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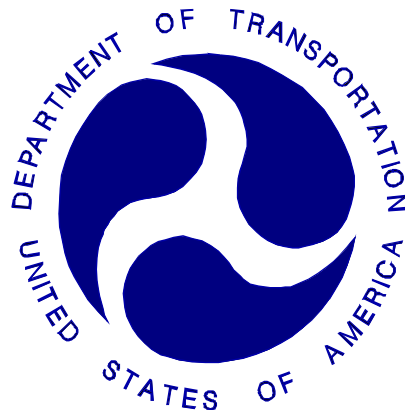
NEW CAR ASSESSMENT PROGRAM (NCAP)
SIDE AIRBAG OUT-OF-POSITION INJURY TESTING

GENERAL MOTORS CORP.
2007 SATURN OUTLOOK
4-DOOR SUV

NHTSA NUMBER: M70107TWG2

CALSPAN CORPORATION TEST NUMBER: 8642-TWG-29

CALSPAN CORPORATION
TRANSPORTATION SCIENCES CENTER
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May 16, 2007

FINAL REPORT

U. S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Rulemaking
Office of Crashworthiness Standards
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Washington, DC 20590

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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 17, 2007.							
Injury Summary							
HIC15	HIC36	Clip (g's)	Chest Displacement (mm)	NIJ NTF	NIJ NTE	NIJ NCF	NIJ NCE
0.5	0.5	2.2	-0.1	0.06	0.04	0.06	0.06
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SECTION 1

PURPOSE AND SUMMARY OF TEST M70107TWG2

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. DTNH22-03-D-22005.

1.2 SUMMARY

The effects of a side rail mounted curtain airbag deployment in a 2007 Saturn Outlook with an out-of-position six-year-old child were evaluated. The test was performed by Calspan Corporation on May 17, 2007. 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, upper and lower sternum and pelvic triaxial accelerometers. In addition upper and lower six axial neck force and moment load cell sensors and left and right femur load cell sensors were utilized.

Twenty-six 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 side 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 240 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:	Side Rail	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>	26	
<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:	None
Lower Torso Contact:	None
Left Knee Contact:	None
Right Knee Contact:	None

DATA SHEET 2

VEHICLE PARAMETER DATA

TEST VEHICLE INFORMATION:

Year/Make/Model/Body Style: 2007 Saturn Outlook 4-Door SUV‡

NHTSA No. : M70107 ; VIN: 5GZEV13707J100964 ; Color: White

Engine Data: 6 cylinders; - CID; 3.6 Liters; - cc

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

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

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

AUTOMATIC DOOR LOCKS:

Is test vehicle equipped with Automatic Door Locks (ADLs)? X Yes; - No;

Does vehicle owner's manual describe how to deactivate ADLs? - Yes; X No; - N/A

DEALER AND DELIVERY INFORMATION:

Date Received: 1/12/2007 ; Odometer Reading 66 km

Selling Dealer: Lansing Delta Township Assembly

Dealer Address: Lansing, MI

TEST VEHICLE OPTIONS:

X AC; X Power Steering; X Power Brakes; X Power Locks; X Power Seats

X ABS; X Tilt Wheel; - Stability Control X Traction Control X Anti-Theft

SAFETY BELT FEATURES:

Driver: X Pretensioner (Shoulder); X Load Limiter; X Adjustable Anchorage

Passenger: X Pretensioner (Shoulder); X Load Limiter; X Adjustable Anchorage

AIRBAG FEATURES:

Position	Frontal	Knee Bolster	Side Torso	Side Head/Torso Combination	Side Curtain
Driver:	Yes	No	Yes	No	Yes
Passenger:	Yes	No	Yes	No	Yes
Rear Passenger:	N/A	N/A	N/A	N/A	Yes

DATA FROM VEHICLE'S CERTIFICATION LABEL:

Vehicle Manufactured by: General Motors Corporation

Date of Manufacture 11/06

GVWR: 2903 kg; GAWR: 1450 kg FRONT; 1600 kg REAR

VEHICLE CAPACITY DATA:

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

Number of Occupants: 2 Front; 6 Rear; 8 Total

Vehicle Capacity Weight (VCW) = 659.0 kg

No. of Occupants x 68.04 kg = 544.3 kg

Rated Cargo/Luggage Weight (RCLW) = 114.7 kg

‡ This vehicle had previously been tested in an NCAP frontal impact on February 2, 2007.

DATA SHEET NO. 3

CHILD DUMMY POSITIONING IN VEHICLE

NHTSA No. M70107TWG2

Measurement		Value
Total Fore/Aft Travel (mm)		240
Test Distance Rearward of Full-Forward (mm)		120
Total Fore/Aft Travel (Detents)		25
Placed in Position #		13
Seat Back Angle	SA (°)	19
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/Window	HD (mm)	255
Head to Seat Back Centerline	HSC (mm)	-
Head to B-Pillar (cg)	HB (mm)	225
Head to Roof, Z (top of the head)	HZ (mm)	184
Head to Header	HHH (mm)	480
Chest to Dash	CD (mm)	562
Chest to Seatback	CS (mm)	228
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)	90
Toe to Toe	TT (mm)	80
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. M70107TWG2

DESCRIPTION	Unit	MAXIMUM VALUE			
		Position #2			
		Maximum	Time (ms)	Minimum	Time (ms)
Head X	g	5.6	43.7	-1.9	106.8
Head Y	g	2.1	25.3	-1.7	51.4
Head Z	g	1.7	24.8	-2.4	106.5
Head Resultant	g	5.8	43.7	0	7.65
Upper Neck Fx	N	6.6	45.4	-88.9	74.5
Upper Neck Fy	N	14.8	70.6	-8	32.2
Upper Neck Fz	N	90.8	44.1	-107.1	28
Upper Neck F Resultant	N	135.7	74.5	0.1	5.9
Upper Neck Mx	N-m	1.1	61.6	-1	46.4
Upper Neck My	N-m	3.2	47.9	-2.3	33.7
Upper Neck Mz	N-m	1.5	40.7	-1.6	63.3
Upper Neck M Resultant	N-m	3.4	47.8	0	3.8
Lower Neck Fx	N	19.6	47.4	-59.3	79.9
Lower Neck Fy	N	9.1	72	-8.2	42.1
Lower Neck Fz	N	79.8	44.2	-115.3	74.5
Lower Neck F Resultant	N	127.1	74.8	0.1	3.7
Lower Neck Mx	N-m	1.7	67.8	-2.1	40.7
Lower Neck My	N-m	14.9	74.8	-2.5	44
Lower Neck Mz	N-m	1.8	39.8	-1.8	60.9
Lower Neck M Resultant	N-m	15	74.8	0	8.2
Upper Sternum Ax	g	1.9	58.7	-0.7	12.8
Lower Sternum Ax	g	1.0	34.9	-1.2	51.9
Chest X	g	2.1	59.4	-0.1	15.4
Chest Y	g	0.2	43.0	-0.4	26.1
Chest Z	g	1.1	28.1	-0.5	45.0
Chest Resultant	g	2.2	59.4	0	0.5
Chest Displacement	mm	0.3	167.1	-0.1	44.5
Pelvic X	g	0.5	17.6	-1.3	84.8
Pelvic Y	g	0.4	96.6	-1.1	72
Pelvic Z	g	1	26.9	-1	106.6
Pelvic Resultant	g	1.3	84.5	0	2.2
Left Femur	N	13.7	88.2	-14.8	23.5
Right Femur	N	11.3	79	-26.1	119.8

DATA SHEET 4

CHILD DUMMY INJURY CRITERIA VALUES (CONTINUED)

NHTSA No. M70107TWG2

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	0.5	38.7	51.1	12.4	0.5	38.7	51.1	12.4

CLIP SUMMARY*				
CLIP (g's)	t ₁ (msec)	t ₂ (msec)	CSI	
Position #2 – Right Front	2.2	58.5	61.5	0.2

* 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	0.06	45.0	86.3	5.43	2.4
Nte	0.04	35.7	13.7	-24.4	-1.5
Ncf	0.06	74.3	-102.3	-88.7	1.9
Nce	0.06	31.2	-63.9	-29.0	-1.5

Peak Tension (CFC1000) 90.8 N

Peak Compression (CFC1000) -107.1 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 Left Side of Dummy View



Figure A-8: Post-Test Left Side of Dummy View



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



Figure A-10: Post-Test Right Side of Dummy View

APPENDIX B

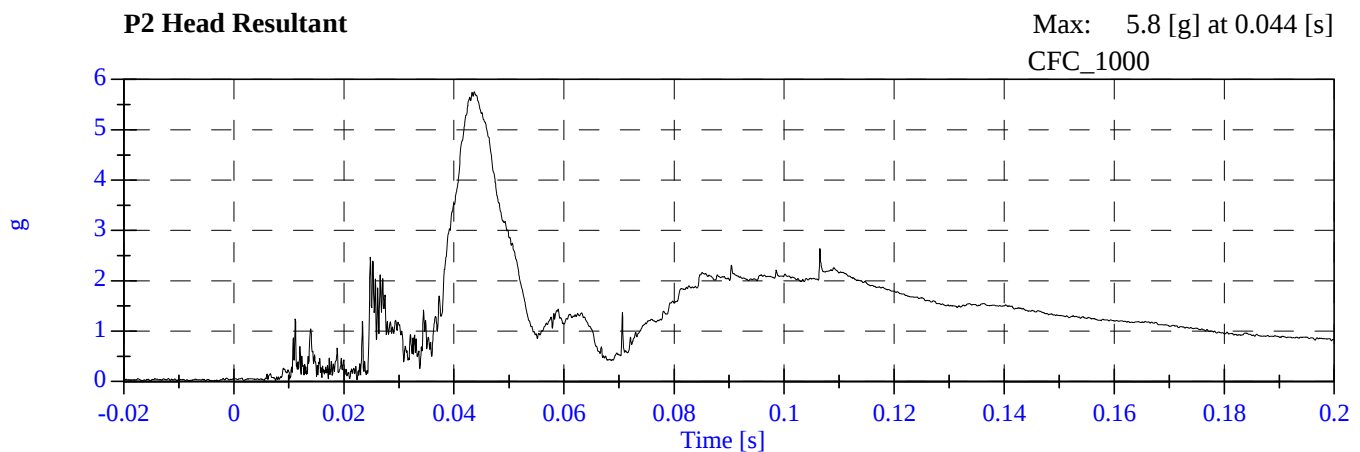
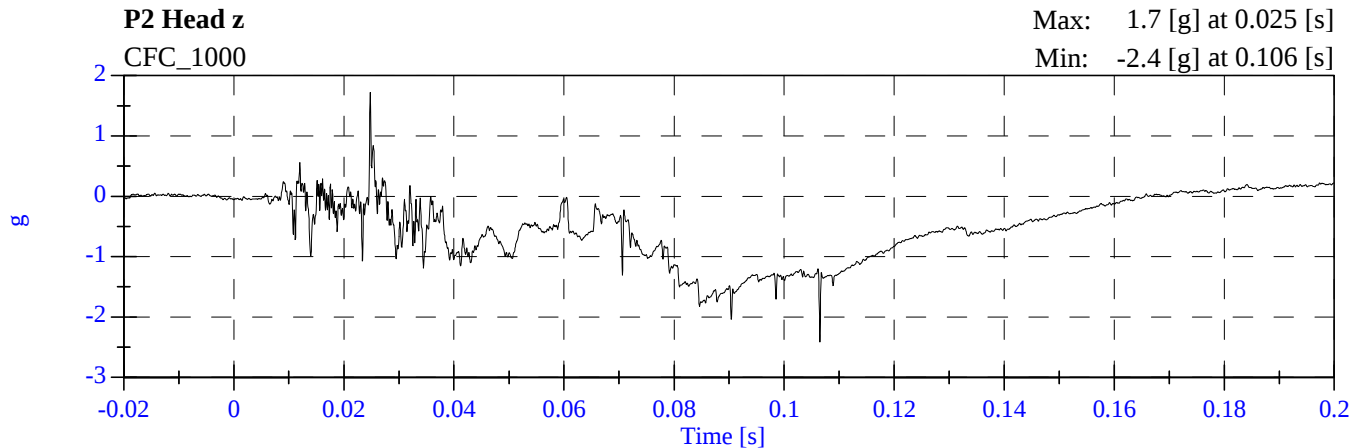
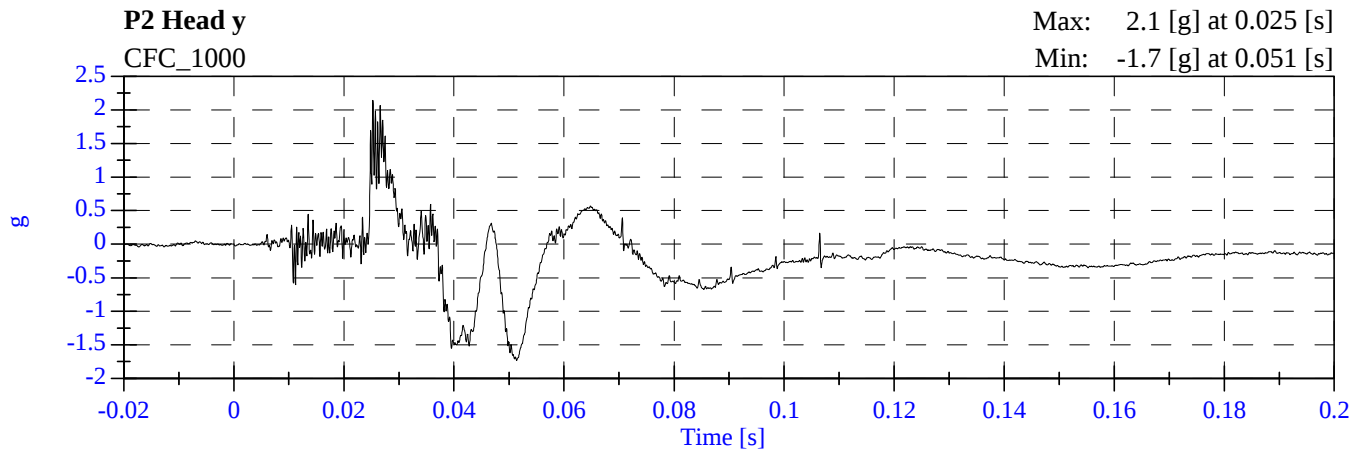
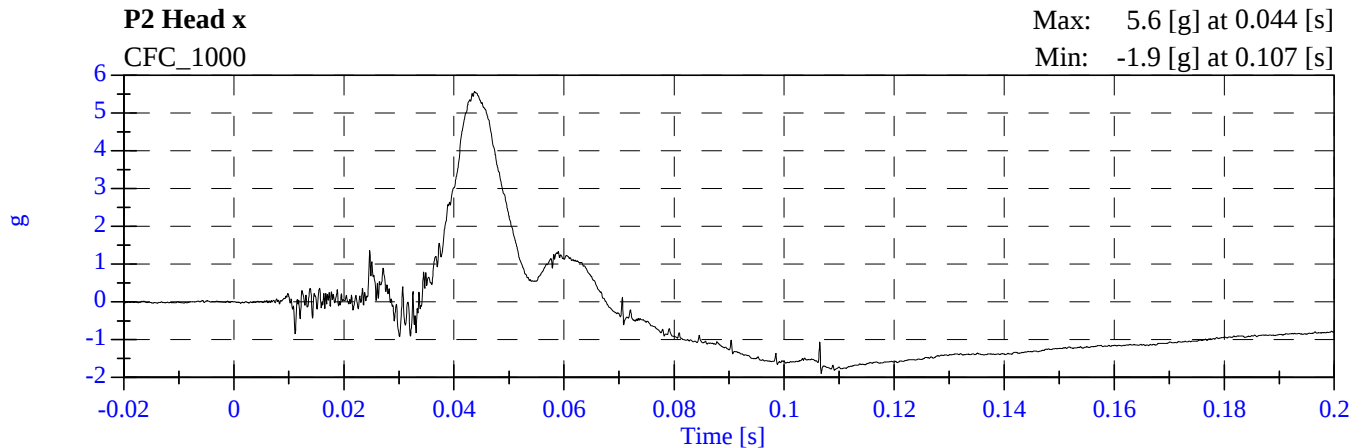
CHILD DUMMY RESPONSE DATA TRACES

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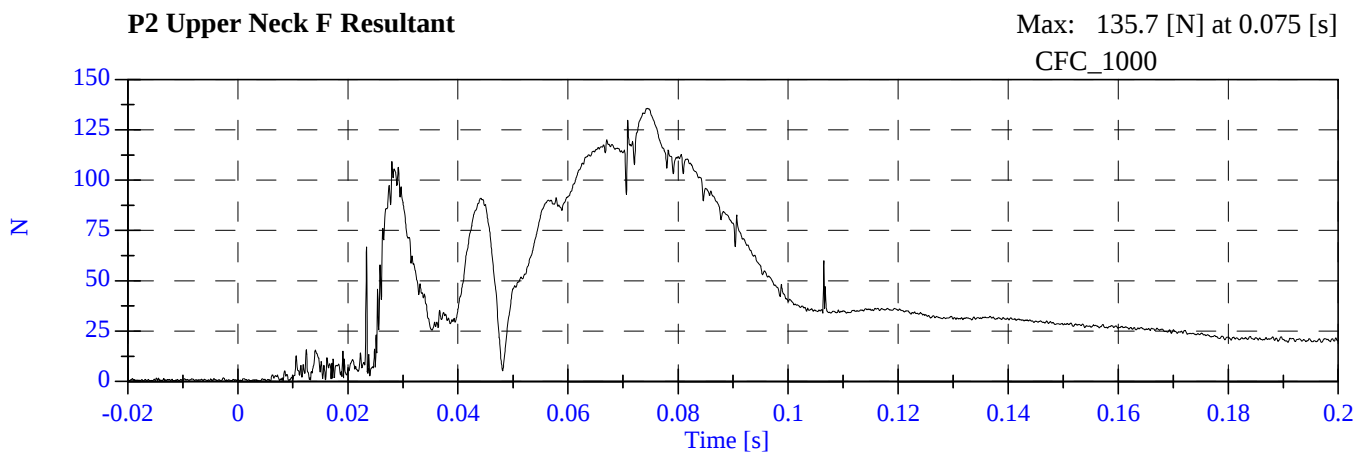
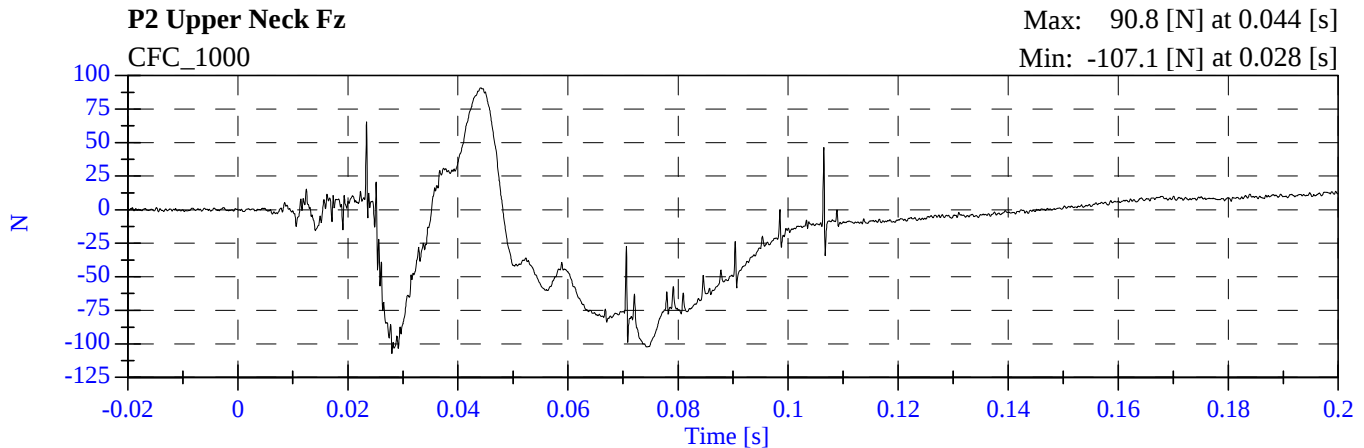
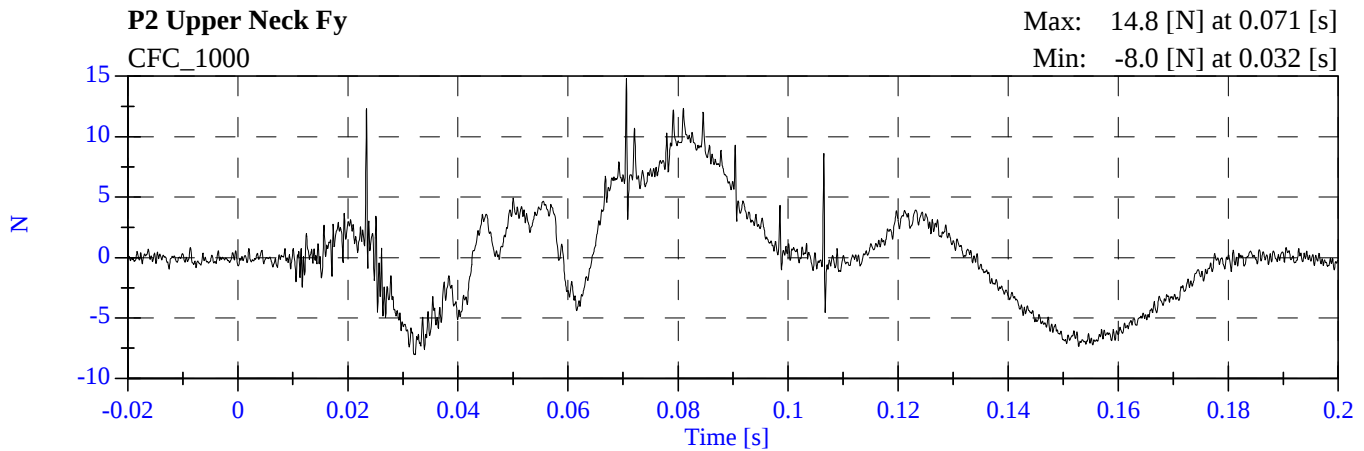
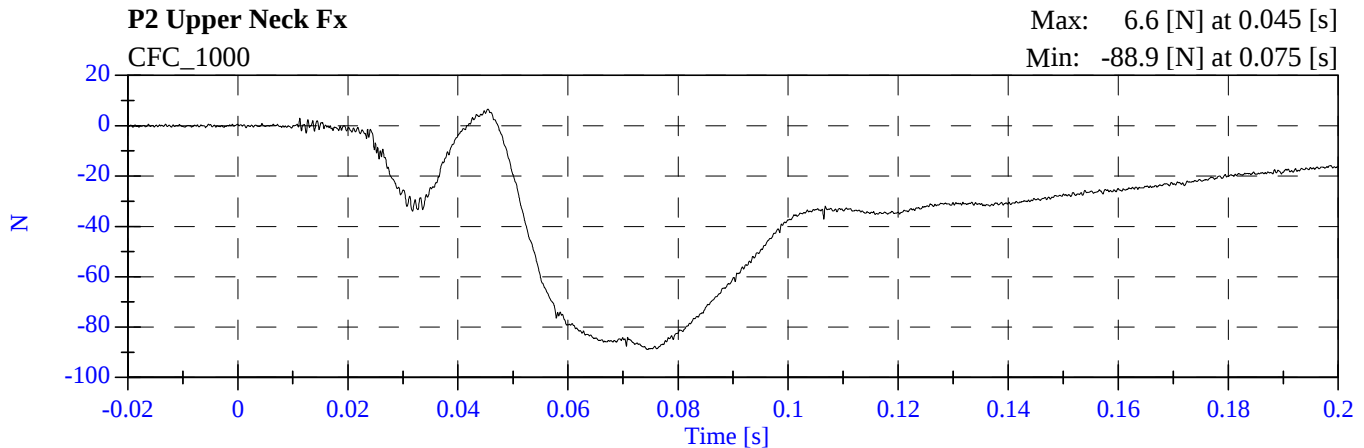
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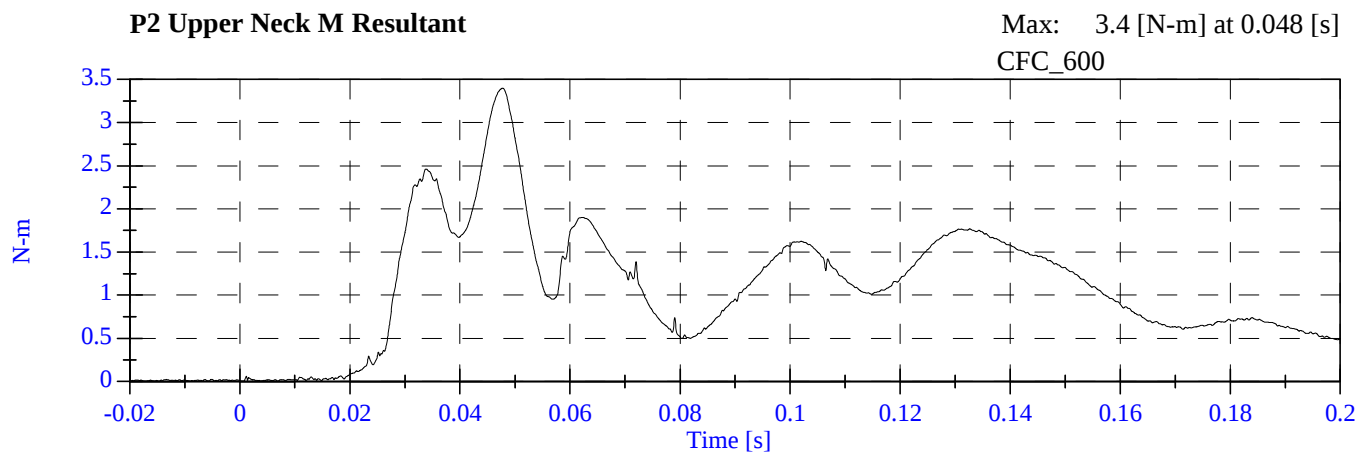
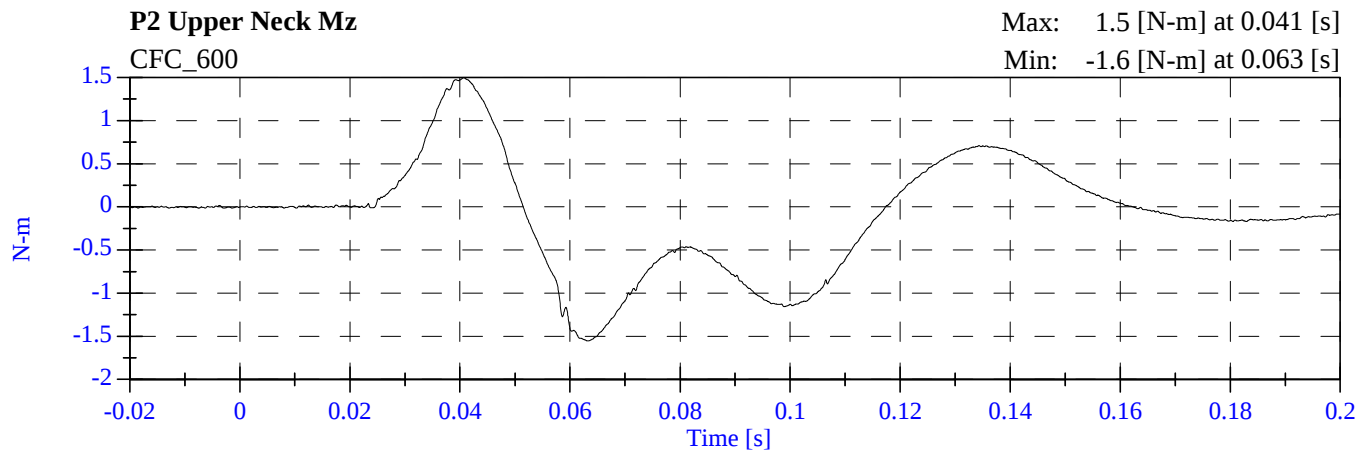
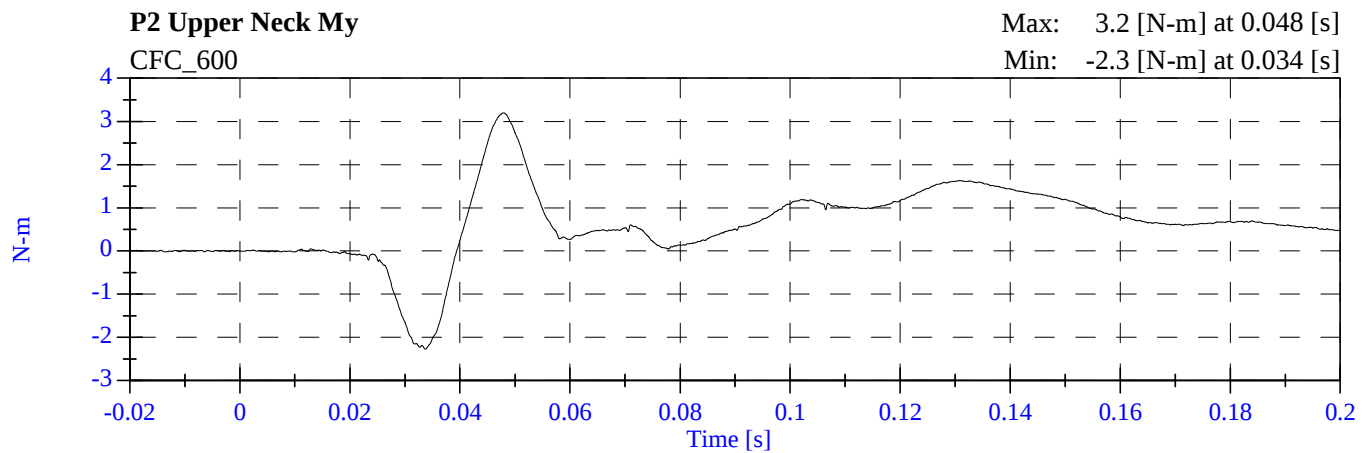
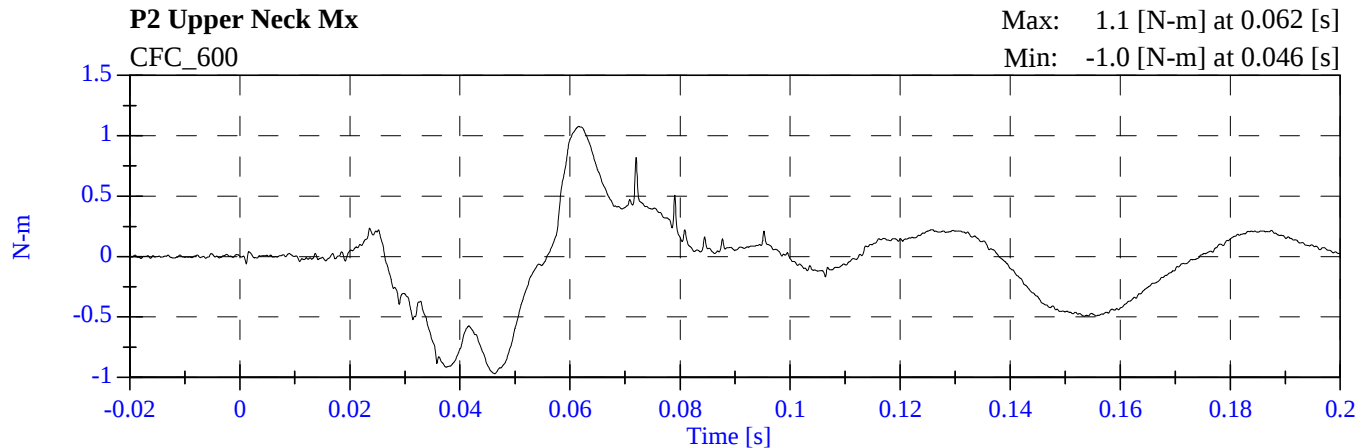


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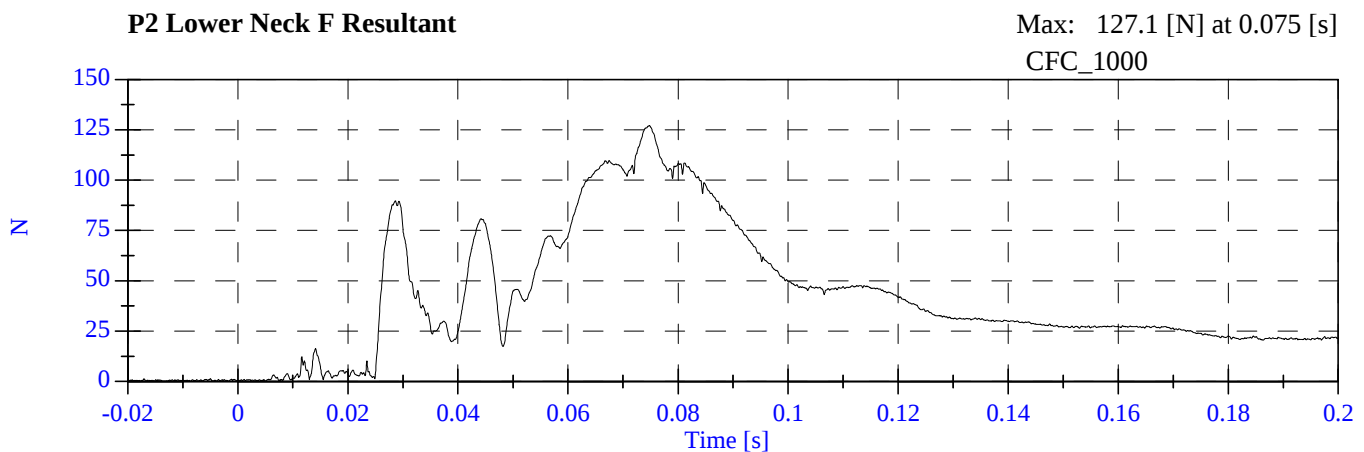
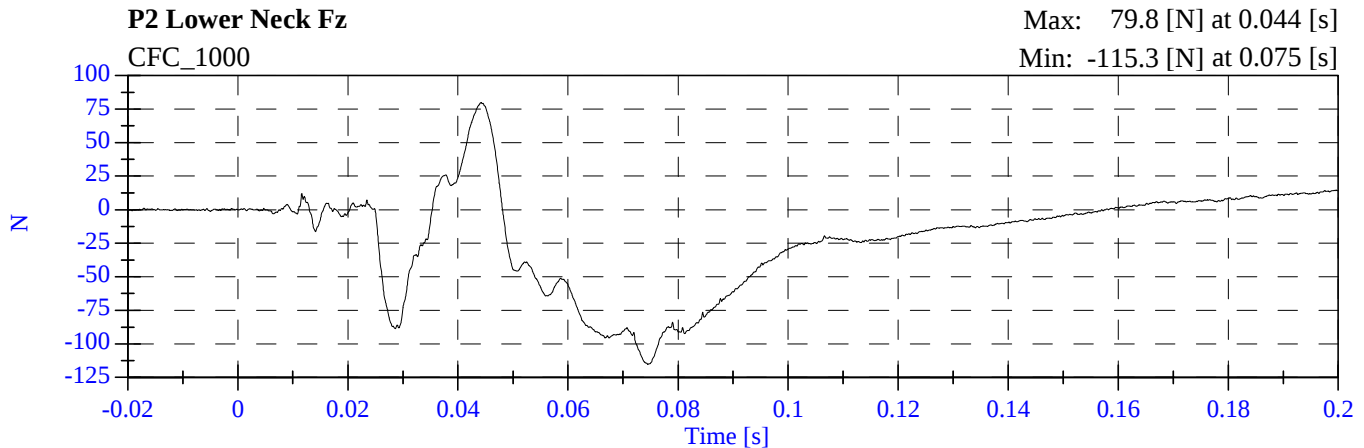
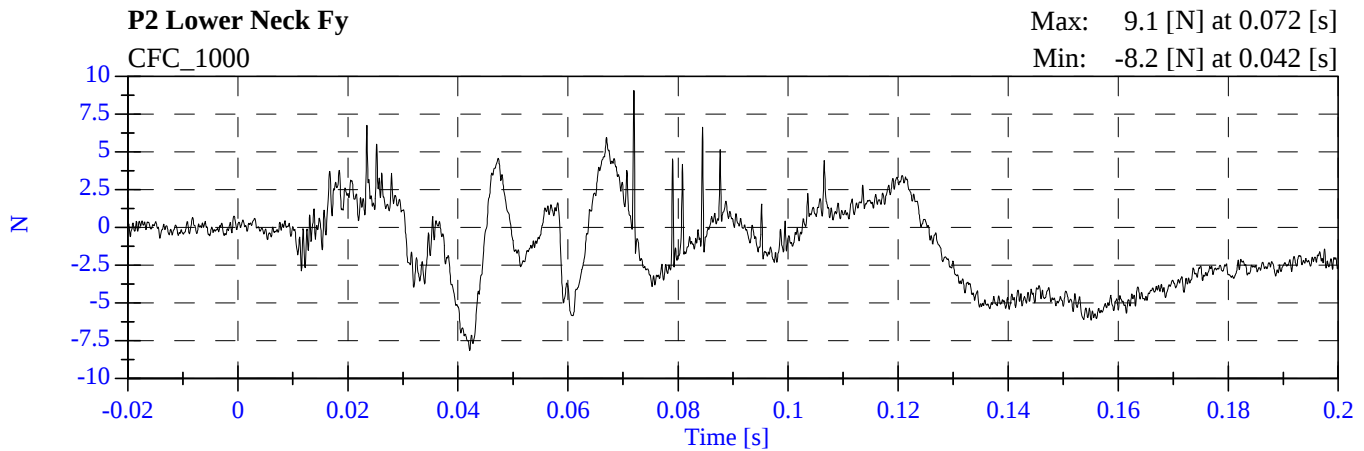
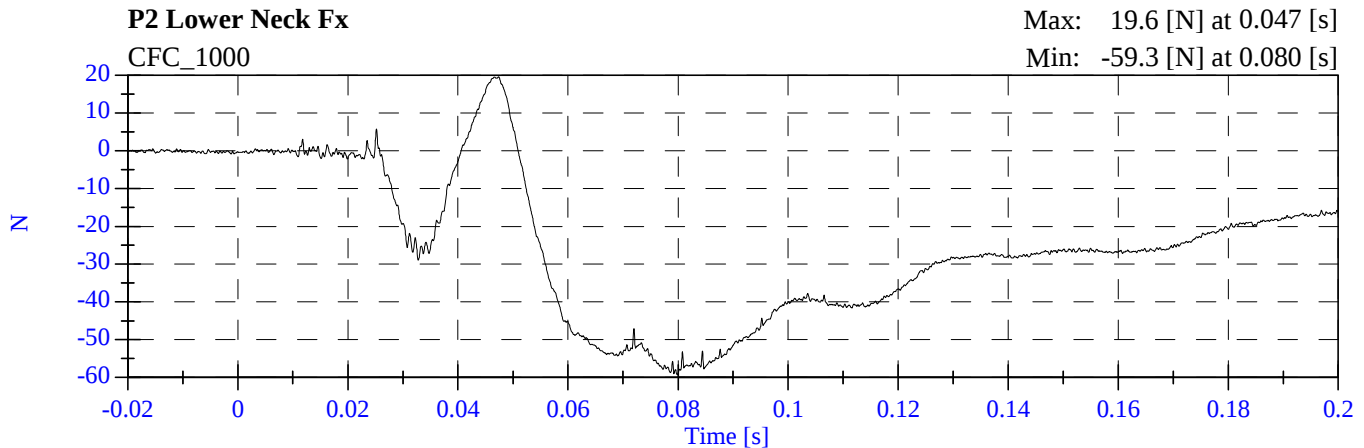
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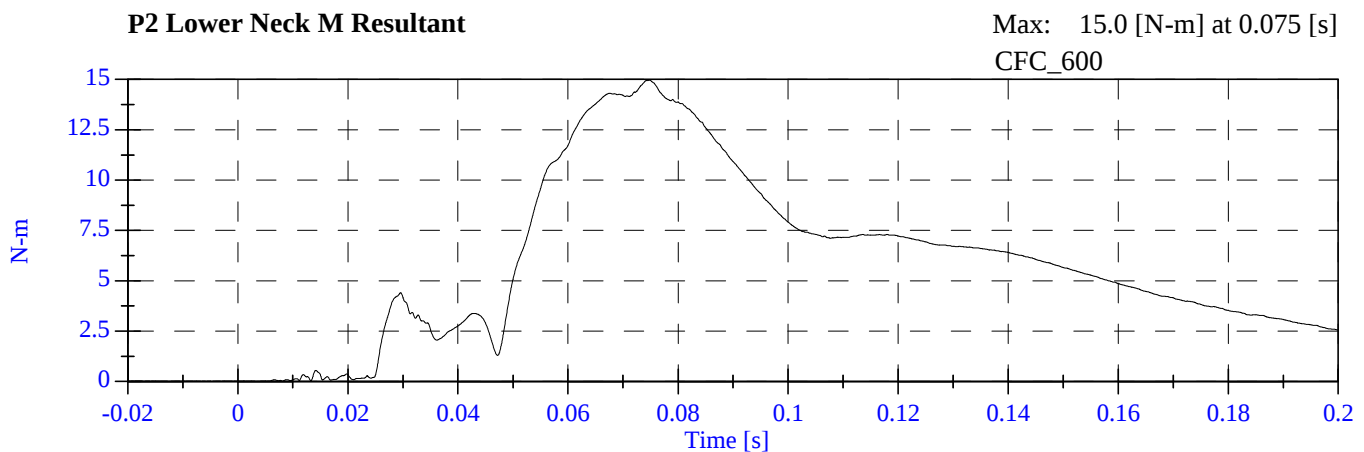
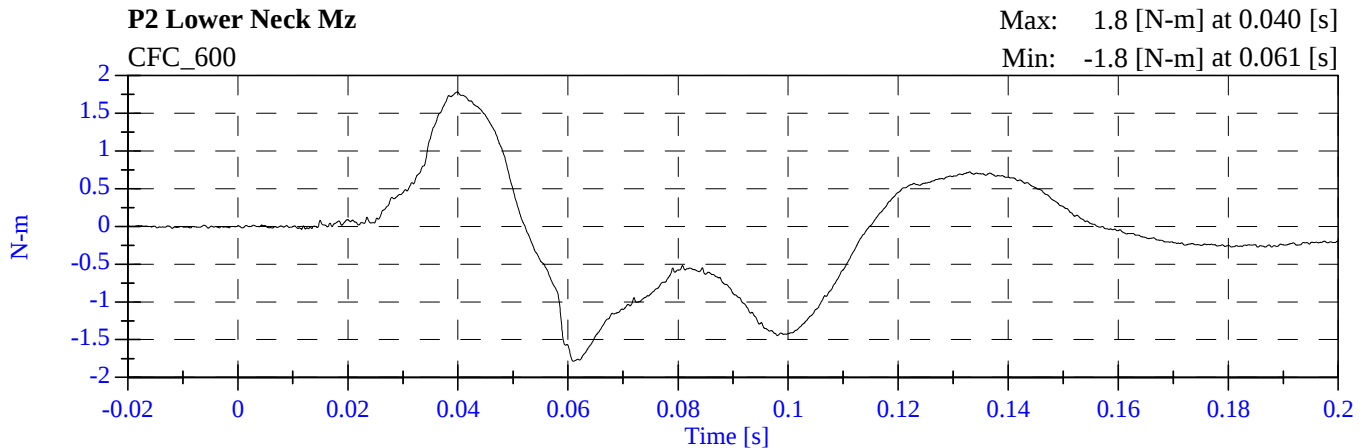
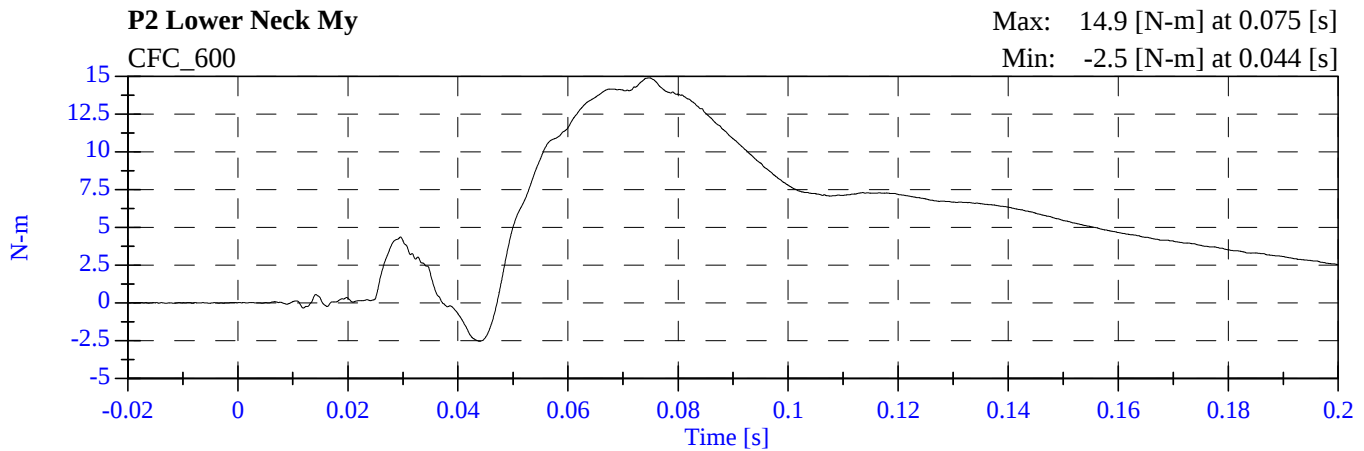
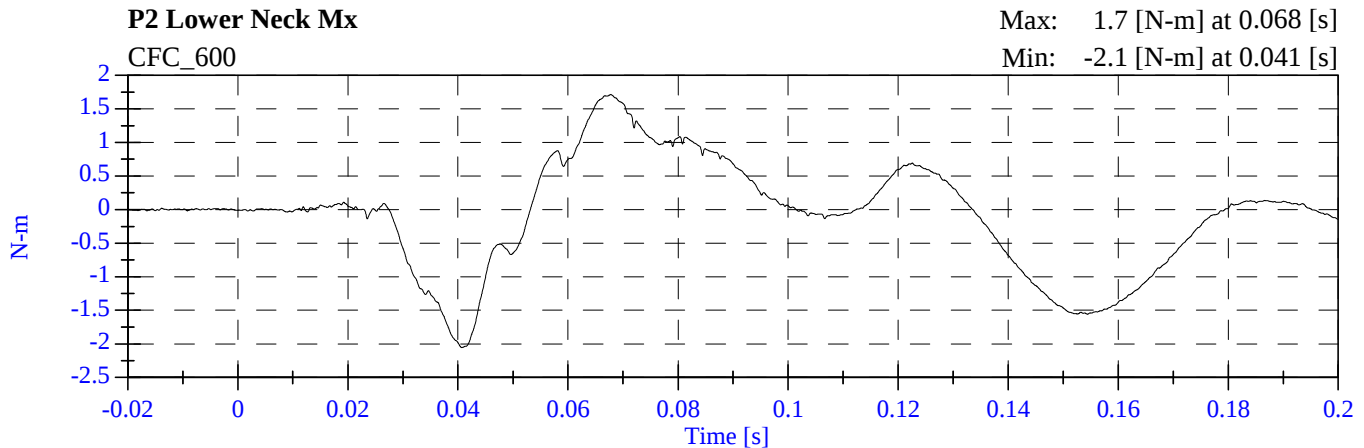
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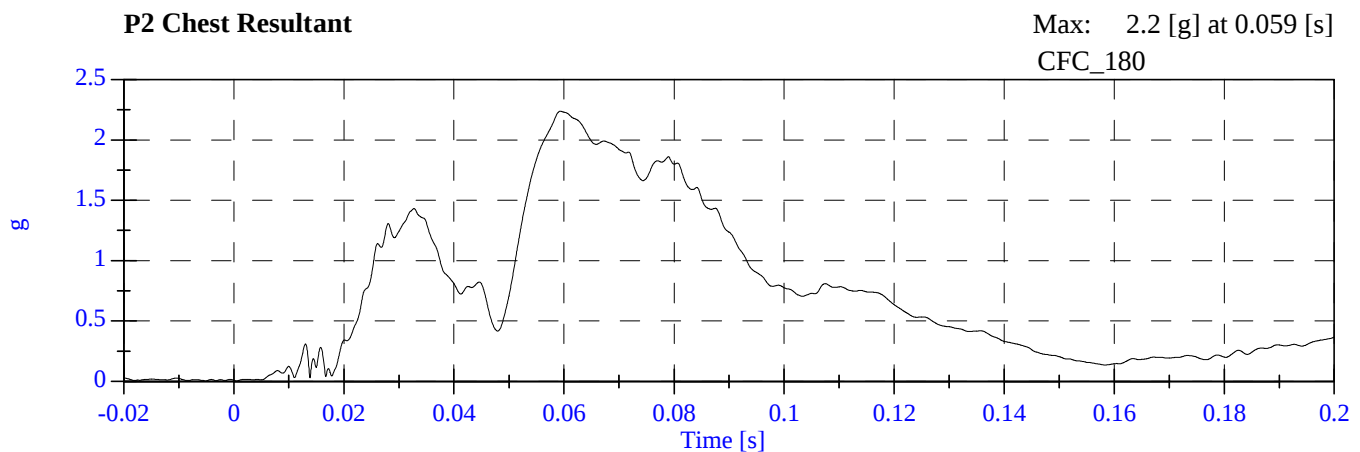
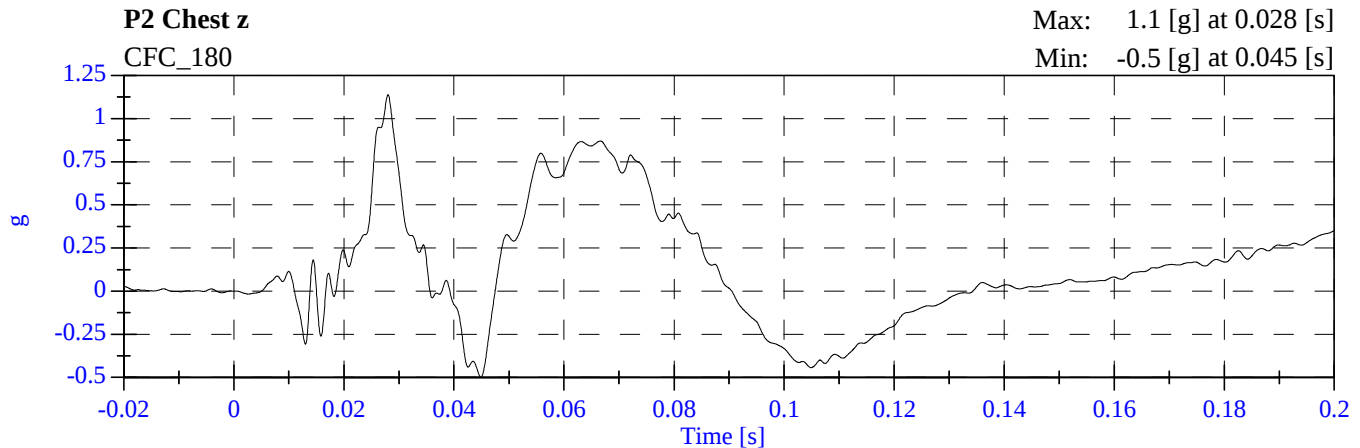
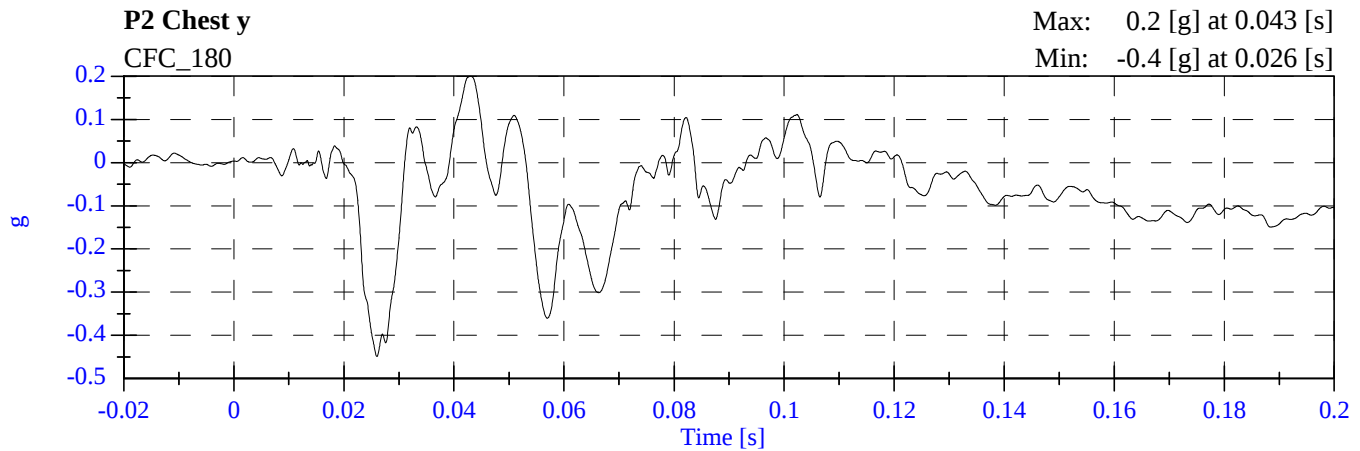
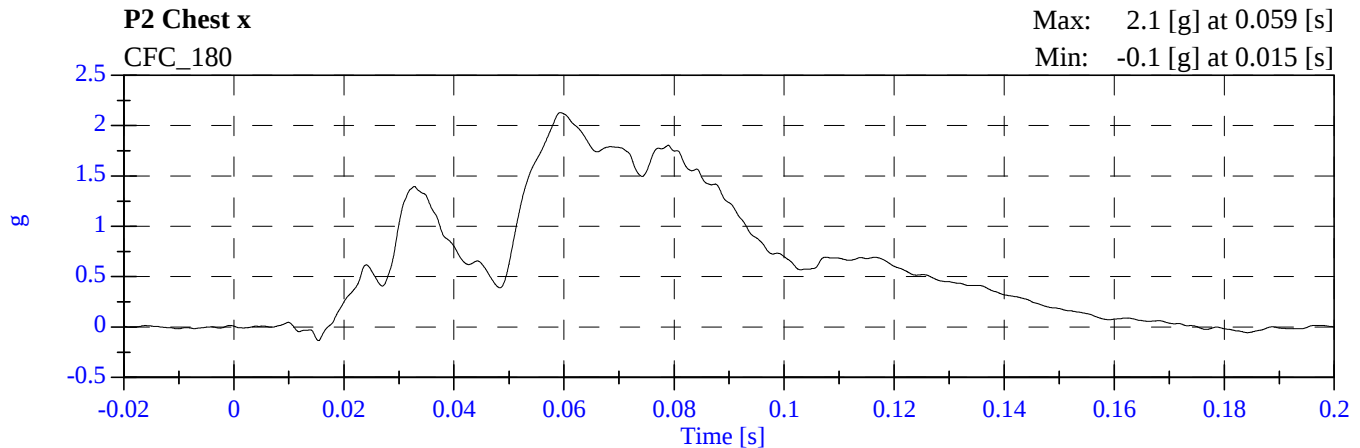
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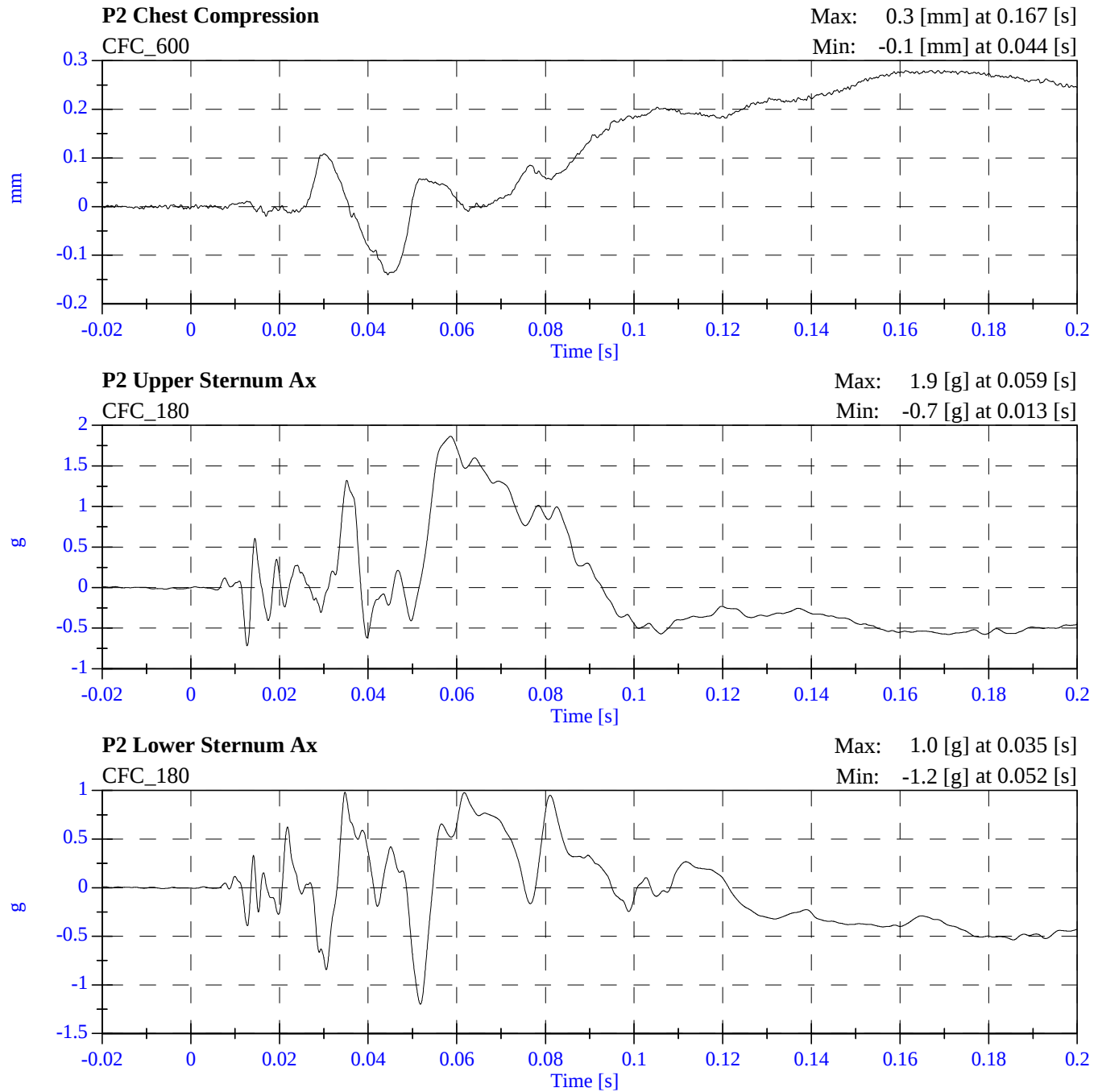
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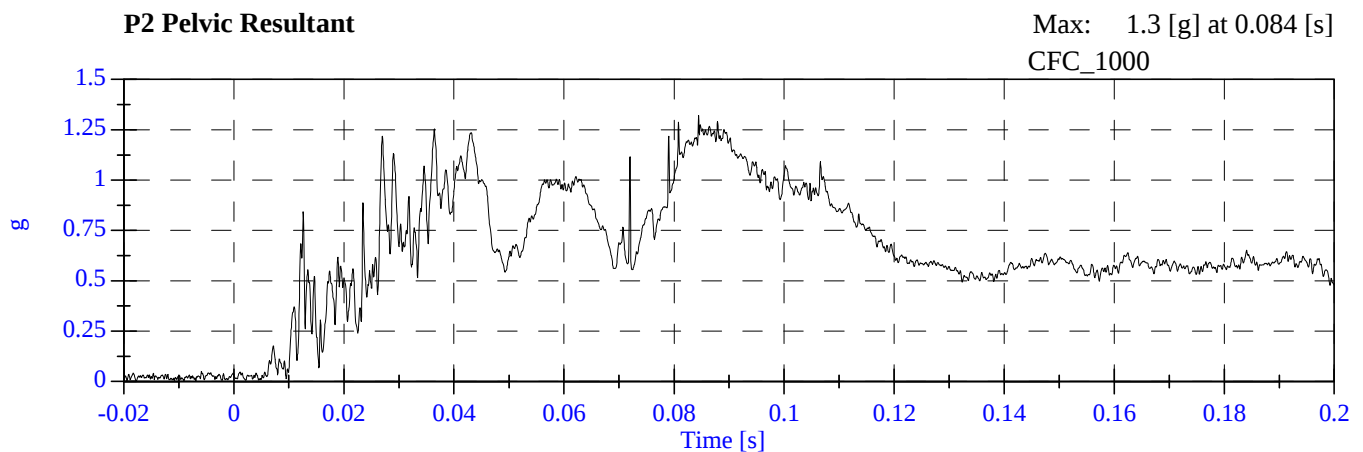
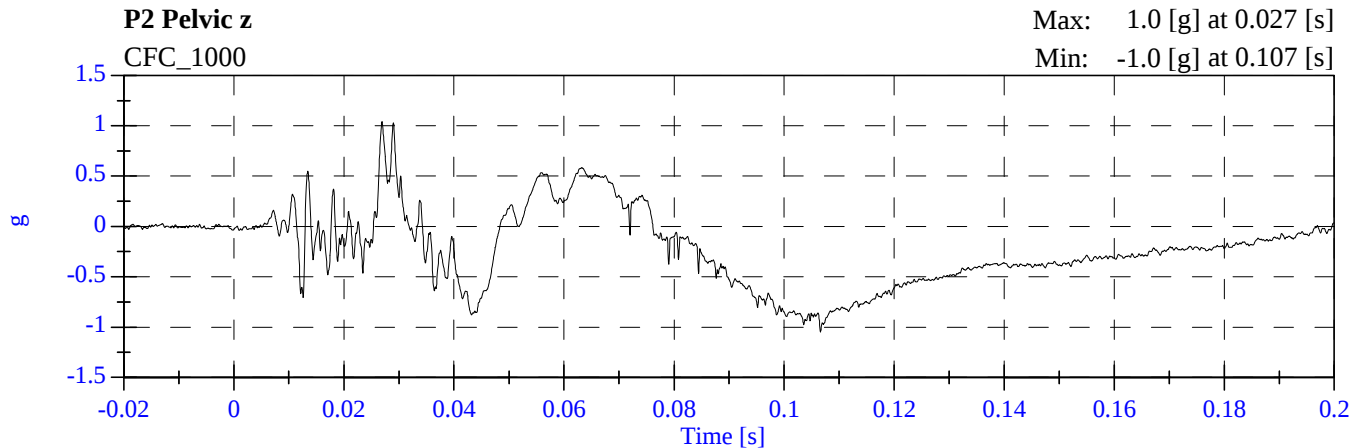
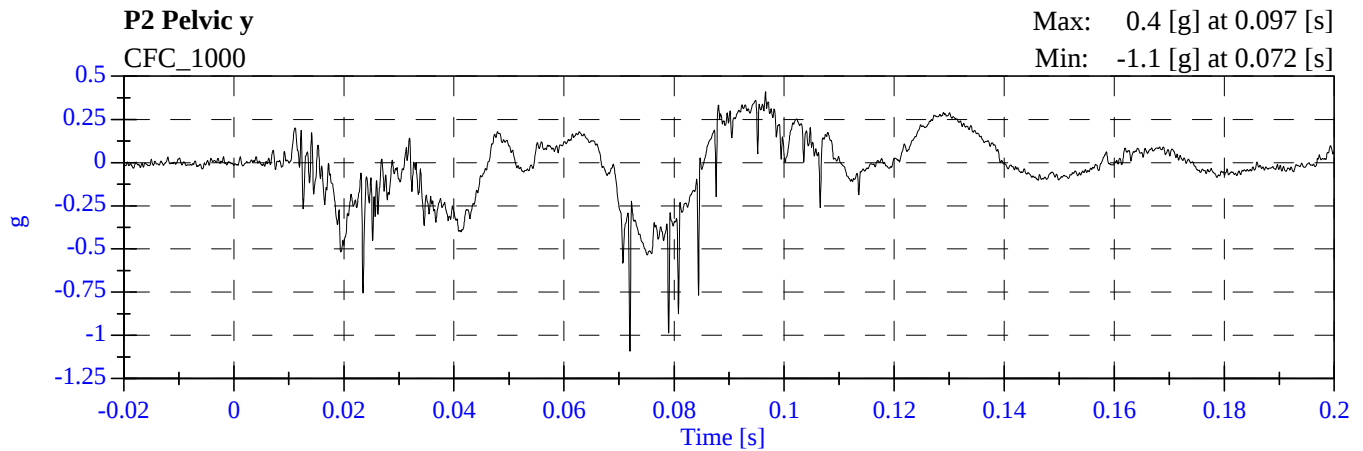
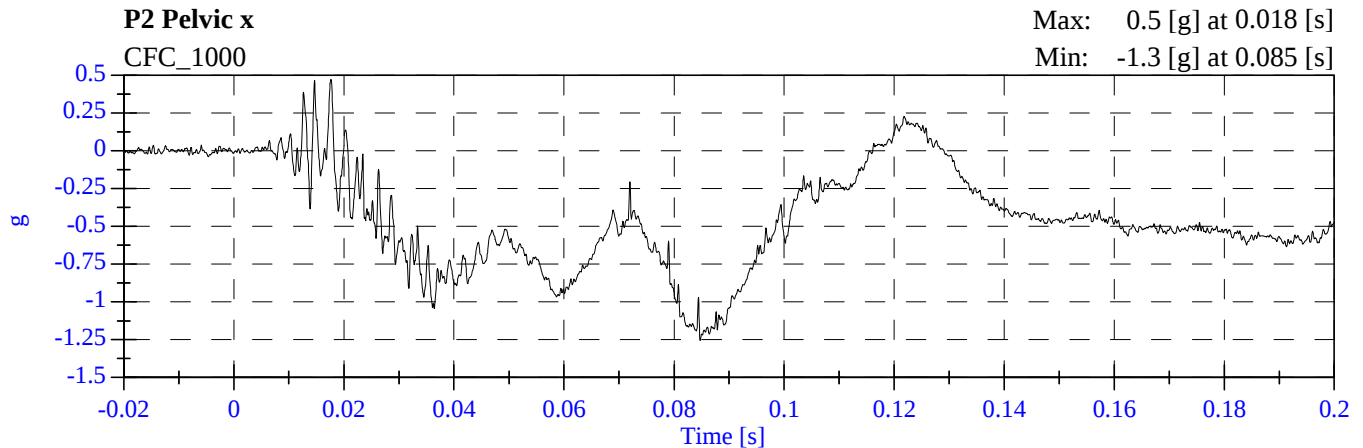
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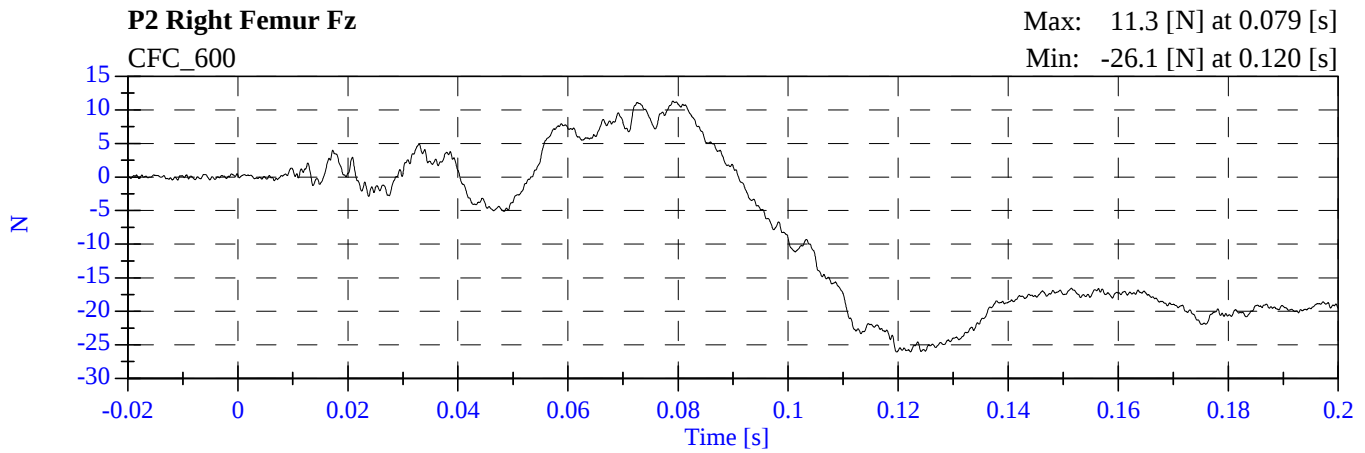
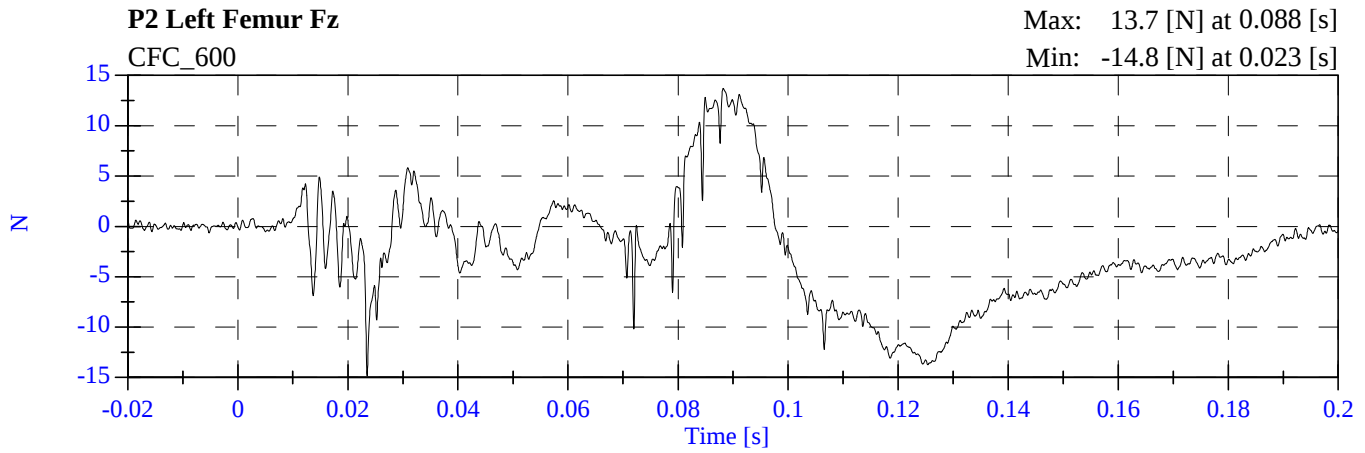
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APPENDIX C

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-04J04I20-Z23	ENTRAN	3/13/2007
HEAD AY	AC-04J04I01-R12	ENTRAN	3/13/2007
HEAD AZ	AC-02I02I16-A08	ENTRAN	3/13/2007
UPPER NECK FX	LC-175Fx	DENTON	5/2/2007
UPPER NECK FY	LC-175Fy	DENTON	5/2/2007
UPPER NECK FZ	LC-175Fz	DENTON	5/2/2007
UPPER NECK MX	LC-175Mx	DENTON	5/2/2007
UPPER NECK MY	LC-175My	DENTON	5/2/2007
UPPER NECK MZ	LC-175Mz	DENTON	5/18/2006
LOWER NECK FX	LC-138Fx	DENTON	5/18/2006
LOWER NECK FY	LC-138Fy	DENTON	5/18/2006
LOWER NECK FZ	LC-138Fz	DENTON	5/18/2006
LOWER NECK MX	LC-138Mx	DENTON	5/18/2006
LOWER NECK MY	LC-138My	DENTON	5/18/2006
LOWER NECK MZ	LC-138Mz	DENTON	5/18/2006
UPPER STERNUM AX	AC-04J04I08-F25	ENTRAN	3/13/2007
LOWER STERNUM AX	AC-03E03E20-N05	ENTRAN	3/13/2007
CHEST AX	AC-03E03D30-N08	ENTRAN	3/13/2007
CHEST AY	DS-186	SERVO	5/10/2006
CHEST AZ	AC-02A16-A26	ENTRAN	3/13/2007
CHEST DISPLACEMENT X	AC-99H12-F24	ENTRAN	3/13/2007
PELVIS AX	AC-04J04I01-R06	ENTRAN	3/13/2007
PELVIS AY	AC-03E03D30-N03	ENTRAN	3/13/2007
PELVIS AZ	AC-03D03D16-F04	ENTRAN	3/13/2007
LEFT FEMUR FZ	LC-247	DENTON	5/18/2006
RIGHT FEMUR FZ	LC-248	DENTON	5/16/2006