REPORT NUMBER: TWG-CAL-04-08

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

2004 VOLKSWAGEN TOUAREG

NHTSA NUMBER: M45800TWG2

GENERAL DYNAMICS TEST NUMBER: 8642-TWG-08

GENERAL DYNAMICS
ADVANCED INFORMATION ENGINEERING SERVICES
TRANSPORTATION SCIENCES CENTER
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May 25, 2004

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

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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 General Dynamics Advanced Information Engineering Services Crash Test Facility in Buffalo, New York, on May 25, 2004.

Injury Summary

HIC15	HIC36	Clip (g's)	Chest Displacement (mm)	NIJ NTF	NIJ NTE	NIJ NCF	NIJ NCE
1.2	1.2	11.1	-0.3	0.06	0.23	0.16	0.03

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TABLE OF CONTENTS

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

TABLE OF PHOTOGRAPHS

Figure	Photograph Title	Page
Figure A- 1	PRE-TEST VEHICLE LEFT SIDE VIEW	A- 3
Figure A- 2	POST-TEST VEHICLE LEFT SIDE VIEW	A- 3
Figure A- 3	VEHICLE CERTIFICATION PLACARD	A- 4
Figure A- 4	VEHICLE TIRE PLACARD	A- 4
Figure A- 5	PRE-TEST FRONTAL VIEW OF DUMMY	A- 5
Figure A- 6	POST-TEST FRONTAL VIEW OF DUMMY	A- 5
Figure A- 7	PRE-TEST RIGHT SIDE VIEW OF DUMMY	A- 6
Figure A- 8	POST-TEST RIGHT SIDE VIEW OF DUMMY	A- 6
Figure A- 9	PRE-TEST LEFT SIDE VIEW OF DUMMY	A- 7
Figure A- 10	POST-TEST LEFT SIDE VIEW OF DUMMY	A- 7

TABLE OF DATA PLOTS

PLOT	PLOT NAME[UNITS, CHANNEL FILTER CLASS]	PAGE
1	P2 Head x [g, CFC_1000]	B-3
2	P2 Head y [g, CFC_1000]	B-3
3	P2 Head z [g, CFC_1000]	B-3
4	P2 Head Resultant [g, CFC_1000]	B-3
5	P2 Upper Neck Fx [N, CFC_1000]	B-4
6	P2 Upper Neck Fy [N, CFC_1000]	B-4
7	P2 Upper Neck Fz [N, CFC_1000]	B-4
8	P2 Upper Neck F Resultant [N, CFC_1000]	B-4
9	P2 Upper Neck Mx [N-m, CFC_600]	B-5
10	P2 Upper Neck My [N-m, CFC_600]	B-5
11	P2 Upper Neck Mz [N-m, CFC_600]	B-5
12	P2 Upper Neck M Resultant [N-m, CFC_600]	B-5
13	P2 Chest x [g, CFC_180]	B-6
14	P2 Chest y [g, CFC_180]	B-6
15	P2 Chest z [g, CFC_180]	B-6
16	P2 Chest Resultant [g, CFC_180]	B-6
17	P2 Chest Displacement [mm, CFC_600]	B-7
18	P2 Pelvic x [g, CFC_1000]	B-8
19	P2 Pelvic y [g, CFC_1000]	B-8
20	P2 Pelvic z [g, CFC_1000]	B-8
21	P2 Pelvic Resultant [g, CFC_1000]	B-8

SECTION 1

PURPOSE AND SUMMARY OF TEST M45800TWG2

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 a seat mounted side airbag deployment in a 2004 Volkswagen Touareg with an out-of-position six-year-old child were evaluated. The test was performed by General Dynamics Advanced Information Engineering Services on May 25, 2004. 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 line with 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 forward 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, a chest displacement and upper six axial neck force and moment load cell sensors were utilized.

Sixteen 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 IIII six-year-old child dummy's visible contact points were as follows: The airbag to the back of the head and back of the right side of the torso of the ATD.

The six-year-old child dummy was placed on a booster block and oriented in the forward facing position on the outboard portion of the seat cushion. The seat was placed in the lowest height position with the seatback placed at the manufacturer's design position for a fiftieth percentile male. Due to the vehicle being previously tested in a 35 mph NCAP frontal impact, the seat tracks were not able to be placed in the rearmost position and the passenger side window was not able to be placed in the closed position. The dummy's spine was aligned with the leading edge of the seat bolster with the head placed between but not in contact with the seat bolster and the B-Pillar with the neck/torso junction aligned vertically with the top edge of the airbag module. The dummy legs were aligned so that they crossed the heel placement points at a location of 50 mm from the leading edge of the seat cushion and 75 mm to either side of the seat cushion centerline. The dummy's heels were ahead of the leading edge of the seat cushion. The dummy's right arm was placed on the arm rest with the forearm and hand aligned along the armrest. The dummy's left arm was in contact with the seatback with the left forearm located such that the fingertips contacted the booster seat. This orientation complies with section 3.3.3.5 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 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:	3.3.3.5*	Forward facing Hybrid-III 6-year-old child dummy on booster block
Airbag:	Seatback	Seatback side 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/182	Hybrid III six year old child dummy

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

Number of Data Channels	16	
Number of Cameras:	0	Real Time
	1	High Speed Digital
	0	High Speed Film

VISIBLE DUMMY CONTACT POINTS

Head Contact:	The back of the head was struck by the airbag during deployment
Upper Torso Contact:	The back of the right side of the torso.
Lower Torso Contact:	The back of the right side of the torso.
Left Knee Contact:	None
Right Knee Contact:	None

DATA SHEET 2

VEHICLE PARAMETER DATA

TEST VEHICLE INFORMATION:

Year/Make/Model/Body Style: 2004 Volkswagen Touareg SUV‡

NHTSA No. : M45800 ; VIN: WVGBC77L14D048755 ; Color: Red

Engine Data: 6 cylinders; 195 CID; 3.2 Liters; - cc

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

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

Final Drive: - Rear Wheel Drive; - Front Wheel Drive; X 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; X Pwr. Door Locks; X Tilt Wheel

Date Received: 2/28/2004 ; Odometer Reading 188 km

Selling Dealer: Palisades Volkswagen

& Address: 175 Route 303 West Nyack, NY

DATA FROM TIRE VEHICLE'S CERTIFICATION LABEL:

Vehicle Manufactured by: Volkswagen AG Germany

Date of Manufacture 12/03

GVWR: 2945.2 kg; GAWR: 1414.8 kg FRONT; 1609.8 kg REAR

DATA FROM TIRE PLACARD:

Recommended Tire Size: 255/60 R17

* Recommended Cold Tire Pressure: 250 kpa FRONT; 300 kpa REAR

DATA FROM TIRE SIDEWALL:

Size of Tires on Test Vehicle: P255/60R17 ; Manufacturer: Dunlop Grandtrek ST8000

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

Treadwear: 200 ; 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) = 461 kg

No. of Occupants x 68.04 kg = 340.2 kg

Rated Cargo/Luggage Weight (RCLW) = 120.8 kg

*Tire pressure used for test

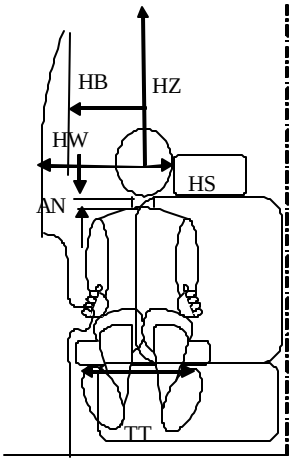
‡ This vehicle had previously been tested in an NCAP 35 mph frontal impact on May 4, 2004.

DATA SHEET NO. 3

CHILD DUMMY POSITIONING IN VEHICLE

NHTSA No. M45800TWG2

Measurements for Seat Mounted Airbags



X-Y View

HZ = Head CG to Roof
HC = Head CG to C-Pillar
HB = Head CG to B-Pillar
HS = Head CG to Seat
HW = Head CG to Window
TT = Toe to Toe
AN = Top of the Airbag Module to the Head/Neck Junction

Measurements for Position #2 (Right Front)	
	Dimension (mm)
HZ	282
HW	185
HC	-
HB	158
HS	180
TT	120
AN	0
Airbag Module Length	330
Airbag Module Width	80
Foam Block Depth[1]	300
Foam Block Width[1]	450
Foam Block Thickness[1]	75

[1] Foam block consisted of HD36 foam material with a density of 44.8 g/L

DATA SHEET 4

CHILD DUMMY INJURY CRITERIA VALUES

NHTSA No. M45800TWG2

		MAXIMUM VALUE			
		Position #2			
DESCRIPTION	**Unit**	**Maximum**	**Time (ms)**	**Minimum**	**Time (ms)**
Head X	**g**	4.9	13.4	-1.3	199.5
Head Y	**g**	0.8	8.1	-3.5	11.7
Head Z	**g**	2.1	26.5	-8.1	9.6
Head Resultant	**g**	9.3	12.9	0.0	-45.8
Upper Neck Fx	**N**	108.2	17.4	-39.1	199.7
Upper Neck Fy	**N**	10.9	148.0	-78.4	21.1
Upper Neck Fz	**N**	69.5	26.4	-224.7	12.9
Upper Neck F Resultant	**N**	247.4	12.9	0.1	-47.6
Upper Neck Mx	**N-m**	3.2	12.7	-5.7	29.9
Upper Neck My	**N-m**	10.1	16.2	-7.8	41.2
Upper Neck Mz	**N-m**	2.3	66.2	-2.8	23.1
Upper Neck M Resultant	**N-m**	10.4	16.2	0.0	-36.4
Chest X	**g**	25.6	8.7	-2.0	46.9
Chest Y	**g**	1.2	11.3	-9.3	13.4
Chest Z	**g**	0.4	67.9	-1.8	13.4
Chest Resultant	**g**	25.6	8.7	0.0	-16.5
Chest Displacement	**mm**	1.8	28.5	-0.3	9.8
Pelvic X	**g**	5.6	13.9	-2.4	11.8
Pelvic Y	**g**	3.0	11.9	-5.6	15.8
Pelvic Z	**g**	2.5	12.9	-5.5	12.0
Pelvic Resultant	**g**	7.2	13.6	0.0	-19.3

DATA SHEET 4

CHILD DUMMY INJURY CRITERIA VALUES (CONTINUED)

NHTSA No. M45800TWG2

	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	1.2	9.0	22.7	5.9	1.2	9.0	22.7	5.9

	CLIP SUMMARY*			
	CLIP (g's)	t_1 (msec)	t_2 (msec)	CSI
Position #2 – Right Front	11.1	7.7	10.7	6.9

* 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	0.06	20.6	0.5	99.9	5.2
Nte	0.23	41.7	28.7	11.6	-8.0
Ncf	0.16	13.7	-217.2	84.8	8.2
Nce	0.03	8.5	-82.9	-4.7	-0.1

Peak Tension (CFC1000) 69.5 N **Peak Compression (CFC1000) -224.7 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

Condyle Offset -0.01778

APPENDIX A

PHOTOGRAPHS

TABLE OF PHOTOGRAPHS

Figure	Photograph Title	Page
Figure A- 1	PRE-TEST VEHICLE LEFT SIDE VIEW	A- 3
Figure A- 2	POST-TEST VEHICLE LEFT SIDE VIEW	A- 3
Figure A- 3	VEHICLE CERTIFICATION PLACARD	A- 4
Figure A- 4	VEHICLE TIRE PLACARD	A- 4
Figure A- 5	PRE-TEST FRONTAL VIEW OF DUMMY	A- 5
Figure A- 6	POST-TEST FRONTAL VIEW OF DUMMY	A- 5
Figure A- 7	PRE-TEST RIGHT SIDE VIEW OF DUMMY	A- 6
Figure A- 8	POST-TEST RIGHT SIDE VIEW OF DUMMY	A- 6
Figure A- 9	PRE-TEST LEFT SIDE VIEW OF DUMMY	A- 7
Figure A- 10	POST-TEST LEFT SIDE VIEW OF DUMMY	A- 7

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

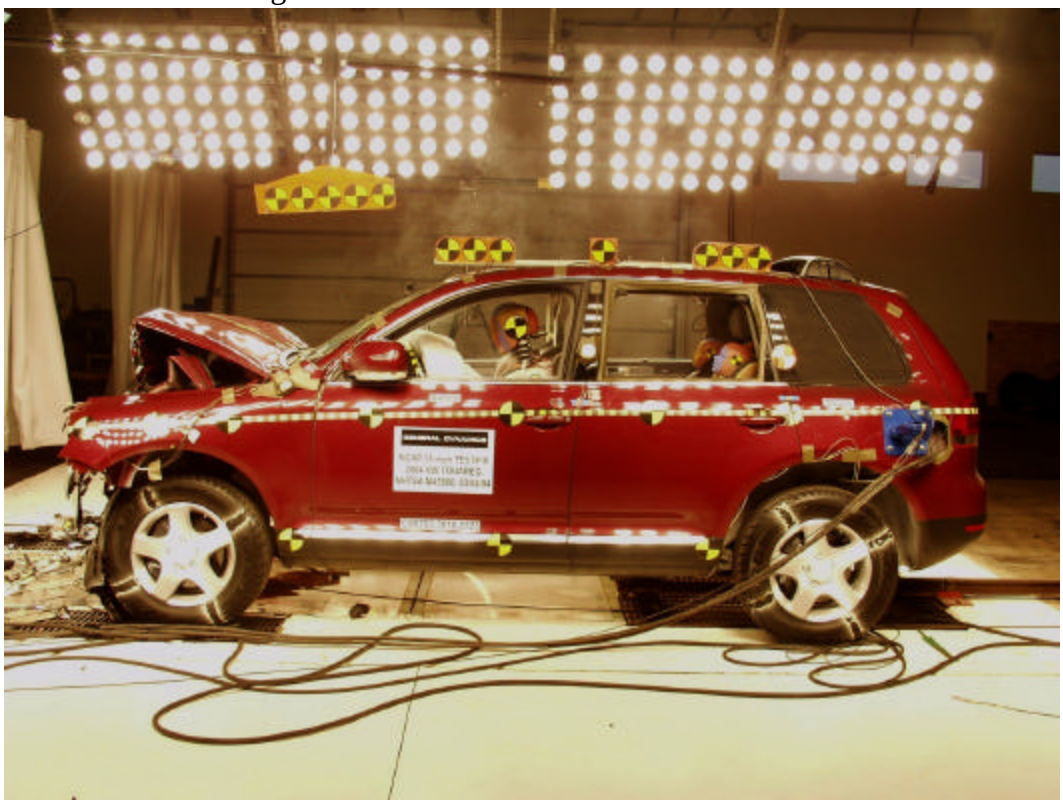


Figure A-2: Post-Test Vehicle Left Side View

Figure A-3: Vehicle Certification Placard

Figure A-4: Vehicle Tire Placard

Figure A-5: Pre-Test Frontal View of Dummy

Figure A-6: Post-Test Frontal View of Dummy

Figure A-7: Pre-Test Left Side View of Dummy

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

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

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

APPENDIX B

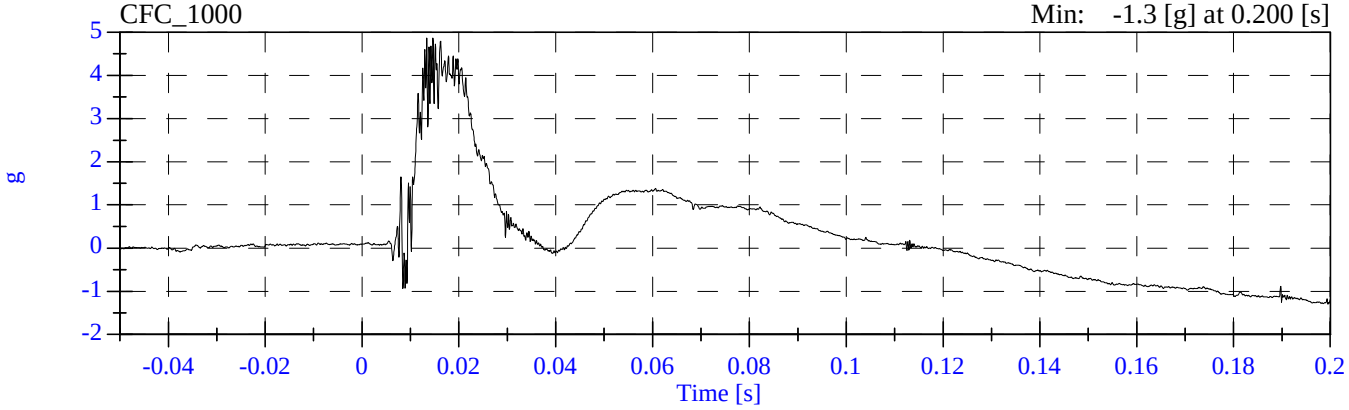
CHILD DUMMY RESPONSE DATA TRACES

TABLE OF DATA PLOTS

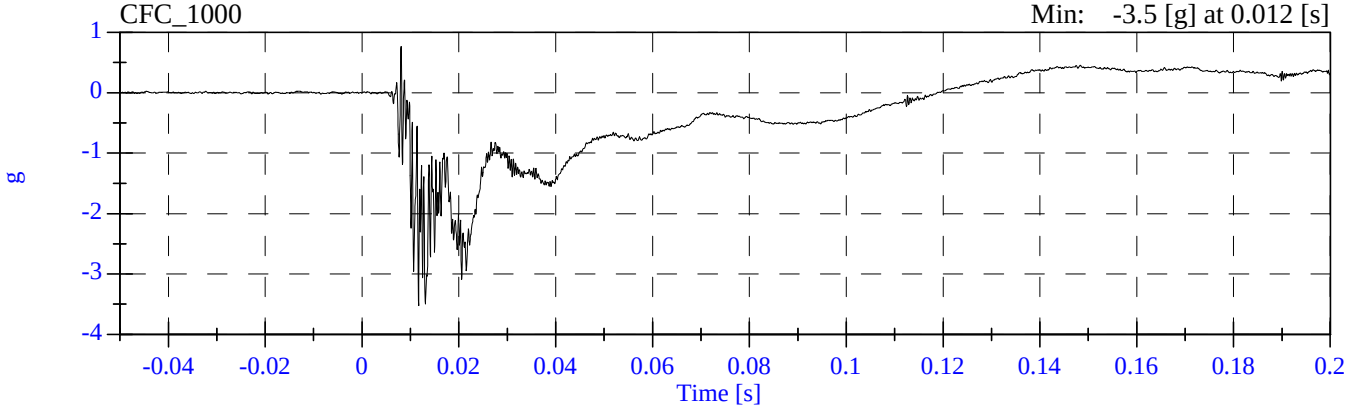
PLOT	PLOT NAME[UNITS, CHANNEL FILTER CLASS]	PAGE
1	P2 Head x [g, CFC_1000]	B-3
2	P2 Head y [g, CFC_1000]	B-3
3	P2 Head z [g, CFC_1000]	B-3
4	P2 Head Resultant [g, CFC_1000]	B-3
5	P2 Upper Neck Fx [N, CFC_1000]	B-4
6	P2 Upper Neck Fy [N, CFC_1000]	B-4
7	P2 Upper Neck Fz [N, CFC_1000]	B-4
8	P2 Upper Neck F Resultant [N, CFC_1000]	B-4
9	P2 Upper Neck Mx [N-m, CFC_600]	B-5
10	P2 Upper Neck My [N-m, CFC_600]	B-5
11	P2 Upper Neck Mz [N-m, CFC_600]	B-5
12	P2 Upper Neck M Resultant [N-m, CFC_600]	B-5
13	P2 Chest x [g, CFC_180]	B-6
14	P2 Chest y [g, CFC_180]	B-6
15	P2 Chest z [g, CFC_180]	B-6
16	P2 Chest Resultant [g, CFC_180]	B-6
17	P2 Chest Displacement [mm, CFC_600]	B-7
18	P2 Pelvic x [g, CFC_1000]	B-8
19	P2 Pelvic y [g, CFC_1000]	B-8
20	P2 Pelvic z [g, CFC_1000]	B-8
21	P2 Pelvic Resultant [g, CFC_1000]	B-8

TWG08 - 2004 Volkswagen Touareg
M45800TWG2 - May 25, 2004

V1P2 Head x
CFC_1000
Max: 4.9 [g] at 0.013 [s]
Min: -1.3 [g] at 0.200 [s]



V1P2 Head y
CFC_1000
Max: 0.8 [g] at 0.008 [s]
Min: -3.5 [g] at 0.012 [s]



V1P2 Head z
CFC_1000
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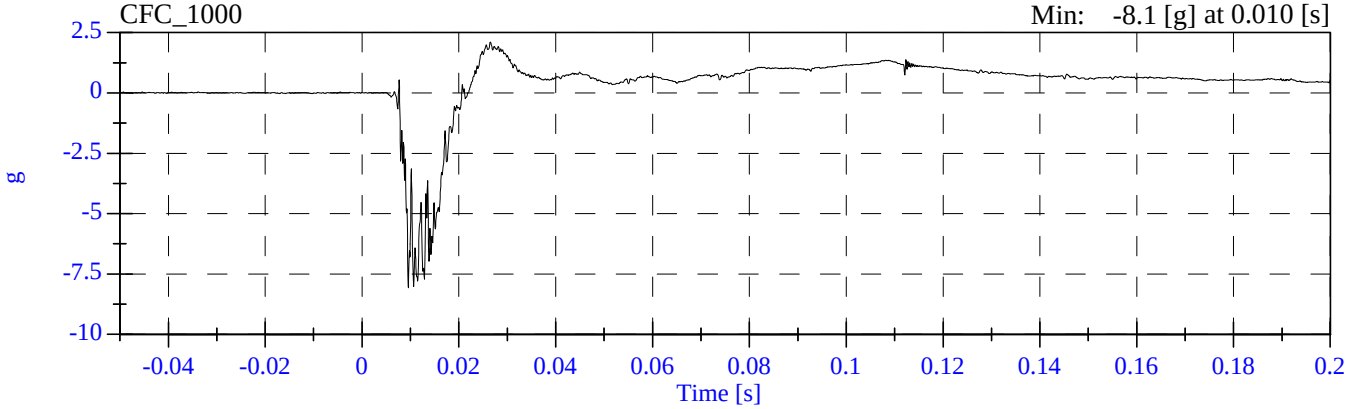
Min: -8.1 [g] at 0.010 [s]



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CFC_1000
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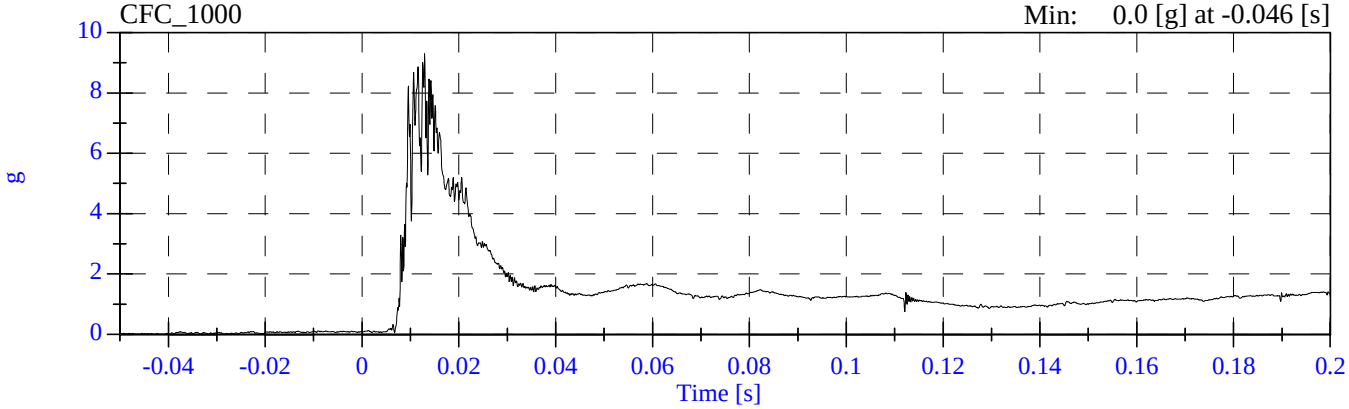
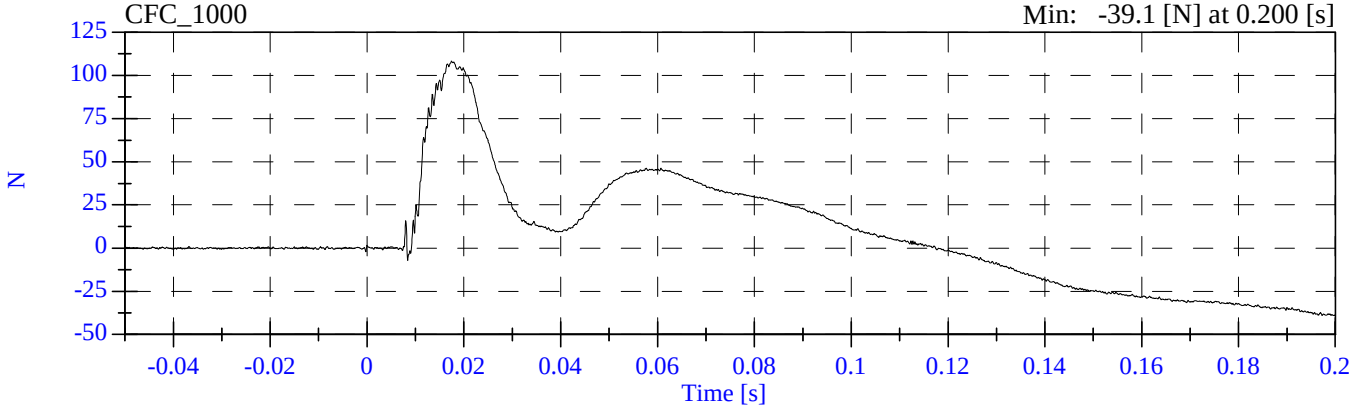
Min: 0.0 [g] at -0.046 [s]



TWG08 - 2004 Volkswagen Touareg
M45800TWG2 - May 25, 2004

V1P2 Upper Neck Fx
CFC_1000
Max: 108.2 [N] at 0.017 [s]
Min: -39.1 [N] at 0.200 [s]



V1P2 Upper Neck Fy
CFC_1000
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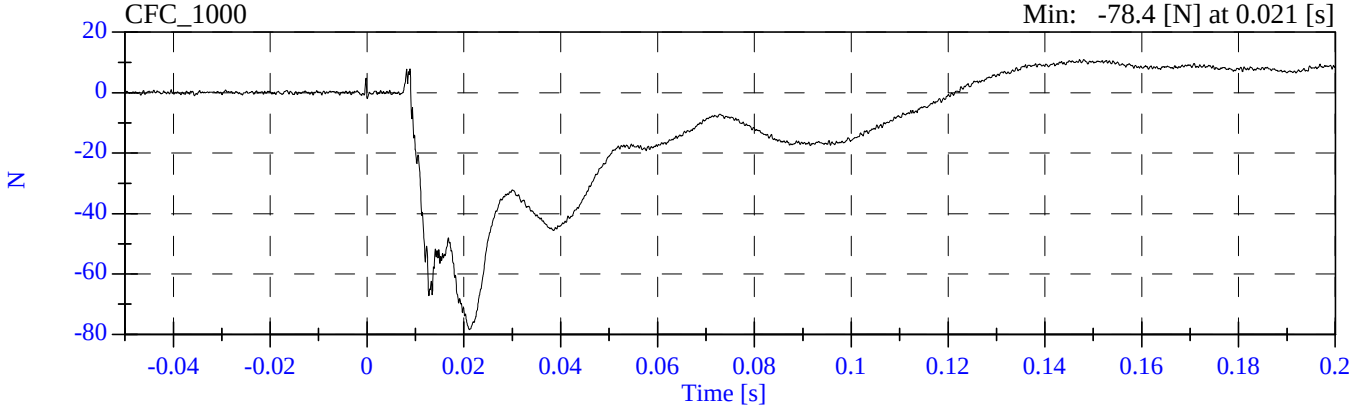
Min: -78.4 [N] at 0.021 [s]



V1P2 Upper Neck Fz
CFC_1000
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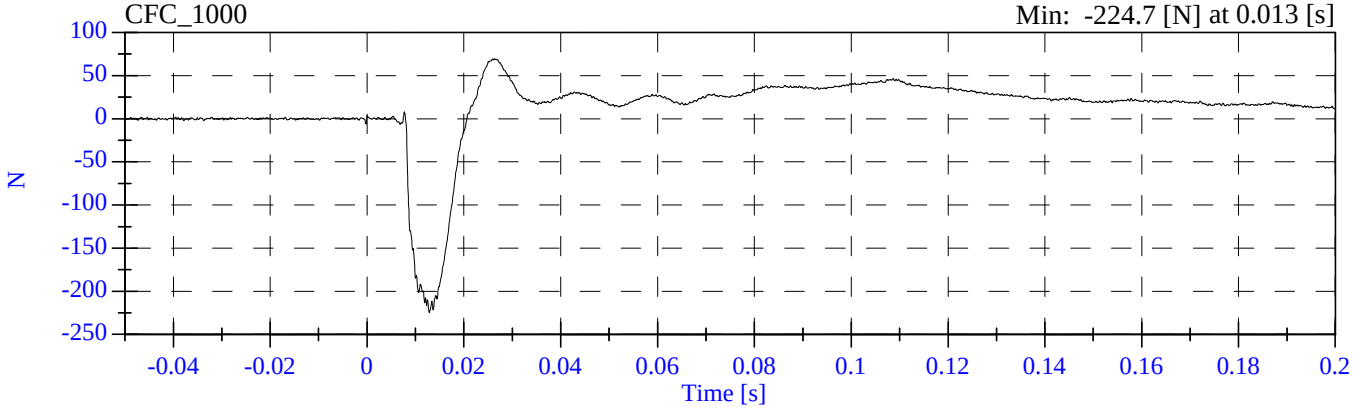
Min: -224.7 [N] at 0.013 [s]



V1P2 Upper Neck F Resultant
CFC_1000
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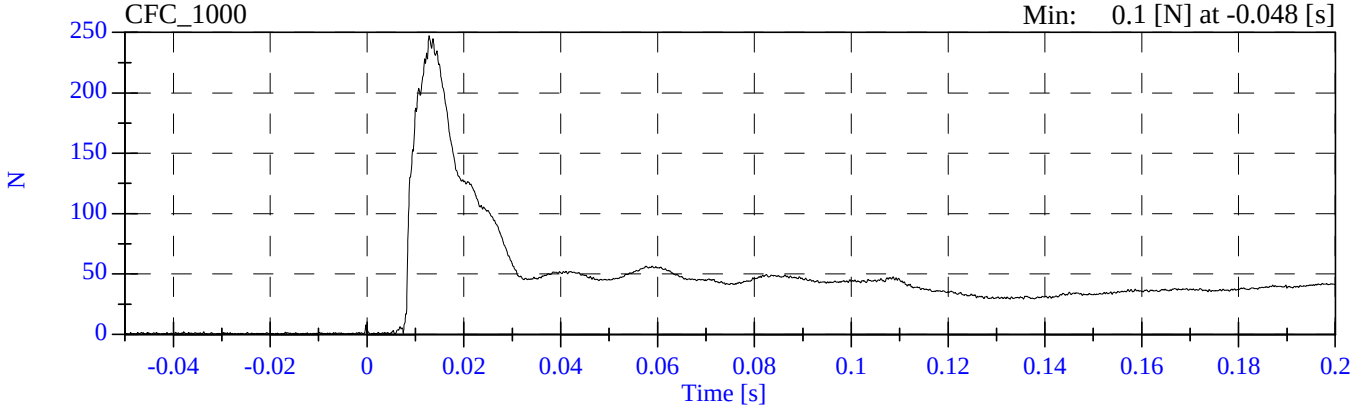
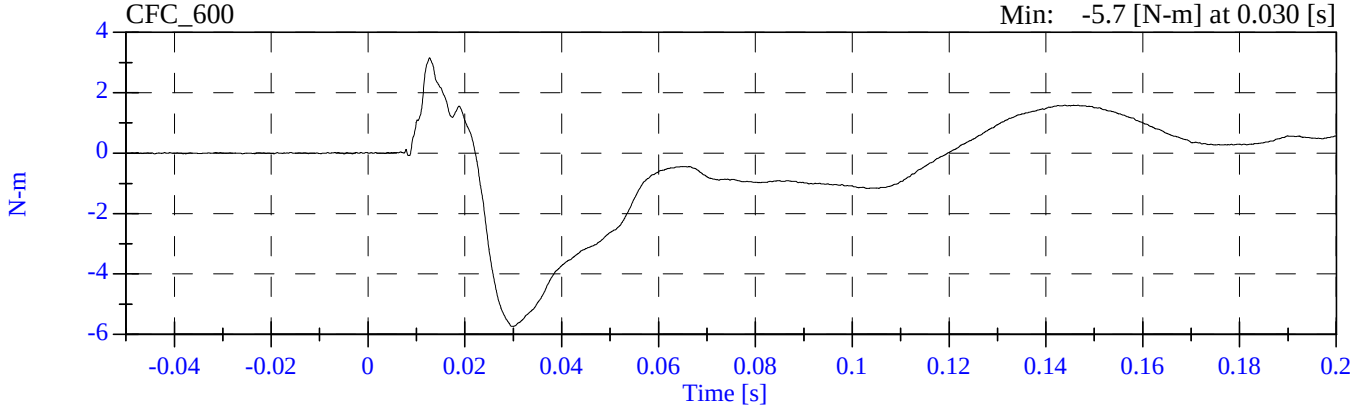
Min: 0.1 [N] at -0.048 [s]

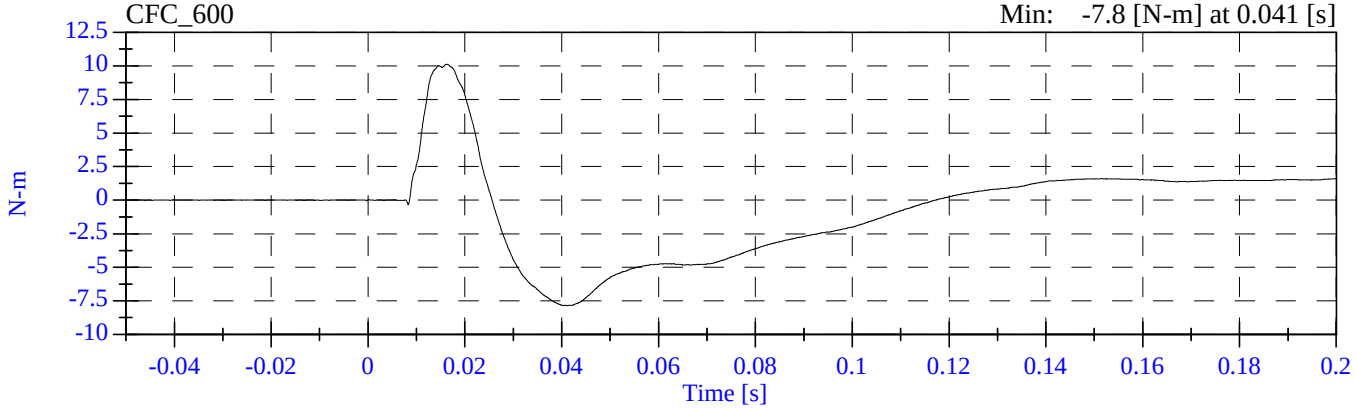


TWG08 - 2004 Volkswagen Touareg
M45800TWG2 - May 25, 2004

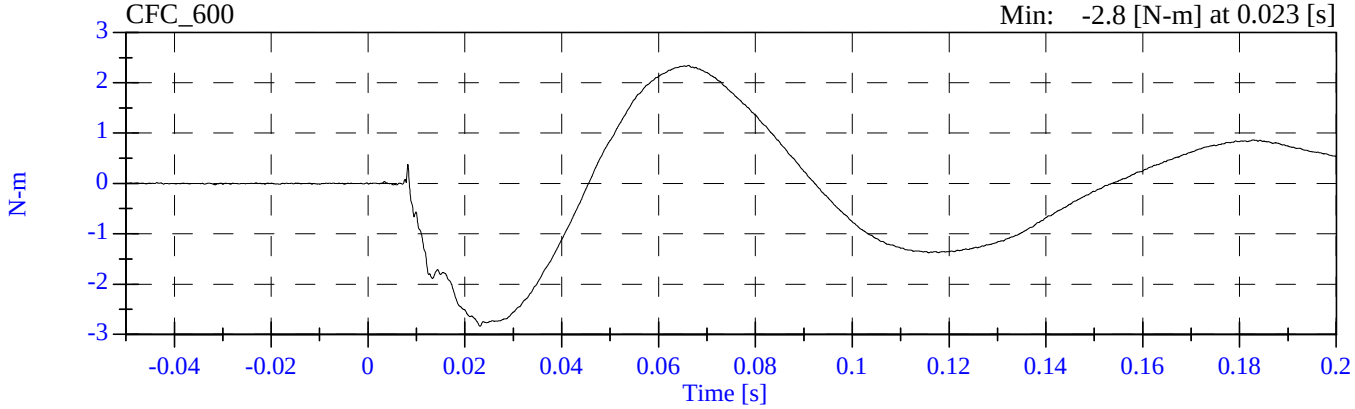
V1P2 Upper Neck Mx
CFC_600
Max: 3.2 [N-m] at 0.013 [s]
Min: -5.7 [N-m] at 0.030 [s]



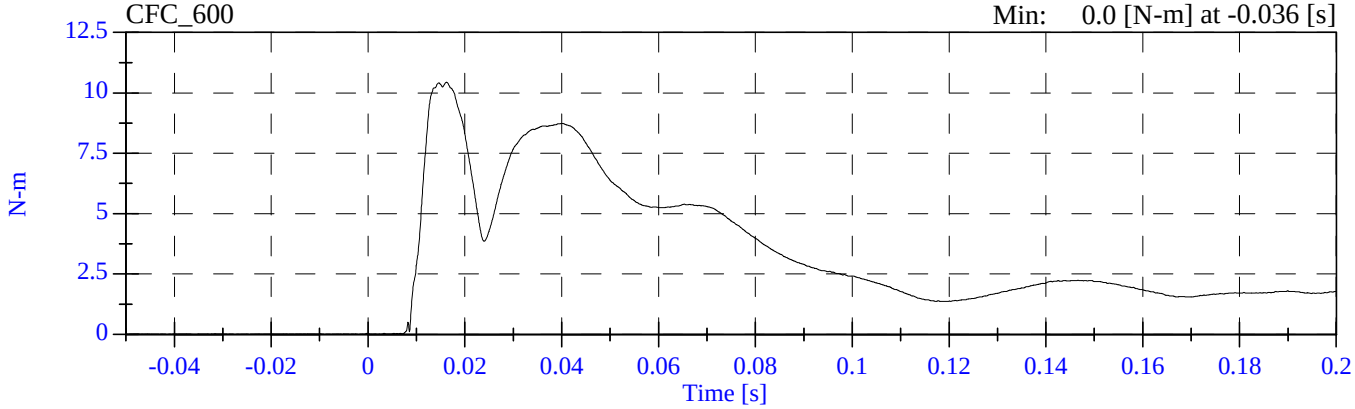
V1P2 Upper Neck My
CFC_600
Max: 10.1 [N-m] at 0.016 [s]
Min: -7.8 [N-m] at 0.041 [s]



V1P2 Upper Neck Mz
CFC_600
Max: 2.3 [N-m] at 0.066 [s]
Min: -2.8 [N-m] at 0.023 [s]

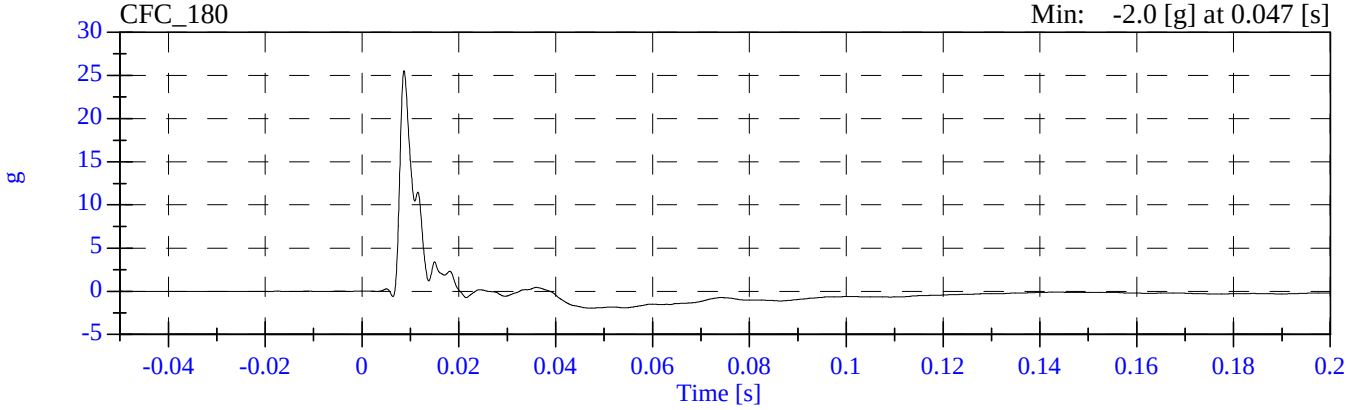


V1P2 Upper Neck M Resultant
CFC_600
Max: 10.4 [N-m] at 0.016 [s]
Min: 0.0 [N-m] at -0.036 [s]

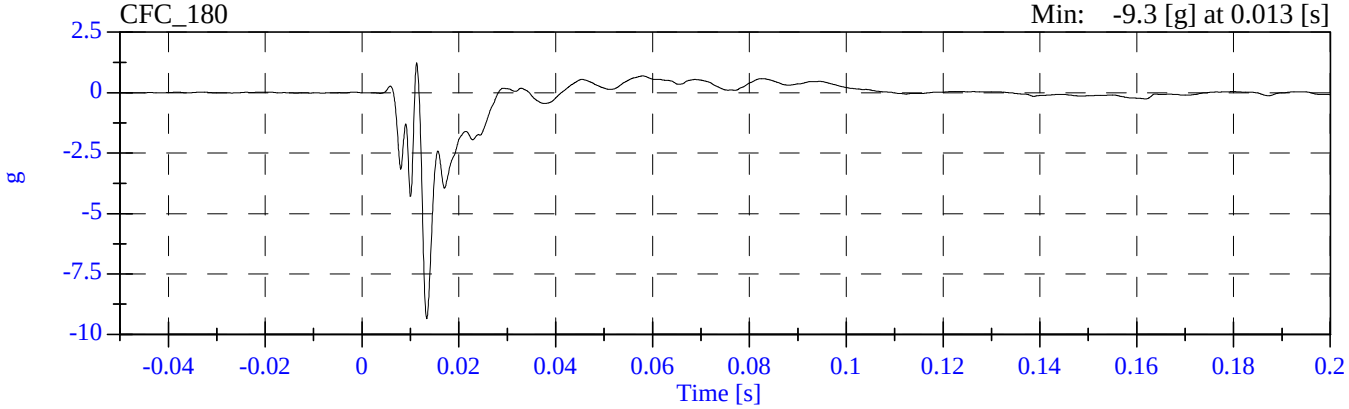


TWG08 - 2004 Volkswagen Touareg
M45800TWG2 - May 25, 2004

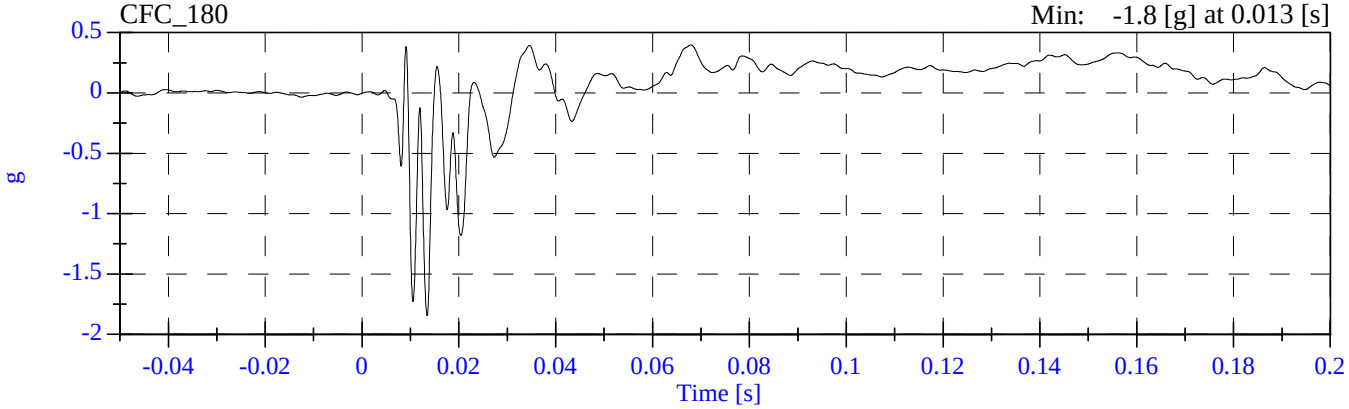
V1P2 Chest x
CFC_180
Max: 25.6 [g] at 0.009 [s]
Min: -2.0 [g] at 0.047 [s]



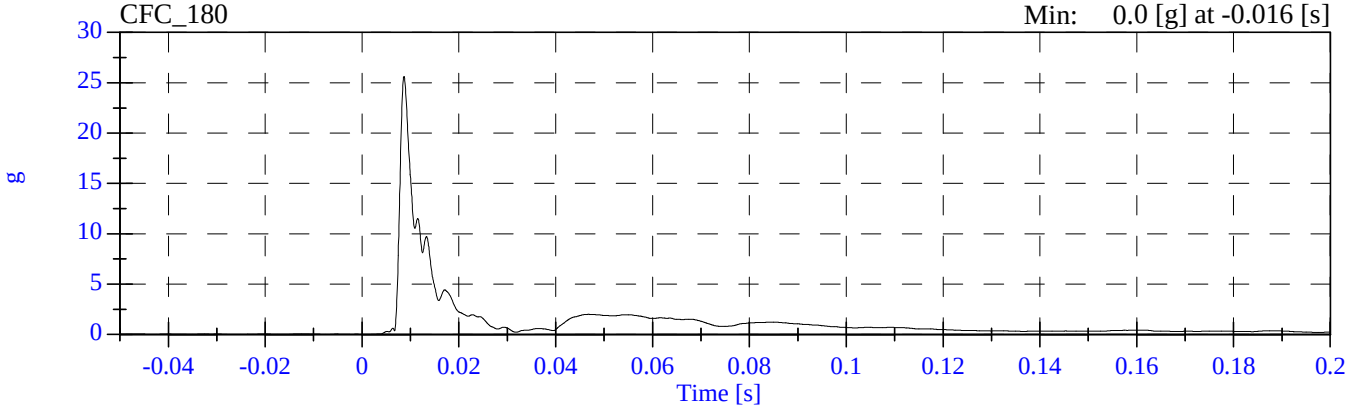
V1P2 Chest y
CFC_180
Max: 1.2 [g] at 0.011 [s]
Min: -9.3 [g] at 0.013 [s]



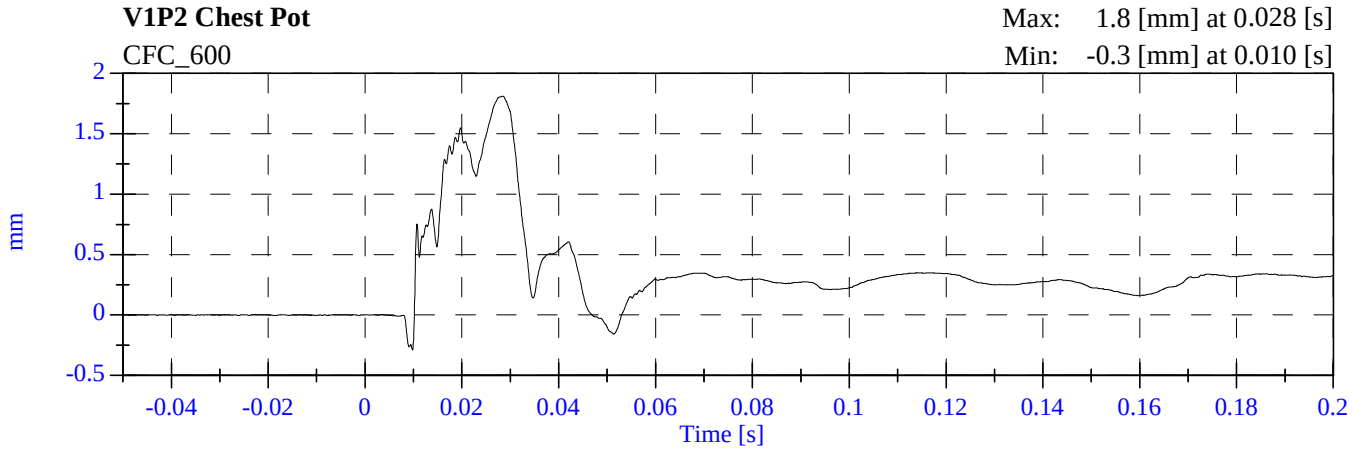
V1P2 Chest z
CFC_180
Max: 0.4 [g] at 0.068 [s]
Min: -1.8 [g] at 0.013 [s]



V1P2 Chest Resultant
CFC_180
Max: 25.6 [g] at 0.009 [s]
Min: 0.0 [g] at -0.016 [s]

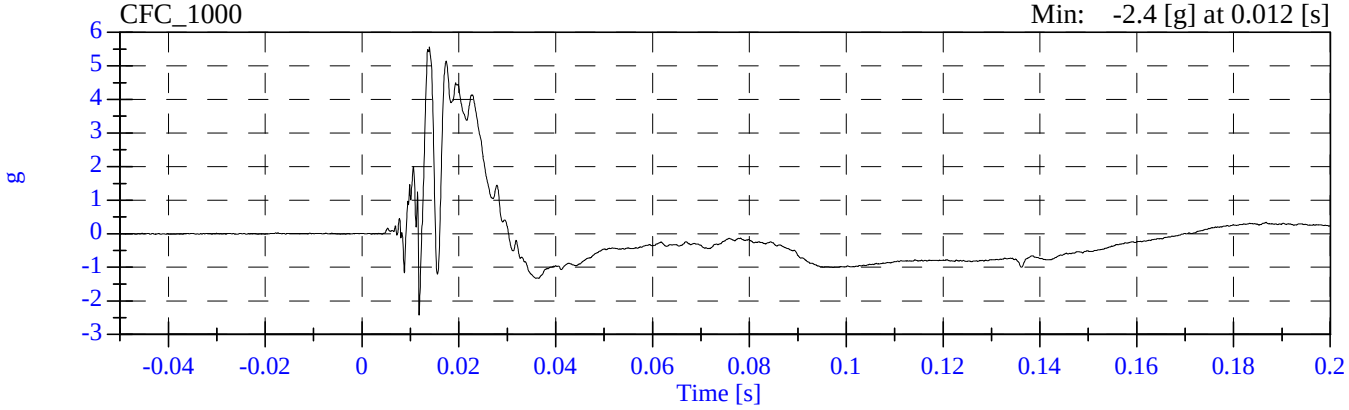


TWG08 - 2004 Volkswagen Touareg
M45800TWG2 - May 25, 2004

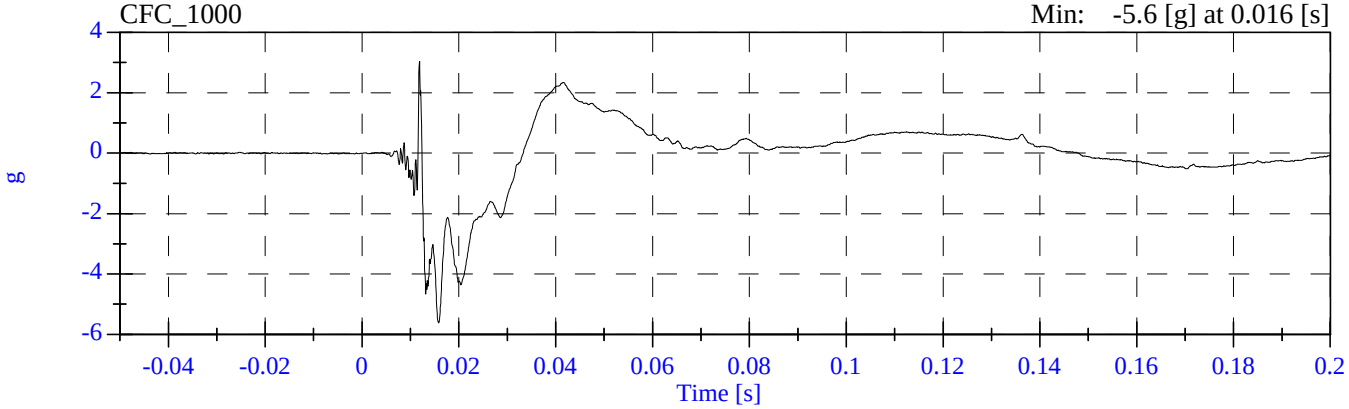


TWG08 - 2004 Volkswagen Touareg
M45800TWG2 - May 25, 2004

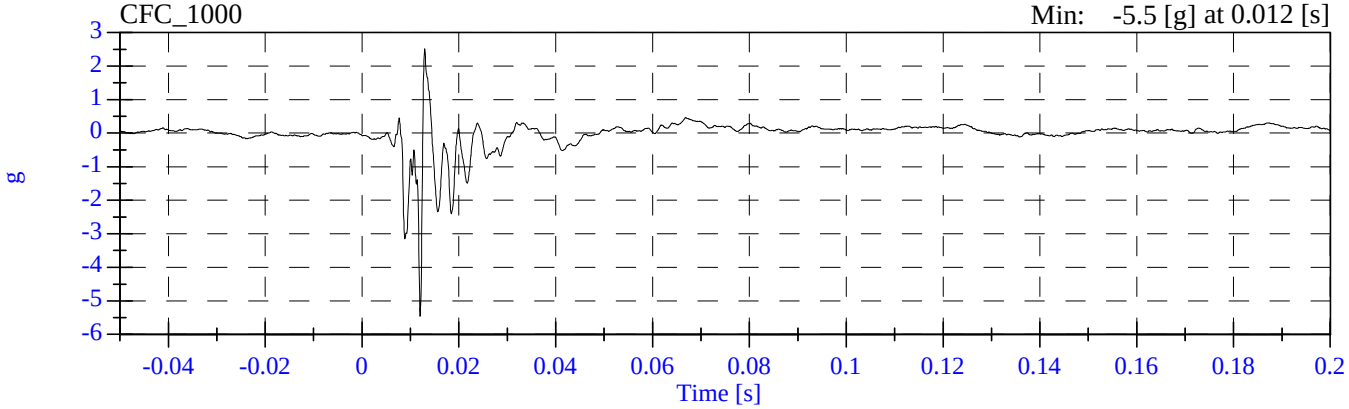
V1P2 Pelvic x
CFC_1000
Max: 5.6 [g] at 0.014 [s]
Min: -2.4 [g] at 0.012 [s]



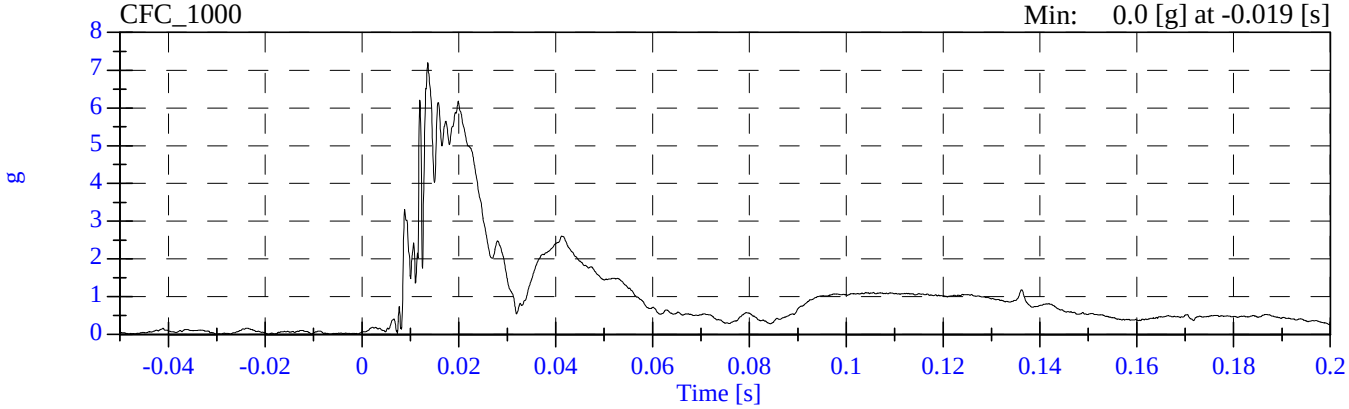
V1P2 Pelvic y
CFC_1000
Max: 3.0 [g] at 0.012 [s]
Min: -5.6 [g] at 0.016 [s]



V1P2 Pelvic z
CFC_1000
Max: 2.5 [g] at 0.013 [s]
Min: -5.5 [g] at 0.012 [s]



V1P2 Pelvic Resultant
CFC_1000
Max: 7.2 [g] at 0.014 [s]
Min: 0.0 [g] at -0.019 [s]



APPENDIX C

TEST EQUIPMENT LIST AND CALIBRATION INFORMATION

TEST EQUIPMENT LIST AND CALIBRATION INFORMATION

P572N INSTRUMENTATION

	POSITION #2 (RIGHT FRONT) SERIAL NO.: 182		
	SERIAL NUMBER	MANUFACTURER	CALIBRATION DATE
HEAD AX	AC-AGN83	ENDEVCO	04-May-04
HEAD AY	AC-ACC63	ENDEVCO	04-May-04
HEAD AZ	AC-AJ4G1	ENDEVCO	04-May-04
UPPER NECK FX	LC-1563Fx	DENTON	29-Sep-03
UPPER NECK FY	LC-1563Fy	DENTON	29-Sep-03
UPPER NECK FZ	LC-1563Fz	DENTON	29-Sep-03
UPPER NECK MX	LC-1563Mx	DENTON	29-Sep-03
UPPER NECK MY	LC-1563My	DENTON	29-Sep-03
UPPER NECK MZ	LC-1563Mz	DENTON	29-Sep-03
CHEST AX	AC-ACC02	ENDEVCO	04-May-04
CHEST AY	AC-AKAA4	ENDEVCO	04-May-04
CHEST AZ	AC-AJ4R6	ENDEVCO	04-May-04
CHEST DISPLACEMENT X	DS-182	SERVO	03-Oct-03
PELVIS AX	AC-P10095	ENDEVCO	05-May-04
PELVIS AY	AC-P18728	ENDEVCO	05-May-04
PELVIS AZ	AC-J20047	ENDEVCO	05-May-04