REPORT NUMBER: TWG-CAL-13-03

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

Chrysler Group LLC
2013 Dodge Dart
Four Door Sedan

NHTSA NUMBER: MD0303TWG3
CALSPAN TEST NUMBER: CT2013-03

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

January 16, 2013

FINAL REPORT

Alpha Technology Associate, Inc.
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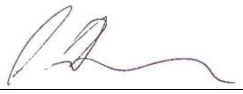
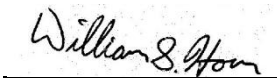
Fairfax, VA 22031

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 3GC171. 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.

Prepared By: 

Adam Hardbattle, Project Engineer

Approved By: 

William Horn, Project Manager

Approval Date: _____

FINAL REPORT ACCEPTANCE BY:

Accepted By: _____

Acceptance Date: _____

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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 January 14, 2013.

Injury Summary

HIC15	Maximum Chest Displacement (mm)	Maximum Chest Displacement Rate (m/s)	NIJ(NTF)	NIJ(NTE)	NIJ(NCF)	NIJ(NCE)
147.047	N/A	N/A	0.097	0.207	0.048	0.101

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

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TABLE OF CONTENTS

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 3GC171.

1.2 SUMMARY

The effects of both a seat-mounted side airbag and a curtain airbag deployment in a 2013 Dodge Dart Four Door Sedan on an out-of-position SIDIIs (Hybrid III 5th female anthropomorphic test device (ATD) and HIII-3YO were evaluated simultaneously. The tests were performed by Calspan on January 14, 2013. Pre-and post-test photographs of the vehicle and ATD can be found in Appendix A.

One high-speed digital camera was used to document the side airbag deployment event. Images were recorded at rates of 1000 frames per second. The camera was placed perpendicular to the right-rear seat centerline to capture the deployment event from the side.

The HIII-3YO anthropomorphic test device (ATD) was placed in the right rear (passenger) seat situated perpendicular to the centerline of the seat, facing upwards in the 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 3.3.3.4

The 3YO ATD was instrumented with head x, y and z accelerometers (primary). In addition, six upper axial neck forces, and moment load cell sensors and six lower 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 HIII-3YO ATD was positioned facing upwards on the right rear (passenger) seat lying cross car with its head against the right rear door. The seat track was adjusted to locate the head c.g. on top of 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 body was moved outboard until the dummy's head contacted the door trim panel armrest. The center of gravity of the head was centered in the deployment trajectory of the airbag. The ATD's arms were straight at its side. This orientation complies with section 3.3.3.4 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:	P3	Right Rear Seating Position
Test:	3.3.3.4	Upward Facing HIII-3YO on Seat (Driver and Passenger Positions with Seat-Mounted Airbags)
Airbag:	Seat	Seat mounted – outside seam
Booster Block:	N/A	N/A
ATD Type/Serial No.:	8012	HIII-3YO

Number of Data Channels:	17	
Number of Cameras:	0	Real Time
	1	High Speed Digital
	0	High Speed Film

VISIBLE DUMMY CONTACT POINTS

Head Contact:	Pelvis Airbag & Seat Back
Upper Torso Contact:	Seat Bottom & Seat Back
Lower Torso Contact:	Seat Bottom
Left Knee Contact:	None
Right Knee Contact:	None

DATA SHEET NO. 2
VEHICLE PARAMETER DATA

TEST VEHICLE INFORMATION:

Year/Make/Model/Body Style: 2013 Dodge Dart Four Door Sedan

NHTSA No. : MD0303TWG3 VIN: 1C3CDFBA7DD708372 Color: Light Grey/Silver

Engine Data: 4 cylinders; - CID; 2.0 Liters; - cc

Placement: - Longitudinal or In-Line; Lateral 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; - 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: 9/6/2011; Odometer Reading 56.3 Km

Selling Dealer: Transitown Dodge Chrysler Jeep

& Address: Amherst, NY 14226

DATA FROM TIRE VEHICLE'S CERTIFICATION LABEL:

Vehicle Manufactured by: Chrysler Group LLC

Date of Manufacture 07/12

GVWR: 1944 kg; GAWR: 1076 kg FRONT; 870 kg REAR

DATA FROM TIRE PLACARD:

Recommended Tire Size: P225/45R17

*Recommended Cold Tire Pressure: 235 Kpa Front 235 kpa Rear

DATA FROM TIRE SIDEWALL:

Size of Tires on Test Vehicle: P225/45R17; Manufacturer: Continental

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

Treadwear: 500; Traction: AA: 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) = 374 Kg

No. of Occupants x 68.04 kg = 340.2 Kg

Rated Cargo/Luggage Weight (RCLW) = 33.8 Kg

*Tire pressure used for test

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

DATA SHEET NO. 3
HIII 3YO DUMMY POSITIONING IN VEHICLE

NHTSA No. MD0303-TWG3

Measurement	Value
Total Fore/Aft Travel (mm)	220
Test Distance Rearward of Full-Forward (mm)	110
Total Fore/Aft Travel (Detents)	22
Placed in Position #	11

Seat Back Angle	SA (^{o})	Value
Head CG to Door Panel/Side Window	HD (mm)	0
Head to Seat Back Centerline	HSC (mm)	-
Head to B-Pillar (cg)	HB (mm)	450
Head to Roof, Z (top of the head)	HZ (mm)	570
Head to Header	HHD (mm)	-
Chest to Dash	CD (mm)	-
Chest to Seatback	CS (mm)	-

DATA SHEET 4

HIII 3YO DUMMY INJURY CRITERIA VALUES

NHTSA No.: MD0303TWG3

Channel	Max	Time (ms)	Min	Time (ms)
V1P3 Head x [g , CFC_1000]	94.975	2.850	-6.425	29.000
V1P3 Head y [g , CFC_1000]	33.002	7.400	-4.855	26.450
V1P3 Head z [g , CFC_1000]	3.612	2.150	-21.411	2.750
V1P3 Headform Resultant [g, CFC_1000]	102.180	2.850	0	0
V1P3 Upper Neck Mocy [N-m, CFC_600]	10.600	34.350	-7.687	7.050
V1P3 Upper Neck Ntf [N-m, CFC_600]	0.097	24.650	0	0
V1P3 Upper Neck Nte [N-m, CFC_600]	0.207	9.400	0	0
V1P3 Upper Neck Ncf [N-m, CFC_600]	0.048	491.250	0	0
V1P3 Upper Neck Nce [N-m, CFC_600]	0.101	3.850	0	0
V1P3 Upper Neck Nij [Nij, CFC_600]	0.210	9.400	0	0
V1P3 Upper Neck Fx [N , CFC_1000]	40.779	144.950	-441.740	9.400
V1P3 Upper neck Fy [N , CFC_1000]	156.098	7.450	-82.135	481.000
V1P3 Upper neck Fz [N , CFC_1000]	445.657	6.200	-183.569	3.750
V1P3 Neck F Res	620.450	9.450	0	0
V1P3 Upper Neck Mx [N-m , CFC_600]	11.693	22.050	-7.649	470.650
V1P3 Upper Neck My [N-m , CFC_600]	9.371	34.450	-15.177	9.350
V1P3 Upper Neck Mz [N-m , CFC_600]	9.106	40.550	-4.109	89.200
V1P3 Neck M Res	15.487	9.350	0	0
V1P3 Lower Neck Fx F [N , CFC_1000]	321.962	7.950	-15.758	674.200
V1P3 Lower Neck Fy F [N , CFC_1000]	45.426	103.150	-152.969	9.600
V1P3 Lower Neck Fz F [N , CFC_1000]	108.749	3.700	-501.168	6.050
V1P3 Lower Neck Res	577.812	9.500	0	0
V1P3 Lower Neck Mx F [N-m , CFC_600]	13.235	477.250	-22.653	19.150
V1P3 Lower Neck My F [N-m , CFC_600]	1.784	145.500	-17.993	11.700
V1P3 Lower Neck Mz F [N-m , CFC_600]	7.595	34.500	-5.001	90.050
V1P3 Lower Neck Res	26.861	18.950	0	0
Pelvis Airbag Volts	39.270	0.850	-0.020	0.100
Pelvis Airbag Current	3.374	0.400	0	0.100

DATA SHEET 4

CHILD DUMMY INJURY CRITERIA VALUES (CONTINUED)

VEHICLE: 2013 Dodge Dart Four Door Sedan NHTSA No.: MD0303TWG3

HEAD INJURY CRITERIA (HIC)

	HIC15			
	HIC(15)	t_1 (msec)	t_2 (msec)	Average Acceleration t_1 to t_2
Position #3 - Right	147.047	2.050	9.850	51.164

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 3 Neck Injury Summary (HIII 3YO – In Position)

Nij V10	Nij	Time (ms)	Z Force (N)	X Force (N)	Y Moment (N-m)
Ntf	0.097	24.650	220.636	-126.275	7.022
Nte	0.207	9.400	414.316	-435.831	-7.427
Ncf	0.048	491.250	-18.044	-64.814	6.658
Nce	0.101	3.850	-175.669	-269.960	-3.752

Peak Tension (CFC1000) 445.657 **N** **Peak Compression (CFC1000)** -183.569 **N**

Critical Values

Nij Intercepts				Peak Limits	
Tension (CVt)	4287 N	Extension (mCVe)	67 N-m	Tension	2070 N
Compression (CVc)	3880 N	Flexion (mCVf)	155 N-m	Compression	2520 N

APPENDIX A

PHOTOGRAPHS

TABLE OF PHOTOGRAPHS

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 3YO Dummy Left Side View

Figure A-6: Post-Test 3YO Dummy Left Side View

Figure A-7: Pre-Test 3YO Dummy Left Side Close-up View

Figure A-8: Post-Test 3YO Dummy Left Side Close-up View

Figure A-9: Pre-Test 3YO Dummy Left ¾ Front View

Figure A-10: Post-Test 3YO Dummy Left ¾ Front View

Figure A-11: Pre-Test 3YO Dummy Left ¾ Front Close-up View

Figure A-12: Post-Test 3YO Dummy Left ¾ Front Close-up View

Figure A-13: Pre-Test 3YO Dummy Front View

Figure A-14: Post-Test 3YO Dummy Front View

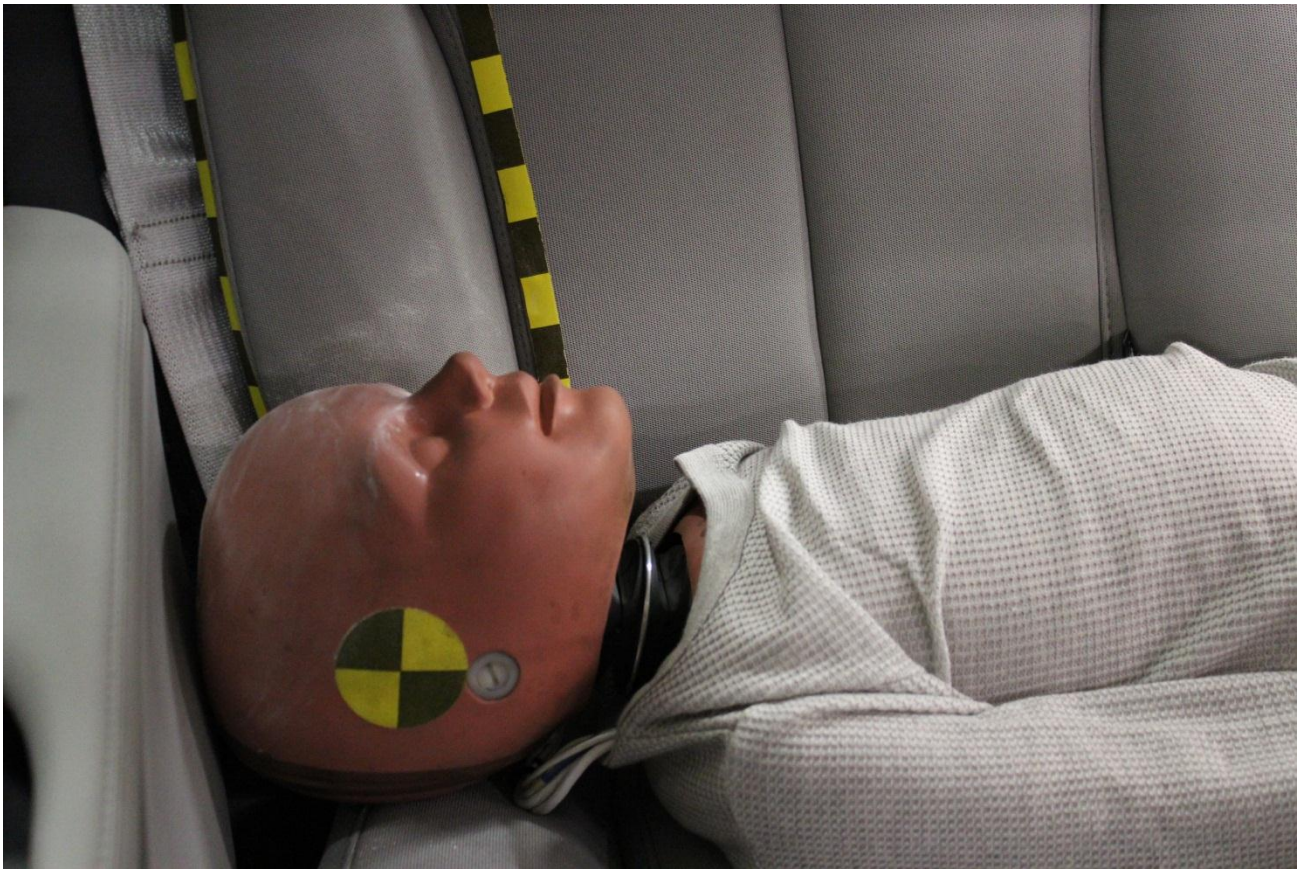


Figure A-15: Pre-Test 3YO Dummy Front Close-up View

Figure A-16: Pre-Test 3YO Dummy Right Side View

Figure A-17: Post-Test Curtain Airbag Left Side View

Figure A-18: Post-Test Curtain Airbag Left ¾ Front View

Figure A-19: Post-Test Curtain Airbag Front View

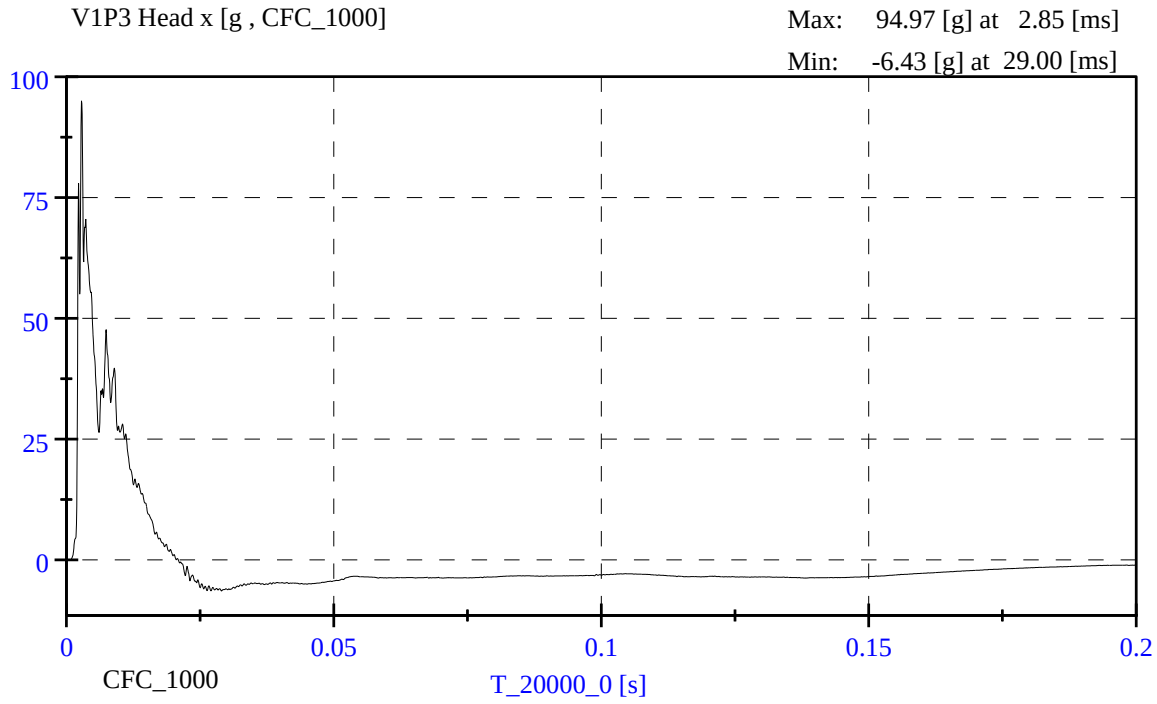
Figure A-20: Post-Test Curtain Airbag Right Side View

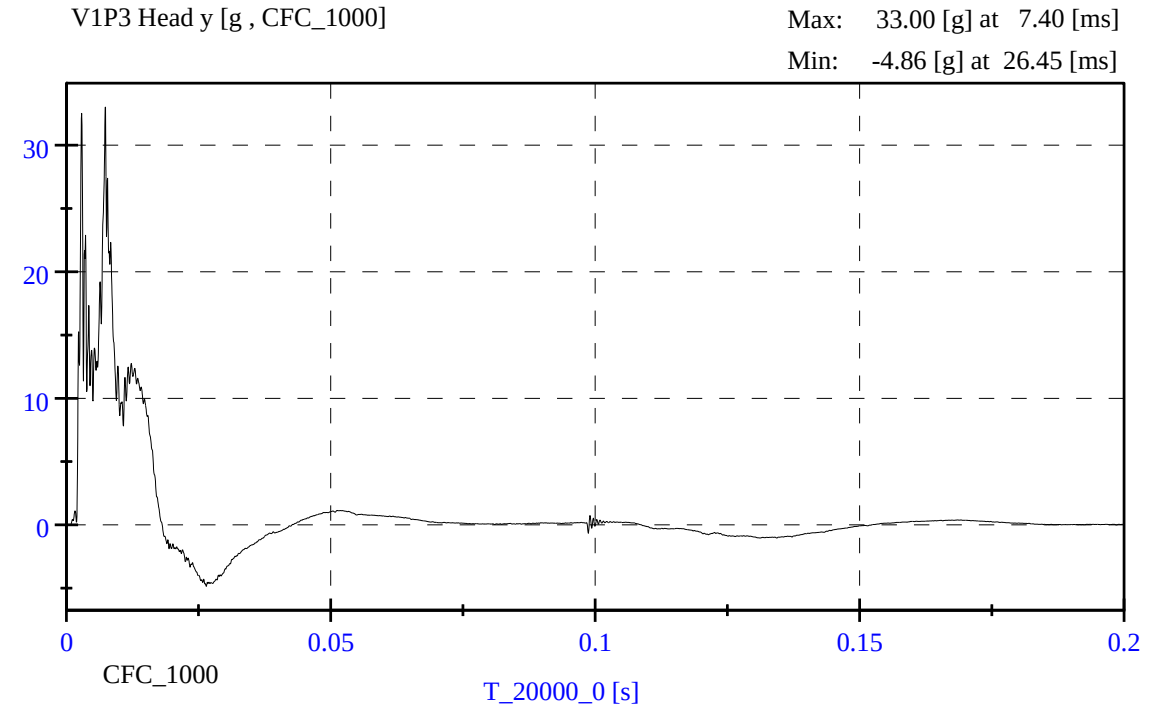
Figure A-21: Pre-Test NCAP Left Side View

Figure A-22: Post-Test NCAP Left Side View

Appendix B
Vehicle and Dummy Plots

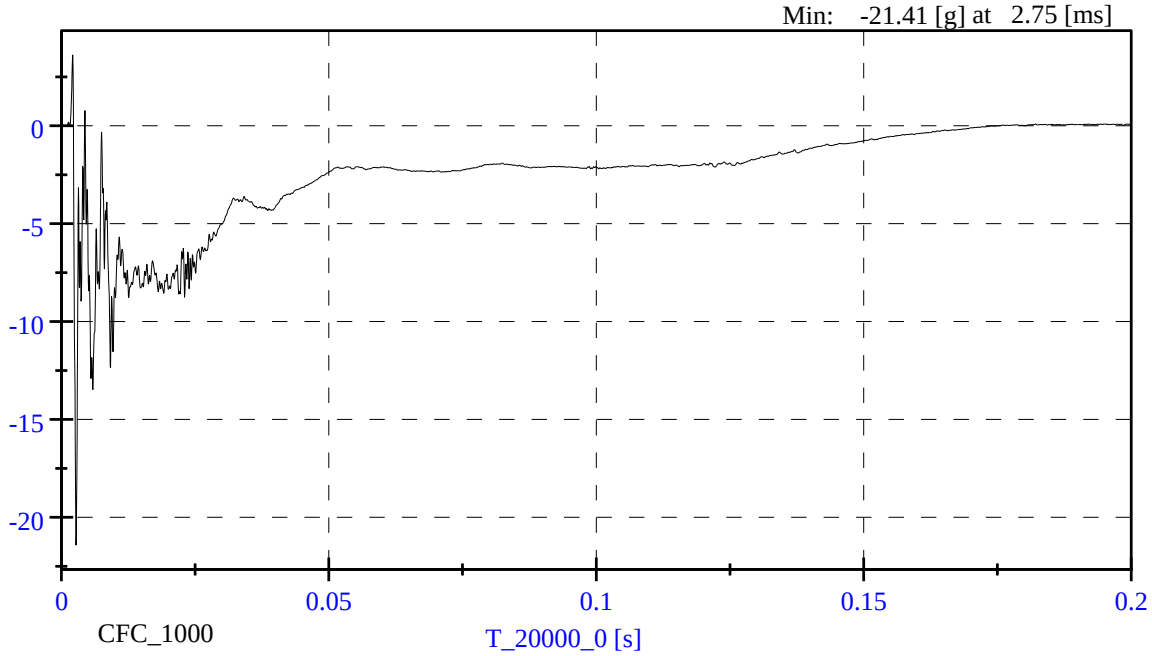
Table of Data Plots


V1P3 Head x [g , CFC_1000]
Max: 94.97 [g] at 2.85 [ms]
Min: -6.43 [g] at 29.00 [ms]
100
75
50
25
0
0
0.05
0.1
0.15
0.2
CFC_1000
T_20000_0 [s]


V1P3 Head y [g , CFC_1000]
Max: 33.00 [g] at 7.40 [ms]
Min: -4.86 [g] at 26.45 [ms]
30
20
10
0
0
0.05
0.1
0.15
0.2
CFC_1000
T_20000_0 [s]

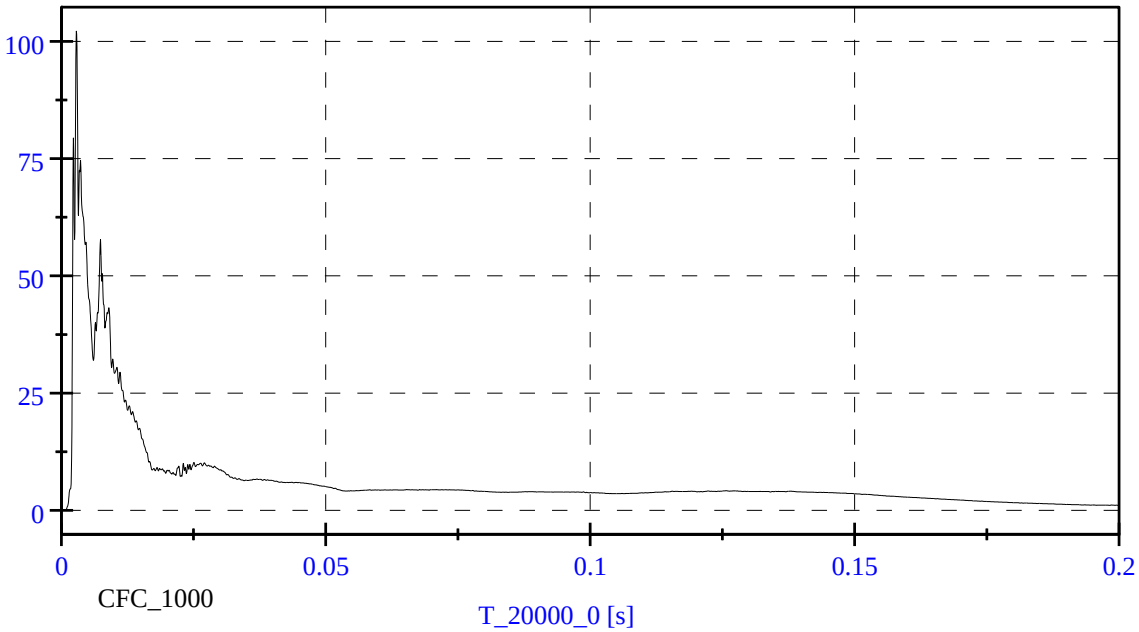
V1P3 Head z [g , CFC_1000]

Max: 3.61 [g] at 2.15 [ms]
Min: -21.41 [g] at 2.75 [ms]



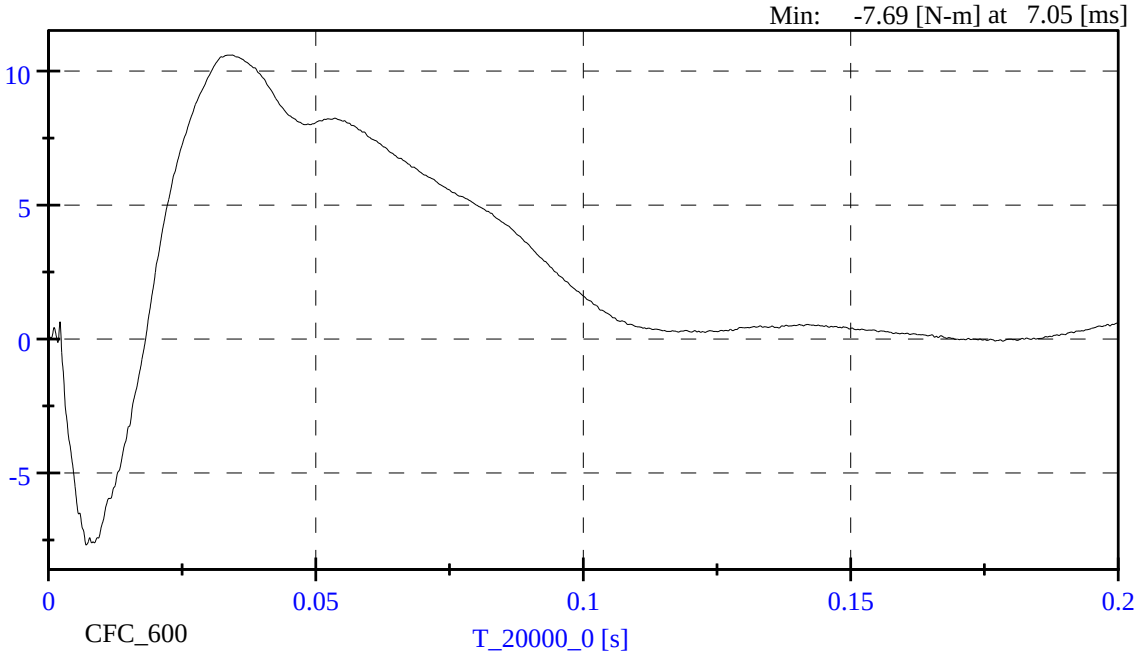
V1P3 Headform Resultant [g, CFC_1000]

Max: 102.18 [g] at 2.85 [ms]
Min: 0.00 [g] at 0.00 [ms]



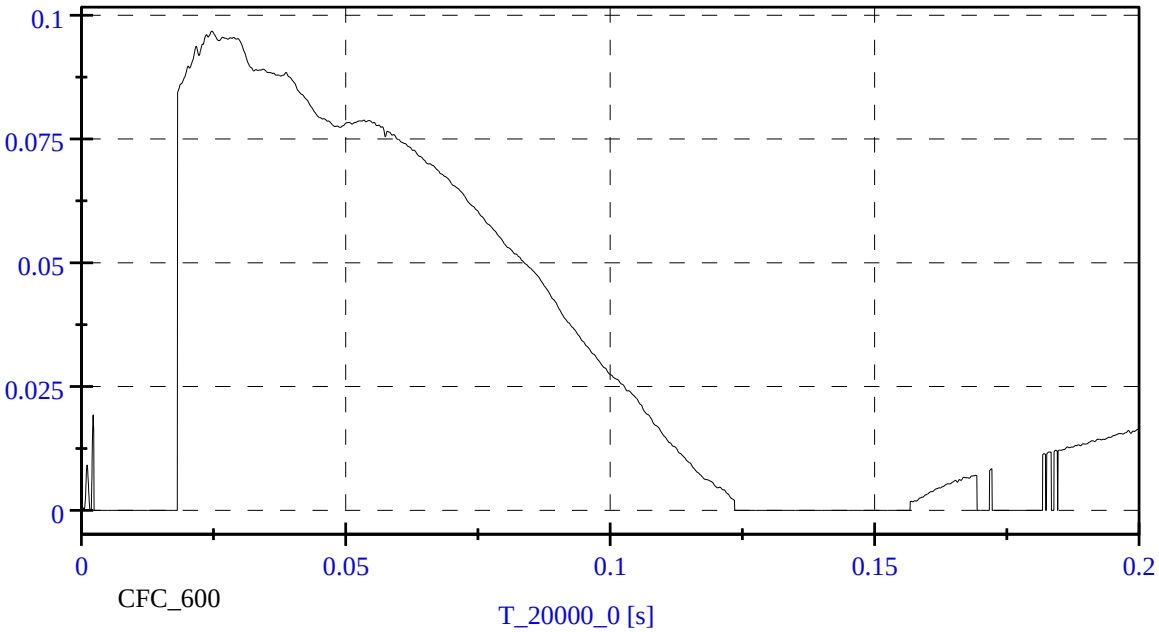
V1P3 Upper Neck Mocy [N-m, CFC_600]

Max: 10.60 [N-m] at 34.35 [ms]
Min: -7.69 [N-m] at 7.05 [ms]



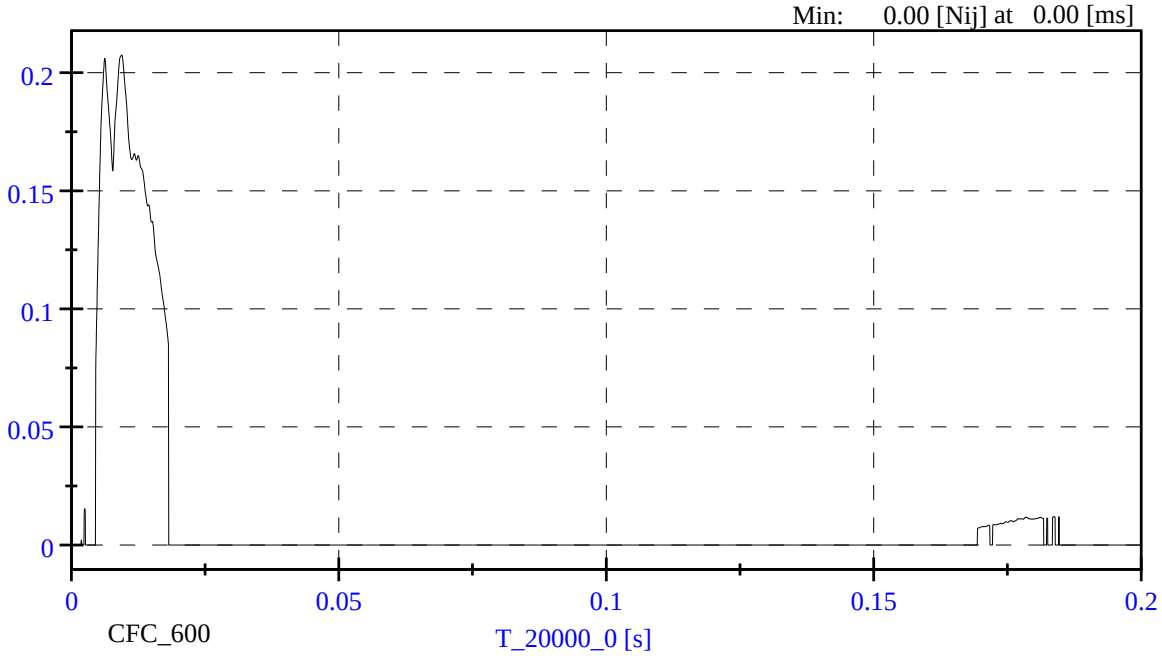
V1P3 Upper Neck Ntf [N-m, CFC_600]

Max: 0.10 [Nij] at 24.65 [ms]
Min: 0.00 [Nij] at 0.45 [ms]



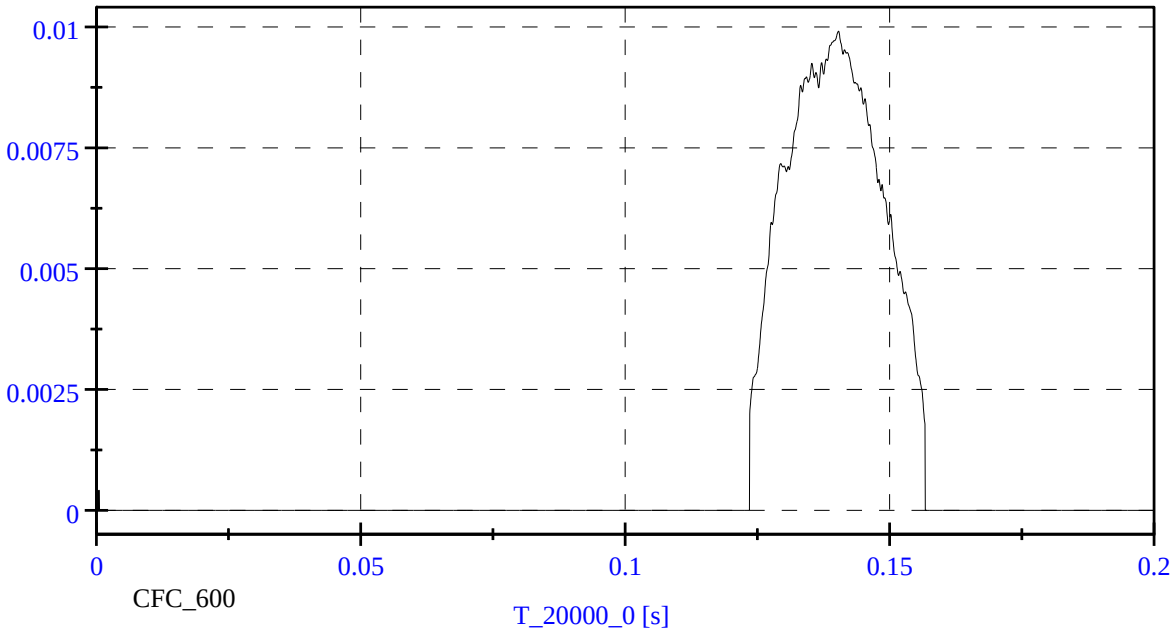
V1P3 Upper Neck Nte [N-m, CFC_600]

Max: 0.21 [Nij] at 9.40 [ms]
Min: 0.00 [Nij] at 0.00 [ms]



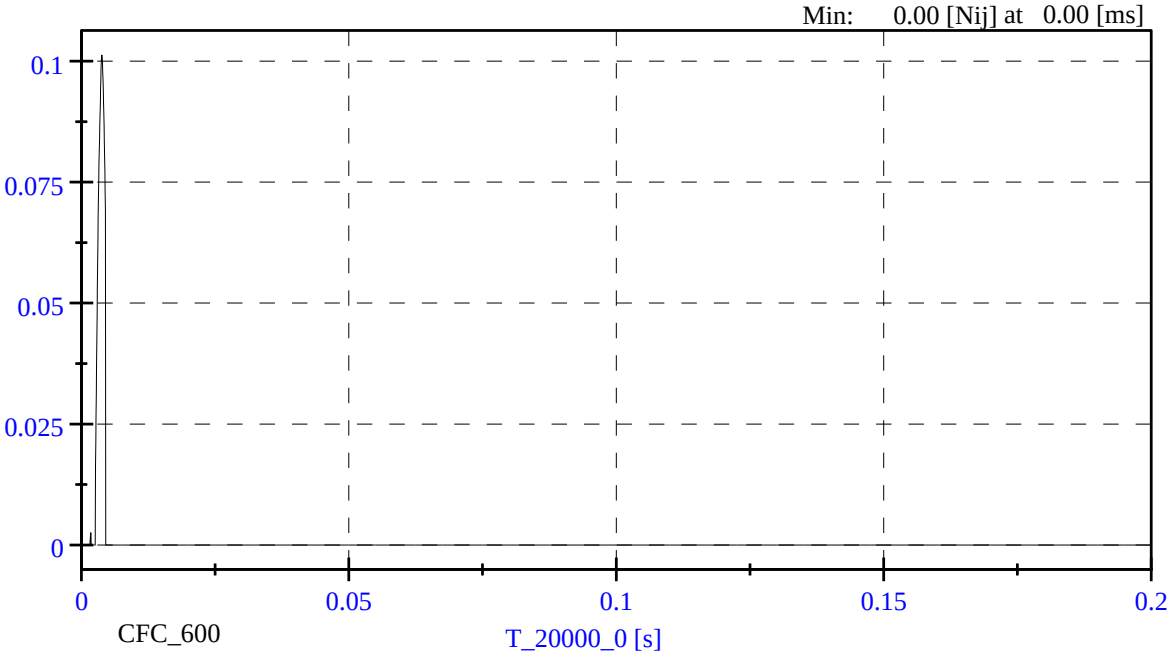
V1P3 Upper Neck Ncf [N-m, CFC_600]

Max: 0.01 [Nij] at 140.35 [ms]
Min: 0.00 [Nij] at 0.00 [ms]



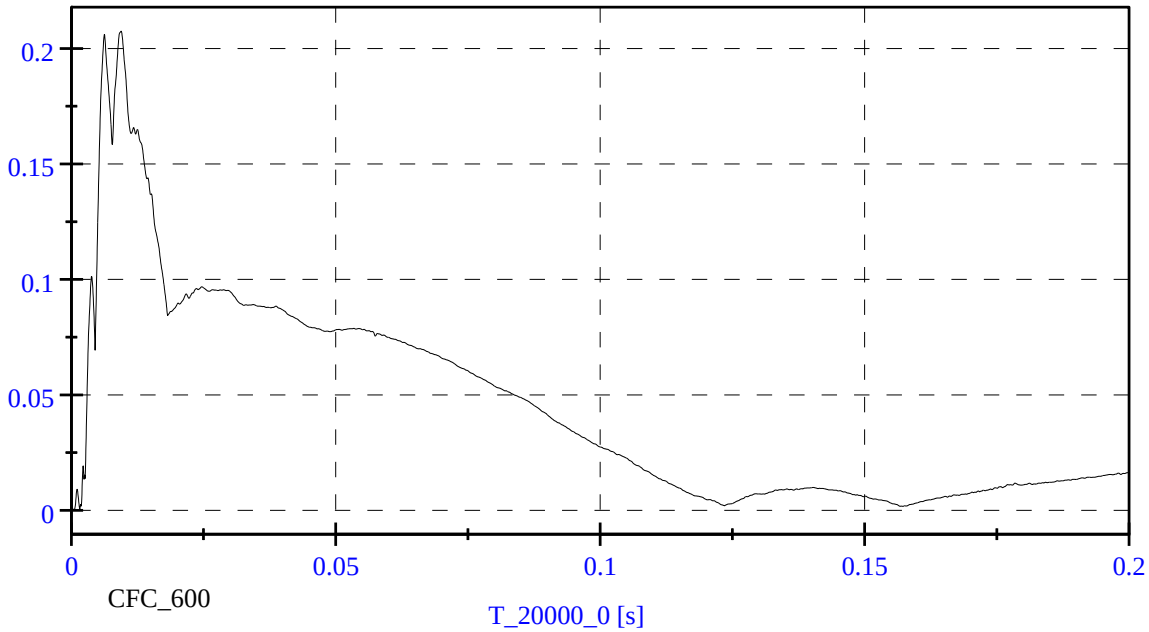
V1P3 Upper Neck Nce [N-m, CFC_600]

Max: 0.10 [Nij] at 3.85 [ms]
Min: 0.00 [Nij] at 0.00 [ms]



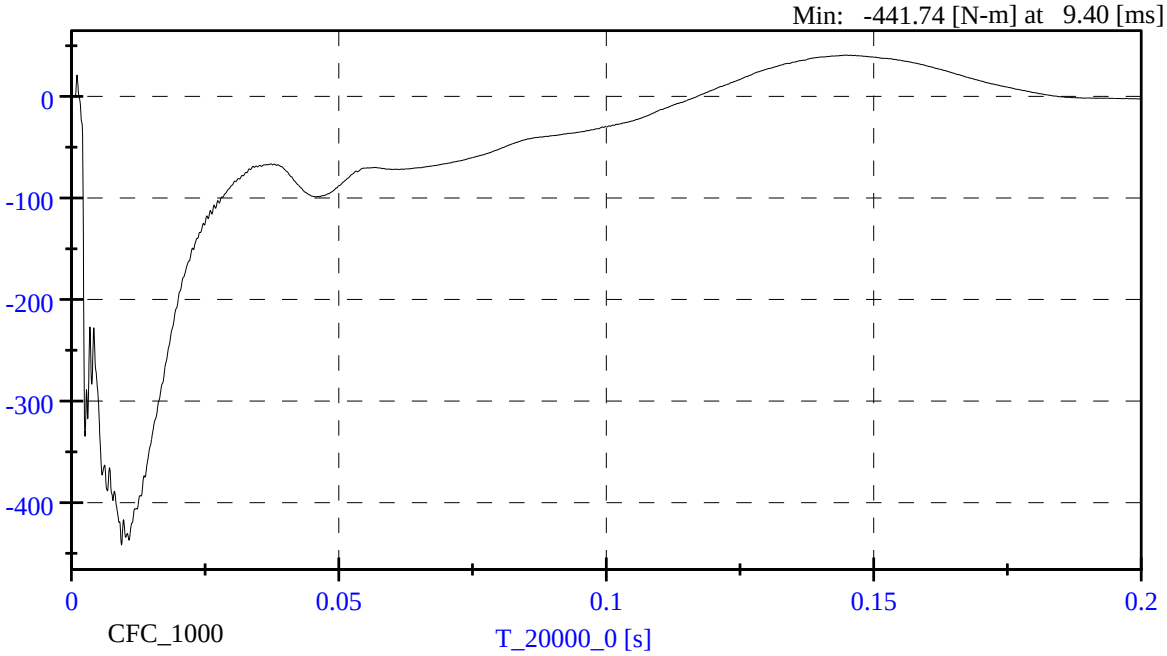
V1P3 Upper Neck Nij [Nij, CFC_600]

Max: 0.21 [Nij] at 9.40 [ms]
Min: 0.00 [Nij] at 0.00 [ms]



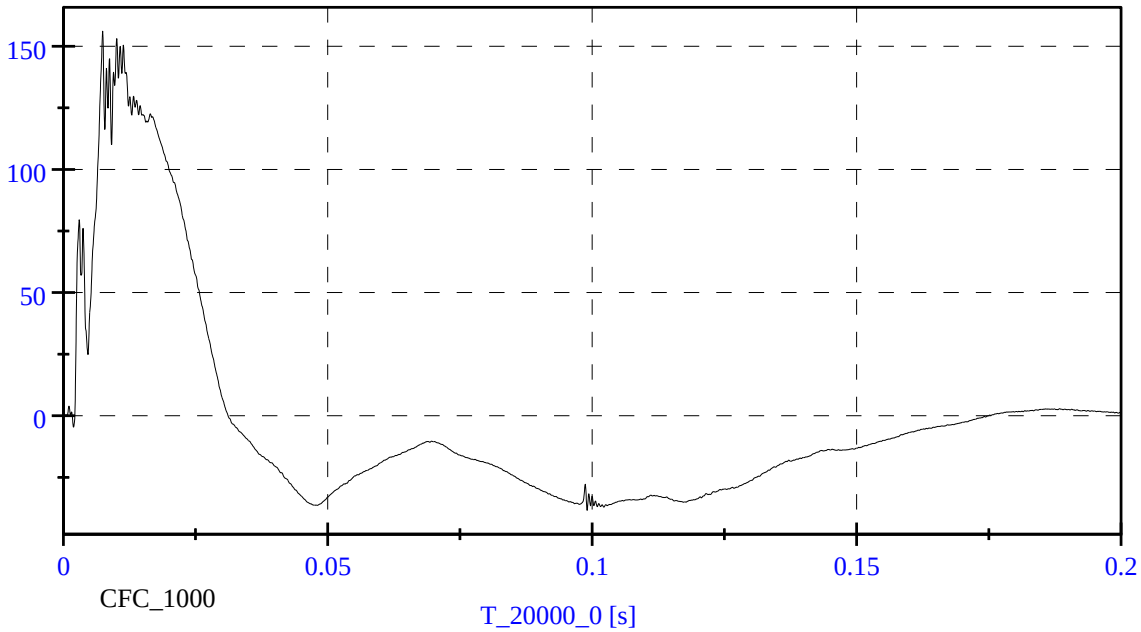
V1P3 Upper Neck Fx [N-m , CFC_1000]

Max: 40.78 [N-m] at 144.95 [ms]
Min: -441.74 [N-m] at 9.40 [ms]



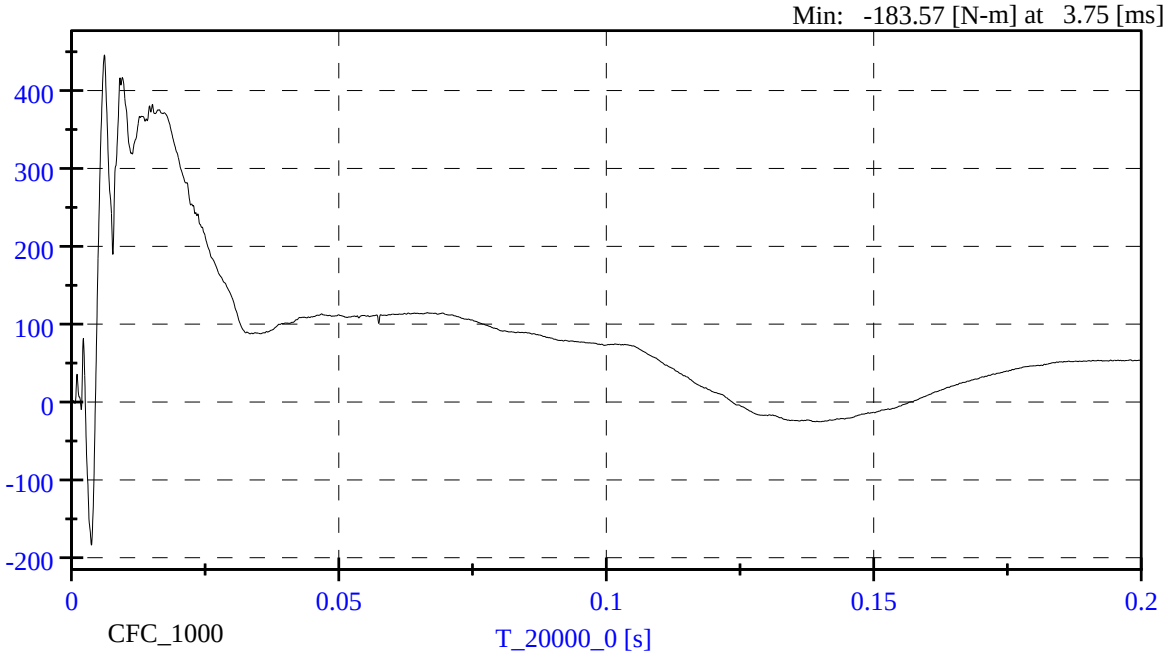
V1P3 Upper Neck Fy [N-m , CFC_1000]

Max: 156.10 [N-m] at 7.45 [ms]
Min: -38.38 [N-m] at 99.05 [ms]



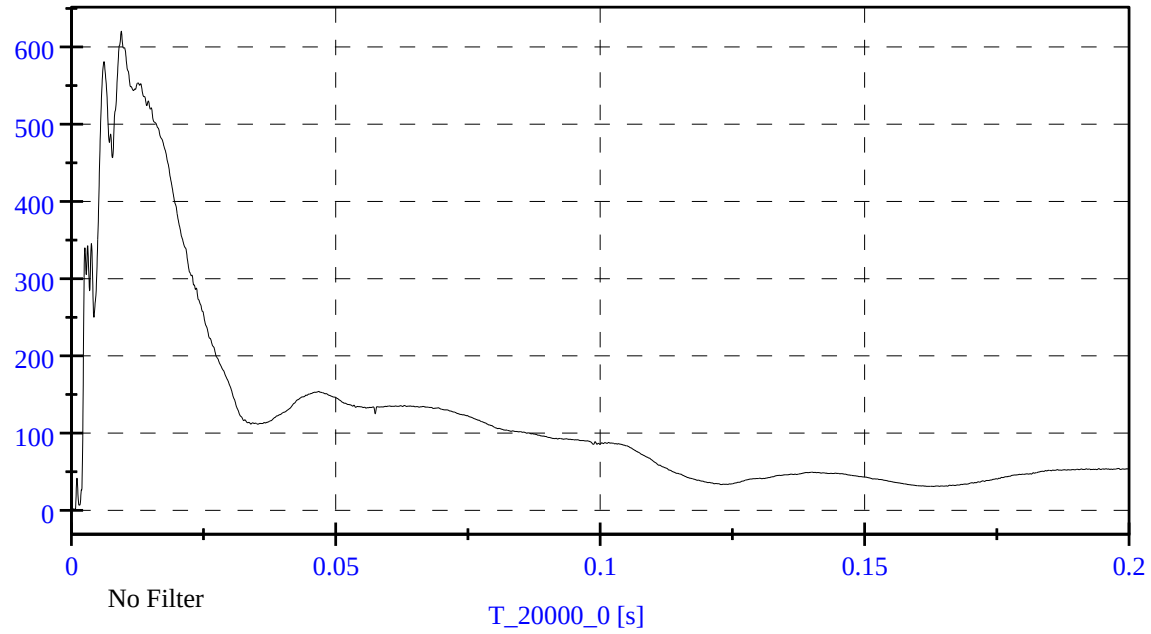
V1P3 Upper Neck Fz [N-m , CFC_1000]

Max: 445.66 [N-m] at 6.20 [ms]
Min: -183.57 [N-m] at 3.75 [ms]



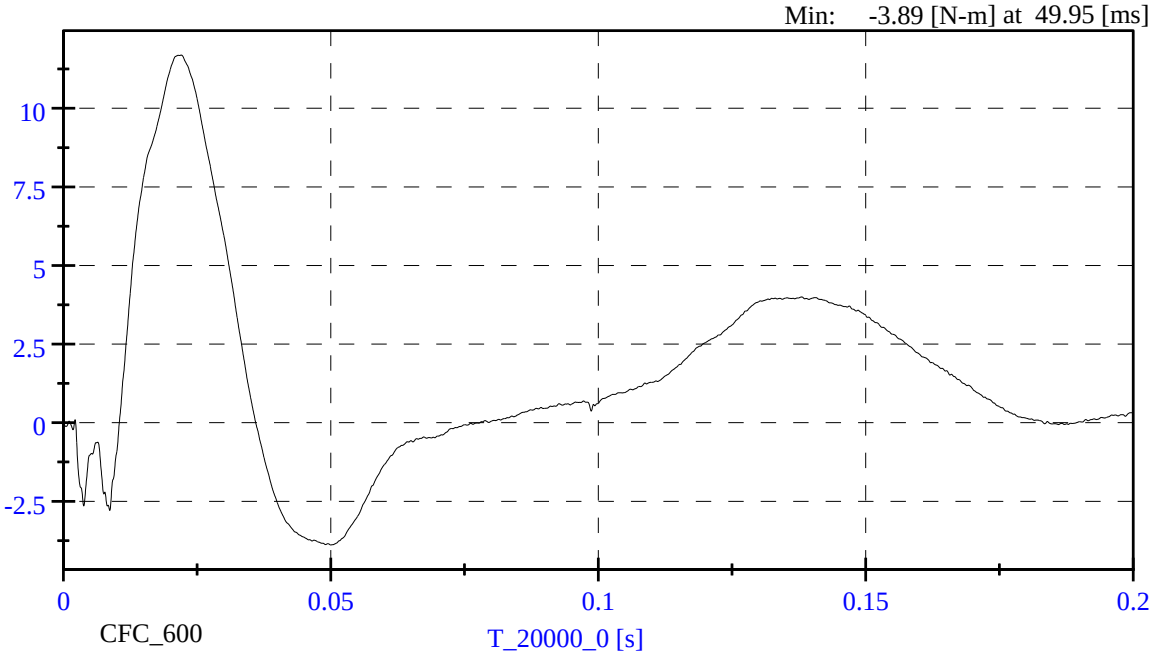
Input: V1P3 NEKU Fx F (75), V1P3 NEKU Fy F (76)...

Max: 620.45 [N-m] at 9.45 [ms]
Min: 0.00 [N-m] at 0.00 [ms]



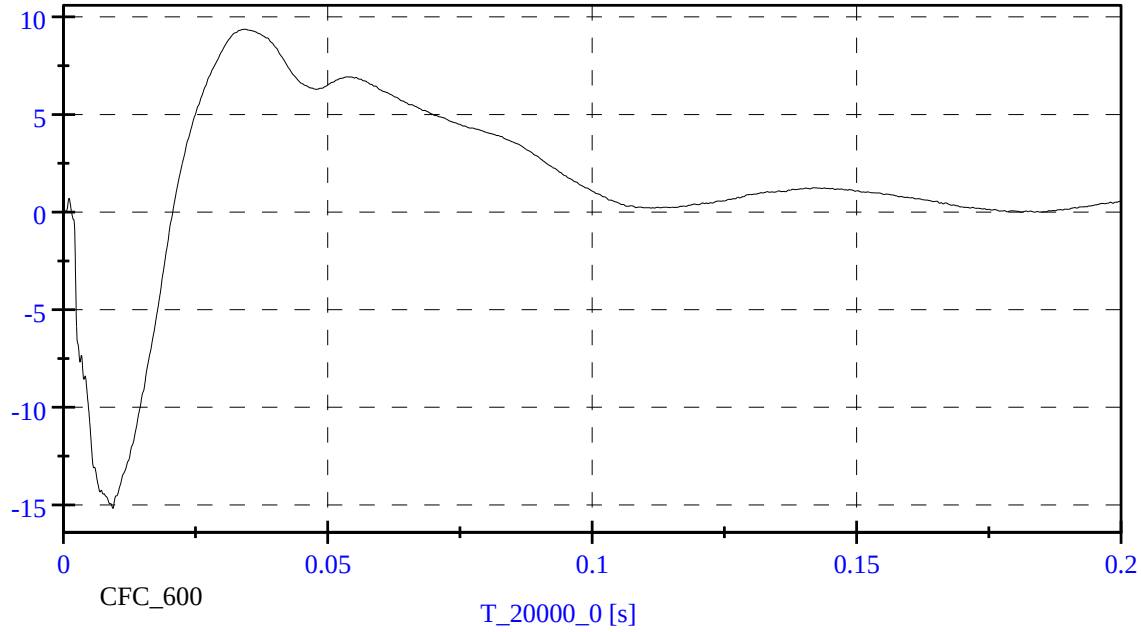
V1P3 Upper Neck Mx [N-m , CFC_600]

Max: 11.69 [N-m] at 22.05 [ms]
Min: -3.89 [N-m] at 49.95 [ms]



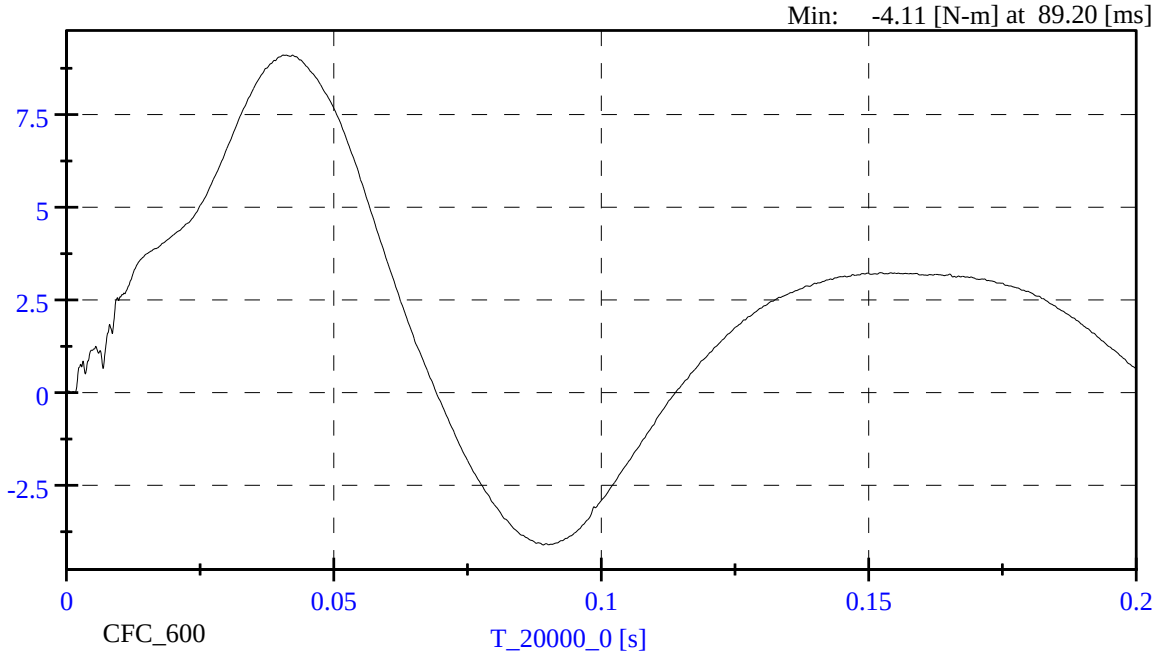
V1P3 Upper Neck My [N-m , CFC_600]

Max: 9.37 [N-m] at 34.45 [ms]
Min: -15.18 [N-m] at 9.35 [ms]



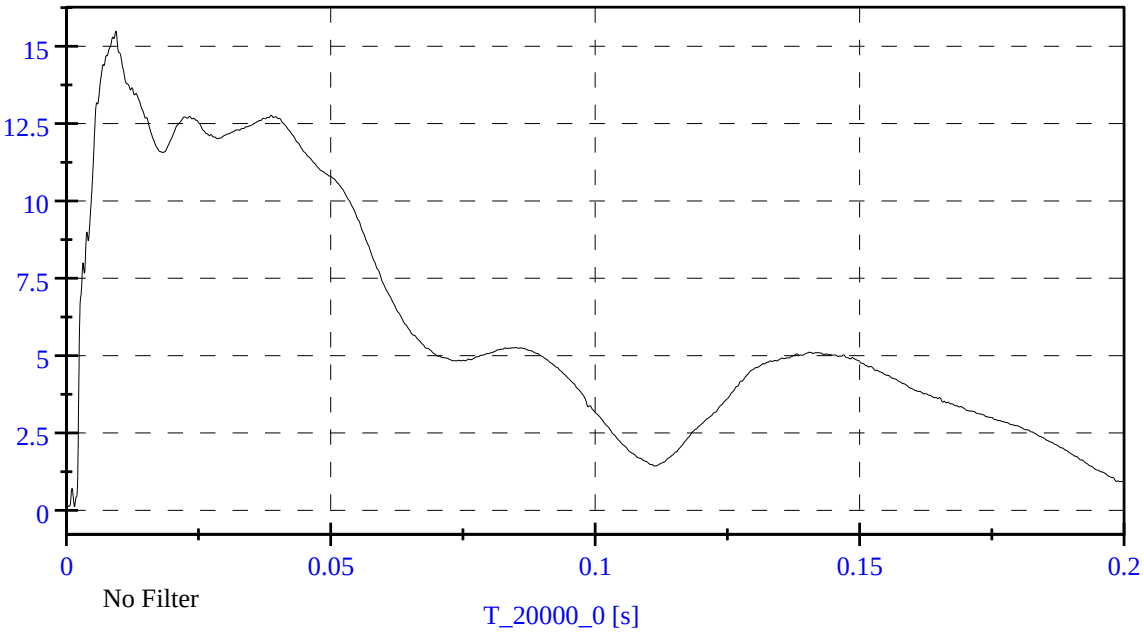
V1P3 Upper Neck Mz [N-m , CFC_600]

Max: 9.11 [N-m] at 40.55 [ms]
Min: -4.11 [N-m] at 89.20 [ms]



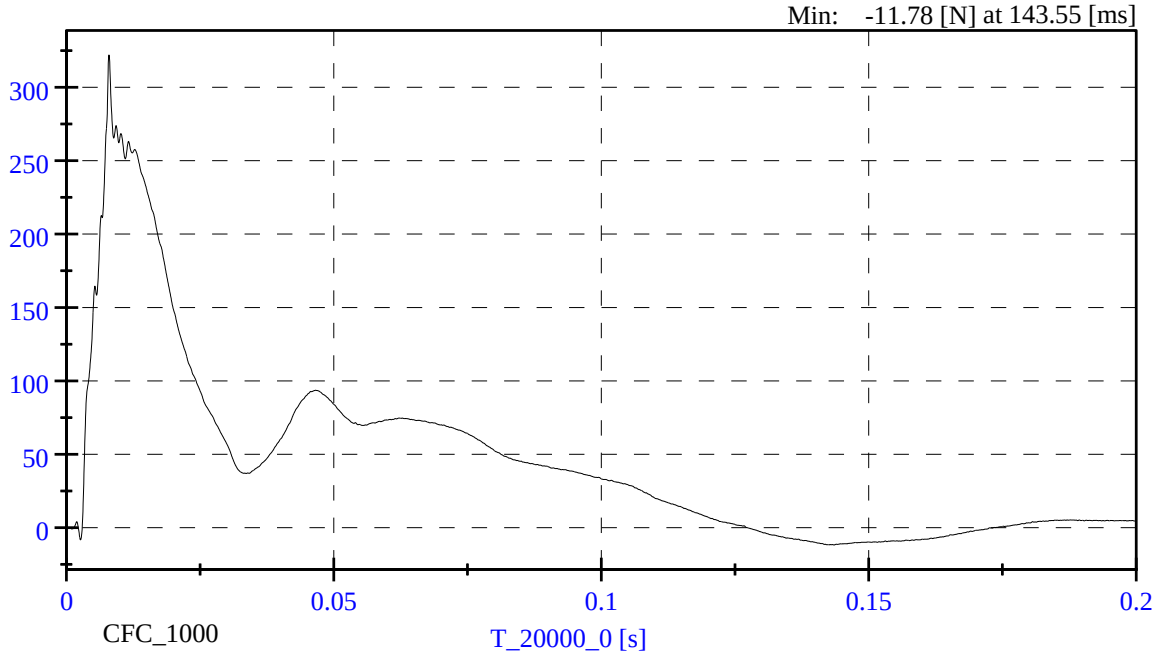
Input: V1P3 NEKU Mx F (78), V1P3 NEKU My F (79)...

Max: 15.49 [N-m] at 9.35 [ms]
Min: 0.00 [N-m] at 0.00 [ms]



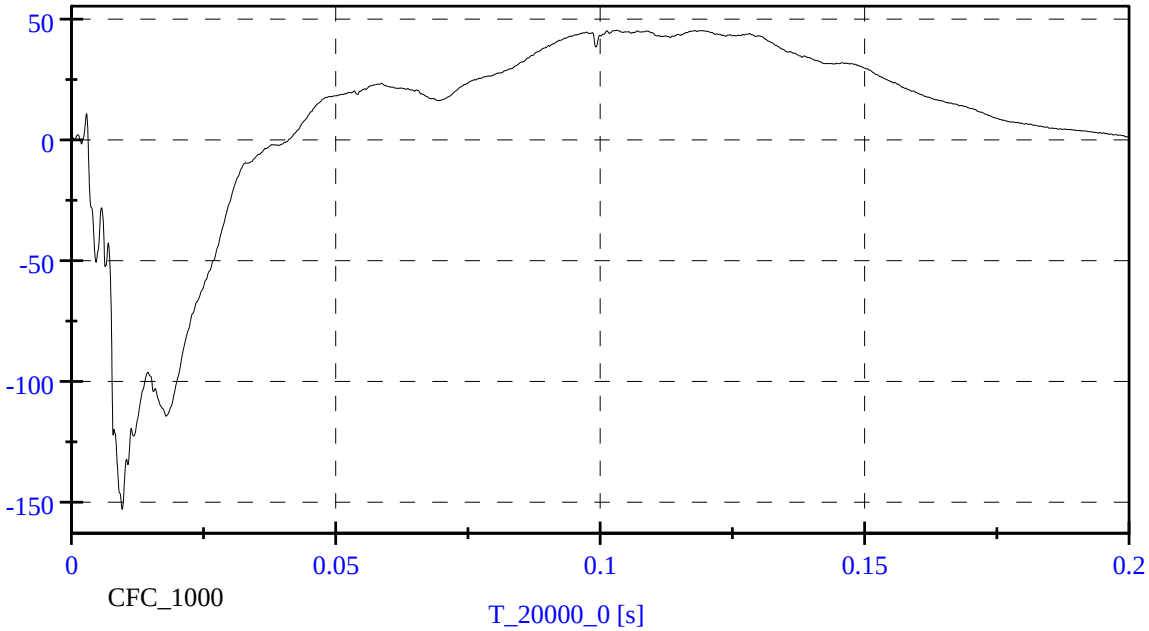
V1P3 Lower Neck Fx [N , CFC_1000]

Max: 321.96 [N] at 7.95 [ms]
Min: -11.78 [N] at 143.55 [ms]



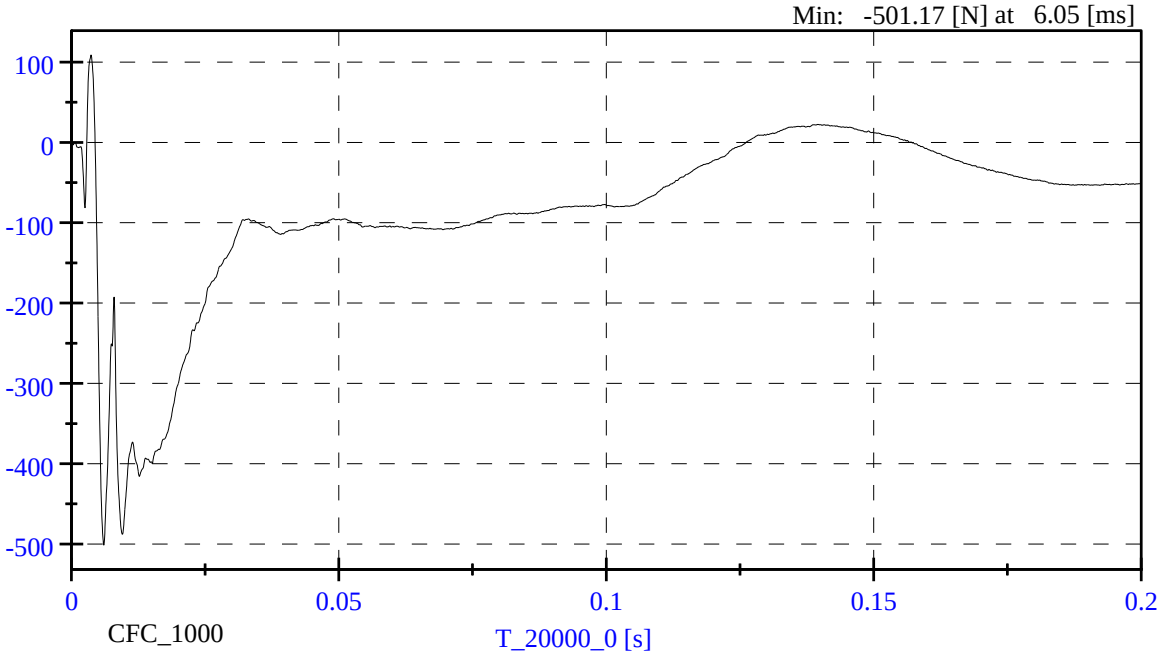
V1P3 Lower Neck Fy [N , CFC_1000]

Max: 45.43 [N] at 103.15 [ms]
Min: -152.97 [N] at 9.60 [ms]



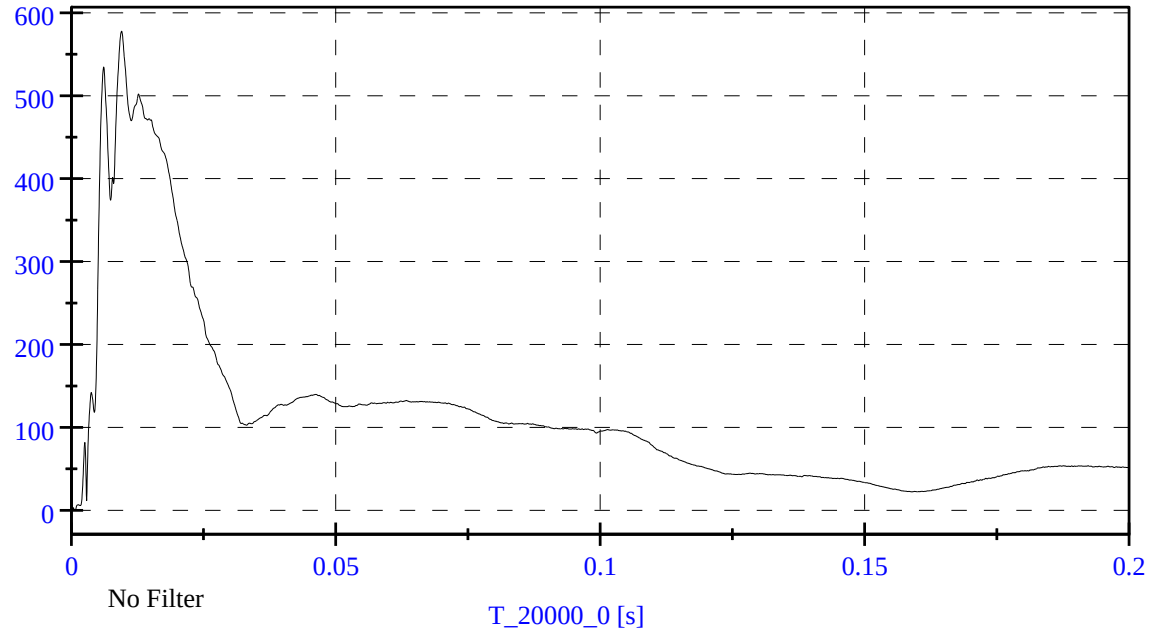
V1P3 Lower Neck Fz [N , CFC_1000]

Max: 108.75 [N] at 3.70 [ms]
Min: -501.17 [N] at 6.05 [ms]



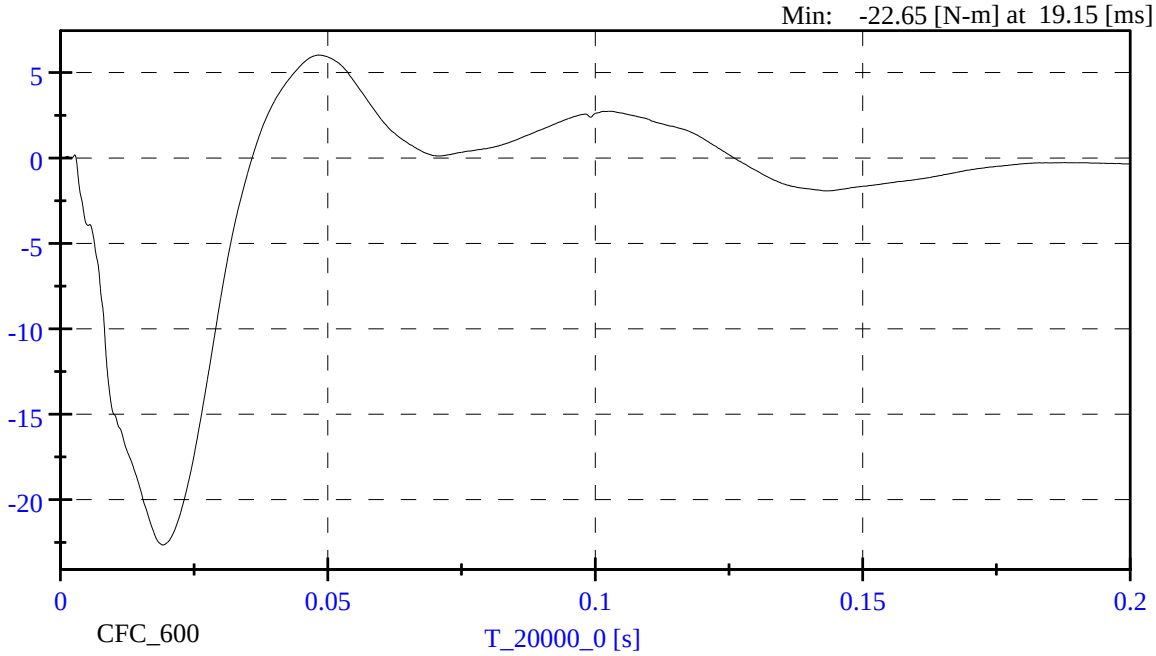
Input: V1P3 NEKL Fx F (82), V1P3 NEKL Fy F (83)...

Max: 577.81 [N] at 9.50 [ms]
Min: 0.00 [N] at 0.00 [ms]



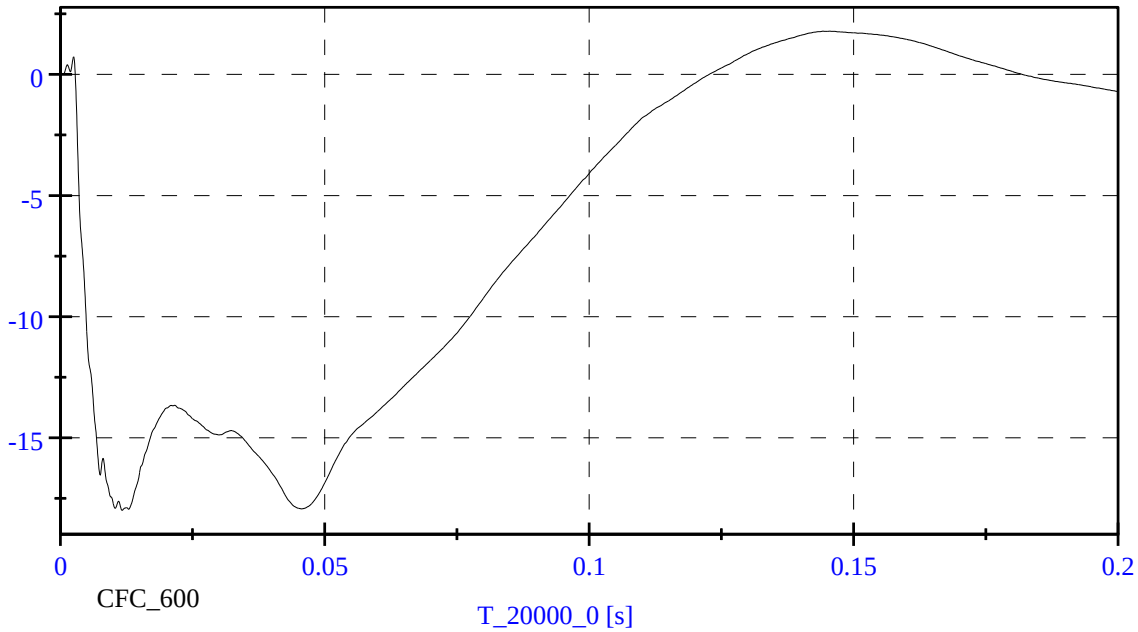
V1P3 Lower Neck Mx [N-m , CFC_600]

Max: 6.03 [N-m] at 48.30 [ms]
Min: -22.65 [N-m] at 19.15 [ms]



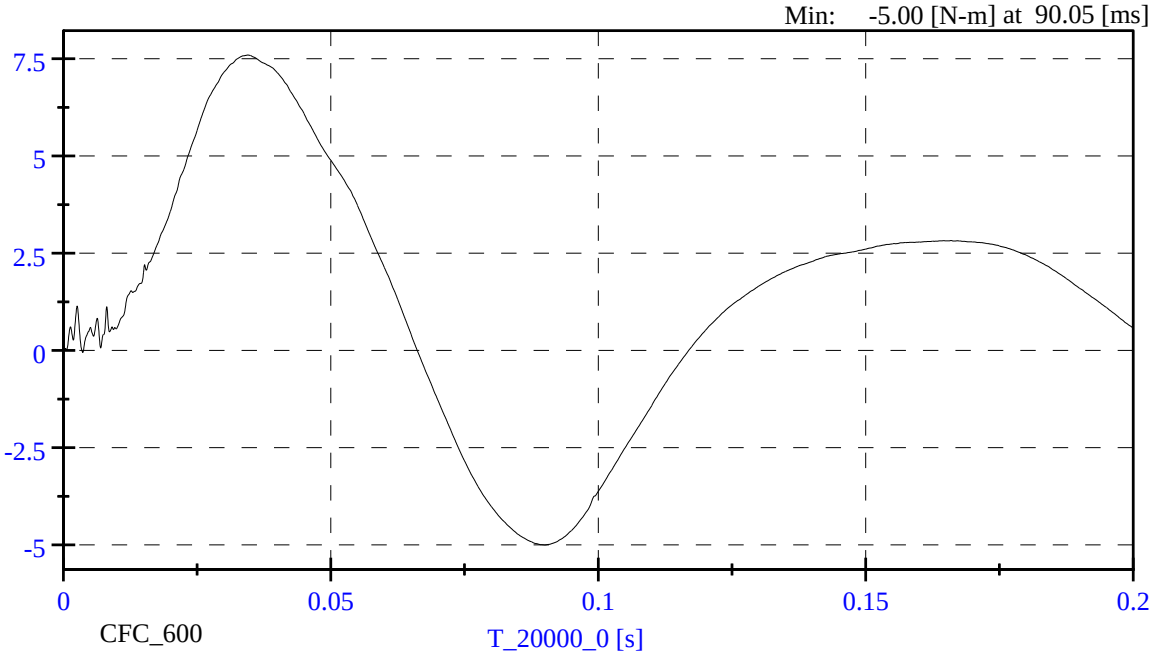
V1P3 Lower Neck My [N-m , CFC_600]

Max: 1.78 [N-m] at 145.50 [ms]
Min: -17.99 [N-m] at 11.70 [ms]



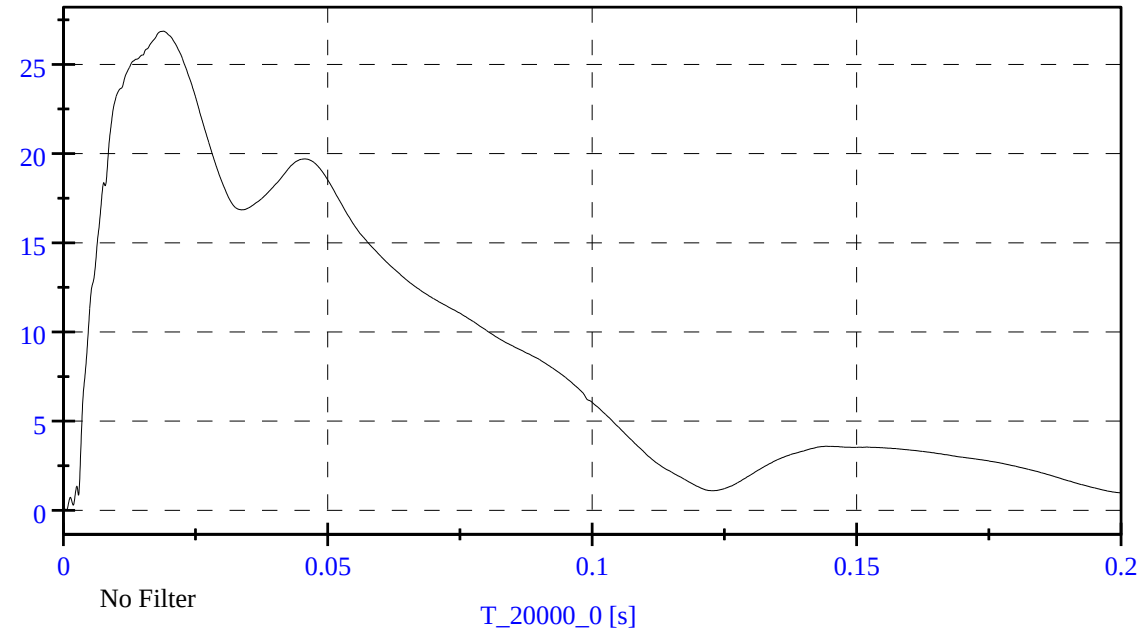
V1P3 Lower Neck Mz [N-m , CFC_600]

Max: 7.59 [N-m] at 34.50 [ms]
Min: -5.00 [N-m] at 90.05 [ms]



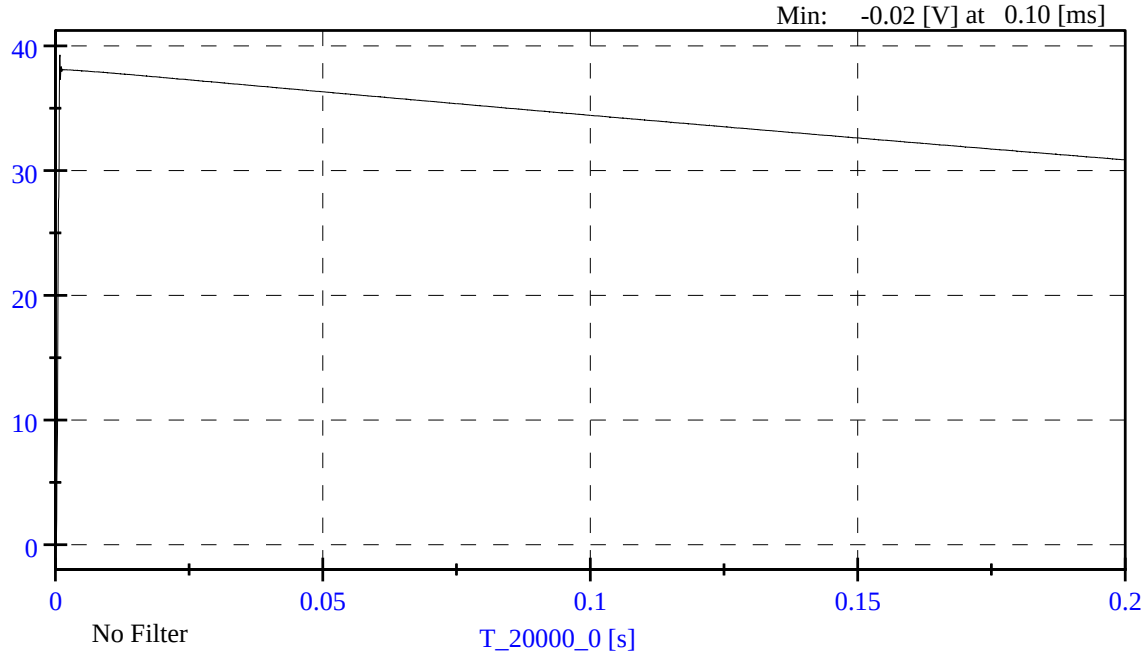
Input: V1P3 NEKL Mx F (86), V1P3 NEKL My F (87)...

Max: 26.86 [N-m] at 18.95 [ms]
Min: 0.00 [N-m] at 0.00 [ms]



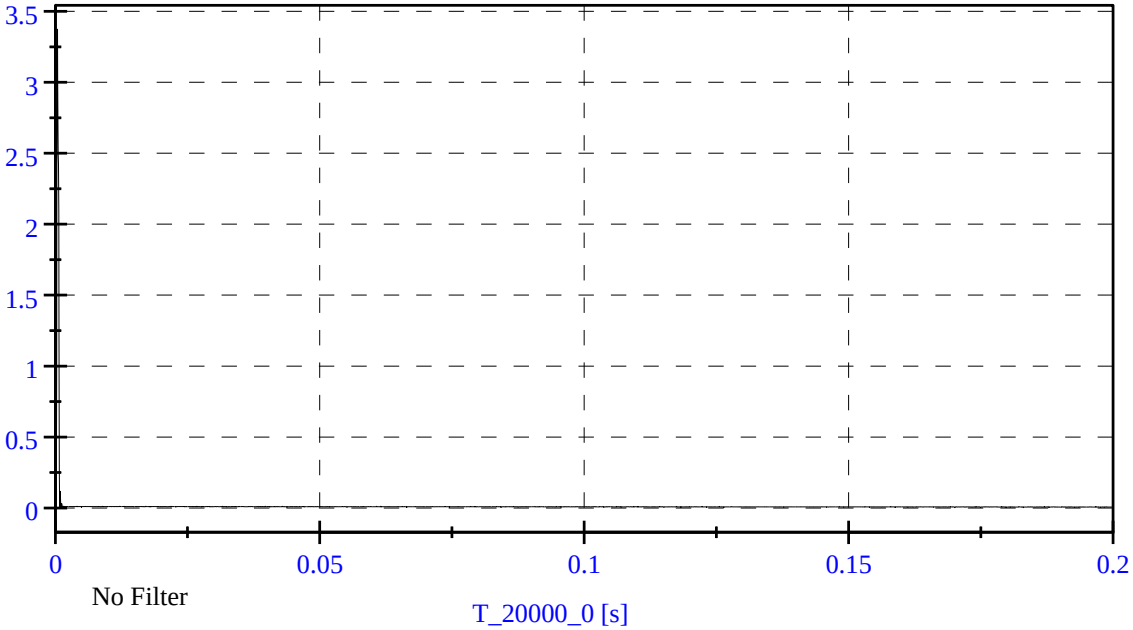
V1P3 Pelvis Airbag Voltage

Max: 39.27 [V] at 0.85 [ms]
Min: -0.02 [V] at 0.10 [ms]



V1P3 Pelvis Airbag Current

Max: 3.37 [A] at 0.40 [ms]
Min: -0.00 [A] at 0.10 [ms]



APPENDIX C

TEST EQUIPMENT LIST AND CALIBRATION INFORMATION

TEST EQUIPMENT LIST AND CALIBRATION INFORMATION

P572C INSTRUMENTATION

	POSITION #3 (RIGHT) SERIAL NO.: MD0303TWG3		
	SERIAL NUMBER	MANUFACTURER	CALIBRATION DATE
HEAD AX	AC-P64001	ENDEVCO	01/8/2013
HEAD AY	AC-P51687	ENDEVCO	01/8/2013
HEAD AZ	AC-P52154	ENDEVCO	01/8/2013
UPPER NECK FX	LC-158	DENTON	3/28/2012
UPPER NECK FY	LC-158	DENTON	3/28/2012
UPPER NECK FZ	LC-158	DENTON	3/28/2012
UPPER NECK MX	LC-158	DENTON	3/28/2012
UPPER NECK MY	LC-158	DENTON	3/28/2012
UPPER NECK MZ	LC-158	DENTON	3/28/2012
LOWER NECK FX	LC-121	DENTON	3/14/2012
LOWER NECK FY	LC-121	DENTON	3/14/2012
LOWER NECK FZ	LC-121	DENTON	3/14/2012
LOWER NECK MX	LC-121	DENTON	3/14/2012
LOWER NECK MY	LC-121	DENTON	3/14/2012
LOWER NECK MZ	LC-121	DENTON	3/14/2012
Curtain Bag Voltage	KT Minidau timer	N/A	N/A
Curtain Bag Current	KT Minidau timer	N/A	N/A