

**REPORT NUMBER: TWG-KAR-19-001**

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

**FCA US LLC  
2019 DODGE GRAND CARAVAN 5-DOOR MINIVAN**

**NHTSA NUMBER: M20190304TWG2**

**PREPARED BY:  
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**AUGUST 2, 2019**


**FINAL REPORT**

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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.

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		<b>15. Supplementary Notes</b>																																	
<b>16. Abstract</b> <p>A side airbag out of position test was conducted on the subject 2019 Dodge Grand Caravan 5-door minivan 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 August 2, 2019.</p> <p>The curtain and torso/pelvis side airbags were deployed and responses were measured on a Hybrid III 3-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 21.1°C</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <thead> <tr> <th colspan="4" style="text-align: center;">Section 3.3.3.2 - HIII 3-Year Old Child Dummy - P2</th> </tr> <tr> <th style="width: 30%;">Measurement Description</th> <th style="width: 10%;">Units</th> <th style="width: 20%;">IARV</th> <th style="width: 40%;">Result</th> </tr> </thead> <tbody> <tr> <td>Head Injury Criteria (HIC<sub>15</sub>)</td> <td>N/A</td> <td>570</td> <td>53</td> </tr> <tr> <td>Nij</td> <td>N/A</td> <td>1</td> <td>0.53</td> </tr> <tr> <td>Neck Tension</td> <td>N</td> <td>1130</td> <td>707.9</td> </tr> <tr> <td>Neck Compression</td> <td>N</td> <td>1380</td> <td>-871.2</td> </tr> <tr> <td>Chest Deflection</td> <td>mm</td> <td>36</td> <td>-13.0</td> </tr> <tr> <td>Chest Deflection Rate</td> <td>m/s</td> <td>8.0</td> <td>-4.4</td> </tr> </tbody> </table>				Section 3.3.3.2 - HIII 3-Year Old Child Dummy - P2				Measurement Description	Units	IARV	Result	Head Injury Criteria (HIC <sub>15</sub> )	N/A	570	53	Nij	N/A	1	0.53	Neck Tension	N	1130	707.9	Neck Compression	N	1380	-871.2	Chest Deflection	mm	36	-13.0	Chest Deflection Rate	m/s	8.0	-4.4
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## **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 Dodge Grand Caravan 5-door minivan with an out-of-position Hybrid III 3-year old crash test dummy were evaluated. The test was performed at Applus+ IDIADA KARCO Engineering, LLC. on July 19, 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 3-year old anthropomorphic test device (ATD) was placed in the right front passenger seating position, along the outboard edge of the seat cushion, kneeling and facing rearward according to the dummy placement instructions (3.3.3.2) in the July 2003 Revision of the Technical Working Group's 'Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags'.

The 3-year old ATD was instrumented with head tri-axial accelerometers, upper and lower neck force and moment transducers, and a chest potentiometer.

The airbags were deployed and sixteen (16) 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 3-year old dummy was with the dummy facing rearward. The seat is set at the 117 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 is placed on the along the outboard edge of the seat cushion, kneeling and facing rearward. The vertical centerline of the dummy's sternum was aligned as close as possible with the leading edge of the seat back bolster. The sternum contacted the seat. The dummy's head was placed in between the seat bolster and b-pillar trim to maximize contact between the sternum and the seatback. The head remained in a neutral orientation while in this position. This orientation complies with section 3.3.3.2 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 3-year old dummy's visible contact points were as follows: The ATD's head contacted the curtain airbag and seatback. The ATD's torso contacted the torso/pelvis airbag, seat pan, and seatback. The ATD's pelvis contacted the torso/pelvis airbag, seat pan, and door panel. The ATD's left knee contacted the seat pan and door panel. The ATD's right knee contacted the seat pan.

The occupant data is summarized below:

Measurement Description	Units	Passenger ATD (HIII 3YO)	
		IARV	Result
Head Injury Criteria (HIC15)	N/A	570	53.0
Upper Neck Nij	N/A	1	0.53
Upper Neck Peak Tension	N	1130	544.6
Upper Neck Peak Compression	N	1380	-462.4
Chest Deflection	mm	36	-13.0
Chest Deflection Rate	m/s	8	-4.4

## SECTION 2

### OCCUPANT AND VEHICLE INFORMATION / DATA SHEETS

Test Vehicle: 2019 Dodge Grand Caravan 5-Door Minivan NHTSA No.: M20190304TWG2

Test Program: TWG 3.3.3.2 Test Date: 07/19/19

#### 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 <sup>2</sup>	kPa	6.895
Temperature	General Use	°F	°C	$=(T_f - 32)/1.8$
Force	Dynamic Forces	lbf	N	4.448
Moment	Torque	lbf-ft	N•m	1.355

## DATA SHEET NO. 1

### TEST SUMMARY

Test Vehicle: 2019 Dodge Grand Caravan 5-Door Minivan NHTSA No.: M20190304TWG2  
Test Program: TWG 3.3.3.2 Test Date: 07/19/19

### TEST DUMMY INFORMATION

Description	Passenger Seat
Dummy Type / Serial No.	3-year old / 044
Head Contact	Curtain Airbag
Chest Contact	Torso/Pelvis Airbag
Abdomen Contact	Torso/Pelvis Airbag
Pelvis Contact	Torso/Pelvis Airbag
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
Chest Potentiometer	1
Total	16



**DATA SHEET NO. 2**

**GENERAL TEST AND VEHICLE PARAMETER DATA**

Test Vehicle: 2019 Dodge Grand Caravan 5-Door Minivan NHTSA No.: M20190304TWG2  
 Test Program: TWG 3.3.3.2 Test Date: 07/19/19

**TEST VEHICLE INFORMATION AND OPTIONS**

NHTSA Number	M20190304TWG2
Model Year	2019
Make	Dodge
Model	Grand Caravan
Body Style	5-Door Minivan
VIN	2C4RDGBG8KR547041
Body Color	Octane Red Pearl
Odometer Reading (km / mi)	95 / 59
Engine Displacement (L)	3.6
Type / No. of Cylinders	Inline / 6
Engine Placement	Longitudinal
Transmission Type	Automatic
Transmission Speeds	9
Overdrive	Yes
Final Drive	FWD
Roof Rack	No
Sunroof / T-Top	No
Running Boards	No
Tilt Steering Wheel	Yes
Power Seats	Yes
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	Yes
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	Yes
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?

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**DATA FROM CERTIFICATION LABEL**

Manufactured By	FCA US LLC
Date of Manufacture	9/18
Vehicle Type	MPV

GVWR (kg)	2745
GAWR Front (kg)	1339
GAWR Rear (kg)	1407

**VEHICLE SEATING AND CAPACITY WEIGHT INFORMATION**

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Bench	Bench	
Designated Seating Capacity	2	2	3	7
Capacity Weight (VCW) (kg)				521.0
DSC x 68.04 (kg)				476.3
Cargo Weight (RCLW) (kg)				44.7

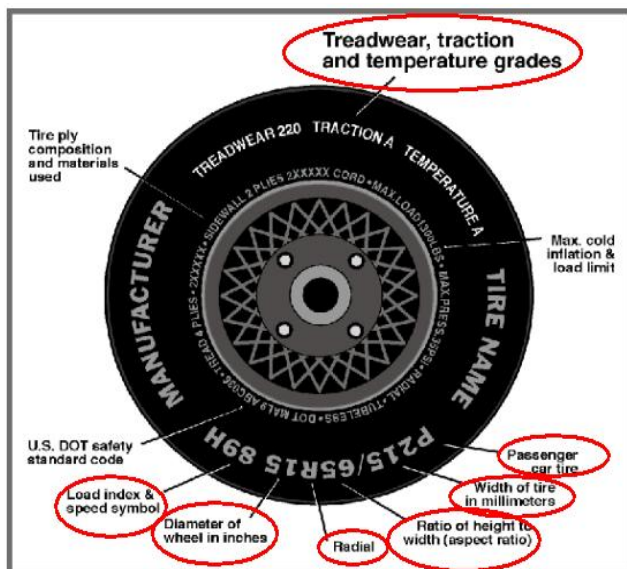
A  
B  
A-B

\*Vehicle underwent New Car Assessment Program Side MDB Impact Testing on December 18, 2018.

## DATA SHEET NO. 2 ... (CONTINUED)

### GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2019 Dodge Grand Caravan 5-Door Minivan NHTSA No.: M20190304TWG2  
 Test Program: TWG 3.3.3.2 Test Date: 07/19/19



### VEHICLE TIRE INFORMATION

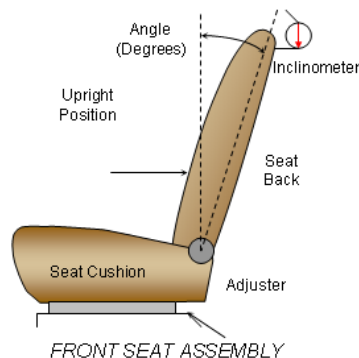
Measured Parameter	Front	Rear
Max. Tire Pressure (kpa)	300	300
Cold Pressure (kPa)	250	250
Recommended Tire Size	P225/65R17	P225/65R17
Tire Size on Vehicle	P225/65R17	P225/65R17
Tire Manufacturer	Michelin	Michelin
Tire Model	Energy Saver A/S	Energy Saver A/S
Treadware	400	400
Traction Grade	A	A
Temperature Grade	B	B
Tire Plies Sidewall	1 Polyester	1 Polyester
Tire Plies Body	1 Polyester, 2 Steel, 1 Polyamide	1 Polyester, 2 Steel, 1 Polyamide
Load Index/Speed Symbol	100 T	100 T
Tire Material	Polyester, Steel, Polyamide	Polyester, Steel, Polyamide
DOT Safety Code Left	M33T 00KW 3218	M33T 00KW 3218
DOT Safety Code Right	M33T 00KW 3218	M33T 00KW 3218

**DATA SHEET NO. 3**  
**SEAT ADJUSTMENTS**

Test Vehicle: 2019 Dodge Grand Caravan 5-Door Minivan NHTSA No.: M20190304TWG2  
 Test Program: TWG 3.3.3.2 Test Date: 07/19/19

**SEAT BACK ANGLE**

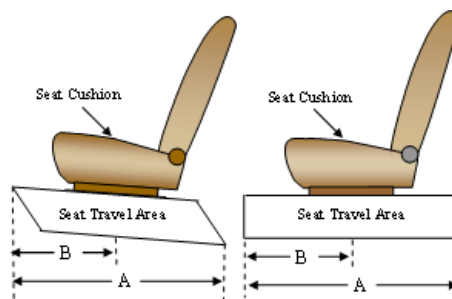
The passenger seat back is positioned per section 3.3.3.2 of the TWG recommendation in the Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags. Seat back angle is measured at the headrest post.



Seating Position	Degrees
Passenger Seat	8.4

**SEAT FORE / AFT POSITIONING**

The passenger seat track travel is set per section 3.3.3.2 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	220	33	117	18

**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	3	H

**DATA SHEET NO. 4**

**DUMMY POSITIONING AND AIRBAG DIMENSIONS**

Test Vehicle: 2019 Dodge Grand Caravan 5-Door Minivan NHTSA No.: M20190304TWG2  
 Test Program: TWG 3.3.3.2 Test Date: 07/19/19

**DUMMY POSITIONING**

Code	Measurement Description	Passenger	
		Length (mm)	Angle (°)
SA	Seat Back Angle		8.4
AN	Top of Airbag Module to Head/Neck Junction	50	90.0
HD	Head CG to Door Panel/ Window	180	0.0
HSC	Head to Seat Back Centerline	130	0.0
HB	Head to B-Pillar (measured from bridge of nose)	65	28.3
HZ	Head to Roof (Z)	385	90.0
HHD	Head to Side Header	451	29.1
ND	Nose to Dash	681	27.1
NS	Nose to Seat Back	0	0.0
NR	Nose to Header	640	34.9
CD	Chest to Dash	546	12.1
CS	Chest to Seat Back (measured to centerline)	0	0.0
RACL	Right Arm to Seat Back Centerline	58	0.0
LACL	Left Arm to Seat Back Centerline	320	0.0
RA	Right Arm to Door Panel	265	0.0
LA	Left Arm to Door Panel	0	0.0
KK	Knee to Knee	135	0.0
TT	Toe to Toe	165	0.0
KSCR	Right Knee to Seat Cushion Centerline	102	0.0
KSCL	Left Knee to Seat Cushion Centerline	230	0.0
	Head Level (X Direction)		
	Head Level (Y Direction)		

**AIRBAG DIMENSIONS**

Code	Measurement Description	Airbag
		Length (mm)
AMW	Curtain Airbag Module Diameter	38
AML	Curtain Airbag Module Length	397
ABW	Curtain Airbag Width	1790
ABL	Curtain Airbag Length	110
AMW	Torso/Pelvis Airbag Module Diameter	25
AML	Torso/Pelvis Airbag Module Length	135
ABW	Torso/Pelvis Airbag Width	450
ABL	Torso/Pelvis Airbag Length	130

**DATA SHEET NO. 5**

**DUMMY INJURY CRITERIA AND PERFORMANCE DATA**

Test Vehicle: 2019 Dodge Grand Caravan 5-Door Minivan NHTSA No.: M20190304TWG2

Test Program: TWG 3.3.3.2 Test Date: 07/19/19

**HEAD PEAK ACCELERATIONS / CHEST DEFLECTIONS**

Location	Axis	Units	3 Year Old			
			Max	Time	Min	Time
Head CG	X	g	25.9	26.0	-15.5	114.3
Head CG	Y	g	12.1	49.6	-56.4	18.1
Head CG	Z	g	48.0	18.1	-8.7	19.5
Head CG Resultant	N/A	g	76.9	18.1		
Chest Deflection	X	mm	1.3	20.6	-13.0	10.2
Chest Deflection Rate	X	m/s	3.1	13.9	-4.4	9.4

**UPPER NECK PEAK FORCES AND MOMENTS**

Location	Axis	Units	3 Year Old			
			Max	Time	Min	Time
Neck Force	X	N	79.3	9.0	-226.1	23.6
Neck Force	Y	N	348.2	29.0	-211.2	14.1
Neck Force	Z	N	544.6	30.1	-462.4	18.9
Neck Force Resultant	N/A	N	615.0	32.2		
Neck Moment	X	Nm	17.1	43.6	-27.1	22.8
Neck Moment	Y	Nm	3.5	9.3	-9.8	23.2
Neck Moment	Z	Nm	3.8	141.8	-5.8	38.9
Neck Moment Resultant	N/A	Nm	28.9	22.8		

**LOWER NECK PEAK FORCES AND MOMENTS**

Location	Axis	Units	3 Year Old			
			Max	Time	Min	Time
Neck Force	X	N	99.3	7.7	-227.3	27.5
Neck Force	Y	N	315.9	32.0	-359.0	11.9
Neck Force	Z	N	707.9	29.4	-871.2	27.5
Neck Force Resultant	N/A	N	904.1	27.5		
Neck Moment	X	Nm	31.3	49.1	-30.6	15.3
Neck Moment	Y	Nm	7.4	260.6	-6.6	9.9
Neck Moment	Z	Nm	3.5	136.1	-8.5	36.8
Neck Moment Resultant	N/A	Nm	32.1	49.0		

**HEAD INJURY CRITERIA (HIC15)**

Location	3 Year Old			
	HIC15	T <sup>1</sup>	T <sup>2</sup>	Avg G
Head CG	53.0	17.9	32.9	26.2

**UPPER NECK NIJ VALUES**

Location	3 Year Old			
	Ntf	Nte	Ncf	Nce
Upper Neck	0.18	0.53	0.06	0.50

## DATA SHEET NO. 6

### HIGH SPEED CAMERA LOCATIONS AND DATA

Test Vehicle: 2019 Dodge Grand Caravan 5-Door Minivan NHTSA No.: M20190304TWG2  
Test Program: TWG 3.3.3.2 Test Date: 07/19/19

#### CAMERA LOCATIONS

No.	Camera View	Location (mm)			Angle (Deg.)	Lens (mm)	Speed (fps)
		X	Y	Z			
1	High Speed Side View	406	2230	240	7.5	24	1000
2	High Speed 3/4 View	2240	1340	550	11.9	50	1000
3	High Speed Front View	2600	300	553	12.7	50	1000
4	Real Time	406	2230	453	7.5		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**

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FIGURE 1. Right Front 3/4 View, As Received



FIGURE 2. Vehicle Certification Label



FIGURE 3. Post-Test Left Front 3/4 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 3/4 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,  $\frac{3}{4}$  View



FIGURE 10. Post-Test Dummy Position,  $\frac{3}{4}$  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

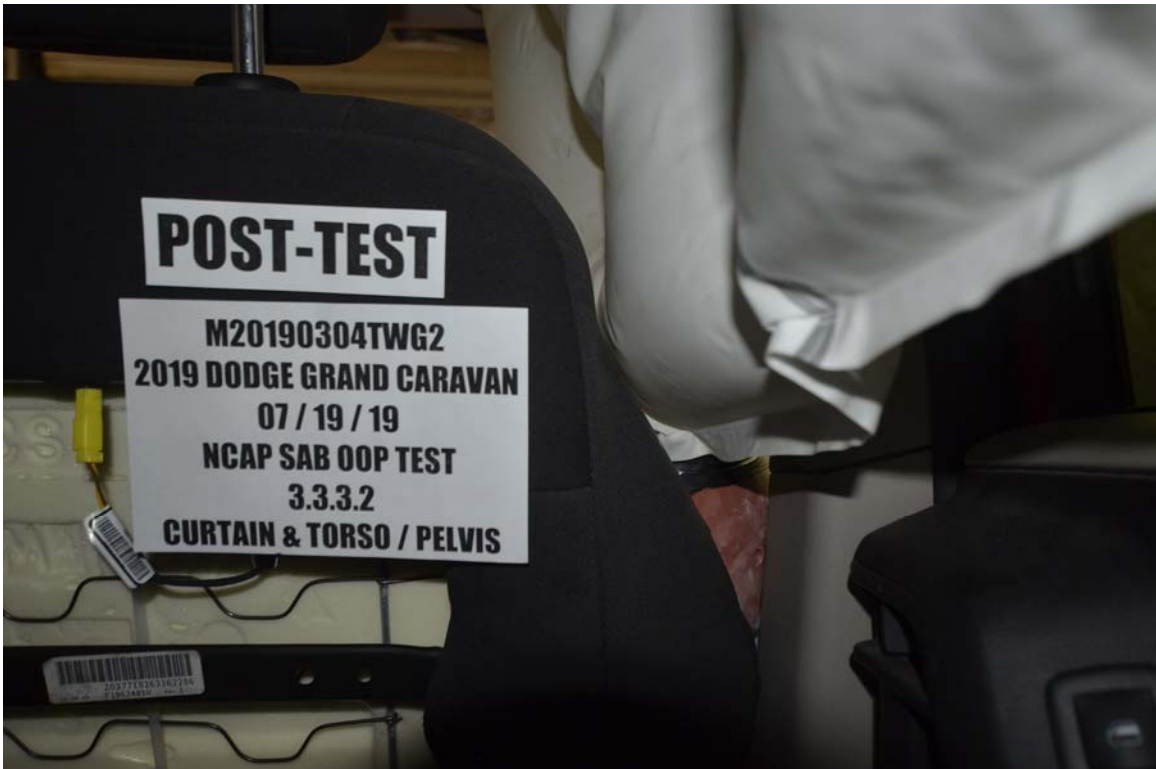


FIGURE 16. Post-Test Dummy Position, Close-Up Rear View





FIGURE 17. Post-Test Airbags, Left Side View



FIGURE 18. Post-Test Airbags, Left Front 3/4 View

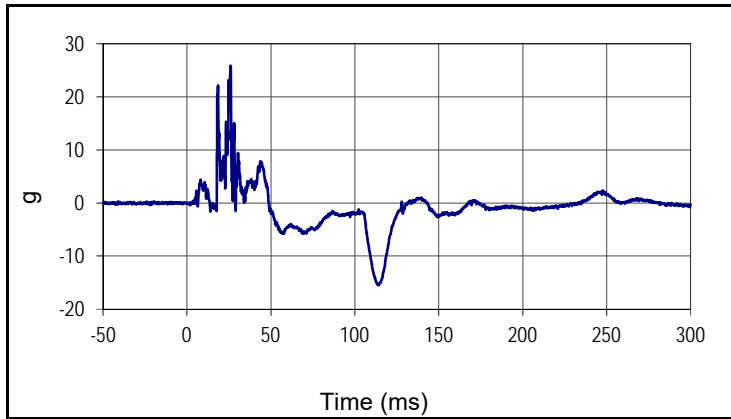
**APPENDIX B**  
**DUMMY RESPONSE DATA TRACES**

## TABLE OF DATA PLOTS

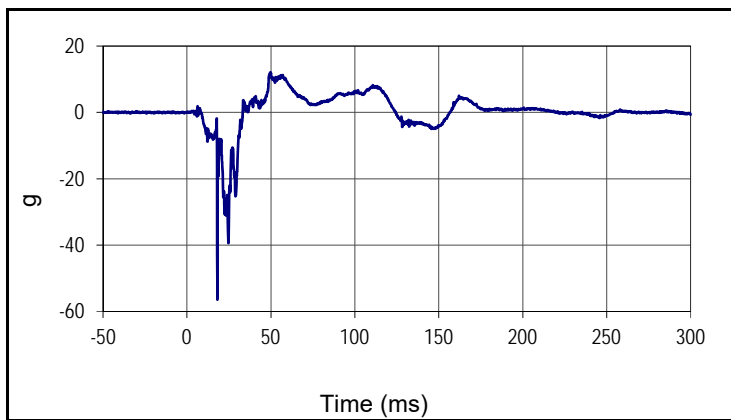
<u>Plot</u>		<u>Page</u>
1	3 Yr. Old Head Acceleration X	B-1
2	3 Yr. Old Head Acceleration Y	B-1
3	3 Yr. Old Head Acceleration Z	B-1
4	3 Yr. Old Head Acceleration Resultant	B-1
5	3 Yr. Old Upper Neck Force X	B-2
6	3 Yr. Old Upper Neck Force Y	B-2
7	3 Yr. Old Upper Neck Force Z	B-2
8	3 Yr. Old Upper Neck Force Resultant	B-2
9	3 Yr. Old Upper Neck Moment X	B-3
10	3 Yr. Old Upper Neck Moment Y	B-3
11	3 Yr. Old Upper Neck Moment Z	B-3
12	3 Yr. Old Upper Neck Moment Resultant	B-3
13	3 Yr. Old Lower Neck Force X	B-4
14	3 Yr. Old Lower Neck Force Y	B-4
15	3 Yr. Old Lower Neck Force Z	B-4
16	3 Yr. Old Lower Neck Force Resultant	B-4
17	3 Yr. Old Lower Neck Moment X	B-5
18	3 Yr. Old Lower Neck Moment Y	B-5
19	3 Yr. Old Lower Neck Moment Z	B-5
20	3 Yr. Old Lower Neck Moment Resultant	B-5
21	3 Yr. Old Chest Displacement X	B-6
22	3 Yr. Old Chest Deflection Rate	B-6

Test Vehicle: 2019 Dodge Grand Caravan 5-Door Minivan  
 Test Program: TWG 3.3.3.2

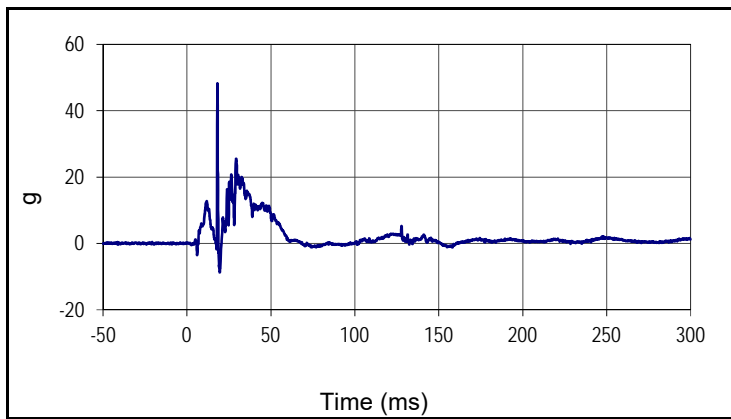
Test Date: 07/19/19  
 NHTSA No.: M20190304TWG2



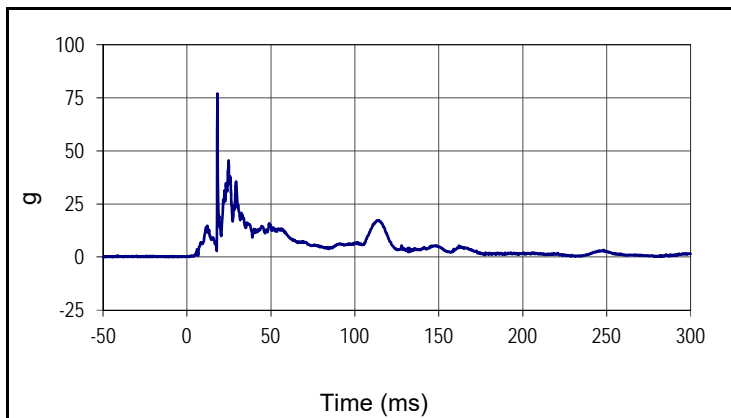
Curve Description			
3 Year Old Head Acceleration X			
Plot No.		SAE Class	Units
001		1000	g
Max	Time	Min	Time
25.9	26.0	-15.5	114.3



Curve Description			
3 Year Old Head Acceleration Y			
Plot No.		SAE Class	Units
002		1000	g
Max	Time	Min	Time
12.1	49.6	-56.4	18.1



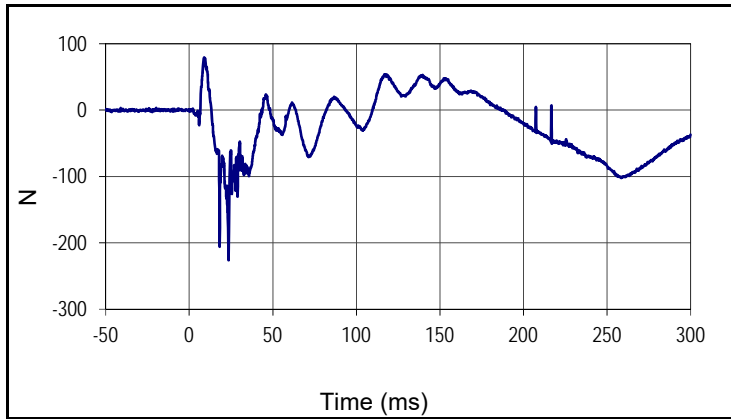
Curve Description			
3 Year Old Head Acceleration Z			
Plot No.		SAE Class	Units
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Max	Time	Min	Time
48.0	18.1	-8.7	19.5



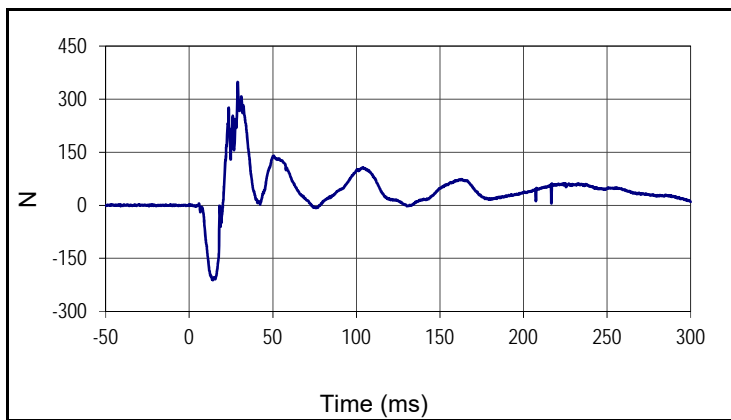
Curve Description			
3 Year Old Head Acceleration Resultant			
Plot No.		SAE Class	Units
004		1000	g
Max	Time	Min	Time
76.9	18.1	0.0	1.4

Test Vehicle: 2019 Dodge Grand Caravan 5-Door Minivan  
 Test Program: TWG 3.3.3.2

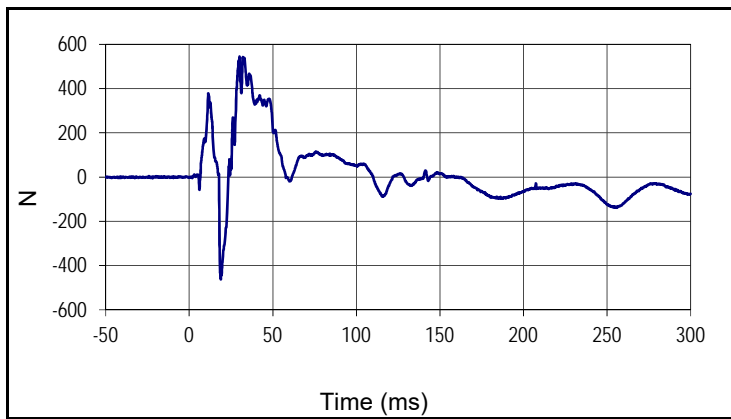
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 NHTSA No.: M20190304TWG2



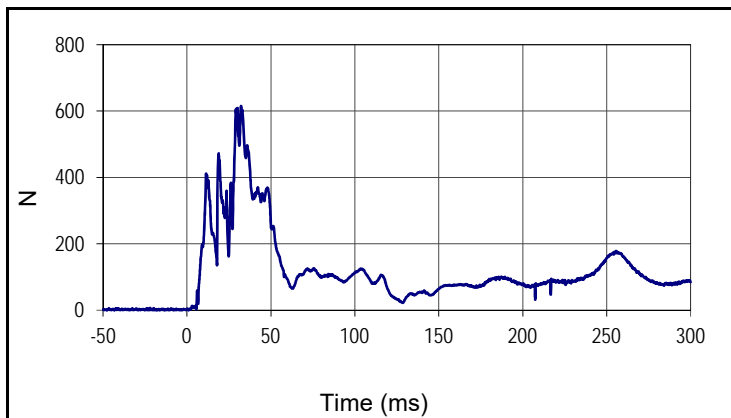
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Plot No.		SAE Class	Units
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Max	Time	Min	Time
79.3	9.0	-226.1	23.6



Curve Description			
3 Year Old Upper Neck Force Y			
Plot No.		SAE Class	Units
006		1000	N
Max	Time	Min	Time
348.2	29.0	-211.2	14.1



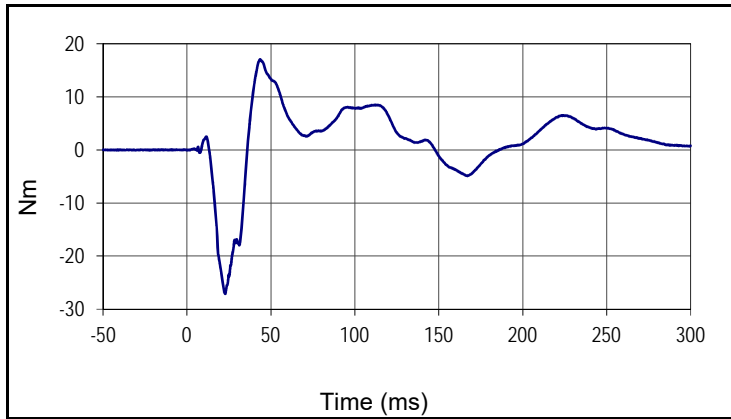
Curve Description			
3 Year Old Upper Neck Force Z			
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Max	Time	Min	Time
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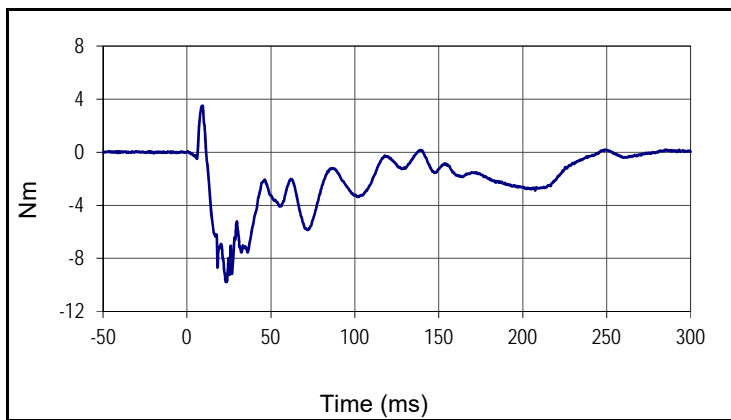
Curve Description			
3 Year Old Upper Neck Force Resultant			
Plot No.		SAE Class	Units
008		1000	N
Max	Time	Min	Time
615.0	32.2	0.3	1.1

Test Vehicle: 2019 Dodge Grand Caravan 5-Door Minivan  
 Test Program: TWG 3.3.3.2

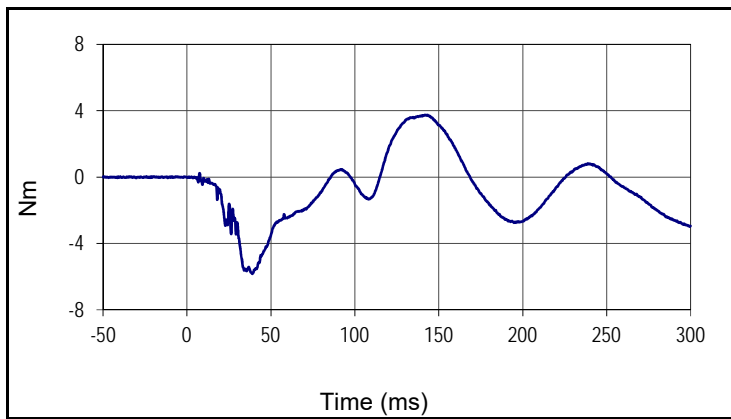
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 NHTSA No.: M20190304TWG2



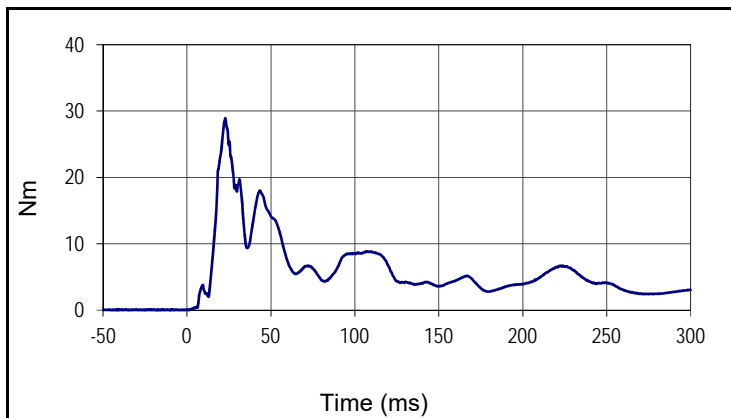
Curve Description			
3 Year Old Upper Neck Moment X			
Plot No.		SAE Class	Units
009		600	Nm
Max	Time	Min	Time
17.1	43.6	-27.1	22.8



Curve Description			
3 Year Old Upper Neck Moment Y			
Plot No.		SAE Class	Units
010		600	Nm
Max	Time	Min	Time
3.5	9.3	-9.8	23.2



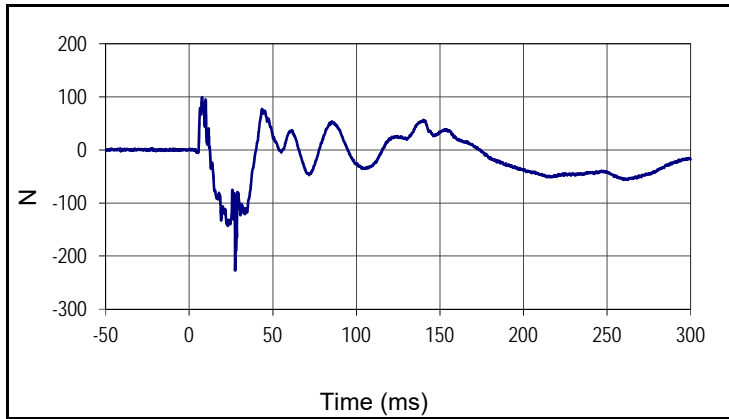
Curve Description			
3 Year Old Upper Neck Moment Z			
Plot No.		SAE Class	Units
011		600	Nm
Max	Time	Min	Time
3.8	141.8	-5.8	38.9



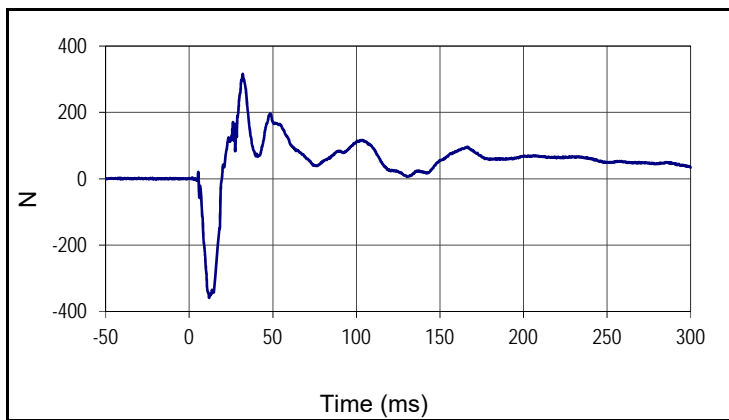
Curve Description			
3 Year Old Upper Neck Moment Resultant			
Plot No.		SAE Class	Units
012		1000	Nm
Max	Time	Min	Time
28.9	22.8	0.0	1.4

Test Vehicle: 2019 Dodge Grand Caravan 5-Door Minivan  
 Test Program: TWG 3.3.3.2

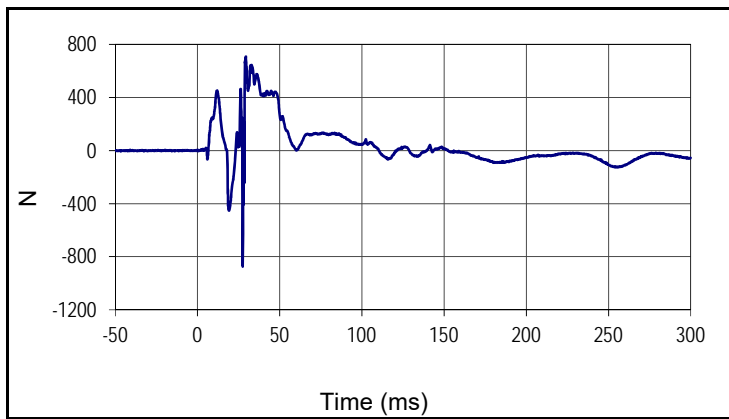
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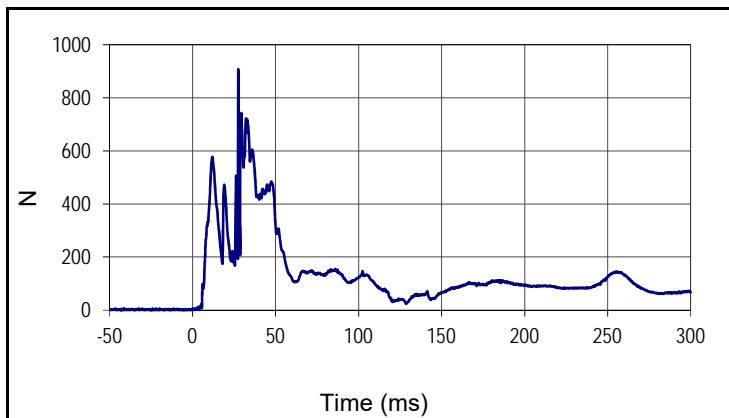
Curve Description			
3 Year Old Lower Neck Force X			
Plot No.		SAE Class	Units
013		1000	N
Max	Time	Min	Time
99.3	7.7	-227.3	27.5



Curve Description			
3 Year Old Lower Neck Force Y			
Plot No.		SAE Class	Units
014		1000	N
Max	Time	Min	Time
315.9	32.0	-359.0	11.9



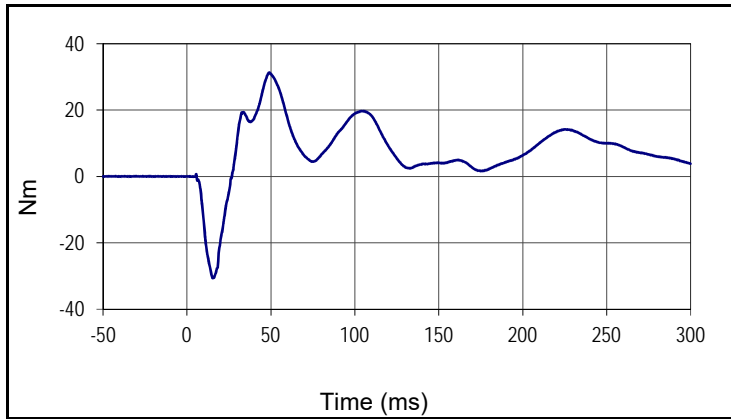
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3 Year Old Lower Neck Force Z			
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015		1000	N
Max	Time	Min	Time
707.9	29.4	-871.2	27.5



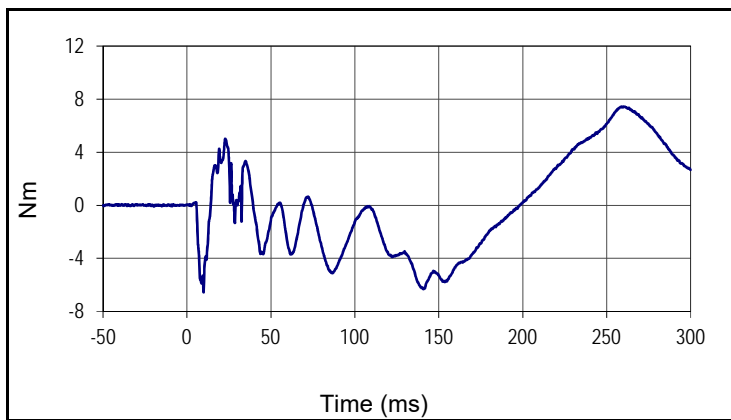
Curve Description			
3 Year Old Lower Neck Force Resultant			
Plot No.		SAE Class	Units
016		1000	N
Max	Time	Min	Time
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Test Vehicle: 2019 Dodge Grand Caravan 5-Door Minivan  
 Test Program: TWG 3.3.3.2

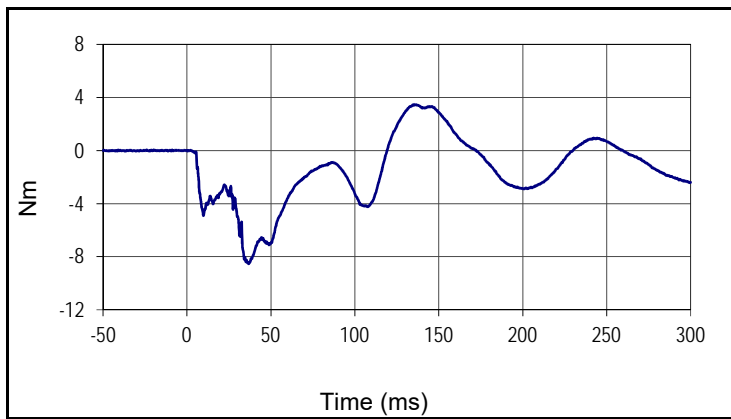
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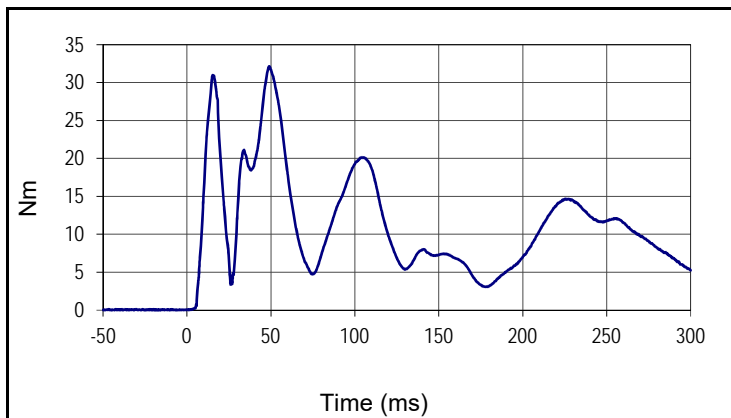
Curve Description			
3 Year Old Lower Neck Moment X			
Plot No.		SAE Class	Units
017		600	Nm
Max	Time	Min	Time
31.3	49.1	-30.6	15.3



Curve Description			
3 Year Old Lower Neck Moment Y			
Plot No.		SAE Class	Units
018		600	Nm
Max	Time	Min	Time
7.4	260.6	-6.6	9.9



Curve Description			
3 Year Old Lower Neck Moment Z			
Plot No.		SAE Class	Units
019		600	Nm
Max	Time	Min	Time
3.5	136.1	-8.5	36.8

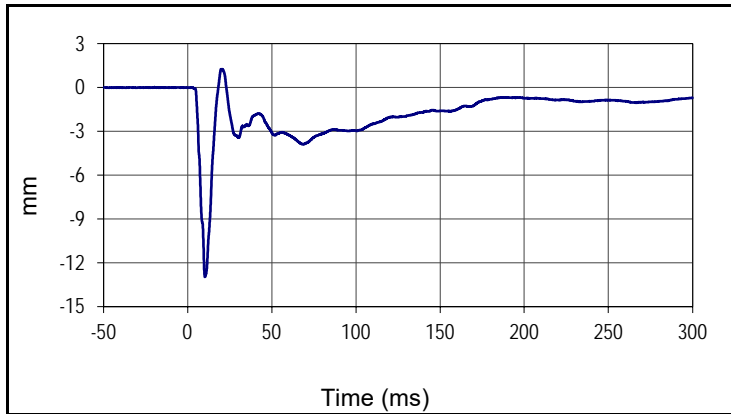


Curve Description			
3 Year Old Lower Neck Moment Resultant			
Plot No.		SAE Class	Units
020		600	Nm
Max	Time	Min	Time
32.1	49.0	0.0	1.0

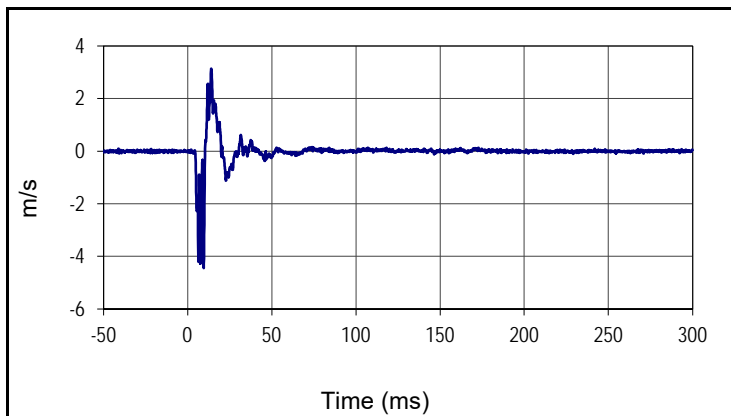


Test Vehicle: 2019 Dodge Grand Caravan 5-Door Minivan  
 Test Program: TWG 3.3.3.2

Test Date: 07/19/19  
 NHTSA No.: M20190304TWG2



Curve Description			
3 Year Old Chest Displacement X			
Plot No.		SAE Class	Units
021		600	mm
Max	Time	Min	Time
1.3	20.6	-13.0	10.2

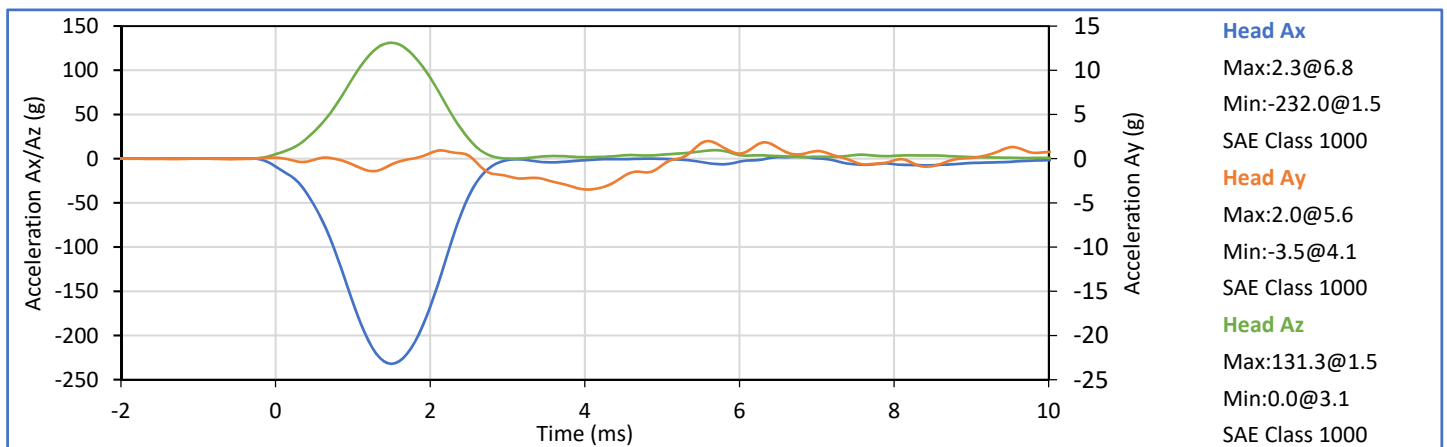
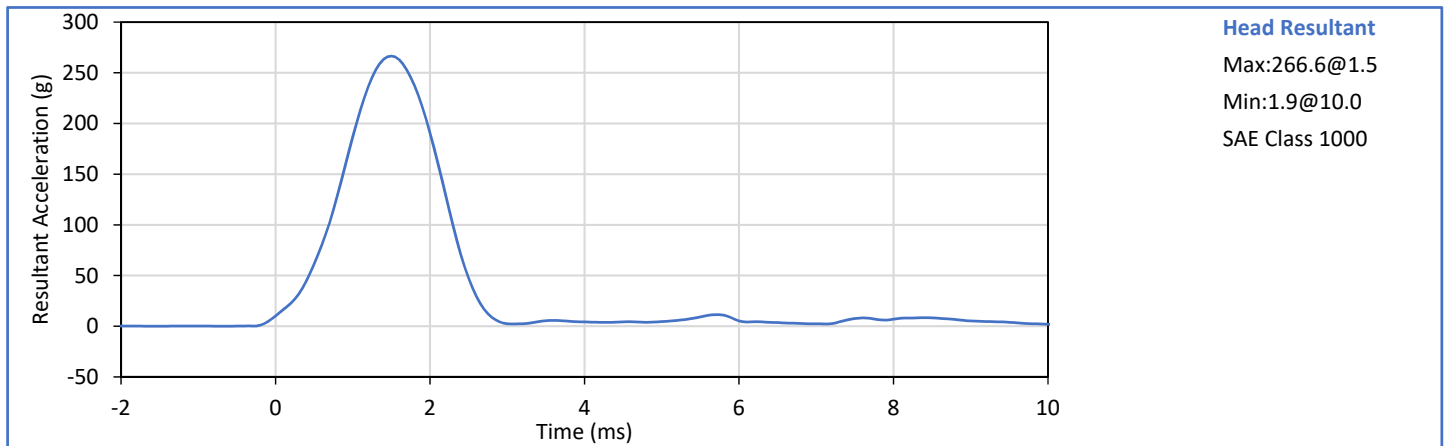


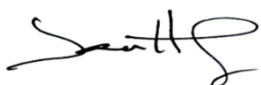
Curve Description			
3 Year Old Chest Deflection Rate			
Plot No.		SAE Class	Units
022		600	m/s
Max	Time	Min	Time
3.1	13.9	-4.4	9.4


**APPENDIX C**  
**ATD CONFIGURATION AND PERFORMANCE VERIFICATION DATA**

**APPENDIX C**  
**Pre-Test ATD Configuration And Performance Verification Data**  
**Hybrid III 3 Year-Old Child ATD**  
**S/N: 044**

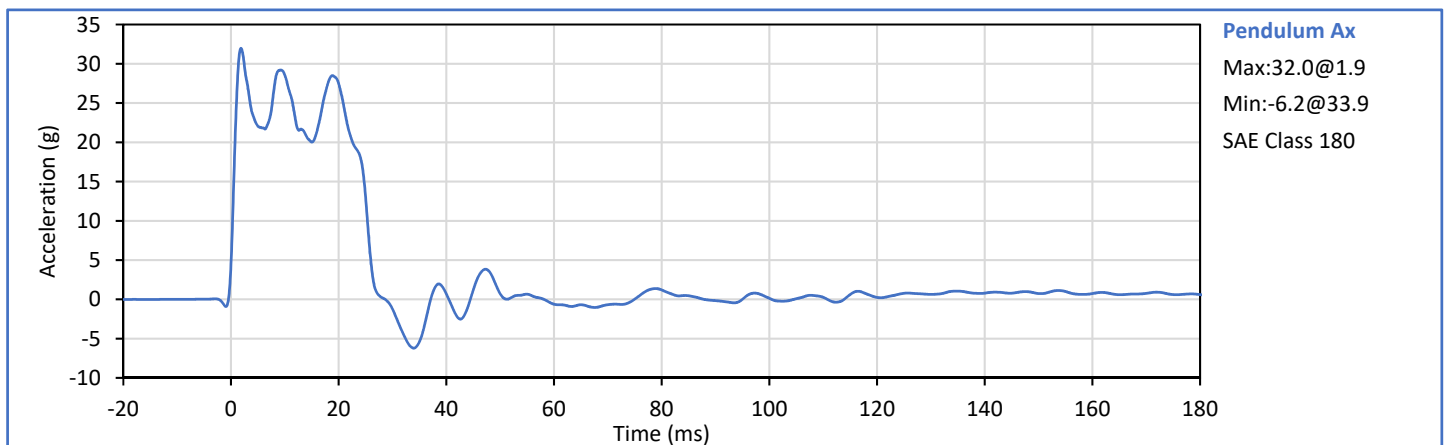
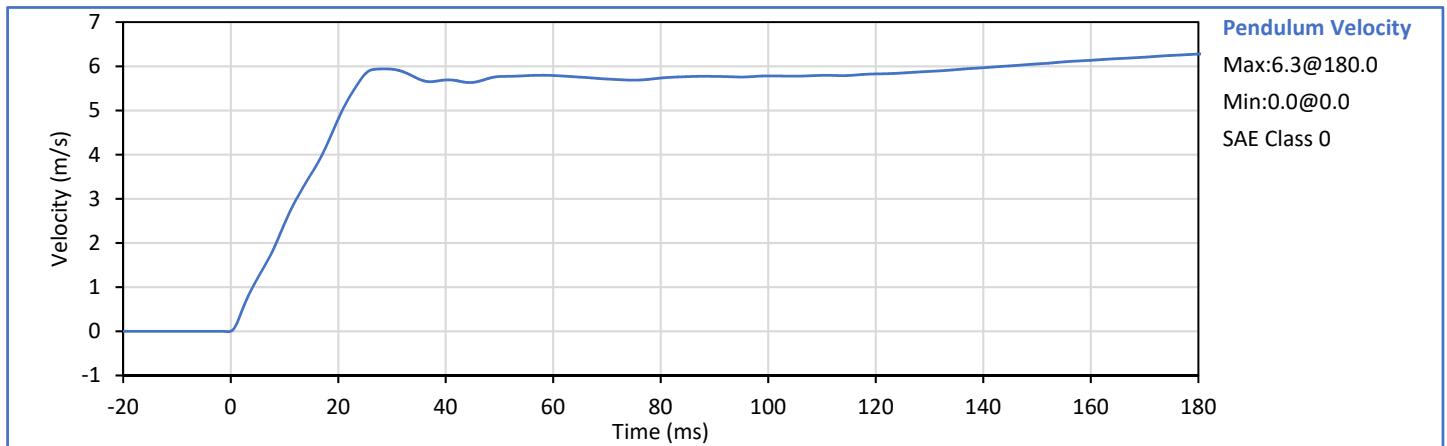
Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	18.9	25.6	21.1	Pass
Laboratory Humidity	%	10	70	29	Pass
Peak Resultant Acceleration	g	250.0	280.0	266.6	Pass
Peak Lateral Acceleration	g	-15.0	15.0	-3.5	Pass
Oscillations After Main Pulse	%	0.0	10.0	4.3	Pass
Is Acceleration Unimodal?	Yes/No	Yes		Yes	Pass
<b>Overall Test Results</b>					<b>Pass</b>





Technician:   
J. Hernandez

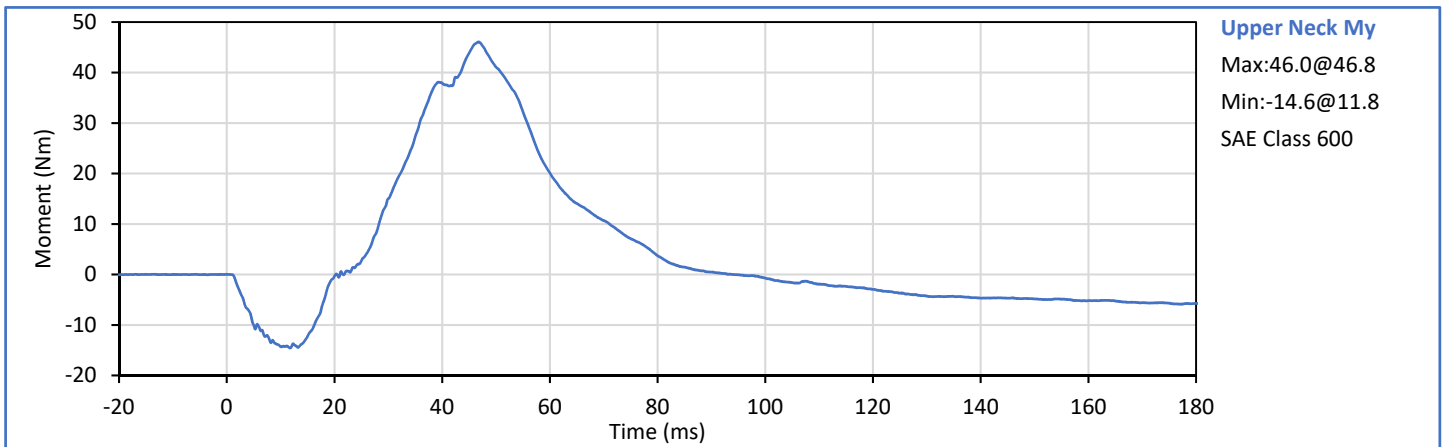
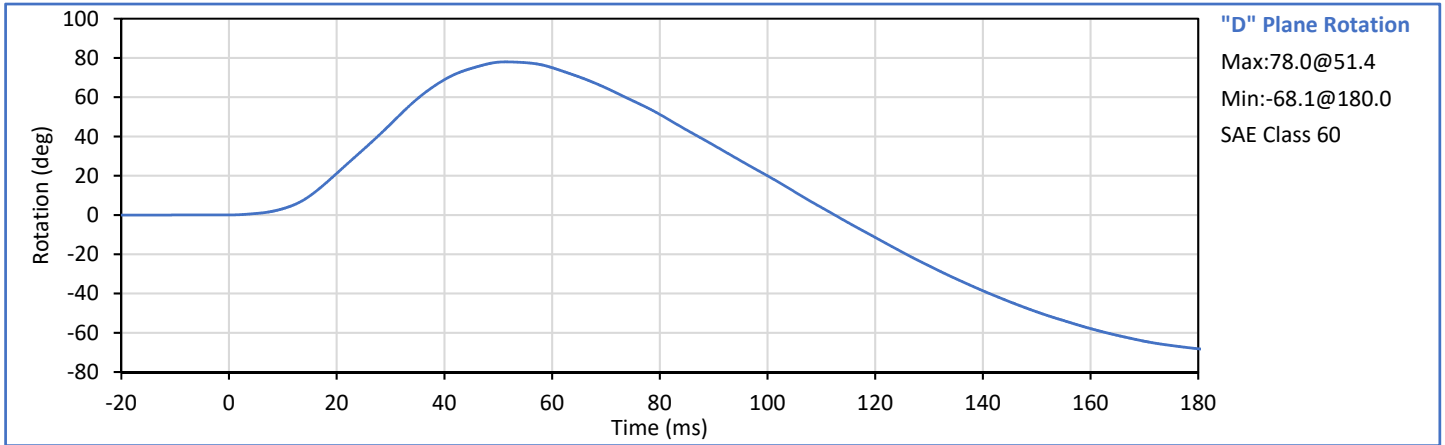
Approved By:   
P. Puzzuto

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Humidity	%	10	70	31	Pass
Pendulum Velocity	m/s	5.40	5.60	5.55	Pass
Pendulum Velocity at 10 ms	m/s	2.00	2.70	2.44	Pass
Pendulum Velocity at 15 ms	m/s	3.00	4.00	3.57	Pass
Pendulum Velocity at 20 ms	m/s	4.00	5.10	4.81	Pass
Peak Moment in Rotation	Nm	42.0	53.0	46.0	Pass
	deg	70.0	82.0	76.1	Pass
Positive Moment Decay to 10 Nm	ms	60.0	80.0	71.1	Pass
Overall Test Results					Pass

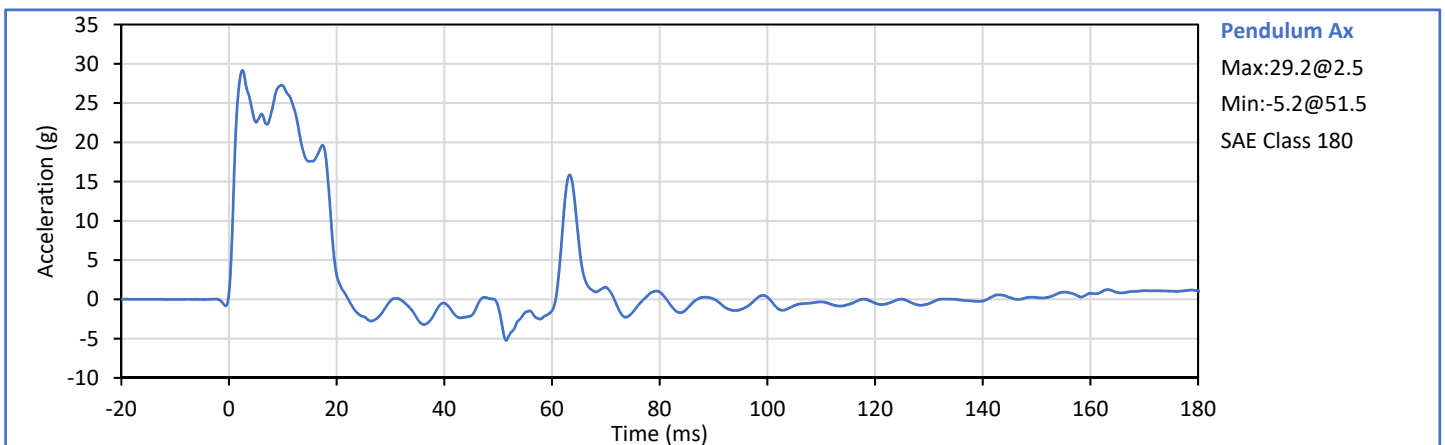
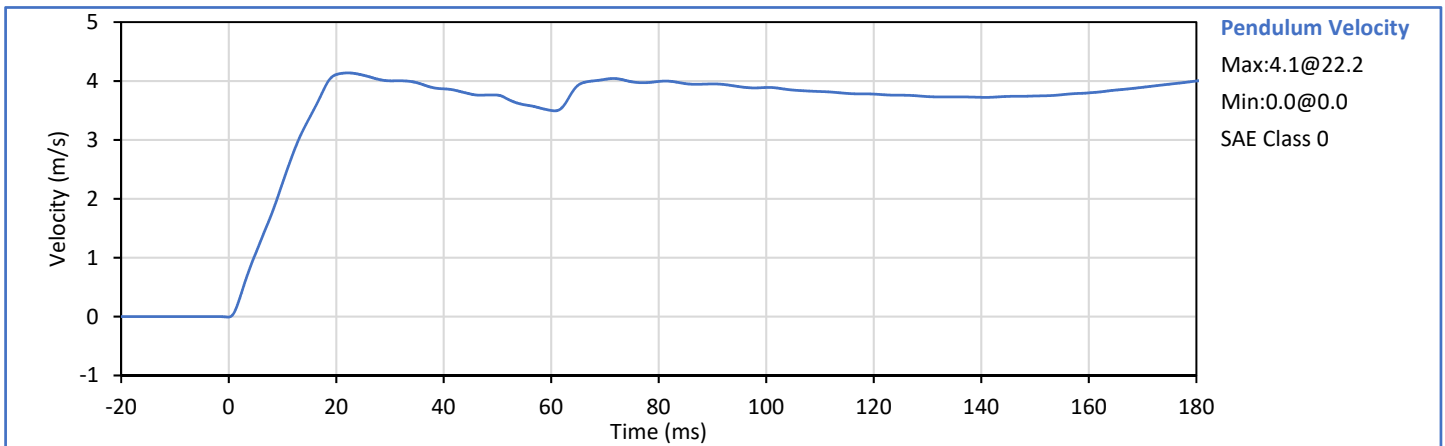



Technician:   
J. Hernandez


Approved By:   
P. Puzuto

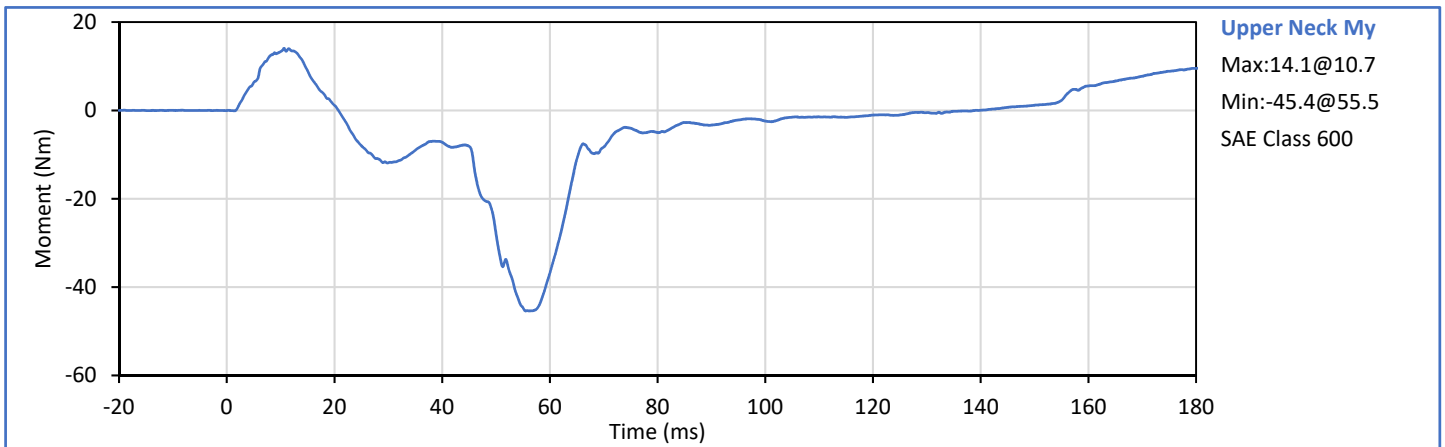
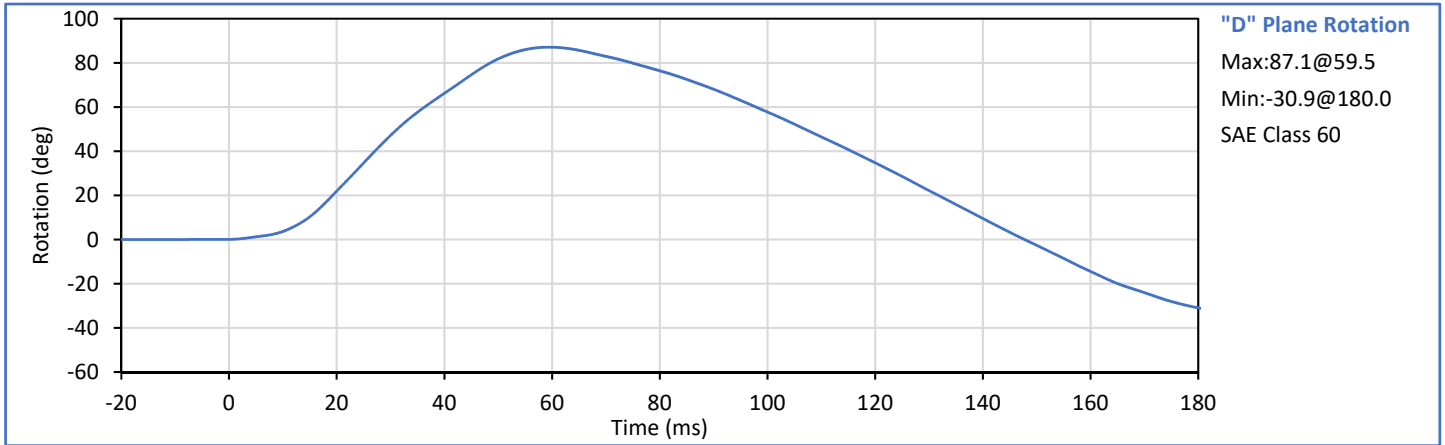


Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Humidity	%	10	70	31	Pass
Pendulum Velocity	m/s	3.55	3.75	3.73	Pass
Pendulum Velocity at 6 ms	m/s	1.00	1.40	1.30	Pass
Pendulum Velocity at 10 ms	m/s	1.90	2.50	2.27	Pass
Pendulum Velocity at 14 ms	m/s	2.80	3.50	3.20	Pass
Peak Moment in Rotation	Nm	-53.3	-43.7	-45.4	Pass
	deg	83.0	93.0	86.2	Pass
Positive Moment Decay to -10 Nm	ms	60.0	80.0	65.2	Pass
Overall Test Results					Pass



Technician:   
J. Hernandez

Approved By:   
P. Puzuto





**APPENDIX D**  
**INSTRUMENTATION DATA CHANNEL ASSIGNMENTS**

**TWG 3.3.3.2**

**Test Equipment and Instrumentation Calibration Data**

**A.T.D. Serial Number 044**

**07/19/19**

**2019 Dodge Grand Caravan 5-Door Minivan**

Channel	Location	Axis	Sensor S/N	MFR	Model	Units	Calibration Date
1	Head Acceleration	X	A290221	MSI	64C	g	06/08/19
2	Head Acceleration	Y	A290237	MSI	64C	g	06/08/19
3	Head Acceleration	Z	A290267	MSI	64C	g	06/08/19
4	Upper Neck Force	X	212 Fx	R.A. Denton	3303	N	04/11/19
5	Upper Neck Force	Y	212 Fy	R.A. Denton	3303	N	04/11/19
6	Upper Neck Force	Z	212 Fz	R.A. Denton	3303	N	04/11/19
7	Upper Neck Moment	X	212 Mx	R.A. Denton	3303	Nm	04/11/19
8	Upper Neck Moment	Y	212 My	R.A. Denton	3303	Nm	04/11/19
9	Upper Neck Moment	Z	212 Mz	R.A. Denton	3303	Nm	04/11/19
10	Lower Neck Force	X	93 Fx	R.A. Denton	3303	N	04/11/19
11	Lower Neck Force	Y	93 Fy	R.A. Denton	3303	N	04/11/19
12	Lower Neck Force	Z	93 Fz	R.A. Denton	3303	N	04/11/19
13	Lower Neck Moment	X	93 Mx	R.A. Denton	3303	Nm	04/11/19
14	Lower Neck Moment	Y	93 My	R.A. Denton	3303	Nm	04/11/19
15	Lower Neck Moment	Z	93 Mz	R.A. Denton	3303	Nm	04/11/19
16	Chest Displacement	X	1035 (Y6)	SERVO	14CBI	mm	06/14/19