

REPORT NUMBER: TWG-KAR-20-001

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

**VOLVO CAR CORPORATION
2020 VOLVO XC60 T5 5-DOOR MPV**

NHTSA NUMBER: M20205905TWG2

**PREPARED BY:
APPLUS+ IDIADA KARCO ENGINEERING, LLC.
9270 HOLLY ROAD
ADELANTO, CA 92301**



AUGUST 17, 2020

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.

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Prepared By: Amjad A. Jadallah

Mr. Amjad A. Jadallah, Project Manager
Applus+ IDIADA KARCO Engineering, LLC.

Reviewed By: Andrew J. Espindola

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

Michael L. Dunlap

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

Approved By: Steven D. Matsusaka

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

Approval Date: August 17, 2020

FINAL REPORT ACCEPTANCE BY:

Engineer, Alpha Technology Associate, Inc.

Date of Acceptance

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No. TWG-KAR-20-001	2. Government Accession No.	3. Recipient's Catalog No.																									
4. Title and Subtitle Final Report of New Car Assessment Program Side Airbag Out-of-Position Testing of a 2020 Volvo XC60 T5 5-Door MPV NHTSA No. M20205905TWG2		5. Report Date August 17, 2020																									
		6. Performing Organization Code KAR																									
7. Authors Mr. Amjad Jadallah, Project Manager, Applus+ IDIADA KARCO Engineering, LLC Mr. Steven D. Matsusaka, Engineering Manager, Applus+ IDIADA KARCO Engineering, LLC		8. Performing Organization Report No. TR-P40218-01-NC																									
		10. Work Unit No.																									
9. Performing Organization Name and Address Applus+ IDIADA KARCO Engineering, LLC. 9270 Holly Rd. Adelanto, CA 92301		11. Contract or Grant No. DTNH22-13-D-00311L																									
		13. Type of Report and Period Covered Final Test Report, July 30 - August 17, 2020																									
12. Sponsoring Agency Name and Address 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		14. Sponsoring Agency Code NRM-110																									
		15. Supplementary Notes																									
16. Abstract <p>A side airbag out of position test was conducted on the subject 2020 Volvo XC60 T5 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, 2020.</p> <p>The curtain and torso/pelvis side airbags were deployed and responses were measured on a Hybrid III SID-IIs dummy. Three high speed cameras recorded the event. The ambient temperature at the time of airbag deployment was 20.8°C</p> <table border="1" style="width: 100%; margin: 10px 0; border-collapse: collapse;"> <thead> <tr> <th colspan="4" style="text-align: center;">Section 3.3.5.3 - SID-IIs Dummy - P2</th> </tr> <tr> <th style="width: 35%;">Measurement Description</th> <th style="width: 10%;">Units</th> <th style="width: 20%;">IARV</th> <th style="width: 35%;">Result</th> </tr> </thead> <tbody> <tr> <td>Head Injury Criteria (HIC₁₅)</td> <td>N/A</td> <td>723</td> <td style="background-color: yellow;">26.8</td> </tr> <tr> <td>Nij</td> <td>N/A</td> <td>1</td> <td style="background-color: yellow;">0.8</td> </tr> <tr> <td>Neck Tension</td> <td>N</td> <td>1490</td> <td style="background-color: yellow;">80.5</td> </tr> <tr> <td>Neck Compression</td> <td>N</td> <td>1820</td> <td style="background-color: yellow;">-1742.0</td> </tr> </tbody> </table>				Section 3.3.5.3 - SID-IIs Dummy - P2				Measurement Description	Units	IARV	Result	Head Injury Criteria (HIC ₁₅)	N/A	723	26.8	Nij	N/A	1	0.8	Neck Tension	N	1490	80.5	Neck Compression	N	1820	-1742.0
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17. Key Words New Car Assessment Program (NCAP) Side Airbag Out-of-position 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																									
19. Security Classification of this report UNCLASSIFIED	20. Security Classification of this page UNCLASSIFIED	21. No. of Pages 41	22. Price																								

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SECTION 1

PURPOSE AND SUMMARY OF TEST

PURPOSE

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 2020 Volvo XC60 T5 5-Door MPV with an out-of-position (SID-IIs) crash test dummy were evaluated. The test was performed at IDIADA KARCO Engineering, LLC. on July 30, 2020. 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 SID-IIs anthropomorphic test device (ATD) was placed in the right front passenger seating position facing inboard according to the dummy placement instructions (3.3.5.3) in the July 2003 Revision of the Technical Working Group's 'Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags'.

The SID-IIs 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 SID-IIs dummy was with the dummy facing toward the center of the vehicle with its arm against the seatback. The seat track was adjusted to minimize the vertical distance between the dummy's head and the roof-rail module and to maximize the airbag to head interaction. The seat height was set such that there was a 10mm gap between the ATD's head and the A-Pillar. The dummy's pelvis is slid outboard until the dummy's back contacts the door trim panel or armrest and the CG of the head is centered in the deployment trajectory of the airbag. This orientation complies with section 3.3.5.3 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 SID-IIs dummy's visible contact points were as follows: The ATD's head contacted the curtain airbag and center console. The ATD's abdomen and pelvis contacted the torso/pelvis airbag.

The occupant data is summarized below:

Measurement Description	Units	Passenger ATD (SID-IIs)	
		IARV	Result
Head Injury Criteria (HIC15)	N/A	779	26.8
Upper Neck Nij	N/A	1	0.80
Upper Neck Peak Tension	Newtons (N)	2070	80.5
Upper Neck Peak Compression	Newtons (N)	2520	-1742.0

SECTION 2

OCCUPANT AND VEHICLE INFORMATION / DATA SHEETS

Test Vehicle: 2020 Volvo XC60 T5 5-Door MPV NHTSA No.: M20205905TWG2
Test Program: TWG 3.3.5.1 Test Date: 07/30/20

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	°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: 2020 Volvo XC60 T5 5-Door MPV

NHTSA No.: M20205905TWG2

Test Program: TWG 3.3.5.1

Test Date: 07/30/20

TEST DUMMY INFORMATION

Description	Passenger Seat
Dummy Type / Serial No.	SID-IIs / 299
Head Contact	Curtain Airbag
Chest Contact	None
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
Total	15

DATA SHEET NO. 2

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2020 Volvo XC60 T5 5-Door MPV NHTSA No.: M20205905TWG2
 Test Program: TWG 3.3.5.1 Test Date: 07/30/20

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA Number	M20205905TWG2
Model Year	2020
Make	Volvo
Model	XC60 T5
Body Style	5-Door MPV
VIN	YV4102DK1L1458735
Body Color	Blue
Odometer Reading (km / mi)	32/ 20
Engine Displacement (L)	2.0
Type / No. of Cylinders	Inline 4
Engine Placement	Transverse
Transmission Type	Automatic
Transmission Speeds	8
Overdrive	Yes
Final Drive	FWD
Roof Rack	Yes
Sunroof / T-Top	Yes
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	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	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	Yes
Driver Load Limiter	Yes
Rear Pass. Load Limiter	Yes
Other Safety Restraint	No

Does Owner's Manual provide instructions to turn off automatic door locks? Yes

DATA FROM CERTIFICATION LABEL

Manufactured By	Volvo Car Corporation
Date of Manufacture	Aug-19
Vehicle Type	MPV

GVWR (kg)	2370
GAWR Front (kg)	1188
GAWR Rear (kg)	1220

VEHICLE SEATING AND CAPACITY WEIGHT INFORMATION

Measured Parameter	Front	Rear	Third	Total
Designated Seating Capacity	2	3		5
Capacity Weight (VCW) (kg)				425.0
DSC x 68.04 (kg)				340.2
Cargo Weight (RCLW) (kg)				89.8

A
B
A-B

*Vehicle underwent New Car Assessment Program Side MDB Impact Testing on January 22, 2020.

DATA SHEET NO. 2 ... (CONTINUED)

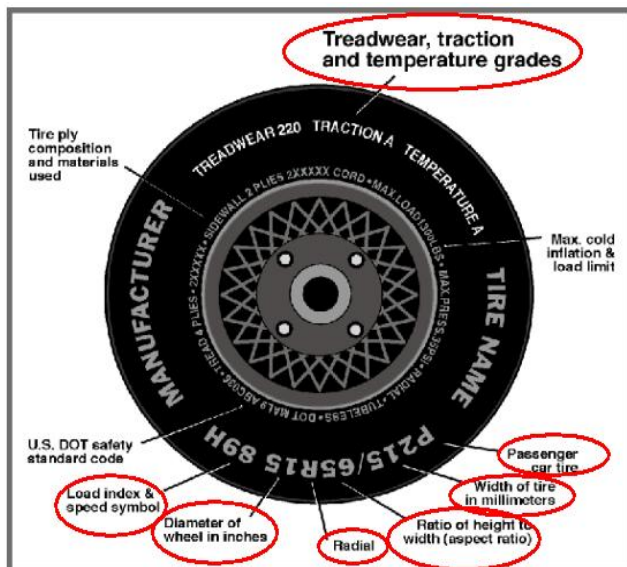
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2020 Volvo XC60 T5 5-Door MPV

NHTSA No.: M20205905TWG2

Test Program: TWG 3.3.5.1

Test Date: 07/30/20



VEHICLE TIRE INFORMATION

Measured Parameter	Front	Rear
Max. Tire Pressure (kpa)	340	340
Cold Pressure (kPa)	240	240
Recommended Tire Size	235/55 R19	235/55 R19
Tire Size on Vehicle	235/55 R19	235/55 R19
Tire Manufacturer	Pirelli	Pirelli
Tire Model	Scorpion Zero	Scorpion Zero
Treadware	500	500
Traction Grade	A	A
Temperature Grade	A	A
Tire Plies Sidewall	2 Rayon	2 Rayon
Tire Plies Body	2 Rayon, 2 Steel, 1 Polyamide	2 Rayon, 2 Steel, 1 Polyamide
Load Index/Speed Symbol	105V	105V
Tire Material	Rayon, Steel, Polyamide	Rayon, Steel, Polyamide
DOT Safety Code Left	XB08 031B 2019	XB08 031B 2019
DOT Safety Code Right	XB08 031B 2019	XB08 031B 2019

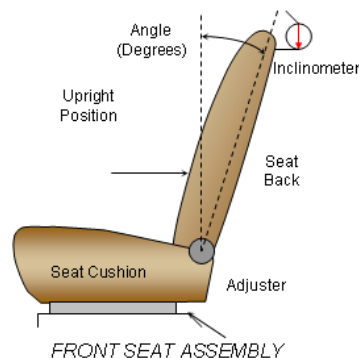
DATA SHEET NO. 3
SEAT ADJUSTMENTS

Test Vehicle: 2020 Volvo XC60 T5 5-Door MPV
 Test Program: TWG 3.3.5.1

NHTSA No.: M20205905TWG2
 Test Date: 07/30/20

SEAT BACK ANGLE

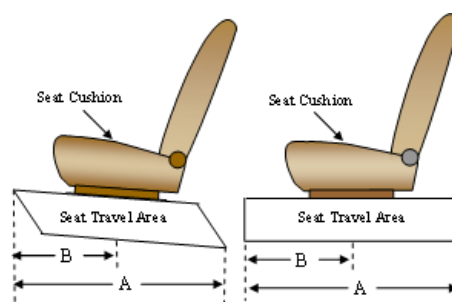
The passenger seat back is positioned per section 3.3.5.1 of the TWG recommendation in the Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags. Seat back angle is measured at the headrest post.



Seating Position	Degrees
Passenger Seat	36.0

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	265		235	

SEAT BELT UPPER ANCHORAGE

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	Fixed	Fixed

DATA SHEET NO. 4

DUMMY POSITIONING AND AIRBAG DIMENSIONS

Test Vehicle: 2020 Volvo XC60 T5 5-Door MPV NHTSA No.: M20205905TWG2
 Test Program: TWG 3.3.5.1 Test Date: 07/30/20

DUMMY POSITIONING

Code	Measurement Description	Passenger	
		Length (mm)	Angle (°)
SA	Seat Back Angle		36.0
AN	Top of Airbag Module to Head/Neck Junction	290	90.0
HD	Head CG to Door Panel/ Window	145	0.0
HSC	Head to Seat Back Centerline	120	0.0
HB	Head to B-Pillar (first contact)	260	4.5
HZ	Head to Roof (Z)	155	90.0
HHD	Head to Header (measured from back of head)	322	20.8
ND	Nose to Dash	560	35.0
NS	Nose to Seat Back	139	0.0
NR	Nose to Header	355	35.7
CD	Chest to Dash	546	13.2
CS	Chest to Seat Back	219	0.0
RACL	Right Arm to Seat Back	35	0.0
LACL	Left Arm to Seat Back	35	0.0
RA	Right Arm to Door Panel	130	0.0
LA	Left Arm to Door Panel	320	0.0
KK	Knee to Knee	170	0.0
TT	Toe to Toe	130	0.0
KSCR	Right Knee to Seat Cushion Centerline	195	0.0

AIRBAG DIMENSIONS

Code	Measurement Description	Airbag
		Length (mm)
AMW	Curtain Airbag Module Diameter	17
AML	Curtain Airbag Module Length	120
ABW	Curtain Airbag Width	1820
ABL	Curtain Airbag Length	350
AMW	Torso/Pelvis Airbag Module Diameter	20
AML	Torso/Pelvis Airbag Module Length	270
ABW	Torso/Pelvis Airbag Width	490
ABL	Torso/Pelvis Airbag Length	310

DATA SHEET NO. 5

DUMMY INJURY CRITERIA AND PERFORMANCE DATA

Test Vehicle: 2020 Volvo XC60 T5 5-Door MPV NHTSA No.: M20205905TWG2
 Test Program: TWG 3.3.5.1 Test Date: 07/30/20

HEAD PEAK ACCELERATIONS

Location	Axis	Units	SID-IIs			
			Max	Time	Min	Time
Head CG	X	g	28.3	8.7	-3.0	100.5
Head CG	Y	g	12.0	14.4	-13.4	8.4
Head CG	Z	g	62.1	8.2	-16.4	11.9
Head CG Resultant	N/A	g	68.3	8.2		

UPPER NECK PEAK FORCES AND MOMENTS

Location	Axis	Units	SID-IIs			
			Max	Time	Min	Time
Neck Force	X	N	17.8	10.1	-511.3	28.4
Neck Force	Y	N	197.0	34.4	-91.3	8.8
Neck Force	Z	N	80.5	104.2	-1742.0	11.1
Neck Force Resultant	N/A	N	1742.6	11.1		
Neck Moment	X	Nm	12.1	56.2	-9.4	20.0
Neck Moment	Y	Nm	7.5	70.0	-39.6	31.0
Neck Moment	Z	Nm	5.1	19.0	-5.2	62.7
Neck Moment Resultant	N/A	Nm	39.9	31.0		

LOWER NECK PEAK FORCES AND MOMENTS

Location	Axis	Units	SID-IIs			
			Max	Time	Min	Time
Neck Force	X	N	184.9	11.4	-318.3	29.0
Neck Force	Y	N	227.9	23.4	-90.2	114.5
Neck Force	Z	N	170.2	4.5	-2060.0	11.3
Neck Force Resultant	N/A	N	2065.8	11.3	0.9	1.6
Neck Moment	X	Nm	27.4	30.5	-22.4	116.9
Neck Moment	Y	Nm	97.7	27.6	-0.8	6.6
Neck Moment	Z	Nm	12.0	23.5	-6.8	80.9
Neck Moment Resultant	N/A	Nm	101.2	27.7		

HEAD INJURY CRITERIA (HIC 15)

Location	SID-IIs			
	HIC15	T ¹	T ²	Avg G
Head CG	26.8	7.3	10.5	36.6

UPPER NECK NIJ VALUES

Location	SID-IIs			
	Ntf	Nte	Ncf	Nce
Upper Neck	0.05	0.01	0.48	0.80

DATA SHEET NO. 6**HIGH SPEED CAMERA LOCATIONS AND DATA**

Test Vehicle: 2020 Volvo XC60 T5 5-Door MPV NHTSA No.: M20205905TWG2
Test Program: TWG 3.3.5.1 Test Date: 07/30/20

CAMERA LOCATIONS

No.	Camera View	Location (mm)			Angle (Deg.)	Lens (mm)	Speed (fps)
		X	Y	Z			
1	High Speed Front View	2370	275	580	6.9	35	1000
2	High Speed 3/4 View	2380	1645	580	8.1	35	1000
3	High Speed Left Side View	140	2745	1150	4.0	25	1000
4	Real Time	140	2745	1150			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
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FIGURE 1. Right Front ¾ View, As Received



FIGURE 2. Vehicle Certification Label



FIGURE 3. Pre-Test Vehicle Left Side View (as prepared for NCAP crash test)



FIGURE 4. Post-Test Vehicle Left Side View (as prepared for NCAP crash test)

Photo Not Available

FIGURE 5. Pre-Test Vehicle Location of Air Bag 1
(vehicle headliner for curtain air bag)

Photo Not Available

FIGURE 6. Pre-Test Vehicle Location of Air Bag 2
(vehicle a-pillar for curtain air bag)

Photo Not Available

FIGURE 7. Pre-Test Vehicle Location of Air Bag 3
(vehicle seat or door for torso air bag)

Photo Not Available

FIGURE 8. Pre-Test Vehicle Seat Back Angle (put inclinometer on headrest)



FIGURE 9. Pre-Test Dummy Left Side View



FIGURE 10. Post-Test Dummy Left Side View



FIGURE 11. Pre-Test Dummy Left Side Close-up View



FIGURE 12. Post-Test Dummy Left Side Close-up View



FIGURE 13. Pre-Test Dummy Left 3/4 View



FIGURE 14. Post-Test Dummy Left 3/4 View



FIGURE 15. Pre-Test Dummy Front Left ¾ Close-Up View



FIGURE 16. Post-Test Dummy Front Left ¾ Close-Up View

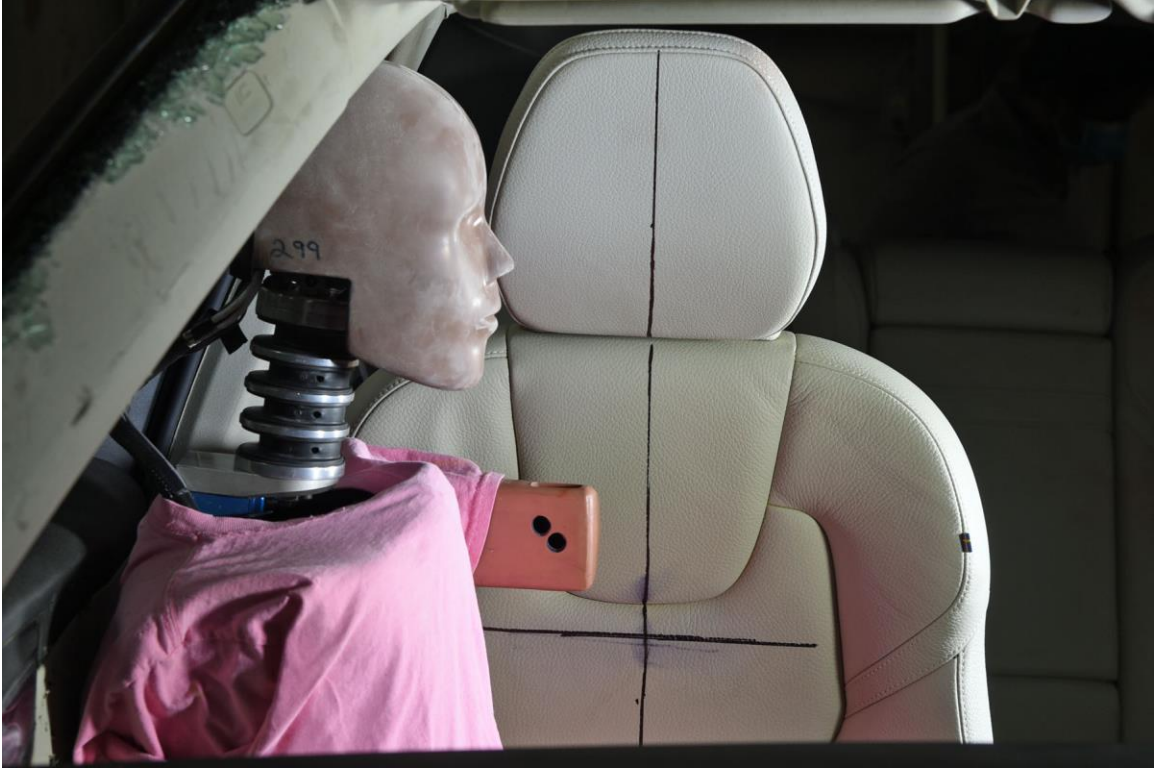


FIGURE 17. Pre-Test Dummy Front View



FIGURE 18. Post-Test Dummy Front View

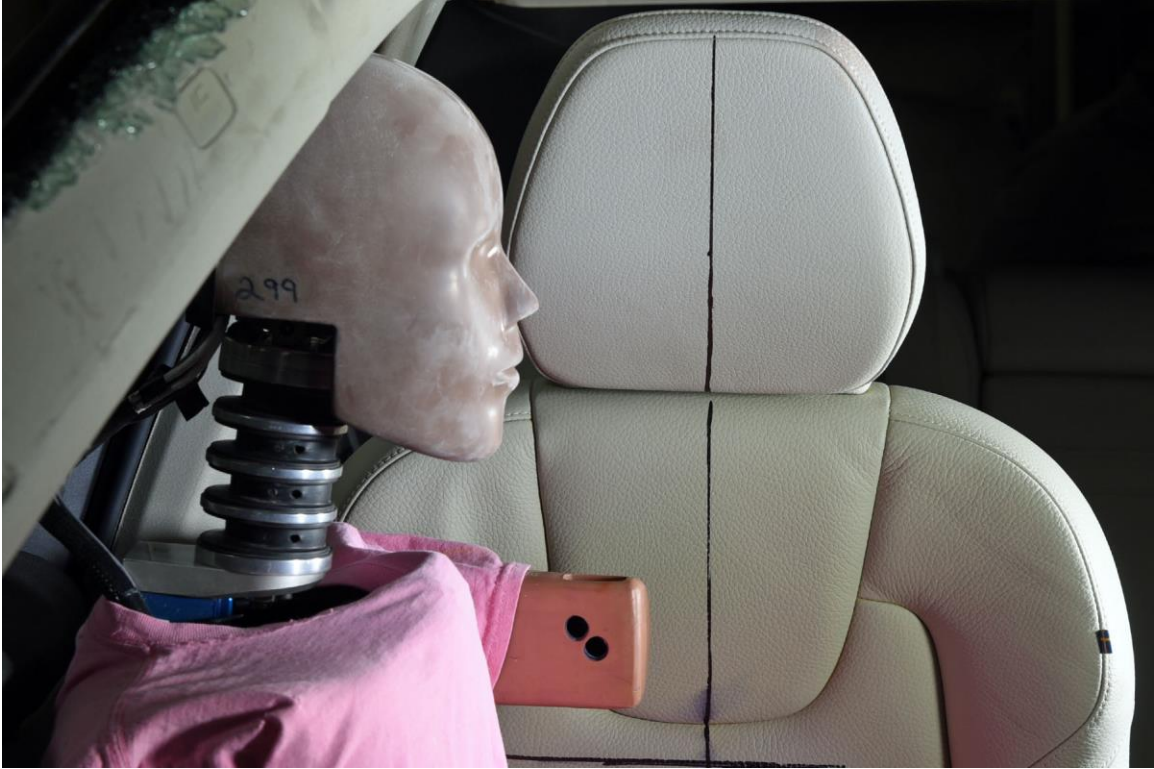


FIGURE 19. Pre-Test Dummy Front Close-up View



FIGURE 20. Post Test Dummy Front Close-up View



FIGURE 21. Pre-Test Dummy Right $\frac{3}{4}$ View



FIGURE 22. Post-Test Dummy Right $\frac{3}{4}$ View



FIGURE 23. Pre-Test Dummy Right Side View



FIGURE 24. Post-Test Dummy Right Side View

Photo Not Available

FIGURE 25. Post-Test Dummy Right Side View (Door Open)



FIGURE 26. Post-Test Curtain Air Bag Left Side View



FIGURE 27. Post-Test Curtain Air Bag Front Left ¾ View



FIGURE 28. Post-Test Curtain Air Bag Front View

Photo Not Available

FIGURE 29. Post-Test Curtain Air Bag Right Side View (Door Open)

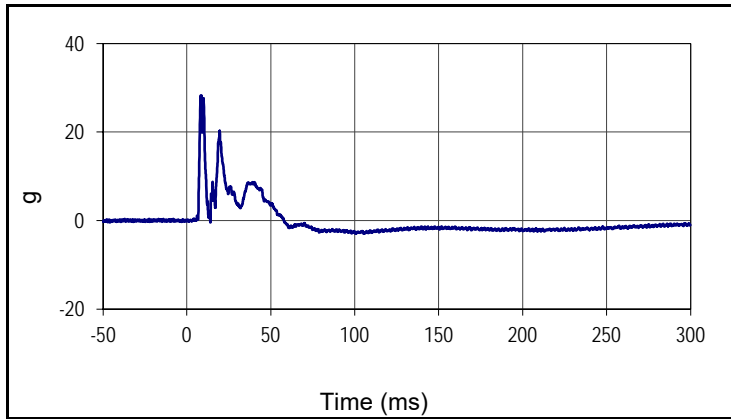
APPENDIX B
DUMMY RESPONSE DATA TRACES

TABLE OF DATA PLOTS

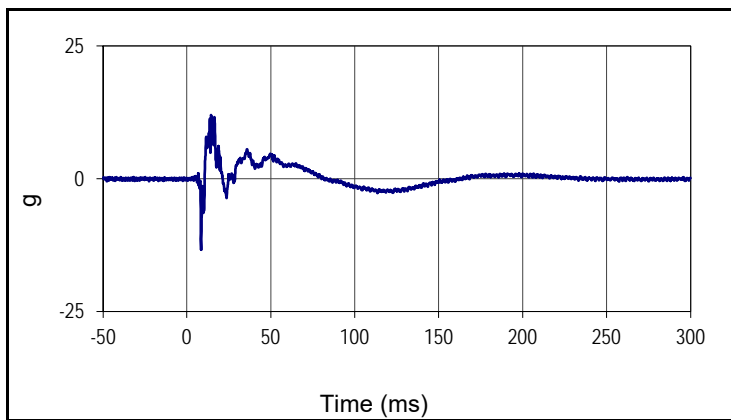
<u>Plot</u>		<u>Page</u>
1	SID-IIs Head X	B-1
2	SID-IIs Head Y	B-1
3	SID-IIs Head Z	B-1
4	SID-IIs Head Resultant	B-1
5	SID-IIs Upper Neck Force X	B-2
6	SID-IIs Upper Neck Force Y	B-2
7	SID-IIs Upper Neck Force Z	B-2
8	SID-IIs Upper Neck Force Resultant	B-2
9	SID-IIs Upper Neck Moment X	B-3
10	SID-IIs Upper Neck Moment Y	B-3
11	SID-IIs Upper Neck Moment Z	B-3
12	SID-IIs Upper Neck Moment Resultant	B-3
13	SID-IIs Lower Neck Force X	B-4
14	SID-IIs Lower Neck Force Y	B-4
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16	SID-IIs Lower Neck Force Resultant	B-4
17	SID-IIs Lower Neck Moment X	B-5
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20	SID-IIs Lower Neck Moment Resultant	B-5
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Test Vehicle: 2020 Volvo XC60 T5 5-Door MPV
 Test Program: TWG 3.3.5.3

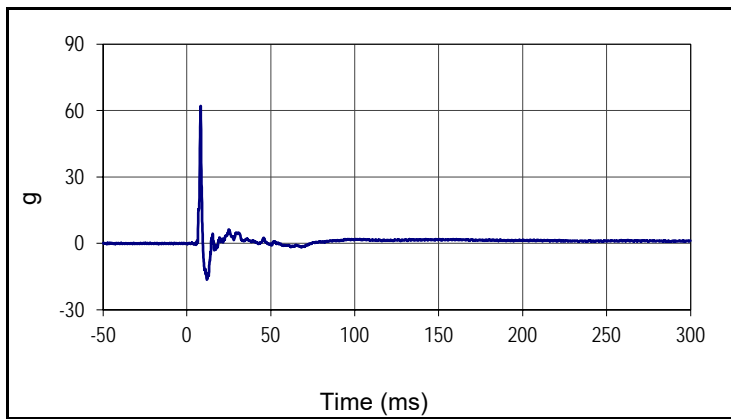
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 NHTSA No.: M20205905TWG2



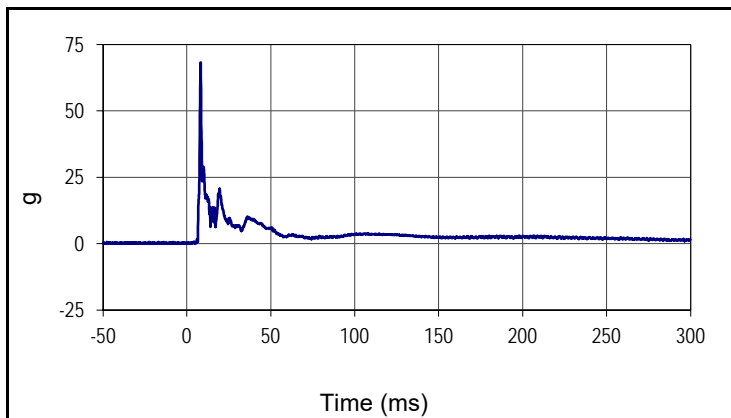
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SID-ILs Head Primary Ax			
Plot No.		SAE Class	Units
001		1000	g
Max	Time	Min	Time
28.3	8.7	-3.0	100.5



Curve Description			
SID-ILs Head Primary Ay			
Plot No.		SAE Class	Units
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Max	Time	Min	Time
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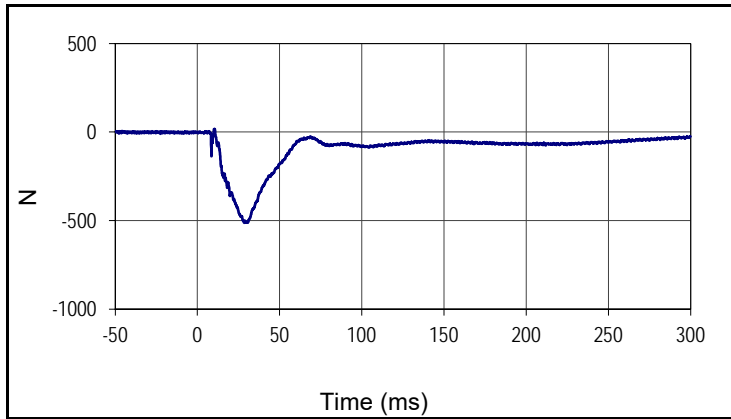
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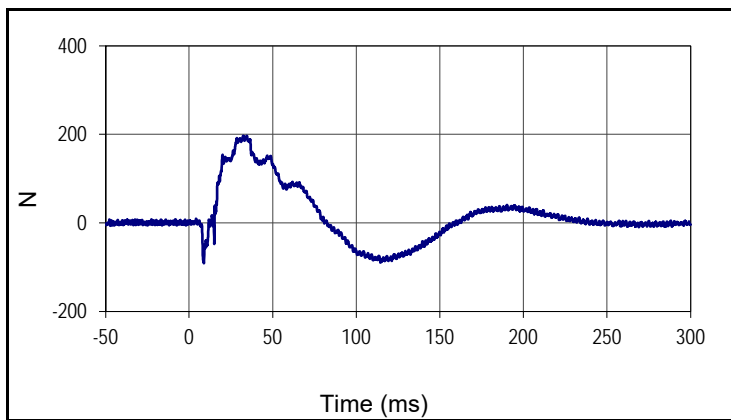
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SID-ILs Head Acceleration Primary Resultant			
Plot No.		SAE Class	Units
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Test Vehicle: 2020 Volvo XC60 T5 5-Door MPV
 Test Program: TWG 3.3.5.3

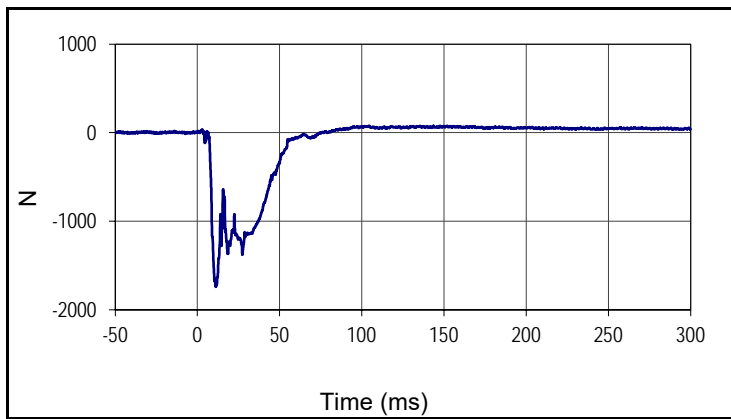
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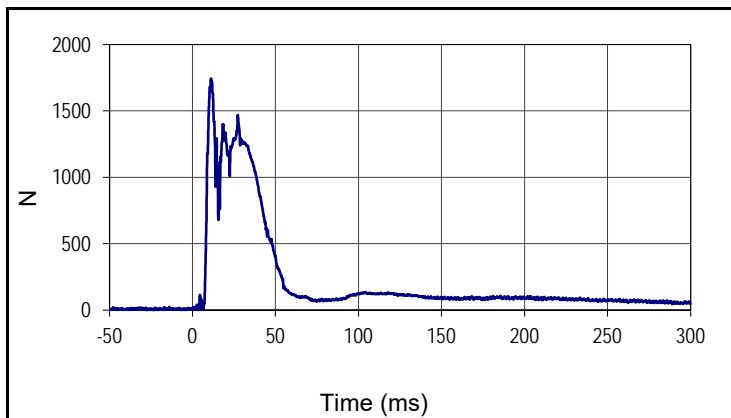
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Curve Description			
SID-IIs Upper Neck Fy			
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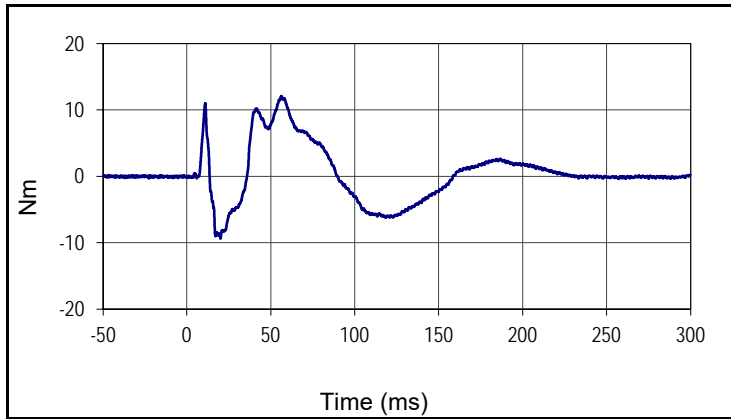
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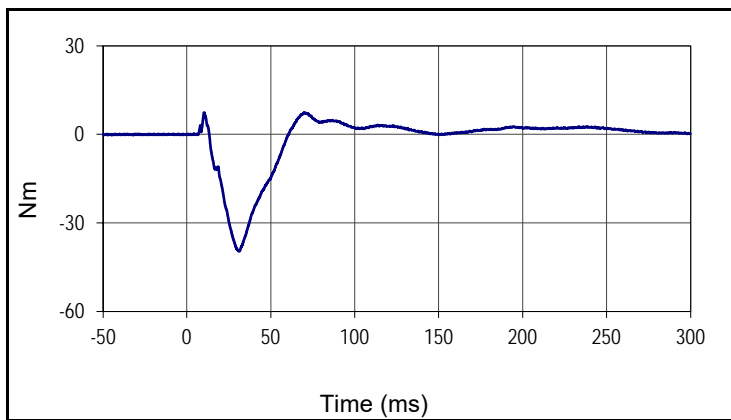
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SID-IIs Upper Neck Force Resultant			
Plot No.		SAE Class	Units
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Test Vehicle: 2020 Volvo XC60 T5 5-Door MPV
 Test Program: TWG 3.3.5.3

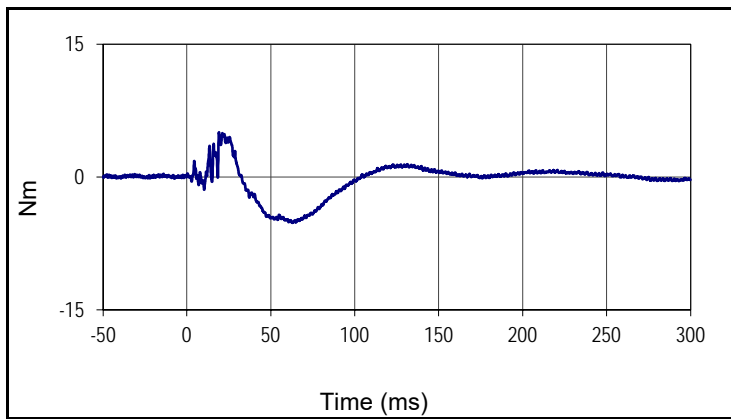
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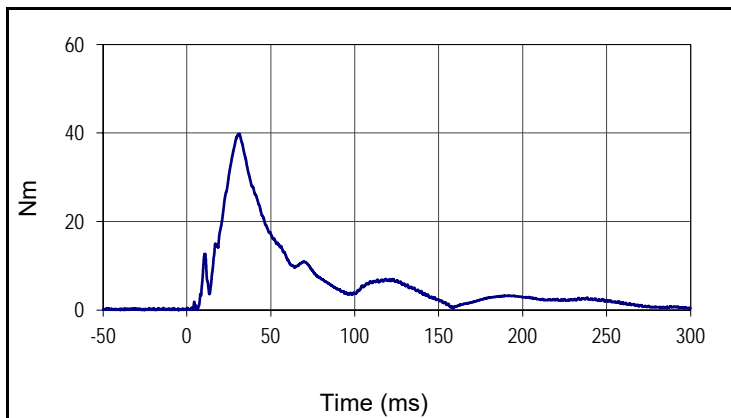
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SID-IIs Upper Neck Mx			
Plot No.		SAE Class	Units
009		600	Nm
Max	Time	Min	Time
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Curve Description			
SID-IIs Upper Neck My			
Plot No.		SAE Class	Units
010		600	Nm
Max	Time	Min	Time
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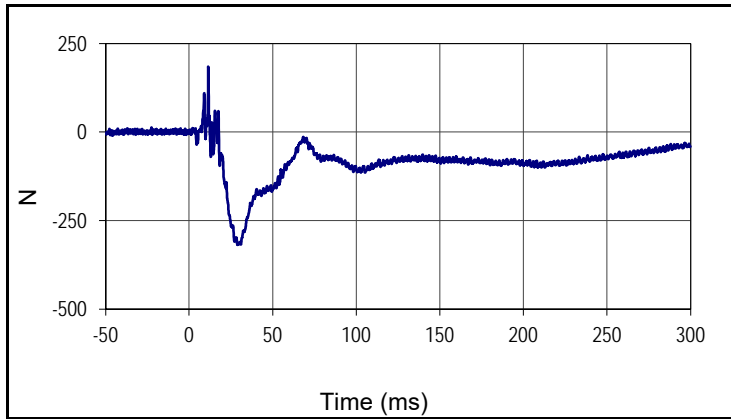
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Max	Time	Min	Time
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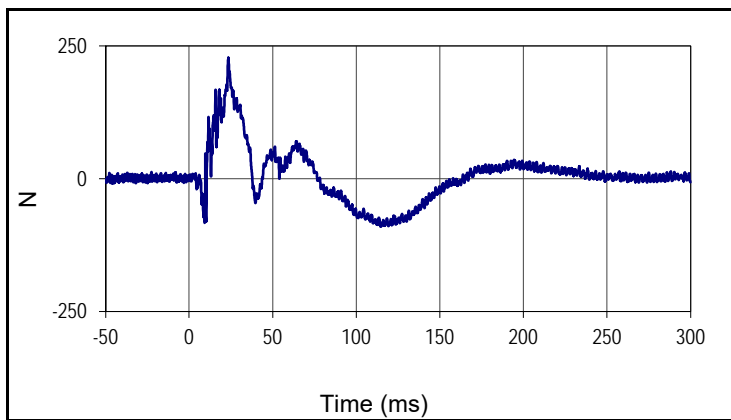
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SID-IIs Upper Neck Moment Resultant			
Plot No.		SAE Class	Units
012		600	Nm
Max	Time	Min	Time
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Test Vehicle: 2020 Volvo XC60 T5 5-Door MPV
 Test Program: TWG 3.3.5.3

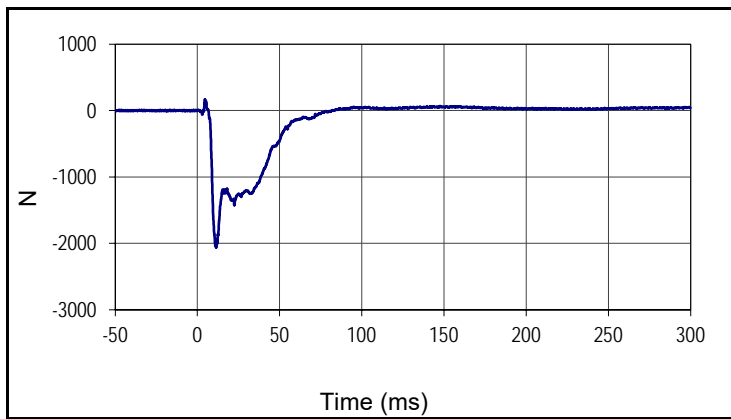
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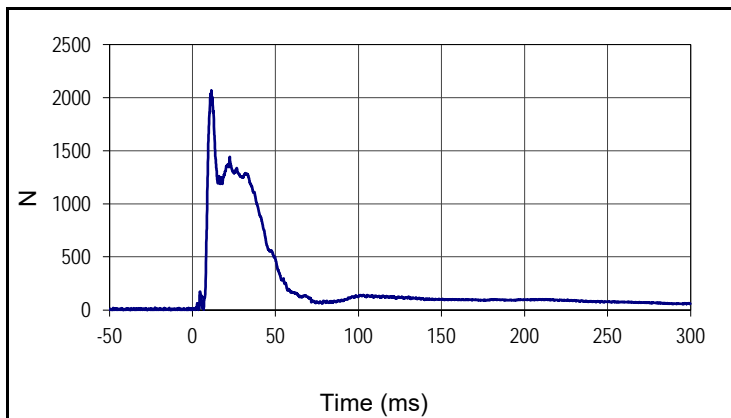
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SID-IIs Lower Neck Fx			
Plot No.		SAE Class	Units
013		1000	N
Max	Time	Min	Time
184.9	11.4	-318.3	29.0



Curve Description			
SID-IIs Lower Neck Fy			
Plot No.		SAE Class	Units
014		1000	N
Max	Time	Min	Time
227.9	23.4	-90.2	114.5



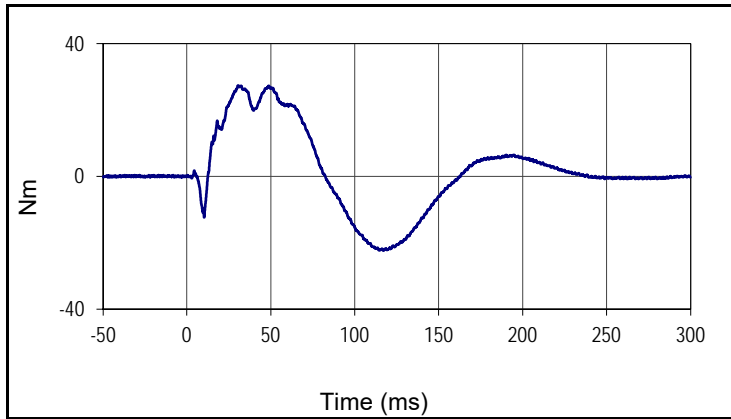
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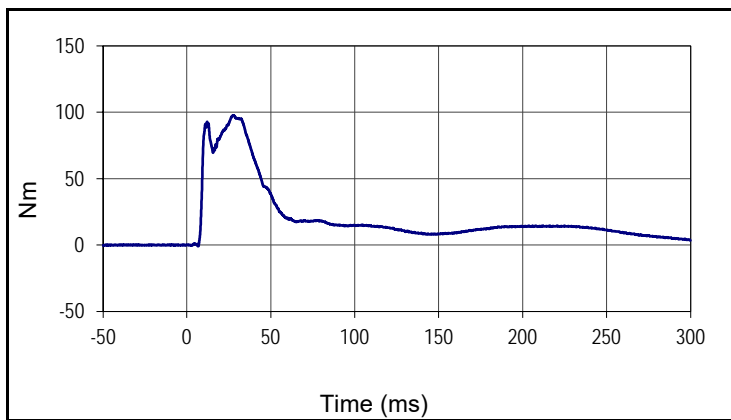
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SID-IIs Lower Neck Force Resultant			
Plot No.		SAE Class	Units
016		1000	N
Max	Time	Min	Time
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Test Vehicle: 2020 Volvo XC60 T5 5-Door MPV
 Test Program: TWG 3.3.5.3

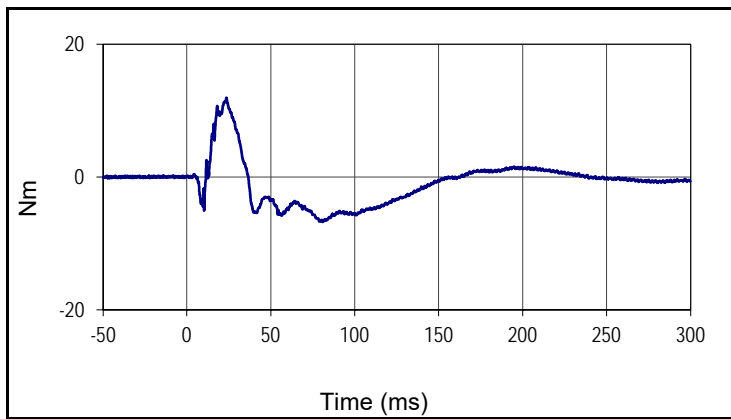
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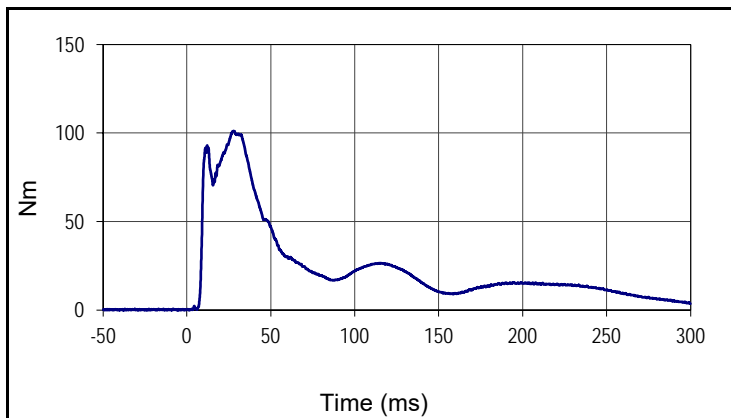
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SID-IIs Lower Neck Mx			
Plot No.		SAE Class	Units
017		600	Nm
Max	Time	Min	Time
27.4	30.5	-22.4	116.9



Curve Description			
SID-IIs Lower Neck My			
Plot No.		SAE Class	Units
018		600	Nm
Max	Time	Min	Time
97.7	27.6	-0.8	6.6



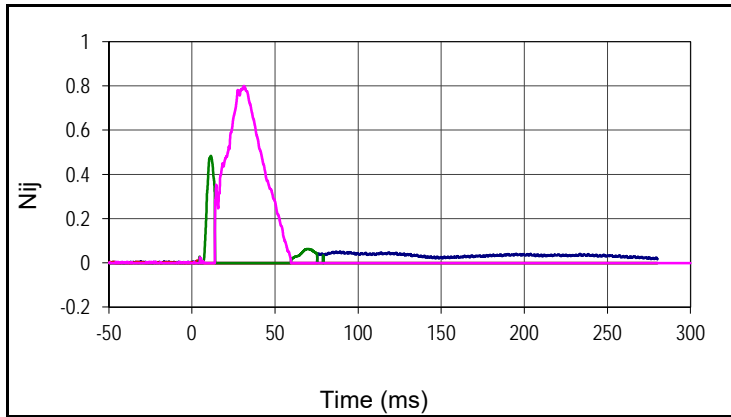
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SID-IIs Lower Neck Mz			
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Max	Time	Min	Time
12.0	23.5	-6.8	80.9



Curve Description			
SID-IIs Lower Neck Moment Resultant			
Plot No.		SAE Class	Units
020		600	Nm
Max	Time	Min	Time
101.2	27.7	0.0	1.6

Test Vehicle: 2020 Volvo XC60 T5 5-Door MPV
 Test Program: TWG 3.3.5.3

Test Date: 07/30/20
 NHTSA No.: M20205905TWG2



Curve Description		
Driver Nij		
Units	Max	Time
Ntf	0.05	86.6
Units	Max	Time
Nte	0.01	2.9
Units	Max	Time
Ncf	0.48	11.2
Units	Max	Time
Nce	0.80	31.2

APPENDIX C
ATD CONFIGURATION AND PERFORMANCE VERIFICATION DATA

APPENDIX C
Pre-Test ATD Qualification and Performance Verification
SID-IIs Small Side Impact ATD
S/N: 299

Tested Parameter	Units	Spec Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.9	Pass
Laboratory Relative Humidity	%	10	70	35	Pass
A - Sitting Height	mm	772	788	778	Pass
B - Shoulder Pivot Height	mm	437	453	450	Pass
C - Hpoint Height	mm	79	89	82	Pass
D - H Point From Seatback	mm	141	151	146	Pass
E - Shoulder Pivot From Backline	mm	97	107	104	Pass
F - Thigh Clearance	mm	119	135	130	Pass
G - Head Breadth	mm	140	148	144	Pass
H - Head Back From Backline	mm	40	46	44	Pass
I - Head Depth	mm	178	188	184	Pass
J - Head Circumference	mm	541	551	549	Pass
K - Buttock To Knee Length	mm	514	540	529	Pass
L - Popliteal Height	mm	343	369	352	Pass
K - Knee Pivot To Floor Height	mm	392	409	396	Pass
N - Buttock Popliteal Length	mm	416	442	438	Pass
O - Chest Depth W/O Jacket	mm	195	211	206	Pass
P - Foot Length	mm	216	232	227	Pass
Q - Hip Breadth (W/Pelvic Plugs)	mm	313	323	316	Pass
R - Arm Length	mm	249	259	256	Pass
S - Knee Joint To Seatback	mm	477	493	482	Pass
V - Shoulder Width	mm	341	357	351	Pass
W - Foot Width	mm	78	94	81	Pass
Y - Chest Circumference W/Jacket	mm	851	881	866	Pass
Z - Waist Circumference	mm	761	791	777	Pass
Overall Test Results					Pass

Technician:



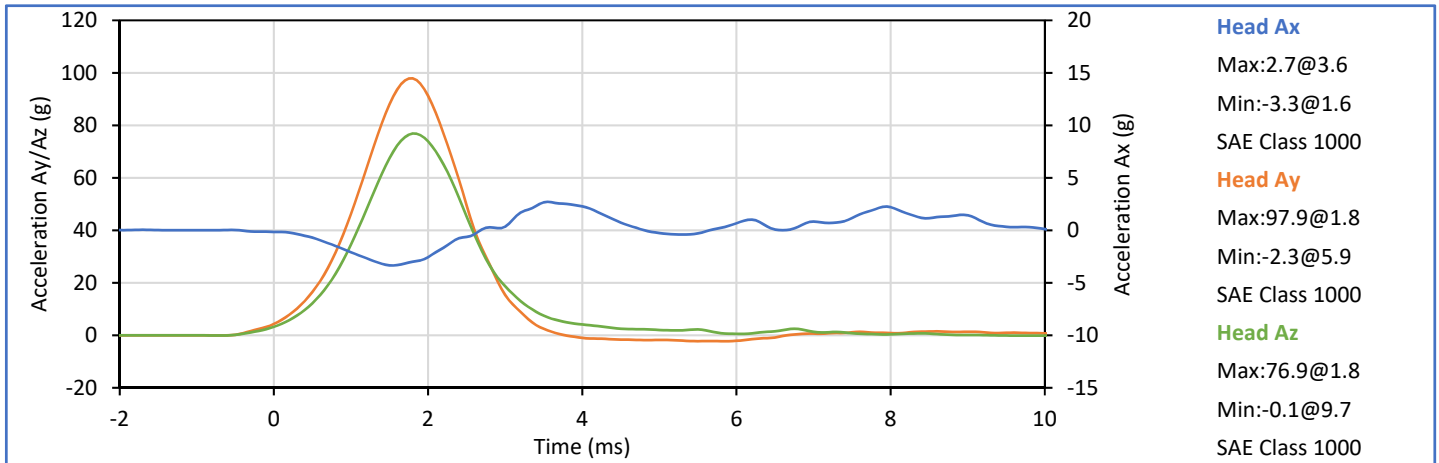
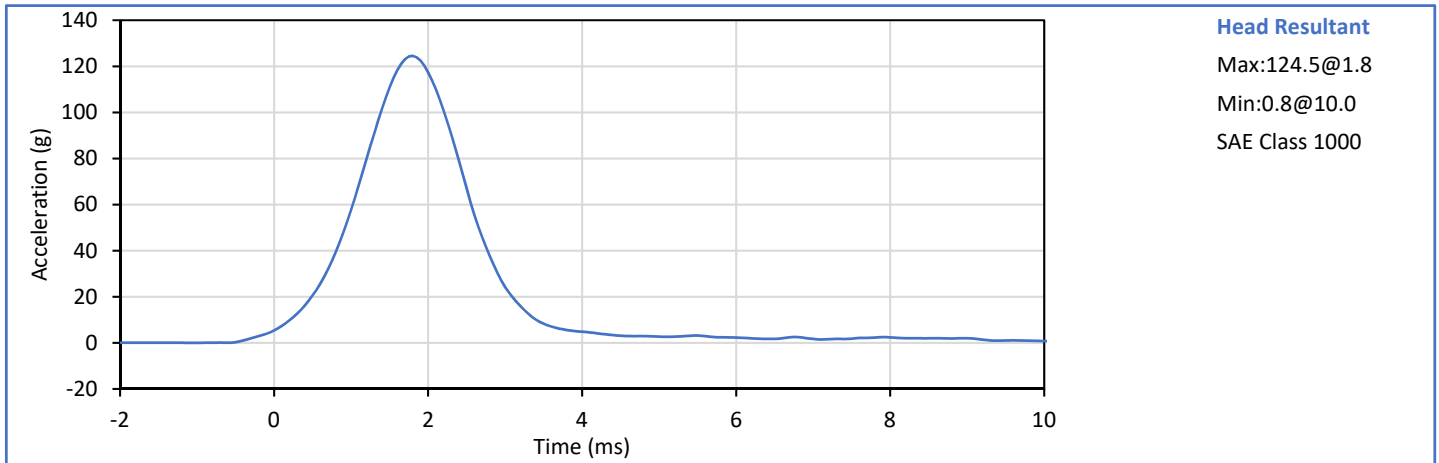
J. Hernandez


Approved By:




P. Puzzuto

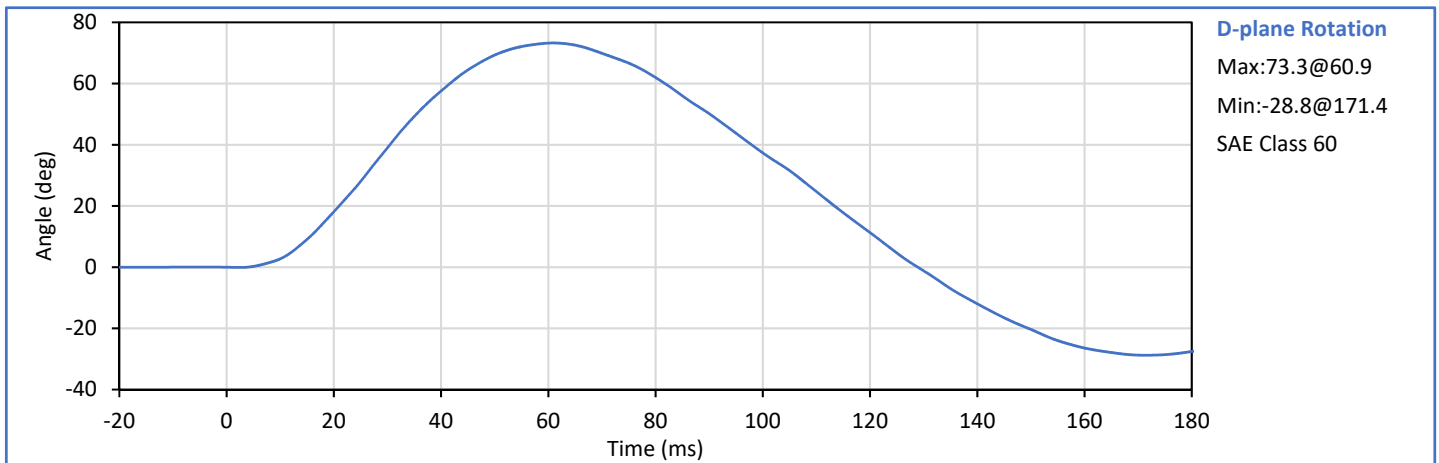
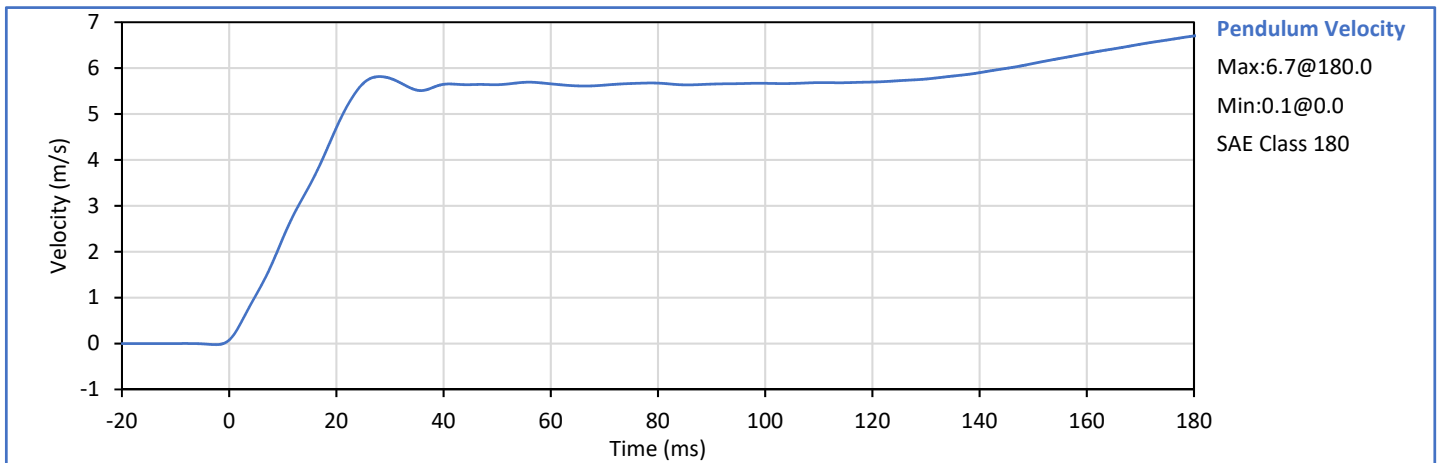
Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	18.9	25.6	21.7	Pass
Laboratory Humidity	%	10	70	34	Pass
Peak Resultant Acceleration	g	115.0	137.0	124.5	Pass
Peak Head Ax	g	-15.0	15.0	-3.3	Pass
Oscillations After Main Pulse	%	0.0	15.0	2.0	Pass
Is Acceleration Unimodal?	Yes/No	Yes		Yes	Pass
Overall Test Results					Pass




Technician: 
J. Hernandez

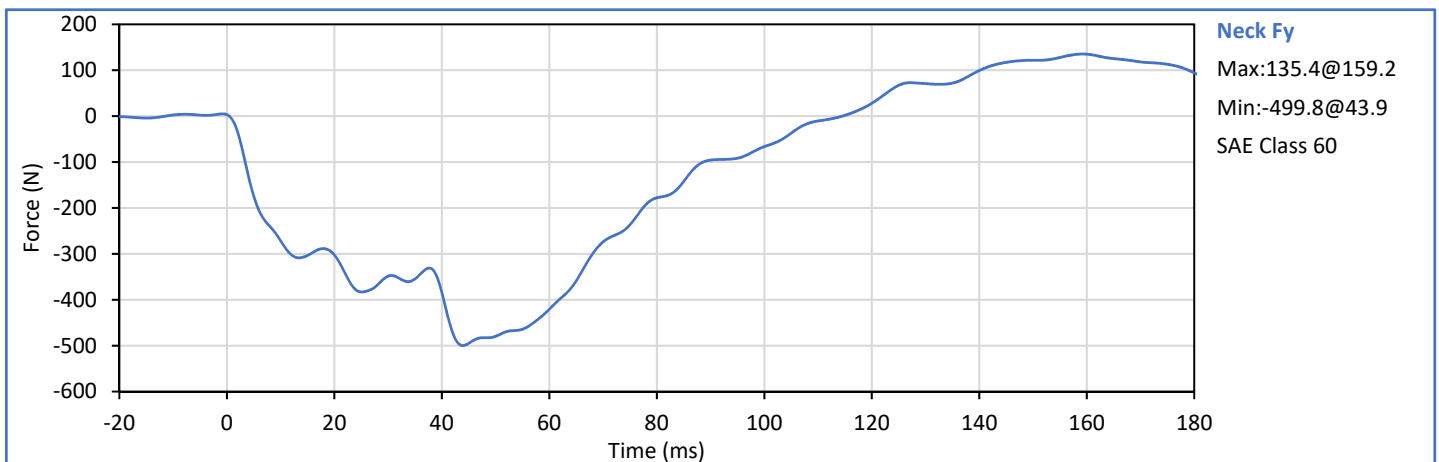
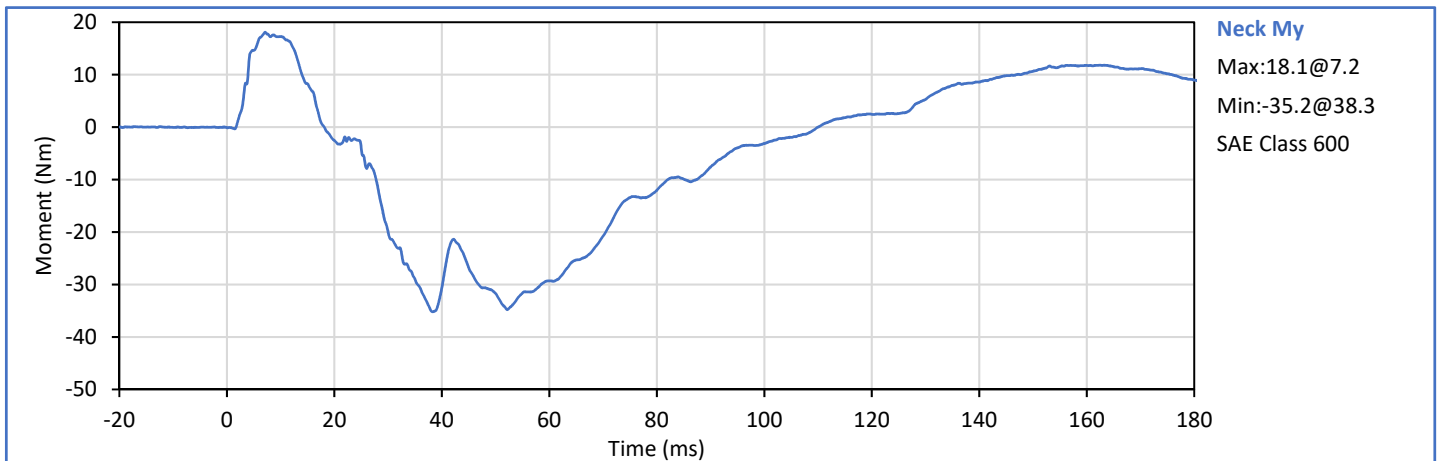
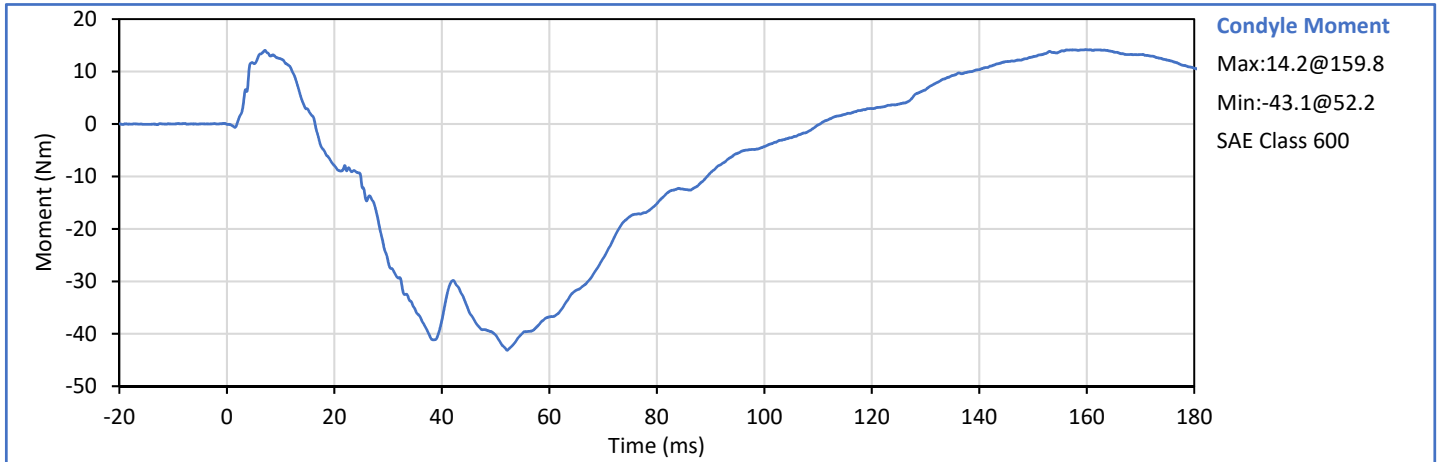
Approved By: 
P. Puzzuto

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.4	Pass
Laboratory Humidity	%	10	70	34	Pass
Pendulum Velocity	m/s	5.51	5.63	5.61	Pass
Pendulum Decel at 10 ms	m/s	2.20	2.80	2.29	Pass
Pendulum Decel at 15 ms	m/s	3.30	4.10	3.44	Pass
Pendulum Decel at 20 ms	m/s	4.40	5.40	4.70	Pass
Pendulum Decel at 25 ms	m/s	5.40	6.10	5.67	Pass
Pendulum Decel from 25-100 ms	m/s	5.50	6.20	5.82	Pass
Peak "D" Plane Rotation	deg	71.0	81.0	73.3	Pass
Time of Peak "D" Plane Rotation	ms	50.0	70.0	60.9	Pass
Peak Occ. Condyle Moment	Nm	-44.0	-36.0	-43.1	Pass
Time of Moment Decay to 0 Nm	ms	102.0	126.0	110.4	Pass
Overall Test Results					Pass

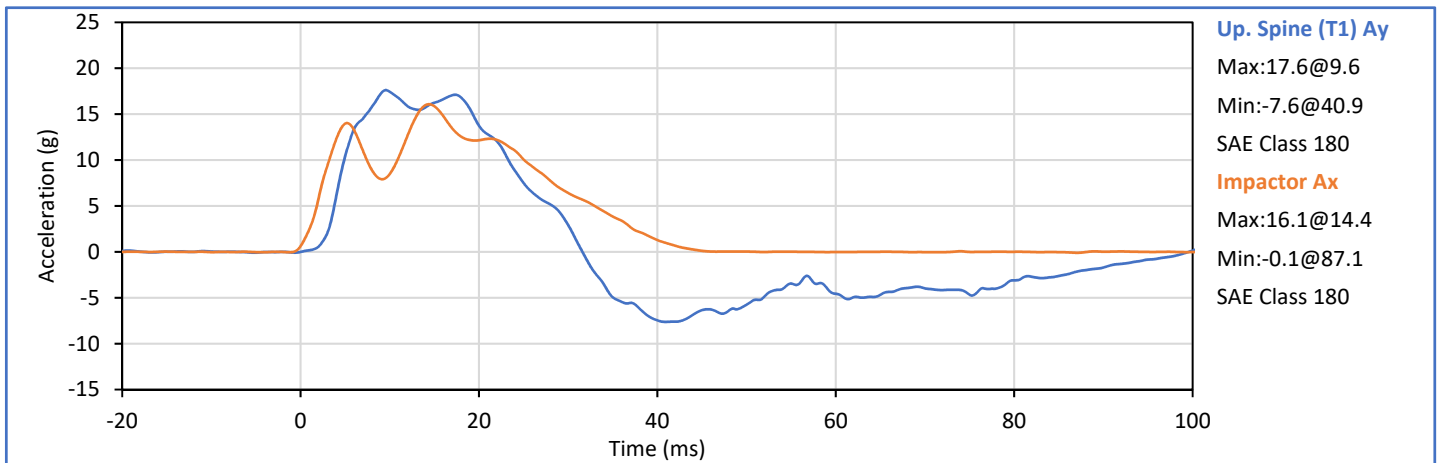
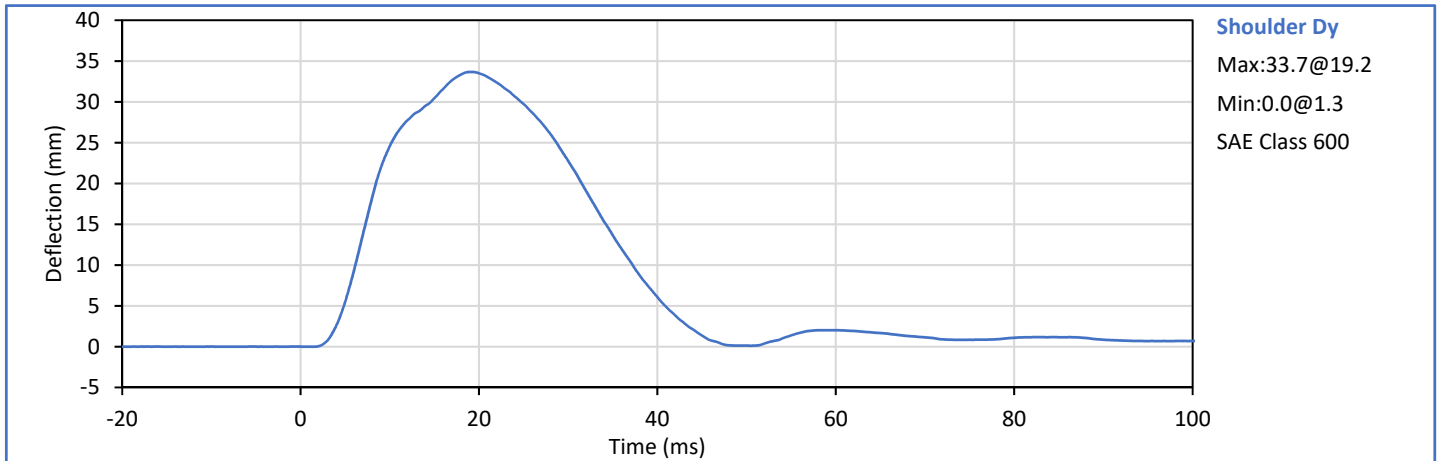


Technician: 
J. Hernandez


Approved By: 
P. Puzzuto



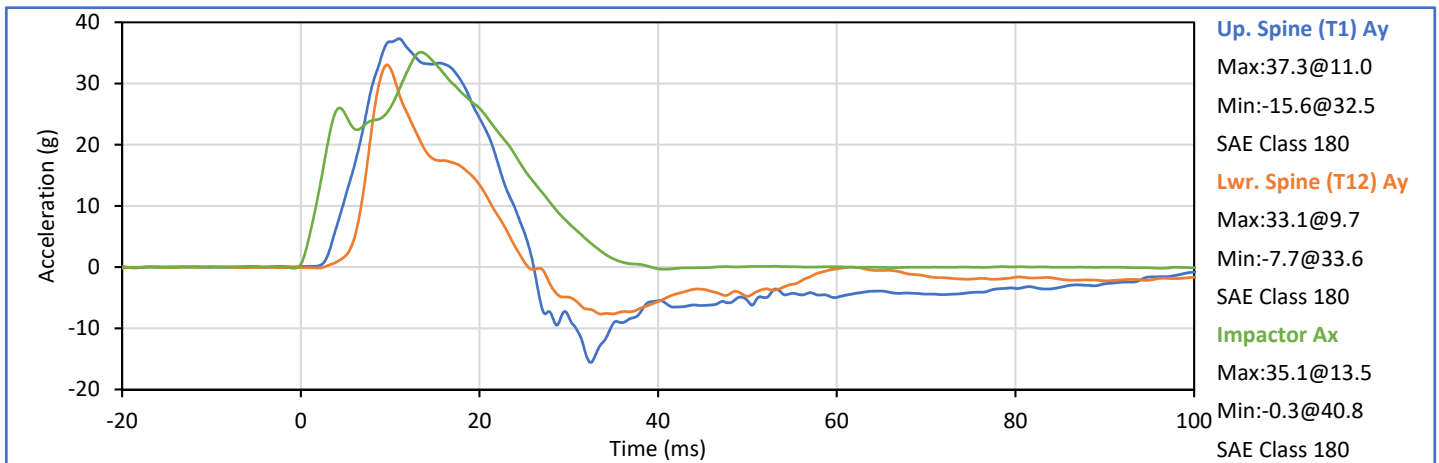
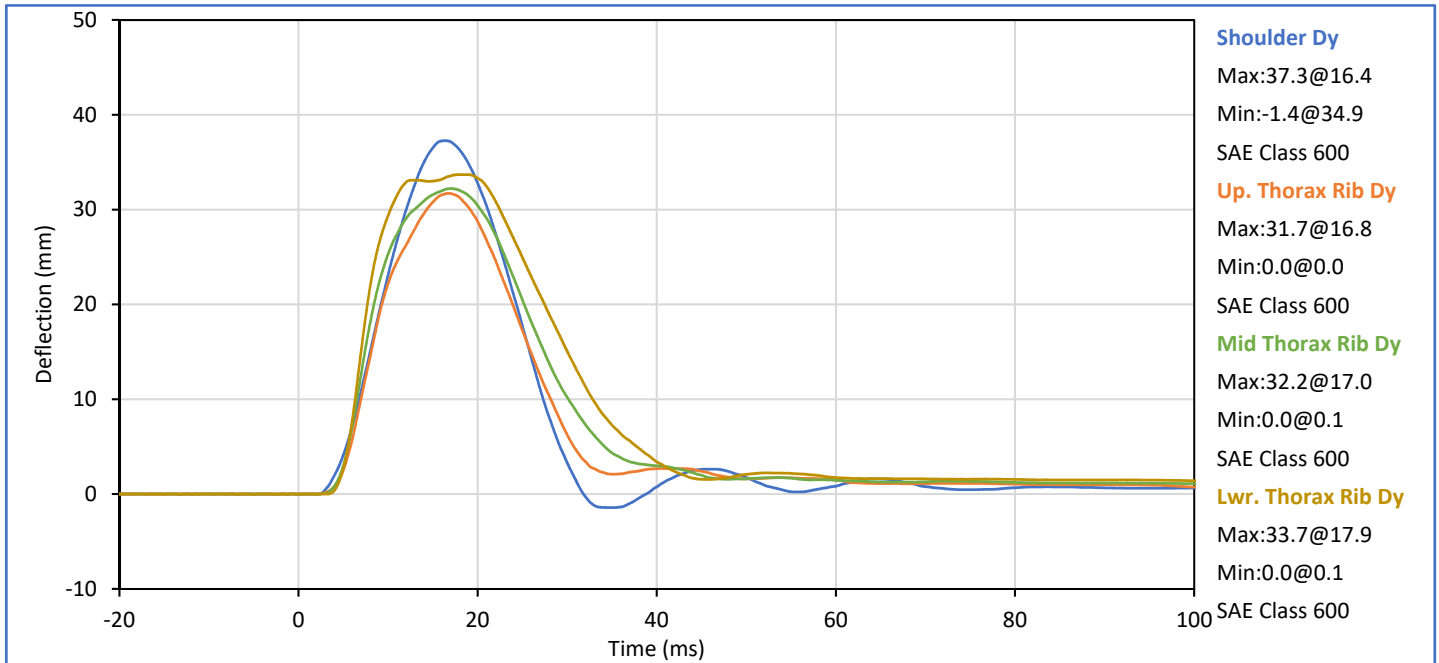
Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Humidity	%	10	70	32	Pass
Impactor Velocity	m/s	4.20	4.40	4.31	Pass
Peak Shoulder Dy	mm	28.0	37.0	33.7	Pass
Peak Upper Spine (T1) Ay	g	17.0	22.0	17.6	Pass
Peak Impactor Ax	g	13.0	18.0	16.1	Pass
Overall Test Results					Pass




Technician: 
J. Hernandez

Approved By: 
P. Puzzuto

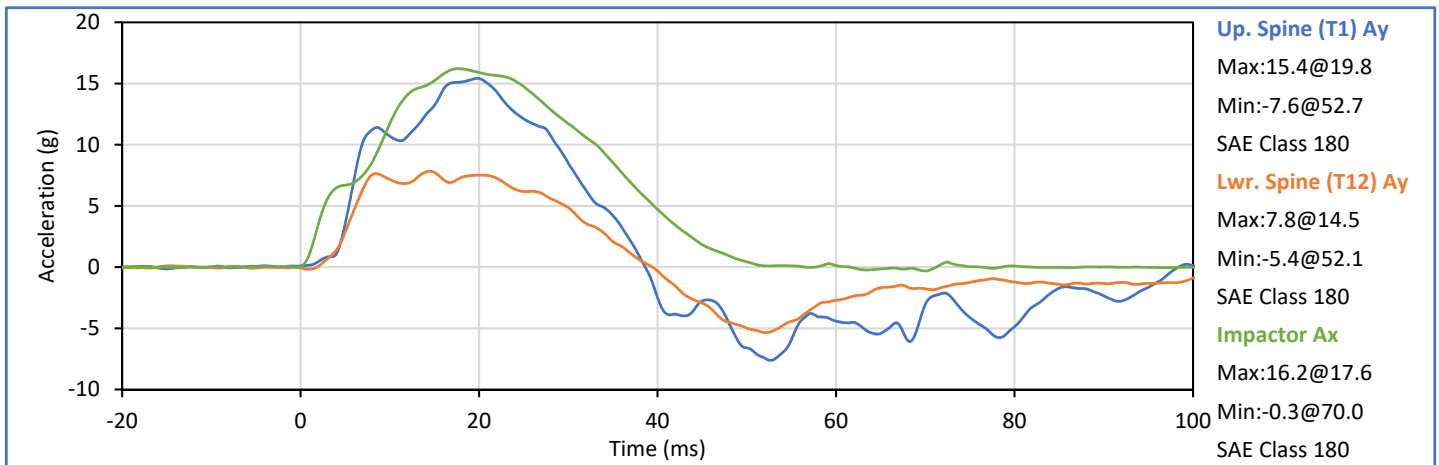
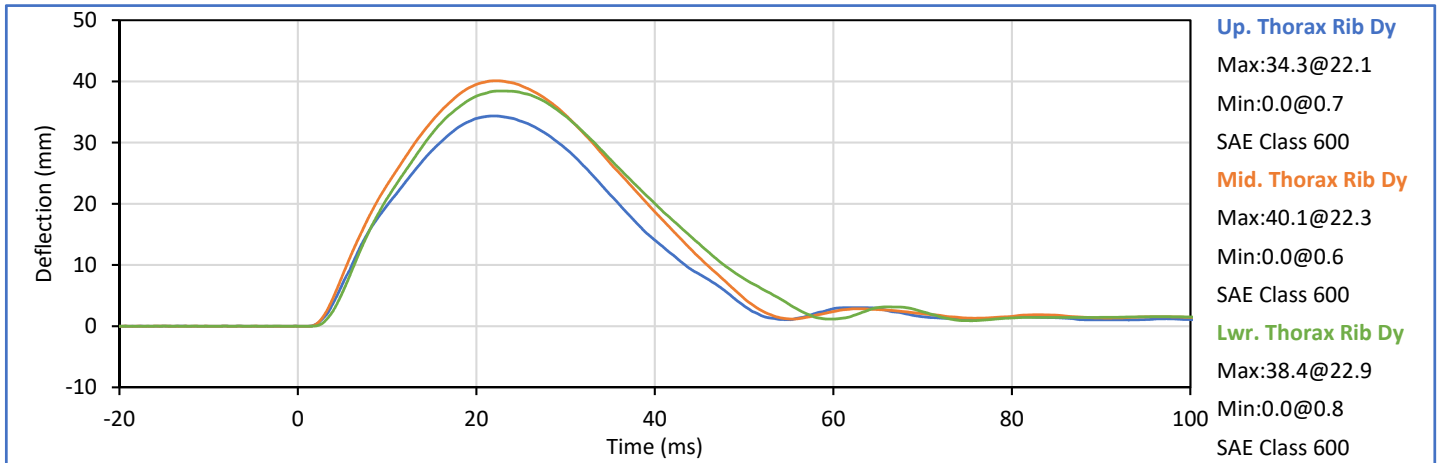
Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Humidity	%	10	70	42	Pass
Impactor Velocity	m/s	6.60	6.80	6.65	Pass
Peak Shoulder Dy	mm	31.0	40.0	37.3	Pass
Peak Upper Rib Dy	mm	25.0	32.0	31.7	Pass
Peak Middle Rib Dy	mm	30.0	36.0	32.2	Pass
Peak Lower Rib Dy	mm	32.0	38.0	33.7	Pass
Peak Upper Spine (T1) Ay	g	34.0	43.0	37.3	Pass
Peak Lower Spine (T12) Ay	g	29.0	37.0	33.1	Pass
Peak Impactor Ax	g	30.0	36.0	35.1	Pass
Overall Test Results					Pass




Technician: 
J. Hernandez

Approved By: 
P. Puzzuto

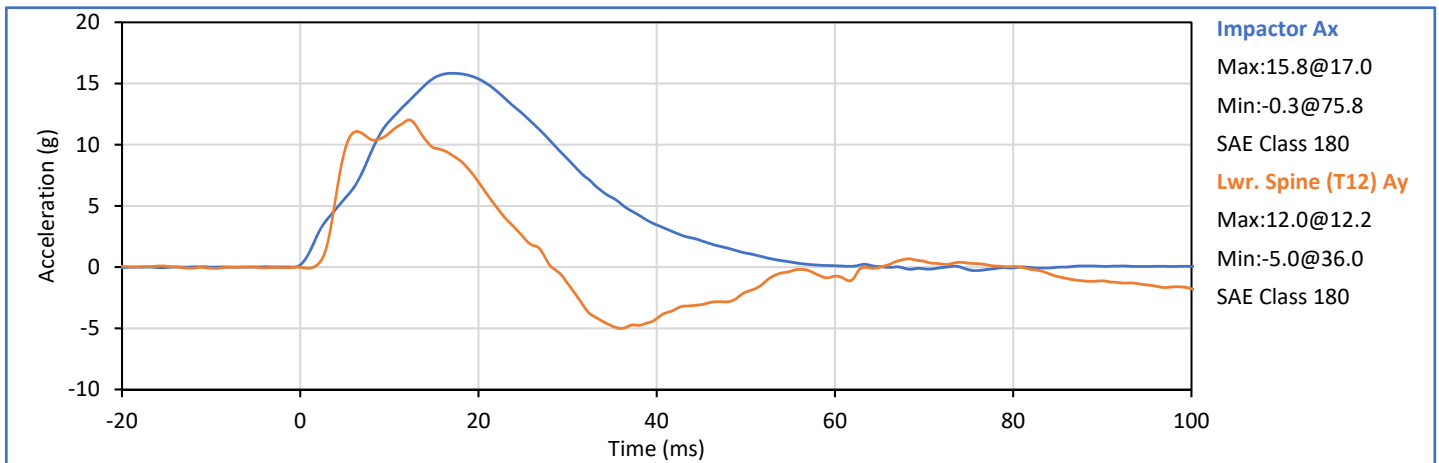
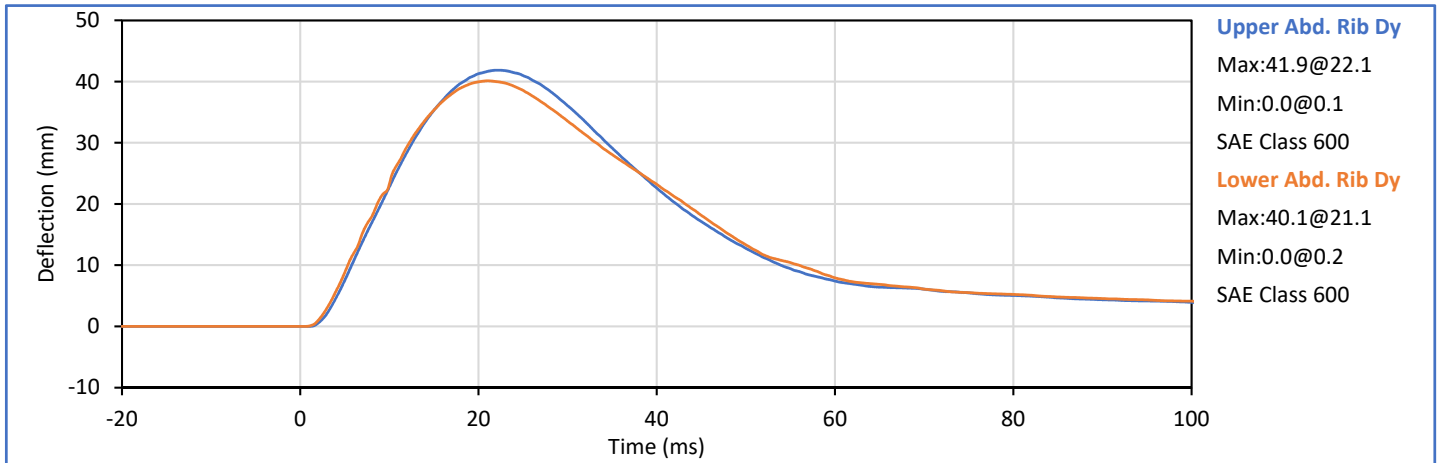
Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Humidity	%	10	70	32	Pass
Impactor Velocity	m/s	4.20	4.40	4.32	Pass
Peak Upper Rib Dy	mm	32.0	40.0	34.3	Pass
Peak Middle Rib Dy	mm	39.0	45.0	40.1	Pass
Peak Lower Rib Dy	mm	35.0	43.0	38.4	Pass
Peak Upper Spine (T1) Ay	g	13.0	17.0	15.4	Pass
Peak Lower Spine (T12) Ay	g	7.0	11.0	7.8	Pass
Peak Impactor Ax	g	14.0	18.0	16.2	Pass
Overall Test Results					Pass





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	32	Pass
Impactor Velocity	m/s	4.20	4.40	4.32	Pass
Peak Upper Abdomen Rib Dy	mm	36.0	47.0	41.9	Pass
Peak Lower Abdomen Rib Dy	mm	33.0	44.0	40.1	Pass
Peak Lower Spine T12 Ay	mm	9.0	14.0	12.0	Pass
Peak Impactor Ax	g	12.0	16.0	15.8	Pass
Overall Test Results					Pass

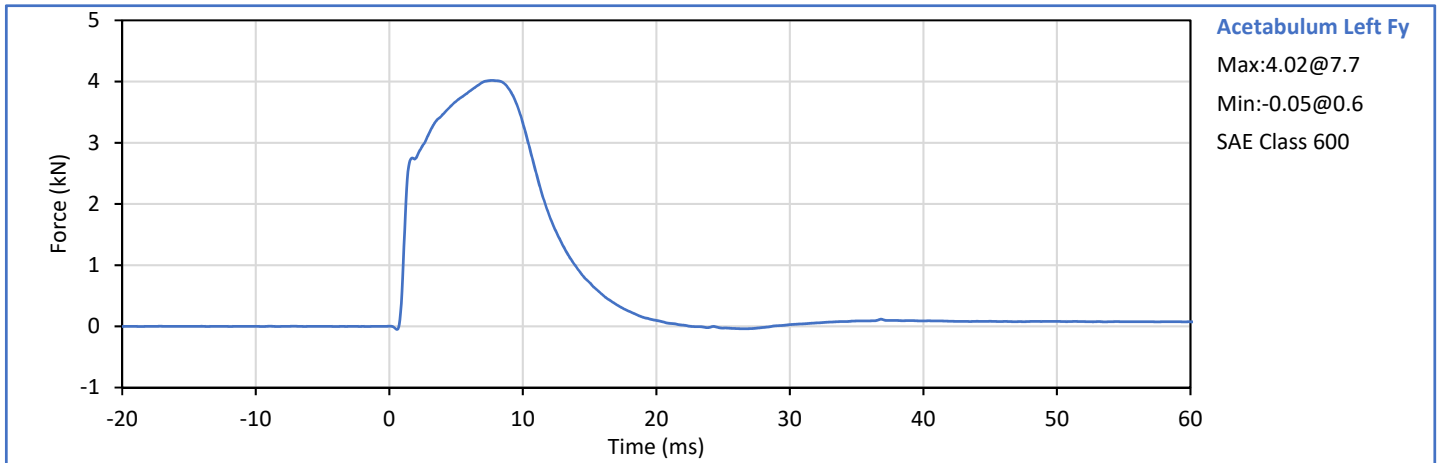
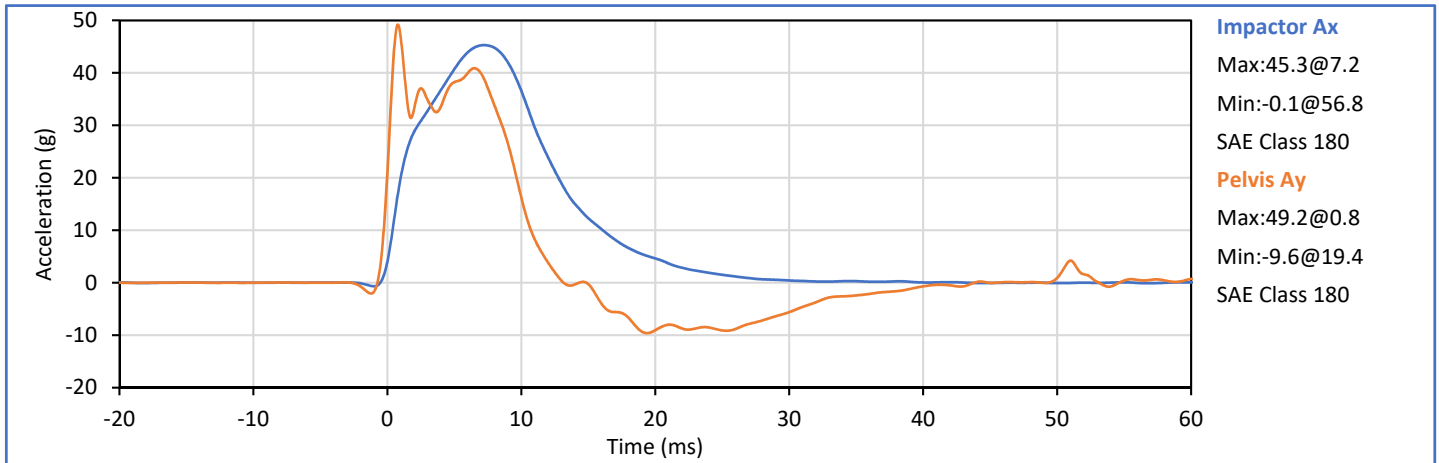


Technician: 
J. Hernandez

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	32	Pass
Impactor Velocity	m/s	6.60	6.80	6.71	Pass
Peak Acetabulum Fy	kN	3.60	4.30	4.02	Pass
Pelvis Ay after 6ms	g	34.0	42.0	40.9	Pass
Peak Impactor Ax	g	38.0	47.0	45.3	Pass
Overall Test Results					Pass

Pelvis Plug S/N: 12296



Technician: *J. Hernandez*
J. Hernandez

Approved By: *P. Puzzuto*
P. Puzzuto



SID-IIs Pelvis Plug Certification Test

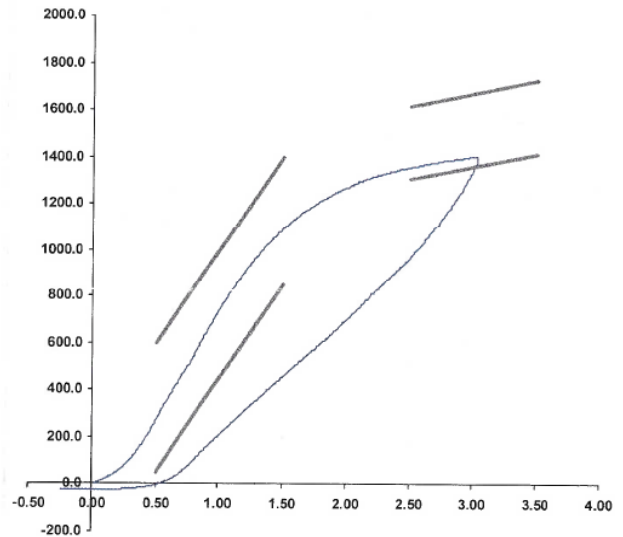
Plug S/N 12296
Test Number 6680
Report Number 6695
Test Date 3/15/2018 11:57:40 AM

	Test Results	Spec Min	Spec Max
Force @ 0.5 mm (N)	275.59	50.00	600.00
Force @ 1.5 mm (N)	1,092.66	850.00	1,400.00
Force @ 2.5 mm (N)	1,357.73	1,306.00	1,618.00
Force @ 3.0 mm (N)	1,403.19	1,361.00	1,673.00

Testing Machine STM-20 5965542
Load Cell S/N (FI360947), Units (LBS) 1000
Crosshead Speed (mm / min) or Rate 12.7
Extension or Position Measured by XHD_100 (XHD100)

Notes:

Force (-N) vs Extension (-mm)



Operator _____
Part Number 180-4450

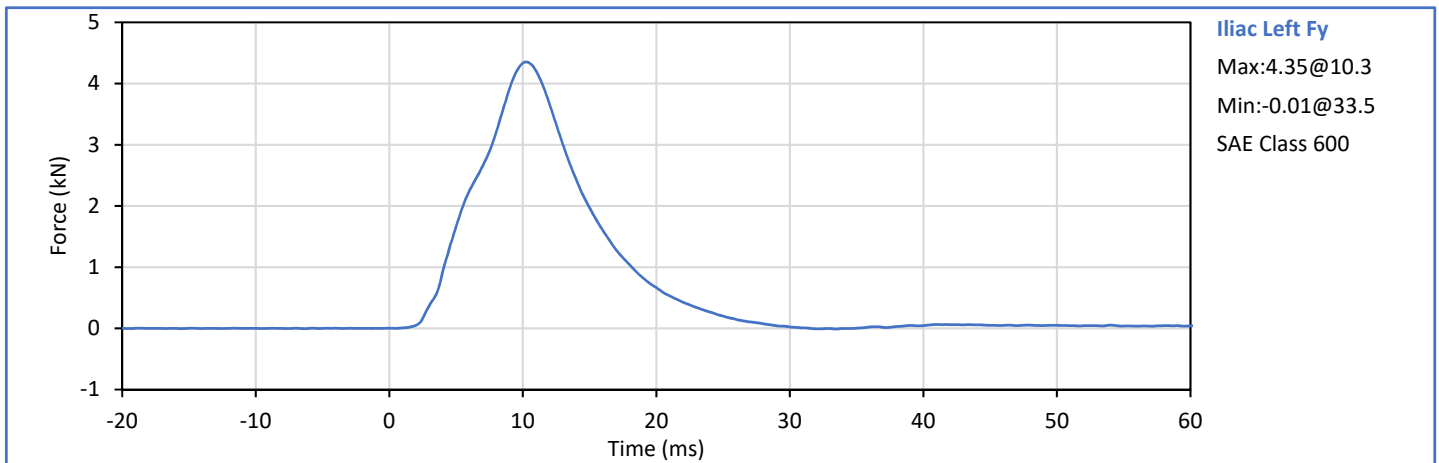
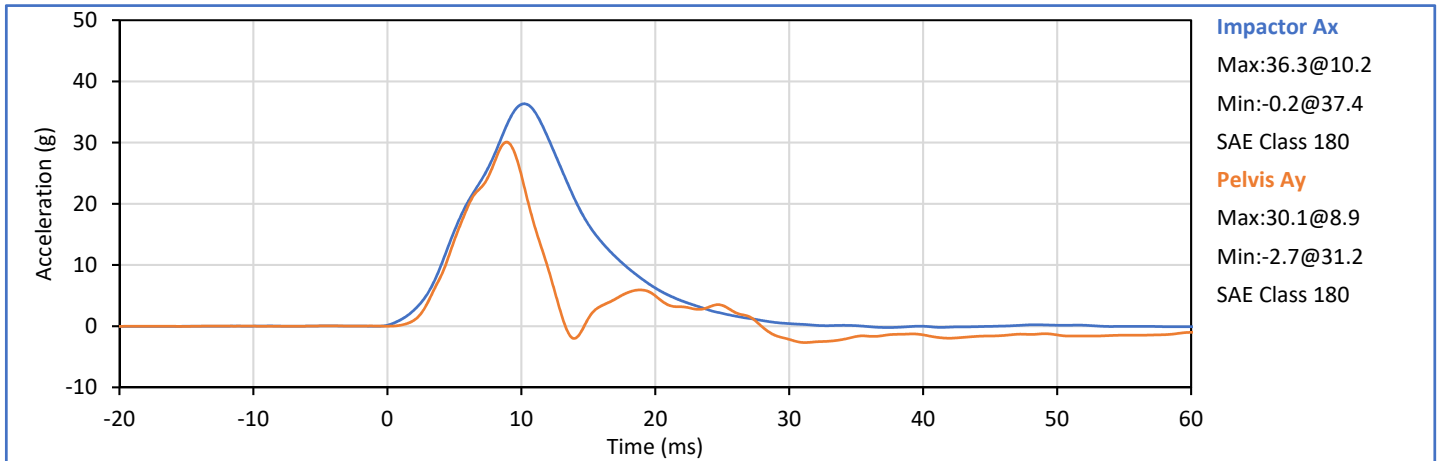
Template No 107 15-Mar-18
SACO Research

By: DC Date: 3/15/18
SACO Research 41735 Elm St, #401 Murrieta, CA 92562 Tel 310-694-2082 FAX

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Humidity	%	10	70	32	Pass
Impactor Velocity	m/s	4.20	4.40	4.32	Pass
Peak Iliac Fy	kN	4.10	5.10	4.35	Pass
Pelvis Ay after 6ms	g	28.0	39.0	30.1	Pass
Peak Impactor Ax	g	36.0	45.0	36.3	Pass
Overall Test Results					Pass

Pelvis Plug S/N: 12228 *

* Plug is not impacted and remains certified



Technician: *J. Hernandez*
J. Hernandez

Approved By: *P. Puzzuto*
P. Puzzuto

APPENDIX D
INSTRUMENTATION DATA CHANNEL ASSIGNMENTS

Table 1 - ATD Instrumentation

Sensor Location	Sensor S\N	Mfr	Model	Cal Date
Head Acceleration X Primary	P51929	Endevco	7264C-2k	2020-07-22
Head Acceleration Y Primary	P50086	Endevco	7264C-2k	2020-07-22
Head Acceleration Z Primary	P51931	Endevco	7264C-2k	2020-07-22
Upper Neck Force X	1626 Fx	R.A. Denton	1716A	2019-09-25
Upper Neck Force Y	1626 Fy	R.A. Denton	1716A	2019-09-25
Upper Neck Force Z	1626 Fz	R.A. Denton	1716A	2019-09-25
Upper Neck Moment X	1626 Mx	R.A. Denton	1716A	2019-09-25
Upper Neck Moment Y	1626 My	R.A. Denton	1716A	2019-09-25
Upper Neck Moment Z	1626 Mz	R.A. Denton	1716A	2019-09-25
Lower Neck Force X	143 Fx	Humanetics	3166JTF	2020-02-19
Lower Neck Force Y	143 Fy	Humanetics	3166JTF	2020-02-19
Lower Neck Force Z	143 Fz	Humanetics	3166JTF	2020-02-19
Lower Neck Moment X	143 Mx	Humanetics	3166JTF	2020-02-19
Lower Neck Moment Y	143 My	Humanetics	3166JTF	2020-02-19
Lower Neck Moment Z	143 Mz	Humanetics	3166JTF	2020-02-19