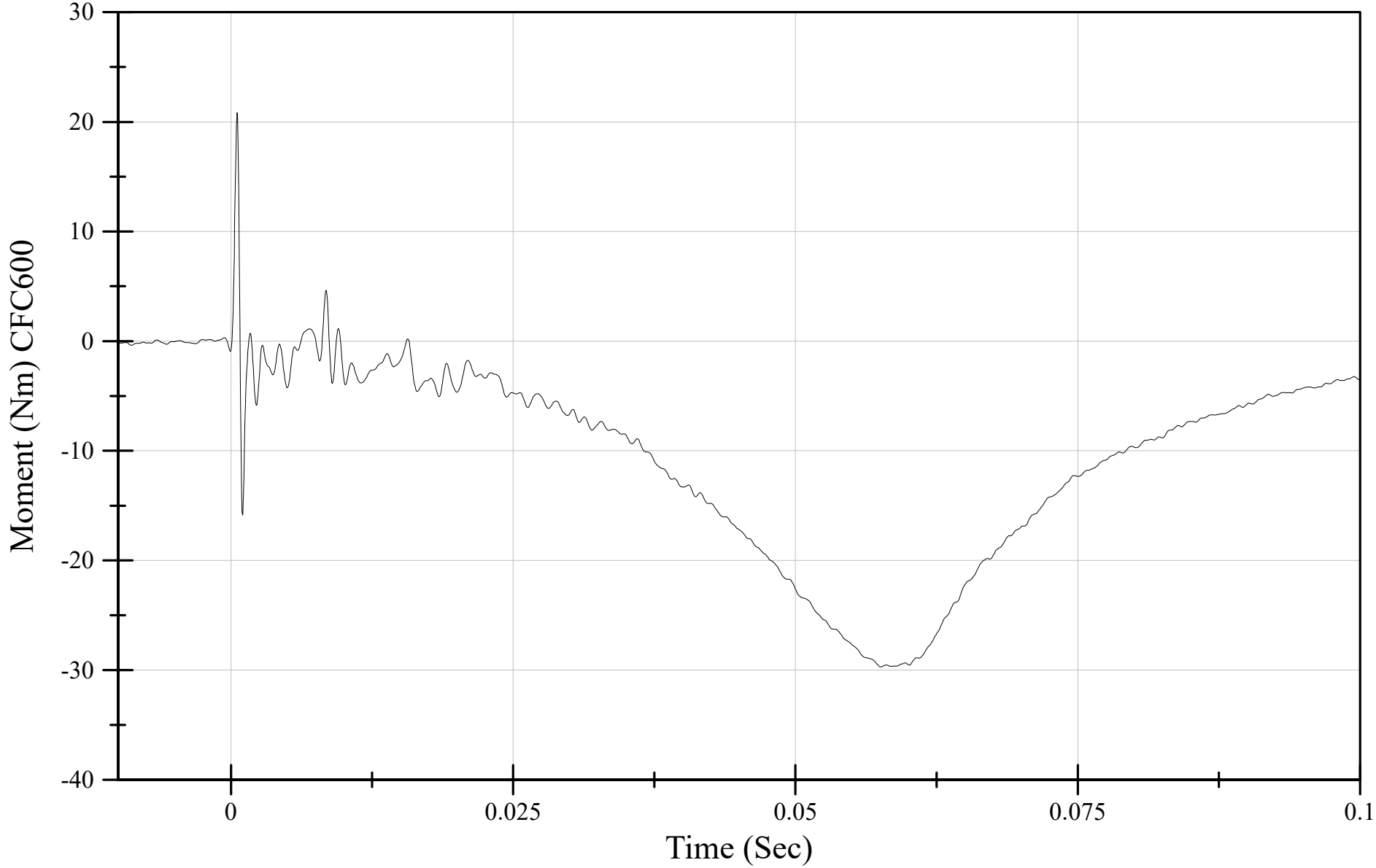
THOR-05F Left Foot Inversion Qualification
Tibia Load - Force Z
Ankle Serial Number: EV4000



File Name: 221003-2 processed

10/3/2022 7:41 AM

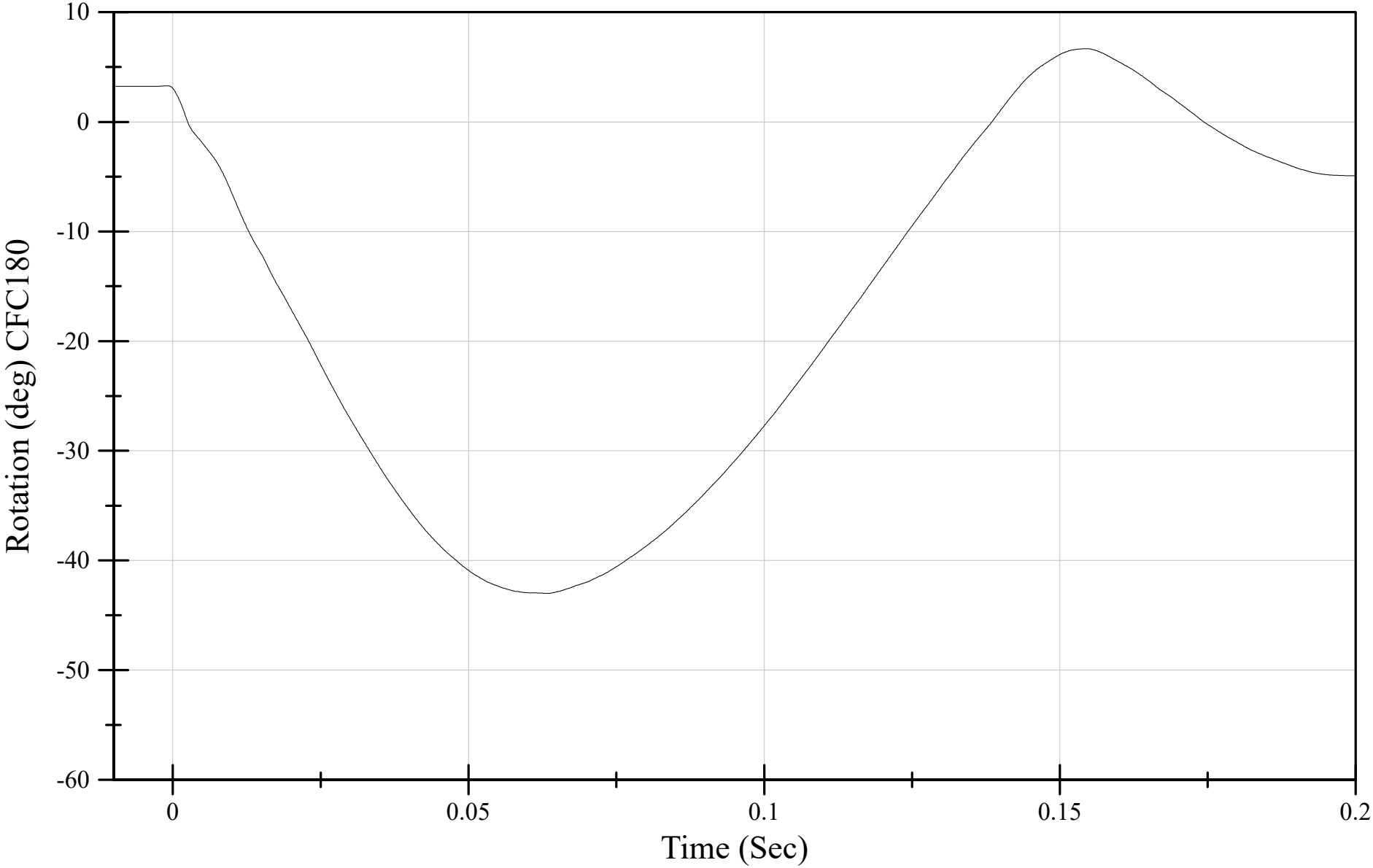
THOR-05F Left Foot Inversion Qualification
Ankle Moment - X axis
Ankle Serial Number: EV4000



File Name: 221003-2 processed

10/3/2022 7:41 AM

THOR-05F Left Foot Inversion Qualification
Ankle X-Rotation
Ankle Serial Number: EV4000



File Name: 221003-2 processed

10/3/2022 7:41 AM

THOR-05F Left Foot Eversion Qualification
Test Results Summary

Dummy Serial Number: EV0647

Tested Components	Test ID: 221003-6
Ankle Serial: EV4000	Test Date: 10/3/2022
Eversion Stop Assembly: EU9453	Test Time: 10:57 AM

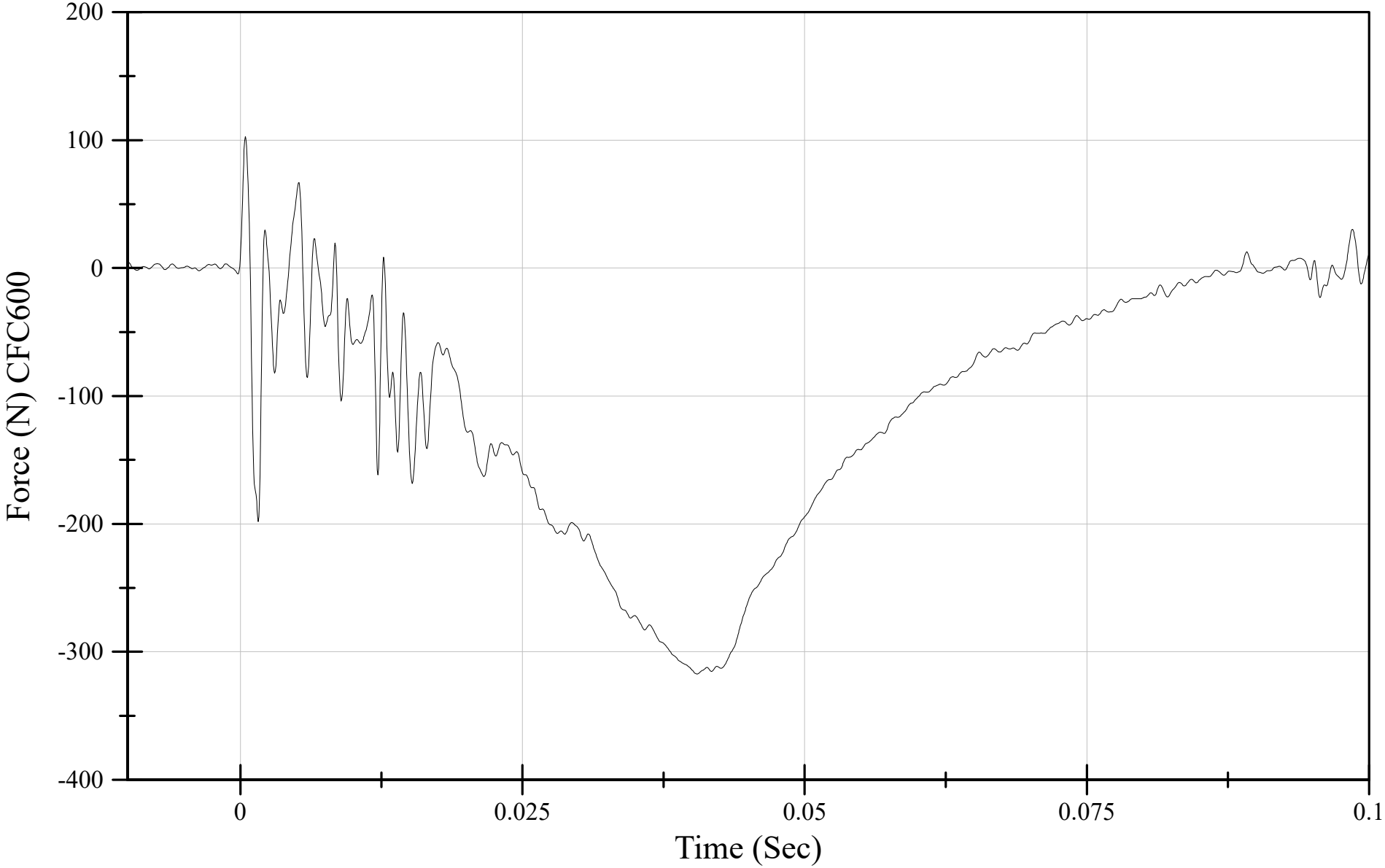
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.1	Pass
Test Humidity (%)	10 - 70	40	Pass
Test Velocity (m/s)	1.95 - 2.05	2.04	Pass
Peak Lower Tibia Fz		-317.4	
Peak Ankle X-axis Resistive Moment		29.8	
Peak Ankle X-axis Rotation		30.9	

* THOR-05F Qualification Manual - July 2022

File Name: 221003-6 processed
Software Version: 2.8

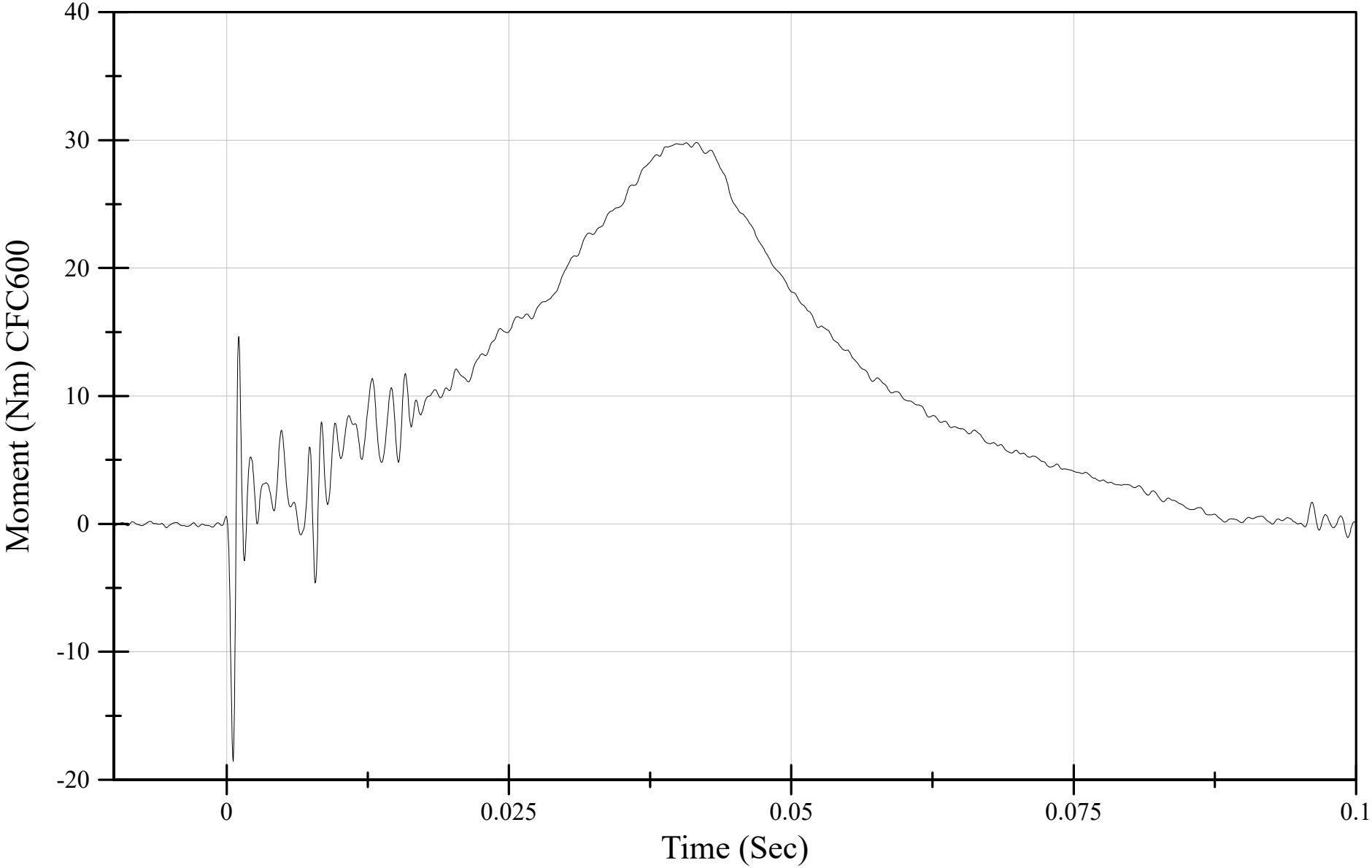
THOR-05F Left Foot Eversion Qualification
Tibia Load - Force Z
Ankle Serial Number: EV4000



File Name: 221003-6 processed

10/3/2022 10:57 AM

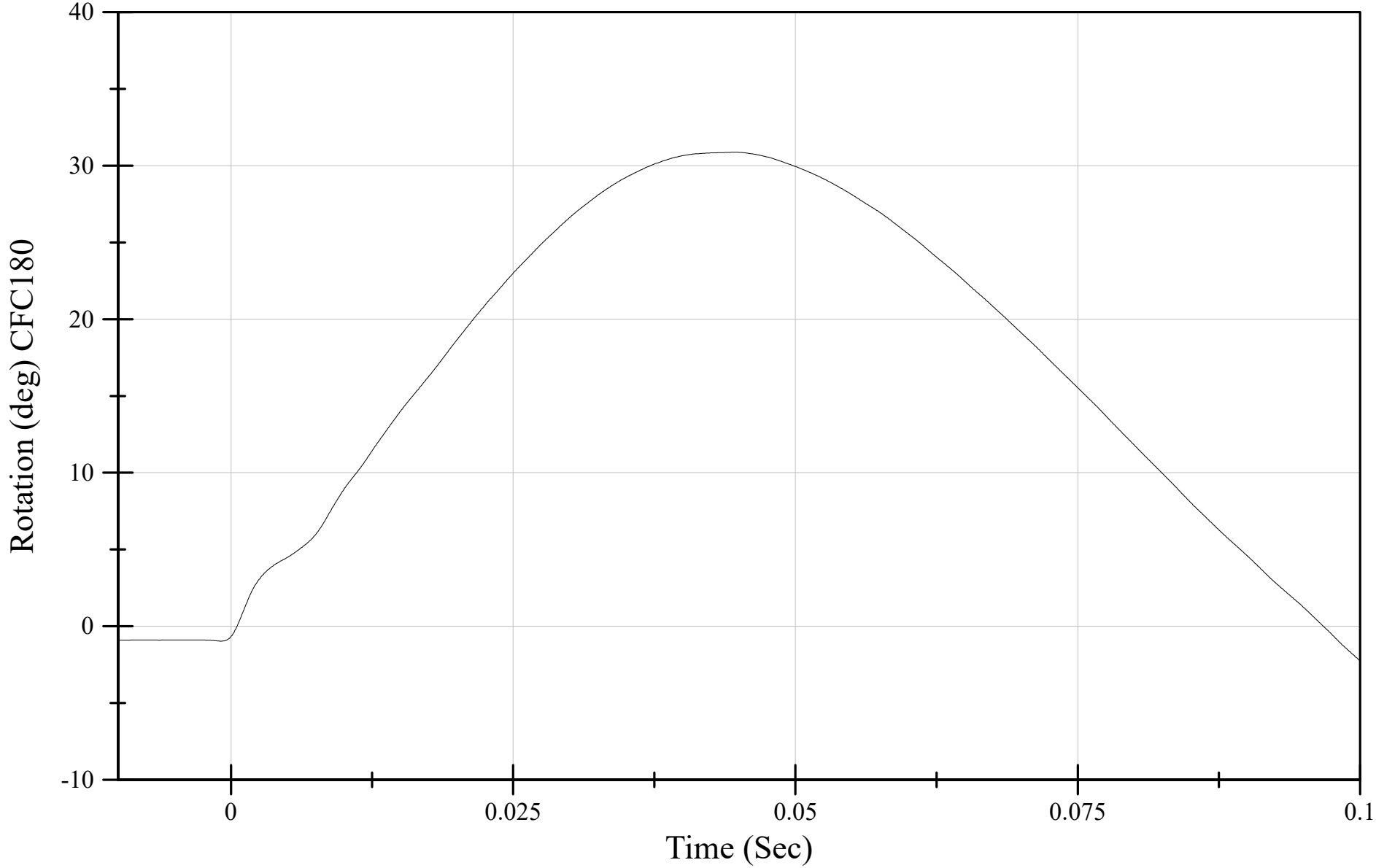
THOR-05F Left Foot Eversion Qualification
Ankle Moment - X axis
Ankle Serial Number: EV4000



File Name: 221003-6 processed

10/3/2022 10:57 AM

THOR-05F Left Foot Eversion Qualification
Ankle X-Rotation
Ankle Serial Number: EV4000



File Name: 221003-6 processed

10/3/2022 10:57 AM

THOR-05F Left Heel Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Left Ankle: EV4000

Test ID: 221004-17
Test Date: 10/4/2022
Test Time: 2:41 PM

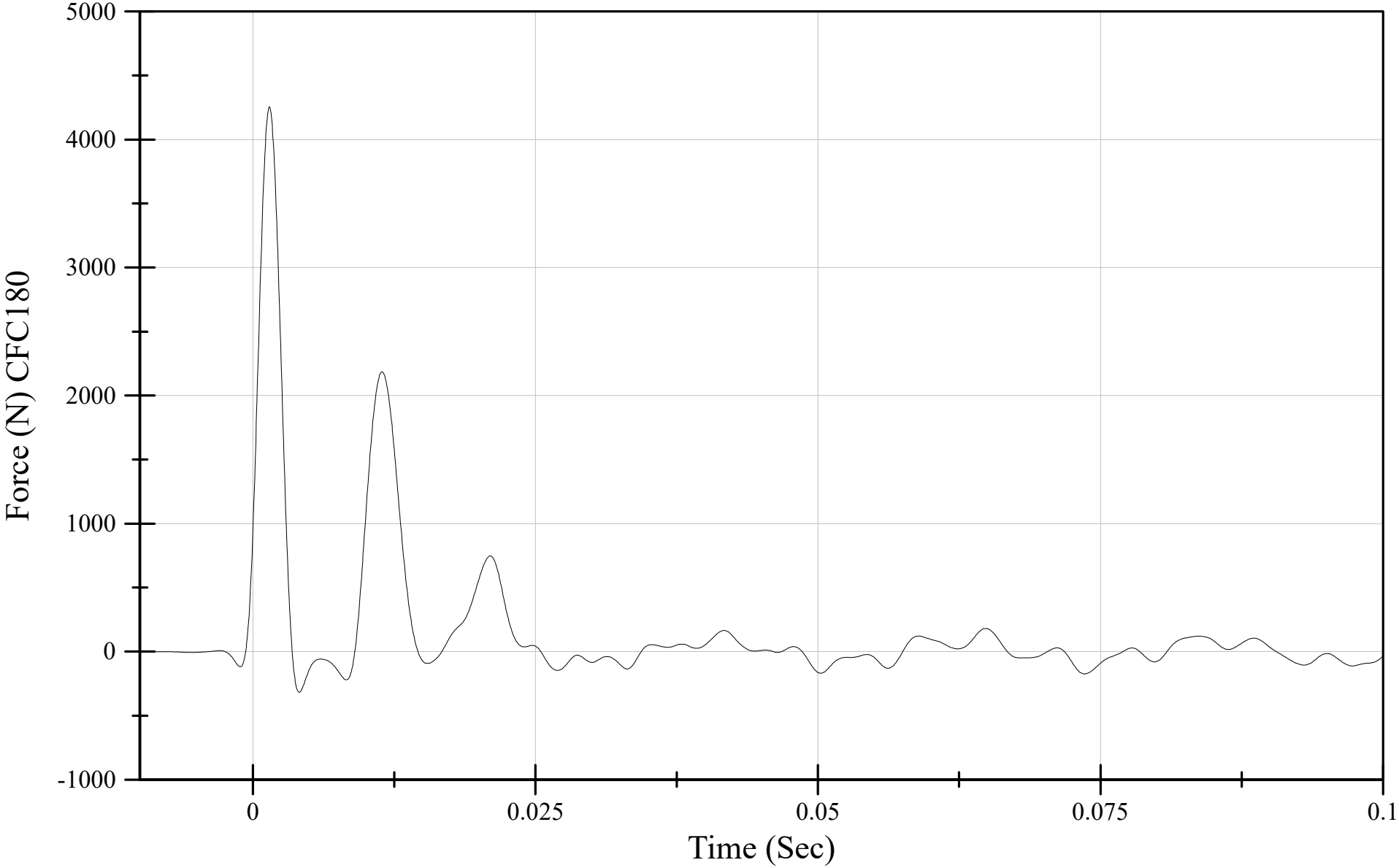
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.3	Pass
Test Humidity (%)	10 - 70	44	Pass
Test Velocity (m/s)	3.95 - 4.05	3.99	Pass
Probe Force (N)		4255.3	
Peak Lower Tibia Fz (N)		-2036.5	

* THOR-05F Qualification Manual - July 2022

File Name: 221004-17 processed
Software Version: 2.8

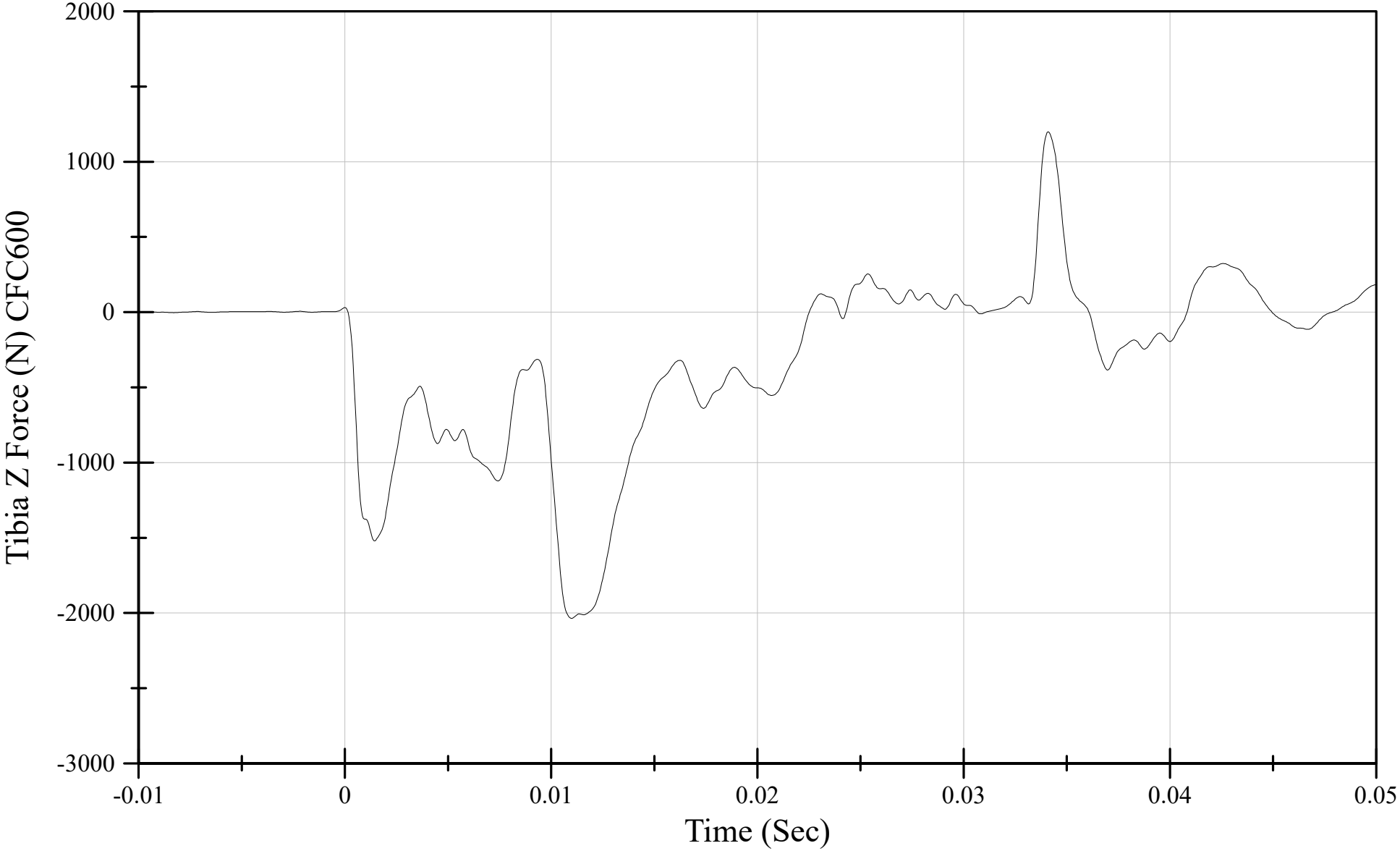
THOR-05F Left Heel Qualification
Probe Force
Dummy Serial Number: EV0674



File Name: 221004-17 processed

10/4/2022 2:41 PM

THOR-05F Left Heel Qualification
Tibia Load
Serial Number: EV0674



File Name: 221004-17 processed

10/4/2022 2:41 PM

THOR-05F Right Upper Leg Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Compression Element: EV0619
Right Thigh Flesh: EV0939

Test ID: 220927-14
Test Date: 9/27/2022
Test Time: 3:06 PM

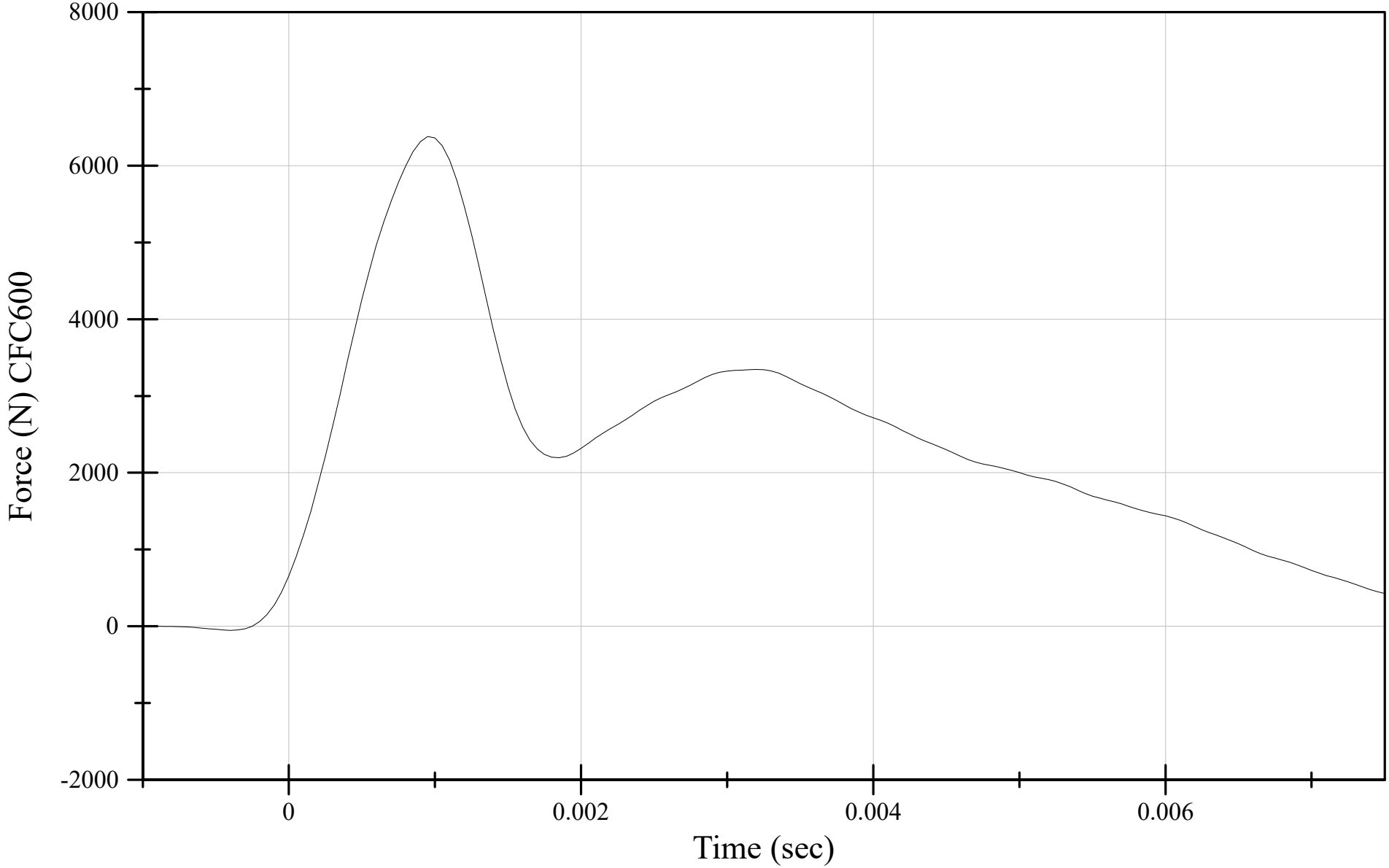
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.2	Pass
Test Humidity (%)	10 - 70	42.9	Pass
Test Velocity (m/s)	3.25 - 3.35	3.30	Pass
Peak Probe Force (N)		6381	
Peak Femur Force (N)		-3725	
Peak Resultant Acetabulum Force (N)		1816	

* THOR-05F Qualification Manual - July 2022

File Name: 220927-14 processed

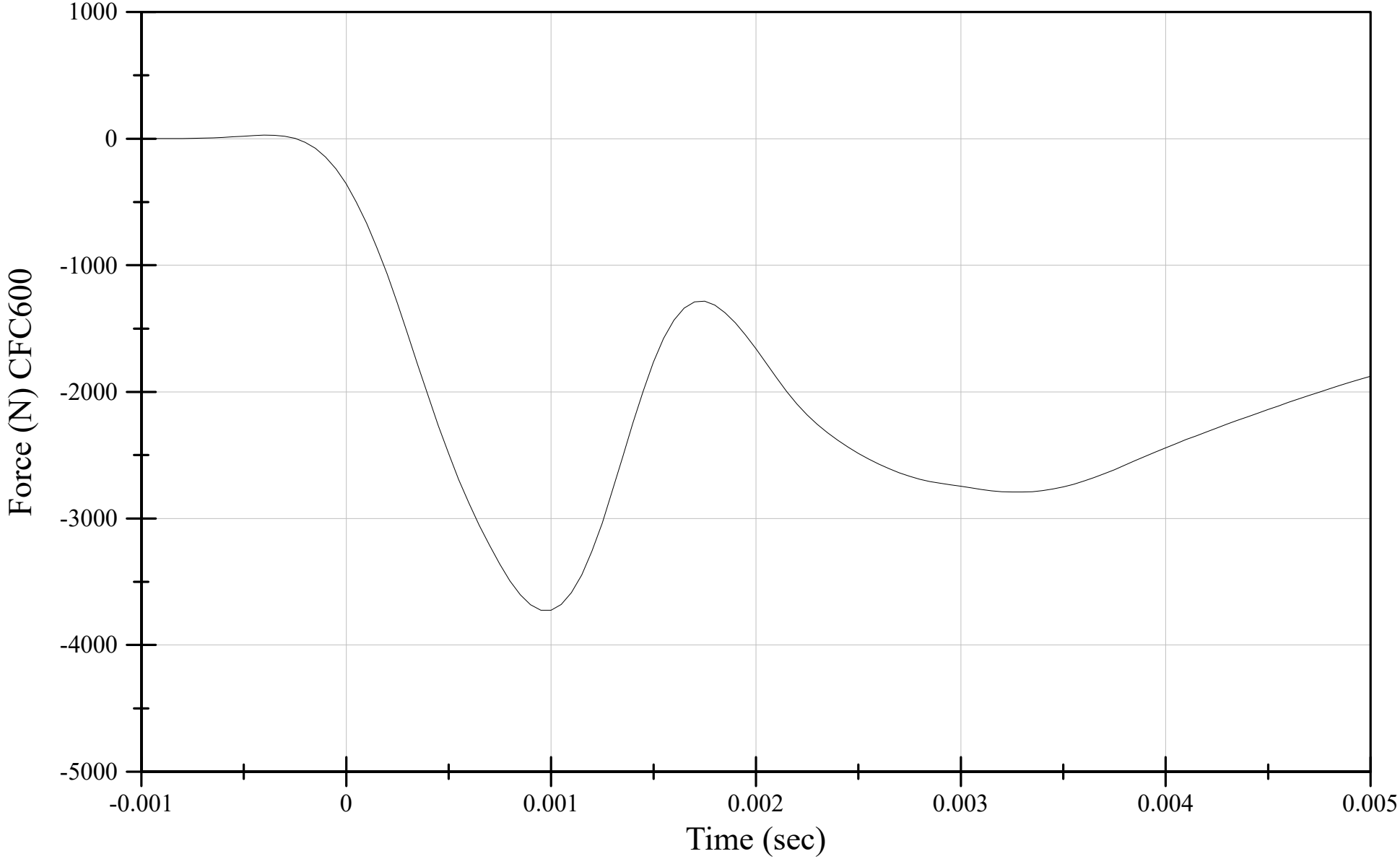
THOR-05F Right Upper Leg Qualification
Probe Force
Serial Number: EV0674



File Name: 220927-14 processed

9/27/2022 3:06 PM

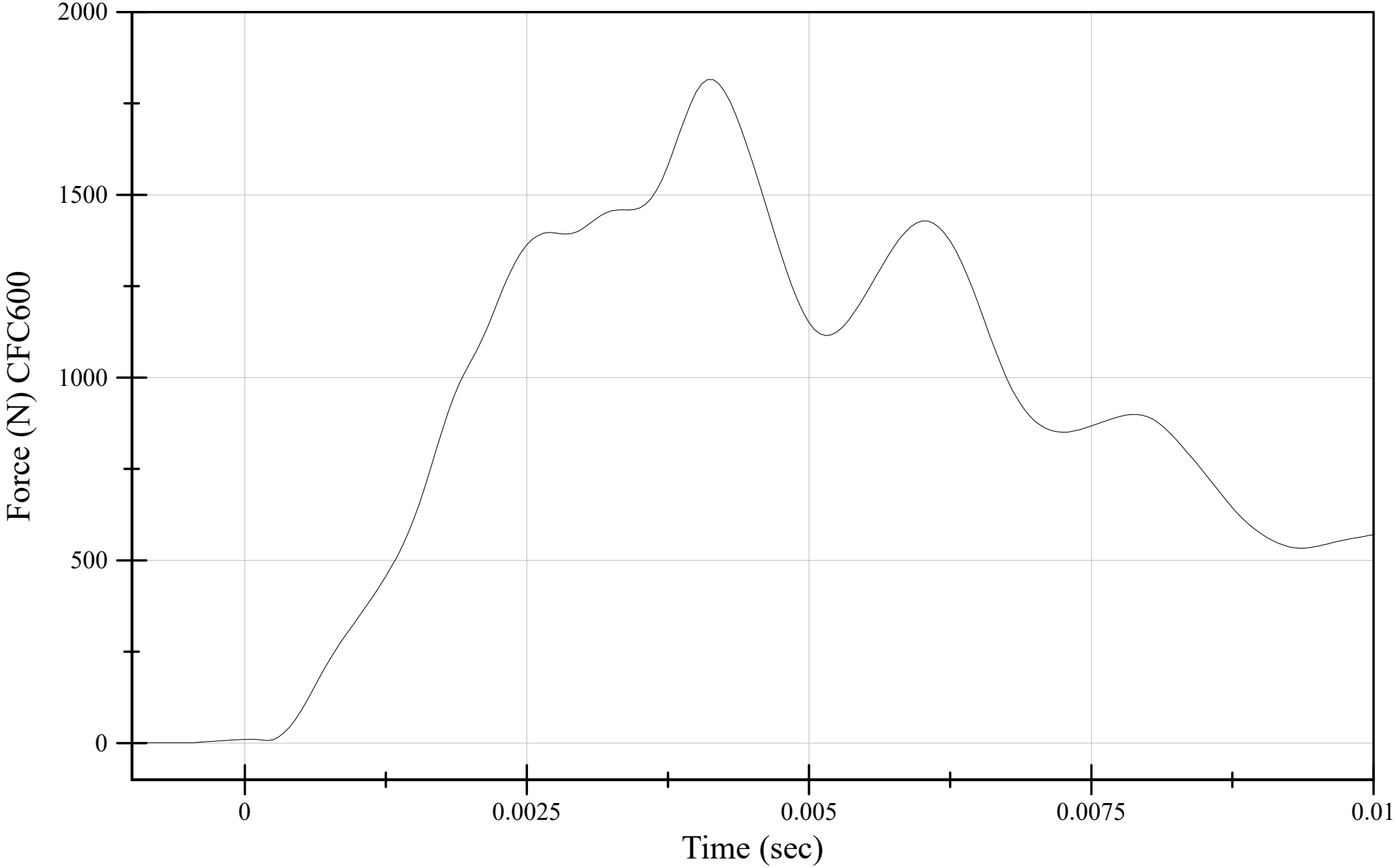
THOR-05F Right Upper Leg Qualification
Femur Z-Force
Serial Number: EV0674



File Name: 220927-14 processed

9/27/2022 3:06 PM

THOR-05F Right Upper Leg Qualification
Peak Acetabulum Resultant Force
Serial Number: EV0674



File Name: 220927-14 processed

9/27/2022 3:06 PM

THOR-05F Right Knee Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Right Knee Slider: EV2939

Test ID: 220928-3
Test Date: 9/28/2022
Test Time: 1:54 PM

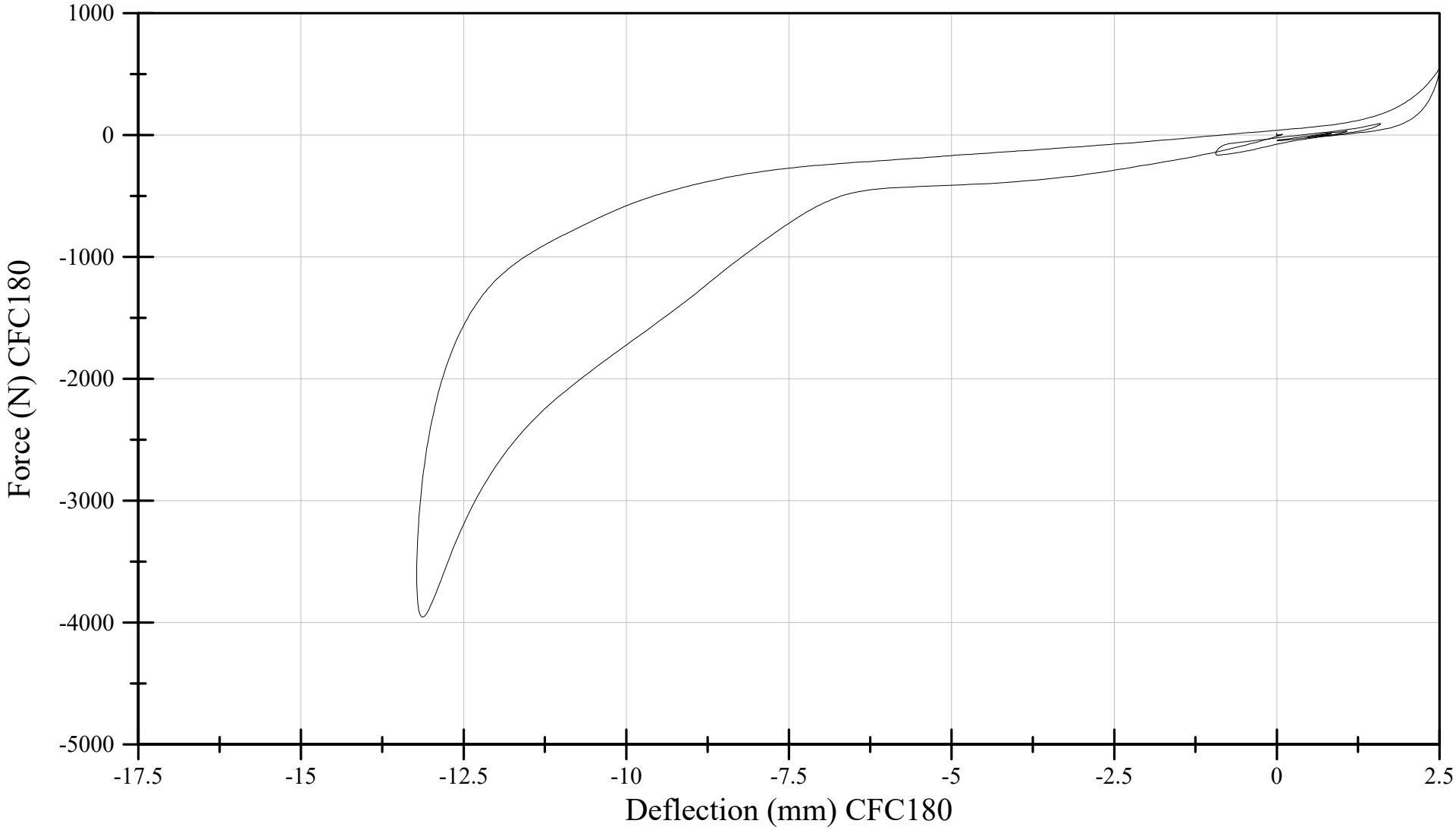
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.1	Pass
Test Humidity (%)	10 - 70	42.7	Pass
Test Velocity (m/s)	2.10 - 2.20	2.18	Pass
Peak Femur Fz (N)		-3954.1	
Knee Deflection at Peak Femur Force (N)		-13.2	

* THOR-05F Qualification Manual - July 2022

File Name: 220928-3 processed
Software Version: 2.8

THOR-05F Right Knee Qualification
Peak Deflection at Peak Force
Serial Number: EV0674



File Name: 220928-3 processed

9/28/2022 1:54 PM

THOR-05F Right Achilles Tension Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Left Ankle Assembly: EV4210

Test ID: 221005-1
Test Date: 10/5/2022
Test Time: 8:52 AM

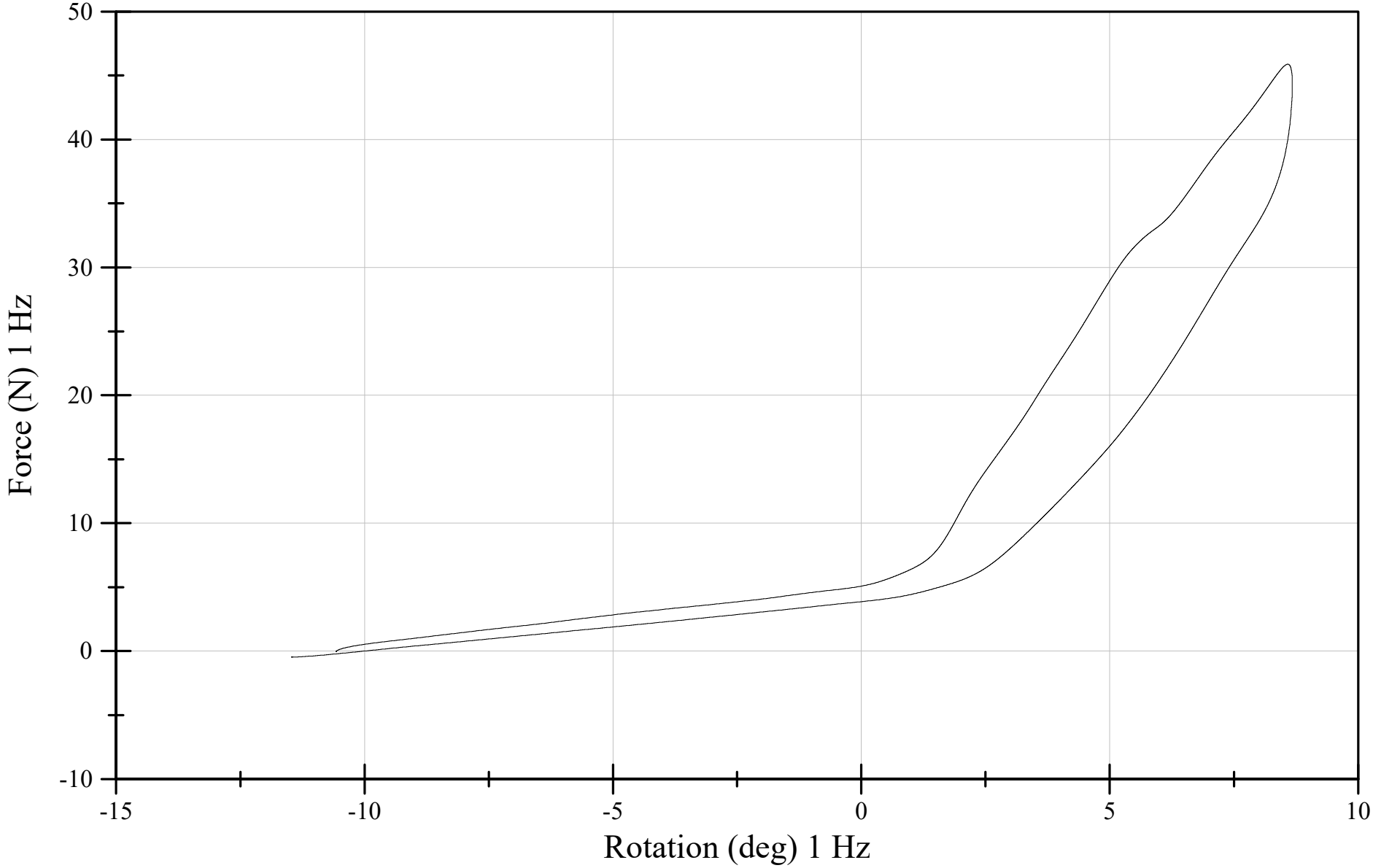
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.0	Pass
Test Humidity (%)	10 - 70	41	Pass
Force at 0° Y Rotation (N)		5	

* THOR-05F Qualification Manual - July 2022

File Name: 221005-1 processed
Software Version: 2.8

THOR-05F Right Achilles Tension Qualification
Force vs Rotation
Ankle Serial Number: EV4210



File Name: 221005-1 processed

10/5/2022 8:52 AM

THOR-05F Right Ball of Foot Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components

Right Ankle: EV4210

Right Dorsiflexion Stop: EU1417

Test ID: 221005-3

Test Date: 10/5/2022

Test Time: 10:05 AM

Test Results

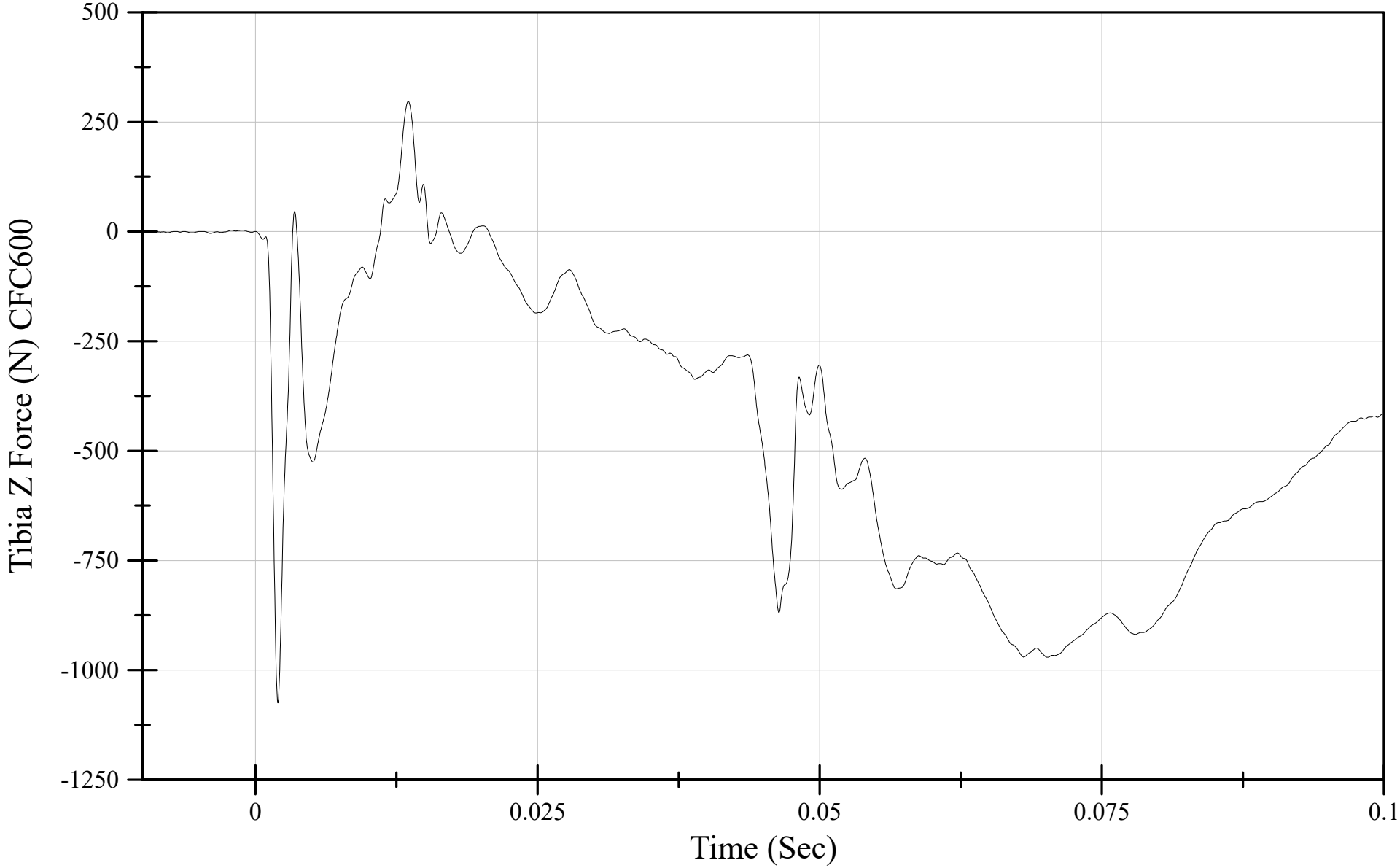
Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.2	Pass
Test Humidity (%)	10 - 70	39	Pass
Test Velocity (m/s)	1.95 - 2.05	1.96	Pass
Peak Lower Tibia Fz after 10 ms (N)		-971.0	
Peak Ankle Resistive Moment (Nm)		46.6	
Peak Ankle Y-axis Rotation (deg)		32.5	

* THOR-05F Qualification Manual - July 2022

File Name: 221005-3 processed

Software Version: 2.8

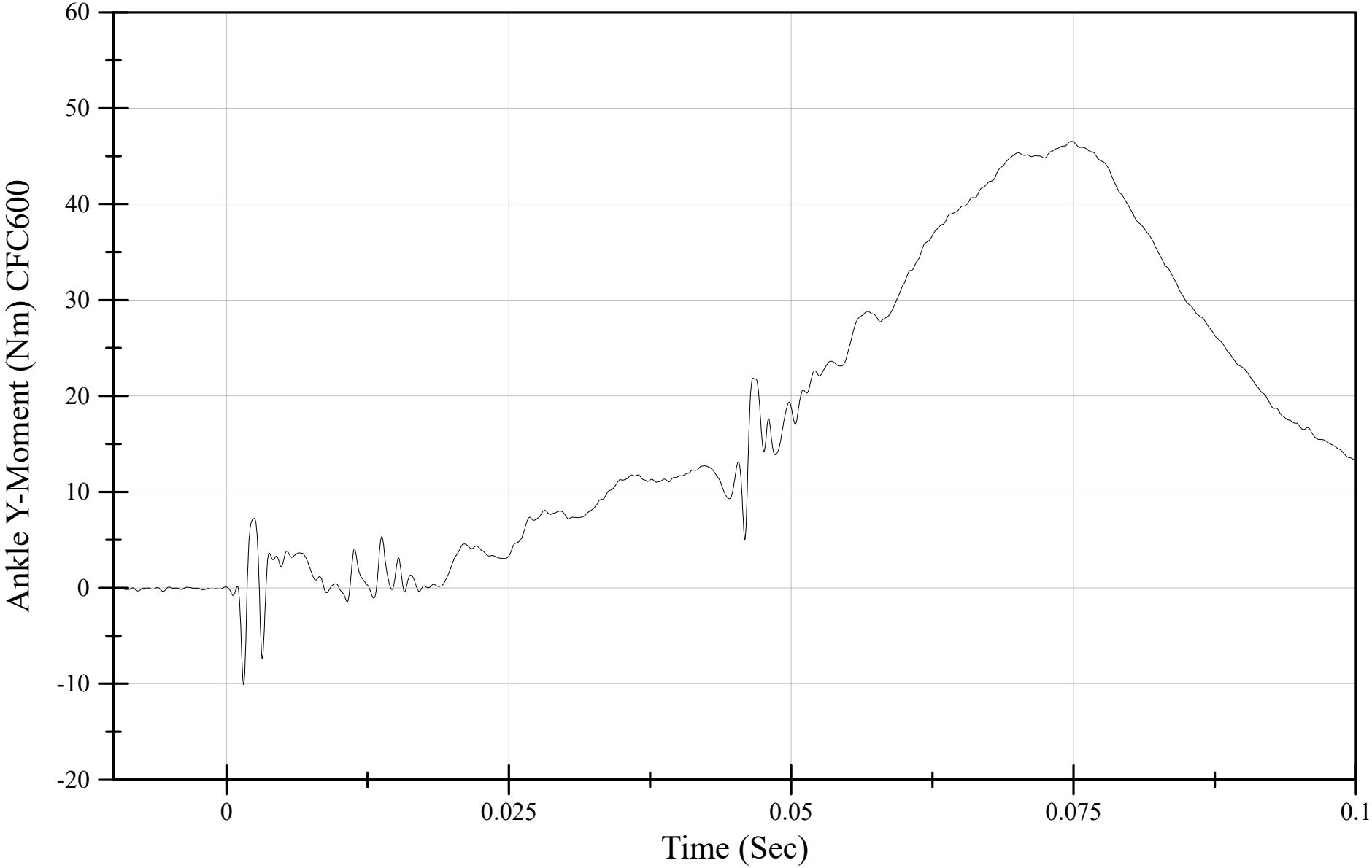
THOR-05F Right Ball of Foot Qualification
Lower Tibia Fz
Ankle Serial Number: EV4210



File Name: 221005-3 processed

10/5/2022 10:05 AM

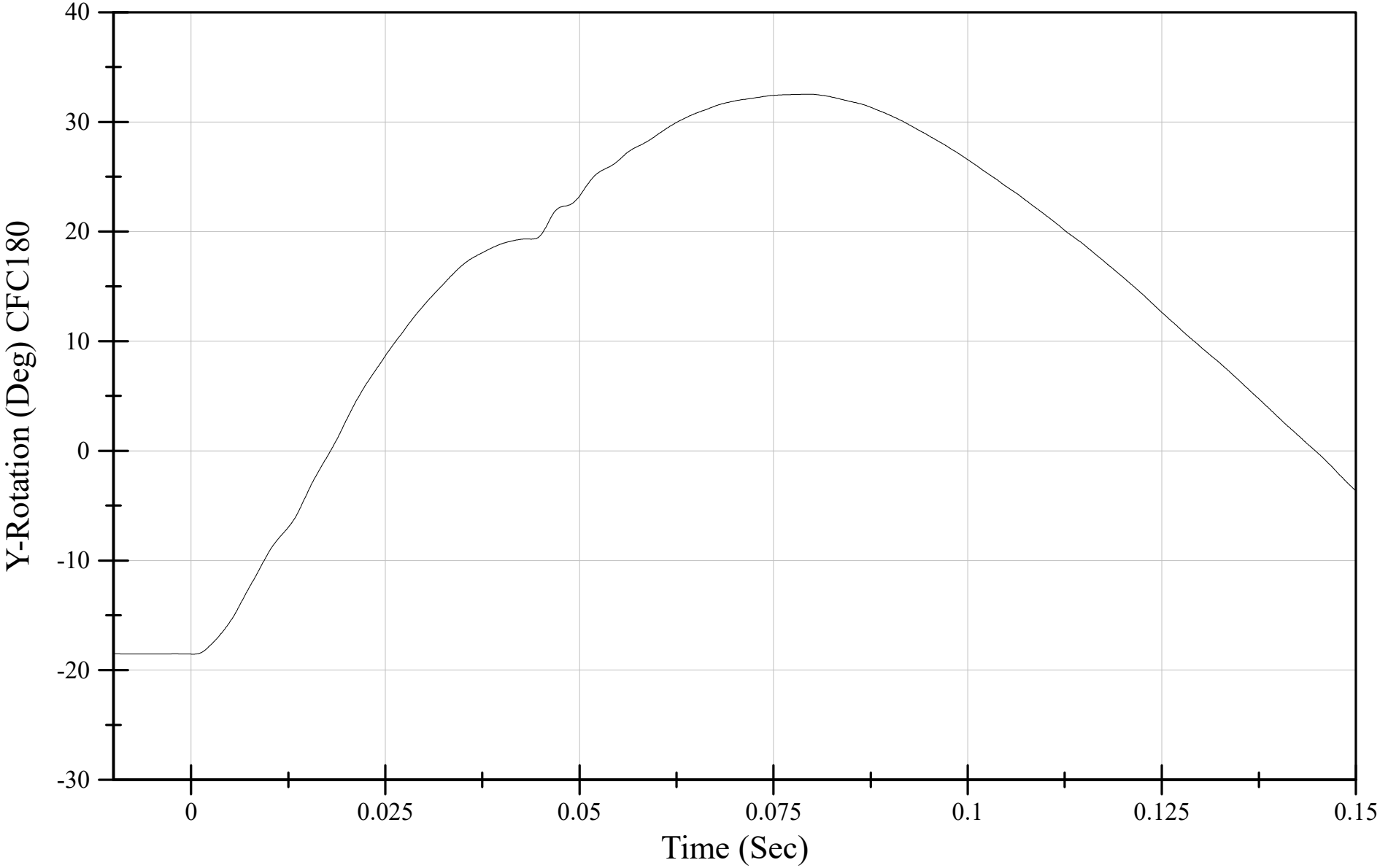
THOR-05F Right Ball of Foot Qualification
Ankle Y-Moment
Ankle Serial Number: EV4210



File Name: 221005-3 processed

10/5/2022 10:05 AM

THOR-05F Right Ball of Foot Qualification
Ankle Y-Rotation
Ankle Serial Number: EV4210



File Name: 221005-3 processed

10/5/2022 10:05 AM

THOR-05F Right Foot Inversion Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components	Test ID: 221005-9
Ankle Serial: EV4210	Test Date: 10/5/2022
Inversion Stop Assembly: EP6305	Test Time: 12:43 PM

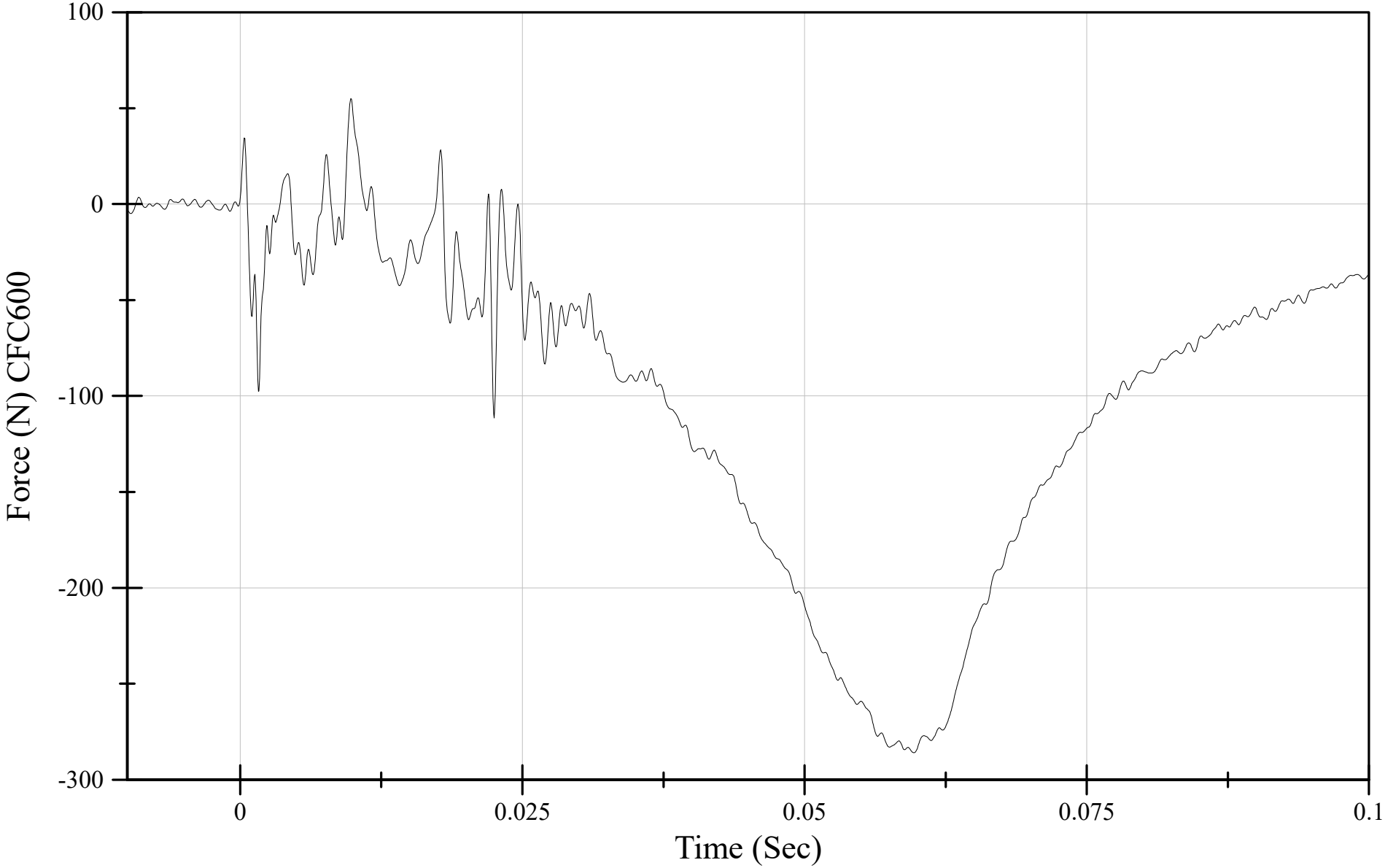
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.2	Pass
Test Humidity (%)	10 - 70	39	Pass
Test Velocity (m/s)	1.95 - 2.05	2.05	Pass
Peak Lower Tibia Fz		-285.9	
Peak Ankle X-axis Resistive Moment		33.3	
Peak Ankle X-axis Rotation		45.3	

* THOR-05F Qualification Manual - July 2022

File Name: 221005-9 processed
Software Version: 2.8

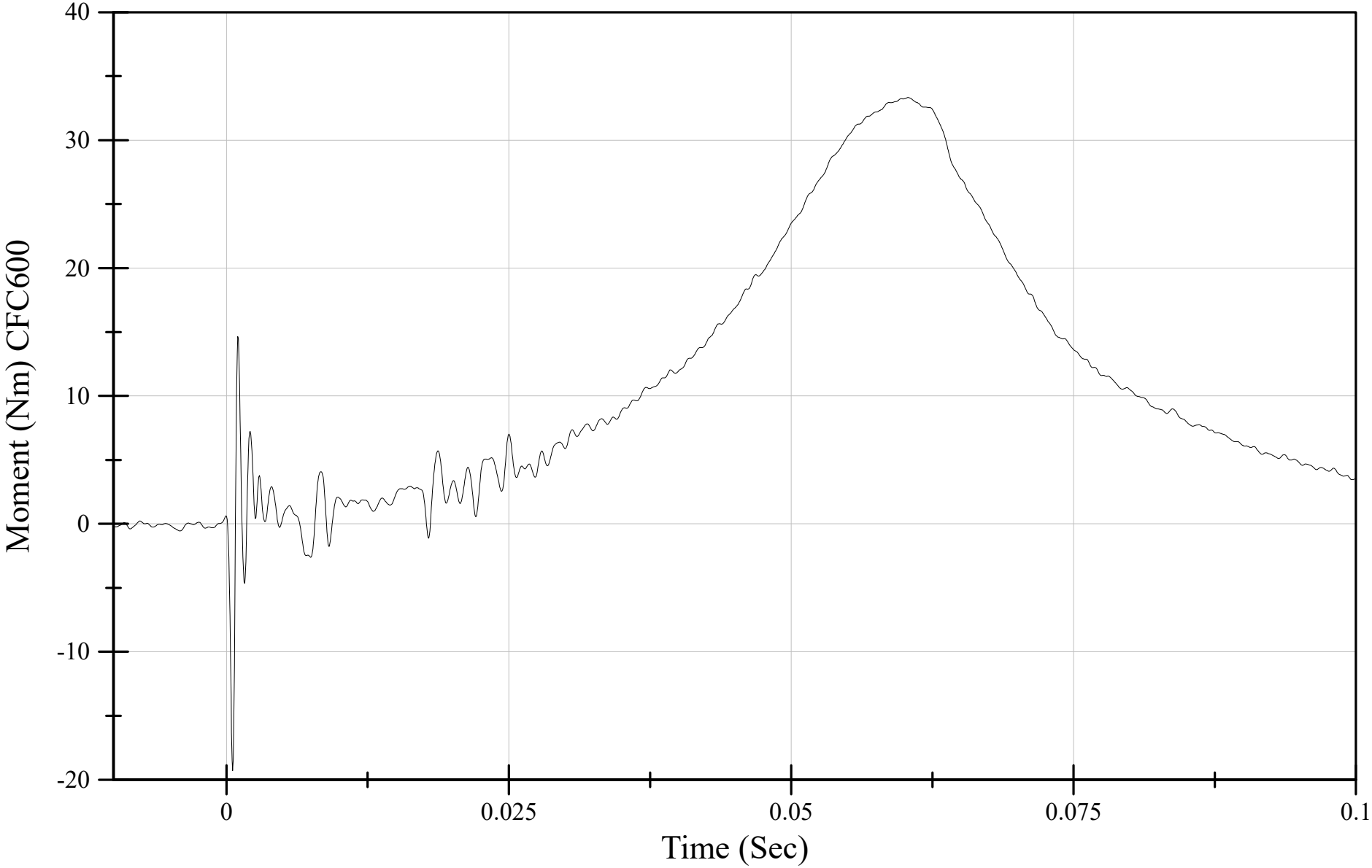
THOR-05F Right Foot Inversion Qualification
Tibia Load - Force Z
Ankle Serial Number: EV4210



File Name: 221005-9 processed

10/5/2022 12:43 PM

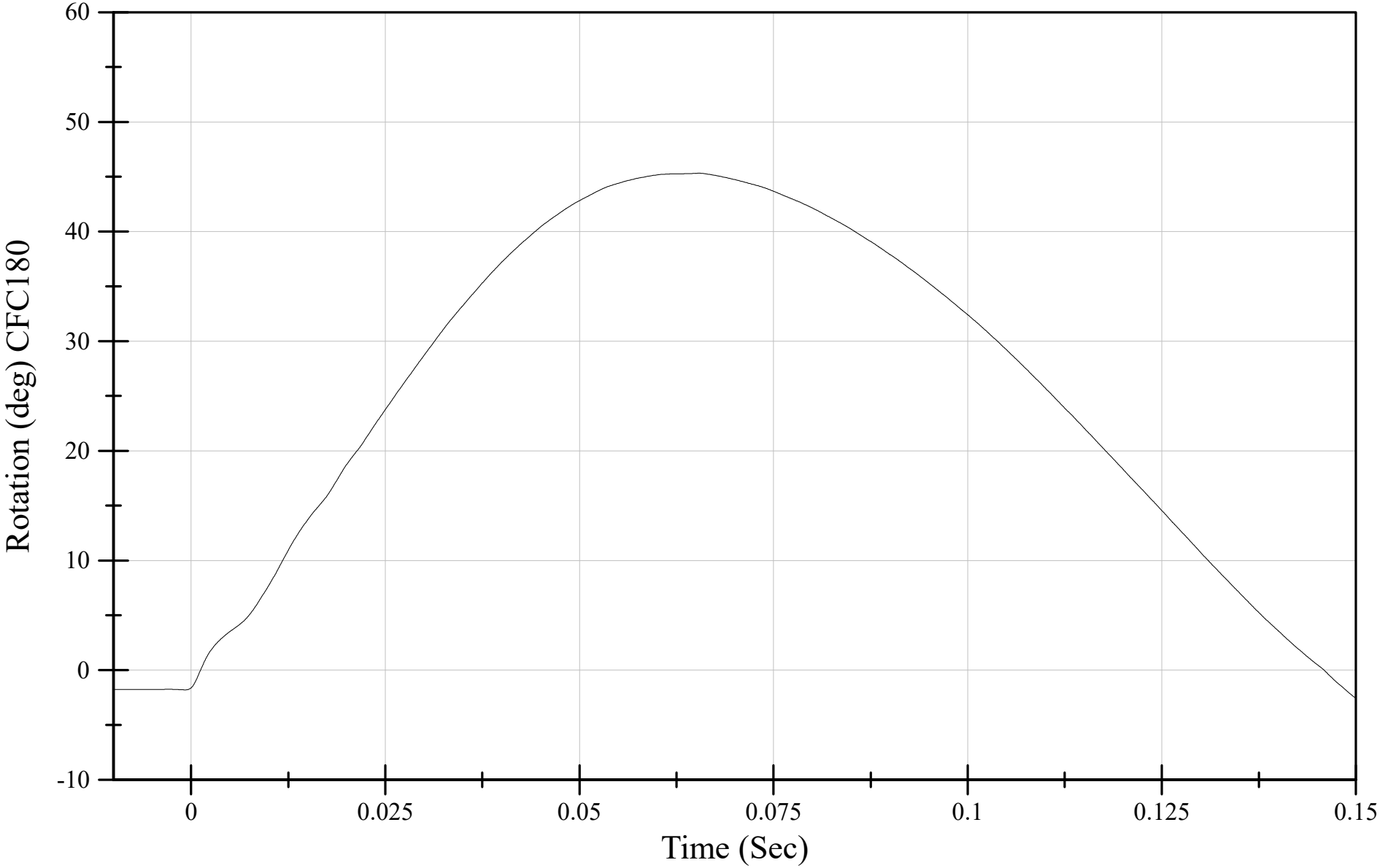
THOR-05F Right Foot Inversion Qualification
Ankle Moment - X axis
Ankle Serial Number: EV4210



File Name: 221005-9 processed

10/5/2022 12:43 PM

THOR-05F Right Foot Inversion Qualification
Ankle X-Rotation
Ankle Serial Number: EV4210



File Name: 221005-9 processed

10/5/2022 12:43 PM

THOR-05F Right Foot Eversion Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components	Test ID: 221005-10
Ankle Serial: EV4210	Test Date: 10/5/2022
Eversion Stop Assembly: EV3439	Test Time: 1:16 PM

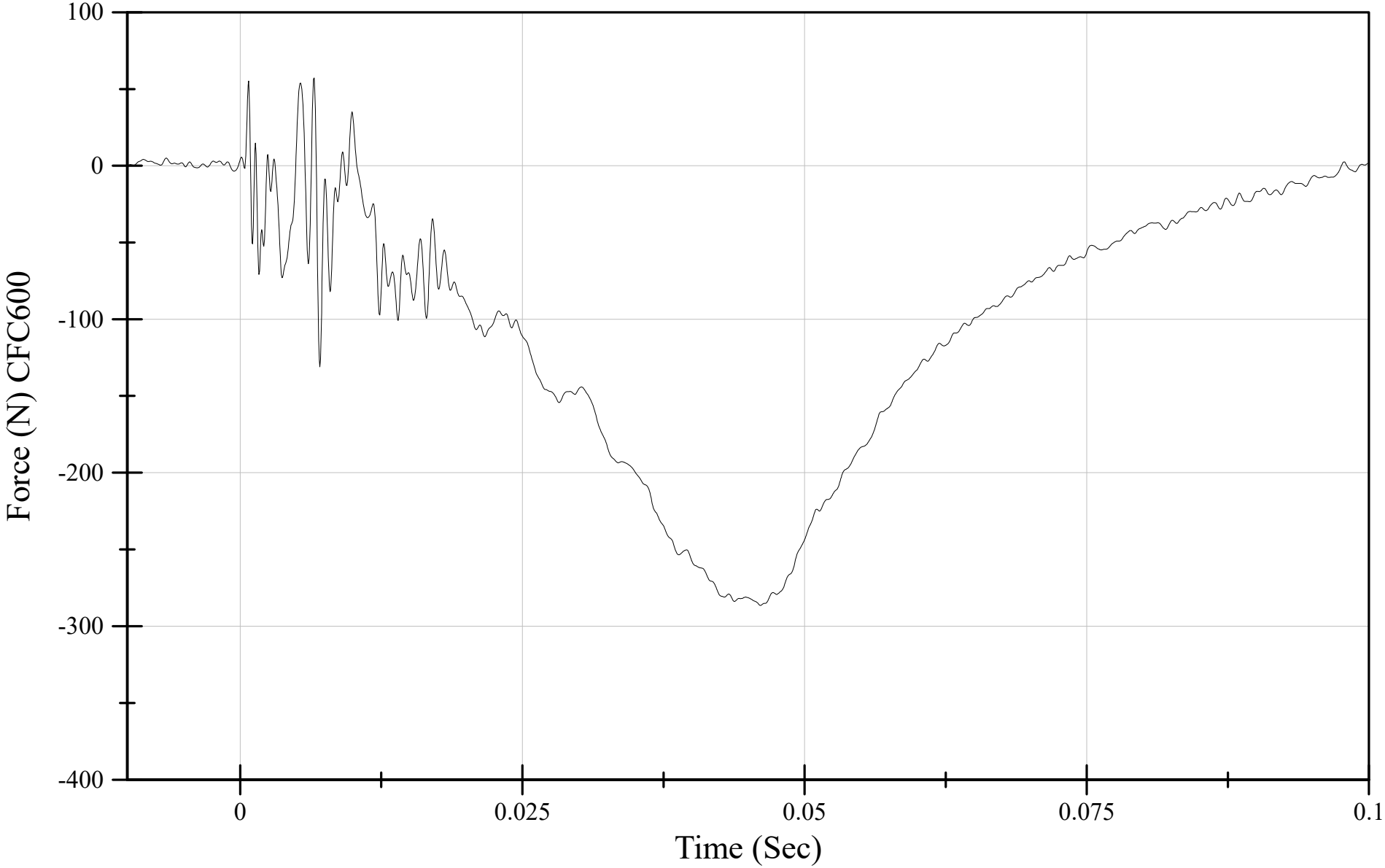
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.4	Pass
Test Humidity (%)	10 - 70	46	Pass
Test Velocity (m/s)	1.95 - 2.05	2.01	Pass
Peak Lower Tibia Fz		-286.4	
Peak Ankle X-axis Resistive Moment		-27.5	
Peak Ankle X-axis Rotation		-33.2	

* THOR-05F Qualification Manual - July 2022

File Name: 221005-10 processed
Software Version: 2.8

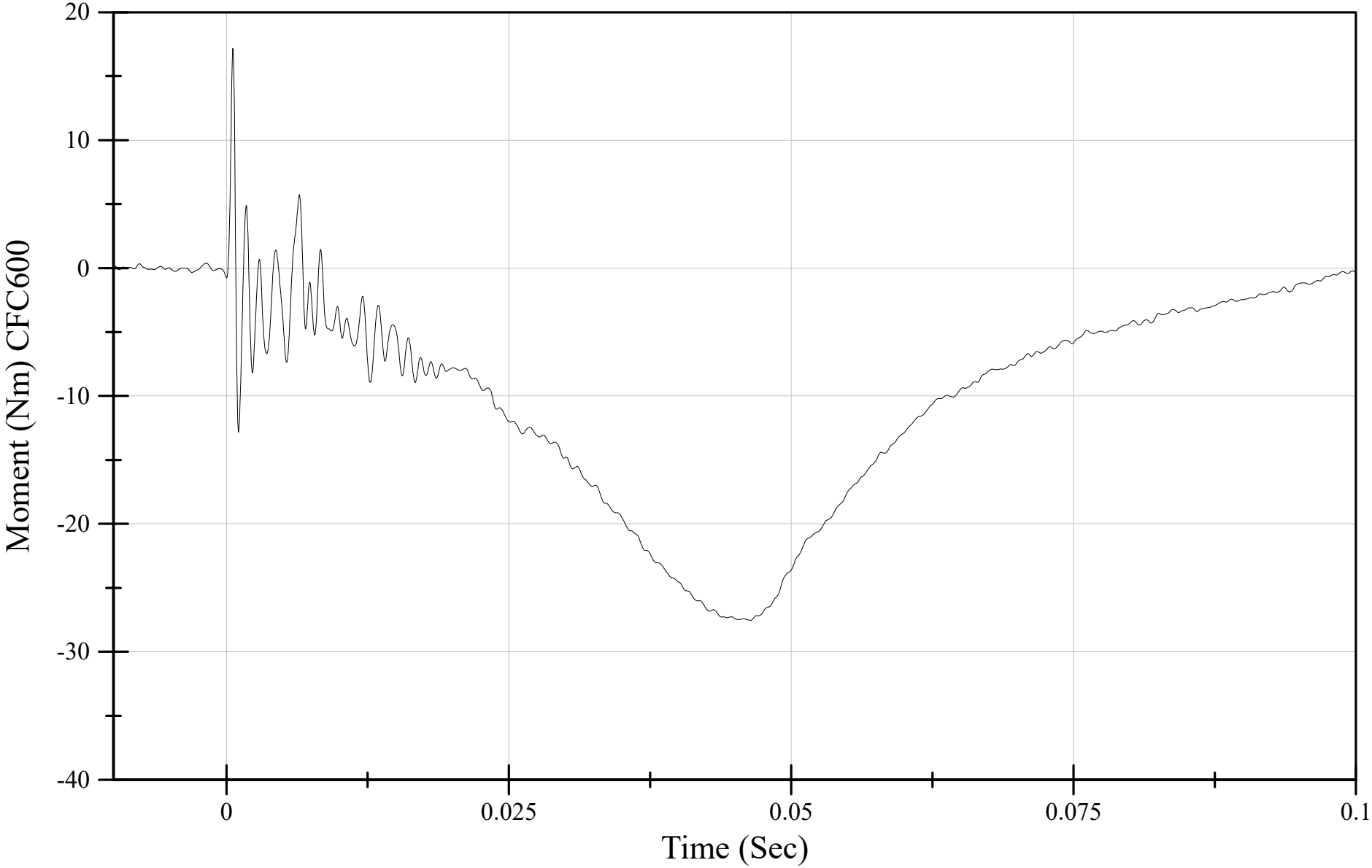
THOR-05F Right Foot Eversion Qualification
Tibia Load - Force Z
Ankle Serial Number: EV4210



File Name: 221005-10 processed

10/5/2022 1:16 PM

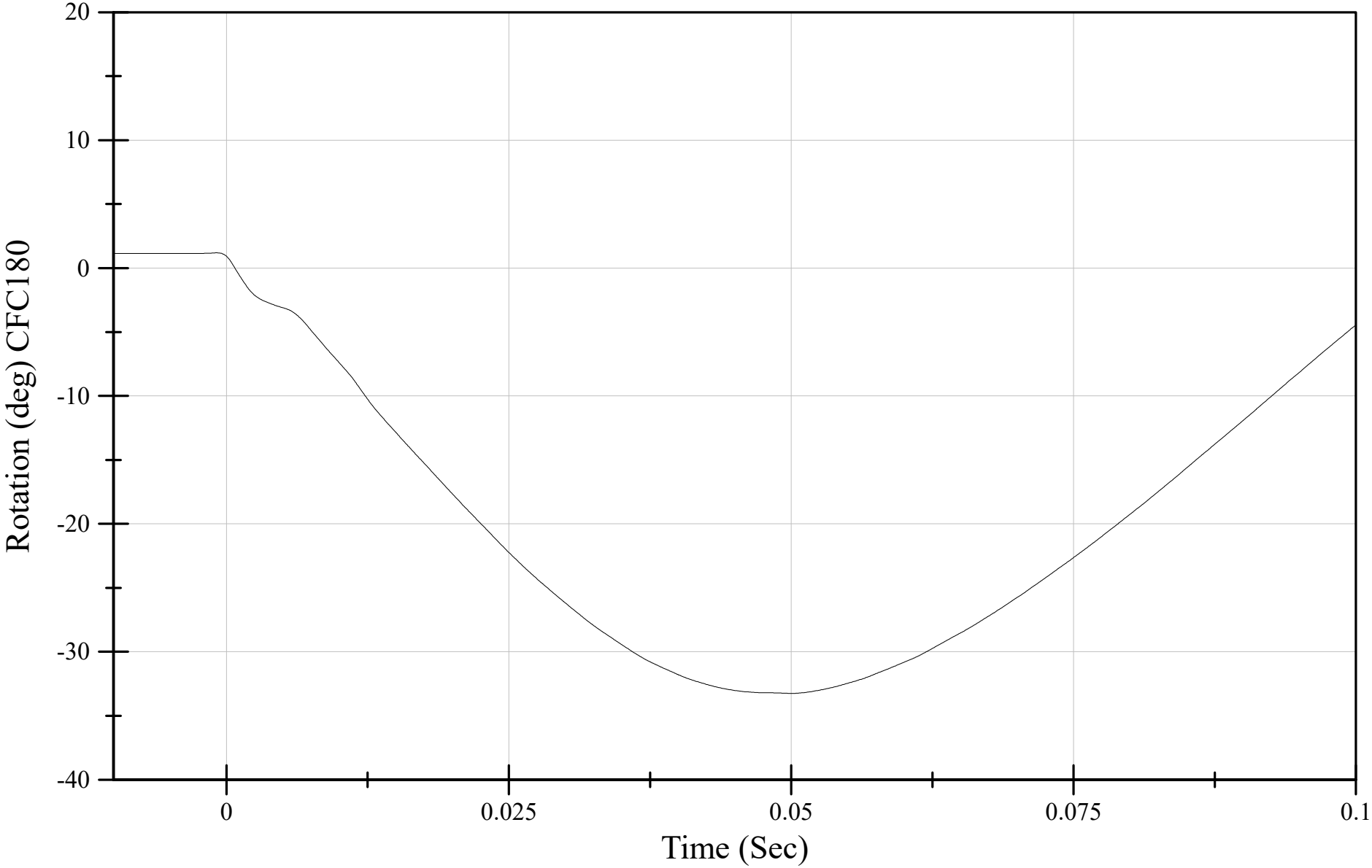
THOR-05F Right Foot Eversion Qualification
Ankle Moment - X axis
Ankle Serial Number: EV4210



File Name: 221005-10 processed

10/5/2022 1:16 PM

THOR-05F Right Foot Eversion Qualification
Ankle X-Rotation
Ankle Serial Number: EV4210



File Name: 221005-10 processed

10/5/2022 1:16 PM

THOR-05F Right Heel Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Right Ankle: EV4210

Test ID: 221005-11
Test Date: 10/5/2022
Test Time: 1:47 PM

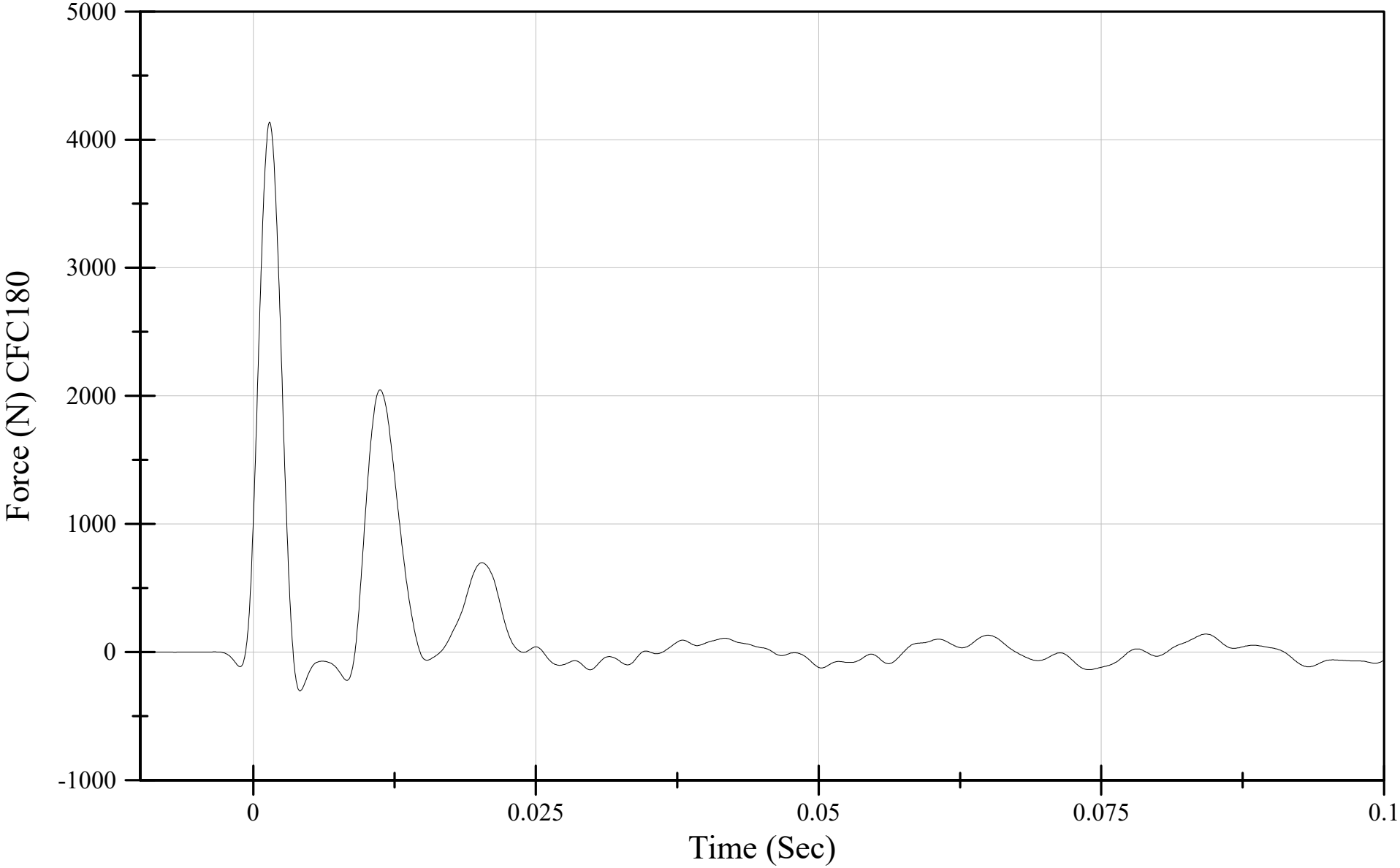
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.4	Pass
Test Humidity (%)	10 - 70	44	Pass
Test Velocity (m/s)	3.95 - 4.05	3.99	Pass
Probe Force (N)		4136.7	
Peak Lower Tibia Fz (N)		-1927.1	

* THOR-05F Qualification Manual - July 2022

File Name: 221005-11 processed
Software Version: 2.8

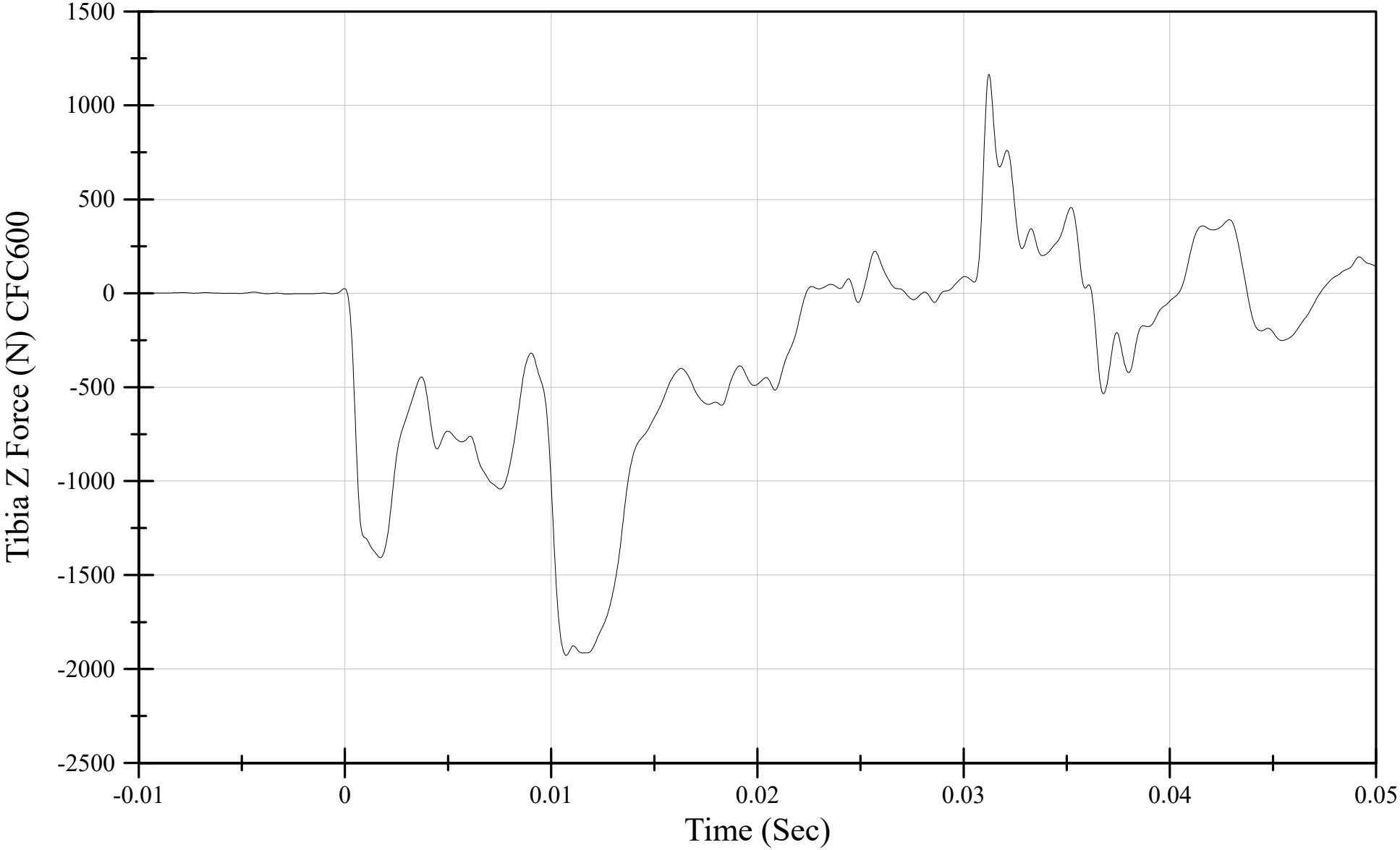
THOR-05F Right Heel Qualification
Probe Force
Dummy Serial Number: EV0674



File Name: 221005-11 processed

10/5/2022 1:47 PM

THOR-05F Right Heel Qualification
Tibia Load
Serial Number: EV0674



File Name: 221005-11 processed

10/5/2022 1:47 PM

THOR-05F Head Impact Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Head Skin: EV3771

Test ID: 221206-1
Test Date: 12/6/2022
Test Time: 6:20 AM

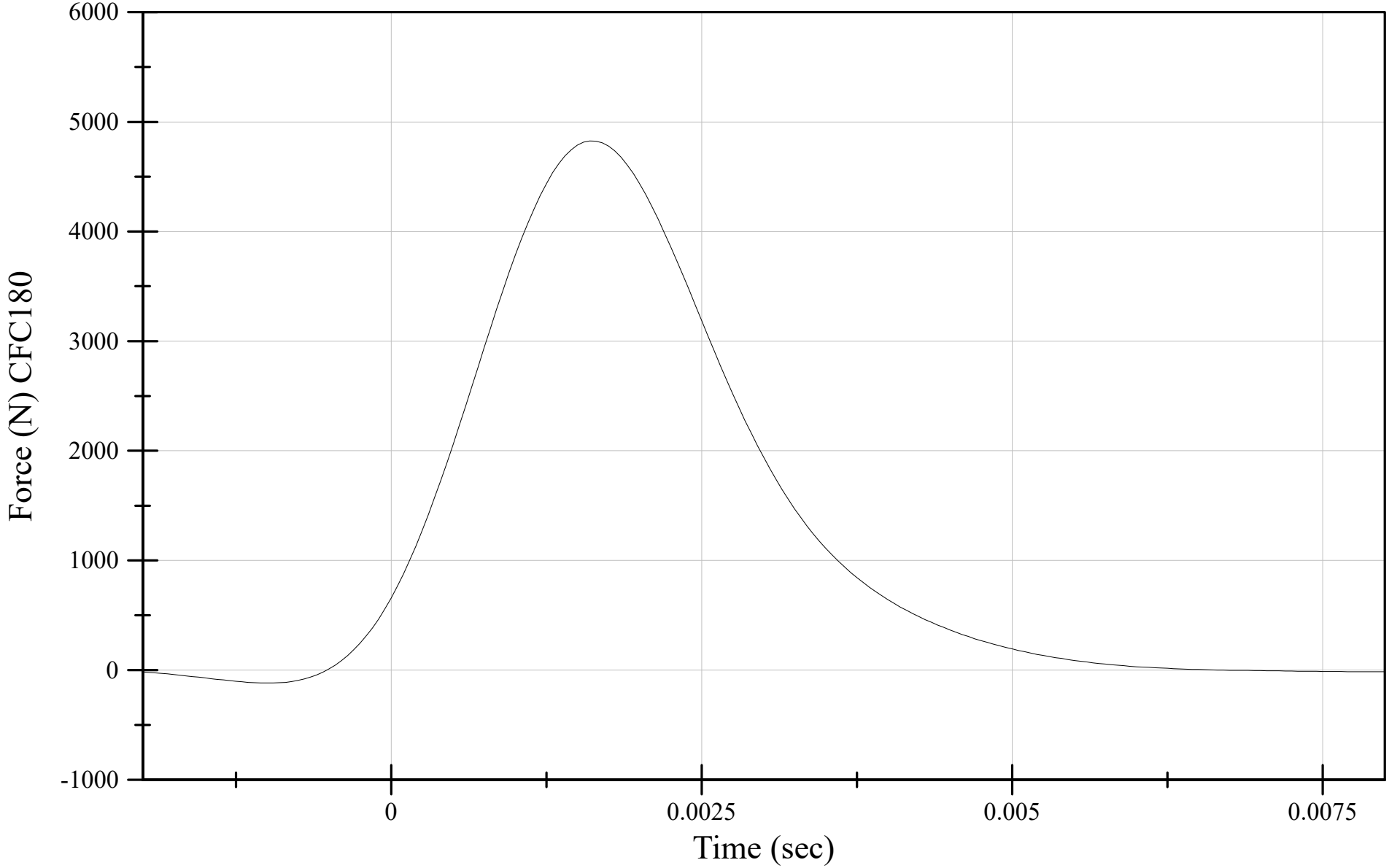
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.0	Pass
Test Humidity (%)	10 - 70	55	Pass
Test Velocity (m/s)	1.95 - 2.05	2.00	Pass
Peak Probe Force (N)		4828	
Peak Head CG Resultant Acceleration (g)		149	

* THOR-05F Qualification Manual - July 2022

File Name: 221206-1 processed
Software Version: 2.8

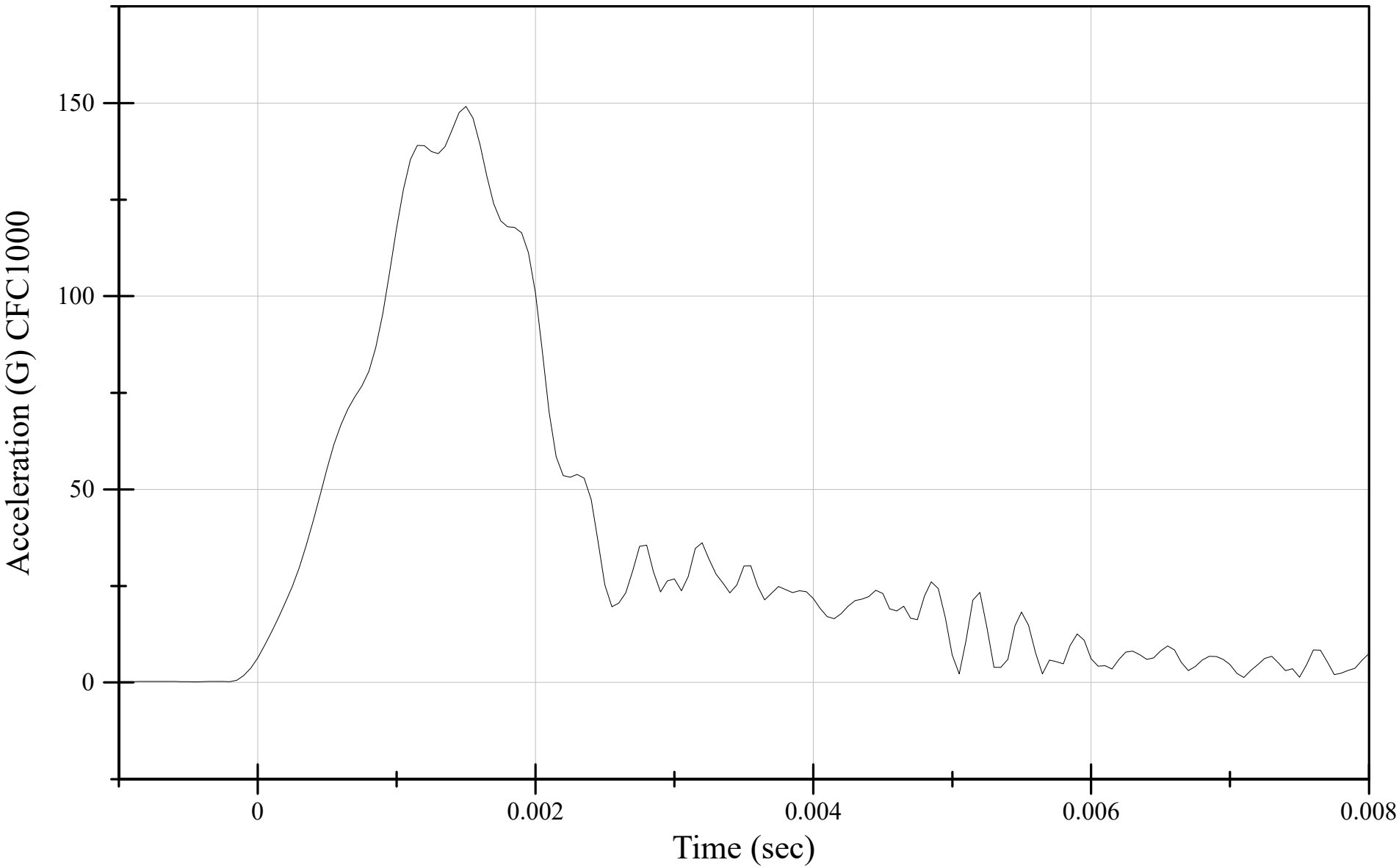
THOR-05F Head Impact Qualification
Probe Force
Dummy Serial Number: EV0674



File Name: 221206-1 processed

12/6/2022 6:20 AM

THOR-05F Head Impact Qualification
Head CG Resultant Acceleration
Dummy Serial Number: EV0674



File Name: 221206-1 processed

12/6/2022 6:20 AM

THOR-05F Face Disk Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components

Head Skin: EV3771

Face Foam: EV0674

Test ID: 221206-2

Test Date: 12/6/2022

Test Time: 9:49 AM

Test Results

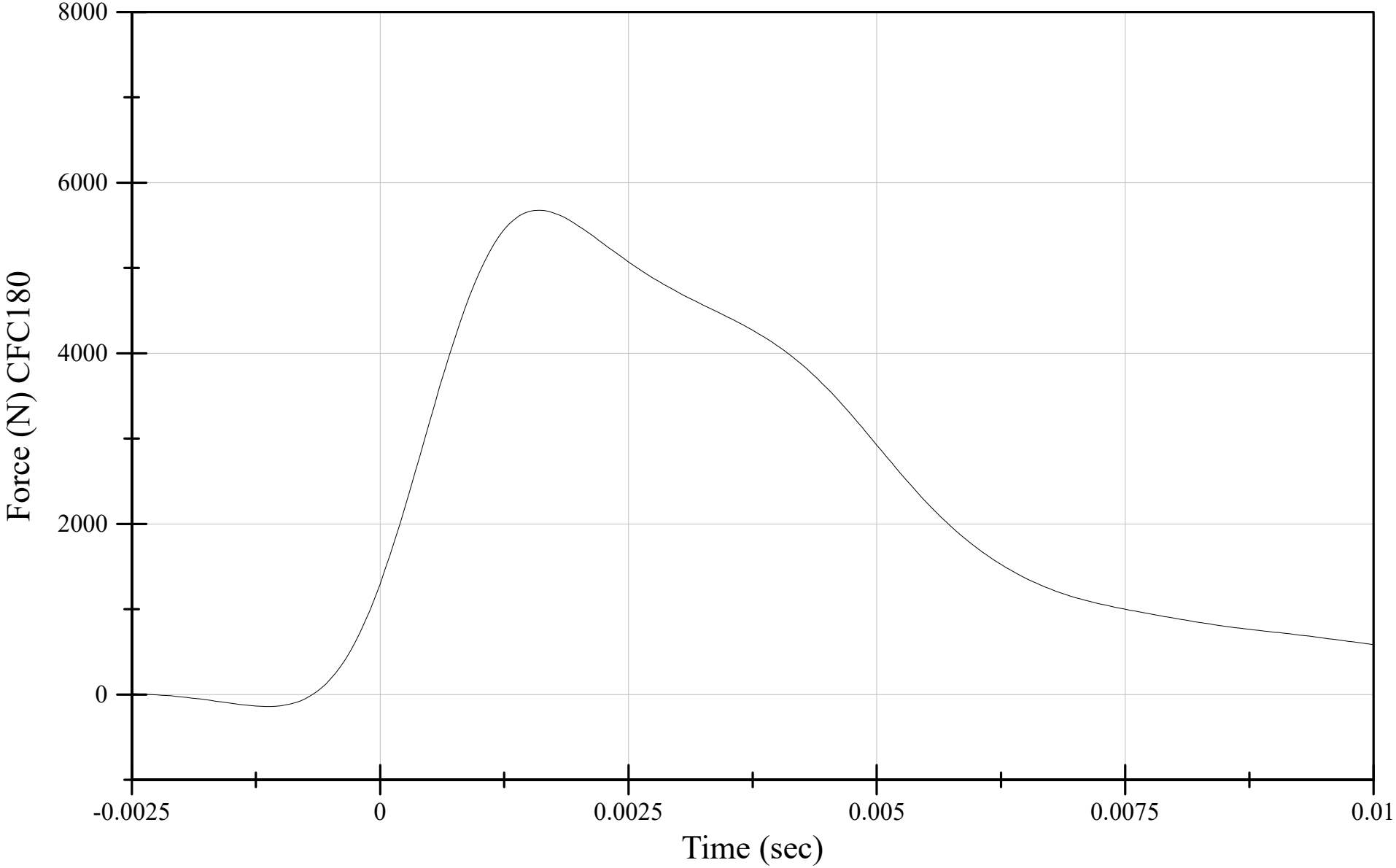
Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.0	Pass
Test Humidity (%)	10 - 70	55	Pass
Test Velocity (m/s)	6.68 - 6.78	6.72	Pass
Peak Probe Force (N)		5681	
Peak Head CG Resultant Acceleration prior to 2 ms (g)		173	
Peak Head CG Resultant Acceleration after to 2 ms (g)		128	

* THOR-05F Qualification Manual - July 2022

File Name: 221206-2 processed

Software Version: 2.8

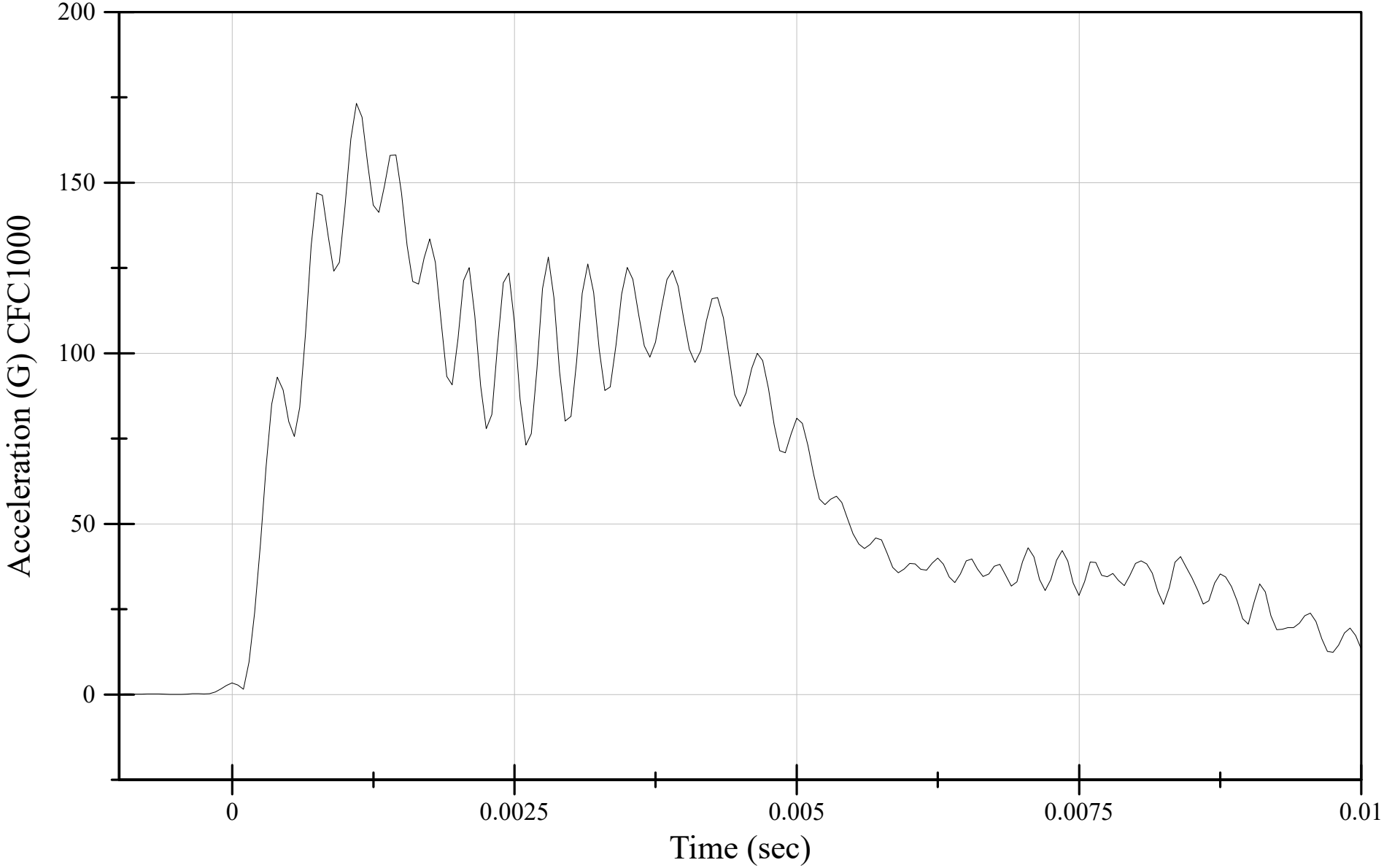
THOR-05F Face Disk Qualification
Probe Force
Dummy Serial Number: EV0674



File Name: 221206-2 processed

12/6/2022 9:49 AM

THOR-05F Face Disk Qualification
Head CG Resultant Acceleration
Dummy Serial Number: EV0674



File Name: 221206-2 processed

12/6/2022 9:49 AM

THOR-05F Neck Extension Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components	Test ID: 221130-4
Neck Serial Number: EV1357	Test Date: 11/30/2022
O.C. Stop Assembly:	Test Time: 8:36 AM
O.C. Cam:	

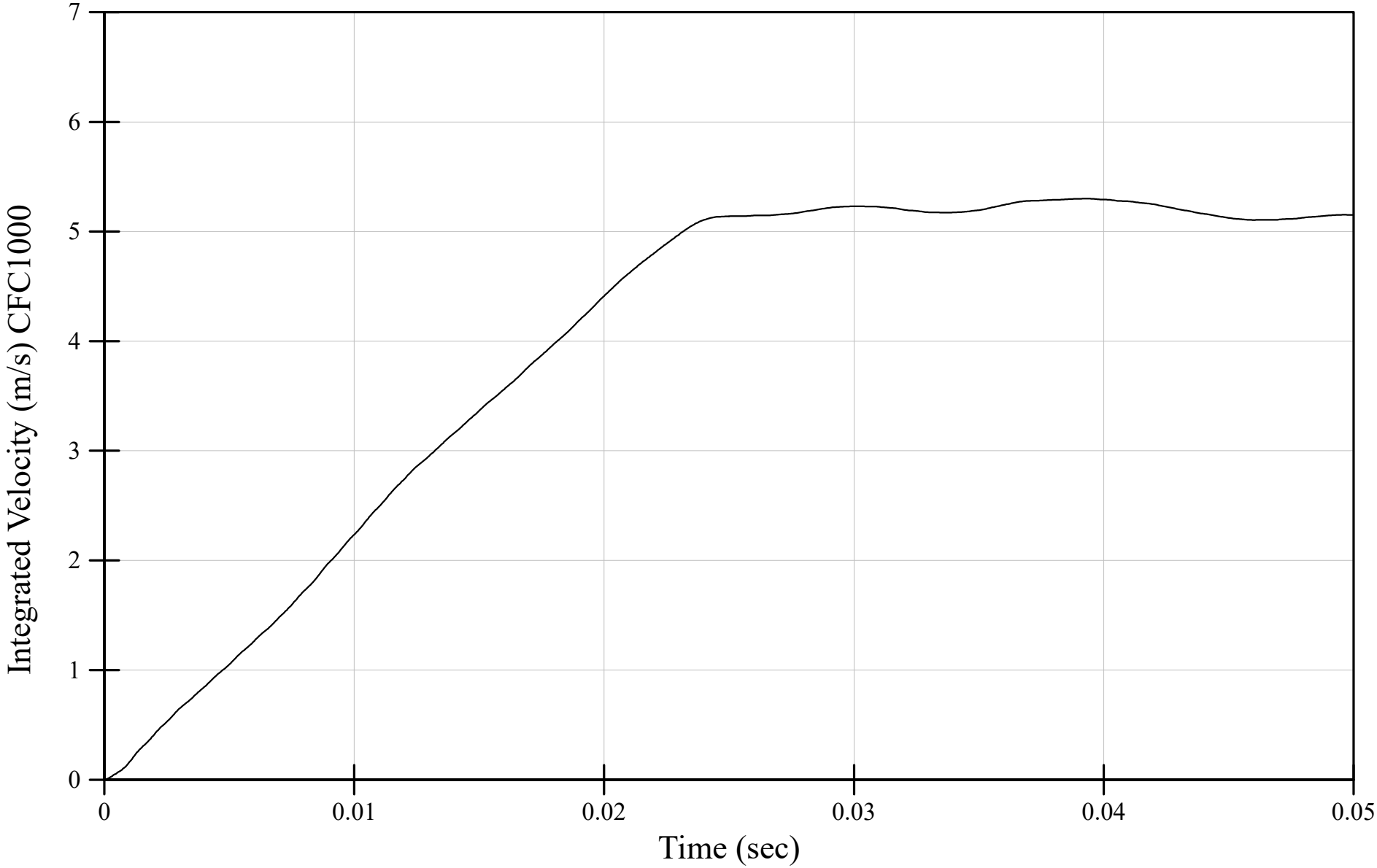
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.0	Pass
Test Humidity (%)	10 - 70	51	Pass
Test Velocity (m/s)	4.95 - 5.05	4.95	Pass
Pendulum Velocity at 8 ms (m/s)		1.72	
Pendulum Velocity at 16 ms (m/s)		3.56	
Pendulum Velocity at 24 ms (m/s)		5.11	
Peak Upper Neck My (Nm)		-19.0	
Peak Upper Neck Fz (N)		-1401	
Peak Head Angular Velocity Y (deg/sec)		2446	
Peak Head Rotation (deg)		88.6	

* THOR-05F Qualification Manual - July 2022

File Name: 221130-4 processed

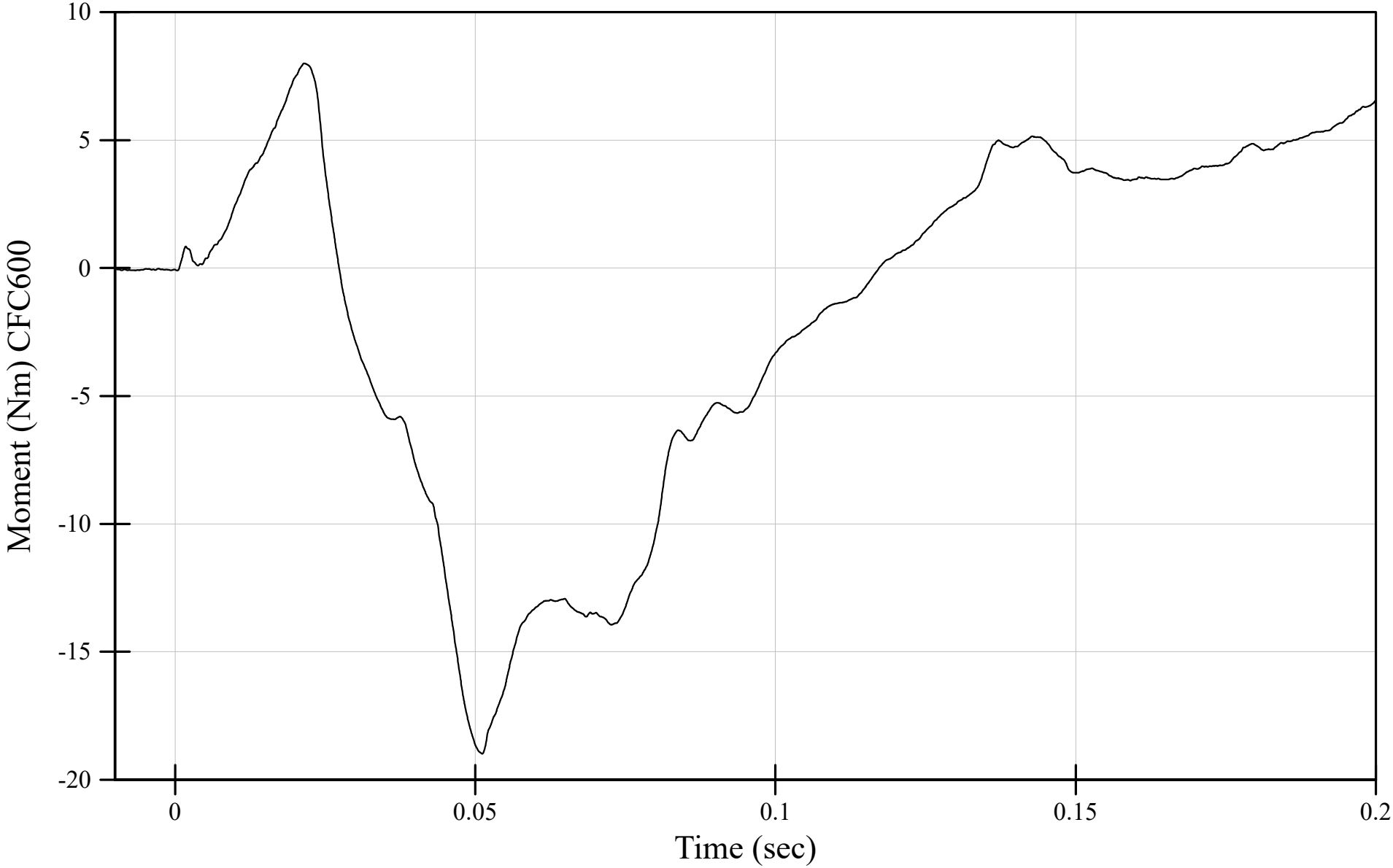
THOR-05F Neck Extension Qualification
Probe Acceleration
Neck Serial Number: EV1357



File Name: 221130-4 processed

11/30/2022 8:36 AM

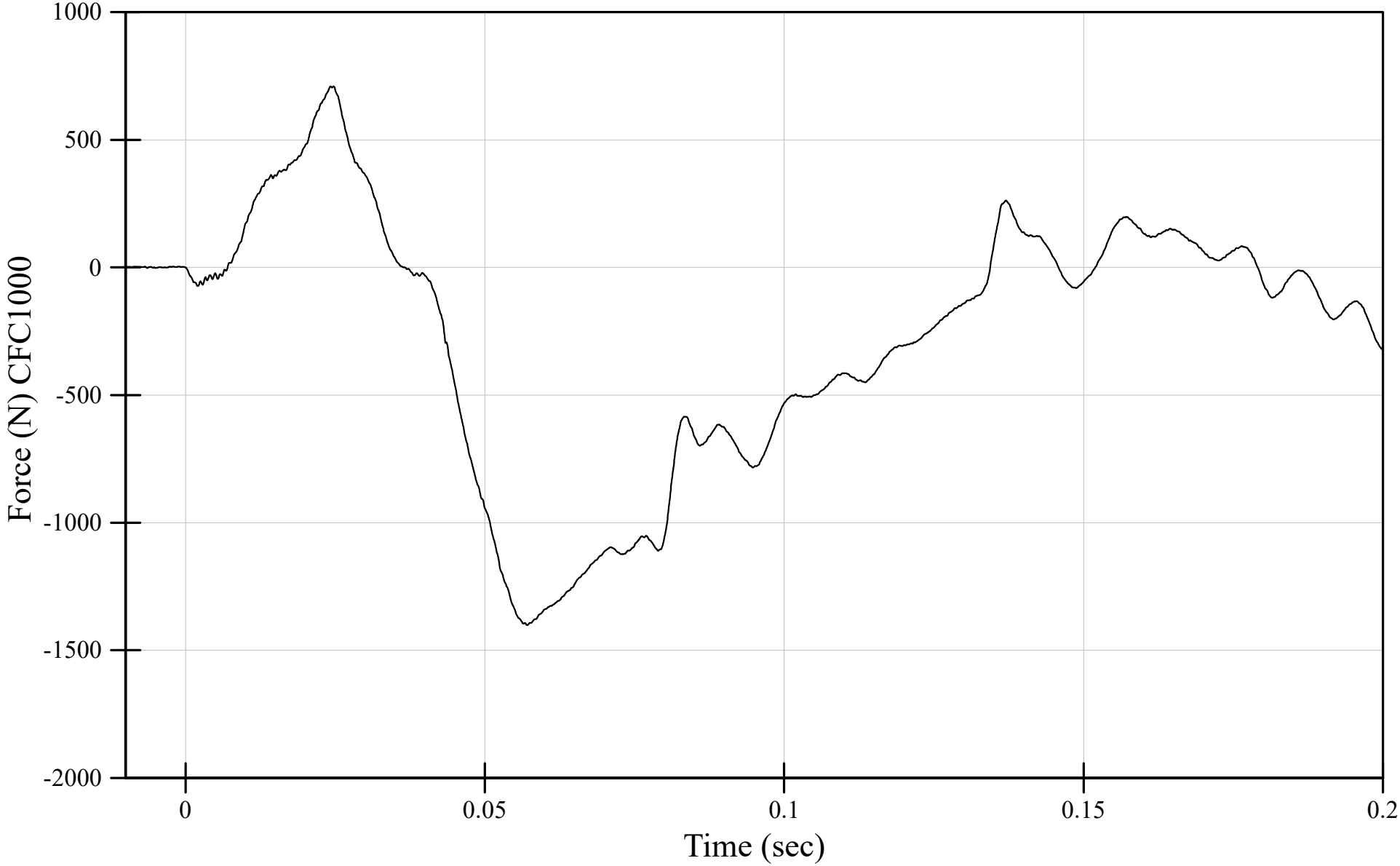
THOR-05F Neck Extension Qualification
Y-Moment as Measured
Neck Serial Number: EV1357



File Name: 221130-4 processed

11/30/2022 8:36 AM

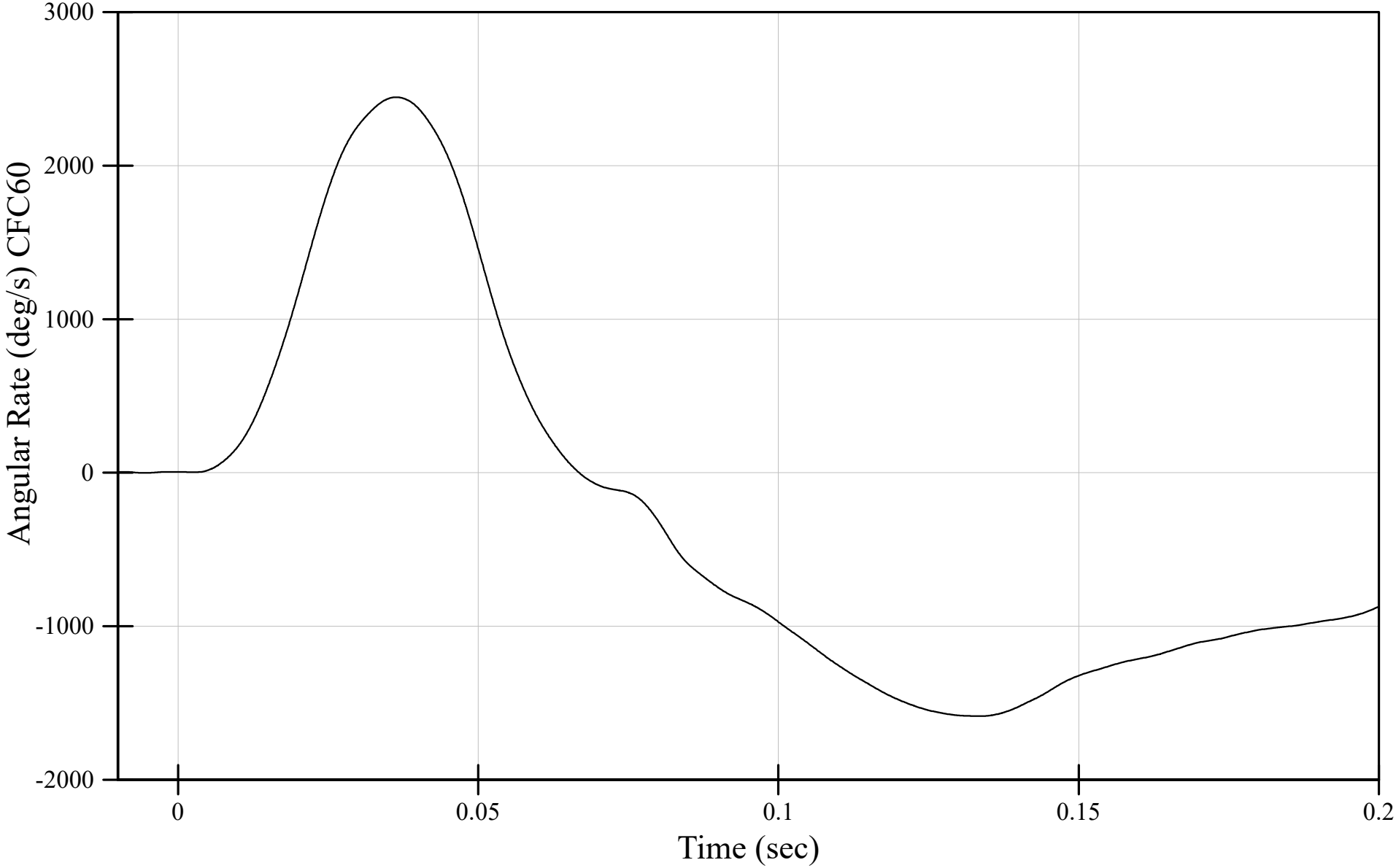
THOR-05F Neck Extension Qualification
Z-Force as Measured
Neck Serial Number: EV1357



File Name: 221130-4 processed

11/30/2022 8:36 AM

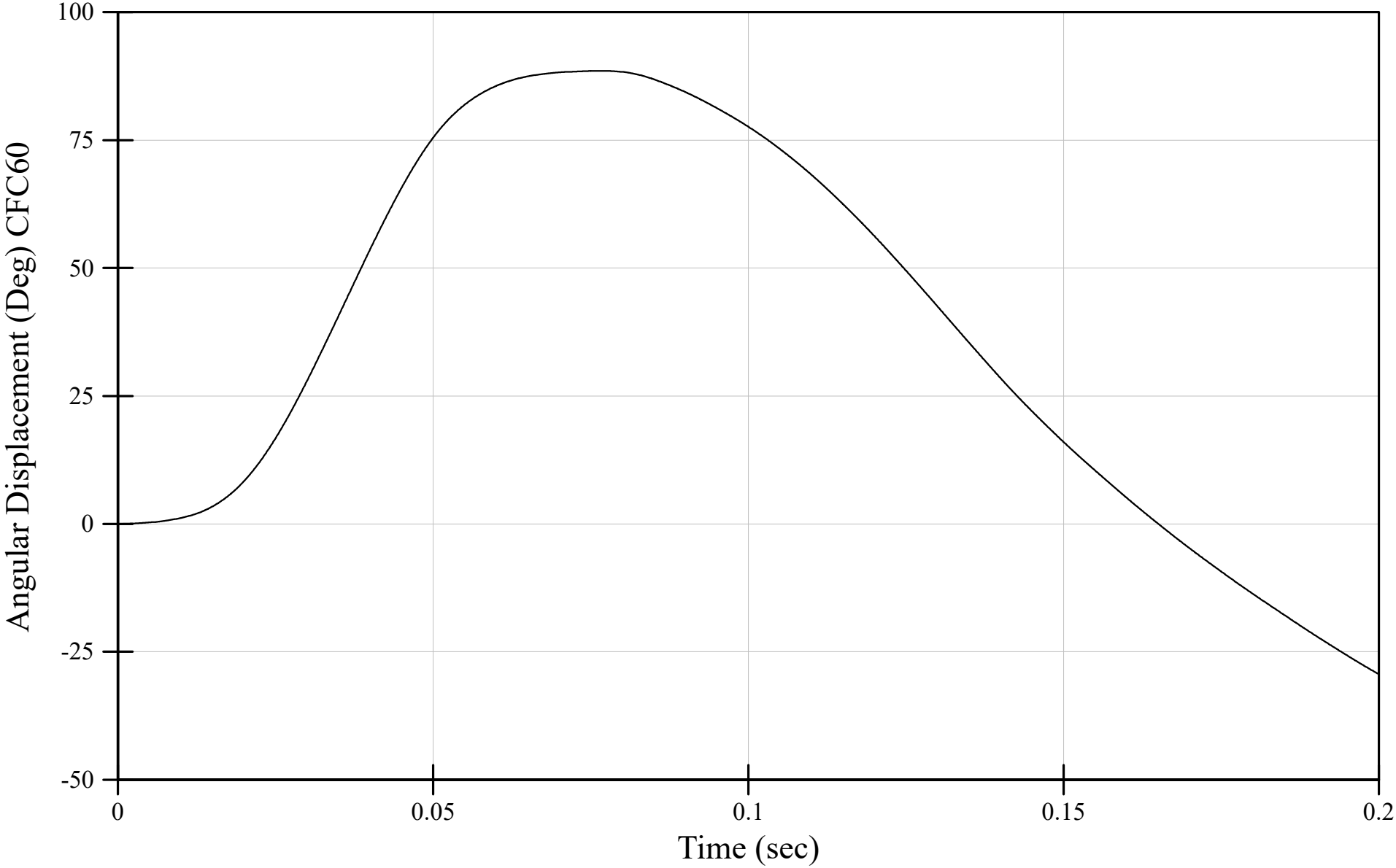
THOR-05F Neck Extension Qualification
Peak Head Angular Rate
Neck Serial Number: EV1357



File Name: 221130-4 processed

11/30/2022 8:36 AM

THOR-05F Neck Extension Qualification
Neck Rotation
Neck Serial Number: EV1357



File Name: 221130-4 processed

11/30/2022 8:36 AM

THOR-05F Neck Front Flexion Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Neck Serial Number: EV1357
O.C. Stop Assembly:
O.C. Cam:

Test ID: 221130-1
Test Date: 11/30/2022
Test Time: 6:34 AM

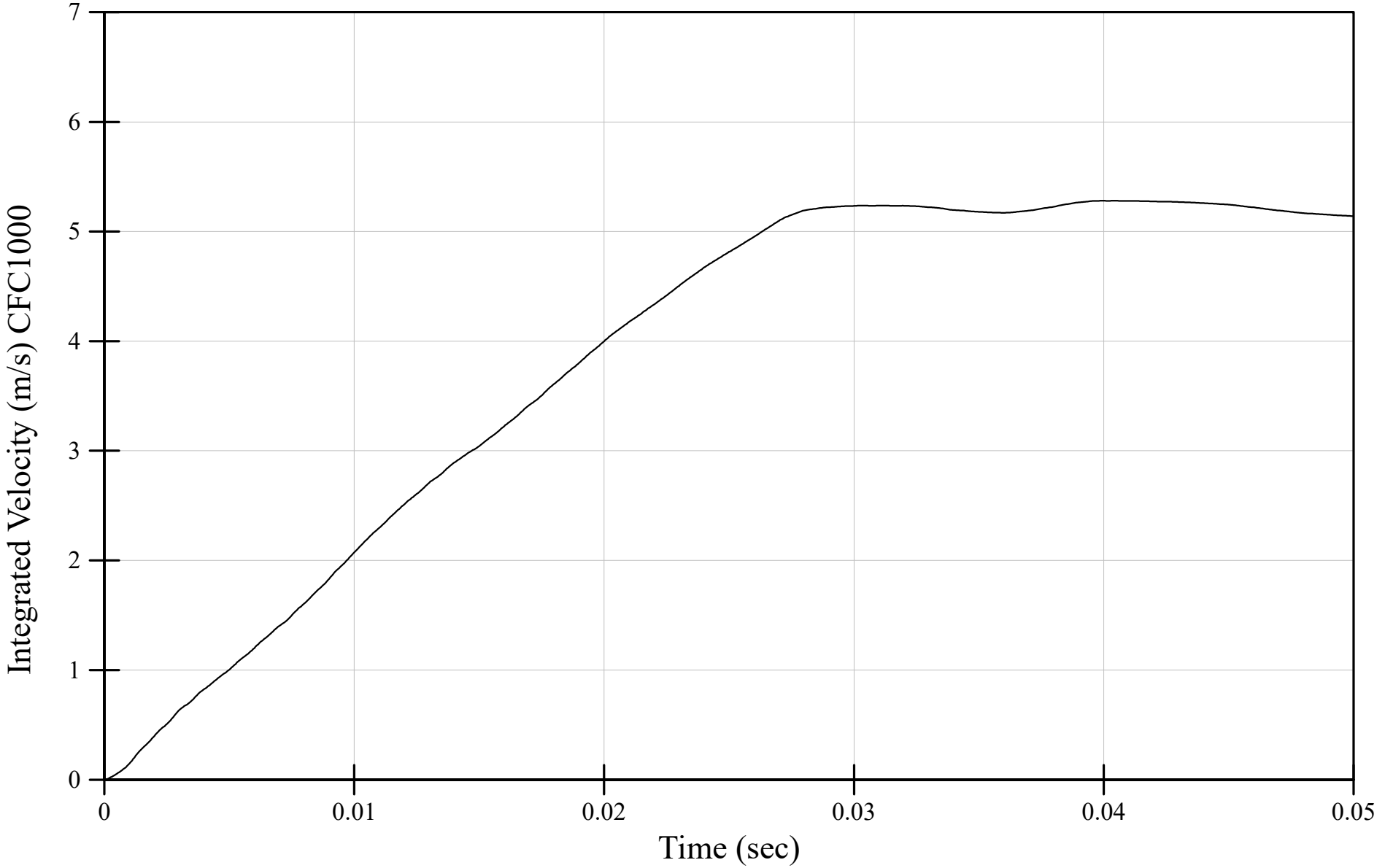
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.0	Pass
Test Humidity (%)	10 - 70	50	Pass
Test Velocity (m/s)	4.95 - 5.05	4.95	Pass
Pendulum Velocity at 8 ms (m/s)		1.61	
Pendulum Velocity at 16 ms (m/s)		3.23	
Pendulum Velocity at 24 ms (m/s)		4.67	
Peak Upper Neck My (Nm)		18.6	
Peak Upper Neck Fz prior to 40 ms (N)		732	
Peak Head Angular Velocity Y (deg/sec)		-2067	
Peak Head Rotation (deg)		-75.5	

* THOR-05F Qualification Manual - July 2022

File Name: 221130-1 processed
Software Version: 2.8

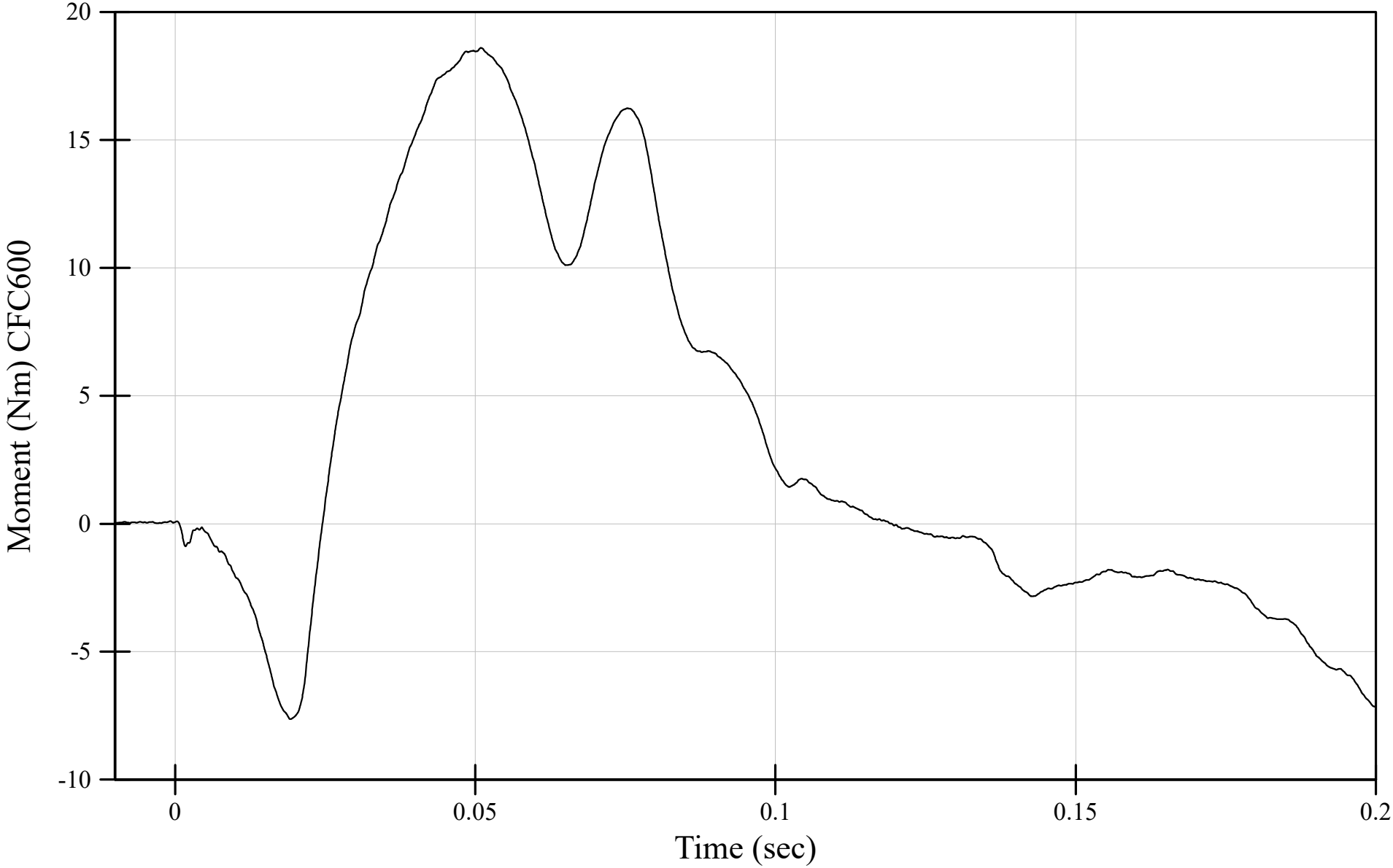
THOR-05F Neck Flexion Qualification
Pendulum Pulse
Neck Serial Number: EV1357



File Name: 221130-1 processed

11/30/2022 6:34 AM

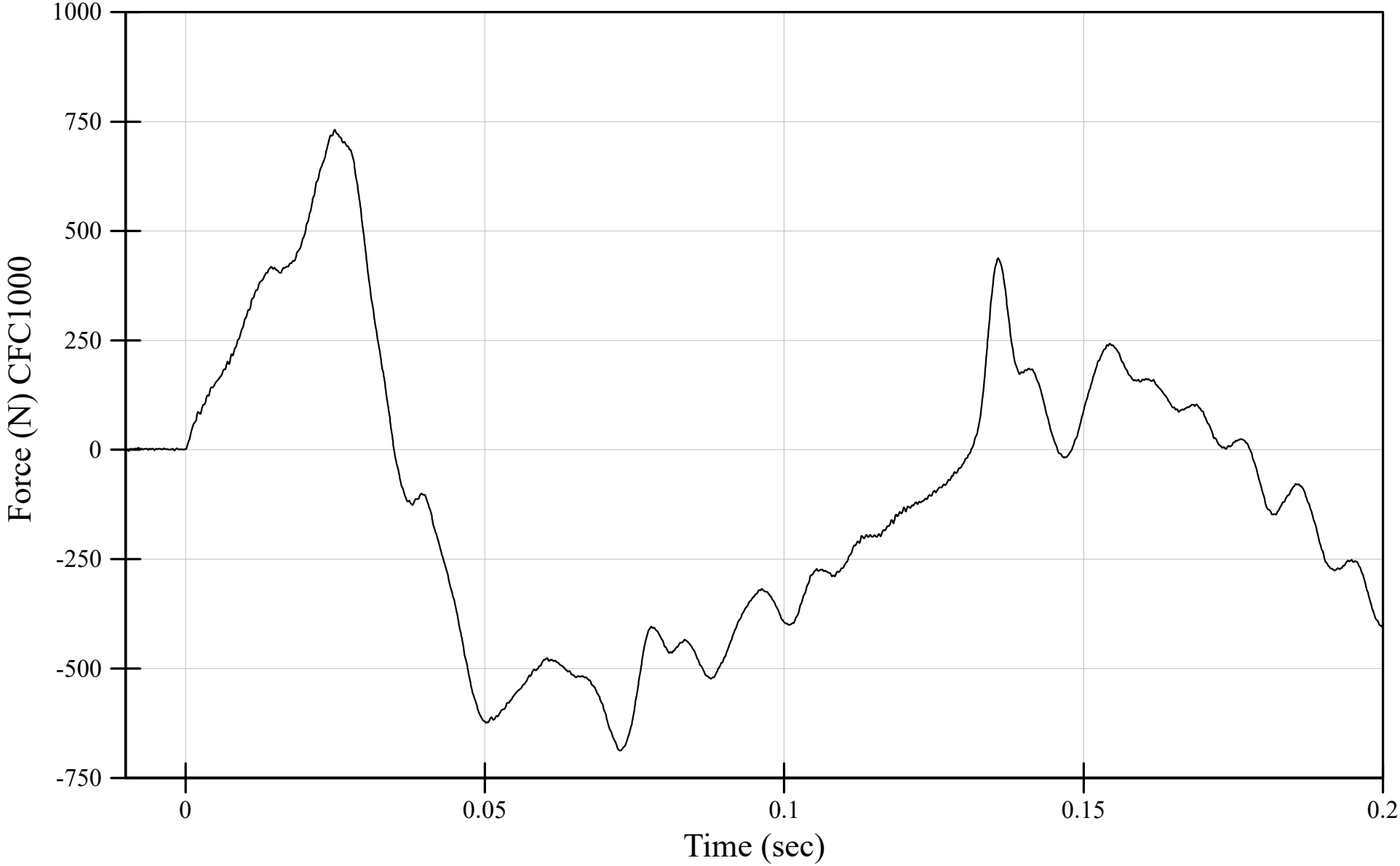
THOR-05F Neck Flexion Qualification
Y-Moment as Measured
Neck Serial Number: EV1357



File Name: 221130-1 processed

11/30/2022 6:34 AM

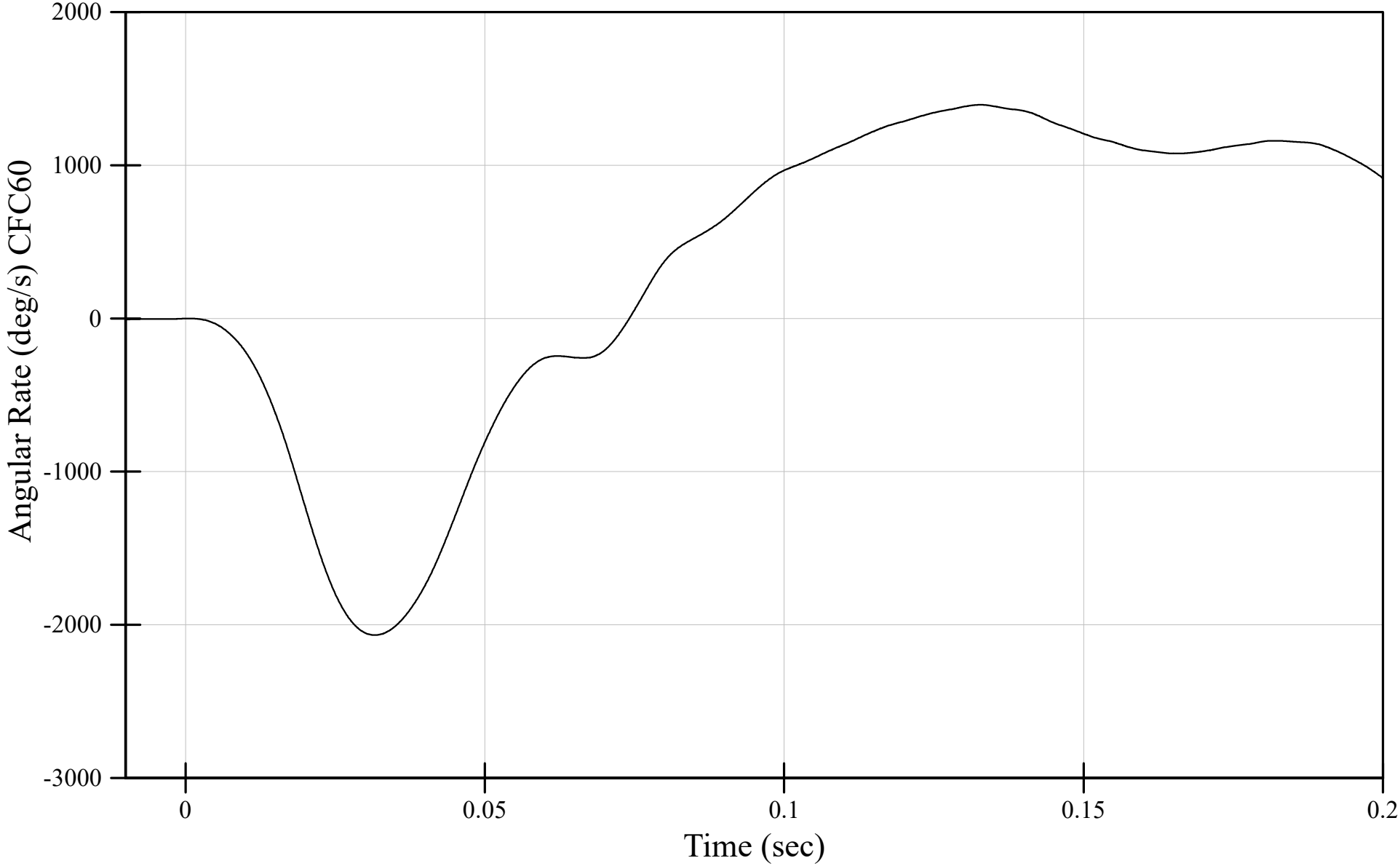
THOR-05F Neck Flexion Qualification
Z-Force as Measured
Neck Serial Number: EV1357



File Name: 221130-1 processed

11/30/2022 6:34 AM

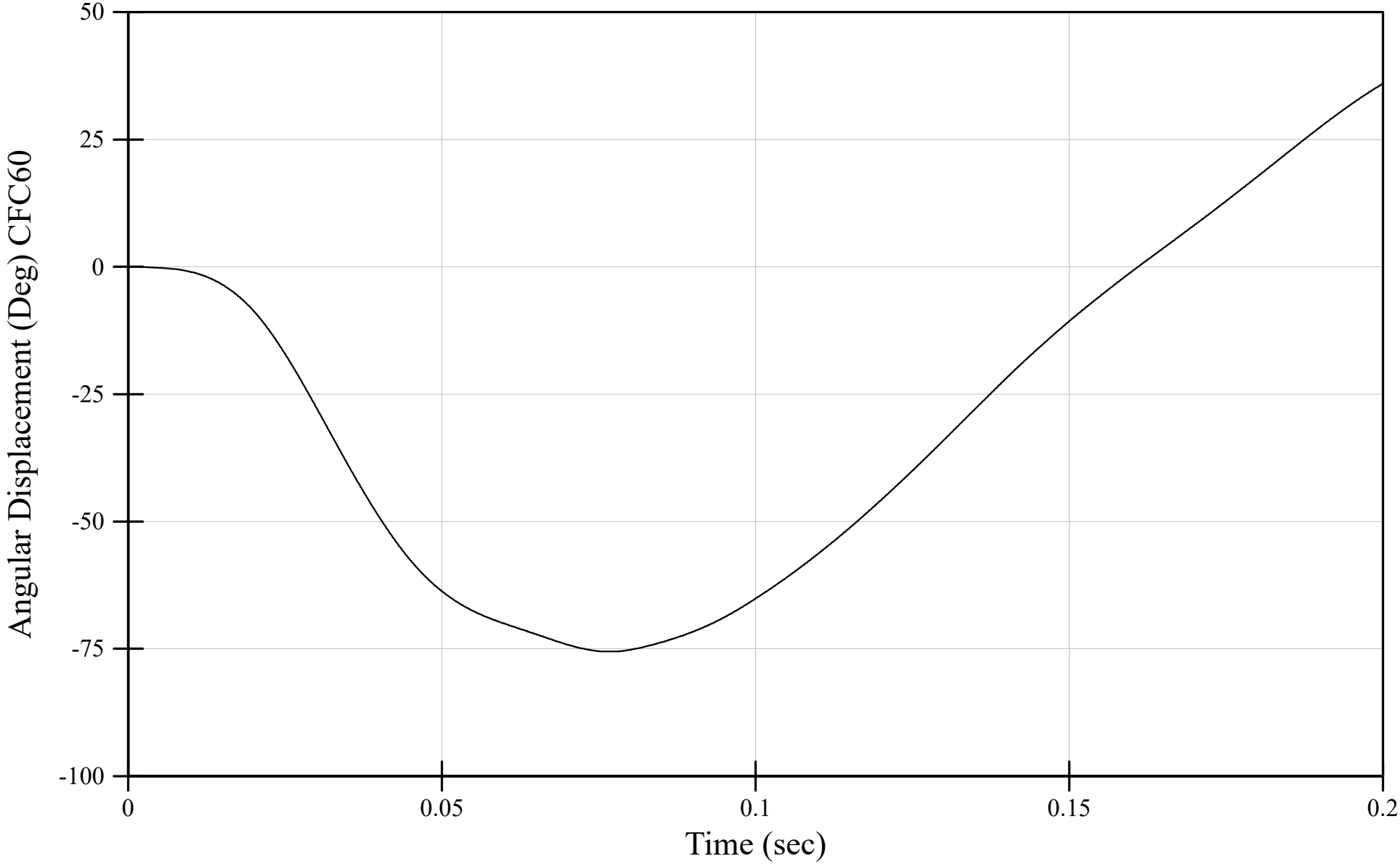
THOR-05F Neck Flexion Qualification
Peak Angular Rate
Neck Serial Number: EV1357



File Name: 221130-1 processed

11/30/2022 6:34 AM

THOR-05F Neck Flexion Qualification
Neck Rotation
Neck Serial Number: EV1357



File Name: 221130-1 processed

11/30/2022 6:34 AM

THOR-05F Neck Left Lateral Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Neck Serial Number: EV1357
O.C. Stop Assembly Serial Number:
O.C. Cam Serial Number:

Test ID: 221130-7
Test Date: 11/30/2022
Test Time: 9:16 AM

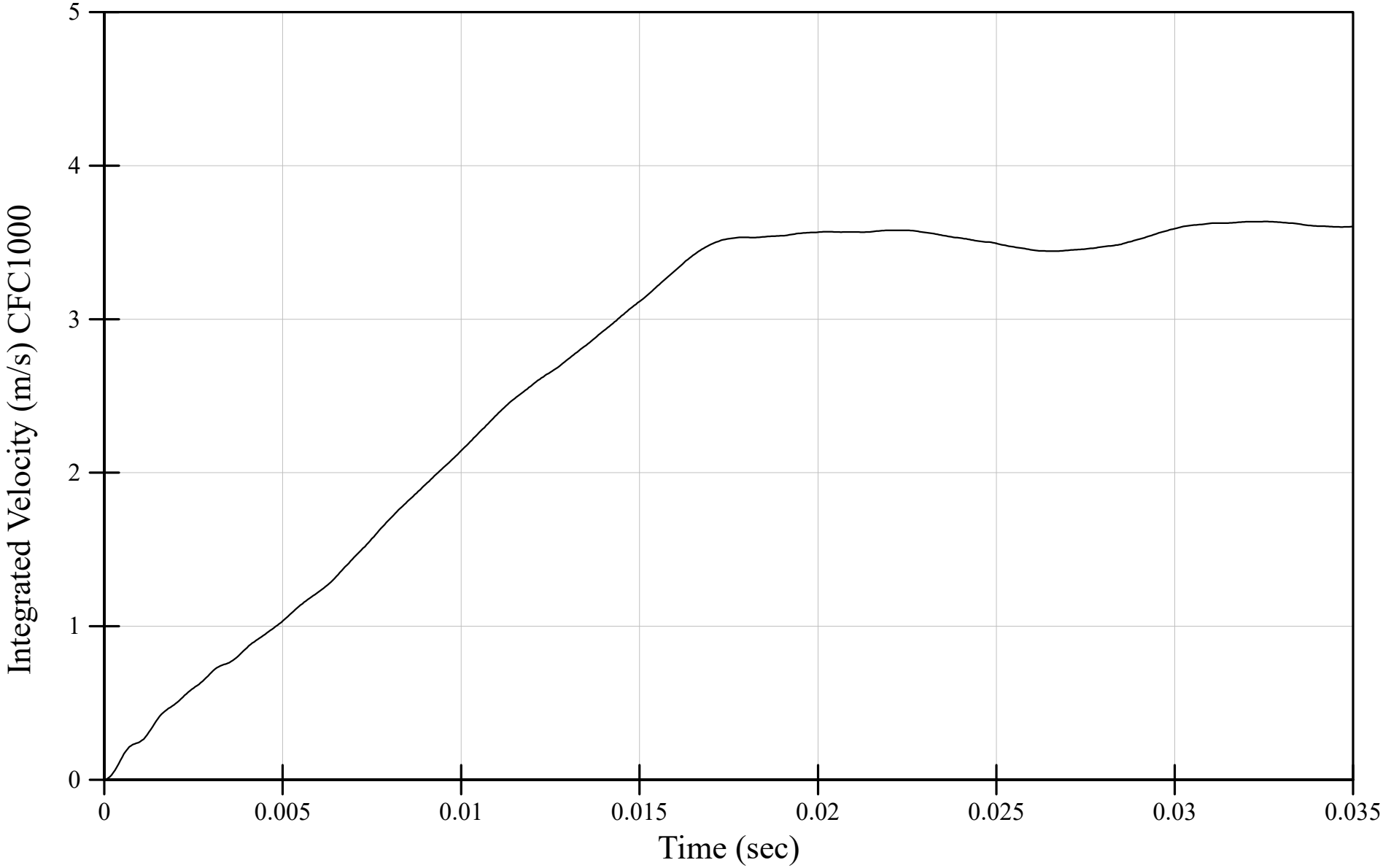
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.0	Pass
Test Humidity (%)	10 - 70	56	Pass
Test Velocity (m/s)	3.35 - 3.45	3.41	Pass
Pendulum Velocity at 5 ms (m/s)		1.03	
Pendulum Velocity at 10 ms (m/s)		2.14	
Pendulum Velocity at 15 ms (m/s)		3.12	
Peak Upper Neck Mx after 40 ms (N)		30.3	
Peak Head Angular Velocity X (deg/sec)		-1337.0	
Peak Head Rotation (deg)		-50.7	

* THOR-05F Qualification Manual - July 2022

File Name: 221130-7 processed
Software Version: 2.8

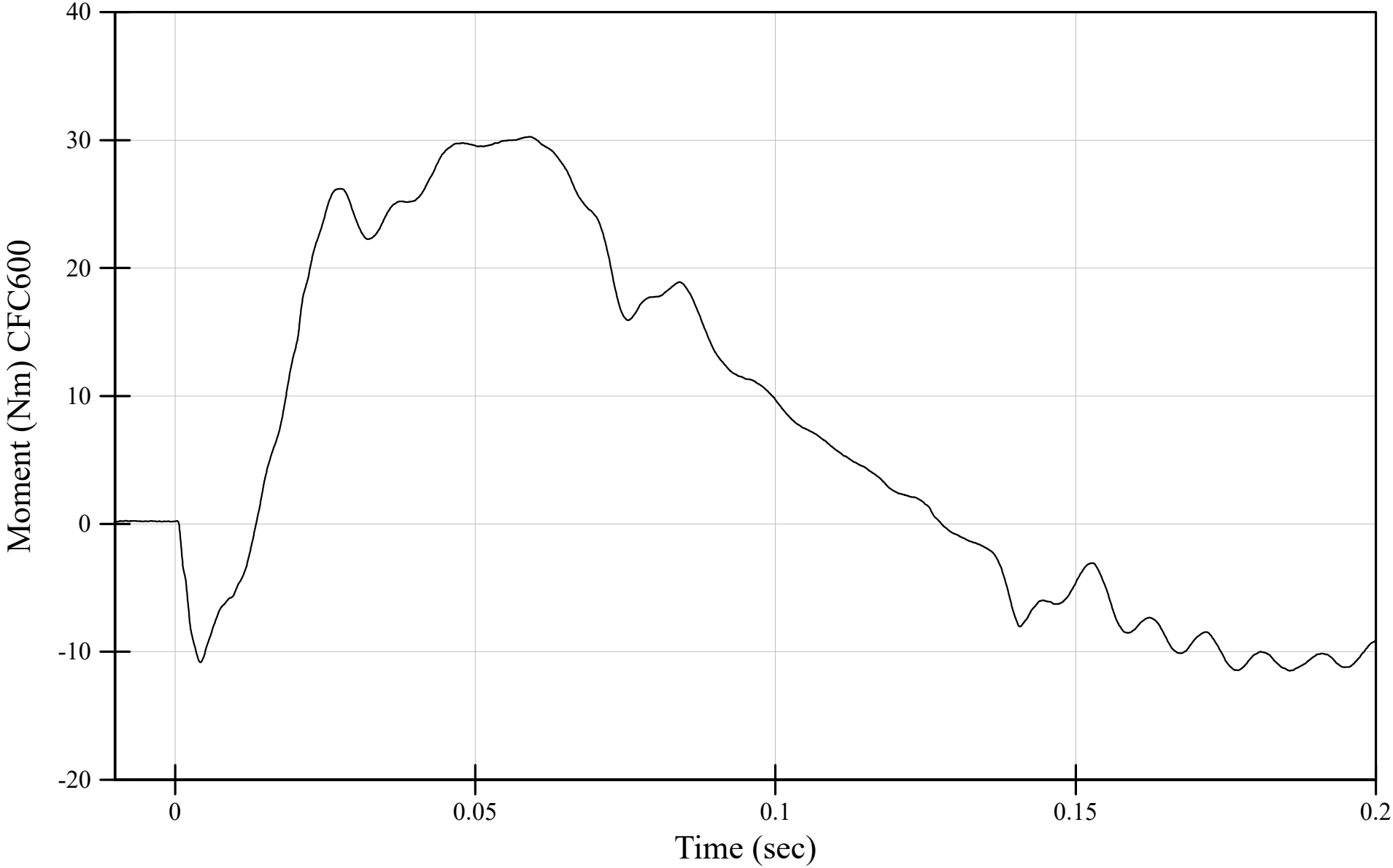
THOR-05F Neck Left Lateral Qualification
Pendulum Pulse
Serial Number: EV1357



File Name: 221130-7 processed

11/30/2022 9:16 AM

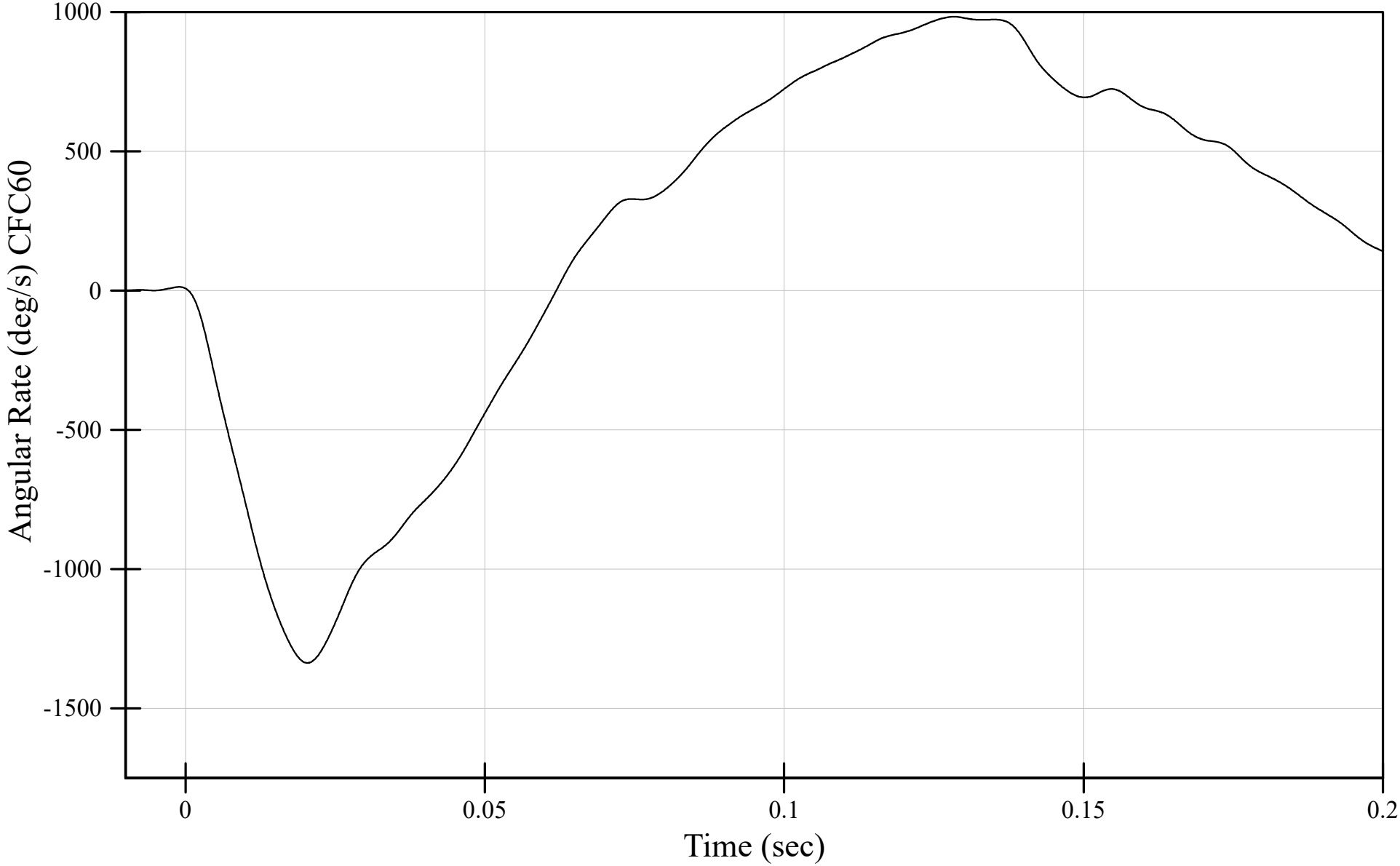
THOR-05F Neck Left Lateral Qualification
X-Moment as Measured
Serial Number: EV1357



File Name: 221130-7 processed

11/30/2022 9:16 AM

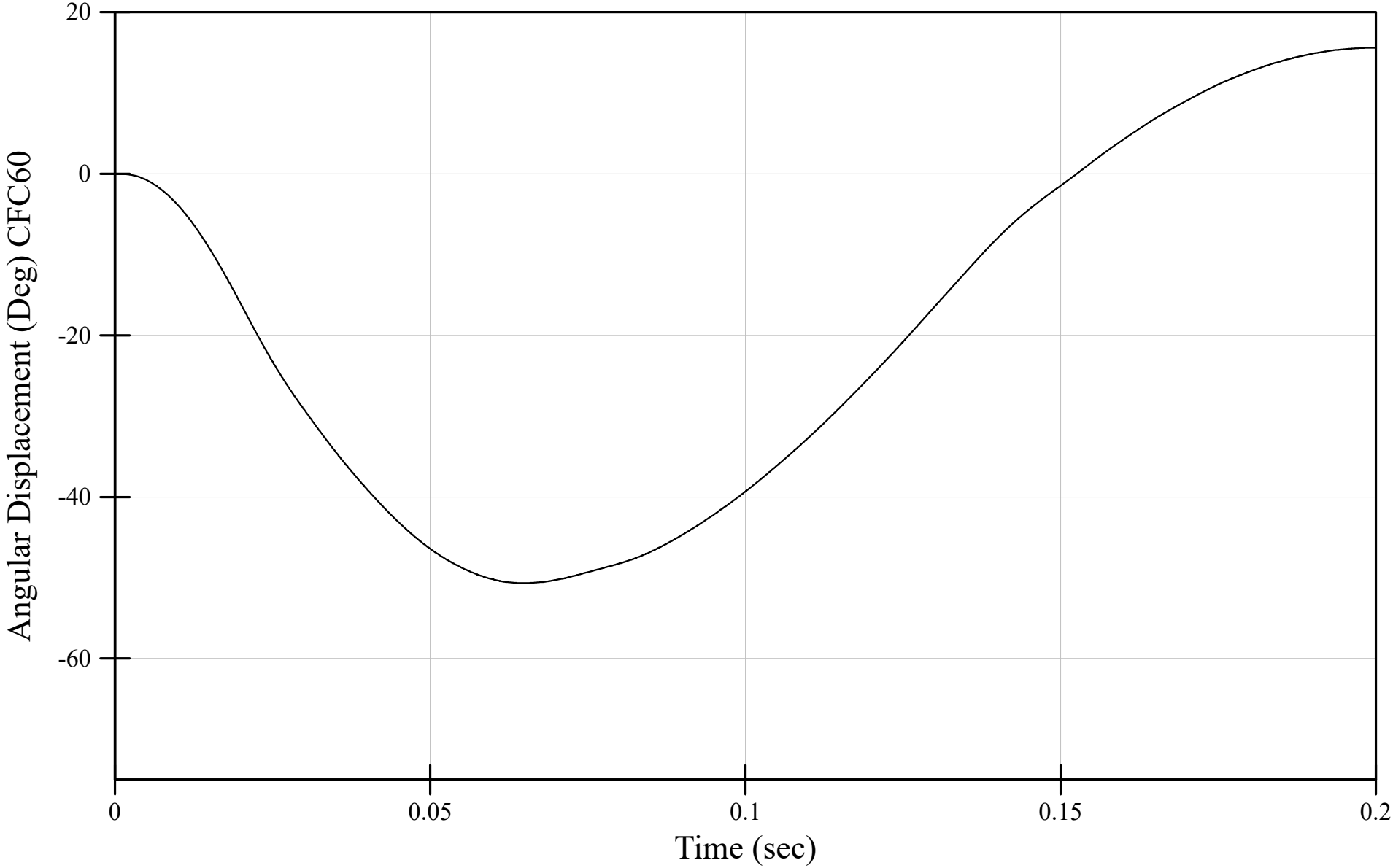
THOR-05F Neck Left Lateral Qualification
Peak Angular Rate
Serial Number: EV1357



File Name: 221130-7 processed

11/30/2022 9:16 AM

THOR-05F Neck Left Lateral Qualification
Neck Rotation
Serial Number: EV1357



File Name: 221130-7 processed

11/30/2022 9:16 AM

THOR-05F Neck Right Lateral Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Neck Serial Number: EV1357
O.C. Stop Assembly Serial Number:
O.C. Cam Serial Number:

Test ID: 221130-8
Test Date: 11/30/2022
Test Time: 9:56 AM

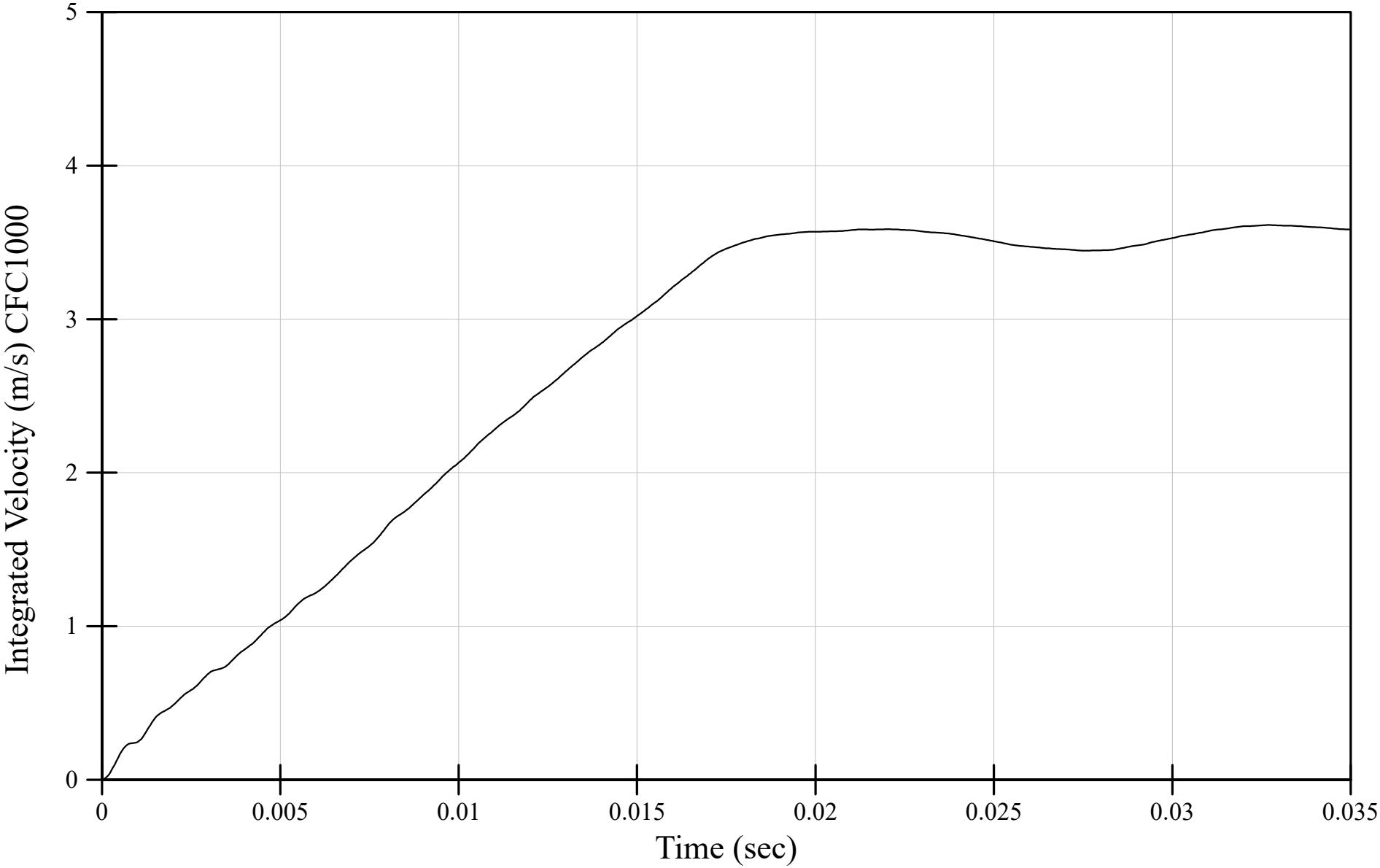
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	20.9	Pass
Test Humidity (%)	10 - 70	50	Pass
Test Velocity (m/s)	3.35 - 3.45	3.40	Pass
Pendulum Velocity at 5 ms (m/s)		1.04	
Pendulum Velocity at 10 ms (m/s)		2.07	
Pendulum Velocity at 15 ms (m/s)		3.02	
Peak Upper Neck Mx after 40 ms (N)		-30.0	
Peak Head Angular Velocity X (deg/sec)		1316.9	
Peak Head Rotation (deg)		50.2	

* THOR-05F Qualification Manual - July 2022

File Name: 221130-8 processed
Software Version: 2.8

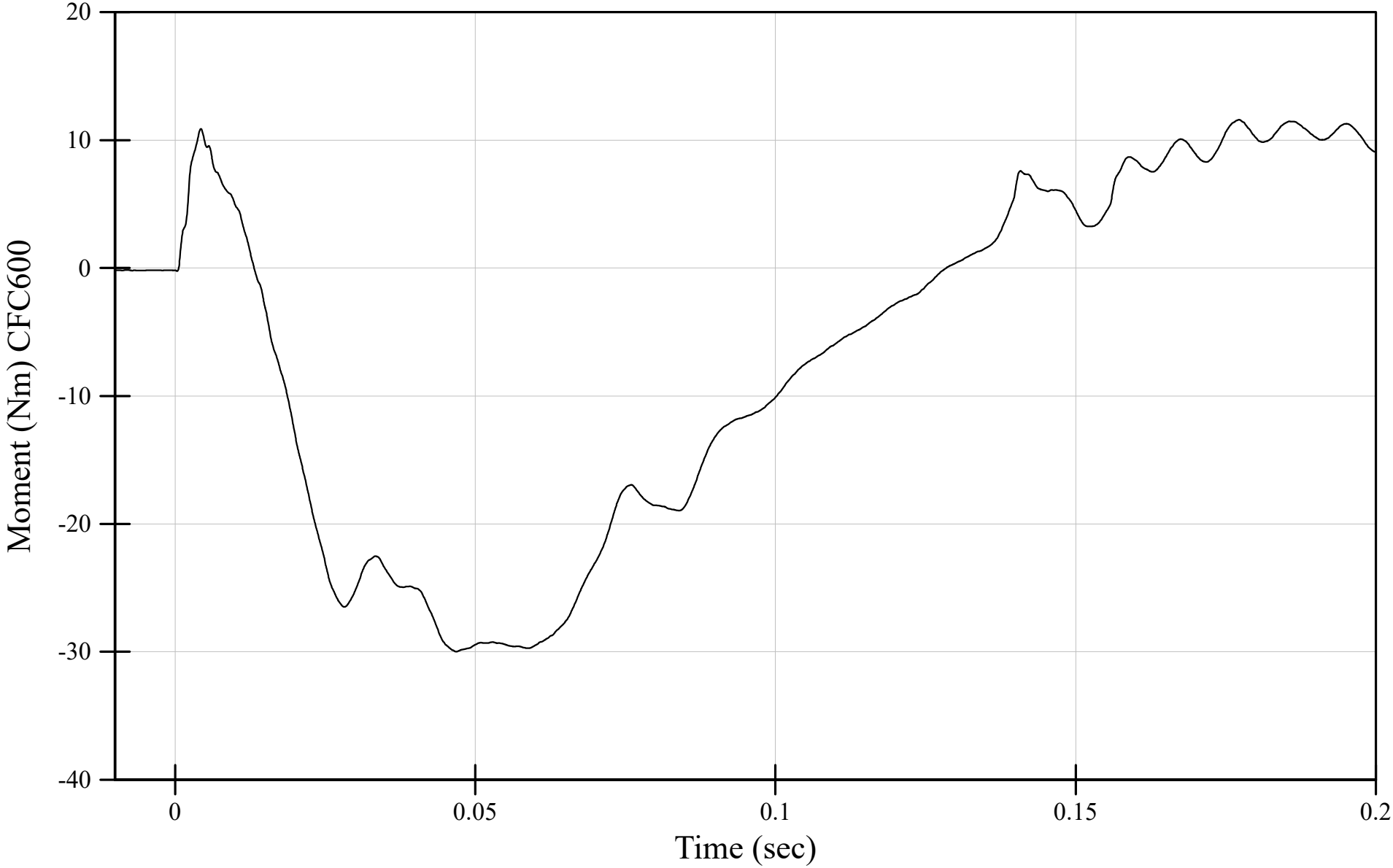
THOR-05F Neck Right Lateral Qualification
Pendulum Pulse
Neck Serial Number: EV1357



File Name: 221130-8 processed

11/30/2022 9:56 AM

THOR-05F Neck Right Lateral Qualification
X-Moment as Measured
Neck Serial Number: EV1357



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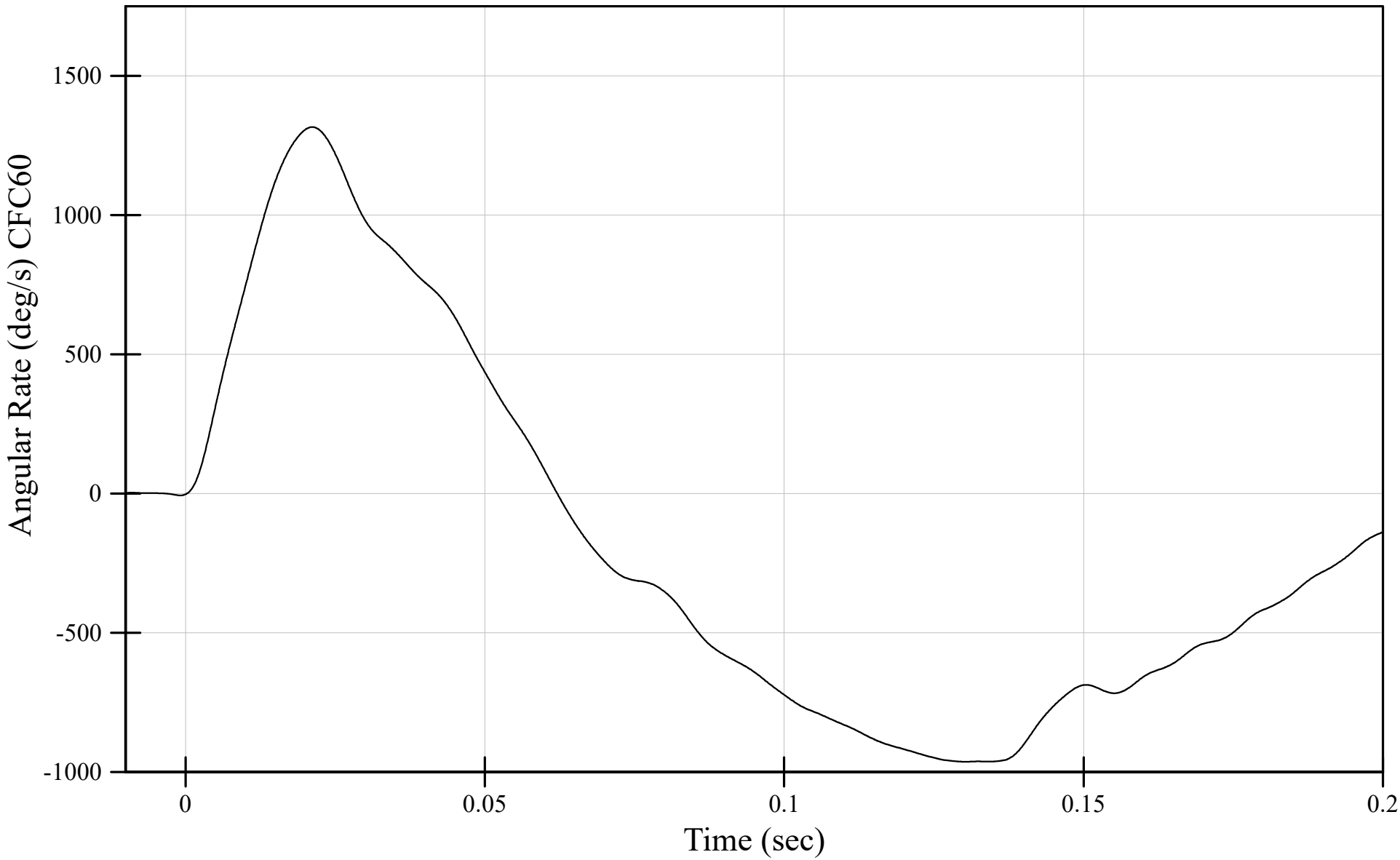
11/30/2022 9:56 AM

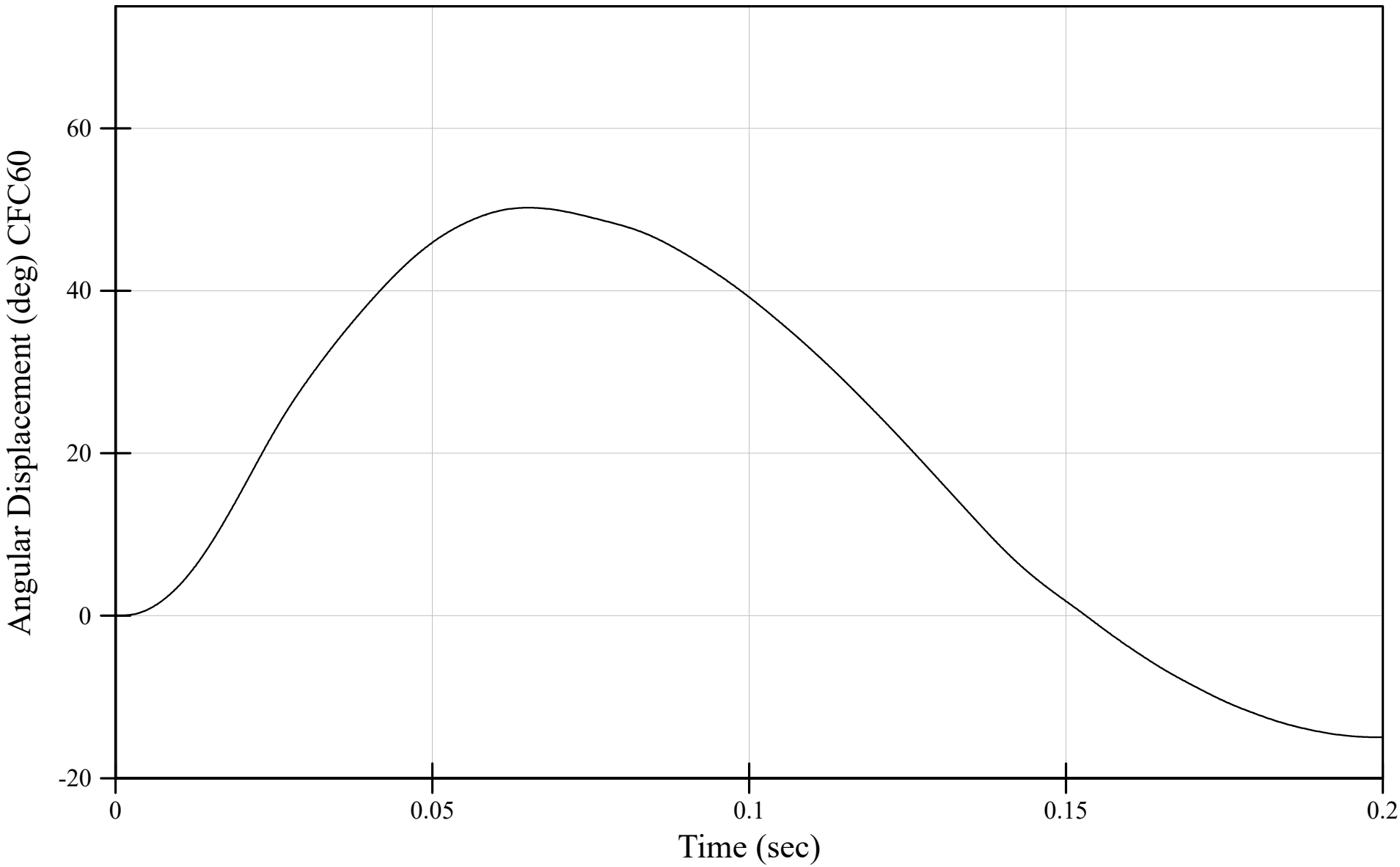
THOR-05F Neck Right Lateral Qualification
Peak Angular Rate
Neck Serial Number: EV1357



File Name: 221130-8 processed

11/30/2022 9:56 AM

THOR-05F Neck Right Lateral Qualification
Neck Rotation
Neck Serial Number: EV1357



File Name: 221130-8 processed

11/30/2022 9:56 AM

THOR-05F Neck Left Torsion Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Neck Serial Number: EV1357
O.C. Stop Assembly Serial Number:
O.C. Cam Serial Number:

Test ID: 221129-9
Test Date: 11/29/2022
Test Time: 2:41 PM

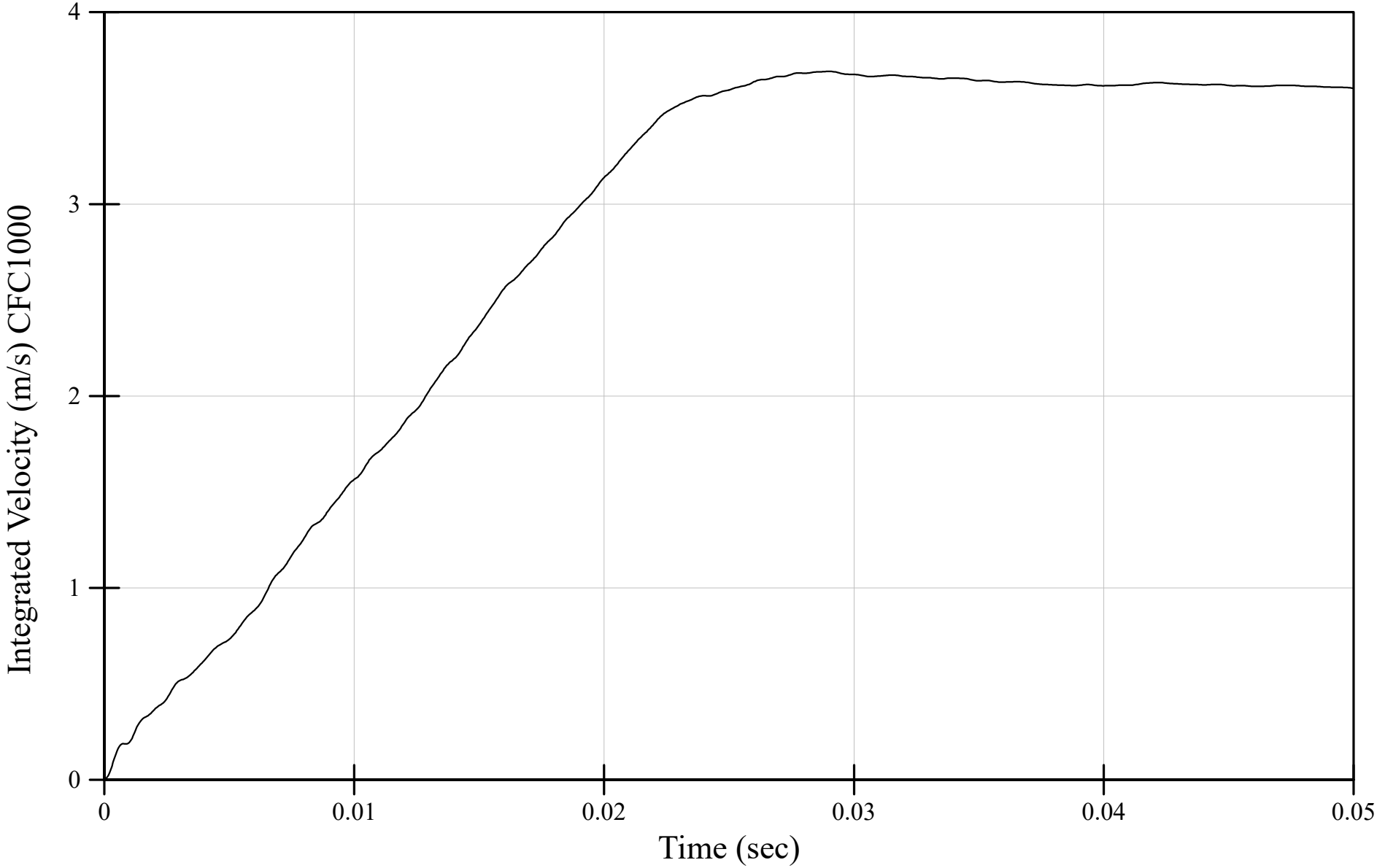
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.2	Pass
Test Humidity (%)	10 - 70	48	Pass
Test Velocity (m/s)	3.35 - 3.45	3.40	Pass
Pendulum Velocity at 10 ms (m/s)		1.08	
Pendulum Velocity at 15 ms (m/s)		2.19	
Pendulum Velocity at 20 ms (m/s)		3.28	
Peak Upper Neck Mz (Nm)		20.5	
Peak Neck Fixture Rotation (deg)		-50.4	
Peak Upper Neck Angular Velocity Z (deg/sec)		-1282.7	

* THOR-05F Qualification Manual - July 2022

File Name: 221129-9 processed
Software Version: 2.8

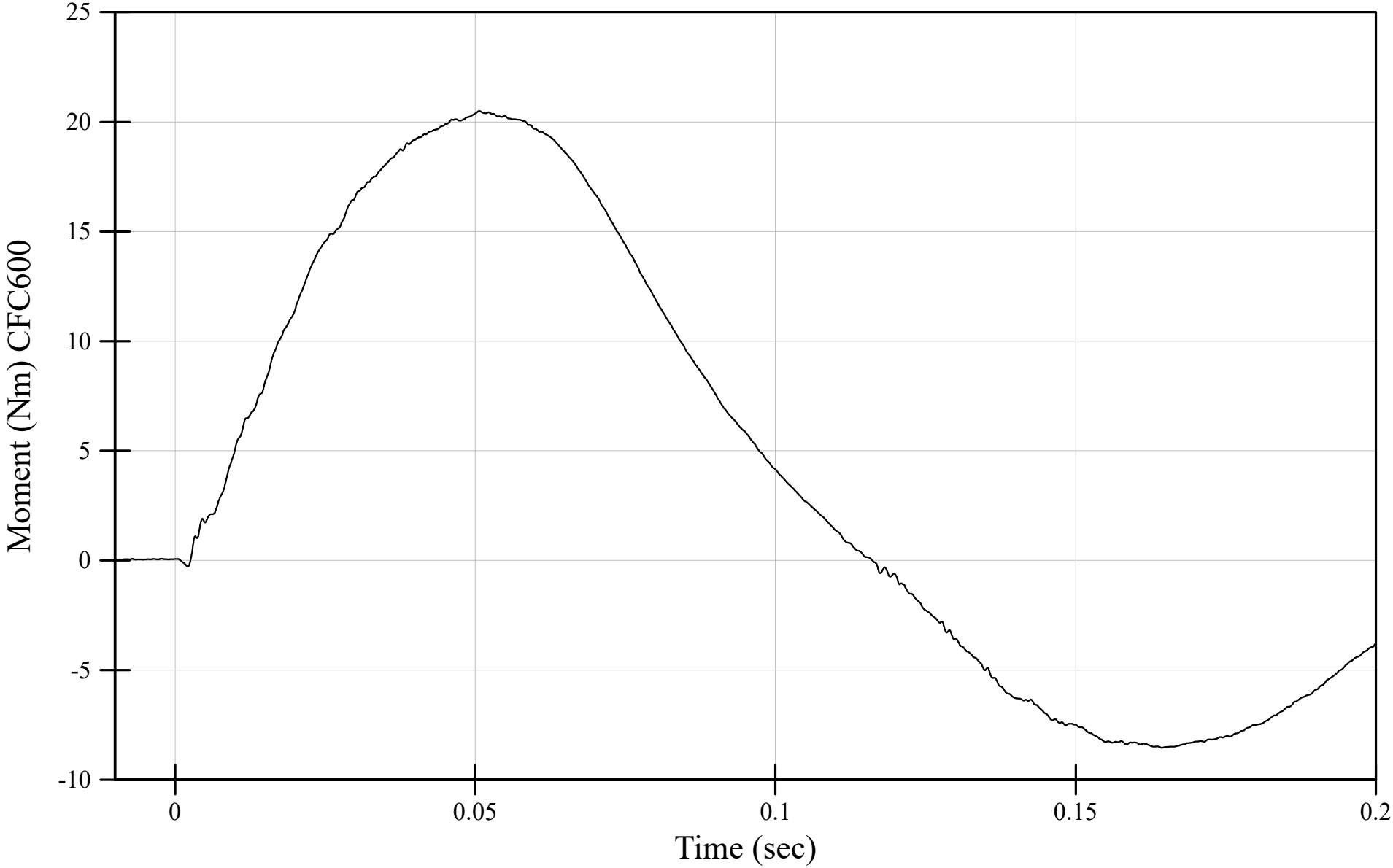
THOR-05F Neck Left Torsion Qualification
Pendulum Pulse
Neck Serial Number: EV1357



File Name: 221129-9 processed

11/29/2022 2:41 PM

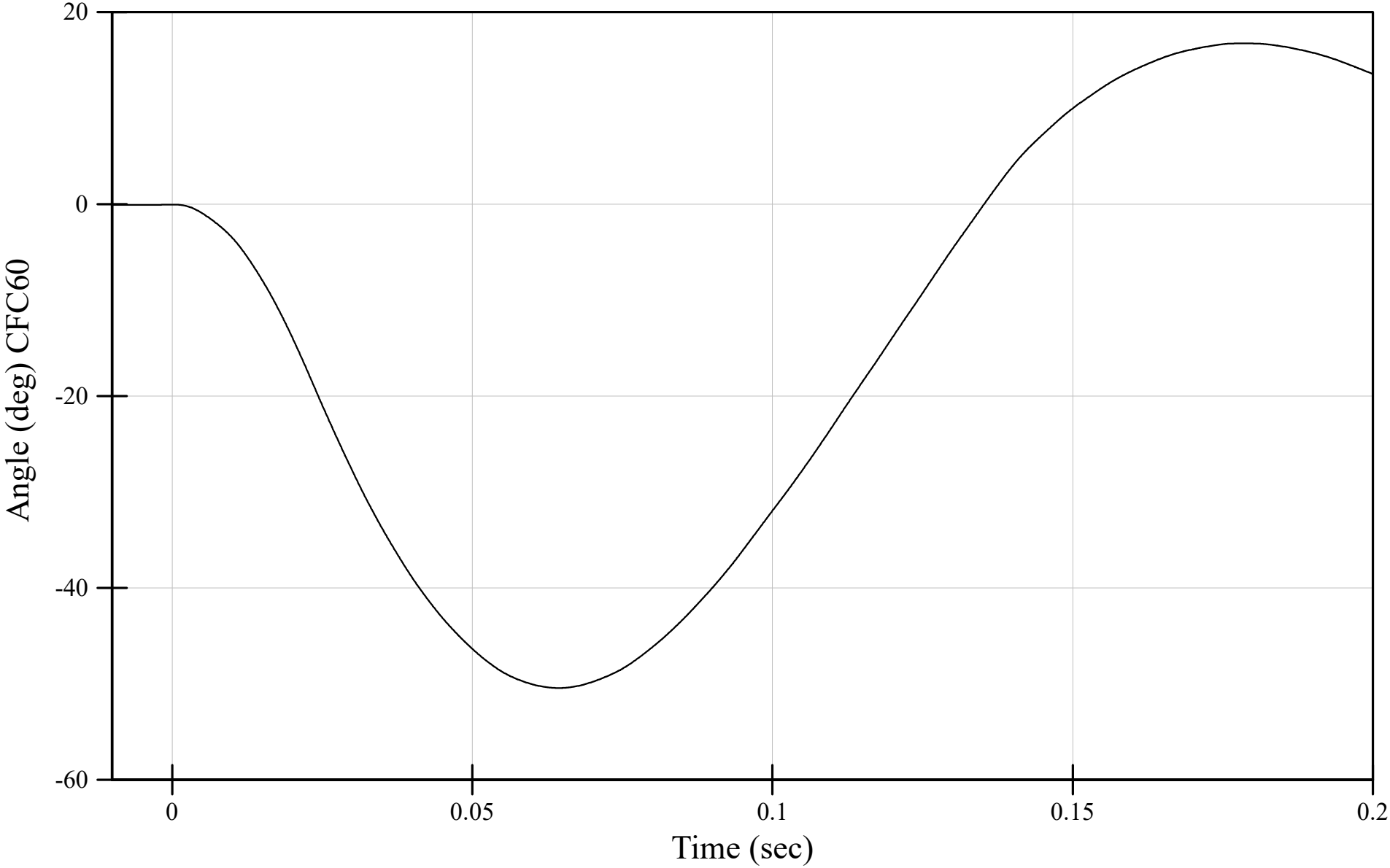
THOR-05F Neck Left Torsion Qualification
Z-Moment as Measured
Neck Serial Number: EV1357



File Name: 221129-9 processed

11/29/2022 2:41 PM

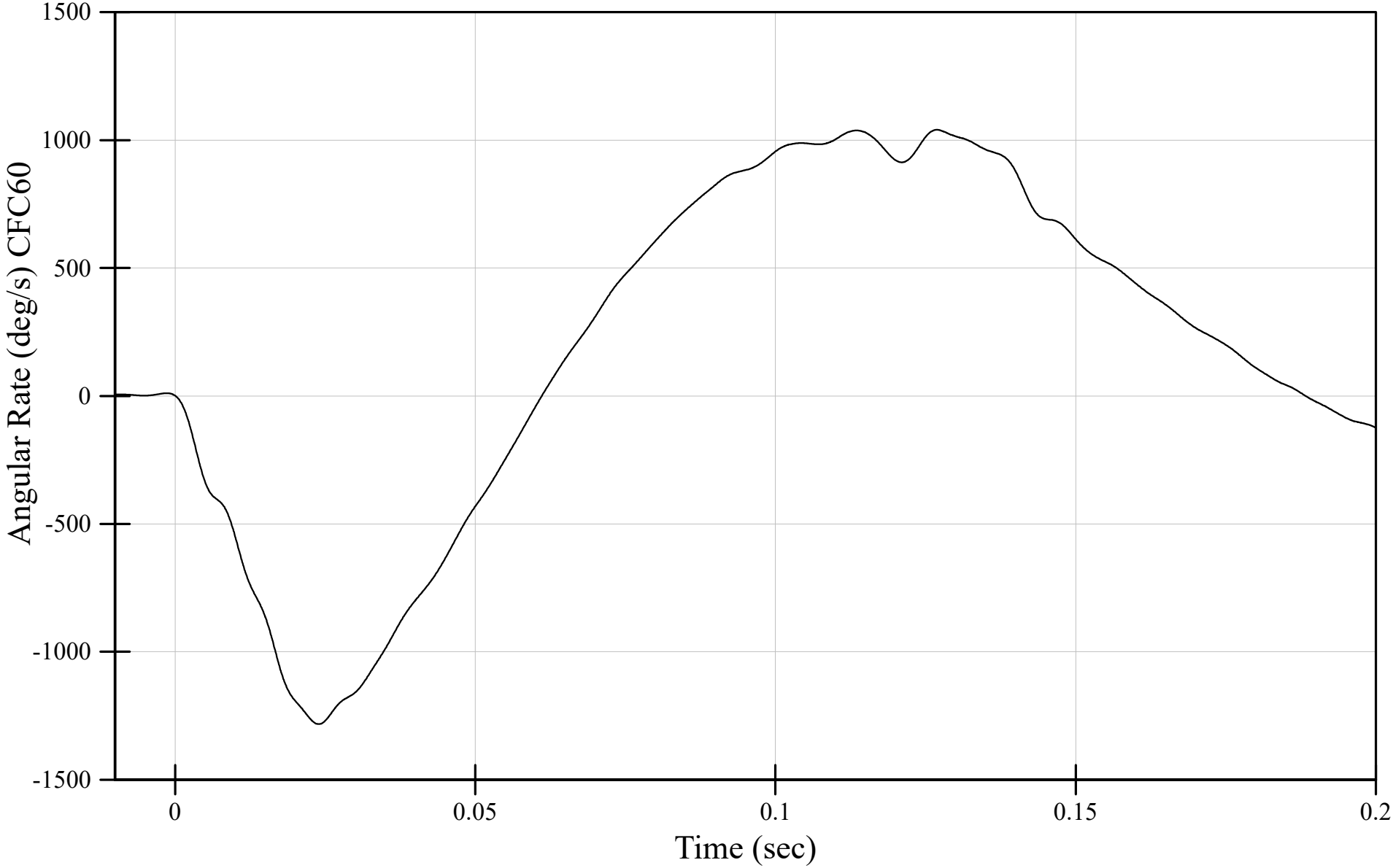
THOR-05F Neck Left Torsion Qualification
Neck Fixture Rotation
Neck Serial Number: EV1357



File Name: 221129-9 processed

11/29/2022 2:41 PM

THOR-05F Neck Left Torsion Qualification
Peak Angular Rate
Neck Serial Number: EV1357



File Name: 221129-9 processed

11/29/2022 2:41 PM

THOR-05F Neck Right Torsion Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Neck Serial Number: EV1357
O.C. Stop Assembly:
O.C. Cam:

Test ID: 221129-8
Test Date: 11/29/2022
Test Time: 1:56 PM

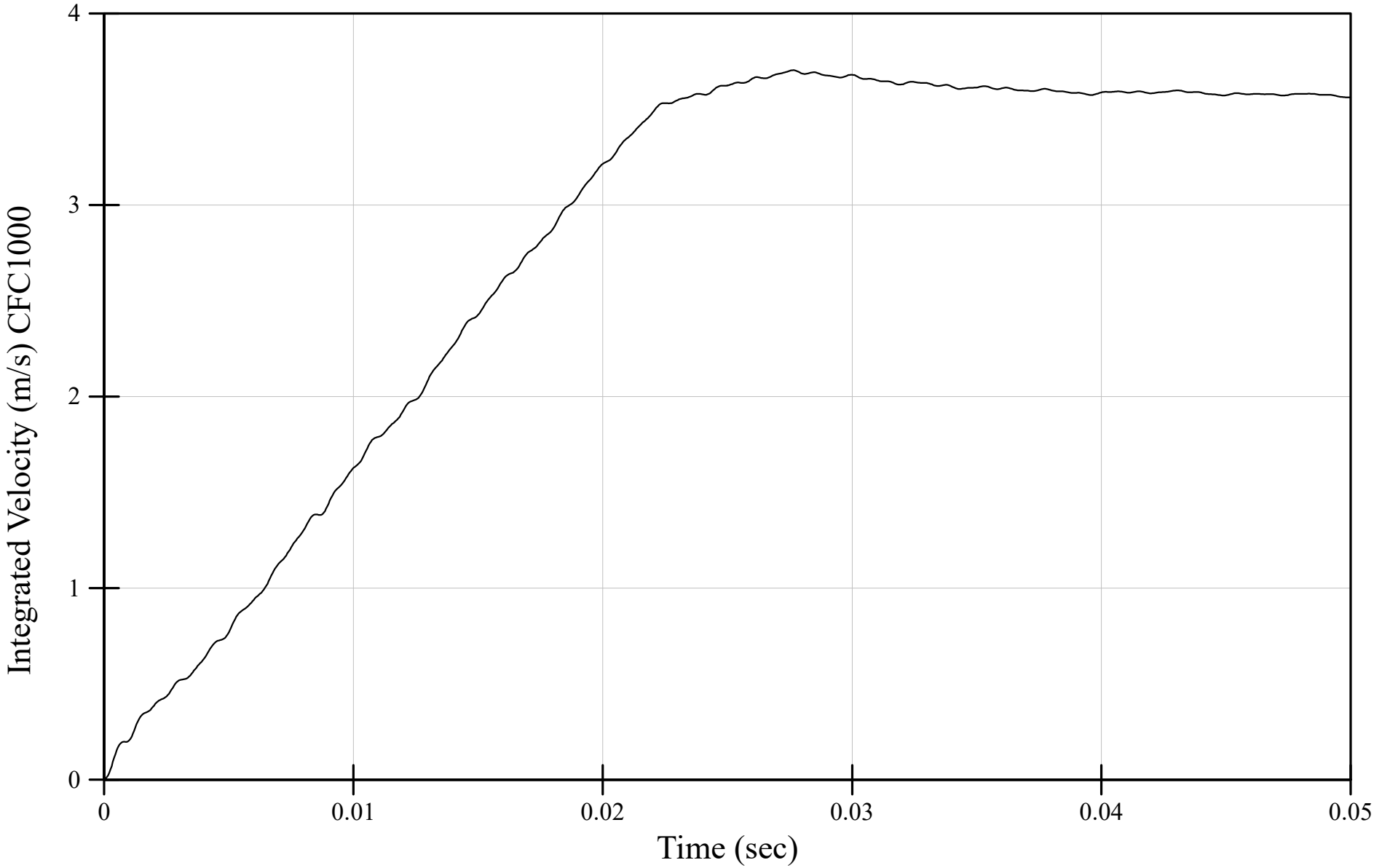
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.2	Pass
Test Humidity (%)	10 - 70	48	Pass
Test Velocity (m/s)	3.35 - 3.45	3.42	Pass
Pendulum Velocity at 7 ms (m/s)		1.13	
Pendulum Velocity at 14 ms (m/s)		2.27	
Pendulum Velocity at 21 ms (m/s)		3.35	
Peak Upper Neck Mz (Nm)		-20.7	
Peak Neck Fixture Rotation (deg)		49.6	
Peak Upper Neck Angular Velocity Z (deg/sec)		1294.9	

* THOR-05F Qualification Manual - July 2022

File Name: 221129-8 processed
Software Version: 2.8

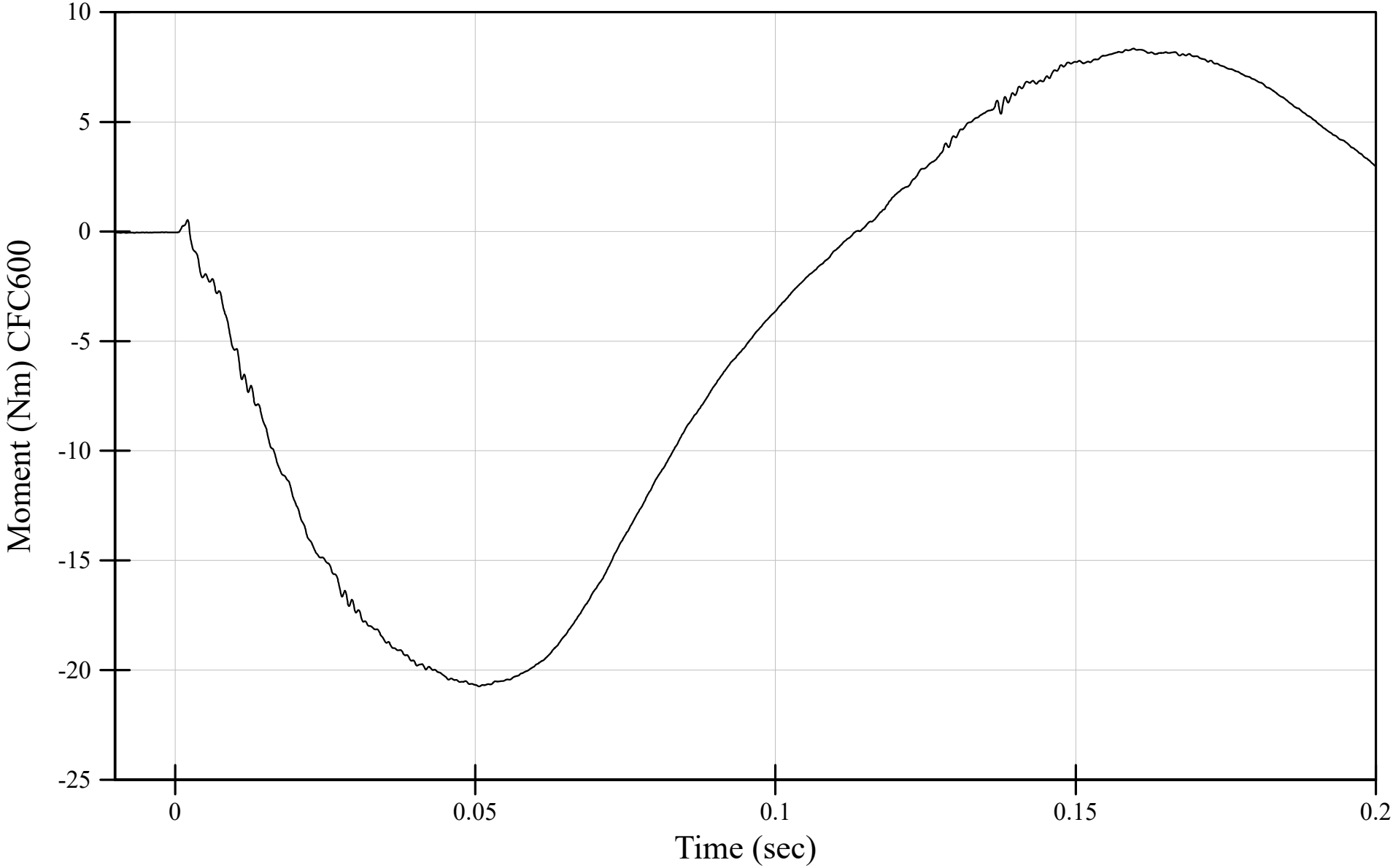
THOR-05F Neck Right Torsion Qualification
Pendulum Pulse
Neck Serial Number: EV1357



File Name: 221129-8 processed

11/29/2022 1:56 PM

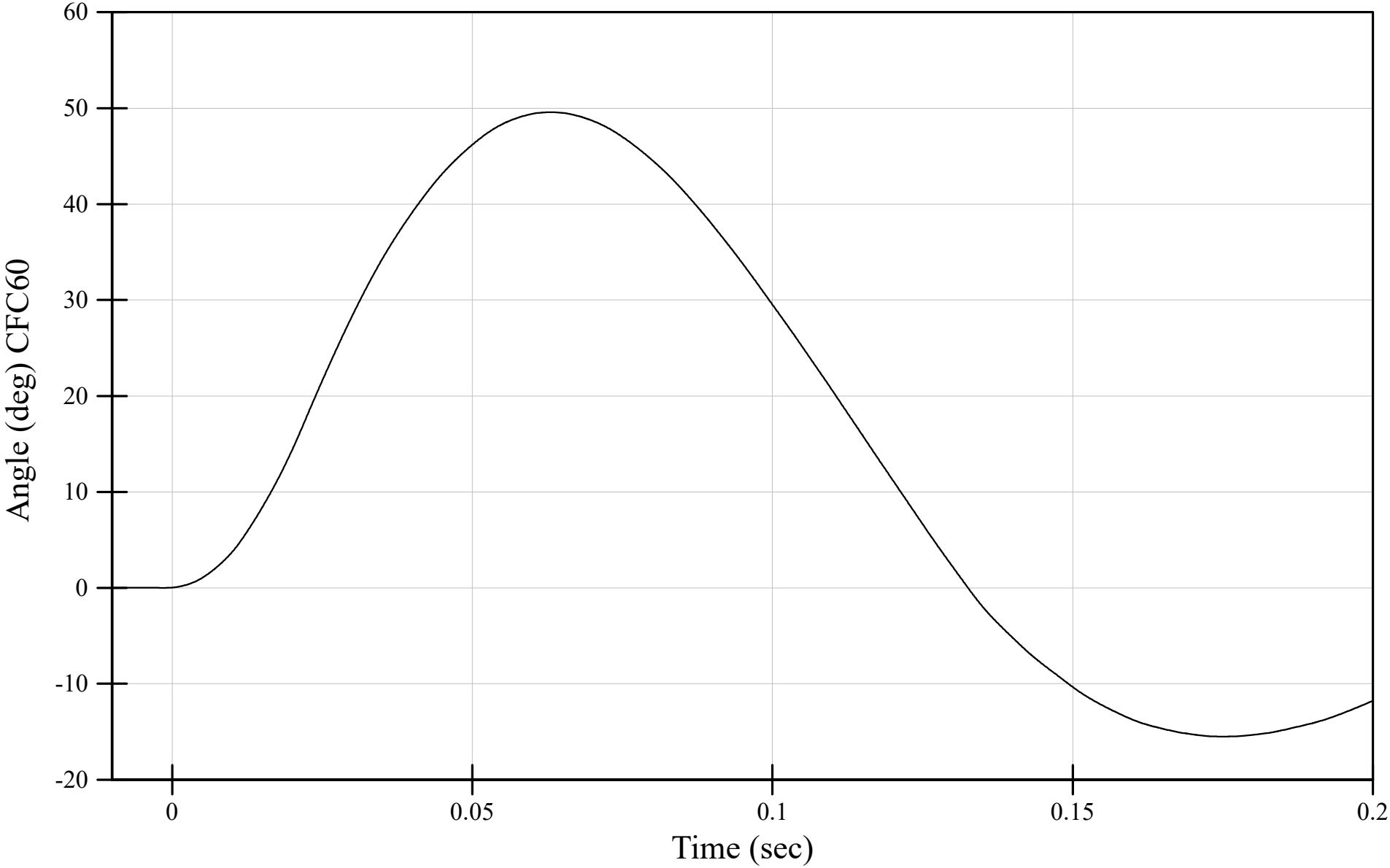
THOR-05F Neck Right Torsion Qualification
Z-Moment as Measured
Neck Serial Number: EV1357



File Name: 221129-8 processed

11/29/2022 1:56 PM

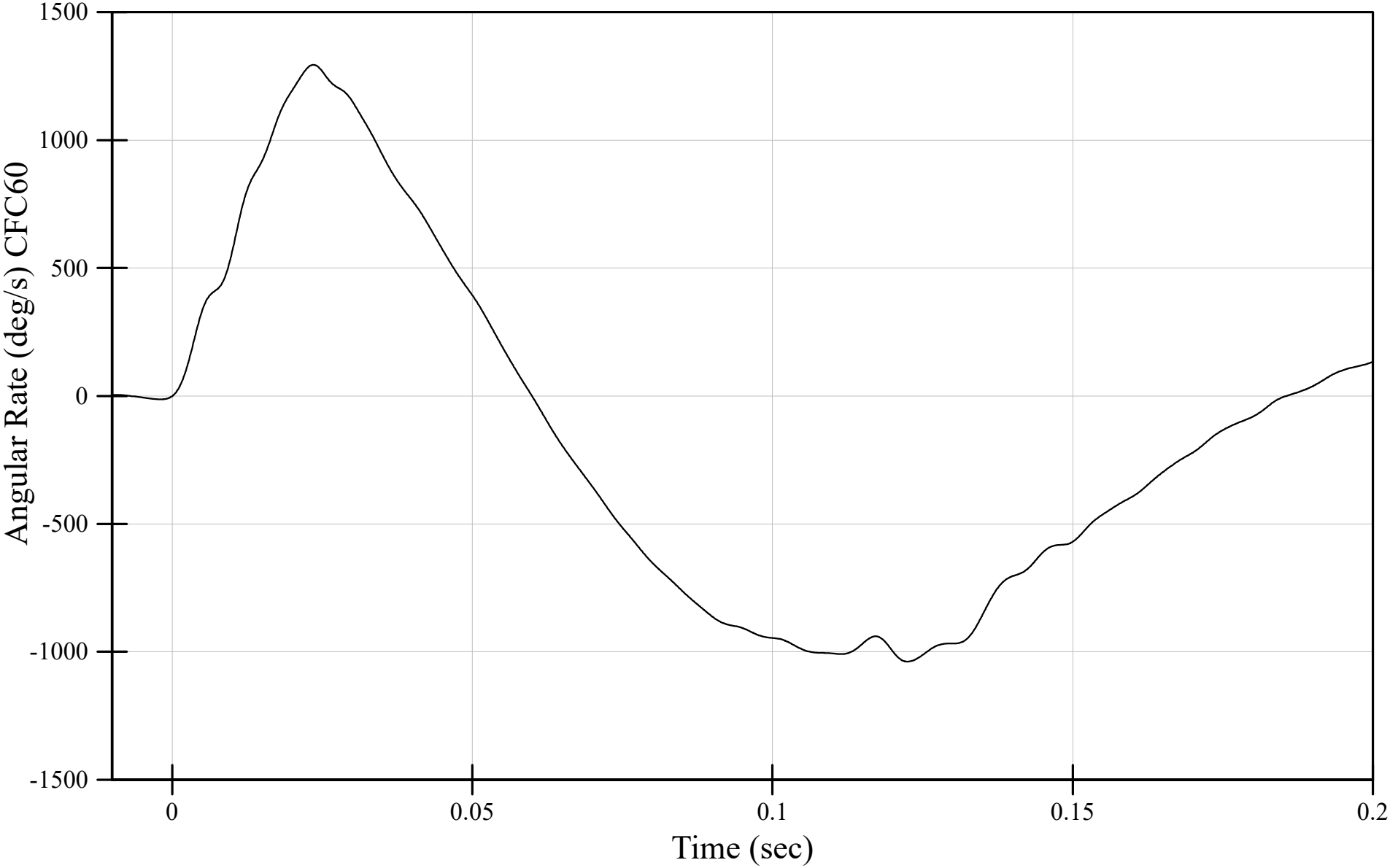
THOR-05F Neck Right Torsion Qualification
Neck Fixture Rotation
Neck Serial Number: EV1357



File Name: 221129-8 processed

11/29/2022 1:56 PM

THOR-05F Neck Right Torsion Qualification
Peak Angular Rate
Neck Serial Number: EV1357



File Name: 221129-8 processed

11/29/2022 1:56 PM

THOR-05F Upper Thorax Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components

Rib 1 Serial Number: EU8361
Rib 2 Serial Number: EU8362
Rib 3 Serial Number: EU8363
Rib 4 Serial Number: EL6732
Rib 5 Serial Number: EU8364
Rib 6 Serial Number: EL6737
Rib 7 Serial Number: EL6736

Test ID: 221201-1
Test Date: 12/1/2022
Test Time: 9:48 AM

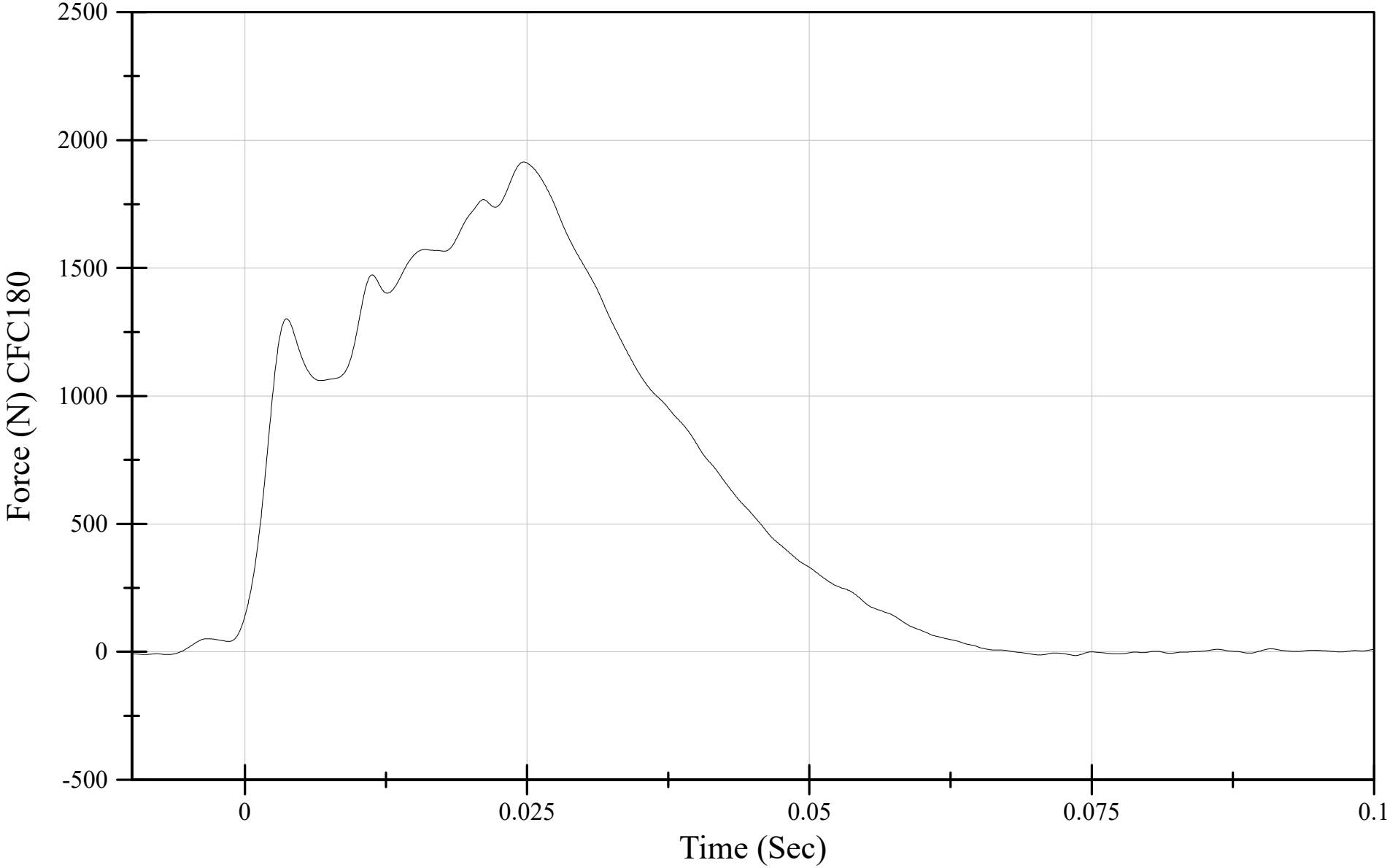
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.0	Pass
Test Humidity (%)	10 - 70	49	Pass
Test Velocity (m/s)	4.25 - 4.35	4.30	Pass
Peak Probe Force (N)		1915	
Peak Upper Left Resultant Deflection (mm)		47.6	
Peak Upper Right Resultant Deflection (mm)		43.7	
Difference Between Peak Left & Right Resultant Deflections (mm)		3.9	
Force at Left Peak Resultant Deflection (N)		1739	
Force at Right Peak Resultant Deflection (N)		1755	

* THOR-05F Qualification Manual - July 2022

File Name: 221201-1 processed

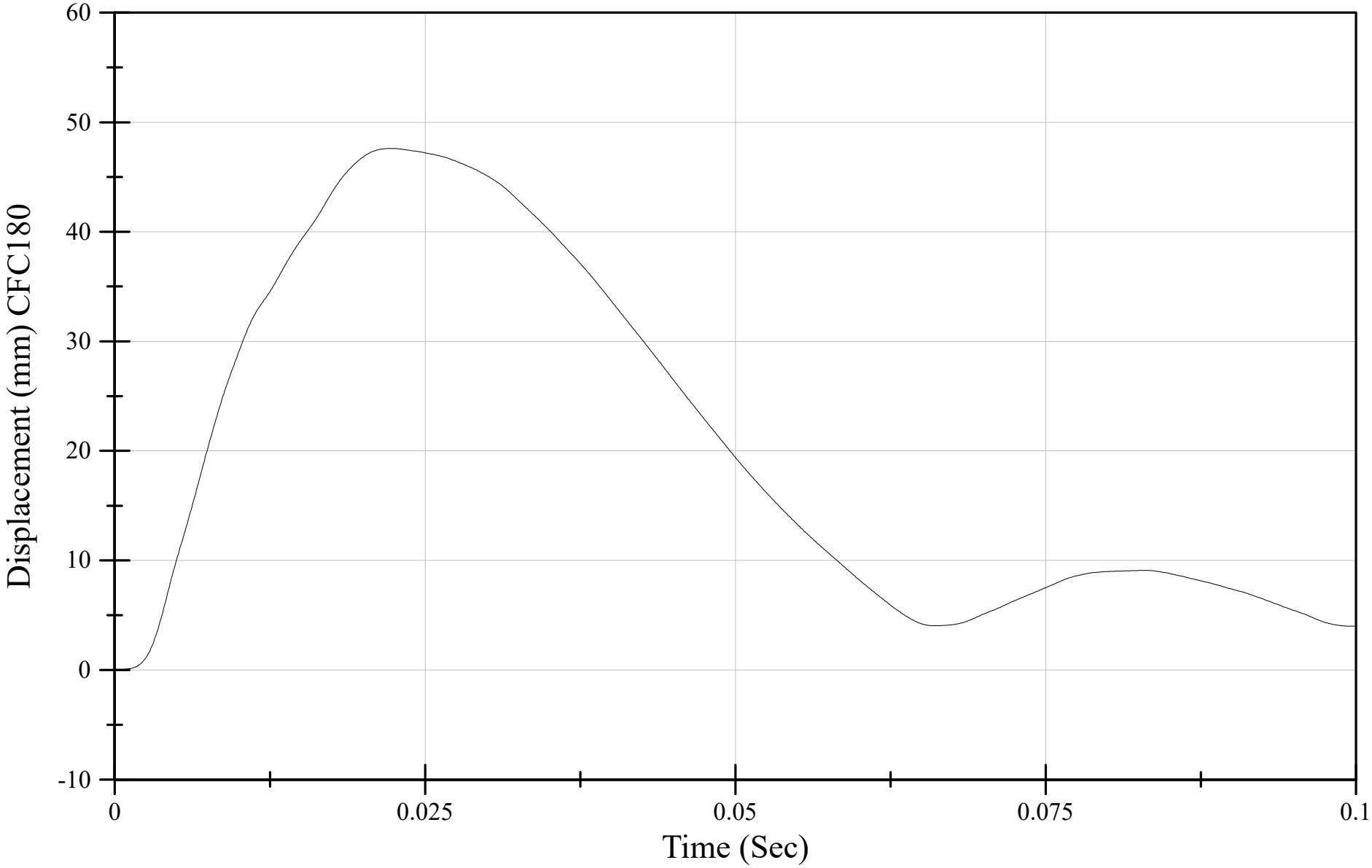
THOR-05F Upper Thorax Qualification
Probe Force
Dummy Serial Number: EV0674



File Name: 221201-1 processed

12/1/2022 9:48 AM

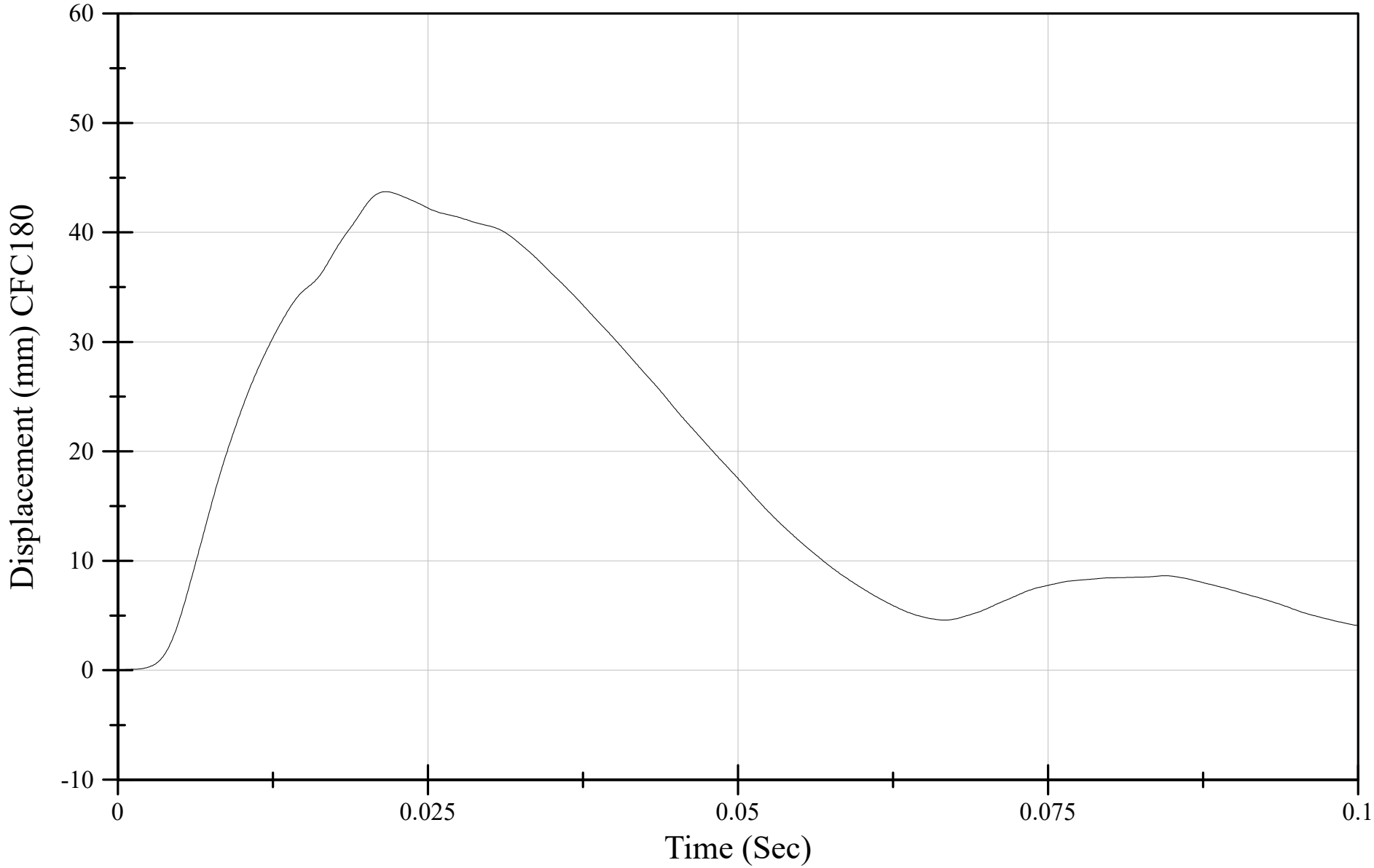
THOR-05F Upper Thorax Qualification
Left Resultant Deflection
Dummy Serial Number: EV0674



File Name: 221201-1 processed

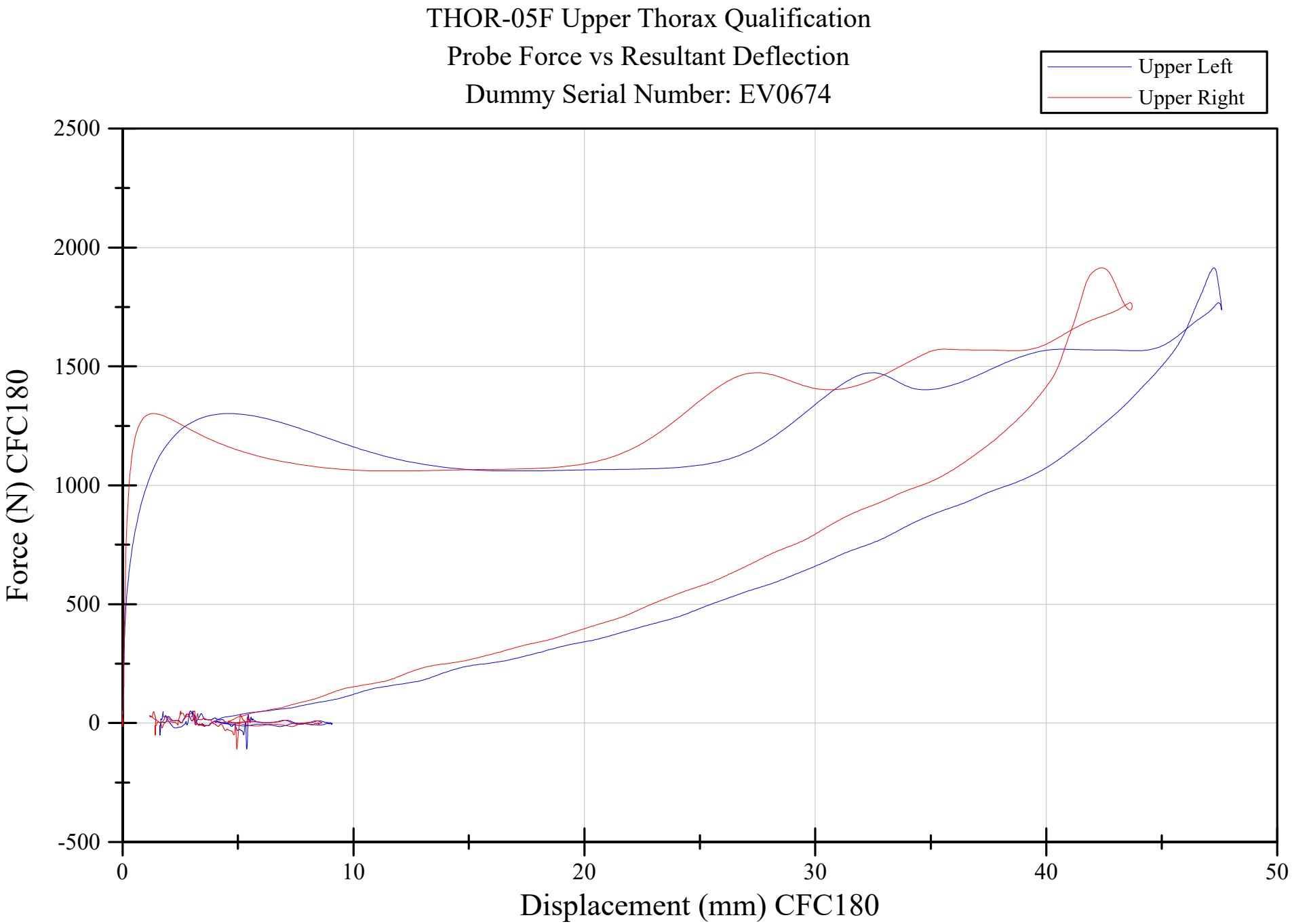
12/1/2022 9:48 AM

THOR-05F Upper Thorax Qualification
Right Resultant Deflection
Dummy Serial Number: EV0674



File Name: 221201-1 processed

12/1/2022 9:48 AM



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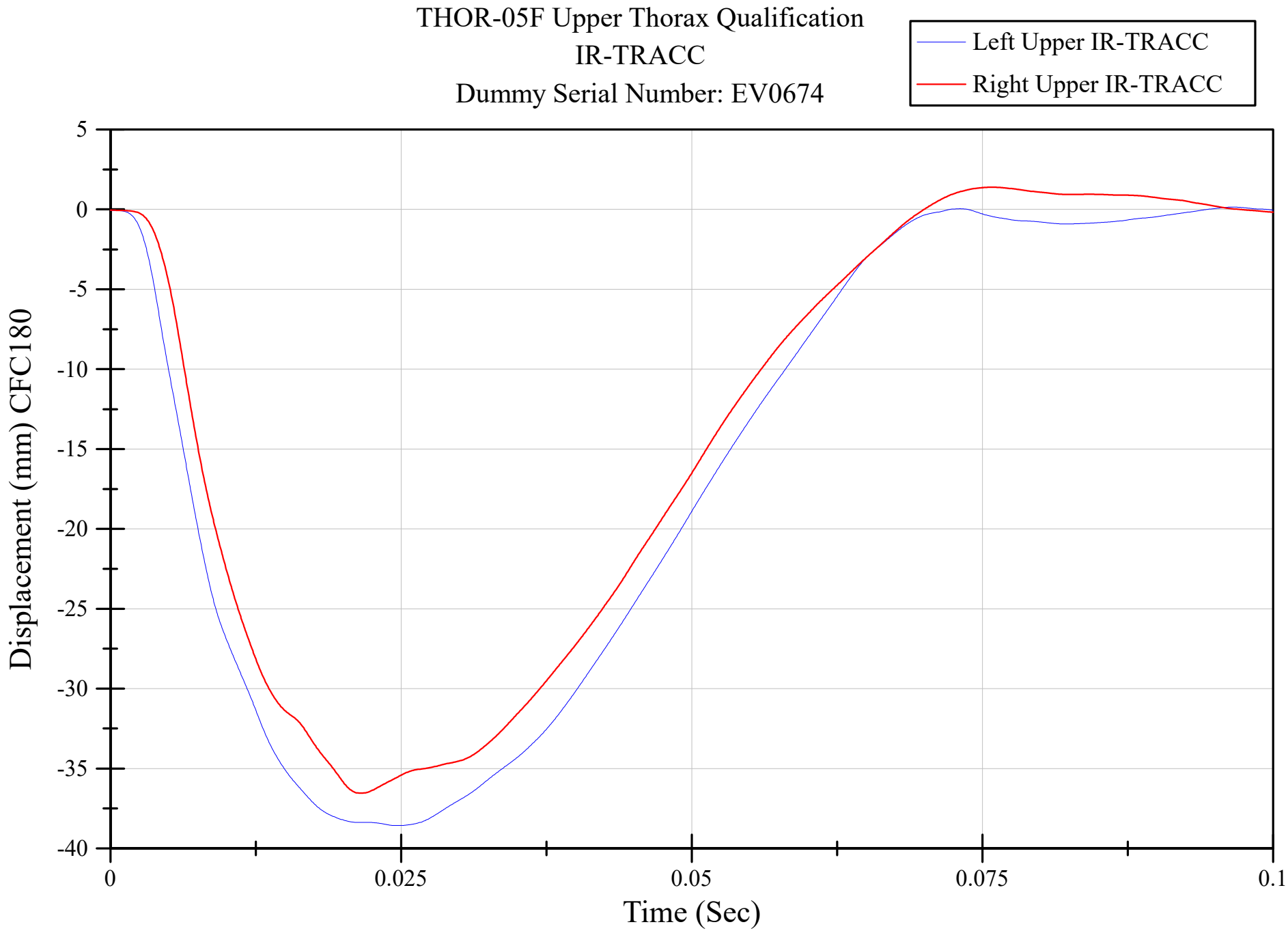
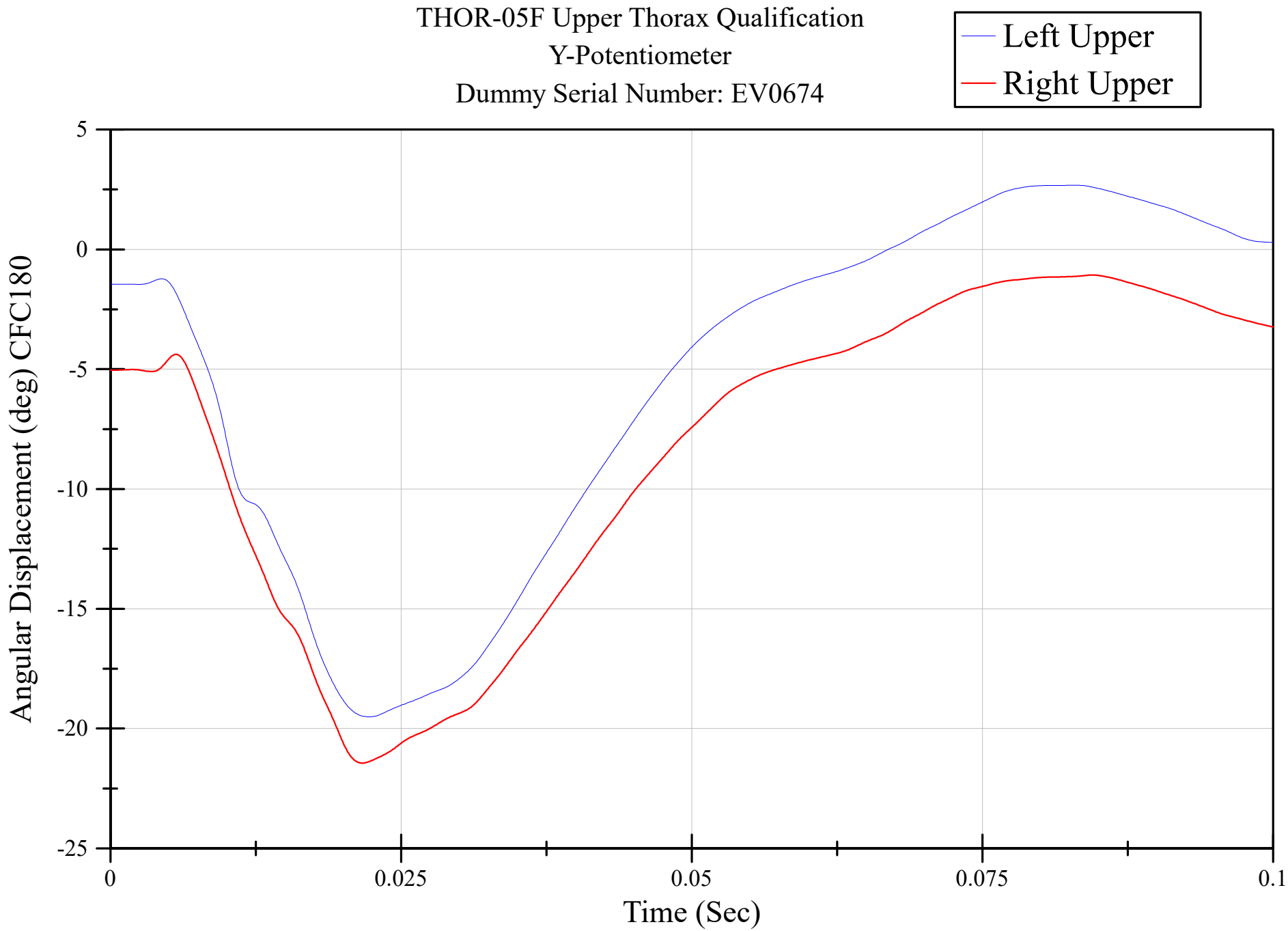
12/1/2022 9:48 AM



File Name: 221201-1 processed

12/1/2022 9:48 AM



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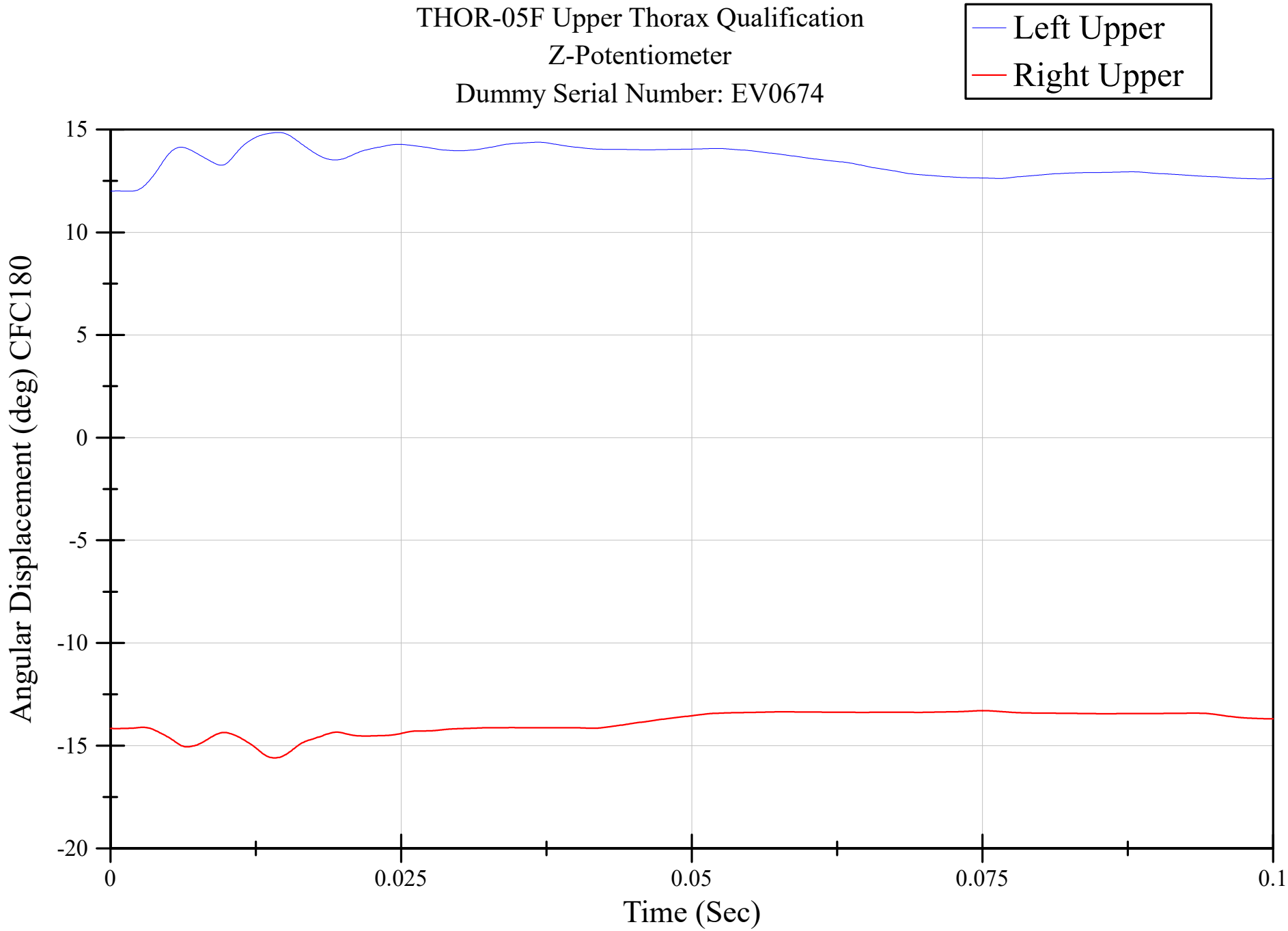
12/1/2022 9:48 AM



File Name: 221201-1 processed

12/1/2022 9:48 AM

THOR-05F Lower Left Thorax Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components

Rib 1 Serial Number: EU8361
Rib 2 Serial Number: EU8362
Rib 3 Serial Number: EU8363
Rib 4 Serial Number: EL6732
Rib 5 Serial Number: EU8364
Rib 6 Serial Number: EL6737
Rib 7 Serial Number: EL6736

Test ID: 221205-1
Test Date: 12/5/2022
Test Time: 7:06 AM

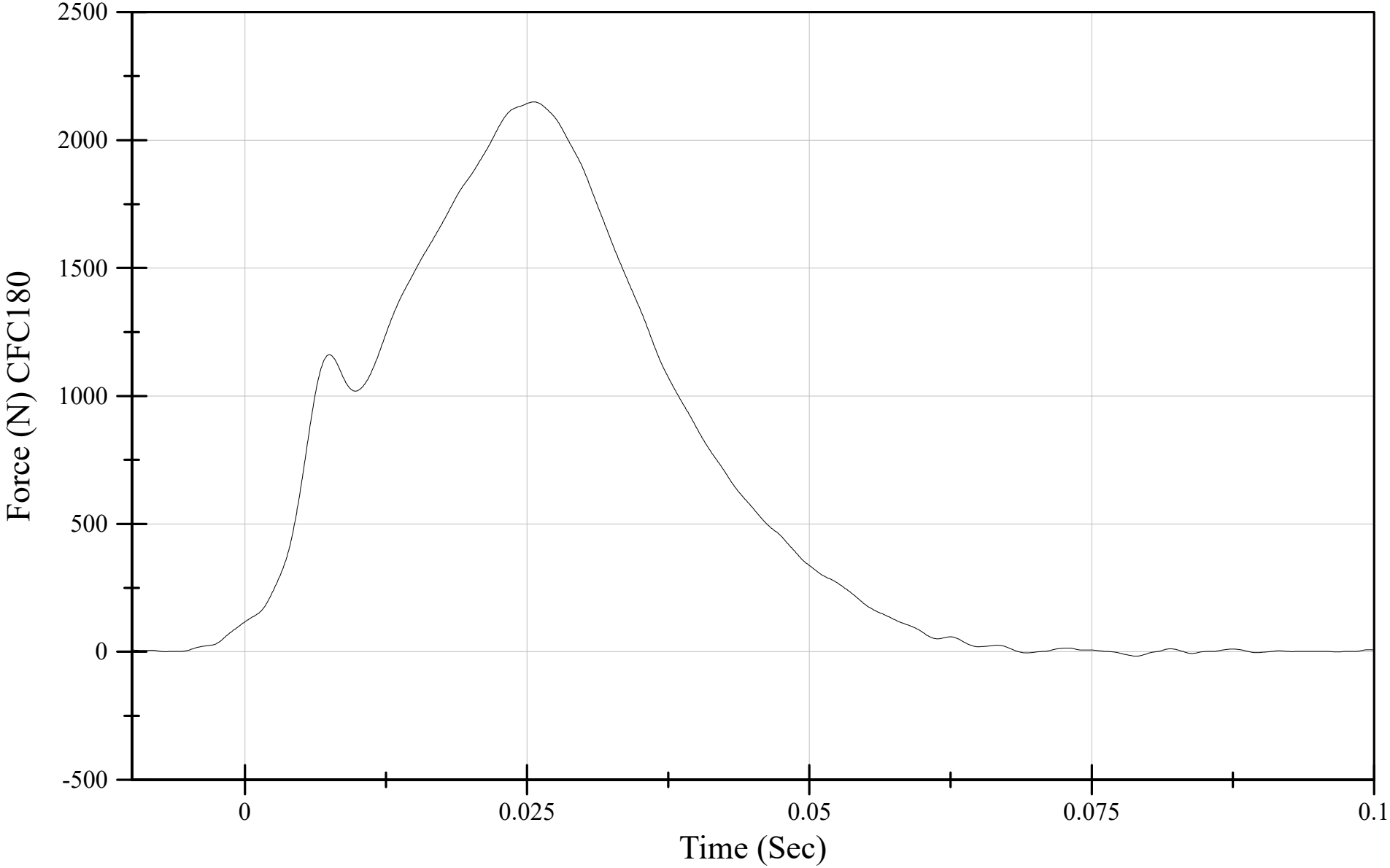
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.2	Pass
Test Humidity (%)	10 - 70	50	Pass
Test Velocity (m/s)	4.25 - 4.35	4.29	Pass
Peak Probe Force (N)		2150	
Left Resultant Deflection at Peak Force (mm)		50.1	

* THOR-05F Qualification Manual - July 2022

File Name: 221205-1 processed
Software Version: 2.8

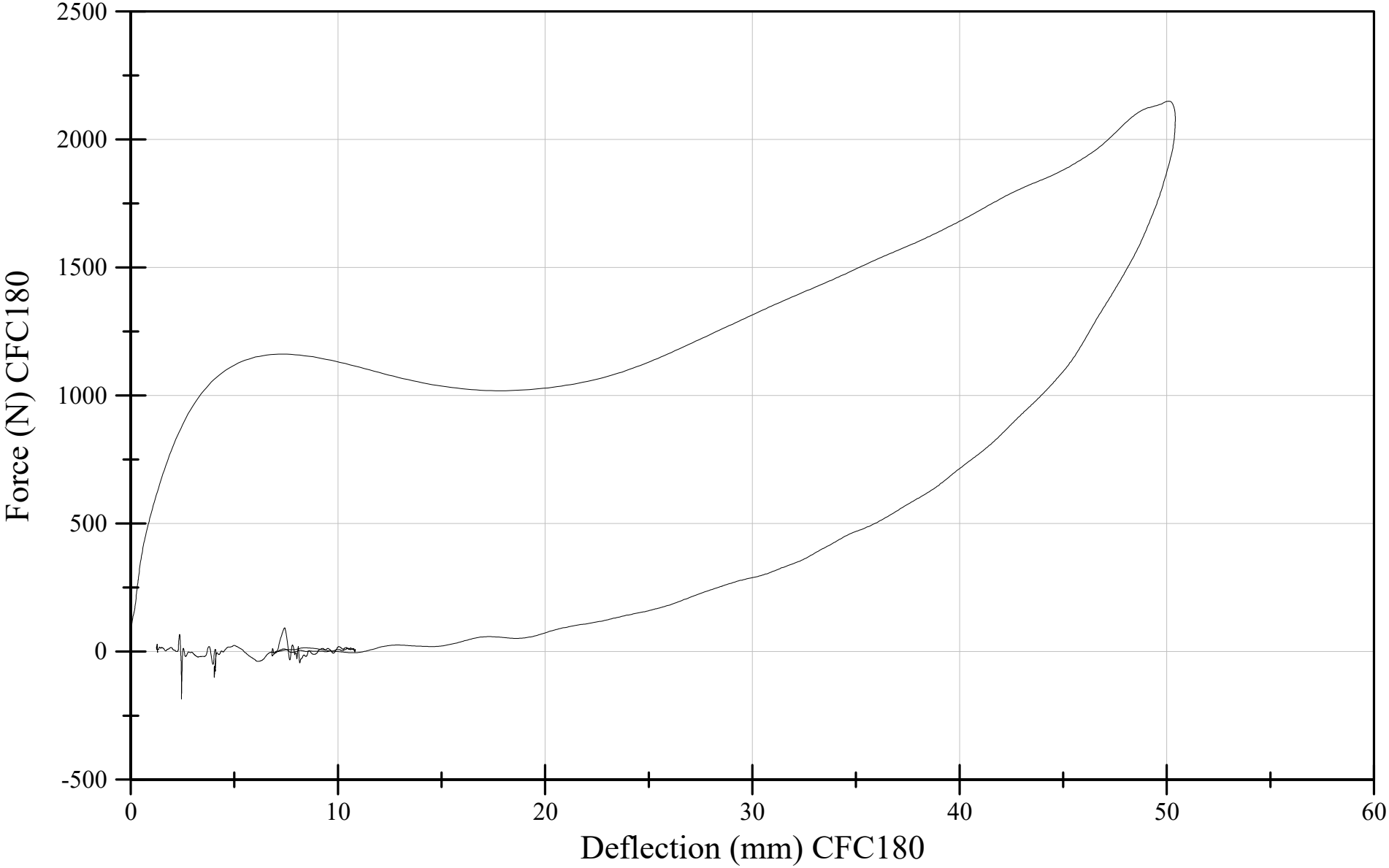
THOR-05F Lower Left Thorax Qualification
Peak Probe Force
Serial Number: EV0674



File Name: 221205-1 processed

12/5/2022 7:06 AM

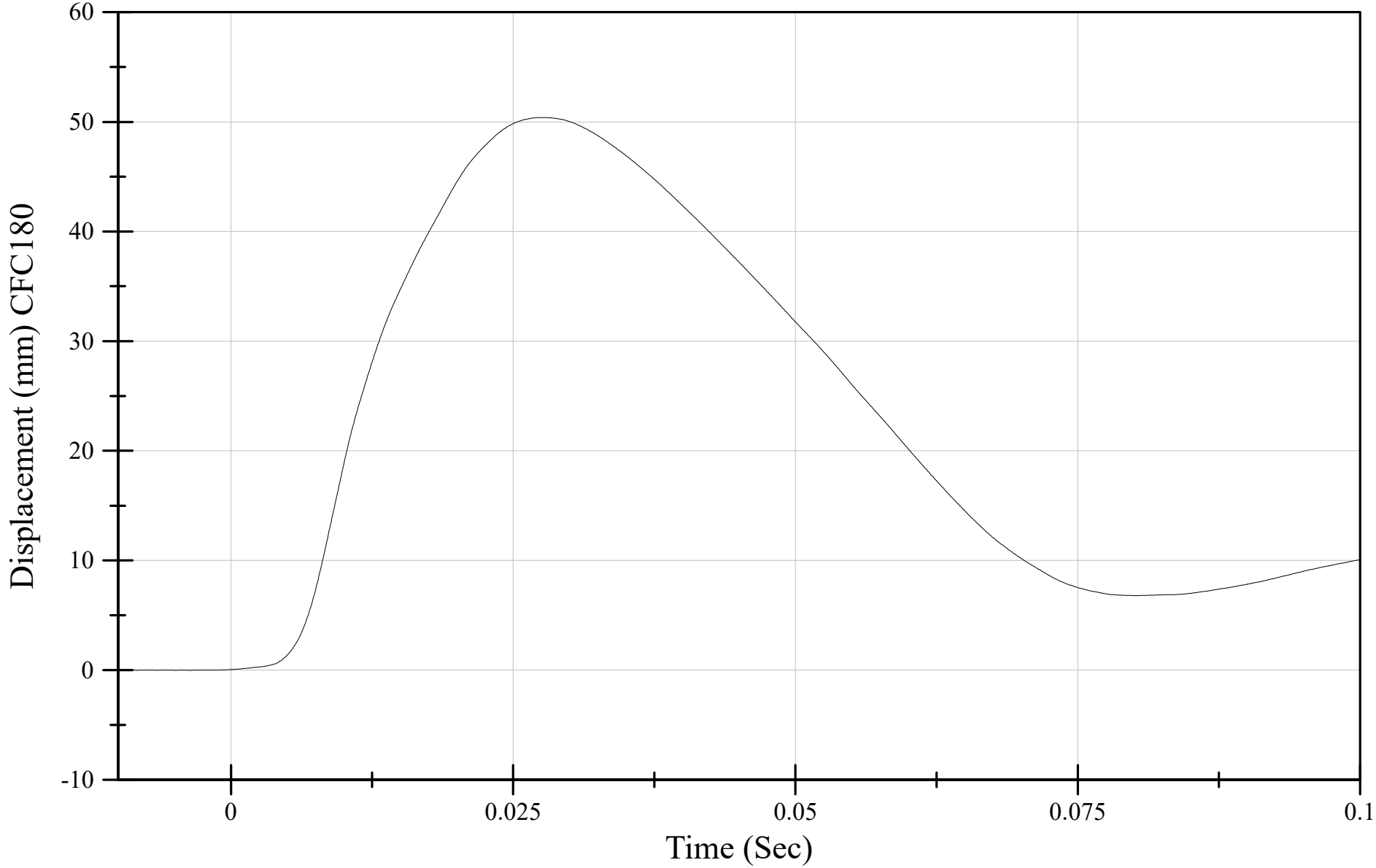
THOR-05F Lower Left Thorax Qualification
Probe Force vs Left Resultant Deflection
Serial Number: EV0674



File Name: 221205-1 processed

12/5/2022 7:06 AM

THOR-05F Lower Left Thorax Qualification
Left Resultant Deflection
Serial Number: EV0674



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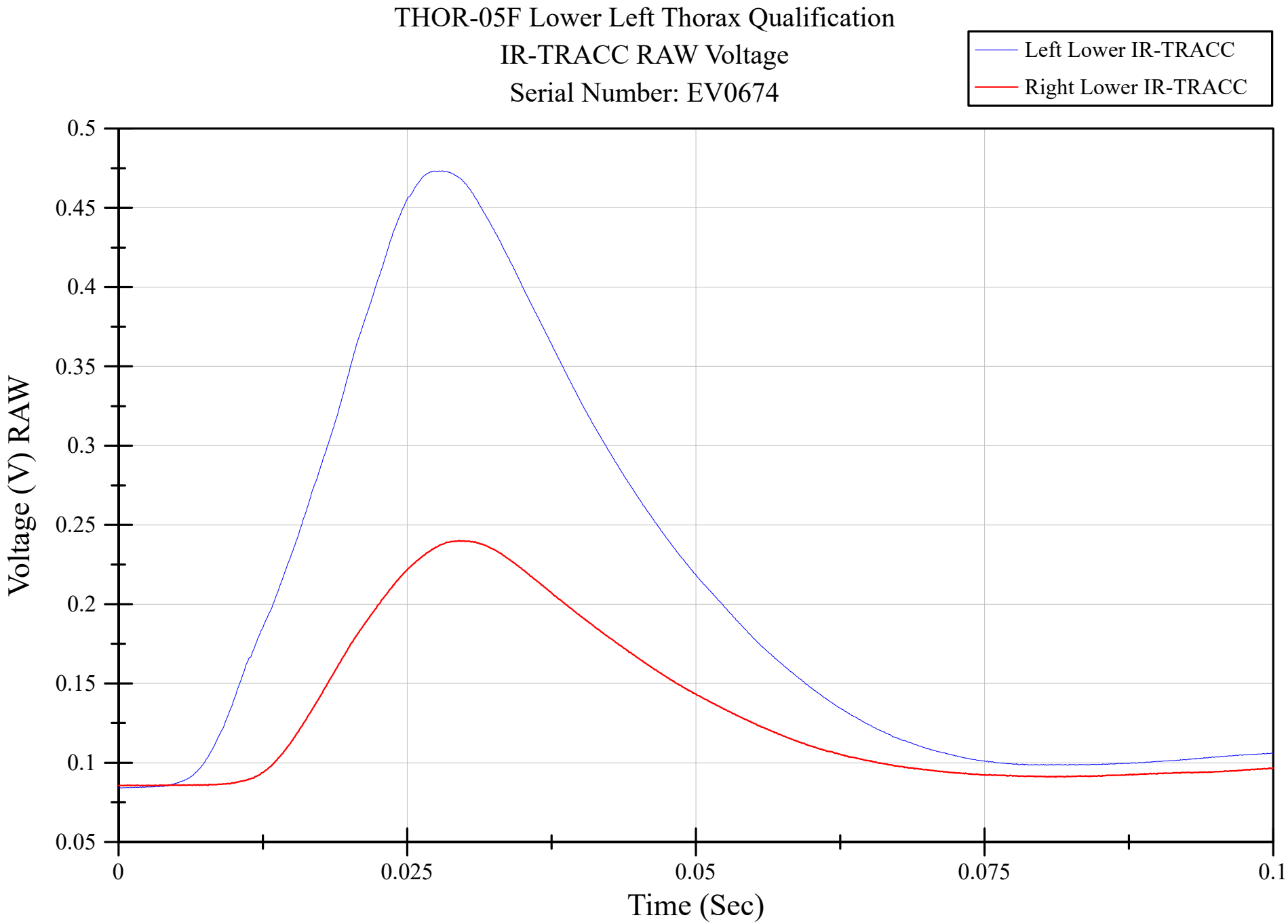
12/5/2022 7:06 AM



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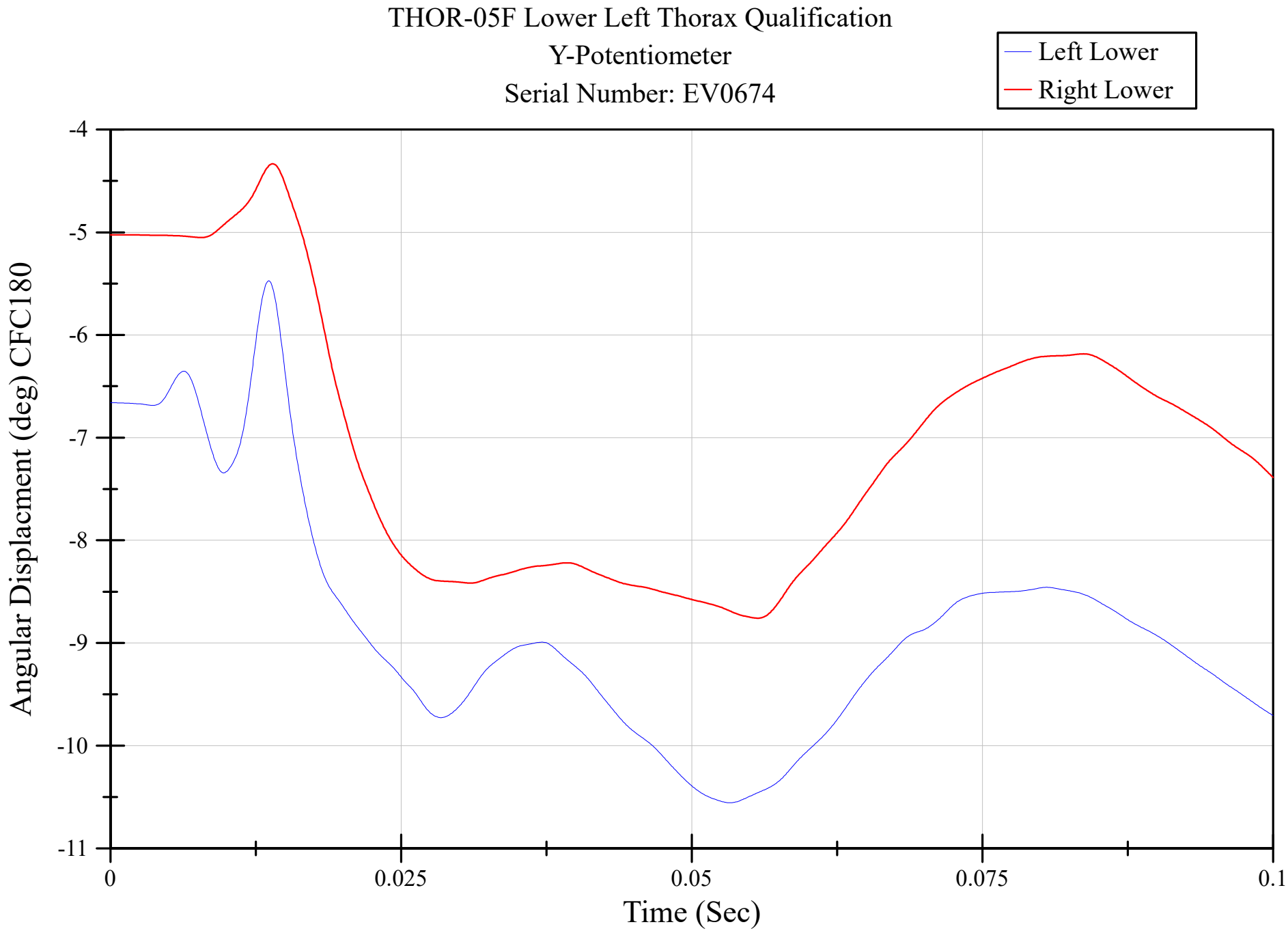
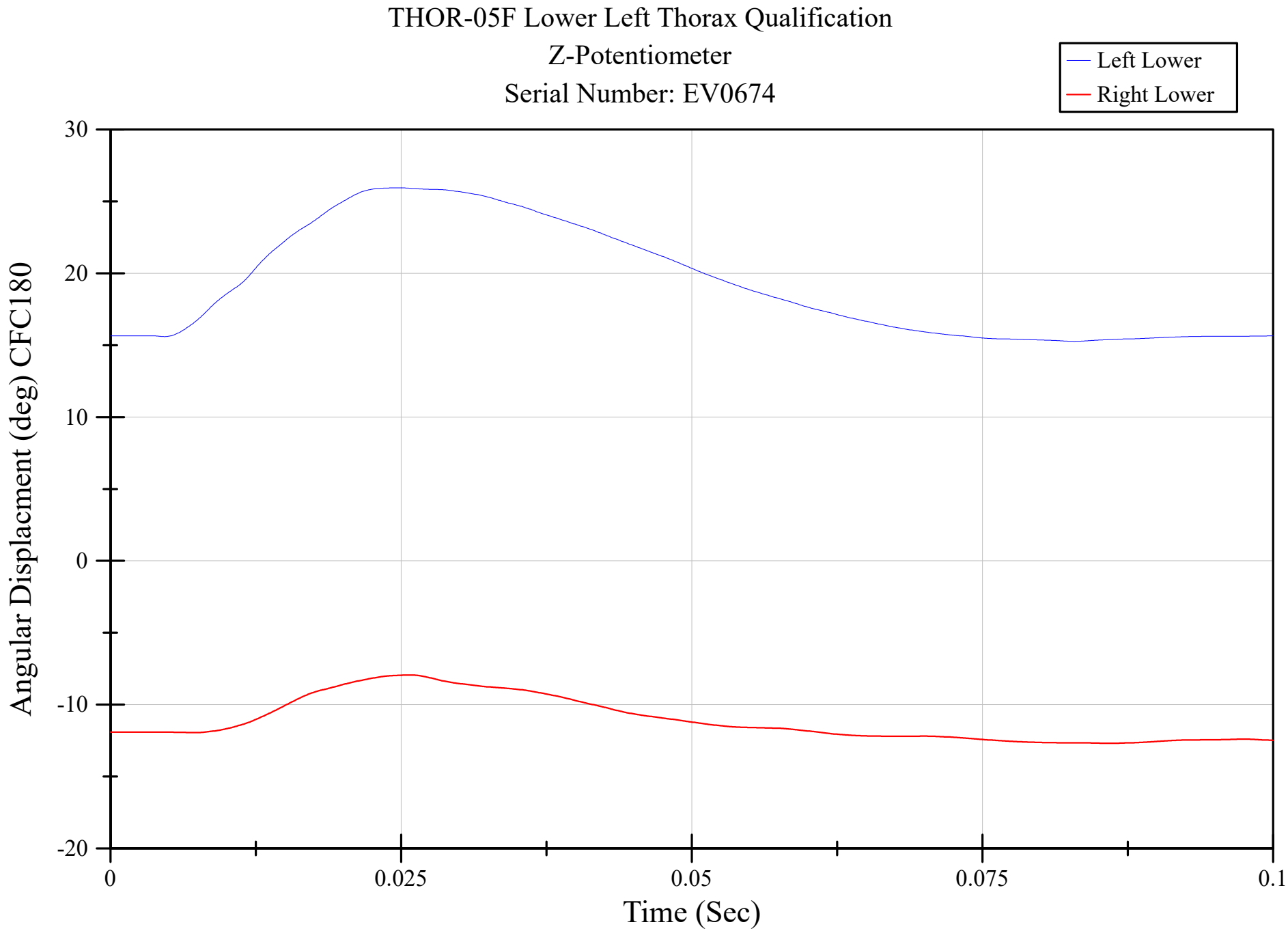
12/5/2022 7:06 AM



File Name: 221205-1 processed

12/5/2022 7:06 AM



File Name: 221205-1 processed

12/5/2022 7:06 AM

THOR-05F Lower Right Thorax Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components

Rib 1 Serial Number: EU8361
Rib 2 Serial Number: EU8362
Rib 3 Serial Number: EU8363
Rib 4 Serial Number: EL6732
Rib 5 Serial Number: EU8364
Rib 6 Serial Number: EL6737
Rib 7 Serial Number: EL6736

Test ID: 221205-4
Test Date: 12/5/2022
Test Time: 8:22 AM

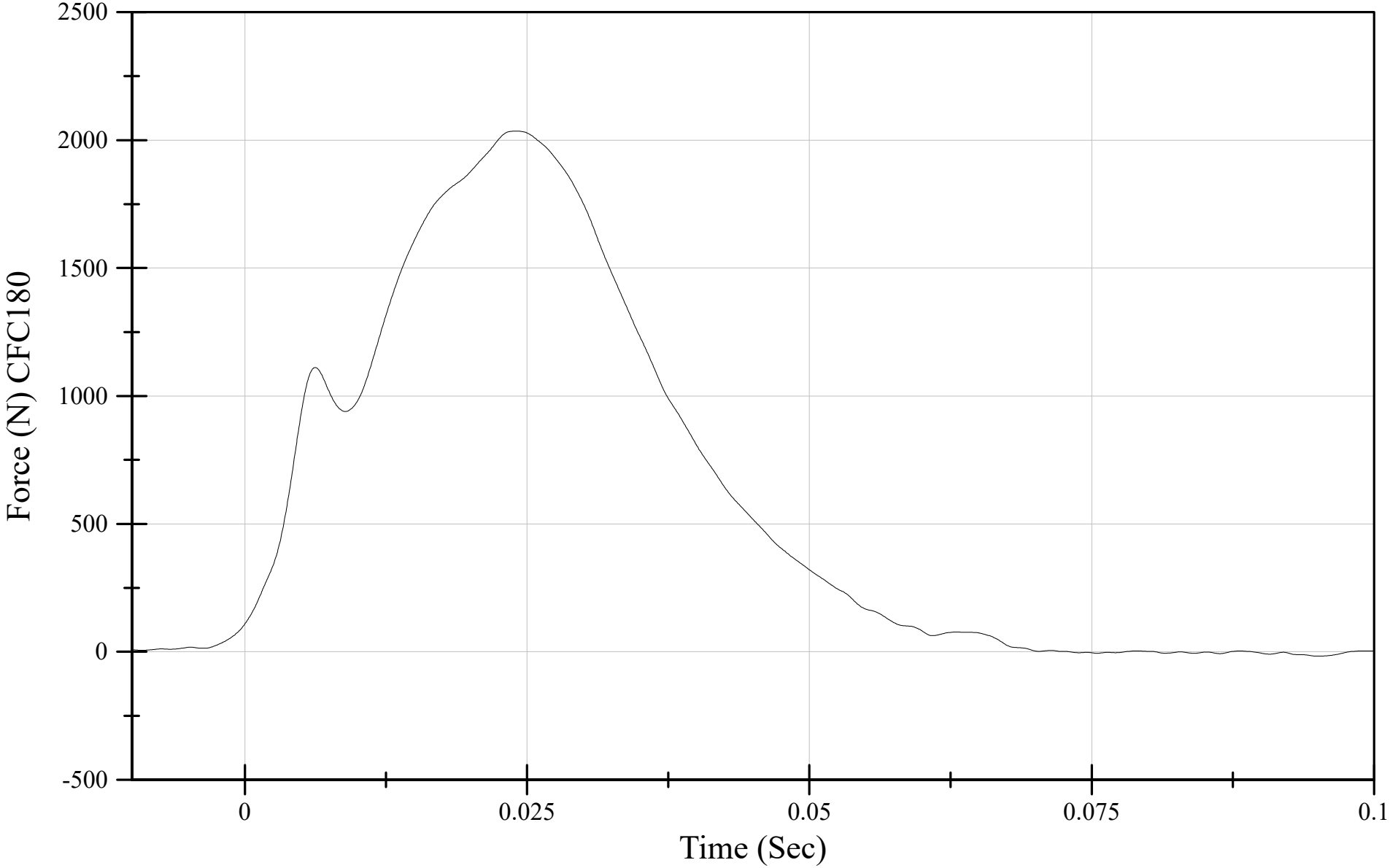
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.0	Pass
Test Humidity (%)	10 - 70	49	Pass
Test Velocity (m/s)	4.25 - 4.35	4.29	Pass
Peak Probe Force (N)		2036	
Right Resultant Deflection at Peak Force (mm)		48.6	

* THOR-05F Qualification Manual - July 2022

File Name: 221205-4 processed
Software Version: 2.8

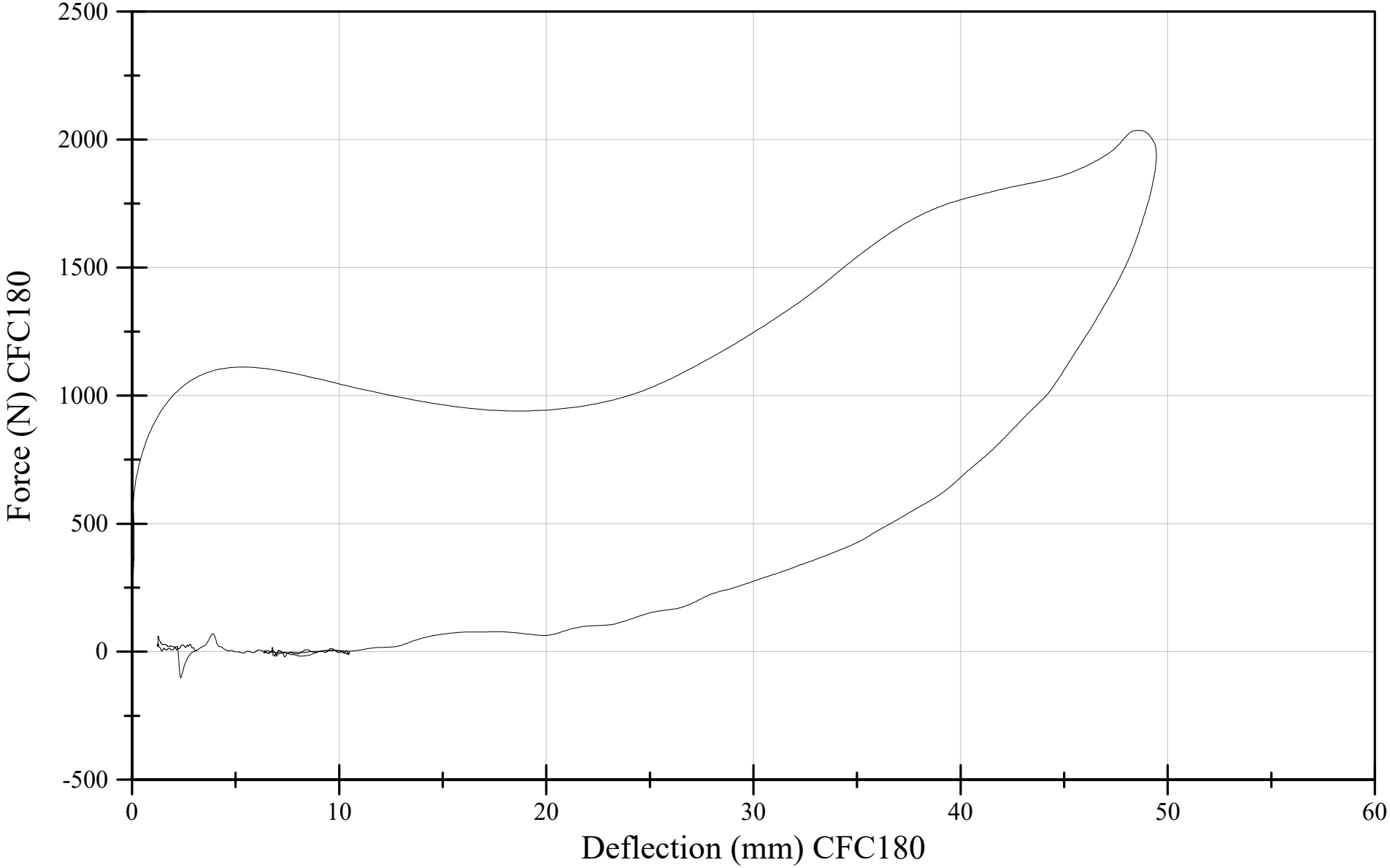
THOR-05F Lower Right Thorax Qualification
Peak Probe Force
Serial Number: EV0674



File Name: 221205-4 processed

12/5/2022 8:22 AM

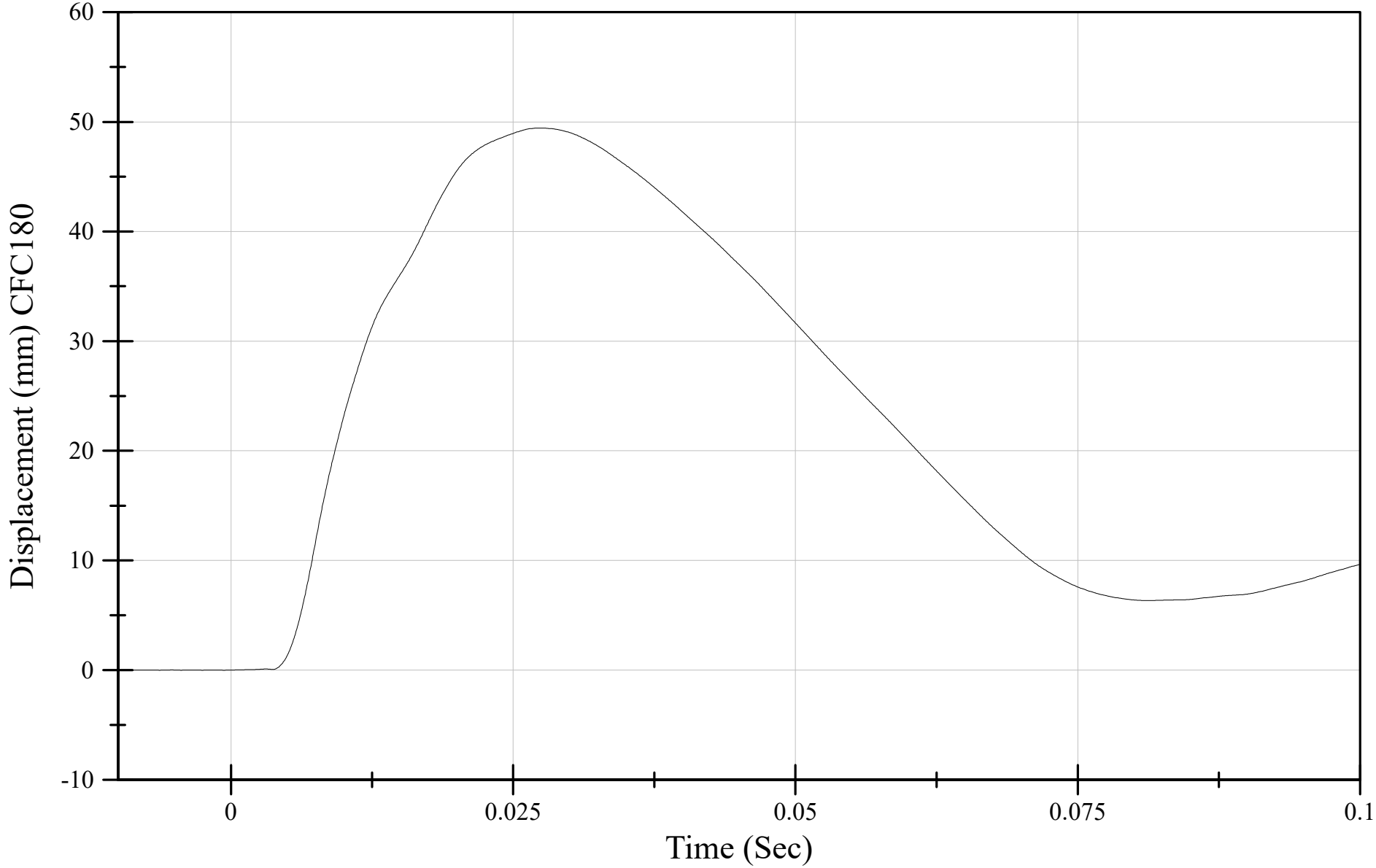
THOR-05F Lower Right Thorax Qualification
Probe Force vs Right Resultant Deflection
Serial Number: EV0674



File Name: 221205-4 processed

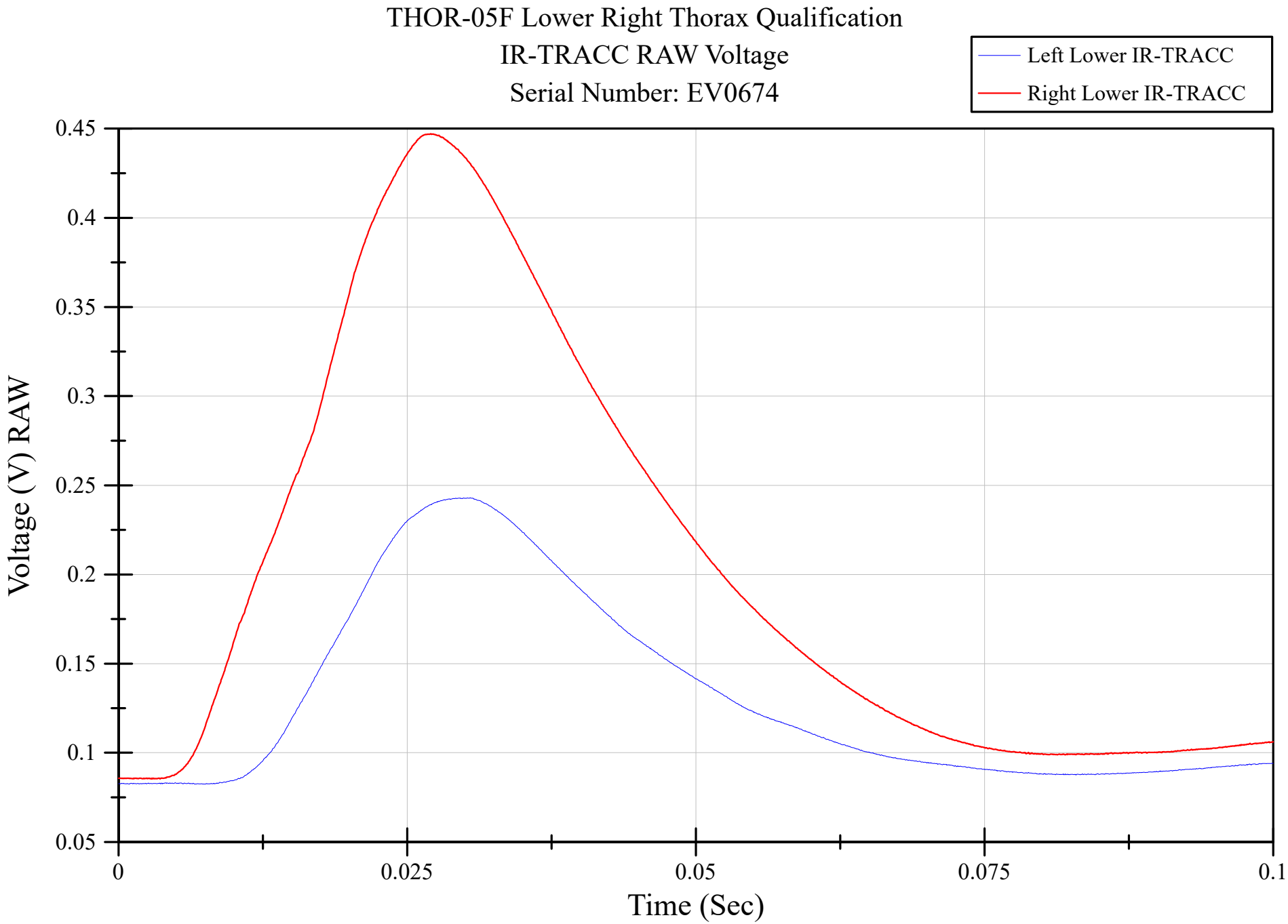
12/5/2022 8:22 AM

THOR-05F Lower Right Thorax Qualification
Right Resultant Deflection
Serial Number: EV0674



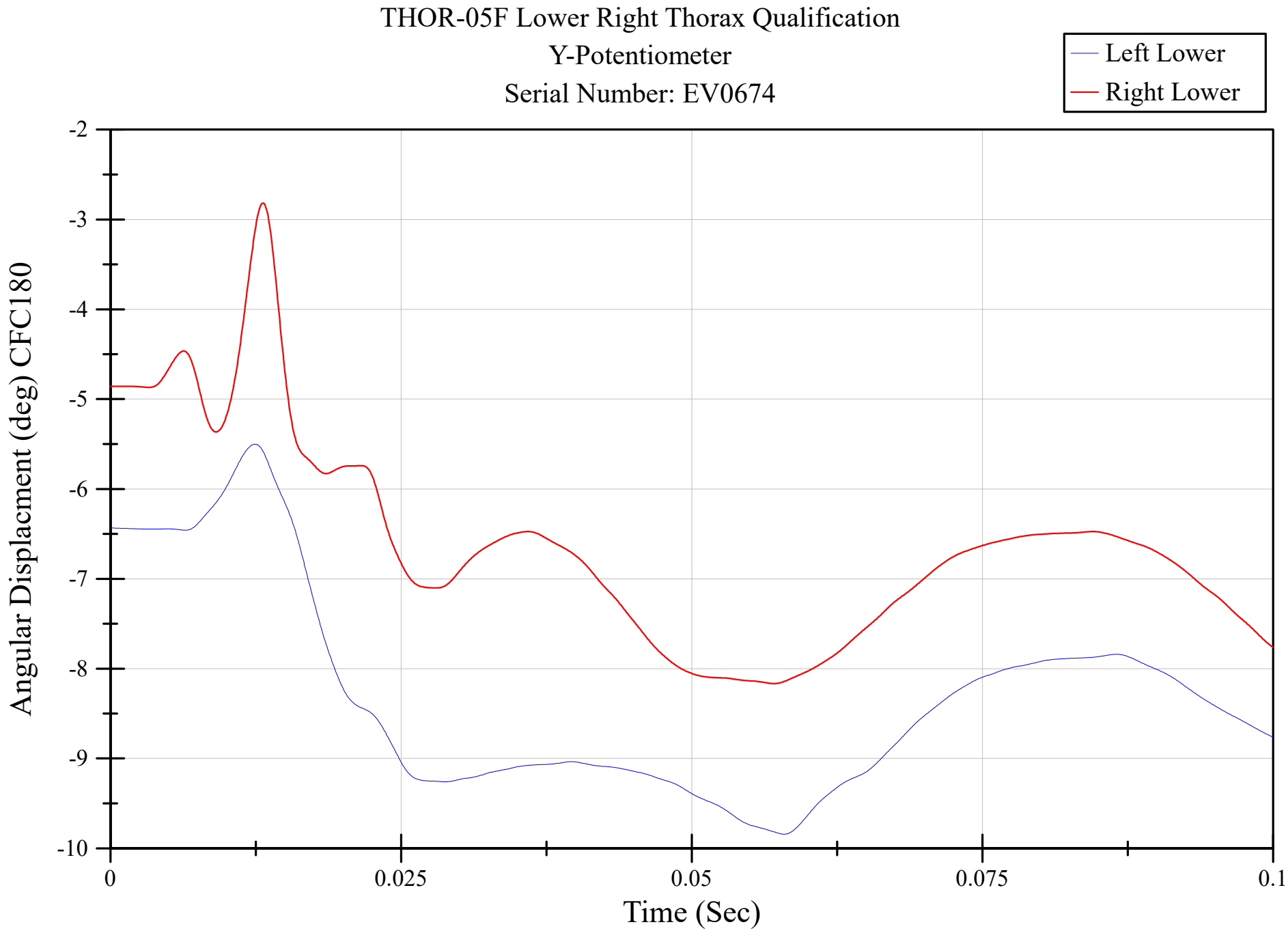
File Name: 221205-4 processed

12/5/2022 8:22 AM



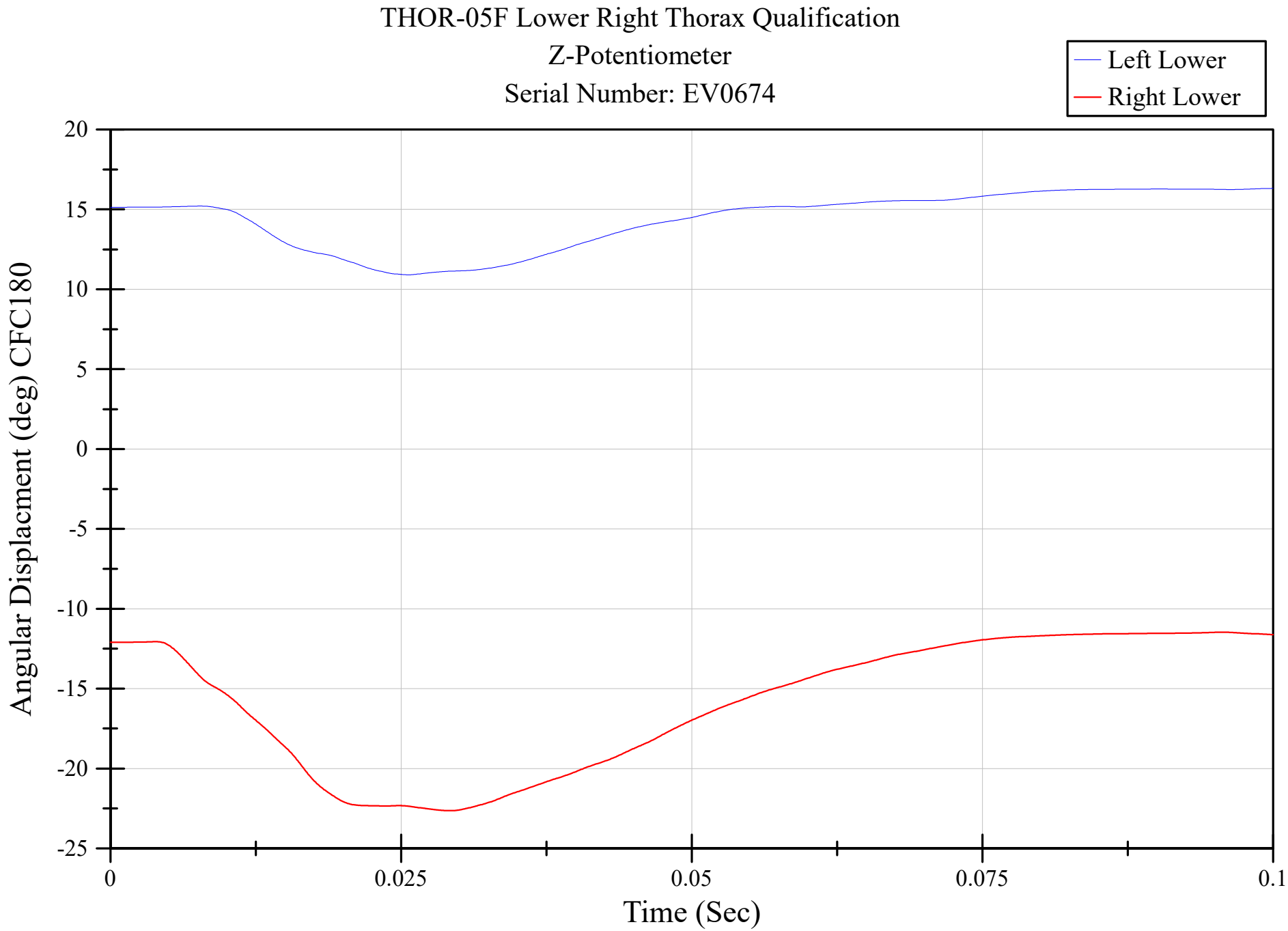
File Name: 221205-4 processed

12/5/2022 8:22 AM



File Name: 221205-4 processed

12/5/2022 8:22 AM



File Name: 221205-4 processed

12/5/2022 8:22 AM

THOR-05F Lower Abdomen Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components

Abdomen Foam: EV1098

Test ID: 221206-4
Test Date: 12/6/2022
Test Time: 11:00 AM

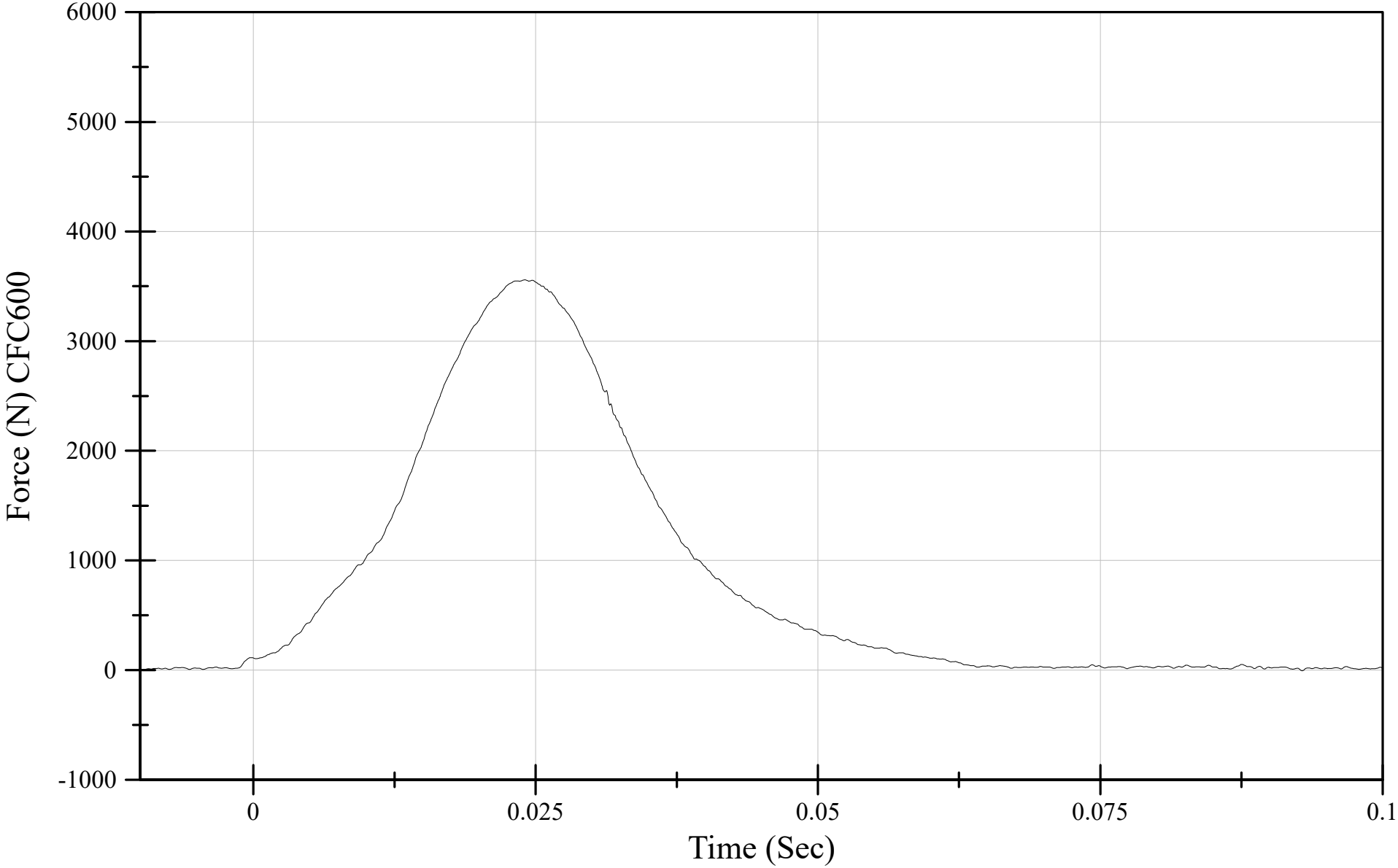
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.2	Pass
Test Humidity (%)	10 - 70	54	Pass
Test Velocity (m/s)	6.05 - 6.15	6.09	Pass
Peak Probe Force (N)		3559	
Peak Left Abdomen Pressure (kPa)		133	
Peak Right Abdomen Pressure (kPa)		154	
Difference between Left and Right Pressure (kPa)		21	

* THOR-05F Qualification Manual - July 2022

File Name: 221206-4 processed
Software Version: 2.8

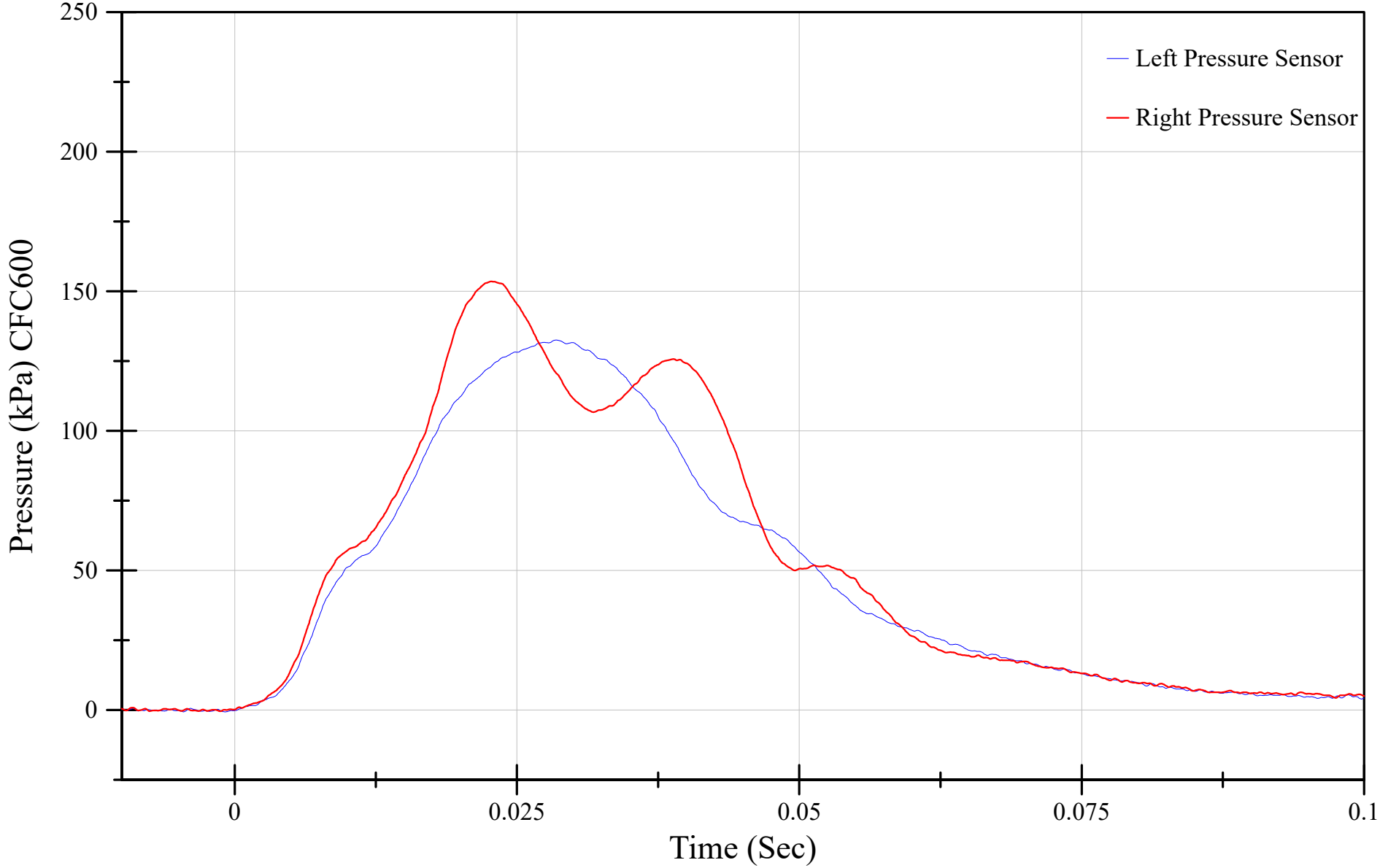
THOR-05F Lower Abdomen Qualification
Peak Probe Force
Serial Number: EV0674



File Name: 221206-4 processed

12/6/2022 11:00 AM

THOR-05F Lower Abdomen Qualification
Abdomen Pressure Sensors
Serial Number: EV0674



File Name: 221206-4 processed

12/6/2022 11:00 AM

THOR-05F Left Upper Leg Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Compression Element: EV0593
Left Thigh Flesh: EV3102

Test ID: 221206-12
Test Date: 12/6/2022
Test Time: 3:15 PM

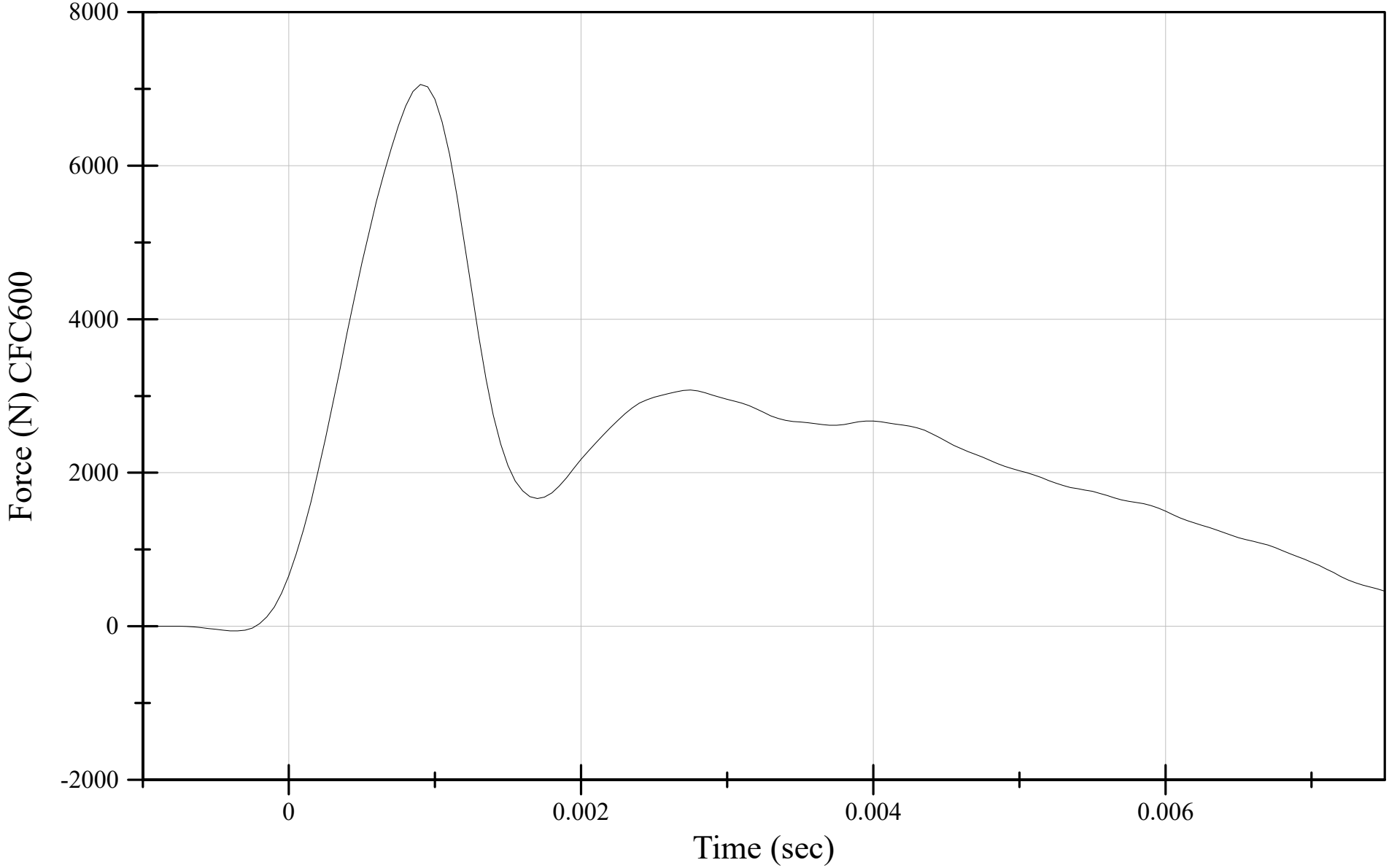
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.3	Pass
Test Humidity (%)	10 - 70	49	Pass
Test Velocity (m/s)	3.25 - 3.35	3.31	Pass
Peak Probe Force (N)		7058.2	
Peak Femur Force (N)		-4044.3	
Peak Resultant Acetabulum Force (N)		1668.3	

* THOR-05F Qualification Manual - July 2022

File Name: 221206-12 processed

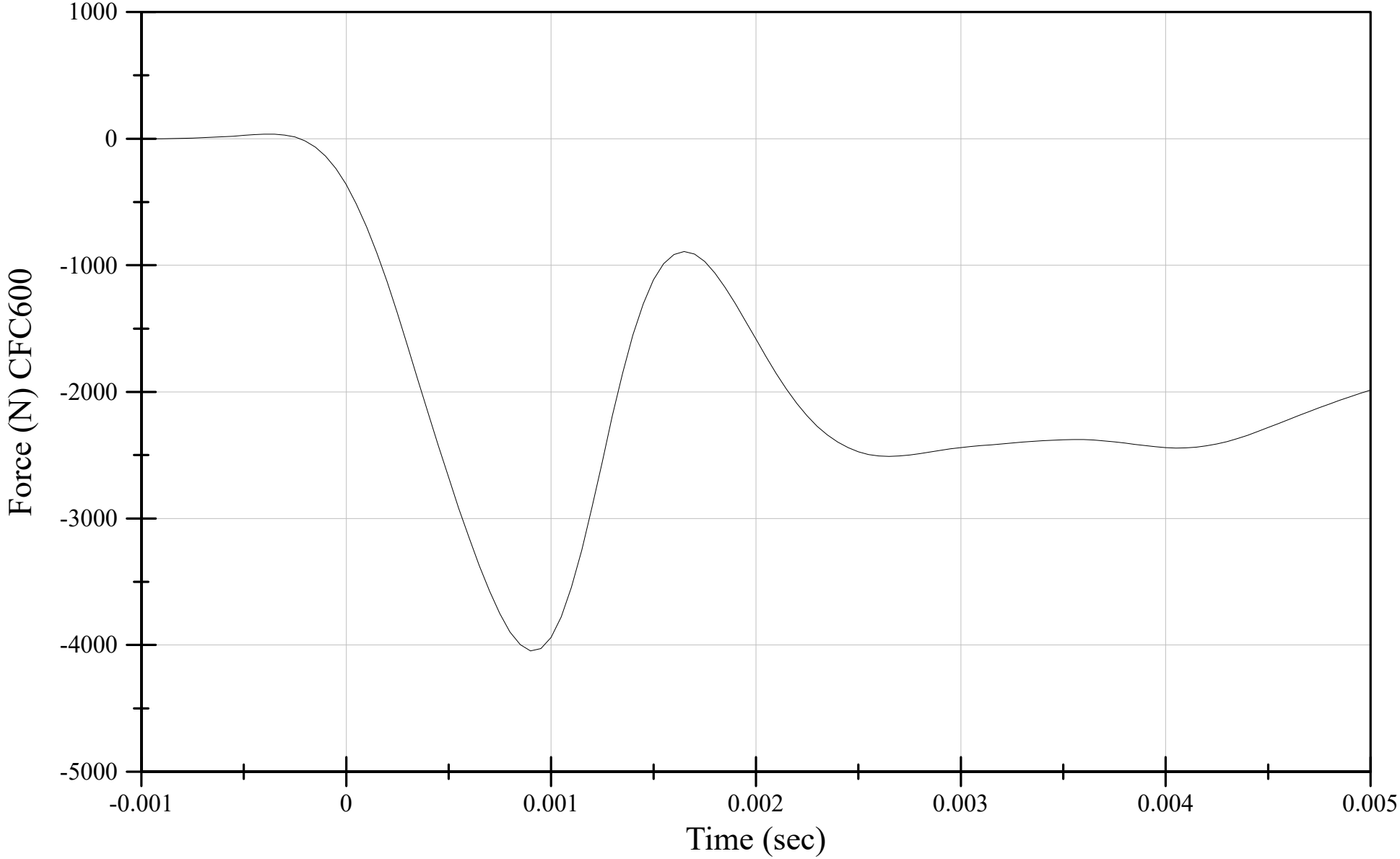
THOR-05F Left Upper Leg Qualification
Probe Force
Serial Number: EV0674



File Name: 221206-12 processed

12/6/2022 3:15 PM

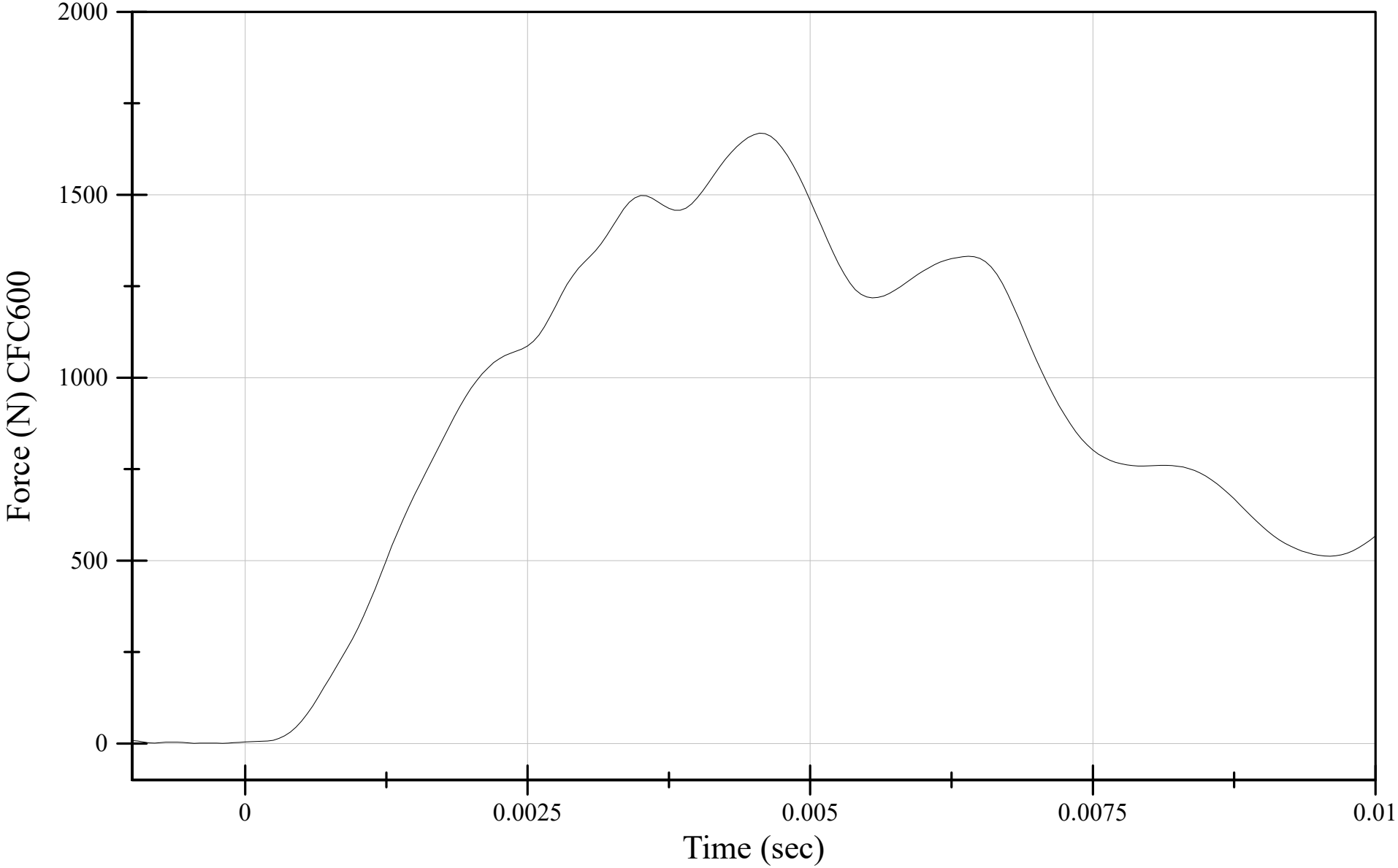
THOR-05F Left Upper Leg Qualification
Femur Z-Force
Serial Number: EV0674



File Name: 221206-12 processed

12/6/2022 3:15 PM

THOR-05F Left Upper Leg Qualification
Peak Acetabulum Resultant Force
Serial Number: EV0674



File Name: 221206-12 processed

12/6/2022 3:15 PM

THOR-05F Left Knee Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Left Knee Slider: EV0858

Test ID: 221207-5
Test Date: 12/7/2022
Test Time: 11:33 AM

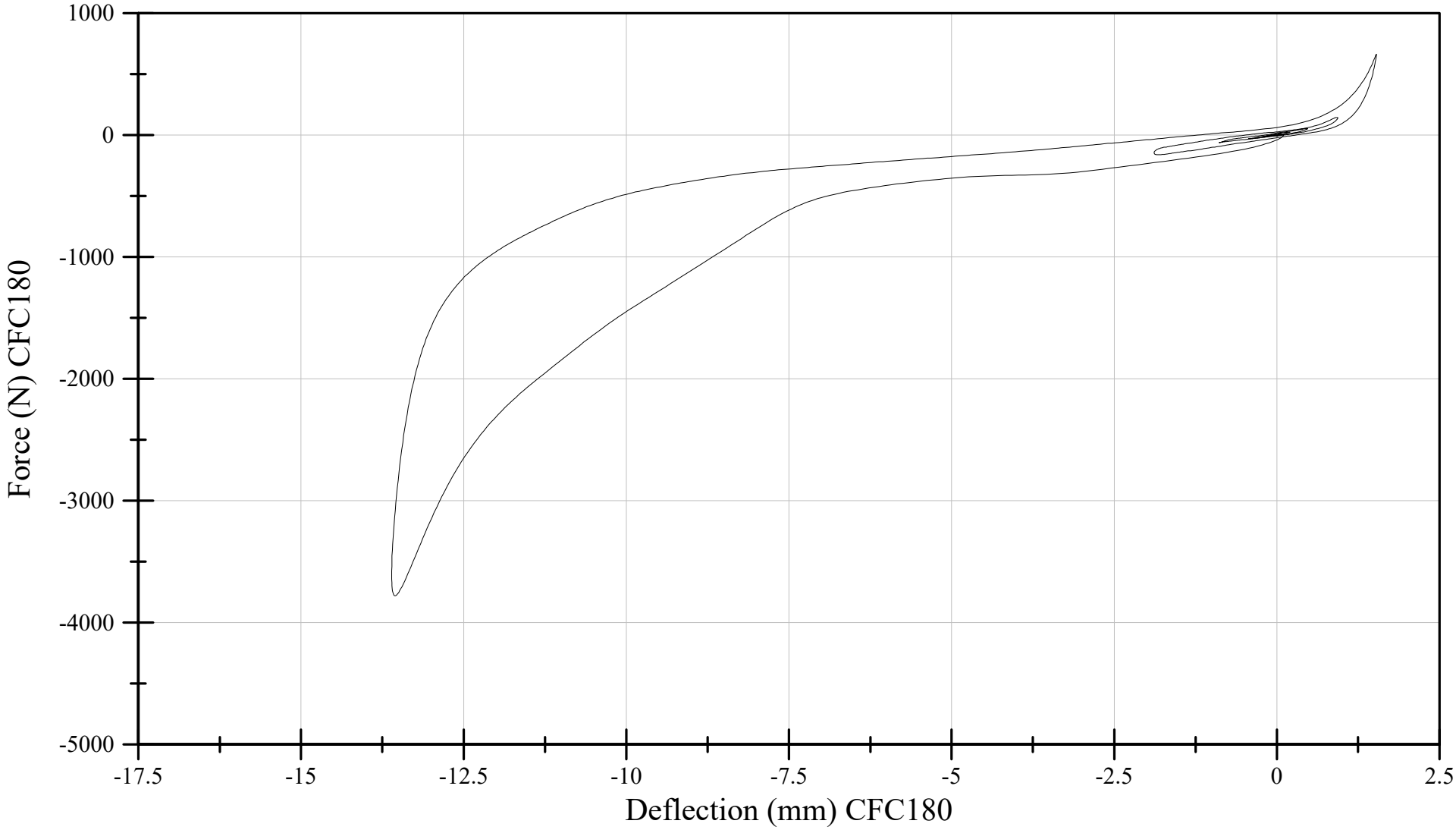
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.2	Pass
Test Humidity (%)	10 - 70	47	Pass
Test Velocity (m/s)	2.10 - 2.20	2.16	Pass
Peak Femur Fz (N)		-3779.8	
Knee Deflection at Peak Femur Force (N)		-13.6	

* THOR-05F Qualification Manual - July 2022

File Name: 221207-5 processed
Software Version: 2.8

THOR-05F Left Knee Qualification
Peak Deflection at Peak Force
Serial Number: EV0674



File Name: 221207-5 processed

12/7/2022 11:33 AM

THOR-05F Left Achilles Tension Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Left Ankle Assembly: EV4000

Test ID: 221214-6
Test Date: 12/14/2022
Test Time: 10:07 AM

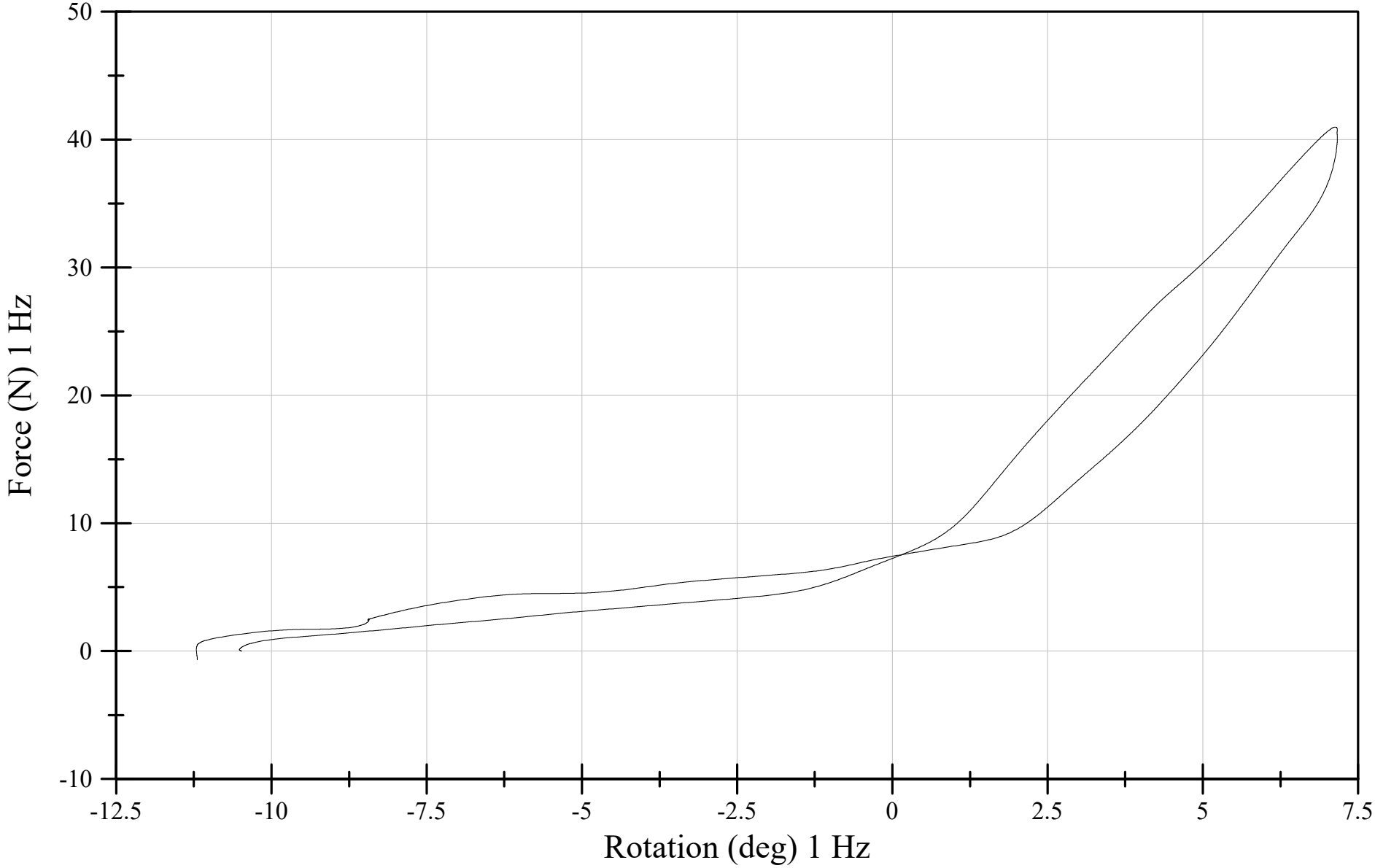
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.0	Pass
Test Humidity (%)	10 - 70	52	Pass
Force at 0° Y Rotation (N)		7	

* THOR-05F Qualification Manual - July 2022

File Name: 221214-6 processed
Software Version: 2.8

THOR-05F Left Achilles Tension Qualification
Force vs Rotation
Ankle Serial Number: EV4000



File Name: 221214-6 processed

12/14/2022 10:07 AM

THOR-05F Left Ball of Foot Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Left Ankle: EV4000
Dorsiflexion Stop: EV3717

Test ID: 221214-9
Test Date: 12/14/2022
Test Time: 2:25 PM

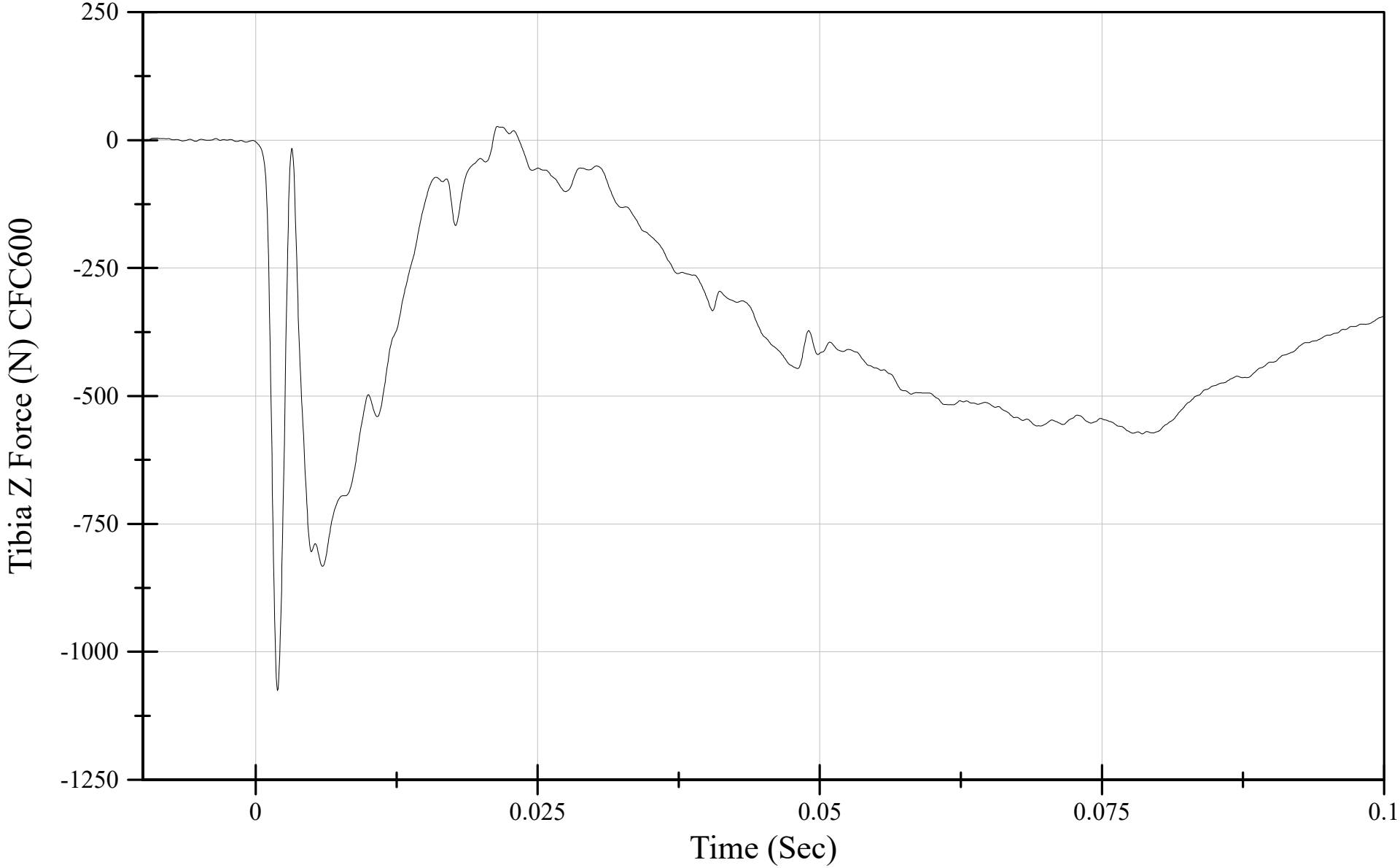
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.1	Pass
Test Humidity (%)	10 - 70	48	Pass
Test Velocity (m/s)	1.95 - 2.05	2.01	Pass
Peak Lower Tibia Fz after 10 ms (N)		-573.7	
Peak Ankle Resistive Moment (Nm)		14.4	
Peak Ankle Y-axis Rotation (deg)		20.8	

* THOR-05F Qualification Manual - July 2022

File Name: 221214-9 processed
Software Version: 2.8

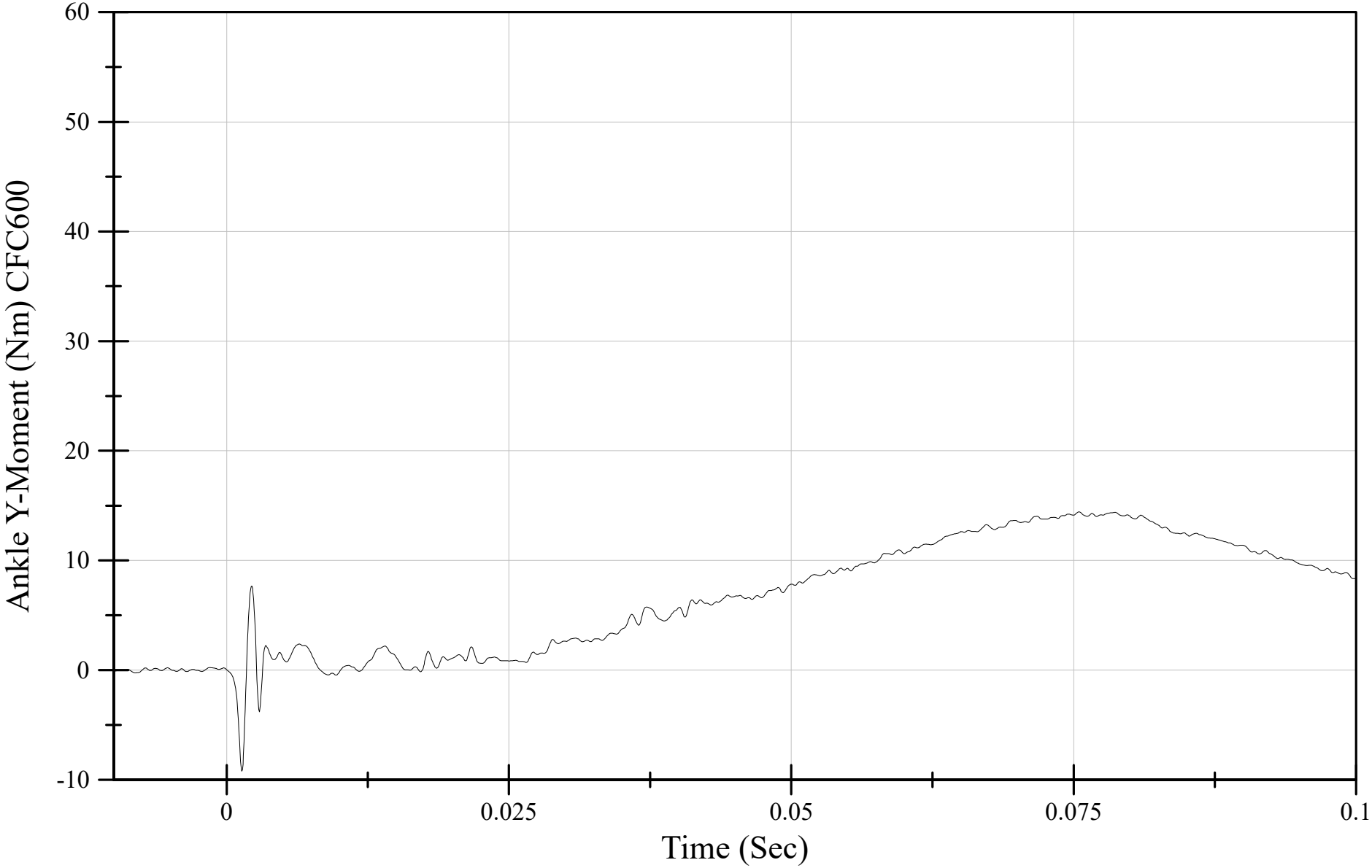
THOR-05F Left Ball of Foot Qualification
Lower Tibia Fz
Serial Number: EV0674



File Name: 221214-9 processed

12/14/2022 2:25 PM

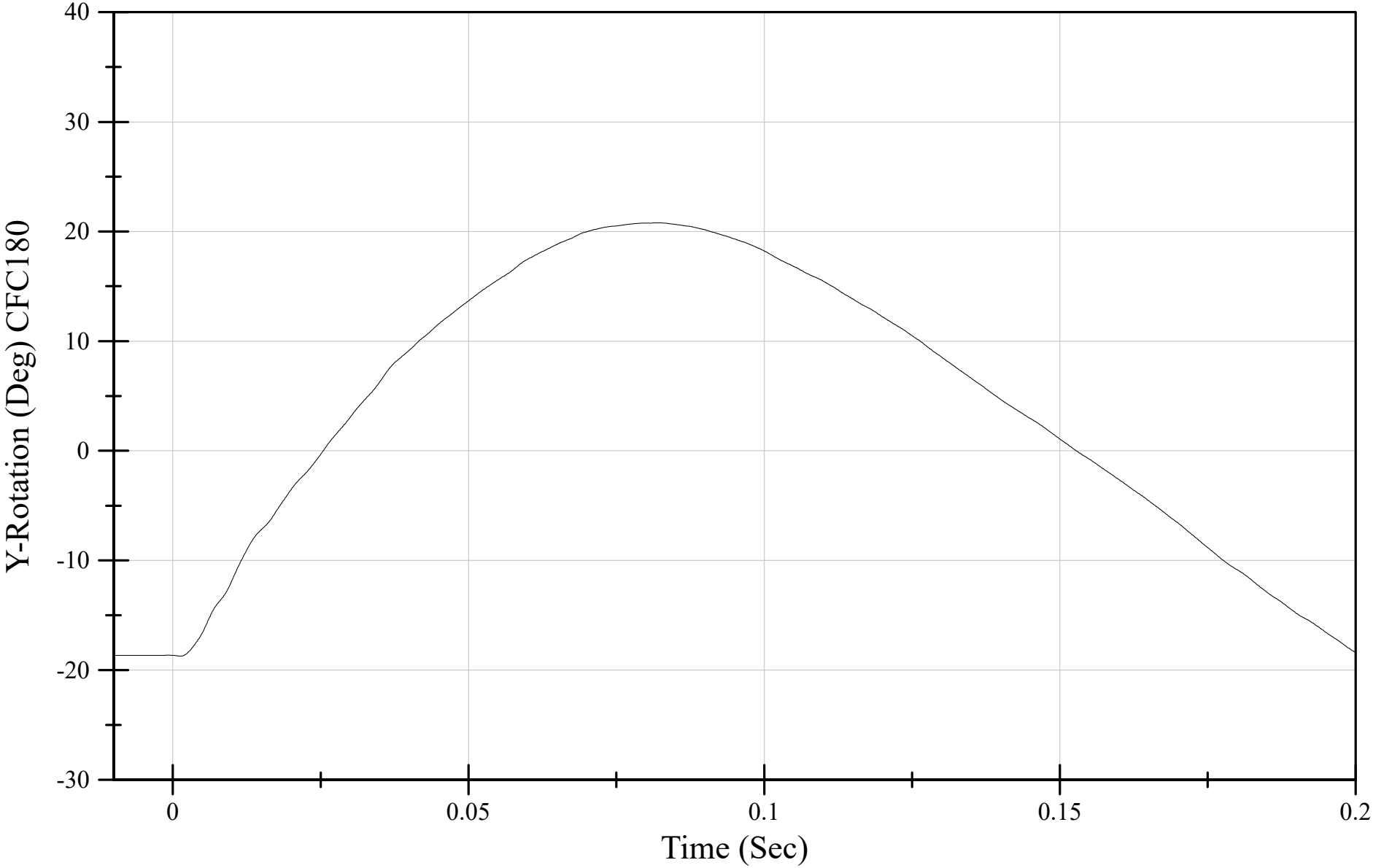
THOR-05F Left Ball of Foot Qualification
Ankle Y-Moment
Serial Number: EV0674



File Name: 221214-9 processed

12/14/2022 2:25 PM

THOR-05F Left Ball of Foot Qualification
Ankle Y-Rotation
Serial Number: EV0674



File Name: 221214-9 processed

12/14/2022 2:25 PM

THOR-05F Left Foot Inversion Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components	Test ID: 221214-4
Ankle Serial: EV4000	Test Date: 12/14/2022
Inversion Stop Assembly: ET9530	Test Time: 9:16 AM

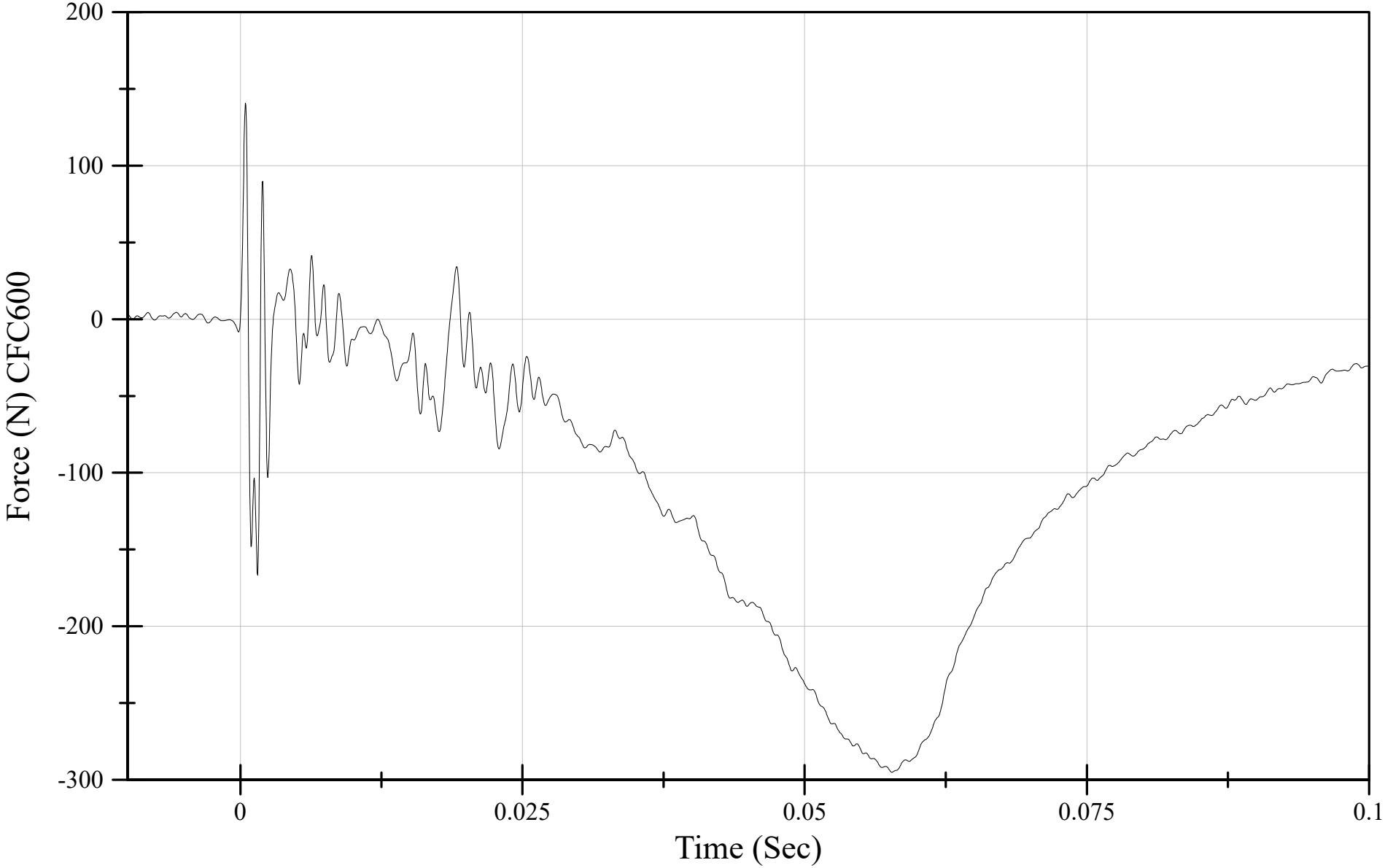
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.1	Pass
Test Humidity (%)	10 - 70	56	Pass
Test Velocity (m/s)	1.95 - 2.05	2.02	Pass
Peak Lower Tibia Fz		-295.2	
Peak Ankle X-axis Resistive Moment		-32.3	
Peak Ankle X-axis Rotation		-44.1	

* THOR-05F Qualification Manual - July 2022

File Name: 221214-4 processed
Software Version: 2.8

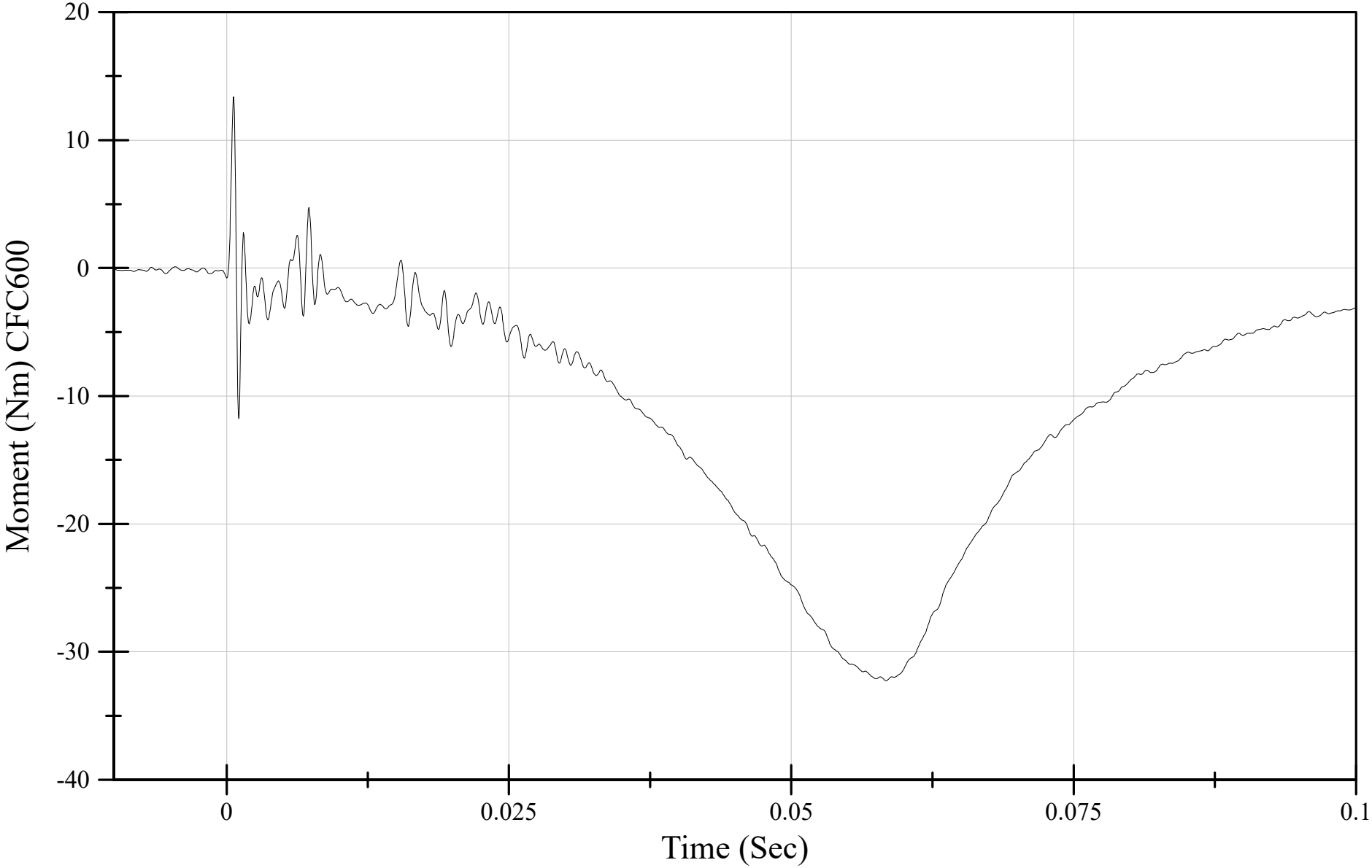
THOR-05F Left Foot Inversion Qualification
Tibia Load - Force Z
Ankle Serial Number: EV4000



File Name: 221214-4 processed

12/14/2022 9:16 AM

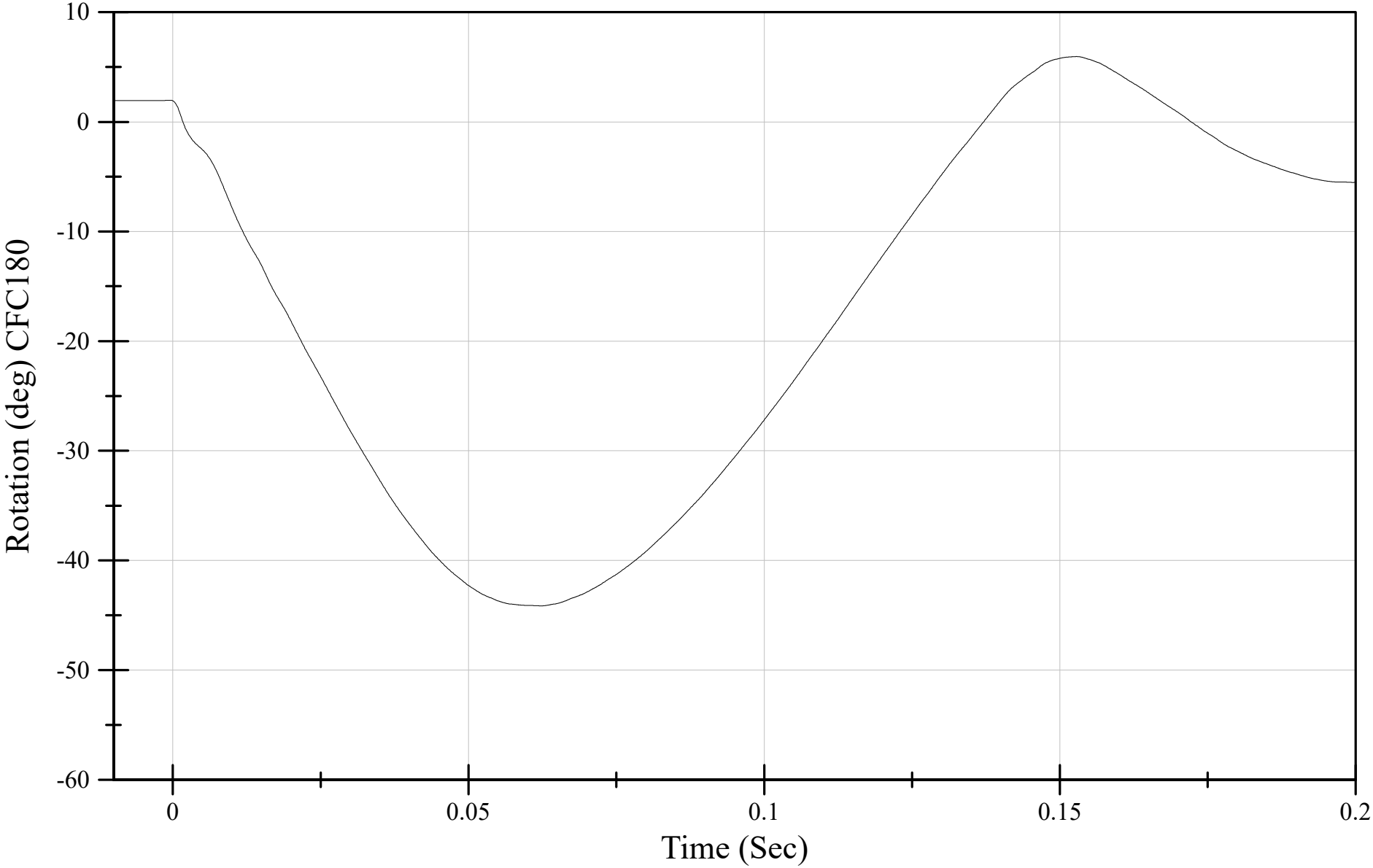
THOR-05F Left Foot Inversion Qualification
Ankle Moment - X axis
Ankle Serial Number: EV4000



File Name: 221214-4 processed

12/14/2022 9:16 AM

THOR-05F Left Foot Inversion Qualification
Ankle X-Rotation
Ankle Serial Number: EV4000



File Name: 221214-4 processed

12/14/2022 9:16 AM

THOR-05F Left Foot Eversion Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Ankle Serial: EV4000
Eversion Stop Assembly: EU9453

Test ID: 221214-3
Test Date: 12/14/2022
Test Time: 9:02 AM

Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.1	Pass
Test Humidity (%)	10 - 70	54	Pass
Test Velocity (m/s)	1.95 - 2.05	2.02	Pass
Peak Lower Tibia Fz		-312.0	
Peak Ankle X-axis Resistive Moment		29.6	
Peak Ankle X-axis Rotation		29.9	

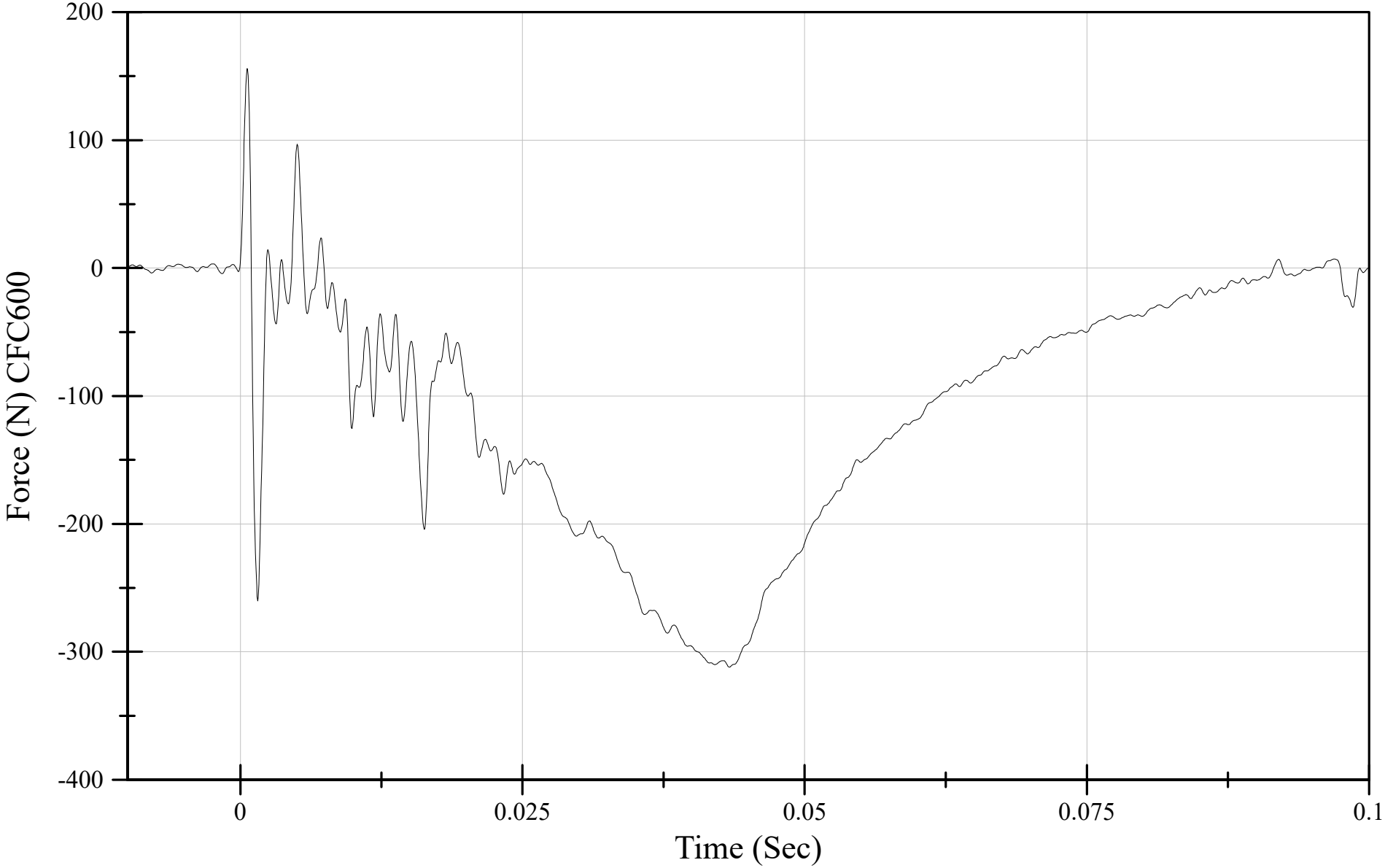
* THOR-05F Qualification Manual - July 2022

File Name: 221214-3 processed
Software Version: 2.8

THOR-05F Left Foot Eversion Qualification

Tibia Load - Force Z

Ankle Serial Number: EV4000



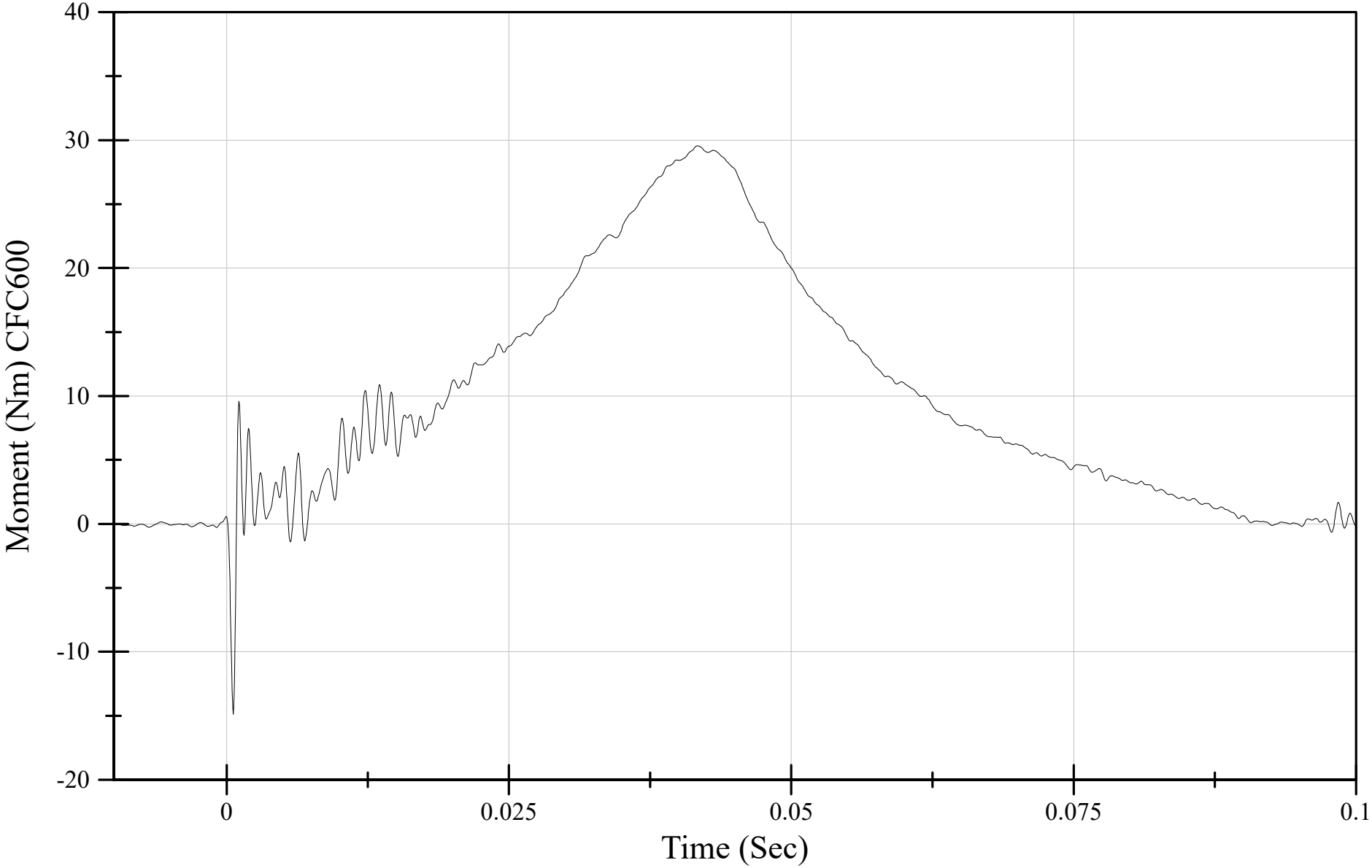
File Name: 221214-3 processed

12/14/2022 9:02 AM

THOR-05F Left Foot Eversion Qualification

Ankle Moment - X axis

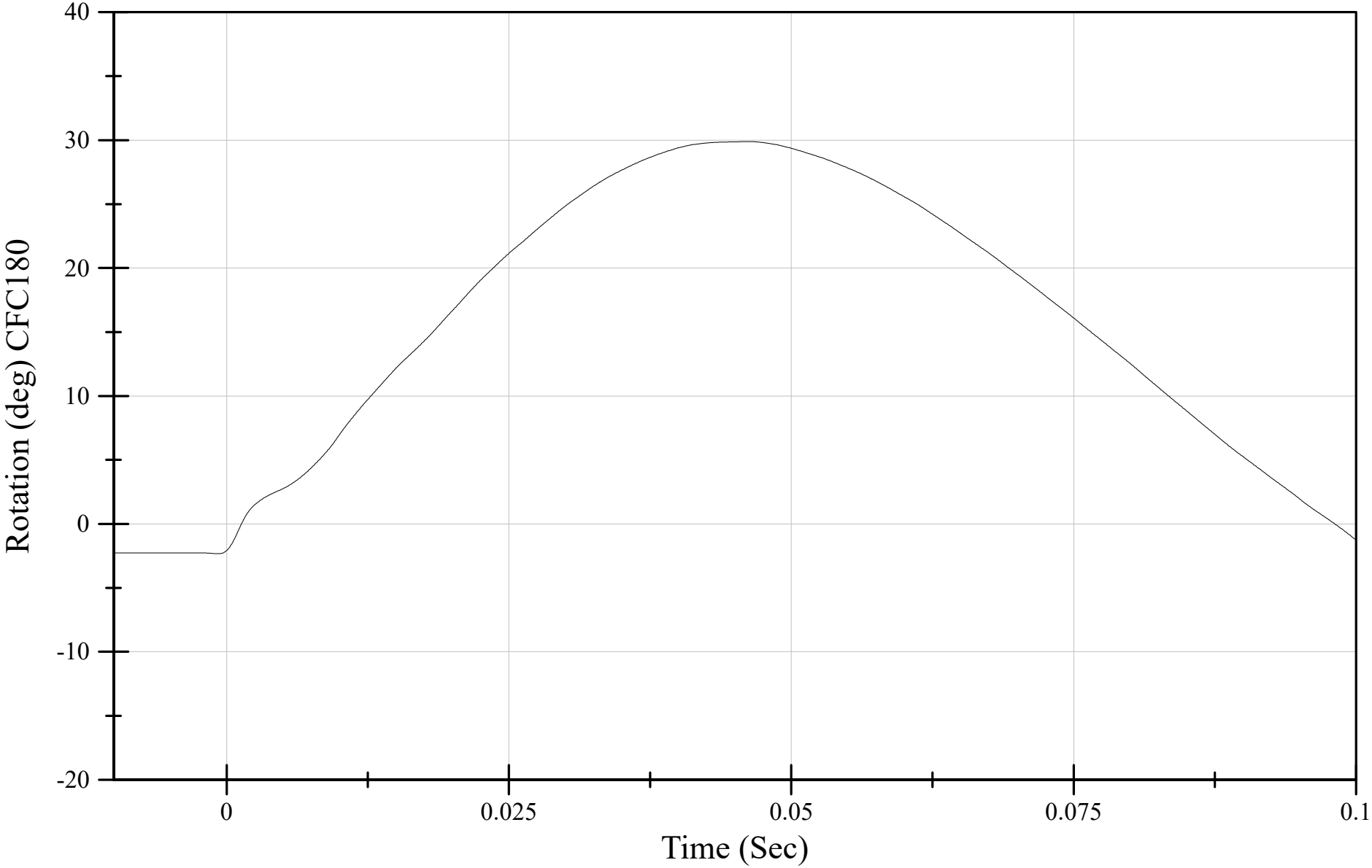
Ankle Serial Number: EV4000



File Name: 221214-3 processed

12/14/2022 9:02 AM

THOR-05F Left Foot Eversion Qualification
Ankle X-Rotation
Ankle Serial Number: EV4000



File Name: 221214-3 processed

12/14/2022 9:02 AM

THOR-05F Left Heel Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Left Ankle: EV4000

Test ID: 221215-1
Test Date: 12/15/2022
Test Time: 8:02 AM

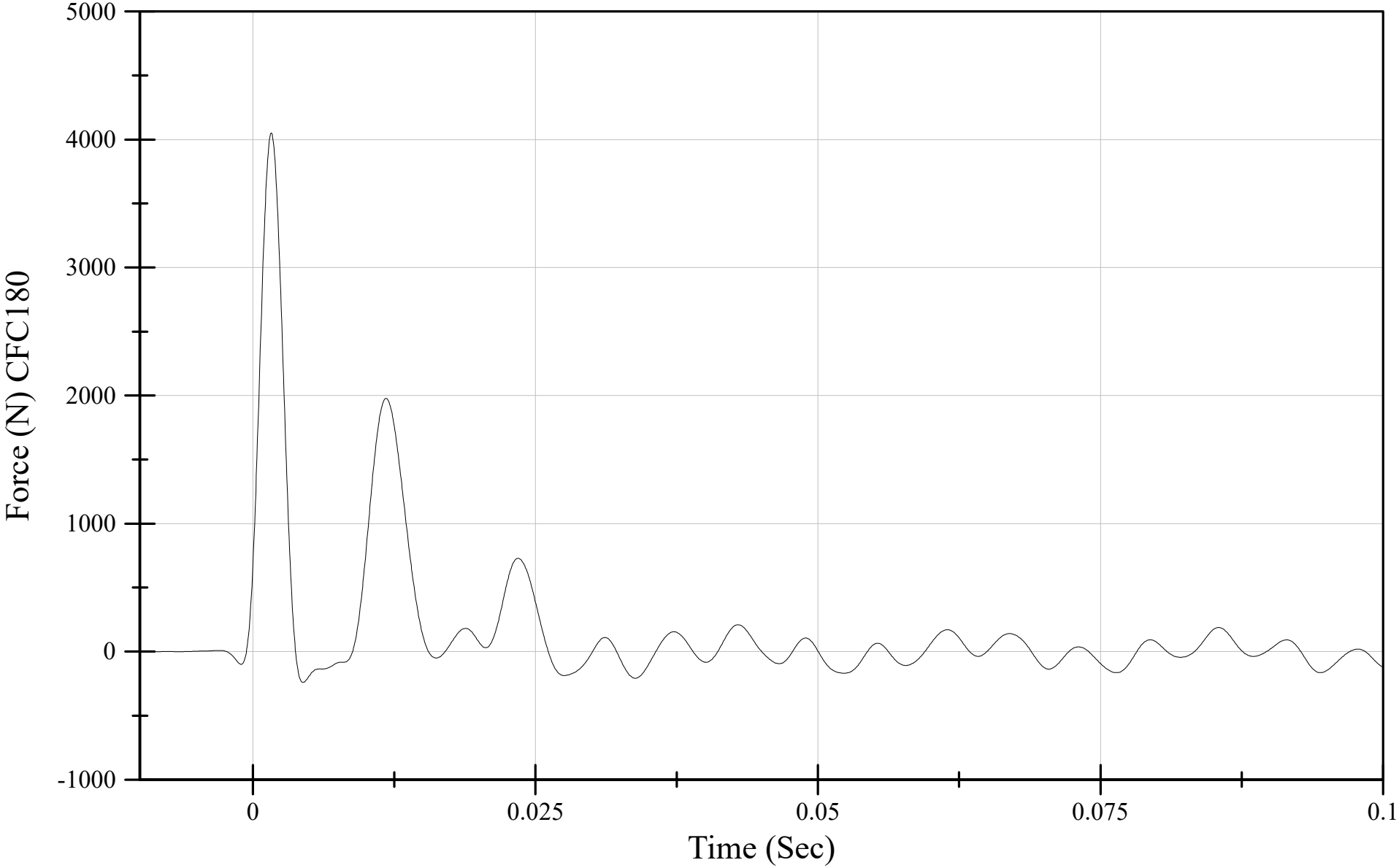
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.0	Pass
Test Humidity (%)	10 - 70	49	Pass
Test Velocity (m/s)	3.95 - 4.05	3.97	Pass
Probe Force (N)		4051.5	
Peak Lower Tibia Fz (N)		-1818.6	

* THOR-05F Qualification Manual - July 2022

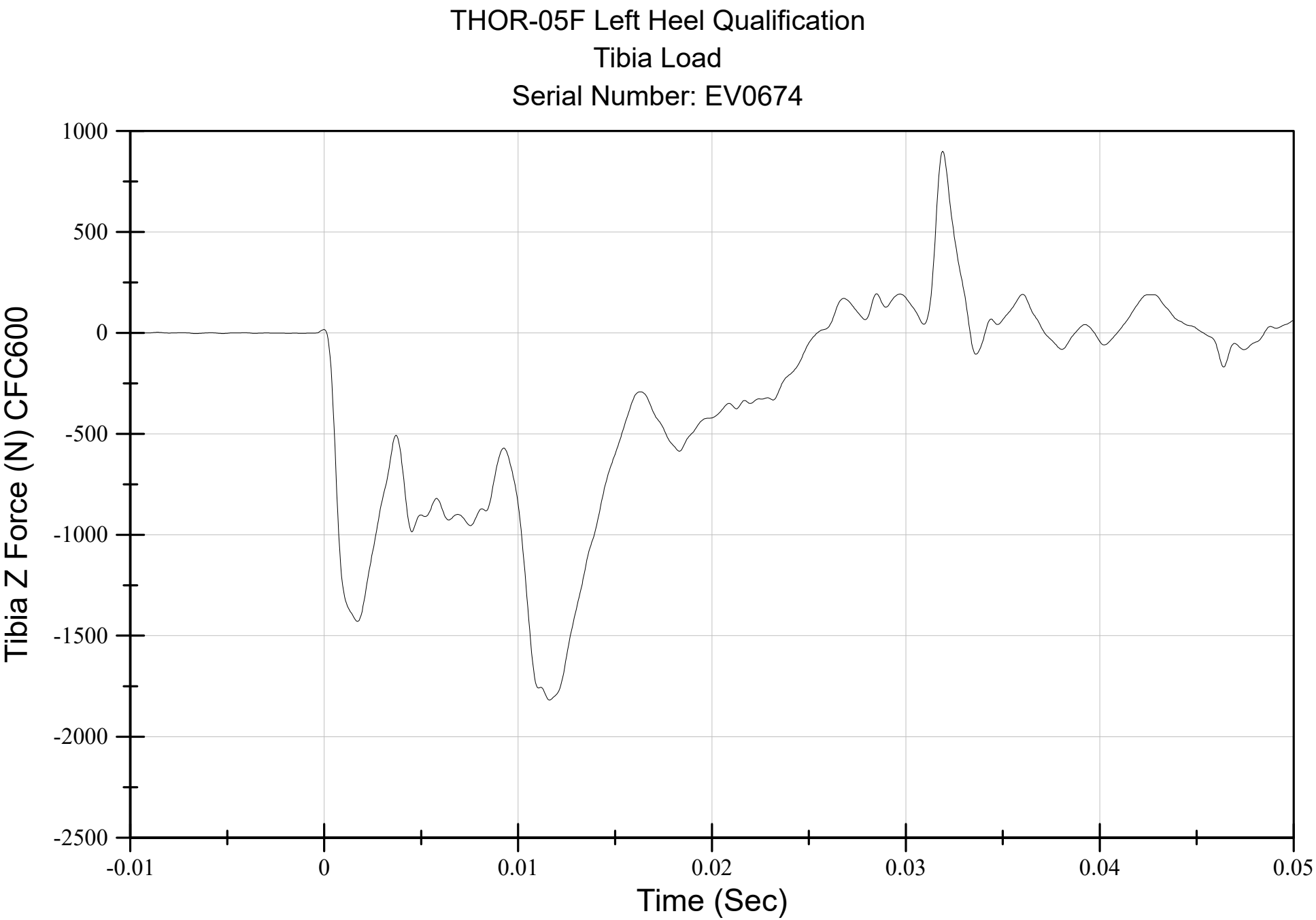
File Name: 221215-1 processed
Software Version: 2.8

THOR-05F Left Heel Qualification
Probe Force
Dummy Serial Number: EV0674



File Name: 221215-1 processed

12/15/2022 8:02 AM



File Name: 221215-1 processed

12/15/2022 8:02 AM

THOR-05F Right Upper Leg Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Compression Element: EV0619
Right Thigh Flesh: EV0939

Test ID: 221206-11
Test Date: 12/6/2022
Test Time: 2:29 PM

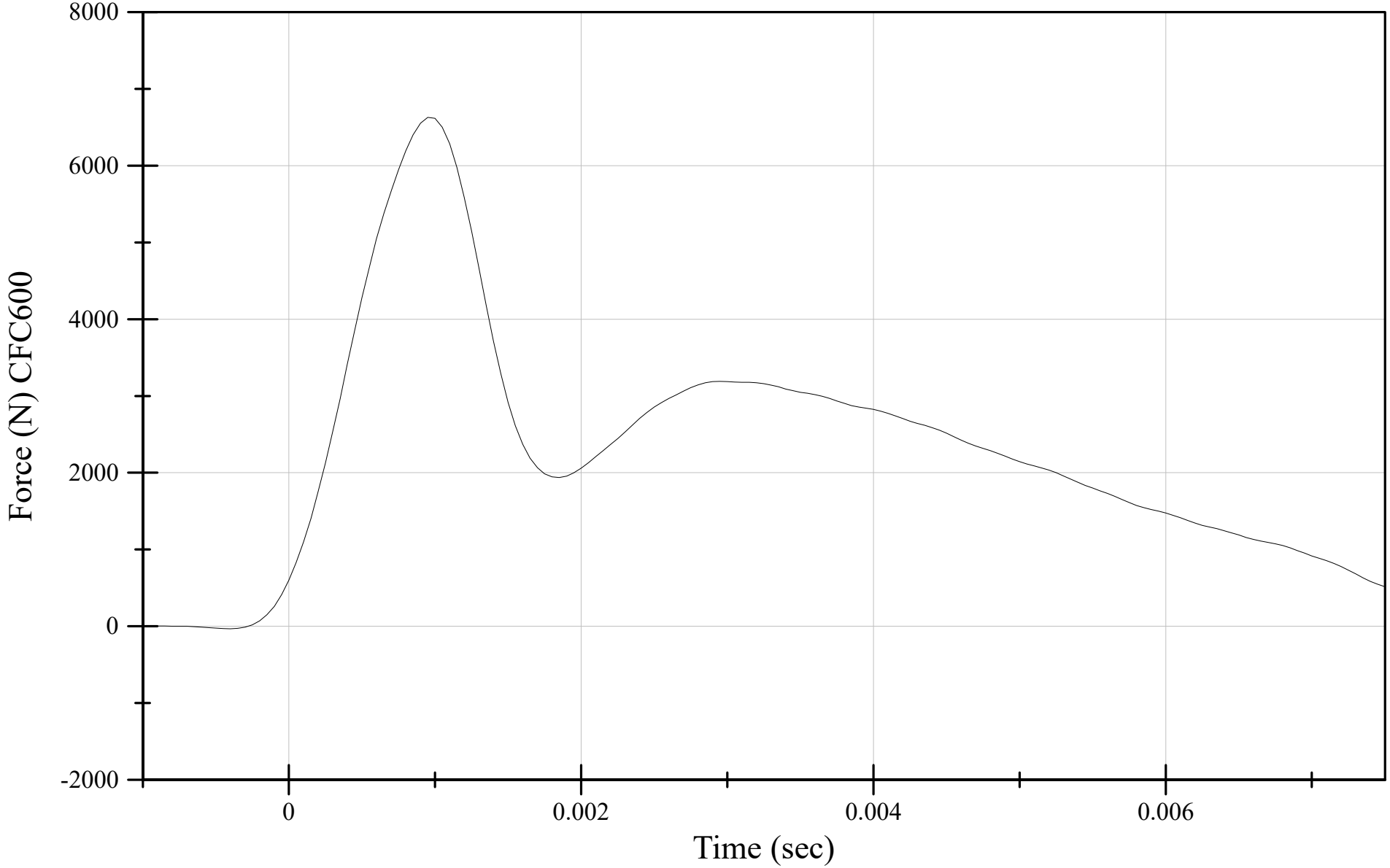
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.4	Pass
Test Humidity (%)	10 - 70	49	Pass
Test Velocity (m/s)	3.25 - 3.35	3.31	Pass
Peak Probe Force (N)		6632	
Peak Femur Force (N)		-3834	
Peak Resultant Acetabulum Force (N)		1777	

* THOR-05F Qualification Manual - July 2022

File Name: 221206-11 processed

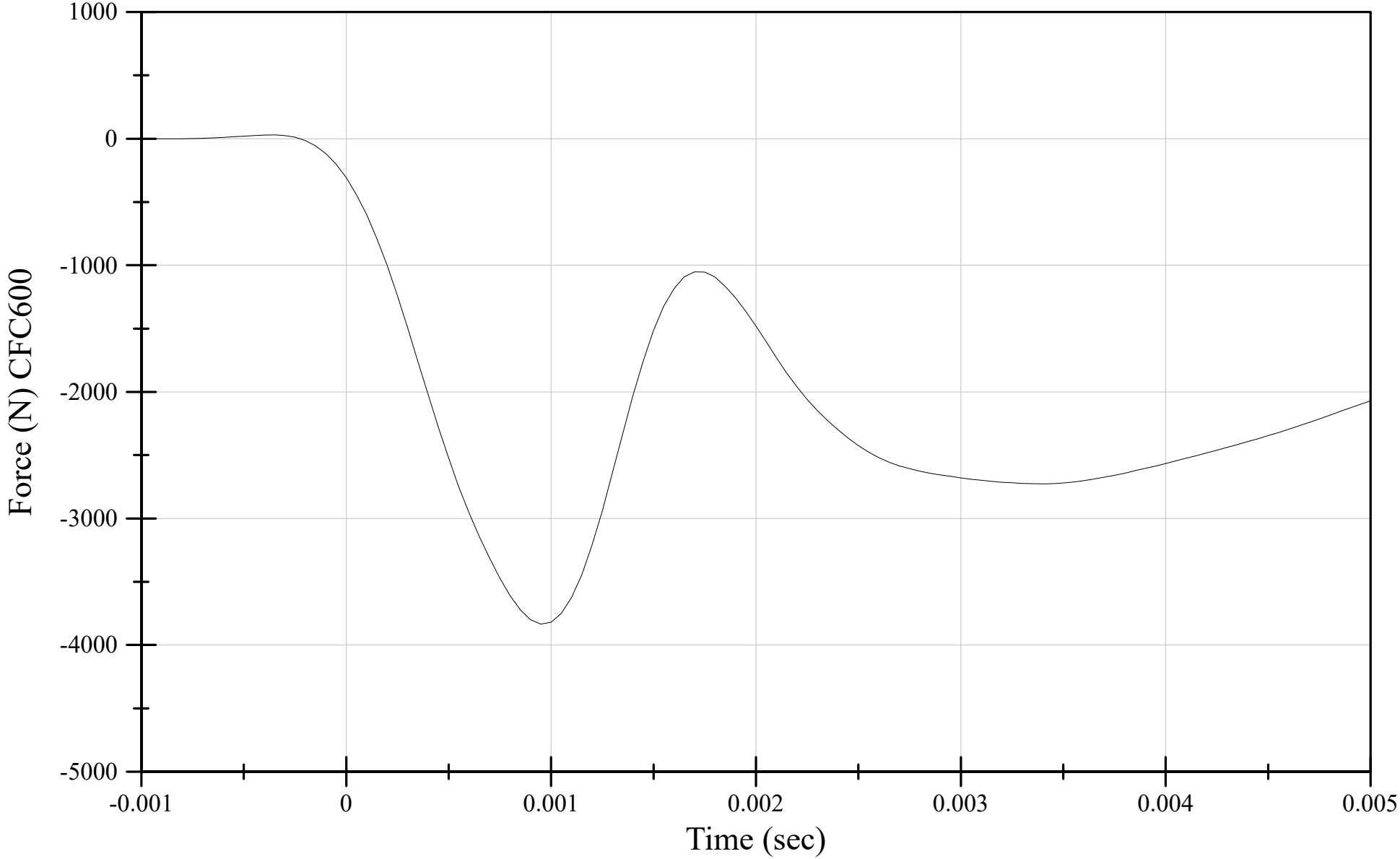
THOR-05F Right Upper Leg Qualification
Probe Force
Serial Number: EV0674



File Name: 221206-11 processed

12/6/2022 2:29 PM

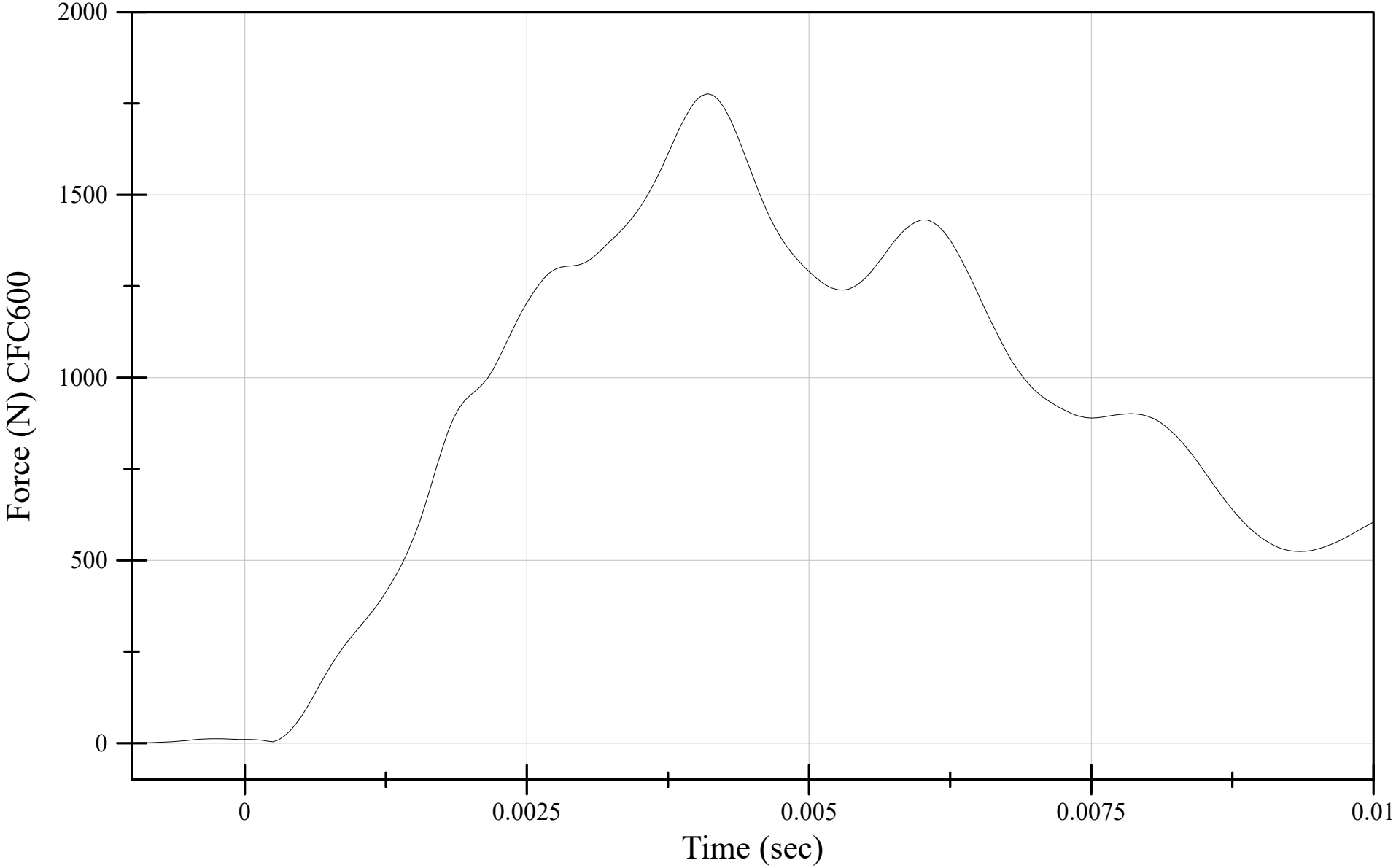
THOR-05F Right Upper Leg Qualification
Femur Z-Force
Serial Number: EV0674



File Name: 221206-11 processed

12/6/2022 2:29 PM

THOR-05F Right Upper Leg Qualification
Peak Acetabulum Resultant Force
Serial Number: EV0674



File Name: 221206-11 processed

12/6/2022 2:29 PM

THOR-05F Right Knee Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Right Knee Slider: EV2939

Test ID: 221207-10
Test Date: 12/7/2022
Test Time: 2:25 PM

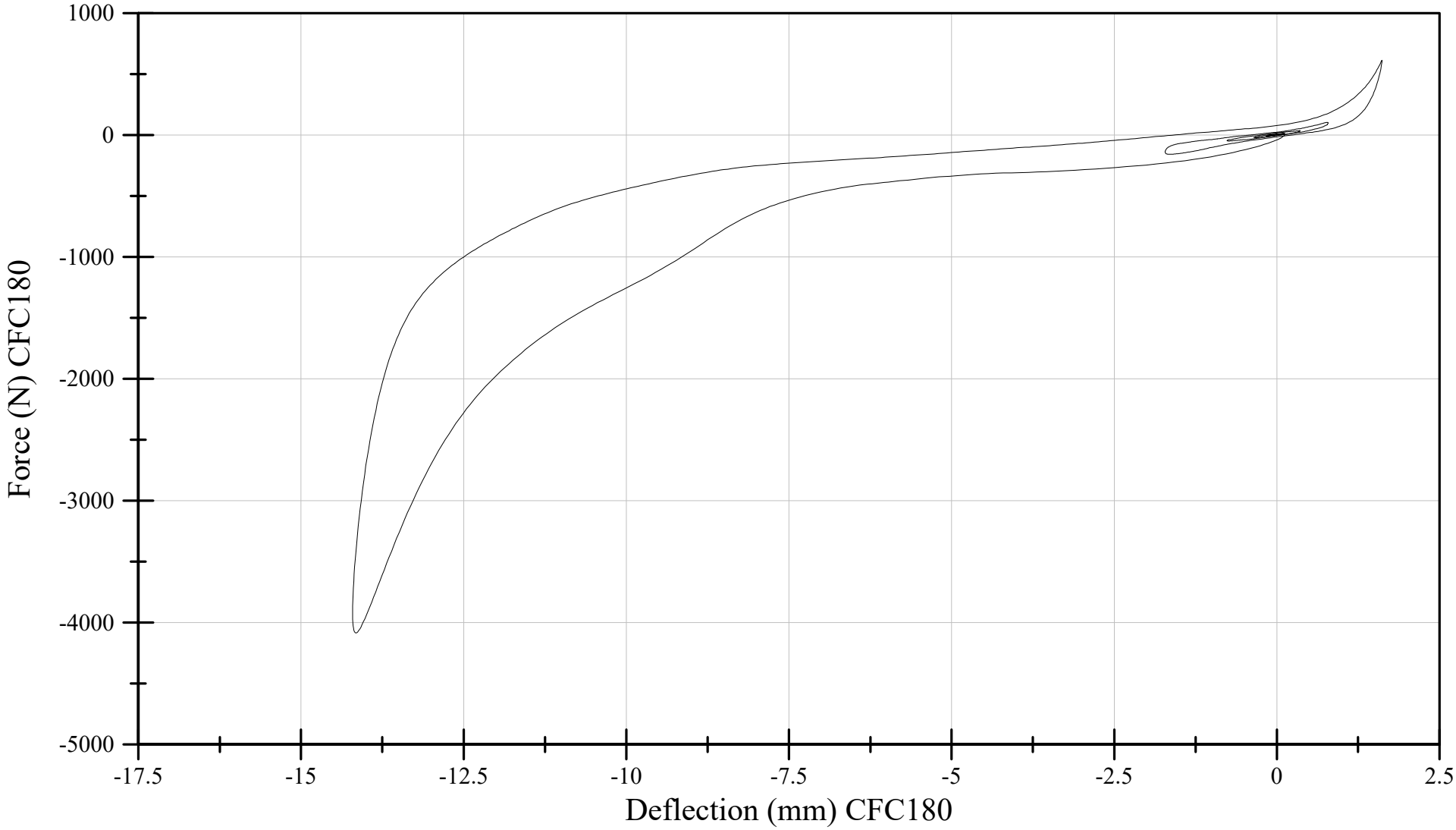
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.2	Pass
Test Humidity (%)	10 - 70	47	Pass
Test Velocity (m/s)	2.10 - 2.20	2.15	Pass
Peak Femur Fz (N)		-4083.5	
Knee Deflection at Peak Femur Force (N)		-14.2	

* THOR-05F Qualification Manual - July 2022

File Name: 221207-10 processed
Software Version: 2.8

THOR-05F Right Knee Qualification
Peak Deflection at Peak Force
Serial Number: EV0674



File Name: 221207-10 processed

12/7/2022 2:25 PM

THOR-05F Right Achilles Tension Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Left Ankle Assembly: EV4210

Test ID: 221208-11
Test Date: 12/8/2022
Test Time: 3:31 PM

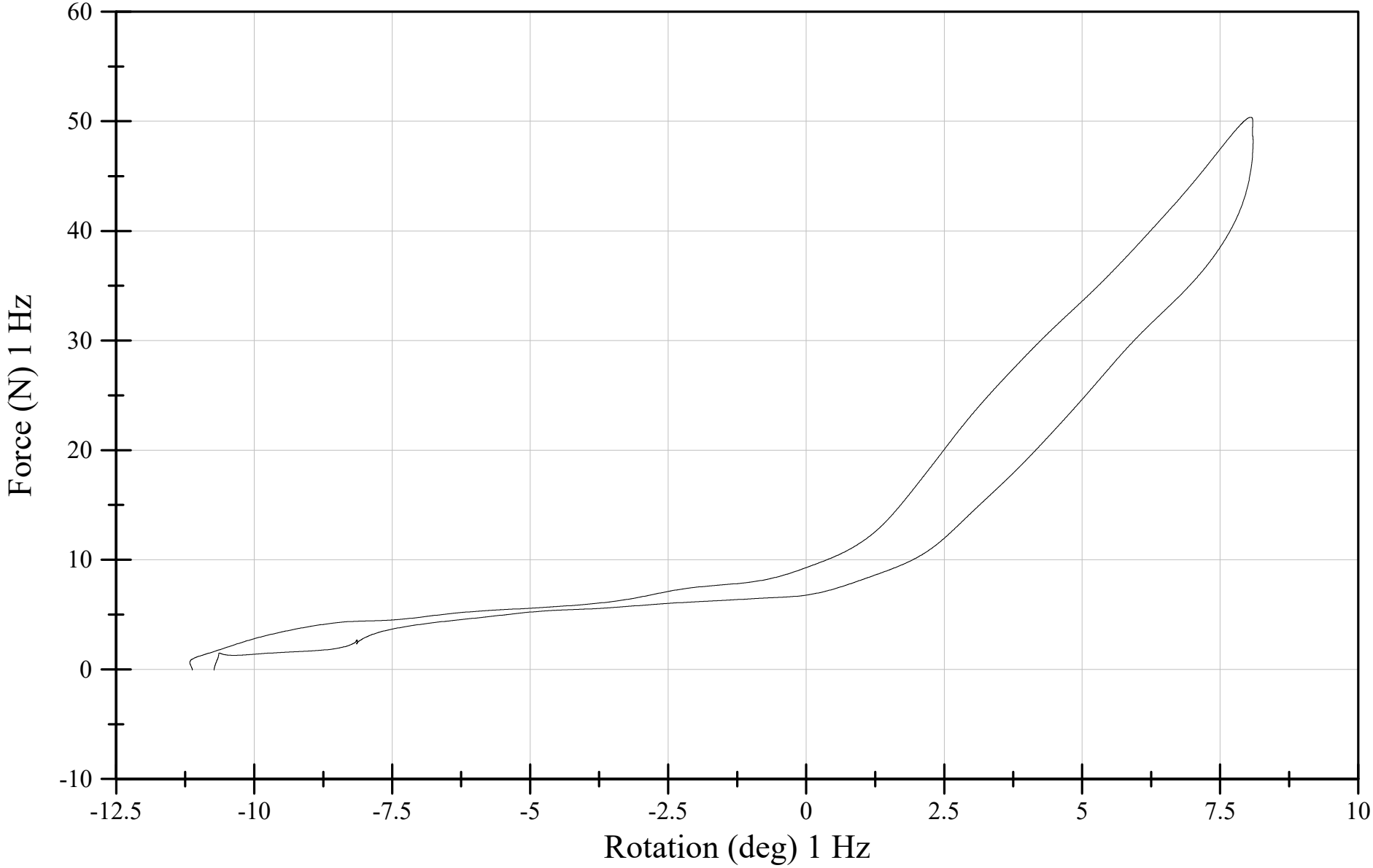
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.1	Pass
Test Humidity (%)	10 - 70	50	Pass
Force at 0° Y Rotation (N)		9	

* THOR-05F Qualification Manual - July 2022

File Name: 221208-11 processed
Software Version: 2.8

THOR-05F Right Achilles Tension Qualification
Force vs Rotation
Ankle Serial Number: EV4210



File Name: 221208-11 processed

12/8/2022 3:31 PM

THOR-05F Right Ball of Foot Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components

Right Ankle: EV4210

Right Dorsiflexion Stop: EU1417

Test ID: 221213-6

Test Date: 12/13/2022

Test Time: 2:44 PM

Test Results

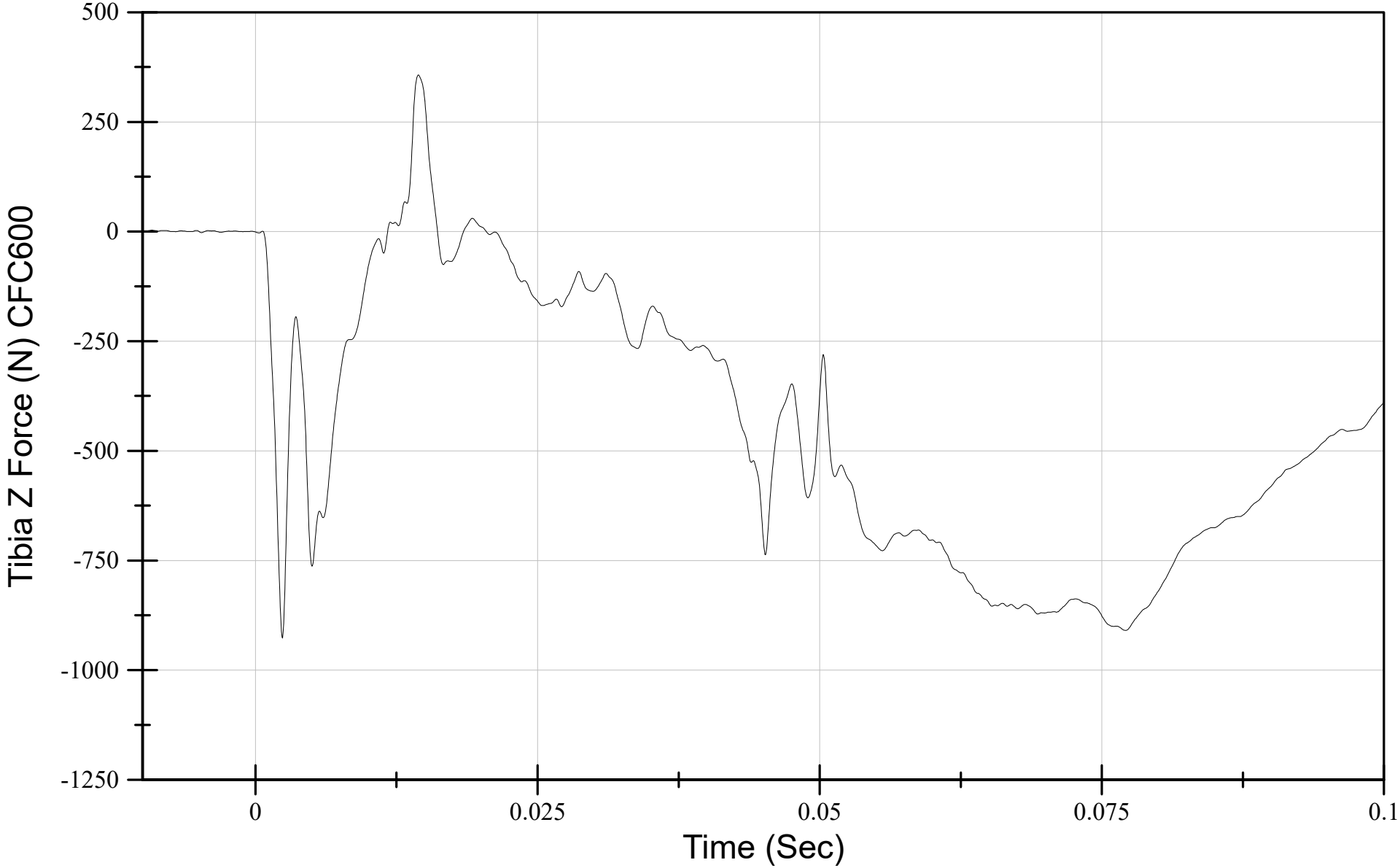
Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.0	Pass
Test Humidity (%)	10 - 70	57	Pass
Test Velocity (m/s)	1.95 - 2.05	2.02	Pass
Peak Lower Tibia Fz after 10 ms (N)		-909.8	
Peak Ankle Resistive Moment (Nm)		38.2	
Peak Ankle Y-axis Rotation (deg)		29.9	

* THOR-05F Qualification Manual - July 2022

File Name: 221213-6 processed

Software Version: 2.8

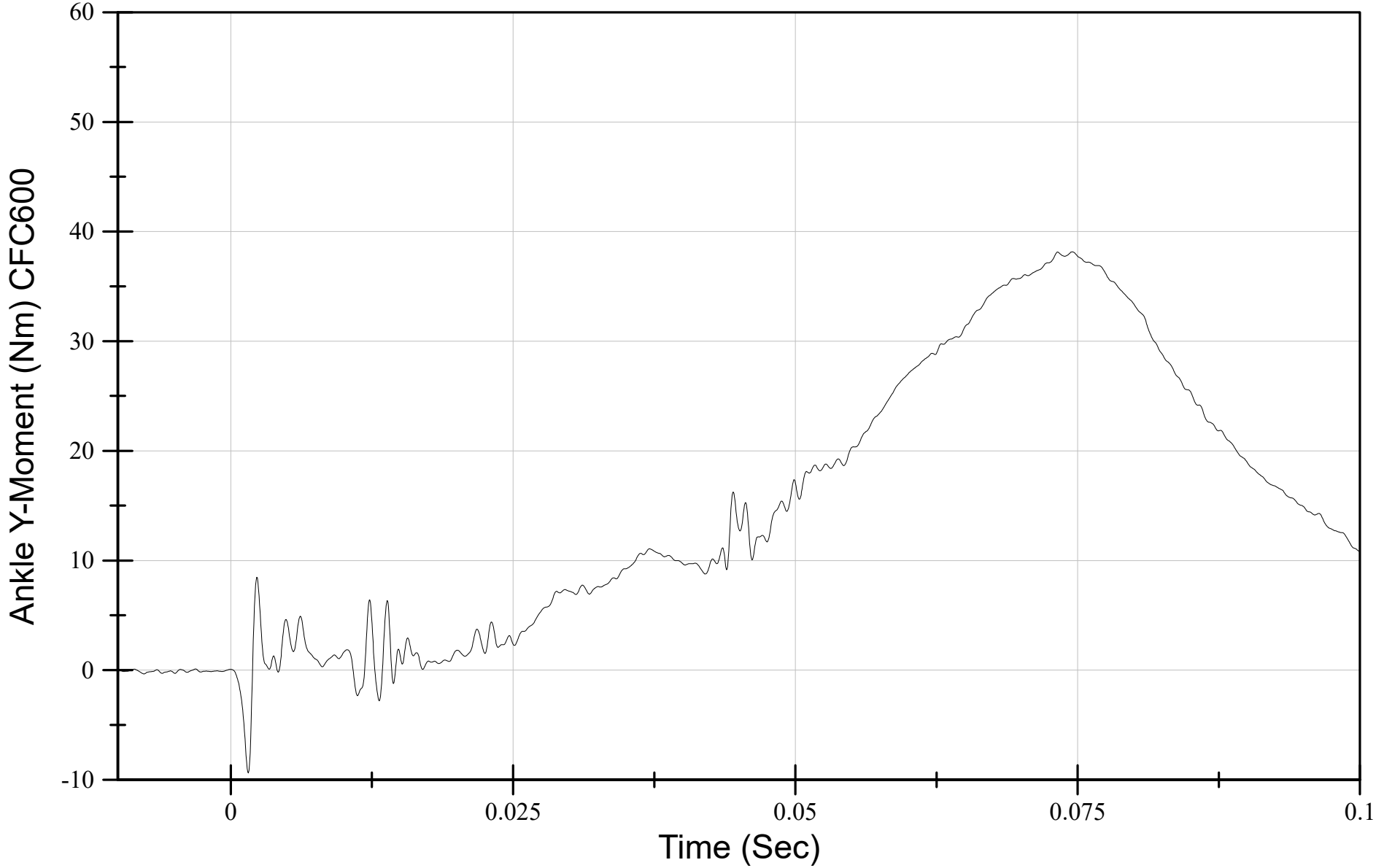
THOR-05F Right Ball of Foot Qualification
Lower Tibia Fz
Ankle Serial Number: EV4210



File Name: 221213-6 processed

12/13/2022 2:44 PM

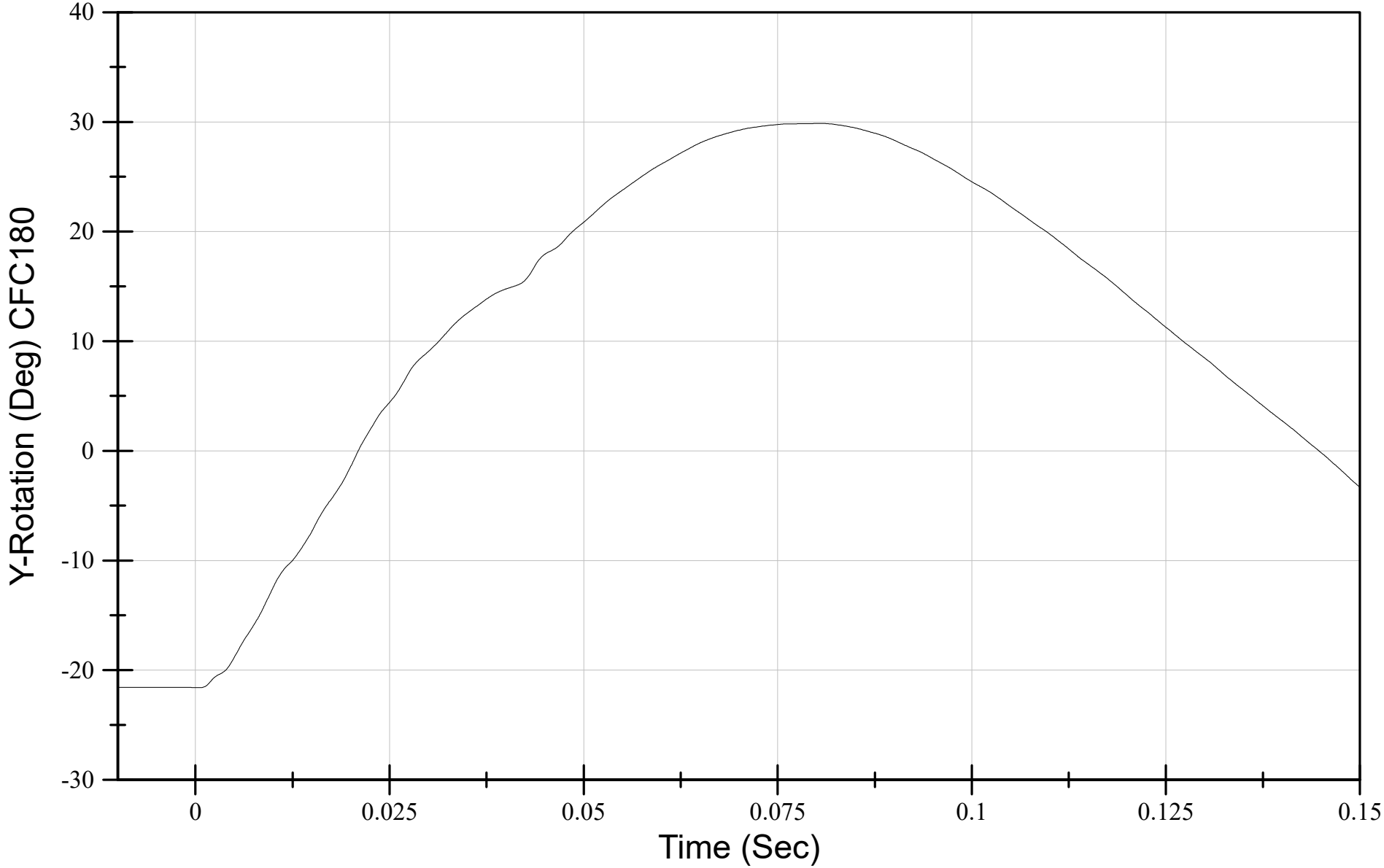
THOR-05F Right Ball of Foot Qualification
Ankle Y-Moment
Ankle Serial Number: EV4210



File Name: 221213-6 processed

12/13/2022 2:44 PM

THOR-05F Right Ball of Foot Qualification
Ankle Y-Rotation
Ankle Serial Number: EV4210



File Name: 221213-6 processed

12/13/2022 2:44 PM

THOR-05F Right Foot Inversion Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components	Test ID: 221208-4
Ankle Serial: EV4210	Test Date: 12/8/2022
Inversion Stop Assembly: EP6365	Test Time: 8:35 AM

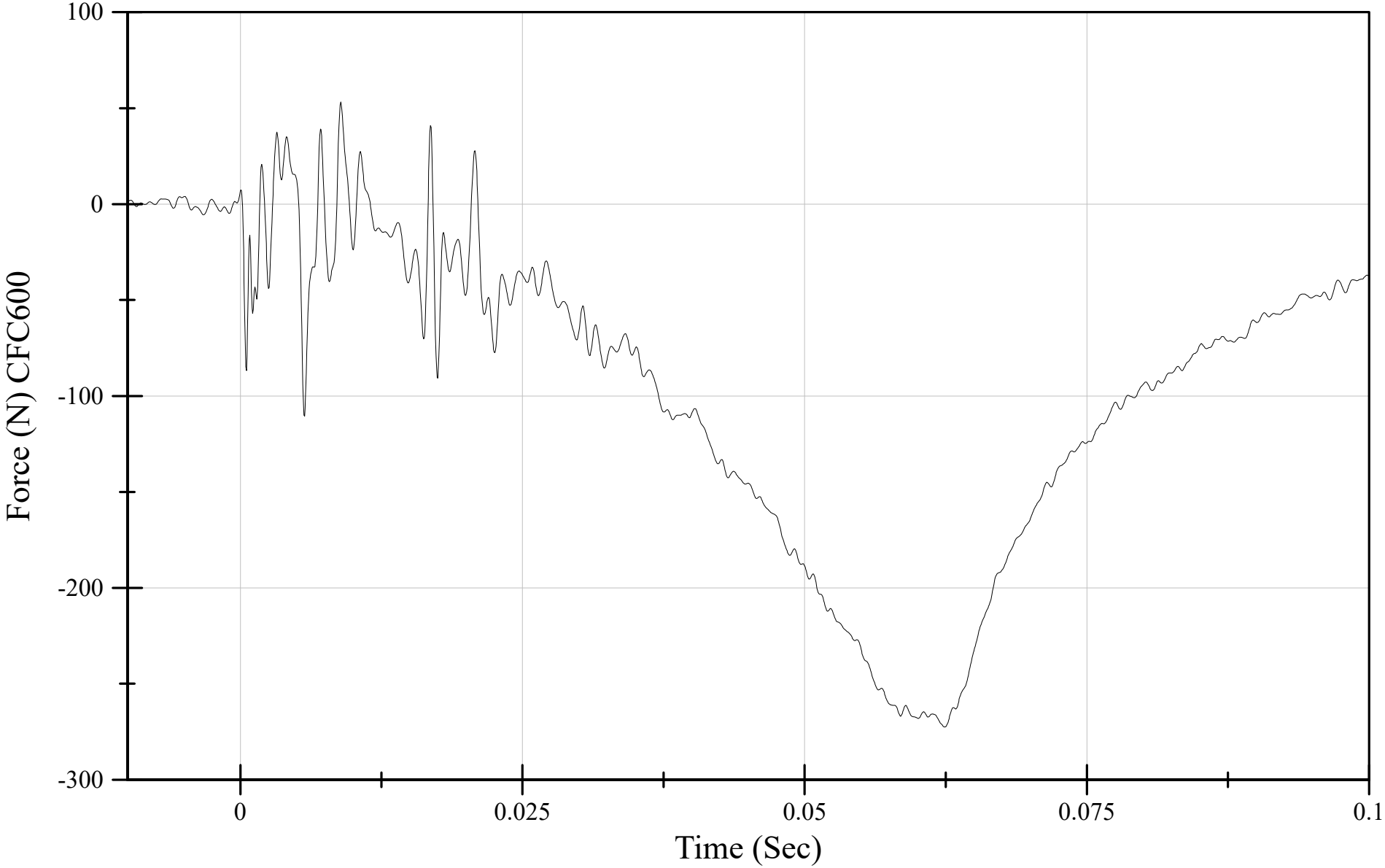
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.2	Pass
Test Humidity (%)	10 - 70	49	Pass
Test Velocity (m/s)	1.95 - 2.05	1.99	Pass
Peak Lower Tibia Fz		-272.5	
Peak Ankle X-axis Resistive Moment		31.1	
Peak Ankle X-axis Rotation		45.8	

* THOR-05F Qualification Manual - July 2022

File Name: 221208-4 processed
Software Version: 2.8

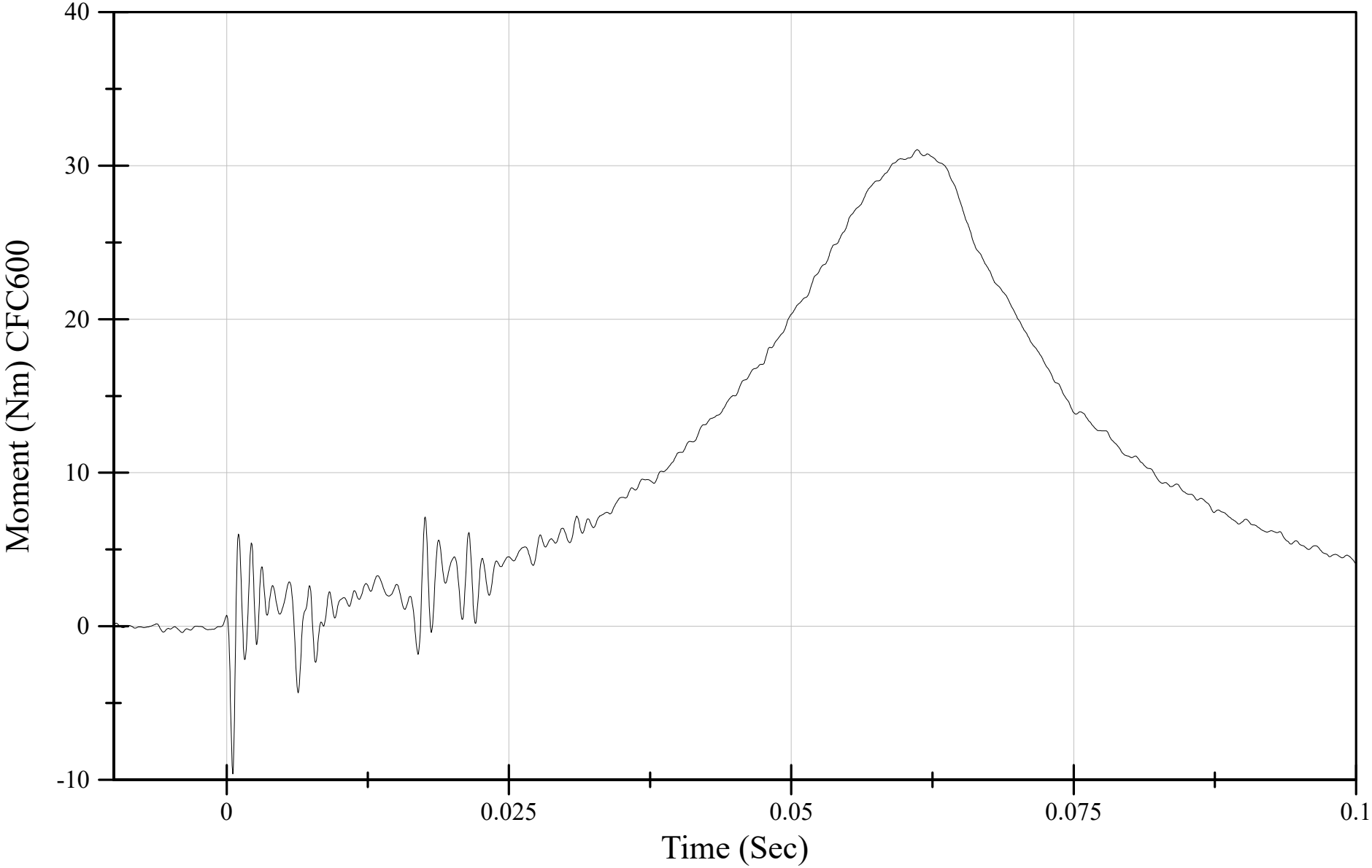
THOR-05F Right Foot Inversion Qualification
Tibia Load - Force Z
Ankle Serial Number: EV4210



File Name: 221208-4 processed

12/8/2022 8:35 AM

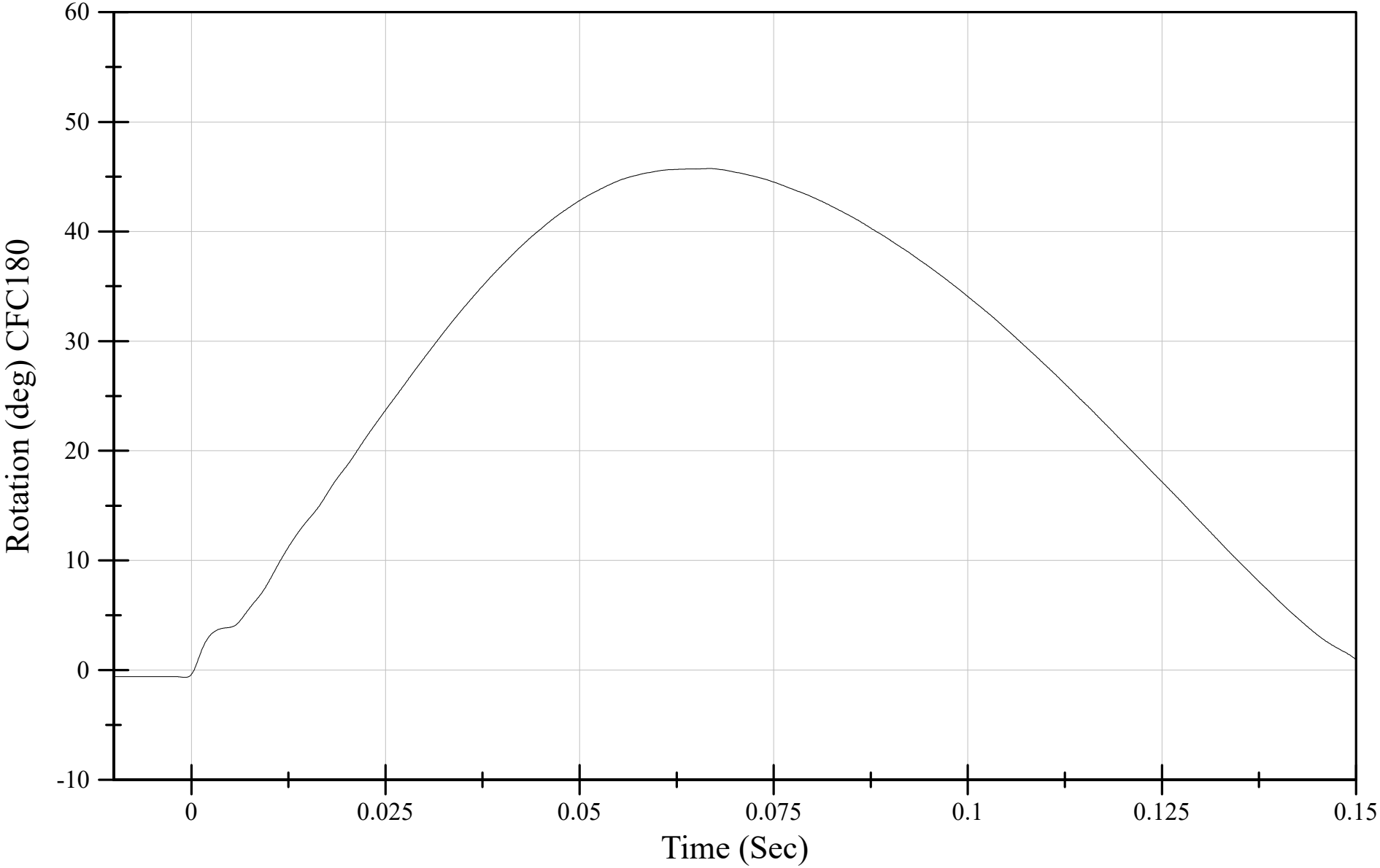
THOR-05F Right Foot Inversion Qualification
Ankle Moment - X axis
Ankle Serial Number: EV4210



File Name: 221208-4 processed

12/8/2022 8:35 AM

THOR-05F Right Foot Inversion Qualification
Ankle X-Rotation
Ankle Serial Number: EV4210



File Name: 221208-4 processed

12/8/2022 8:35 AM

THOR-05F Right Foot Eversion Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components	Test ID: 221208-6
Ankle Serial: EV4210	Test Date: 12/8/2022
Eversion Stop Assembly: EV3439	Test Time: 11:32 AM

Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.2	Pass
Test Humidity (%)	10 - 70	54	Pass
Test Velocity (m/s)	1.95 - 2.05	2.05	Pass
Peak Lower Tibia Fz		-298.9	
Peak Ankle X-axis Resistive Moment		-29.8	
Peak Ankle X-axis Rotation		-34.1	

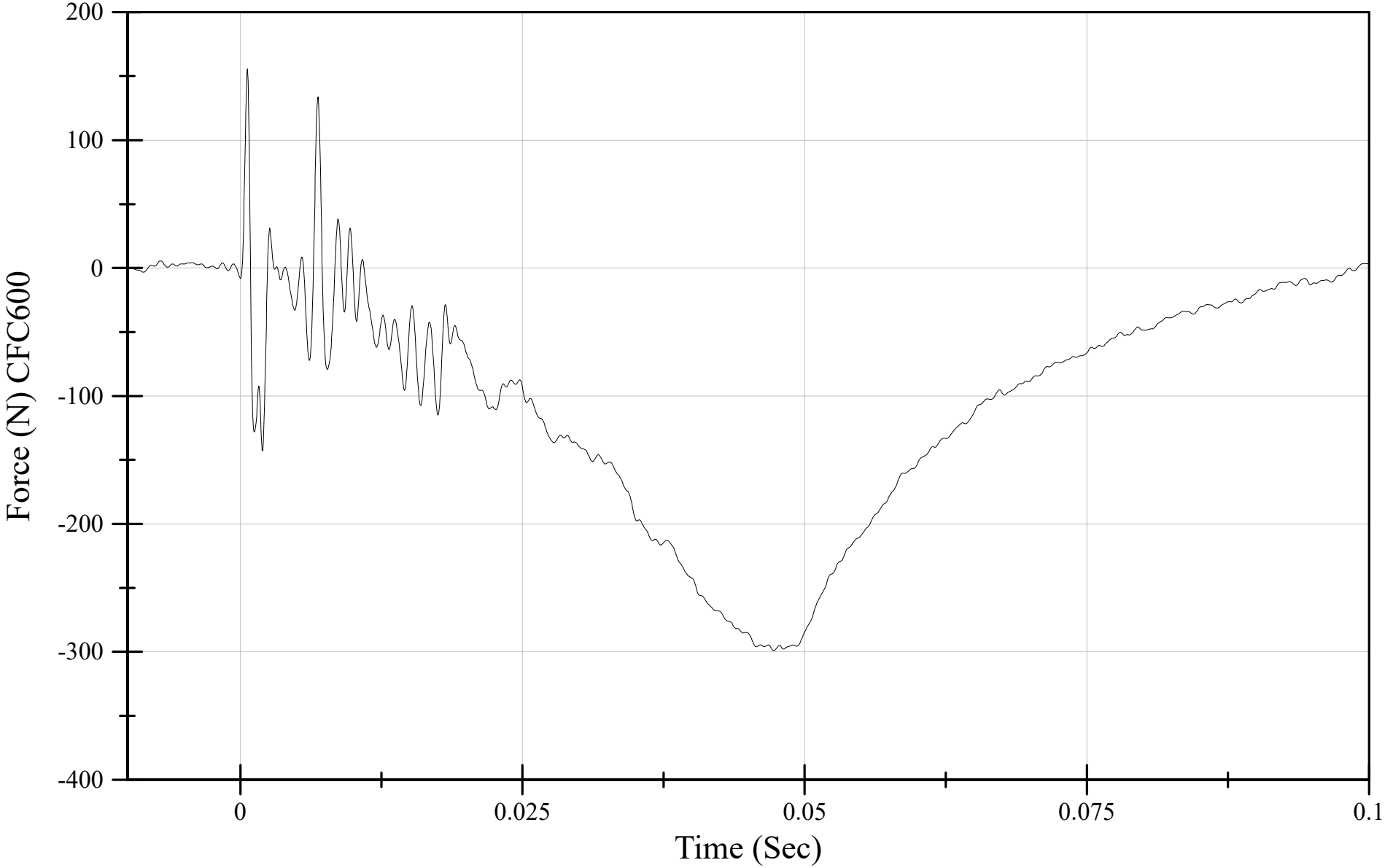
* THOR-05F Qualification Manual - July 2022

File Name: 221208-6 processed
Software Version: 2.8

THOR-05F Right Foot Eversion Qualification

Tibia Load - Force Z

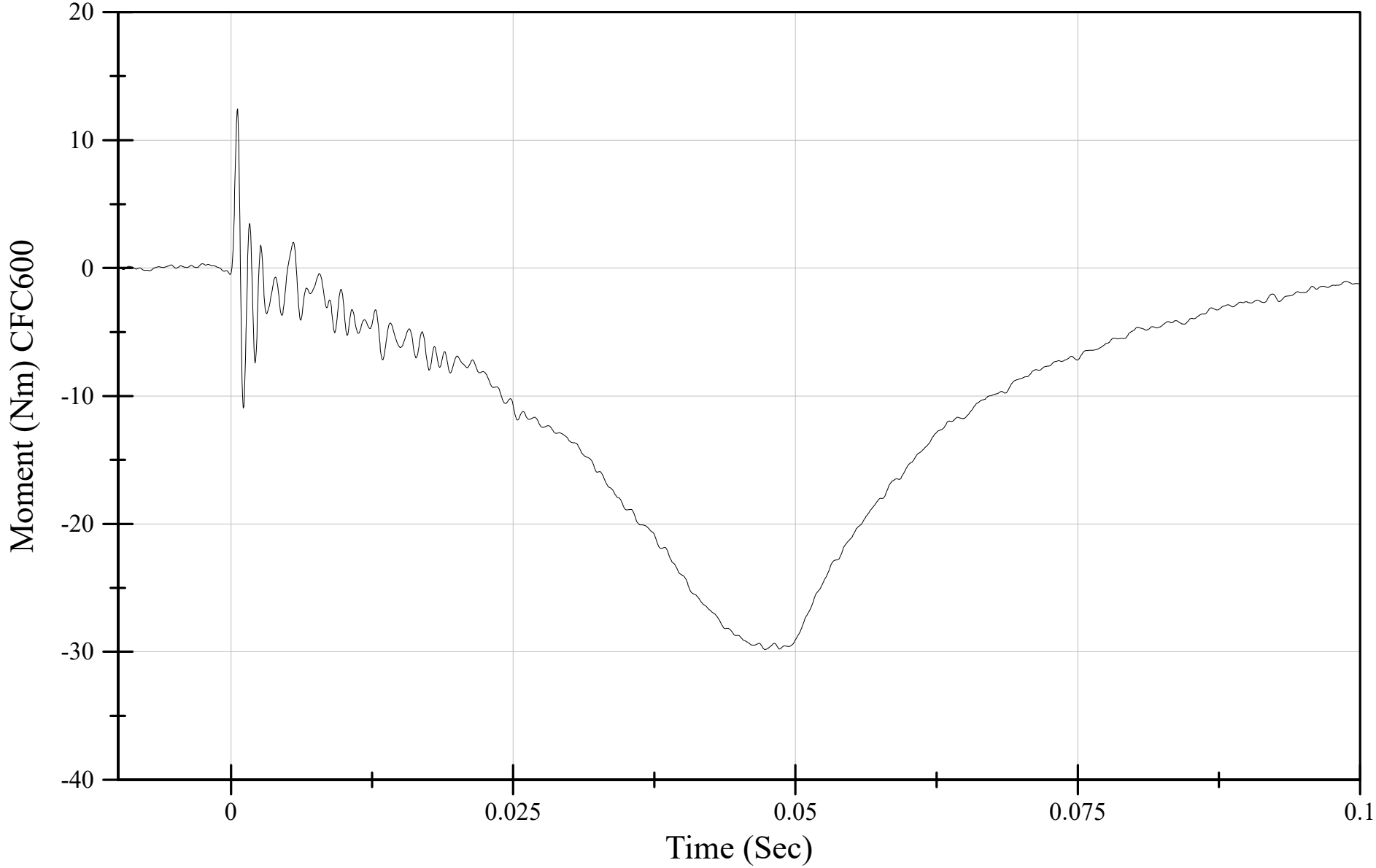
Ankle Serial Number: EV4210



File Name: 221208-6 processed

12/8/2022 11:32 AM

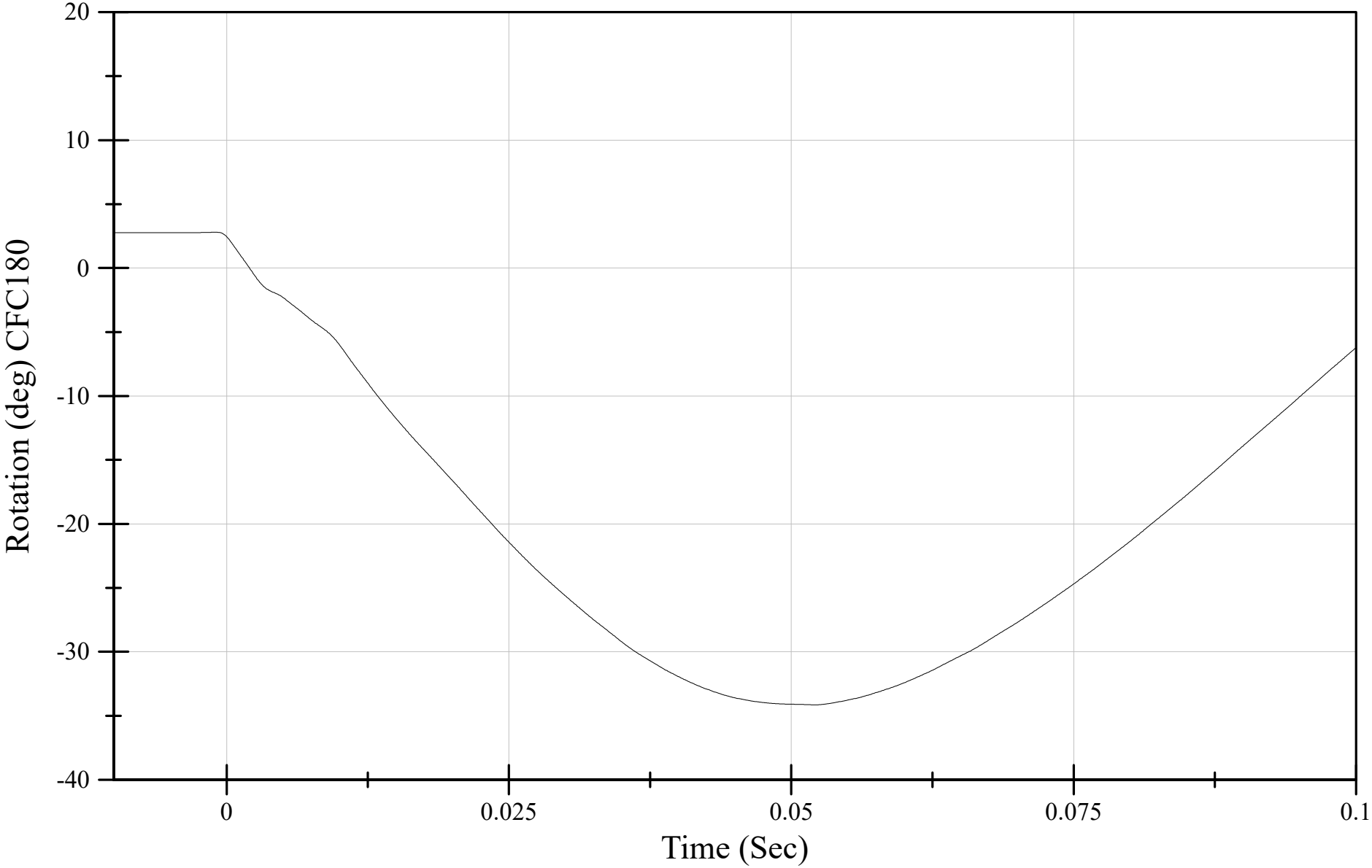
THOR-05F Right Foot Eversion Qualification
Ankle Moment - X axis
Ankle Serial Number: EV4210



File Name: 221208-6 processed

12/8/2022 11:32 AM

THOR-05F Right Foot Eversion Qualification
Ankle X-Rotation
Ankle Serial Number: EV4210



File Name: 221208-6 processed

12/8/2022 11:32 AM

THOR-05F Right Heel Qualification
Test Results Summary

Dummy Serial Number: EV0674

Tested Components
Right Ankle: EV4210

Test ID: 221213-10
Test Date: 12/13/2022
Test Time: 3:19 PM

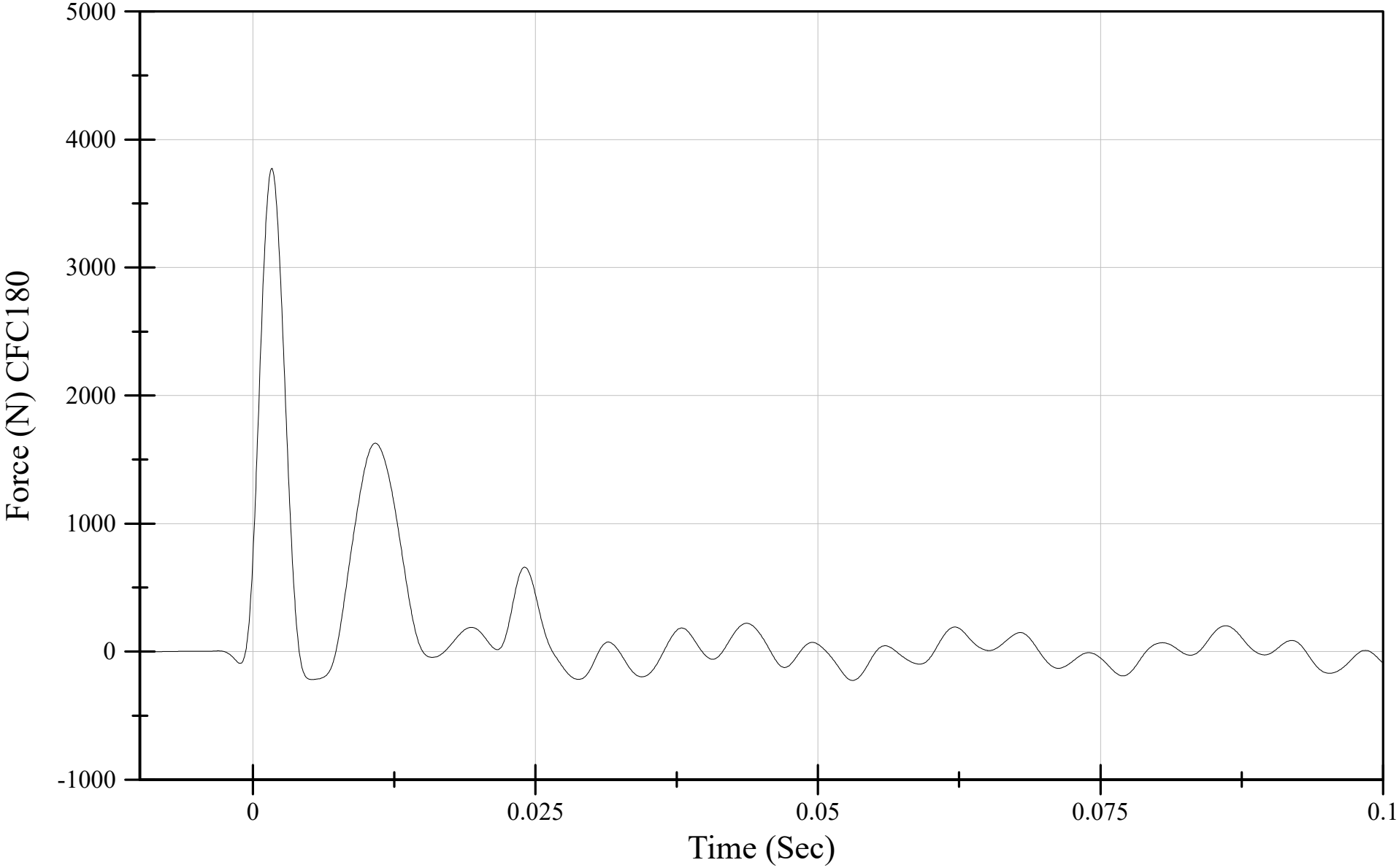
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.1	Pass
Test Humidity (%)	10 - 70	48	Pass
Test Velocity (m/s)	3.95 - 4.05	4.03	Pass
Probe Force (N)		3774.9	
Peak Lower Tibia Fz (N)		-1903.5	

* THOR-05F Qualification Manual - July 2022

File Name: 221213-10 processed
Software Version: 2.8

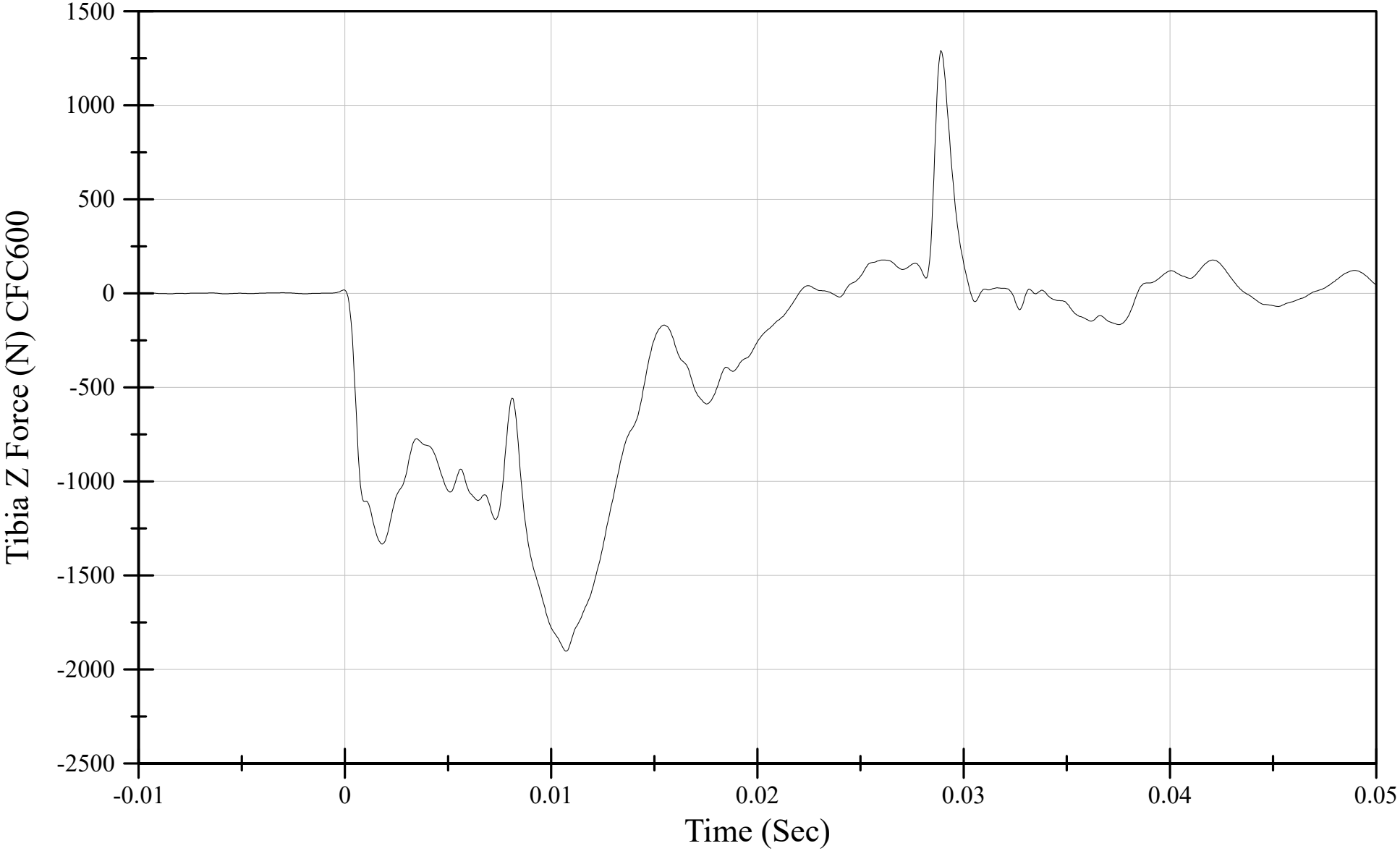
THOR-05F Right Heel Qualification
Probe Force
Dummy Serial Number: EV0674



File Name: 221213-10 processed

12/13/2022 3:19 PM

THOR-05F Right Heel Qualification
Tibia Load
Serial Number: EV0674



File Name: 221213-10 processed

12/13/2022 3:19 PM

THOR-05F Head Impact Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Head Skin:

Test ID: 220426-3
Test Date: 4/26/2022
Test Time: 8:53 AM

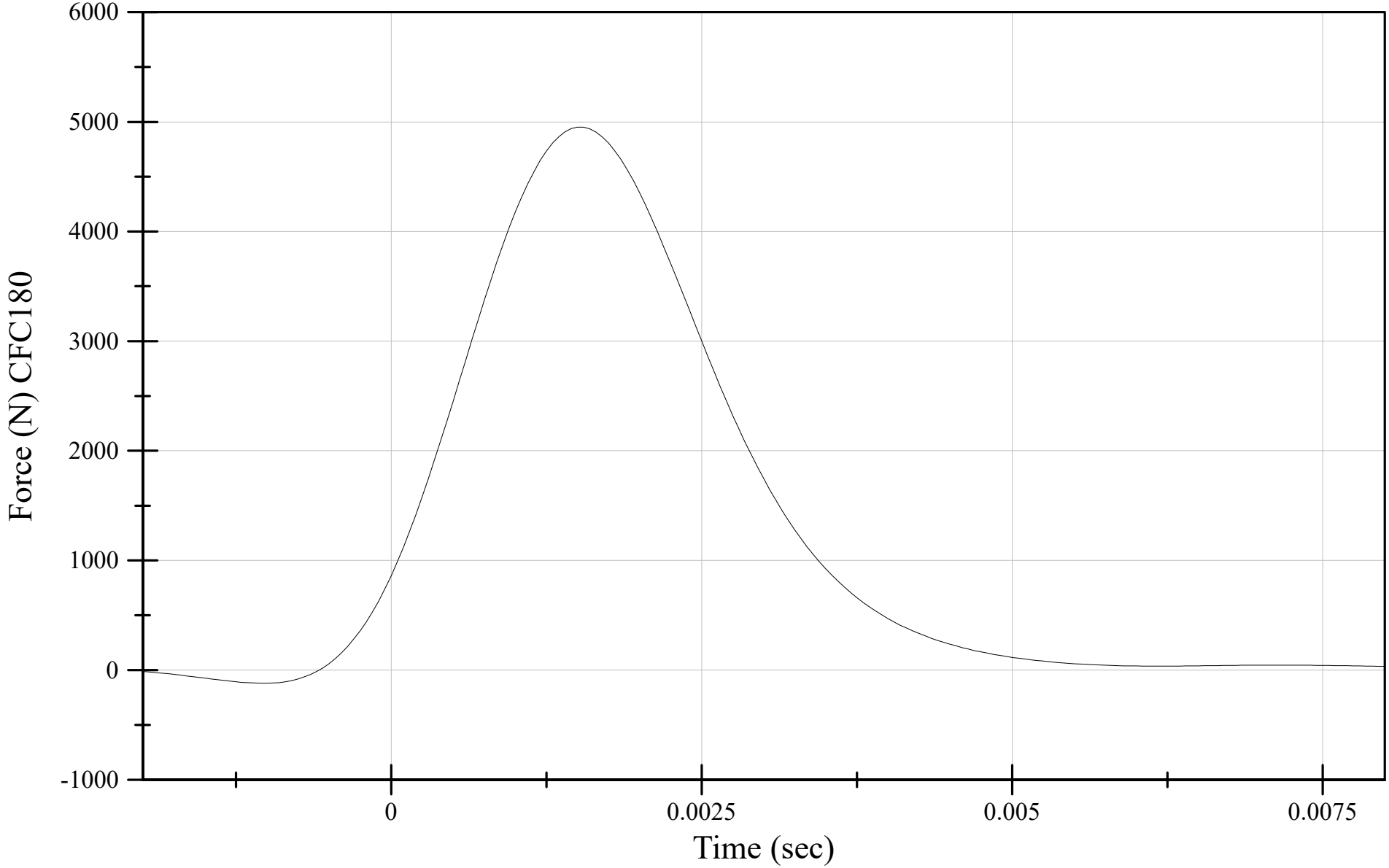
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.6	Pass
Test Humidity (%)	10 - 70	45	Pass
Test Velocity (m/s)	1.95 - 2.05	2.00	Pass
Peak Probe Force (N)		4952	
Peak Head CG Resultant Acceleration (g)		149	

* THOR-05F Qualification Manual - March 2022

File Name: 220426-3 processed
Software Version: 2.8

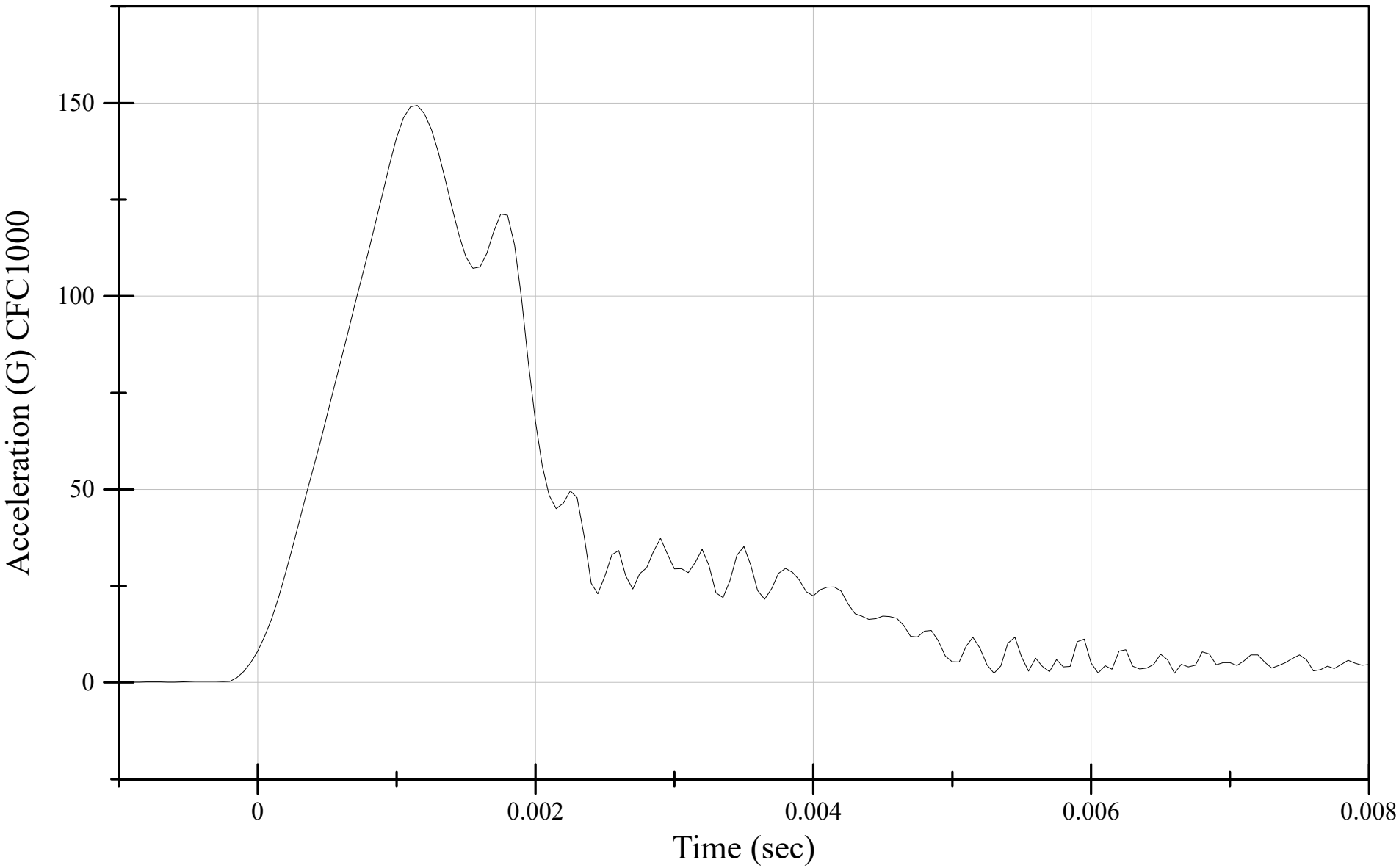
THOR-05F Head Impact Qualification
Probe Force
Dummy Serial Number: EU3430



File Name: 220426-3 processed

4/26/2022 8:53 AM

THOR-05F Head Impact Qualification
Head CG Resultant Acceleration
Dummy Serial Number: EU3430



File Name: 220426-3 processed

4/26/2022 8:53 AM

THOR-05F Face Disk Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components

Head Skin: ET8171

Face Foam: ET4086

Test ID: 220112-10

Test Date: 1/12/2022

Test Time: 4:58 PM

Test Results

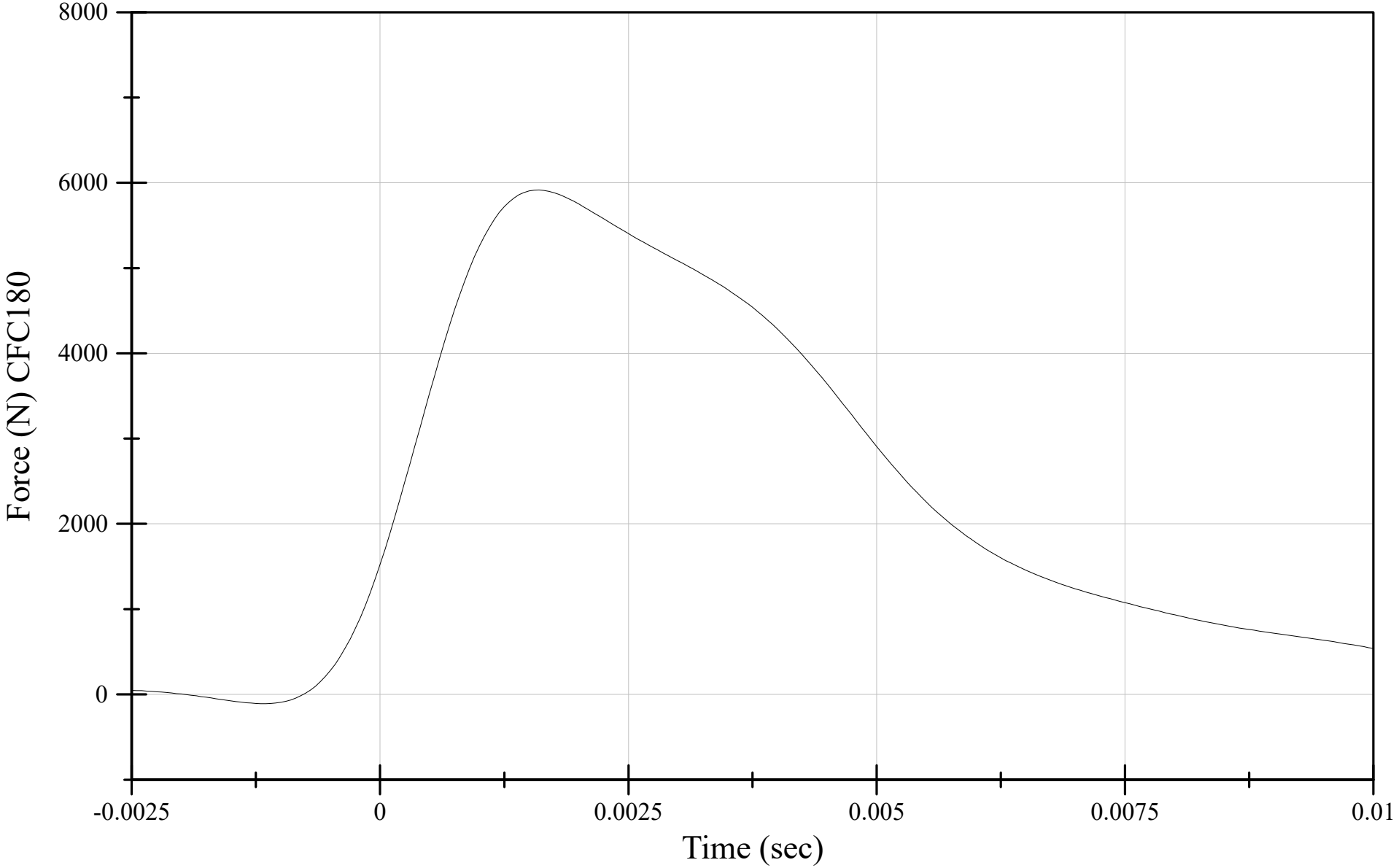
Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.4	Pass
Test Humidity (%)	10 - 70	43	Pass
Test Velocity (m/s)	6.68 - 6.78	6.72	Pass
Peak Probe Force (N)		5917	
Peak Head CG Resultant Acceleration prior to 2 ms (g)		171	
Peak Head CG Resultant Acceleration after to 2 ms (g)		154	

* THOR-05F Qualification Manual - March 2020

File Name: 220112-10 processed

Software Version: 2.8

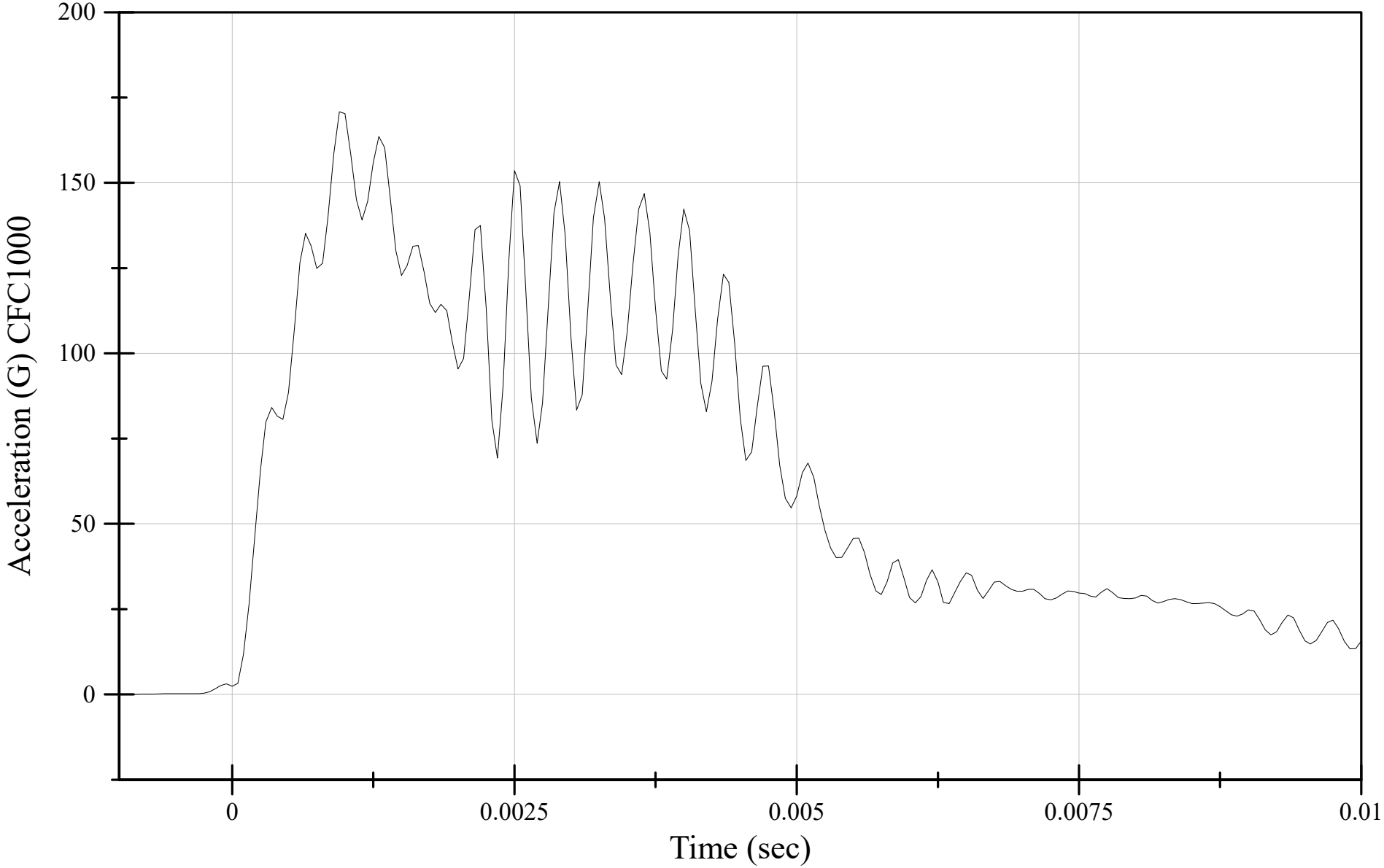
THOR-05F Face Disk Qualification
Probe Force
Dummy Serial Number: EU3430



File Name: 220112-10 processed

1/12/2022 4:58 PM

THOR-05F Face Disk Qualification
Head CG Resultant Acceleration
Dummy Serial Number: EU3430



File Name: 220112-10 processed

1/12/2022 4:58 PM

THOR-05F Neck Extension Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components	Test ID: 220413-7
Neck Serial Number: EU1156	Test Date: 4/13/2022
O.C. Stop Assembly:	Test Time: 3:31 PM
O.C. Cam:	

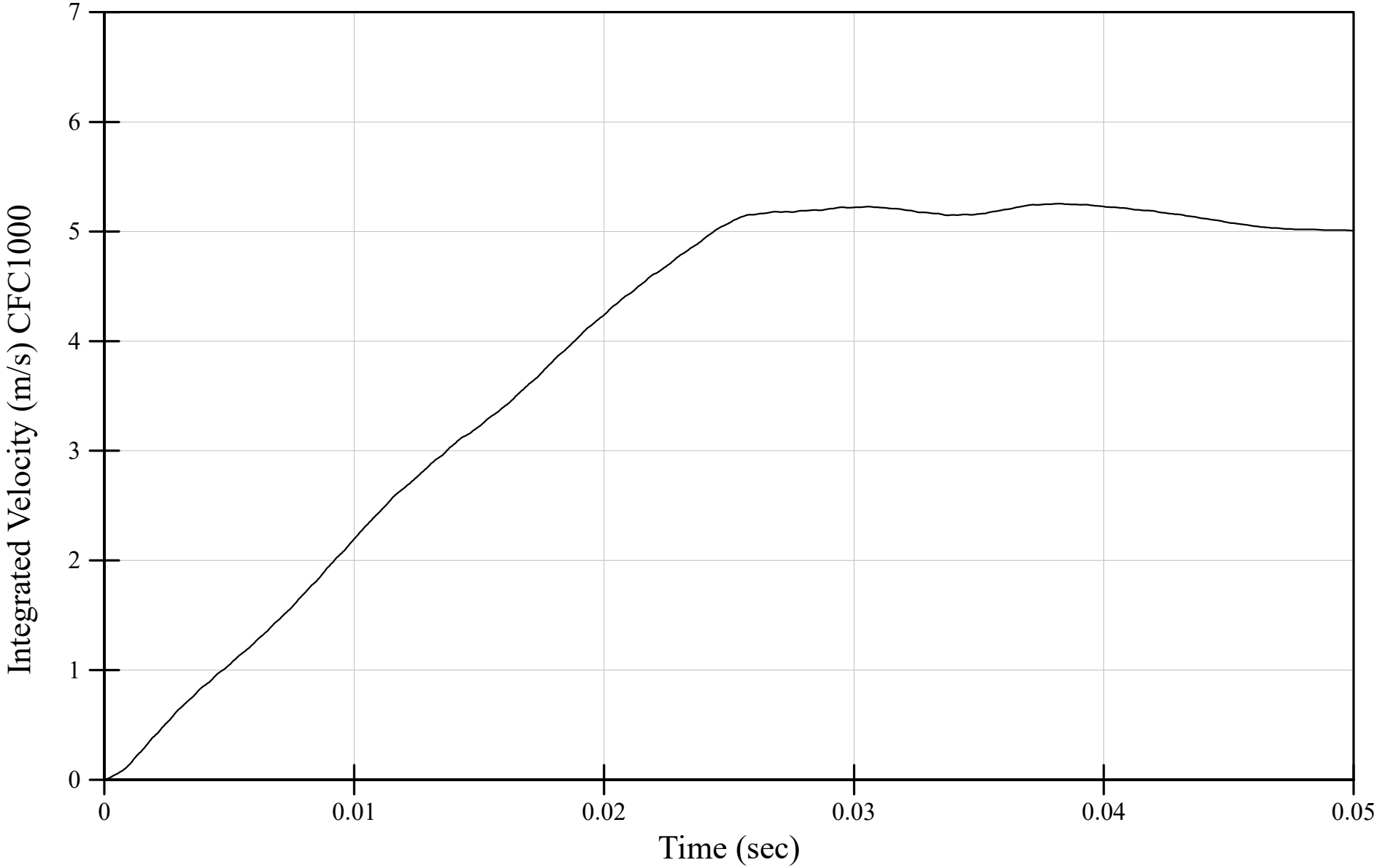
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.8	Pass
Test Humidity (%)	10 - 70	60	Pass
Test Velocity (m/s)	4.95 - 5.05	5.00	Pass
Pendulum Velocity at 8 ms (m/s)		1.70	
Pendulum Velocity at 16 ms (m/s)		3.40	
Pendulum Velocity at 24 ms (m/s)		4.94	
Peak Upper Neck My (Nm)		-17.5	
Peak Upper Neck Fz (N)		-1301	
Peak Head Angular Velocity Y (deg/sec)		2349	
Peak Head Rotation (deg)		86.0	

* THOR-05F Qualification Manual - March 2022

File Name: 220413-7 processed

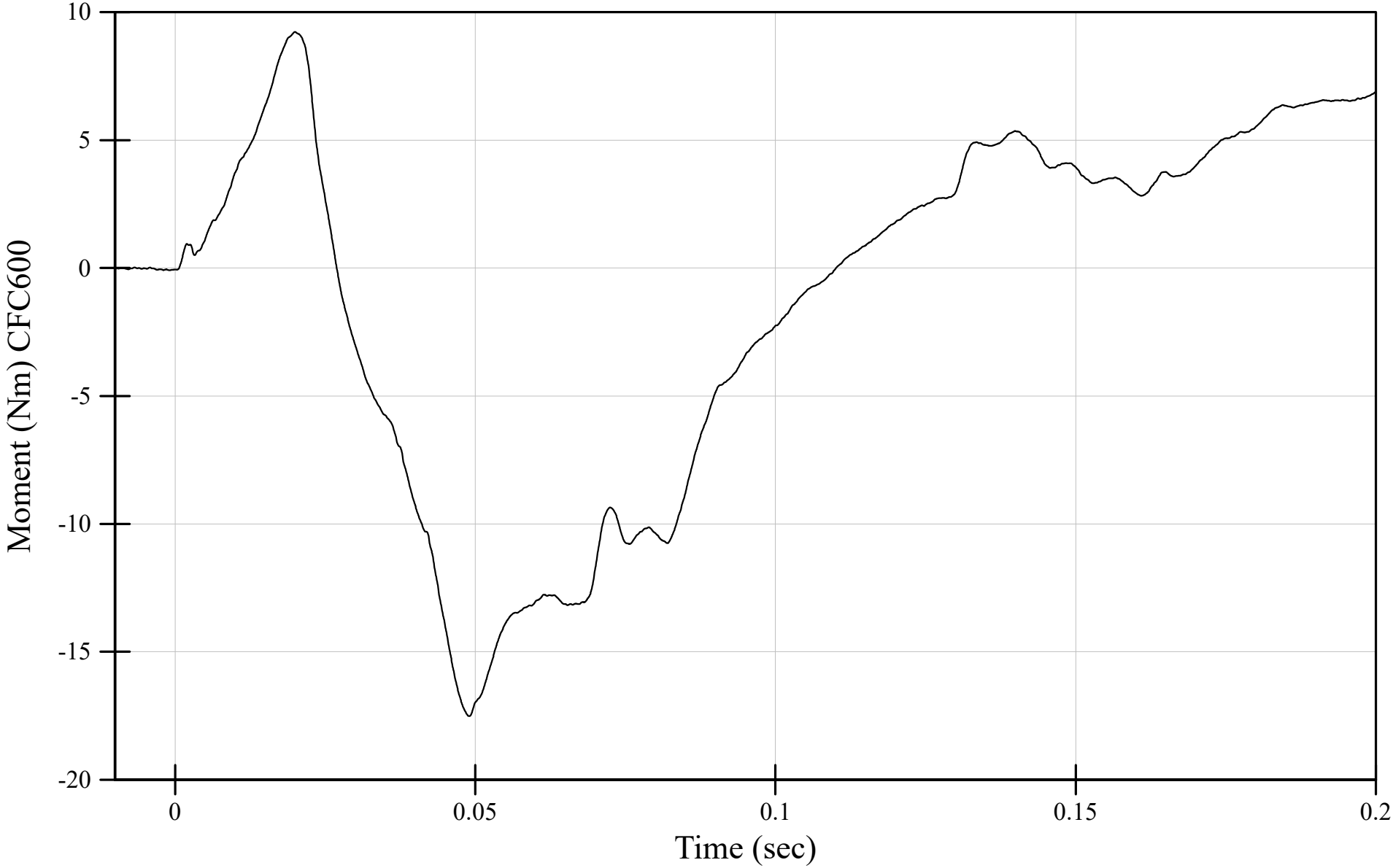
THOR-05F Neck Extension Qualification
Probe Acceleration
Neck Serial Number: EU1156



File Name: 220413-7 processed

4/13/2022 3:31 PM

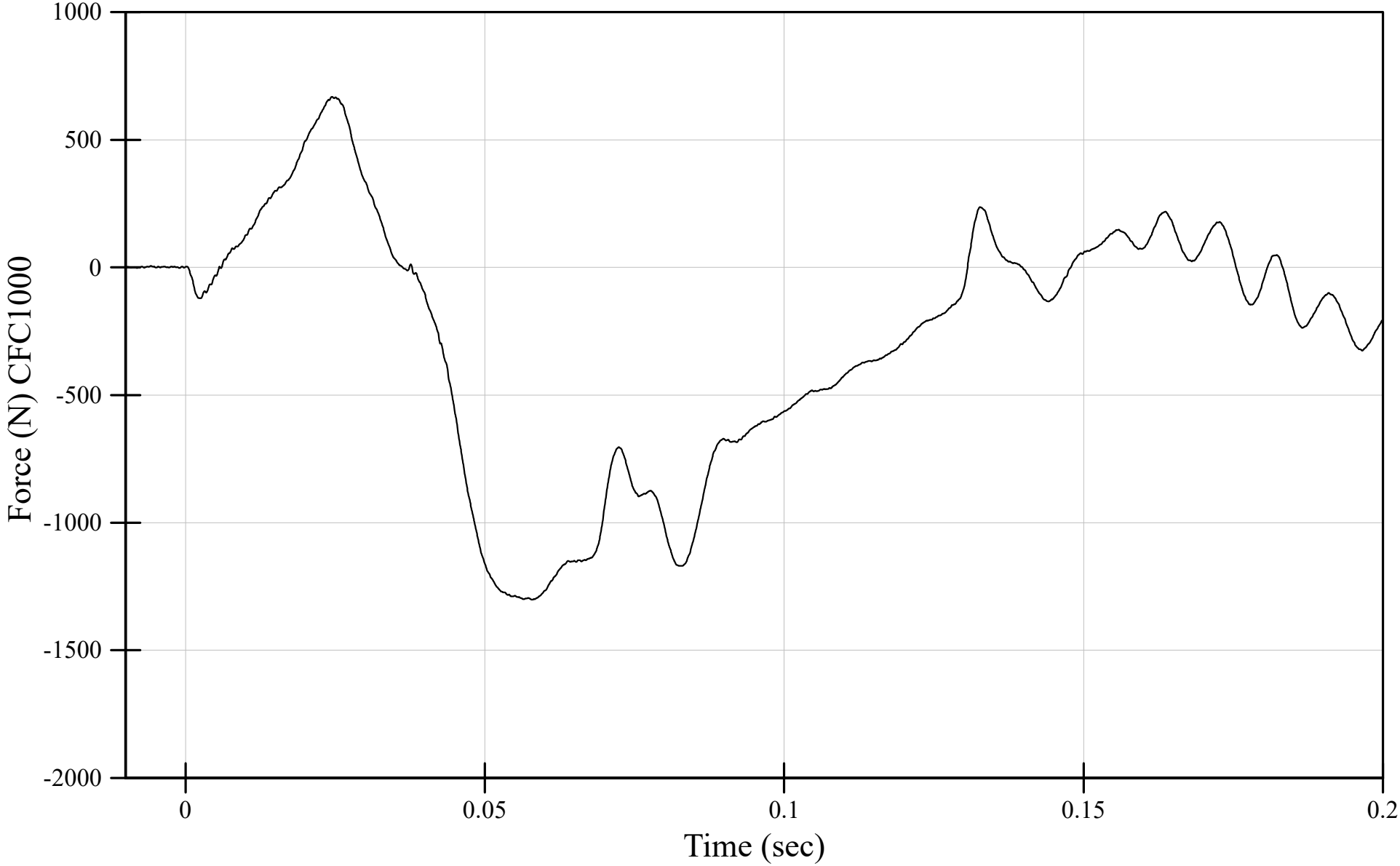
THOR-05F Neck Extension Qualification
Y-Moment as Measured
Neck Serial Number: EU1156



File Name: 220413-7 processed

4/13/2022 3:31 PM

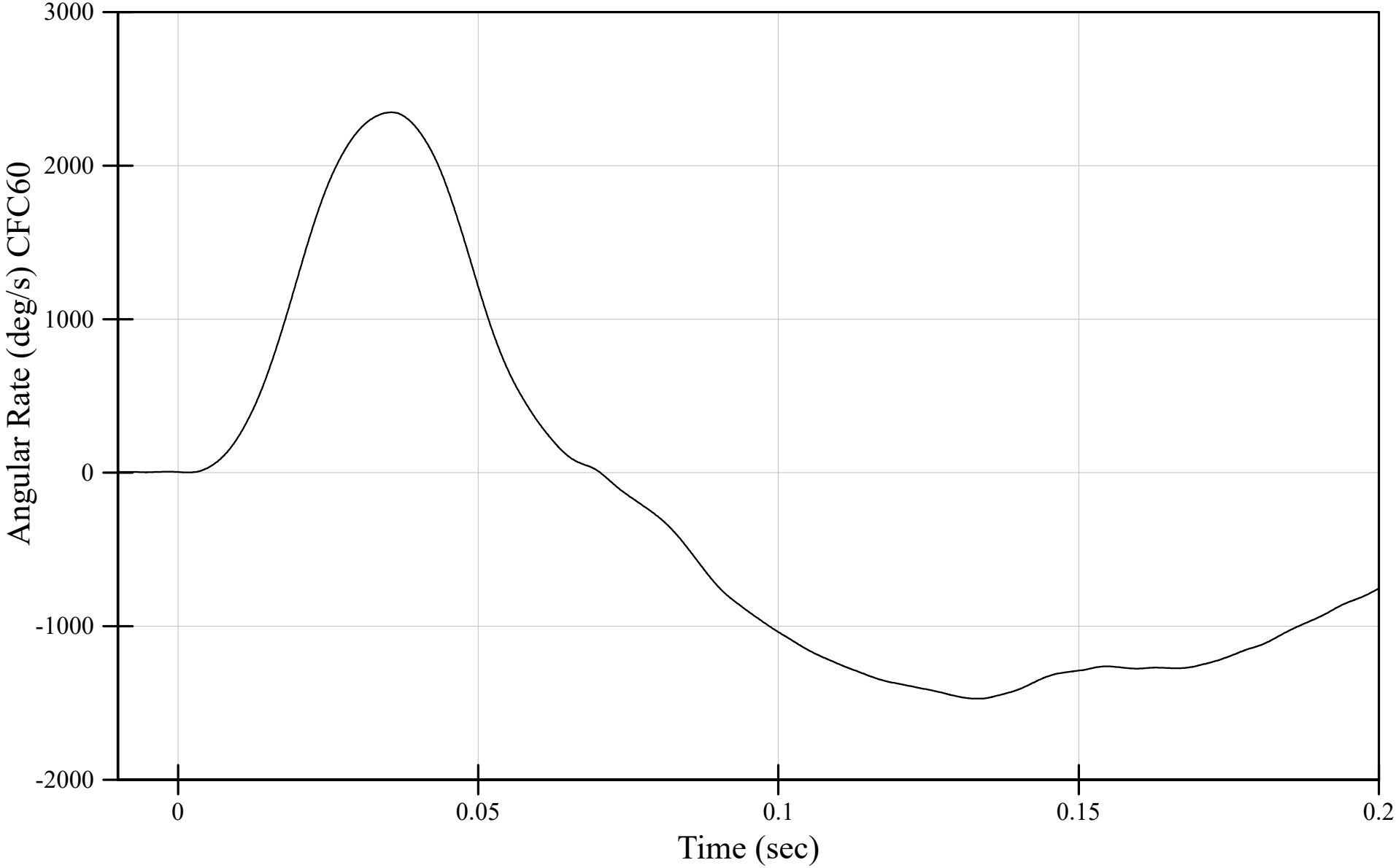
THOR-05F Neck Extension Qualification
Z-Force as Measured
Neck Serial Number: EU1156



File Name: 220413-7 processed

4/13/2022 3:31 PM

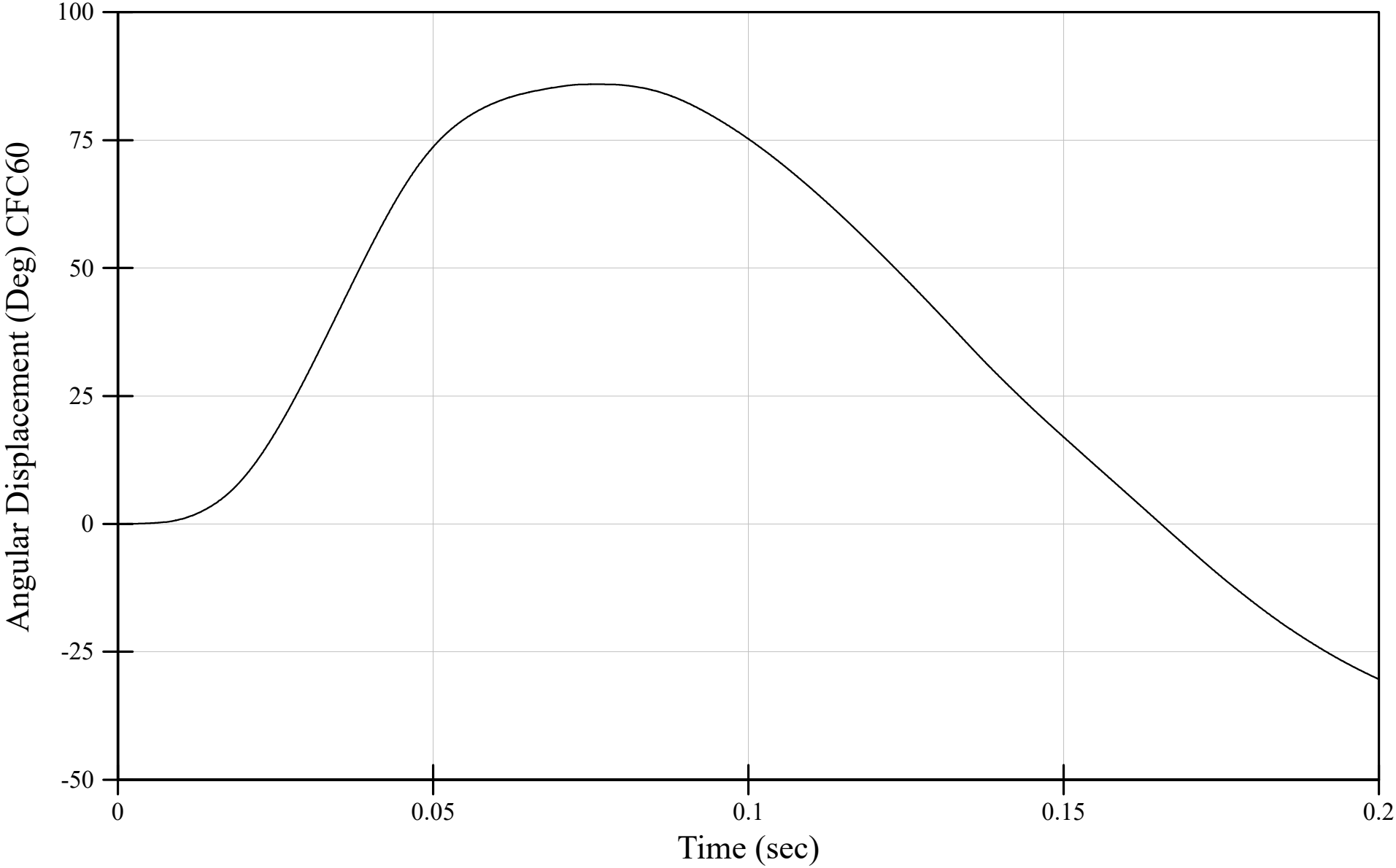
THOR-05F Neck Extension Qualification
Peak Head Angular Rate
Neck Serial Number: EU1156



File Name: 220413-7 processed

4/13/2022 3:31 PM

THOR-05F Neck Extension Qualification
Neck Rotation
Neck Serial Number: EU1156



File Name: 220413-7 processed

4/13/2022 3:31 PM

THOR-05F Neck Front Flexion Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Neck Serial Number: EU1156
O.C. Stop Assembly:
O.C. Cam:

Test ID: 220413-5
Test Date: 4/13/2022
Test Time: 2:18 PM

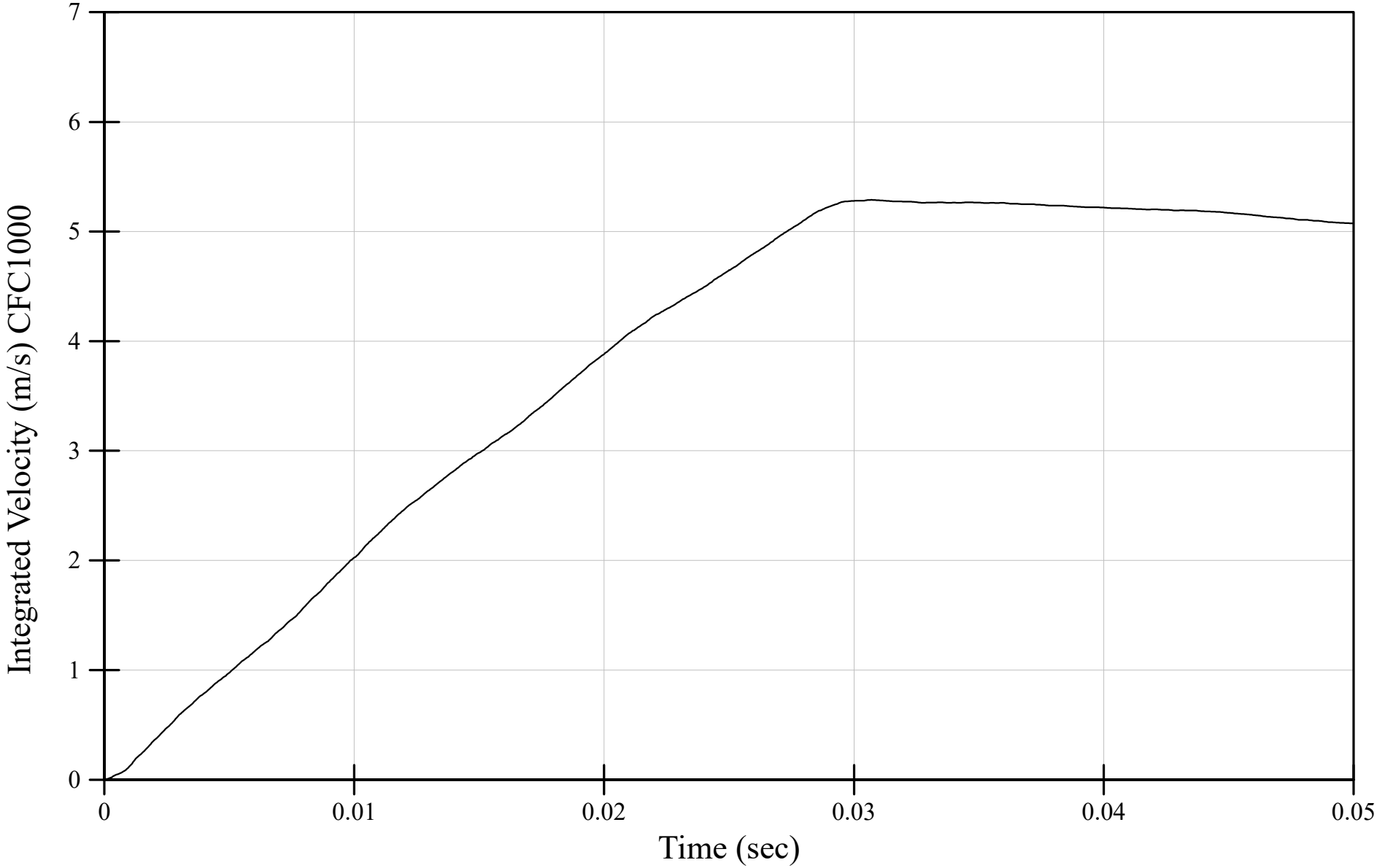
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.7	Pass
Test Humidity (%)	10 - 70	59	Pass
Test Velocity (m/s)	4.95 - 5.05	5.04	Pass
Pendulum Velocity at 8 ms (m/s)		1.58	
Pendulum Velocity at 16 ms (m/s)		3.14	
Pendulum Velocity at 24 ms (m/s)		4.49	
Peak Upper Neck My (Nm)		17.9	
Peak Upper Neck Fz prior to 40 ms (N)		681	
Peak Head Angular Velocity Y (deg/sec)		-1964	
Peak Head Rotation (deg)		-75.2	

* THOR-05F Qualification Manual - March 2022

File Name: 220413-5 processed
Software Version: 2.8

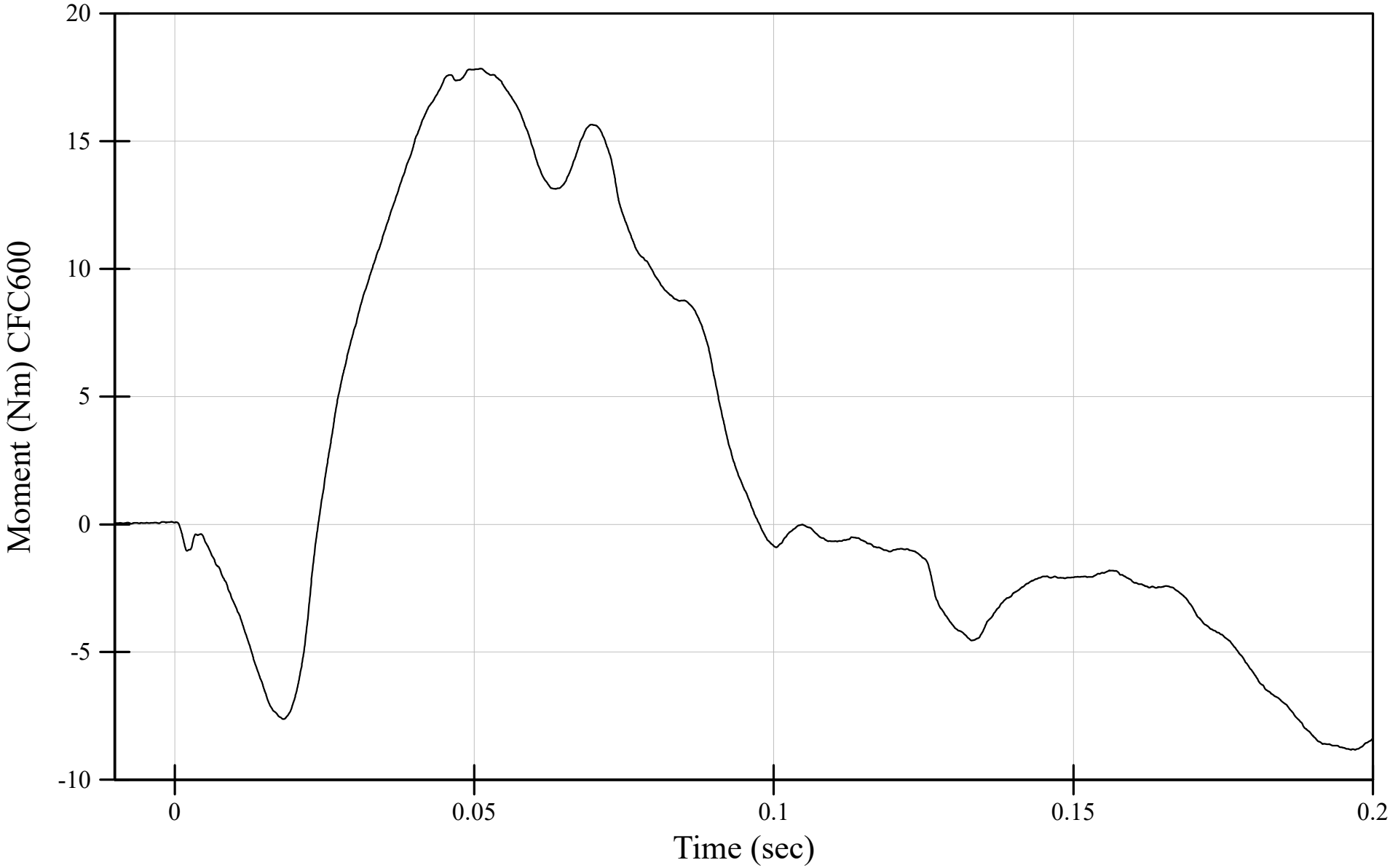
THOR-05F Neck Flexion Qualification
Pendulum Pulse
Neck Serial Number: EU1156



File Name: 220413-5 processed

4/13/2022 2:18 PM

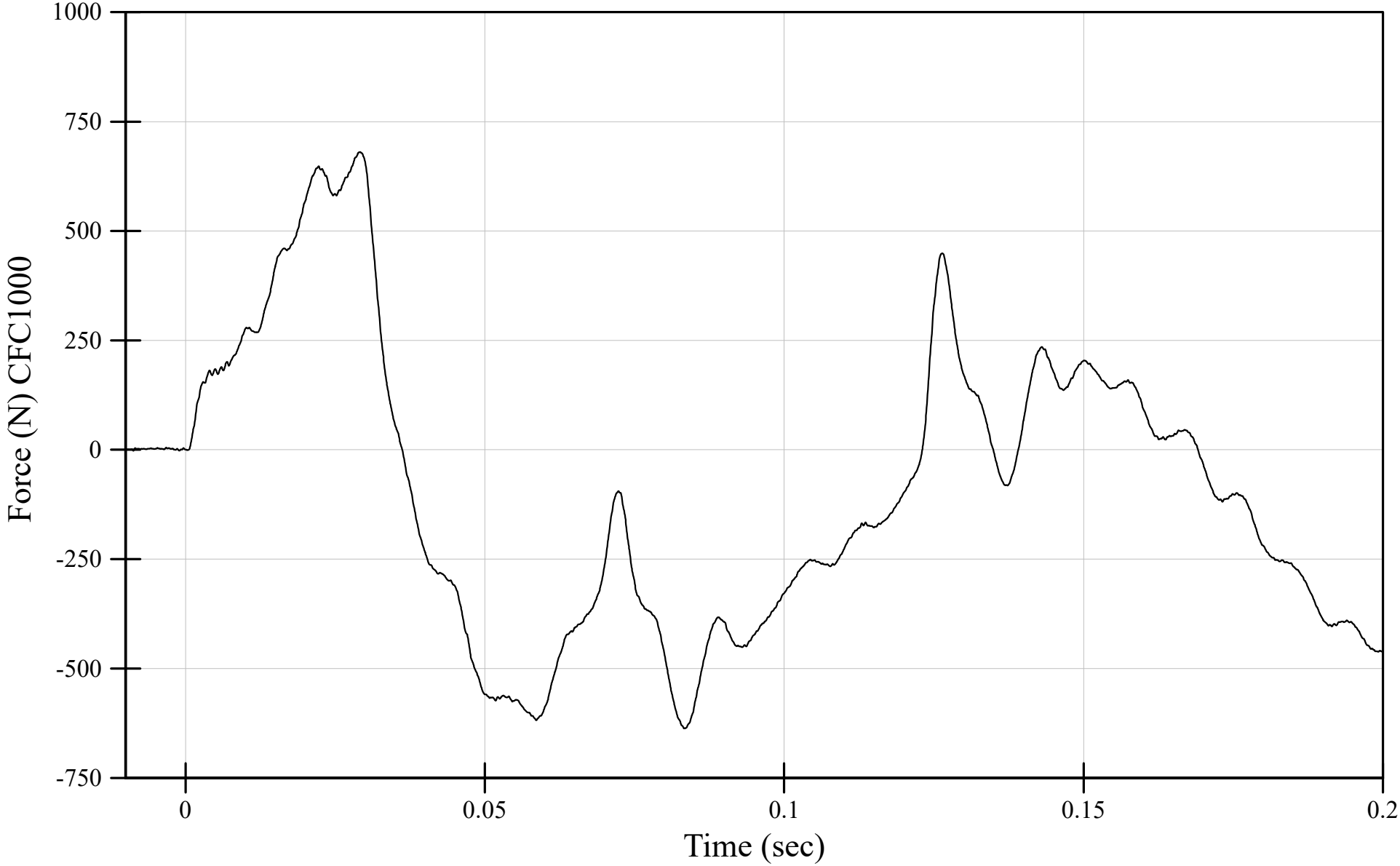
THOR-05F Neck Flexion Qualification
Y-Moment as Measured
Neck Serial Number: EU1156



File Name: 220413-5 processed

4/13/2022 2:18 PM

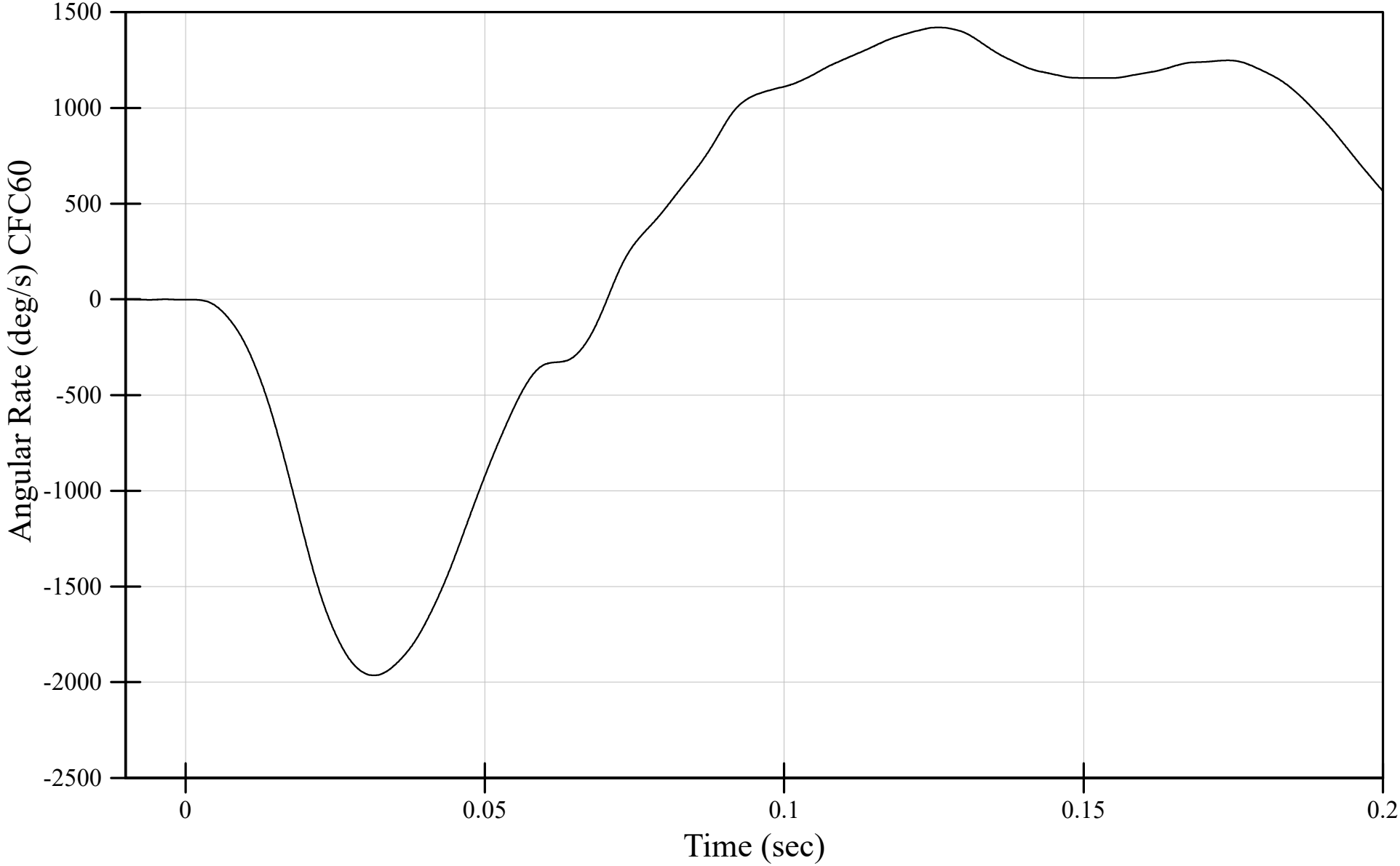
THOR-05F Neck Flexion Qualification
Z-Force as Measured
Neck Serial Number: EU1156



File Name: 220413-5 processed

4/13/2022 2:18 PM

THOR-05F Neck Flexion Qualification
Peak Angular Rate
Neck Serial Number: EU1156



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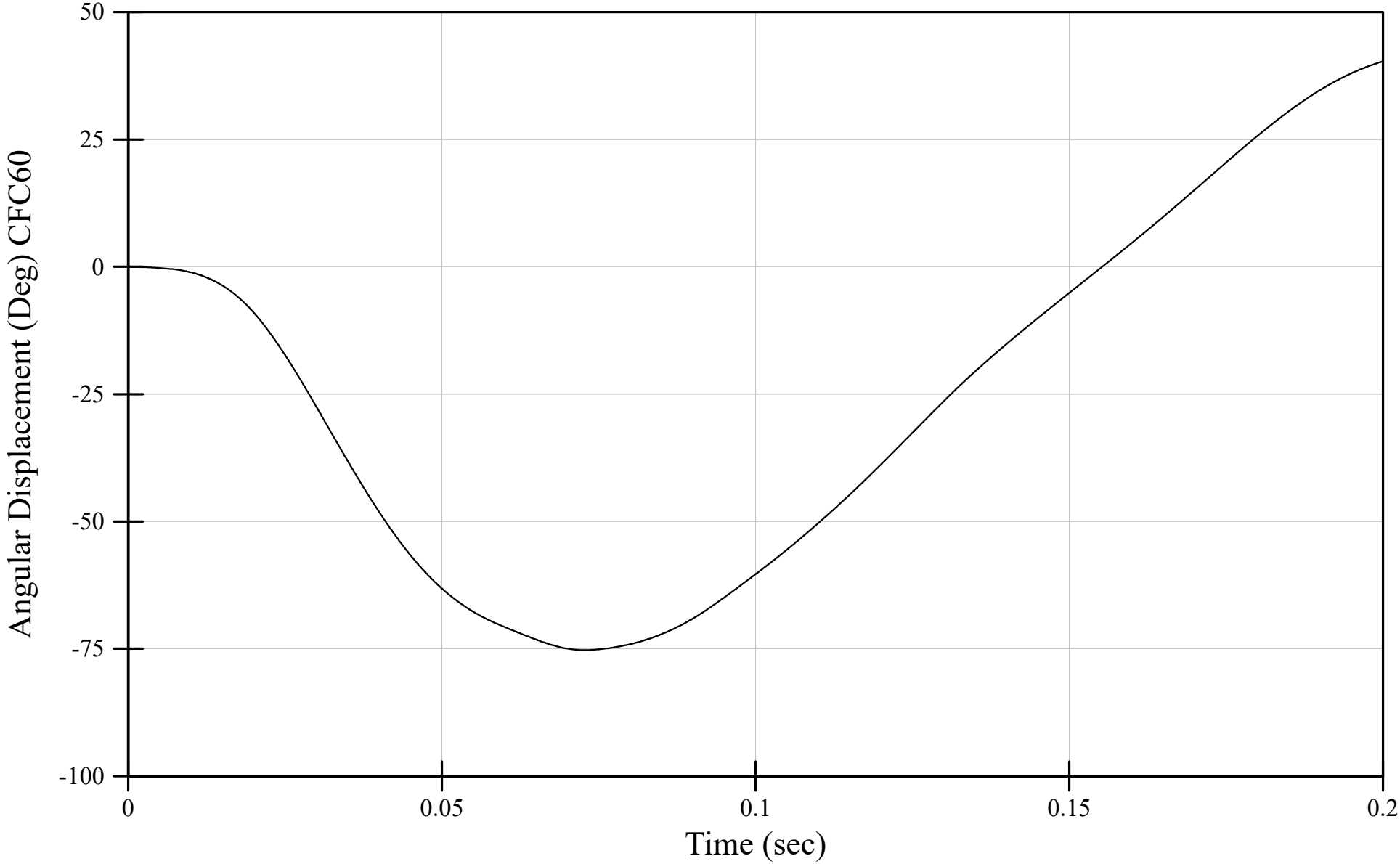
4/13/2022 2:18 PM

THOR-05F Neck Flexion Qualification
Neck Rotation
Neck Serial Number: EU1156



File Name: 220413-5 processed

4/13/2022 2:18 PM

THOR-05F Neck Left Lateral Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Neck Serial Number: EU1156
O.C. Stop Assembly Serial Number:
O.C. Cam Serial Number:

Test ID: 220414-1
Test Date: 4/14/2022
Test Time: 10:58 AM

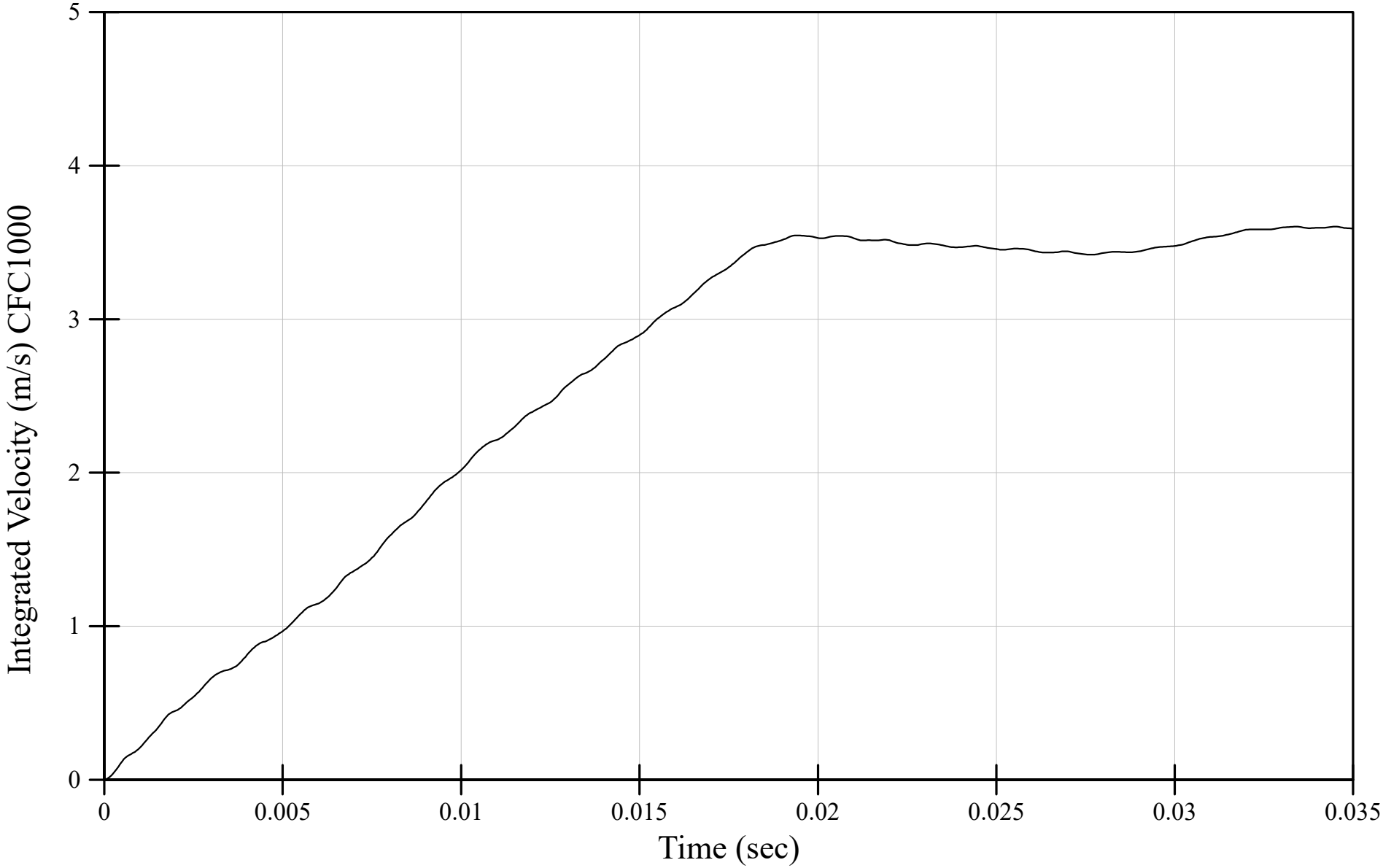
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.6	Pass
Test Humidity (%)	10 - 70	51	Pass
Test Velocity (m/s)	3.35 - 3.45	3.40	Pass
Pendulum Velocity at 5 ms (m/s)		0.97	
Pendulum Velocity at 10 ms (m/s)		2.02	
Pendulum Velocity at 15 ms (m/s)		2.90	
Peak Upper Neck Mx after 40 ms (N)		29.0	
Peak Head Angular Velocity X (deg/sec)		-1280.7	
Peak Head Rotation (deg)		-48.9	

* THOR-05F Qualification Manual - March 2022

File Name: 220414-1 processed
Software Version: 2.8

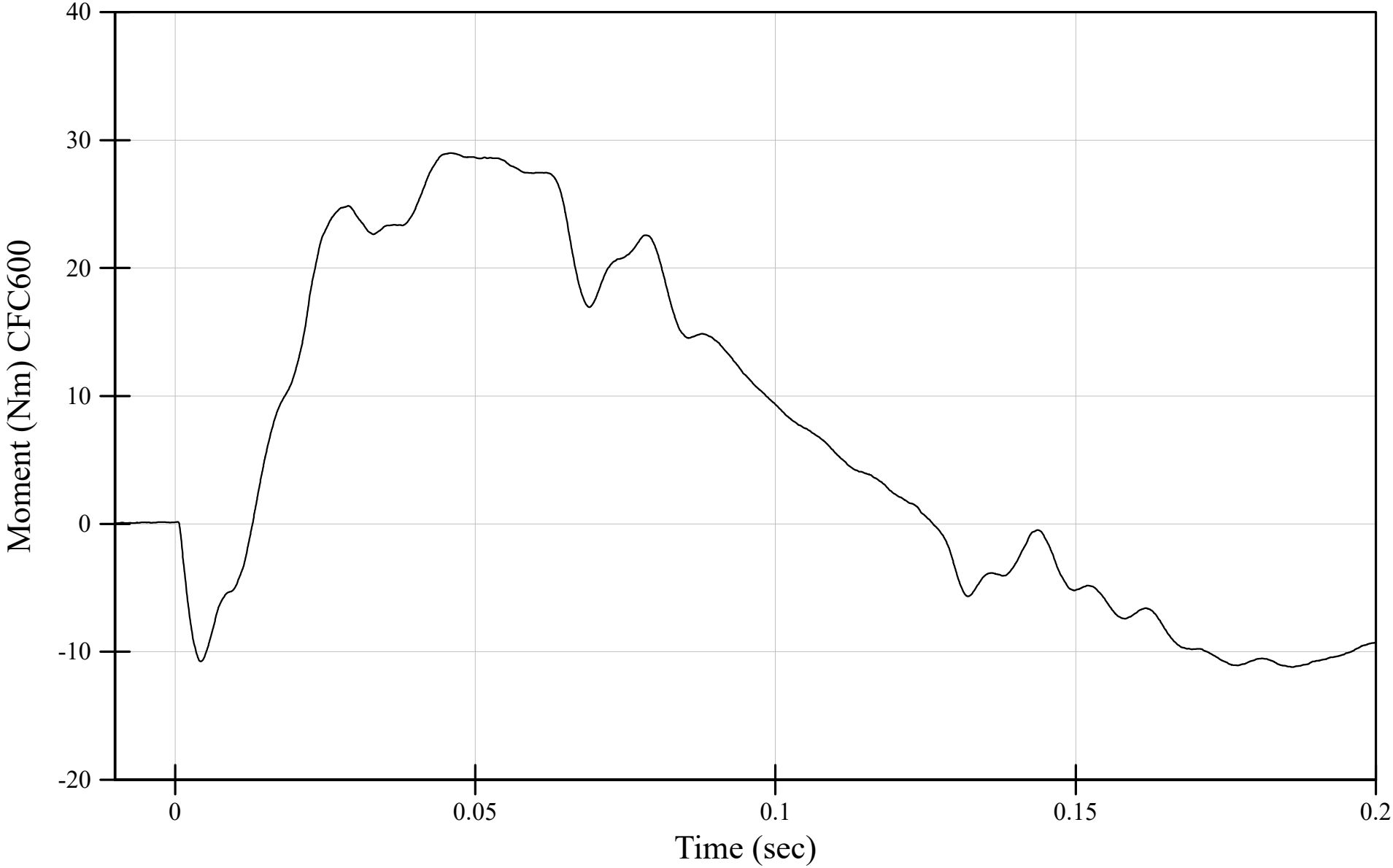
THOR-05F Neck Left Lateral Qualification
Pendulum Pulse
Serial Number: EU1156



File Name: 220414-1 processed

4/14/2022 10:58 AM

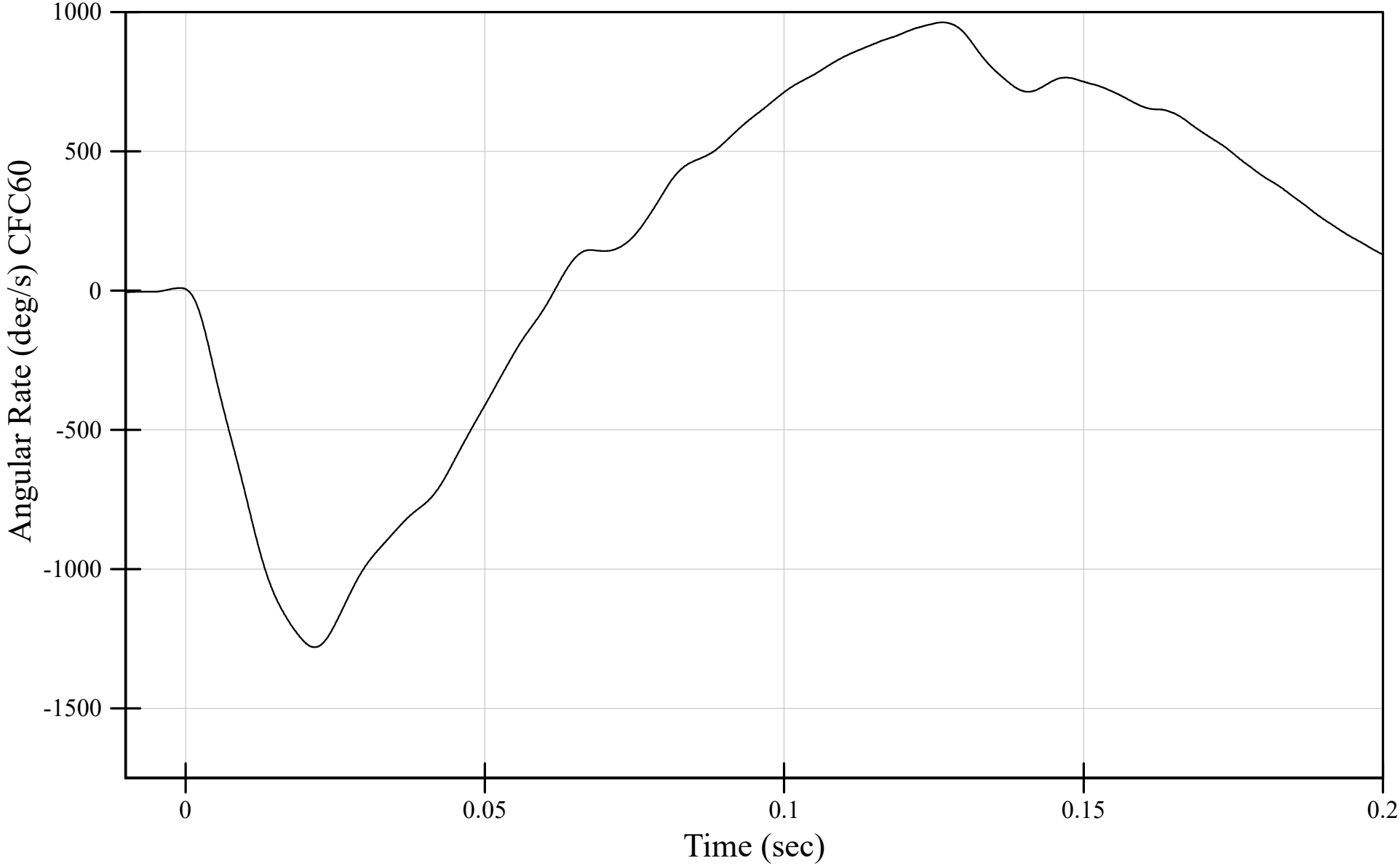
THOR-05F Neck Left Lateral Qualification
X-Moment as Measured
Serial Number: EU1156



File Name: 220414-1 processed

4/14/2022 10:58 AM

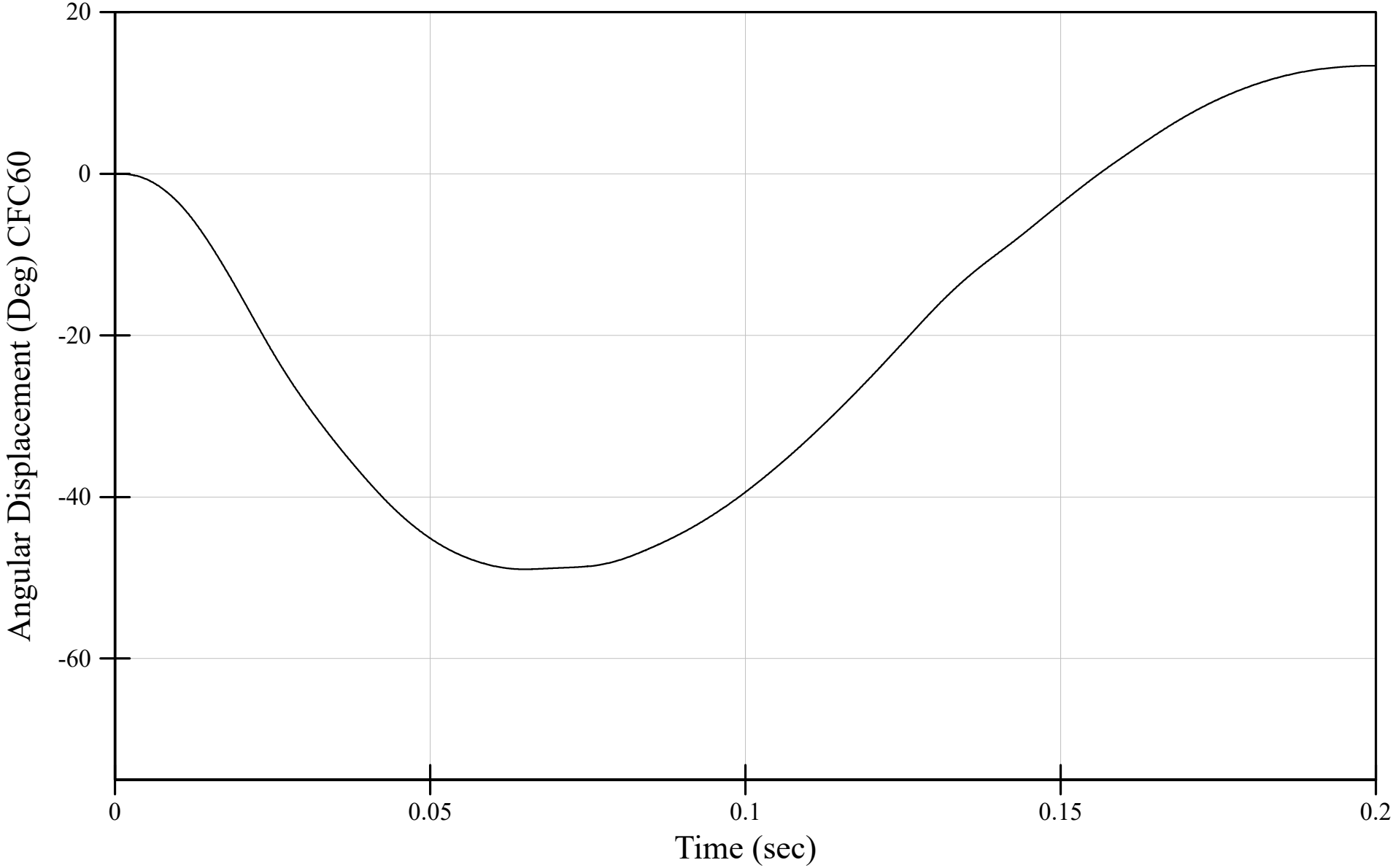
THOR-05F Neck Left Lateral Qualification
Peak Angular Rate
Serial Number: EU1156



File Name: 220414-1 processed

4/14/2022 10:58 AM

THOR-05F Neck Left Lateral Qualification
Neck Rotation
Serial Number: EU1156



File Name: 220414-1 processed

4/14/2022 10:58 AM

THOR-05F Neck Right Lateral Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Neck Serial Number: EU1156
O.C. Stop Assembly Serial Number:
O.C. Cam Serial Number:

Test ID: 220414-2
Test Date: 4/14/2022
Test Time: 12:14 PM

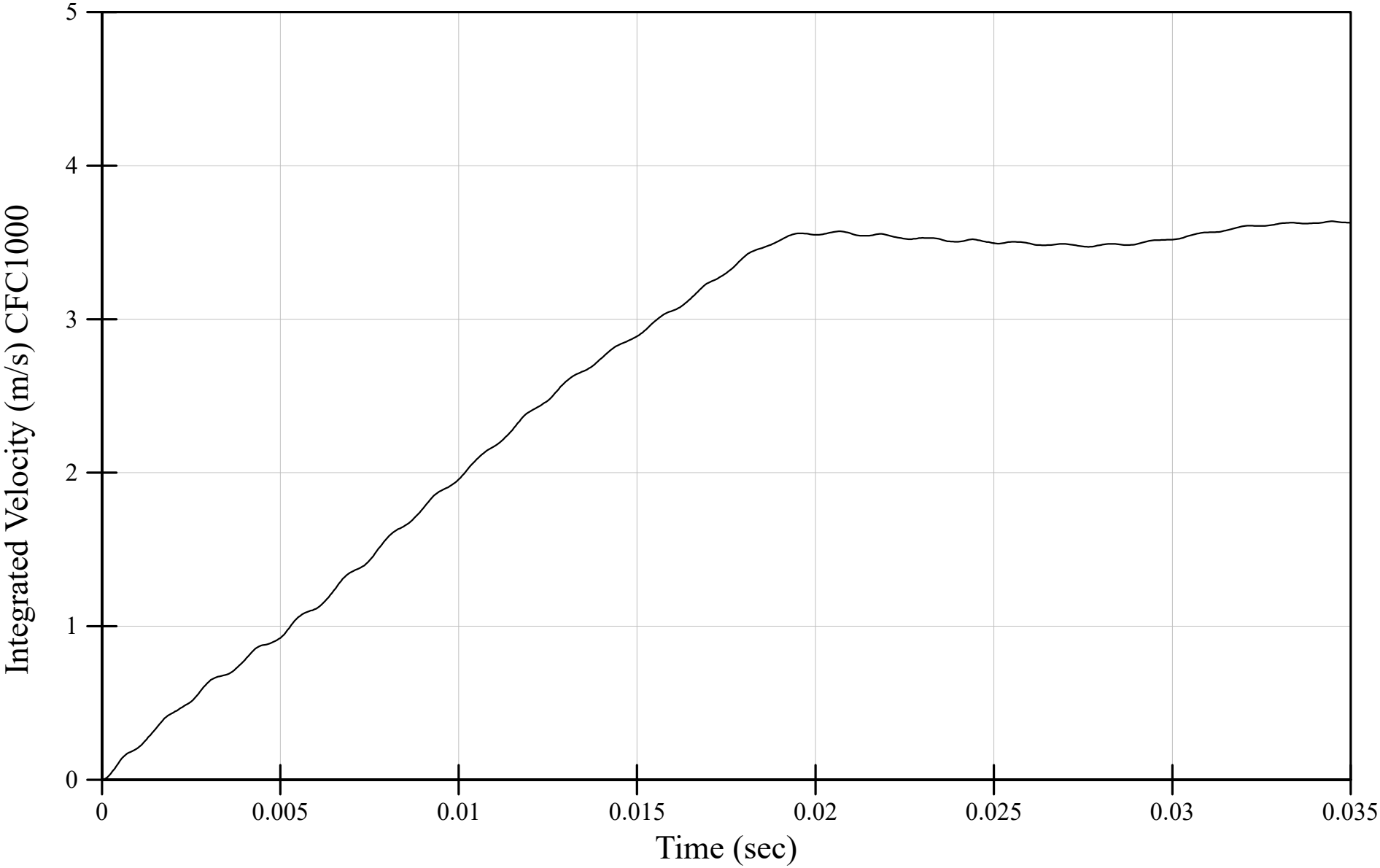
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.1	Pass
Test Humidity (%)	10 - 70	50	Pass
Test Velocity (m/s)	3.35 - 3.45	3.40	Pass
Pendulum Velocity at 5 ms (m/s)		0.92	
Pendulum Velocity at 10 ms (m/s)		1.96	
Pendulum Velocity at 15 ms (m/s)		2.89	
Peak Upper Neck Mx after 40 ms (N)		-29.7	
Peak Head Angular Velocity X (deg/sec)		1292.7	
Peak Head Rotation (deg)		48.6	

* THOR-05F Qualification Manual - March 2022

File Name: 220414-2 processed
Software Version: 2.8

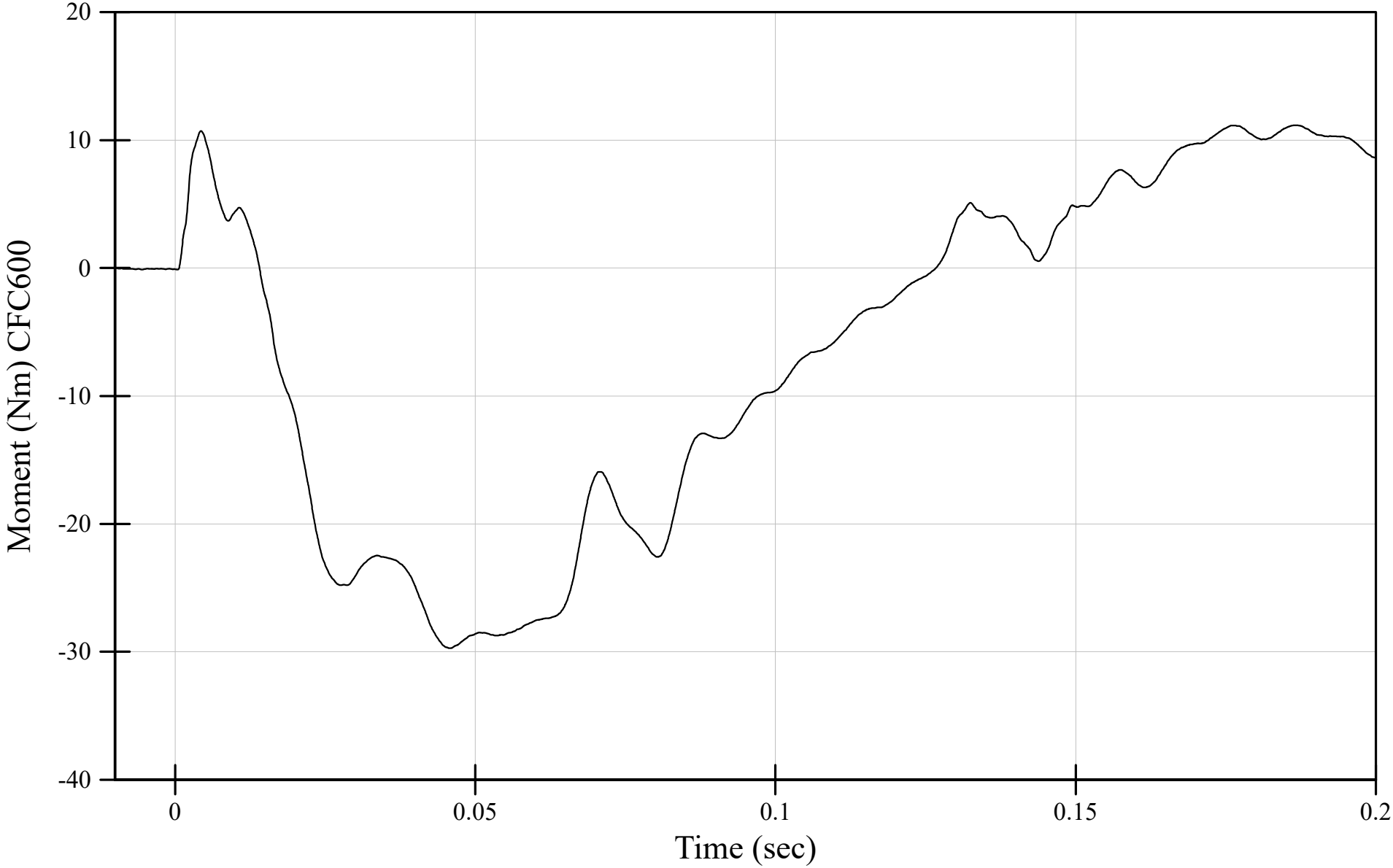
THOR-05F Neck Right Lateral Qualification
Pendulum Pulse
Neck Serial Number: EU1156



File Name: 220414-2 processed

4/14/2022 12:14 PM

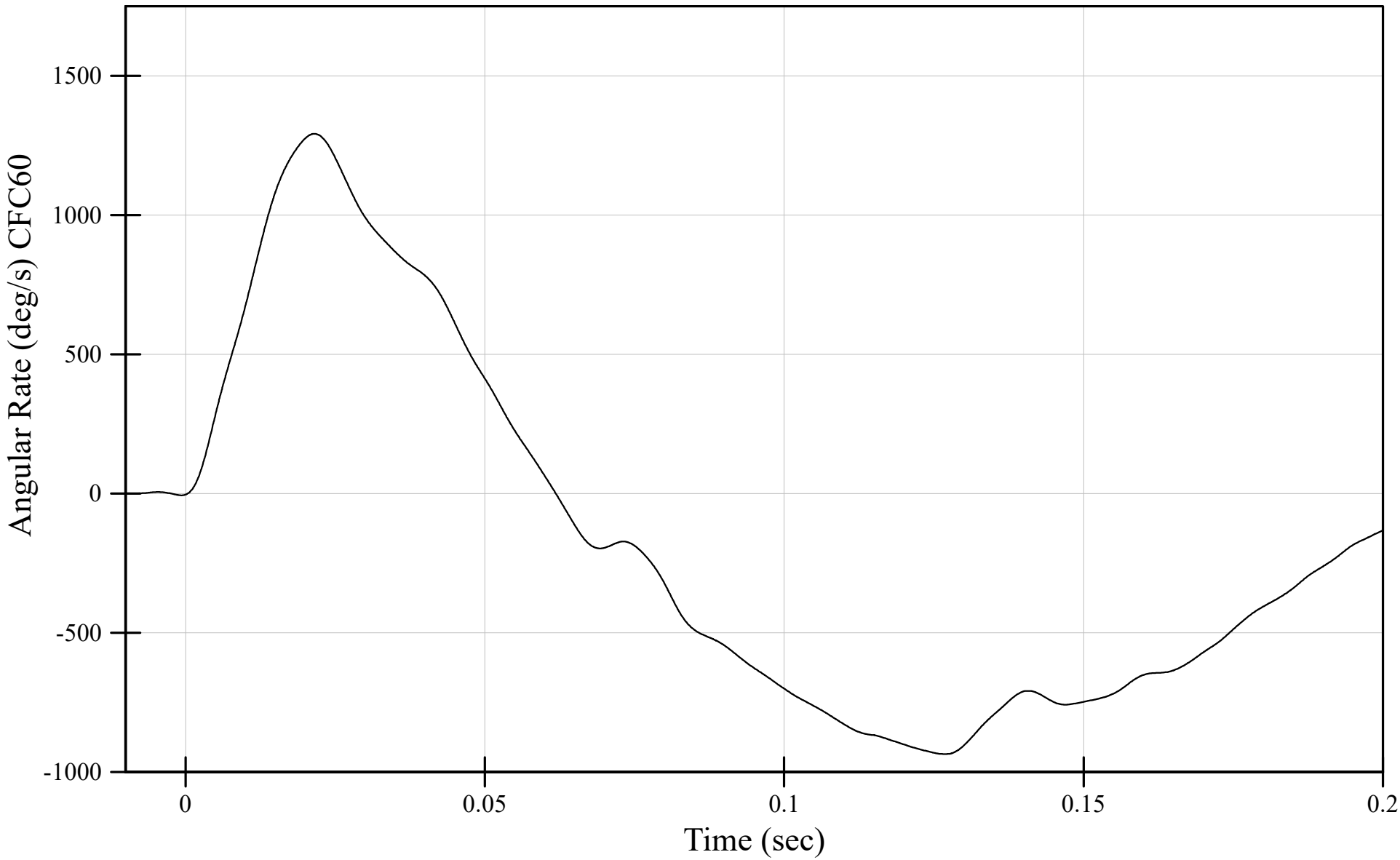
THOR-05F Neck Right Lateral Qualification
X-Moment as Measured
Neck Serial Number: EU1156



File Name: 220414-2 processed

4/14/2022 12:14 PM

THOR-05F Neck Right Lateral Qualification
Peak Angular Rate
Neck Serial Number: EU1156



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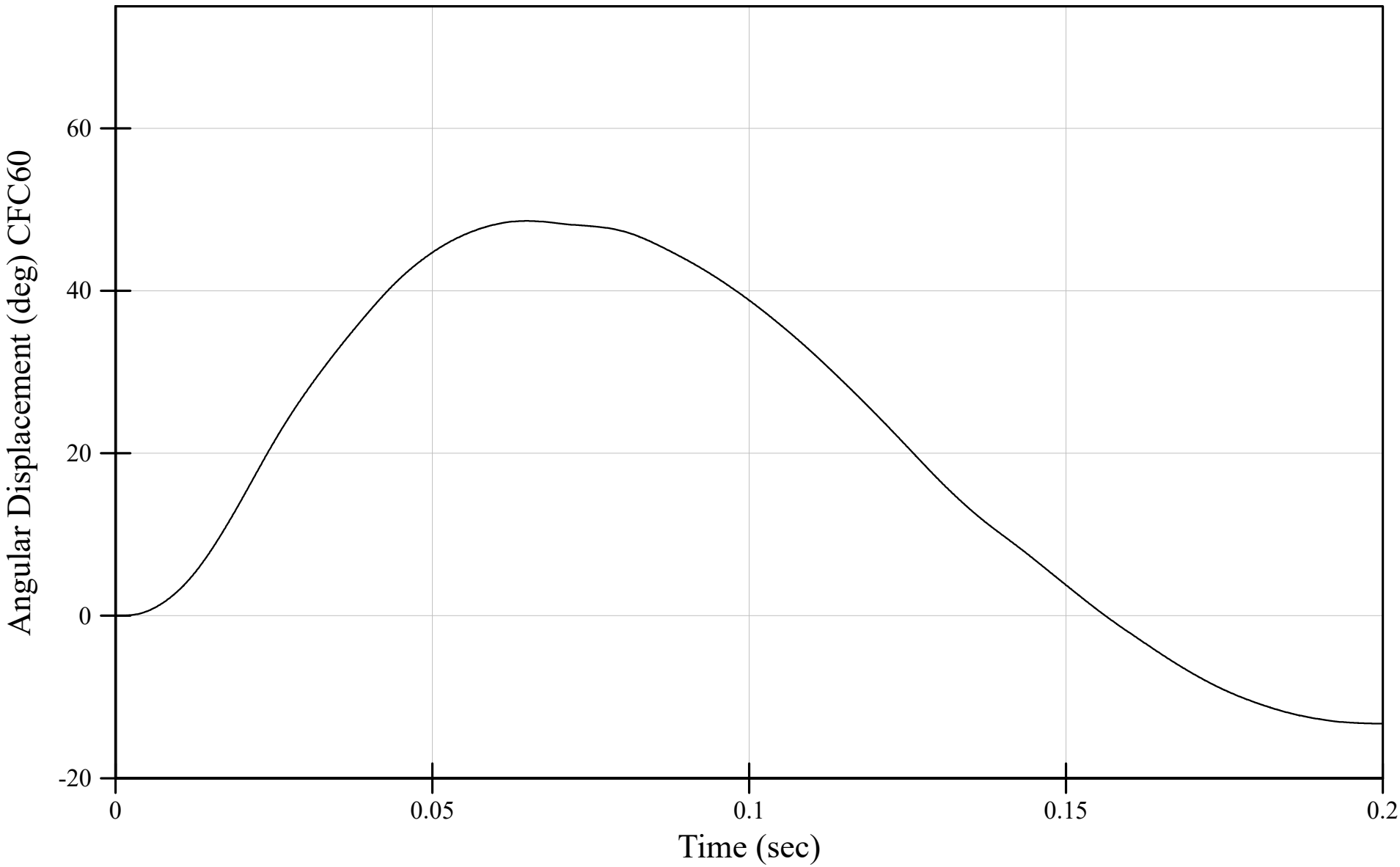
4/14/2022 12:14 PM

THOR-05F Neck Right Lateral Qualification
Neck Rotation
Neck Serial Number: EU1156



File Name: 220414-2 processed

4/14/2022 12:14 PM

THOR-05F Neck Left Torsion Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Neck Serial Number: EU1156
O.C. Stop Assembly Serial Number:
O.C. Cam Serial Number:

Test ID: 220413-4
Test Date: 4/13/2022
Test Time: 12:11 PM

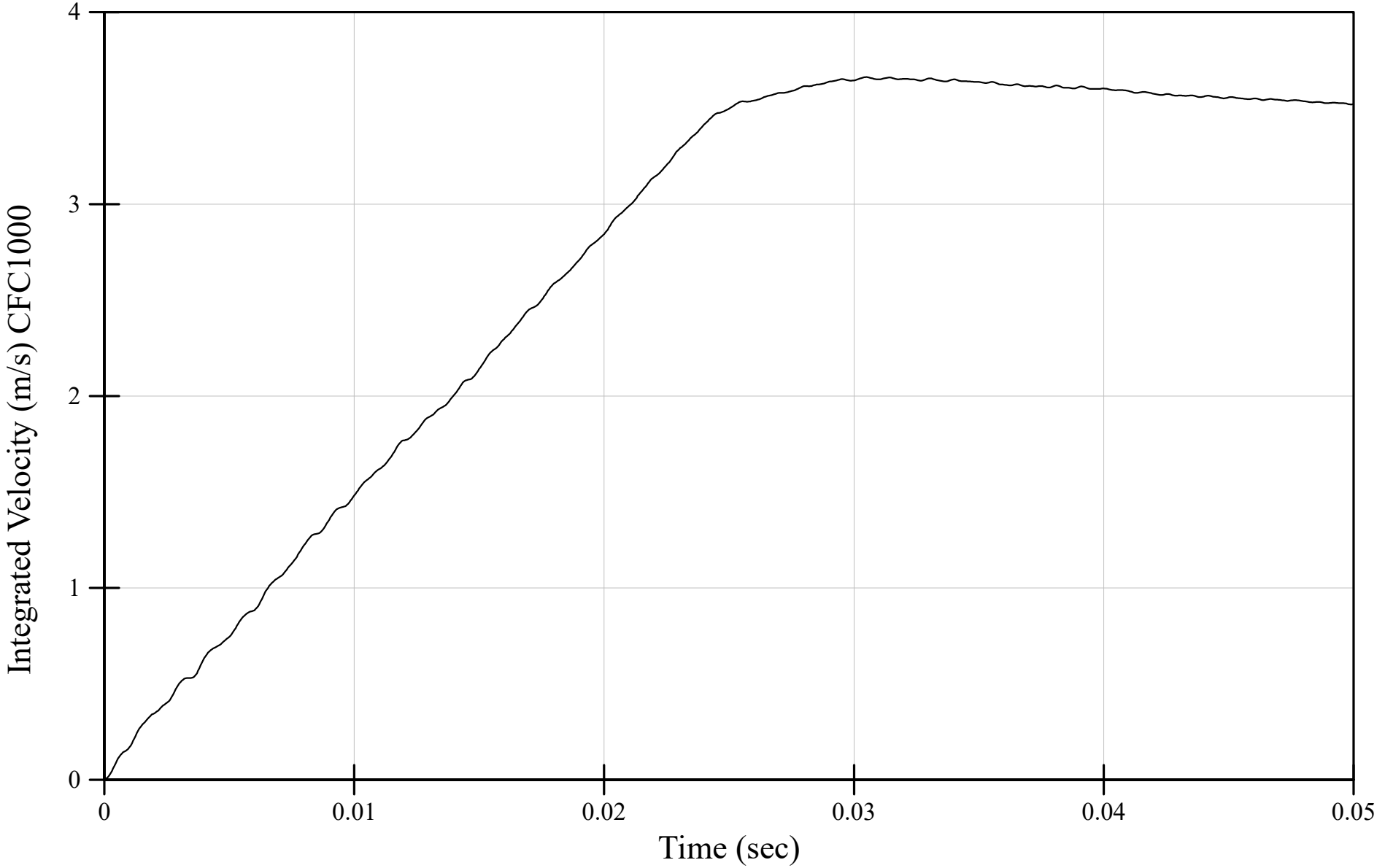
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.5	Pass
Test Humidity (%)	10 - 70	56	Pass
Test Velocity (m/s)	3.35 - 3.45	3.41	Pass
Pendulum Velocity at 10 ms (m/s)		1.06	
Pendulum Velocity at 15 ms (m/s)		2.01	
Pendulum Velocity at 20 ms (m/s)		2.99	
Peak Upper Neck Mz (Nm)		21.3	
Peak Neck Fixture Rotation (deg)		-47.1	
Peak Upper Neck Angular Velocity Z (deg/sec)		-1233.0	

* THOR-05F Qualification Manual - March 2022

File Name: 220413-4 processed
Software Version: 2.8

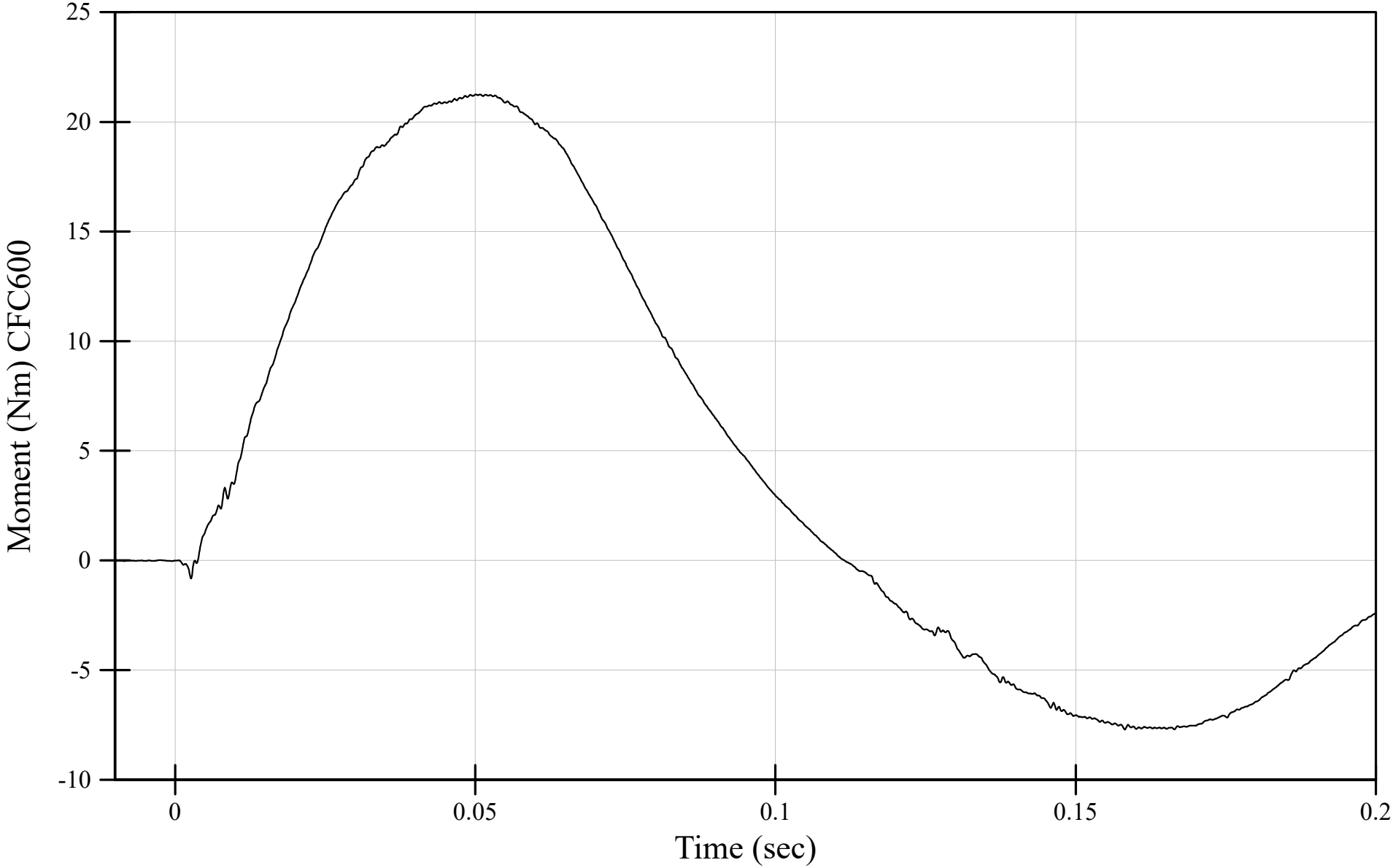
THOR-05F Neck Left Torsion Qualification
Pendulum Pulse
Neck Serial Number: EU1156



File Name: 220413-4 processed

4/13/2022 12:11 PM

THOR-05F Neck Left Torsion Qualification
Z-Moment as Measured
Neck Serial Number: EU1156



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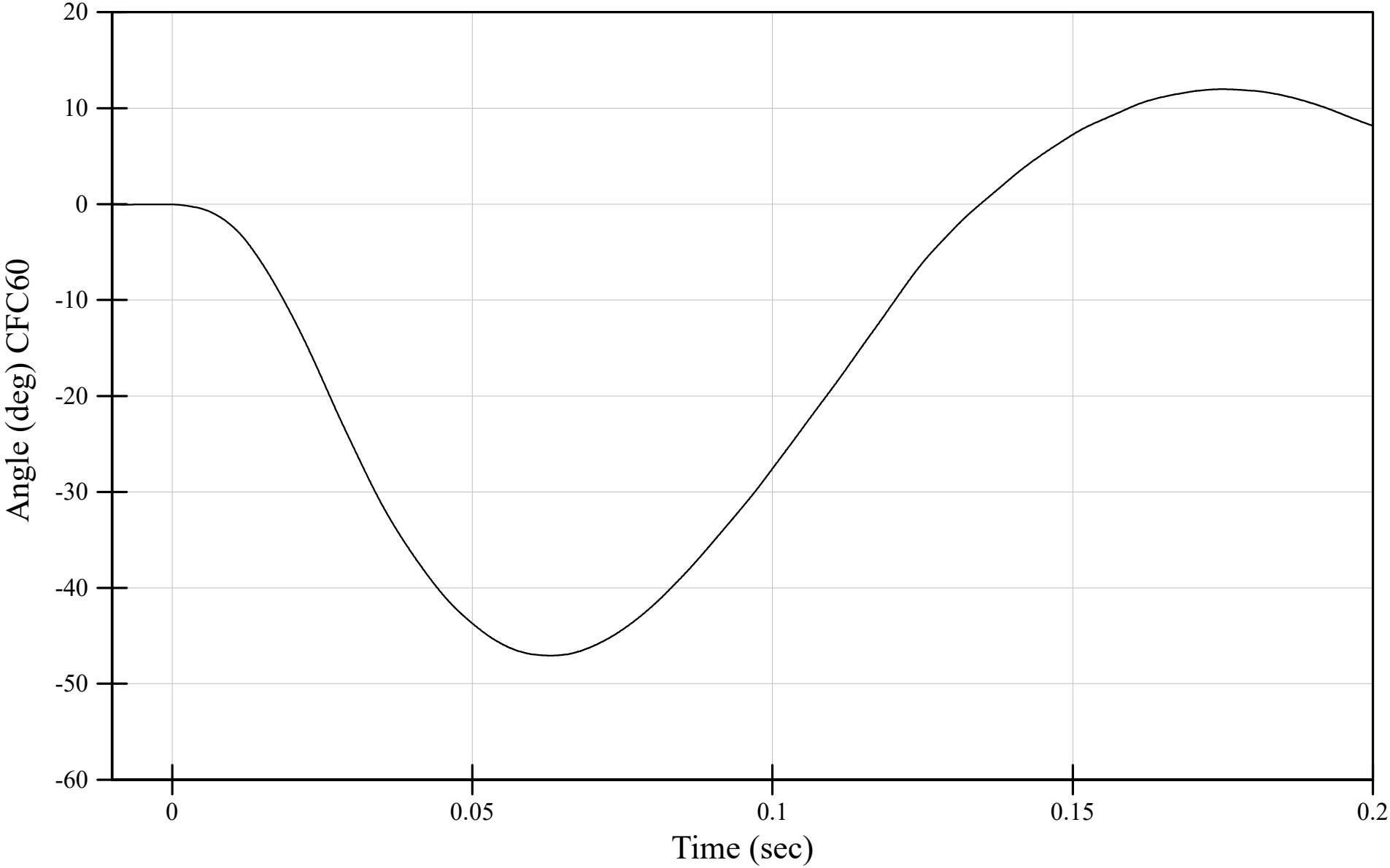
4/13/2022 12:11 PM

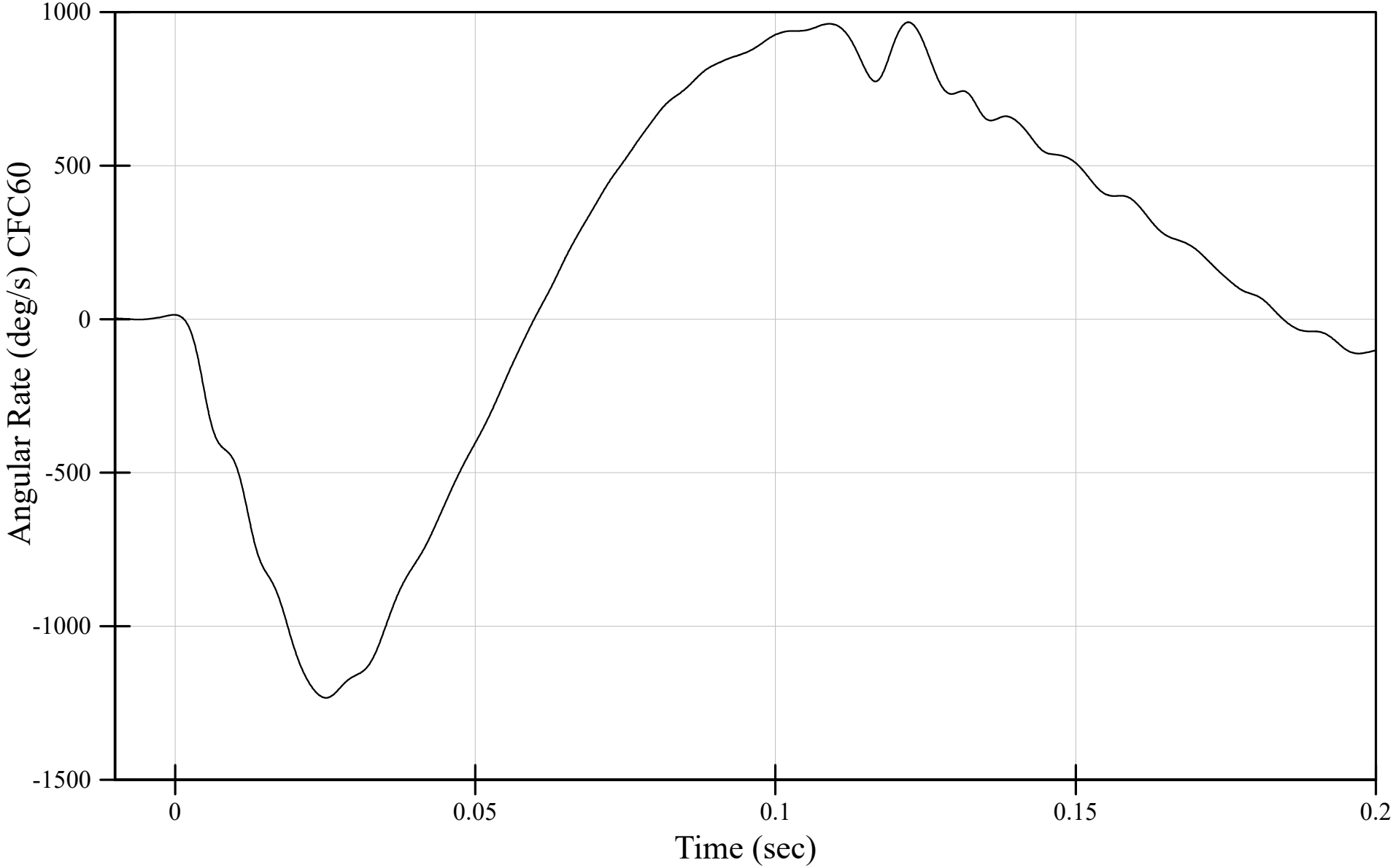
THOR-05F Neck Left Torsion Qualification
Neck Fixture Rotation
Neck Serial Number: EU1156



File Name: 220413-4 processed

4/13/2022 12:11 PM

THOR-05F Neck Left Torsion Qualification
Peak Angular Rate
Neck Serial Number: EU1156



File Name: 220413-4 processed

4/13/2022 12:11 PM

THOR-05F Neck Right Torsion Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Neck Serial Number: EU1156
O.C. Stop Assembly:
O.C. Cam:

Test ID: 220413-3
Test Date: 4/13/2022
Test Time: 9:21 AM

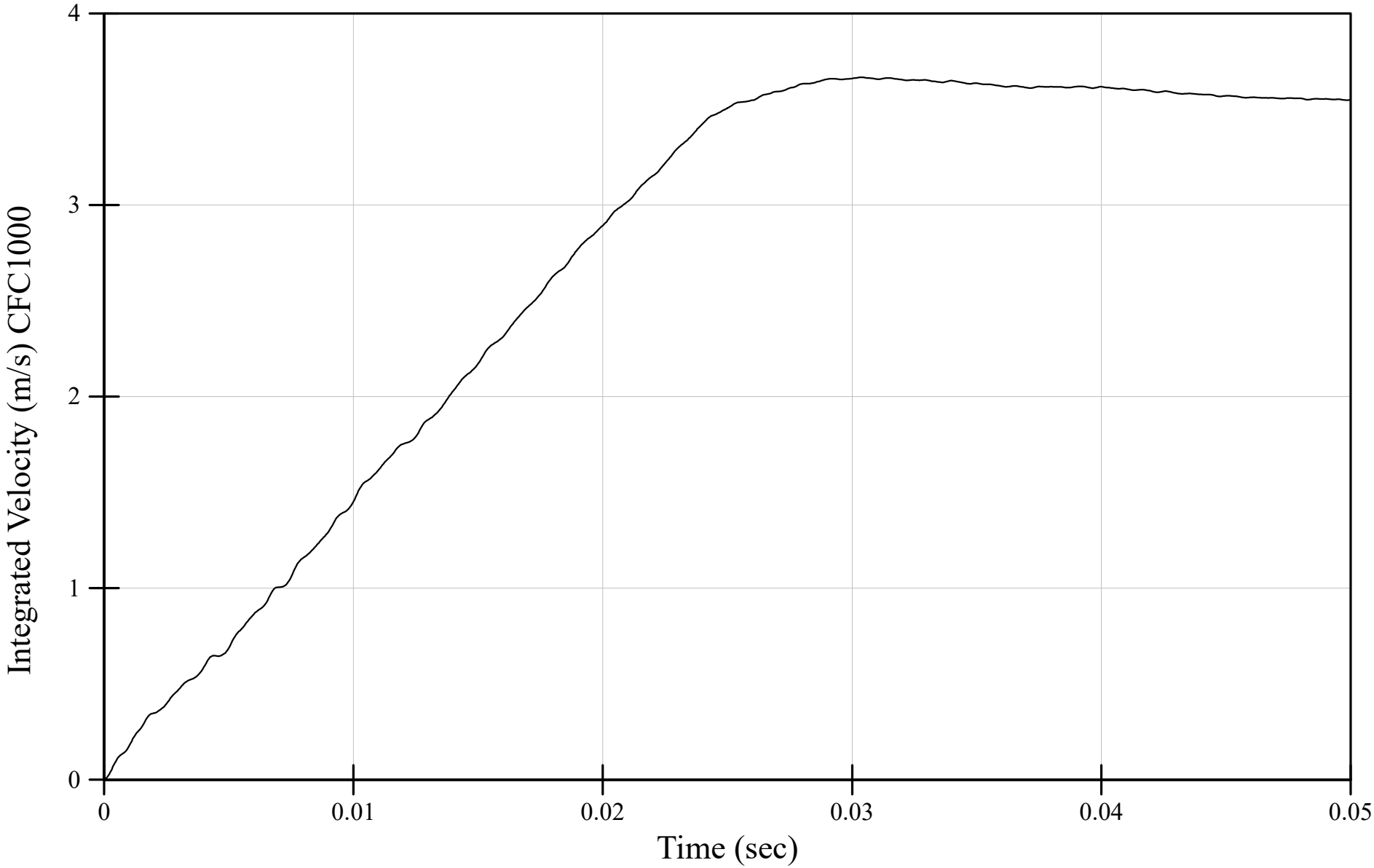
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.4	Pass
Test Humidity (%)	10 - 70	57	Pass
Test Velocity (m/s)	3.35 - 3.45	3.41	Pass
Pendulum Velocity at 7 ms (m/s)		1.01	
Pendulum Velocity at 14 ms (m/s)		2.03	
Pendulum Velocity at 21 ms (m/s)		3.02	
Peak Upper Neck Mz (Nm)		-21.4	
Peak Neck Fixture Rotation (deg)		46.8	
Peak Upper Neck Angular Velocity Z (deg/sec)		1215.6	

* THOR-05F Qualification Manual - March 2022

File Name: 220413-3 processed
Software Version: 2.8

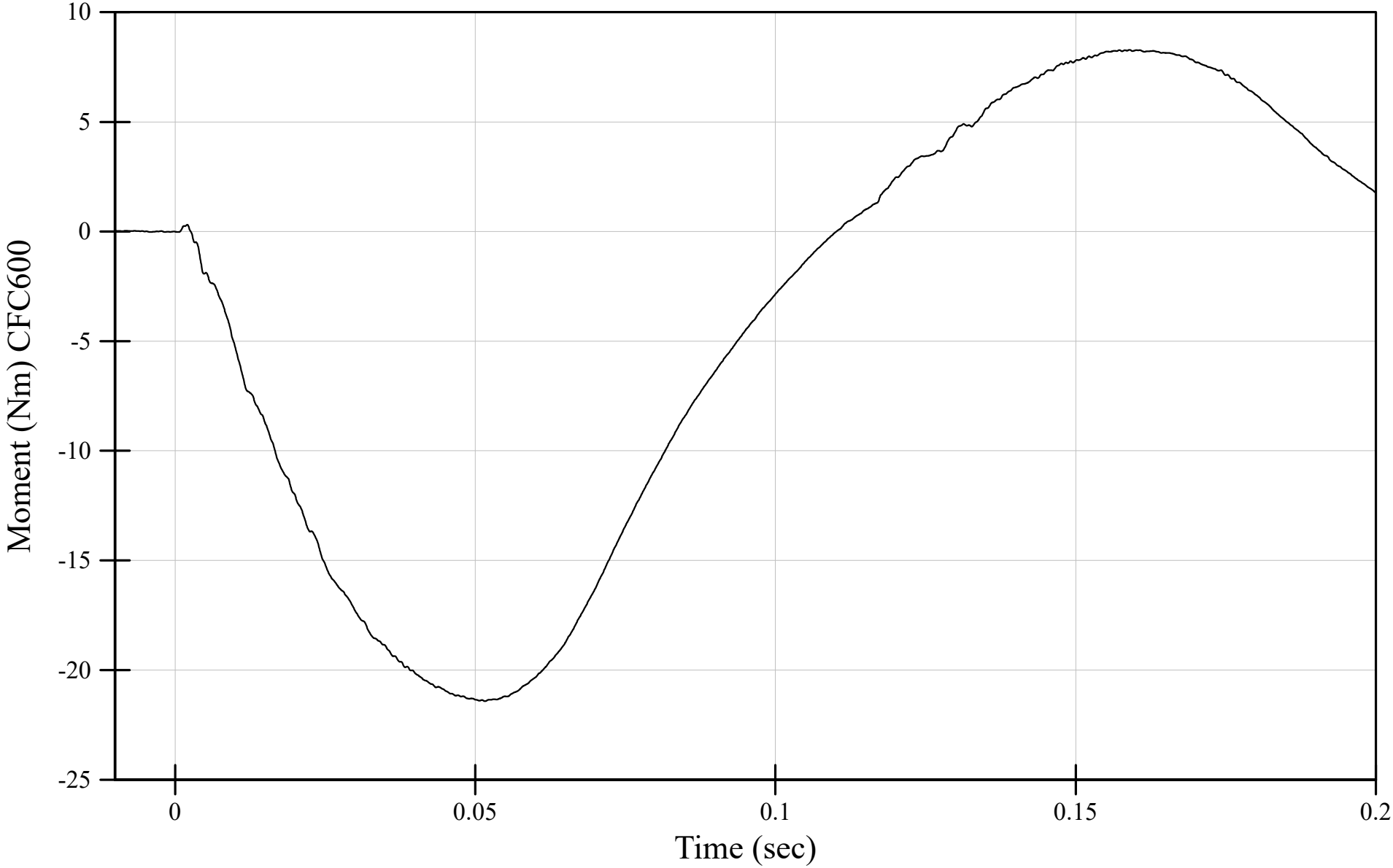
THOR-05F Neck Right Torsion Qualification
Pendulum Pulse
Neck Serial Number: EU1156



File Name: 220413-3 processed

4/13/2022 9:21 AM

THOR-05F Neck Right Torsion Qualification
Z-Moment as Measured
Neck Serial Number: EU1156



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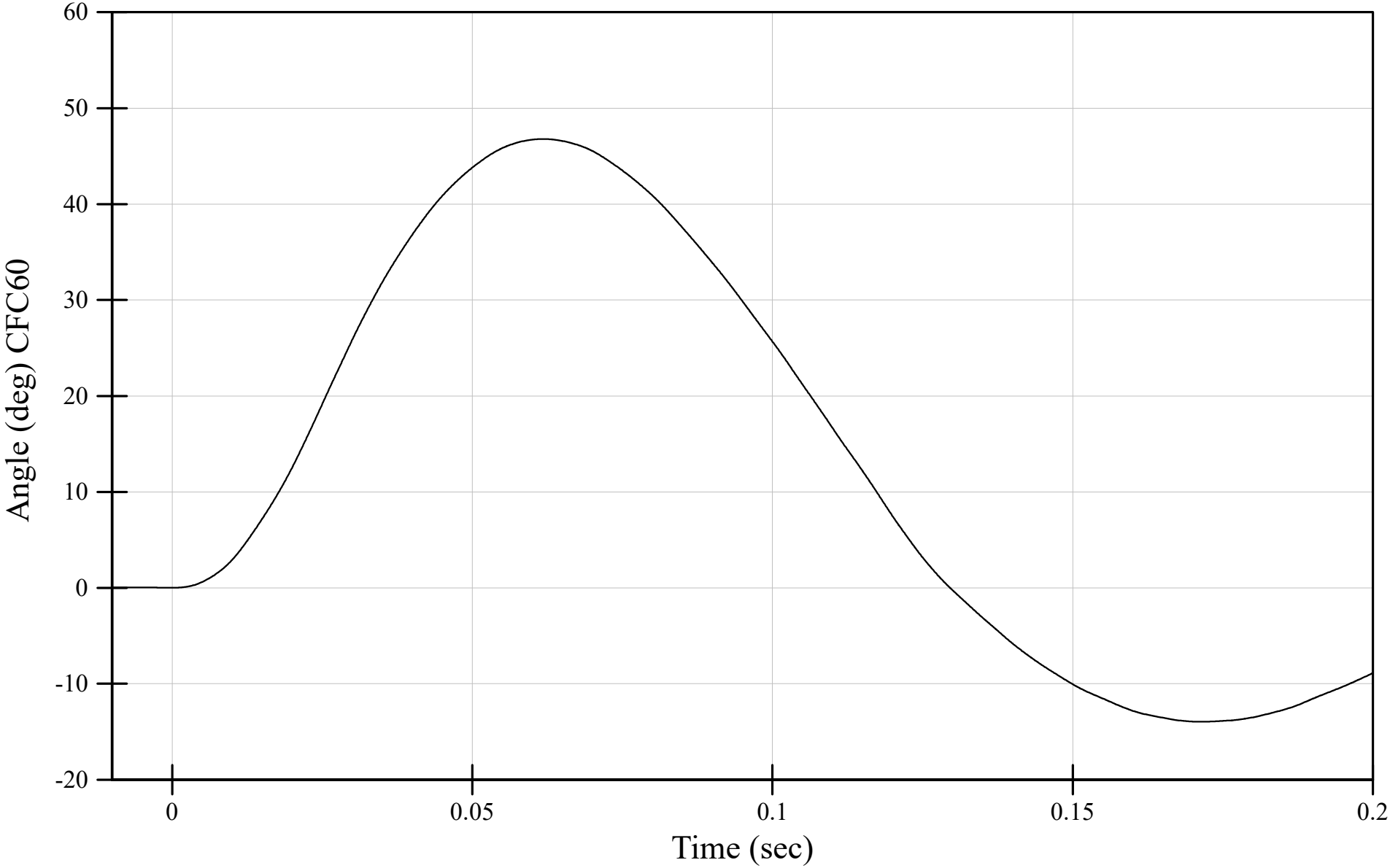
4/13/2022 9:21 AM

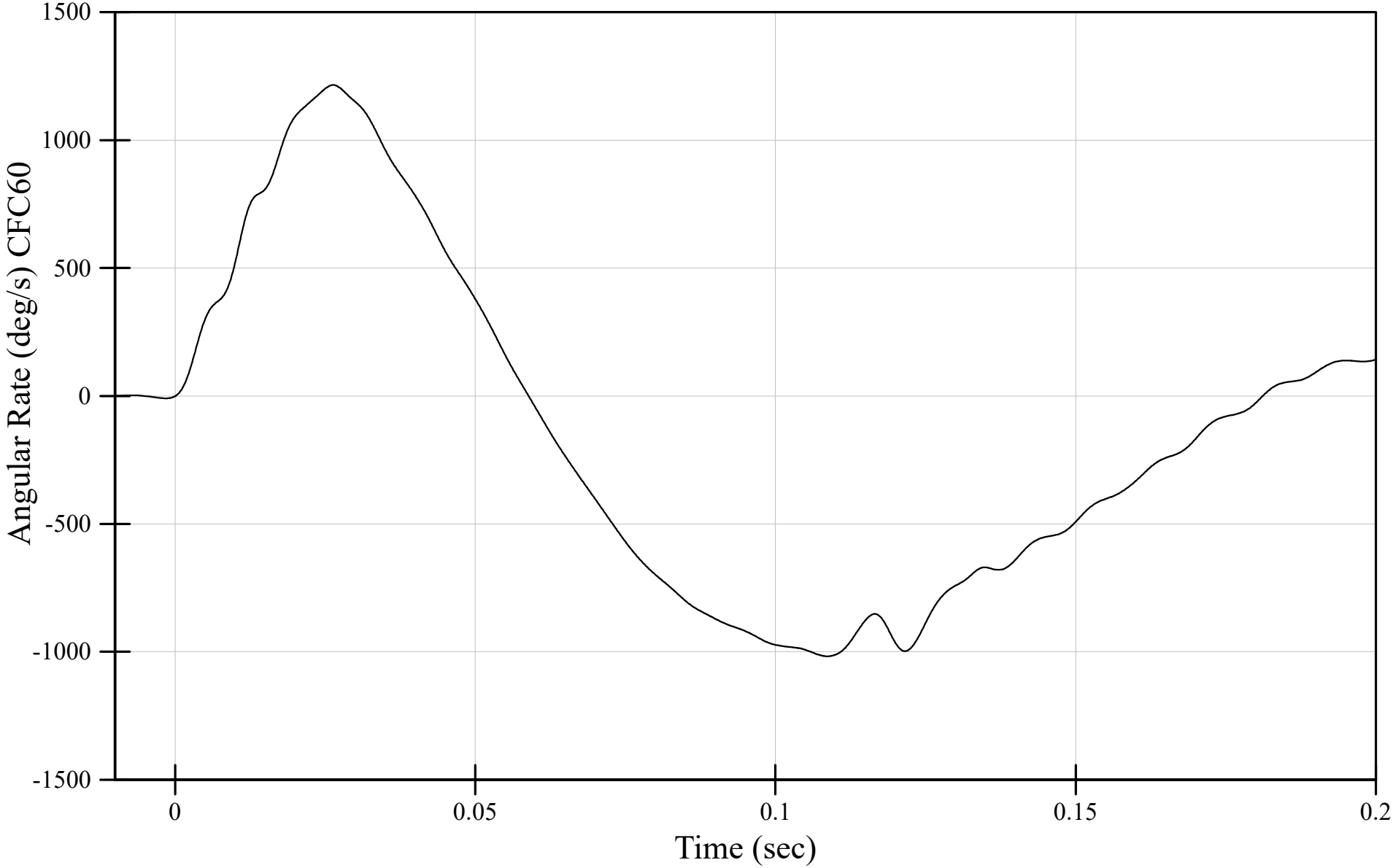
THOR-05F Neck Right Torsion Qualification
Neck Fixture Rotation
Neck Serial Number: EU1156



File Name: 220413-3 processed

4/13/2022 9:21 AM

THOR-05F Neck Right Torsion Qualification
Peak Angular Rate
Neck Serial Number: EU1156



File Name: 220413-3 processed

4/13/2022 9:21 AM

THOR-05F Upper Thorax Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components

Rib 1 Serial Number: ET5497
Rib 2 Serial Number: ET5498
Rib 3 Serial Number: ET5499
Rib 4 Serial Number: ET5500
Rib 5 Serial Number: ET5589
Rib 6 Serial Number: ET5502
Rib 7 Serial Number: ET5503

Test ID: 220425-9
Test Date: 4/25/2022
Test Time: 3:07 PM

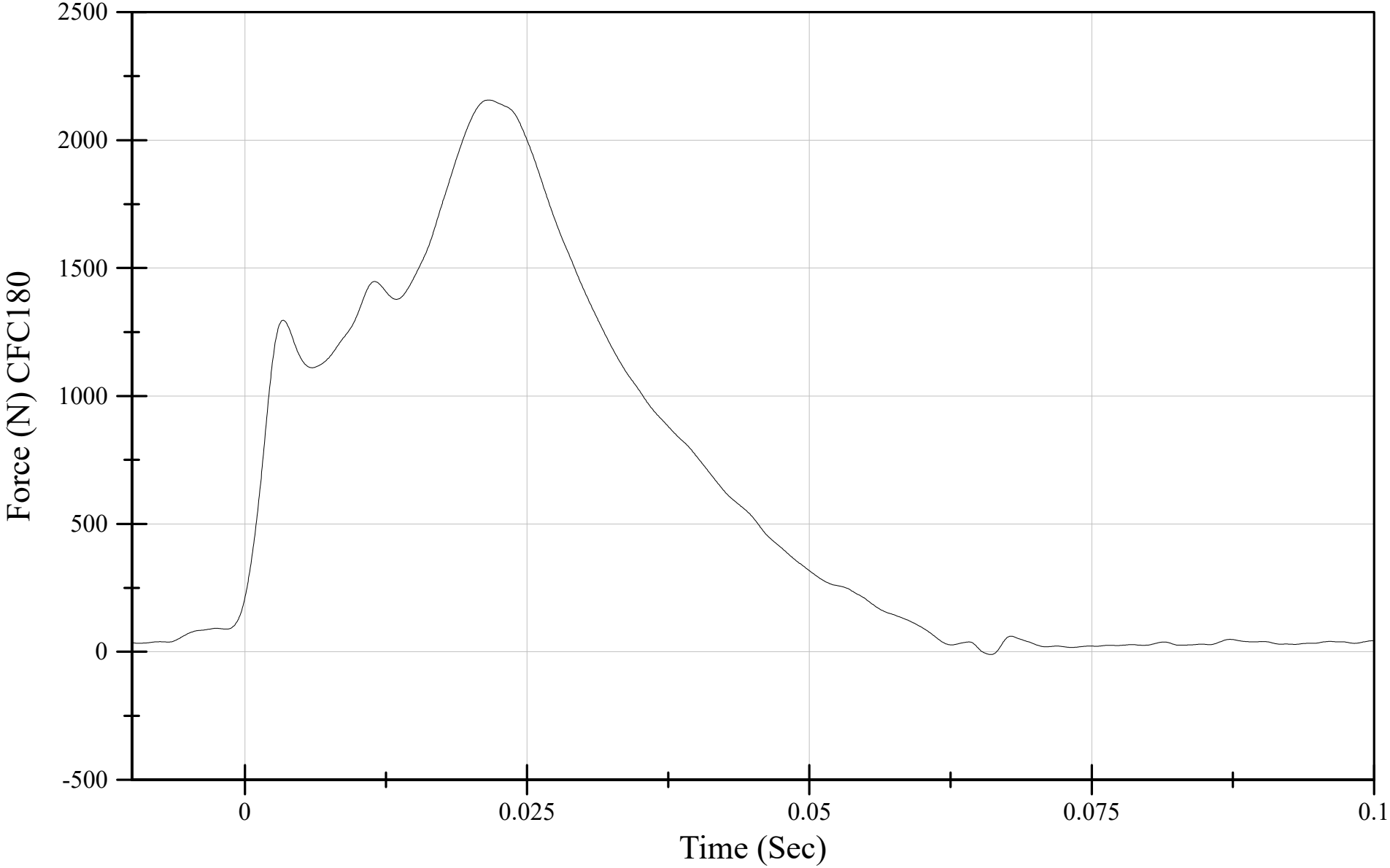
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	22.0	Pass
Test Humidity (%)	10 - 70	58	Pass
Test Velocity (m/s)	4.25 - 4.35	4.25	Pass
Peak Probe Force (N)		2157	
Peak Upper Left Resultant Deflection (mm)		45.9	
Peak Upper Right Resultant Deflection (mm)		46.6	
Difference Between Peak Left & Right Resultant Deflections (mm)		0.6	
Force at Left Peak Resultant Deflection (N)		2155	
Force at Right Peak Resultant Deflection (N)		2156	

* THOR-05F Qualification Manual - March 2022

File Name: 220425-9 processed

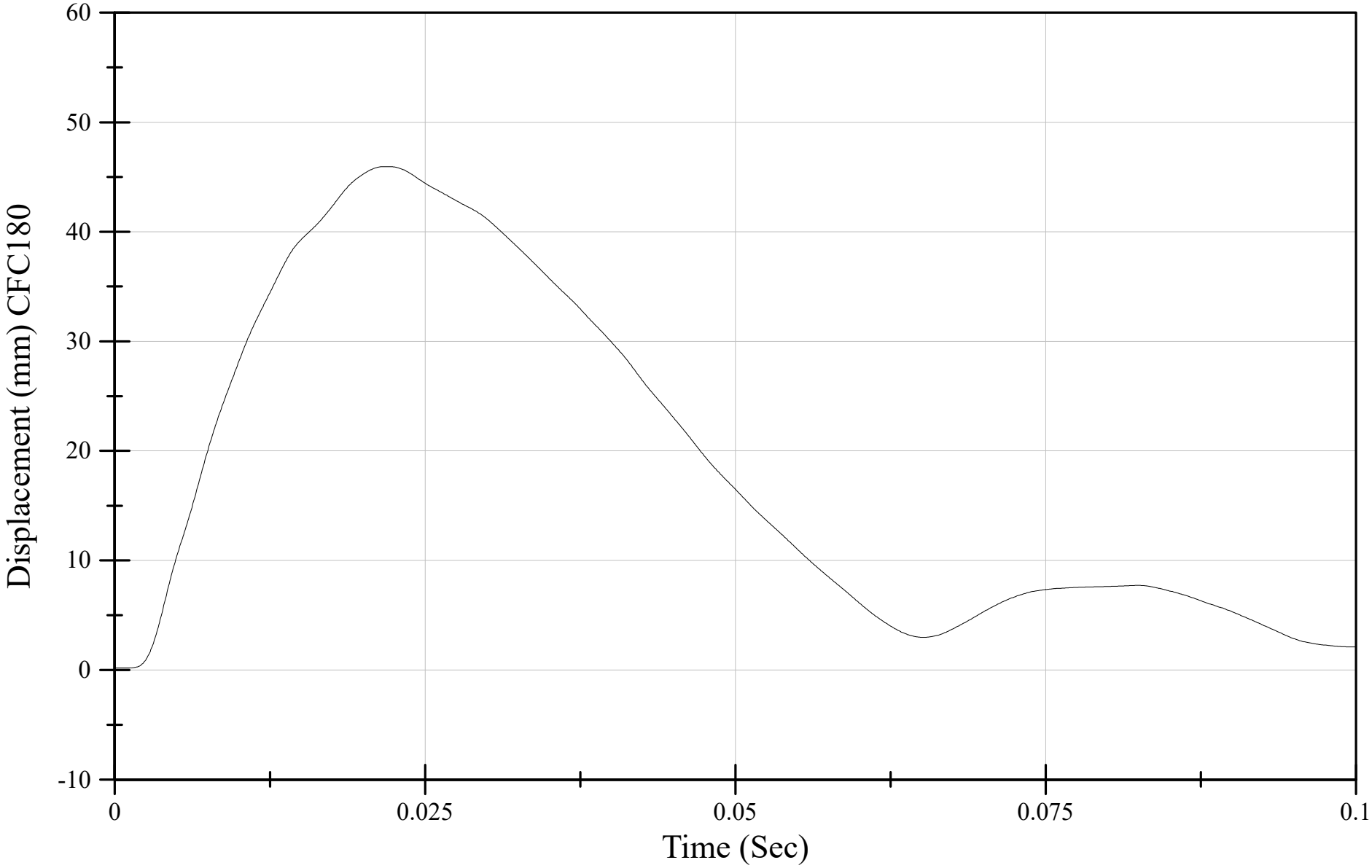
THOR-05F Upper Thorax Qualification
Probe Force
Dummy Serial Number: EU3430



File Name: 220425-9 processed

4/25/2022 3:07 PM

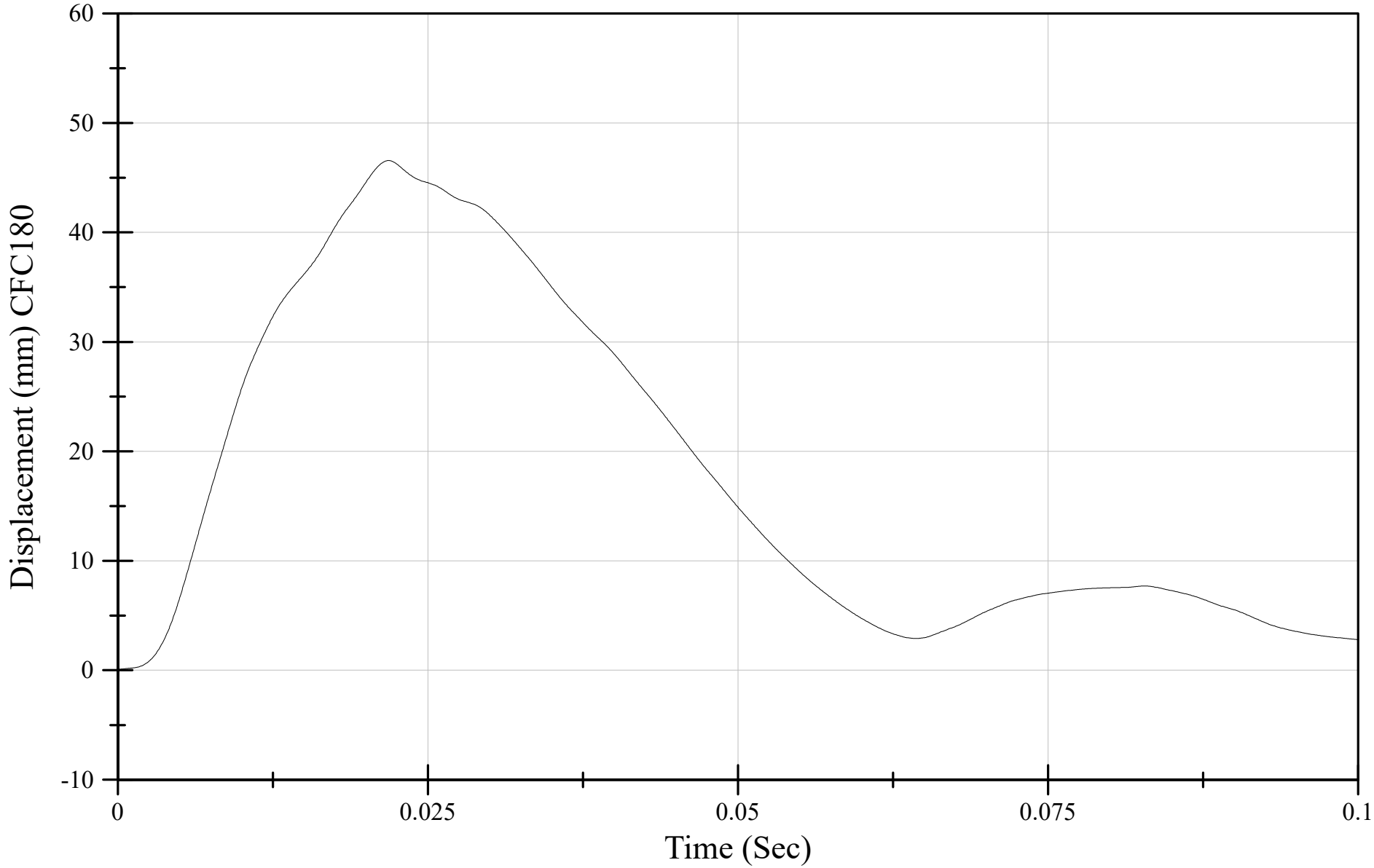
THOR-05F Upper Thorax Qualification
Left Resultant Deflection
Dummy Serial Number: EU3430



File Name: 220425-9 processed

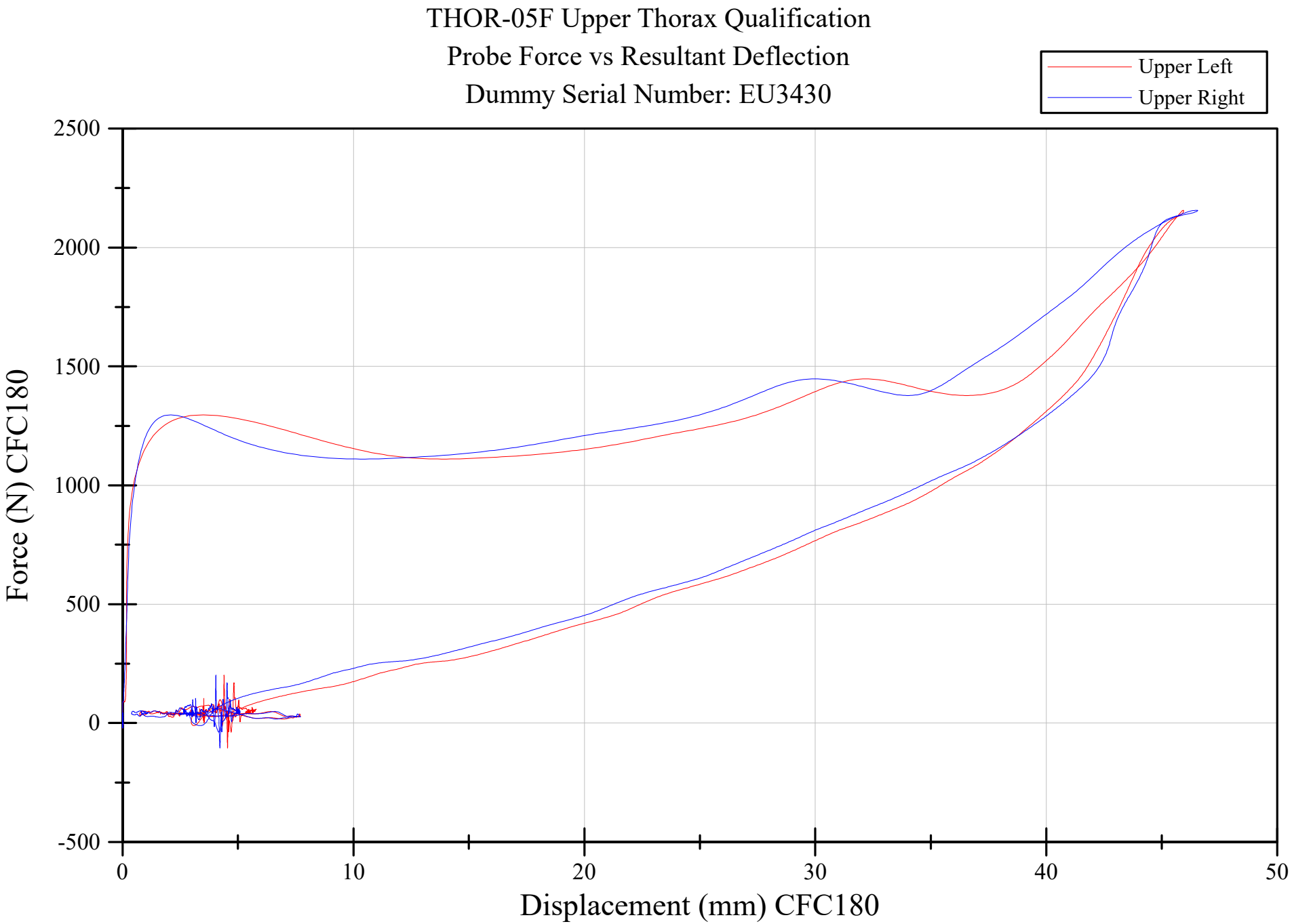
4/25/2022 3:07 PM

THOR-05F Upper Thorax Qualification
Right Resultant Deflection
Dummy Serial Number: EU3430



File Name: 220425-9 processed

4/25/2022 3:07 PM



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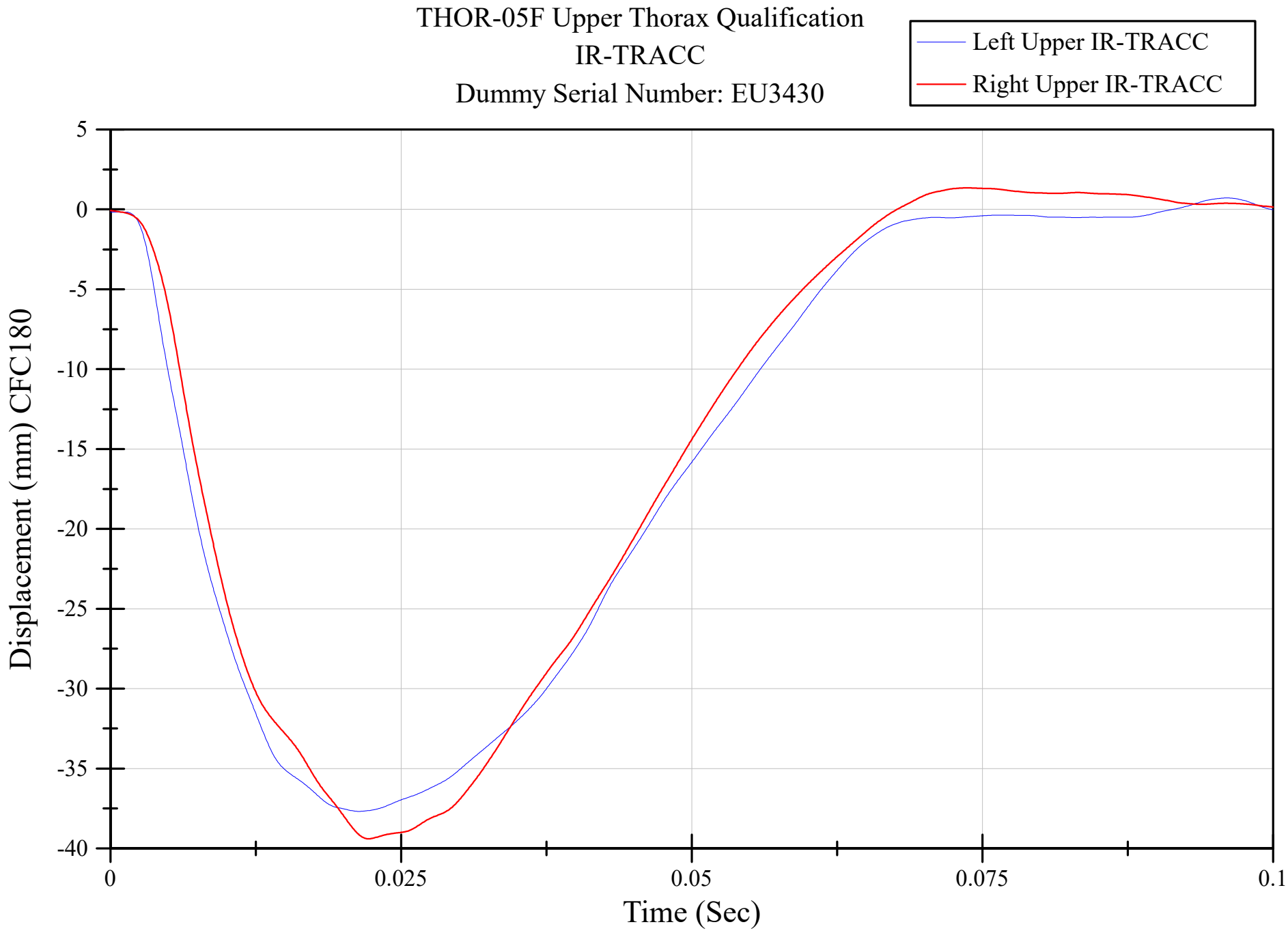
4/25/2022 3:07 PM



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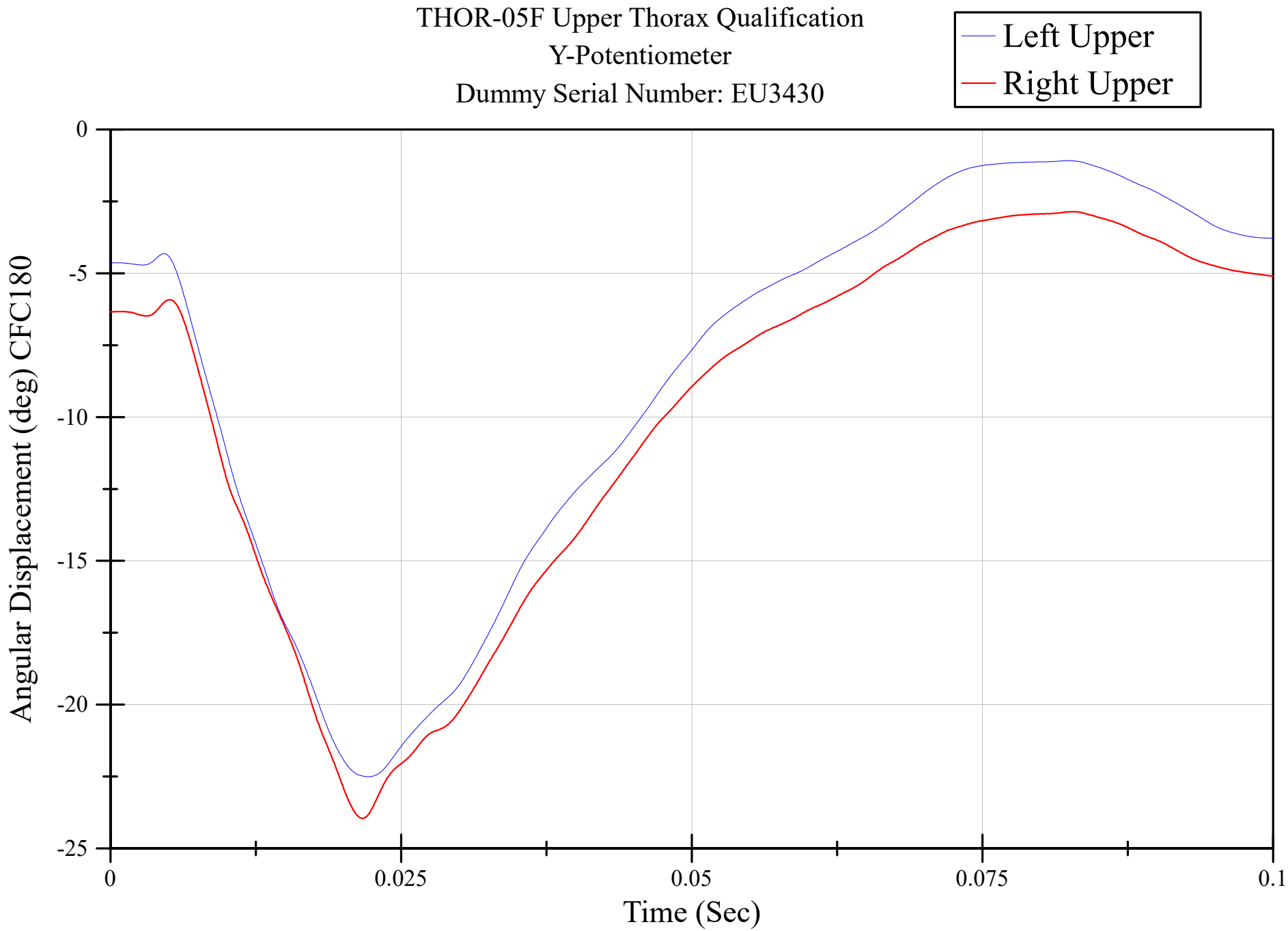
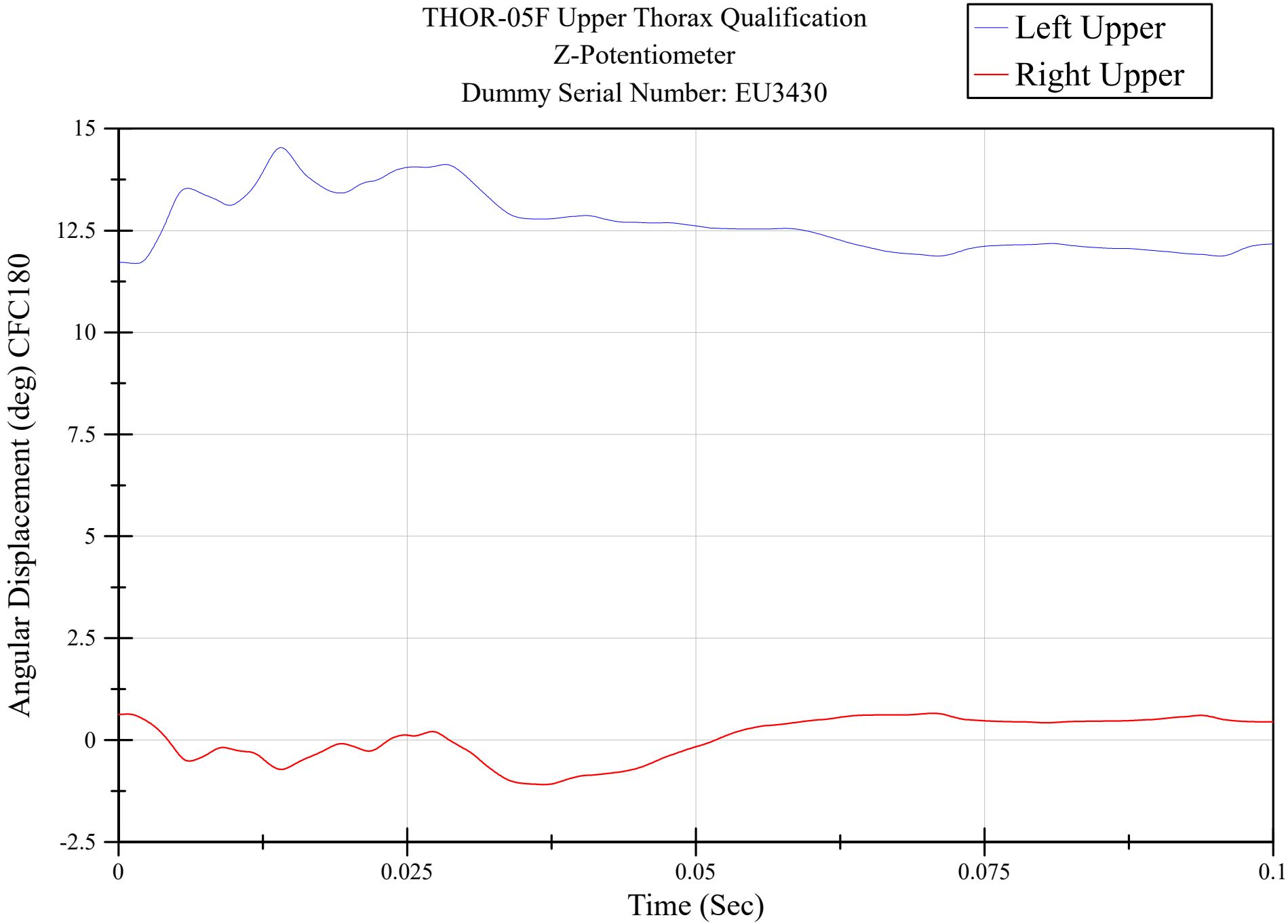
4/25/2022 3:07 PM



File Name: 220425-9 processed

4/25/2022 3:07 PM



File Name: 220425-9 processed

4/25/2022 3:07 PM

THOR-05F Lower Left Thorax Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components

Rib 1 Serial Number: ET5497
Rib 2 Serial Number: ET5498
Rib 3 Serial Number: ET5499
Rib 4 Serial Number: ET5500
Rib 5 Serial Number: ET5589
Rib 6 Serial Number: ET5502
Rib 7 Serial Number: ET5503

Test ID: 220425-3
Test Date: 4/25/2022
Test Time: 8:52 AM

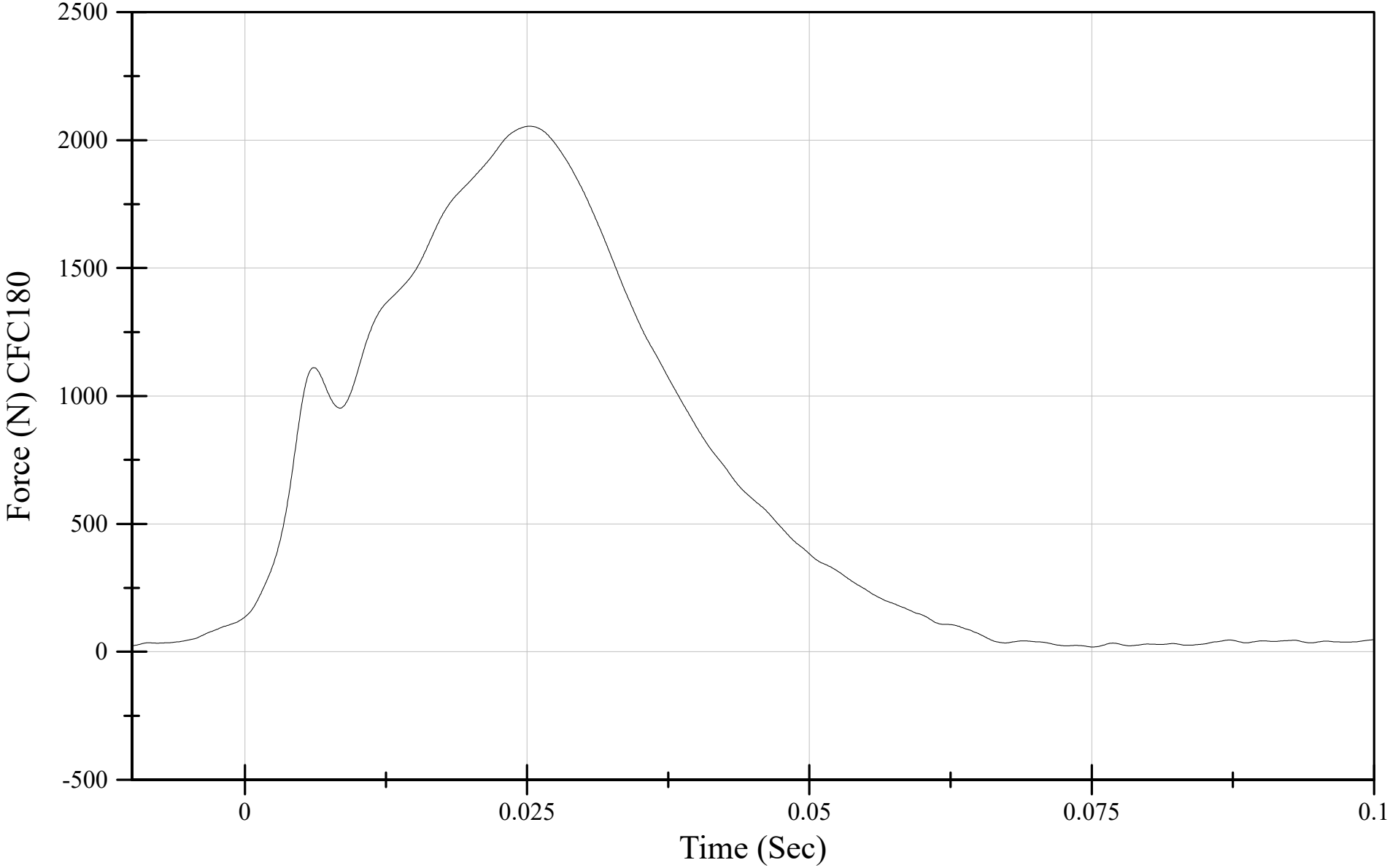
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	22.1	Pass
Test Humidity (%)	10 - 70	54	Pass
Test Velocity (m/s)	4.25 - 4.35	4.26	Pass
Peak Probe Force (N)		2054	
Left Resultant Deflection at Peak Force (mm)		49.9	

* THOR-05F Qualification Manual - March 2022

File Name: 220425-3 processed
Software Version: 2.8

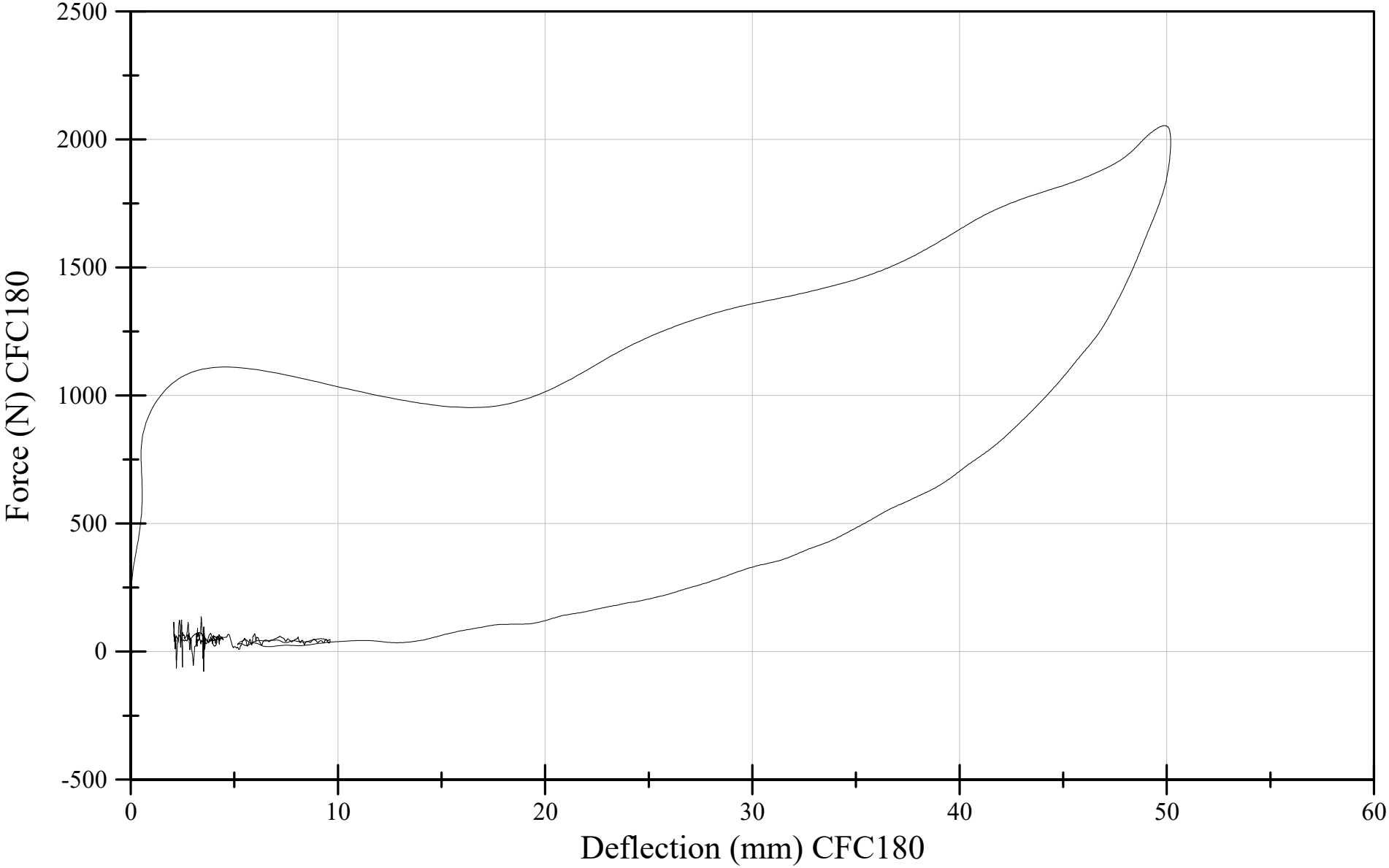
THOR-05F Lower Left Thorax Qualification
Peak Probe Force
Serial Number: EU3430



File Name: 220425-3 processed

4/25/2022 8:52 AM

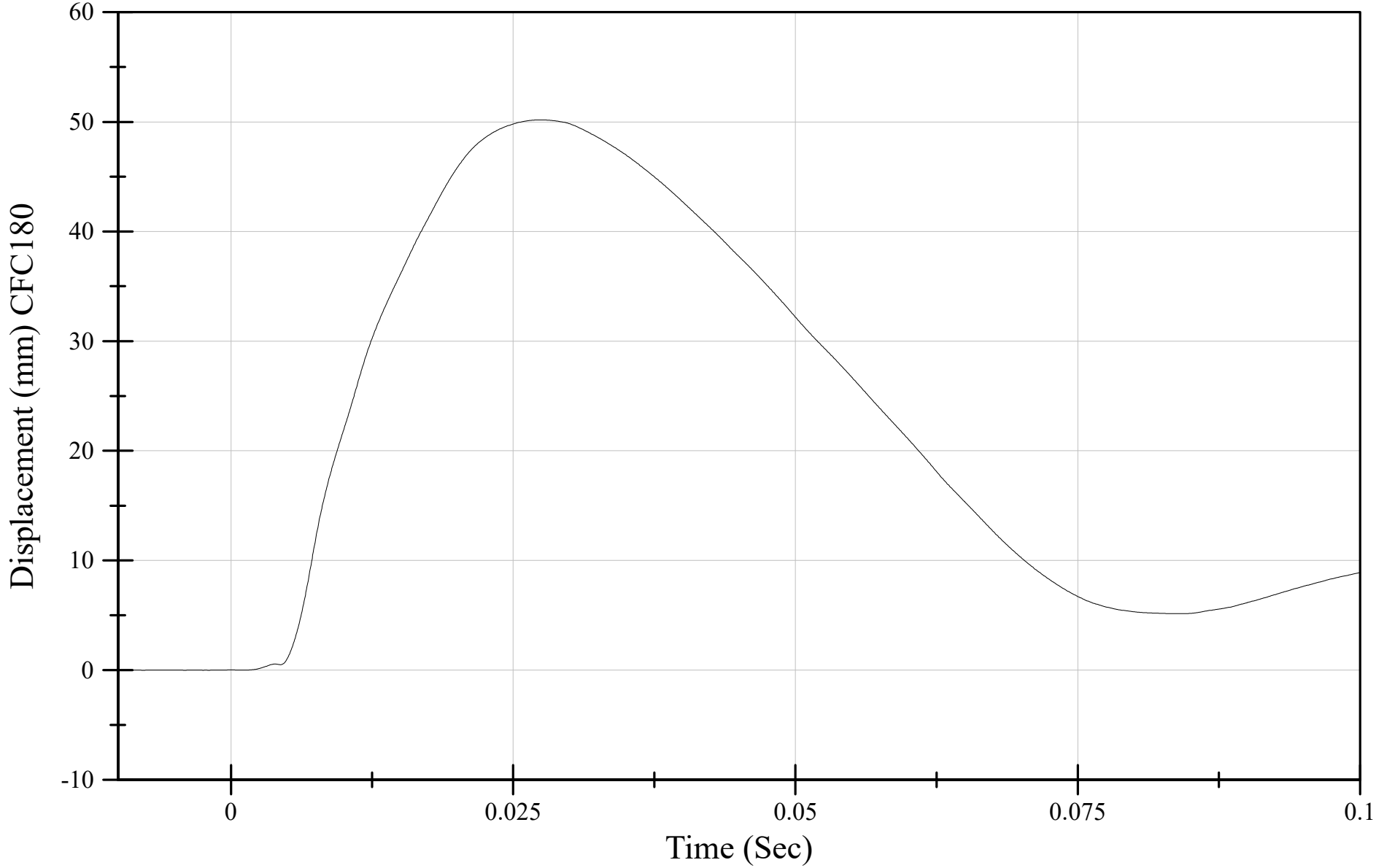
THOR-05F Lower Left Thorax Qualification
Probe Force vs Left Resultant Deflection
Serial Number: EU3430



File Name: 220425-3 processed

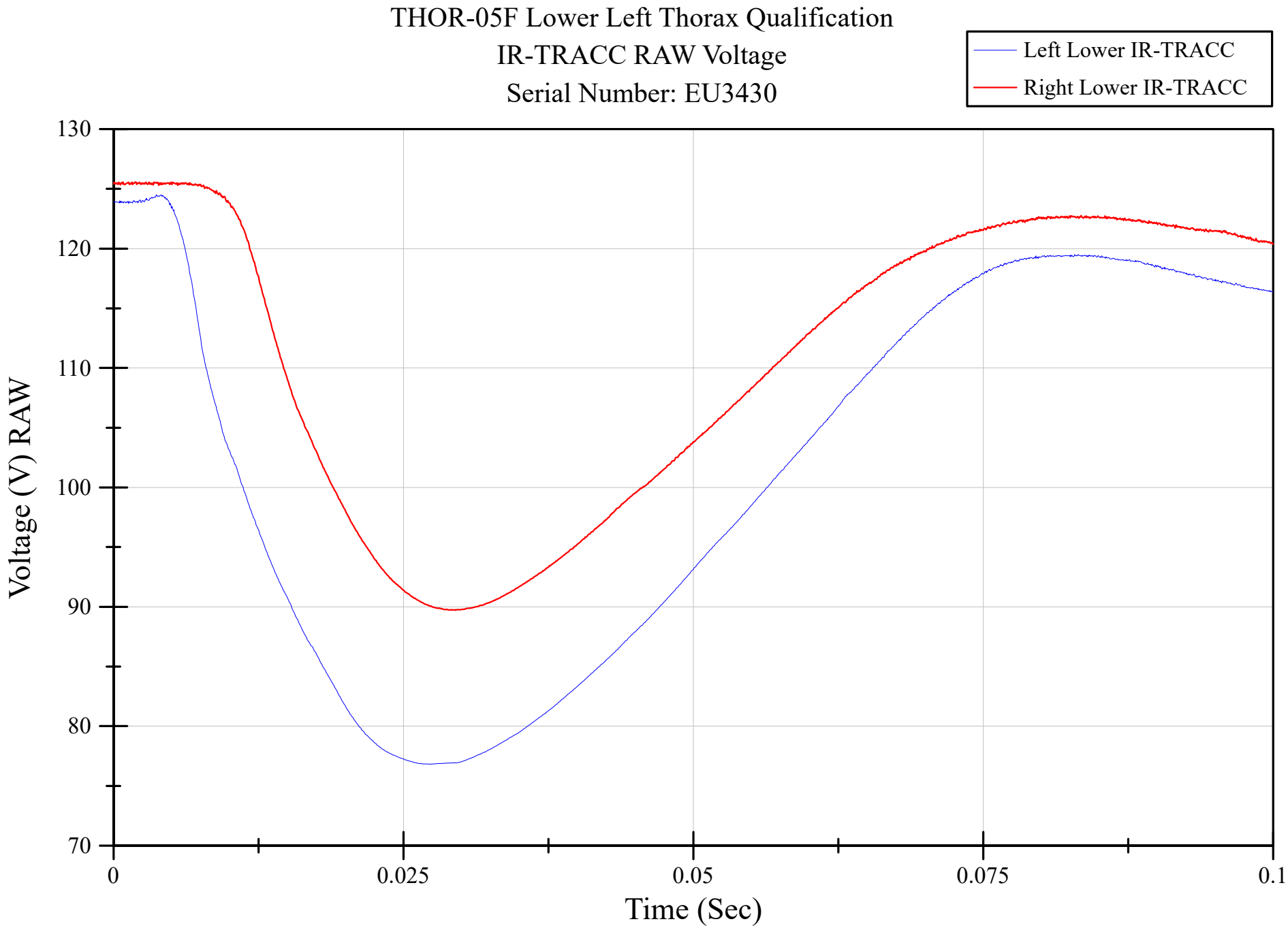
4/25/2022 8:52 AM

THOR-05F Lower Left Thorax Qualification
Left Resultant Deflection
Serial Number: EU3430



File Name: 220425-3 processed

4/25/2022 8:52 AM



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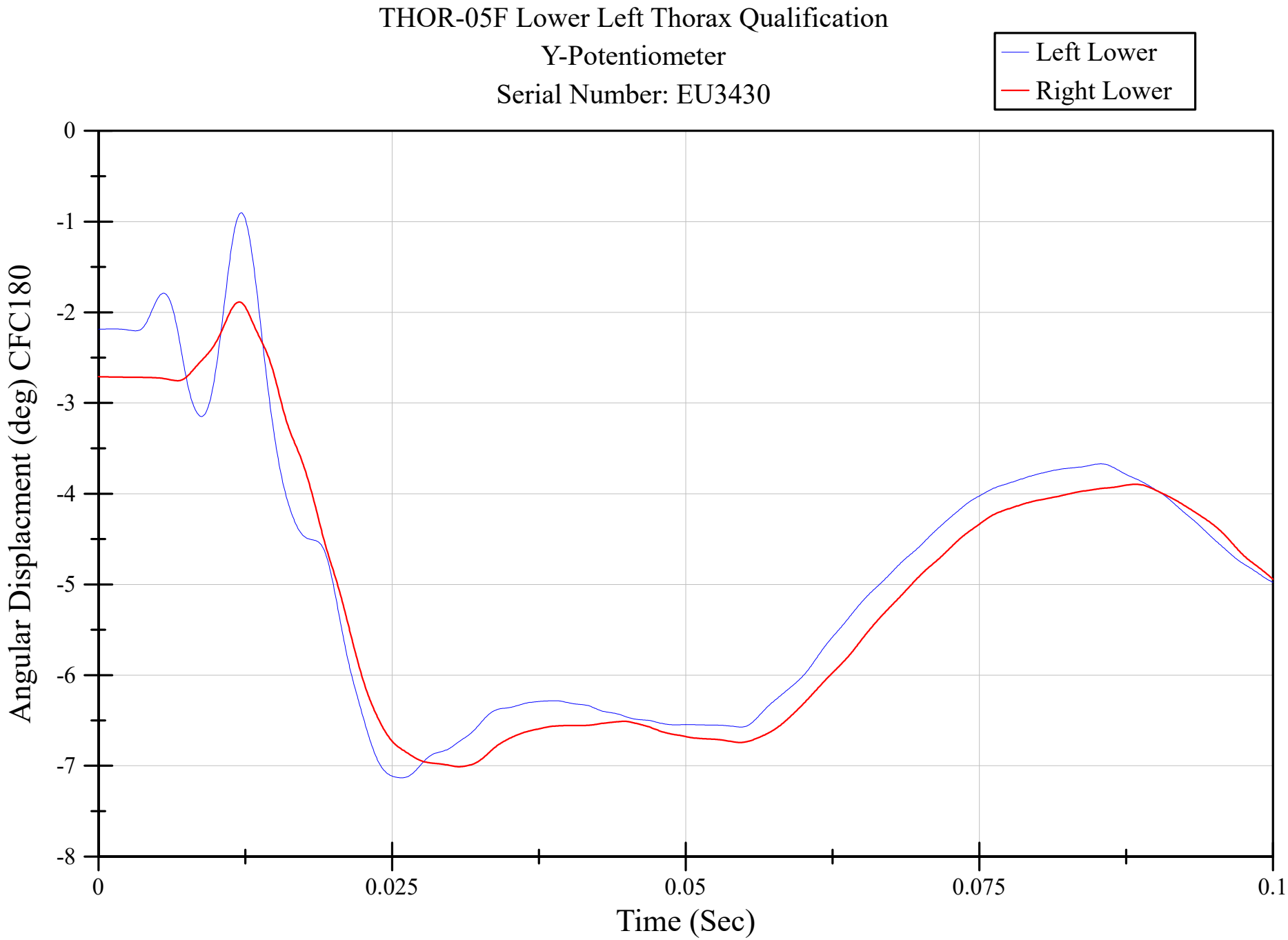
4/25/2022 8:52 AM



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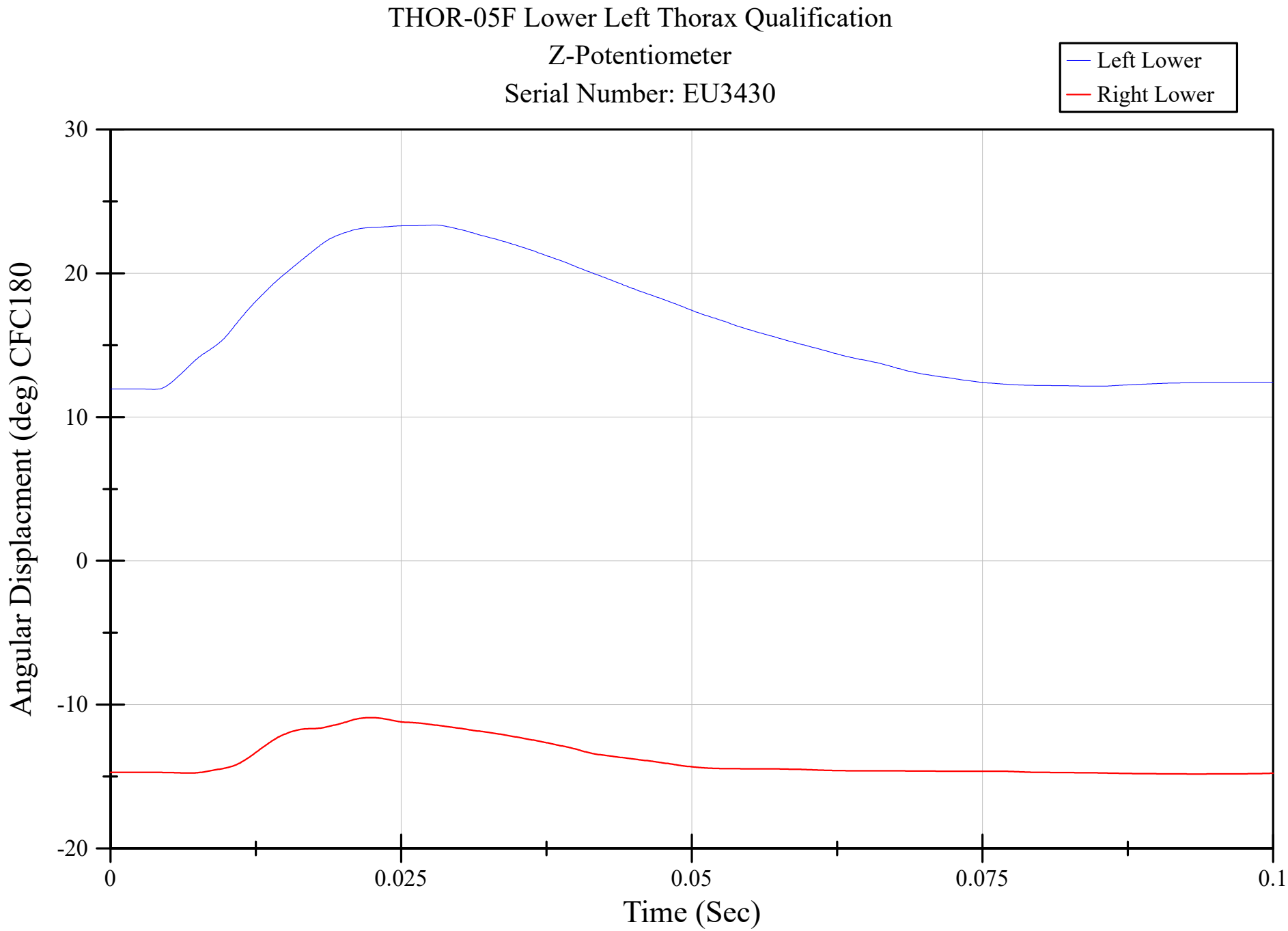


File Name: 220425-3 processed

4/25/2022 8:52 AM

THOR-05F Lower Right Thorax Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components

Rib 1 Serial Number: ET5497
Rib 2 Serial Number: ET5498
Rib 3 Serial Number: ET5499
Rib 4 Serial Number: ET5500
Rib 5 Serial Number: ET5589
Rib 6 Serial Number: ET5502
Rib 7 Serial Number: ET5503

Test ID: 220425-5
Test Date: 4/25/2022
Test Time: 9:54 AM

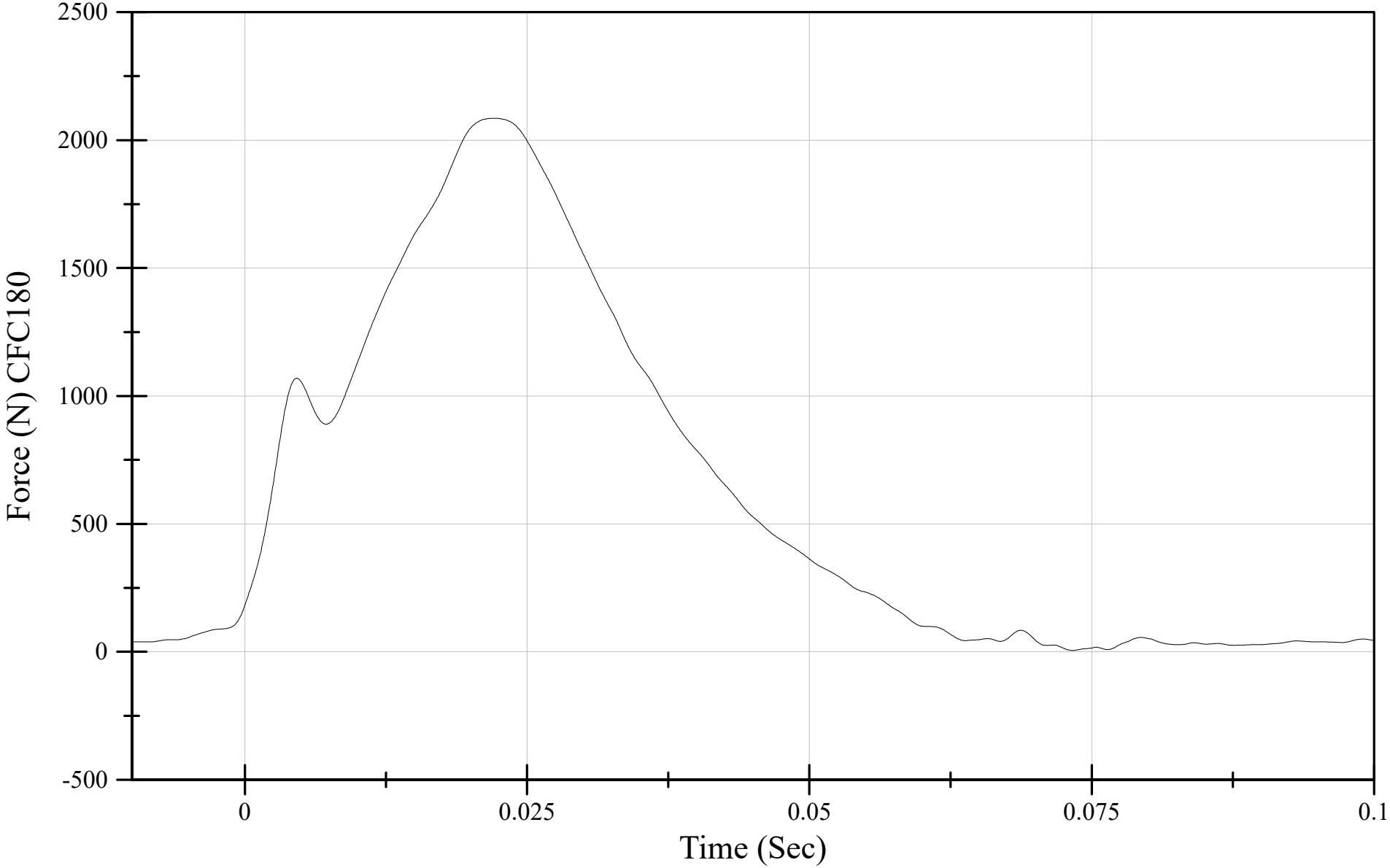
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	22.2	Pass
Test Humidity (%)	10 - 70	54	Pass
Test Velocity (m/s)	4.25 - 4.35	4.26	Pass
Peak Probe Force (N)		2086	
Right Resultant Deflection at Peak Force (mm)		48.5	

* THOR-05F Qualification Manual - March 2022

File Name: 220425-5 processed
Software Version: 2.8

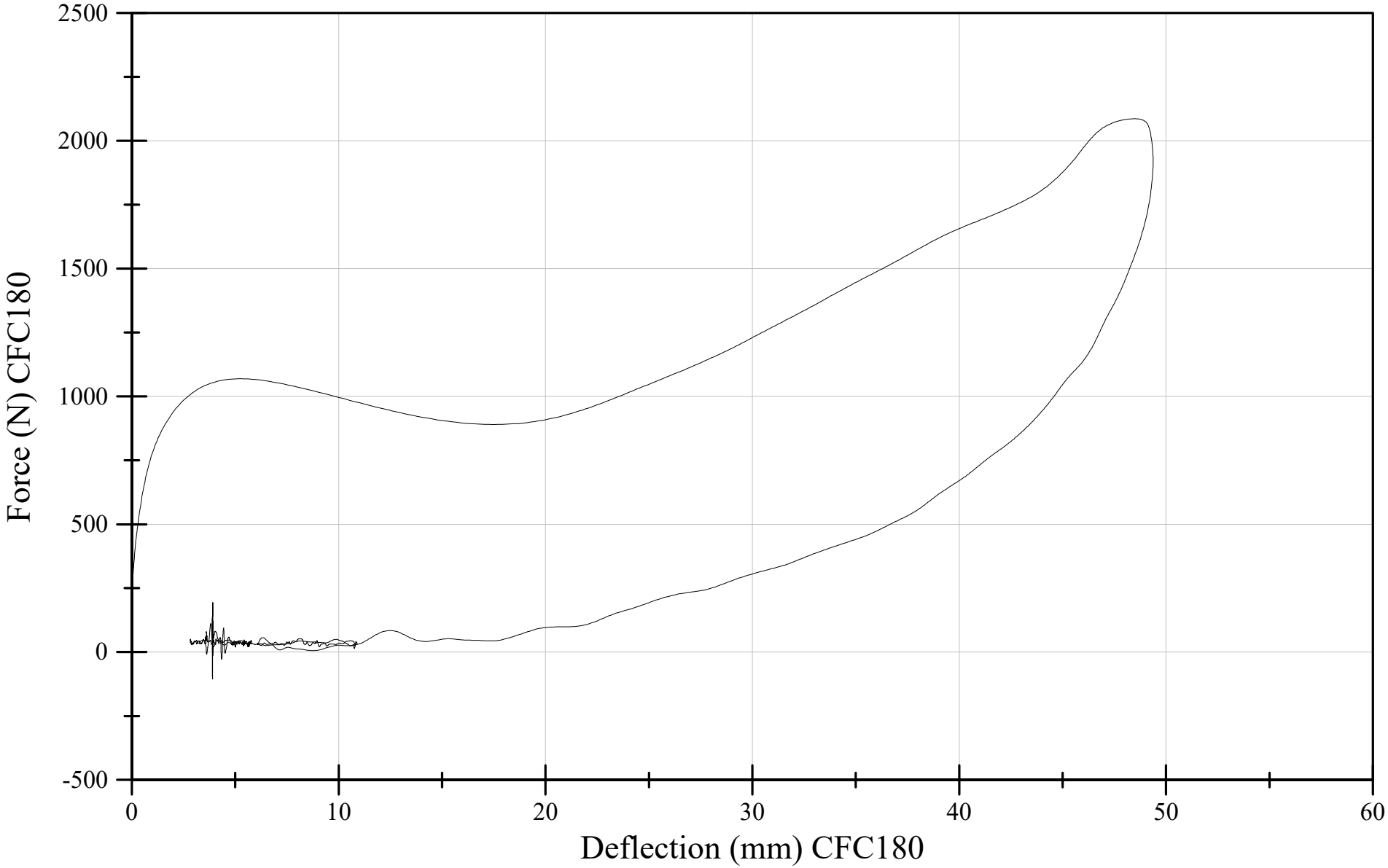
THOR-05F Lower Right Thorax Qualification
Peak Probe Force
Serial Number: EU3430



File Name: 220425-5 processed

4/25/2022 9:54 AM

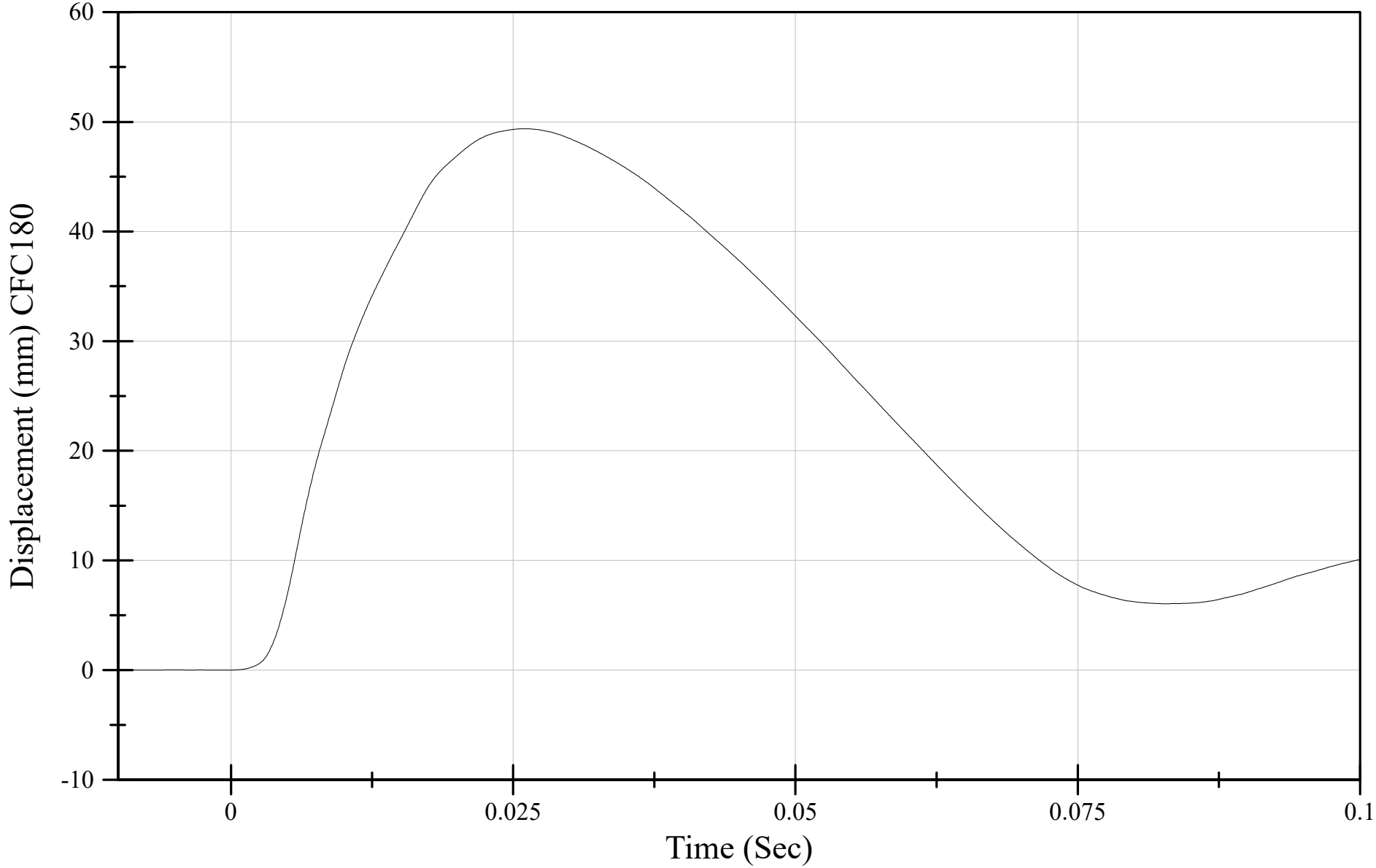
THOR-05F Lower Right Thorax Qualification
Probe Force vs Right Resultant Deflection
Serial Number: EU3430



File Name: 220425-5 processed

4/25/2022 9:54 AM

THOR-05F Lower Right Thorax Qualification
Right Resultant Deflection
Serial Number: EU3430



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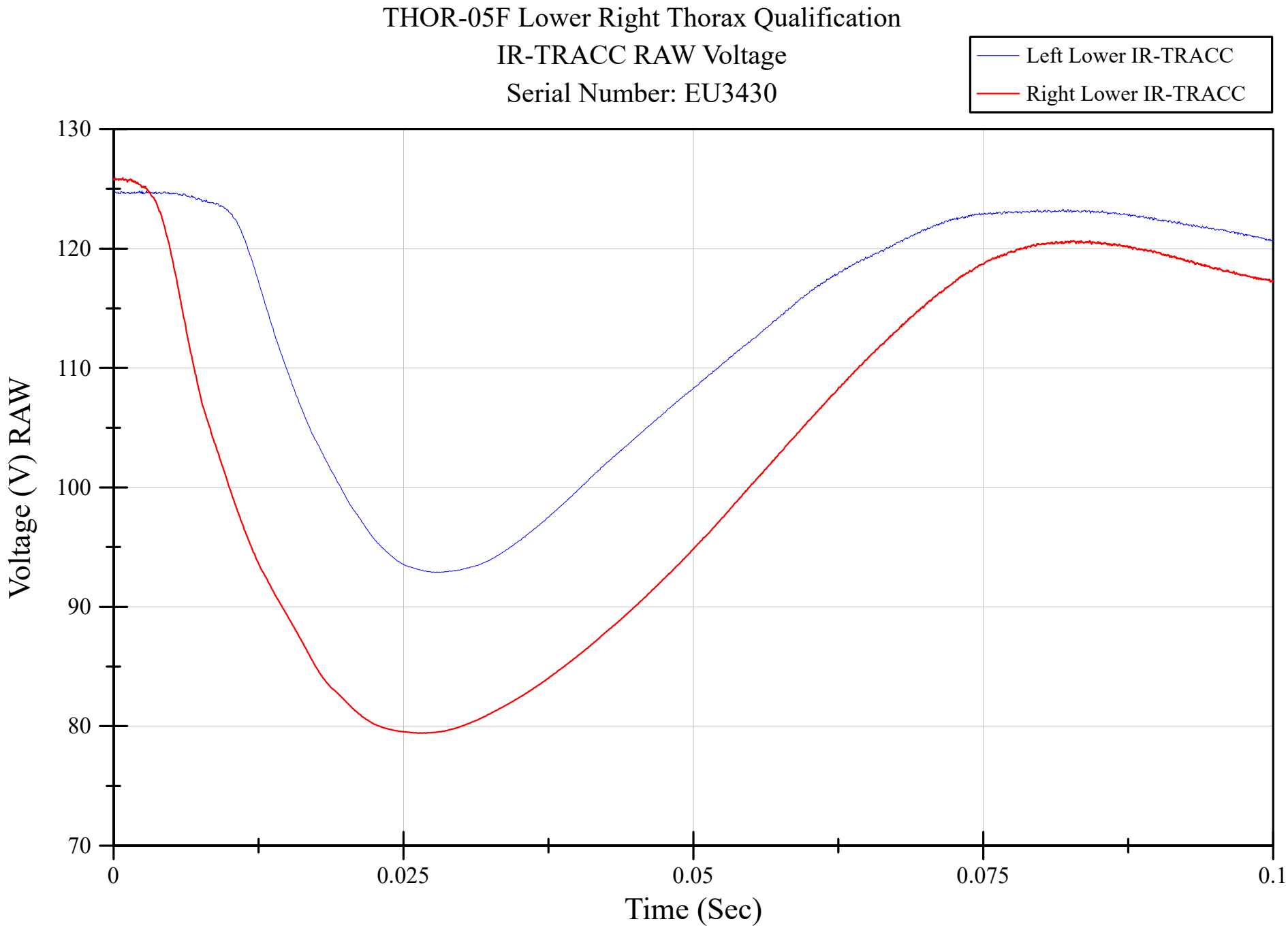
4/25/2022 9:54 AM



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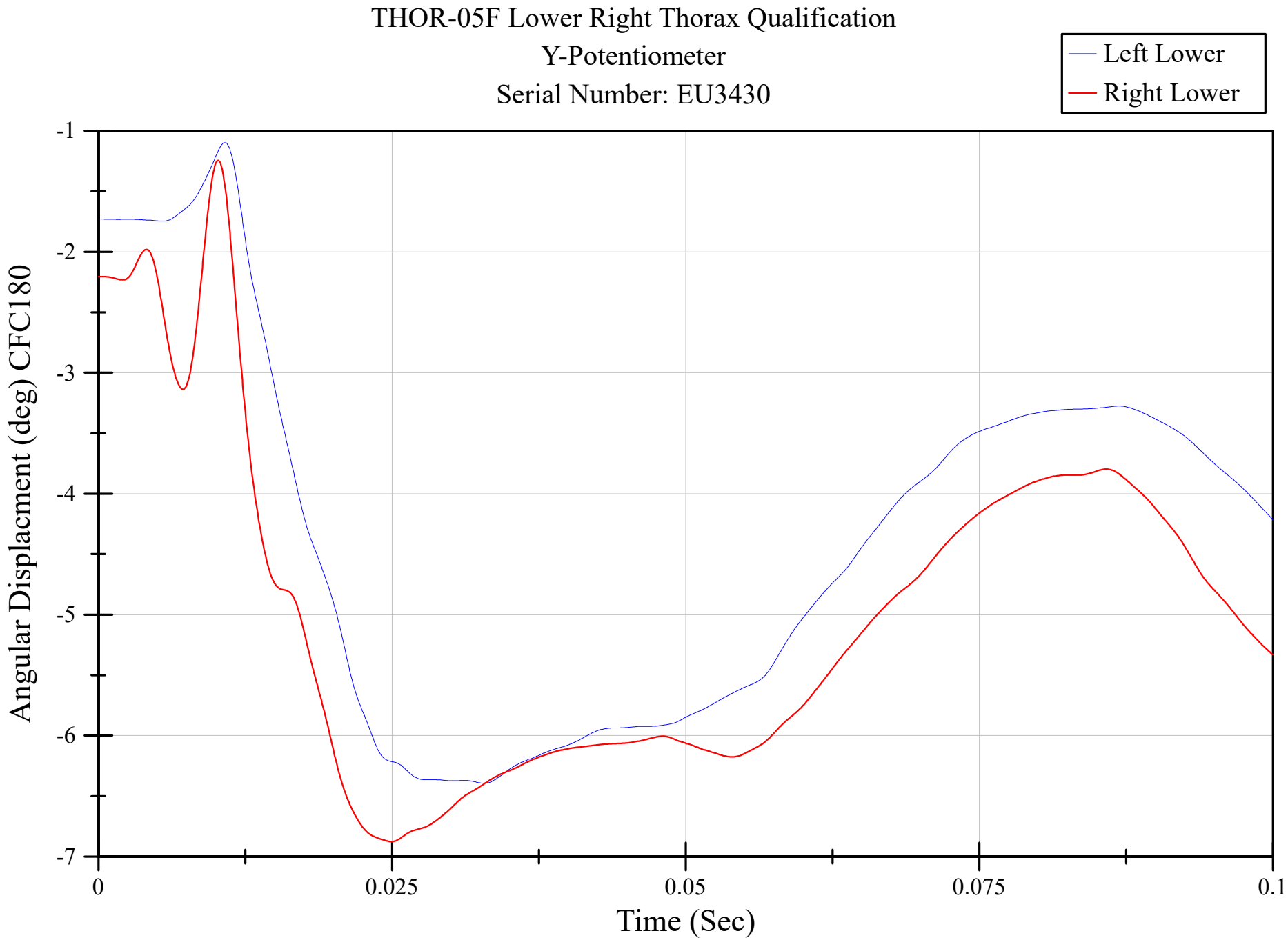
4/25/2022 9:54 AM



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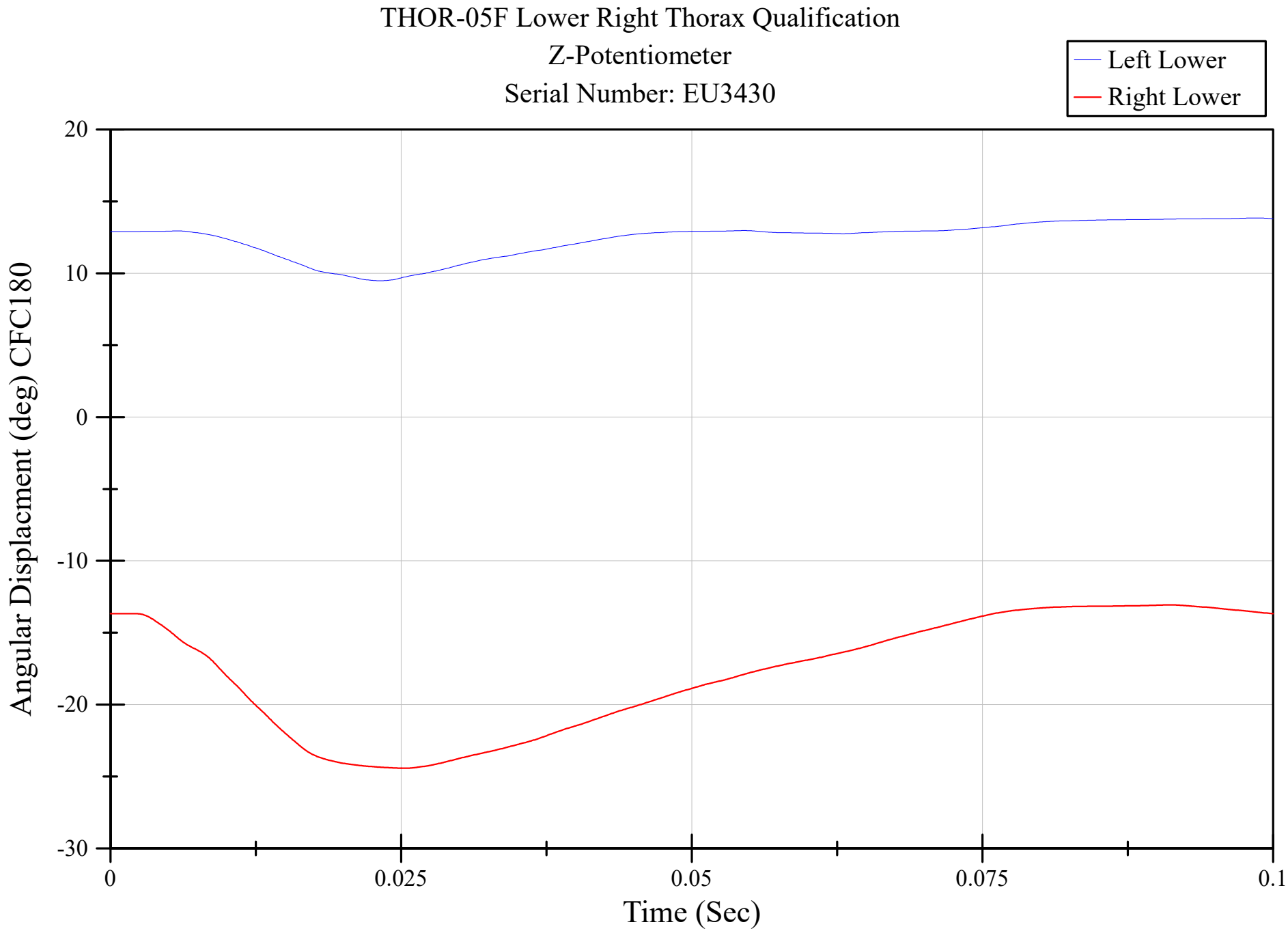
4/25/2022 9:54 AM



File Name: 220425-5 processed

4/25/2022 9:54 AM

THOR-05F Lower Abdomen Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components

Abdomen Foam:

Test ID: 220419-11
Test Date: 4/19/2022
Test Time: 2:50 PM

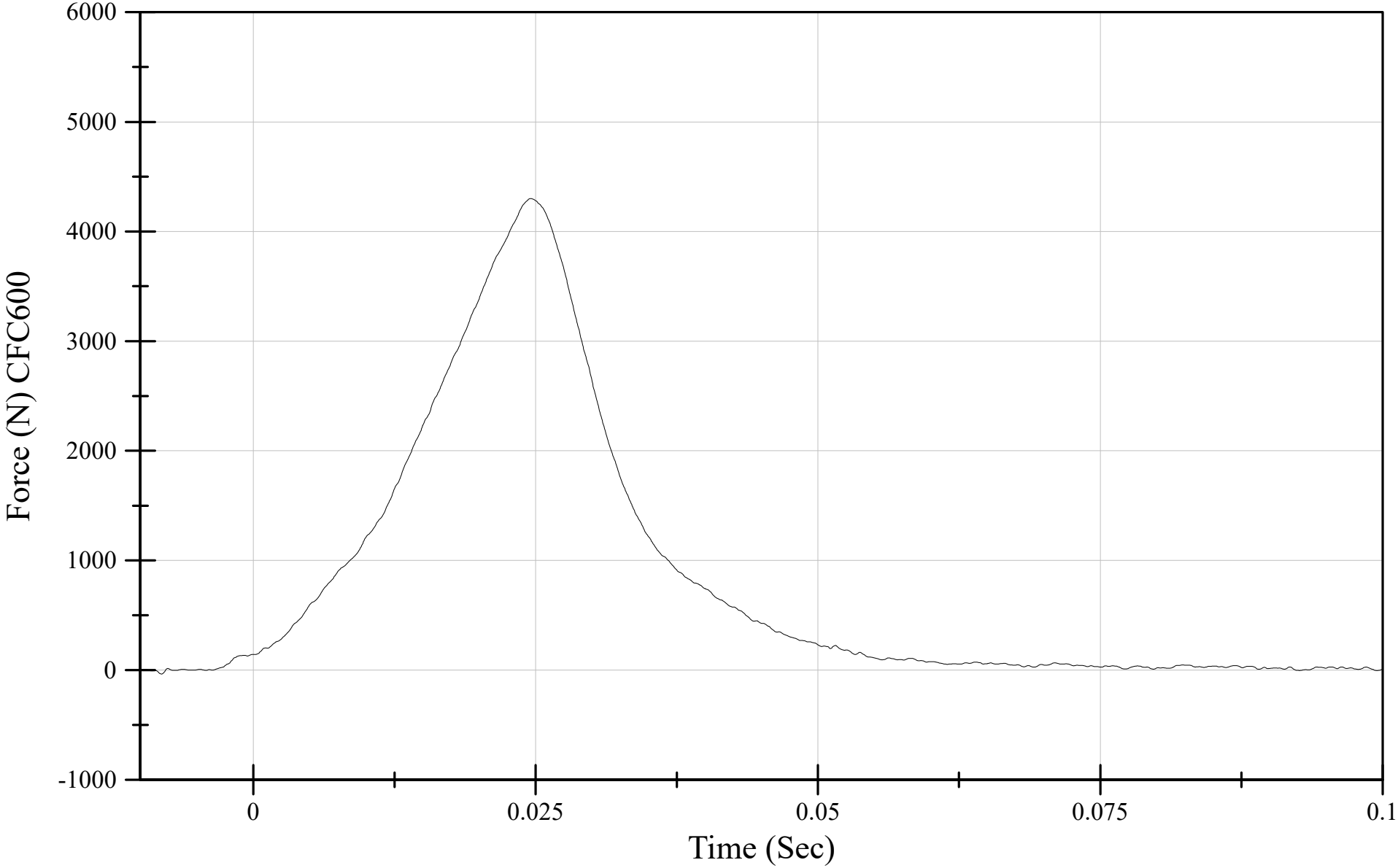
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.5	Pass
Test Humidity (%)	10 - 70	43	Pass
Test Velocity (m/s)	6.05 - 6.15	6.10	Pass
Peak Probe Force (N)		4301	
Peak Left Abdomen Pressure (kPa)		157	
Peak Right Abdomen Pressure (kPa)		158	
Difference between Left and Right Pressure (kPa)		1	

* THOR-05F Qualification Manual - March 2022

File Name: 220419-11 processed
Software Version: 2.8

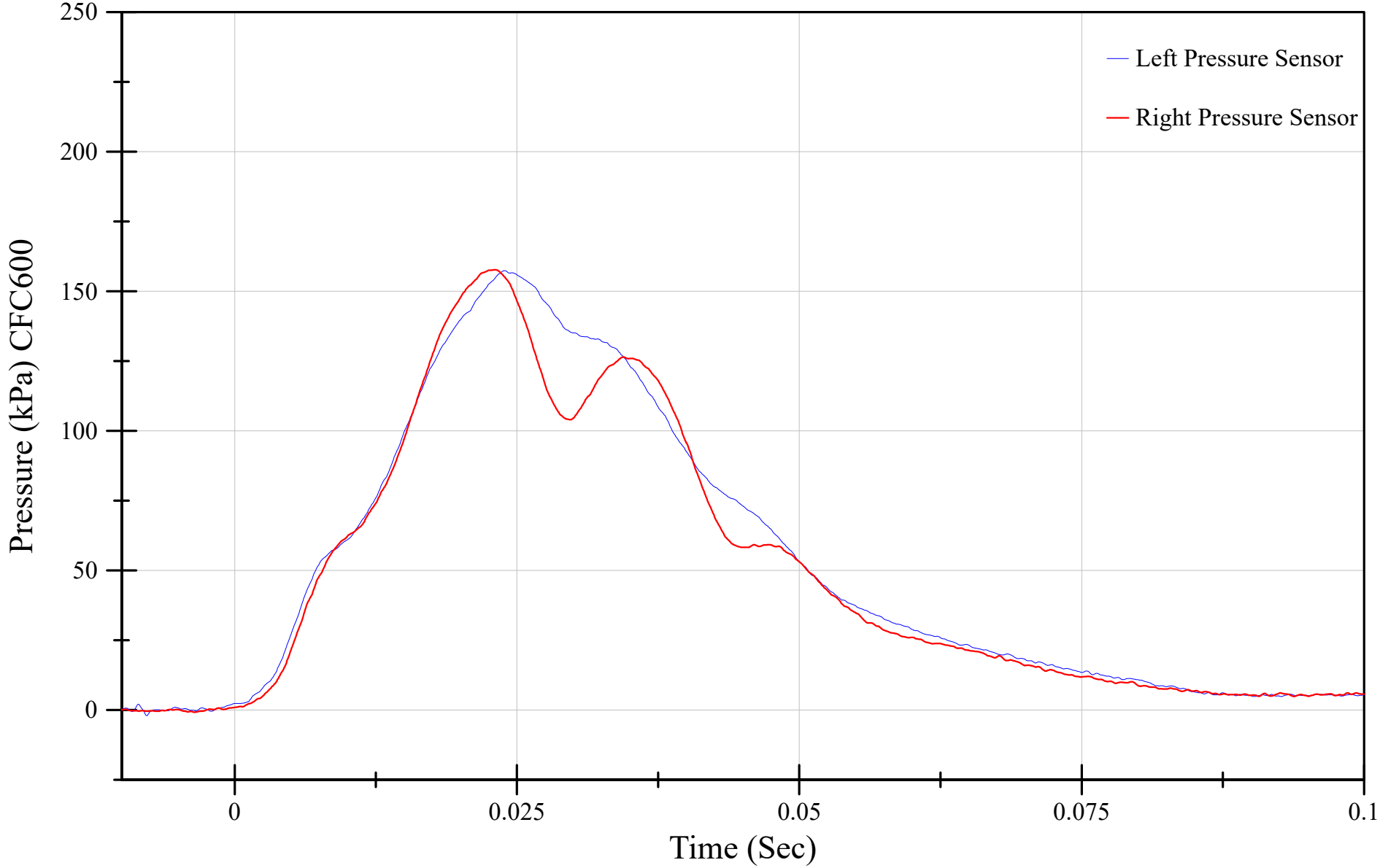
THOR-05F Lower Abdomen Qualification
Peak Probe Force
Serial Number: EU3430



File Name: 220419-11 processed

4/19/2022 2:50 PM

THOR-05F Lower Abdomen Qualification
Abdomen Pressure Sensors
Serial Number: EU3430



File Name: 220419-11 processed

4/19/2022 2:50 PM

THOR-05F Left Upper Leg Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Compression Element:
Left Thigh Flesh:

Test ID: 220427-6
Test Date: 4/27/2022
Test Time: 12:14 PM

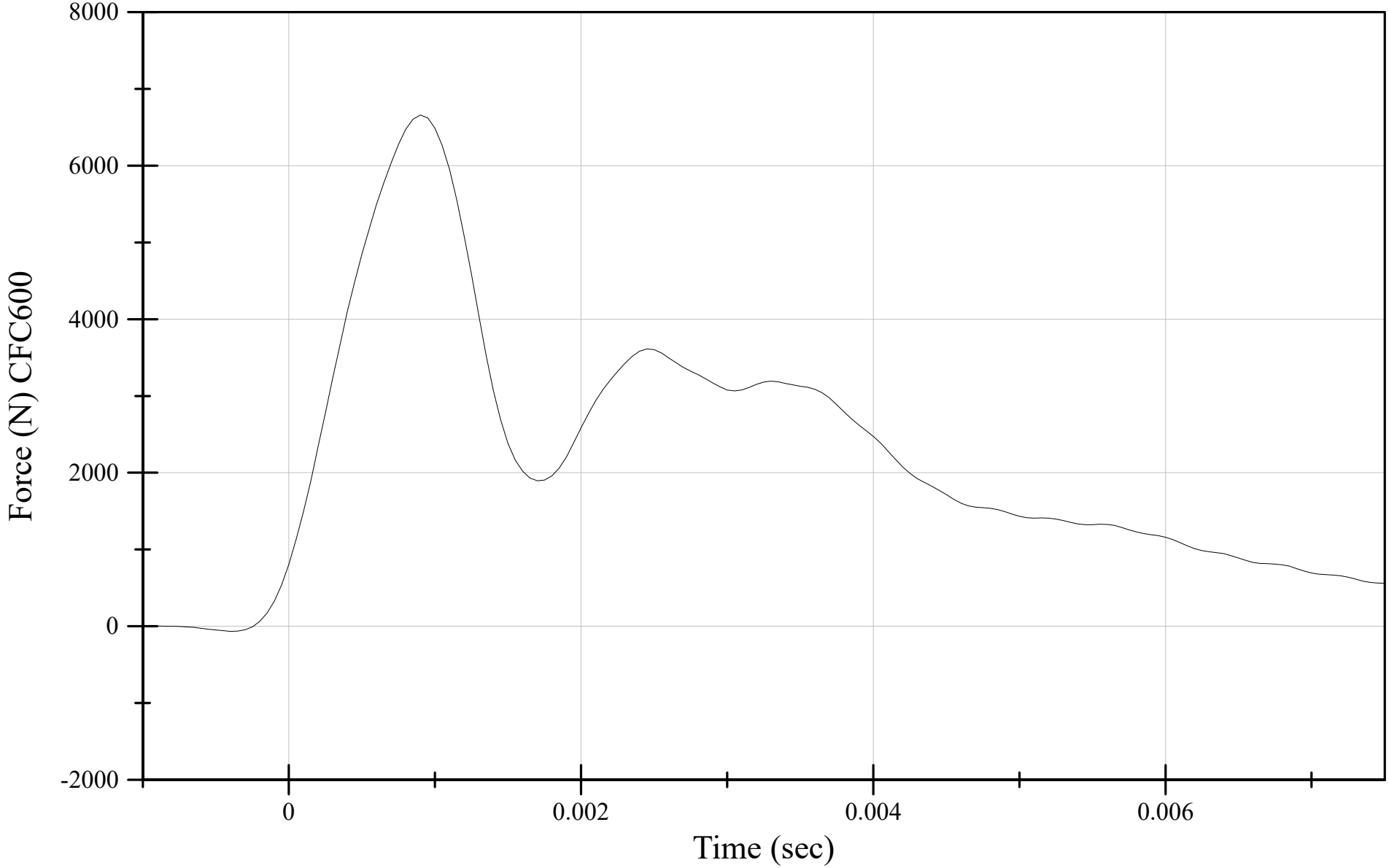
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.5	Pass
Test Humidity (%)	10 - 70	45	Pass
Test Velocity (m/s)	3.25 - 3.35	3.30	Pass
Peak Probe Force (N)		6662.0	
Peak Femur Force (N)		-4128.2	
Peak Resultant Acetabulum Force (N)		1991.2	

* THOR-05F Qualification Manual - March 2022

File Name: 220427-6 processed

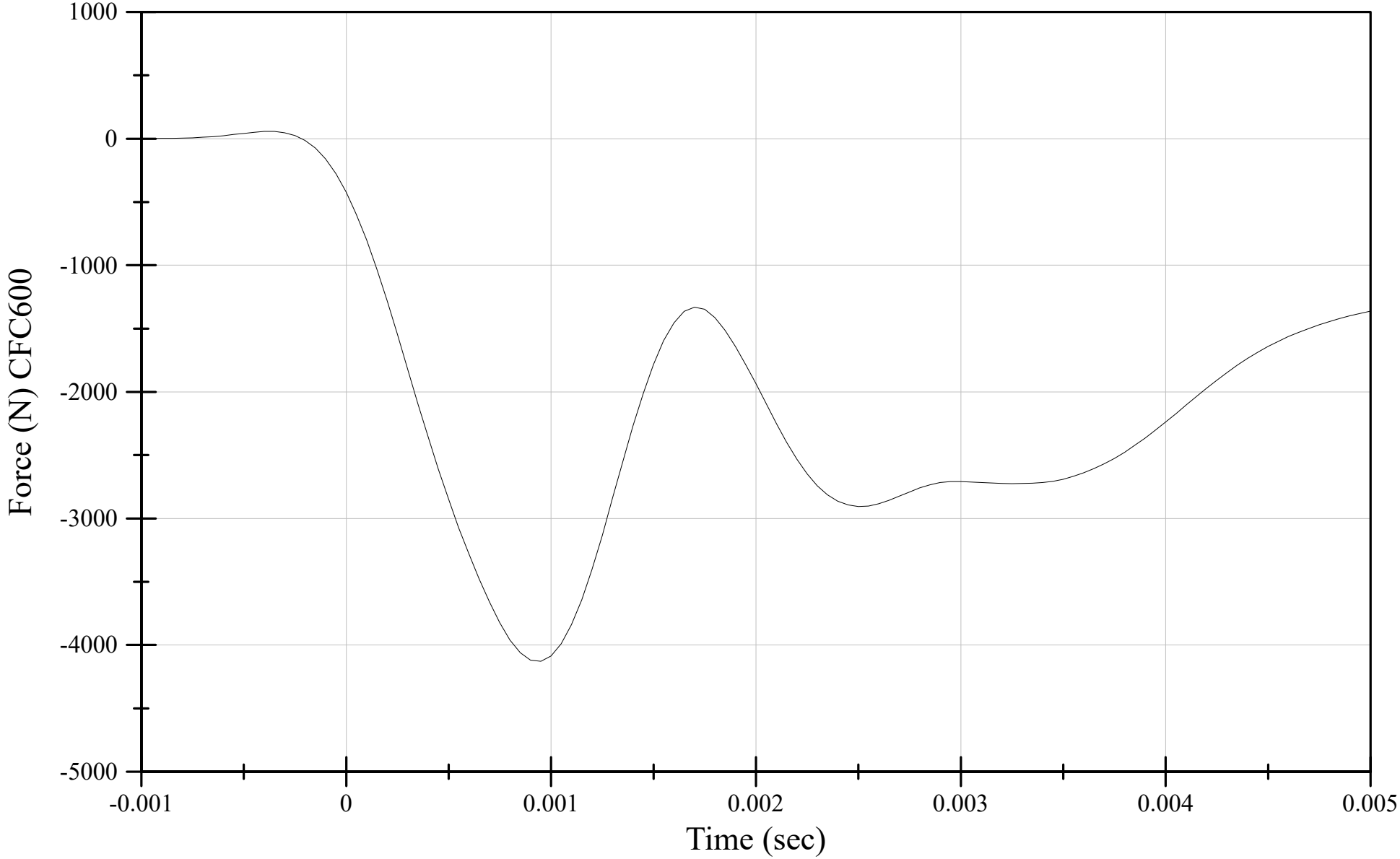
THOR-05F Left Upper Leg Qualification
Probe Force
Serial Number: EU3430



File Name: 220427-6 processed

4/27/2022 12:14 PM

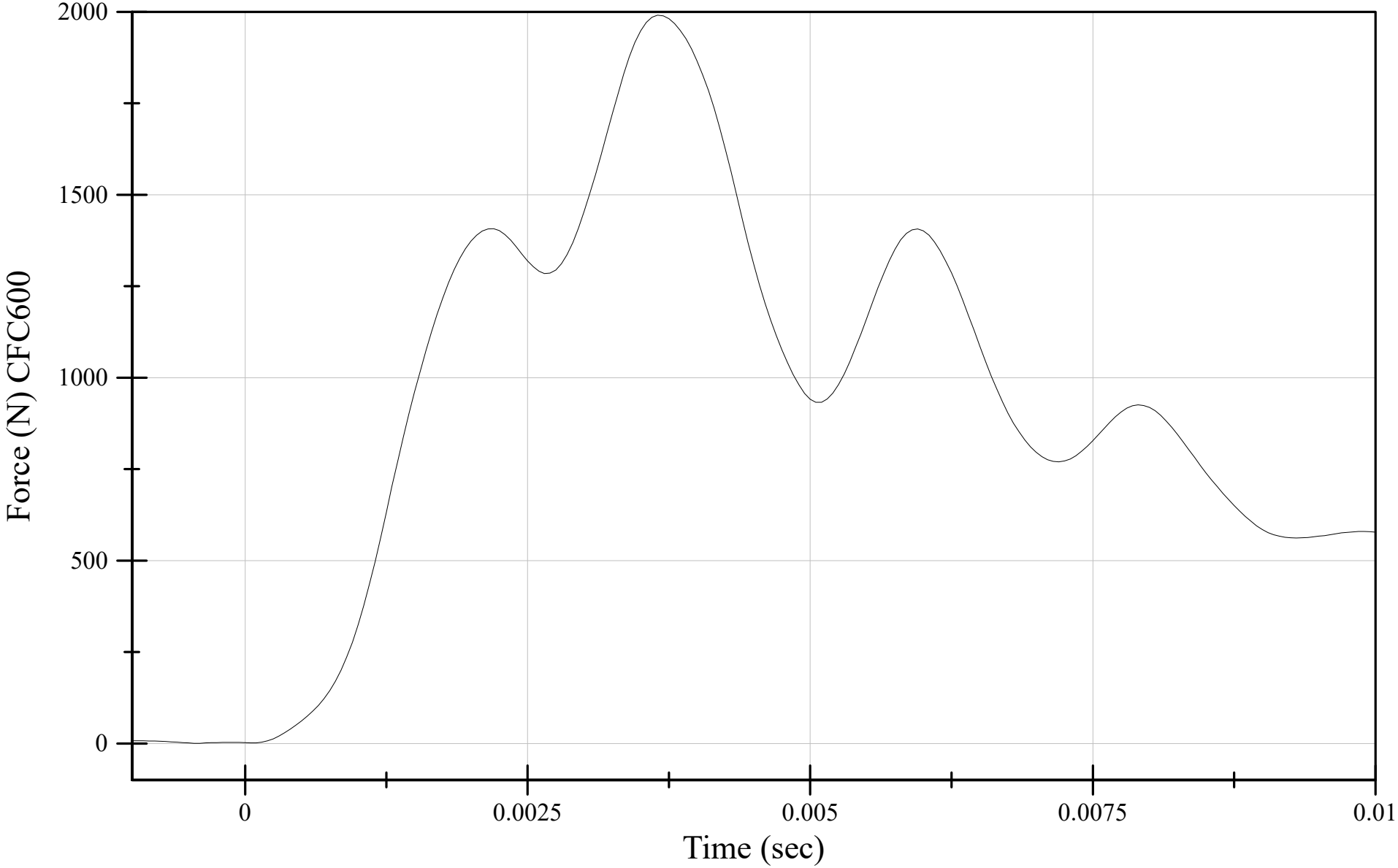
THOR-05F Left Upper Leg Qualification
Femur Z-Force
Serial Number: EU3430



File Name: 220427-6 processed

4/27/2022 12:14 PM

THOR-05F Left Upper Leg Qualification
Peak Acetabulum Resultant Force
Serial Number: EU3430



File Name: 220427-6 processed

4/27/2022 12:14 PM

THOR-05F Left Knee Qualification
Test Results Summary

Dummy Serial Number: EU3430

Test ID: 220705-5
Test Date: 7/5/2022
Test Time: 2:28 PM

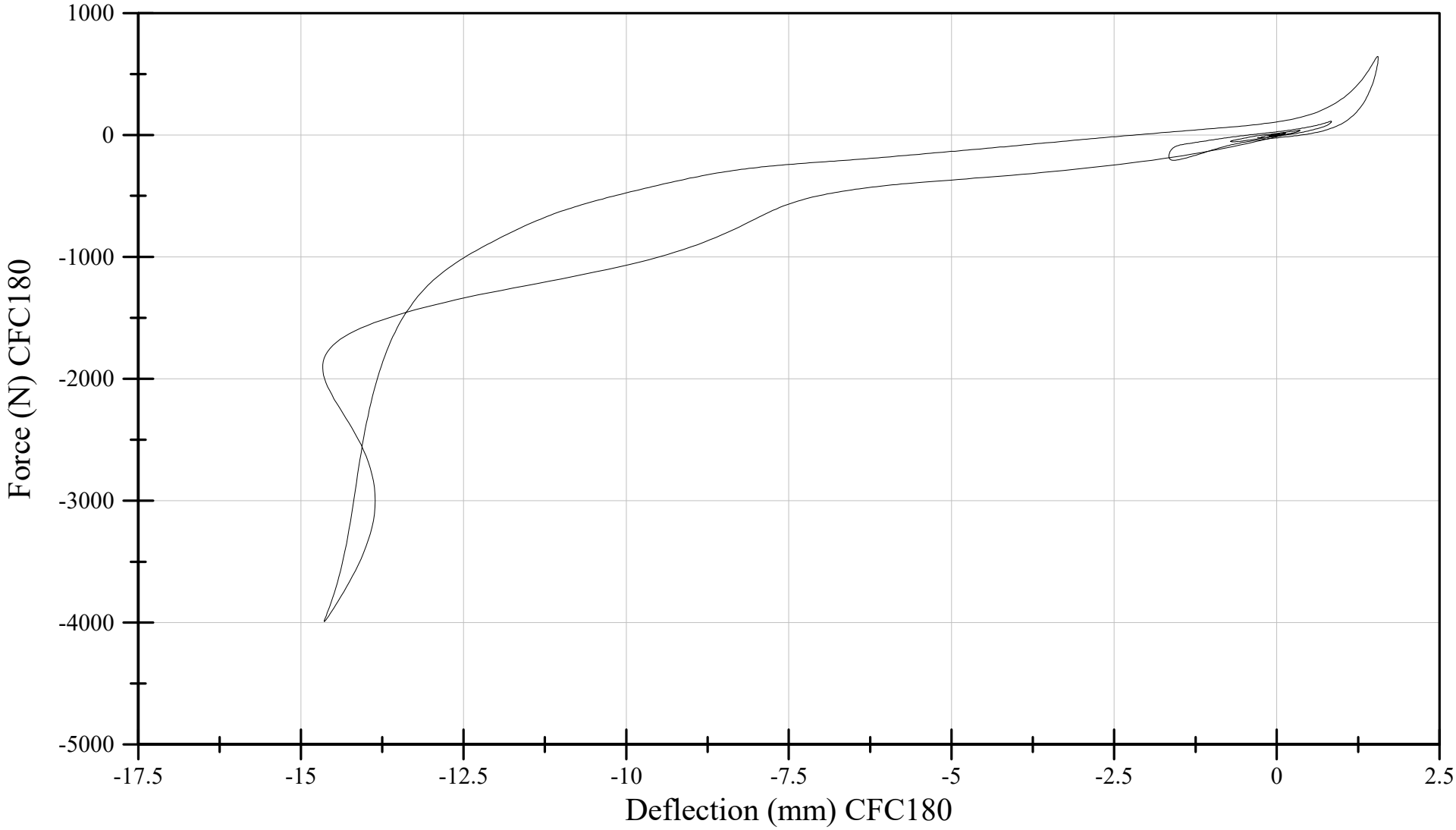
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.1	Pass
Test Humidity (%)	10 - 70	48	Pass
Test Velocity (m/s)	2.10 - 2.20	2.20	Pass
Peak Femur Fz (N)		-3991.3	
Knee Deflection at Peak Femur Force (N)		-14.7	

* THOR-05F Qualification Manual - March 2022

File Name: 220705-5 processed
Software Version: 2.8

THOR-05F Left Knee Qualification
Peak Deflection at Peak Force
Serial Number: EU3430

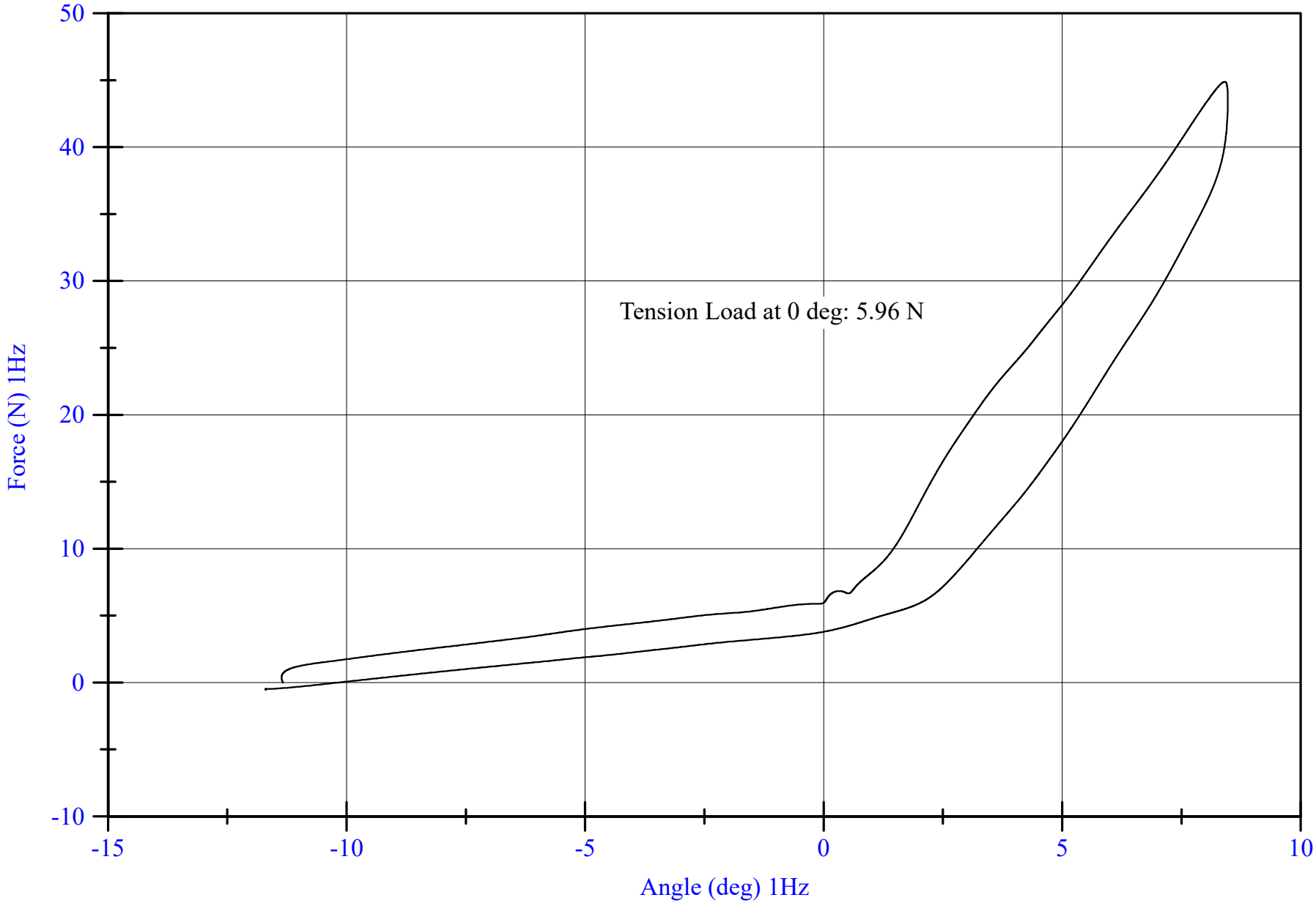


File Name: 220705-5 processed

7/5/2022 2:28 PM

Test Temperature: 20.9° C
Relative Humidity: 45%

THOR-05F Left Leg Achilles Qualification
Force vs Rotation
Leg Serial Number: EV3430



Data file: 220711-2 processed

THOR-05F Left Dorsiflexion Qualification
Test Results Summary

Dummy Serial Number: EV3430

Tested Components

Left Ankle: EV4180

Dorsiflexion Stop: EV3711

Test ID: 220711-4

Test Date: 7/11/2022

Test Time: 9:24 AM

Test Results

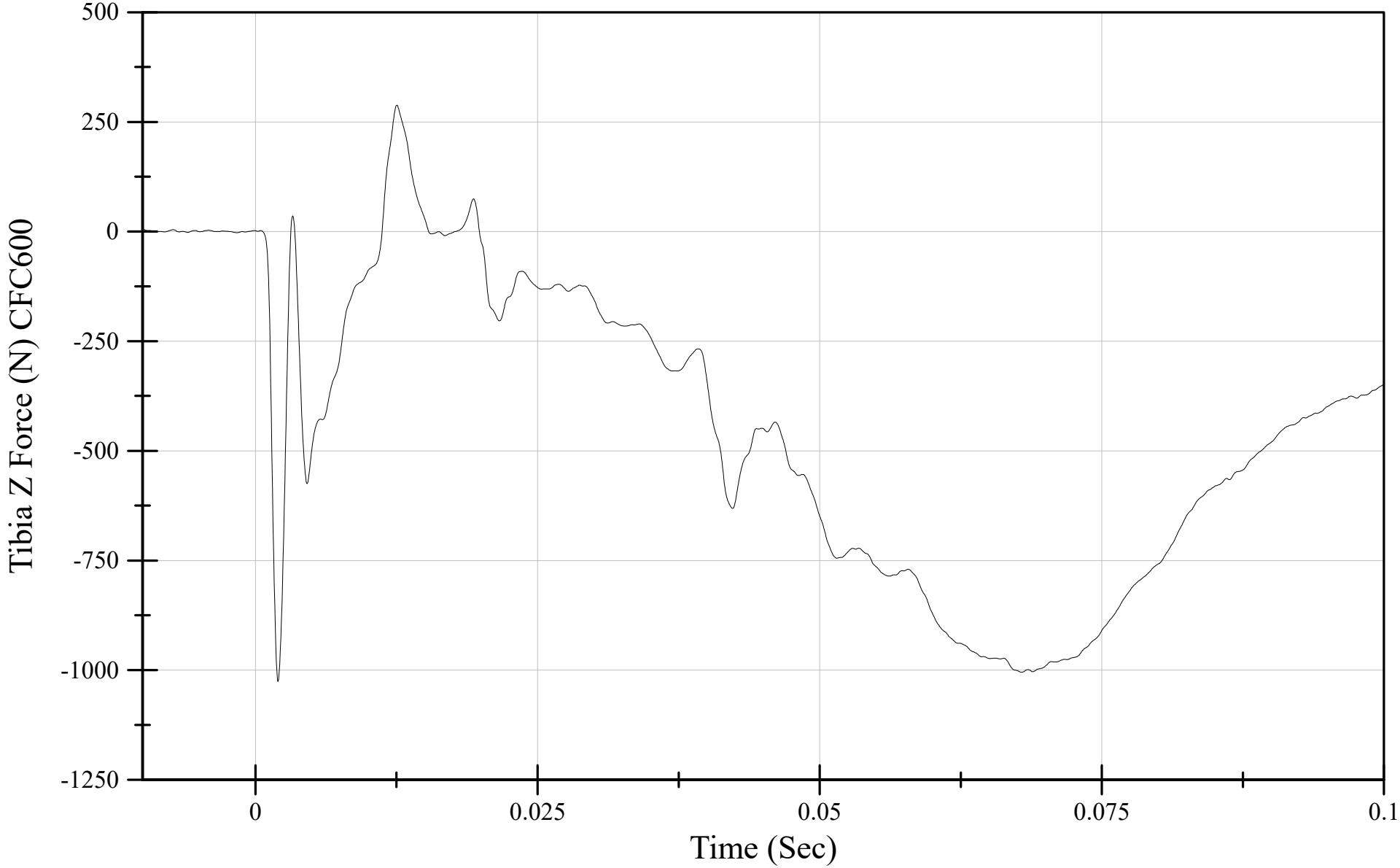
Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.0	Pass
Test Humidity (%)	10 - 70	45	Pass
Test Velocity (m/s)	1.95 - 2.05	2.00	Pass
Peak Lower Tibia Fz after 10 ms (N)		-1004.8	
Peak Ankle Resistive Moment (Nm)		48.7	
Peak Ankle Y-axis Rotation (deg)		31.2	

* THOR-05F Qualification Manual - March 2022

File Name: 220711-4 processed

Software Version: 2.8

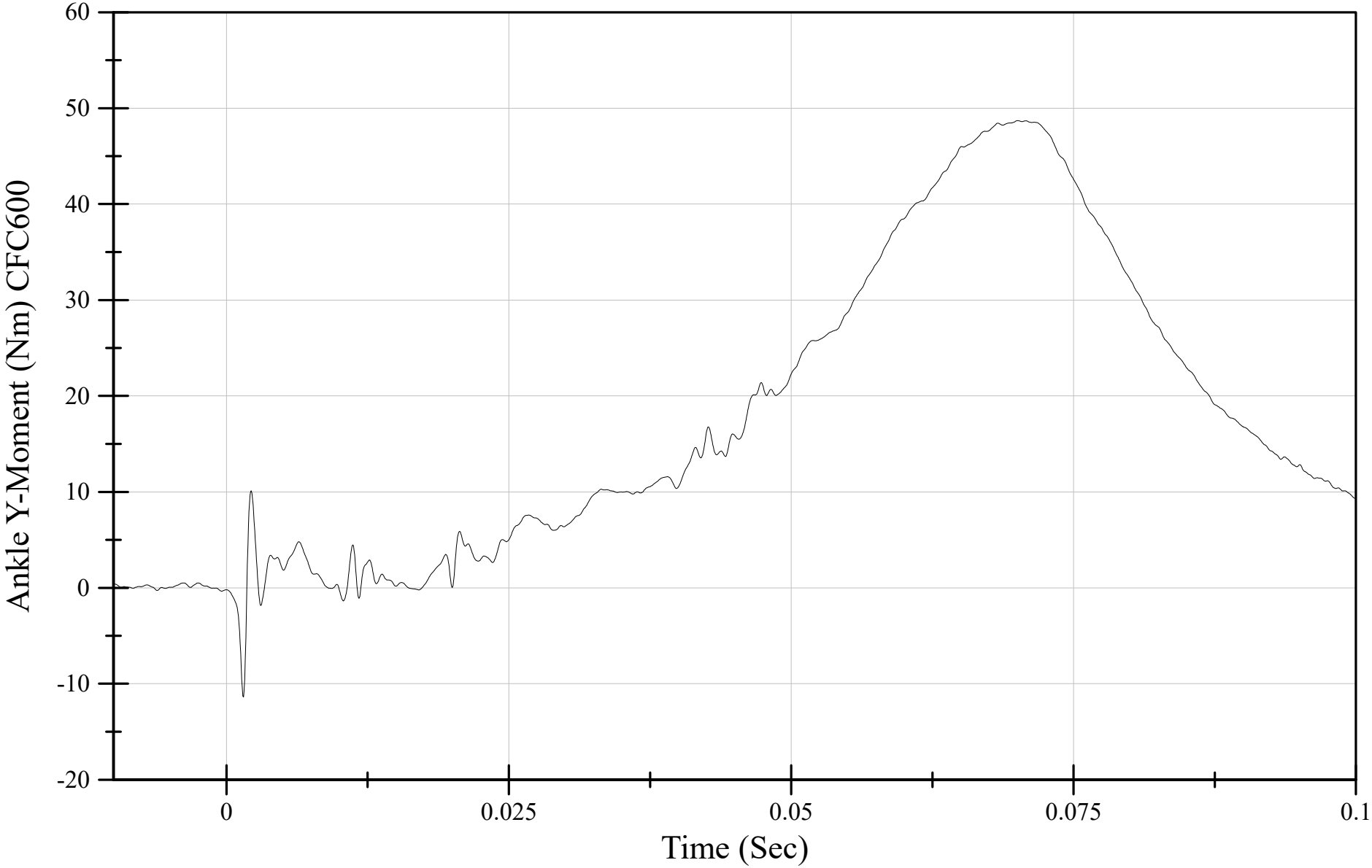
THOR-05F Left Dorsiflexion Qualification
Lower Tibia Fz
Serial Number: EV3430



File Name: 220711-4 processed

7/11/2022 9:24 AM

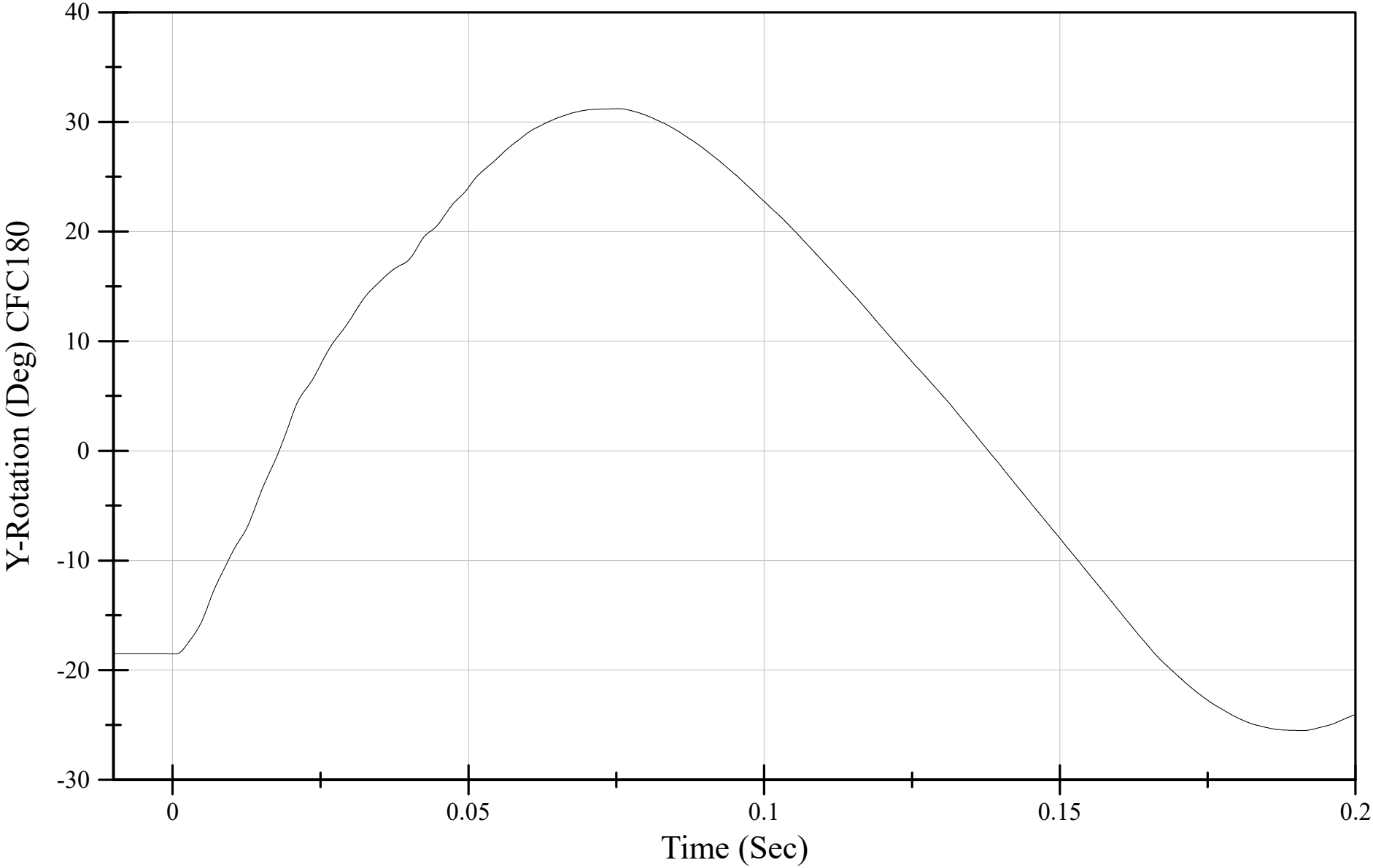
THOR-05F Left Dorsiflexion Qualification
Ankle Y-Moment
Serial Number: EV3430



File Name: 220711-4 processed

7/11/2022 9:24 AM

THOR-05F Left Dorsiflexion Qualification
Ankle Y-Rotation
Serial Number: EV3430



File Name: 220711-4 processed

7/11/2022 9:24 AM

THOR-05F Left Foot Inversion Qualification
Test Results Summary

Dummy Serial Number: EV3430

Tested Components	Test ID: 220711-5
Ankle Serial: EV4180	Test Date: 7/11/2022
Inversion Stop Assembly: EP6307	Test Time: 11:38 AM

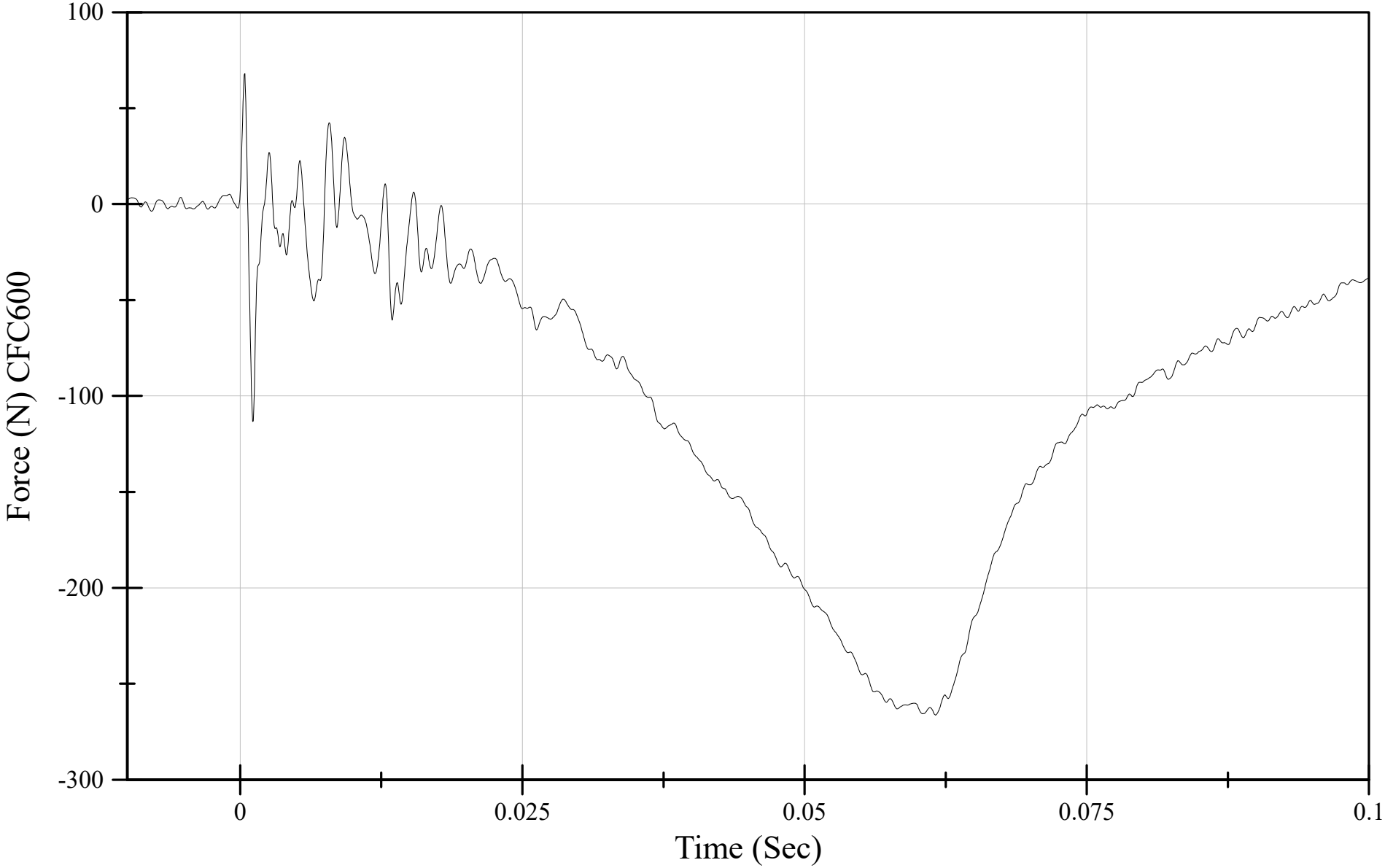
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.0	Pass
Test Humidity (%)	10 - 70	47	Pass
Test Velocity (m/s)	1.95 - 2.05	2.03	Pass
Peak Lower Tibia Fz		-266.3	
Peak Ankle X-axis Resistive Moment		-29.4	
Peak Ankle X-axis Rotation		-46.4	

* THOR-05F Qualification Manual - March 2022

File Name: 220711-5 processed
Software Version: 2.8

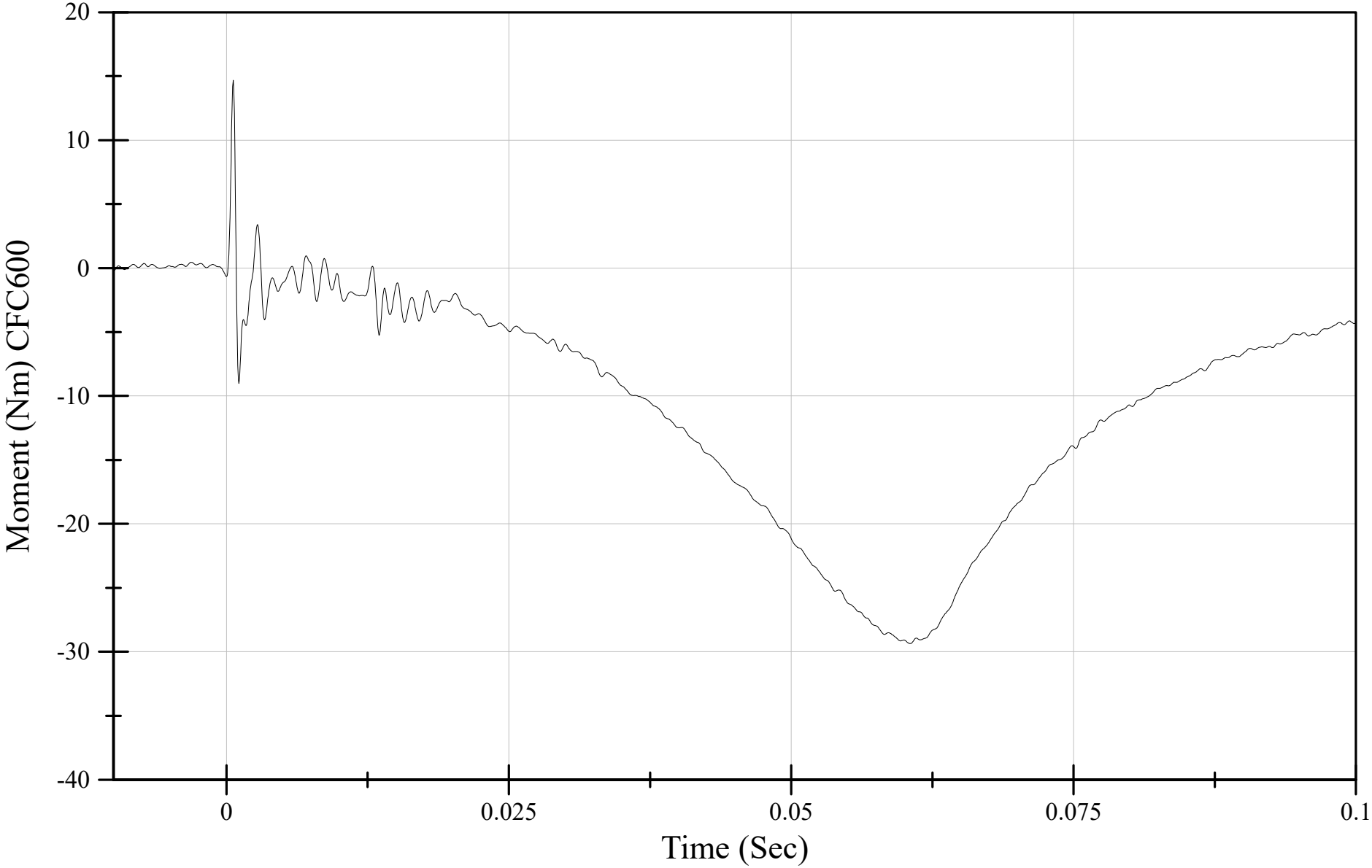
THOR-05F Left Foot Inversion Qualification
Tibia Load - Force Z
Ankle Serial Number: EV4180



File Name: 220711-5 processed

7/11/2022 11:38 AM

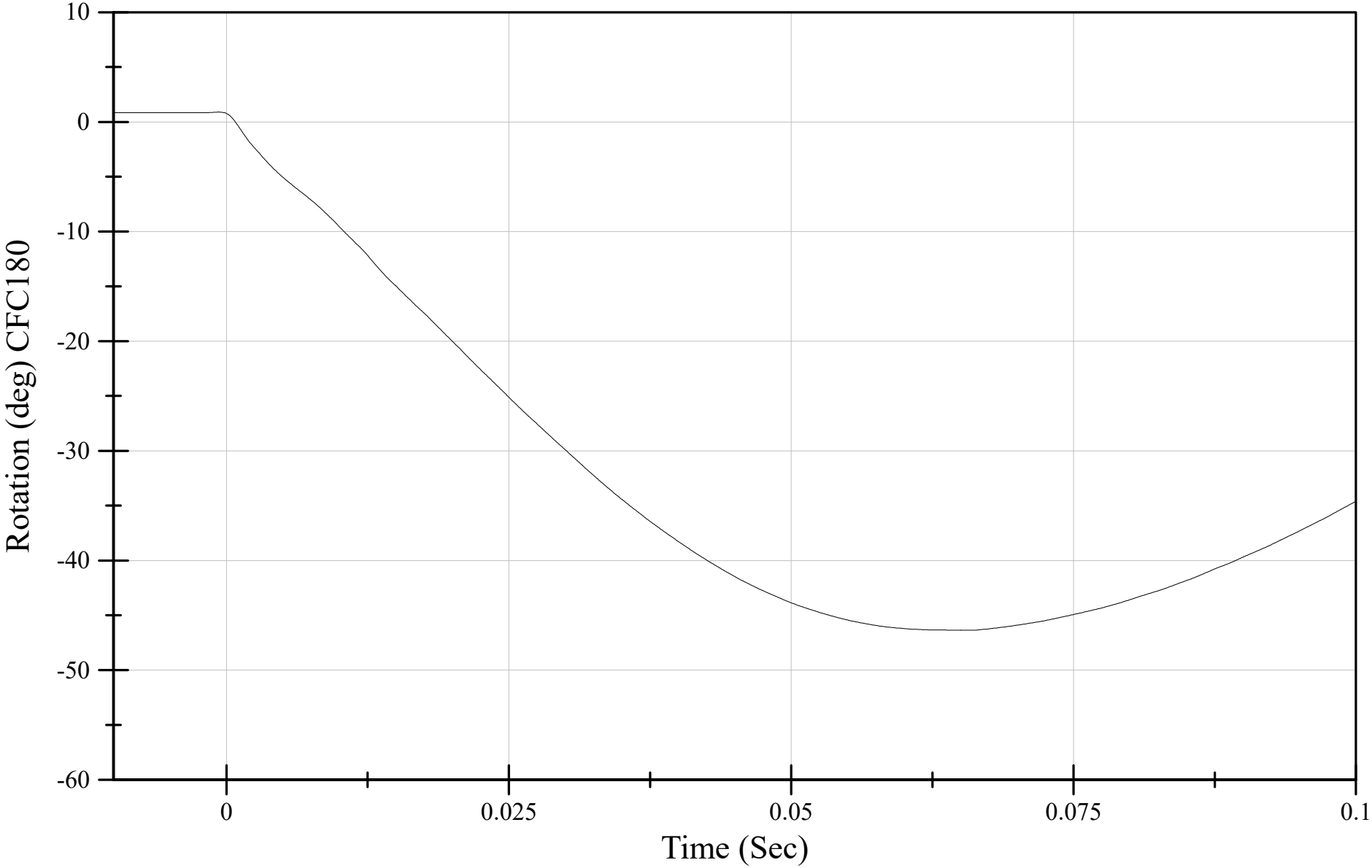
THOR-05F Left Foot Inversion Qualification
Ankle Moment - X axis
Ankle Serial Number: EV4180



File Name: 220711-5 processed

7/11/2022 11:38 AM

THOR-05F Left Foot Inversion Qualification
Ankle X-Rotation
Ankle Serial Number: EV4180



File Name: 220711-5 processed

7/11/2022 11:38 AM

THOR-05F Left Foot Eversion Qualification
Test Results Summary

Dummy Serial Number: EV3430

Tested Components	Test ID: 220711-6
Ankle Serial: EV4180	Test Date: 7/11/2022
Eversion Stop Assembly: EV3436	Test Time: 12:13 PM

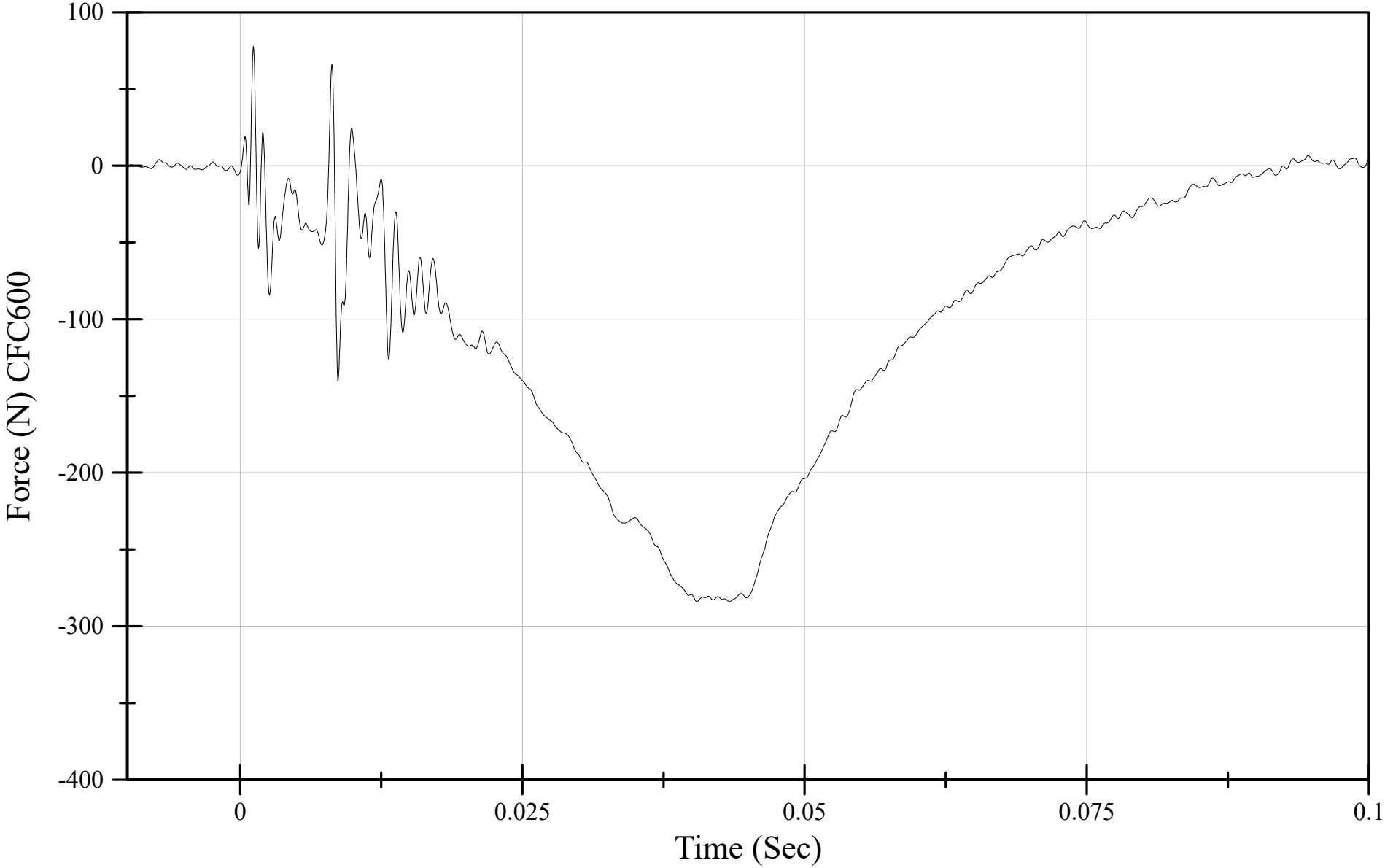
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.2	Pass
Test Humidity (%)	10 - 70	47	Pass
Test Velocity (m/s)	1.95 - 2.05	2.02	Pass
Peak Lower Tibia Fz		-284.0	
Peak Ankle X-axis Resistive Moment		27.7	
Peak Ankle X-axis Rotation		29.7	

* THOR-05F Qualification Manual - March 2022

File Name: 220711-6 processed
Software Version: 2.8

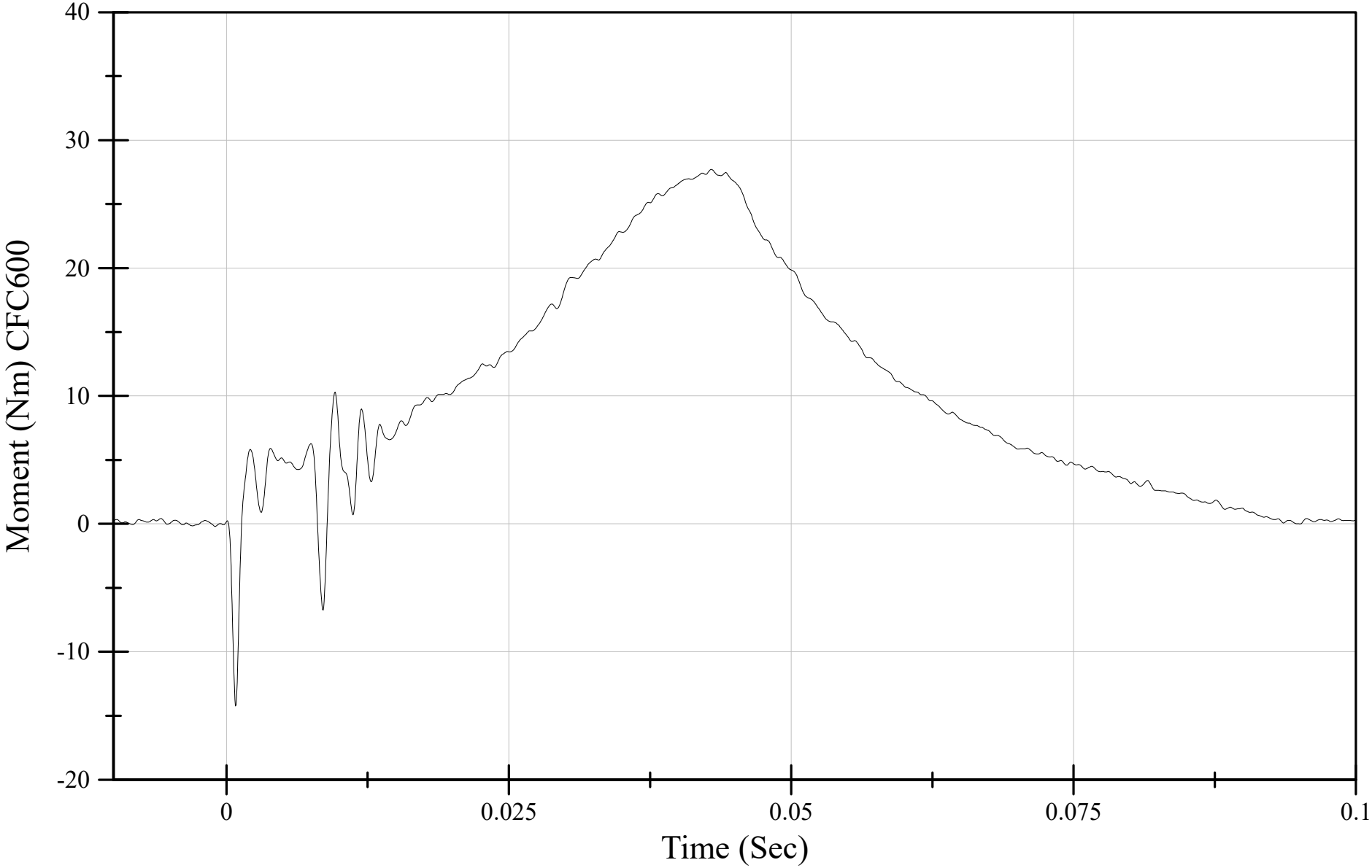
THOR-05F Left Foot Eversion Qualification
Tibia Load - Force Z
Ankle Serial Number: EV4180



File Name: 220711-6 processed

7/11/2022 12:13 PM

THOR-05F Left Foot Eversion Qualification
Ankle Moment - X axis
Ankle Serial Number: EV4180



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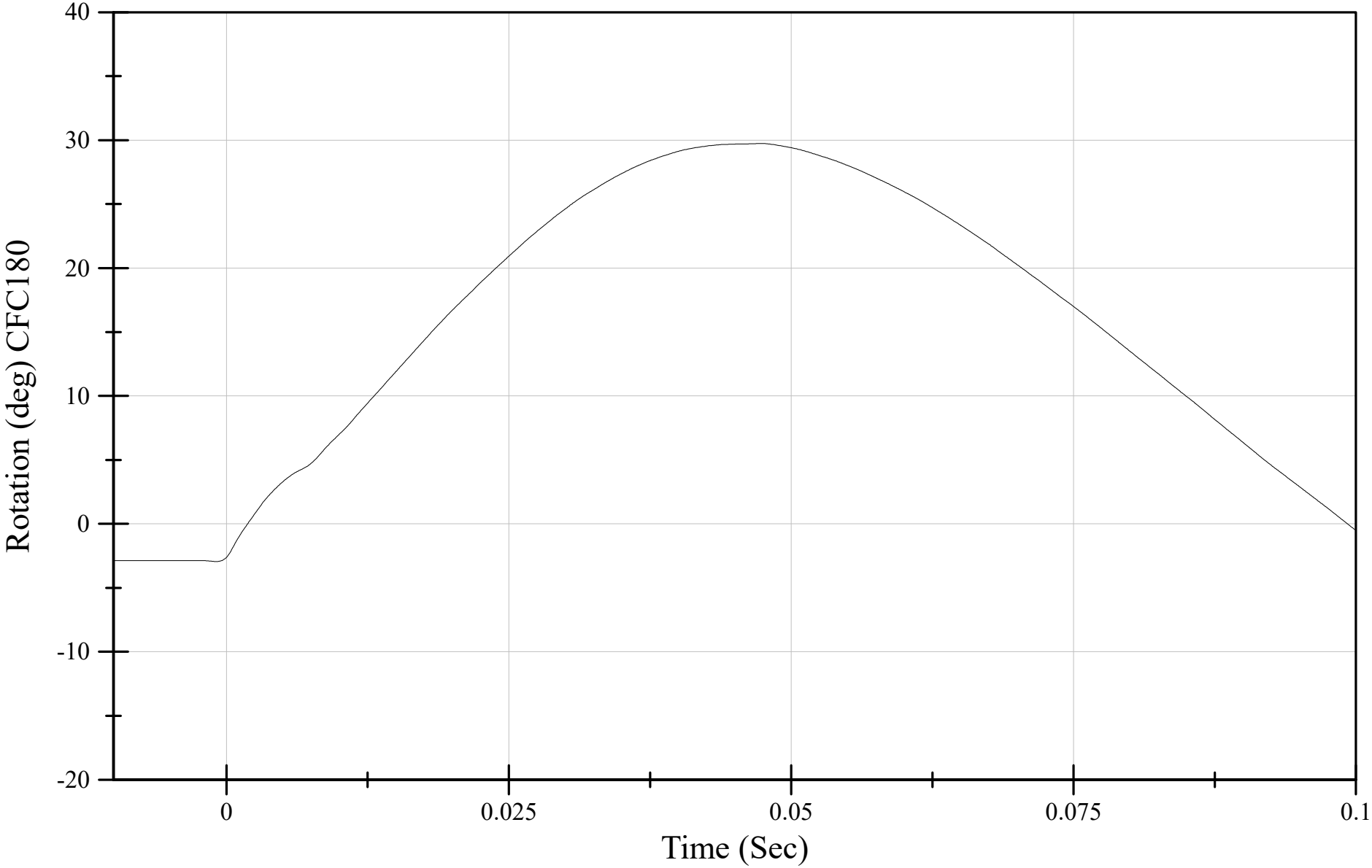
7/11/2022 12:13 PM

THOR-05F Left Foot Eversion Qualification
Ankle X-Rotation
Ankle Serial Number: EV4180



File Name: 220711-6 processed

7/11/2022 12:13 PM

THOR-05F Left Heel Qualification
Test Results Summary

Dummy Serial Number: EV3430

Tested Components
Left Ankle: EV4180

Test ID: 220711-7
Test Date: 7/11/2022
Test Time: 2:31 PM

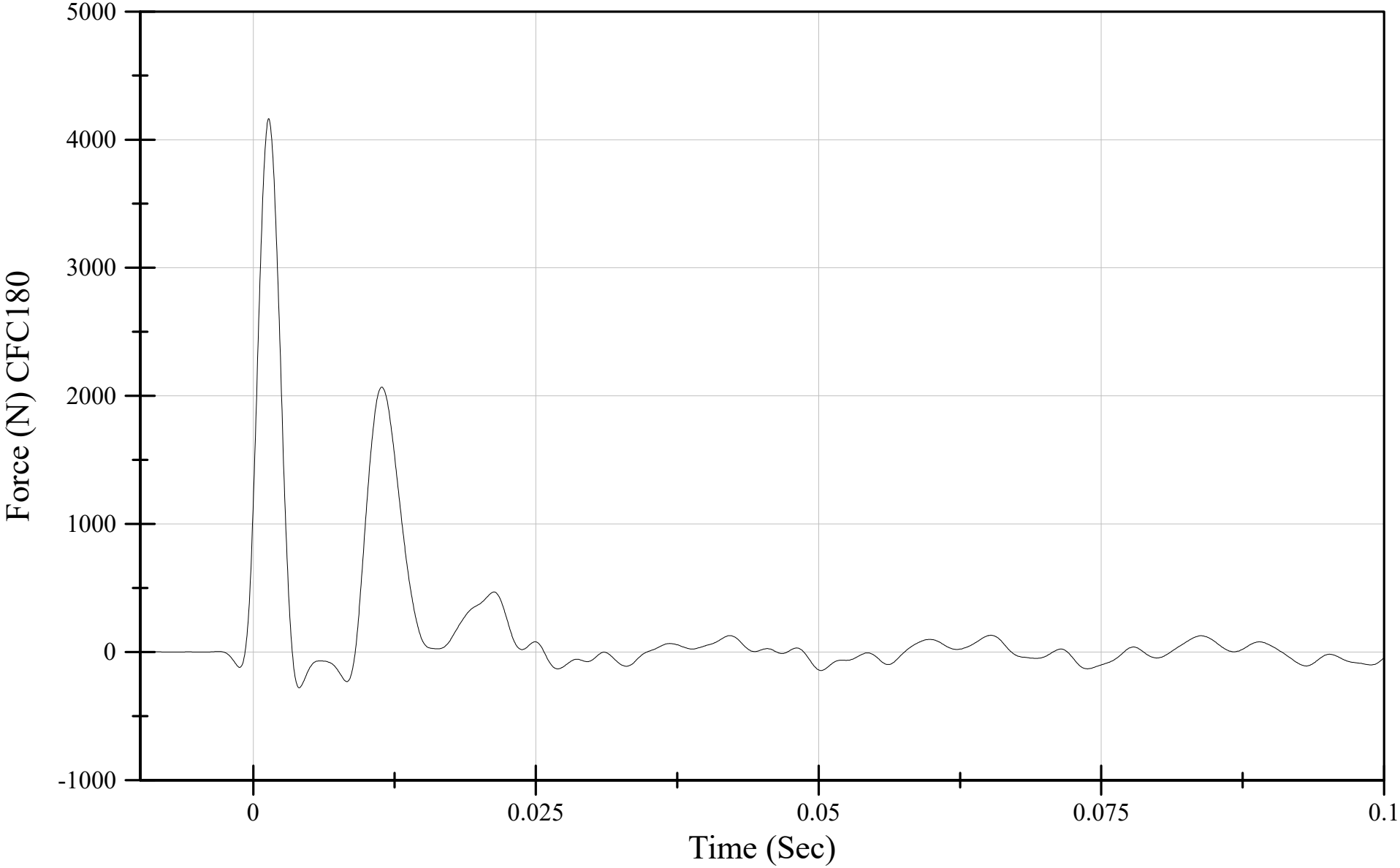
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.2	Pass
Test Humidity (%)	10 - 70	45	Pass
Test Velocity (m/s)	3.95 - 4.05	4.00	Pass
Probe Force (N)		4162.8	
Peak Lower Tibia Fz (N)		-2200.4	

* THOR-05F Qualification Manual - March 2022

File Name: 220711-7 processed
Software Version: 2.8

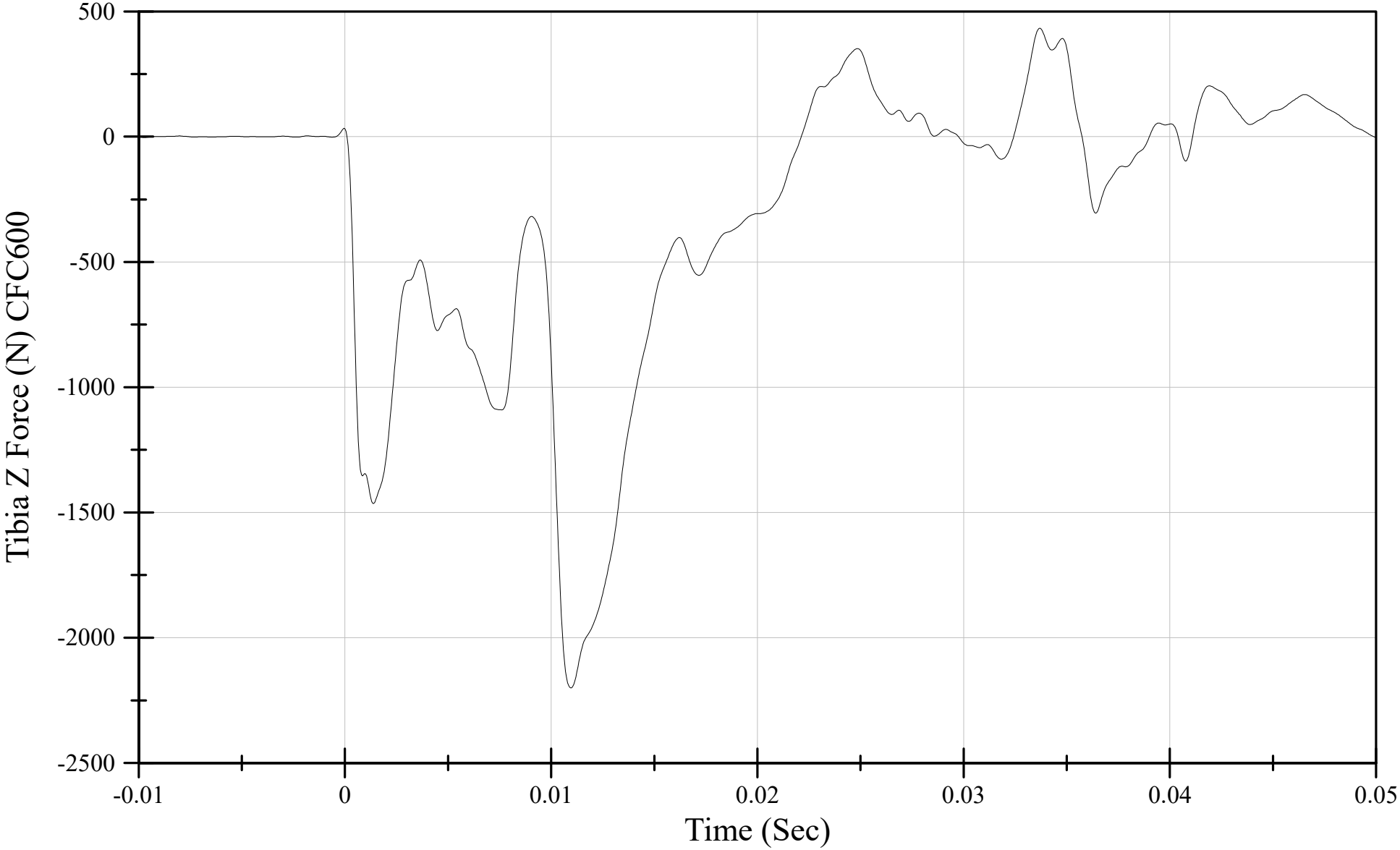
THOR-05F Left Heel Qualification
Probe Force
Dummy Serial Number: EV3430



File Name: 220711-7 processed

7/11/2022 2:31 PM

THOR-05F Left Heel Qualification
Tibia Load
Serial Number: EV3430



File Name: 220711-7 processed

7/11/2022 2:31 PM

THOR-05F Right Upper Leg Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components	Test ID: 220427-3
Compression Element:	Test Date: 4/27/2022
Right Thigh Flesh:	Test Time: 9:05 AM

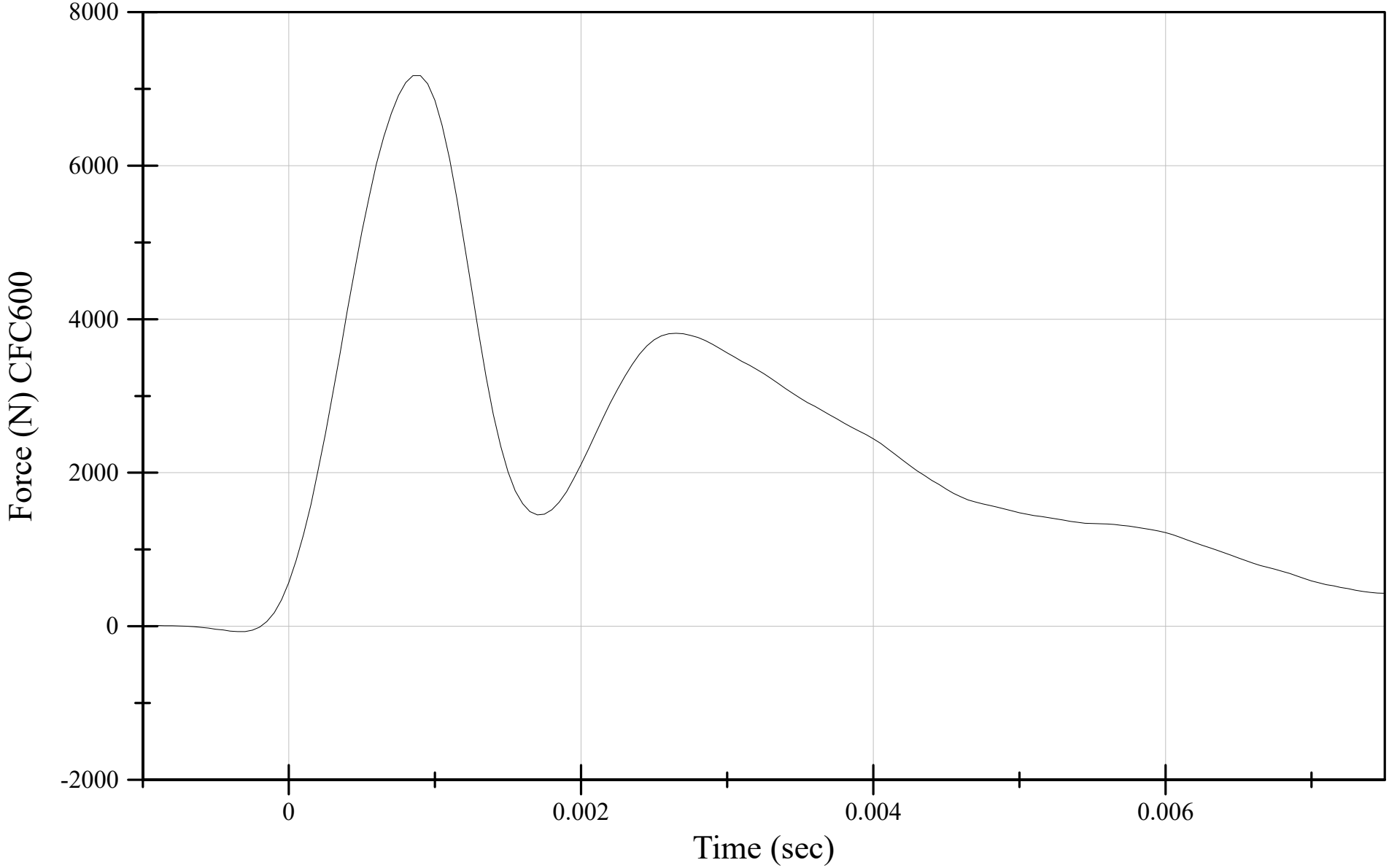
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.9	Pass
Test Humidity (%)	10 - 70	48	Pass
Test Velocity (m/s)	3.25 - 3.35	3.30	Pass
Peak Probe Force (N)		7175	
Peak Femur Force (N)		-4289	
Peak Resultant Acetabulum Force (N)		1808	

* THOR-05F Qualification Manual - March 2022

File Name: 220427-3 processed

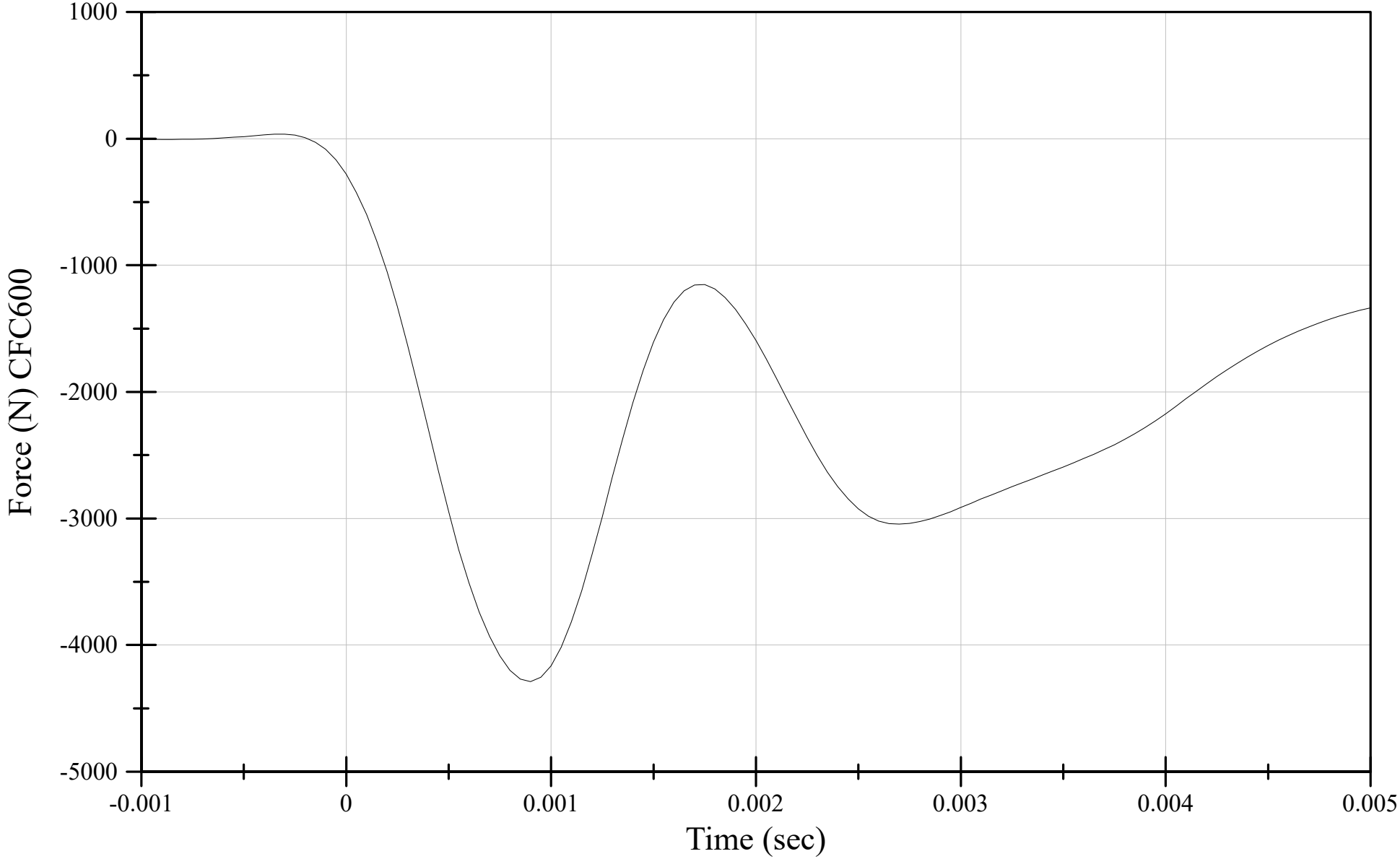
THOR-05F Right Upper Leg Qualification
Probe Force
Serial Number: EU3430



File Name: 220427-3 processed

4/27/2022 9:05 AM

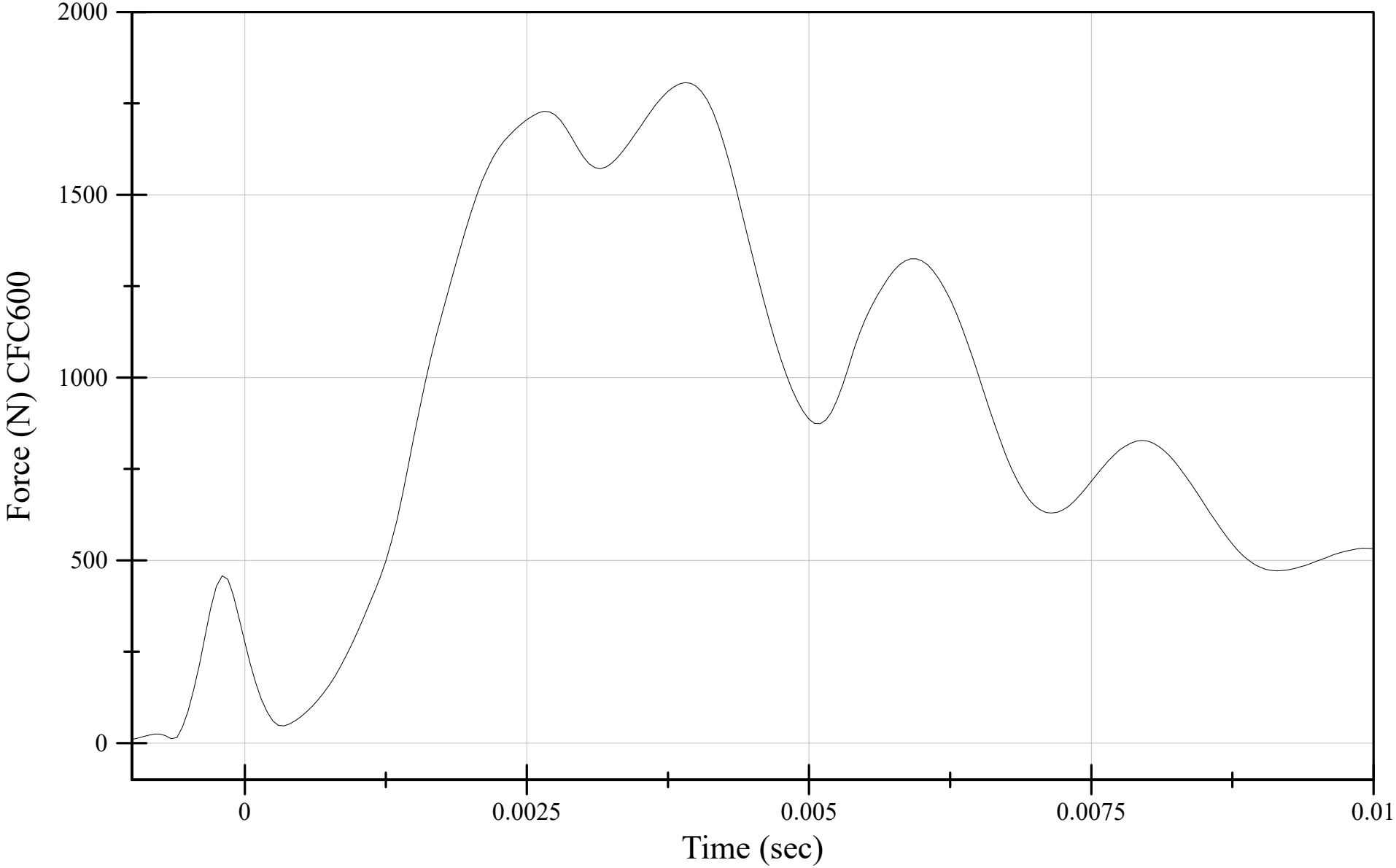
THOR-05F Right Upper Leg Qualification
Femur Z-Force
Serial Number: EU3430



File Name: 220427-3 processed

4/27/2022 9:05 AM

THOR-05F Right Upper Leg Qualification
Peak Acetabulum Resultant Force
Serial Number: EU3430



File Name: 220427-3 processed

4/27/2022 9:05 AM

THOR-05F Right Knee Qualification
Test Results Summary

Dummy Serial Number: EU3430

Test ID: 220705-7
Test Date: 7/5/2022
Test Time: 3:46 PM

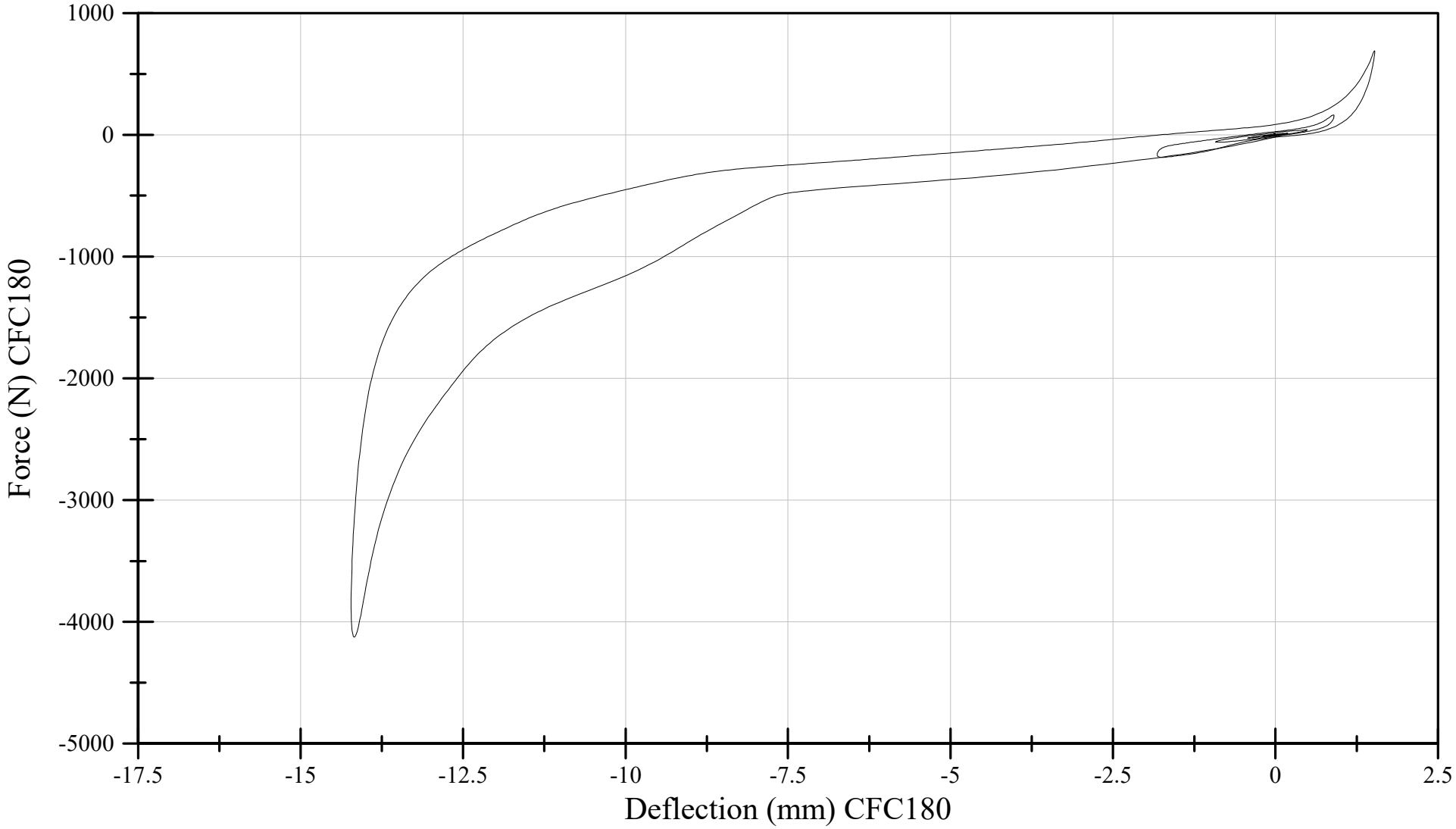
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.1	Pass
Test Humidity (%)	10 - 70	47	Pass
Test Velocity (m/s)	2.10 - 2.20	2.19	Pass
Peak Femur Fz (N)		-4125.9	
Knee Deflection at Peak Femur Force (N)		-14.2	

* THOR-05F Qualification Manual - March 2022

File Name: 220705-7 processed
Software Version: 2.8

THOR-05F Right Knee Qualification
Peak Deflection at Peak Force
Serial Number: EU3430

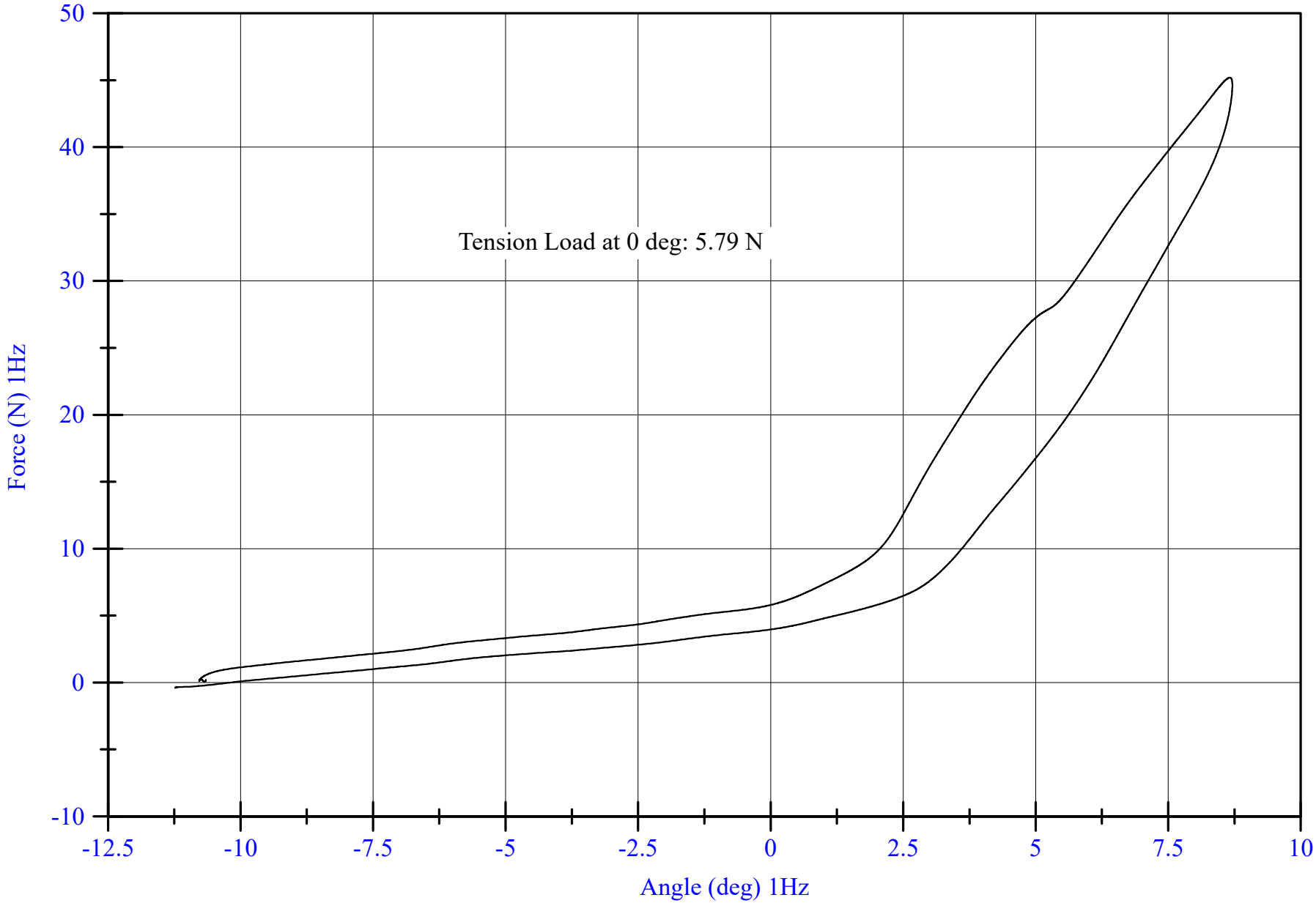


File Name: 220705-7 processed

7/5/2022 3:46 PM

Test Temperature: 21° C
Relative Humidity: 48%

THOR-05F Right Achilles Tension Qualification
Force vs Rotation
Leg Serial Number: EV3870



Test ID: 220711-10 processed

THOR-05F Right Ball of Foot Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Right Ankle: EV3870
Right Dorsiflexion Stop: EV3714

Test ID: 220711-11
Test Date: 7/11/2022
Test Time: 5:18 PM

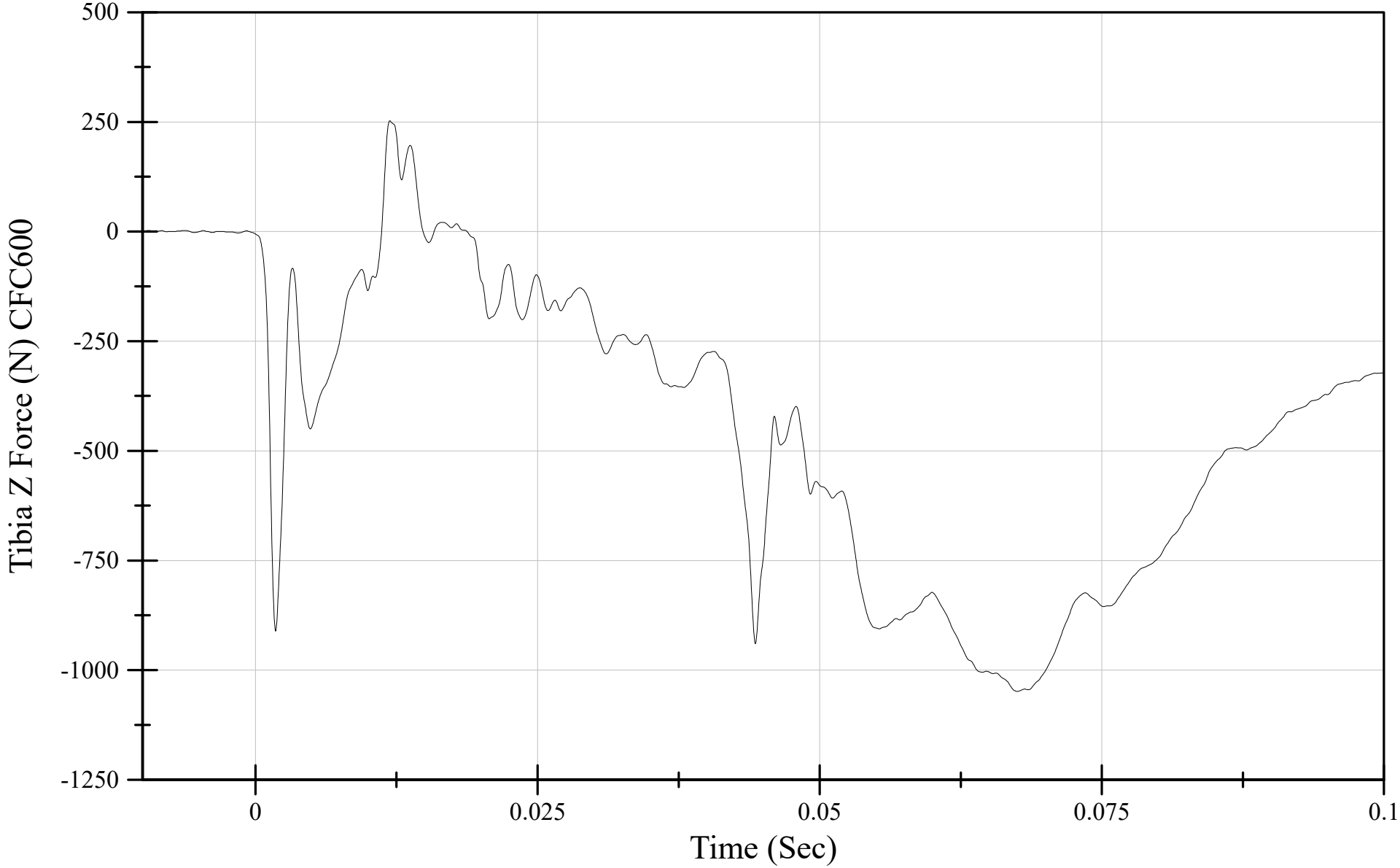
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.1	Pass
Test Humidity (%)	10 - 70	48	Pass
Test Velocity (m/s)	1.95 - 2.05	1.98	Pass
Peak Lower Tibia Fz after 10 ms (N)		-1048.6	
Peak Ankle Resistive Moment (Nm)		51.8	
Peak Ankle Y-axis Rotation (deg)		30.2	

* THOR-05F Qualification Manual - July 2022

File Name: 220711-11 processed
Software Version: 2.8

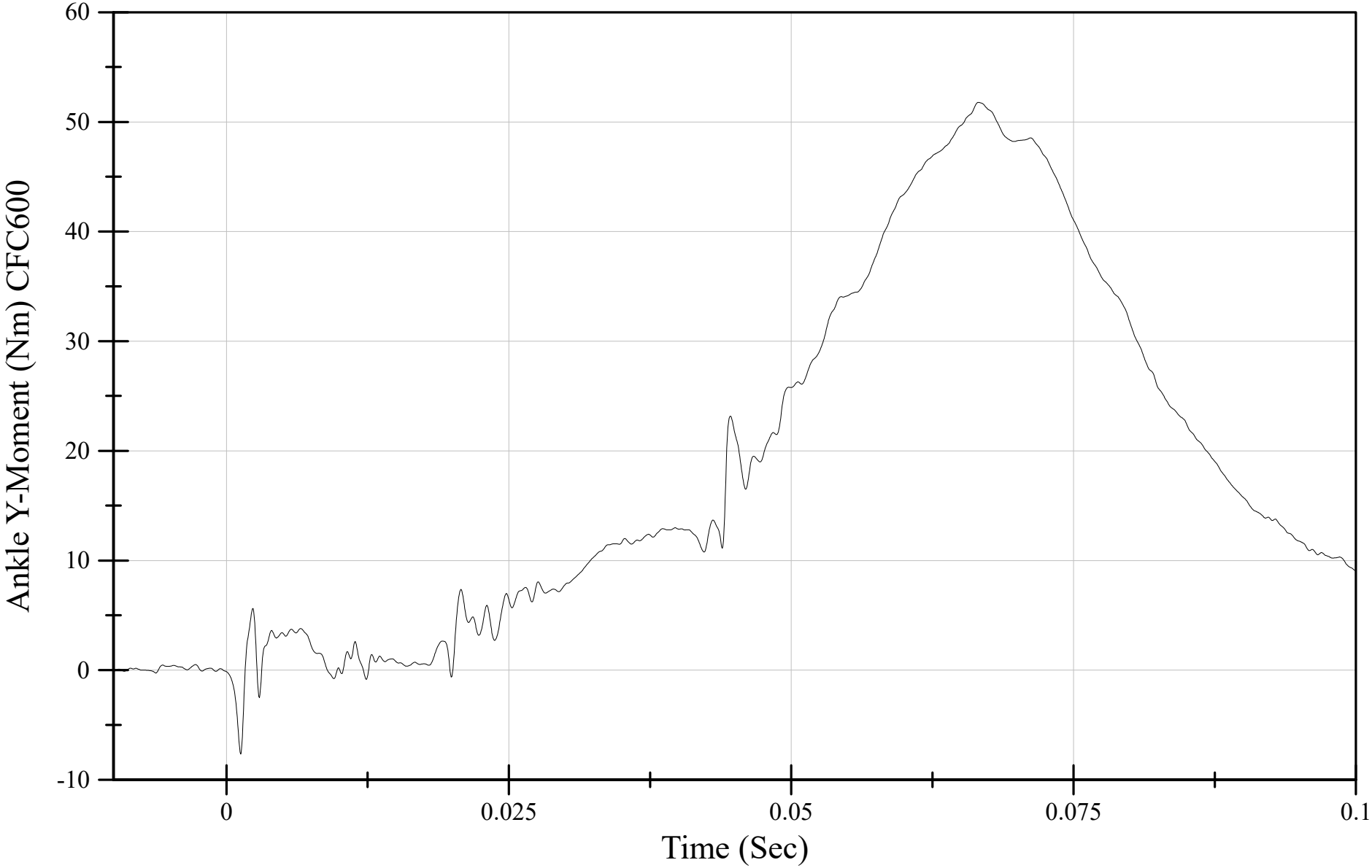
THOR-05F Right Ball of Foot Qualification
Lower Tibia Fz
Ankle Serial Number:



File Name: 220711-11 processed

7/11/2022 5:18 PM

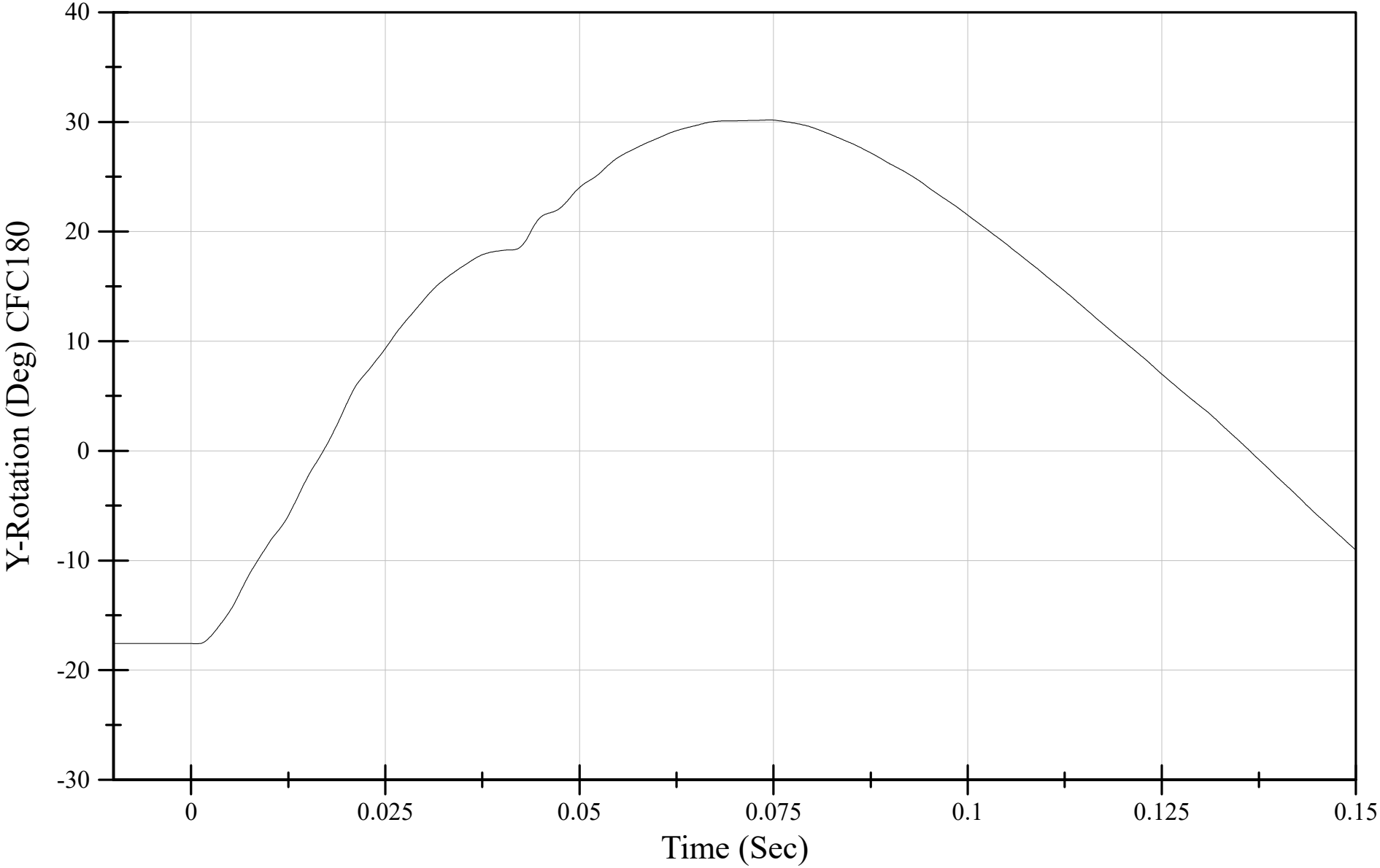
THOR-05F Right Ball of Foot Qualification
Ankle Y-Moment
Ankle Serial Number:



File Name: 220711-11 processed

7/11/2022 5:18 PM

THOR-05F Right Ball of Foot Qualification
Ankle Y-Rotation
Ankle Serial Number:



File Name: 220711-11 processed

7/11/2022 5:18 PM

THOR-05F Right Foot Inversion Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components	Test ID: 220712-1
Ankle Serial: EV3870	Test Date: 7/12/2022
Inversion Stop Assembly: ET6304	Test Time: 7:55 AM

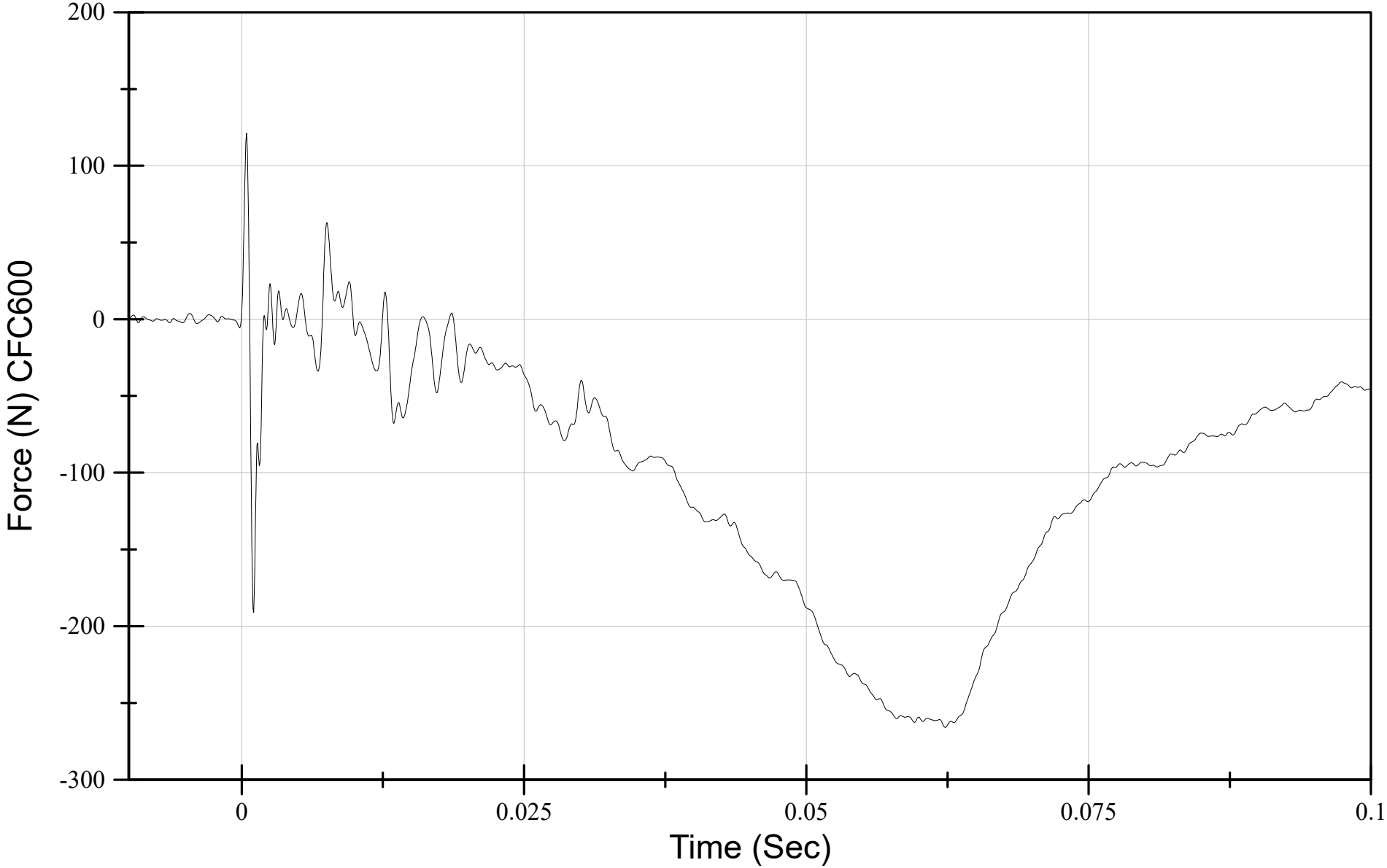
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.1	Pass
Test Humidity (%)	10 - 70	47	Pass
Test Velocity (m/s)	1.95 - 2.05	2.02	Pass
Peak Lower Tibia Fz		-265.9	
Peak Ankle X-axis Resistive Moment		29.6	
Peak Ankle X-axis Rotation		46.6	

* THOR-05F Qualification Manual - March 2022

File Name: 220712-1 processed
Software Version: 2.8

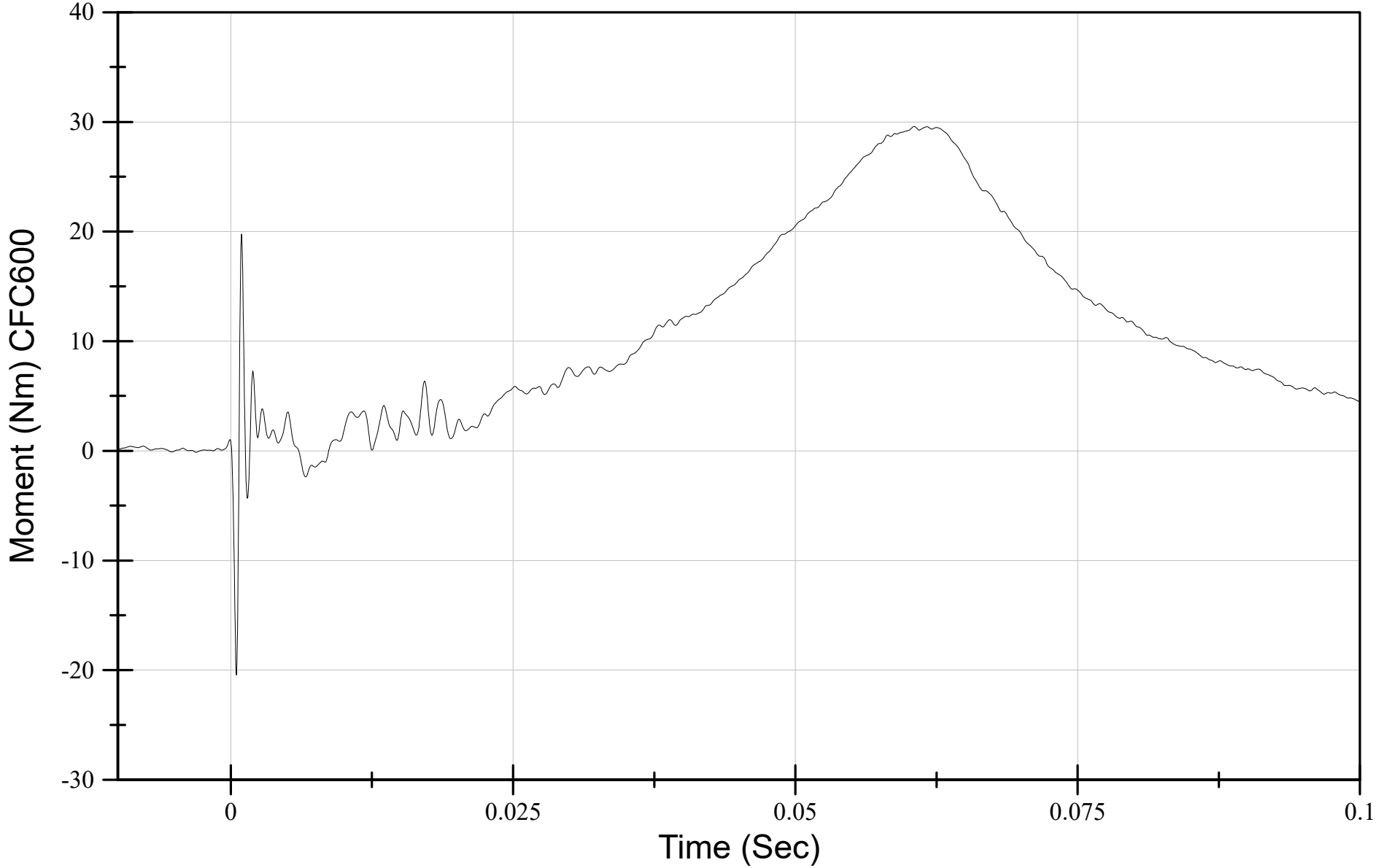
THOR-05F Right Foot Inversion Qualification
Tibia Load - Force Z
Ankle Serial Number: EV3870



File Name: 220712-1 processed

7/12/2022 7:55 AM

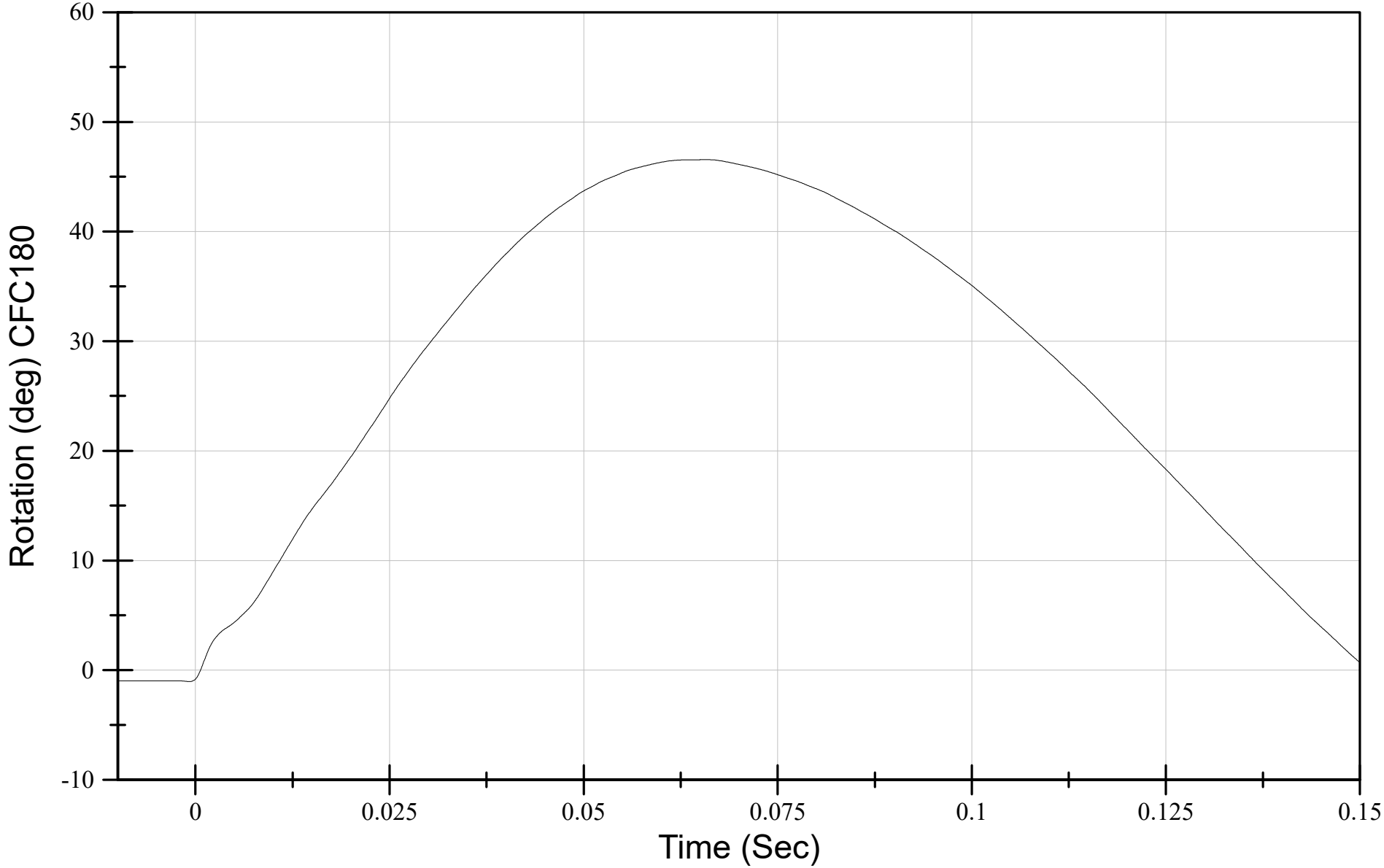
THOR-05F Right Foot Inversion Qualification
Ankle Moment - X axis
Ankle Serial Number: EV3870



File Name: 220712-1 processed

7/12/2022 7:55 AM

THOR-05F Right Foot Inversion Qualification
Ankle X-Rotation
Ankle Serial Number: EV3870



File Name: 220712-1 processed

7/12/2022 7:55 AM

THOR-05F Right Foot Eversion Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components	Test ID: 220712-2
Ankle Serial: EV3870	Test Date: 7/12/2022
Eversion Stop Assembly: ET9523	Test Time: 8:25 AM

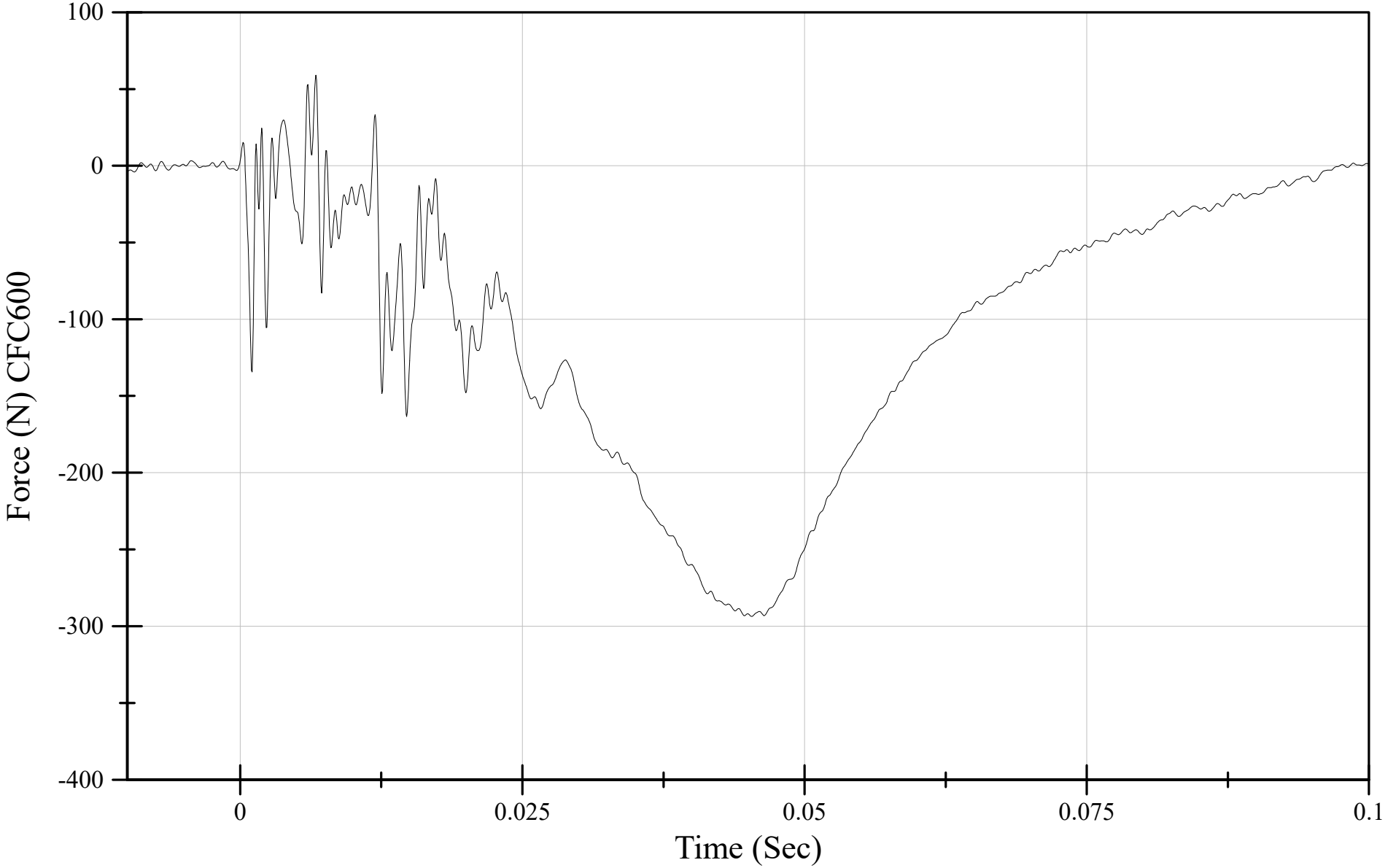
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.0	Pass
Test Humidity (%)	10 - 70	47	Pass
Test Velocity (m/s)	1.95 - 2.05	2.02	Pass
Peak Lower Tibia Fz		-293.6	
Peak Ankle X-axis Resistive Moment		-28.4	
Peak Ankle X-axis Rotation		-31.8	

* THOR-05F Qualification Manual - March 2022

File Name: 220712-2 processed
Software Version: 2.8

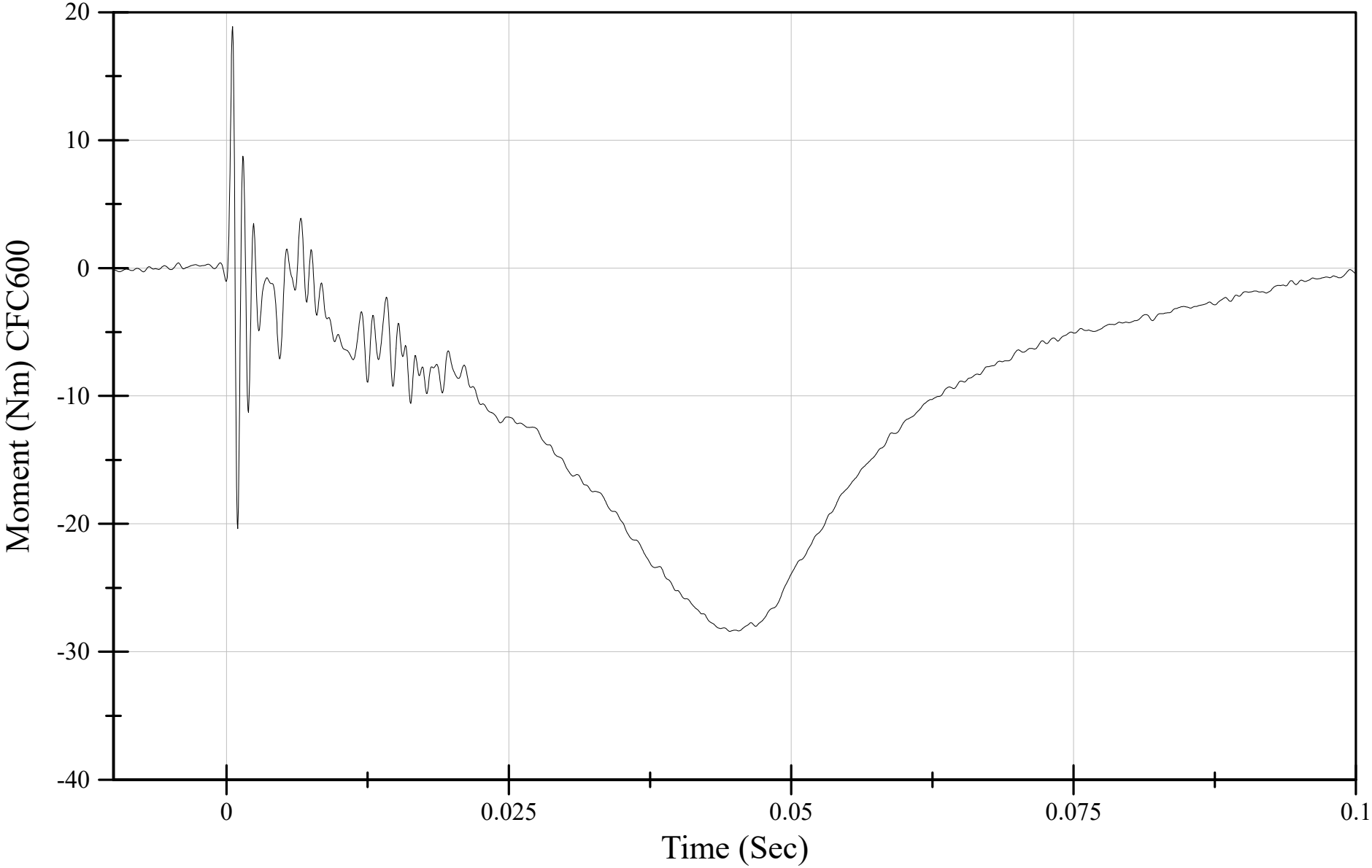
THOR-05F Right Foot Eversion Qualification
Tibia Load - Force Z
Ankle Serial Number: EV3870



File Name: 220712-2 processed

7/12/2022 8:25 AM

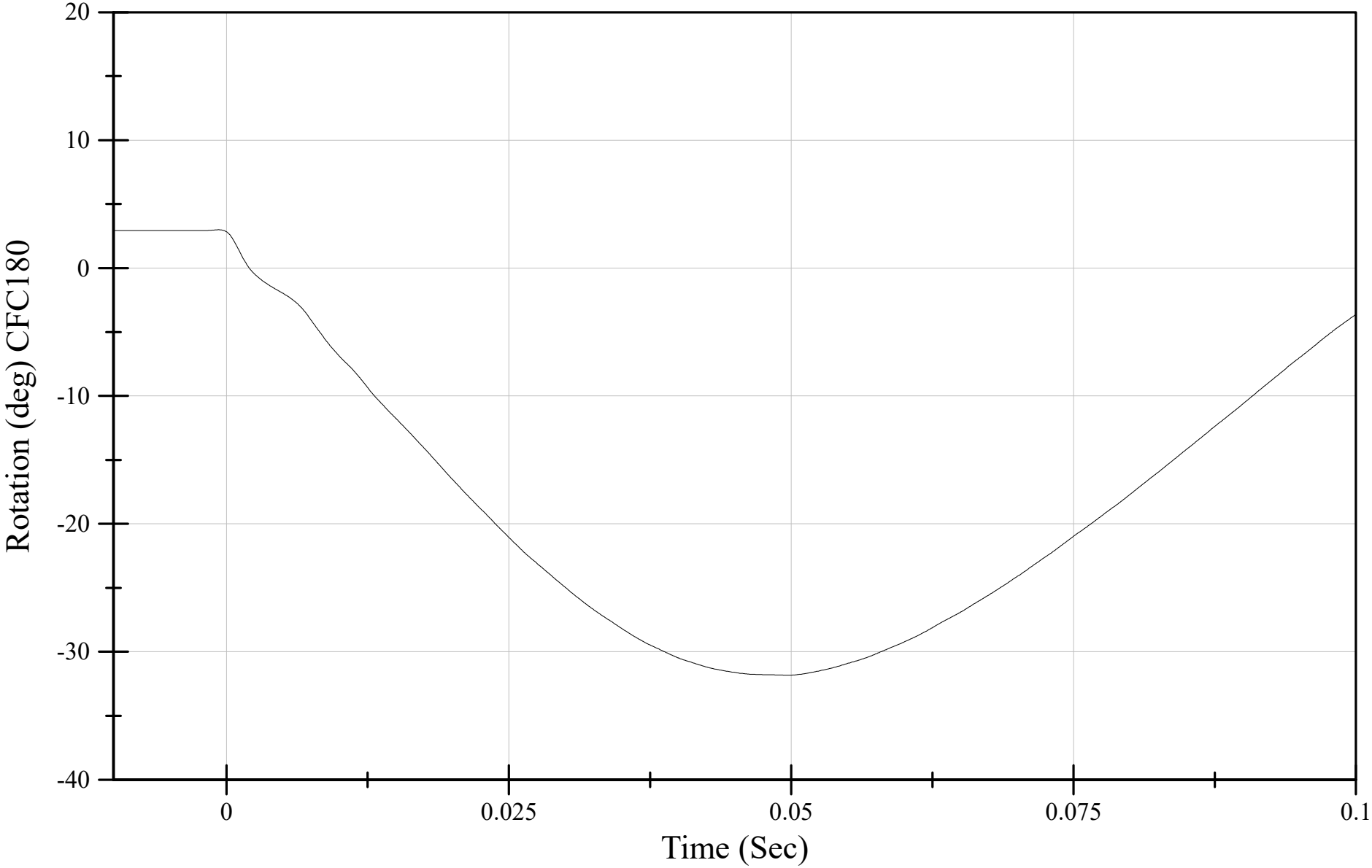
THOR-05F Right Foot Eversion Qualification
Ankle Moment - X axis
Ankle Serial Number: EV3870



File Name: 220712-2 processed

7/12/2022 8:25 AM

THOR-05F Right Foot Eversion Qualification
Ankle X-Rotation
Ankle Serial Number: EV3870



File Name: 220712-2 processed

7/12/2022 8:25 AM

THOR-05F Right Heel Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Right Ankle: EV3870

Test ID: 220712-3
Test Date: 7/12/2022
Test Time: 8:57 AM

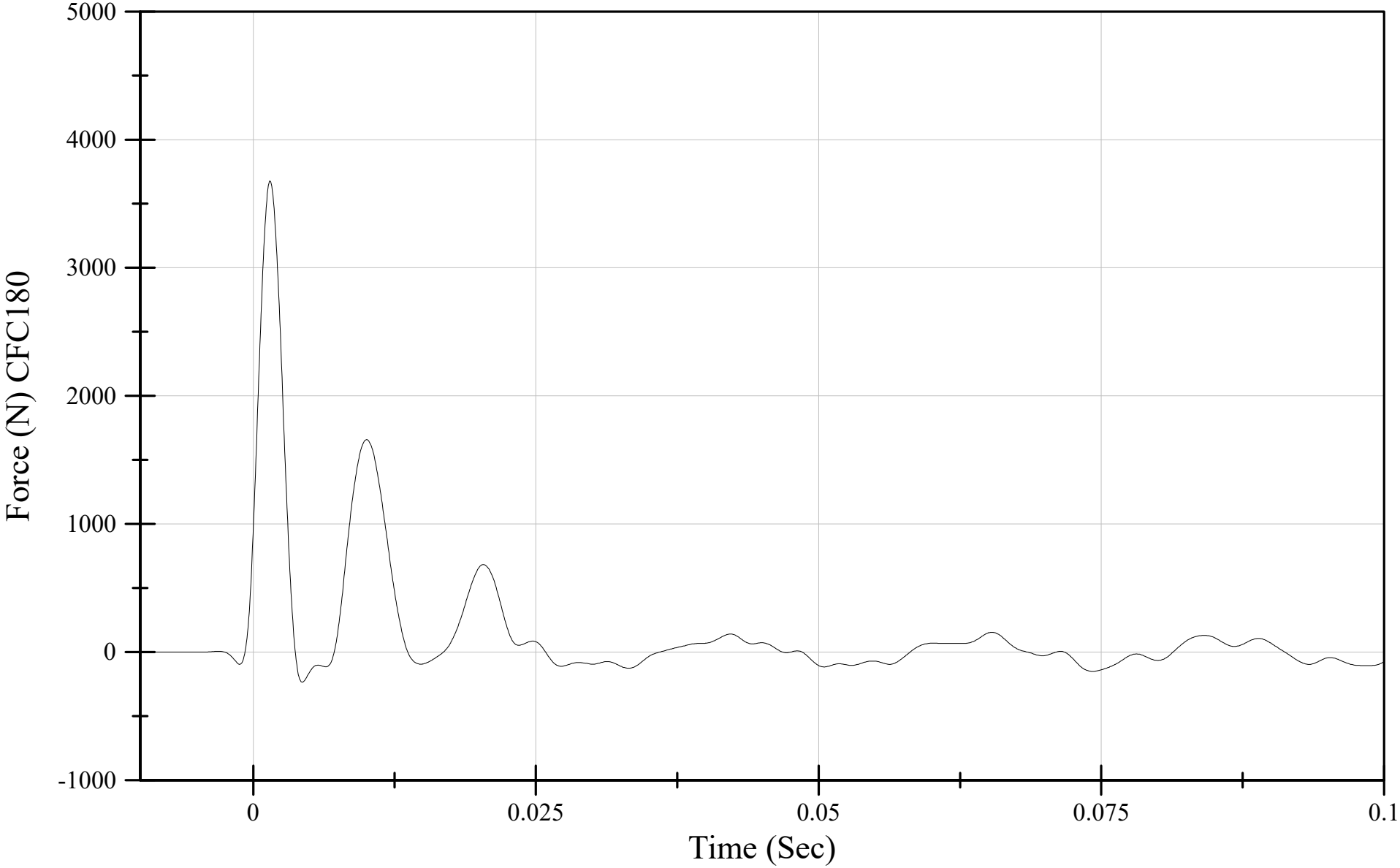
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.0	Pass
Test Humidity (%)	10 - 70	47	Pass
Test Velocity (m/s)	3.95 - 4.05	3.99	Pass
Probe Force (N)		3677.9	
Peak Lower Tibia Fz (N)		-1930.7	

* THOR-05F Qualification Manual - March 2022

File Name: 220712-3 processed
Software Version: 2.8

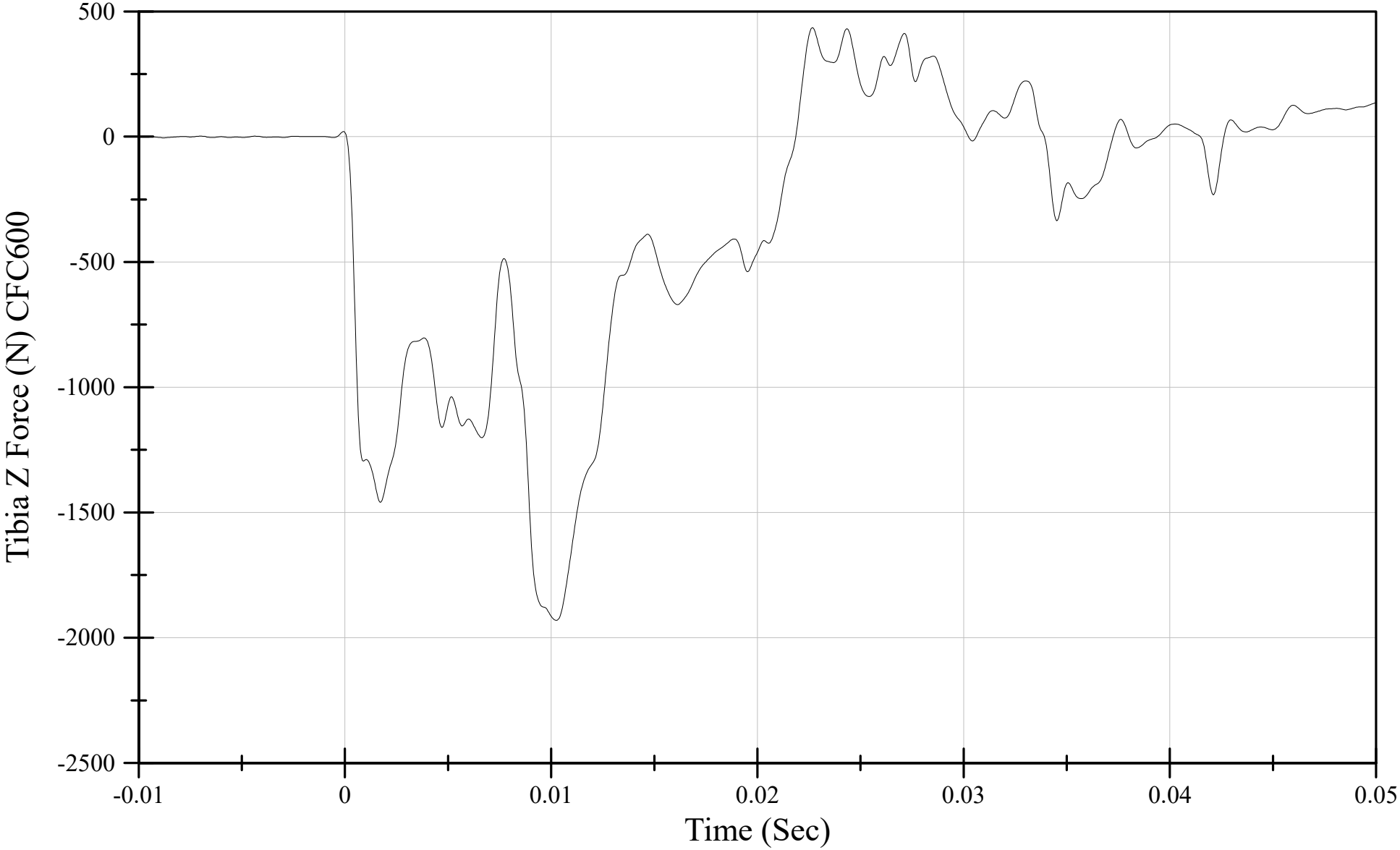
THOR-05F Right Heel Qualification
Probe Force
Dummy Serial Number: EU3430



File Name: 220712-3 processed

7/12/2022 8:57 AM

THOR-05F Right Heel Qualification
Tibia Load
Serial Number: EU3430



File Name: 220712-3 processed

7/12/2022 8:57 AM

THOR-05F Head Impact Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Head Skin: ET8171

Test ID: 220927-1
Test Date: 9/27/2022
Test Time: 8:12 AM

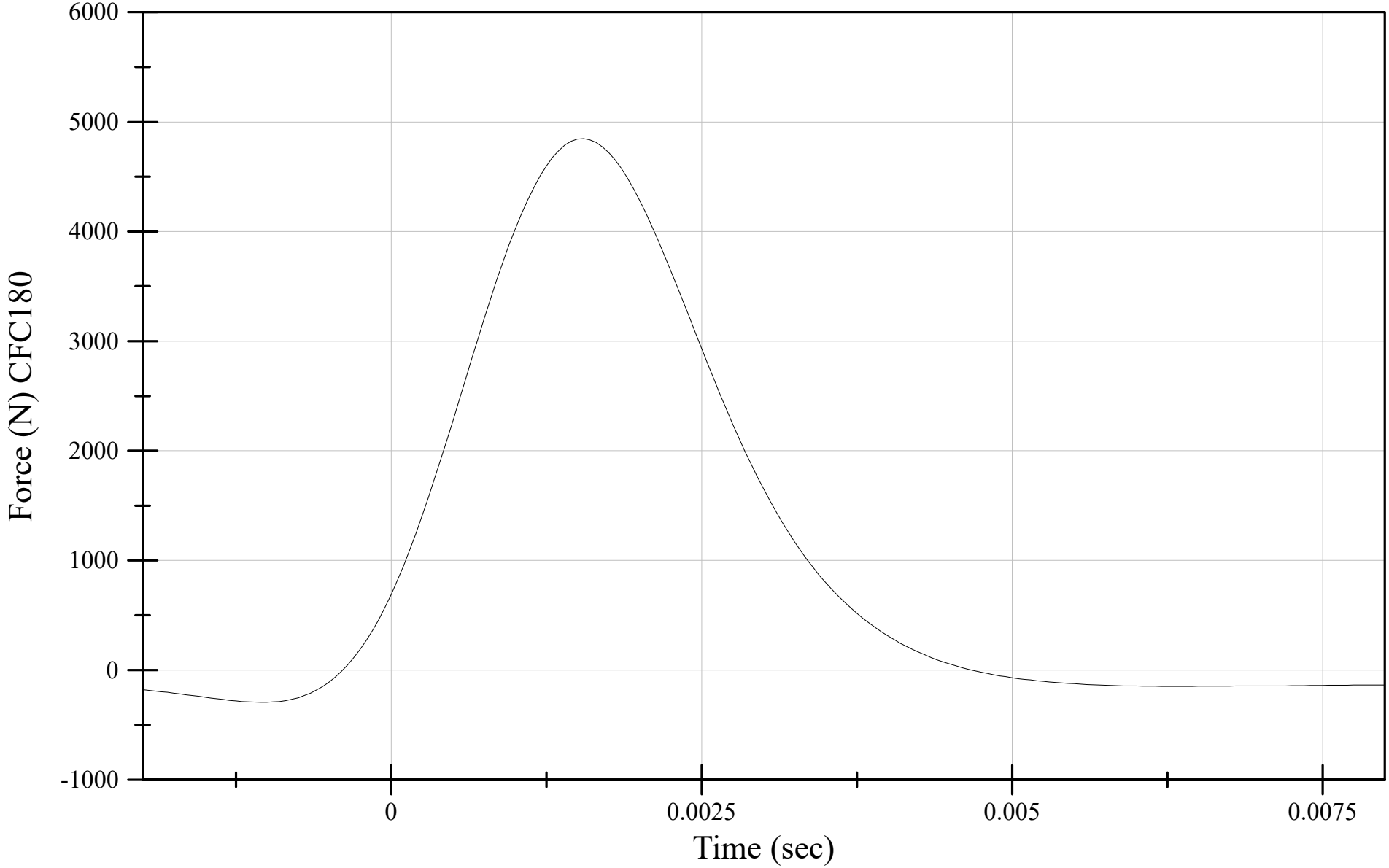
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.0	Pass
Test Humidity (%)	10 - 70	43	Pass
Test Velocity (m/s)	1.95 - 2.05	1.99	Pass
Peak Probe Force (N)		4848	
Peak Head CG Resultant Acceleration (g)		145	

* THOR-05F Qualification Manual - July 2022

File Name: 220927-1 processed
Software Version: 2.8

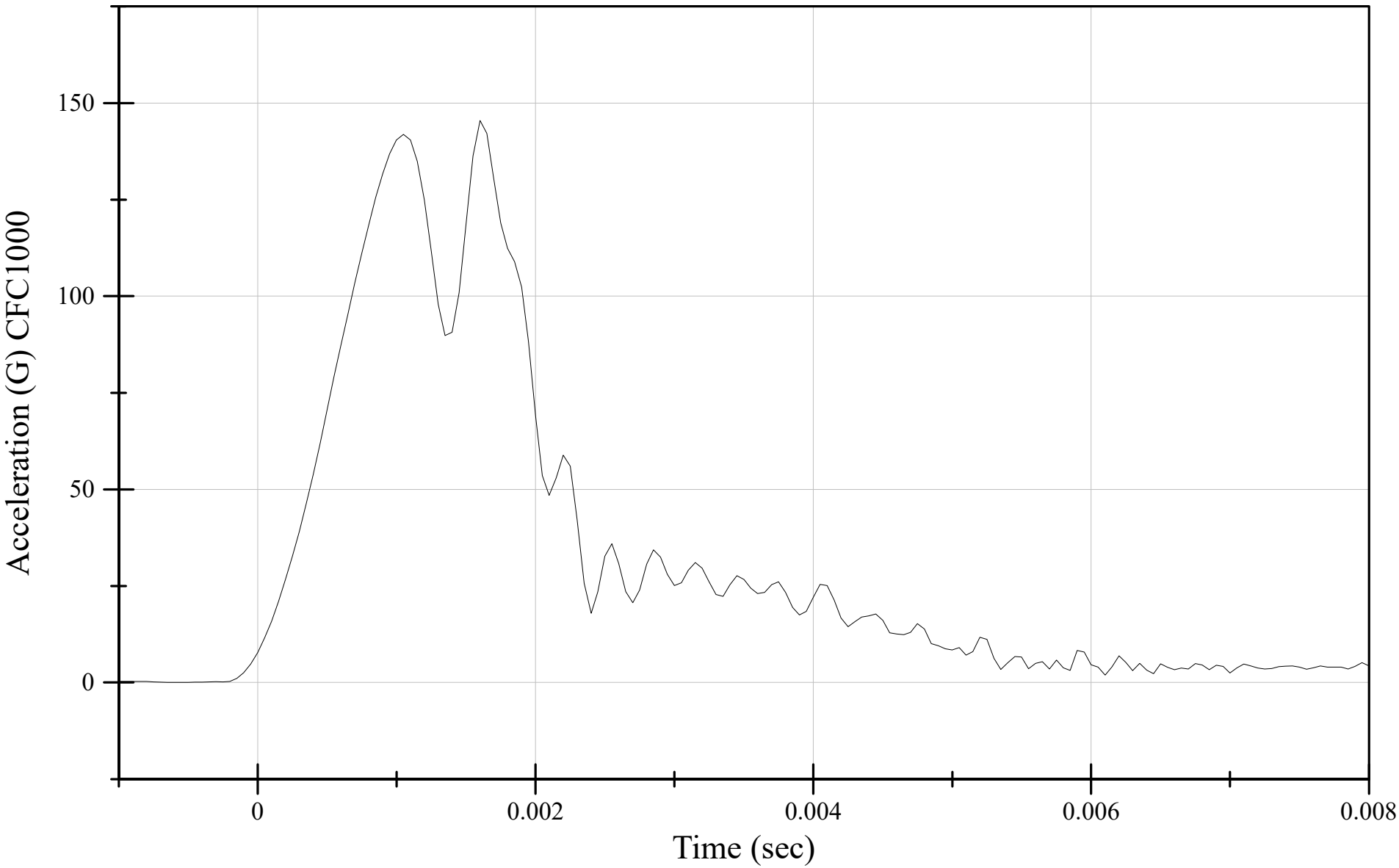
THOR-05F Head Impact Qualification
Probe Force
Dummy Serial Number: EU3430



File Name: 220927-1 processed

9/27/2022 8:12 AM

THOR-05F Head Impact Qualification
Head CG Resultant Acceleration
Dummy Serial Number: EU3430



File Name: 220927-1 processed

9/27/2022 8:12 AM

THOR-05F Face Disk Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components

Head Skin: ET8171

Face Foam: EU2586

Test ID: 220928-1

Test Date: 9/28/2022

Test Time: 6:12 AM

Test Results

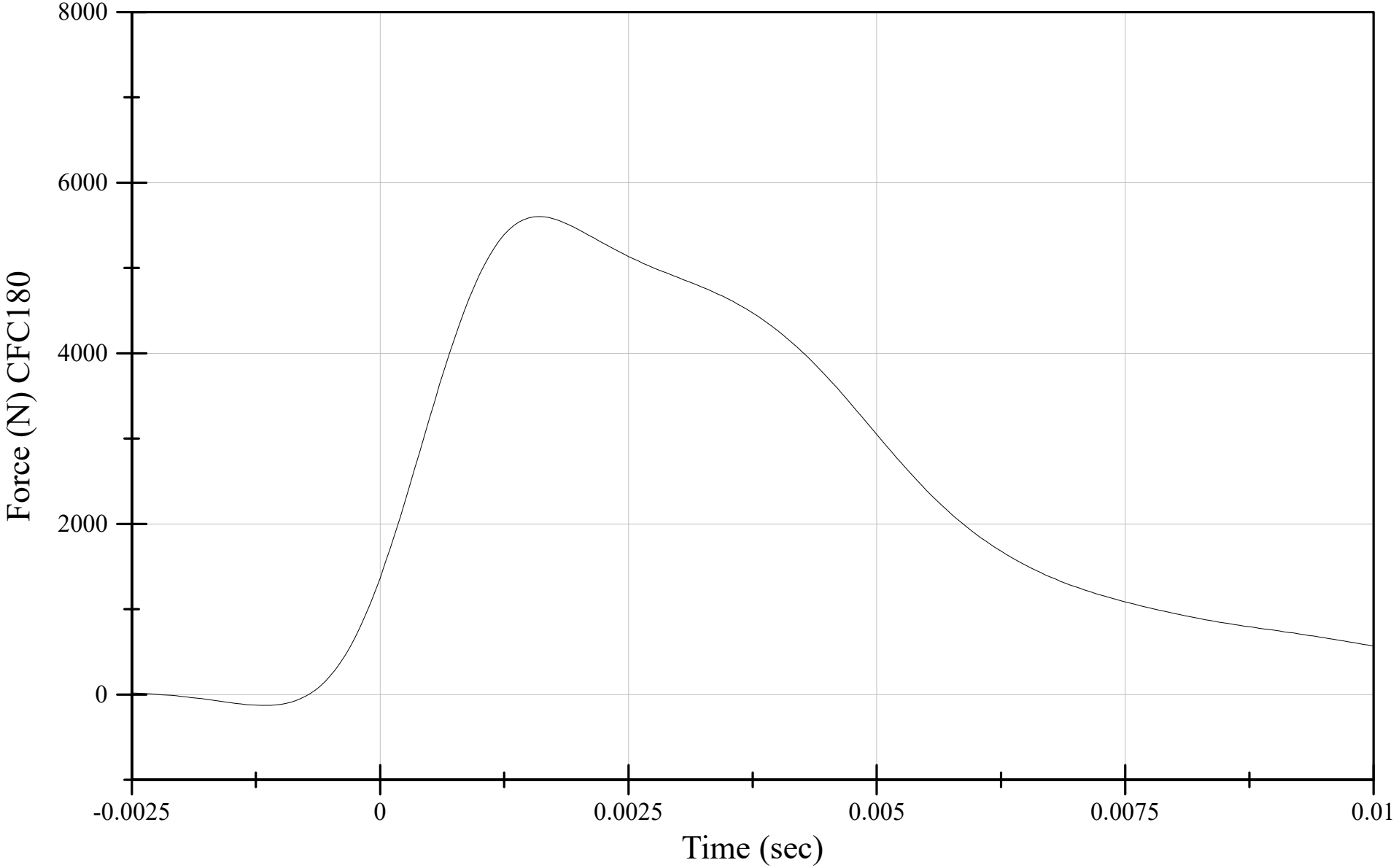
Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.0	Pass
Test Humidity (%)	10 - 70	43	Pass
Test Velocity (m/s)	6.68 - 6.78	6.70	Pass
Peak Probe Force (N)		5605	
Peak Head CG Resultant Acceleration prior to 2 ms (g)		160	
Peak Head CG Resultant Acceleration after to 2 ms (g)		166	

* THOR-05F Qualification Manual - July 2022

File Name: 220928-1 processed

Software Version: 2.8

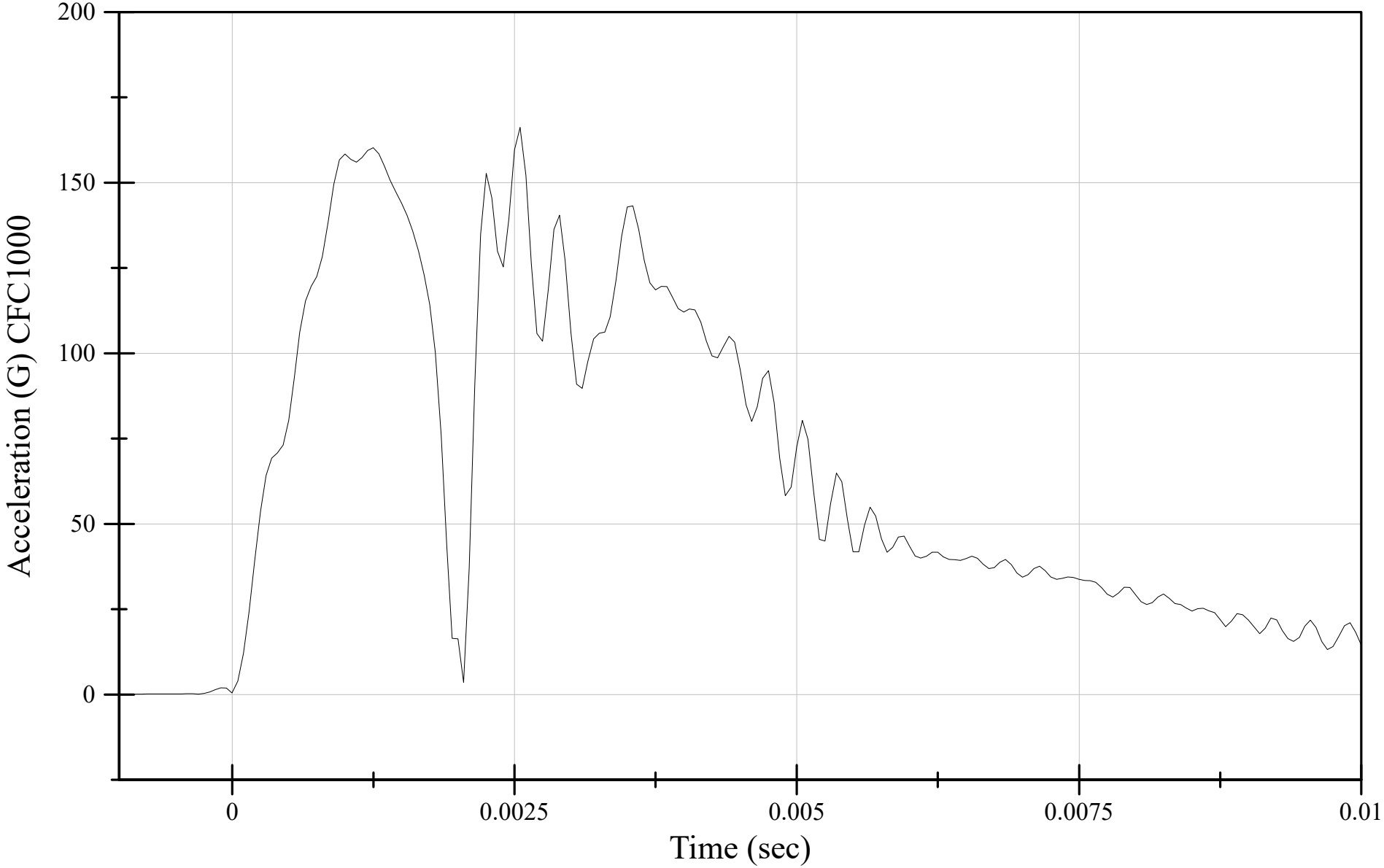
THOR-05F Face Disk Qualification
Probe Force
Dummy Serial Number: EU3430



File Name: 220928-1 processed

9/28/2022 6:12 AM

THOR-05F Face Disk Qualification
Head CG Resultant Acceleration
Dummy Serial Number: EU3430



File Name: 220928-1 processed

9/28/2022 6:12 AM

THOR-05F Neck Extension Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components	Test ID: 220913-2
Neck Serial Number: EU1156	Test Date: 9/13/2022
O.C. Stop Assembly:	Test Time: 11:39 AM
O.C. Cam:	

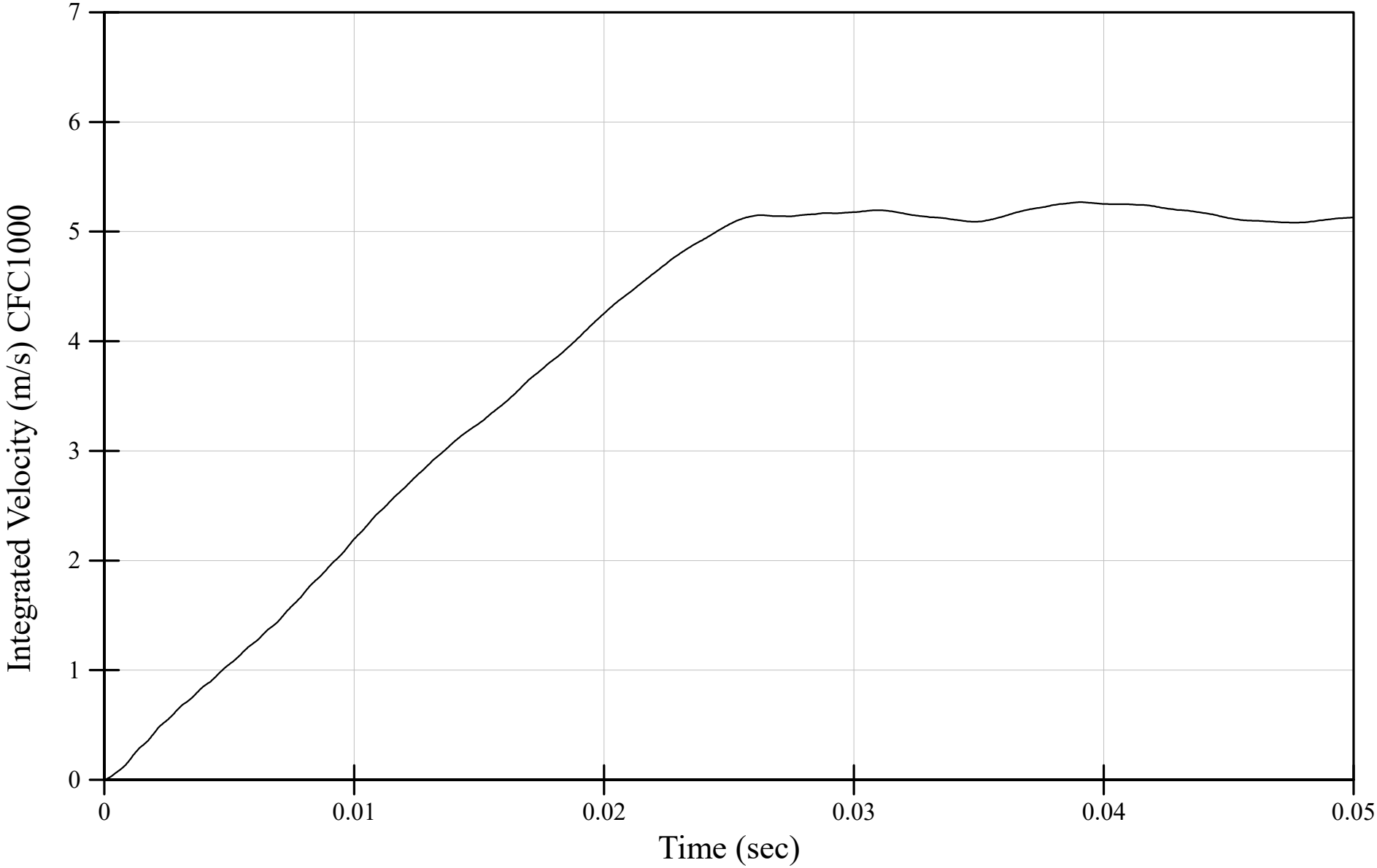
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.8	Pass
Test Humidity (%)	10 - 70	56	Pass
Test Velocity (m/s)	4.95 - 5.05	4.95	Pass
Pendulum Velocity at 8 ms (m/s)		1.71	
Pendulum Velocity at 16 ms (m/s)		3.43	
Pendulum Velocity at 24 ms (m/s)		4.93	
Peak Upper Neck My (Nm)		-18.8	
Peak Upper Neck Fz (N)		-1227	
Peak Head Angular Velocity Y (deg/sec)		2379	
Peak Head Rotation (deg)		85.7	

* THOR-05F Qualification Manual - July 2022

File Name: 220913-2 processed

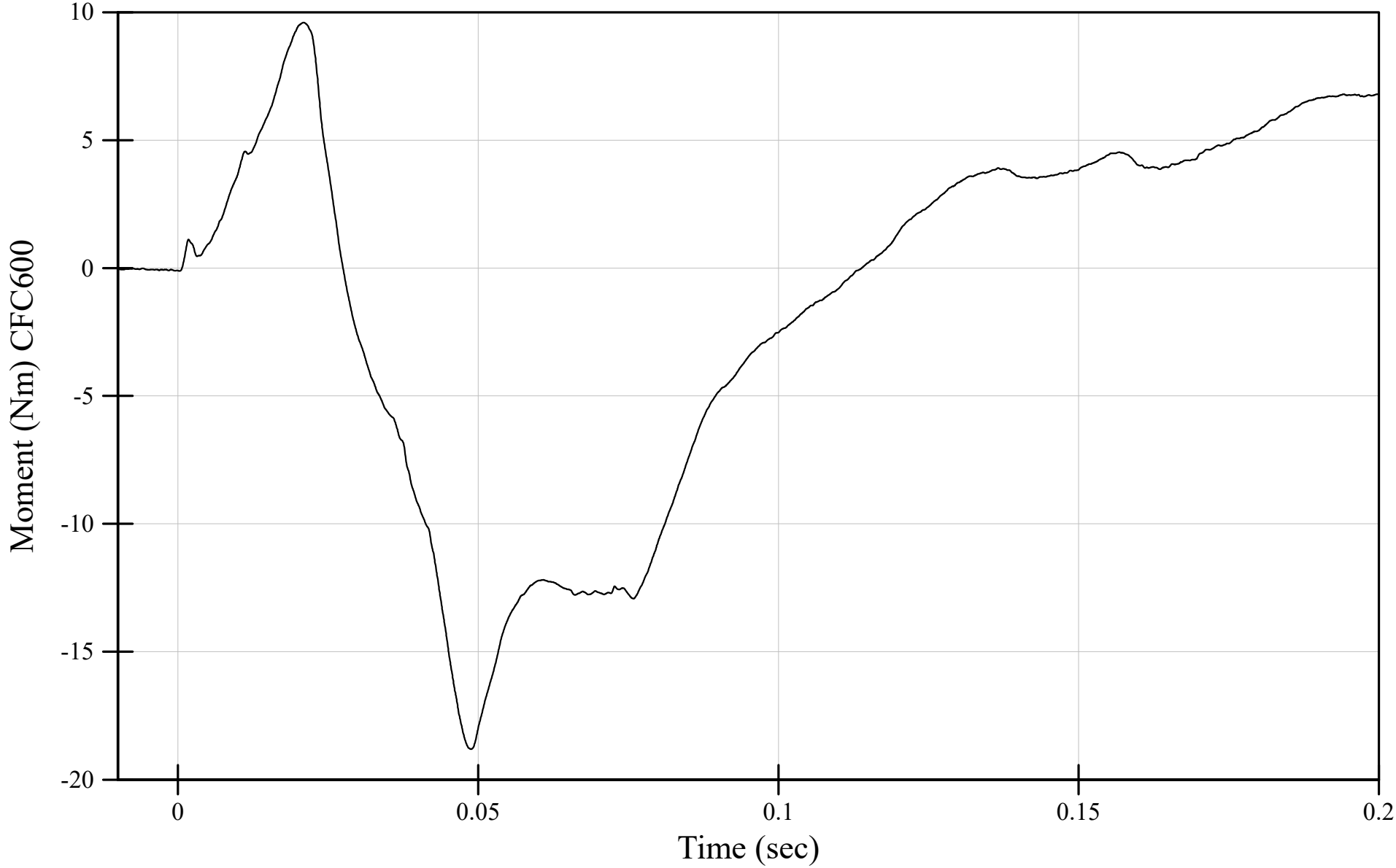
THOR-05F Neck Extension Qualification
Probe Acceleration
Neck Serial Number: EU1156



File Name: 220913-2 processed

9/13/2022 11:39 AM

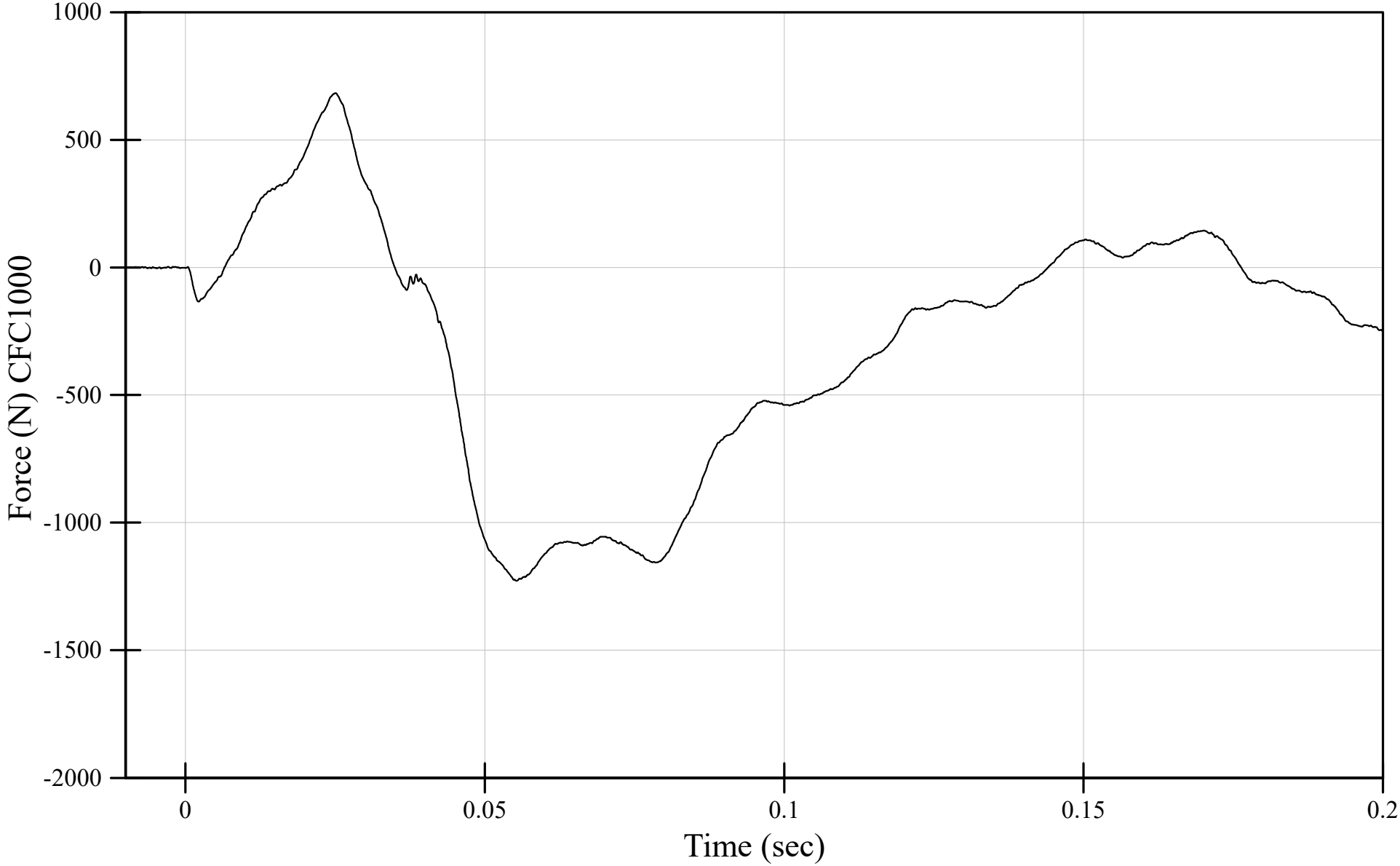
THOR-05F Neck Extension Qualification
Y-Moment as Measured
Neck Serial Number: EU1156



File Name: 220913-2 processed

9/13/2022 11:39 AM

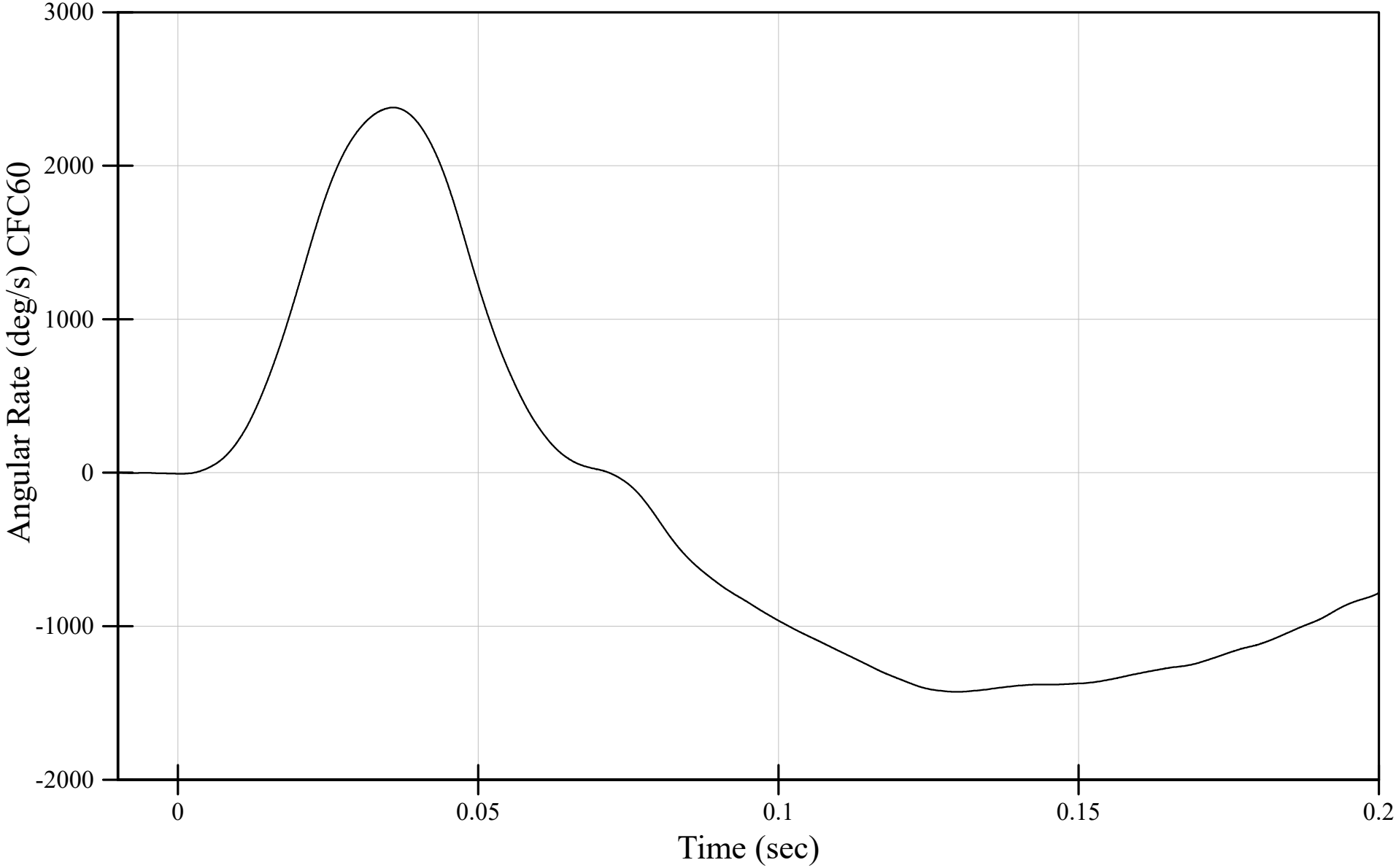
THOR-05F Neck Extension Qualification
Z-Force as Measured
Neck Serial Number: EU1156



File Name: 220913-2 processed

9/13/2022 11:39 AM

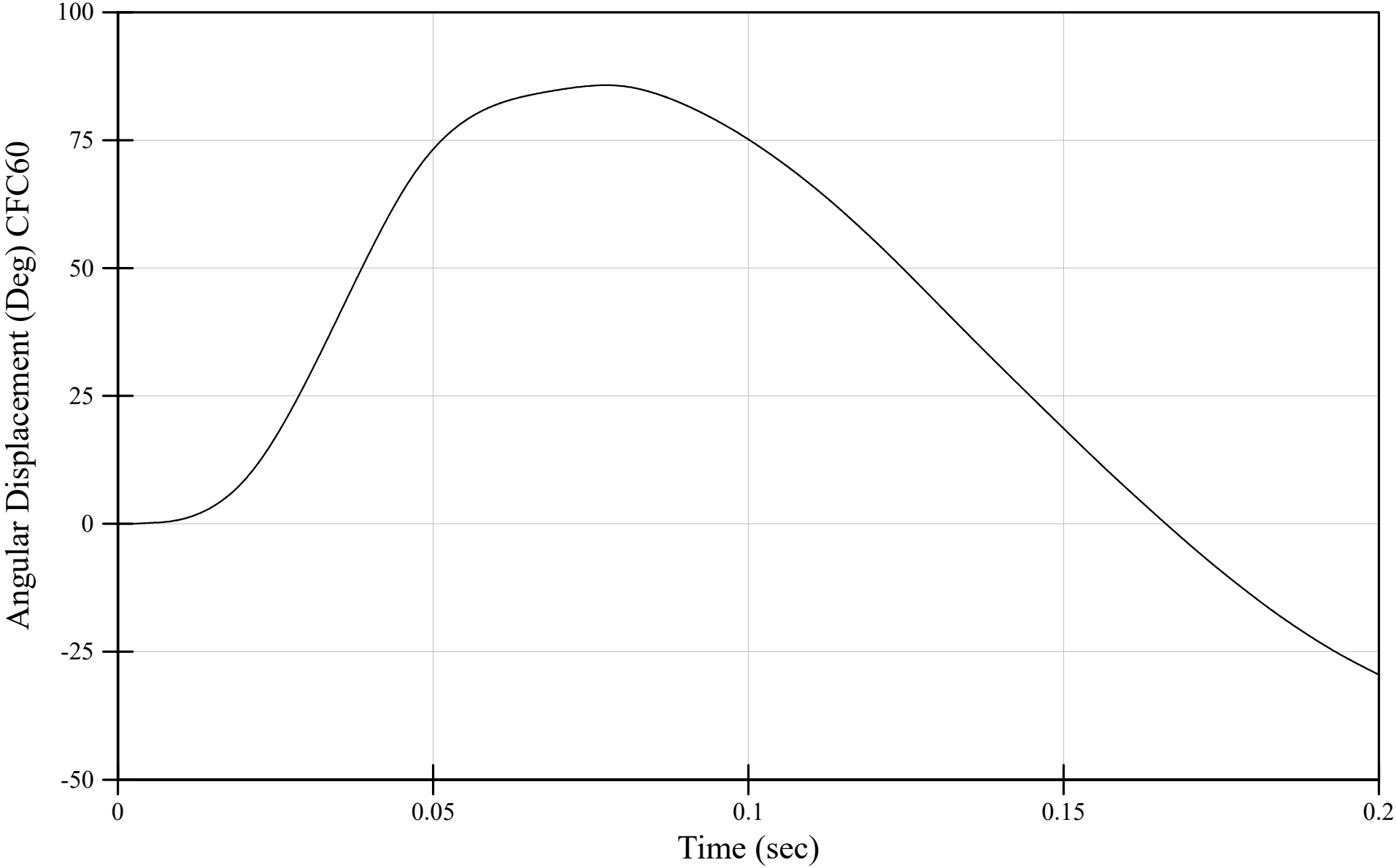
THOR-05F Neck Extension Qualification
Peak Head Angular Rate
Neck Serial Number: EU1156



File Name: 220913-2 processed

9/13/2022 11:39 AM

THOR-05F Neck Extension Qualification
Neck Rotation
Neck Serial Number: EU1156



File Name: 220913-2 processed

9/13/2022 11:39 AM

THOR-05F Neck Front Flexion Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Neck Serial Number: EU1156
O.C. Stop Assembly:
O.C. Cam:

Test ID: 220913-4
Test Date: 9/13/2022
Test Time: 1:15 PM

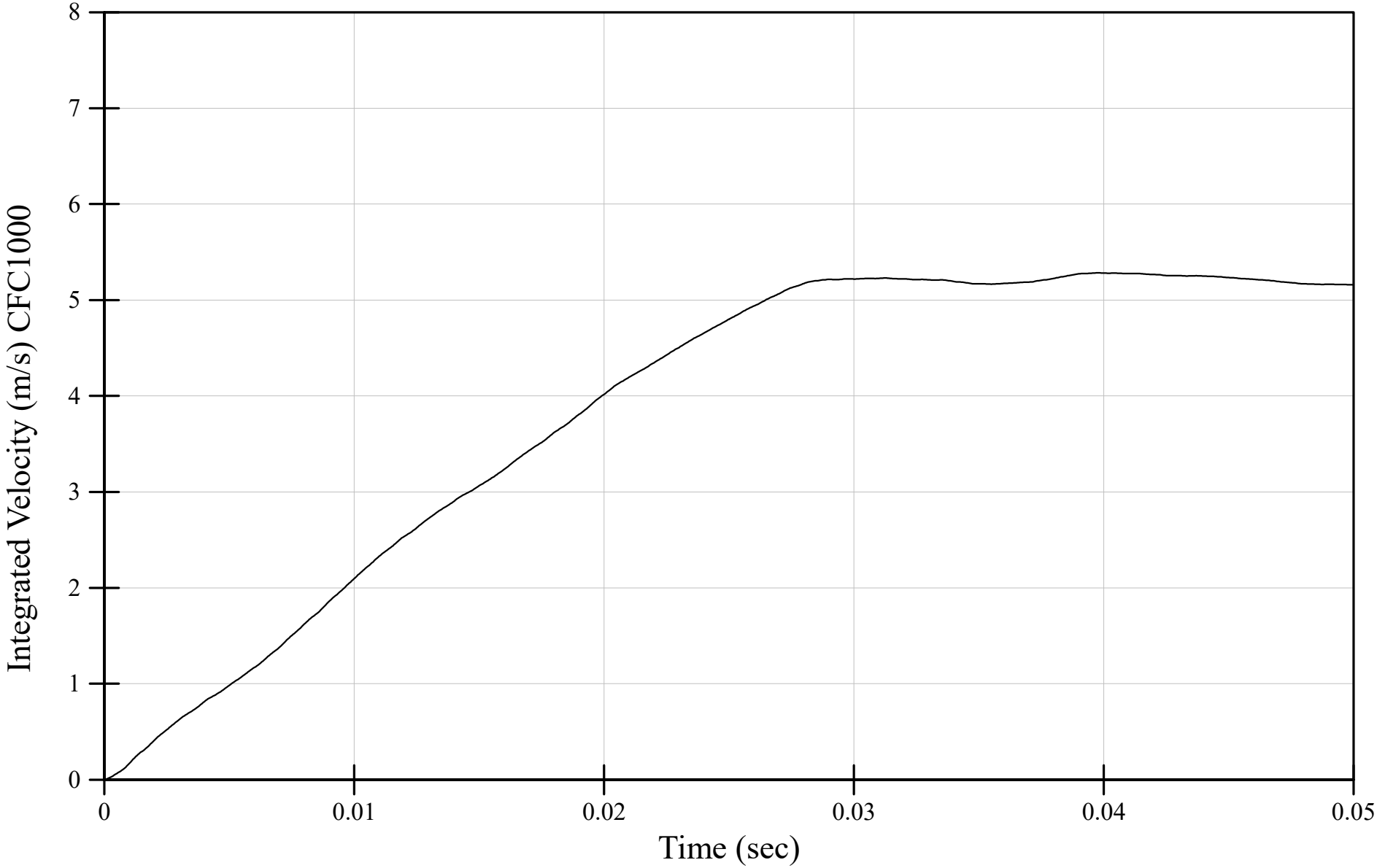
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.8	Pass
Test Humidity (%)	10 - 70	57	Pass
Test Velocity (m/s)	4.95 - 5.05	4.99	Pass
Pendulum Velocity at 8 ms (m/s)		1.62	
Pendulum Velocity at 16 ms (m/s)		3.23	
Pendulum Velocity at 24 ms (m/s)		4.66	
Peak Upper Neck My (Nm)		17.5	
Peak Upper Neck Fz prior to 40 ms (N)		679	
Peak Head Angular Velocity Y (deg/sec)		-2049	
Peak Head Rotation (deg)		-78.4	

* THOR-05F Qualification Manual - July 2022

File Name: 220913-4 processed
Software Version: 2.8

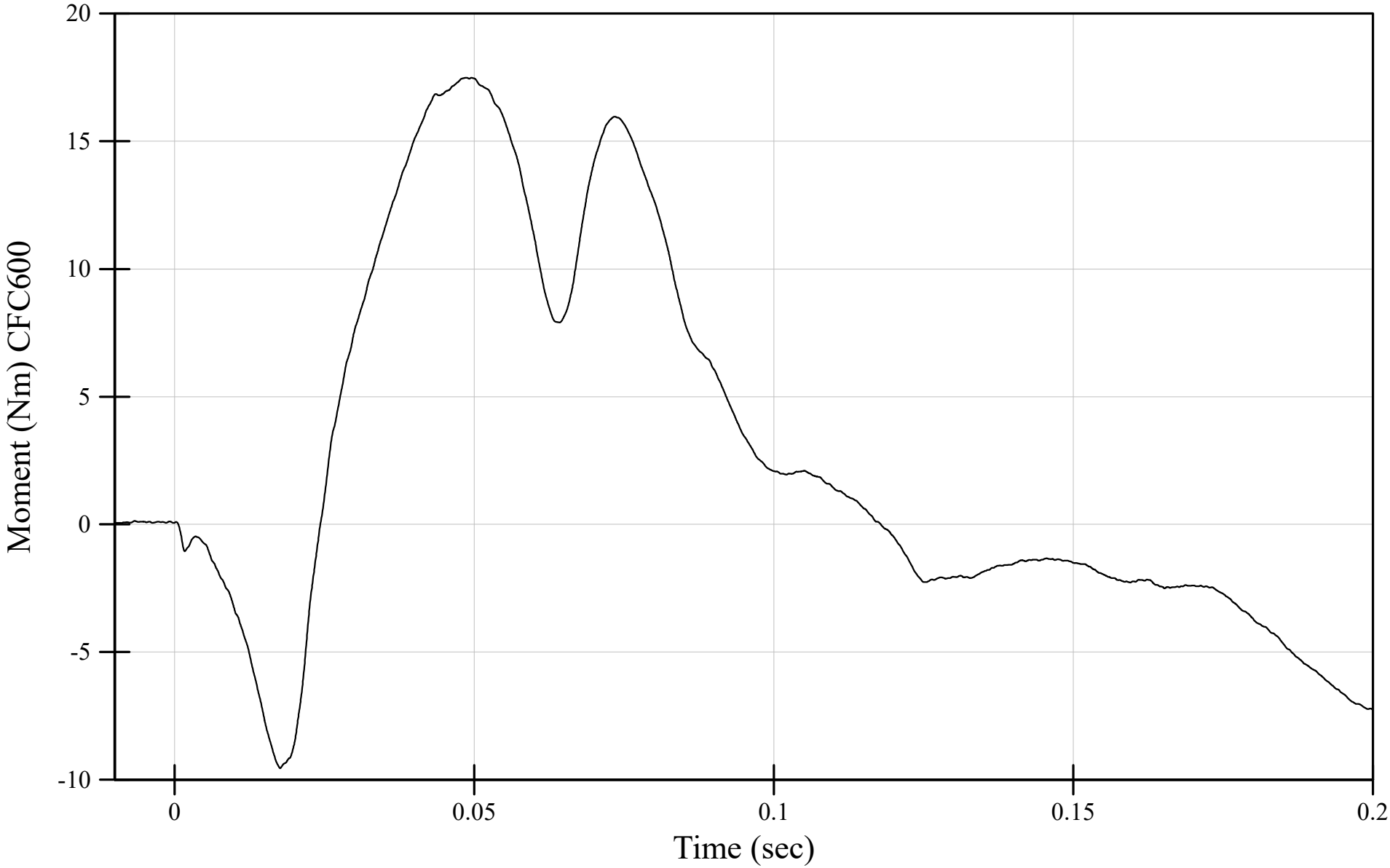
THOR-05F Neck Flexion Qualification
Pendulum Pulse
Neck Serial Number: EU1156



File Name: 220913-4 processed

9/13/2022 1:15 PM

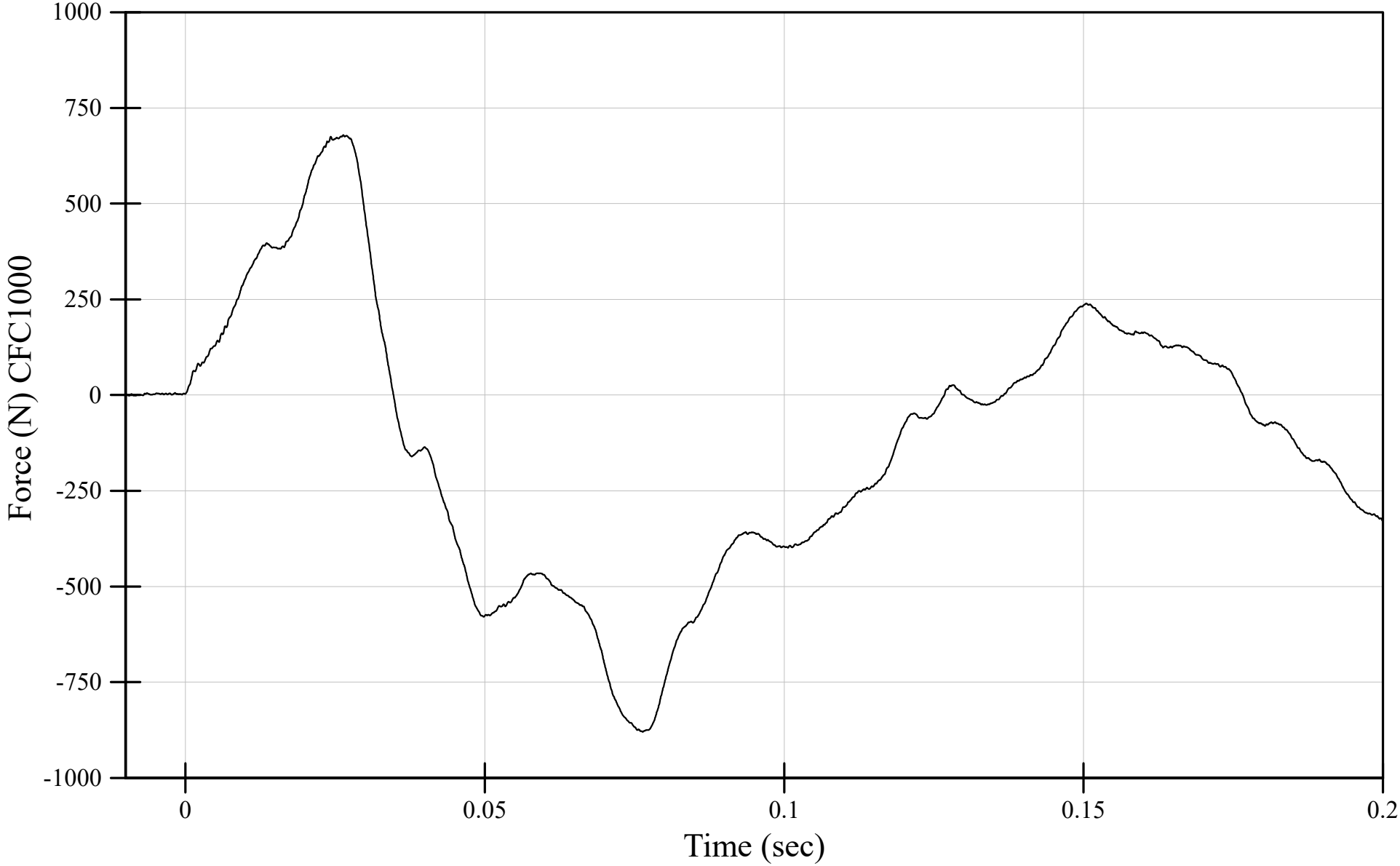
THOR-05F Neck Flexion Qualification
Y-Moment as Measured
Neck Serial Number: EU1156



File Name: 220913-4 processed

9/13/2022 1:15 PM

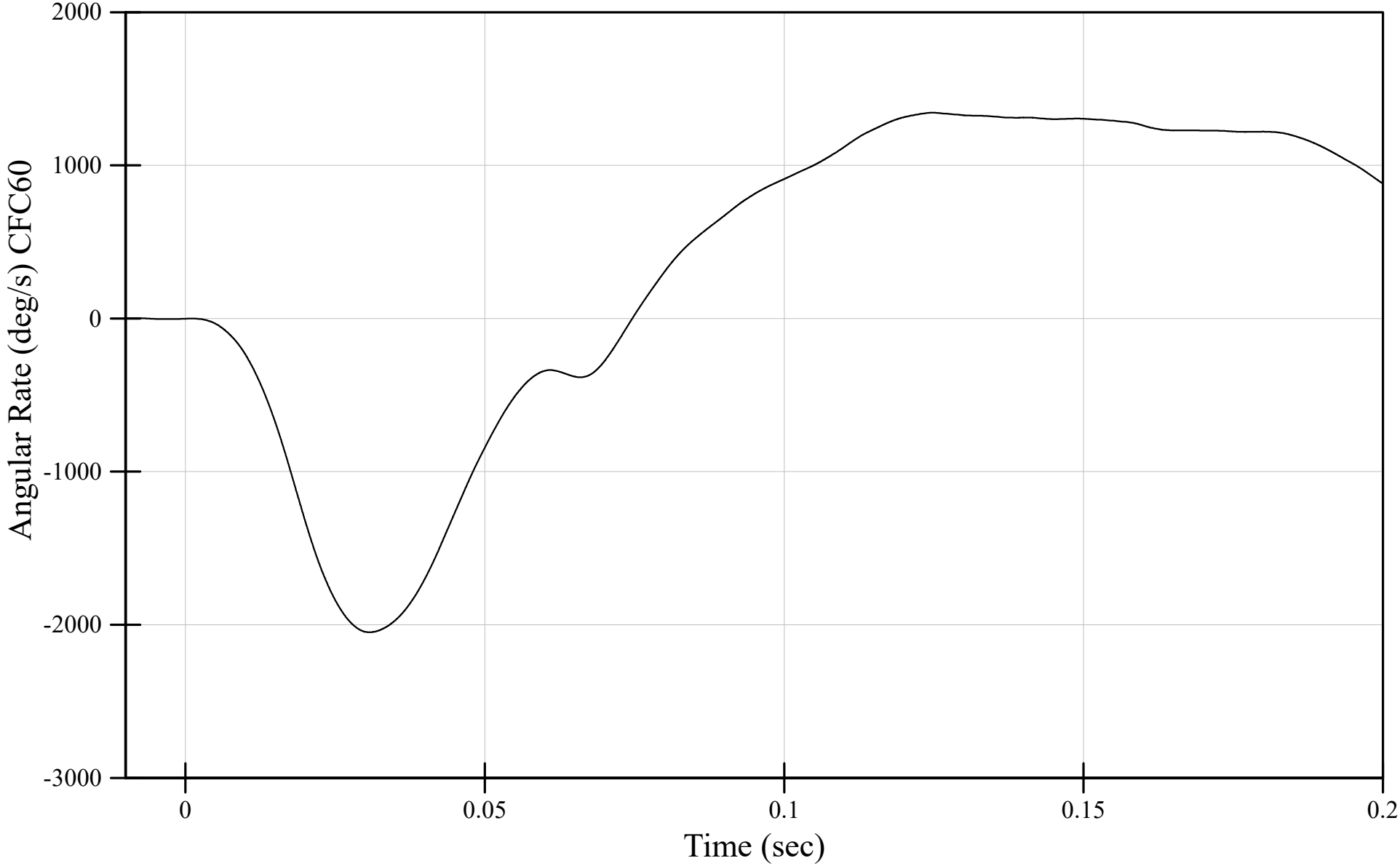
THOR-05F Neck Flexion Qualification
Z-Force as Measured
Neck Serial Number: EU1156



File Name: 220913-4 processed

9/13/2022 1:15 PM

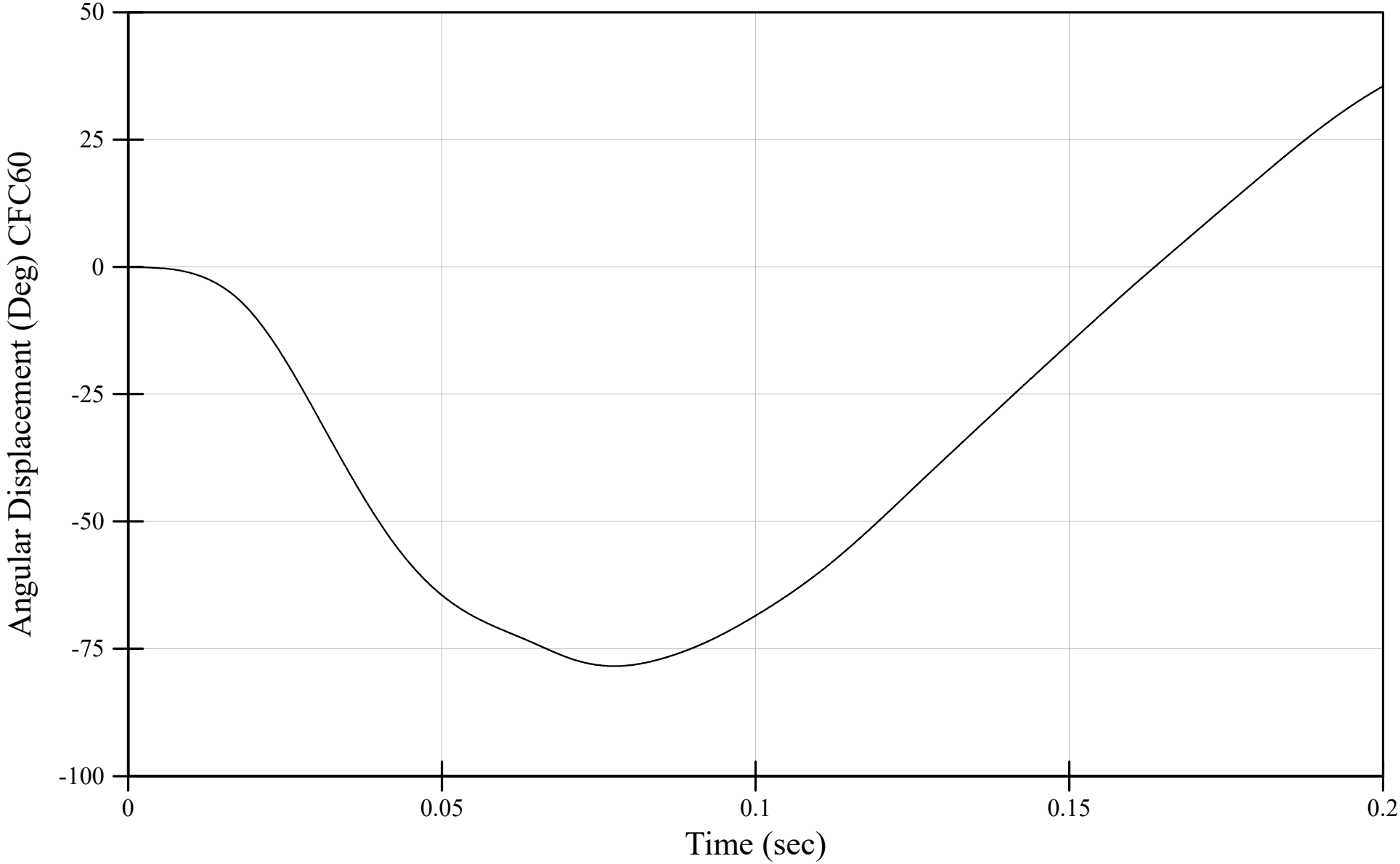
THOR-05F Neck Flexion Qualification
Peak Angular Rate
Neck Serial Number: EU1156



File Name: 220913-4 processed

9/13/2022 1:15 PM

THOR-05F Neck Flexion Qualification
Neck Rotation
Neck Serial Number: EU1156



File Name: 220913-4 processed

9/13/2022 1:15 PM

THOR-05F Neck Left Lateral Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Neck Serial Number: EU1156
O.C. Stop Assembly Serial Number:
O.C. Cam Serial Number:

Test ID: 220913-5
Test Date: 9/13/2022
Test Time: 1:51 PM

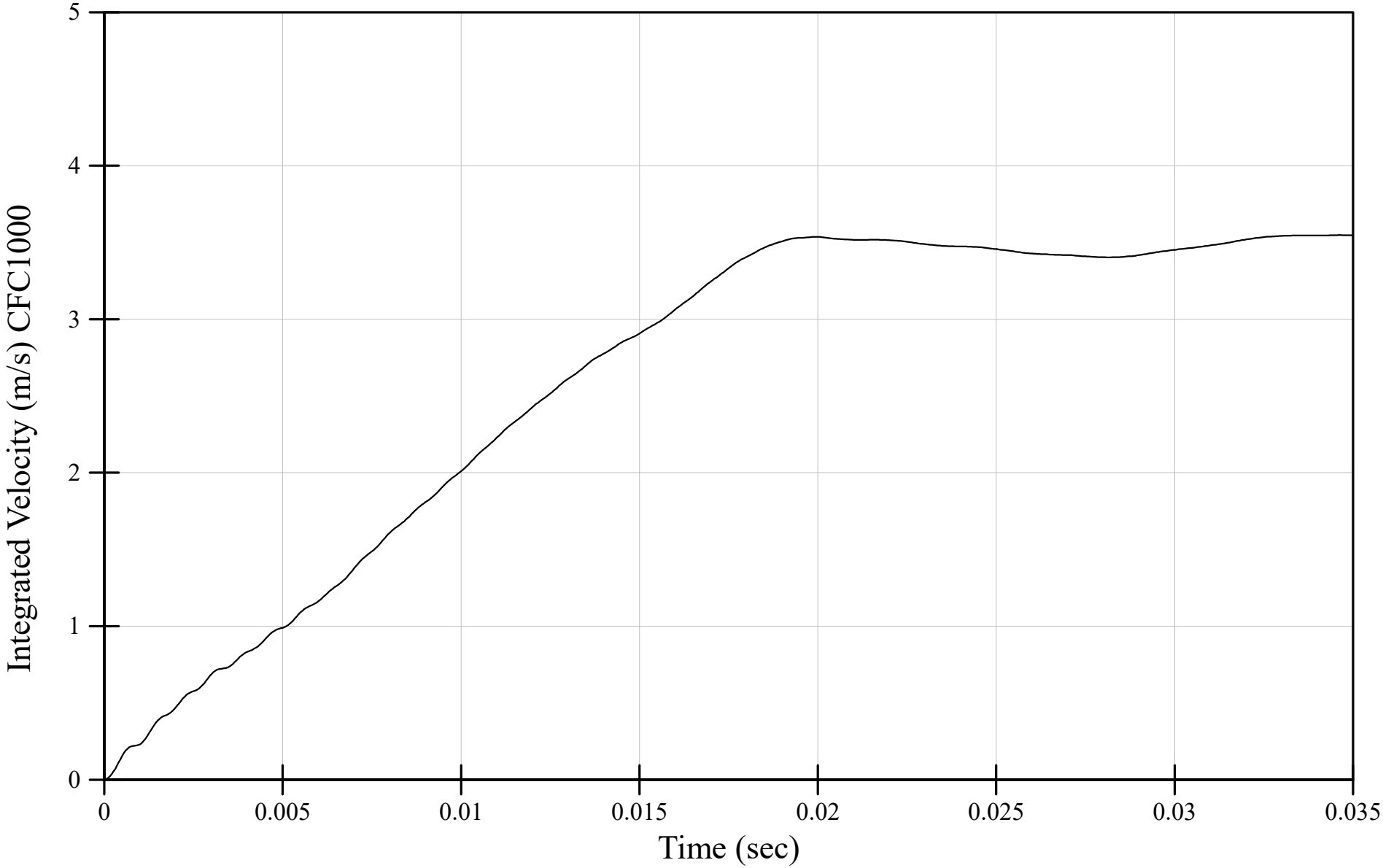
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.8	Pass
Test Humidity (%)	10 - 70	57	Pass
Test Velocity (m/s)	3.35 - 3.45	3.38	Pass
Pendulum Velocity at 5 ms (m/s)		0.99	
Pendulum Velocity at 10 ms (m/s)		2.01	
Pendulum Velocity at 15 ms (m/s)		2.91	
Peak Upper Neck Mx after 40 ms (N)		29.7	
Peak Head Angular Velocity X (deg/sec)		-1253.1	
Peak Head Rotation (deg)		-48.9	

* THOR-05F Qualification Manual - July 2022

File Name: 220913-5 processed
Software Version: 2.8

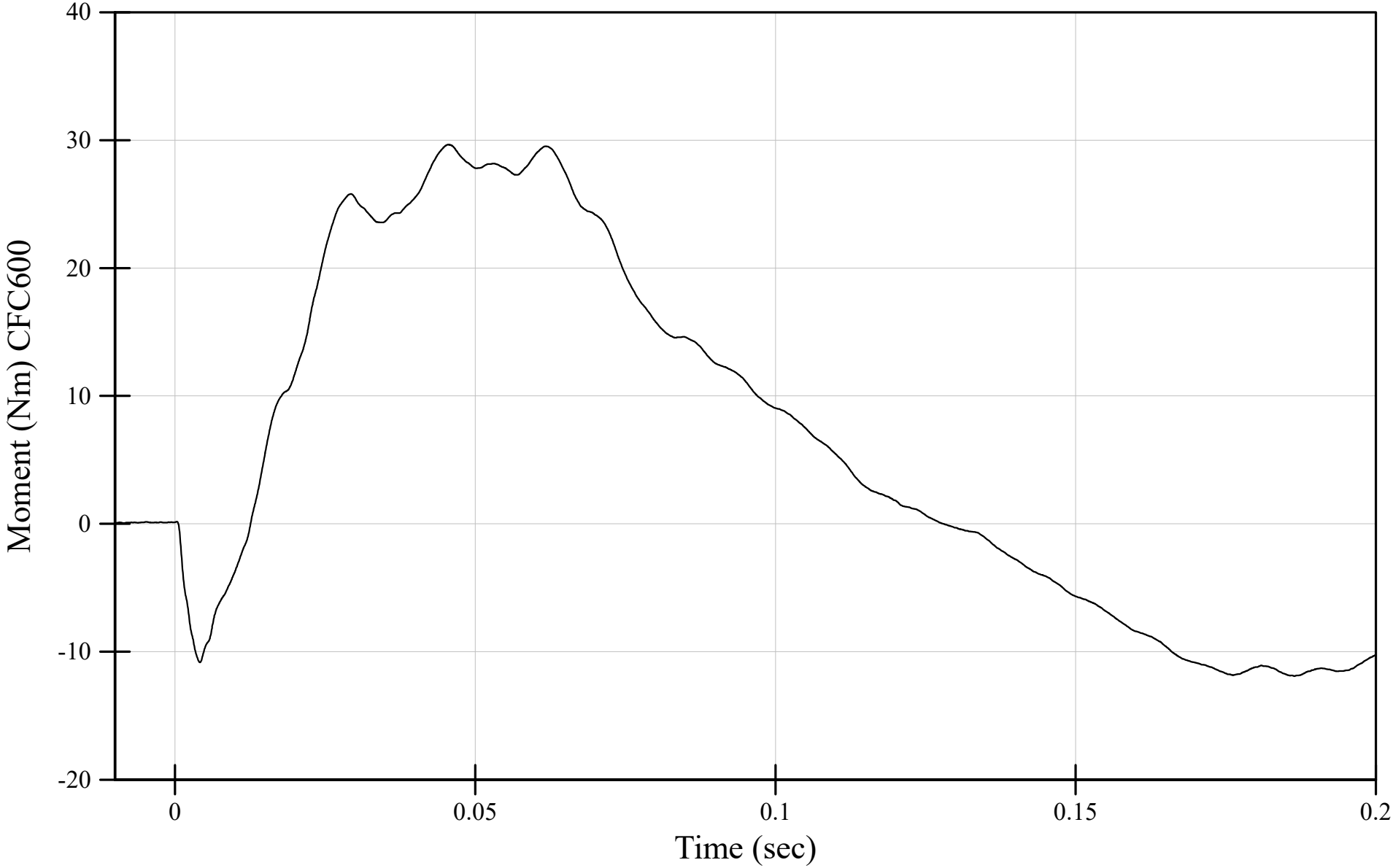
THOR-05F Neck Left Lateral Qualification
Pendulum Pulse
Serial Number: EU1156



File Name: 220913-5 processed

9/13/2022 1:51 PM

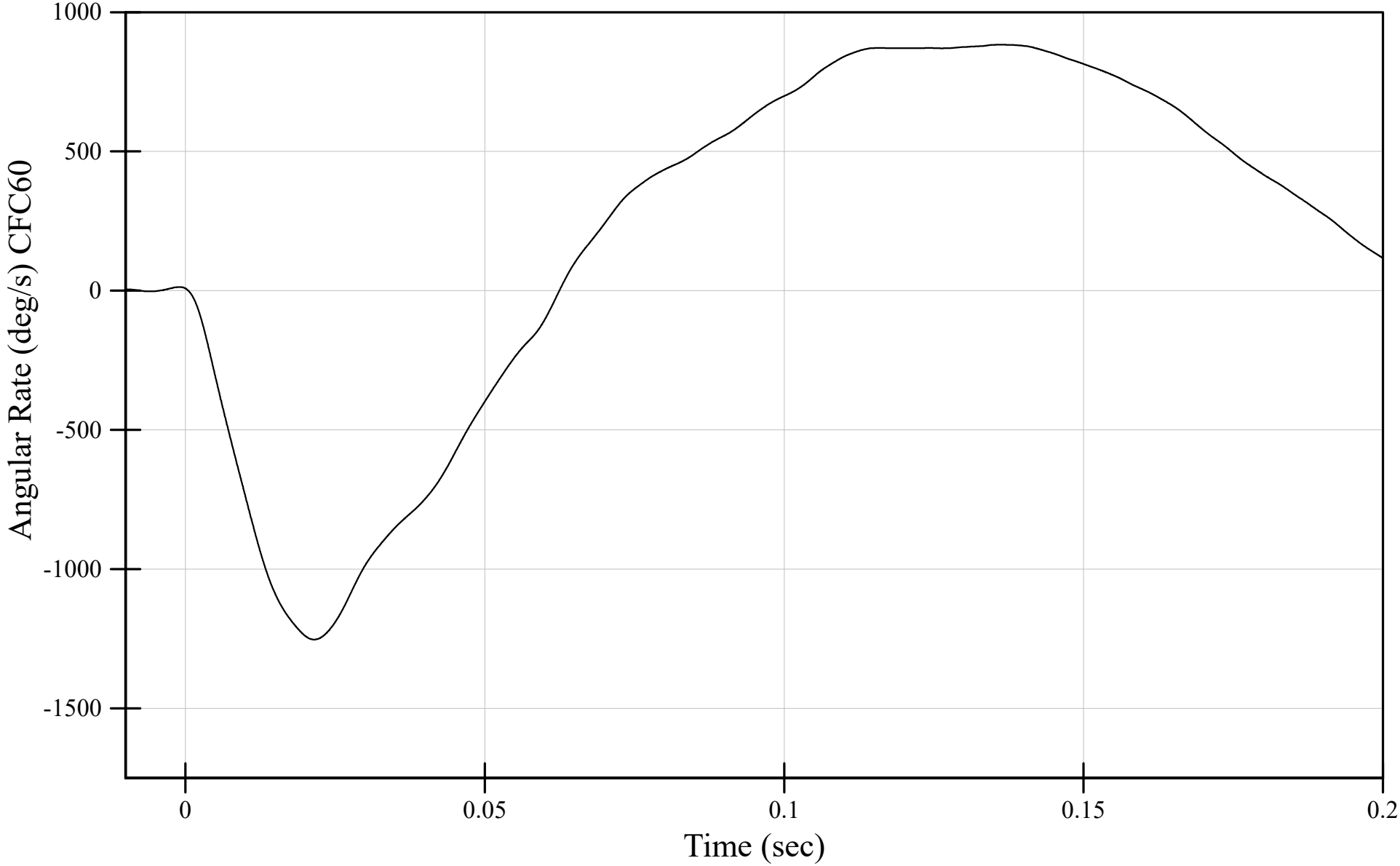
THOR-05F Neck Left Lateral Qualification
X-Moment as Measured
Serial Number: EU1156



File Name: 220913-5 processed

9/13/2022 1:51 PM

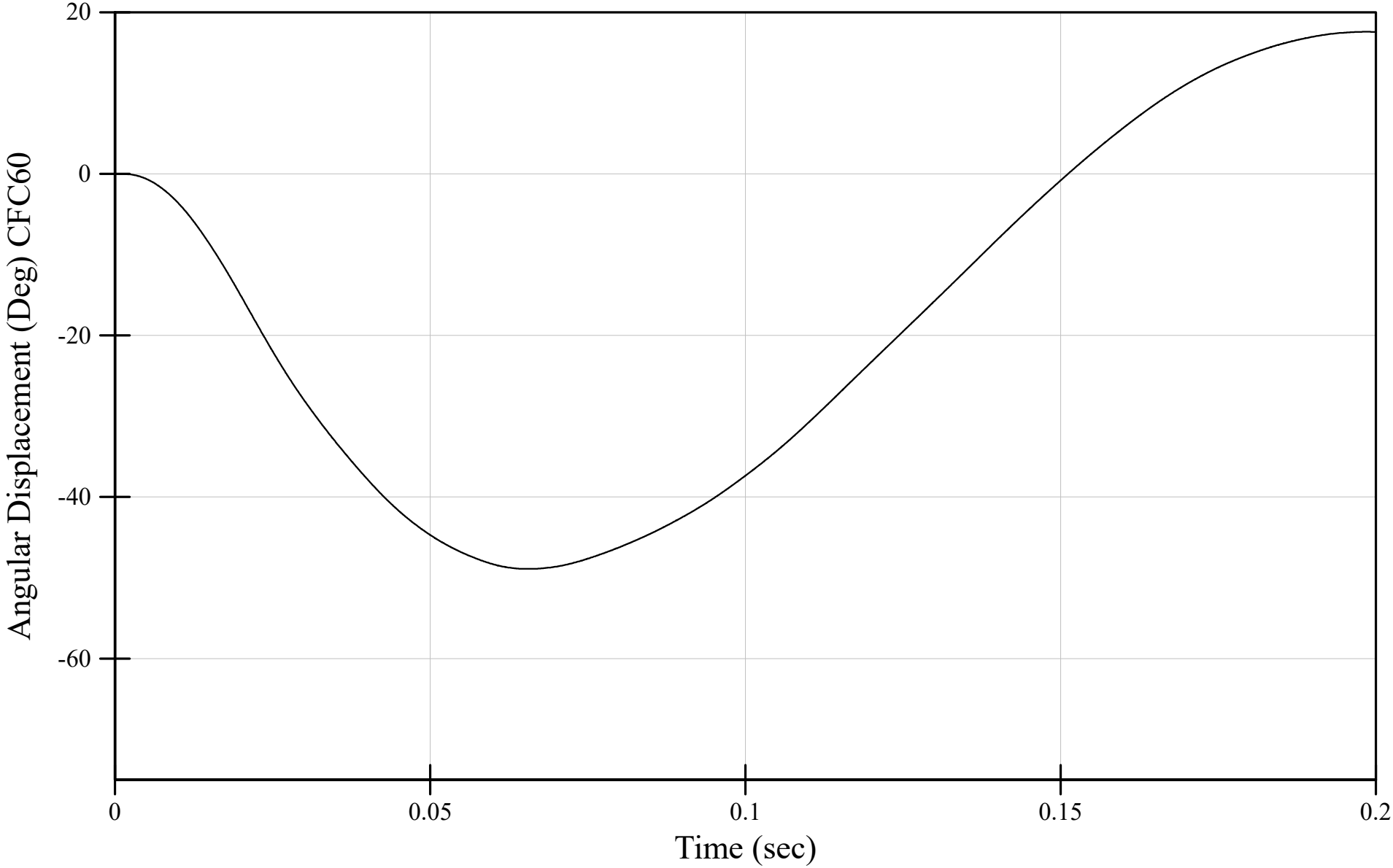
THOR-05F Neck Left Lateral Qualification
Peak Angular Rate
Serial Number: EU1156



File Name: 220913-5 processed

9/13/2022 1:51 PM

THOR-05F Neck Left Lateral Qualification
Neck Rotation
Serial Number: EU1156



File Name: 220913-5 processed

9/13/2022 1:51 PM

THOR-05F Neck Right Lateral Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Neck Serial Number: EU1156
O.C. Stop Assembly Serial Number:
O.C. Cam Serial Number:

Test ID: 220913-7
Test Date: 9/13/2022
Test Time: 3:45 PM

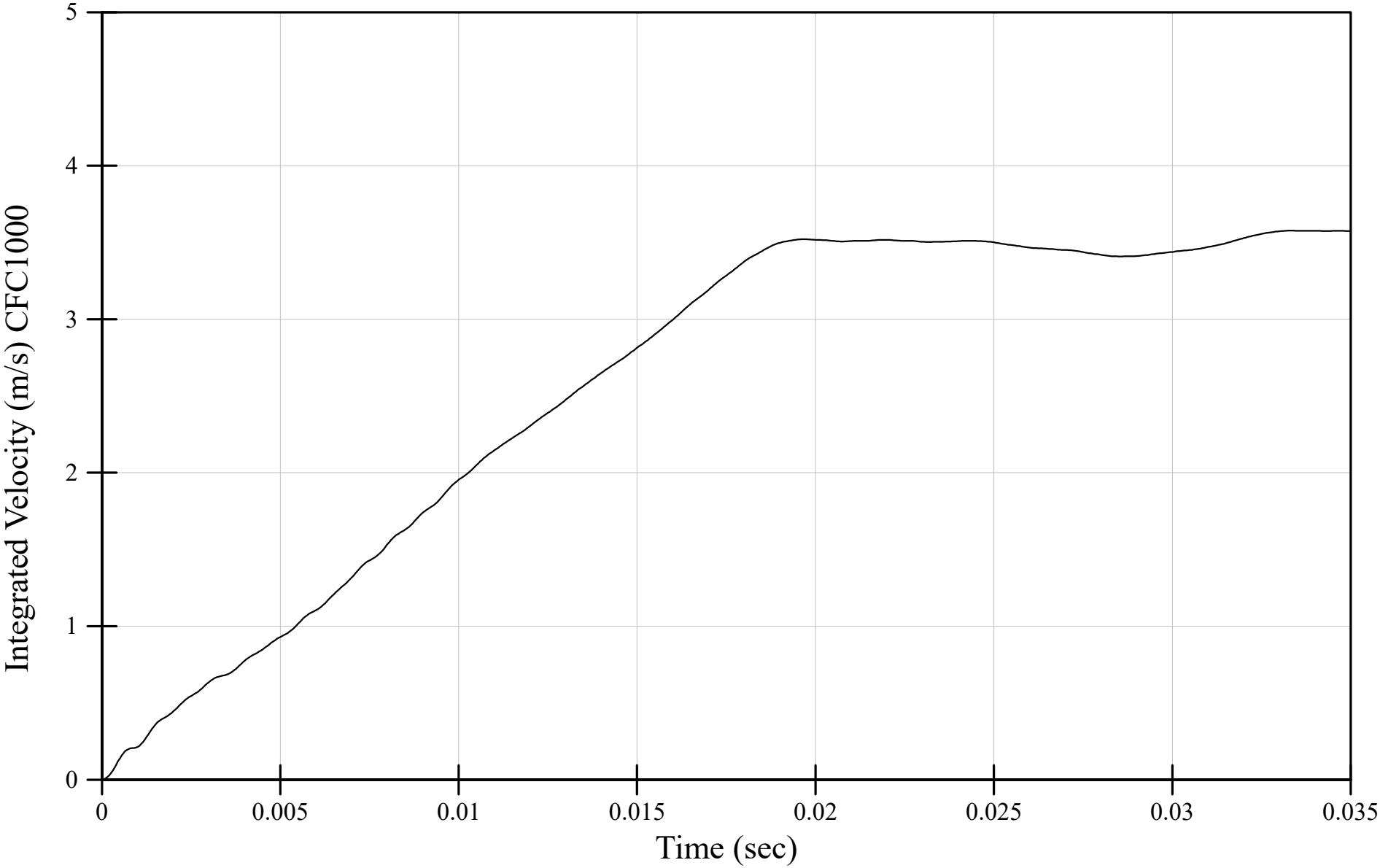
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.6	Pass
Test Humidity (%)	10 - 70	55	Pass
Test Velocity (m/s)	3.35 - 3.45	3.38	Pass
Pendulum Velocity at 5 ms (m/s)		0.93	
Pendulum Velocity at 10 ms (m/s)		1.95	
Pendulum Velocity at 15 ms (m/s)		2.81	
Peak Upper Neck Mx after 40 ms (N)		-29.4	
Peak Head Angular Velocity X (deg/sec)		1257.9	
Peak Head Rotation (deg)		50.2	

* THOR-05F Qualification Manual - July 2022

File Name: 220913-7 processed
Software Version: 2.8

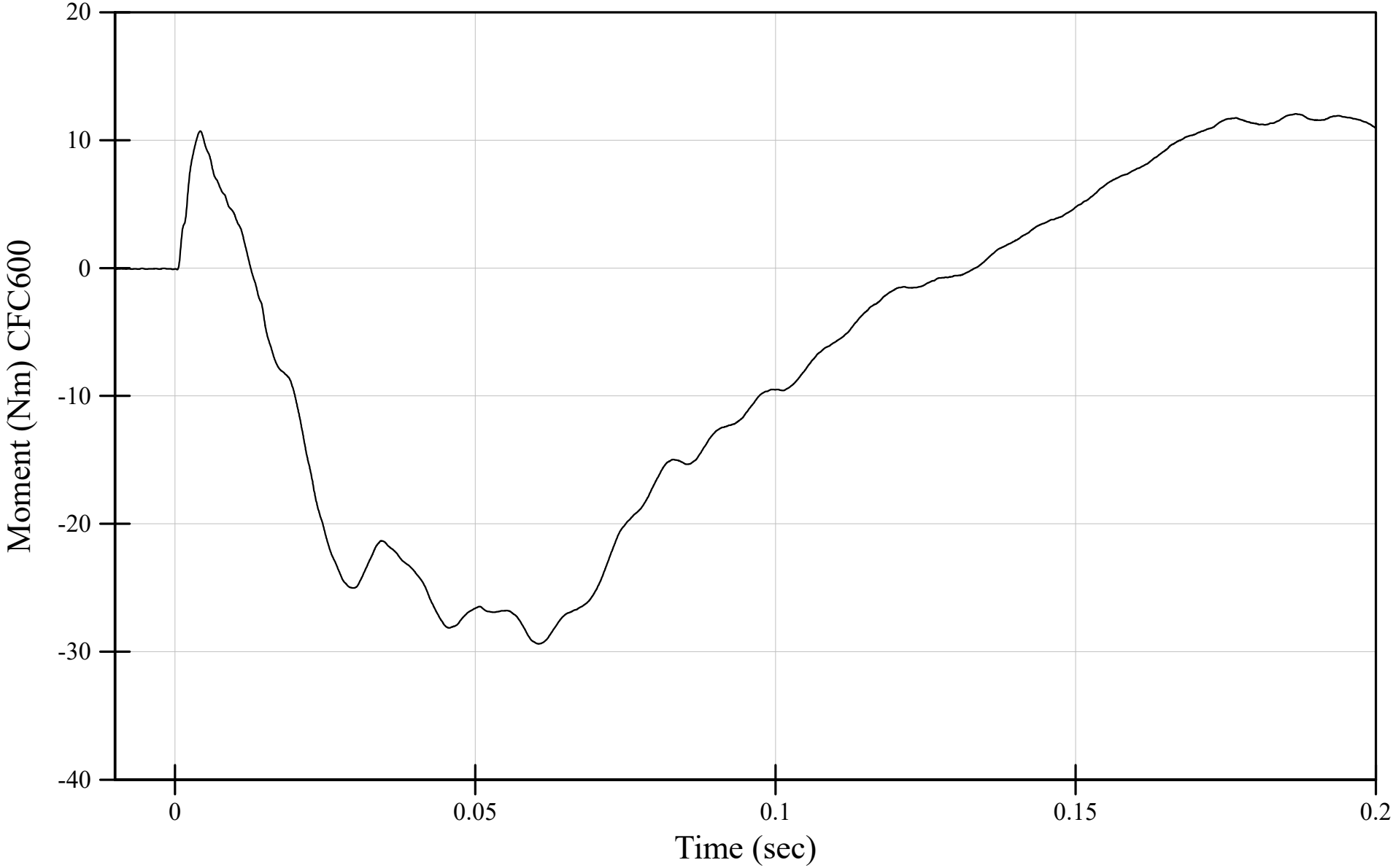
THOR-05F Neck Right Lateral Qualification
Pendulum Pulse
Neck Serial Number: EU1156



File Name: 220913-7 processed

9/13/2022 3:45 PM

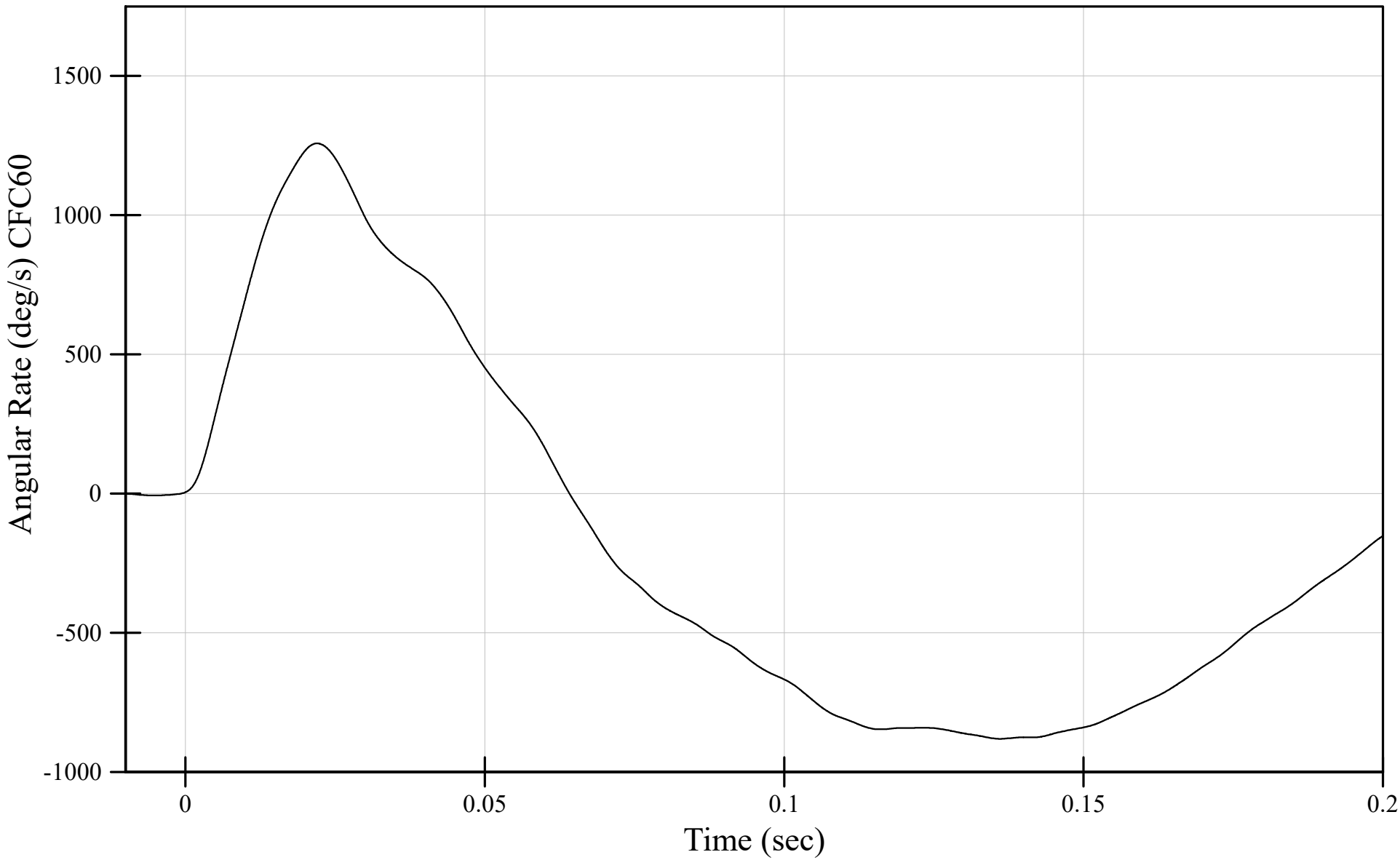
THOR-05F Neck Right Lateral Qualification
X-Moment as Measured
Neck Serial Number: EU1156



File Name: 220913-7 processed

9/13/2022 3:45 PM

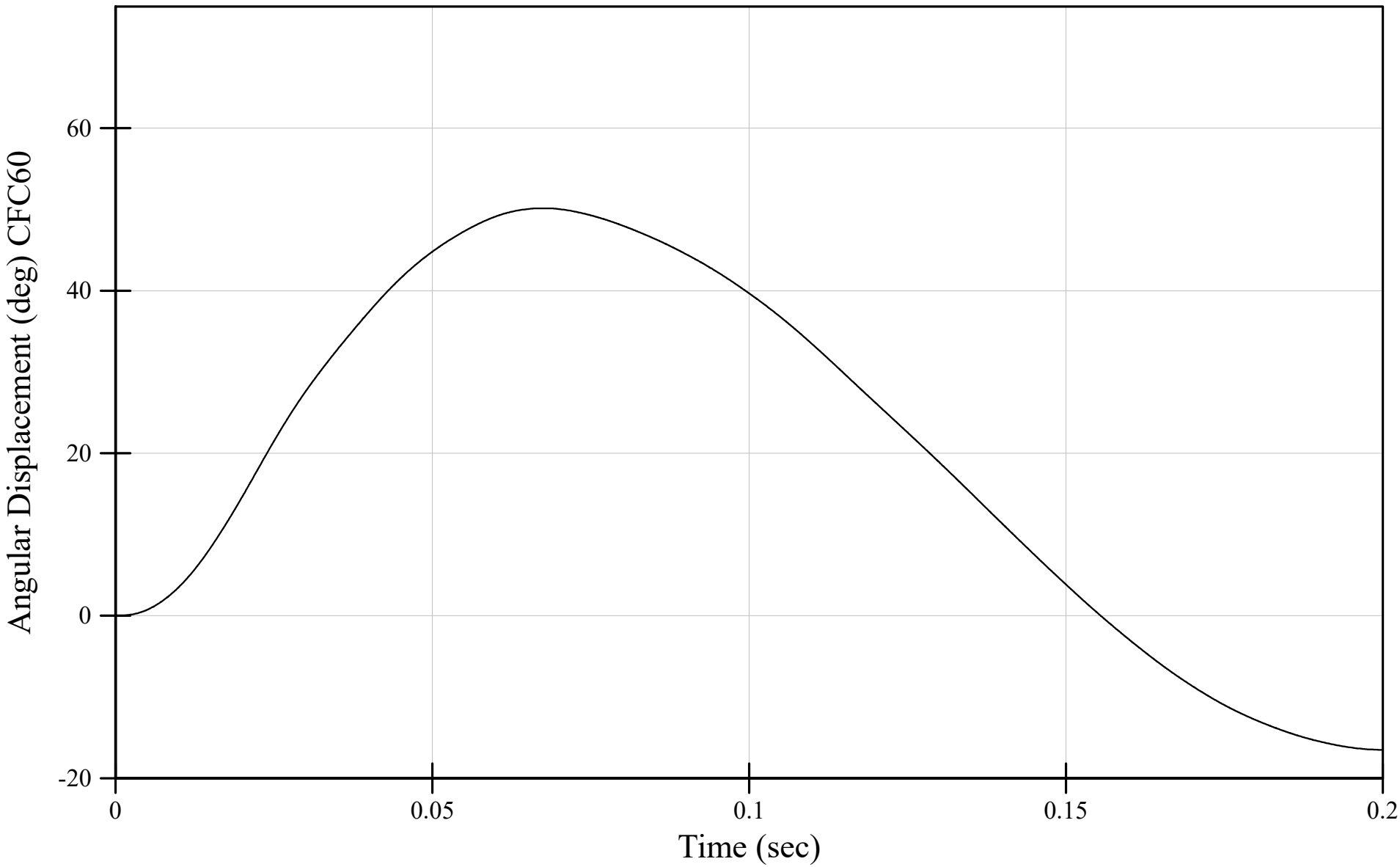
THOR-05F Neck Right Lateral Qualification
Peak Angular Rate
Neck Serial Number: EU1156



File Name: 220913-7 processed

9/13/2022 3:45 PM

THOR-05F Neck Right Lateral Qualification
Neck Rotation
Neck Serial Number: EU1156



File Name: 220913-7 processed

9/13/2022 3:45 PM

THOR-05F Neck Left Torsion Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Neck Serial Number: EU1156
O.C. Stop Assembly Serial Number:
O.C. Cam Serial Number:

Test ID: 220914-2
Test Date: 9/14/2022
Test Time: 8:42 AM

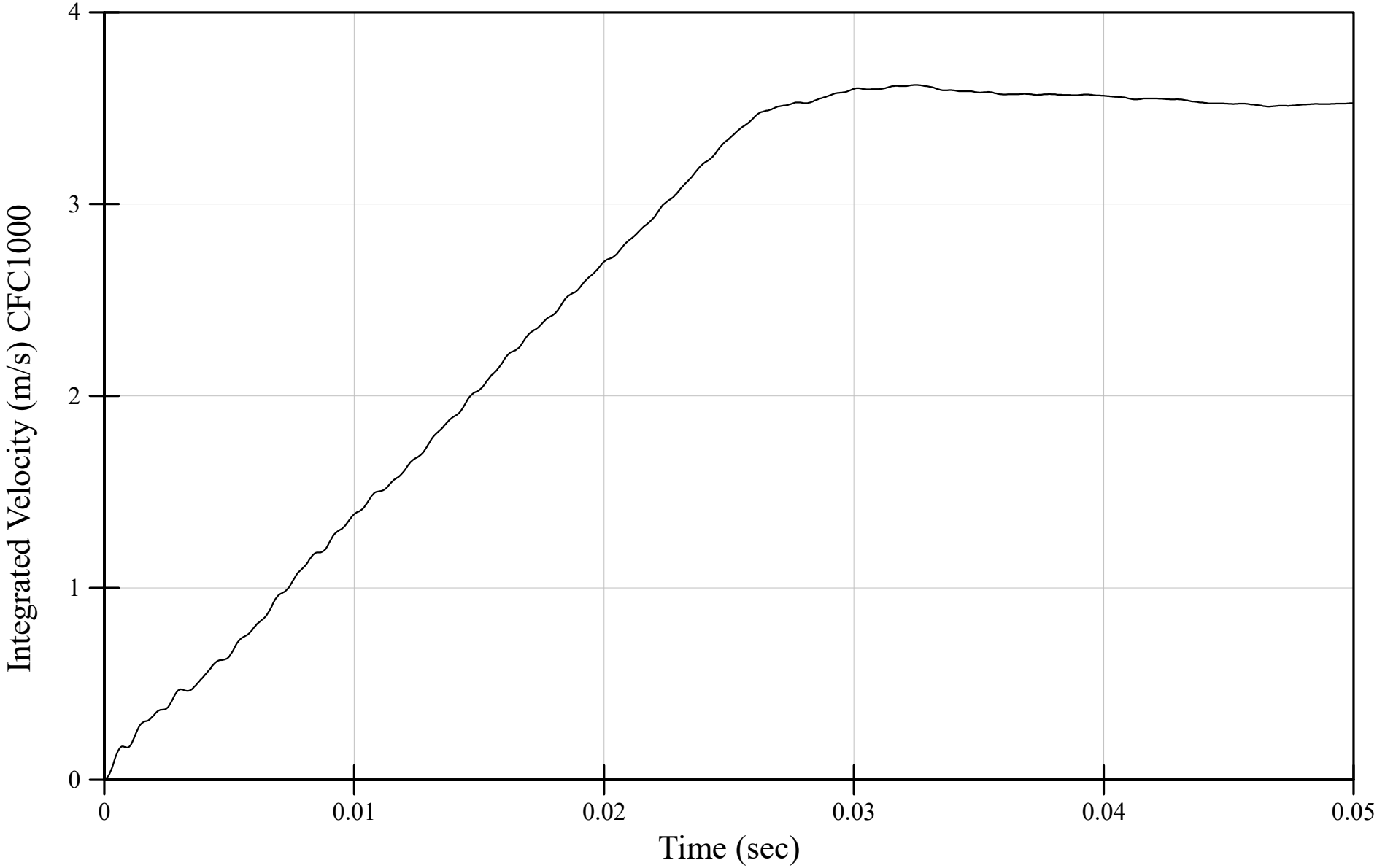
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.4	Pass
Test Humidity (%)	10 - 70	56	Pass
Test Velocity (m/s)	3.35 - 3.45	3.37	Pass
Pendulum Velocity at 10 ms (m/s)		0.96	
Pendulum Velocity at 15 ms (m/s)		1.89	
Pendulum Velocity at 20 ms (m/s)		2.81	
Peak Upper Neck Mz (Nm)		20.7	
Peak Neck Fixture Rotation (deg)		-47.2	
Peak Upper Neck Angular Velocity Z (deg/sec)		-1214.0	

* THOR-05F Qualification Manual - July 2022

File Name: 220914-2 processed
Software Version: 2.8

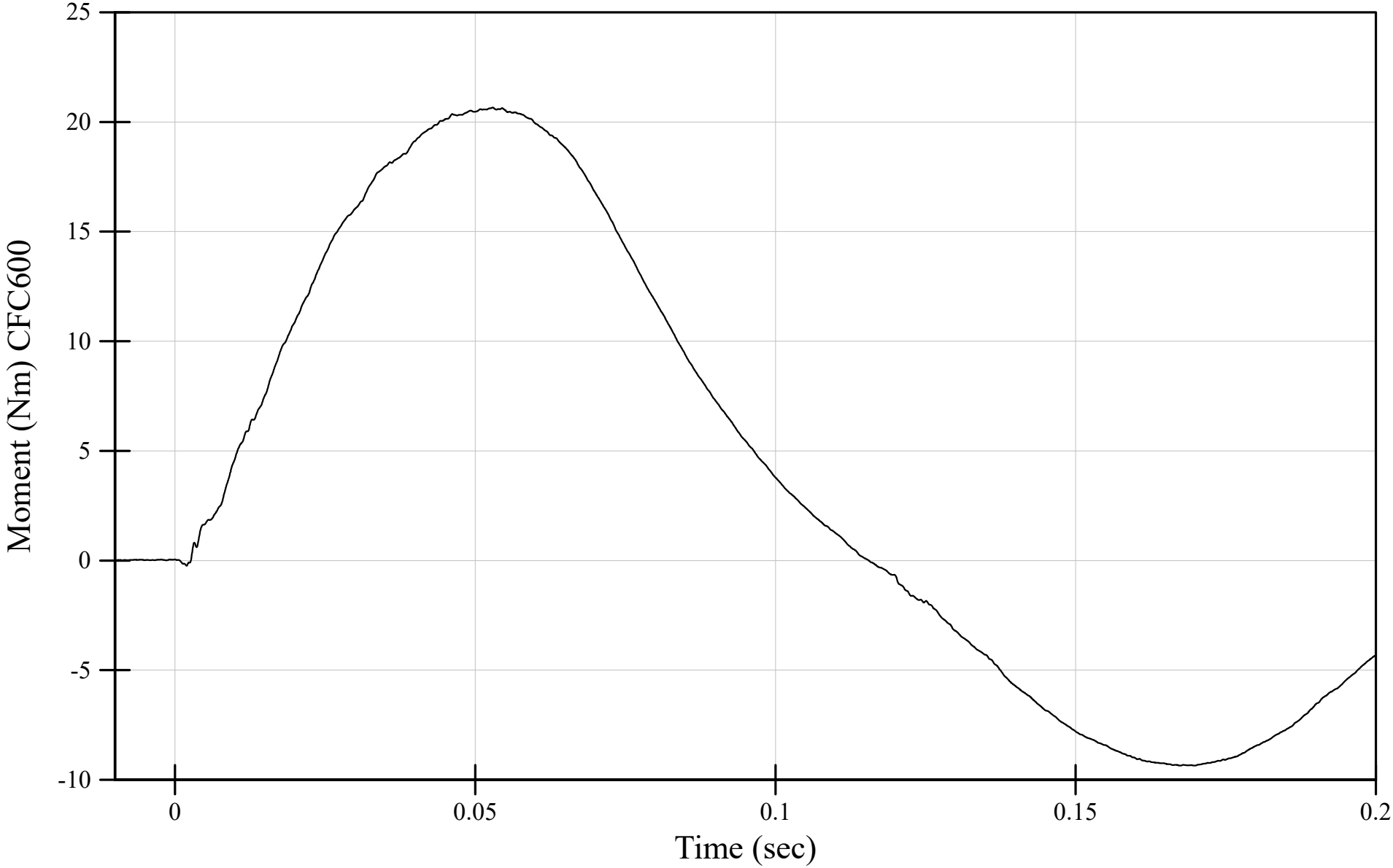
THOR-05F Neck Left Torsion Qualification
Pendulum Pulse
Neck Serial Number: EU1156



File Name: 220914-2 processed

9/14/2022 8:42 AM

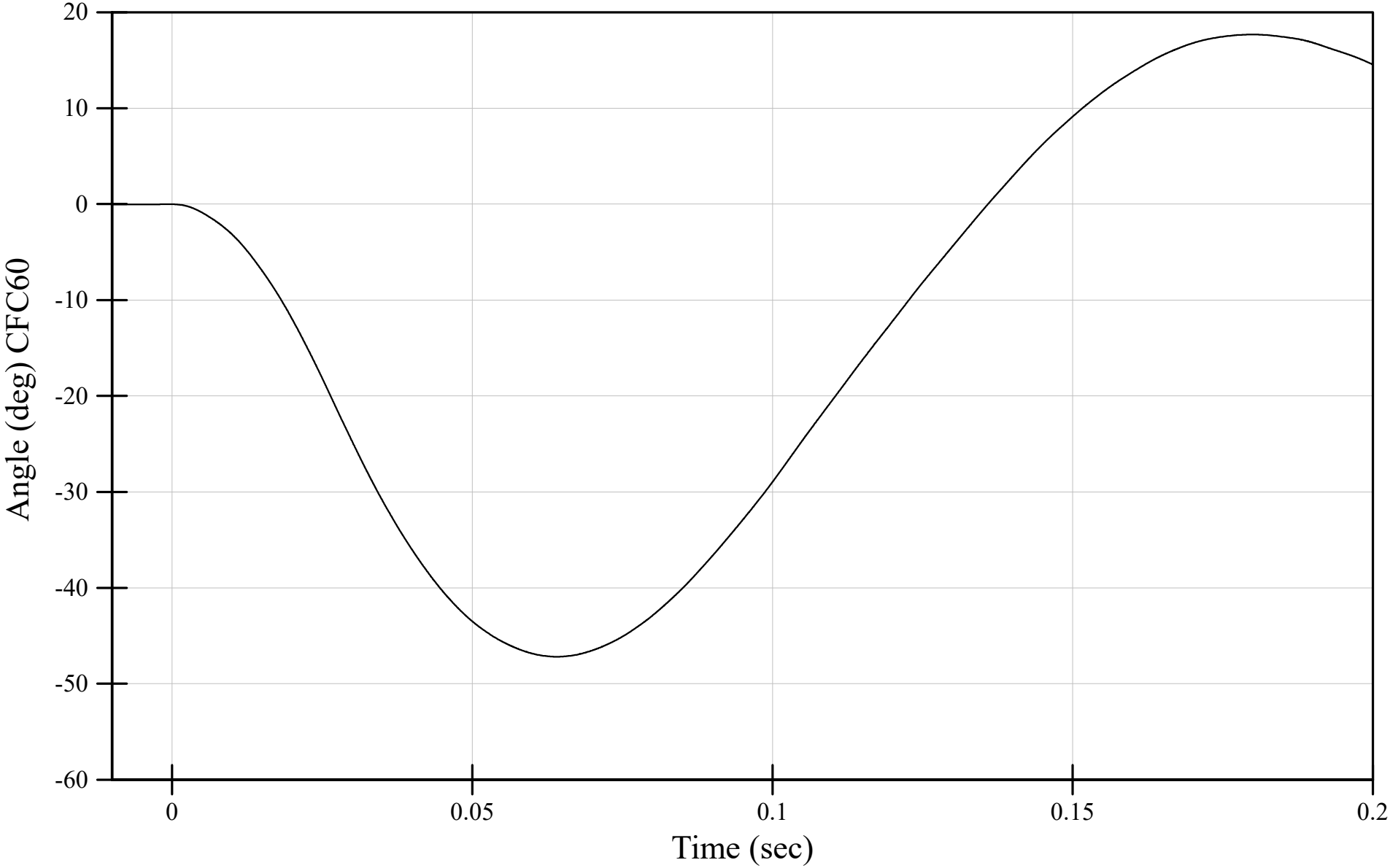
THOR-05F Neck Left Torsion Qualification
Z-Moment as Measured
Neck Serial Number: EU1156



File Name: 220914-2 processed

9/14/2022 8:42 AM

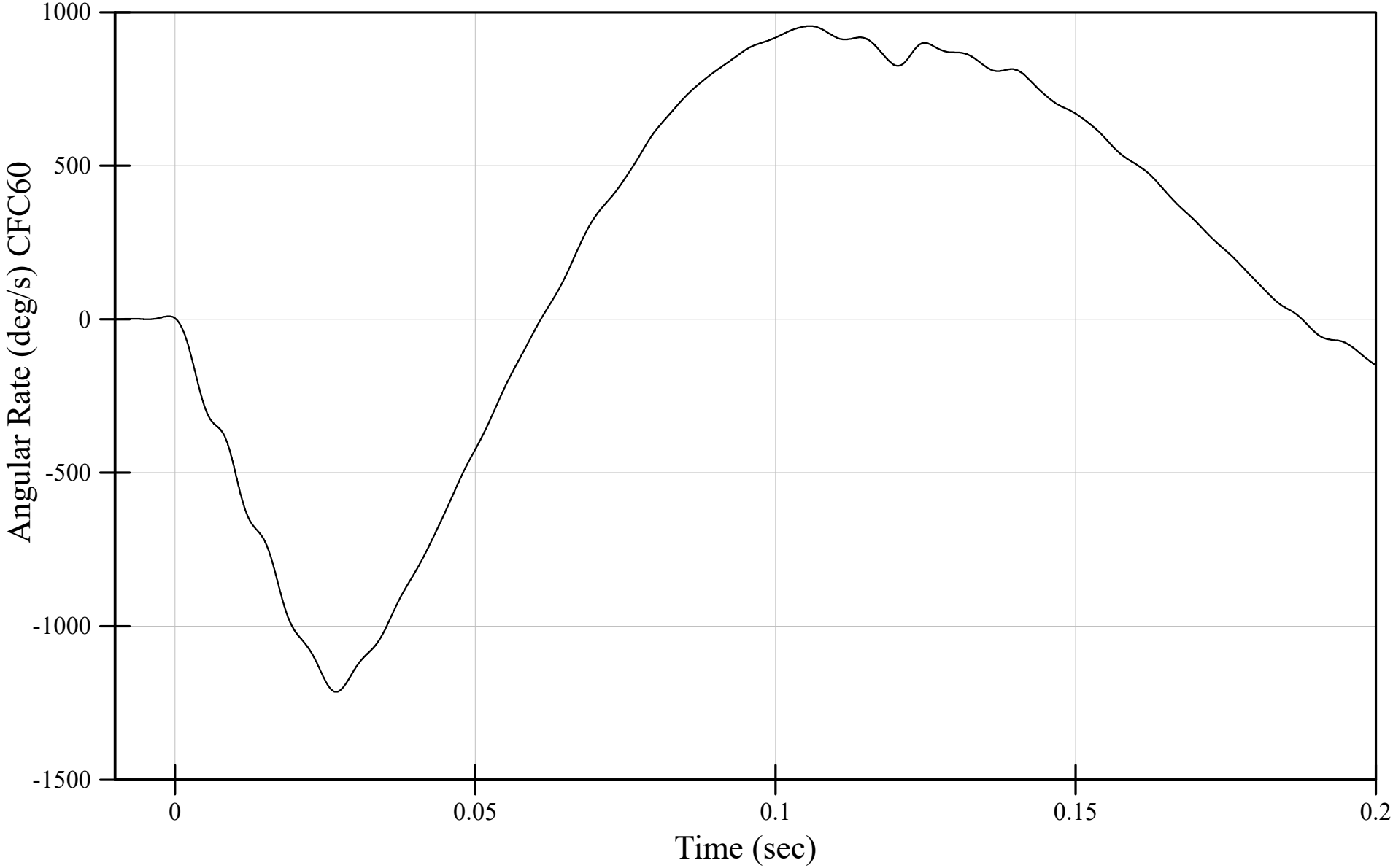
THOR-05F Neck Left Torsion Qualification
Neck Fixture Rotation
Neck Serial Number: EU1156



File Name: 220914-2 processed

9/14/2022 8:42 AM

THOR-05F Neck Left Torsion Qualification
Peak Angular Rate
Neck Serial Number: EU1156



File Name: 220914-2 processed

9/14/2022 8:42 AM

THOR-05F Neck Right Torsion Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Neck Serial Number: EU1156
O.C. Stop Assembly:
O.C. Cam:

Test ID: 220914-3
Test Date: 9/14/2022
Test Time: 9:13 AM

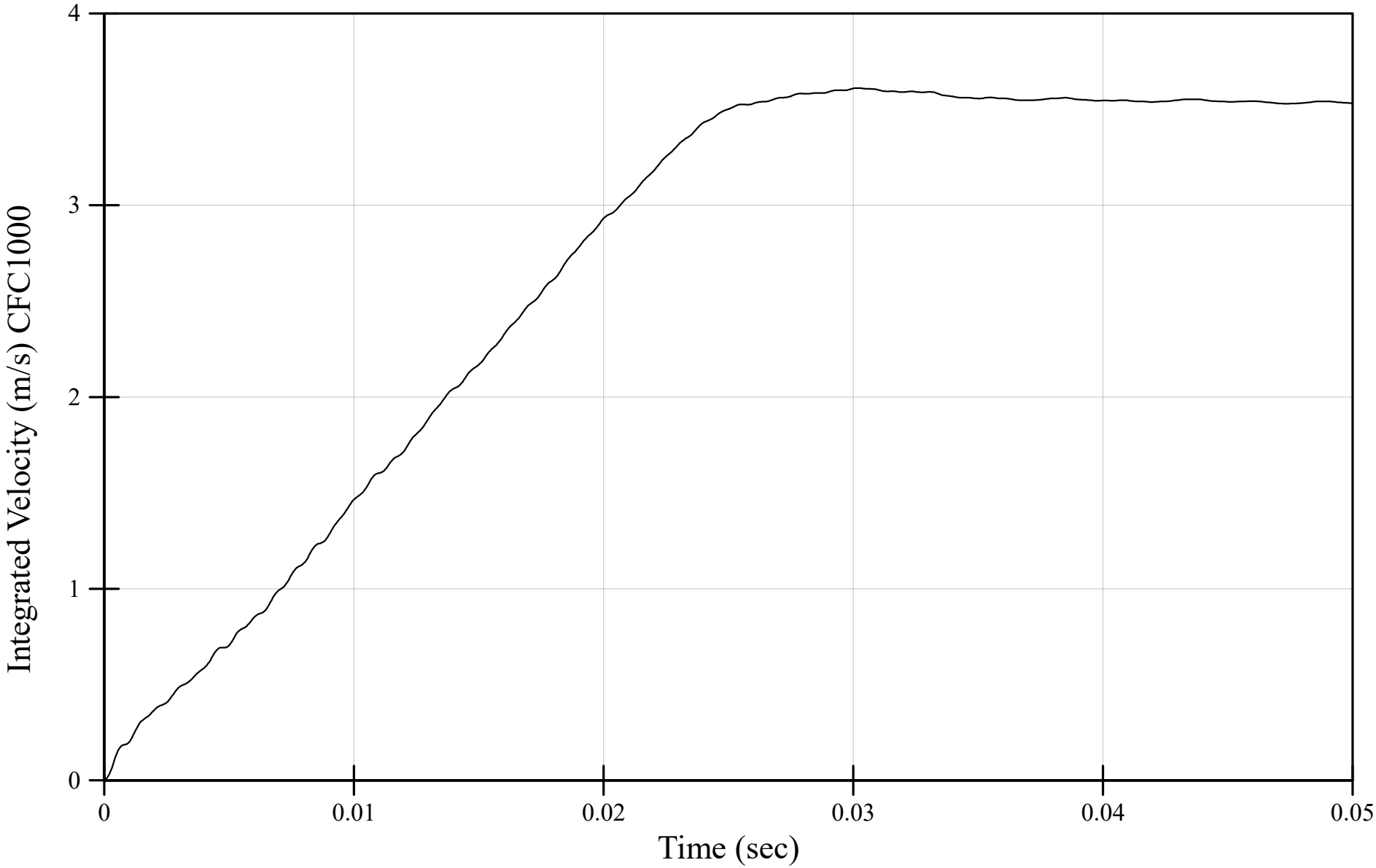
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.9	Pass
Test Humidity (%)	10 - 70	57	Pass
Test Velocity (m/s)	3.35 - 3.45	3.37	Pass
Pendulum Velocity at 7 ms (m/s)		0.99	
Pendulum Velocity at 14 ms (m/s)		2.04	
Pendulum Velocity at 21 ms (m/s)		3.04	
Peak Upper Neck Mz (Nm)		-20.6	
Peak Neck Fixture Rotation (deg)		47.4	
Peak Upper Neck Angular Velocity Z (deg/sec)		1219.6	

* THOR-05F Qualification Manual - July 2022

File Name: 220914-3 processed
Software Version: 2.8

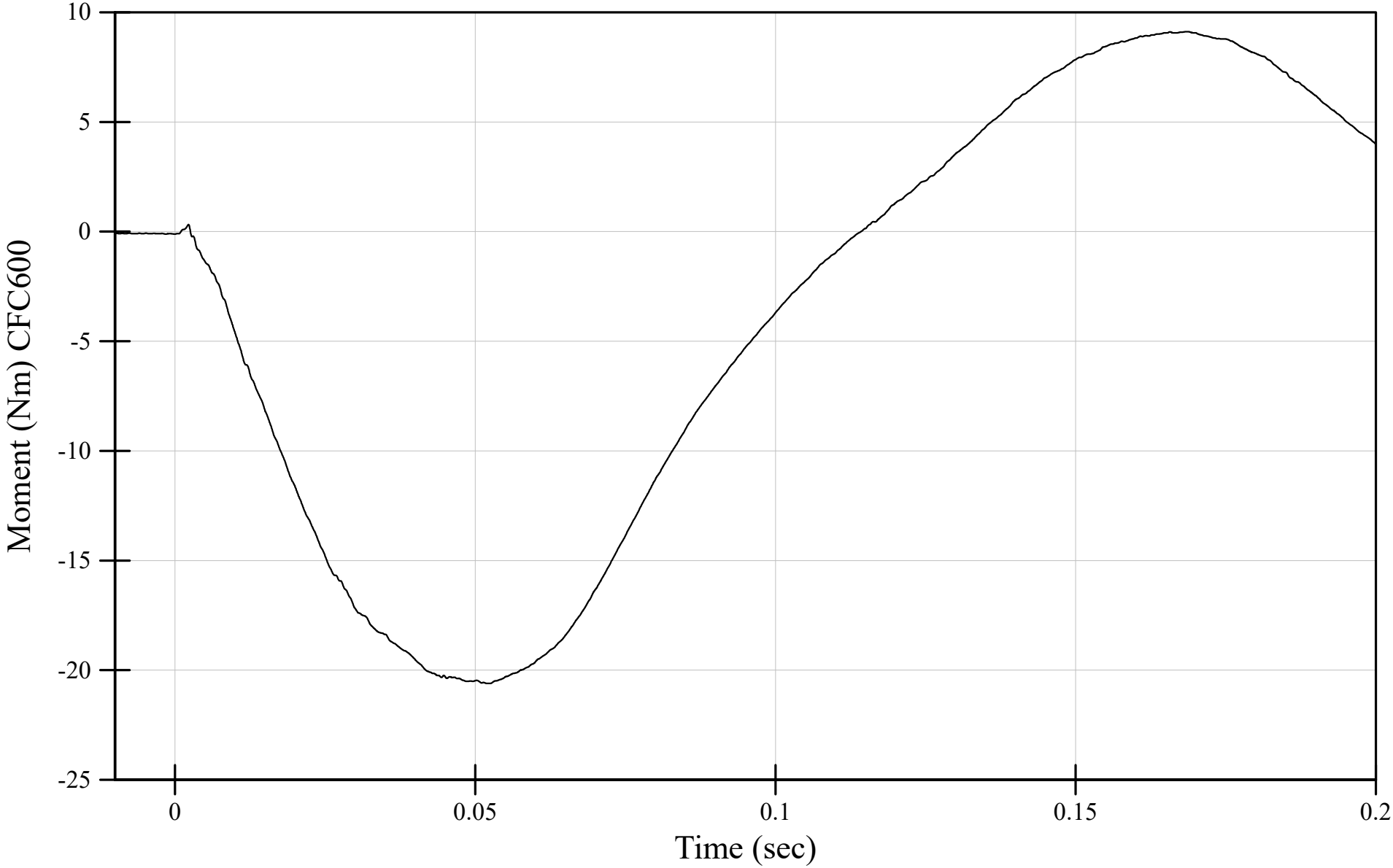
THOR-05F Neck Right Torsion Qualification
Pendulum Pulse
Neck Serial Number: EU1156



File Name: 220914-3 processed

9/14/2022 9:13 AM

THOR-05F Neck Right Torsion Qualification
Z-Moment as Measured
Neck Serial Number: EU1156



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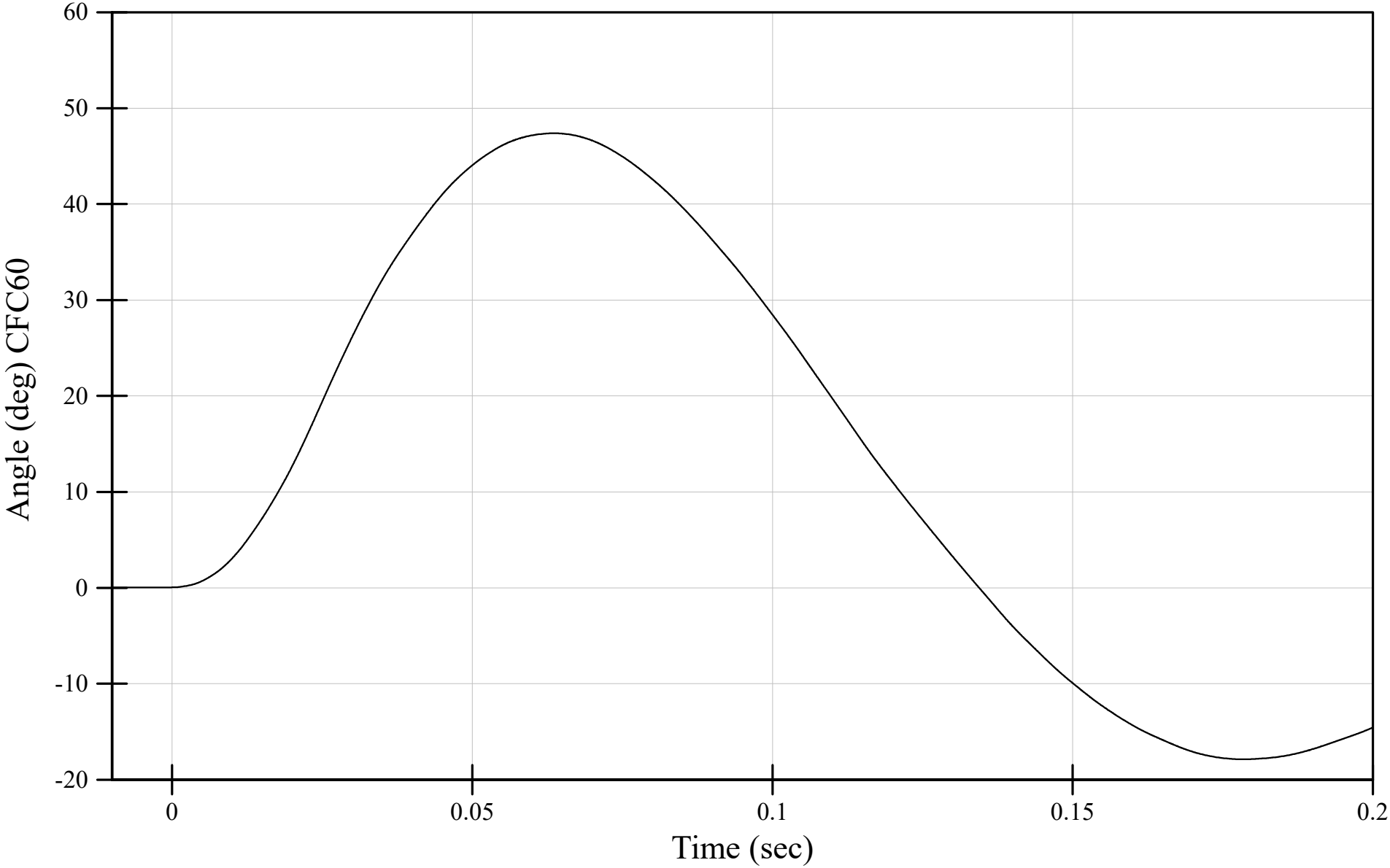
9/14/2022 9:13 AM

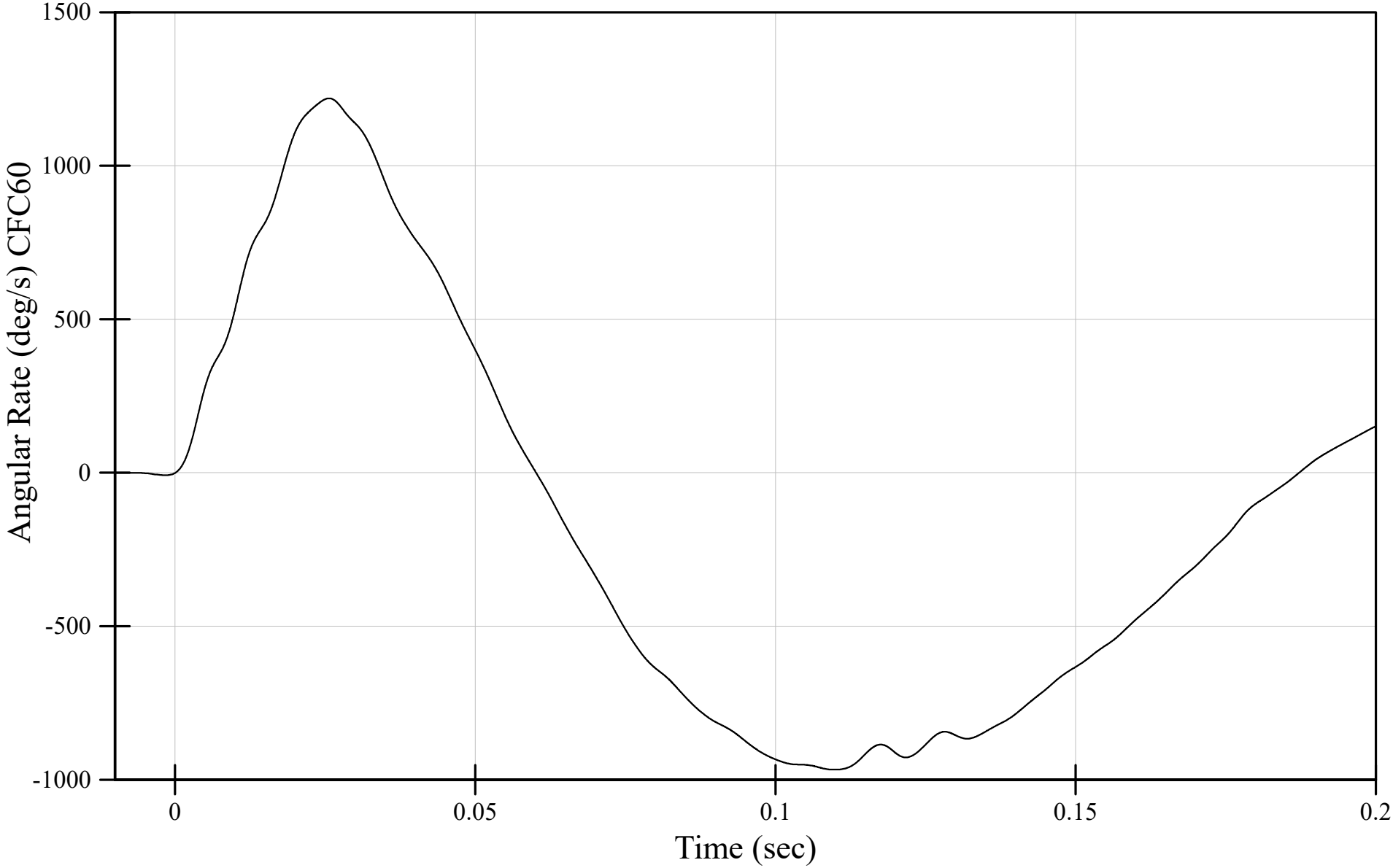
THOR-05F Neck Right Torsion Qualification
Neck Fixture Rotation
Neck Serial Number: EU1156



File Name: 220914-3 processed

9/14/2022 9:13 AM

THOR-05F Neck Right Torsion Qualification
Peak Angular Rate
Neck Serial Number: EU1156



File Name: 220914-3 processed

9/14/2022 9:13 AM

THOR-05F Upper Thorax Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components

Rib 1 Serial Number: ET5497
Rib 2 Serial Number: ET5498
Rib 3 Serial Number: ET5499
Rib 4 Serial Number: ET5500
Rib 5 Serial Number: ET5589
Rib 6 Serial Number: ET5502
Rib 7 Serial Number: ET5503

Test ID: 220929-3
Test Date: 9/29/2022
Test Time: 12:31 PM

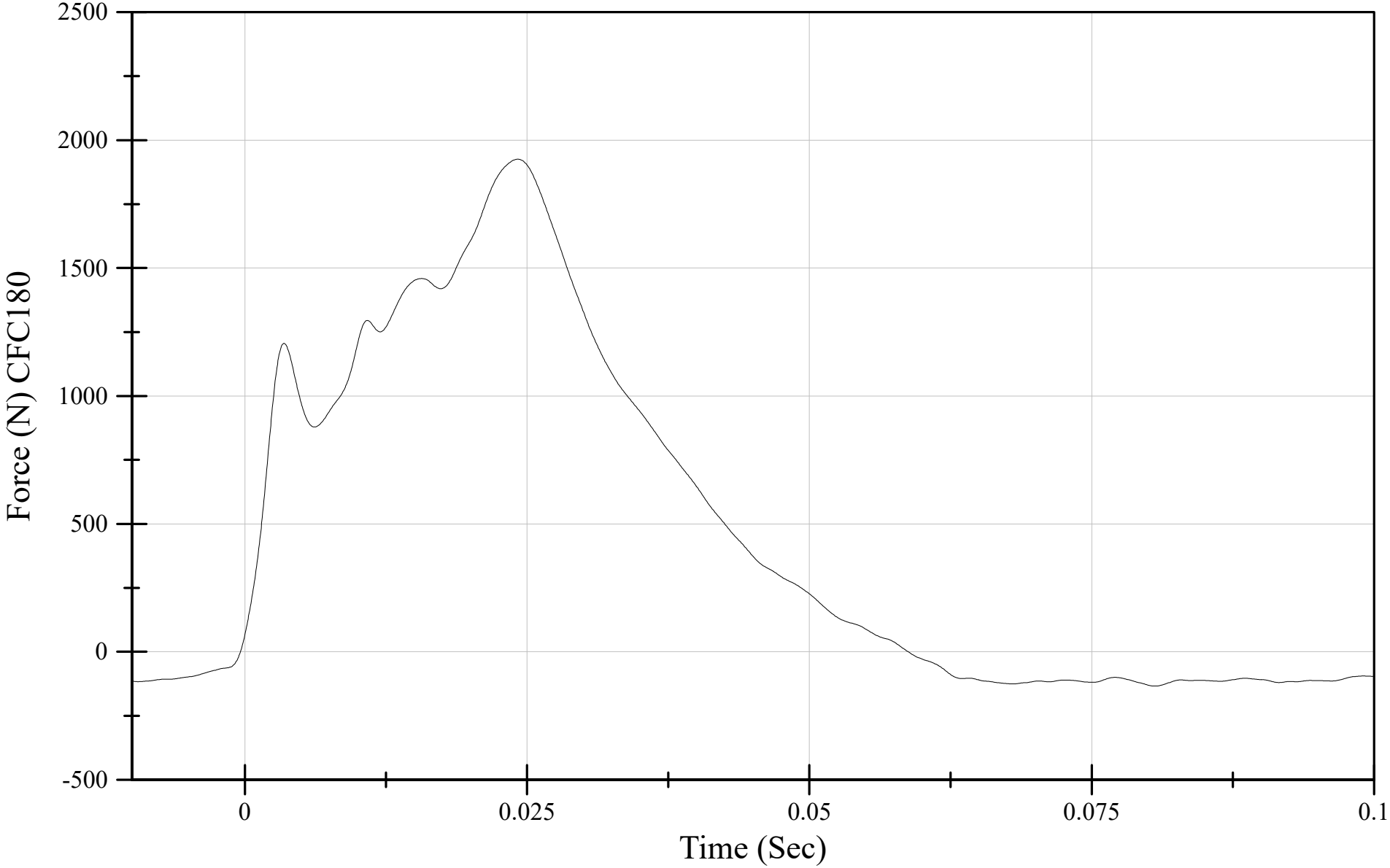
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.3	Pass
Test Humidity (%)	10 - 70	42	Pass
Test Velocity (m/s)	4.25 - 4.35	4.29	Pass
Peak Probe Force (N)		1926	
Peak Upper Left Resultant Deflection (mm)		46.4	
Peak Upper Right Resultant Deflection (mm)		46.3	
Difference Between Peak Left & Right Resultant Deflections (mm)		0.1	
Force at Left Peak Resultant Deflection (N)		1873	
Force at Right Peak Resultant Deflection (N)		1915	

* THOR-05F Qualification Manual - July 2022

File Name: 220929-3 processed

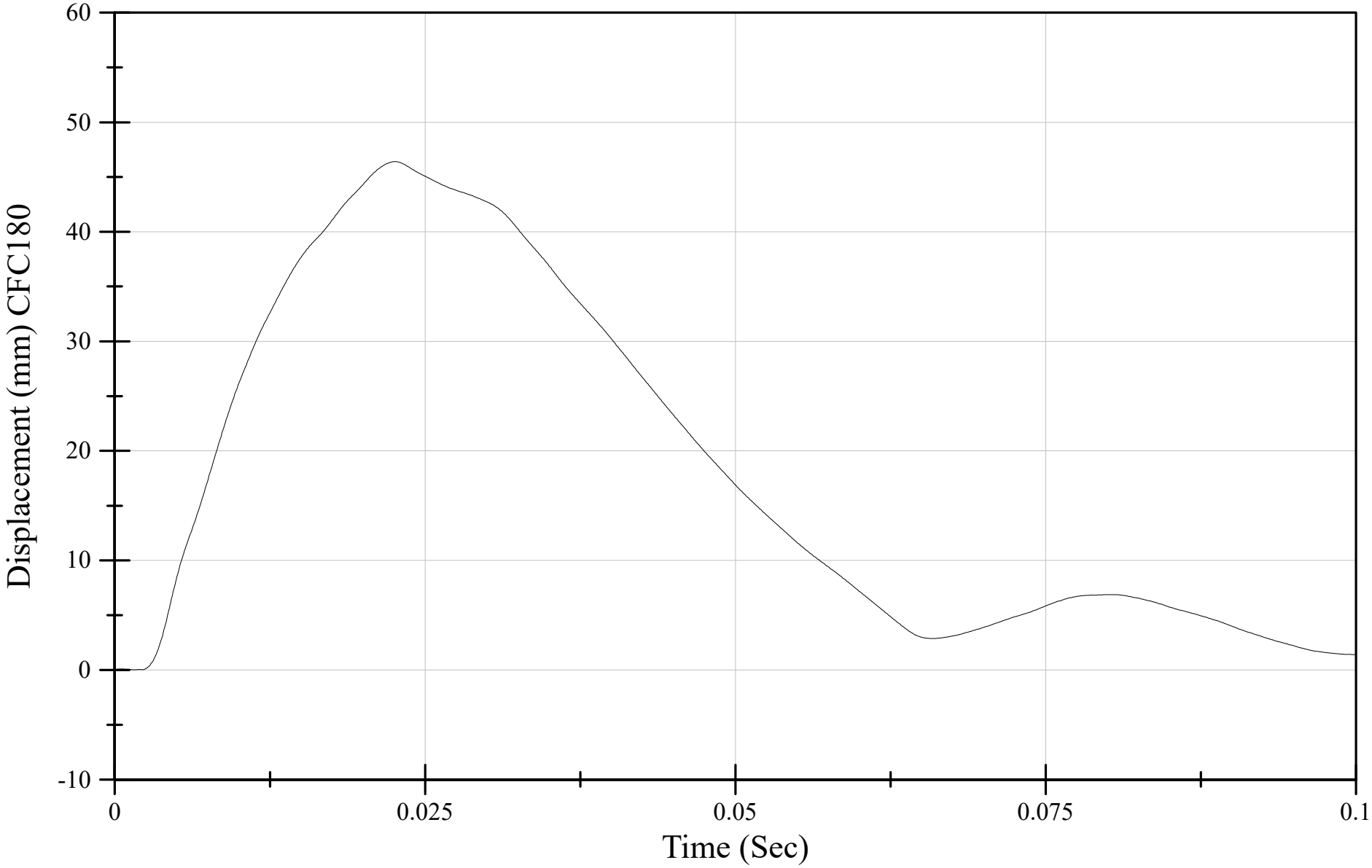
THOR-05F Upper Thorax Qualification
Probe Force
Dummy Serial Number: EU3430



File Name: 220929-3 processed

9/29/2022 12:31 PM

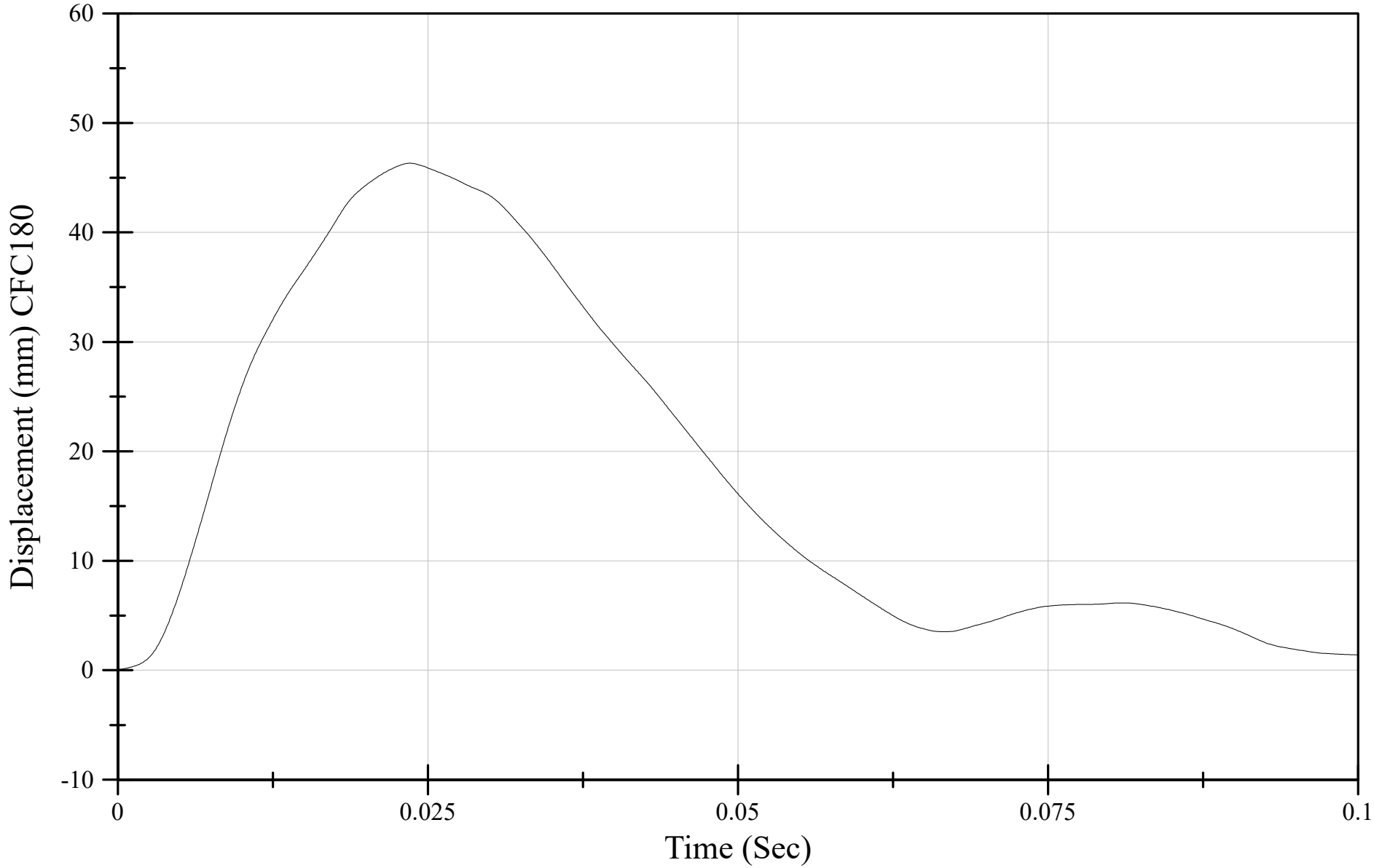
THOR-05F Upper Thorax Qualification
Left Resultant Deflection
Dummy Serial Number: EU3430



File Name: 220929-3 processed

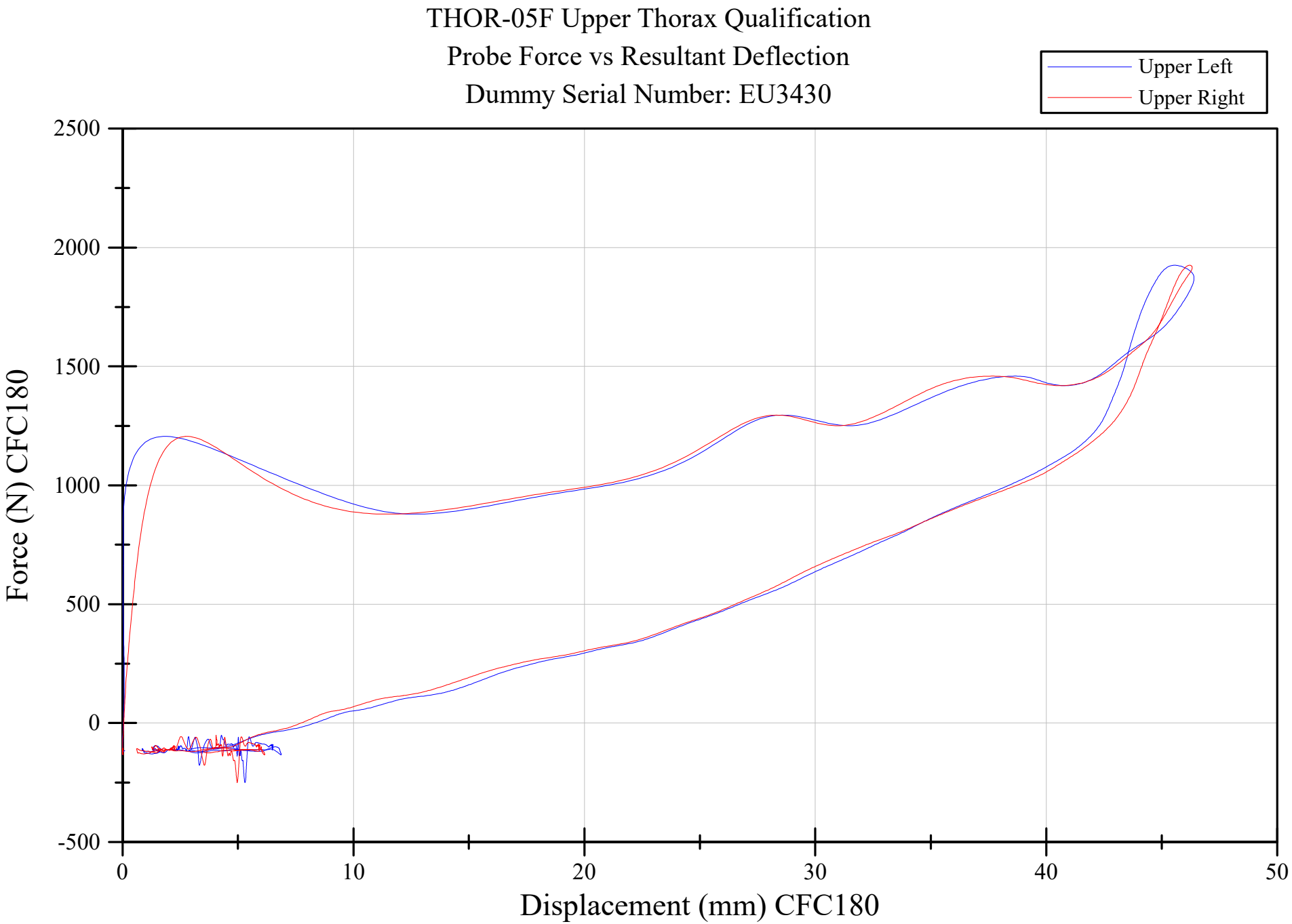
9/29/2022 12:31 PM

THOR-05F Upper Thorax Qualification
Right Resultant Deflection
Dummy Serial Number: EU3430



File Name: 220929-3 processed

9/29/2022 12:31 PM



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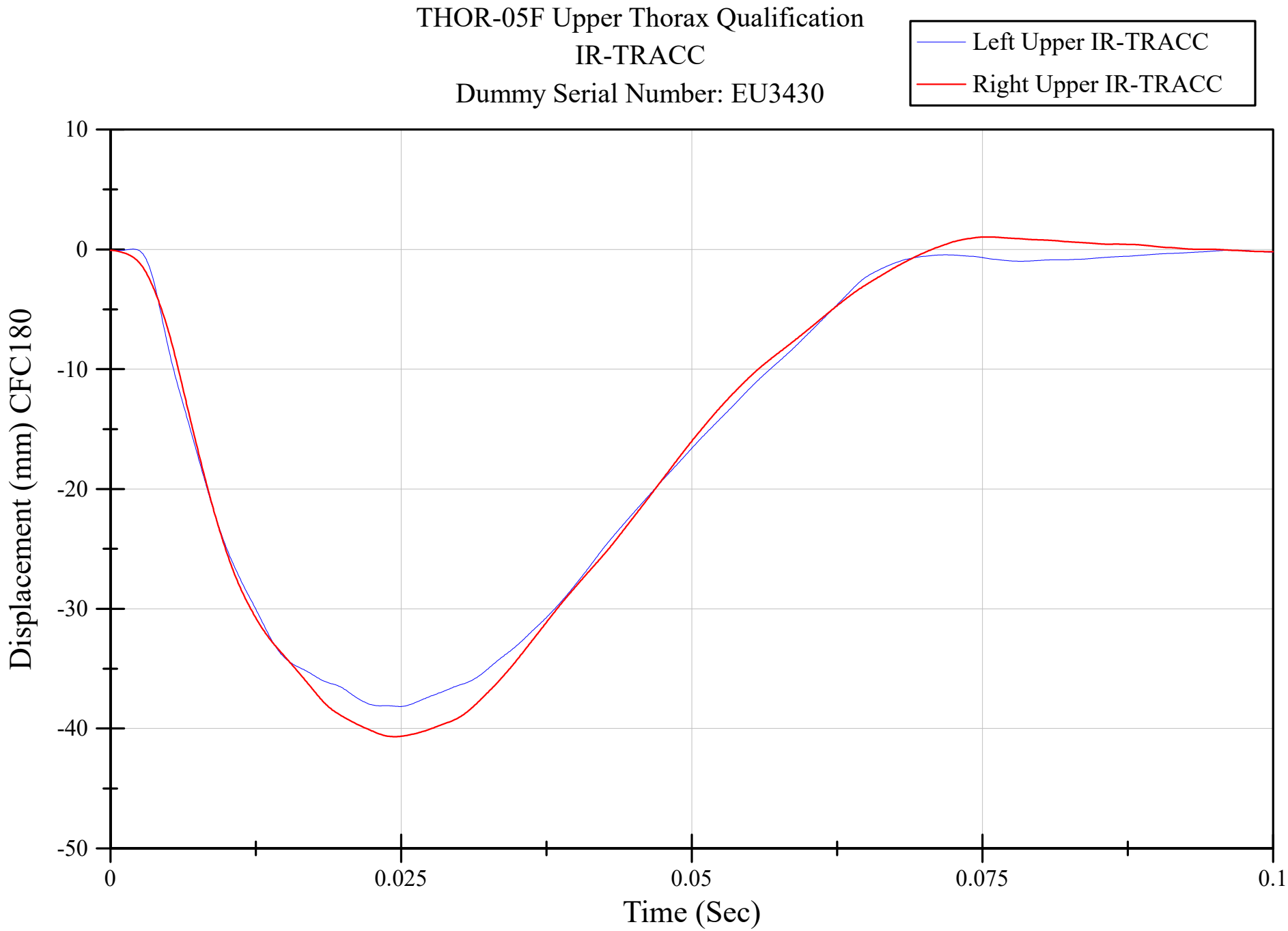
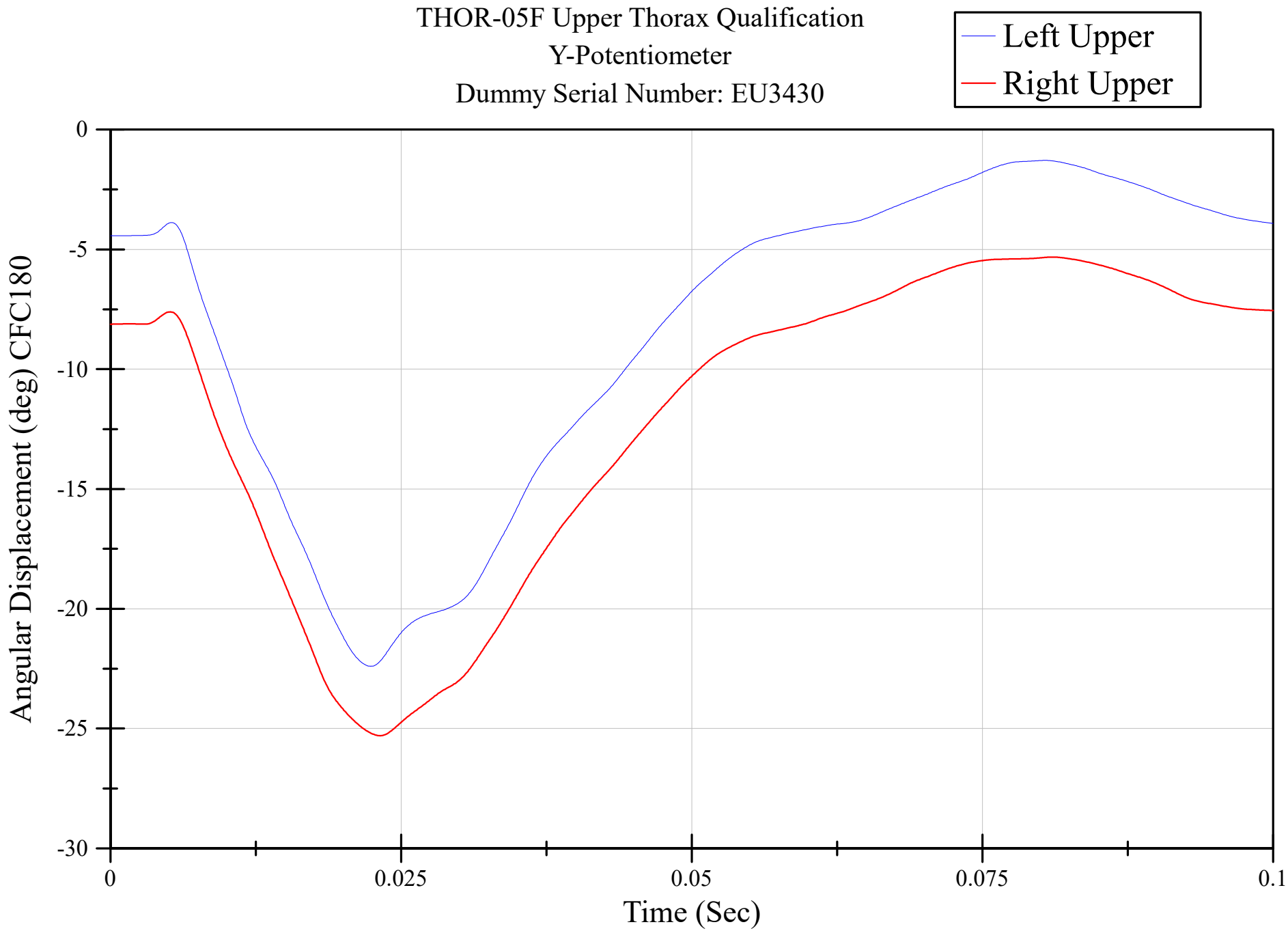
9/29/2022 12:31 PM



File Name: 220929-3 processed

9/29/2022 12:31 PM



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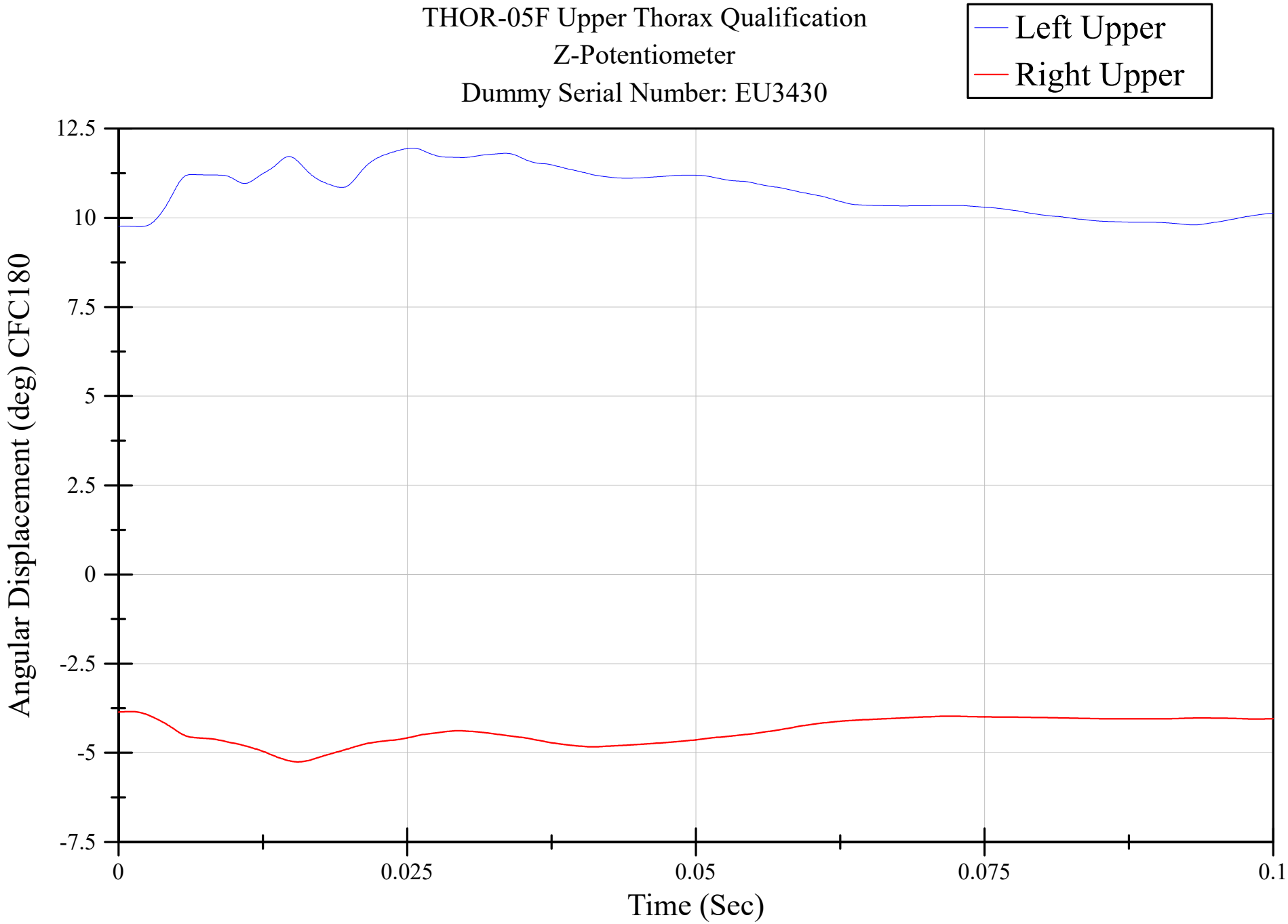
9/29/2022 12:31 PM



File Name: 220929-3 processed

9/29/2022 12:31 PM

THOR-05F Lower Left Thorax Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components

Rib 1 Serial Number: ET5497
Rib 2 Serial Number: ET5498
Rib 3 Serial Number: ET5499
Rib 4 Serial Number: ET5500
Rib 5 Serial Number: ET5589
Rib 6 Serial Number: ET5502
Rib 7 Serial Number: ET5503

Test ID: 220929-4
Test Date: 9/29/2022
Test Time: 2:28 PM

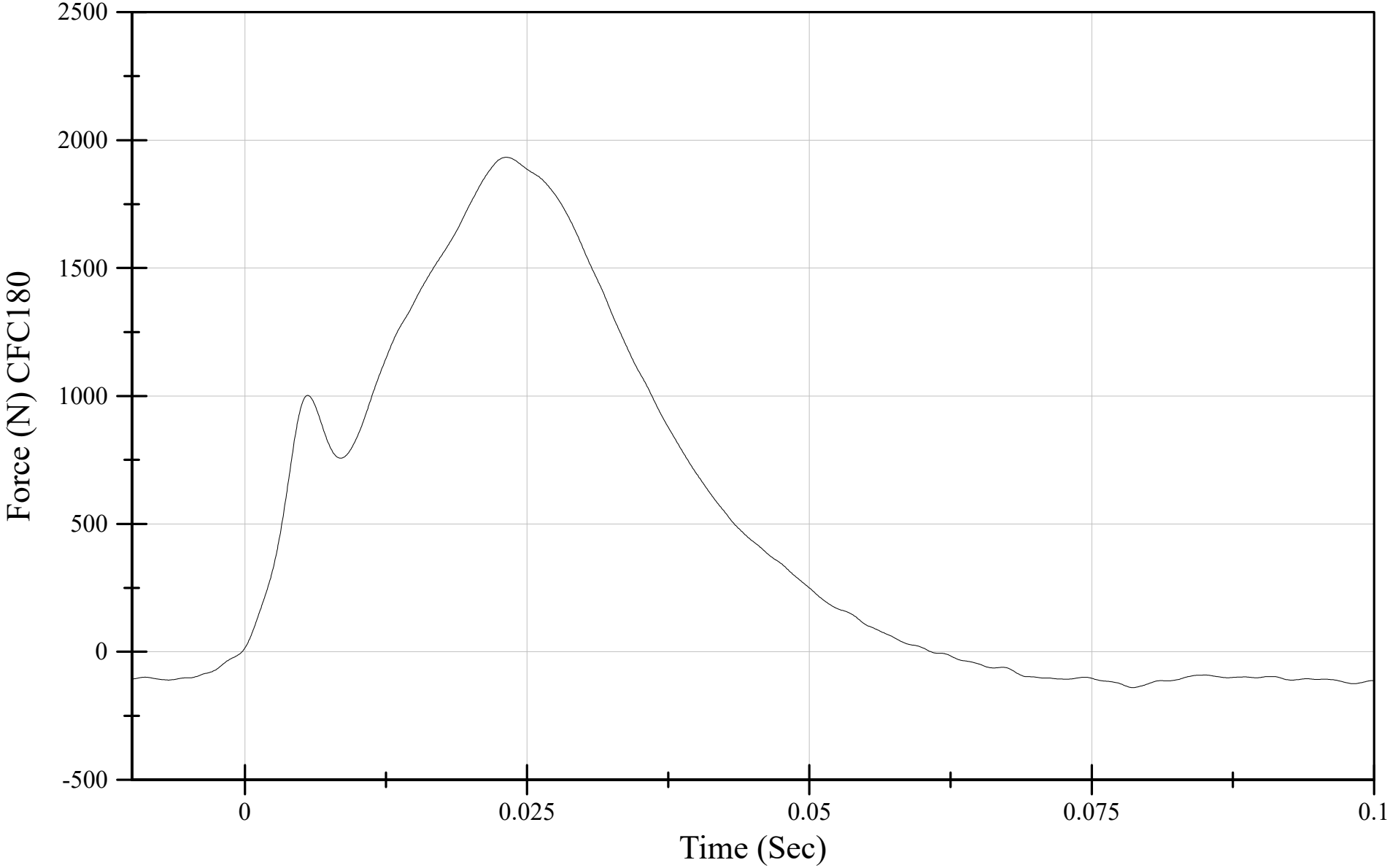
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.3	Pass
Test Humidity (%)	10 - 70	42	Pass
Test Velocity (m/s)	4.25 - 4.35	4.29	Pass
Peak Probe Force (N)		1933	
Left Resultant Deflection at Peak Force (mm)		46.4	

* THOR-05F Qualification Manual - July 2022

File Name: 220929-4 processed
Software Version: 2.8

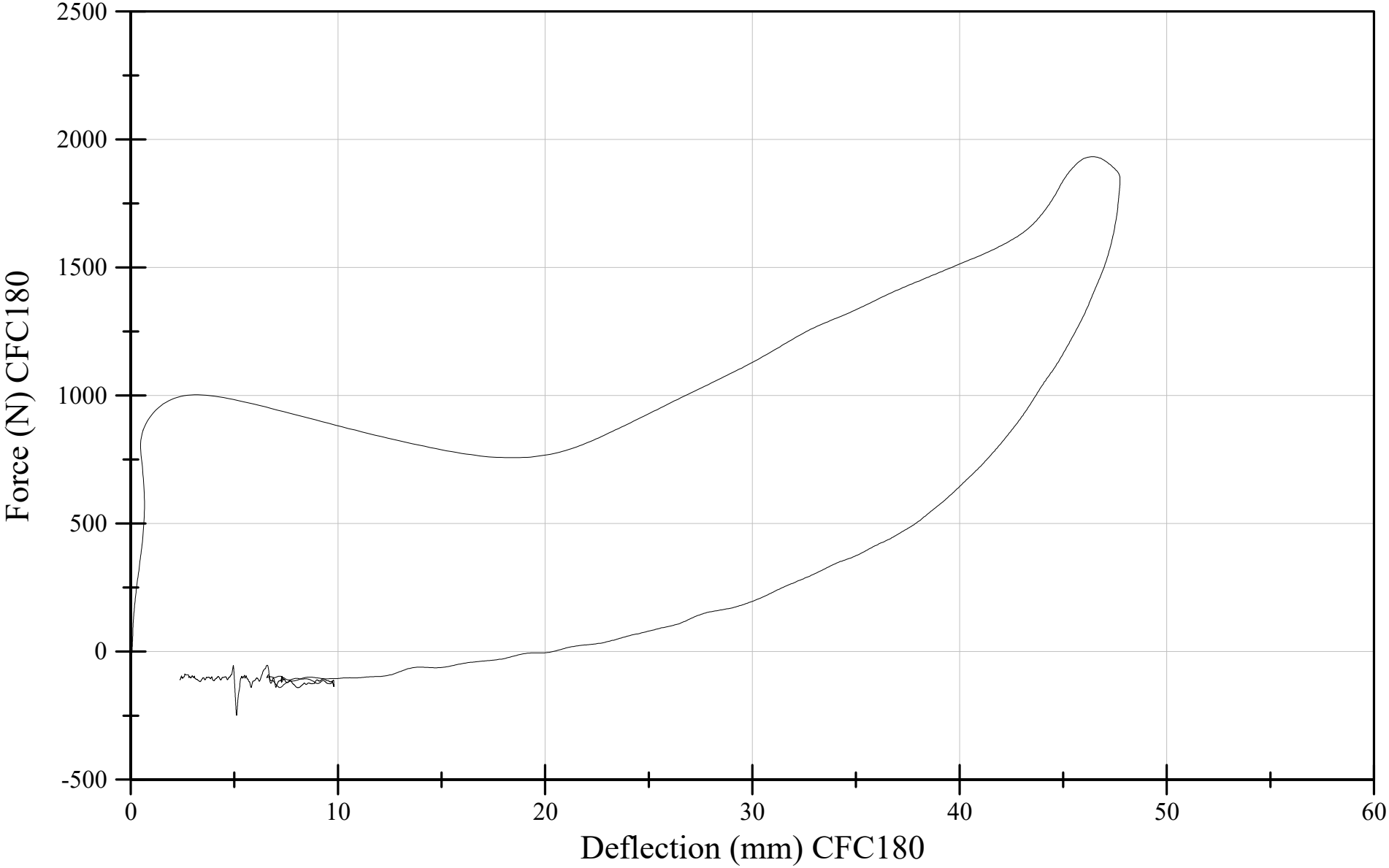
THOR-05F Lower Left Thorax Qualification
Peak Probe Force
Serial Number: EU3430



File Name: 220929-4 processed

9/29/2022 2:28 PM

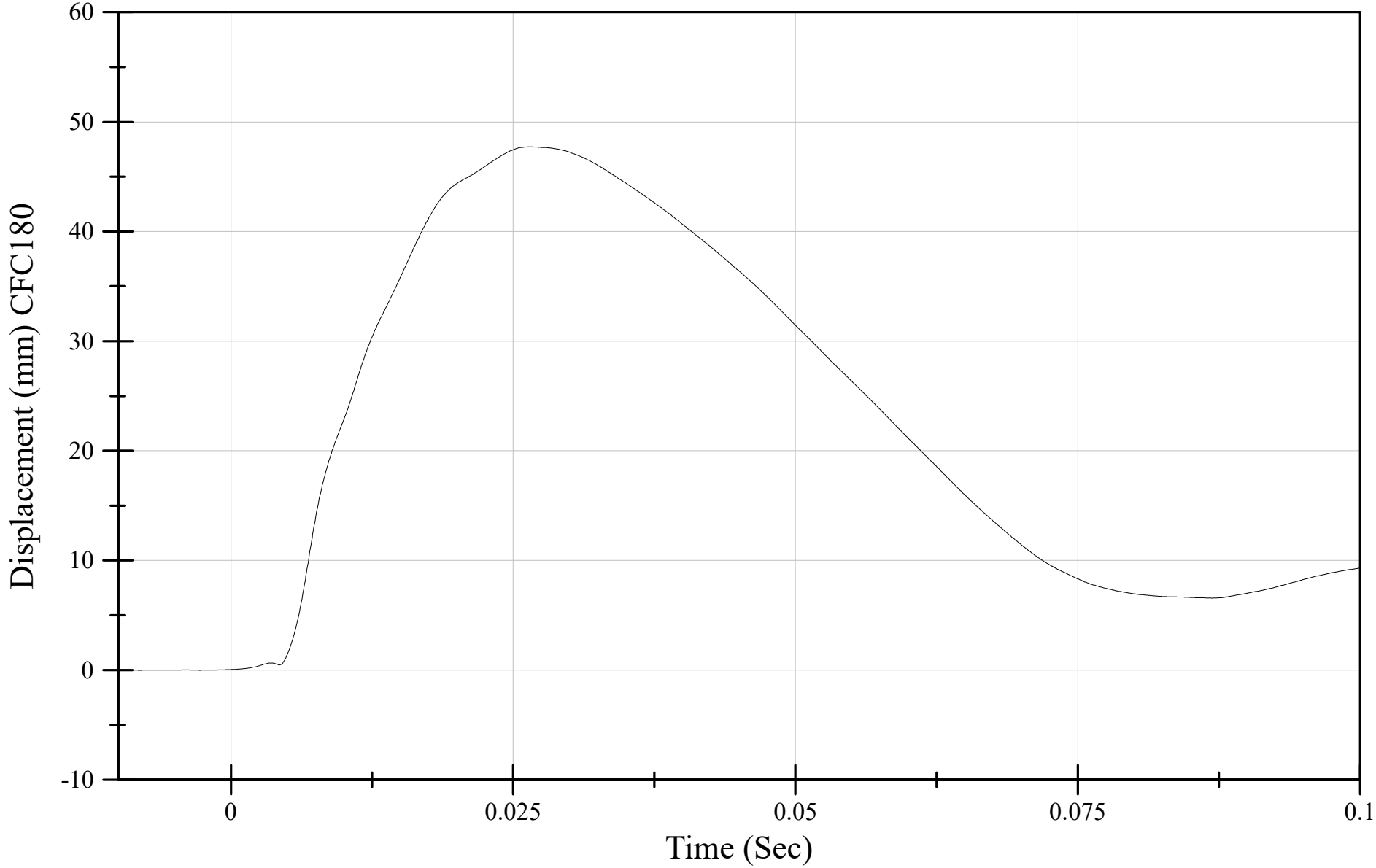
THOR-05F Lower Left Thorax Qualification
Probe Force vs Left Resultant Deflection
Serial Number: EU3430



File Name: 220929-4 processed

9/29/2022 2:28 PM

THOR-05F Lower Left Thorax Qualification
Left Resultant Deflection
Serial Number: EU3430



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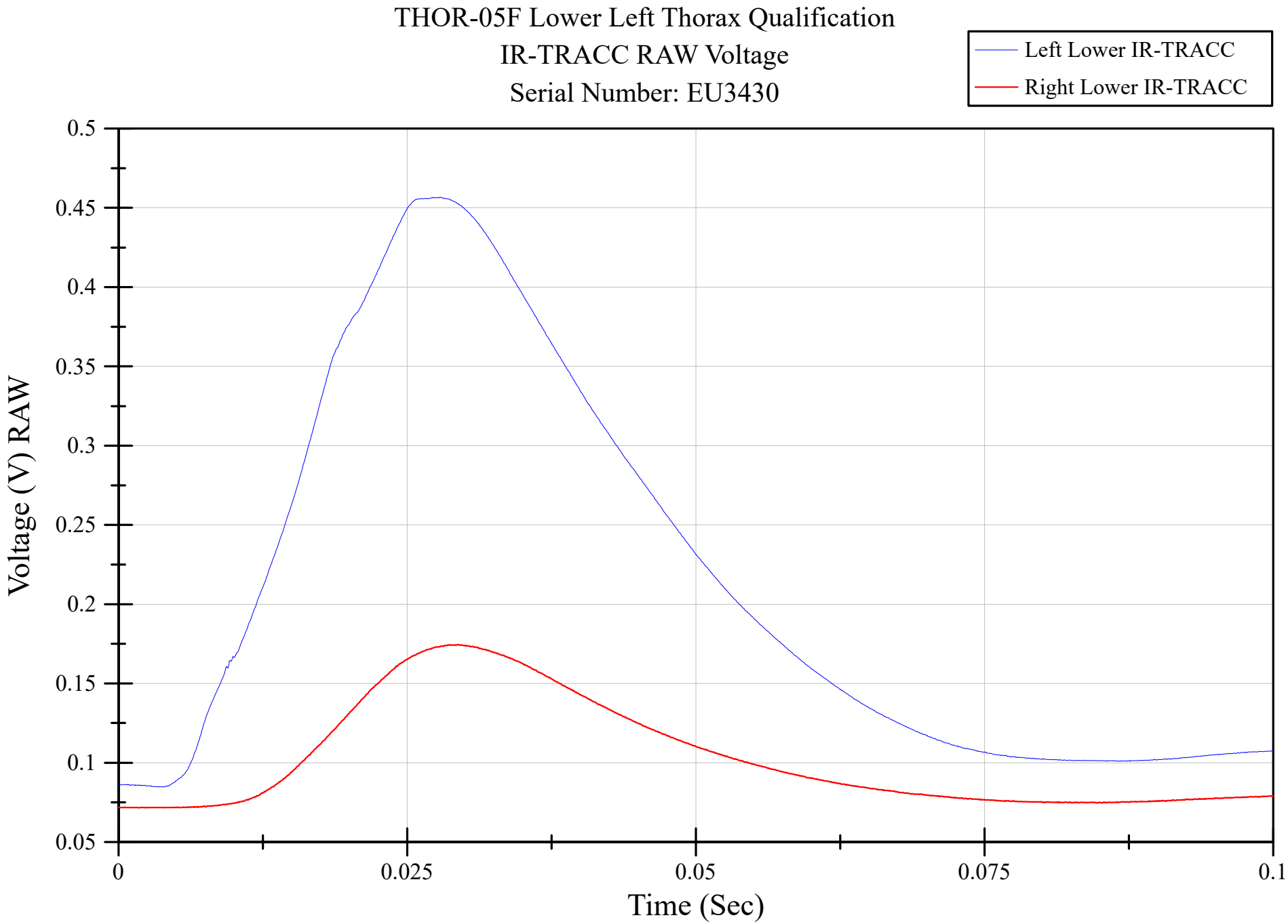
9/29/2022 2:28 PM



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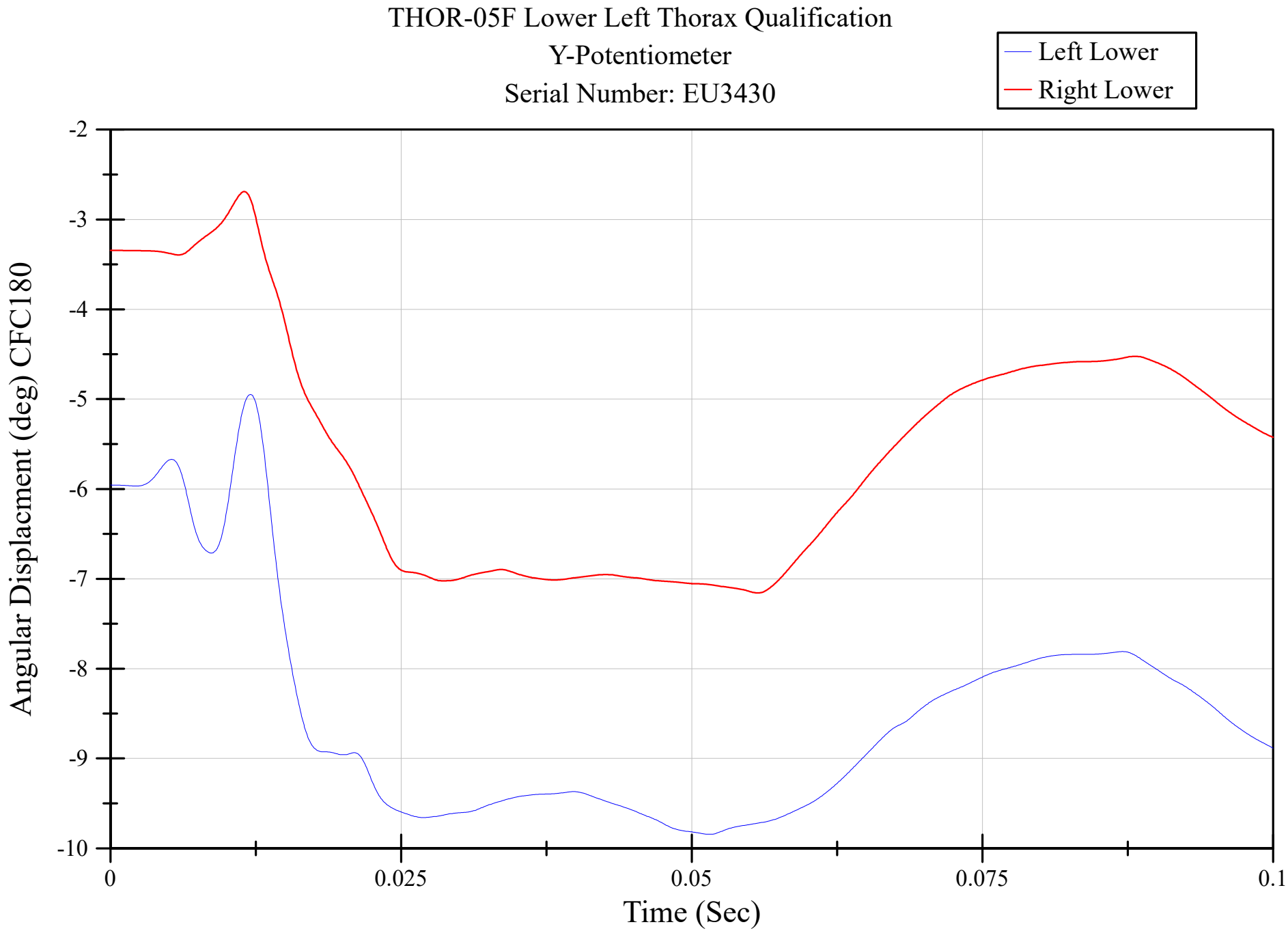
9/29/2022 2:28 PM



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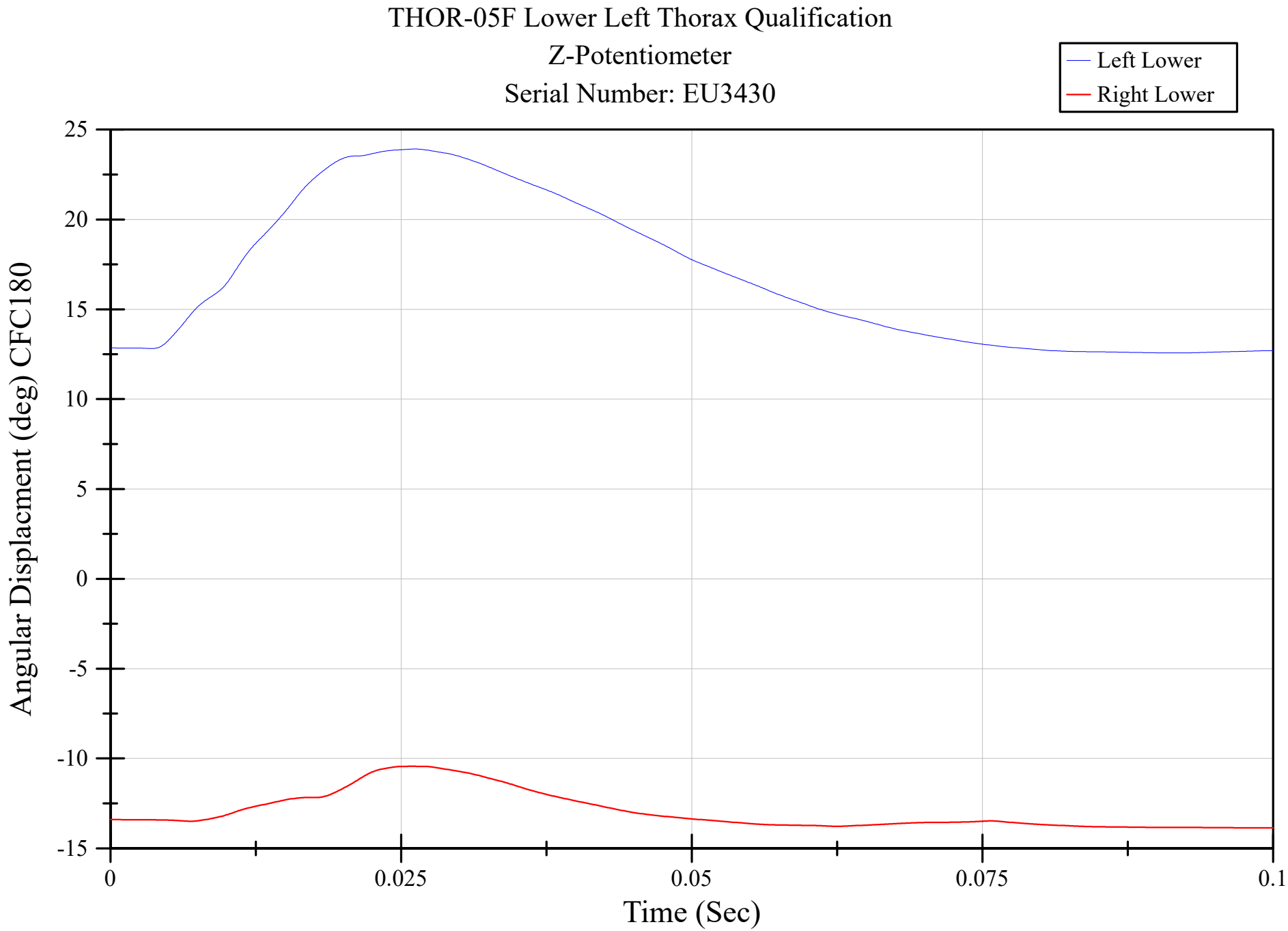
9/29/2022 2:28 PM



File Name: 220929-4 processed

9/29/2022 2:28 PM

THOR-05F Lower Right Thorax Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components

Rib 1 Serial Number: ET5497
Rib 2 Serial Number: ET5498
Rib 3 Serial Number: ET5499
Rib 4 Serial Number: ET5500
Rib 5 Serial Number: ET5589
Rib 6 Serial Number: ET5502
Rib 7 Serial Number: ET5503

Test ID: 220929-5
Test Date: 9/29/2022
Test Time: 3:09 PM

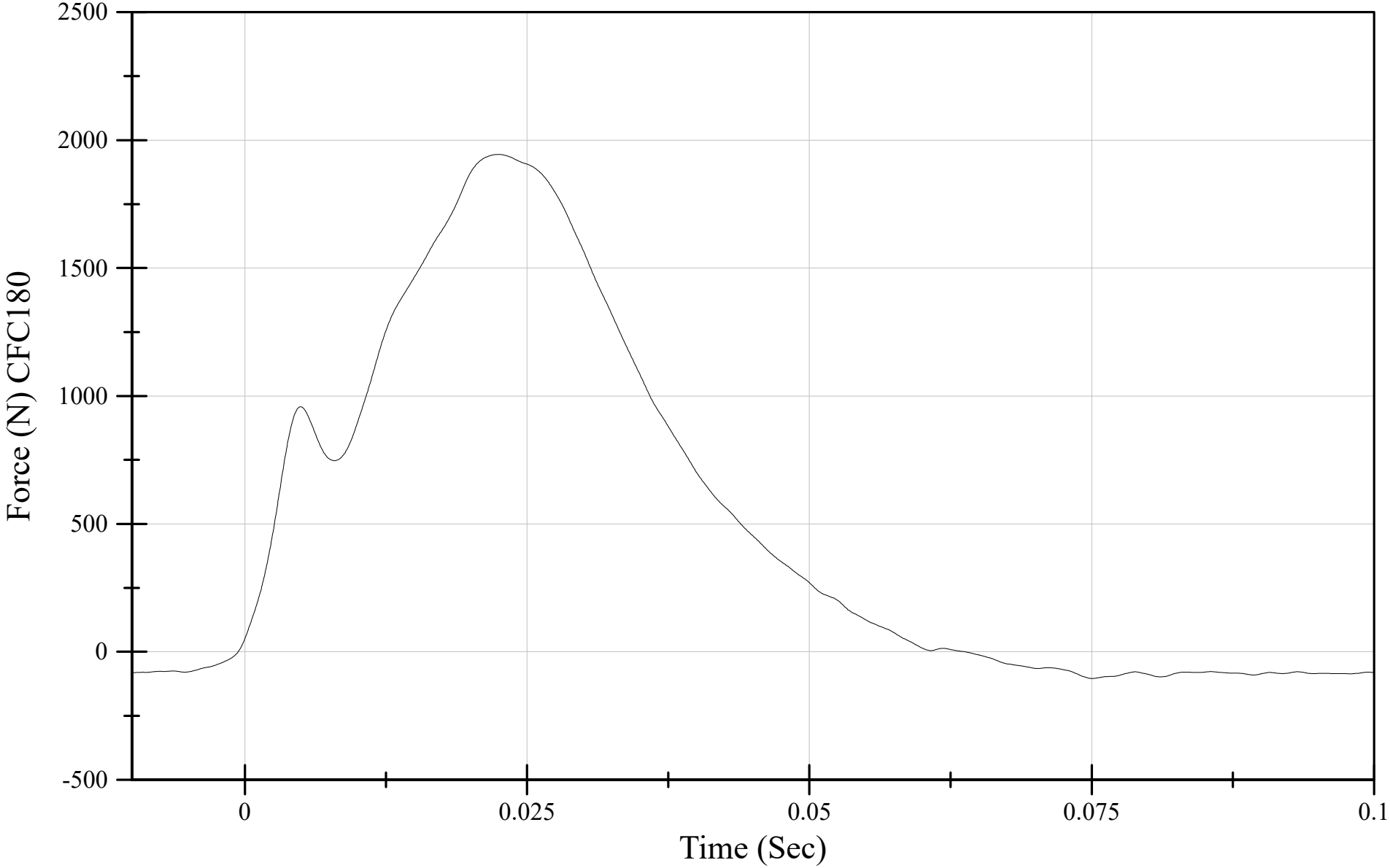
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.3	Pass
Test Humidity (%)	10 - 70	42	Pass
Test Velocity (m/s)	4.25 - 4.35	4.30	Pass
Peak Probe Force (N)		1944	
Right Resultant Deflection at Peak Force (mm)		49.0	

* THOR-05F Qualification Manual - July 2022

File Name: 220929-5 processed
Software Version: 2.8

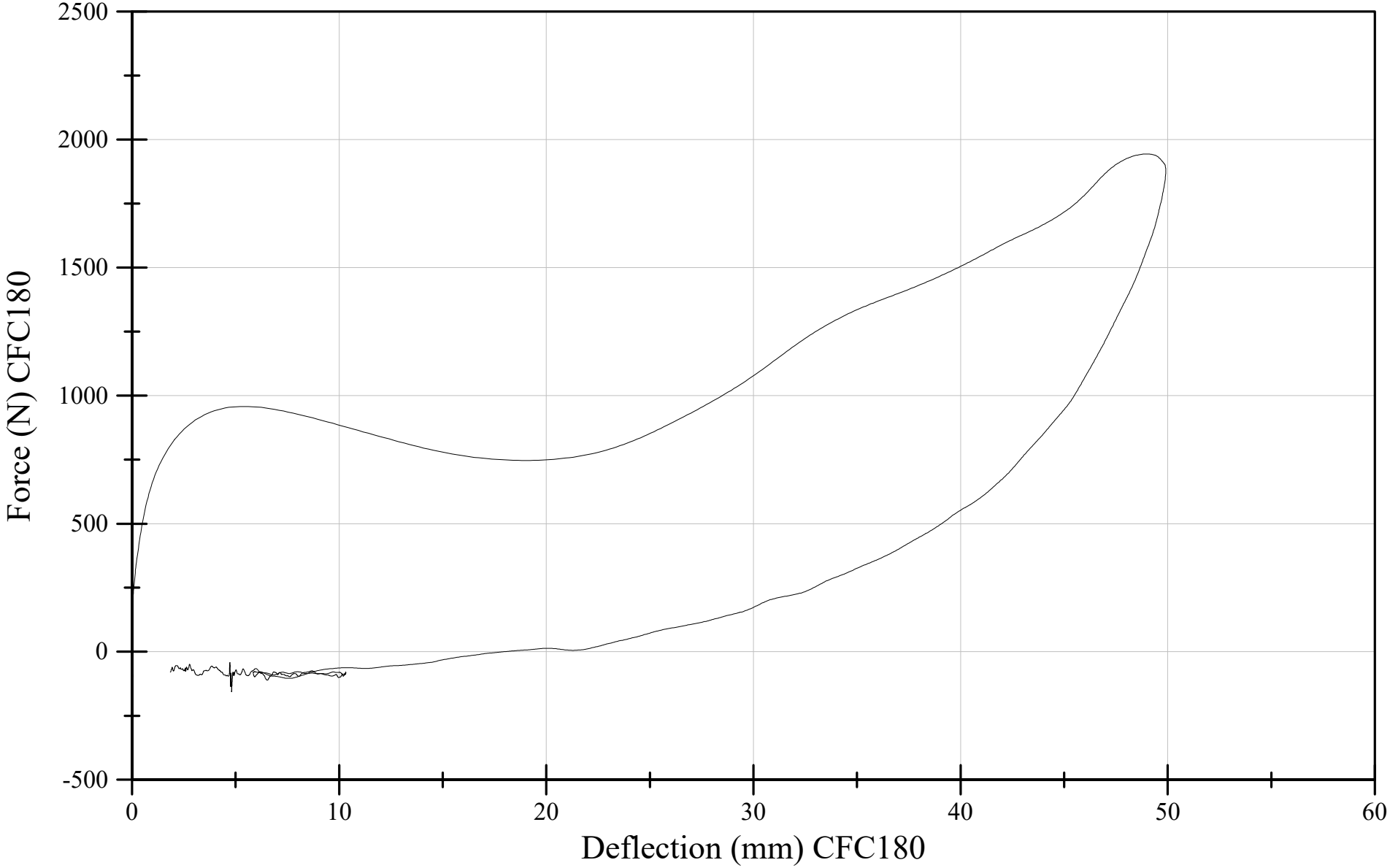
THOR-05F Lower Right Thorax Qualification
Peak Probe Force
Serial Number: EU3430



File Name: 220929-5 processed

9/29/2022 3:09 PM

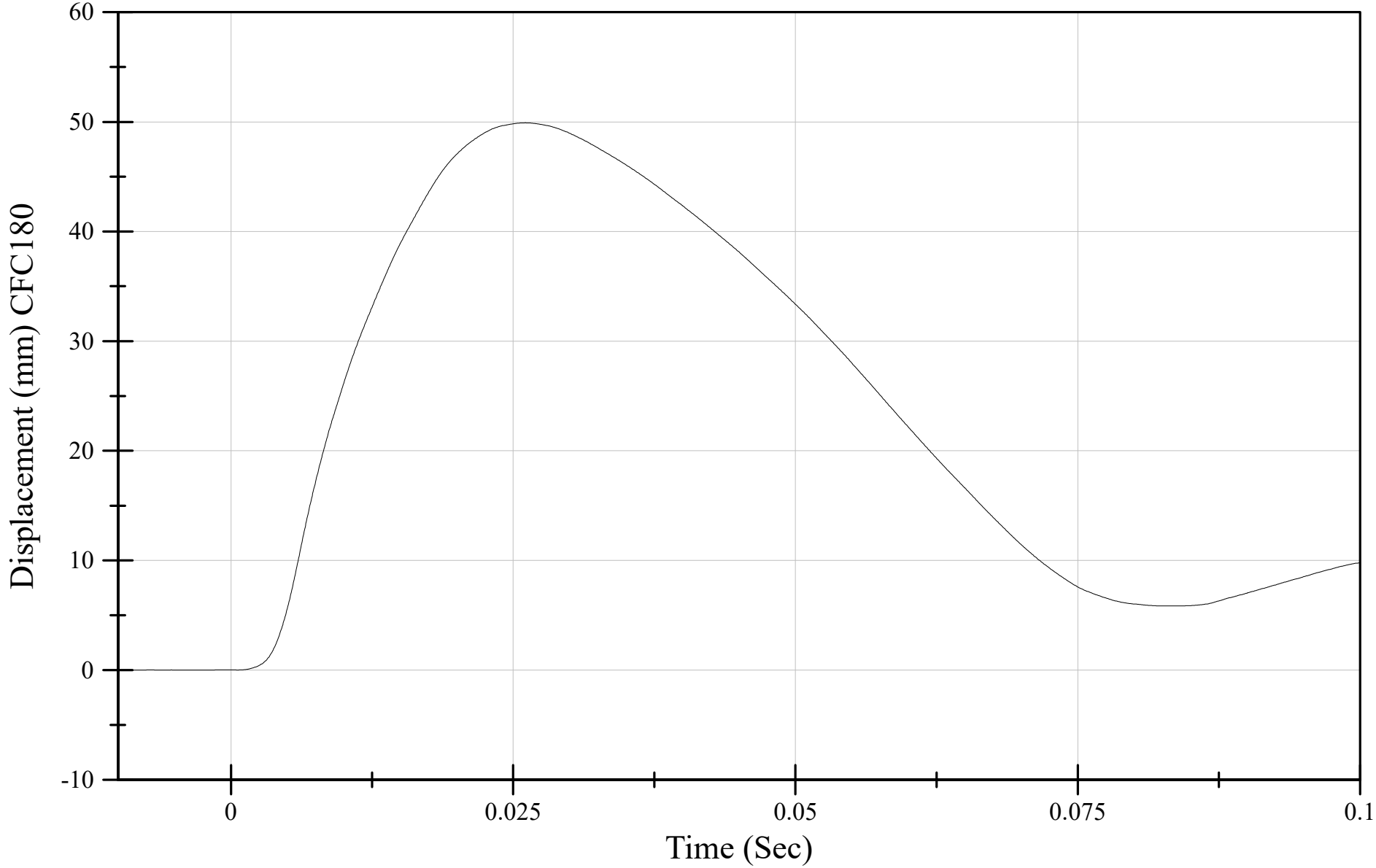
THOR-05F Lower Right Thorax Qualification
Probe Force vs Right Resultant Deflection
Serial Number: EU3430



File Name: 220929-5 processed

9/29/2022 3:09 PM

THOR-05F Lower Right Thorax Qualification
Right Resultant Deflection
Serial Number: EU3430



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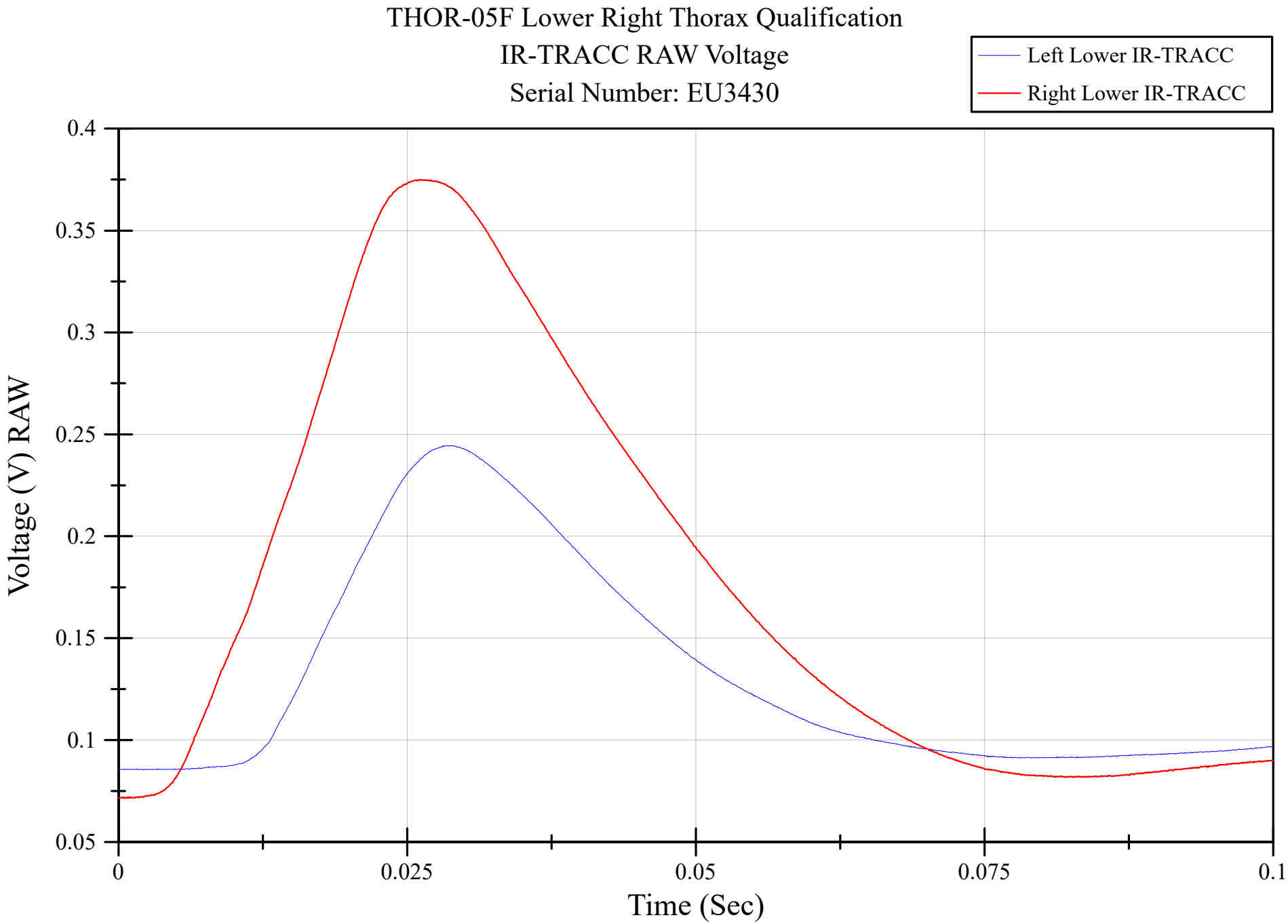
9/29/2022 3:09 PM



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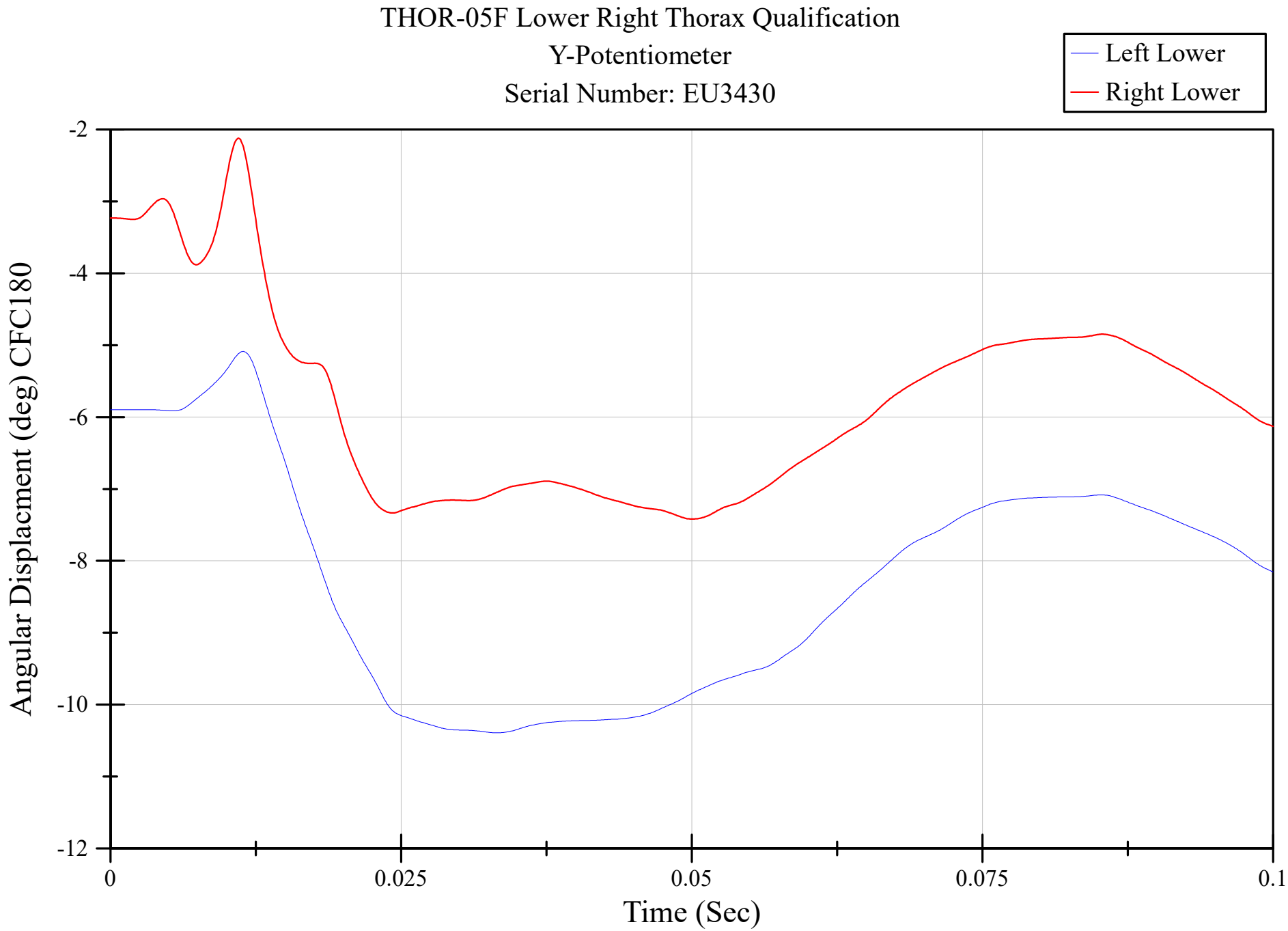
9/29/2022 3:09 PM



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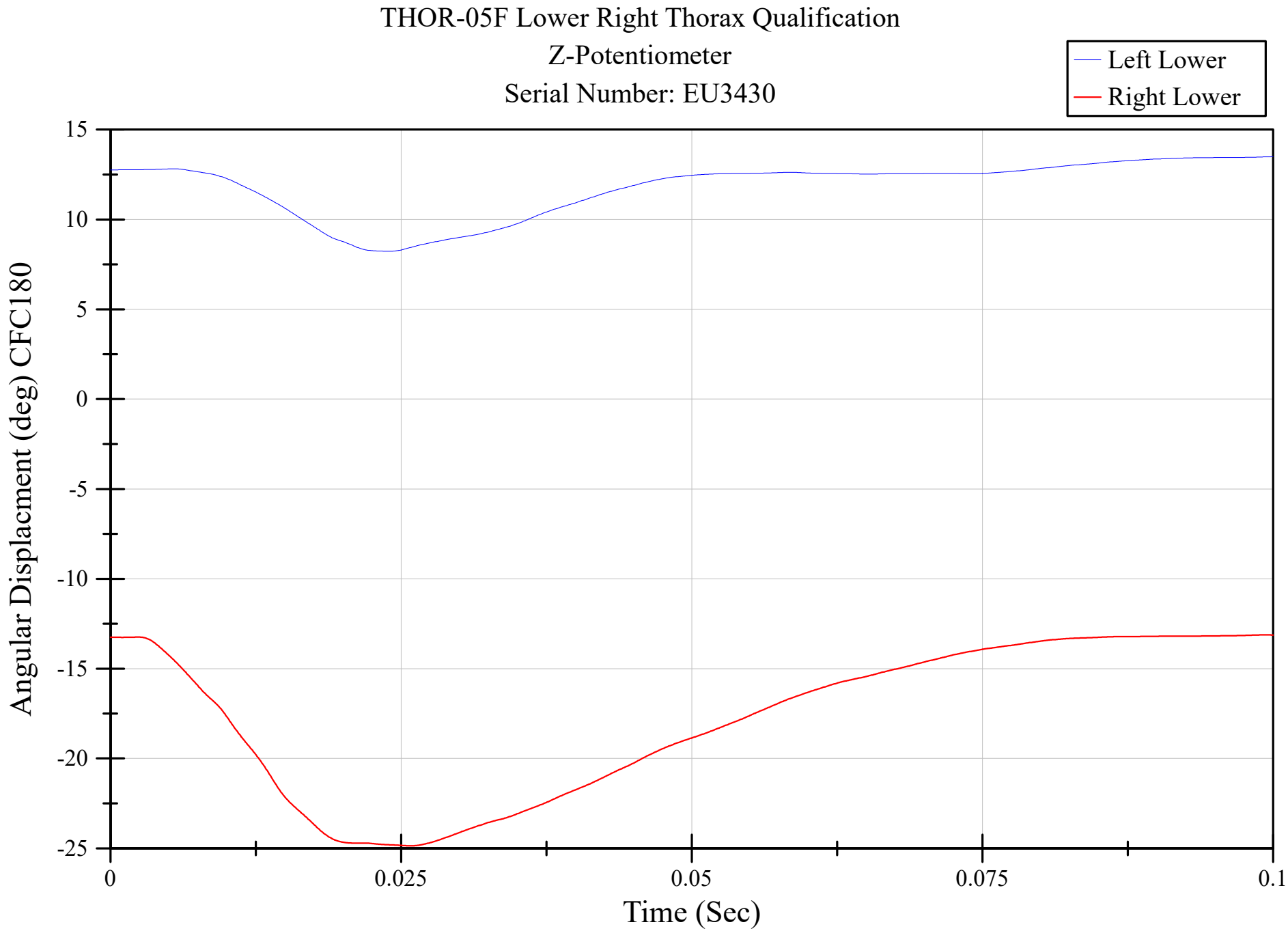
9/29/2022 3:09 PM



File Name: 220929-5 processed

9/29/2022 3:09 PM

THOR-05F Lower Abdomen Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components

Abdomen Foam: ET7603

Test ID: 221003-7
Test Date: 10/3/2022
Test Time: 11:21 AM

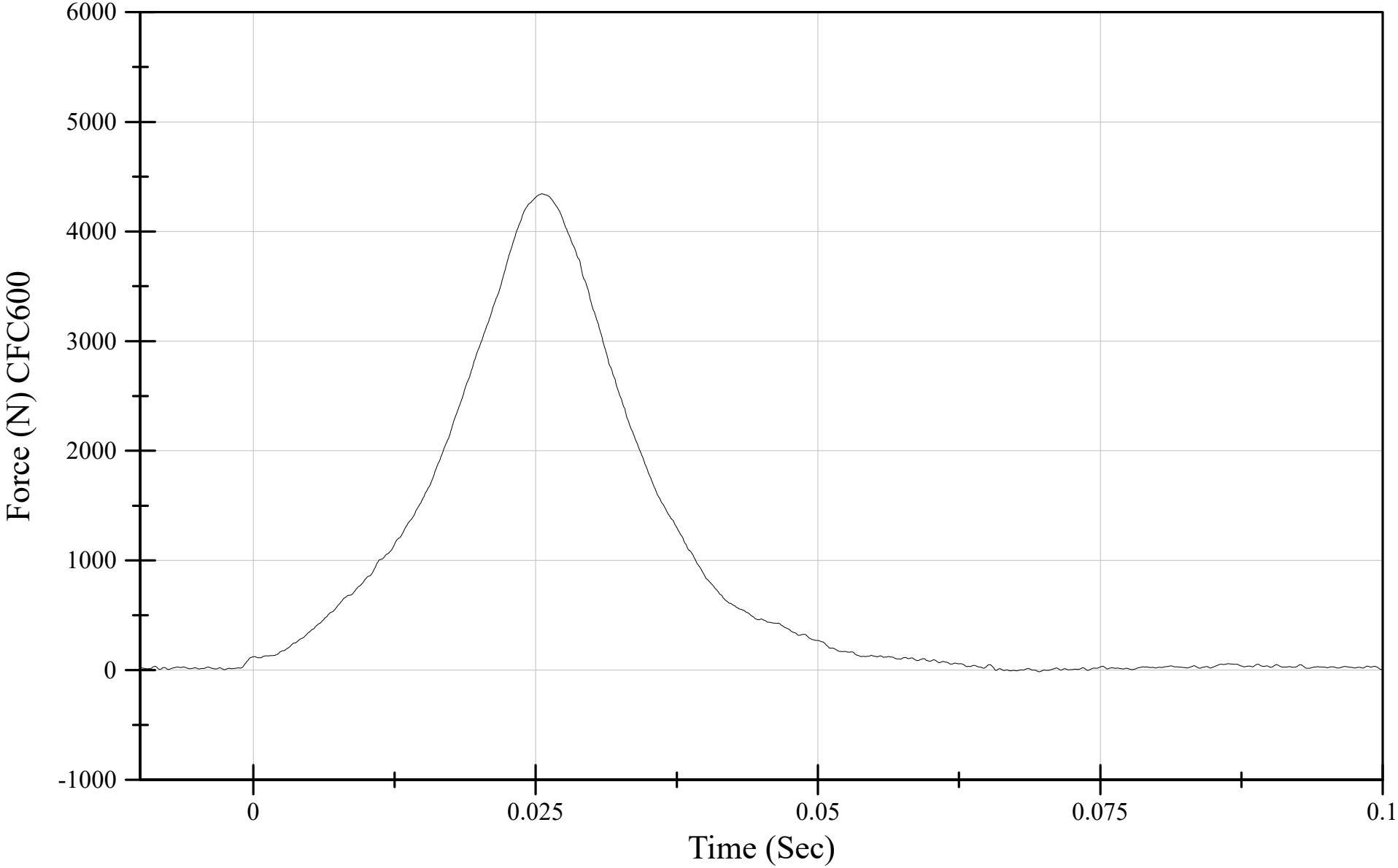
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.2	Pass
Test Humidity (%)	10 - 70	40	Pass
Test Velocity (m/s)	6.05 - 6.15	6.12	Pass
Peak Probe Force (N)		4345	
Peak Left Abdomen Pressure (kPa)		172	
Peak Right Abdomen Pressure (kPa)		158	
Difference between Left and Right Pressure (kPa)		14	

* THOR-05F Qualification Manual - July 2022

File Name: 221003-7 processed
Software Version: 2.8

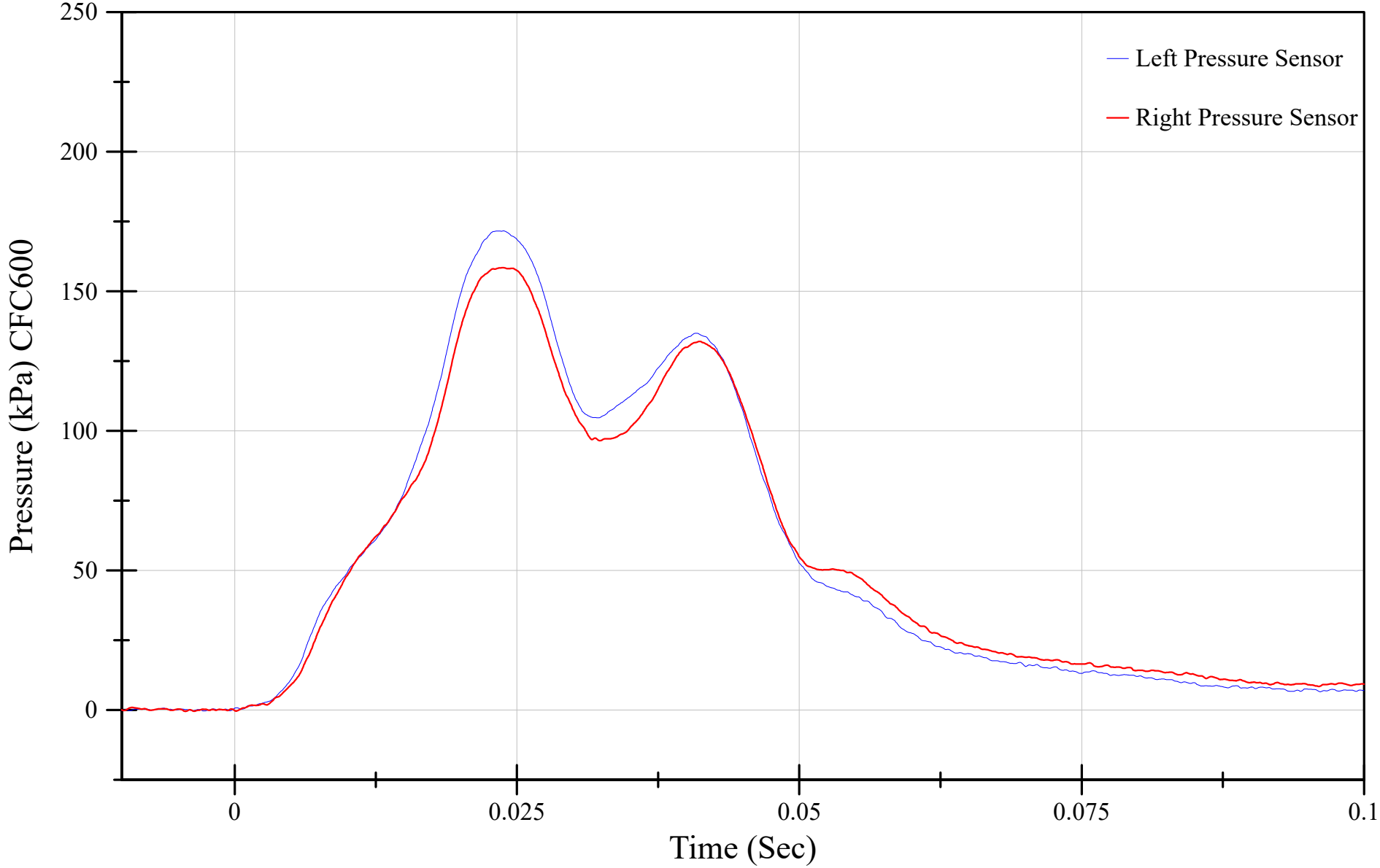
THOR-05F Lower Abdomen Qualification
Peak Probe Force
Serial Number: EU3430



File Name: 221003-7 processed

10/3/2022 11:21 AM

THOR-05F Lower Abdomen Qualification
Abdomen Pressure Sensors
Serial Number: EU3430



File Name: 221003-7 processed

10/3/2022 11:21 AM

THOR-05F Left Upper Leg Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Compression Element: ES6546
Left Thigh Flesh: ET8030

Test ID: 220915-13
Test Date: 9/15/2022
Test Time: 1:03 PM

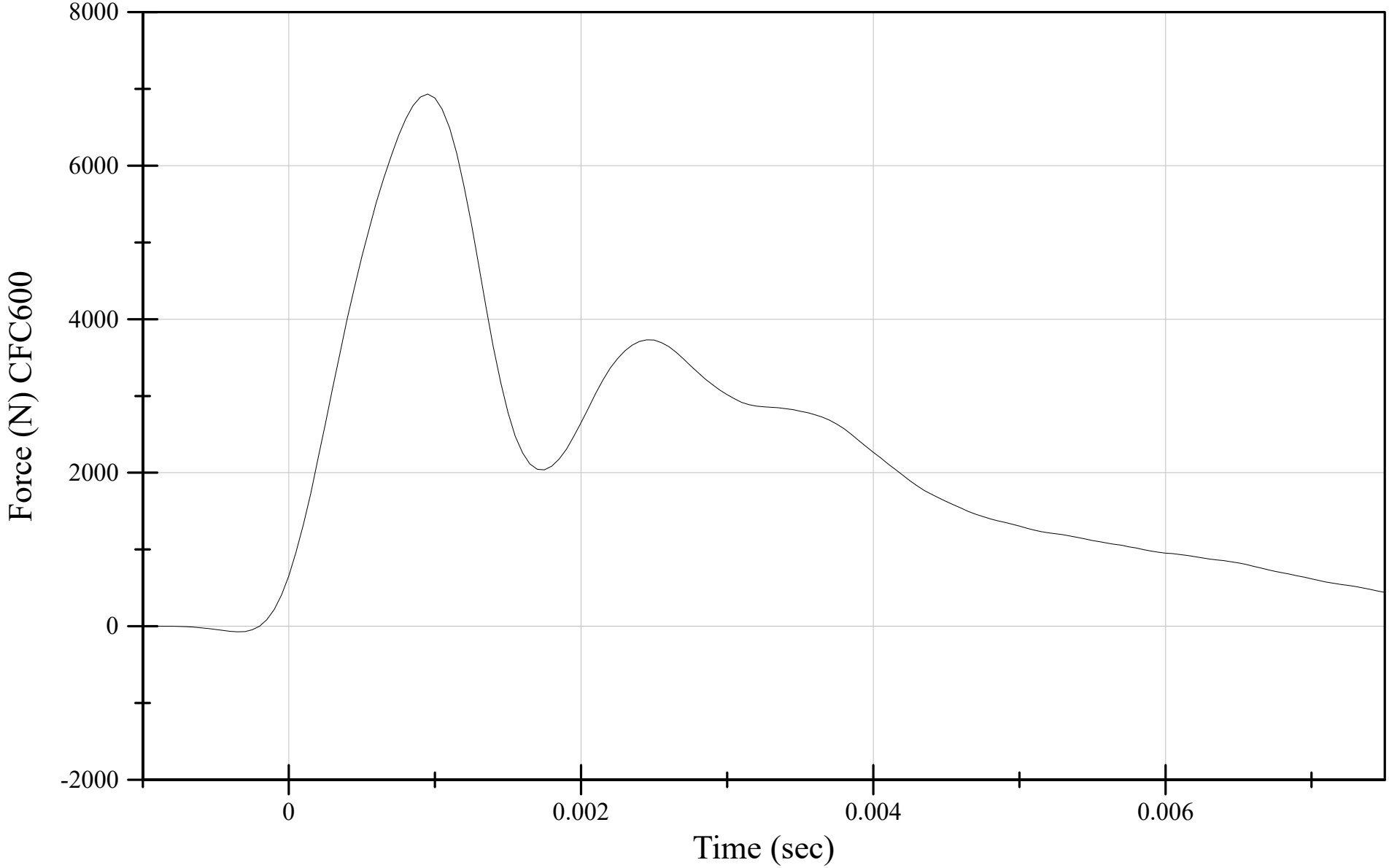
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.8	Pass
Test Humidity (%)	10 - 70	57.6	Pass
Test Velocity (m/s)	3.25 - 3.35	3.29	Pass
Peak Probe Force (N)		6932.9	
Peak Femur Force (N)		-4464.1	
Peak Resultant Acetabulum Force (N)		2007.8	

* THOR-05F Qualification Manual - July 2022

File Name: 220915-13 processed

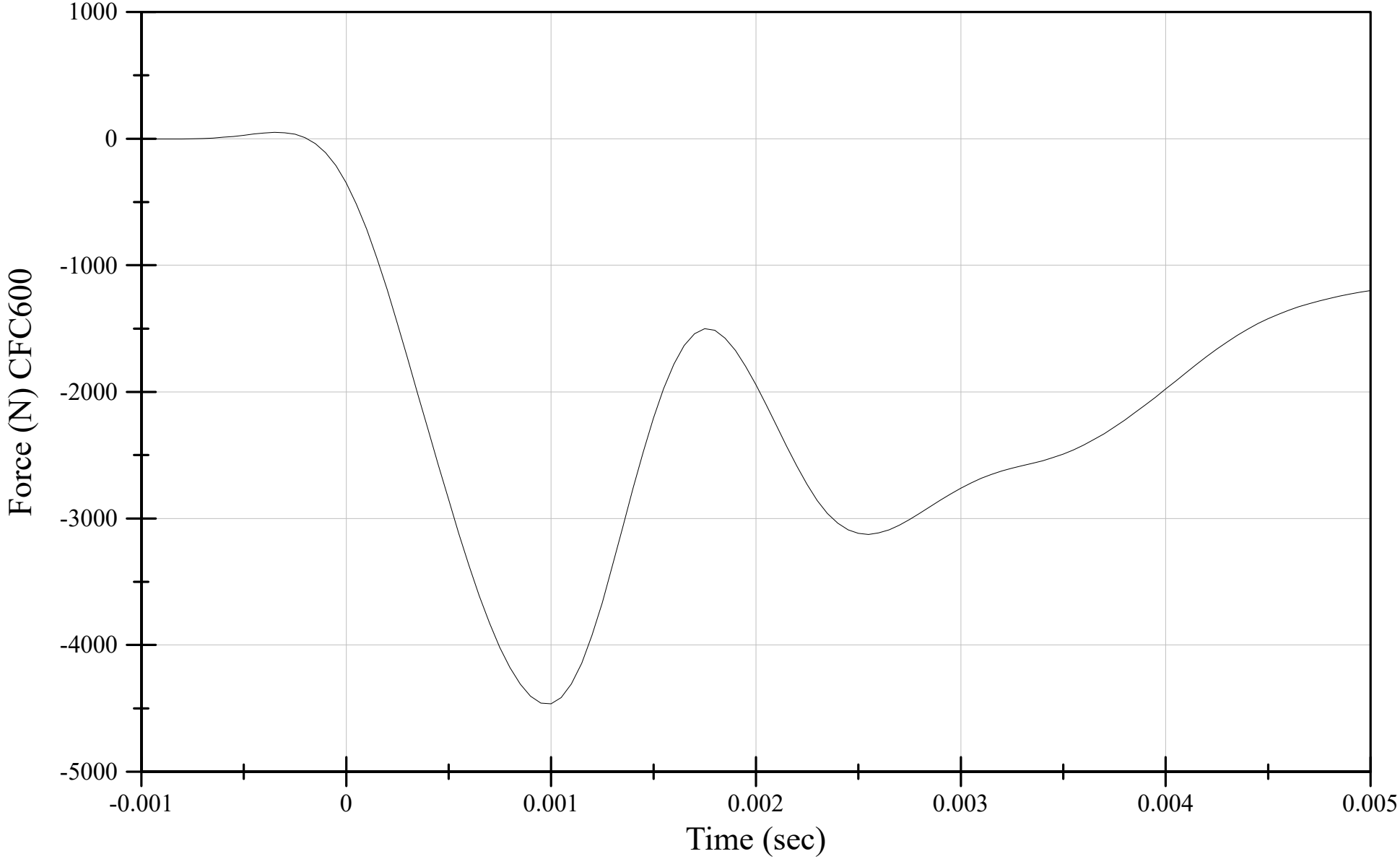
THOR-05F Left Upper Leg Qualification
Probe Force
Serial Number: EU3430



File Name: 220915-13 processed

9/15/2022 1:03 PM

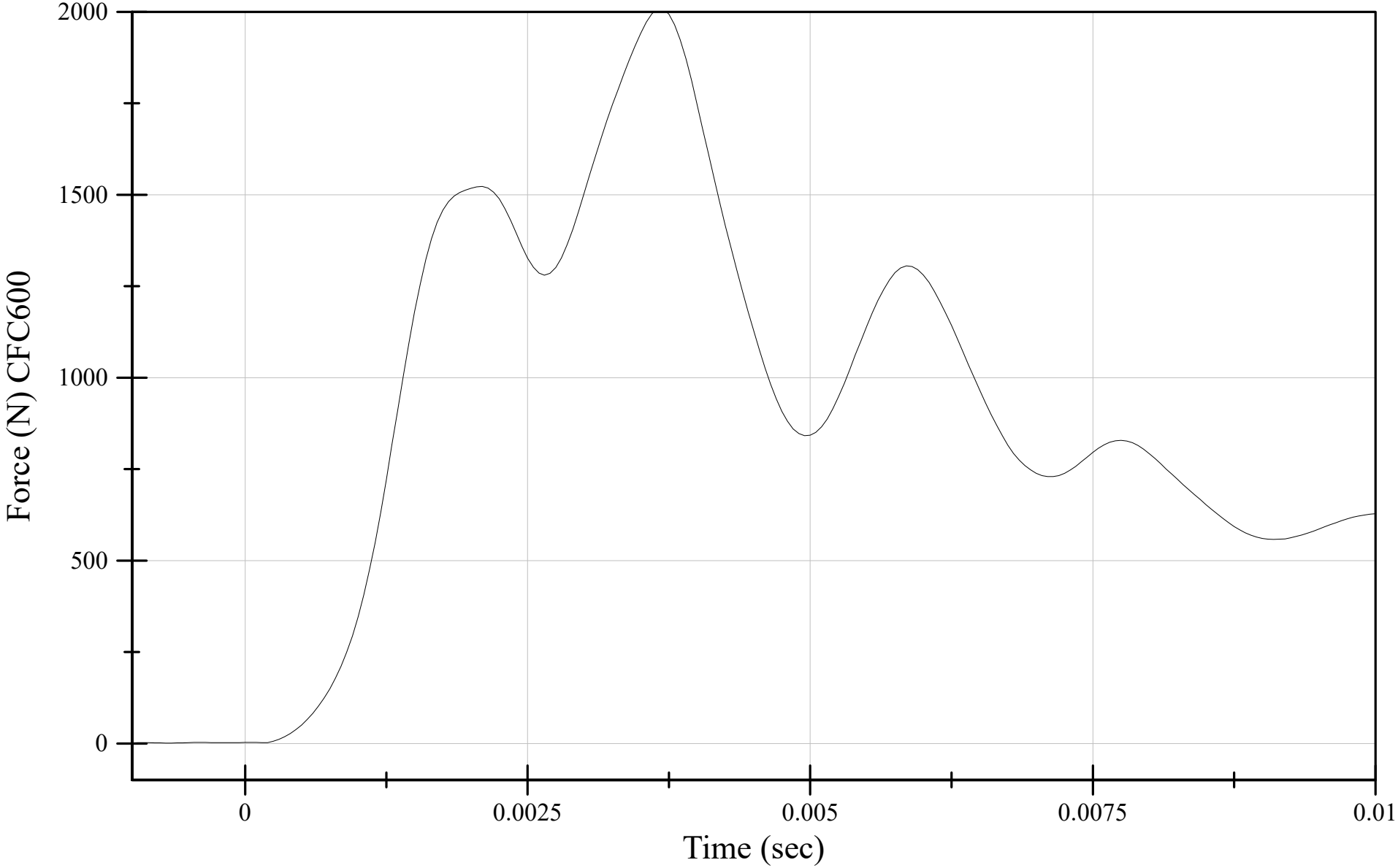
THOR-05F Left Upper Leg Qualification
Femur Z-Force
Serial Number: EU3430



File Name: 220915-13 processed

9/15/2022 1:03 PM

THOR-05F Left Upper Leg Qualification
Peak Acetabulum Resultant Force
Serial Number: EU3430



File Name: 220915-13 processed

9/15/2022 1:03 PM

THOR-05F Left Knee Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Left Knee Slider: EV2938

Test ID: 220919-2
Test Date: 9/19/2022
Test Time: 10:08 AM

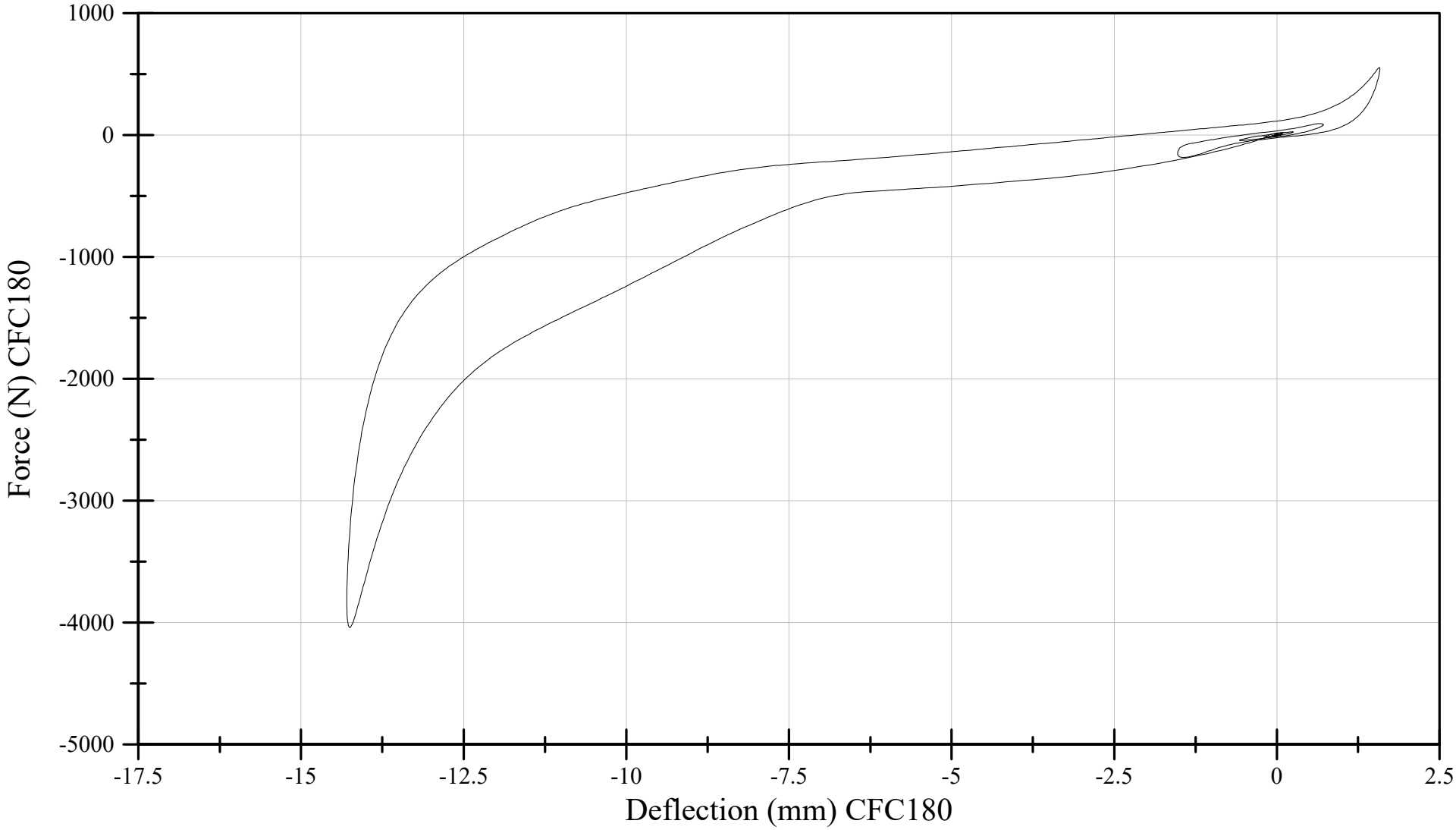
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.1	Pass
Test Humidity (%)	10 - 70	68.8	Pass
Test Velocity (m/s)	2.10 - 2.20	2.19	Pass
Peak Femur Fz (N)		-4040.6	
Knee Deflection at Peak Femur Force (N)		-14.3	

* THOR-05F Qualification Manual - July 2022

File Name: 220919-2 processed
Software Version: 2.8

THOR-05F Left Knee Qualification
Peak Deflection at Peak Force
Serial Number: EU3430



File Name: 220919-2 processed

9/19/2022 10:08 AM

THOR-05F Left Achilles Tension Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Left Ankle Assembly: EV4180

Test ID: 220920-3
Test Date: 9/20/2022
Test Time: 1:24 PM

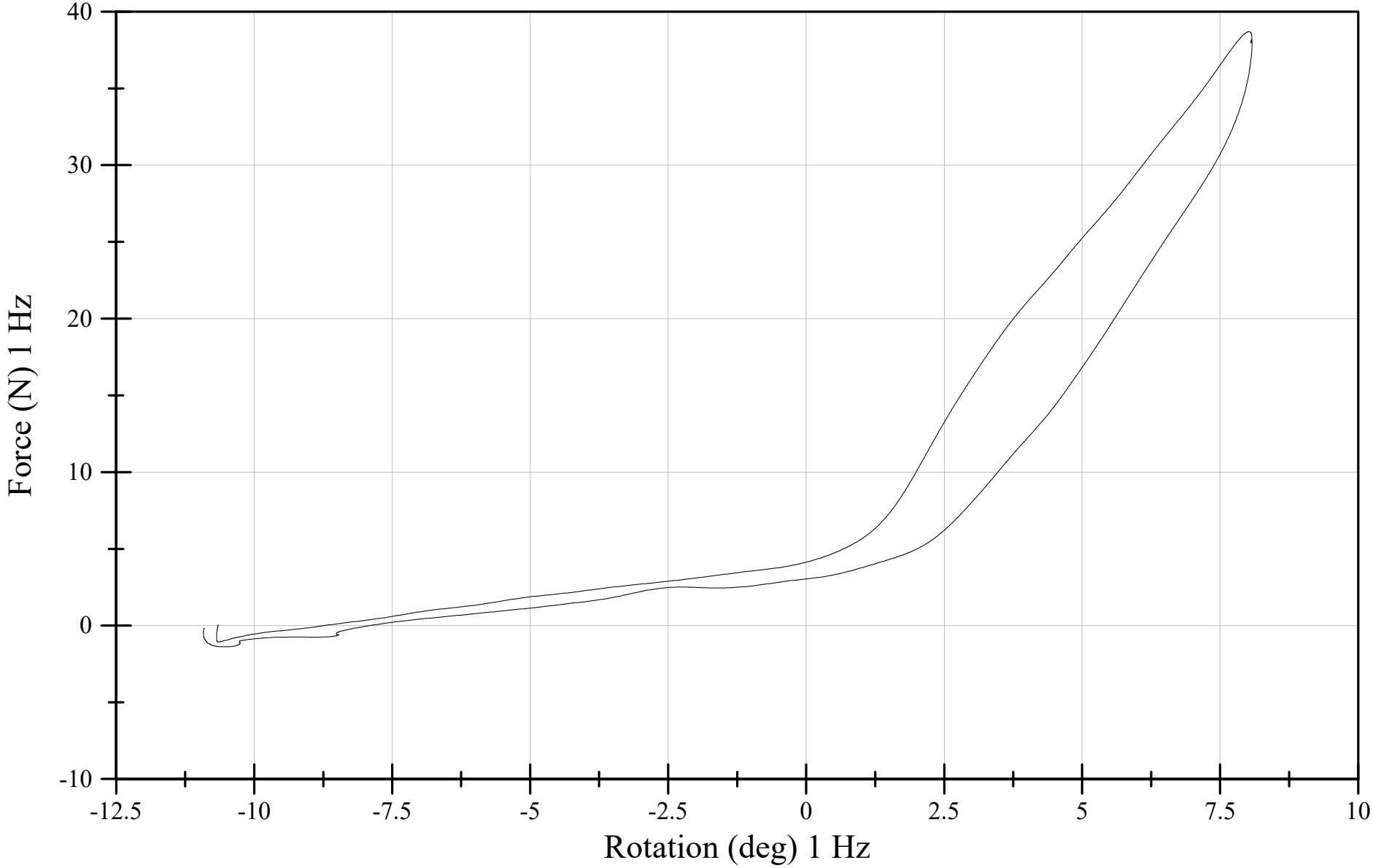
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.4	Pass
Test Humidity (%)	10 - 70	63.9	Pass
Force at 0° Y Rotation (N)		4	

* THOR-05F Qualification Manual - July 2022

File Name: 220920-3 processed
Software Version: 2.8

THOR-05F Left Achilles Tension Qualification
Force vs Rotation
Ankle Serial Number: EV4180



File Name: 220920-3 processed

9/20/2022 1:24 PM

THOR-05F Left Ball of Foot Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Left Ankle: EV4180
Dorsiflexion Stop: EV3711

Test ID: 220922-1
Test Date: 9/22/2022
Test Time: 6:43 AM

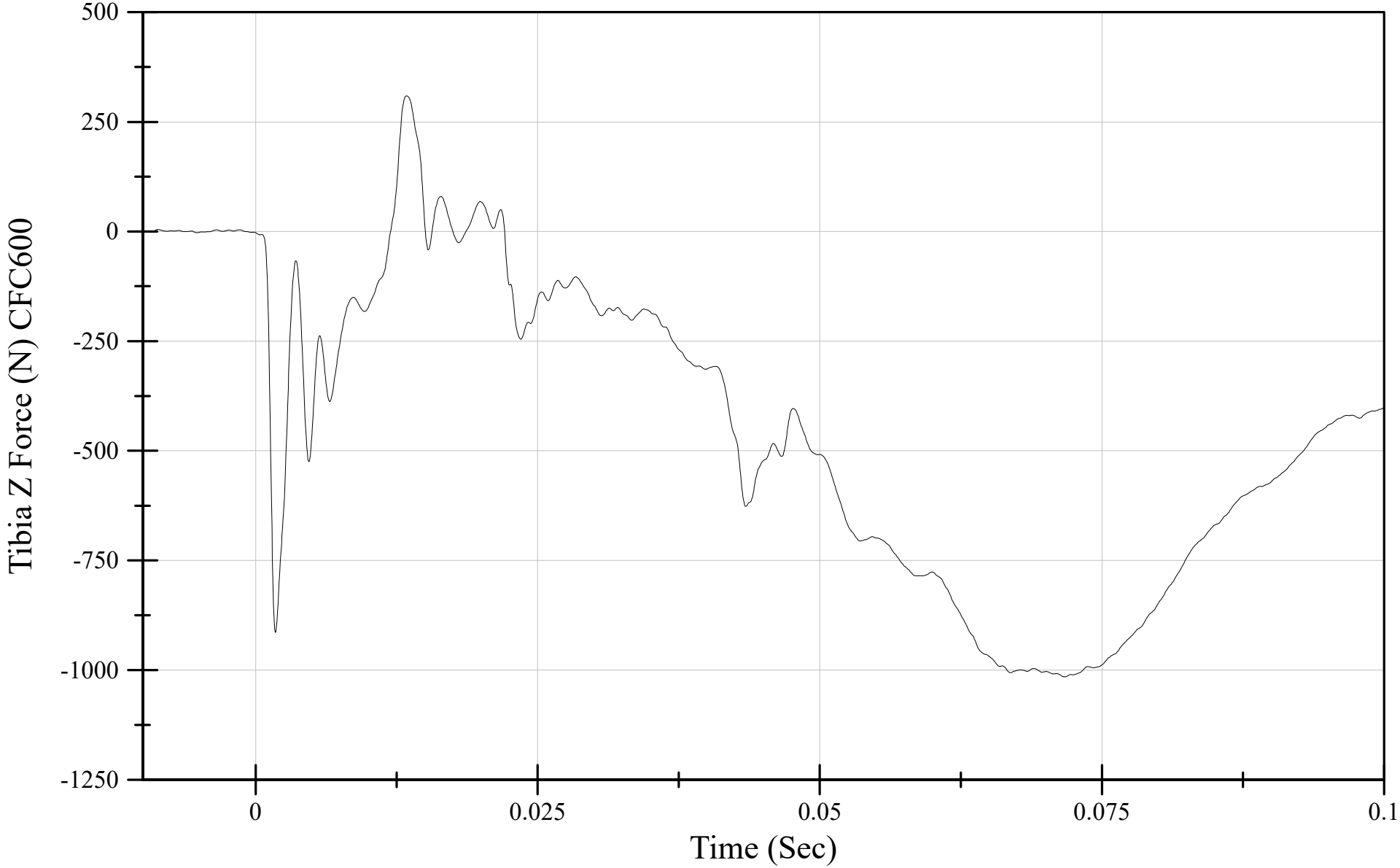
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	20.3	Fail
Test Humidity (%)	10 - 70	61.8	Pass
Test Velocity (m/s)	1.95 - 2.05	1.98	Pass
Peak Lower Tibia Fz after 10 ms (N)		-1015.4	
Peak Ankle Resistive Moment (Nm)		49.6	
Peak Ankle Y-axis Rotation (deg)		33.2	

* THOR-05F Qualification Manual - July 2022

File Name: 220922-1 processed
Software Version: 2.8

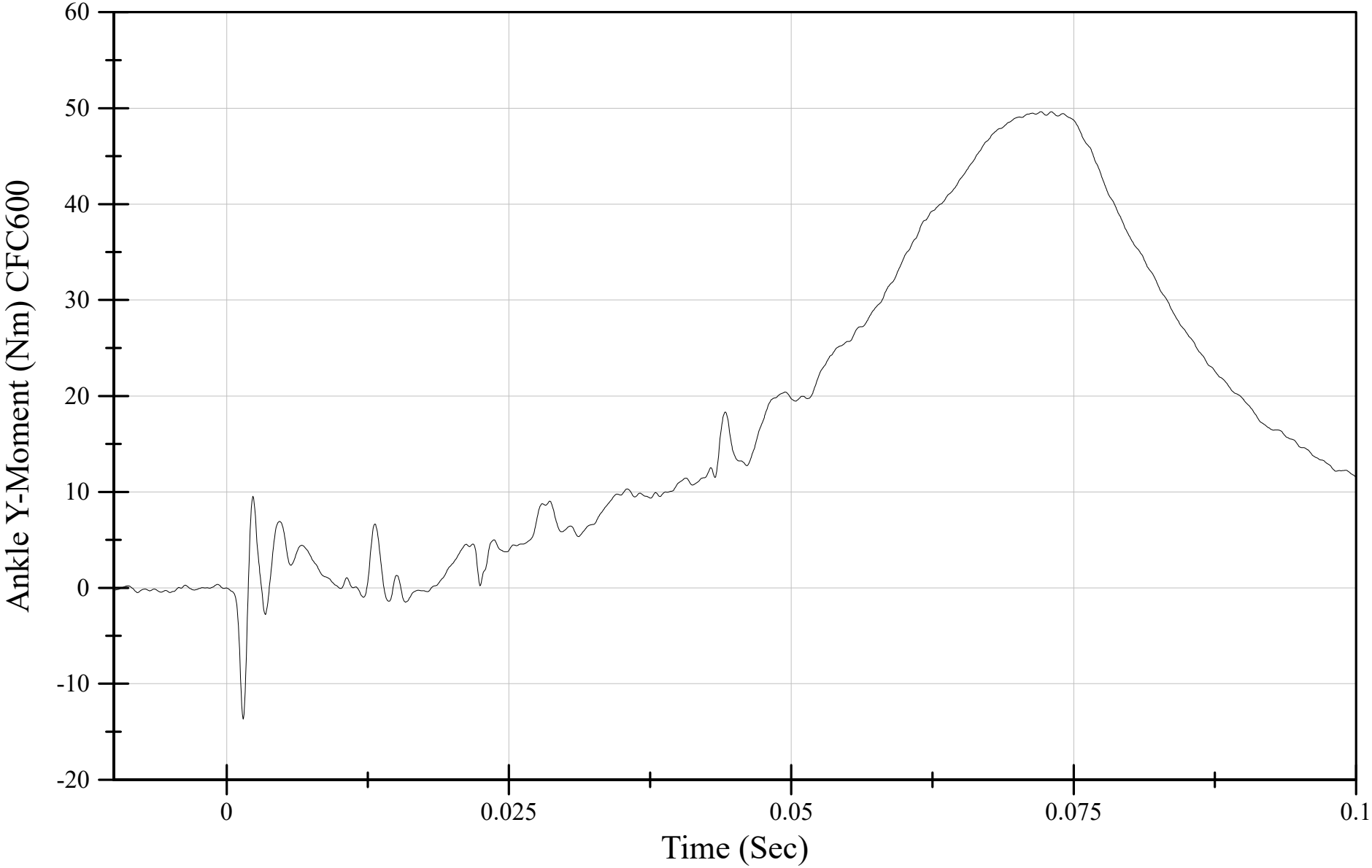
THOR-05F Left Ball of Foot Qualification
Lower Tibia Fz
Serial Number: EU3430



File Name: 220922-1 processed

9/22/2022 6:43 AM

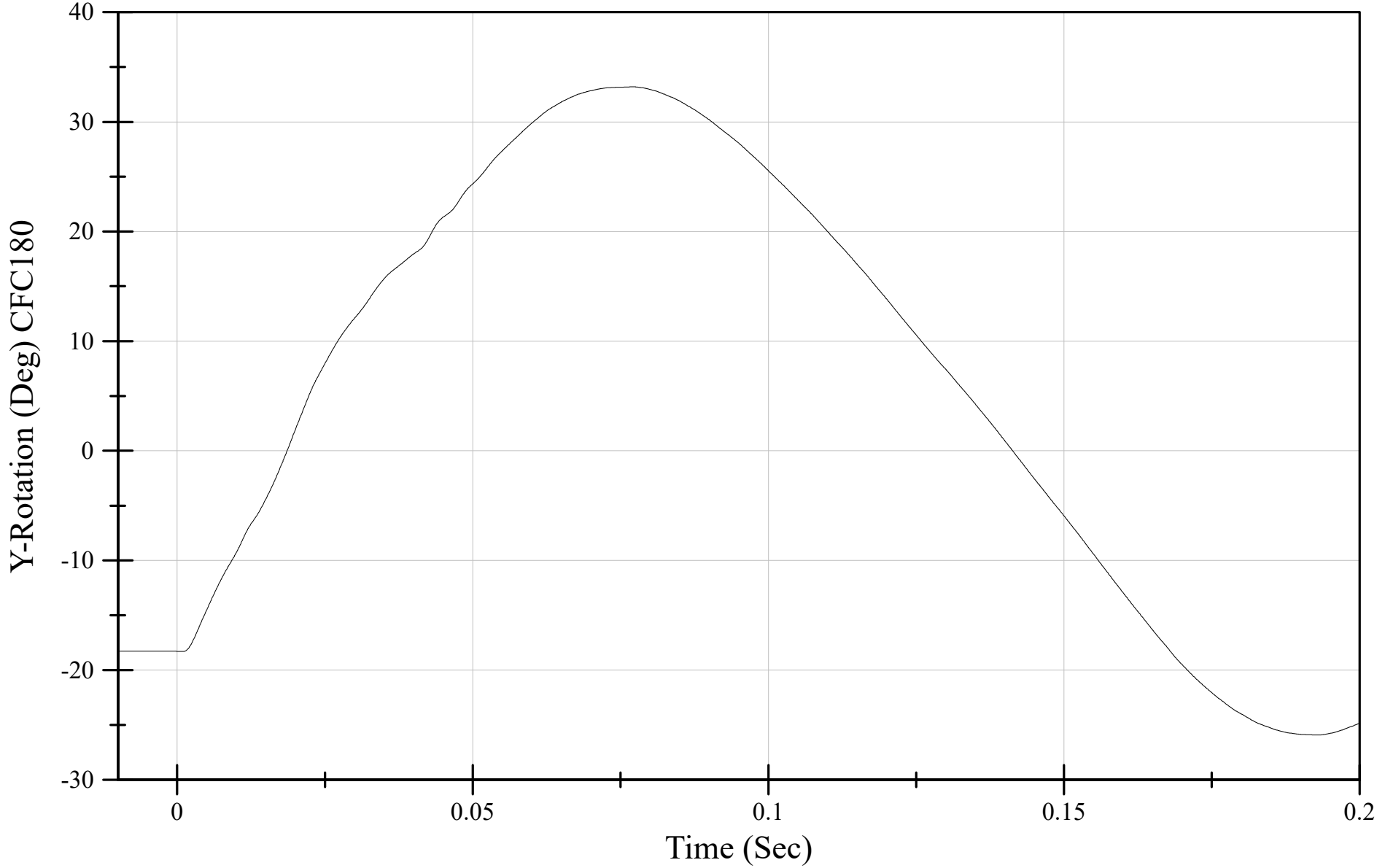
THOR-05F Left Ball of Foot Qualification
Ankle Y-Moment
Serial Number: EU3430



File Name: 220922-1 processed

9/22/2022 6:43 AM

THOR-05F Left Ball of Foot Qualification
Ankle Y-Rotation
Serial Number: EU3430



File Name: 220922-1 processed

9/22/2022 6:43 AM

THOR-05F Left Foot Inversion Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components	Test ID: 220921-2
Ankle Serial: EV4180	Test Date: 9/21/2022
Inversion Stop Assembly: EP6307	Test Time: 7:10 AM

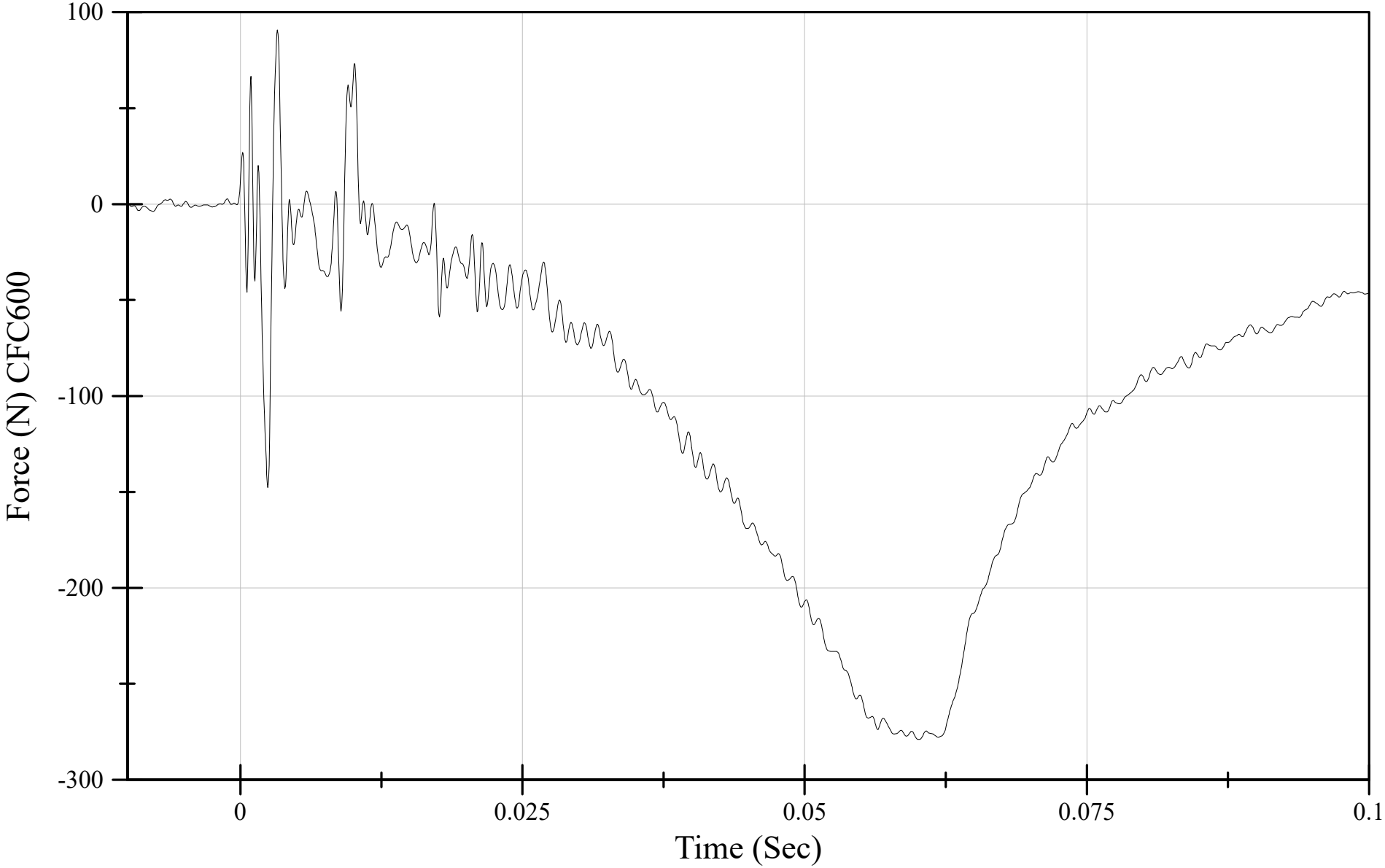
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.2	Pass
Test Humidity (%)	10 - 70	62	Pass
Test Velocity (m/s)	1.95 - 2.05	2.05	Pass
Peak Lower Tibia Fz		-279.0	
Peak Ankle X-axis Resistive Moment		-31.7	
Peak Ankle X-axis Rotation		-47.1	

* THOR-05F Qualification Manual - July 2022

File Name: 220921-2 processed
Software Version: 2.8

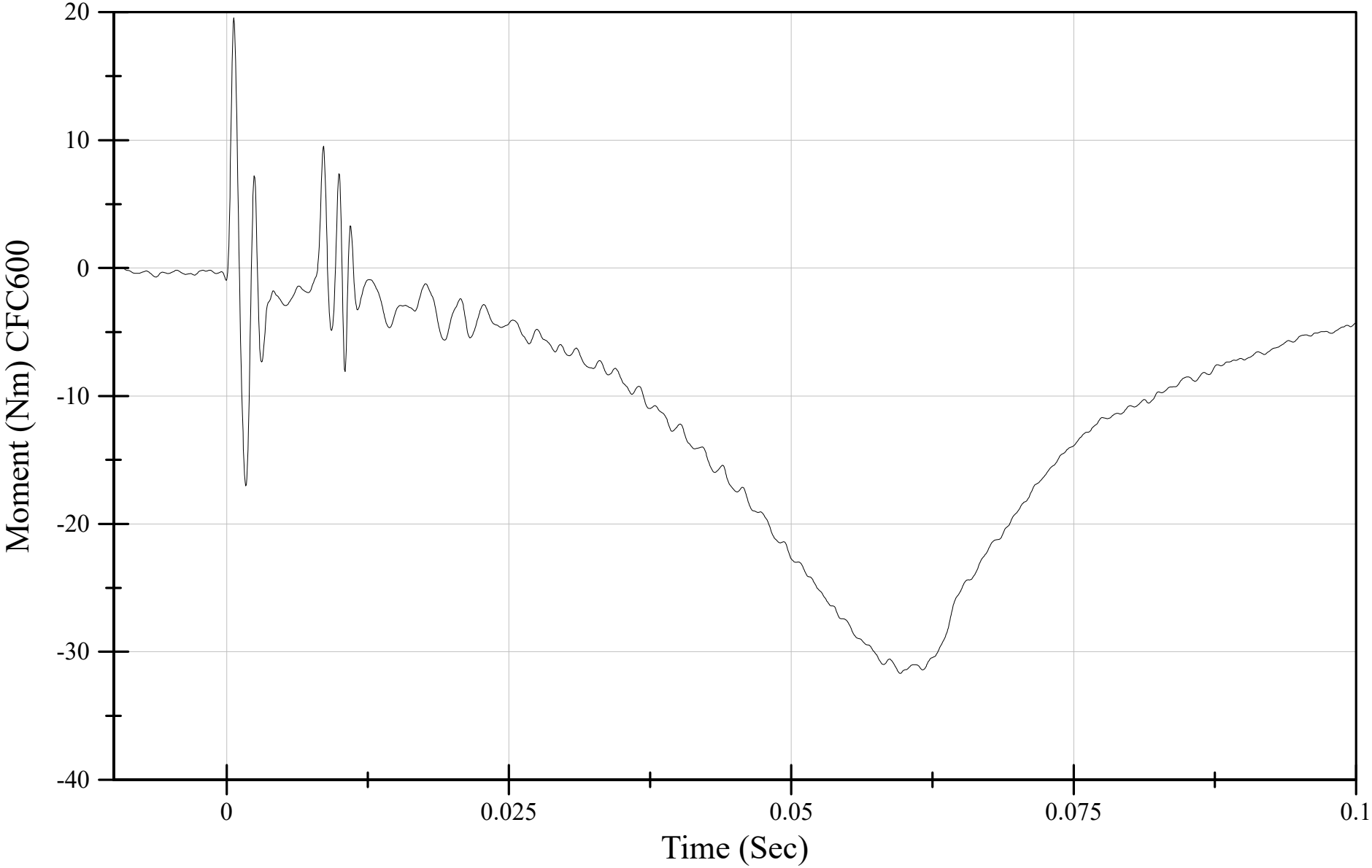
THOR-05F Left Foot Inversion Qualification
Tibia Load - Force Z
Ankle Serial Number: EV4180



File Name: 220921-2 processed

9/21/2022 7:10 AM

THOR-05F Left Foot Inversion Qualification
Ankle Moment - X axis
Ankle Serial Number: EV4180



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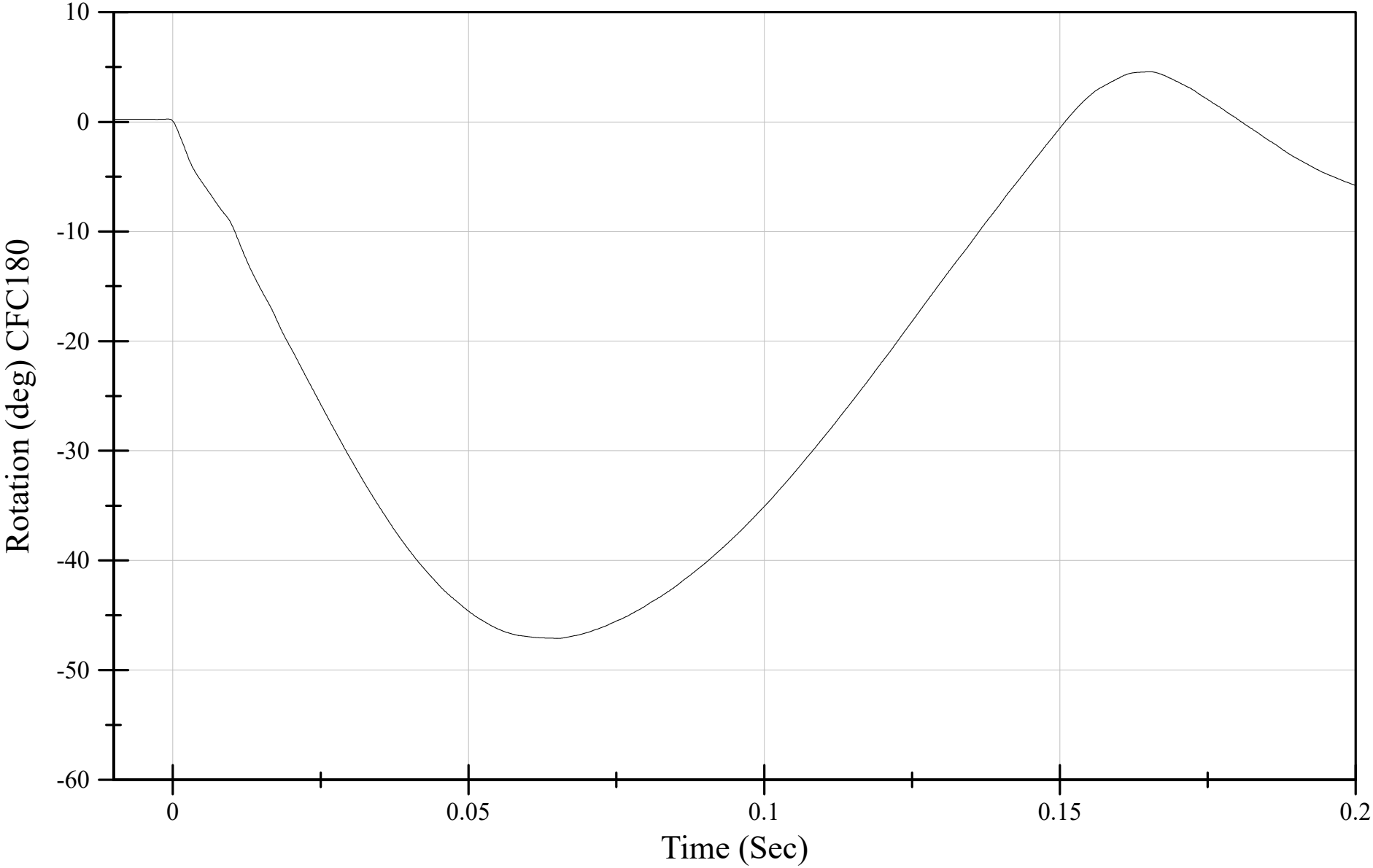
9/21/2022 7:10 AM

THOR-05F Left Foot Inversion Qualification
Ankle X-Rotation
Ankle Serial Number: EV4180



File Name: 220921-2 processed

9/21/2022 7:10 AM

THOR-05F Left Foot Eversion Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components	Test ID: 220921-1
Ankle Serial: EV4180	Test Date: 9/21/2022
Eversion Stop Assembly: EV3436	Test Time: 6:34 AM

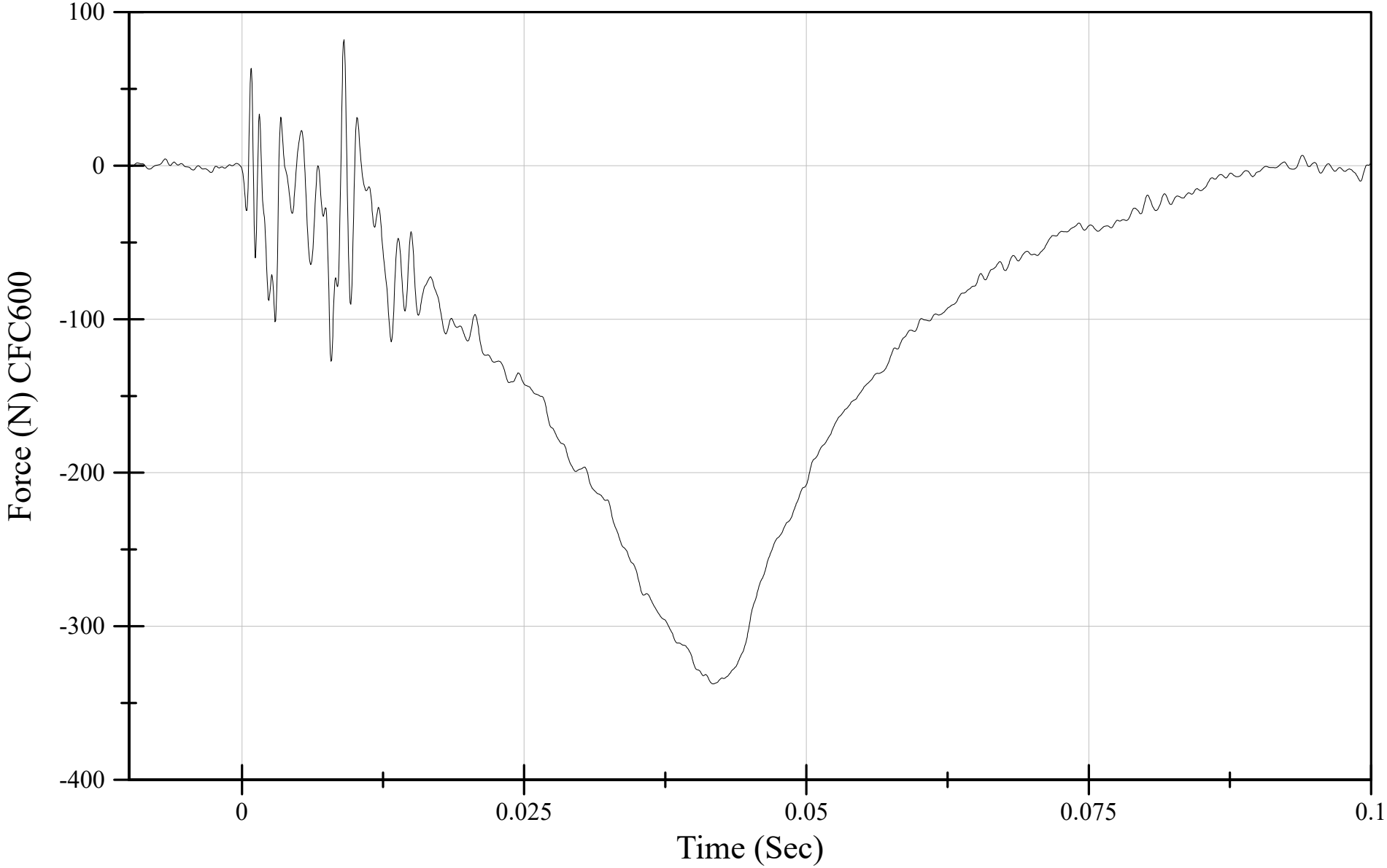
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.3	Pass
Test Humidity (%)	10 - 70	62	Pass
Test Velocity (m/s)	1.95 - 2.05	2.05	Pass
Peak Lower Tibia Fz		-337.6	
Peak Ankle X-axis Resistive Moment		31.8	
Peak Ankle X-axis Rotation		29.6	

* THOR-05F Qualification Manual - July 2022

File Name: 220921-1 processed
Software Version: 2.8

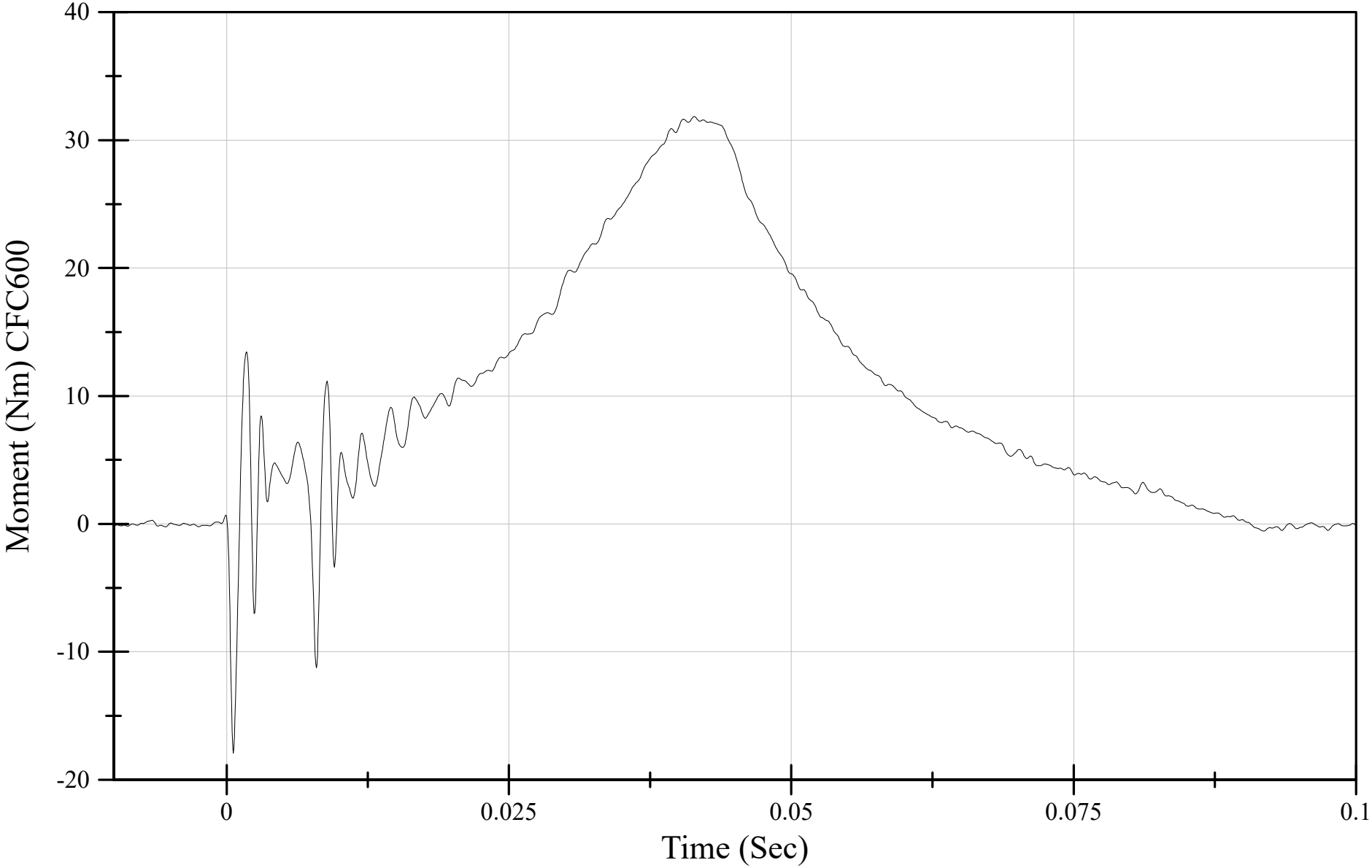
THOR-05F Left Foot Eversion Qualification
Tibia Load - Force Z
Ankle Serial Number: EV4180



File Name: 220921-1 processed

9/21/2022 6:34 AM

THOR-05F Left Foot Eversion Qualification
Ankle Moment - X axis
Ankle Serial Number: EV4180



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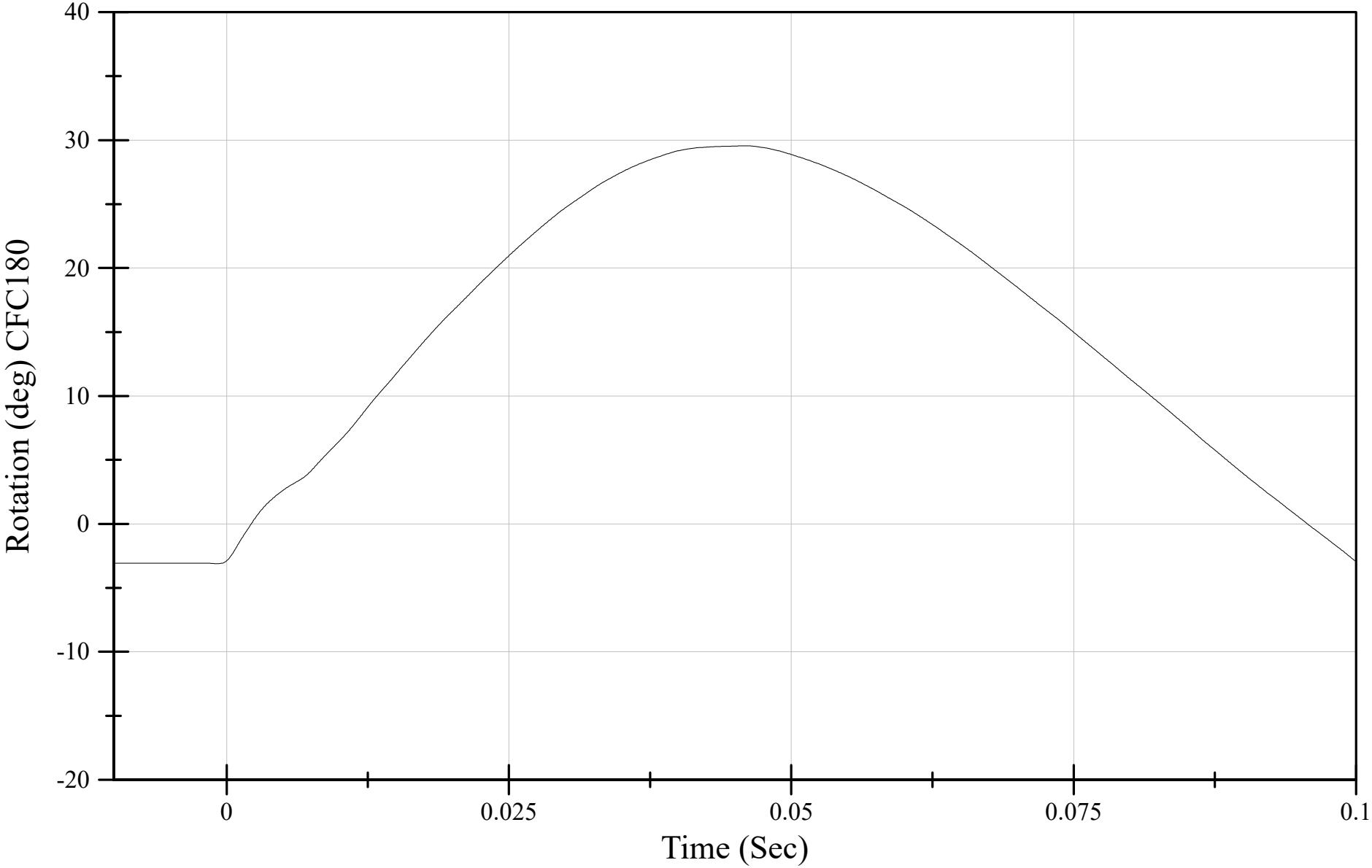
9/21/2022 6:34 AM

THOR-05F Left Foot Eversion Qualification
Ankle X-Rotation
Ankle Serial Number: EV4180



File Name: 220921-1 processed

9/21/2022 6:34 AM

THOR-05F Left Heel Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Left Ankle: EV4180

Test ID: 220922-4
Test Date: 9/22/2022
Test Time: 8:17 AM

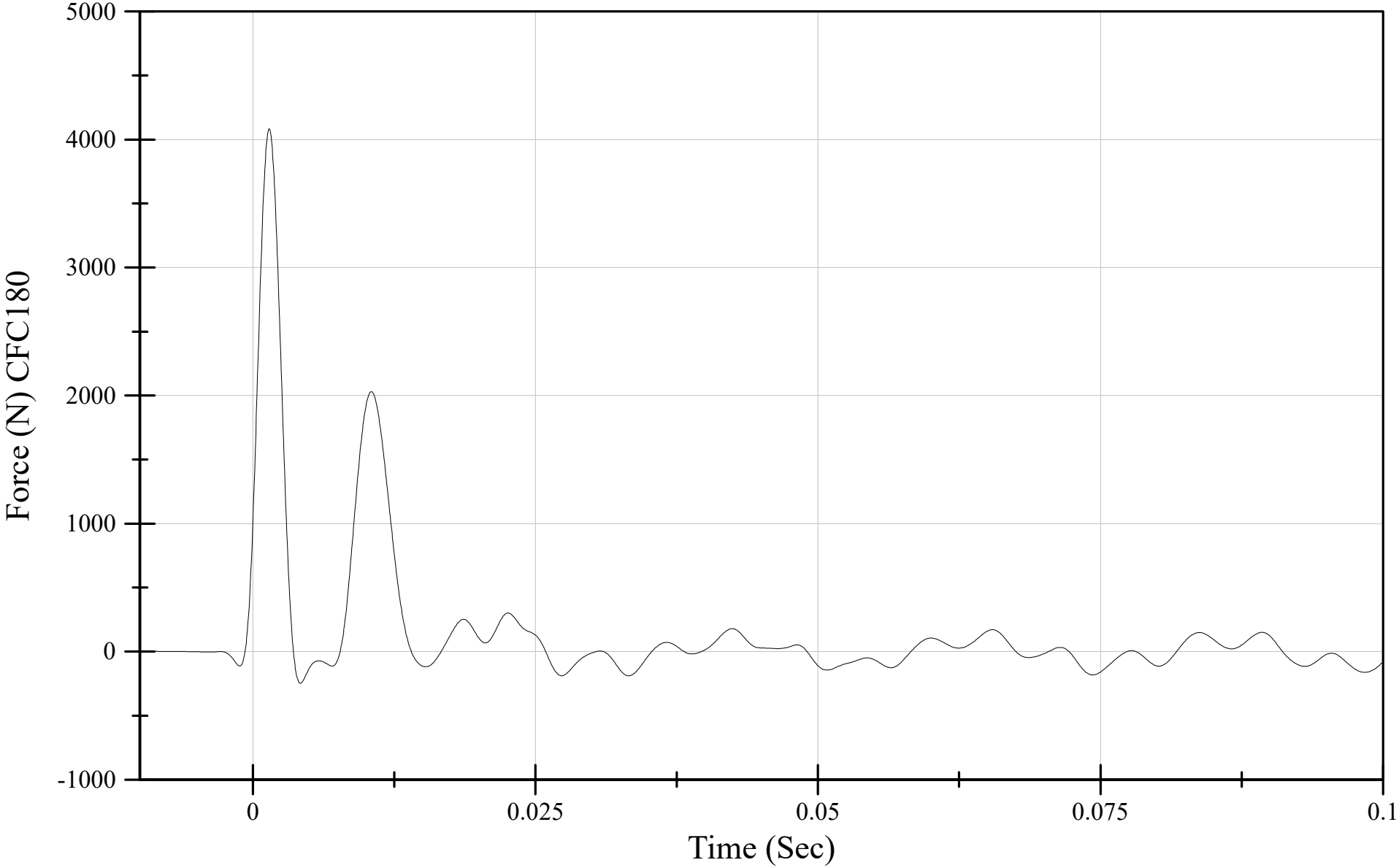
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	18.8	Fail
Test Humidity (%)	10 - 70	44	Pass
Test Velocity (m/s)	3.95 - 4.05	3.95	Pass
Probe Force (N)		4084.9	
Peak Lower Tibia Fz (N)		-2213.4	

* THOR-05F Qualification Manual - July 2022

File Name: 220922-4 processed
Software Version: 2.8

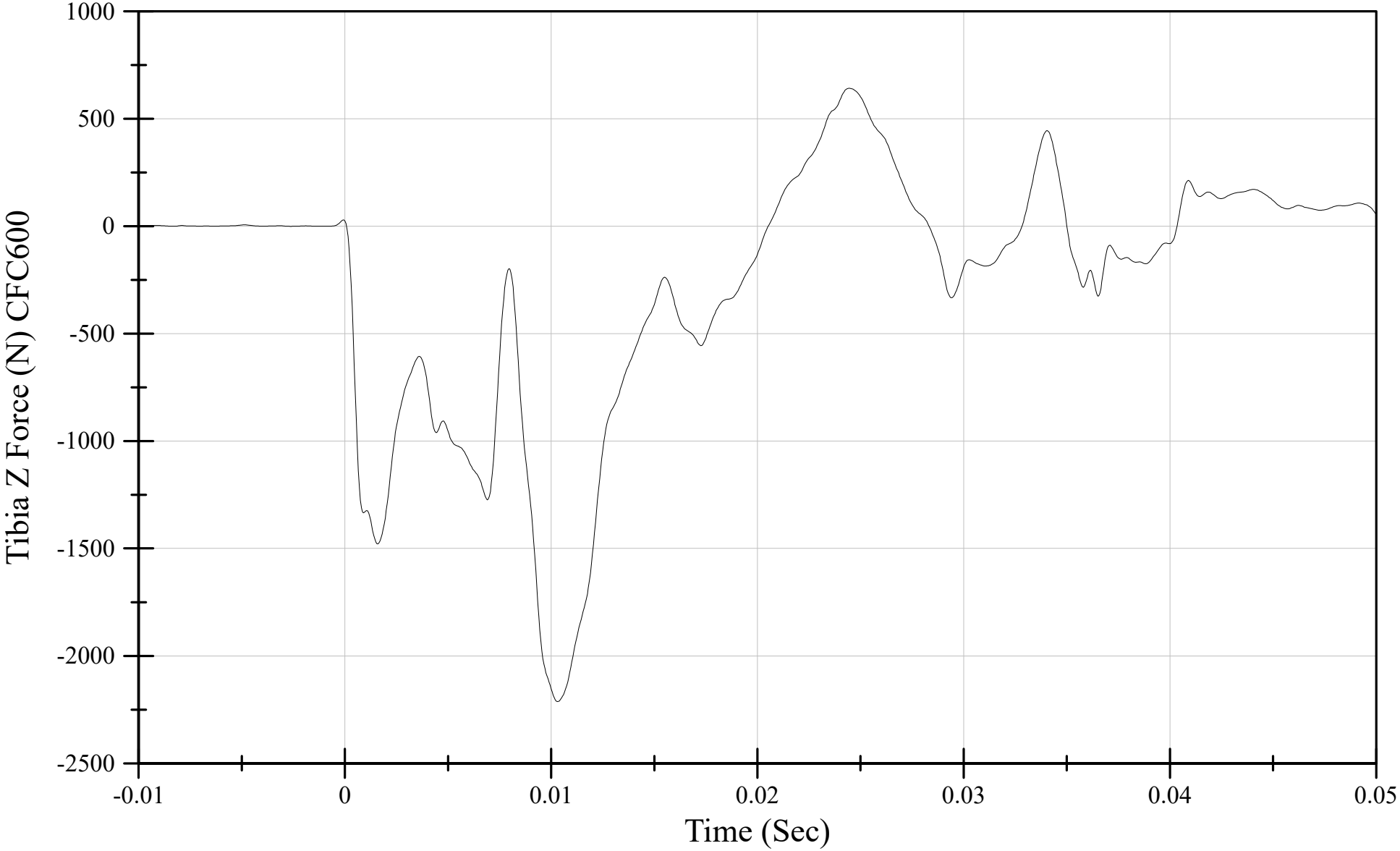
THOR-05F Left Heel Qualification
Probe Force
Dummy Serial Number: EU3430



File Name: 220922-4 processed

9/22/2022 8:17 AM

THOR-05F Left Heel Qualification
Tibia Load
Serial Number: EU3430



File Name: 220922-4 processed

9/22/2022 8:17 AM

THOR-05F Right Upper Leg Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Compression Element: ET6710
Right Thigh Flesh: ET7855

Test ID: 220915-10
Test Date: 9/15/2022
Test Time: 11:25 AM

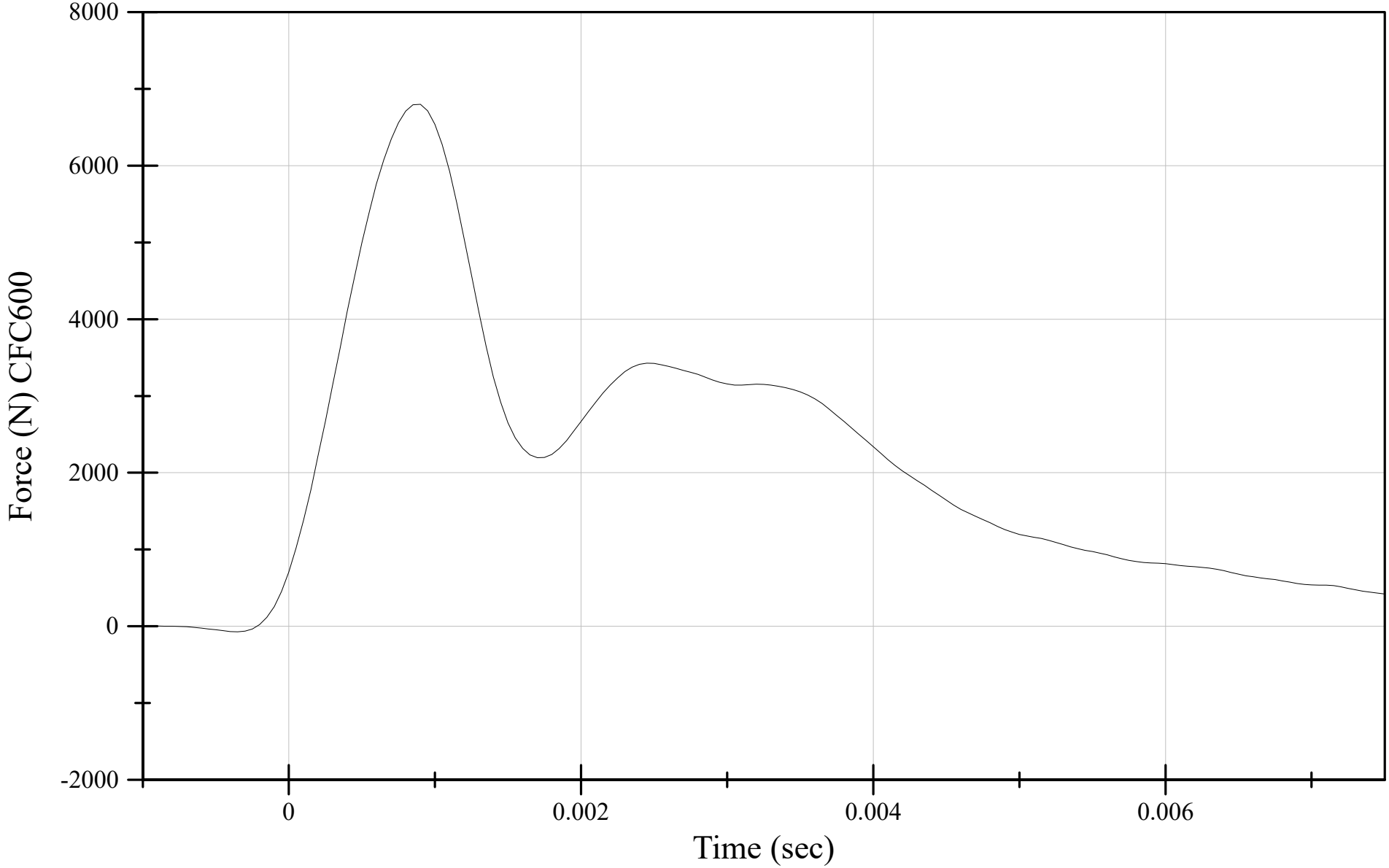
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.8	Pass
Test Humidity (%)	10 - 70	57.9	Pass
Test Velocity (m/s)	3.25 - 3.35	3.29	Pass
Peak Probe Force (N)		6799	
Peak Femur Force (N)		-4148	
Peak Resultant Acetabulum Force (N)		1847	

* THOR-05F Qualification Manual - July 2022

File Name: 220915-10 processed

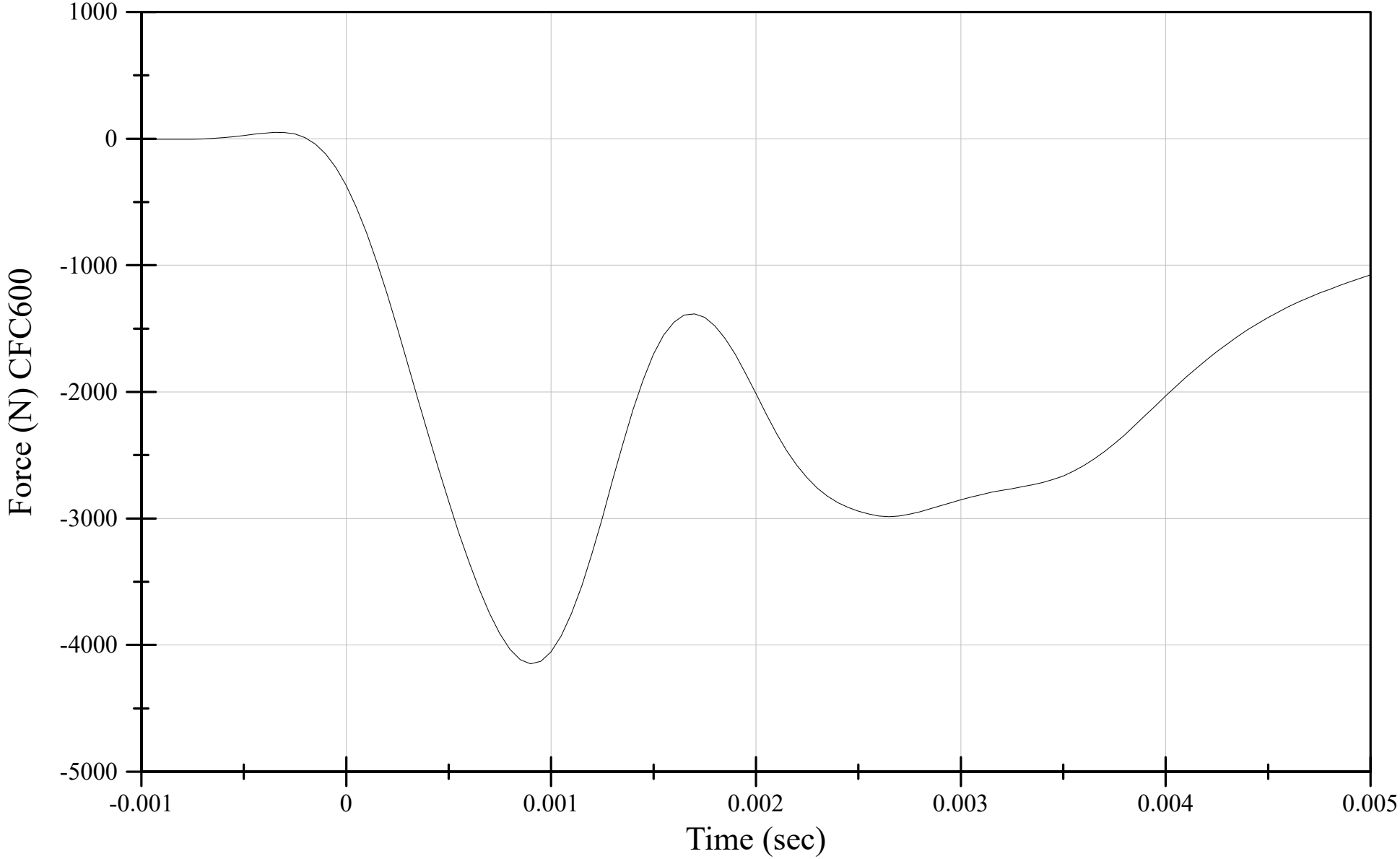
THOR-05F Right Upper Leg Qualification
Probe Force
Serial Number: EU3430



File Name: 220915-10 processed

9/15/2022 11:25 AM

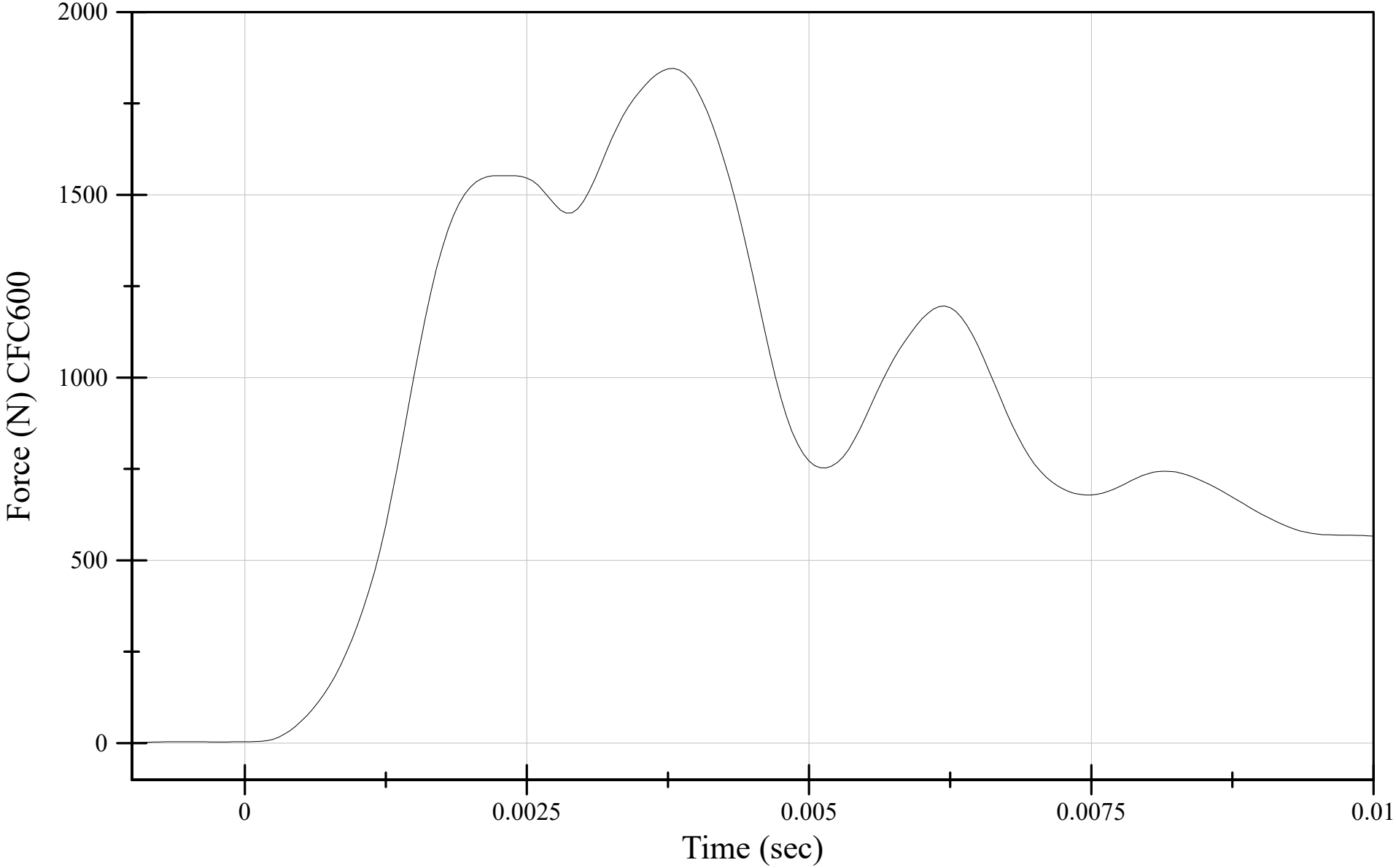
THOR-05F Right Upper Leg Qualification
Femur Z-Force
Serial Number: EU3430



File Name: 220915-10 processed

9/15/2022 11:25 AM

THOR-05F Right Upper Leg Qualification
Peak Acetabulum Resultant Force
Serial Number: EU3430



File Name: 220915-10 processed

9/15/2022 11:25 AM

THOR-05F Right Knee Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Right Knee Slider: EV2939

Test ID: 220919-4
Test Date: 9/19/2022
Test Time: 2:15 PM

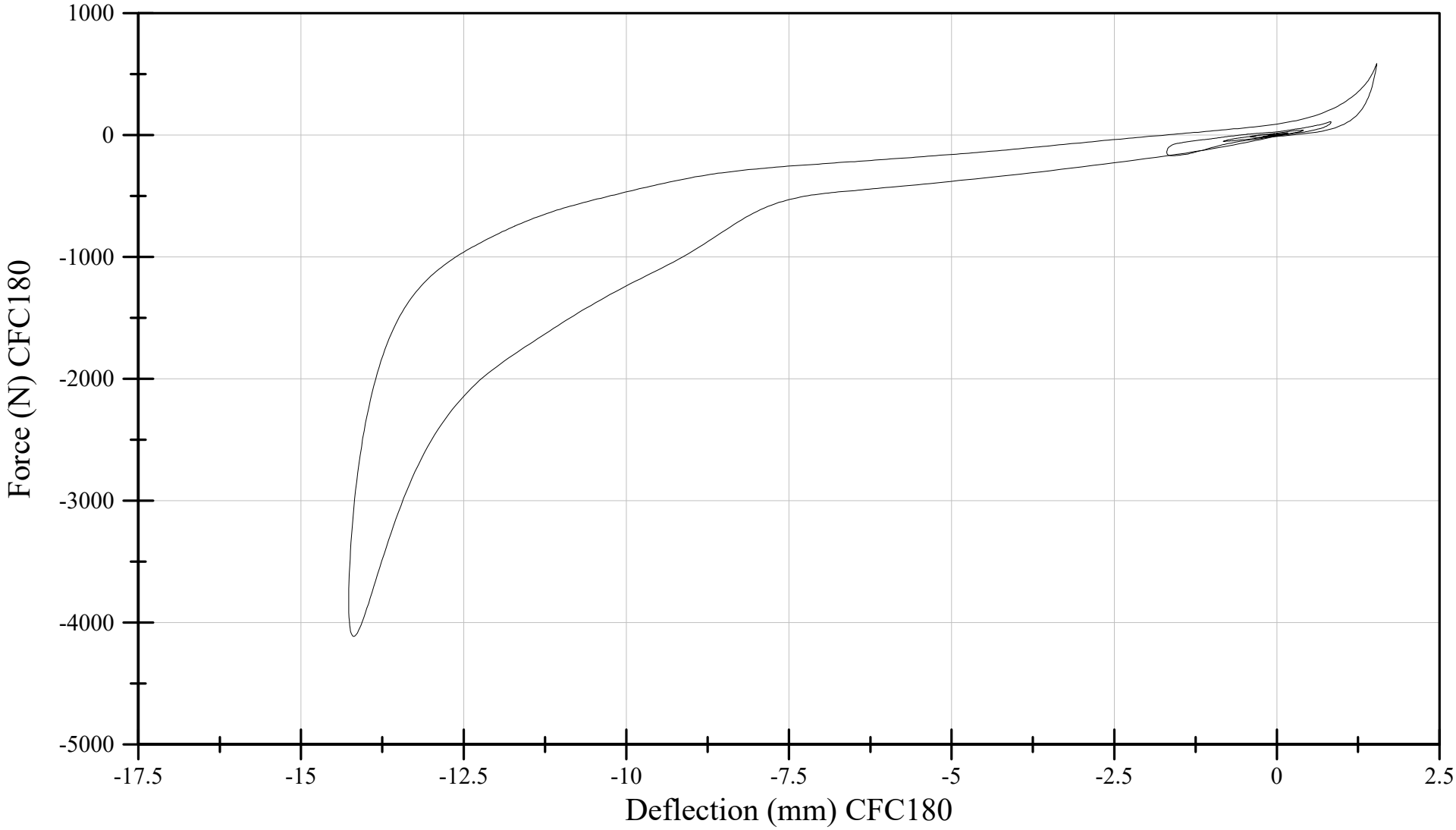
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	19.9	Fail
Test Humidity (%)	10 - 70	49.1	Pass
Test Velocity (m/s)	2.10 - 2.20	2.19	Pass
Peak Femur Fz (N)		-4112.0	
Knee Deflection at Peak Femur Force (N)		-14.3	

* THOR-05F Qualification Manual - July 2022

File Name: 220919-4 processed
Software Version: 2.8

THOR-05F Right Knee Qualification
Peak Deflection at Peak Force
Serial Number: EU3430



File Name: 220919-4 processed

9/19/2022 2:15 PM

THOR-05F Right Achilles Tension Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Left Ankle Assembly: EV3870

Test ID: 220922-7
Test Date: 9/22/2022
Test Time: 2:16 PM

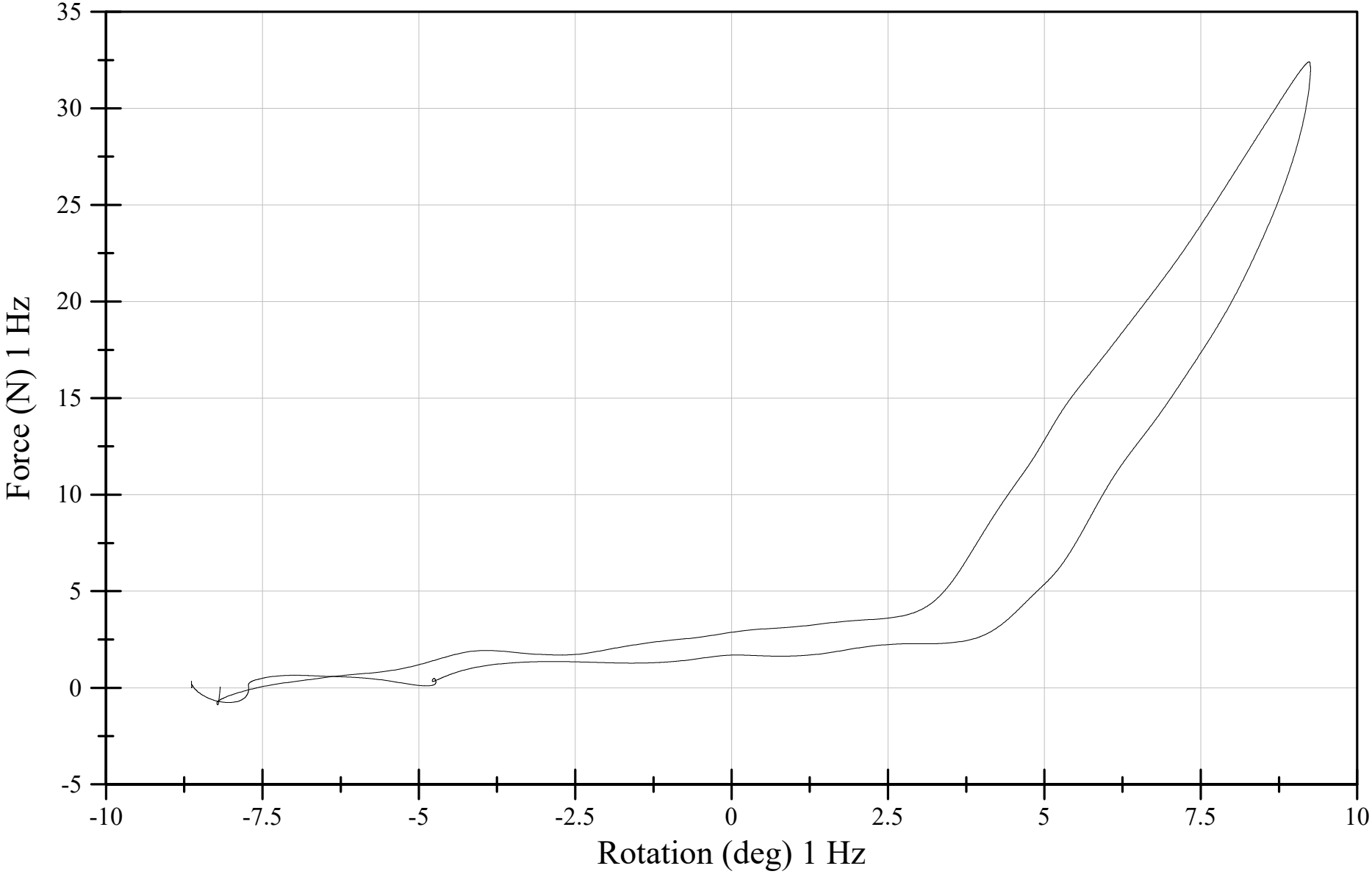
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.3	Pass
Test Humidity (%)	10 - 70	54	Pass
Force at 0° Y Rotation (N)		3	

* THOR-05F Qualification Manual - July 2022

File Name: 220922-7 processed
Software Version: 2.8

THOR-05F Right Achilles Tension Qualification
Force vs Rotation
Ankle Serial Number: EV3870



File Name: 220922-7 processed

9/22/2022 2:16 PM

THOR-05F Right Ball of Foot Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Right Ankle: EV3870
Right Dorsiflexion Stop: EV3714

Test ID: 220926-6
Test Date: 9/26/2022
Test Time: 9:47 AM

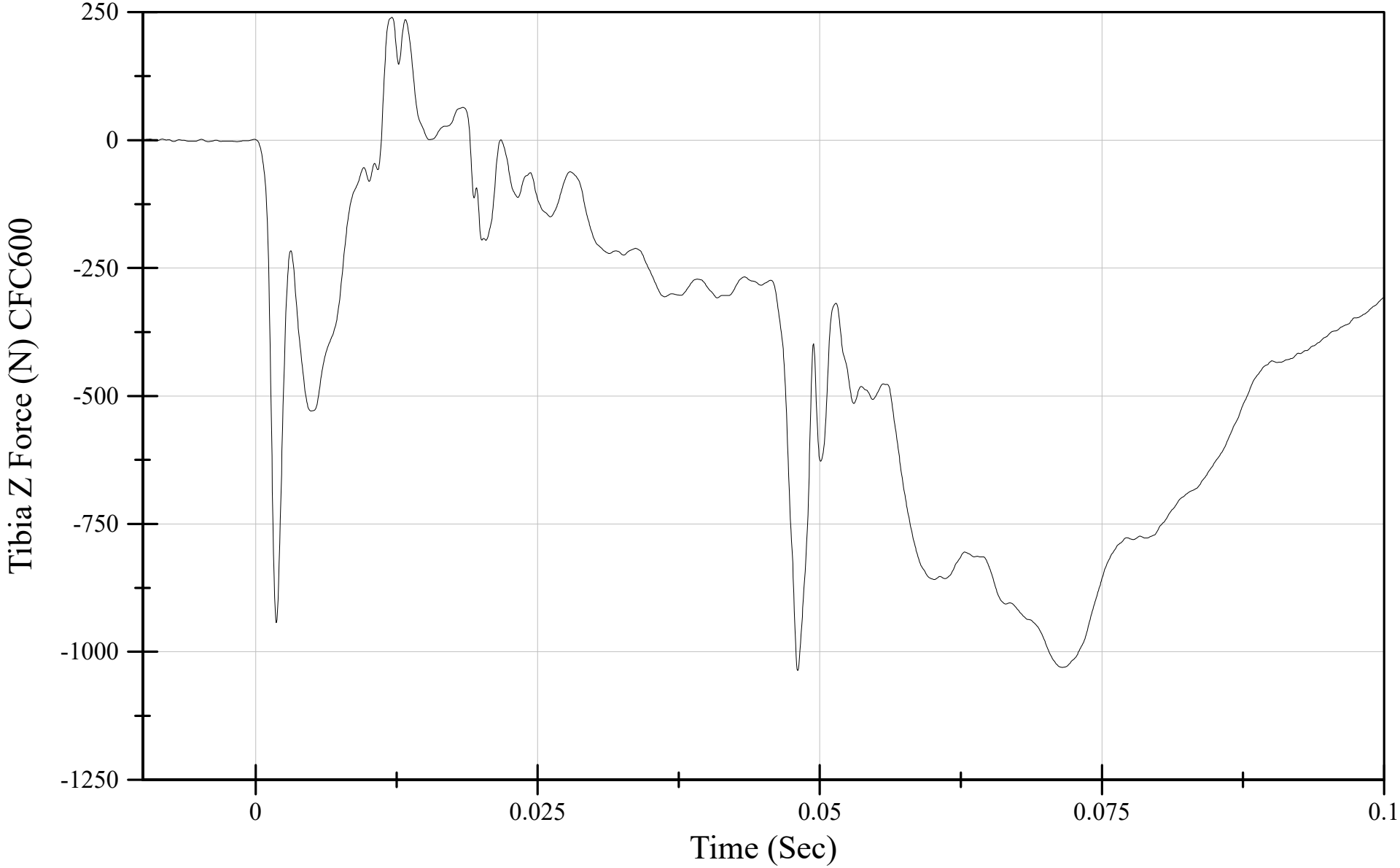
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.2	Pass
Test Humidity (%)	10 - 70	47	Pass
Test Velocity (m/s)	1.95 - 2.05	1.97	Pass
Peak Lower Tibia Fz after 10 ms (N)		-1036.5	
Peak Ankle Resistive Moment (Nm)		54.3	
Peak Ankle Y-axis Rotation (deg)		31.6	

* THOR-05F Qualification Manual - July 2022

File Name: 220926-6 processed
Software Version: 2.8

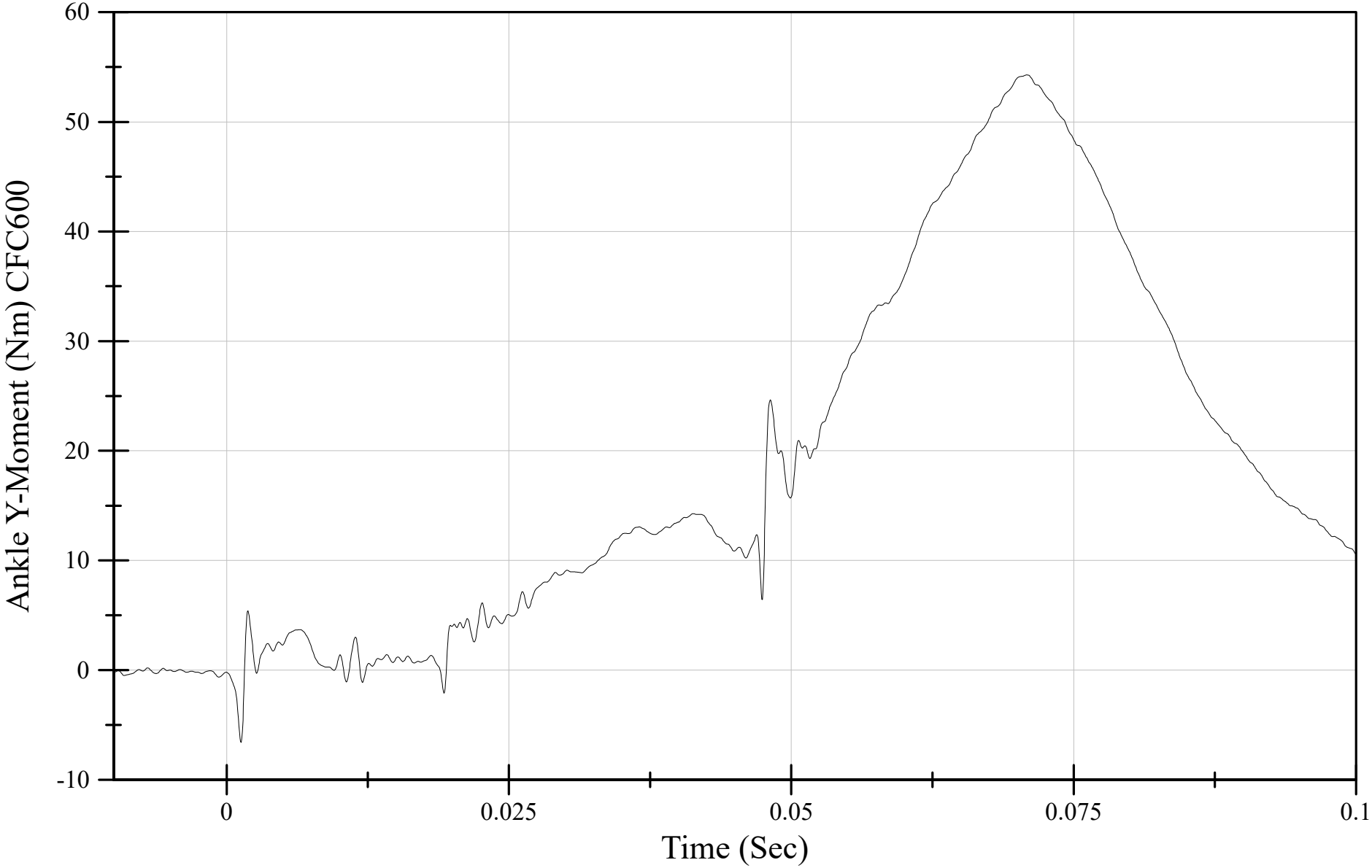
THOR-05F Right Ball of Foot Qualification
Lower Tibia Fz
Ankle Serial Number: EV3870



File Name: 220926-6 processed

9/26/2022 9:47 AM

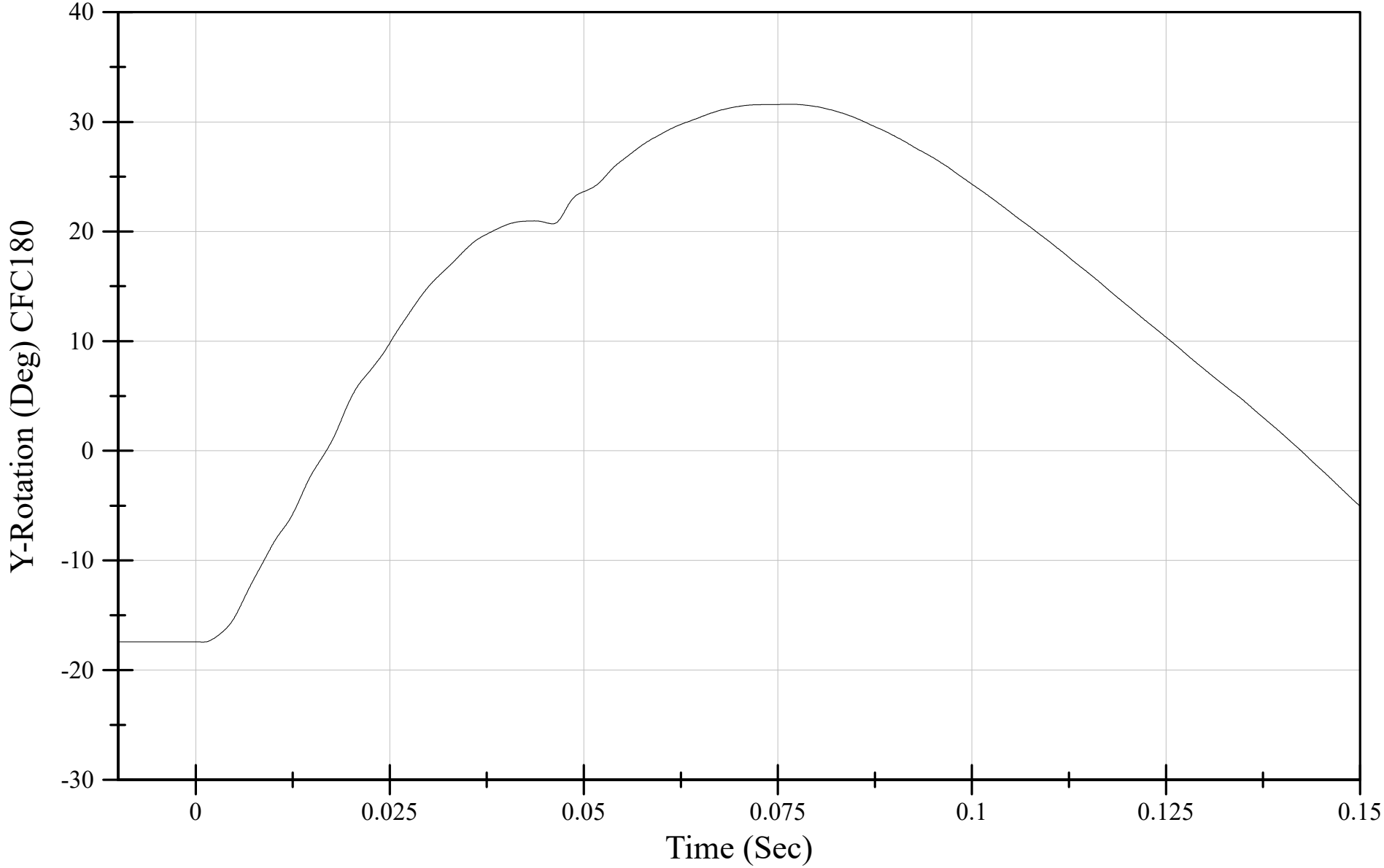
THOR-05F Right Ball of Foot Qualification
Ankle Y-Moment
Ankle Serial Number: EV3870



File Name: 220926-6 processed

9/26/2022 9:47 AM

THOR-05F Right Ball of Foot Qualification
Ankle Y-Rotation
Ankle Serial Number: EV3870



File Name: 220926-6 processed

9/26/2022 9:47 AM

THOR-05F Right Foot Inversion Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components	Test ID: 220922-8
Ankle Serial: EV3870	Test Date: 9/22/2022
Inversion Stop Assembly: ET6304	Test Time: 3:12 PM

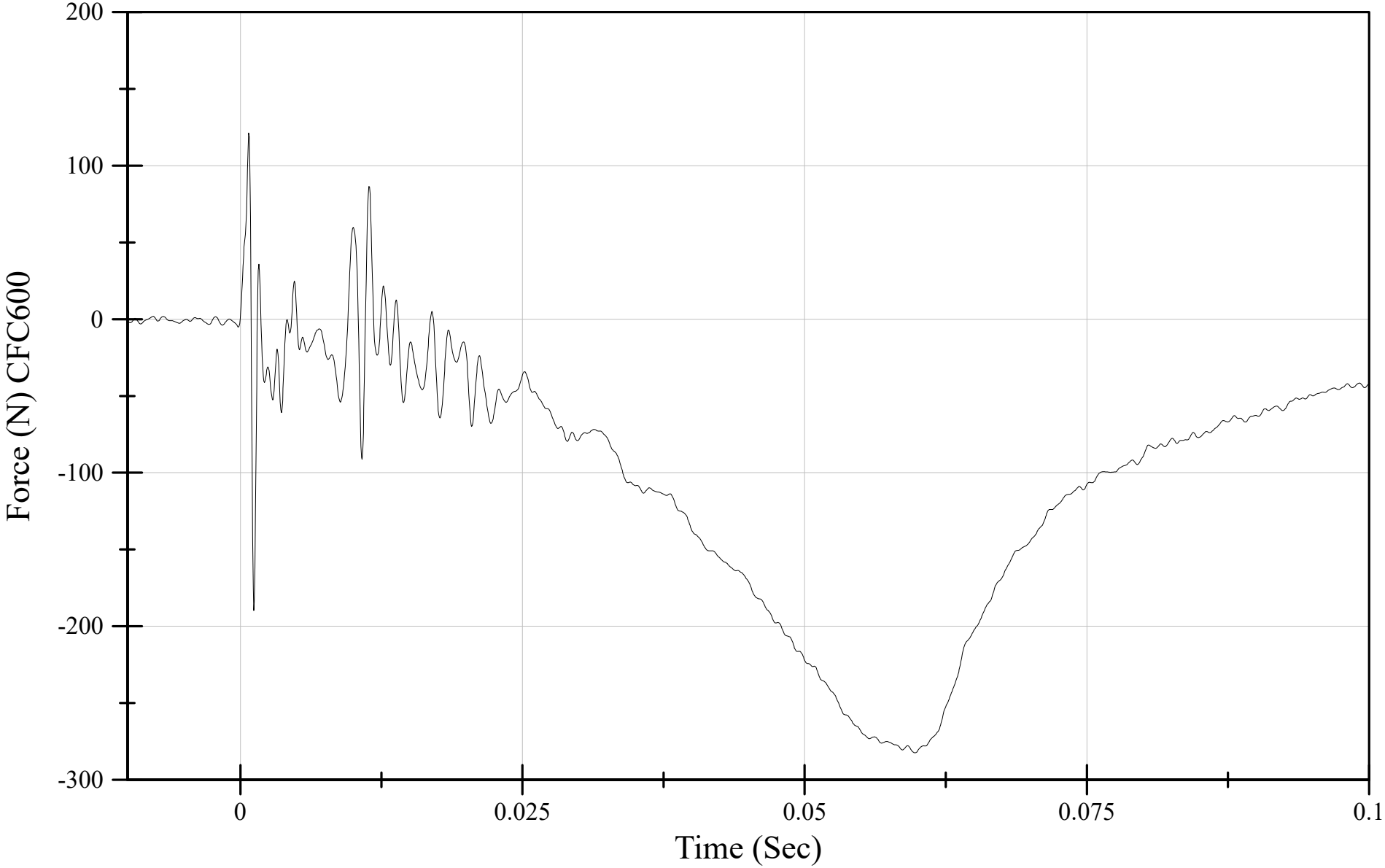
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.4	Pass
Test Humidity (%)	10 - 70	53	Pass
Test Velocity (m/s)	1.95 - 2.05	2.05	Pass
Peak Lower Tibia Fz		-282.5	
Peak Ankle X-axis Resistive Moment		30.9	
Peak Ankle X-axis Rotation		47.4	

* THOR-05F Qualification Manual - July 2022

File Name: 220922-8 processed
Software Version: 2.8

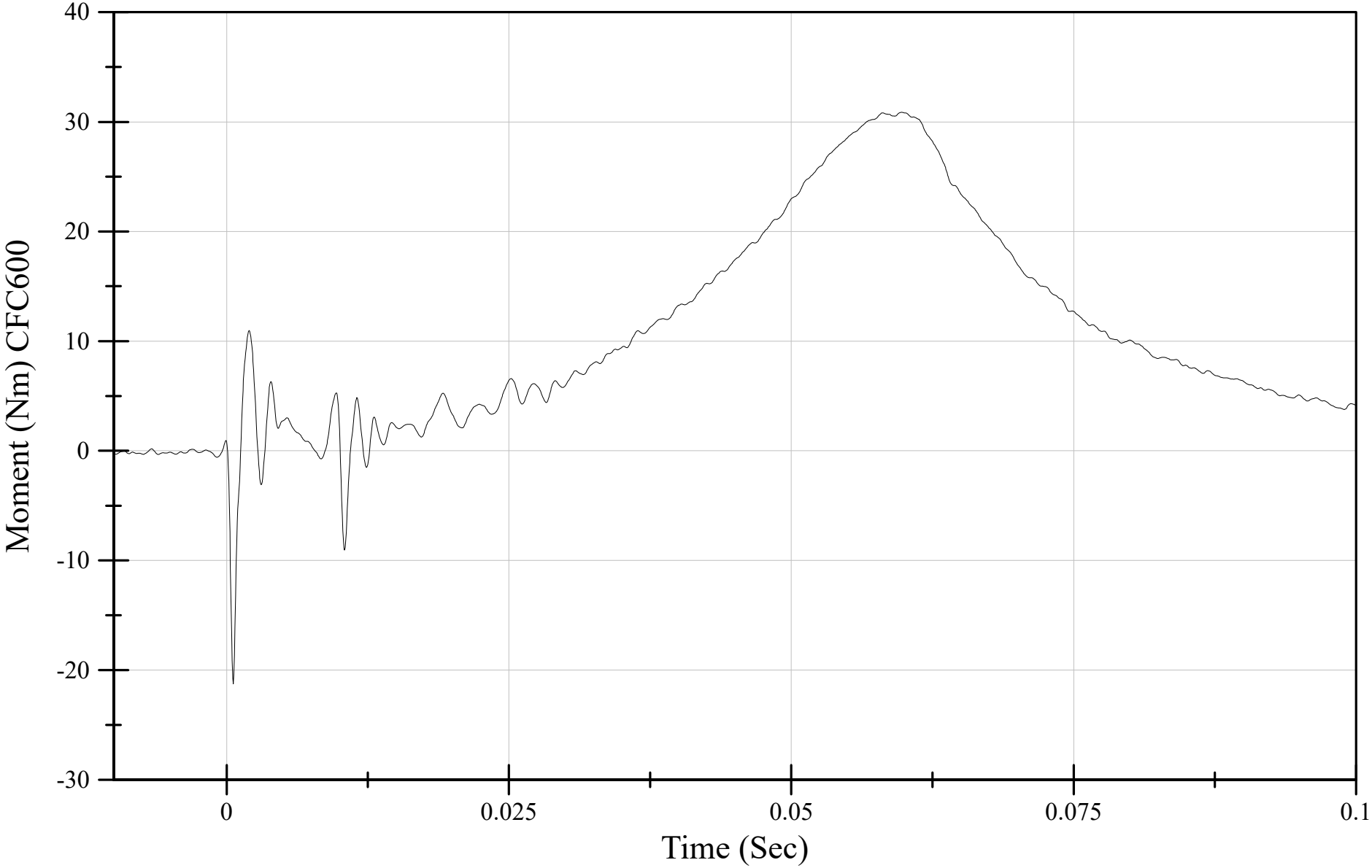
THOR-05F Right Foot Inversion Qualification
Tibia Load - Force Z
Ankle Serial Number: EV3870



File Name: 220922-8 processed

9/22/2022 3:12 PM

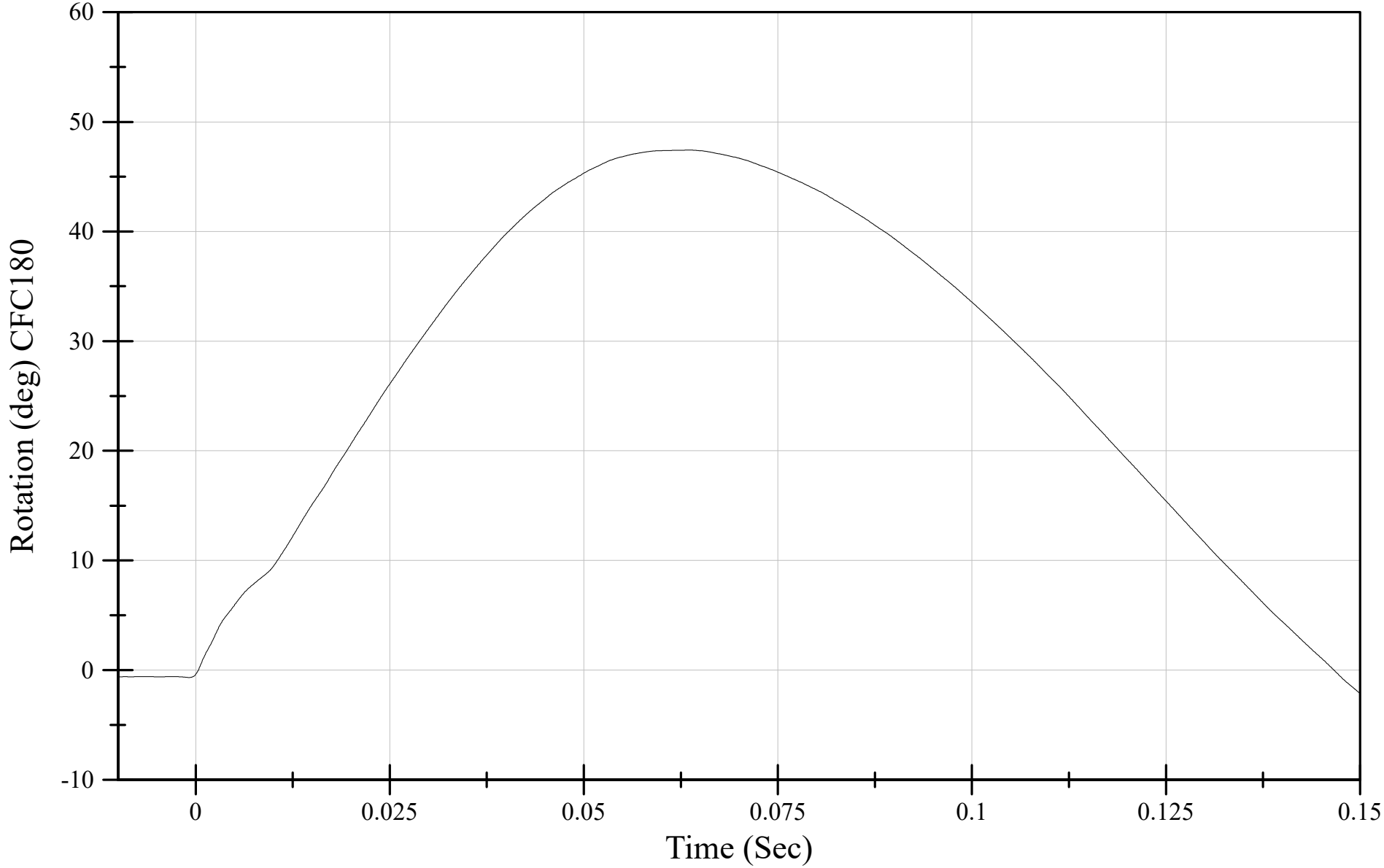
THOR-05F Right Foot Inversion Qualification
Ankle Moment - X axis
Ankle Serial Number: EV3870



File Name: 220922-8 processed

9/22/2022 3:12 PM

THOR-05F Right Foot Inversion Qualification
Ankle X-Rotation
Ankle Serial Number: EV3870



File Name: 220922-8 processed

9/22/2022 3:12 PM

THOR-05F Right Foot Eversion Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components	Test ID: 220922-9
Ankle Serial: EV3870	Test Date: 9/22/2022
Eversion Stop Assembly: ET9523	Test Time: 3:48 PM

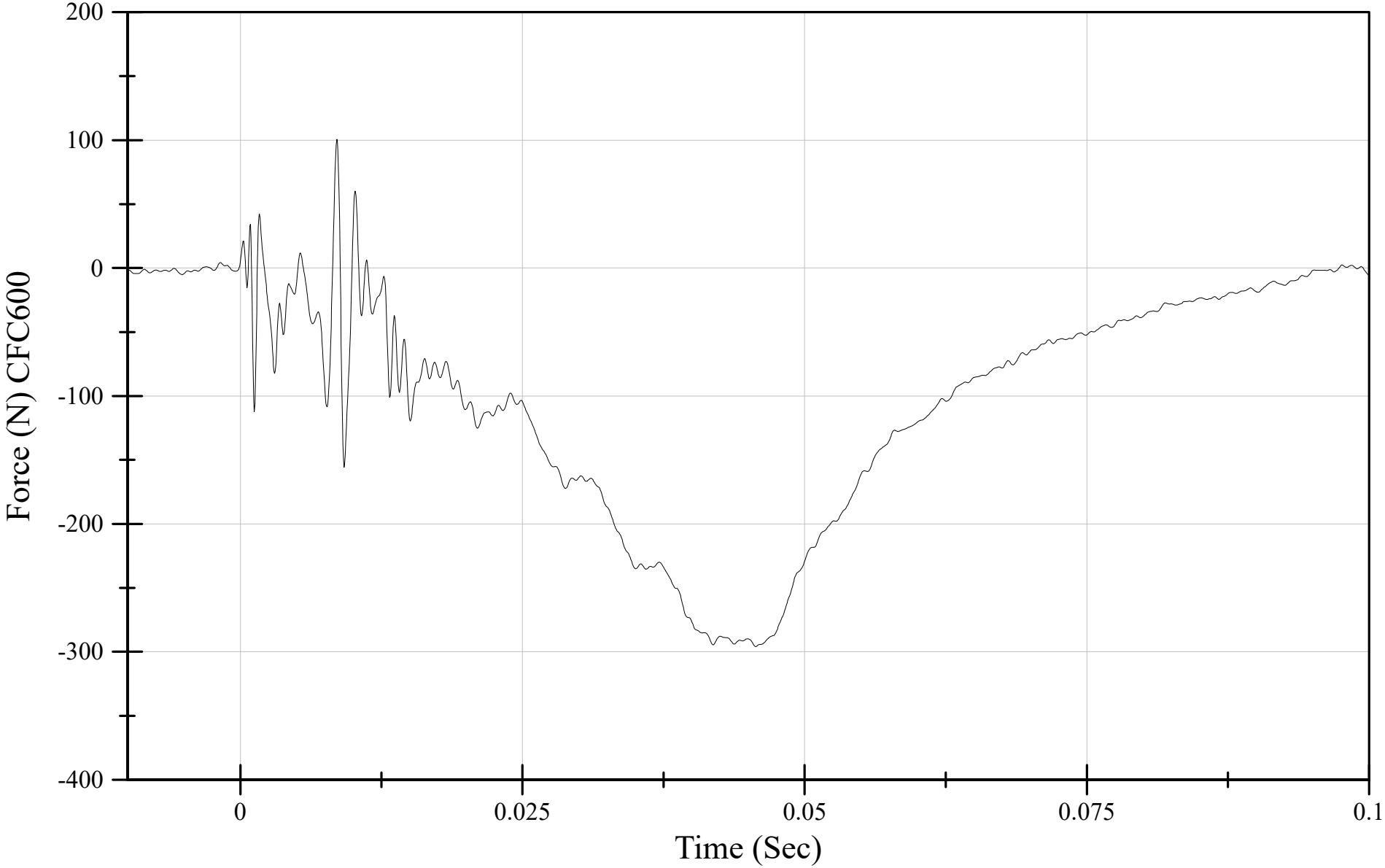
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.4	Pass
Test Humidity (%)	10 - 70	53	Pass
Test Velocity (m/s)	1.95 - 2.05	2.01	Pass
Peak Lower Tibia Fz		-295.9	
Peak Ankle X-axis Resistive Moment		-28.0	
Peak Ankle X-axis Rotation		-31.4	

* THOR-05F Qualification Manual - July 2022

File Name: 220922-9 processed
Software Version: 2.8

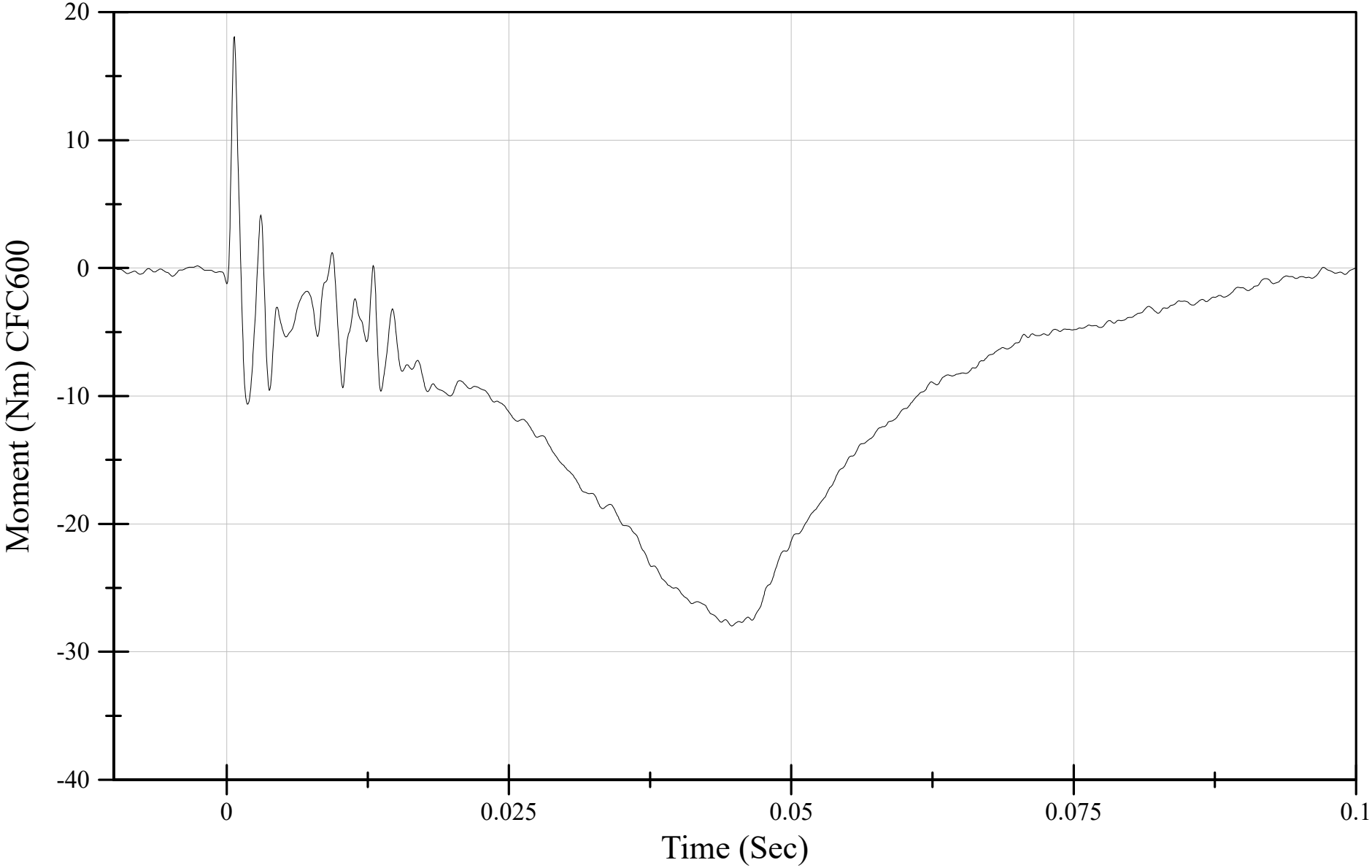
THOR-05F Right Foot Eversion Qualification
Tibia Load - Force Z
Ankle Serial Number: EV3870



File Name: 220922-9 processed

9/22/2022 3:48 PM

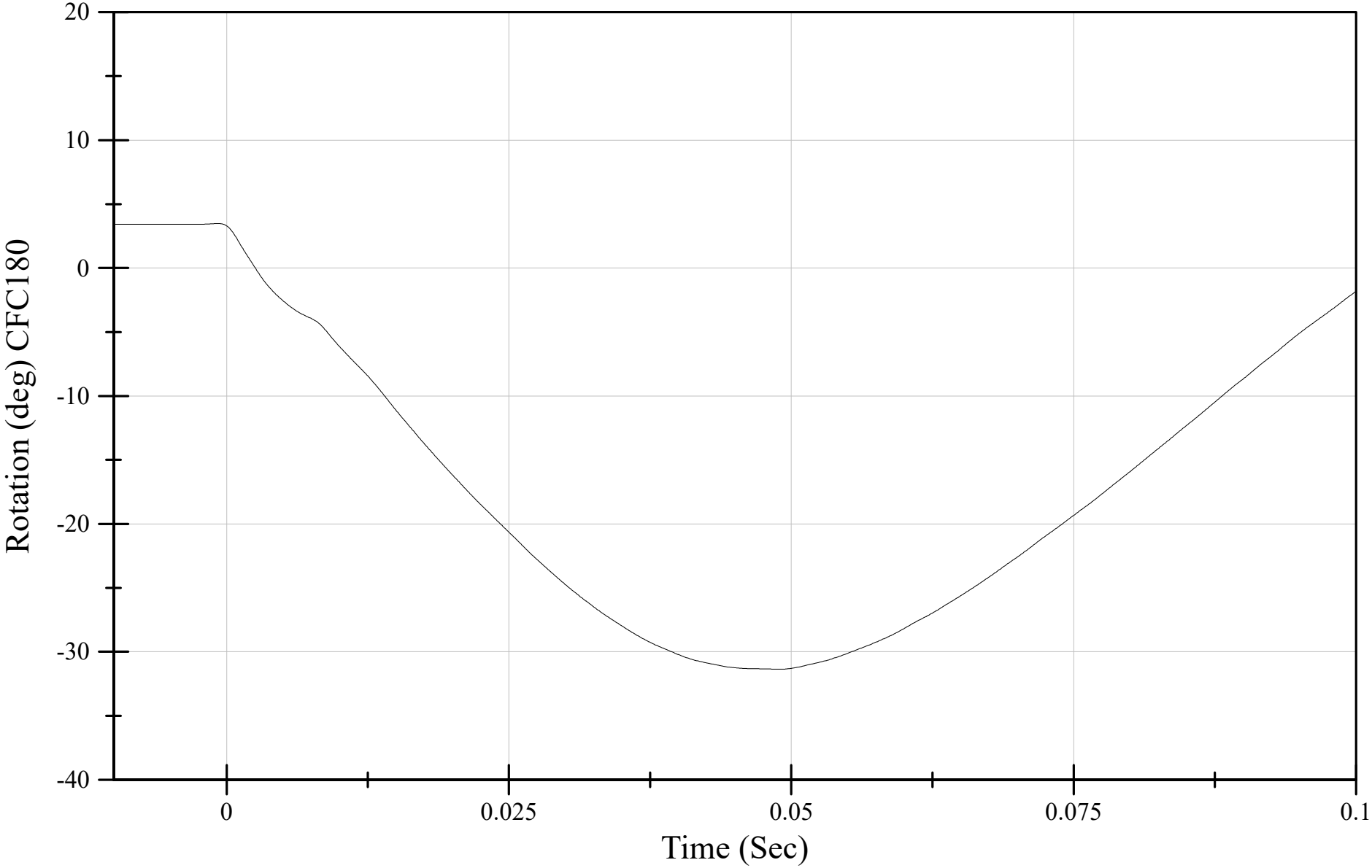
THOR-05F Right Foot Eversion Qualification
Ankle Moment - X axis
Ankle Serial Number: EV3870



File Name: 220922-9 processed

9/22/2022 3:48 PM

THOR-05F Right Foot Eversion Qualification
Ankle X-Rotation
Ankle Serial Number: EV3870



File Name: 220922-9 processed

9/22/2022 3:48 PM

THOR-05F Right Heel Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Right Ankle: EV3870

Test ID: 220926-9
Test Date: 9/26/2022
Test Time: 2:41 PM

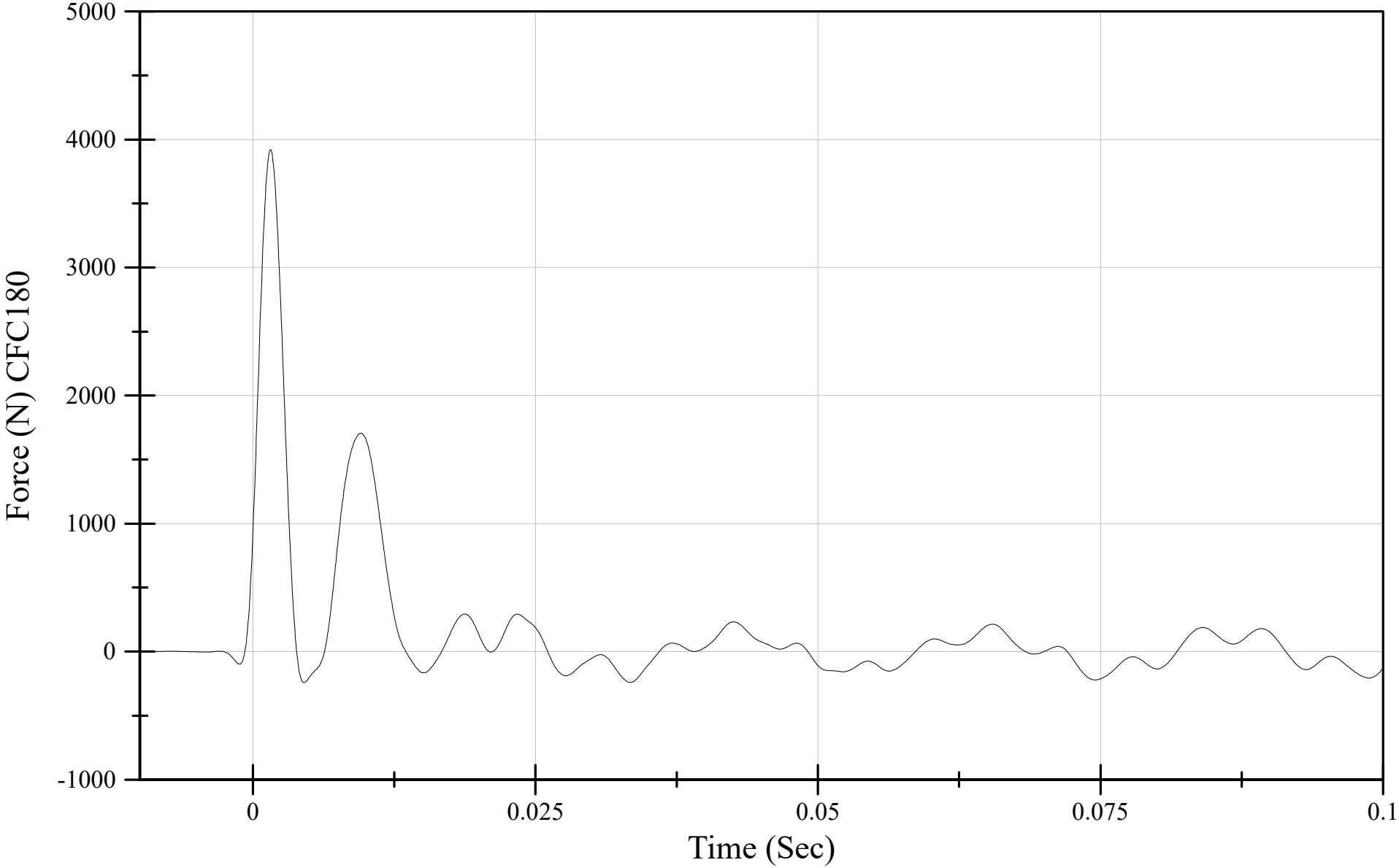
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.4	Pass
Test Humidity (%)	10 - 70	44	Pass
Test Velocity (m/s)	3.95 - 4.05	4.00	Pass
Probe Force (N)		3921.1	
Peak Lower Tibia Fz (N)		-2121.9	

* THOR-05F Qualification Manual - July 2022

File Name: 220926-9 processed
Software Version: 2.8

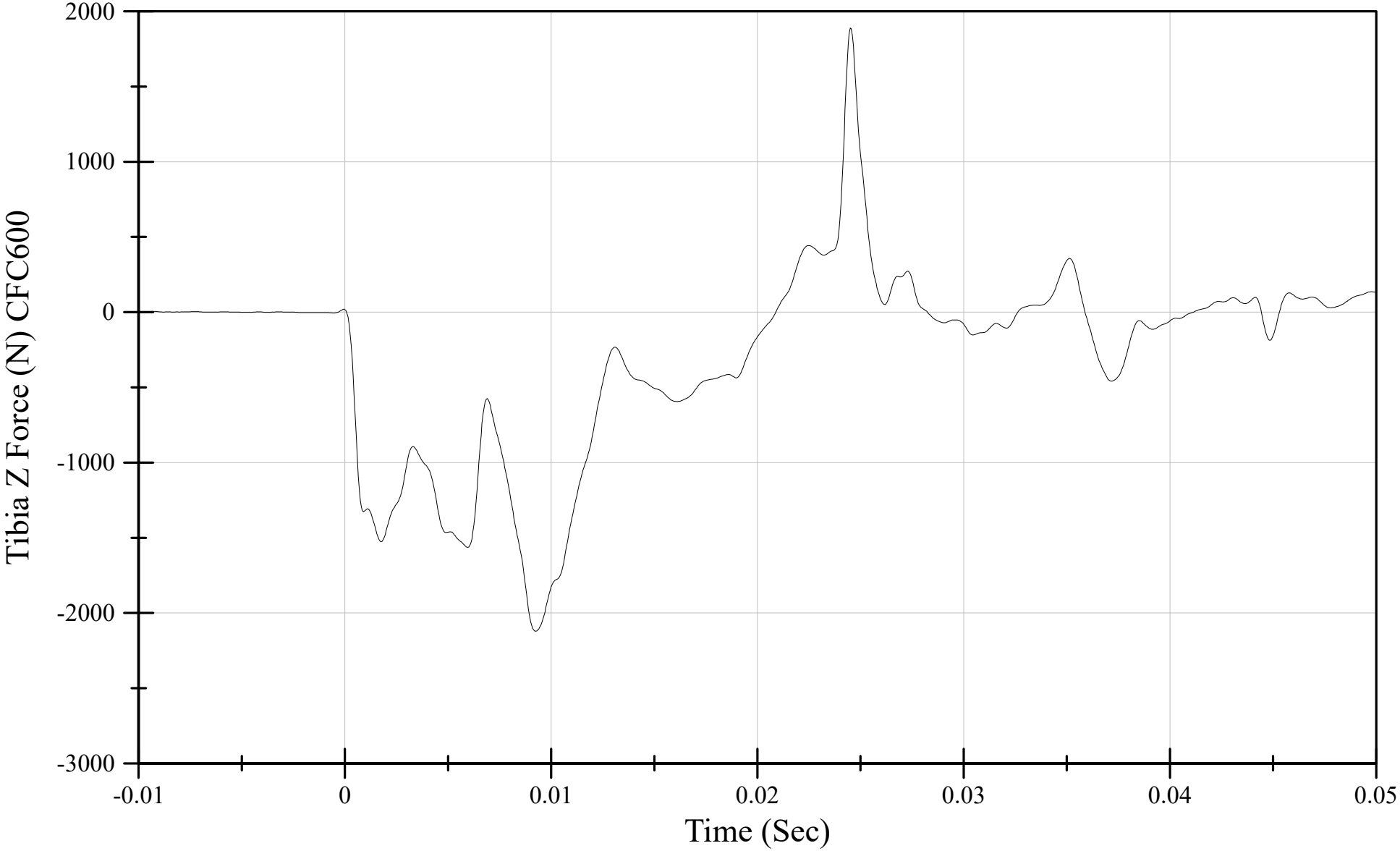
THOR-05F Right Heel Qualification
Probe Force
Dummy Serial Number: EU3430



File Name: 220926-9 processed

9/26/2022 2:41 PM

THOR-05F Right Heel Qualification
Tibia Load
Serial Number: EU3430



File Name: 220926-9 processed

9/26/2022 2:41 PM

THOR-05F Head Impact Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Head Skin: ET8171

Test ID: 221207-4
Test Date: 12/7/2022
Test Time: 10:59 AM

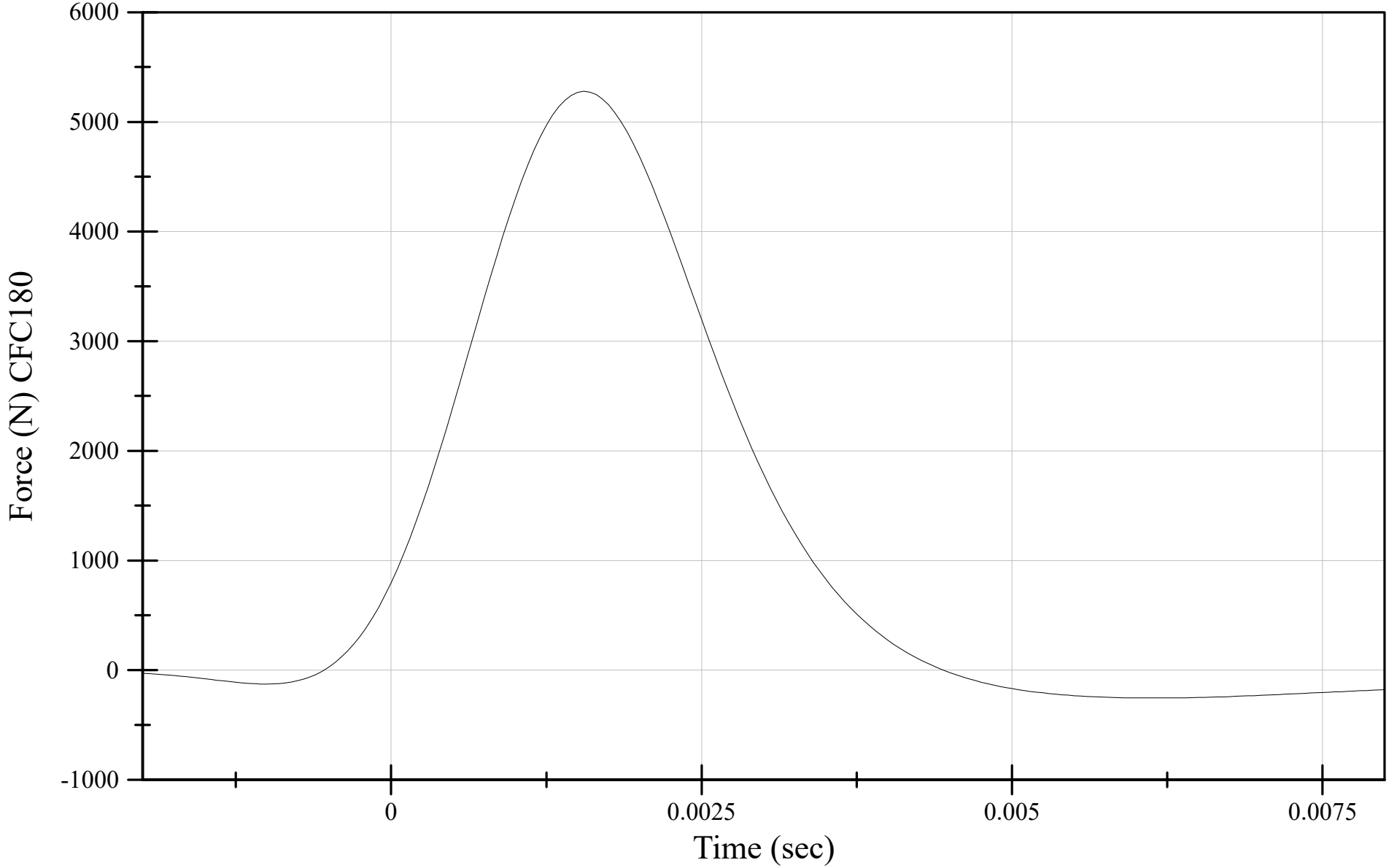
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.3	Pass
Test Humidity (%)	10 - 70	47	Pass
Test Velocity (m/s)	1.95 - 2.05	1.97	Pass
Peak Probe Force (N)		5279	
Peak Head CG Resultant Acceleration (g)		147	

* THOR-05F Qualification Manual - July 2022

File Name: 221207-4 processed
Software Version: 2.8

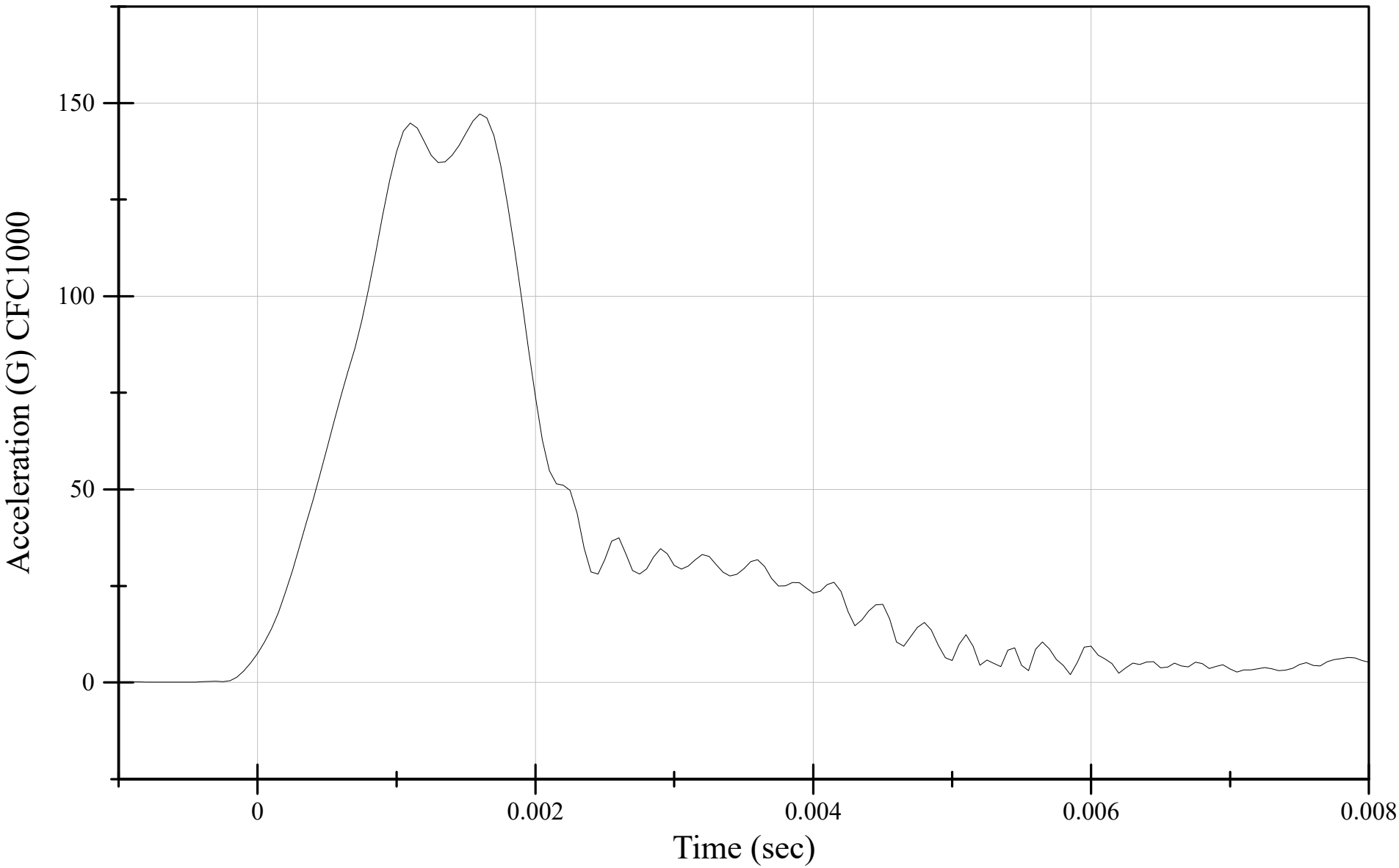
THOR-05F Head Impact Qualification
Probe Force
Dummy Serial Number: EU3430



File Name: 221207-4 processed

12/7/2022 10:59 AM

THOR-05F Head Impact Qualification
Head CG Resultant Acceleration
Dummy Serial Number: EU3430



File Name: 221207-4 processed

12/7/2022 10:59 AM

THOR-05F Face Disk Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components

Head Skin: ET8171

Face Foam: ET4086

Test ID: 221207-6

Test Date: 12/7/2022

Test Time: 11:45 AM

Test Results

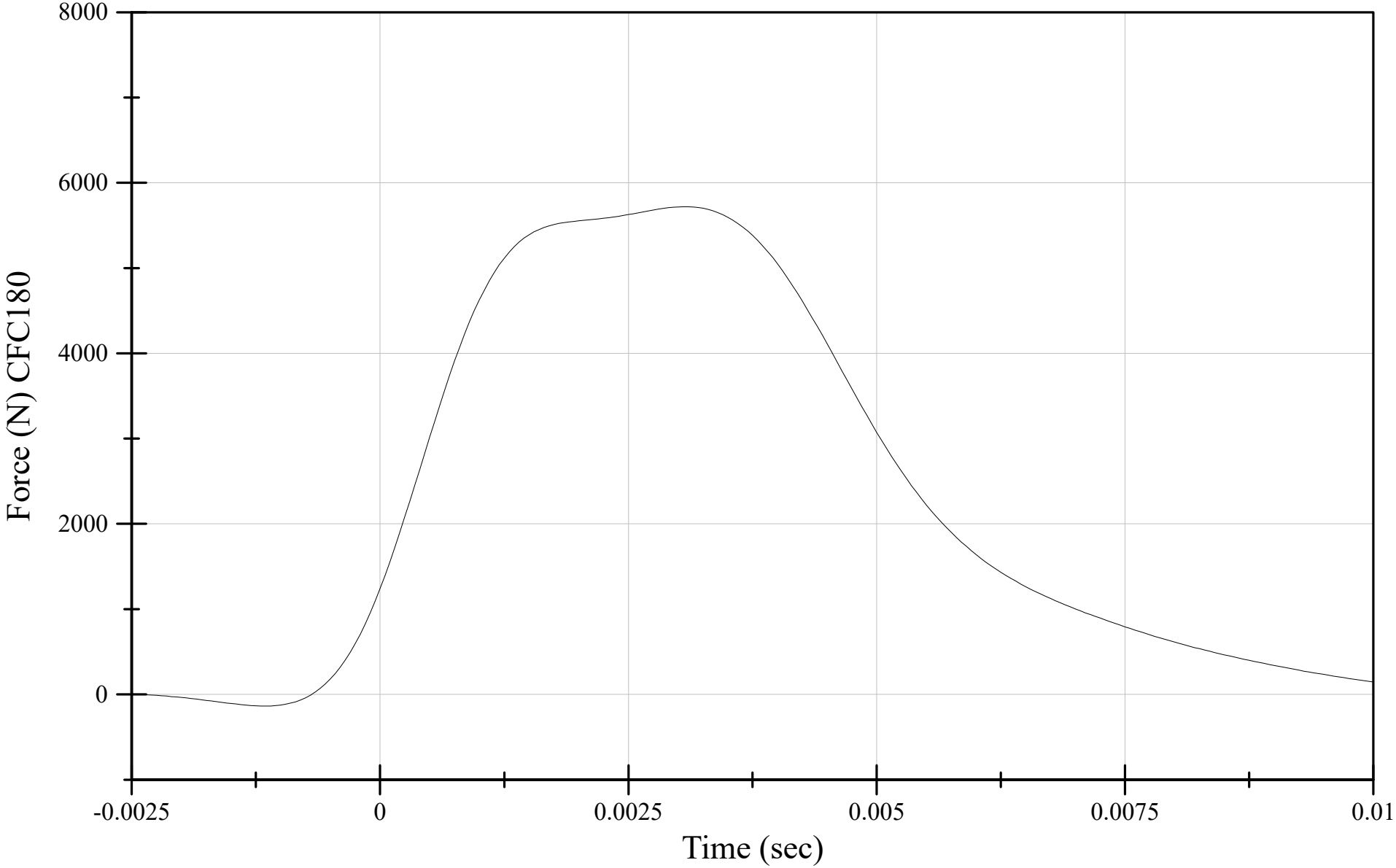
Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.2	Pass
Test Humidity (%)	10 - 70	48	Pass
Test Velocity (m/s)	6.68 - 6.78	6.72	Pass
Peak Probe Force (N)		5720	
Peak Head CG Resultant Acceleration prior to 2 ms (g)		145	
Peak Head CG Resultant Acceleration after to 2 ms (g)		158	

* THOR-05F Qualification Manual - July 2022

File Name: 221207-6 processed

Software Version: 2.8

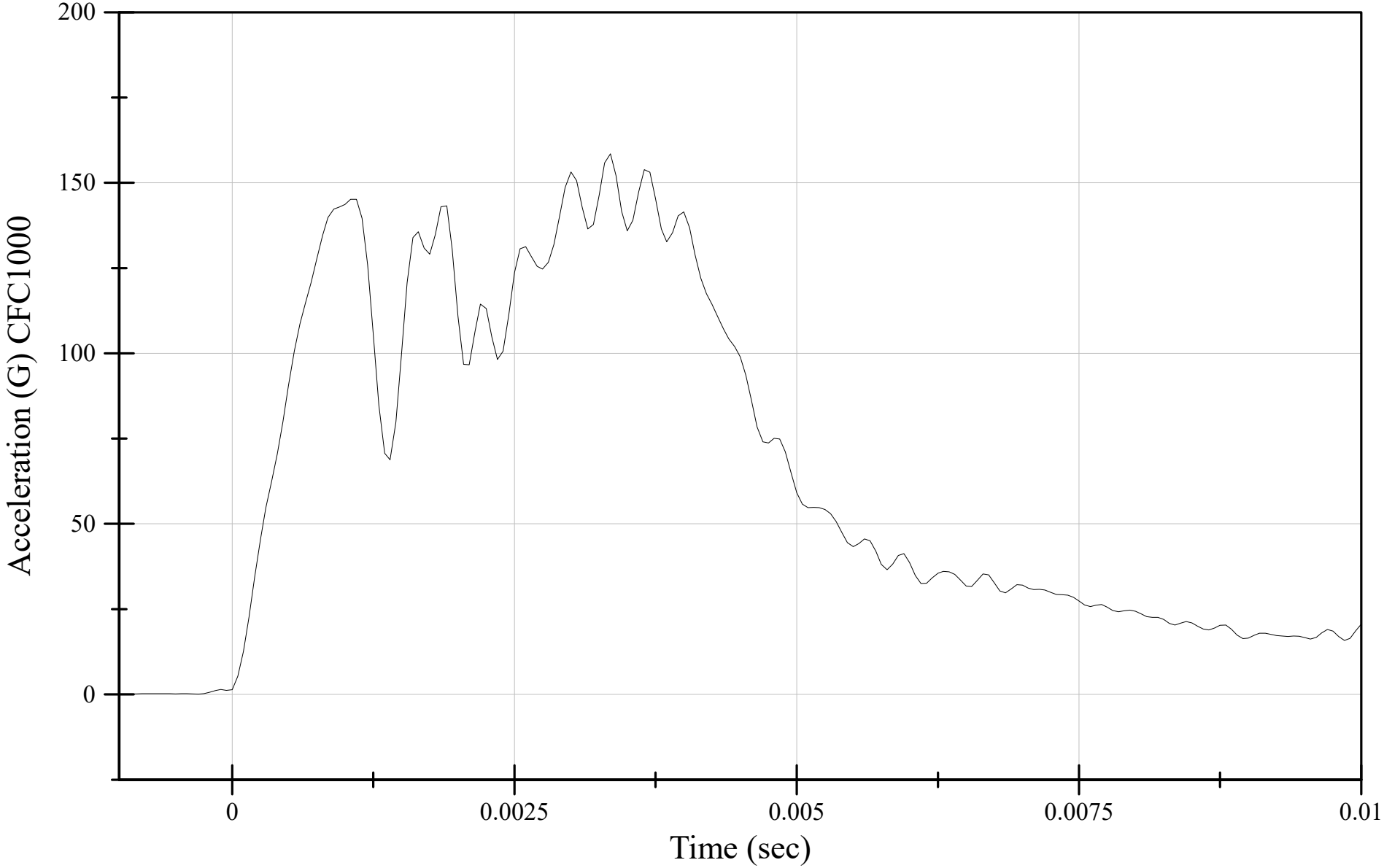
THOR-05F Face Disk Qualification
Probe Force
Dummy Serial Number: EU3430



File Name: 221207-6 processed

12/7/2022 11:45 AM

THOR-05F Face Disk Qualification
Head CG Resultant Acceleration
Dummy Serial Number: EU3430



File Name: 221207-6 processed

12/7/2022 11:45 AM

THOR-05F Neck Extension Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components	Test ID: 221130-6
Neck Serial Number: EU1156	Test Date: 11/30/2022
O.C. Stop Assembly:	Test Time: 9:42 AM
O.C. Cam:	

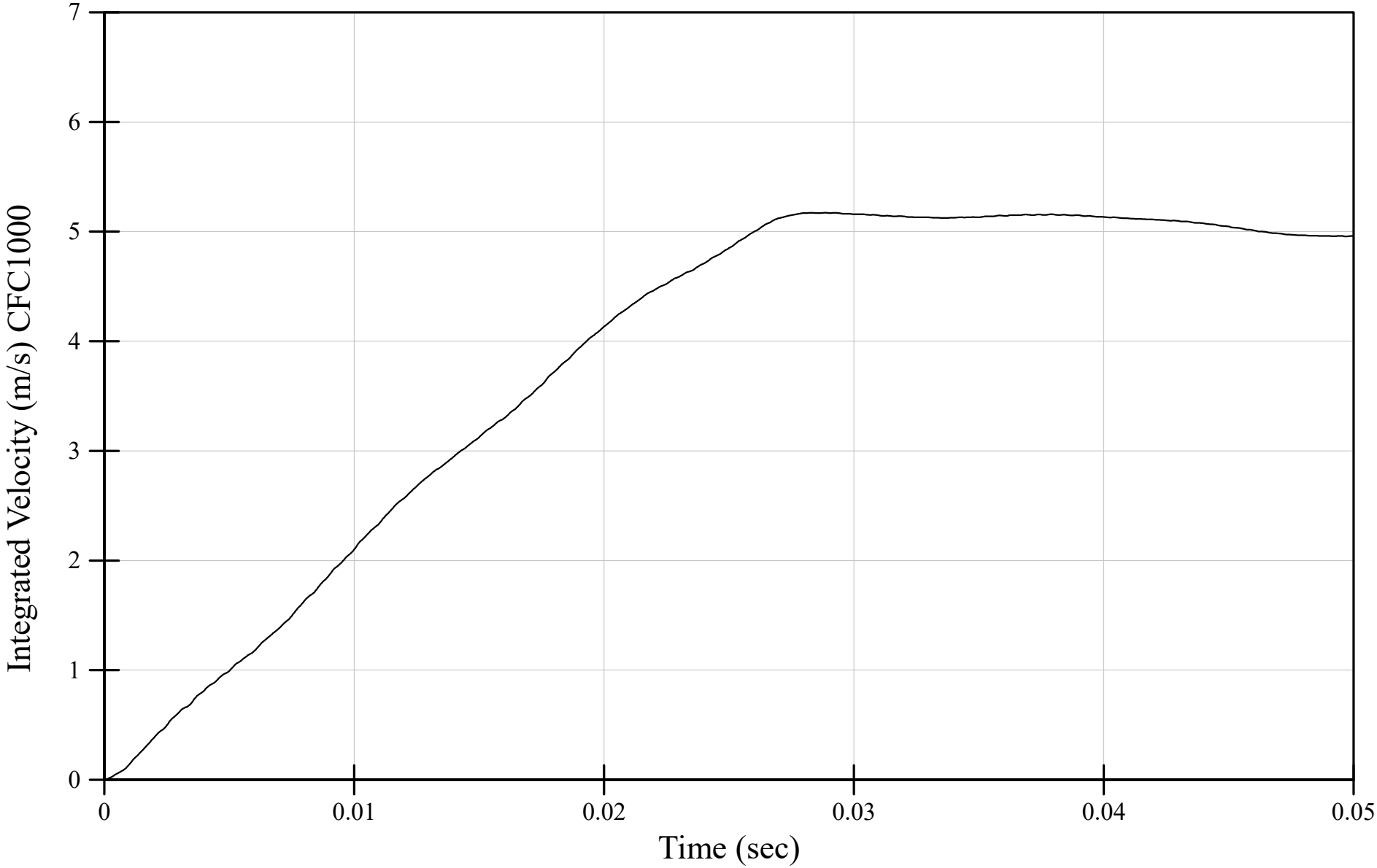
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.2	Pass
Test Humidity (%)	10 - 70	52	Pass
Test Velocity (m/s)	4.95 - 5.05	4.97	Pass
Pendulum Velocity at 8 ms (m/s)		1.63	
Pendulum Velocity at 16 ms (m/s)		3.30	
Pendulum Velocity at 24 ms (m/s)		4.71	
Peak Upper Neck My (Nm)		-18.9	
Peak Upper Neck Fz (N)		-1213	
Peak Head Angular Velocity Y (deg/sec)		2319	
Peak Head Rotation (deg)		86.3	

* THOR-05F Qualification Manual - July 2022

File Name: 221130-6 processed

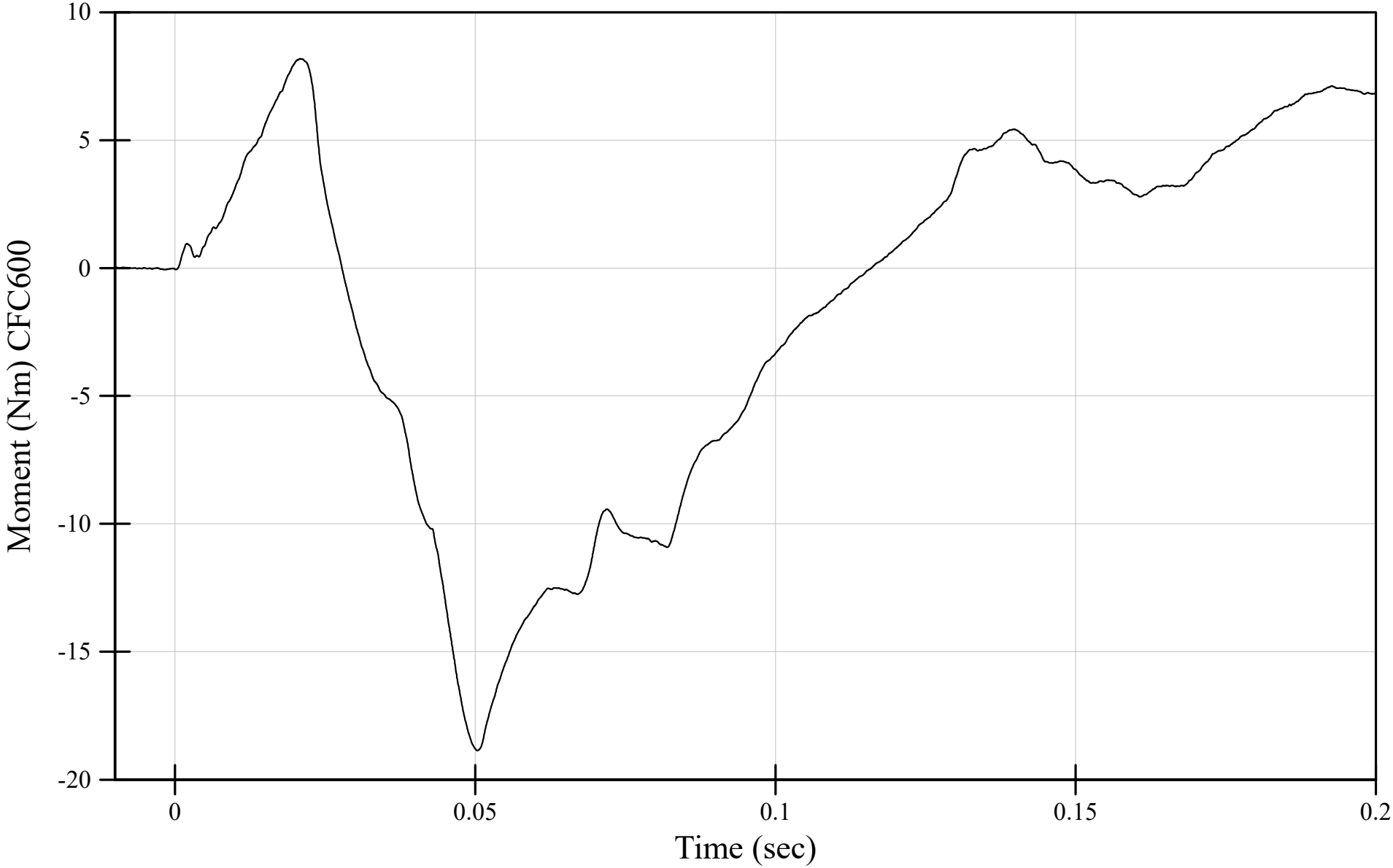
THOR-05F Neck Extension Qualification
Probe Acceleration
Neck Serial Number: EU1156



File Name: 221130-6 processed

11/30/2022 9:42 AM

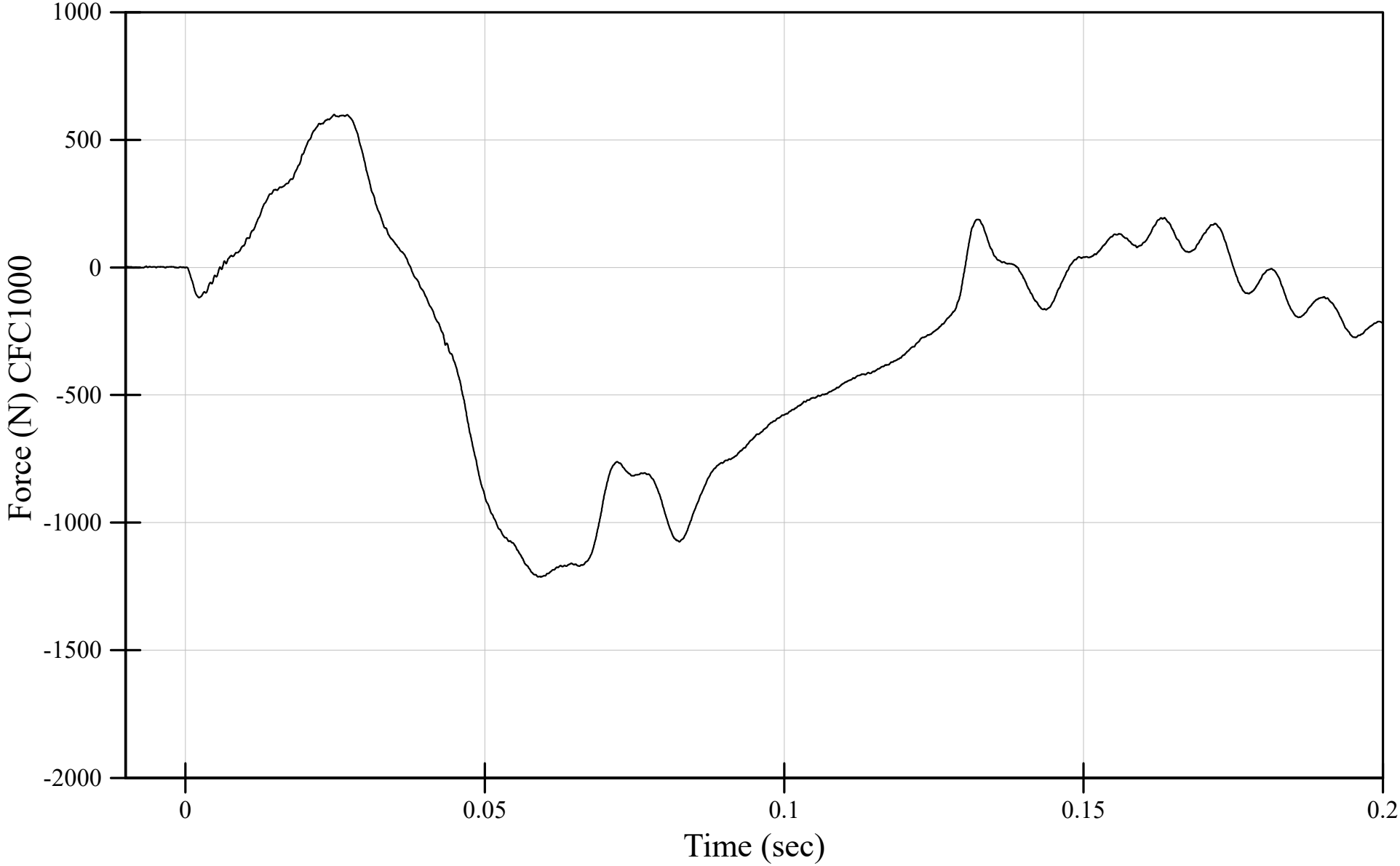
THOR-05F Neck Extension Qualification
Y-Moment as Measured
Neck Serial Number: EU1156



File Name: 221130-6 processed

11/30/2022 9:42 AM

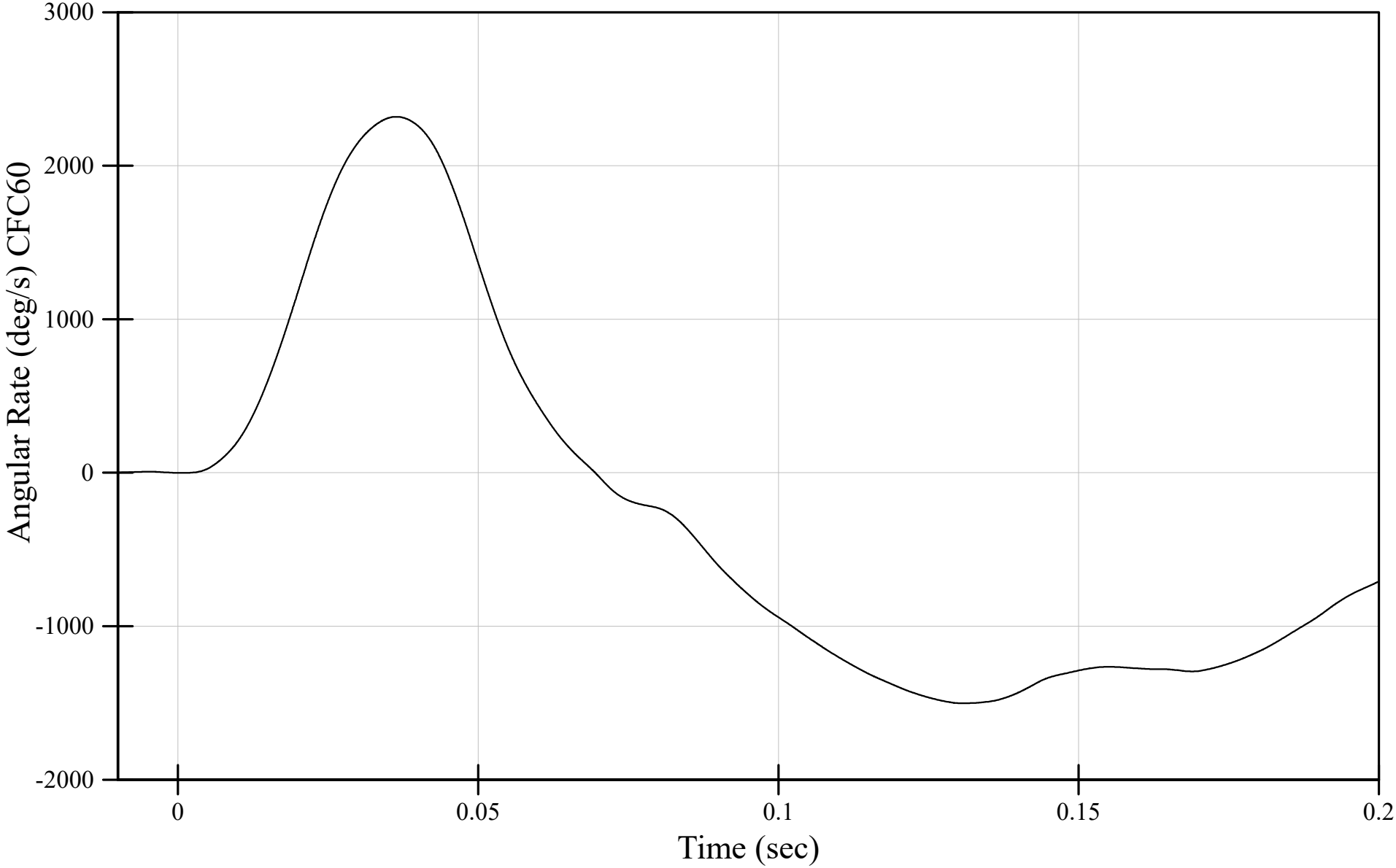
THOR-05F Neck Extension Qualification
Z-Force as Measured
Neck Serial Number: EU1156



File Name: 221130-6 processed

11/30/2022 9:42 AM

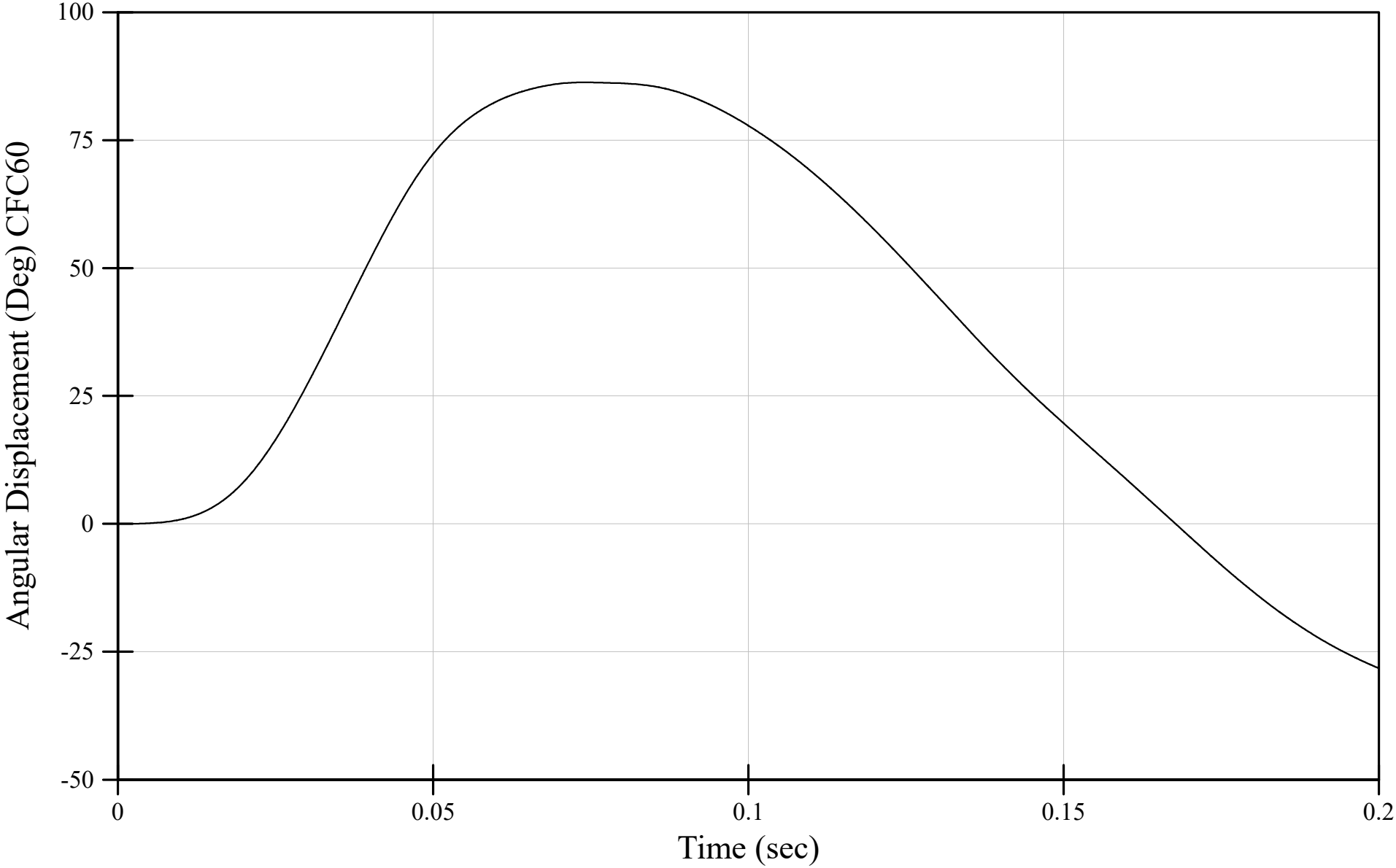
THOR-05F Neck Extension Qualification
Peak Head Angular Rate
Neck Serial Number: EU1156



File Name: 221130-6 processed

11/30/2022 9:42 AM

THOR-05F Neck Extension Qualification
Neck Rotation
Neck Serial Number: EU1156



File Name: 221130-6 processed

11/30/2022 9:42 AM

THOR-05F Neck Front Flexion Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Neck Serial Number: EU1156
O.C. Stop Assembly:
O.C. Cam:

Test ID: 221130-9
Test Date: 11/30/2022
Test Time: 11:32 AM

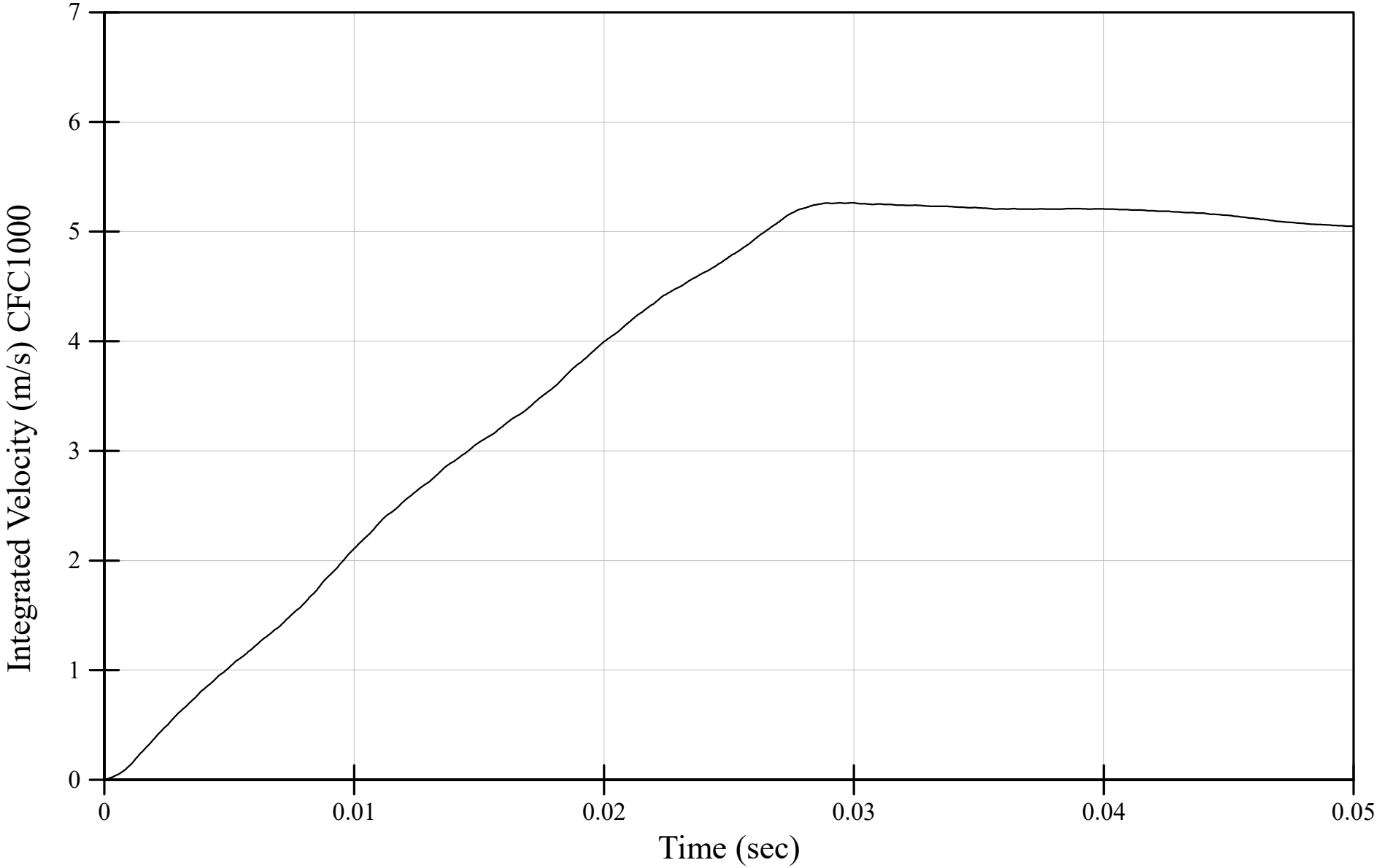
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.2	Pass
Test Humidity (%)	10 - 70	55	Pass
Test Velocity (m/s)	4.95 - 5.05	5.02	Pass
Pendulum Velocity at 8 ms (m/s)		1.61	
Pendulum Velocity at 16 ms (m/s)		3.24	
Pendulum Velocity at 24 ms (m/s)		4.63	
Peak Upper Neck My (Nm)		18.1	
Peak Upper Neck Fz prior to 40 ms (N)		694	
Peak Head Angular Velocity Y (deg/sec)		-2037	
Peak Head Rotation (deg)		-76.1	

* THOR-05F Qualification Manual - July 2022

File Name: 221130-9 processed
Software Version: 2.8

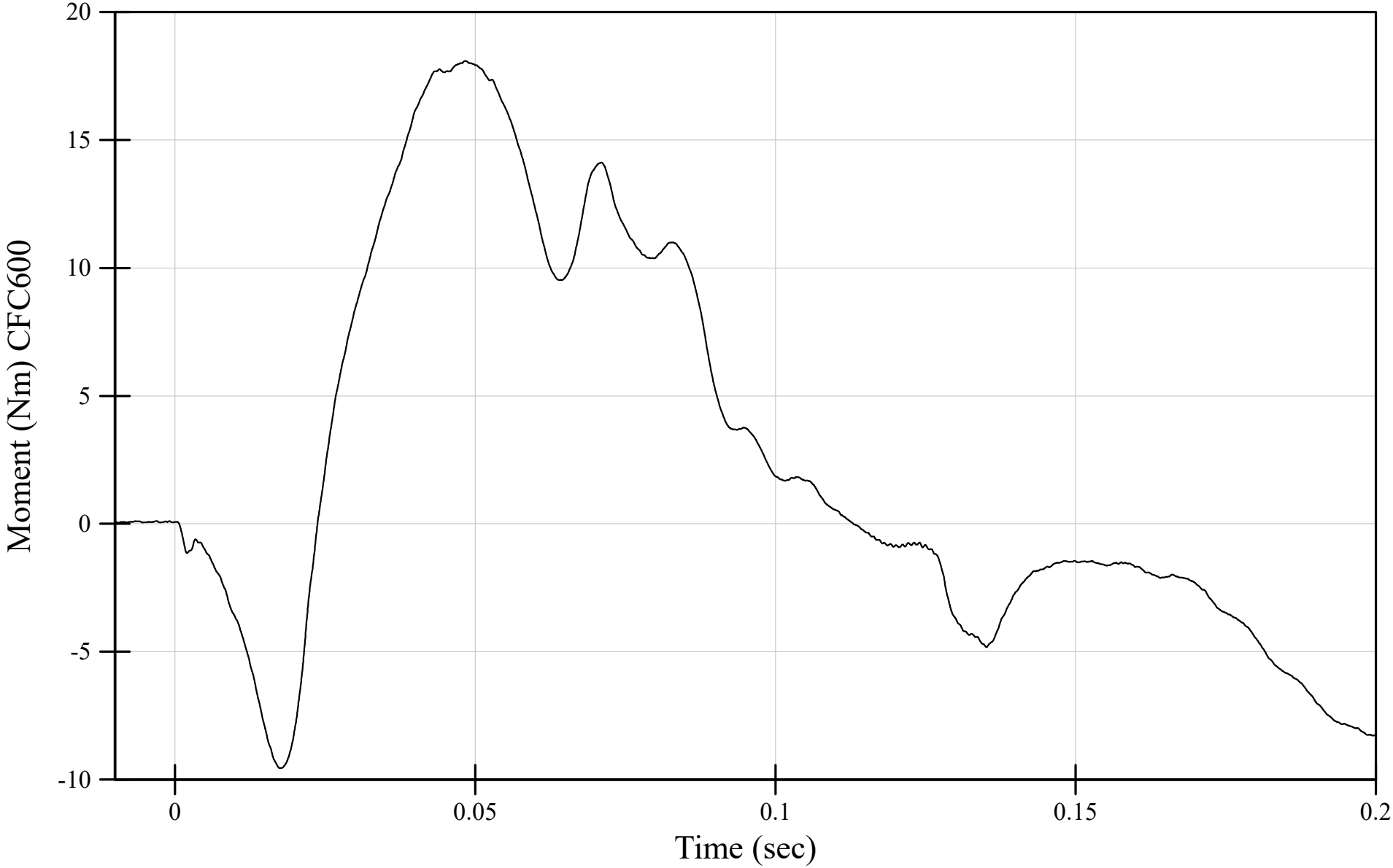
THOR-05F Neck Flexion Qualification
Pendulum Pulse
Neck Serial Number: EU1156



File Name: 221130-9 processed

11/30/2022 11:32 AM

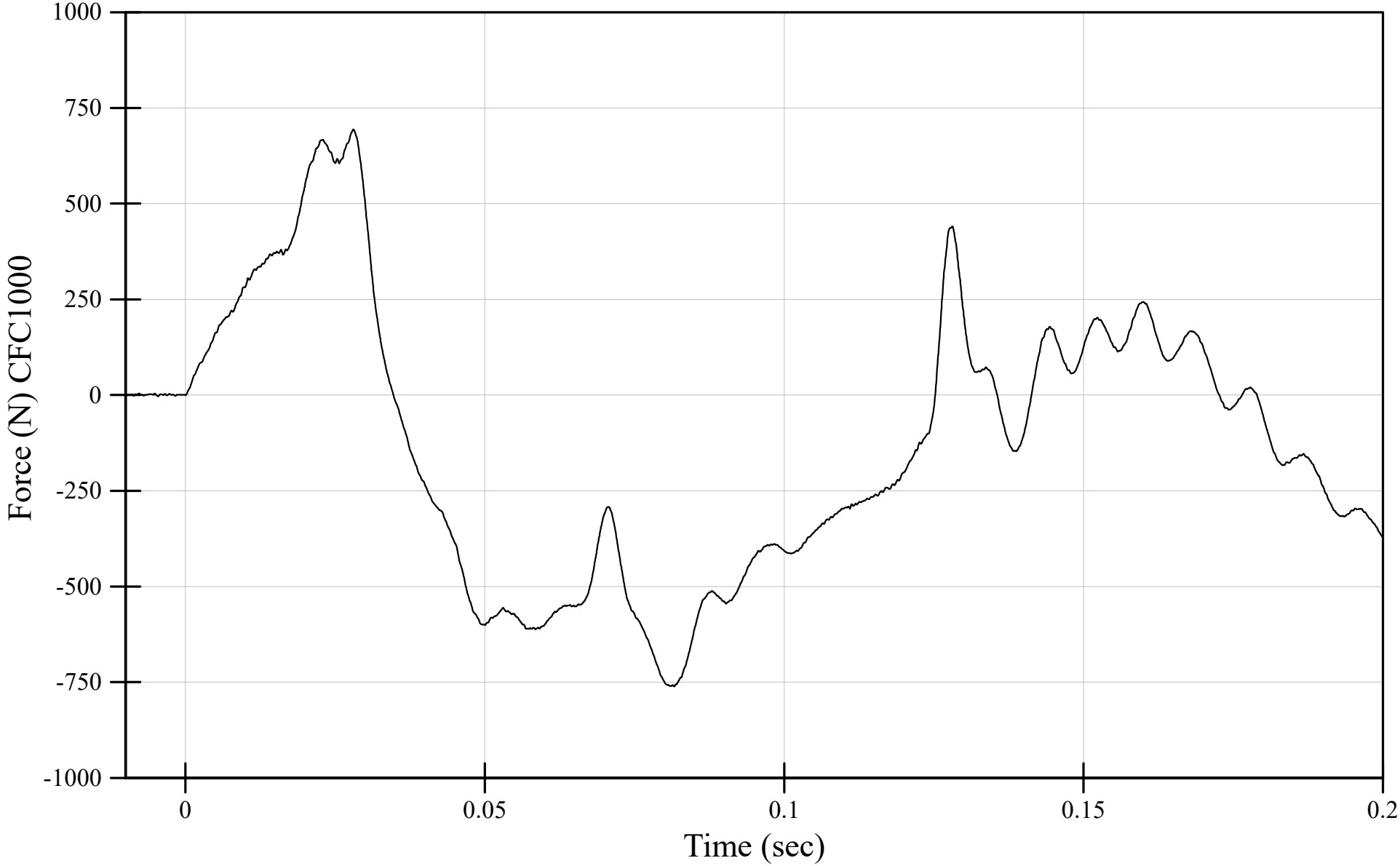
THOR-05F Neck Flexion Qualification
Y-Moment as Measured
Neck Serial Number: EU1156



File Name: 221130-9 processed

11/30/2022 11:32 AM

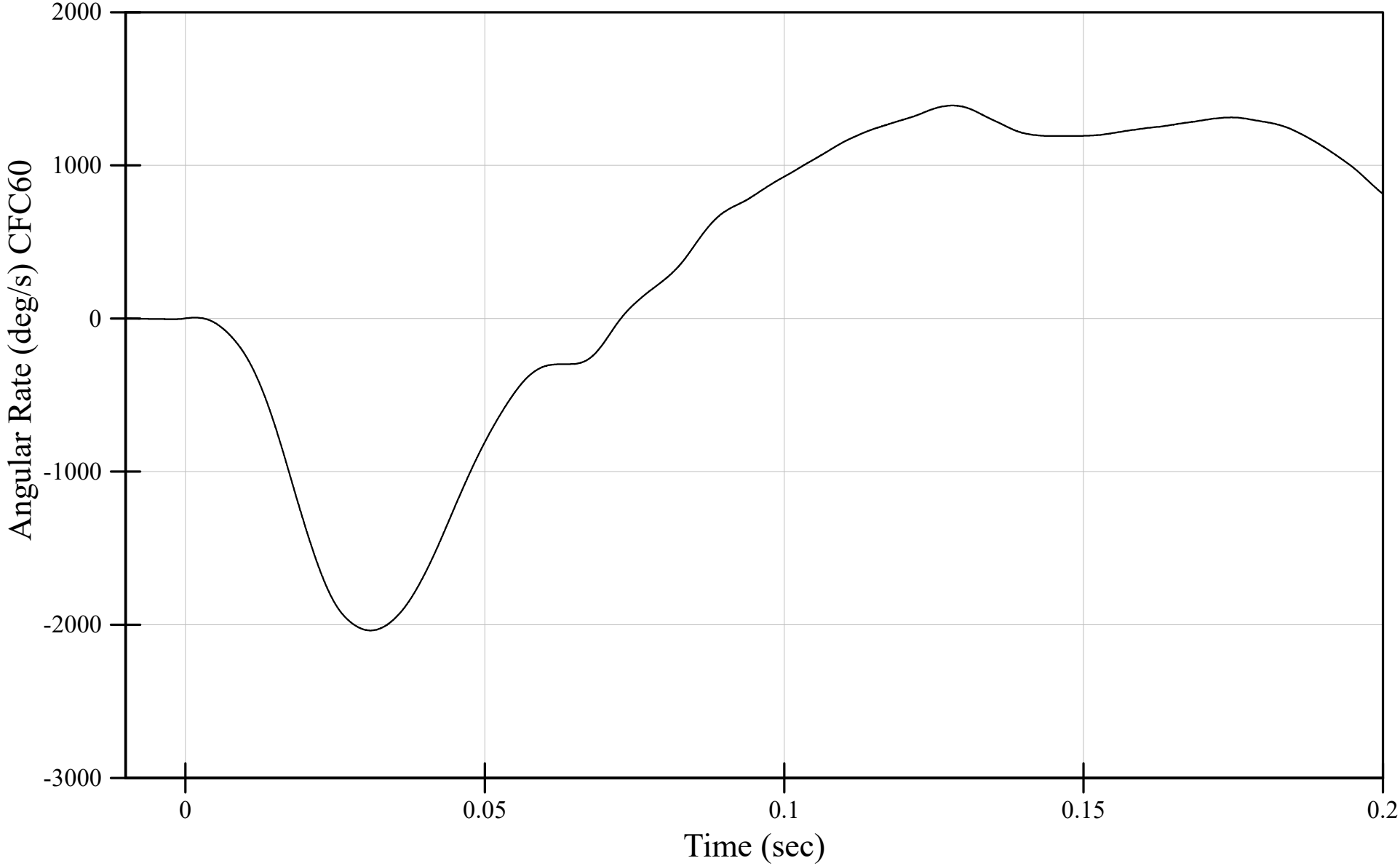
THOR-05F Neck Flexion Qualification
Z-Force as Measured
Neck Serial Number: EU1156



File Name: 221130-9 processed

11/30/2022 11:32 AM

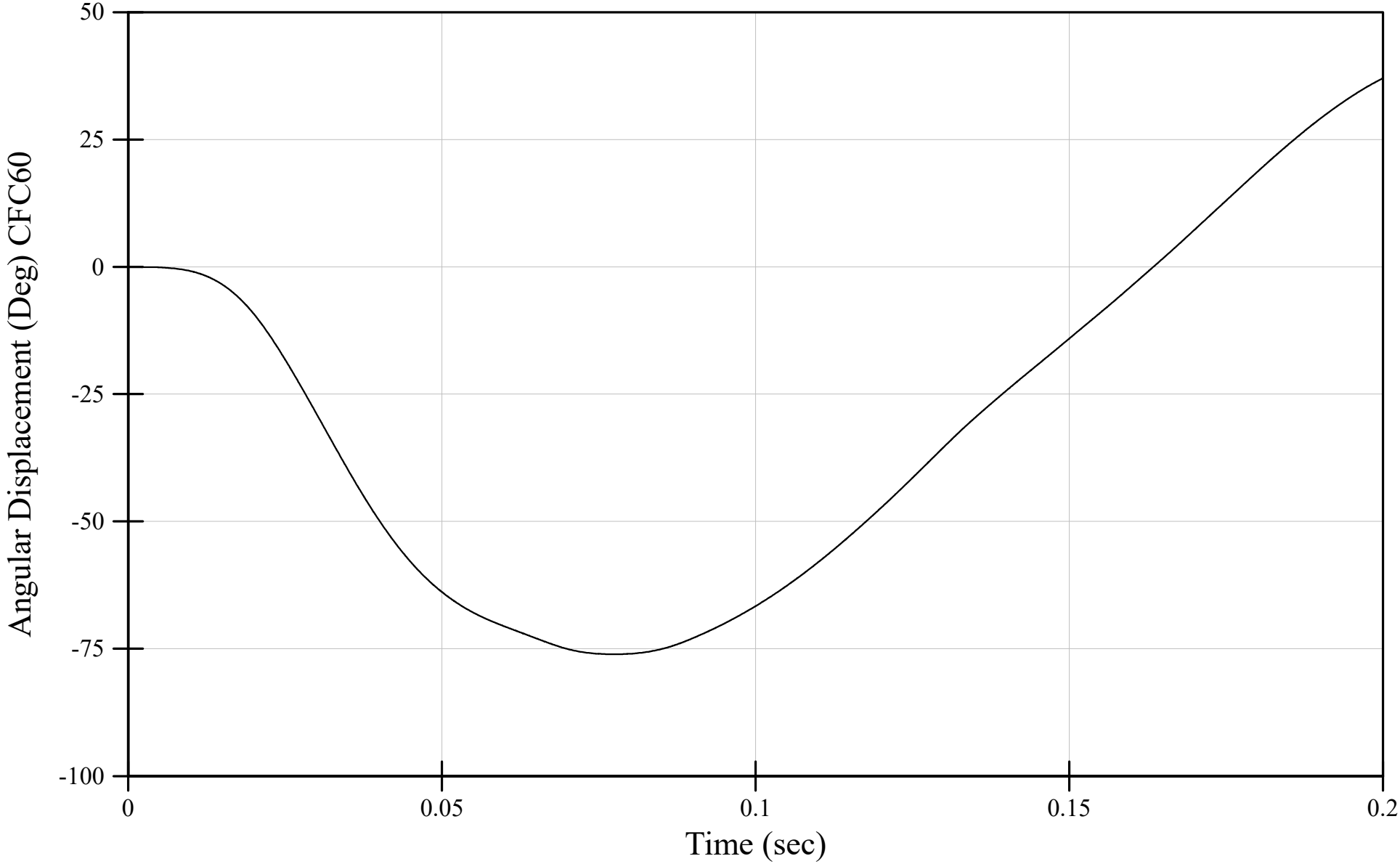
THOR-05F Neck Flexion Qualification
Peak Angular Rate
Neck Serial Number: EU1156



File Name: 221130-9 processed

11/30/2022 11:32 AM

THOR-05F Neck Flexion Qualification
Neck Rotation
Neck Serial Number: EU1156



File Name: 221130-9 processed

11/30/2022 11:32 AM

THOR-05F Neck Left Lateral Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Neck Serial Number: EU1156
O.C. Stop Assembly Serial Number:
O.C. Cam Serial Number:

Test ID: 221130-10
Test Date: 11/30/2022
Test Time: 12:51 PM

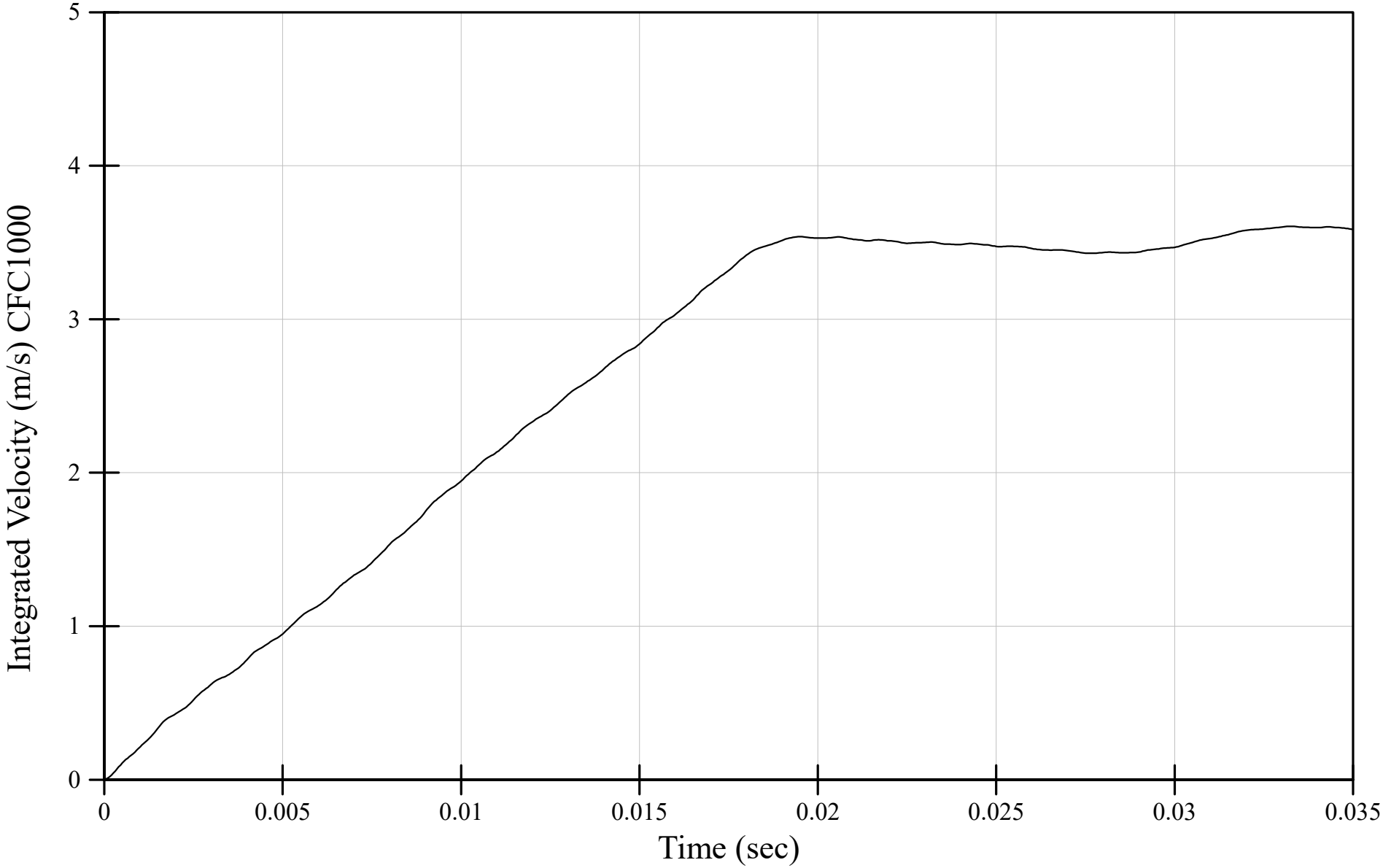
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.1	Pass
Test Humidity (%)	10 - 70	54	Pass
Test Velocity (m/s)	3.35 - 3.45	3.39	Pass
Pendulum Velocity at 5 ms (m/s)		0.95	
Pendulum Velocity at 10 ms (m/s)		1.95	
Pendulum Velocity at 15 ms (m/s)		2.84	
Peak Upper Neck Mx after 40 ms (N)		29.7	
Peak Head Angular Velocity X (deg/sec)		-1273.6	
Peak Head Rotation (deg)		-48.1	

* THOR-05F Qualification Manual - July 2022

File Name: 221130-10 processed
Software Version: 2.8

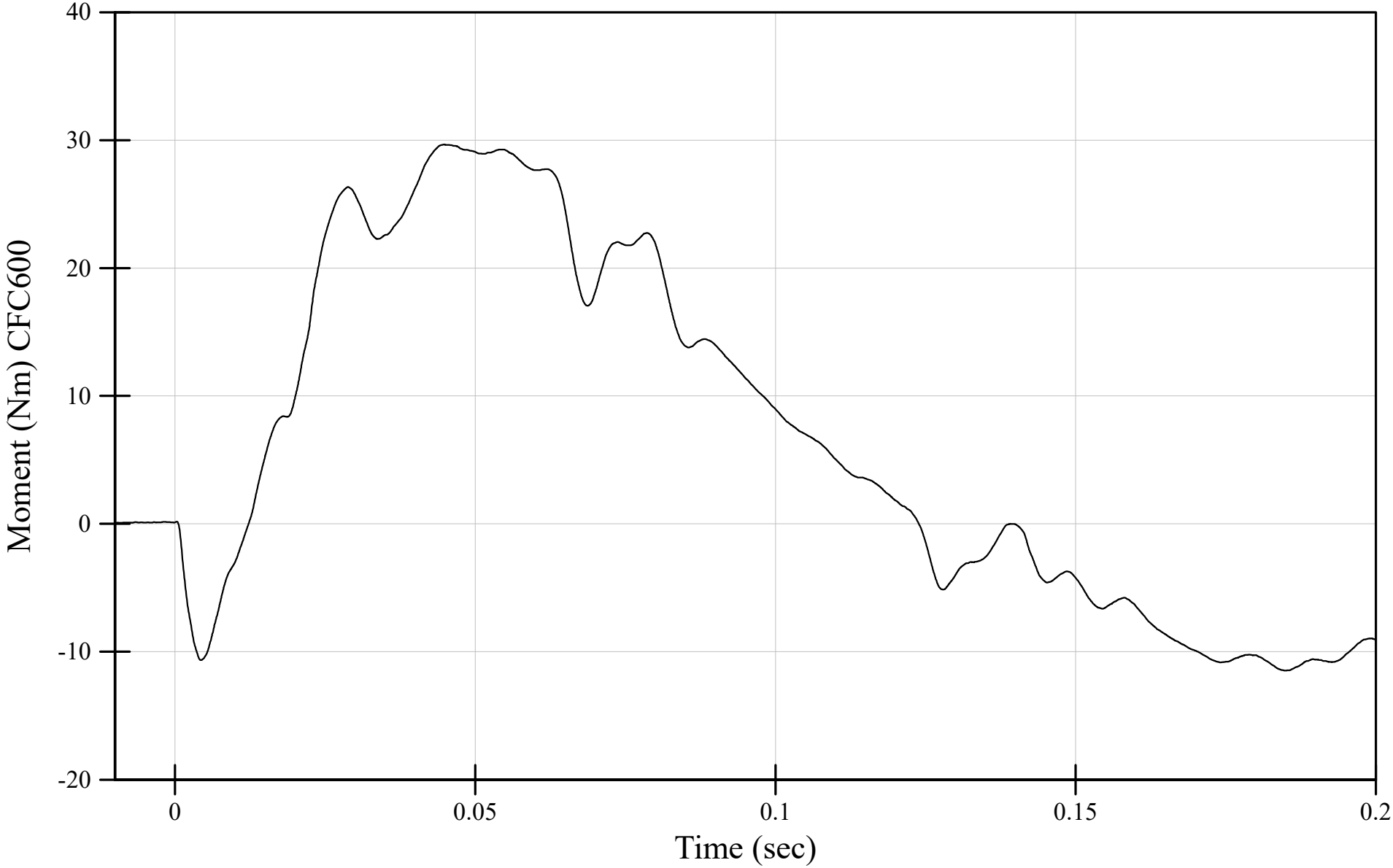
THOR-05F Neck Left Lateral Qualification
Pendulum Pulse
Serial Number: EU1156



File Name: 221130-10 processed

11/30/2022 12:51 PM

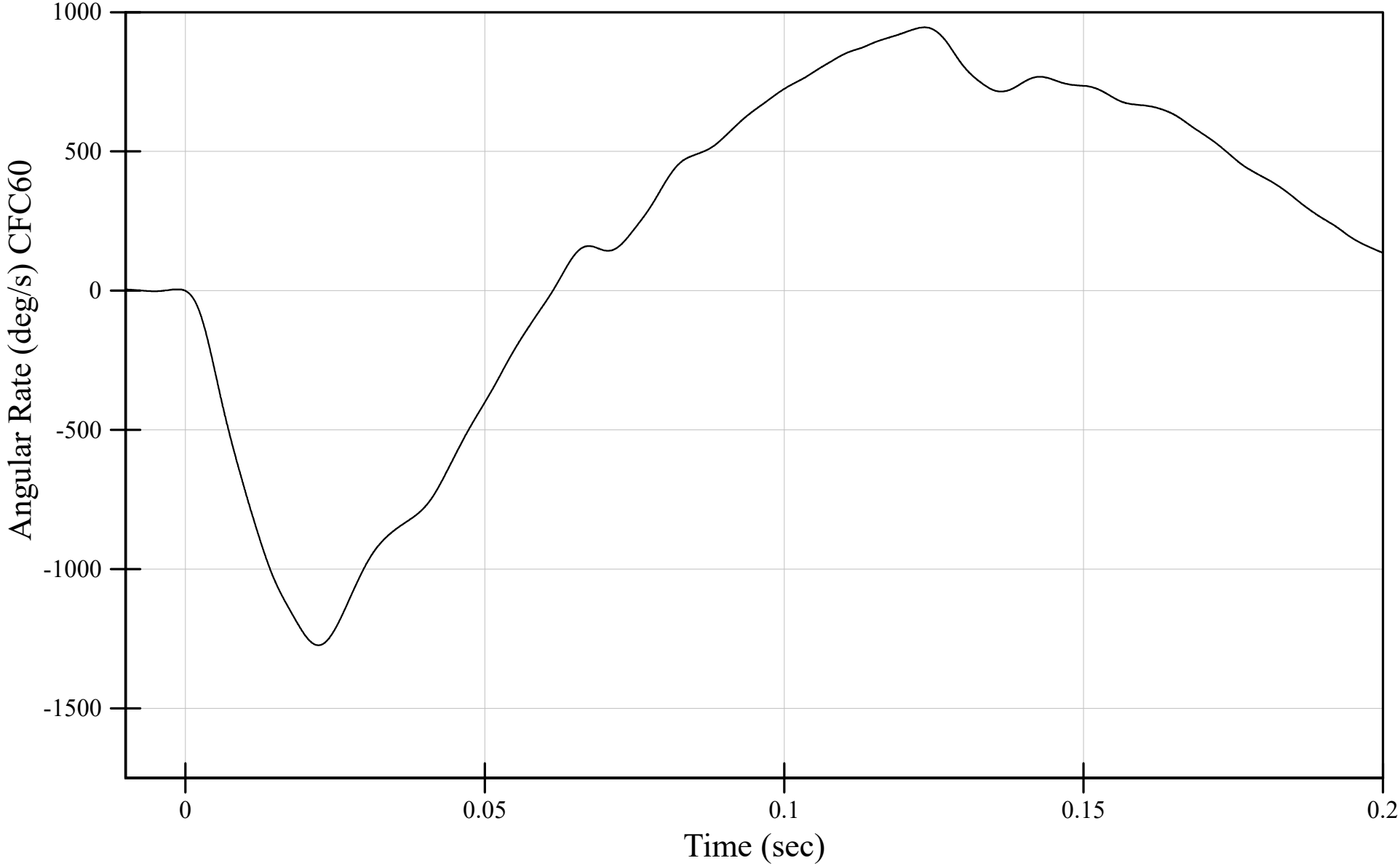
THOR-05F Neck Left Lateral Qualification
X-Moment as Measured
Serial Number: EU1156



File Name: 221130-10 processed

11/30/2022 12:51 PM

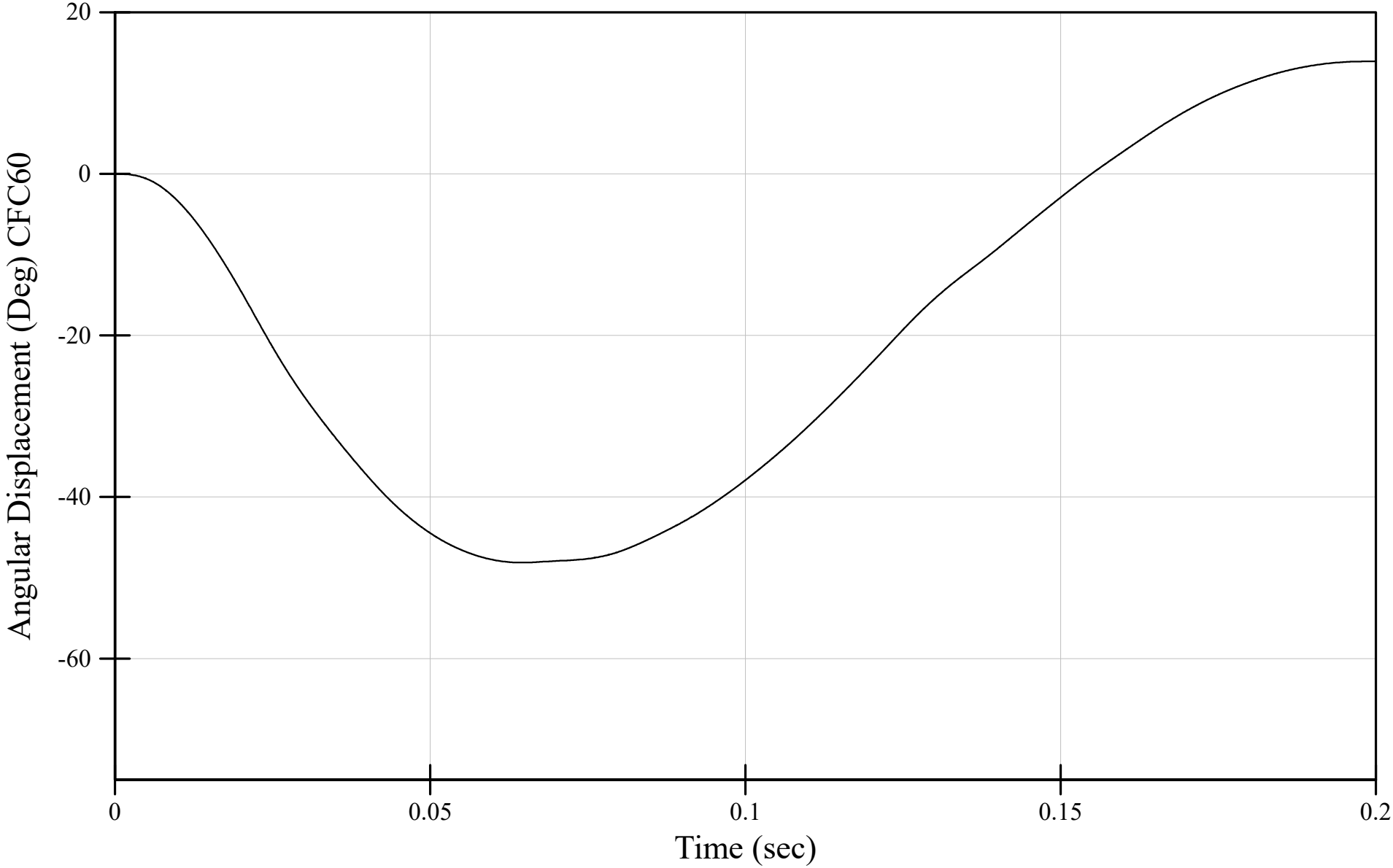
THOR-05F Neck Left Lateral Qualification
Peak Angular Rate
Serial Number: EU1156



File Name: 221130-10 processed

11/30/2022 12:51 PM

THOR-05F Neck Left Lateral Qualification
Neck Rotation
Serial Number: EU1156



File Name: 221130-10 processed

11/30/2022 12:51 PM

THOR-05F Neck Right Lateral Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Neck Serial Number: EU1156
O.C. Stop Assembly Serial Number:
O.C. Cam Serial Number:

Test ID: 221130-11
Test Date: 11/30/2022
Test Time: 1:21 PM

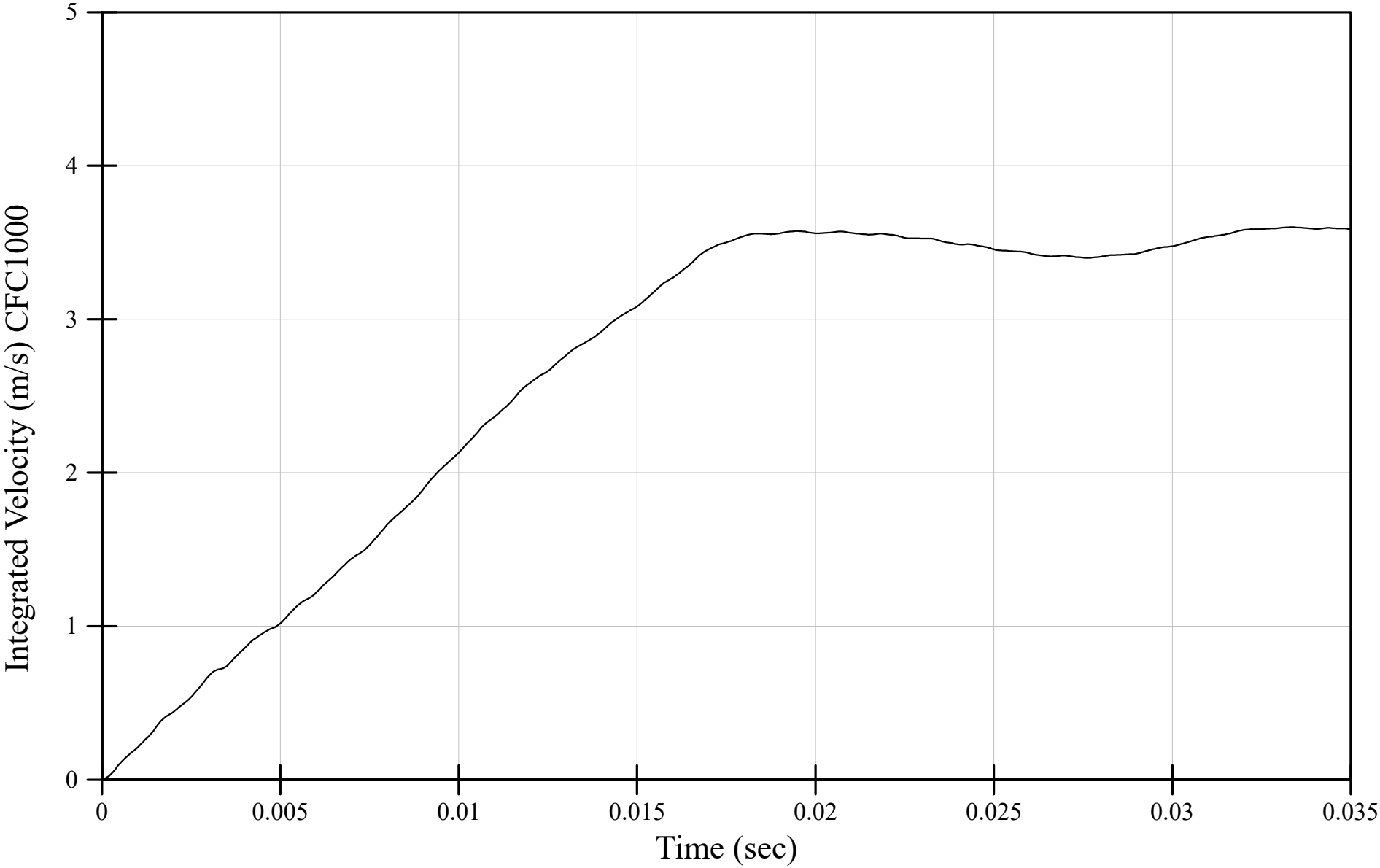
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.0	Pass
Test Humidity (%)	10 - 70	47	Pass
Test Velocity (m/s)	3.35 - 3.45	3.39	Pass
Pendulum Velocity at 5 ms (m/s)		1.02	
Pendulum Velocity at 10 ms (m/s)		2.13	
Pendulum Velocity at 15 ms (m/s)		3.08	
Peak Upper Neck Mx after 40 ms (N)		-31.1	
Peak Head Angular Velocity X (deg/sec)		1307.2	
Peak Head Rotation (deg)		49.0	

* THOR-05F Qualification Manual - July 2022

File Name: 221130-11 processed
Software Version: 2.8

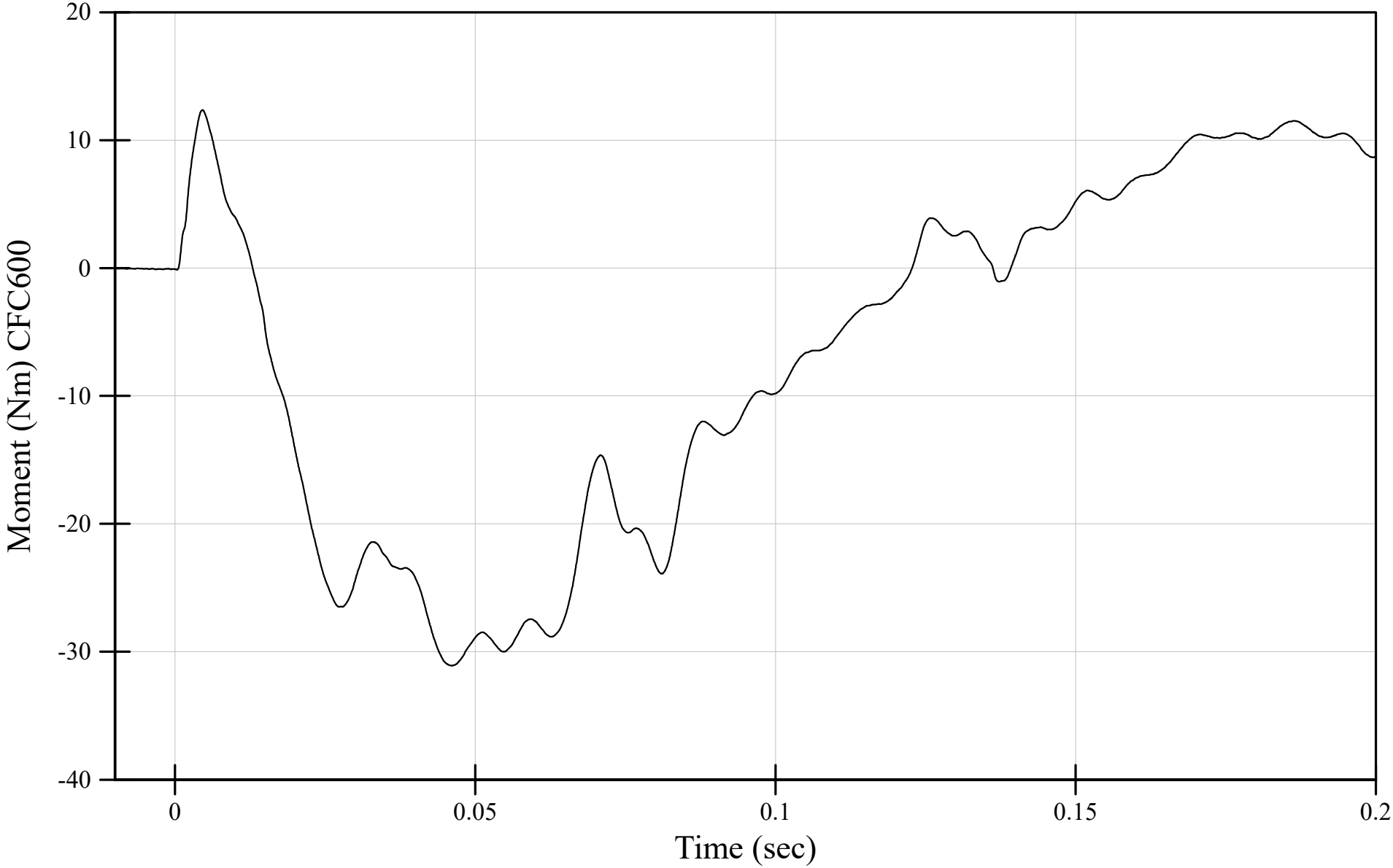
THOR-05F Neck Right Lateral Qualification
Pendulum Pulse
Neck Serial Number: EU1156



File Name: 221130-11 processed

11/30/2022 1:21 PM

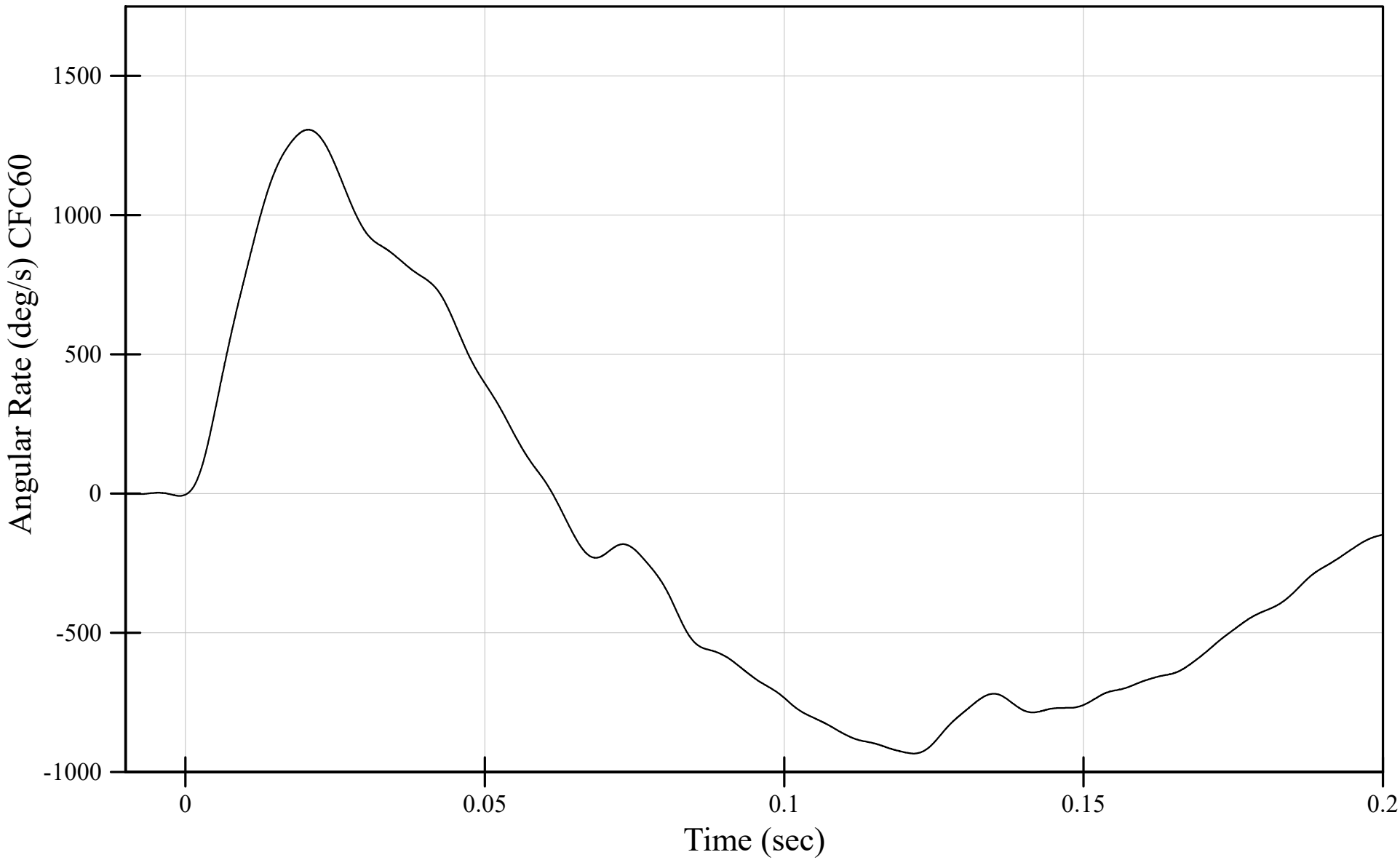
THOR-05F Neck Right Lateral Qualification
X-Moment as Measured
Neck Serial Number: EU1156



File Name: 221130-11 processed

11/30/2022 1:21 PM

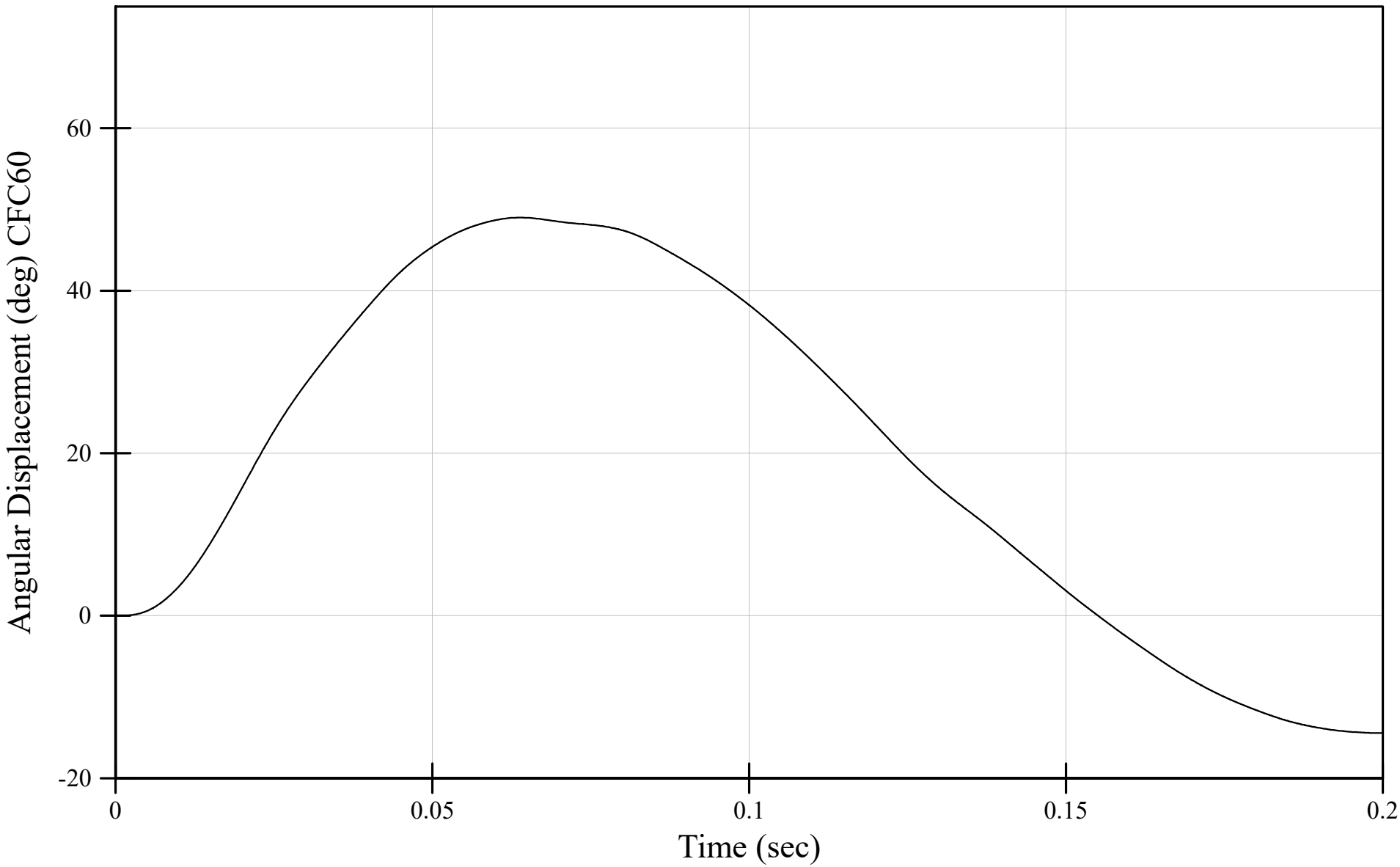
THOR-05F Neck Right Lateral Qualification
Peak Angular Rate
Neck Serial Number: EU1156



File Name: 221130-11 processed

11/30/2022 1:21 PM

THOR-05F Neck Right Lateral Qualification
Neck Rotation
Neck Serial Number: EU1156



File Name: 221130-11 processed

11/30/2022 1:21 PM

THOR-05F Neck Left Torsion Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Neck Serial Number: EU1156
O.C. Stop Assembly Serial Number:
O.C. Cam Serial Number:

Test ID: 221130-12
Test Date: 11/30/2022
Test Time: 2:24 PM

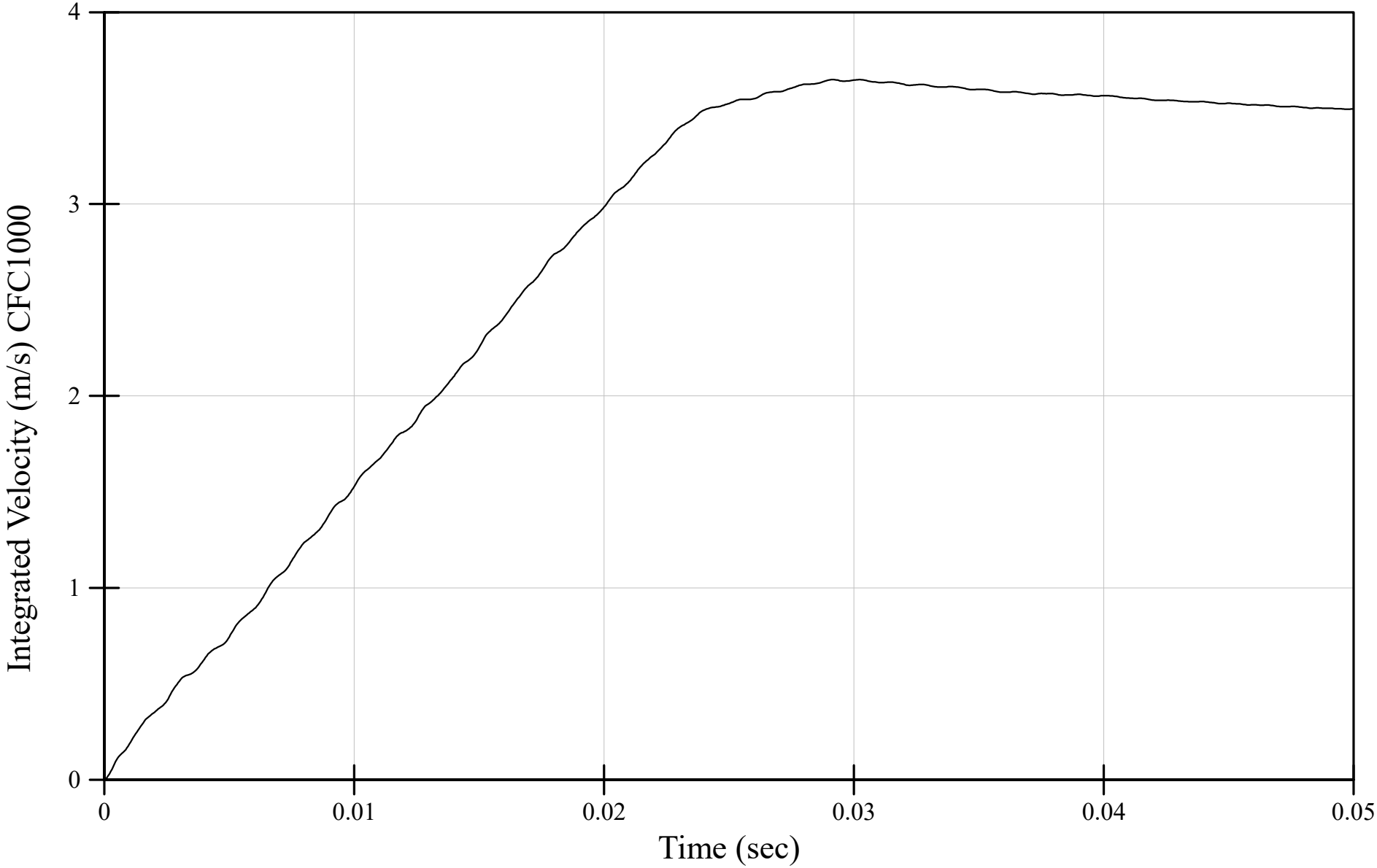
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.0	Pass
Test Humidity (%)	10 - 70	55	Pass
Test Velocity (m/s)	3.35 - 3.45	3.40	Pass
Pendulum Velocity at 10 ms (m/s)		1.07	
Pendulum Velocity at 15 ms (m/s)		2.10	
Pendulum Velocity at 20 ms (m/s)		3.12	
Peak Upper Neck Mz (Nm)		21.0	
Peak Neck Fixture Rotation (deg)		-48.1	
Peak Upper Neck Angular Velocity Z (deg/sec)		-1259.0	

* THOR-05F Qualification Manual - July 2022

File Name: 221130-12 processed
Software Version: 2.8

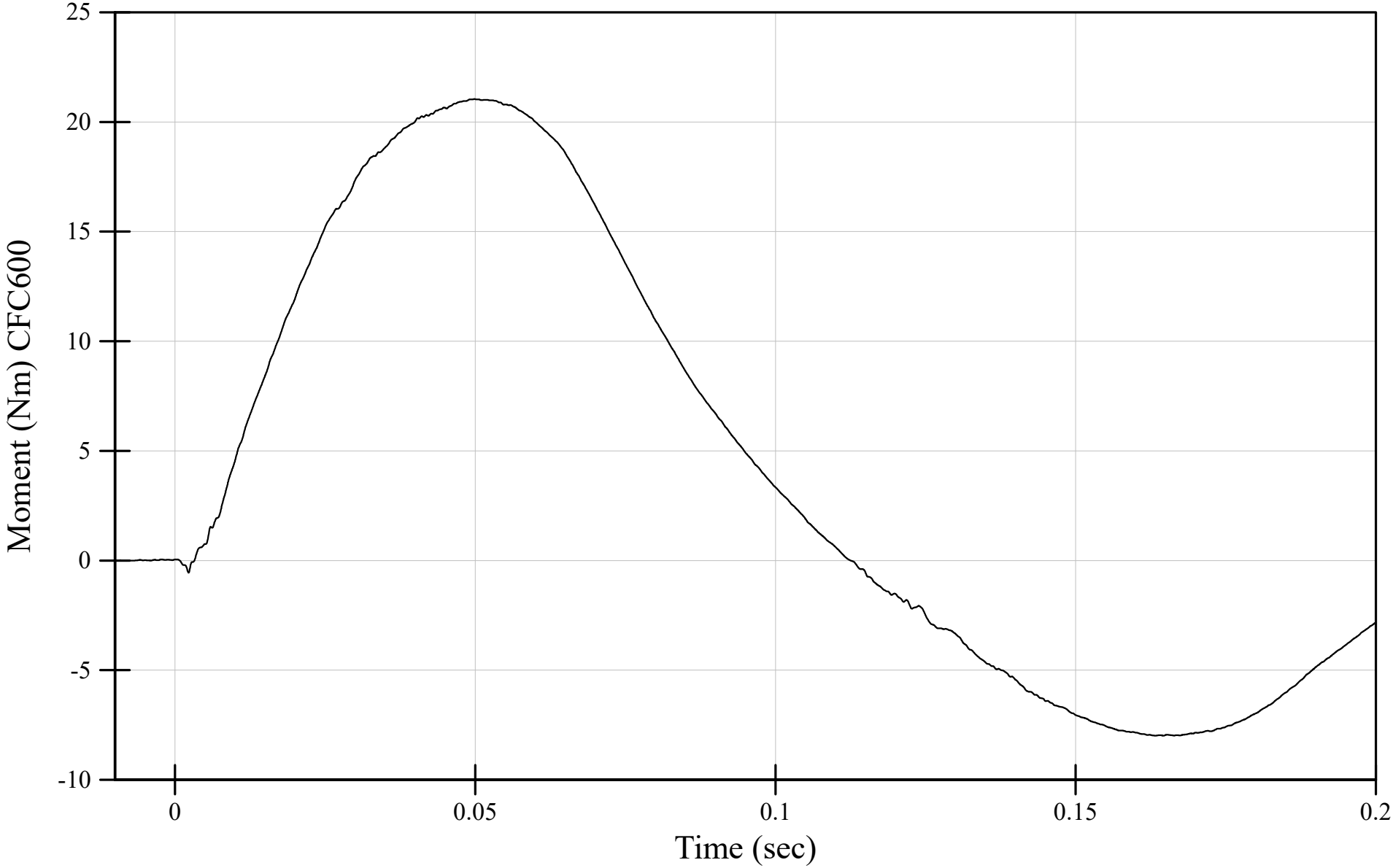
THOR-05F Neck Left Torsion Qualification
Pendulum Pulse
Neck Serial Number: EU1156



File Name: 221130-12 processed

11/30/2022 2:24 PM

THOR-05F Neck Left Torsion Qualification
Z-Moment as Measured
Neck Serial Number: EU1156



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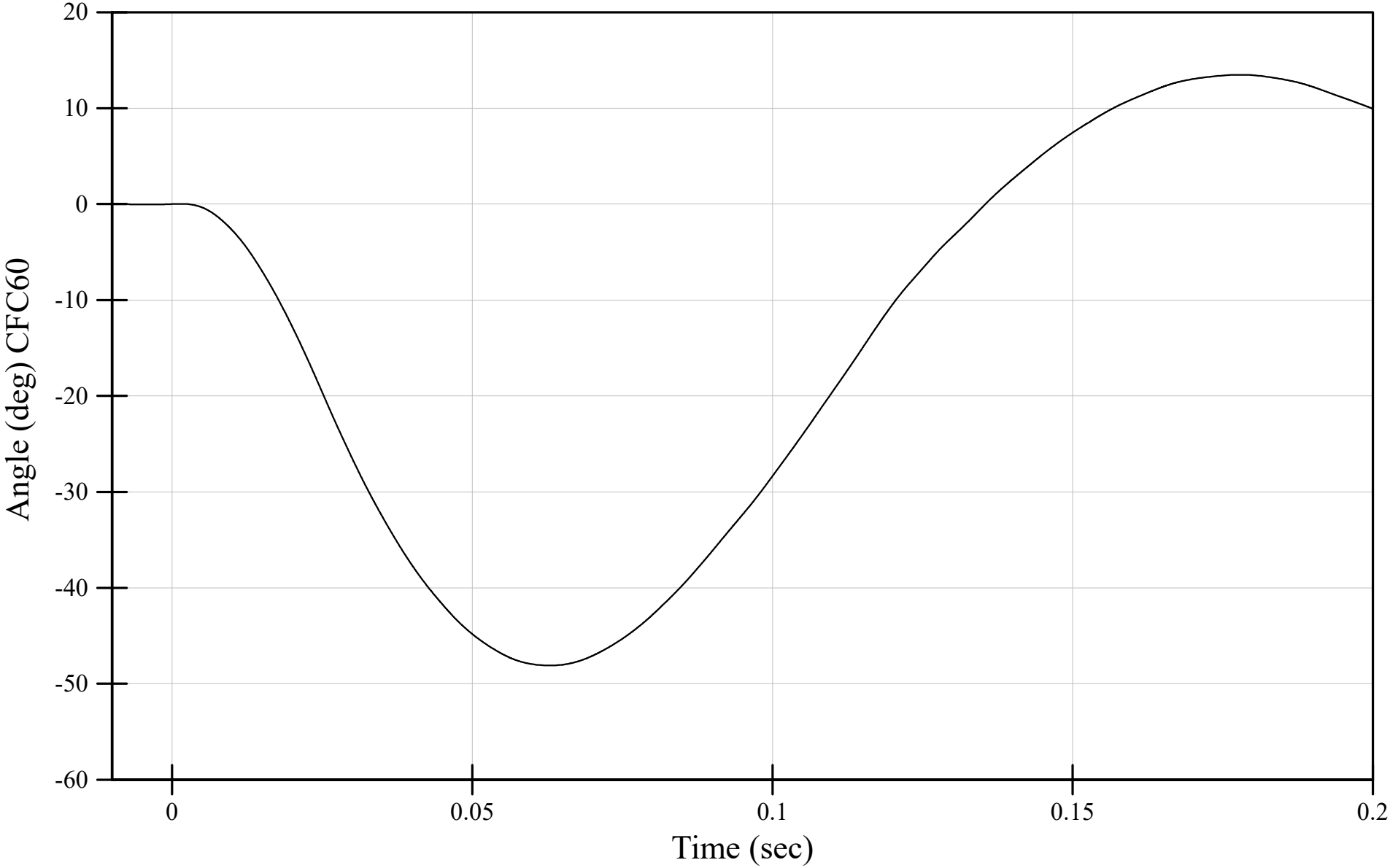
11/30/2022 2:24 PM

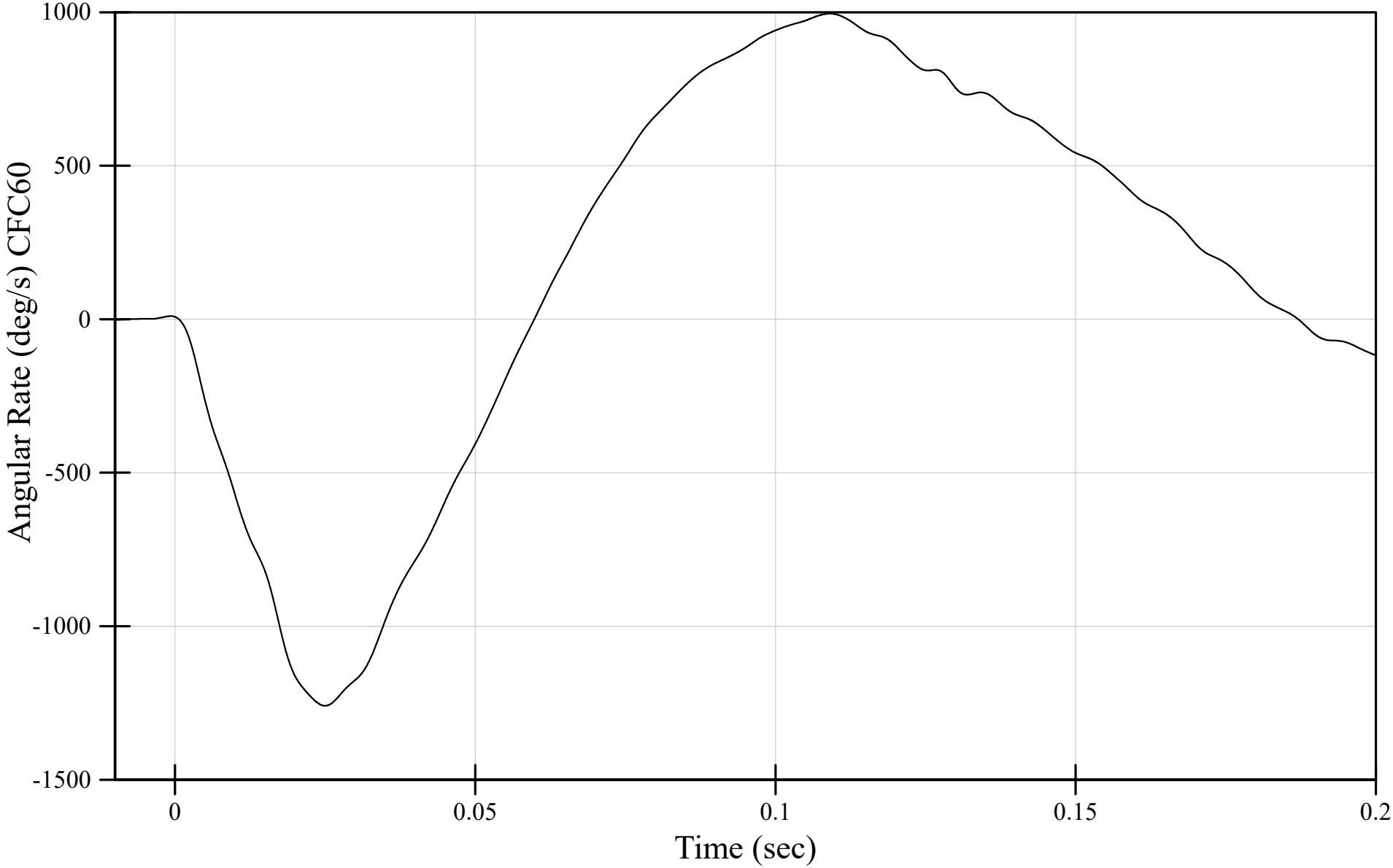
THOR-05F Neck Left Torsion Qualification
Neck Fixture Rotation
Neck Serial Number: EU1156



File Name: 221130-12 processed

11/30/2022 2:24 PM

THOR-05F Neck Left Torsion Qualification
Peak Angular Rate
Neck Serial Number: EU1156



File Name: 221130-12 processed

11/30/2022 2:24 PM

THOR-05F Neck Right Torsion Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Neck Serial Number: EU1156
O.C. Stop Assembly:
O.C. Cam:

Test ID: 221130-13
Test Date: 11/30/2022
Test Time: 3:07 PM

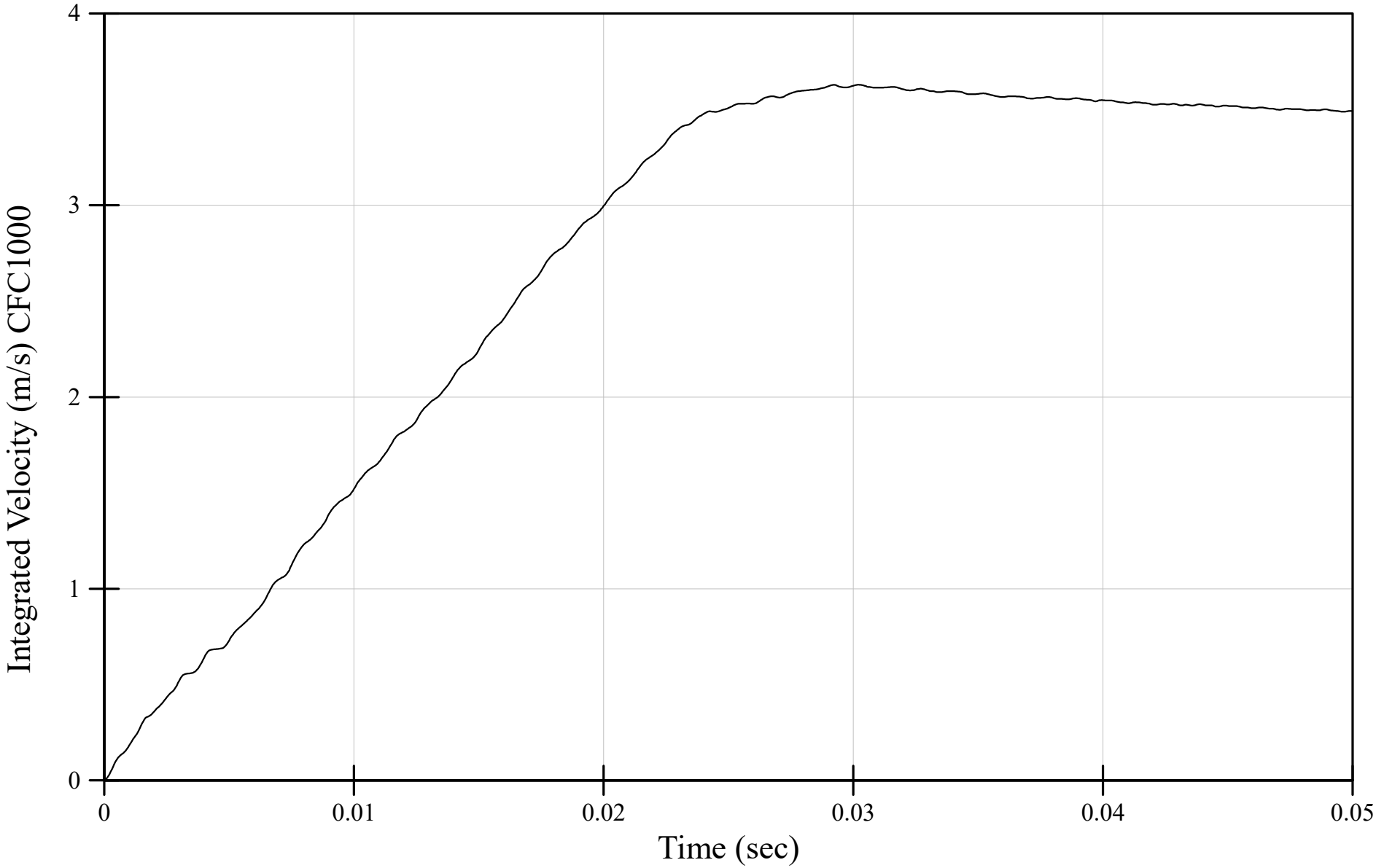
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.2	Pass
Test Humidity (%)	10 - 70	51	Pass
Test Velocity (m/s)	3.35 - 3.45	3.39	Pass
Pendulum Velocity at 7 ms (m/s)		1.05	
Pendulum Velocity at 14 ms (m/s)		2.11	
Pendulum Velocity at 21 ms (m/s)		3.13	
Peak Upper Neck Mz (Nm)		-20.6	
Peak Neck Fixture Rotation (deg)		47.3	
Peak Upper Neck Angular Velocity Z (deg/sec)		1226.5	

* THOR-05F Qualification Manual - July 2022

File Name: 221130-13 processed
Software Version: 2.8

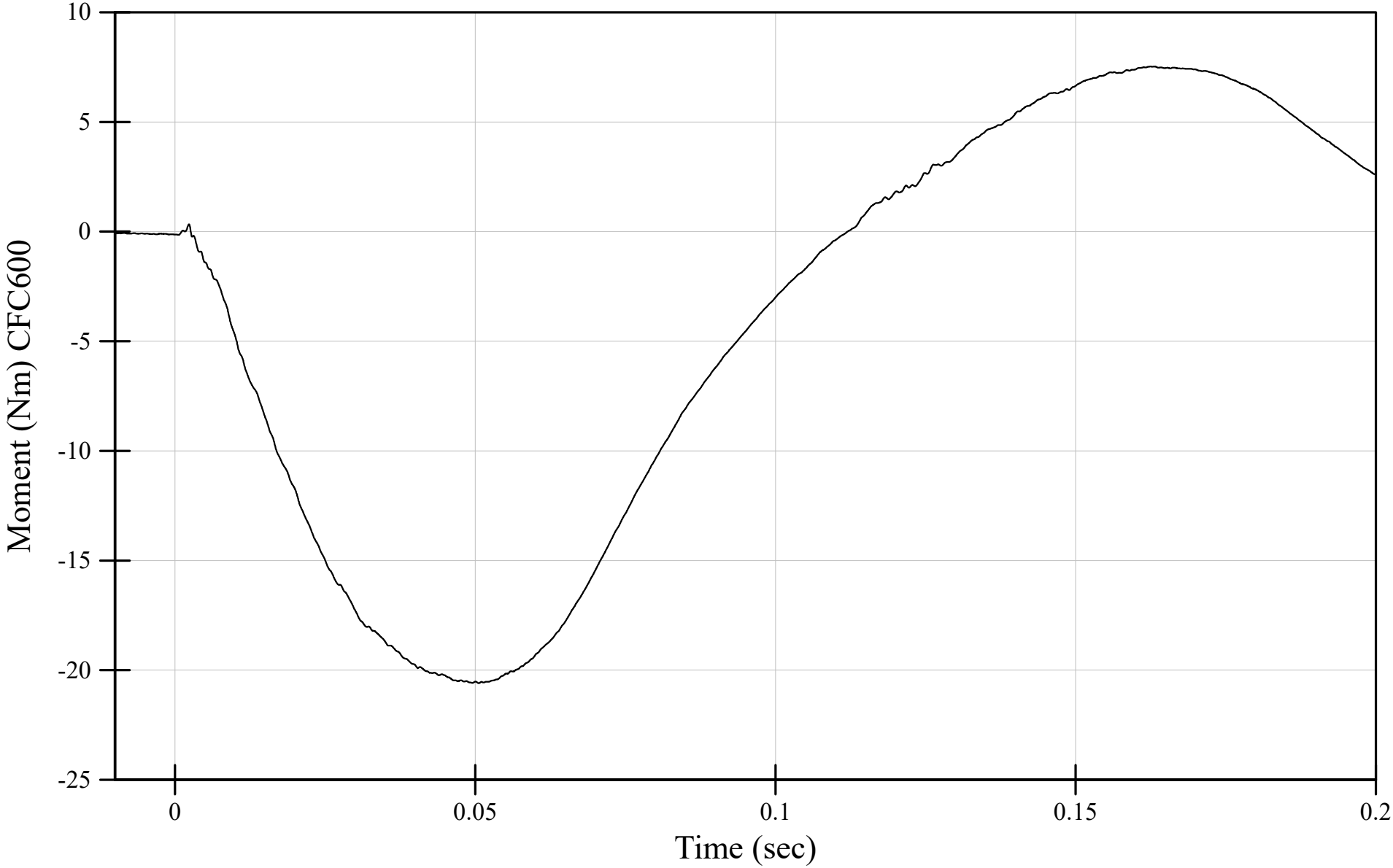
THOR-05F Neck Right Torsion Qualification
Pendulum Pulse
Neck Serial Number: EU1156



File Name: 221130-13 processed

11/30/2022 3:07 PM

THOR-05F Neck Right Torsion Qualification
Z-Moment as Measured
Neck Serial Number: EU1156



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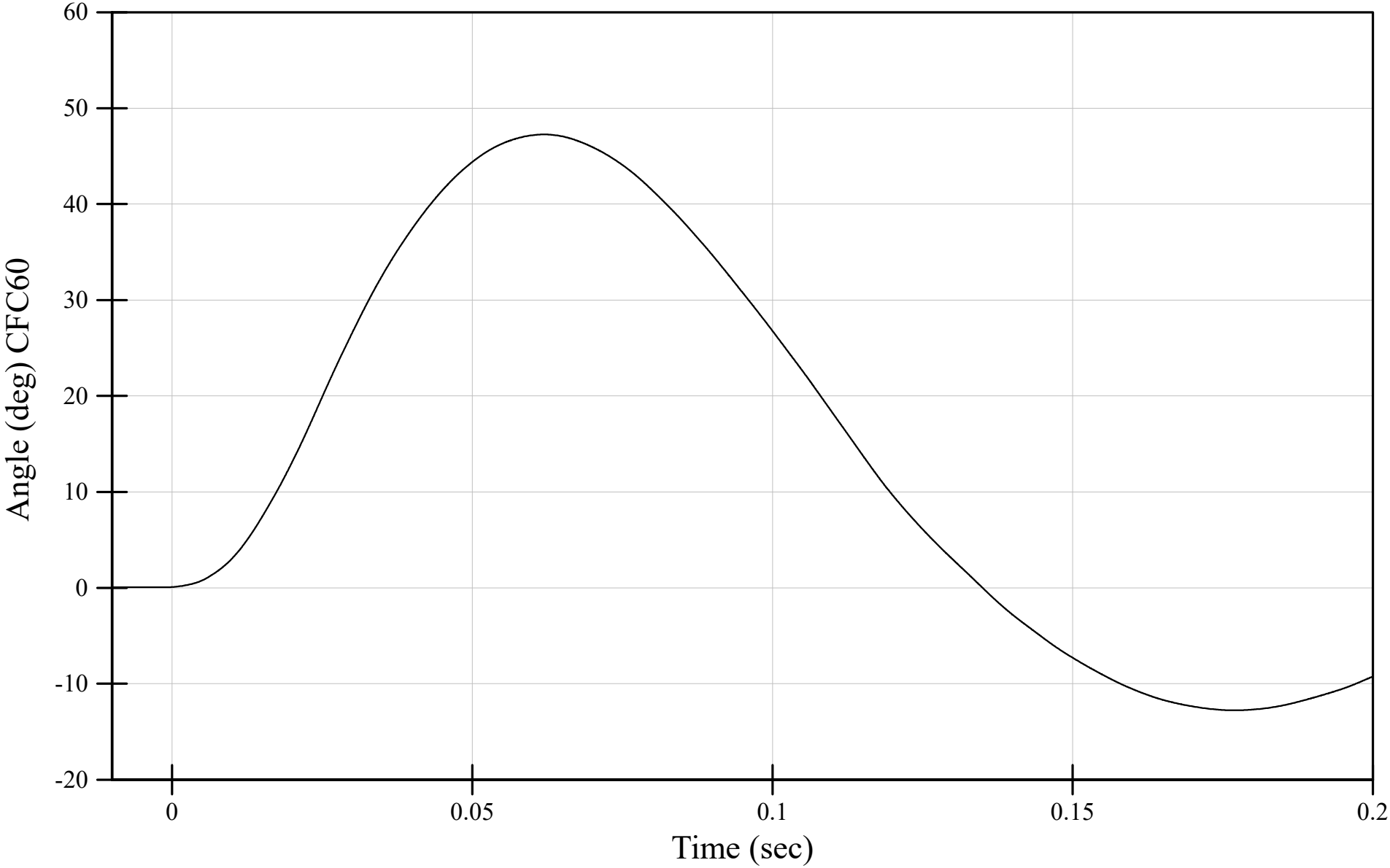
11/30/2022 3:07 PM

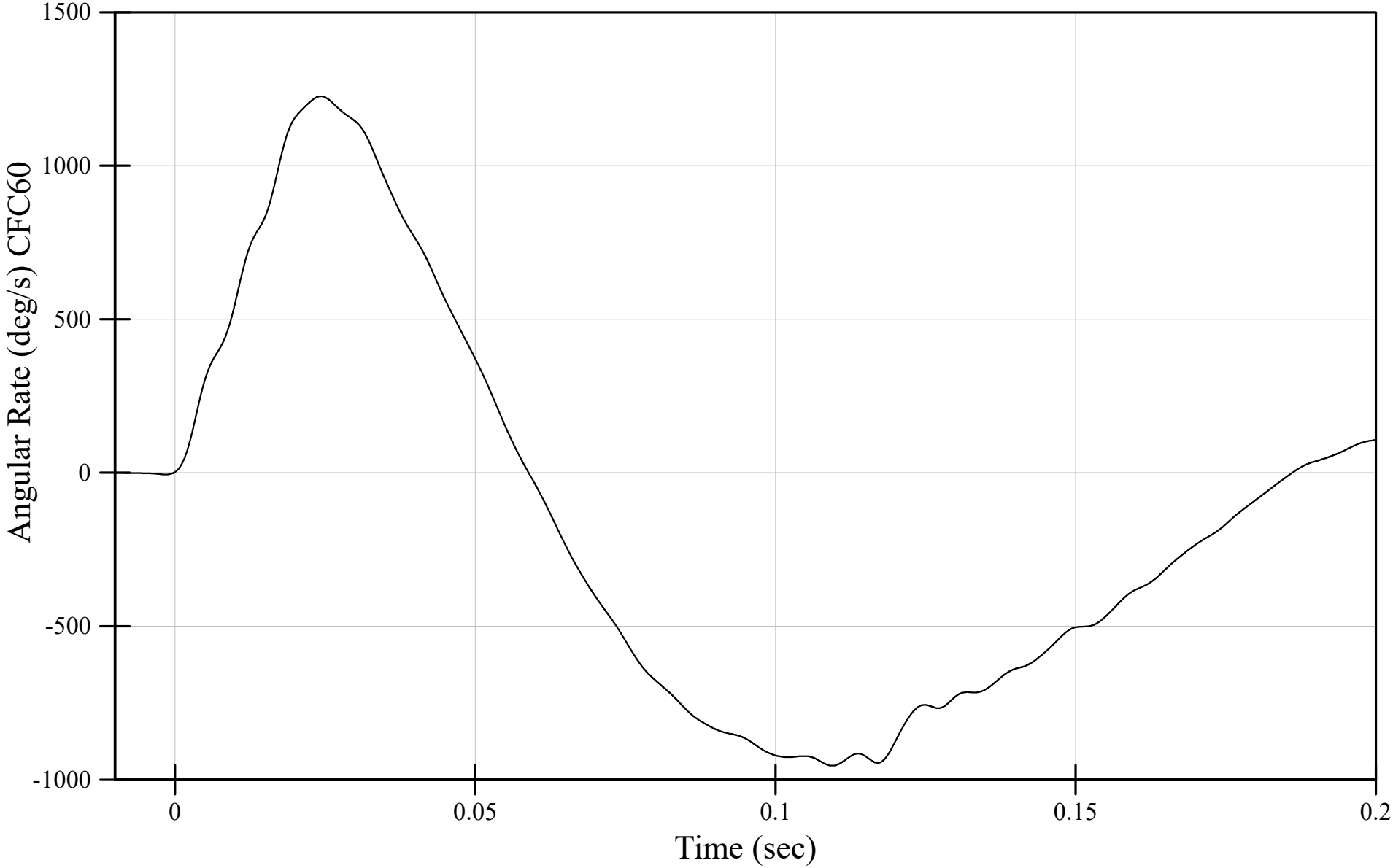
THOR-05F Neck Right Torsion Qualification
Neck Fixture Rotation
Neck Serial Number: EU1156



File Name: 221130-13 processed

11/30/2022 3:07 PM

THOR-05F Neck Right Torsion Qualification
Peak Angular Rate
Neck Serial Number: EU1156



File Name: 221130-13 processed

11/30/2022 3:07 PM

THOR-05F Upper Thorax Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components

Rib 1 Serial Number: ET5497
Rib 2 Serial Number: ET5498
Rib 3 Serial Number: ET5499
Rib 4 Serial Number: ET5500
Rib 5 Serial Number: ET5589
Rib 6 Serial Number: ET5502
Rib 7 Serial Number: ET5503

Test ID: 221207-9
Test Date: 12/7/2022
Test Time: 2:32 PM

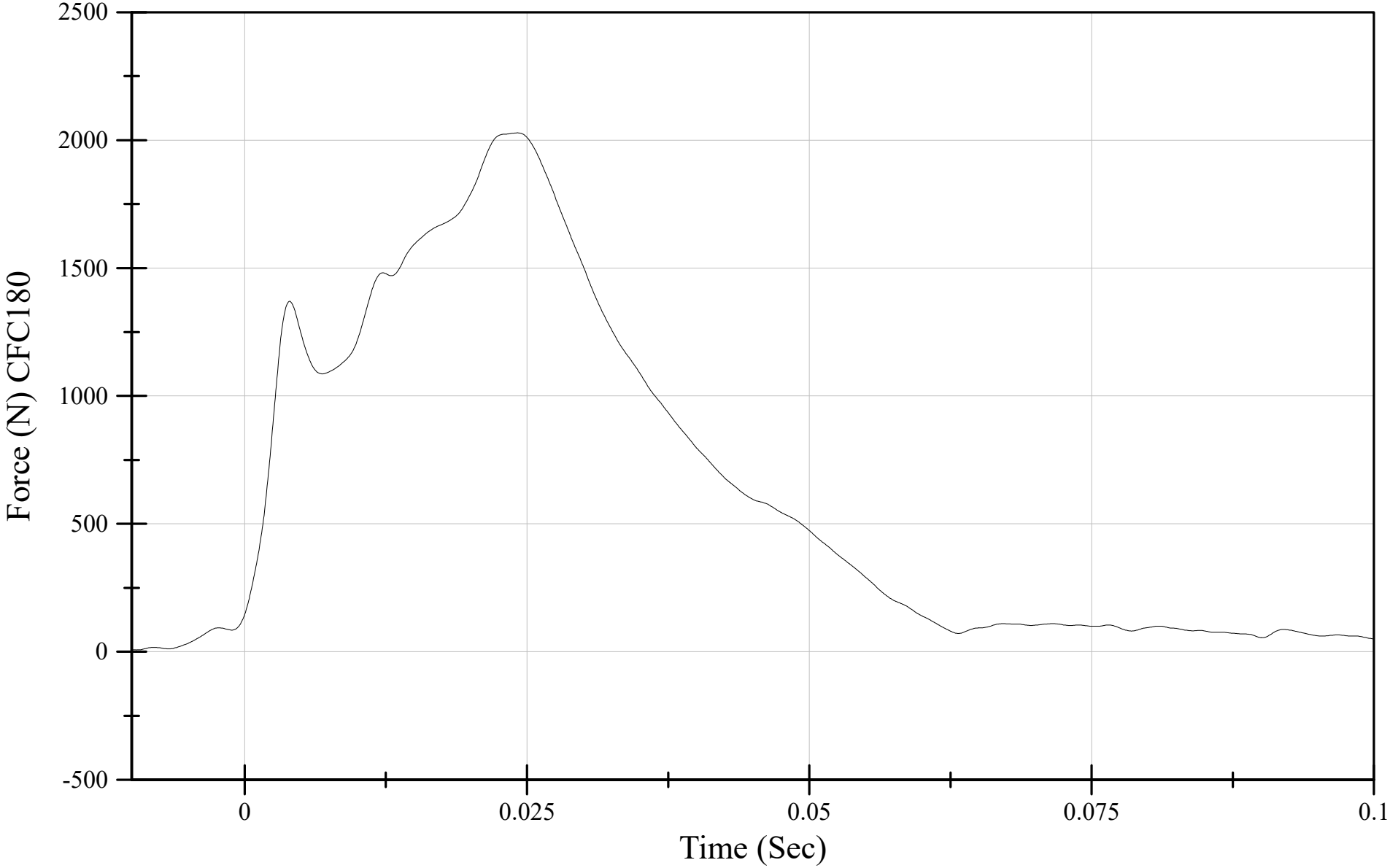
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.3	Pass
Test Humidity (%)	10 - 70	47	Pass
Test Velocity (m/s)	4.25 - 4.35	4.29	Pass
Peak Probe Force (N)		2029	
Peak Upper Left Resultant Deflection (mm)		45.8	
Peak Upper Right Resultant Deflection (mm)		45.3	
Difference Between Peak Left & Right Resultant Deflections (mm)		0.5	
Force at Left Peak Resultant Deflection (N)		2024	
Force at Right Peak Resultant Deflection (N)		2025	

* THOR-05F Qualification Manual - July 2022

File Name: 221207-9 processed

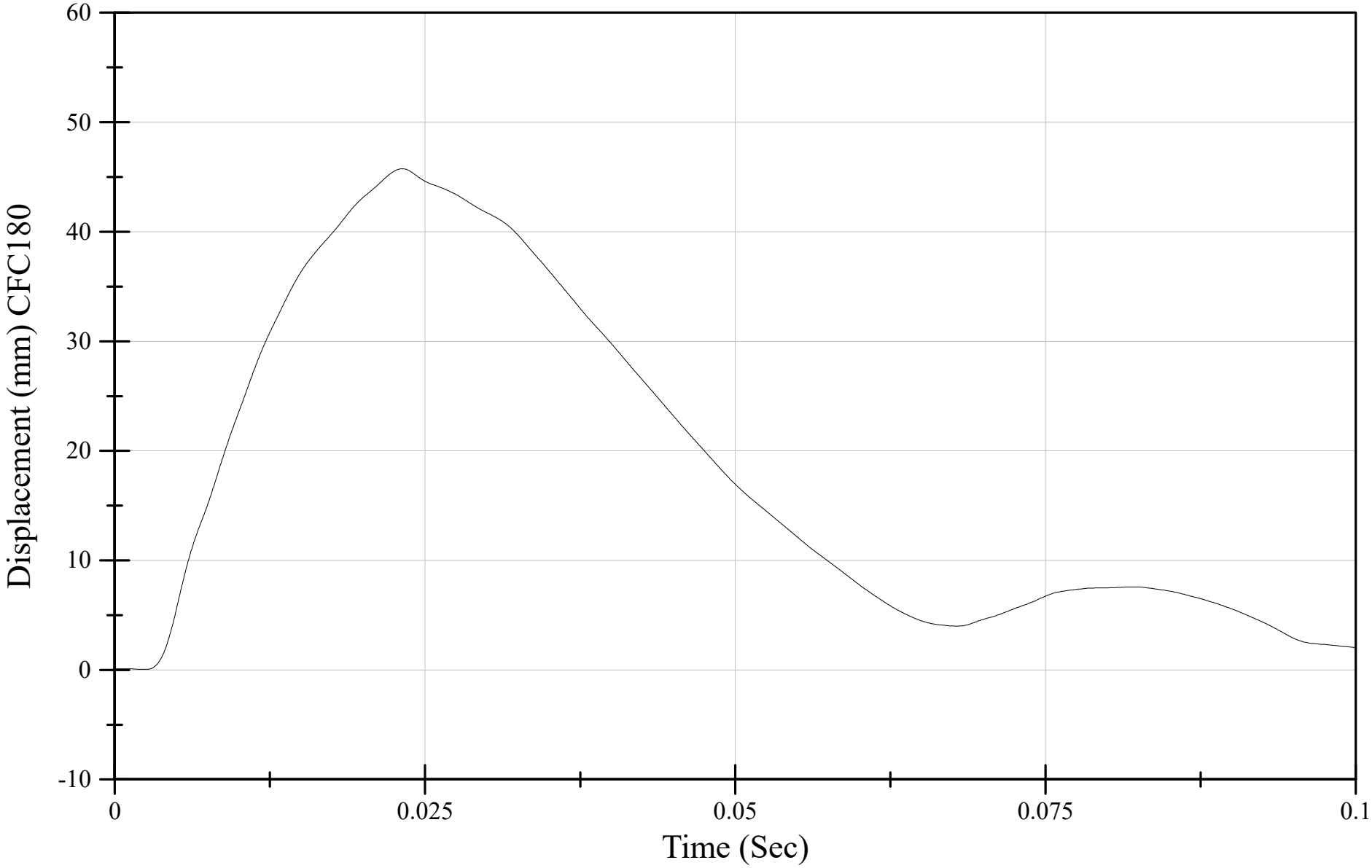
THOR-05F Upper Thorax Qualification
Probe Force
Dummy Serial Number: EU3430



File Name: 221207-9 processed

12/7/2022 2:32 PM

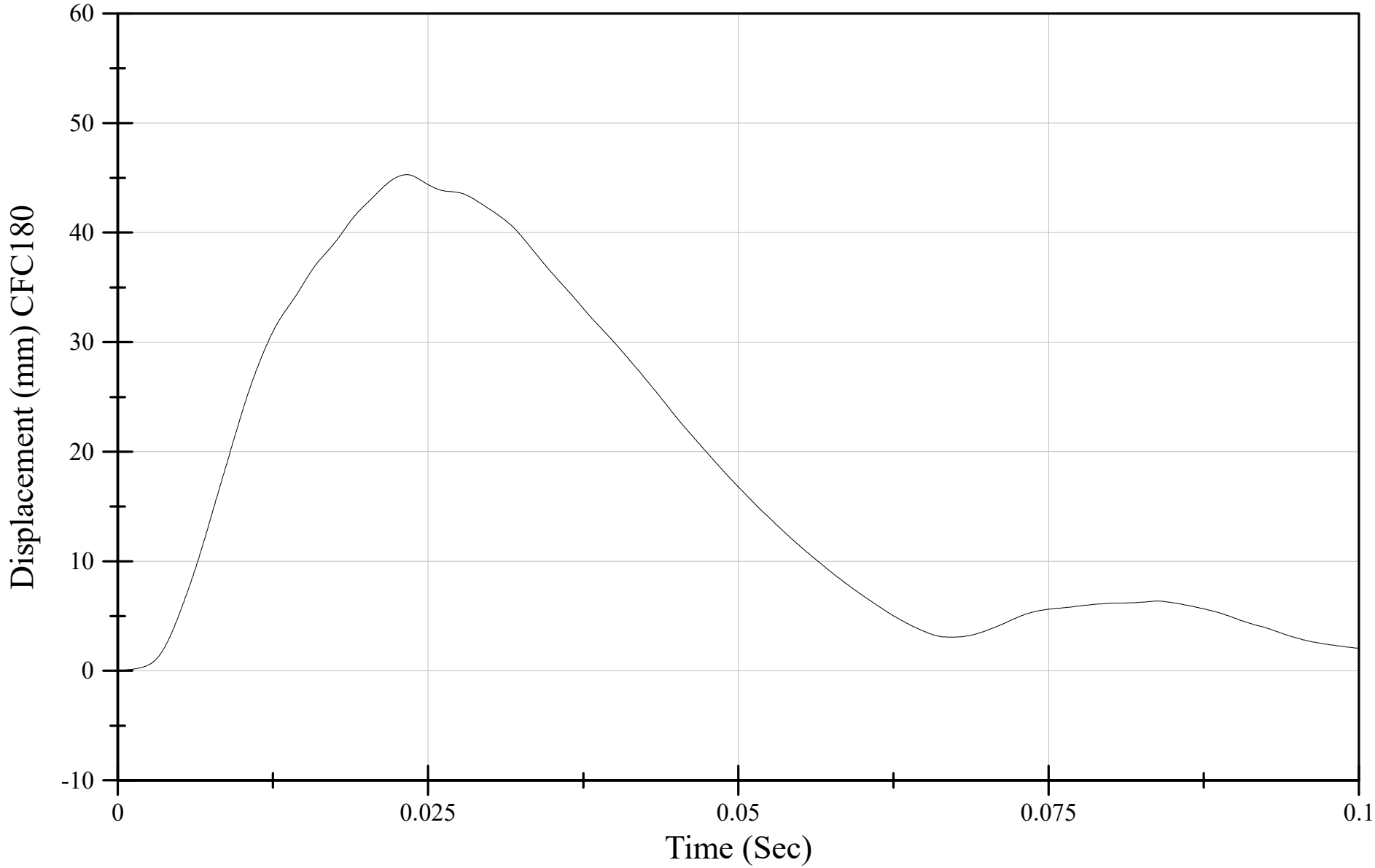
THOR-05F Upper Thorax Qualification
Left Resultant Deflection
Dummy Serial Number: EU3430



File Name: 221207-9 processed

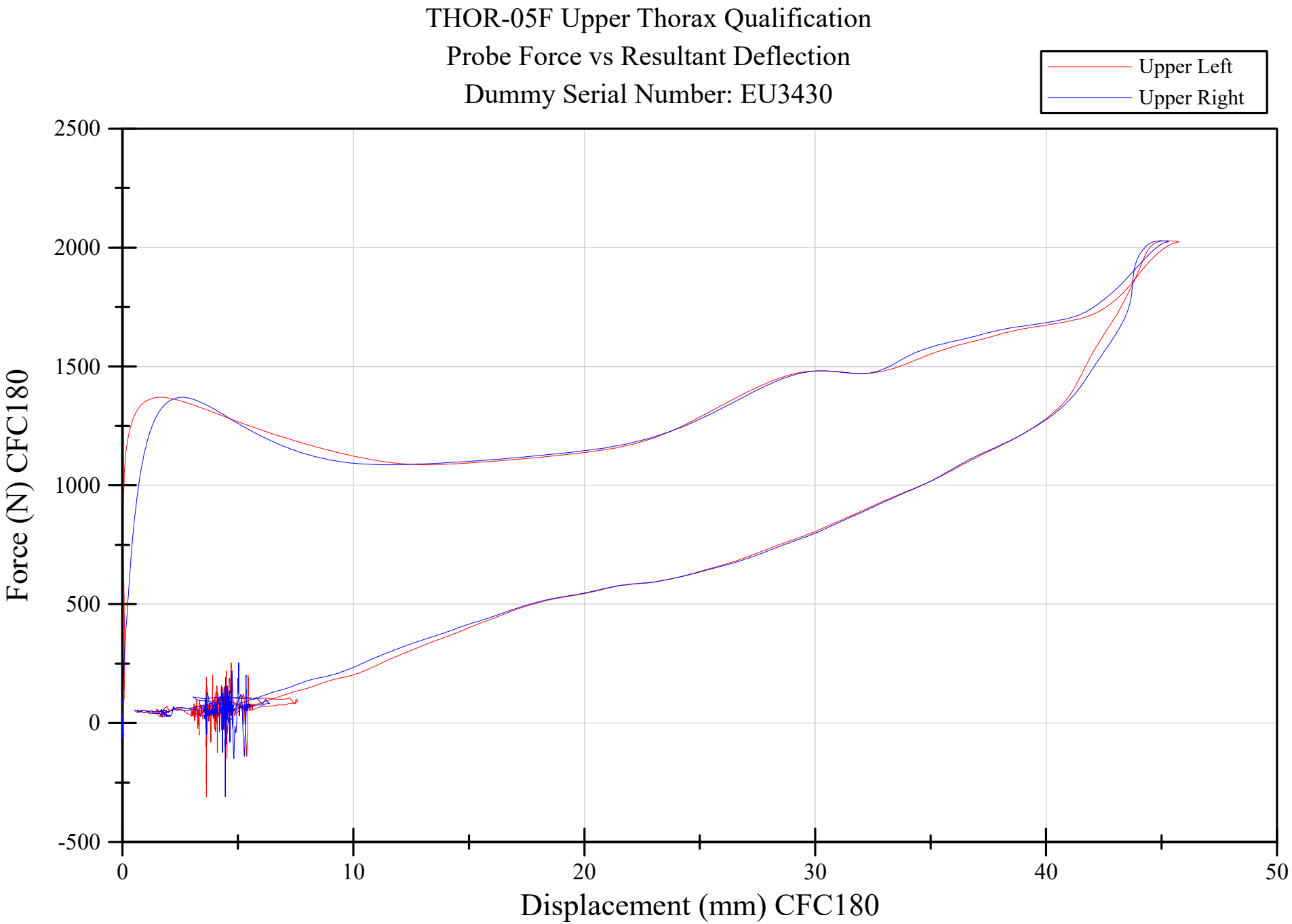
12/7/2022 2:32 PM

THOR-05F Upper Thorax Qualification
Right Resultant Deflection
Dummy Serial Number: EU3430



File Name: 221207-9 processed

12/7/2022 2:32 PM



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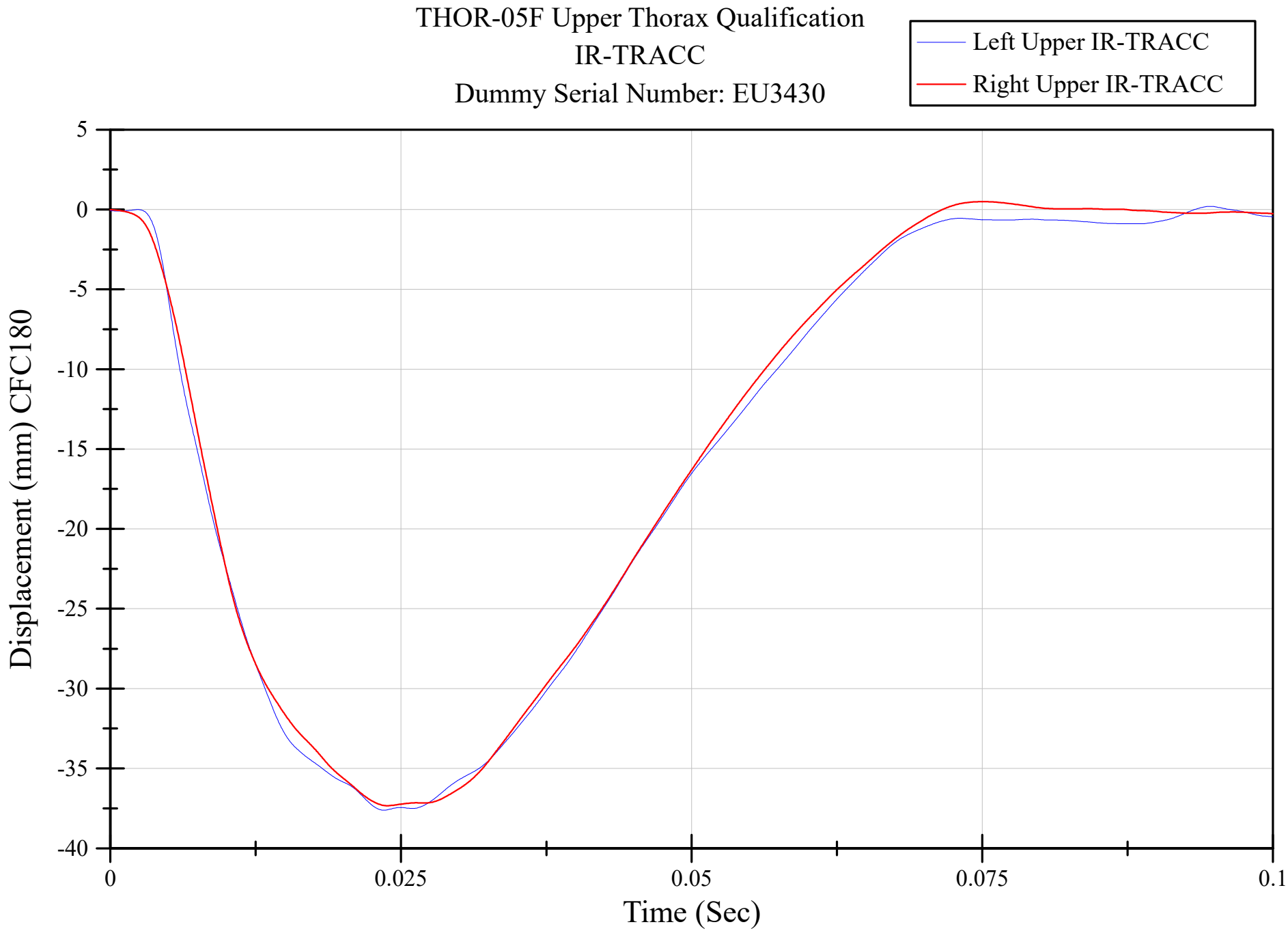
12/7/2022 2:32 PM



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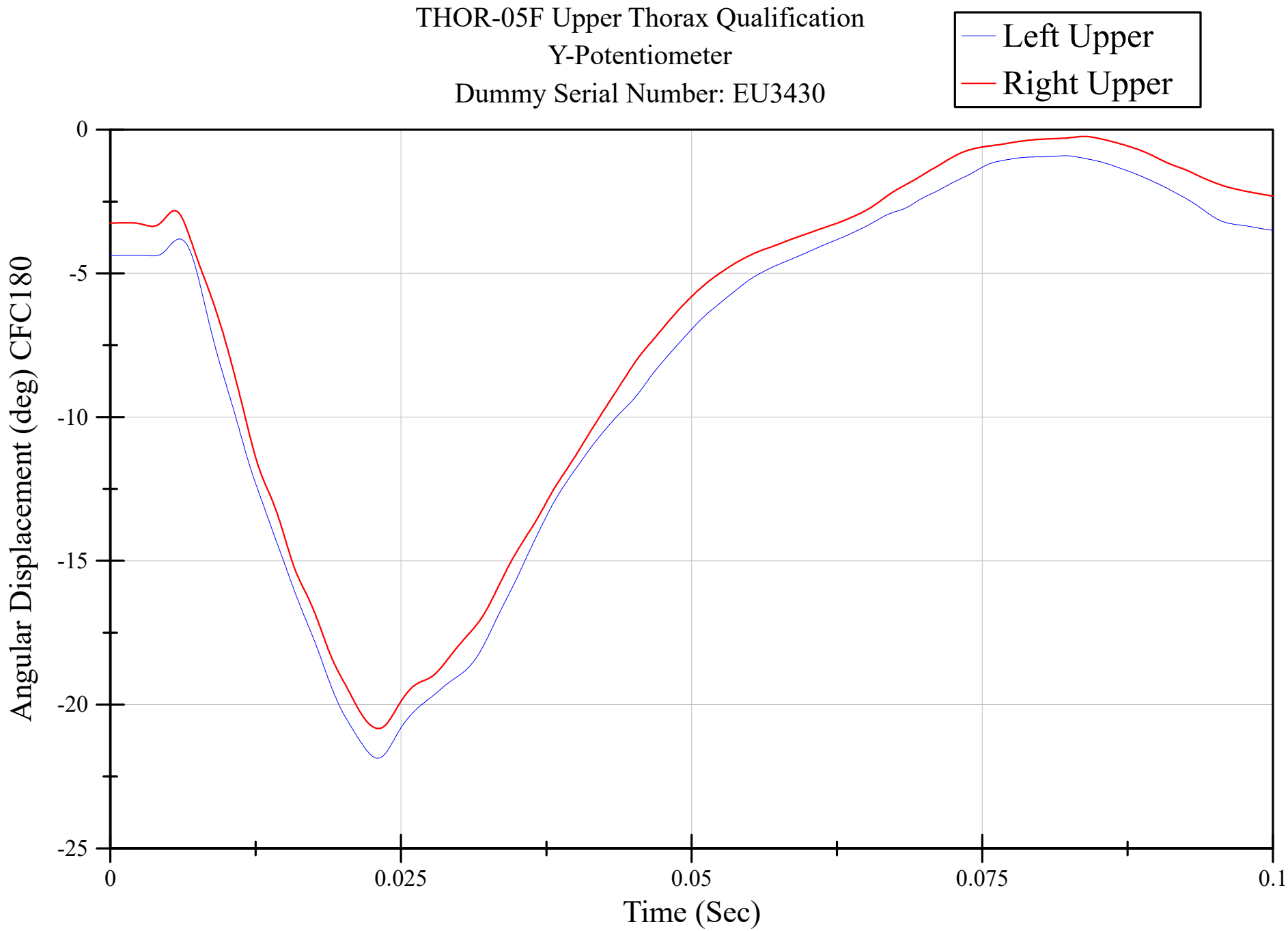
12/7/2022 2:32 PM



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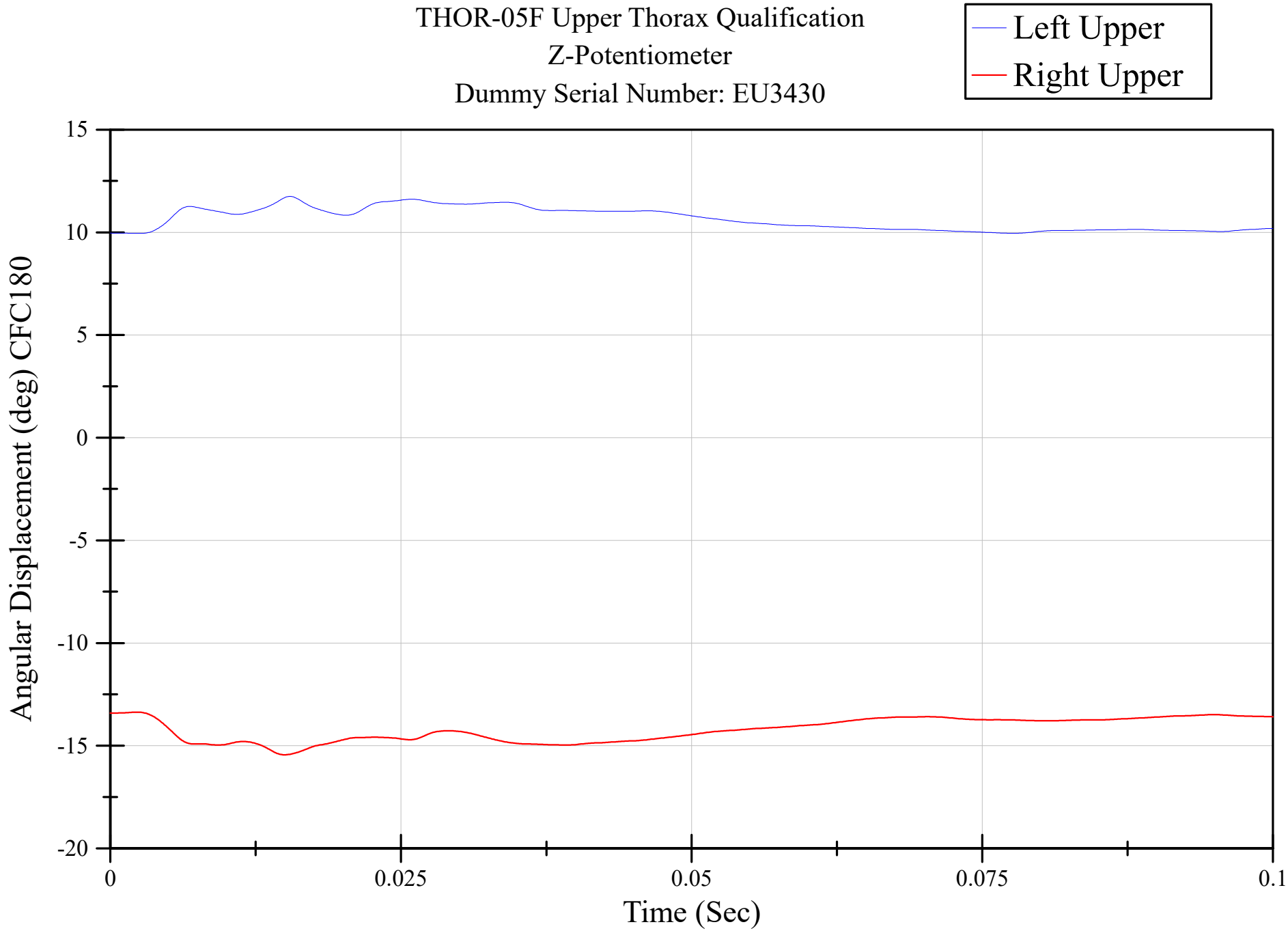
12/7/2022 2:32 PM



File Name: 221207-9 processed

12/7/2022 2:32 PM

THOR-05F Lower Left Thorax Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components

Rib 1 Serial Number: ET5497
Rib 2 Serial Number: ET5498
Rib 3 Serial Number: ET5499
Rib 4 Serial Number: ET5500
Rib 5 Serial Number: ET5589
Rib 6 Serial Number: ET5502
Rib 7 Serial Number: ET5503

Test ID: 221207-11
Test Date: 12/7/2022
Test Time: 3:41 PM

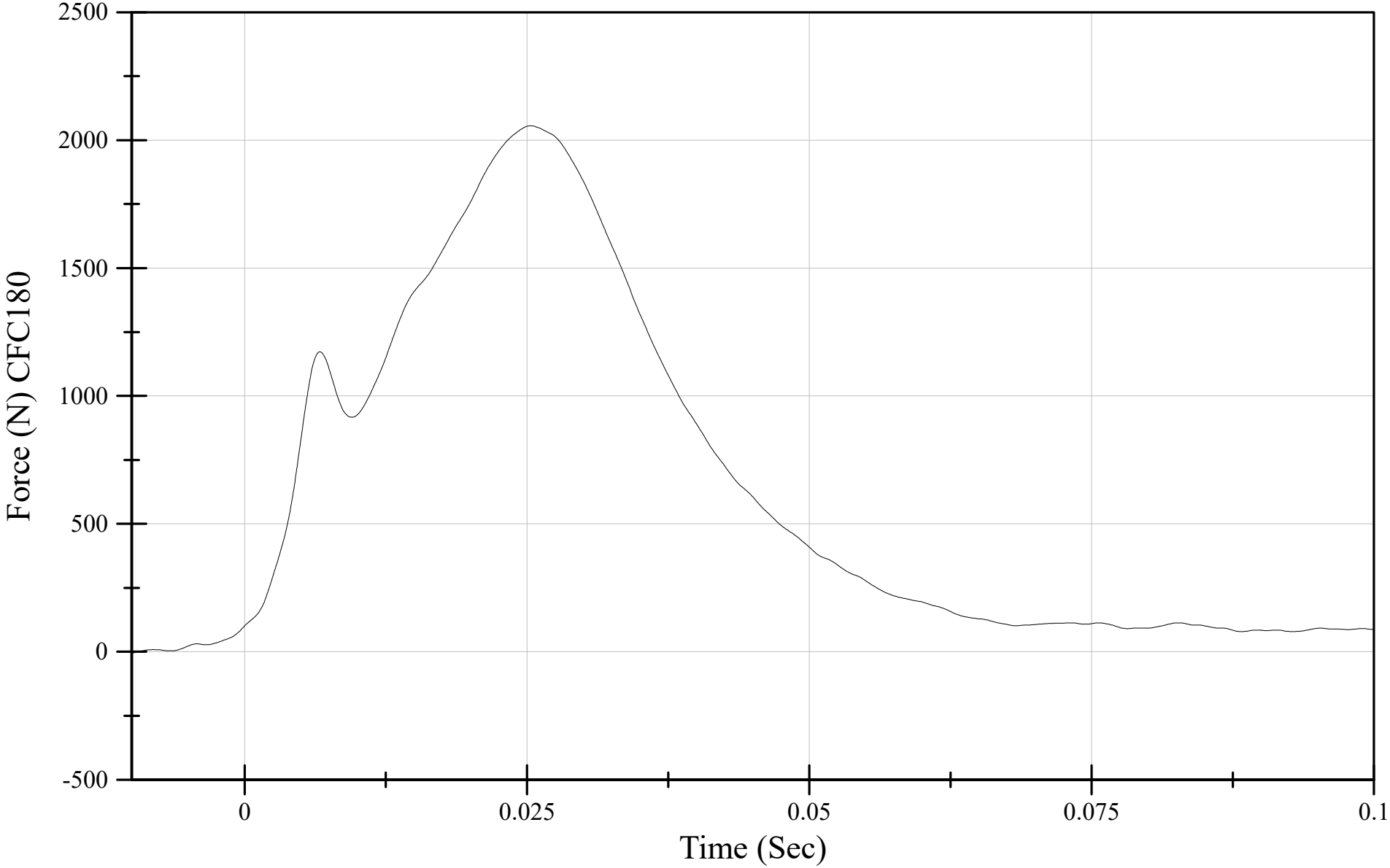
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.2	Pass
Test Humidity (%)	10 - 70	47	Pass
Test Velocity (m/s)	4.25 - 4.35	4.30	Pass
Peak Probe Force (N)		2056	
Left Resultant Deflection at Peak Force (mm)		47.6	

* THOR-05F Qualification Manual - July 2022

File Name: 221207-11 processed
Software Version: 2.8

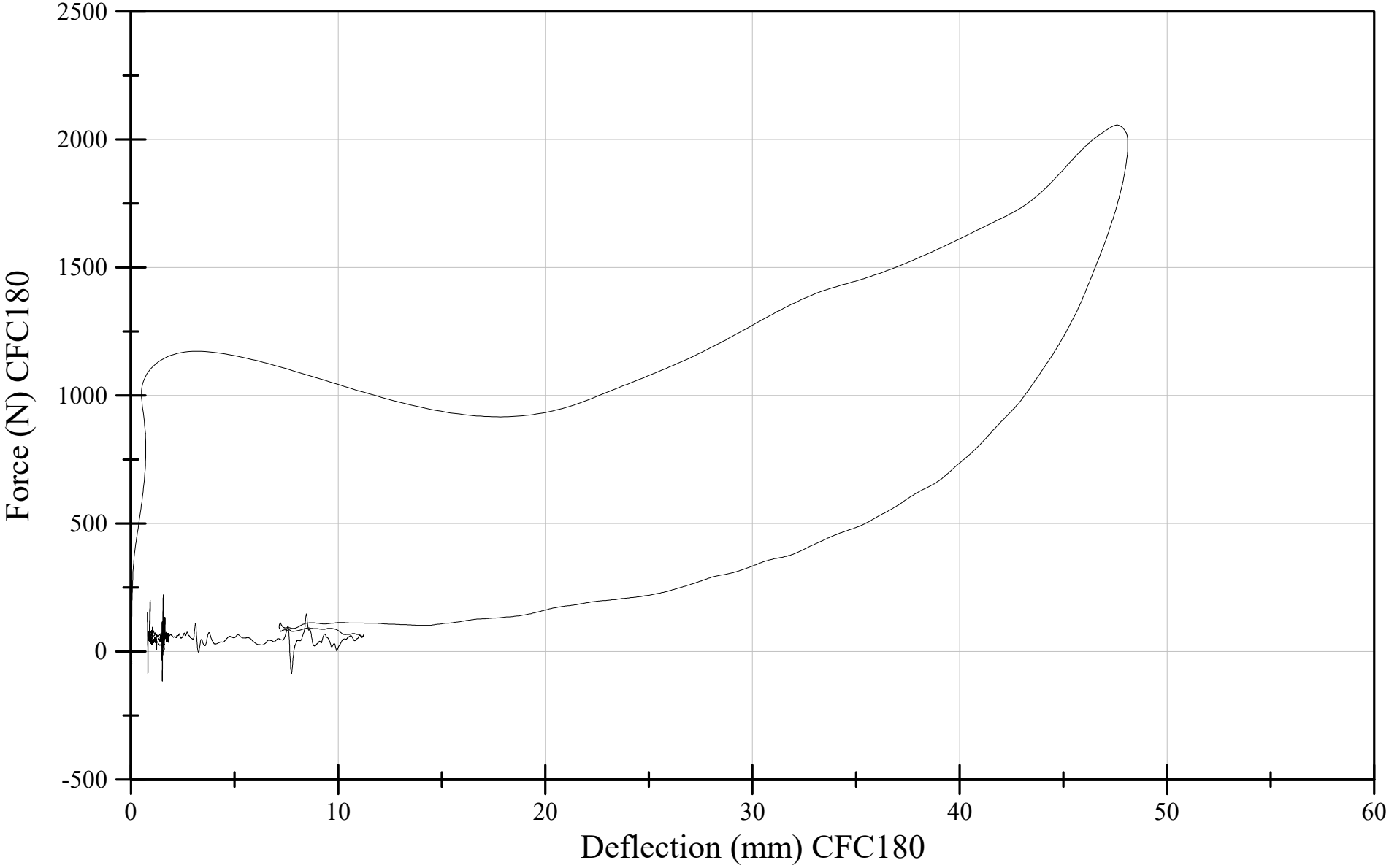
THOR-05F Lower Left Thorax Qualification
Peak Probe Force
Serial Number: EU3430



File Name: 221207-11 processed

12/7/2022 3:41 PM

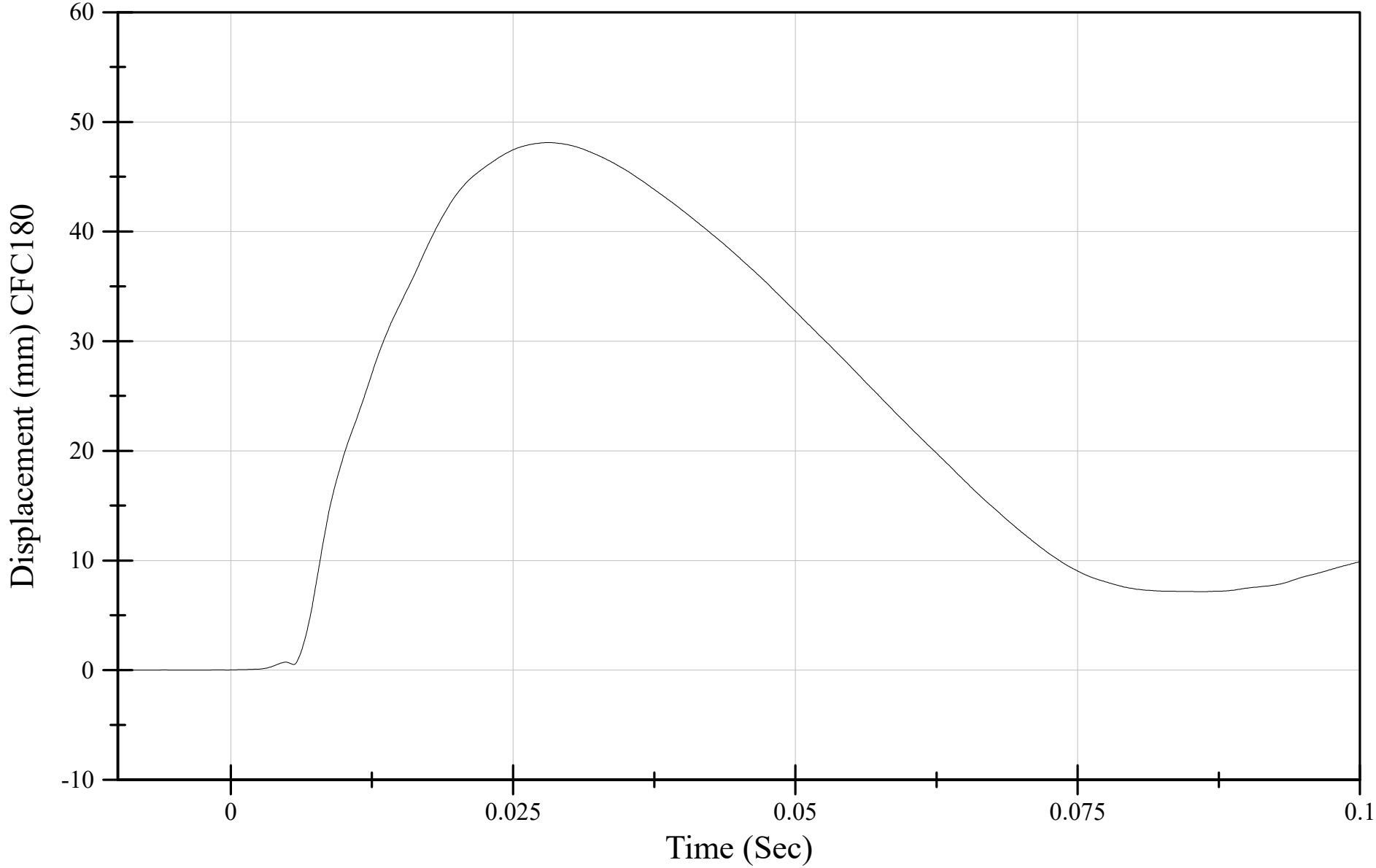
THOR-05F Lower Left Thorax Qualification
Probe Force vs Left Resultant Deflection
Serial Number: EU3430



File Name: 221207-11 processed

12/7/2022 3:41 PM

THOR-05F Lower Left Thorax Qualification
Left Resultant Deflection
Serial Number: EU3430



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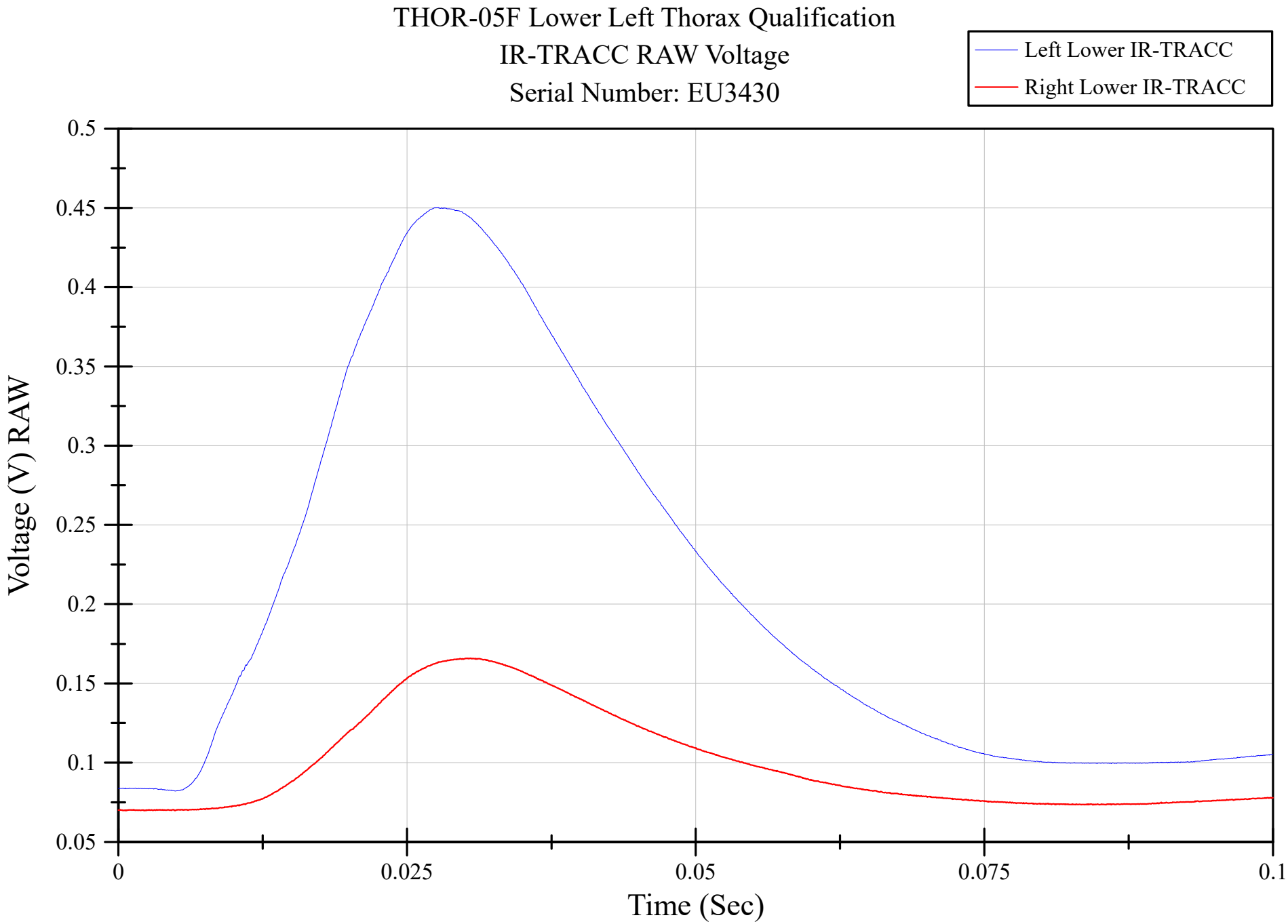
12/7/2022 3:41 PM



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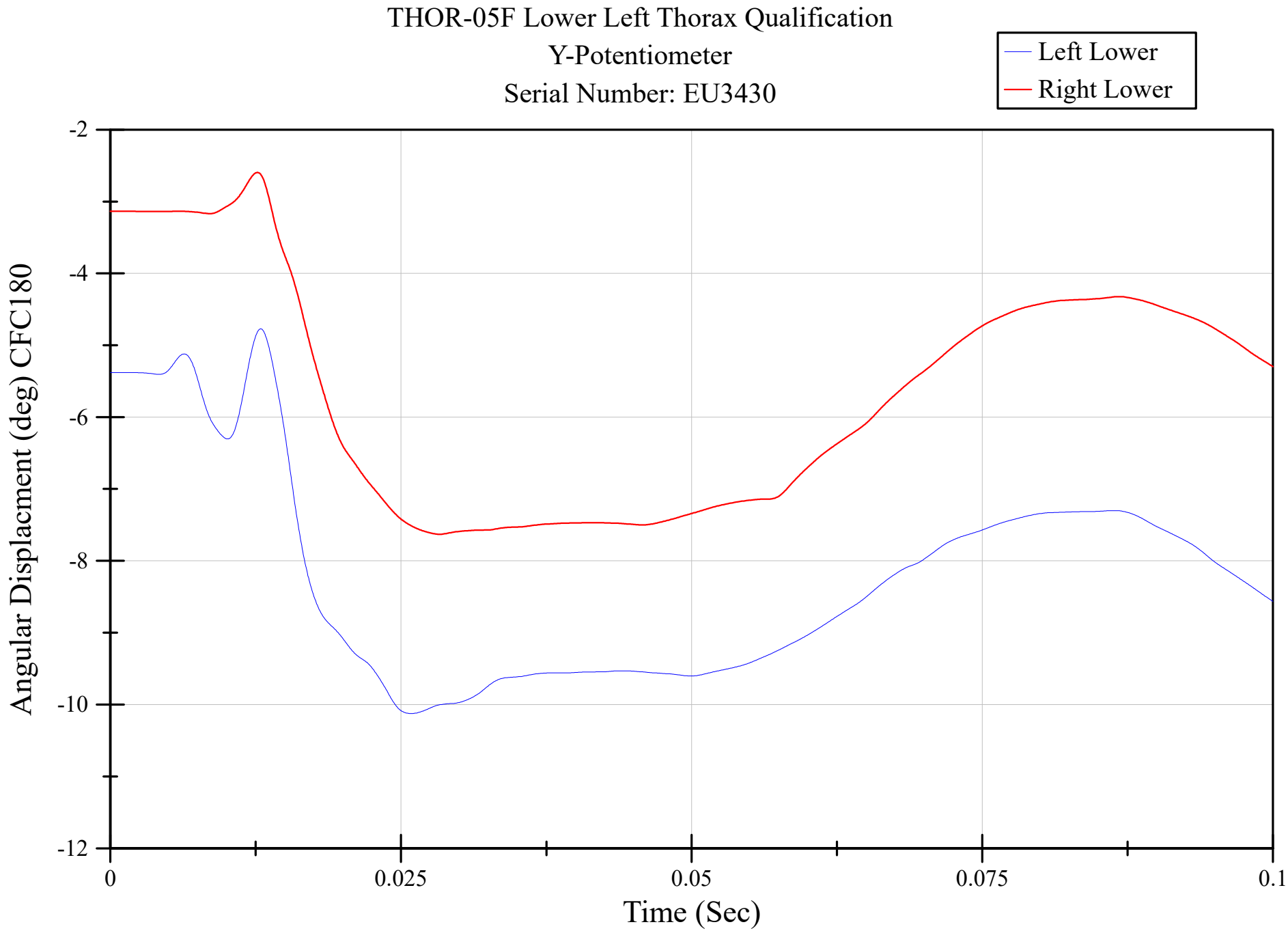
12/7/2022 3:41 PM



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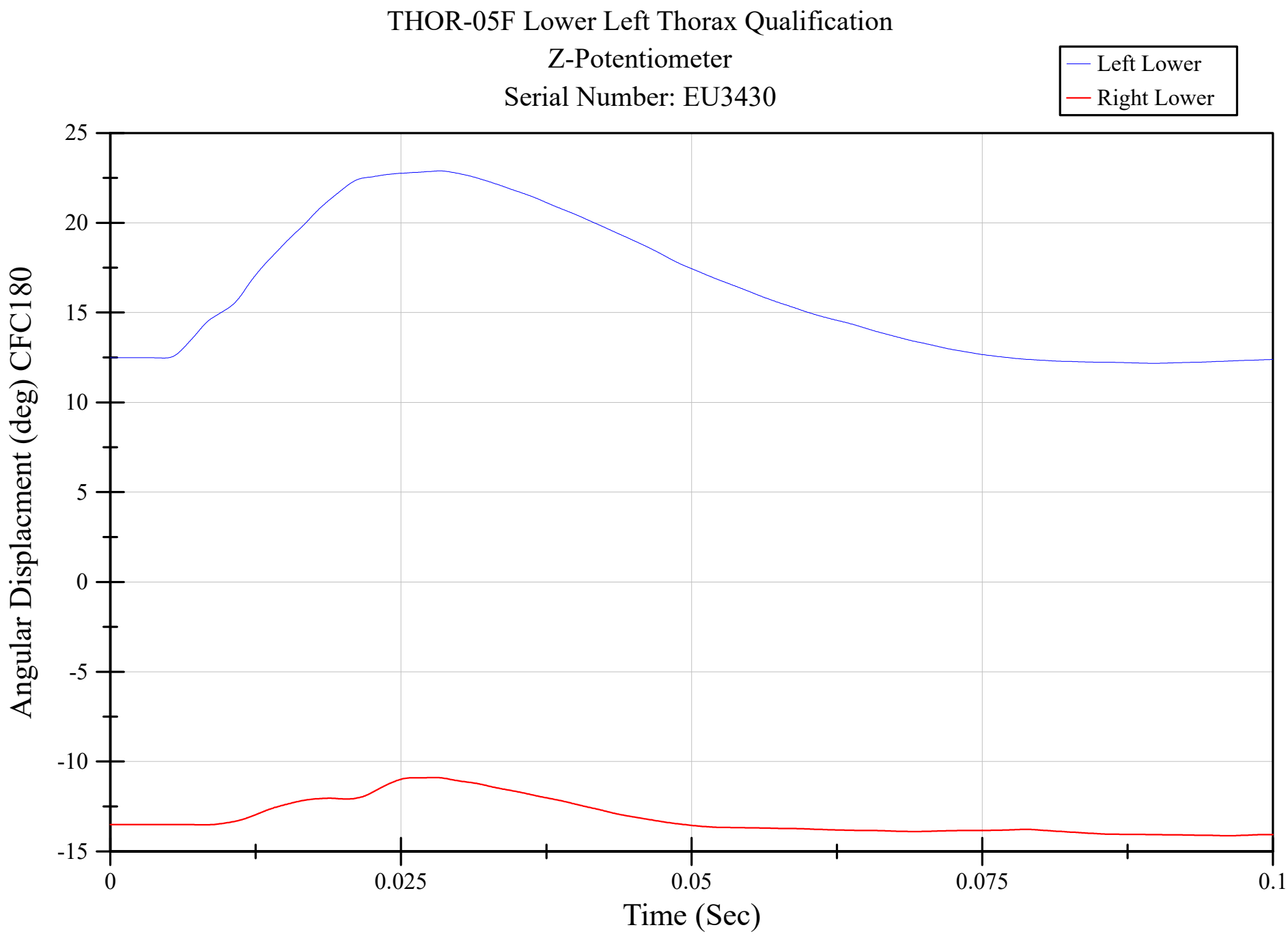
12/7/2022 3:41 PM



File Name: 221207-11 processed

12/7/2022 3:41 PM

THOR-05F Lower Right Thorax Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components

Rib 1 Serial Number: ET5497
Rib 2 Serial Number: ET5498
Rib 3 Serial Number: ET5499
Rib 4 Serial Number: ET5500
Rib 5 Serial Number: ET5589
Rib 6 Serial Number: ET5502
Rib 7 Serial Number: ET5503

Test ID: 221207-12
Test Date: 12/7/2022
Test Time: 4:23 PM

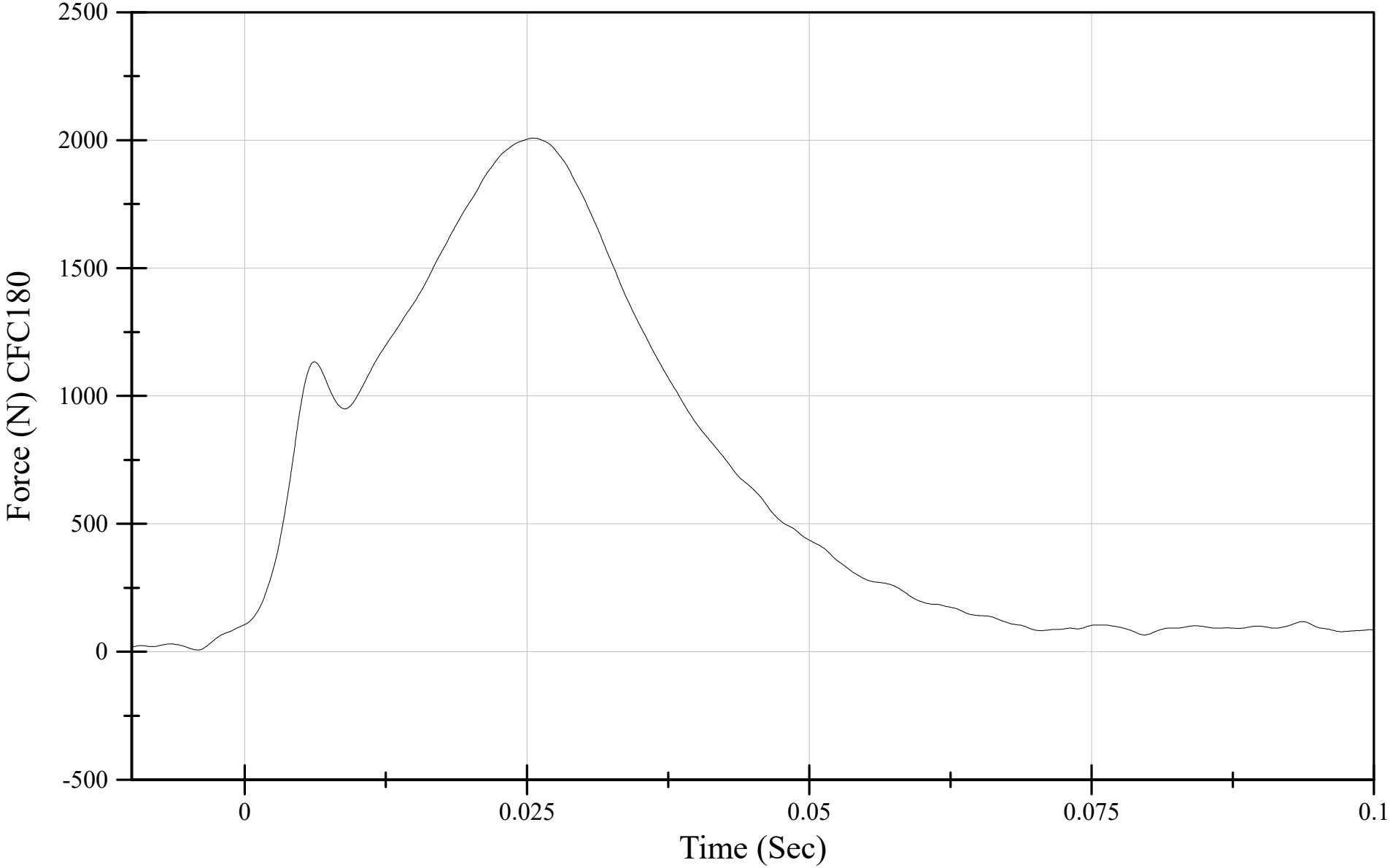
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.3	Pass
Test Humidity (%)	10 - 70	47	Pass
Test Velocity (m/s)	4.25 - 4.35	4.29	Pass
Peak Probe Force (N)		2009	
Right Resultant Deflection at Peak Force (mm)		49.5	

* THOR-05F Qualification Manual - July 2022

File Name: 221207-12 processed
Software Version: 2.8

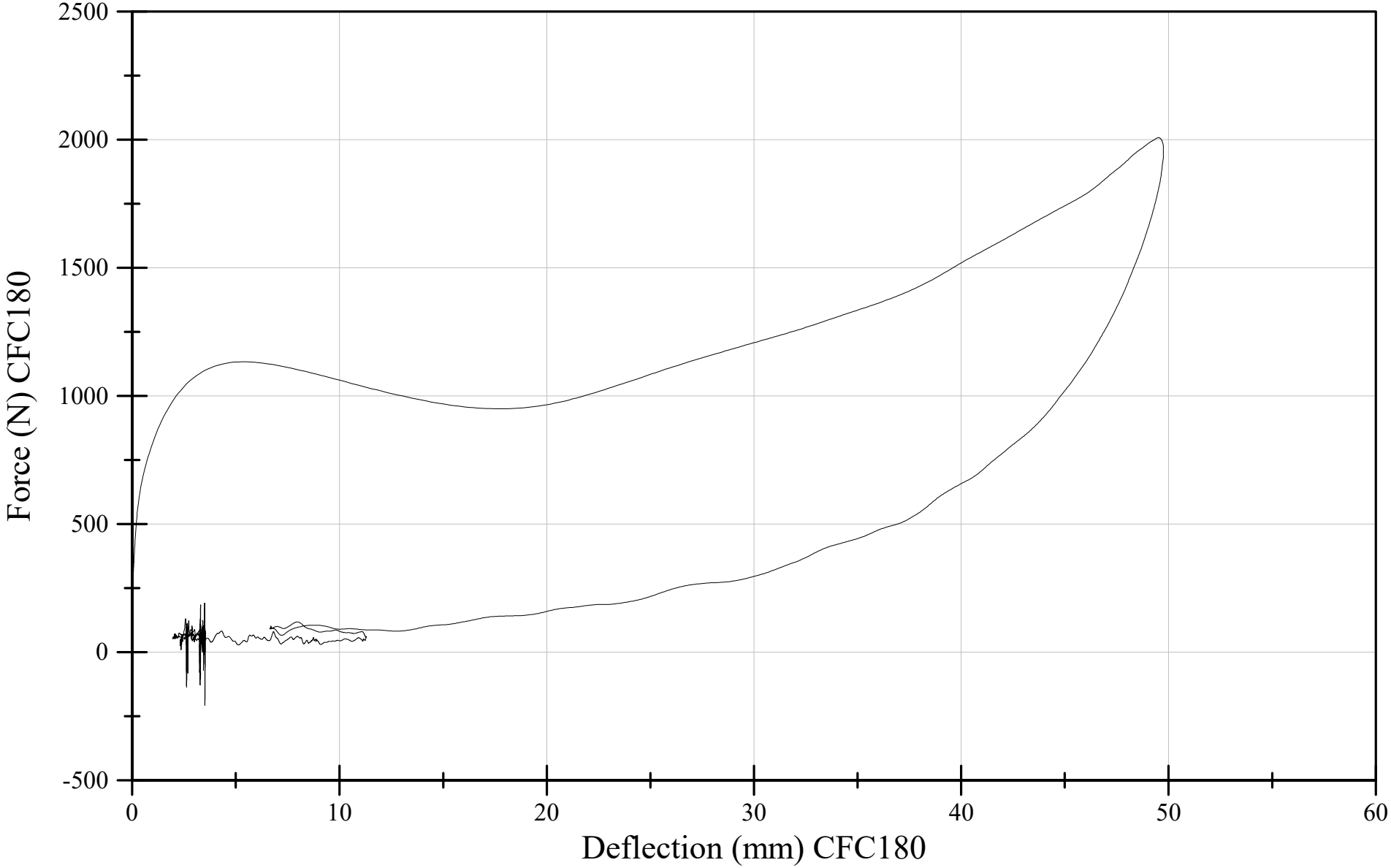
THOR-05F Lower Right Thorax Qualification
Peak Probe Force
Serial Number: EU3430



File Name: 221207-12 processed

12/7/2022 4:23 PM

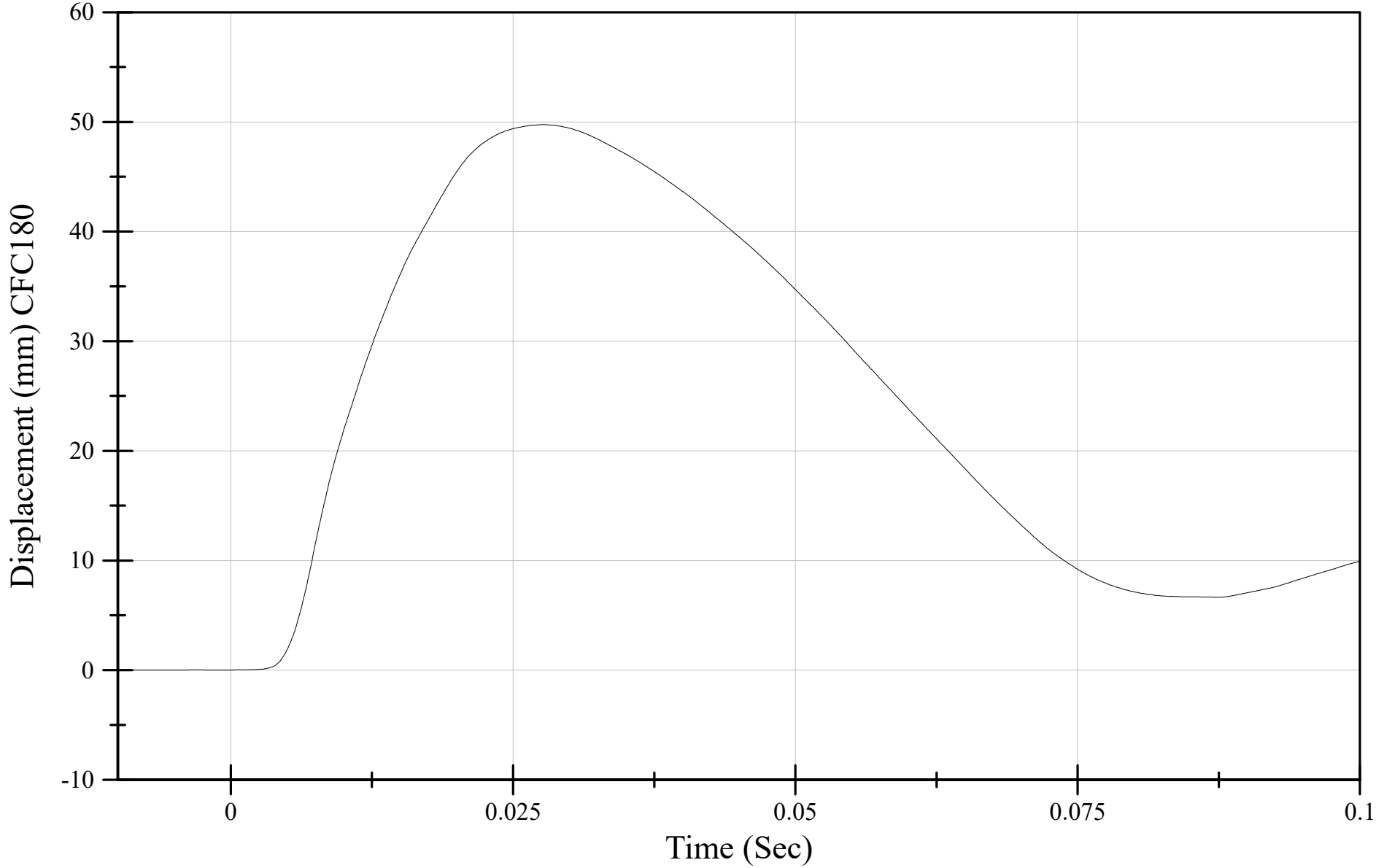
THOR-05F Lower Right Thorax Qualification
Probe Force vs Right Resultant Deflection
Serial Number: EU3430



File Name: 221207-12 processed

12/7/2022 4:23 PM

THOR-05F Lower Right Thorax Qualification
Right Resultant Deflection
Serial Number: EU3430



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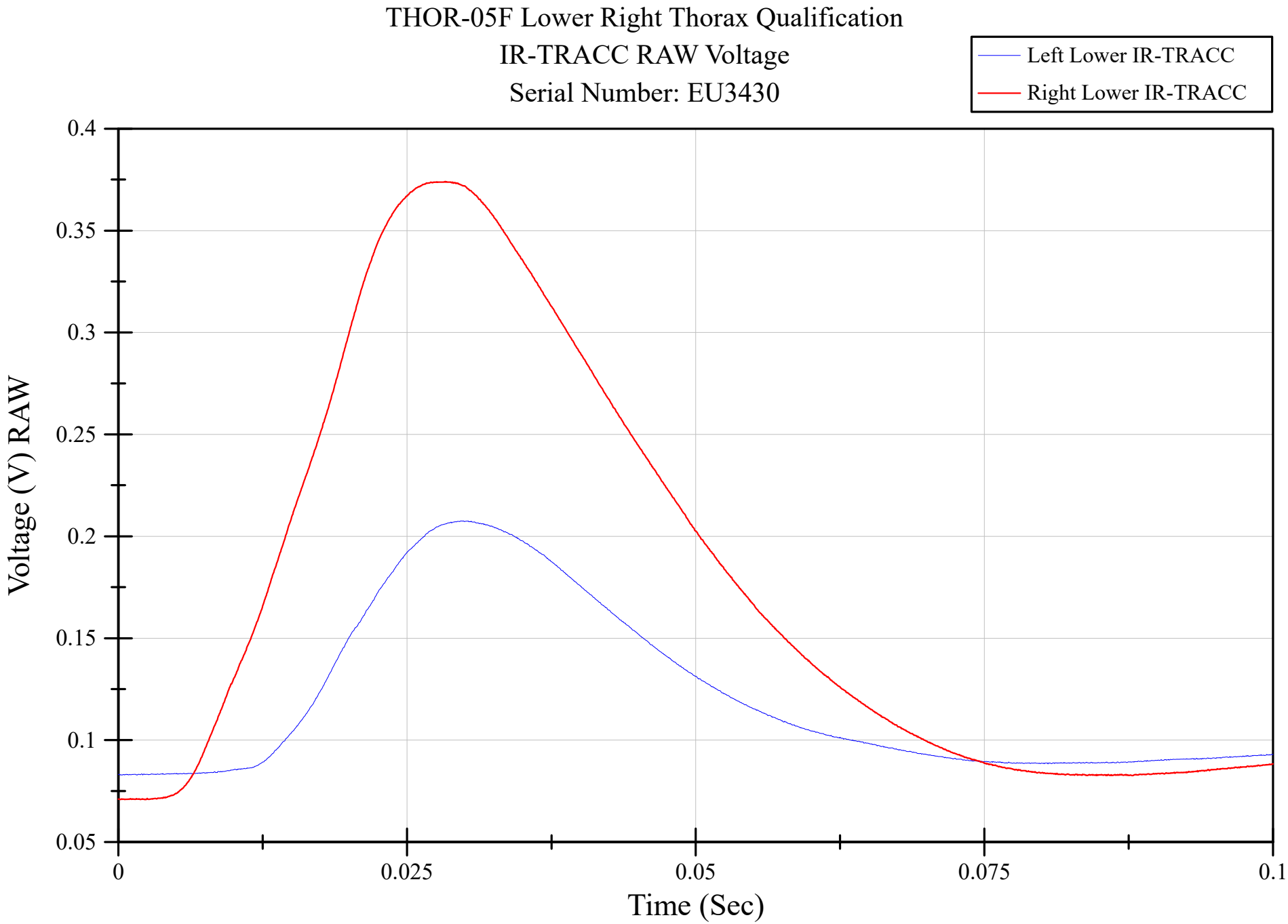
12/7/2022 4:23 PM



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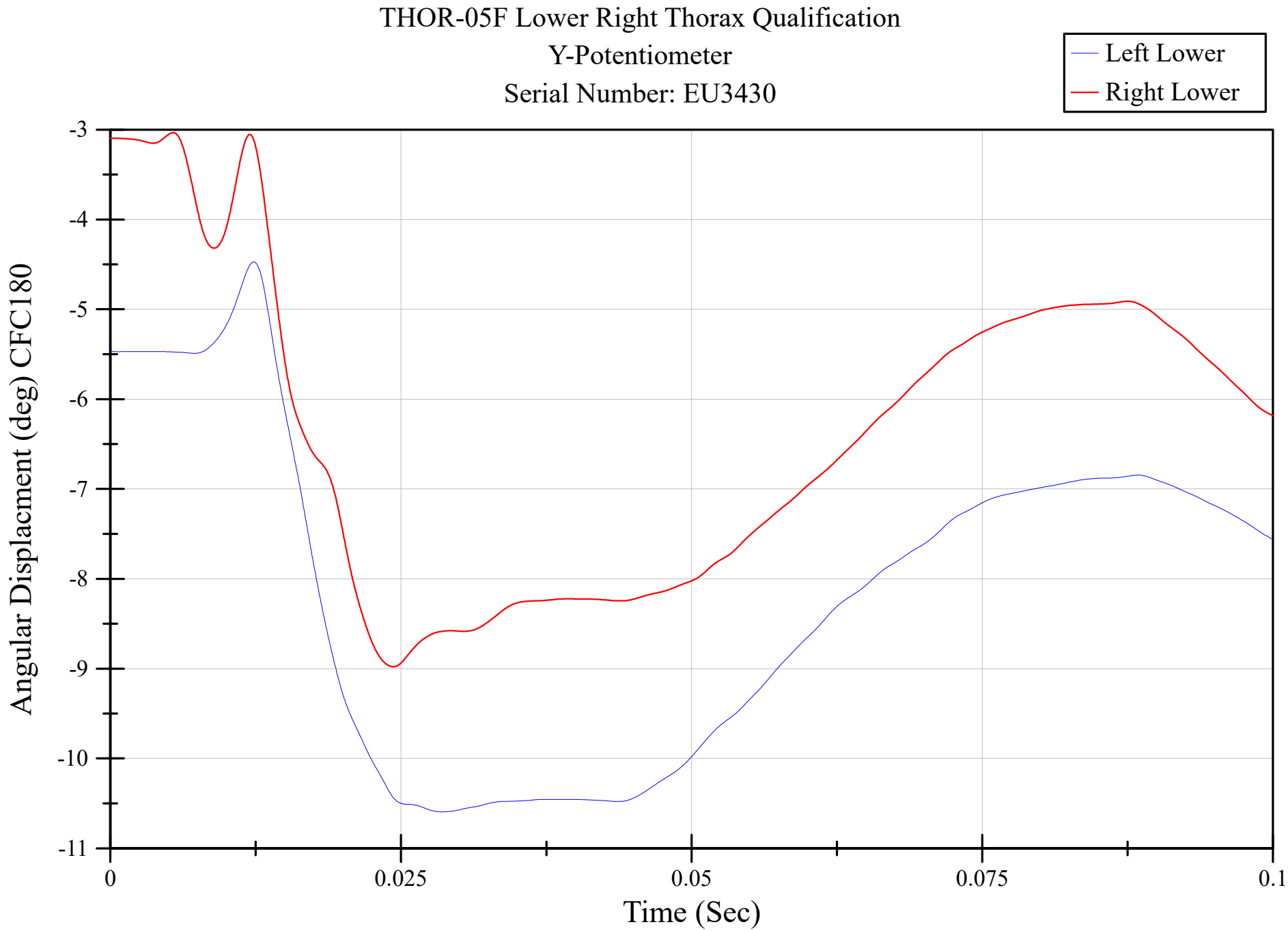
12/7/2022 4:23 PM



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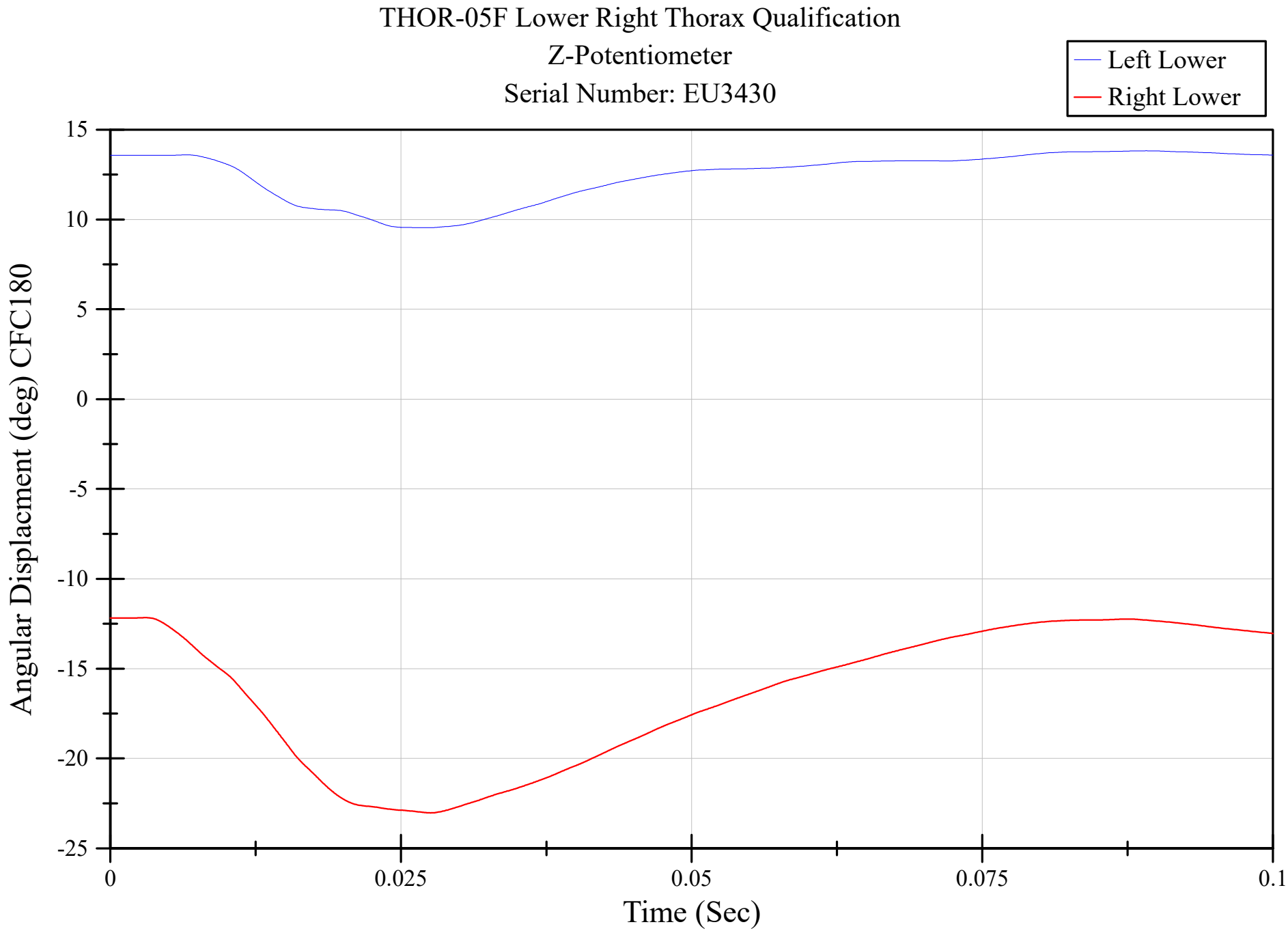
12/7/2022 4:23 PM



File Name: 221207-12 processed

12/7/2022 4:23 PM

THOR-05F Lower Abdomen Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components

Abdomen Foam: EE7299

Test ID: 221206-9
Test Date: 12/6/2022
Test Time: 3:50 PM

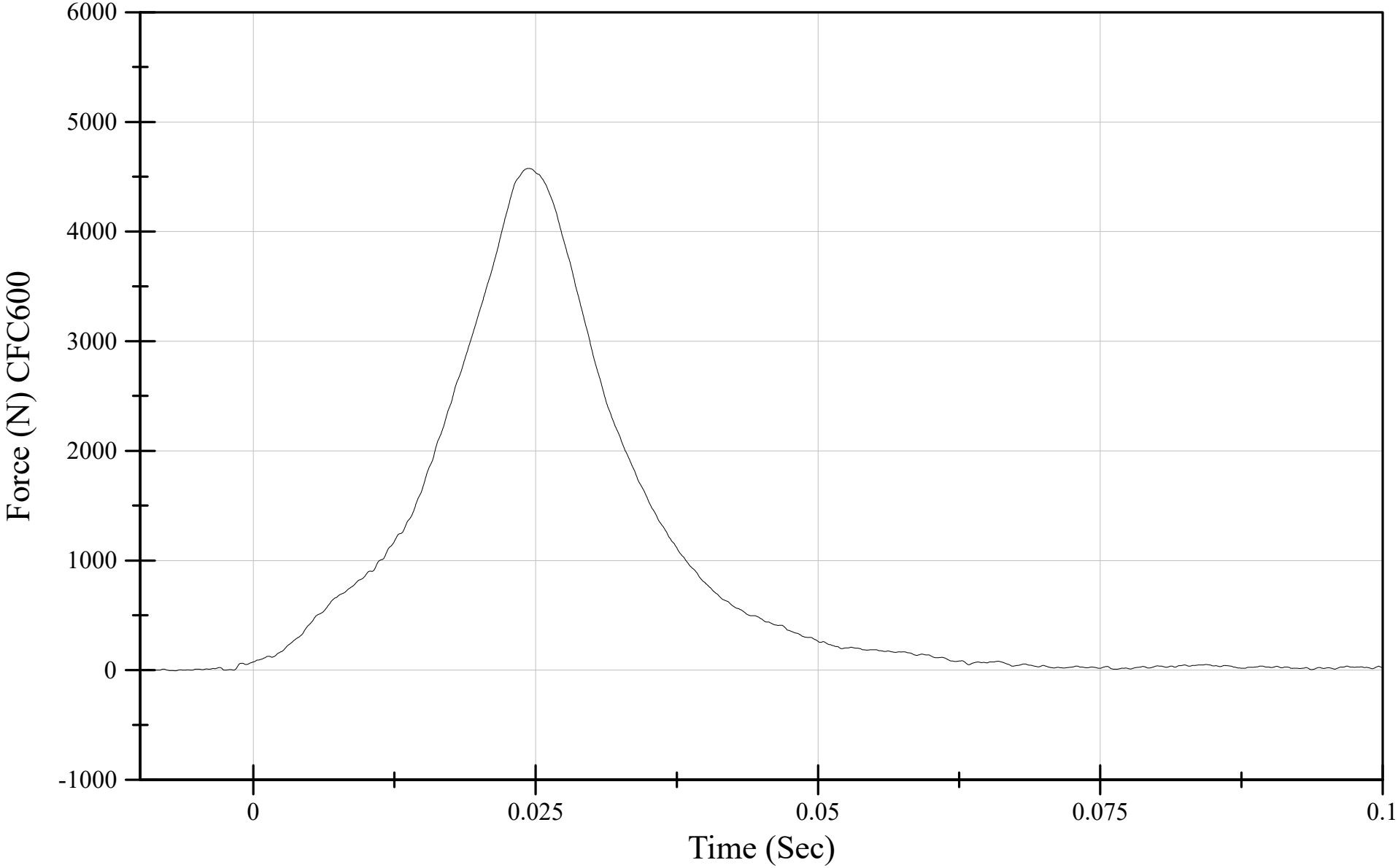
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.2	Pass
Test Humidity (%)	10 - 70	48	Pass
Test Velocity (m/s)	6.05 - 6.15	6.09	Pass
Peak Probe Force (N)		4576	
Peak Left Abdomen Pressure (kPa)		170	
Peak Right Abdomen Pressure (kPa)		174	
Difference between Left and Right Pressure (kPa)		4	

* THOR-05F Qualification Manual - July 2022

File Name: 221206-9 processed
Software Version: 2.8

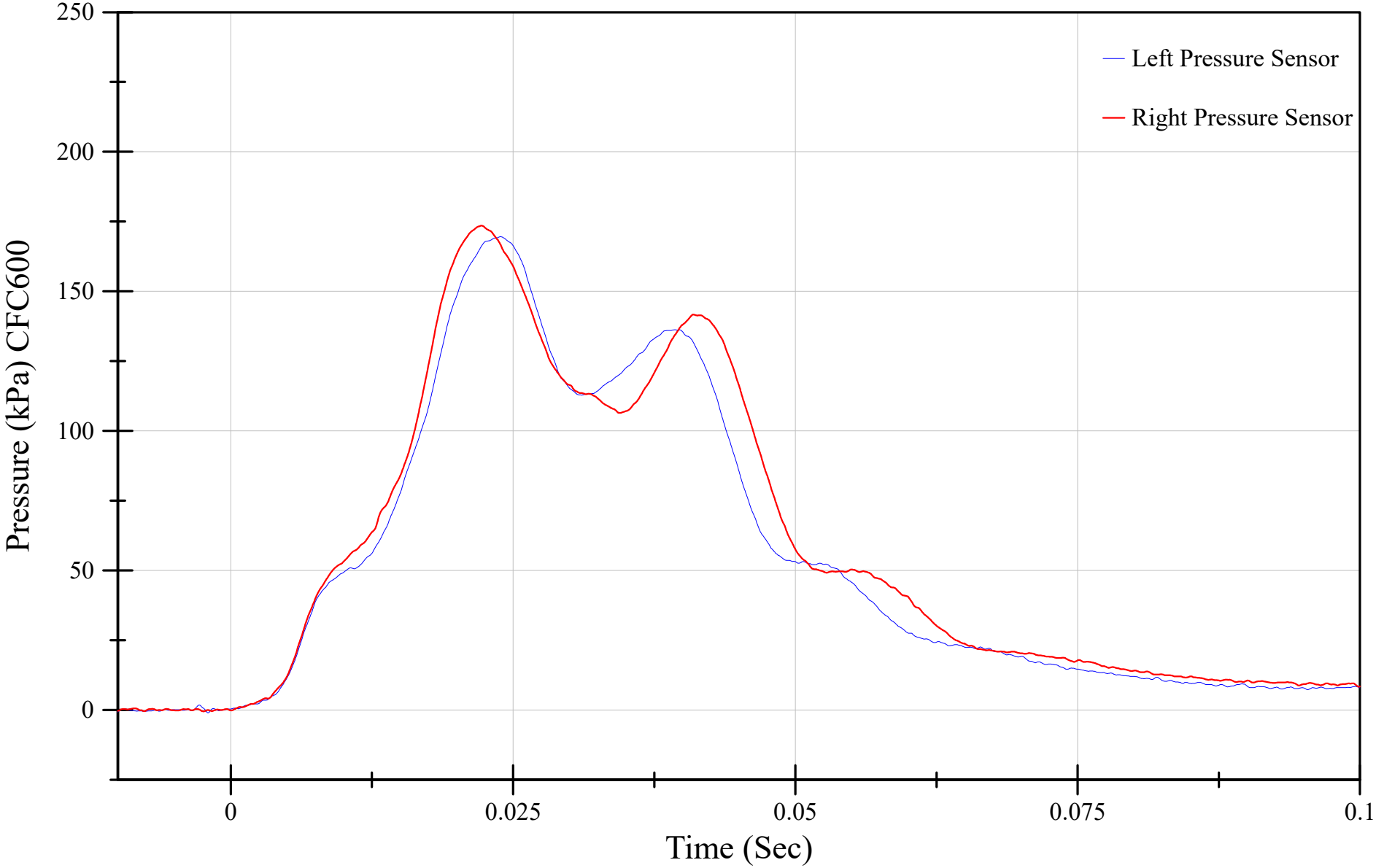
THOR-05F Lower Abdomen Qualification
Peak Probe Force
Serial Number: EU3430



File Name: 221206-9 processed

12/6/2022 3:50 PM

THOR-05F Lower Abdomen Qualification
Abdomen Pressure Sensors
Serial Number: EU3430



File Name: 221206-9 processed

12/6/2022 3:50 PM

THOR-05F Left Upper Leg Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Compression Element: ES6546
Left Thigh Flesh: ET8030

Test ID: 221206-3
Test Date: 12/6/2022
Test Time: 9:24 AM

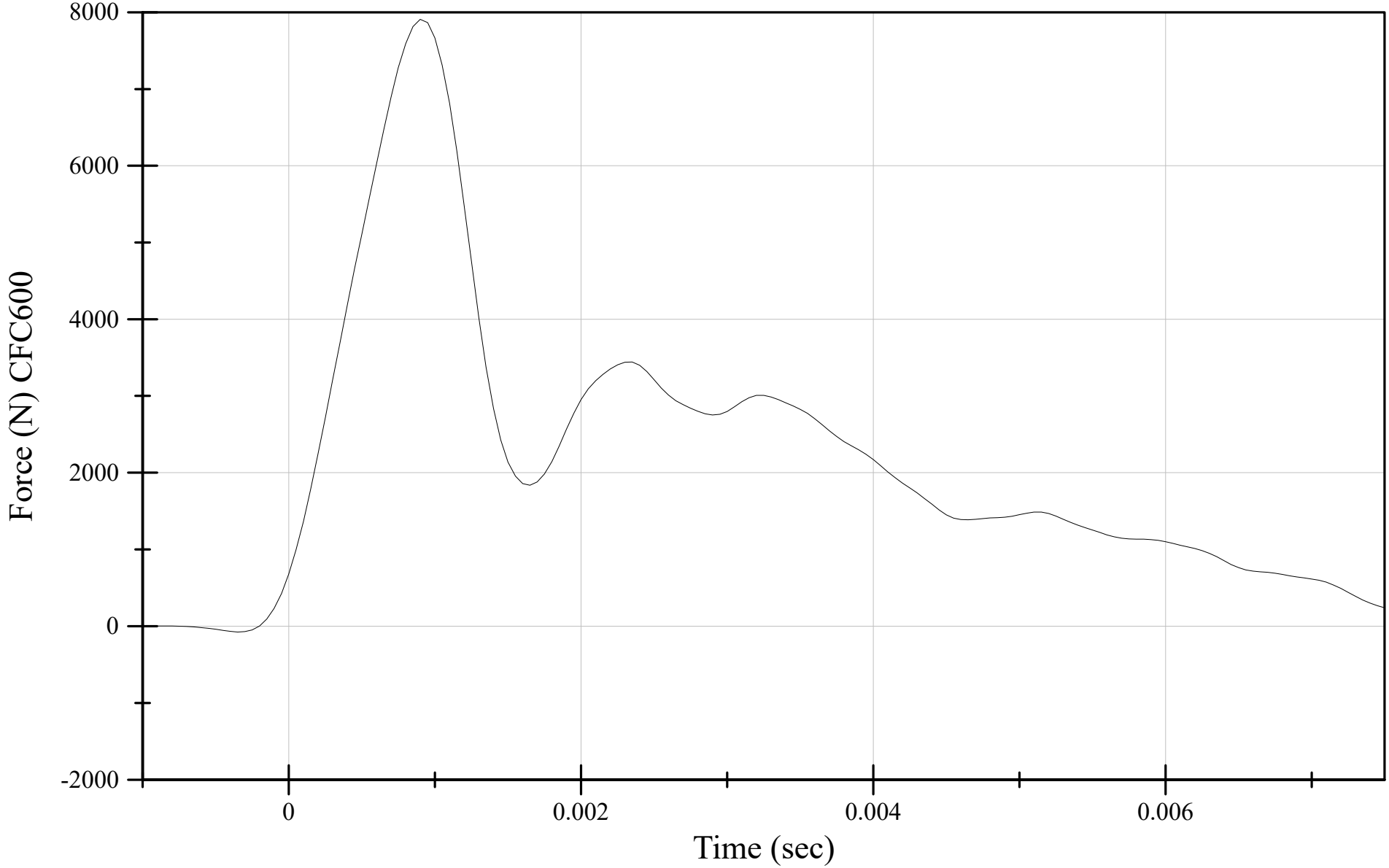
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.1	Pass
Test Humidity (%)	10 - 70	47	Pass
Test Velocity (m/s)		3.30	Pass
Peak Probe Force (N)		7909.0	
Peak Femur Force (N)		-4891.4	
Peak Resultant Acetabulum Force (N)		1855.6	

* THOR-05F Qualification Manual - July 2022

File Name: 221206-3 processed

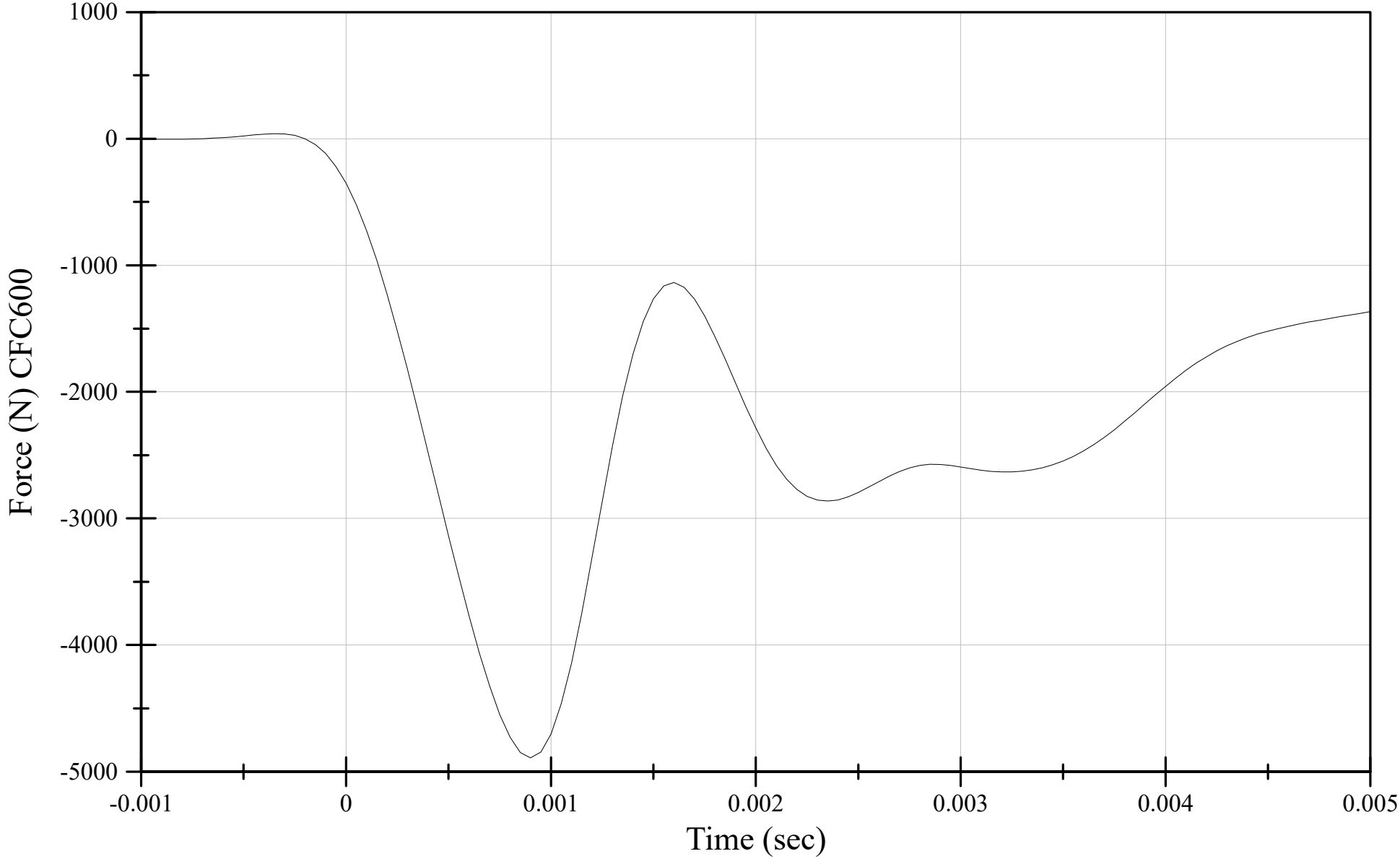
THOR-05F Left Upper Leg Qualification
Probe Force
Serial Number: EU3430



File Name: 221206-3 processed

12/6/2022 9:24 AM

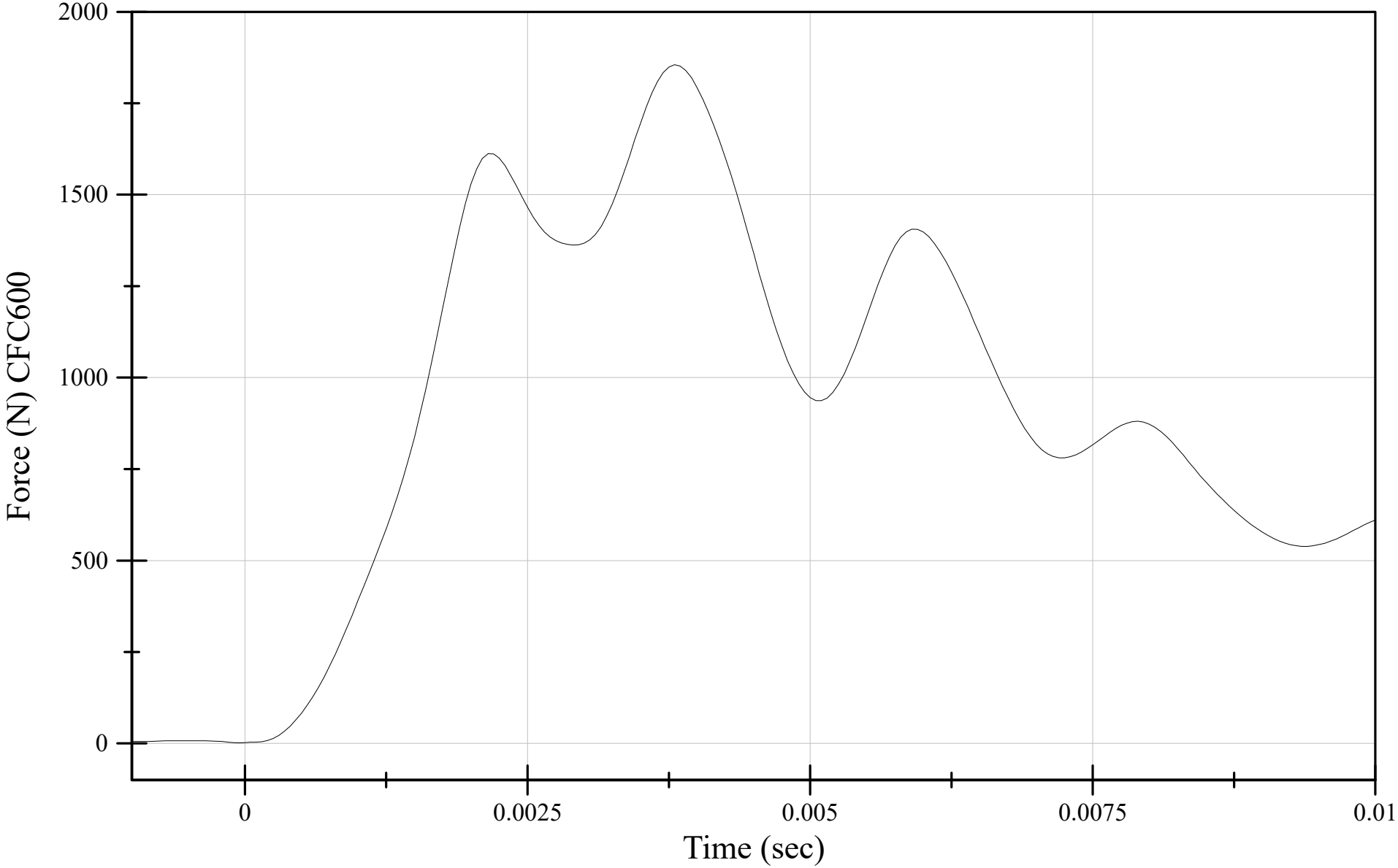
THOR-05F Left Upper Leg Qualification
Femur Z-Force
Serial Number: EU3430



File Name: 221206-3 processed

12/6/2022 9:24 AM

THOR-05F Left Upper Leg Qualification
Peak Acetabulum Resultant Force
Serial Number: EU3430



File Name: 221206-3 processed

12/6/2022 9:24 AM

THOR-05F Left Knee Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Left Knee Slider: EV2938

Test ID: 221206-6
Test Date: 12/6/2022
Test Time: 11:46 AM

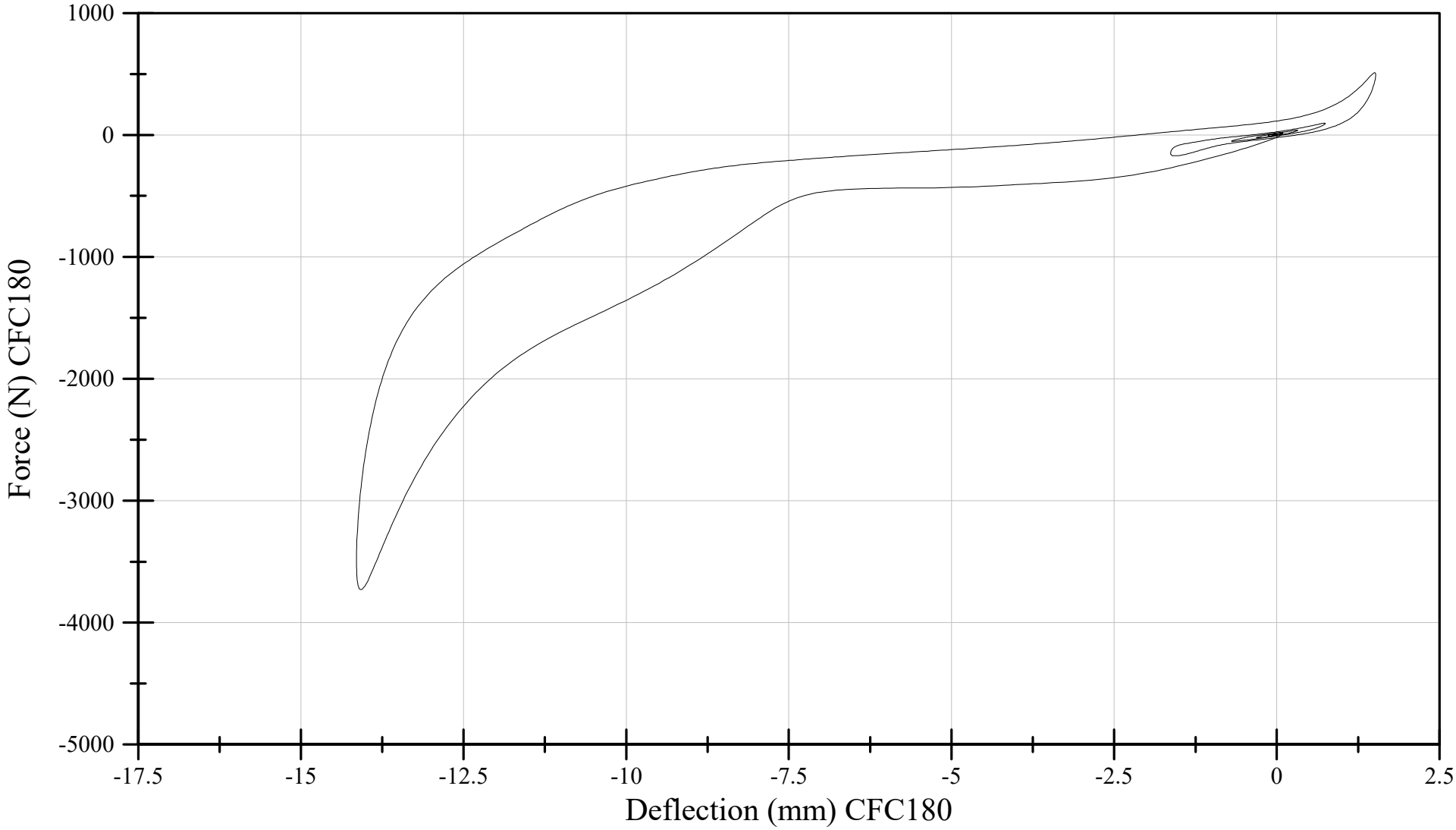
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.1	Pass
Test Humidity (%)	10 - 70	51	Pass
Test Velocity (m/s)	2.10 - 2.20	2.18	Pass
Peak Femur Fz (N)		-3729.9	
Knee Deflection at Peak Femur Force (N)		-14.1	

* THOR-05F Qualification Manual - July 2022

File Name: 221206-6 processed
Software Version: 2.8

THOR-05F Left Knee Qualification
Peak Deflection at Peak Force
Serial Number: EU3430



File Name: 221206-6 processed

12/6/2022 11:46 AM

THOR-05F Left Ball of Foot Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Left Ankle: EV4180
Dorsiflexion Stop: EV3711

Test ID: 230103-8
Test Date: 1/3/2023
Test Time: 5:10 PM

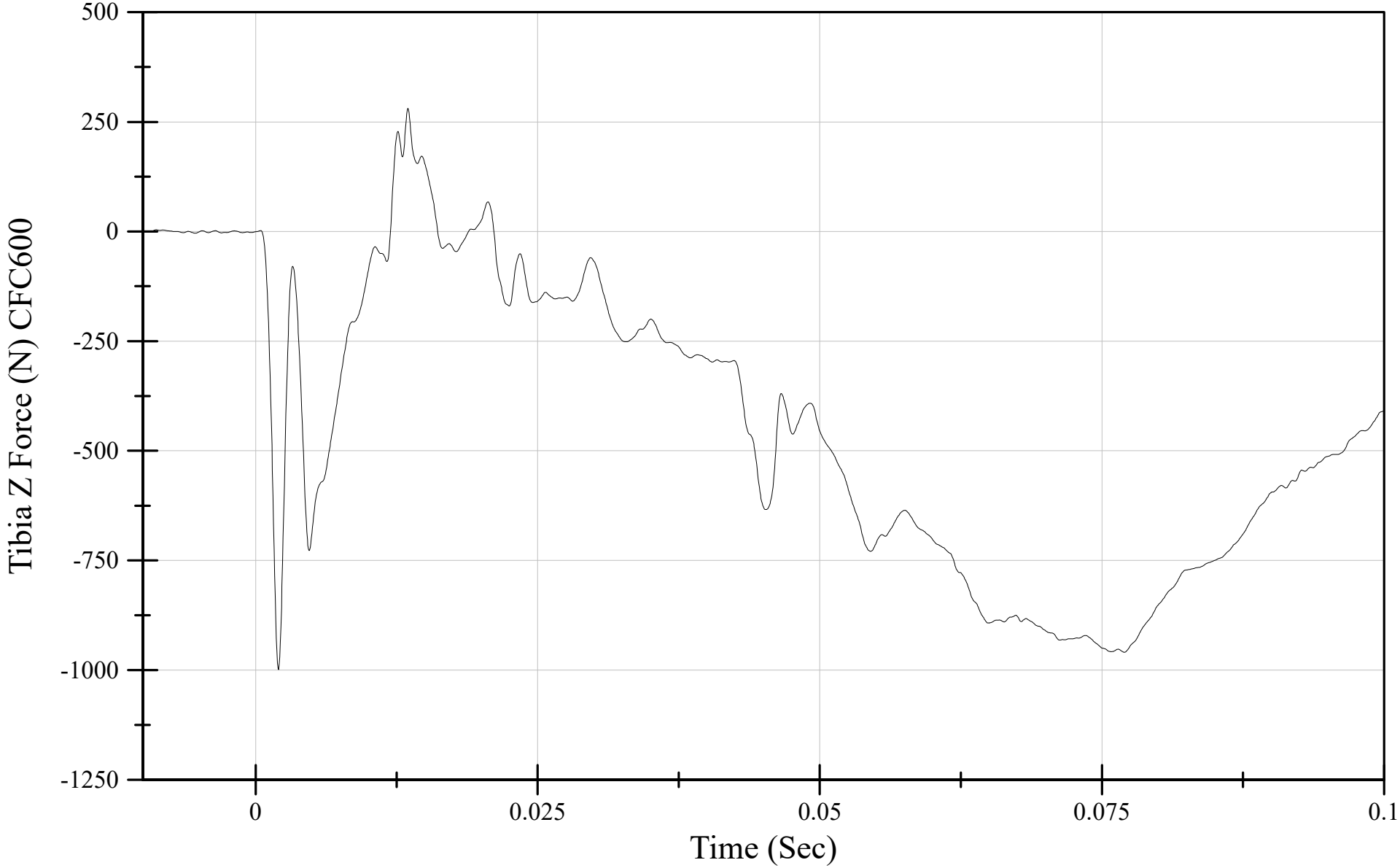
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.2	Pass
Test Humidity (%)	10 - 70	58	Pass
Test Velocity (m/s)	1.95 - 2.05	2.03	Pass
Peak Lower Tibia Fz after 10 ms (N)		-959.3	
Peak Ankle Resistive Moment (Nm)		45.7	
Peak Ankle Y-axis Rotation (deg)		35.9	

* THOR-05F Qualification Manual - July 2022

File Name: 230103-8 processed
Software Version: 2.8

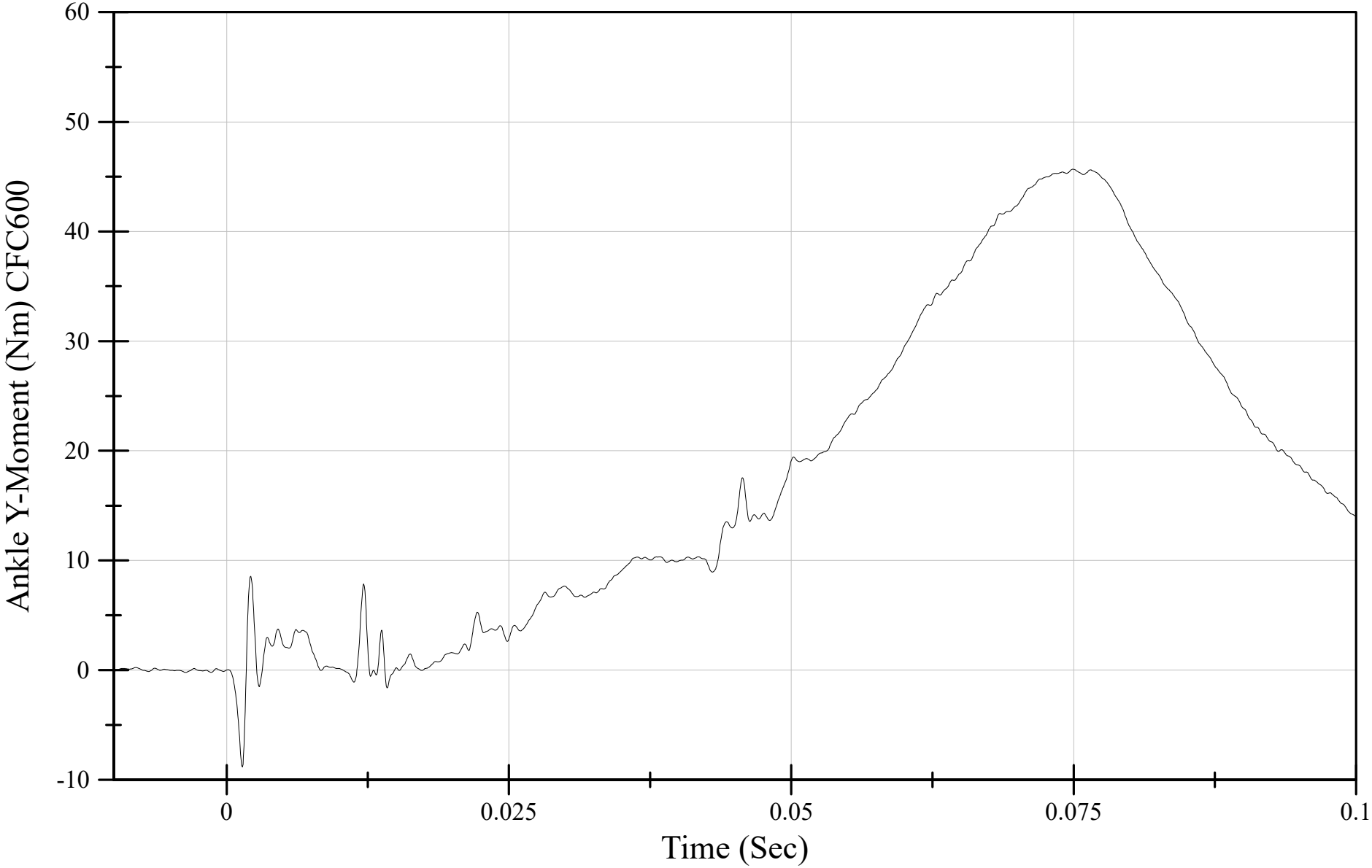
THOR-05F Left Ball of Foot Qualification
Lower Tibia Fz
Serial Number: EU3430



File Name: 230103-8 processed

1/3/2023 5:10 PM

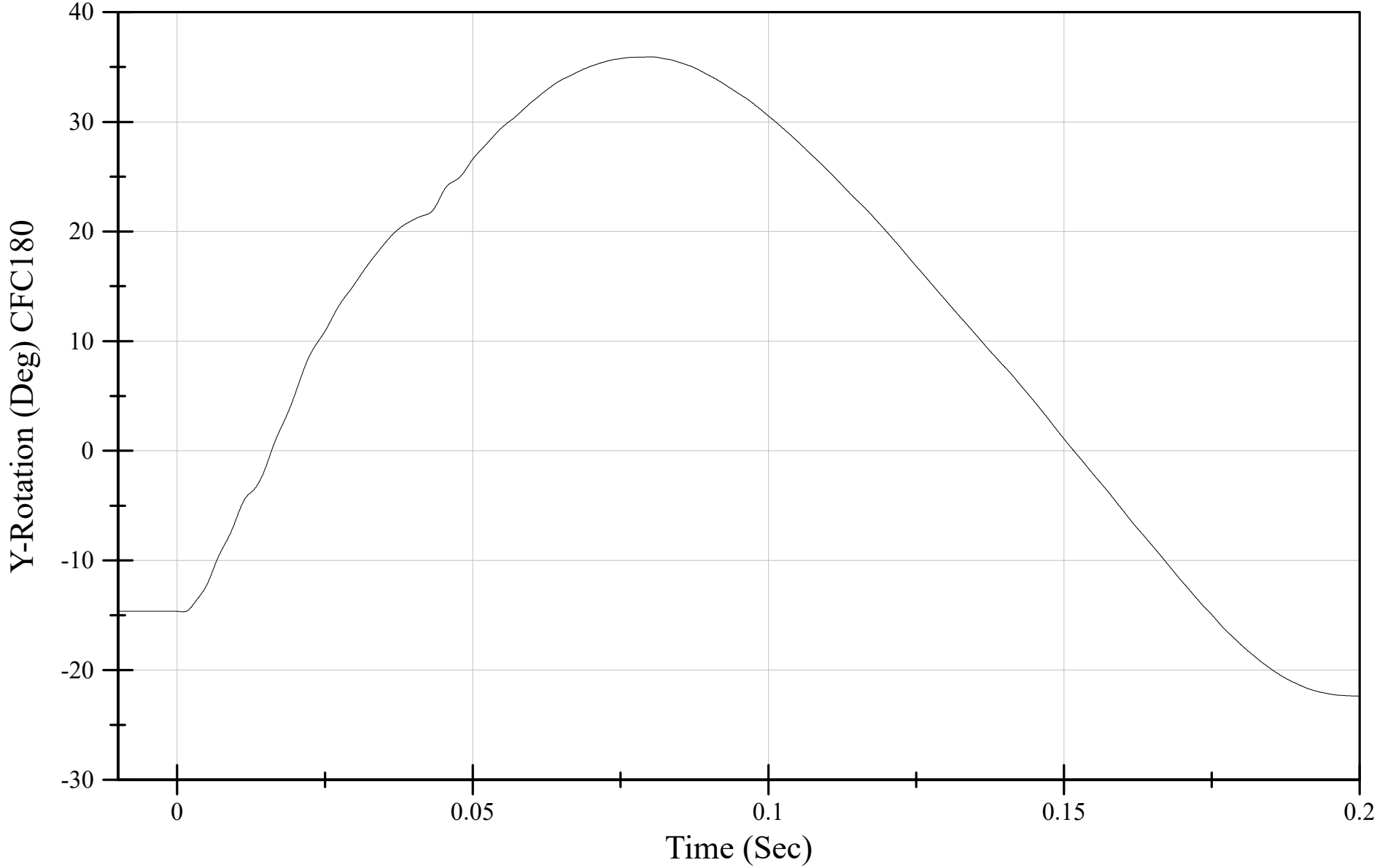
THOR-05F Left Ball of Foot Qualification
Ankle Y-Moment
Serial Number: EU3430



File Name: 230103-8 processed

1/3/2023 5:10 PM

THOR-05F Left Ball of Foot Qualification
Ankle Y-Rotation
Serial Number: EU3430



File Name: 230103-8 processed

1/3/2023 5:10 PM

THOR-05F Left Foot Inversion Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Ankle Serial: EV4180
Inversion Stop Assembly: EP6307

Test ID: 230110-9
Test Date: 1/10/2023
Test Time: 4:33 PM

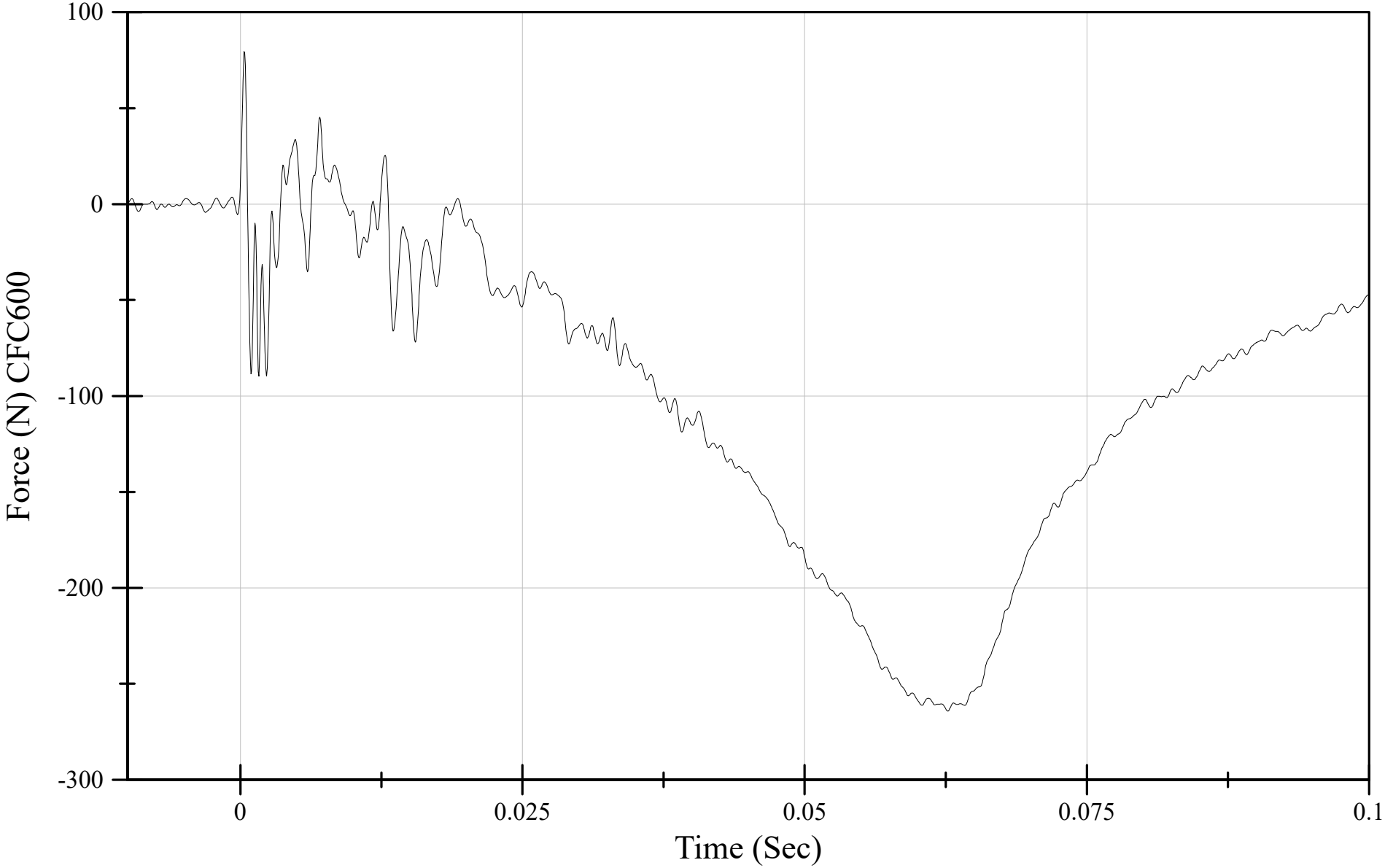
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.1	Pass
Test Humidity (%)	10 - 70	50	Pass
Test Velocity (m/s)	1.95 - 2.05	2.04	Pass
Peak Lower Tibia Fz		-264.1	
Peak Ankle X-axis Resistive Moment		-31.6	
Peak Ankle X-axis Rotation		-46.6	

* THOR-05F Qualification Manual - July 2022

File Name: 230110-9 processed
Software Version: 2.8

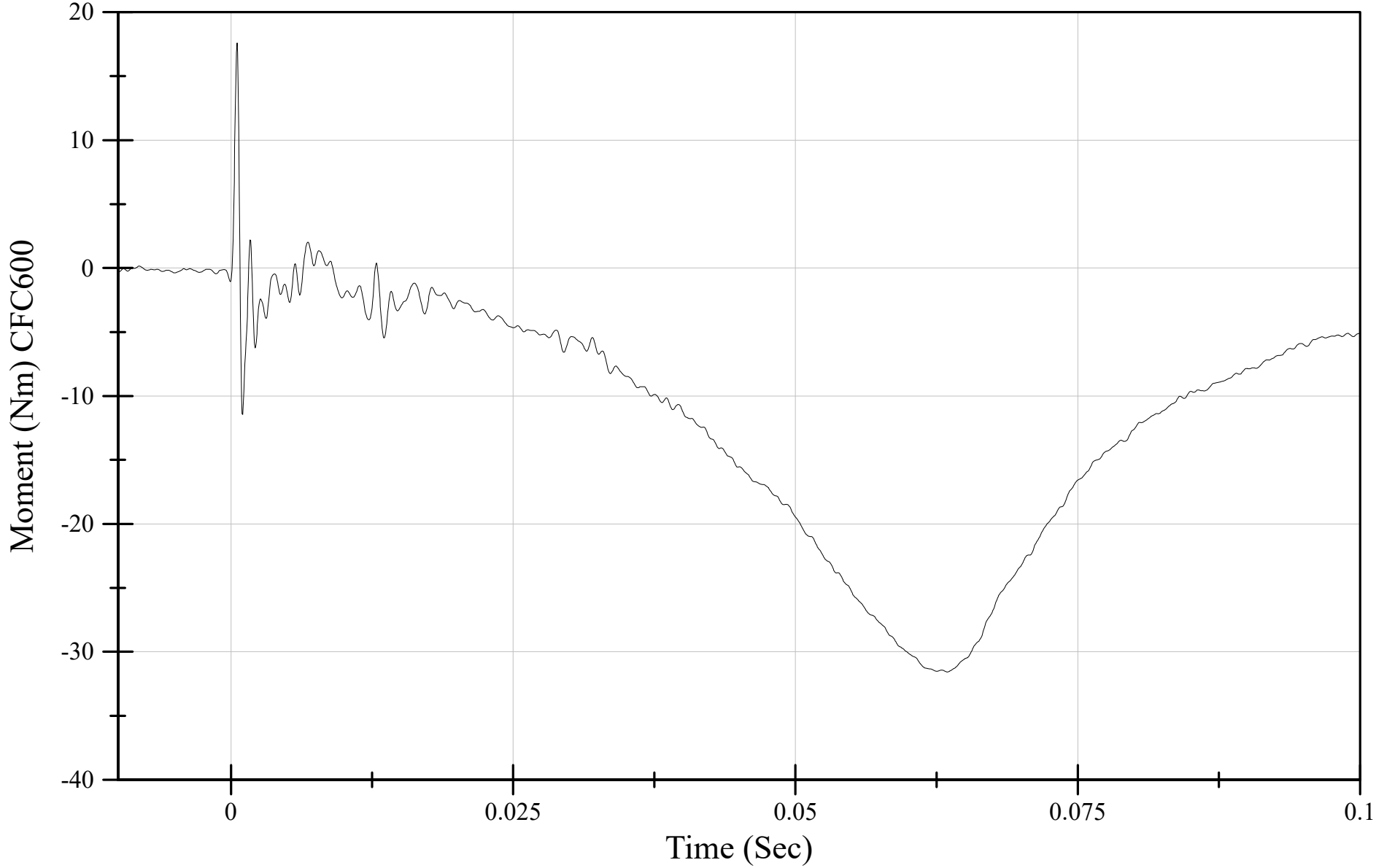
THOR-05F Left Foot Inversion Qualification
Tibia Load - Force Z
Ankle Serial Number: EV4180



File Name: 230110-9 processed

1/10/2023 4:33 PM

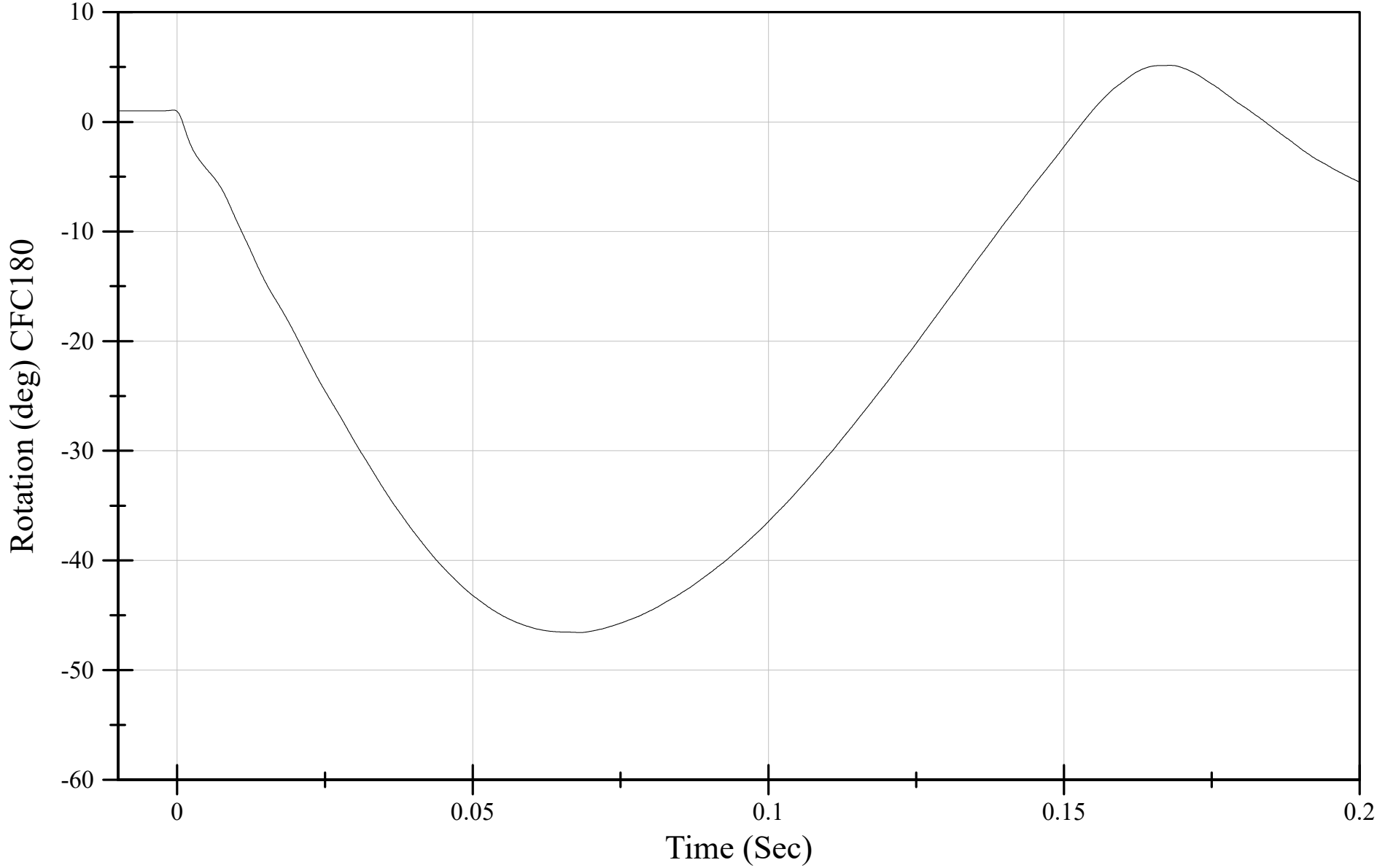
THOR-05F Left Foot Inversion Qualification
Ankle Moment - X axis
Ankle Serial Number: EV4180



File Name: 230110-9 processed

1/10/2023 4:33 PM

THOR-05F Left Foot Inversion Qualification
Ankle X-Rotation
Ankle Serial Number: EV4180



File Name: 230110-9 processed

1/10/2023 4:33 PM

THOR-05F Left Foot Eversion Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components	Test ID: 230110-7
Ankle Serial: EV4180	Test Date: 1/10/2023
Eversion Stop Assembly: EV3436	Test Time: 3:37 PM

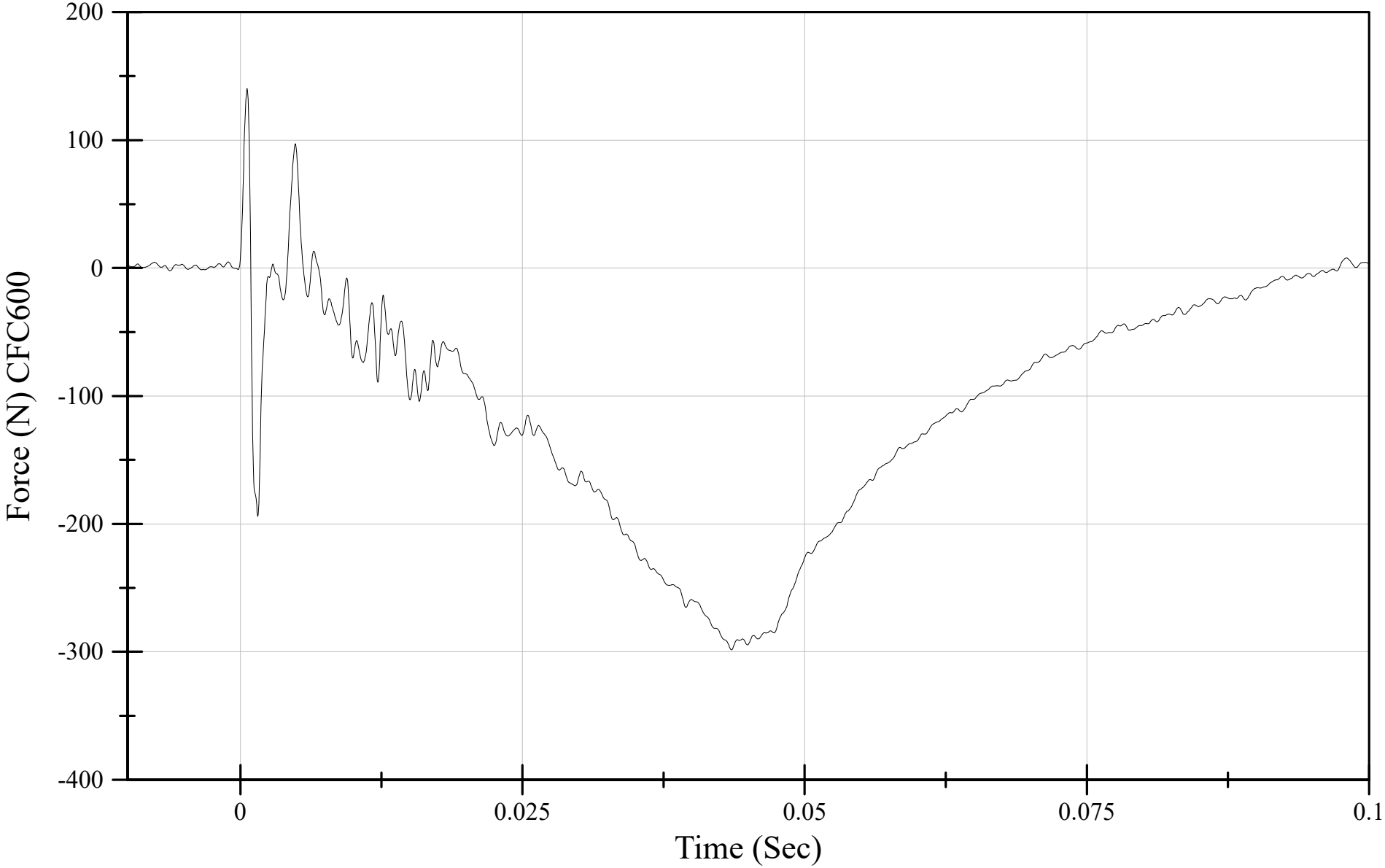
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.0	Pass
Test Humidity (%)	10 - 70	49	Pass
Test Velocity (m/s)	1.95 - 2.05	2.04	Pass
Peak Lower Tibia Fz		-298.4	
Peak Ankle X-axis Resistive Moment		29.3	
Peak Ankle X-axis Rotation		30.5	

* THOR-05F Qualification Manual - July 2022

File Name: 230110-7 processed
Software Version: 2.8

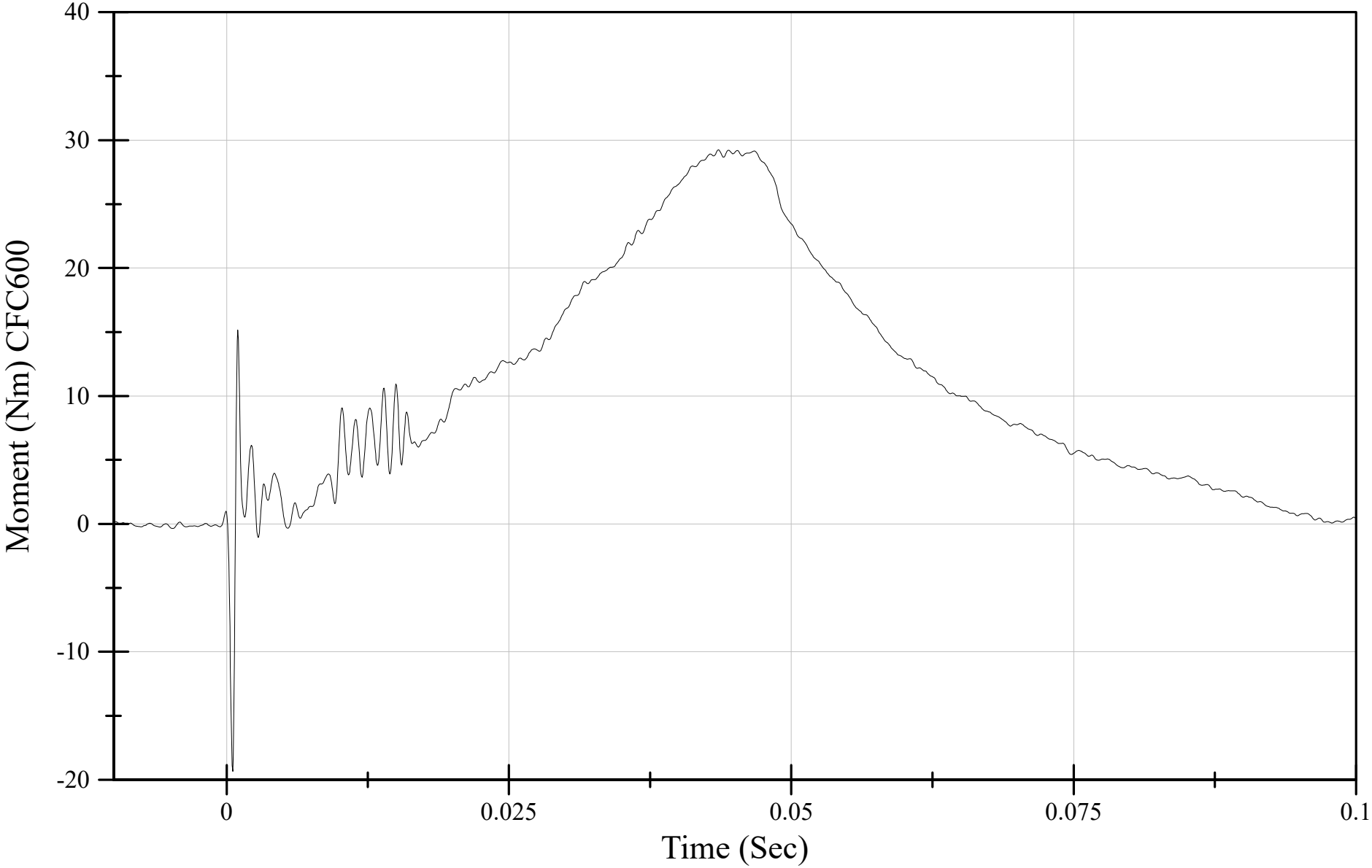
THOR-05F Left Foot Eversion Qualification
Tibia Load - Force Z
Ankle Serial Number: EV4180



File Name: 230110-7 processed

1/10/2023 3:37 PM

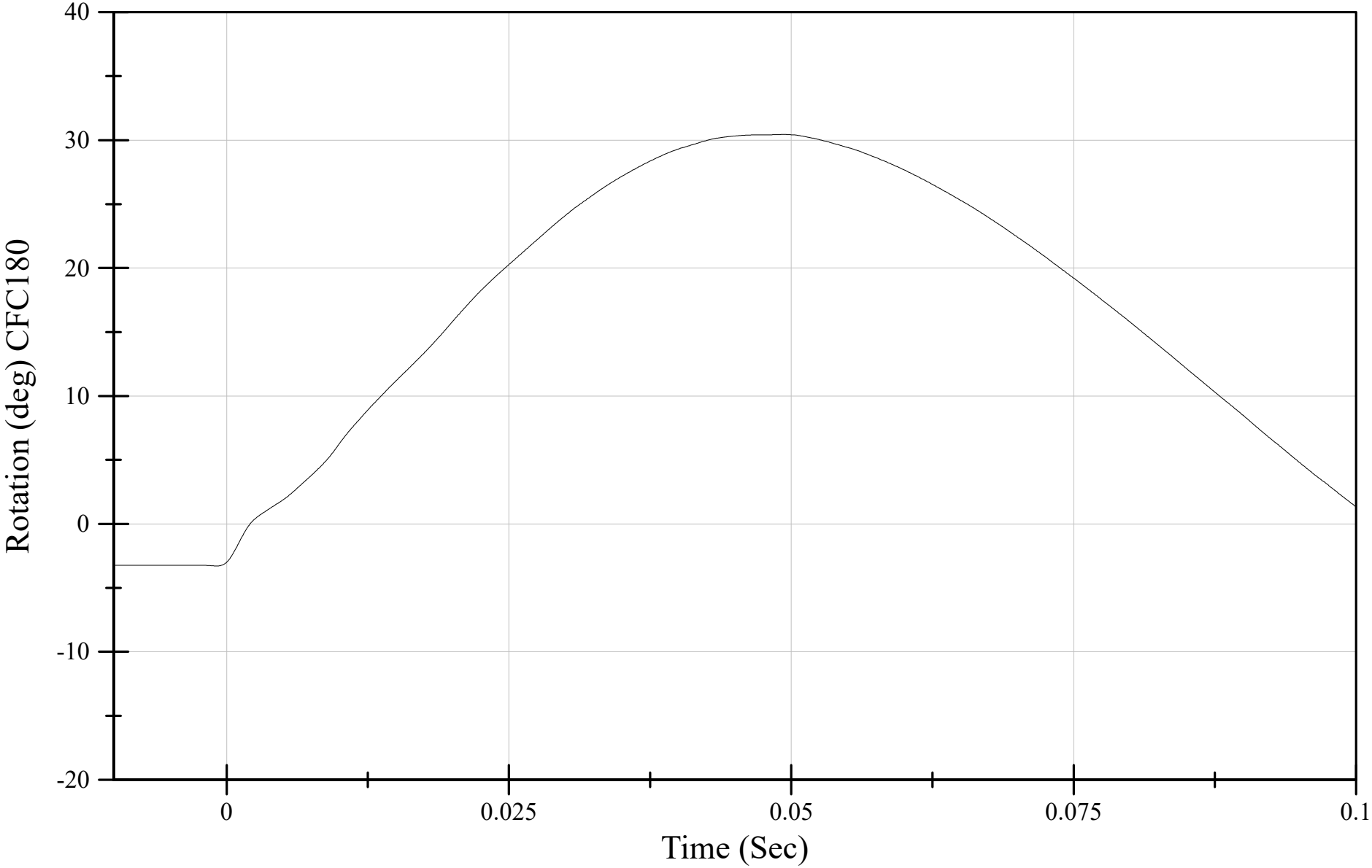
THOR-05F Left Foot Eversion Qualification
Ankle Moment - X axis
Ankle Serial Number: EV4180



File Name: 230110-7 processed

1/10/2023 3:37 PM

THOR-05F Left Foot Eversion Qualification
Ankle X-Rotation
Ankle Serial Number: EV4180



File Name: 230110-7 processed

1/10/2023 3:37 PM

THOR-05F Left Heel Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Left Ankle: EV4180

Test ID: 230110-4
Test Date: 1/10/2023
Test Time: 8:15 AM

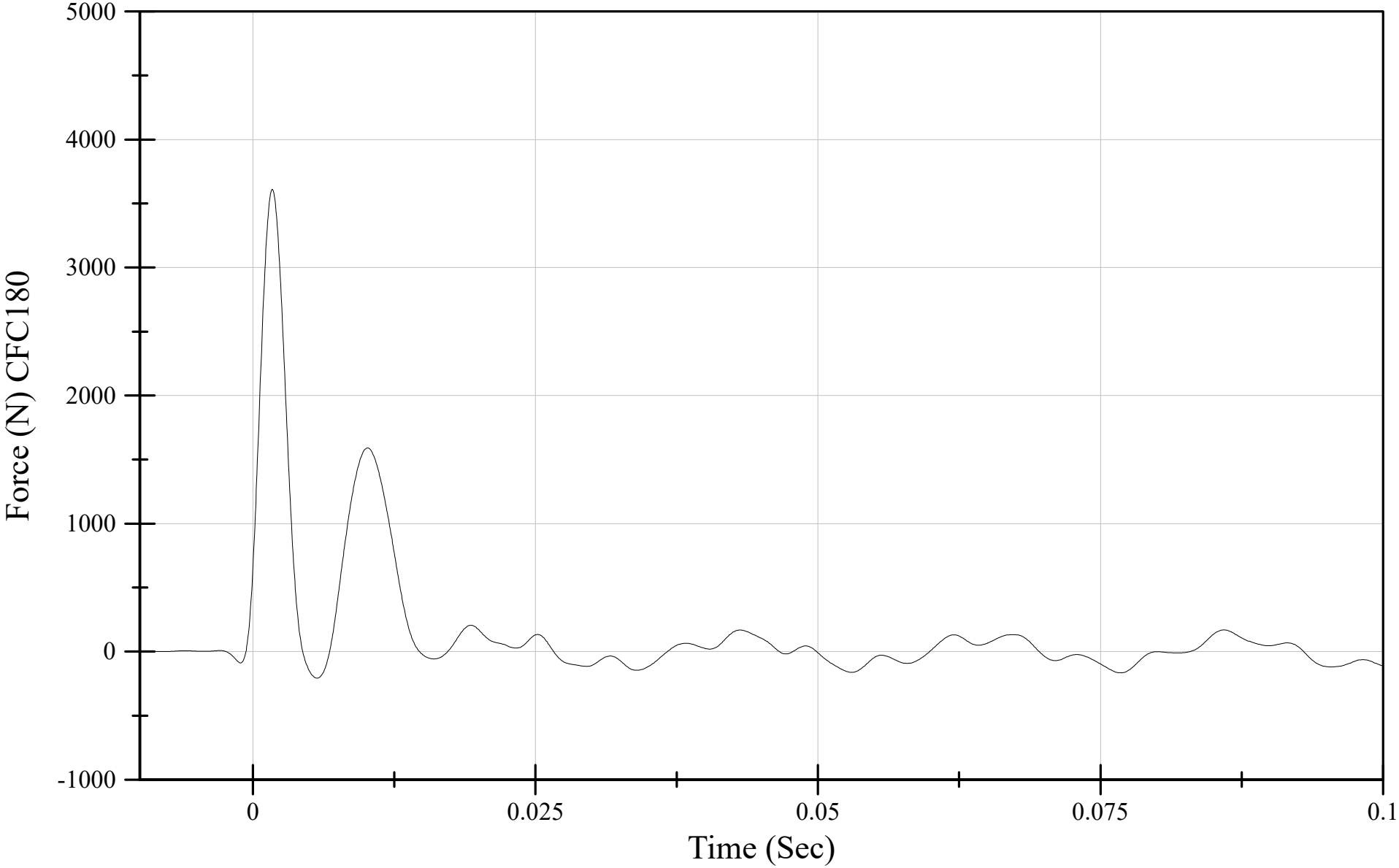
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.2	Pass
Test Humidity (%)	10 - 70	57	Pass
Test Velocity (m/s)	3.95 - 4.05	4.03	Pass
Probe Force (N)		3611.2	
Peak Lower Tibia Fz (N)		-2038.8	

* THOR-05F Qualification Manual - July 2022

File Name: 230110-4 processed
Software Version: 2.8

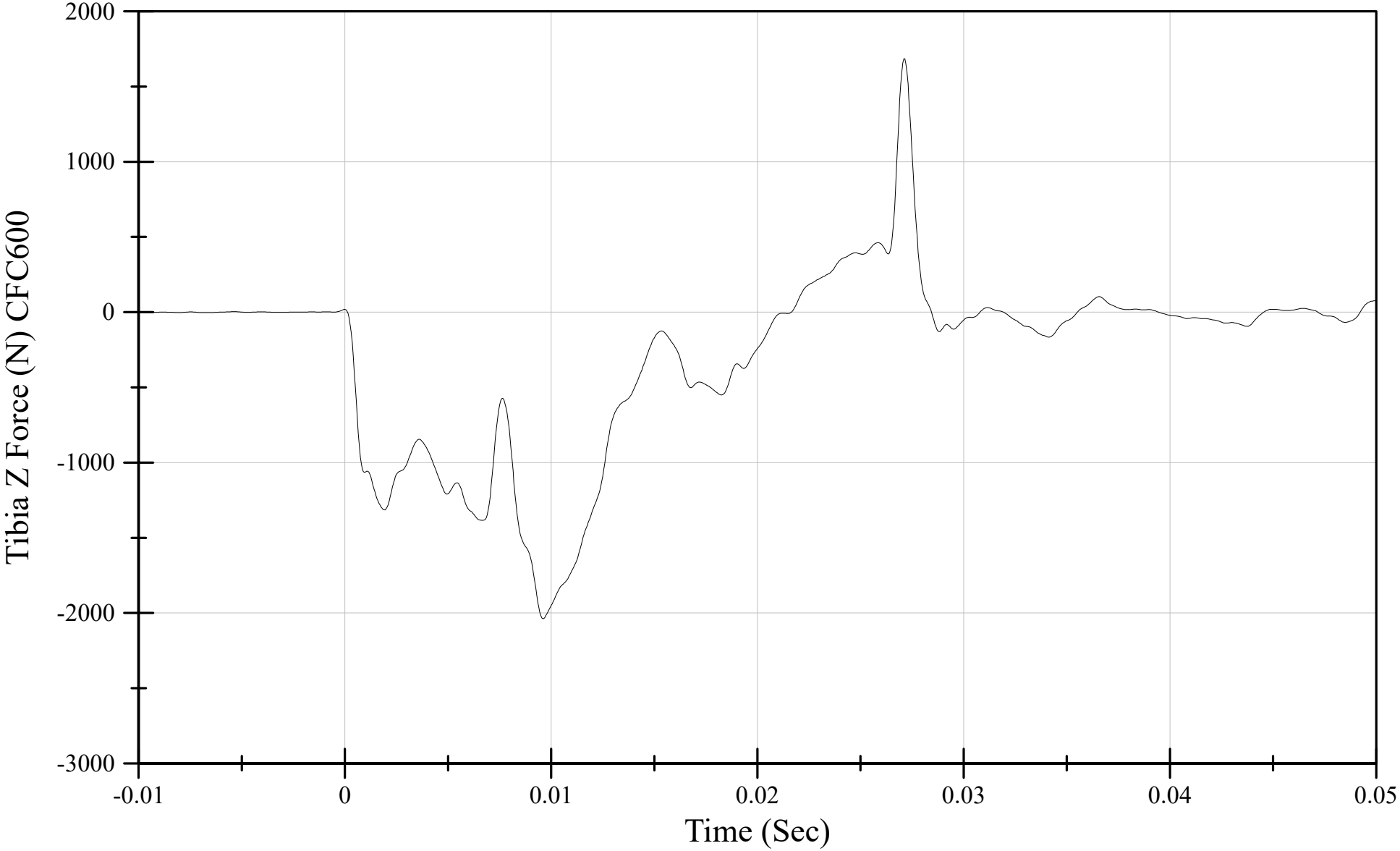
THOR-05F Left Heel Qualification
Probe Force
Dummy Serial Number: EU3430



File Name: 230110-4 processed

1/10/2023 8:15 AM

THOR-05F Left Heel Qualification
Tibia Load
Serial Number: EU3430



File Name: 230110-4 processed

1/10/2023 8:15 AM

THOR-05F Right Upper Leg Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Compression Element: ET6710
Right Thigh Flesh: ET7855

Test ID: 221205-7
Test Date: 12/5/2022
Test Time: 3:49 PM

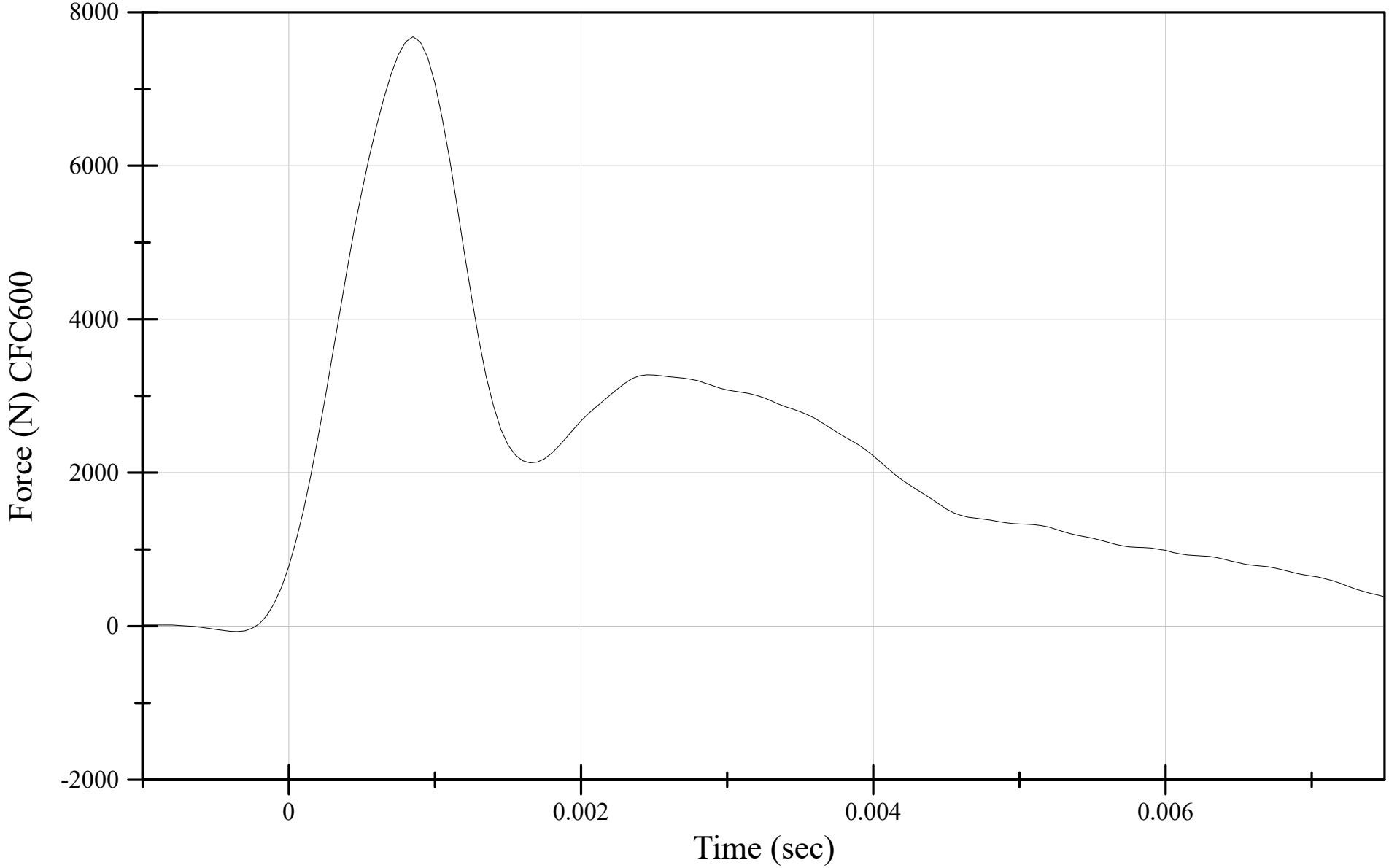
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.1	Pass
Test Humidity (%)	10 - 70	53	Pass
Test Velocity (m/s)	3.25 - 3.35	3.29	Pass
Peak Probe Force (N)		7681	
Peak Femur Force (N)		-4567	
Peak Resultant Acetabulum Force (N)		1845	

* THOR-05F Qualification Manual - July 2022

File Name: 221205-7 processed

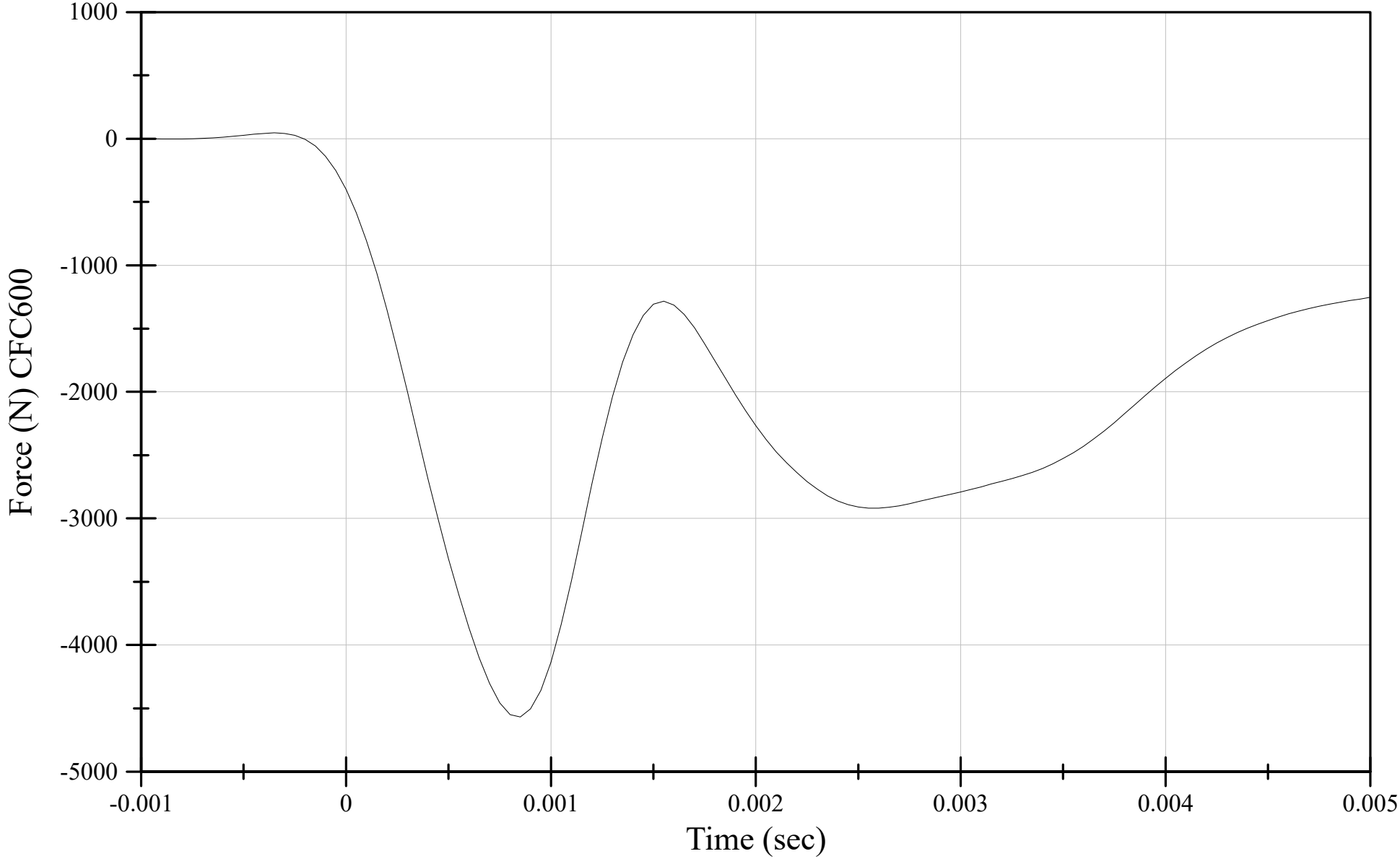
THOR-05F Right Upper Leg Qualification
Probe Force
Serial Number: EU3430



File Name: 221205-7 processed

12/5/2022 3:49 PM

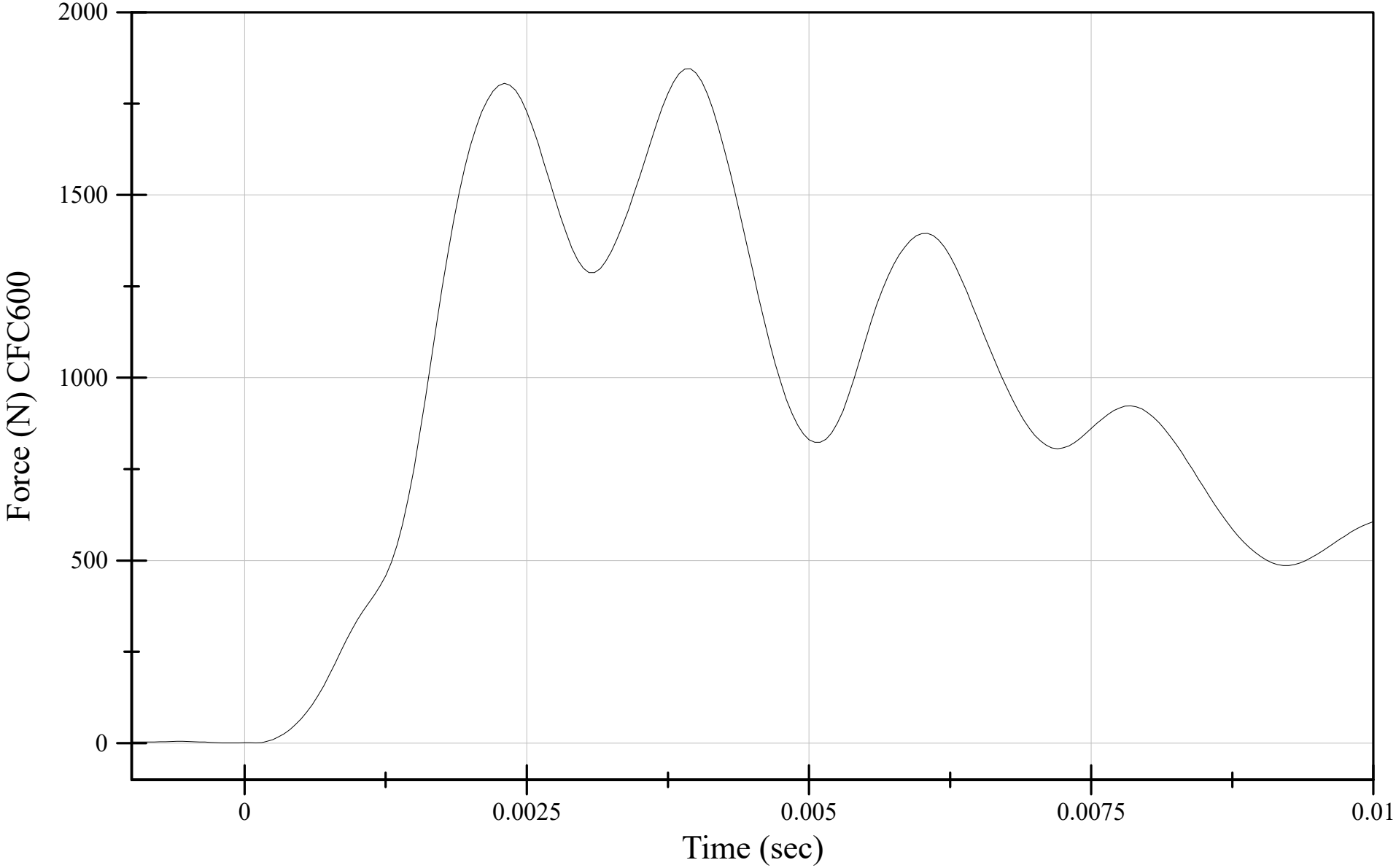
THOR-05F Right Upper Leg Qualification
Femur Z-Force
Serial Number: EU3430



File Name: 221205-7 processed

12/5/2022 3:49 PM

THOR-05F Right Upper Leg Qualification
Peak Acetabulum Resultant Force
Serial Number: EU3430



File Name: 221205-7 processed

12/5/2022 3:49 PM

THOR-05F Right Knee Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Right Knee Slider: EV2939

Test ID: 221206-8
Test Date: 12/6/2022
Test Time: 12:50 PM

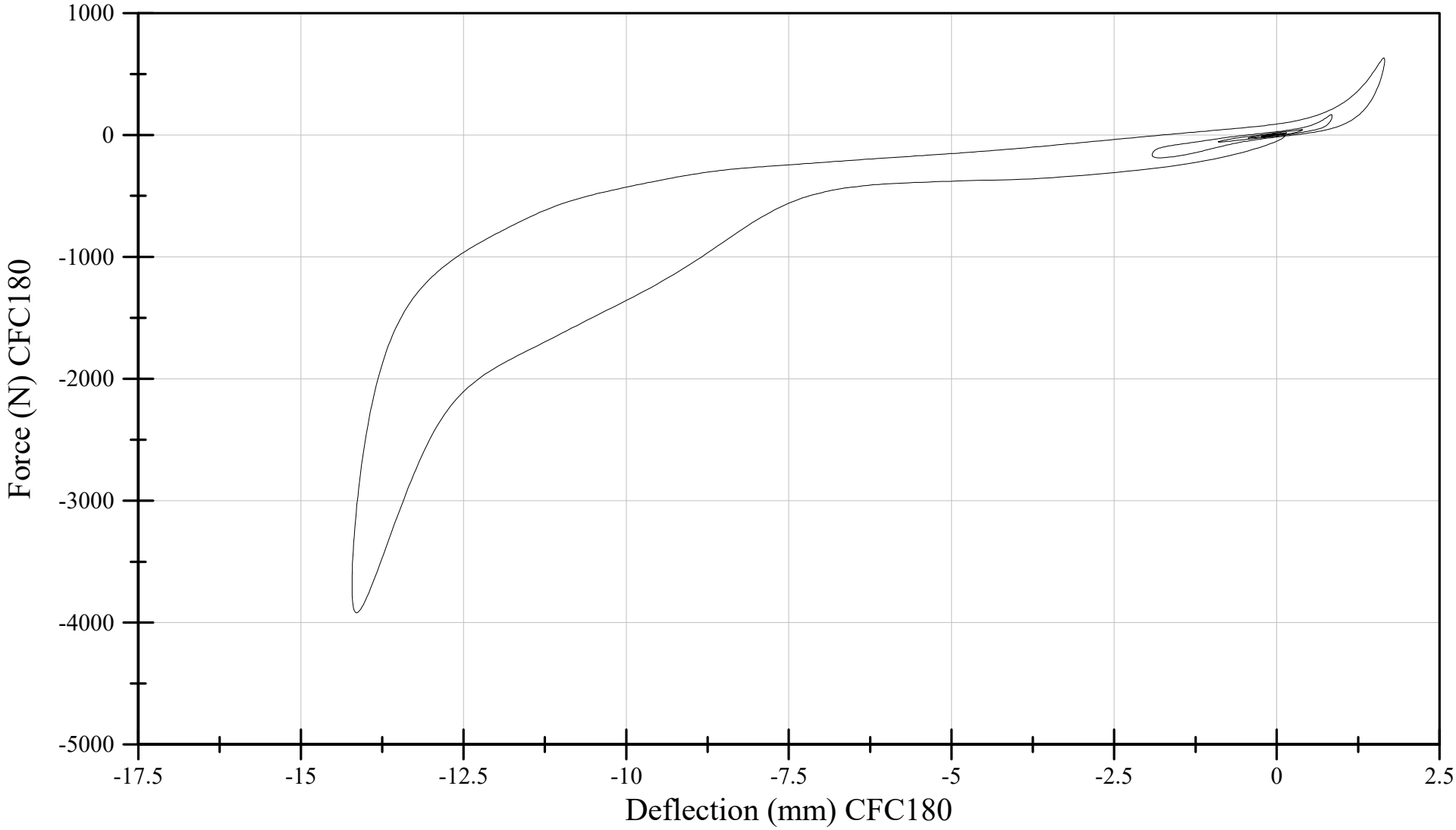
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.2	Pass
Test Humidity (%)	10 - 70	49	Pass
Test Velocity (m/s)	2.10 - 2.20	2.20	Pass
Peak Femur Fz (N)		-3919.6	
Knee Deflection at Peak Femur Force (N)		-14.2	

* THOR-05F Qualification Manual - July 2022

File Name: 221206-8 processed
Software Version: 2.8

THOR-05F Right Knee Qualification
Peak Deflection at Peak Force
Serial Number: EU3430



File Name: 221206-8 processed

12/6/2022 12:50 PM

THOR-05F Right Foot Inversion Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components	Test ID: 230112-9
Ankle Serial: EV3870	Test Date: 1/12/2023
Inversion Stop Assembly: ET6304	Test Time: 1:29 PM

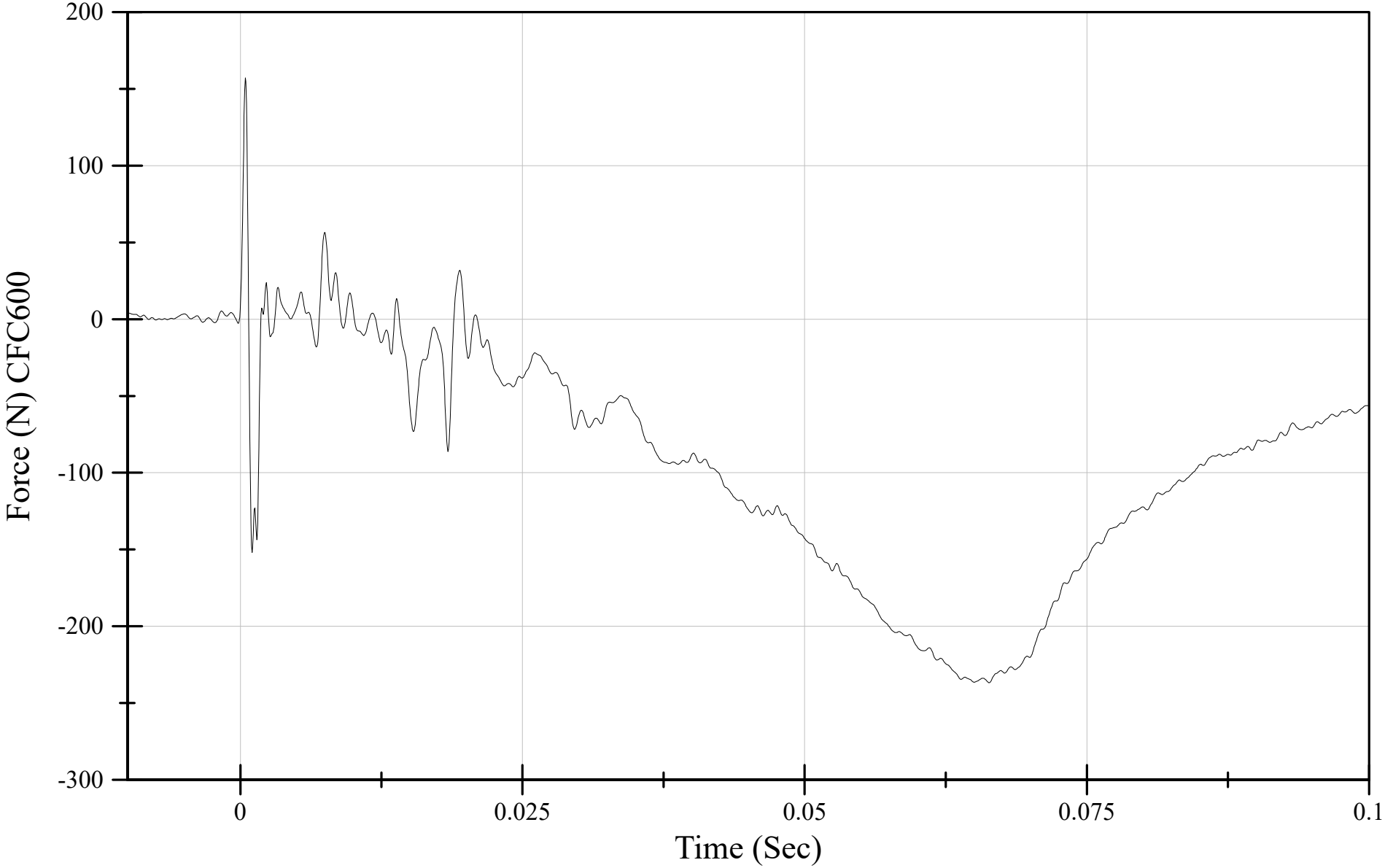
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.4	Pass
Test Humidity (%)	10 - 70	56	Pass
Test Velocity (m/s)	1.95 - 2.05	2.04	Pass
Peak Lower Tibia Fz		-236.8	
Peak Ankle X-axis Resistive Moment		29.6	
Peak Ankle X-axis Rotation		47.6	

* THOR-05F Qualification Manual - July 2022

File Name: 230112-9 processed
Software Version: 2.8

THOR-05F Right Foot Inversion Qualification
Tibia Load - Force Z
Ankle Serial Number: EV3870



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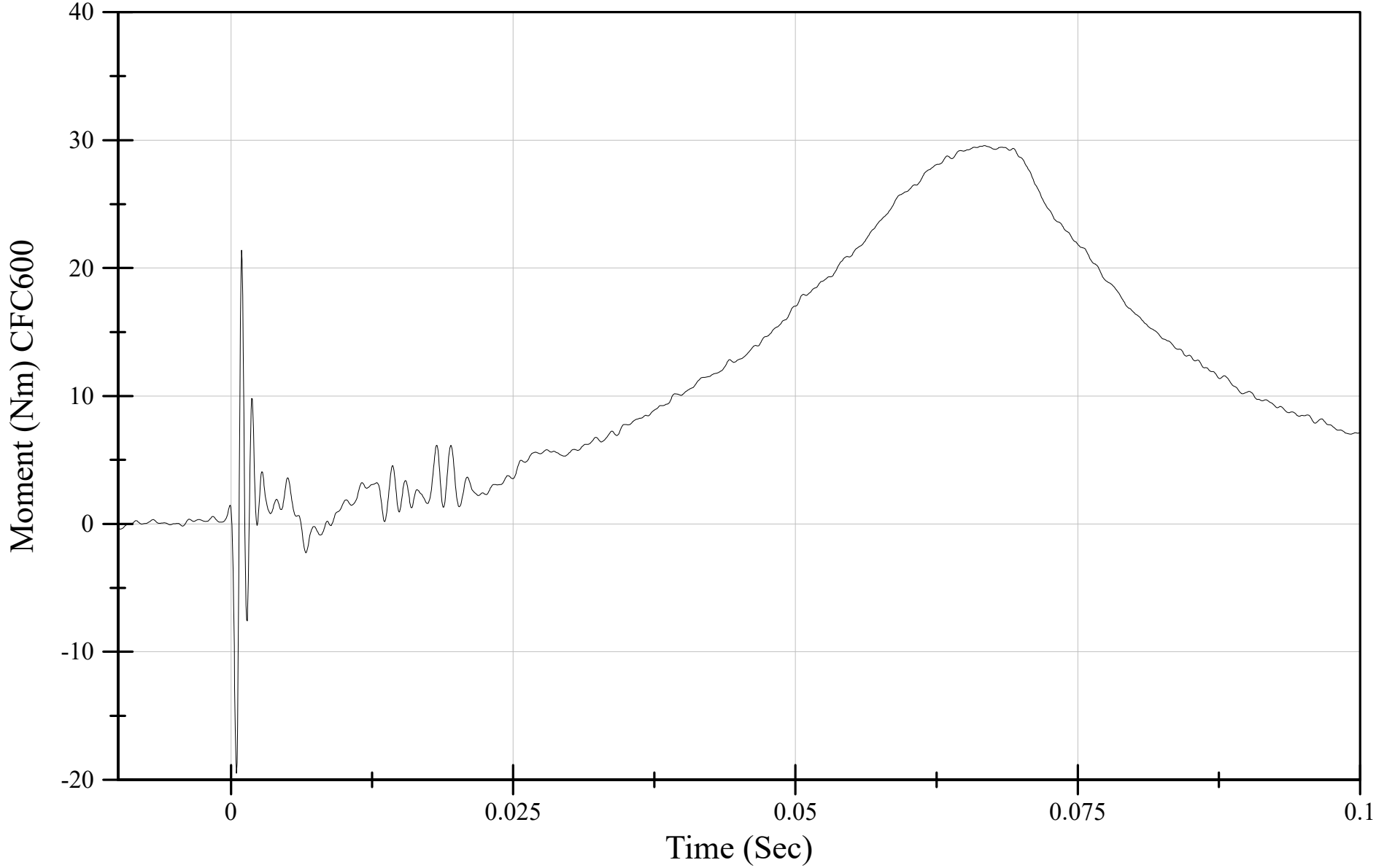
1/12/2023 1:29 PM

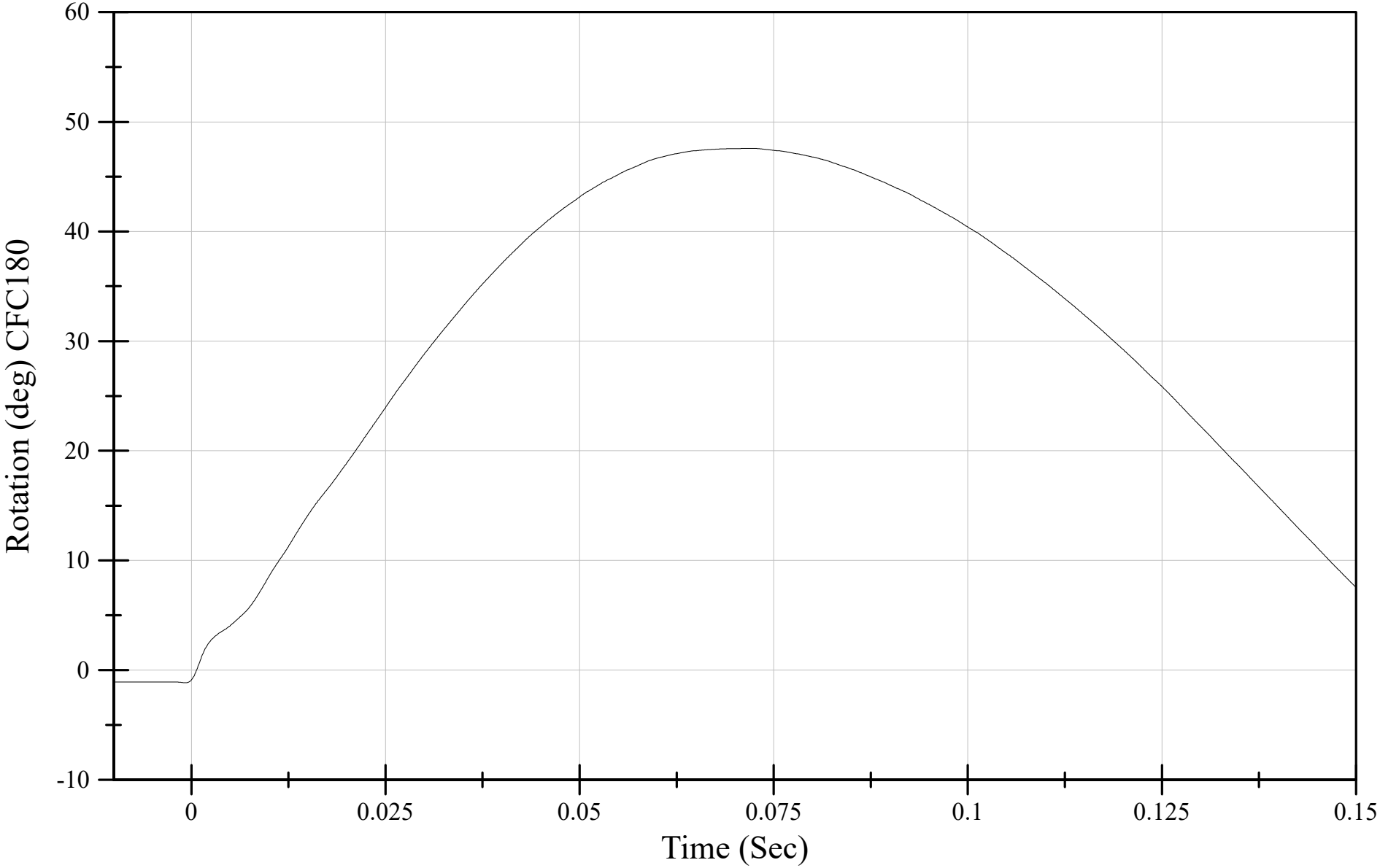
THOR-05F Right Foot Inversion Qualification
Ankle Moment - X axis
Ankle Serial Number: EV3870



File Name: 230112-9 processed

1/12/2023 1:29 PM

THOR-05F Right Foot Inversion Qualification
Ankle X-Rotation
Ankle Serial Number: EV3870



File Name: 230112-9 processed

1/12/2023 1:29 PM

THOR-05F Right Foot Eversion Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components	Test ID: 230112-5
Ankle Serial: EV3870	Test Date: 1/12/2023
Eversion Stop Assembly: ET9523	Test Time: 11:16 AM

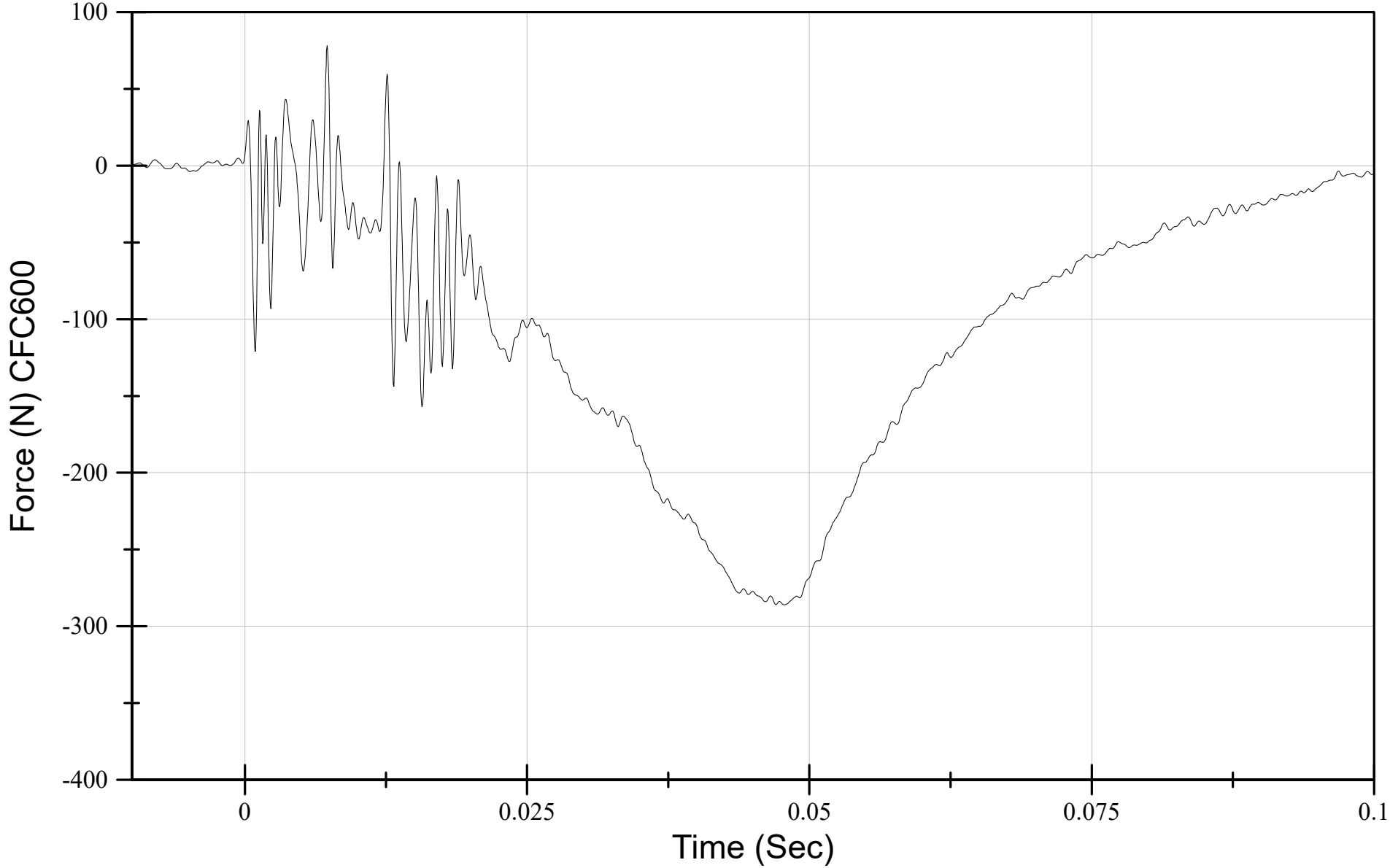
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.3	Pass
Test Humidity (%)	10 - 70	47	Pass
Test Velocity (m/s)	1.95 - 2.05	2.04	Pass
Peak Lower Tibia Fz		-286.1	
Peak Ankle X-axis Resistive Moment		-28.6	
Peak Ankle X-axis Rotation		-31.6	

* THOR-05F Qualification Manual - July 2022

File Name: 230112-5 processed
Software Version: 2.8

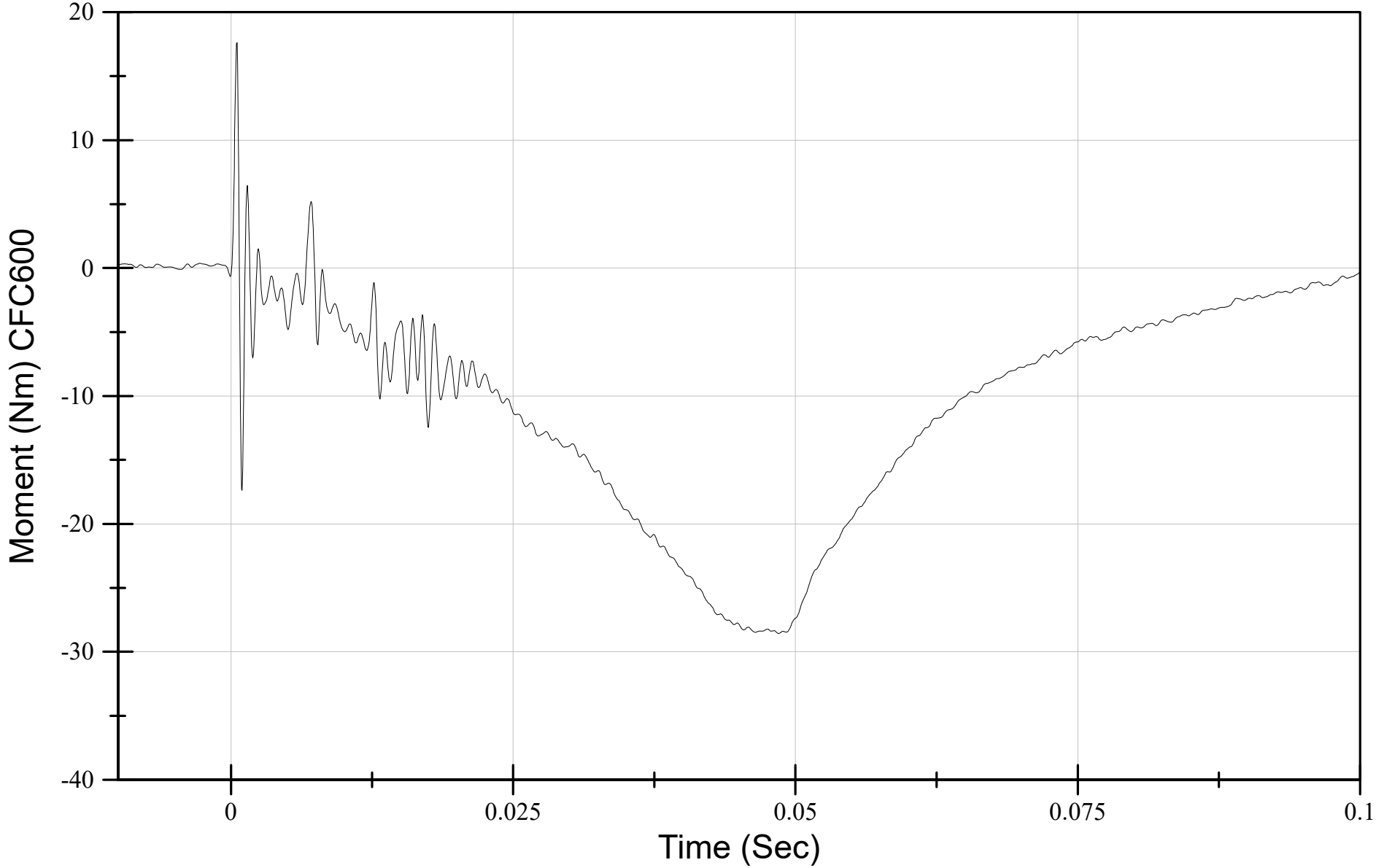
THOR-05F Right Foot Eversion Qualification
Tibia Load - Force Z
Ankle Serial Number: EV3870



File Name: 230112-5 processed

1/12/2023 11:16 AM

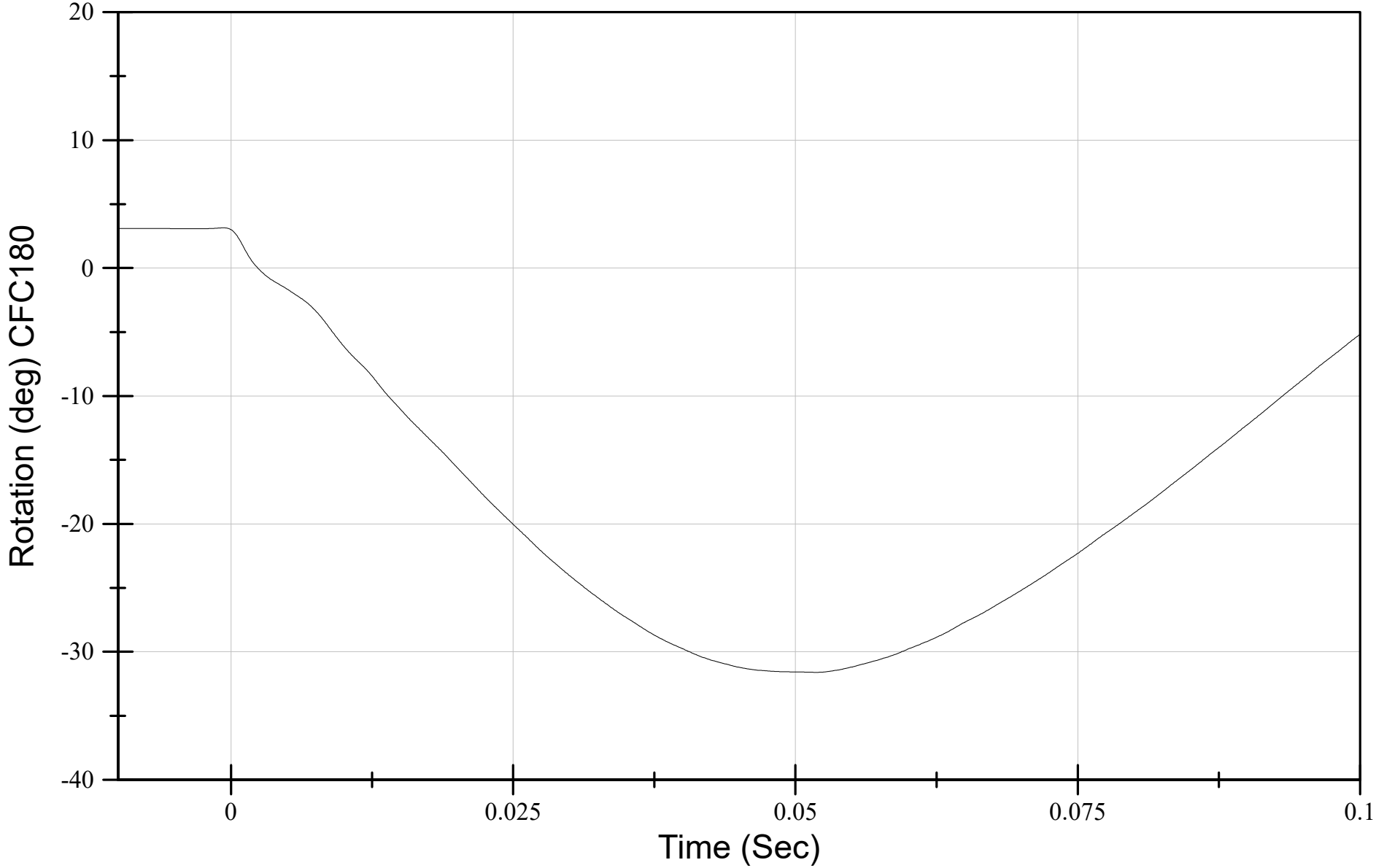
THOR-05F Right Foot Eversion Qualification
Ankle Moment - X axis
Ankle Serial Number: EV3870



File Name: 230112-5 processed

1/12/2023 11:16 AM

THOR-05F Right Foot Eversion Qualification
Ankle X-Rotation
Ankle Serial Number: EV3870



File Name: 230112-5 processed

1/12/2023 11:16 AM

THOR-05F Right Ball of Foot Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Right Ankle: EV3870
Right Dorsiflexion Stop: EV3714

Test ID: 230607-2
Test Date: 6/7/2023
Test Time: 7:04 AM

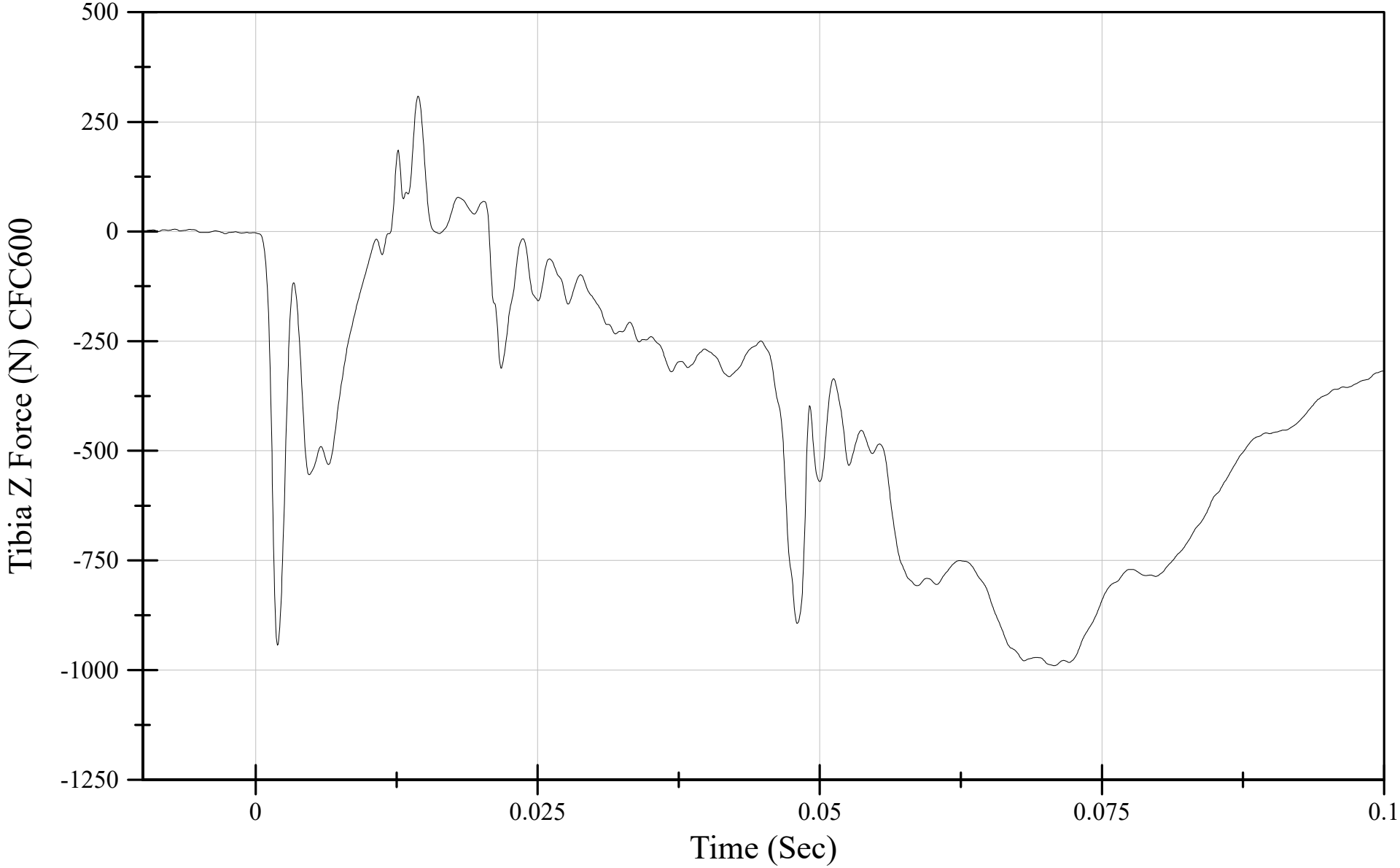
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	20.9	Pass
Test Humidity (%)	10 - 70	45	Pass
Test Velocity (m/s)	1.95 - 2.05	2.01	Pass
Peak Lower Tibia Fz after 10 ms (N)		-989.9	
Peak Ankle Resistive Moment (Nm)		51.4	
Peak Ankle Y-axis Rotation (deg)		29.6	

* THOR-05F Qualification Manual - July 2022

File Name: 230607-2 processed
Software Version: 2.8

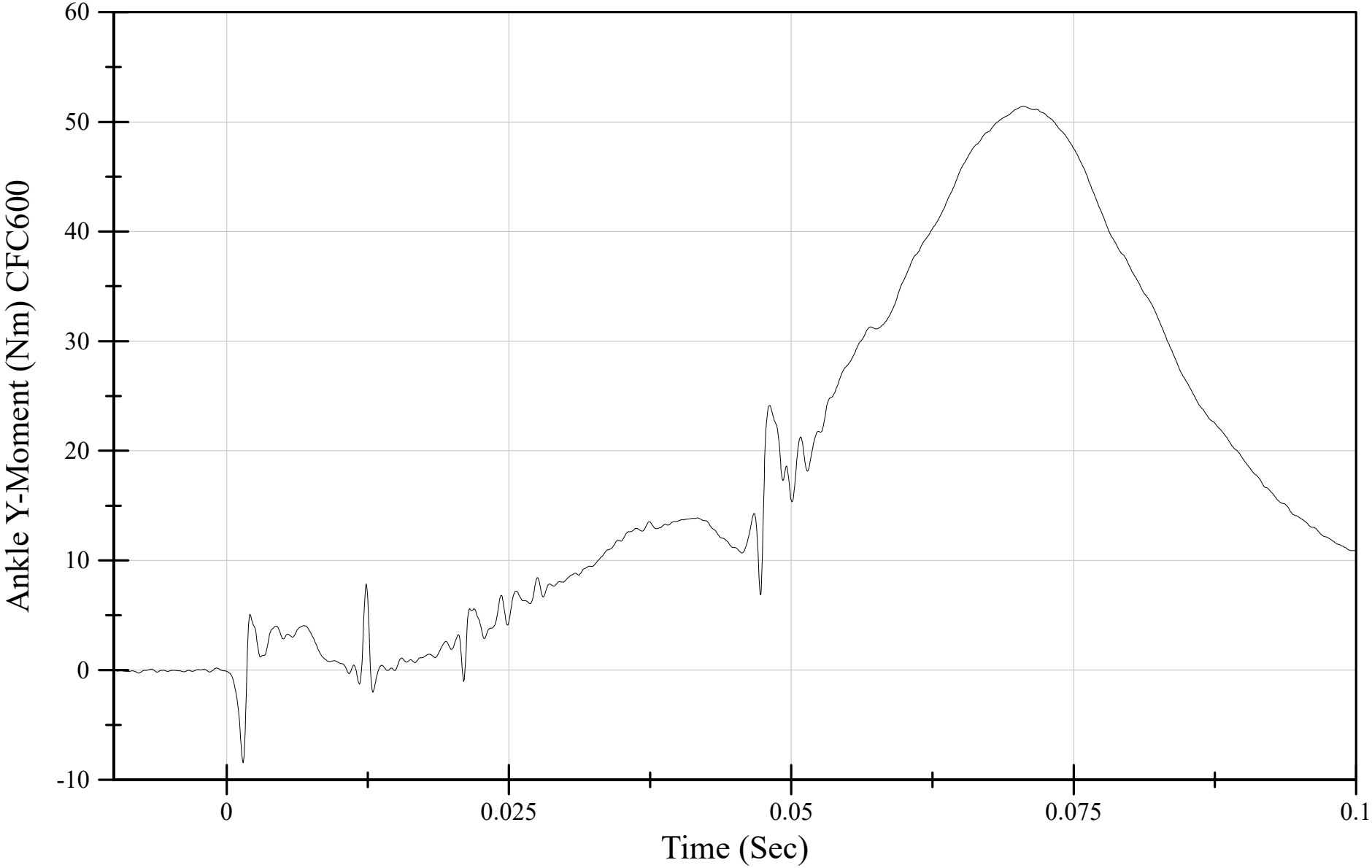
THOR-05F Right Ball of Foot Qualification
Lower Tibia Fz
Ankle Serial Number: EV3870



File Name: 230607-2 processed

6/7/2023 7:04 AM

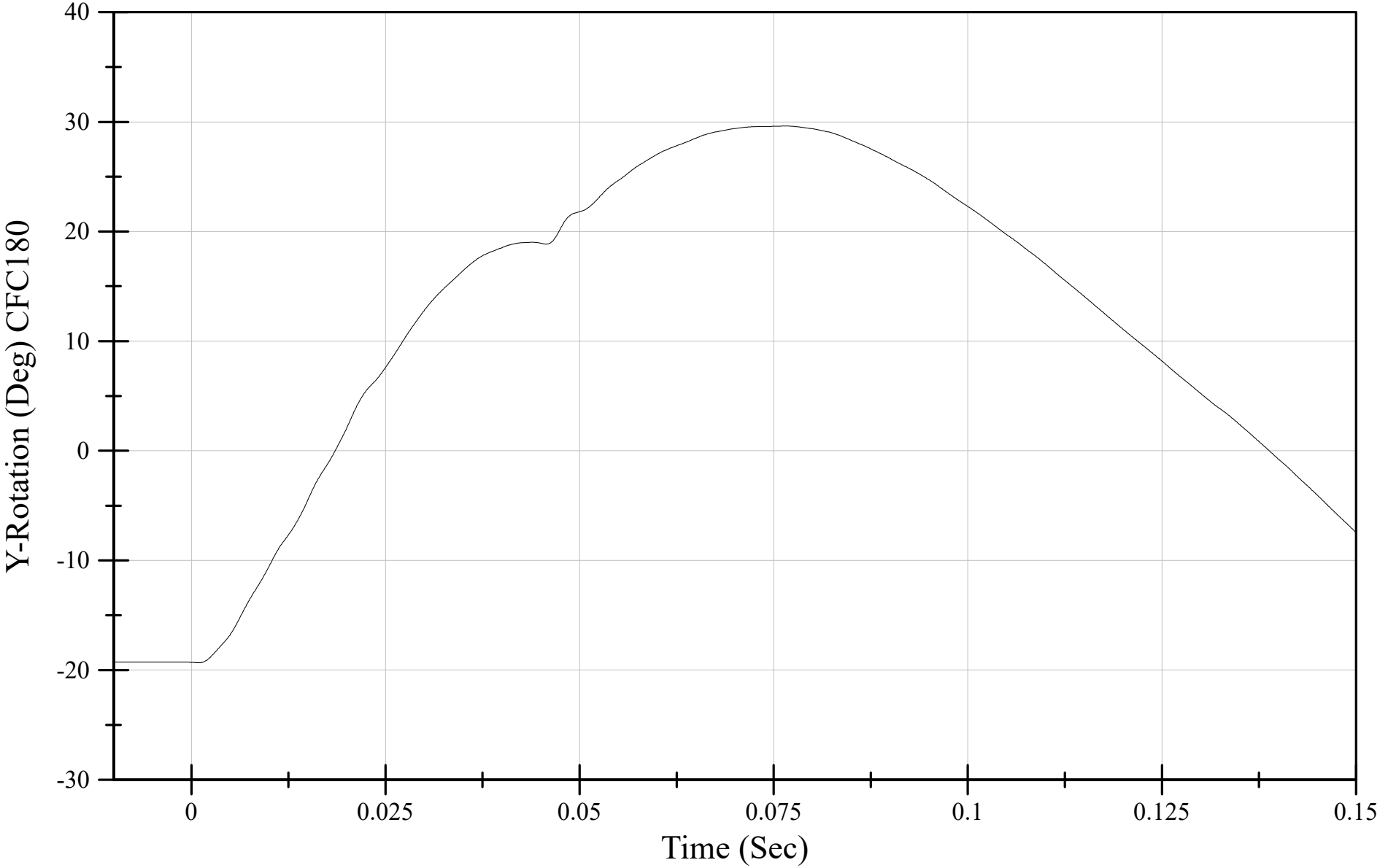
THOR-05F Right Ball of Foot Qualification
Ankle Y-Moment
Ankle Serial Number: EV3870



File Name: 230607-2 processed

6/7/2023 7:04 AM

THOR-05F Right Ball of Foot Qualification
Ankle Y-Rotation
Ankle Serial Number: EV3870



File Name: 230607-2 processed

6/7/2023 7:04 AM

THOR-05F Right Heel Qualification
Test Results Summary

Dummy Serial Number: EU3430

Tested Components
Right Ankle: EV3870

Test ID: 230607-3
Test Date: 6/7/2023
Test Time: 11:01 AM

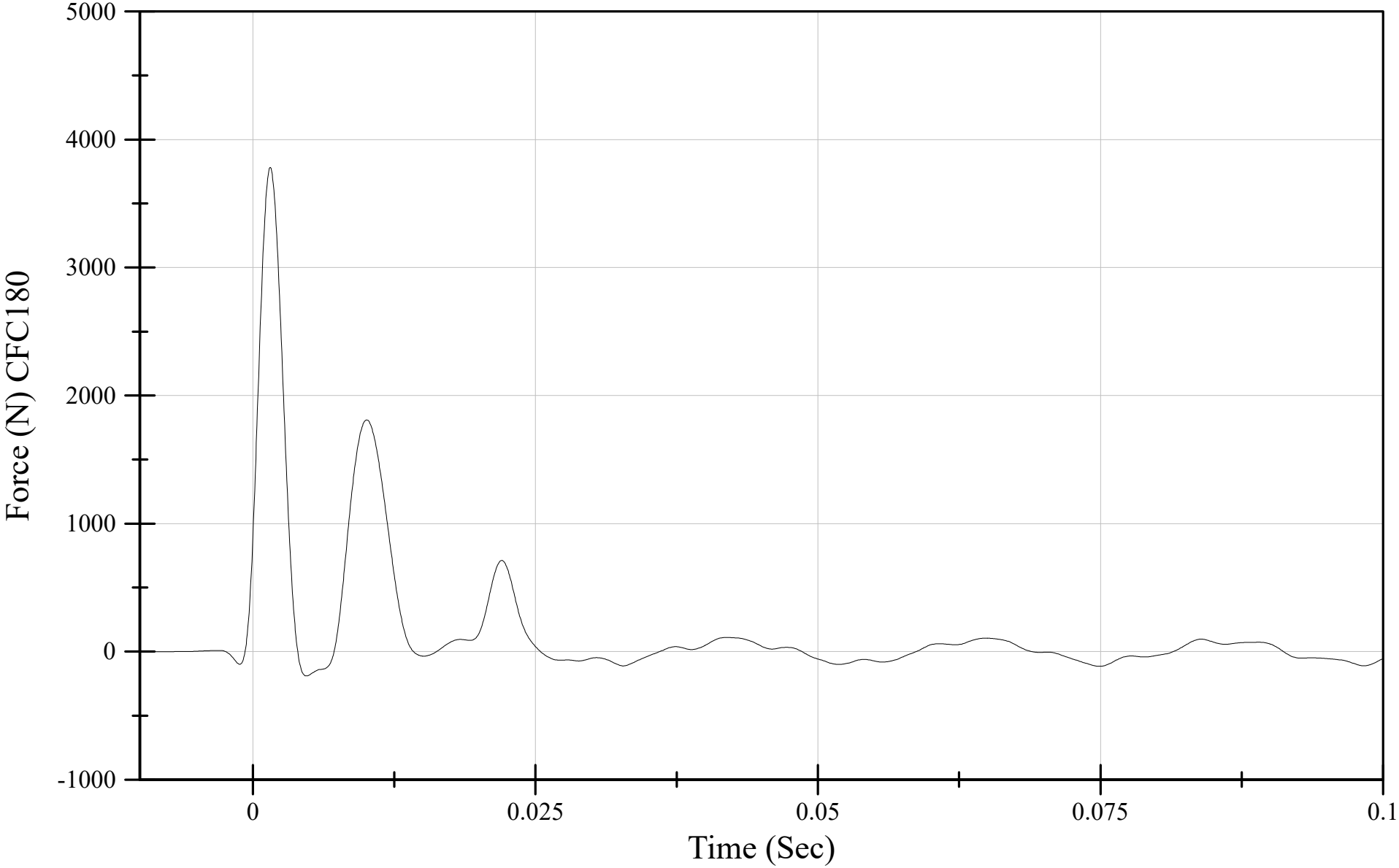
Test Results

Test Parameter	Specification Range*	Result	Pass/Fail
Test Temperature (°C)	20.6 - 22.2	21.1	Pass
Test Humidity (%)	10 - 70	44	Pass
Test Velocity (m/s)	3.95 - 4.05	4.02	Pass
Probe Force (N)		3781.7	
Peak Lower Tibia Fz (N)		-1939.1	

* THOR-05F Qualification Manual - July 2022

File Name: 230607-3 processed
Software Version: 2.8

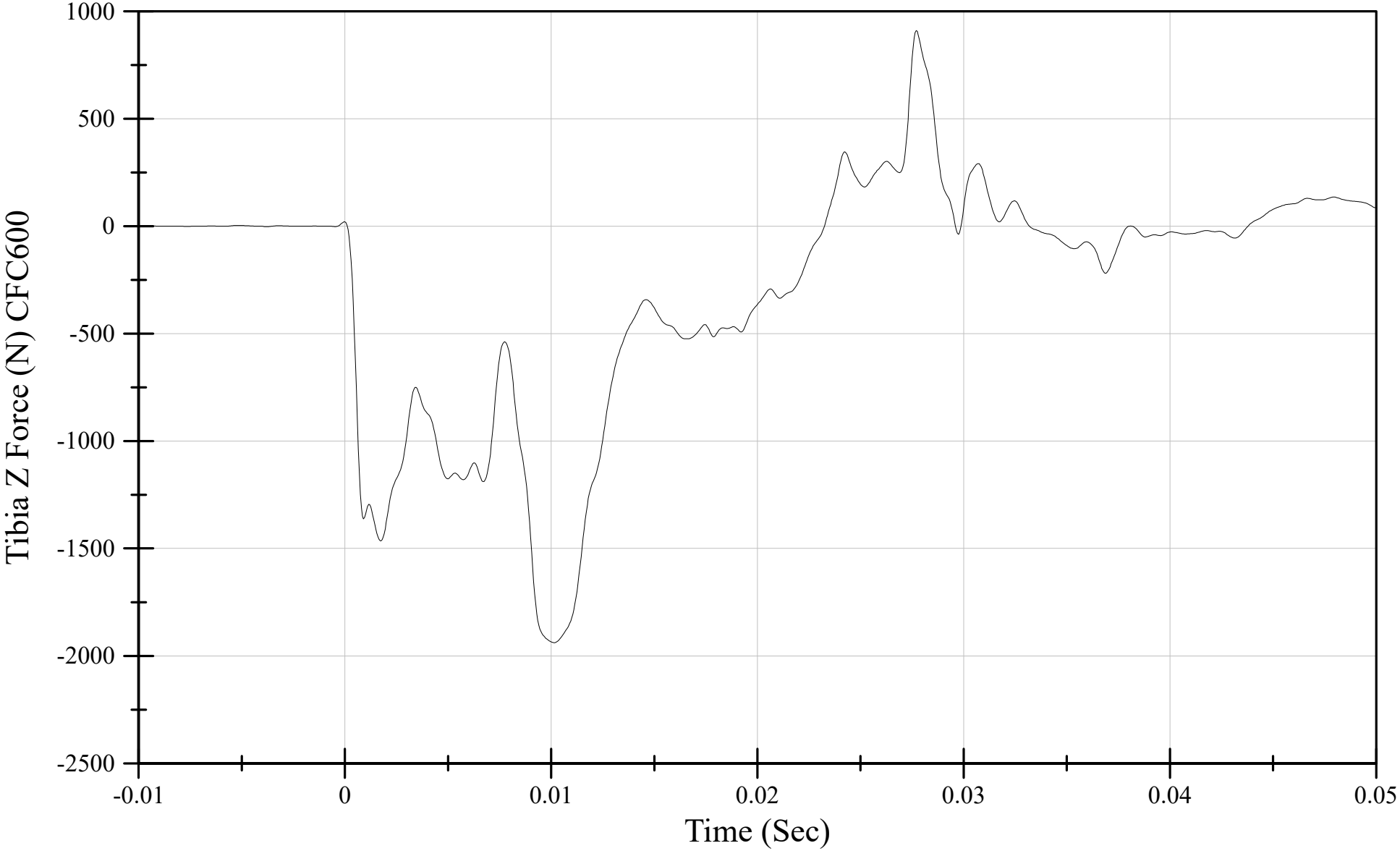
THOR-05F Right Heel Qualification
Probe Force
Dummy Serial Number: EU3430



File Name: 230607-3 processed

6/7/2023 11:01 AM

THOR-05F Right Heel Qualification
Tibia Load
Serial Number: EU3430



File Name: 230607-3 processed

6/7/2023 11:01 AM

APPENDIX E

TEST EQUIPMENT AND INSTRUMENTATION CALIBRATION

TABLE 1 – DRIVER DUMMY INSTRUMENTATION

Instrumentation			Axis/Location	THOR-05F S/N EV0674		
				Serial Number	Manufacturer	Calibration Date
Head Accelerometers			X	T31613	Endevco	24-Jan-2022
			Y	T31614	Endevco	24-Jan-2022
			Z	T31615	Endevco	24-Jan-2022
Head Angular Rate Sensors			X	ARS20140	DTS	12-Jan-2022
			Y	ARS20141	DTS	12-Jan-2022
			Z	ARS20142	DTS	12-Jan-2022
Neck Spring Load Cells		Front	FZ	EK6428N	Humanetics	7-Feb-2022
		Rear	FZ	EK6429N	Humanetics	7-Feb-2022
Occipital Condyle Rotary Potentiometer			Y	EU9379	Humanetics	3-Feb-2022
Neck Load Cells		Upper	FX, FY, FZ, MX, MY, MZ	EV3575	Humanetics	18-Mar-2022
		Lower	FX, FY, FZ, MX, MY, MZ	EV4041	Humanetics	18-Mar-2022
T1 Accelerometers			X	T31627	Endevco	25-Jan-2022
			Y	T31628	Endevco	25-Jan-2022
			Z	T31630	Endevco	25-Jan-2022
Clavicle Load Cells	Left	Outer	FX, FZ	EU6173	Humanetics	10-Mar-2022
		Inner	FX, FZ	EU6173	Humanetics	10-Mar-2022
Thorax IR-TRACCs	Left	Upper	N/A	EU0758	Humanetics	2-Mar-2022
	Right		N/A	EU0759	Humanetics	2-Mar-2022
	Left	Lower	N/A	EU0757	Humanetics	2-Mar-2022
	Right		N/A	EQ6013	Humanetics	2-Mar-2022
Thorax Rotary Potentiometers	Left	Upper	Y	EU7994	Humanetics	2-Mar-2022
			Z	EU7995	Humanetics	1-Jun-2022
	Right	Upper	Y	EU7992	Humanetics	2-Mar-2022
			Z	EU7993	Humanetics	2-Mar-2022
	Left	Lower	Y	EU7990	Humanetics	2-Mar-2022
			Z	EU7991	Humanetics	2-Mar-2022
	Right	Lower	Y	EU7988	Humanetics	2-Mar-2022
			Z	EU7989	Humanetics	2-Mar-2022
T8 Accelerometers			X	T31633	Endevco	25-Jan-2022
			Y	T31634	Endevco	25-Jan-2022
			Z	T31645	Endevco	26-Jan-2022
Thoracic Spine Load Cells			MX	EV1118	Humanetics	16-Mar-2022
			MY	EV1118	Humanetics	16-Mar-2022
Abdomen Pressure Sensors		Left	N/A	JJ8810H2	Transpolis	21-Dec-2021
		Right	N/A	JK1340H1	Transpolis	21-Dec-2021
A.S.I.S. Load Cells		Left	FX, MY	EU6179	Humanetics	11-Mar-2022
		Right	FX, MY	EV4014	Humanetics	14-Mar-2022

TABLE 1 – DRIVER DUMMY INSTRUMENTATION (CONT'D)

Instrumentation			Axis/Location	THOR-05F S/N EV0674		
				Serial Number	Manufacturer	Calibration Date
Acetabulum Load Cells		Left	FX, FY, FZ	EU6170	Humanetics	9-Mar-2022
		Right	FX, FY, FZ	EV4010	Humanetics	11-Mar-2022
Pelvis Accelerometers			X	T31682	Endevco	24-Jan-2022
			Y	T31685	Endevco	24-Jan-2022
			Z	T31686	Endevco	24-Jan-2022
Pelvis Angular Rate Sensors			X	ARS20312	DTS	24-Jan-2022
			Y	ARS20314	DTS	24-Jan-2022
			Z	ARS20315	DTS	24-Jan-2022
Femur Load Cells		Left	FX, FY, FZ, MX, MY, MZ	EV4021	Humanetics	18-Mar-2022
		Right	FX, FY, FZ, MX, MY, MZ	EV3576	Humanetics	22-Mar-2022
Knee Slider Potentiometers		Left	FX	21116372	Space Age	7-Mar-2022
		Right	FX	21095460	Space Age	27-Jun-2022
Tibia Load Cells	Left	Upper	FX, FY, FZ, MX, MY	EV3572	Humanetics	17-Mar-2022
		Lower	FX, FY, FZ, MX, MY	EV4018	Humanetics	14-Mar-2022
	Right	Upper	FX, FY, FZ, MX, MY	EV4550	Humanetics	18-Mar-2022
		Lower	FX, FY, FZ, MX, MY	EV3574	Humanetics	18-Mar-202
Achilles Load Cell Forces		Left	FZ	EK4723N	Humanetics	9-Feb-2022
		Right	FZ	EK4738N	Humanetics	9-Feb-2022
Tibia Accelerometers		Left	X	T31723	Endevco	24-Jan-2022
			Y	P51292	Endevco	6-May-2022
		Right	X	T20848	Endevco	28-Jun-2022
			Y	T29279	Endevco	7-Jun-2022
Ankle Rotary Potentiometers		Left	X	EU9381	Humanetics	3-Feb-2022
			Y	EU9382	Humanetics	3-Feb-2022
			Z	EU9383	Humanetics	3-Feb-2022
		Right	X	EU9384	Humanetics	3-Feb-2022
			Y	EU9385	Humanetics	3-Feb-2022
			Z	EU9389	Humanetics	3-Feb-2022
Foot Accelerometers		Left	X	T31802	Endevco	24-Jan-2022
			Y	T31803	Endevco	24-Jan-2022
			Z	T31805	Endevco	24-Jan-2022
		Right	X	T31806	Endevco	24-Jan-2022
			Y	T31807	Endevco	24-Jan-2022
			Z	T31808	Endevco	24-Jan-2022
Seat Belt Load Cells		Lap	N/A	N/A	N/A	N/A
		Shoulder	N/A	N/A	N/A	N/A

TABLE 2 – FRONT PASSENGER DUMMY INSTRUMENTATION

Instrumentation			Axis/Location	THOR-05F S/N EV3430		
				Serial Number	Manufacturer	Calibration Date
Head Accelerometers			X	T30065	Endevco	28-Mar-2022
			Y	T30064	Endevco	28-Mar-2022
			Z	T30070	Endevco	28-Mar-2022
Head Angular Rate Sensors			X	ARS18941	DTS	28-Oct-2021
			Y	ARS19386	DTS	28-Oct-2021
			Z	ARS19387	DTS	28-Oct-2021
Neck Spring Load Cells		Front	FZ	EK4802N	Humanetics	22-Oct-2021
		Rear	FZ	EK4804N	Humanetics	22-Oct-2021
Occipital Condyle Rotary Potentiometer			Y	EU1874	Humanetics	2-Nov-2021
Neck Load Cells		Upper	FX, FY, FZ, MX, MY, MZ	ET6581	Humanetics	1-Nov-2021
		Lower	FX, FY, FZ, MX, MY, MZ	EU3551	Humanetics	11-Nov-2021
T1 Accelerometers			X	T28620	Endevco	28-Mar-2022
			Y	T28521	Endevco	28-Mar-2022
			Z	T28523	Endevco	28-Mar-2022
Clavicle Load Cells	Right	Outer	FX, FZ	EU3542	Humanetics	3-Nov-2021
		Inner	FX, FZ	EU3542	Humanetics	3-Nov-2021
Thorax IR-TRACCs	Left	Upper	N/A	EU0662	Humanetics	19-Oct-2021
	Right		N/A	EU0682	Humanetics	4-Nov-2021
	Left	Lower	N/A	ES5322	Humanetics	9-Sep-2021
	Right		N/A	ES5324	Humanetics	9-Sep-2021
Thorax Rotary Potentiometers	Left	Upper	Y	ES6420	Humanetics	20-Oct-2021
			Z	ES6421	Humanetics	20-Oct-2021
	Right	Upper	Y	ET8504	Humanetics	4-Nov-2021
			Z	ET8505	Humanetics	4-Nov-2021
	Left	Lower	Y	ES6422	Humanetics	9-Sep-2021
			Z	ES6423	Humanetics	9-Sep-2021
	Right	Lower	Y	ES6387	Humanetics	9-Sep-2021
			Z	ES6388	Humanetics	9-Sep-2021
T8 Accelerometers			X	T28511	Endevco	28-Mar-2022
			Y	T28512	Endevco	28-Mar-2022
			Z	T28513	Endevco	28-Mar-2022
Thoracic Spine Load Cells			MX	EU2725	Humanetics	27-Dec-2021
			MY	EU2725	Humanetics	7-Dec-2021
Abdomen Pressure Sensors		Left	N/A	JH6640I3	Transpolis	20-Sep-2021
		Right	N/A	JH6640J6	Transpolis	20-Sep-2021
A.S.I.S. Load Cells		Left	FX, MY	EK8713	Humanetics	27-Oct-2021
		Right	FX, MY	EK8713	Humanetics	27-Oct-2021

TABLE 1 – FRONT PASSENGER DUMMY INSTRUMENTATION (CONT'D)

Instrumentation			Axis/Location	THOR-05F S/N EV3430		
				Serial Number	Manufacturer	Calibration Date
Acetabulum Load Cells		Left	FX, FY, FZ	EU2728	Humanetics	9-Dec-2021
		Right	FX, FY, FZ	ED3552	Humanetics	27-Apr-2022
Pelvis Accelerometers			X	T30077	Endevco	28-Mar-2022
			Y	T30079	Endevco	28-Mar-2022
			Z	T30073	Endevco	30-Mar-2022
Pelvis Angular Rate Sensors			X	ARS19483	DTS	28-Oct-2021
			Y	ARS19491	DTS	28-Oct-2021
			Z	ARS19487	DTS	28-Oct-2021
Femur Load Cells		Left	FX, FY, FZ, MX, MY, MZ	ES5335	Humanetics	27-Oct-2021
		Right	FX, FY, FZ, MX, MY, MZ	EP5782	Humanetics	27-Oct-2021
Knee Slider Potentiometers		Left	FX	21074835	Space Age	5-Jul-2022
		Right	FX	21074836	Space Age	5-Jul-2022
Tibia Load Cells	Left	Upper	FX, FY, FZ, MX, MY	EV4046	Humanetics	6-Apr-2022
		Lower	FX, FY, FZ, MX, MY	EV5808	Humanetics	7-Apr-2022
	Right	Upper	FX, FY, FZ, MX, MY	EV4048	Humanetics	8-Apr-2022
		Lower	FX, FY, FZ, MX, MY	EV5810	Humanetics	8-Apr-2022
Achilles Load Cell Forces		Left	FZ	EK4673N	Humanetics	11-Jan-2022
		Right	FZ	EK4686N	Humanetics	11-Jan-2022
Tibia Accelerometers		Left	X	T31705	Endevco	28-Jan-2022
			Y	T31706	Endevco	28-Jan-2022
		Right	X	T31707	Endevco	28-Jan-2022
			Y	T31708	Endevco	28-Jan-2022
Ankle Rotary Potentiometers		Left	X	EU9373	Humanetics	28-Jan-2022
			Y	EU9372	Humanetics	28-Jan-2022
			Z	EU9374	Humanetics	28-Jan-2022
		Right	X	EU9377	Humanetics	28-Jan-2022
			Y	EU9380	Humanetics	28-Jan-2022
			Z	EU9387	Humanetics	28-Jan-2022
Foot Accelerometers		Left	X	T31730	Endevco	28-Jan-2022
			Y	T31734	Endevco	28-Jan-2022
			Z	T31735	Endevco	28-Jan-2022
		Right	X	T31130	Endevco	11-Feb-2022
			Y	T31852	Endevco	11-Feb-2022
			Z	T31854	Endevco	11-Feb-2022
Seat Belt Load Cells		Lap	N/A	N/A	N/A	N/A
		Shoulder	N/A	N/A	N/A	N/A

TABLE 3 – Vehicle Instrumentation

Instrumentation		Axis	Serial Number	Manufacturer	Calibration Date
Vehicle CG Accelerations		X	A367454	Measurement Specialties	22-Aug-2022
		Y	A400097	Measurement Specialties	22-Aug-2022
		Z	A349806	Measurement Specialties	30-Aug-2022
Floor Pan Accelerations	Driver	X	A386351	Measurement Specialties	22-Aug-2022
		Y	A254916	Measurement Specialties	29-Aug-2022
		Z	A297048	Measurement Specialties	29-Aug-2022
	Passenger	X	A378327	Measurement Specialties	22-Aug-2022
		Y	A386354	Measurement Specialties	22-Aug-2022
		Z	A378330	Measurement Specialties	22-Aug-2022
Door Sill LR X Accelerations	Left Rear	X	A373334	Measurement Specialties	22-Aug-2022
	Right Rear	X	A386348	Measurement Specialties	22-Aug-2022
Seat Crossmember Accelerations	Left Rear	X	A400129	Measurement Specialties	19-Sep-2022
	Left Rear	Z	A400117	Measurement Specialties	22-Aug-2022
	Right Rear	X	A386358	Measurement Specialties	22-Aug-2022
	Right Rear	Z	A377406	Measurement Specialties	19-Sep-2022

APPENDIX F
SEATING PROCEDURE

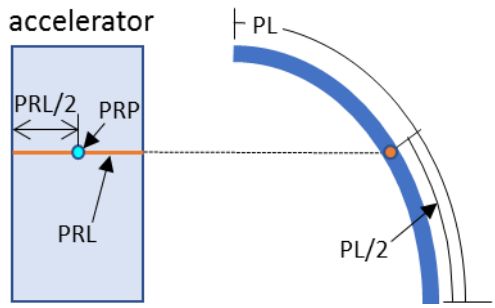
DRAFT THOR 5TH - FEMALE DUMMY SEATING & POSITIONING PROCEDURES DRIVER POSITION

DRAFT

Seating and Dummy Positioning Procedures for the THOR 5th Female Driver Dummy

1. Determine the seat type
   Visually inspect the seats to determine type (i.e., bucket or bench).
   __Bench
   __Bucket
2. Position lumbar supports
   Position the seat's adjustable lumbar supports to the lowest, retracted, or deflated adjustment positions.
   __*N/A* No lumbar adjustment
3. Position additional supports
   Position any adjustable parts of the seat that provide additional support so that they are in the lowest or most open adjustment position.
   __*N/A* No additional support adjustment
4. Position leg supports
   Position an adjustable leg support system in its rearmost position.
   __*N/A* No adjustable leg support system
5. Mark the centerline of the seat
   5.1 Mark the center of the seat using a vehicle longitudinal, vertical (XZ) plane (complete ONLY the one that is applicable to seat being marked).
      5.1.1. Bucket Seat: For future reference, locate and mark the line on the seat cushion that is the intersection of the XZ plane which passes through the centerline of the seat and the seat cushion upper surface.
      5.1.2. Bench Seat: For future reference, locate and mark the line on the seat cushion that is the intersection of the XZ plane which passes through the centerline of the steering wheel and the seat cushion upper surface.
   5.2 Translate centerline of the seat to the floor by creating a line and recording it with the CMM.
6. Determine the type of accelerator pedal in the vehicle in order to mark the heel placement. It is suggested to do the measurements using a Coordinate-Measuring Machine (CMM).
   6.1 Place adjustable pedals in the foremost position (towards the front of the vehicle).
      __N/A the pedals are not adjustable.
   6.2 Is it a suspended accelerator pedal?
      ___Yes, go to step 7.1
      ___No, go to step 6.3
   6.3 Is it a floor-mounted accelerator pedal?
      ___Yes, go to step 7.2
7. Locate the Pedal Refence Point on the accelerator. It is suggested to do the measurements using a CMM.
   7.1 For a suspended pedal: Using the diagram below locate the Pedal Reference Point (PRP) on the accelerator pedal. (using a measurement device such as a flexible tape measure, CMM, and/or calipers).

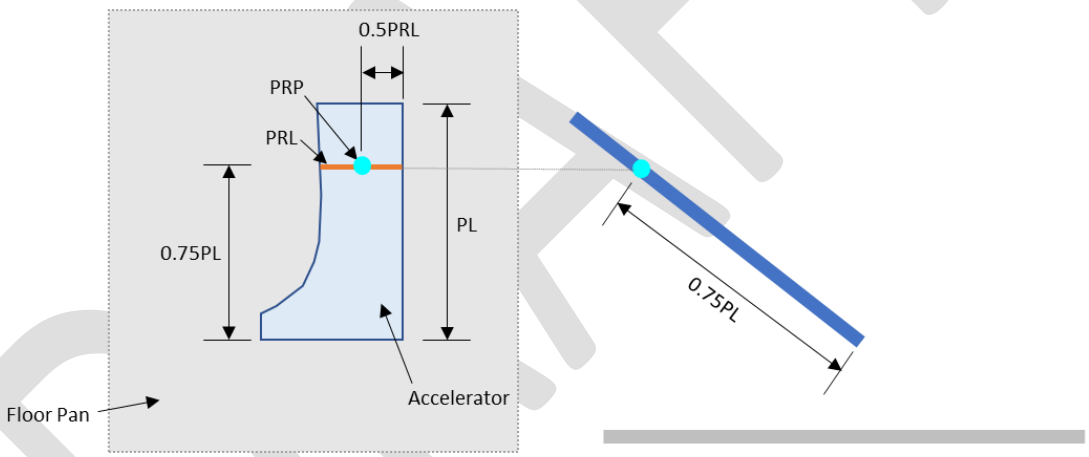
DRAFT



7.1.1. Measure the accelerator pedal length (PL) along the surface of the pedal from the top edge to the bottom edge. Establish the pedal refence line (PRL) by marking a line in the y-direction on the pedal surface at the mid-point of the PL.

7.1.2. Measure the accelerator pedal width along the PRL. Establish the pedal reference point (PRP) by marking the midpoint of the PRL.

7.2 For a floor mounted pedal: Using the diagram below, locate the Pedal Reference Point (PRP) using a measurement device such as a tape measure, CMM, and/or calipers. Use the active part of the pedal, which is defined as the moveable part of the floor-mounted pedal.

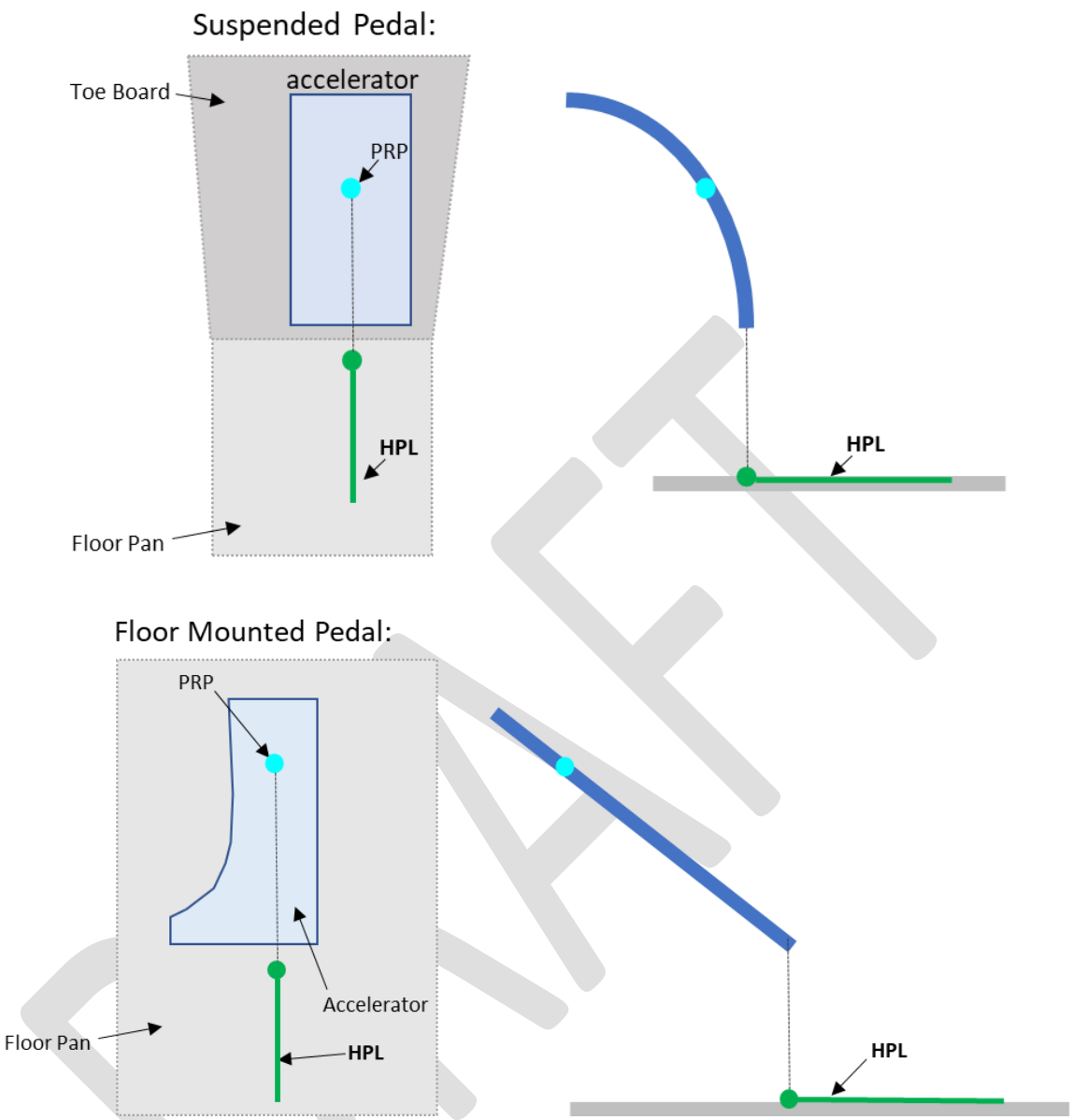


7.2.1. Determine the overall pedal length (PL) on the active pedal, as measured along the surface of the moveable pedal. Record the length:_____. Calculate 75% of this height (0.75PL). Establish the pedal reference line (PRL) by marking a line in the y-direction at 0.75PL.

7.2.2. Measure the length of the PRL in the y-direction and mark the center point of the PRL. This is the PRP.

8. Locate and mark the Heel Point Line (HPL) on the floorpan.

8.1 Using a measurement device (CMM, tape measure, calipers), locate a point on the floorpan at or directly below the bottom edge of the pedal that is in the same longitudinal (XZ) which passes through PRP. Draw a line in the x-direction that is approximately 200mm on the floor pan. This is the HPL.



9. Mark the range of seat travel.
   Prior to marking the seat for fore/aft travel, move the seat through its full range of motion using all available controls. Separately, operate each control to determine whether it moves the seat and/or seat cushion primarily in the fore-aft or up-down directions.

   9.1 Mark a point (seat cushion reference point - SCRP) on the side of the seat cushion that is between 150 mm and 250 mm from the front edge of the seat cushion. For seat cushions that move up and down independently from the seat housing, mark the point on the side of the cushion in an area that will not be obscured by the seat housing when the seat cushion is at its lowest height position.

   9.2 Draw a horizontal line (seat cushion reference line - SCRL) through the SCRP.

Alternative method for 9.2, is to set the inclinometer on the seat pan cushion and zero at the rearmost fore-aft position, minimum angle, and lowest seat height.

9.3 Using only the controls that primarily move the seat in the fore-aft direction, move the SCRP to the lowest rearmost position.

9.4 If the seat cushion adjusts fore-aft, independent of the seat back, using only the controls that primarily move the seat cushion in the fore-aft direction, move the SCRP to the rearmost position.

__ *N/A* No independent fore-aft seat cushion adjustment

9.5 Using any part of any control, other than the parts just used for fore-aft positioning, determine the range of angles of the SCRL and set the SCRL at mid-angle. Record the maximum, minimum, and mid-angles in the table below.

SCRL (deg)	Max	Min	Mid
Driver			

9.6 If the seat and/or seat cushion height is adjustable, using any part of any control other than the parts which primarily move the seat or seat cushion fore-aft, put the SCRP in its lowest position with the SCRL angle at the mid-angle found in 9.5.

__ *N/A* No seat height adjustment

9.7 Using only the controls that primarily move the seat in the fore-aft direction, verify the seat is in the rearmost position.

9.8 While maintaining the mid-angle found in step 9.5 use only the controls that primarily move the seat up and down. Measure the SCRP the highest, lowest, and mid-height position that the mid-angle can be achieved.

SCRP Height	Max	Min	Mid
Driver			

9.9 While maintaining the Mid Angle and Mid Height found in steps 9.5 and 9.8. Using only the controls that primarily move the seat in the fore-aft direction, mark the fore-aft seat positions. Mark each position so that there is a visual indication when the seat is at a particular position.

- For manual seats, move the seat forward one detent at a time and mark each detent.
- For power seats, mark only the rearmost, middle, and foremost positions. Label three of the positions with the following: F for foremost, M for mid-track (if there is no mid-track, label the closest adjustment position to the rear of mid-track), and R for rearmost.

9.10 Measure the SCRP fore-aft location for each seat position on the table below

	SCRL Mid-Angle (deg)							SCRP Height (mm) Spacing measurement between detents (if applicable)
		Rearmost		Mid-track		Foremost		
		X	Z	X	Z	X	Z	Z
Driver								

10. Position the head restraint

10.1 Using any adjustment of the head restraint, position it to its manufacturer specified position or lowest position, not stored position.

10.2 Using any adjustment of the head restraint, position it to the rearmost setting. If it rotates, rotate it such that the head restraint extends as far rearward as possible.

__*N/A* The test vehicle is equipped with automatically adjusting head restraints or there is no head restraint adjustment.

11. Set the seat for a test dummy

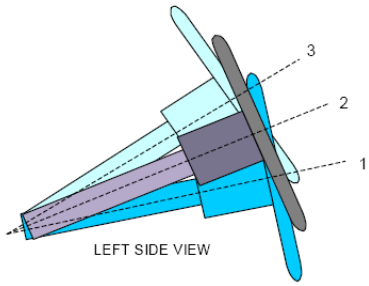
Using the reference marks on the seat, set the seat in the rearmost position at the mid-height, and mid seat cushion angle as follows:

11.1 Using the control that primarily moves the seat fore and aft, move the SCRP to the rear most position recorded in Step 9.10.

11.2 If the seat or seat cushion height is adjustable, other than by using the controls that primarily move the seat or seat cushion up or down, set the height of the SCRP to the mid-height found in Step 9.8, with the SCRL set as closely as possible to the mid-angle determined in previous step 9.5.

11.3 Position the Seat back so that it is in a reclined position

11.3.1 Using a 2-foot level vertically on the centerline of the seat back surface; verify that the seat back is reclined to a maximum of 45 degrees (Approximately 35-45 degrees).



STEERING COLUMN ASSEMBLY

12. Set the steering wheel to the mid-position

Use the markings to position the steering wheel hub at the geometric center of full range of driving positions including any telescoping positions. For steering columns with discrete positions and no detent at the mid-angle, position the column in the next lowest detent from the mid-angle.

Complete the following table:

	Degrees	Fore/Aft Position (mm)
Lowermost - Position 1		
Geometric Center – Position 2		
Uppermost – Position 3		
Telescoping Steering Wheel Travel		
Test Position		

_____ *N/A* The steering wheel does not adjust.

13. Set adjustable seat belt upper anchorages

Fill in the following table based on an adjustable seat belt D-ring. If an adjustable seat belt D-ring anchorage exists, place it in the manufacturer's designed position for a 5th adult female. This information will be supplied by the COTR.

Seat	Total # of Positions	Placed in Position #
Driver		

_____ *N/A* The seat belt upper anchorage does not adjust.

14. Retract the armrest

Retract any folding armrest

_____ *N/A* No armrest or armrest is fixed, not retractable.

15. Prepare to set a qualified THOR5th test dummy in the driver seat of the test vehicle.

15.1 Follow the procedures in the THOR-5th Qualification Manual for setting the joint torques. Also, make sure the neck and spine are placed in the proper position (e.g. ERECT or SLOUCHED, and neutral position for neck) setting before placing the test dummy in the vehicle

15.2 Record the lumbar spine pitch change joint and neck pitch change joint settings below:

Lumbar spine pitch change joint: _____ Neck pitch change joint: _____

15.3 Verify the head, T1, T6, T12, and pelvis tilt sensors installed in the test dummy are reading correctly about the X & Y axes.

15.4 Verify the seat back angle, seat cushion angle, seat cushion height, steering wheel location, and the seat belt height adjustment are in the correct positions defined in Step 11

Steps 16.1-16.9 are used for an initial posturing of the test dummy in the vehicle seat; it is to be noted that that the tolerances on the tilt sensors do not apply until Step 16.10 and after. For those steps, tolerances on the tilt sensors should be applied stay within or as close as possible to the specified range as applicable.

16. Positioning the test dummy in the seat

16.1 Place the test dummy into the driver's seat. Position the legs so that the calves are not touching the seat cushion

16.2 Set the angle between the legs and thighs to 120 degrees.

16.3 Position the test dummy in the seat such that its plane of symmetry (i.e., mid-sagittal plane) is coincident with the centerline marking on the seat cushion, seat back and head restraint.

16.3.1. Verify the test dummy's shoulders are not twisted and are sitting square.

16.4 Position the pelvis so that the tilt sensor is reading approximately 20-25 degrees (about

the y-axis) Gently rock the upper torso side to side in order to adjust the pelvis to 0 degree +/- 1 degree about the x-axis direction.

16.5 Set the initial transverse distance between the longitudinal centerlines at the front of the test dummy's knees at 210 mm to 220 mm (8.26 to 8.66 in), with the thighs and legs of the test dummy in vertical planes.

16.6 Push rearward on the test dummy's knees to force the pelvis into the seat so there is no gap between the pelvis and the seat back or until contact occurs between the back of the test dummy's calves and the front of the seat cushion. If needed, extend the legs slightly so that the feet are not in contact with the floor pan. Let the thighs rest on the seat cushion to the extent permitted by the foot movement.

16.7 Recline test dummy so that the back is in contact with the seat back

16.8 Keeping the leg and thigh in a vertical plane, attempt to place the right foot in the vertical longitudinal plane that passes through the centerline of the accelerator pedal or as close as possible.

16.9 Holding the thighs in place rotate the seat back forward until the head tilt sensor reads 0 degrees (+/- 1 degrees) about the Y-Axis. As seatback adjustment is made, the test dummy should periodically be leaned slightly forward (using the back or shoulders of the dummy not the head) and pressed back against the seat in order to avoid binding with the test dummy's back and vehicle seatback. Monitor all tilt sensors as you rotate the test dummy forward with the seatback; maintain the tilt sensors about the X-axis to be at 0 (+/- 1 degree). Verify the test dummy's shoulders are not twisted and are sitting square.

16.10 Adjust the test dummy to set the pelvis tilt sensor to the following angles:

<u>Erect Posture</u> position:

About the X-axis = 0 degrees +/- 1 degrees

About the Y-axis = 20 degrees +/- 2.5 degrees.

<u>Slouch Posture</u> position:

About the X-axis = 0 degrees +/- 1 degrees

About the Y-axis = 25 degrees +/- 2.5 degrees

16.10.1. Adjust the test dummy's pelvis angle as close to desired angle as possible while keeping the head level. X-axis tilt sensors should be 0 (+/- 1 degree)

*The priority order of adjustment angles is head angle then pelvis angle.

16.11 After adjusting the test dummy, press rearward on the shoulders again to ensure that it is in the rearmost rotated position with maximum seat back interaction.

16.11.1. Verify the test dummy's shoulders are not twisted and the test dummy is sitting square in the seat.

16.12 Lift the feet the minimal amount needed to slide the seat forward (using only the control that moves the seat fore and aft) to the full forward position or first contact with the dash (recorded position in Step 9.10). *(The right foot may contact and depress the accelerator and/or change the angle of the foot with respect to the leg during seat movement. Final foot position is addressed in Step 17.4.)*

Verify the seat position with the SCRP point.

16.13 Is there interference between the vehicle and the test dummy before reaching the full forward seat position (as recorded in Step 9.10)

__No, go to step 17

__Yes, go to step 16.14

16.14 Without taking the pelvis and head out of tolerance, can the knees be adjusted (i.e. vertically or laterally)?

__No, go to step 16.15

__Yes, adjust as necessary and go back to step 16.13.

16.15 Is there interference between the steering wheel and the test dummy?

__No, go to step 17

__Yes, go to step 16.15.1

16.15.1. If either of the test dummy's legs first contact the steering wheel, adjust the steering wheel upward until leg contact with the steering wheel is avoided. If the steering wheel is not adjustable, separate the knees enough to avoid steering wheel contact.

16.15.2. Proceed with moving the seat forward until either the leg contacts the vehicle interior, or the seat reaches the foremost position found in step 9.10. **Avoid contact with the outboard knee with the vehicles brake, clutch pedal or footrest.** If necessary to avoid contact with the vehicle's brake, clutch pedal, or footrest, rotate the test dummy's left foot about the leg. If there is still interference, rotate the left thigh outboard about the hip the minimum distance necessary to avoid pedal interference. *(The right foot may contact and depress the accelerator and/or change the angle of the foot with respect to the leg during seat movement. Final foot position is addressed in Step 17.4.)*

16.16 Is there contact with the knee bolster or instrument panel?

__No, go to step 17

__Yes, go to step 16.16.1

16.16.1. Can the pelvis be pushed back against the seat back any further?

__No, go to step 16.17

__Yes, adjust test dummy and go back to Step 16.13 and repeat steps.

16.17 If a test dummy leg contacts the vehicle interior before the foremost position is attained, position the seat at the next detent back at which there is no contact. If the seat is a power seat, move the seat fore and aft to avoid contact while assuring that there is a maximum of 5 mm (0.2 in) distance between the vehicle interior and the point on the test dummy that would first contact the vehicle interior.

16.18 If the steering wheel was moved, return it to the position described in Section 12, if possible, without contacting the test dummy's legs. If the steering wheel contacts the test dummy's leg(s) prior to attaining this position, adjust it to the next higher detent, or if infinitely adjustable, until there is 5 mm (0.2 in) clearance between the wheel and the test dummy's leg(s).

17. Final Test Dummy Positioning

The priority order of the adjustment angles is head angle then pelvis angle.

17.1 Verify/Measure the pelvis angle using the tilt sensor installed in the test dummy.

<u>Erect Posture</u> position:

About the X-axis = 0 degrees +/- 1 degree

About the Y-axis = 20 degrees +/- 2.5 degrees.

<u>Slouch Posture</u> position:

About the X-axis = 0 degrees +/- 1 degree

About the Y-axis = 25 degrees +/- 2.5 degrees

Are the pelvis angles within specification?

__No, adjust the test dummy a minimal amount needed to achieve the specifications as described in 17.1 and go to step 17.2

__Yes, go to step 17.2

17.2 Verify/Measure the head angle using tilt sensor installed in the test dummy. Verify the head angles are 0°±1° (about the X-axis) and 0° ± 1° (about the Y-axis)

17.2.1 Is the head touching the head restraint?

__No, go to step 17.2.2

__Yes, without moving the pelvis, rotate dummy about the hip leaning forward and reposition the dummy against the seat back. (Do not adjust head by rotating about the neck or pulling forward on the head) Verify the test dummy's shoulders are not twisted and are sitting square. If the head is still in contact with the head restraint, go to step 17.2.2

17.2.2 Are the head angles within specification?

__No, adjust seatback angle and go back to Step 17.1

__Yes, go to Step 17.3

17.3 If, at this time, due to adjusting the pelvis and head in steps 17.1 and 17.2, the torso is in contact with the steering wheel, adjust the steering wheel in the following order until there is no contact: telescoping adjustment, lowering adjustment, raising adjustment. If the vehicle has no adjustments or contact with the steering wheel cannot be eliminated by adjustment, position the seat at the next detent where there is no contact with the steering wheel. If the seat is a power seat, position the seat to avoid contact while assuring that there is a maximum of 5 mm (0.2 in) distance between the steering wheel and the point of contact on the test dummy.

17.3.1. Was the seat adjusted?

__No, go to step 17.4

__Yes, go back to step 17.1

17.4 Driver Foot Positioning - Right foot

Place the right foot on the floor pan in line or as close as possible with the HPL.

Does the heel of the right foot contact the floor pan?

__Yes, follow the positioning procedure in Section 17.4.1

__No, follow the positioning procedure in Section 17.4.3

17.4.1. Perform the following steps until either all steps are completed, or the foot contacts the accelerator pedal.

17.4.1.1. With the rear of the heel contacting the floor pan, move the foot forward along the HPL until pedal contact occurs or the foot is at the full forward position. If the heel cannot be placed on the HPL, position heel as close as possible to the HPL.

Is the heel in contact with the floor pan and accelerator pedal?

___No, go to step 17.4.1.2

___Yes, go to step 17.4.2

17.4.1.2. If the vehicle has an adjustable accelerator pedal, move the pedals rearward until pedal contact occurs or the pedals reach the full rearward position.

Is the heel in contact with the floor pan and accelerator pedal?

___No, go to step 17.4.1.3

___Yes, go to step 17.4.2

___N/A No pedal adjustment. go to step 17.4.1.3

17.4.1.3. Extend the leg, allowing the heel to lose contact with the floor until the foot contacts the pedal. Do not raise the toe of the foot higher than the top of the accelerator pedal.

Is there foot contact with the pedal?

__No, go to Step 17.4.1.4

__Yes, place a tapered foam block as shown below under the heel with the shallow part of the taper facing forward. Go to step 17.4.2

17.4.1.4. Angle the foot to achieve contact between the foot and the pedal.

Is there foot contact with the pedal?

___No. Return the foot to the perpendicular orientation and go to step 17.4.1.5

___Yes. Place a tapered foam block as shown in Figure 1 under the heel with the shallow part of the taper facing forward. Go to step 17.4.2

17.4.1.5. Align the centerline of the foot with the HPL. Place a tapered foam block as shown below under the heel with the shallow part of the taper

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facing forward. If the heel cannot be placed on the HPL, position heel as close as possible to the HPL.

17.4.2. Record foot position; Go to Step 17.5

___Pedal Contact achieved. Contact occurred at step _____.
___ Heel contacts floor pan
___ Heel set _____ mm from floor pan.
___ Pedal Contact not achieved. Heel set _____ mm from the floor pan

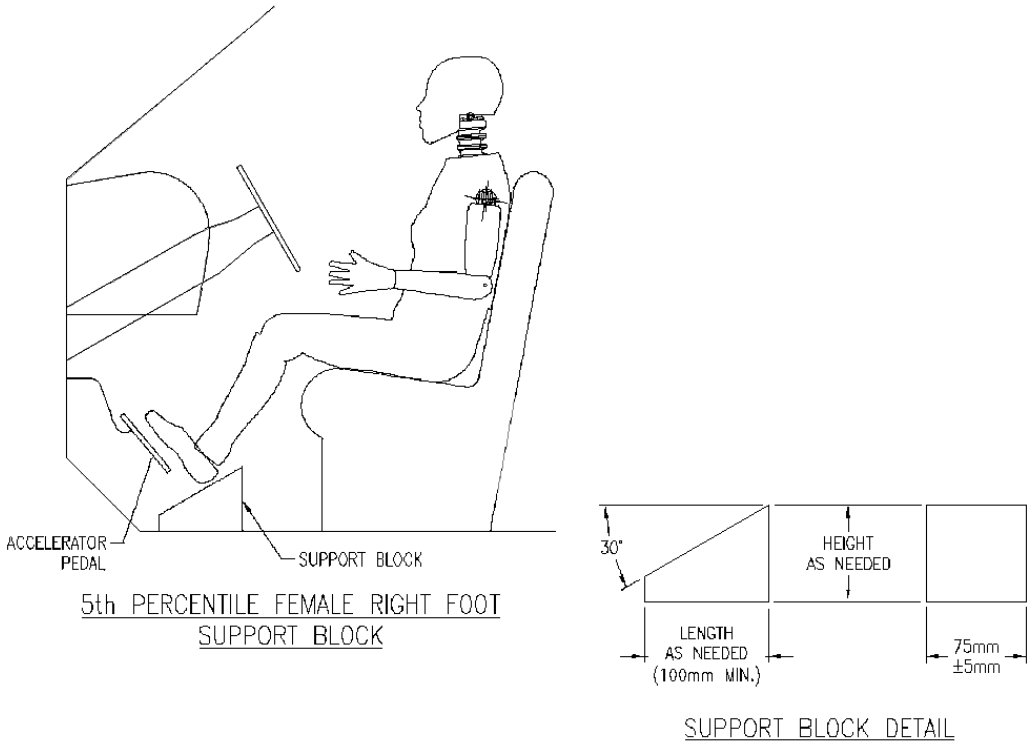

Figure 1: Support Block

17.4.3. Perform the following steps until either all steps are completed, or the foot contacts the accelerator pedal. Extend the leg until the foot contacts the pedal. Do not raise the toe of the foot higher than the top of the accelerator pedal.
Is there foot contact with the pedal?
____No, go to step 17.4.3.2
____Yes, place a tapered foam block (Figure 1) under the heel with the shallow part of the taper facing forward. Go to step 17.4.4

17.4.3.2. If the vehicle has an adjustable accelerator pedal, move the pedals rearward until pedal contact occurs or the pedals reach the full rearward

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position.

Is there foot contact with the pedal?

____Yes, go to step 17.4.4

____No. Place a tapered foam block as shown below under the heel with the shallow part of the taper facing forward. Go to step 17.4.3.3

___ N/A No Pedal Adjustment

17.4.3.3. Angle the foot to achieve contact between the foot and the pedal.

Is there foot contact with the pedal?

___No. Return the foot to the perpendicular orientation; Go to Step 17.4.4

___Yes. Place a tapered foam block as shown below under the heel with the shallow part of the taper facing forward. Go to step 17.4.3.4

17.4.3.4. Align the centerline of the foot with the HPL. Place a tapered foam block (Figure 1) under the heel with the shallow part of the taper facing forward. If the heel cannot be placed on the HPL position heel as close as possible to the HPL.

17.4.4. Record foot position; Go to Step 17.5.

___ Pedal Contact achieved. Contact occurred at step _____.

___ Heel set _____ mm from floor pan.

___ Pedal Contact not achieved. Heel set _____ mm from the floor pan.

17.5 Driver's foot positioning - Left foot.

17.5.1. Place the foot perpendicular to the leg and determine if the heel contacts the floor pan at any leg position.

Does the heel contact the floor pan at any leg position (adjust if necessary)?

___ No. Position the leg as perpendicular to the thigh as possible with the foot parallel to the floor pan. Go to step 17.5.3

___ Yes, go to step 17.5.2

17.5.2. Place the foot on the toe board with the heel resting on the floor pan as close to the intersection of the floor pan and the toe board as possible. Adjust the angle of the foot if necessary to contact the toe board. If the foot will not contact the toe board, allow the foot to remain in its natural relaxed foot position (i.e plantar flexion) with the heel on the floor pan as far forward as possible.

17.5.2.1. Avoid contact with the brake pedal, clutch pedal, wheel well projection, and footrest.

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To avoid this contact, use the following three manipulations in the order listed, with each subsequent option incorporating the previous, until contact is avoided: rotate the foot about the lower leg (abduction/adduction), plantar flex the foot, rotate the leg outboard about the hip.
Movement should be the minimum amount necessary. If it is not possible to avoid all foot contact, give priority to avoiding brake or clutch pedal contact.

___No contact
___Foot rotated about the leg (abduction/adduction)
___Foot rotated about the leg, and foot plantar flexed
___Foot rotated about the leg, foot plantar flexed, and the leg rotated about the hip.

17.5.3 Verify the lower leg is still in a vertical plane and record foot position; go to step 18.

___Heel does not contact floor pan.
___Heel on floor pan and foot on toe board.
___Heel on floor pan and foot not on toe board

18. Arm and belt placement.

Verify the shoulders of the test dummy are rotated fully rearward.

18.1 Is the seat belt used for this test? Verify it is in the required position (Step 13).

__Yes, go to step 18.1.1
__No, go to step 18.2

18.1.1. Fasten the seat belt around the test dummy and fasten the buckle. Ensure that the test dummy's head remains as level as possible

18.1.2. Remove all slack from the lap belt portion.

18.1.3. Pull the upper torso webbing out of the retractor and allow it to retract; repeat this four times.

18.1.4. Apply a 2 to 4-pounds of (9-18N) tension load to the lap and shoulder belt
____measurement of load applied

18.1.5. Is the belt system equipped with a tension-relieving device?

____Yes, go to step 18.1.6.1
____No, go to step 18.2

18.1.6.1. Introduce the maximum amount of slack into the upper torso belt that is recommended by the vehicle manufacturer in the vehicle owner's manual.

18.2 Place the right and left upper arms adjacent to the torso with the centerline as close to a vertical plane as possible.

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18.3 Place the right and left hand with the palm in contact with the steering wheel at the rim's horizontal centerline and with the thumb over the steering wheel.

18.4 Tape the thumb of each hand to the steering wheel using masking tape with a width of 6 mm. The length of the tape shall only be enough to go around the thumb and steering wheel one time.

19. Record the final positions of the following in addition to the ATD measurements as required:

19.1 Final SCRP (it is suggested to use a CMM)

19.2 Steering Wheel Position

19.3 Head Restraint Post Angle

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DRAFT THOR 5TH - FEMALE DUMMY SEATING & POSITIONING PROCEDURES FRONT PASSENGER POSITION

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Seating and Dummy Positioning Procedures for the THOR 5th Female Passenger Dummy

1. Determine the seat type
   Visually inspect the seats to determine type (i.e., bucket or bench).
   __Bench
   __Bucket
2. Position lumbar supports
   Position the seat's adjustable lumbar supports to the lowest, retracted, or deflated adjustment positions.
   __*N/A* No lumbar adjustment
3. Position additional supports
   Position any adjustable parts of the seat that provide additional support so that they are in the lowest or most open adjustment position.
   __*N/A* No additional support adjustment
4. Position leg supports
   Position an adjustable leg support system in its rearmost position.
   __*N/A* No adjustable leg support system
5. Mark the centerline of the seat using a vehicle longitudinal, vertical (XZ) plane (complete ONLY the one that is applicable to seat being marked)
   5.1 Bucket Seat: For future reference, locate and mark the line on the seat cushion that is the intersection of the XZ plane which passes through the centerline of the seat and the seat cushion upper surface.
   5.2 Bench Seat: For future reference, locate and mark the line on the seat cushion that is the intersection of the XZ plane which passes through the centerline of the seat.
6. Mark the range of seat travel.
   Prior to marking the seat for fore/aft travel, move the seat through its full range of motion using all available controls. Separately, operate each control to determine whether it moves the seat and/or seat cushion primarily in the fore-aft or up-down directions.

   6.1 Mark a point (seat cushion reference point - SCRP) on the side of the seat cushion that is between 150 mm and 250 mm from the front edge of the seat cushion. For seat cushions that move up and down independently from the seat housing, mark the point on the side of the cushion in an area that will not be obscured by the seat housing when the seat cushion is at its lowest height position.
   6.2 Draw a horizontal line (seat cushion reference line - SCRL) through the SCRP.

   Alternative method for 6.2, is to set the inclinometer on the seat pan cushion and zero at the rearmost fore-aft position, minimum angle, and lowest seat height.

   6.3 Using only the controls that primarily move the seat in the fore-aft direction, move the SCRP to the lowest rearmost position.
   6.4 If the seat cushion adjusts fore-aft, independent of the seat back, using only the controls that primarily move the seat cushion in the fore-aft direction, move the SCRP to the rearmost position.
   __ *N/A* No independent fore-aft seat cushion adjustment
   6.5 Using any part of any control, other than the parts just used for fore-aft positioning, determine

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the range of angles of the SCRL and set the SCRL at mid-angle. Record the maximum, minimum, and mid-angles in the table below.

SCRL (deg)	Max	Min	Mid
Passenger			

6.6 If the seat and/or seat cushion height is adjustable, using any part of any control other than the parts which primarily move the seat or seat cushion fore-aft, put the SCRP in its lowest position with the SCRL angle at the mid-angle found in 6.5.

__ *N/A* No seat height adjustment

6.7 Using only the controls that primarily move the seat in the fore-aft direction, verify the seat is in the rearmost position.

6.8 While maintaining the mid-angle found in step 6.5 use only the controls that primarily move the seat up and down. Measure the SCRP the highest, lowest, and mid-height position that the mid-angle can be achieved.

SCRP Height	Max	Min	Mid
Passenger			

6.9 While maintaining the Mid Angle and Mid Height found in steps 6.5 and 6.8. Using only the controls that primarily move the seat in the fore-aft direction, mark the fore-aft seat positions. Mark each position so that there is a visual indication when the seat is at a particular position.

- For manual seats, move the seat forward one detent at a time and mark each detent.
- For power seats, mark only the rearmost, middle, and foremost positions. Label three of the positions with the following: F for foremost, M for mid-track (if there is no mid-track, label the closest adjustment position to the rear of mid-track), and R for rearmost.

6.10 Measure the SCRP fore-aft location for each seat position on the table below.

	SCRL Mid-Angle (deg)							SCRP spacing (mm) Spacing measurement between detents (if applicable)
		Rearmost		Mid-track		Foremost		
		X	Z	X	Z	X	Z	X
Passenger								

7. Position the head restraint

7.1 Using any adjustment of the head restraint, position it to its manufacturer specified position or lowest position, not stored position.

7.2 Using any adjustment of the head restraint, position it to the rearmost setting. If it rotates, rotate it such that the head restraint extends as far rearward as possible.

__*N/A* The test vehicle is equipped with automatically adjusting head restraints or there is no head restraint adjustment.

8. Set the seat for a test dummy

Using the reference marks on the seat, set the seat in the rearmost position at the mid-height, mid seat cushion angle as follows:

8.1 Using the control that primarily moves the seat fore and aft, move the SCRP to the rear most

position recorded in Step 6.10.

8.2 If the seat or seat cushion height is adjustable, other than by using the controls that primarily move the seat or seat cushion up or down, set the height of the SCRP to the mid-height found in Step 6.8, with the SCRL set as closely as possible to the mid-angle determined in previous Step 6.5.

8.3 Position the seat back so that it is in a reclined position

8.3.1. Using a 2-foot level vertically on the centerline of the seat back surface; verify that the seat back is reclined to a maximum of 45 degrees (Approximately 35-45 degrees)

9. Set adjustable seat belt upper anchorages

Use the markings to position an adjustable seat belt upper anchorage at the manufacturer's nominal design position for a 5th percentile female adult occupant or highest position if not provided. Fill in the following table:

Seat	Total # of Positions	Placed in Position #
Passenger		

_____ *N/A* The seat belt upper anchorage does not adjust.

10. Retract the armrest

Retract any folding armrest

_____ *N/A* No armrest or armrest is fixed, not retractable.

11. Prepare to set a qualified THOR5th dummy in the passenger seat of the test vehicle.

11.1 Follow the procedures in the THOR-5th Qualification Manual for setting the joint torques. Also, make sure the neck and spine are placed in the proper position (e.g. ERECT or SLOUCHED) setting before placing the dummy in the vehicle

11.2 Verify the head, T1, T8, T12, and pelvis tilt sensors installed in the dummy are reading correctly about the X & Y axes.

11.3 Verify the seat back angle, seat cushion angle, seat cushion height, and the seat belt height adjustment are in the correct positions defined in Step 6.

Steps 12.1-12.9 are used for an initial posturing of the test dummy in the vehicle seat; it is to be noted that that the tolerances on the tilt sensors do not apply until Step 16.10 and after. For those steps, tolerances on the tilt sensors should be applied stay within or as close as possible to the specified range as applicable.

12. Positioning the test dummy in the seat

12.1 Place the test dummy into the Passenger's seat. Position the legs so that the calves are not touching the seat cushion

12.2 Set the angle between the legs and thighs to 120 degrees.

12.3 Position the test dummy in the seat such that its plane of symmetry (i.e., mid-sagittal plane) is

coincident with the centerline marking on the seat cushion, seat back and head restraint.

12.3.1. Verify the test dummy's shoulders are not twisted and are sitting square.

12.4 Position the pelvis so that the tilt sensor is reading approximately 20-25 degrees. Gently rock the upper torso side to side in order to adjust the pelvis to 0 degree +/- 1 degree in the x-axis direction.

12.5 Set the initial transverse distance between the longitudinal centerlines at the front of the dummy's knees at 210 mm to 220 mm (8.26 to 8.66 in), with the thighs and legs of the dummy in vertical planes.

12.6 Push rearward on the dummy's knees to force the pelvis into the seat so there is no gap between the pelvis and the seat back or until contact occurs between the back of the dummy's calves and the front of the seat cushion. If needed, extend the legs slightly so that the feet are not in contact with the floor pan. Let the thighs rest on the seat cushion to the extent permitted by the foot movement.

12.7 Recline dummy so that the back is in contact with the seat back

12.8 Holding the thighs in place rotate the seat back forward until the head tilt sensor reads 0 degrees (+/- 1 degrees) about the Y-Axis. As seatback adjustment is made, the test dummy should periodically be leaned slightly forward (using the back or shoulders of the dummy not the head) and pressed back against the seat in order to avoid binding with the test dummy's back and vehicle seatback. Monitor all tilt sensors as you rotate the test dummy forward with the seatback; maintain the tilt sensors about the X-axis to be at 0 (+/- 1 degree). Verify the test dummy's shoulders are not twisted and are sitting square.

12.9 Adjust the test dummy to set the pelvis tilt sensor to the following angles:

Erect Posture position:

About the X-axis = 0 degrees +/- 1 degrees

About the Y-axis = 20 degrees +/- 2.5 degrees.

Slouch Posture position:

About the X-axis = 0 degrees +/- 1 degrees

About the Y-axis = 25 degrees +/- 2.5 degrees

12.9.1. Adjust the test dummy's pelvis angle as close to desired angle as possible while keeping the head level. X-axis tilt sensors should be 0 (+/- 1 degree)

*The priority order of adjustment angles is head angle then pelvis angle.

12.10 After adjusting the test dummy, press rearward on the shoulders again to ensure that it is in the rearmost rotated position with maximum seat back interaction.

12.10.1. Verify the test dummy's shoulders are not twisted and the test dummy is sitting square in the seat

12.11 Lift the feet the minimal amount needed to slide the seat forward (using only the control that moves the seat fore and aft) to the full forward position or first contact with the dash. Verify the seat position with the SCRP point.

12.12 Is there interference between the dummy's knees and the interior before reaching the full forward position?

__No, go to step 13

__Yes, continue to step 12.12.1

12.12.1. Without taking the pelvis and head out of tolerance, can the knees be adjusted (i.e. vertically or laterally)

__No, go to step 12.14

__Yes, adjust as necessary and go back to step 12.12.2

12.12.2. Proceed with moving the seat forward until either the leg contacts the vehicle interior, or the seat reaches the foremost position found in step 6.10.

Is there contact with the knee bolster or interior before reaching full forward position found in step 6.10?

__No, go to step 13

__Yes, go to step 12.12.3

12.12.3. Can the pelvis be pushed back against the seat back any further?

__No, go to step 12.13

__Yes, adjust test dummy and go back to step 12.12 and repeat steps.

12.13 If a dummy leg contacts the vehicle interior before the foremost position is attained, position the seat at the next detent at which there is no contact. If the seat is a power seat, move the seat fore and aft to avoid contact while assuring that there is a maximum of 5 mm (0.2 in) distance between the vehicle interior and the point on the dummy that would first contact the vehicle interior.

13. Final Dummy Positioning

The priority order of the adjustment angles is head angle then pelvis angle.

13.1 Verify/Measure the pelvis angle using the tilt sensor installed in the test dummy.

<u>Erect Posture</u> position:

About the X-axis = 0 degrees +/- 1 degree

About the Y-axis = 20 degrees +/- 2.5 degrees.

<u>Slouch Posture</u> position:

About the X-axis = 0 degrees +/- 1 degree

About the Y-axis = 25 degrees +/- 2.5 degrees

Are the pelvis angles within specification?

__No, adjust the test dummy a minimal amount needed to achieve the specifications as described in 13.1 and go to step 13.2

__Yes, go to step 13.2

13.2 Verify/Measure the head angle using tilt sensor installed in the test dummy. Verify the head angles are 0°±1° (about the X-axis) and 0° ± 1° (about the Y-axis)

13.2.1 Is the head touching the head restraint?

__No, go to step 13.2.2

__Yes, without moving the pelvis, rotate dummy about the hip leaning forward and reposition the dummy against the seat back. (Do not adjust head by rotating about the neck or pulling forward on the head) Verify the test dummy's shoulders are not twisted and are sitting square. If the head is still in contact with the head restraint, go to step 13.2.2

13.2.2 Are the head angles within specification?

__No, adjust seatback angle and go back to Step 13.1

__Yes, go to Step 13.3

13.3 Passenger Foot Positioning

13.3.1. Set the foot perpendicular to the leg and place it as far forward as possible with the heel resting on the floor pan and allow the foot to remain in its natural relaxed foot position (i.e plantar flexion) with the heel on the floor pan as far forward as possible.

13.3.2. If the heels do not touch the floor pan, set the legs as perpendicular to the thighs as possible and, allow the foot to remain in its natural relaxed foot position (i.e plantar flexion) and as parallel to floorpan as possible.

14. Arm and belt placement

14.1 Is the seat belt used for this test? Verify it is in the required position (Step 13).

___Yes, go to step 14.1.1

___No, go to step 14.2

14.1.1. Fasten the seat belt around the test dummy and fasten the buckle. Ensure that the test dummy's head remains as level as possible

14.1.2. Remove all slack from the lap belt portion.

14.1.3. Pull the upper torso webbing out of the retractor and allow it to retract; repeat this four times.

Apply a 2 to 4-pounds of (9-18N) tension load to the lap and shoulder belt

____measurement of load applied

14.1.4. Is the belt system equipped with a tension-relieving device?

___Yes, go to step 14.1.4.1

___No, go to step 14.2

14.1.4.1. Introduce the maximum amount of slack into the upper torso belt that is recommended by the vehicle manufacturer in the vehicle owner's manual.

14.2 Place the right and left upper arms adjacent to the torso with the centerline as close to a vertical plane as possible

14.3 Place the palms of the dummy in contact with the outer part of the thighs

14.4 Place the little fingers in contact with the seat cushion

15. Record the final positions of the following in addition to the ATD measurements as required:

15.1 Final SCRP (it is suggested to use a CMM)
15.2 Head Restraint Post Angle

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APPENDIX G

RESEARCH REFERENCE MEASUREMENTS AND DESCRIPTIONS

RESEARCH REFERENCE MEASUREMENTS AND DESCRIPTIONS

RESEARCH REFERENCE OVERVIEW

This appendix provides details and test reference material for targets, accelerometer placement, and key measurements for the data sheets in the report. Some of these descriptions were taken from a draft research frontal test procedure and applied to this test series with some additional clarifications.

TEST VEHICLE AT LEVEL CONDITION

Note: Attention should be paid to the requirement within certain checklists that steps are performed in relation to the vehicle's TVLC orientation. If the vehicle is not on jack stands, attention must be paid to the orientation of the vehicle defined by the TVLC setup.

Reference Figure 1 as the following steps are completed.

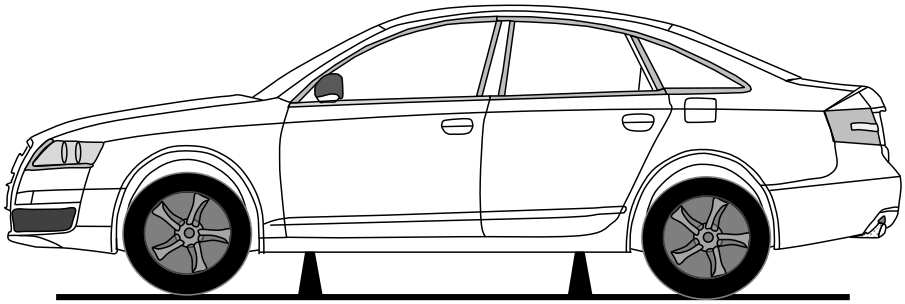


Figure 1: Vehicle in TVLC

STEP A.1.1 ☐ With the vehicle in the As Delivered/UVW condition, place it on a flat, level surface.

STEP A.1.2 ☐ Place a vehicle jack at each of the manufacturer's recommended positions.

STEP A.1.3 ☐ Raise each jack until the following conditions are met:

1) Push any point of the test vehicle and the test vehicle body does not move
2) Check to make sure the bottom of the left sill is parallel to the ground.
3) Check to make sure the bottom of the right sill is parallel to the ground.
4) Check to make sure the bottom of the left sill relative to the right sill is parallel to the ground

VEHICLE COORDINATE SYSTEM

Note: The Vehicle Coordinate System (VHC) applies to all data tables unless specified otherwise. Reference Figure 2 as the following steps are completed.

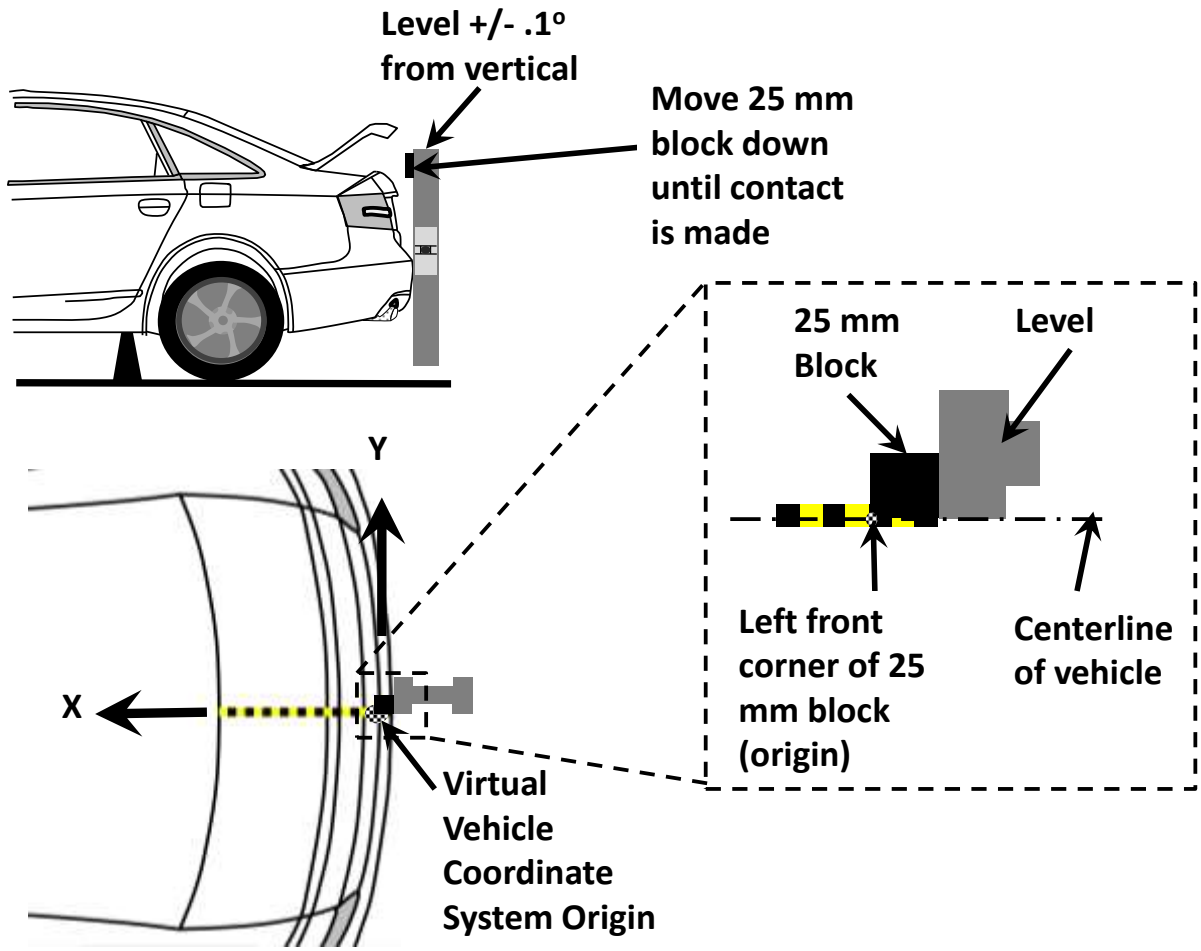


Figure 2: Determination of vehicle coordinate system

STEP A.1.4 ☐ Make sure that steps are performed in relation to the vehicle's TVLC orientation.

STEP A.1.5 ☐ Place the center of 25 mm checkerboard tape down the centerline of the vehicle from the bottom of the front bumper to the bottom of the rear bummper

Note: Do not put any tape on the windshield and back window

STEP A.1.6 ☐ Open the trunk or hatchback. For a pickup truck, leave the rear gate shut.

STEP A.1.7 ☐ Position a level behind the vehicle so it is perpendicular to the floor and the left edge of the level is aligned with the longitudinal centerline of the test vehicle

STEP A.1.8 ☐ Move the level longitudinally toward the rear of the vehicle until it makes contact with the vehicle. Ensure that the level is vertical (within +/- .1°)

STEP A.1.9 ☐ Slide a 25 mm deep block downward along the front edge of the level and aligned with the left edge of level until it contacts the vehicle at the vehicle centerline and mark this point. This is the origin of the "Vehicle Coordinate System" (VCS). Note: This point does not have to be on a solid surface.

STEP A.1.10 ☐ Create a VCS using a coordinate measuring machine (CMM) where the following conditions are met:

1. Positive X - From the back of the vehicle to the front of the vehicle.
2. Positive Y - From the driver side of the vehicle to the passenger side of the vehicle.
3. Positive Z - From the top of the vehicle to the bottom of the vehicle.
4. The XY plane is parallel to the ground and passes through the origin of the VCS.
5. The XZ plane is vertical and passes through the longitudinal centerline of the vehicle and the origin of the VCS.

STEP A.1.11 ☐ Using the CMM, verify that the centers of the center left and right strikers are symmetric and the car is level. Record the X, Y, and Z values of each striker (Figure 3) with respect to the origin of the VCS

STEP A.1.12 ☐ Create a set of widely distributed reference points on a part of the vehicle that will not deform. These reference points shall be used to reestablish the VCS so the intrusion points can be measured following the test.

Figure 3: Example of the center of the striker

TEST VEHICLE SIDE TARGETING

Reference Figure 4 as the following steps are completed

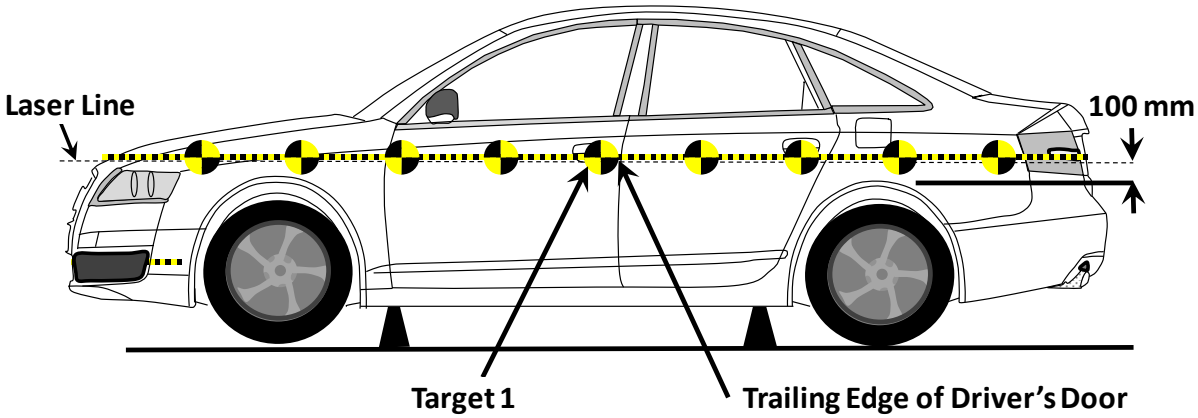


Figure 4: Driver side targeting of test vehicle

STEP A.1.13 ☐ Make sure that steps are performed in relation to the vehicle's TVLC orientation.

STEP A.1.14 ☐ Apply 25 mm wide checkerboard tape horizontally down both sides of the vehicle with the bottom edge of the tape 100 mm above rear wheel well opening with the bottom edge of the tape aligned with the laser line

STEP A.1.15 ☐ On the driver's side of the vehicle, apply a 152 mm non-glare target such that the edge of the target is aligned with the trailing edge of the driver's front door. The center of this target shall also be aligned with the center of the 25 mm checkerboard tape

STEP A.1.16 ☐ Apply 152 mm non-glare targets at 450 mm intervals (center to center) from this target towards both the front and rear of the vehicle. No targets shall be applied less than 450 mm apart

STEP A.1.17 ☐ Repeat STEP A.1.14 through STEP A.1.16on the ride side of the vehicle

TARGETS TOP OF ROOF

Reference Figure 5 as the following steps are completed

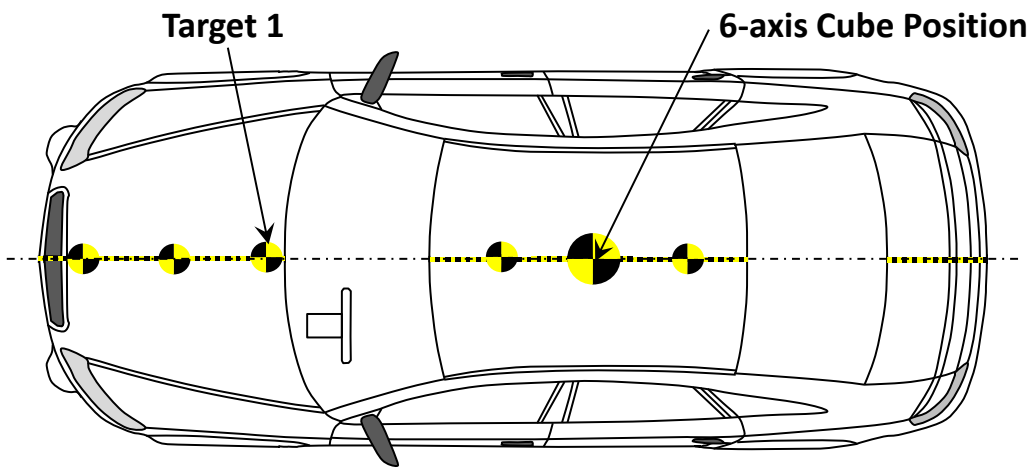


Figure 5: Placement of targets on top of the vehicle

STEP A.1.18 ☐ Make sure that steps are performed in relation to the vehicle's TVLC orientation.

STEP A.1.19 ☐ Determine the X distance from the origin of the VCS to the point that is 100 mm behind the center console

STEP A.1.20 ☐ Apply the center of a 250 mm non-glare target at the x distance from the origin of the VCS on the roof

STEP A.1.21 ☐ Apply 152 mm non-glare targets 450 mm from the center of the 6-axis target toward the front of the vehicle on the roof of the vehicle

Note: No target shall be applied less than 450 mm apart

STEP A.1.22 ☐ Apply 152 mm non-glare targets 450 mm from the center of the 6-axis target toward the back of the vehicle on the roof of the vehicle

Note: No target shall be applied less than 450 mm apart

STEP A.1.23 ☐ Apply 152 mm non-glare target such that the right edge of the target is aligned with the edge of the hood at the centerline of the vehicle (Target 1)

STEP A.1.24 ☐ Apply 152 mm non-glare targets 450 mm from the center of the Target 1 toward the front of the vehicle on the hood of the vehicle

Note: No target shall be applied less than 450 mm apart

DRIVER INTERIOR INTRUSION POINTS

Note: Make sure that steps are performed in relation to the vehicle's TVLC orientation, and the X, Y, and Z points are relative to the VCS. All points are recorded in the seating tables.

Reference Figure 6 and 7 below when following the steps listed.

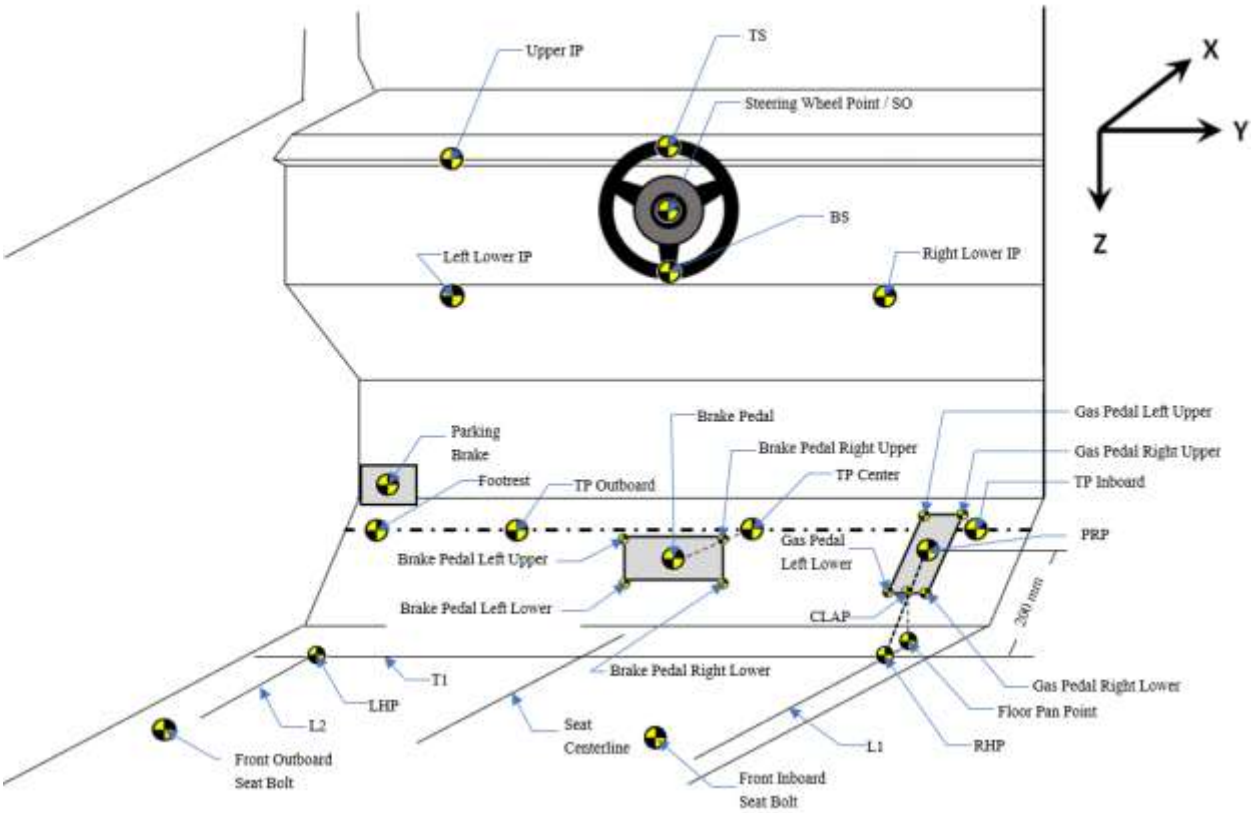


Figure 6: Driver interior intrusion points

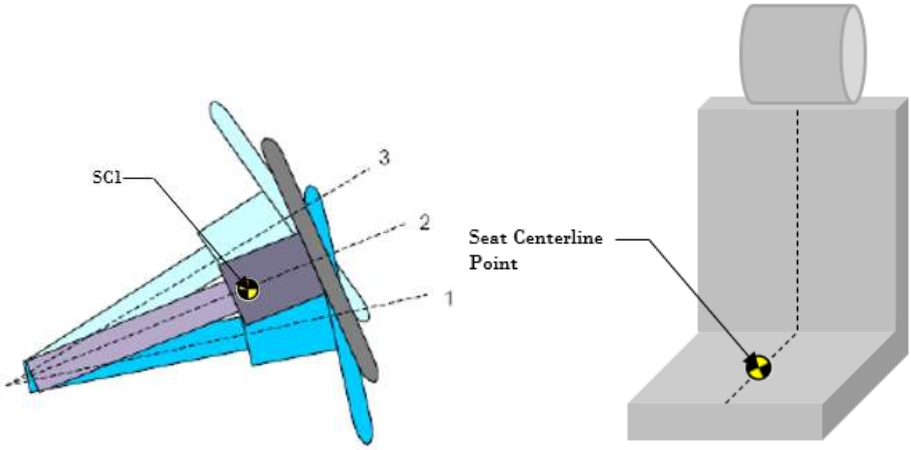


Figure 7: Steering wheel position and seat centerline

Driver Front Outboard Seat Bolt

STEP A.1.1.1 ☐ Create and record the center of driver front outboard seat bolt

Note: If no bolt is present, create and measure a point at the center of the front of the outboard seat track.

Driver Front Inboard Seat Bolt

STEP A.1.1.2 ☐ Create and record the center of driver front inboard seat bolt

Note: If no bolt is present, create and measure a point at the center of the front of the outboard seat track.

Driver Rear Outboard Seat Bolt

STEP A.1.1.3 ☐ Create and record the center of driver rear outboard seat bolt

Note: If no bolt is present, create and measure a point at the center of the front of the outboard seat track.

Driver Rear Inboard Seat Bolt

STEP A.1.1.4 ☐ Create and record the center of driver rear inboard seat bolt

Note: If no bolt is present, create and measure a point at the center of the front of the outboard seat track.

Steering Wheel Point (SO)

STEP A.1.1.5 ☐ Create and record Steering Wheel Point which is the point located on the outer surface of the steering wheel hub (air bag cover) at the geometric center of the steering wheel

Top Steering Wheel Point (TS)

STEP A.1.1.6 ☐ Create and record Steering Wheel Point which is taken on the highest point on the steering wheel at the same Y coordinates as S0

Bottom Steering Wheel Point (BS)

STEP A.1.1.7 ☐ Create and record Steering Wheel Point which is taken on the lowest point on the steering wheel at the same Y coordinates as S0

Steering Column Point 1 (SC1)

STEP A.1.1.8 ☐ Create and record the point on the center of the steering column when the steering column is at the geometric center of full range of driving positions including any telescoping positions.

Floor Pan Point

STEP A.1.1.9 ☐ Create and record the Floor Pan Point using the following Steps:

STEP A.1.1.10 ☐ If the vehicle has an accelerator pedal with fore-aft adjustment, adjust the pedal to its forward most position.

STEP A.1.1.11 ☐ Remove floor mats

STEP A.1.1.12 ☐ Locate the centerline of the top surface at the bottom of the accelerator pedal. Create and record the **(CLAP)**

STEP A.1.1.13 ☐ Project a vertical line down from the CLAP point until contact is made to the floor. Create and record the **Floor Pan Point**.

STEP A.1.1.14 ☐ Create and record the **Brake Pedal Point**, which is the point located at the geometric center of the brake pedal

Driver Left Lower IP Point

STEP A.1.1.15 ☐ Create and record the Driver Left Lower IP Point using the following steps:

STEP A.1.1.16 ☐ The lateral coordinate of Left Lower IP Point (knee bolster) is 15 cm outboard of the Steering Wheel Point in the lateral direction.

STEP A.1.1.17 ☐ The vertical coordinate is 45 cm above the Floor Pan Reference Point

STEP A.1.1.18 ☐ The longitudinal coordinate of the Left Lower IP Point is created by holding the lateral and vertical position constant and moving in the longitudinal direction until the Left IP is contacted.

Driver Right Lower IP

Create and record the Driver Right Lower IP Point using the following steps:

STEP A.1.1.19 ☐ The lateral coordinate of Right Lower IP Point (knee bolster) is 15 cm inboard of the Steering Wheel Point in the lateral direction.

STEP A.1.1.20 ☐ The vertical coordinate is 45 cm above the Floor Pan Reference Point

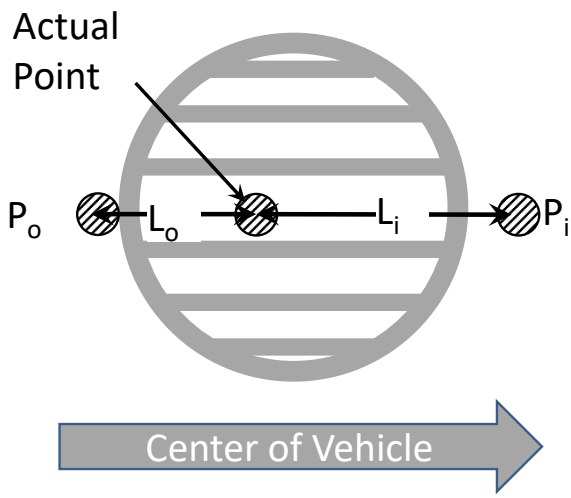
STEP A.1.1.21 ☐ The longitudinal coordinate of the Left Lower IP Point is created by holding the lateral and vertical position constant and moving in the longitudinal direction until the Left IP is contacted.

Create and measure the Driver Upper IP Point:

Create and record the Driver Upper IP Point using the following steps:

STEP A.1.1.22 ☐ Create a XZ plane the passes through the Left Lower IP point

STEP A.1.1.23 ☐ At a height greater than 30 cm above the Brake Pedal Point, find the rearward most (toward the rear of the vehicle) point on the Upper IP that lies on the XZ plane.



$$dp = \frac{L_i}{L_o+L_i}[X_0, Y_0, Z_0] + \frac{L_0}{L_o+L_i}[X_1, Y_1, Z_1] \qquad (1)$$

Parking Brake Pedal Point

STEP A.1.1.24 ☐ Create and record the parking brake pedal point, which is the geometric center of the parking brake pedal (top surface) when not engaged

Driver Footrest

STEP A.1.1.25 ☐ Create and record the Driver Footrest Point using the following steps:

STEP A.1.1.26 ☐ The lateral coordinate of Driver Footrest Point is 25 cm outboard from the Brake Pedal Point

STEP A.1.1.27 ☐ The vertical coordinate is at the same Z height as the Brake Pedal Point

STEP A.1.1.28 ☐ The longitudinal coordinate of the Driver Footrest Reference Point is created by the lateral and vertical coordinates defined above held constant and moving in the longitudinal direction until the toepan is contacted

Driver Outboard Toepan Point (TP Outboard)

STEP A.1.1.29 ☐ Create and record the Driver Footrest Point using the following steps:

STEP A.1.1.30 ☐ The lateral coordinate of TP Outboard Point is 15 cm outboard from the Brake Pedal Reference Point.

STEP A.1.1.31 ☐ The vertical coordinate of the TP Outboard Point is at the same height as the Brake Pedal Reference Point.

STEP A.1.1.32 ☐ The longitudinal coordinate of the TP Outboard Point is created by the lateral and vertical coordinates defined above held constant and moving in the longitudinal direction until the toepan is contacted.

Driver Center Toepan Point (TP Center)

Create and record the Driver Center Point using the following steps:

STEP A.1.1.33 ☐ The lateral coordinate of TP Outboard Point is 0 cm outboard from the Brake Pedal Reference Point.

STEP A.1.1.34 ☐ The vertical coordinate of the TP Outboard Point is at the same height as the Brake Pedal Reference Point.

STEP A.1.1.35 ☐ The longitudinal coordinate of the TP Outboard Point is created by the lateral and vertical coordinates defined above held constant and moving in the longitudinal direction until the toepan is contacted.

Driver Inboard Toepan Point (TP Inboard)

Create and record the Driver Inboard Point using the following steps:

STEP A.1.1.36 ☐ The lateral coordinate of TP Outboard Point is 15 cm inboard from the Brake Pedal Point.

STEP A.1.1.37 ☐ The vertical coordinate of the TP Outboard Point is at the same height as the Brake Pedal Reference Point.

STEP A.1.1.38 ☐ The longitudinal coordinate of the TP Outboard Point is created by the lateral and vertical coordinates defined above held constant and moving in the longitudinal direction until the toepan is contacted.

Pedal Reference Point (PRP)

Create and record the Pedal Reference Point using the following steps:

STEP A.1.1.39 ☐ Taken at the center point of suspended accelerator pedal or center width and 75% height for floor mounted pedals

Right Heel Point (RHP)

STEP A.1.1.40 ☐ Create and record the right heel point, which is the projected point on the floor pan from PRP

STEP A.1.1.41 ☐ Create and record the **left heel point (LHP)**, which is the projected point on the floor pan from RHP

Gas Pedal Points

STEP A.1.1.42 ☐ Create and record the right and left upper and lower corners of the accelerator pedal.

Brake Pedal Points

STEP A.1.1.43 ☐ Create and record the right and left upper and lower corners of the brake pedal.

Seat Centerline Point

STEP A.1.1.44 ☐ Create and record a point on the center of the center of the driver seat centerline

PASSENGER INTERIOR INTRUSION POINTS

Note: Make sure that steps are performed in relation to the vehicle's TVLC orientation, and the X, Y, and Z points are relative to the VCS. All points are recorded in the seating tables.

Reference Figure 8 as the following steps are completed.

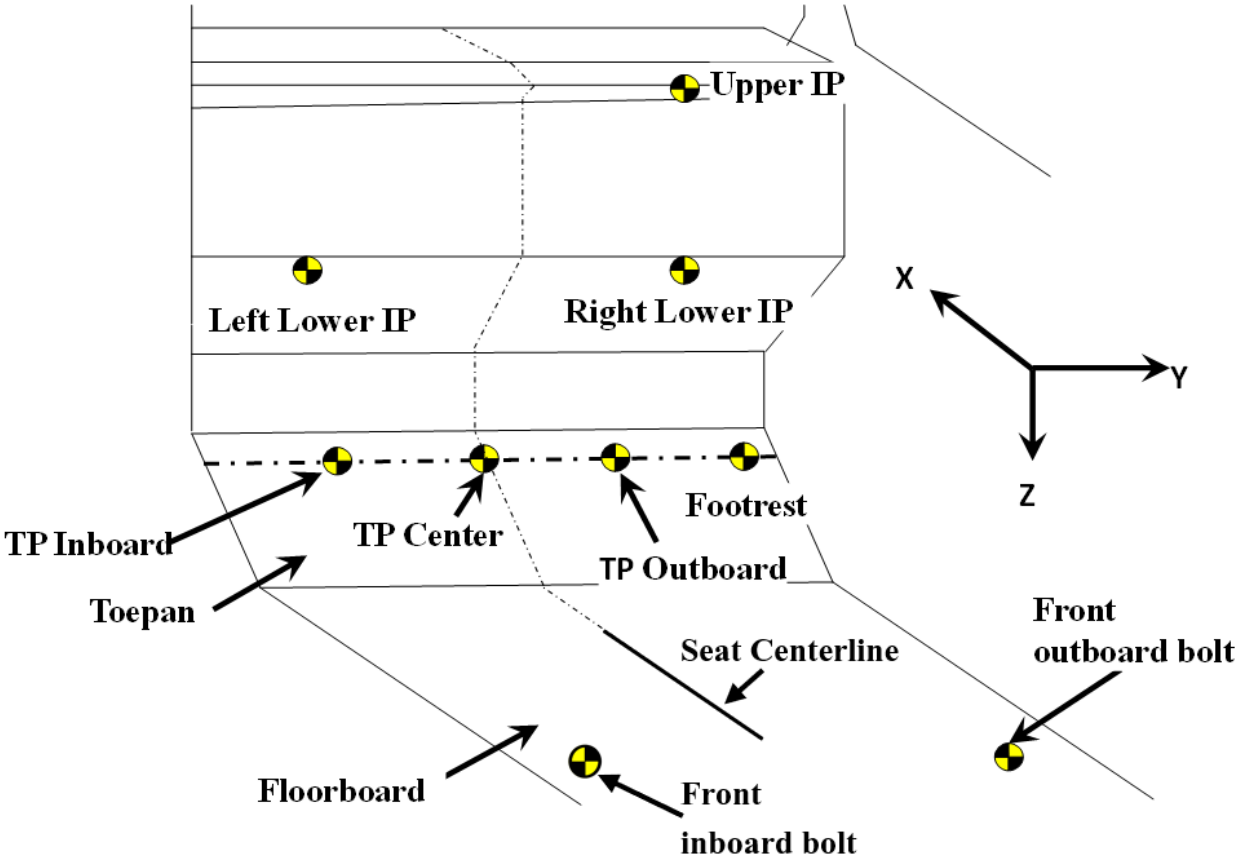
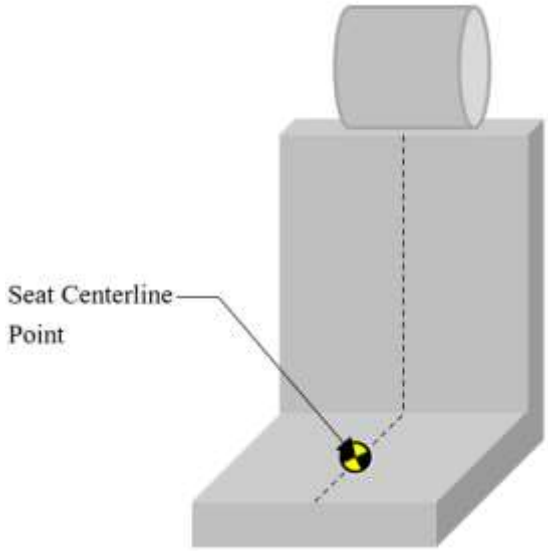


Figure 8: Passenger interior intrusion points



Passenger Front Outboard Seat Bolt

STEP A.1.1.45 ☐ Create and record the center of passenger front outboard seat bolt

Note: If no bolt is present, create and measure a point at the center of the front of the outboard seat track.

Passenger Front Inboard Seat Bolt

STEP A.1.1.46 ☐ Create and record the center of passenger front inboard seat bolt

Note: If no bolt is present, create and measure a point at the center of the front of the outboard seat track.

Passenger Rear Outboard Seat Bolt

STEP A.1.1.47 ☐ Create and record the center of passenger rear outboard seat bolt

Note: If no bolt is present, create and measure a point at the center of the front of the outboard seat track.

Passenger Rear Inboard Seat Bolt

STEP A.1.1.48 ☐ Create and record the center of passenger rear inboard seat bolt

Note: If no bolt is present, create and measure a point at the center of the front of the outboard seat track.

Passenger Left Lower IP Point

STEP A.1.1.49 ☐ Create and record the Passenger Left Lower IP Point using the following steps:

STEP A.1.1.50 ☐ The lateral coordinate of Left Lower IP Point (knee bolster) is 15 cm inboard of the centerline of front passenger seat in the lateral direction.

STEP A.1.1.51 ☐ The vertical coordinate is 45 cm above the driver side Floor Pan Reference Point

STEP A.1.1.52 ☐ The longitudinal coordinate of the Left Lower IP Point is created by holding the lateral and vertical position constant and moving in the longitudinal direction until the Left IP is contacted.

Passenger Right Lower IP

STEP A.1.1.53 ☐ Create and record the Passenger Right Lower IP Point using the following steps:

STEP A.1.1.54 ☐ The lateral coordinate of Right Lower IP Point (knee bolster) is 15 cm outboard of the centerline of front passenger seat in the lateral direction.

STEP A.1.1.55 ☐ The vertical coordinate is 45 cm above the driver side Floor Pan Reference Point

STEP A.1.1.56 ☐ The longitudinal coordinate of the Left Lower IP Point is created by holding the lateral and vertical position constant and moving in the longitudinal direction until the Left IP is contacted.

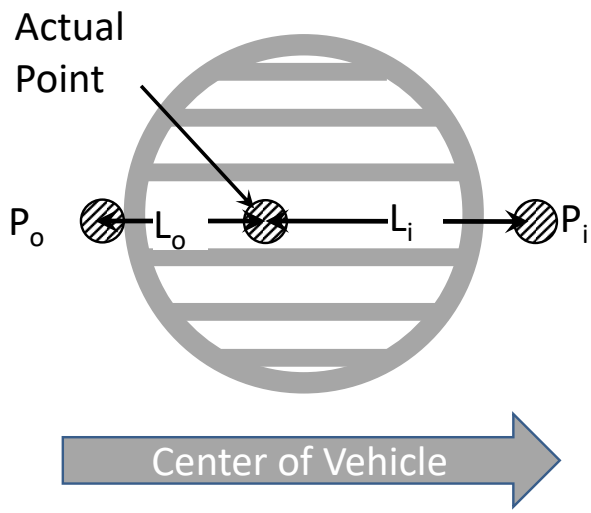
Create and measure the Passenger Upper IP Point:

STEP A.1.1.57 Create and record the Passenger Upper IP Point using the following steps:

STEP A.1.1.58 ☐ Create a XZ plane the passes through the Right Lower IP point

STEP A.1.1.59 ☐ At a height greater than 30 cm above the Brake Pedal Point, find the rearward most (toward the rear of the vehicle) point on the Upper IP that lies on the XZ plane.

NOTE: There may be instances when the upper dash point is located on a "soft component" such as an air vent or control knob (Figure E-12). To measure a more robust structure, the upper dash point is replaced with two additional points, and the weighted average of their coordinates is used to represent the deformation of a point at the original location (Equation 1). Each new point is determined by moving inboard/outboard to a location that is just off of the soft component.



$$dp = \frac{L_i}{L_o+L_i}[X_0, Y_0, Z_0] + \frac{L_o}{L_o+L_i}[X_1, Y_1, Z_1] \qquad (1)$$

Passenger Footrest

STEP A.1.1.60 ☐ Create and record the Passenger Footrest Point using the following steps:

STEP A.1.1.61 ☐ The lateral coordinate of Passenger Footrest Point is 25 cm outboard from the Seat Centerline

STEP A.1.1.62 ☐ The vertical coordinate is at the same Z height as the Brake Pedal Point

STEP A.1.1.63 ☐ The longitudinal coordinate of the Passenger Footrest Reference Point is created by the lateral and vertical coordinates defined above held constant and moving in the longitudinal direction until the toepan is contacted

Passenger Outboard Toepan Point (TP Outboard)

STEP A.1.1.64 ☐ Create and record the Passenger Outboard Toepan Point using the following steps:

STEP A.1.1.65 ☐ The lateral coordinate of TP Outboard Point is 15 cm outboard from the seat centerline.

STEP A.1.1.66 ☐ The vertical coordinate of the TP Outboard Point is at the same height as the Brake Pedal Reference Point.

STEP A.1.1.67 ☐ The longitudinal coordinate of the TP Outboard Point is created by the lateral and vertical coordinates defined above held constant and moving in the longitudinal direction until the toepan is contacted.

Passenger Center Toepan Point (TP Center)

STEP A.1.1.68 ☐ Create and record the Passenger Center Point using the following steps:

STEP A.1.1.69 ☐ The lateral coordinate of TP Center Point is 0 cm outboard from the Seat Centerline.

STEP A.1.1.70 ☐ The vertical coordinate of the TP Center Point is at the same height as the Brake Pedal Reference Point.

STEP A.1.1.71 ☐ The longitudinal coordinate of the TP Center Point is created by the lateral and vertical coordinates defined above held constant and moving in the longitudinal direction until the toepan is contacted.

Passenger Inboard Toepan Point (TP Inboard)

STEP A.1.1.72 ☐ Create and record the Passenger Inboard Point using the following steps:

STEP A.1.1.73 ☐ The lateral coordinate of TP Inboard Point is 15 cm inboard from the Seat Centerline.

STEP A.1.1.74 ☐ The vertical coordinate of the TP Inboard Point is at the same height as the Brake Pedal Reference Point.

STEP A.1.1.75 ☐ The longitudinal coordinate of the TP Inboard Point is created by the lateral and vertical coordinates defined above held constant and moving in the longitudinal direction until the toepan is contacted.

Seat Centerline Point

STEP A.1.1.76 ☐ Create and record a point on the center of the center of the driver seat centerline

DOOR PROFILES

Make sure that steps are performed in relation to the vehicle's TVLC orientation and the X, Y, and Z points are relative to the VCS. The Contractor is only required to record points 1, 2, 3, 5, 6, 7, 19 and 20. All points are recorded in the seating tables.

Reference Figure 9 as the following steps are completed.

Note: Mark the following points on the pinch weld of the door frame.

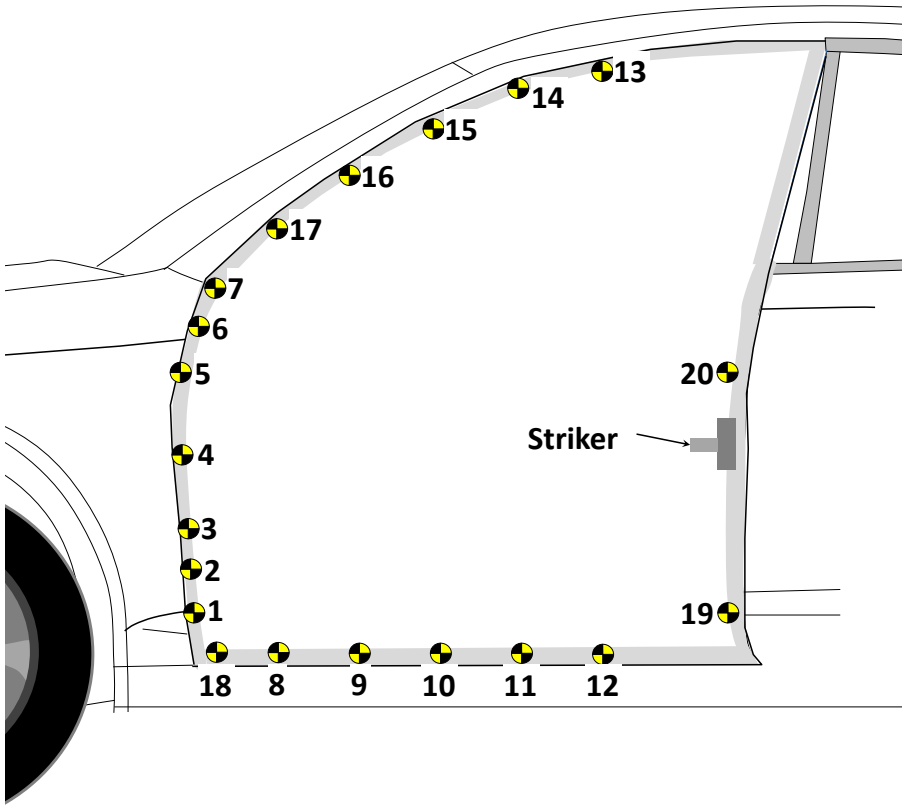


Figure 9: Door profiles

STEP A.1.25 ☐ Make sure that steps are performed in relation to the vehicle's TVLC orientation.

STEP A.1.26 ☐ Create and measure Point 1: The vertical coordinate of this point is at the same Z height as the center of the brake pedal.

STEP A.1.27 ☐ Create and measure Point 2: The vertical coordinate of this point is 7.5 cm above the Z height of the center of the brake pedal.

STEP A.1.28 ☐ Create and measure Point 3: The vertical coordinate of this point is 15 cm above the Z height of the center of the brake pedal.

STEP A.1.29 ☐ Create and measure Point 5: The vertical coordinate of this point is 45 cm above the Brake Pedal Reference Point

STEP A.1.30 ☐ Create and measure Point 6: The vertical coordinate of this point is 52.5 cm above the Z height of the center of the brake pedal

STEP A.1.31 ☐ Create and measure Point 7: The vertical coordinate of this point is 60 cm above the Z height of the center of the brake pedal

STEP A.1.32 ☐ Create and measure Point 19: This point is at the same height as the Brake Pedal Reference Point.

STEP A.1.33 ☐ Create and measure Point 20: The vertical coordinates of this point is 45 cm above the Brake Pedal Reference Point.

STEP A.1.34 ☐ Mark and measure the center of the striker

STEP A.1.35 ☐ Repeat STEP A.1.25 through STEP A.1.34 on the passenger side door opening.

DOOR OPENING AND WHEELBASE

Reference Figure 10 as the following steps are completed. All points are recorded in the seating tables.

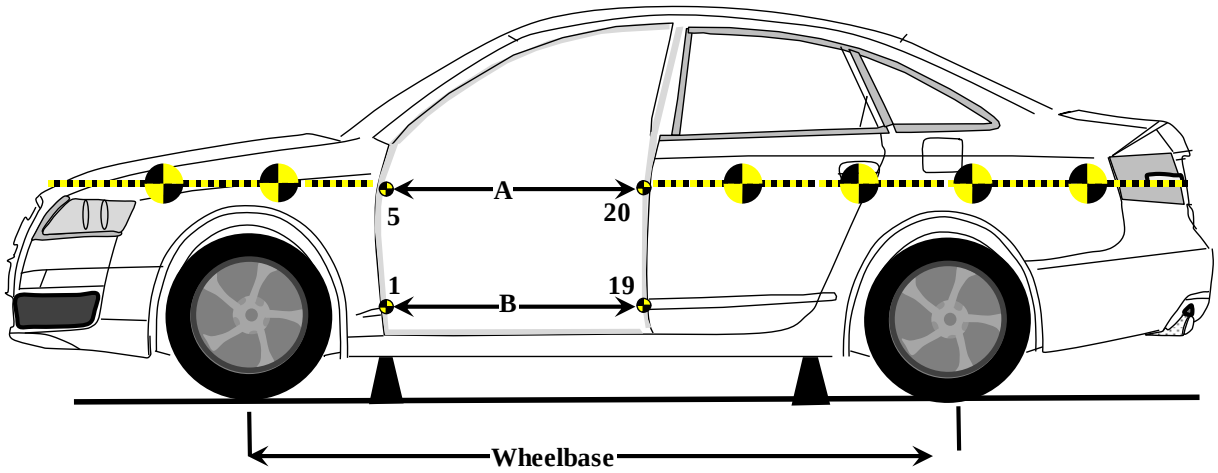


Figure 10: Door opening and wheelbase

STEP A.1.36 ☐ A is calculated by subtracting the X distance of point 20 minus point 5 of the driver's door

STEP A.1.37 ☐ B is calculated by subtracting the X distance of point 19 minus point 1 of the driver's door

STEP A.1.38 ☐ Measure from the center of the front tire to the center of the rear tire on the driver's side (Wheelbase)

☐ Perform the same calculations and measurements on the passenger