

**Vehicle Research and Test Center
Eval of ATD
LODC**

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Summary Report

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**Prepared For
Vehicle Research and Test Center
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SECTION 1
PURPOSE AND SUMMARY FOR LODC

The purpose of this test series was to dynamically evaluate the proposed seating procedure for the LODC ATD on the FMVSS 213 test bench.

SUMMARY

The LODC was seating and secured on the passenger side position of the 213 buck. The LODC was instrumented with triaxial accelerometers (head, T1, T6, T12 and pelvis), angular rate sensors (head, T1, T6, T12 and pelvis), upper/lower neck force and moment, chest displacement, lumbar force and moment, ASIS force, and abdomen pressure (right and left). During this test series the dummy was restrained with a 3-point seatbelt.

Section 2 contains the testing performed using a belt positioning booster CRS in the right rear seating position. Section 3 contains the dummy certification information.

SECTION 2
LEFT SIDE 213 BUCK TEST SUMMARY

TEST DUMMY INFORMATION

Description	Position # 3
ATD Type/Serial No.	LODC / 003
Restraint System	3-Point Seatbelt
CRS Direction	Forward Facing
Foam Cushion	WB8, WB16

CAMERA POSITIONING FARO MEASUREMENTS

Description	Units	X	Y	Z
Origin	mm	0.00	0.00	0.00
N5 Passenger Front	mm	--- ¹	--- ¹	--- ¹
Passenger Excursion	mm	814.24	938.93	-374.64
Passenger Side	mm	364.32	935.19	-381.72

¹ Measurements not recorded

DUMMY POSITIONING

CRS: Graco TurboBooster NB – Belt Positioning Booster – SB3PT

TRC Test Number: S220314-1

VRTC Test Number: FR_BE_12



DUMMY POSITIONING FARO MEASUREMENTS

Description	Units	X	Y	Z
Z-Point	mm	-0.11	-0.15	-0.02
Center of the seat frame bottom	mm	615.70	-349.88	-102.81
CRS base center	mm	505.97	-349.15	-256.44
Center of seat frame back	mm	-165.77	-350.72	-829.36
Top of the head	mm	111.61	-350.61	-873.93
Bridge of nose	mm	179.35	-352.30	-789.74
Head CG outboard	mm	99.18	-282.76	-783.17
Neck center	mm	93.50	-351.76	-663.17
Knee Outer	mm	525.95	-224.09	-373.25
Right knee top	mm	547.57	-262.87	-418.89
Left knee top	mm	551.15	-444.39	-418.62
Ankle Outer	mm	676.98	-245.11	-119.95
CRS 2	mm	199.77	-152.54	-260.65
CRS 3	mm	435.64	-148.74	-235.74
Shoulder belt top	mm	173.70	-350.26	-598.39
Shoulder belt bottom	mm	213.20	-350.64	-519.25
Lap belt top	mm	276.53	-350.15	-388.05
Lap belt bottom	mm	312.06	-350.55	-358.08

DUMMY INJURY

HIC (36 ms)	584
HIC (15 ms)	373
Bric	0.94
NIJ Max	1.76
Neck Tension Load (N)	2973
Neck Comp Load (N)	-52
Upper Neck Fx (N)	1151
Upper Neck Fy (N)	186
Upper Neck Fz (N)	2973
Upper Neck Mx (Nm)	13.5
Upper Neck My (Nm)	-42.1
Upper Neck Mz (Nm)	3.4
Lower Neck Fx (N)	-2441
Lower Neck Fy (N)	919
Lower Neck Fz (N)	1177
Lower Neck Mx (Nm)	53.4
Lower Neck My (Nm)	150.3
Lower Neck Mz (Nm)	-4.0
Chest Clip 3ms (g) T1	42.3
Chest Clip 3ms (g) T6	43.5
Chest Clip 3ms (g) T12	47.1
Chest Deflection (mm)	54.7
ASIS Left Upper Fx (N)	-398
ASIS Left Lower Fx (N)	-1465
ASIS Right Upper Fx (N)	-267
ASIS Right Lower Fx (N)	-1480
Lumbar Fx (N)	-1527
Lumbar Fy (N)	281
Lumbar Fz (N)	-1048
Lumbar Mx (Nm)	-37.3
Lumbar My (Nm)	-50.2
Lumbar Mz (Nm)	5.4
Abdomen Left Pressure (psi)	10.2
Abdomen Right Pressure (psi)	13.1
Pelvis Resultant (g)	46
Lap Belt Load (N)	5252
Shoulder Belt Load (N)	5340
Head Excursion (mm)	500
Knee Excursion (mm)	722

DUMMY POSITIONING

CRS: Baby Trend Protect 2 in 1 – Belt Positioning Booster – SB3PT

TRC Test Number: S220315-1

VRTC Test Number: FR_BE_14



DUMMY POSITIONING FARO MEASUREMENTS

Description	Units	X	Y	Z
Z-Point	mm	0.12	-0.15	-0.11
Center of the seat frame bottom	mm	615.25	-350.88	-103.48
CRS base center	mm	534.69	-349.99	-205.35
Center of seat frame back	mm	-120.13	-350.75	-679.63
Top of seat	mm	-49.84	-350.17	-741.24
Top of headrest	mm	-62.38	-353.25	-887.18
Top of the head	mm	177.93	-350.80	-883.51
Bridge of nose	mm	244.38	-350.34	-797.79
Head CG outboard	mm	162.13	-282.44	-792.98
Neck center	mm	155.78	-350.33	-672.62
Knee Outer	mm	588.01	-226.07	-392.54
Right knee top	mm	609.97	-265.49	-438.25
Left knee top	mm	609.19	-448.76	-434.95
Ankle Outer	mm	644.51	-243.72	-101.85
CRS 1	mm	38.70	-165.82	-629.30
CRS 4	mm	140.18	-154.58	-369.52
CRS 2	mm	270.90	-112.62	-292.20
CRS 3	mm	426.22	-94.59	-251.45
Shoulder belt top	mm	238.88	-350.19	-593.20
Shoulder belt bottom	mm	274.60	-350.51	-521.88
Lap belt top	mm	335.52	-350.14	-401.29
Lap belt bottom	mm	370.32	-350.01	-370.18

DUMMY INJURY

HIC (36 ms)	417
HIC (15 ms)	197
BriC	0.84
NIJ Max	1.26
Neck Tension Load (N)	2009
Neck Comp Load (N)	-13
Upper Neck Fx (N)	875
Upper Neck Fy (N)	217
Upper Neck Fz (N)	2009
Upper Neck Mx (Nm)	15.4
Upper Neck My (Nm)	-34.5
Upper Neck Mz (Nm)	4.3
Lower Neck Fx (N)	-1595
Lower Neck Fy (N)	916
Lower Neck Fz (N)	1303
Lower Neck Mx (Nm)	73.1
Lower Neck My (Nm)	102.4
Lower Neck Mz (Nm)	-9.0
Chest Clip 3ms (g) T1	41.4
Chest Clip 3ms (g) T6	39.8
Chest Clip 3ms (g) T12	42.6
Chest Deflection (mm)	-60.2
ASIS Left Upper Fx (N)	-259
ASIS Left Lower Fx (N)	-764
ASIS Right Upper Fx (N)	-301
ASIS Right Lower Fx (N)	-788
Lumbar Fx (N)	-1687
Lumbar Fy (N)	338
Lumbar Fz (N)	-1241
Lumbar Mx (Nm)	-57.1
Lumbar My (Nm)	-87.5
Lumbar Mz (Nm)	-21.1
Abdomen Left Pressure (psi)	10.4
Abdomen Right Pressure (psi)	12.3
Pelvis Resultant (g)	50
Lap Belt Load (N)	4047
Shoulder Belt Load (N)	5777
Head Excursion (mm)	577
Knee Excursion (mm)	777

DUMMY POSITIONING

CRS: Evenflo Big Kid LX HB – Belt Positioning Booster – SB3PT

TRC Test Number: S220315-2

VRTC Test Number: FR_BE_16



DUMMY POSITIONING FARO MEASUREMENTS

Description	Units	X	Y	Z
Z-Point	mm	0.03	-0.08	-0.10
Center of the seat frame bottom	mm	615.39	-350.11	-103.96
CRS base center	mm	528.16	-349.15	-222.93
Center of seat frame back	mm	-120.19	-350.77	-679.77
Top of seat	mm	-8.72	-350.86	-685.31
Top of headrest	mm	7.30	-349.01	-934.13
Top of the head	mm	167.28	-349.27	-907.45
Bridge of nose	mm	236.22	-350.83	-823.70
Head CG outboard	mm	155.16	-281.70	-816.21
Neck center	mm	150.91	-351.45	-696.65
Knee Outer	mm	593.19	-228.31	-387.85
Right knee top	mm	620.55	-268.06	-430.88
Left knee top	mm	622.75	-445.63	-426.25
Ankle Outer	mm	643.86	-243.53	-95.58
CRS 1	mm	39.07	-186.32	-628.36
CRS 4	mm	87.98	-197.09	-359.38
CRS 2	mm	199.63	-165.92	-323.83
CRS 3	mm	371.72	-153.40	-233.08
Shoulder belt top	mm	221.02	-350.07	-643.01
Shoulder belt bottom	mm	265.01	-350.77	-573.52
Lap belt top	mm	328.75	-350.02	-436.28
Lap belt bottom	mm	366.66	-350.47	-406.33

DUMMY INJURY

HIC (36 ms)	535
HIC (15 ms)	414
BriC	0.92
NIJ Max	2.13
Neck Tension Load (N)	3995
Neck Comp Load (N)	-9
Upper Neck Fx (N)	1459
Upper Neck Fy (N)	169
Upper Neck Fz (N)	3995
Upper Neck Mx (Nm)	10.0
Upper Neck My (Nm)	-41.6
Upper Neck Mz (Nm)	1.9
Lower Neck Fx (N)	-2708
Lower Neck Fy (N)	751
Lower Neck Fz (N)	1157
Lower Neck Mx (Nm)	41.6
Lower Neck My (Nm)	185.4
Lower Neck Mz (Nm)	-3.3
Chest Clip 3ms (g) T1	39.5
Chest Clip 3ms (g) T6	42.2
Chest Clip 3ms (g) T12	43.5
Chest Deflection (mm)	-57.5
ASIS Left Upper Fx (N)	-566
ASIS Left Lower Fx (N)	-656
ASIS Right Upper Fx (N)	-407
ASIS Right Lower Fx (N)	-897
Lumbar Fx (N)	-2002
Lumbar Fy (N)	237
Lumbar Fz (N)	-1339
Lumbar Mx (Nm)	-24.7
Lumbar My (Nm)	-90.5
Lumbar Mz (Nm)	7.5
Abdomen Left Pressure (psi)	10.8
Abdomen Right Pressure (psi)	13.6
Pelvis Resultant (g)	43
Lap Belt Load (N)	4895
Shoulder Belt Load (N)	4842
Head Excursion (mm)	522
Knee Excursion (mm)	752

SECTION 3
DUMMY CALIBRATION DATA

LODC 300 mm Frontal Head Impact Qualification Test Results Summary

Dummy Serial Number: 003

Tested Components

Head: 003

Test ID: 220301-3

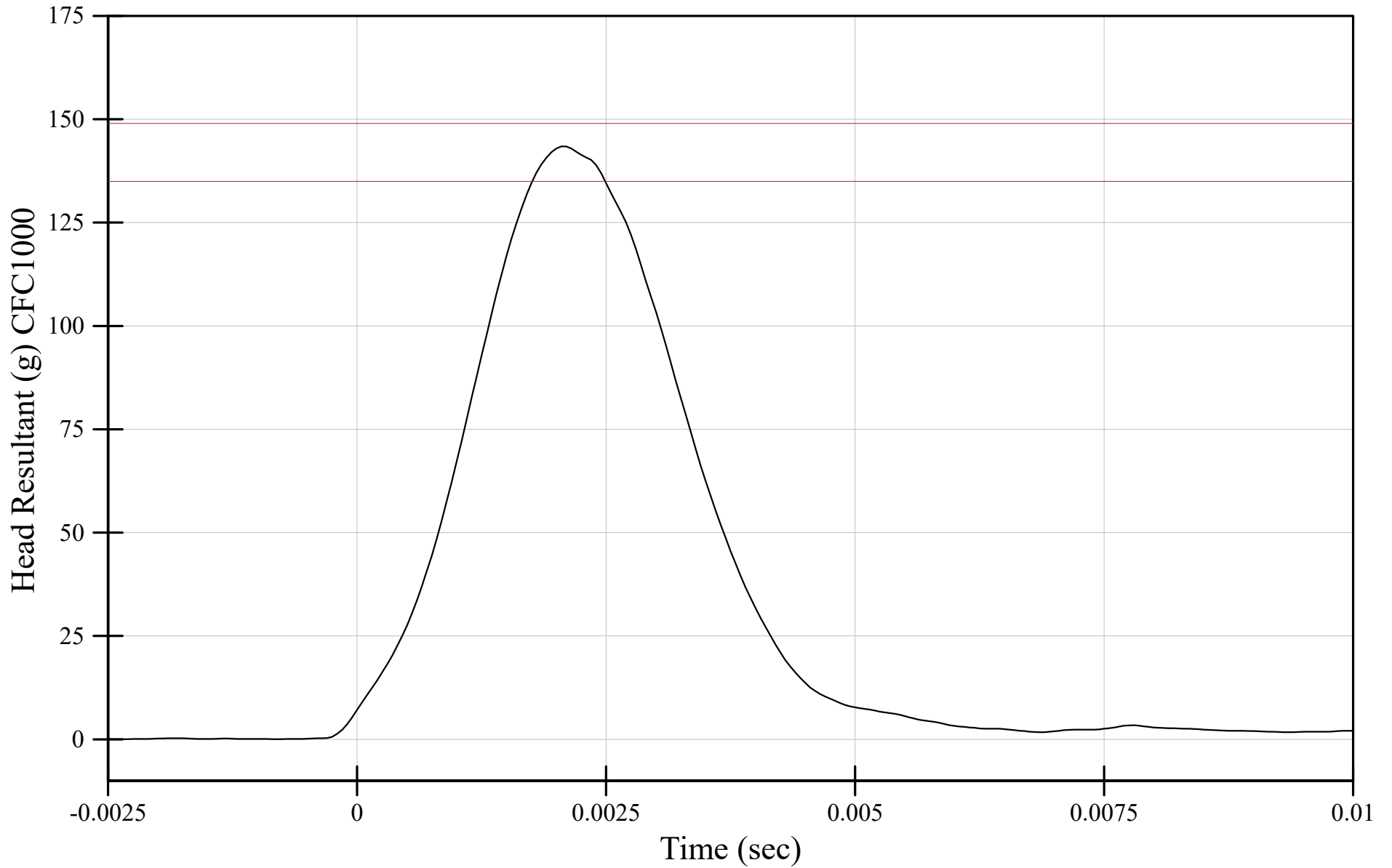
Test Date: 3/1/2022

Test Time: 1:08 PM

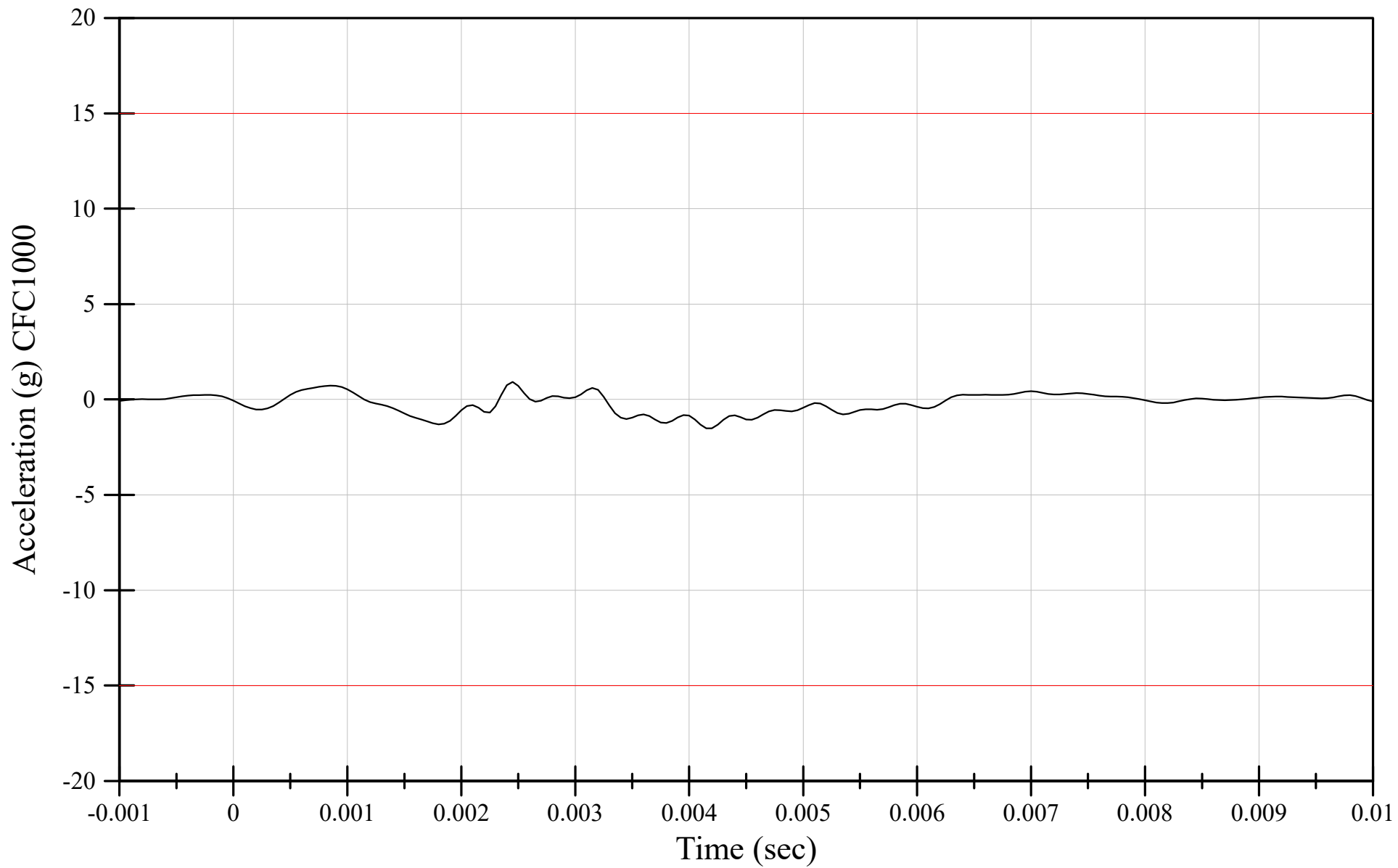
Test Results

<u>Test Parameter</u>	<u>Specification Range*</u>	<u>Result</u>	<u>Pass/Fail</u>
Test Temperature (°C)	20.6 - 22.2	21.2	Pass
Test Humidity (%)	10 - 70	47	Pass
Peak Resultant Acceleration (g)	121 - 149	143	Pass
Peak Acceleration, y-axis (g)	-15.0 - 15.0	-1.5	Pass
Oscillations occurring after the main acceleration pulse (%)	-10.0 - 10.0	2.4	Pass

LODC 300 mm Frontal Head Impact Qualification
Peak Resultant Acceleration
Head Serial Number: 003



LODC 300 mm Frontal Head Impact Qualification
Peak Lateral Y Acceleration
Head Serial Number: 003



LODC Neck Frontal Flexion Qualification

Test Results Summary

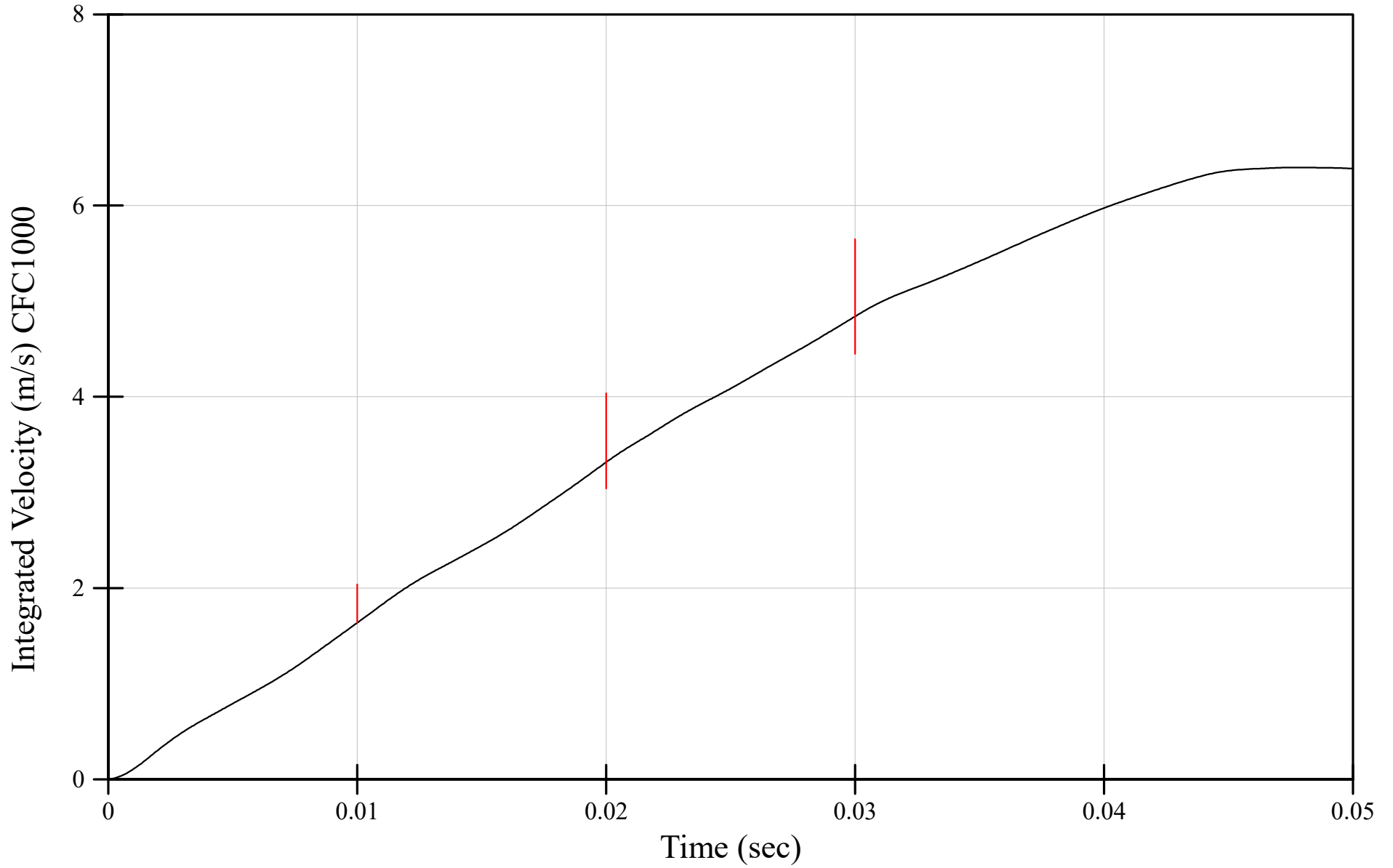
Dummy Serial Number: 003

<p><u>Tested Components</u> Neck Serial Number: 017</p>	<p>Test ID: 220302-3 Test Date: 3/2/2022 Test Time: 1:41 PM</p>
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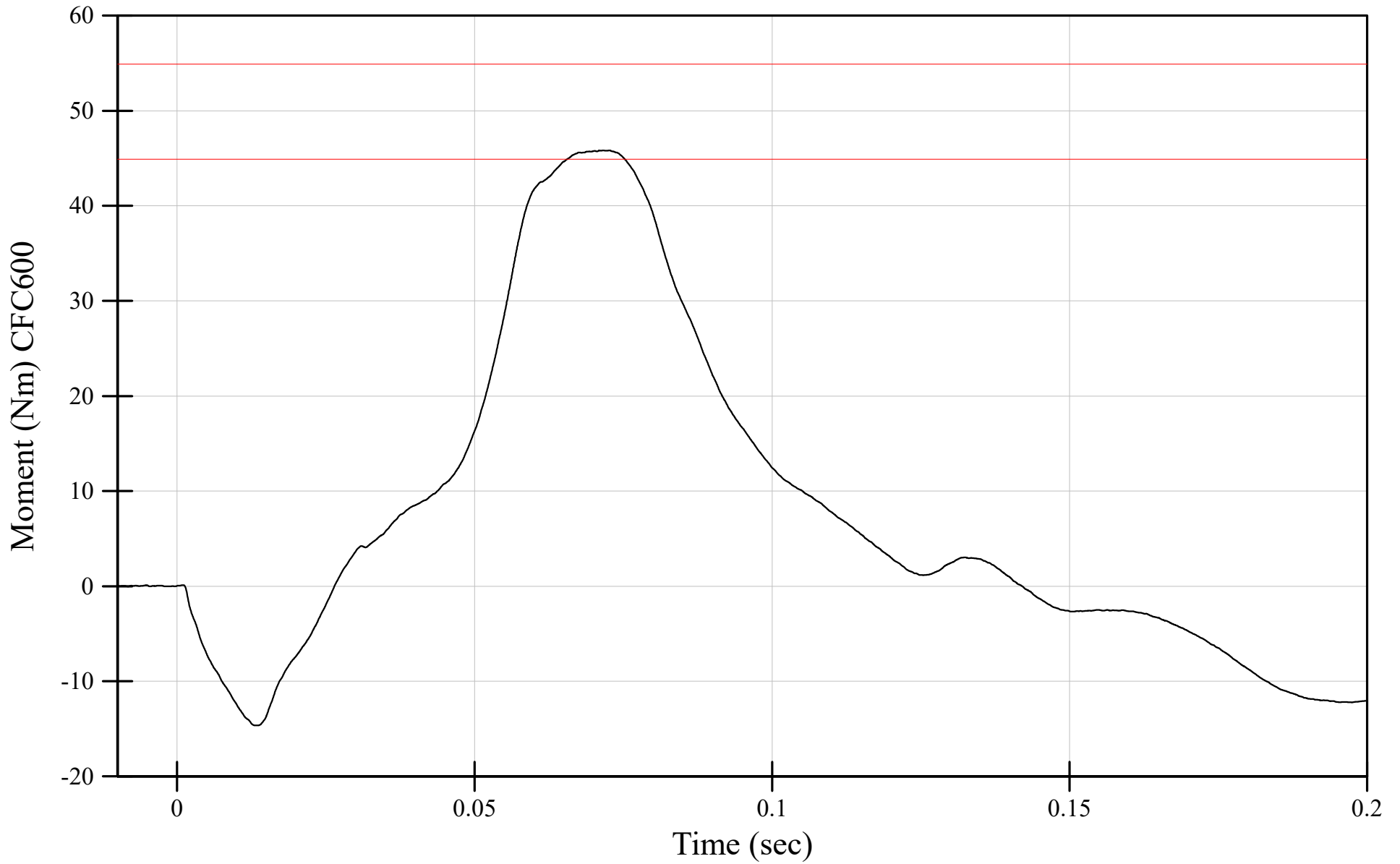
Test Results			
<u>Test Parameter</u>	<u>Specification Range*</u>	<u>Result</u>	<u>Pass/Fail</u>
Test Temperature (°C)	20.6 - 22.2	21.3	Pass
Test Humidity (%)	10 - 70	48	Pass
Test Velocity (m/s)	5.98 - 6.22	6.15	Pass
Pendulum Velocity at 10 ms (m/s)	1.64 - 2.04	1.64	Pass
Pendulum Velocity at 20 ms (m/s)	3.04 - 4.04	3.32	Pass
Pendulum Velocity at 30 ms (m/s)	4.45 - 5.65	4.84	Pass
Peak Moment about OC (Nm)	44.9 - 54.9	45.8	Pass
OC Moment Decay Time to 10 Nm (ms)	86 - 105	105	Pass
Peak Neck Rotation (deg)	83 - 102	92	Pass

* LODC Qualification Manual - January 2022

LODC Neck Frontal Flexion Qualification
Pendulum Pulse
Neck Serial Number: 017



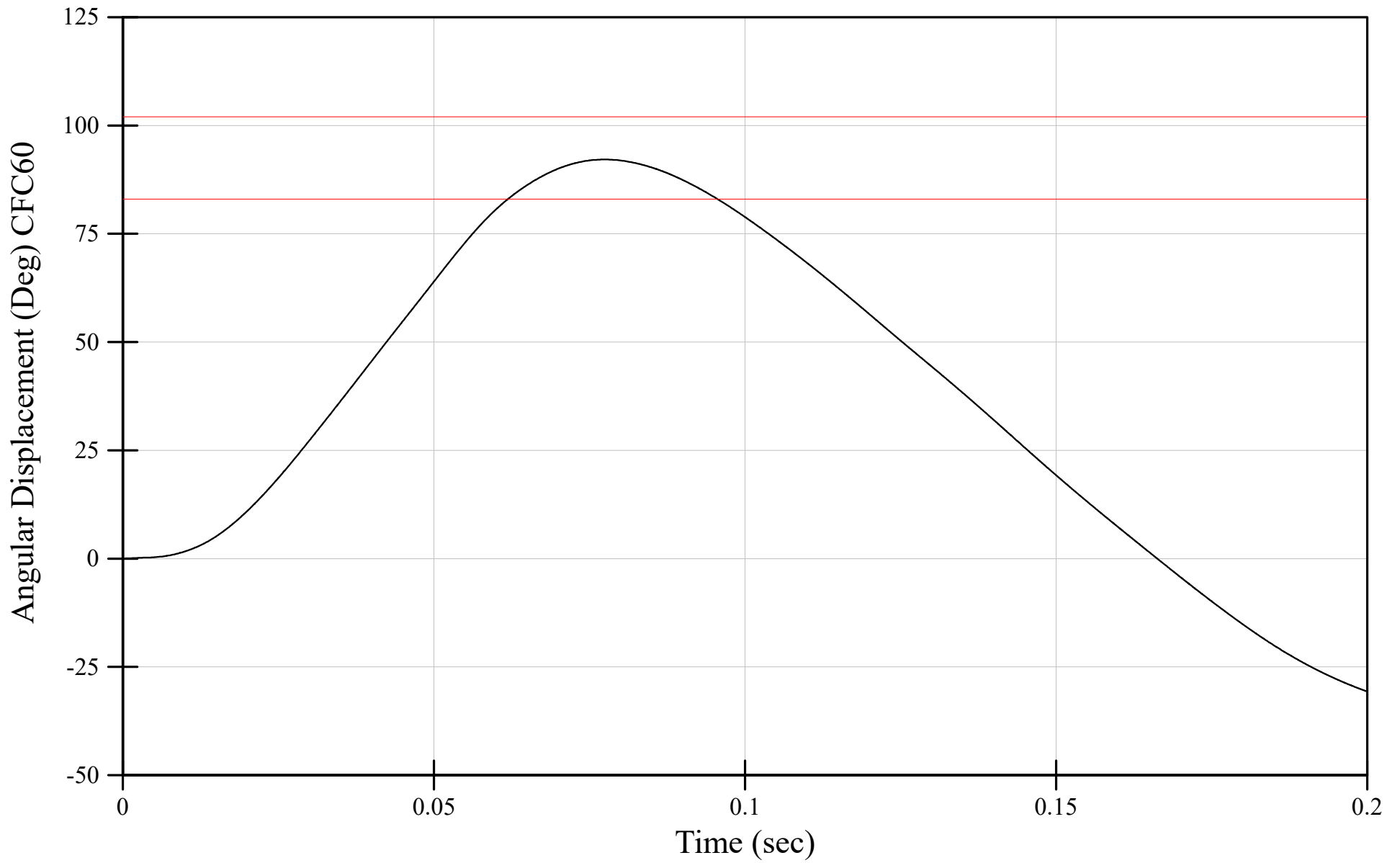
LODC Neck Frontal Flexion Qualification
Y-Moment as Measured
Neck Serial Number: 017



LODC Neck Frontal Flexion Qualification

Neck Rotation

Neck Serial Number: 017



LODC Thorax Qualification

Test Results Summary

Dummy Serial Number: 003

Tested Components

Flesh Jacket: 008

Test ID: 220310-1

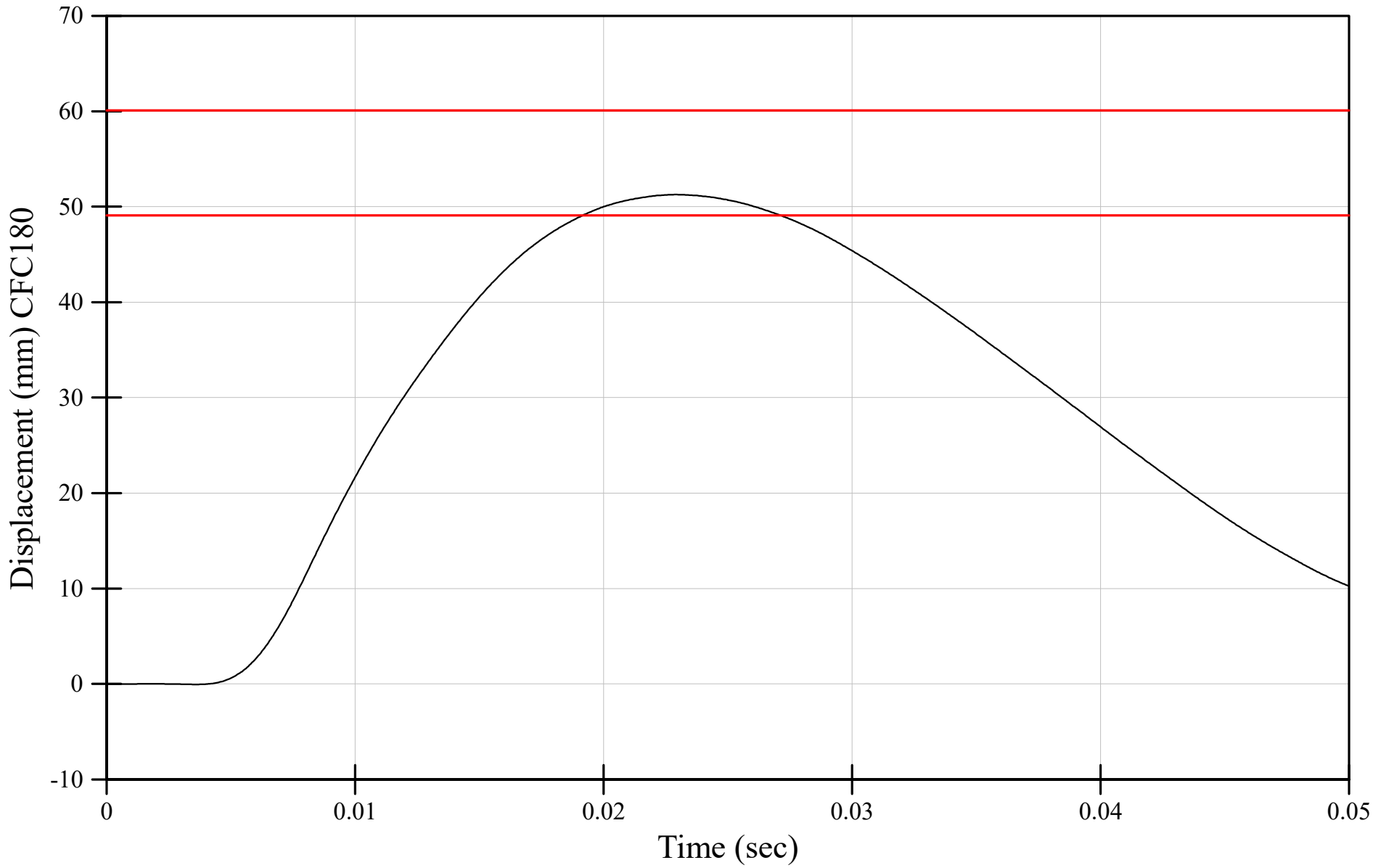
Test Date: 3/10/2022

Test Time: 8:31 AM

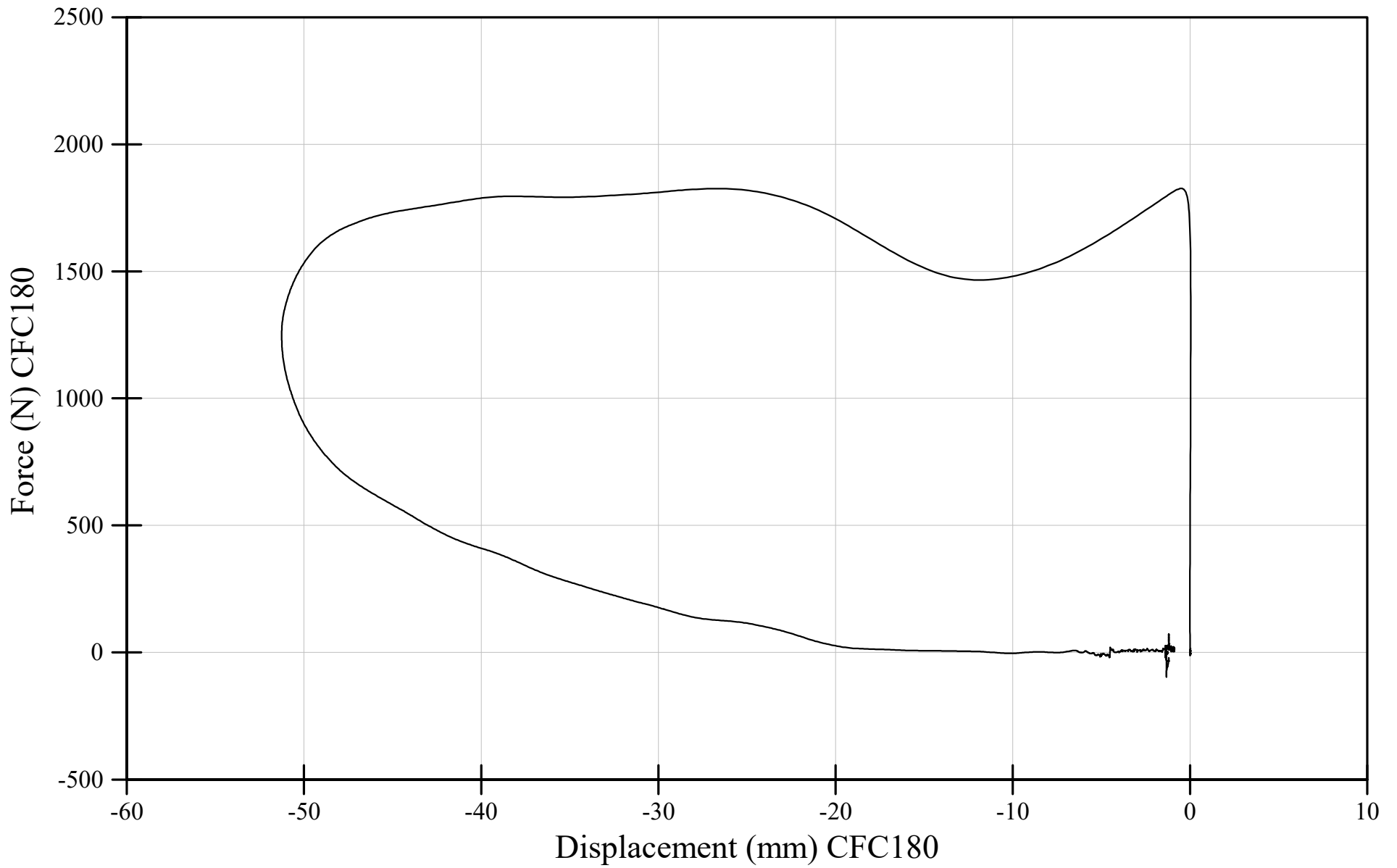
Test Results

<u>Test Parameter</u>	<u>Specification Range*</u>	<u>Result</u>	<u>Pass/Fail</u>
Test Temperature (°C)	20.6 - 22.2	21.4	Pass
Test Humidity (%)	10 - 70	45	Pass
Test Velocity (m/s)	5.90 - 6.10	5.98	Pass
Peak Chest Compression (mm)	49.1 - 60.1	51.3	Pass
Peak Probe Force between 20 - 49.1 mm Compression (N)	less than 1854	1826	Pass
Peak Probe Force between 49.1 - 60.1 mm Compression (N)	1446 - 1767	1606	Pass
Peak Ribcage Hysteresis (%)	76 - 93	87	Pass

LODC Thorax Qualification
Peak Chest Compression
Dummy Serial Number: 003



LODC Thorax Qualification
Force vs Displacement
Dummy Serial Number: 003



LODC Abdomen Qualification

Test Results Summary

Dummy Serial Number: 003

Tested Components

Test ID: 220310-2
Test Date: 3/10/2022
Test Time: 9:53 AM

Test Results

<u>Test Parameter</u>	<u>Specification Range*</u>	<u>Result</u>	<u>Pass/Fail</u>
Test Temperature (°C)	20.6 - 22.2	22.0	Pass
Test Humidity (%)	10 - 70	48	Pass
Test Velocity (m/s)	6.20 - 6.40	6.34	Pass
Peak Abdomen Compression (mm)	-79.2 - (-64.8)	-68.5	Pass
Peak Probe Force between 64.8 - 79.2 mm Compression (N)	1370 - 1675	1557	Pass

LODC Thorax Qualification
Peak Abdomen Compression
Dummy Serial Number: 003

