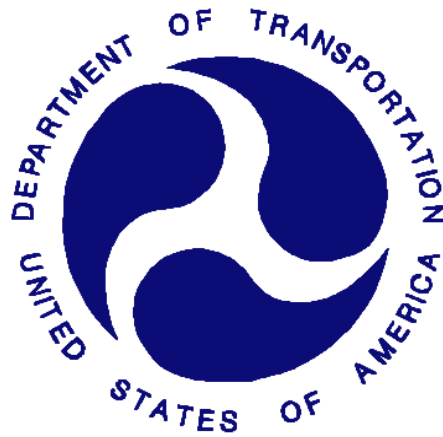


**Vehicle Research and Test Center
FMVSS 213 Testing
Hybrid III 10 Year Old**

**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 10 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 10 year old dummy (serial number F001) was secured in the left rear occupant position (position 4 or P4). The Hybrid III 10 year old was instrumented with head, chest, and pelvis triaxial accelerometers, upper neck, lower neck, and lumbar force and moment load cells, a displacement potentiometer and a rate gyro in the chest, rate gyros in the head. During this test series the dummy was restrained with a 3 point seat belt (SB3PT) in belt positioning boosters with or without rigid lower anchor attachments (rigid LATCH).

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

SECTION 2
BELT POSITIONING BOOSTER CRS LEFT REAR TEST SUMMARY

TEST DUMMY INFORMATION

Description	Position # 4 CRS
ATD Type/Serial No.	Hybrid III 10 Year Old/F001
Restraint System	SB3PT, SB3PT/Rigid 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	--- ¹	--- ¹	--- ¹
Driver Excursion	mm	811.12	-891.91	-363.35
Driver Side	mm	377.11	-893.64	-365.61

¹ Measurements not recorded

DUMMY POSITIONING

CRS: Maxi Cosi Rodifix – Belt Positioning Booster – SB3PT/Rigid LATCH

TRC Test Number: S220310-1

VRTC Test Number: FR_BE_09



DUMMY POSITIONING FARO MEASUREMENTS

Description	Units	X	Y	Z
Z-Point	mm	-0.19	-0.10	0.72
Center of the seat frame bottom	mm	613.68	351.08	-105.42
CRS base center	mm	511.54	349.39	-205.07
Center of seat frame back	mm	-120.31	350.06	-680.53
Top of CRS	mm	13.47	349.49	-564.11
Top of Headrest	mm	-79.08	349.63	-896.40
Top of the head	mm	130.09	351.06	-922.12
Bridge of nose	mm	227.36	350.82	-834.10
Head CG outboard	mm	142.35	282.99	-821.58
Neck center	mm	155.10	351.50	-701.95
Knee pivot	mm	584.52	216.72	-343.08
Left top of knee	mm	591.44	259.76	-394.36
Right top of knee	mm	594.77	445.66	-391.98
Ankle	mm	657.99	250.18	-62.54
Shoulder belt top	mm	230.48	350.22	-626.21
Shoulder belt bottom	mm	267.29	350.02	-549.66
Lap belt top	mm	333.80	349.66	-415.17
Lap belt bottom	mm	370.04	350.58	-384.47
CRS 1	mm	17.56	259.74	-617.31
CRS 4	mm	123.39	164.30	-389.80
CRS 2	mm	226.58	150.42	-285.45
CRS 3	mm	363.82	143.00	-259.06

HIC (36 ms)	375
Chest Clip (3 ms)	45.1 g
Head Excursion (mm)	546
Knee Excursion (mm)	688

DUMMY POSITIONING

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

TRC Test Number: S220314-1

VRTC Test Number: FR_BE_11



DUMMY POSITIONING FARO MEASUREMENTS

Description	Units	X	Y	Z
Z-Point	mm	-0.44	-0.13	0.72
Center of the seat frame bottom	mm	613.57	350.67	-105.50
CRS base center	mm	531.46	349.94	-228.87
Center of seat frame back	mm	-120.50	349.98	-680.63
Top of CRS	mm	-7.79	351.44	-687.40
Top of Headrest	mm	2.71	357.90	-937.05
Top of the head	mm	200.13	350.74	-933.57
Bridge of nose	mm	274.68	350.37	-825.89
Head CG outboard	mm	190.77	279.65	-835.67
Neck center	mm	175.10	348.34	-714.40
Knee pivot	mm	551.17	212.81	-389.91
Left top of knee	mm	549.30	259.52	-438.72
Right top of knee	mm	548.19	440.70	-436.81
Ankle	mm	662.33	233.33	-120.55
Shoulder belt top	mm	237.43	350.57	-627.36
Shoulder belt bottom	mm	259.80	350.09	-549.72
Lap belt top	mm	294.49	350.23	-432.22
Lap belt bottom	mm	330.21	350.67	-401.60
CRS 1	mm	42.60	185.66	-619.48
CRS 4	mm	96.49	197.85	-356.20
CRS 2	mm	181.69	146.97	-305.11
CRS 3	mm	345.91	140.53	-234.06

HIC (36 ms)	274
Chest Clip (3 ms)	41.3 g
Head Excursion (mm)	541
Knee Excursion (mm)	670

DUMMY POSITIONING

CRS: Chicco GoFit NB – Belt Positioning Booster – SB3PT

TRC Test Number: S220315-1

VRTC Test Number: FR_BE_13



DUMMY POSITIONING FARO MEASUREMENTS

Description	Units	X	Y	Z
Z-Point	mm	-0.10	-0.14	0.42
Center of the seat frame bottom	mm	613.61	350.39	-105.60
CRS base center	mm	517.62	350.24	-228.52
Center of seat frame back	mm	-169.35	350.14	-828.51
Top of the head	mm	95.00	350.13	-911.36
Bridge of nose	mm	185.18	349.50	-815.55
Head CG outboard	mm	100.09	280.02	-811.03
Neck center	mm	103.86	349.37	-690.15
Knee pivot	mm	515.86	213.18	-375.05
Left top of knee	mm	513.96	256.88	-426.76
Right top of knee	mm	511.74	436.74	-426.83
Ankle	mm	660.51	242.86	-122.69
Shoulder belt top	mm	180.08	350.06	-602.21
Shoulder belt bottom	mm	214.20	350.39	-512.60
Lap belt top	mm	270.11	350.07	-402.88
Lap belt bottom	mm	307.56	350.37	-374.01
CRS 2	mm	227.57	143.01	-307.16
CRS 3	mm	468.38	129.52	-248.57

HIC (36 ms)	381
Chest Clip (3 ms)	42.5 g
Head Excursion (mm)	501
Knee Excursion (mm)	646

DUMMY POSITIONING

CRS: Clek Ozzi NB – Belt Positioning Booster – SB3PT/Rigid LATCH

TRC Test Number: S220315-2

VRTC Test Number: FR_BE_15



DUMMY POSITIONING FARO MEASUREMENTS

Description	Units	X	Y	Z
Z-Point	mm	-0.18	-0.14	0.33
Center of the seat frame bottom	mm	613.82	350.72	-105.17
CRS base center	mm	461.58	349.51	-198.10
Center of seat frame back	mm	-168.97	351.91	-830.33
Top of the head	mm	61.37	351.47	-908.31
Bridge of nose	mm	161.30	349.13	-820.95
Head CG outboard	mm	74.02	282.66	-807.41
Neck center	mm	91.78	351.12	-687.83
Knee pivot	mm	530.34	221.17	-347.96
Left top of knee	mm	535.15	264.48	-400.21
Right top of knee	mm	536.51	443.62	-401.85
Ankle	mm	694.48	253.94	-109.35
Shoulder belt top	mm	172.47	349.94	-602.81
Shoulder belt bottom	mm	208.34	350.86	-527.61
Lap belt top	mm	278.75	350.87	-407.96
Lap belt bottom	mm	316.05	350.25	-377.64
CRS 2	mm	213.50	148.10	-308.58
CRS 3	mm	442.91	187.77	-246.47

HIC (36 ms)	545
Chest Clip (3 ms)	48.6 g
Head Excursion (mm)	483
Knee Excursion (mm)	680

SECTION 3
DUMMY CALIBRATION DATA

Transportation Research Center Inc.

ATD Certification Report

Customer:

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

Anthropomorphic Device:

Hybrid III (10) Year Old
Serial No. F001
Certification No. 34



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) 666-2011
Date Received: February 18, 2022
Date Completed: February 21, 2022

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.

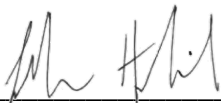
Each certification test was conducted by an authorized Transportation Research Center Inc. (TRC Inc.) employee within the requirements of the ISO/IEC 17025:2017 standards and adheres to CFR Part 572 Subparts B, E, N, O, P, R, T, U, V, SAE J2860, J2856, J2862; depending on ATD type. Any statements of 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 Received: 02/18/2022

Testing Conducted by: 
Robert Benavides

Date: 02/21/2022

Testing Approved by: 
Josh Hendricks

Date: 02/23/2022

Appendix A – Incoming Inspection



TRC ATD Laboratory As Received Inspection Report

Name: Robert Benavides

Date: 2/18/2022

Customer: VRTC

ATD S/N: F001

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		





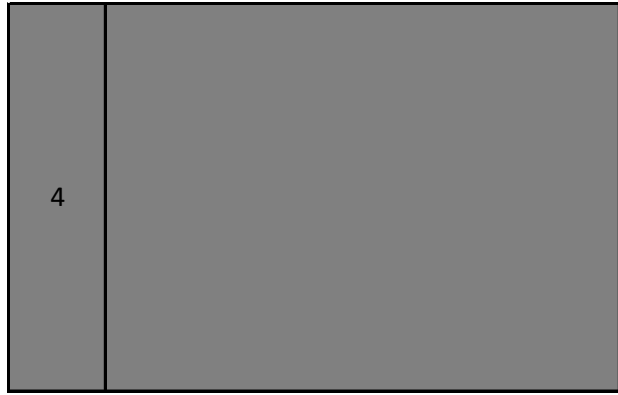
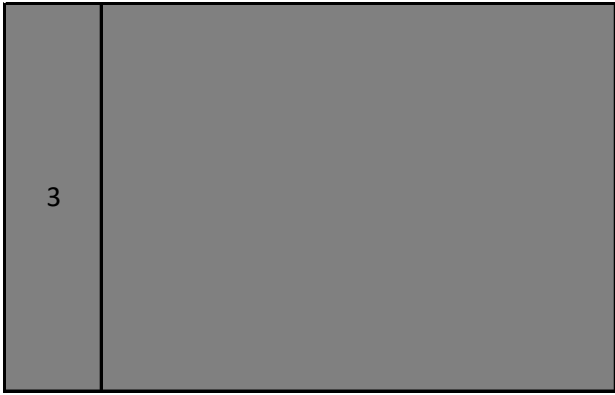
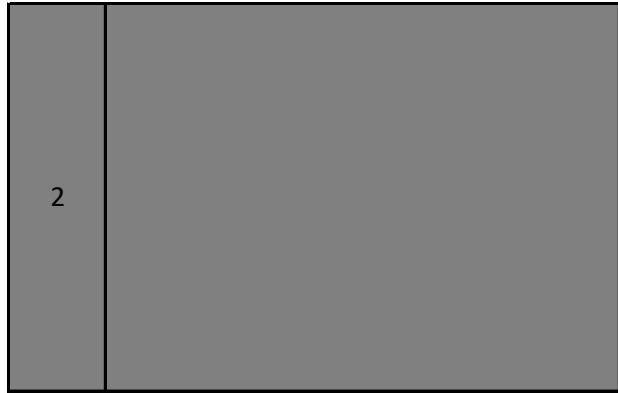
TRC ATD Laboratory As Received Inspection Photos

Name: Robert Benavides

Date: 2/18/2022

Customer: VRTC

ATD S/N: F001





TRC ATD Laboratory Inspection Report Action Items

Name: Robert Benavides

Date: 2/18/2022

Customer: VRTC

ATD S/N: F001

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 10YO Serial No. F001 Certification No. 34-1

Test Date: 2/21/2022

Test Parameter	Specification	Test Results	Pass
Temperature	18.9 - 25.6 °C	21.4 °C	Yes
Relative Humidity	10 - 70 %	33 %	Yes
Peak Head Resultant Acceleration	250 - 300 g	275.0 g	Yes
Peak Head Lateral Acceleration	(-15) - 15 g	4.7 g	Yes
Is Acceleration Curve Unimodal	< 10 %	1.22 %	Yes

Test meets specifications.

Condition: Used

Comments:

Head S/N: 1352

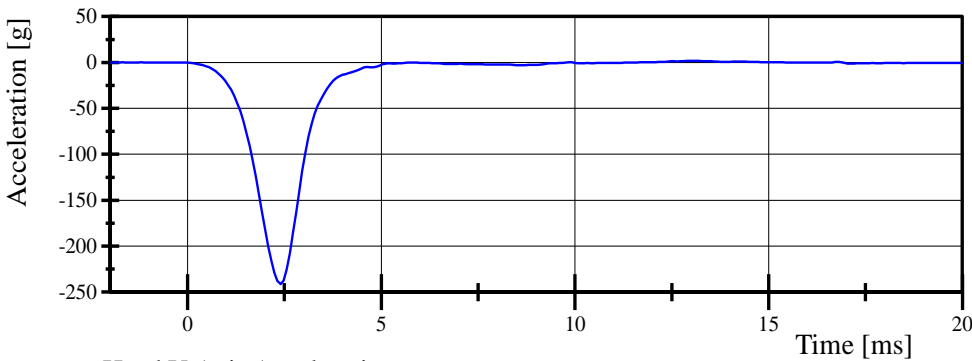
Transportation Research Center Inc.

Front Head Drop

HIII 10YO Serial No. F001 Certification No. 34-1

Test Date: 2/21/2022

Head X-Axis Acceleration

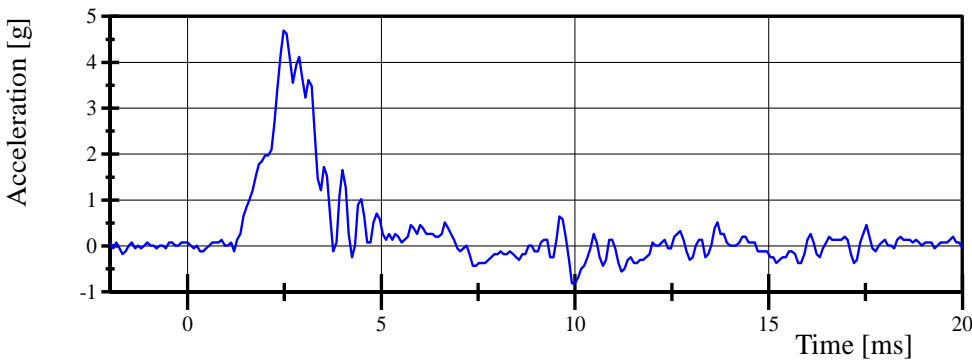


Filter Class: CFC_1000

Max: 1.8 g at 13.0 ms

Min: -241.2 g at 2.4 ms

Head Y-Axis Acceleration

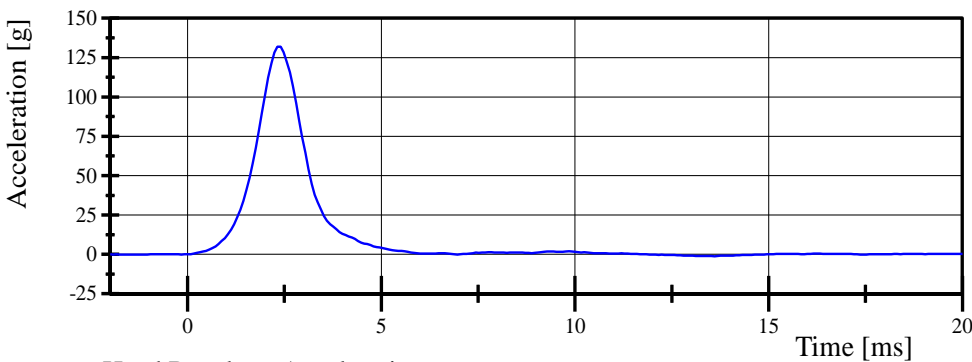


Filter Class: CFC_1000

Max: 4.7 g at 2.5 ms

Min: -0.8 g at 9.9 ms

Head Z-Axis Acceleration

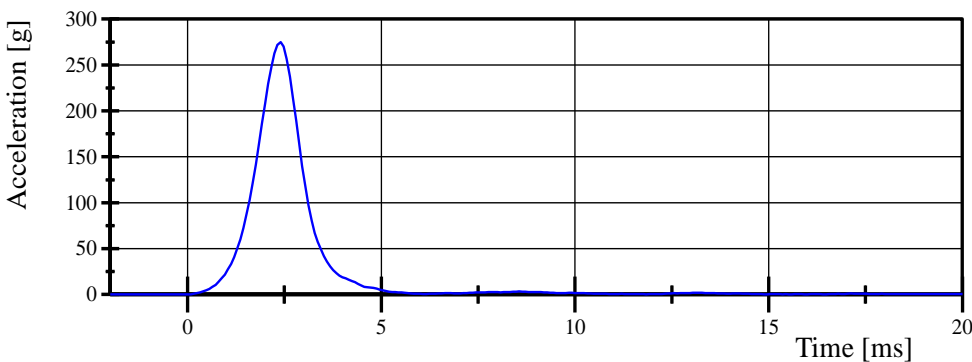


Filter Class: CFC_1000

Max: 131.9 g at 2.4 ms

Min: -1.1 g at 13.6 ms

Head Resultant Acceleration



Filter Class: CFC_1000

Max: 275.0 g at 2.4 ms

Min: 0.0 g at -0.7 ms

Transportation Research Center Inc.

Neck Flexion

HIII 10YO Serial No. F001 Certification No. 34-1

Test Date: 2/21/2022

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	21.4 °C	Yes
Relative Humidity	10 - 70 %	32 %	Yes
Pendulum Impact Velocity	5.98 - 6.22 m/s	6.125 m/s	Yes
Pendulum Integrated Velocity at 10ms	(-1.64) - (-2.04) m/s	-2.030 m/s	Yes
Pendulum Integrated Velocity at 20ms	(-3.04) - (-4.04) m/s	-3.899 m/s	Yes
Pendulum Integrated Velocity at 30ms	(-4.45) - (-5.65) m/s	-5.582 m/s	Yes
Total Head D-Plane Rotation	(-76.0) - (-90.0) °	-78.93 °	Yes
Total Neck Occipital Condyles Moment Between -76° and -90° Rotation	50.0 - 62.0 Nm	54.96 Nm	Yes
Neck Occipital Condyles Moment Decay to 10 Nm	86.0 - 105.0 ms	92.05 ms	Yes

Test meets specifications.

Condition: Used

Comments:

Neck S/N: 2202 0053 A

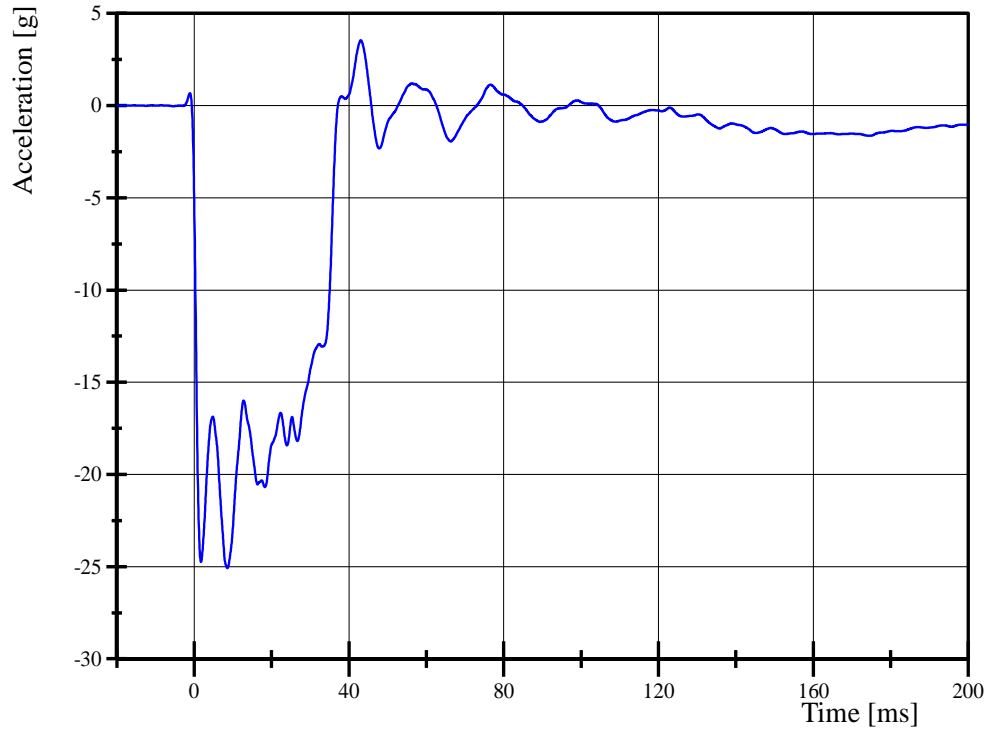
Transportation Research Center Inc.

Neck Flexion

HIII 10YO Serial No. F001 Certification No. 34-1

Test Date: 2/21/2022

Pendulum Acceleration

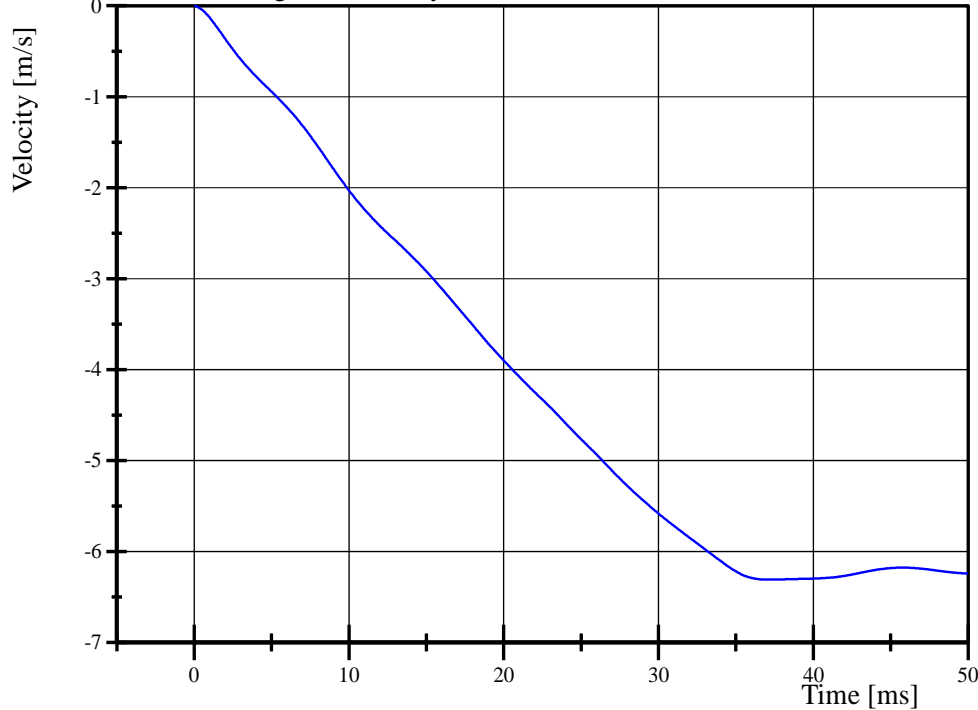


Filter Class: CFC_180

Max: 3.5 g at 43.1 ms

Min: -25.1 g at 8.6 ms

Pendulum Integrated Velocity



Filter Class: CFC_180

Max: 0.0 m/s at 0.0 ms

Min: -6.3 m/s at 37.2 ms

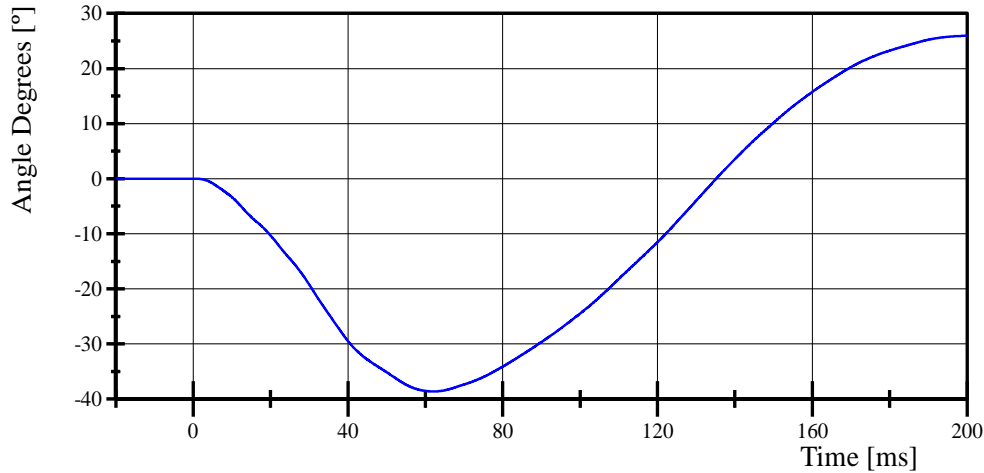
Transportation Research Center Inc.

Neck Flexion

HIII 10YO Serial No. F001 Certification No. 34-1

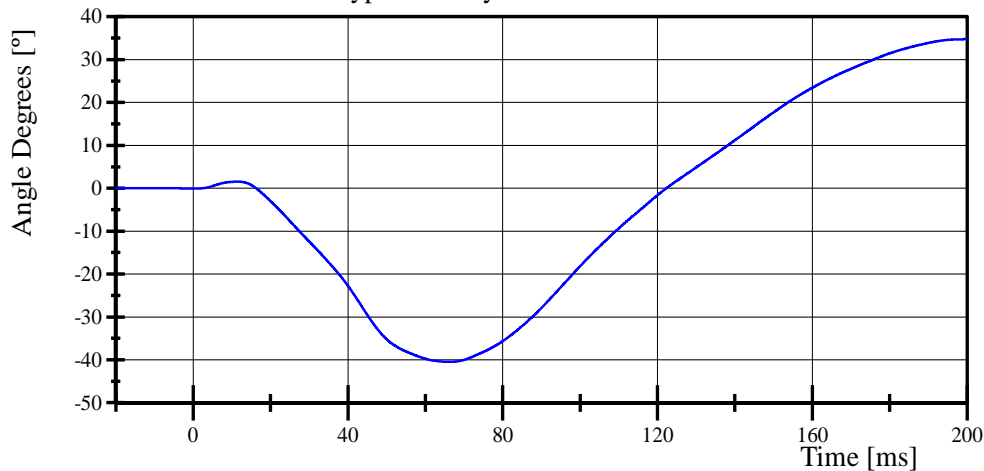
Test Date: 2/21/2022

Pot Rotation at the Base of Neck



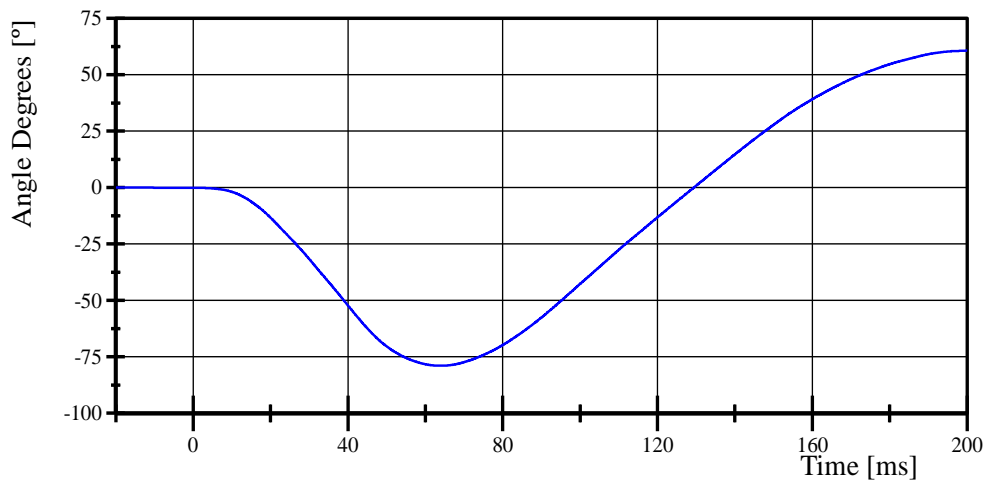
Filter Class: CFC_60
Max: 26.0 ° at 200.0 ms
Min: -38.6 ° at 62.1 ms

Head Rotation at Occypital Condyles



Filter Class: CFC_60
Max: 34.8 ° at 200.0 ms
Min: -40.5 ° at 66.2 ms

Total Head D-Plane Rotation



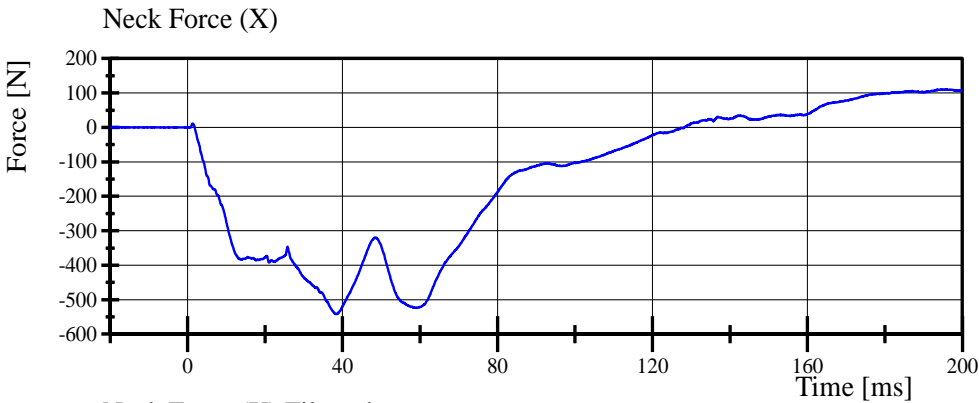
Filter Class: CFC_60
Max: 60.8 ° at 200.0 ms
Min: -78.9 ° at 64.0 ms

Transportation Research Center Inc.

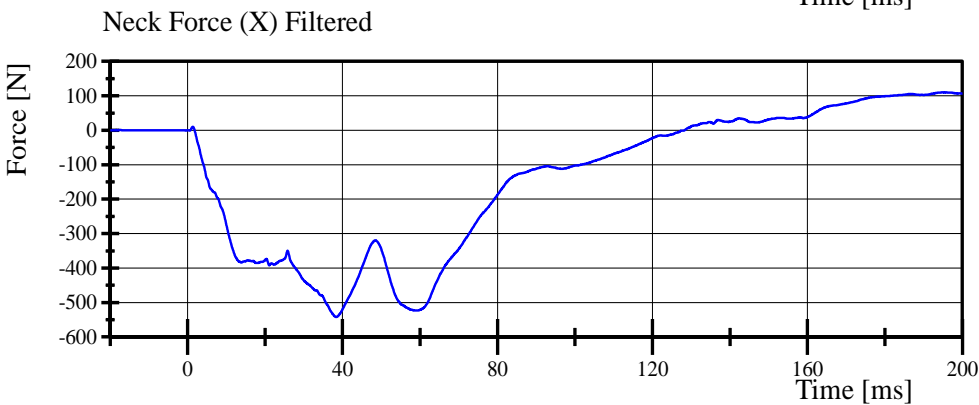
Neck Flexion

HIII 10YO Serial No. F001 Certification No. 34-1

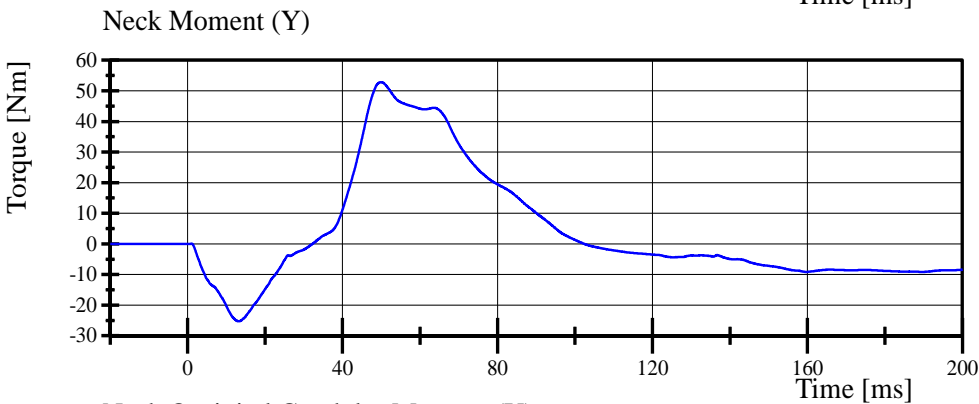
Test Date: 2/21/2022



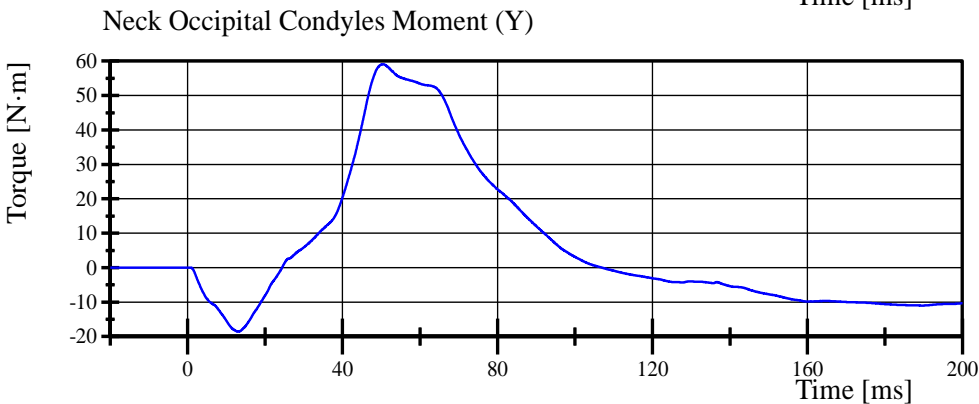
Filter Class: CFC_1000
Max: 110.6 N at 194.9 ms
Min: -541.9 N at 38.3 ms



Filter Class: CFC_600
Max: 110.3 N at 194.9 ms
Min: -541.9 N at 38.4 ms



Filter Class: CFC_600
Max: 52.8 Nm at 49.9 ms
Min: -25.3 Nm at 13.2 ms



Filter Class: Without_(Constar
Max: 59.0 N·m at 50.4 ms
Min: -18.5 N·m at 13.1 ms

Transportation Research Center Inc.

Neck Extension

HIII 10YO Serial No. F001 Certification No. 34-3

Test Date: 2/21/2022

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	21.9 °C	Yes
Relative Humidity	10 - 70 %	32 %	Yes
Pendulum Impact Velocity	4.91 - 5.15 m/s	4.992 m/s	Yes
Pendulum Integrated Velocity at 10ms	1.49 - 1.89 m/s	1.721 m/s	Yes
Pendulum Integrated Velocity at 20ms	2.88 - 3.68 m/s	3.416 m/s	Yes
Pendulum Integrated Velocity at 30ms	4.20 - 5.20 m/s	5.000 m/s	Yes
Total Head D-Plane Rotation	96.0 - 115.0 °	103.25 °	Yes
Total Neck Occipital Condyles Moment Between 96° and 115° Rotation	(-37.0) - (-46.0) Nm	-40.86 Nm	Yes
Neck Occipital Condyles Moment Decay to -10 Nm	100.0 - 116.0 ms	106.60 ms	Yes

Test meets specifications.

Condition: Used

Comments:

Neck S/N: 2202 0053 A

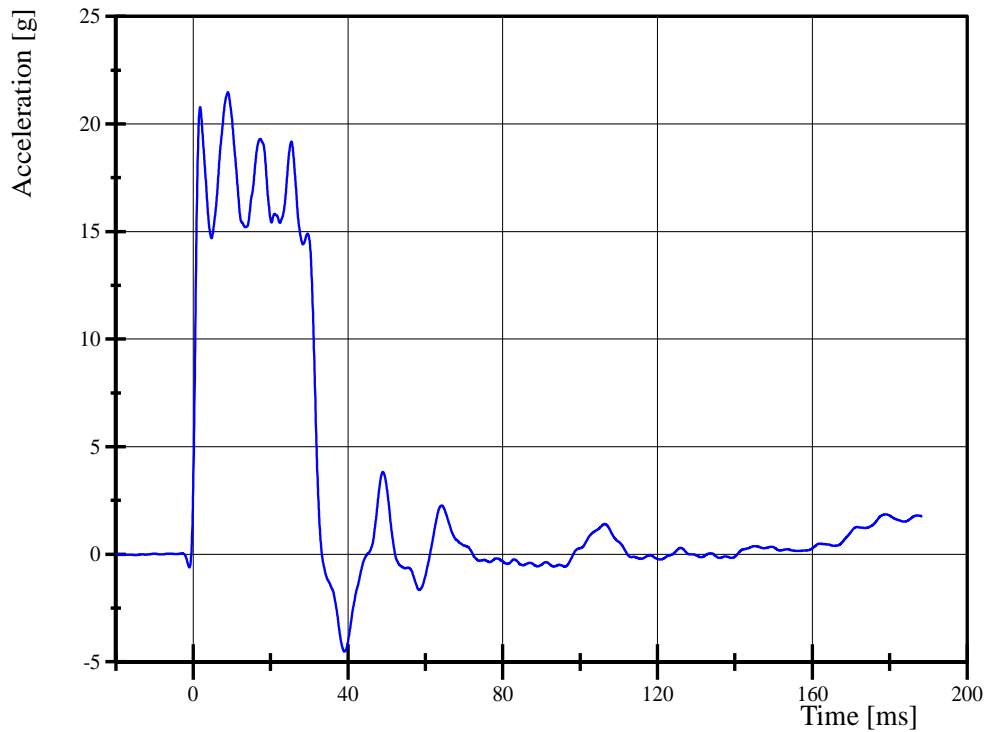
Transportation Research Center Inc.

Neck Extension

HIII 10YO Serial No. F001 Certification No. 34-3

Test Date: 2/21/2022

Pendulum Acceleration

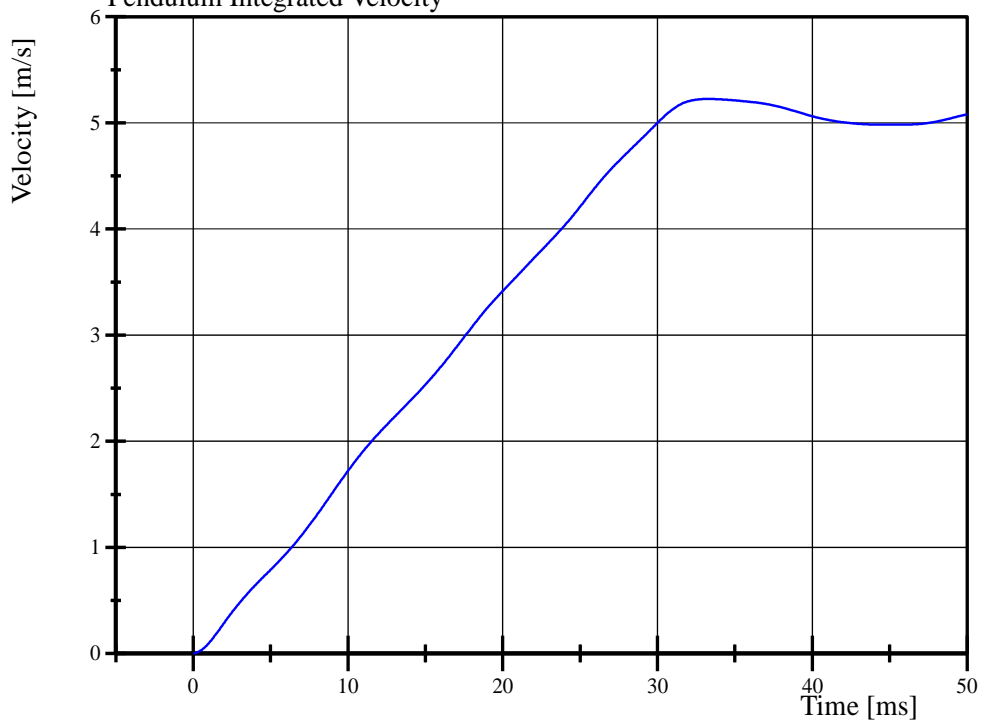


Filter Class: CFC_180

Max: 21.5 g at 9.0 ms

Min: -4.5 g at 39.1 ms

Pendulum Integrated Velocity



Filter Class: CFC_180

Max: 5.2 m/s at 33.3 ms

Min: 0.0 m/s at 0.0 ms

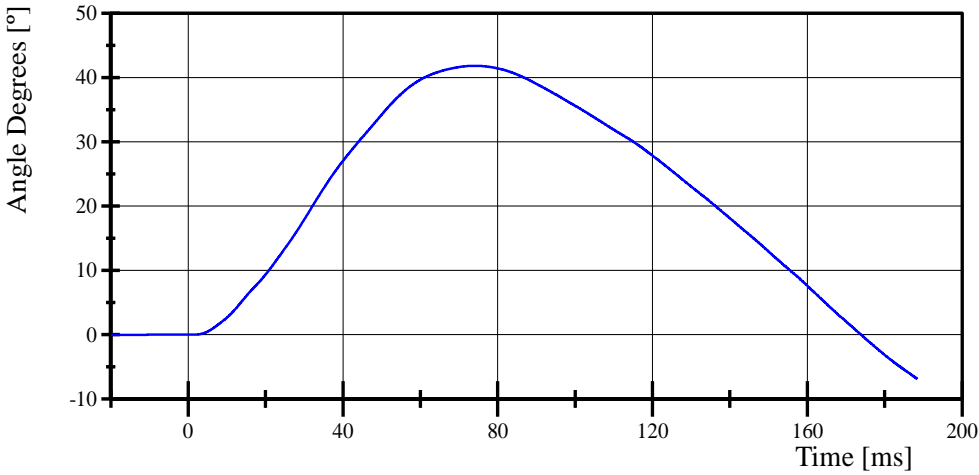
Transportation Research Center Inc.

Neck Extension

HIII 10YO Serial No. F001 Certification No. 34-3

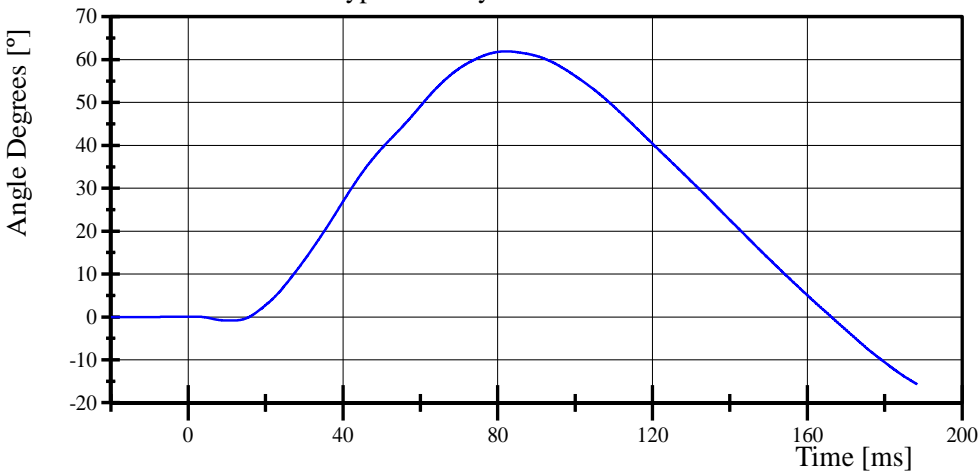
Test Date: 2/21/2022

Pot Rotation at the Base of Neck



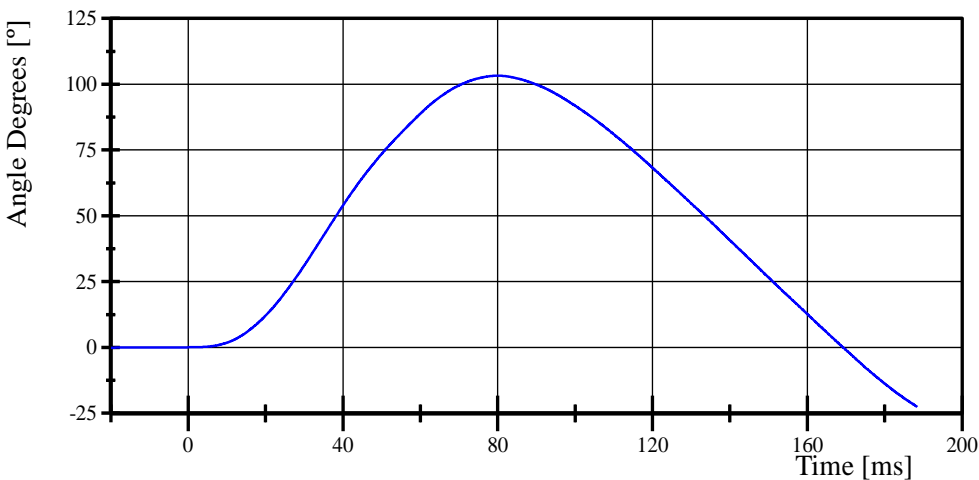
Filter Class: CFC_60
Max: 41.9 ° at 74.0 ms
Min: -6.9 ° at 188.5 ms

Head Rotation at Occypital Condyles



Filter Class: CFC_60
Max: 61.9 ° at 82.1 ms
Min: -15.7 ° at 188.5 ms

Total Head D-Plane Rotation



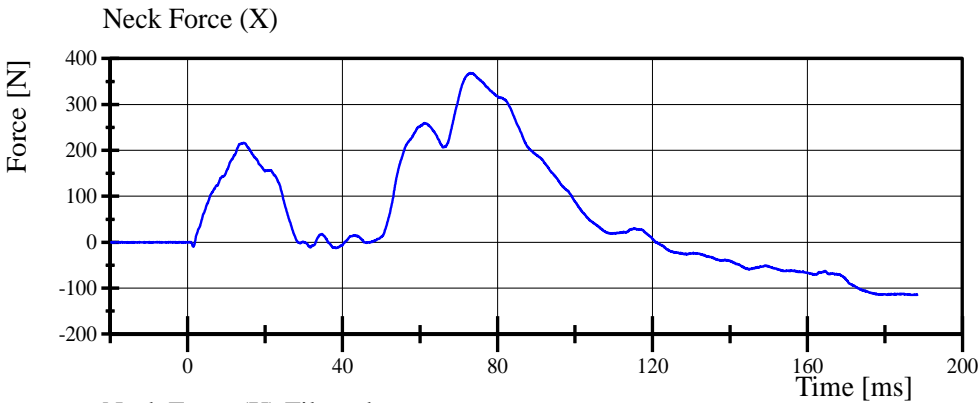
Filter Class: CFC_60
Max: 103.2 ° at 80.0 ms
Min: -22.6 ° at 188.5 ms

Transportation Research Center Inc.

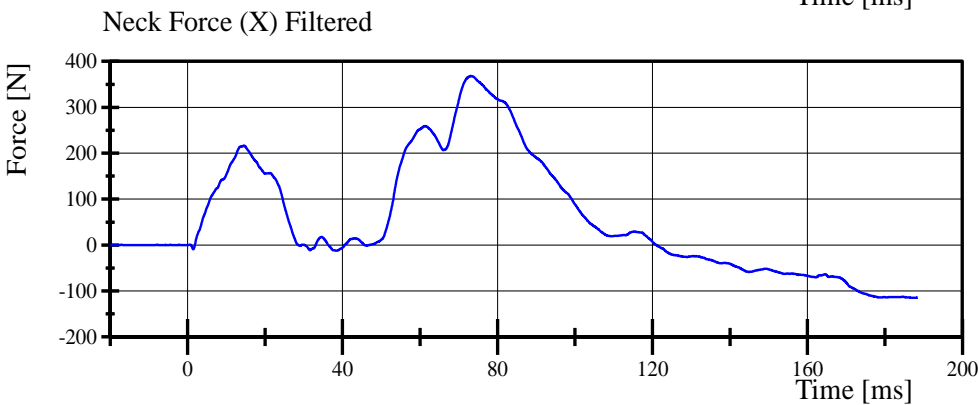
Neck Extension

HIII 10YO Serial No. F001 Certification No. 34-3

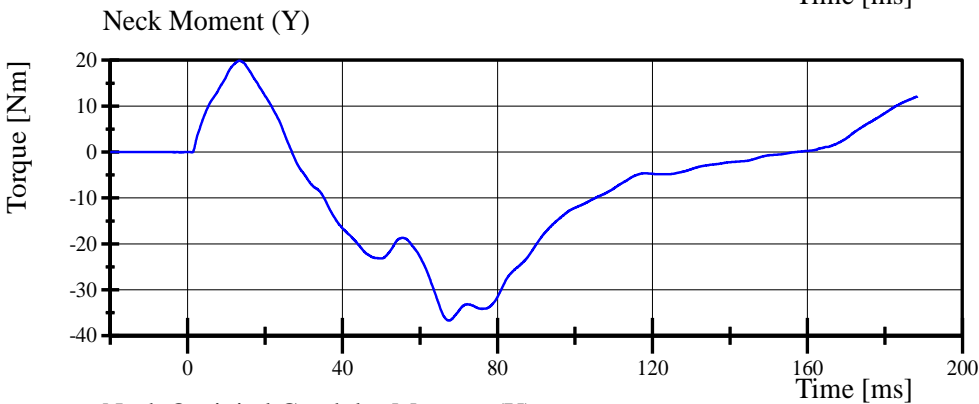
Test Date: 2/21/2022



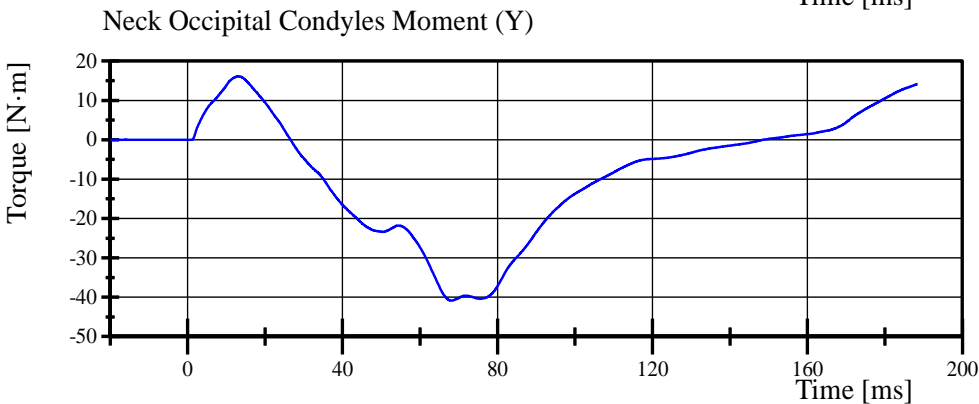
Filter Class: CFC_1000
Max: 368.2 N at 72.9 ms
Min: -115.0 N at 186.6 ms



Filter Class: CFC_600
Max: 368.0 N at 73.1 ms
Min: -114.8 N at 186.8 ms



Filter Class: CFC_600
Max: 19.9 Nm at 13.4 ms
Min: -36.7 Nm at 67.5 ms



Filter Class: Without_(Constar
Max: 16.1 N·m at 13.1 ms
Min: -40.9 N·m at 68.0 ms

Transportation Research Center Inc.

Front Thorax

HIII 10YO Serial No. F001 Certification No. 34-1

Test Date: 2/18/2022

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	21.4 °C	Yes
Relative Humidity	10 - 70 %	33 %	Yes
Probe Velocity	5.88 - 6.12 m/s	6.006 m/s	Yes
Probe Force Peak Between 37 mm and 46 mm Chest Deflection	(-2,000) - (-2,450) N	-2,182.1 N	Yes
Probe Force Peak Between 20.0 mm and 37 mm Chest Deflection	>= (-2,520) N	-2,196.6 N	Yes
Maximum Chest Compression	(-37) - (-46) mm	-44.0 mm	Yes
Internal Hysteresis	69 - 85 %	80.1 %	Yes

Test meets specifications.

Condition: Used

Comments:

Jacket S/N: 08948

Rib Set S/N: 22031804A

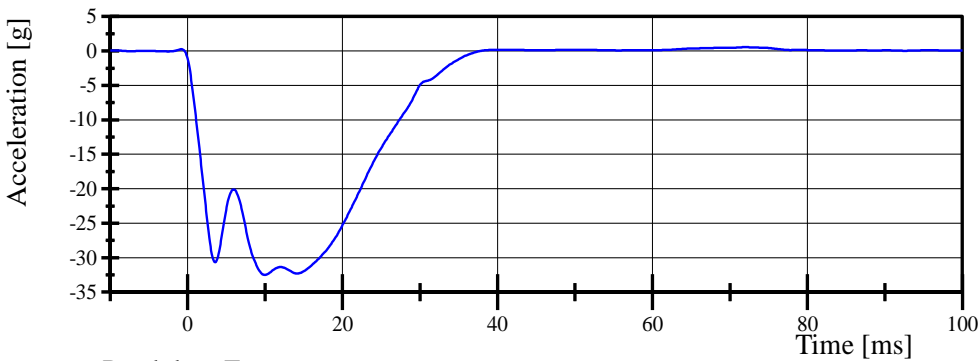
Transportation Research Center Inc.

Front Thorax

HIII 10YO Serial No. F001 Certification No. 34-1

Test Date: 2/18/2022

Pendulum Acceleration

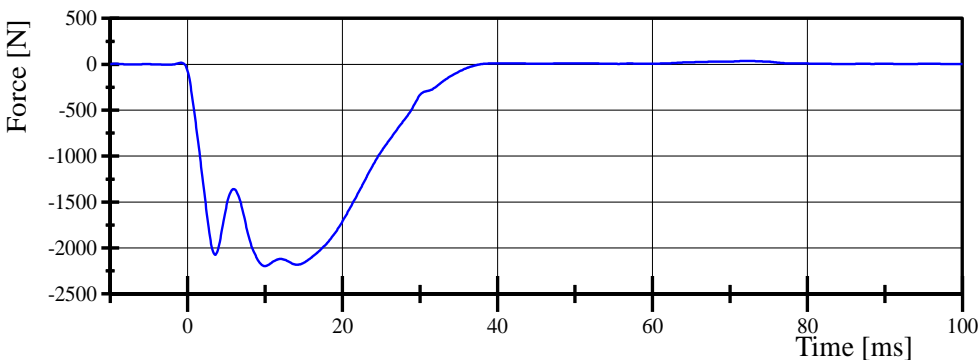


Filter Class: CFC_180

Max: 0.5 g at 71.9 ms

Min: -32.5 g at 9.9 ms

Pendulum Force

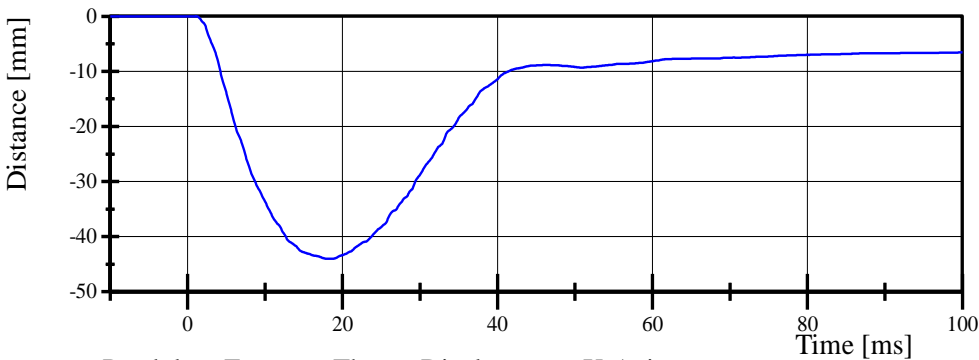


Filter Class: CFC_180

Max: 36.5 N at 71.9 ms

Min: -2,196.6 N at 9.9 ms

Thorax Displacement X-Axis

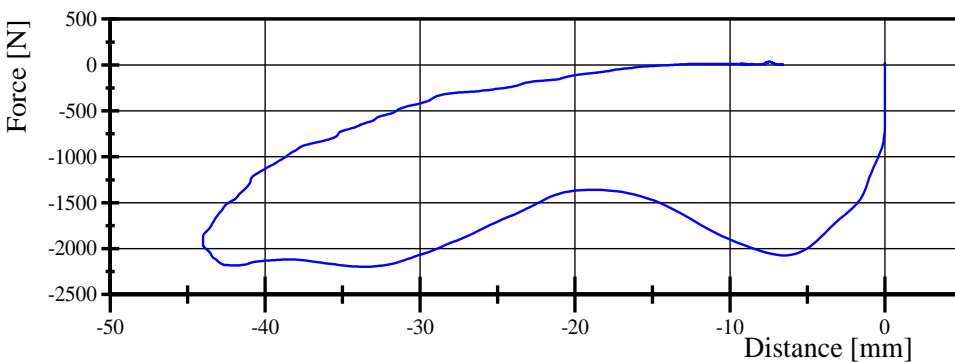


Filter Class: CFC_600

Max: 0.0 mm at 1.0 ms

Min: -44.0 mm at 18.0 ms

Pendulum Force vs. Thorax Displacement X-Axis



Filter Class: CFC_180

Max: 36.5 N at -7.5 mm

Min: -2,196.6 N at -33.4 mm

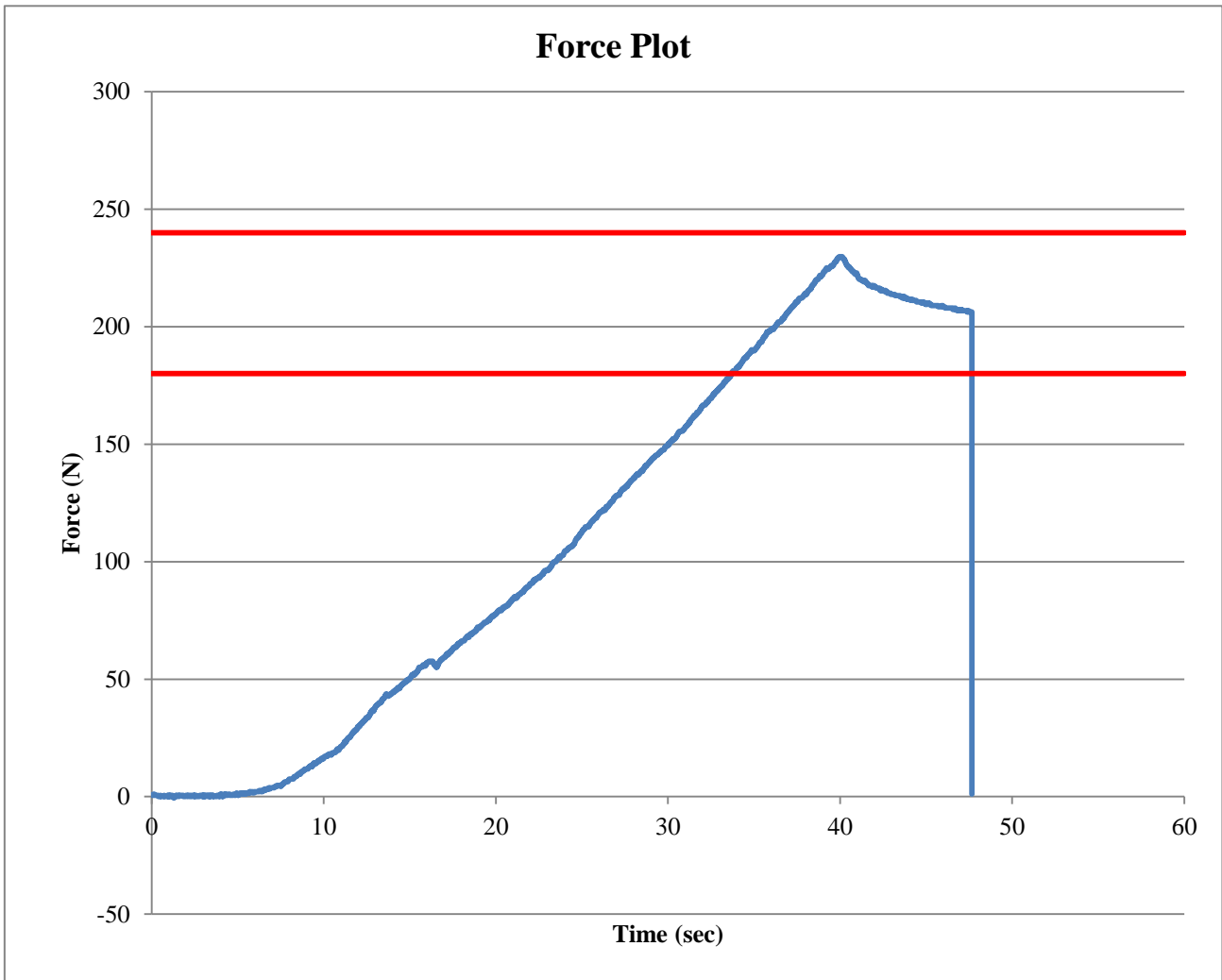
Transportation Research Center Inc.

Hybrid III 10-Year Old Torso Flexion



Customer: VRTC
Serial Number: F001 Date: 2/18/2022
Test Number: 1 Time: 15:04

TEST PARAMETER	SPECIFICATION	TEST RESULTS
Temperature	18.9 - 25.6	21.4 °C Pass
Humidity	10 - 70	32 % Pass
Average Angular Velocity	0.5 - 1.5	0.99 deg/sec Pass
Initial Angle	0 - 20	2.44 deg Pass
Peak Force at 35.18°	180 - 240	229.79 N Pass
Final Angle	0 - 8	2.59 deg Pass



Comments:
Jacket S/N: 08948
Abdomen S/N: N/A

Transportation Research Center Inc.

Left Knee Femur Response Test

HIII 10YO Serial No. F001 Certification No. 34-1

Test Date: 2/21/2022

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	21.4 °C	Yes
Relative Humidity	10 - 70 %	31 %	Yes
Probe Velocity	2.07 - 2.13 m/s	2.093 m/s	Yes
Peak Femur Force	(-2,600) - (-3,200) N	-2,978.7 N	Yes

Test meets specifications.

Condition: Used

Comments:

Knee Skin S/N: 09253

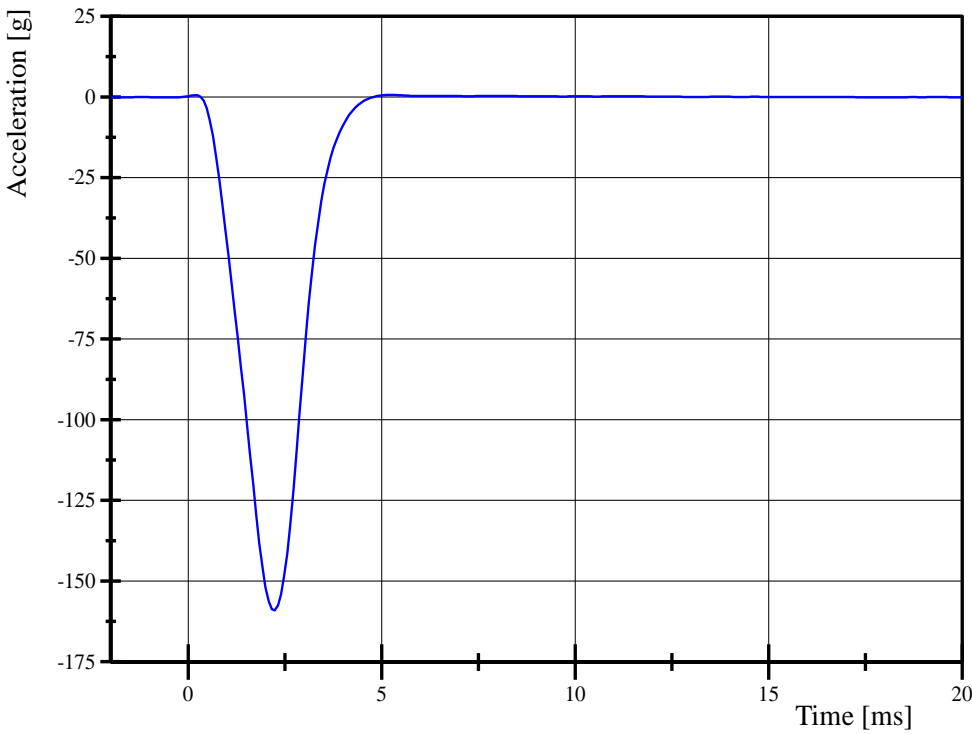
Transportation Research Center Inc.

Left Knee Femur Response Test

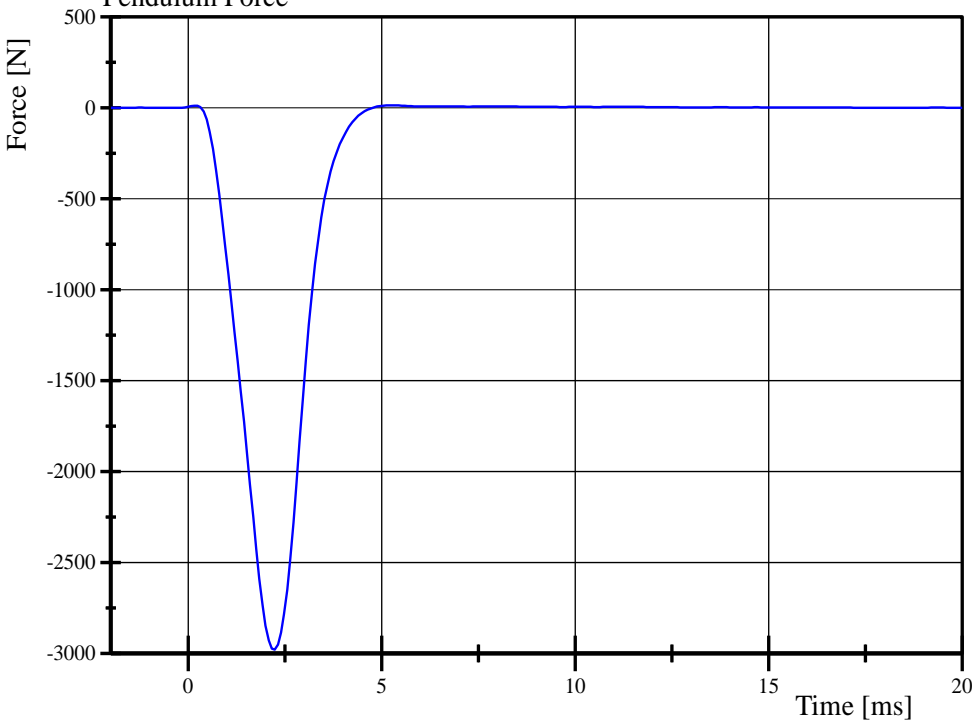
HIII 10YO Serial No. F001 Certification No. 34-1

Test Date: 2/21/2022

Pendulum Acceleration



Pendulum Force



Transportation Research Center Inc.

Right Knee Femur Response Test

HIII 10YO Serial No. F001 Certification No. 34-1

Test Date: 2/21/2022

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	21.4 °C	Yes
Relative Humidity	10 - 70 %	32 %	Yes
Probe Velocity	2.07 - 2.13 m/s	2.088 m/s	Yes
Peak Femur Force	(-2,600) - (-3,200) N	-3,014.8 N	Yes

Test meets specifications.

Condition: Used

Comments:

Knee Skin S/N: 22070074

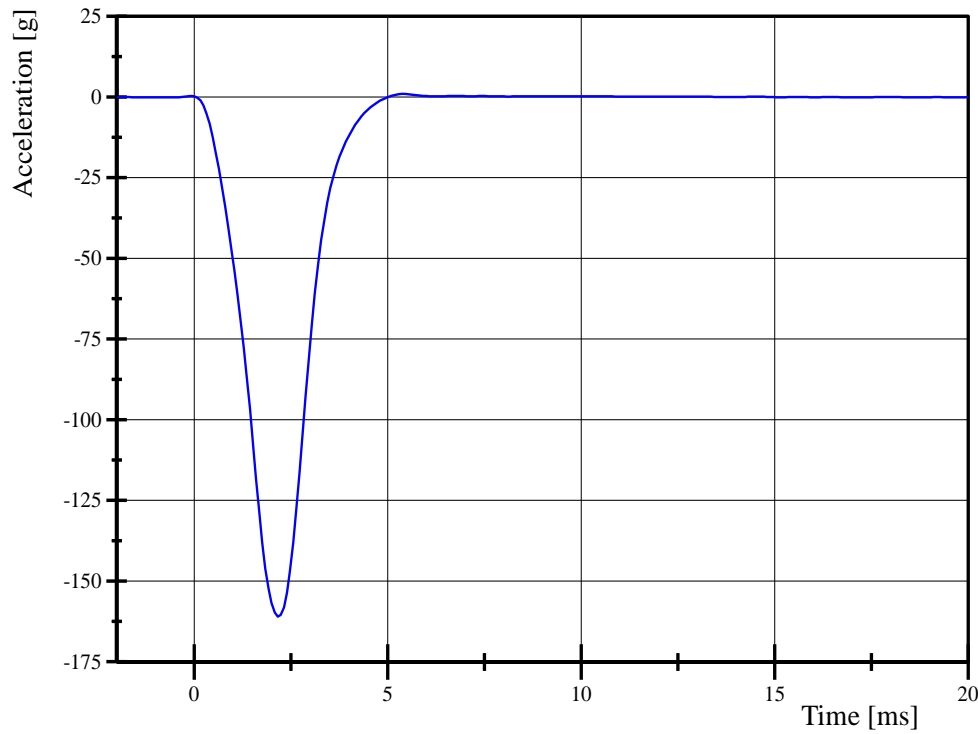
Transportation Research Center Inc.

Right Knee Femur Response Test

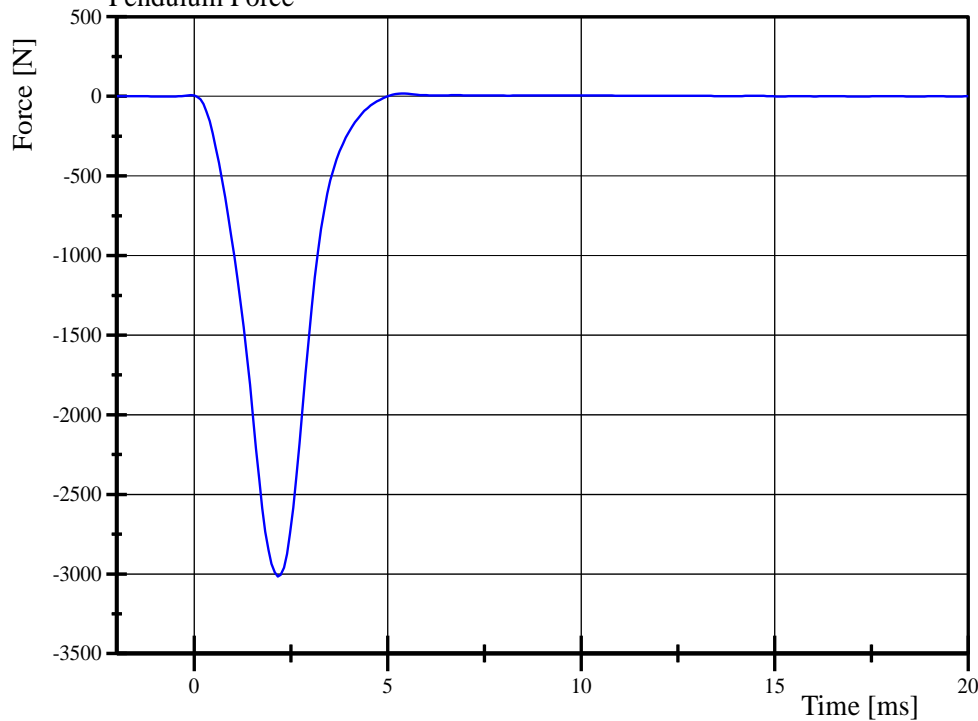
HIII 10YO Serial No. F001 Certification No. 34-1

Test Date: 2/21/2022

Pendulum Acceleration

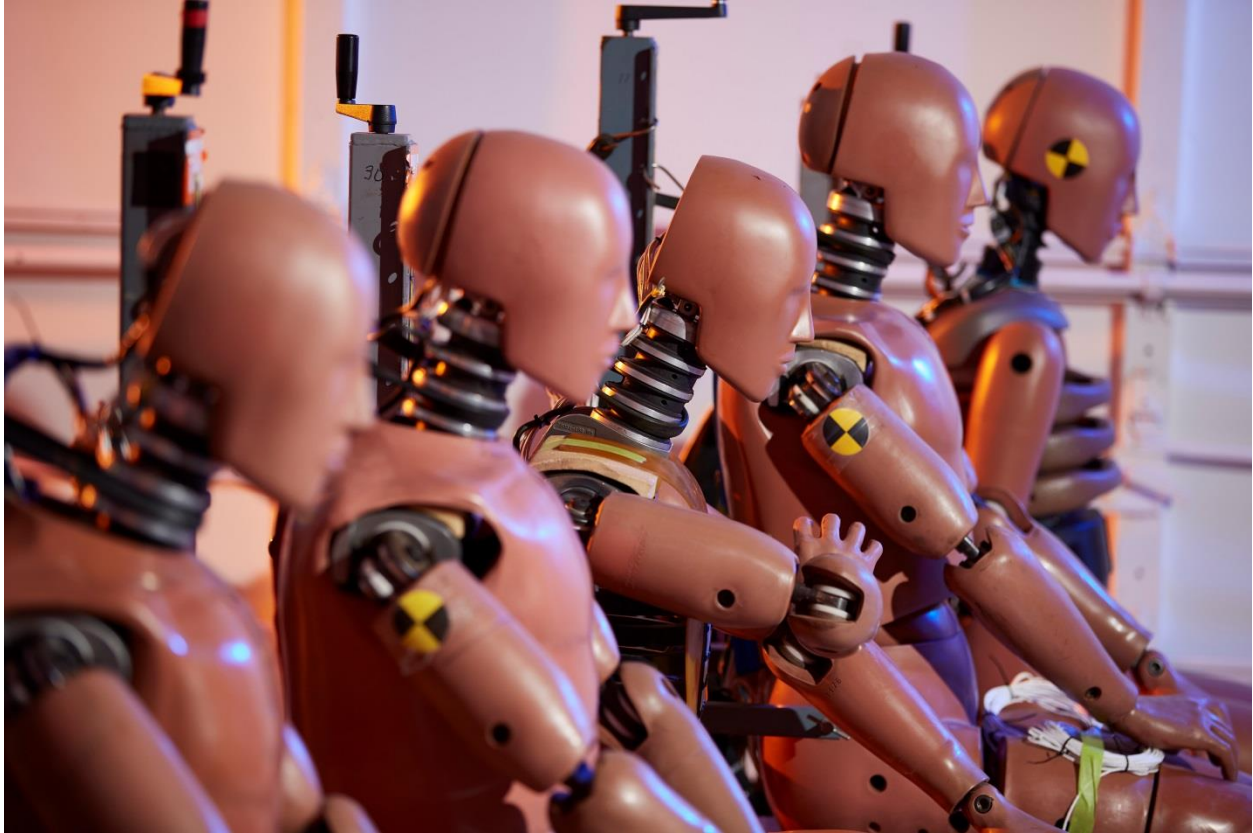


Pendulum Force



Appendix C – Quality Assurance

Quality Assurance



ATD Assembly & Final Inspection

ATD Type: Hybrid III (10) Year Old

ATD Serial Number: F001

Assembled by: *Paul B...*

Date Inspected: 02/21/2022