

REPORT NUMBER: TWG-CAL-12-01

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

AUTO ALLIANCE INTERNATIONAL, INC.
2012 MAZDA 6
4-DOOR SEDAN

NHTSA NUMBER: MC5401-TWG2
CALSPAN TEST NUMBER: CT2012-01

CALSPAN
TRANSPORTATION SCIENCES CENTER
P.O. BOX 400
BUFFALO, NEW YORK 14225



March 29, 2012

FINAL REPORT

Alpha Technology Associate, Inc.
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This Final Test Report was prepared for the U.S. Department of Transportation, National Highway Traffic Safety Administration, under Contract No. DTNH22-08-D-00088, Alpha Technology PO 3GC164. 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

1. Report No. TWG-CAL-12-01	2. Government Accession No.	3. Recipient's Catalog No.				
4. Title and Subtitle Final Report 2012 , TWG/Out-of-Position Tests NHTSA No.: MC5401TWG2		5. Report Date				
		6. Performing Organization Code CAL				
7. Author(s) Edward Dutton, Project Engineer David Travale, Program Manager		8. Performing Organization Report No. CT2012-01				
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. DTNH22-08-D-00088				
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 Final Report, March 29, 2012				
		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 February 15, 2012.						
Injury Summary						
HIC15	Maximum Chest Displacement (mm)	Maximum Chest Displacement Rate (m/s)	NIJ(NTF)	NIJ(NTE)	NIJ(NCF)	NIJ(NCE)
48.45	N/A	N/A	0.025	0.016	0.473	0.203
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 39	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. DTNH22-08-D-00088 and through Alpha Technology Associate, Inc. PO 2GC154.

1.2 SUMMARY

The effects of both a seat-mounted side airbag and a curtain airbag deployment in a 2012 Mazda Mazda6 Sport 4-Door Sedan on an out-of-position SIDII (Hybrid III 5th female anthropomorphic test device (ATD)) were evaluated. The test was performed by Calspan on February 15, 2012. 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 and redundant). In addition, upper six axial neck force, and moment load cell sensors were utilized. Please note that the supplied ATD did not come with a lower six axial neck force and moment load cell sensor nor could one be installed.

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:	Seat	Seat mounted – outside seam
Airbag:	Side Rail	Side curtain airbag.
Booster Block:	N/A	N/A
ATD Type/Serial No.:	300	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>

VISIBLE DUMMY CONTACT POINTS

Head Contact:	Curtain Airbag
Upper Torso Contact:	Torso Airbag and Passenger side door
Lower Torso Contact:	Seat Back
Left Knee Contact:	None
Right Knee Contact:	None

**DATA SHEET NO. 2
VEHICLE PARAMETER DATA**

TEST VEHICLE INFORMATION:

Year/Make/Model/Body Style: 2012 Mazda Mazda6 Sport Four Door Sedan
NHTSA No. : MC5401TWG2 ; VIN: 1YVHZ8BH8C5M00612 Color: Light Grey/Silver
Engine Data: 4 cylinders; - CID; 2.5 Liters; - cc
Placement: - Longitudinal or In-Line; Lateral Transverse or Lateral
Transmission Data: 5 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 - Pretensioner (Shoulder); - 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: 9/16/2011 ; Odometer Reading 37 Km
Selling Dealer: Northtown Mazda
& Address: 3900 Sheridan Dr. Amherst, NY 14226

DATA FROM TIRE VEHICLE'S CERTIFICATION LABEL:

Vehicle Manufactured by: Auto Alliance International, Inc
Date of Manufacture 6/11
GVWR: 1,996 kg; GAWR: 1,066 kg FRONT; 934 kg REAR

DATA FROM TIRE PLACARD:

Recommended Tire Size: P205/65R16
*Recommended Cold Tire Pressure: 220 Kpa Front 220 kpa Rear

DATA FROM TIRE SIDEWALL:

Size of Tires on Test Vehicle: P205/65R16 ; Manufacturer: Michelin
Tire Pressure with Maximum Capacity Vehicle Load: Front 300 kPa Rear: 300 kPa
Treadwear: 440 ; 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) = 385 Kg
No. of Occupants x 68.04 kg = 340.2 Kg
Rated Cargo/Luggage Weight (RCLW) = 44.8 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. MC5401-TWG2

Measurement	Value
Total Fore/Aft Travel (mm)	240
Test Distance Rearward of Full-Forward (mm)	70
Total Fore/Aft Travel (Detents)	24
Placed in Position #	7

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)	72
Head to Seat Back Centerline	HSC (mm)	-
Head to B-Pillar (cg)	HB (mm)	348
Head to Roof, Z (top of the head)	HZ (mm)	51
Head to Header	HHD (mm)	257
Chest to Dash	CD (mm)	504
Chest to Seatback	CS (mm)	259
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)	132
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)	-
Foam Block Width	(mm)	-
Foam Block Thickness	(mm)	-
HD36 foam density	(g/L)	-

DATA SHEET 4

SID-IIs DUMMY INJURY CRITERIA VALUES

NHTSA No.: MC5401-TWG2

Channel	Max	Time (ms)	Min	Time (ms)
V1P2 Head x [g , CFC_1000]	28.19	82.150	-25.115	12.000
V1P2 Head y [g , CFC_1000]	20.964	80.900	-21.352	12.550
V1P2 Head z [g , CFC_1000]	54.185	11.850	-8.557	15.850
V1P2 Head x Redundant [g , CFC_1000]	27.914	82.000	-25.422	12.000
V1P2 Head y Redundant [g , CFC_1000]	21.205	81.000	-21.857	13.000
V1P2 Head z Redundant [g , CFC_1000]	48.282	12.000	-11.885	15.000
V1P2 Headform Resultant [g, CFC_1000]	53.636	12.000	0	0
V1P2 Upper Neck Mocy [N-m, CFC_600]	10.839	19.650	-12.563	139.400
V1P2 Upper Neck Ntf [N-m, CFC_600]	0.025	5.200	0	0
V1P2 Upper Neck Nte [N-m, CFC_600]	0.016	10.600	0	0
V1P2 Upper Neck Ncf [N-m, CFC_600]	0.473	24.350	0	0
V1P2 Upper Neck Nce [N-m, CFC_600]	0.203	139.450	0	0
V1P2 Upper Neck Nij [Nij, CFC_600]	0.473	24.000	0	0
V1P2 Upper Neck Fx [N , CFC_1000]	469.629	33.600	-17.093	5.200
V1P2 Upper neck Fy [N , CFC_1000]	399.67	81.850	-181.396	17.000
V1P2 Upper neck Fz [N , CFC_1000]	82.106	5.250	-1732.727	24.350
Input: V1P2 NEKU Fx F (32), V1P2 NEKU Fy F (33)	1777.336	27.000	0	0
V1P2 Upper Neck Mx [N-m , CFC_600]	28.079	18.400	-7.262	31.150
V1P2 Upper Neck My [N-m , CFC_600]	16.268	20.250	-8.41	139.350
V1P2 Upper Neck Mz [N-m , CFC_600]	15.412	63.900	-0.148	337.900
Input: V1P2 NEKU Mx F (35), V1P2 NEKU My F (36)	31.8	18.550	0	0
Curtain Volts	26.489	3.000	0	0
Torso Volts	32.666	6.000	0	0
Curtain Current	3.334	0	-0.002	63.000
Torso Current	3.304	0	-0.002	13.000

DATA SHEET 4

CHILD DUMMY INJURY CRITERIA VALUES (CONTINUED)

VEHICLE: Mazda Mazda 6 Four Door Sedan

NHTSA No.: MC5401-TWG1

HEAD INJURY CRITERIA (HIC)

	HIC15			
	HIC(15)	t ₁ (msec)	t ₂ (msec)	Average Acceleration t ₁ to t ₂
Position #2 - Right	48.45	76.45	86.75	29.39

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	0.025	5.20	76.83	-16.12	1.036
Nte	0.016	10.60	11.15	-9.78	-0.917
Ncf	0.473	24.35	-1710.27	370.11	5.003
Nce	0.203	139.45	-58.77	233.60	-12.562

Peak Tension (CFC1000) 82.11 N **Peak Compression (CFC1000)** 1732.73 N

Critical Values

Nij Intercepts				Peak Limits	
Tension (CVt)	3880 N	Extension (mCVe)	61 N-m	Tension	2070 N
Compression (CVc)	3880 N	Flexion (mCVf)	155 N-m	Compression	2520 N

APPENDIX A

PHOTOGRAPHS

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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-IIs Dummy Left Side View



Figure A-6: Post-Test 5th female SID-IIs Dummy Left Side View



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



Figure A-8: Post-Test 5th female SID-II's Dummy Left Side Closeup 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 $\frac{3}{4}$ Front View



Figure A-11: Pre-Test 5th female SID-IIIs Dummy Left ¾ Front Closeup View



Figure A-12: Post-Test 5th female SID-IIIs Dummy Left ¾ Front Closeup View



Figure A-13: Pre-Test 5th female SID-II's Dummy Front View



Figure A-14: Post-Test 5th female SID-II's Dummy Front View



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



Figure A-16: Pre-Test 5th female SID-IIs 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: Post NCAP Left Side View

Photo Not Available

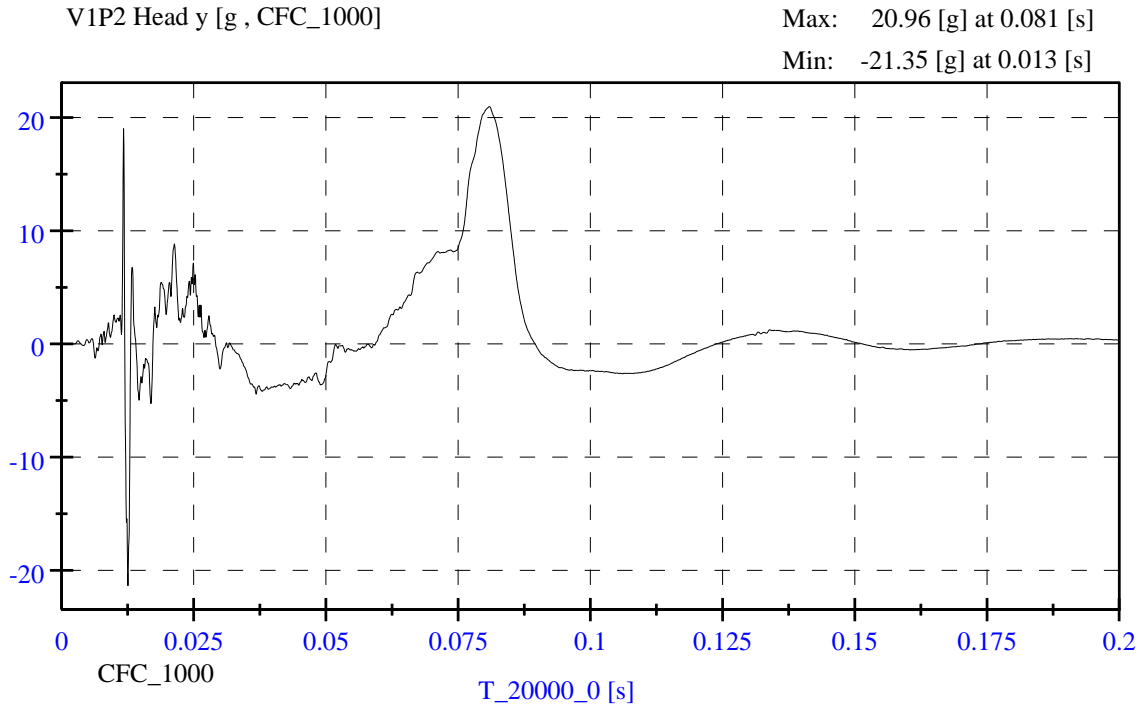
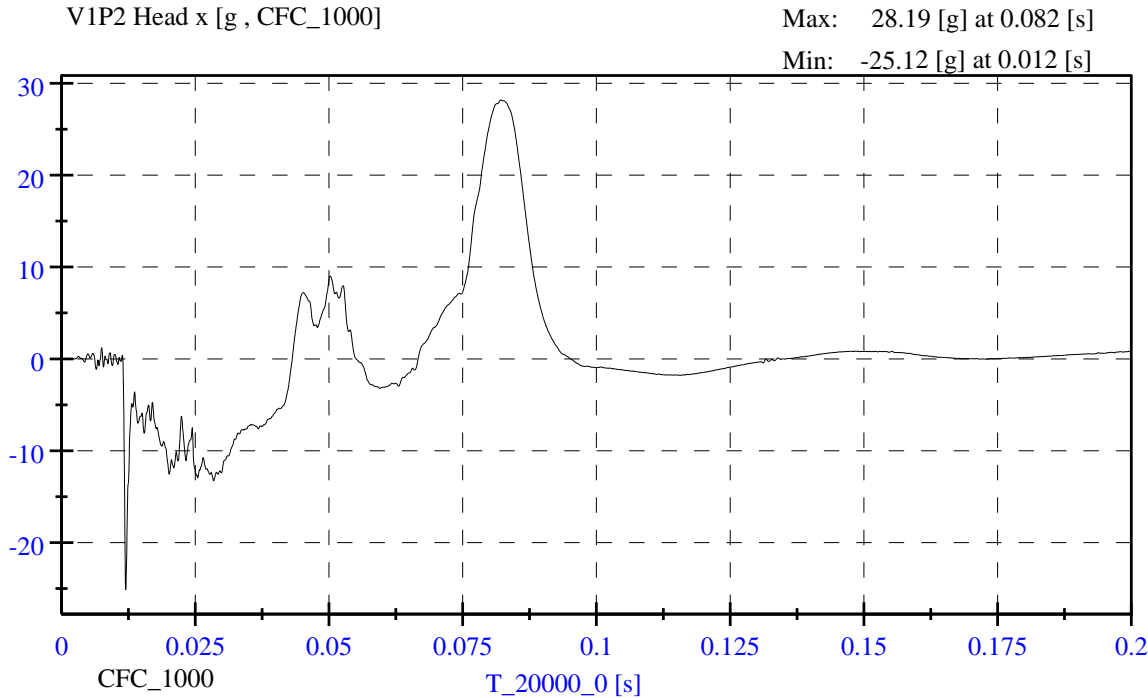
Figure A-22: Post-Test Side Airbag View

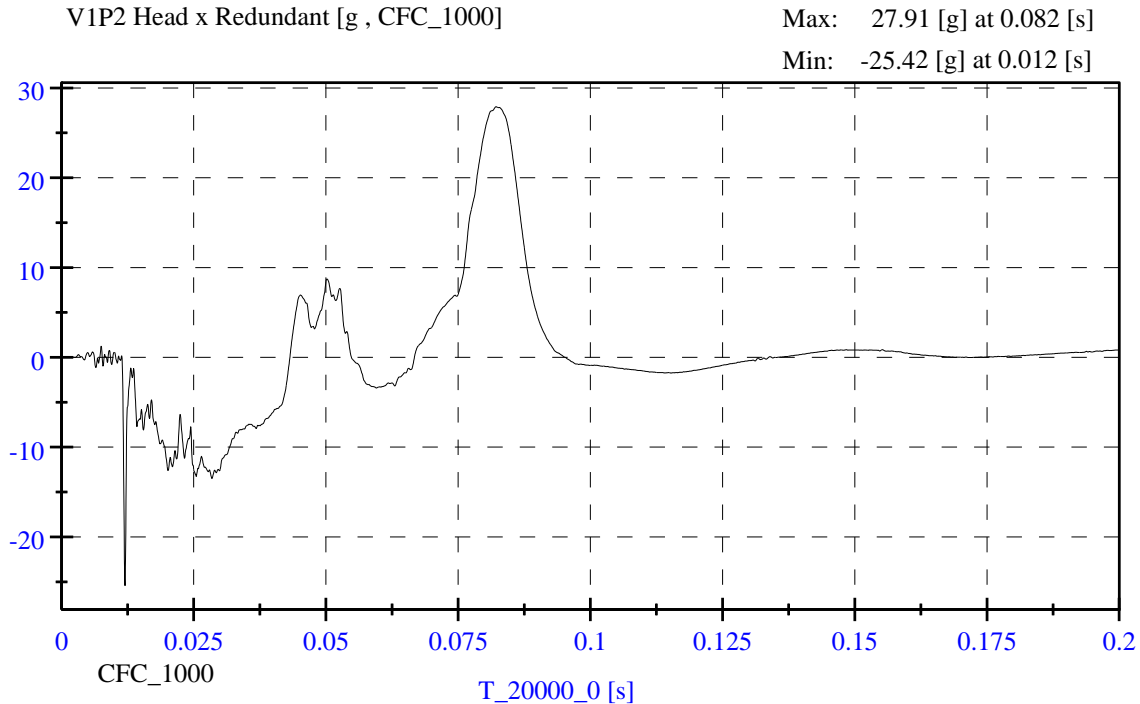
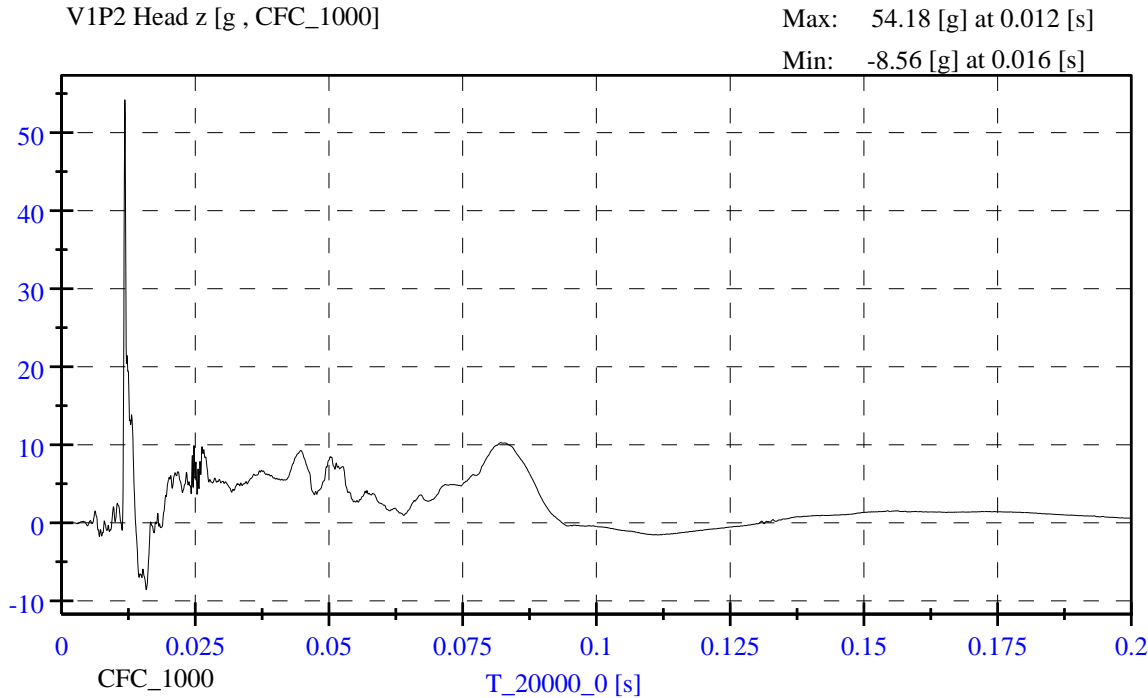
APPENDIX B

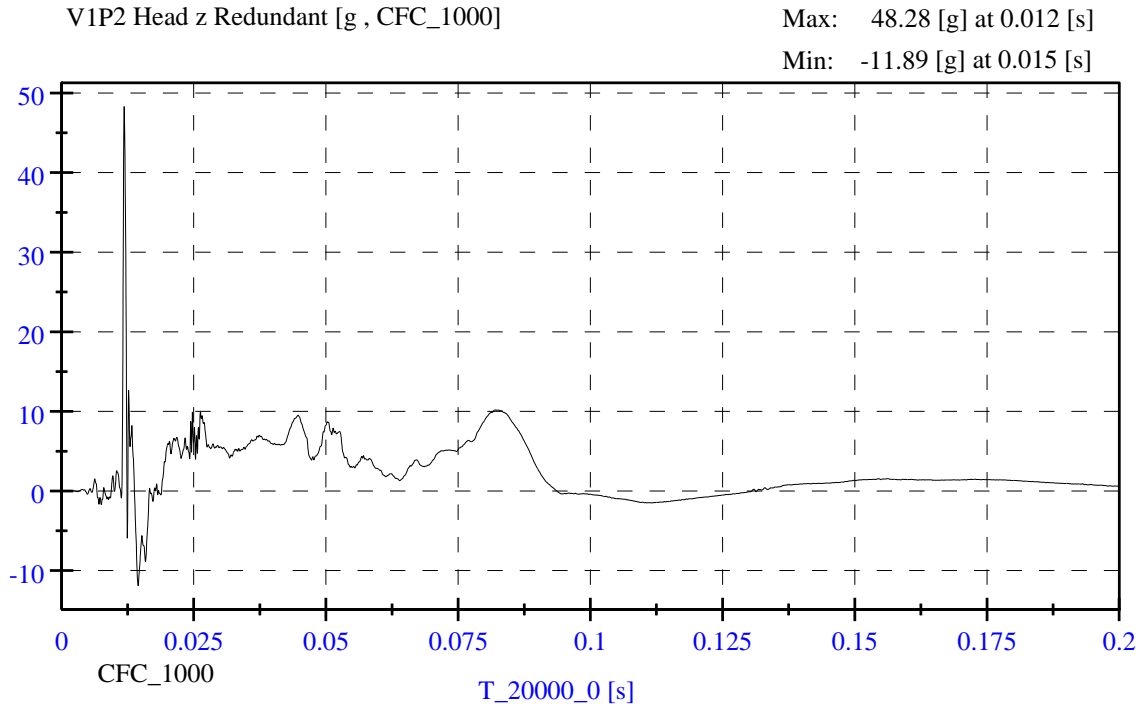
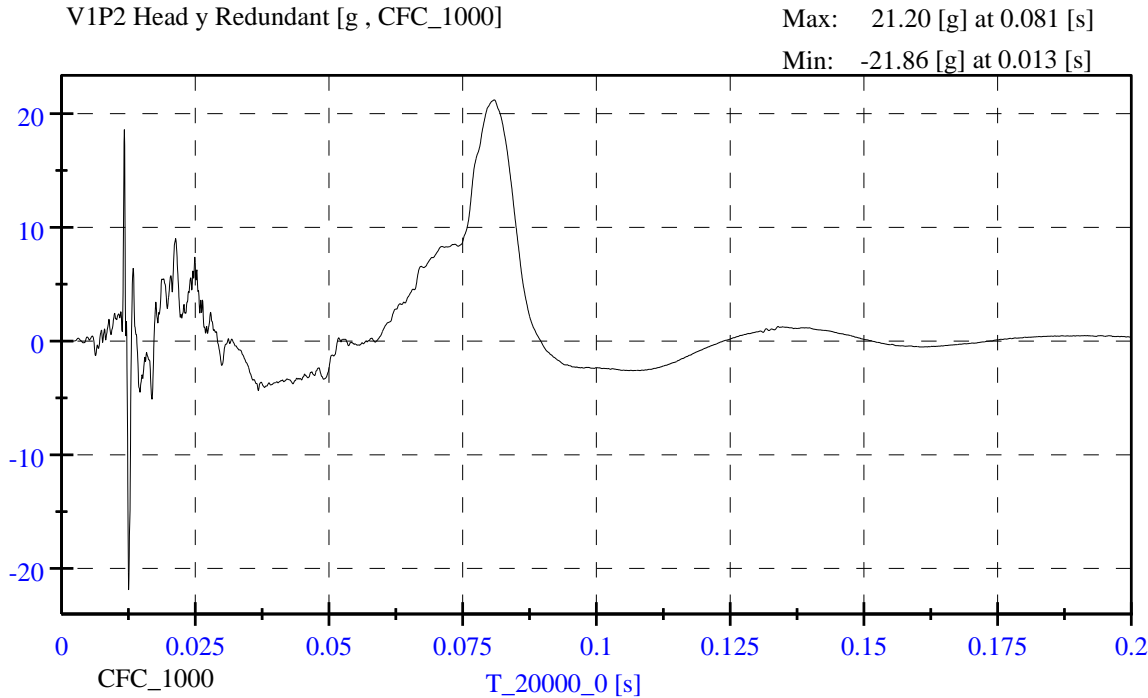
SID-IIs RESPONSE DATA TRACES

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1	V1P2 Head x [g , CFC_1000]	B-3
2	V1P2 Head y [g , CFC_1000]	B-3
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9	V1P2 Upper Neck Ntf [N-m, CFC_600]	B-7
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15	V1P2 Upper Neck Fy [N , CFC_1000]	B-10
16	V1P2 Upper Neck Fz [N , CFC_1000]	B-10
17	Input: V1P2 NEKU Fx F (32), V1P2 NEKU Fy F (33)...	B-11
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21	Input: V1P2 NEKU Mx F (35), V1P2 NEKU My F (36)...	B-13
22	Curtain Volts	B-13
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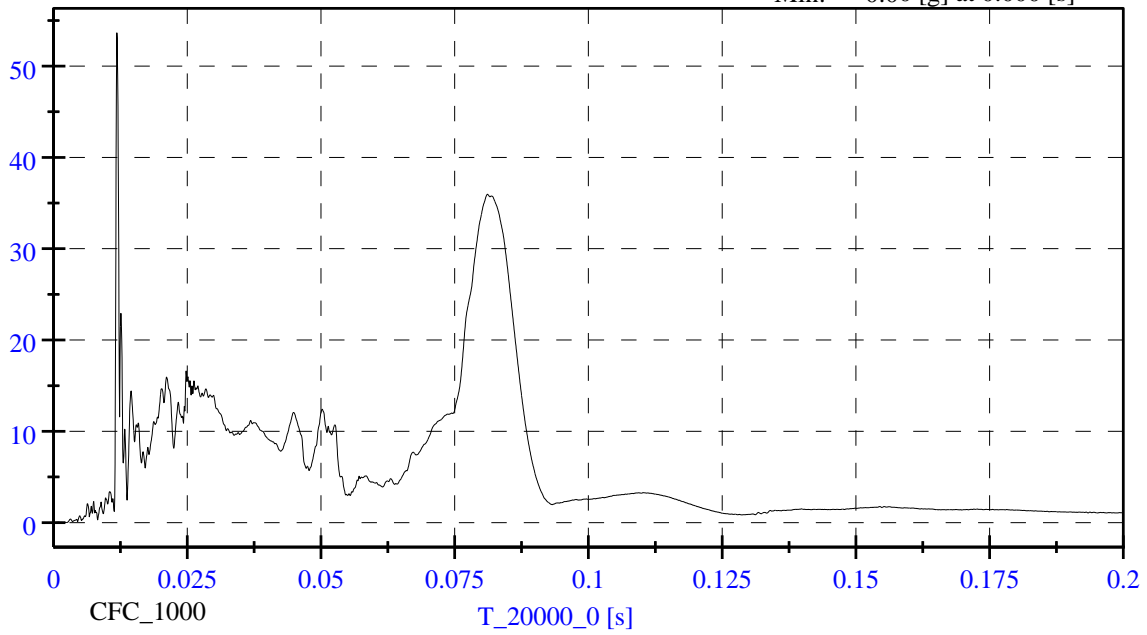




V1P2 Headform Resultant [g, CFC_1000]

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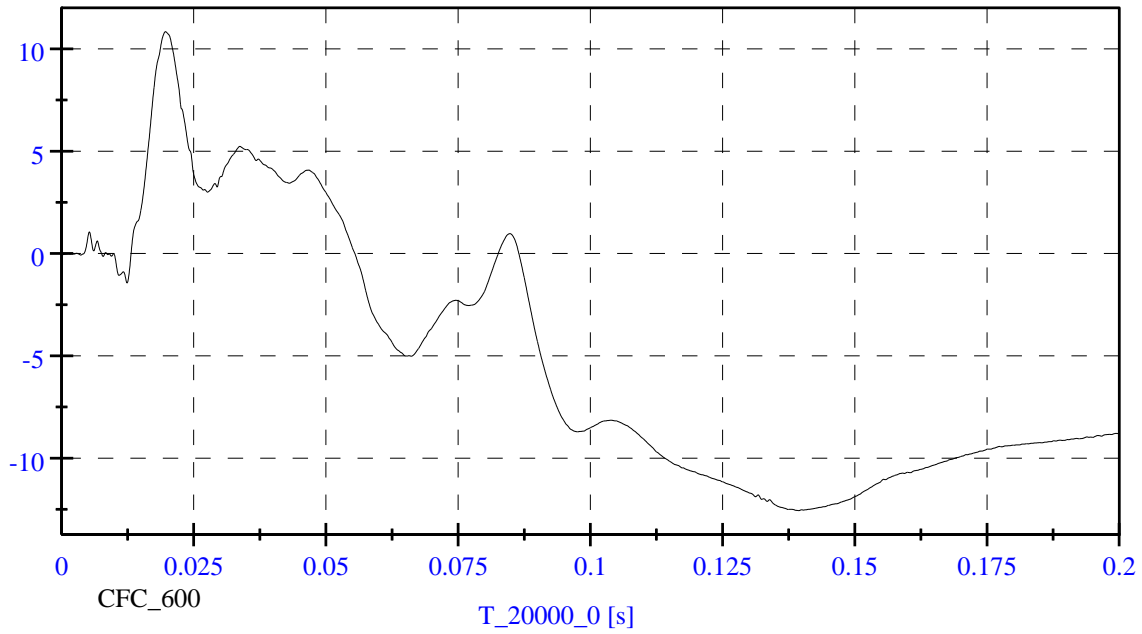
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V1P2 Upper Neck Mocy [N-m, CFC_600]

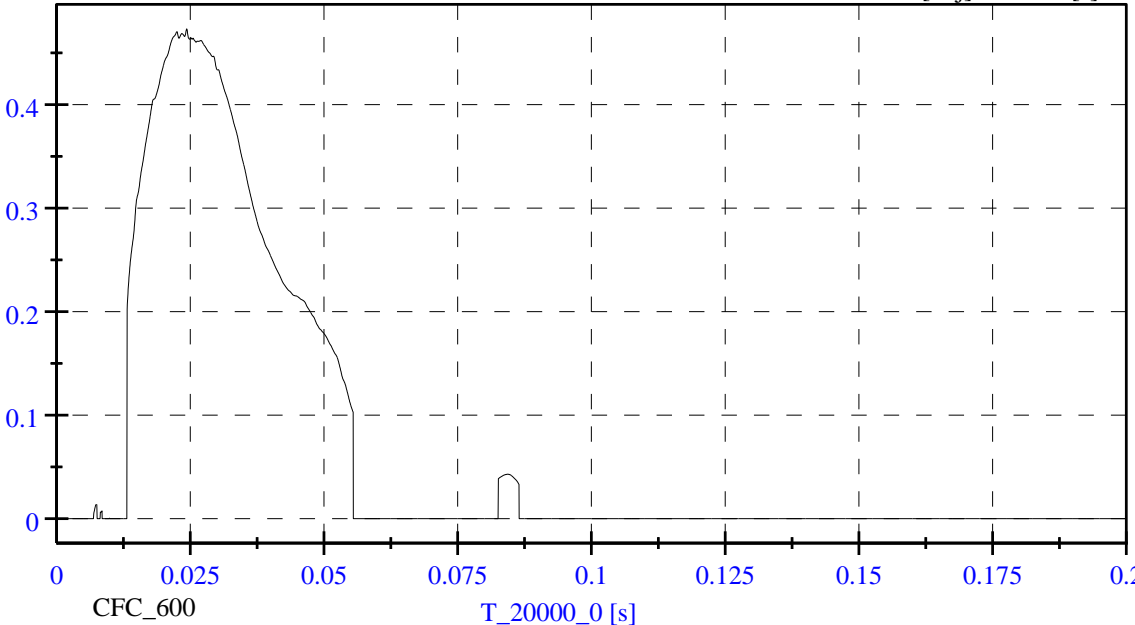
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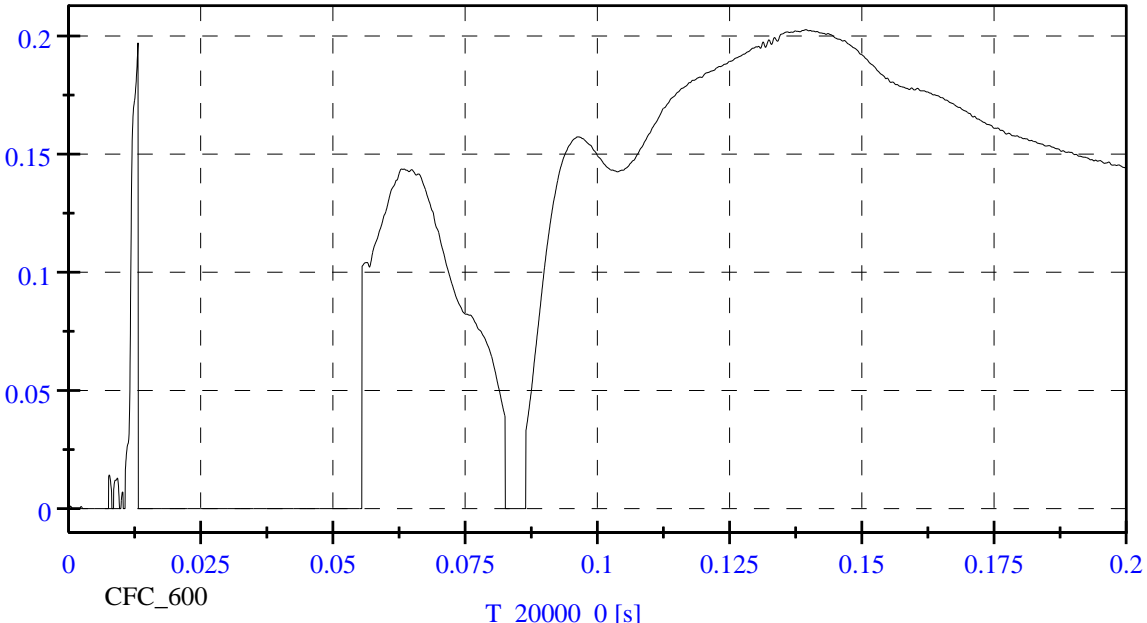
V1P2 Upper Neck Ncf [N-m, CFC_600]

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Min: 0.00 [Nij] at 0.000 [s]



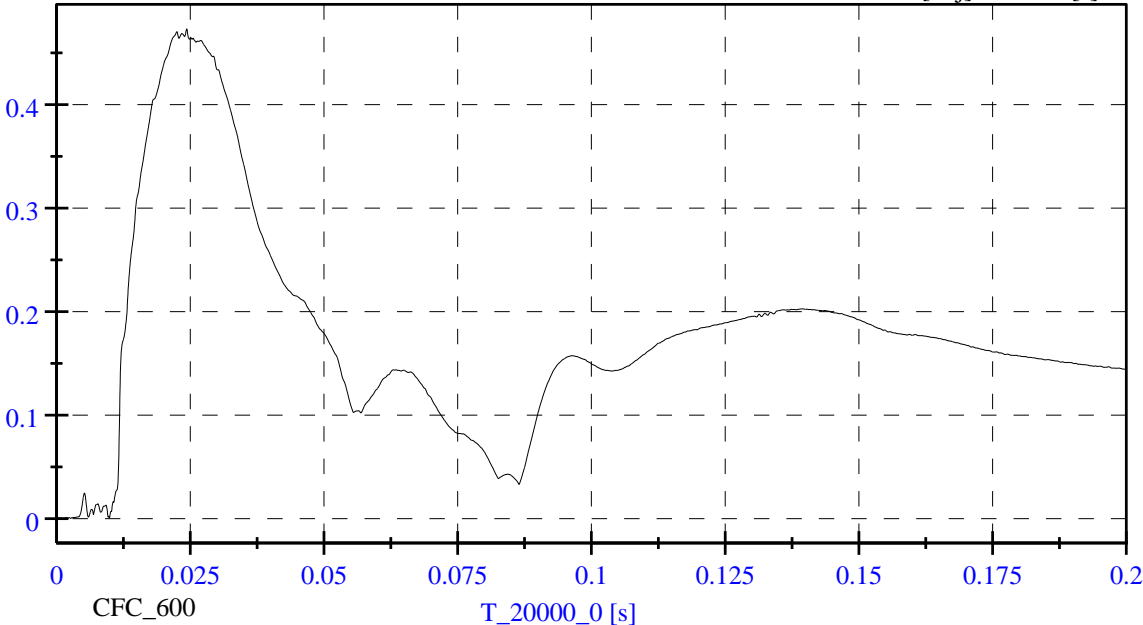
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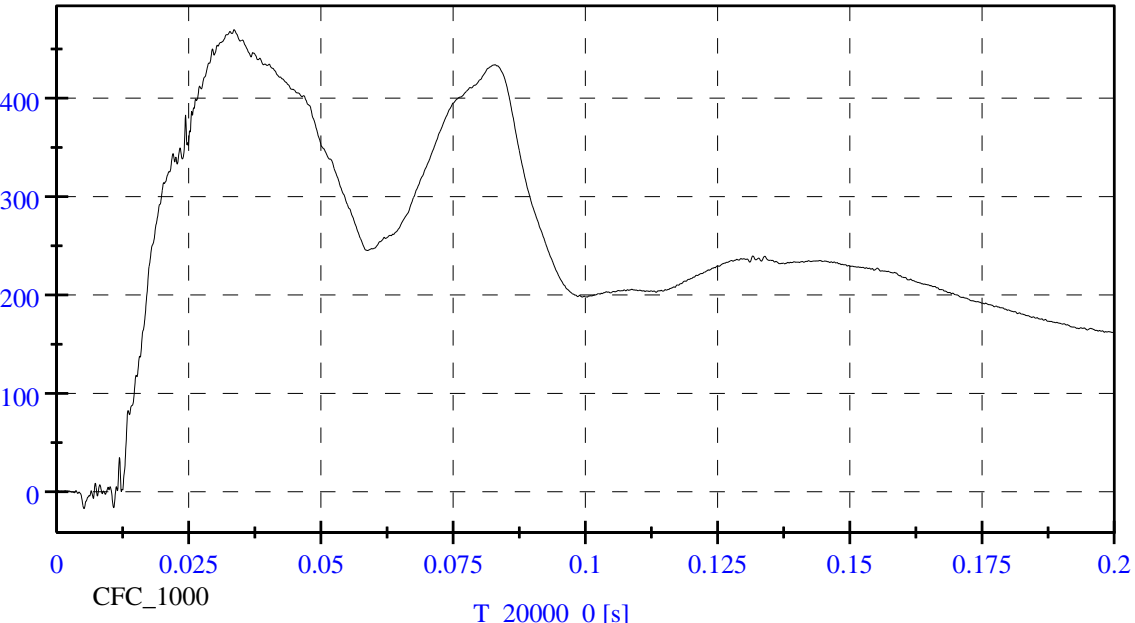
V1P2 Upper Neck Nij [Nij, CFC_600]

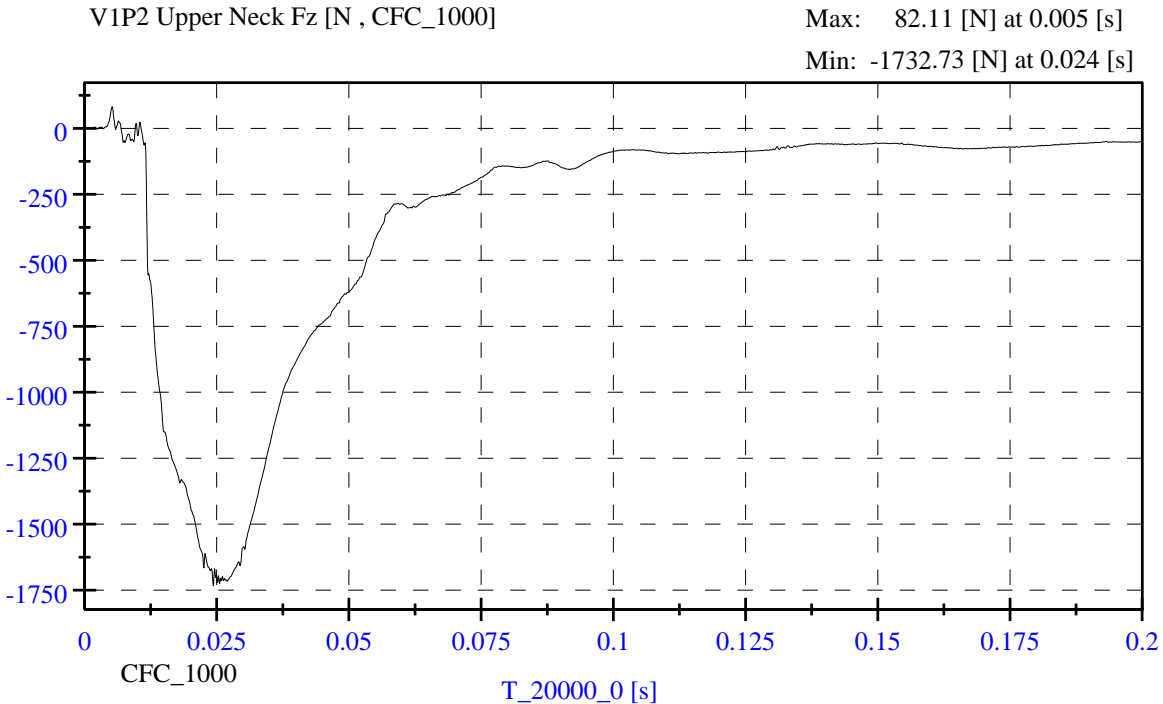
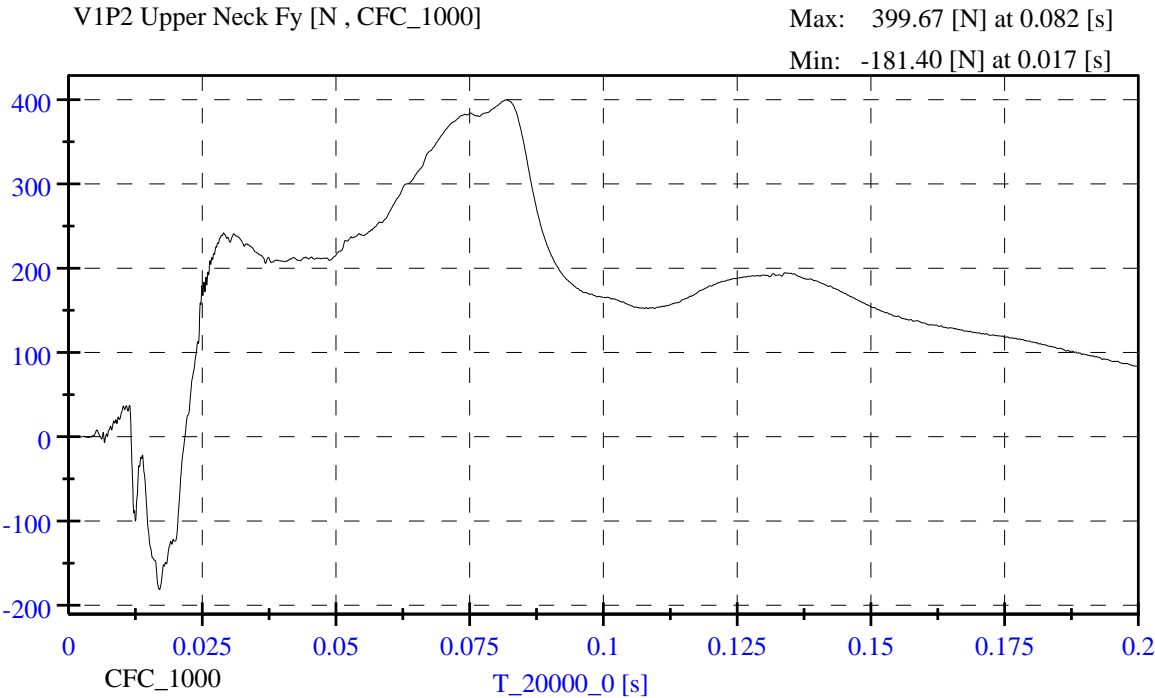
Max: 0.47 [Nij] at 0.024 [s]
Min: 0.00 [Nij] at 0.000 [s]



V1P2 Upper Neck Fx [N, CFC_1000]

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Min: -17.09 [N] at 0.005 [s]

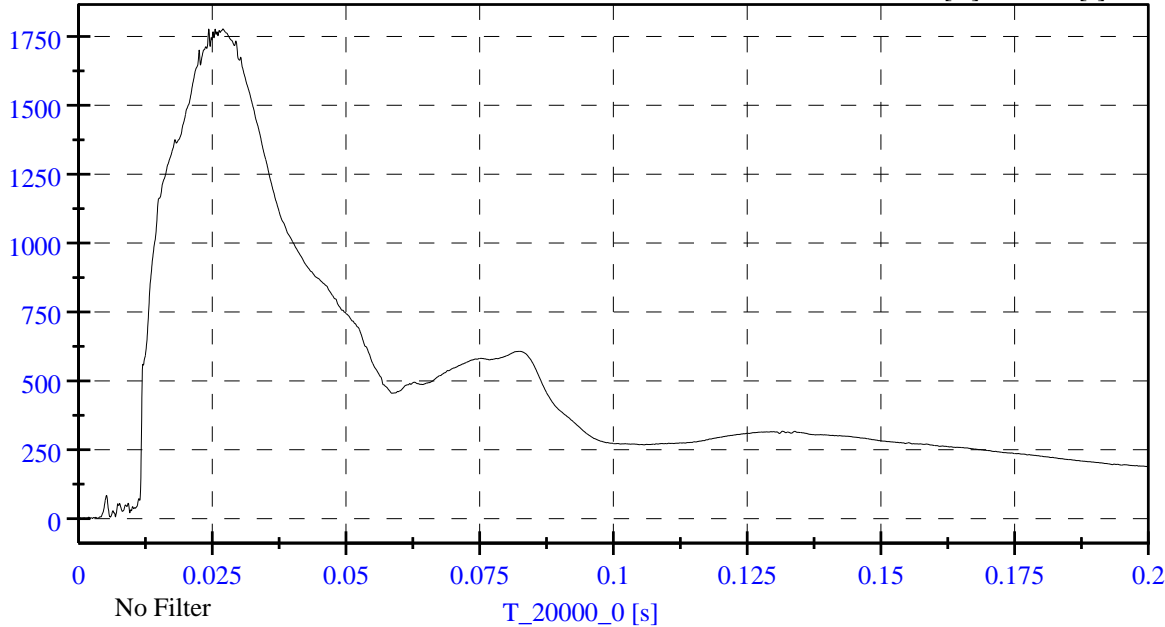




Input: V1P2 NEKU Fx F (32), V1P2 NEKU Fy F (33)...

Max: 1777.34 [N] at 0.027 [s]

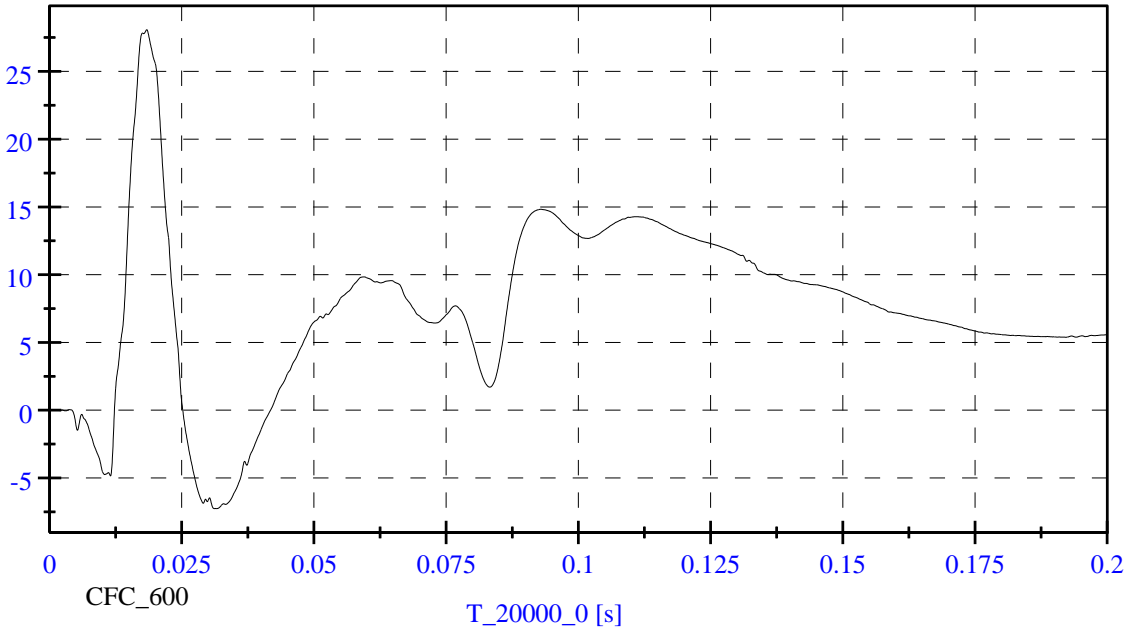
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V1P2 Upper Neck Mx [N-m , CFC_600]

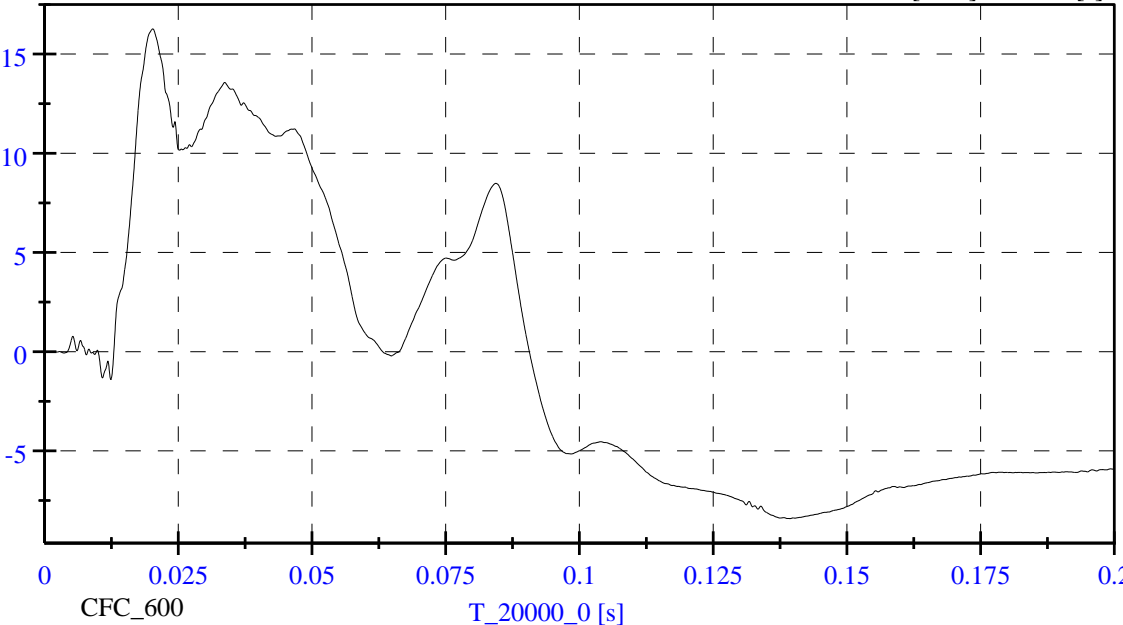
Max: 28.08 [N-m] at 0.018 [s]

Min: -7.26 [N-m] at 0.031 [s]



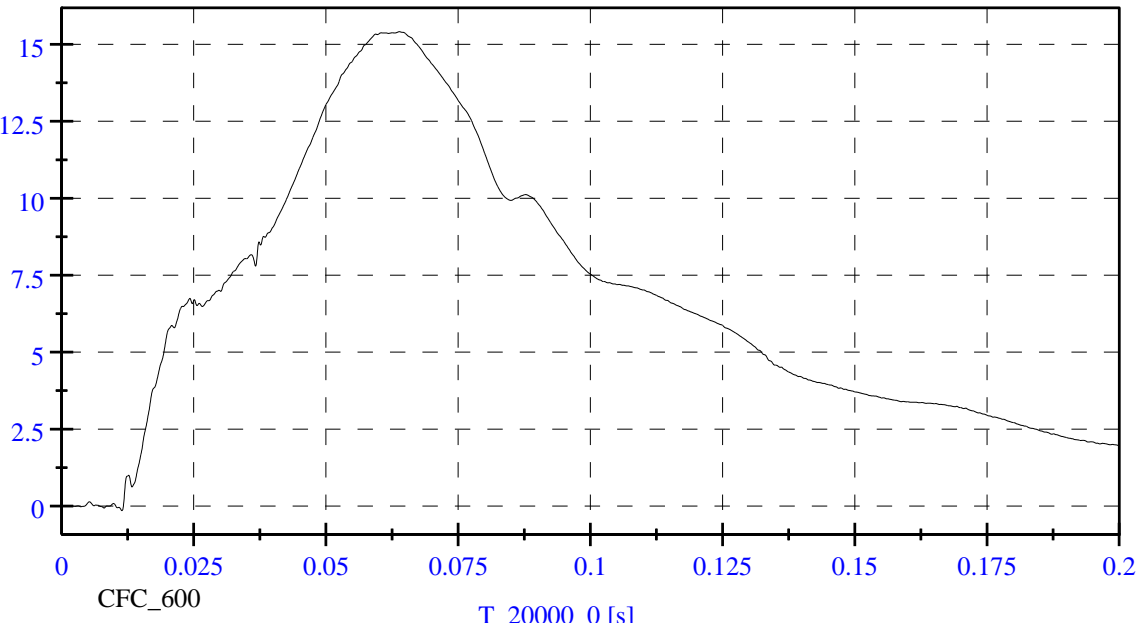
V1P2 Upper Neck My [N-m , CFC_600]

Max: 16.27 [N-m] at 0.020 [s]
Min: -8.41 [N-m] at 0.139 [s]



V1P2 Upper Neck Mz [N-m , CFC_600]

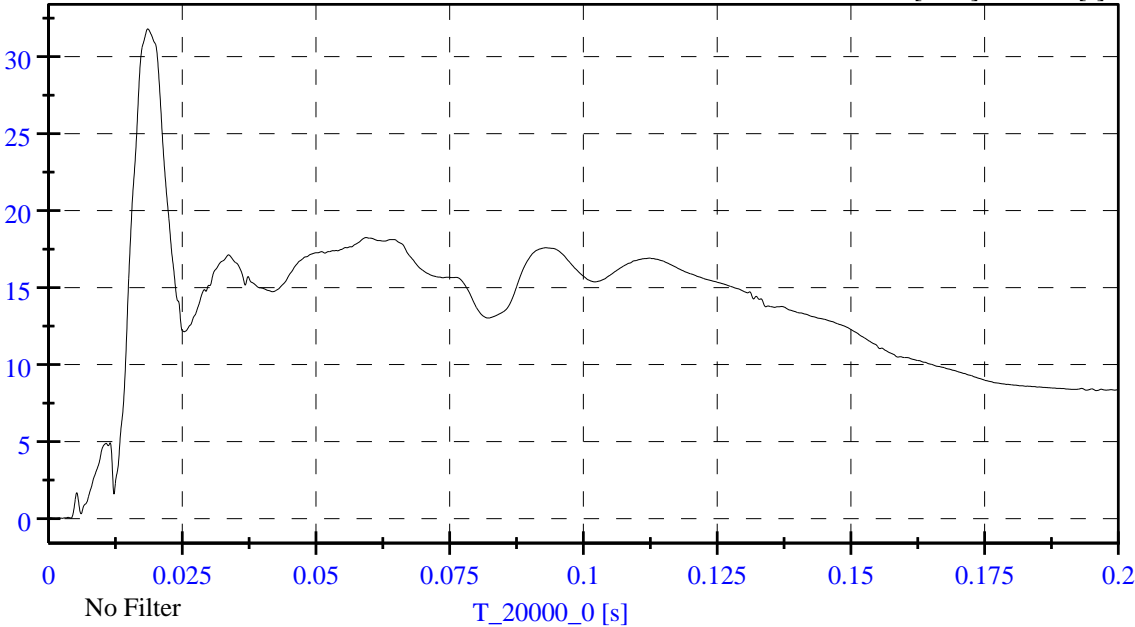
Max: 15.41 [N-m] at 0.064 [s]
Min: -0.15 [N-m] at 0.011 [s]



Input: V1P2 NEKU Mx F (35), V1P2 NEKU My F (36)...

Max: 31.80 [N-m] at 0.019 [s]

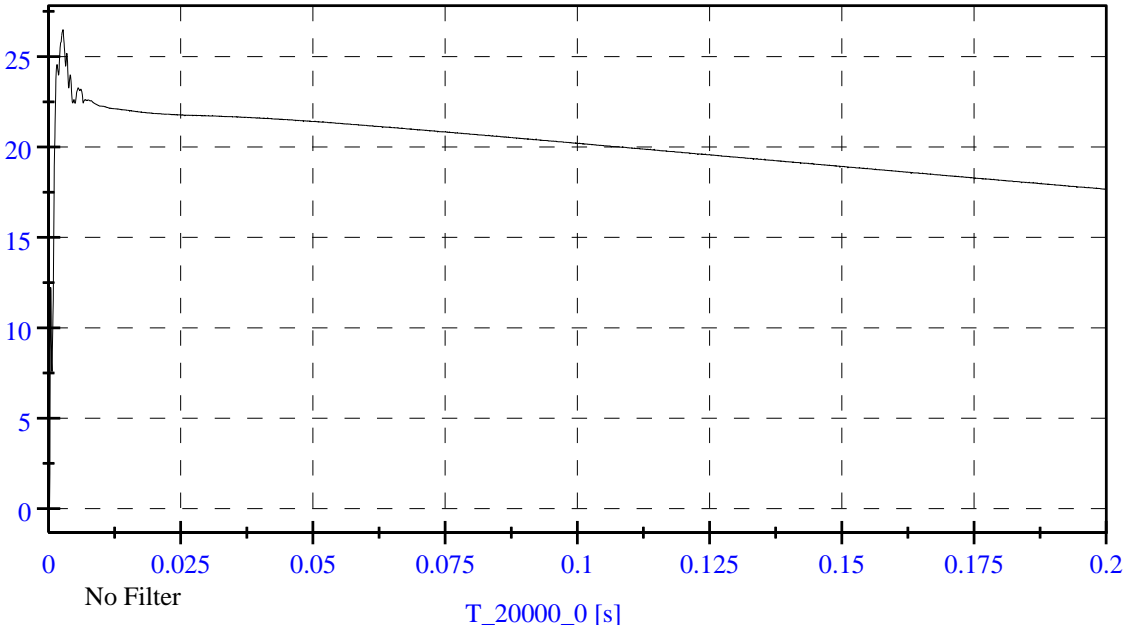
Min: 0.00 [N-m] at 0.000 [s]

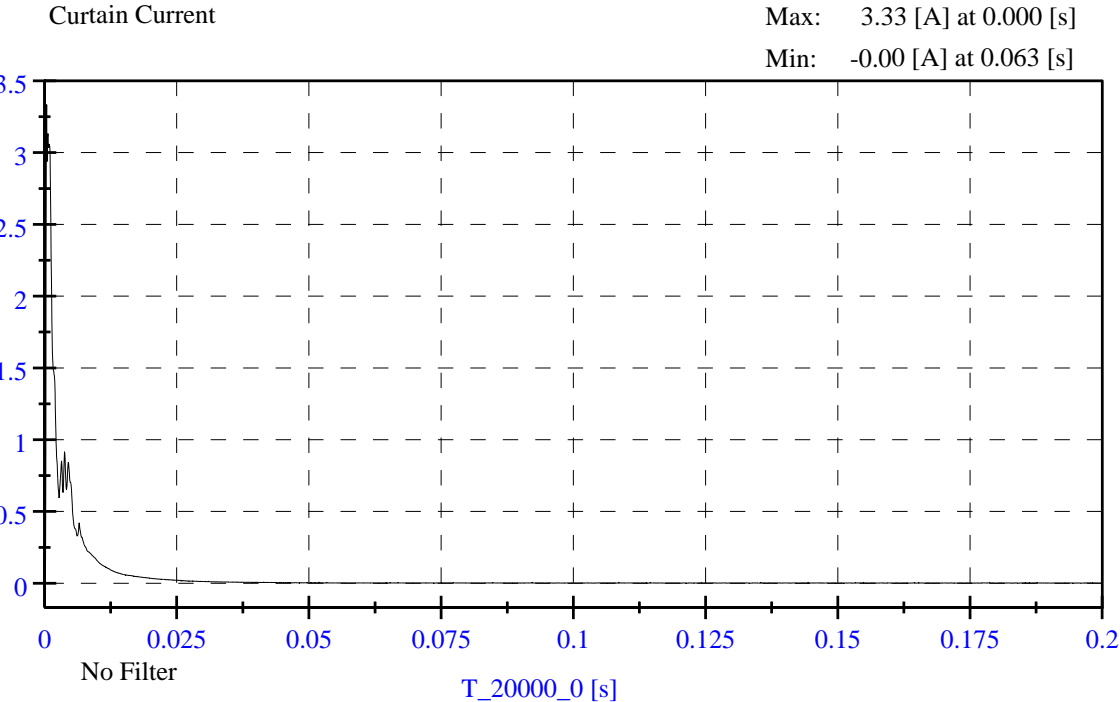
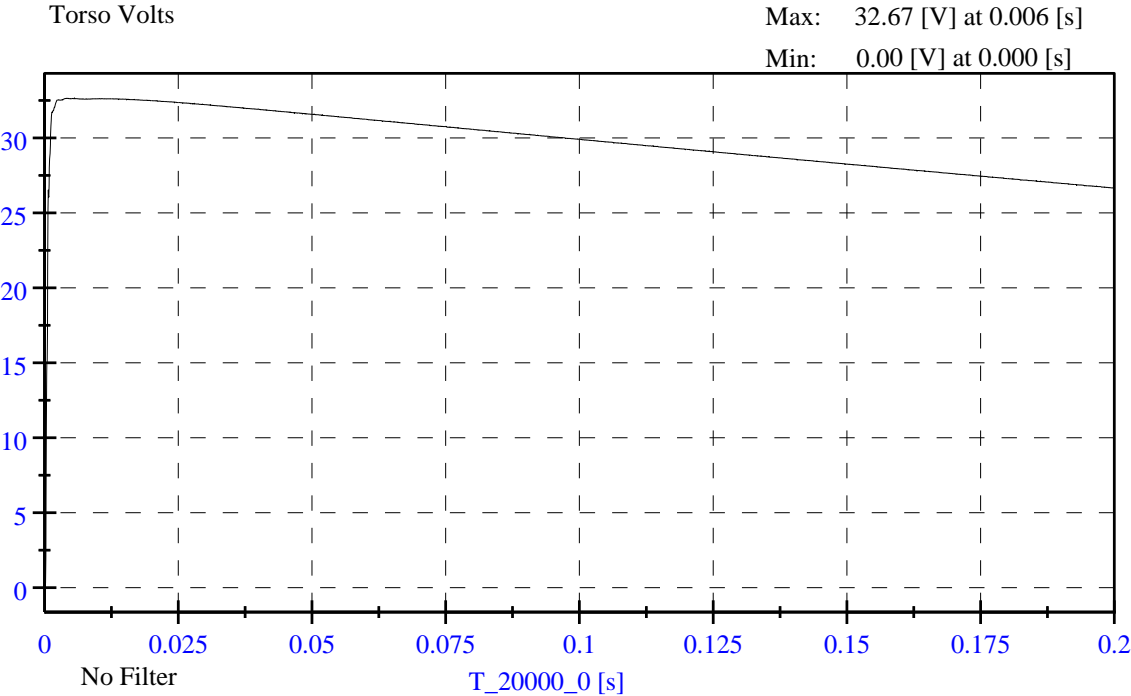


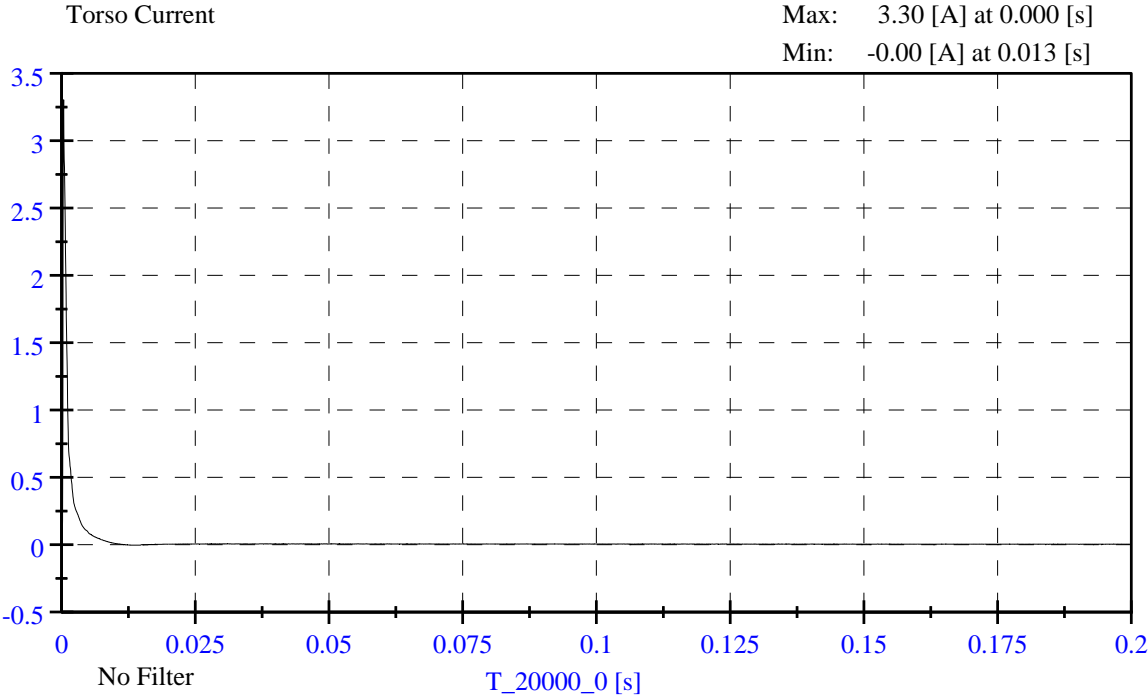
Curtain Volts

Max: 26.49 [V] at 0.003 [s]

Min: 0.00 [V] at 0.000 [s]







APPENDIX C

TEST EQUIPMENT LIST AND CALIBRATION INFORMATION

TEST EQUIPMENT LIST AND CALIBRATION INFORMATION

P572C INSTRUMENTATION

	POSITION #2 (RIGHT) SERIAL NO.: MC5401TWG2		
	SERIAL NUMBER	MANUFACTURER	CALIBRATION DATE
HEAD AX	AC-951685	ENDEVCO	10/31/2011
HEAD AY	AC-P51682	ENDEVCO	10/31/2011
HEAD AZ	AC-P51699	ENDEVCO	10/31/2011
HEAD RedAX	AC-P51701	ENDEVCO	10/31/2011
HEAD RedAY	AC-P45019	ENDEVCO	10/31/2011
HEAD RedAZ	AC-P51690	ENDEVCO	10/31/2011
UPPER NECK FX	LC-1591Fx	DENTON	6/20/2011
UPPER NECK FY	LC-1591Fy	DENTON	6/20/2011
UPPER NECK FZ	LC-1591Fz	DENTON	6/20/2011
UPPER NECK MX	LC-1591Mx	DENTON	6/20/2011
UPPER NECK MY	LC-1591My	DENTON	6/20/2011
UPPER NECK MZ	LC-1591Mz	DENTON	6/20/2011
Torso Bag Voltage	KT Minidau timer	N/A	6/21/2011
Curtain Bag Voltage	KT Minidau timer	N/A	6/21/2011
Torso Bag Curent	KT Minidau timer	N/A	6/21/2011
Curtain Bag Current	KT Minidau timer	N/A	6/21/2011