REPORT NUMBER: TWG-CAL-14-04

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

Ford Motor Co.
2015 Ford Focus

NHTSA NUMBER: M20150222TWG2
CALSPAN TEST NUMBER: CT2014-04

PREPARED BY:
CALSPAN CORPORATION
P.O. Box 400
BUFFALO, NEW YORK 14225

May 29, 2015

DRAFT REPORT

Alpha Technology Associate, Inc.
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This Final Test Report was prepared for the U.S. Department of Transportation, National Highway Traffic Safety Administration, under Contract No. DTNH22-13-R-00694, Alpha Technology PO 4GC154. 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.

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FINAL REPORT ACCEPTANCE BY:

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 Calspan Test Facility in Buffalo, New York on May 29, 2015.

Injury Summary

HIC15	Maximum Chest Displacement (mm)	Maximum Chest Displacement Rate (m/s)	NIJ(NTF)	NIJ(NTE)	NIJ(NCF)	NIJ(NCE)
13.59	N/A	N/A	0.188	0.161	0.143	0.313

17. Key Words New Car Assessment Program (NCAP) Side Airbag Out-Of-Position	18. Distribution Statement Copies of this report are available from: Alpha Technology Associate, Inc. 2810 Old Lee Hwy, Suite 120 Fairfax, VA 22031 Phone: (703) 876-0010 Fax: (703) 876-0120 Attn: Mai Lan Aram

19. Security Classification of Report UNCLASSIFIED	20. Security Classification of Page UNCLASSIFIED	21. No. of Pages 36	22. Price

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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 previously undergone a New Car Assessment Program (NCAP) sponsored frontal impact test requested by the National Highway Traffic Safety Administration (NHTSA). This test was performed under NHTSA contract No. DTNH22-13-R-00694 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 2015 Ford Focus on an out-of-position SID-IIs (Hybrid III 5th female) anthropomorphic test device (ATD) were evaluated. The test was performed by Calspan on May 29, 2015. Pre-and post-test photographs of the vehicle and ATD can be found in Appendix A.

Three high-speed digital cameras were used to document the side airbag deployment event. Images were recorded at rates of 1000 frames per second. One camera was placed perpendicular to the right-front seat centerline to capture the deployment event from the side. The second camera was placed parallel to the right-front seat centerline to capture the deployment event from the front. A third camera was placed ¾ to the front to also capture the deployment event.

The SID-IIs 5th female anthropomorphic test device (ATD) was placed in the right front (passenger) seat situated parallel to the centerline of the seat, facing forward according to the ATD placement instructions specified Alpha Technology Associate, Inc. who referenced 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). This orientation complies with section 3.3.5.2 of the TWG Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags as defined by Lund, et al and the Technical Working Group First Revision dated July, 2003.

The SID-IIs ATD was instrumented with head x, y and z accelerometers (primary and redundant). In addition, six axis upper and lower neck load cell sensors were utilized to record the resulting neck forces and moments during the event.

Twenty-two 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.

SECTION 2

DATA SHEET NO. 1
TEST SUMMARY

TEST CONFIGURATION INFORMATION:

Seating Position:	P2	Right Front Seating Position
Test:	3.3.5.2	Forward Facing SID-IIs on Raised Seat (Driver and Passenger Positions with Roof-Rail-Mounted Airbags)
Airbag: 1	Curtain	Roof Rail Mounted – Passenger Side
Airbag: 2	Seat/Torso	Passenger Seat Mounted – Outside Seam
Booster Block:	N/A	N/A
ATD Type/Serial No.:	DG8012	SID-IIs

Number of Data Channels:	22	
Number of Cameras:	0	Real Time
	3	High Speed Digital

PRE-TEST VISIBLE DUMMY CONTACT POINTS

Head Contact:	None
Upper Torso Contact:	Seat Back
Lower Torso Contact:	Seat Back
Knee Contact:	None
Foot Contact:	None

POST-TEST VISIBLE DUMMY CONTACT POINTS

Head Contact:	Curtain Airbag
Upper Torso Contact:	Seat/Torso Airbag, Seat Back
Lower Torso Contact:	Seat/Torso Airbag, Seat Back
Knee Contact:	None
Foot Contact:	None

DATA SHEET NO. 2
VEHICLE PARAMETER DATA

TEST VEHICLE INFORMATION:

Year/Make/Model/Body Style: 2015 Ford Focus

NHTSA No. : M20150222TWG2 ; VIN: 1FADP3F27FL200555 Color: Chracoal Gray

Engine Data: I4 cylinders; 122 CID; 2.0 Liters; 2000 cc

Placement: - Longitudinal or In-Line; X Transverse or Lateral

Transmission Data: 6 speeds; - Manual; X Automatic; X Overdrive

Final Drive: - Rear Wheel Drive; X Front Wheel Drive; - Four Wheel Drive

Safety Belt Features – Driver X Pretensioner (Shoulder); X Load Limiter; X Adj. Anchorage

Safety Belt Features - Passenger X Pretensioner (Shoulder); X Load Limiter; X Adj. Anchorage

Major Options: X A/C; X Pwr. Steering.; X Pwr. Brakes

X Pwr. Windows; X Pwr. Door Locks; X Tilt Wheel

Date Received: 01/23/2015 ; Odometer Reading 225.3 Km

Selling Dealer: Gibbons Ford

& Address: 950 Main St Dickson City, PA 18519

DATA FROM TIRE VEHICLE'S CERTIFICATION LABEL:

Vehicle Manufactured by: Ford Motor Co.

Date of Manufacture 12/2014

GVWR: 1810 kg; GAWR: 972 kg FRONT; 880 kg REAR

DATA FROM TIRE PLACARD:

Recommended Tire Size: 215/55R16

*Recommended Cold Tire Pressure: 250 kPa Front 250 kPa Rear

DATA FROM TIRE SIDEWALL:

Size of Tires on Test Vehicle: 215/55R16 ; Manufacturer: Continental

Tire Pressure with Maximum Capacity Vehicle Load: Front 350 kPa Rear: 350 kPa

Treadwear: 360 ; Traction: A : Temperature: A

VEHICLE CAPACITY DATA:

Type of Front Seats: - Bench; X Bucket; - Split Bench

Number of Occupants: 2 Front; 3 Rear; 5 Total

Vehicle Capacity Weight (VCW) = 375 Kg

No. of Occupants x 68.04 kg = 340.2 Kg

Rated Cargo/Luggage Weight (RCLW) = 34.8 Kg

*Tire pressure used for test

‡Vehicle had previously undergone a New Car Assessment Program Frontal NCAP Test.

DATA SHEET NO. 3
SID-IIs DUMMY POSITIONING IN VEHICLE

NHTSA No. M20150222TWG2

Measurement	Value
Total Fore/Aft Travel (mm)	255
Test Distance Rearward of Full-Forward (mm)	0
Total Fore/Aft Travel (Detents)	37
Placed in Position #	0

Seat Back Angle	SA (+3.3º)	Value
Airbag Module Width	AMW (mm)	-
Airbag Width (deployed)	ABW (mm)	450
Airbag Module Length	AML (mm)	-
Airbag Length (deployed)	ABL (mm)	1560
Top of Airbag Module to Head/Neck Junction	AN (mm)	-
Head CG to Door Panel/Side Window	HD (mm)	215
Head to Seat Back Centerline	HSC (mm)	185
Head to B-Pillar (cg)	HB (mm)	235
Head to Roof, Z (top of the head)	HZ (mm)	180
Head to Header	HHD (mm)	265
Chest to Dash	CD (mm)	293
Chest to Seatback	CS (mm)	0
Right Arm to Seat Back Centerline	RACL (mm)	315
Right Arm to Seat Back Centerline	RACL (º)	0
Left Arm to Seat Back Centerline	LACL (mm)	-
Left Arm to Seat Back Centerline	LACL (º)	-
Right Arm to Door Panel	RA (mm)	75
Left Arm to Door Panel	LA (mm)	-
Knee to Knee	KK (mm)	160
Toe to Toe	TT (mm)	-
Right Knee to Seat Cushion Centerline	KSCR (mm)	-
Left Knee to Seat Cushion Centerline	KSCL (mm)	-
Right Toe to Seat Cushion Centerline	TSCR (mm)	-
Left Toe to Seat Cushion Centerline	TSCL (mm)	-
Nose to Dash	ND (mm)	-
Nose to Seatback	NS (mm)	-
Nose to Header	NR (mm)	-
Foam Block Depth	(mm)	-
Foam Block Width	(mm)	-
Foam Block Thickness	(mm)	-
HD36 foam density	(g/L)	-

DATA SHEET 4

SID-IIs DUMMY INJURY CRITERIA VALUES

NHTSA No.: M20150222TWG2

Channel	Units	Max	Time (ms)	Min	Time (ms)
V1P2 Head x [CFC_1000]	g's	17.89	9.10	-10.36	9.65
V1P2 Head y [CFC_1000]	g's	34.80	9.40	-48.91	9.20
V1P2 Head z [CFC_1000]	g's	81.51	9.20	-14.33	13.60
V1P2 Headform Resultant [CFC_1000]	g's	95.88	9.20	0.00	-15.00
V1P2 Upper Neck Mocy [CFC_600]	Nm	5.50	22.25	-11.07	37.55
V1P2 Upper Neck Ntf [CFC_600]	-	0.19	19.40	0.00	-50.00
V1P2 Upper Neck Nte [CFC_600]	-	0.16	31.95	0.00	-50.00
V1P2 Upper Neck Ncf [CFC_600]	-	0.14	15.35	0.00	-49.65
V1P2 Upper Neck Nce [CFC_600]	-	0.31	12.10	0.00	-50.00
V1P2 Upper Neck Nij [CFC_600]	-	0.31	12.10	0.00	-36.40
V1P2 Upper Neck Fx [CFC_1000]	N	146.20	22.65	-186.31	9.20
V1P2 Upper neck Fy [CFC_1000]	N	158.51	12.10	-171.60	22.90
V1P2 Upper neck Fz [CFC_1000]	N	646.50	20.45	-1066.55	12.15
V1P2 Neck Force Resultant [CFC_1000]	N	1078.65	12.10	0.05	-16.70
V1P2 Upper Neck Mx [CFC_600]	Nm	7.05	22.95	-18.33	14.40
V1P2 Upper Neck My [CFC_600]	Nm	7.97	22.55	-11.72	37.60
V1P2 Upper Neck Mz [CFC_600]	Nm	3.16	95.20	-4.79	34.35
V1P2 Neck Moment Resultant [CFC_600]	Nm	18.56	14.35	0.00	1.35
V1P2 Lower Neck Fx F [CFC_1000]	N	352.78	20.00	-84.66	39.50
V1P2 Lower Neck Fy F [CFC_1000]	N	135.50	14.25	-209.07	20.50
V1P2 Lower Neck Fz F [CFC_1000]	N	829.01	20.30	-1172.01	12.70
V1P2 Lower Neck Force Resultant [CFC_1000]	N	1175.49	12.75	0.03	-49.60
V1P2 Lower Neck Mx F [CFC_600]	Nm	17.69	132.45	-26.02	25.35
V1P2 Lower Neck My F [CFC_600]	Nm	51.07	12.50	-56.56	20.20
V1P2 Lower Neck Mz F [CFC_600]	Nm	5.42	14.65	-11.46	20.60
V1P2 Lower Neck Moment Resultant [CFC_600]	Nm	61.35	20.25	0.00	-8.10
Curtain Airbag Current	A	1.94	0.40	-1.37	129.05
Torso Airbag Current	A	1.74	0.70	-1.46	19.25

DATA SHEET 4

SID-IIs DUMMY INJURY CRITERIA VALUES (CONTINUED)

VEHICLE: 2015 Ford Focus NHTSA No.: M20150222TWG2

HEAD INJURY CRITERIA (HIC)

	HIC15			
	HIC(15)	t_1 (msec)	t_2 (msec)	Average Acceleration t_1 to t_2
Position 2 – Right Front Passenger	13.59	9.05	9.30	84.37

THORAX CRITERIA

	Critical Values	Actual	Time(ms)
Maximum Deflection (mm)	N/A	N/A	N/A
Maximum Deflection Rate (m/s)	N/A	N/A	N/A

Position 2 - Neck Injury Summary (SID-IIs – In Position)

Nij V10	Nij	Time (ms)	Z Force (N)	X Force (N)	Y Moment (N-m)
Ntf	0.188	19.400	623.959	66.527	4.983
Nte	0.161	31.950	29.721	-16.845	-9.671
Ncf	0.143	15.350	-551.844	9.644	0.214
Nce	0.313	12.100	-1066.320	-36.500	-3.033

Peak Tension (CFC1000) 646.50 **N** **Peak Compression (CFC1000)** -1066.55 **N**

Critical Values

Nij Intercepts				Peak Limits	
Tension (CVt)	3880 N	Extension (mCVe)	61 N-m	Tension	2070 N
Compression (CVc)	3880 N	Flexion (mCVf)	155 N-m	Compression	2520 N

Appendix A

PHOTOGRAPHS

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Figure A-1: Right ¾ Front View of Vehicle, As Received

Figure A-2: Vehicle Certification Placard

Figure A-3: Pre-Test Vehicle Left Side View

Figure A-4: Post-Test Vehicle Left Side View

Figure A-5: Pre-Test SID-IIs Dummy Left Side View

Figure A-6: Post-Test SID-IIs Dummy Left Side View

Figure A-7: Pre-Test SID-IIs Dummy Left Side Close-up View

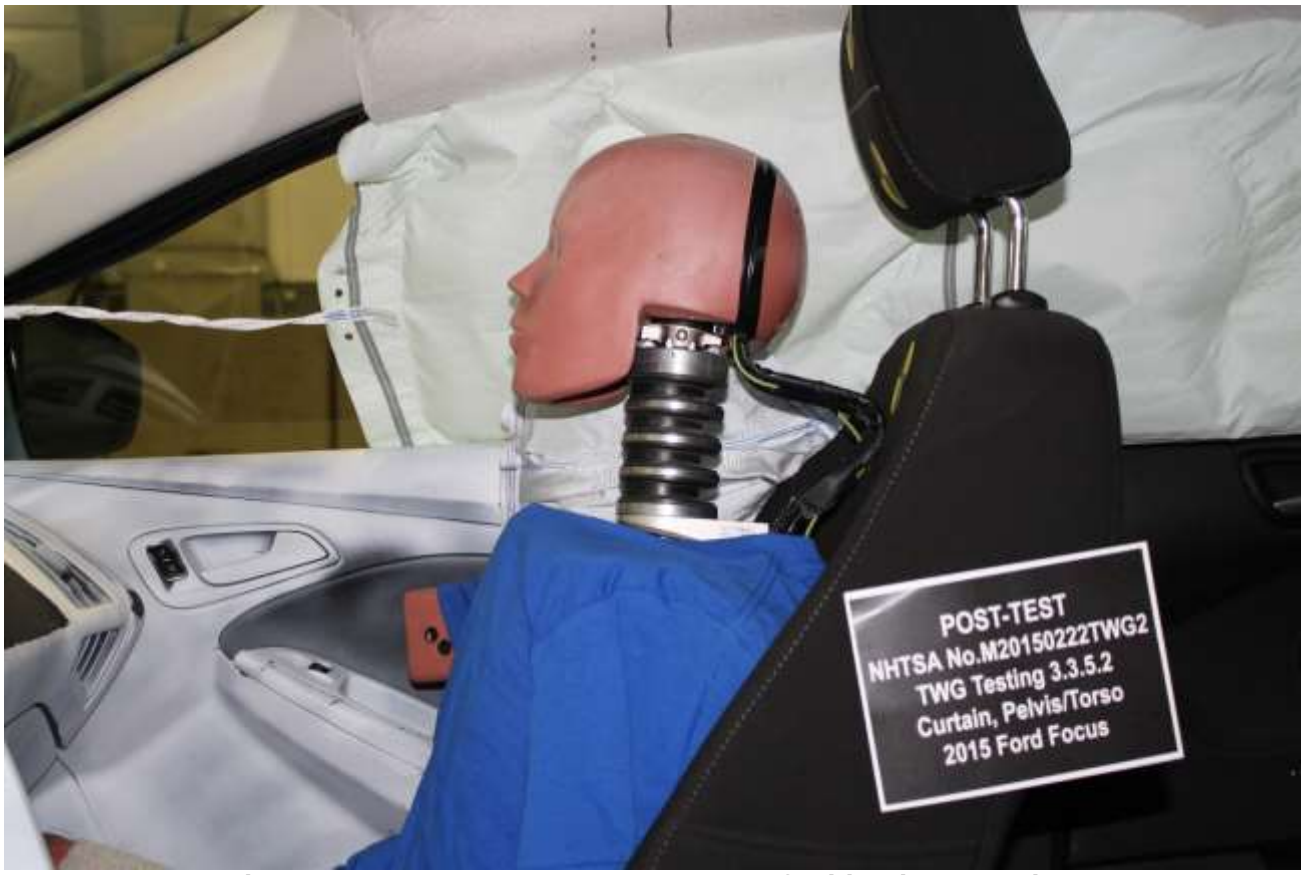


Figure A-8: Post-Test SID-IIs Dummy Left Side Close-up View

Figure A-9: Pre-Test SID-IIs Dummy Left ¾ Front View

Figure A-10: Post-Test SID-IIs Dummy Left ¾ Front View

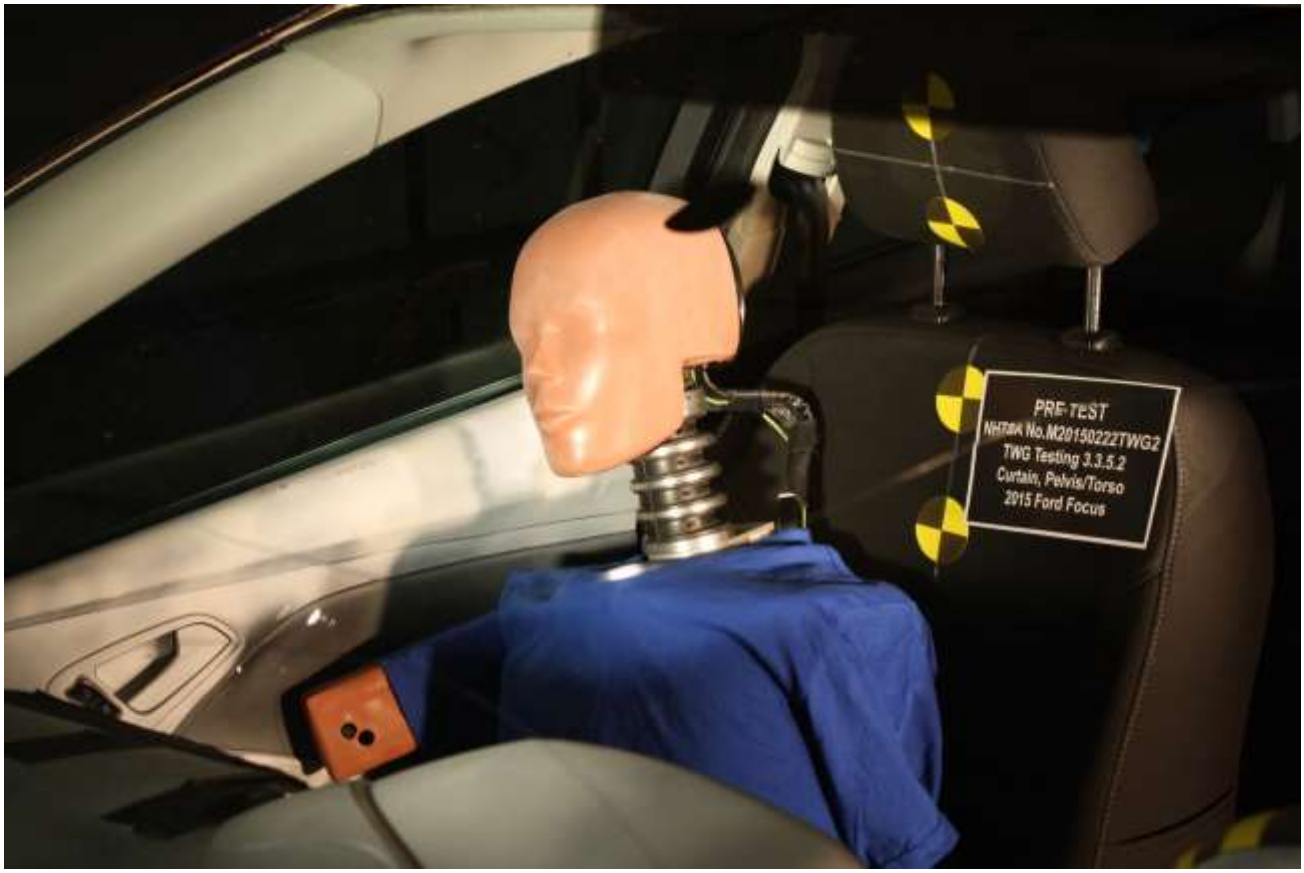


Figure A-11: Pre-Test SID-IIs Dummy Left ¾ Front Close-up View

Figure A-12: Post-Test SID-IIs Dummy Left ¾ Front Close-up View

Figure A-13: Pre-Test SID-IIs Dummy Front View

Figure A-14: Post-Test SID-IIs Dummy Front View

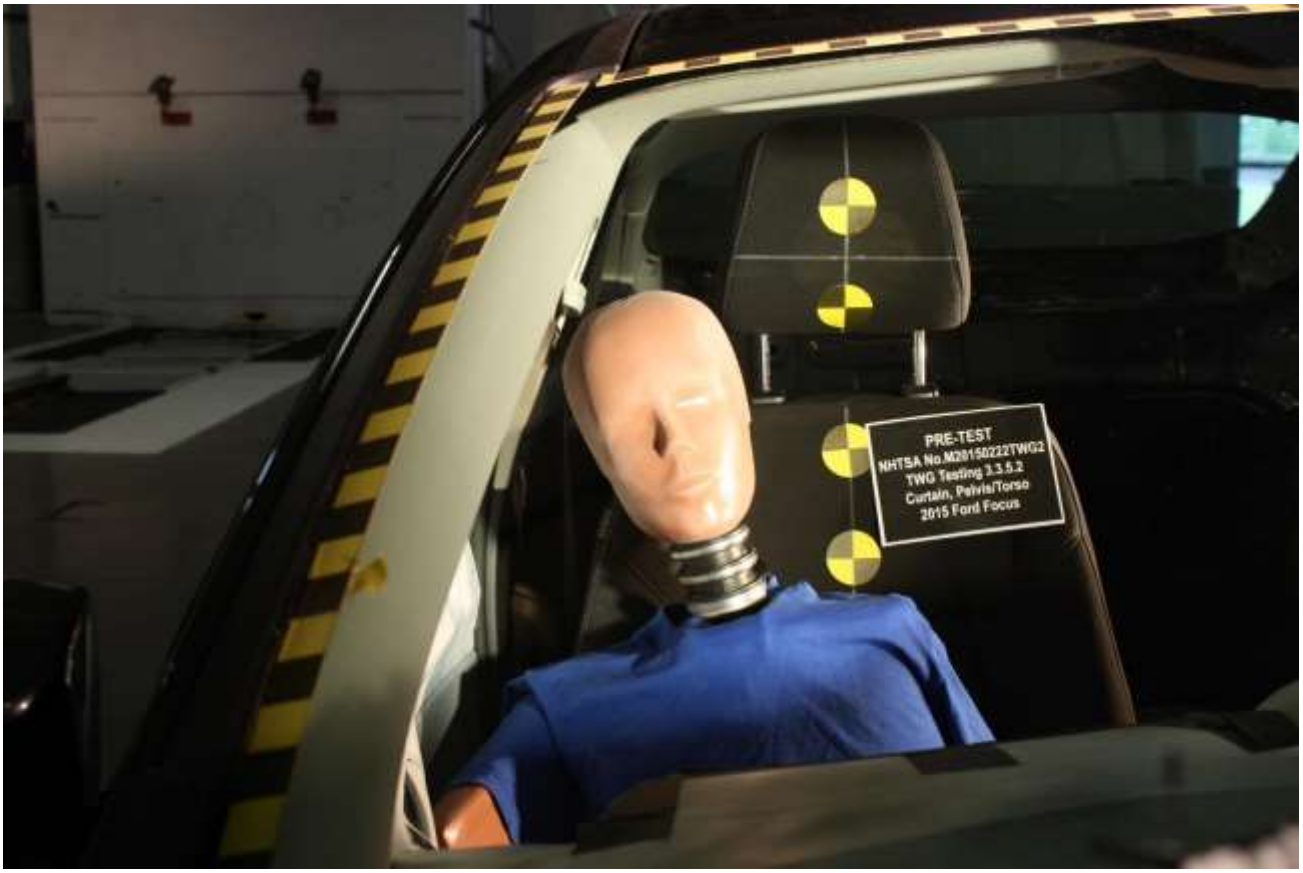


Figure A-15: Pre-Test SID-IIs Dummy Front Close-up View

Figure A-16: Pre-Test SID-IIs Dummy Right Side View

Figure A-17: Pre-Test SID-IIs Dummy Right Side Clearance View

Figure A-18: Pre-Test SID-IIs Dummy Rear Right Side Clearance View

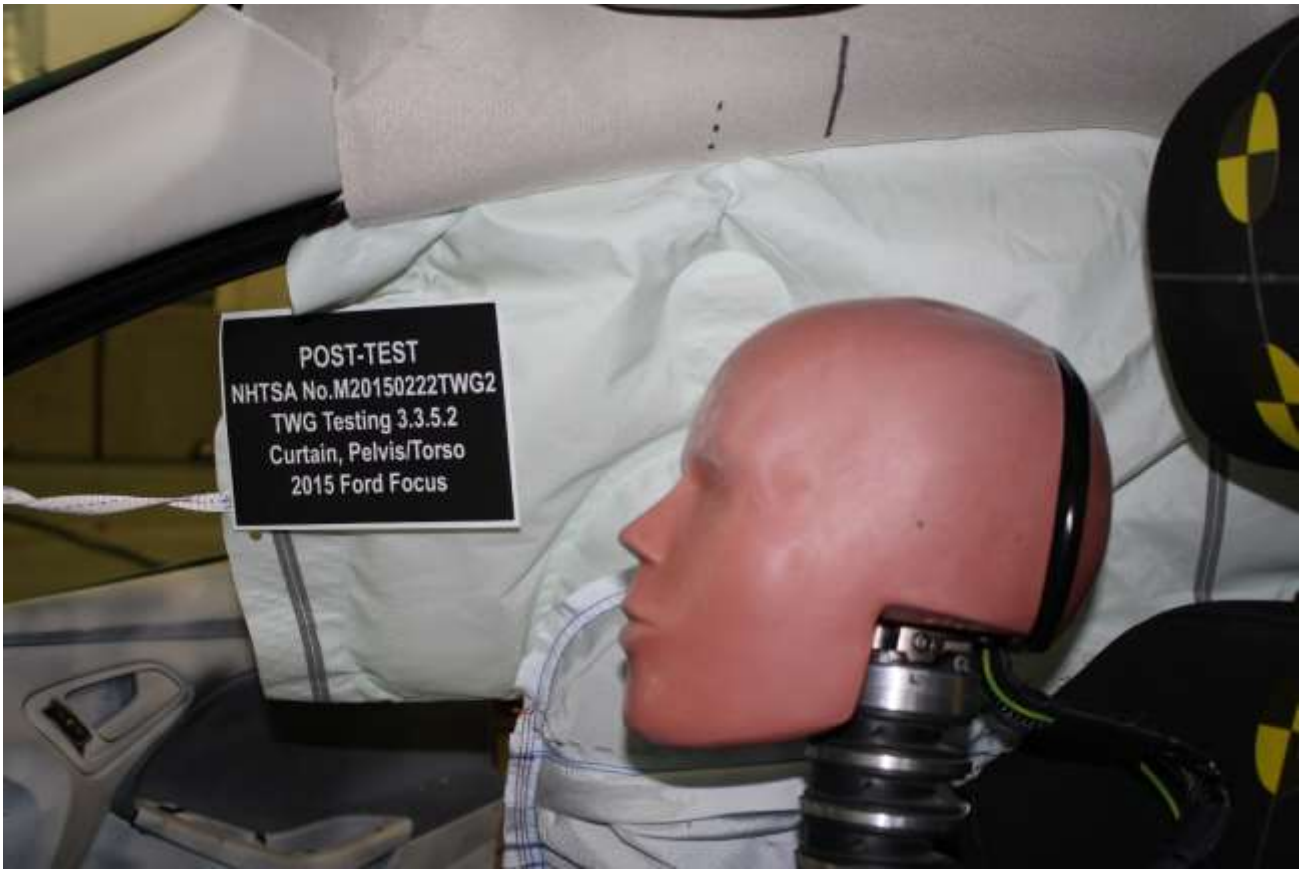


Figure A-19: Post-Test Curtain Airbag Left Side View

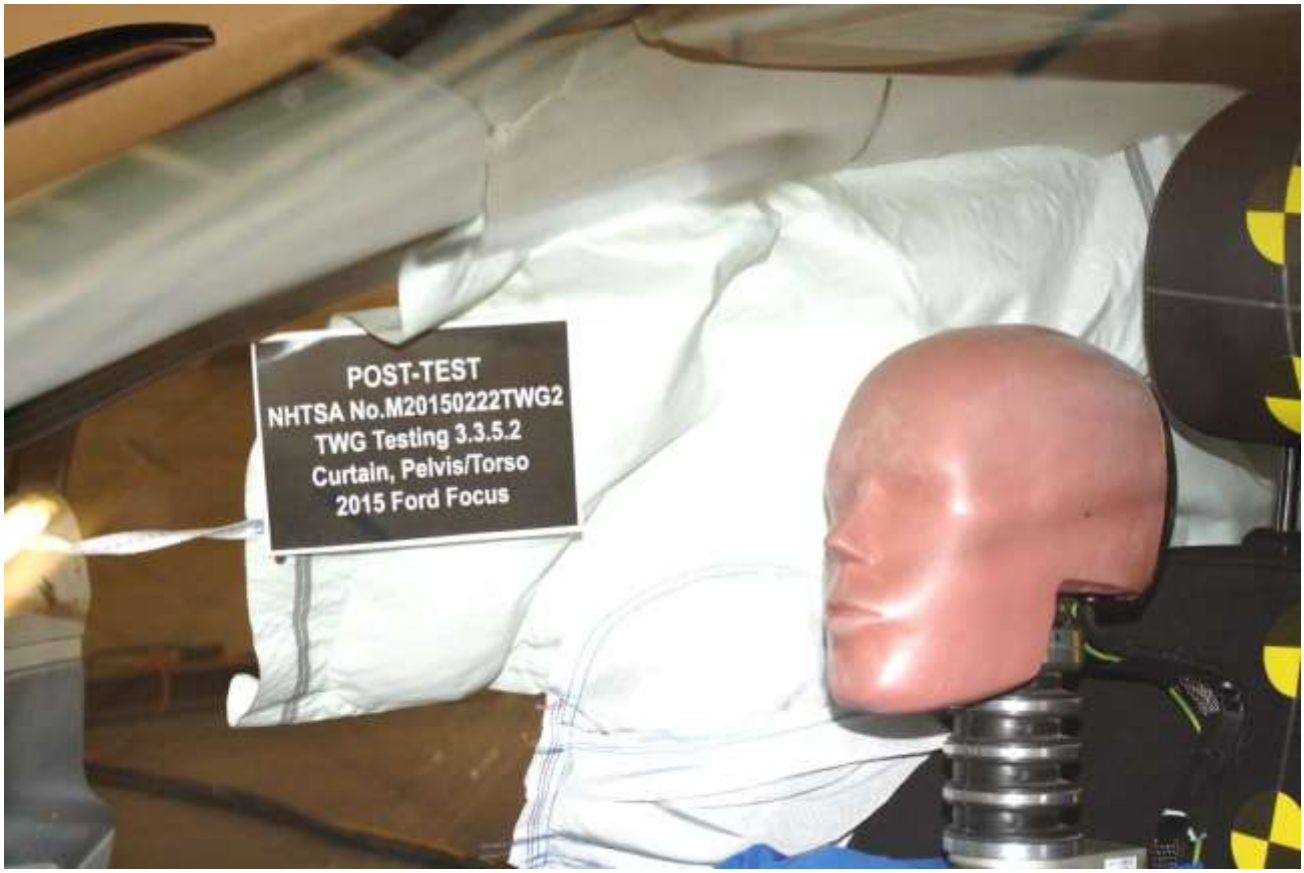


Figure A-20: Post-Test Curtain Airbag Left ¾ Front View

Figure A-21: Post-Test Curtain Airbag Front View

Figure A-22: Post-Test Curtain Airbag Right Side View

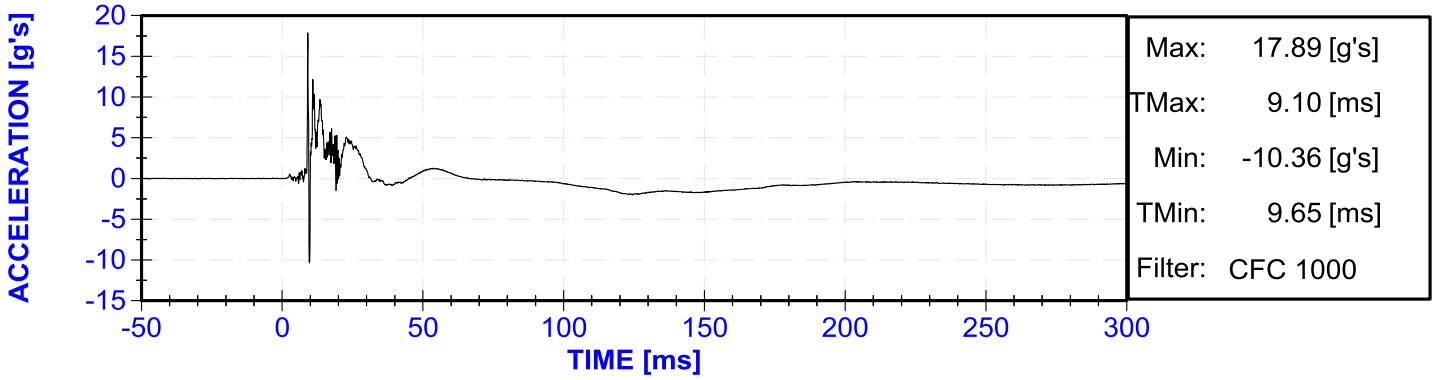
Figure A-23: Post-Test Curtain Airbag Rear Right Side View

Figure A-24: Post NCAP Left Side View

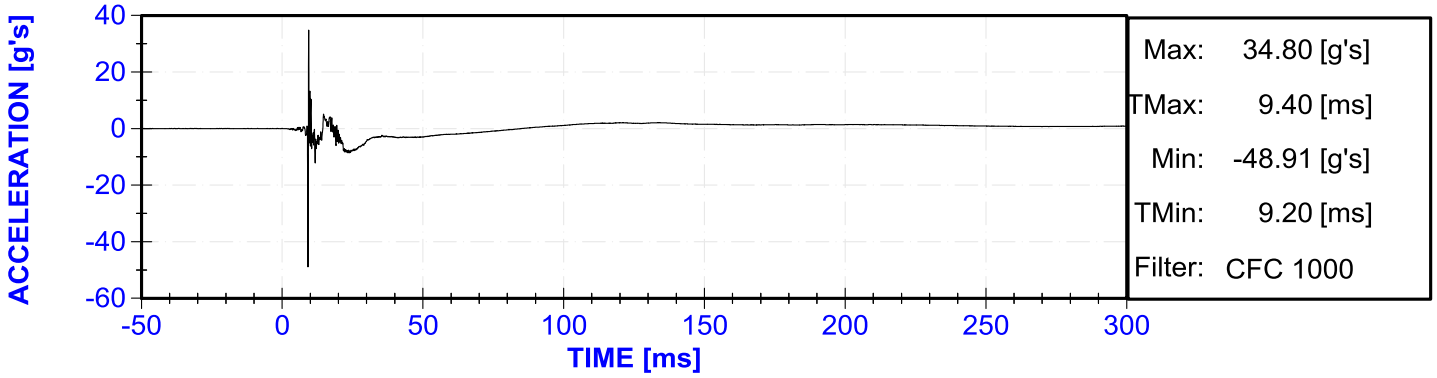
APPENDIX B
DUMMY RESPONSE DATA TRACES

Table of Data Plots

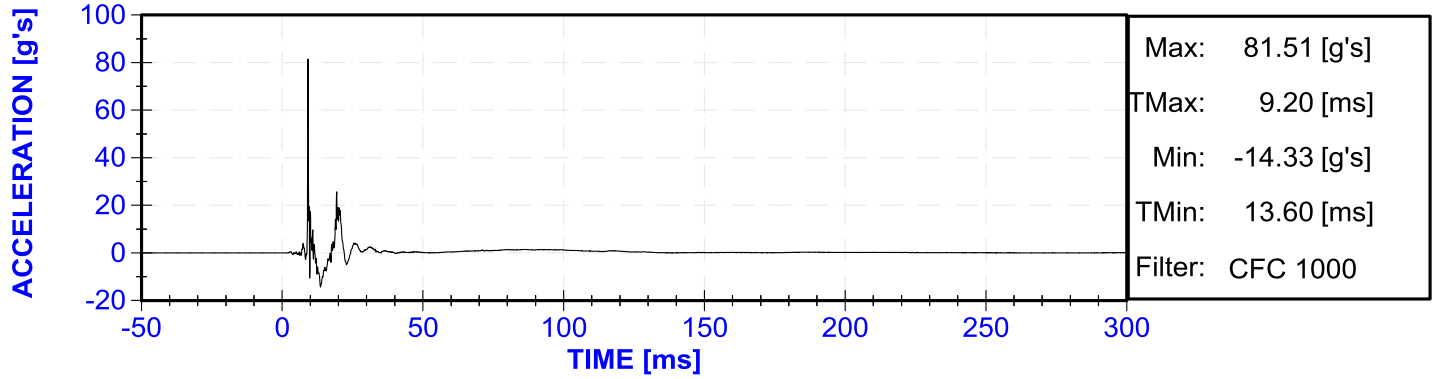
Head CG X Acceleration



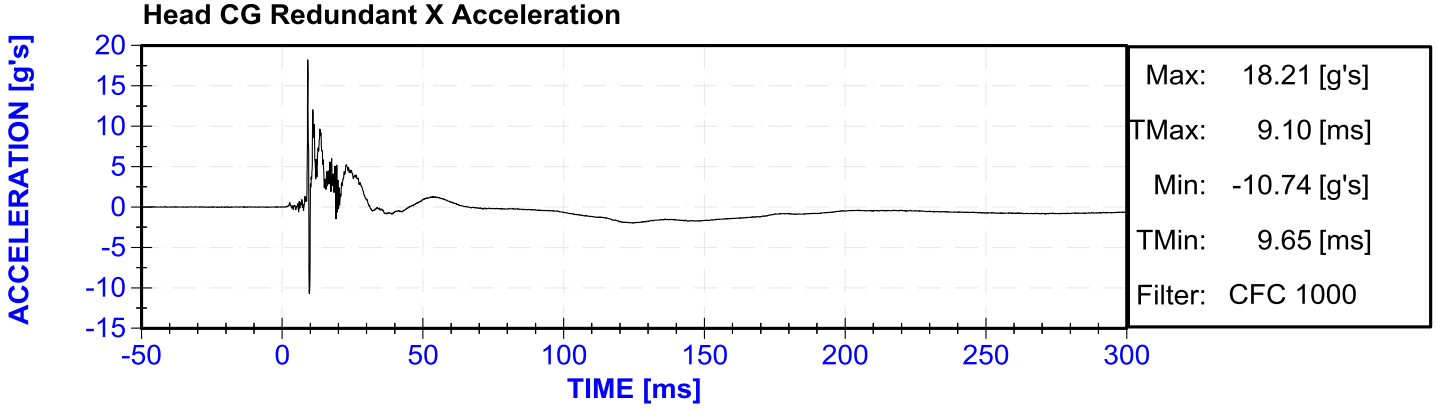
Head CG Y Acceleration



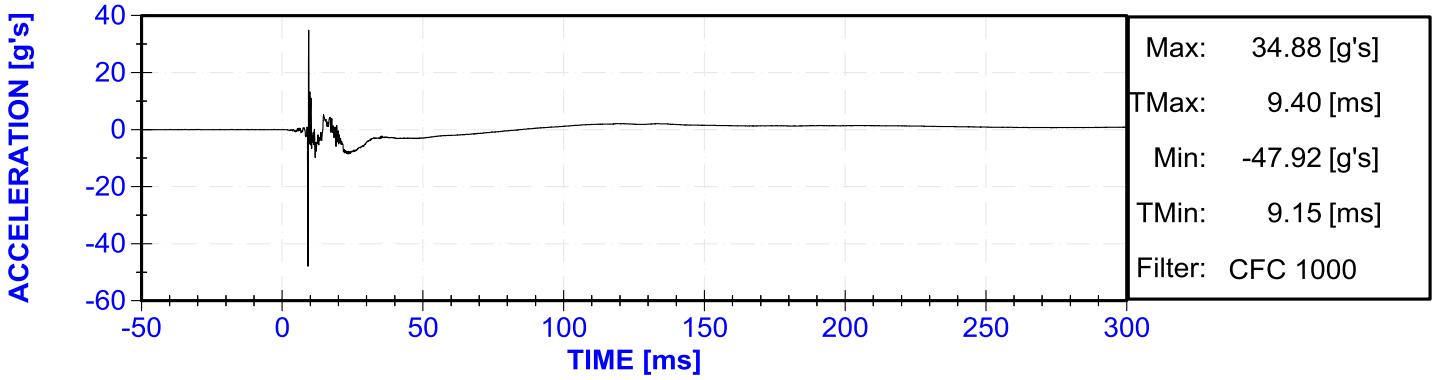
Head CG Z Acceleration



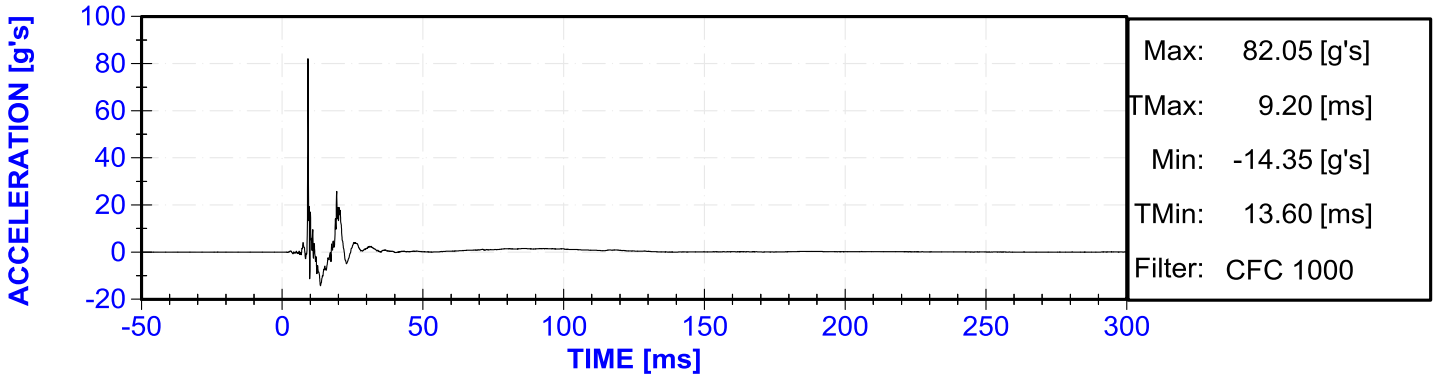
Head CG Redundant X Acceleration



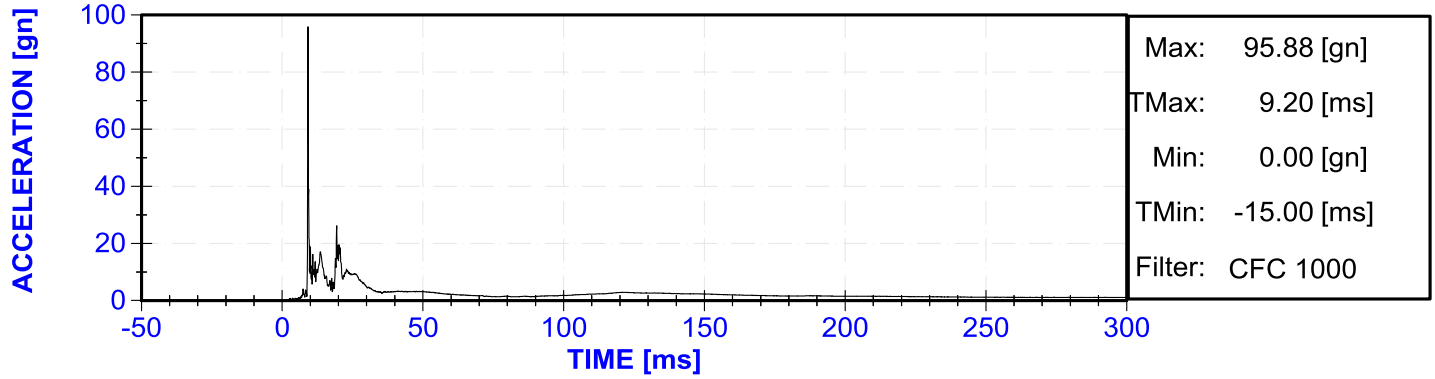
Head CG Redundant Y Acceleration



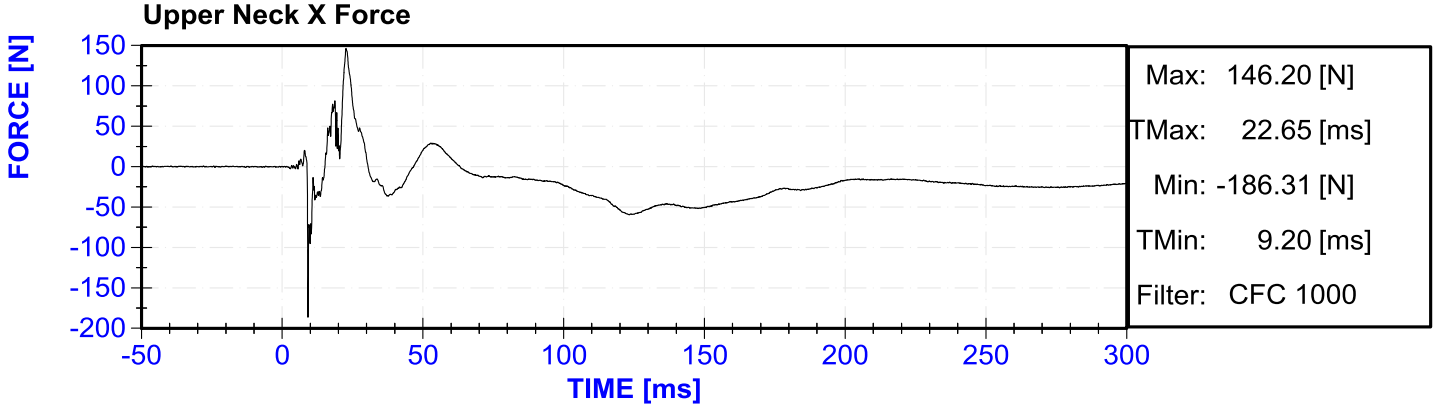
Head CG Redundant Z Acceleration



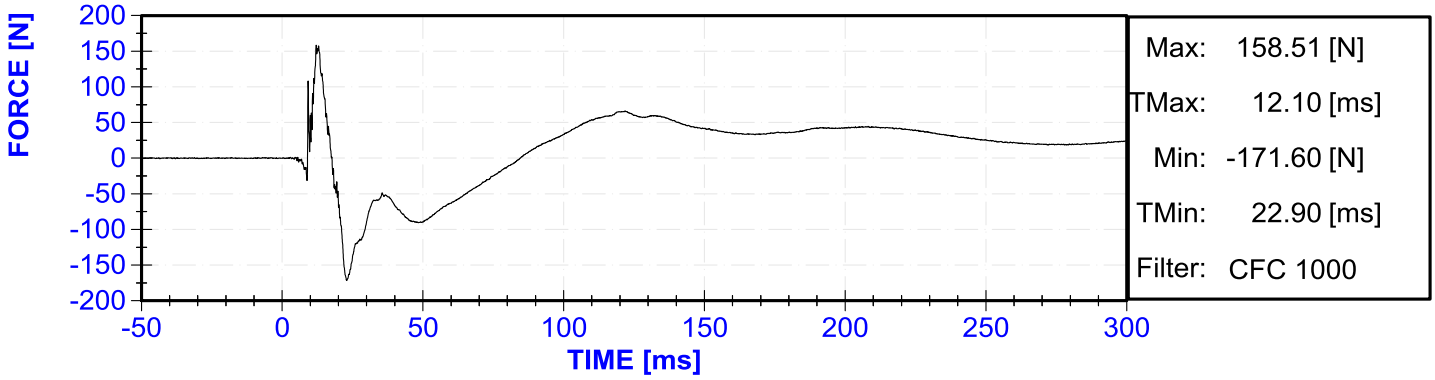
Head CG Acceleration Resultant



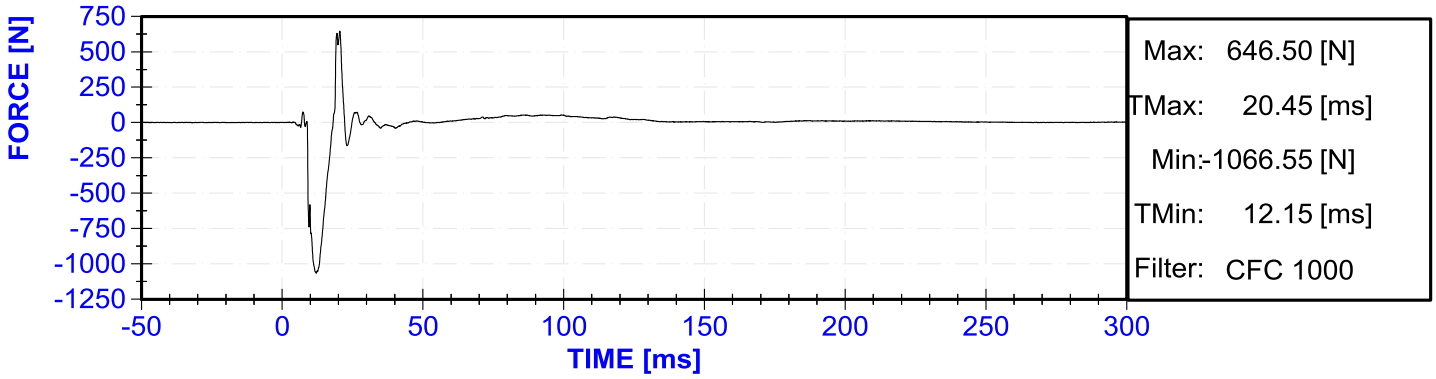
Upper Neck X Force



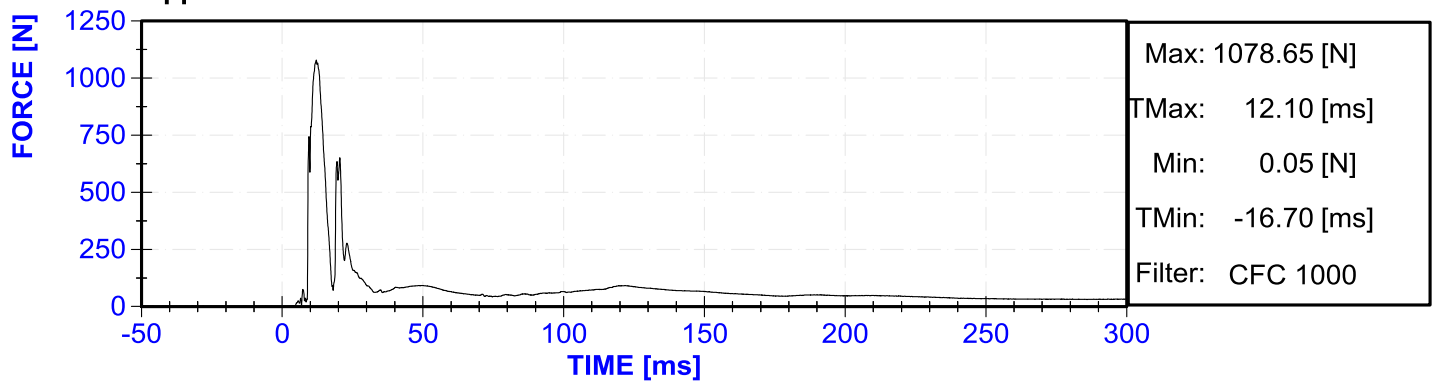
Upper Neck Y Force



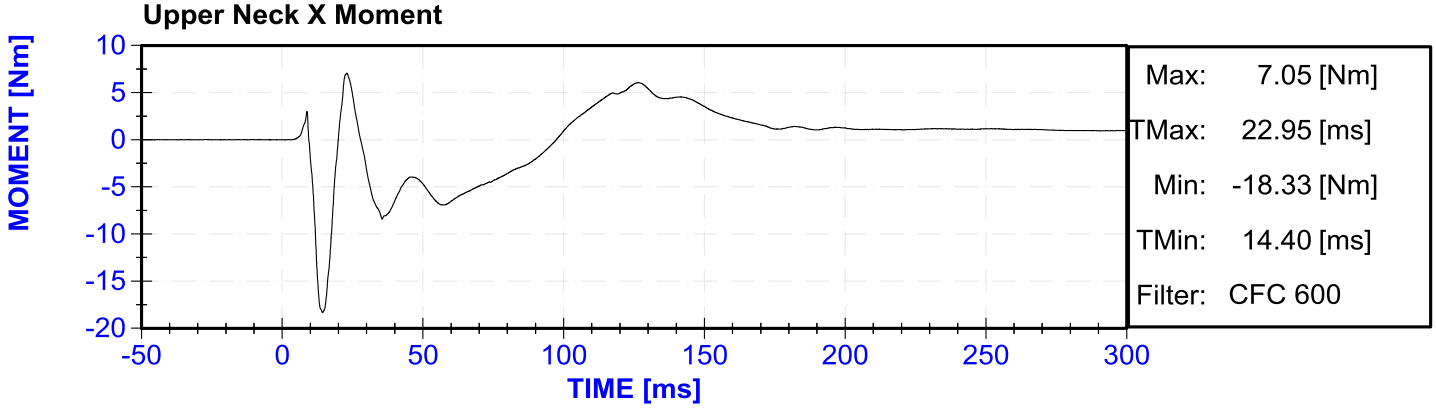
Upper Neck Z Force



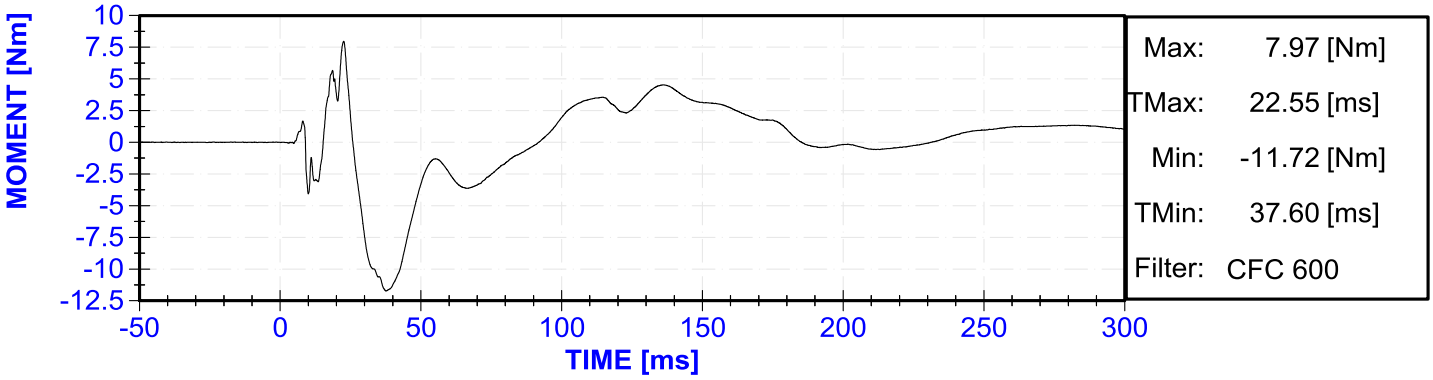
Upper Neck Force Resultant



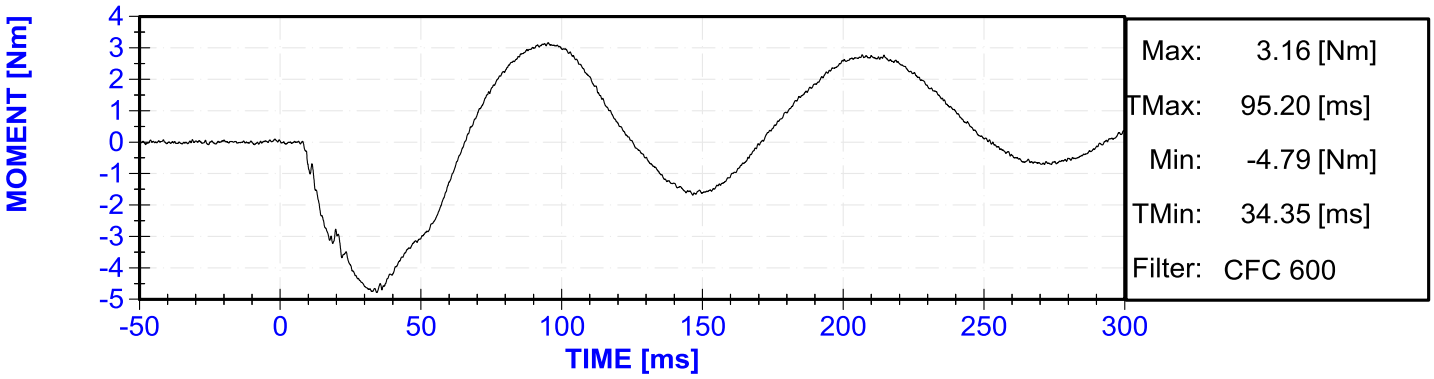
Upper Neck X Moment



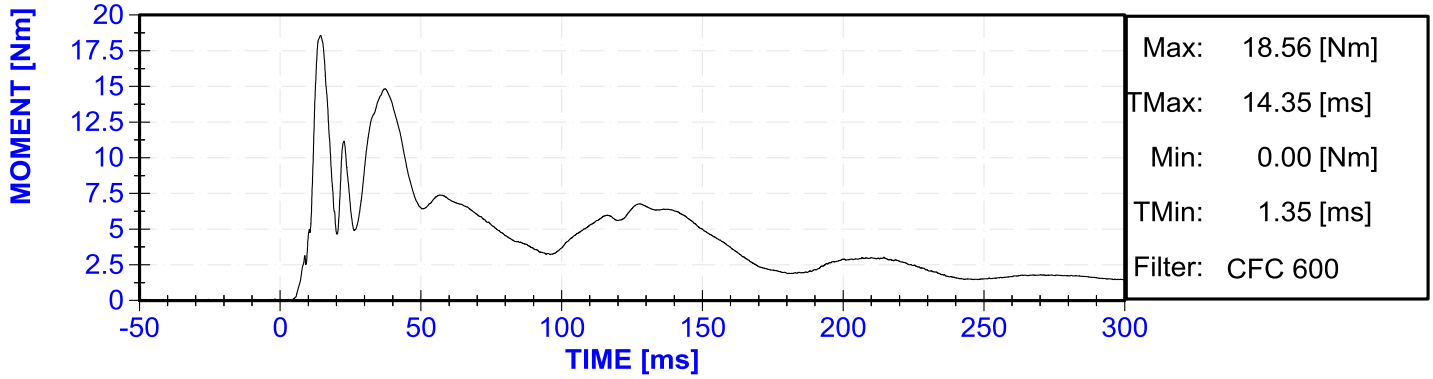
Upper Neck Y Moment



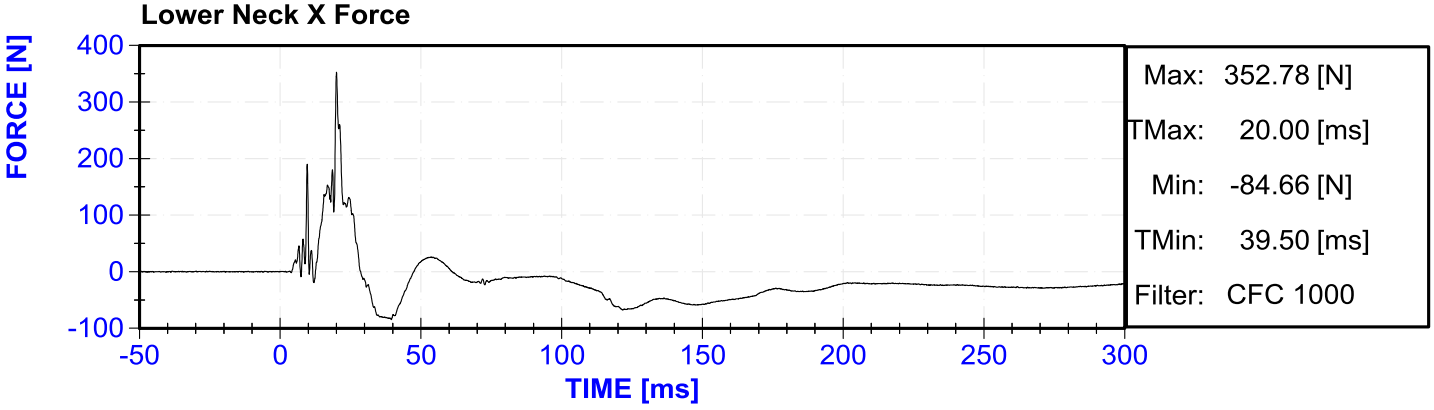
Upper Neck Z Moment



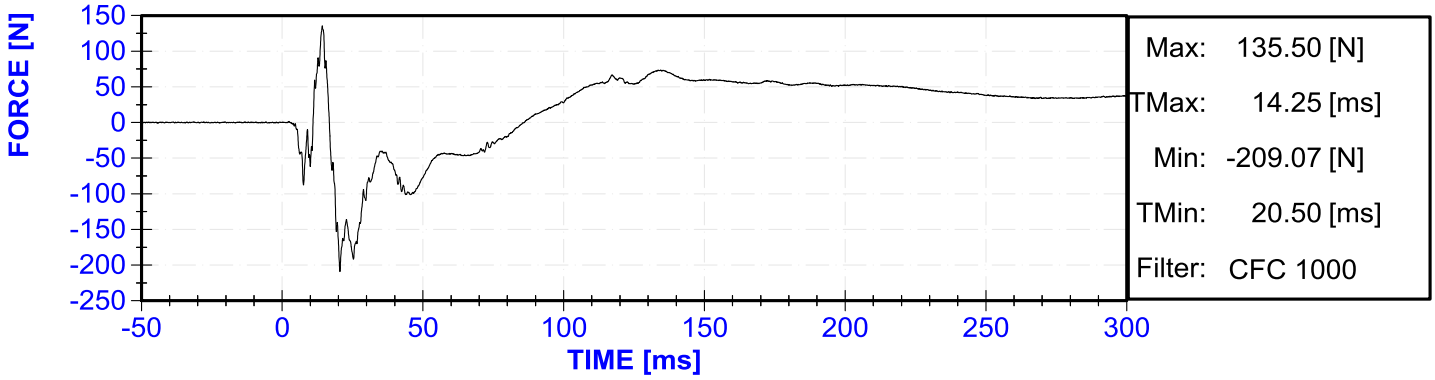
Upper Neck Moment Resultant



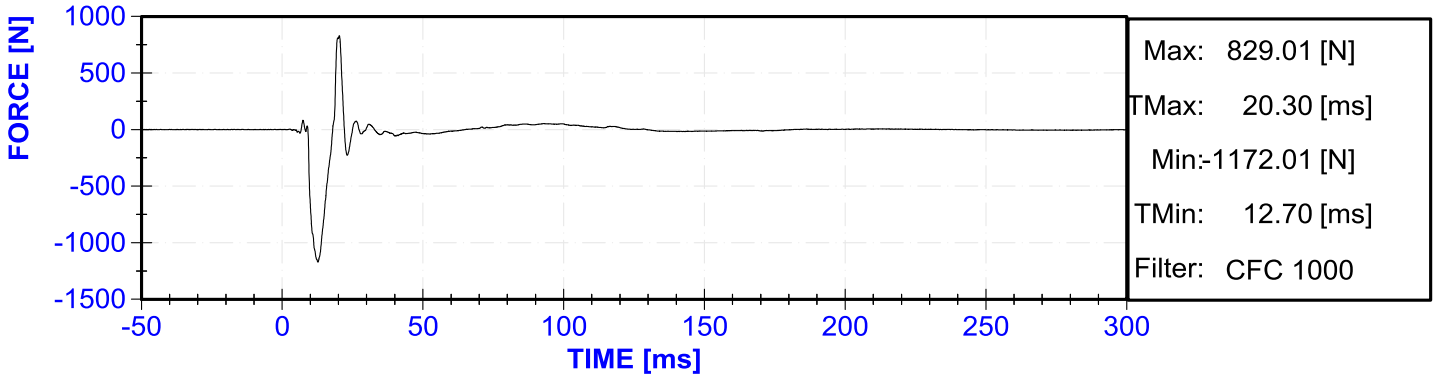
Lower Neck X Force



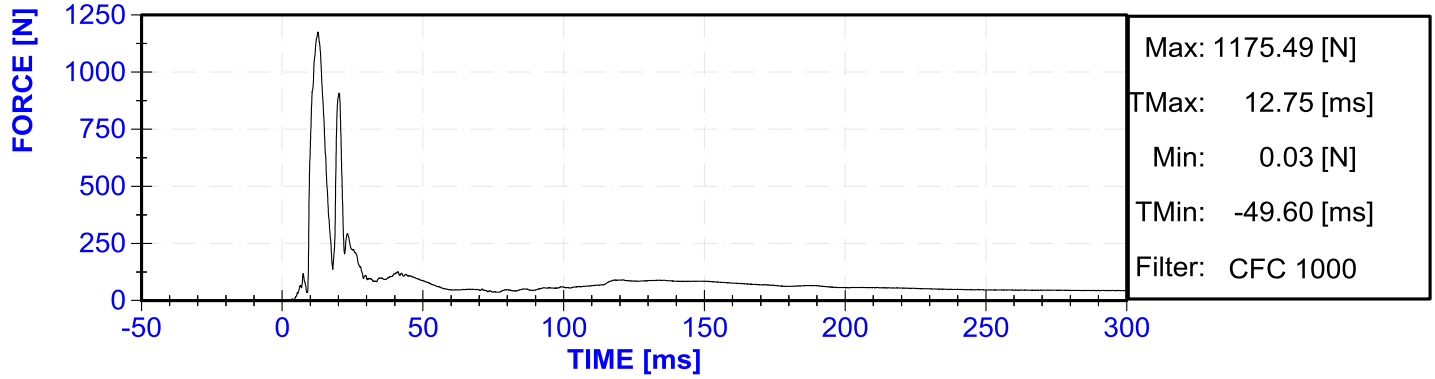
Lower Neck Y Force



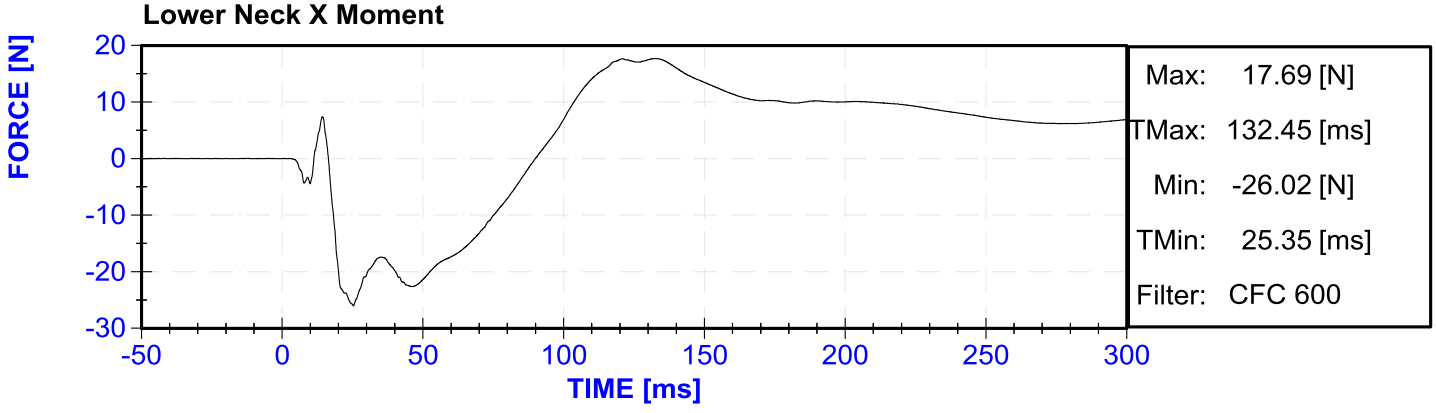
Lower Neck Z Force



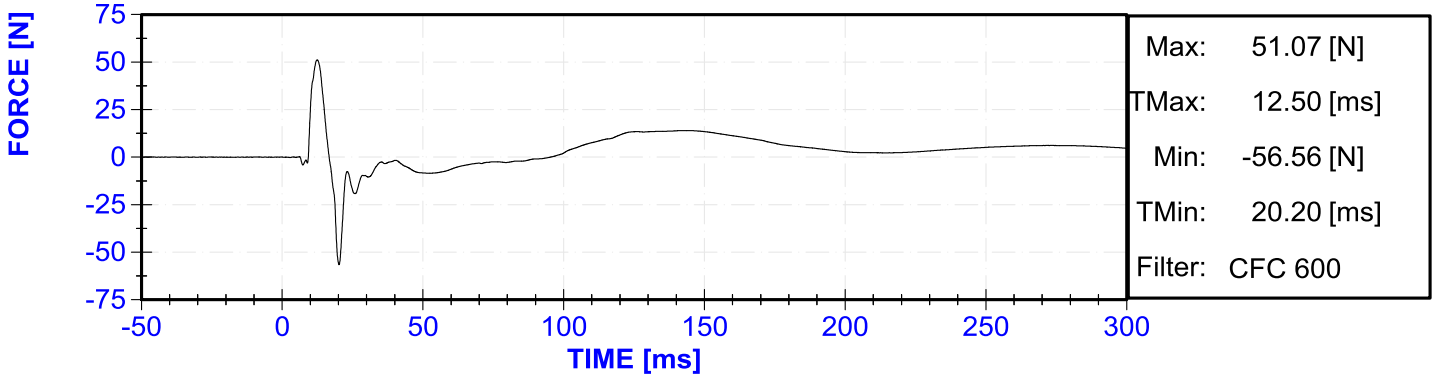
Lower Neck Force Resultant



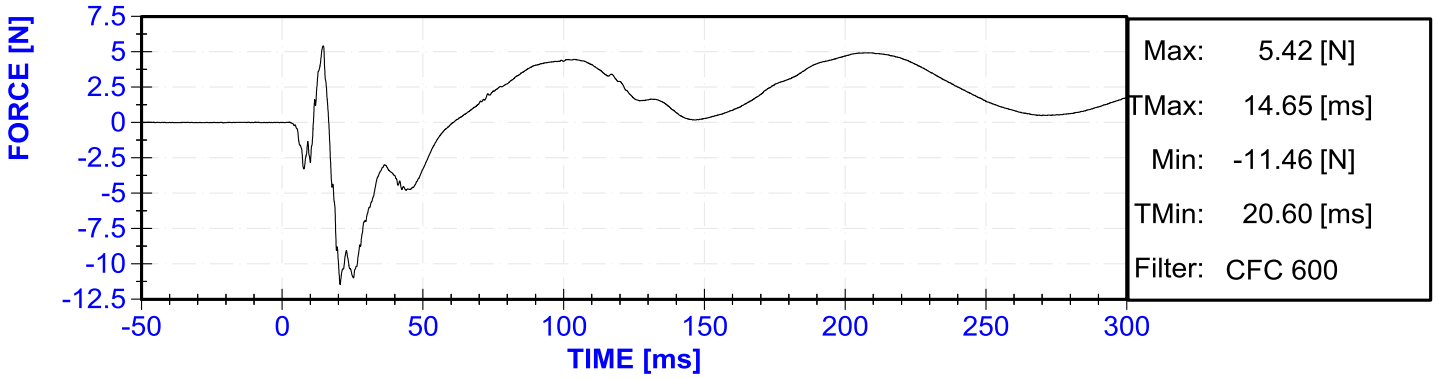
Lower Neck X Moment



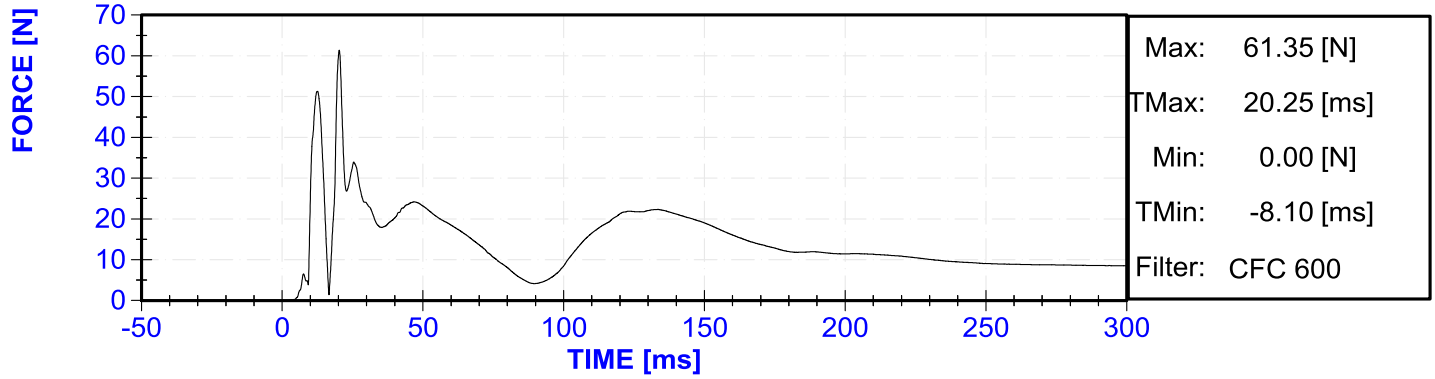
Lower Neck Y Moment



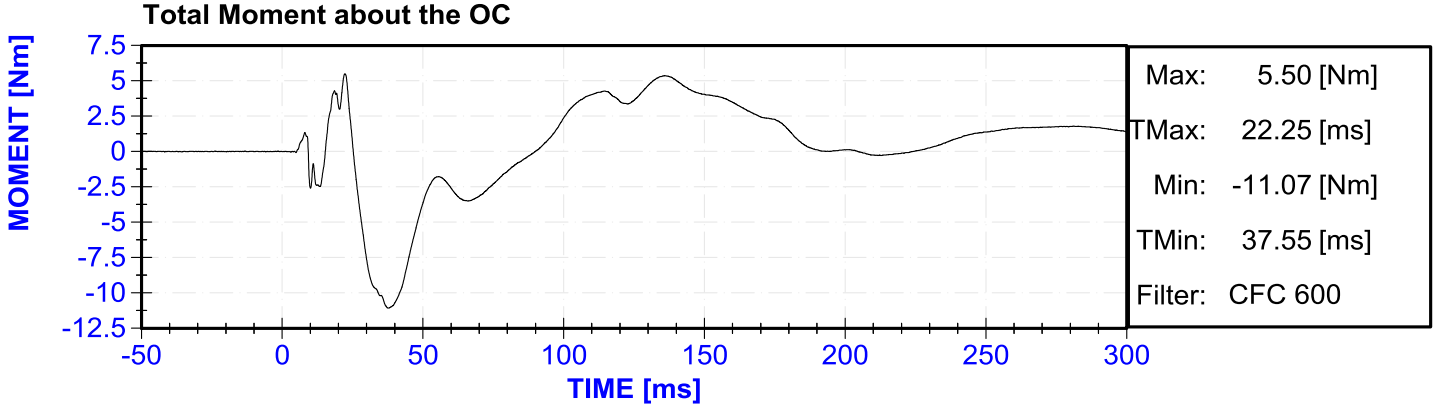
Lower Neck Z Moment



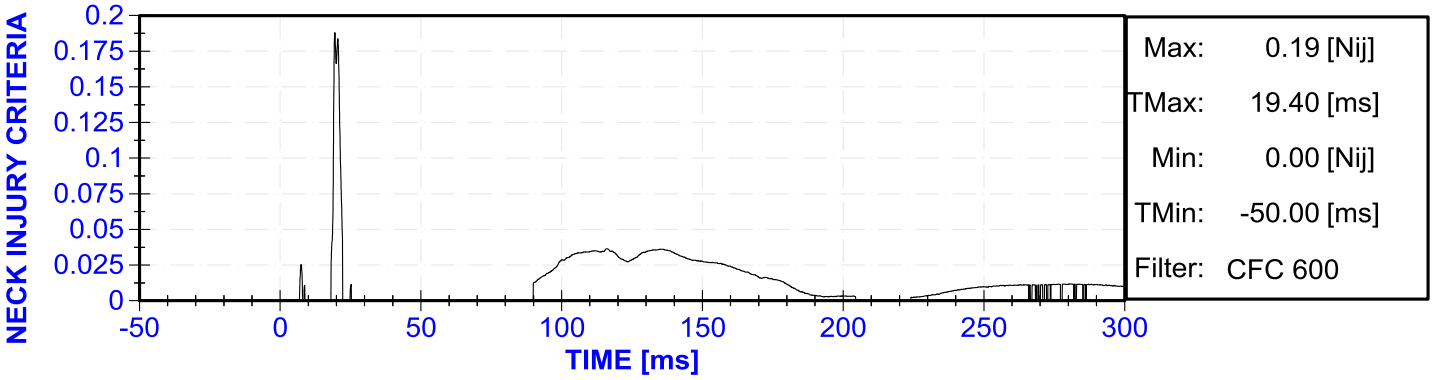
Lower Neck Moment Resultant



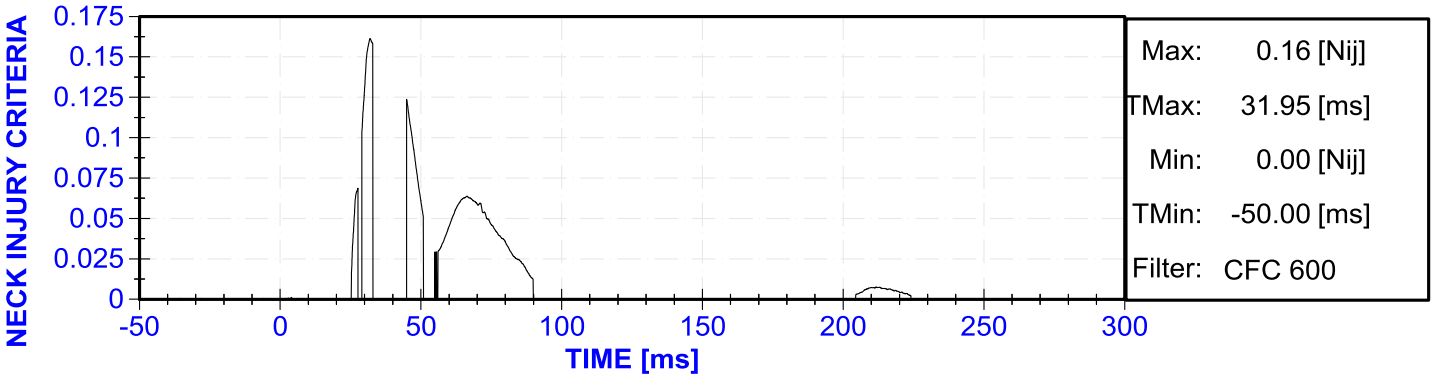
Total Moment about the OC



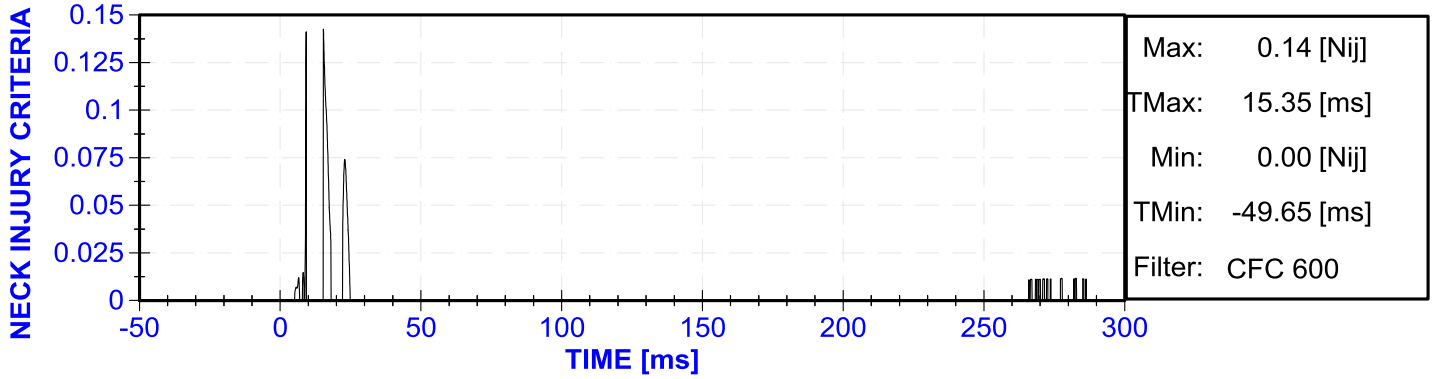
Neck Tension-Flexion Injury



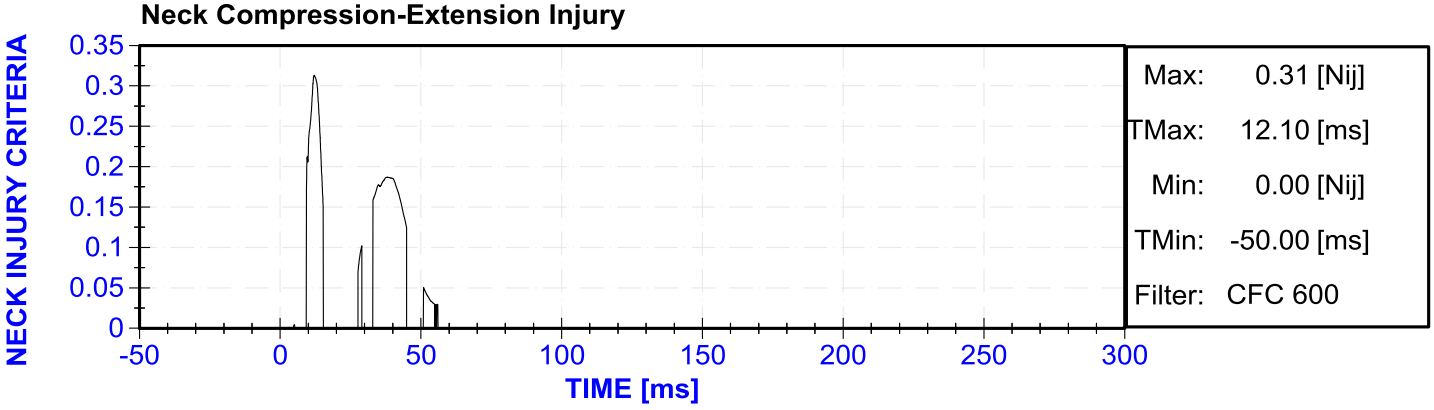
Neck Tension-Extension Injury



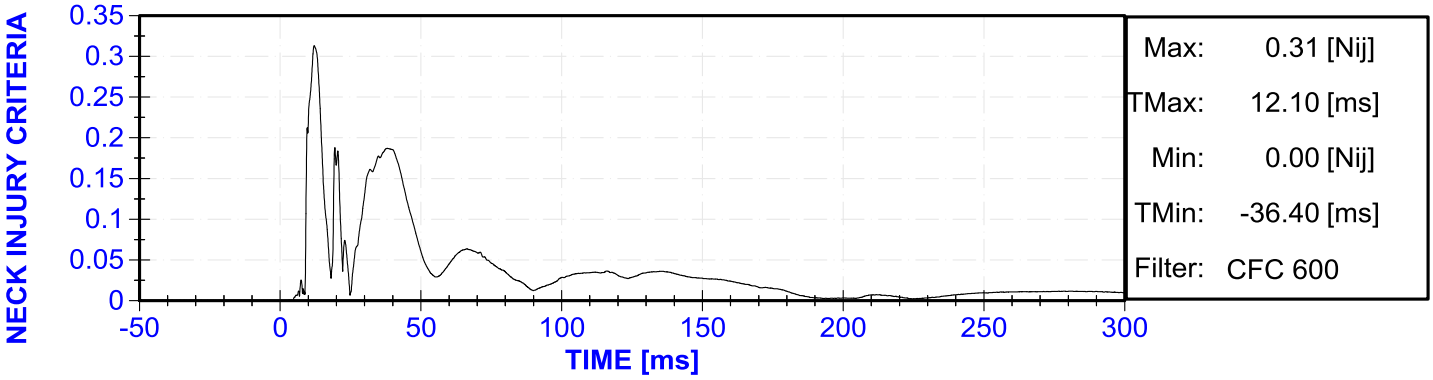
Neck Compression-Flexion Injury



Neck Compression-Extension Injury

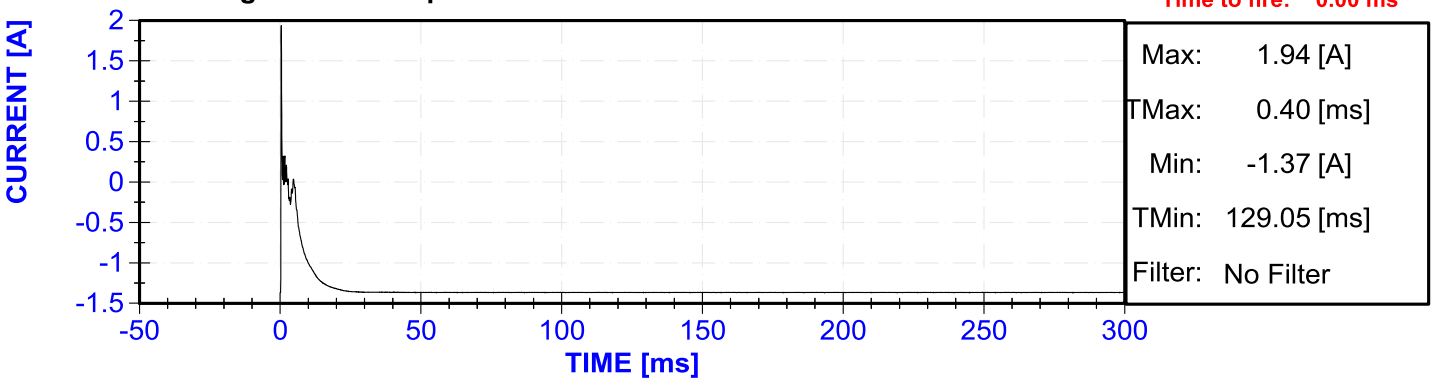


Total Neck Injury



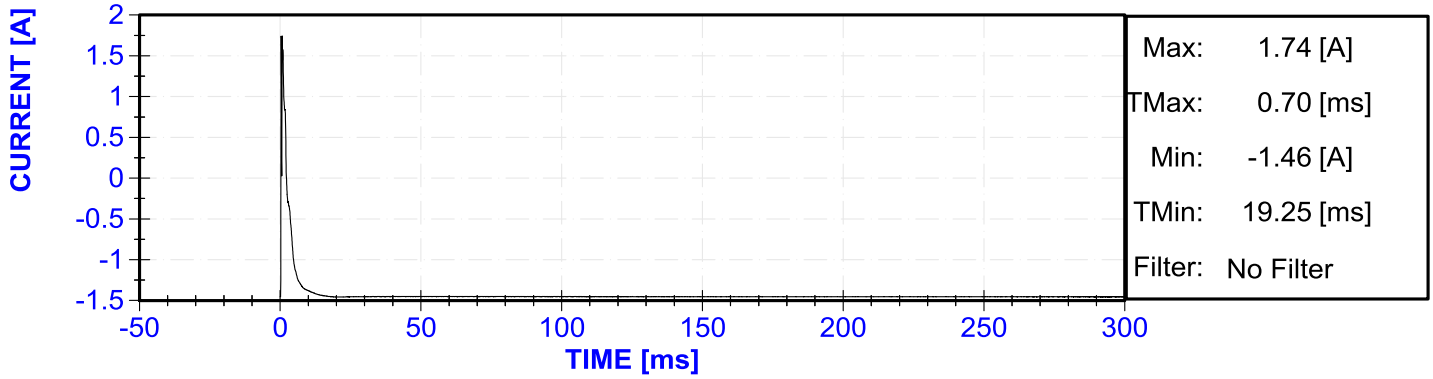
Passenger Curtain Squib Current

Time to fire: 0.00 ms



Passenger Seat Squib Current

Time to fire: 0.00 ms



APPENDIX C

TEST EQUIPMENT LIST AND CALIBRATION INFORMATION

TEST EQUIPMENT LIST AND CALIBRATION INFORMATION

	POSITION #2 (Passenger) SERIAL NO.: DG8012		
	SERIAL NUMBER	MANUFACTURER	CALIBRATION DATE
Head X Acceleration	AC-P51685	ENDEVCO 7264CT	5/22/2015
Head Y Acceleration	AC-P51682	ENDEVCO 7264CT	5/22/2015
Head Z Acceleration	AC-P51699	ENDEVCO 7264CT	5/22/2015
Head Redundant X Acceleration	AC-P51701	ENDEVCO 7264CT	5/22/2015
Head Redundant Y Acceleration	AC-P45019	ENDEVCO 7264CT	5/22/2015
Head Redundant Z Acceleration	AC-P51690	ENDEVCO 7264CT	5/22/2015
Upper Neck X Force	LC-798Fx	Denton 1716A	5/9/2015
Upper Neck Y Force	LC-798Fy	Denton 1716A	5/9/2015
Upper Neck Z Force	LC-798Fz	Denton 1716A	5/9/2015
Upper Neck X Moment	LC-798Mx	Denton 1716A	5/9/2015
Upper Neck Y Moment	LC-798My	Denton 1716A	5/9/2015
Upper Neck Z Moment	LC-798Mz	Denton 1716A	5/9/2015
Lower Neck X Force	LC-149Fx	Denton 3166JTF	5/11/2015
Lower Neck Y Force	LC-149Fy	Denton 3166JTF	5/11/2015
Lower Neck Z Force	LC-149Fz	Denton 3166JTF	5/11/2015
Lower Neck X Moment	LC-149Mx	Denton 3166JTF	5/11/2015
Lower Neck Y Moment	LC-149My	Denton 3166JTF	5/11/2015
Lower Neck Z Moment	LC-149Mz	Denton 3166JTF	5/11/2015
Curtain Bag Current	ABT squib amps	AutoLab System	NOVALUE
Seat/Torso Bag Current	ABT squib amps	AutoLab System	NOVALUE