

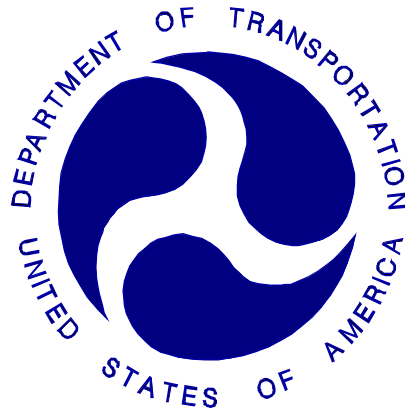
REPORT NUMBER: TWG-CAL-13-07

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

Toyota Motor Manufacturing, Texas, Inc
2013 Toyota Tacoma 4x2
Access Cab Pickup

NHTSA NUMBER: MD5120TWG2
CALSPAN TEST NUMBER: CT2013-07

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

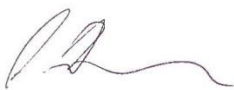


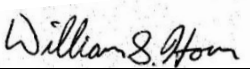
April 10, 2013

FINAL REPORT

Alpha Technology Associate, Inc.
2810 Old Lee Highway, Suite 120
Fairfax, VA 22031

This Final Test Report was prepared for the U.S. Department of Transportation, National Highway Traffic Safety Administration, under Contract No. DTNH22-12-D-00260, 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: _____

Acceptance Date: _____

TECHNICAL REPORT STANDARD TITLE PAGE

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4. Title and Subtitle Final Report 2013 , TWG/Out-of-Position Tests NHTSA No.: MD5120TWG2		5. Report Date 10 April, 2013				
		6. Performing Organization Code CAL				
7. Author(s) William Horn, Project Manager Adam Hardbattle, Project Engineer		8. Performing Organization Report No. CT2013-07				
9. Performing Organization Name and Address Calspan Corporation Transportation Sciences Center P.O. Box 400 Buffalo, New York 14225		10. Work Unit No.				
		11. Contract or Grant No. DTNH22-12-D-00260				
12. Sponsoring Agency Name and Address Alpha Technology Associate, Inc 2810 Old Lee Hwy, Suite 120 Fairfax,VA 22031		13. Type of Report and Period Covered Draft Report, 10 April, 2013				
		14. Sponsoring Agency Code NVS-111				
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 April 5, 2013.						
Injury Summary						
HIC15	Maximum Chest Displacement (mm)	Maximum Chest Displacement Rate (m/s)	NIJ(NTF)	NIJ(NTE)	NIJ(NCF)	NIJ(NCE)
65.342	N/A	N/A	0.000	0.498	0.854	0.681
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: Mai Lan Aram			
19. Security Classification of Report UNCLASSIFIED		20. Security Classification of Page UNCLASSIFIED		21. No. of Pages 45		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 undergone a New Car Assessment Program (NCAP) sponsored test requested by the National Highway Traffic Safety Administration (NHTSA). This test was performed under NHTSA contract No. DTNH22-12-D-00260 and through Alpha Technology Associate, Inc. PO 4GC154

1.2 SUMMARY

The effects of both a seat-mounted side airbag and a curtain airbag deployment in a 2013 Toyota Tacoma 4x2 Access Cab Pickup on an out-of-position SIDII (Hybrid III 5th female anthropomorphic test device (ATD)) were evaluated. The test was performed by Calspan on April 5, 2013. 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. The third camera was placed $\frac{3}{4}$ to the front to also capture the deployment event.

The SID-II 5th female anthropomorphic test device (ATD) was placed in the right front (passenger) seat situated perpendicular to the centerline of the seat, facing towards left front seat 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). The specific test was section 3.3.5.3.

The female ATD was instrumented with head x, y and z accelerometers (primary). In addition, upper six axial neck forces, and moment load cell sensors and lower six axial neck force and moment load cell sensors were utilized.

Seventeen 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 5th female ATD was placed with its left arm outstretched against the back of the right front (passenger) seat facing inboard cross car with its legs extended. After consultation with the program sponsor, the seat track was adjusted to locate the head C.G. under the expected deployment location of a head curtain chamber to maximize the airbag to head interaction. The location was determined by observing test data from the previous left side impact test on this vehicle. While keeping the head in neutral orientation, the ATD's pelvis was moved outboard until the dummy's back contacted the door trim panel armrest. The center of gravity of the head was centered in the deployment trajectory of the airbag. The dummy was then moved to maintain the vertical plane through the centerline of the ATD's shoulder bolts parallel to the vehicle centerline. The ATD's arm was bent straight across the back seat cushion. This orientation complies with section 3.3.5.3 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.

SECTION 2

DATA SHEET NO. 1 TEST SUMMARY

TEST CONFIGURATION INFORMATION:

Seating Position:	P2	Right Front Seating Position
Test:	3.3.5.3	Inboard 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.:	8012	5 th Female SID-IIs

Number of Data Channels:	17	
Number of Cameras:	0	<u>Real Time</u>
	3	<u>High Speed Digital</u>
	0	<u>High Speed Film</u>

PRE-TEST VISIBLE DUMMY CONTACT POINTS

Head Contact:	None
Upper Torso Contact:	Front passenger door and seat back
Lower Torso Contact:	Front passenger door and seat back
Knee Contact:	Console
Foot Contact:	None

POST-TEST VISIBLE DUMMY CONTACT POINTS

Head Contact:	Curtain Airbag / Front Dash
Upper Torso Contact:	Seat/Torso Airbag
Lower Torso Contact:	Seat/Torso Airbag and Seat Back
Knee Contact:	Console
Foot Contact:	None

DATA SHEET NO. 2
VEHICLE PARAMETER DATA

TEST VEHICLE INFORMATION:

Year/Make/Model/Body Style: 2013 Toyota Tacoma 4x2 Access Cab Pickup

NHTSA No. : MD5120TWG2 ; VIN: 5TFTX4CN6DX022234 Color: Charcoal gray

Engine Data: I4 cylinders; - CID; 2.7 Liters; - cc

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

Transmission Data: 4 speeds; - Manual; X Automatic; X Overdrive

Final Drive: X Rear Wheel Drive; - 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.Strg.; X Pwr. Brakes

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

Date Received: 10/16/2012 ; Odometer Reading 50 Km

Selling Dealer: Folsom Lake Toyota

& Address: 800 Nevada Street Auburn, CA 95603

DATA FROM TIRE VEHICLE'S CERTIFICATION LABEL:

Vehicle Manufactured by: Toyota Motor Manufacturing Texas INC

Date of Manufacture 08/12

GVWR: 2,220 kg; GAWR: 1,075 kg FRONT; 1,200 kg REAR

DATA FROM TIRE PLACARD:

Recommended Tire Size: P245/75R16

*Recommended Cold Tire Pressure: 210 Kpa Front 210 kpa Rear

DATA FROM TIRE SIDEWALL:

Size of Tires on Test Vehicle: P245/75R16 ; Manufacturer: Dunlop

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

Treadwear: 300 ; Traction: B ; Temperature: B

VEHICLE CAPACITY DATA:

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

Number of Occupants: 2 Front; 2 Rear; 4 Total

Vehicle Capacity Weight (VCW) = 475.0 Kg

No. of Occupants x 68.04 kg = 272.2 Kg

Rated Cargo/Luggage Weight (RCLW) = 202.8 Kg

*Tire pressure used for test

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

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

NHTSA No. MD5120TWG2

Measurement	Value
Total Fore/Aft Travel (mm)	237
Test Distance Rearward of Full-Forward (mm)	150
Total Fore/Aft Travel (Detents)	16
Placed in Position #	10

Seat Back Angle	SA (°)	Value
Airbag Module Width	AMW (mm)	-
Airbag Width	ABW (mm)	-
Airbag Module Length	AML (mm)	-
Airbag Length	ABL (mm)	-
Top of Airbag Module to Head/Neck Junction	AN (mm)	-
Head CG to Door Panel/Side Window	HD (mm)	150
Head to Seat Back Centerline	HSC (mm)	-
Head to B-Pillar (cg)	HB (mm)	175
Head to Roof, Z (top of the head)	HZ (mm)	80
Head to Header	HHH (mm)	340
Chest to Dash	CD (mm)	350 (side)
Chest to Seatback	CS (mm)	0
Right Arm to Seat Back Centerline	RACL (mm)	-
Right Arm to Seat Back Centerline	RACL (°)	-
Left Arm to Seat Back Centerline	LACL (mm)	-
Left Arm to Seat Back Centerline	LACL (°)	-
Right Arm to Door Panel	RA (mm)	N/A
Left Arm to Door Panel	LA (mm)	N/A
Knee to Knee	KK (mm)	-
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.: MD5120TWG2

Channel	Max	Time (ms)	Min	Time (ms)
V1P2 Head x [g , CFC_1000]	16.586	3.550	-19.334	23.550
V1P2 Head y [g , CFC_1000]	3.359	3.750	-21.440	2.050
V1P2 Head z [g , CFC_1000]	9.677	1.450	-34.391	8.450
V1P2 Headform Resultant [g, CFC_1000]	36.254	8.450	0	0
V1P2 Upper Neck MocY [N-m, CFC_600]	43.666	9.950	-33.649	112.300
V1P2 Upper Neck Ntf [N-m, CFC_600]	0.000	0.000	0	0
V1P2 Upper Neck Nte [N-m, CFC_600]	0.498	148.450	0	0
V1P2 Upper Neck Ncf [N-m, CFC_600]	0.854	8.500	0	0
V1P2 Upper Neck Nce [N-m, CFC_600]	0.681	23.550	0	0
V1P2 Upper Neck Nij [Nij, CFC_600]	0.850	8.500	0	0
V1P2 Upper Neck Fx [N , CFC_1000]	301.619	8.850	-208.411	23.550
V1P2 Upper neck Fy [N , CFC_1000]	-0.000	0.000	-439.200	88.600
V1P2 Upper neck Fz [N , CFC_1000]	452.458	197.550	-2326.872	7.600
V1P2 Neck F Res	2346.746	7.600	0	0
V1P2 Upper Neck Mx [N-m , CFC_600]	16.945	8.850	0	0
V1P2 Upper Neck My [N-m , CFC_600]	48.687	9.800	-34.763	23.400
V1P2 Upper Neck Mz [N-m , CFC_600]	7.481	14.900	-14.629	187.900
V1P2 Neck M Res	51.709	9.800	0	0
V1P2 Lower Neck Fx F [N , CFC_1000]	458.965	9.950	-515.825	107.450
V1P2 Lower Neck Fy F [N , CFC_1000]	582.386	75.350	-9.025	1.300
V1P2 Lower Neck Fz F [N , CFC_1000]	110.785	200.000	-2533.572	8.050
V1P2 Lower Neck Res	2591.492	8.050	0	0
V1P2 Lower Neck Mx F [N-m , CFC_600]	21.225	164.700	-12.466	8.900
V1P2 Lower Neck My F [N-m , CFC_600]	83.208	6.550	-6.824	195.750
V1P2 Lower Neck Mz F [N-m , CFC_600]	0.190	0.850	-33.919	82.150
V1P2 Lower Neck Res	84.322	6.600	0	0
Curtain Airbag Volts	22.91	1.9	0	0
Curtain Airbag Current	3.40	0.4	0	45.65
Seat/Torso Airbag Volts	32.93	10.15	0	0
Seat/Torso Airbag Current	3.40	0.4	0	9.55

DATA SHEET 4

CHILD DUMMY INJURY CRITERIA VALUES (CONTINUED)

VEHICLE: 2013 Toyota Tacoma 4x2 Access Cab Pickup

NHTSA No.: MD5120TWG2

HEAD INJURY CRITERIA (HIC)

	HIC15			
	HIC(15)	t ₁ (msec)	t ₂ (msec)	Average Acceleration t ₁ to t ₂
Position #2 - Right	65.342	62.500	77.500	28.550

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	0.000	0.000	0.000	0.000	-0.000
Nte	0.498	148.450	143.752	166.224	-31.144
Ncf	0.854	8.500	-2274.832	291.803	41.434
Nce	0.681	23.550	-852.717	-207.027	-30.919

Peak Tension (CFC1000) 452.458 N

Peak Compression (CFC1000) -2326.872 N

Critical Values

Nij Intercepts				Peak Limits	
Tension (CVt)	4287	Extension (mCVe)	67 N-m	Tension	2070 N
Compression (CVc)	3880	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 5th female SID-II's Dummy Left Side View



Figure A-6: Post-Test 5th female SID-II's Dummy Left Side View



Figure A-7: Pre-Test 5th female SID-III's Dummy Left Side Close-up View



Figure A-8: Post-Test 5th female SID-III's Dummy Left Side Close-up View

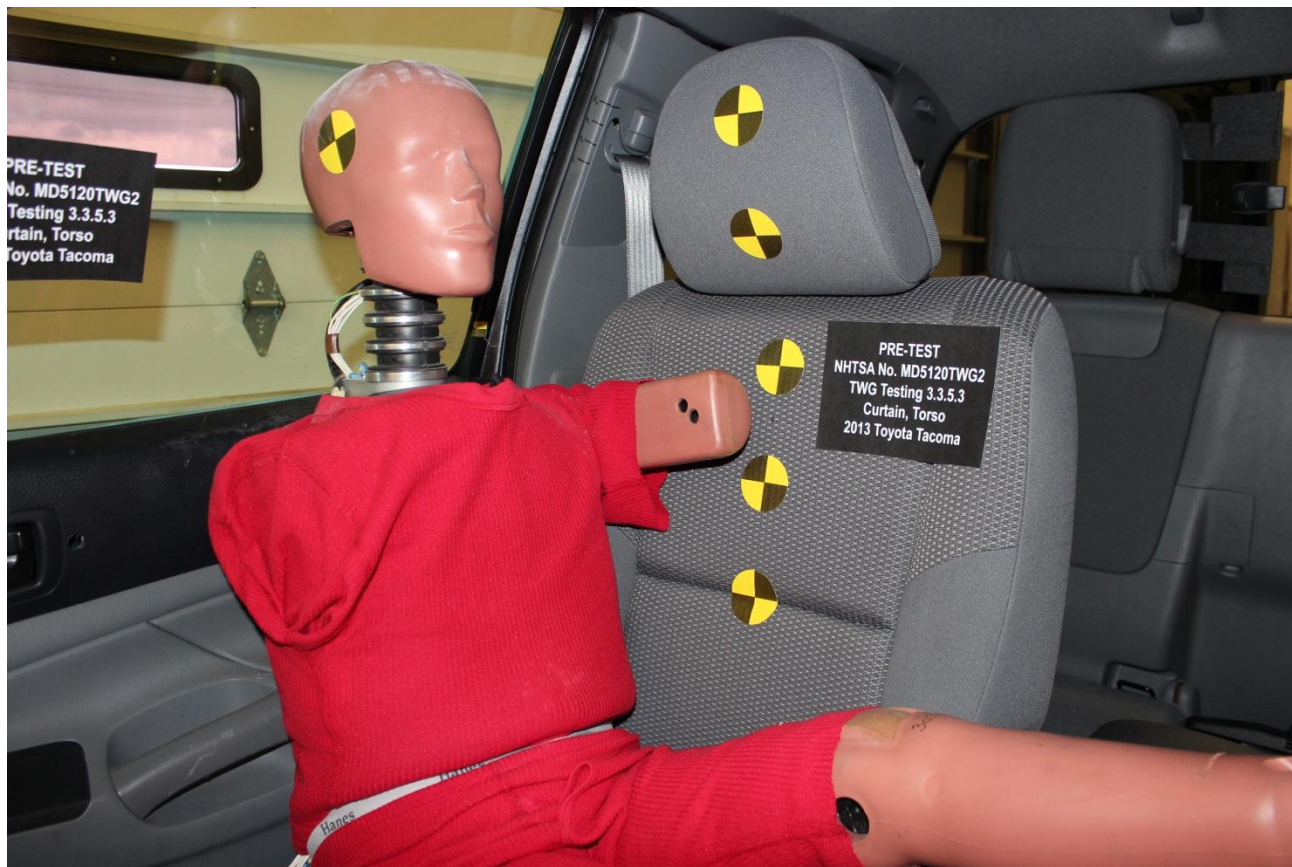


Figure A-9: Pre-Test 5th female SID-III Dummy Left $\frac{3}{4}$ Front View

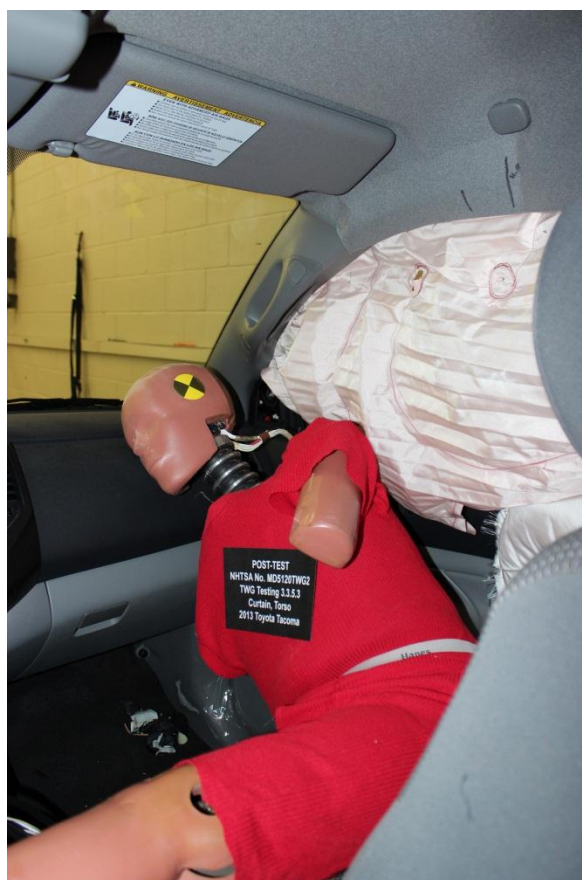


Figure A-10: Post-Test 5th female SID-III Dummy Left $\frac{3}{4}$ Rear View

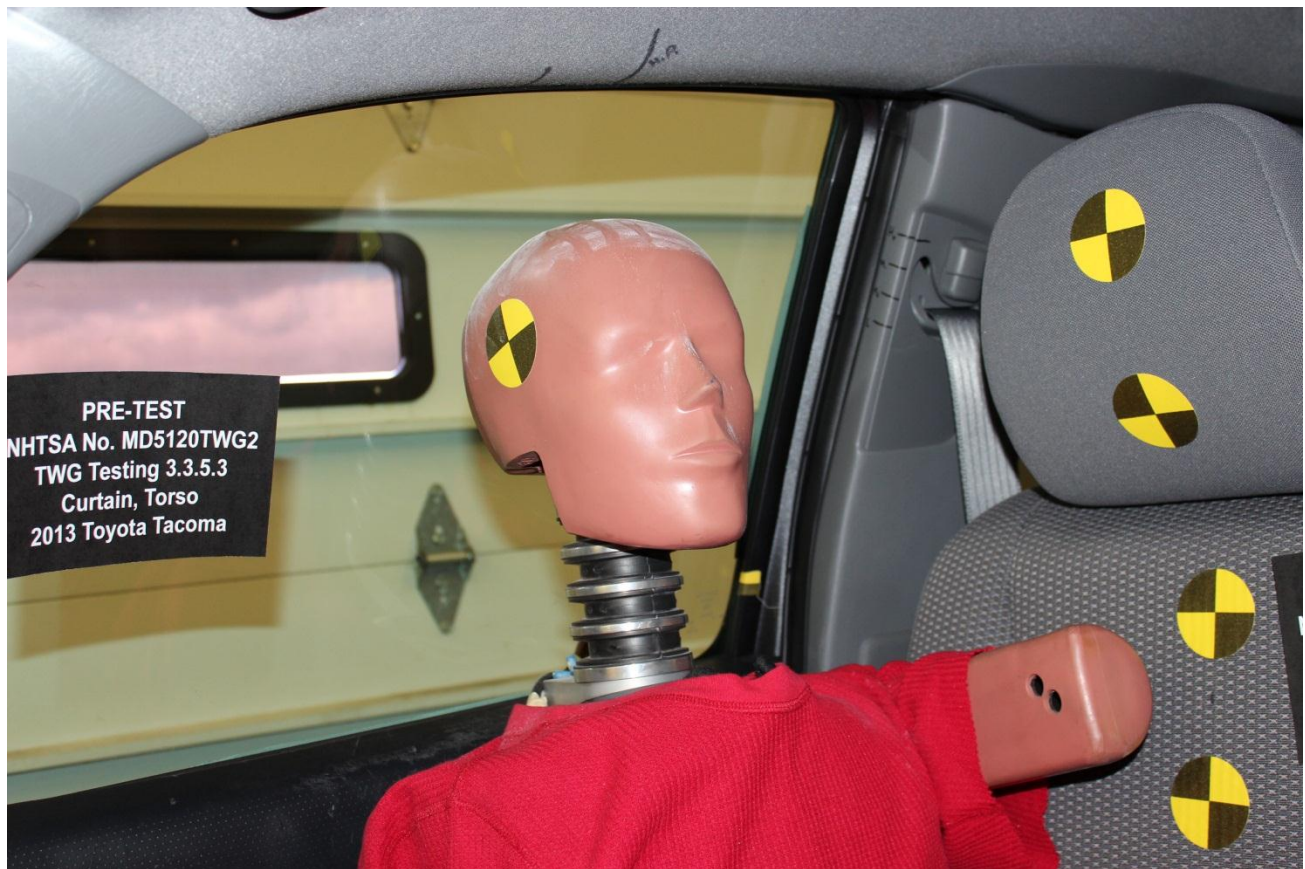


Figure A-11: Pre-Test 5th female SID-III Dummy Left $\frac{3}{4}$ Front Close-up View



Figure A-12: Post-Test 5th female SID-III Dummy Left $\frac{3}{4}$ Front Close-up View

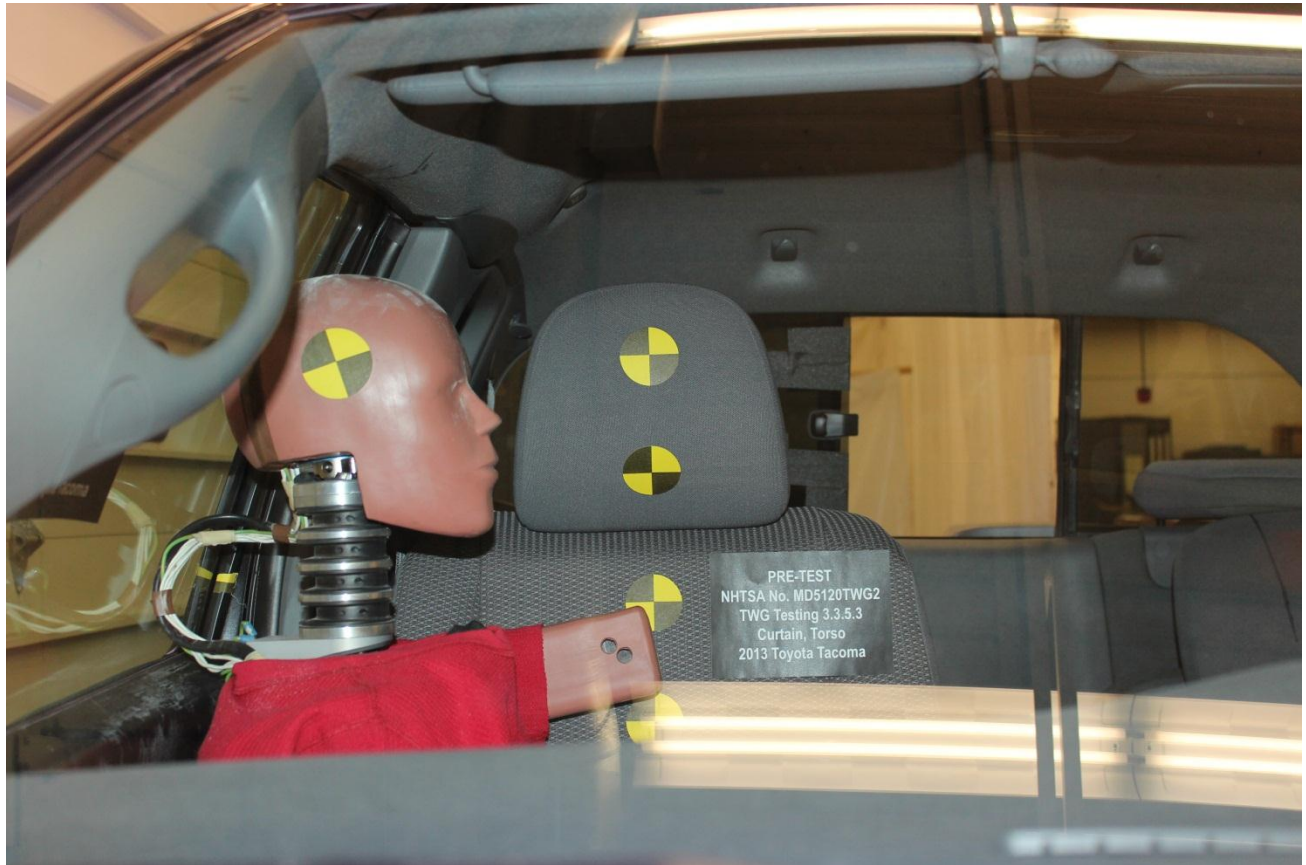


Figure A-13: Pre-Test 5th female SID-IIs Dummy Front View



Figure A-14: Post-Test 5th female SID-IIs Dummy Front View

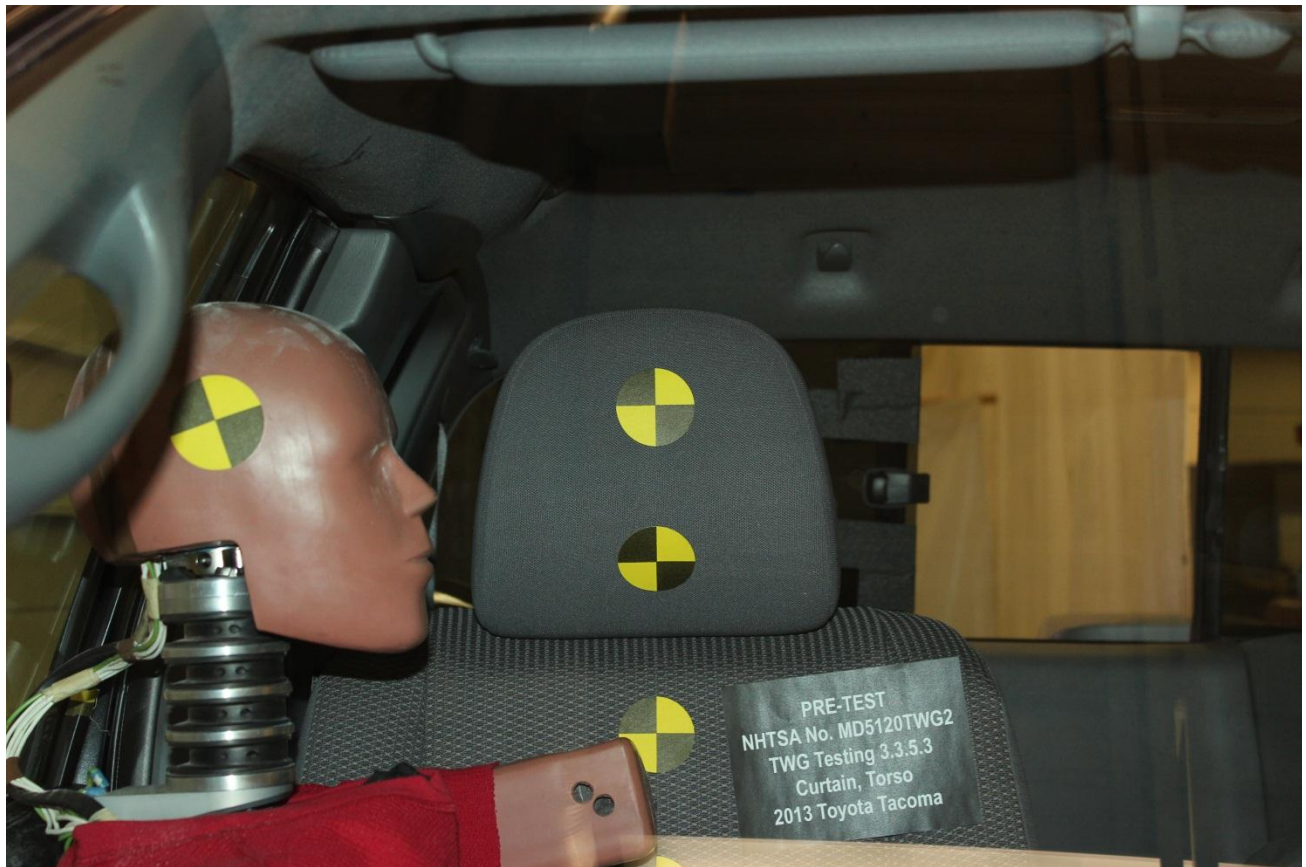


Figure A-15: Pre-Test 5th female SID-IIs Dummy Front Close-up View

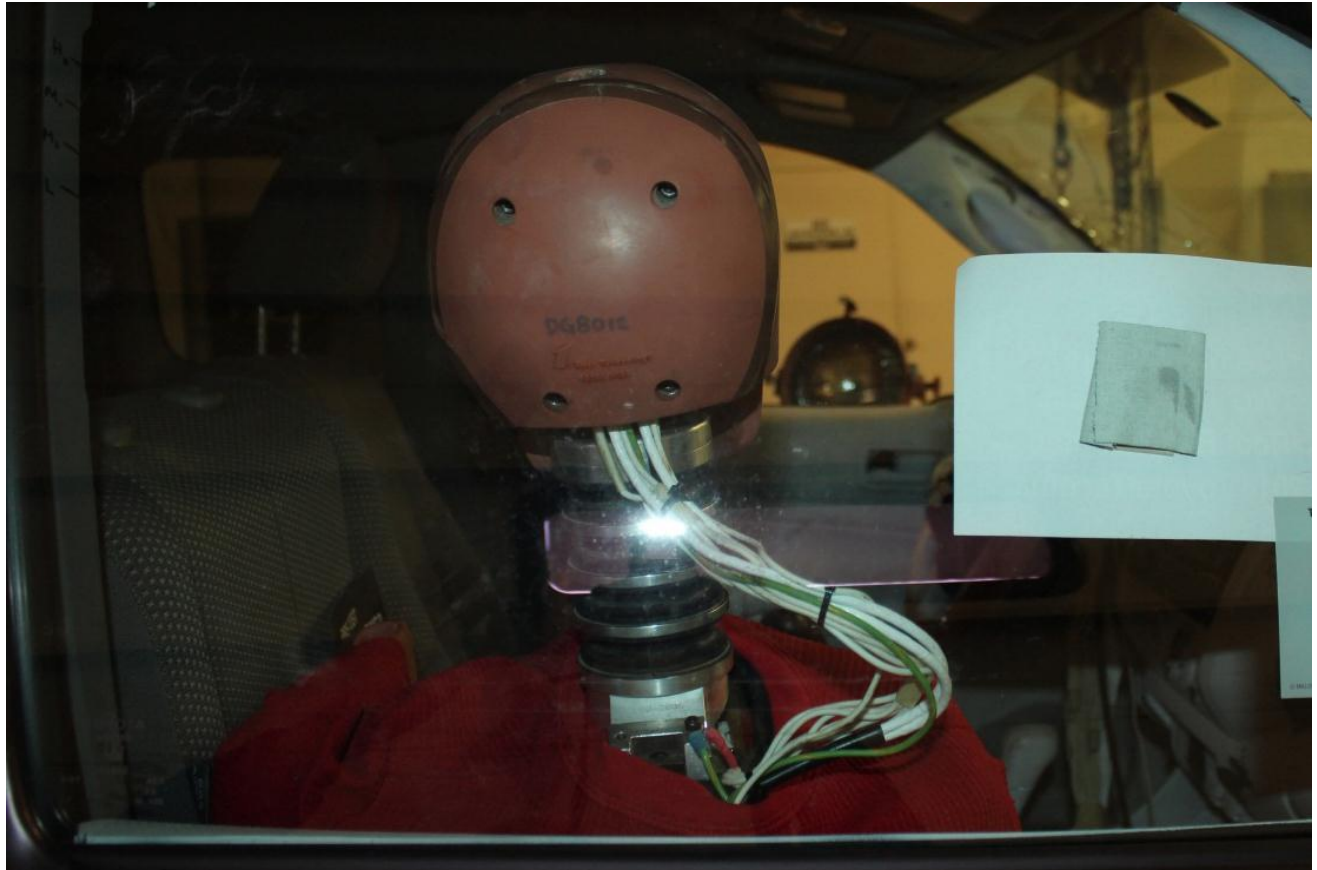


Figure A-16: Pre-Test 5th female SID-IIs Dummy Right Side View



Figure A-17: Pre-Test 5th female SID-IIs Dummy Right Side Clearance View



Figure A-18: Pre-Test 5th female 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 $\frac{3}{4}$ 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



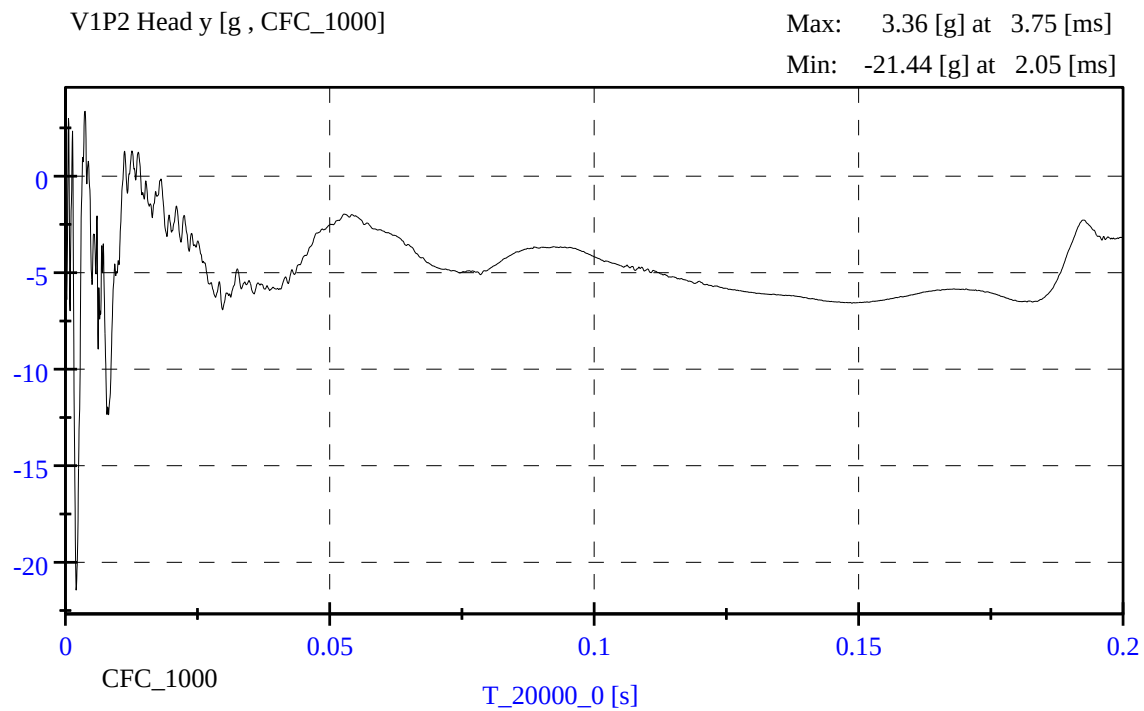
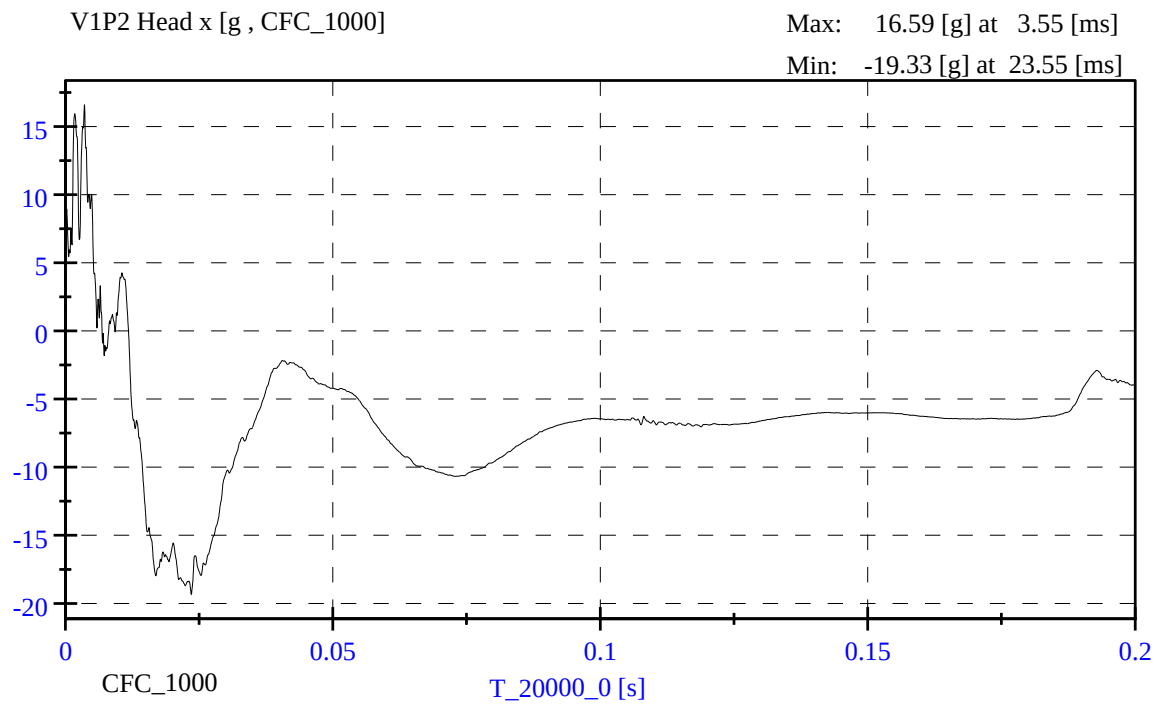
Figure A-24: Post NCAP Left Side View

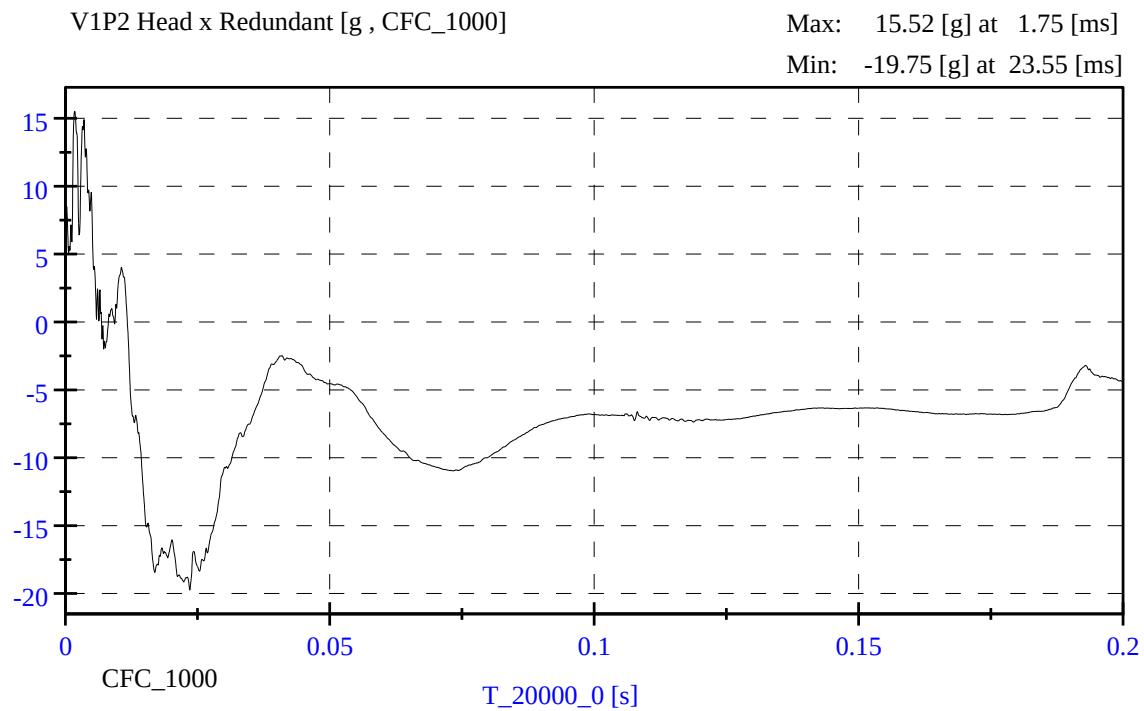
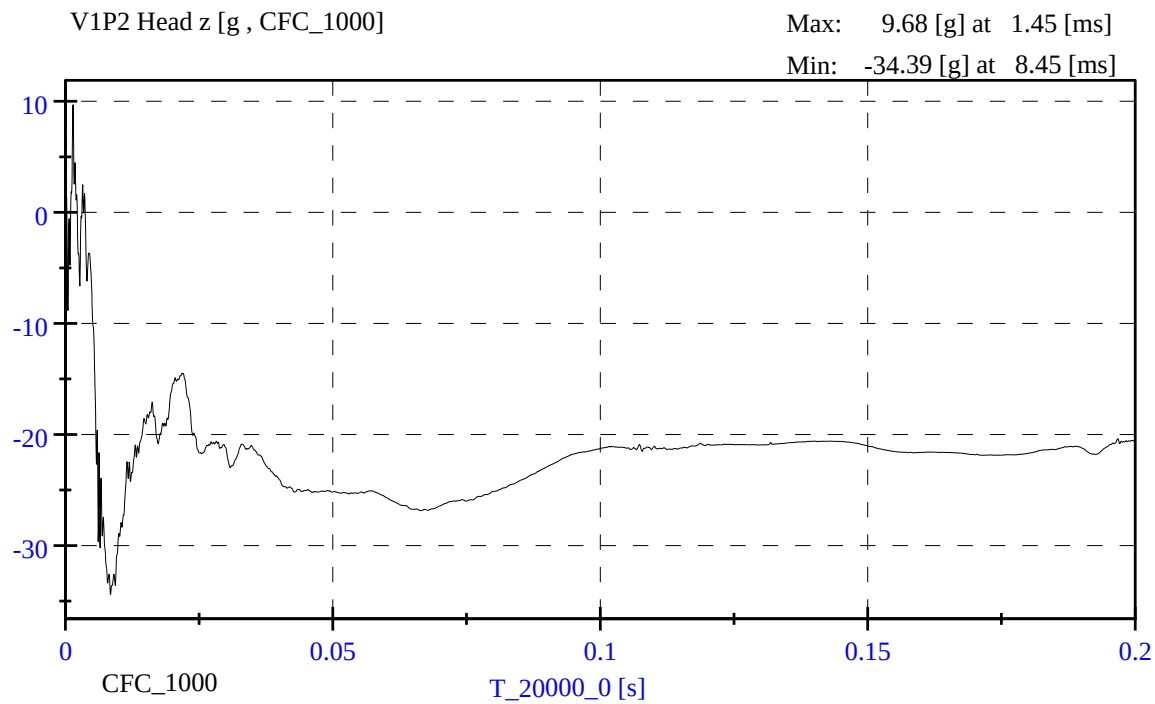
Appendix B

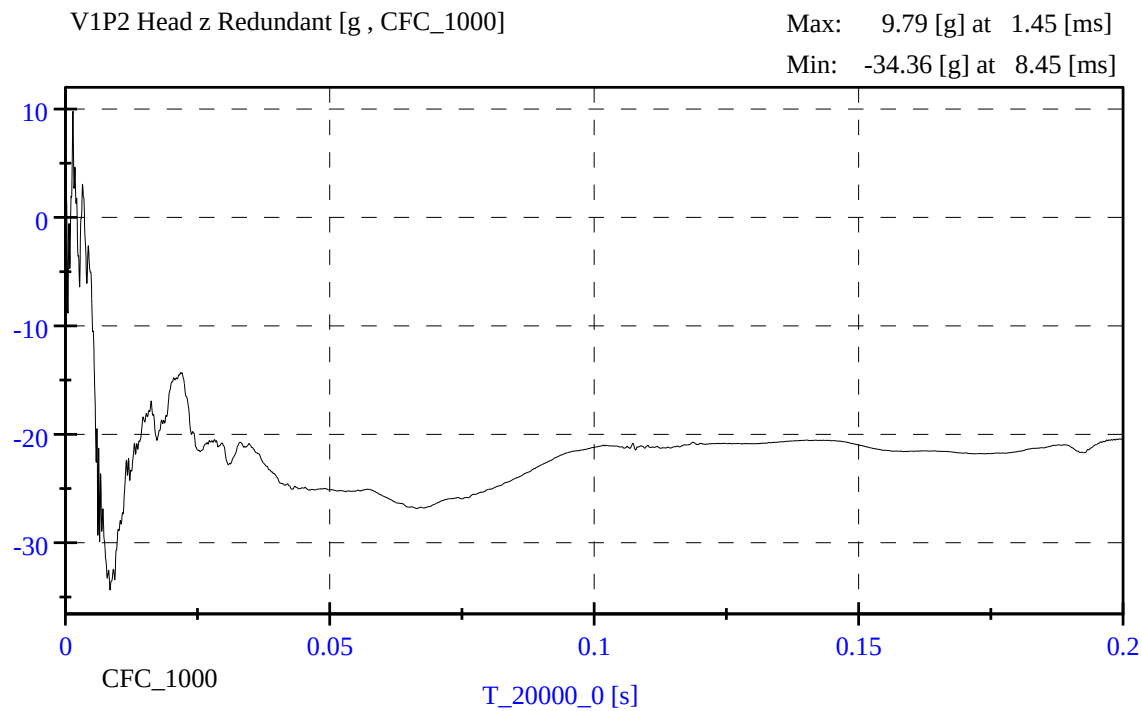
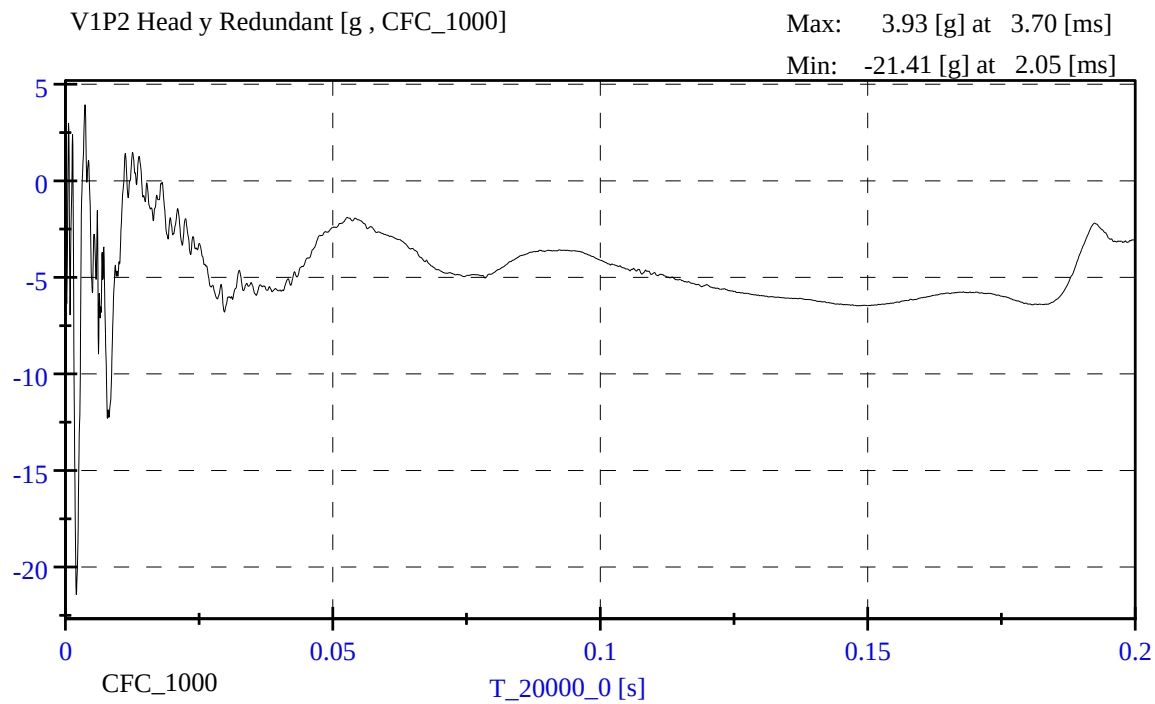
Vehicle and Dummy Plots

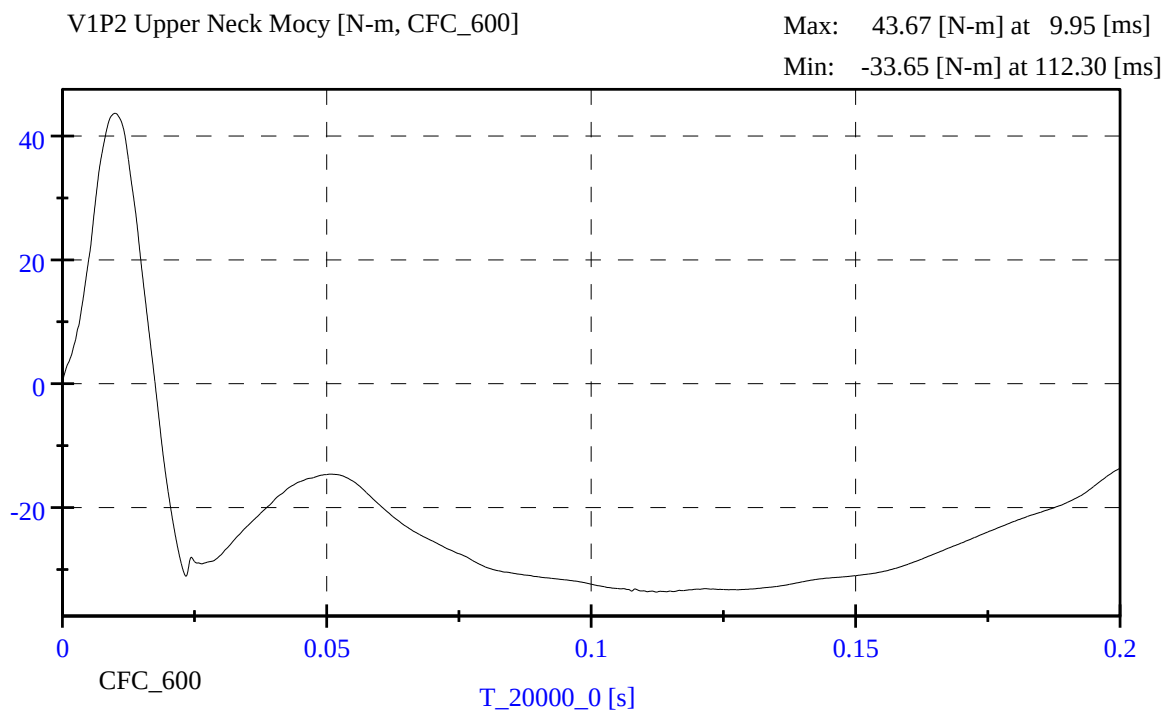
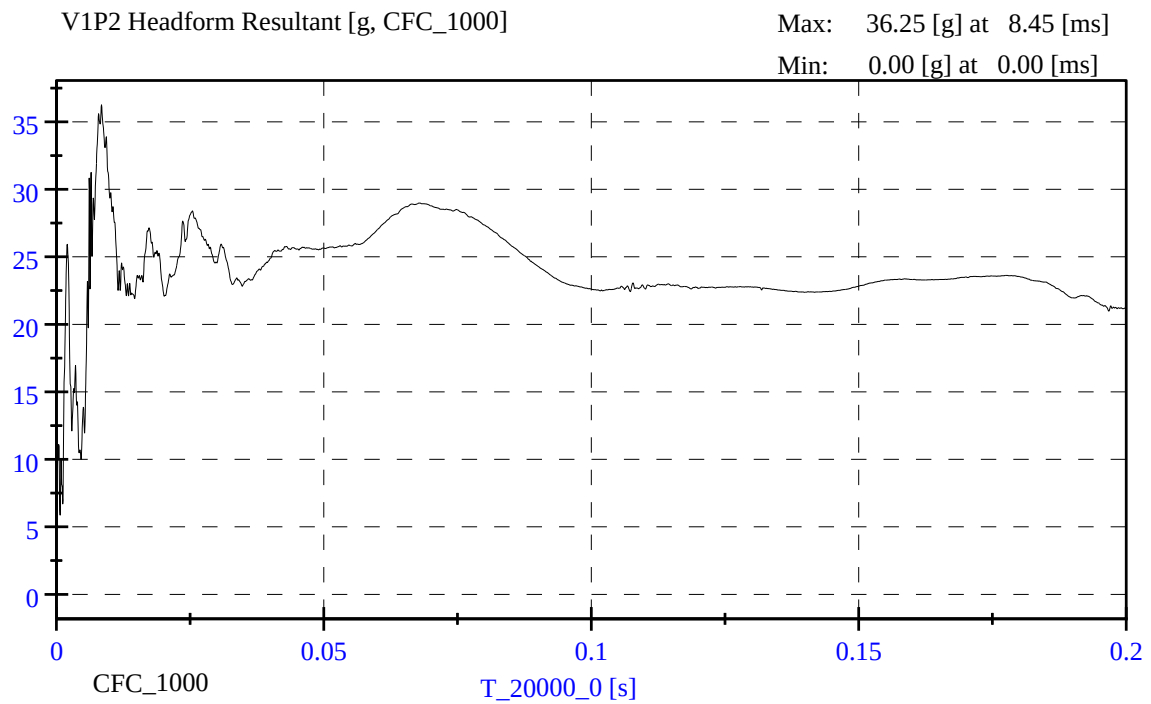
Table of Data Plots

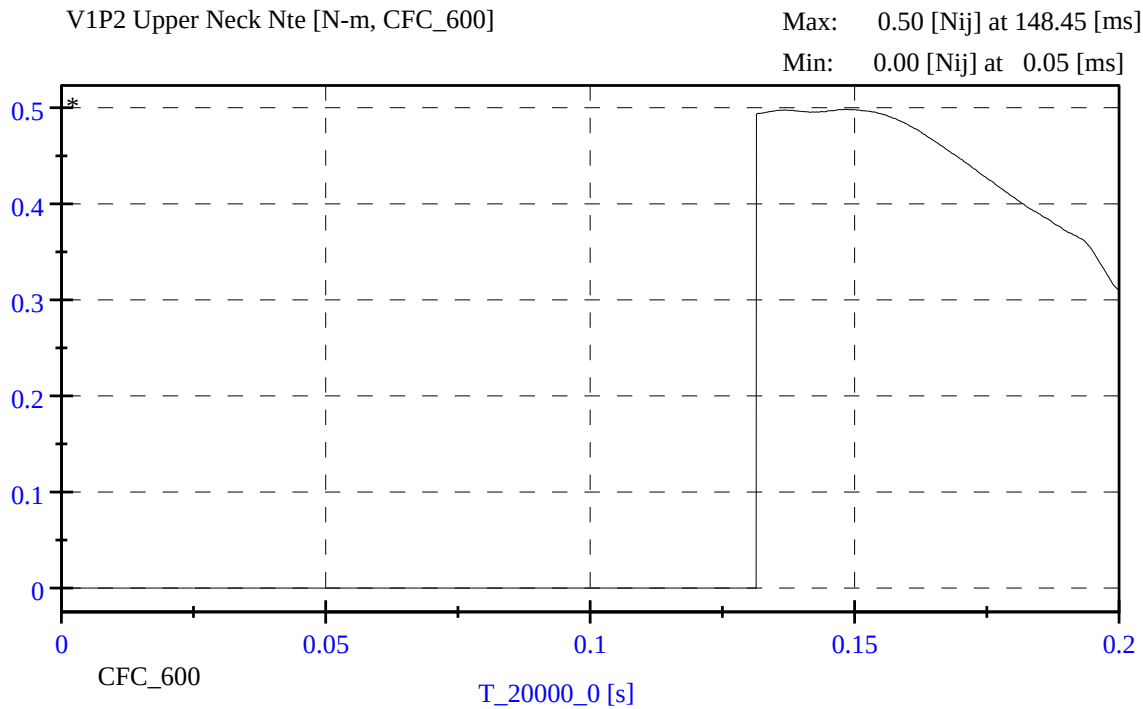
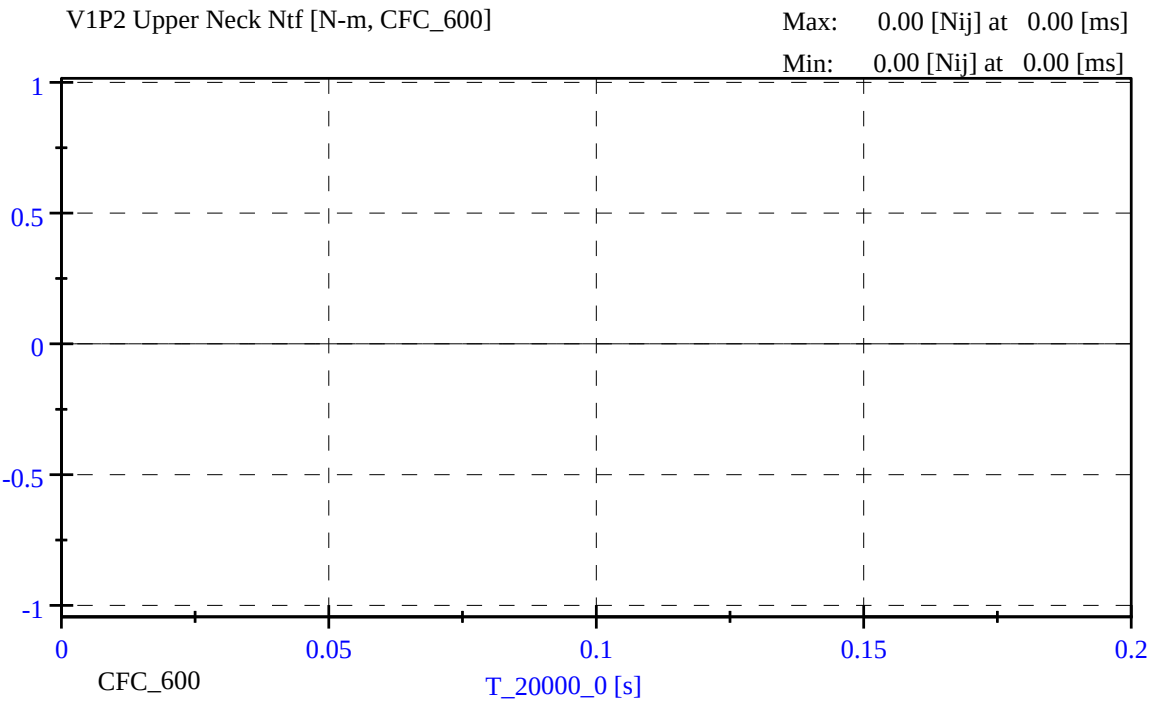
No.	Description	Page
1	V1P2 Head x [g , CFC_1000]	B-3
2	V1P2 Head y [g , CFC_1000]	B-3
3	V1P2 Head z [g , CFC_1000]	B-4
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20	V1P2 Upper Neck Load Cell Mz [N-m , CFC_600]	B-12
21	Input: V1P2 NEKU Mx F (38), V1P2 NEKU My F (39)...	B-13
22	V1P2 Lower Neck Load Cell Fx [N , CFC_1000]	B-13
23	V1P2 Lower Neck Load Cell Fy [N , CFC_1000]	B-14
24	V1P2 Lower Neck Load Cell Fz [N , CFC_1000]	B-14
25	Input: V1P2 NEKL Fx F (42), V1P2 NEKL Fy F (43)...	B-15
26	V1P2 Lower Neck Load Cell Mx [N-m , CFC_600]	B-15
27	V1P2 Lower Neck Load Cell My [N-m , CFC_600]	B-16
28	V1P2 Lower Neck Load Cell Mz [N-m , CFC_600]	B-16
29	Input: V1P2 NEKL Mx F (46), V1P2 NEKL My F (47)...	B-17
30	V1P2 Curtain Airbag Voltage	B-17
31	V1P2 Seat Airbag Voltage	B-18
32	V1P2 Curtain Airbag Current	B-18
33	V1P2 Seat Airbag Current	B-19

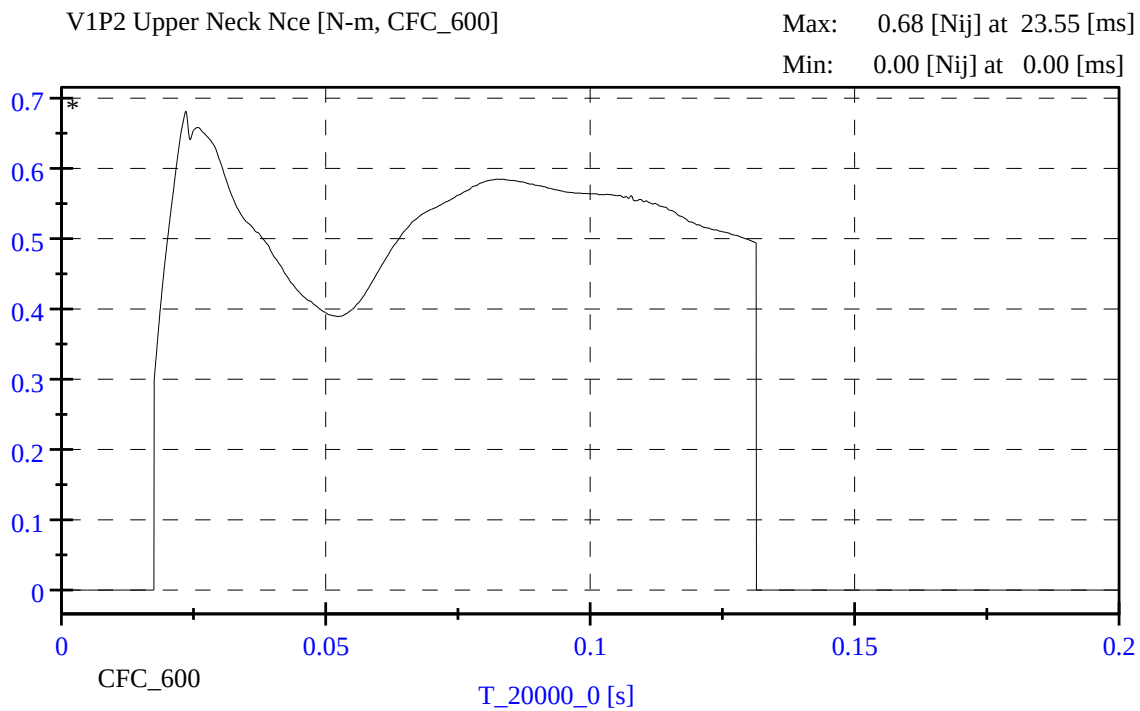
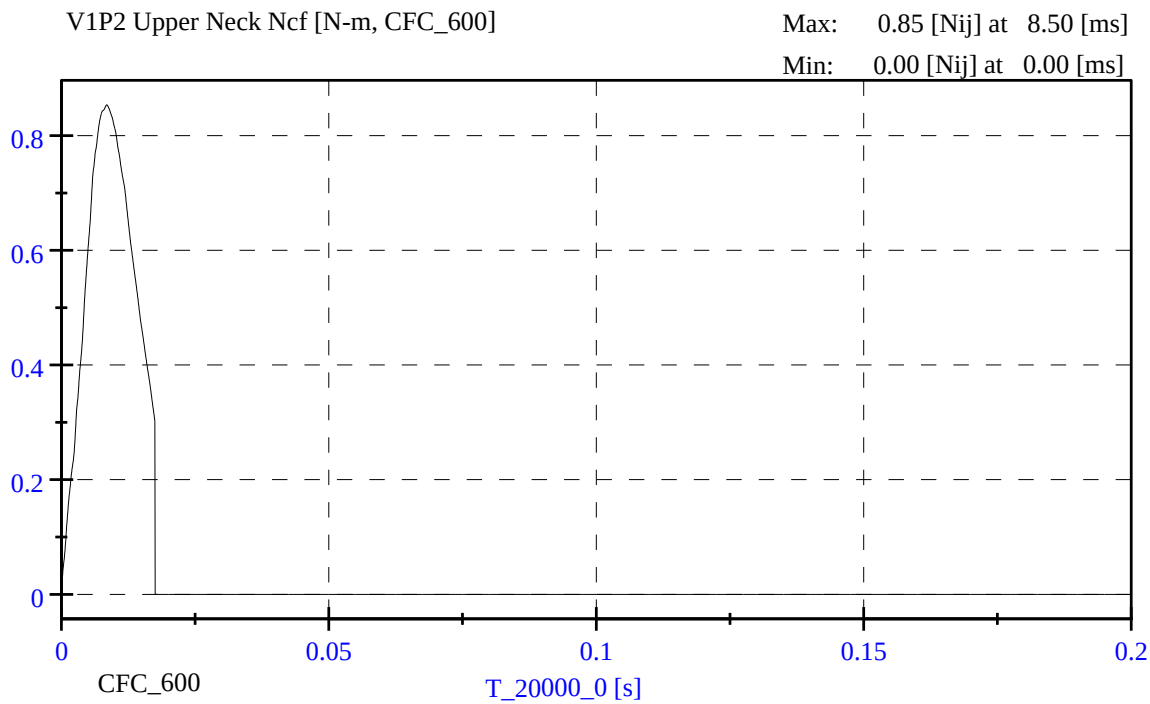


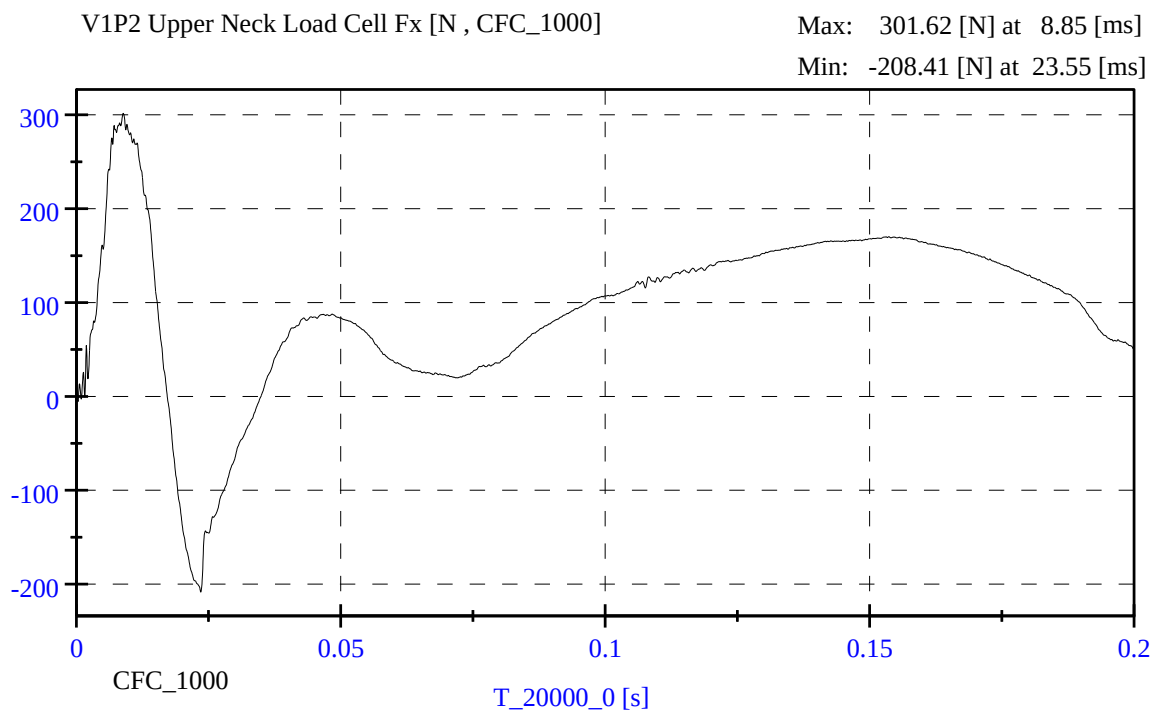
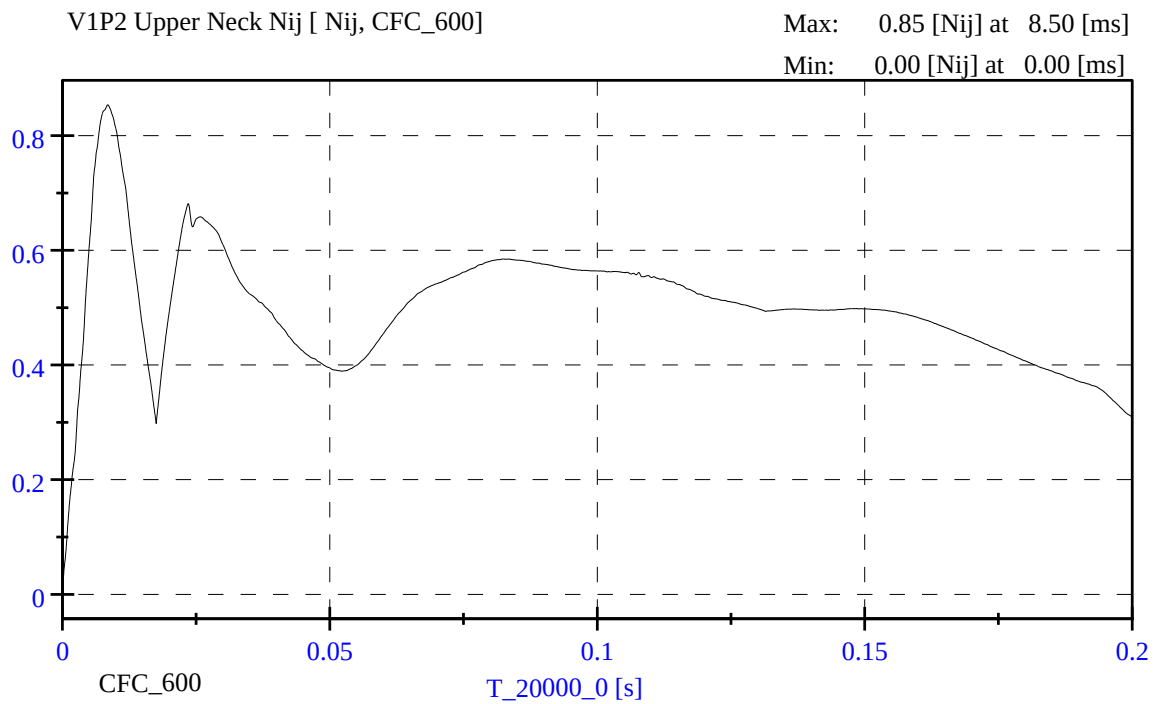


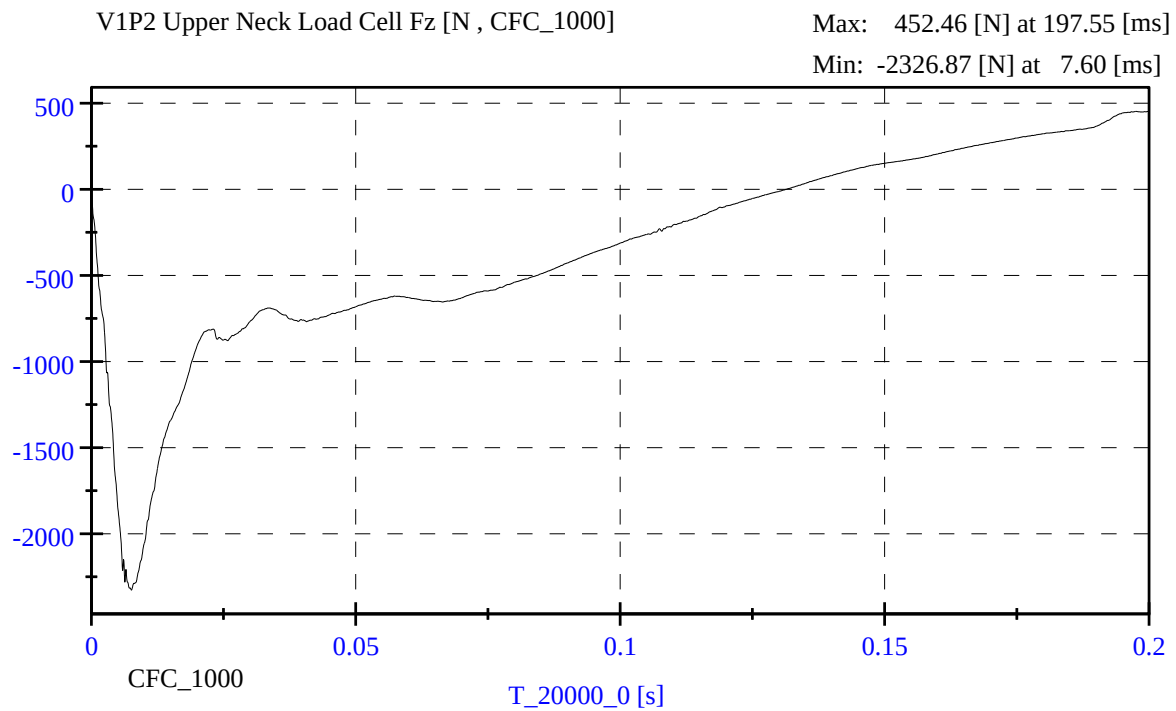
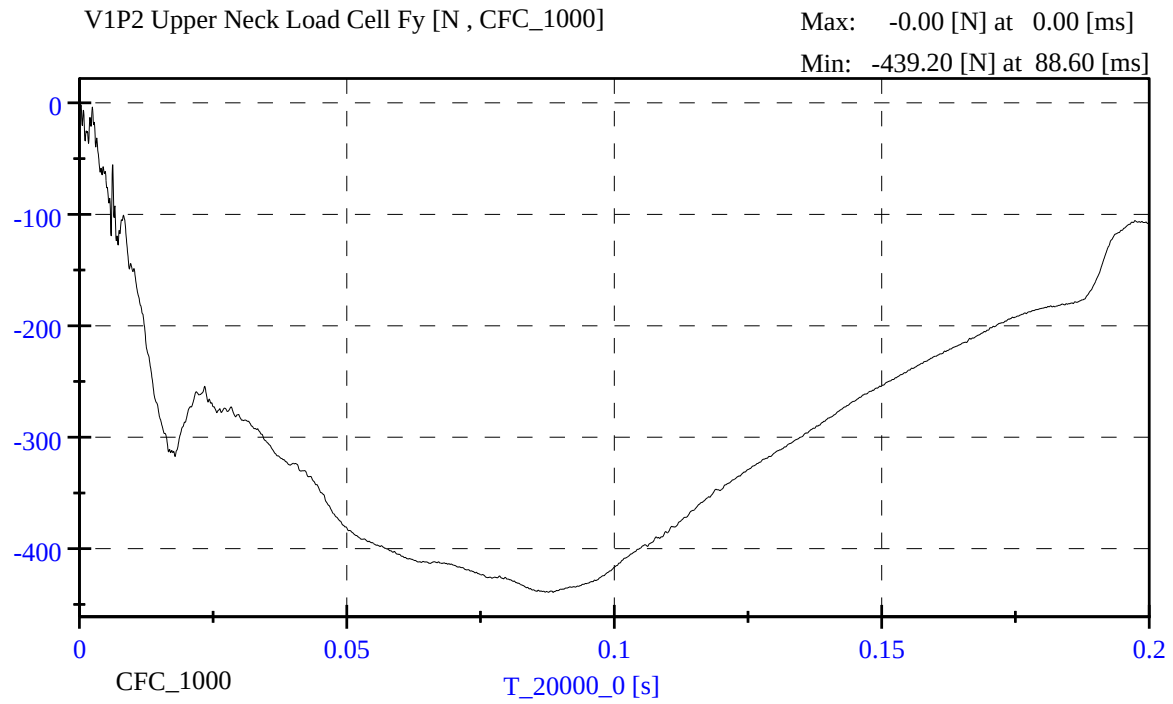


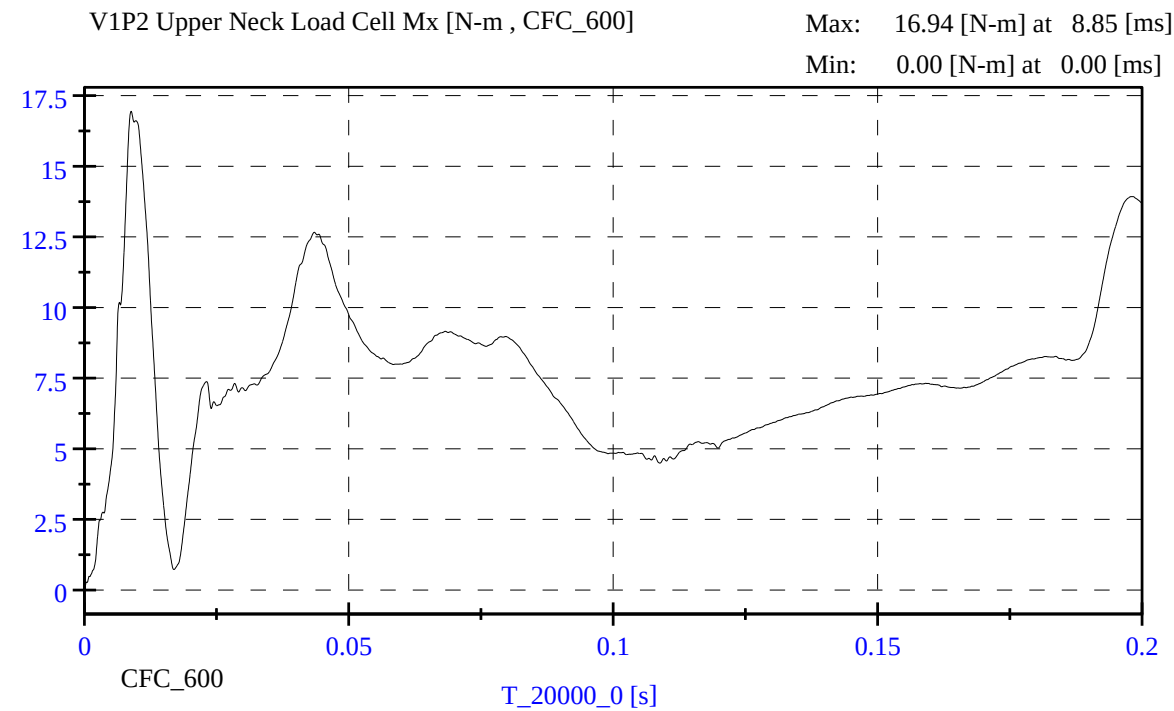
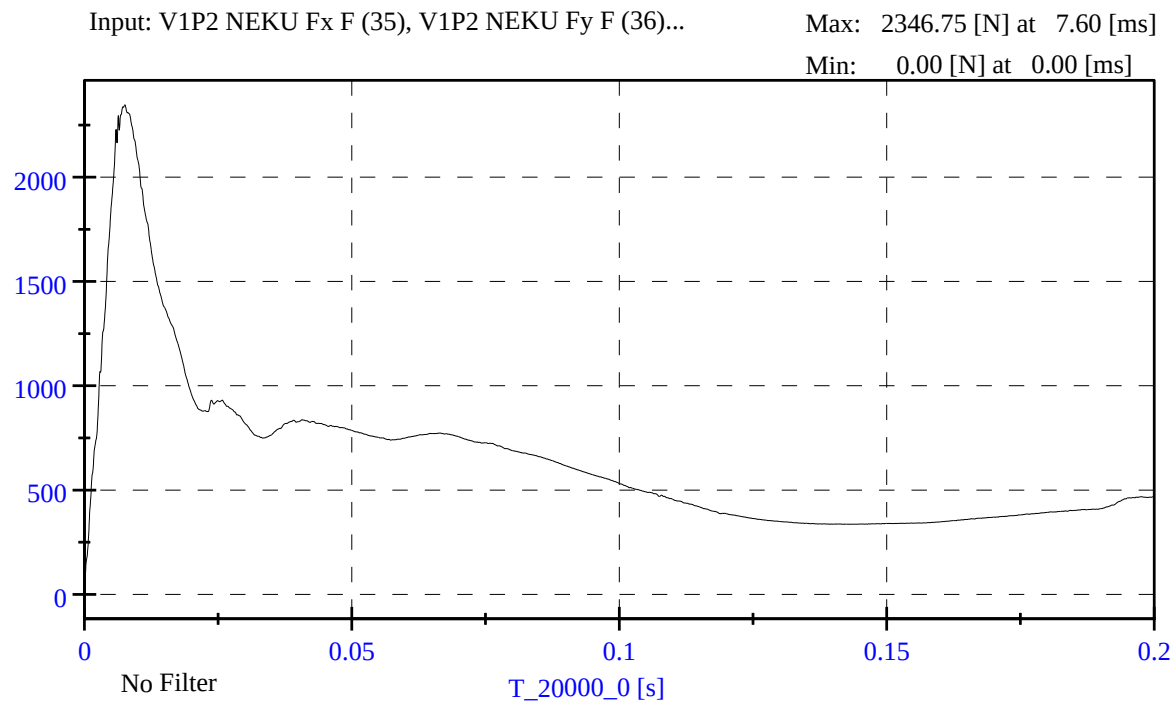


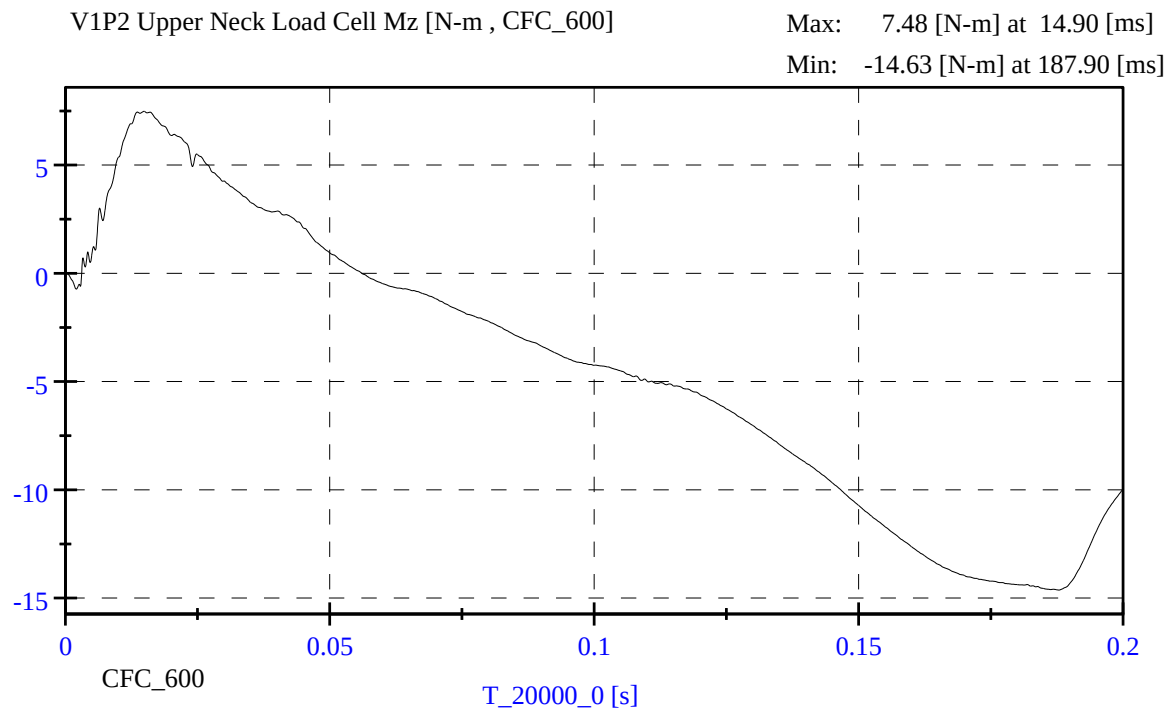
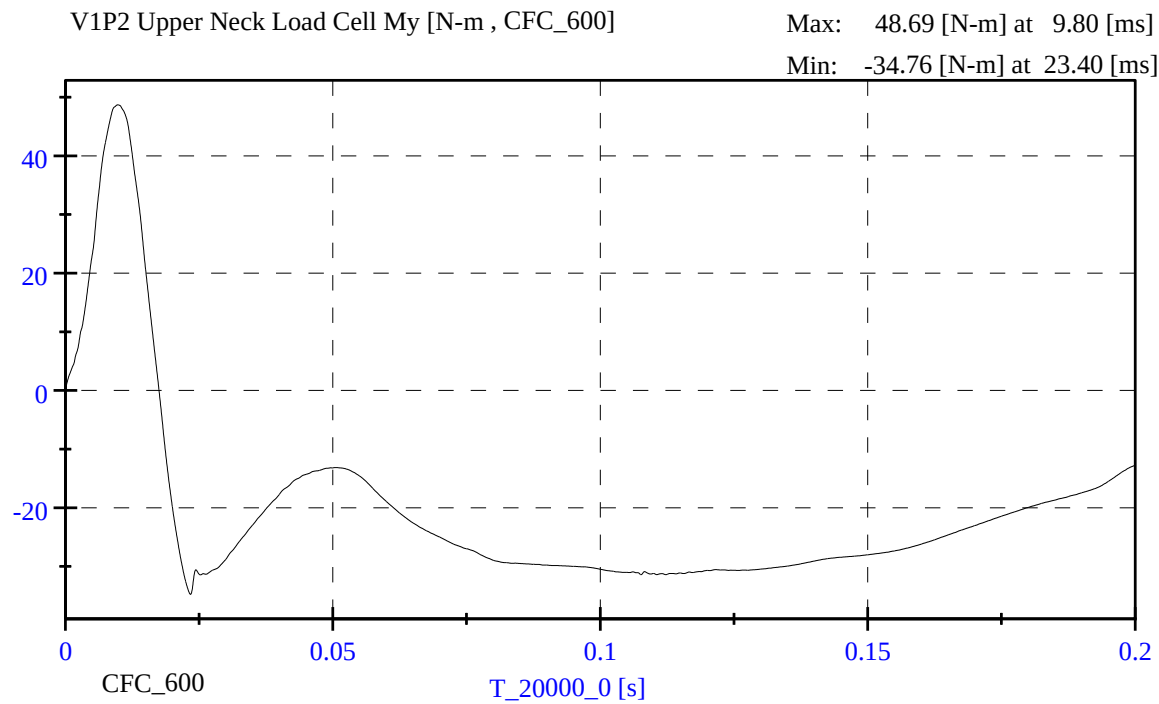


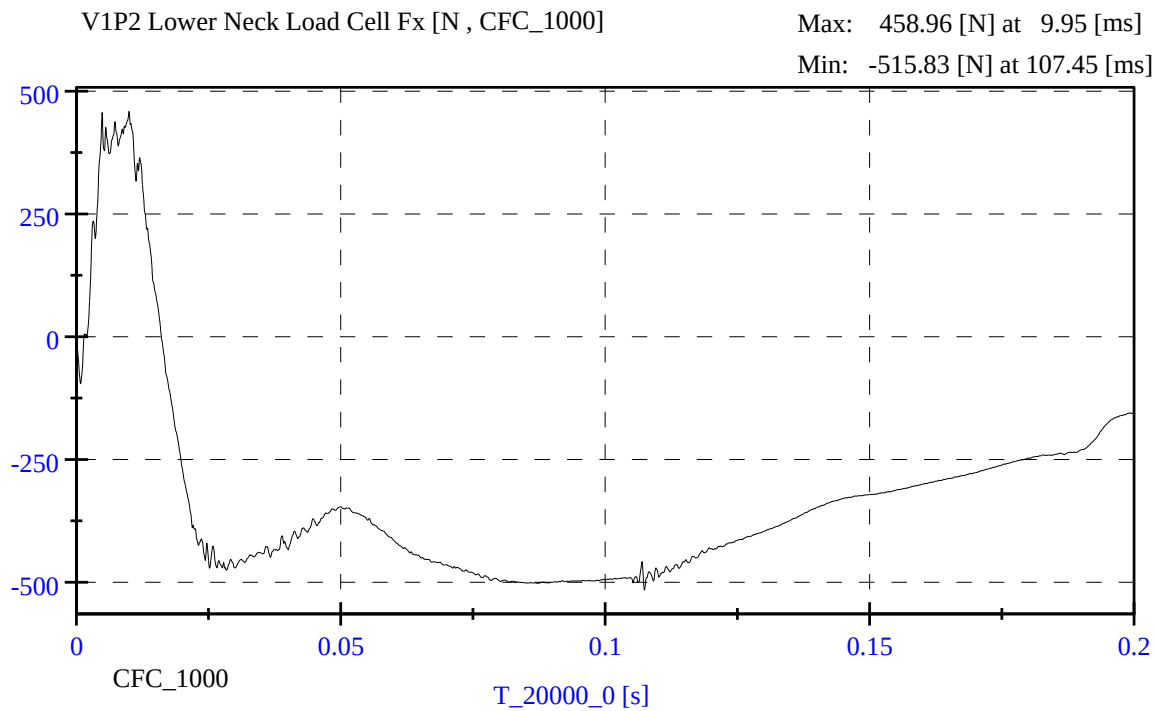
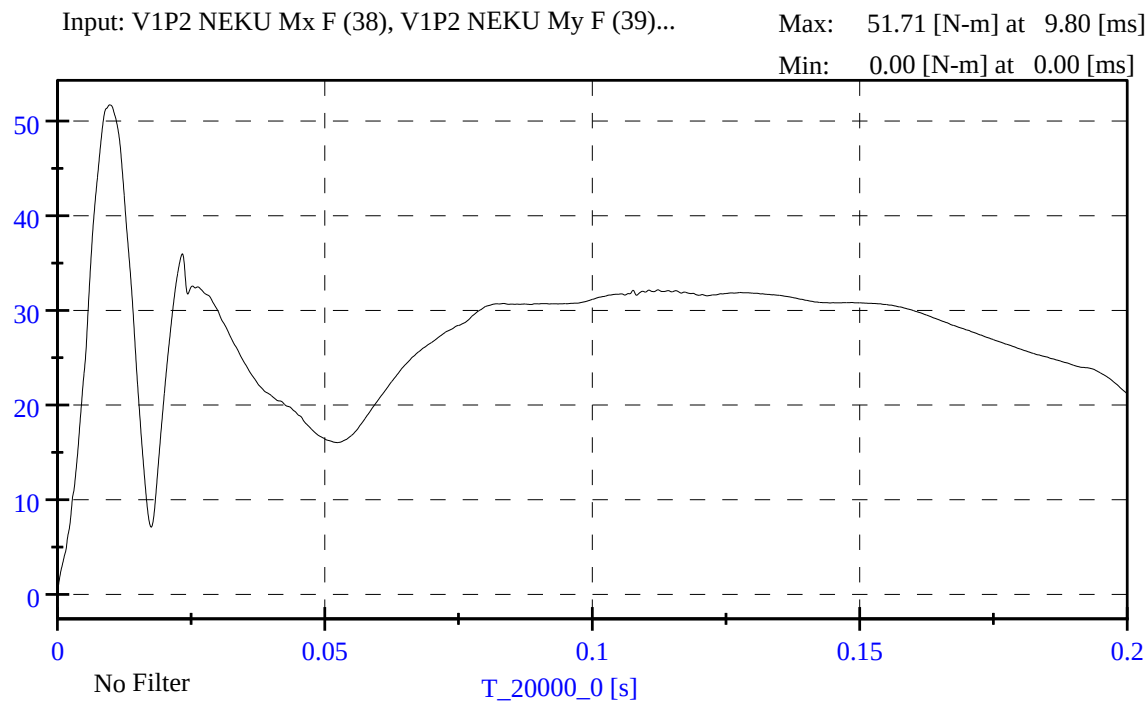


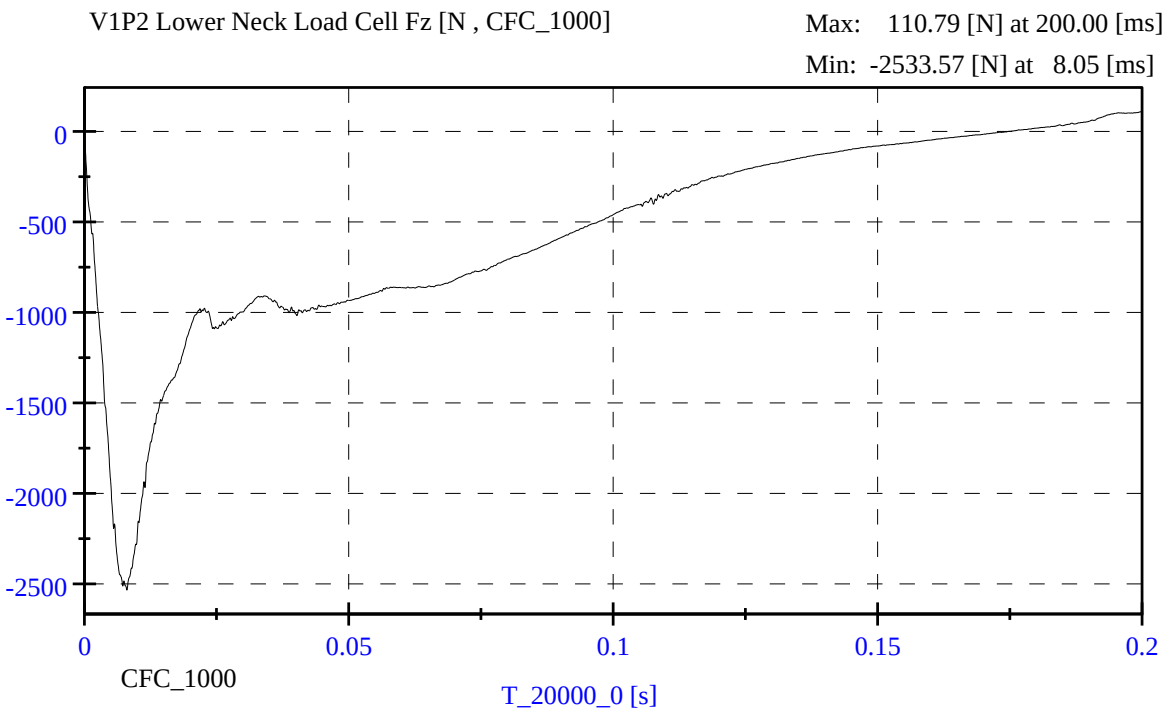
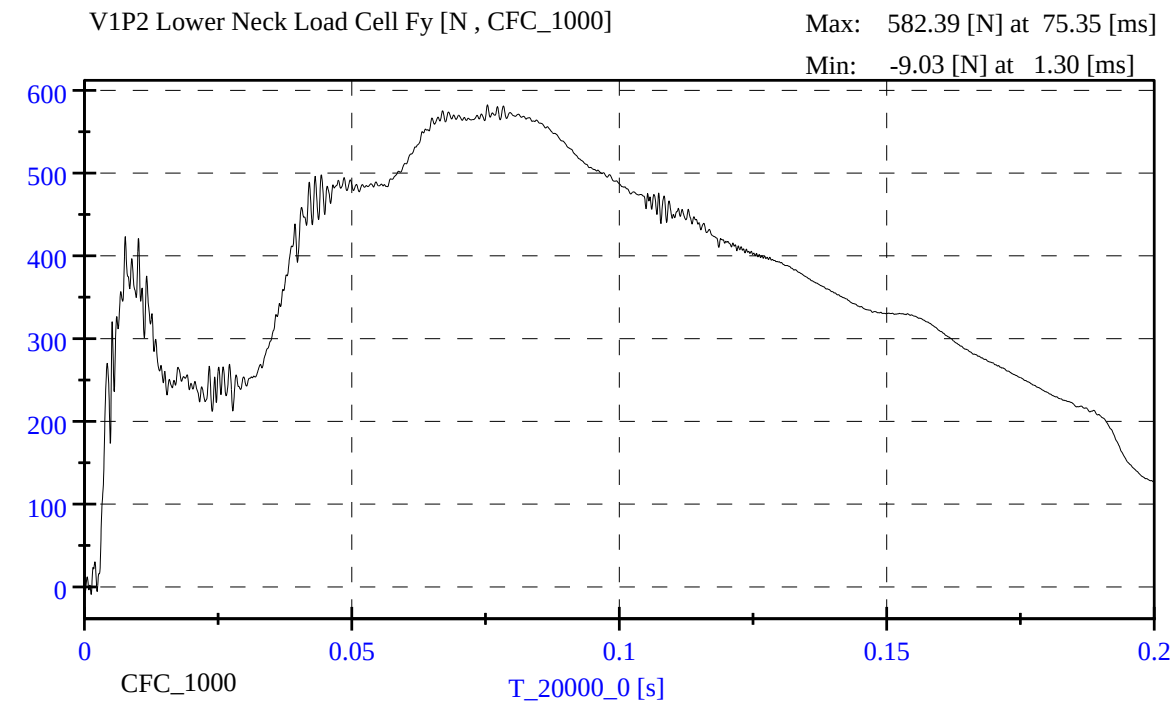


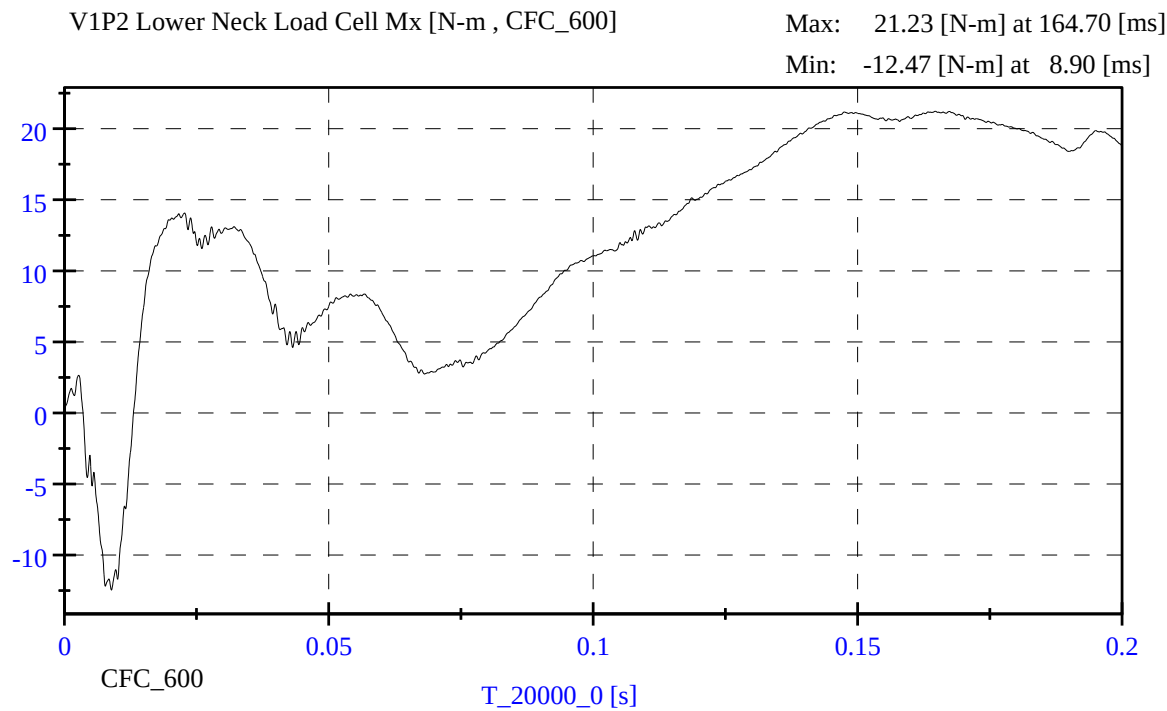
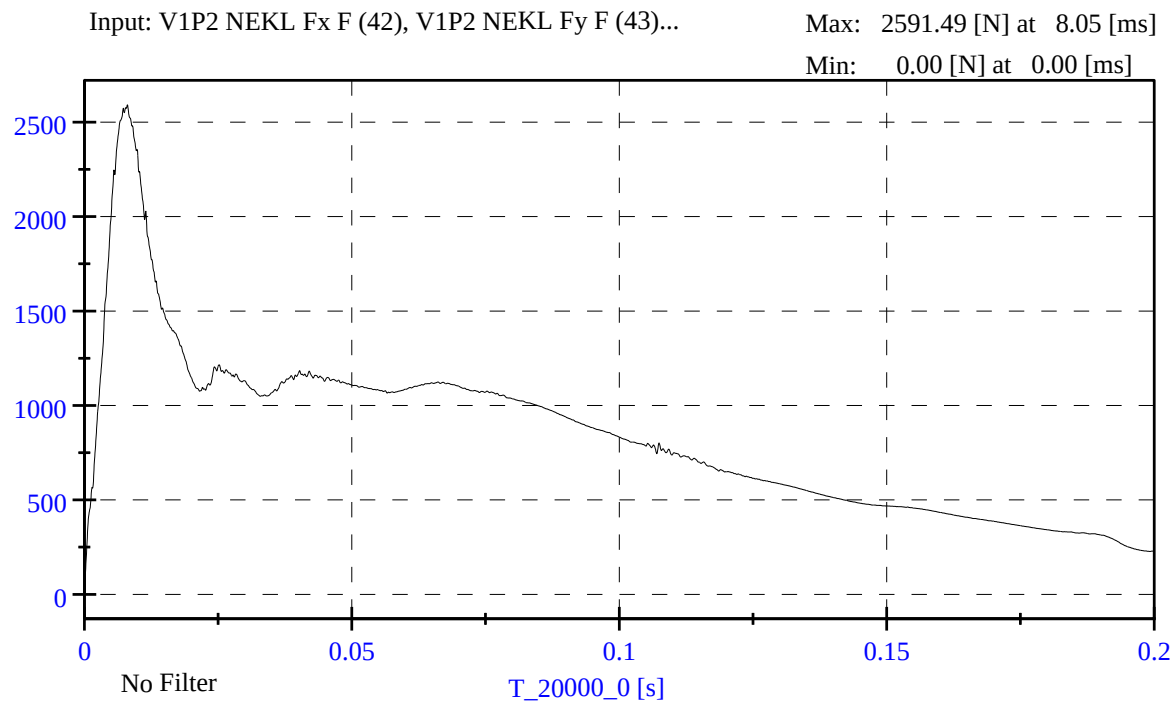


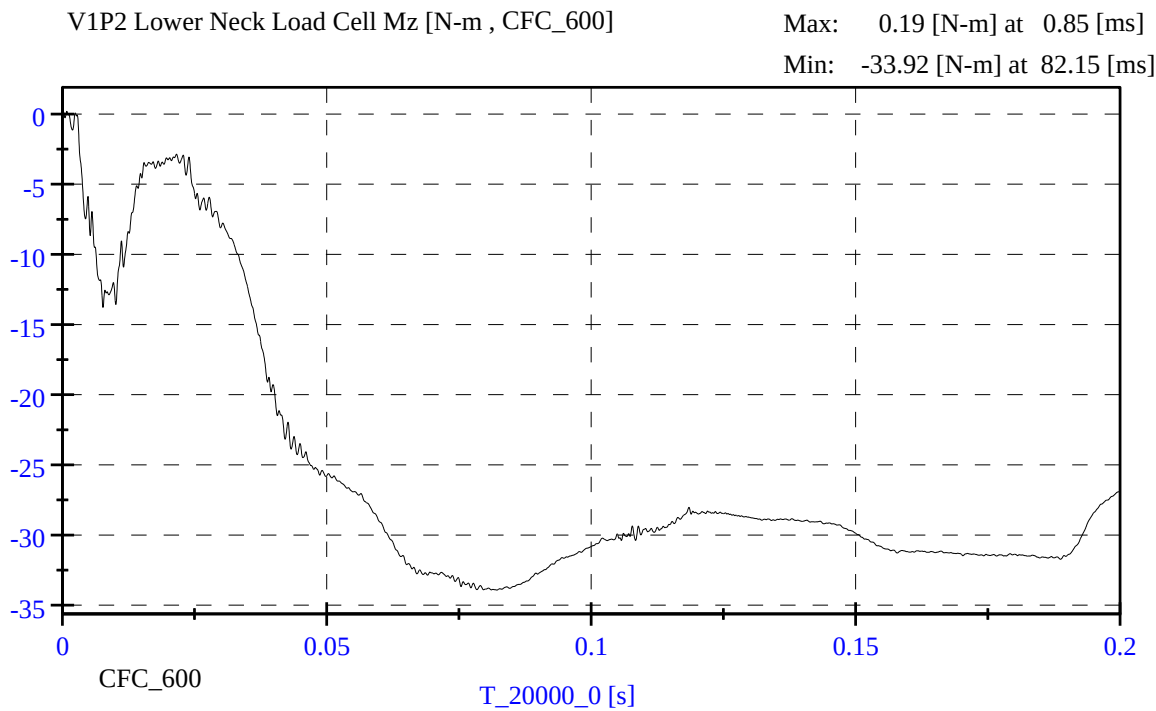
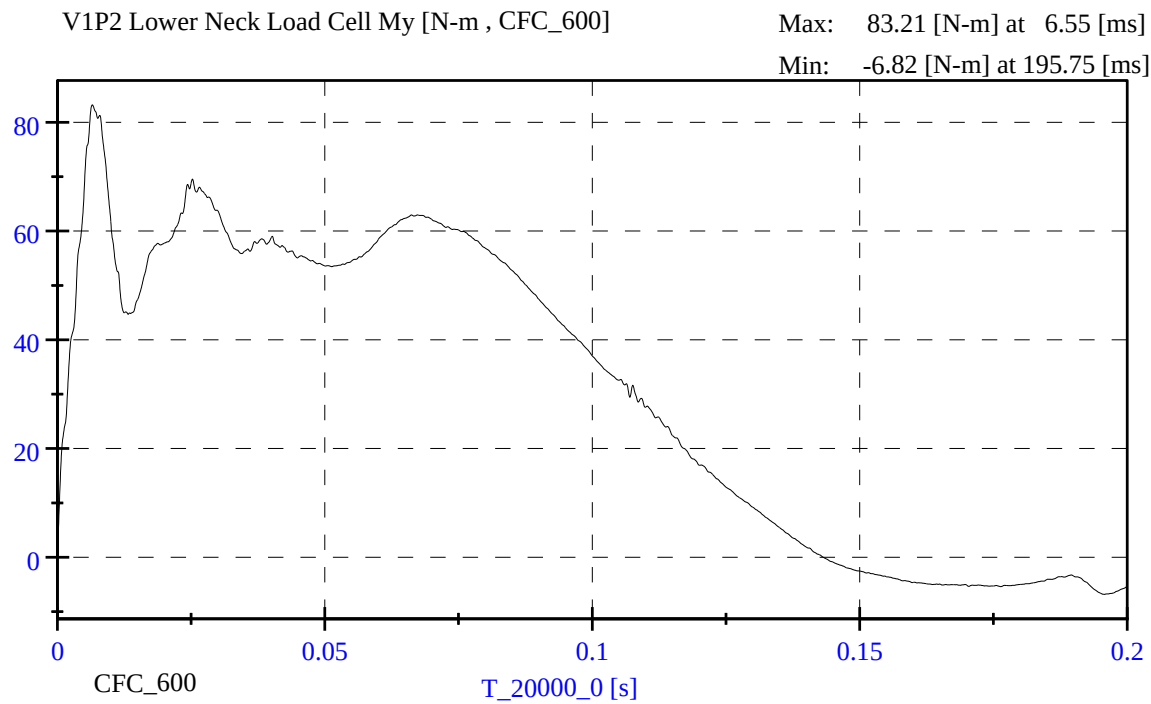


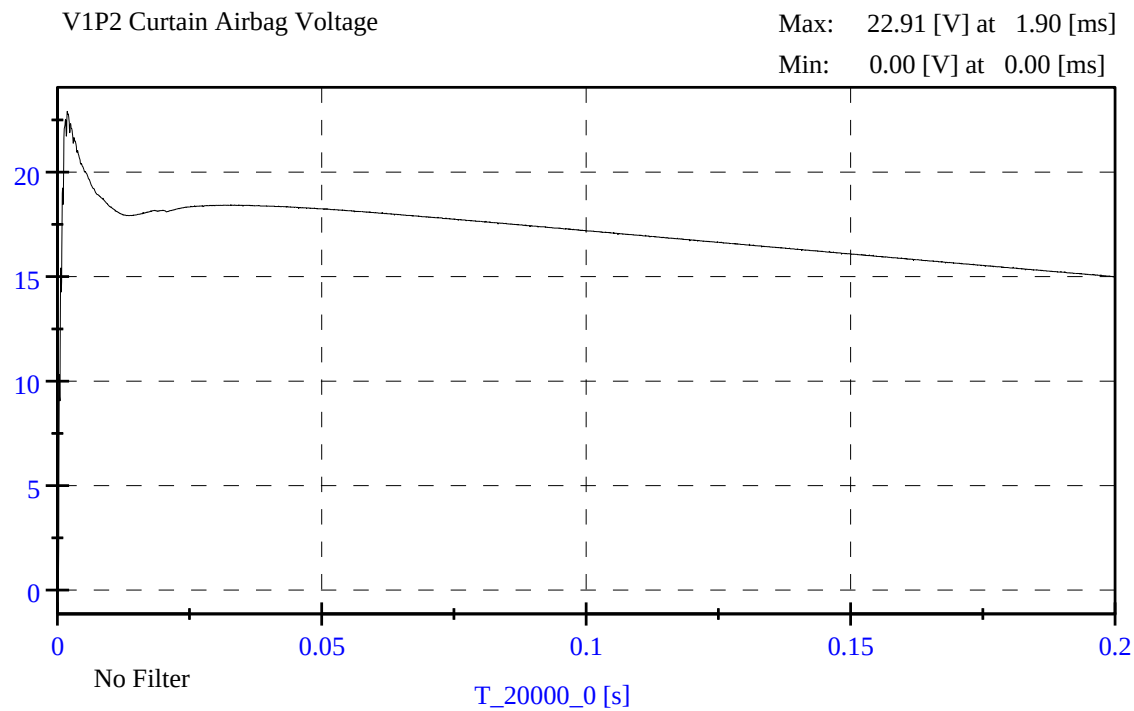
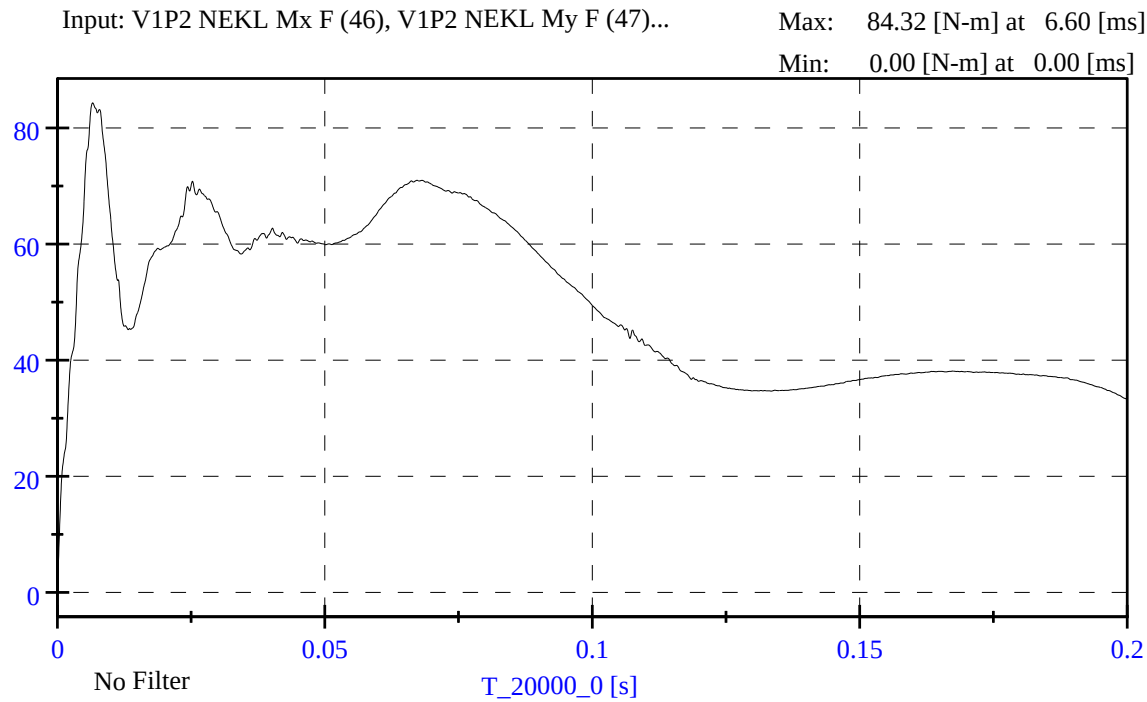


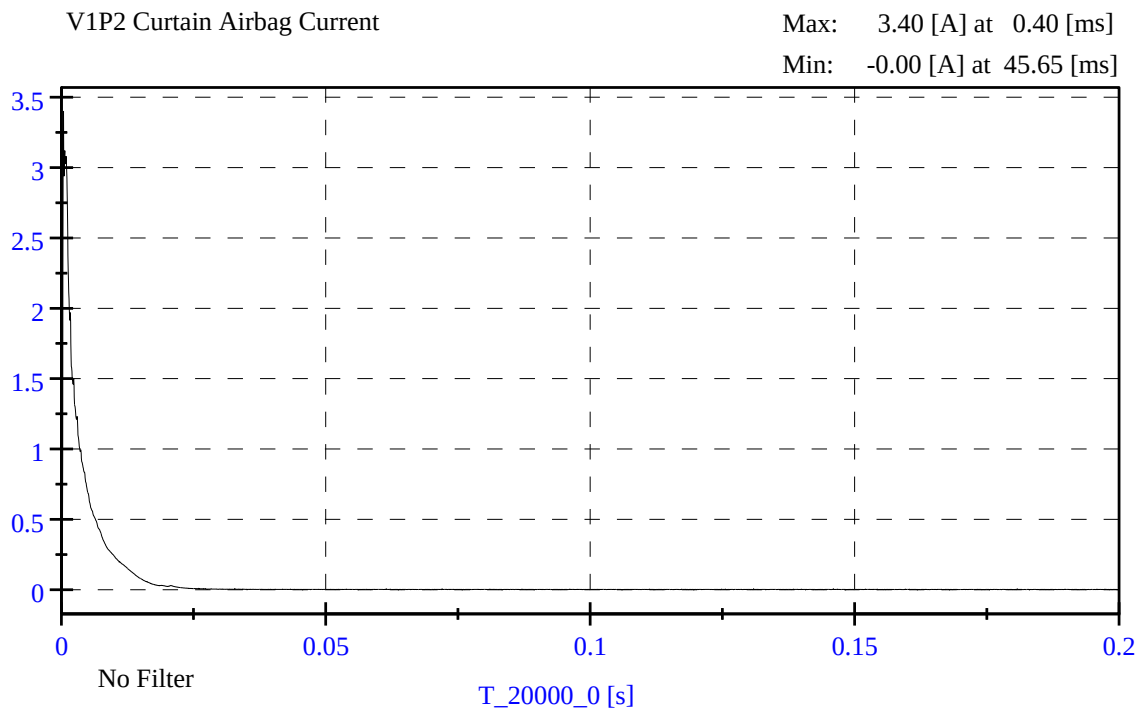
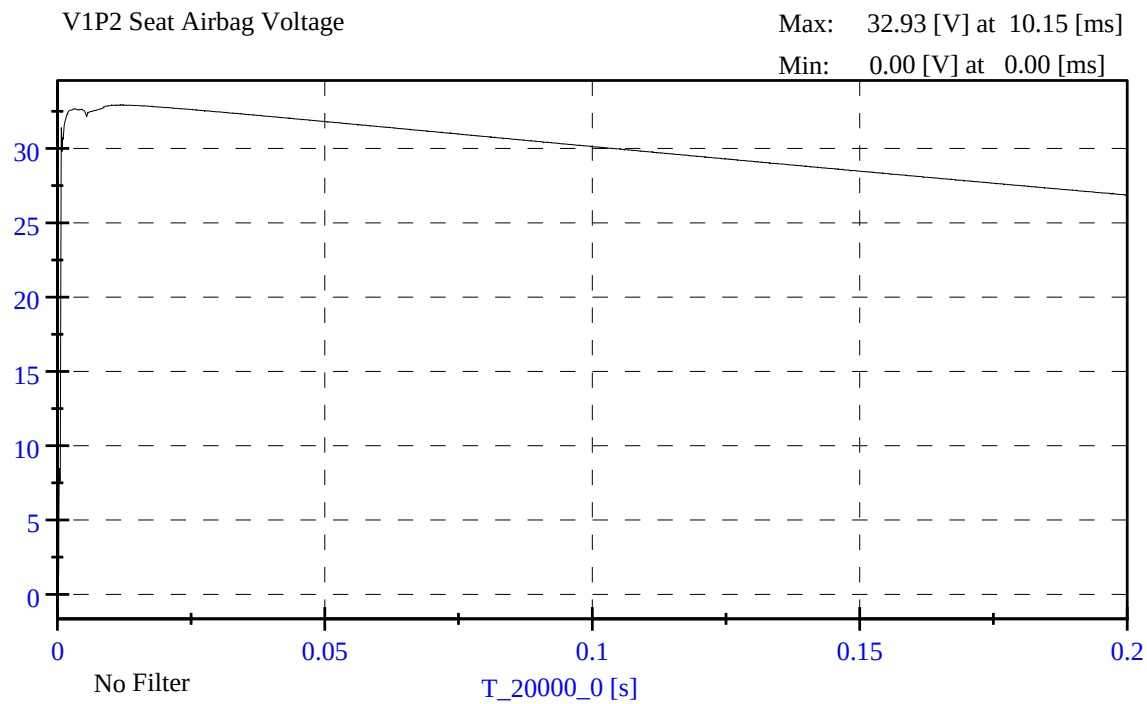


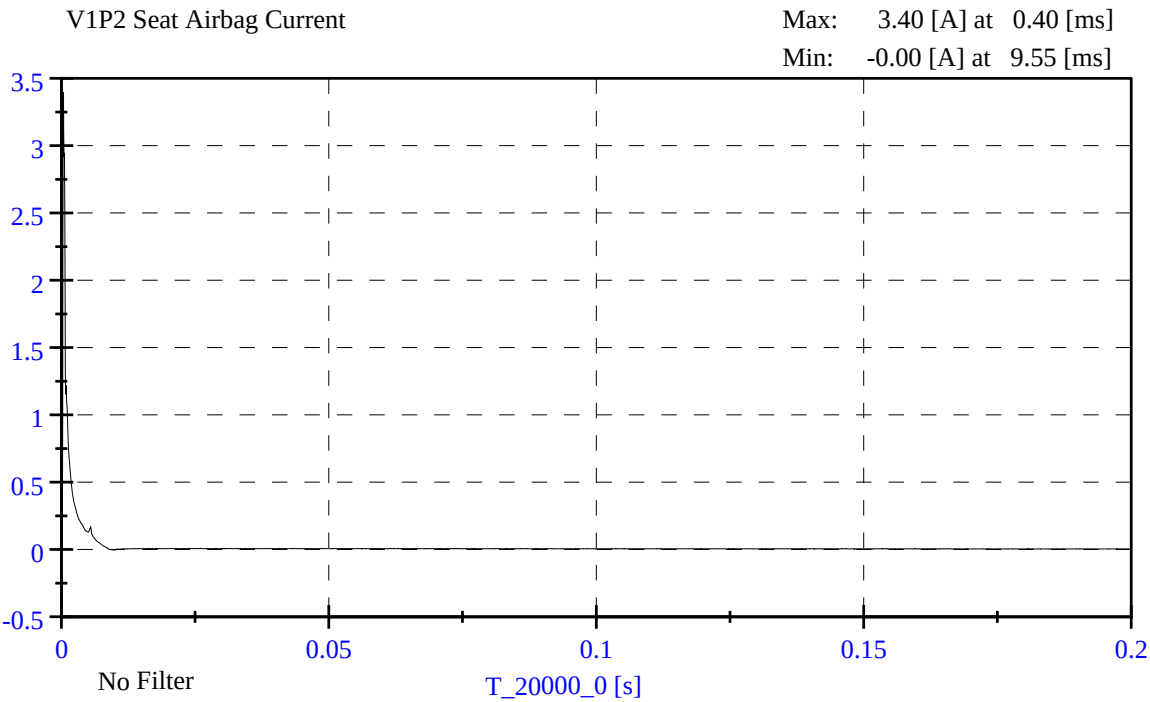












APPENDIX C

TEST EQUIPMENT LIST AND CALIBRATION INFORMATION

TEST EQUIPMENT LIST AND CALIBRATION INFORMATION

P572C INSTRUMENTATION

	POSITION #2 (RIGHT) SERIAL NO.: MD5120TWG2		
	SERIAL NUMBER	MANUFACTURER	CALIBRATION DATE
HEAD AX	AC-P59021	ENDEVCO	01/25/2013
HEAD AY	AC-P52088	ENDEVCO	01/25/2013
HEAD AZ	AC-P58794	ENDEVCO	01/25/2013
HEAD Redundant AX	AC-P52095	ENDEVCO	01/25/2013
HEAD Redundant AY	AC-P58908	ENDEVCO	01/25/2013
HEAD Redundant AZ	AC-P58986	ENDEVCO	01/25/2013
UPPER NECK FX	LC-2192	DENTON	5/21/2012
UPPER NECK FY	LC-2192	DENTON	5/21/2012
UPPER NECK FZ	LC-2192	DENTON	5/21/2012
UPPER NECK MX	LC-2192	DENTON	5/21/2012
UPPER NECK MY	LC-2192	DENTON	5/21/2012
UPPER NECK MZ	LC-2192	DENTON	5/21/2012
LOWER NECK FX	LC-DJ2031	DENTON	3/14/2013
LOWER NECK FY	LC-DJ2031	DENTON	3/14/2013
LOWER NECK FZ	LC-DJ2031	DENTON	3/14/2013
LOWER NECK MX	LC-DJ2031	DENTON	3/14/2013
LOWER NECK MY	LC-DJ2031	DENTON	3/14/2013
LOWER NECK MZ	LC-DJ2031	DENTON	3/14/2013
Curtain Bag Voltage	KT Minidau timer	N/A	N/A
Curtain Bag Current	KT Minidau timer	N/A	N/A
Seat/Torso Bag Voltage	KT Minidau timer	N/A	N/A
Seat/Torso Bag Current	KT Minidau timer	N/A	N/A