

**Vehicle Research and Test Center
FMVSS 213 Testing
CRABI 12 Month 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 12 MONTH OLD CRABI

The purpose of the testing is: 1) to determine whether test data from the revised FMVSS No. 213 bench is repeatable and reproducible when compared to other test facility results; and 2) to refine additional test procedure measures to improve R&R.

SUMMARY

A CRABI 12 month old dummy (serial number 094) was secured in the left rear occupant position (position 4 or P4) in a rearward facing child restraint system (CRS) and a forward facing child restraint system (CRS). The CRABI 12 month old was instrumented with head, chest, and pelvic triaxial accelerometers, and upper neck, and lumbar force and moment load cells. During this test series the dummy was restrained with a 3-point seatbelt with top tether (SB3PT&T).

Section 2 contains testing performed using a forward facing CRS. Section 3 contains the dummy certification information.

SECTION 2
FORWARD FACING CRS TEST SUMMARY

TEST DUMMY INFORMATION

Description	Position # 4 CRS
ATD Type/Serial No.	CRABI 12 Month Old/094
Restrain System	SB3PT&T
CRS Direction	Forward Facing
Foam Cushion	WB7, WB13

CAMERA POSITIONING FARO MEASUREMENTS

Description	Units	X	Y	Z
Origin	mm	0.00	0.00	0.00
Driver Front	mm	1843.92	313.63	-505.41
N1 Driver Excursion	mm	720.45	-906.50	-447.79
N4 Driver Side	mm	444.19	-880.48	-376.24

DUMMY POSITIONING

CRS: Baby Trend Hybrid – Forward Facing – SB3PT&T

TRC Test Number: S210114-1

VRTC Test Number: FR_RR_PE_07



DUMMY POSITIONING FARO MEASUREMENTS

Description	Units	X	Y	Z
Z-Point	mm	-0.20	-0.34	0.48
Center of Seat Back Frame	mm	-118.48	351.75	-684.24
Top of Headrest	mm	-75.69	352.33	-834.41
Top of Head	mm	139.10	350.77	-682.78
Bridge of Nose	mm	217.06	350.72	-625.38
Head CG Outboard	mm	153.74	289.73	-612.82
Chest Clip	mm	243.90	349.95	-486.08
Buckle	mm	354.47	347.54	-359.18
Base Center	Mm	535.61	350.13	-306.48
Center of Seat Frame Bottom	mm	618.93	349.77	-103.79
Outboard Knee	mm	397.47	258.98	-336.43
Outboard Ankle	mm	536.02	249.28	-371.80
Target 1 - Seat Side Upper	mm	114.00	142.50	-637.79
Target 4 - Seat Side Lower	mm	185.11	142.12	-373.59
Target 2 - Seat Base H-Point	mm	242.96	136.66	-285.01
Target 3 - Seat Base Side	mm	411.07	122.44	-246.77

DUMMY INJURY

HIC (36 ms)	293
Chest Clip (3 ms)	46.48 g
Head Excursion (mm)	554
Knee Excursion (mm)	523

DUMMY POSITIONING

CRS: Baby Trend Hybrid – Forward Facing – SB3PT&T

TRC Test Number: S210115-1

VRTC Test Number: FR_RR_PE_09



DUMMY POSITIONING FARO MEASUREMENTS

Description	Units	X	Y	Z
Z-Point	mm	-0.21	-0.36	0.43
Center of Seat Back Frame	mm	-120.46	350.04	-683.30
Top of Headrest	mm	-78.10	347.04	-834.64
Top of Head	mm	133.86	348.80	-673.36
Bridge of Nose	mm	211.82	347.73	-617.56
Head CG Outboard	mm	148.60	287.69	-603.11
Chest Clip	mm	236.22	348.83	-483.72
Buckle	mm	347.73	348.40	-356.93
Base Center	Mm	530.85	348.82	-313.19
Center of Seat Frame Bottom	mm	618.01	350.54	-105.39
Outboard Knee	mm	394.23	259.98	-331.06
Outboard Ankle	mm	529.36	245.92	-379.33
Target 1 - Seat Side Upper	mm	112.99	136.35	-641.02
Target 4 - Seat Side Lower	mm	176.54	137.96	-375.91
Target 2 - Seat Base H-Point	mm	239.85	129.90	-291.66
Target 3 - Seat Base Side	mm	411.72	116.36	-253.11

DUMMY INJURY

HIC (36 ms)	233
Chest Clip (3 ms)	44.21 g
Head Excursion (mm)	487
Knee Excursion (mm)	505

DUMMY POSITIONING

CRS: Baby Trend Hybrid – Forward Facing – SB3PT&T

TRC Test Number: S210119-1

VRTC Test Number: FR_RR_PE_11



DUMMY POSITIONING FARO MEASUREMENTS

Description	Units	X	Y	Z
Z-Point	mm	-0.24	-0.14	0.33
Center of Seat Back Frame	mm	-121.21	351.23	-682.98
Top of Headrest	mm	-72.44	351.32	-836.32
Top of Head	mm	144.55	348.10	-682.02
Bridge of Nose	mm	220.82	350.25	-624.26
Head CG Outboard	mm	159.60	287.24	-611.08
Chest Clip	mm	237.85	349.07	-487.81
Buckle	mm	349.92	348.53	-357.68
Base Center	Mm	532.95	352.17	-307.49
Center of Seat Frame Bottom	mm	618.16	350.89	-105.38
Outboard Knee	mm	392.04	259.77	-335.87
Outboard Ankle	mm	528.13	250.68	-377.50
Target 1 - Seat Side Upper	mm	122.39	140.78	-645.57
Target 4 - Seat Side Lower	mm	182.58	137.27	-377.60
Target 2 - Seat Base H-Point	mm	242.82	130.01	-294.25
Target 3 - Seat Base Side	mm	412.96	113.84	-253.14

DUMMY INJURY

HIC (36 ms)	287
Chest Clip (3 ms)	53.86 g
Head Excursion (mm)	561
Knee Excursion (mm)	530

SECTION 3
DUMMY CALIBRATION DATA

Transportation Research Center Inc. ATD Certification Report

Customer:

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

Anthropomorphic Device:

CRABI (12) Month Old
Serial No. 094
Certification No. 22



**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
Rear Head Drop Certification	Page 11
Neck Flexion Certification	Page 13
Neck Extension Certification	Page 17
Front Thorax Certification	Page 21
Appendix C – TRC Inc. Quality Assurance	Page 23

Introduction

Customer Name: VRTC
Customer Contact: Bryan Crabtree
Email: Bryan.Crabtree.CTR@dot.gov
Phone: (937) 666-2011
Date Received: December 1, 2020
Date Completed: December 1, 2020

Special Instruction: N/A

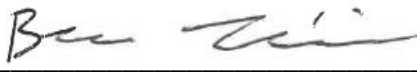
This Certification Report meets the requirements set forth by the ANSI National Accreditation Board ISO/IEC 17025:2017 accreditation under the scope of Mechanical Testing for Crash Test Dummy Certification Testing (ANAB Certificate #L2187). **This testing certification shall not be reproduced, except 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.

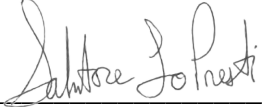
Each certification test was conducted by an authorized Transportation Research Center Inc. (TRC Inc.) employee within the requirements of the ISO/IEC 17025:2017 standards and adheres to CFR Part 572 Subparts B, E, N, O, P, R, T, U, V, SAE J2860, J2856, J2862; depending on ATD type. Any statements of 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: 12/01/2020

Testing Conducted by: 
Bryce Williams, Engineering Technician I

Date: 12/01/2020

Testing Approved by: 
Sal LoPresti, Supervisor - Calibration Services

Date: 12/01/2020

Appendix A – Incoming Inspection



TRC ATD Laboratory As Received Inspection Report

Name: Bryce Williams

Date: 12/1/2020

Customer: VRTC

ATD S/N: 094

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		





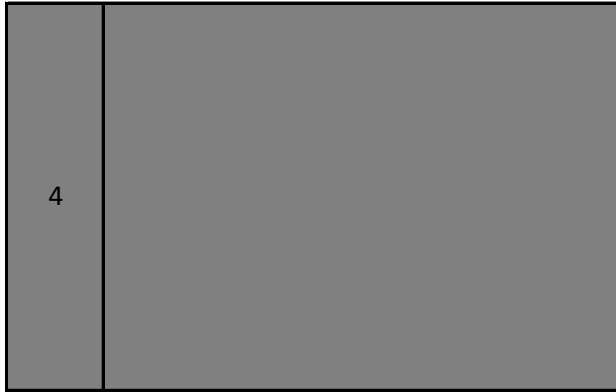
TRC ATD Laboratory As Received Inspection Photos

Name: Bryce Williams

Date: 12/1/2020

Customer: VRTC

ATD S/N: 094





TRC ATD Laboratory Inspection Report Action Items

Name: Bryce Williams

Date: 12/1/2020

Customer: VRTC

ATD S/N: 094

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

CRABI 12 MO Serial No. 094 Certification No. 22-1

Test Date: 12/1/2020

Test Parameter	Specification	Test Results	Pass
Temperature	18.9 - 25.6 °C	21.7 °C	Yes
Relative Humidity	10 - 70 %	40 %	Yes
Peak Head Resultant Acceleration	100 - 120 g	107.8 g	Yes
Peak Head Lateral Acceleration	(-15) - 15 g	-4.0 g	Yes
Is Acceleration Curve Unimodal within 17% of Peak?	< 17 %	9.11 %	Yes

Test meets specifications.

Condition: Used

Comments:

Head Skin S/N: DN0343

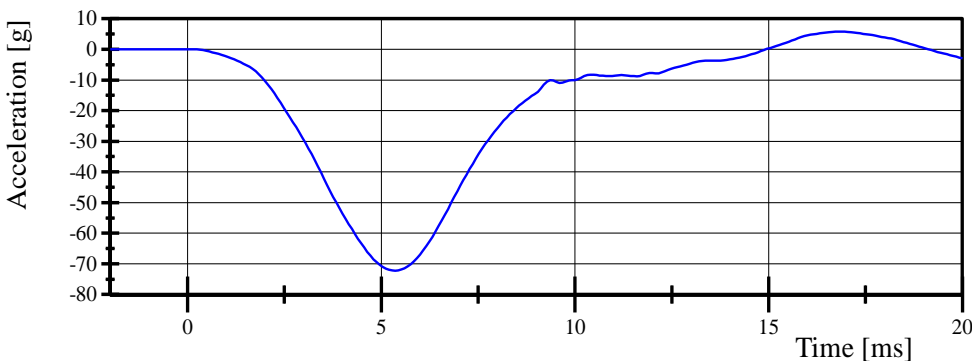
Transportation Research Center Inc.

Front Head Drop

CRABI 12 MO Serial No. 094 Certification No. 22-1

Test Date: 12/1/2020

Head X-Axis Acceleration

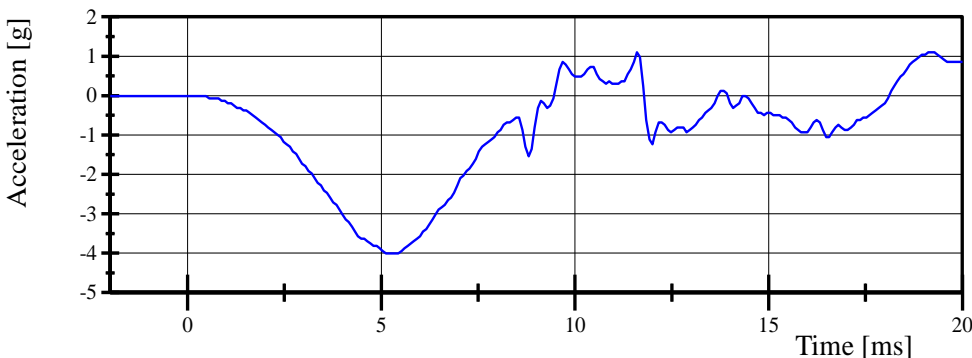


Filter Class: CFC_1000

Max: 5.8 g at 16.7 ms

Min: -72.2 g at 5.4 ms

Head Y-Axis Acceleration

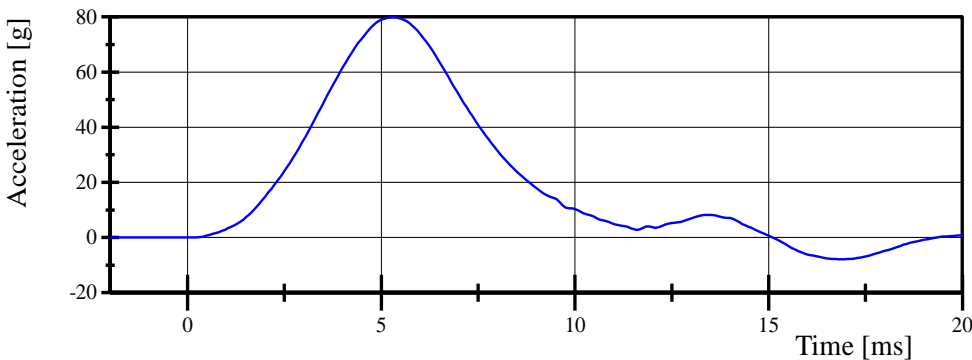


Filter Class: CFC_1000

Max: 1.1 g at 11.6 ms

Min: -4.0 g at 5.1 ms

Head Z-Axis Acceleration

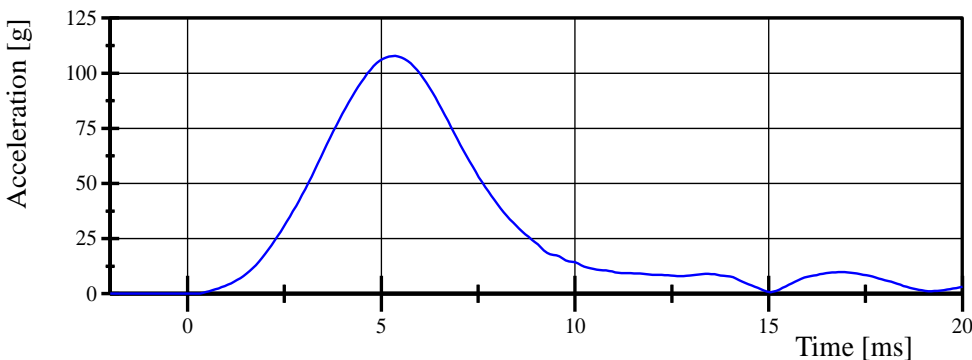


Filter Class: CFC_1000

Max: 79.9 g at 5.3 ms

Min: -7.9 g at 16.8 ms

Head Resultant Acceleration



Filter Class: CFC_1000

Max: 107.8 g at 5.4 ms

Min: 0.0 g at -2.0 ms

Transportation Research Center Inc.

Rear Head Drop

CRABI 12 MO Serial No. 094 Certification No. 22-1

Test Date: 12/1/2020

Test Parameter	Specification	Test Results	Pass
Temperature	18.9 - 25.6 °C	21.6 °C	Yes
Relative Humidity	10 - 70 %	39 %	Yes
Peak Head Resultant Acceleration	55 - 71 g	68.4 g	Yes
Peak Head Lateral Acceleration	(-15) - 15 g	2.0 g	Yes
Is Acceleration Curve Unimodal within 17% of Peak?	< 17 %	10.38 %	Yes

Test meets specifications.

Condition: Used

Comments:

Head Skin S/N: DN0343

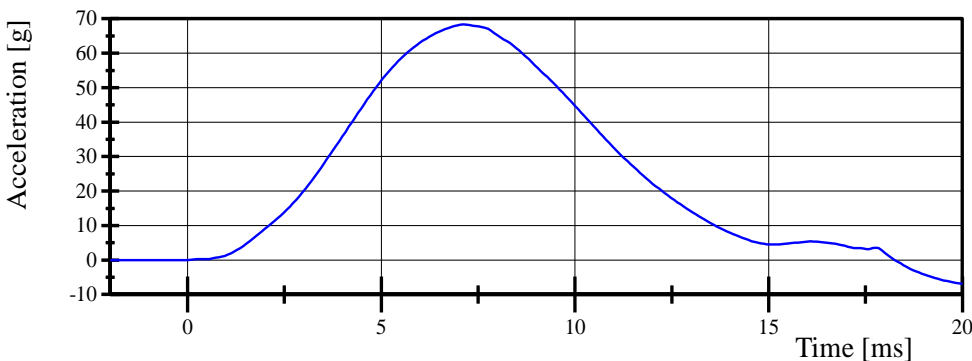
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Rear Head Drop

CRABI 12 MO Serial No. 094 Certification No. 22-1

Test Date: 12/1/2020

Head X-Axis Acceleration

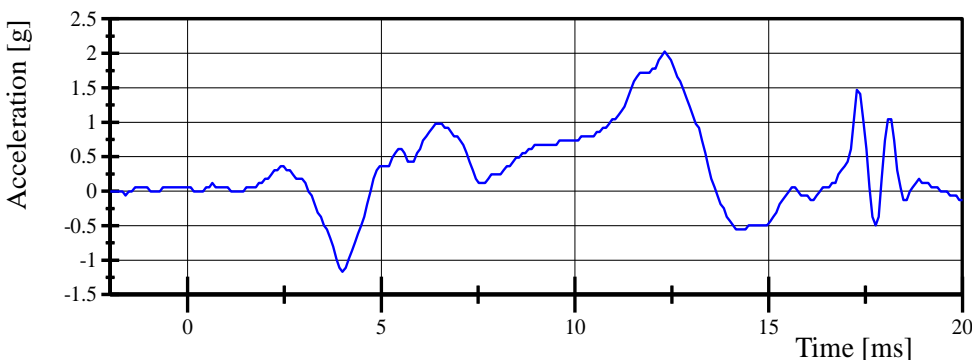


Filter Class: CFC_1000

Max: 68.4 g at 7.1 ms

Min: -6.9 g at 20.0 ms

Head Y-Axis Acceleration

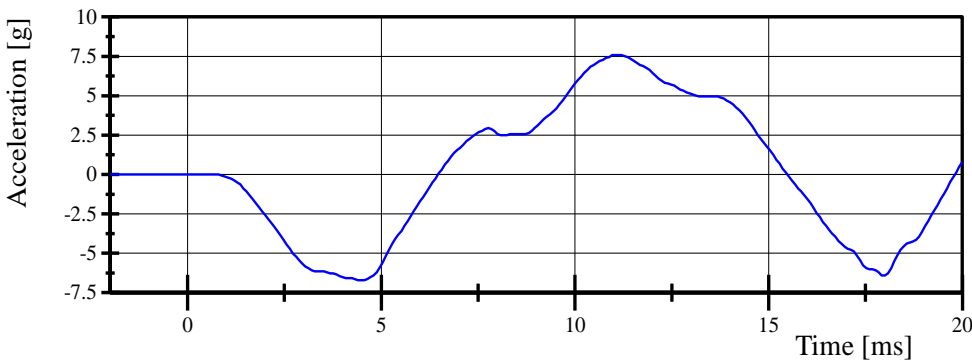


Filter Class: CFC_1000

Max: 2.0 g at 12.3 ms

Min: -1.2 g at 4.0 ms

Head Z-Axis Acceleration

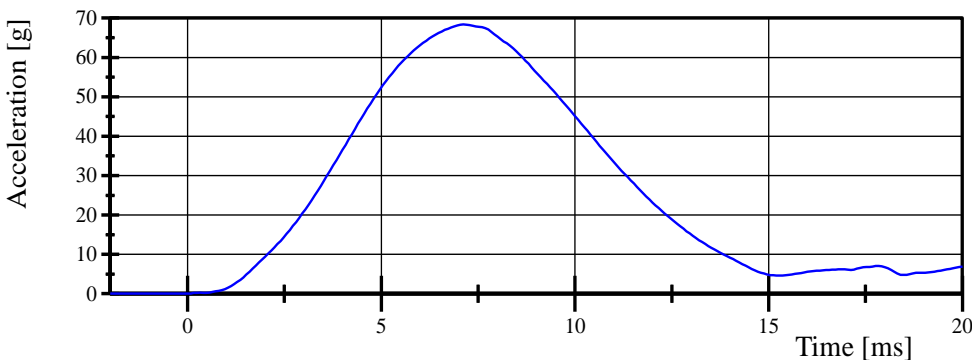


Filter Class: CFC_1000

Max: 7.6 g at 11.0 ms

Min: -6.7 g at 4.4 ms

Head Resultant Acceleration



Filter Class: CFC_1000

Max: 68.4 g at 7.1 ms

Min: 0.0 g at -2.0 ms

Transportation Research Center Inc.

Neck Flexion

CRABI 12 MO Serial No. 094 Certification No. 22-1

Test Date: 12/1/2020

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	21.6 °C	Yes
Relative Humidity	10 - 70 %	41 %	Yes
Pendulum Velocity	5.1 - 5.3 m/s	5.29 m/s	Yes
Pendulum Integrated Velocity Change at 10ms	(-1.6) - (-2.3) m/s	-1.87 m/s	Yes
Pendulum Integrated Velocity Change at 20ms	(-3.4) - (-4.2) m/s	-3.87 m/s	Yes
Pendulum Integrated Velocity Change at 25ms	(-4.3) - (-5.2) m/s	-4.71 m/s	Yes
Total Head D-Plane Rotation	(-75) - (-86) °	-79.8 °	Yes
Total Neck Occipital Condyles Moment	36 - 45 N·m	40.4 N·m	Yes
Total Neck Occipital Condyles Moment Decay to 5 Nm	60 - 80 ms	74.5 ms	Yes

Test meets specifications.

Condition: Used

Comments:

Neck S/N: 307

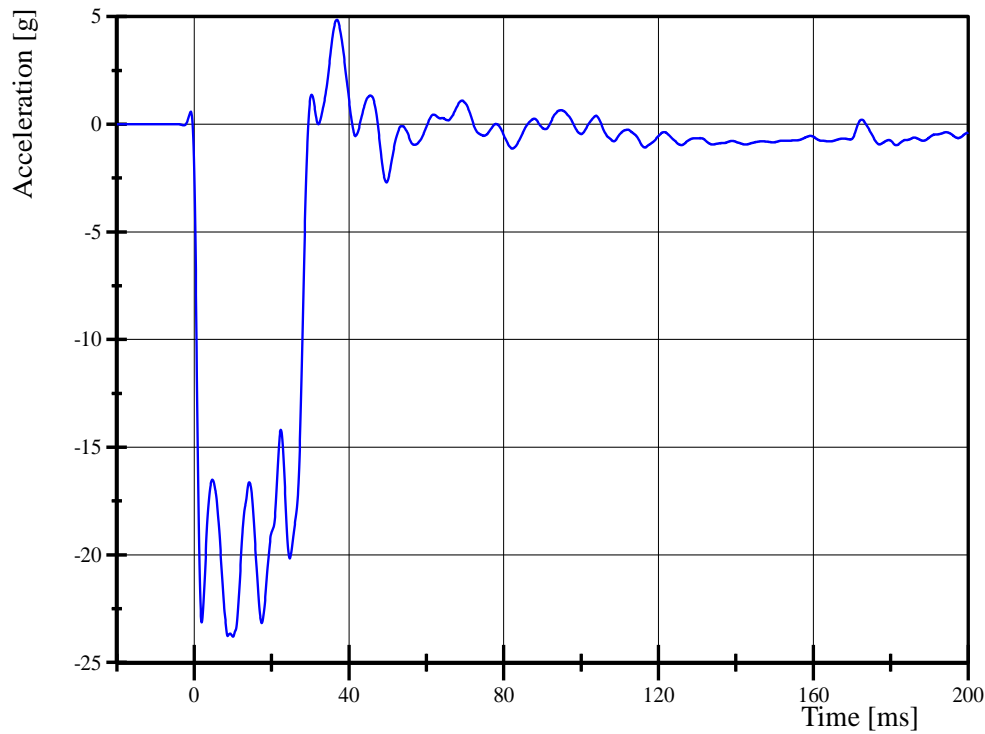
Transportation Research Center Inc.

Neck Flexion

CRABI 12 MO Serial No. 094 Certification No. 22-1

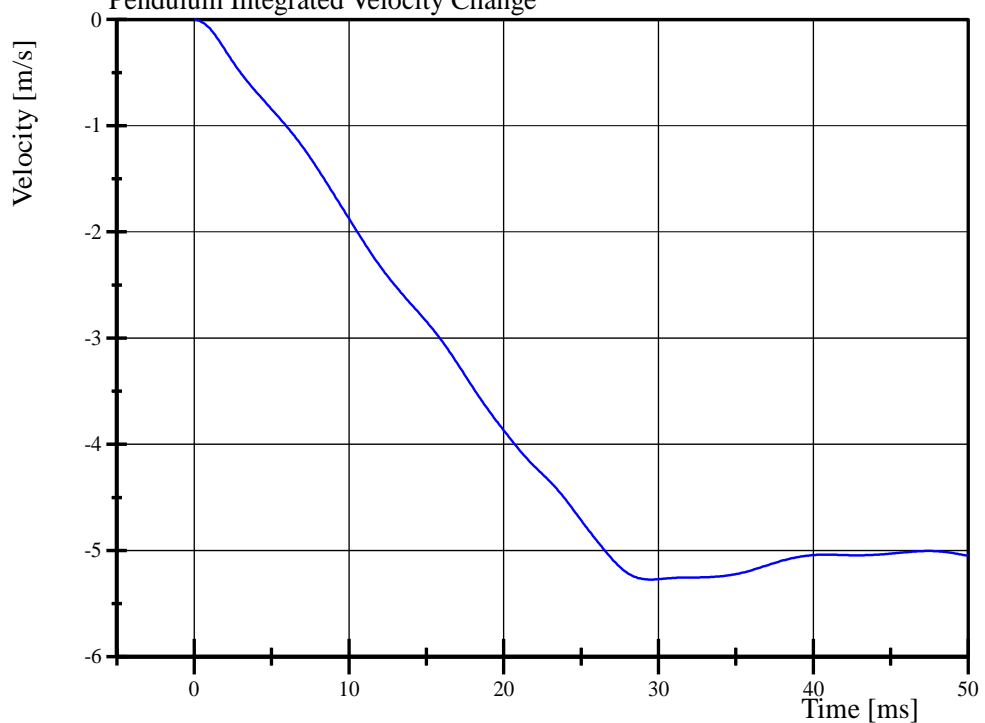
Test Date: 12/1/2020

Pendulum Acceleration



Filter Class: CFC_180
Max: 4.9 g at 37.0 ms
Min: -23.8 g at 10.1 ms

Pendulum Integrated Velocity Change



Filter Class: CFC_180
Max: 0.0 m/s at 0.0 ms
Min: -5.3 m/s at 29.5 ms

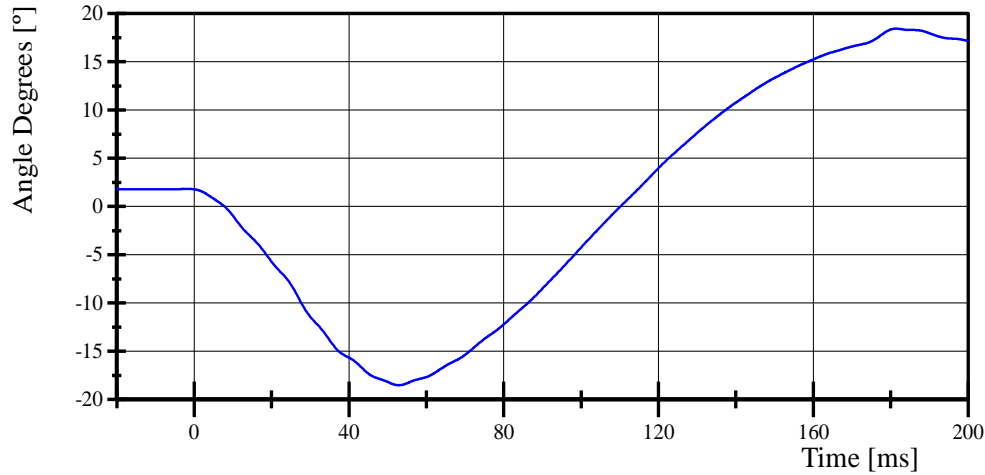
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Neck Flexion

CRABI 12 MO Serial No. 094 Certification No. 22-1

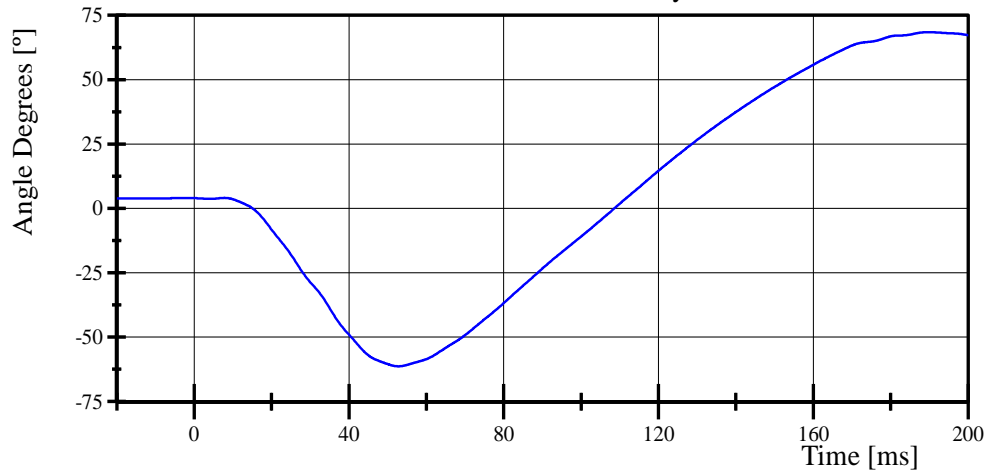
Test Date: 12/1/2020

Forward Pot Rotation at Base of Pendulum



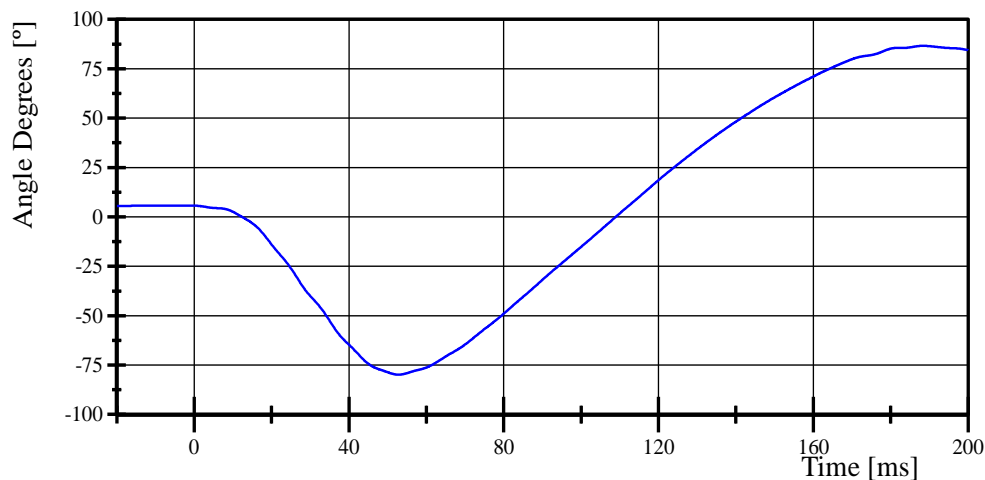
Filter Class: CFC_60
Max: 18.4 ° at 181.4 ms
Min: -18.5 ° at 52.9 ms

Center Headform Pot Rotation at Center of Gravity



Filter Class: CFC_60
Max: 68.4 ° at 189.7 ms
Min: -61.3 ° at 52.8 ms

Total Head D-Plane Rotation



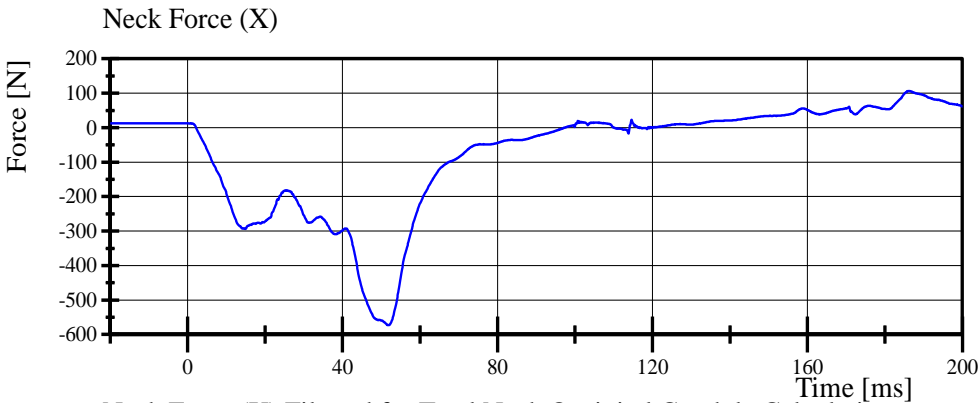
Filter Class: CFC_60
Max: 86.6 ° at 188.4 ms
Min: -79.8 ° at 52.8 ms

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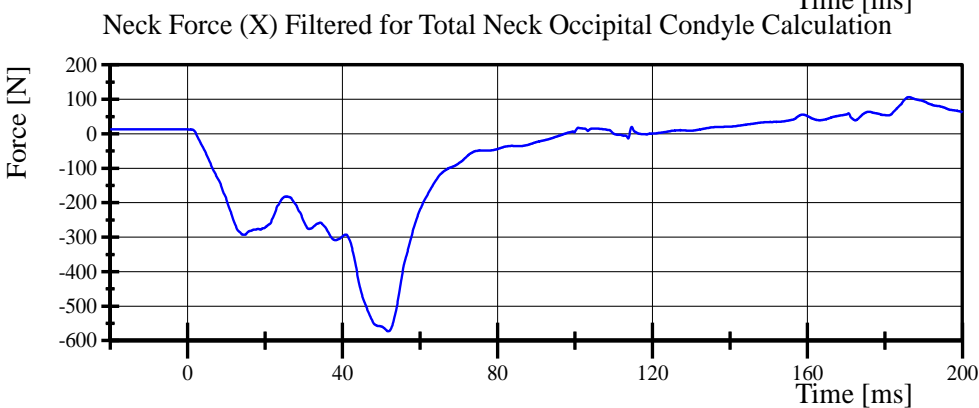
Neck Flexion

CRABI 12 MO Serial No. 094 Certification No. 22-1

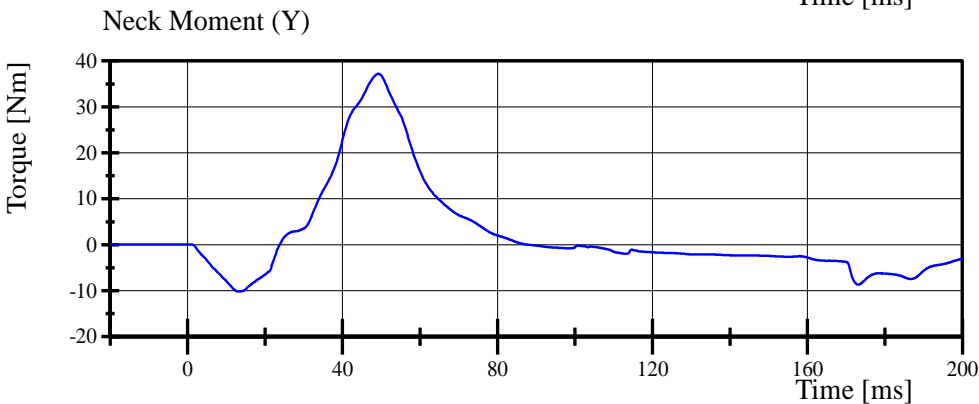
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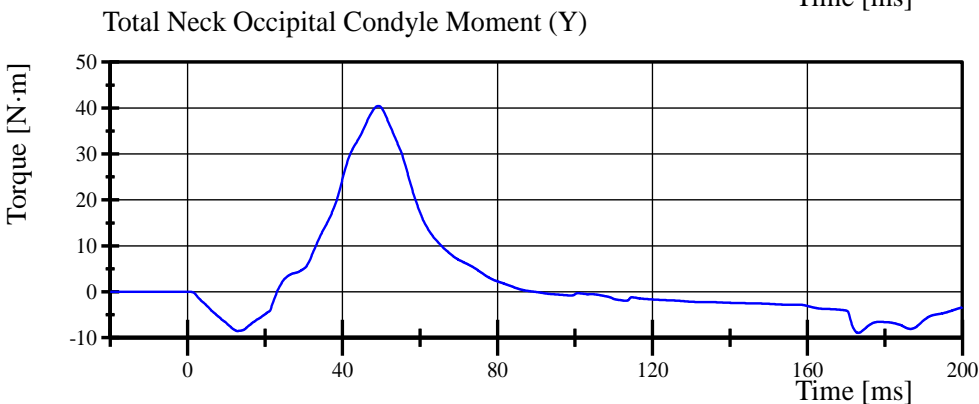
Filter Class: CFC_1000
Max: 106.4 N at 186.1 ms
Min: -572.6 N at 51.7 ms



Filter Class: CFC_600
Max: 106.4 N at 186.2 ms
Min: -572.7 N at 51.8 ms



Filter Class: CFC_600
Max: 37.2 Nm at 49.2 ms
Min: -10.2 Nm at 13.0 ms



Filter Class: Without_(Constar
Max: 40.4 N·m at 49.2 ms
Min: -8.9 N·m at 173.1 ms

Transportation Research Center Inc.

Neck Extension

CRABI 12 MO Serial No. 094 Certification No. 22-1

Test Date: 12/1/2020

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	21.6 °C	Yes
Relative Humidity	10 - 70 %	40 %	Yes
Pendulum Velocity	(-2.4) - (-2.6) m/s	-2.55 m/s	Yes
Pendulum Integrated Velocity Change at 6ms	0.8 - 1.2 m/s	1.01 m/s	Yes
Pendulum Integrated Velocity Change at 10ms	1.5 - 2.1 m/s	1.90 m/s	Yes
Pendulum Integrated Velocity Change at 14ms	2.2 - 2.9 m/s	2.65 m/s	Yes
Total Head D-Plane Rotation	80 - 92 °	87.6 °	Yes
Total Neck Occipital Condyles Moment	(-12) - (-23) N·m	-16.0 N·m	Yes
Total Neck Occipital Condyles Moment Decay to -5 Nm	76 - 90 ms	82.6 ms	Yes

Test meets specifications.

Condition: Used

Comments:

Neck S/N: 307

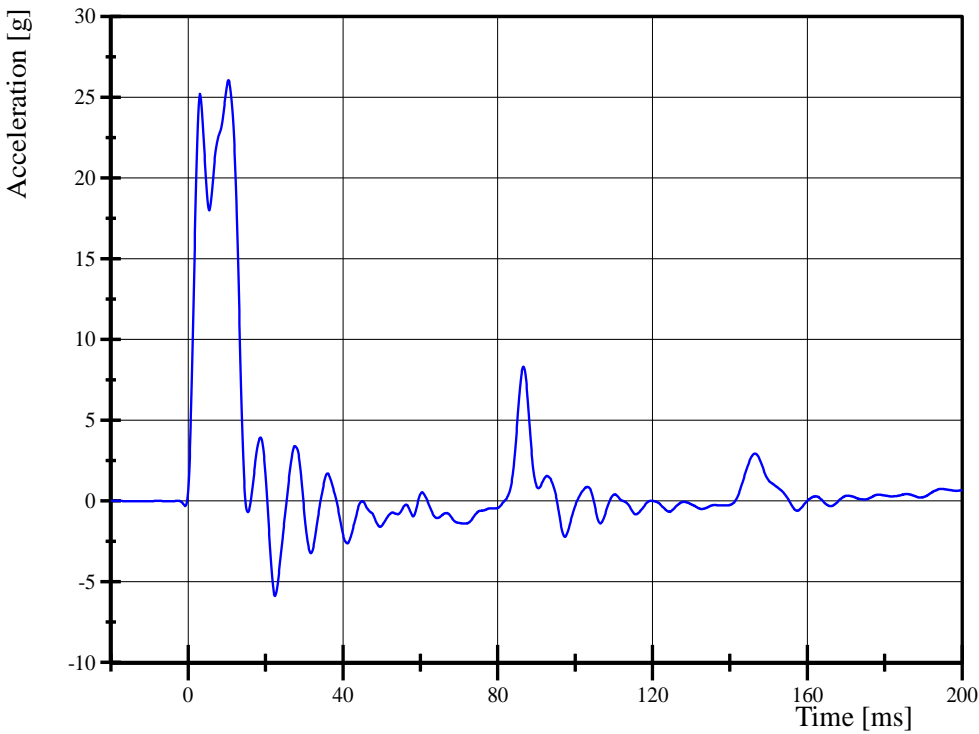
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Neck Extension

CRABI 12 MO Serial No. 094 Certification No. 22-1

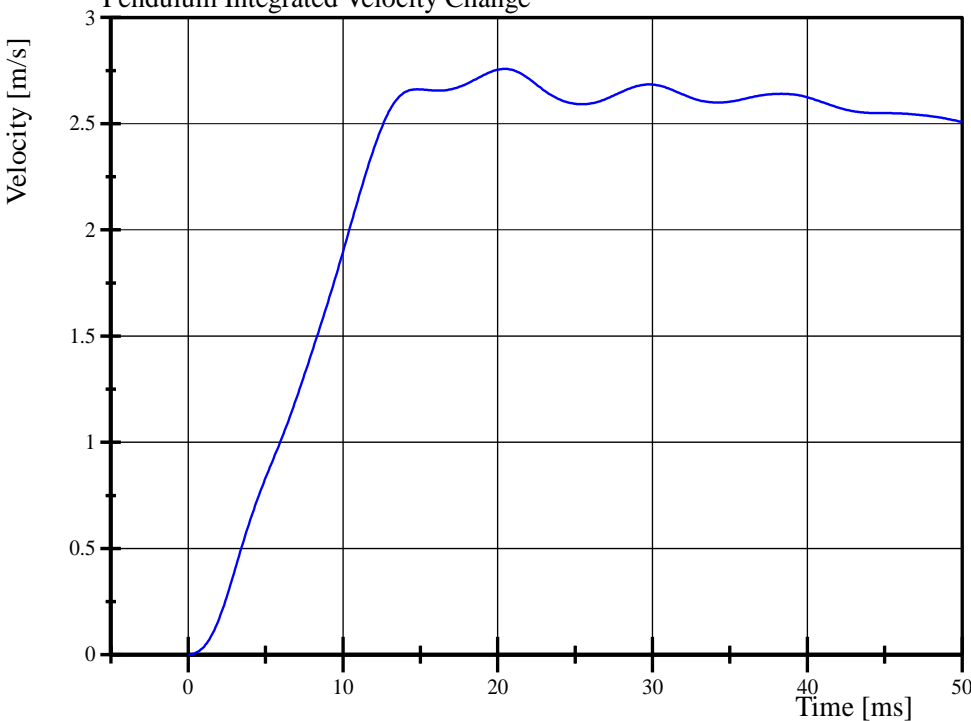
Test Date: 12/1/2020

Pendulum Acceleration



Filter Class: CFC_180
Max: 26.1 g at 10.4 ms
Min: -5.9 g at 22.5 ms

Pendulum Integrated Velocity Change



Filter Class: CFC_180
Max: 2.8 m/s at 20.5 ms
Min: 0.0 m/s at 0.0 ms

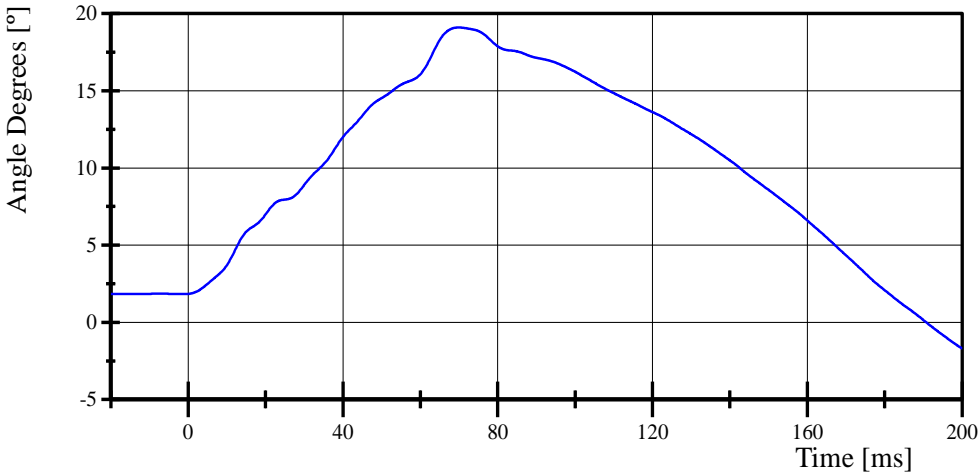
Transportation Research Center Inc.

Neck Extension

CRABI 12 MO Serial No. 094 Certification No. 22-1

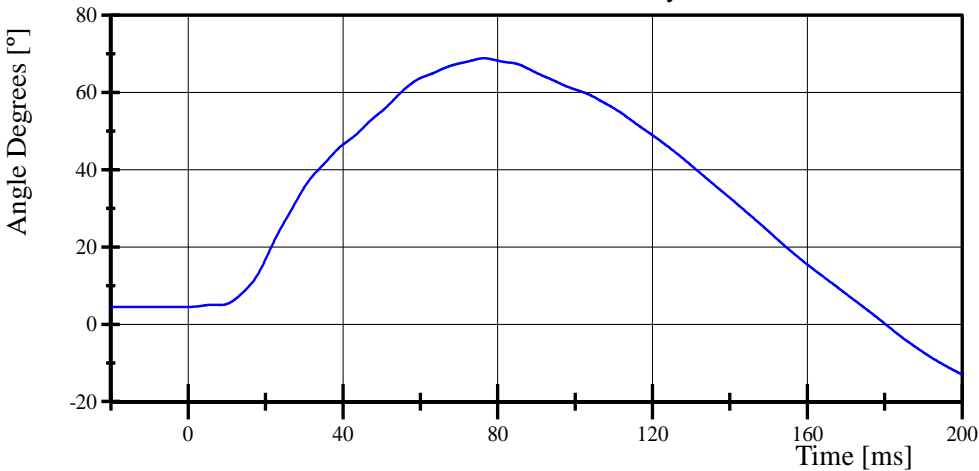
Test Date: 12/1/2020

Forward Pot Rotation at Base of Pendulum



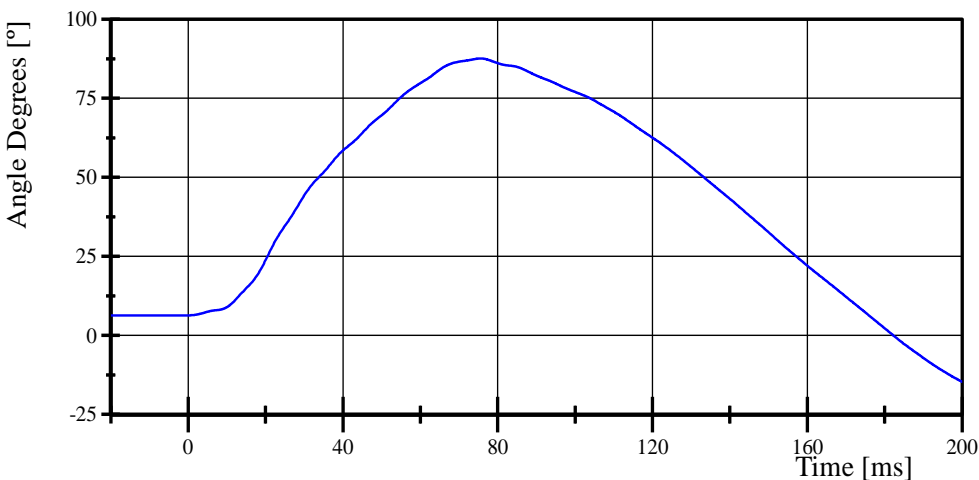
Filter Class: CFC_60
Max: 19.1 ° at 69.9 ms
Min: -1.7 ° at 200.0 ms

Center Headform Pot Rotation at Center of Gravity



Filter Class: CFC_60
Max: 68.9 ° at 76.4 ms
Min: -13.0 ° at 200.0 ms

Total Head D-Plane Rotation



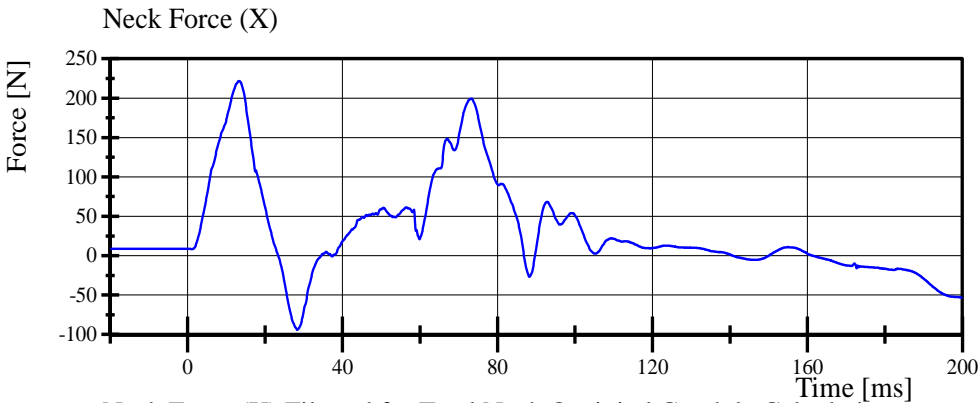
Filter Class: CFC_60
Max: 87.6 ° at 75.5 ms
Min: -14.7 ° at 200.0 ms

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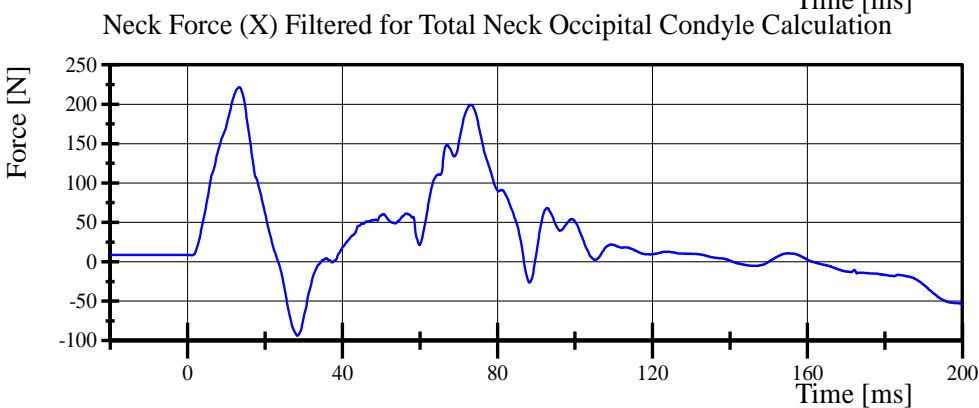
Neck Extension

CRABI 12 MO Serial No. 094 Certification No. 22-1

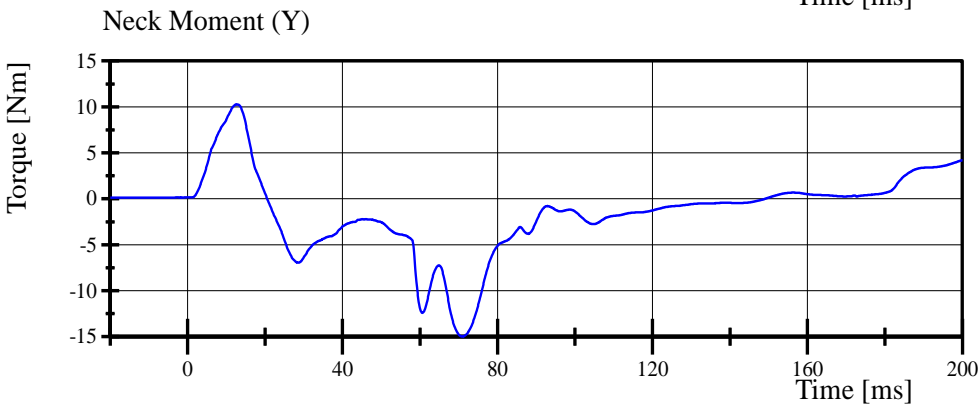
Test Date: 12/1/2020



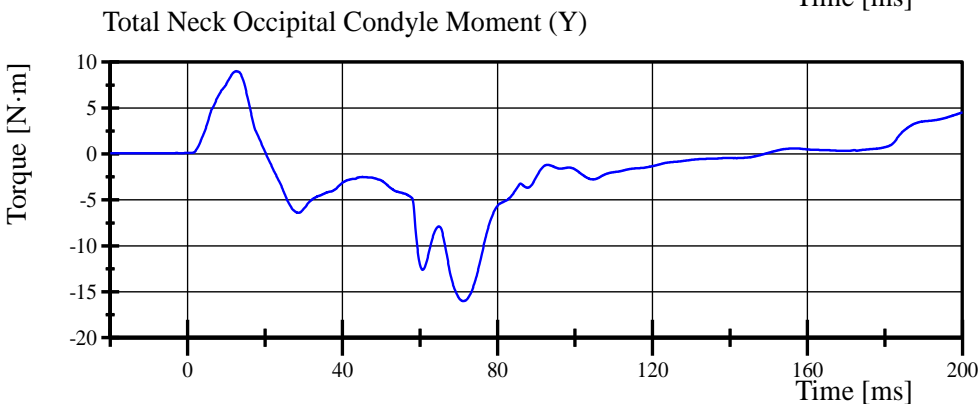
Filter Class: CFC_1000
Max: 221.8 N at 13.3 ms
Min: -94.0 N at 28.3 ms



Filter Class: CFC_600
Max: 221.7 N at 13.3 ms
Min: -93.8 N at 28.3 ms



Filter Class: CFC_600
Max: 10.3 Nm at 12.6 ms
Min: -15.0 Nm at 71.0 ms



Filter Class: Without_(Constar
Max: 9.0 N·m at 12.6 ms
Min: -16.0 N·m at 71.1 ms

Transportation Research Center Inc.

Front Thorax

CRABI 12 MO Serial No. 094 Certification No. 22-1

Test Date: 12/1/2020

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	21.6 °C	Yes
Relative Humidity	10 - 70 %	37 %	Yes
Impactor Velocity	4.9 - 5.1 m/s	4.93 m/s	Yes
Impactor Force	(-1,514) - (-1,796) N	-1,694.7 N	Yes

Test meets specifications.

Condition: Used

Comments:

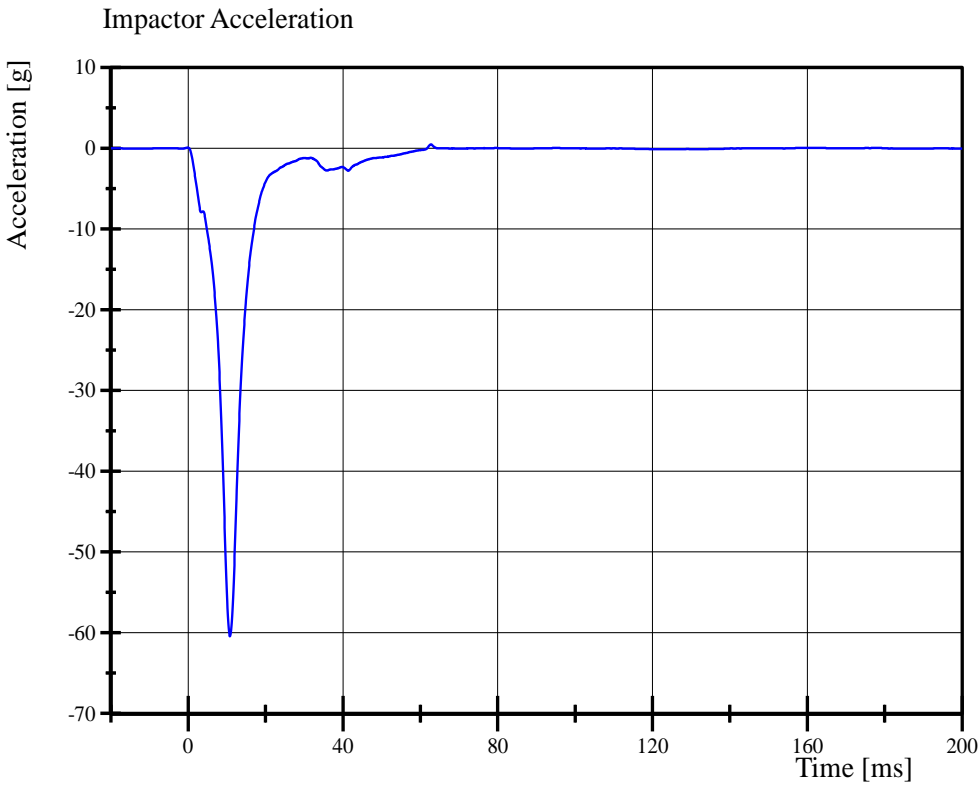
Torso Flesh S/N: N/A

Transportation Research Center Inc.

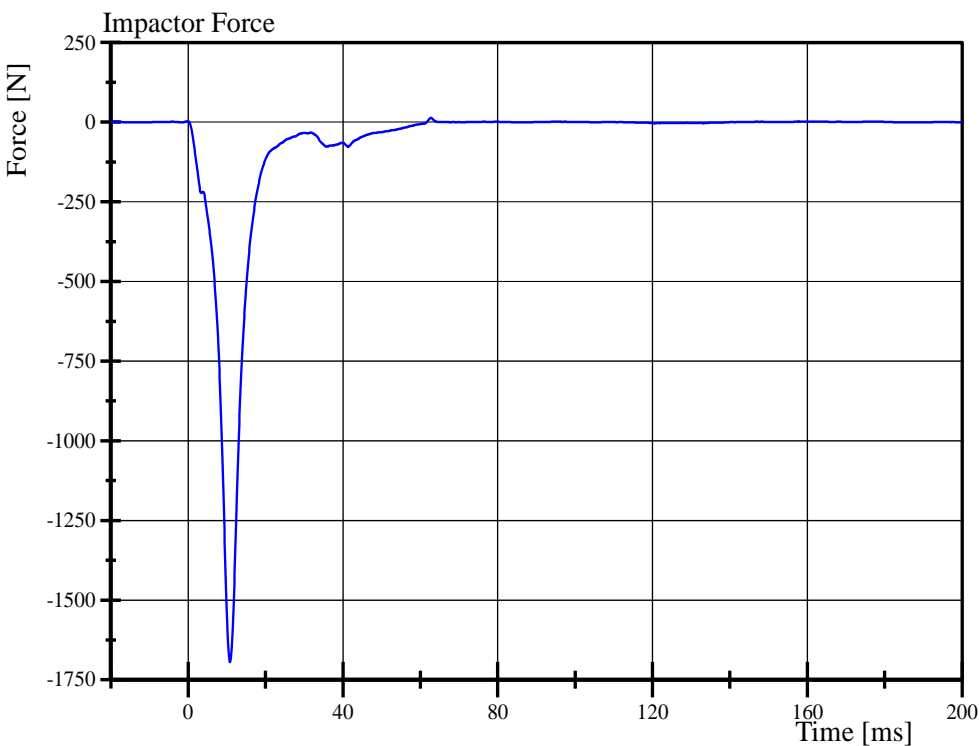
Front Thorax

CRABI 12 MO Serial No. 094 Certification No. 22-1

Test Date: 12/1/2020



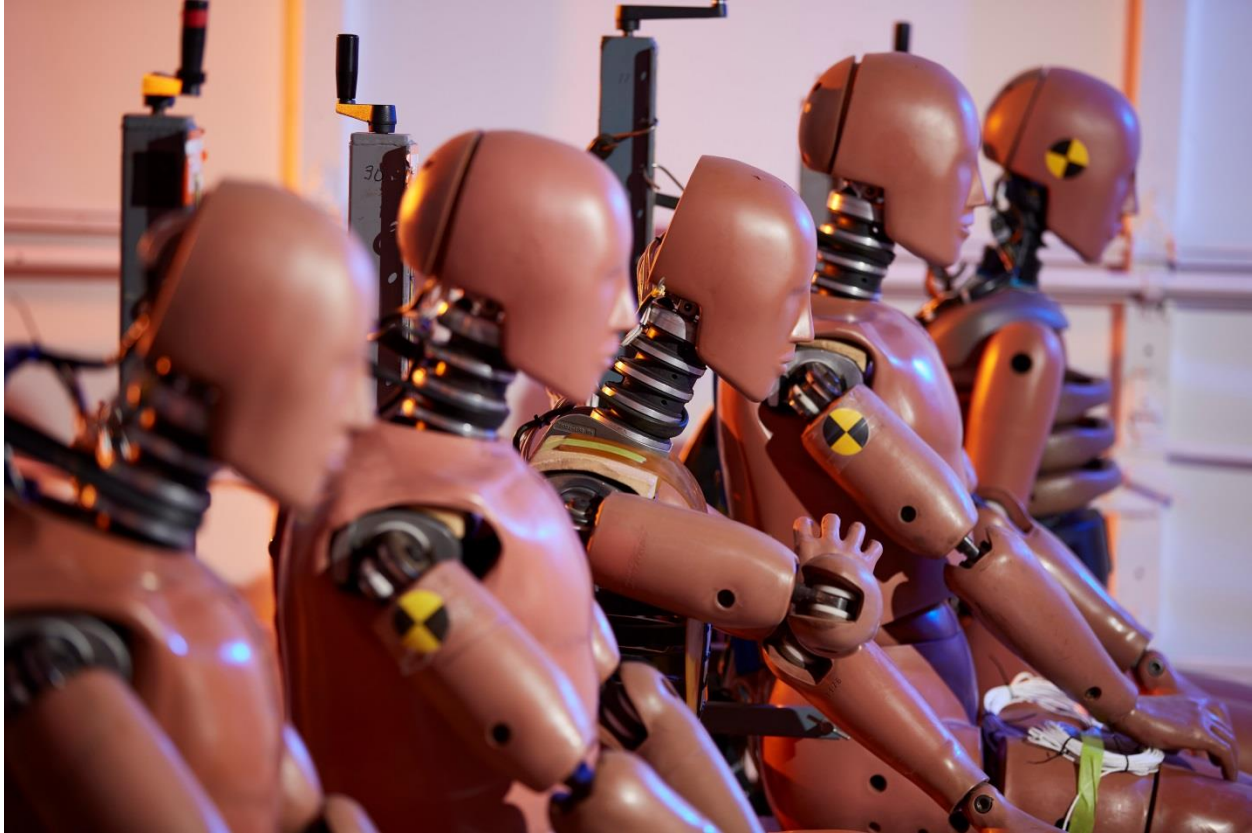
Filter Class: CFC_180
Max: 0.5 g at 62.7 ms
Min: -60.4 g at 10.8 ms



Filter Class: CFC_180
Max: 13.8 N at 62.7 ms
Min: -1,694.7 N at 10.8 ms

Appendix C – Quality Assurance

Quality Assurance



ATD Assembly & Final Inspection

ATD Type: CRABI (12) Month Old

ATD Serial Number: 094

Assembled by: *Ben Lin*

Inspected by: *Dot Beale*

Date Inspected: 12/01/2020