

**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**

**March 2022**

**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 the test bench and test procedures for the proposed FMVSS 213 frontal impact test.

**SUMMARY**

A Hybrid III 3 year old dummy (serial number 1869) was secured in the left rear occupant position (position 4 or P4) in a rearward facing child restraint system (CRS) or secured in a forward 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 Lower Anchors (LA Only) or Lower anchors with top tether (LATCH).

Section 2 contains rearward facing CRS. Section 3 contains forward facing CRS. Section 4 contains the dummy certification data.

**SECTION 2**  
**REARWARD FACING CRS TEST SUMMARY**

**TEST DUMMY INFORMATION**

Description	Position # 4 CRS
ATD Type/Serial No.	Hybrid III 3 Year Old/1869
Restraint System	LA Only
CRS Direction	Rearward Facing
Foam Cushion	WB7

**CAMERA POSITIONING FARO MEASUREMENTS**

Description	Units	X	Y	Z
Origin	mm	0.00	0.00	0.00
N1 Driver Front	mm	--- <sup>1</sup>	--- <sup>1</sup>	--- <sup>1</sup>
Driver Side	mm	377.15	-893.72	-365.63

<sup>1</sup> Measurements not recorded

## DUMMY POSITIONING

CRS: Baby Trend Protect 3 in 1 – Rearward Facing – LA Only

TRC Test Number: S220308-1

VRTC Test Number: FR\_BE\_03



### DUMMY POSITIONING FARO MEASUREMENTS

Description	Units	X	Y	Z
Z-Point	mm	-0.18	-0.36	0.45
Center of the seat frame bottom	mm	613.65	350.80	-105.45
CRS base center	mm	531.62	348.81	-194.95
CRS mid-height	mm	741.82	348.82	-538.14
Top of CRS	mm	824.16	352.65	-734.62
CRS bottom strap center	mm	86.24	348.83	-455.86
Top of the head	mm	671.92	349.78	-696.57
Bridge of nose	mm	545.77	349.55	-689.78
Head CG outboard	mm	608.34	283.35	-643.18
Chest Clip	mm	448.64	351.78	-554.76
Buckle	mm	273.48	349.46	-439.23
Knee pivot	mm	178.79	229.70	-453.91
CRS 1	mm	756.56	220.59	-662.39
CRS 4	mm	580.53	166.68	-476.24
CRS 2	mm	350.44	147.61	-327.59
CRS 3	mm	198.04	210.64	-297.31
Center of seat frame back	mm	-120.39	349.96	-680.51

HIC (36 ms)	361
Chest Clip (3 ms)	53.3 g
Max Seat Back Angle (from vertical)	45 °

**SECTION 3**  
**FORWARD FACING CRS TEST SUMMARY**

**TEST DUMMY INFORMATION**

Description	Position # 4 CRS
ATD Type/Serial No.	Hybrid III 3 Year Old/1869
Restraint System	LA Only, LATCH
CRS Direction	Forward Facing
Foam Cushion	WB15, WB7

**CAMERA POSITIONING FARO MEASUREMENTS**

Description	Units	X	Y	Z
Origin	mm	0.00	0.00	0.00
N1 Driver Front	mm	--- <sup>1</sup>	--- <sup>1</sup>	--- <sup>1</sup>
Driver Side	mm	377.15	-893.72	-365.63

<sup>1</sup> Measurements not recorded

## DUMMY POSITIONING

CRS: Britax Marathon Clicktight – Forward Facing – LA Only

TRC Test Number: S220309-1

VRTC Test Number: FR\_BE\_05



### DUMMY POSITIONING FARO MEASUREMENTS

Description	Units	X	Y	Z
Z-Point	mm	-0.10	-0.22	0.24
Center of the seat frame bottom	mm	613.49	350.37	-105.60
CRS base center	mm	577.29	350.26	-234.41
CRS base center at strap	mm	619.59	349.36	-318.26
Center of seat frame back	mm	-120.46	349.93	-680.51
Top of CRS	mm	-38.98	349.27	-707.32
Top of Headrest	mm	-34.15	350.03	-765.17
Top of the head	mm	142.39	350.66	-761.33
Bridge of nose	mm	256.23	351.74	-708.12
Head CG outboard	mm	184.34	286.86	-685.90
Neck center	mm	225.46	351.70	-599.41
Chest Clip	mm	300.92	350.08	-567.63
Buckle	mm	434.29	350.14	-432.05
Knee pivot	mm	544.62	251.72	-437.44
Left top of knee	mm	532.43	273.83	-466.73
Right top of knee	mm	531.56	422.07	-469.07
Ankle	mm	735.19	255.51	-381.74
CRS 1	mm	38.37	169.49	-636.58
CRS 4	mm	206.53	162.79	-388.81
CRS 2	mm	360.81	149.55	-333.39
CRS 3	mm	512.64	144.11	-350.99

### DUMMY INJURY

HIC (36 ms)	652
Chest Clip (3 ms)	52.6 g
Head Excursion (mm)	749
Knee Excursion (mm)	777

## Dummy Positioning

CRS: Chicco NextFit Sport – Forward Facing – LATCH

TRC Test Number: S220309-2

VRTC Test Number: FR\_BE\_07



### Dummy Positioning FARO Measurements

Description	Units	X	Y	Z
Z-Point	mm	-0.40	-0.21	0.49
Center of the seat frame bottom	mm	613.65	350.42	-105.57
CRS base center	mm	602.48	350.93	-244.92
CRS base center at strap	mm	601.63	350.85	-330.64
Center of seat frame back	mm	-121.12	350.83	-681.89
Top of CRS	mm	-27.07	350.39	-727.89
Top of Headrest	mm	-21.73	353.15	-854.40
Top of the head	mm	119.66	349.92	-800.99
Bridge of nose	mm	224.25	349.14	-729.95
Head CG outboard	mm	147.85	286.28	-720.17
Neck center	mm	176.98	350.29	-627.64
Chest Clip	mm	245.75	350.86	-585.03
Buckle	mm	365.96	351.61	-431.70
Knee pivot	mm	478.80	258.09	-410.97
Left top of knee	mm	471.80	282.85	-443.01
Right top of knee	mm	471.43	415.55	-444.10
Ankle	mm	676.76	258.32	-416.95
CRS 1	mm	13.60	182.71	-626.69
CRS 4	mm	199.02	151.82	-398.71
CRS 2	mm	309.43	144.21	-341.68
CRS 3	mm	450.02	140.19	-368.09

### DUMMY INJURY

HIC (36 ms)	311
Chest Clip (3 ms)	45.3 g
Head Excursion (mm)	589
Knee Excursion (mm)	NA

**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. 15



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

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# Introduction

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Customer Name: VRTC  
Customer Contact: Bryan Crabtree  
Email: Bryan.Crabtree.CTR@dot.gov  
Phone: (937) 666-4511  
Date Received: February 17, 2022  
Date Completed: February 17, 2022

Special Instruction: N/A

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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.

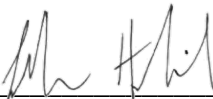
Each component of the ATD to be tested was contained in a temperature controlled environment for a period of at least 4 hours before the test. The temperature in the ATD Certification Laboratory was between 20.6°C and 22.2°C (69.08°F – 71.96°F). The relative humidity in the ATD Certification Laboratory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

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Date Received: 02/17/2022

Testing Conducted by:   
Robert Benavides

Date: 02/17/2022

Testing Approved by:   
Josh Hendricks

Date: 02/17/2022

## Appendix A – Incoming Inspection



# TRC ATD Laboratory As Received Inspection Report

Name: Robert Benavides

Date: 2/17/2022

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		





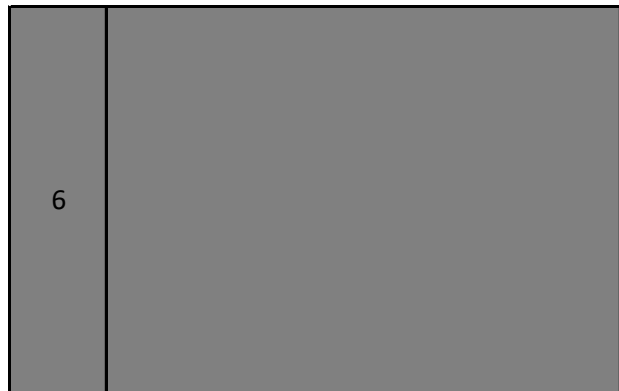
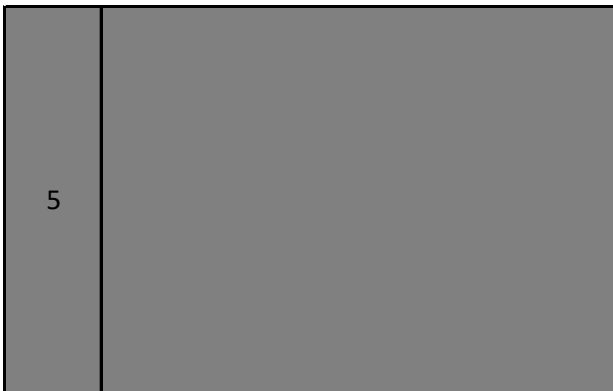
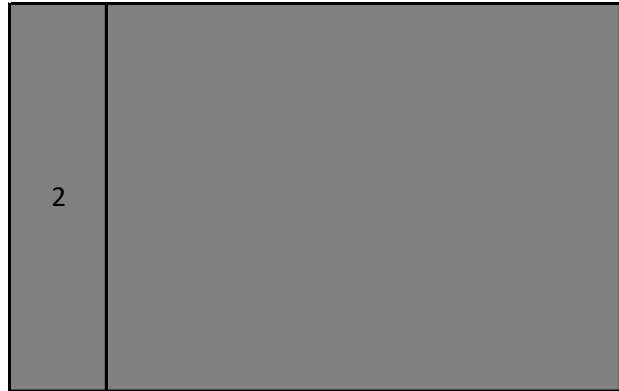
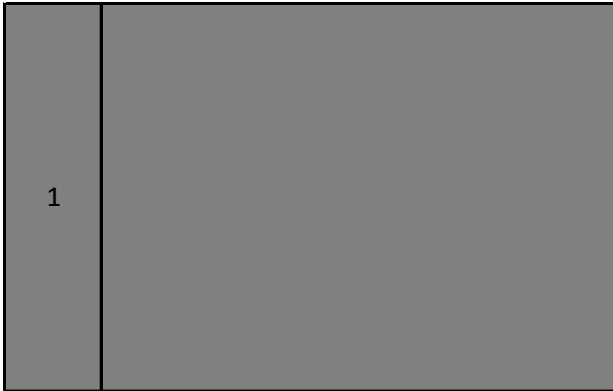
TRC ATD Laboratory As Received Inspection Photos

Name: Robert Benavides

Date: 2/17/2022

Customer: VRTC

ATD S/N: 1869





# TRC ATD Laboratory Inspection Report Action Items

Name: Robert Benavides

Date: 2/17/2022

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. 15-1

Test Date: 2/17/2022

<b>Test Parameter</b>	<b>Specification</b>	<b>Test Results</b>	<b>Pass</b>
Temperature	18.9 - 25.6 °C	21.7 °C	Yes
Relative Humidity	10 - 70 %	40 %	Yes
Peak Head Resultant Acceleration	250 - 280 g	256.5 g	Yes
Peak Head Lateral Acceleration	(-15) - 15 g	2.9 g	Yes
Is Acceleration Curve Unimodal?	< 10 %	5.19 %	Yes

**Test meets specifications.**

**Condition: Used**

**Comments:**

**Head Skin S/N: 03254**

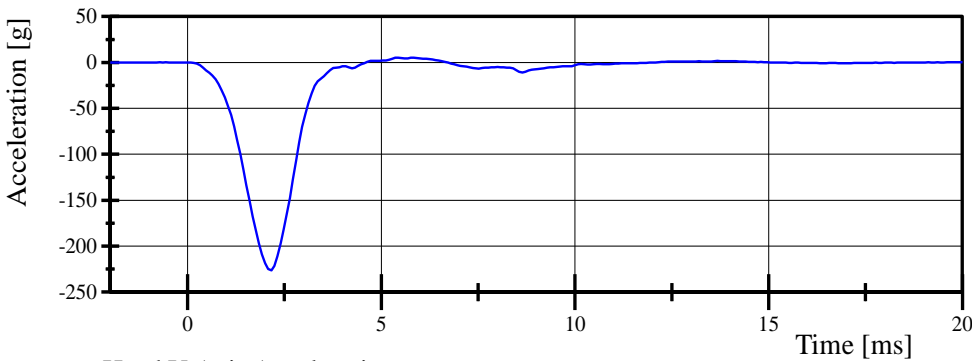
# Transportation Research Center Inc.

Front Head Drop

HIII 3YO Serial No. 1869 Certification No. 15-1

Test Date: 2/17/2022

Head X-Axis Acceleration

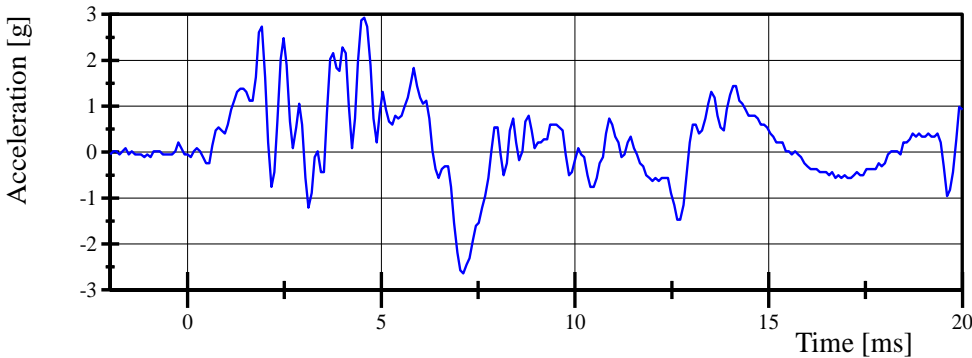


Filter Class: CFC\_1000

Max: 5.2 g at 5.4 ms

Min: -226.4 g at 2.2 ms

Head Y-Axis Acceleration

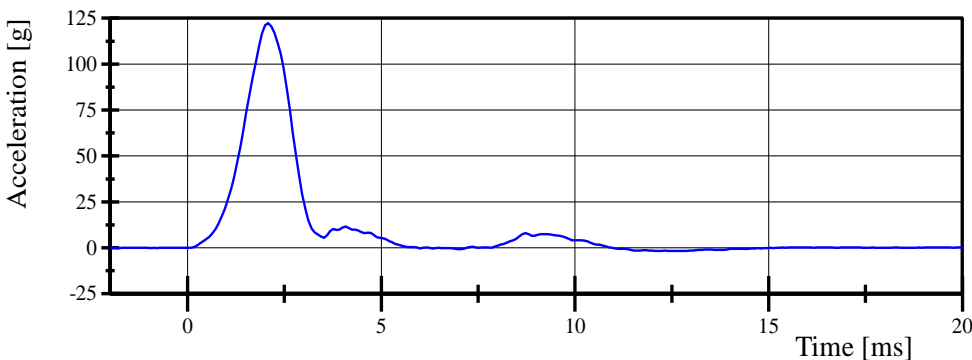


Filter Class: CFC\_1000

Max: 2.9 g at 4.6 ms

Min: -2.6 g at 7.1 ms

Head Z-Axis Acceleration

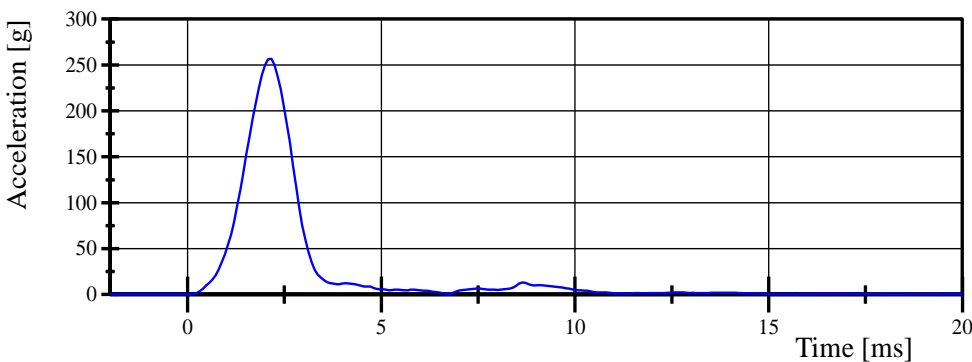


Filter Class: CFC\_1000

Max: 122.3 g at 2.1 ms

Min: -1.7 g at 12.6 ms

Head Resultant Acceleration



Filter Class: CFC\_1000

Max: 256.5 g at 2.2 ms

Min: 0.0 g at -1.2 ms

# Transportation Research Center Inc.

Neck Flexion

HIII 3YO Serial No. 1869 Certification No. 15-1

Test Date: 2/17/2022

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	21.8 °C	Yes
Relative Humidity	10 - 70 %	42 %	Yes
Pendulum Impact Velocity	5.40 - 5.60 m/s	5.593 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	-3.37 m/s	Yes
Pendulum Integrated Velocity Change at 20 ms	(-4.0) - (-5.1) m/s	-4.56 m/s	Yes
Total Headform D-Plane Rotation	(-70) - (-82) °	-78.2 °	Yes
Peak Neck Occipital Condyles Moment	42 - 53 Nm	43.6 Nm	Yes
Neck Occipital Condyles Moment Decay to 10 Nm	60 - 80 ms	70.9 ms	Yes

**Test meets specifications.**

**Condition: Used**

**Comments:**

**Neck S/N: DG7094**

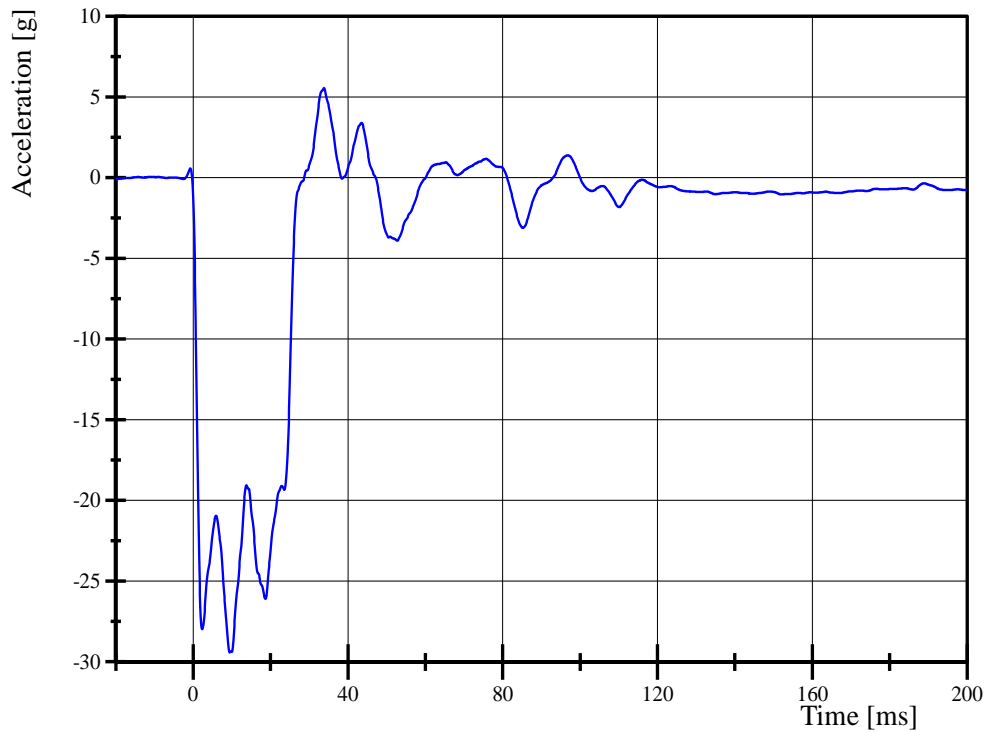
# Transportation Research Center Inc.

Neck Flexion

HIII 3YO Serial No. 1869 Certification No. 15-1

Test Date: 2/17/2022

Pendulum Acceleration

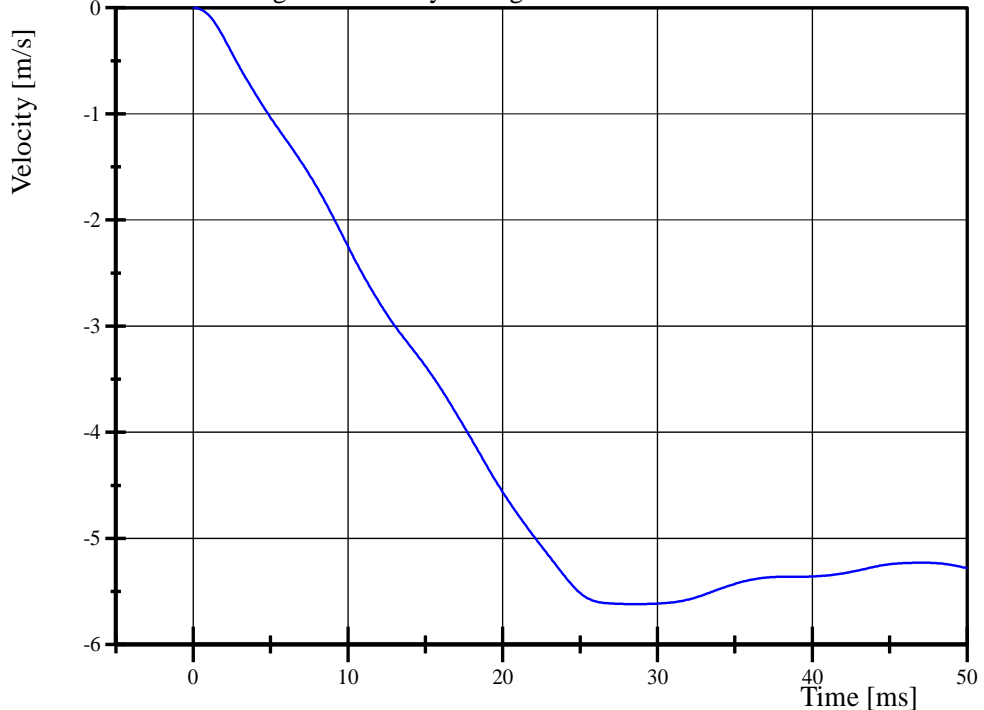


Filter Class: CFC\_180

Max: 5.6 g at 33.8 ms

Min: -29.4 g at 9.4 ms

Pendulum Integrated Velocity Change



Filter Class: CFC\_180

Max: 0.0 m/s at 0.0 ms

Min: -5.6 m/s at 28.7 ms

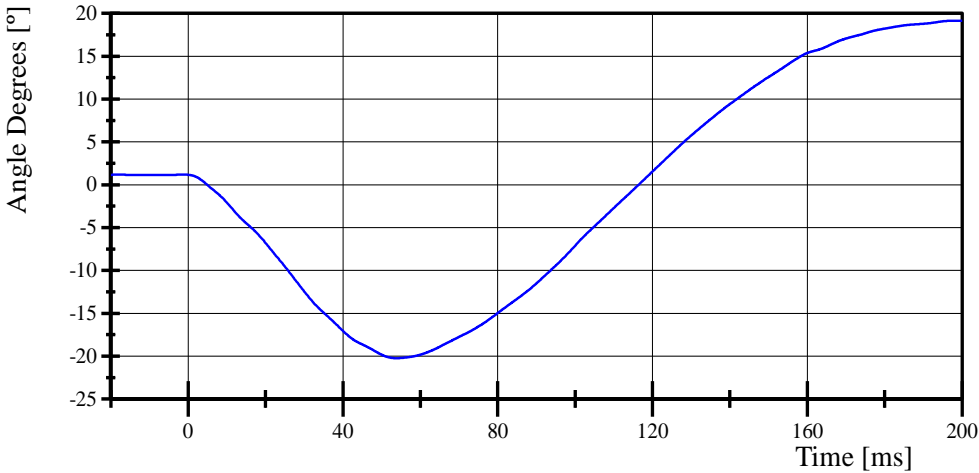
# Transportation Research Center Inc.

Neck Flexion

HIII 3YO Serial No. 1869 Certification No. 15-1

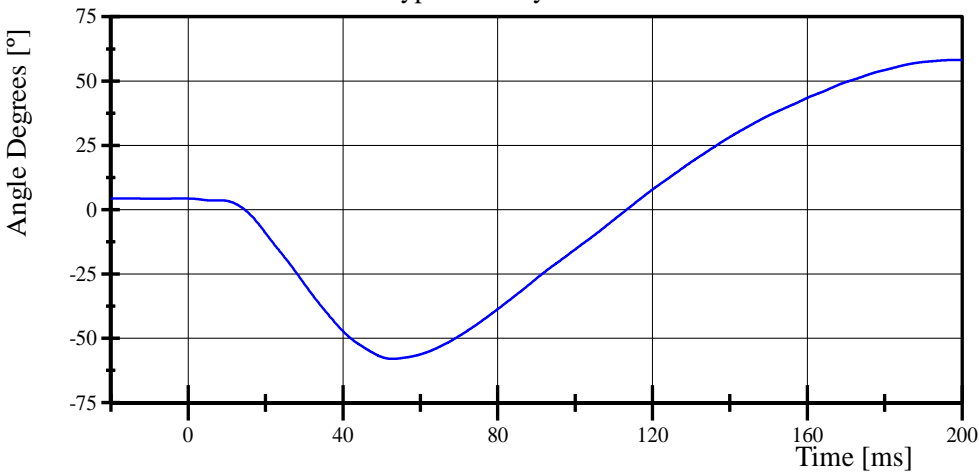
Test Date: 2/17/2022

Pot Rotation at the Base of Neck



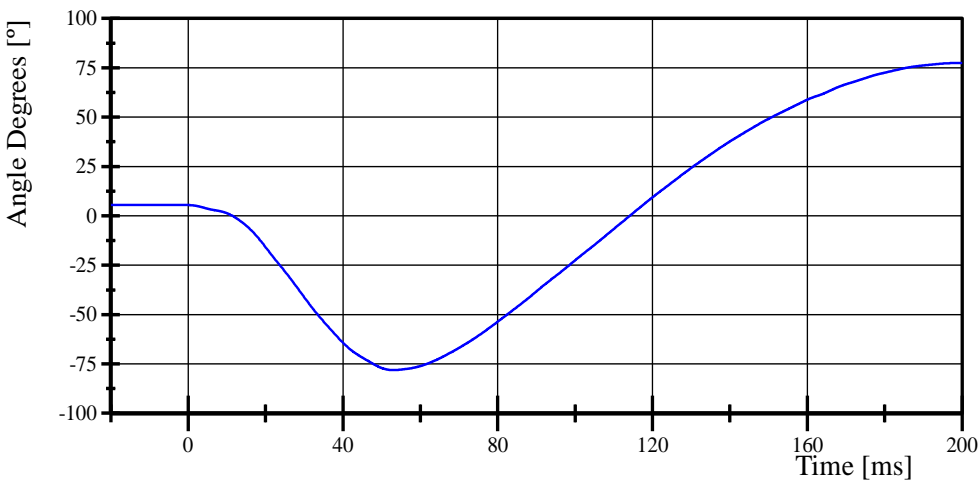
Filter Class: CFC\_60  
Max: 19.1 ° at 198.0 ms  
Min: -20.2 ° at 53.8 ms

Headform Rotation at Occypital Condyles



Filter Class: CFC\_60  
Max: 58.2 ° at 200.0 ms  
Min: -58.0 ° at 52.8 ms

Total Headform D-Plane Rotation



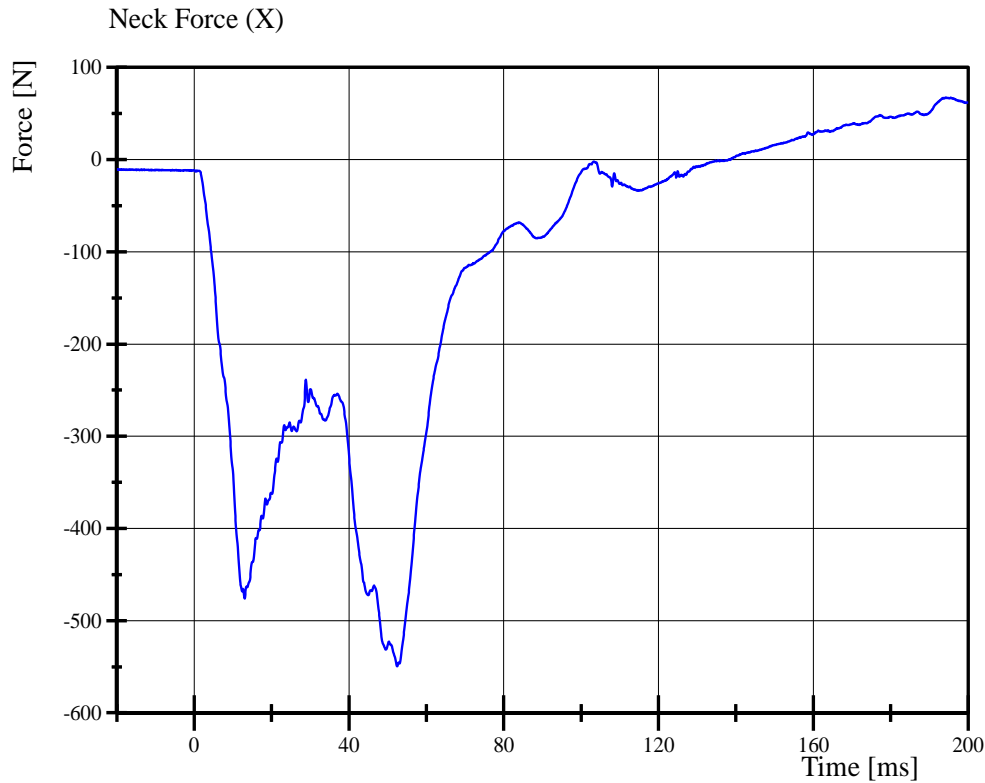
Filter Class: CFC\_60  
Max: 77.4 ° at 199.0 ms  
Min: -78.2 ° at 53.0 ms

# Transportation Research Center Inc.

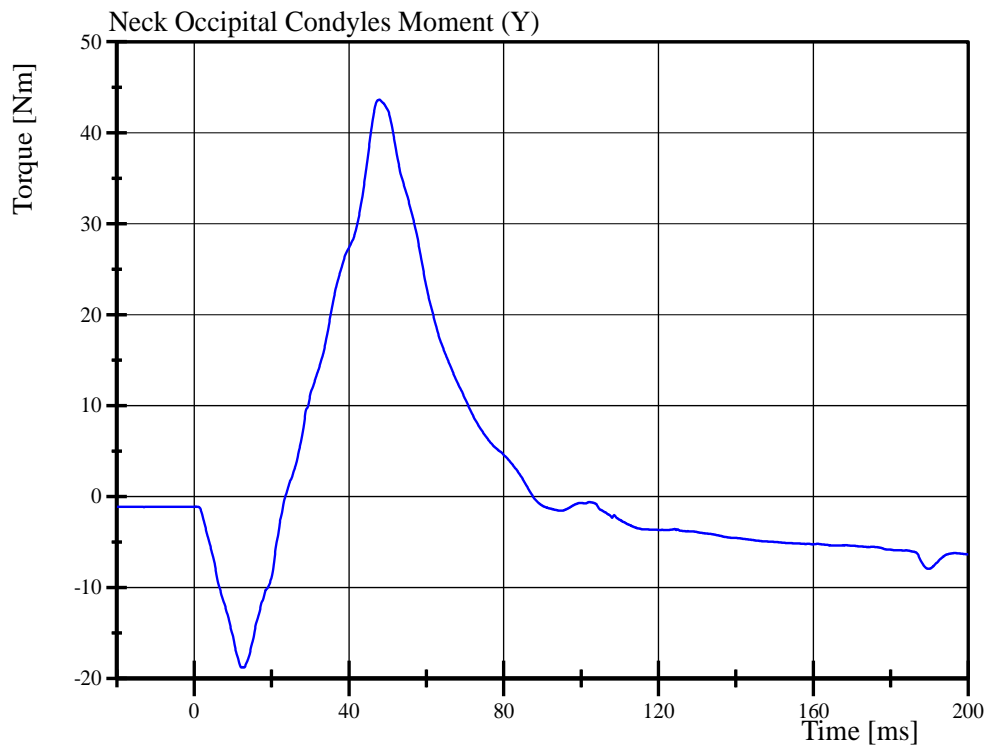
Neck Flexion

HIII 3YO Serial No. 1869 Certification No. 15-1

Test Date: 2/17/2022



Filter Class: CFC\_1000  
Max: 67.1 N at 194.2 ms  
Min: -549.4 N at 52.4 ms



Filter Class: CFC\_600  
Max: 43.6 Nm at 47.8 ms  
Min: -18.8 Nm at 12.9 ms

# Transportation Research Center Inc.

Neck Extension

HIII 3YO Serial No. 1869 Certification No. 15-2

Test Date: 2/17/2022

<b>Test Parameter</b>	<b>Specification</b>	<b>Test Results</b>	<b>Pass</b>
Temperature	20.6 - 22.2 °C	21.4 °C	Yes
Relative Humidity	10 - 70 %	45 %	Yes
Pendulum Impact Velocity	(-3.55) - (-3.75) m/s	-3.725 m/s	Yes
Pendulum Integrated Velocity Change at 6 ms	1.0 - 1.4 m/s	1.21 m/s	Yes
Pendulum Integrated Velocity Change at 10 ms	1.9 - 2.5 m/s	2.27 m/s	Yes
Pendulum Integrated Velocity Change at 14 ms	2.8 - 3.5 m/s	3.24 m/s	Yes
Total Headform D-Plane Rotation	83 - 93 °	85.7 °	Yes
Peak Neck Occipital Condyles Moment	(-43.7) - (-53.3) Nm	-46.77 Nm	Yes
Neck Occipital Condyles Moment Decay to 10 Nm	60 - 80 ms	67.4 ms	Yes

**Test meets specifications.**

**Condition: Used**

**Comments:**

**Neck S/N: DG7094**

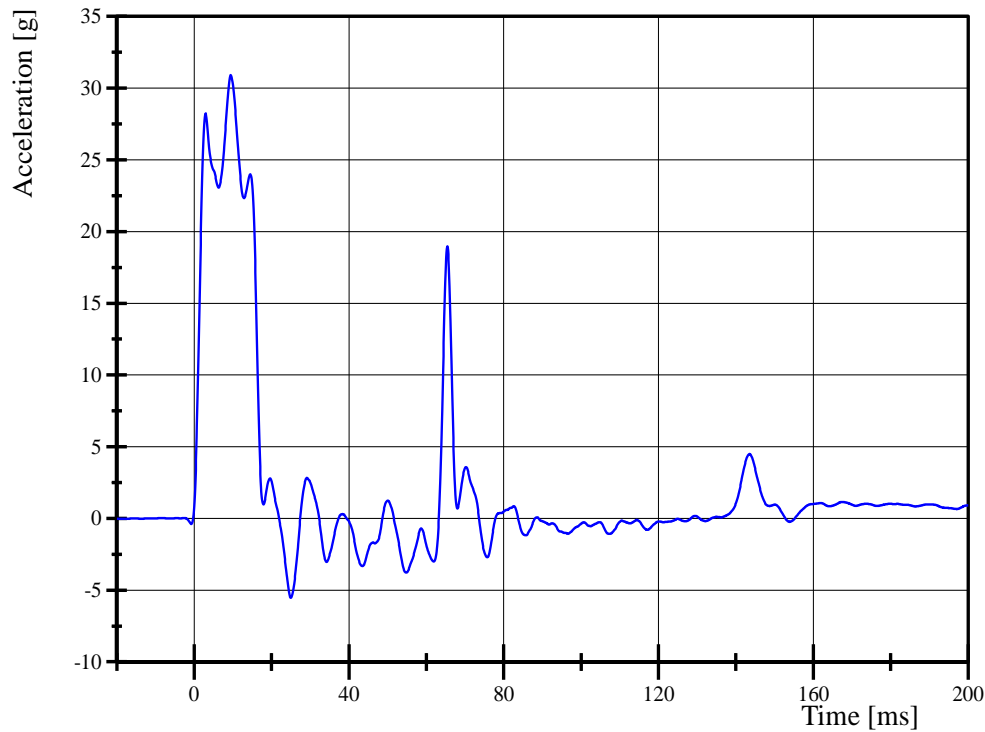
# Transportation Research Center Inc.

Neck Extension

HIII 3YO Serial No. 1869 Certification No. 15-2

Test Date: 2/17/2022

### Pendulum Acceleration

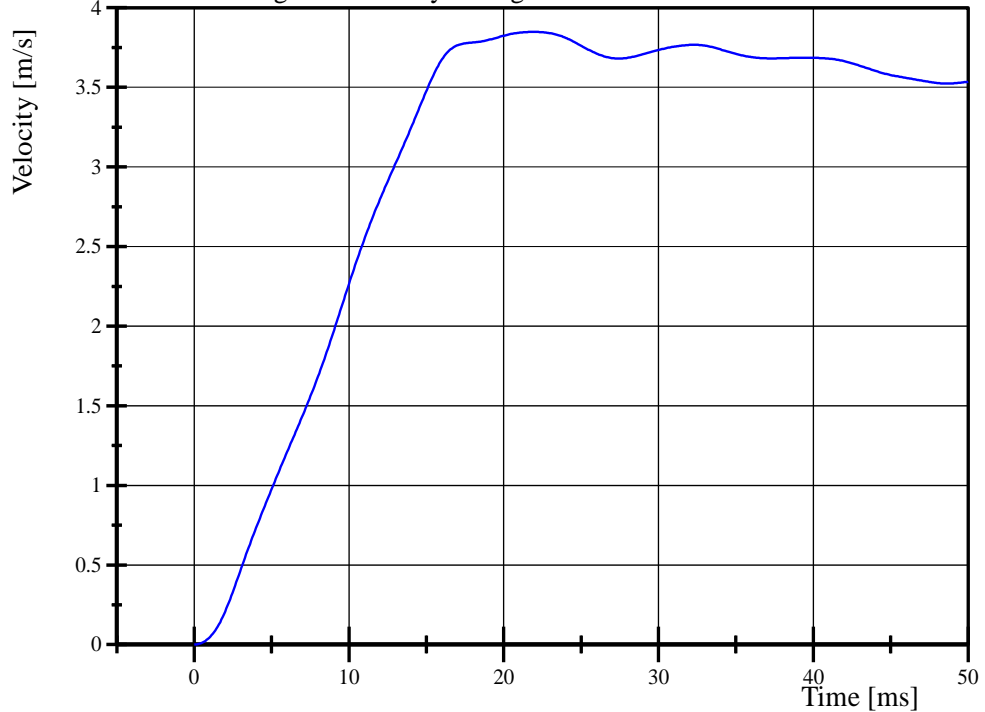


Filter Class: CFC\_180

Max: 30.9 g at 9.4 ms

Min: -5.5 g at 25.0 ms

### Pendulum Integrated Velocity Change



Filter Class: CFC\_180

Max: 3.8 m/s at 21.9 ms

Min: 0.0 m/s at 0.0 ms

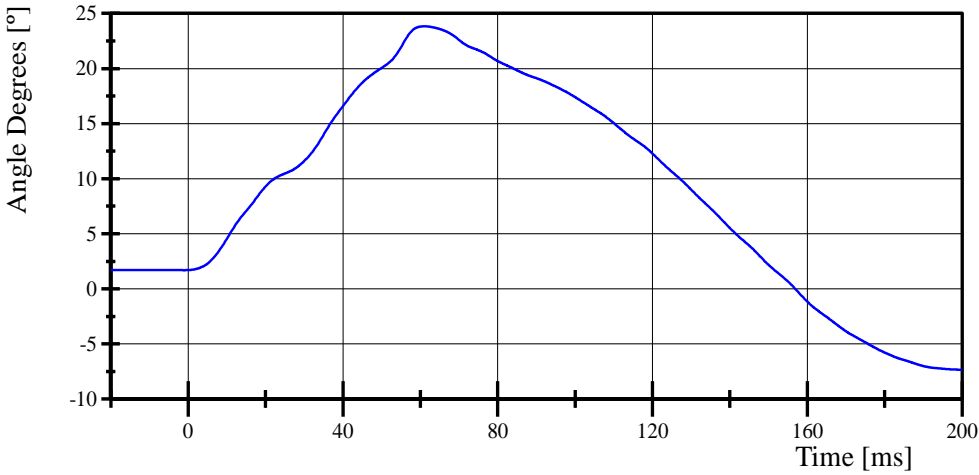
# Transportation Research Center Inc.

Neck Extension

HIII 3YO Serial No. 1869 Certification No. 15-2

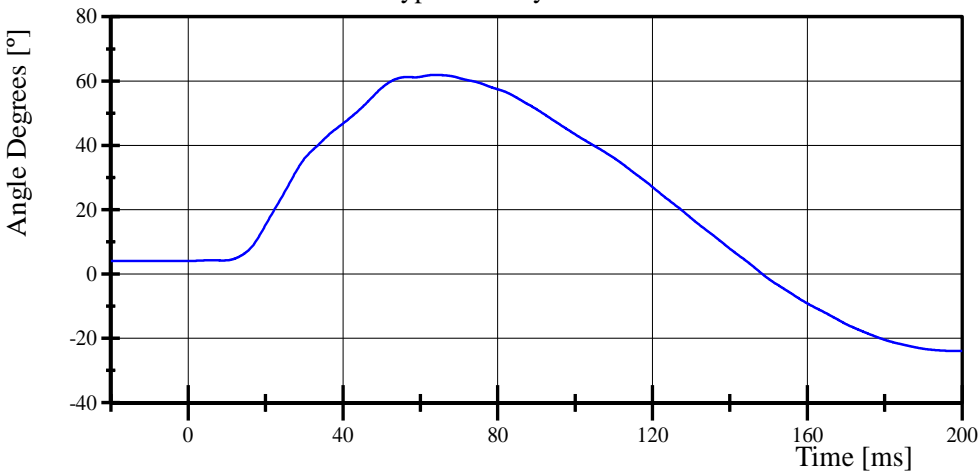
Test Date: 2/17/2022

Pot Rotation at the Base of Neck



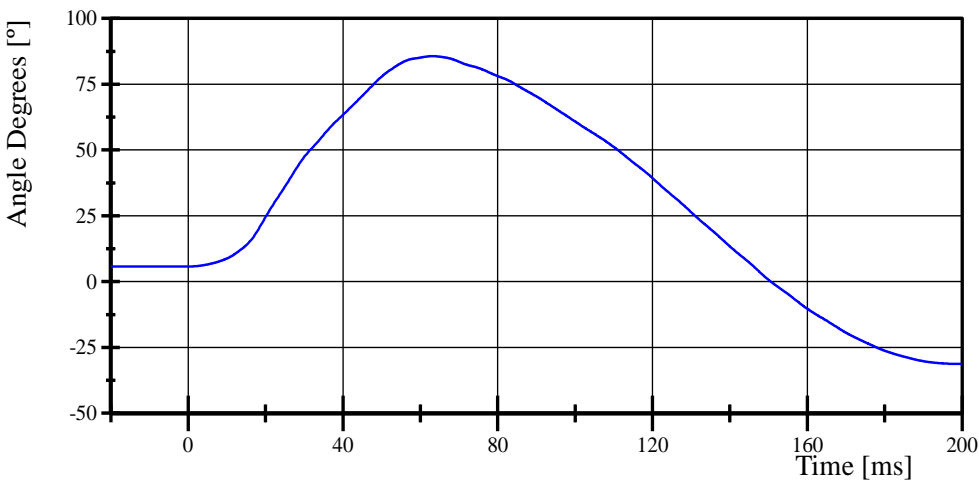
Filter Class: CFC\_60  
Max: 23.8 ° at 61.0 ms  
Min: -7.3 ° at 200.0 ms

Headform Rotation at Occypital Condyles



Filter Class: CFC\_60  
Max: 61.9 ° at 63.8 ms  
Min: -23.9 ° at 200.0 ms

Total Headform D-Plane Rotation



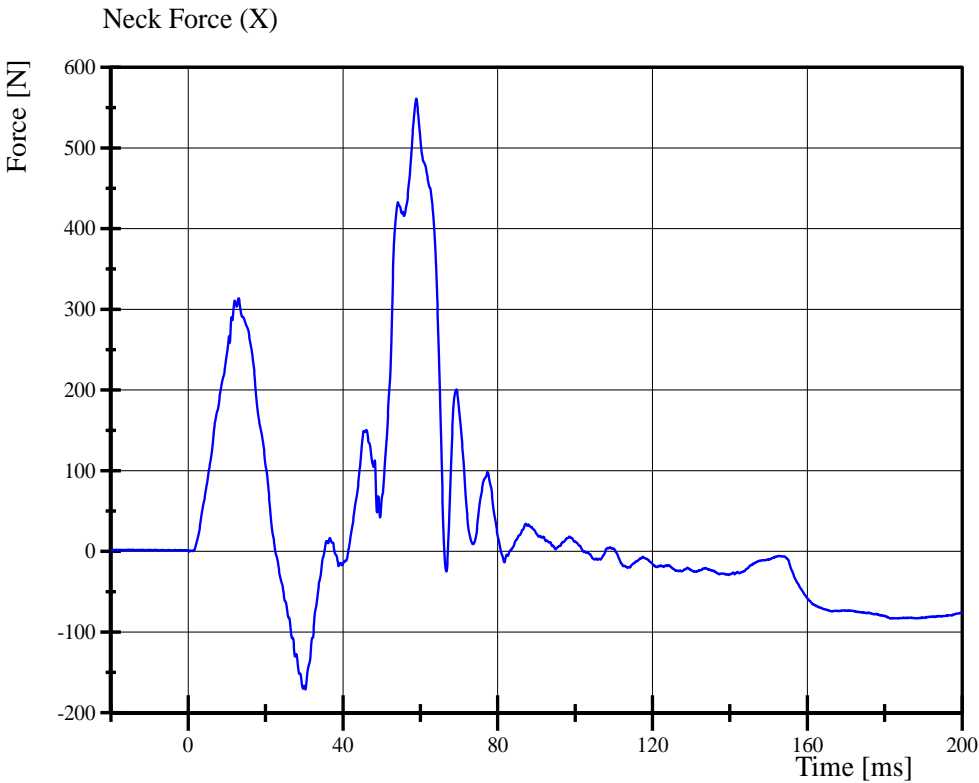
Filter Class: CFC\_60  
Max: 85.7 ° at 63.1 ms  
Min: -31.3 ° at 200.0 ms

# Transportation Research Center Inc.

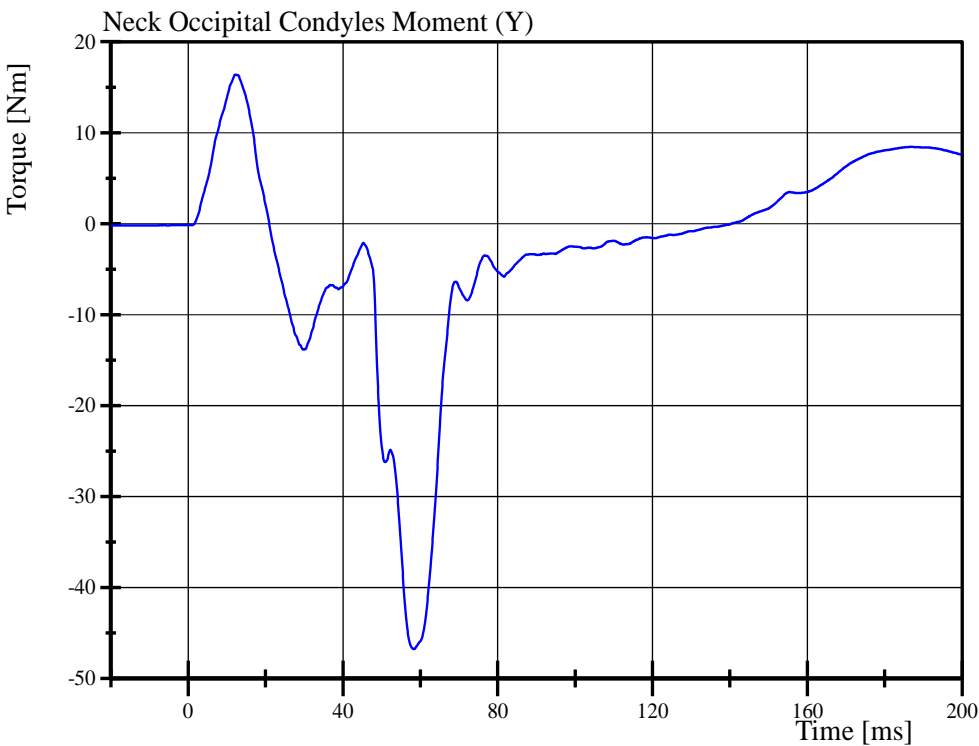
Neck Extension

HIII 3YO Serial No. 1869 Certification No. 15-2

Test Date: 2/17/2022



Filter Class: CFC\_1000  
Max: 561.0 N at 59.0 ms  
Min: -170.8 N at 30.3 ms



Filter Class: CFC\_600  
Max: 16.4 Nm at 12.2 ms  
Min: -46.8 Nm at 58.4 ms

# Transportation Research Center Inc.

Front Thorax

HIII 3YO Serial No. 1869 Certification No. 15-1

Test Date: 2/17/2022

<b>Test Parameter</b>	<b>Specification</b>	<b>Test Results</b>	<b>Pass</b>
Temperature	20.6 - 22.2 °C	21.6 °C	Yes
Relative Humidity	10 - 70 %	39 %	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	-722.0 N	Yes
Probe Force Peak Between 12.5 mm and 32.0 mm Chest Deflection	>= (-910) N	-729.3 N	Yes
Maximum Chest Compression	(-32) - (-38) mm	-34.7 mm	Yes
Internal Hysteresis	65 - 85 %	65.6 %	Yes

**Test meets specifications.**

**Condition: Used**

**Comments:**

**Jacket S/N: 16503**

**Rib Set S/N: 16031758A**

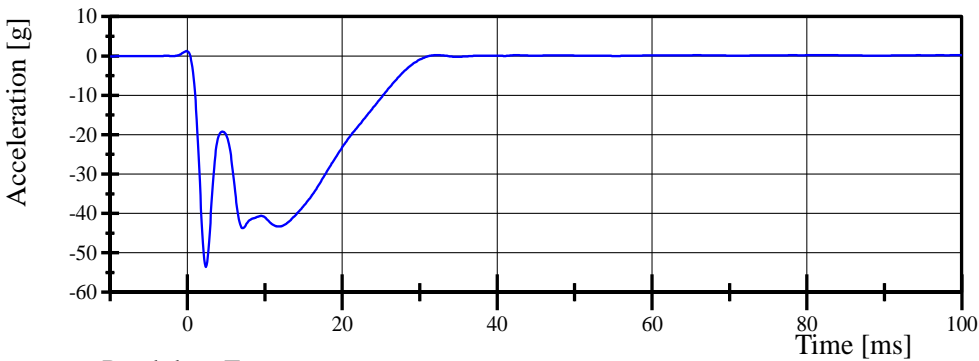
# Transportation Research Center Inc.

Front Thorax

HIII 3YO Serial No. 1869 Certification No. 15-1

Test Date: 2/17/2022

Pendulum Acceleration

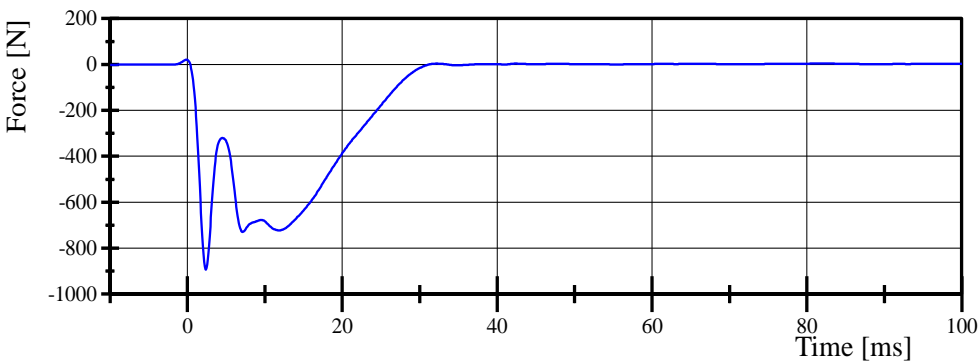


Filter Class: CFC\_180

Max: 1.3 g at -0.1 ms

Min: -53.6 g at 2.4 ms

Pendulum Force

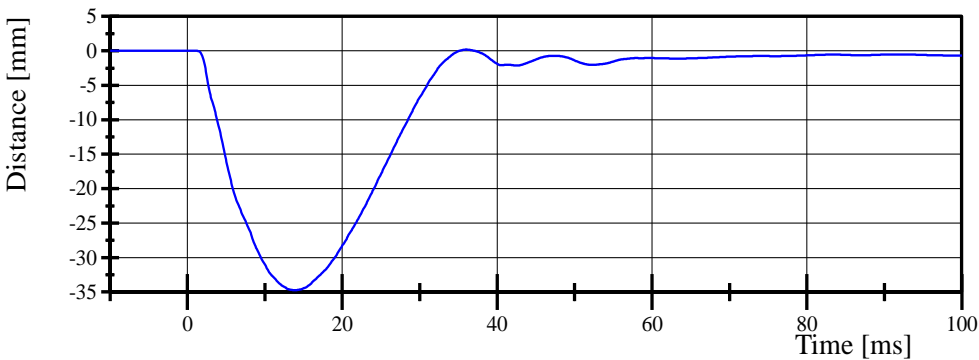


Filter Class: CFC\_180

Max: 20.9 N at -0.1 ms

Min: -893.6 N at 2.4 ms

Thorax Displacement X-Axis

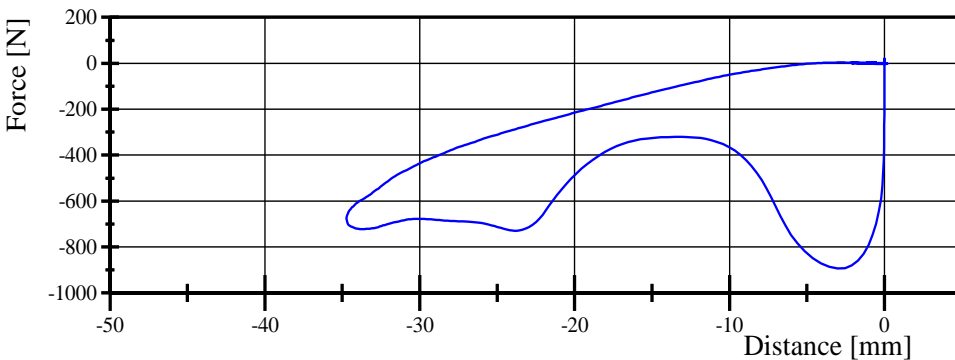


Filter Class: CFC\_600

Max: 0.2 mm at 36.0 ms

Min: -34.7 mm at 13.9 ms

Pendulum Force vs. Thorax Displacement X-Axis



Filter Class: CFC\_180

Max: 20.9 N at -0.0 mm

Min: -893.6 N at -3.0 mm

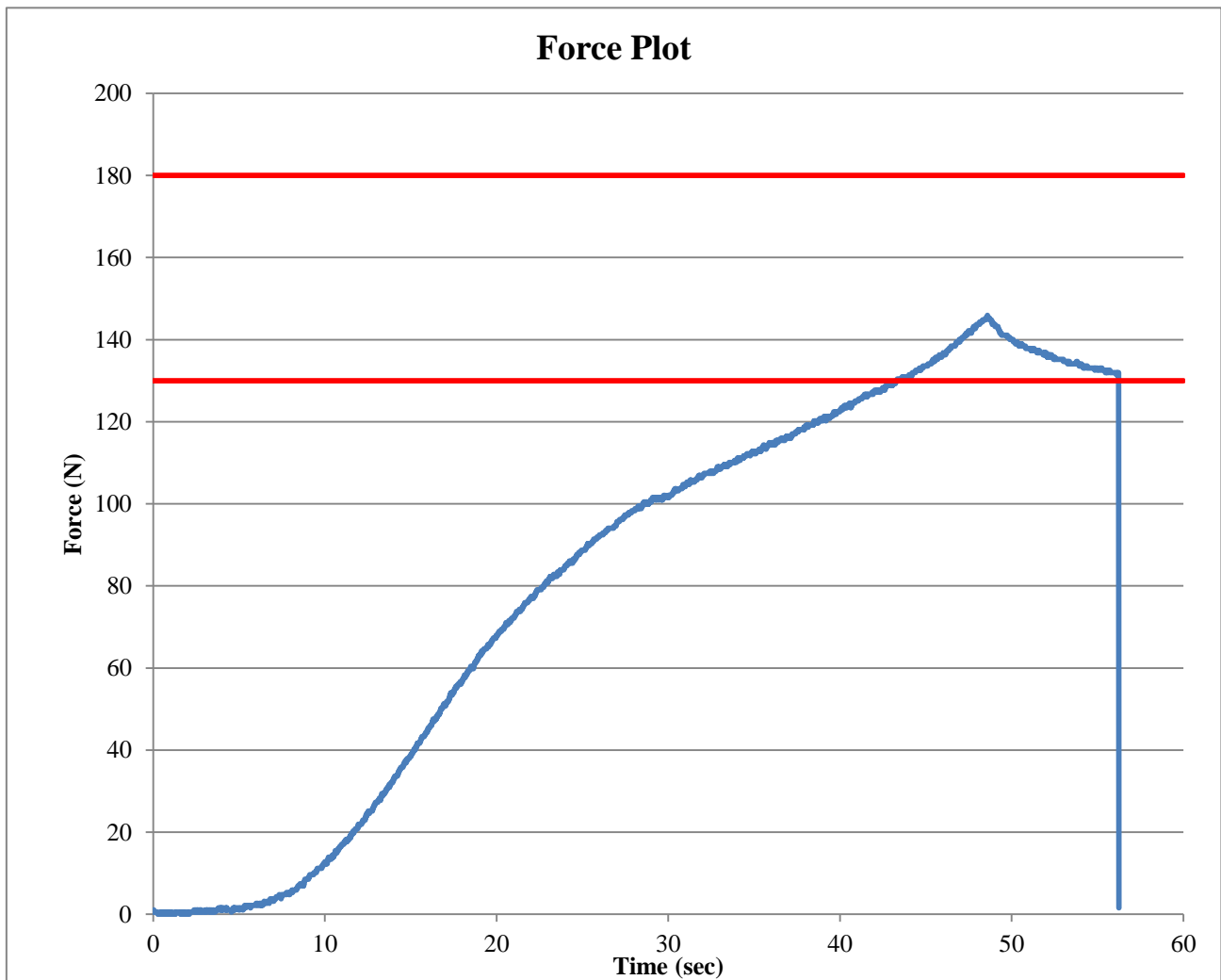
# Transportation Research Center Inc.

Hybrid III 3-Year Old Child Torso Flexion



Customer: VRTC  
Serial Number: 1869      Date: 2/17/2022  
Test Number: 1      Time: 10:05

TEST PARAMETER	SPECIFICATION	TEST RESULTS
Temperature	18.9 - 25.6	21.4 °C Pass
Humidity	10 - 70	40 % Pass
Average Angular Velocity	0.5 - 1.5	0.92 deg/sec Pass
Initial Angle	0 - 15	8.13 deg Pass
Peak Force at 45.13°	130 - 180	145.89 N Pass
Final Angle	-10 - 10	5.28 deg Pass

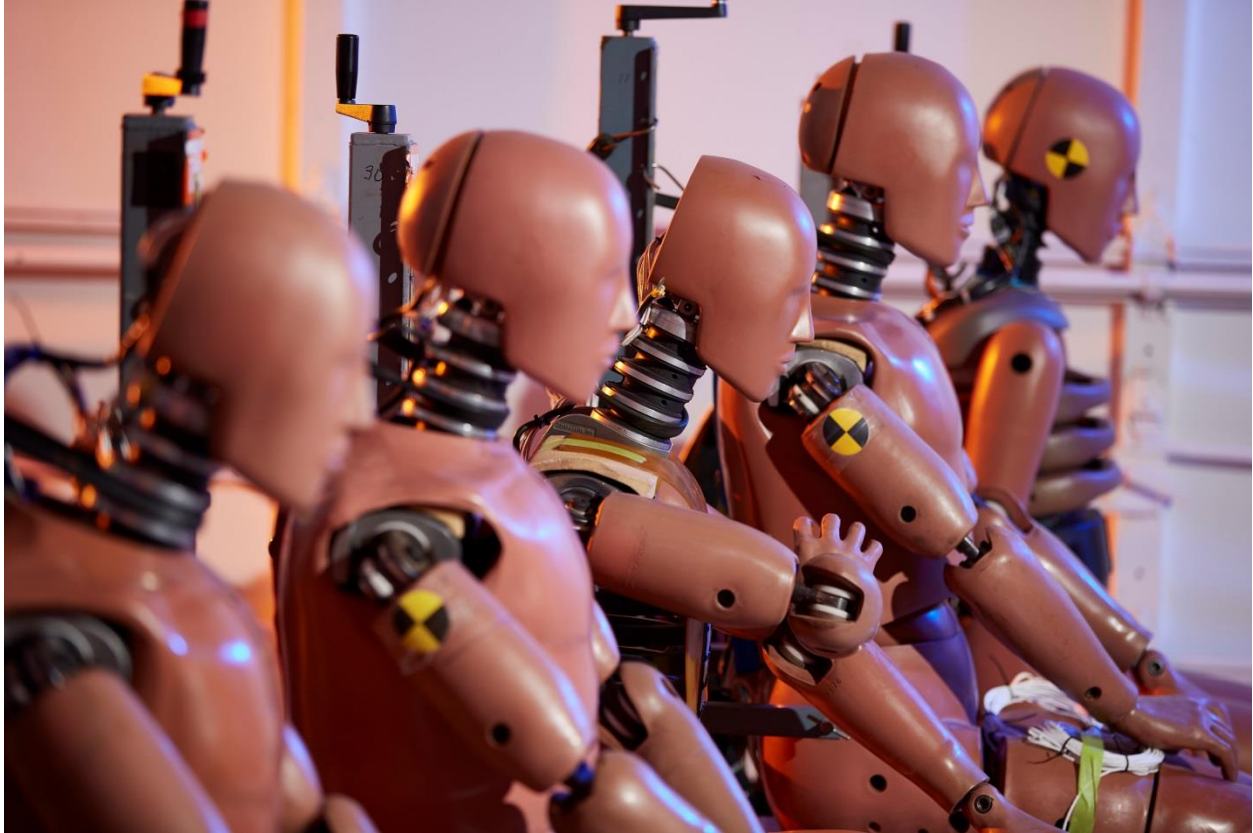


Comments:  
Jacket S/N: 16503  
Abdomen S/N: D63677

## Appendix C – Quality Assurance

# Quality Assurance

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## ATD Assembly & Final Inspection

ATD Type: Hybrid III (3) Year Old

ATD Serial Number: 1869

Assembled by: *Dot Beaulieu*

Date Inspected: 02/17/2022