

REPORT NUMBER: TWG-CAL-05-03

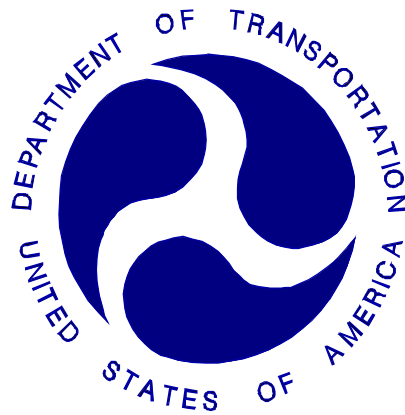
NEW CAR ASSESSMENT PROGRAM (NCAP)
SIDE AIRBAG OUT-OF-POSITION INJURY TESTING

2005 SUBARU OUTBACK
MULTIPURPOSE VEHICLE

NHTSA NUMBER: M55501TWG2

CALSPAN CORPORATION TEST NUMBER: 8642-TWG-11

CALSPAN CORPORATION
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May 12, 2005

FINAL REPORT

U. S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Rulemaking
Office of Crashworthiness Standards
Mail Code: NVS-111
400 Seventh Street, SW, Room No. 5313
Washington, DC 20590

This Final Test Report was prepared for the U.S. Department of Transportation, National Highway Traffic Safety Administration, under Contract No. DTNH22-01-D-32005. 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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Accepted By:

Acceptance Date:

TECHNICAL REPORT STANDARD TITLE PAGE							
1. Report No. TWG-CAL-05-03		2. Government Accession No.		3. Recipient's Catalog No.			
4. Title and Subtitle Final Report NHTSA No.: M55501TWG2				5. Report Date May 12, 2005			
				6. Performing Organization Code CAL			
7. Author(s) Patrick G. MacDiarmid, Jr., Project Engineer David J. Travale, Program Manager				8. Performing Organization Report No. 8642-TWG-11			
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. DTNH22-01-D-32005			
12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Administration Office of Crashworthiness Standards Mail Code: NVS-111 400 Seventh SW, Room 5313 Washington, D.C. 20590				13. Type of Report and Period Covered Final Report, May 12, 2005			
				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 Corporation Crash Test Facility in Buffalo, New York, on May 12, 2005.							
Injury Summary							
HIC15	HIC36	Clip (g's)	Chest Displacement (mm)	NIJ NTF	NIJ NTE	NIJ NCF	NIJ NCE
6.2	11.3	19.4	-0.9	0.11	0.52	0.24	0.43
17. Key Words New Car Assessment Program (NCAP) Side Airbag Out-of-Position				18. Distribution Statement Copies of this report are available from: National Highway Traffic Safety Administration Technical Reference Division Room 5111 (NAD-52) 400 Seventh St., S.W. Washington, D.C. 20590 Telephone No. (202) 366-4946 ATTN: Robert Hornicle			
19. Security Classification of Report UNCLASSIFIED		20. Security Classification of Page UNCLASSIFIED		21. No. of Pages 31		22. Price	

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SECTION 1

PURPOSE AND SUMMARY OF TEST M55501TWG2

1.1 PURPOSE

The purpose of this test was to obtain data in a static out-of-position side impact. These data constitute part of the general consumer information collected by the New Car Assessment Program (NCAP) sponsored by the National Highway Traffic Safety Administration (NHTSA) under contract No. DTNH22-01-D-32005.

1.2 SUMMARY

The effects of both a seat-mounted side airbag and a curtain airbag deployment in a 2005 Subaru Outback with an out-of-position six-year-old child were evaluated. The test was performed by Calspan Corporation on May 12, 2005. Pre-and post-test photographs of the vehicle and dummy can be found in Appendix A.

One high-speed digital camera was used to document the side airbag deployment event. The camera was placed in perpendicular the right-front seat centerline as to capture the deployment event. The recorded image rate is 1000 frames per second.

One part 572, Hybrid III six-year-old child anthropomorphic test device (ATD), was placed in the right front seat situated in the inboard facing position according to dummy 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 child dummy was instrumented with head, chest, and pelvic triaxial accelerometers. In addition upper and lower six axial neck force and moment load cell sensors were utilized.

Twenty-three channels of data were recorded using an on-board data acquisition system. Appendix A contains photographs. Appendix B contains dummy response data traces. Appendix C contains the Instrumentation Data Channel assignments.

The Hybrid III six-year-old child dummy's visible contact points were as follows: The seat airbag to the left scapula and left side of the posterior thorax and pelvis and the curtain airbag to the top and the back of the head.

The six-year old child dummy was placed with its arms hanging at its sides on the foam block facing inboard with its legs extended. The seat track was adjusted to 95 mm rearward of full forward to minimize the vertical distance between the dummy's head and the roof-rail module and to maximize the cushion to head interaction. While keeping the head in neutral orientation, the dummy's pelvis was moved outboard until the dummy's back contacted the door trim panel armrest and 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 dummy's shoulder bolts parallel to the vehicle centerline. The dummy's arms were then bent at the elbow until the fingers contacted the booster seat. This orientation complies with section 3.3.5.1 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:

	TEST DATA	DESCRIPTION
Seating Position:	P2	Right Front Seating Position
Test:	3.3.5.1*	Inboard facing Hybrid-III six-year-old child dummy on booster block
Airbag:	Seat; Side Rail	Bolster mounted thorax side airbag and side curtain airbag.
Booster Block	300mm x 450 mm x 75 mm	Block consisted of HD36 foam with a density of 44.8 g/L
ATD Type/Serial No.:	P572N/186	Hybrid III six-year-old child dummy

*- Procedure as defined by Lund, et al and the Technical Working Group dated July, 2003

<u>Number of Data Channels</u>	23	
<u>Number of Cameras:</u>	0	<u>Real Time</u>
	1	<u>High Speed Digital</u>
	0	<u>High Speed Film</u>

VISIBLE DUMMY CONTACT POINTS

Head Contact:	The back (occipital) and the top (parietal) of the head by the side curtain.
Upper Torso Contact:	Side airbag to the left scapula and left side of the posterior thorax
Lower Torso Contact:	Side airbag to the left side of the pelvis
Left Knee Contact:	None
Right Knee Contact:	None

DATA SHEET 2

VEHICLE PARAMETER DATA

TEST VEHICLE INFORMATION:

Year/Make/Model/Body Style: 2005 Subaru Outback MPV

Vehicle Body Color: Black VIN: 4S4BP61C857302047‡

Vehicle NHTSA No.: M55501 Month & Year of Manufacture: 03/04

Engine Data: 4 Cylinders; - CID; 2.5 Liters; - cc

Engine Placement: X Longitudinal; or - Lateral

Transmission: 4 Speed; - Manual; X Automatic; X Overdrive

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

Odometer Reading 48 km

Supplemental Airbag Restraints:

Front Occupant: X Frontal; - Knee; X Side; X Curtain

Rear Occupant: - Frontal; - Knee; - Side; X Curtain

Options:

- ADL; X A/C; X Power Steering; X Power Brakes; X Power Windows

DATA FROM TIRE PLACARD

Recommended Tire Size: P225/60R16

*Recommended Cold Tire Pressure: 220 kPa FRONT; 210 kPa REAR

DATA FROM TIRE SIDEWALL:

Size of Tires on Test Vehicle: P225/60R16 97H ; Manufacturer: Bridgestone Potenza

Tire Pressure with Maximum Capacity Vehicle Load: Front: 300 kPa; Rear: 300 kPa

Treadwear: 360 ; Traction: A ; Temperature: A

VEHICLE CAPACITY DATA:

Number of Occupants: 2 Front; 3 Rear; - 3rd Seat; 5 Total

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

Type of Front Seat Back: - Fixed; X Adjustable with X Lever or - Knob

Vehicle Max Capacity Loading = 408 kg (A)

No. of Occupants x 68.04 kg. = 340.2 kg (B)

Vehicle Cargo Capacity = 67.8 kg (A-B)

TEST VEHICLE DELIVERED WEIGHT WITH MAXIMUM FLUIDS:

Left Front = 422.0 kg Left Rear = 375.0 kg

Right Front = 430.0 kg Right Rear = 340.0 kg

TOTAL FRONT = 852.0 kg TOTAL REAR = 715.0 kg

% of Total Weight = 54.4 % % of Total Weight = 45.6 %

TOTAL WEIGHT = 1567.0 kg

* Tire pressure used in test.

‡ This vehicle had previously been tested in an NCAP side impact on August 4, 2004.

DATA SHEET NO. 3

CHILD DUMMY POSITIONING IN VEHICLE

NHTSA No. M55501TWG2

Measurement		Value
Total Fore/Aft Travel (mm)		216
Test Distance Rearward of Full-Forward (mm)		95
Total Fore/Aft Travel (Detents)		-
Placed in Position #		-
Seat Back Angle	SA (°)	13
Airbag Module Width	AMW (mm)	100
Airbag Width	ABW (mm)	280
Airbag Module Length	AML (mm)	200
Airbag Length	ABL (mm)	300
Top of Airbag Module to Head/Neck Junction	AN (mm)	103
Head CG to Door Panel/Window	HD (mm)	106
Head to Seat Back Centerline	HSC (mm)	192
Head to B-Pillar (side of the head)	HB (mm)	282
Head to Roof, Z (top of the head)	HZ (mm)	121
Head to Header	HHH (mm)	334
Chest to Dash	CD (mm)	503
Chest to Seatback	CS (mm)	168
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)	0
Left Arm to Door Panel	LA (mm)	0
Knee to Knee	KK (mm)	120
Toe to Toe	TT (mm)	120
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)	300
Foam Block Width	(mm)	450
Foam Block Thickness	(mm)	75
HD36 foam density	(g/L)	44.8

DATA SHEET 4

CHILD DUMMY INJURY CRITERIA VALUES

NHTSA No. M55501TWG2

DESCRIPTION	Unit	MAXIMUM VALUE			
		Position #2			
		Maximum	Time (ms)	Minimum	Time (ms)
Head X	g	14.5	14.5	-4.6	15.5
Head Y	g	13.9	27.1	-12.7	17.1
Head Z	g	47.7	14.6	-6.2	11.5
Head Resultant	g	48.4	14.6	0.0	-9.8
Upper Neck Fx	N	141.2	44.2	-85.3	167.6
Upper Neck Fy	N	228.3	28.2	-29.5	140.5
Upper Neck Fz	N	513.2	27.1	-565.3	26.8
Upper Neck F Resultant	N	598.0	26.8	0.1	-43.7
Upper Neck Mx	N-m	17.7	21.1	-12.4	11.3
Upper Neck My	N-m	12.0	14.0	-18.2	34.1
Upper Neck Mz	N-m	4.6	25.1	-3.9	71.3
Upper Neck M Resultant	N-m	18.5	21.0	0.0	-46.1
Lower Neck Fx	N	260.8	12.5	-78.4	199.8
Lower Neck Fy	N	322.0	10.2	-95.1	21.4
Lower Neck Fz	N	257.0	115.2	-454.2	18.5
Lower Neck F Resultant	N	482.7	18.4	0.0	-25.9
Lower Neck Mx	N-m	28.1	30.3	-5.7	134.6
Lower Neck My	N-m	17.3	174.3	-19.3	36.7
Lower Neck Mz	N-m	16.5	12.0	-8.7	55.8
Lower Neck M Resultant	N-m	29.6	12.7	0.0	-0.1
Chest X	g	54.2	10.2	-15.4	12.3
Chest Y	g	19.9	7.7	-10.1	12.6
Chest Z	g	6.8	10.1	-3.3	34.4
Chest Resultant	g	54.7	10.2	0.0	-9.5
Chest Displacement	mm	2.0	199.9	-0.9	13.2
Pelvic X	g	8.0	27.1	-3.0	74.0
Pelvic Y	g	3.4	30.8	-2.5	85.9
Pelvic Z	g	5.6	20.7	-7.4	27.1
Pelvic Resultant	g	10.7	27.1	0.0	-28.8

DATA SHEET 4

CHILD DUMMY INJURY CRITERIA VALUES (CONTINUED)

NHTSA No. M55501TWG2

	HEAD INJURY CRITERIA (HIC)							
	HIC15				HIC36			
	HIC	t ₁ (msec)	t ₂ (msec)	Average Acceleration t ₁ to t ₂	HIC	t ₁ (msec)	t ₂ (msec)	Average Acceleration t ₁ to t ₂
Position #2 – Right Front	6.2	28.9	43.9	11.1 g	11.3	10.7	46.7	10.0 g

	CLIP SUMMARY*			
	CLIP (g's)	t ₁ (msec)	t ₂ (msec)	CSI
Position #2 – Right Front	19.4	8.5	11.5	45.9

* The maximum chest resultant acceleration is defined as the maximum acceleration which exceeds 0.003 seconds in duration.

Position 2 Neck Injury Summary (HIII 6 year old – Out of Position)

Nij V10	Nij	Time (ms)	Z Force (N)	X Force (N)	Y Moment (N-m)
Ntf	0.11	160.8	76.4	-80.5	7.4
Nte	0.52	34.8	137.0	-40.3	-17.4
Ncf	0.24	16.9	-428.6	68.7	8.0
Nce	0.43	32.2	-1.1	-40.4	-15.9

Peak Tension (CFC1000) 513.2 N

Peak Compression (CFC1000) -565.3 N

Critical Values

Nij Intercepts				Peak Limits	
Tension (CVt)	2880 N	Extension (mCVe)	37 N-m	Tension	1890 N
Compression (CVc)	2880 N	Flexion (mCVf)	93 N-m	Compression	-1820 N

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APPENDIX A

PHOTOGRAPHS

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Figure A-1: Pre-Test Vehicle Left Side View



Figure A-2: Post-Test Vehicle Left Side View



Figure A-3: Vehicle Certification Placard



Figure A-4: Vehicle Tire Placard



Figure A-5: Pre-Test Dummy Frontal View



Figure A-6: Post-Test Dummy Frontal View



Figure A-7: Pre-Test Dummy Rear View



Figure A-8: Post-Test Dummy Rear View



Figure A-9: Pre-Test Right Side of Dummy View



Figure A-9: Post-Test Right Side of Dummy View

APPENDIX B

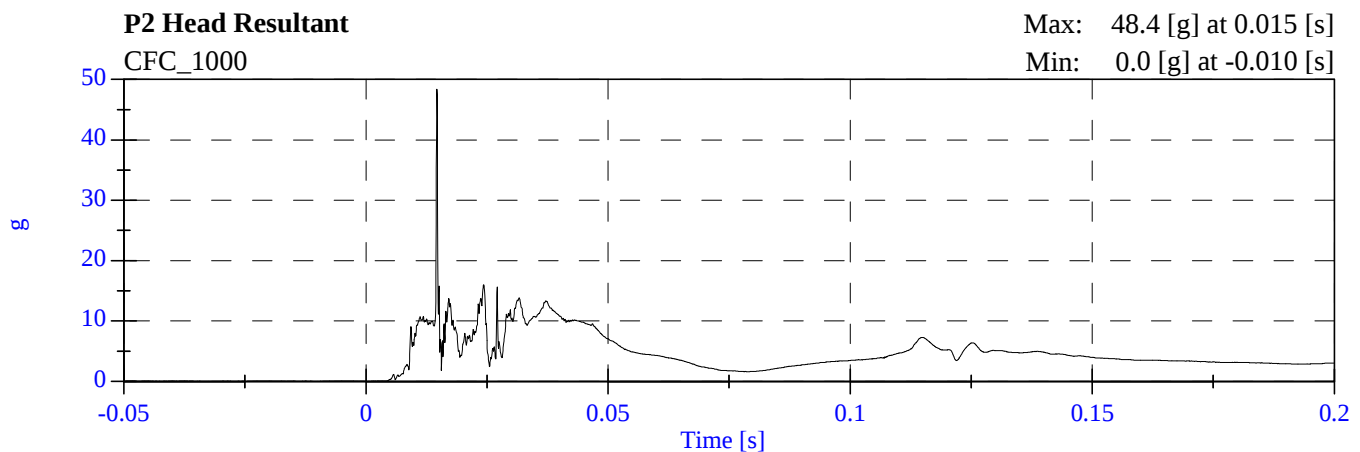
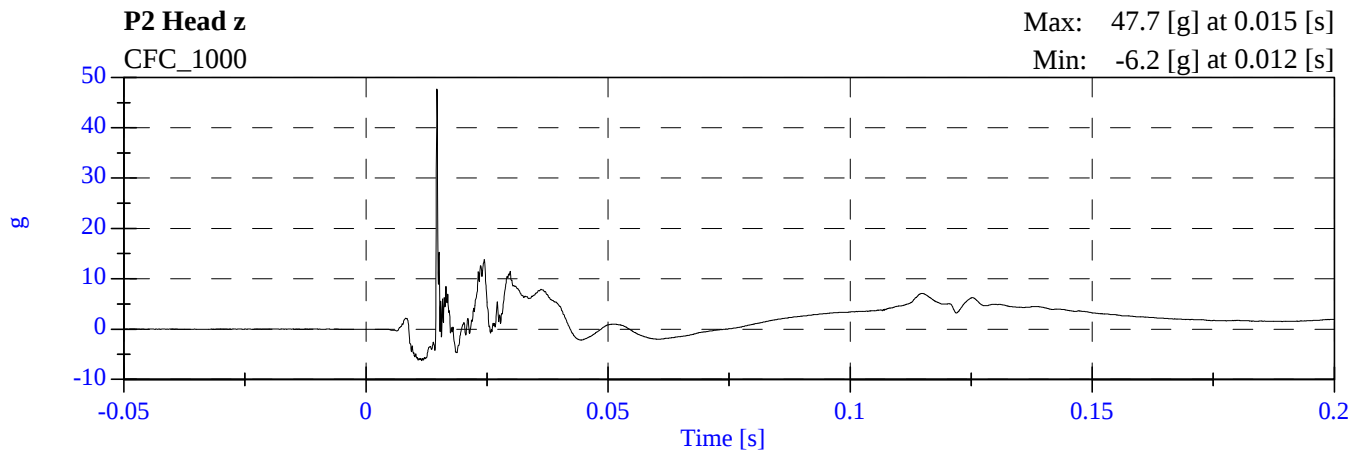
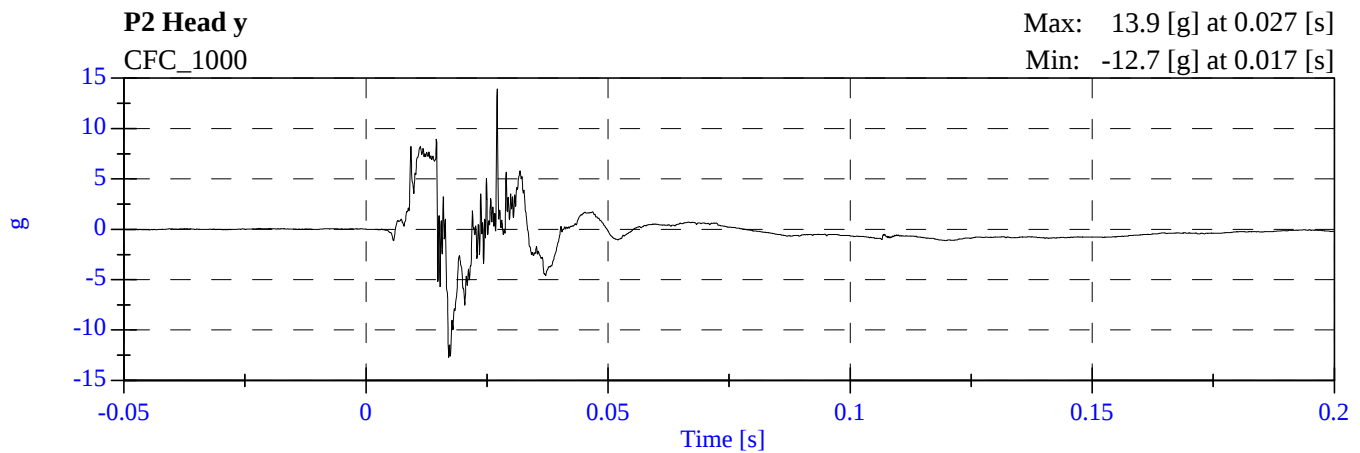
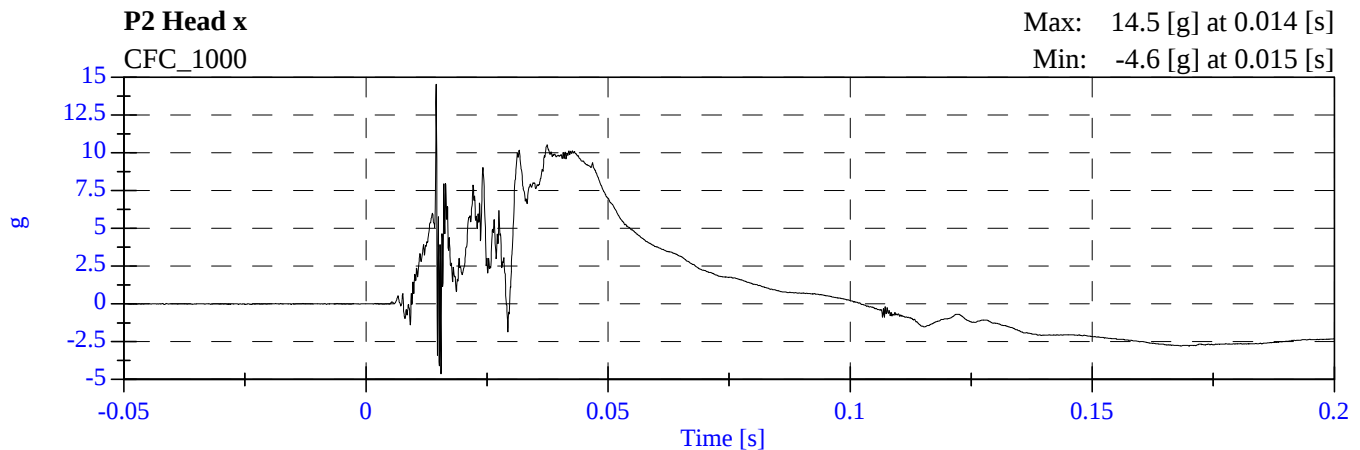
CHILD DUMMY RESPONSE DATA TRACES

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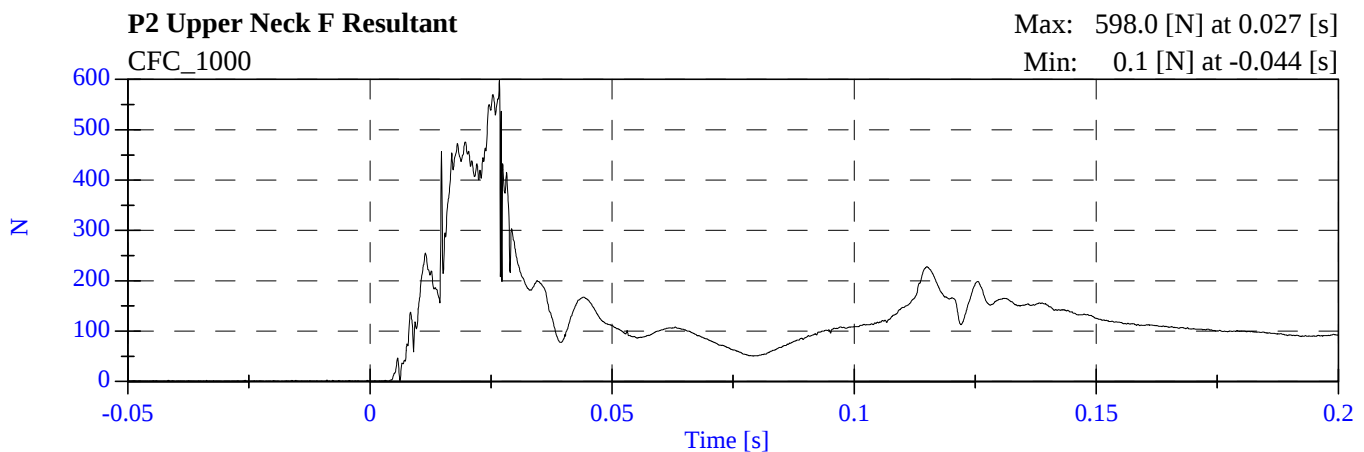
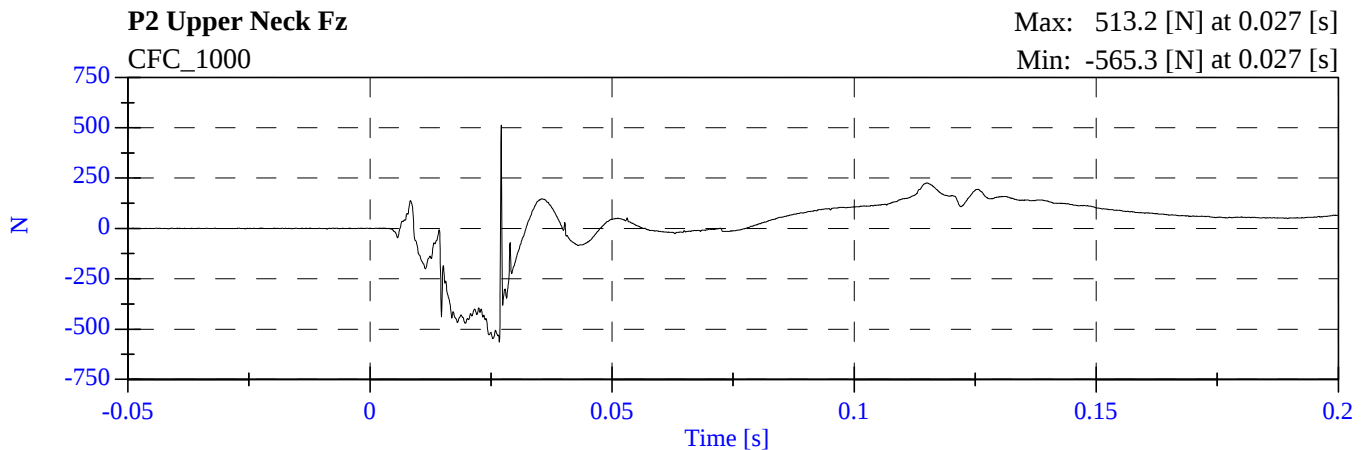
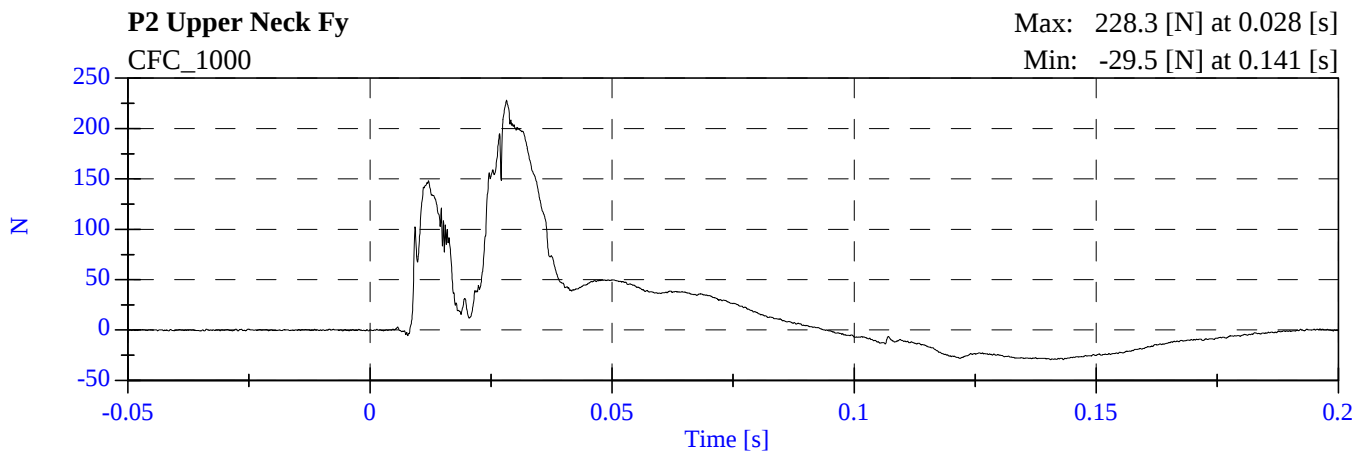
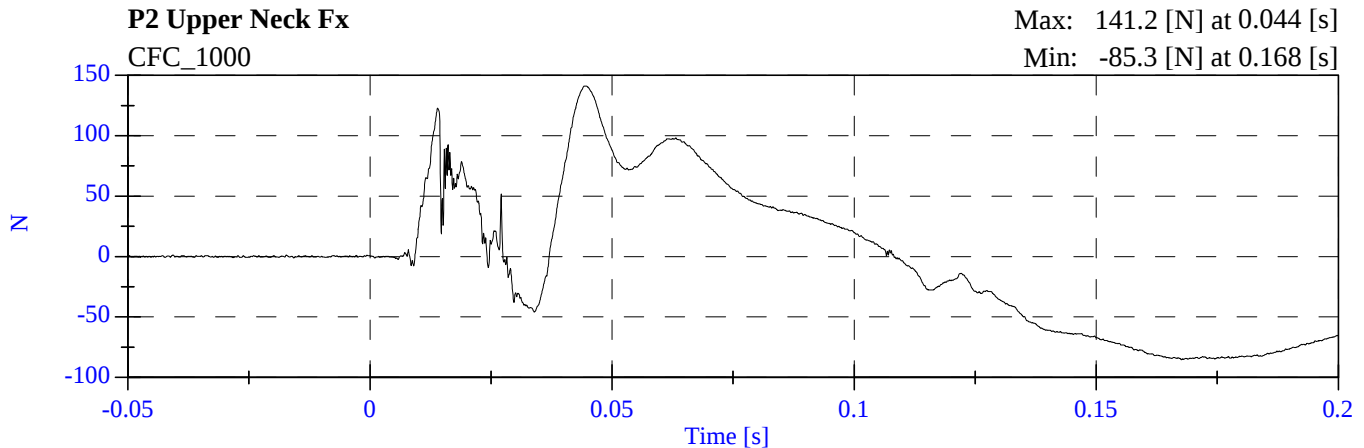
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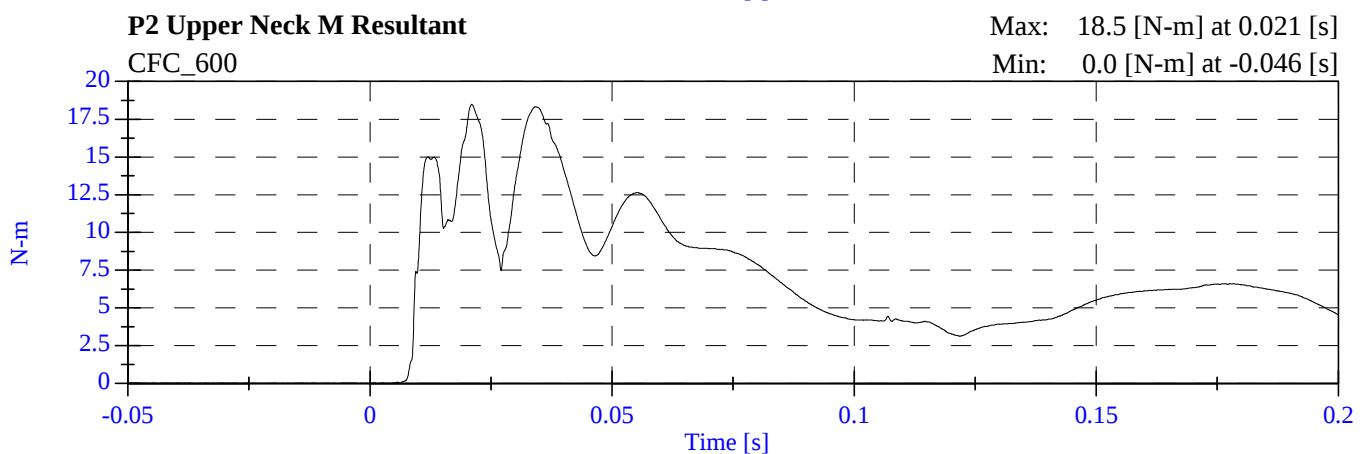
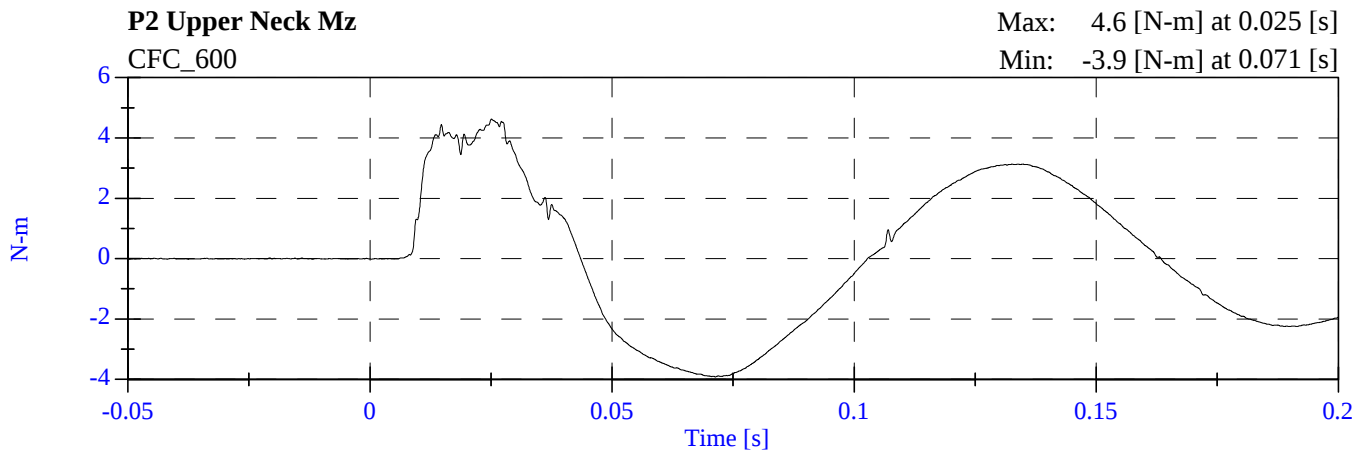
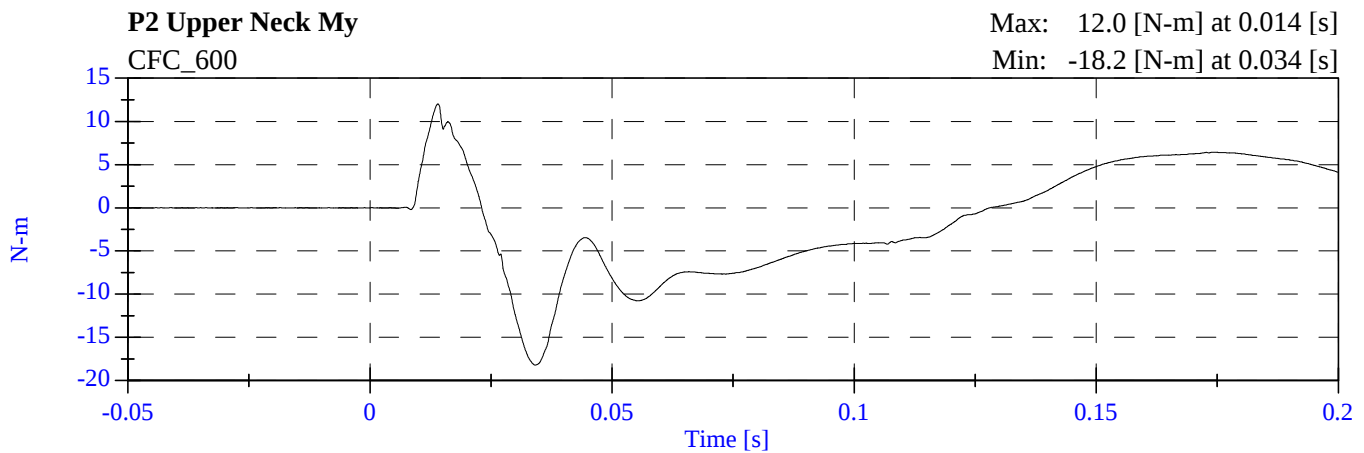
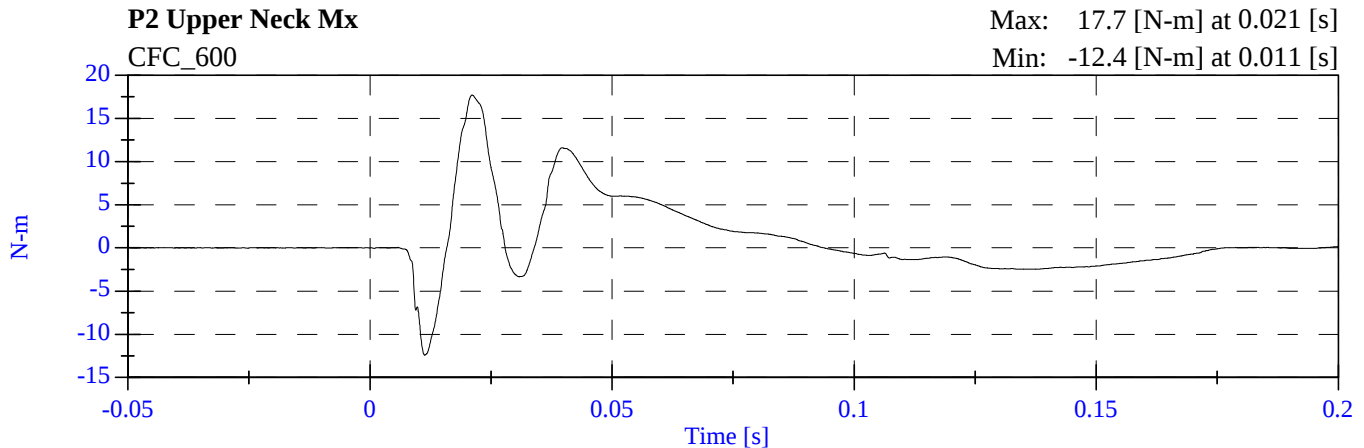
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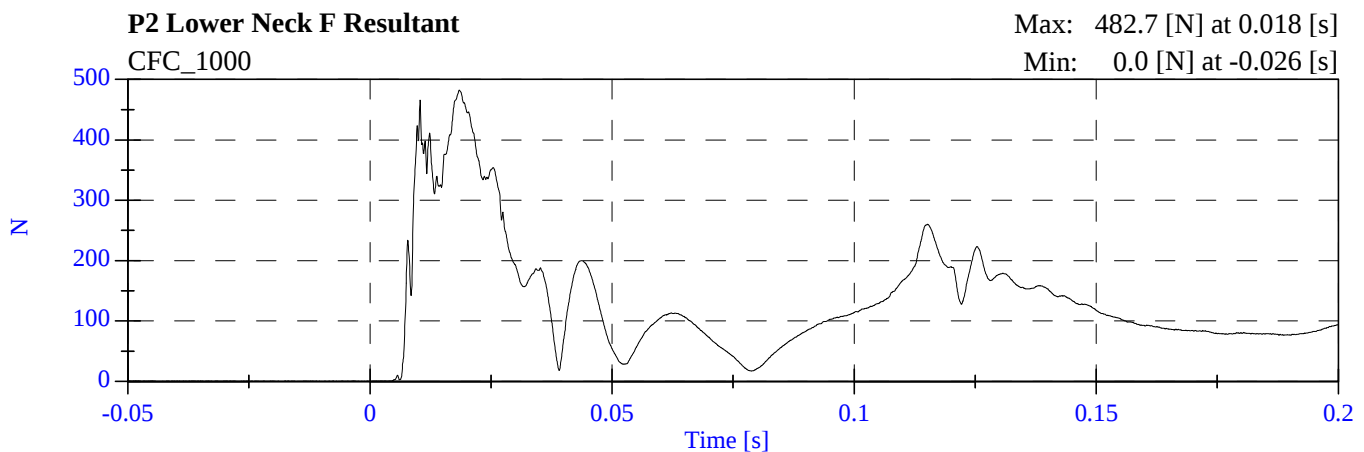
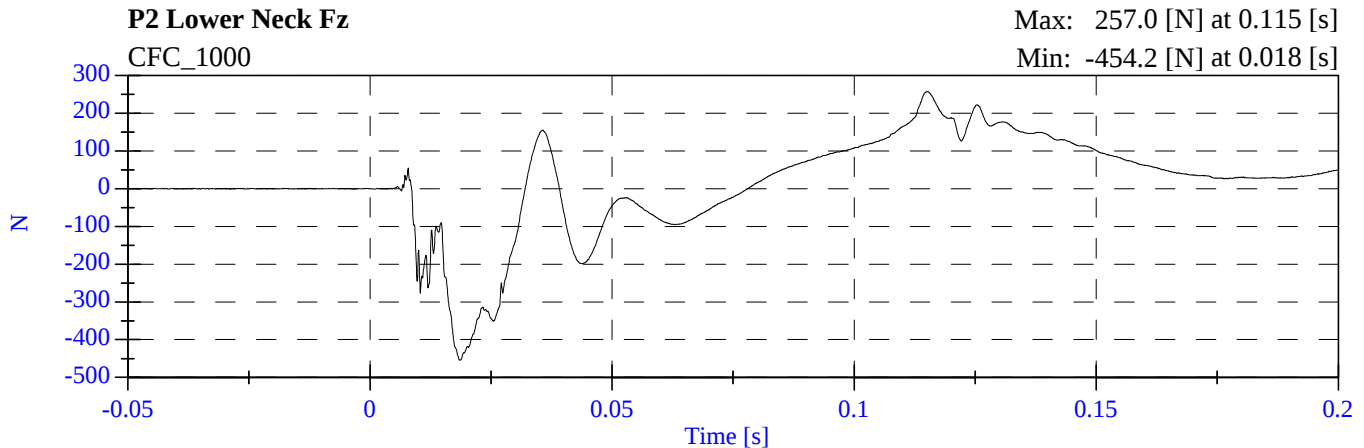
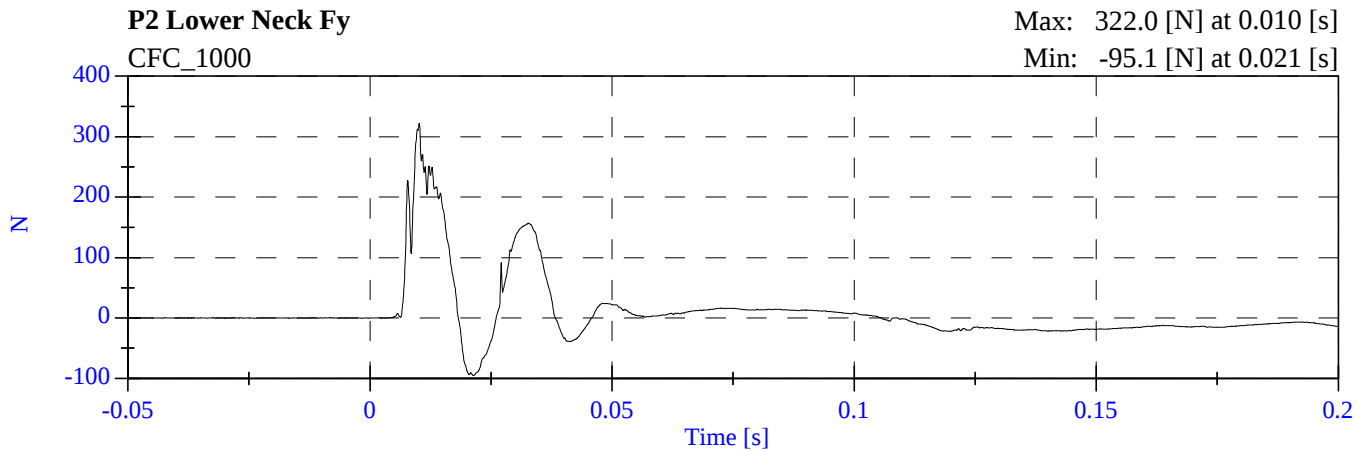
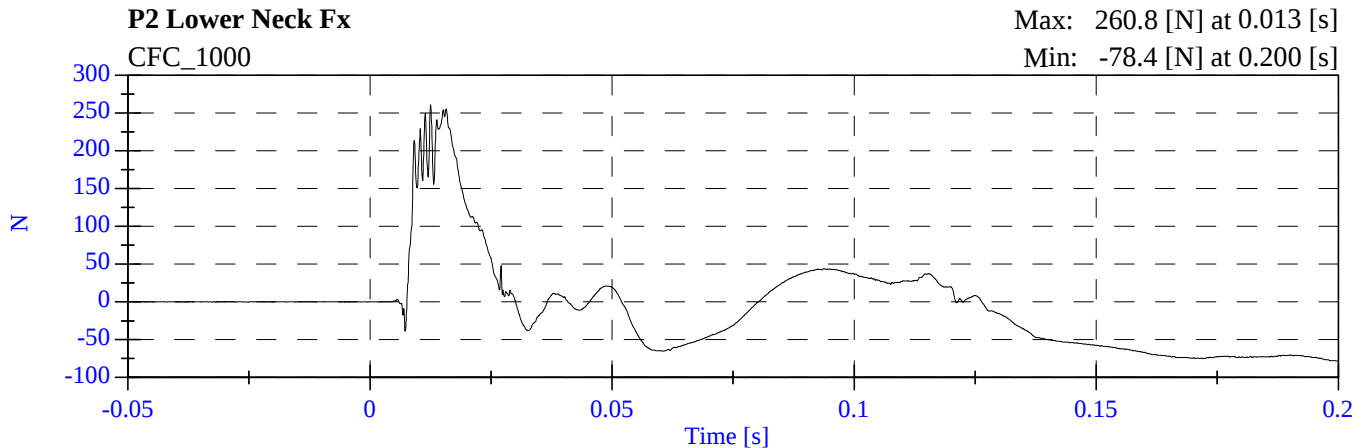
M55501TWG2 - 2005 Subaru Outback

M55501TWG2 - May 12, 2005



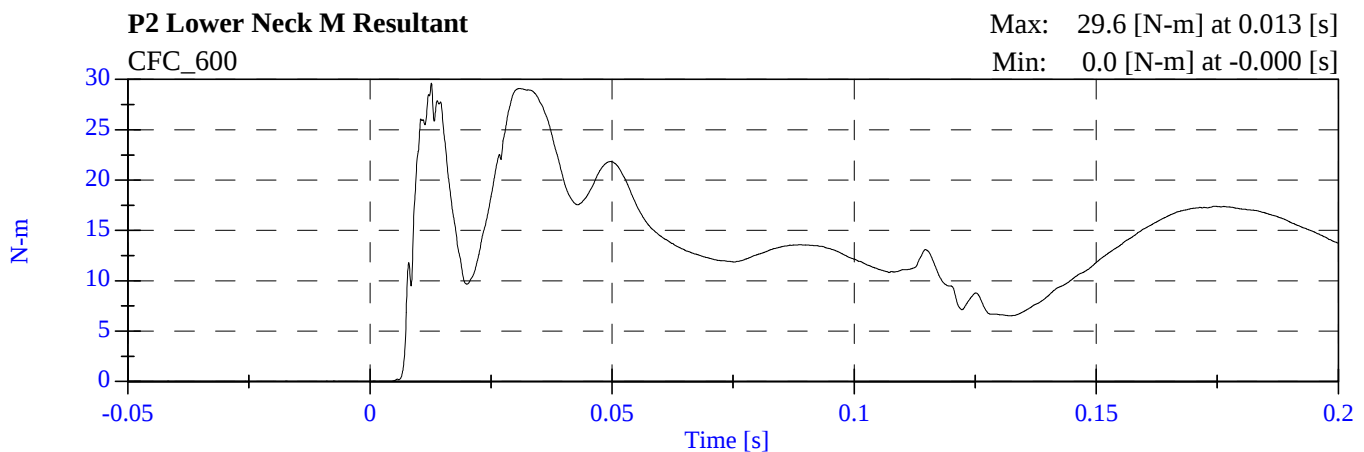
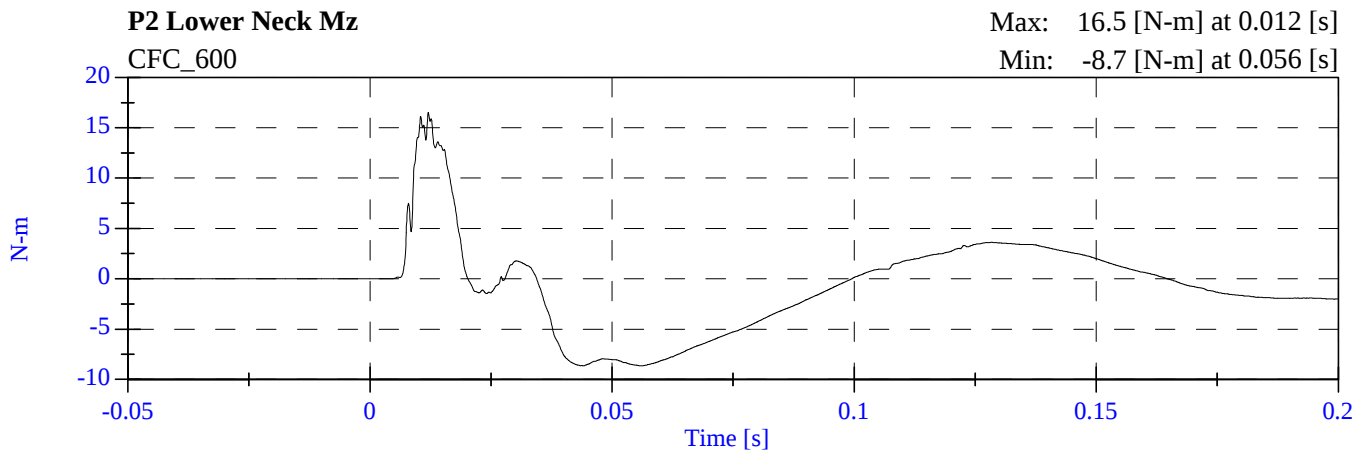
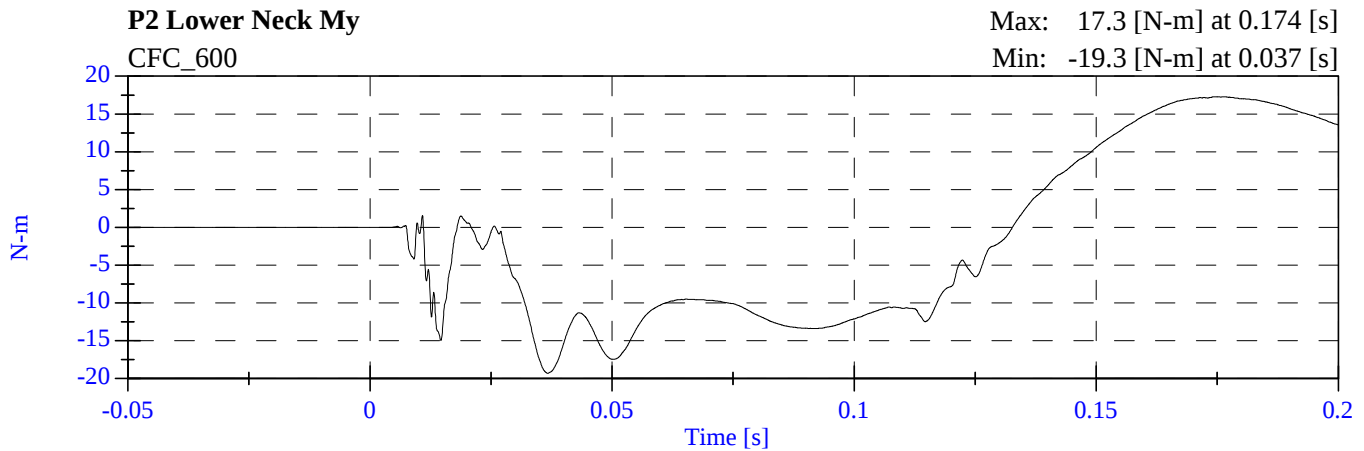
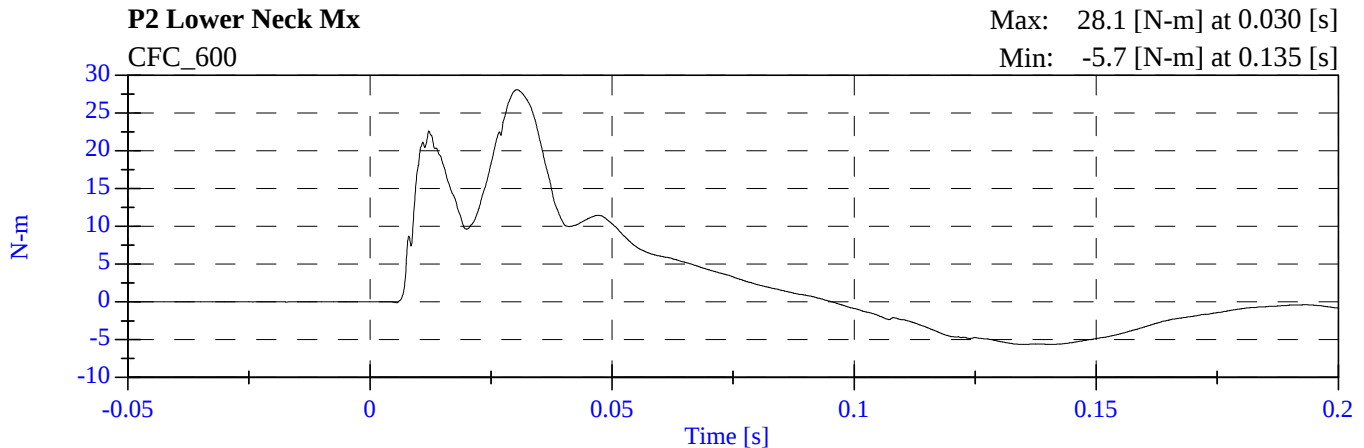
M55501TWG2 - 2005 Subaru Outback

M55501TWG2 - May 12, 2005



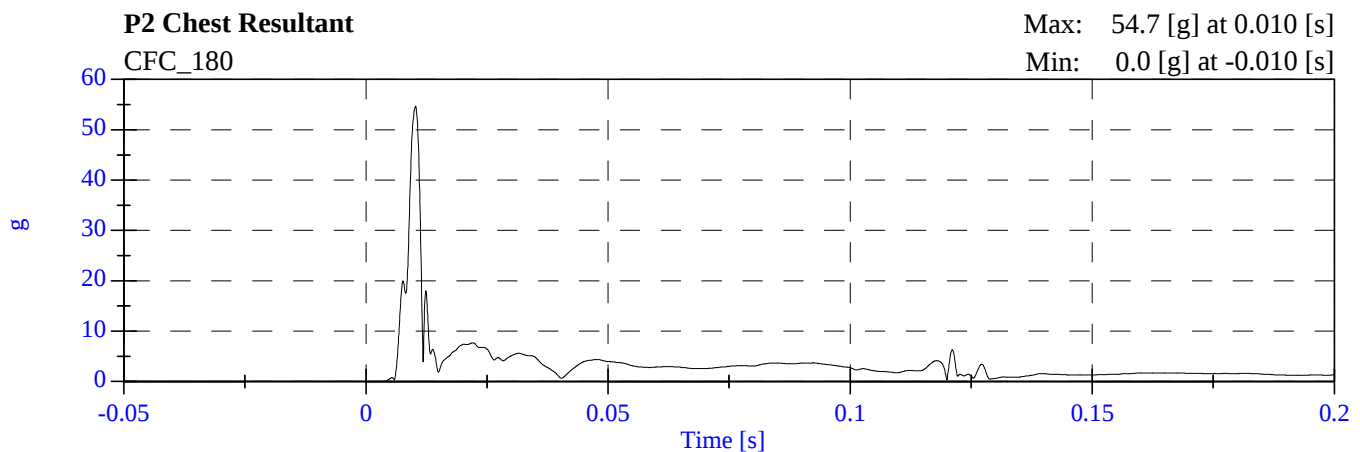
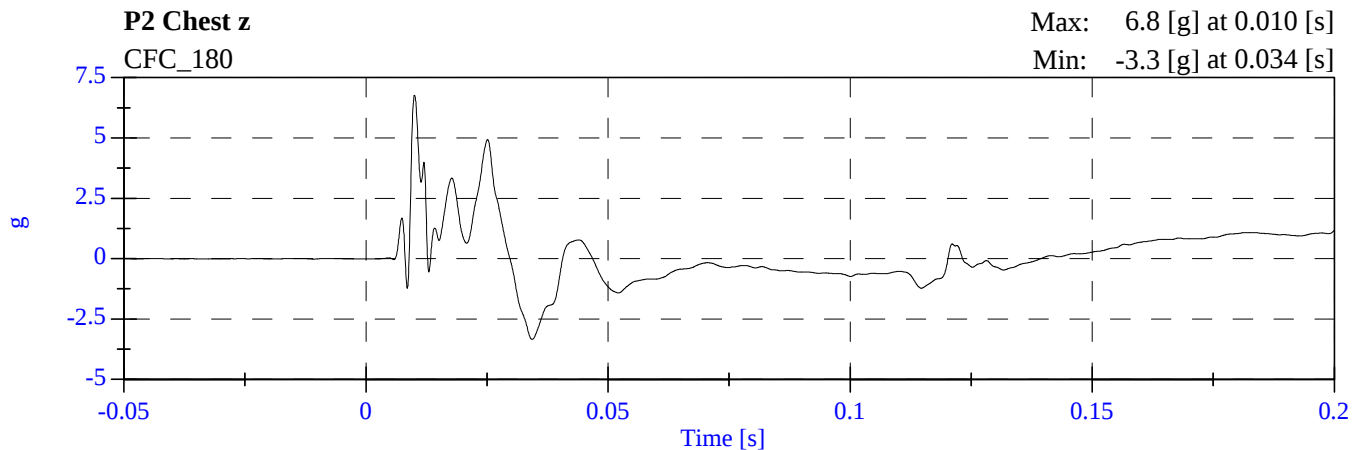
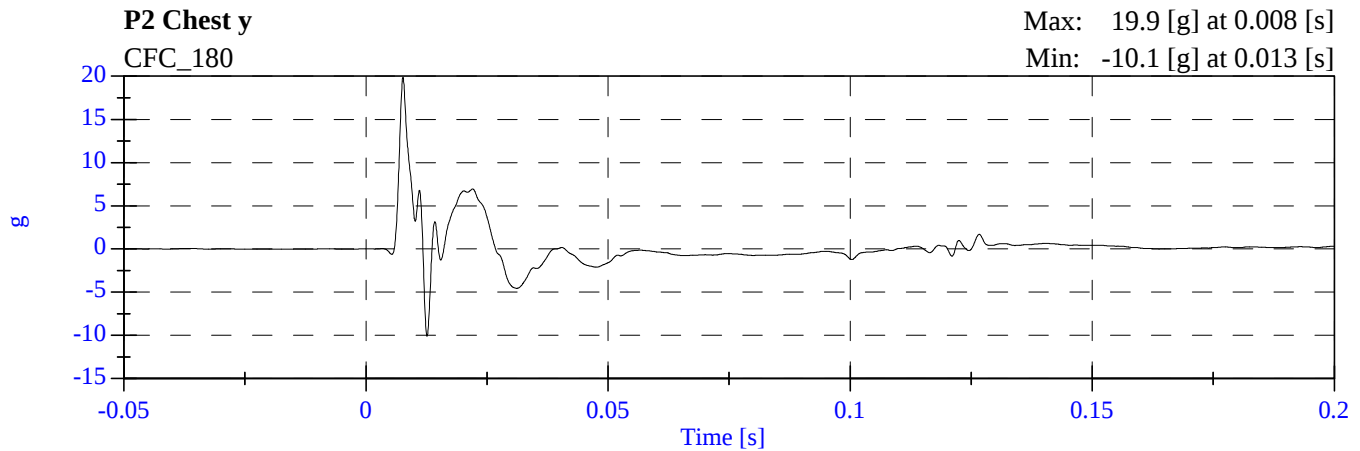
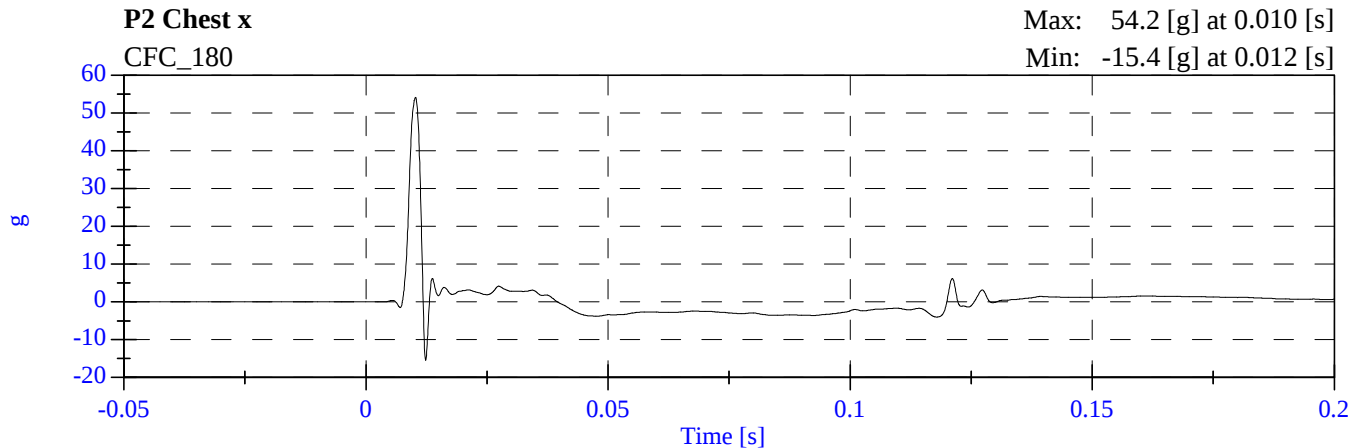
M55501TWG2 - 2005 Subaru Outback

M55501TWG2 - May 12, 2005

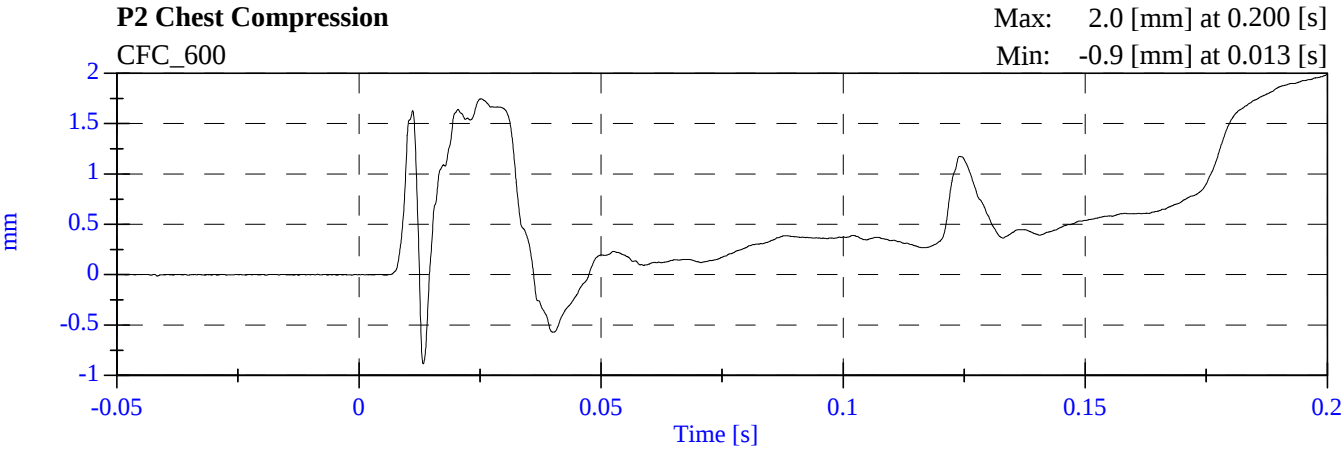


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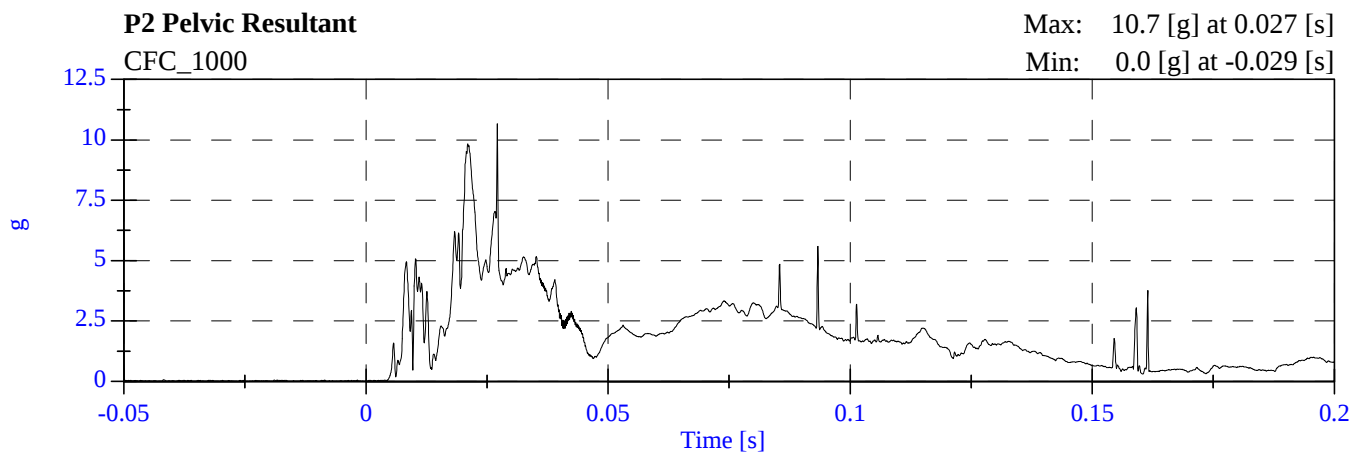
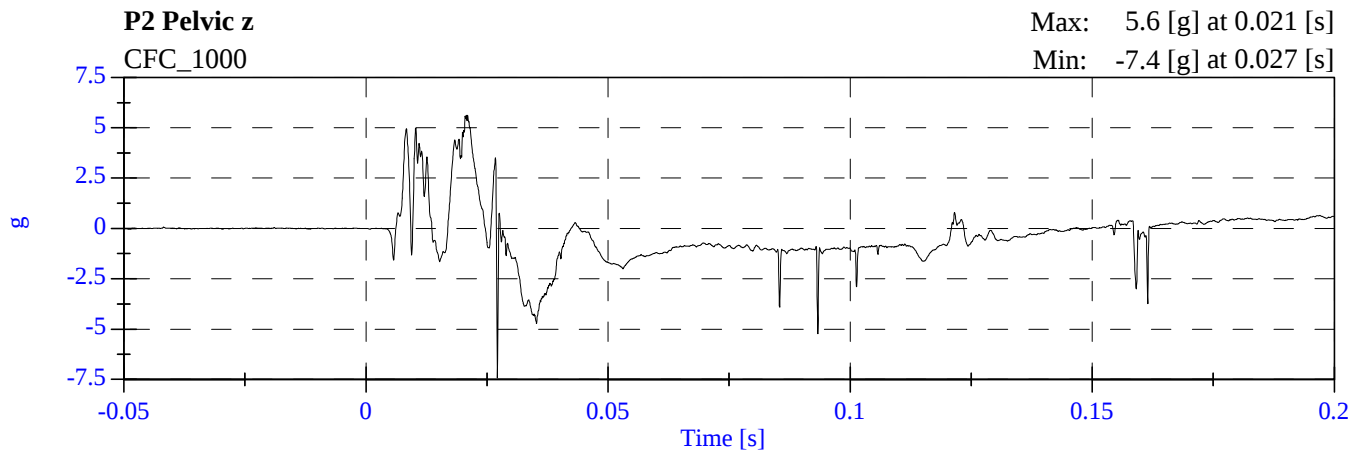
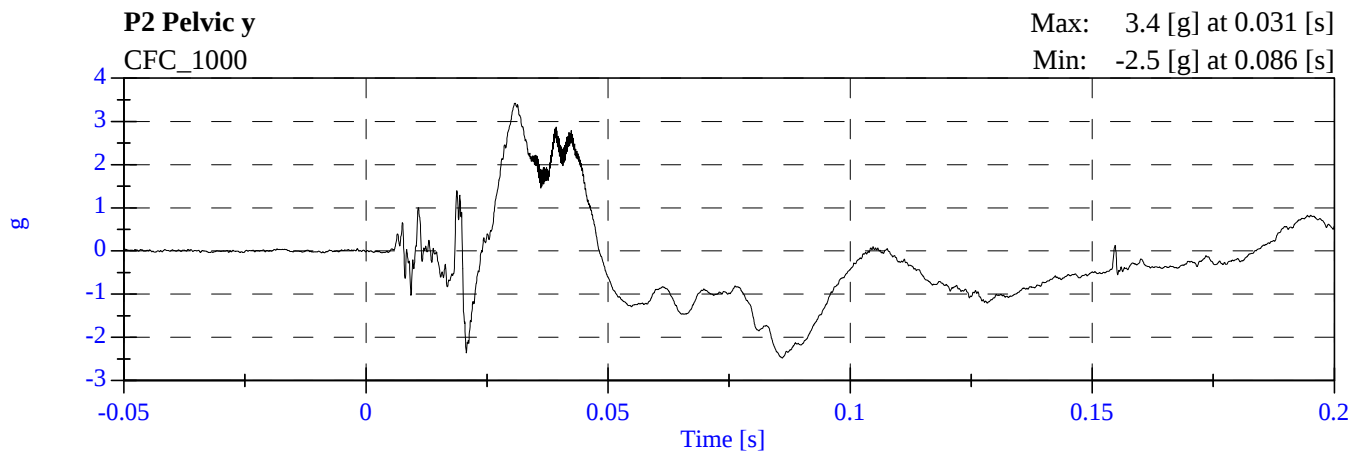
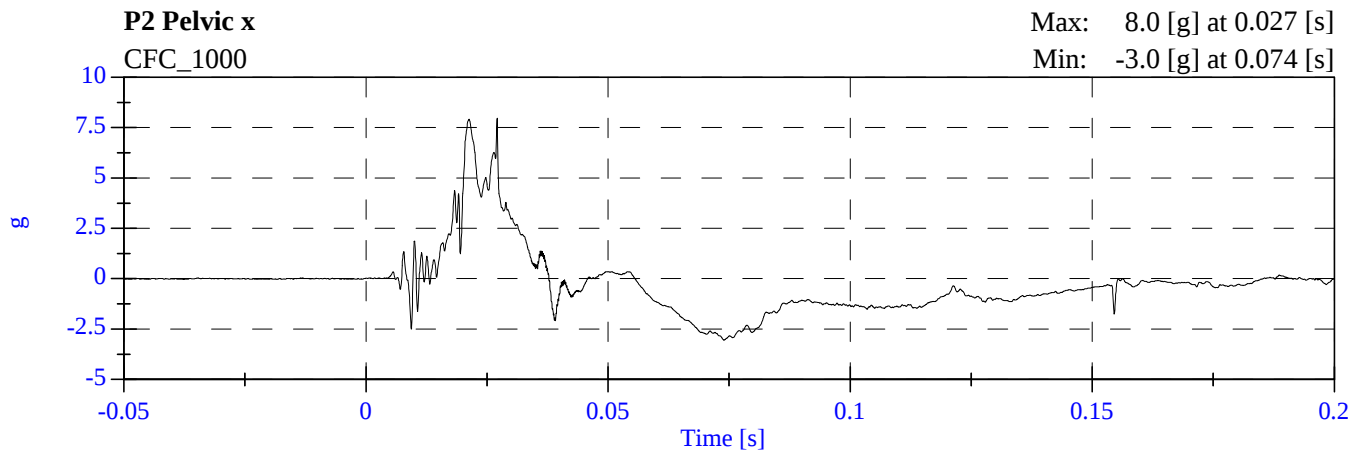


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APPENDIX C

TEST EQUIPMENT LIST AND CALIBRATION INFORMATION

TEST EQUIPMENT LIST AND CALIBRATION INFORMATION

P572N INSTRUMENTATION

	POSITION #2 (RIGHT FRONT) SERIAL NO.: 186		
	SERIAL NUMBER	MANUFACTURER	CALIBRATION DATE
HEAD AX	AC-99H30-Z09	ENTRAN	02-Feb-05
HEAD AY	AC-J31026	ENDEVCO	18-Aug-04
HEAD AZ	AC-01J02-F08	ENTRAN	02-Feb-05
UPPER NECK FX	LC-1632Fx	DENTON	12-Aug-03
UPPER NECK FY	LC-1632Fy	DENTON	12-Aug-03
UPPER NECK FZ	LC-1632Fz	DENTON	12-Aug-03
UPPER NECK MX	LC-1632Mx	DENTON	12-Aug-03
UPPER NECK MY	LC-1632My	DENTON	12-Aug-03
UPPER NECK MZ	LC-1632Mz	DENTON	12-Aug-03
LOWER NECK FX	LC-138Fx	DENTON	16-Apr-03
LOWER NECK FY	LC-138Fy	DENTON	16-Apr-03
LOWER NECK FZ	LC-138Fz	DENTON	16-Apr-03
LOWER NECK MX	LC-138Mx	DENTON	16-Apr-03
LOWER NECK MY	LC-138My	DENTON	16-Apr-03
LOWER NECK MZ	LC-138Mz	DENTON	16-Apr-03
CHEST AX	AC-02I02I05-F10	ENTRAN	02-Feb-05
CHEST AY	AC-02I02I16-A04	ENTRAN	02-Feb-05
CHEST AZ	AC-03E03E20-N18	ENTRAN	02-Feb-05
CHEST DISPLACEMENT X	DS-186	SERVO	19-May-04
PELVIS AX	AC-02I02I05-F05	ENTRAN	02-Feb-05
PELVIS AY	AC-98H14-K13	ENTRAN	02-Feb-05
PELVIS AZ	AC-02I02I16-A10	ENTRAN	02-Feb-05