REPORT NUMBER: TWG-KAR-19-003

SIDE AIRBAG OCCUPANT RISK PROGRAM
OCCUPANT OUT-OF-POSITION TESTS

HYUNDAI MOTOR COMPANY

2019 HYUNDAI KONA SE 5-DOOR MPV

NHTSA NUMBER: M20194202TWG2

PREPARED BY:

APPLUS+ IDIADA KARCO ENGINEERING, LLC.

9270 HOLLY ROAD

ADELANTO, CA 92301

AUGUST 12, 2019

FINAL REPORT

PREPARED FOR:

ALPHA TECHNOLOGY ASSOCIATE, INC

2810 OLD LEE HWY, SUITE 120

FAIRFAX, VA 22031

This final test report was prepared for the U.S. Department of Transportation, Alpha Technology Associate, Inc., in response to Contract Number DTNH22-13-D-00311L.

Prepared By: Bruno Haesbaert

Mr. Bruno R. Haesbaert, Project Engineer
Applus+ IDIADA KARCO Engineering, LLC.

Reviewed By:

Mr. Andrew J. Espindola, Quality Assurance Manager
Applus+ IDIADA KARCO Engineering, LLC.

Mr. Michael L. Dunlap, Director of Operations
Applus+ IDIADA KARCO Engineering, LLC.

Approved By:

Mr. Steven D. Matsusaka, Engineering Manager
Applus+ IDIADA KARCO Engineering, LLC.

Approval Date: August 12, 2019

FINAL REPORT ACCEPTANCE BY:

Engineer, Alpha Technology Associate, Inc.

Date of Acceptance

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
TWG-KAR-19-003		

4. Title and Subtitle	5. Report Date
Final Report of New Car Assessment Program Side Airbag Out-of-Position Testing of 2019 Hyundai Kona SE 5-Door MPV NHTSA No. M20194202TWG2	August 12, 2019
	6. Performing Organization Code KAR
7. Authors	**8. Performing Organization Report No.**
Mr. Bruno Haesbaert, Project Engineer, Applus+ IDIADA KARCO Engineering, LLC Mr. Steven D. Matsusaka, Engineering Manager, Applus+ IDIADA KARCO Engineering, LLC	TR-P39221-01-NC
9. Performing Organization Name and Address	**10. Work Unit No.**
Applus+ IDIADA KARCO Engineering, LLC. 9270 Holly Rd. Adelanto, CA 92301	**11. Contract or Grant No.** DTNH22-13-D-00311L
12. Sponsoring Agency Name and Address	**13. Type of Report and Period Covered**
United States Department of Transportation National Highway Traffic Safety Administration Office of Crashworthiness Standards (NRM-110) 1200 New Jersey Ave., SE, Room W43-410 Washington, DC 20590	Final Test Report, July 30 - August 12, 2019
	14. Sponsoring Agency Code NRM-110

15. Supplementary Notes

16. Abstract

A side airbag out of position test was conducted on the subject 2019 Hyundai Kona SE 5-Door MPV 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 airbag protection. The test was conducted at the Applus+ IDIADA KARCO Engineering, LLC. facility in Adelanto, California on July 30, 2019.

The curtain and torso/pelvis side airbags were deployed and responses were measured on a Hybrid III 6-year old child dummy. Three high speed cameras, and one real time camera recorded the event. The ambient temperature at the time of airbag deployment was 21.6°C

Section 3.3.5.1 - HIII 6-Year Old Child Dummy - P2			
Measurement Description	**Units**	**IARV**	**Result**
Head Injury Criteria (HIC_{15})	N/A	723	8.8
Nij	N/A	1	0.24
Upper Neck Tension	N	1490	488.1
Upper Neck Compression	N	1820	-235.3

17. Key Words	18. Distribution Statement
New Car Assessment Program (NCAP) Side Airbag Out-of-position Technical Working Group (TWG)	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

19. Security Classification of this report	20. Security Classification of this page	21. No. of Pages	22. Price
UNCLASSIFIED	UNCLASSIFIED	41	

TABLE OF CONTENTS

Section		Page No.
1	Purpose and Summary of Test	1
2	Occupant and Vehicle Information / Data Sheets	3

Data Sheet No.		Page No.
1	Test Summary	4
2	General Test and Vehicle Parameter Data	5
3	Seat Adjustments	7
4	Dummy Positioning and Airbag Dimensions	8
5	Dummy Injury Criteria and Performance Data	9
6	High Speed Camera Locations and Data	10

Appendix		Page No.
A	Photographs	A
B	Dummy Response Data Traces	B
C	ATD Configuration and Performance Verification Data	C
D	Instrumentation Data Channel Assignments	D

SECTION 1
PURPOSE AND SUMMARY OF TEST

PURPOSE

This occupant out-of-position static side airbag deployment test is part of the Technical Working Group Occupant Injury Risk from Deploying Side Airbags Testing Program sponsored by Alpha Technology Associate, Inc. under Contract No. DTNH22-13-D-00311L. The purpose of this test was to obtain occupant injury data for a side airbag deployment.

The occupant out-of-position (OOP) side airbag test was conducted in accordance with the Technical Working Group Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags.

SUMMARY

The effects of a roof mounted curtain airbag and a seat mounted torso/pelvis airbag deployment in a 2019 Hyundai Kona SE 5-door MPV with an out-of-position Hybrid III 6-year old crash test dummy were evaluated. The test was performed at Applus+ IDIADA KARCO Engineering, LLC. on July 30, 2019. Pre- and post-test photographs of the vehicle and dummy can be found in Appendix A.

Three (3) high-speed digital cameras and one (1) real time camera were used to document the deployment of the airbags. Camera locations and other pertinent camera information can be found on Data Sheet No.1 and Data Sheet No.6.

A 6-year old anthropomorphic test device (ATD) was placed in the right front passenger seating position, along the outboard edge of foam block, facing inboard, and spine aligned with deployment trajectory of airbag according to the dummy placement instructions (3.3.5.1) in the July 2003 Revision of the Technical Working Group's 'Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags'.

The 6-year old ATD was instrumented with head tri-axial accelerometers, upper and lower neck force, and moment transducers.

The airbags were deployed and fifteen (15) channels of data were recorded using a data acquisition system. Appendix B contains dummy response data traces. Appendix C contains the instrumentation data channel assignments. Appendix D contains ATD calibration sheets.

Orientation of the 6-year old dummy was with the dummy facing inboard. The seat is set 20 mm from the full forward position. The seat was not tested in the rearmost position in order to maximize the interaction and contact between the dummy and airbag. The dummy was placed with its arms hanging at its sides on the foam block facing inboard with its legs extended. The dummy's pelvis is slid outboard until contact is made with the door panel while keeping the head in a neutral orientation. The center of gravity of the head is centered in the deployment trajectory of the airbag. The dummy's arms are bent at the elbow until the fingers just touch the booster seat. This orientation complies with section 3.3.5.1 of the Technical Working Group (TWG) recommendation in the Recommended procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags.

The passenger side door remained closed during the test and was operable after the airbag deployed.

The 6-year old dummy's visible contact points were as follows: The ATD's head contacted the curtain airbag. The ATD's torso contacted the torso/pelvis and curtain airbag.

The occupant data is summarized below:

Measurement Description	**Units**	**Passenger ATD (HIII 3YO)**	
		IARV	Result
Head Injury Criteria (HIC15)	N/A	723	8.8
Upper Neck Nij	N/A	1	0.24
Upper Neck Peak Tension	N	1490	488.1
Upper Neck Peak Compression	N	1820	-235.3

SECTION 2

OCCUPANT AND VEHICLE INFORMATION / DATA SHEETS

Test Vehicle: 2019 Hyundai Kona SE 5-Door MPV NHTSA No.: M20194202TWG2

Test Program: TWG 3.3.5.1 Test Date: 07/30/19

CONVERSION FACTORS

Quantity	Typical Application	Std Units	Metric Unit	Multiply By
Mass	Vehicle Weight	lb	kg	0.4536
Linear Velocity	Impact Velocity	miles/hr	km/hr	1.609344
Length or Distance	Measurements	in	mm	25.4
Volume	Fuel Systems	gal	liter	3.785
Volume	Small Fluids	oz	mL	29.574
Pressure	Tire Pressures	lbf/in^2	kPa	6.895
Temperature	General Use	^oF	^oC	=(Tf -32)/1.8
Force	Dynamic Forces	lbf	N	4.448
Moment	Torque	lbf-ft	N•m	1.355

DATA SHEET NO. 1

TEST SUMMARY

Test Vehicle: 2019 Hyundai Kona SE 5-Door MPV NHTSA No.: M20194202TWG2

Test Program: TWG 3.3.5.1 Test Date: 07/30/19

TEST DUMMY INFORMATION

Description	Passenger Seat
Dummy Type / Serial No.	6-year old / 186
Head Contact	Curtain Airbag
Chest Contact	Torso/Pelvis/Curtain Airbag
Abdomen Contact	None
Pelvis Contact	None
Left Knee Contact	None
Right Knee Contact	None

VIDEO COVERAGE

Description	Quantity
High Speed Digital	3
Real Time	1
Total	4

DATA CHANNELS

Description	Quantity
Head Accelerometers	3
Upper Neck Transducers	6
Lower Neck Transducers	6
Total	15

DATA SHEET NO. 2

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2019 Hyundai Kona SE 5-Door MPV NHTSA No.: M20194202TWG2

Test Program: TWG 3.3.5.1 Test Date: 07/30/19

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA Number	M20194202TWG2
Model Year	2019
Make	Hyundai
Model	Kona SE
Body Style	5-Door MPV
VIN	KM8K12AA7KU251906
Body Color	Sunset Orange
Odometer Reading (km / mi)	63 / 39
Engine Displacement (L)	2.0
Type / No. of Cylinders	Inline 4
Engine Placement	Transverse
Transmission Type	Automatic
Transmission Speeds	6
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	Yes
Power Window Auto-Reverse	Yes
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 Pass. Pelvis Airbag	No
Driver Seat Belt Pretensioner	Yes
Rear Pass. Seat Belt Pretensioner	No
Driver Load Limiter	Yes
Rear Pass. Load Limiter	No
Other Safety Restraint	Yes

Does Owner's Manual provide instructions to turn off automatic door locks? pg 3-76

DATA FROM CERTIFICATION LABEL

Manufactured By	Hyundai Motor Co.
Date of Manufacture	Oct-19
Vehicle Type	MPV

GVWR (kg)	3979
GAWR Front (kg)	2293
GAWR Rear (kg)	2205

VEHICLE SEATING AND CAPACITY WEIGHT INFORMATION

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

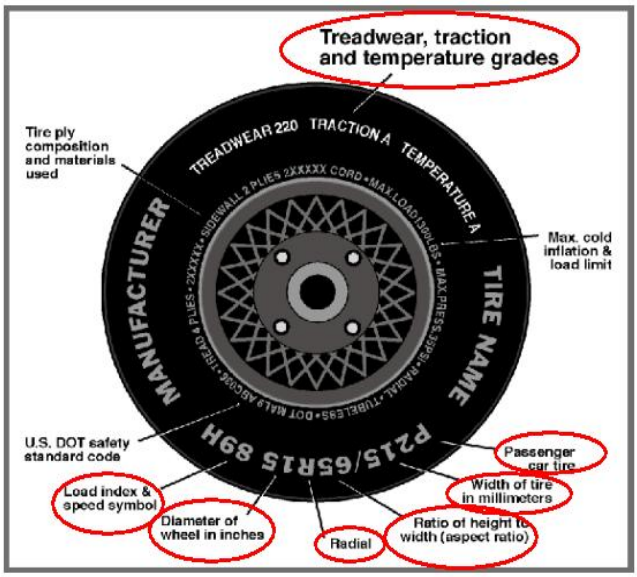
*Vehicle underwent New Car Assessment Program Side MDB Impact Testing on January 31, 2019.

DATA SHEET NO. 2 … (CONTINUED)

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2019 Hyundai Kona SE 5-Door MPV NHTSA No.: M20194202TWG2

Test Program: TWG 3.3.5.1 Test Date: 07/30/19



VEHICLE TIRE INFORMATION

Measured Parameter	Front	Rear
Max. Tire Pressure (kpa)	350	350
Cold Pressure (kPa)	230	230
Recommended Tire Size	P205/60R16	P205/60R16
Tire Size on Vehicle	P205/60R16	P205/60R16
Tire Manufacturer	Hankook	Hankook
Tire Model	Kinergy GT	Kinergy GT
Treadware	500	500
Traction Grade	A	A
Temperature Grade	A	A
Tire Plies Sidewall	1 Polyester	1 Polyester
Tire Plies Body	1 Polyester, 2 Steel, 1 Nylon	1 Polyester, 2 Steel, 1 Nylon
Load Index/Speed Symbol	92H	92H
Tire Material	Polyester, Steel, Nylon	Polyester, Steel, Nylon
DOT Safety Code Left	1T79 XC1B HO	1T79 XC1B HO
DOT Safety Code Right	1T79 XC1B HO	1T79 XC1B HO

DATA SHEET NO. 3

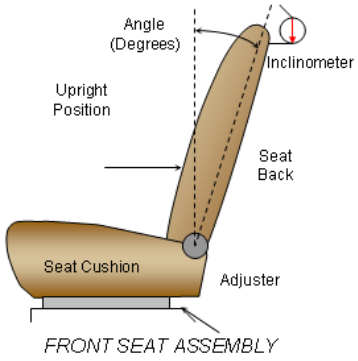
SEAT ADJUSTMENTS

Test Vehicle: 2019 Hyundai Kona SE 5-Door MPV NHTSA No.: M20194202TWG2

Test Program: TWG 3.3.5.1 Test Date: 07/30/19

SEAT BACK ANGLE

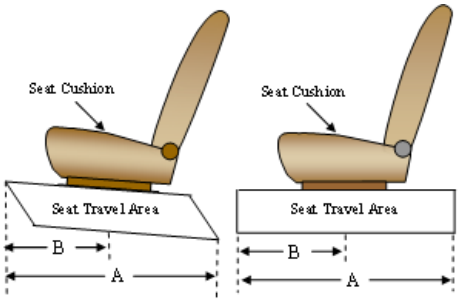
The passenger seat back is positioned per section 3.3.5.1 of the TWG recommendation in the Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags. Seat back angle is measured at the headrest post.



Seating Position	Degrees
Passenger Seat	3.0

SEAT FORE / AFT POSITIONING

The passenger seat track travel is set per section 3.3.5.1 of the TWG recommendation in the Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags. The first or forward most position is counted as zero (0)



Seating Position	Total Fore-Aft Travel		Placed in Position	
	mm	Detents	mm	Detents
Passenger Seat	243	38	20	3

SEAT BELT UPPER ANCHORAGE

The seat belt upper anchorage is positioned to the uppermost position. Position “H” is the uppermost position, followed by position “M1”. Position “L” is the lowermost position.

Seating Position	Total No. of Positions	Placed in Position
Passenger Seat	5	H

DATA SHEET NO. 4

DUMMY POSITIONING AND AIRBAG DIMENSIONS

Test Vehicle: 2019 Hyundai Kona SE 5-Door MPV NHTSA No.: M20194202TWG2

Test Program: TWG 3.3.5.1 Test Date: 07/30/19

DUMMY POSITIONING

Code	Measurement Description	Passenger	
		Length (mm)	Angle (°)
SA	Seat Back Angle		3.0
AN	Top of Airbag Module to Head/Neck Junction	123	90.0
HD	Head CG to Door Panel/ Window	123	0.0
HSC	Head to Seat Back Centerline	265	0.0
HB	Head to B-Pillar (measured from bridge of nose)	278	0.0
HZ	Head to Roof (Z)	145	90.0
HHD	Head to Side Header	148	90.0
ND	Nose to Dash	563	18.0
NS	Nose to Seat Back	258	0.0
NR	Nose to Header	354	44.6
CD	Chest to Dash	488	3.8
CS	Chest to Seat Back (measured to centerline)	300	0.0
RACL	Right Arm to Seat Back Centerline	458	0.0
LACL	Left Arm to Seat Back Centerline	221	0.0
RA	Right Arm to Door Panel	54	0.0
LA	Left Arm to Door Panel	76	0.0
KK	Knee to Knee	90	0.0
TT	Toe to Toe	75	0.0
KSCR	Right Knee to Seat Cushion Centerline	55	0.0
KSCL	Left Knee to Seat Cushion Centerline	55	0.0
	Head Level (X Direction)		2.6
	Head Level (Y Direction)		10.0

AIRBAG DIMENSIONS

Code	Measurement Description	Airbag
		Length (mm)
AMW	Curtain Airbag Module Diameter	30
AML	Curtain Airbag Module Length	280
ABW	Curtain Airbag Width	1690
ABL	Curtain Airbag Length	370
AMW	Torso/Pelvis Airbag Module Diameter	30
AML	Torso/Pelvis Airbag Module Length	210
ABW	Torso/Pelvis Airbag Width	600
ABL	Torso/Pelvis Airbag Length	320

DATA SHEET NO. 5

DUMMY INJURY CRITERIA AND PERFORMANCE DATA

Test Vehicle: 2019 Hyundai Kona SE 5-Door MPV NHTSA No.: M20194202TWG2

Test Program: TWG 3.3.5.1 Test Date: 07/30/19

HEAD PEAK ACCELERATIONS / CHEST DEFLECTIONS

Location	Axis	Units	6 Year Old			
			Max	Time	Min	Time
Head CG	X	g	20.3	60.4	-12.4	9.0
Head CG	Y	g	9.8	13.2	-7.5	8.5
Head CG	Z	g	17.9	8.5	-12.3	11.5
Head CG Resultant	N/A	g	21.0	60.4		

UPPER NECK PEAK FORCES AND MOMENTS

Location	Axis	Units	6 Year Old			
			Max	Time	Min	Time
Neck Force	X	N	262.2	25.0	-70.3	74.0
Neck Force	Y	N	280.0	24.9	-73.6	5.7
Neck Force	Z	N	488.1	8.7	-235.3	20.2
Neck Force Resultant	N/A	N	491.0	8.7		
Neck Moment	X	Nm	11.2	32.2	-18.7	13.5
Neck Moment	Y	Nm	20.0	25.9	-4.2	9.5
Neck Moment	Z	Nm	10.2	27.7	-7.4	9.0
Neck Moment Resultant	N/A	Nm	22.3	26.0		

LOWER NECK PEAK FORCES AND MOMENTS

Location	Axis	Units	6 Year Old			
			Max	Time	Min	Time
Neck Force	X	N	255.0	23.6	-129.6	88.5
Neck Force	Y	N	407.1	12.9	-108.7	8.5
Neck Force	Z	N	621.9	9.2	-302.3	11.5
Neck Force Resultant	N/A	N	626.3	9.2		
Neck Moment	X	Nm	14.5	13.2	-4.0	8.6
Neck Moment	Y	Nm	31.2	41.3	-8.1	6.8
Neck Moment	Z	Nm	10.4	6.9	-23.5	9.2
Neck Moment Resultant	N/A	Nm	35.0	28.1		

HEAD INJURY CRITERIA (HIC15)

Location	6 Year Old			
	HIC15	T^1	T^2	Avg G
Head CG	8.8	58.8	69.3	14.7

UPPER NECK NIJ VALUES

Location	6 Year Old			
	Ntf	Nte	Ncf	Nce
Upper Neck	0.17	0.24	0.24	0.07

DATA SHEET NO. 6

HIGH SPEED CAMERA LOCATIONS AND DATA

Test Vehicle: 2019 Hyundai Kona SE 5-Door MPV NHTSA No.: M20194202TWG2

Test Program: TWG 3.3.5.1 Test Date: 07/30/19

CAMERA LOCATIONS

No.	Camera View	Location (mm)			Angle (Deg.)	Lens (mm)	Speed (fps)
		X	Y	Z			
1	High Speed Side View	90	2300	231	2.7	24	1000
2	High Speed 3/4 View	2179	1210	1550	9.7	50	1000
3	High Speed Front View	2380	520	1544	9.3	50	1000
4	Real Time	90	2300	231	2.7		24

Coordinates: +X = forward of vehicle relative to dummy's head CG

+Y = right of vehicle relative to dummy's head CG

+Z = into ground

APPENDIX A
PHOTOGRAPHS

TABLE OF PHOTOGRAPHS

Figure		Page
1	Right Front ¾ View, As Received	A-1
2	Vehicle Certification Label	A-1
3	Post-Test Left Front ¾ View of NCAP Side MDB Impact Test	A-2
4	Post-Test Left Side View of NCAP Side MDB Impact Test	A-2
5	Post-Test Left Rear ¾ View of NCAP Side MDB Impact Test	A-3
6	Post-Test Right Side View of NCAP Side MDB Impact Test	A-3
7	Pre-Test Dummy Position, Left View	A-4
8	Post-Test Dummy Position, Left View	A-4
9	Pre-Test Dummy Position, ¾ View	A-5
10	Post-Test Dummy Position, ¾ View	A-5
11	Pre-Test Dummy Position, Front View	A-6
12	Post-Test Dummy Position, Front View	A-6
13	Pre-Test Dummy Position, Close-Up Front View	A-7
14	Post-Test Dummy Position, Close-Up Front View	A-7
15	Pre-Test Dummy Position, Close-Up Rear View	A-8
16	Post-Test Dummy Position, Close-Up Rear View	A-8
17	Post-Test Airbags, Left Side View	A-9
18	Post-Test Airbags, Left Front ¾ View	A-9

FIGURE 1. Right Front ¾ View, As Received

FIGURE 2. Vehicle Certification Label

FIGURE 3. Post-Test Left Front ¾ View of NCAP Side MDB Impact Test

FIGURE 4. Post-Test Left Side View of NCAP Side MDB Impact Test

FIGURE 5. Post-Test Left Rear ¾ View of NCAP Side MDB Impact Test

FIGURE 6. Post-Test Right Side View of NCAP Side MDB Impact Test

FIGURE 7. Pre-Test Dummy Position, Left View

FIGURE 8. Post-Test Dummy Position, Left View

FIGURE 9. Pre-Test Dummy Position, ¾ View

FIGURE 10. Post-Test Dummy Position, ¾ View

FIGURE 11. Pre-Test Dummy Position, Front View

FIGURE 12. Post-Test Dummy Position, Front View

FIGURE 13. Pre-Test Dummy Position, Close-Up Front View

FIGURE 14. Post-Test Dummy Position, Close-Up Front View

FIGURE 15. Pre-Test Dummy Position, Close-Up Rear View

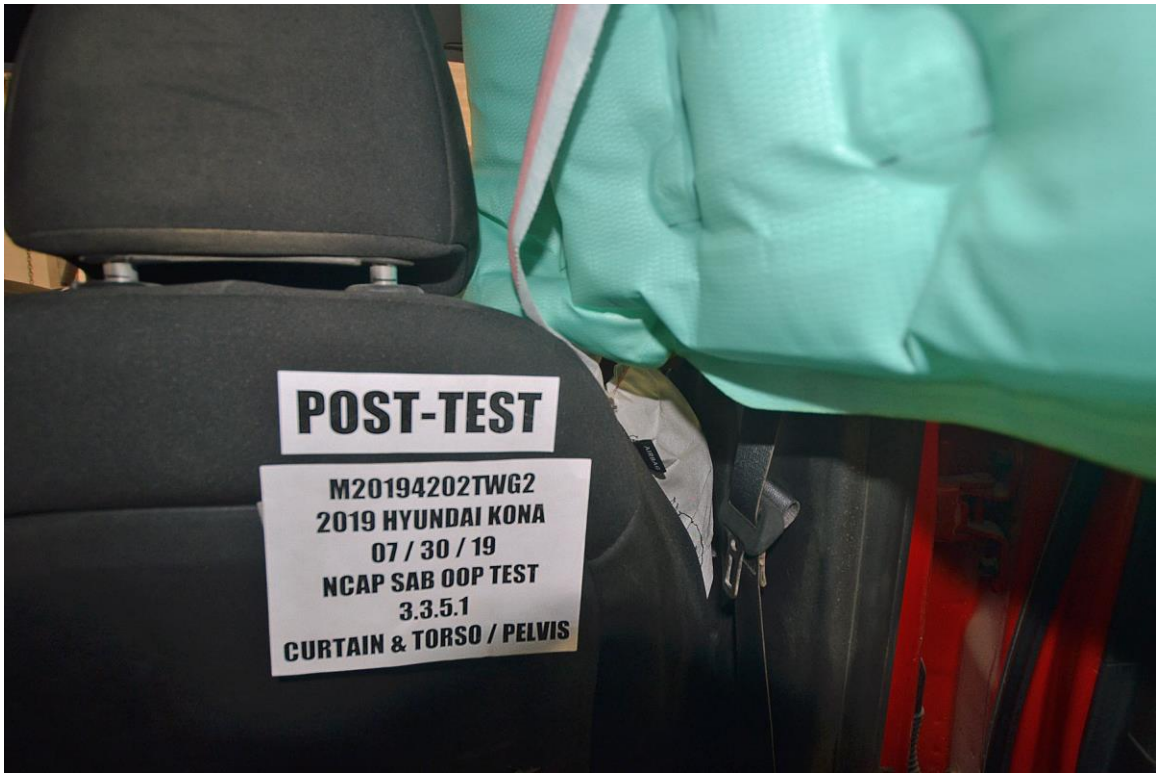


FIGURE 16. Post-Test Dummy Position, Close-Up Rear View

FIGURE 17. Post-Test Airbags, Left Side View

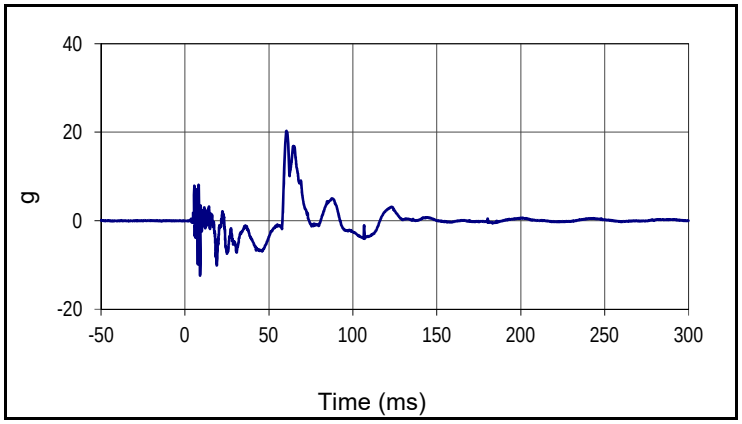
FIGURE 18. Post-Test Airbags, Left Front ¾ View

APPENDIX B
DUMMY RESPONSE DATA TRACES

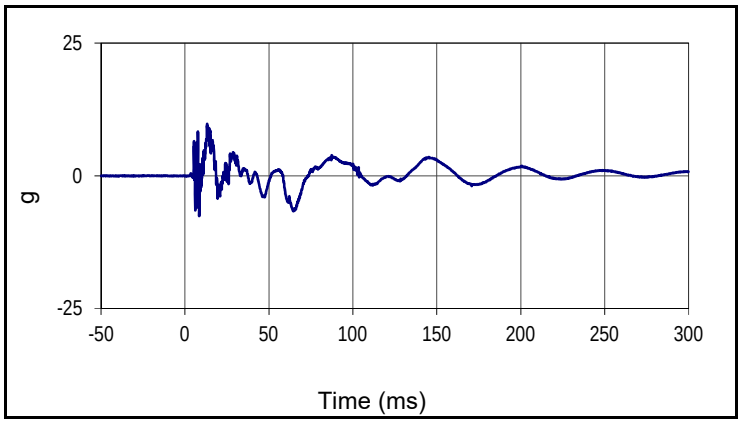
TABLE OF DATA PLOTS

Plot		Page
1	6 Yr. Old Head Acceleration X	B-1
2	6 Yr. Old Head Acceleration Y	B-1
3	6 Yr. Old Head Acceleration Z	B-1
4	6 Yr. Old Head Acceleration Resultant	B-1
5	6 Yr. Old Upper Neck Force X	B-2
6	6 Yr. Old Upper Neck Force Y	B-2
7	6 Yr. Old Upper Neck Force Z	B-2
8	6 Yr. Old Upper Neck Force Resultant	B-2
9	6 Yr. Old Upper Neck Moment X	B-3
10	6 Yr. Old Upper Neck Moment Y	B-3
11	6 Yr. Old Upper Neck Moment Z	B-3
12	6 Yr. Old Upper Neck Moment Resultant	B-3
13	6 Yr. Old Lower Neck Force X	B-4
14	6 Yr. Old Lower Neck Force Y	B-4
15	6 Yr. Old Lower Neck Force Z	B-4
16	6 Yr. Old Lower Neck Force Resultant	B-4
17	6 Yr. Old Lower Neck Moment X	B-5
18	6 Yr. Old Lower Neck Moment Y	B-5
19	6 Yr. Old Lower Neck Moment Z	B-5
20	6 Yr. Old Lower Neck Moment Resultant	B-5

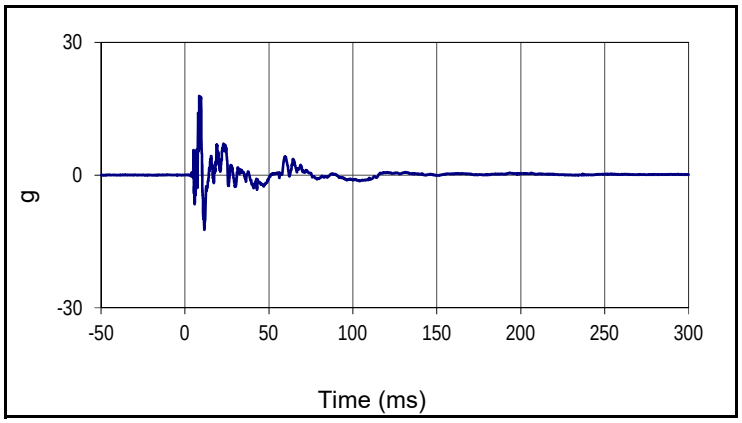
Test Vehicle:	2019 Hyundai Kona SE 5-Door MPV	Test Date:	07/30/19
Test Program:	TWG 3.3.5.1	NHTSA No.:	M20194202TWG2



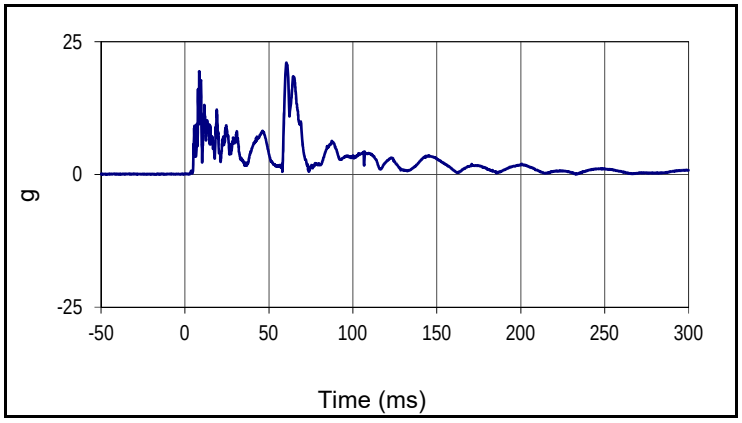
Curve Description			
6 Year Old Head Acceleration X			
Plot No.		SAE Class	Units
001		1000	g
Max	Time	Min	Time
20.3	60.4	-12.4	9.0



Curve Description			
6 Year Old Head Acceleration Y			
Plot No.		SAE Class	Units
002		1000	g
Max	Time	Min	Time
9.8	13.2	-7.5	8.5

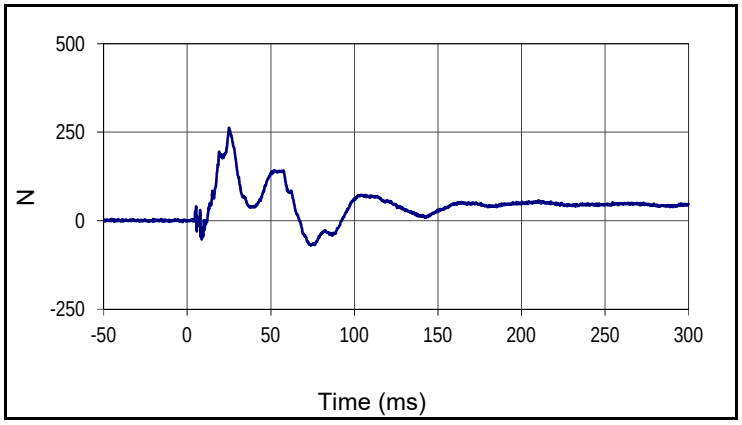


Curve Description			
6 Year Old Head Acceleration Z			
Plot No.		SAE Class	Units
003		1000	g
Max	Time	Min	Time
17.9	8.5	-12.3	11.5

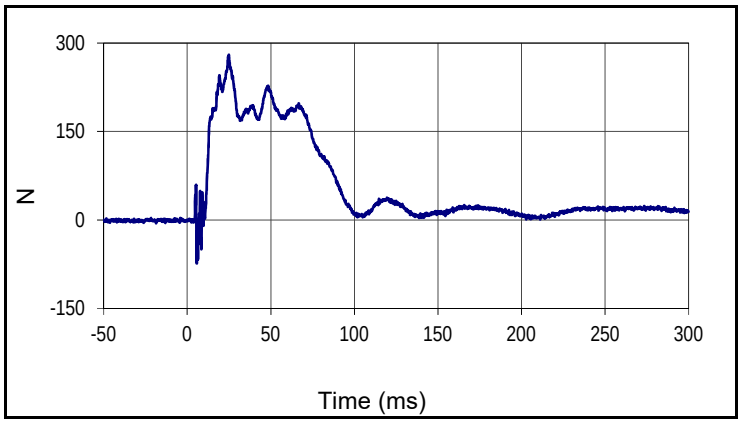


Curve Description			
6 Year Old Head Acceleration Resultant			
Plot No.		SAE Class	Units
004		1000	g
Max	Time	Min	Time
21.0	60.4	0.0	2.8

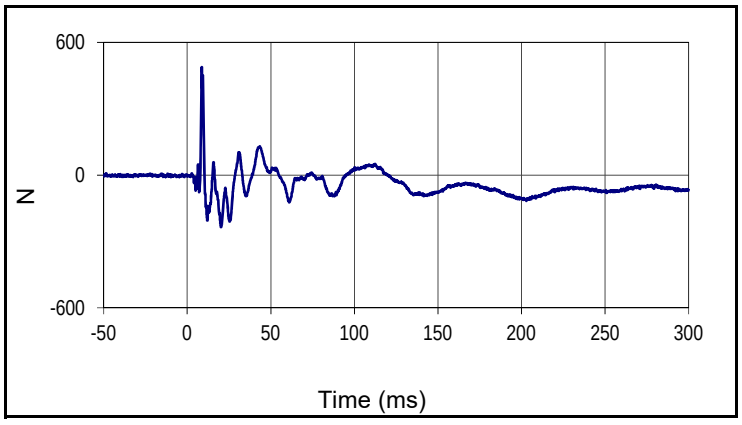
Test Vehicle:	2019 Hyundai Kona SE 5-Door MPV	Test Date:	07/30/19
Test Program:	TWG 3.3.5.1	NHTSA No.:	M20194202TWG2



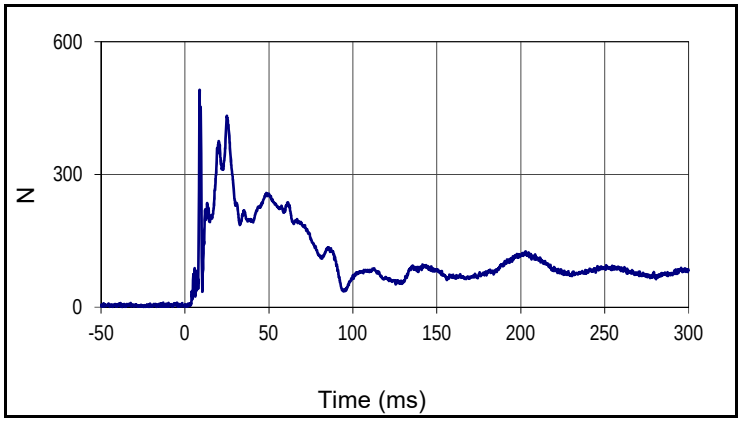
Curve Description			
6 Year Old Upper Neck Force X			
Plot No.		SAE Class	Units
005		1000	N
Max	Time	Min	Time
262.2	25.0	-70.3	74.0



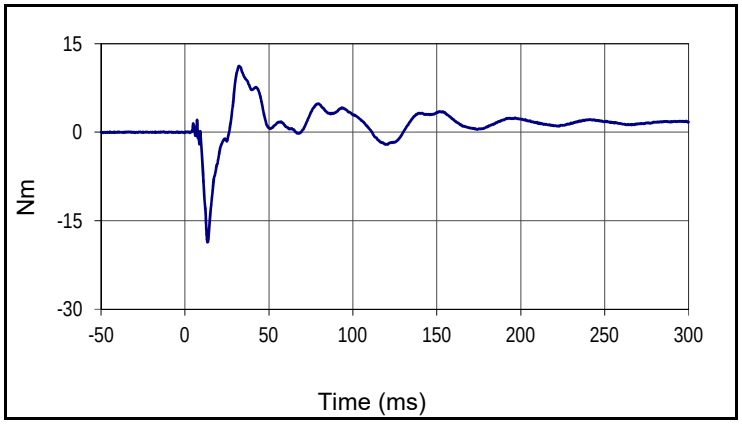
Curve Description			
6 Year Old Upper Neck Force Y			
Plot No.		SAE Class	Units
006		1000	N
Max	Time	Min	Time
280.0	24.9	-73.6	5.7



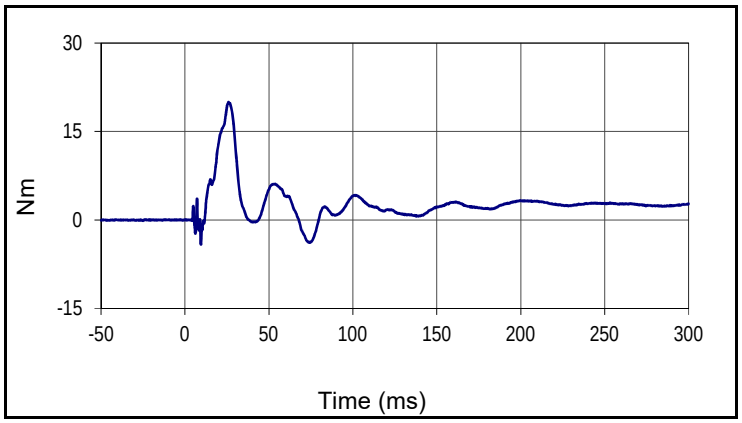
Curve Description			
6 Year Old Upper Neck Force Z			
Plot No.		SAE Class	Units
007		1000	N
Max	Time	Min	Time
488.1	8.7	-235.3	20.2



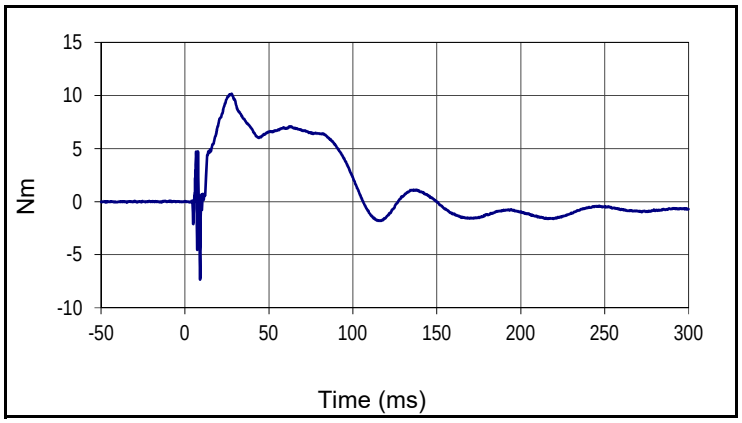
Curve Description			
6 Year Old Upper Neck Force Resultant			
Plot No.		SAE Class	Units
008		1000	N
Max	Time	Min	Time
491.0	8.7	1.3	0.2



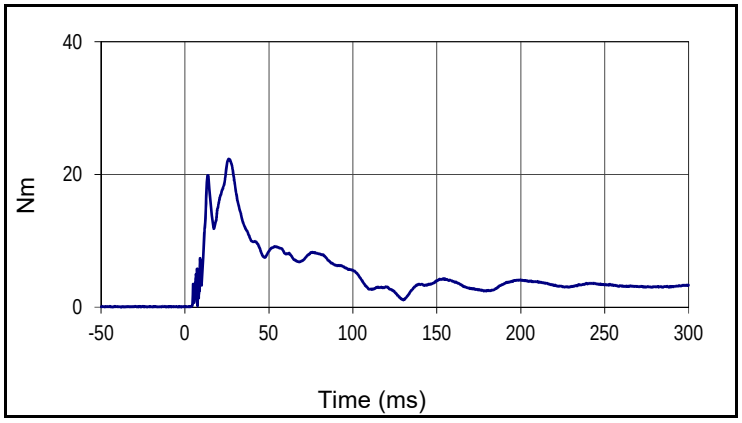
Curve Description			
6 Year Old Upper Neck Moment X			
Plot No.		SAE Class	Units
009		600	Nm
Max	Time	Min	Time
11.2	32.2	-18.7	13.5



Curve Description			
6 Year Old Upper Neck Moment Y			
Plot No.		SAE Class	Units
010		600	Nm
Max	Time	Min	Time
20.0	25.9	-4.2	9.5

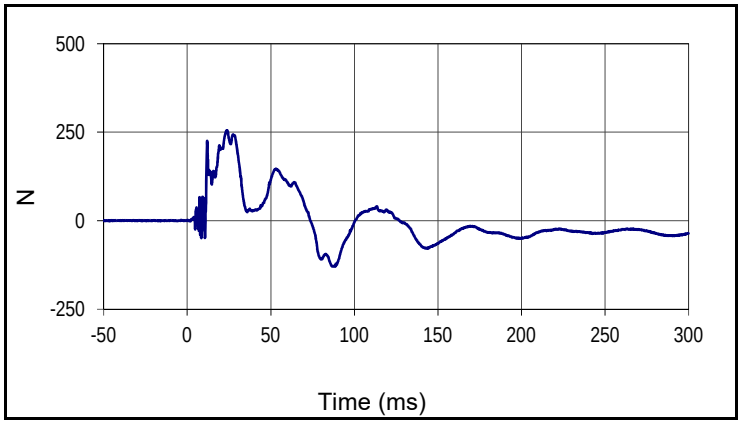


Curve Description			
6 Year Old Upper Neck Moment Z			
Plot No.		SAE Class	Units
011		600	Nm
Max	Time	Min	Time
10.2	27.7	-7.4	9.0

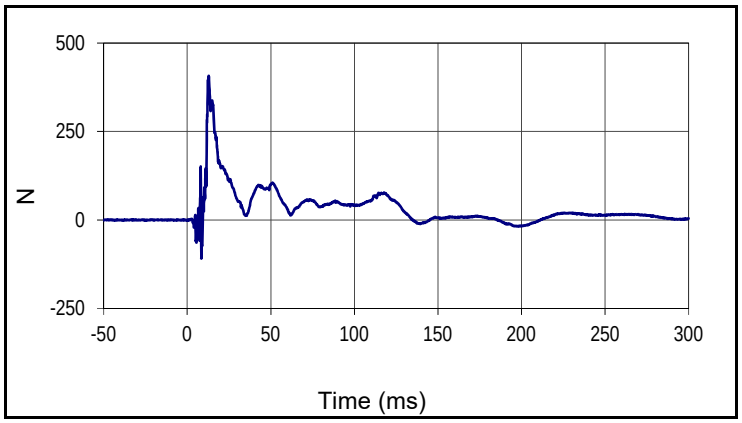


Curve Description			
6 Year Old Upper Neck Moment Resultant			
Plot No.		SAE Class	Units
012		1000	Nm
Max	Time	Min	Time
22.3	26.0	0.0	1.6

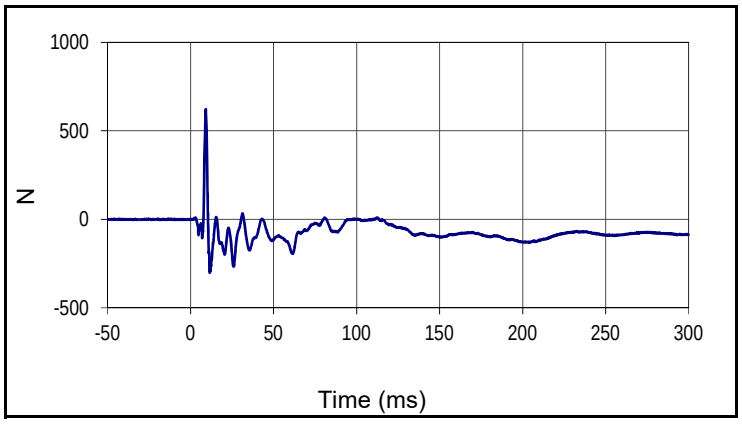
Test Vehicle:	2019 Hyundai Kona SE 5-Door MPV	Test Date:	07/30/19
Test Program:	TWG 3.3.5.1	NHTSA No.:	M20194202TWG2



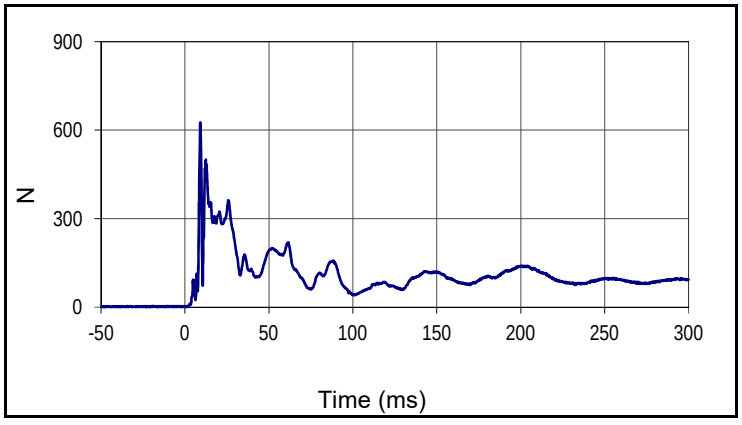
Curve Description			
6 Year Old Lower Neck Force X			
Plot No.		SAE Class	Units
013		1000	N
Max	Time	Min	Time
255.0	23.6	-129.6	88.5



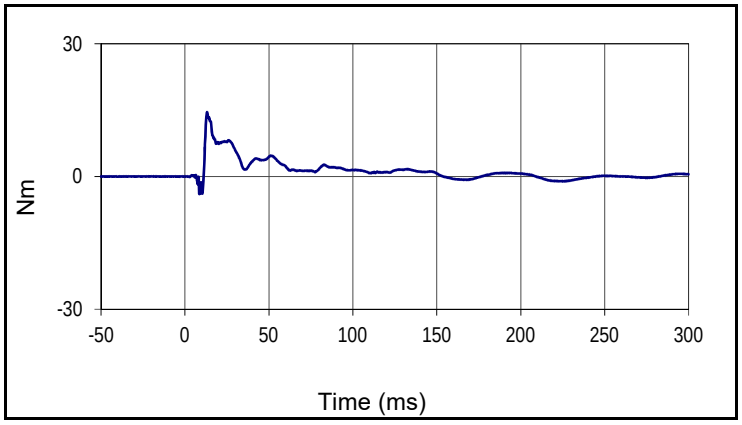
Curve Description			
6 Year Old Lower Neck Force Y			
Plot No.		SAE Class	Units
014		1000	N
Max	Time	Min	Time
407.1	12.9	-108.7	8.5



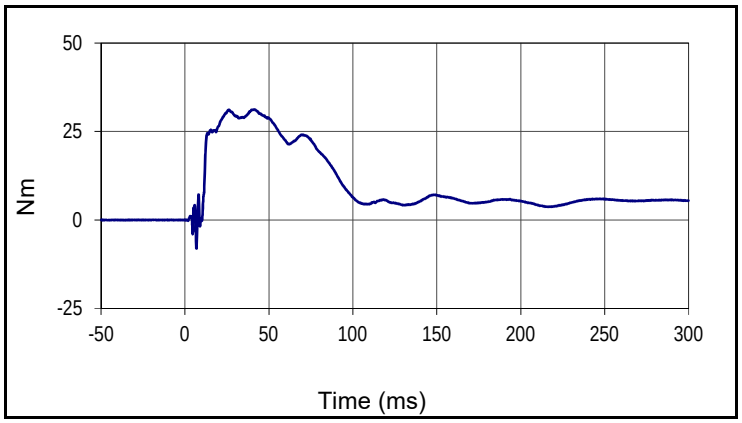
Curve Description			
6 Year Old Lower Neck Force Z			
Plot No.		SAE Class	Units
015		1000	N
Max	Time	Min	Time
621.9	9.2	-302.3	11.5



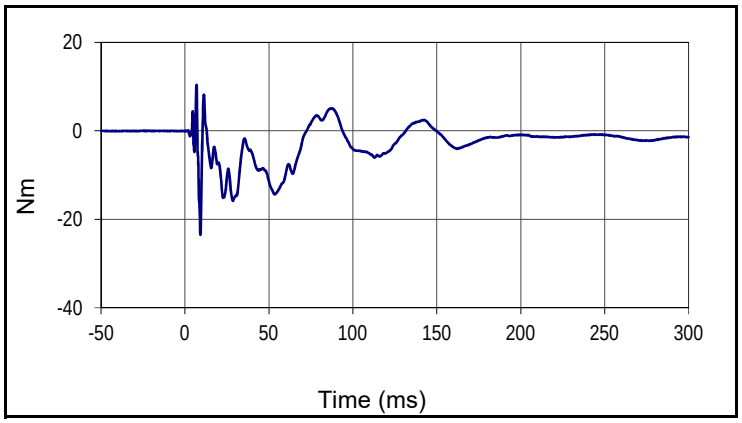
Curve Description			
6 Year Old Lower Neck Force Resultant			
Plot No.		SAE Class	Units
016		1000	N
Max	Time	Min	Time
626.3	9.2	0.7	0.9



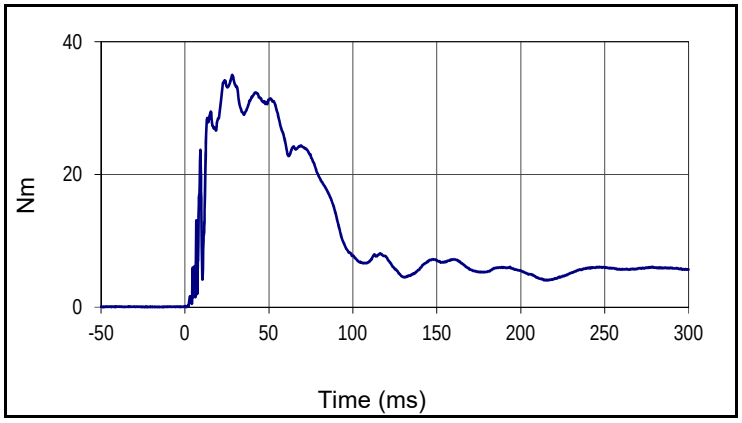
Curve Description			
6 Year Old Lower Neck Moment Z			
Plot No.		SAE Class	Units
017		600	Nm
Max	Time	Min	Time
14.5	13.2	-4.0	8.6



Curve Description			
6 Year Old Lower Neck Moment X			
Plot No.		SAE Class	Units
018		600	Nm
Max	Time	Min	Time
31.2	41.3	-8.1	6.8



Curve Description			
6 Year Old Lower Neck Moment Y			
Plot No.		SAE Class	Units
019		600	Nm
Max	Time	Min	Time
10.4	6.9	-23.5	9.2



Curve Description			
6 Year Old Lower Neck Moment Resultant			
Plot No.		SAE Class	Units
020		600	Nm
Max	Time	Min	Time
35.0	28.1	0.0	0.9

APPENDIX C
ATD CONFIGURATION AND PERFORMANCE VERIFICATION DATA

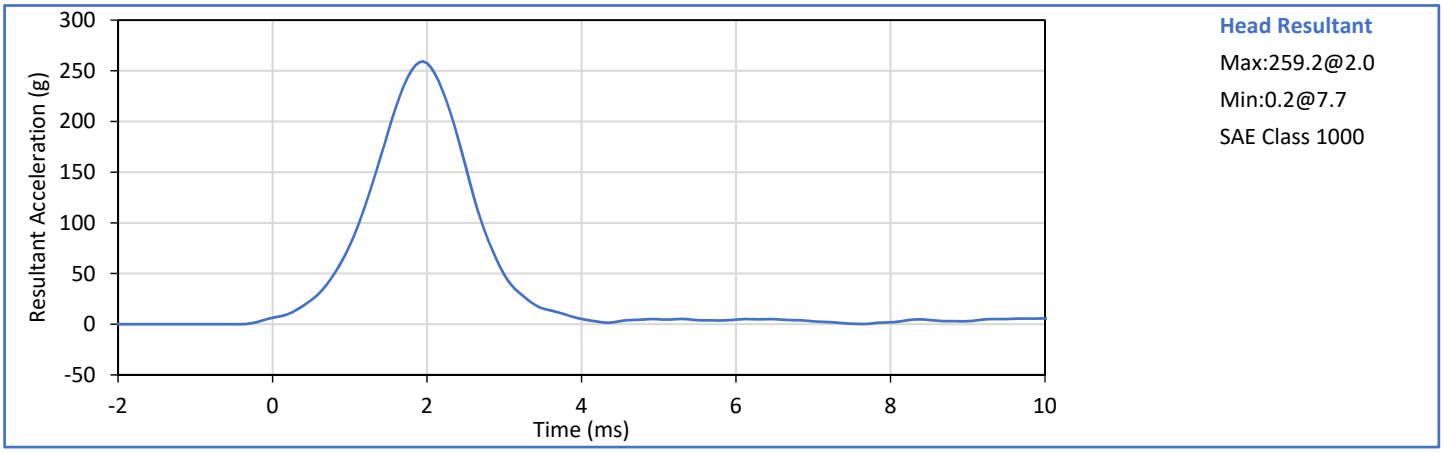
APPENDIX C
PRE-TEST ATD CONFIGURATION AND PERFORMANCE VERIFICATION DATA

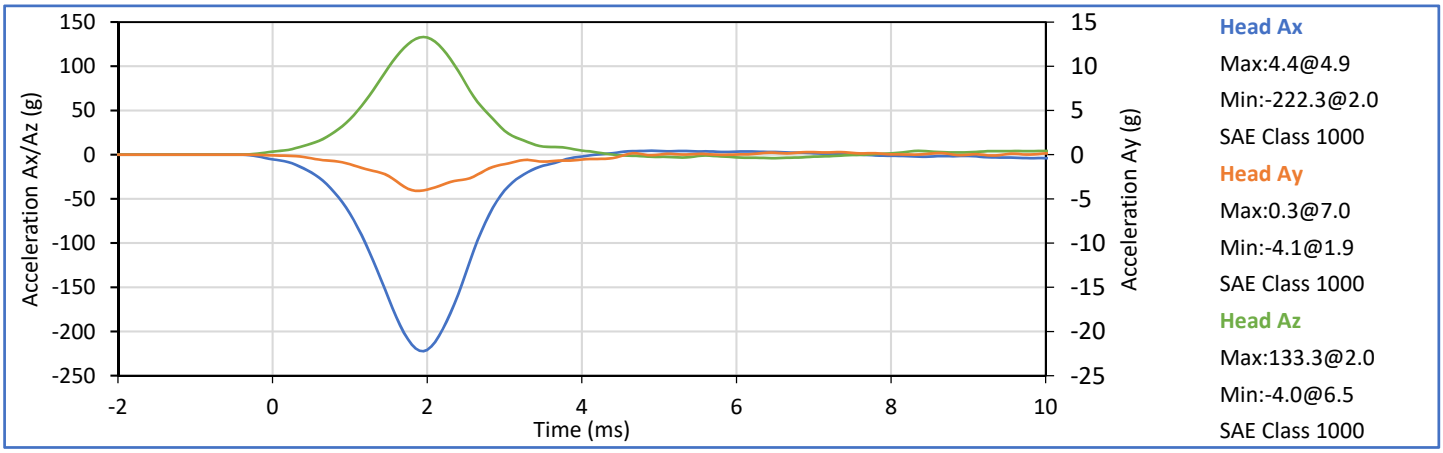
KARCO Engineering
9270 Holly Road, Adelanto, CA 92301
Tel: +1 760 246 1672 Fax: +1 760 246 8112
Info@karco.com www.karco.com

Hybrid III 6 Year-Old Child Dummy
Head Drop

ATD Serial No.: 186 Test Date: 2019-07-19

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	18.9	25.6	21.1	Pass
Laboratory Humidity	%	10	70	30	Pass
Peak Resultant Acceleration	g	250.0	280.0	259.2	Pass
Peak Lateral Acceleration	g	-15.0	15.0	-4.1	Pass
Oscillations After Main Pulse	%	0.0	10.0	2.2	Pass
Is Acceleration Unimodal?	Yes/No	Yes		Yes	Pass
			Overall Test Results		Pass





Technician: J. Hernandez

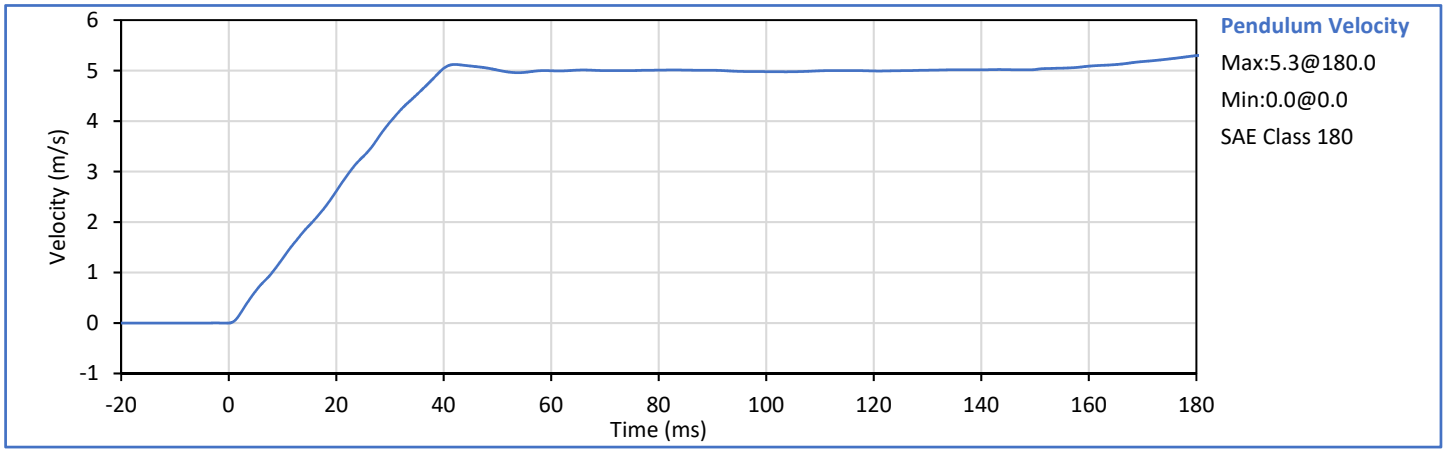
Approved By: P. Puzzuto

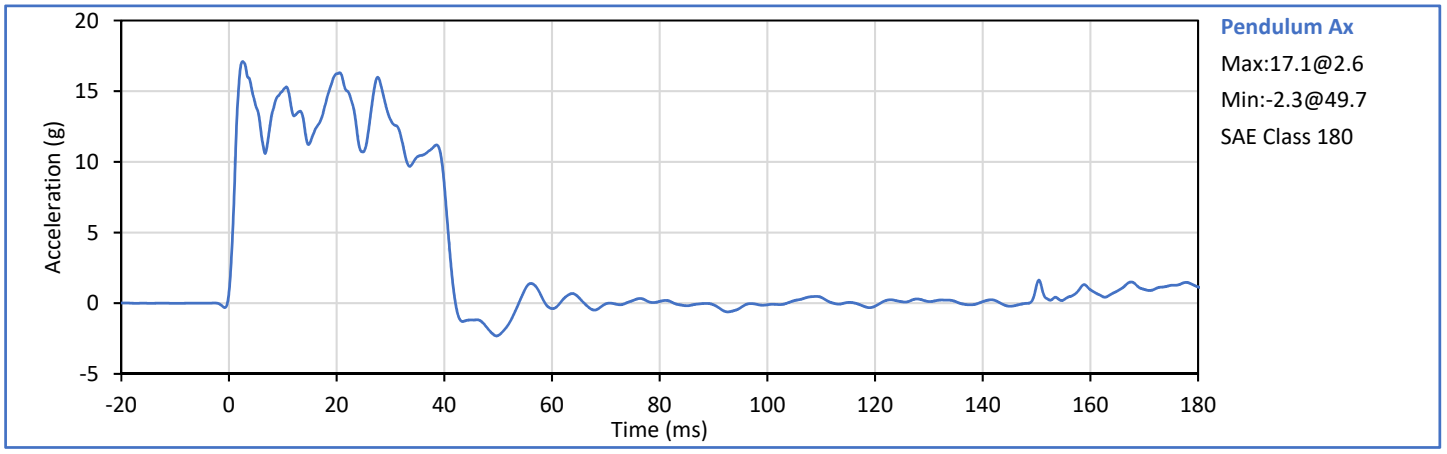
KARCO Engineering
9270 Holly Road, Adelanto, CA 92301
Tel: +1 760 246 1672 Fax: +1 760 246 8112
Info@karco.com www.karco.com

Hybrid III 6 Year-Old Child Dummy
Neck Flexion Test

ATD Serial No.: 186 Test Date: 2019-07-26

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.2	Pass
Laboratory Humidity	%	10	70	39	Pass
Pendulum Velocity	m/s	4.83	5.07	5.00	Pass
Pendulum Velocity at 10 ms	m/s	1.20	1.60	1.27	Pass
Pendulum Velocity at 20 ms	m/s	2.40	3.40	2.61	Pass
Pendulum Velocity at 30 ms	m/s	3.80	5.00	3.98	Pass
Peak Moment in Rotation	Nm	27.0	33.0	29.9	Pass
	deg	74.0	92.0	74.2	Pass
Positive Moment Decay to 5 Nm	ms	103.0	123.0	117.5	Pass
			Overall Test Results		Pass





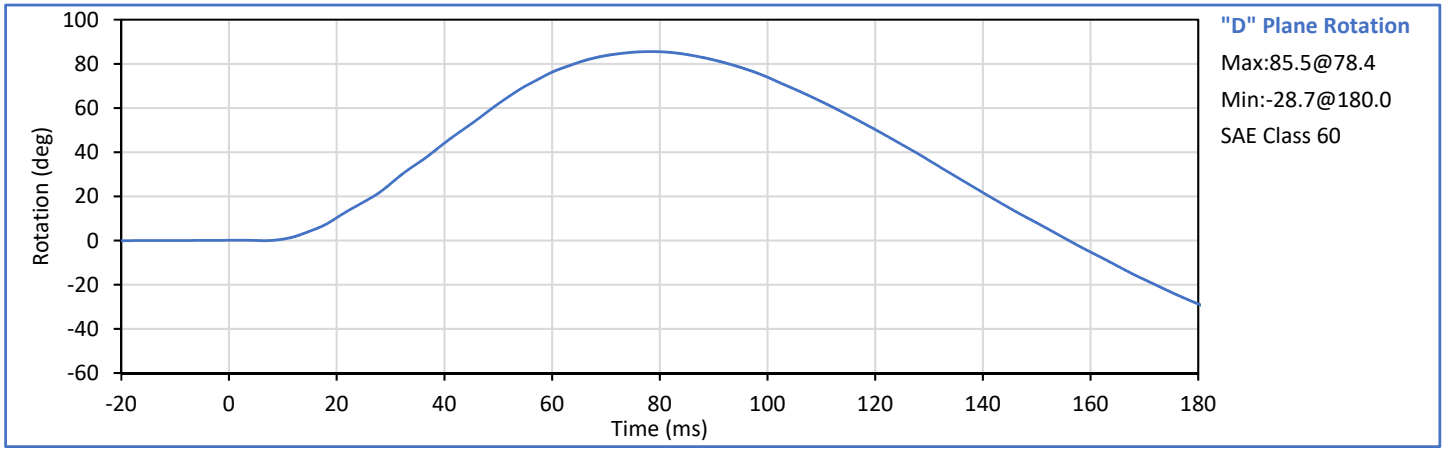
Technician: J. Hernandez

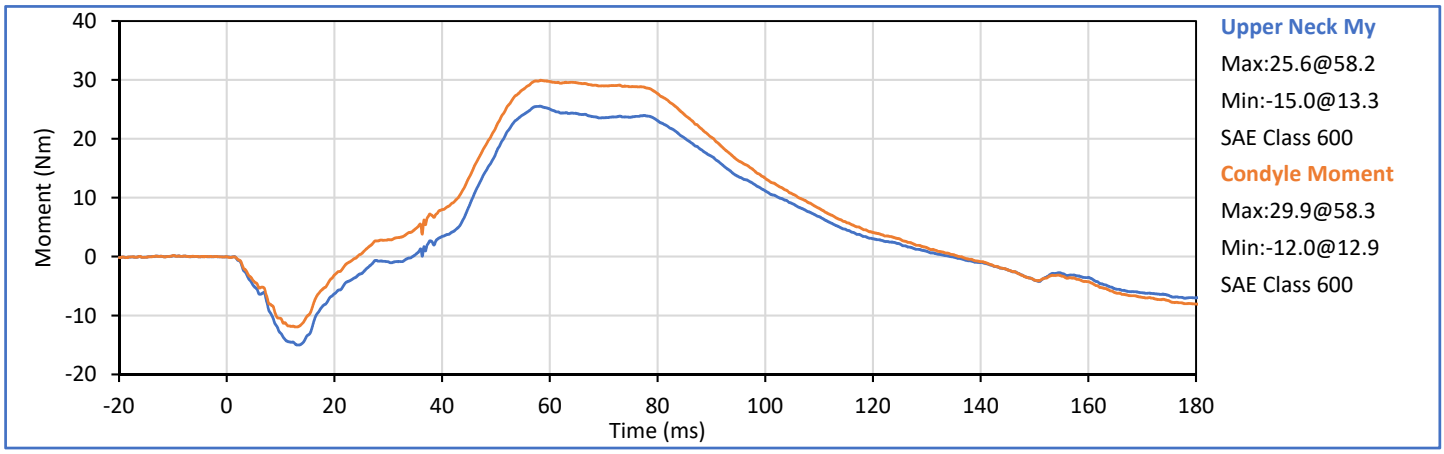
Approved By: P. Puzzuto

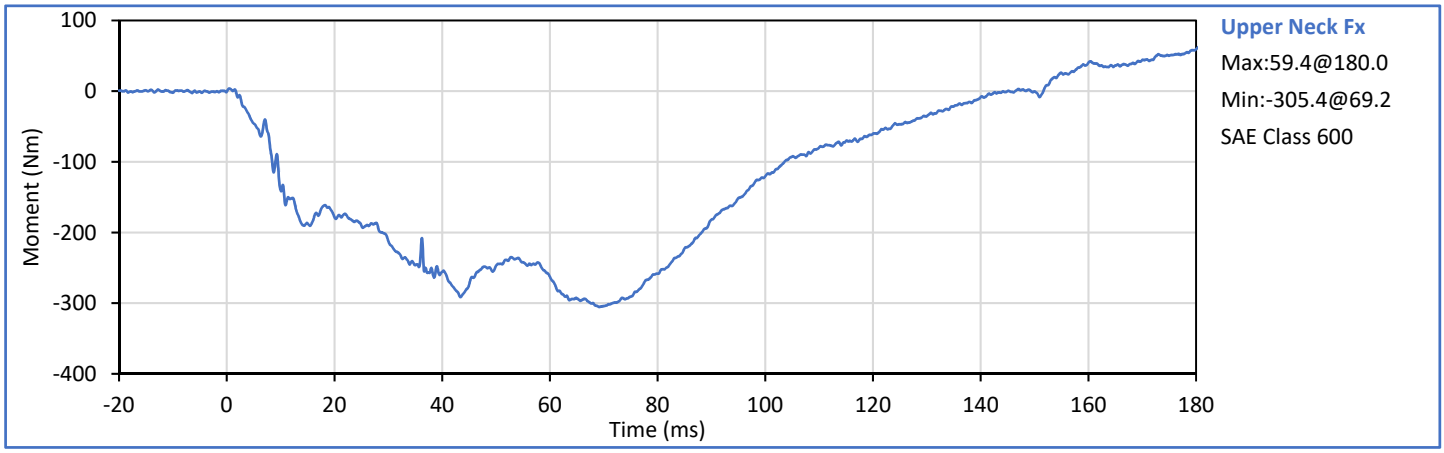
KARCO Engineering
9270 Holly Road, Adelanto, CA 92301
Tel: +1 760 246 1672 Fax: +1 760 246 8112
Info@karco.com www.karco.com

Hybrid III 6 Year-Old Child Dummy
Neck Flexion Test

ATD Serial No.: 186 Test Date: 2019-07-26





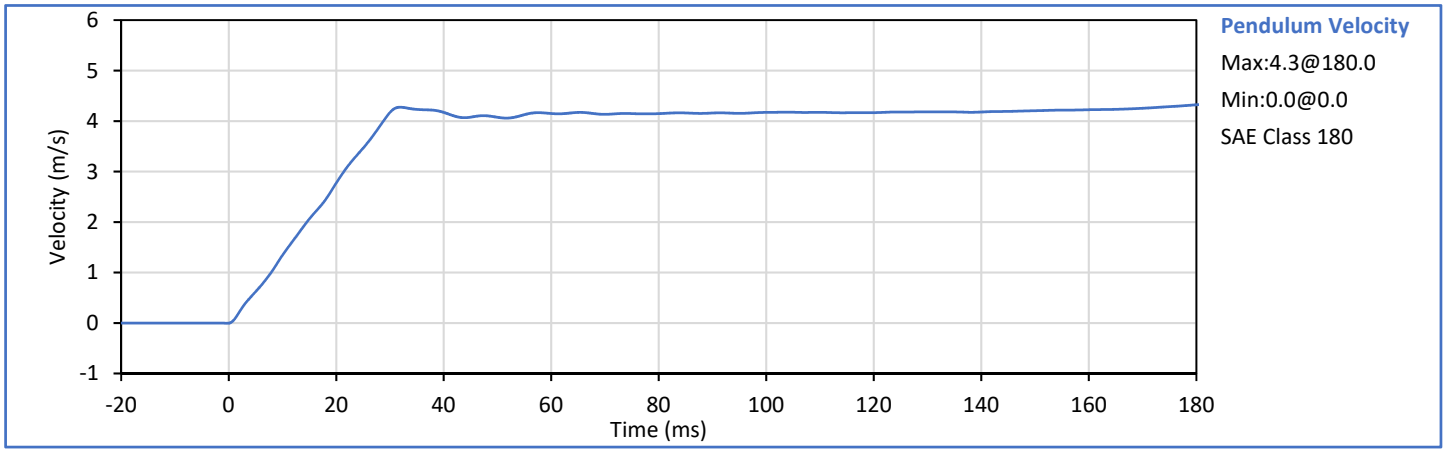


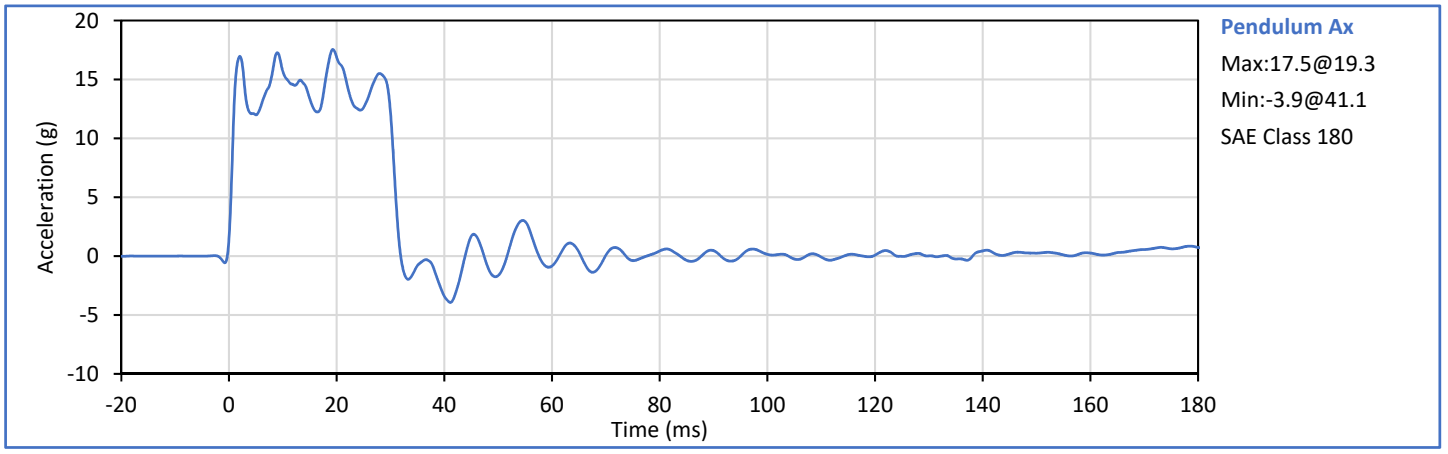
KARCO Engineering
9270 Holly Road, Adelanto, CA 92301
Tel: +1 760 246 1672 Fax: +1 760 246 8112
Info@karco.com www.karco.com

Hybrid III 6 Year-Old Child Dummy
Neck Flexion Test

ATD Serial No.: 186 Test Date: 2019-07-26

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.2	Pass
Laboratory Humidity	%	10	70	39	Pass
Pendulum Velocity	m/s	4.18	4.42	4.21	Pass
Pendulum Velocity at 10 ms	m/s	1.00	1.40	1.34	Pass
Pendulum Velocity at 20 ms	m/s	2.20	3.00	2.77	Pass
Pendulum Velocity at 30 ms	m/s	3.20	4.20	4.17	Pass
Peak Moment in Rotation	Nm	-24.0	-19.0	-22.9	Pass
	deg	85.0	103.0	86.6	Pass
Negative Moment Decay to -5 Nm	ms	123.0	147.0	126.2	Pass
			Overall Test Results		Pass





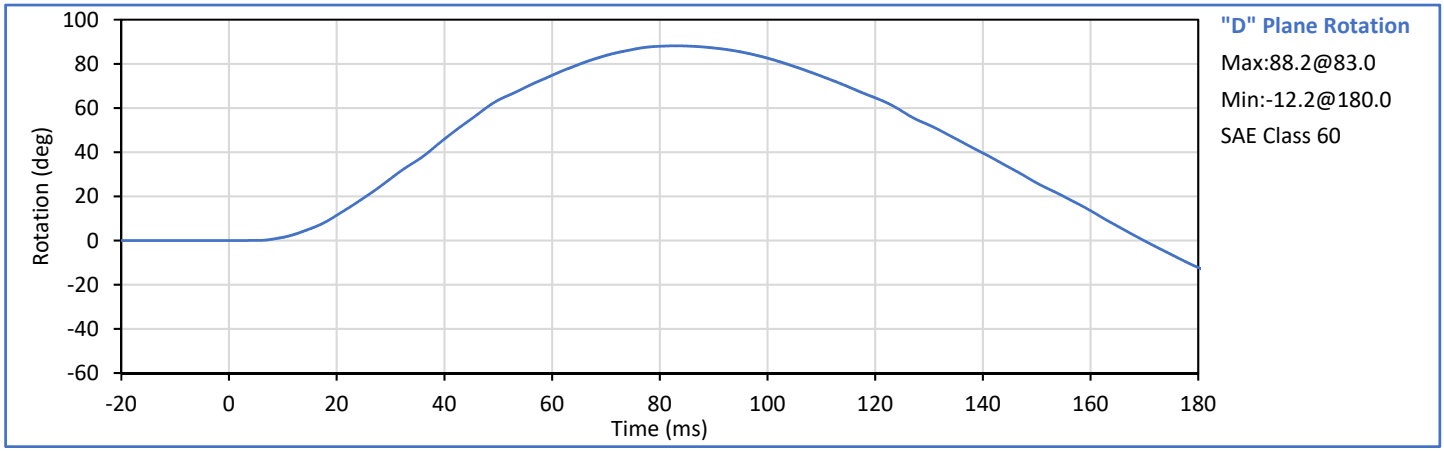
Technician: J. Hernandez

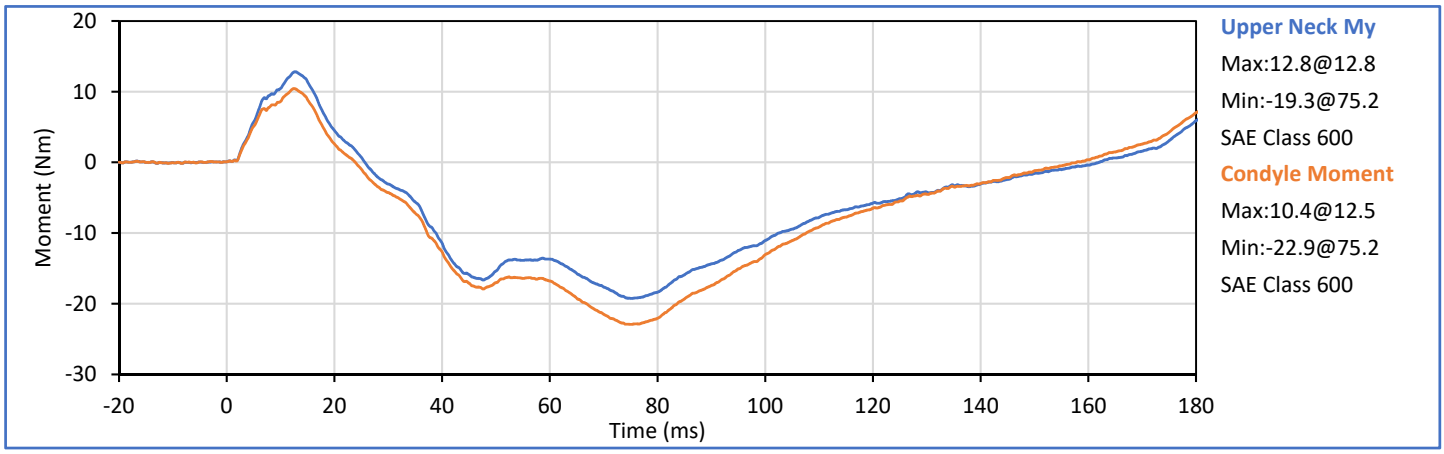
Approved By: P. Puzzuto

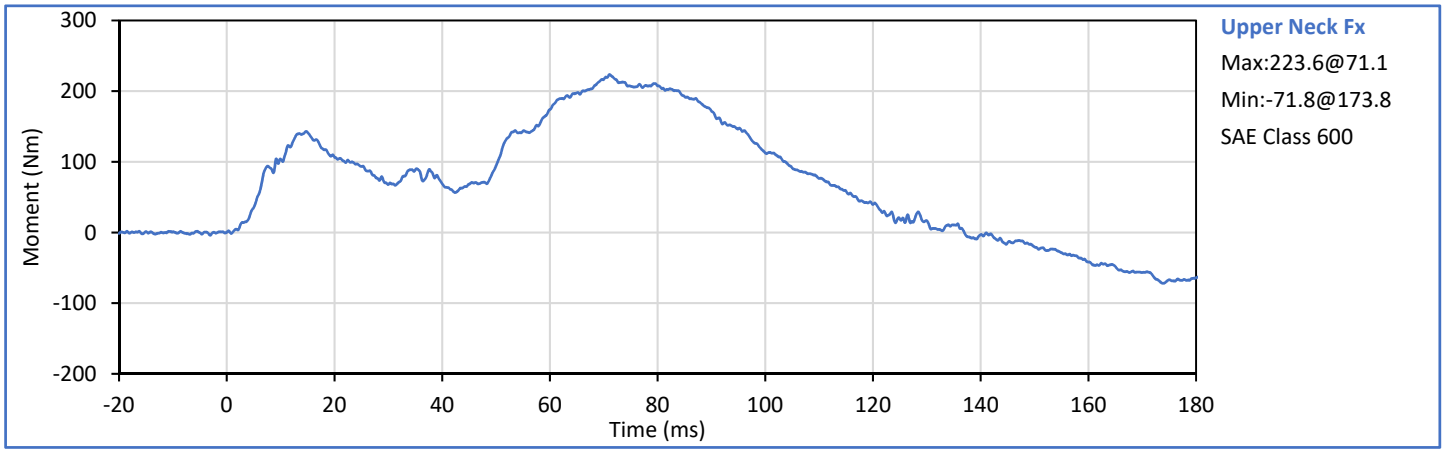
KARCO Engineering
9270 Holly Road, Adelanto, CA 92301
Tel: +1 760 246 1672 Fax: +1 760 246 8112
Info@karco.com www.karco.com

Hybrid III 6 Year-Old Child Dummy
Neck Flexion Test

ATD Serial No.: 186 Test Date: 2019-07-26







APPENDIX D
INSTRUMENTATION DATA CHANNEL ASSIGNMENTS

TWG 3.3.5.1

Test Equipment and Instrumentation Calibration Data

A.T.D. Serial Number 186

08/09/19

2019 Hyundai Kona SE 5-Door MPV

Channel	Location	Axis	Sensor S/N	MFR	Model	Units	Calibration Date
1	Head Acceleration	X	A301106	MSI	64C-2000	g	06/14/19
2	Head Acceleration	Y	A301096	MSI	64C-2000	g	06/14/19
3	Head Acceleration	Z	A301124	MSI	64C-2000	g	06/14/19
4	Upper Neck Force	X	3303 Fx	R.A. Denton	1633	N	04/10/19
5	Upper Neck Force	Y	3303 Fy	R.A. Denton	1633	N	04/10/19
6	Upper Neck Force	Z	3303 Fz	R.A. Denton	1633	N	04/10/19
7	Upper Neck Moment	X	3303 Mx	R.A. Denton	1633	Nm	04/10/19
8	Upper Neck Moment	Y	3303 My	R.A. Denton	1633	Nm	04/10/19
9	Upper Neck Moment	Z	3303 Mz	R.A. Denton	1633	Nm	04/10/19
10	Lower Neck Force	X	180 Fx	R.A. Denton	2430-D	N	12/06/18
11	Lower Neck Force	Y	180 Fy	R.A. Denton	2430-D	N	12/06/18
12	Lower Neck Force	Z	180 Fz	R.A. Denton	2430-D	N	12/06/18
13	Lower Neck Moment	X	180 Mx	R.A. Denton	2430-D	Nm	12/06/18
14	Lower Neck Moment	Y	180 My	R.A. Denton	2430-D	Nm	12/06/18
15	Lower Neck Moment	Z	180 Mx	R.A. Denton	2430-D	Nm	12/06/18