Vehicle Research and Test Center

FMVSS 213 Testing

Hybrid III 3-Year-Old

Prepared By:

Transportation Research Center Inc.

10820 State Route 347

P. O. Box B-67

East Liberty, OH 43319

Summary Report

August 2023

Prepared For

Vehicle Research and Test Center

P. O. Box 37

East Liberty, OH 43319

SECTION 1
PURPOSE AND SUMMARY FOR HYBRID III 3-YEAR-OLD

The purpose of this test series was to evaluate buck durability and ATD responses when installing varies CRSs with a 2 point belt configuration.

SUMMARY

A Hybrid III 3-Year-Old dummy (serial number 1869) was secured in the right rear occupant position (position 3 or P3) in a rearward-facing and in a forward-facing child restraint system (CRS). The Hybrid III 3-Year-Old was instrumented with head and chest triaxial accelerometers. During this test series the dummy was restrained with a 2-point seatbelt (SB2PT).

Section 2 contains the testing performed using a rearward-facing child restraint system (CRS) in the right rear seating position. Section 3 contains the testing performed using a forward-facing child restraint system (CRS) in the right rear seating position. Section 4 contains the dummy certification information.

SECTION 2

REARWARD FACING CRS TEST SUMMARY

TEST DUMMY INFORMATION

Description	Position # 3 CRS
ATD Type/Serial No.	Hybrid III 3-Year-Old/1869
Restraint System	SB2PT
CRS Direction	Rearward Facing
Foam Cushion	WB8, WB7

CAMERA POSITIONING FARO MEASUREMENTS

Description	Units	X	Y	Z
Origin	mm	0.00	0.00	0.00
PA Front	mm	536.60	924.64	-386.87
PA Side	mm	1848.67	-320.73	-515.91

Dummy Positioning

CRS: Graco Turn2Me – RF – 2PT Belt

TRC Test Number: S230814-1 VRTC Test Number: FR_2PT_04

Dummy Positioning FARO Measurements

Description	Units	X	Y	Z
Z point	mm	0.56	0.44	-0.52
Center of the seat frame bottom	mm	615.35	-350.74	-104.08
CRS base center	mm	562.48	-351.40	-234.81
Center of seat frame back	mm	-119.79	-350.98	-679.94
Top of seat	mm	730.16	-348.65	-638.36
Top of headrest	mm	770.50	-347.43	-811.58
Top of the head	mm	610.13	-354.82	-755.02
Bridge of nose	mm	496.60	-351.81	-711.99
Head CG outboard	mm	568.57	-288.58	-680.83
Neck center	mm	520.58	-349.98	-595.05
Chest Clip	mm	448.60	-346.97	-582.53
Buckle	mm	299.94	-347.05	-466.00
Knee Outer	mm	177.25	-248.45	-455.63
Right knee top	mm	207.55	-424.92	-500.42
Left knee top	mm	189.64	-276.17	-484.56
Ankle Outer	mm	45.34	-239.89	-603.00
CRS 1	mm	652.45	-201.87	-531.73
CRS 4	mm	476.75	-204.99	-322.46
CRS 2	mm	364.13	-133.82	-340.33
CRS 3	mm	210.01	-186.05	-302.30

DUMMY INJURY

HIC (36 ms)	Bad Data
Chest Clip (3 ms)	48.7g
Max Seatback Angle (from vertical)	65.2 deg

Dummy Positioning

CRS: Cosco Scenera Next – RF – 2PT Belt

TRC Test Number: S230814-2 VRTC Test Number: FR_2PT_05

Dummy Positioning FARO Measurements

Description	Units	X	Y	Z
Z point	mm	0.17	-0.73	0.67
Center of the seat frame bottom	mm	615.59	-351.75	-102.42
CRS base center	mm	116.95	-356.98	-388.03
Center of seat frame back	mm	-120.47	-351.75	-679.29
Top of seat	mm	729.85	-349.22	-618.49
Top of headrest	mm	649.37	-352.47	-509.90
Top of the head	mm	639.38	-350.18	-651.49
Bridge of nose	mm	516.47	-353.01	-647.94
Head CG outboard	mm	574.87	-286.76	-598.67
Neck center	mm	495.77	-350.27	-528.95
Chest Clip	mm	406.68	-348.30	-500.26
Buckle	mm	259.17	-348.71	-397.78
Knee Outer	mm	177.24	-233.61	-422.67
Right knee top	mm	201.56	-445.42	-450.42
Left knee top	mm	197.19	-257.39	-450.54
Ankle Outer	mm	46.92	-206.09	-569.09
CRS 1	mm	553.14	-139.35	-622.84
CRS 4	mm	511.05	-220.60	-342.77
CRS 2	mm	318.42	-197.59	-259.62
CRS 3	mm	168.16	-218.12	-232.02

DUMMY INJURY

HIC (36 ms)	415
Chest Clip (3 ms)	44.2g
Max Seatback Angle (from vertical)	57.5 deg

SECTION 3

FORWARD FACING CRS TEST SUMMARY

TEST DUMMY INFORMATION

Description	Position # 3 CRS
ATD Type/Serial No.	Hybrid III 3-Year-Old/1869
Restraint System	SB2PT
CRS Direction	Forward Facing
Foam Cushion	WB8

CAMERA POSITIONING FARO MEASUREMENTS

Description	Units	X	Y	Z
Origin	mm	0.00	0.00	0.00
PA Front	mm	536.60	924.64	-386.87
PA Side	mm	1848.67	-320.73	-515.91

DUMMY POSITIONING

CRS: Cosco Scenera Next – FF – 2PT Belt

TRC Test Number: S230830-1 VRTC Test Number: FR_2PT_06

DUMMY POSITIONING FARO MEASUREMENTS

Description	Units	X	Y	Z
Z point	mm	0.17	-0.76	-0.07
Center of the seat frame bottom	mm	616.54	-351.73	-103.29
CRS base center	mm	588.26	-350.91	-267.27
Center of seat frame back	mm	-120.27	-353.10	-679.92
Top of headrest	mm	-48.05	-349.92	-663.69
Top of the head	mm	70.37	-349.07	-688.44
Bridge of nose	mm	191.08	-347.30	-660.85
Head CG outboard	mm	121.17	-279.43	-623.92
Neck center	mm	189.40	-346.53	-541.89
Chest Clip	mm	264.33	-348.79	-507.46
Buckle	mm	397.28	-348.59	-393.08
Knee Outer	mm	506.85	-246.91	-372.33
Right knee top	mm	486.96	-272.35	-404.77
Left knee top	mm	480.65	-426.63	-409.55
Ankle Outer	mm	695.61	-256.47	-332.08
CRS 1	mm	53.73	-209.65	-588.91
CRS 4	mm	133.25	-213.95	-435.33
CRS 2	mm	279.44	-182.28	-329.98
CRS 3	mm	445.88	-220.00	-217.61

DUMMY INJURY

HIC (36 ms)	636
Chest Clip (3 ms)	57.0g
Head Excursion	632mm
Knee Excursion	658mm

SECTION 4
DUMMY CALIBRATION DATA

Transportation Research Center Inc.
ATD Certification Report

Customer:

Vehicle Research and Test Center
10820 State Route 347
East Liberty, OH 43319

Anthropomorphic Device:

Hybrid III (3) Year Old
Serial No. 1869
Certification No. 16

Transportation Research Center Inc.
P.O. Box B-67
10820 St. Rt. 347
East Liberty, OH 43319-0367

Website: www.trcpg.com

Phone: (937) 666-2011

Table of Contents

Introduction

Customer Name:	VRTC
Customer Contact:	Bryan Crabtree
Email:	Bryan.Crabtree.CTR@dot.gov
Phone:	(937) 666-4511
Date Received:	June 22, 2023
Date Completed:	July 20, 2023

Special Instruction: N/A

This Certification Report meets the requirements set forth by the ANSI National Accreditation Board ISO/IEC 17025:2017 accreditation under the scope of Mechanical Testing for Crash Test Dummy Certification Testing (ANAB Certificate #L2187).

The evidence measurements of this Certification Report are traceable by the Serial Number and Certification Number located at the top of the first section for each certification.

Each certification test was conducted by an authorized Transportation Research Center Inc. (TRC Inc.) employee within the requirements of the ISO/IEC 17025:2017 standards and adheres to CFR Part 572 Subparts B, E, N, O, P, R, T, U, V, SAE J2860, J2856, J2862; depending on ATD type. Any statements of conformity in this report are made using the shared risk method.

Each component of the ATD to be tested was contained in a temperature controlled environment for a period of at least 4 hours before the test. The temperature in the ATD Certification Laboratory was between 20.6°C and 22.2°C (69.08°F – 71.96°F). The relative humidity in the ATD Certification Laboratory was between 10% and 70%.

Date Received: 06/22/2023

Testing Conducted by: _____ Date: 07/20/2023
Robert Benavides

Testing Approved by: _____ Date: 07/24/2023
Josh Hendricks

Appendix A – Incoming Inspection

TRC ATD Laboratory As Received Inspection Report

Name: Robert Benavides

Date: 7/14/2023

Customer: VRTC

ATD S/N: 1869

HEAD / NECK

No.	Comments	Photo No.
1	None to report.	
2		
3		

THORAX / ABDOMEN

No.	Comments	Photo No.
4	None to report.	
5		
6		

SHOULDERS / ARMS

No.	Comments	Photo No.
7	None to report.	
8		
9		

PELVIS / LUMBAR

No.	Comments	Photo No.
10	None to report.	
11		
12		

FEMUR / KNEES

No.	Comments	Photo No.
13	None to report.	
14		
15		

LOWER LEGS / FEET

No.	Comments	Photo No.
16	None to report.	
17		
18		

TRC ATD Laboratory As Received Inspection Photos

Name: Robert Benavides

Date: 7/14/2023

Customer: VRTC

ATD S/N: 1869

1	
2	
3	
4	
5	
6	

TRC ATD Laboratory Inspection Report Action Items

Name:	Robert Benavides	Date:	7/14/2023
Customer:	VRTC	ATD S/N:	1869

Action #1	None to report.
Resolution #1	
Action #2	
Resolution #2	
Action #3	
Resolution #3	
Comments	

Appendix B – Test Results

Transportation Research Center Inc.

Front Head Drop
HIII 3YO Serial No. 1869 Certification No. 16-1
Test Date: 7/14/2023

Test Parameter	Specification	Test Results	Pass
Temperature	18.9 - 25.6 ºC	20.8 ºC	Yes
Relative Humidity	10 - 70 %	65 %	Yes
Peak Head Resultant Acceleration	250 - 280 g	256.8 g	Yes
Peak Head Lateral Acceleration	(-15) - 15 g	-9.3 g	Yes
Is Acceleration Curve Unimodal?	< 10 %	4.79 %	Yes

Test meets specifications.

Condition: Used

Comments:
Head Skin S/N: 03254

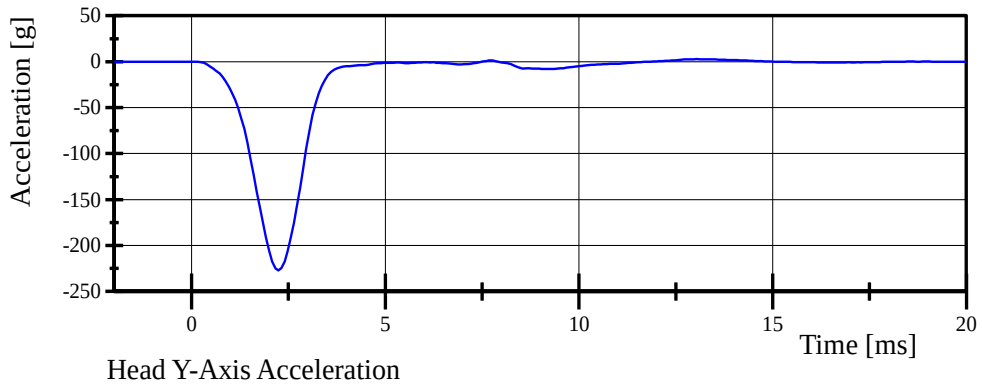
Specification Source: CFR49 Part 572 Subpart P
with Polarity in accordance with J211

07.14.2023 14:09:44 611

Transportation Research Center Inc.

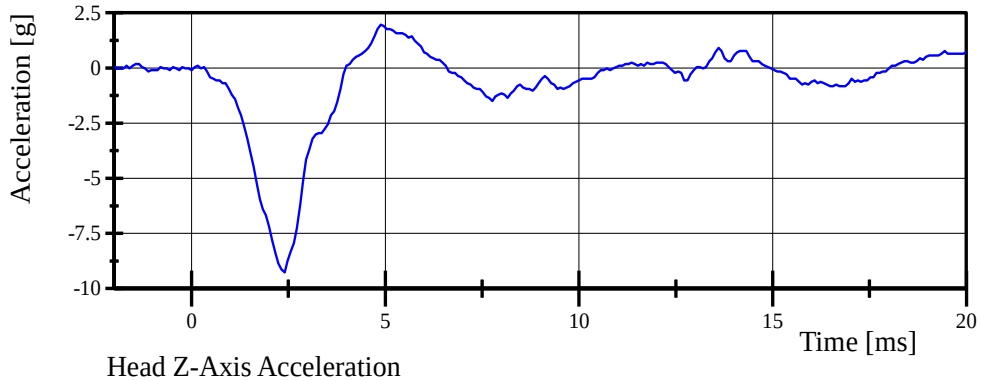
Front Head Drop
HIII 3YO Serial No. 1869 Certification No. 16-1
Test Date: 7/14/2023

Head X-Axis Acceleration



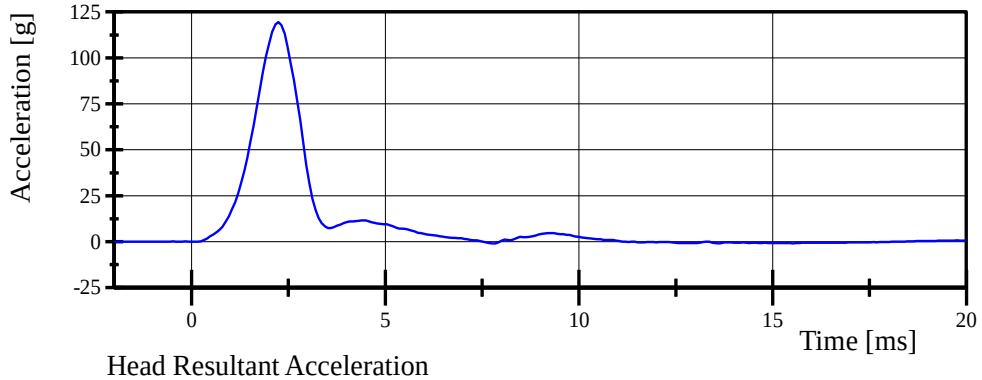
Filter Class: CFC_1000
Max: 2.8 g at 13.0 ms
Min: -227.1 g at 2.2 ms

Head Y-Axis Acceleration



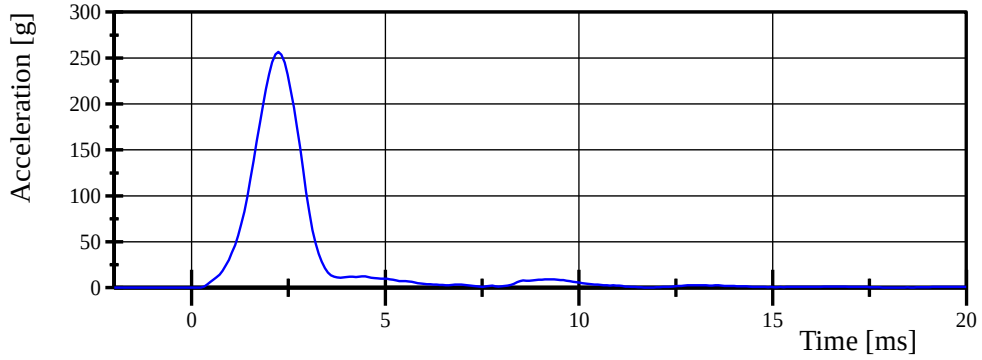
Filter Class: CFC_1000
Max: 2.0 g at 4.9 ms
Min: -9.3 g at 2.4 ms

Head Z-Axis Acceleration



Filter Class: CFC_1000
Max: 119.5 g at 2.2 ms
Min: -0.9 g at 7.8 ms

Head Resultant Acceleration



Filter Class: CFC_1000
Max: 256.8 g at 2.2 ms
Min: 0.0 g at -1.8 ms

Specification Source: CFR49 Part 572 Subpart P
with Polarity in accordance with J211

07.14.2023 14:14:24 611

Transportation Research Center Inc.

Neck Flexion
HIII 3YO Serial No. 1869 Certification No. 16-4
Test Date: 7/20/2023

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 ºC	20.8 ºC	Yes
Relative Humidity	10 - 70 %	68 %	Yes
Pendulum Impact Velocity	5.40 - 5.60 m/s	5.416 m/s	Yes
Pendulum Integrated Velocity Change at 10 ms	(-2.0) - (-2.7) m/s	-2.20 m/s	Yes
Pendulum Integrated Velocity Change at 15 ms	(-3.0) - (-4.0) m/s	-3.27 m/s	Yes
Pendulum Integrated Velocity Change at 20 ms	(-4.0) - (-5.1) m/s	-4.44 m/s	Yes
Total Headform D-Plane Rotation	(-70) - (-82) º	-78.6 º	Yes
Peak Neck Occipital Condyles Moment	42 - 53 Nm	43.0 Nm	Yes
Neck Occipital Condyles Moment Decay to 10 Nm	60 - 80 ms	72.7 ms	Yes

Test meets specifications.

Condition: Used

Comments:
Neck S/N: N/A

Specification Source: CFR49 Part 572 Subpart P
with Polarity in accordance with J211

07.20.2023 13:24:48 655

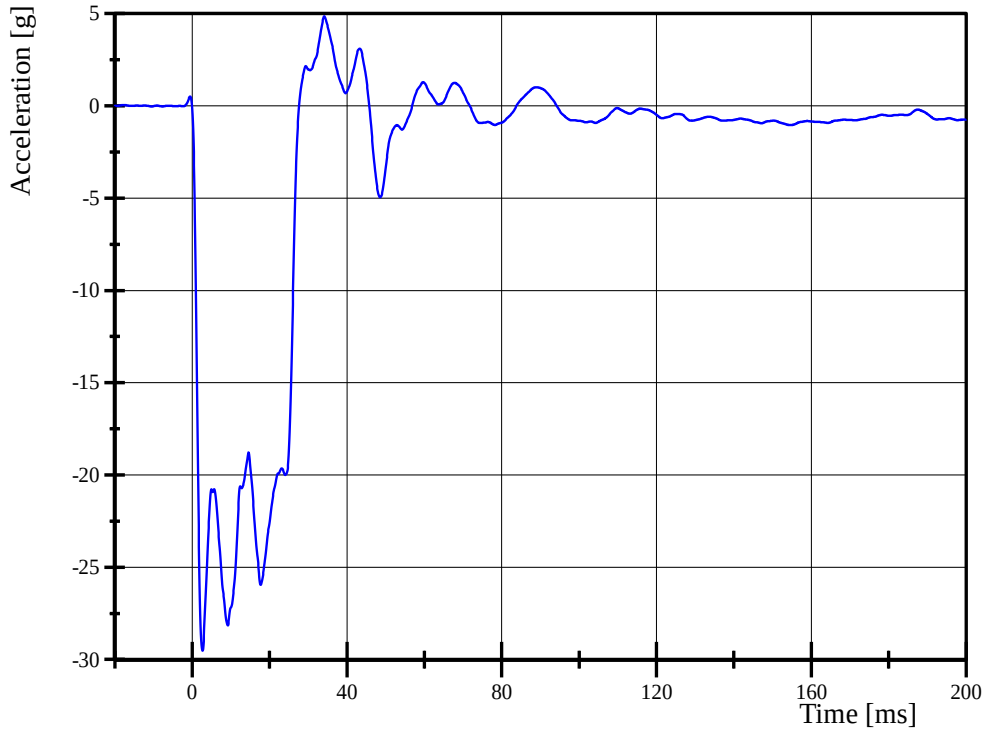
Transportation Research Center Inc.

Neck Flexion

HIII 3YO Serial No. 1869 Certification No. 16-4

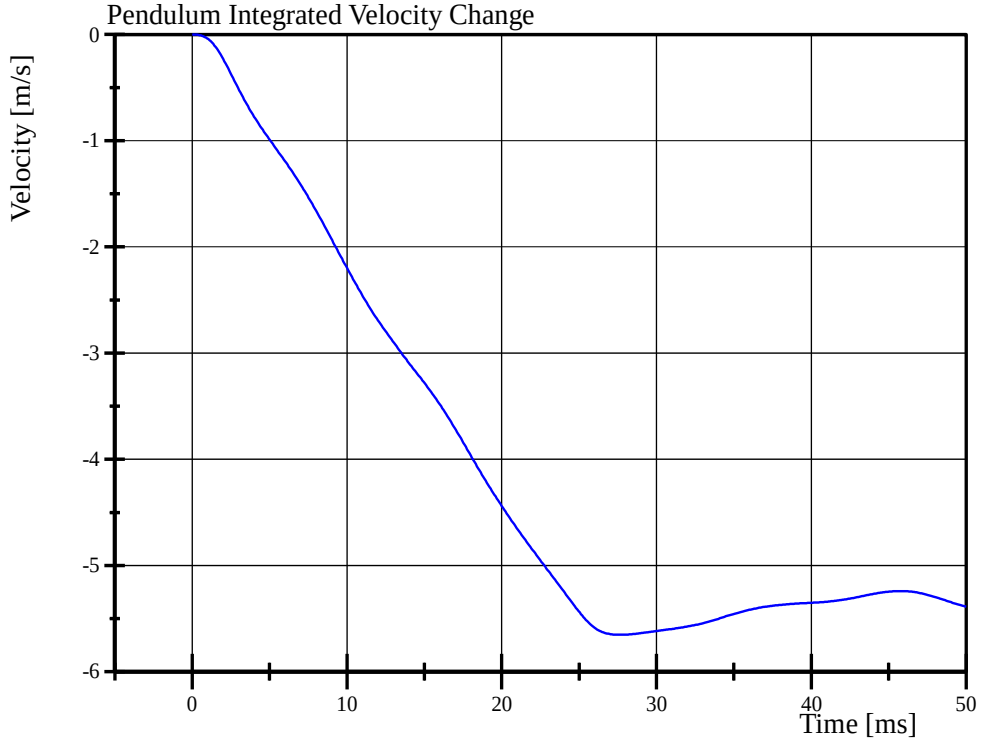
Test Date: 7/20/2023

Pendulum Acceleration



Filter Class: CFC_180
Max: 4.9 g at 34.2 ms
Min: -29.5 g at 2.6 ms

Pendulum Integrated Velocity Change



Filter Class: CFC_180
Max: 0.0 m/s at 0.0 ms
Min: -5.7 m/s at 27.7 ms

Specification Source: CFR49 Part 572 Subpart P
with Polarity in accordance with J211

07.20.2023 13:25:07 655

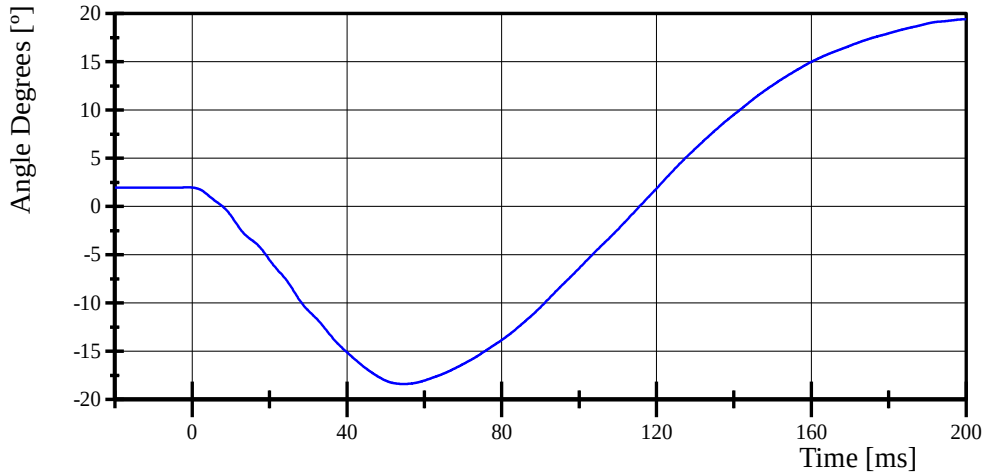
Transportation Research Center Inc.

Neck Flexion

HIII 3YO Serial No. 1869 Certification No. 16-4

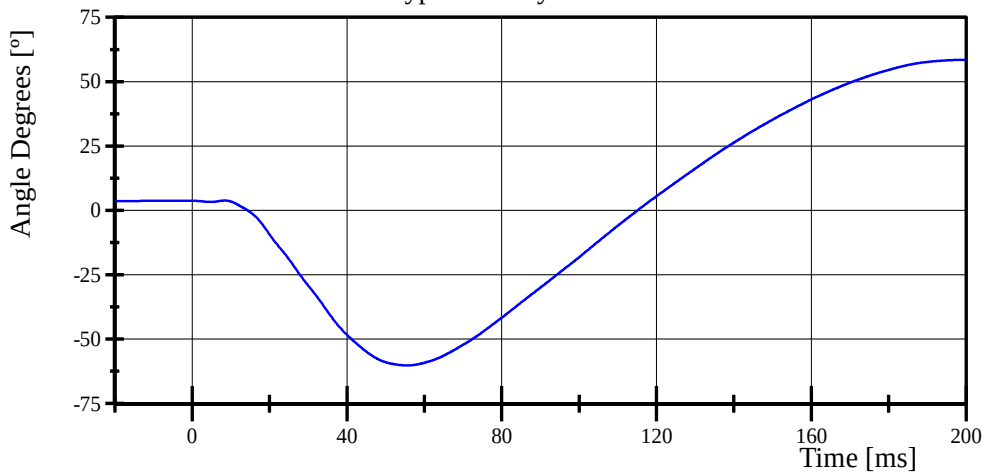
Test Date: 7/20/2023

Pot Rotation at the Base of Neck



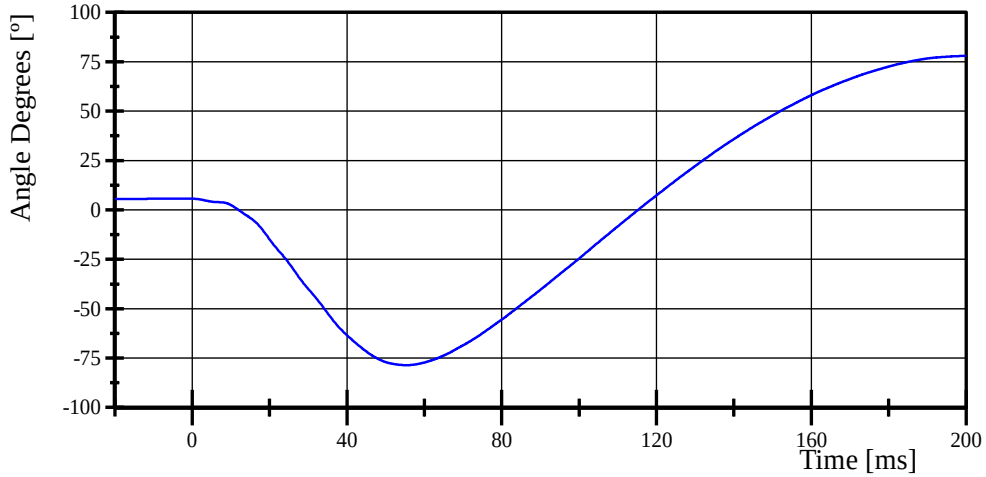
Filter Class: CFC_60
Max: 19.4 ° at 200.0 ms
Min: -18.4 ° at 54.6 ms

Headform Rotation at Occypital Condyles



Filter Class: CFC_60
Max: 58.5 ° at 200.0 ms
Min: -60.2 ° at 55.5 ms

Total Headform D-Plane Rotation



Filter Class: CFC_60
Max: 77.9 ° at 200.0 ms
Min: -78.6 ° at 55.4 ms

Specification Source: CFR49 Part 572 Subpart P
with Polarity in accordance with J211

07.20.2023 13:25:07 655

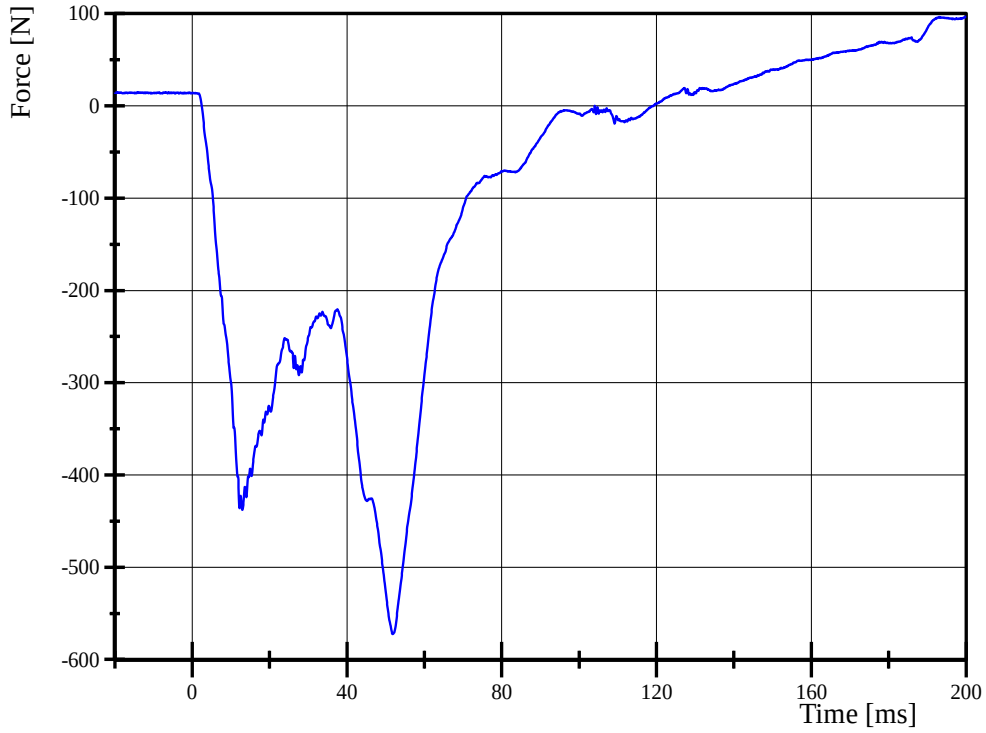
Transportation Research Center Inc.

Neck Flexion

HIII 3YO Serial No. 1869 Certification No. 16-4

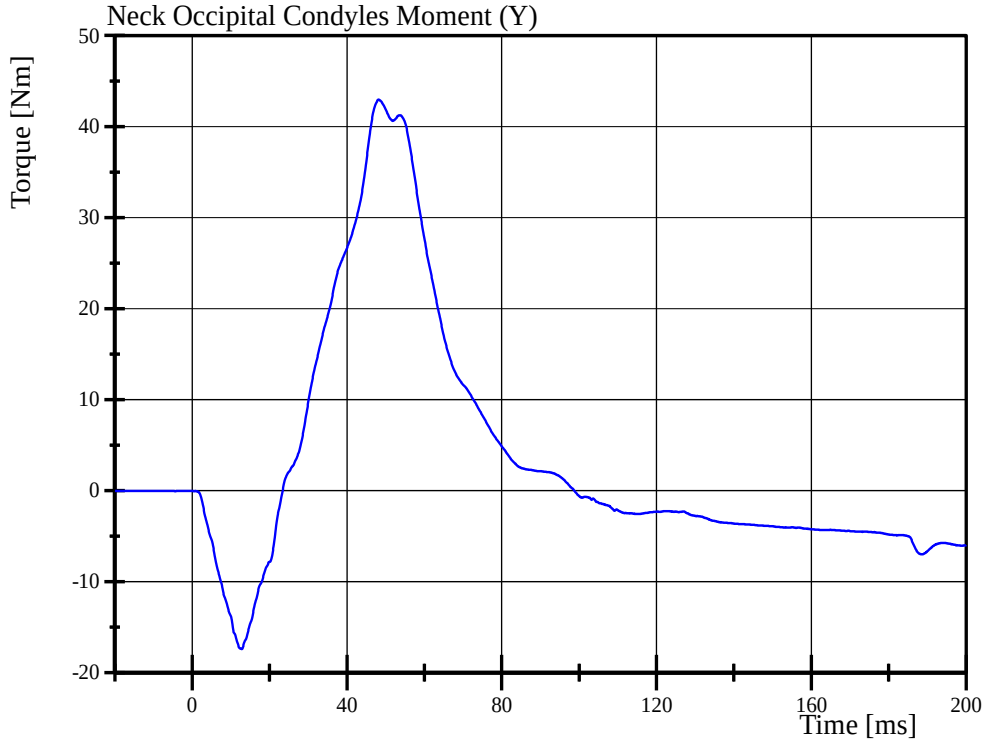
Test Date: 7/20/2023

Neck Force (X)



Filter Class: CFC_1000
Max: 97.0 N at 200.0 ms
Min: -572.3 N at 51.8 ms

Neck Occipital Condyles Moment (Y)



Filter Class: CFC_600
Max: 43.0 Nm at 48.2 ms
Min: -17.4 Nm at 12.8 ms

Specification Source: CFR49 Part 572 Subpart P
with Polarity in accordance with J211

07.20.2023 13:25:07 655

Transportation Research Center Inc.

Neck Extension
HIII 3YO Serial No. 1869 Certification No. 16-1
Test Date: 7/20/2023

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 ºC	20.8 ºC	Yes
Relative Humidity	10 - 70 %	68 %	Yes
Pendulum Impact Velocity	(-3.55) - (-3.75) m/s	-3.618 m/s	Yes
Pendulum Integrated Velocity Change at 6 ms	1.0 - 1.4 m/s	1.13 m/s	Yes
Pendulum Integrated Velocity Change at 10 ms	1.9 - 2.5 m/s	2.13 m/s	Yes
Pendulum Integrated Velocity Change at 14 ms	2.8 - 3.5 m/s	3.16 m/s	Yes
Total Headform D-Plane Rotation	83 - 93 º	88.1 º	Yes
Peak Neck Occipital Condyles Moment	(-43.7) - (-53.3) Nm	-48.42 Nm	Yes
Neck Occipital Condyles Moment Decay to 10 Nm	60 - 80 ms	67.0 ms	Yes

Test meets specifications.

Condition: Used

Comments:
Neck S/N: N/A

Specification Source: CFR49 Part 572 Subpart P
with Polarity in accordance with J211

07.20.2023 14:03:02 957

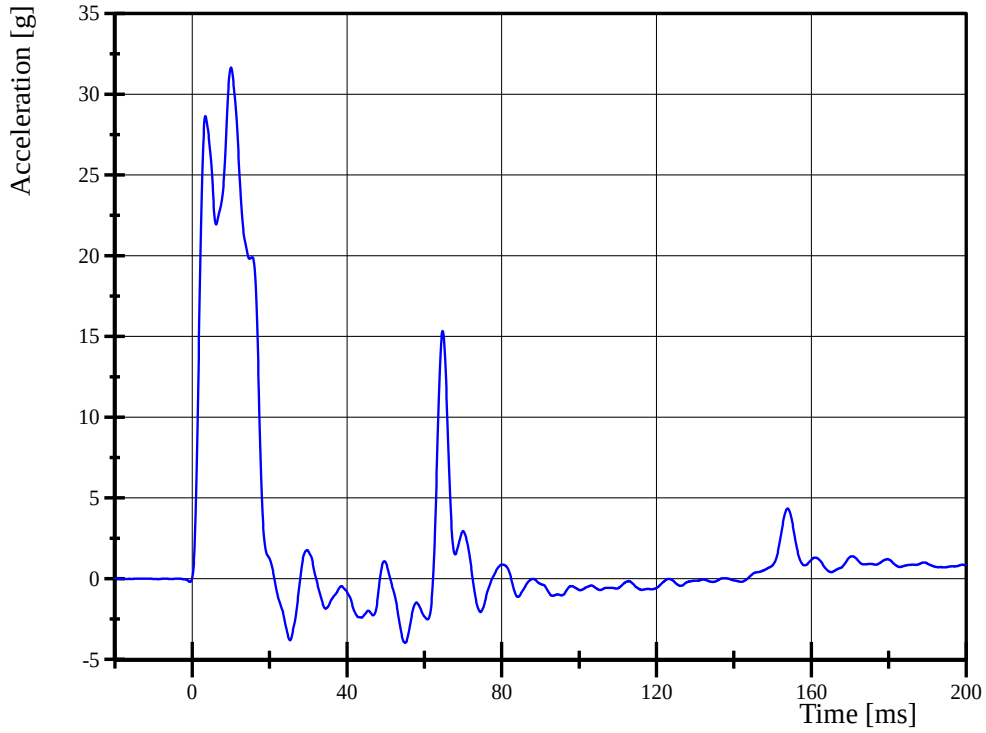
Transportation Research Center Inc.

Neck Extension

HIII 3YO Serial No. 1869 Certification No. 16-1

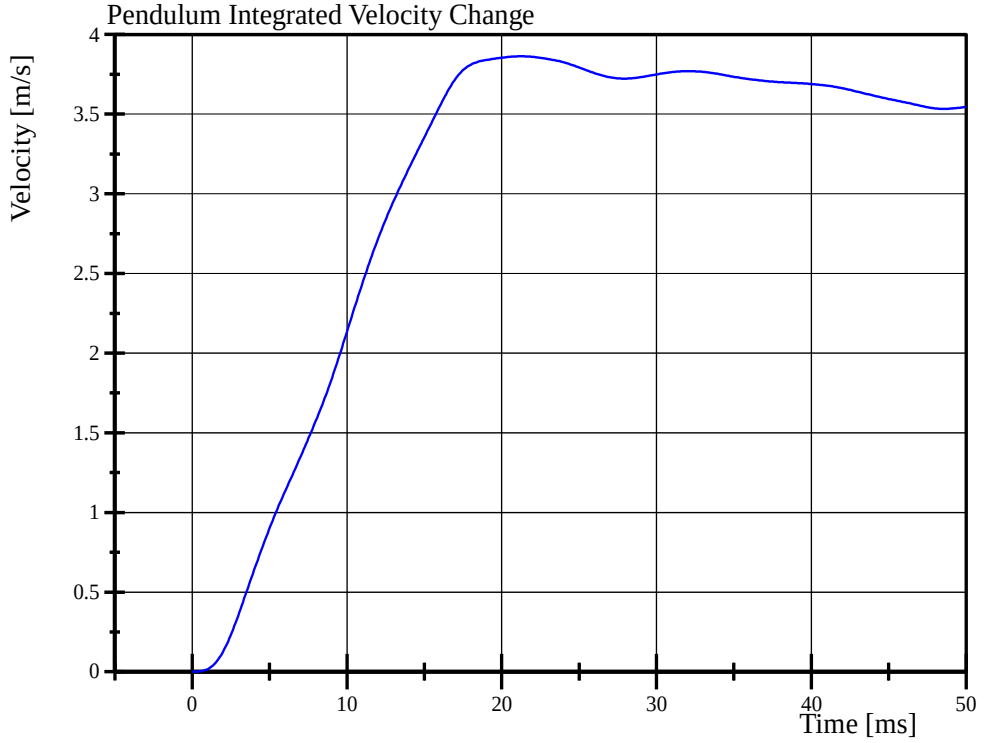
Test Date: 7/20/2023

Pendulum Acceleration



Filter Class: CFC_180
Max: 31.7 g at 10.0 ms
Min: -4.0 g at 55.0 ms

Pendulum Integrated Velocity Change



Filter Class: CFC_180
Max: 3.9 m/s at 21.3 ms
Min: 0.0 m/s at 0.0 ms

Specification Source: CFR49 Part 572 Subpart P
with Polarity in accordance with J211

07.20.2023 14:03:18 957

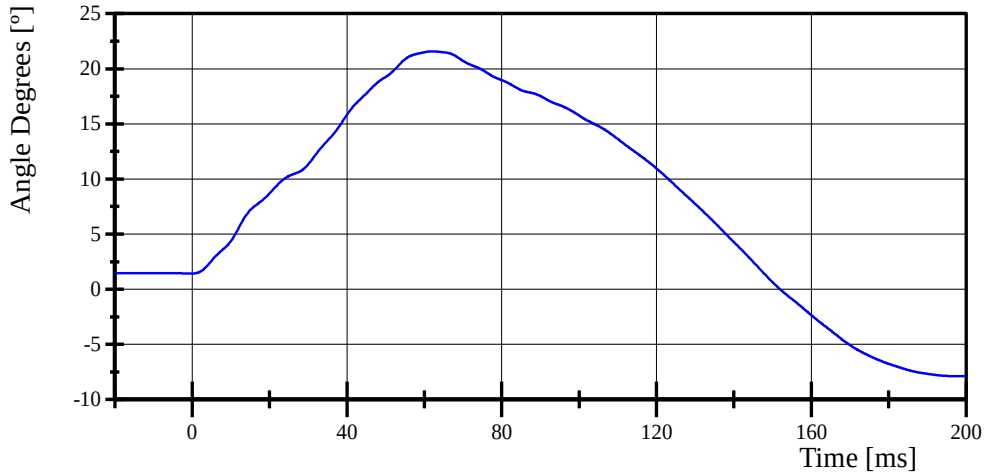
Transportation Research Center Inc.

Neck Extension

HIII 3YO Serial No. 1869 Certification No. 16-1

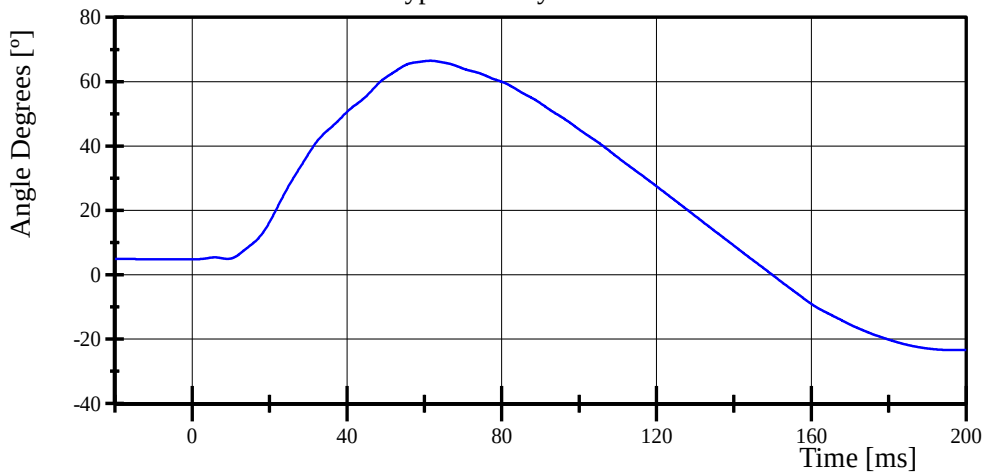
Test Date: 7/20/2023

Pot Rotation at the Base of Neck



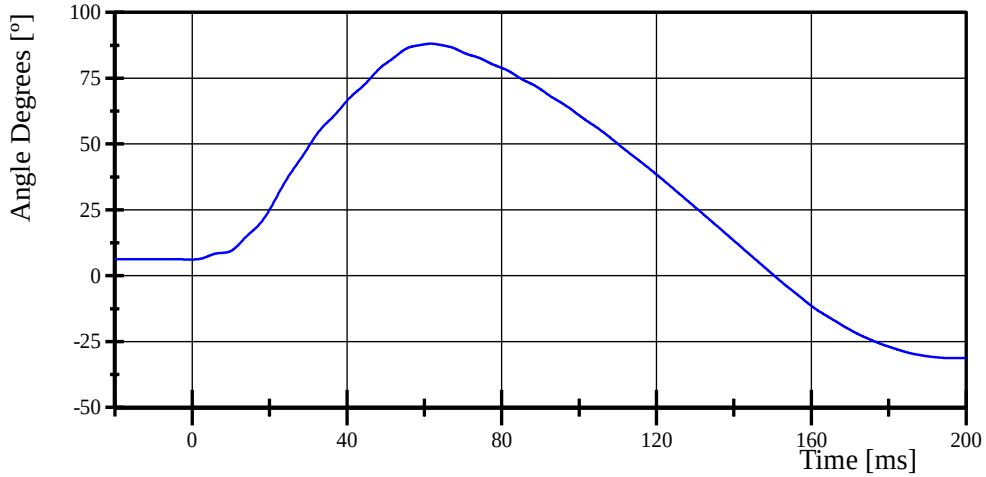
Filter Class: CFC_60
Max: 21.6 ° at 62.1 ms
Min: -7.9 ° at 198.0 ms

Headform Rotation at Occypital Condyles



Filter Class: CFC_60
Max: 66.5 ° at 61.5 ms
Min: -23.4 ° at 196.9 ms

Total Headform D-Plane Rotation



Filter Class: CFC_60
Max: 88.1 ° at 61.7 ms
Min: -31.3 ° at 197.0 ms

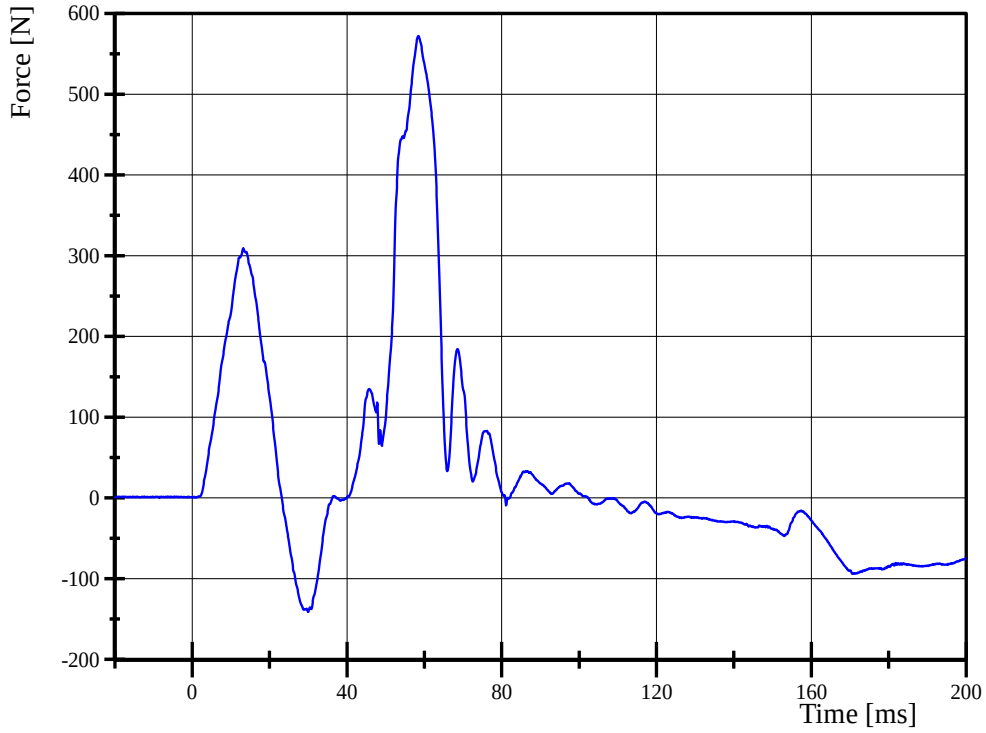
Specification Source: CFR49 Part 572 Subpart P
with Polarity in accordance with J211

07.20.2023 14:03:19 957

Transportation Research Center Inc.

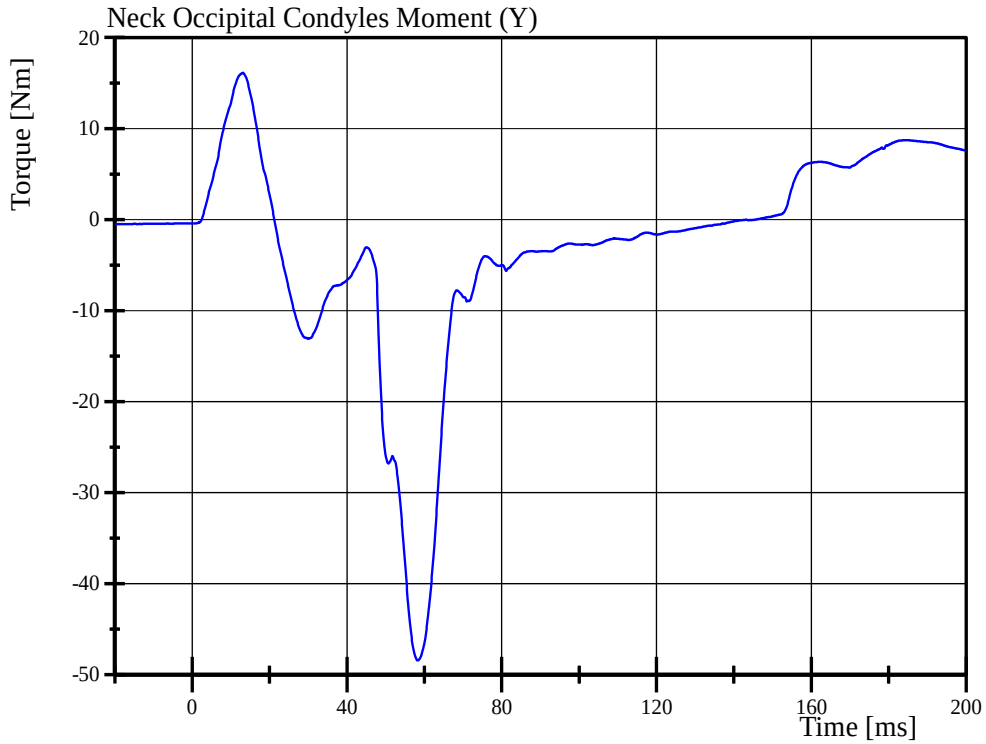
Neck Extension
HIII 3YO Serial No. 1869 Certification No. 16-1
Test Date: 7/20/2023

Neck Force (X)



Filter Class: CFC_1000
Max: 572.3 N at 58.5 ms
Min: -141.0 N at 30.0 ms

Neck Occipital Condyles Moment (Y)



Filter Class: CFC_600
Max: 16.1 Nm at 13.1 ms
Min: -48.4 Nm at 58.3 ms

Specification Source: CFR49 Part 572 Subpart P
with Polarity in accordance with J211

07.20.2023 14:03:19 957

Transportation Research Center Inc.

Front Thorax
HIII 3YO Serial No. 1869 Certification No. 16-1
Test Date: 7/14/2023

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 ºC	20.9 ºC	Yes
Relative Humidity	10 - 70 %	67 %	Yes
Probe Velocity	5.9 - 6.1 m/s	6.01 m/s	Yes
Probe Force Peak Between 32.0 mm and 38.0 mm Chest Deflection	(-680) - (-810) N	-717.7 N	Yes
Probe Force Peak Between 12.5 mm and 32.0 mm Chest Deflection	>= (-910) N	-708.7 N	Yes
Maximum Chest Compression	(-32) - (-38) mm	-36.6 mm	Yes
Internal Hysteresis	65 - 85 %	66.1 %	Yes

Test meets specifications.

Condition: Used

Comments:
Jacket S/N: 16503
Rib Set S/N: 18031758A

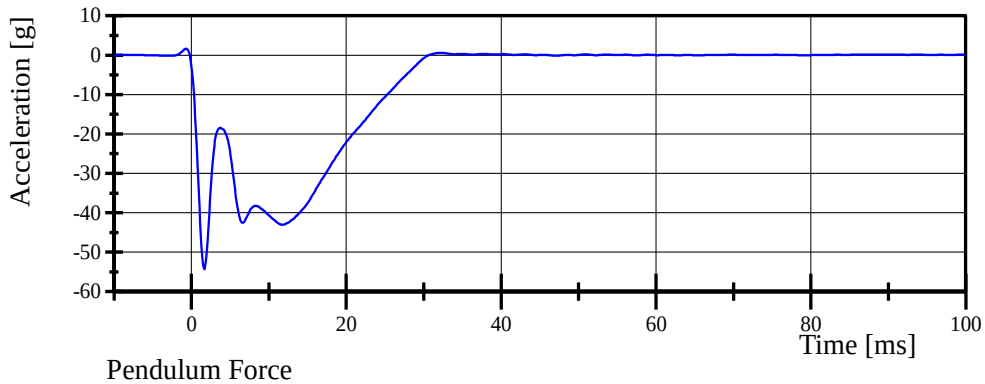
Specification Source: CFR49 Part 572 Subpart P
with Polarity in accordance with J211

07.14.2023 10:15:35 481

Transportation Research Center Inc.

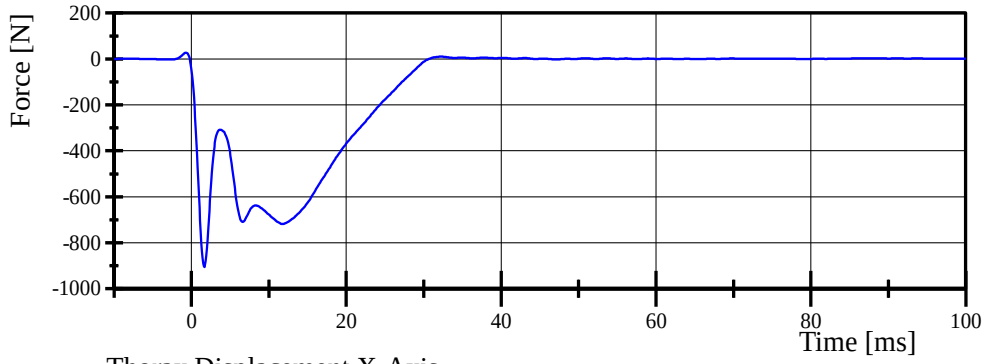
Front Thorax
HIII 3YO Serial No. 1869 Certification No. 16-1
Test Date: 7/14/2023

Pendulum Acceleration



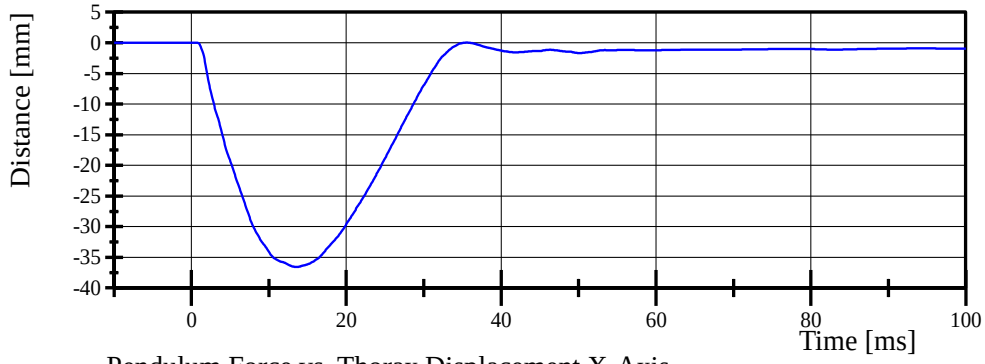
Filter Class: CFC_180
Max: 1.6 g at -0.7 ms
Min: -54.3 g at 1.7 ms

Pendulum Force



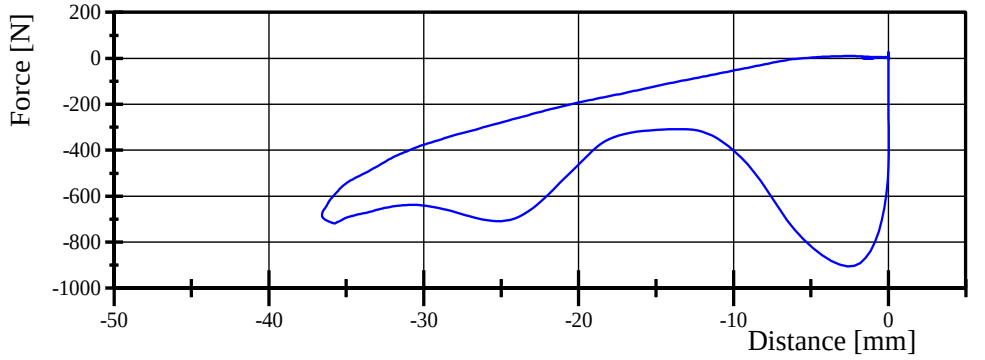
Filter Class: CFC_180
Max: 27.2 N at -0.7 ms
Min: -905.0 N at 1.7 ms

Thorax Displacement X-Axis



Filter Class: CFC_600
Max: 0.0 mm at 35.6 ms
Min: -36.6 mm at 13.5 ms

Pendulum Force vs. Thorax Displacement X-Axis



Filter Class: CFC_180
Max: 27.2 N at -0.0 mm
Min: -905.0 N at -2.6 mm

Specification Source: CFR49 Part 572 Subpart P
with Polarity in accordance with J211

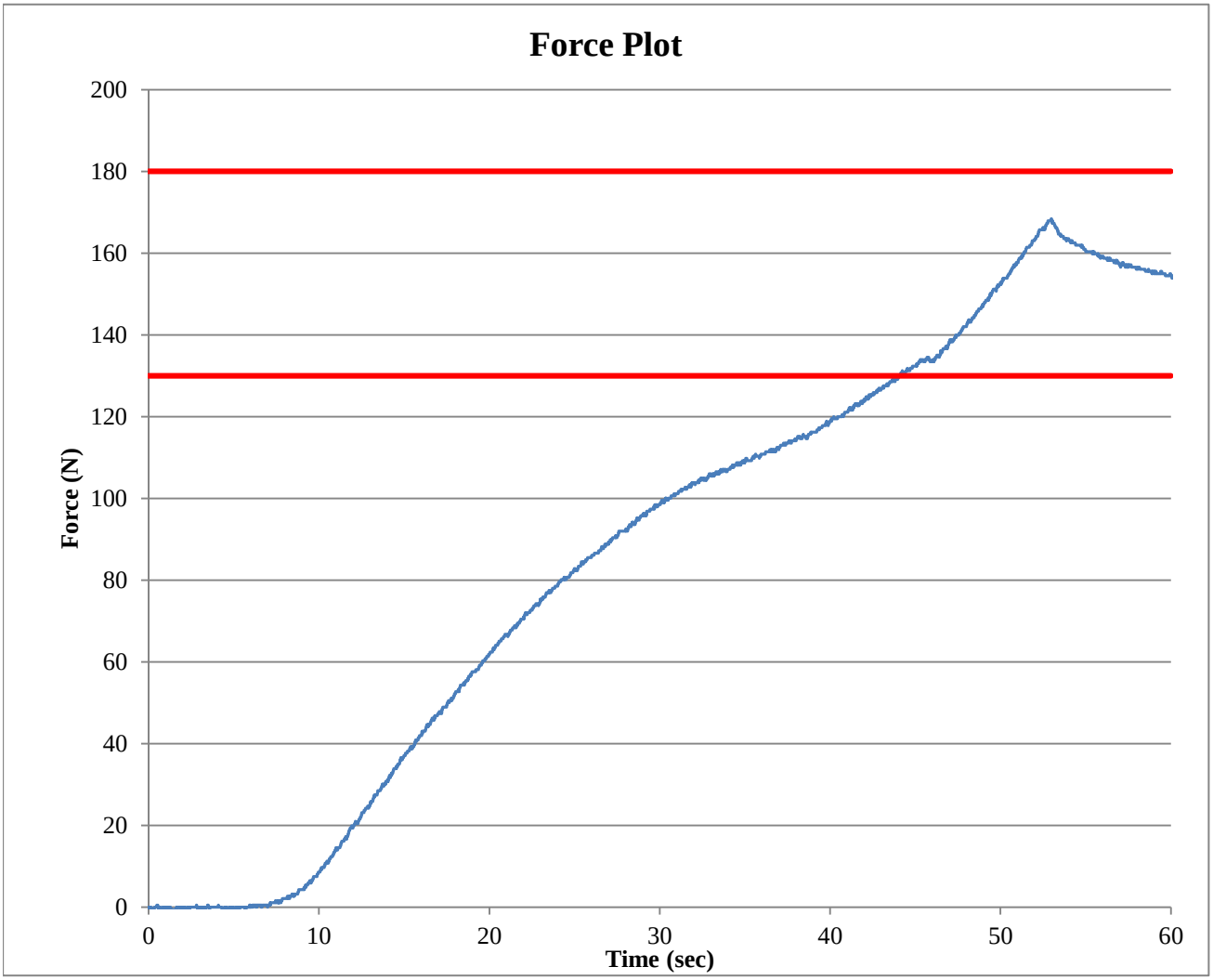
07.14.2023 10:19:29 481

Transportation Research Center Inc.

Hybrid III 3-Year Old Child Torso Flexion

Customer:	VRTC		
Serial Number:	1869	Date:	7/14/2023
Test Number:	3	Time:	12:59

TEST PARAMETER	SPECIFICATION			TEST RESULTS		
Temperature	18.9	-	25.6	21	°C	Pass
Humidity	10	-	70	68	%	Pass
Average Angular Rate	0.5	-	1.5	0.93	deg/sec	Pass
Initial Angle	0	-	15	4.43	deg	Pass
Peak Force at 45.53°	130	-	180	168.43	N	Pass
Final Angle	-10	-	10	-1.44	deg	Pass



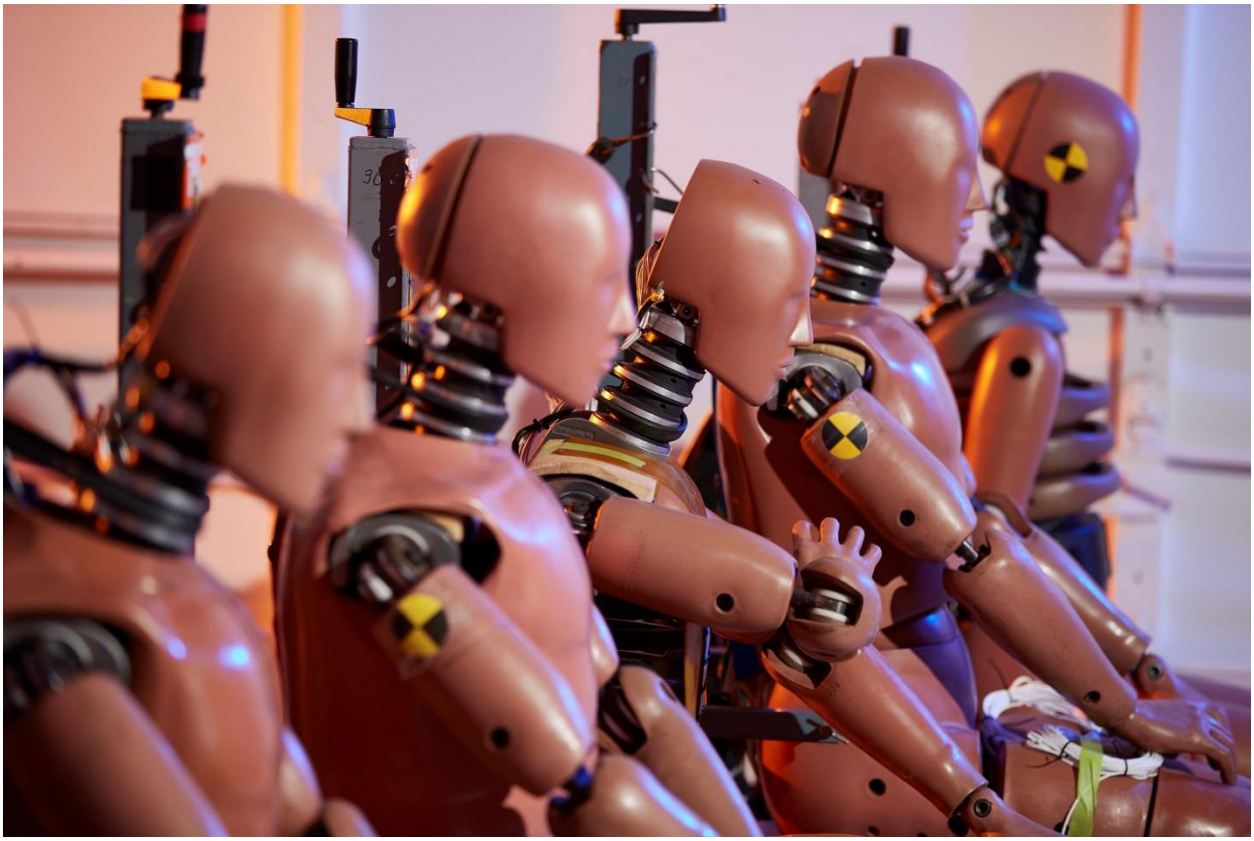
Components:

Jacket S/N:	16503
Abdomen S/N:	DG3677
Lumbar S/N:	N/A

Comments:

Appendix C – Quality Assurance

Quality Assurance



ATD Assembly & Final Inspection

ATD Type: Hybrid III (3) Year Old

ATD Serial Number: 1869

Assembled by:

Date Inspected: 07/20/2023