

REPORT NUMBER: TWG-TRC-17-02

NEW CAR ASSESSMENT PROGRAM (NCAP)
SIDE AIRBAG OUT-OF-POSITION INJURY TESTING

DAIMLER AG STUTTGART
2017 Mercedes-Benz E-Class Sedan

NHTSA NUMBER: M20174300TWG2
TRC TEST NUMBER: 170530-2

PREPARED BY:
TRANSPORTATION RESEARCH CENTER INC.
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P.O. BOX B-67
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Test Date: May 30, 2017

FINAL REPORT

Alpha Technology Associate, Inc.
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This Draft Test Report was prepared for the U.S. Department of Transportation, National Highway Traffic Safety Administration, under Contract No. DTNH22-13-D-00311L, Alpha Technology PO 13GT151. This document is disseminated under the sponsorship of the U.S. Department of Transportation in the interest of information exchange. The United States Government assumes no liability for its contents or use thereof.

Prepared By: ILO Projects Operations Group

Approved By: 
John Shultz
Project Manager

Approval Date: July 20, 2017

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Accepted By: _____

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15. Supplementary Notes						
16. Abstract This side impact Out-Of-Position test was performed in conjunction with a New Car Assessment Program (NCAP). This test was conducted at the TRC Test Facility in East Liberty, Ohio, on May 30, 2017.						
Injury Summary						
HIC15	Maximum Chest Displacement (mm)	Maximum Chest Displacement Rate (m/s)	NIJ(NTF)	NIJ(NTE)	NIJ(NCF)	NIJ(NCE)
43	N/A	N/A	0.2702	0.2604	0.0005	0.0007
17. Key Words New Car Assessment Program (NCAP) Side Airbag Out-Of-Position			18. Distribution Statement <u>Copies of this report are available from:</u> Alpha Technology Associate, Inc 2810 Old Lee Hwy, Suite 120 Fairfax, VA 22031 Phone: (703) 876-0010 Fax: (703) 876-0120 Attn: Steven Kim			
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TABLE OF CONTENTS

<u>Section</u>	Page No.
1 PURPOSE AND SUMMARY OF TEST	1
2 DATA SHEETS	2
Data Sheet 1 – Test Summary	2
Data Sheet 2 – General Test and Vehicle Parameter Data	3
Data Sheet 3 – Dummy Positioning in Vehicle	4
Data Sheet 4 – Dummy Injury Criteria Values	5
A PHOTOGRAPHS	A-1
B DUMMY RESPONSE DATA TRACES	B-1
C TEST EQUIPMENT LIST AND CALIBRATION INFORMATION	C-1

Test Vehicle: 2017 Mercedes-Benz E-Class Sedan
Test Program: Side Airbag O.O.P. Injury Testing

NHTSA No.: M20174300TWG2
Test Date: 5/30/2017

SECTION 1

PURPOSE AND SUMMARY OF TEST

1.1 PURPOSE

The purpose of this test was to obtain data from a static out-of-position side impact using a vehicle that had undergone a New Car Assessment Program (NCAP) sponsored test requested by the National Highway Traffic Safety Administration (NHTSA). This test was performed following the technical requirements under NHTSA contract No. DTNH22-13-D-00311L and through Alpha Technology Associate, Inc.

1.2 SUMMARY

The effects of both a seat-mounted side airbag and a curtain airbag deployment in a 2017 Mercedes-Benz E-Class Sedan on an out-of-position Hybrid III 3-year-old anthropomorphic test device (ATD) were evaluated. The test was performed by TRC on May 30, 2017. Pre and post-test photographs of the vehicle and ATD can be found in Appendix A.

Three (3) high-speed digital cameras were used to document the front seat side airbag deployment event. Images were recorded at rates of 1000 frames per second. Cameras were placed relative to the right front seat and positioned to capture the deployment event from the side, front, and oblique views.

The Hybrid III 3-year-old anthropomorphic test device (ATD) was placed in the right front (passenger) seat situated on the seat lying on its back with its arms aligned per section 3.3.3.3. This was placed following the ATD placement instructions specified in the Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags as prepared by the Side Airbag Out-of-Position Injury Technical Working Group (TWG).

The Hybrid III 3-year-old ATD was instrumented with head x, y and z accelerometers, six upper neck axial force and moment load cell transducers, and six lower neck axial force and moment load cell transducers.

Twenty-two (22) channels of data were recorded using an on-board data acquisition system. Appendix A contains photographs. Appendix B contains ATD response data traces. Appendix C contains the instrumentation data channel assignments.

The Hybrid III 3-year-old ATD was positioned lying across seat with its head on door trim panel. The seat was set in the full rearward position with a seatback angle of 18.5 degrees. The head just touching arm rest with CG aligned with anticipated torso bag deployment path. The left arm not in contact with seat back due to deep side bolsters on the seat back. This orientation complies with section 3.3.3.3 of the TWG Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags, First Revision dated July, 2003.

Test Vehicle: 2017 Mercedes-Benz E-Class Sedan
Test Program: Side Airbag O.O.P. Injury Testing

NHTSA No.: M20174300TWG2
Test Date: 5/30/2017

SECTION 2

DATA SHEET NO. 1

TEST SUMMARY

TEST CONFIGURATION INFORMATION:

Seating Position:	P2	Right Front Seating Position
Test:	3.3.3.3	Hybrid III 3-Year-Old Child Dummy Lying on Seat with Head on Armrest (Passenger Positions with Seat-Mounted Airbags)
Airbag:	Seat	Seat mounted – outside seam
Airbag:	Side Rail	Side curtain airbag
Booster Block:	Yes	A foam wedge was used to support the dummy's weight allowing the dummy's head to touch the armrest without applying a significant downward force.
ATD Type/Serial Number:	Hybrid 3 Year Old	040

Measurement	Value
Total Fore/Aft Travel (mm):	262
Placed in Position #:	Full Rearward

Number of Data Channels: 22

Number of Cameras: 3 High Speed Digital

VISIBLE DUMMY CONTACT POINTS

Head Contact:	Torso/Pelvis Airbag
Upper Torso Contact:	None
Lower Torso Contact:	None
Left Knee Contact:	None
Right Knee Contact:	None

Test Vehicle: 2017 Mercedes-Benz E-Class Sedan
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NHTSA No.: M20174300TWG2
 Test Date: 5/30/2017

DATA SHEET NO. 2

GENERAL TEST AND VEHICLE PARAMETER DATA

TEST VEHICLE INFORMATION

NHTSA No.	M20174300
Model Year	2017
Make	Mercedes-Benz
Model	E300 E-Class
Body Style	Sedan
VIN	WDDZF4KB5HA030179
Body Color	Selenite Grey Metallic
Odometer Reading (km/mi)	17 miles
Engine Displacement (L)	2.0
Type/No. Cylinders	Inline/4
Engine Placement	Front/Longitudinal
Transmission Type	Automatic
Transmission Speeds	9 Speed
Overdrive	Yes
Final Drive	AWD
Roof Rack	No
Sunroof/T-Top	Yes
Running Boards	No
Tilt Steering Wheel	Yes
Power Seats	Yes
Anti-Lock Brakes (ABS)	Yes
Automatic Door Locks (ADLs)	Yes

TEST VEHICLE OPTIONS

Traction Control System (TCS)	Yes
Power Steering	Yes
Power Window Auto-Reverse	Yes
Driver Frontal 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
Front Pass. Frontal Airbag	Yes
Front Pass. Curtain Airbag	Yes
Front Pass. Head/Torso Airbag	No
Front Pass. Torso Airbag	No
Front Pass. Torso/Pelvis Airbag	Yes
Front Pass. Pelvis Airbag	No
Front Pass. Knee Airbag	No
Driver Pretensioner	Yes
Driver Load Limiter	Yes
Front Pass. Pretensioner	Yes
Front Pass. Load Limiter	Yes
Other	No

Does owner's manual provide instructions to turn off automatic door locks?

Yes

DATA FROM CERTIFICATION LABEL

Manufactured by	DAIMLER AG STUTTGART
Date of Manufacture	04/16

GVWR (kg)	2345
GAWR Front (kg)	1120
GAWR Rear (kg)	1225

VEHICLE SEATING AND WEIGHT CAPACITY

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Split Bench		
Number of Occupants	2	3		5
Capacity Wt. (VCW) (kg)				485
Cargo Wt. (RCLW) (kg)				144.8

Test Vehicle: 2017 Mercedes-Benz E-Class Sedan
 Test Program: Side Airbag O.O.P. Injury Testing

NHTSA No.: M20174300TWG2
 Test Date: 5/30/2017

DATA SHEET NO. 3
DUMMY POSITIONING IN VEHICLE

Measurement		Value
Seat Position		Full Rearward
Seat Vertical Position		Full Down
Placed in Position #		02
Seat Back Angle at Headrest Post	SA (°)	18.5 Rearward
Top of Curtain Airbag Module to Head/Neck Junction	AN (mm)	619
Top of Seat Airbag Module to Head/Neck Junction	AN (mm)	81
Head CG to Door Panel/Window	HD (mm)	N/A
Head to Seat Back Centerline	HSC (mm)	216
Chest to Dash	CD (mm)	N/A
Chest to Seat Back	CS (mm)	199
Right Arm to Seat Back Centerline	RACL (mm)	300
Left Arm to Seat Back Centerline	LACL (mm)	50
Right Arm to Door Panel	RA (mm)	N/A
Left Arm to B-Post	LA (mm)	N/A
Knee to Knee	KK (mm)	76
Toe to Toe	TT (mm)	47
Right Knee to Seat Cushion Centerline	KSCR (mm)	204
Left Knee to Seat Cushion Centerline	KSCL (mm)	190
Right Toe to Seat Cushion Centerline	TSCR (mm)	N/A
Left Toe to Seat Cushion Centerline	TSCL (mm)	N/A
Nose to Seat	ND (mm)	N/A
Nose to Seat Back	NS (mm)	238
Top of Head to Headliner	HH (mm)	473

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NHTSA No.: M20174300TWG2
 Test Date: 5/30/2017

DATA SHEET NO. 4
DUMMY INJURY CRITERIA VALUES

Channel	Max	Time (ms)	Min	Time (ms)
Head Ax [g , CFC_1000]	82.35	9.20	-11.17	8.40
Head Ay [g , CFC_1000]	77.52	9.04	-4.15	40.32
Head Az [g , CFC_1000]	17.48	9.76	-25.01	8.80
Upper Neck Fx [N , CFC_1000]	455.47	9.12	-59.23	112.88
Upper Neck Fy [N , CFC_1000]	310.66	8.96	-142.73	34.48
Upper Neck Fz [N , CFC_1000]	521.46	10.08	-1.12	2.40
Upper Neck Mx [N-m , CFC_600]	4.75	9.52	-11.93	27.20
Upper Neck My [N-m , CFC_600]	3.35	120.32	-4.05	27.20
Upper Neck Mz [N-m , CFC_600]	5.33	9.36	-1.23	88.64
Lower Neck Fx [N , CFC_1000]	49.90	110.56	-124.86	9.52
Lower Neck Fy [N , CFC_1000]	132.79	33.52	-77.68	7.68
Lower Neck Fz [N , CFC_1000]	568.00	9.84	-1.00	-19.28
Lower Neck Mx [N-m , CFC_600]	4.35	88.24	-25.86	31.84
Lower Neck My [N-m , CFC_600]	9.25	111.92	-4.93	9.44
Lower Neck Mz [N-m , CFC_600]	6.07	19.28	-1.31	77.60
Airbag Event Passenger Side Curtain Voltage [V]	32.97	3.28	0.00	-20.00
Airbag Event Front Passenger Seat Voltage [V]	34.25	0.64	0.00	-20.00
Airbag Event Passenger Side Curtain Current [A]	3.36	3.04	0.00	-20.00
Airbag Event Front Passenger Seat Current [A]	3.29	0.80	0.00	-20.00

HEAD INJURY CRITERIA (HIC)

	HIC(15)	T ₁ (msec)	T ₂ (msec)	HIC(36)	T ₁ (msec)	T ₂ (msec)
Position #2 Right Front	43	7.68	21.52	43	7.68	21.52

Position 2 Neck Injury Summary (H-III 3 YO)

Nij V10	Nij	Time (ms)
Upper Neck NTF	0.2702	10.08
Upper Neck NTE	0.2604	24.72
Upper Neck NCF	0.0005	2.40
Upper Neck NCE	0.0007	2.64
Peak Tension (CFC1000)	521.46 N	
Peak Compression (CFC1000)	-1.12 N	

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NHTSA No.: M20174300TWG2
Test Date: 5/30/2017

APPENDIX A
PHOTOGRAPHS

Test Vehicle: 2017 Mercedes-Benz E-Class Sedan
Test Program: Side Airbag O.O.P. Injury Testing

NHTSA No.: M20174300TWG2
Test Date: 5/30/2017

TABLE OF PHOTOGRAPHS

<u>Figure</u>	<u>Photograph Title</u>	<u>Page</u>
Figure A-1	Front 3/4 View, As received	A-3
Figure A-2	Vehicle Certification Label	A-3
Figure A-3	Pre-Test Right Front 3/4 View of Test Vehicle	A-4
Figure A-4	Post-Test Right Front 3/4 View of Test Vehicle	A-4
Figure A-5	Pre-Test Left Side View of Test Vehicle	A-5
Figure A-6	Post-Test Left Side View of Test Vehicle	A-5
Figure A-7	Pre-Test Left Rear 3/4 View of Test Vehicle	A-6
Figure A-8	Post-Test Left Rear 3/4 View of Test Vehicle	A-6
Figure A-9	Pre-Test 3 Year Old Dummy - Left Side View	A-7
Figure A-10	Post-Test 3 Year Old Dummy - Left Side View	A-7
Figure A-11	Pre-Test 3 Year Old Dummy - Left Side Close-Up View	A-8
Figure A-12	Post-Test 3 Year Old Dummy - Left Side Close-Up View	A-8
Figure A-13	Pre-Test 3 Year Old Dummy - Left Front 3/4 View	A-9
Figure A-14	Post-Test 3 Year Old Dummy - Left Front 3/4 View	A-9
Figure A-15	Pre-Test 3 Year Old Dummy - Left Front 3/4 Close-Up View	A-10
Figure A-16	Post-Test 3 Year Old Dummy - Left Front 3/4 Close-Up View	A-10
Figure A-17	Pre-Test 3 Year Old Dummy - Front View	A-11
Figure A-18	Post-Test 3 Year Old Dummy - Front View	A-11
Figure A-19	Pre-Test 3 Year Old Dummy - Front Close-Up View	A-12
Figure A-20	Post-Test 3 Year Old Dummy - Front Close-Up View	A-12
Figure A-21	Pre-Test 3 Year Old Dummy - Right Front 3/4 View	A-13
Figure A-22	Post-Test 3 Year Old Dummy - Right Front 3/4 View	A-13
Figure A-23	Pre-Test 3 Year Old Dummy - Right Side View	A-14
Figure A-24	Post-Test 3 Year Old Dummy - Right Side View	A-14
Figure A-25	Post-Test 3 Year Old Dummy - Right Side View (Door Open)	A-15
Figure A-26	Post-Test Curtain Airbag - Left Side View	A-16
Figure A-27	Post-Test Curtain Airbag - Left Front 3/4 View	A-16
Figure A-28	Post-Test Curtain Airbag - Front View	A-17
Figure A-29	Post-Test Curtain Airbag - Right Side View (Door Open)	A-17



Figure A-1 Front 3/4 View, As Received



Figure A-2 Vehicle Certification Label



Figure A-3 Pre-Test Right Front 3/4 View of Test Vehicle



Figure A-4 Post-Test Right Front 3/4 View of Test Vehicle



Figure A-5 Pre-Test Left Side View of Test Vehicle



Figure A-6 Post-Test Left Side View of Test Vehicle



Figure A-7 Pre-Test Left Rear 3/4 View of Test Vehicle



Figure A-8 Post-Test Left Rear 3/4 View of Test Vehicle



Figure A-9 Pre-Test 3 Year Old Dummy - Left Side View



Figure A-10 Post-Test 3 Year Old Dummy - Left Side View



Figure A-11 Pre-Test 3 Year Old Dummy - Left Side Close-Up View



Figure A-12 Post-Test 3 Year Old Dummy - Left Side Close-Up View



Figure A-13 Pre-Test 3 Year Old Dummy - Left Front 3/4 View

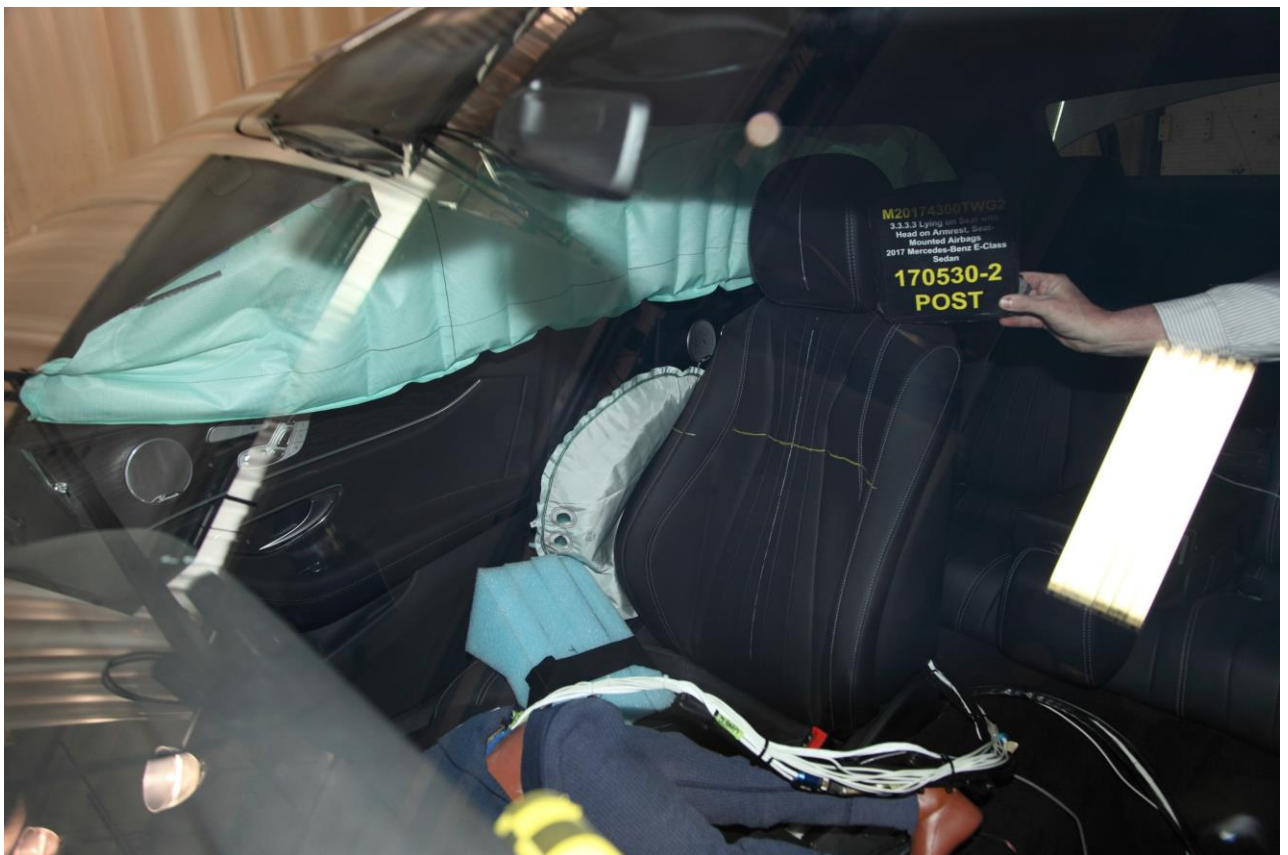


Figure A-14 Post-Test 3 Year Old Dummy - Left Front 3/4 View



Figure A-15 Pre-Test 3 Year Old Dummy - Left Front 3/4 Close-Up View



Figure A-16 Post-Test 3 Year Old Dummy - Left Front 3/4 Close-Up View



Figure A-17 Pre-Test 3 Year Old Dummy - Front View



Figure A-18 Post-Test 3 Year Old Dummy - Front View

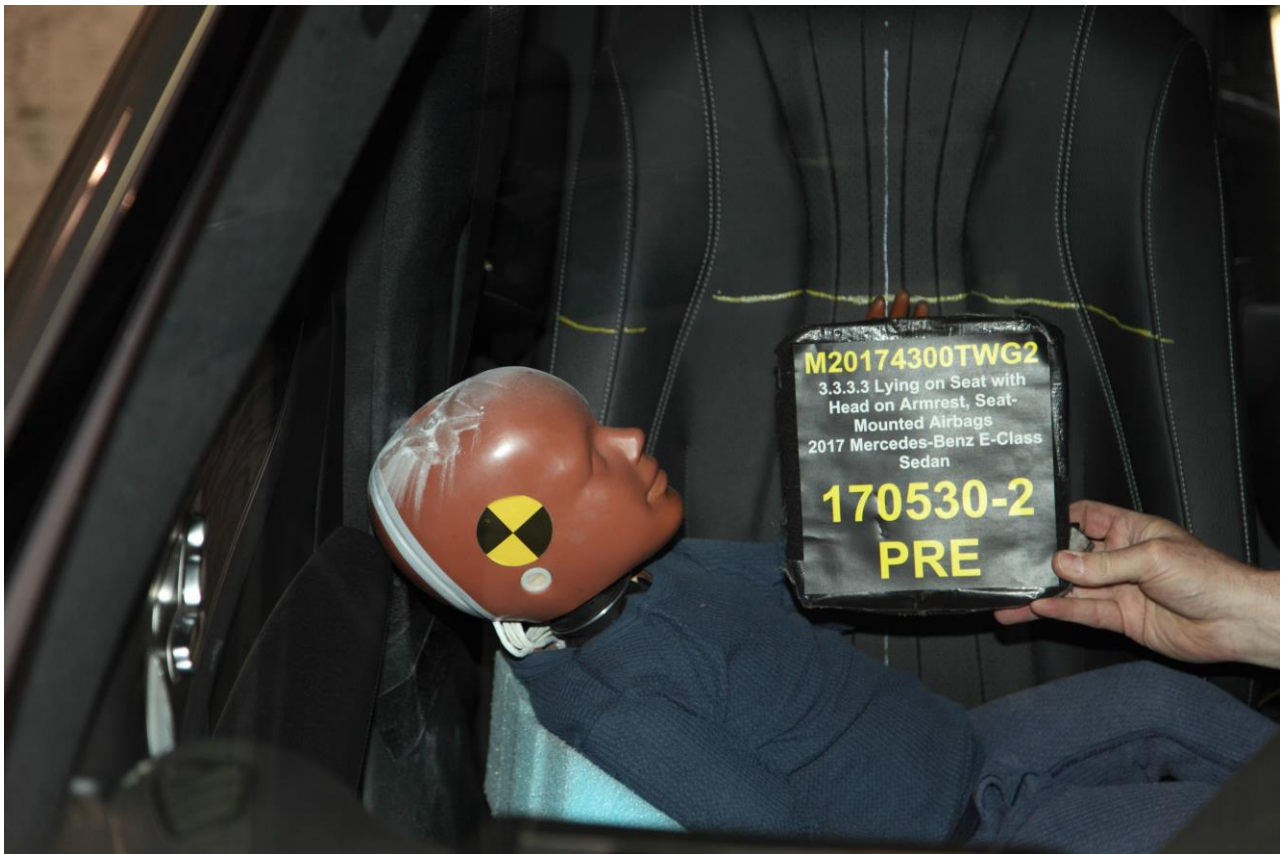


Figure A-19 Pre-Test 3 Year Old Dummy - Front Close-Up View



Figure A-20 Post-Test 3 Year Old Dummy - Front Close-Up View



Figure A-21 Pre-Test 3 Year Old Dummy - Right Front 3/4 View



Figure A-22 Post-Test 3 Year Old Dummy - Right Front 3/4 View



Figure A-23 Pre-Test 3 Year Old Dummy - Right Side View



Figure A-24 Post-Test 3 Year Old Dummy - Right Side View



Figure A-25 Post-Test 3 Year Old Dummy - Right Side View (Door Open)

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Figure A-26 Post-Test Airbags - Left Side View



Figure A-27 Post-Test Airbags - Left Front 3/4 View



Figure A-28 Post-Test Airbags - Front View



Figure A-29 Post-Test Airbags - Right Side View (Door Open)

Test Vehicle: 2017 Mercedes-Benz E-Class Sedan
Test Program: Side Airbag O.O.P. Injury Testing

NHTSA No.: M20174300TWG2
Test Date: 5/30/2017

APPENDIX B
DUMMY RESPONSE DATA TRACES

Test Vehicle: 2017 Mercedes-Benz E-Class Sedan
Test Program: Side Airbag O.O.P. Injury Testing

NHTSA No.: M20174300TWG2
Test Date: 5/30/2017

Table of Data Plots

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

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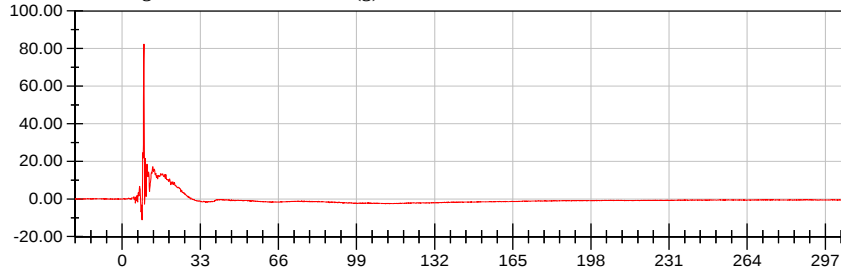
Test Lab: CTF

Test Number: 170530-2 (M20174300TWG2)

Test Date: 05/30/2017

Position #2 Hybrid III 3 year old Dummy (Part 572 P) (040)

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



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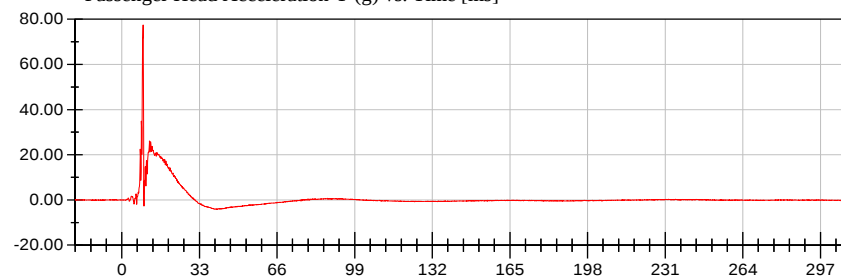
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-11.17 g at 8.40 ms

CFC_1000

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



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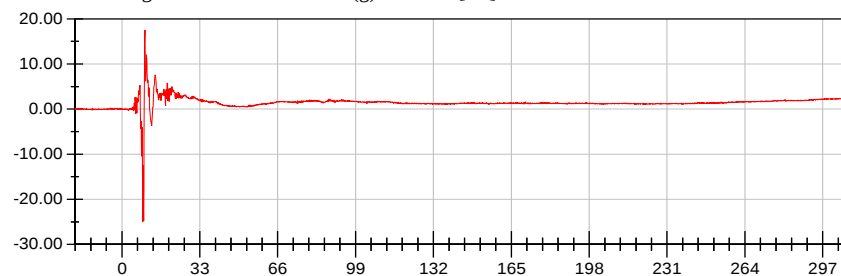
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-4.15 g at 40.32 ms

CFC_1000

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



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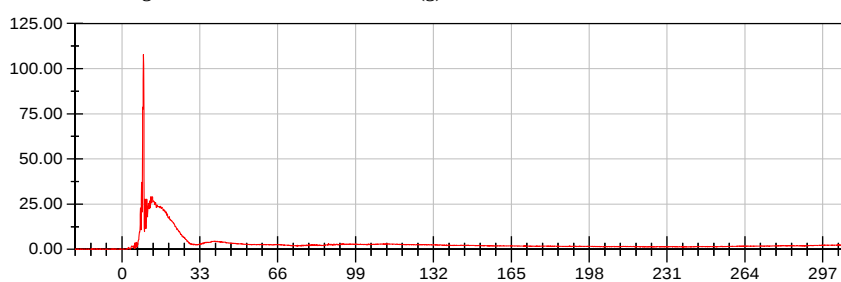
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-25.01 g at 8.80 ms

CFC_1000

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



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0.04 g at -15.04 ms

CFC_1000



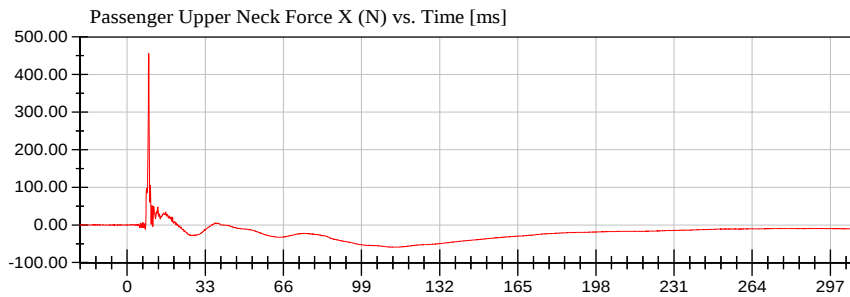
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Test Lab: CTF

Test Number: 170530-2 (M20174300TWG2)

Test Date: 05/30/2017

Position #2 Hybrid III 3 year old Dummy (Part 572 P) (040)



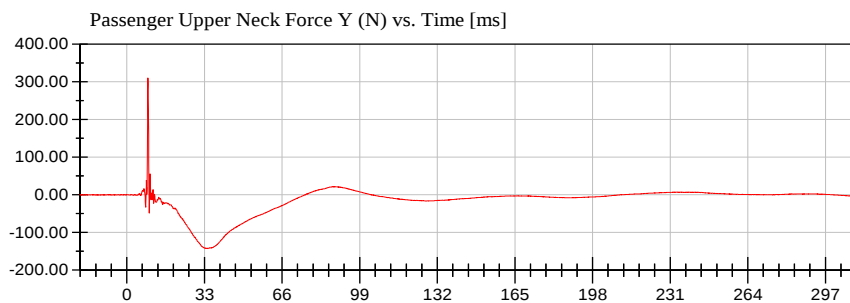
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455.47 N at 9.12 ms

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-59.23 N at 112.88 ms

CFC_1000



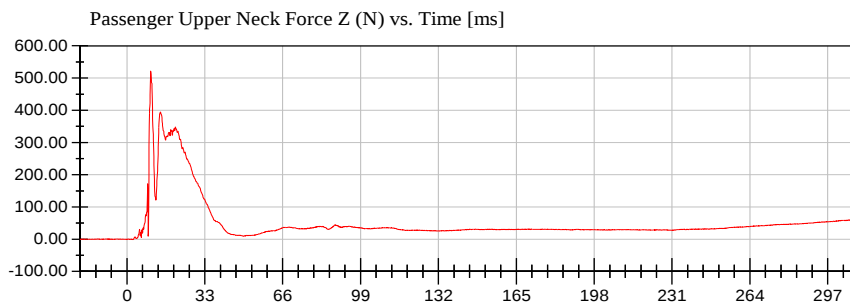
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310.66 N at 8.96 ms

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-142.73 N at 34.48 ms

CFC_1000



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521.46 N at 10.08 ms

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-1.12 N at 2.40 ms

CFC_1000



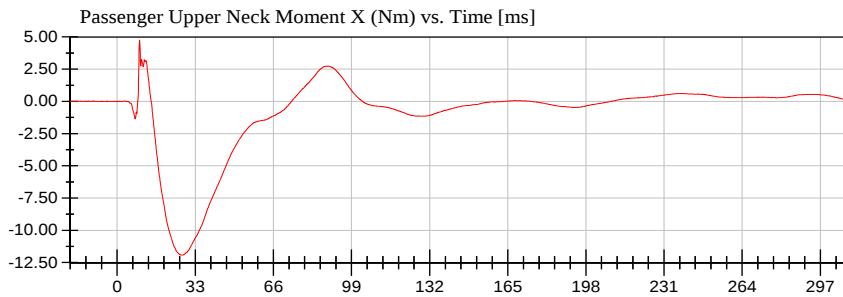
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Test Lab: CTF

Test Number: 170530-2 (M20174300TWG2)

Test Date: 05/30/2017

Position #2 Hybrid III 3 year old Dummy (Part 572 P) (040)



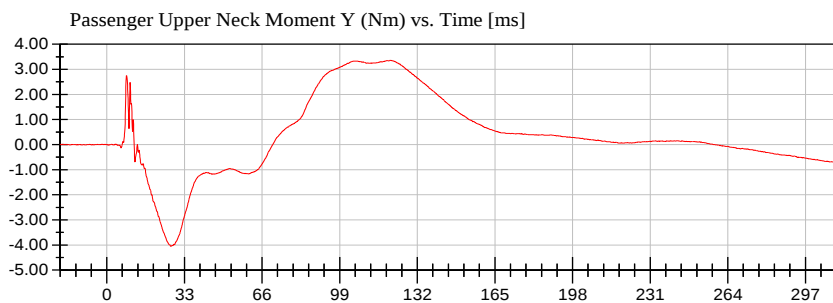
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4.75 Nm at 9.52 ms

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-11.93 Nm at 27.20 ms

CFC_600



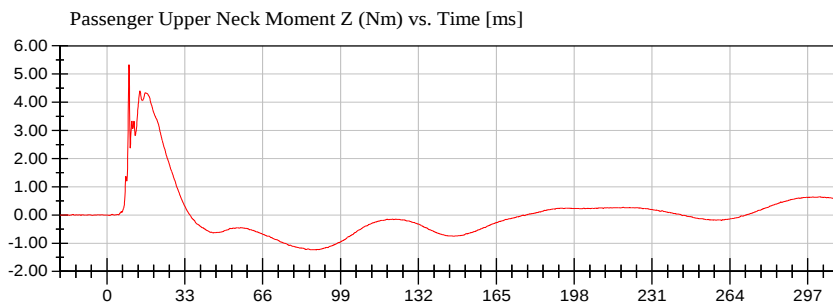
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-4.05 Nm at 27.20 ms

CFC_600



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5.33 Nm at 9.36 ms

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-1.23 Nm at 88.64 ms

CFC_600



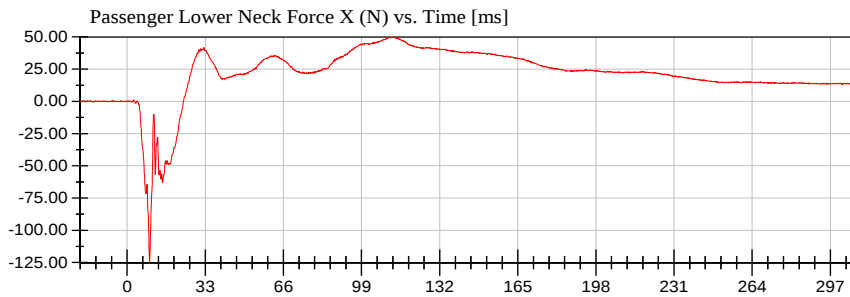
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Position #2 Hybrid III 3 year old Dummy (Part 572 P) (040)



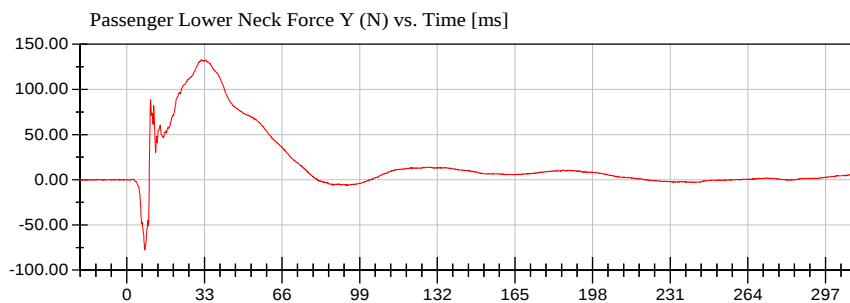
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CFC_1000



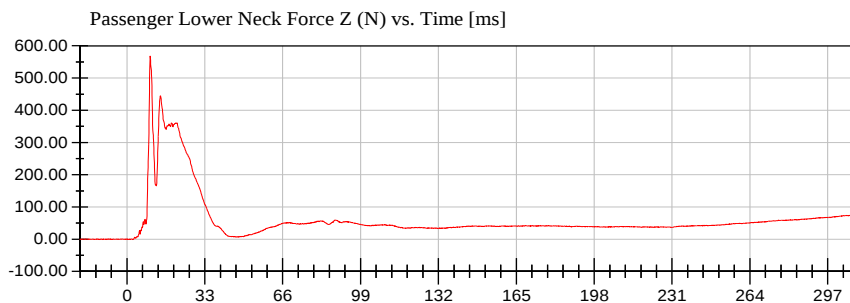
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-77.68 N at 7.68 ms

CFC_1000



<Max>

568.00 N at 9.84 ms

<Min>

-1.00 N at -19.28 ms

CFC_1000



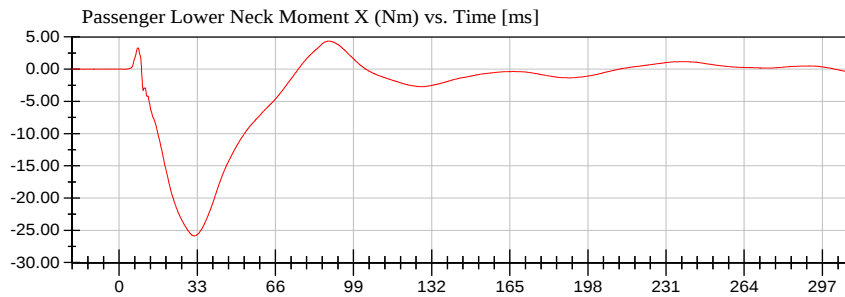
Alpha Technology

Test Lab: CTF

Test Number: 170530-2 (M20174300TWG2)

Test Date: 05/30/2017

Position #2 Hybrid III 3 year old Dummy (Part 572 P) (040)



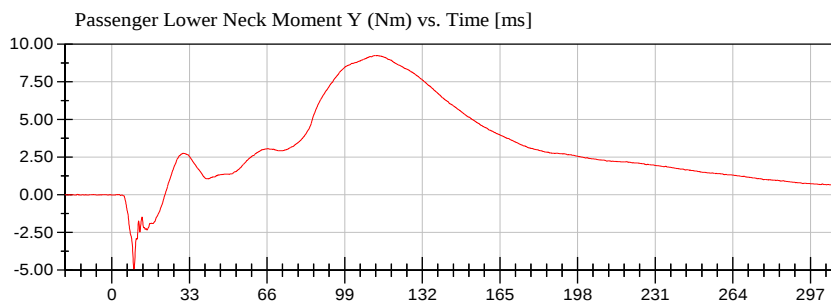
<Max>

4.35 Nm at 88.24 ms

<Min>

-25.86 Nm at 31.84 ms

CFC_600



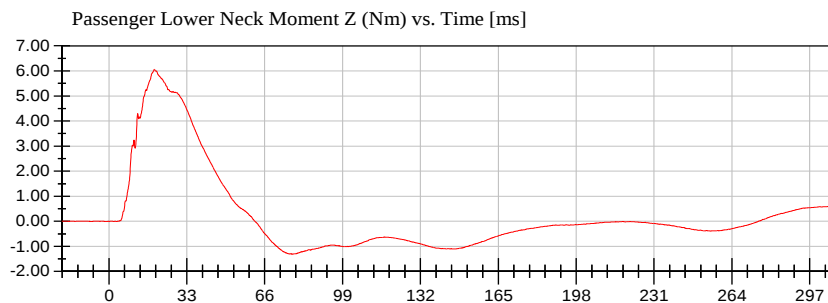
<Max>

9.25 Nm at 111.92 ms

<Min>

-4.92 Nm at 9.44 ms

CFC_600



<Max>

6.07 Nm at 19.28 ms

<Min>

-1.31 Nm at 77.60 ms

CFC_600



Alpha Technology

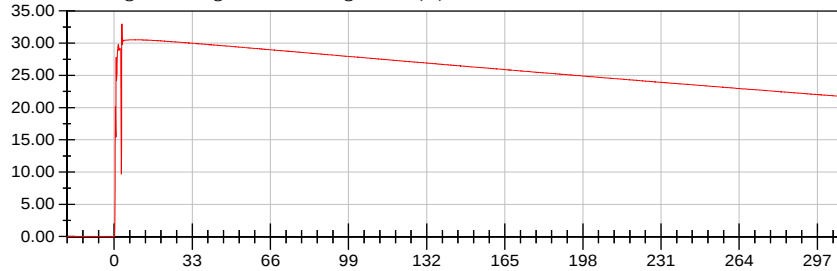
Test Lab: CTF

Test Number: 170530-2 (M20174300TWG2)

Test Date: 05/30/2017

Position #2 Hybrid III 3 year old Dummy (Part 572 P) (040)

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



<Max>

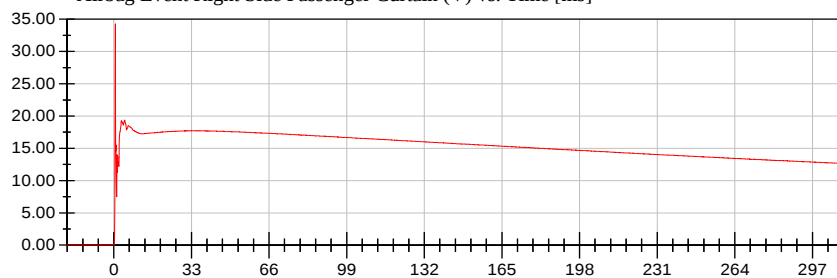
32.97 V at 3.28 ms

<Min>

0.00 V at -20.00 ms

Unfiltered

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



<Max>

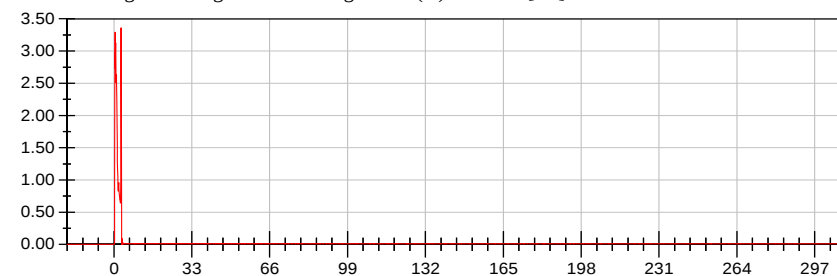
34.25 V at 0.64 ms

<Min>

0.00 V at -20.00 ms

Unfiltered

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



<Max>

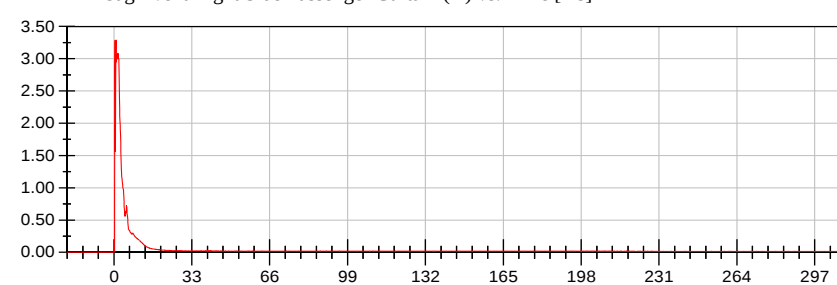
3.36 A at 3.04 ms

<Min>

0.00 A at -20.00 ms

Unfiltered

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



<Max>

3.29 A at 0.80 ms

<Min>

0.00 A at -20.00 ms

Unfiltered



Test Vehicle: 2017 Mercedes-Benz E-Class Sedan
Test Program: Side Airbag O.O.P. Injury Testing

NHTSA No.: M20174300TWG2
Test Date: 5/30/2017

APPENDIX C

TEST EQUIPMENT LIST AND CALIBRATION INFORMATION

Test Vehicle: 2017 Mercedes-Benz E-Class Sedan
 Test Program: Side Airbag O.O.P. Injury Testing

NHTSA No.: M20174300TWG2
 Test Date: 5/30/2017

TEST EQUIPMENT LIST AND CALIBRATION INFORMATION

P572P INSTRUMENTATION

	POSITION #2 (RIGHT) SERIAL NO.: 040		
	SERIAL NUMBER	MANUFACTURER	CALIBRATION DATE
Head Accel X	P51292	Endevco	28-Apr-2017
Head Accel Y	P58999	Endevco	8-May-2017
Head Accel Z	P58797	Endevco	28-Apr-2017
Upper Neck Force X	214-FX	Denton	25-May-2017
Upper Neck Force Y	214-FY	Denton	25-May-2017
Upper Neck Force Z	214-FZ	Denton	25-May-2017
Upper Neck Moment X	214-MX	Denton	25-May-2017
Upper Neck Moment Y	214-MY	Denton	25-May-2017
Upper Neck Moment Z	214-MZ	Denton	25-May-2017
Lower Neck Force X	210-FX	Denton	25-May-2017
Lower Neck Force Y	210-FY	Denton	25-May-2017
Lower Neck Force Z	210-FZ	Denton	25-May-2017
Lower Neck Moment X	210-MX	Denton	25-May-2017
Lower Neck Moment Y	210-MY	Denton	25-May-2017
Lower Neck Moment Z	210-MZ	Denton	25-May-2017
Airbag Event Front Passenger Seat	K3789-195	KAYSER-THREDE	30-May-2017
Airbag Event Passenger Side Curtain	K3789-195	KAYSER-THREDE	30-May-2017
Airbag Event Front Passenger Seat	K3789-195	KAYSER-THREDE	30-May-2017
Airbag Event Passenger Side Curtain	K3789-195	KAYSER-THREDE	30-May-2017