

**Vehicle Research and Test Center
FMVSS 213 Testing
Hybrid III 6-Year-Old Weighted**

**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 6-YEAR-OLD WEIGHTED

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

SUMMARY

A Hybrid III 6-year-old weighted dummy (serial number 088) was secured in the right rear occupant position (position 3 or P3) in a forward-facing child restraint system (CRS). The Hybrid III 6-year-old weighted dummy was instrumented with head and chest accelerometers. During this test series the dummy was restrained with a 2-point seatbelt (SB2PT).

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

SECTION 2
FORWARD FACING CRS TEST SUMMARY

TEST DUMMY INFORMATION

Description	Position # 3 CRS
ATD Type/Serial No.	Hybrid III 6-Year-Old Weighted/088
Restrain System	SB2PT
CRS Direction	Forward Facing
Foam Cushion	WB8

CAMERA POSITIONING FARO MEASUREMENTS

Description	Units	X	Y	Z
Origin	mm	0	0	0
PA Front	mm	536.60	924.64	-386.87
PA Side	mm	1848.67	-320.73	-515.91

DUMMY POSITIONING

CRS: Britax Marathon Clicktight – FF – 2PT Belt

TRC Test Number: S230810-1

VRTC Test Number: FR_2PT_02



DUMMY POSITIONING FARO MEASUREMENTS

Description	Units	X	Y	Z
Z point	mm	-0.04	-0.78	-0.67
Center of the seat frame bottom	mm	615.30	-351.30	-103.61
CRS base center	mm	572.87	-348.63	-230.22
Center of seat frame back	mm	-119.87	-351.66	-679.65
Top of seat	mm	-42.67	-342.52	-705.40
Top of headrest	mm	-92.92	-347.01	-853.26
Top of the head	mm	83.69	-347.77	-843.76
Bridge of nose	mm	192.26	-347.77	-781.04
Head CG outboard	mm	126.17	-279.12	-754.10
Neck center	mm	170.41	-347.64	-668.07
Chest Clip	mm	264.97	-347.52	-610.82
Buckle	mm	431.51	-346.73	-427.58
Knee Outer	mm	597.19	-225.14	-457.49
Left top of knee	mm	584.79	-417.59	-503.69
Right top of knee	mm	582.74	-263.13	-501.03
Ankle Outer	mm	696.40	-240.49	-220.83
CRS 1	mm	28.90	-172.16	-623.39
CRS 4	mm	186.45	-163.47	-403.38
CRS 2	mm	311.17	-148.52	-358.49
CRS 3	mm	473.81	-160.53	-315.21

DUMMY INJURY

HIC (36 ms)	772
Chest Clip (3 ms)	54.3g
Head Excursion	800mm
Knee Excursion	831mm

SECTION 3
DUMMY CALIBRATION DATA

Transportation Research Center Inc.

ATD Qualification Report

Customer:

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

Anthropomorphic Device:

Hybrid III Weighted (6) Year Old
Serial No. 088
Qualification No. 28



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

Table of Contents

Introduction	Page 3
Appendix A – Incoming Inspection	Page 4
Findings	Page 5
Photographs	Page 6
Summary of Action Items	Page 7
Appendix B – Test Results	Page 8
Front Head Drop Certification	Page 9
Neck Flexion Certification	Page 11
Neck Extension Certification	Page 15
Front Thorax Certification	Page 19
Torso Flexion Certification	Page 21
Left Knee Femur Response Test Certification	Page 22
Right Knee Femur Response Test Certification	Page 24
Appendix C – TRC Inc. Quality Assurance	Page 26



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 12, 2023

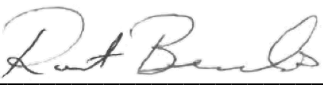
Special Instruction:

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

Each qualification test was conducted by an authorized Transportation Research Center Inc. (TRC Inc.) employee within the requirements of the CFR Part 572 Subpart I.

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 – 71.6°F). The relative humidity in the ATD Certification Laboratory was between 10% and 70%.

Date Received: 06/22/2023

Testing Completed by: 
Robert Benavides

Date: 07/12/2023

Testing Approved by: 
Josh Hendricks

Date: 07/19/2023



Appendix A – Incoming Inspection





TRC ATD Laboratory As Received Inspection Report

Name: Robert Benavides

Date: 7/11/2023

Customer: VRTC

ATD S/N: 088

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		





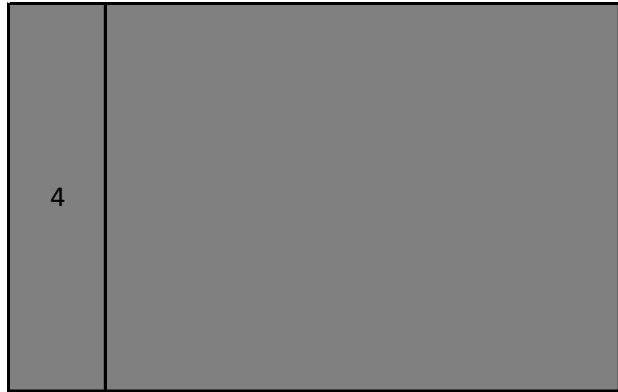
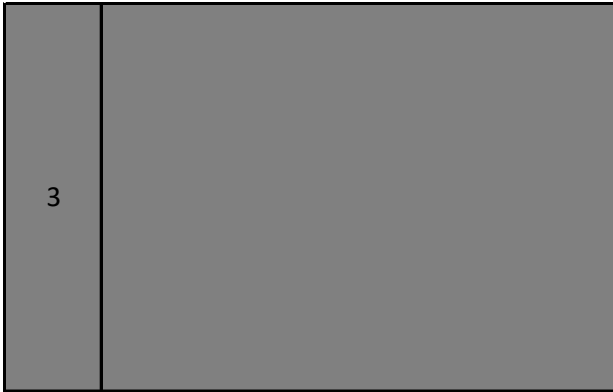
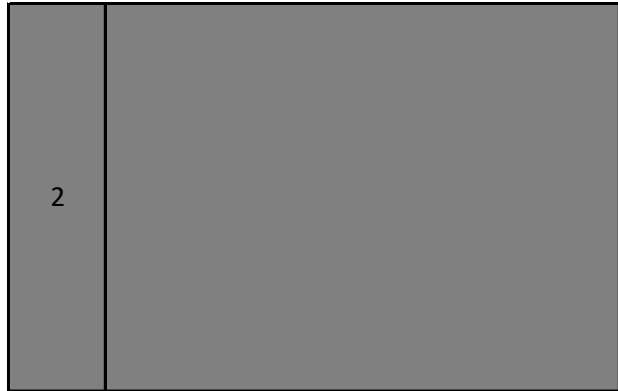
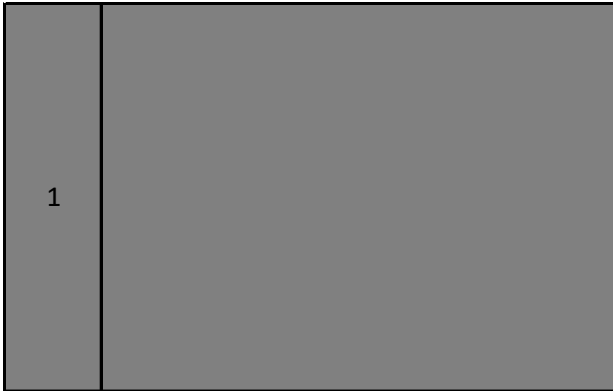
TRC ATD Laboratory As Received Inspection Photos

Name: Robert Benavides

Date: 7/11/2023

Customer: VRTC

ATD S/N: 088





TRC ATD Laboratory Inspection Report Action Items

Name: Robert Benavides

Date: 7/11/2023

Customer: VRTC

ATD S/N: 088

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 6YO Serial No. 088 Certification No. 28-1

Test Date: 7/12/2023

Test Parameter	Specification	Test Results	Pass
Temperature	18.9 - 25.6 °C	21.2 °C	Yes
Relative Humidity	10 - 70 %	67 %	Yes
Peak Head Resultant Acceleration	245 - 300 g	279.4 g	Yes
Peak Head Lateral Acceleration	(-15) - 15 g	-5.2 g	Yes
Is Acceleration Curve Unimodal	< 10 %	0.53 %	Yes

Test meets specifications.

Condition: Used

Comments:

Head Skin S/N: 885

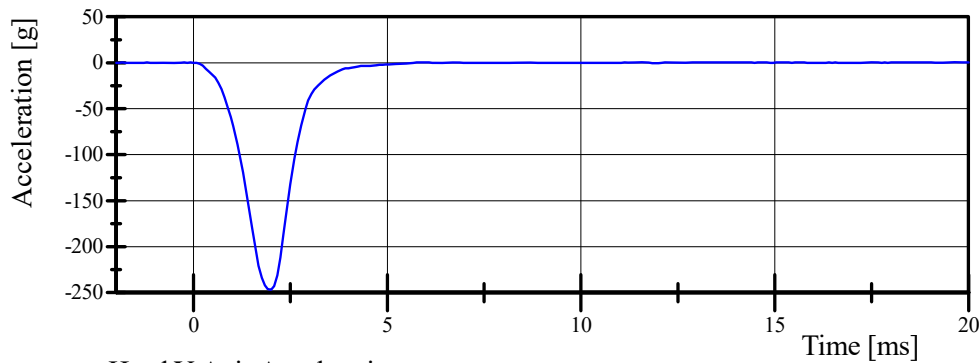
Transportation Research Center Inc.

Front Head Drop

HIII 6YO Serial No. 088 Certification No. 28-1

Test Date: 7/12/2023

Head X-Axis Acceleration

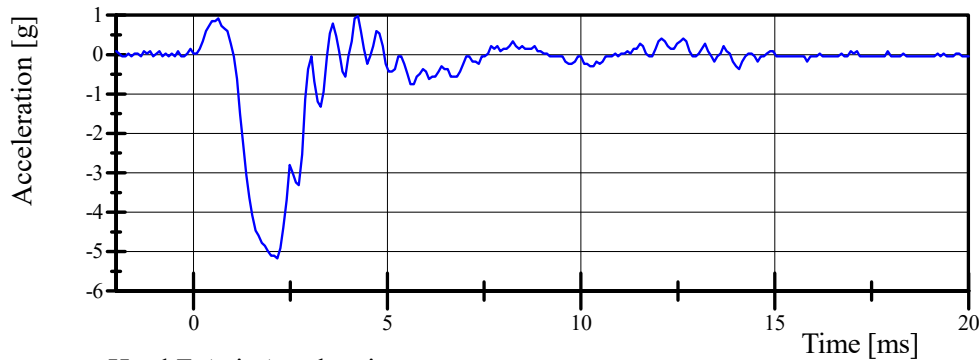


Filter Class: CFC_1000

Max: 0.7 g at 11.6 ms

Min: -247.0 g at 2.0 ms

Head Y-Axis Acceleration

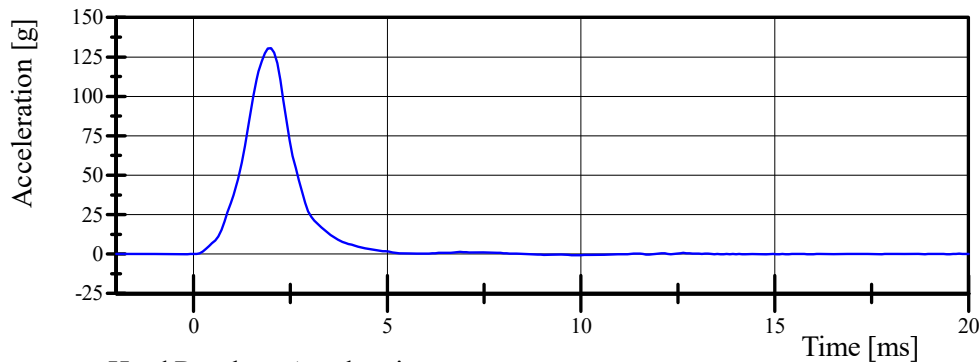


Filter Class: CFC_1000

Max: 1.0 g at 4.2 ms

Min: -5.2 g at 2.2 ms

Head Z-Axis Acceleration

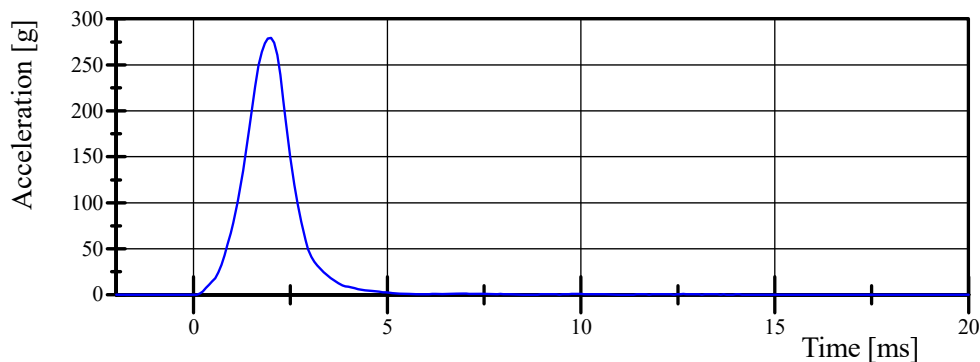


Filter Class: CFC_1000

Max: 130.6 g at 2.0 ms

Min: -0.9 g at 9.8 ms

Head Resultant Acceleration



Filter Class: CFC_1000

Max: 279.4 g at 2.0 ms

Min: 0.0 g at 0.0 ms

Transportation Research Center Inc.

Neck Flexion

HIII 6YO Serial No. 088 Certification No. 28-1

Test Date: 7/12/2023

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	20.8 °C	Yes
Relative Humidity	10 - 70 %	67 %	Yes
Pendulum Impact Velocity	4.83 - 5.07 m/s	4.881 m/s	Yes
Pendulum Integrated Velocity at 10ms	(-1.2) - (-1.6) m/s	-1.30 m/s	Yes
Pendulum Integrated Velocity at 20ms	(-2.4) - (-3.4) m/s	-2.61 m/s	Yes
Pendulum Integrated Velocity at 30ms	(-3.8) - (-5.0) m/s	-3.84 m/s	Yes
Total Head D-Plane Rotation	(-74) - (-92) °	-74.0 °	Yes
Peak Neck Occipital Condyles Moment Between -74° and -92° Rotation	27 - 33 Nm	28.1 Nm	Yes
Neck Occipital Condyles Moment Decay to 5 Nm	103 - 123 ms	112.7 ms	Yes

Test meets specifications.

Condition: Used

Comments:

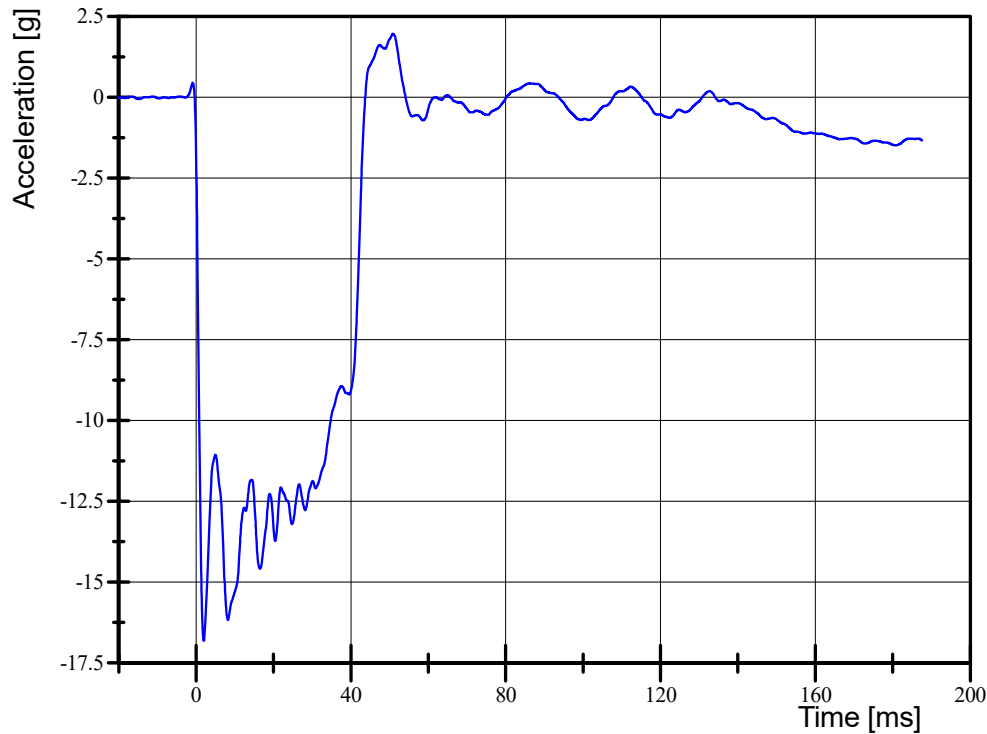
Transportation Research Center Inc.

Neck Flexion

HIII 6YO Serial No. 088 Certification No. 28-1

Test Date: 7/12/2023

Pendulum Acceleration

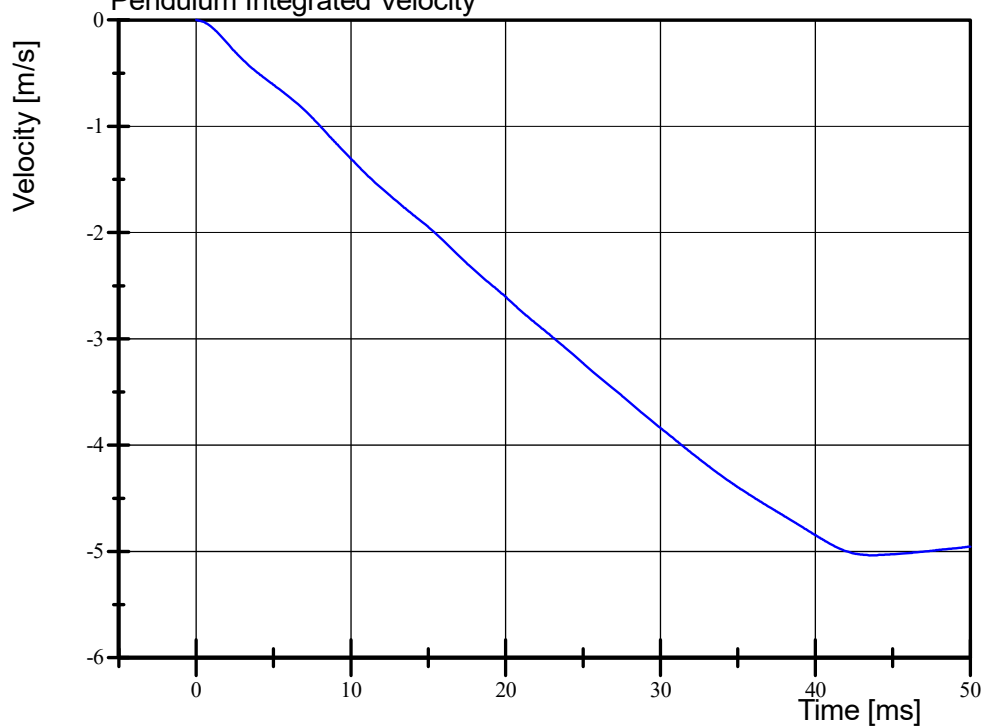


Filter Class: CFC_180

Max: 2.0 g at 50.9 ms

Min: -16.8 g at 2.0 ms

Pendulum Integrated Velocity



Filter Class: CFC_180

Max: 0.0 m/s at 0.0 ms

Min: -5.0 m/s at 43.7 ms

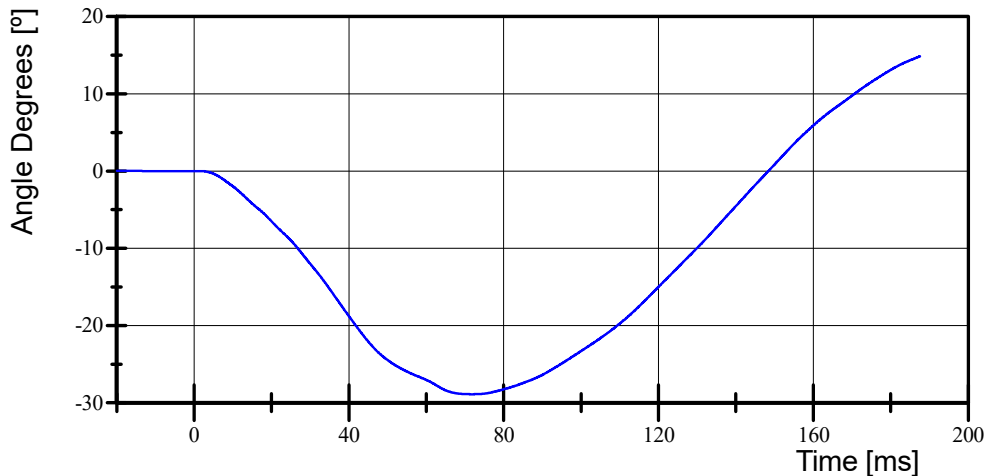
Transportation Research Center Inc.

Neck Flexion

HIII 6YO Serial No. 088 Certification No. 28-1

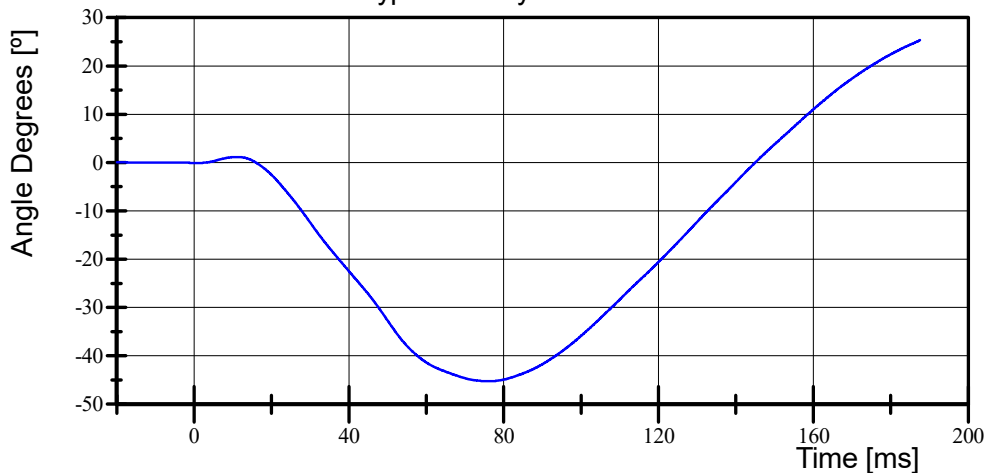
Test Date: 7/12/2023

Pot Rotation at the Base of Neck



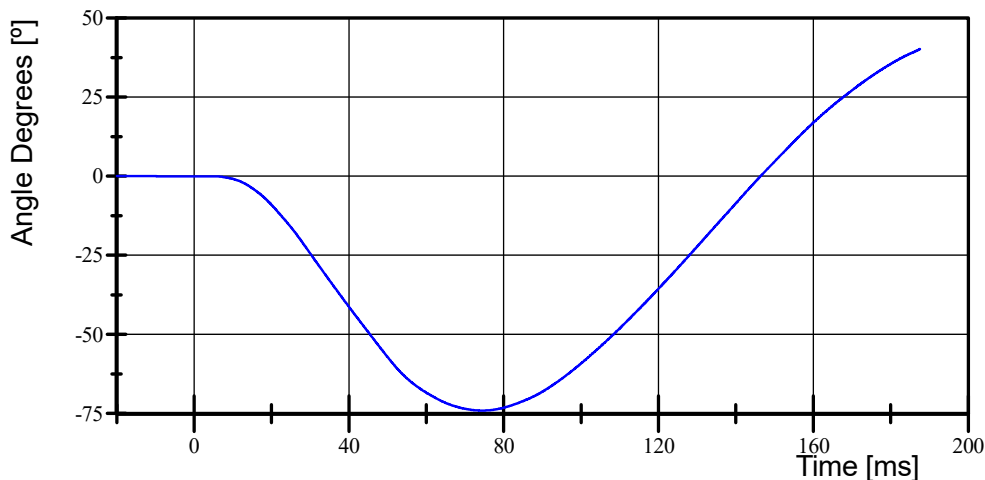
Filter Class: CFC_60
Max: 14.9 ° at 187.6 ms
Min: -28.9 ° at 71.8 ms

Head Rotation at Occypital Condyles



Filter Class: CFC_60
Max: 25.3 ° at 187.6 ms
Min: -45.2 ° at 76.2 ms

Total Head D-Plane Rotation



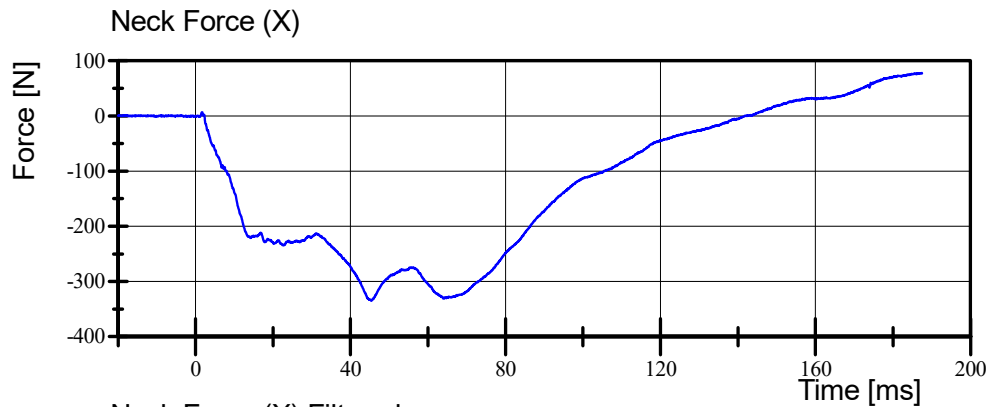
Filter Class: CFC_60
Max: 40.2 ° at 187.6 ms
Min: -74.0 ° at 74.5 ms

Transportation Research Center Inc.

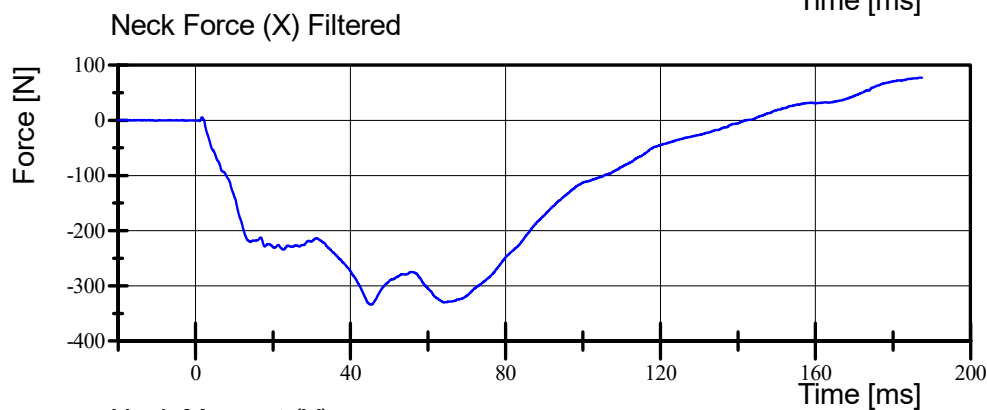
Neck Flexion

HIII 6YO Serial No. 088 Certification No. 28-1

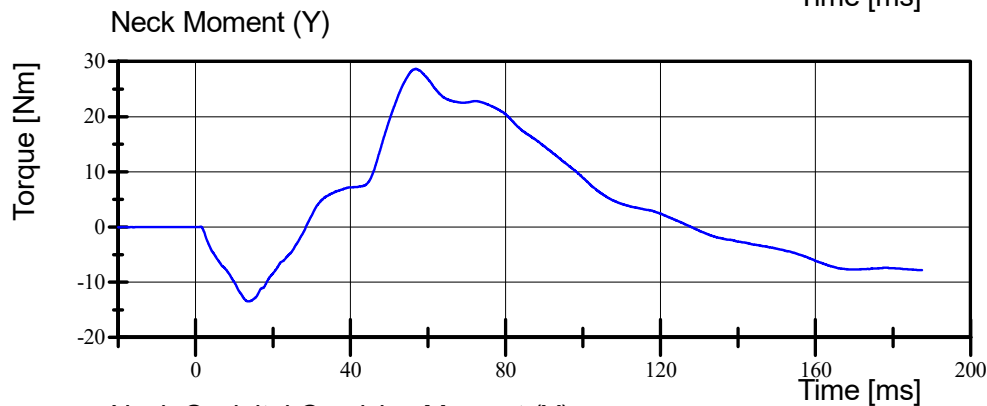
Test Date: 7/12/2023



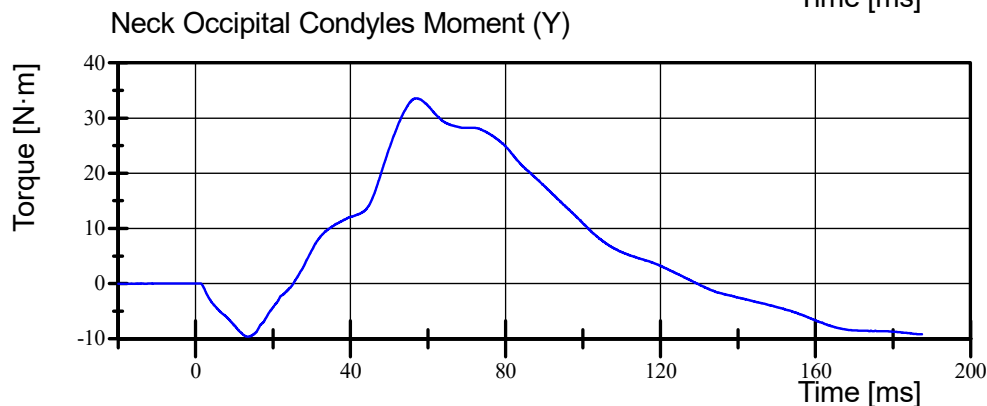
Filter Class: CFC_1000
Max: 78.1 N at 187.5 ms
Min: -334.6 N at 45.4 ms



Filter Class: CFC_600
Max: 77.6 N at 187.6 ms
Min: -334.0 N at 45.4 ms



Filter Class: CFC_600
Max: 28.6 Nm at 56.9 ms
Min: -13.5 Nm at 13.6 ms



Filter Class: Without_(Cons
Max: 33.6 N·m at 57.1 ms
Min: -9.6 N·m at 13.4 ms

Transportation Research Center Inc.

Neck Extension

HIII 6YO Serial No. 088 Certification No. 28-1

Test Date: 7/12/2023

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	20.8 °C	Yes
Relative Humidity	10 - 70 %	67 %	Yes
Pendulum Impact Velocity	4.18 - 4.42 m/s	4.365 m/s	Yes
Pendulum Integrated Velocity at 10ms	(-1.0) - (-1.4) m/s	-1.16 m/s	Yes
Pendulum Integrated Velocity at 20ms	(-2.2) - (-3.0) m/s	-2.30 m/s	Yes
Pendulum Integrated Velocity at 30ms	(-3.2) - (-4.2) m/s	-3.40 m/s	Yes
Total Head D-Plane Rotation	85 - 103 °	88.3 °	Yes
Peak Neck Occipital Condyles Moment Between 85° and 103° Rotation	(-19) - (-24) Nm	-21.4 Nm	Yes
Neck Occipital Condyles Moment Decay to 5 Nm	123 - 147 ms	133.6 ms	Yes

Test meets specifications.

Condition: Used

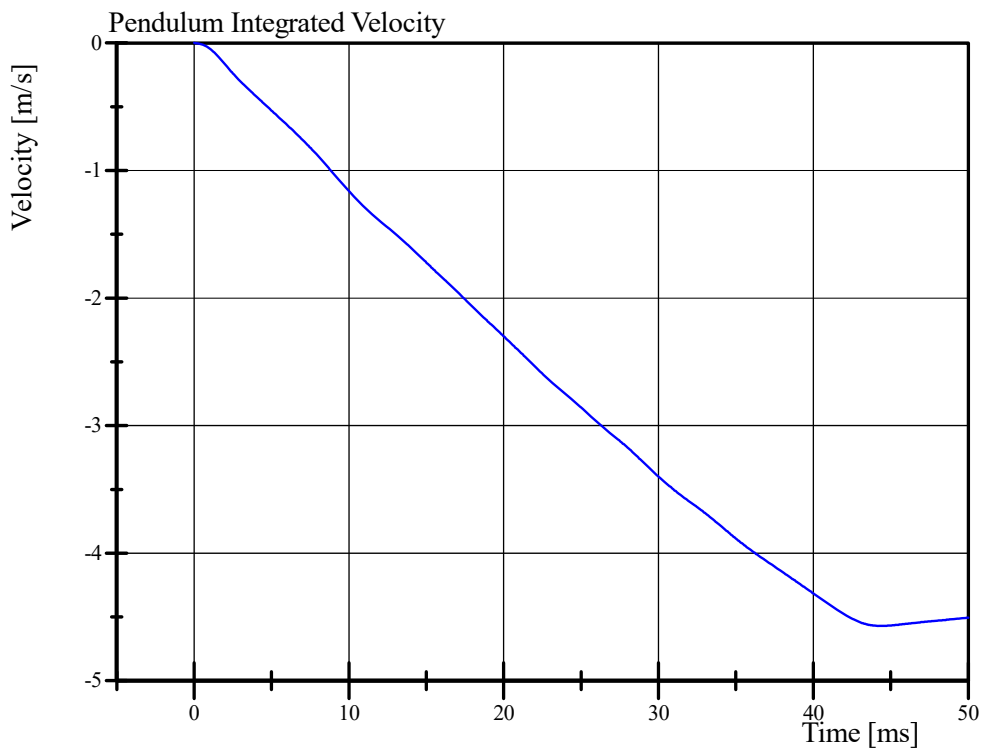
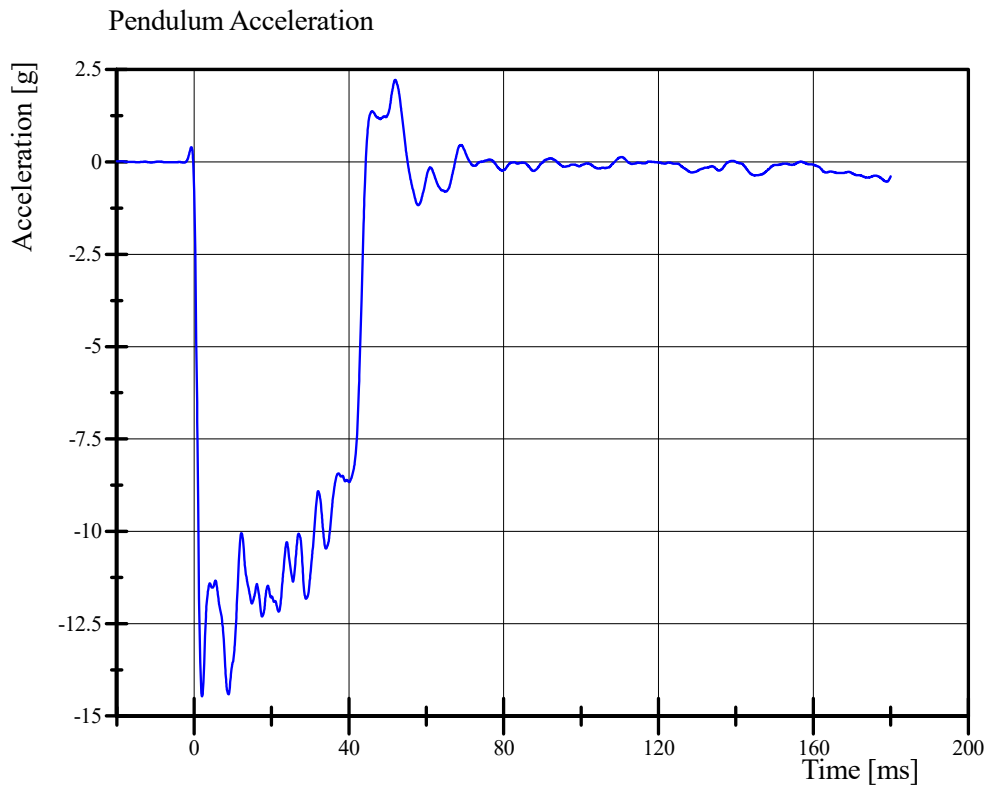
Comments:

Transportation Research Center Inc.

Neck Extension

HIII 6YO Serial No. 088 Certification No. 28-1

Test Date: 7/12/2023



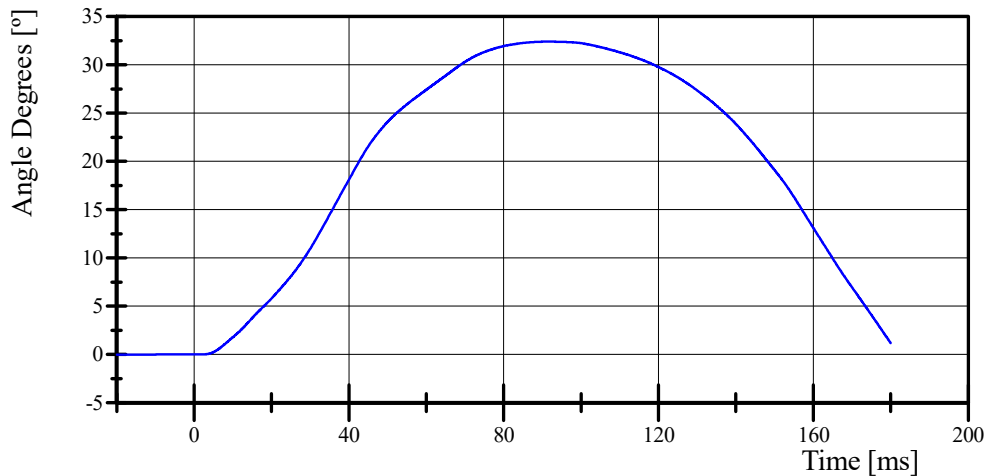
Transportation Research Center Inc.

Neck Extension

HIII 6YO Serial No. 088 Certification No. 28-1

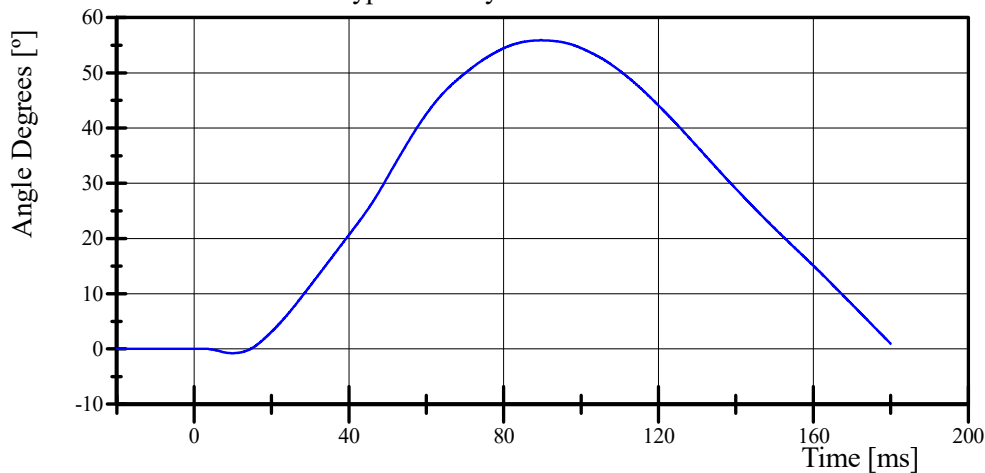
Test Date: 7/12/2023

Pot Rotation at the Base of Neck



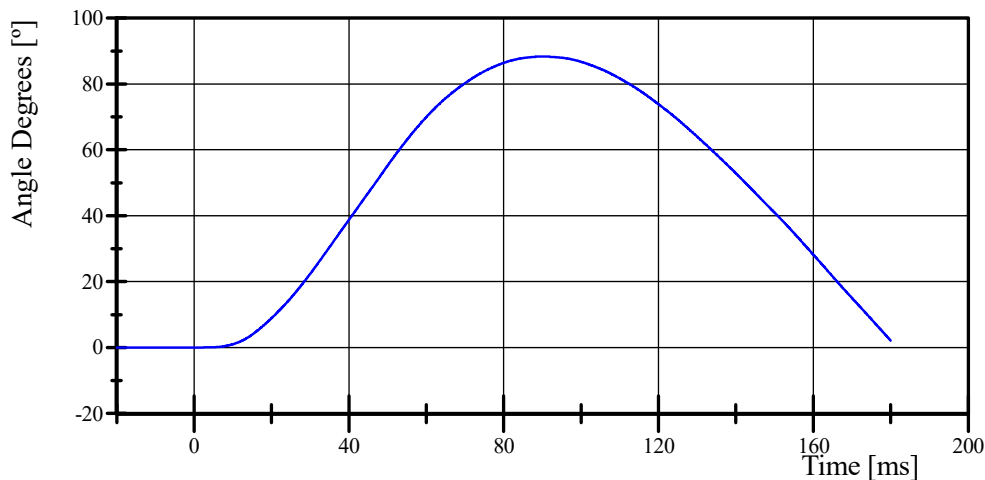
Filter Class: CFC_60
Max: 32.4 ° at 91.5 ms
Min: -0.0 ° at -20.0 ms

Head Rotation at Occypital Condyles



Filter Class: CFC_60
Max: 55.9 ° at 89.7 ms
Min: -0.8 ° at 9.9 ms

Total Head D-Plane Rotation



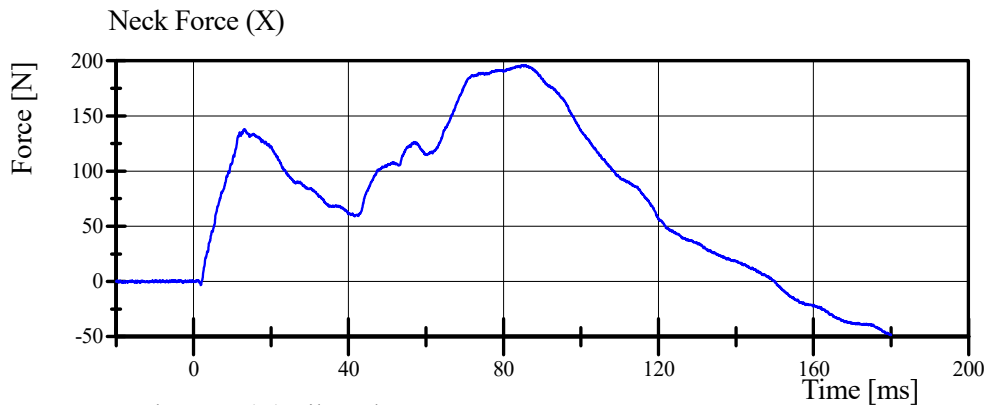
Filter Class: CFC_60
Max: 88.3 ° at 90.1 ms
Min: -0.0 ° at -20.0 ms

Transportation Research Center Inc.

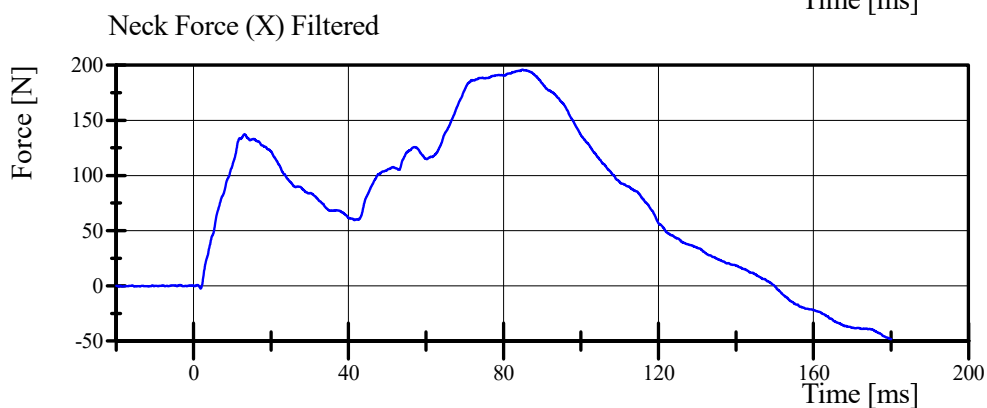
Neck Extension

HIII 6YO Serial No. 088 Certification No. 28-1

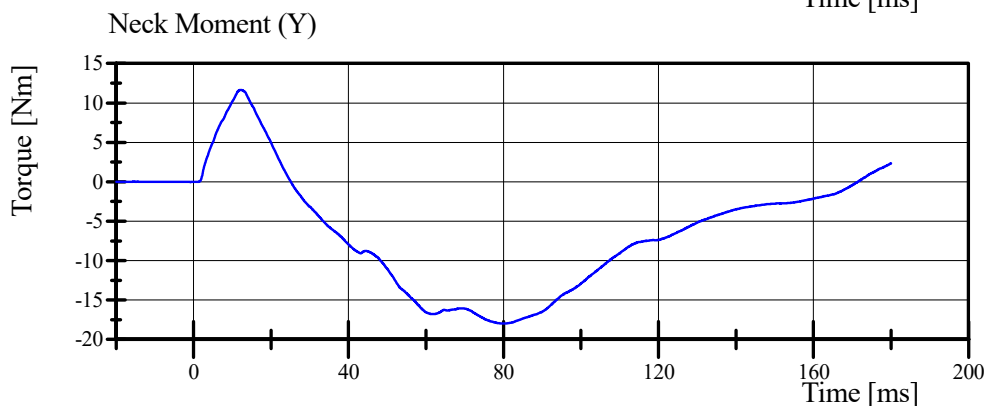
Test Date: 7/12/2023



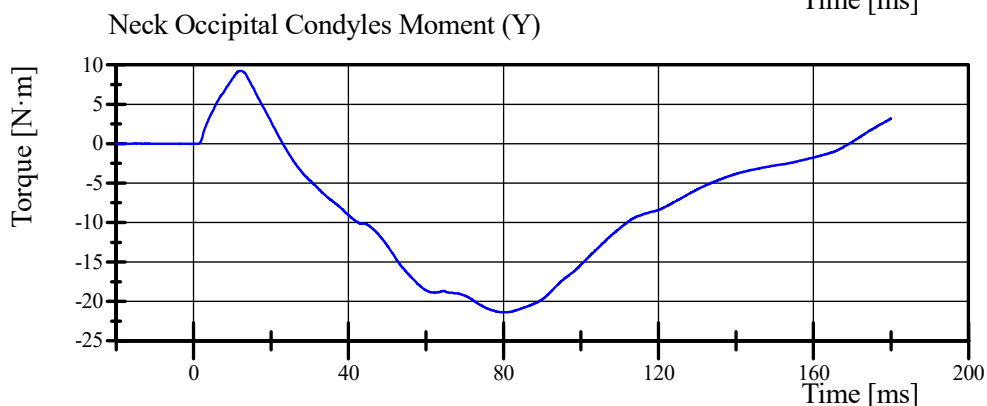
Filter Class: CFC_1000
Max: 196.0 N at 84.7 ms
Min: -48.7 N at 179.9 ms



Filter Class: CFC_600
Max: 195.9 N at 84.9 ms
Min: -48.4 N at 180.0 ms



Filter Class: CFC_600
Max: 11.6 Nm at 12.0 ms
Min: -18.0 Nm at 79.8 ms



Filter Class: Without_(Consta
Max: 9.3 N·m at 12.2 ms
Min: -21.4 N·m at 79.7 ms

Transportation Research Center Inc.

Front Thorax

HIII 6YO Serial No. 088 Certification No. 28-1

Test Date: 7/11/2023

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	20.8 °C	Yes
Relative Humidity	10 - 70 %	69 %	Yes
Probe Velocity	6.59 - 6.83 m/s	6.748 m/s	Yes
Probe Force Peak Between 38.0 mm and 46.0 mm Chest Deflection	(-1,205) - (-1,435) N	-1,292.1 N	Yes
Probe Force Peak Between 12.5 mm and 38.0 mm Chest Deflection	\geq (-1,500) N	-1,331.6 N	Yes
Maximum Chest Compression	(-38) - (-46) mm	-45.7 mm	Yes
Internal Hysteresis	65 - 85 %	70.9 %	Yes

Test meets specifications.

Condition: Used

Comments:

Jacket S/N: 775

Rib Set S/N: 18030157A

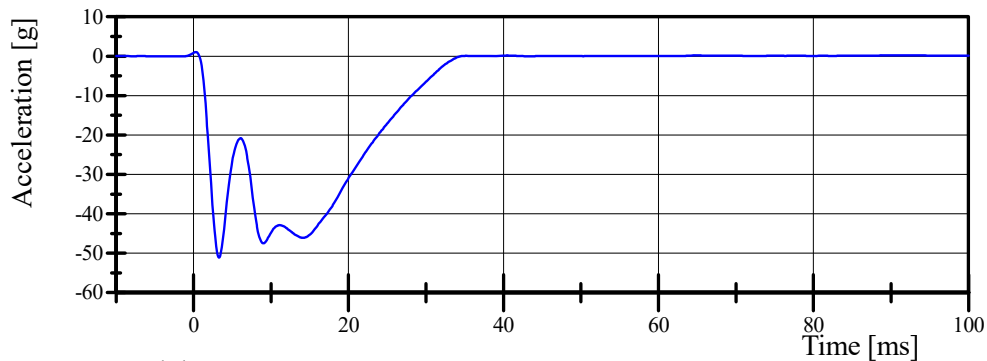
Transportation Research Center Inc.

Front Thorax

HIII 6YO Serial No. 088 Certification No. 28-1

Test Date: 7/11/2023

Pendulum Acceleration

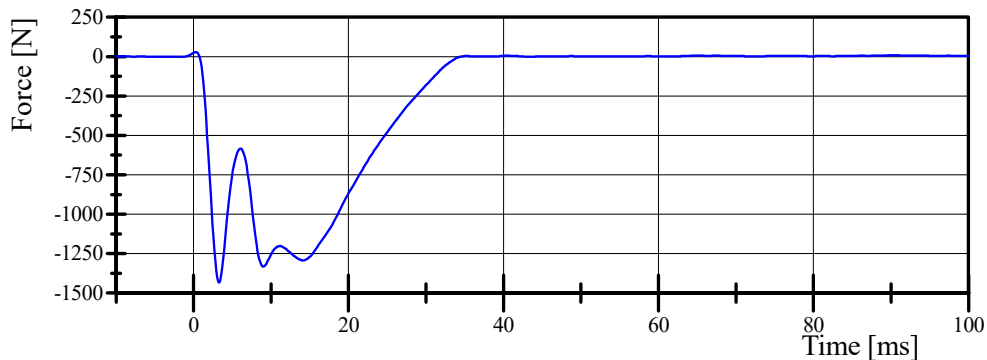


Filter Class: CFC_180

Max: 1.0 g at 0.3 ms

Min: -51.1 g at 3.3 ms

Pendulum Force

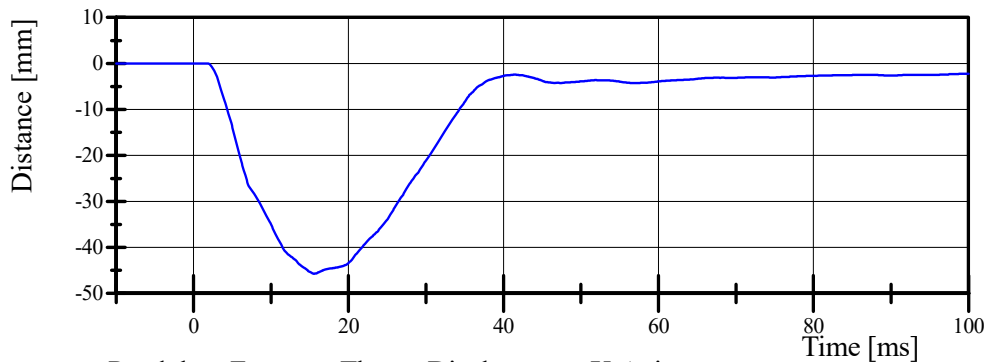


Filter Class: CFC_180

Max: 28.5 N at 0.3 ms

Min: -1,433.0 N at 3.3 ms

Thorax Displacement X-Axis

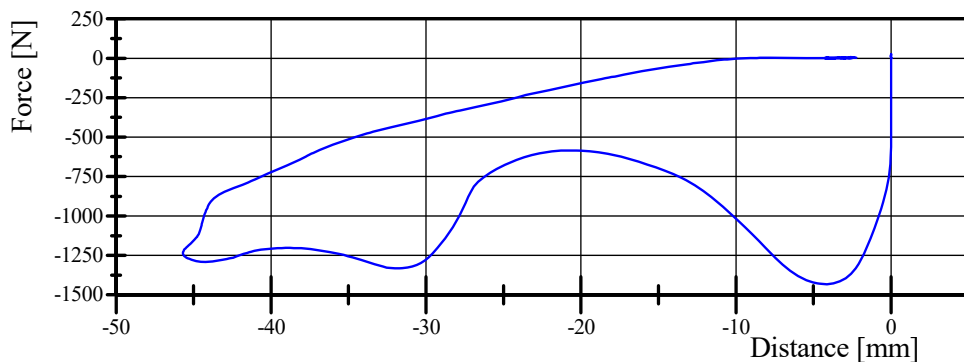


Filter Class: CFC_600

Max: 0.0 mm at 1.8 ms

Min: -45.7 mm at 15.6 ms

Pendulum Force vs. Thorax Displacement X-Axis



Filter Class: CFC_180

Max: 28.5 N at -0.0 mm

Min: -1,433.0 N at -4.1 mm

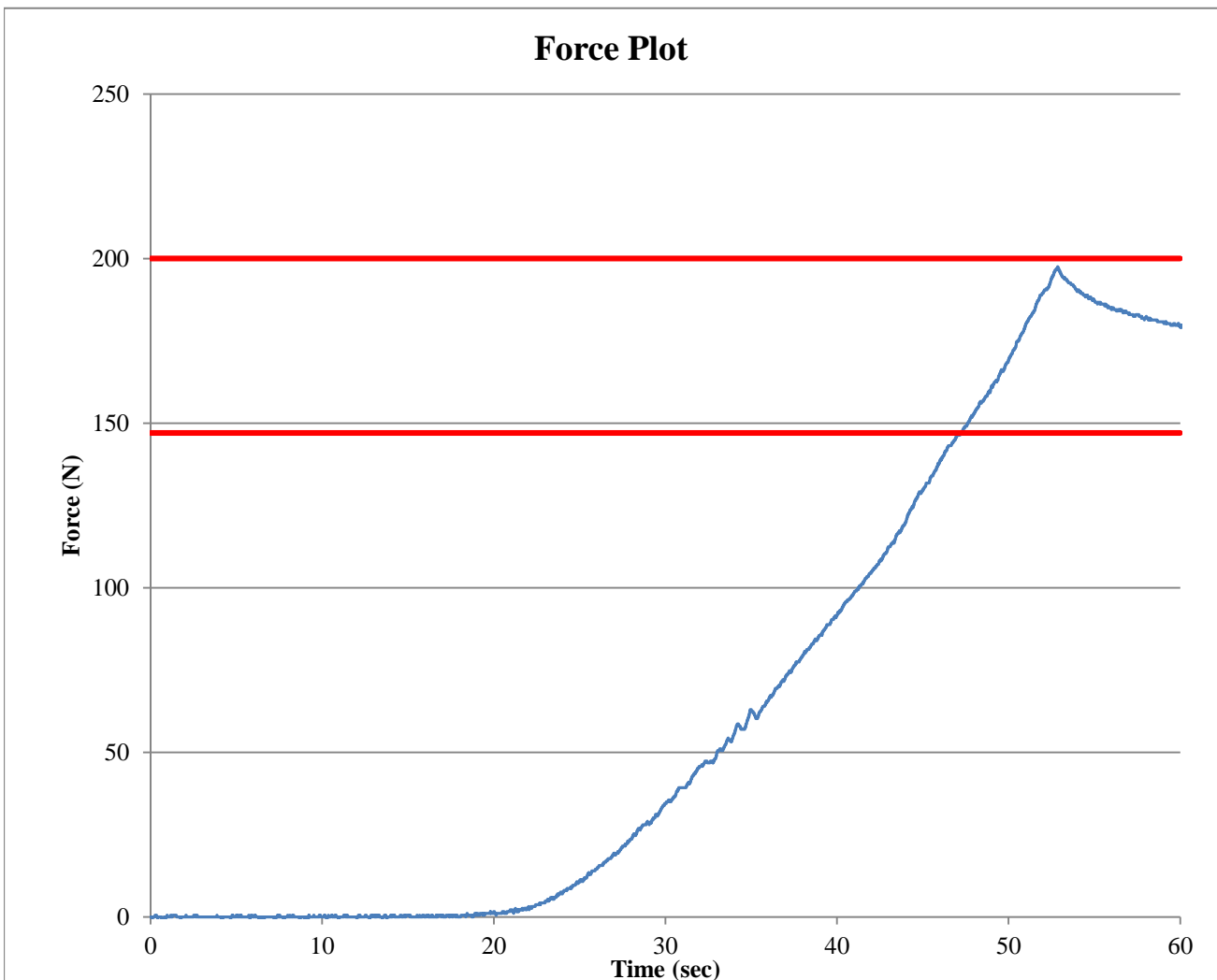
Transportation Research Center Inc.

Hybrid III Six-Year-Old Child Torso Flexion



Customer: VRTC
Serial Number: 088 Date: 7/12/2023
Test Number: 02 Time: 14:03

TEST PARAMETER	SPECIFICATION	TEST RESULTS
Temperature	18.9 - 25.6	21.1 °C Pass
Humidity	10 - 70	67 % Pass
Average Angular Rate	0.5 - 1.5	0.89 deg/sec Pass
Initial Angle	0 - 22	16.38 deg Pass
Peak Force at 45.63°	147 - 200	197.49 N Pass
Final Angle	-8 - 8	-2.78 deg Pass



Components: Comments:
Jacket S/N: 775
Abdomen S/N: 5865
Lumbar S/N: N/A

Transportation Research Center Inc.

Left Knee Femur Response Test
HIII 6YO Serial No. 088 Certification No. 28-1
Test Date: 7/12/2023

Test Parameter	Specification	Test Results	Pass
Temperature	18.9 - 25.6 °C	20.8 °C	Yes
Relative Humidity	10 - 70 %	69 %	Yes
Probe Velocity	2.08 - 2.13 m/s	2.102 m/s	Yes
Peak Femur Force	(-2,000) - (-3,000) N	-2,632.1 N	Yes

Test meets specifications.

Condition: Used

Comments:

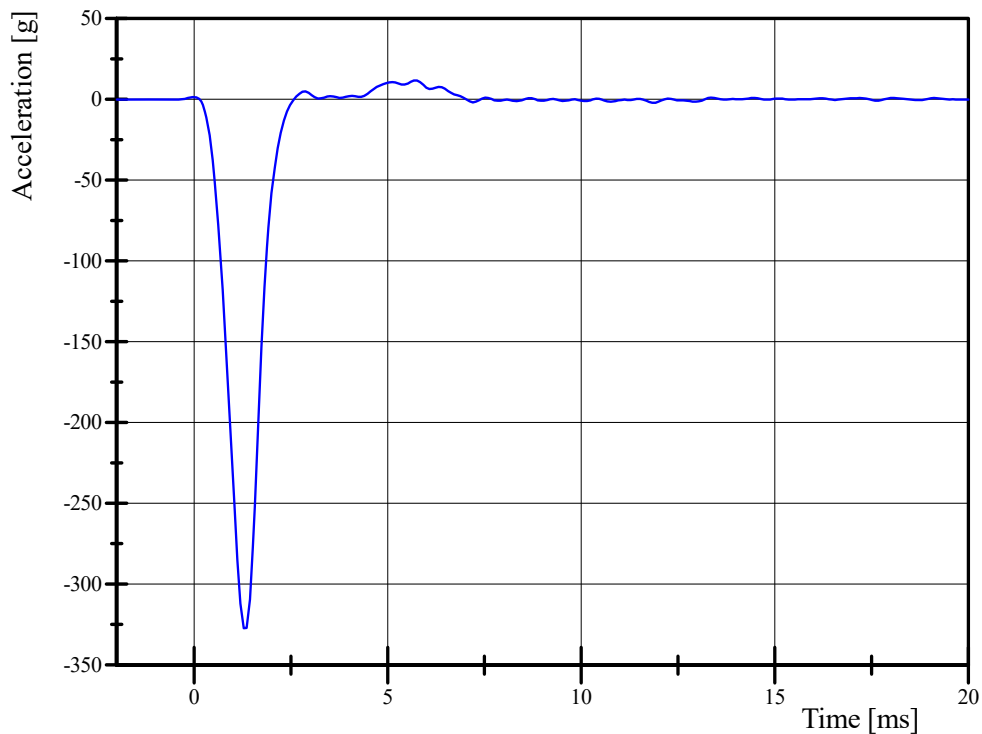
Transportation Research Center Inc.

Left Knee Femur Response Test

HIII 6YO Serial No. 088 Certification No. 28-1

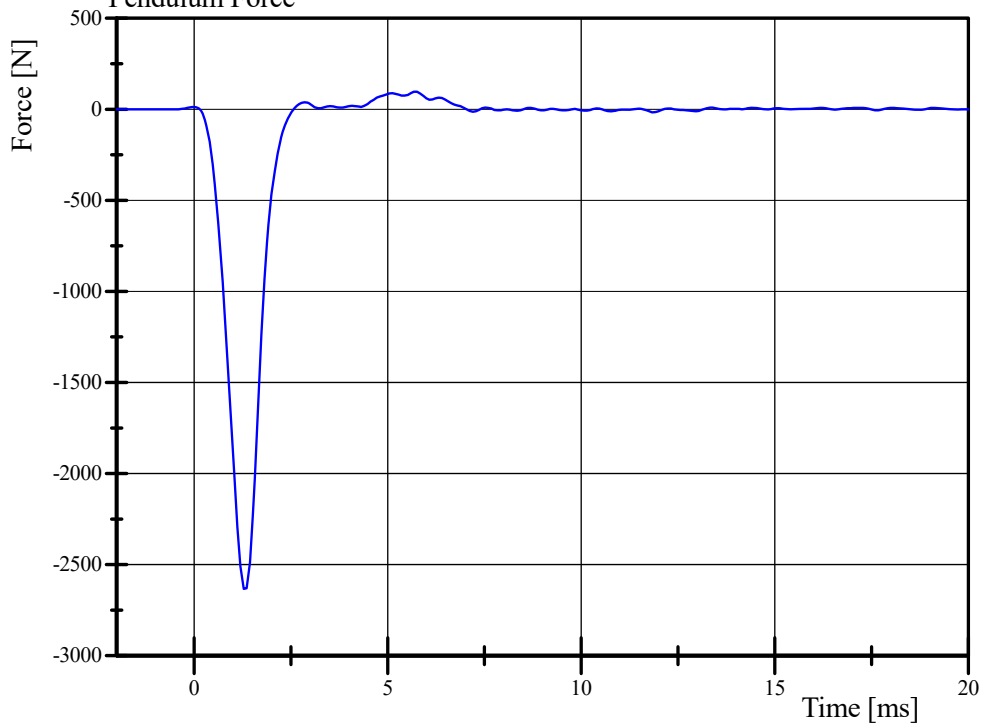
Test Date: 7/12/2023

Pendulum Acceleration



Filter Class: CFC_600
Max: 11.9 g at 5.8 ms
Min: -327.3 g at 1.3 ms

Pendulum Force



Filter Class: CFC_600
Max: 95.3 N at 5.8 ms
Min: -2,632.1 N at 1.3 ms

Transportation Research Center Inc.

Right Knee Femur Response Test
HIII 6YO Serial No. 088 Certification No. 28-1
Test Date: 7/12/2023

Test Parameter	Specification	Test Results	Pass
Temperature	18.9 - 25.6 °C	20.9 °C	Yes
Relative Humidity	10 - 70 %	70 %	Yes
Probe Velocity	2.08 - 2.13 m/s	2.082 m/s	Yes
Peak Femur Force	(-2,000) - (-3,000) N	-2,625.4 N	Yes

Test meets specifications.

Condition: Used

Comments:

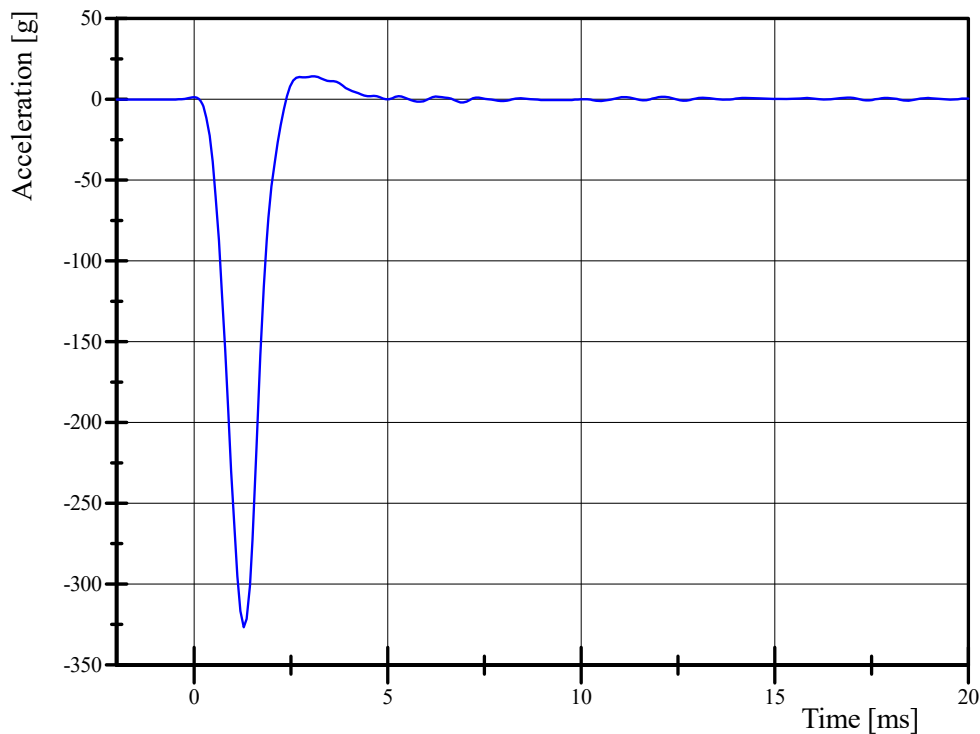
Transportation Research Center Inc.

Right Knee Femur Response Test

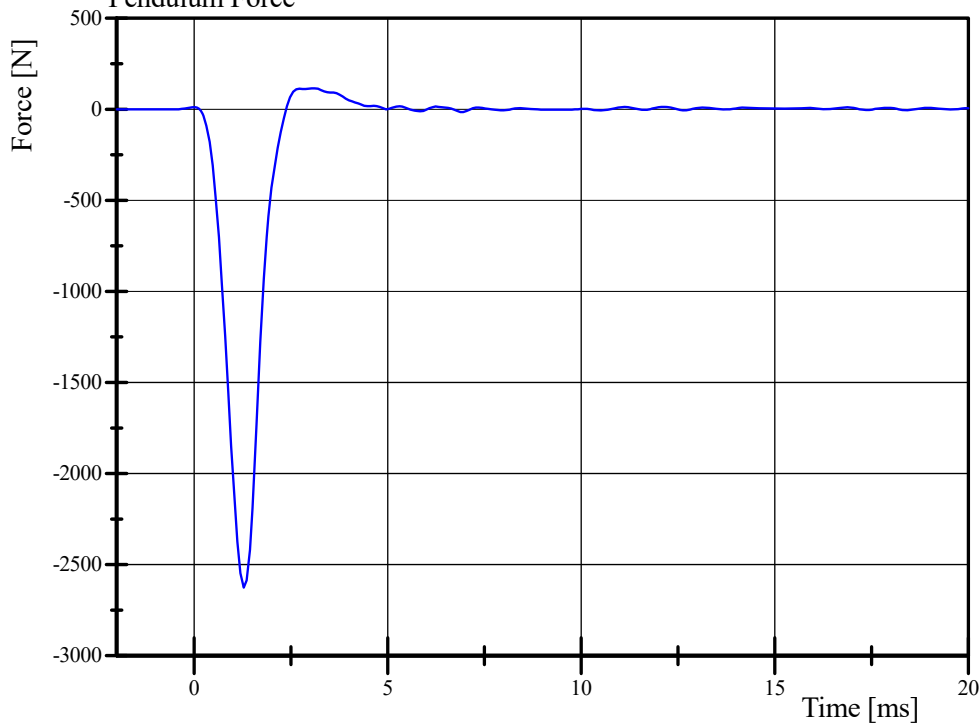
HIII 6YO Serial No. 088 Certification No. 28-1

Test Date: 7/12/2023

Pendulum Acceleration



Pendulum Force



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

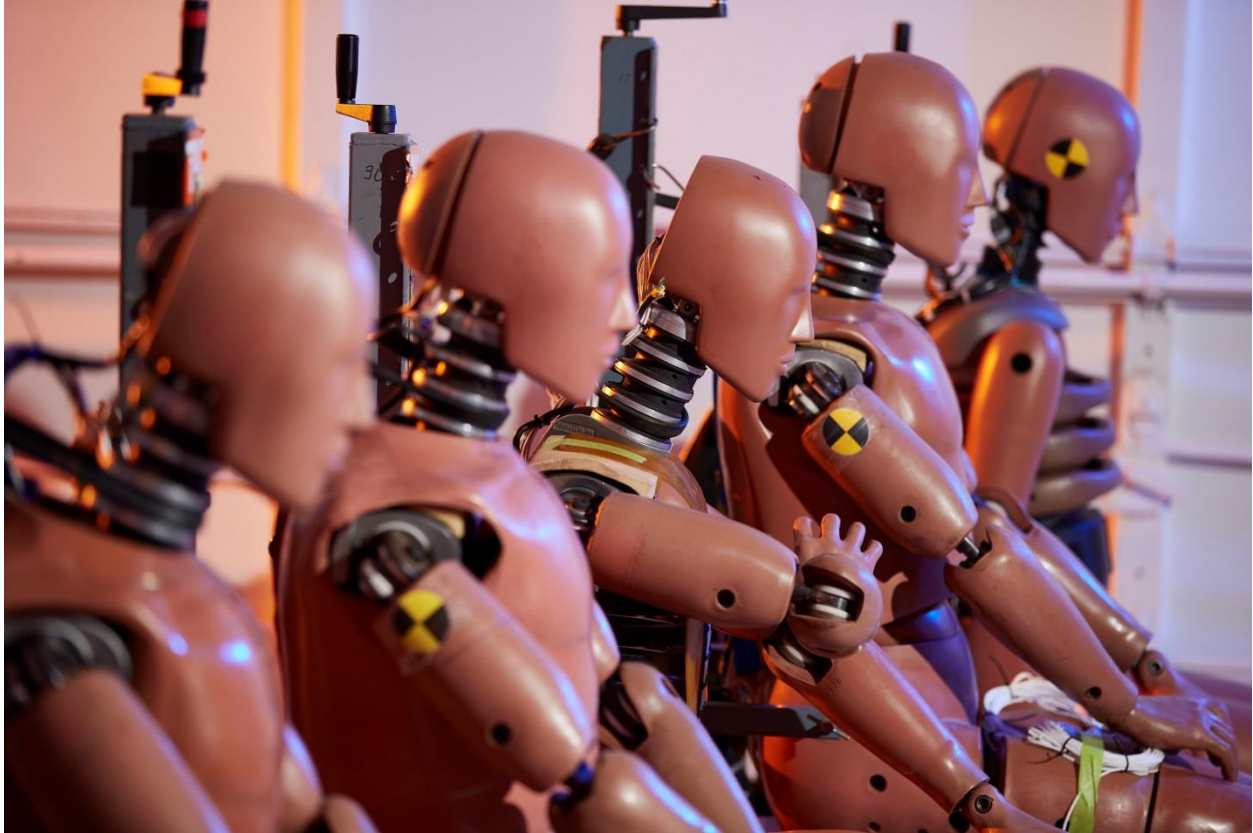
07.13.2023 09:18:13 1825



Appendix C – Quality Assurance



Quality Assurance



ATD Assembly & Final Inspection

ATD Type: Hybrid III (6) Year Old

ATD Serial Number: 088

Assembled by: *Paul B...*

Date Inspected: 07/12/2023