

REPORT NUMBER: TWG-TRC-20-02

NEW CAR ASSESSMENT PROGRAM (NCAP)
Side Airbag Out-of-Position Test

KIA MOTORS CORPORATION
2020 Kia Soul 5-DR SUV

NHTSA NUMBER: M20204214TWG2
TRC TEST NUMBER: 200723-1

PREPARED BY:
TRANSPORTATION RESEARCH CENTER INC.
10820 State Route 347
P.O. BOX B-67
East Liberty, OH 43319



Test Date: July 23, 2020

FINAL REPORT

U.S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Office of Crashworthiness Standards
Mail Code: NRM- 110
1200 New Jersey Ave, SE
Room W43- 410
Washington, DC 20590

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Prepared By: ILO Projects Operations Group

Approved By: 
John Shultz
Project Manager

Approval Date: May 19, 2021

FINAL REPORT ACCEPTANCE BY OCWS:

Division Chief, New Car Assessment Program
NHTSA, Office of Crashworthiness Standards

Date: _____

COR, New Car Assessment Program
NHTSA, Office of Crashworthiness Standards

Date: _____

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15. <u>SUPPLEMENTARY NOTES</u>			
16. <u>ABSTRACT</u> <p>A side air bag out of position test was conducted on the subject 2020 Kia Soul 5-DR SUV in accordance with the specifications of the Office of Crashworthiness Standards SAB OOP NCAP Laboratory Test Procedure for the generation of consumer information on vehicle side air bag protection. The test was conducted at the Transportation Research Center Inc. in East Liberty, Ohio, on July 23, 2020.</p> <p>The curtain and torso side air bags were deployed and responses were measured on a Hybrid III 6-Year-Old. One real-time camera and three high speed cameras recorded the event. The ambient temperature at the time of air bag deployment was 21.4°C.</p>			
Section 3.3.5.1 – Hybrid III 6-Year-Old – Position 2			
Measurement Description		Units	IARV
Head Injury Criteria (HIC15)		N/A	723
Nij		N/A	1
Upper Neck Tension		Newton	1490
Upper Neck Compression		Newton	1820
Maximum Chest Compression		mm	
Maximum Chest Compression rate		m/sec	
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TABLE OF CONTENTS

<u>Section</u>		Page No.
1	Test Purpose and Procedure	1
2	Summary of Test Results	2
3	Data Sheets	3
	Data Sheet 1 – Test Summary	3
	Data Sheet 2 – General Test and Vehicle Parameter Data	4
	Data Sheet 3 – Seat Adjustment Data	5
	Data Sheet 4 – Dummy Setup and Positioning Data	6
	Data Sheet 5 – Dummy Injury Criteria Data	7
	Data Sheet 6 – Camera Setup and Description	9
A	Photographs	A-1
B	Dummy Response Data Plots	B-1
C	Test Equipment List and Calibration Information	C-1
D	Dummy Configuration and Performance Verification Data	D-1

SECTION 1 – TEST PURPOSE AND PROCEDURE

This side air bag out-of-position test is part of the MY20 New Car Assessment Program (NCAP), sponsored by the National Highway Traffic Safety Administration (NHTSA), under contract number 693JJ919D000007. The purpose of this test is to obtain data on the performance of side air bags with an out-of-position occupant in a 2020 Kia Soul 5-DR SUV. The air bag test was conducted in accordance with the Office of Crashworthiness Standard's Laboratory Test Procedure, dated November 2019.

SECTION 2 – SUMMARY OF TEST RESULTS

The effects of both a seat-mounted side air bag and a curtain air bag deployment in a 2020 Kia Soul 5-DR SUV on an out-of-position Hybrid III 6-Year-Old were evaluated. The test was performed by TRC on July 23, 2020. Pre and post-test photographs of the vehicle and ATD can be found in Appendix A.

The vehicle had previously undergone crash testing as part of the NCAP. After conducting the crash test and before conducting the air bag deployment test, the vehicle was inspected for damage. The vehicle was found to be in good condition to undergo the air bag deployment test.

One real-time camera and three high-speed cameras were used to record the air bag deployment event. High speed images were recorded at rates of 1,000 frames per second. Cameras were placed relative to the position 2 and were positioned to capture the deployment event from the side, the front, and the oblique views.

The Hybrid III 6-Year-Old was placed in the right front (passenger) seat situated inboard facing. This placement followed the ATD placement instructions in the NCAP Laboratory Test Procedure as well as the Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags as prepared by the Side Airbag Out-of-Position Injury Technical Working Group (TWG). The specific test section was section 3.3.5.1.

The 6-Year-Old was instrumented with head X, Y, and Z accelerometers, a six-axis upper neck load cell and a six-axis lower neck load cell. During the air bag deployment, a total of twenty-two channels of data were recorded using an on-board data acquisition system. Appendix B contains the ATD response data traces and Appendix C contains the instrumentation list and calibration information. Appendix D contains the dummy's pre-test qualification performance verification data.

No Injury Reference Values were exceeded during the test. The occupant data is summarized below:

Measurement Description	Units	Passenger ATD Hybrid III 6-Year-Old	
		IARV	Result
Head Injury Criteria (HIC15)	N/A	723	17
Nij	N/A	1	0.56
Upper Neck Tension	N	1490	168.7
Upper Neck Compression	N	1820	-861.7
Thorax Compression	mm		
Thorax Compression rate	m/sec		

SECTION 3 DATA SHEET

DATA SHEET NO. 1 TEST SUMMARY

Test Vehicle: 2020 Kia Soul 5-DR SUV
Test Program: Side Air Bag Out-of-Position Test

NHTSA No.: M20204214TWG2
Test Date: 7/23/2020

TEST SUMMARY

TEST CONFIGURATION INFORMATION

Seating Position:	P2	Right Front Seating Position
Test Section:	3.3.5.1	Seat-Mounted, Inboard Facing
Airbag 1:	Seat	Seat mounted – outside seam
Airbag 2:	Side Rail	Side curtain airbag
Booster Block:	Closed Cell Foam	300 mm deep by 450 mm wide by 75 mm thick
ATD Type/Serial No.:	Hybrid III 6-Year-Old	182
Vehicle	Kia	Soul
Previous Crash Test	MDB	191030 and M20204214

EQUIPMENT INFORMATION

Number of Data Channels	22
Number of High Speed Video Cameras	3
Number of Real Time Video Cameras	1

VISIBLE DUMMY CONTACT POINTS

Head	Curtain airbag and Seat Mounted Airbag
Upper Torso	Seat Mounted Airbag
Lower Torso	Seat Mounted Airbag
Knee	None Visible

**DATA SHEET NO. 2
GENERAL TEST AND VEHICLE PARAMETER DATA**

Test Vehicle: 2020 Kia Soul 5-DR SUV
 Test Program: Side Air Bag Out-of-Position Test

NHTSA No.: M20204214TWG2
 Test Date: 7/23/2020

TEST CONFIGURATION INFORMATION

NHTSA No.	M20204214
Model Year	2020
Make	Kia
Model	Soul
Body Style	MPV
VIN	KNDJ23AU4L7011046
Body Color	Inferno Red
Odometer Reading (km/mi)	88 mi
Engine Displacement (L)	2.0
Type/No. Cylinders	Inline/ 4
Engine Placement	Front/ Transverse
Transmission Type	Automatic
Transmission Speeds	CVT
Overdrive	Yes
Final Drive	FWD
Roof Rack	No
Sunroof/T-Top	No
Running Boards	No
Tilt Steering Wheel	Yes
Power Seats	No
Anti-Lock Brakes (ABS)	Yes

Traction Control System (TCS)	Yes
Auto-Leveling System	No
Automatic Door Locks (ADL)	Yes
Power Window Auto-Reverse	No
Other Optional Feature	No
Driver Front Airbag	Yes
Driver Curtain Airbag	Yes
Driver Head/Torso Airbag	No
Driver Torso Airbag	No
Driver Torso/Pelvis Airbag	Yes
Driver Pelvis Airbag	No
Driver Knee Airbag	No
Rear Pass. Curtain Airbag	Yes
Rear Pass. Head/Torso Airbag	No
Rear Pass. Torso Airbag	No
Rear Pass. Torso/Pelvis Airbag	No
Rear Passenger Pelvis Airbag	No
Driver Seat Belt Pretensioner	Yes
Rear Pass. Seat Belt Pretensioner	No
Driver Load Limiter	Yes
Rear Passenger Load Limiter	No
Other Safety Restraint	No

DATA FROM CERTIFICATION LABEL

Manufactured By	KIA MOTORS CORPORATION
Date of Manufacture	01/19
Vehicle Type	MPV

GVWR (kg)	4023
GAWR Front (kg)	2315
GAWR Rear (kg)	2094

VEHICLE SEATING AND CAPACITY WEIGHT INFORMATION

Measured Parameter	Front	Rear	Third	Total	
Designated Seating Capacity (DSC)	2	3	N/A	5	
Capacity Weight (VCW) (kg)				390.0	(A)
DSC x 68.04 (kg)				340.2	(B)
Cargo Weight (RCLW) (kg)				49.8	(A-B)

VEHICLE SEAT TYPE

Seating Location	Type of Seat Pan				Type of Seat Back		
	Bucket	Bench	Split Bench	Contoured	Fixed	Adjustable	
						w/ Lever	w/ Knob
Front Seat	Yes	N/A	N/A		N/A	Yes	N/A
Rear or Second Row Seat	N/A	N/A	Yes	Yes	Yes	N/A	N/A
Third Row Seat	N/A	N/A	N/A	N/A	N/A	N/A	N/A

**DATA SHEET NO. 3
SEAT ADJUSTMENT DATA**

Test Vehicle: 2020 Kia Soul 5-DR SUV
 Test Program: Side Air Bag Out-of-Position Test

NHTSA No.: M20204214TWG2
 Test Date: 7/23/2020

VEHICLE SEAT FORE/AFT POSITION

Seat Location	Total Fore/Aft Travel		Test Position from Forwardmost Position	
	mm	# Detents	mm	# Detents
Front Right	220	56	0	0
Rear Right	Fixed	Fixed	Fixed	Fixed

Seat Fore/Aft Position Per TWG Guidelines	Adjust seat track forward to minimize vertical distance between dummy head and roof-rail module.
Reason for Deviation from TWG Guidelines	N/A

VEHICLE SEAT BACK ANGLE ADJUSTMENT

Seat Location	Total Seat Back Angle Range		Test Position from Most Upright (Vertical)	
	Degrees	# Detents	Degrees	# Detents
Front Right	55.8	28	-0.8	6
Rear Right	Fixed	Fixed	Fixed	Fixed

OEM Back Angle Design Position	0.0 Degrees
Method of Measuring Back Angle Position	Zero inclinometer on the door sill. Measure angle on the headrest post
Seat Back Angle Position Per TWG Guidelines	Set to manufacturer's standard
Reason for Deviation from TWG Guidelines	N/A

VEHICLE SEAT HEIGHT ADJUSTMENT

Seat Location	Total Height Adjustment Range		Test Position from Lowest Position	
	mm	# Detents	mm	# Detents
Front Right	Fixed	Fixed	Fixed	Fixed
Rear Right	Fixed	Fixed	Fixed	Fixed

Seat Height Adjustment Per TWG Guidelines	Set to full up position
Reason for Deviation from TWG Guidelines	Seat height is non-adjustable

**DATA SHEET NO. 4
DUMMY SETUP AND POSITIONING DATA**

Test Vehicle: 2020 Kia Soul 5-DR SUV
 Test Program: Side Air Bag Out-of-Position Test

NHTSA No.: M20204214TWG2
 Test Date: 7/23/2020

DUMMY INFORMATION

ATD Type	Hybrid III 6 Year Old
Serial Number	182
Qualification Date	7/17/2020
Qualification Type	Full Cal
Clothing	Cotton shirt and pants
Other ATD Prep	Electrical tape on skull cap seam, baby power on head

DUMMY POSITIONING INFORMATION

TWG Setup Instructions	As specified in the 3.3.3.5 Test Procedure; Seat is adjusted to its highest position; ATD positioned to 3.3.3.5.1.
Actual Setup	The vehicle seat is set to the full forward position. The seat back angle is set to 0.8 degrees, as called out in the Form 1. The head restraint was set to the lowest position per TWG setup instructions in section 3.3.1. The dummy's skull cap is powdered and the seam is taped. The dummy is facing inboard with its back against the door trim and shoulders aligned in parallel with the centerline of the vehicle. The arms are bent at the elbows with the finger tips touching the booster seat. The centerline of the top of the head is as close as possible to the projected deployment trajectory of the side curtain airbag.

DATA SHEET NO. 5
DUMMY INJURY CRITERIA DATA

Test Vehicle: 2020 Kia Soul 5-DR SUV
Test Program: Side Air Bag Out-of-Position Test

NHTSA No.: M20204214TWG2
Test Date: 7/23/2020

RECORDED DATA - MINIMUMS AND MAXIMUMS

Channel	Unit	CFC	Maximum	Time (ms)	Minimum	Time (ms)
Head X	G	1000	23.84	14.32	-2.61	7.76
Head Y	G	1000	42.00	15.04	-61.82	14.72
Head Z	G	1000	44.12	14.48	-9.20	11.12
Head Resultant	G	1000	66.22	14.72		
Head Red X	G	1000	23.72	14.32	-3.03	7.12
Head Red Y	G	1000	42.09	15.04	-62.61	14.72
Head Red Z	G	1000	44.25	14.48	-9.19	11.12
Head Red Resultant	G	1000	67.10	14.72		
Upper Neck X	N	1000	122.67	13.52	-191.17	21.68
Upper Neck Y	N	1000	303.69	14.96	-60.85	138.48
Upper Neck Z	N	1000	168.72	113.76	-861.71	21.60
Upper Neck Resultant	N	1000	912.99	21.60		
Upper Neck X	Nm	600	15.27	21.20	-18.05	10.48
Upper Neck Y	Nm	600	14.66	13.60	-15.65	35.04
Upper Neck Z	Nm	600	9.35	135.68	-13.45	59.60
Upper Neck Resultant	Nm	600	22.20	11.60		
Lower Neck X	N	1000	324.23	14.32	-215.53	51.84
Lower Neck Y	N	1000	398.38	10.56	-95.40	40.64
Lower Neck Z	N	1000	165.60	113.52	-839.96	22.16
Lower Neck Resultant	N	1000	846.97	22.16		
Lower Neck X	Nm	600	39.88	31.76	-18.20	139.76
Lower Neck Y	Nm	600	24.08	22.40	-13.34	14.32
Lower Neck Z	Nm	600	20.99	10.48	-24.81	56.16
Lower Neck Resultant	Nm	600	44.18	50.00		

HEAD INJURY SUMMARY

HIC15	T1 (ms)	T2 (ms)	HIC36	T1 (ms)	T2 (ms)
17	9.60	24.64	29	8.56	44.56

**DATA SHEET NO. 5
DUMMY INJURY CRITERIA DATA (CONTINUED)**

Test Vehicle: 2020 Kia Soul 5-DR SUV
 Test Program: Side Air Bag Out-of-Position Test

NHTSA No.: M20204214TWG2
 Test Date: 7/23/2020

NECK INJURY SUMMARY

Injury Criteria	Value	Time (ms)
Upper Neck NTF	0.08	164.56
Upper Neck NTE	0.23	71.20
Upper Neck NCF	0.33	14.56
Upper Neck NCE	0.56	39.28
Peak Tension	168.7	113.76
Peak Compression	-861.7	21.60

CHEST INJURY SUMMARY

Injury Criteria	Value	Time (ms)
Chest Deflection ²		
Deflection Rate ¹		

¹ Deflection Rate was assessed by measuring compression from a rotary potentiometer

RESEARCH INJURY SUMMARY

Research Injury Criteria ¹	Value	Time (ms)
Upper Neck Lateral Moment		
Upper Neck Twist Moment		
Lower Neck Flexion Moment		
Lower Neck Extension Moment		
Lower Neck Lateral Moment		
Lower Neck Twist Moment		
Lower Neck Tension		
Lower Neck Compression		
Spine Acceleration		

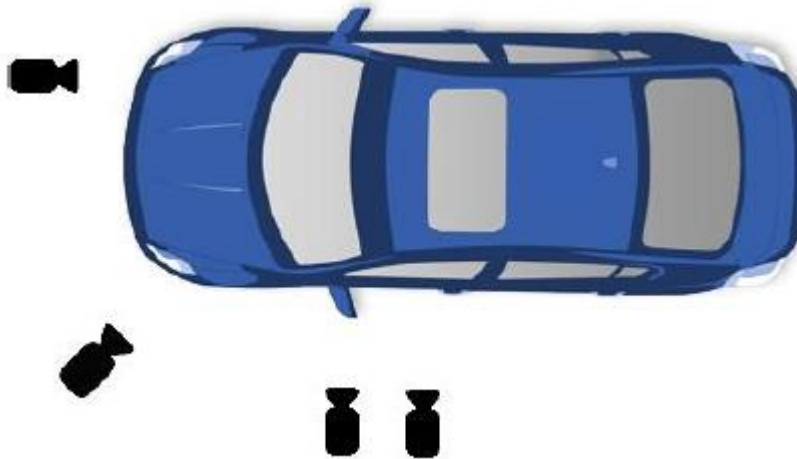
¹These injury criteria are only monitored and not considered pass/fail

**DATA SHEET NO. 6
CAMERA SETUP AND DESCRIPTION**

Test Vehicle: 2020 Kia Soul 5-DR SUV
 Test Program: Side Air Bag Out-of-Position Test

NHTSA No.: M20204214TWG2
 Test Date: 7/23/2020

CAMERA SETUP DIAGRAM FOR SAB OOP TESTS



No.	Camera View	Location (mm) ¹			Lens (mm)	Speed (fps)
		X	Y	Z		
1	Left View	-1995	-3111	-1240	25	1000
2	Oblique View	2298	-1324	-1525	25	1000
3	Front View	2293	260	-1404	28	1000
4	Real Time (optional)	-1763	-3040	-1165	Zoom	30

¹ +X forward of vehicle, +Y right of vehicle, +Z into ground

APPENDIX A
PHOTOGRAPHS

TABLE OF PHOTOGRAPHS

<u>Figure</u>	<u>Photograph Title</u>	<u>Page</u>
Figure A-1	Right Front ¾ View of Test Vehicle as Delivered	A-3
Figure A-2	Vehicle Certification Label	A-3
Figure A-3	Pre-Test Vehicle Left Side View	A-4
Figure A-4	Post-Test Vehicle Left Side View	A-4
Figure A-5	Pre-Test Vehicle Location of Air Bag 1	A-5
Figure A-6	Pre-Test Vehicle Location of Air Bag 2	A-5
Figure A-7	Pre-Test Vehicle Location of Air Bag 3	A-6
Figure A-8	Pre-Test Vehicle Seat Back Angle	A-6
Figure A-9	Pre-Test Dummy Left Side View	A-7
Figure A-10	Post-Test Dummy Left Side View	A-7
Figure A-11	Pre-Test Dummy Left Side Close-up View	A-8
Figure A-12	Post-Test Dummy Left Side Close-up View	A-8
Figure A-13	Pre-Test Dummy Left ¾ Front View	A-9
Figure A-14	Post-Test Dummy Left ¾ Front View	A-9
Figure A-15	Pre-Test Dummy Left ¾ Front Close-up View	A-10
Figure A-16	Post-Test Dummy Left ¾ Front Close-up View	A-10
Figure A-17	Pre-Test Dummy Front View	A-11
Figure A-18	Post-Test Dummy Front View	A-11
Figure A-19	Pre-Test Dummy Front Close-up View	A-12
Figure A-20	Post-Test Dummy Front Close-up View	A-12
Figure A-21	Pre-Test Dummy Right ¾ Front View	A-13
Figure A-22	Post-Test Dummy Right ¾ Front View	A-13
Figure A-23	Pre-Test Dummy Right Side View	A-14
Figure A-24	Post-Test Dummy Right Side View	A-14
Figure A-25	Post-Test Dummy Right Side View	A-15
Figure A-26	Post-Test Curtain Air Bag Left Side View	A-15
Figure A-27	Post-Test Curtain Air Bag Left ¾ Front View	A-16
Figure A-28	Post-Test Curtain Air Bag Front View	A-16
Figure A-29	Post-Test Curtain Air Bag Right Side View	A-17



Figure A-1 Right Front 3/4 View of Test Vehicle as Delivered



Figure A-2 Vehicle Certification Label



Figure A-3 Pre-Test Vehicle Left Side View



Figure A-4 Post-Test Vehicle Left Side View



Figure A-5 Pre-Test Vehicle Location of Air Bag 1



Figure A-6 Pre-Test Vehicle Location of Air Bag 2



Figure A-7 Pre-Test Vehicle Location of Air Bag 3



Figure A-8 Pre-Test Vehicle Seat Back Angle



Figure A-9 Pre-Test Dummy Left Side View



Figure A-10 Post-Test Dummy Left Side View



Figure A-11 Pre-Test Dummy Left Side Close-up View



Figure A-12 Post-Test Dummy Left Side Close-up View



Figure A-13 Pre-Test Dummy Left ¾ Front View



Figure A-14 Post-Test Dummy Left ¾ Front View



Figure A-15 Pre-Test Dummy Left ¾ Front Close-up View

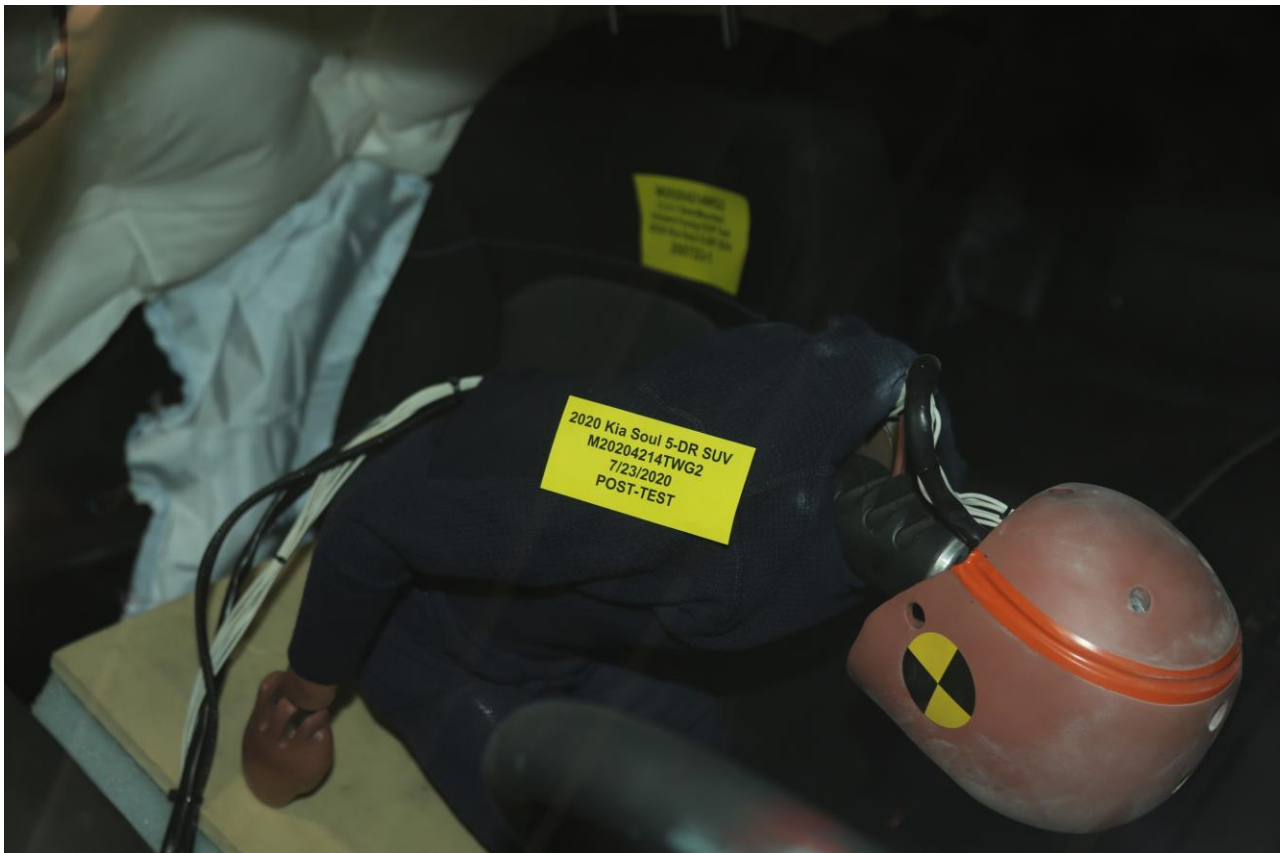


Figure A-16 Post-Test Dummy Left ¾ Front Close-up View



Figure A-17 Pre-Test Dummy Front View



Figure A-18 Post-Test Dummy Front View



Figure A-19 Pre-Test Dummy Front Close-up View



Figure A-20 Post-Test Dummy Front Close-up View



Figure A-21 Pre-Test Dummy Right $\frac{3}{4}$ Front View



Figure A-22 Post-Test Dummy Right $\frac{3}{4}$ Front View



Figure A-23 Pre-Test Dummy Right Side View



Figure A-24 Post-Test Dummy Right Side View



Figure A-25 Post-Test Dummy Right Side View



Figure A-26 Post-Test Curtain Air Bag Left Side View



Figure A-27 Post-Test Curtain Air Bag Left 3/4 Front View



Figure A-28 Post-Test Curtain Air Bag Front View



Figure A-29 Post-Test Curtain Air Bag Right Side View

APPENDIX B
DUMMY RESPONSE DATA PLOTS

<u>No.</u>	<u>List of Data Plots Provided in the Test Report</u>	<u>Page</u>
1	Dummy Head Acceleration (X) Primary vs. Time	B-3
2	Dummy Head Acceleration (Y) Primary vs. Time	B-3
3	Dummy Head Acceleration (Z) Primary vs. Time	B-3
4	Dummy Head Resultant Acceleration Primary vs. Time	B-3
5	Dummy Head Acceleration (X) Redundant vs. Time	B-4
6	Dummy Head Acceleration (Y) Redundant vs. Time	B-4
7	Dummy Head Acceleration (Z) Redundant vs. Time	B-4
8	Dummy Head Resultant Acceleration Redundant vs. Time	B-4
9	Dummy Upper Neck Force X vs. Time	B-5
10	Dummy Upper Neck Force Y vs. Time	B-5
11	Dummy Upper Neck Force Z vs. Time	B-5
12	Dummy Upper Neck Force Resultant vs. Time	B-5
13	Dummy Upper Neck Moment X vs. Time	B-6
14	Dummy Upper Neck Moment Y vs. Time	B-6
15	Dummy Upper Neck Moment Z vs. Time	B-6
16	Dummy Upper Neck Moment Resultant vs. Time	B-6
17	Dummy Lower Neck Force X vs. Time	B-7
18	Dummy Lower Neck Force Y vs. Time	B-7
19	Dummy Lower Neck Force Z vs. Time	B-7
20	Dummy Lower Neck Force Resultant vs. Time	B-7
21	Dummy Lower Neck Moment X vs. Time	B-8
22	Dummy Lower Neck Moment Y vs. Time	B-8
23	Dummy Lower Neck Moment Z vs. Time	B-8
24	Dummy Lower Neck Moment Resultant vs. Time	B-8
25	Dummy Nij vs. Time	B-9
30	Airbag Event Right Side Passenger Seat (V) vs. Time	B-10
31	Airbag Event Right Side Passenger Curtain (V) vs. Time	B-10
32	Airbag Event Right Side Passenger Seat (A) vs. Time	B-10
33	Airbag Event Right Side Passenger Curtain (A) vs. Time	B-10

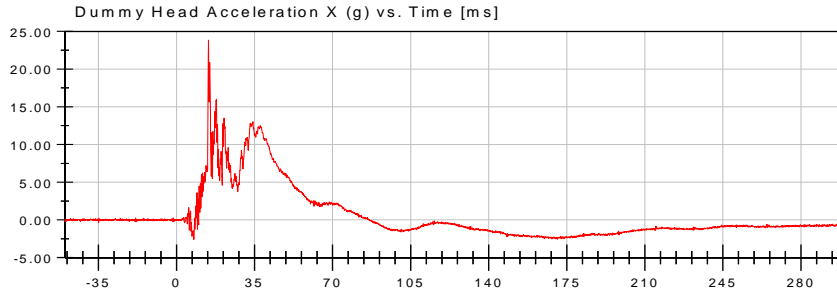
NHTSA

Test Lab: CTF

Test Number: 200723-1 (M20204214TW G2)

Test Date: 07/23/2020

Position #2 Hybrid III 6 year old Dummy (Part 572 N) (13Y7)



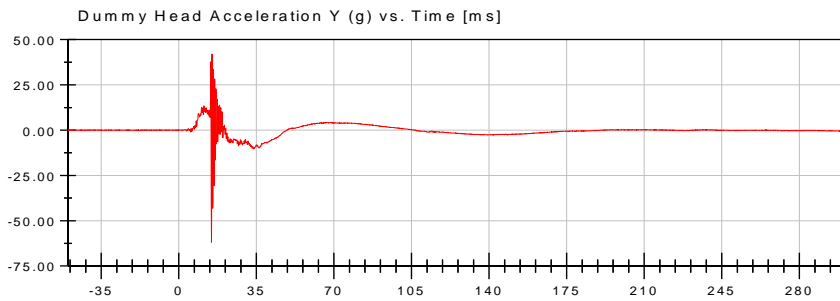
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23.84 g at 14.32 ms

<Min>

-2.61 g at 7.76 ms

CFC_1000



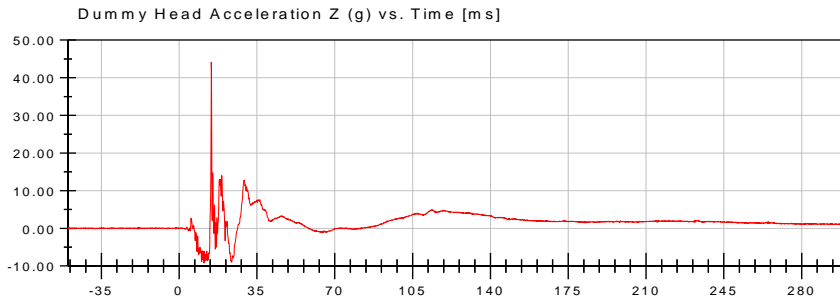
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42.00 g at 15.04 ms

<Min>

-61.82 g at 14.72 ms

CFC_1000



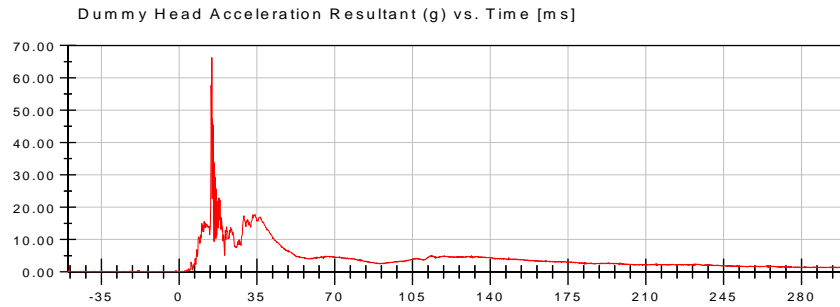
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44.12 g at 14.48 ms

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-9.20 g at 11.12 ms

CFC_1000



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66.22 g at 14.72 ms

<Min>

0.03 g at -49.04 ms

CFC_1000



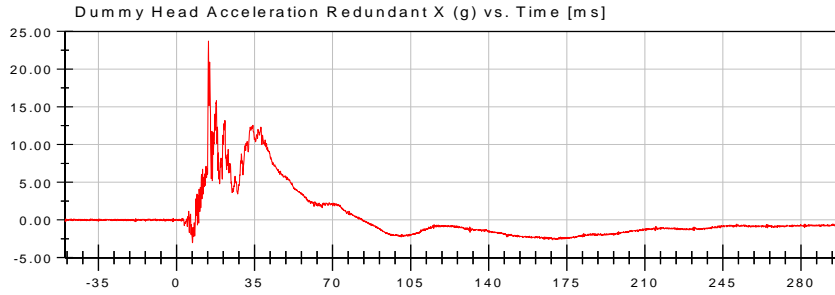
NHTSA

Test Date: 07/23/2020

Position #2 Hybrid III 6 year old Dummy (Part 572 N) (13Y7)

Test Lab: CTF

Test Number: 200723-1 (M20204214TW G2)



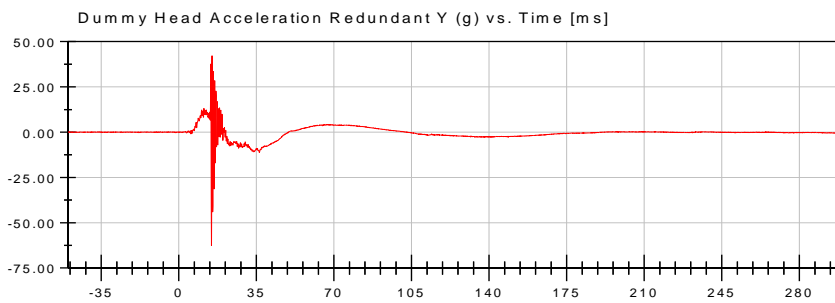
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23.72 g at 14.32 ms

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-3.03 g at 7.12 ms

CFC_1000



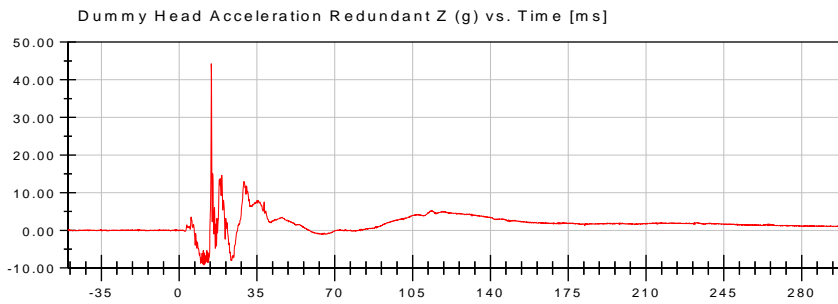
<Max>

42.09 g at 15.04 ms

<Min>

-62.61 g at 14.72 ms

CFC_1000



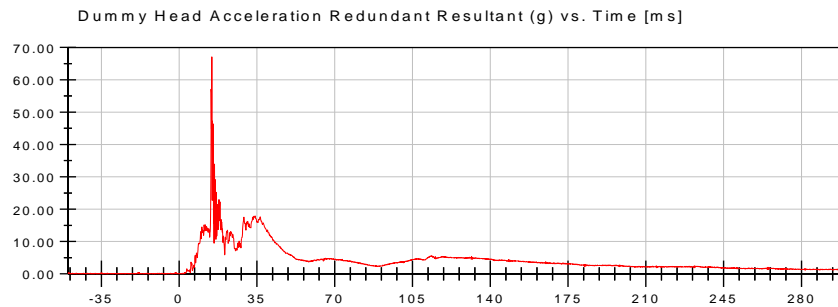
<Max>

44.24 g at 14.48 ms

<Min>

-9.19 g at 11.12 ms

CFC_1000



<Max>

67.10 g at 14.72 ms

<Min>

0.03 g at -49.04 ms

CFC_1000



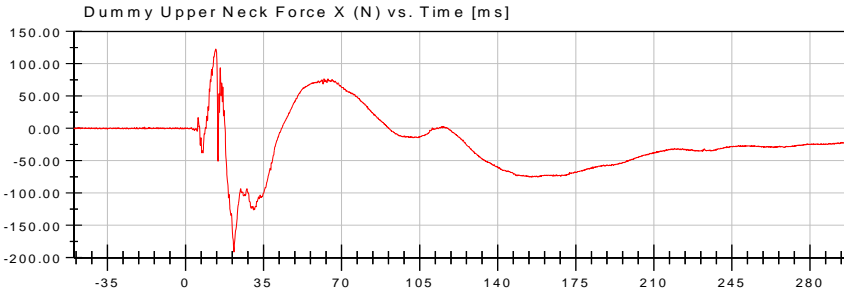
NHTSA

Test Lab: CTF

Test Number: 200723-1 (M20204214TW G2)

Test Date: 07/23/2020

Position #2 Hybrid III 6 year old Dummy (Part 572 N) (13Y7)



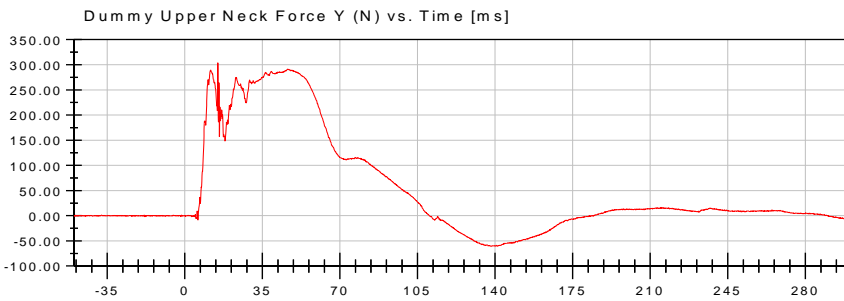
<Max>

122.67 N at 13.52 ms

<Min>

-191.17 N at 21.68 ms

CFC_1000



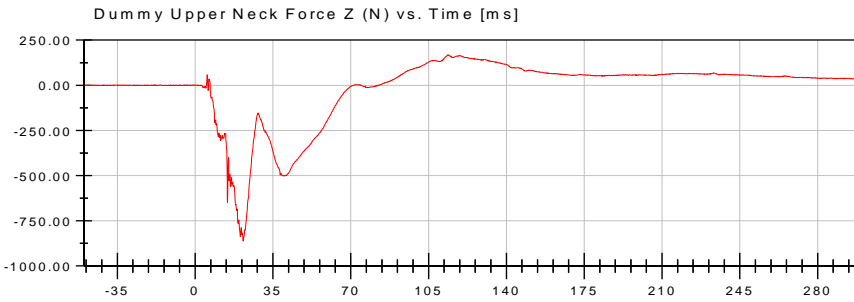
<Max>

303.69 N at 14.96 ms

<Min>

-60.85 N at 138.48 ms

CFC_1000



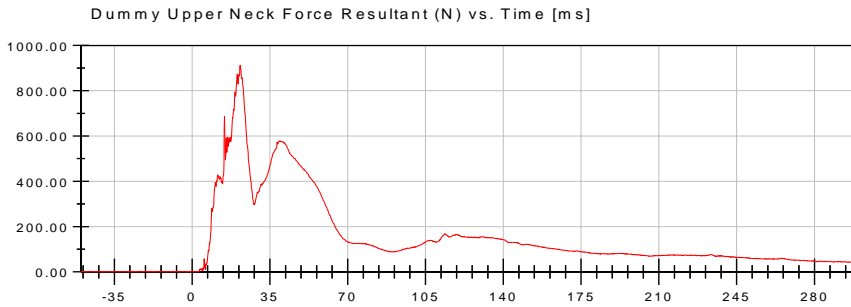
<Max>

168.72 N at 113.76 ms

<Min>

-861.71 N at 21.60 ms

CFC_1000



<Max>

912.99 N at 21.60 ms

<Min>

0.19 N at -46.72 ms

CFC_1000



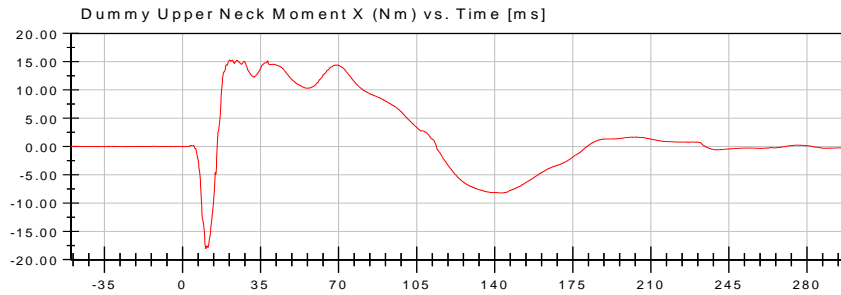
NHTSA

Test Date: 07/23/2020

Position #2 Hybrid III 6 year old Dummy (Part 572 N) (13Y7)

Test Lab: CTF

Test Number: 200723-1 (M20204214TW G2)



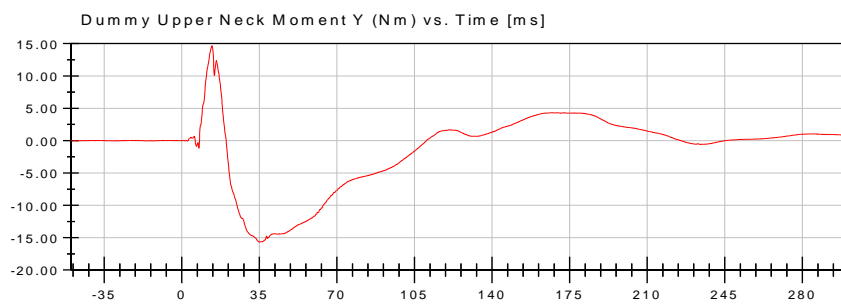
<Max>

15.27 Nm at 21.20 ms

<Min>

-18.05 Nm at 10.48 ms

CFC_600



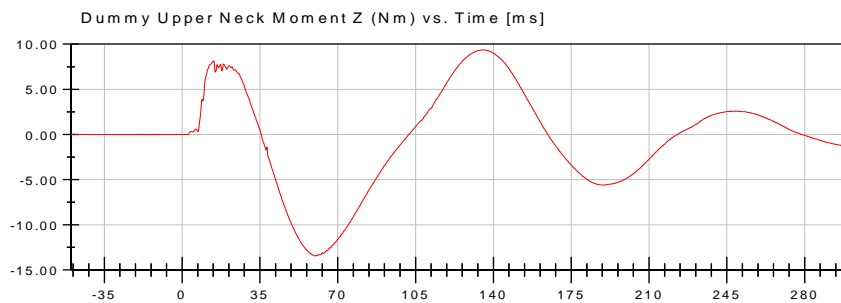
<Max>

14.66 Nm at 13.60 ms

<Min>

-15.65 Nm at 35.04 ms

CFC_600



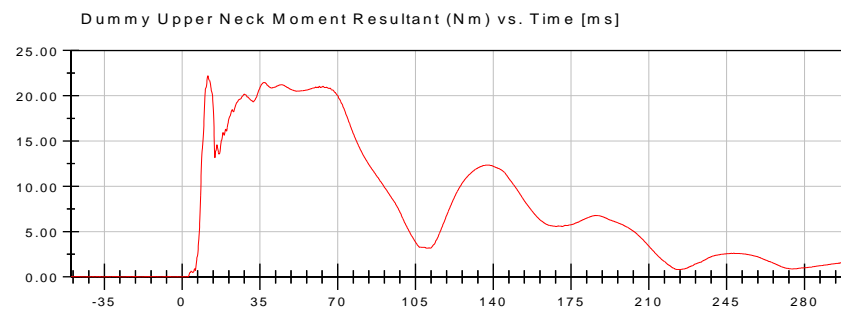
<Max>

9.35 Nm at 135.68 ms

<Min>

-13.45 Nm at 59.60 ms

CFC_600



<Max>

22.20 Nm at 11.60 ms

<Min>

0.00 Nm at -43.20 ms

CFC_600



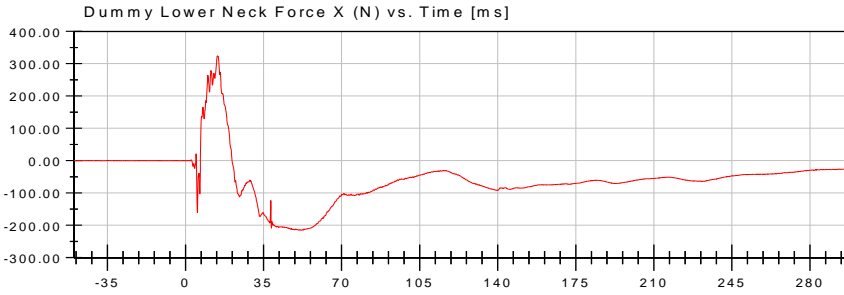
NHTSA

Test Lab: CTF

Test Number: 200723-1 (M20204214TW G2)

Test Date: 07/23/2020

Position #2 Hybrid III 6 year old Dummy (Part 572 N) (13Y7)



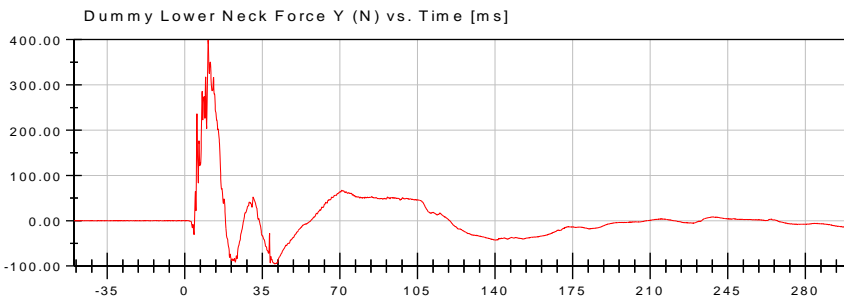
<Max>

324.23 N at 14.32 ms

<Min>

-215.53 N at 51.84 ms

CFC_1000



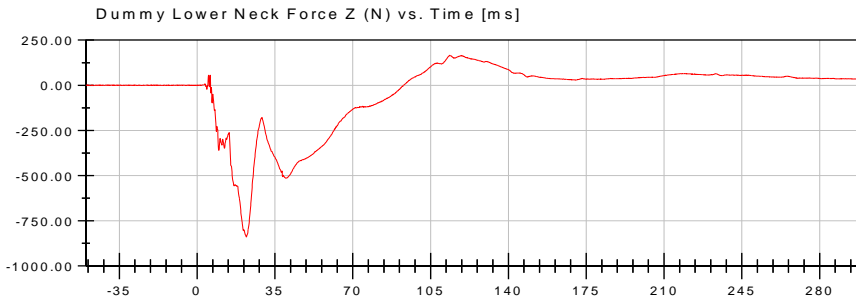
<Max>

398.38 N at 10.56 ms

<Min>

-95.40 N at 40.64 ms

CFC_1000



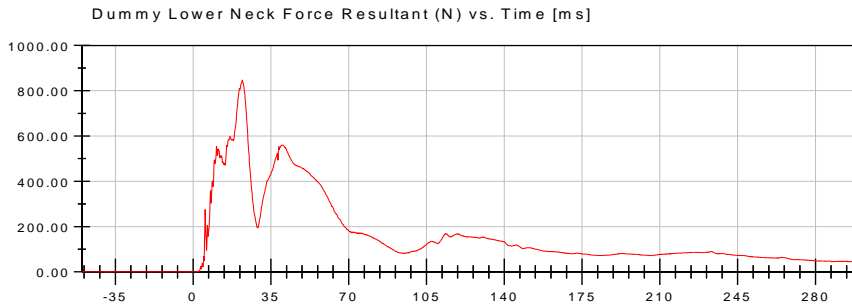
<Max>

165.60 N at 113.52 ms

<Min>

-839.96 N at 22.16 ms

CFC_1000



<Max>

846.97 N at 22.16 ms

<Min>

0.06 N at -49.92 ms

CFC_1000



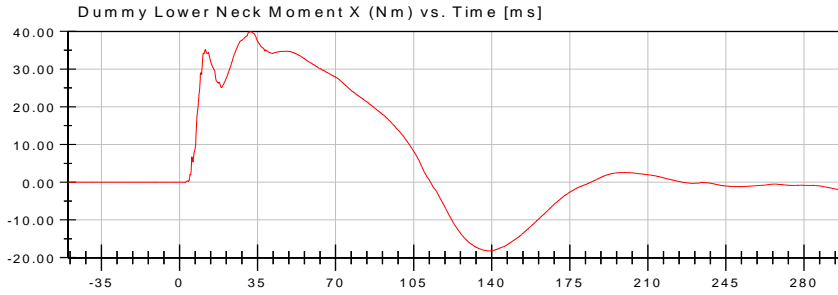
NHTSA

Test Lab: CTF

Test Number: 200723-1 (M20204214TW G2)

Test Date: 07/23/2020

Position #2 Hybrid III 6 year old Dummy (Part 572 N) (13Y7)



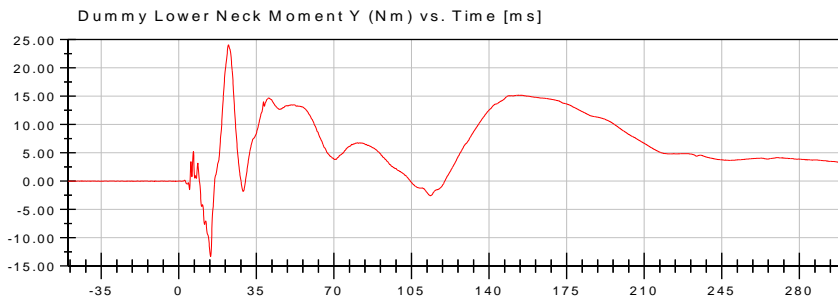
<Max>

39.88 Nm at 31.76 ms

<Min>

-18.20 Nm at 139.76 ms

CFC_600



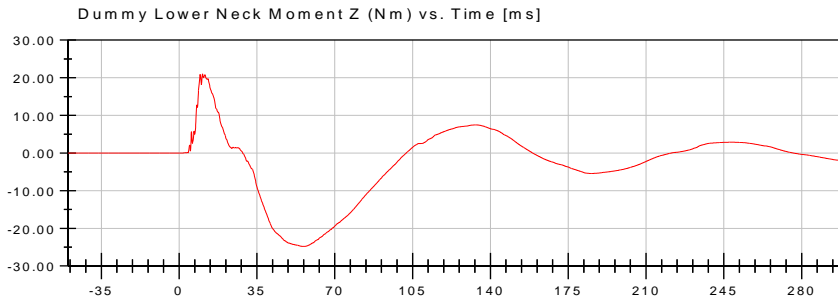
<Max>

24.08 Nm at 22.40 ms

<Min>

-13.34 Nm at 14.32 ms

CFC_600



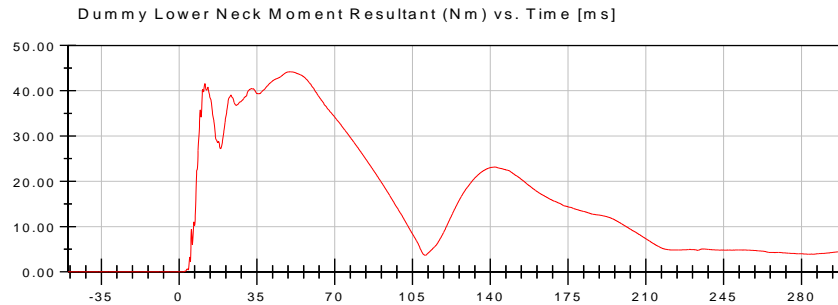
<Max>

20.99 Nm at 10.48 ms

<Min>

-24.81 Nm at 56.16 ms

CFC_600



<Max>

44.18 Nm at 50.00 ms

<Min>

0.00 Nm at -37.52 ms

CFC_600





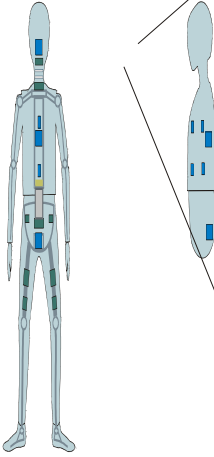
Neck Injury Predictor (NIJ)

Date: 07/23/2020
Time: 10:25

Customer: NHTSA

Test Number: M20204214TWG2

Test Orientation = Frontal
Fzc(Tension) = 2800
Fzc(Compression) = 2800
Myc(Extension) = 37
Myc(Flexion) = 93



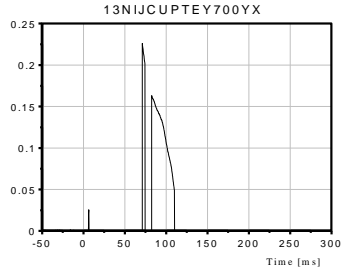
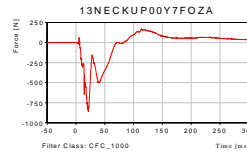
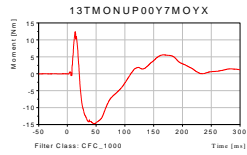
Dummy: HIII 6 Year Old
Seating Position:

Right Front Passenger

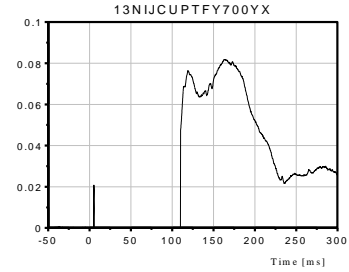
NIJ Source Code: (Fz/Fzc)+(Myc/Myc)

TRC Inc. Test Lab: CTF

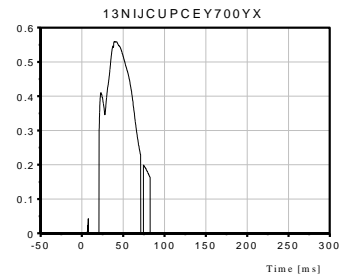
Test Number: 200723-1



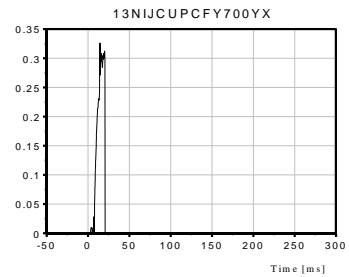
Max [NTE] 0.2260 at 71.20 ms



Max [NTF] 0.0818 at 164.56 ms



Max [NCE] 0.5598 at 39.28 ms



Max [NCF] 0.3260 at 14.56 ms

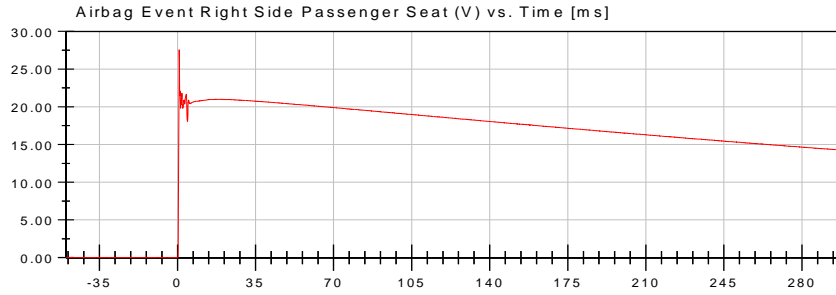
NHTSA

Test Lab: CTF

Test Number: 200723-1 (M20204214TW G2)

Test Date: 07/23/2020

Position #2 Hybrid III 6 year old Dummy (Part 572 N) (13Y7)



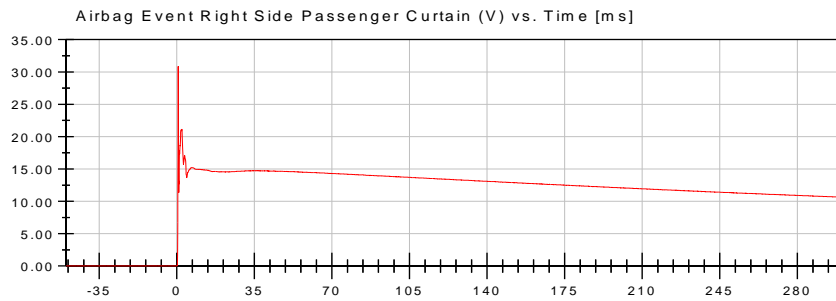
<Max>

27.55 V at 0.80 ms

<Min>

0.00 V at -50.00 ms

Unfiltered



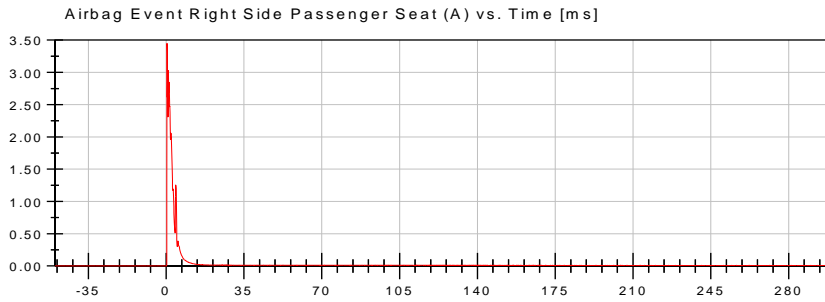
<Max>

30.86 V at 0.64 ms

<Min>

0.00 V at -50.00 ms

Unfiltered



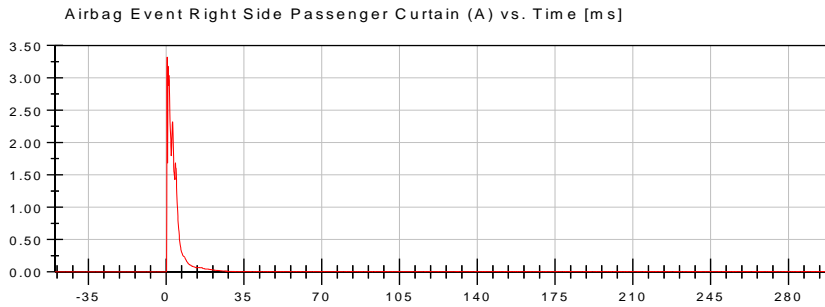
<Max>

3.45 A at 0.40 ms

<Min>

0.00 A at -50.00 ms

Unfiltered



<Max>

3.32 A at 0.48 ms

<Min>

0.00 A at -50.00 ms

Unfiltered



APPENDIX C

TEST EQUIPMENT AND INSTRUMENTATION CALIBRATION

			Serial Number	Manufacturer and Model #	Calibration Date	Date Due
ATD		N/A	182	FTSS	17-Jul-2020	
Head Accelerometers	Primary	X	P82402	Endevco	13-Jul-2020	12-Jan-2021
		Y	P83339	Endevco	13-Jul-2020	12-Jan-2021
		Z	P82403	Endevco	13-Jul-2020	12-Jan-2021
	Redundant	X	P80927	Endevco	13-Jul-2020	12-Jan-2021
		Y	P79626	Endevco	13-Jul-2020	12-Jan-2021
		Z	P51697	Endevco	13-Jul-2020	12-Jan-2021
Upper Neck Load Cell		Fx, Fy, Fz, Mx, My, Mz	2191	Denton	14-Jul-2020	14-Jul-2021
Lower Neck Load Cell		Fx, Fy, Fz, Mx, My, Mz	135	Denton	15-Jul-2020	15-Jul-2021
Chest Potentiometer		Dx				
Sternum Accelerometer		X				
Spine Accelerometer		X				
Data System		N/A	223	Kayser-Threde	23-Jul-2020	
Inclinometer		N/A	DP-7	Mitutoyo Pro 360	7-Nov-2019	7-Nov-2020

APPENDIX D
DUMMY QUALIFICATION DATA

Pre-Test Calibration Sheets
Passenger S/N 182

Transportation Research Center Inc.

Front Head Drop
HIII 6YO Serial No. 182 Certification No. 4-1
Test Date: 7/14/2020

Test Parameter	Specification	Test Results	Pass
Temperature	18.0 - 22.0 °C	20.8 °C	Yes
Relative Humidity	10 - 70 %	59 %	Yes
Peak Head Resultant Acceleration	245 - 300 g	293.5 g	Yes
Peak Head Lateral Acceleration	(-15) - 15 g	-5.0 g	Yes
Is Acceleration Curve Unimodal	< 10 %	1.88 %	Yes

Test meets specifications.

Condition: Used

Comments:

Head Skin S/N: 946

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

07.14.2020 08:22:07 579

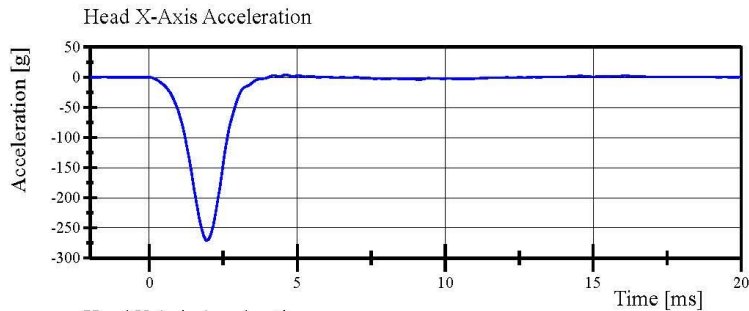


Transportation Research Center Inc.

Front Head Drop

HIII 6YO Serial No. 182 Certification No. 4-1

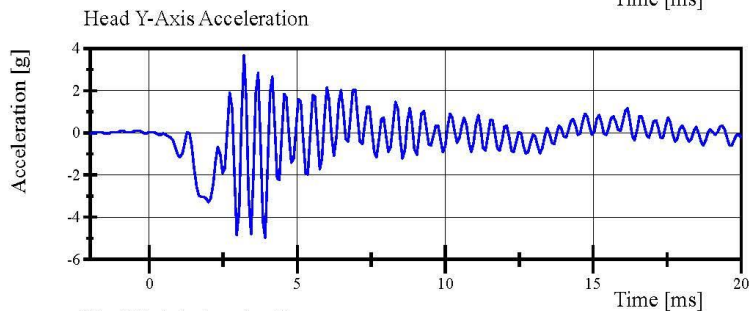
Test Date: 7/14/2020



Filter Class: CFC_1000

Max: 4.2 g at 4.6 ms

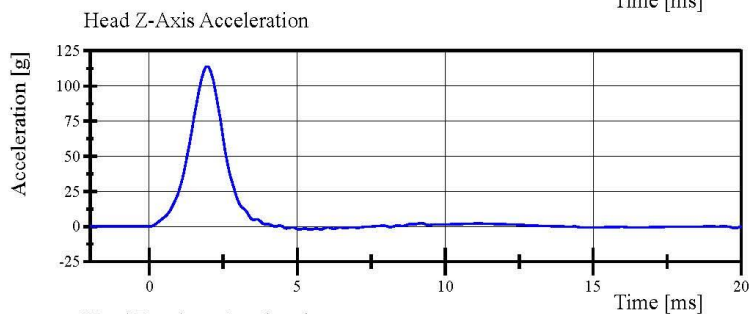
Min: -270.6 g at 1.9 ms



Filter Class: CFC_1000

Max: 3.7 g at 3.2 ms

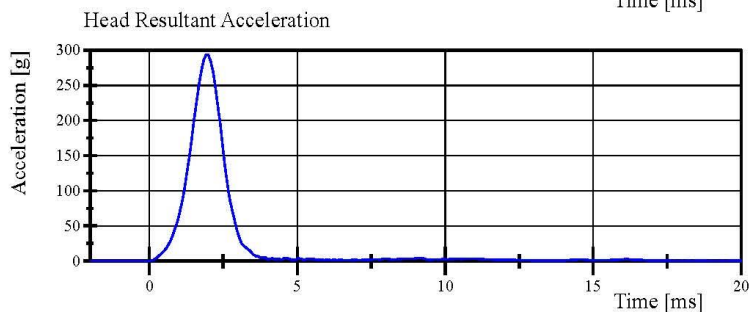
Min: -5.0 g at 3.9 ms



Filter Class: CFC_1000

Max: 113.7 g at 1.9 ms

Min: -2.1 g at 5.4 ms



Filter Class: CFC_1000

Max: 293.5 g at 1.9 ms

Min: 0.0 g at -0.2 ms

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

07.14.2020 08:23:02 579



Transportation Research Center Inc.

Neck Flexion

HIII 6YO Serial No. 182 Certification No. 4-2

Test Date: 7/14/2020

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	20.8 °C	Yes
Relative Humidity	10 - 70 %	59 %	Yes
Pendulum Impact Velocity	4.83 - 5.07 m/s	4.912 m/s	Yes
Pendulum Integrated Velocity at 10ms	(-1.2) - (-1.6) m/s	-1.42 m/s	Yes
Pendulum Integrated Velocity at 20ms	(-2.4) - (-3.4) m/s	-2.85 m/s	Yes
Pendulum Integrated Velocity at 30ms	(-3.8) - (-5.0) m/s	-4.10 m/s	Yes
Total Head D-Plane Rotation	(-74) - (-92) °	-78.0 °	Yes
Peak Neck Occipital Condyles Moment Between -74° and -92° Rotation	27 - 33 Nm	28.8 Nm	Yes
Neck Occipital Condyles Moment Decay to 5 Nm	103 - 123 ms	111.6 ms	Yes

Test meets specifications.

Condition: Used

Comments:

Neck S/N: 867

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

07.15.2020 14:21:05 2217

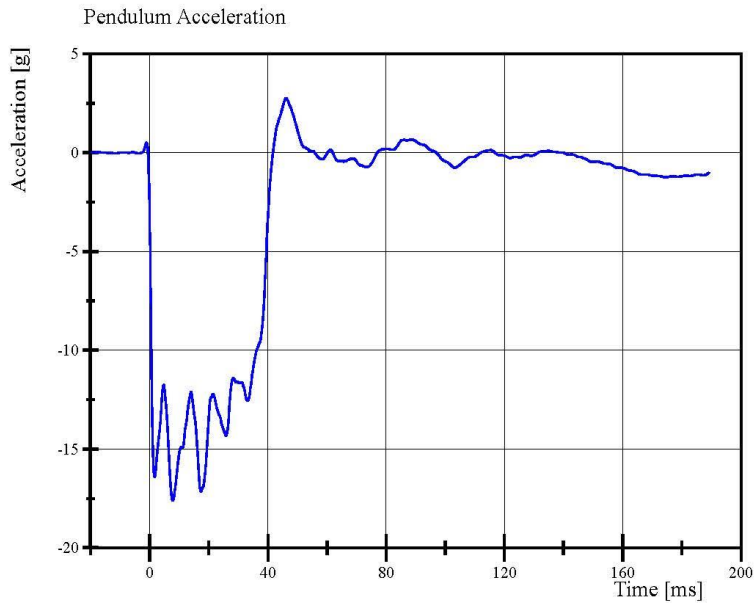


Transportation Research Center Inc.

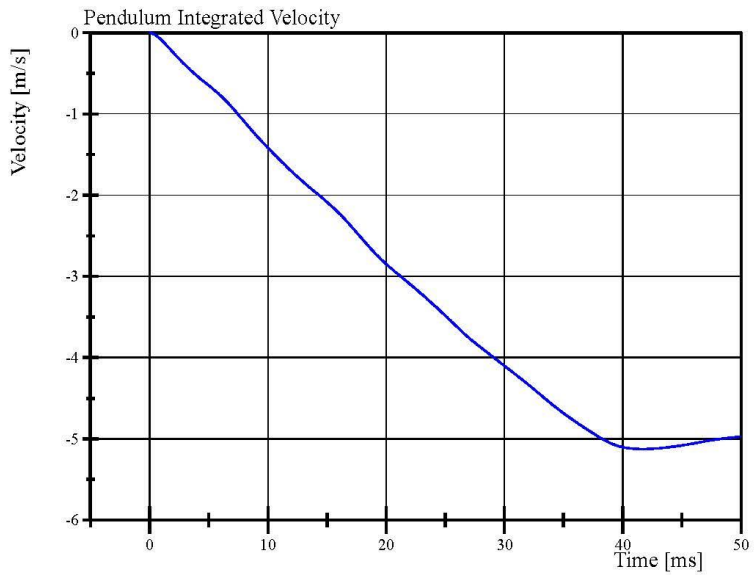
Neck Flexion

HIII 6YO Serial No. 182 Certification No. 4-2

Test Date: 7/14/2020



Filter Class: CFC_180
Max: 2.8 g at 46.2 ms
Min: -17.6 g at 7.8 ms



Filter Class: CFC_180
Max: 0.0 m/s at 0.0 ms
Min: -5.1 m/s at 41.7 ms

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

07.15.2020 14:21:22 2217

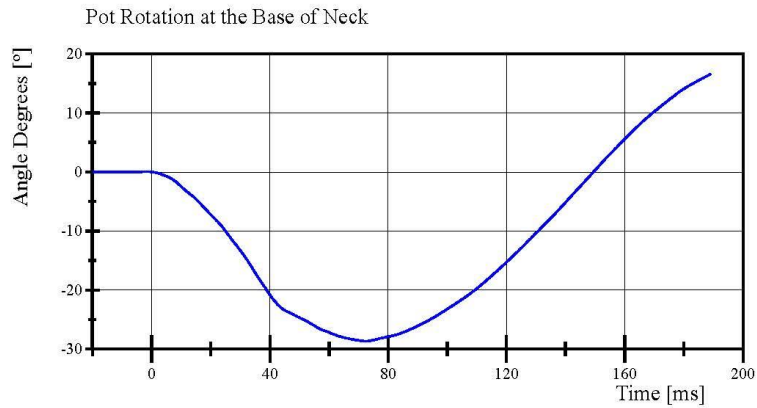


Transportation Research Center Inc.

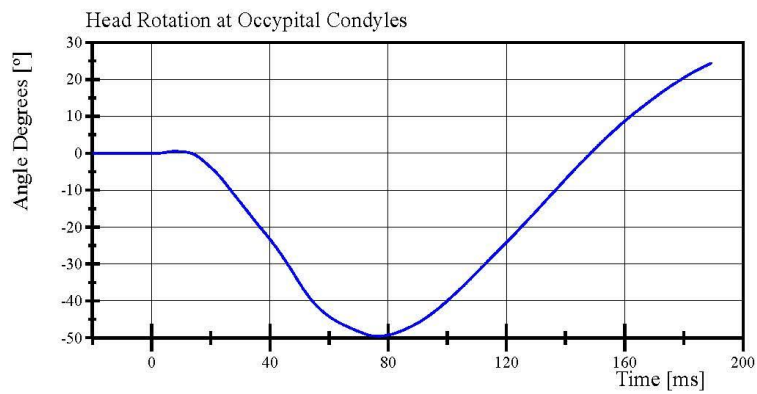
Neck Flexion

HIII 6YO Serial No. 182 Certification No. 4-2

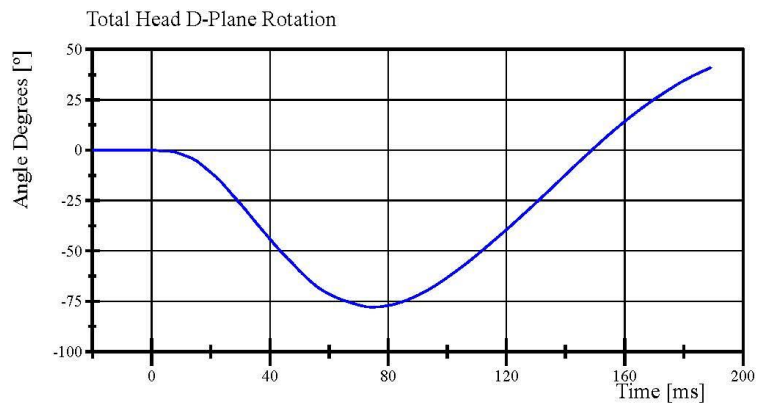
Test Date: 7/14/2020



Filter Class: CFC_60
Max: 16.6 ° at 189.2 ms
Min: -28.6 ° at 72.4 ms



Filter Class: CFC_60
Max: 24.4 ° at 189.2 ms
Min: -49.5 ° at 76.5 ms



Filter Class: CFC_60
Max: 41.0 ° at 189.2 ms
Min: -78.0 ° at 74.7 ms

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

07.15.2020 14:21:22 2217

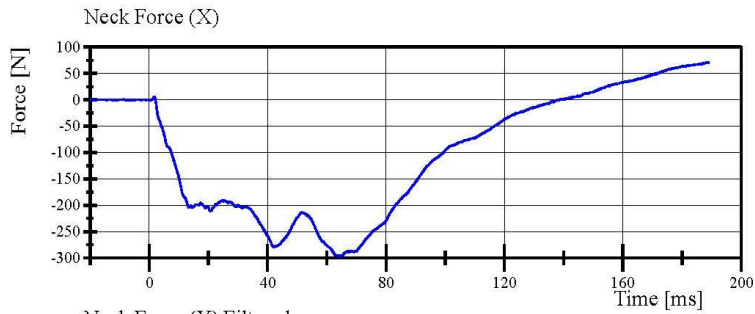


Transportation Research Center Inc.

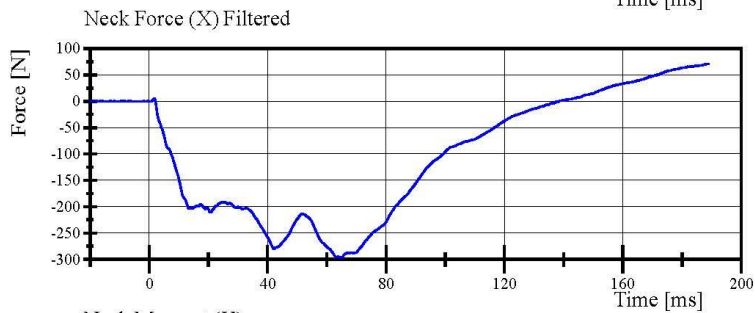
Neck Flexion

HIII 6YO Serial No. 182 Certification No. 4-2

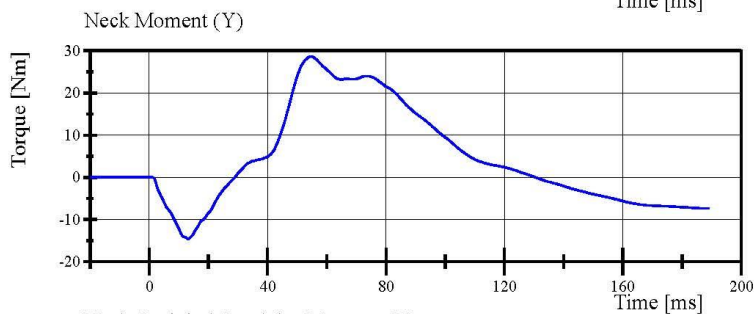
Test Date: 7/14/2020



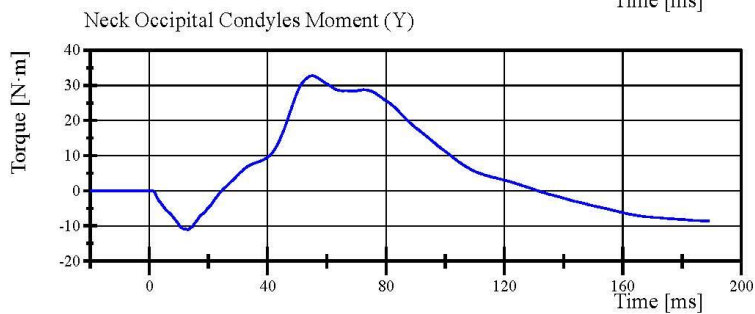
Filter Class: CFC_1000
Max: 70.9 N at 188.7 ms
Min: -296.8 N at 64.3 ms



Filter Class: CFC_600
Max: 70.7 N at 188.8 ms
Min: -296.4 N at 64.3 ms



Filter Class: CFC_600
Max: 28.7 Nm at 54.7 ms
Min: -14.6 Nm at 13.2 ms



Filter Class: Without_(Constar
Max: 32.7 N.m at 55.1 ms
Min: -11.0 N.m at 13.0 ms

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

07.15.2020 14:21:23 2217



Transportation Research Center Inc.

Neck Extension

HIII 6YO Serial No. 182 Certification No. 4-2

Test Date: 7/14/2020

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	20.8 °C	Yes
Relative Humidity	10 - 70 %	59 %	Yes
Pendulum Impact Velocity	4.18 - 4.42 m/s	4.273 m/s	Yes
Pendulum Integrated Velocity at 10ms	(-1.0) - (-1.4) m/s	-1.10 m/s	Yes
Pendulum Integrated Velocity at 20ms	(-2.2) - (-3.0) m/s	-2.21 m/s	Yes
Pendulum Integrated Velocity at 30ms	(-3.2) - (-4.2) m/s	-3.26 m/s	Yes
Total Head D-Plane Rotation	85 - 103 °	93.1 °	Yes
Peak Neck Occipital Condyles Moment Between 85° and 103° Rotation	(-19) - (-24) Nm	-21.1 Nm	Yes
Neck Occipital Condyles Moment Decay to 5 Nm	123 - 147 ms	137.5 ms	Yes

Test meets specifications.

Condition: Used

Comments:

Neck S/N: 867

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

07.15.2020 14:18:52 2413

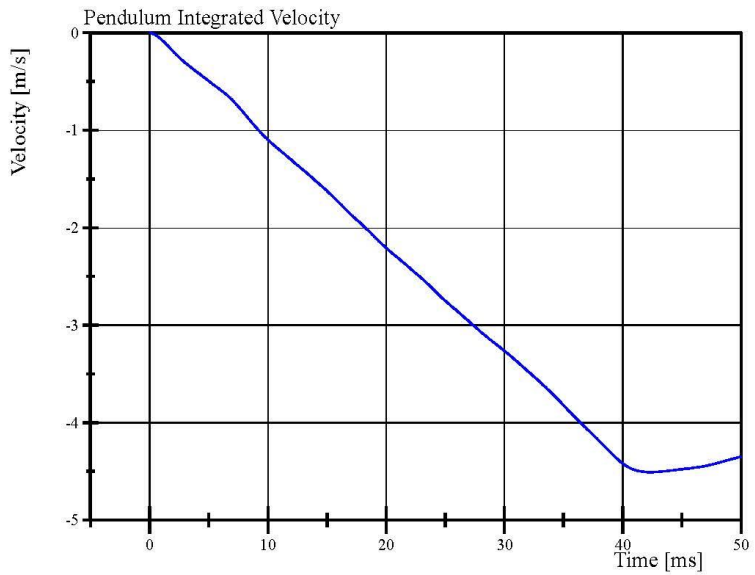
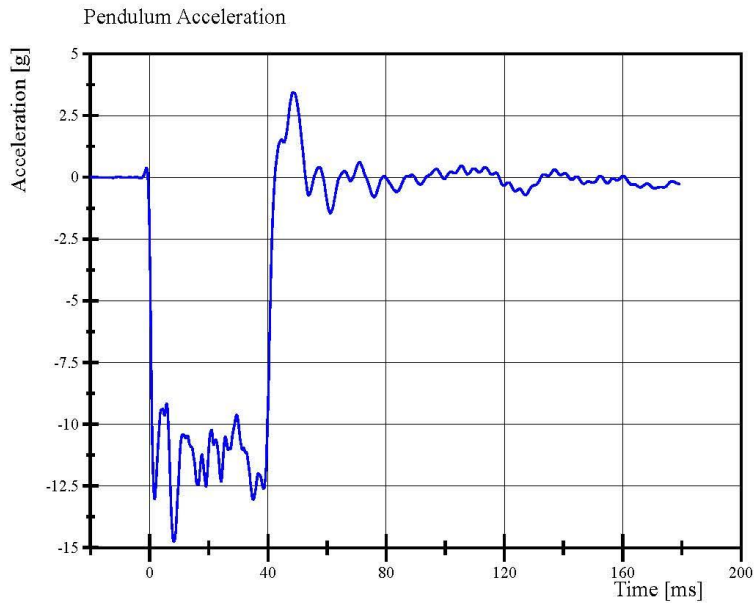


Transportation Research Center Inc.

Neck Extension

HIII 6YO Serial No. 182 Certification No. 4-2

Test Date: 7/14/2020



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

07.15.2020 14:19:11 2413

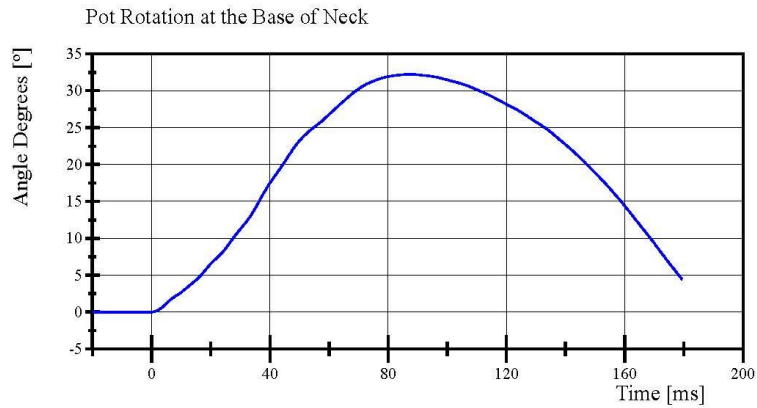


Transportation Research Center Inc.

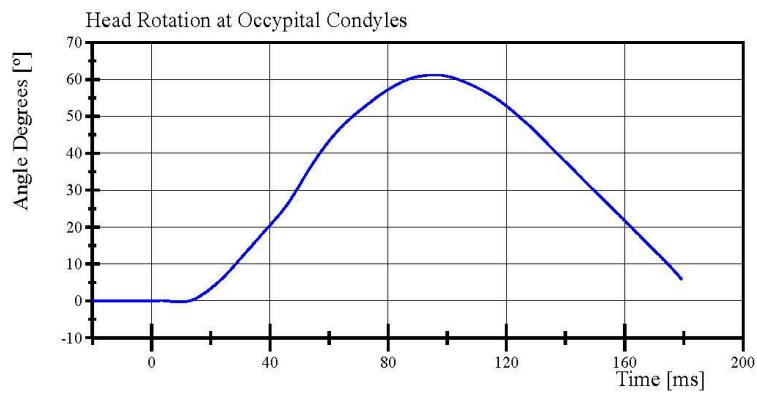
Neck Extension

HIII 6YO Serial No. 182 Certification No. 4-2

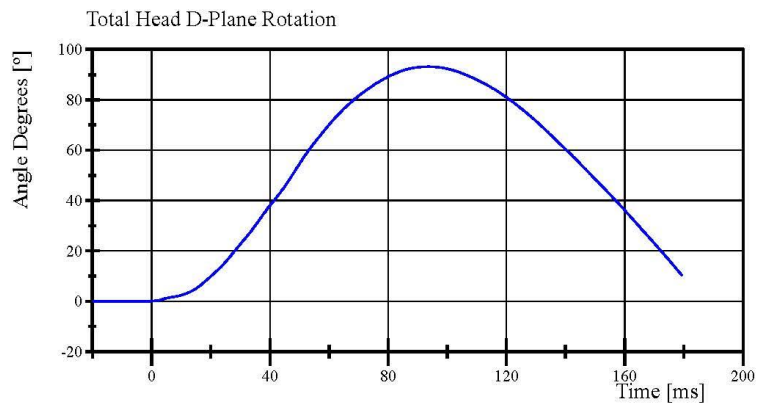
Test Date: 7/14/2020



Filter Class: CFC_60
Max: 32.2 ° at 87.4 ms
Min: -0.0 ° at -20.0 ms



Filter Class: CFC_60
Max: 61.2 ° at 95.9 ms
Min: -0.3 ° at 9.0 ms



Filter Class: CFC_60
Max: 93.1 ° at 93.6 ms
Min: -0.1 ° at -20.0 ms

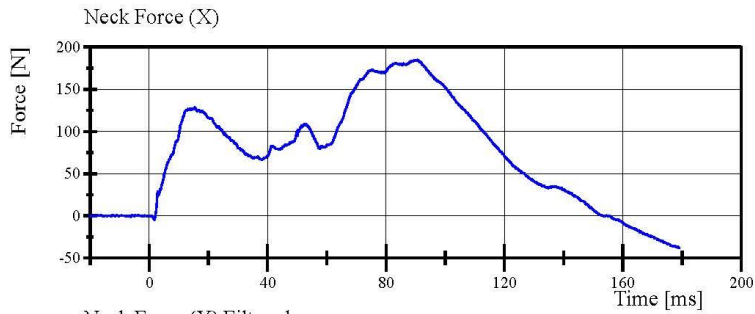
Specification Source: CFR49 Part 572 Subpart N
with Polarity in accordance with J211

07.15.2020 14:19:11 2413

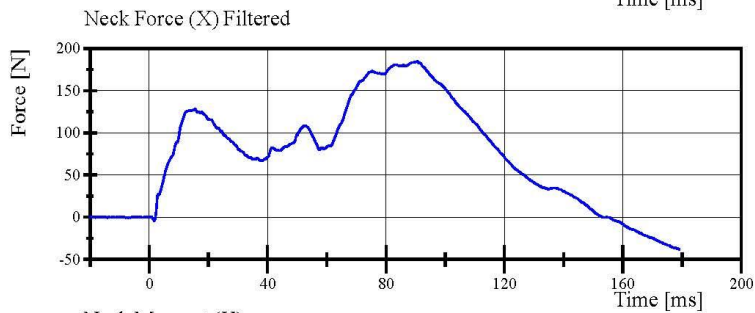


Transportation Research Center Inc.

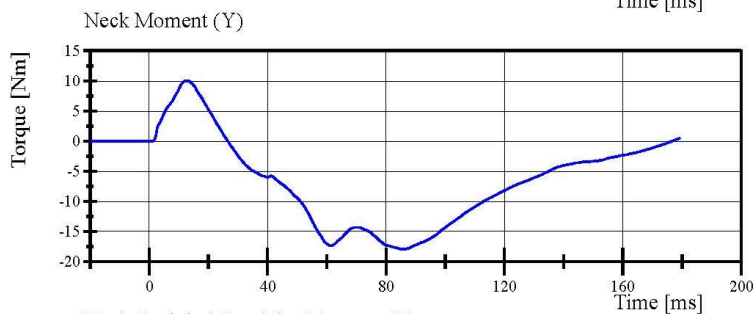
Neck Extension
HIII 6YO Serial No. 182 Certification No. 4-2
Test Date: 7/14/2020



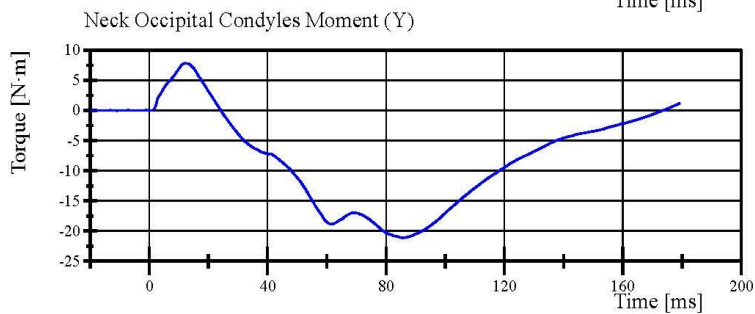
Filter Class: CFC_1000
Max: 185.1 N at 90.5 ms
Min: -38.4 N at 179.0 ms



Filter Class: CFC_600
Max: 184.8 N at 90.6 ms
Min: -38.4 N at 179.3 ms



Filter Class: CFC_600
Max: 10.1 Nm at 12.9 ms
Min: -17.9 Nm at 85.3 ms



Filter Class: Without_(Constar
Max: 7.8 N.m at 12.3 ms
Min: -21.1 N.m at 85.3 ms

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

07.15.2020 14:19:12 2413



Transportation Research Center Inc.

Front Thorax
HIII 6YO Serial No. 182 Certification No. 4-1
Test Date: 7/14/2020

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	21.2 °C	Yes
Relative Humidity	10 - 70 %	60 %	Yes
Probe Velocity	6.59 - 6.83 m/s	6.670 m/s	Yes
Probe Force Peak Between 38.0 mm and 46.0 mm Chest Deflection	(-1,150) - (-1,380) N	-1,200.7 N	Yes
Probe Force Peak Between 12.5 mm and 38.0 mm Chest Deflection	>= (-1,500) N	-1,346.1 N	Yes
Maximum Chest Compression	(-38) - (-46) mm	-38.4 mm	Yes
Internal Hysteresis	65 - 85 %	78.1 %	Yes

Test meets specifications.

Condition: Used

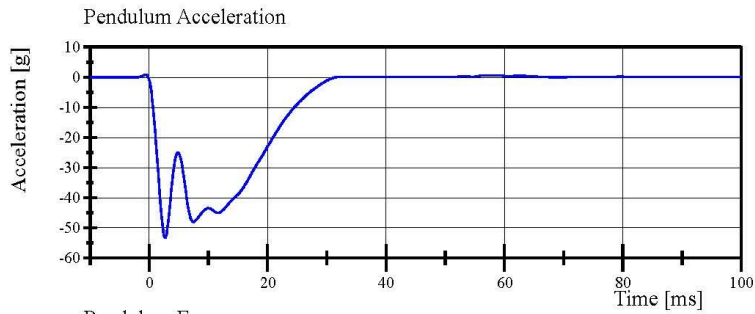
Comments:

Jacket S/N: DL1525

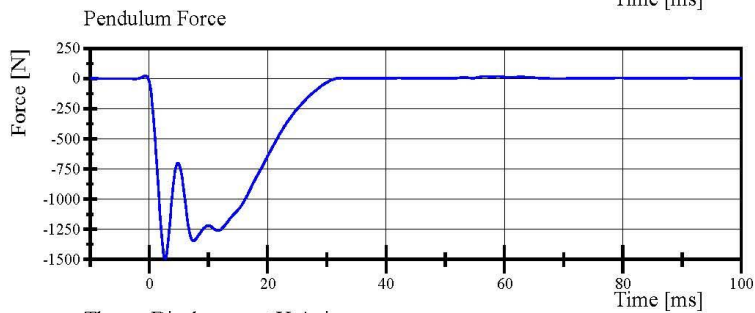
Rib Set S/N: N/A

Transportation Research Center Inc.

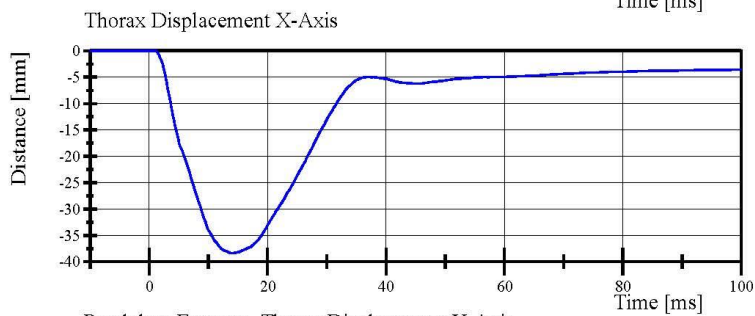
Front Thorax
HIII 6YO Serial No. 182 Certification No. 4-1
Test Date: 7/14/2020



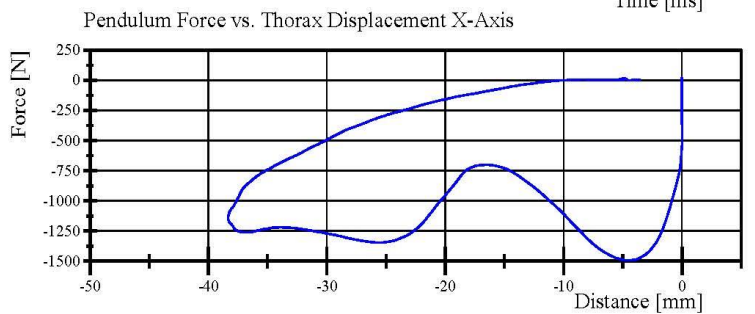
Filter Class: CFC_180
Max: 0.8 g at -0.6 ms
Min: -53.3 g at 2.7 ms



Filter Class: CFC_180
Max: 23.2 N at -0.6 ms
Min: -1,493.9 N at 2.7 ms



Filter Class: CFC_600
Max: 0.0 mm at -8.8 ms
Min: -38.4 mm at 14.2 ms



Filter Class: CFC_180
Max: 23.2 N at -0.0 mm
Min: -1,493.9 N at -4.7 mm

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

07.14.2020 15:00:16 1524



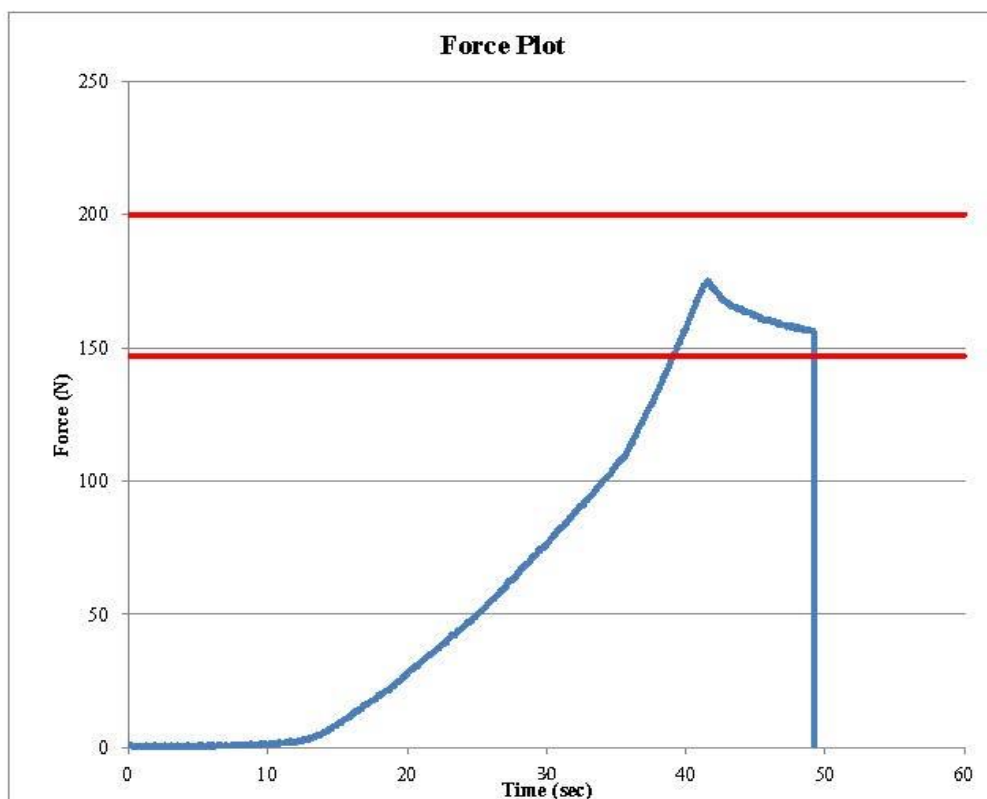
Transportation Research Center Inc.

Hybrid III Six-Year-Old Child Torso Flexion



Customer: NHTSA
Serial Number: 182 Date: 7/15/2020
Test Number: 1 Time: 12:37

TEST PARAMETER	SPECIFICATION	TEST RESULTS
Temperature	18.9 - 25.6	20.8 °C Pass
Humidity	10 - 70	59 % Pass
Average Angular Velocity	0.5 - 1.5	0.91 deg/sec Pass
Initial Angle	0 - 22	18.76 deg Pass
Peak Force at 45.06°	147 - 200	175.26 N Pass
Final Angle	-8 - 8	4.19 deg Pass



Comments:
Abdomen S/N: 756
Lumbar S/N: 339

Transportation Research Center Inc.

Left Knee Femur Response Test
HIII 6YO Serial No. 182 Certification No. 4-1
Test Date: 7/16/2020

Test Parameter	Specification	Test Results	Pass
Temperature	18.9 - 25.6 °C	20.8 °C	Yes
Relative Humidity	10 - 70 %	59 %	Yes
Probe Velocity	2.07 - 2.13 m/s	2.116 m/s	Yes
Peak Femur Force	(-2,000) - (-3,000) N	-2,366.1 N	Yes

Test meets specifications.

Condition: Used

Comments:

Knee Skin S/N: 937

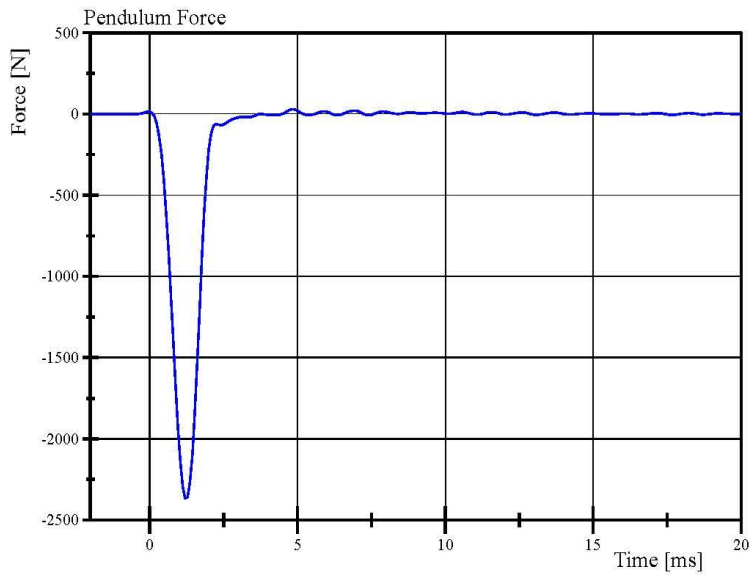
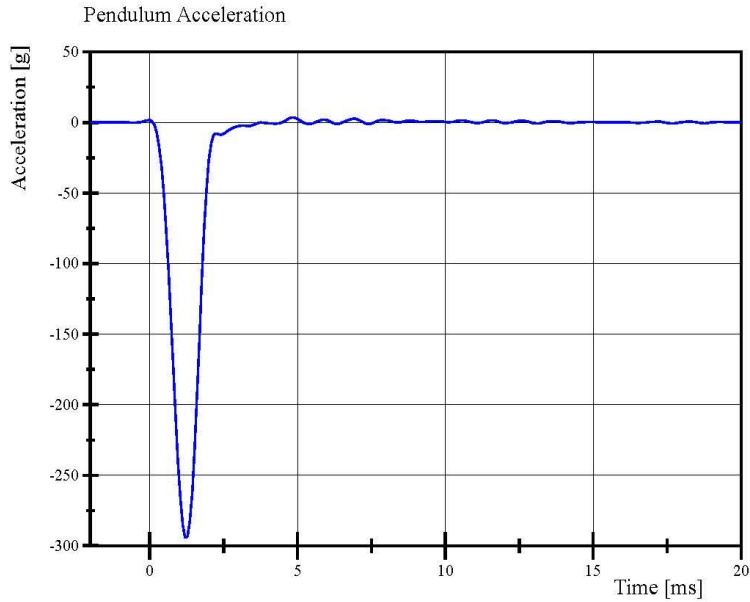
Specification Source: CFR49 Part 572 Subpart N
with Polarity in accordance with J211

07.16.2020 09:51:29 1710



Transportation Research Center Inc.

Left Knee Femur Response Test
HIII 6YO Serial No. 182 Certification No. 4-1
Test Date: 7/16/2020



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

07.16.2020 09:54:32 1710



Transportation Research Center Inc.

Right Knee Femur Response Test
HIII 6YO Serial No. 182 Certification No. 4-1
Test Date: 7/16/2020

Test Parameter	Specification	Test Results	Pass
Temperature	18.9 - 25.6 °C	20.8 °C	Yes
Relative Humidity	10 - 70 %	60 %	Yes
Probe Velocity	2.07 - 2.13 m/s	2.109 m/s	Yes
Peak Femur Force	(-2,000) - (-3,000) N	-2,211.1 N	Yes

Test meets specifications.

Condition: Used

Comments:

Knee Skin S/N: 938

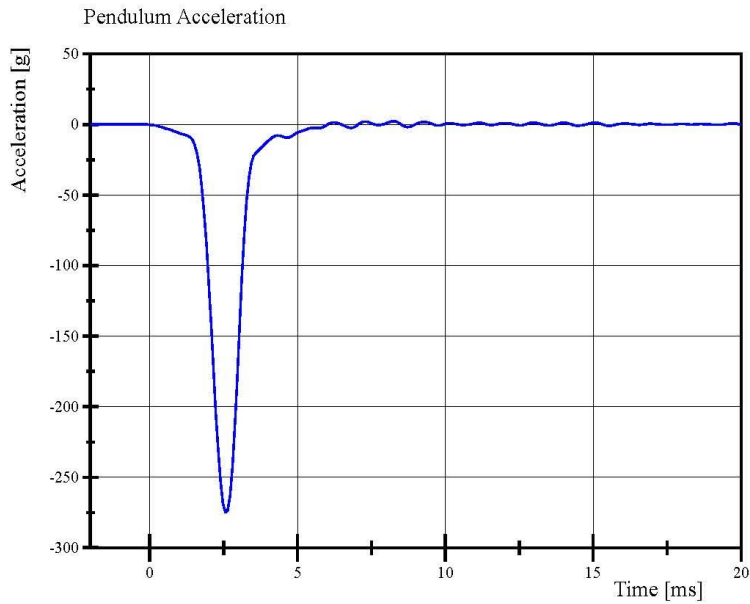
Specification Source: CFR49 Part 572 Subpart N
with Polarity in accordance with J211

07.16.2020 09:57:12 1700

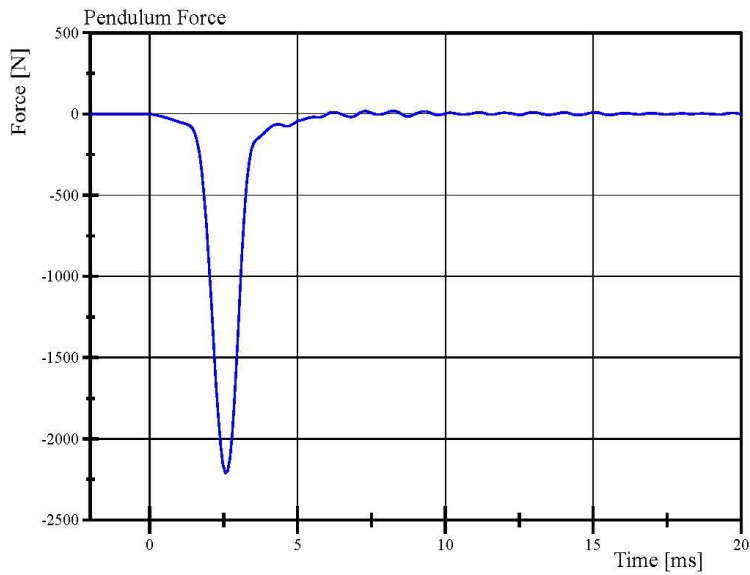


Transportation Research Center Inc.

Right Knee Femur Response Test
HIII 6YO Serial No. 182 Certification No. 4-1
Test Date: 7/16/2020



Filter Class: CFC_600
Max: 2.5 g at 8.2 ms
Min: -275.0 g at 2.6 ms



Filter Class: CFC_600
Max: 19.7 N at 8.2 ms
Min: -2,211.1 N at 2.6 ms

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

07.16.2020 09:57:28 1700

