REPORT NUMBER: TWG-TRC-20-01

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

HYUNDAI MOTOR COMPANY
2020 Hyundai Venue 5-DR Hatchback

NHTSA NUMBER: M20204211TWG2
TRC TEST NUMBER: 200722

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

Test Date: July 22, 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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16. ABSTRACT

A side air bag out of position test was conducted on the subject 2020 Hyundai Venue 5-DR Hatchback 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 22, 2020.

The curtain and torso side air bags were deployed and responses were measured on a SID-IIs. Three high speed cameras recorded the event. The ambient temperature at the time of air bag deployment was 21.1°C.

Section 3.3.5.2 – SID-IIs – Position 2

Measurement Description	Units	IARV	Result
Head Injury Criteria (HIC15)	N/A	779	11
Nij	N/A	1	0.63
Upper Neck Tension	Newton	2070	297.7
Upper Neck Compression	Newton	2520	-2196.3
Maximum Chest Compression	mm	34	
Maximum Chest Compression rate	m/sec	8.2	

17. KEY WORDS New Car Assessment Program Side Air Bag Out-of-position (OOP) Technical Working Group (TWG)	18. DISTRIBUTION STATEMENT Copies of this report are available from the following: National Highway Traffic Safety Administration Technical Information Services 1200 New Jersey Ave, SE Washington, DC 20590 Email: tis@nhtsa.dot.gov FAX: 202-493-2833

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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 Hyundai Venue 5-DR Hatchback. 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 Hyundai Venue 5-DR Hatchback on an out-of-position SID-IIs were evaluated. The test was performed by TRC on July 22, 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 SID-IIs was placed in the right front (passenger) seat situated forward 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 3.3.5.2.

The SID-IIs 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 SID-IIs	
		IARV	Result
Head Injury Criteria (HIC15)	N/A	779	11
Nij	N/A	1	0.63
Upper Neck Tension	N	2070	297.7
Upper Neck Compression	N	2520	-2196.3
Thorax Compression	mm	34	
Thorax Compression rate	m/sec	8.2	

SECTION 3 DATA SHEET

DATA SHEET NO. 1
TEST SUMMARY

Test Vehicle:	2020 Hyundai Venue 5-DR Hatchback	NHTSA No.:	M20204211TWG2
Test Program:	Side Air Bag Out-of-Position Test	Test Date:	7/22/2020

TEST SUMMARY

TEST CONFIGURATION INFORMATION

Seating Position:	P2	Right Front Seating Position
Test Section:	3.3.5.2	Roof-Rail-Mounted, Forward Facing
Airbag 1:	Seat	Seat mounted – outside seam
Airbag 2:	Side Rail	Side curtain airbag
Booster Block:	N/A	N/A
ATD Type/Serial No.:	SID-IIs	DI8818
Vehicle	Hyundai	Venue
Previous Crash Test	MDB	1/23/2020& M20204211

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 Hyundai Venue 5-DR Hatchback	NHTSA No.:	M20204211TWG2
Test Program:	Side Air Bag Out-of-Position Test	Test Date:	7/22/2020

TEST CONFIGURATION INFORMATION

NHTSA No.	M20204211
Model Year	2020
Make	Hyundai
Model	Venue
Body Style	5HB
VIN	KMHRB8A32LU014323
Body Color	Galactic Grey
Odometer Reading (km/mi)	94 mi
Engine Displacement (L)	1.6
Type/No. Cylinders	Straight/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	HYUNDAI MOTOR COMPANY
Date of Manufacture	SEP/24/19
Vehicle Type	Passenger Car

GVWR (lbs)	3770
GAWR Front (lbs)	2101
GAWR Rear (lbs)	1889

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)				380.0	(A)
DSC x 68.04 (kg)				340.2	(B)
Cargo Weight (RCLW) (kg)				39.8	(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 Hyundai Venue 5-DR Hatchback	NHTSA No.:	M20204211TWG2
Test Program:	Side Air Bag Out-of-Position Test	Test Date:	7/22/2020

VEHICLE SEAT FORE/AFT POSITION

Seat Location	Total Fore/Aft Travel		Test Position from Forwardmost Position	
	mm	# Detents	mm	# Detents
Front Right	220	34	0	0
Rear Right	0	Fixed	0	Fixed

Seat Fore/Aft Position Per TWG Guidelines	Adjust seat track position forward to minimize distance from head to roof-rail module
Reason for Deviation from TWG Guidelines	Minimum distance achieved at full forward position

VEHICLE SEAT BACK ANGLE ADJUSTMENT

Seat Location	Total Seat Back Angle Range		Test Position from Most Upright (Vertical)	
	Degrees	# Detents	Degrees	# Detents
Front Right	60.4	32	0.4	7
Rear Right	0	Fixed	0	Fixed

OEM Back Angle Design Position	7 detents from most upright
Method of Measuring Back Angle Position	Inclinometer on headrest post
Seat Back Angle Position Per TWG Guidelines	Adjust to manufacturer's design angle
Reason for Deviation from TWG Guidelines	No deviations

VEHICLE SEAT HEIGHT ADJUSTMENT

Seat Location	Total Height Adjustment Range		Test Position from Lowest Position	
	mm	# Detents	mm	# Detents
Front Right	0	Fixed	0	Fixed
Rear Right	0	Fixed	0	Fixed

Seat Height Adjustment Per TWG Guidelines	Full up
Reason for Deviation from TWG Guidelines	No adjustment available

DATA SHEET NO. 4
DUMMY SETUP AND POSITIONING DATA

Test Vehicle:	2020 Hyundai Venue 5-DR Hatchback	NHTSA No.:	M20204211TWG2
Test Program:	Side Air Bag Out-of-Position Test	Test Date:	7/22/2020

DUMMY INFORMATION

ATD Type	SID-IIs
Serial Number	DI8818
Qualification Date	7/20/2020
Qualification Type	Full
Clothing	Cotton shirt and pants
Other ATD Prep	Electrical tape at skull cap, baby power on head

DUMMY POSITIONING INFORMATION

TWG Setup Instructions	As specified in the 3.3.5.2 Test Procedure; Seat is adjusted to its highest position; ATD positioned to 3.3.5.2.1
Actual Setup	As specified in the 3.3.5.2 Test Procedure; The vehicle seat is set to full forward positions. The seat back angle is set to 0.3 degrees, as called out in Form 1. The dummy's skull cap is powdered and the seam is taped. The dummy is facing forward with the arm in the horizontal position. The seat bolster does not allow the dummy to come in contact with the door trim panel. The dummy is leaned outboard with the centerline of the top of the head 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 Hyundai Venue 5-DR Hatchback NHTSA No.: M20204211TWG2
Test Program: Side Air Bag Out-of-Position Test Test Date: 7/22/2020

RECORDED DATA - MINIMUMS AND MAXIMUMS

Channel	Unit	CFC	Maximum	Time (ms)	Minimum	Time (ms)
Head X	G	1000	12.92	22.56	-7.72	16.72
Head Y	G	1000	8.02	16.32	-19.61	12.72
Head Z	G	1000	56.38	11.12	-14.01	15.60
Head Resultant	G	1000	58.93	11.12		
Head Red X	G	1000	13.43	22.56	-7.99	16.72
Head Red Y	G	1000	8.16	16.32	-19.97	12.72
Head Red Z	G	1000	56.96	11.12	-13.94	15.60
Head Red Resultant	G	1000	59.93	11.12		
Upper Neck X	N	1000	213.14	22.16	-25.69	5.52
Upper Neck Y	N	1000	174.57	189.04	-322.01	96.88
Upper Neck Z	N	1000	297.66	151.36	-2,196.33	24.56
Upper Neck Resultant	N	1000	2,203.76	24.56		
Upper Neck X	Nm	600	24.43	75.20	-14.70	13.60
Upper Neck Y	Nm	600	15.25	22.16	-17.74	36.88
Upper Neck Z	Nm	600	4.19	171.36	-9.73	32.56
Upper Neck Resultant	Nm	600	26.01	75.20		
Lower Neck X	N	1000	199.11	19.04	-286.22	39.60
Lower Neck Y	N	1000	225.07	55.20	-232.72	14.88
Lower Neck Z	N	1000	340.98	151.04	-2,167.01	26.08
Lower Neck Resultant	N	1000	2,172.34	26.08		
Lower Neck X	Nm	600	41.75	186.88	-47.38	97.84
Lower Neck Y	Nm	600	87.38	26.08	-15.86	155.44
Lower Neck Z	Nm	600	16.40	96.08	-10.99	14.88
Lower Neck Resultant	Nm	600	87.53	26.08		

HEAD INJURY SUMMARY

HIC15	T1 (ms)	T2 (ms)	HIC36	T1 (ms)	T2 (ms)
11	10.88	25.92	14	10.40	34.48

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

Test Vehicle:	2020 Hyundai Venue 5-DR Hatchback	NHTSA No.:	M20204211TWG2
Test Program:	Side Air Bag Out-of-Position Test	Test Date:	7/22/2020

NECK INJURY SUMMARY

Injury Criteria	Value	Time (ms)
Upper Neck NTF	0.07	145.92
Upper Neck NTE	0.09	155.44
Upper Neck NCF	0.63	24.00
Upper Neck NCE	0.62	36.08
Peak Tension	297.66	151.36
Peak Compression	-2196.33	24.56

CHEST INJURY SUMMARY

Injury Criteria	Value	Time (ms)
[Chest/Rib] Deflection		
Deflection Rate[1]		

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

RESEARCH INJURY SUMMARY

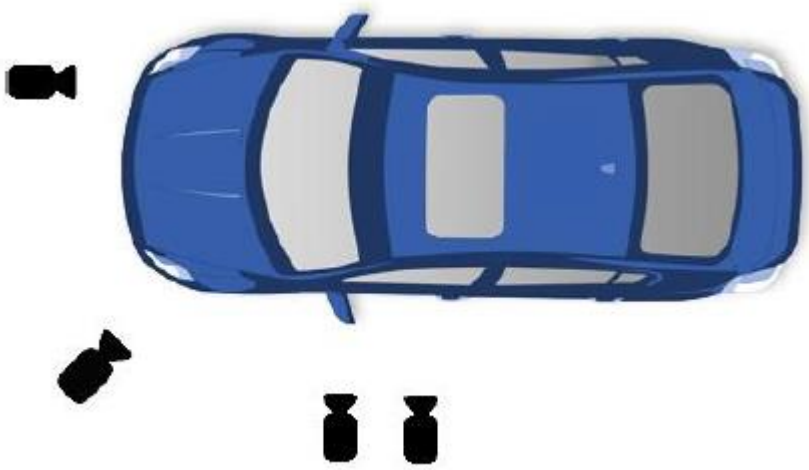
Research Injury Criteria[1]	Value	Time (ms)
Upper Neck Lateral Moment		
Upper Neck Twist Moment		
Lower Neck Flexion Moment		
Lower Neck Extension Moment		
Lower Neck Lateral Moment		
Lower Neck Twist Moment		
Lower Neck Tension		
Lower Neck Compression		
Spine Acceleration		

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

DATA SHEET NO. 6
CAMERA SETUP AND DESCRIPTION

Test Vehicle:	2020 Hyundai Venue 5-DR Hatchback	NHTSA No.:	M20204211TWG2
Test Program:	Side Air Bag Out-of-Position Test	Test Date:	7/22/2020

CAMERA SETUP DIAGRAM FOR SAB OOP TESTS



No.	Camera View	Location (mm)			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[2]	-1763	-3040	-1165	Zoom	30

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

APPENDIX A

PHOTOGRAPHS

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Figure A-1 Right Front ¾ View of Test Vehicle as Delivered

Figure A-2 Vehicle Certification Label

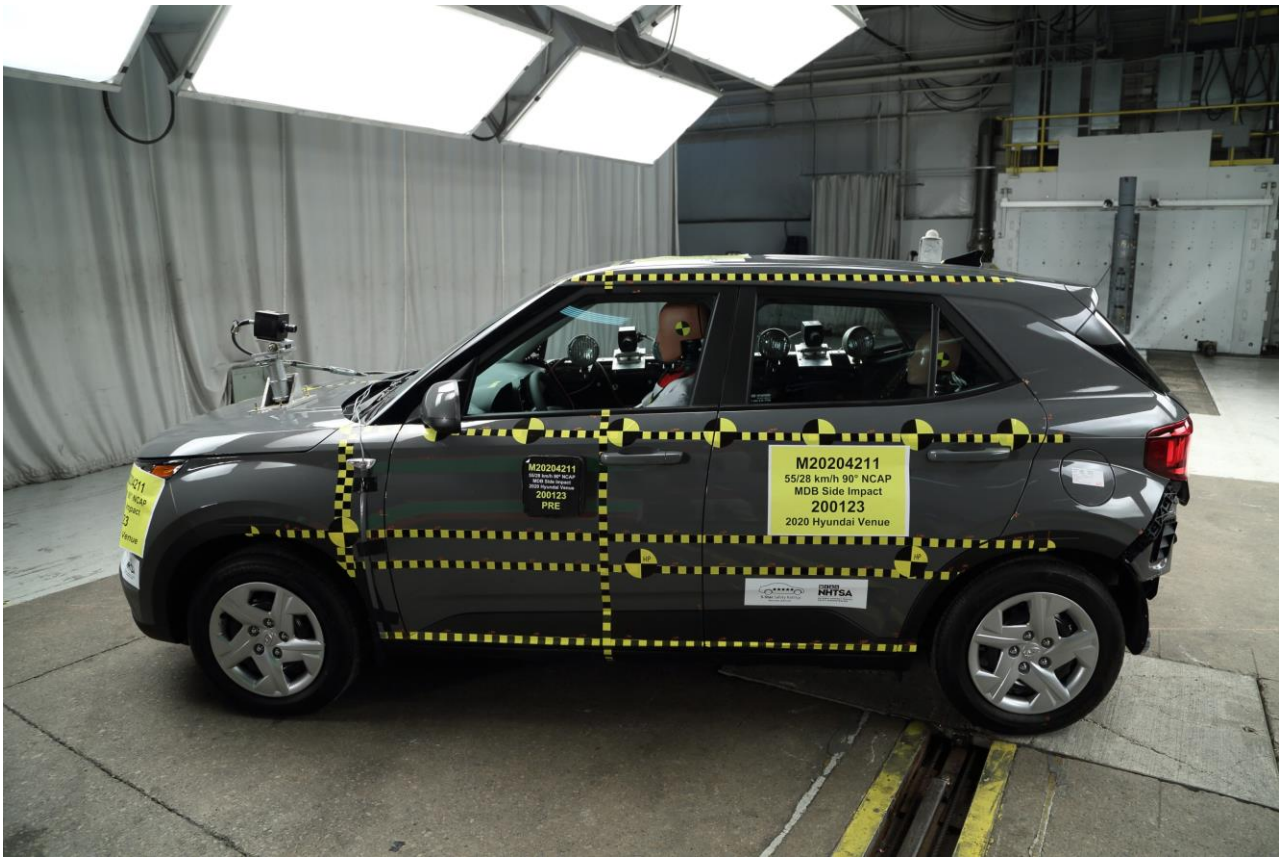


Figure A-3 Pre-Test Vehicle Left Side View

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

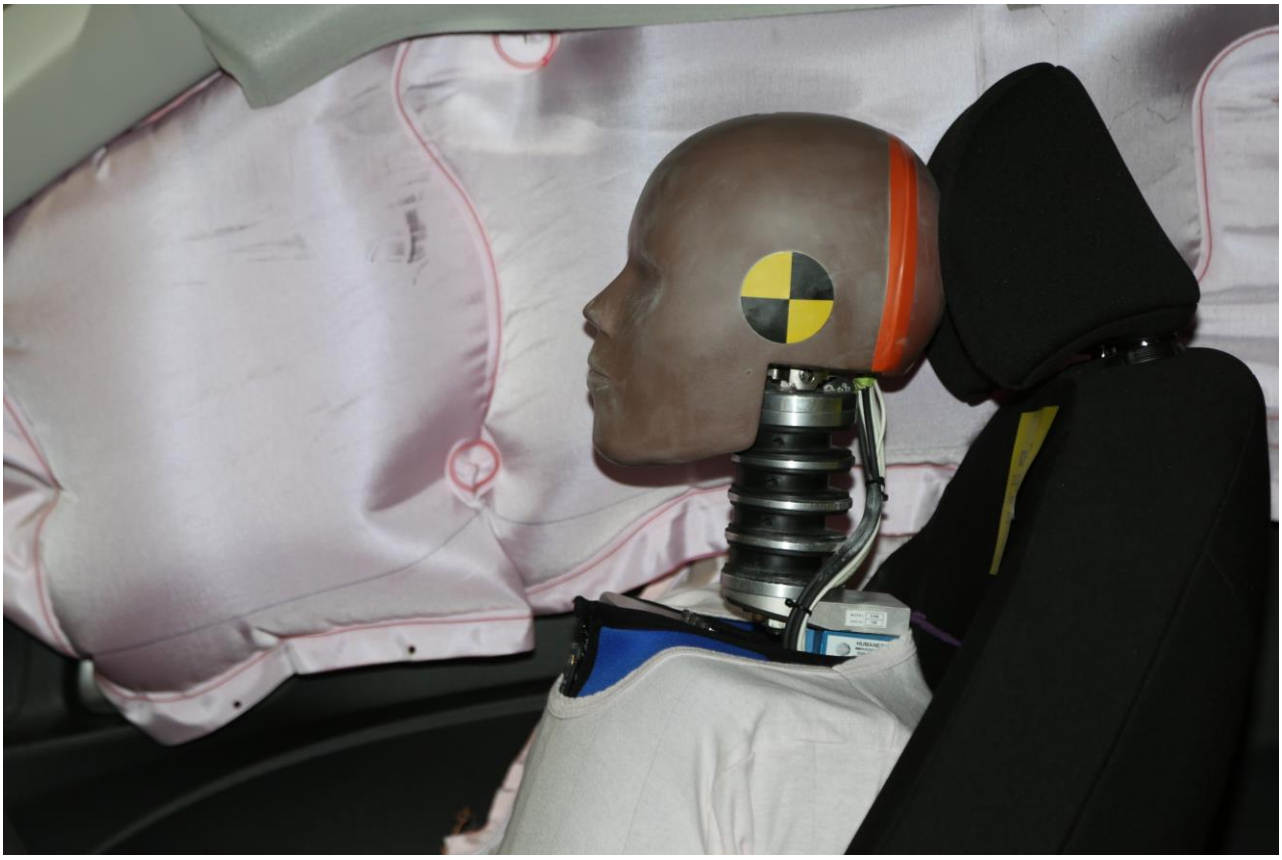


Figure A-12 Post-Test Dummy Left Side Close-up View

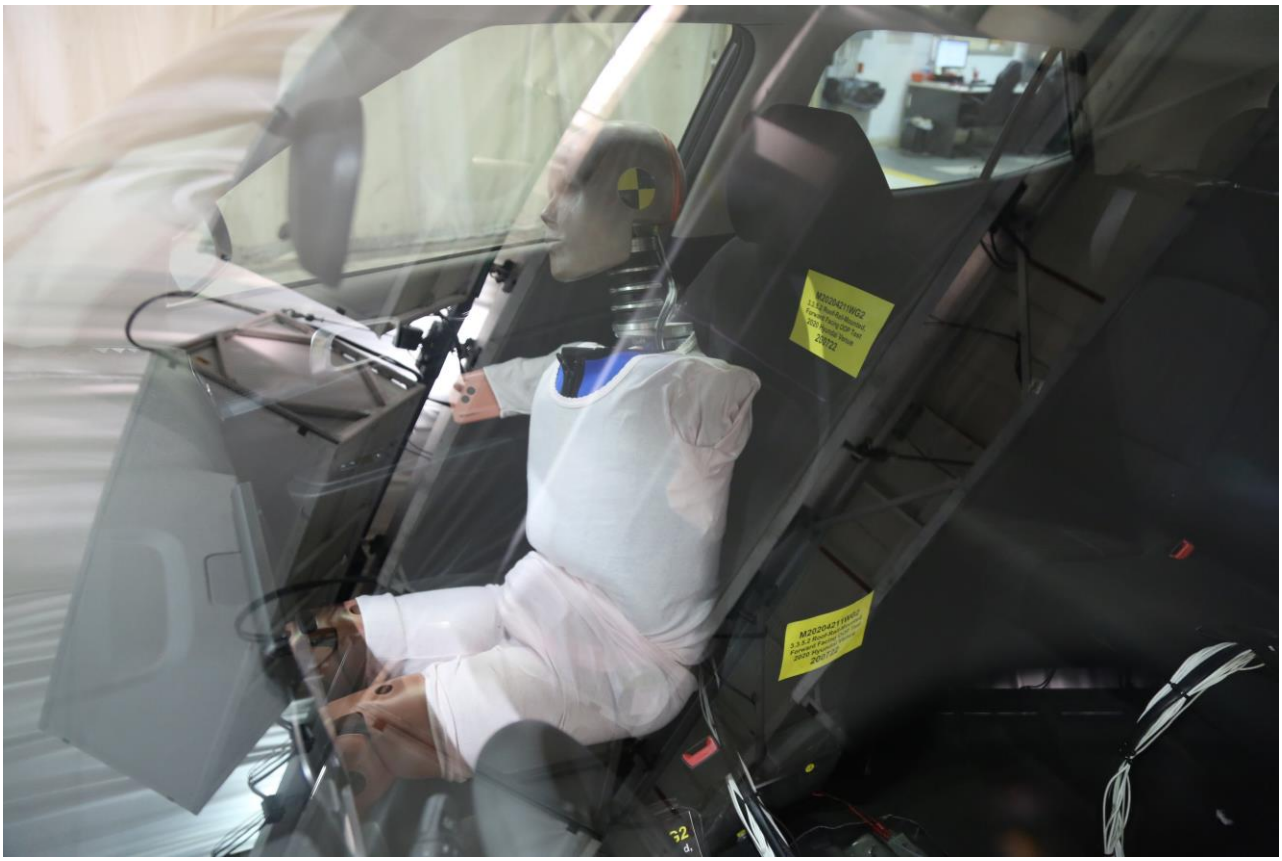


Figure A-13 Pre-Test Dummy Left ¾ Front View

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 ¾ Front View

Figure A-22 Post-Test Dummy Right ¾ 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 ¾ 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

NHTSA

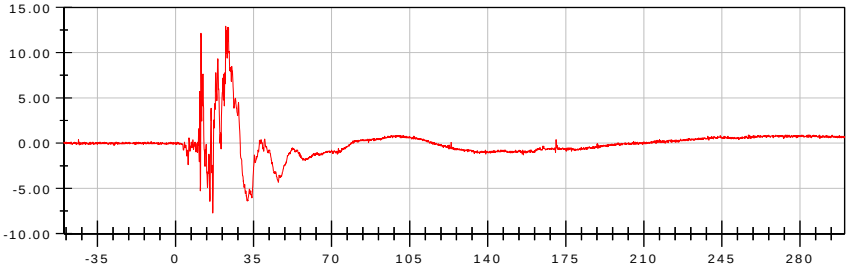
Test Date: 07/22/2020

Position #2 SID IIs Dummy (13S2)

Test Lab: CTF

Test Number: 200722 (M20204211TWG2)

Dummy Head Acceleration X (g) vs. Time [ms]



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12.92 g at 22.56 ms

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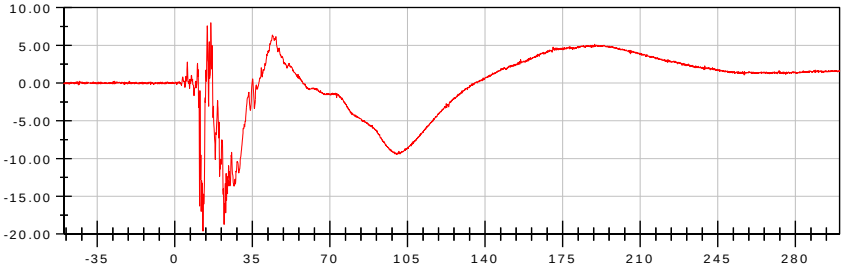
-7.72 g at 16.72 ms

CFC_1000

Dummy Head Acceleration Y (g) vs. Time [ms]



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8.02 g at 16.32 ms

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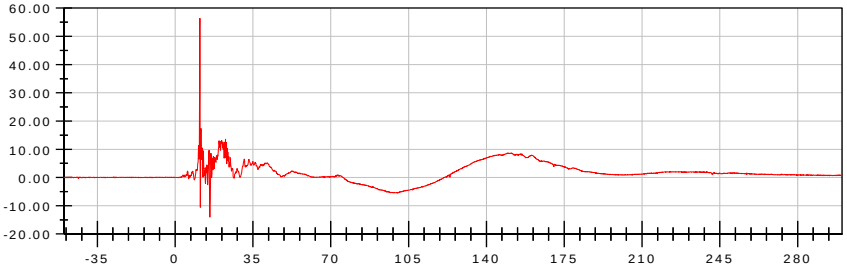
-19.61 g at 12.72 ms

CFC_1000

Dummy Head Acceleration Z (g) vs. Time [ms]



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56.38 g at 11.12 ms

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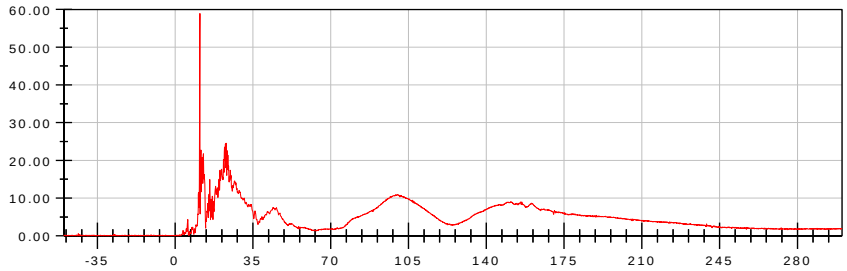
-14.01 g at 15.60 ms

CFC_1000

Dummy Head Acceleration Resultant (g) vs. Time [ms]



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58.93 g at 11.12 ms

<Min>

0.01 g at -48.72 ms

CFC_1000

NHTSA

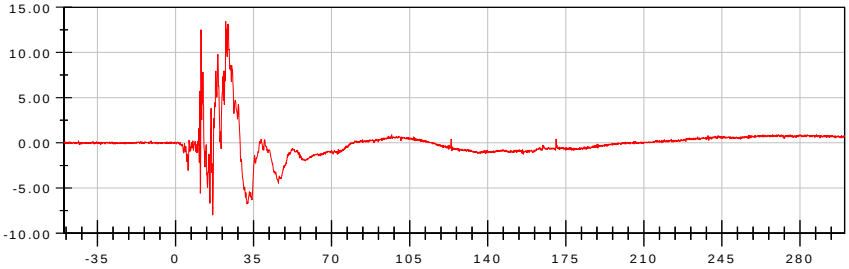
Test Date: 07/22/2020

Position #2 SID IIs Dummy (13S2)

Test Lab: CTF

Test Number: 200722 (M20204211TWG2)

Dummy Head Acceleration Redundant X (g) vs. Time [ms]



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13.43 g at 22.56 ms

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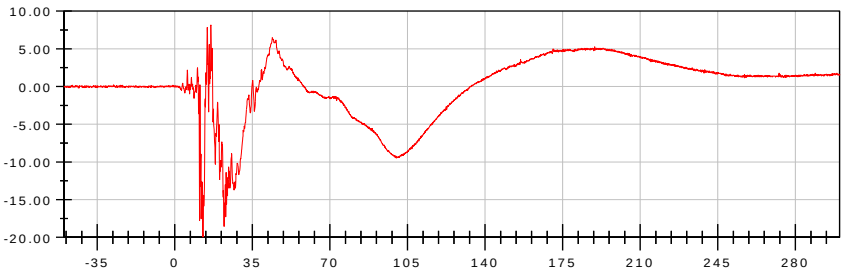
-7.99 g at 16.72 ms

CFC_1000

Dummy Head Acceleration Redundant Y (g) vs. Time [ms]



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8.16 g at 16.32 ms

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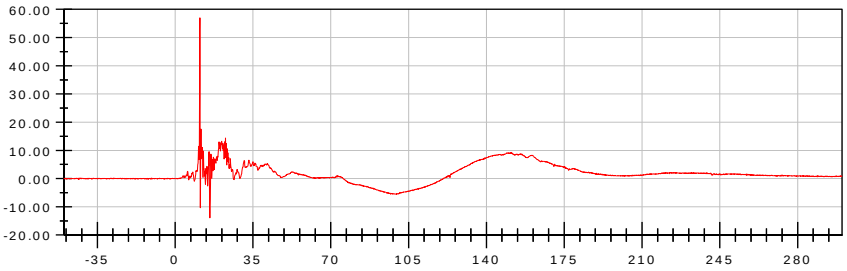
-19.97 g at 12.72 ms

CFC_1000

Dummy Head Acceleration Redundant Z (g) vs. Time [ms]



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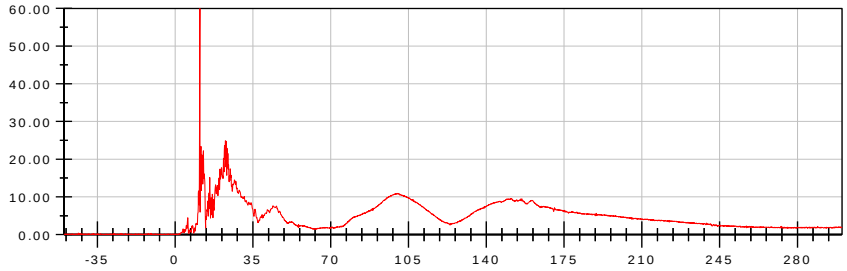
CFC_1000

Dummy Head Acceleration Redundant Resultant (g) vs. Time [ms]



<Max>

59.93 g at 11.12 ms

<Min>

0.04 g at -49.60 ms

CFC_1000

NHTSA

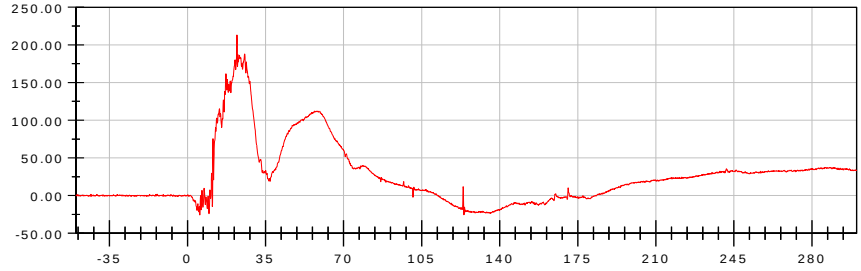
Test Date: 07/22/2020

Position #2 SID IIs Dummy (13S2)

Test Lab: CTF

Test Number: 200722 (M20204211TWG2)

Dummy Upper Neck Force X (N) vs. Time [ms]



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213.14 N at 22.16 ms

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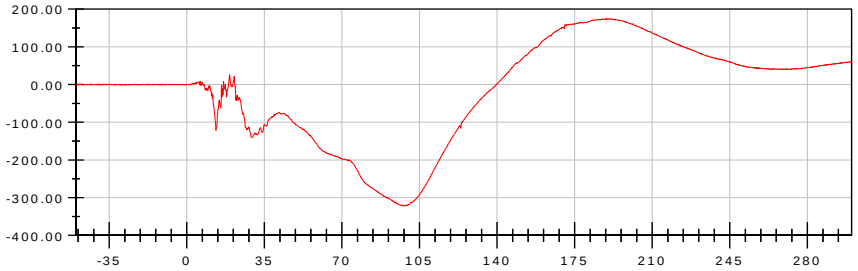
-25.69 N at 5.52 ms

CFC_1000

Dummy Upper Neck Force Y (N) vs. Time [ms]



<Max>

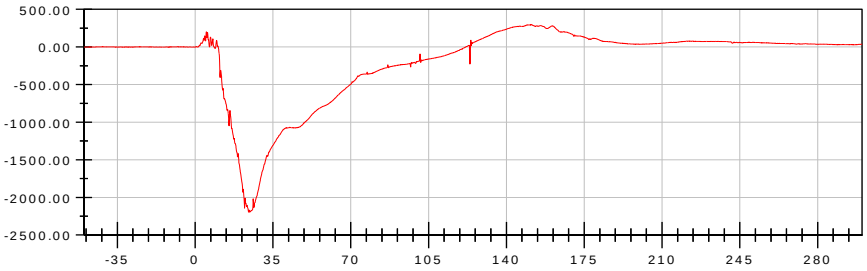
174.57 N at 189.04 ms

<Min>

-322.01 N at 96.88 ms

CFC_1000

Dummy Upper Neck Force Z (N) vs. Time [ms]



<Max>

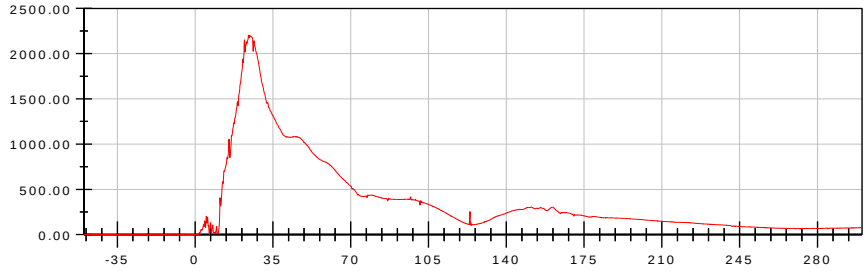
297.66 N at 151.36 ms

<Min>

-2,196.33 N at 24.56 ms

CFC_1000

Dummy Upper Neck Force Resultant (N) vs. Time [ms]



<Max>

2,203.76 N at 24.56 ms

<Min>

0.23 N at -47.60 ms

CFC_1000

NHTSA

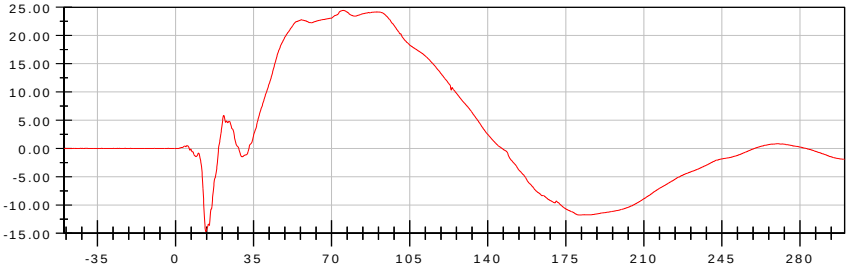
Test Date: 07/22/2020

Position #2 SID IIs Dummy (13S2)

Test Lab: CTF

Test Number: 200722 (M20204211TWG2)

Dummy Upper Neck Moment X (Nm) vs. Time [ms]



<Max>

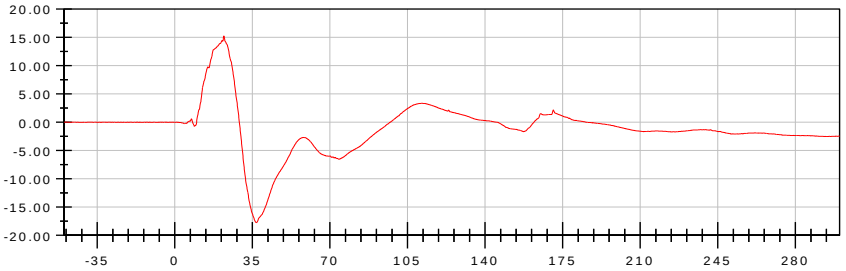
24.43 Nm at 75.20 ms

<Min>

-14.70 Nm at 13.60 ms

CFC_600

Dummy Upper Neck Moment Y (Nm) vs. Time [ms]



<Max>

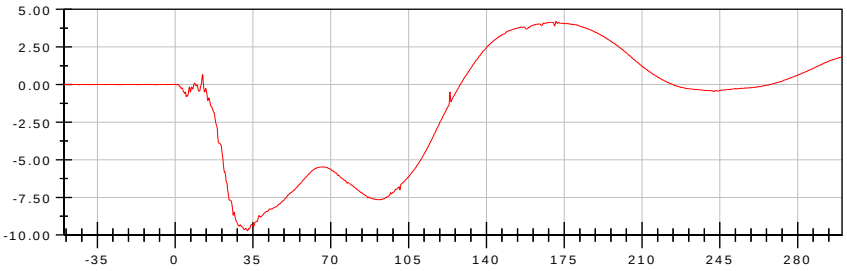
15.25 Nm at 22.16 ms

<Min>

-17.74 Nm at 36.88 ms

CFC_600

Dummy Upper Neck Moment Z (Nm) vs. Time [ms]



<Max>

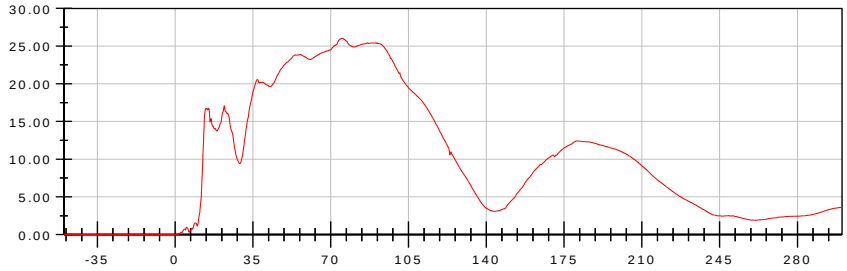
4.19 Nm at 171.36 ms

<Min>

-9.73 Nm at 32.56 ms

CFC_600

Dummy Upper Neck Moment Resultant (Nm) vs. Time [ms]



<Max>

26.01 Nm at 75.20 ms

<Min>

0.00 Nm at -32.32 ms

CFC_600

NHTSA

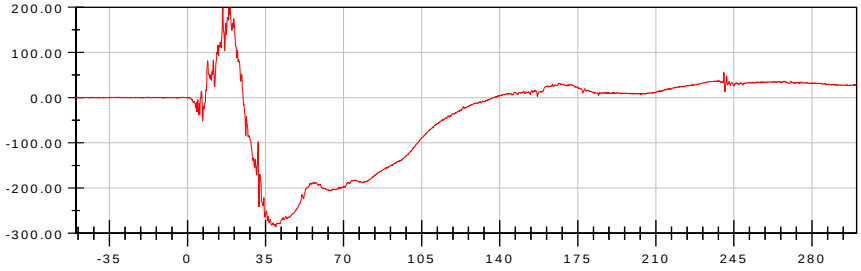
Test Date: 07/22/2020

Position #2 SID IIs Dummy (13S2)

Test Lab: CTF

Test Number: 200722 (M20204211TWG2)

Dummy Lower Neck Force X (N) vs. Time [ms]



<Max>

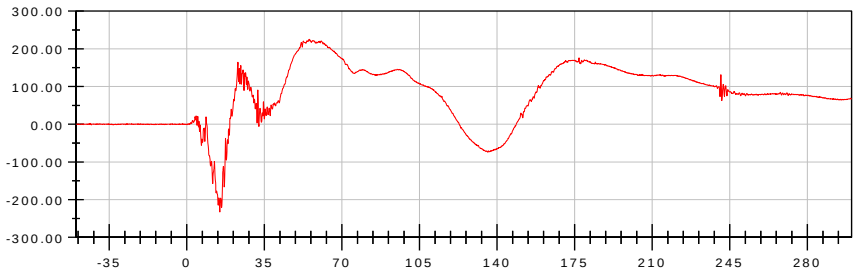
199.11 N at 19.04 ms

<Min>

-286.21 N at 39.60 ms

CFC_1000

Dummy Lower Neck Force Y (N) vs. Time [ms]



<Max>

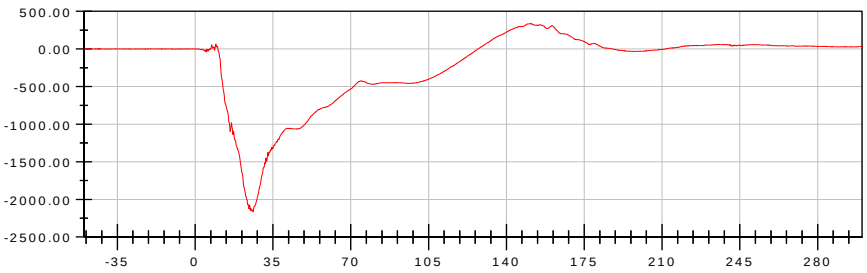
225.07 N at 55.20 ms

<Min>

-232.72 N at 14.88 ms

CFC_1000

Dummy Lower Neck Force Z (N) vs. Time [ms]



<Max>

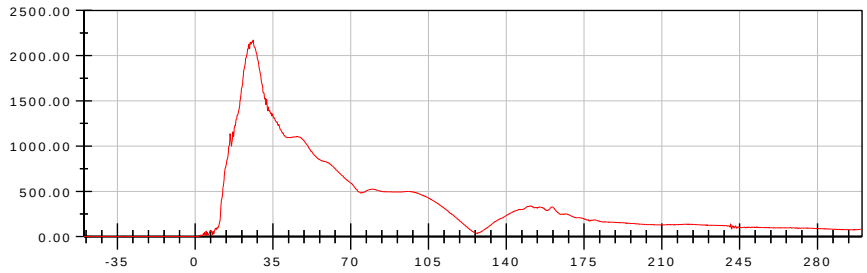
340.98 N at 151.04 ms

<Min>

-2,167.01 N at 26.08 ms

CFC_1000

Dummy Lower Neck Force Resultant (N) vs. Time [ms]



<Max>

2,172.34 N at 26.08 ms

<Min>

0.21 N at -47.68 ms

CFC_1000

NHTSA

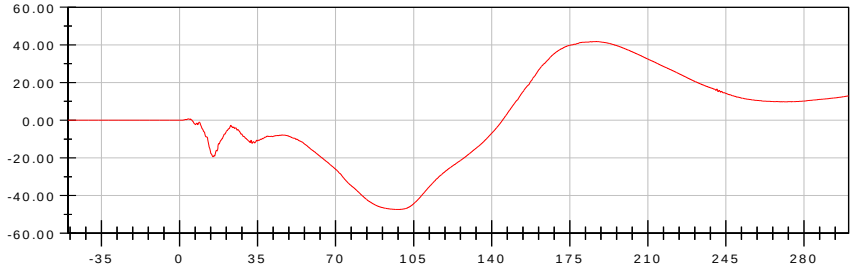
Test Date: 07/22/2020

Position #2 SID IIs Dummy (13S2)

Test Lab: CTF

Test Number: 200722 (M20204211TWG2)

Dummy Lower Neck Moment X (Nm) vs. Time [ms]



<Max>

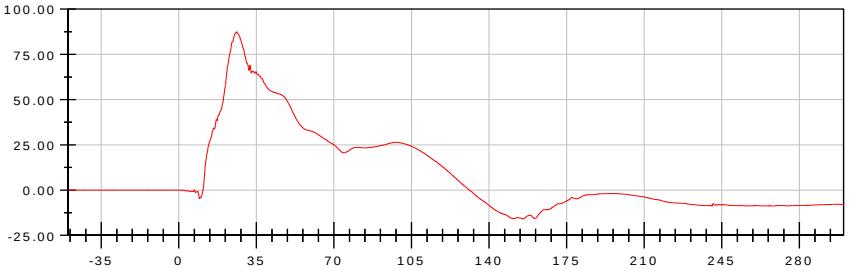
41.75 Nm at 186.88 ms

<Min>

-47.38 Nm at 97.84 ms

CFC_600

Dummy Lower Neck Moment Y (Nm) vs. Time [ms]



<Max>

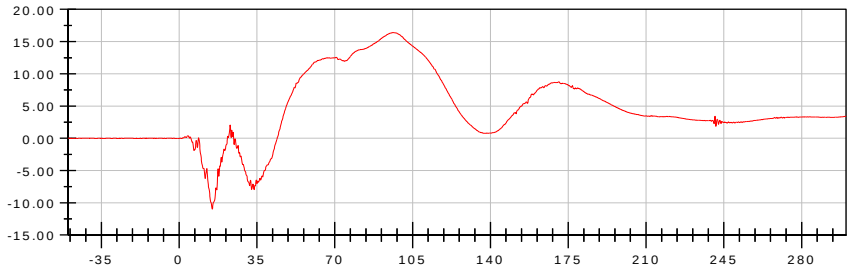
87.38 Nm at 26.08 ms

<Min>

-15.86 Nm at 155.44 ms

CFC_600

Dummy Lower Neck Moment Z (Nm) vs. Time [ms]



<Max>

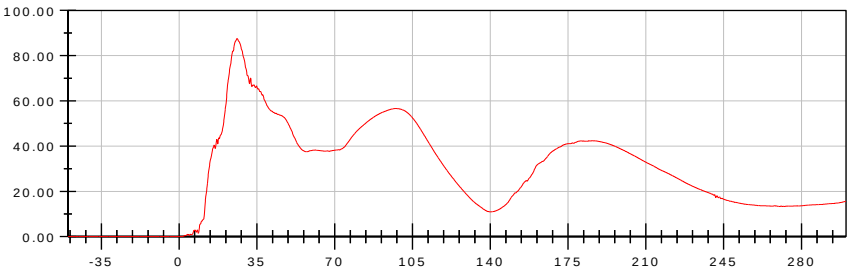
16.40 Nm at 96.08 ms

<Min>

-10.99 Nm at 14.88 ms

CFC_600

Dummy Lower Neck Moment Resultant (Nm) vs. Time [ms]



<Max>

87.53 Nm at 26.08 ms

<Min>

0.00 Nm at -12.96 ms

CFC_600

2020 Hyundai Venue SAB OOP Test 3.3.5.2

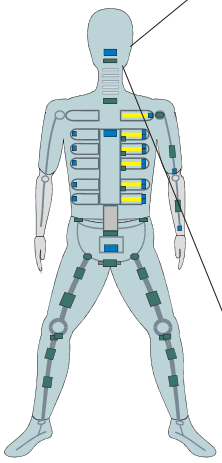
Neck Injury Predictor (NIJ)

Date: 07/22/2020
Time: 13:31

Customer: NHTSA

Test Number: M20204211TWG2

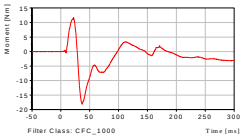
Test Orientation = Frontal
Fzc(Tension) = 3880
Fzc(Compression) = 3880
Myc(Extension) = 61
Myc(Flexion) = 155



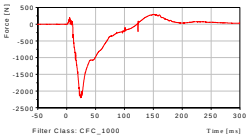
Dummy:SID IIs
Seating Position:
Right Front Passenger

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

13TMONUP00S2MOYX



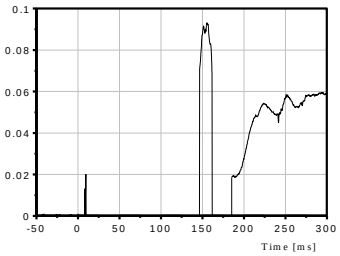
13NECKUP00S2FOZA



TRC Inc. Test Lab: CTF

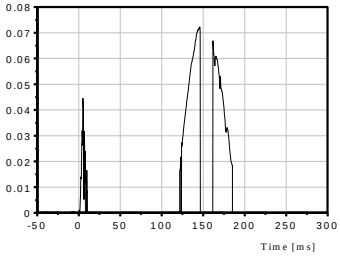
Test Number: 200722

13NIJCUPTES200YX



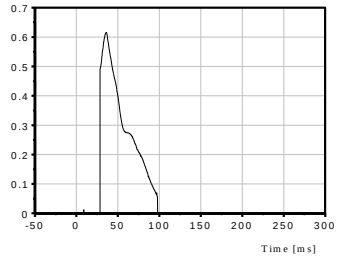
Max [NTE] 0.0932 at 155.44 ms

13NIJCUPTFS200YX



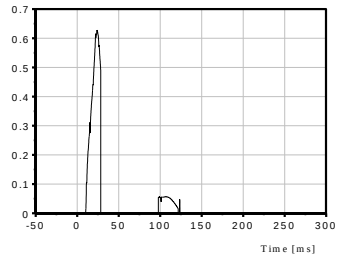
Max [NTF] 0.0724 at 145.92 ms

13NIJCUPCES200YX



Max [NCE] 0.6157 at 36.08 ms

13NIJCUPCFS200YX



Max [NCF] 0.6267 at 24.00 ms

NHTSA

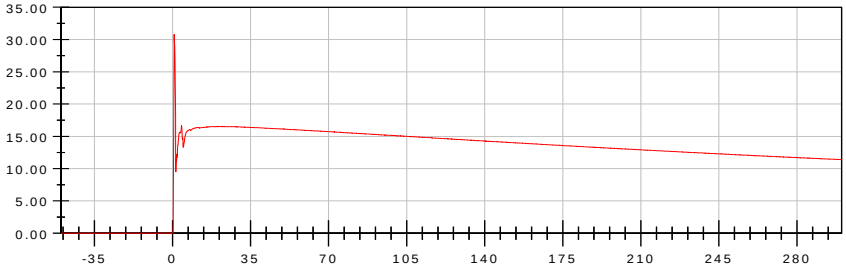
Test Date: 07/22/2020

Position #2 SID IIs Dummy (13S2)

Test Lab: CTF

Test Number: 200722 (M20204211TWG2)

Airbag Event Right Side Passenger Seat (V) vs. Time [ms]



<Max>

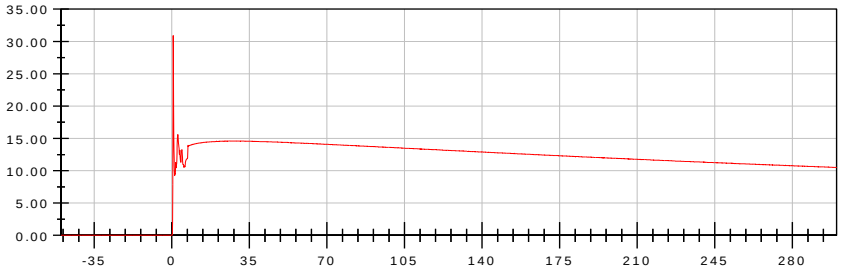
30.79 V at 0.72 ms

<Min>

0.00 V at -50.00 ms

Unfiltered

Airbag Event Right Side Passenger Curtain (V) vs. Time [ms]



<Max>

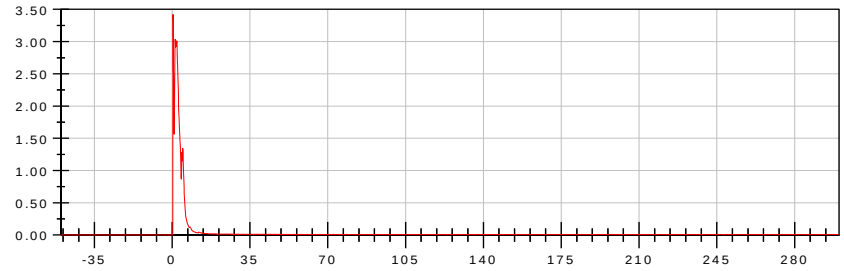
30.90 V at 0.64 ms

<Min>

0.00 V at -50.00 ms

Unfiltered

Airbag Event Right Side Passenger Seat (A) vs. Time [ms]



<Max>

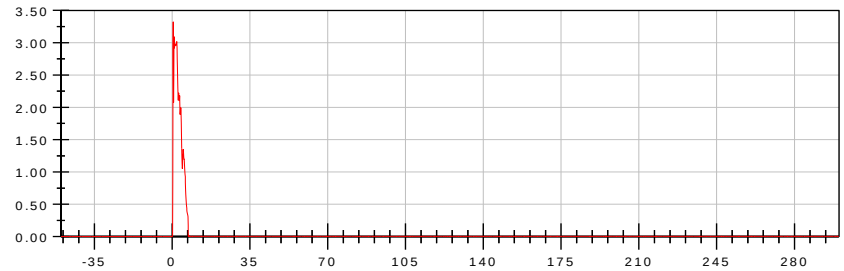
3.42 A at 0.40 ms

<Min>

0.00 A at -50.00 ms

Unfiltered

Airbag Event Right Side Passenger Curtain (A) vs. Time [ms]



<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	DI8818	FTSS	20-Jul-2020	
Head Accelerometers	Primary	X	P97682	Endevco	15-Jul-2020	14-Jan-2021
		Y	P97834	Endevco	14-Jul-2020	13-Jan-2021
		Z	P97883	Endevco	14-Jul-2020	13-Jan-2021
	Redundant	X	P97692	Endevco	14-Jul-2020	14-Jan-2021
		Y	P97543	Endevco	14-Jul-2020	13-Jan-2021
		Z	P97848	Endevco	14-Jul-2020	13-Jan-2021
Upper Neck Load Cell		Fx, Fy, Fz, Mx, My, Mz	DK7373S	FTSS	14-Jul-2020	14-Jul-2021
Lower Neck Load Cell		Fx, Fy, Fz, Mx, My, Mz	130	Denton	19-Feb-2020	18-Feb-2021
Chest Potentiometer		Dx				
Sternum Accelerometer		X				
Spine Accelerometer		X				
Data System		N/A	223	Kayser-Threde	22-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 DI8818

Transportation Research Center Inc.

Right Lateral Head Drop
SID IIs Serial No. DI8818 Certification No. 28-1
Test Date: 7/15/2020

Test Parameter	Specification	Test Results	Pass
Temperature	18.9 - 25.6 °C	20.8 °C	Yes
Relative Humidity	10 - 70 %	59 %	Yes
Peak Head Resultant Acceleration	115 - 137 g	124.8 g	Yes
Peak Head Longitudinal Acceleration	(-15) - 15 g	-4.6 g	Yes
Is Head Resultant Acceleration Curve Unimodal within 15% of Peak?	< 15 %	1.16 %	Yes

Test meets specifications.

Condition: Used

Comments:
Head Skin S/N: DI6457

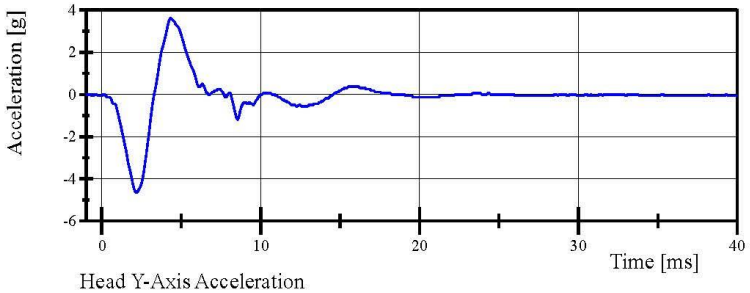
Specification Source: CFR49 Part 572 Subpart V with Polarity in accordance with J211

07.15.2020 13:48:08 200

Transportation Research Center Inc.

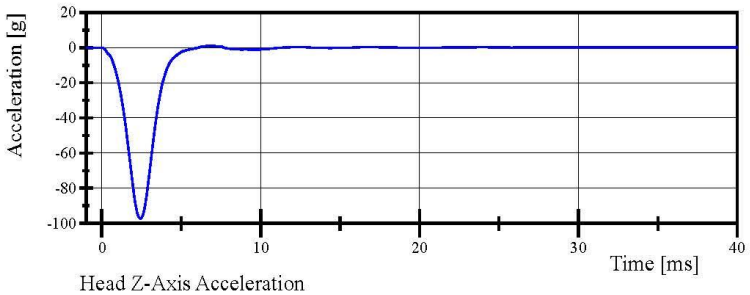
Right Lateral Head Drop
SID IIs Serial No. DI8818 Certification No. 28-1
Test Date: 7/15/2020

Head X-Axis Acceleration



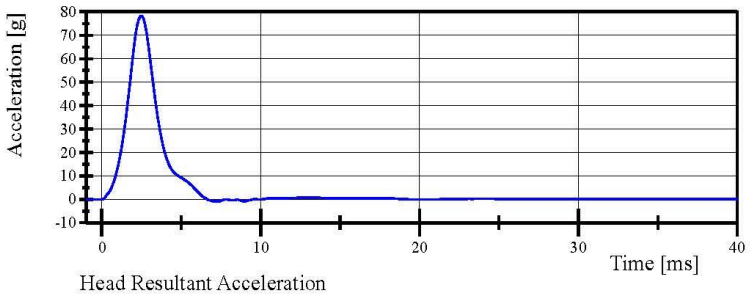
Filter Class: CFC_1000
Max: 3.6 g at 4.3 ms
Min: -4.6 g at 2.2 ms

Head Y-Axis Acceleration



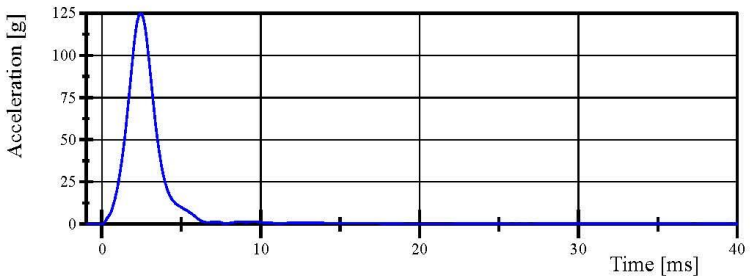
Filter Class: CFC_1000
Max: 1.0 g at 6.6 ms
Min: -97.2 g at 2.4 ms

Head Z-Axis Acceleration



Filter Class: CFC_1000
Max: 78.4 g at 2.5 ms
Min: -0.9 g at 7.2 ms

Head Resultant Acceleration



Filter Class: CFC_1000
Max: 124.8 g at 2.5 ms
Min: 0.0 g at -1.0 ms

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

07.15.2020 13:49:02 200

Transportation Research Center Inc.

Right Lateral Neck
SID IIs Serial No. DI8818 Certification No. 28-3
Test Date: 7/16/2020

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	20.8 °C	Yes
Relative Humidity	10 - 70 %	60 %	Yes
Pendulum Velocity	5.51 - 5.63 m/s	5.581 m/s	Yes
Pendulum Integrated Velocity Change at 10 ms	(-2.20) - (-2.80) m/s	-2.272 m/s	Yes
Change at 15 ms	(-3.30) - (-4.10) m/s	-3.362 m/s	Yes
Change at 20 ms	(-4.40) - (-5.40) m/s	-4.545 m/s	Yes
Change at 25 ms	(-5.40) - (-6.10) m/s	-5.595 m/s	Yes
Change at 25 to 100 ms	(-5.50) - (-6.20) m/s	-5.872 m/s	Yes
Maximum Headform Flexion occurring between 50ms and 70ms.			
Peak	71 - 81 deg	75.8 deg	Yes
Time of Peak	50 - 70 ms	65.0 ms	Yes
Total Neck Occipital Condyles Moment	(-36) - (-44) N·m	-40.4 N·m	Yes
Total Neck Occipital Condyles Moment Decay Time to 0 N·m	102 - 126 ms	123.4 ms	Yes

Test meets specifications.

Condition: Used

Comments:
Neck S/N: DJ1259

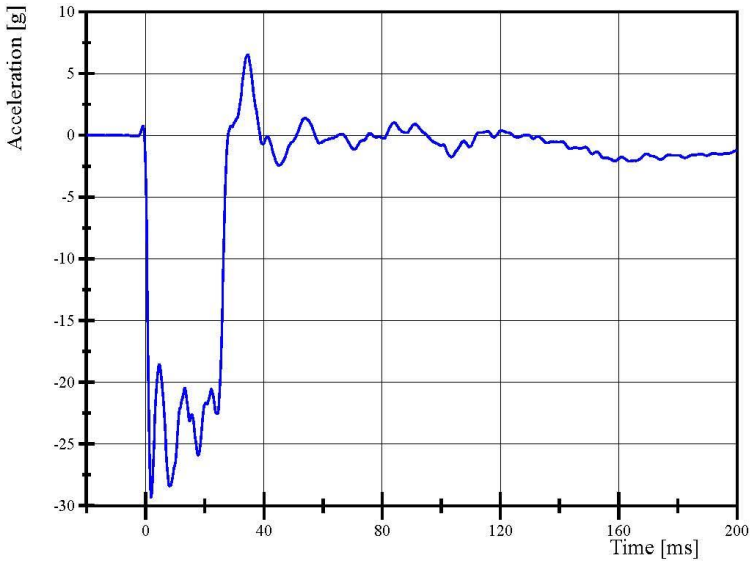
Specification Source: CFR49 Part 572 Subpart V with Polarity in accordance with J211

07.16.2020 07:35:39 721

Transportation Research Center Inc.

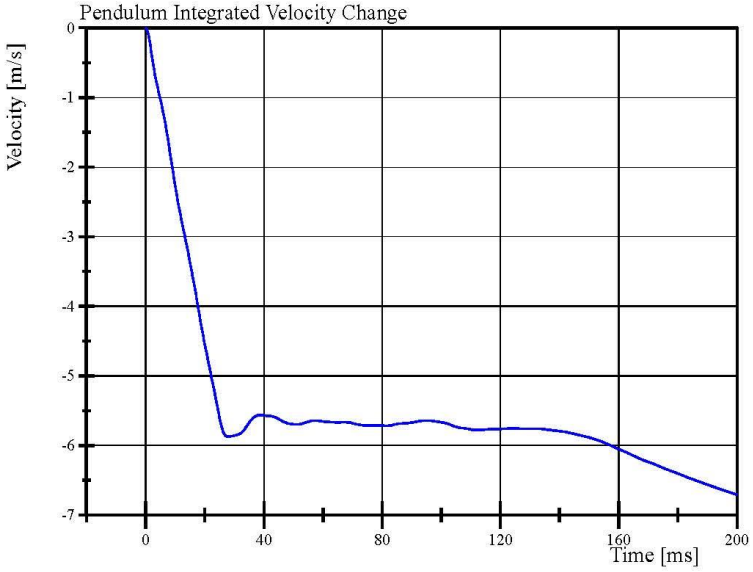
Right Lateral Neck
SID IIs Serial No. DI8818 Certification No. 28-3
Test Date: 7/16/2020

Pendulum Acceleration



Filter Class: CFC_180
Max: 6.5 g at 34.6 ms
Min: -29.3 g at 1.9 ms

Pendulum Integrated Velocity Change



Filter Class: CFC_180
Max: 0.0 m/s at 0.0 ms
Min: -6.7 m/s at 200.0 ms

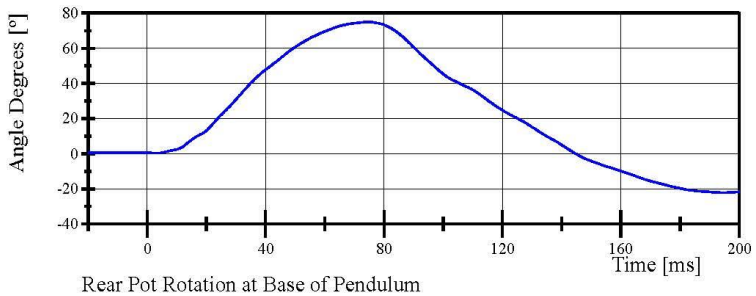
Specification Source: CFR49 Part 572 Subpart V
with Polarity in accordance with J211

07.16.2020 07:36:42 721

Transportation Research Center Inc.

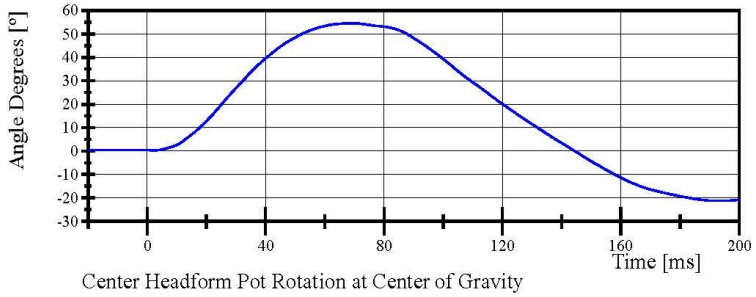
Right Lateral Neck
SID IIs Serial No. DI8818 Certification No. 28-3
Test Date: 7/16/2020

Forward Pot Rotation at Base of Pendulum



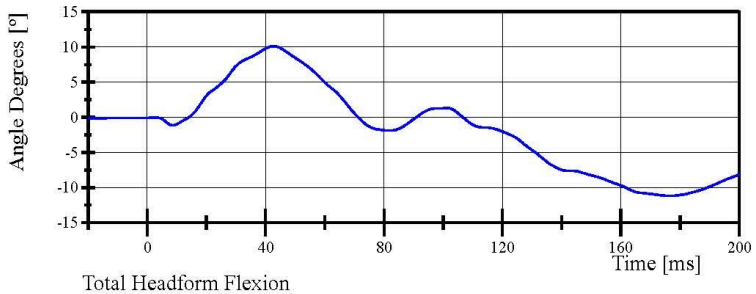
Filter Class: CFC_60
Max: 74.9 ° at 74.7 ms
Min: -22.2 ° at 194.6 ms

Rear Pot Rotation at Base of Pendulum



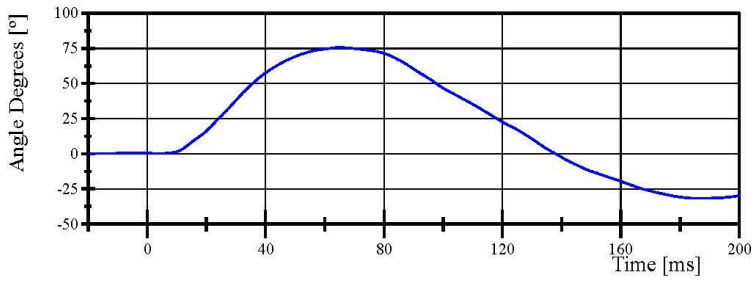
Filter Class: CFC_60
Max: 54.5 ° at 69.5 ms
Min: -21.2 ° at 193.3 ms

Center Headform Pot Rotation at Center of Gravity



Filter Class: CFC_60
Max: 10.1 ° at 42.7 ms
Min: -11.2 ° at 176.8 ms

Total Headform Flexion



Filter Class: CFC_60
Max: 75.8 ° at 65.0 ms
Min: -31.7 ° at 185.9 ms

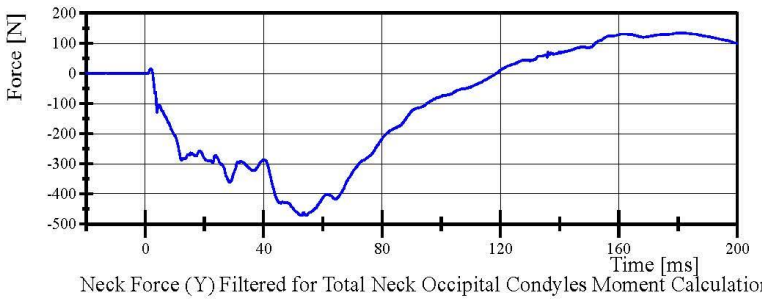
Specification Source: CFR49 Part 572 Subpart V
with Polarity in accordance with J211

07.16.2020 07:36:42 721

Transportation Research Center Inc.

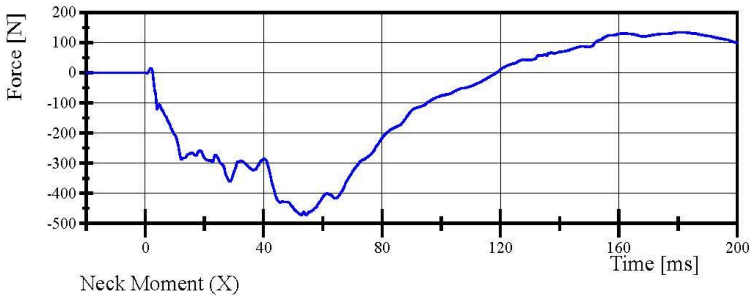
Right Lateral Neck
SID IIs Serial No. DI8818 Certification No. 28-3
Test Date: 7/16/2020

Neck Force (Y)



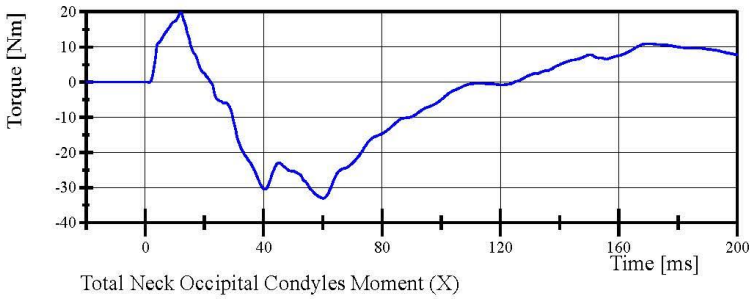
Filter Class: CFC_1000
Max: 134.3 N at 179.6 ms
Min: -472.0 N at 53.0 ms

Neck Force (Y) Filtered for Total Neck Occipital Condyles Moment Calculation



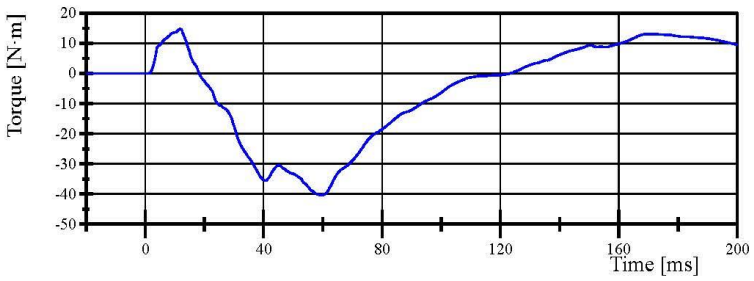
Filter Class: CFC_600
Max: 134.1 N at 180.2 ms
Min: -471.9 N at 52.8 ms

Neck Moment (X)



Filter Class: CFC_600
Max: 19.8 Nm at 12.0 ms
Min: -33.0 Nm at 60.1 ms

Total Neck Occipital Condyles Moment (X)



Filter Class: Without_(Constar
Max: 14.8 N·m at 11.8 ms
Min: -40.4 N·m at 59.6 ms

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

07.16.2020 07:36:42 721

Transportation Research Center Inc.

Right Lateral Shoulder
SID IIs Serial No. DI8818 Certification No. 28-1
Test Date: 7/17/2020

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	21.1 °C	Yes
Relative Humidity	10 - 70 %	59 %	Yes
Impactor Velocity	4.2 - 4.4 m/s	4.27 m/s	Yes
Impactor Acceleration	(-13) - (-18) g	-14.5 g	Yes
Shoulder Displacement	(-28) - (-37) mm	-30.6 mm	Yes
Upper Spine Lateral Acceleration	(-17) - (-22) g	-19.5 g	Yes

Test meets specifications.

Condition: Used

Comments:
Arm S/N: Ab8902
Shoulder Rib S/N: DI7875

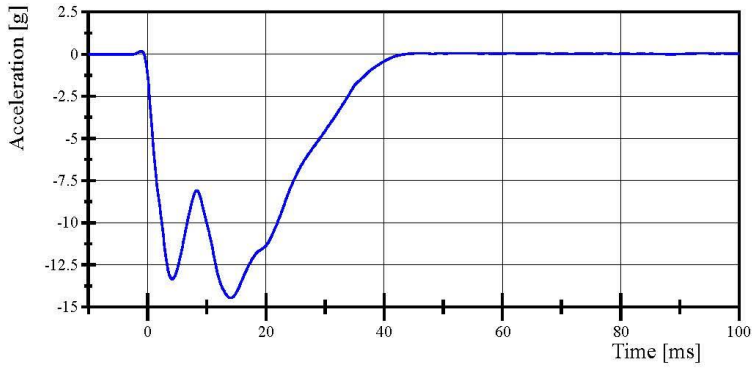
Specification Source: CFR49 Part 572 Subpart V
with Polarity in accordance with J211

07.17.2020 11:16:29 862

Transportation Research Center Inc.

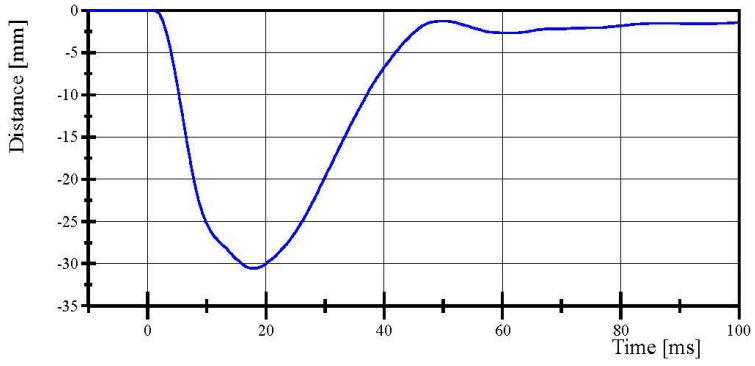
Right Lateral Shoulder
SID IIs Serial No. DI8818 Certification No. 28-1
Test Date: 7/17/2020

Probe Acceleration



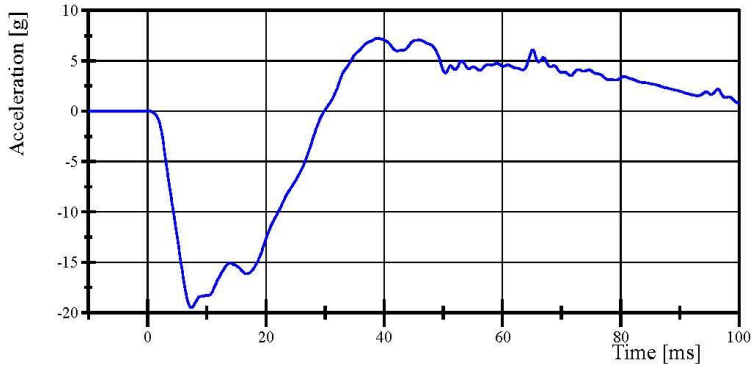
Filter Class: CFC_180
Max: 0.2 g at -1.0 ms
Min: -14.5 g at 14.1 ms

Shoulder Displacement



Filter Class: CFC_600
Max: 0.0 mm at 0.8 ms
Min: -30.6 mm at 18.1 ms

Upper Spine Acceleration (Y)



Filter Class: CFC_180
Max: 7.2 g at 38.9 ms
Min: -19.5 g at 7.4 ms

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

07.17.2020 11:18:38 862

Transportation Research Center Inc.

Right Lateral Thorax with Arm
SID IIs Serial No. DI8818 Certification No. 28-2
Test Date: 7/17/2020

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	21.3 °C	Yes
Relative Humidity	10 - 70 %	58 %	Yes
Impactor Velocity	6.60 - 6.80 m/s	6.706 m/s	Yes
Impactor Acceleration	(-30) - (-36) g	-33.2 g	Yes
Shoulder Displacement	(-31) - (-40) mm	-38.0 mm	Yes
Upper Thorax Rib Displacement	(-25) - (-32) mm	-29.7 mm	Yes
Center Thorax Rib Displacement	(-30) - (-36) mm	-31.7 mm	Yes
Lower Thorax Rib Displacement	(-32) - (-38) mm	-33.3 mm	Yes
Upper Spine Lateral Acceleration	(-34) - (-43) g	-35.5 g	Yes
Lower Spine Lateral Acceleration	(-29) - (-37) g	-34.3 g	Yes

Test meets specifications.

Condition: Used

Comments:
Arm S/N: AB8902
Shoulder Rib S/N: DI7875
Upper Thorax Rib S/N: DJ6449
Middle Thorax Rib S/N: DJ6449
Lower Thorax Rib S/N: DJ6449

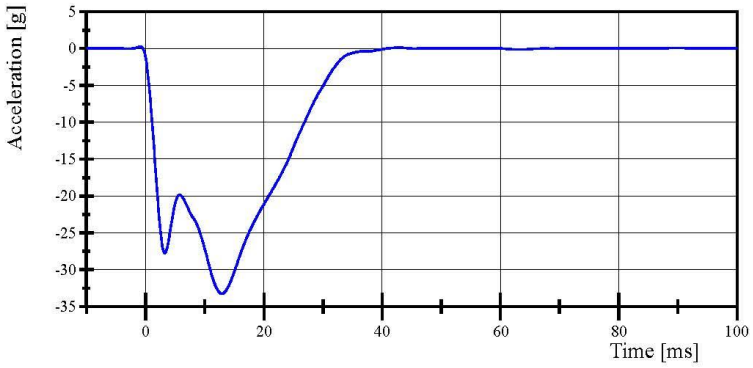
Specification Source: CFR49 Part 572 Subpart V
with Polarity in accordance with J211

07.17.2020 13:42:58 589

Transportation Research Center Inc.

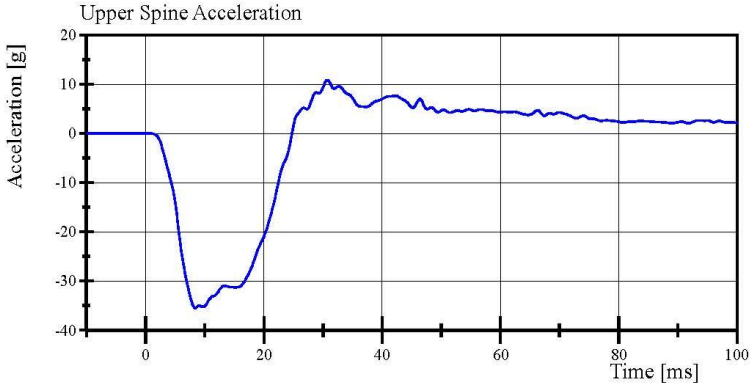
Right Lateral Thorax with Arm
SID IIs Serial No. DI8818 Certification No. 28-2
Test Date: 7/17/2020

Probe Acceleration



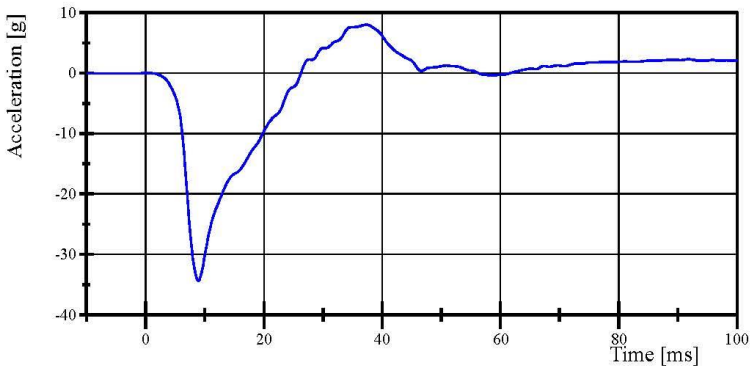
Filter Class: CFC_180
Max: 0.3 g at -0.9 ms
Min: -33.2 g at 12.9 ms

Upper Spine Acceleration



Filter Class: CFC_180
Max: 10.9 g at 30.7 ms
Min: -35.5 g at 8.4 ms

Lower Spine Acceleration



Filter Class: CFC_180
Max: 8.0 g at 37.3 ms
Min: -34.3 g at 8.9 ms

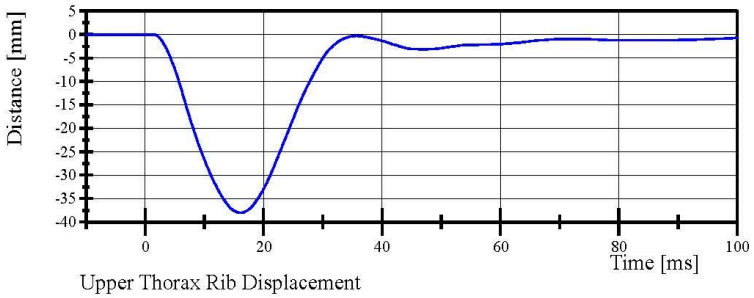
Specification Source: CFR49 Part 572 Subpart V
with Polarity in accordance with J211

07.17.2020 13:44:34 589

Transportation Research Center Inc.

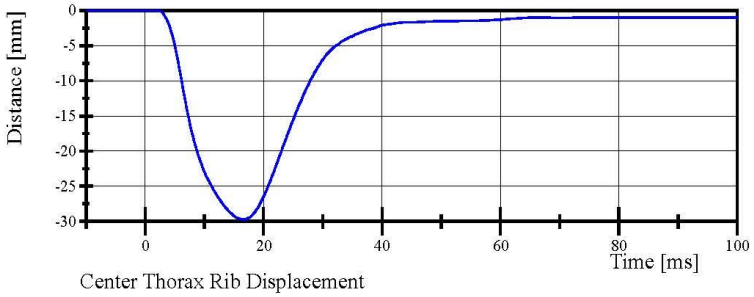
Right Lateral Thorax with Arm
SID IIs Serial No. DI8818 Certification No. 28-2
Test Date: 7/17/2020

Shoulder Rib Displacement



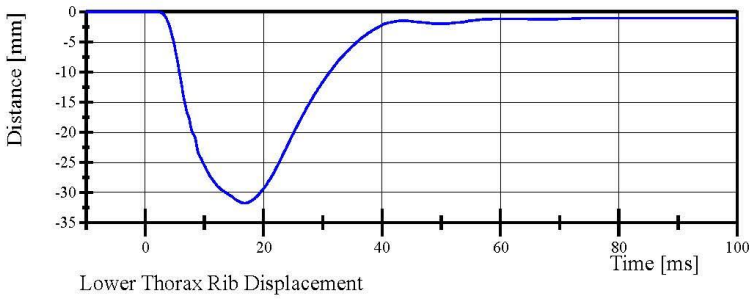
Filter Class: CFC_600
Max: 0.0 mm at 1.4 ms
Min: -38.0 mm at 16.2 ms

Upper Thorax Rib Displacement



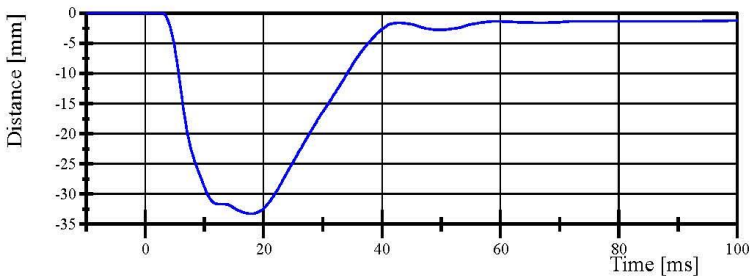
Filter Class: CFC_600
Max: 0.0 mm at 1.7 ms
Min: -29.7 mm at 16.6 ms

Center Thorax Rib Displacement



Filter Class: CFC_600
Max: 0.0 mm at 1.9 ms
Min: -31.7 mm at 16.7 ms

Lower Thorax Rib Displacement



Filter Class: CFC_600
Max: 0.0 mm at 1.7 ms
Min: -33.3 mm at 18.0 ms

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

07.17.2020 13:44:34 589

Transportation Research Center Inc.

Right Lateral Thorax without Arm
SID IIs Serial No. DI8818 Certification No. 28-2
Test Date: 7/17/2020

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	20.8 °C	Yes
Relative Humidity	10 - 70 %	58 %	Yes
Impactor Velocity	4.20 - 4.40 m/s	4.325 m/s	Yes
Impactor Acceleration	(-14) - (-18) g	-15.3 g	Yes
Upper Thorax Rib Displacement	(-32) - (-40) mm	-37.4 mm	Yes
Center Thorax Rib Displacement	(-39) - (-45) mm	-41.5 mm	Yes
Lower Thorax Rib Displacement	(-35) - (-43) mm	-39.0 mm	Yes
Upper Spine Lateral Acceleration	(-13) - (-17) g	-14.3 g	Yes
Lower Spine Lateral Acceleration	(-7) - (-11) g	-8.9 g	Yes

Test meets specifications.

Condition: Used

Comments:
Upper Thorax Rib S/N: DJ6449
Middle Thorax Rib S/N: DJ6449
Lower Thorax Rib S/N: DJ6449

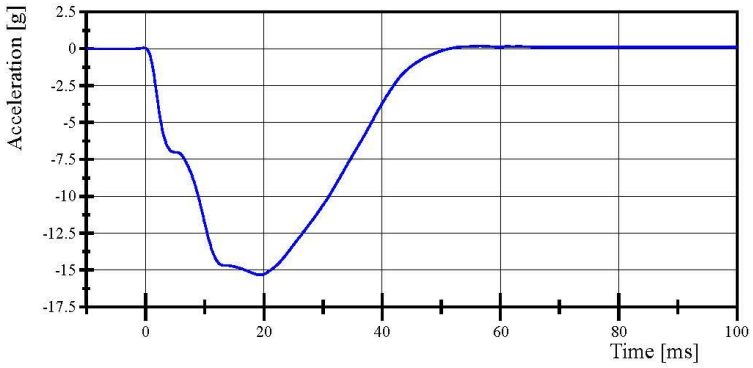
Specification Source: CFR49 Part 572 Subpart V
with Polarity in accordance with J211

07.17.2020 14:17:24 806

Transportation Research Center Inc.

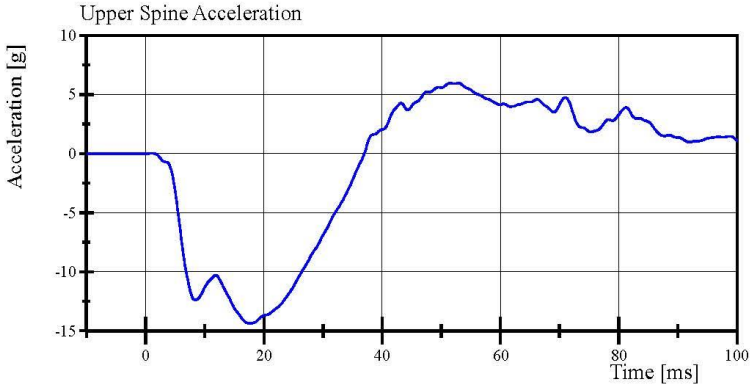
Right Lateral Thorax without Arm
SID IIs Serial No. DI8818 Certification No. 28-2
Test Date: 7/17/2020

Probe Acceleration



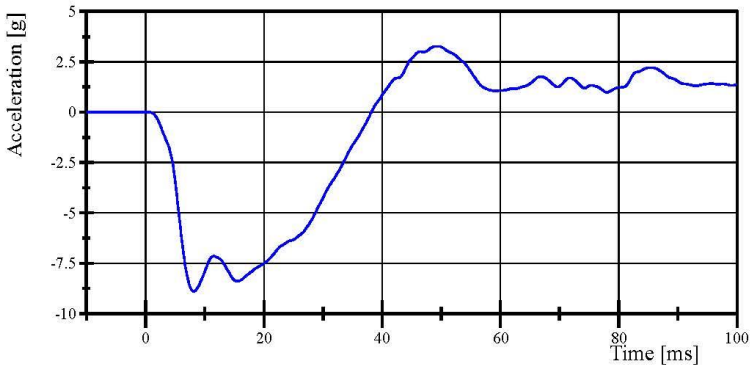
Filter Class: CFC_180
Max: 0.2 g at 56.6 ms
Min: -15.3 g at 19.4 ms

Upper Spine Acceleration



Filter Class: CFC_180
Max: 6.0 g at 51.4 ms
Min: -14.3 g at 17.4 ms

Lower Spine Acceleration



Filter Class: CFC_180
Max: 3.3 g at 49.1 ms
Min: -8.9 g at 8.1 ms

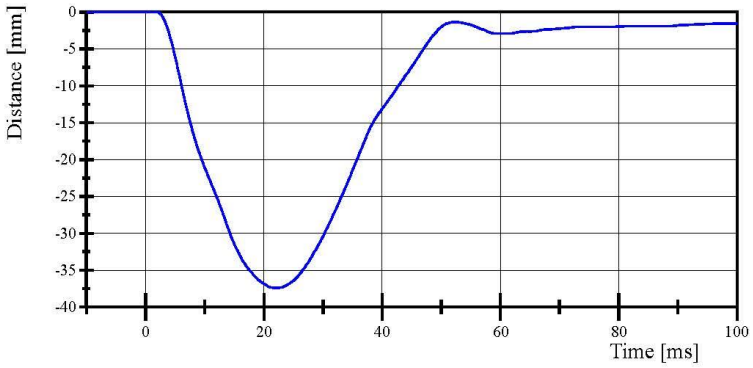
Specification Source: CFR49 Part 572 Subpart V
with Polarity in accordance with J211

07.17.2020 14:18:03 806

Transportation Research Center Inc.

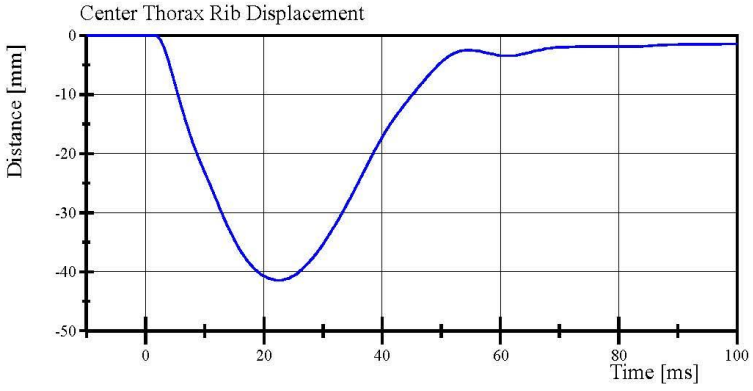
Right Lateral Thorax without Arm
SID IIs Serial No. DI8818 Certification No. 28-2
Test Date: 7/17/2020

Upper Thorax Rib Displacement



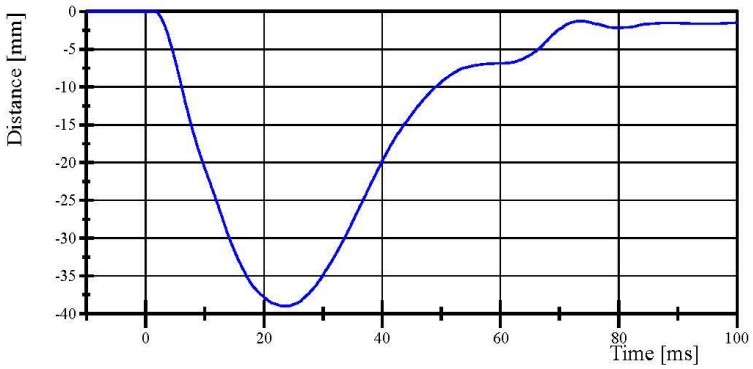
Filter Class: CFC_600
Max: 0.0 mm at 1.8 ms
Min: -37.4 mm at 22.2 ms

Center Thorax Rib Displacement



Filter Class: CFC_600
Max: 0.0 mm at 1.4 ms
Min: -41.5 mm at 22.5 ms

Lower Thorax Rib Displacement



Filter Class: CFC_600
Max: 0.0 mm at -4.5 ms
Min: -39.0 mm at 23.9 ms

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

07.17.2020 14:18:04 806

Transportation Research Center Inc.

Right Lateral Abdomen
SID IIs Serial No. DI8818 Certification No. 28-1
Test Date: 7/17/2020

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	21.0 °C	Yes
Relative Humidity	10 - 70 %	61 %	Yes
Impactor Velocity	4.2 - 4.4 m/s	4.27 m/s	Yes
Impactor Acceleration	(-12) - (-16) g	-14.3 g	Yes
Upper Abdominal Rib Displacement	(-36) - (-47) mm	-38.7 mm	Yes
Lower Abdominal Rib Displacement	(-33) - (-44) mm	-38.4 mm	Yes
Lower Spine Lateral Acceleration	(-9) - (-14) g	-10.8 g	Yes

Test meets specifications.

Condition: Used

Comments:
Upper Abdominal Rib S/N: DJ6449
Lower Abdominal Rib S/N: DJ6449

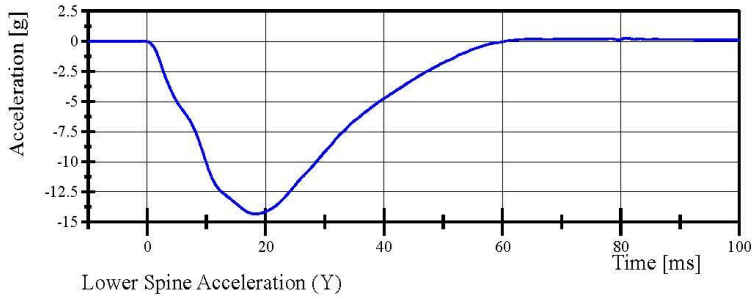
Specification Source: CFR49 Part 572 Subpart V
with Polarity in accordance with J211

07.17.2020 11:36:30 689

Transportation Research Center Inc.

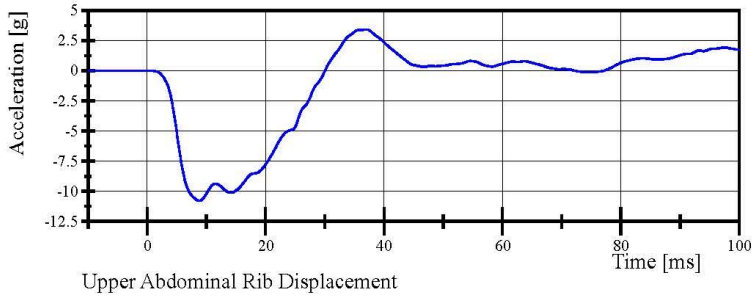
Right Lateral Abdomen
SID IIs Serial No. DI8818 Certification No. 28-1
Test Date: 7/17/2020

Probe Acceleration



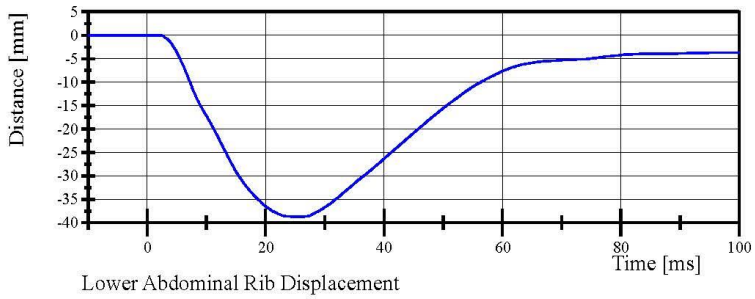
Filter Class: CFC_180
Max: 0.3 g at 80.9 ms
Min: -14.3 g at 18.3 ms

Lower Spine Acceleration (Y)



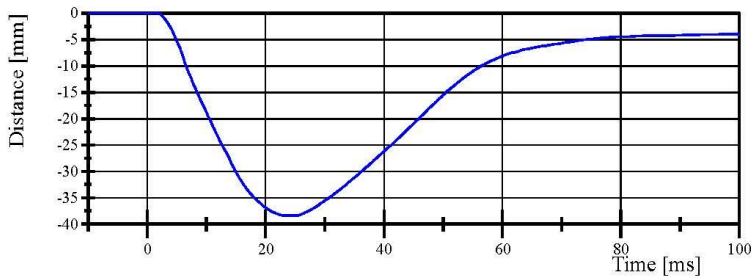
Filter Class: CFC_180
Max: 3.4 g at 37.0 ms
Min: -10.8 g at 8.8 ms

Upper Abdominal Rib Displacement



Filter Class: CFC_600
Max: 0.0 mm at 2.2 ms
Min: -38.7 mm at 24.6 ms

Lower Abdominal Rib Displacement



Filter Class: CFC_600
Max: 0.0 mm at 1.4 ms
Min: -38.4 mm at 23.9 ms

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

07.17.2020 11:38:18 689

Transportation Research Center Inc.

Right Lateral Iliac
SID IIs Serial No. DI8818 Certification No. 28-2
Test Date: 7/20/2020

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	20.8 °C	Yes
Relative Humidity	10 - 70 %	60 %	Yes
Pendulum Velocity	4.2 - 4.4 m/s	4.39 m/s	Yes
Impactor Acceleration	(-36) - (-45) g	-41.5 g	Yes
Peak Pelvis Lateral Acceleration	(-28) - (-39) g	-31.1 g	Yes
Iliac Force	(-4,100) - (-5,100) N	-4,606.4 N	Yes

Test meets specifications.

Condition: Used

Comments:
Pelvis Skin S/N: EN1150

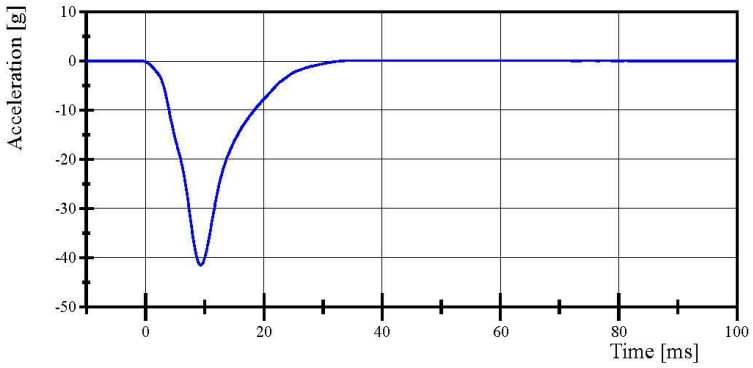
Specification Source: CFR49 Part 572 Subpart V
with Polarity in accordance with J211

07.20.2020 11:02:51 683

Transportation Research Center Inc.

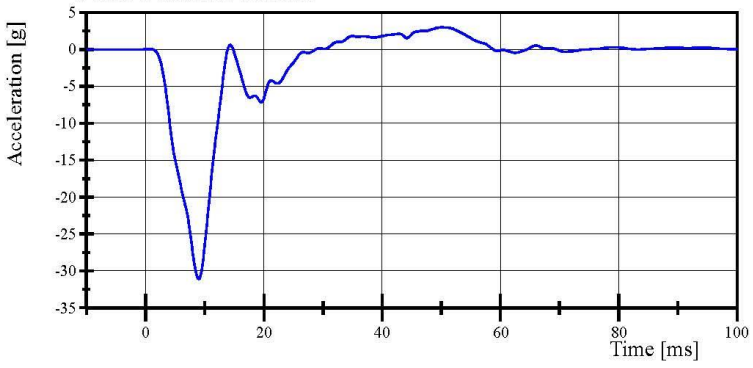
Right Lateral Iliac
SID IIs Serial No. DI8818 Certification No. 28-2
Test Date: 7/20/2020

Probe Acceleration



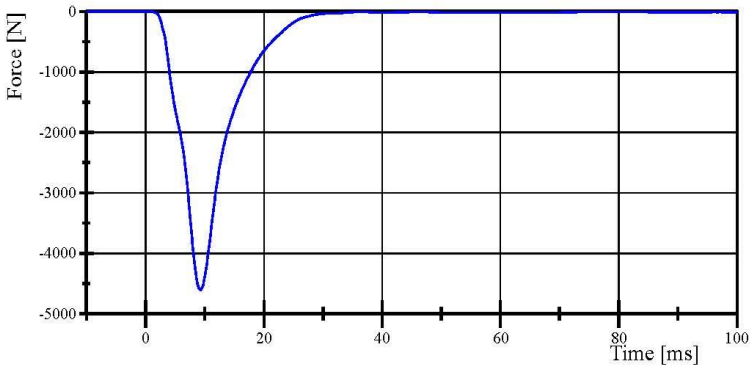
Filter Class: CFC_180
Max: 0.2 g at 55.5 ms
Min: -41.5 g at 9.3 ms

Pelvis Y-Axis Acceleration



Filter Class: CFC_180
Max: 3.0 g at 50.1 ms
Min: -31.1 g at 9.0 ms

Iliac Y-Axis Force



Filter Class: CFC_600
Max: 0.6 N at -5.4 ms
Min: -4,606.4 N at 9.3 ms

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

07.20.2020 11:03:23 683

Transportation Research Center Inc.

Right Lateral Pelvis
SID IIs Serial No. DI8818 Certification No. 28-2
Test Date: 7/20/2020

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	20.8 °C	Yes
Relative Humidity	10 - 70 %	61 %	Yes
Pendulum Velocity	6.6 - 6.8 m/s	6.63 m/s	Yes
Impactor Acceleration	(-38.0) - (-47.0) g	-45.82 g	Yes
Peak Pelvis Lateral Acceleration after 6ms	(-34) - (-42) g	-40.2 g	Yes
Acetabulum Force	(-3,600) - (-4,300) N	-4,238.8 N	Yes

Test meets specifications.

Condition: Used

Comments:
Pelvis Skin S/N: EN1150
Pelvis Plug Info:
Manufacturer: SACO
S/N: 13219
Cal Date: 20190808

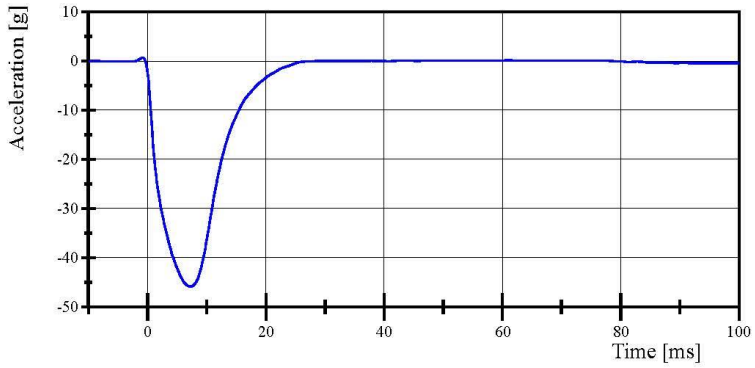
Specification Source: CFR49 Part 572 Subpart V
with Polarity in accordance with J211

07.20.2020 14:02:34 402

Transportation Research Center Inc.

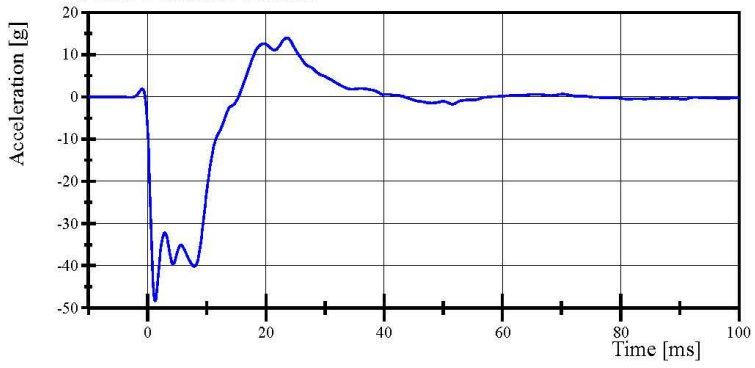
Right Lateral Pelvis
SID IIs Serial No. DI8818 Certification No. 28-2
Test Date: 7/20/2020

Probe Acceleration



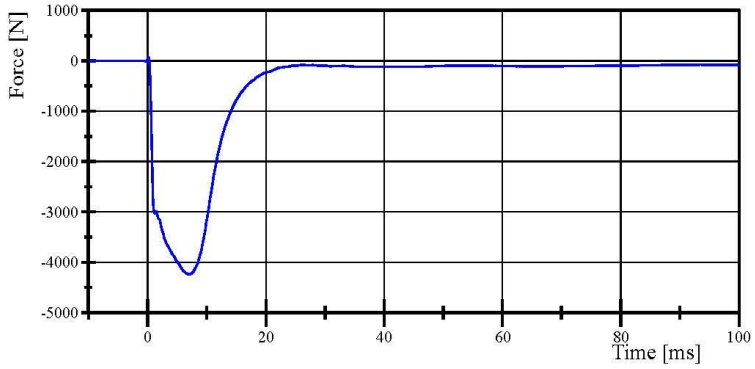
Filter Class: CFC_180
Max: 0.7 g at -0.9 ms
Min: -45.8 g at 7.3 ms

Pelvis Y-Axis Acceleration



Filter Class: CFC_180
Max: 14.0 g at 23.5 ms
Min: -48.4 g at 1.3 ms

Acetabulum Y-Axis Force



Filter Class: CFC_600
Max: 63.1 N at 0.2 ms
Min: -4,238.8 N at 7.0 ms

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

07.20.2020 14:04:30 402