

**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

January 2021

**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 the testing is: to determine if higher pulses within the FMVSS 213 corridor produce different results.

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 forward facing child restraint system (CRS) or secured in the left rear occupant position (position 4 or P4) in a rearward facing child restraint system (CRS). The Hybrid III 3 year old was instrumented with head, chest, and pelvis triaxial accelerometers, upper neck and lumbar force and moment load cells and a displacement potentiometer in the chest. During this test series the dummy was restrained with a 3-point seatbelt with top tether (SB3PT&T).

Section 2 contains forward facing CRS. Section 3 contains the dummy certification data.

SECTION 2
FORWARD FACING CRS TEST SUMMARY

TEST DUMMY INFORMATION

Description	Position # 3 CRS
ATD Type/Serial No.	Hybrid III 3 Year Old/1869
Restraint System	SB3PT&T
CRS Direction	Forward Facing
Foam Cushion	WB10, WB8

CAMERA POSITIONING FARO MEASUREMENTS

Description	Units	X	Y	Z
Origin	mm	0.00	0.00	0.00
Passenger Front	mm	1866.57	-322.94	-501.62
N3 Passenger Excursion	mm	719.40	905.72	-460.21
N5 Passenger Side	mm	418.12	906.19	-391.42

DUMMY POSITIONING

CRS: Harmony Defender 360 – Forward Facing – SB3PT&T

TRC Test Number: S210112-1

VRTC Test Number: FR_RR_PE_02



DUMMY POSITIONING FARO MEASUREMENTS

Description	Units	X	Y	Z
Z-Point	mm	-0.20	-0.29	-0.11
Center of Seat Frame Back	mm	-125.04	-350.01	-680.45
Top of CRS	mm	-2.31	-348.23	-755.03
Top of Headrest	mm	21.12	-354.19	-848.55
Top of Head	mm	174.83	-348.64	-775.70
Bridge of Nose	mm	262.70	-349.01	-692.08
Head CG Outboard	mm	185.78	-283.21	-694.30
Neck Center	mm	207.64	-350.11	-599.55
Chest Clip	mm	268.41	-350.44	-546.20
Buckle	mm	372.20	-352.32	-398.07
Knee Outboard	mm	478.50	-252.95	-364.24
Ankle Outboard	mm	673.17	-248.43	-335.81
Base Center	mm	603.97	-351.19	-275.82
Center of Seat Frame Bottom	mm	616.30	-349.38	-109.63
Target 1 - Seat Side Upper	mm	53.45	-156.71	-609.29
Target 4 - Seat Side Lower	mm	245.08	-132.81	-391.17
Target 2 - Seat Base H-Point	mm	260.89	-140.77	-315.26
Target 3 - Seat Base Side	mm	399.51	-137.97	-360.94

HIC (36 ms)	400
Chest Clip (3 ms)	42.75 g
Head Excursion (mm)	560
Knee Excursion (mm)	660

DUMMY POSITIONING

CRS: Harmony Defender 360 – Forward Facing – SB3PT&T

TRC Test Number: S210113-1

VRTC Test Number: FR_RR_PE_04



DUMMY POSITIONING FARO MEASUREMENTS

Description	Units	X	Y	Z
Z-Point	mm	-0.26	-0.11	0.16
Center of Seat Frame Back	mm	-122.80	-351.31	-681.78
Top of CRS	mm	-5.74	-350.09	-750.34
Top of Headrest	mm	19.26	-352.08	-842.99
Top of Head	mm	178.47	-353.48	-775.15
Bridge of Nose	mm	267.71	-350.67	-692.33
Head CG Outboard	mm	189.50	-287.29	-695.12
Neck Center	mm	213.07	-353.23	-599.60
Chest Clip	mm	271.42	-351.83	-548.37
Buckle	mm	375.56	-352.15	-401.68
Knee Outboard	mm	478.18	-251.71	-366.91
Ankle Outboard	mm	673.06	-249.34	-339.11
Base Center	mm	608.10	-351.54	-278.42
Center of Seat Frame Bottom	mm	616.14	-350.03	-109.94
Target 1 - Seat Side Upper	mm	47.92	-164.72	-608.05
Target 4 - Seat Side Lower	mm	241.98	-137.23	-383.46
Target 2 - Seat Base H-Point	mm	256.80	-144.60	-313.47
Target 3 - Seat Base Side	mm	397.34	-138.57	-365.14

DUMMY INJURY

HIC (36 ms)	444
Chest Clip (3 ms)	46.90 g
Head Excursion (mm)	612
Knee Excursion (mm)	713

DUMMY POSITIONING

CRS: Harmony Defender 360 – Forward Facing – SB3PT&T

TRC Test Number: S210113-2

VRTC Test Number: FR_RR_PE_06



DUMMY POSITIONING FARO MEASUREMENTS

Description	Units	X	Y	Z
Z-Point	mm	-0.26	-0.29	0.05
Center of Seat Frame Back	mm	-121.57	-350.96	-681.89
Top of CRS	mm	-7.56	-351.40	-758.41
Top of Headrest	mm	25.73	-355.04	-850.00
Top of Head	mm	180.74	-349.14	-776.61
Bridge of Nose	mm	265.06	-346.89	-690.73
Head CG Outboard	mm	187.00	-281.91	-696.20
Neck Center	mm	206.75	-348.91	-601.22
Chest Clip	mm	267.46	-350.97	-548.53
Buckle	mm	372.49	-349.43	-400.11
Knee Outboard	mm	483.78	-252.63	-363.93
Ankle Outboard	mm	677.90	-250.64	-331.27
Base Center	mm	600.31	-348.95	-273.65
Center of Seat Frame Bottom	mm	615.99	-350.25	-111.07
Target 1 - Seat Side Upper	mm	46.70	-161.50	-615.71
Target 4 - Seat Side Lower	mm	242.88	-130.17	-393.83
Target 2 - Seat Base H-Point	mm	254.75	-138.14	-313.72
Target 3 - Seat Base Side	mm	395.15	-135.77	-361.25

DUMMY INJURY

HIC (36 ms)	373
Chest Clip (3 ms)	41.84 g
Head Excursion (mm)	570
Knee Excursion (mm)	674

DUMMY POSITIONING

CRS: Harmony Defender 360 – Forward Facing – SB3PT&T

TRC Test Number: S210129-1

VRTC Test Number: FR_RR_PE_26



DUMMY POSITIONING FARO MEASUREMENTS

Description	Units	X	Y	Z
Z-Point	mm	-0.02	-0.33	0.21
Center of Seat Frame Back	mm	-120.96	-350.75	-682.37
Top of CRS	mm	-6.92	-349.12	-758.57
Top of Headrest	mm	15.57	-353.50	-853.48
Top of Head	mm	172.91	-350.66	-771.66
Bridge of Nose	mm	261.72	-349.17	-688.39
Head CG Outboard	mm	184.10	-284.06	-691.07
Neck Center	mm	203.40	-351.24	-594.30
Chest Clip	mm	267.51	-349.17	-542.46
Buckle	mm	373.01	-349.80	-395.79
Base Center	mm	600.66	-351.06	-269.16
Center of Seat Frame Bottom	mm	616.38	-350.16	-109.13
Knee Outboard	mm	480.96	-253.15	-357.58
Ankle Outboard	mm	677.11	-255.89	-342.88
Target 1 - Seat Side Upper	mm	50.96	-159.55	-617.07
Target 4 - Seat Side Lower	mm	244.24	-131.84	-404.54
Target 2 - Seat Base H-Point	mm	257.23	-140.31	-323.77
Target 3 - Seat Base Side	mm	391.66	-136.10	-366.73

DUMMY INJURY

HIC (36 ms)	432
Chest Clip (3 ms)	47.80 g
Head Excursion (mm)	586
Knee Excursion (mm)	680

DUMMY POSITIONING

CRS: Harmony Defender 360 – Forward Facing – SB3PT&T

TRC Test Number: S210202-1

VRTC Test Number: FR_RR_PE_28



DUMMY POSITIONING FARO MEASUREMENTS

Description	Units	X	Y	Z
Z-Point	mm	-0.26	-0.05	0.22
Center of Seat Frame Back	mm	-124.11	-350.16	-681.15
Top of CRS	mm	-6.91	-351.74	-759.57
Top of Headrest	mm	12.28	-351.13	-854.05
Top of Head	mm	175.86	-350.15	-779.19
Bridge of Nose	mm	263.86	-348.49	-695.65
Head CG Outboard	mm	186.16	-284.56	-697.76
Neck Center	mm	206.41	-350.13	-601.75
Chest Clip	mm	275.72	-351.32	-544.68
Buckle	mm	374.67	-352.87	-400.16
Base Center	mm	599.94	-351.94	-269.81
Center of Seat Frame Bottom	mm	615.83	-349.80	-110.55
Knee Outboard	mm	483.23	-253.34	-355.35
Ankle Outboard	mm	678.66	-250.74	-341.04
Target 1 - Seat Side Upper	mm	52.38	-160.15	-617.77
Target 4 - Seat Side Lower	mm	237.26	-136.76	-399.60
Target 2 - Seat Base H-Point	mm	252.67	-145.98	-317.09
Target 3 - Seat Base Side	mm	391.17	-138.73	-359.50

DUMMY INJURY

HIC (36 ms)	480
Chest Clip (3 ms)	48.63 g
Head Excursion (mm)	578
Knee Excursion (mm)	689

DUMMY POSITIONING

CRS: Harmony Defender 360 – Forward Facing – SB3PT&T

TRC Test Number: S210202-2

VRTC Test Number: FR_RR_PE_30



DUMMY POSITIONING FARO MEASUREMENTS

Description	Units	X	Y	Z
Z-Point	mm	-0.01	-0.52	0.18
Center of Seat Frame Back	mm	-124.82	-350.62	-680.86
Top of CRS	mm	-4.10	-349.79	-762.07
Top of Headrest	mm	13.96	-352.57	-856.22
Top of Head	mm	176.71	-349.79	-776.34
Bridge of Nose	mm	265.58	-349.75	-693.18
Head CG Outboard	mm	189.35	-283.64	-694.35
Neck Center	mm	207.11	-349.39	-598.31
Chest Clip	mm	272.21	-349.53	-544.55
Buckle	mm	372.07	-349.67	-401.47
Base Center	mm	598.88	-352.22	-269.68
Center of Seat Frame Bottom	mm	616.36	-349.40	-109.99
Knee Outboard	mm	482.29	-251.22	-353.51
Ankle Outboard	mm	677.47	-247.91	-338.70
Target 1 - Seat Side Upper	mm	59.60	-157.40	-623.09
Target 4 - Seat Side Lower	mm	238.76	-134.32	-405.72
Target 2 - Seat Base H-Point	mm	253.99	-144.02	-319.14
Target 3 - Seat Base Side	mm	388.43	-142.20	-359.17

DUMMY INJURY

HIC (36 ms)	459
Chest Clip (3 ms)	46.94 g
Head Excursion (mm)	582
Knee Excursion (mm)	688

SECTION 3
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. 14



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

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Introduction

Customer Name: VRTC
Customer Contact: Bryan Crabtree
Email: Bryan.Crabtree.CTR@dot.gov
Phone: (937) 666-4511
Date Received: December 03, 2020
Date Completed: December 04, 2020

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). **This testing certification shall not be reproduced, except in full, without written approval of TRC Inc.**

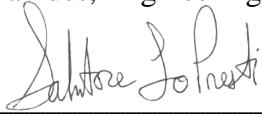
The evidence measurements of this Certification Report are traceable by the Serial Number and Certification Number located at the top of the first section for each certification.

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 Testing Requested: 12/03/2020

Testing Conducted by:  Date: 12/04/2020
Robert Benavides, Engineering Technician I

Testing Approved by:  Date: 12/07/2020
Sal LoPresti, Supervisor - Calibration Services



Appendix A – Incoming Inspection



TRC ATD Laboratory As Received Inspection Report

Name: Robert Benavides

Date: 12/4/2020

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		





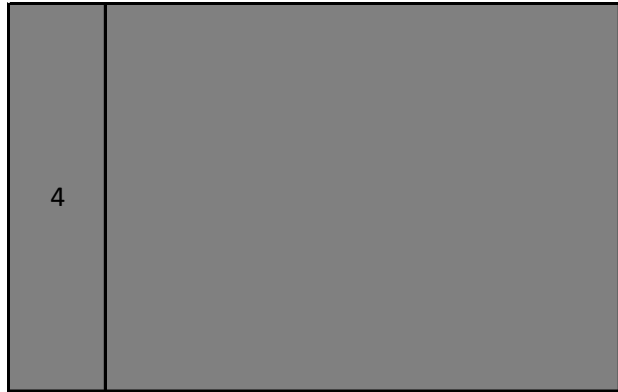
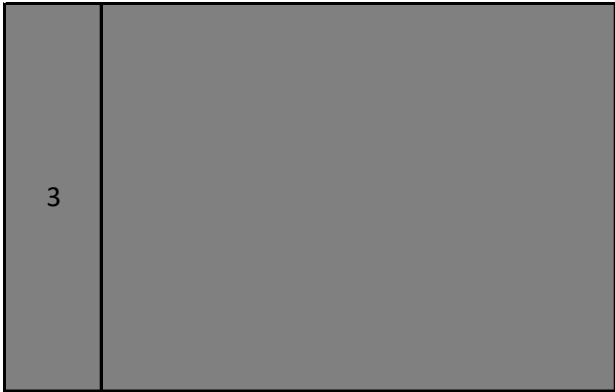
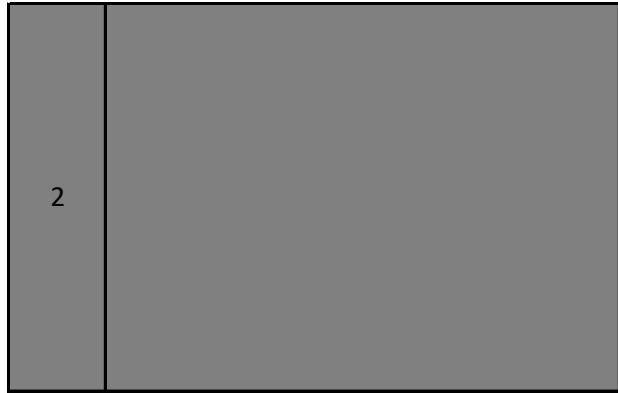
TRC ATD Laboratory As Received Inspection Photos

Name: Robert Benaides

Date: 12/4/2020

Customer: VRTC

ATD S/N: 1869





TRC ATD Laboratory Inspection Report Action Items

Name: Robert Benavides

Date: 12/4/2020

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. 14-1

Test Date: 12/4/2020

Test Parameter	Specification	Test Results	Pass
Temperature	18.9 - 25.6 °C	21.4 °C	Yes
Relative Humidity	10 - 70 %	39 %	Yes
Peak Head Resultant Acceleration	250 - 280 g	254.3 g	Yes
Peak Head Lateral Acceleration	(-15) - 15 g	-9.7 g	Yes
Is Acceleration Curve Unimodal?	< 10 %	4.90 %	Yes

Test meets specifications.

Condition: Used

Comments:

Head Skin S/N: 03254

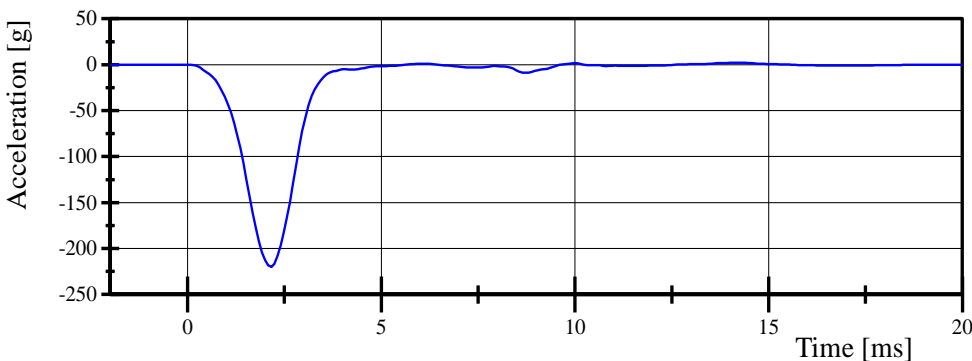
Transportation Research Center Inc.

Front Head Drop

HIII 3YO Serial No. 1869 Certification No. 14-1

Test Date: 12/4/2020

Head X-Axis Acceleration

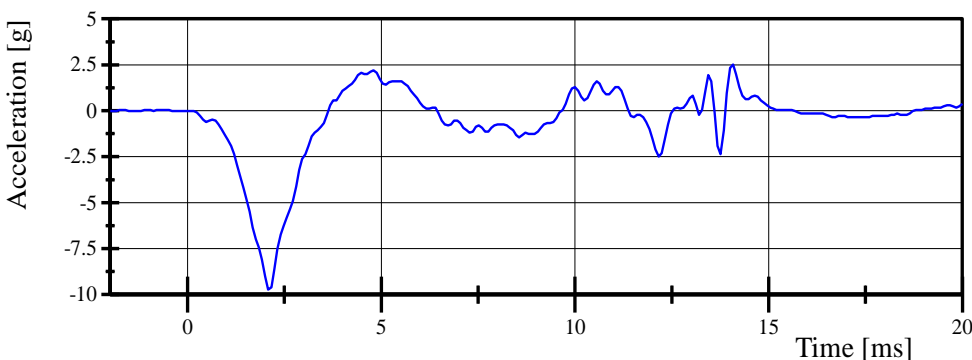


Filter Class: CFC_1000

Max: 2.2 g at 14.1 ms

Min: -219.9 g at 2.2 ms

Head Y-Axis Acceleration

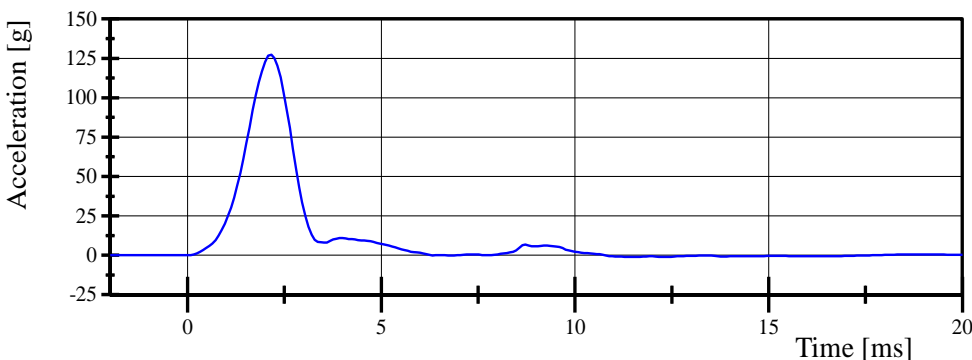


Filter Class: CFC_1000

Max: 2.5 g at 14.1 ms

Min: -9.7 g at 2.1 ms

Head Z-Axis Acceleration

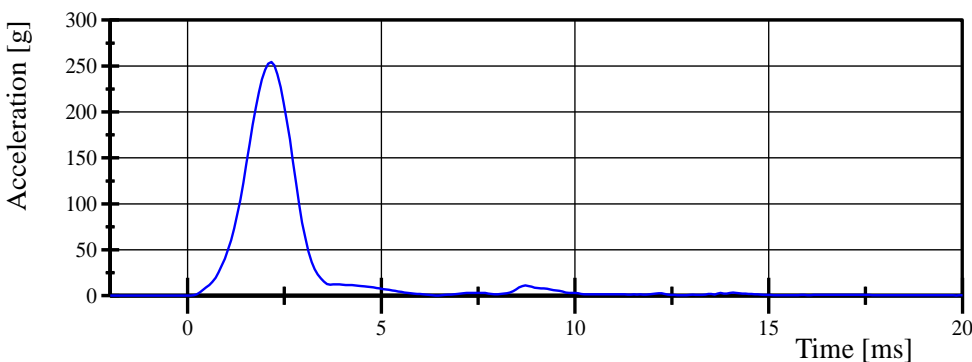


Filter Class: CFC_1000

Max: 127.4 g at 2.2 ms

Min: -1.1 g at 12.2 ms

Head Resultant Acceleration



Filter Class: CFC_1000

Max: 254.3 g at 2.2 ms

Min: 0.0 g at -2.0 ms

Transportation Research Center Inc.

Neck Flexion

HIII 3YO Serial No. 1869 Certification No. 14-1

Test Date: 12/4/2020

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	21.6 °C	Yes
Relative Humidity	10 - 70 %	38 %	Yes
Pendulum Impact Velocity	5.40 - 5.60 m/s	5.591 m/s	Yes
Pendulum Integrated Velocity Change at 10 ms	(-2.0) - (-2.7) m/s	-2.25 m/s	Yes
Pendulum Integrated Velocity Change at 15 ms	(-3.0) - (-4.0) m/s	-3.33 m/s	Yes
Pendulum Integrated Velocity Change at 20 ms	(-4.0) - (-5.1) m/s	-4.54 m/s	Yes
Total Headform D-Plane Rotation	(-70) - (-82) °	-78.6 °	Yes
Peak Neck Occipital Condyles Moment	42 - 53 Nm	45.1 Nm	Yes
Neck Occipital Condyles Moment Decay to 10 Nm	60 - 80 ms	73.0 ms	Yes

Test meets specifications.

Condition: Used

Comments:

Neck S/N: DG7094

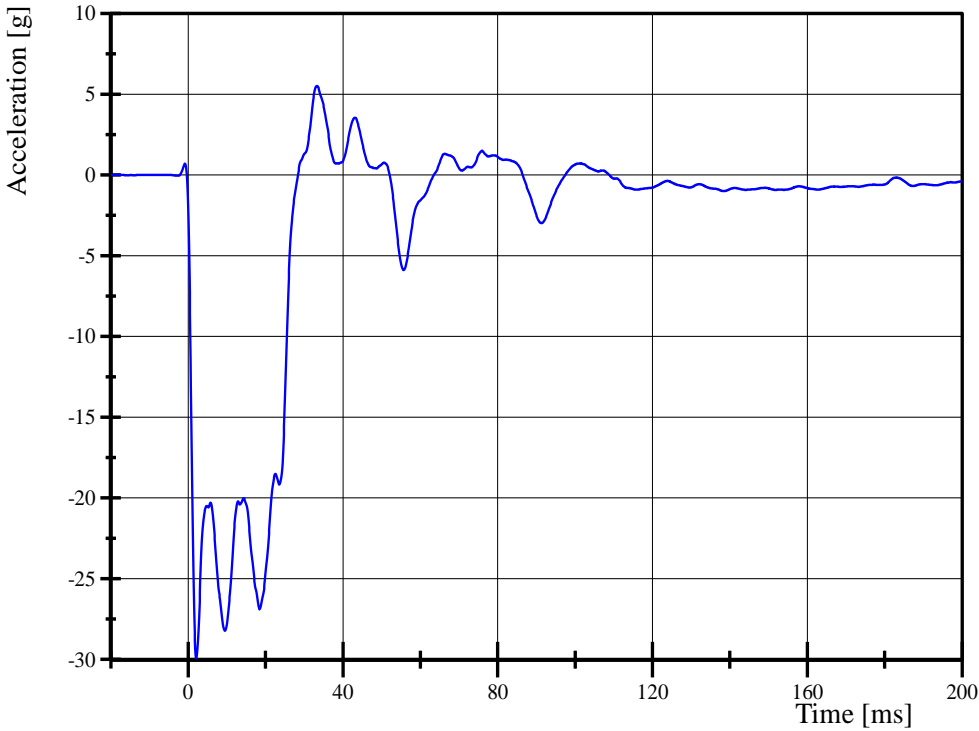
Transportation Research Center Inc.

Neck Flexion

HIII 3YO Serial No. 1869 Certification No. 14-1

Test Date: 12/4/2020

Pendulum Acceleration

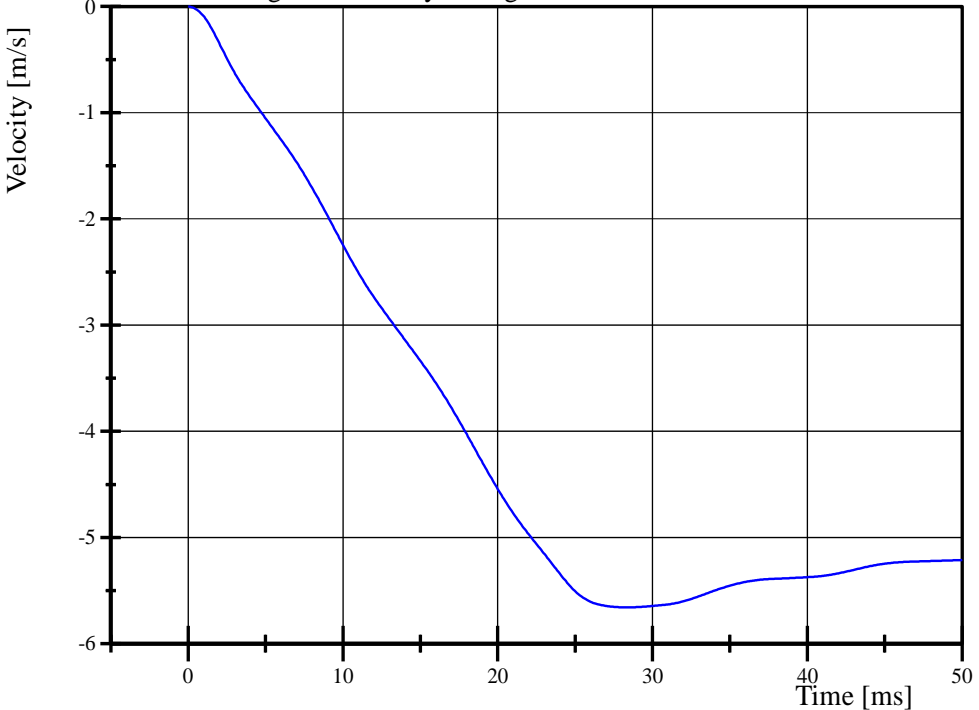


Filter Class: CFC_180

Max: 5.5 g at 33.2 ms

Min: -29.9 g at 2.1 ms

Pendulum Integrated Velocity Change



Filter Class: CFC_180

Max: 0.0 m/s at 0.0 ms

Min: -5.7 m/s at 28.3 ms

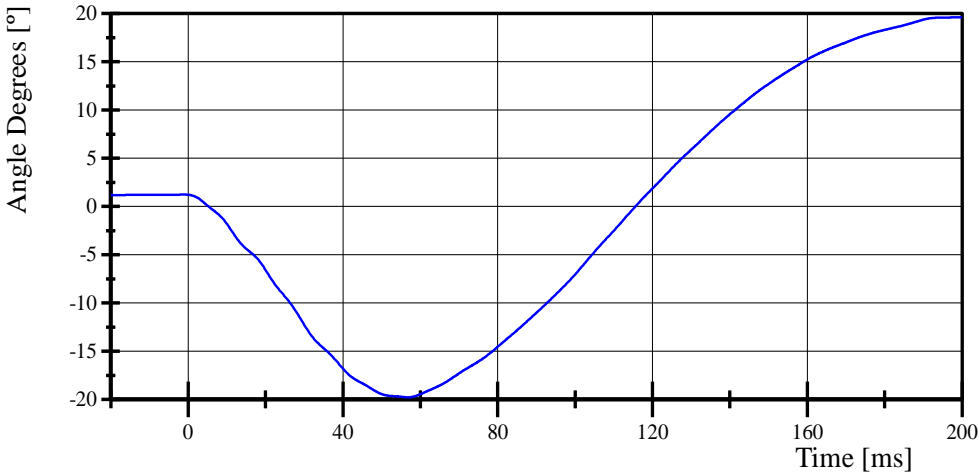
Transportation Research Center Inc.

Neck Flexion

HIII 3YO Serial No. 1869 Certification No. 14-1

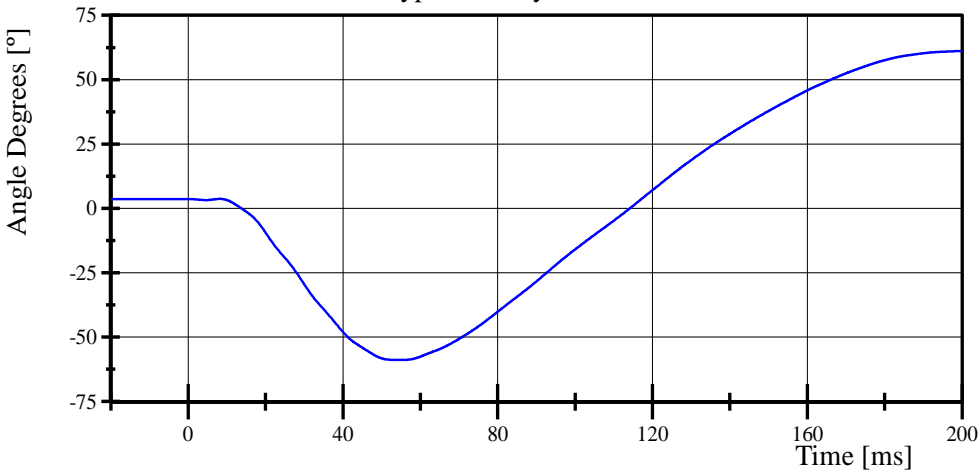
Test Date: 12/4/2020

Pot Rotation at the Base of Neck



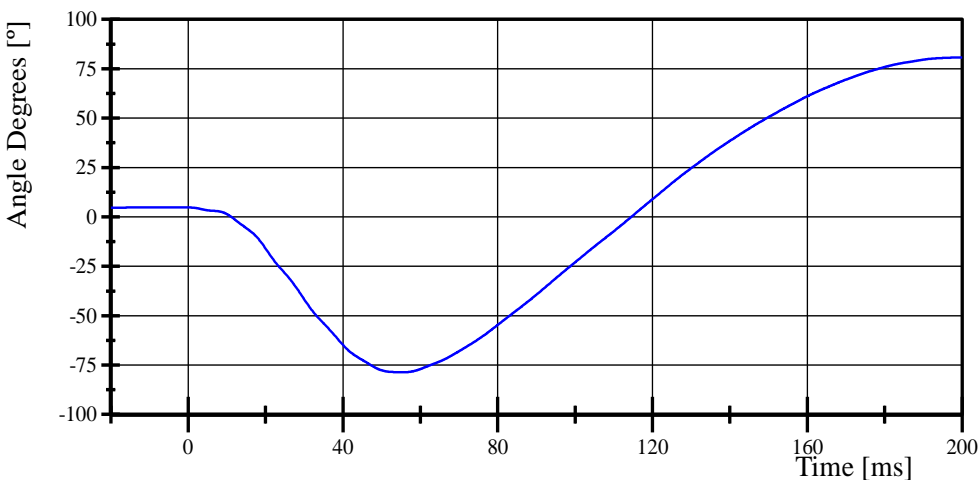
Filter Class: CFC_60
Max: 19.6 ° at 200.0 ms
Min: -19.8 ° at 56.8 ms

Headform Rotation at Occypital Condyles



Filter Class: CFC_60
Max: 61.1 ° at 200.0 ms
Min: -58.9 ° at 54.5 ms

Total Headform D-Plane Rotation



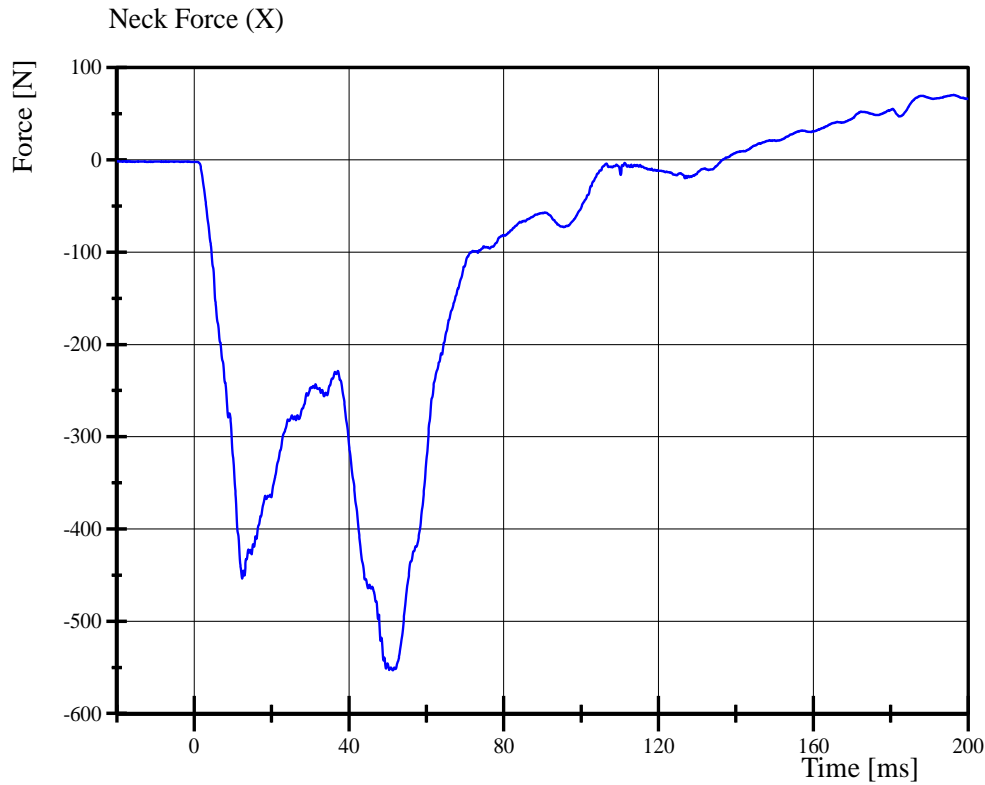
Filter Class: CFC_60
Max: 80.7 ° at 200.0 ms
Min: -78.6 ° at 55.4 ms

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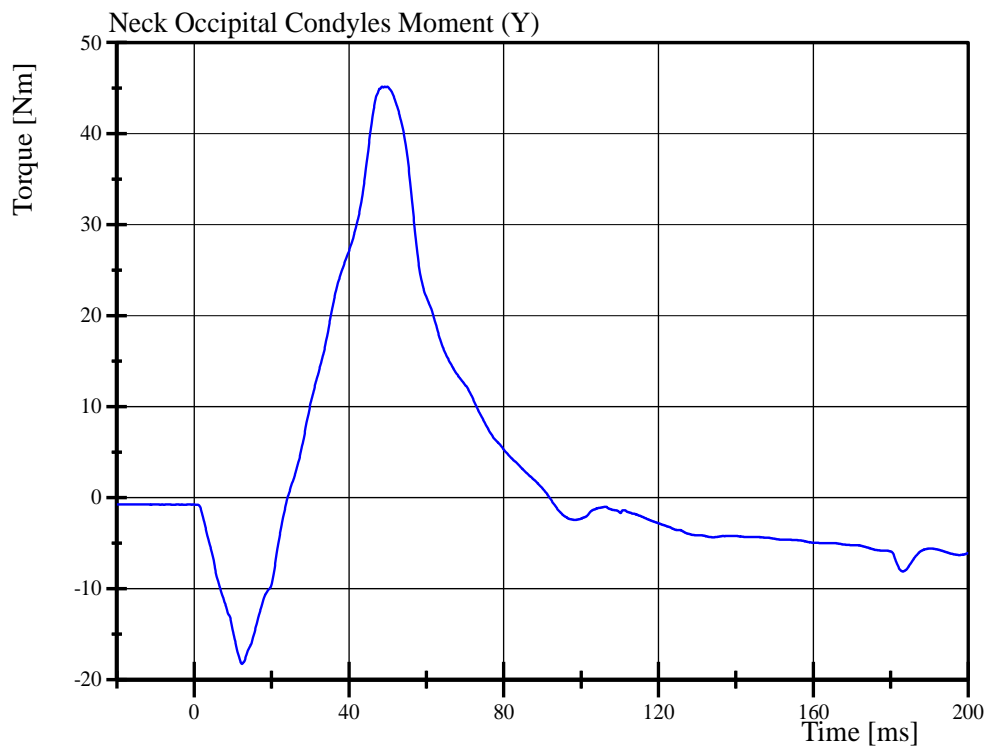
Neck Flexion

HIII 3YO Serial No. 1869 Certification No. 14-1

Test Date: 12/4/2020



Filter Class: CFC_1000
Max: 70.4 N at 196.2 ms
Min: -553.0 N at 51.3 ms



Filter Class: CFC_600
Max: 45.1 Nm at 48.6 ms
Min: -18.2 Nm at 12.3 ms

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Neck Extension

HIII 3YO Serial No. 1869 Certification No. 14-2

Test Date: 12/4/2020

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	21.6 °C	Yes
Relative Humidity	10 - 70 %	39 %	Yes
Pendulum Impact Velocity	(-3.55) - (-3.75) m/s	-3.743 m/s	Yes
Pendulum Integrated Velocity Change at 6 ms	1.0 - 1.4 m/s	1.12 m/s	Yes
Pendulum Integrated Velocity Change at 10 ms	1.9 - 2.5 m/s	2.01 m/s	Yes
Pendulum Integrated Velocity Change at 14 ms	2.8 - 3.5 m/s	2.89 m/s	Yes
Total Headform D-Plane Rotation	83 - 93 °	89.9 °	Yes
Peak Neck Occipital Condyles Moment	(-43.7) - (-53.3) Nm	-50.92 Nm	Yes
Neck Occipital Condyles Moment Decay to 10 Nm	60 - 80 ms	70.8 ms	Yes

Test meets specifications.

Condition: Used

Comments:

Neck S/N: DG7094

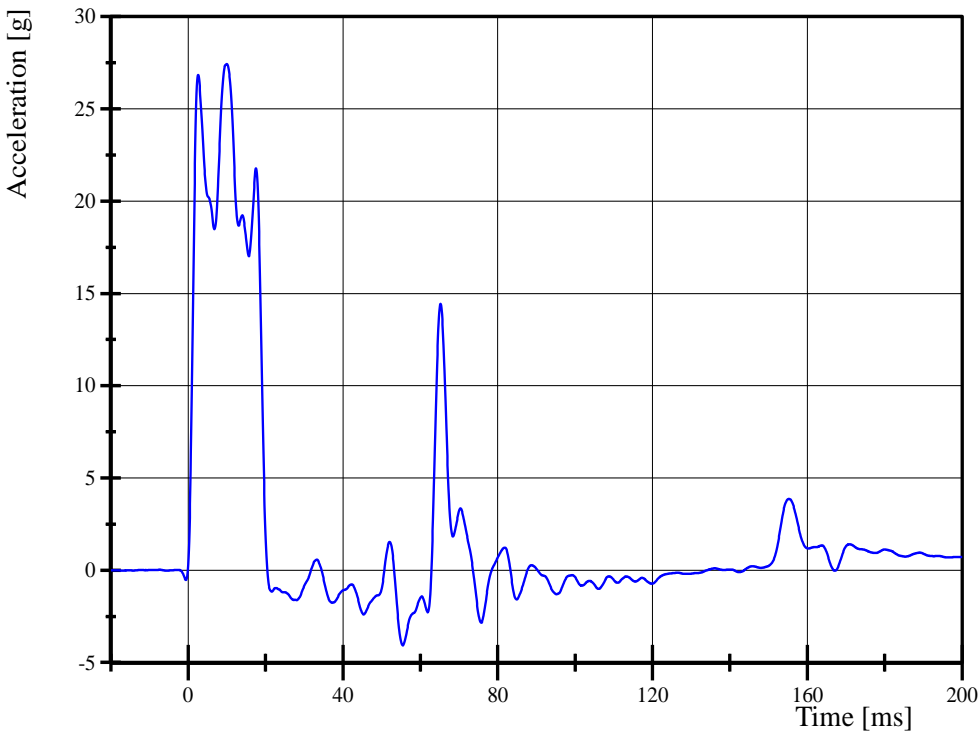
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Neck Extension

HIII 3YO Serial No. 1869 Certification No. 14-2

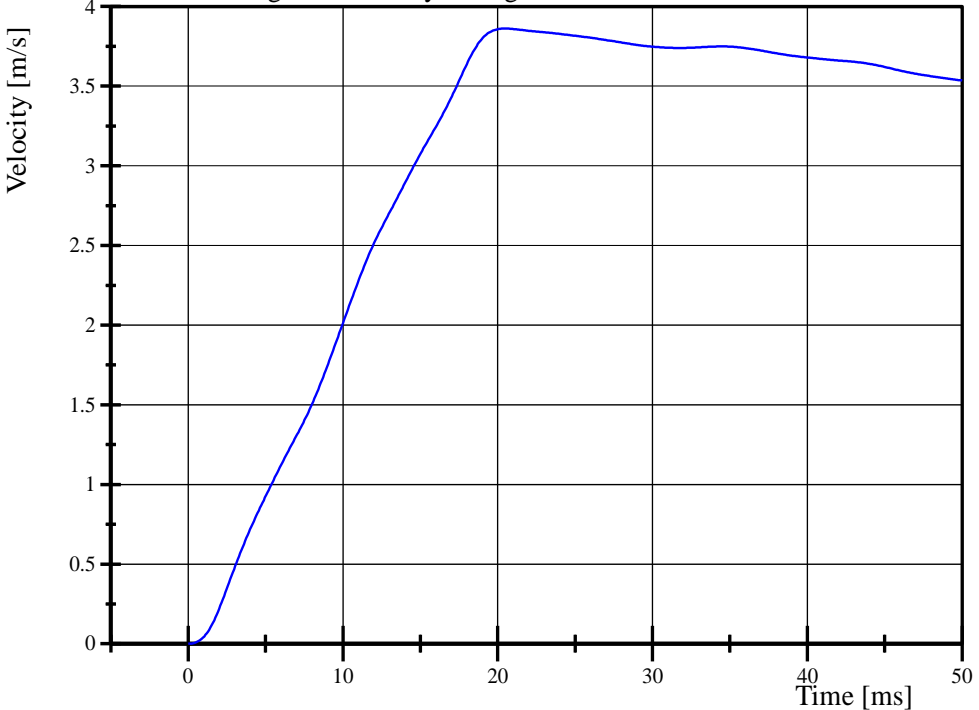
Test Date: 12/4/2020

Pendulum Acceleration



Filter Class: CFC_180
Max: 27.4 g at 10.0 ms
Min: -4.1 g at 55.4 ms

Pendulum Integrated Velocity Change



Filter Class: CFC_180
Max: 3.9 m/s at 20.5 ms
Min: 0.0 m/s at 0.0 ms

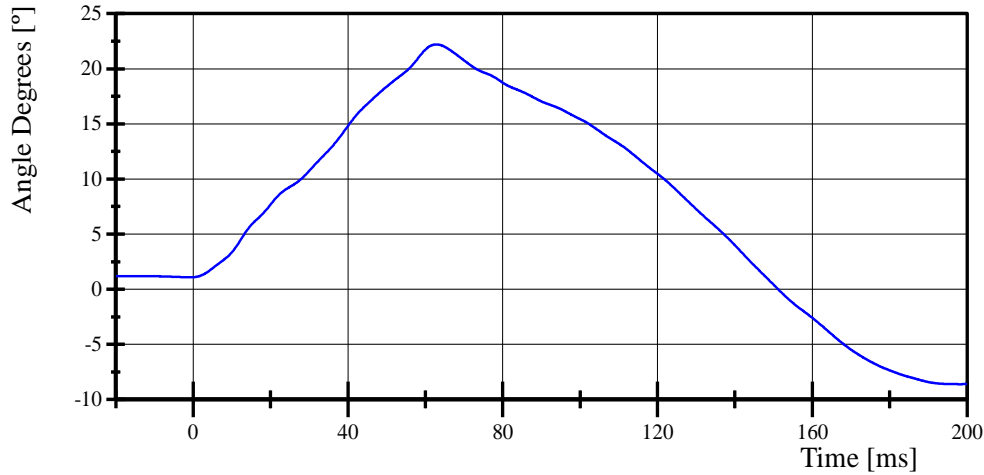
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Neck Extension

HIII 3YO Serial No. 1869 Certification No. 14-2

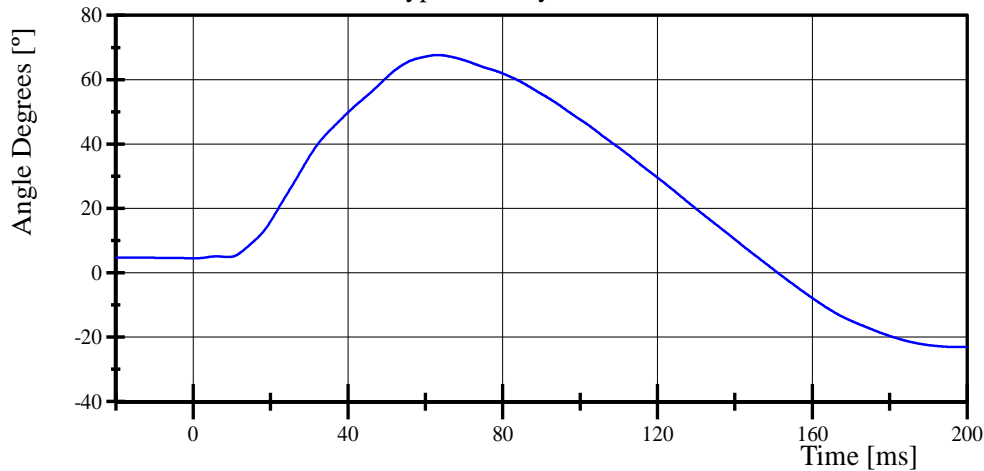
Test Date: 12/4/2020

Pot Rotation at the Base of Neck



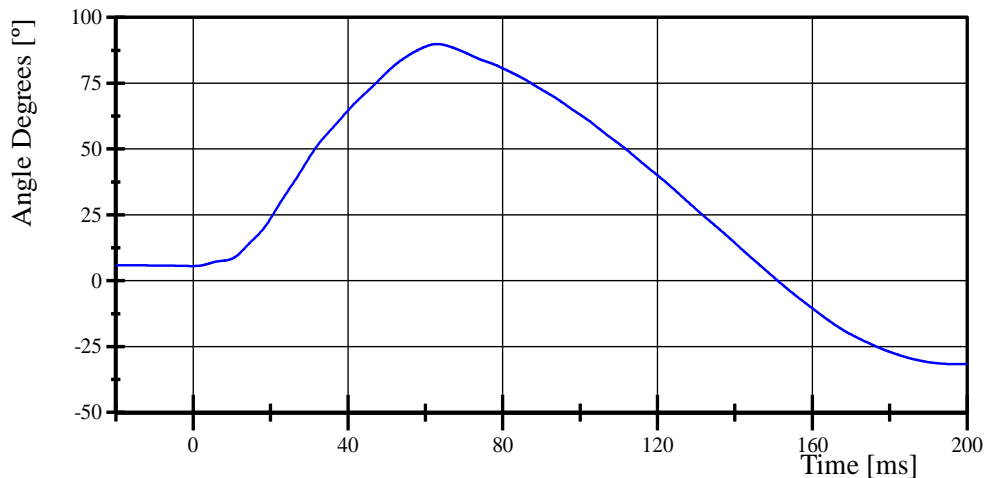
Filter Class: CFC_60
Max: 22.2 ° at 62.8 ms
Min: -8.6 ° at 198.2 ms

Headform Rotation at Occypital Condyles



Filter Class: CFC_60
Max: 67.7 ° at 63.2 ms
Min: -23.1 ° at 197.3 ms

Total Headform D-Plane Rotation



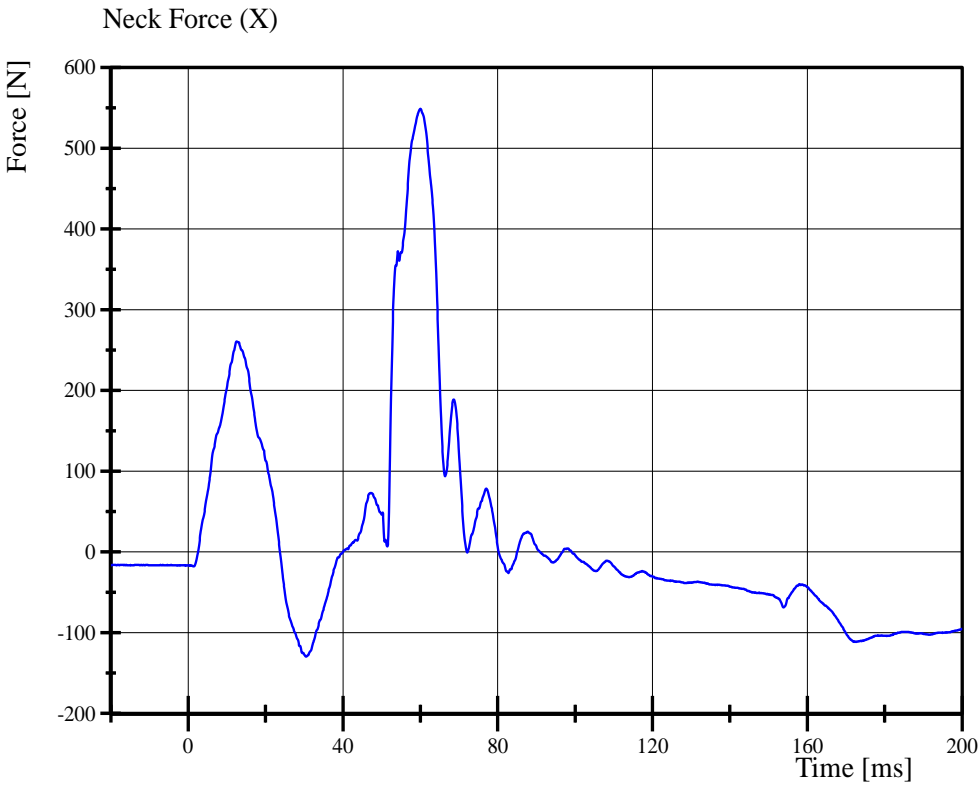
Filter Class: CFC_60
Max: 89.9 ° at 63.0 ms
Min: -31.7 ° at 197.4 ms

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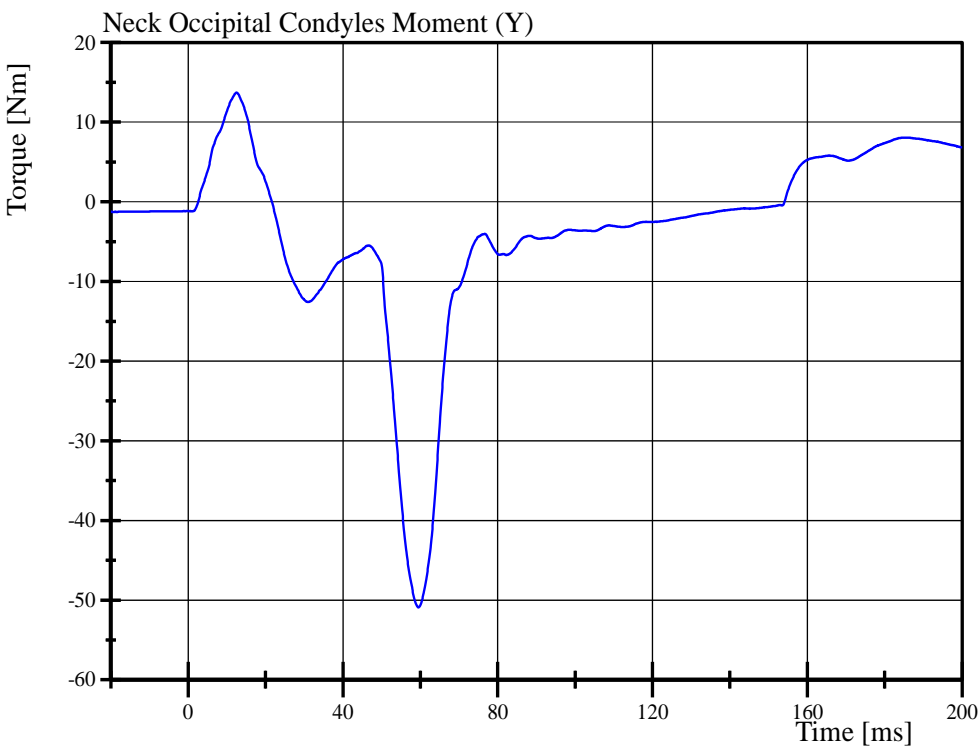
Neck Extension

HIII 3YO Serial No. 1869 Certification No. 14-2

Test Date: 12/4/2020



Filter Class: CFC_1000
Max: 549.0 N at 60.0 ms
Min: -129.5 N at 30.5 ms



Filter Class: CFC_600
Max: 13.7 Nm at 12.5 ms
Min: -50.9 Nm at 59.5 ms

Transportation Research Center Inc.

Front Thorax

HIII 3YO Serial No. 1869 Certification No. 14-1

Test Date: 12/4/2020

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	21.8 °C	Yes
Relative Humidity	10 - 70 %	32 %	Yes
Probe Velocity	5.9 - 6.1 m/s	6.04 m/s	Yes
Probe Force Peak Between 32.0 mm and 38.0 mm Chest Deflection	(-680) - (-810) N	-738.8 N	Yes
Probe Force Peak Between 12.5 mm and 32.0 mm Chest Deflection	>= (-910) N	-682.3 N	Yes
Maximum Chest Compression	(-32) - (-38) mm	-36.8 mm	Yes
Internal Hysteresis	65 - 85 %	65.6 %	Yes

Test meets specifications.

Condition: Used

Comments:

Torso Flesh S/N: 16503

Rib Set S/N: 16031758A

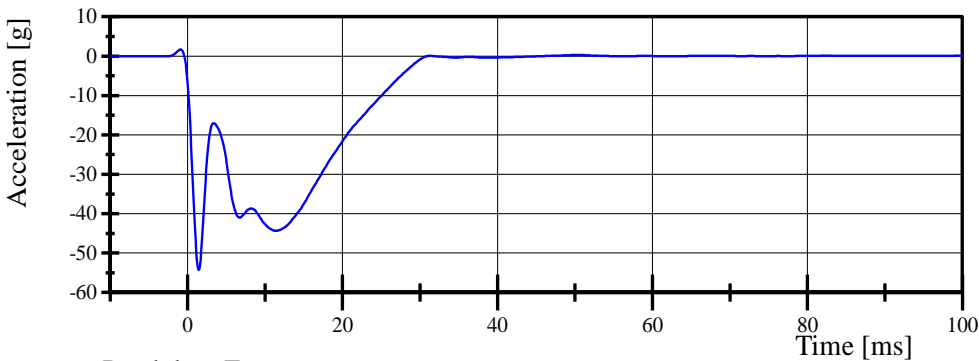
Transportation Research Center Inc.

Front Thorax

HIII 3YO Serial No. 1869 Certification No. 14-1

Test Date: 12/4/2020

Pendulum Acceleration

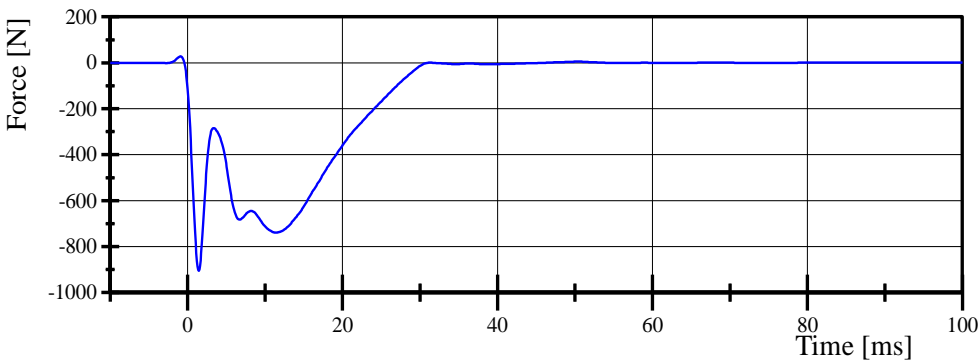


Filter Class: CFC_180

Max: 1.7 g at -0.9 ms

Min: -54.3 g at 1.4 ms

Pendulum Force

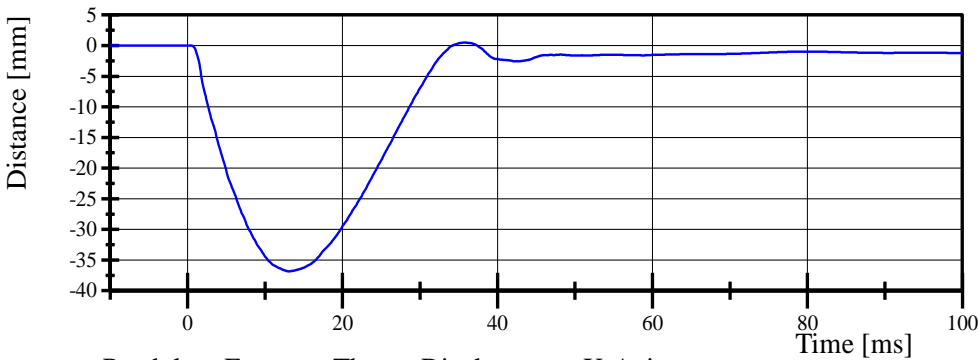


Filter Class: CFC_180

Max: 28.0 N at -0.9 ms

Min: -905.5 N at 1.4 ms

Thorax Displacement X-Axis

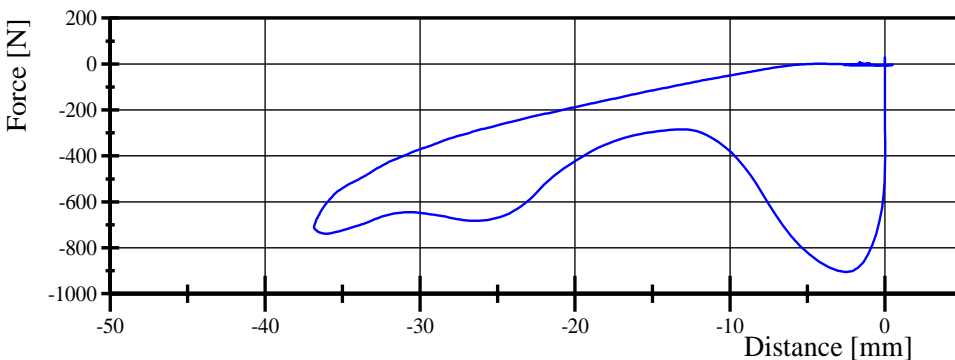


Filter Class: CFC_600

Max: 0.5 mm at 35.8 ms

Min: -36.8 mm at 13.0 ms

Pendulum Force vs. Thorax Displacement X-Axis



Filter Class: CFC_180

Max: 28.0 N at -0.0 mm

Min: -905.5 N at -2.5 mm

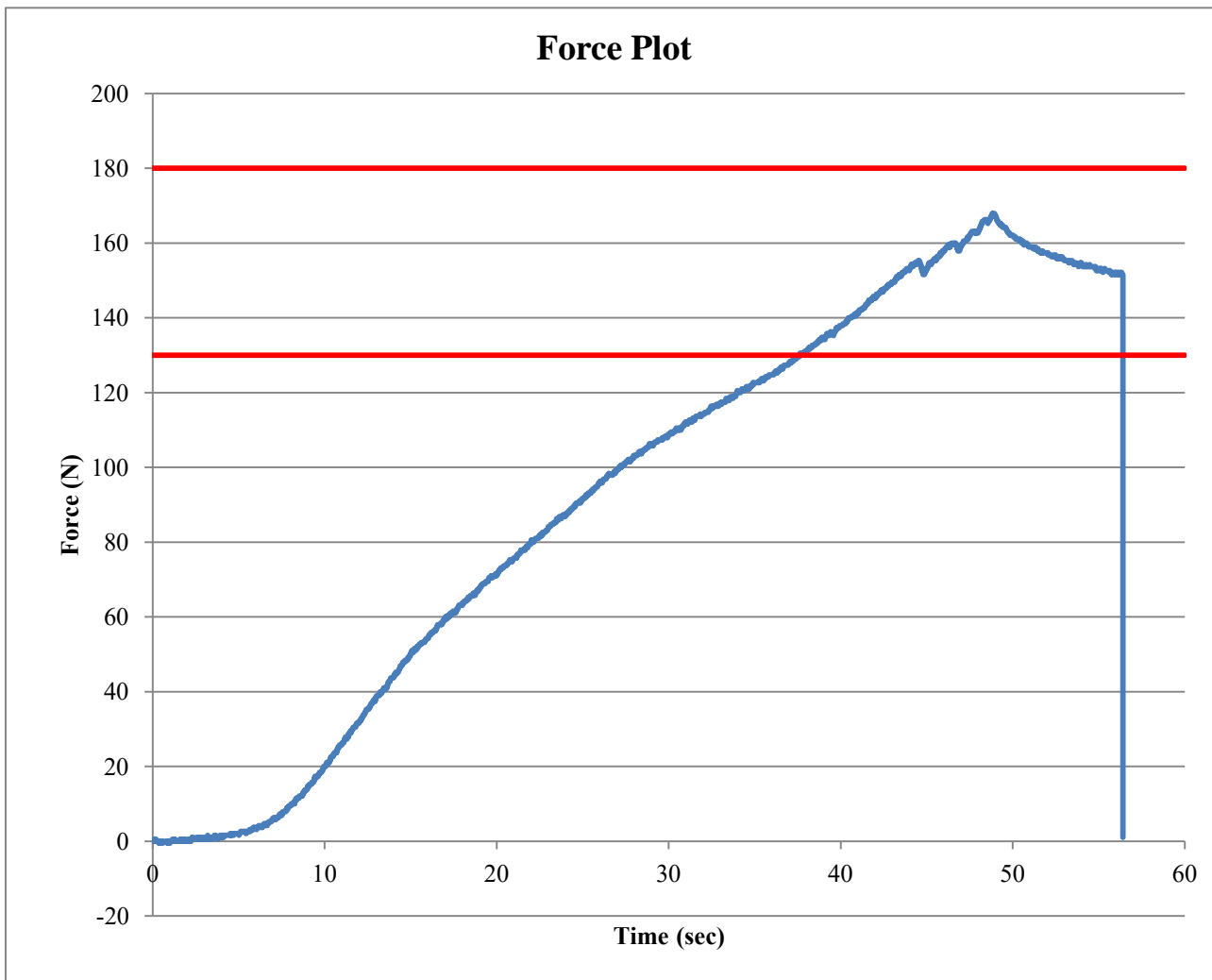
Transportation Research Center Inc.

Hybrid III 3-Year Old Child Torso Flexion



Customer: VRTC
Serial Number: 1869 Date: 12/4/2020
Test Number: 1 Time: 11:45

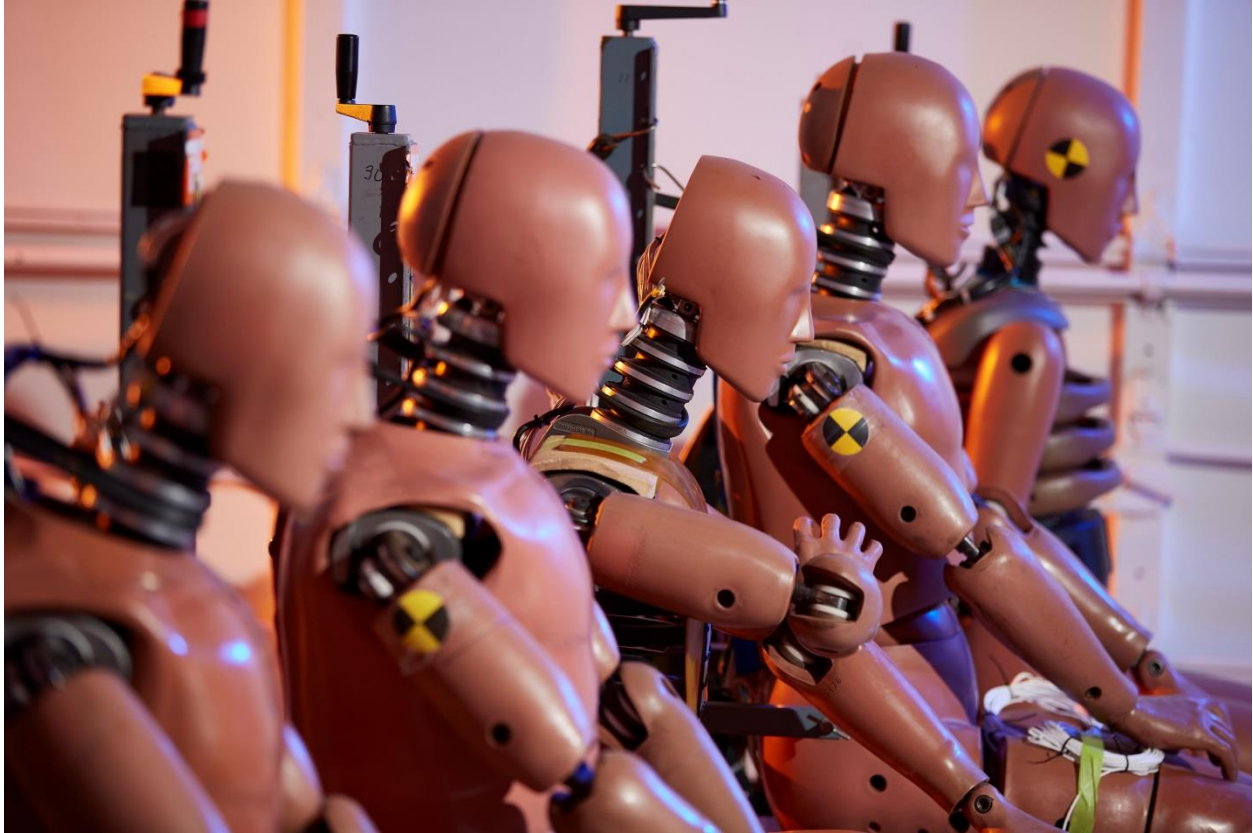
TEST PARAMETER	SPECIFICATION	TEST RESULTS
Temperature	18.9 - 25.6	21.1 °C Pass
Humidity	10 - 70	40 % Pass
Average Angular Velocity	0.5 - 1.5	0.91 deg/sec Pass
Initial Angle	0 - 15	6.89 deg Pass
Peak Force at 45.23°	130 - 180	167.91 N Pass
Final Angle	-10 - 10	4.04 deg Pass



Comments:
Torso Skin S/N: N/A
Lumbar S/N: N/A
Abdomen S/N: D63677

Appendix C – Quality Assurance

Quality Assurance



ATD Assembly & Final Inspection

ATD Type: Hybrid III (3) Year Old

ATD Serial Number: 1869

Assembled by: *Rob Benda*

Inspected by: *Ben Wain*

Date Inspected: 12/04/2020