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CALSPAN REPORT NUMBER: 8102-1

MOVING BARRIER FRONTAL IMPACT TEST
FOR FUEL SYSTEM INTEGRITY

GENERAL MOTORS CORPORATION
1993 CHEVROLET CORSICA
4-DOOR SEDAN

CALSPAN TEST NUMBER: Y47-010-1276

APRIL 20, 1993

CALSPAN CORPORATION
ADVANCED TECHNOLOGY CENTER
P.O. BOX 400
BUFFALO, NEW YORK 14225

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FINAL REPORT

Prepared For:
U.S. Department of Transportation
Research and Special Programs Administration
Transportation Systems Center
Kendall Square
Cambridge, MA 02142

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16. Abstract A Moving Barrier Frontal Impact test of a 1993 Chevrolet Corsica 4-Door Sedan was performed at the Calspan Corporation Advanced Technology Center Crash Test Facility on April 20, 1993. The impact velocity was 40.5 MPH and the ambient temperature at the time of impact was 72°F. There was no fuel leakage detected after the test.			
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Section 1

PURPOSE AND TEST PROCEDURE

This 40 mph front moving barrier impact test is part of a test program conducted for the National Highway Traffic Safety Administration (NHTSA) by Calspan Advanced Technology Center under Contract No. DTRS57-90-C-00104.

The purpose of this test was to generate vehicle and occupant data with regard to the test vehicle, a 1993 Chevrolet Corsica 4-Door Sedan. This test was conducted using the requirement found in the OVSC Laboratory Test Procedure No. TP-301-00, dated April 26, 1989.

Section 2
SUMMARY OF TEST

A frontal moving barrier impacted a 1993 Chevrolet Corsica 4-Door Sedan at a velocity of 40.5 mph. The test vehicle was offset such that 50% of its maximum width was engaged by the moving barrier. This test was performed at the Calspan Advanced Technology Center on April 20, 1993. Pre and Post test photographs can be found in Appendix A of this report.

The test was documented by one real time camera and six high-speed cameras. Camera locations and other pertinent data can be found in Figure 4 and Table 6.

The test vehicle contained two Hybrid III 50th percentile male anthropomorphic test device's (ATDs) in the driver and right front passenger positions. Both ATD's were restrained with a 3-point restraint system. The driver ATD also had an airbag as a supplement restraint device. Both ATD's were instrumented with head and chest accelerations, chest potentiometer, left/right femur load cells, neck transducers and tibial transducers. The ATD's were placed in the vehicle following the dummy placement instructions specified in the Laboratory Indicant Test Procedure.

The 58 channels of data were recorded on a P.C. based data acquisition system. Appendix B contains the vehicle, load cell barrier and dummy response data traces. The moving barrier's accelerometers on the left and right rail have an anomaly at 100 msec. These anomalies occur after the primary impact.

The driver contacted the airbag and sustained a HIC of 173.2. The maximum chest deceleration over 3 milliseconds was 31.6 g's with 1.2 inch of deflection. The left femur load was -832.2 pounds and the right femur load was -653.4 pounds.

The passenger sustained a HIC of 167.9. The maximum chest deceleration over 3 milliseconds was 31.5 g's with 0.1 inches of deflection. The left femur load was -669.4 pounds and -215.1 pounds on the right femur.

Table 1

GENERAL TEST AND VEHICLE PARAMETER DATA

TEST VEHICLE INFORMATION:

Year/Make/Model/Body Style: 1993 Chevrolet Corsica 4-Door Sedan
Run No.: 1276; VIN: 1GILT5341NY195740; Color: Grey
Engine Data: 4 cylinders; - CID; - Liters; - cc
Placement: - Longitudinal or In-Line; X Transverse or Lateral
Transmission Data: 3 speeds; - Manual; X Automatic; - Overdrive
Final Drive: - Rear Wheel Drive; X Front Wheel Drive; - Four Wheel Drive
Major Options: - A/C; X Pwr.Strg.; X Pwr.Brakes
- Pwr.Windows; - Pwr.Door Locks
Date Received: 9-3-92; Odometer Reading 171 miles
Selling Dealer: Bill Gordon Chevrolet, Inc.
& Address 214 Lake Avenue - Rochester, NY 14608

DATA FROM VEHICLE'S CERTIFICATION LABEL:

Vehicle Manufactured by: General Motors
Date of Manufacture: 2/92
GVWR: 3635 lbs.; GAWR: 1904 lbs. FRONT; 1731 lbs. REAR

DATA FROM TIRE PLACARD:

Tire Pressure with Maximum Capacity Vehicle Load: 30 psi FRONT
30 psi REAR
Recommended Tire Size: P185-75R14
Recommended Cold Tire Pressure: 30 psi FRONT; 30 psi REAR
Size of Tires on Test Vehicle: P185-75R14; Manufacturer: Goodyear
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) = 891 lbs.
No. of Occupants x 150 lbs. = 750 lbs.
Rated Cargo/Luggage Weight (RCLW) = 141 lbs. (Difference)

Table 1

GENERAL TEST AND VEHICLE PARAMETER DATA (cont'd)

WEIGHT OF TEST VEHICLE AS RECEIVED FROM DEALER (WITH MAXIMUM FLUIDS) = UDW:

Right Front = 840 lbs. Right Rear = 480 lbs.
 Left Front = 880 lbs. Left Rear = 470 lbs.
 TOTAL FRONT = 1720 lbs. TOTAL REAR = 950 lbs.
 % of Total Vehicle Weight = 64 % of Total Weight = 36 %
 TOTAL DELIVERED WEIGHT = 2670 lbs.

WEIGHT OF TEST VEHICLE WITH TWO DUMMIES AND 196 POUNDS OF CARGO WEIGHT:

Right Front = 900 lbs. Right Rear = 680 lbs.
 Left Front = 920 lbs. Left Rear = 700 lbs.
 TOTAL FRONT = 1820 lbs. TOTAL REAR = 1380 lbs.
 % of Total Weight = 57 % % of Total Weight = 43 %
 TOTAL TEST WEIGHT = 3200 lbs.
 Weight of Ballast Secured in Vehicle Trunk Area = 0 lbs.

VEHICLE ATTITUDE (all dimensions in inches):

AS DELIVERED: RF 26.3 LF 26.3 RR 27.4 LR 27.4
 AS TESTED: RF 25.8 LF 26.2 RR 25.2 LR 24.8
 Vehicle's Wheel Base: 103.4 in.
 Location of Vehicle's C.G.: 44.6 (if required)

FUEL SYSTEM DATA:

Fuel System Capacity From Owner's Manual = 15.6 gallons
 Usable Capacity Figure Furnished by COTR = 15.6 gallons
 Test Volume Range (92 to 94% of Usable Capacity) = 14.2 to 14.7 gallons
 ACTUAL TEST VOLUME = 14.5 gallons (with entire fuel system filled)
 Test Fluid Type: Stoddard Solution; Spec. Grav. 0.764
 Kinematic Viscosity = 0.96 centistokes; Color = Purple

DETAILS OF FUEL SYSTEM:

14.5 gallons of stoddard solution was placed in the fuel tank.

Table 2
 POST-TEST IMPACT DATA
 SUMMARY OF RESULTS

TYPE OF TEST:

Type of Test: Moving Barrier Frontal Impact Impact Angle: 0°
 Test Date: April 20, 1993 Time: 14:50 Temperature: 72 °F
 Vehicle Test No.: Y47-010-1276
 Required Impact Velocity Range: 39.9 to 40.9 mph

BARRIER IMPACT VELOCITY: (Speed traps within 5 feet of impact plane.)

Trap No. 1 = 40.5 mph; Trap No. 2 = 40.5 mph
 Distance from vehicle to barrier: (1) entering trap = 52 inches
 (2) exiting trap = 12 inches

VEHICLE STATIC CRUSH: (For frontal and rear impacts only.)

Vehicle Length:

Pre-Test Right = 178.2; C/L = 183.0; Left = 178.6
 Post-Test Right = 180.7; C/L = 165.2; Left = 152.2
 Crush Right = -2.5; C/L = 17.8; Left = 26.0
 AVERAGE = 13.8 inches

DOOR OPENING:

	Left	Right
Front	<u>Operable</u>	<u>Operable</u>
Rear	<u>Operable</u>	<u>Operable</u>

SEAT MOVEMENT:

	Seat Back Failure	Seat Shift
Front	<u>None</u>	<u>0.0</u>
Rear	<u>None</u>	<u>0.0</u>

Table 2
POST-TEST IMPACT DATA
SUMMARY OF RESULTS (cont'd)

CONTACT PTS.:

	<u>Driver</u>	<u>Passenger</u>
Head	<u>Airbag rear of head with headrest</u>	<u>Rear of head with headrest</u>
Chest	<u>Airbag</u>	<u>No Contact</u>
Abdomen	<u>No Contact</u>	<u>No Contact</u>
Left Knee	<u>Dash Panel</u>	<u>Lower Dash Panel</u>
Right Knee	<u>Dash Panel</u>	<u>Lower Dash Panel</u>

STODDARD SPILLAGE: There was no fuel leakage

GLAZING DAMAGE: None

OTHER NOTABLE IMPACT FEATURES: None

Section 3
VEHICLE AND TEST INFORMATION

Table 3

DUMMY INJURY CRITERIA VALUES

TEST No.: Y47-010-1276 Vehicle: 1993 Chevrolet Corsica 4-Door Sedan

	MAXIMUM HEAD ACCELERATION (g's)			
	X	Y	Z	R
Position #1 - Driver	59.5	24.3	26.5	66.7
Position #2 - Passenger	-28.6	7.1	25.6	31.8

	MAXIMUM CHEST ACCELERATION (g's)			
	X	Y	Z	R
Position #1 - Driver	-32.1	9.7	17.1	31.6
Position #2 - Passenger	-30.9	10.6	-6.5	31.5

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

	MAXIMUM FORCE - FEMUR LOAD (lbs.)	
	LEFT FEMUR	RIGHT FEMUR
Position #1 - Driver	-832.2	-653.4
Position #2 - Passenger	-669.4	-215.1

	HEAD INJURY CRITERIA (HIC)			
	HIC	t ₁ (msec)	t ₂ (msec)	Average Acceleration t ₁ TO t ₂
Position #1 - Driver	173.2	59.4	95.28	29.75
Position #2 - Passenger	167.9	82.08	117.96	29.38

HIC is as defined in FMVSS 208. The maximum time interval from t₁ to t₂ is 36 milliseconds.

Table 4
HYBRID III NECK AND CHEST DATA

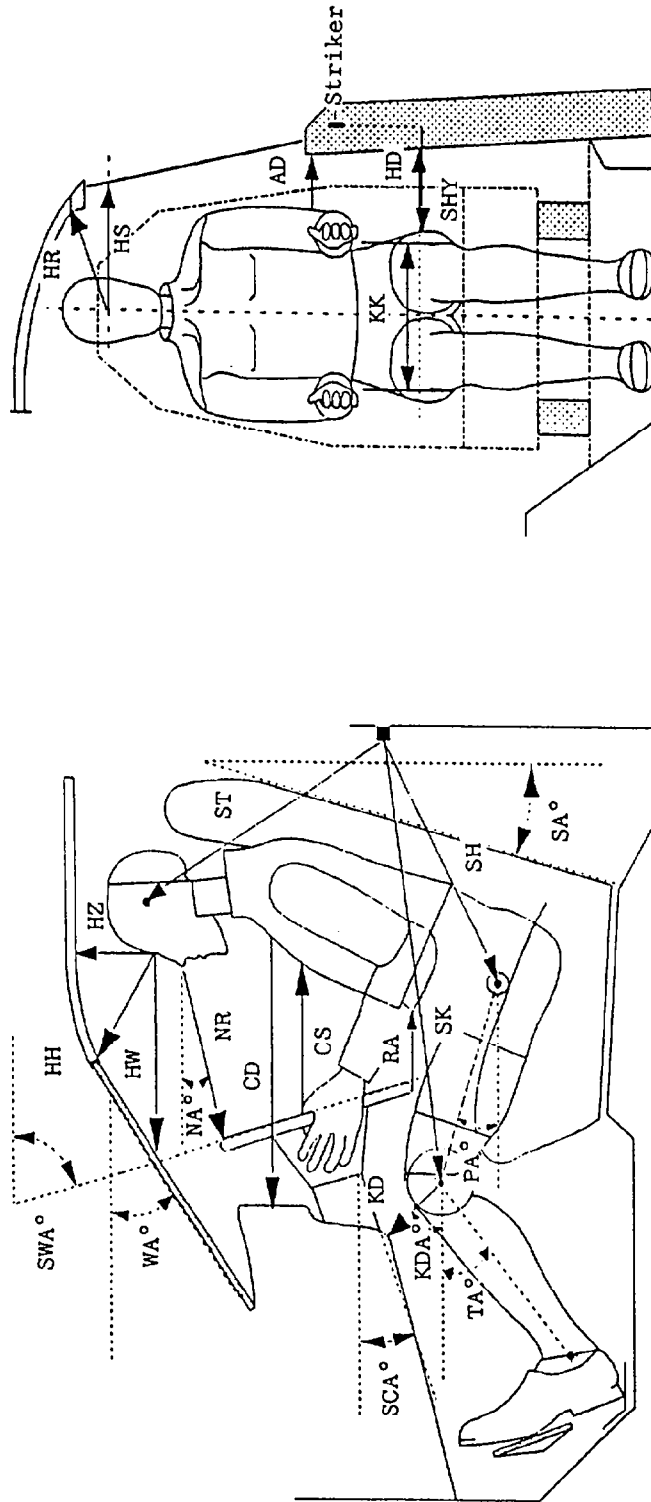
Vehicle Year/Make/Model/Body Style: 1993 Chevrolet Corsica 4-Door Sedan

Test NHTSA No.: Y47-010-1276 Test Date: April 20, 1993

MAXIMUM VALUES	DRIVER DUMMY ID # <u>45</u>	PASSENGER DUMMY ID # <u>150</u>
Neck Load X	-78.8 lbs	235.6 lbs
Neck Load Y	74.8 lbs	67.7 lbs
Neck Load Z	375.4 lbs	248.7 lbs
Neck Moment X	-20.5 ft-lbs	-9.9 ft-lbs
Neck Moment Y	-28.8 ft-lbs	50.9 ft-lbs
Neck Moment Z	-13.9 ft-lbs	4.7 ft-lbs
Chest Deflection X (in.)	1.2 in.	0.1 in.
Time of Max. Occurance	76.7 msec	94.3 msec

NOTE: All values listed must be occurring during primary impact event.

Figure 1
DUMMY MEASUREMENTS FOR FRONT SEAT PASSENGERS

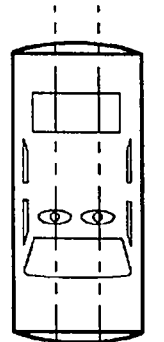
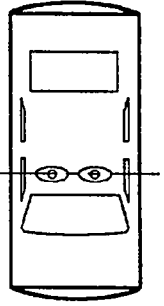


HR - Head to Header
 HS - Head to Side Window
 AD - Arm to Door
 HD - H-Point to Door
 SHY - Striker to H-Point (Y Dir.)
 KK - Knee to Knee

SK - Striker to Knee
 ST - Striker to Head
 NA - Nose to Rim Angle
 TA - Tibial Angle
 PA - Pelvic Angle
 SA - Seat Back Angle
 SCA - Steering Column Angle
 SWA - Steering Wheel Angle
 WA - Windshield Angle

HH - Head to Header
 HW - Head to Windshield
 HZ - Head to Roof
 NR - Nose to Rim
 NA - Nose to Rim Angle
 CD - Chest to Dash
 CS - Steering Wheel to Chest
 RA - Rime to Abdomen
 KDL/KDR - Knee to Dash
 KDA - Knee to Dash Angle
 SH - Striker to H-Point

Vertical Longitudinal Planes



Passenger
 Driver

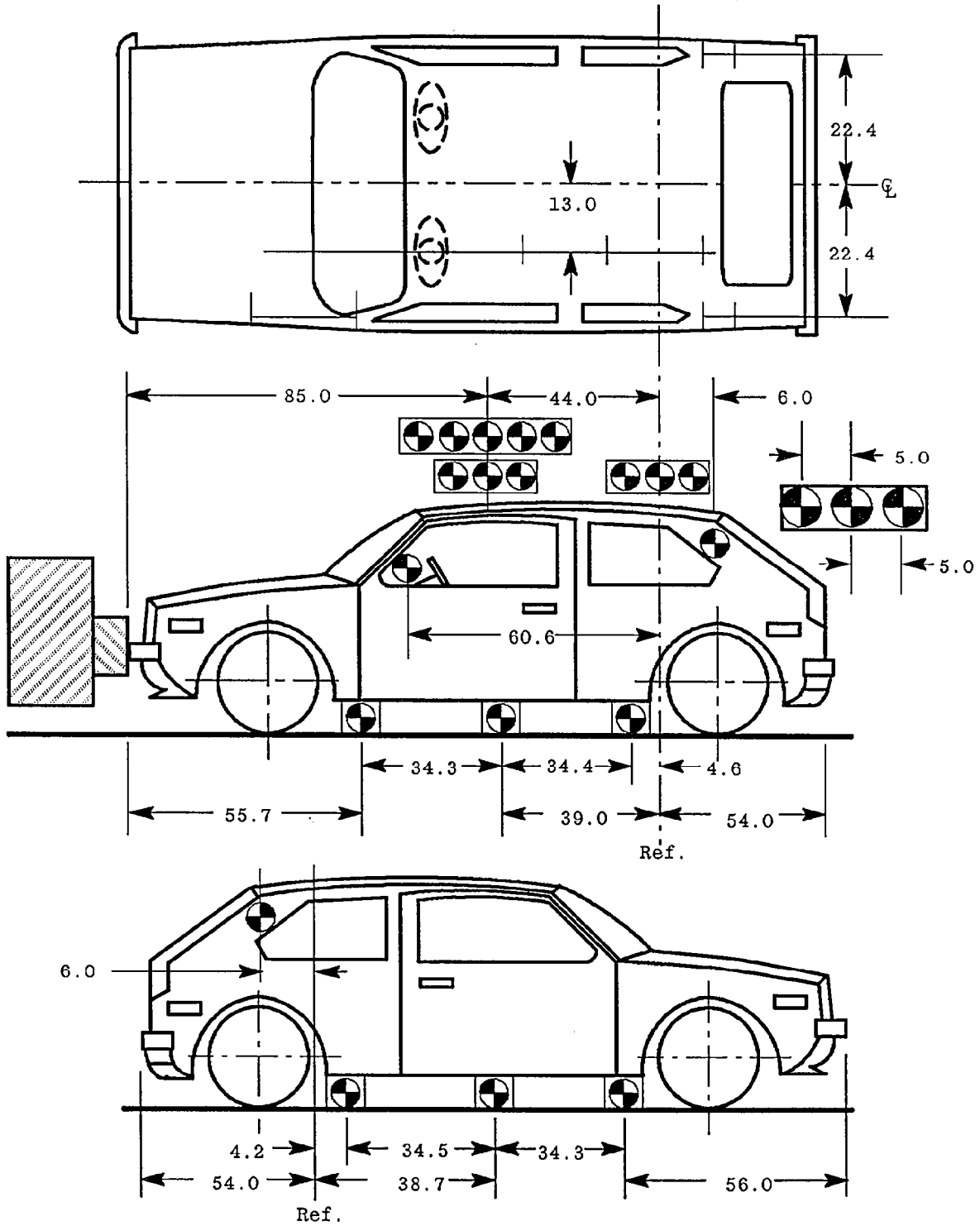
Table 5

FRONT SEAT OCCUPANT MEASUREMENTS

(all dimensions in inches unless otherwise specified)

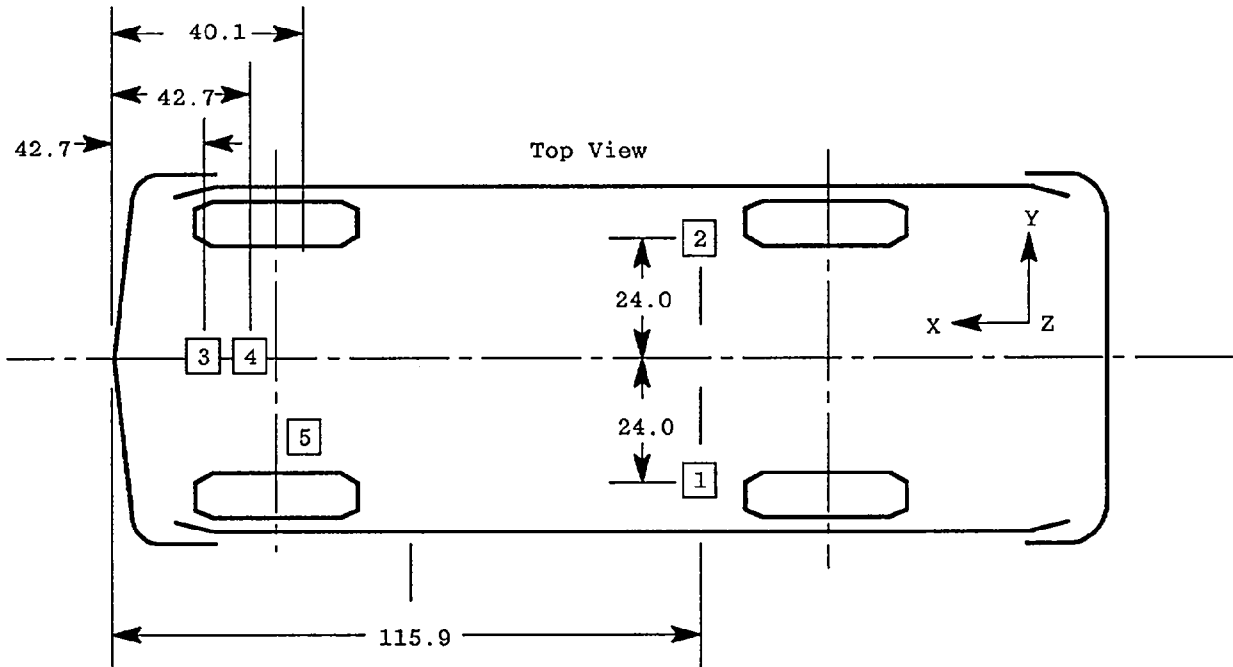
	DRIVER (Serial #45)	PASS (Serial #150)
WA°	38°	-
SWA°	-70°	-
SCA°	20°	-
SA°	26°	26°
HZ	7.5	7.3
HH	11.6	11.7
HW	22.0	21.8
HR	8.8	8.4
NR	13.4 Angle 9°	-
CD	19.5	17.6
CS	10.3	-
RA	7.4	-
KDL	4.6 Angle (KDA) 45°	4.8
KDR	5.3	4.5 Angle (KDA) 45°
PA°	24°	25°
TA°	45°	35°
KK	11.5	10.0
ST	21.2 Angle 12°	21.2 Angle 9°
SK	21.3 Angle 90°	23.5° Angle 93°
SH	7.3 Angle 130°	8.6 Angle 123°
SHY	9.5	9.4
HS	10.3	10.4
AD	3.9	4.5

Figure 2
VEHICLE TARGET LOCATIONS



(Dimensions in inches)

Figure 3
VEHICLE ACCELEROMETER LOCATIONS



ACCELEROMETER NUMBER*	ACCELEROMETER LOCATION	DIRECTION		
		X	Y	Z
1	Left Rear Seat Crossmember	✓		
2	Right Rear Seat Crossmember	✓		
3	Top of Engine	✓		
4	Bottom of Engine	✓		
5	Left Disc Brake Caliper	✓		

*The accelerometer pack number can be correlated with the vehicle response data traces found in Appendix B.

Figure 4

CAMERA POSITIONS FOR FRONTAL IMPACTS

Note: Camera Information Shown on Table 5.

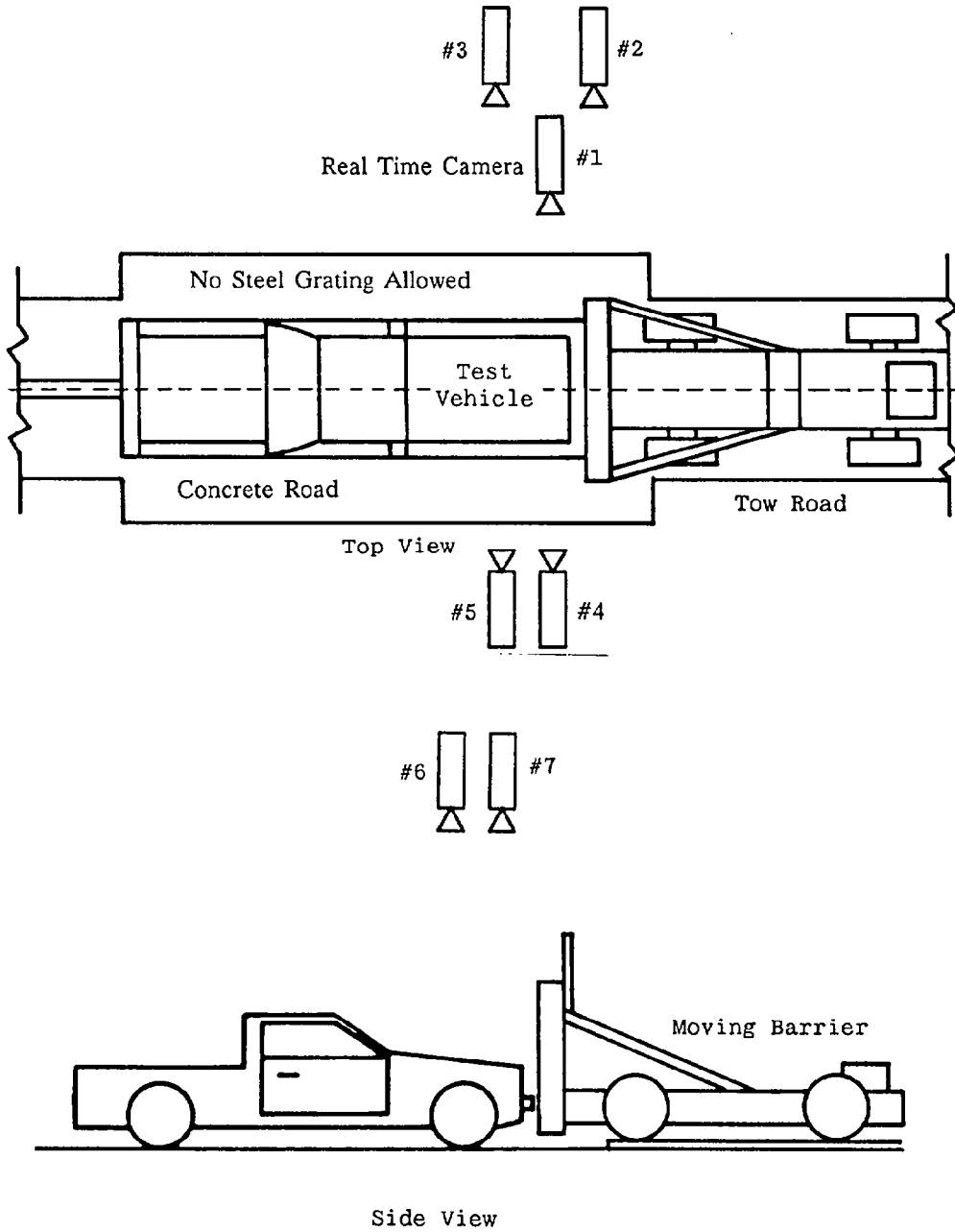


Table 6
HIGH-SPEED CAMERA LOCATIONS

CAMERA NO.	VIEW	CAMERA POSITIONS (in)*			ANGLE** (deg)	LENS (mm)	SPEED (fps)
		X	Y	Z			
1	Real-Time Camera	-	-	-	-	24	
2	Left Side View	246	83	41	-2	570	
3	Right Side View	316	59	32	0	770	
4	Right Side View	326	94	40	0	550	
5	Right Side Closeup	372	76	40	0	620	
6	Overhead View	0	0	386	-90	600	
7	Overhead Overall View	0	0	386	-90	590	

Test No. Y47-010-1276 Vehicle: 1993 Chevrolet Corsica 4-Door Sedan

*X = film plane to monorail centerline
 Y = film plane to impact location
 Z = film plan to ground
 ** = referenced to horizontal plane

Figure 5

TEST VEHICLE MEASUREMENTS

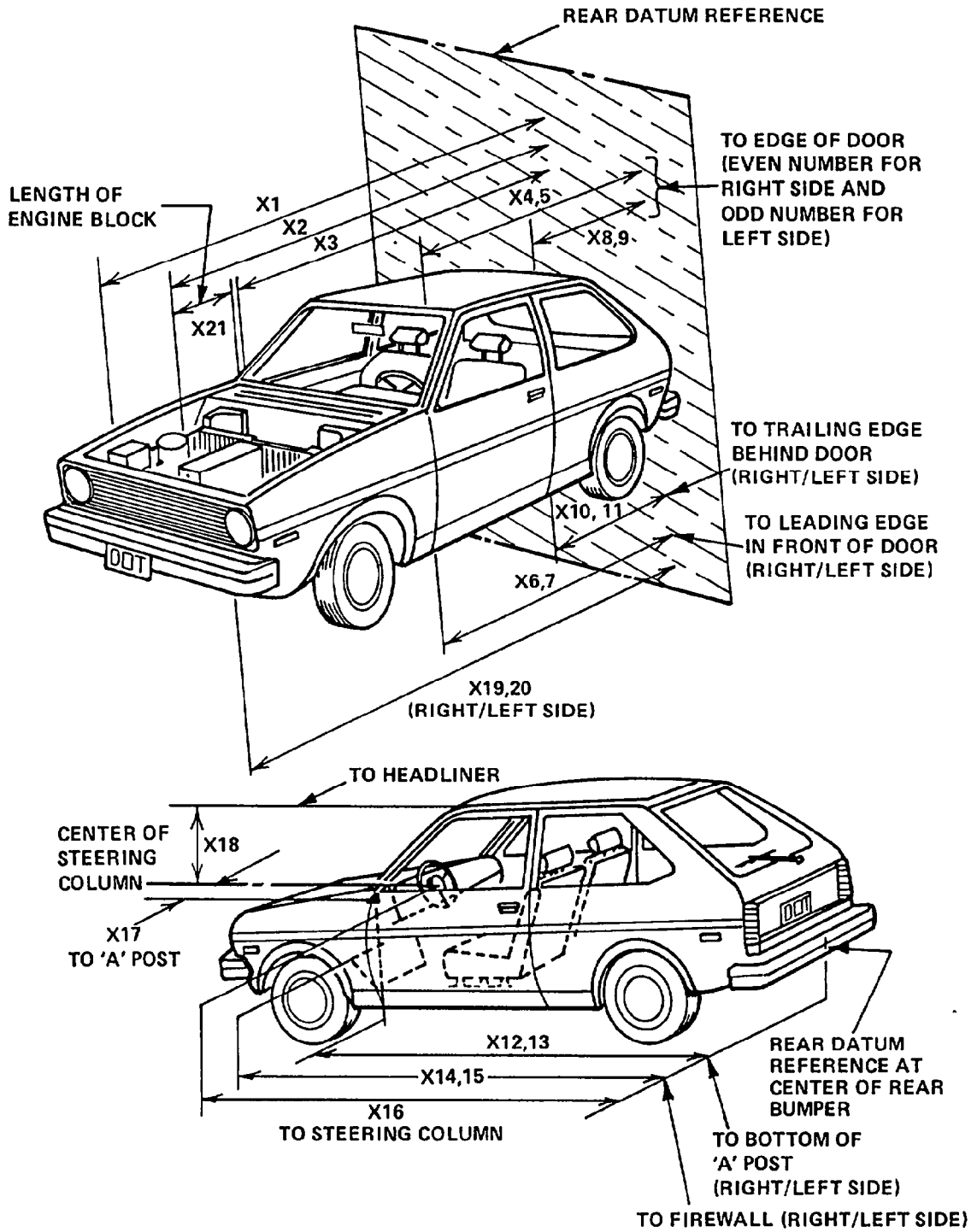


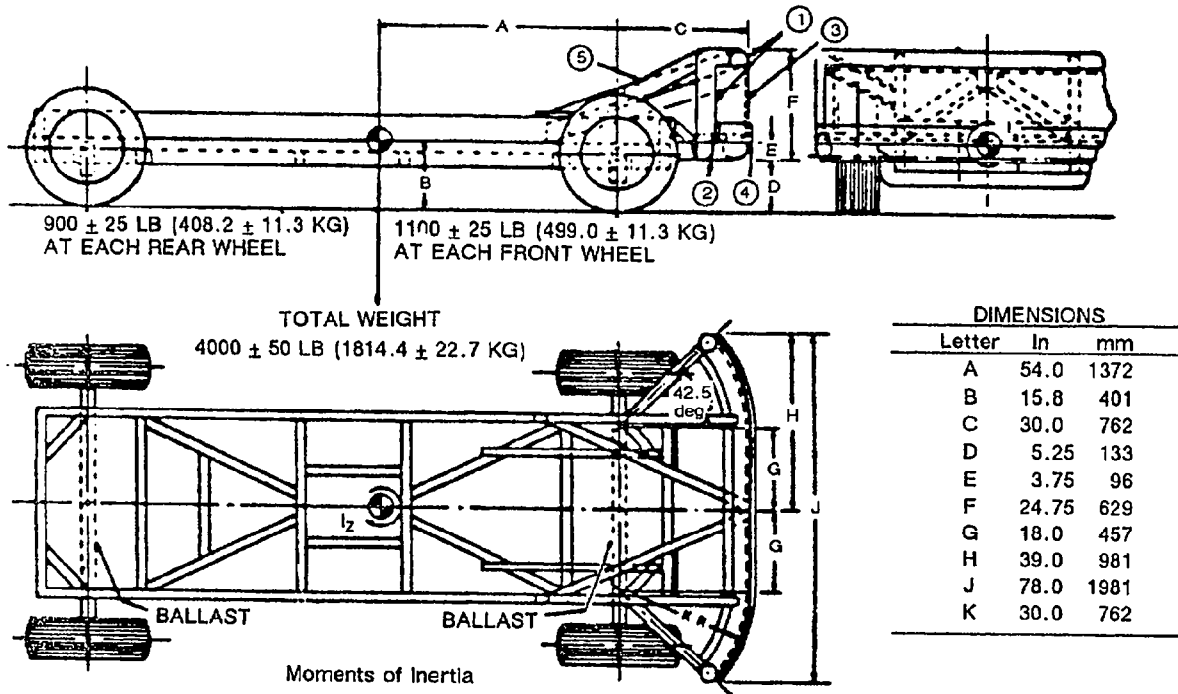
Table 7

VEHICLE MEASUREMENTS

No.		All Dimensions in Millimeters		
		Pre-Test	Post-Test	Differences
X1	Total Length of Vehicle at Centerline	183.0	165.2	17.8
X2	Rear Surface of Vehicle to Front of Engine	155.1	151.5	3.6
X3	Rear Surface of Vehicle to Firewall	135.4	135.0	0.4
X4	Rear Surface of Vehicle to Upper Leading Edge of Right Door	124.3	124.2	0.1
X5	Rear Surface of Vehicle to Upper Leading Edge of Left Door	124.3	123.4	0.9
X6	Rear Surface of Vehicle to Lower Leading Edge of Right Door	123.3	123.9	-0.6
X7	Rear Surface of Vehicle to Lower Leading Edge of Left Door	123.3	123.5	-0.2
X8	Rear Surface of Vehicle to Upper Trailing Edge of Right Door	83.9	84.6	-0.7
X9	Rear Surface of Vehicle to Upper Trailing Edge of Left Door	83.9	84.2	-0.3
X10	Rear Surface of Vehicle to Lower Trailing Edge of Right Door	85.0	85.6	-0.6
X11	Rear Surface of Vehicle to Lower Trailing Edge of Left Door	85.3	85.3	0.0
X12	Rear Surface of Vehicle to Bottom of "A" Post of Right Side	126.3	125.0	1.3
X13	Rear Surface of Vehicle to Bottom of "A" Post of Left Side	126.5	123.0	3.5
X14	Rear Surface of Vehicle to Firewall, Right Side	135.5	136.4	-0.9
X15	Rear Surface of Vehicle to Firewall, Left Side	135.4	132.6	2.8
X16	Rear Surface of Vehicle to Steering Column	106.0	105.6	0.4
X17	Center of Steering Column to "A" Post	16.4	15.9	0.5
X18	Center of Steering Column to Headliner	15.5	16.3	-0.8
X19	Rear Surface of Vehicle to Right Side of Front Bumper	178.2	180.7	-2.5
X20	Rear Surface of Vehicle to Left Side of Front Bumper	178.6	152.2	26.0
X21	Length of Engine Block	12.6	12.6	0.0

Figure 5a

COMMON CARRIAGE WITH CONTOURED IMPACT SURFACE ATTACHED



NOTES:

1. Upper frame 4.0 in dia x 0.25 in wall (102 mm dia x 6 mm wall) steel tubing (three sides).
2. Lower frame 6.0 in dia x 0.50 in wall (152 mm dia x 13 mm wall) steel tubing.
3. Face plate 0.75 in (19 mm) thick cold rolled steel.
4. Leading edge 1.0 x 4.0 in (25 x 102 mm) steel band, sharp edges broken
5. All inner reinforcements 4.0 x 2.0 x 0.19 in (102 x 51 x 5 mm) steel tubing.

Section 4

SUMMARY OF RESULTS FOR FUEL SYSTEM INTEGRITY

Figure 6
FUEL SYSTEM INTEGRITY POST IMPACT TEST IMPACT DATA

TEST NO.: Y47-010-1276 TEST DATE: APRIL 20, 1993

Vehicle Mfgr./Make/Model: 1993 Chevrolet Corsica 4-Door Sedan

Test vehicle fuel tank filled to 92% to 94% of manufacturer's "usable" capacity and with electric fuel pump operating (if it will operate without engine operation). Part 572 test dummies located at each front designated seating position.

.....

TEST VEHICLE IMPACT TYPE: Frontal (30 mph)
 Oblique (30 mph) with ° barrier face first contacting _____
(driver/passenger) side
 Moving Barrier (Frontal Impact)
 Lateral Moving Barrier (20 mph)

FUEL SPILLAGE MEASUREMENT:

1. From impact until vehicle motion ceases
2. For 5 minute period after vehicle motion ceases
3. For next 25 minutes

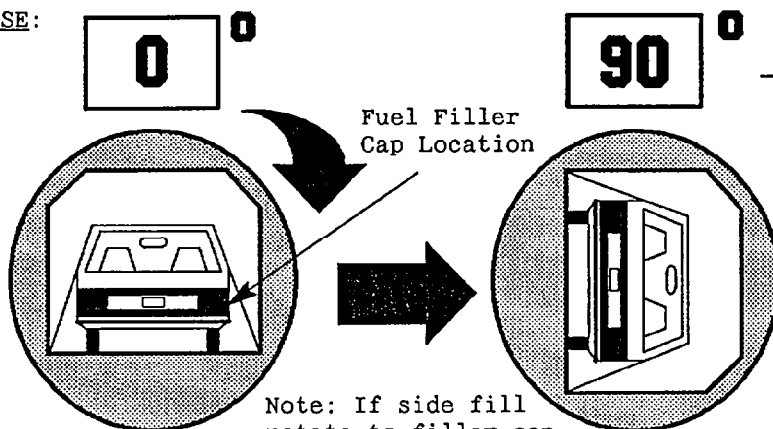
ACTUAL	MAX ALLOWED
0.0	1 oz.
0.0	5 oz.
0.0	1 oz./1 min.

SOLVENT SPILLAGE DETAILS:

None

Figure 7
STATIC ROLLOVER DATA

TEST PHASE:



Vehicle Test No.:

Y47-010-1276

I. DETERMINATION OF SOLVENT COLLECTION TIME PERIOD:

Rollover Fixture 90° Rotation Time (Spec. Range = 1 to 3 minutes)	_____ 3 _____ minutes _____ 00 _____ seconds
FMVSS 301 Position Hold Time +	_____ 5 _____ minutes _____ 00 _____ seconds
TOTAL	_____ 8 _____ minutes _____ 00 _____ seconds
Next whole minute interval	_____ 8 _____ minutes

II. FMVSS 301 REQUIREMENTS:

(1) Time Period

First 5 min FROM onset of rotation	6th min.	7th min.	8th min. if reqd.
------------------------------------	----------	----------	----------------------

(2) Maximum Allowable Solvent Spillage

5 ounces	1 ounce	1 ounce	1 ounce
----------	---------	---------	---------

III. ACTUAL TEST VEHICLE SOLVENT SPILLAGE:

0.0	0.0	0.0	0.0
-----	-----	-----	-----

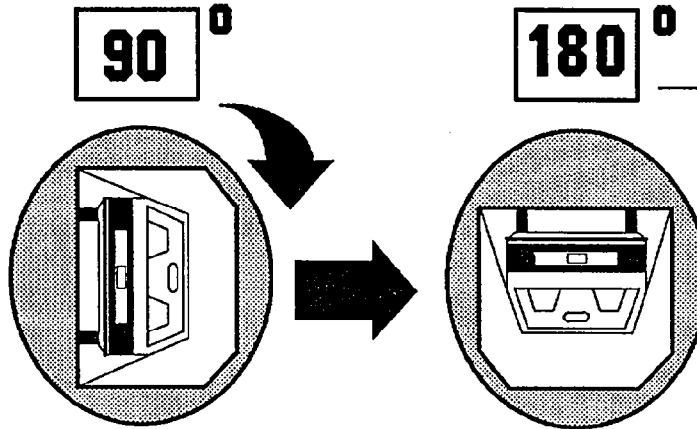
Note: Record spillage for whole minute intervals only as determined above.

IV. SOLVENT SPILLAGE LOCATION(S):

None

Figure 7
 STATIC ROLLOVER DATA (cont.)

TEST PHASE:



Vehicle Test No.:

Y47-010-1276

I. DETERMINATION OF SOLVENT COLLECTION TIME PERIOD:

Rollover Fixture 90° Rotation Time _____ 3 _____ minutes _____ 00 _____ seconds
 (Spec. Range = 1 to 3 minutes)

FMVSS 301 Position Hold Time + _____ 5 _____ minutes _____ 00 _____ seconds

TOTAL _____ 8 _____ minutes _____ 00 _____ seconds

Next whole minute interval _____ 0 _____ minutes

II. FMVSS 301 REQUIREMENTS:

(1) Time Period

First 5 min FROM onset of rotation	6th min.	7th min.	8th min. if reqd.
------------------------------------	----------	----------	----------------------

(2) Maximum Allowable Solvent Spillage

5 ounces	1 ounce	1 ounce	1 ounce
----------	---------	---------	---------

III. ACTUAL TEST VEHICLE SOLVENT SPILLAGE:

0.0	0.0	0.0	0.0
-----	-----	-----	-----

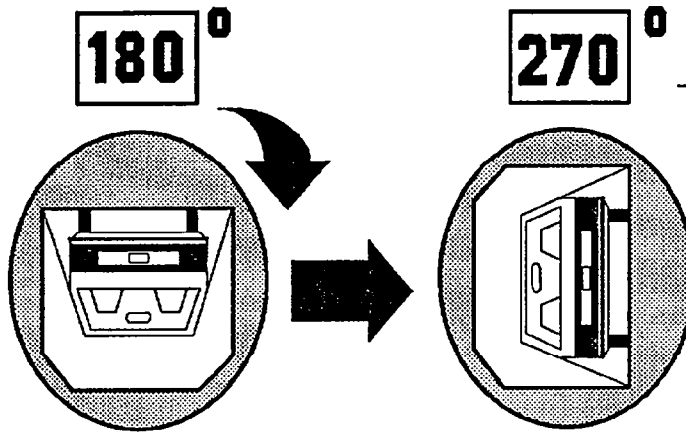
Note: Record spillage for whole minute intervals only as determined above.

IV. SOLVENT SPILLAGE LOCATION(S):

None

Figure 7
 STATIC ROLLOVER DATA (cont.)

TEST PHASE:



Vehicle Test No.:

Y47-010-1276

I. DETERMINATION OF SOLVENT COLLECTION TIME PERIOD:

Rollover Fixture 90° Rotation Time _____ 3 _____ minutes _____ 00 _____ seconds
 (Spec. Range = 1 to 3 minutes)

FMVSS 301 Position Hold Time + _____ 5 _____ minutes _____ 00 _____ seconds

TOTAL _____ 8 _____ minutes _____ 00 _____ seconds

Next whole minute interval _____ 8 _____ minutes

II. FMVSS 301 REQUIREMENTS:

(1) Time Period

First 5 min FROM onset of rotation	6th min.	7th min.	8th min. if reqd.
------------------------------------	----------	----------	----------------------

(2) Maximum Allowable Solvent Spillage

5 ounces	1 ounce	1 ounce	1 ounce
----------	---------	---------	---------

III. ACTUAL TEST VEHICLE SOLVENT SPILLAGE:

0.0	0.0	0.0	0.0
-----	-----	-----	-----

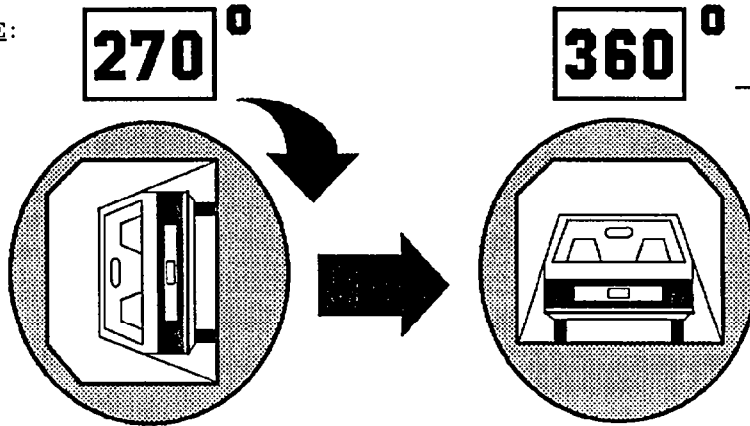
Note: Record spillage for whole minute intervals only as determined above.

IV. SOLVENT SPILLAGE LOCATION(S):

None

Figure 7
 STATIC ROLLOVER DATA (cont.)

TEST PHASE:



Vehicle Test No.:

Y47-010-1276

I. DETERMINATION OF SOLVENT COLLECTION TIME PERIOD:

Rollover Fixture 90° Rotation Time (Spec. Range = 1 to 3 minutes) 3 minutes 00 seconds

FMVSS 301 Position Hold Time + 5 minutes 00 seconds

TOTAL 8 minutes 00 seconds

Next whole minute interval 8 minutes

II. FMVSS 301 REQUIREMENTS:

(1) Time Period

First 5 min FROM onset of rotation	6th min.	7th min.	8th min. if reqd.
------------------------------------	----------	----------	----------------------

(2) Maximum Allowable Solvent Spillage

5 ounces	1 ounce	1 ounce	1 ounce
----------	---------	---------	---------

III. ACTUAL TEST VEHICLE SOLVENT SPILLAGE:

0.0	0.0	0.0	0.0
-----	-----	-----	-----

Note: Record spillage for whole minute intervals only as determined above.

IV. SOLVENT SPILLAGE LOCATION(S):

None

Appendix A

PHOTOGRAPHS

PHOTOGRAPHS

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A-27	PRE-TEST PASSENGER HEAD VIEW	A-30
A-28	POST-TEST ROLLOVER VIEW	A-31

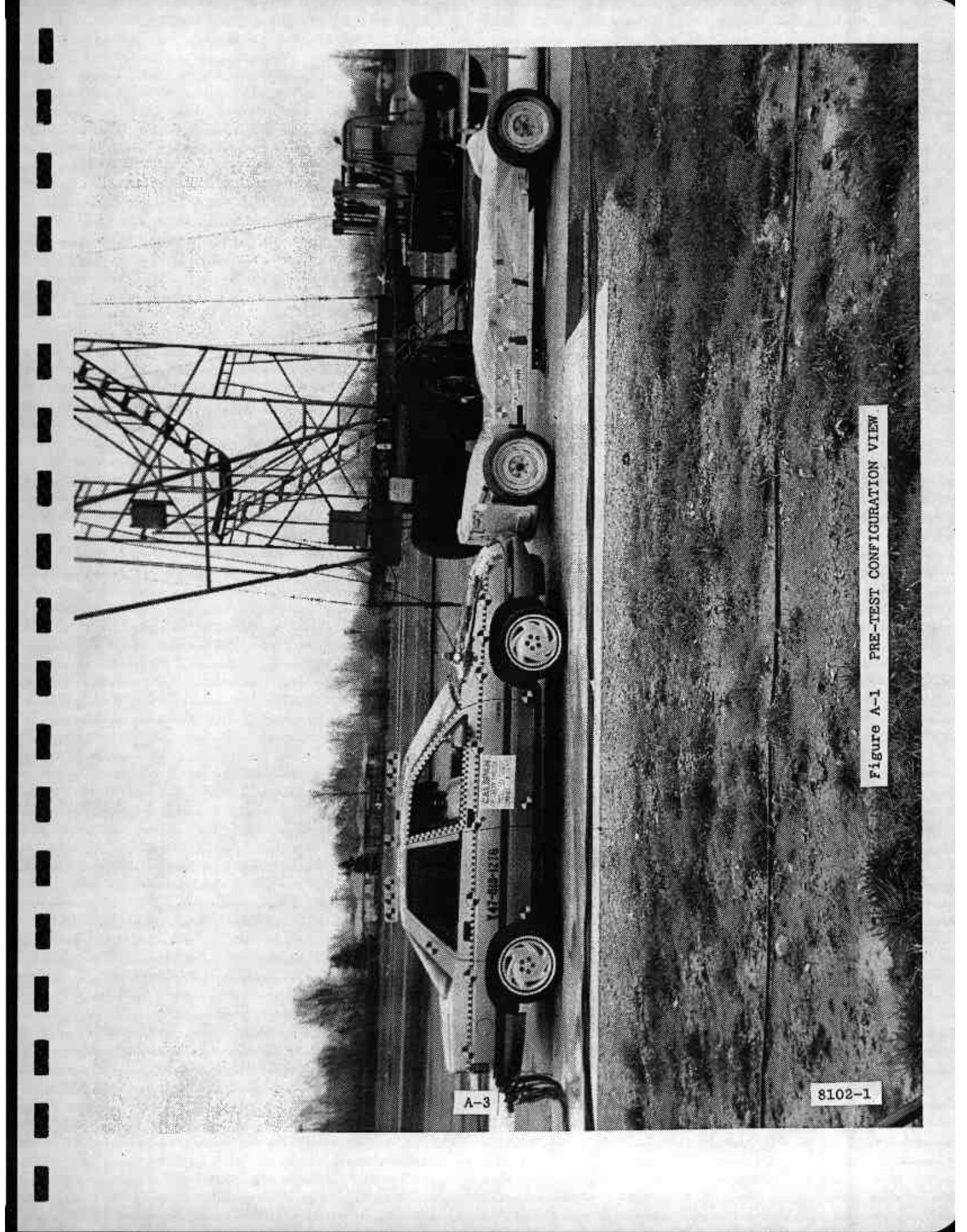


Figure A-1 PRE-TEST CONFIGURATION VIEW

A-3

8102-1

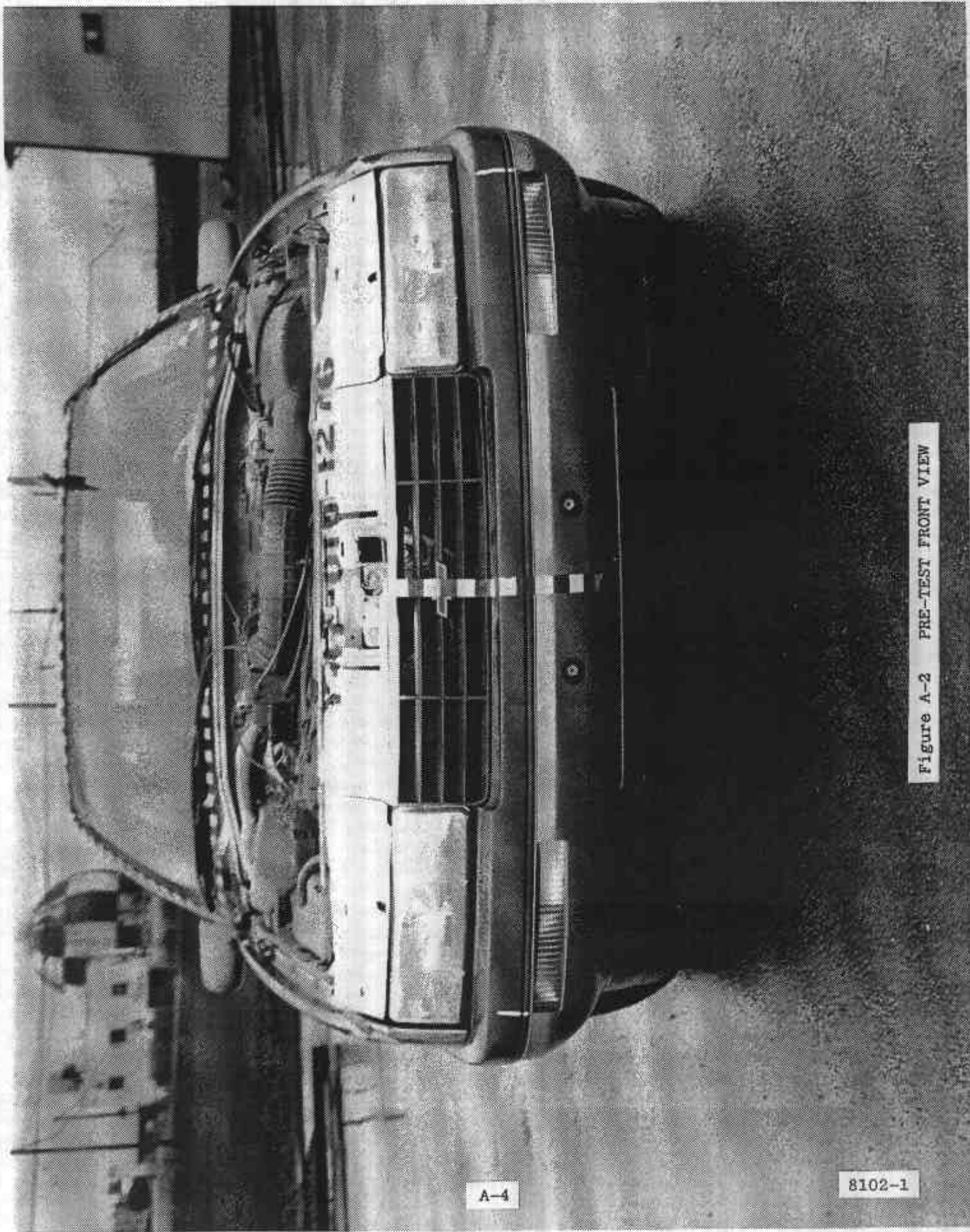


Figure A-2 PRE-TEST FRONT VIEW

A-4

8102-1

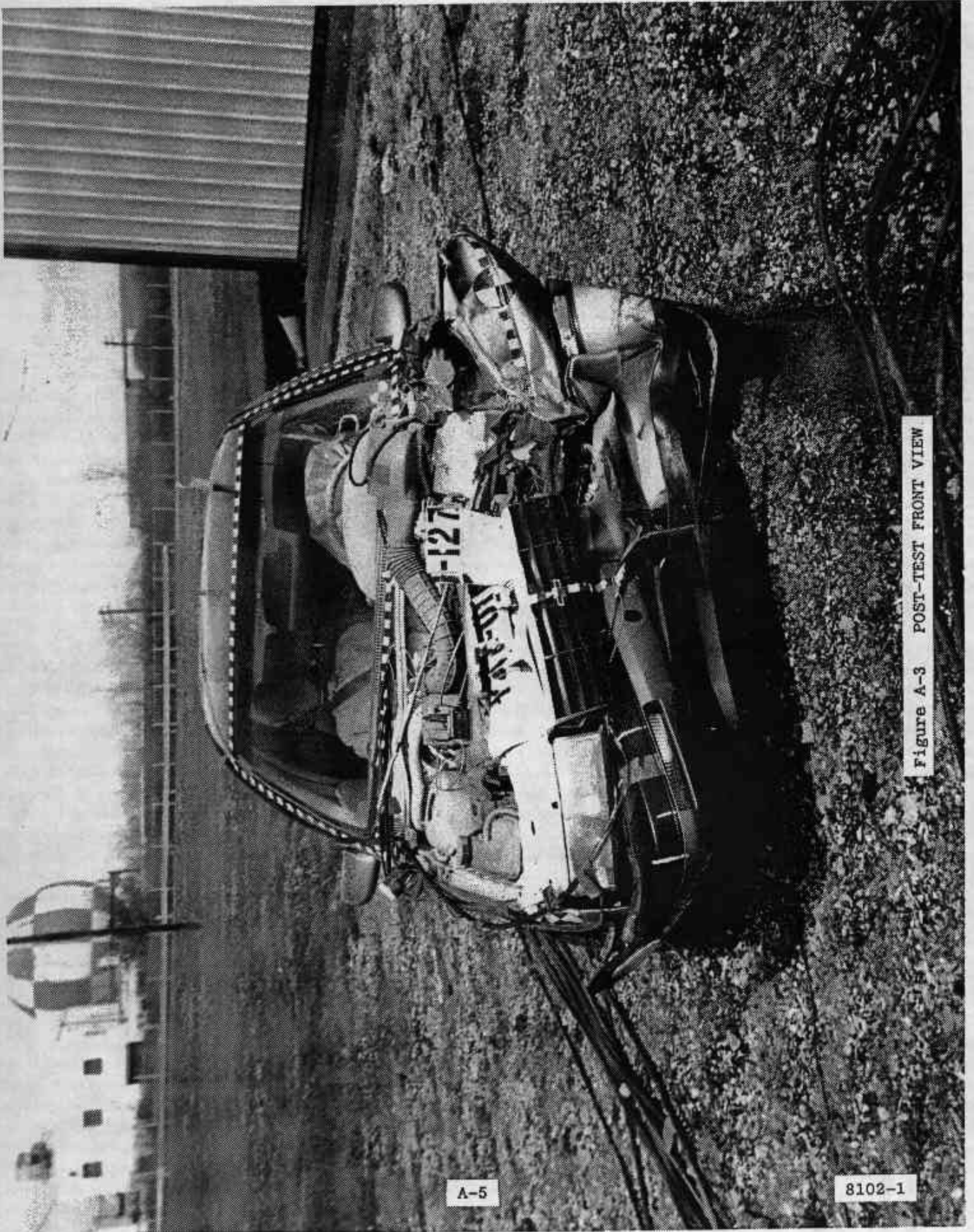
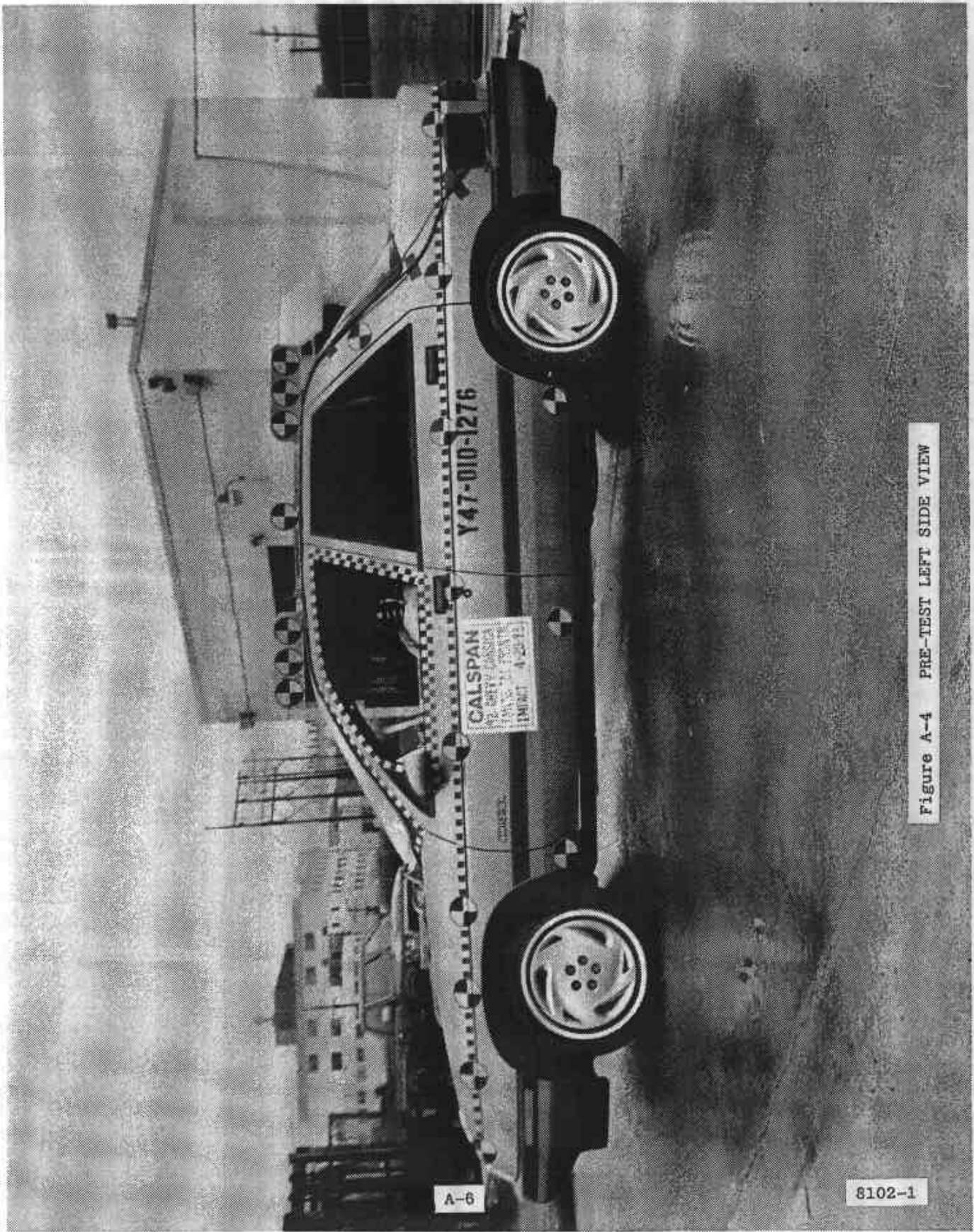


Figure A-3 POST-TEST FRONT VIEW

A-5

8102-1



A-6

8102-1

Figure A-4 PRE-TEST LEFT SIDE VIEW



A-7

8102-1

Figure A-5 POST-TEST LEFT SIDE VIEW

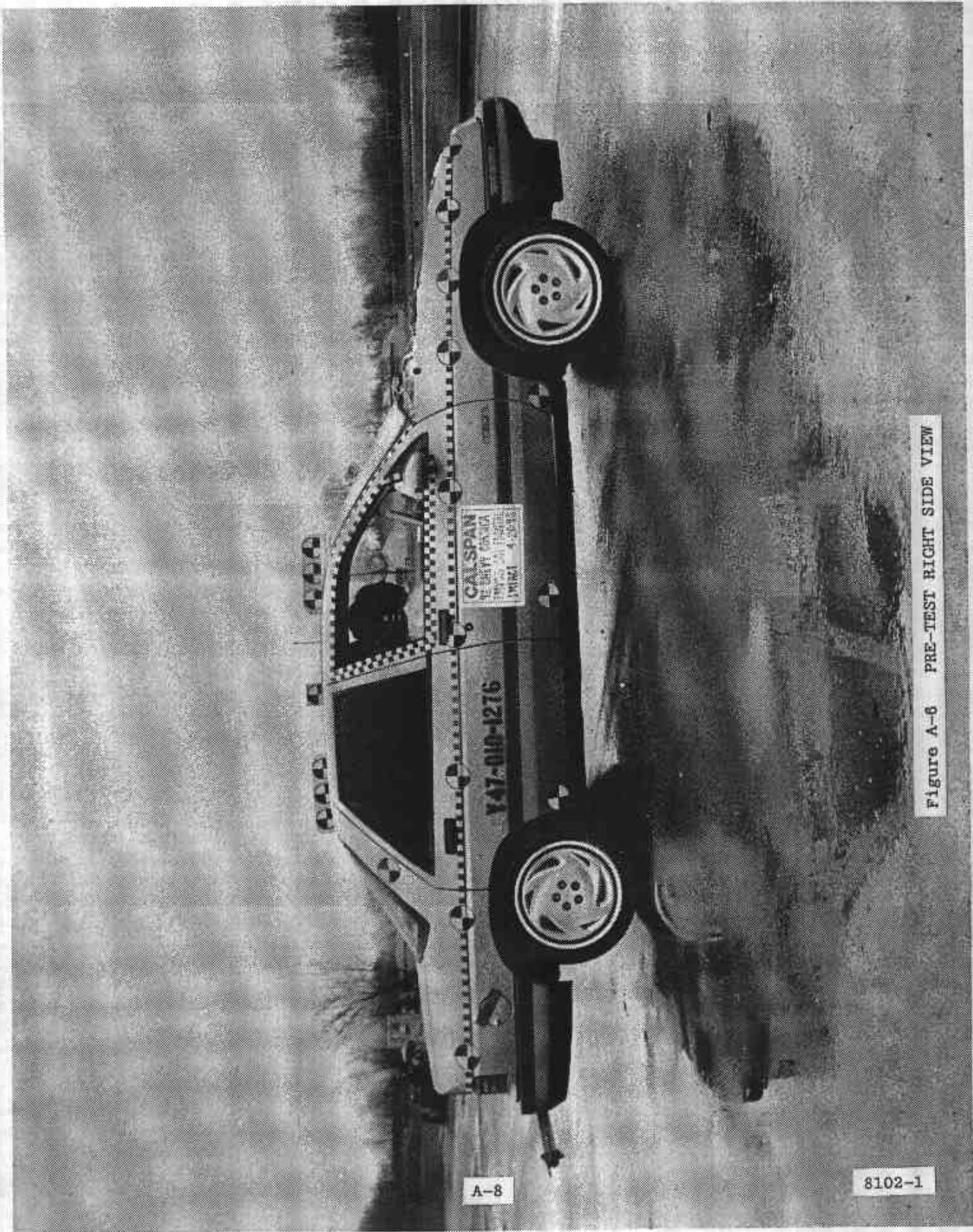


Figure A-6 PRE-TEST RIGHT SIDE VIEW

A-8

8102-1

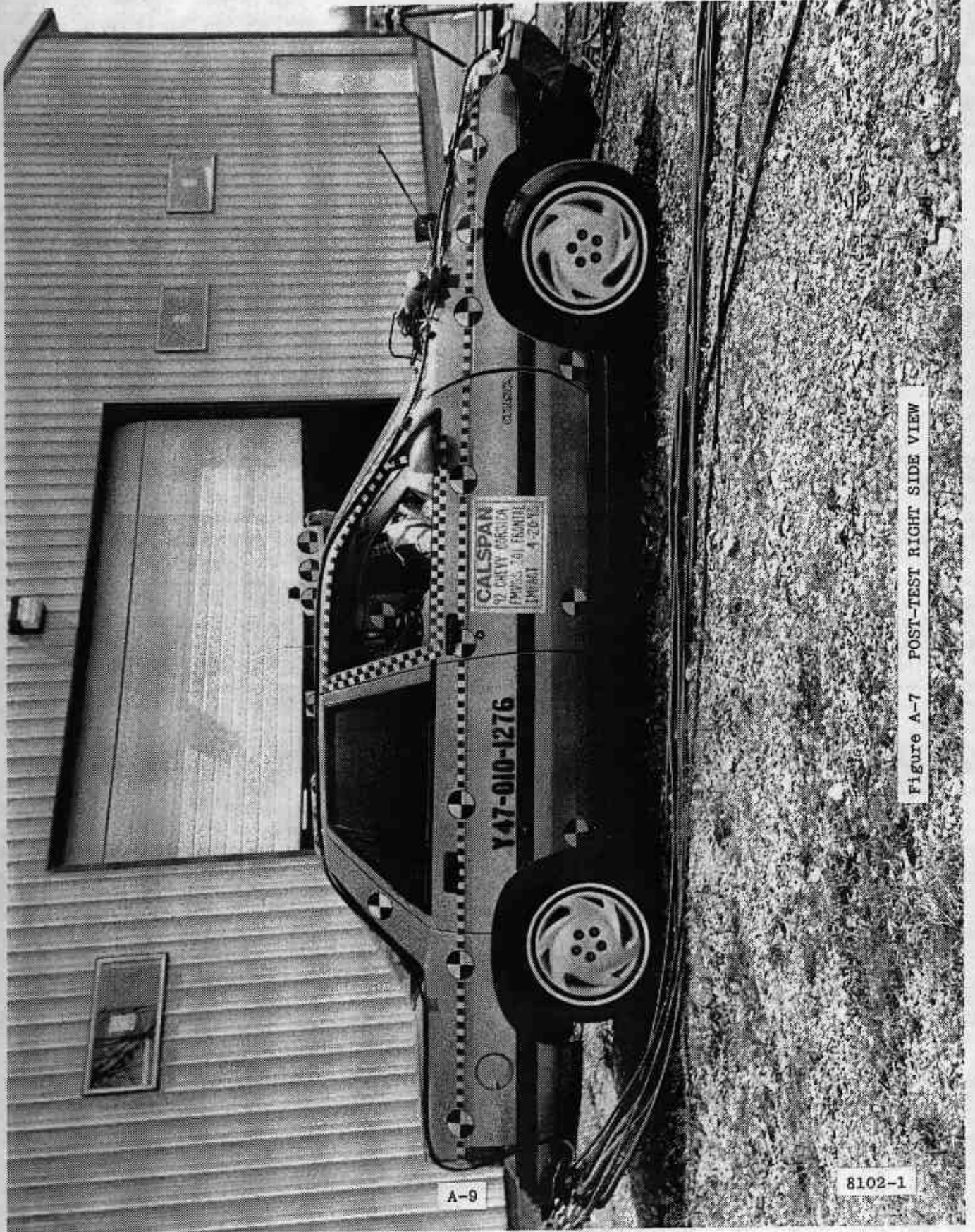


Figure A-7 POST-TEST RIGHT SIDE VIEW

A-9

8102-1

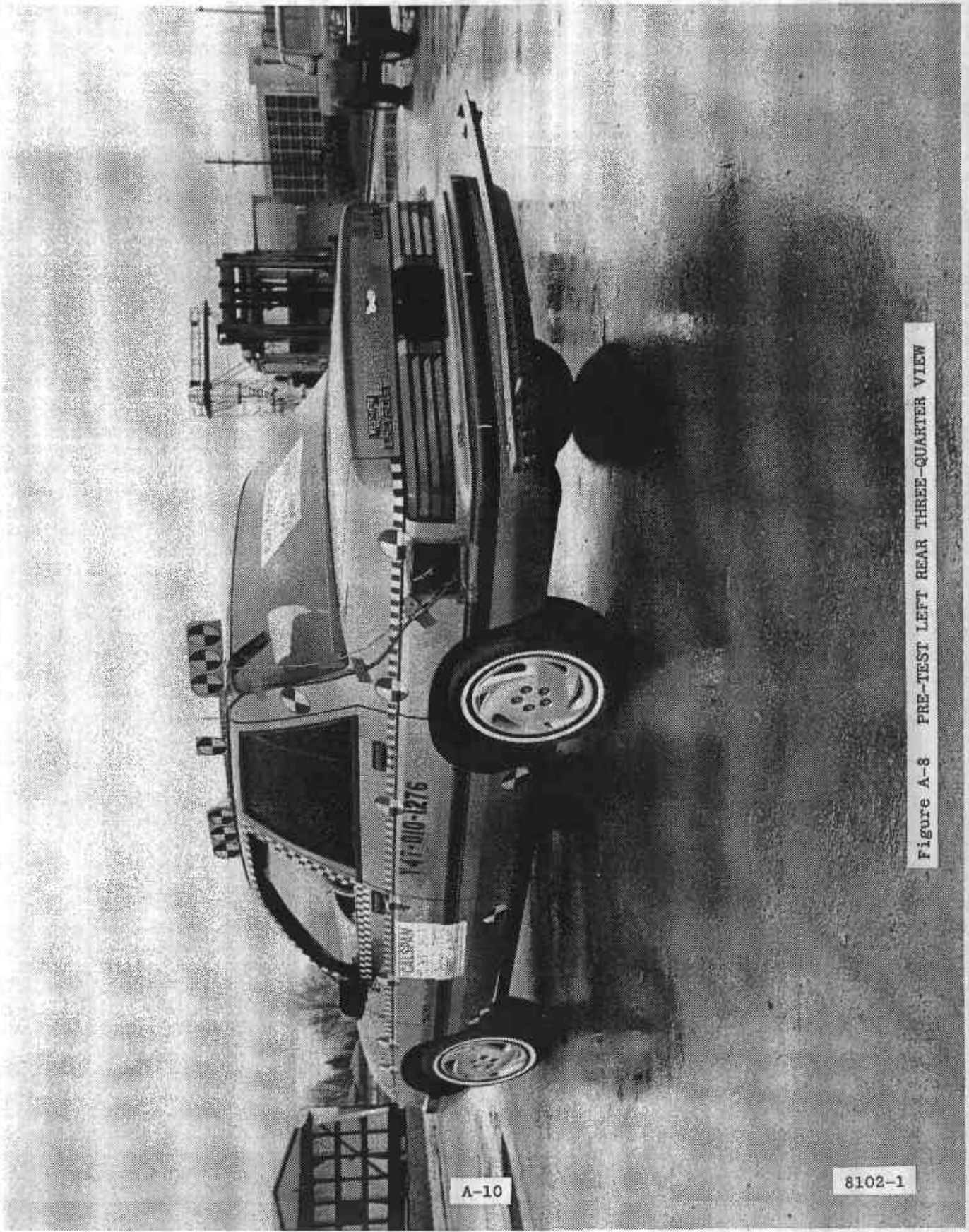


Figure A-8 PRE-TEST LEFT REAR THREE-QUARTER VIEW

A-10

8102-1



A-11

8102-1

Figure A-9 POST-TEST LEFT REAR THREE-QUARTER VIEW



A-12

8102-1

Figure A-10 PRE-TEST LEFT FRONT THREE-QUARTER VIEW

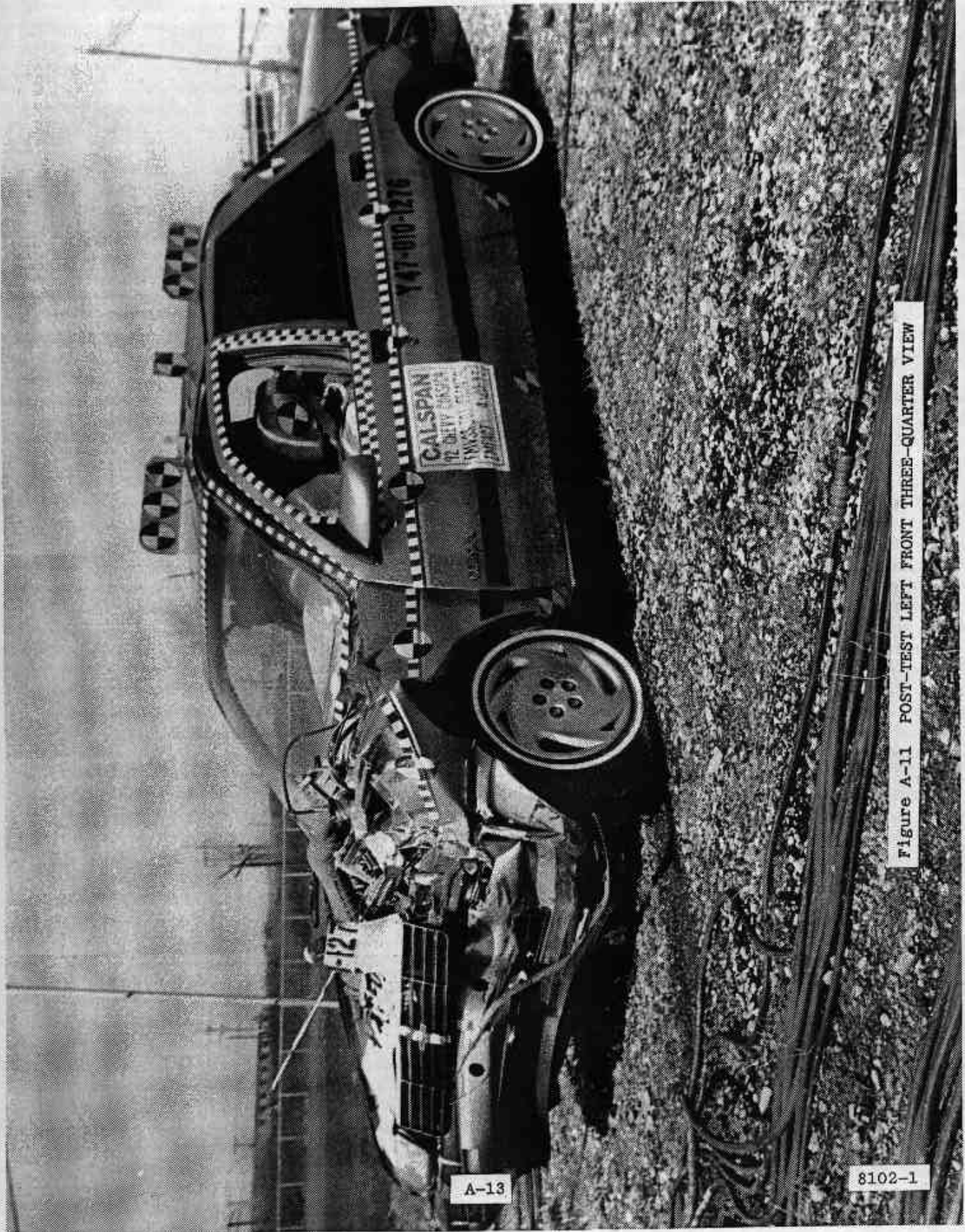


Figure A-11 POST-TEST LEFT FRONT THREE-QUARTER VIEW

A-13

8102-1



Figure A-12 PRE-TEST RIGHT FRONT THREE-QUARTER VIEW

A-14

8102-1



Figure A-13 POST-TEST RIGHT FRONT THREE-QUARTER VIEW

A-15

8102-1

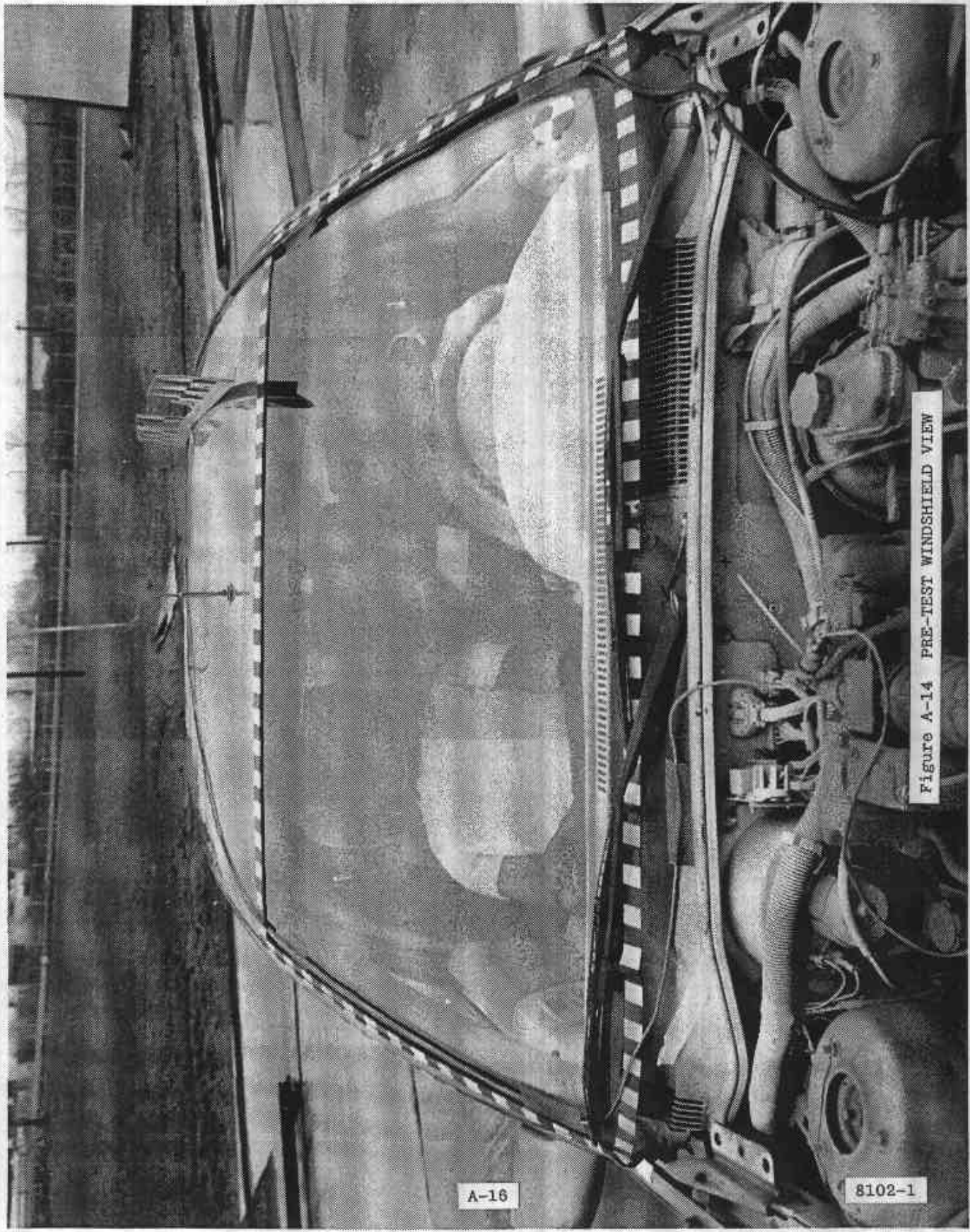


Figure A-14 PRE-TEST WINDSHIELD VIEW

A-16

8102-1

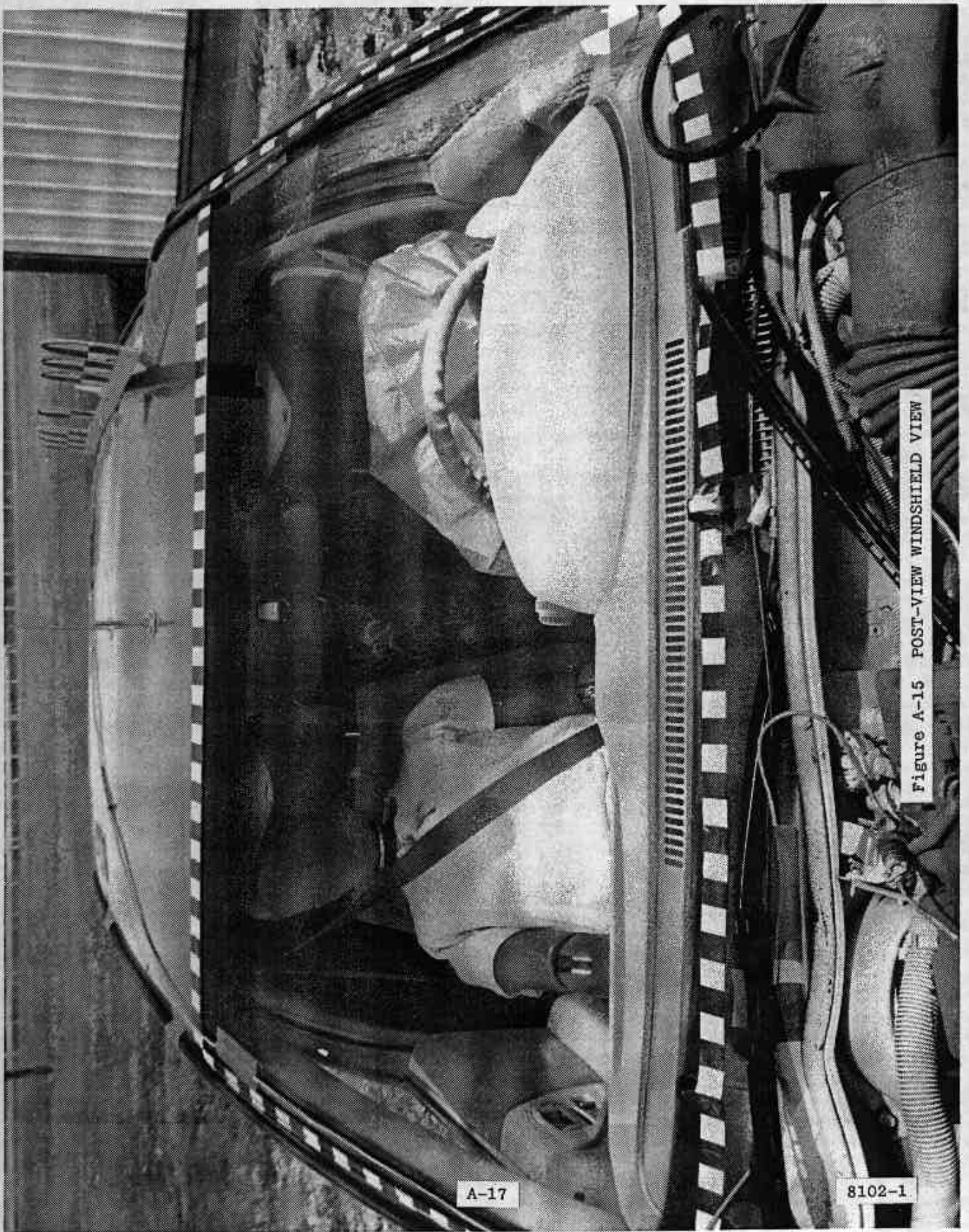


Figure A-15 POST-VIEW WINDSHIELD VIEW

A-17

8102-1

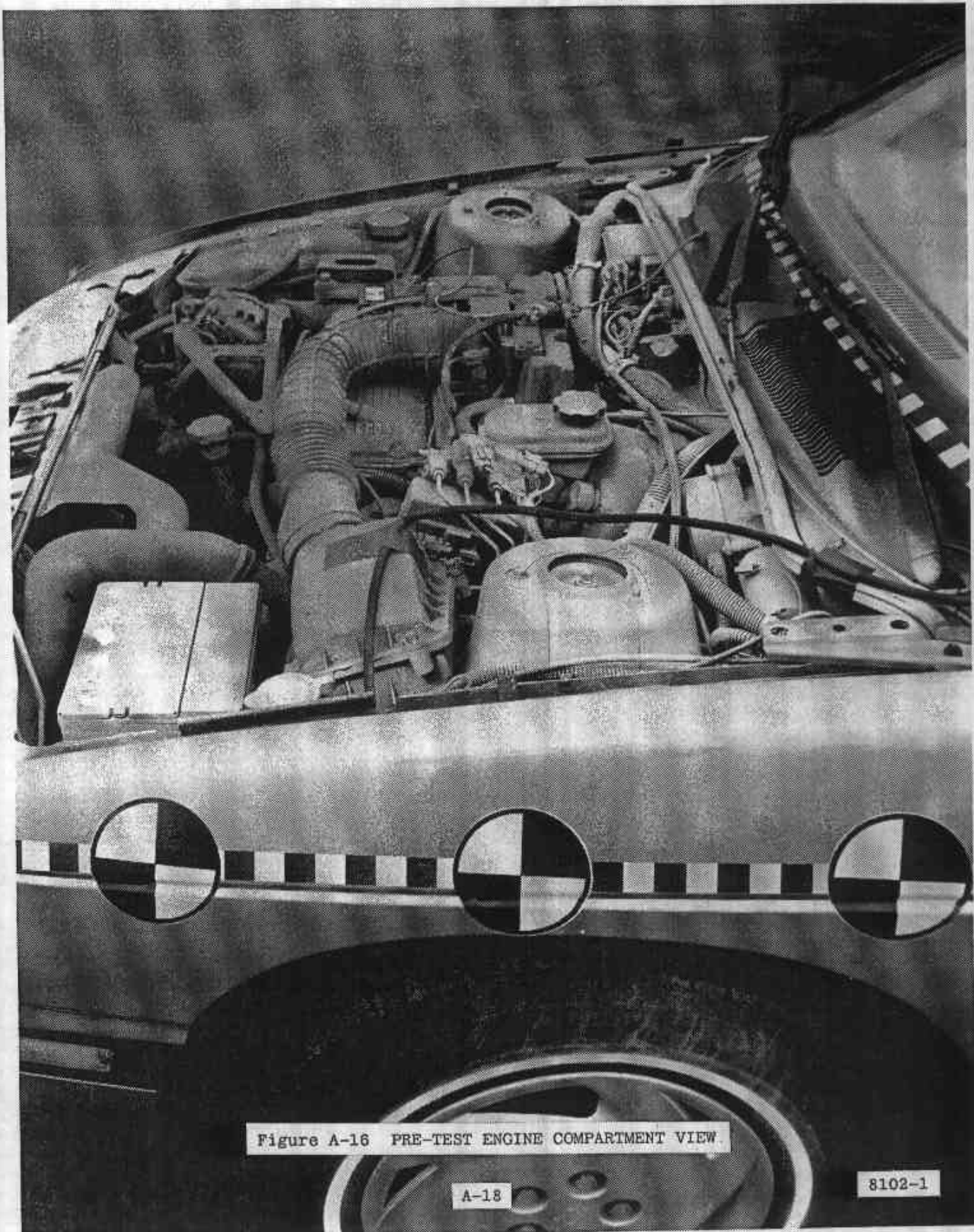


Figure A-16 PRE-TEST ENGINE COMPARTMENT VIEW.

A-18

8102-1

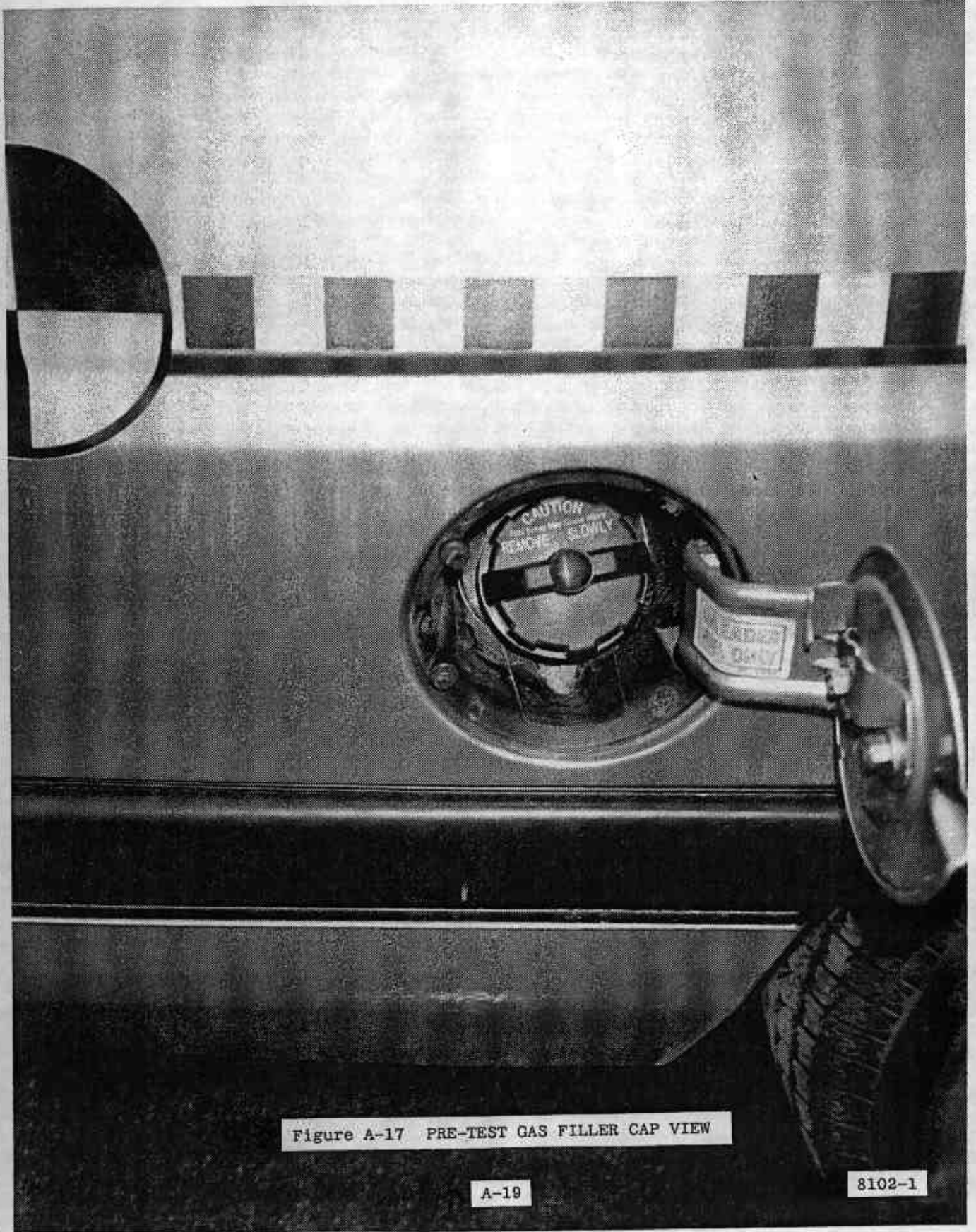


Figure A-17 PRE-TEST GAS FILLER CAP VIEW

A-19

8102-1

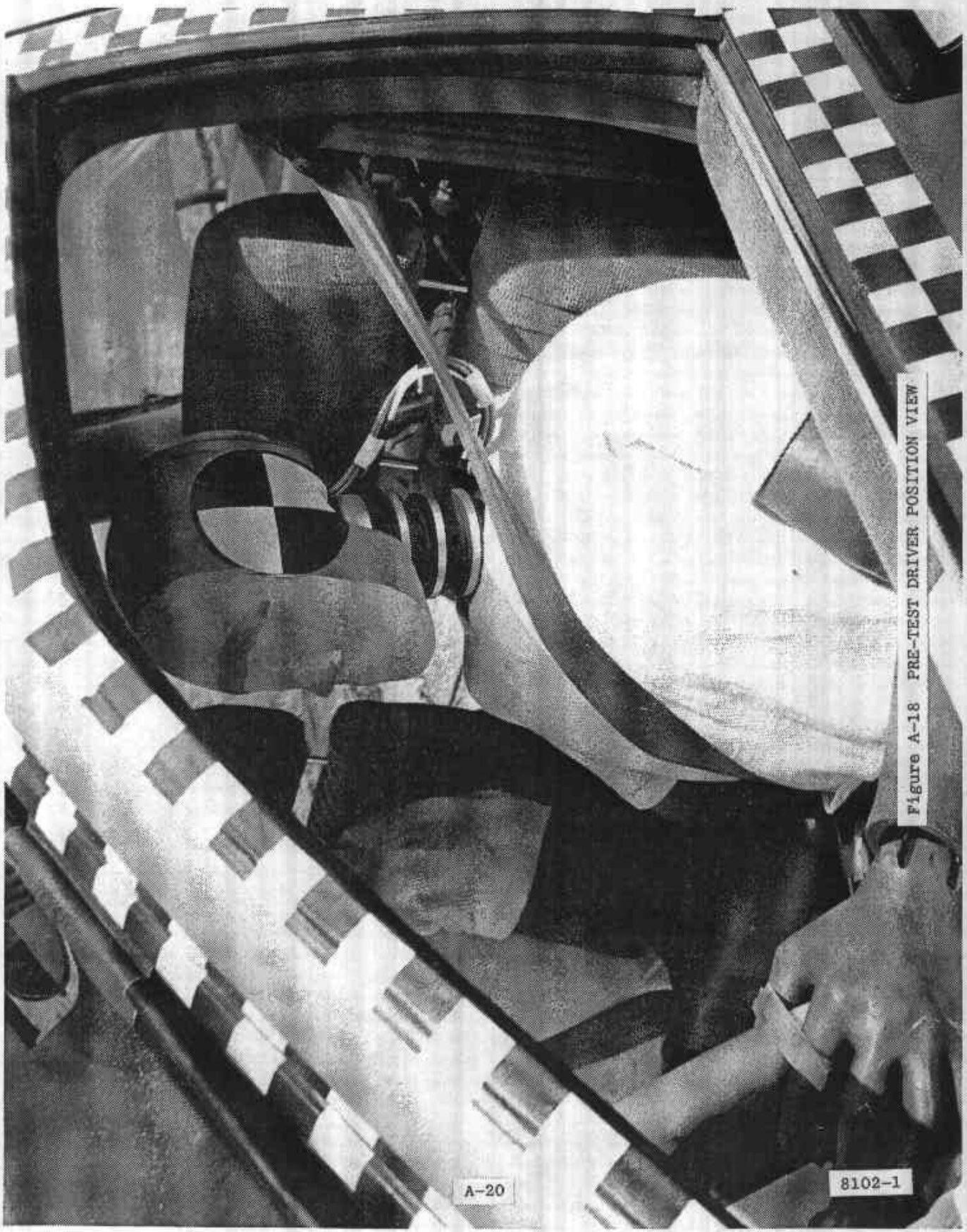


Figure A-18 PRE-TEST DRIVER POSITION VIEW

A-20

8102-1

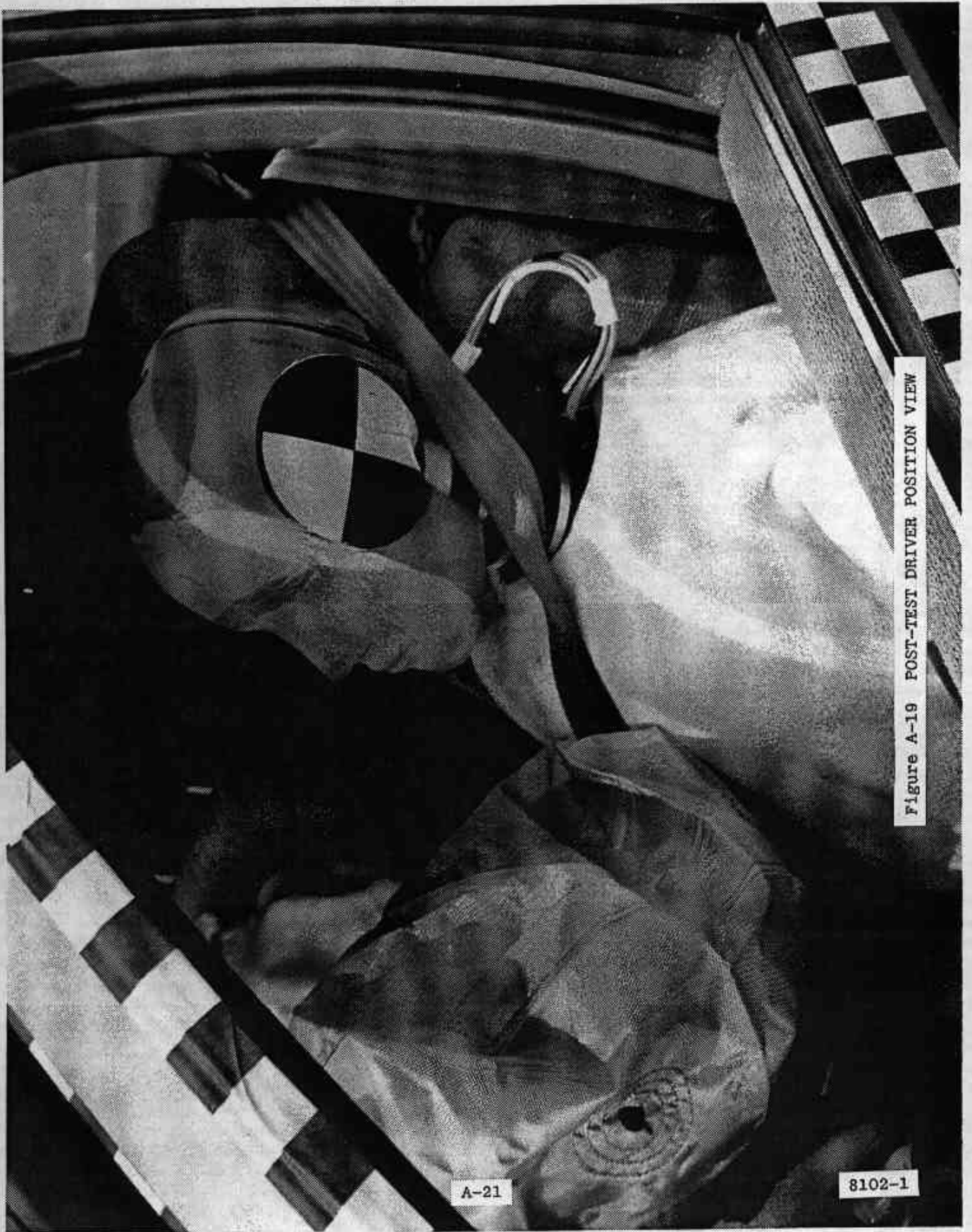


Figure A-19 POST-TEST DRIVER POSITION VIEW

A-21

8102-1

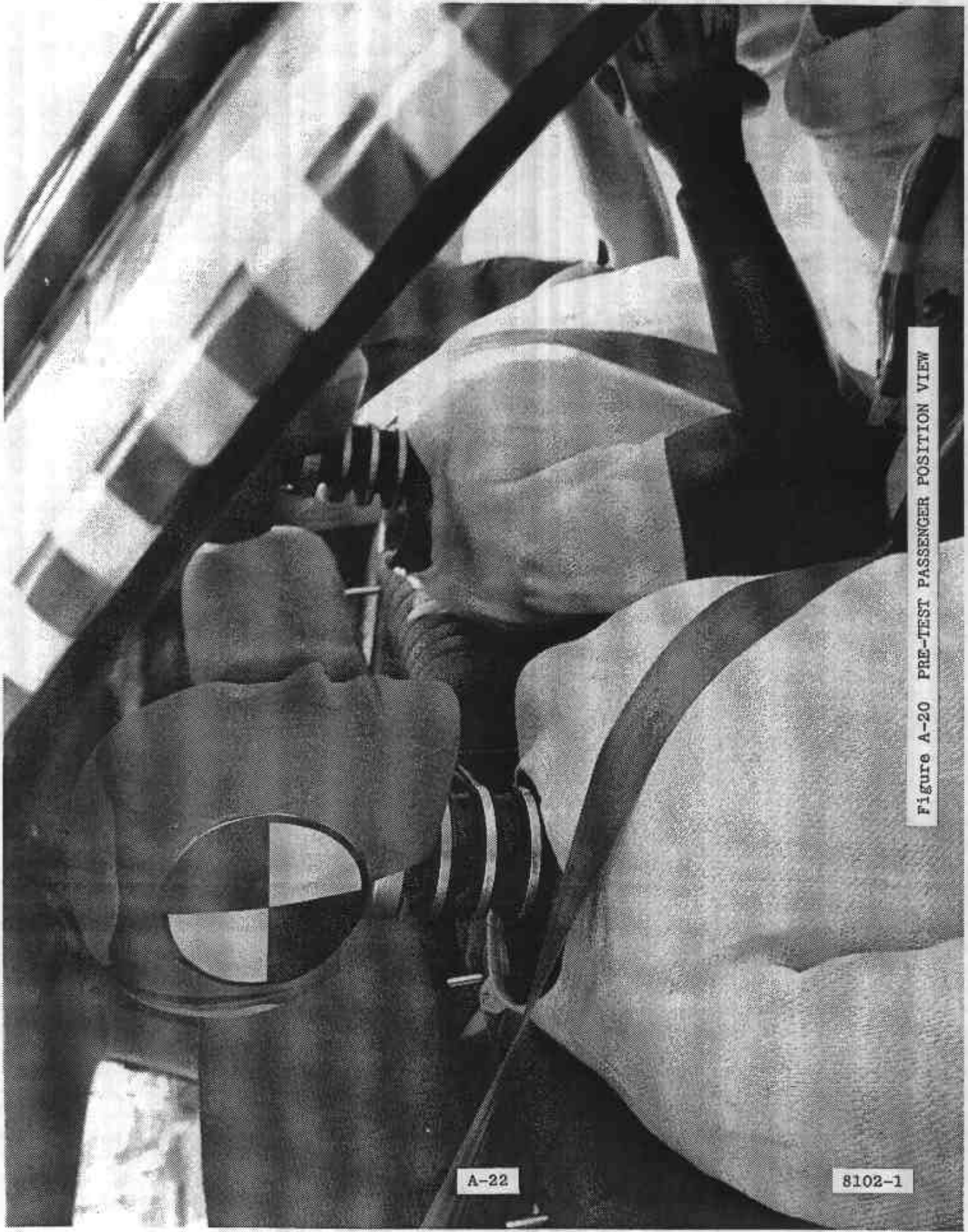


Figure A-20 PRE-TEST PASSENGER POSITION VIEW

A-22

8102-1



Figure A-21 POST-TEST PASSENGER POSITION VIEW

A-23

8102-1



Figure A-22 PRE-TEST DRIVER AND INTERIOR VIEW

A-24

8102-1



Figure A-23 POST-TEST DRIVER AND INTERIOR VIEW

A-25

8102-1

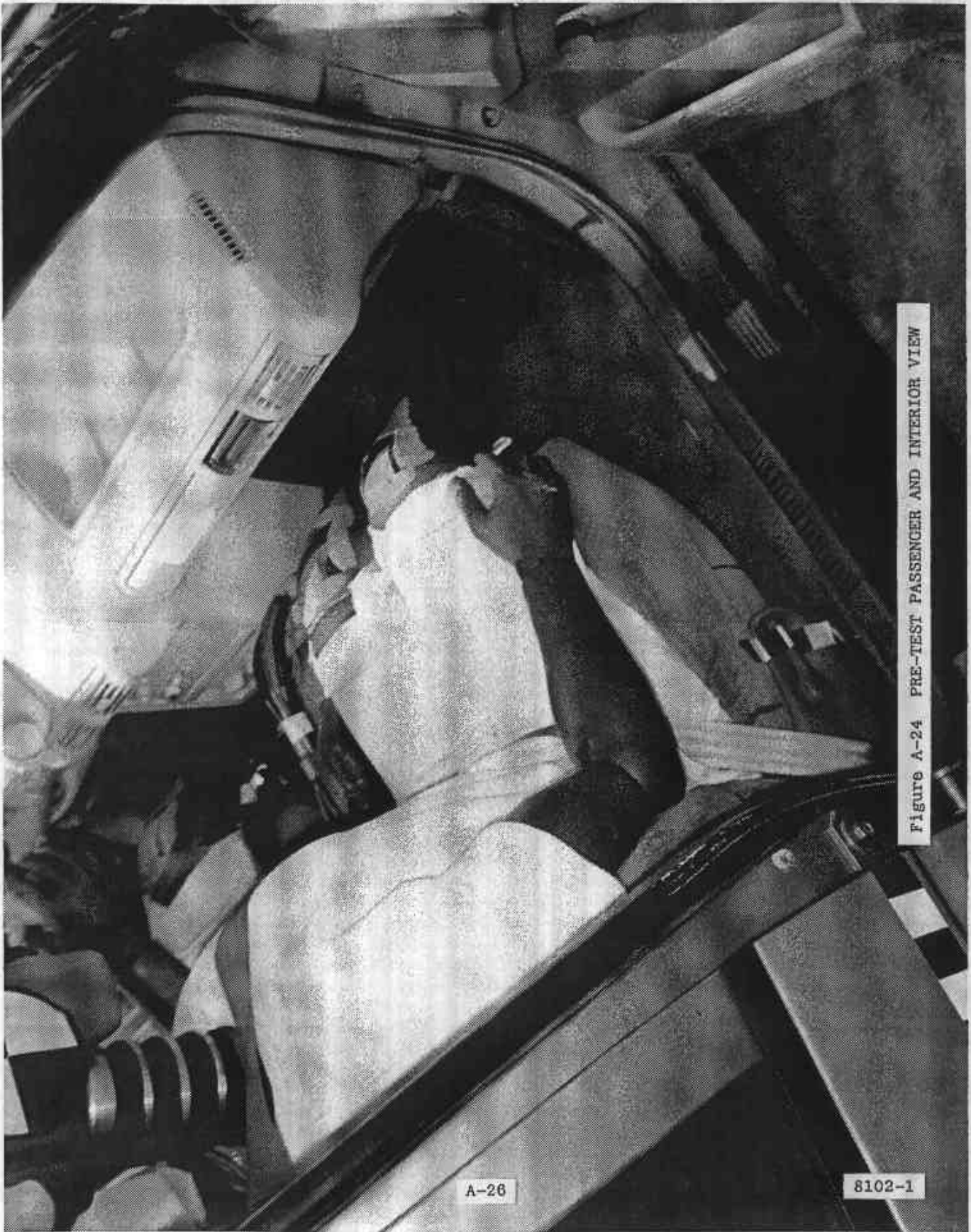


Figure A-24 PRE-TEST PASSENGER AND INTERIOR VIEW

A-26

8102-1



Figure A-25 POST-TEST PASSENGER AND INTERIOR VIEW

A-27

8102-1

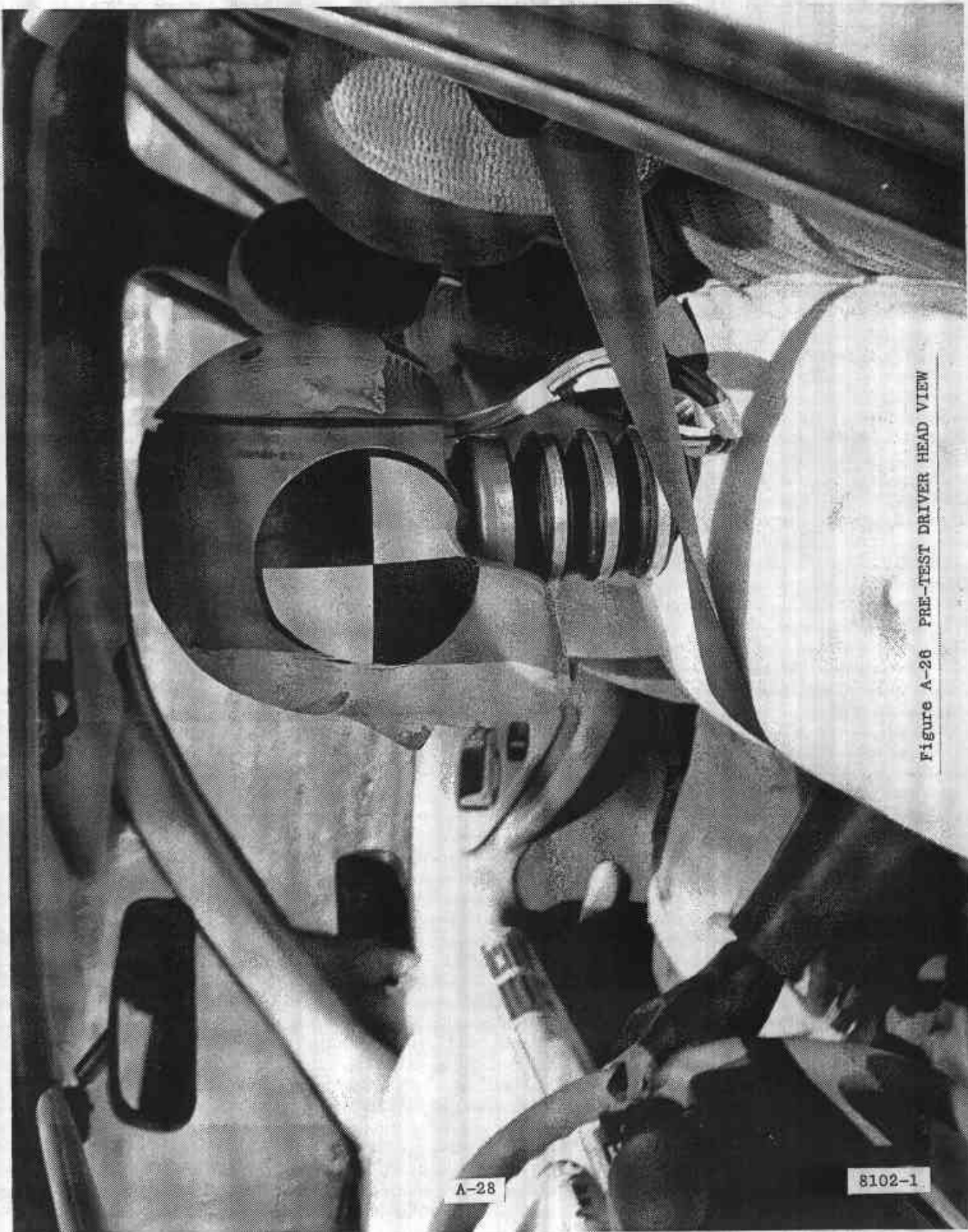


Figure A-26 PRE-TEST DRIVER HEAD VIEW

A-28

8102-1

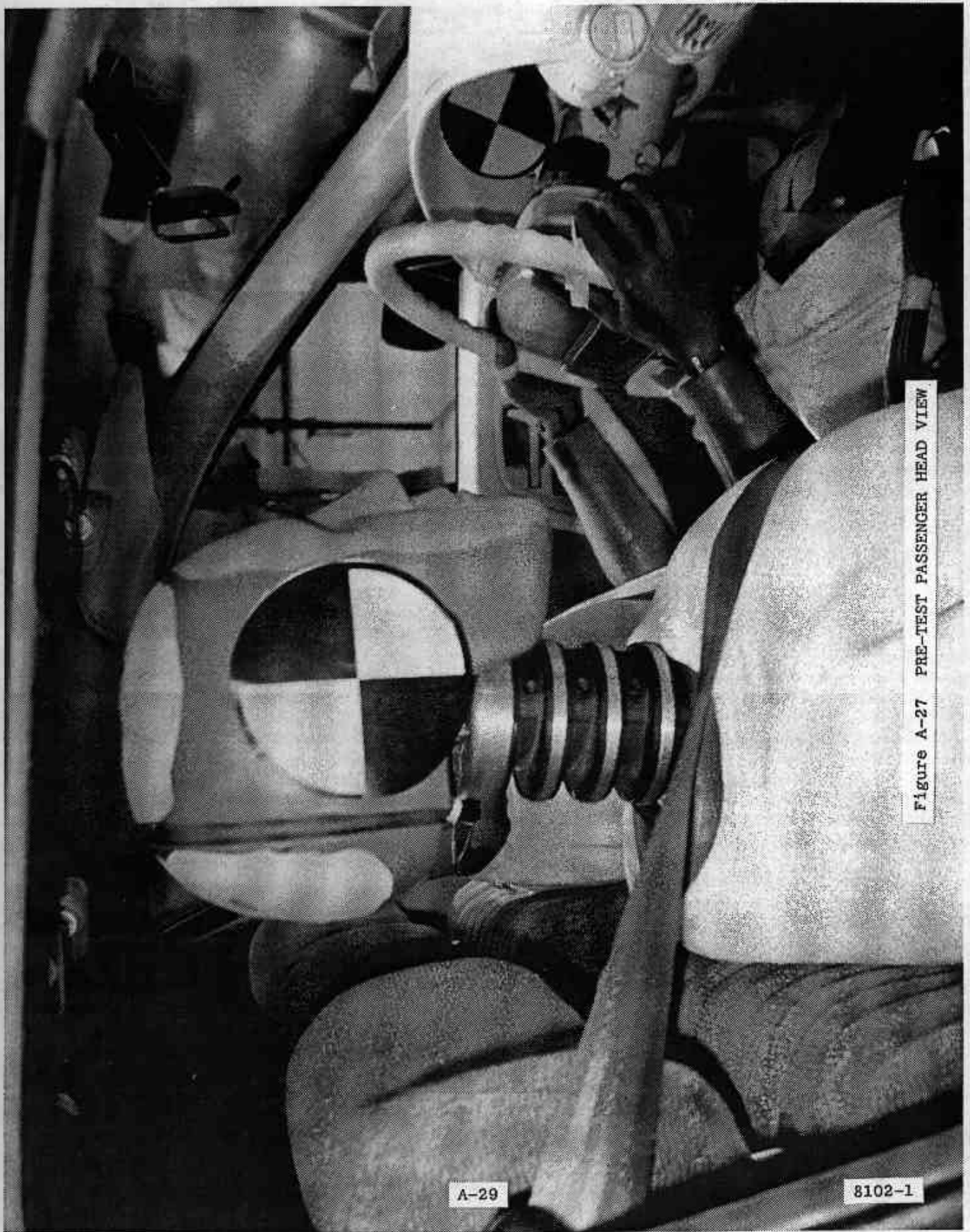


Figure A-27 PRE-TEST PASSENGER HEAD VIEW

A-29

8102-1

Appendix B

VEHICLE AND DUMMY RESPONSE DATA

TEST NO. Y47-010-1276

VEHICLE DATA

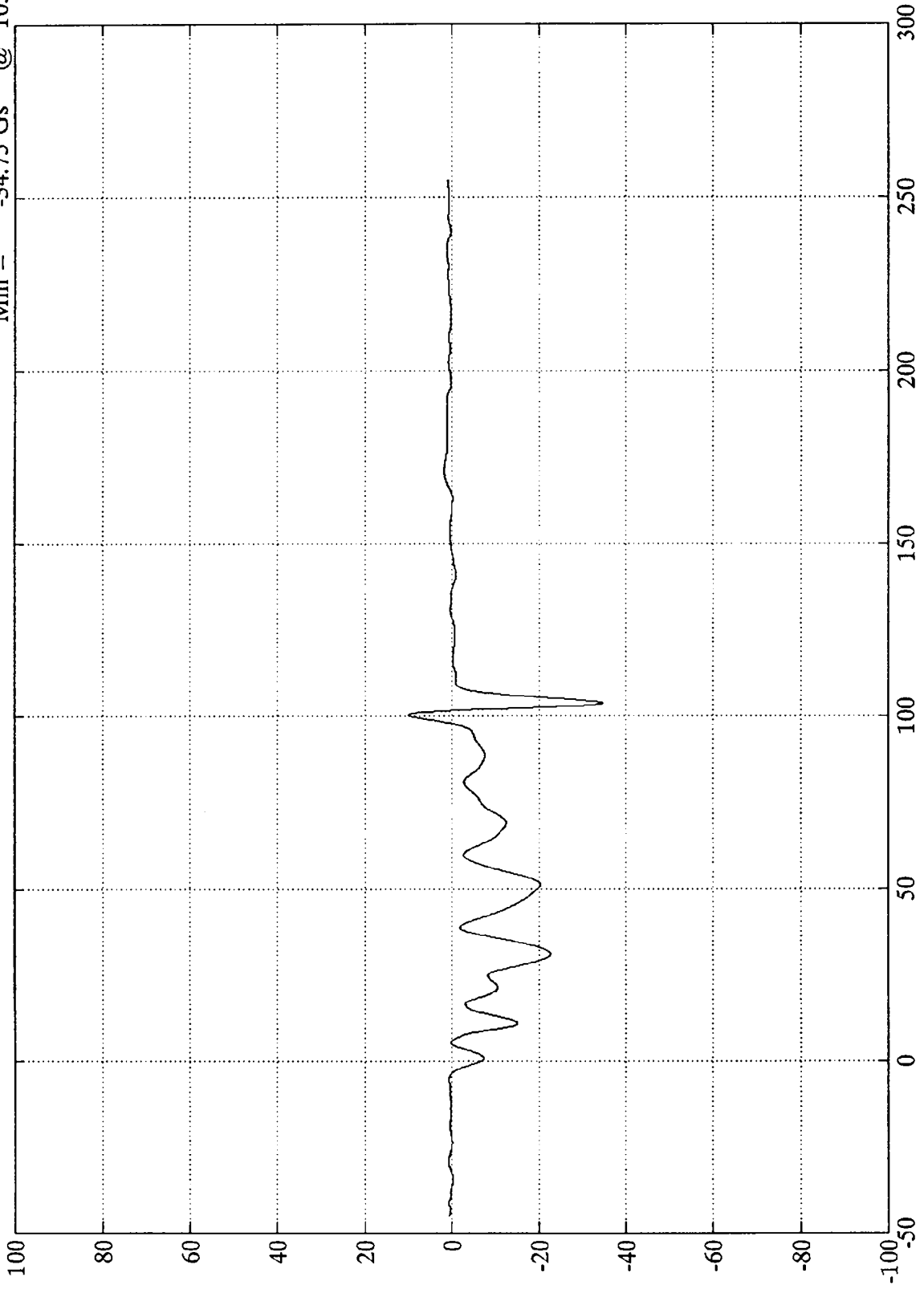
FILTER CHANNEL CLASS

60

TSC 301 TEST 1 - FRONTAL IMPACT

Max = 10.16 Gs @ 100.20 msec
Min = -34.75 Gs @ 103.55 msec

Barrier Left Rail (X)



Time (msec)

SAE Filter Class 60

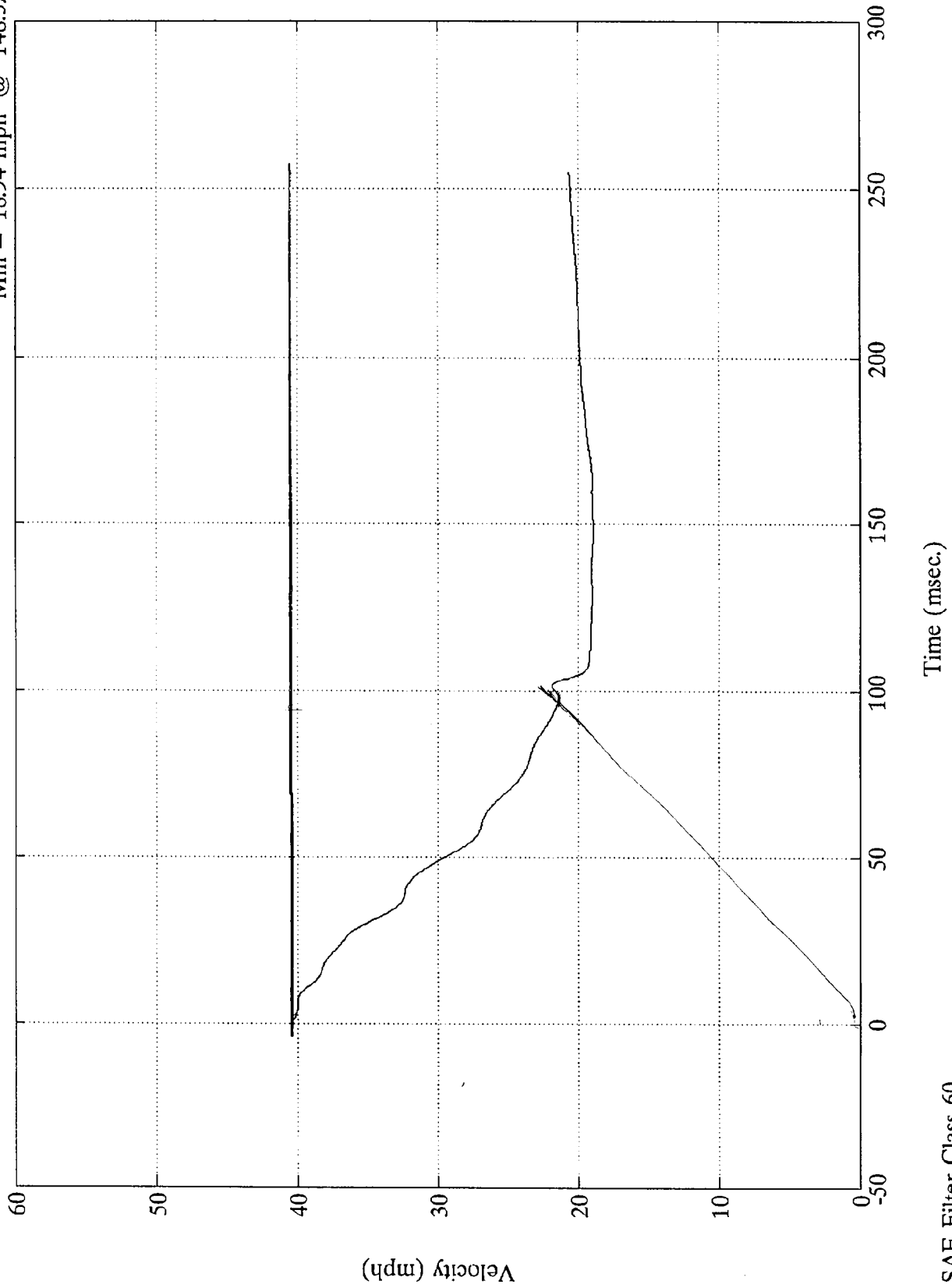
B-3

8102-1

TSC 301 TEST 1 - FRONTAL IMPACT

Barrier Left Rail (X)

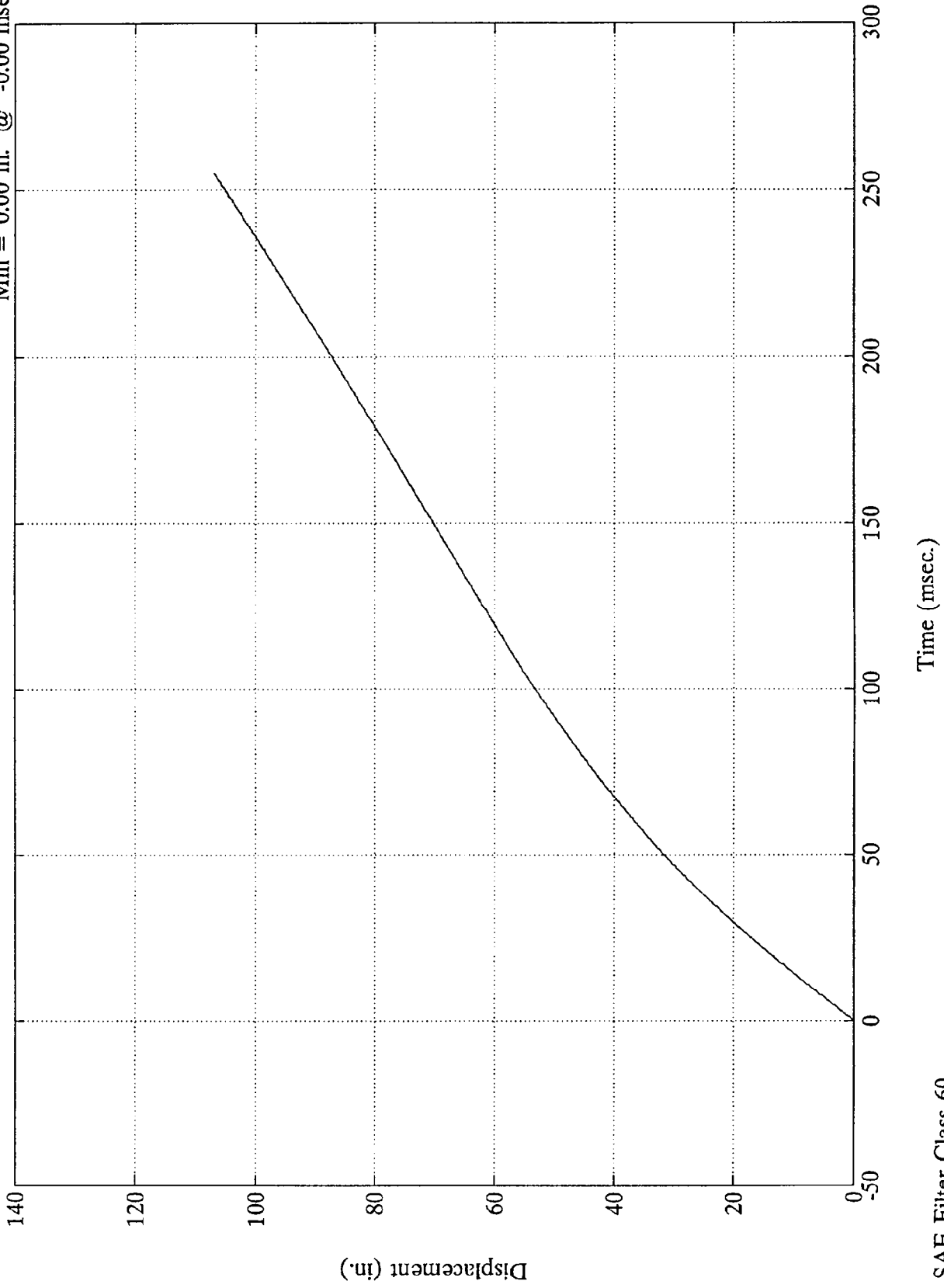
Max = 40.50 mph @ -0.00 msec
Min = 18.94 mph @ 148.32 msec



TSC 301 TEST 1 - FRONTAL IMPACT

Barrier Left Rail (X)

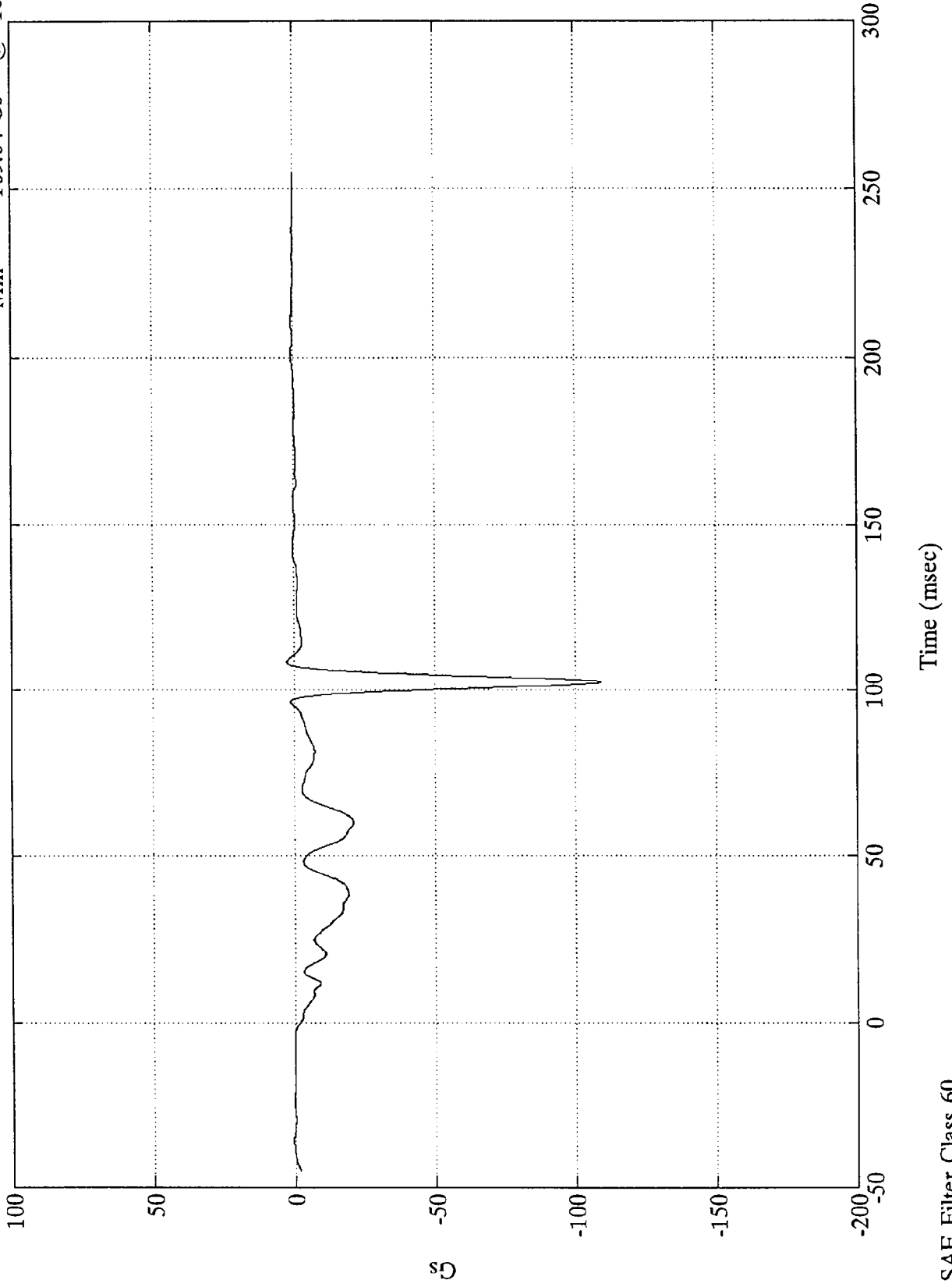
Max = 106.80 in. @ 254.88 msec
Min = 0.00 in. @ -0.00 msec



TSC 301 TEST 1 - FRONTAL IMPACT

Max = 2.66 Gs @ 108.36 msec
Min = -109.04 Gs @ 102.24 msec

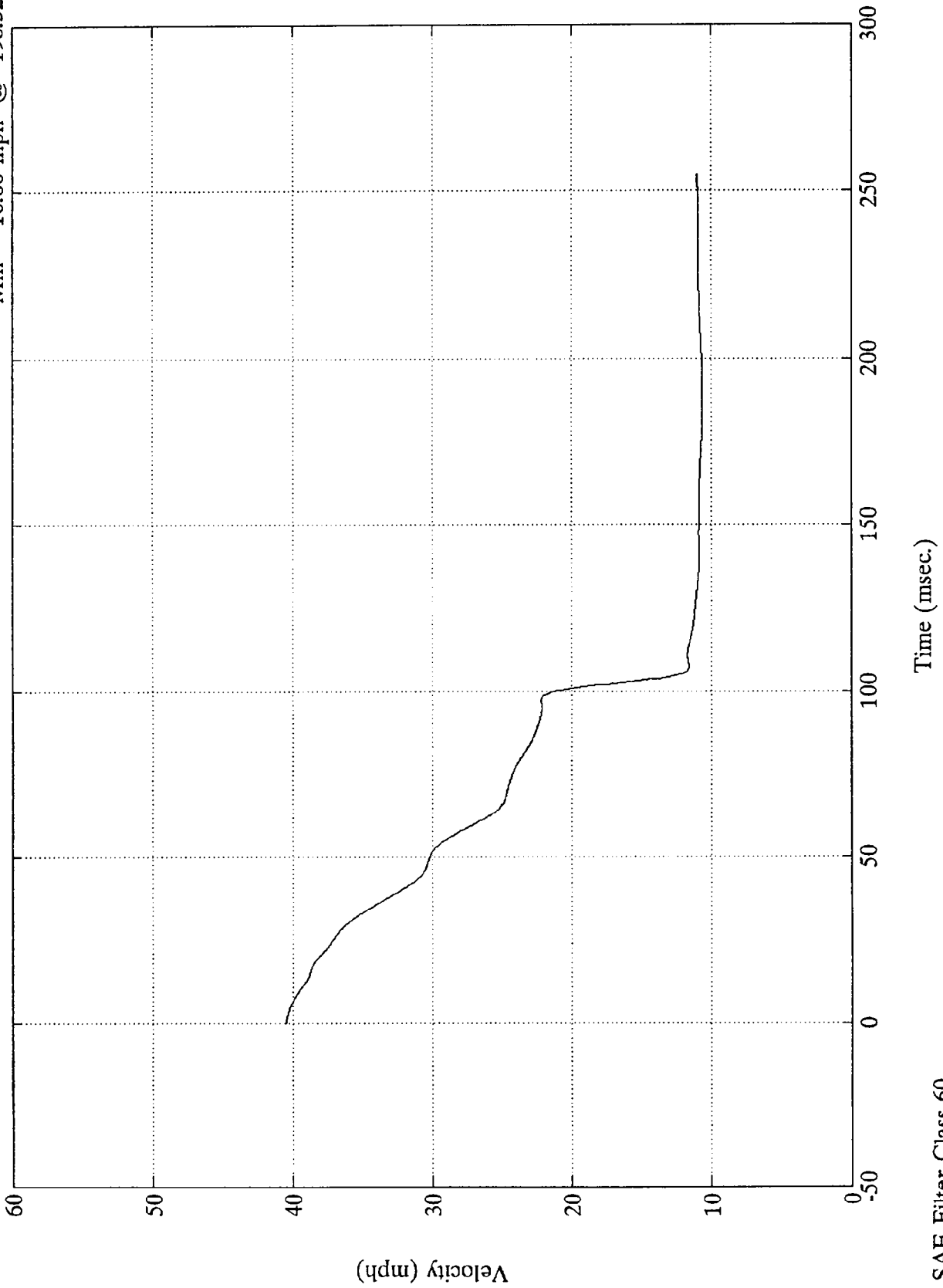
Barrier Right Rail (X)



TSC 301 TEST 1 - FRONTAL IMPACT

Max = 40.50 mph @ -0.00 msec
Min = 10.66 mph @ 196.32 msec

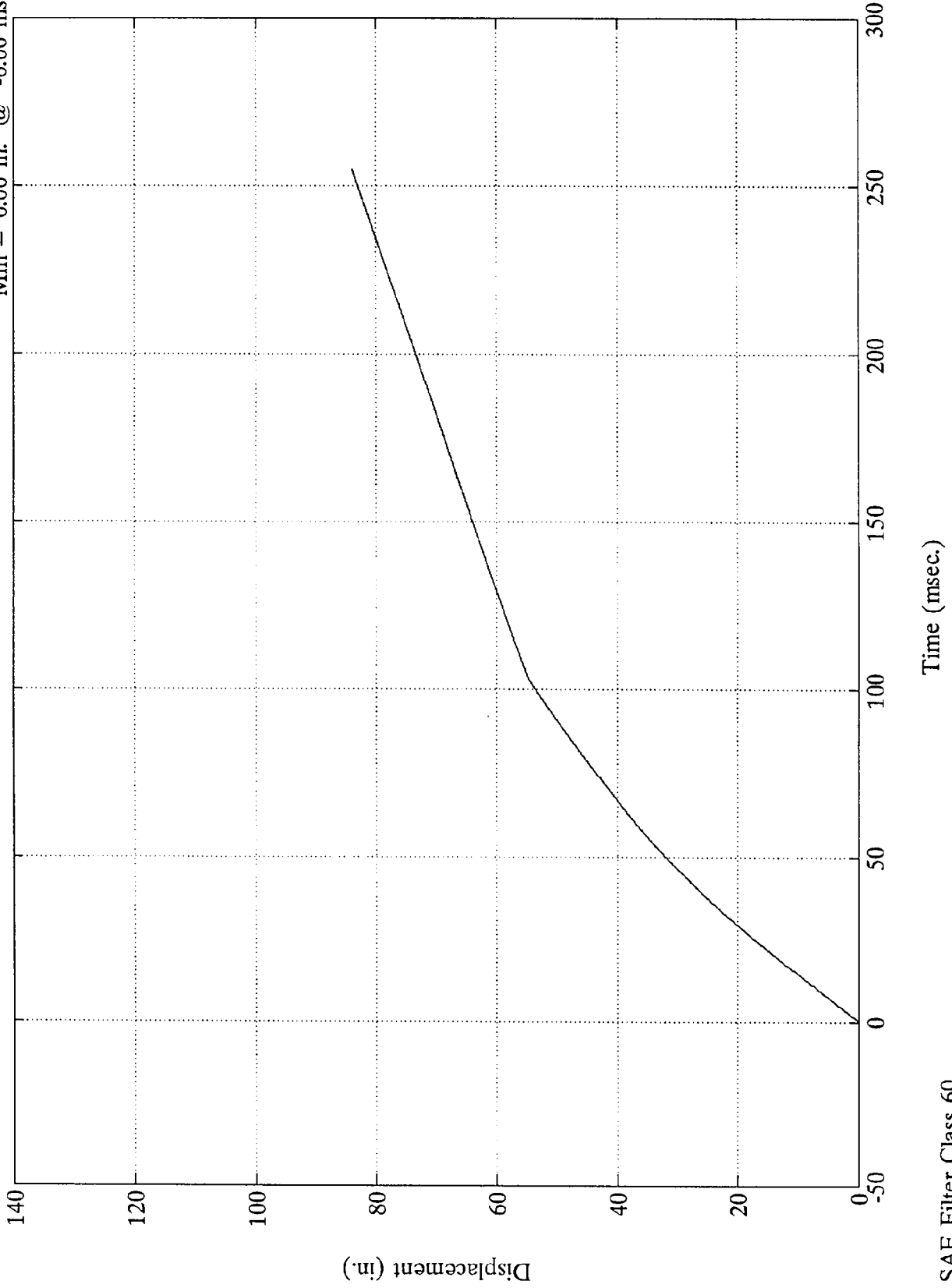
Barrier Right Rail (X)



TSC 301 TEST 1 - FRONTAL IMPACT

Barrier Right Rail (X)

Max = 83.96 in. @ 254.88 msec
Min = 0.00 in. @ -0.00 msec



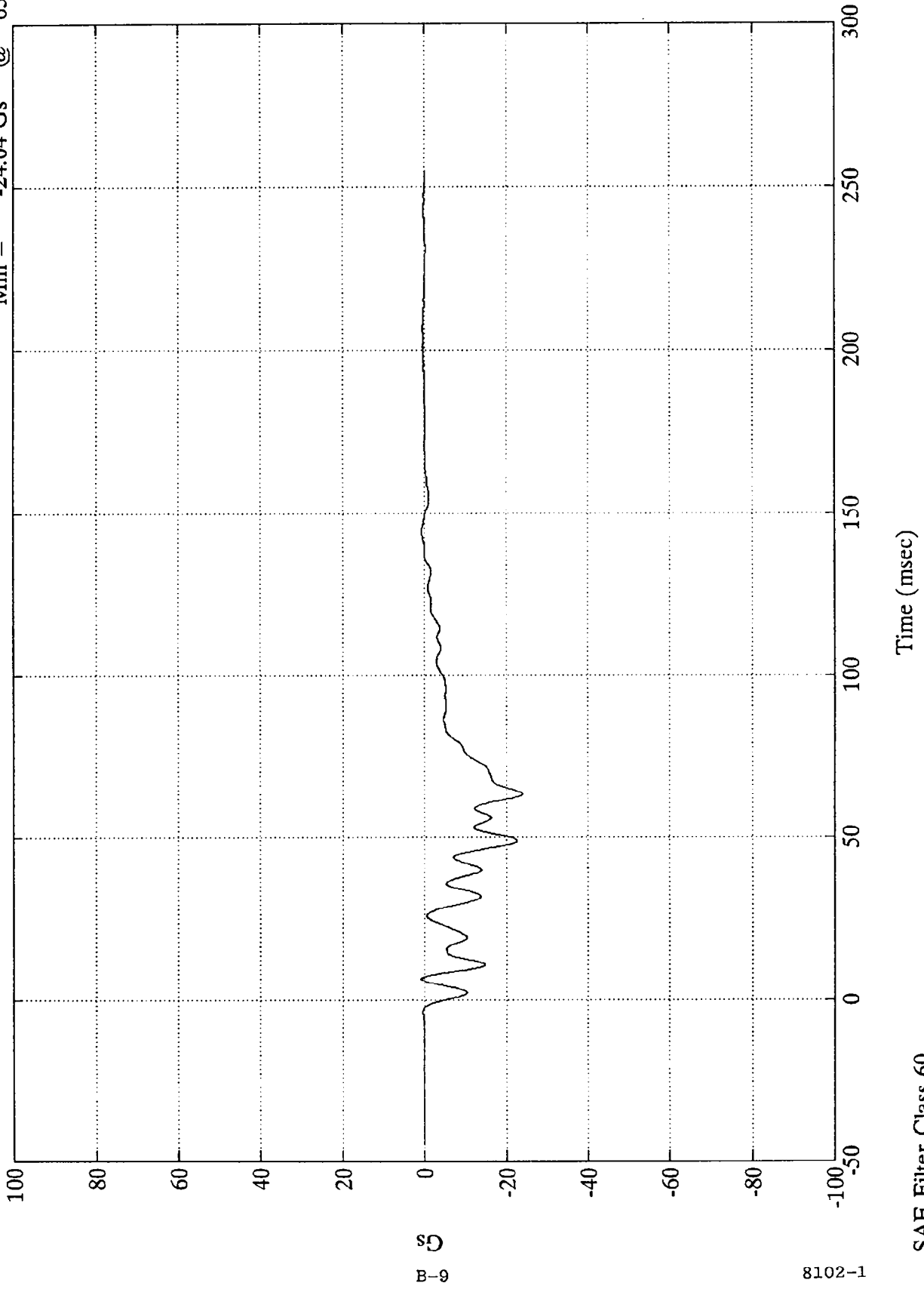
SAE Filter Class 60



TSC 301 TEST 1 - FRONTAL IMPACT

Acc. #1 Left Xmember

Max = .86 Gs @ 6.59 msec
Min = -24.04 Gs @ 63.35 msec



B-9

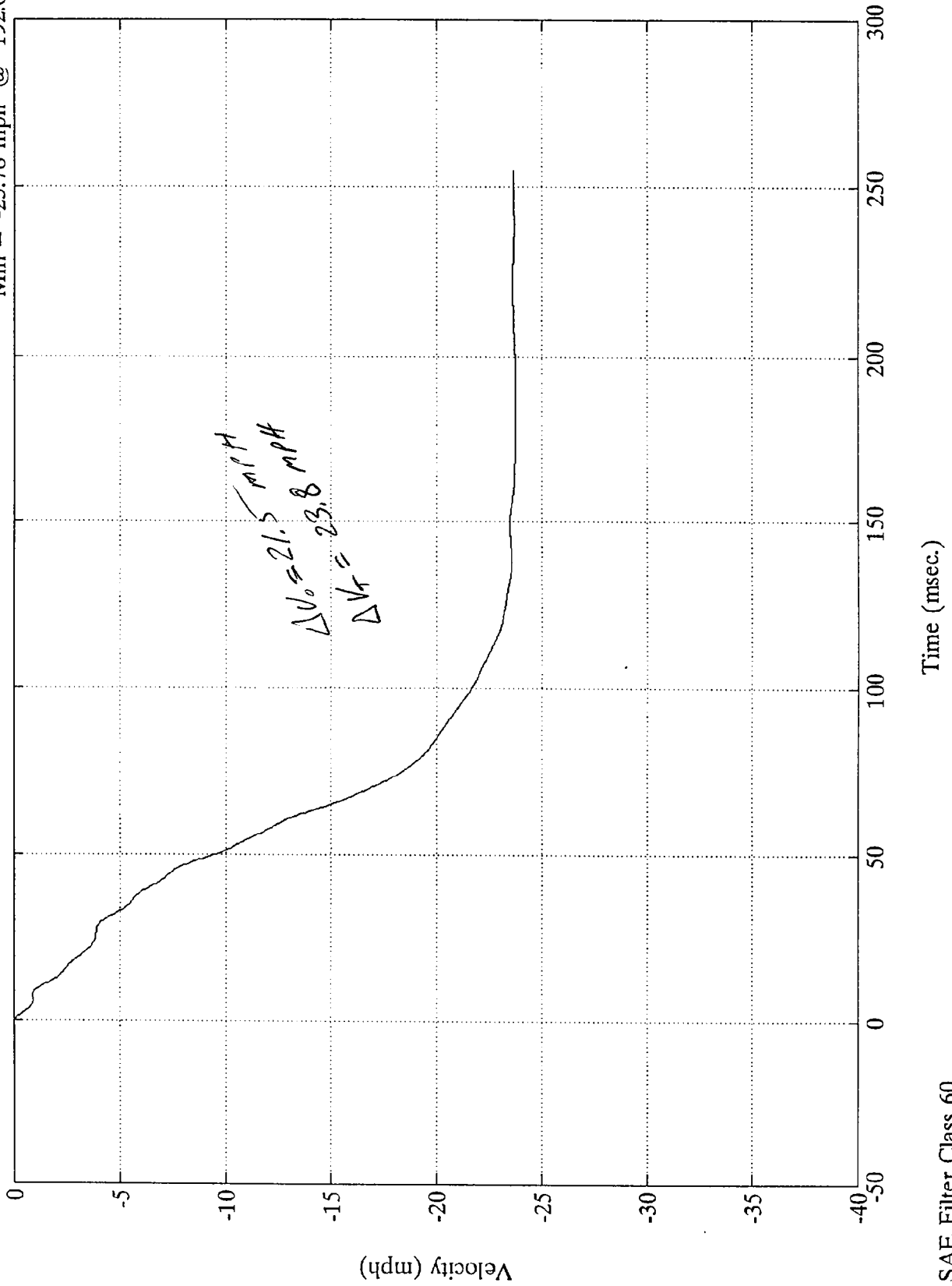
8102-1

SAE Filter Class 60

TSC 301 TEST 1 - FRONTAL IMPACT

Acc. #1 Left Xmember

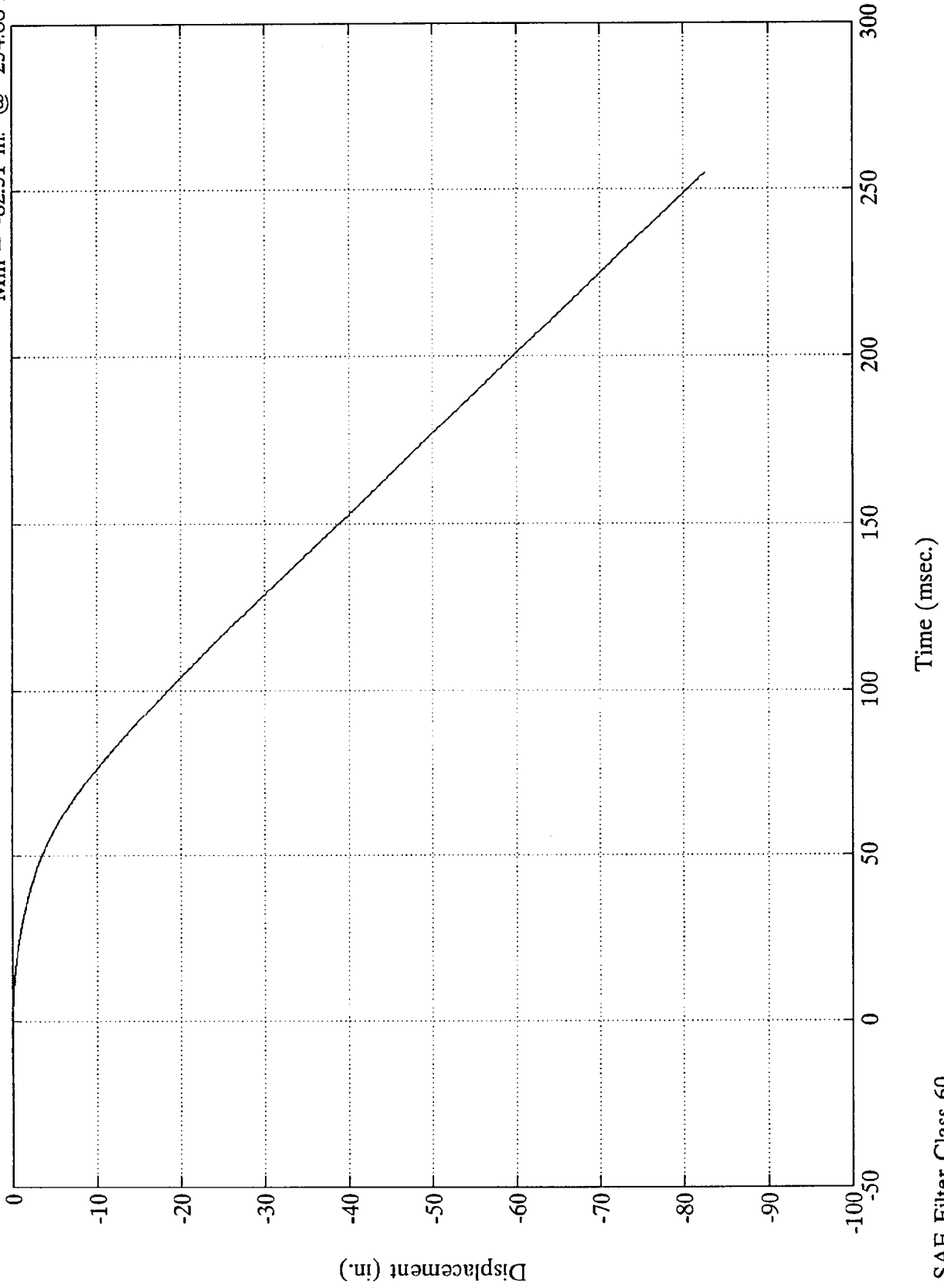
Max = 0.00 mph @ -0.00 msec
Min = -23.78 mph @ 192.00 msec



TSC 301 TEST 1 - FRONTAL IMPACT

Acc. #1 Left Xmember

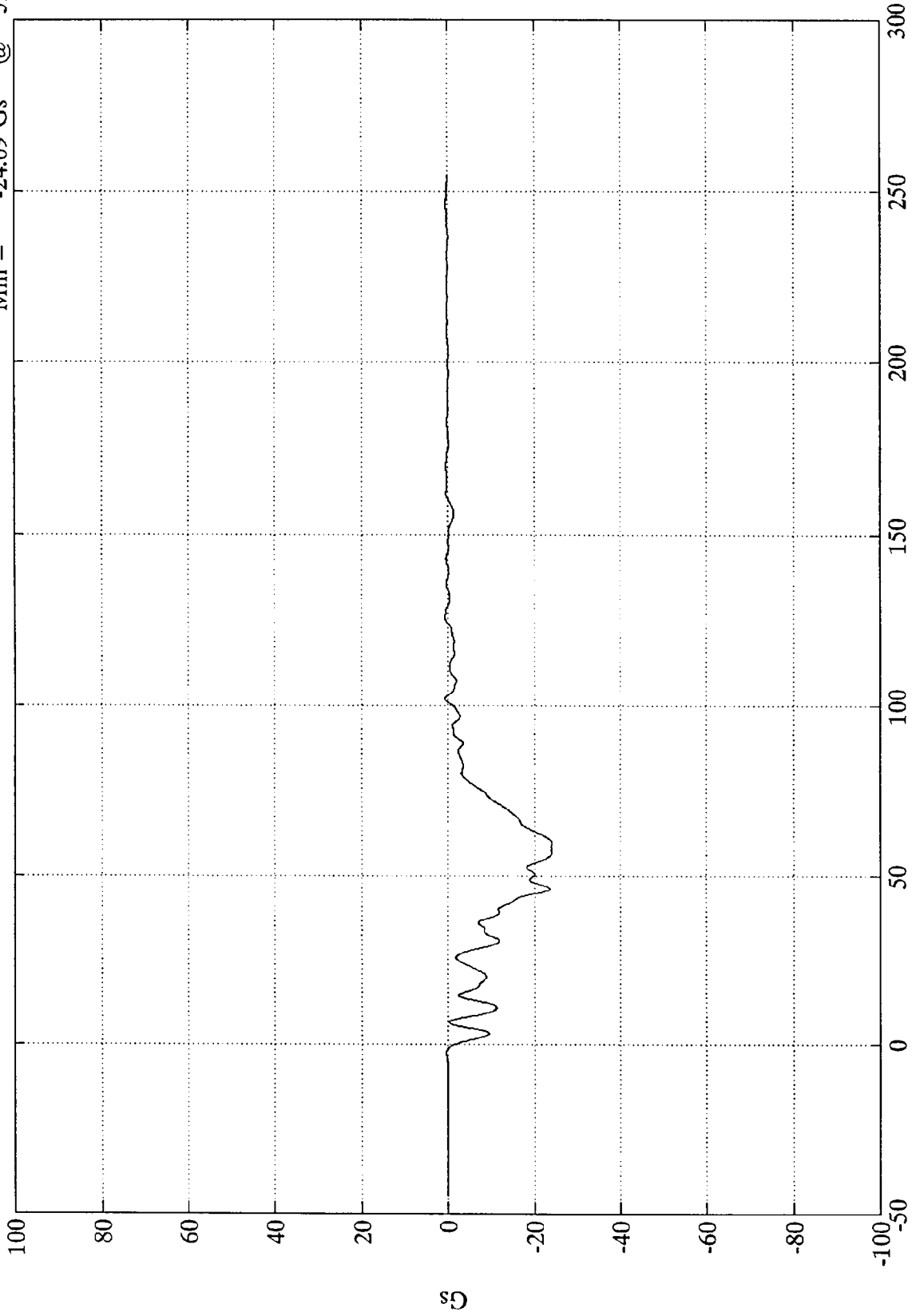
Max = 0.00 in. @ -0.00 msec
Min = -82.51 in. @ 254.88 msec



TSC 301 TEST 1 - FRONTAL IMPACT

Acc. #2 Right Xmember

Max = .67 Gs @ 101.87 msec
Min = -24.09 Gs @ 59.88 msec



Time (msec)

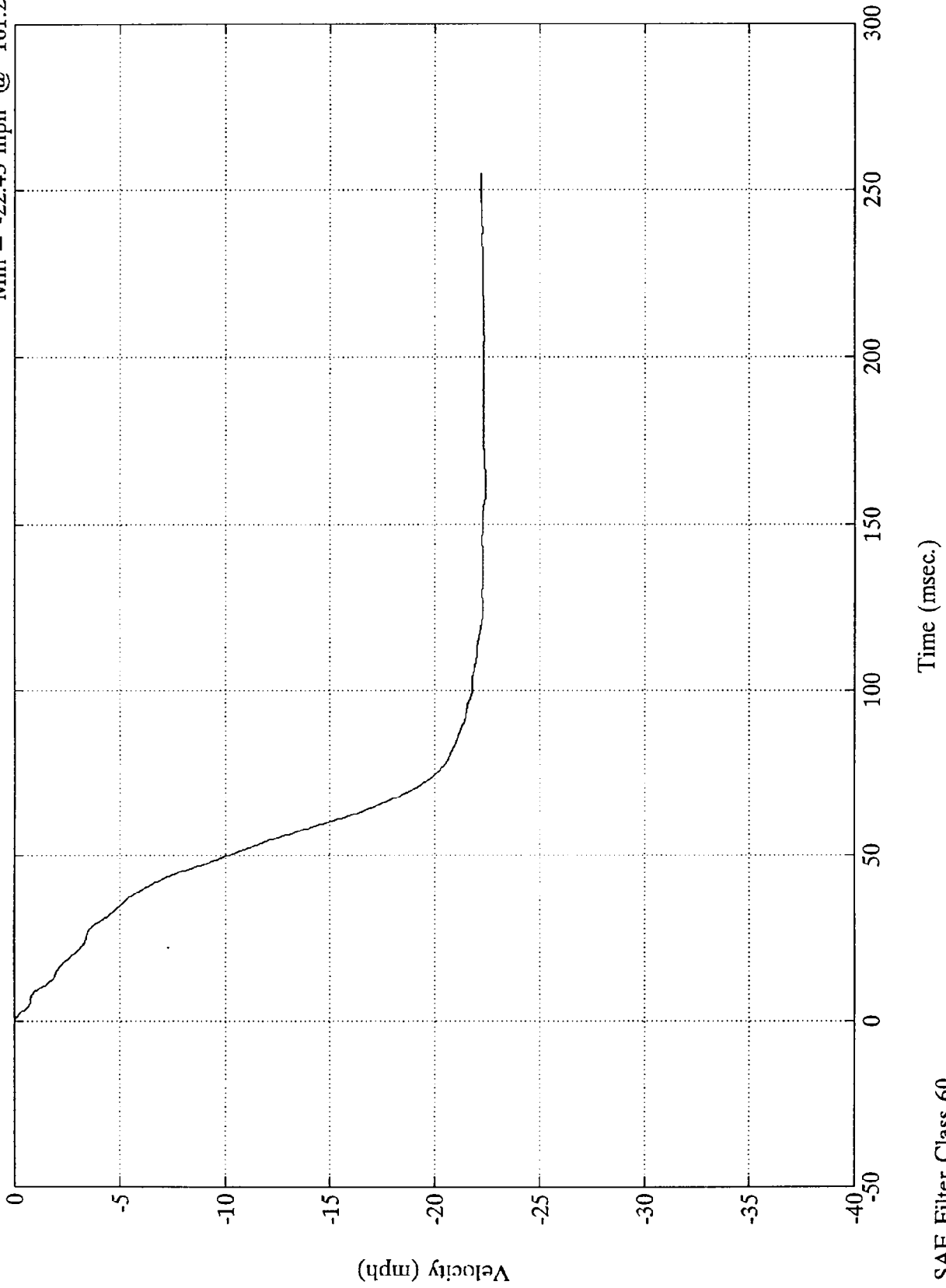
SAE Filter Class 60



TSC 301 TEST 1 - FRONTAL IMPACT

Acc. #2 Right Xmember

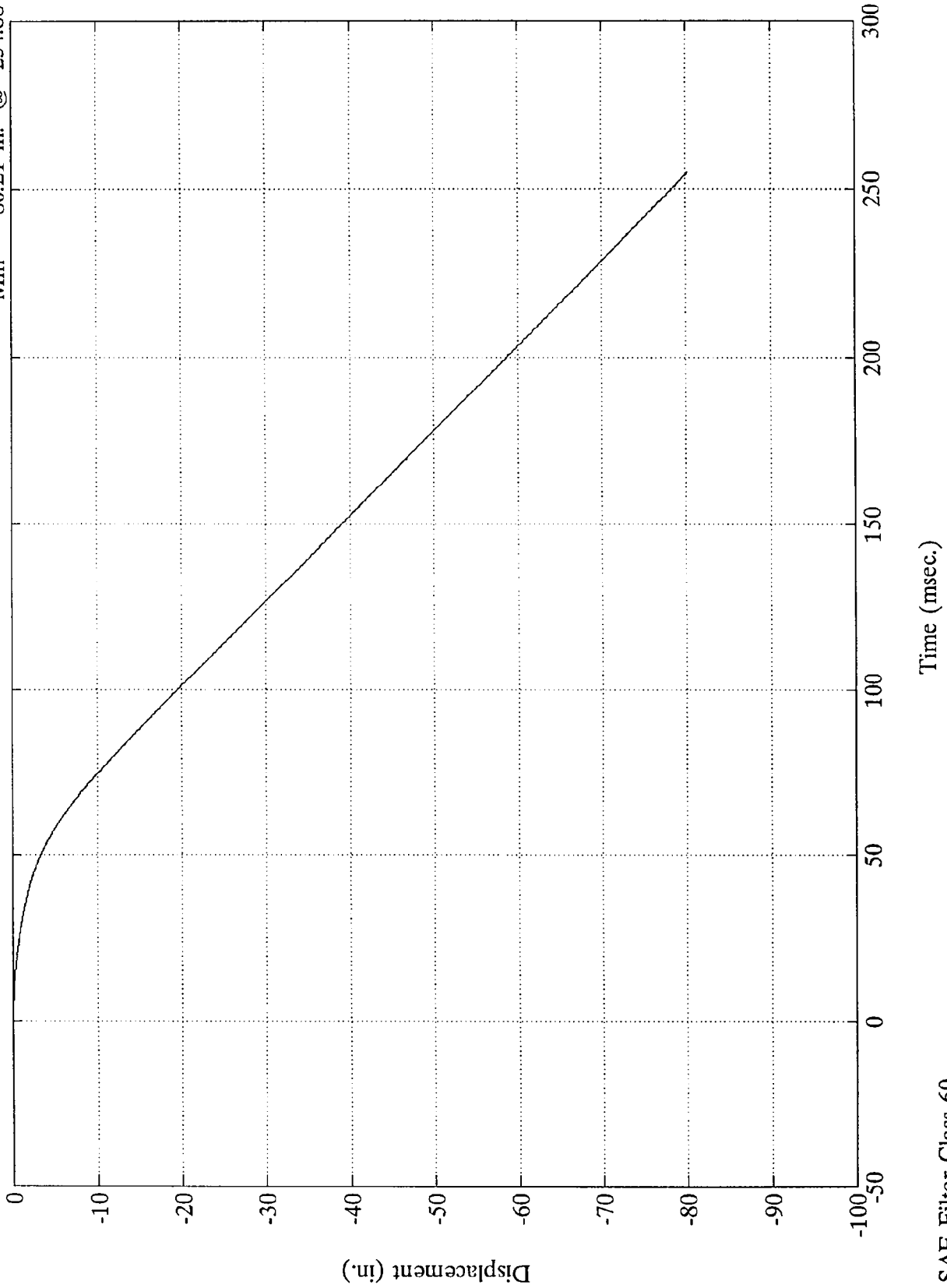
Max = 0.00 mph @ -0.00 msec
Min = -22.43 mph @ 161.28 msec



TSC 301 TEST 1 - FRONTAL IMPACT

Acc. #1 Right Xmember

Max = 0.00 in. @ -0.00 msec
Min = -80.21 in. @ 254.88 msec



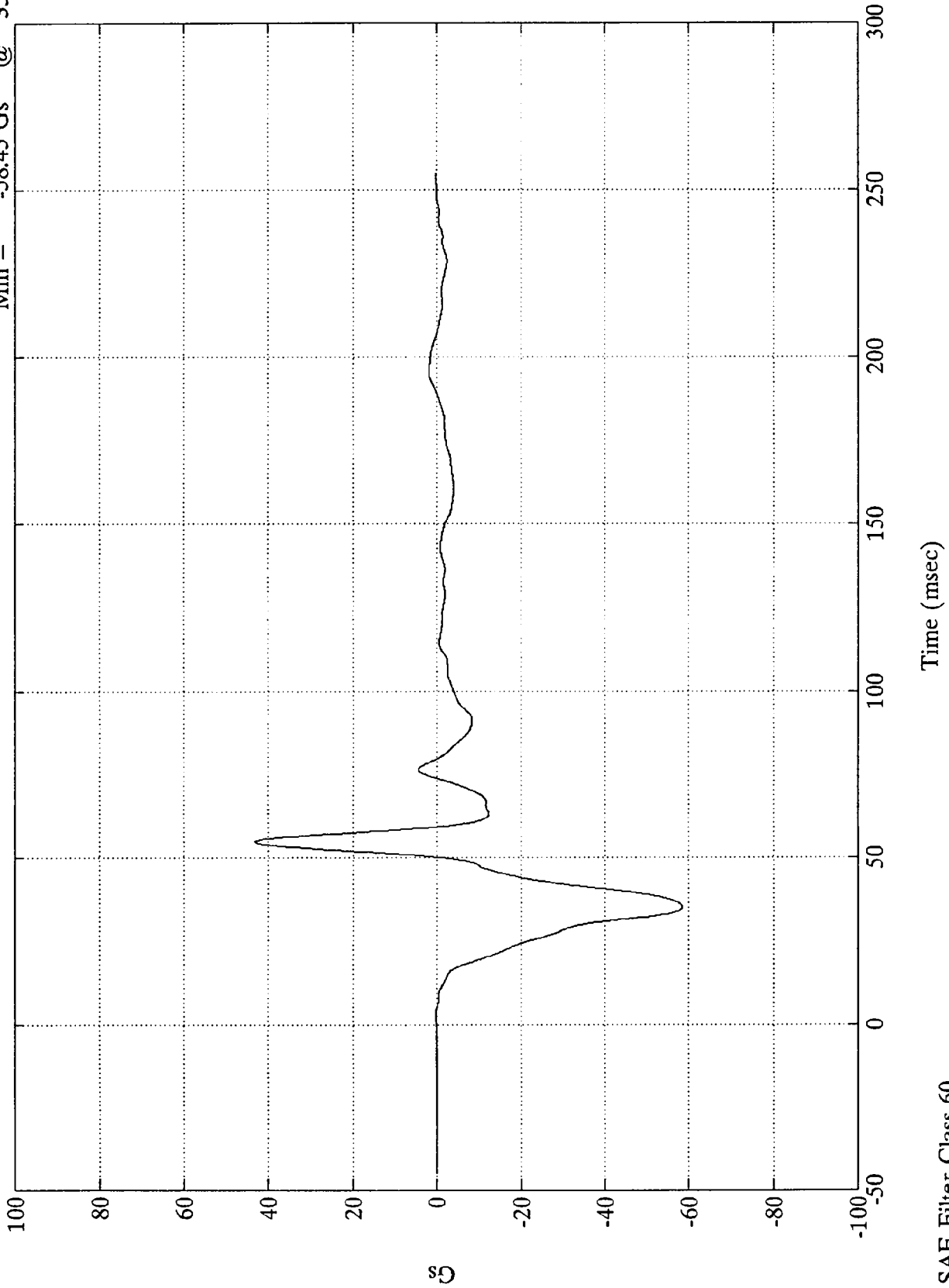
SAE Filter Class 60



TSC 301 TEST 1 - FRONTAL IMPACT

Acc. #3 Engine Top

Max = 43.27 Gs @ 54.84 msec
Min = -58.45 Gs @ 35.27 msec



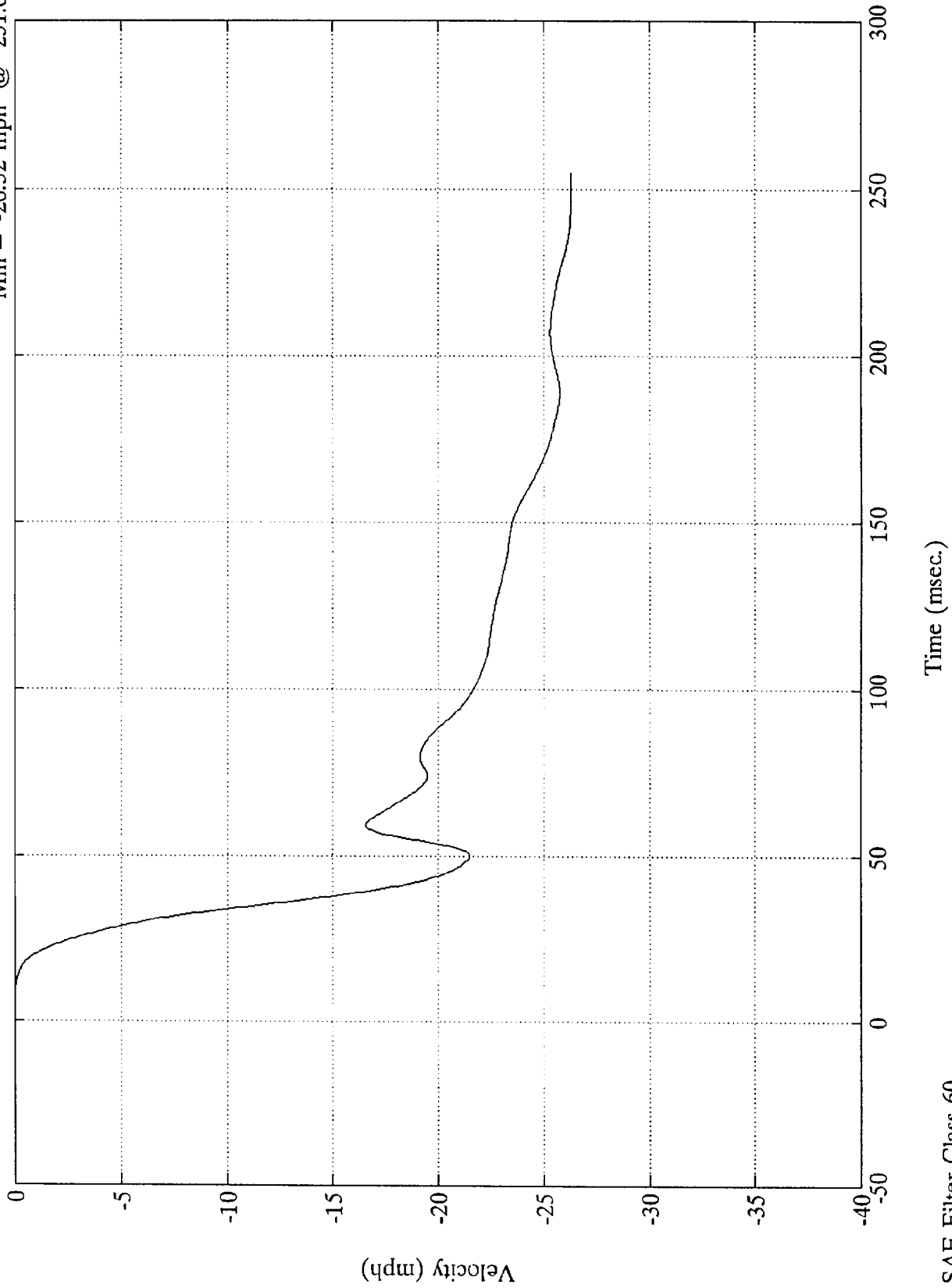
8102-1

SAE Filter Class 60

TSC 301 TEST 1 - FRONTAL IMPACT

Max = 0.02 mph @ 5.04 msec
Min = -26.32 mph @ 251.04 msec

Acc. #3 Engine Top

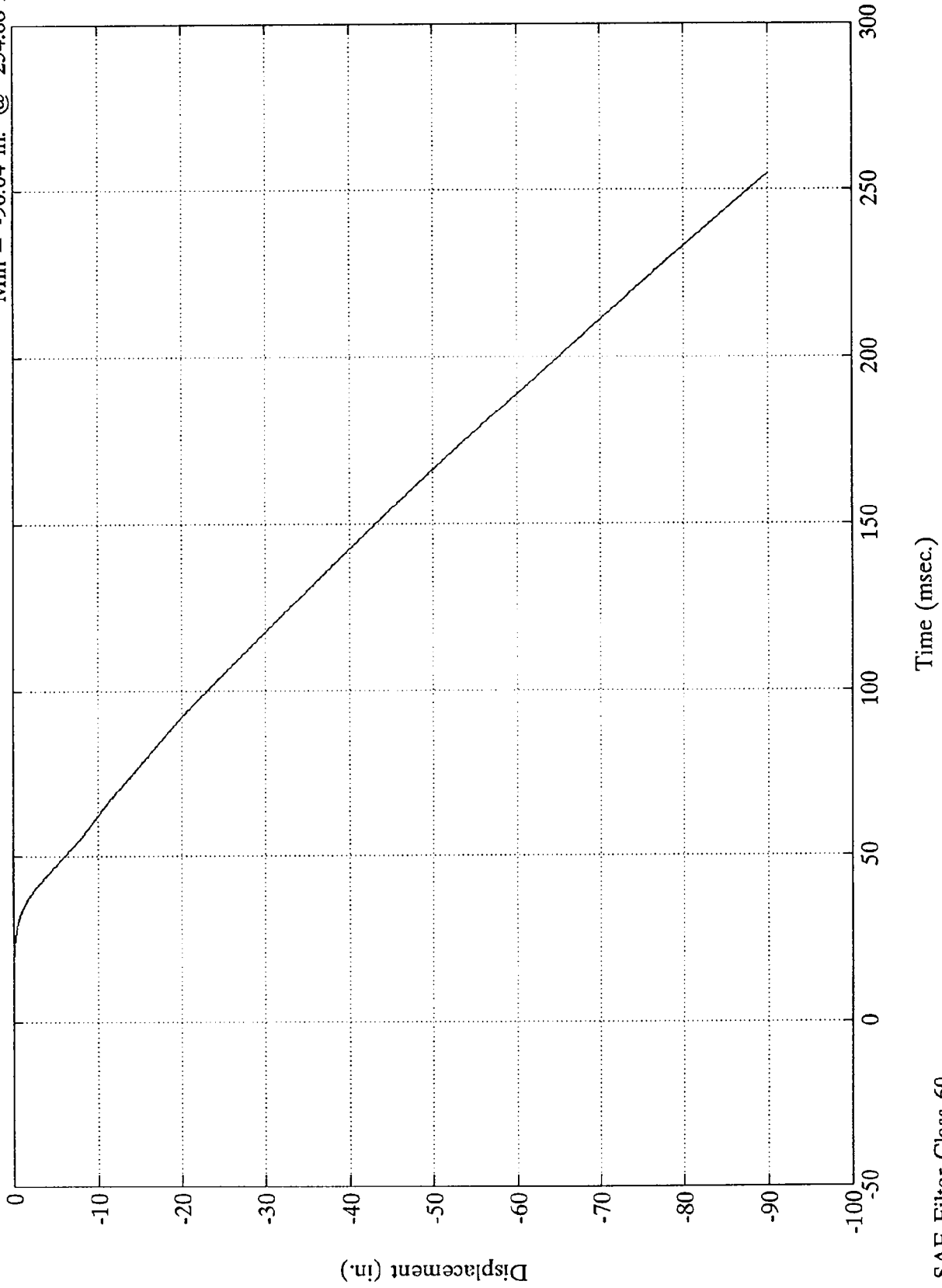


SAE Filter Class 60

TSC 301 TEST 1 - FRONTAL IMPACT

Acc. #3 Engine Top

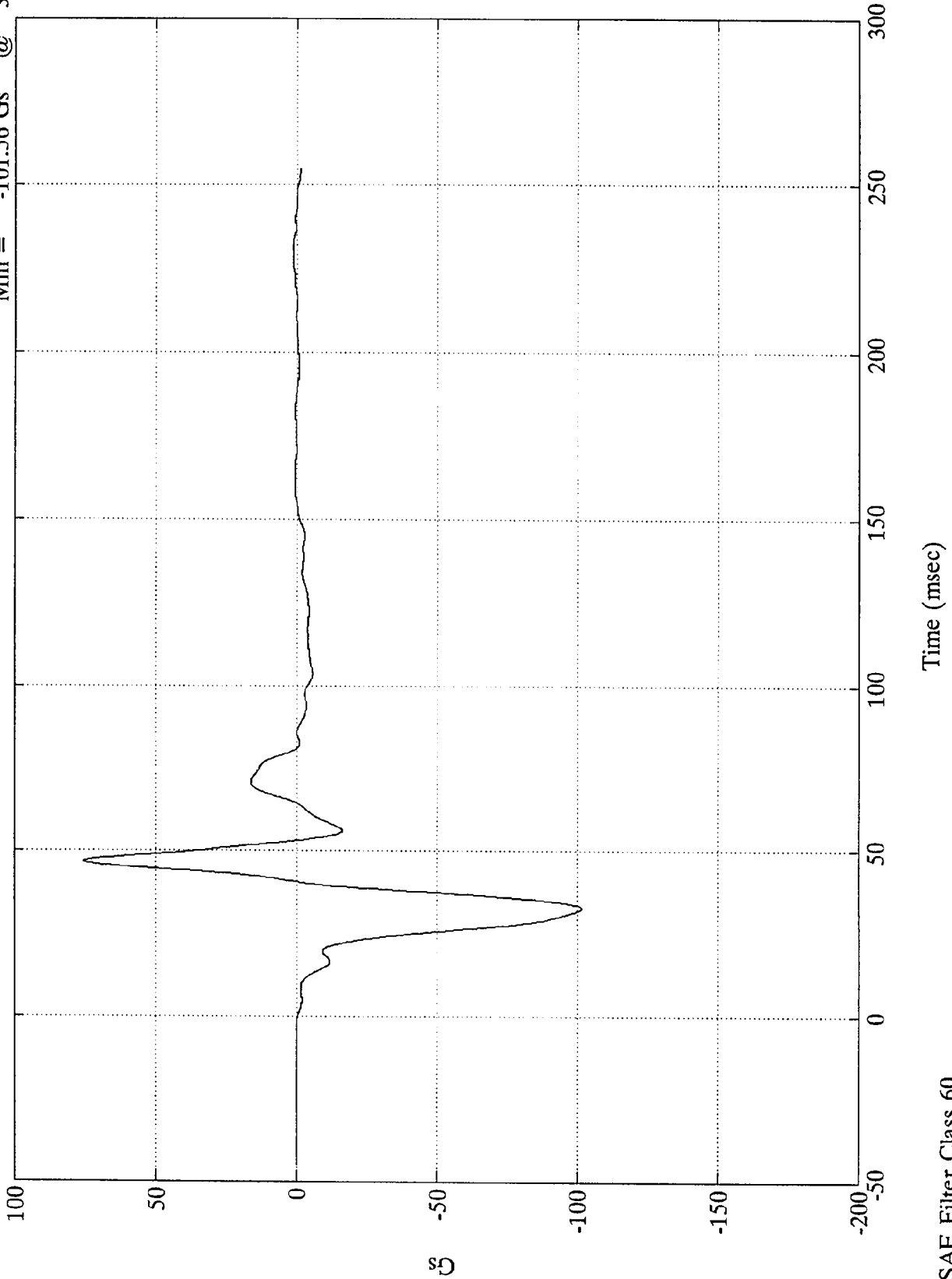
Max = 0.00 in. @ 8.88 msec
Min = -90.04 in. @ 254.88 msec



TSC 301 TEST 1 - FRONTAL IMPACT

Acc. #4 Engine Bottom

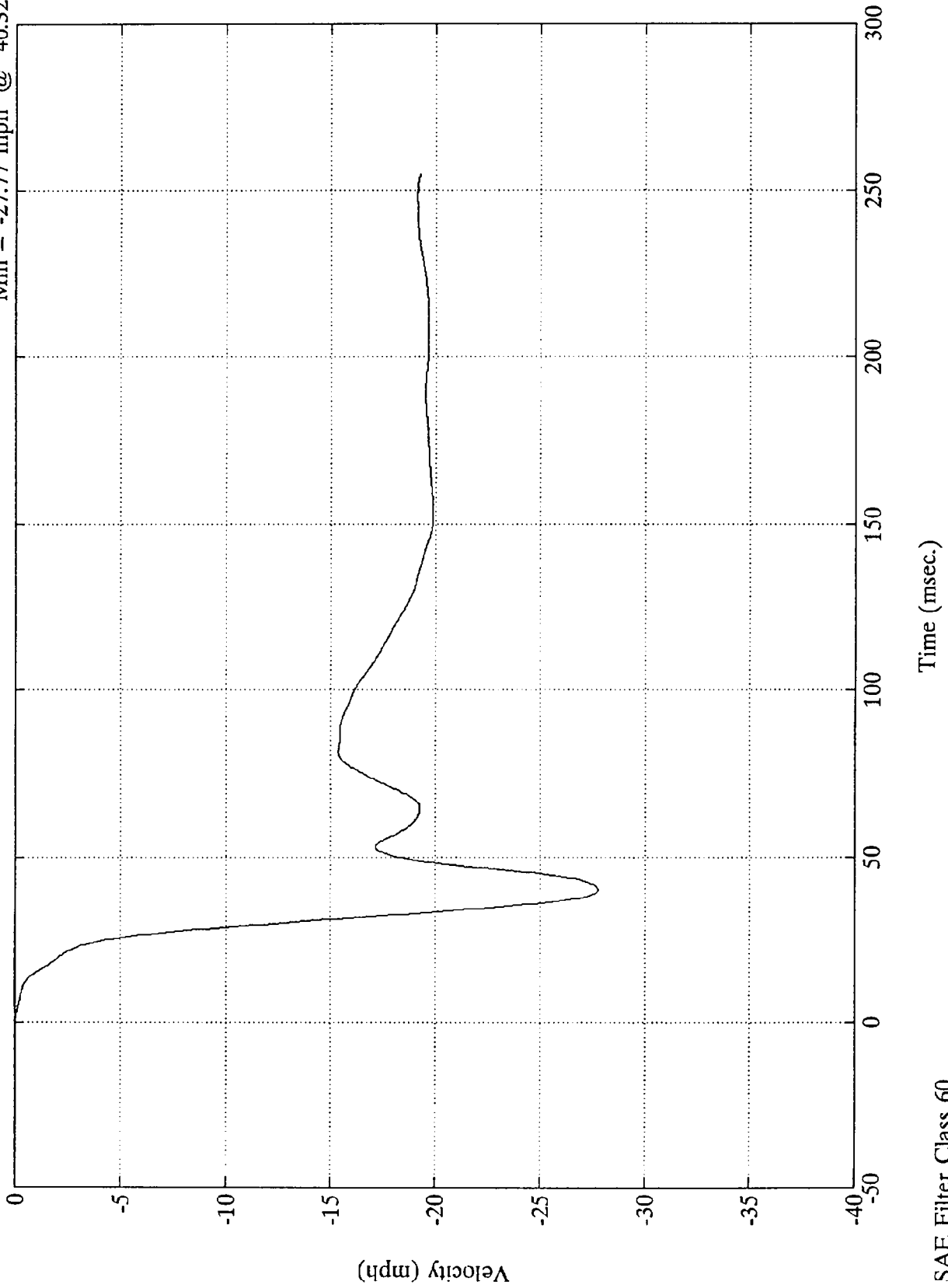
Max = 75.45 Gs @ 46.68 msec
Min = -101.56 Gs @ 32.76 msec



TSC 301 TEST 1 - FRONTAL IMPACT

Acc. #4 Engine Bottom

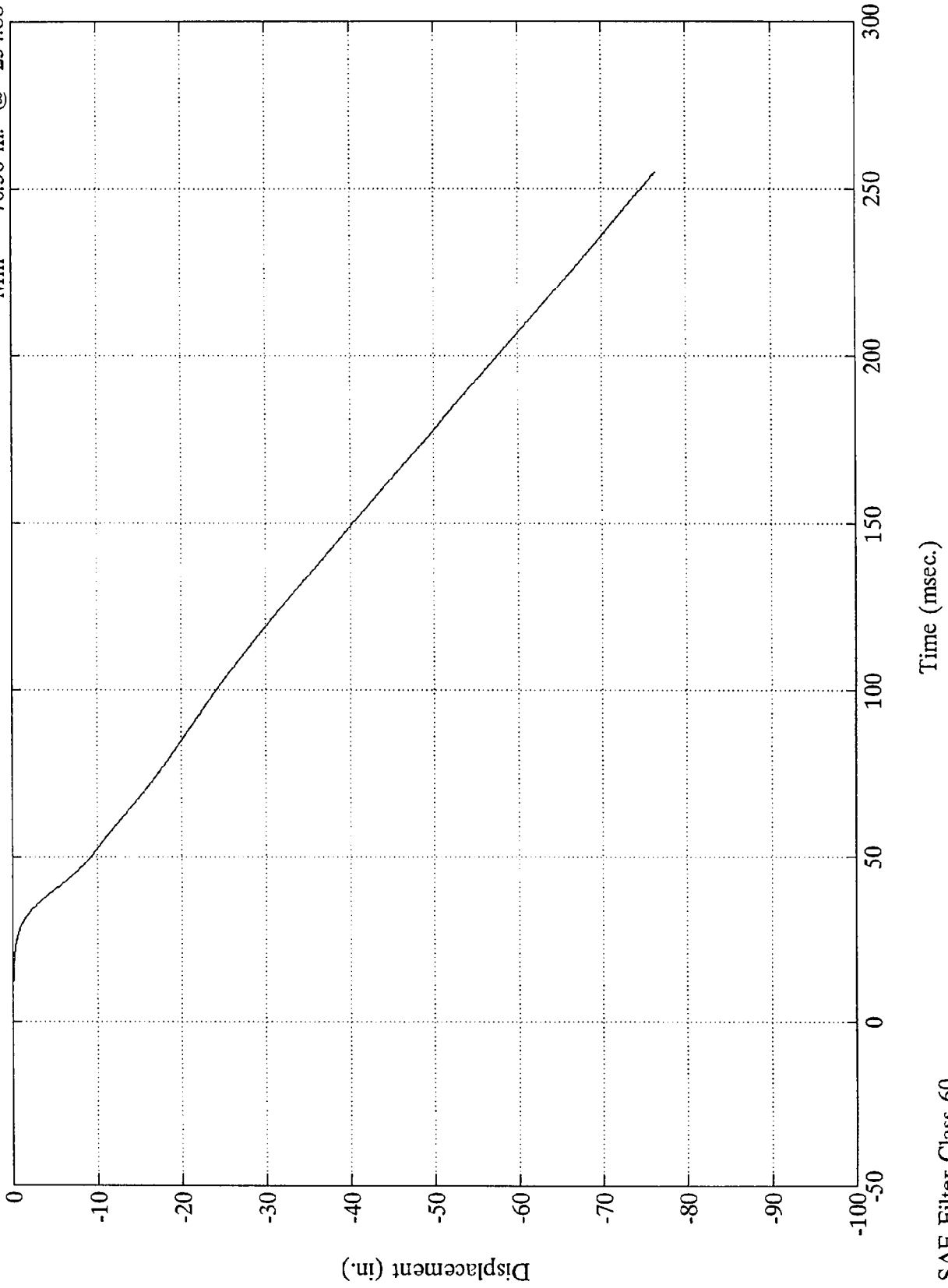
Max = 0.00 mph @ -0.00 msec
Min = -27.77 mph @ 40.32 msec



TSC 301 TEST 1 - FRONTAL IMPACT

Acc. #4 Engine Bottom

Max = 0.00 in. @ -0.00 msec
Min = -76.36 in. @ 254.88 msec



1-20-B

8102-1

SAE Filter Class 60

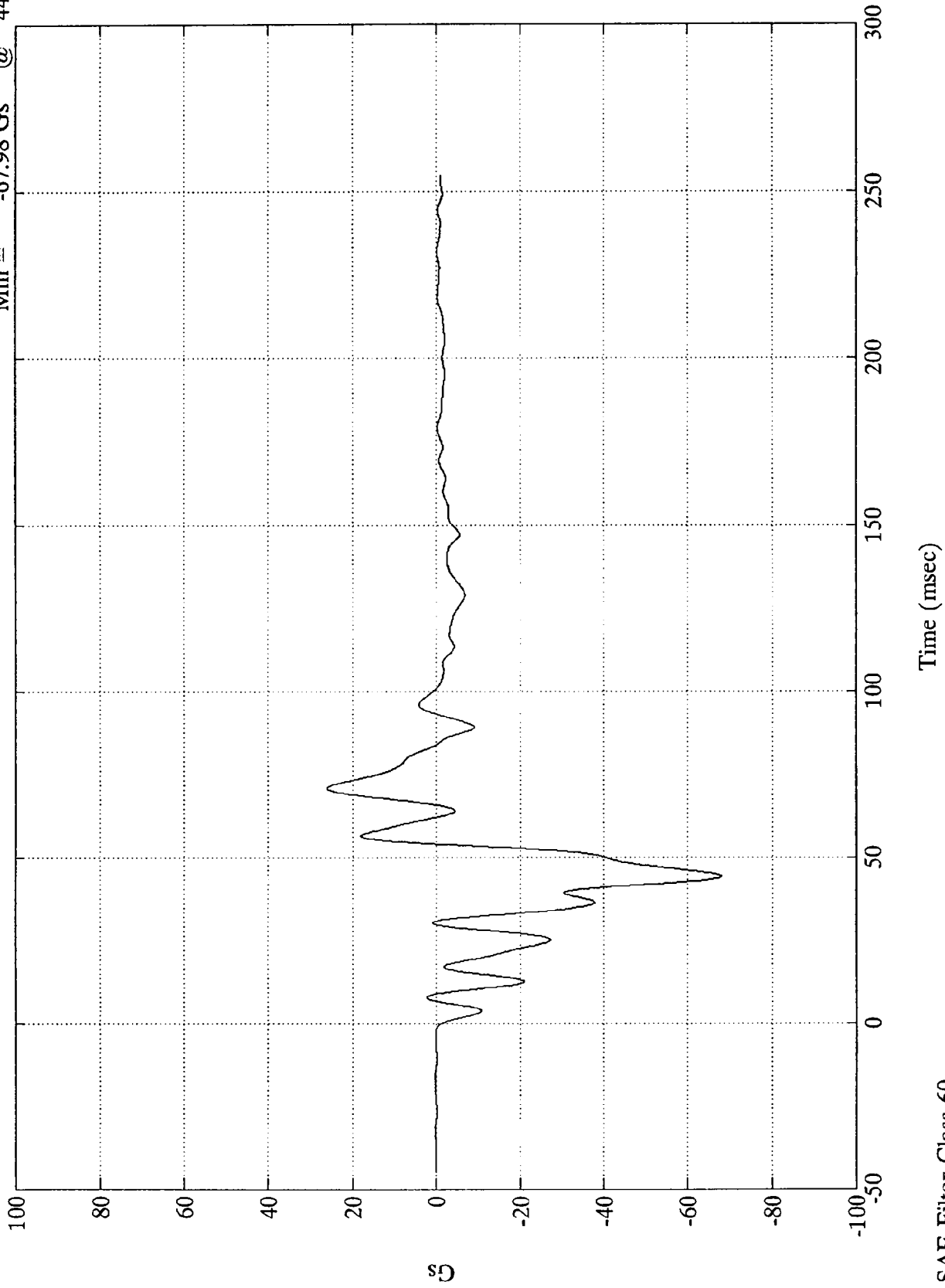
Time (msec.)

Displacement (in.)

TSC 301 TEST 1 - FRONTAL IMPACT

Acc. #5 Left Caliper

Max = 26.04 Gs @ 71.04 msec
Min = -67.98 Gs @ 44.39 msec



B-21

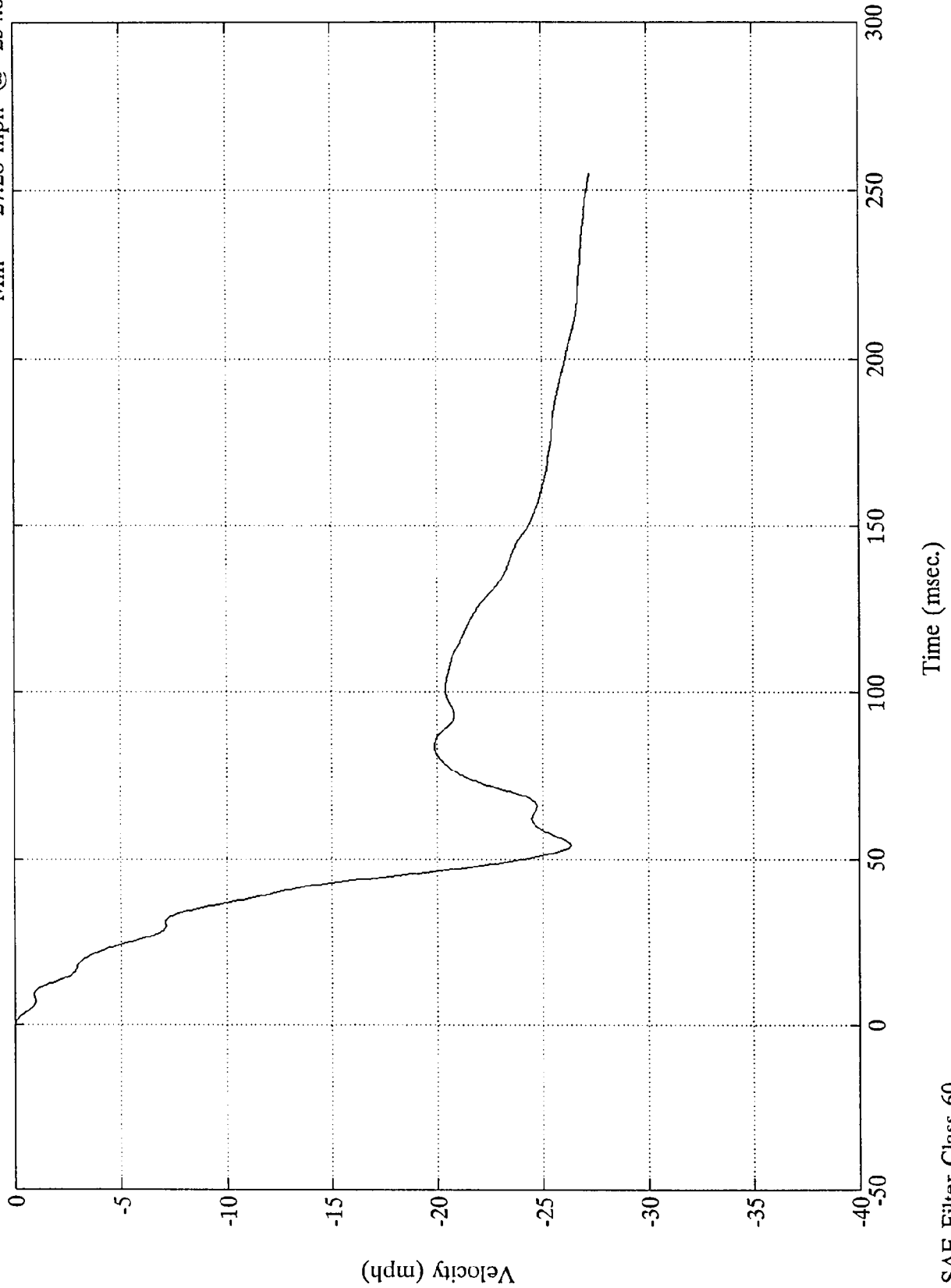
8102-1

SAE Filter Class 60

TSC 301 TEST 1 - FRONTAL IMPACT

Acc. #5 Left Caliper

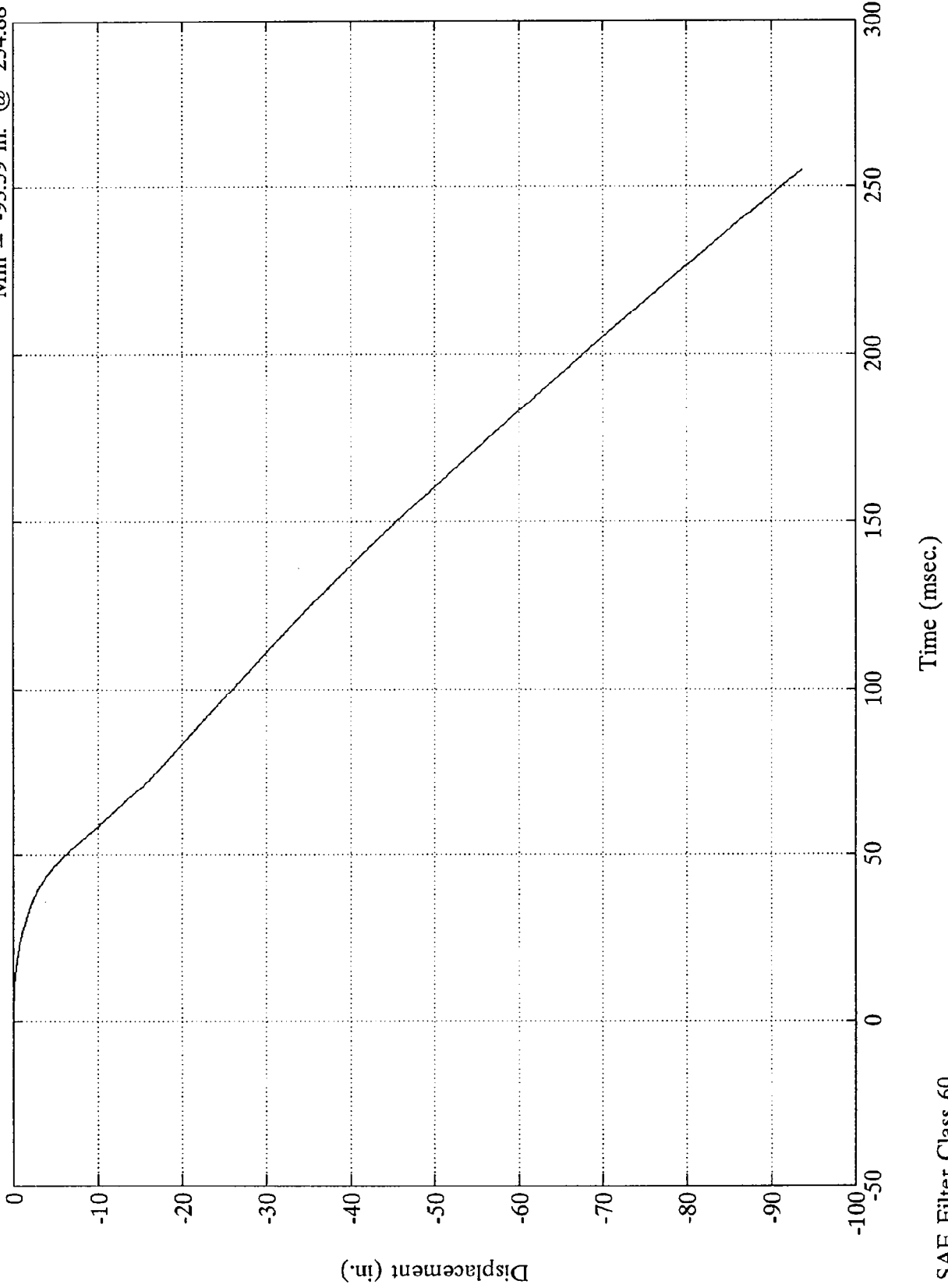
Max = 0.00 mph @ -0.00 msec
Min = -27.28 mph @ 254.88 msec



TSC 301 TEST 1 - FRONTAL IMPACT

Acc. #5 Left Caliper

Max = 0.00 in. @ -0.00 msec
Min = -93.59 in. @ 254.88 msec



TEST NO. Y47-010-1276

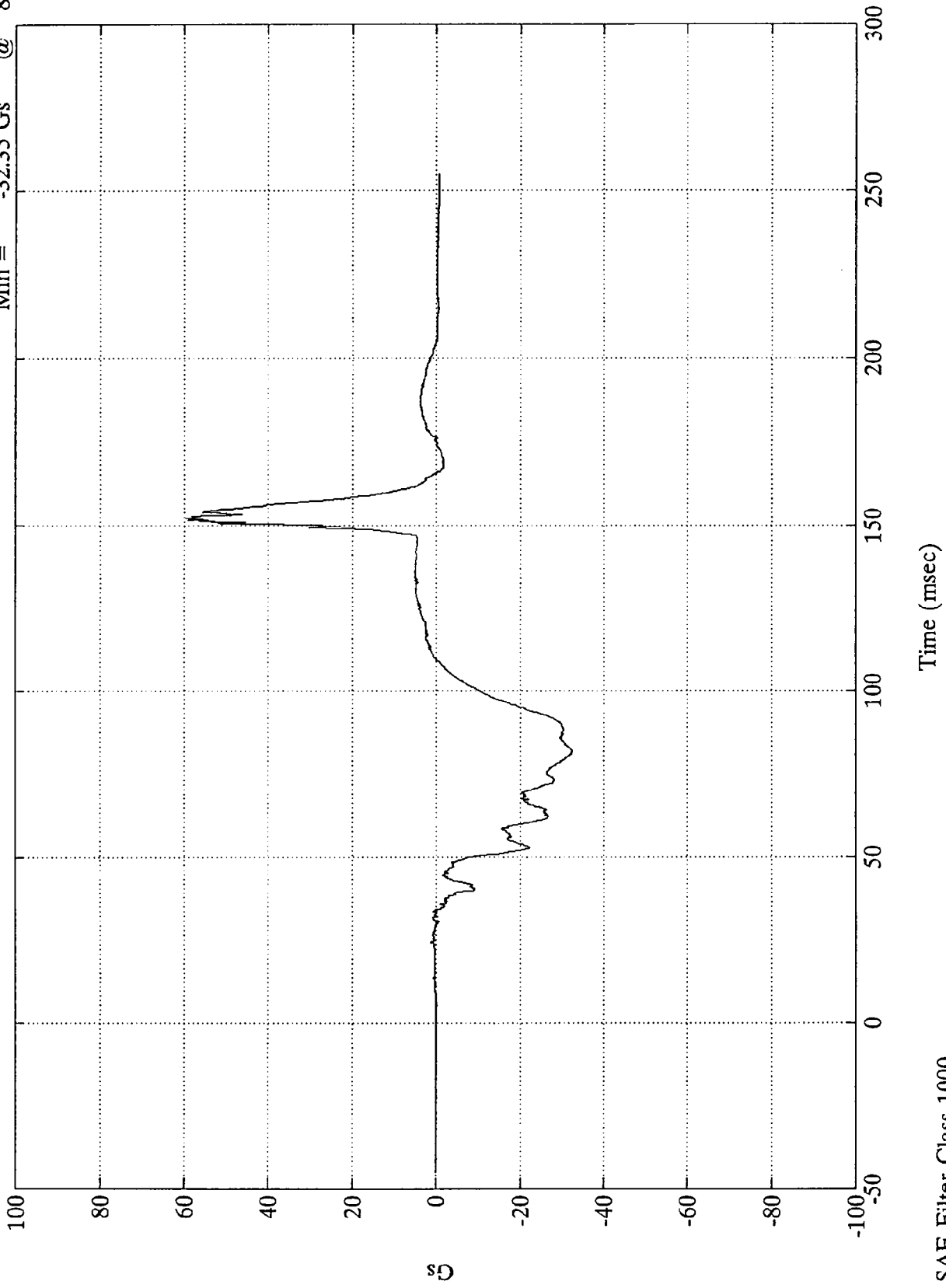
DUMMY DATA

CLASS	FILTER CHANNEL
Head Accelerations	1000
Chest Accelerations	180
Chest Displacements	60
Femur Forces	600
Neck Forces	1000
Neck Moments	600
Tibia Forces	600
Tibia Moments	600

TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 1 Head X

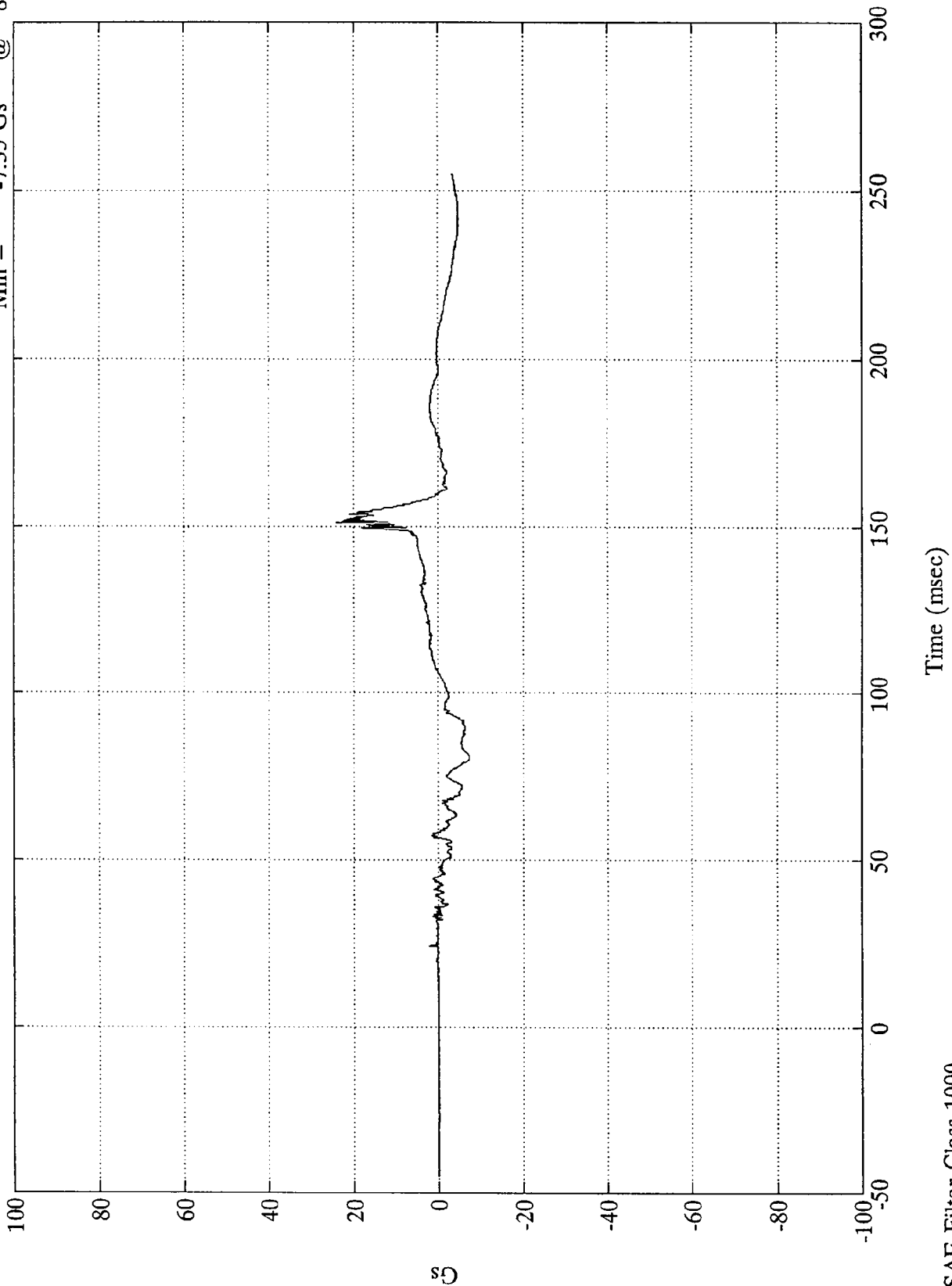
Max = 59.50 Gs @ 152.27 msec
Min = -32.35 Gs @ 82.08 msec



TSC 301 TEST 1 - FRONTAL IMPACT

Max = 24.29 Gs @ 151.20 msec
Min = -7.35 Gs @ 80.88 msec

Pos. 1 Head Y

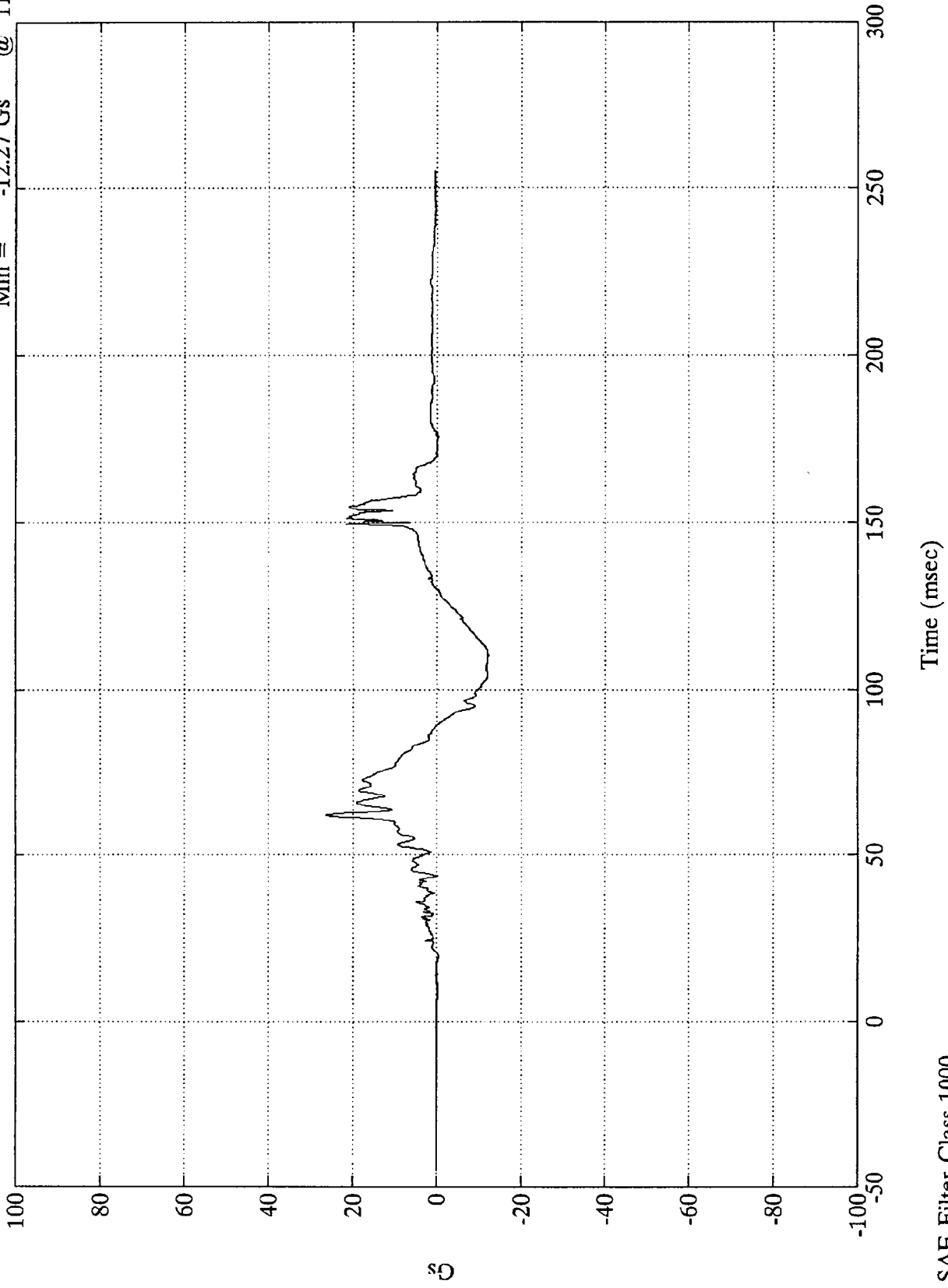


SAE Filter Class 1000

TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 1 Head Z

Max = 26.49 Gs @ 61.68 msec
Min = -12.27 Gs @ 110.27 msec



SD
B-27

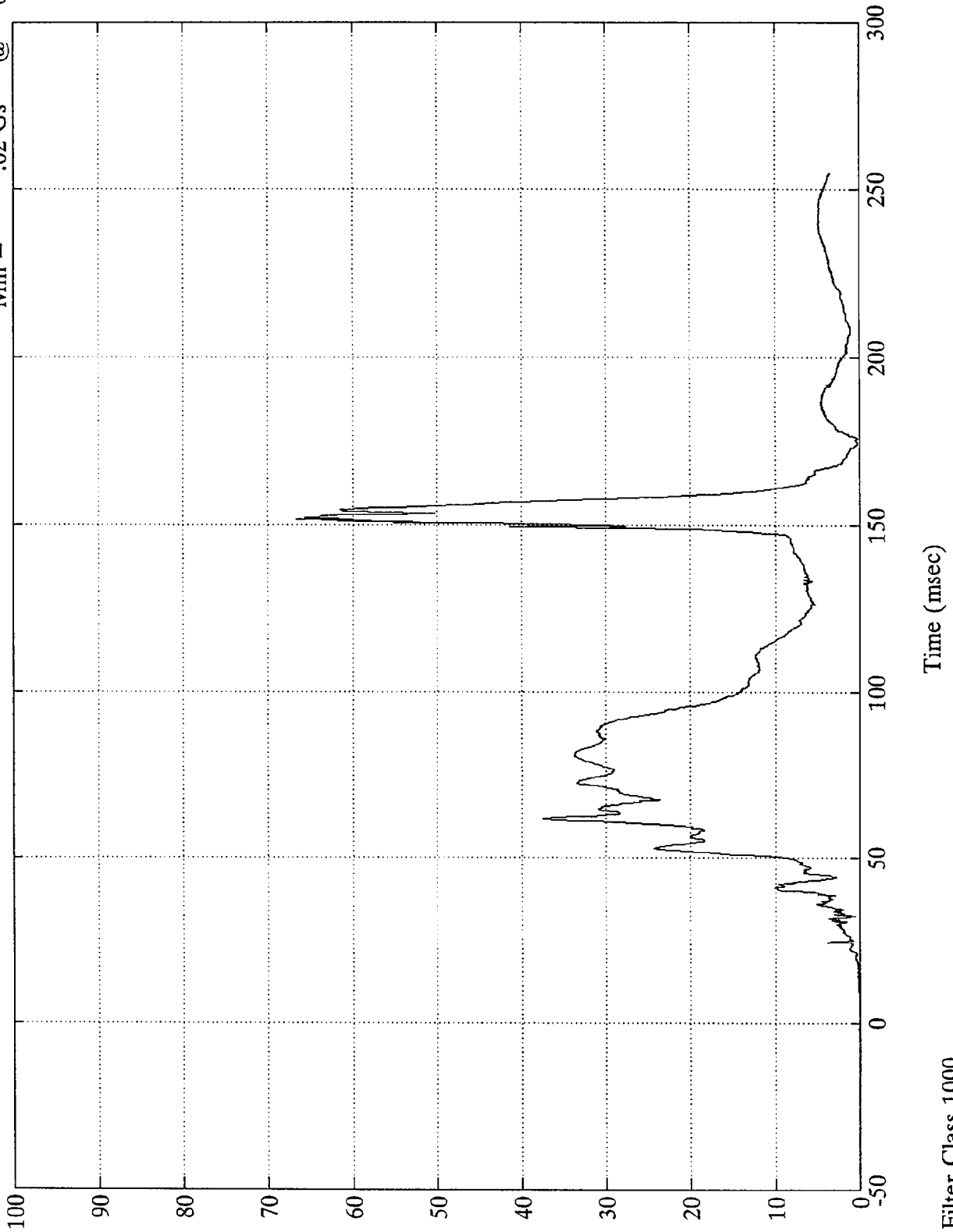
8102-1

SAE Filter Class 1000

TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 1 Head Resultant

Max = 66.66 Gs @ 151.80 msec
Min = .02 Gs @ 6.59 msec

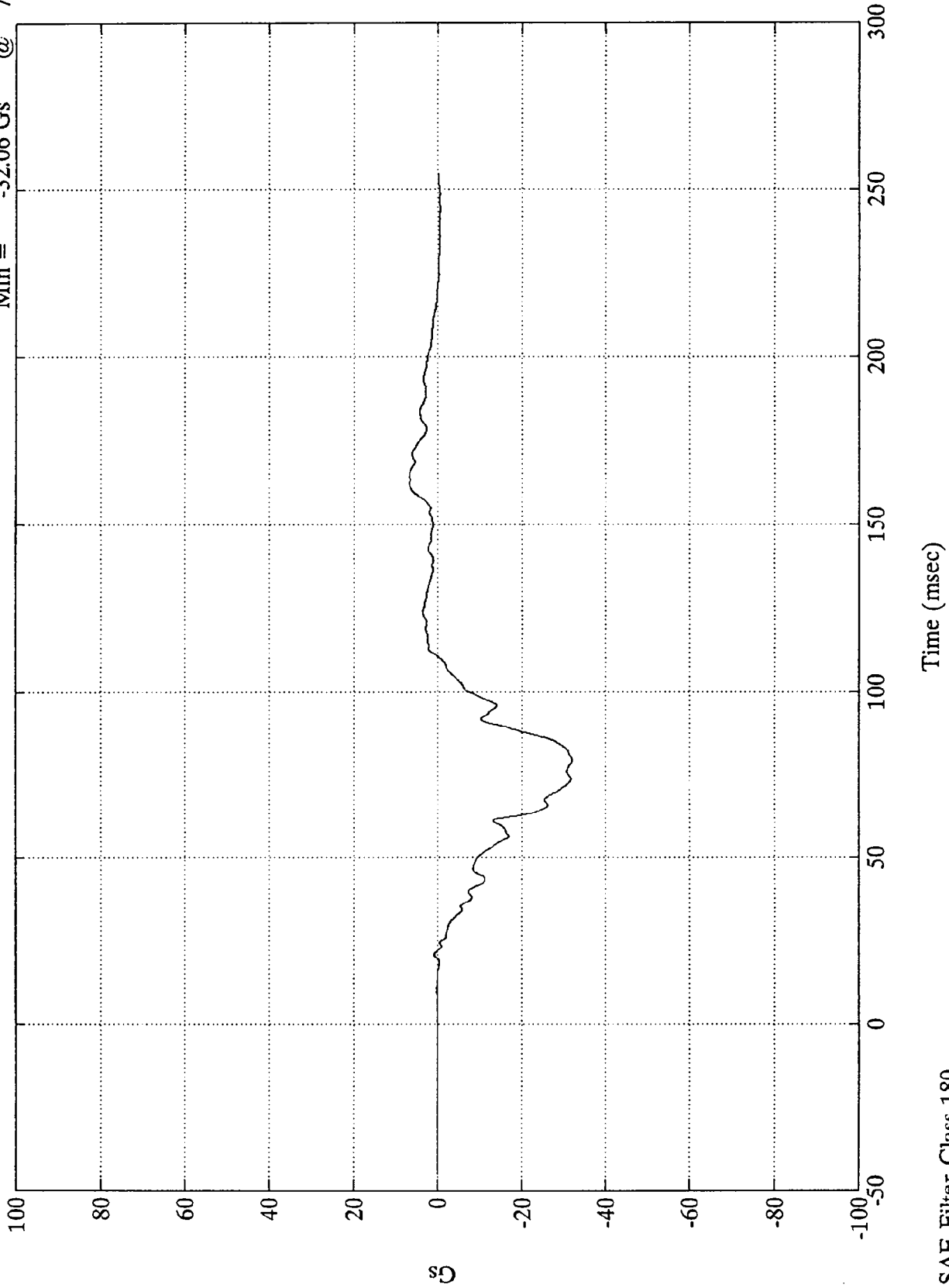


Time (msec)

TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 1 Chest X

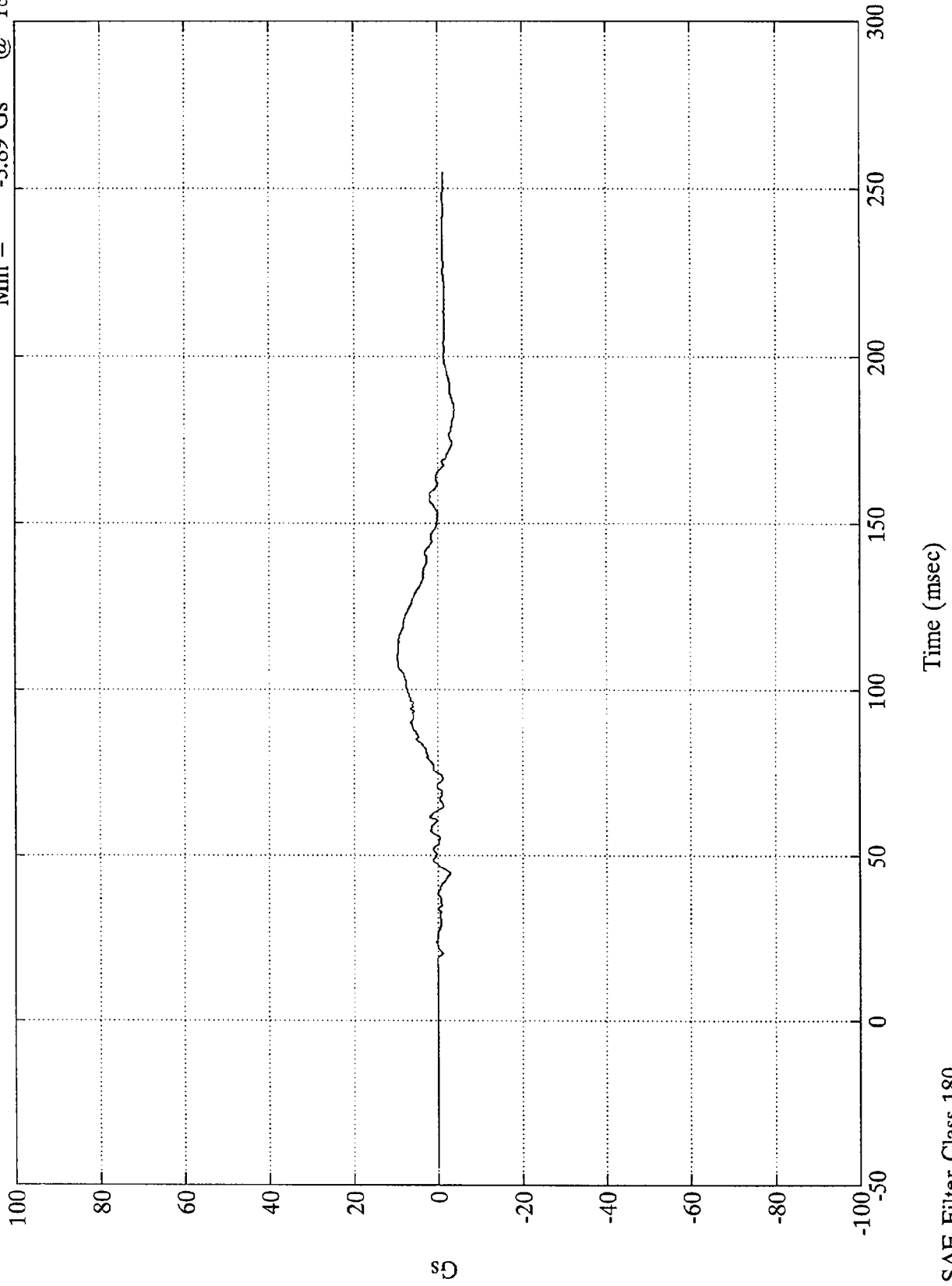
Max = 6.84 Gs @ 162.11 msec
Min = -32.06 Gs @ 79.44 msec



TSC 301 TEST 1 - FRONTAL IMPACT

Max = 9.73 Gs @ 109.31 msec
Min = -3.89 Gs @ 183.84 msec

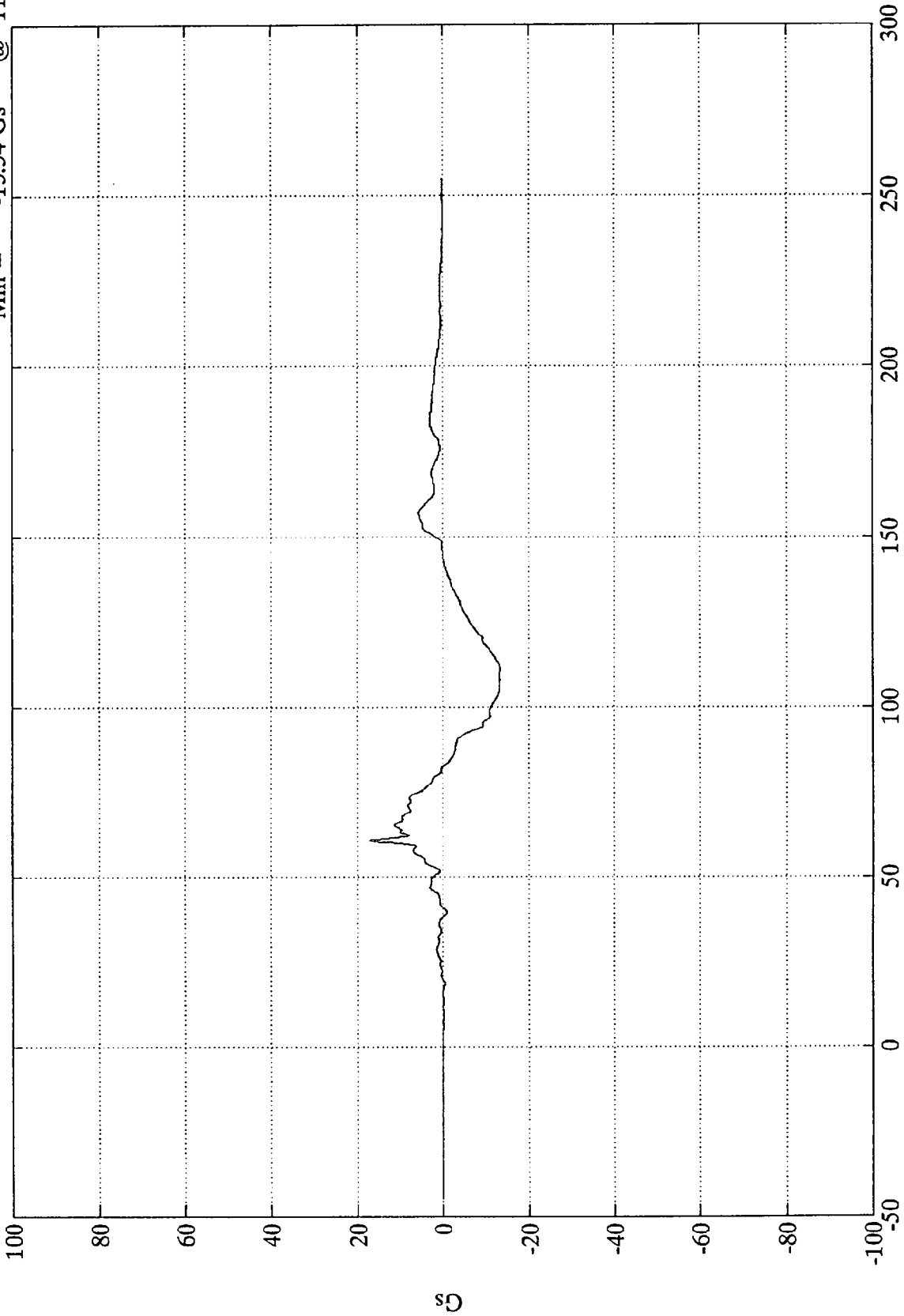
Pos. 1 Chest Y



TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 1 Chest Z

Max = 17.10 Gs @ 60.84 msec
Min = -13.34 Gs @ 110.88 msec



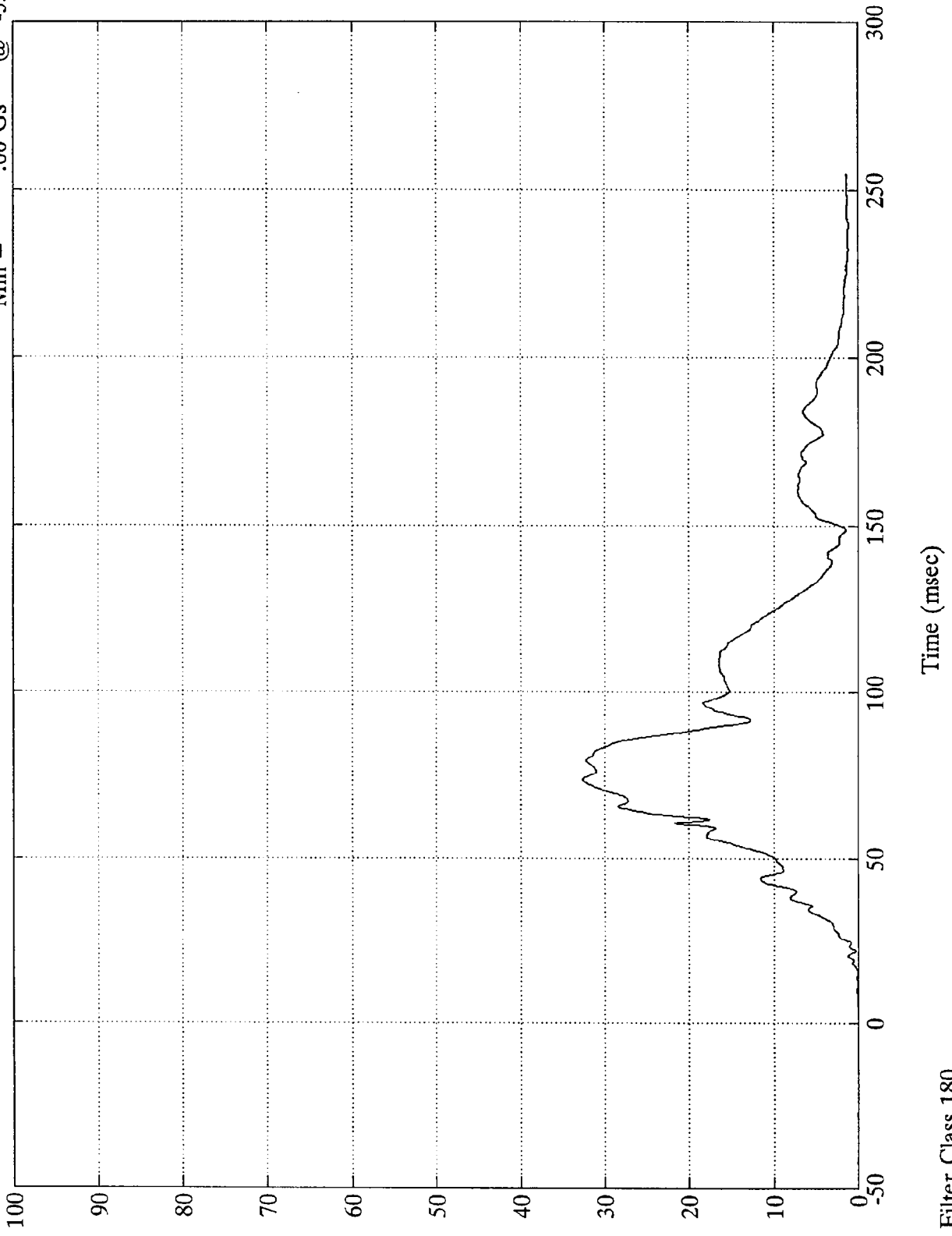
Time (msec)

SAE Filter Class 180

TSC 301 TEST 1 - FRONTAL IMPACT

Max = 32.65 Gs @ 73.68 msec
Min = .00 Gs @ -35.04 msec

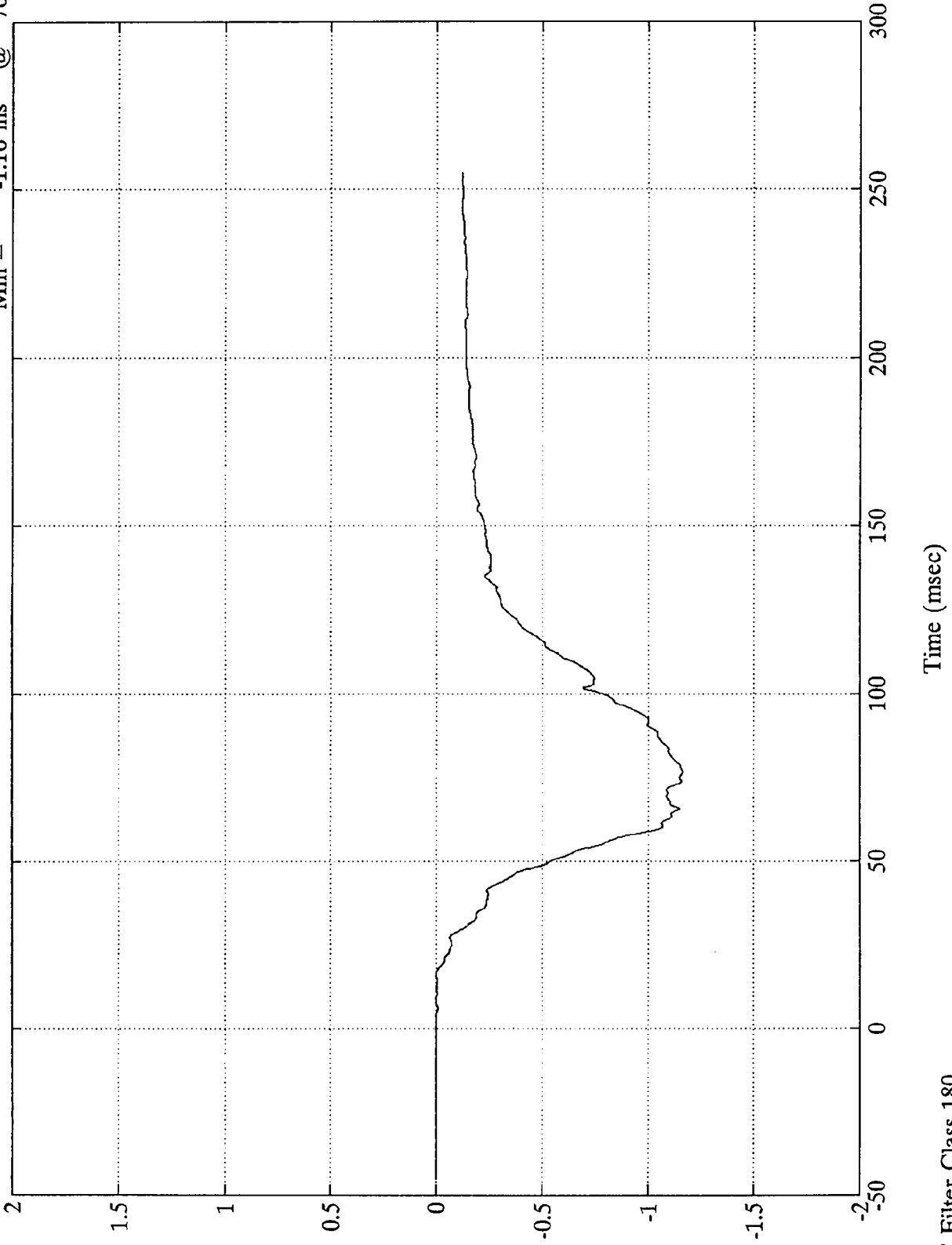
Pos. 1 Chest Resultant



TSC 301 TEST 1 - FRONTAL IMPACT

Max = .00 ins @ 2.87 msec
Min = -1.16 ins @ 76.68 msec

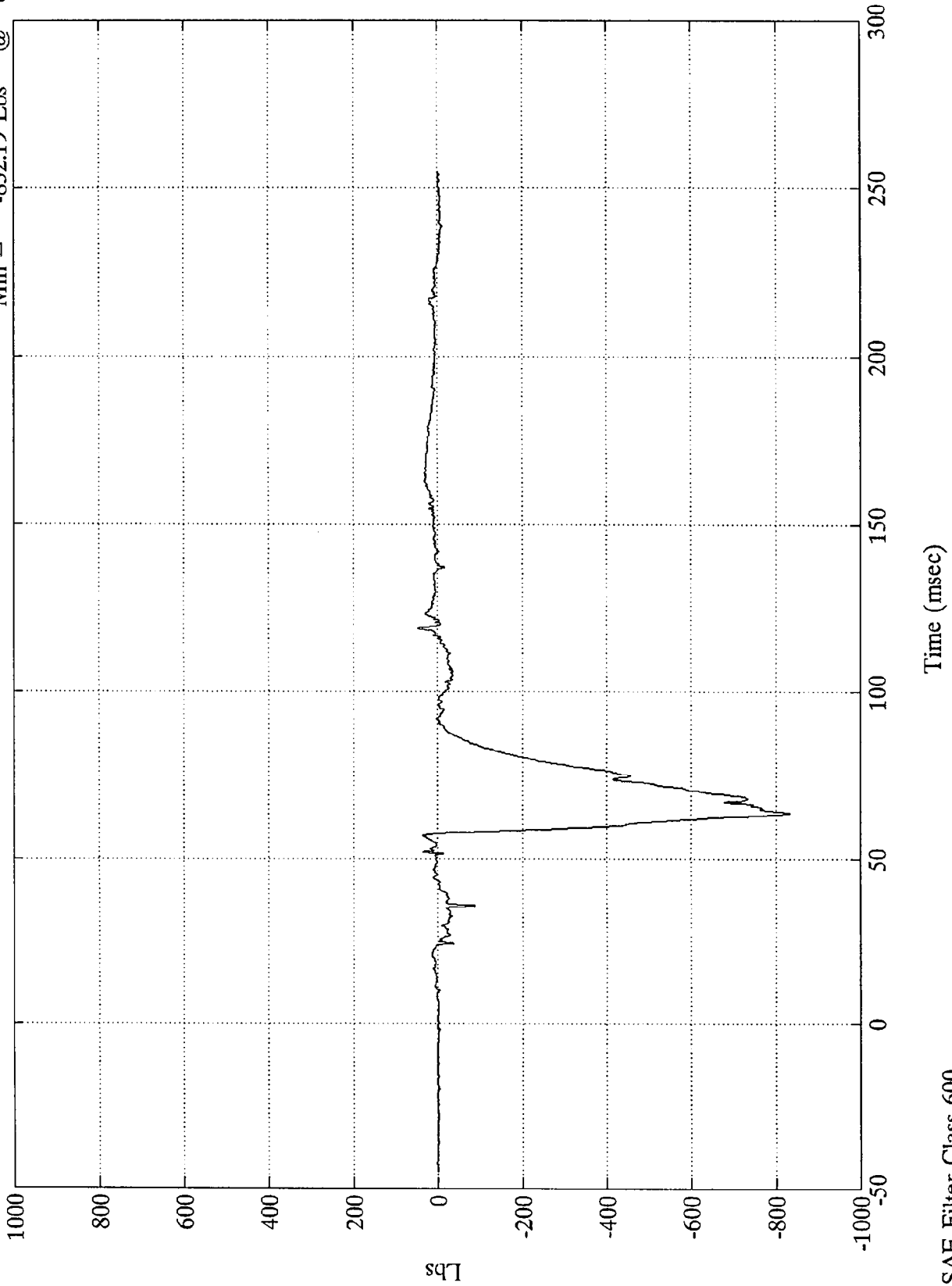
Pos. 1 Chest Deflection



TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 1 Left Femur

Max = 46.66 Lbs @ 118.80 msec
Min = -832.19 Lbs @ 63.84 msec



B-34

8102-1

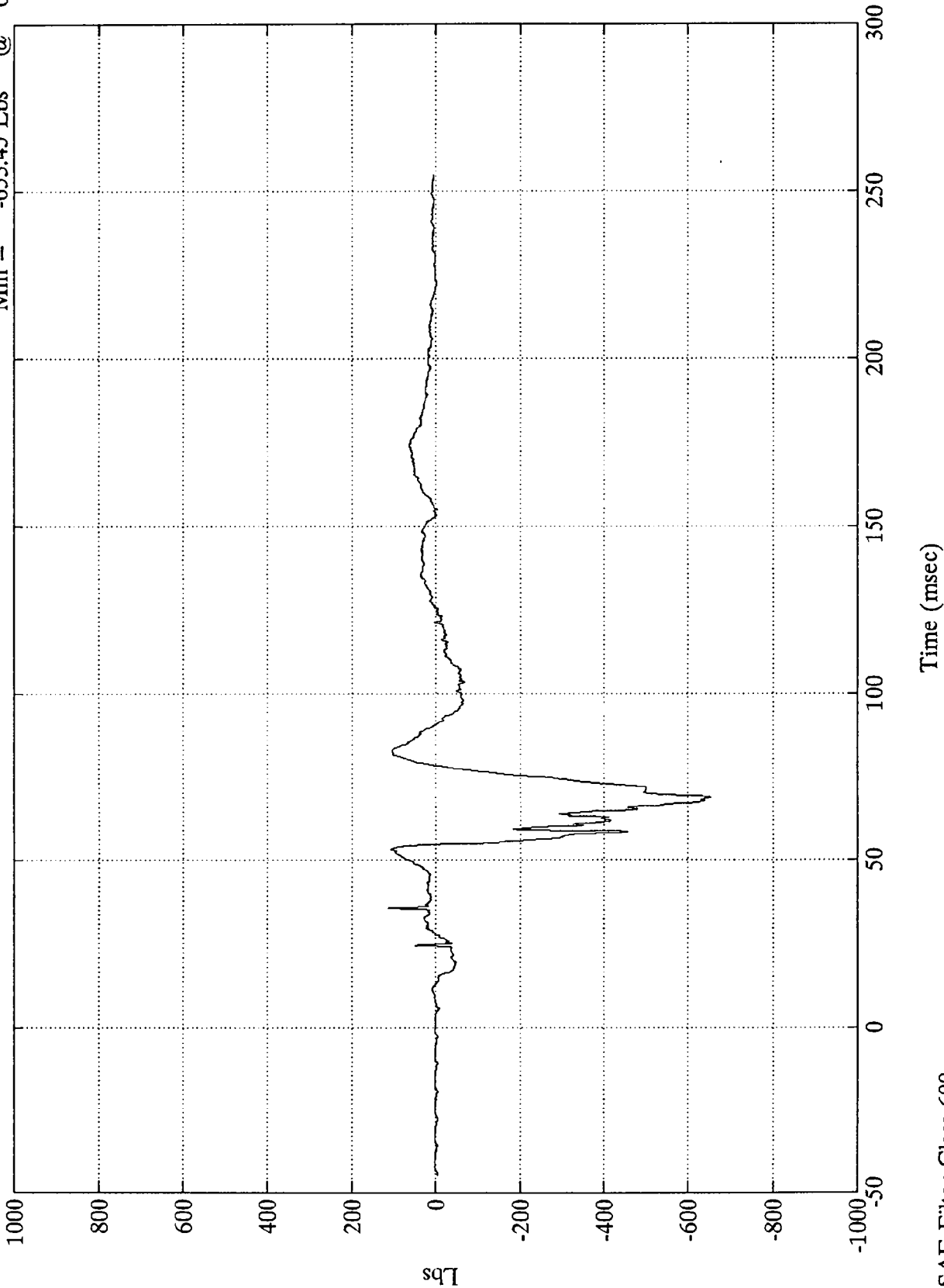
SAE Filter Class 600



TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 1 Right Femur

Max = 114.17 Lbs @ 35.63 msec
Min = -653.45 Lbs @ 69.12 msec



B-35

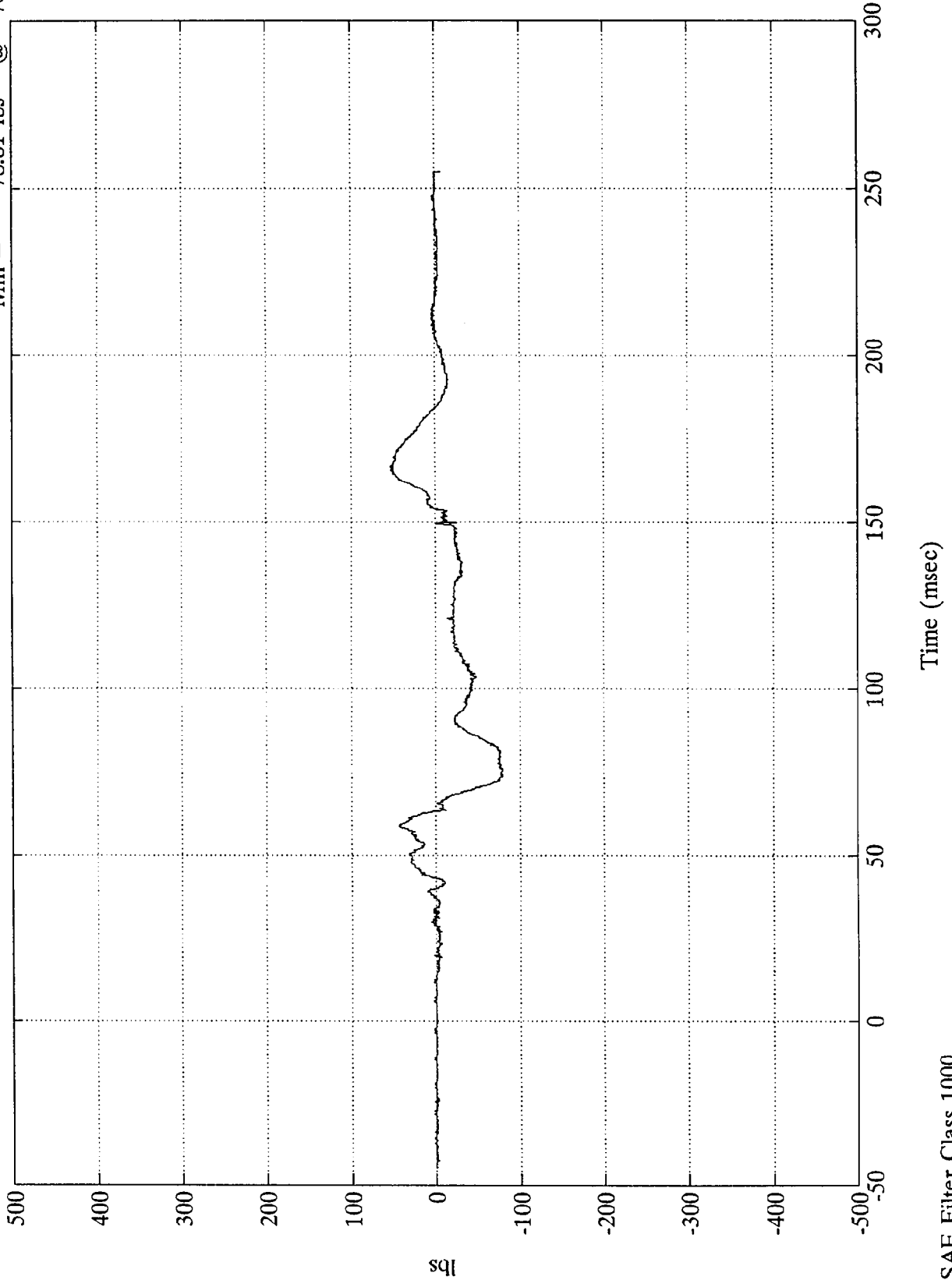
8102-1

SAE Filter Class 600

TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 1 Upper Neck Fx

Max = 52.22 lbs @ 167.04 msec
Min = -78.81 lbs @ 76.31 msec



sq|

B-36

8102-1

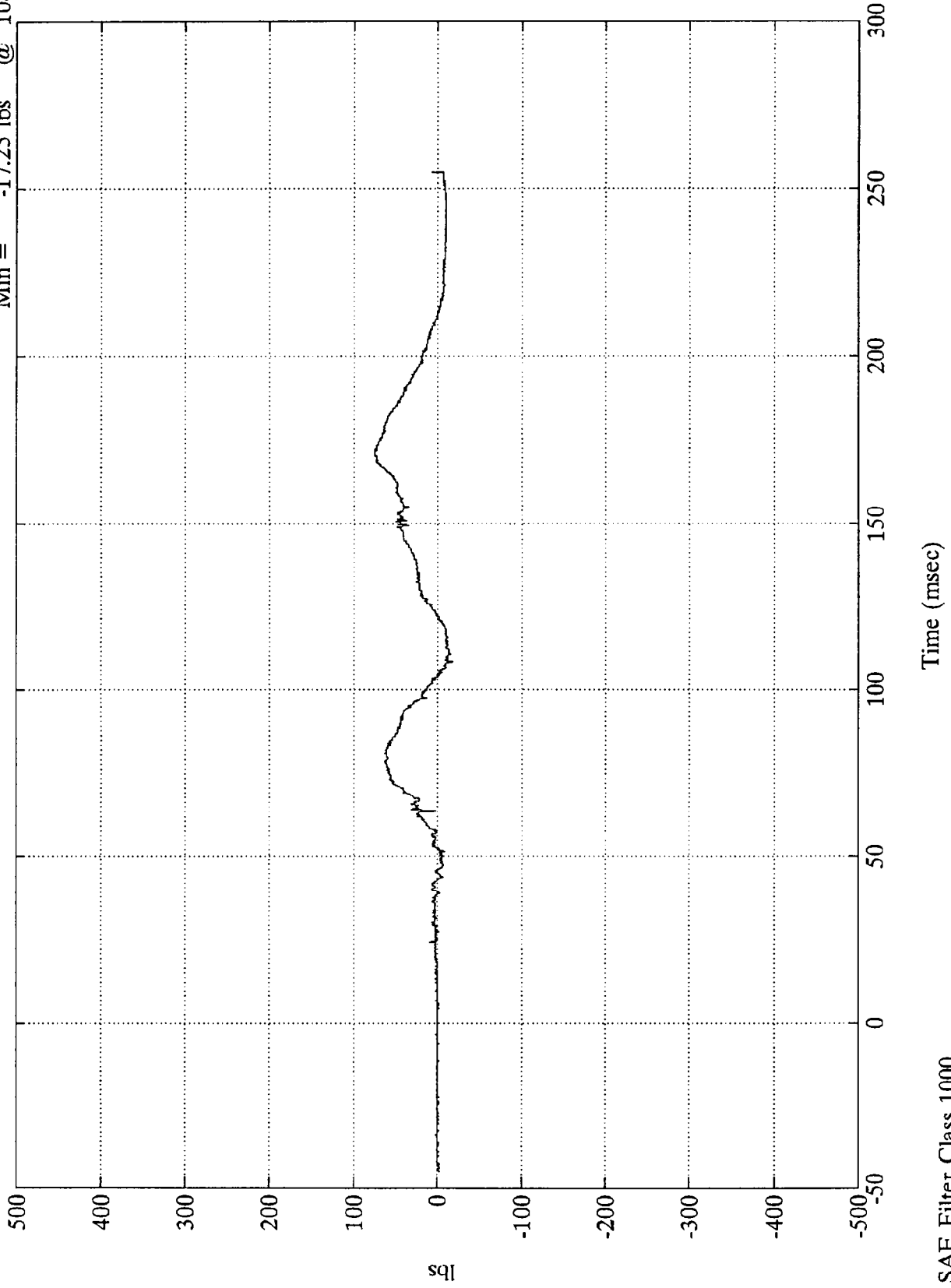
SAE Filter Class 1000

Time (msec)

TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 1 Upper Neck Fy

Max = 74.82 lbs @ 172.20 msec
Min = -17.25 lbs @ 108.36 msec



sqi
B-37

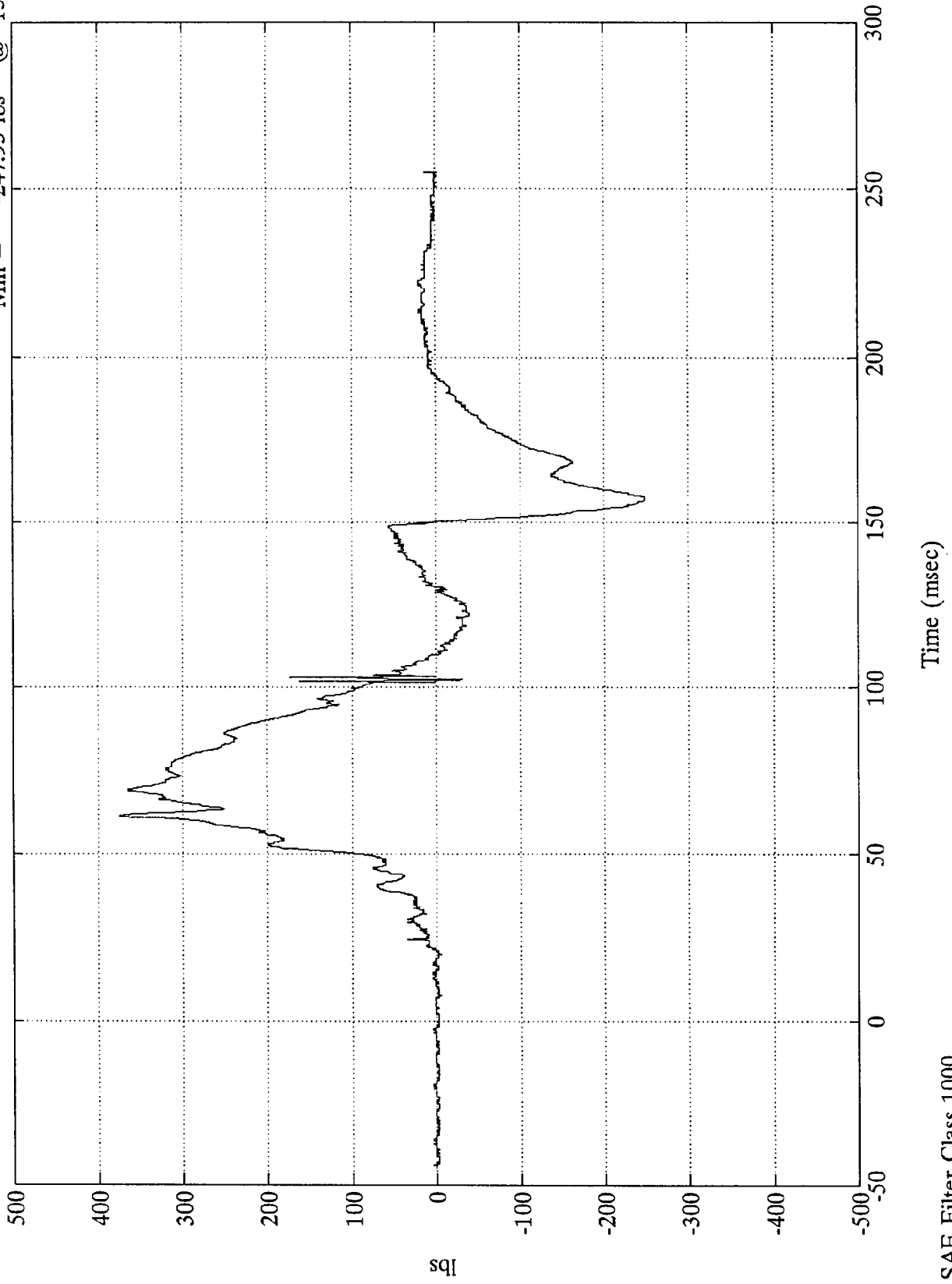
8102-1

SAE Filter Class 1000

TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 1 Upper Neck Fz

Max = 375.40 lbs @ 61.56 msec
Min = -247.93 lbs @ 157.91 msec



sq|
B-38

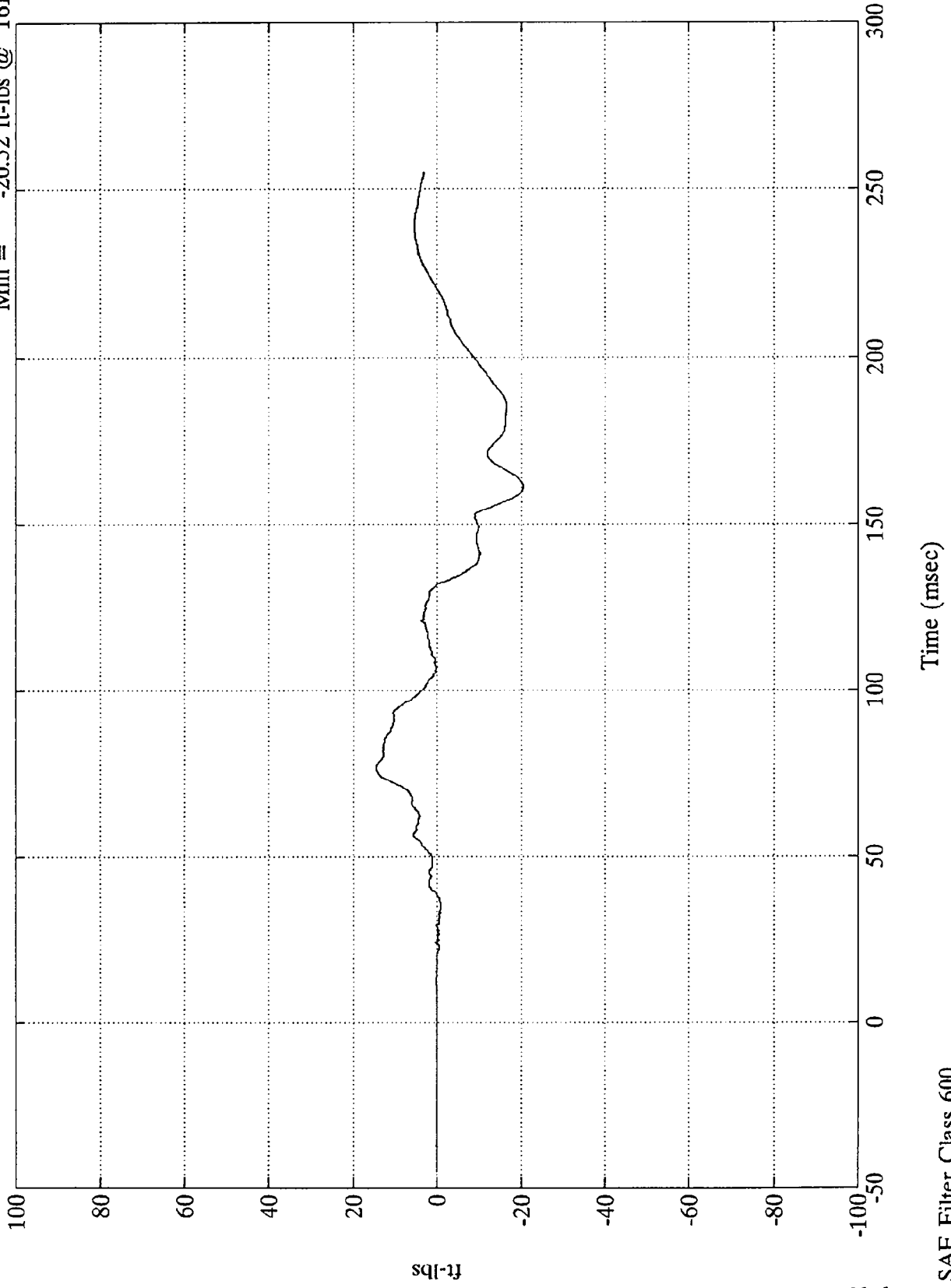
8102-1

SAE Filter Class 1000



TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 1 Upper Neck Mx
Max = 14.60 ft-lbs @ 76.31 msec
Min = -20.52 ft-lbs @ 161.04 msec



sq[-1]
B-39

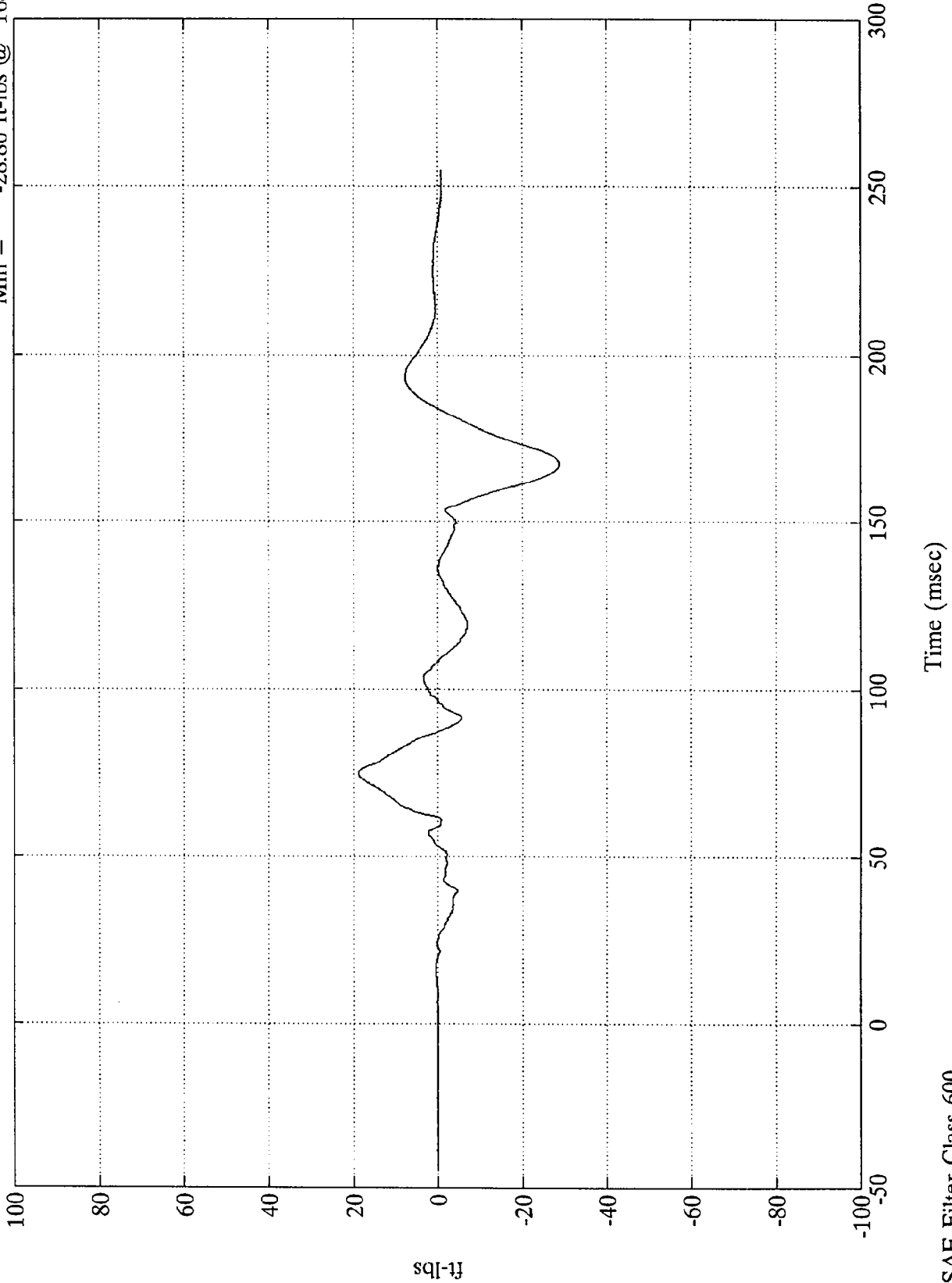
8102-1

SAE Filter Class 600

TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 1 Upper Neck My

Max = 18.87 ft-lbs @ 74.76 msec
Min = -28.80 ft-lbs @ 168.00 msec



sq[-1] lbs
B-40

8102-1

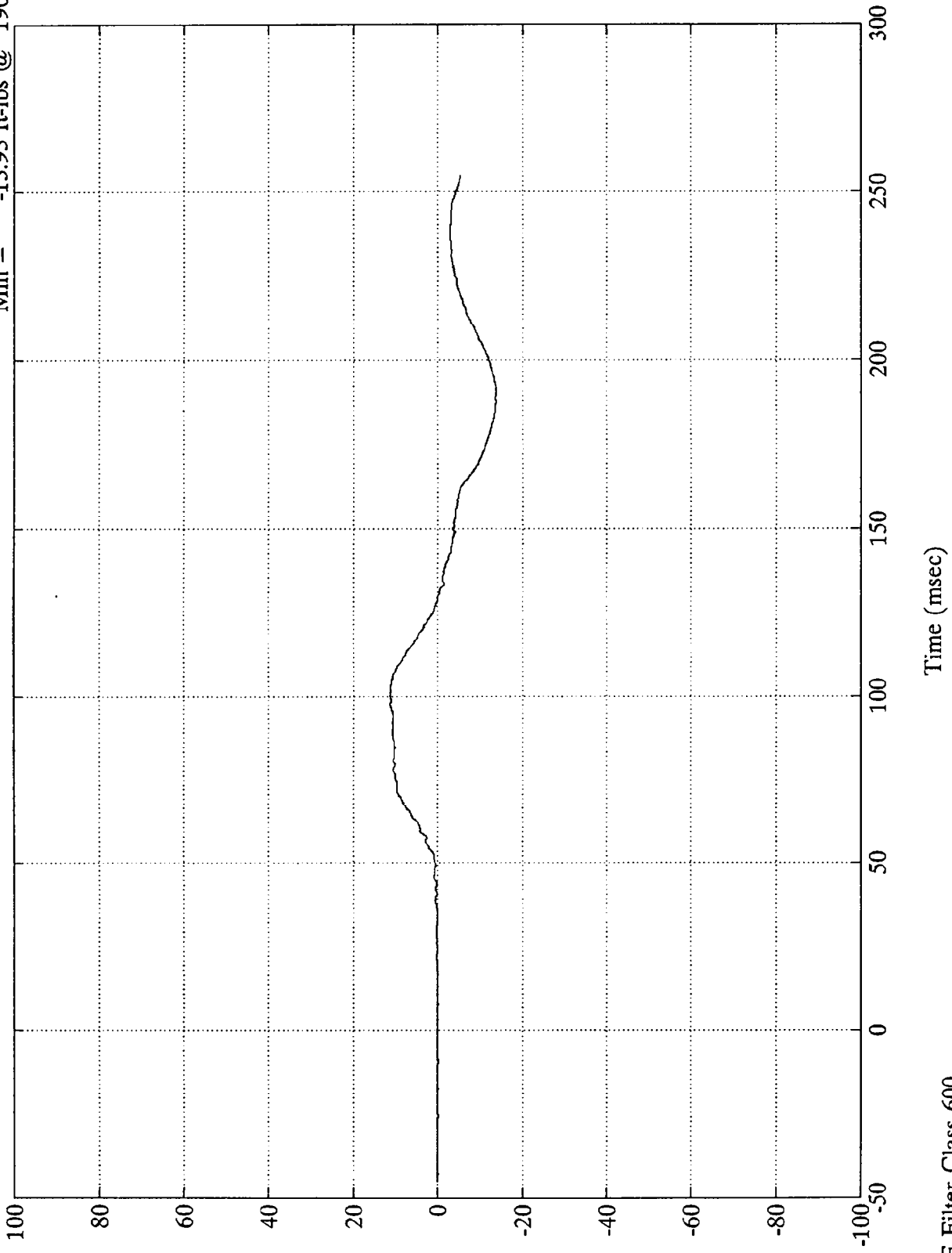
SAE Filter Class 600

Time (msec)

TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 1 Upper Neck Mz

Max = 11.34 ft-lbs @ 97.56 msec
Min = -13.93 ft-lbs @ 190.68 msec



sqf-lj
B-41

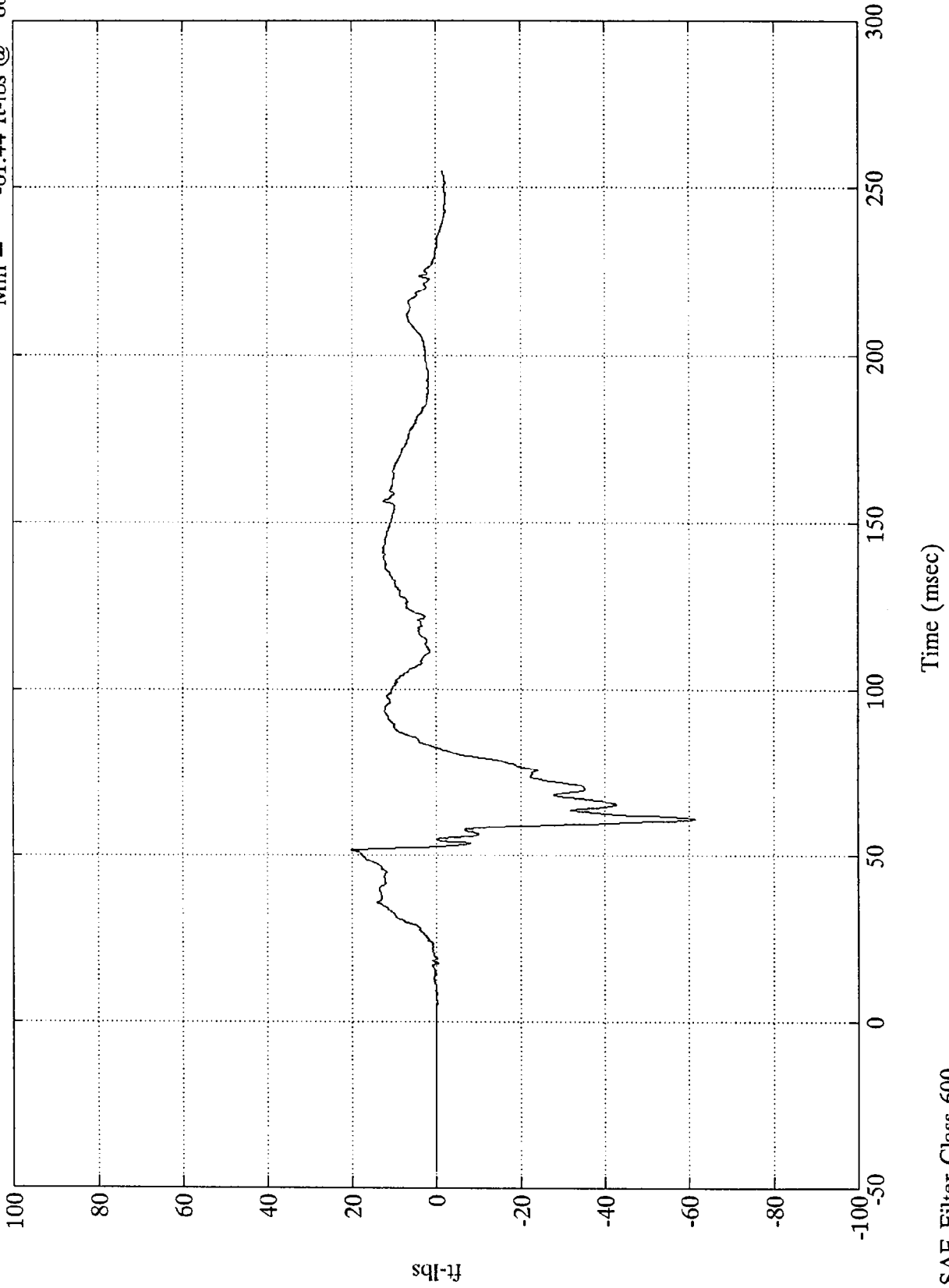
8102-1

SAE Filter Class 600

TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 1 Lt Upper Tibia Mx

Max = 20.44 ft-lbs @ 51.60 msec
Min = -61.44 ft-lbs @ 60.84 msec



B-42

8102-1

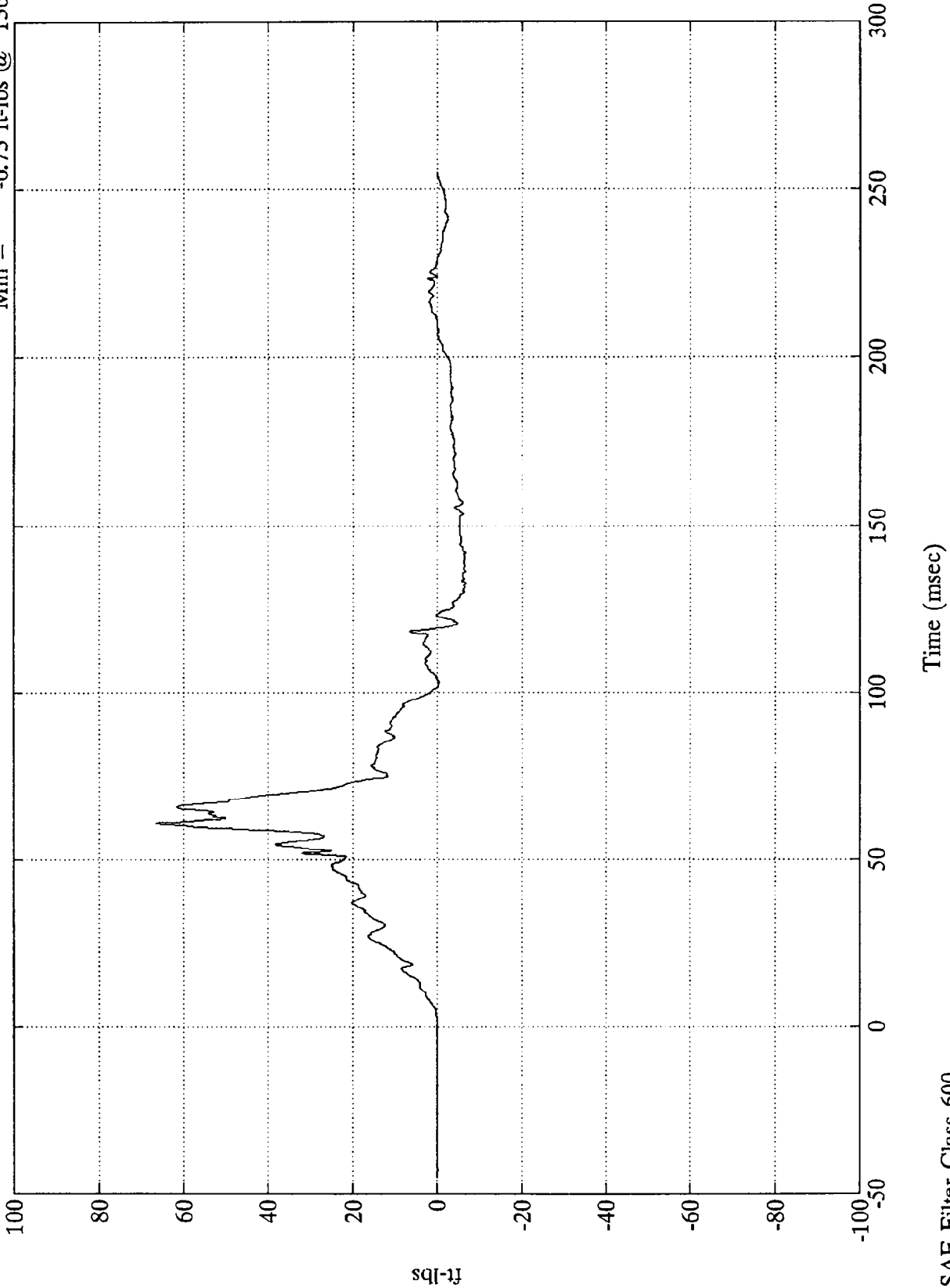
SAE Filter Class 600



TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 1 Lt Upper Tibia My

Max = 66.38 ft-lbs @ 60.84 msec
Min = -6.73 ft-lbs @ 136.44 msec



sqi-1j
B-43

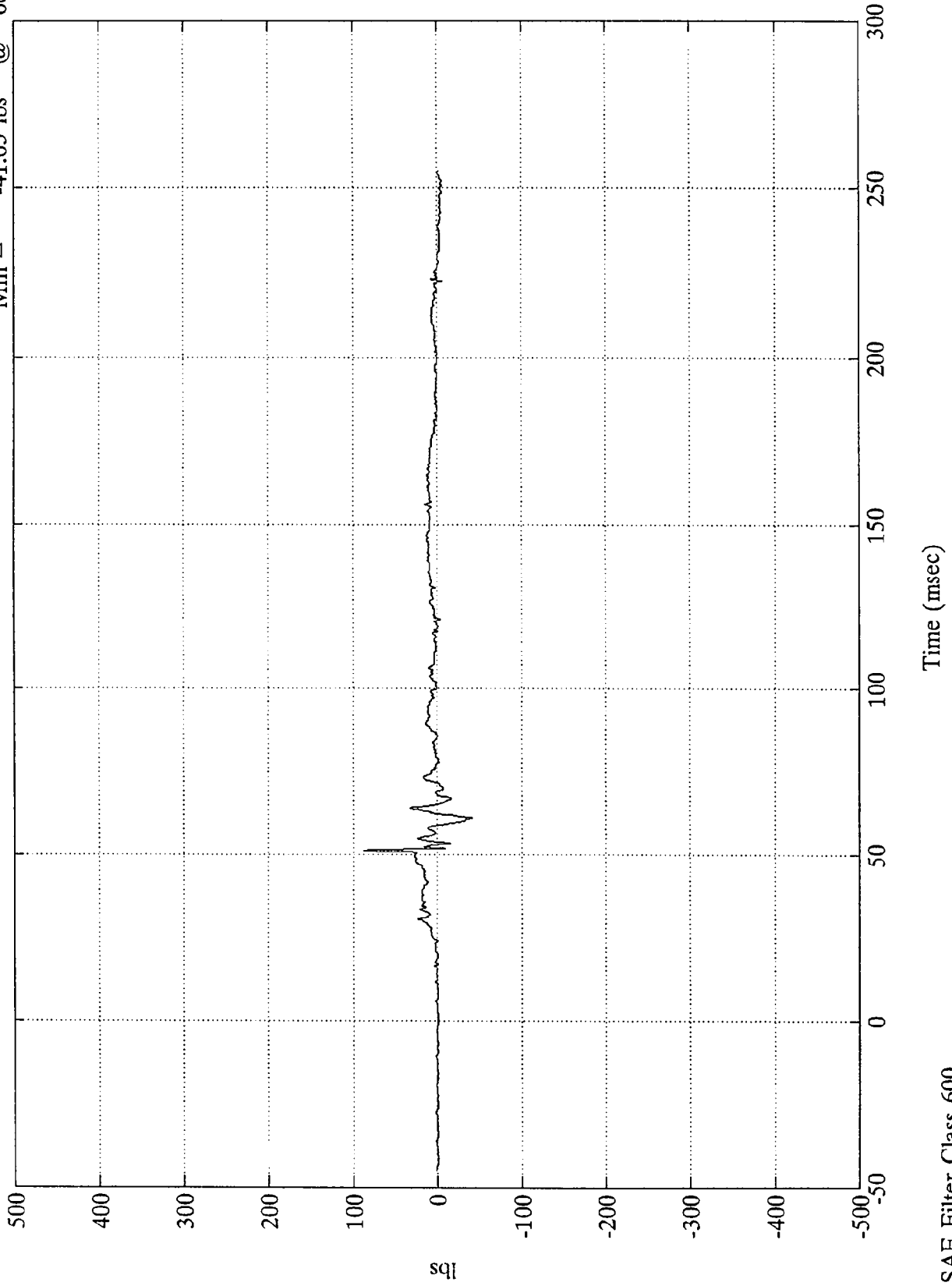
8102-1

SAE Filter Class 600

TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 1 Lt Lower Tibia Fy

Max = 87.31 lbs @ 51.24 msec
Min = -41.63 lbs @ 60.96 msec



sq|
B-44

8102-1

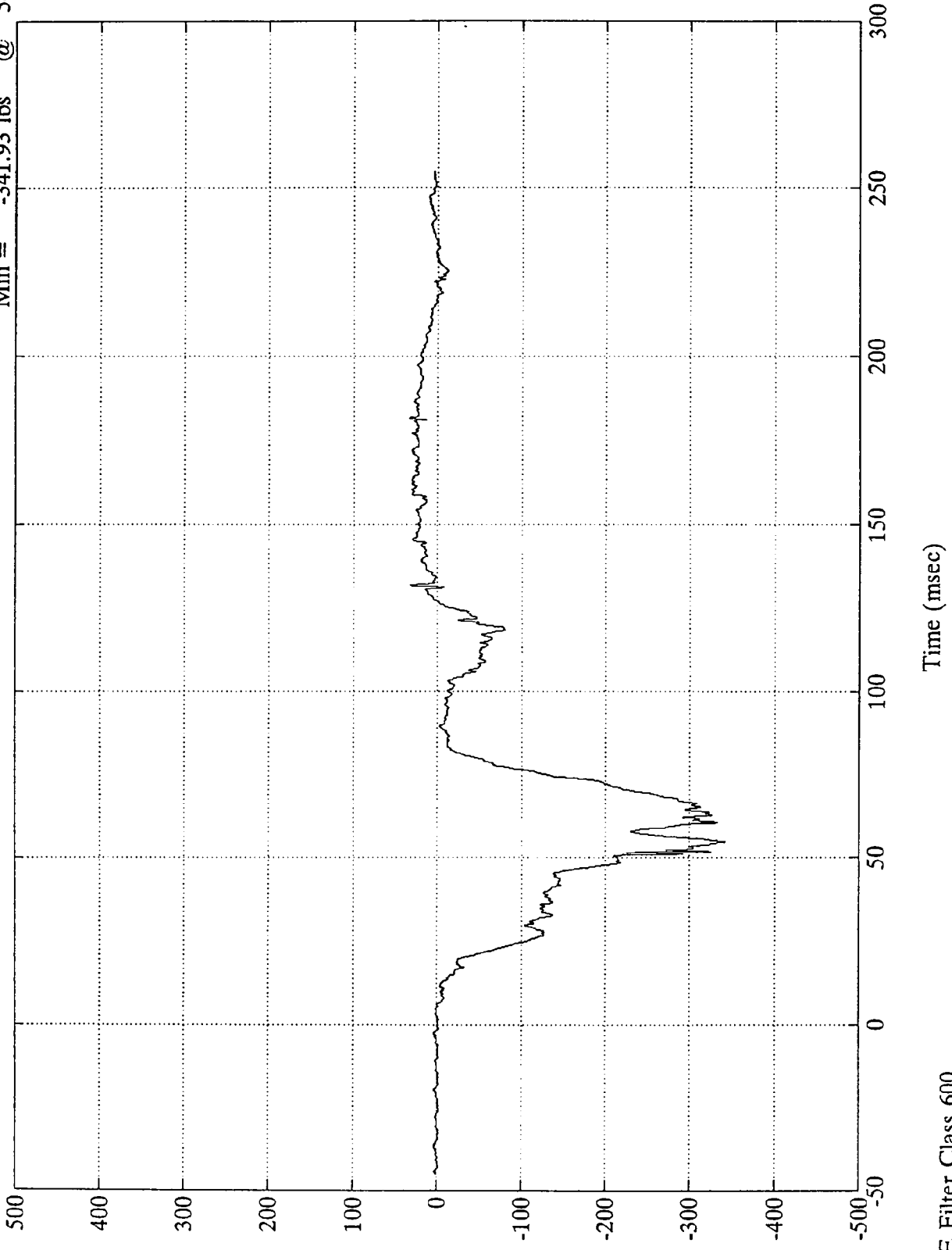
SAE Filter Class 600



TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 1 Lt Lower Tibia Fz

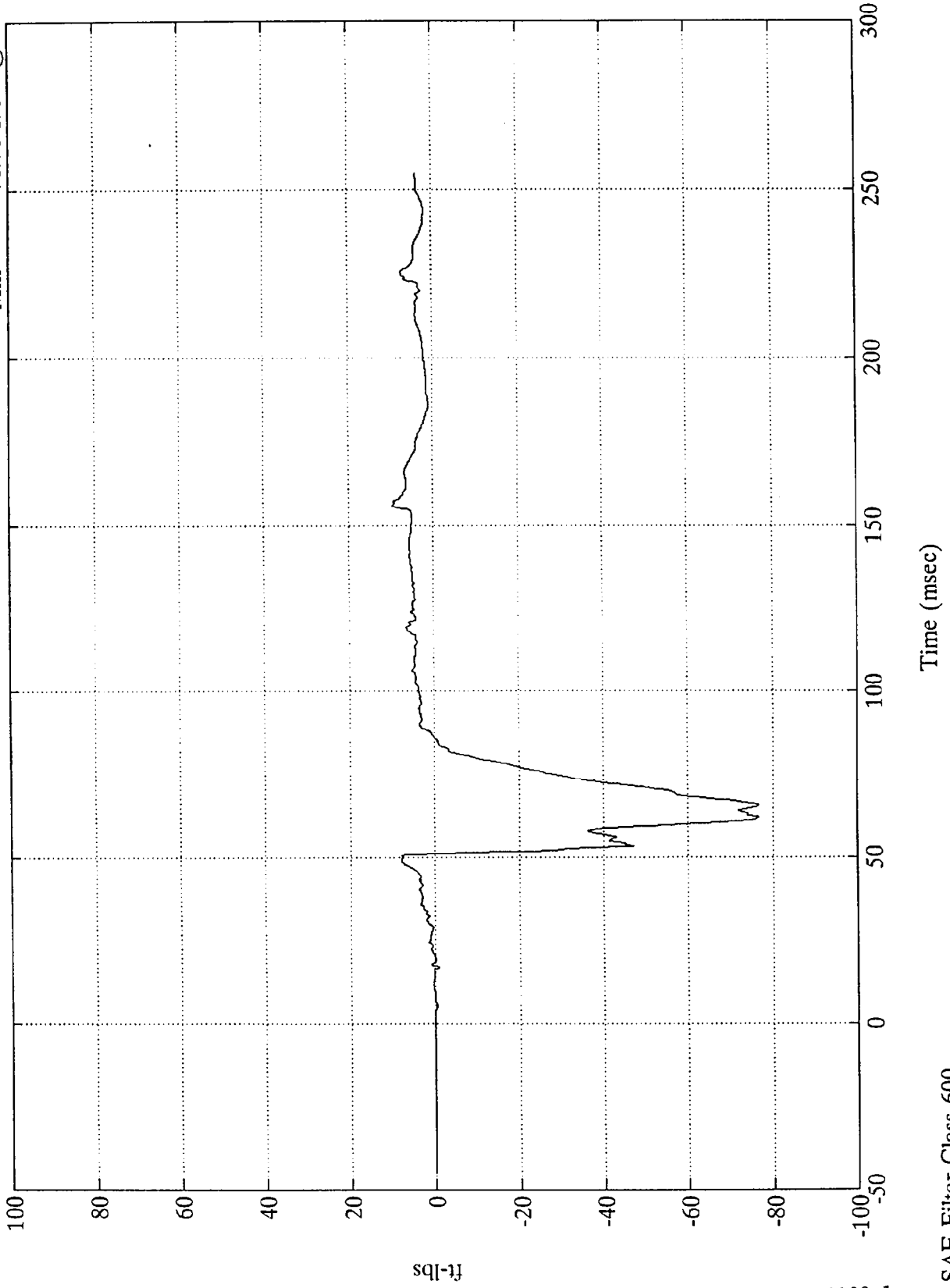
Max = 34.20 lbs @ 181.80 msec
Min = -341.93 lbs @ 54.72 msec



TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 1 Lt Lower Tibia Mx

Max = 9.73 ft-lbs @ 155.88 msec
Min = -76.76 ft-lbs @ 65.63 msec



B-46

8102-1

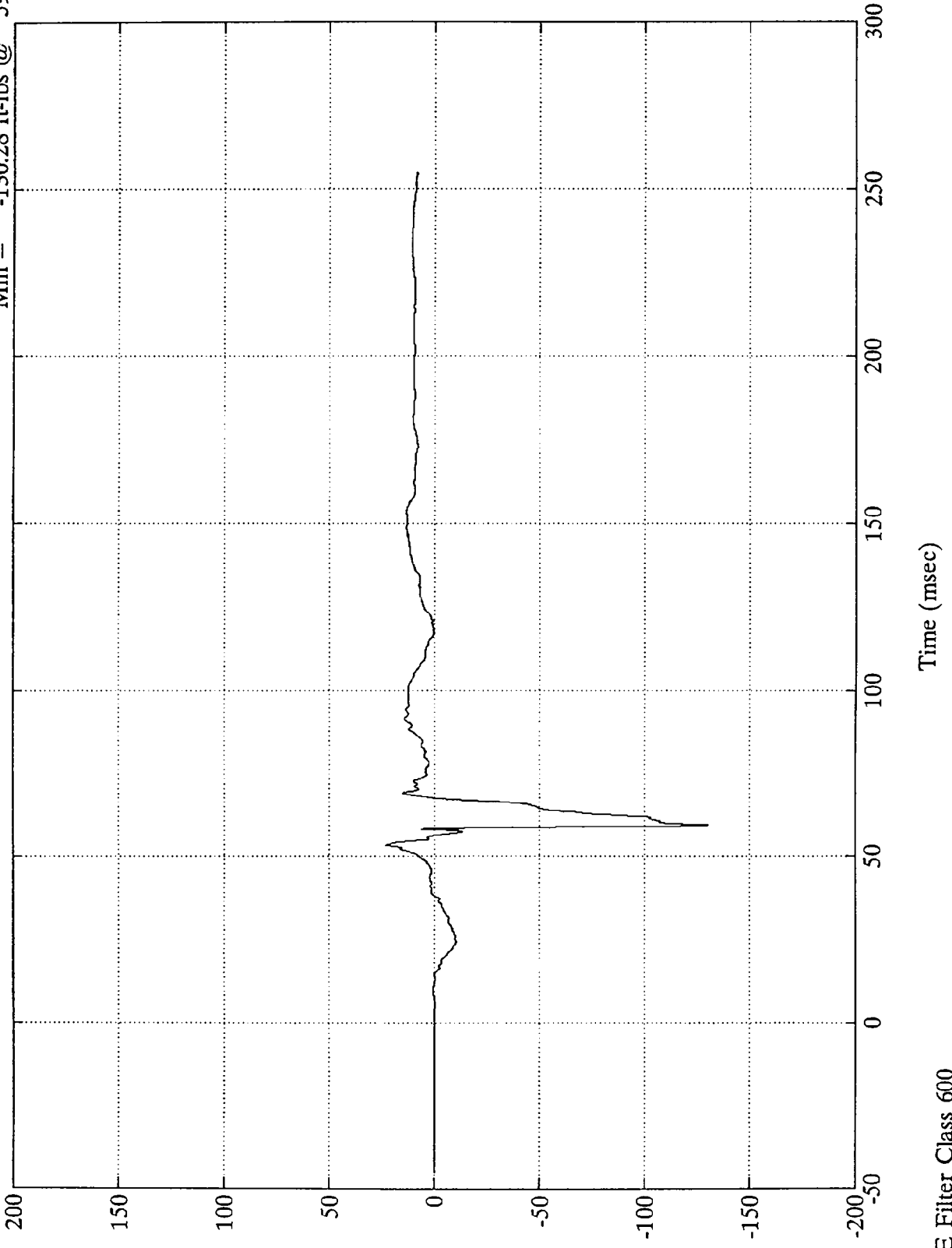
SAE Filter Class 600



TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 1 Rt Upper Tibia Mx

Max = 23.51 ft-lbs @ 53.27 msec
Min = -130.28 ft-lbs @ 59.27 msec



B-47

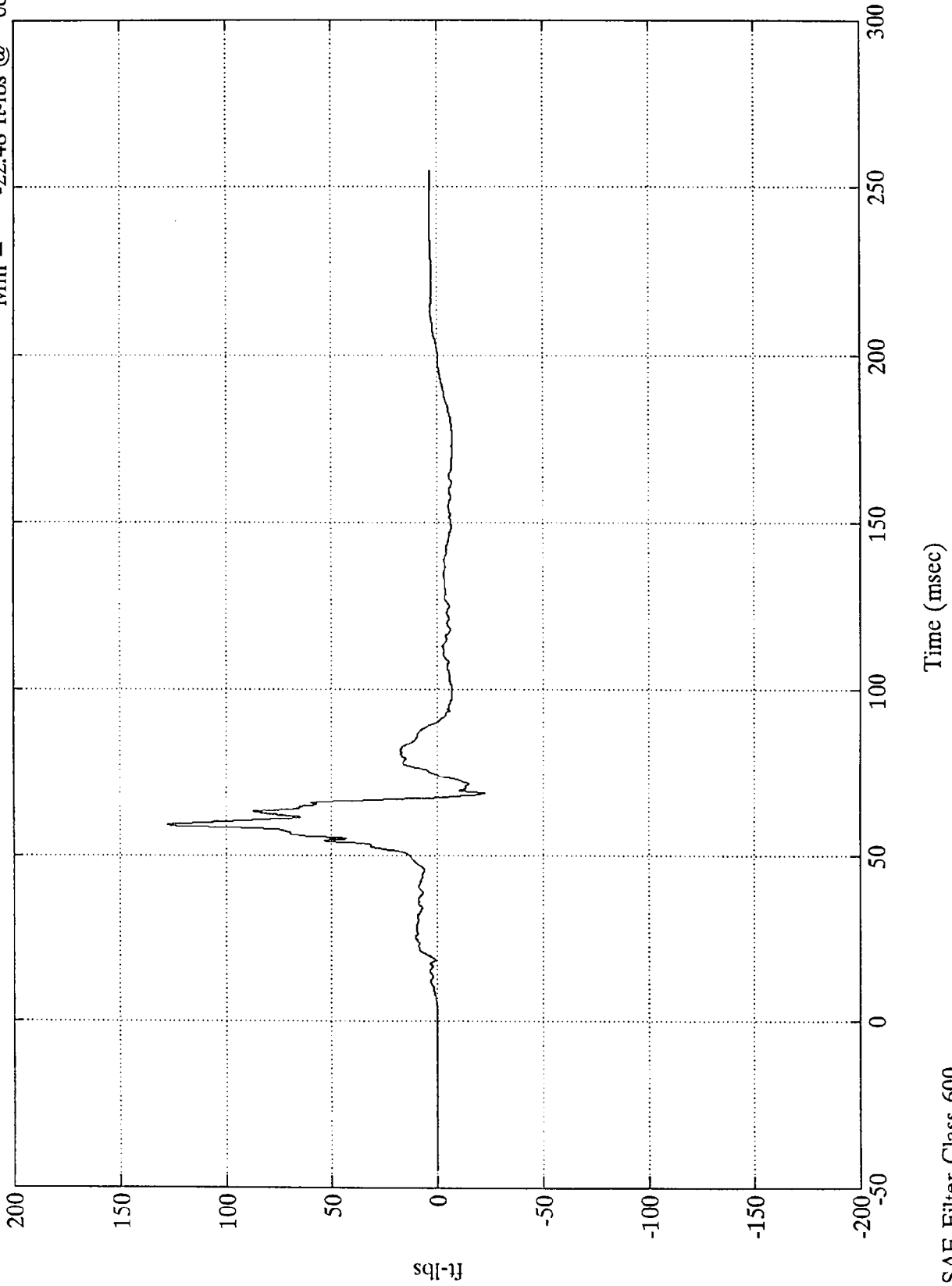
8102-1

SAE Filter Class 600

TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 1 Rt Upper Tibia My

Max = 127.65 ft-lbs @ 59.40 msec
Min = -22.48 ft-lbs @ 68.87 msec

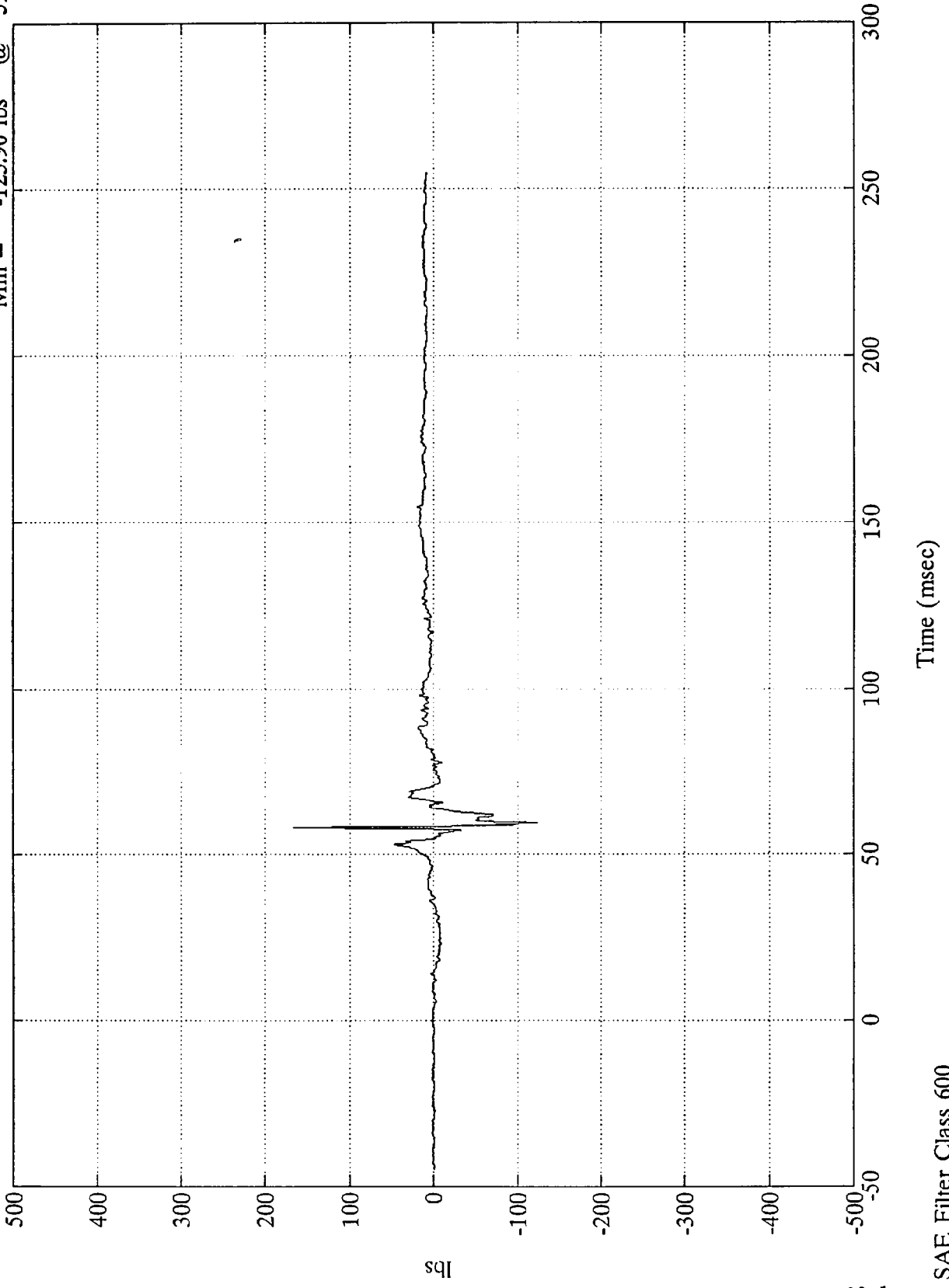


SAE Filter Class 600

TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 1 Rt Lower Tibia Fy

Max = 166.80 lbs @ 57.95 msec
Min = -123.90 lbs @ 59.40 msec



sqi
B-49

8102-1

SAE Filter Class 600

TSC 301 TEST 1 - FRONTAL IMPACT

Max = 47.17 lbs @ 172.32 msec
Min = -1525.44 lbs @ 57.95 msec

Pos. 1 Rt Lower Tibia Fz



sq|
B-50

8102-1

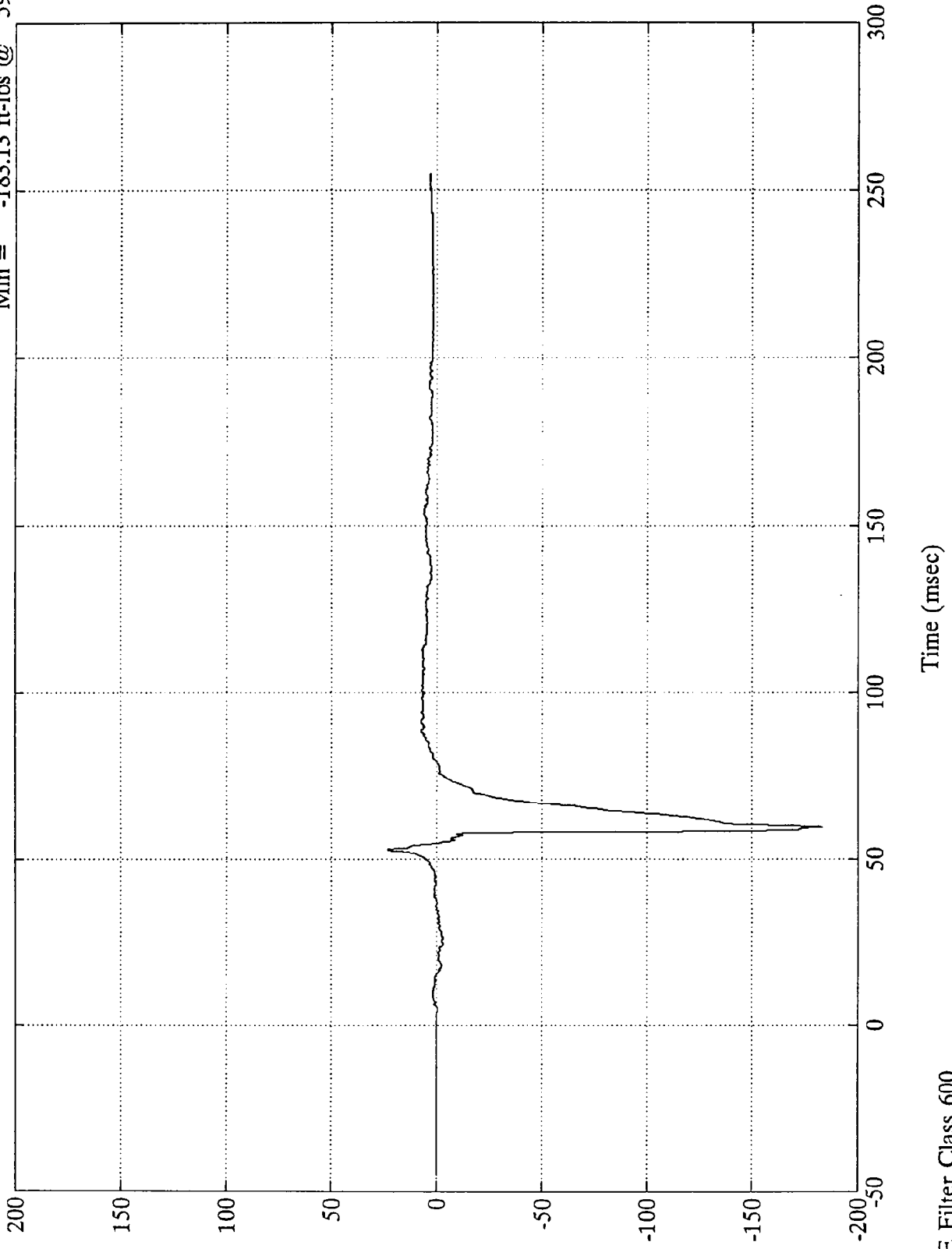
SAE Filter Class 600

Time (msec)

TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 1 Rt Lower Tibia Mx

Max = 23.53 ft-lbs @ 52.68 msec
Min = -183.13 ft-lbs @ 59.52 msec



B-51

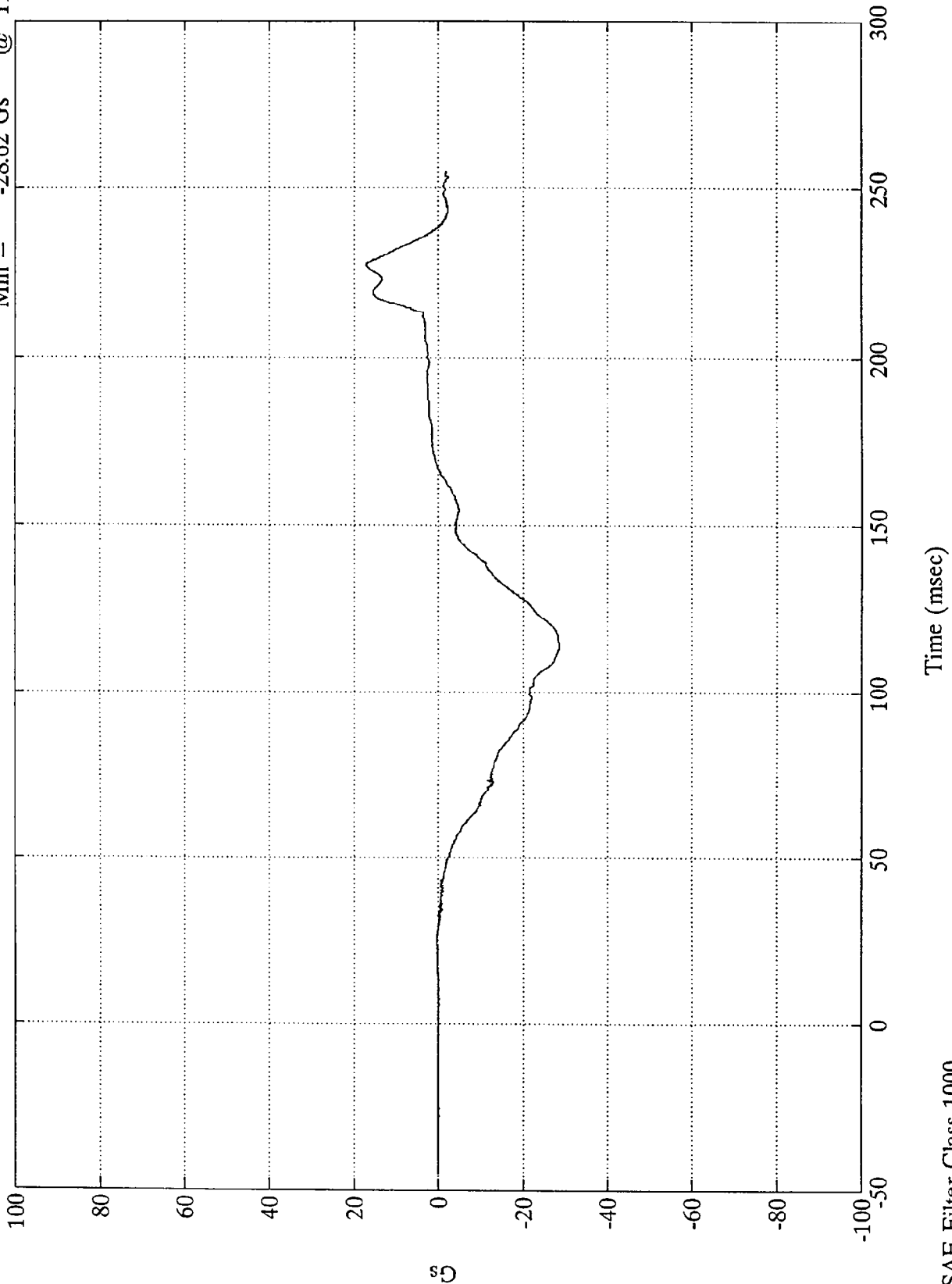
8102-1

SAE Filter Class 600

TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 2 Head X

Max = 17.20 Gs @ 227.40 msec
Min = -28.62 Gs @ 113.40 msec



B-52

8102-1

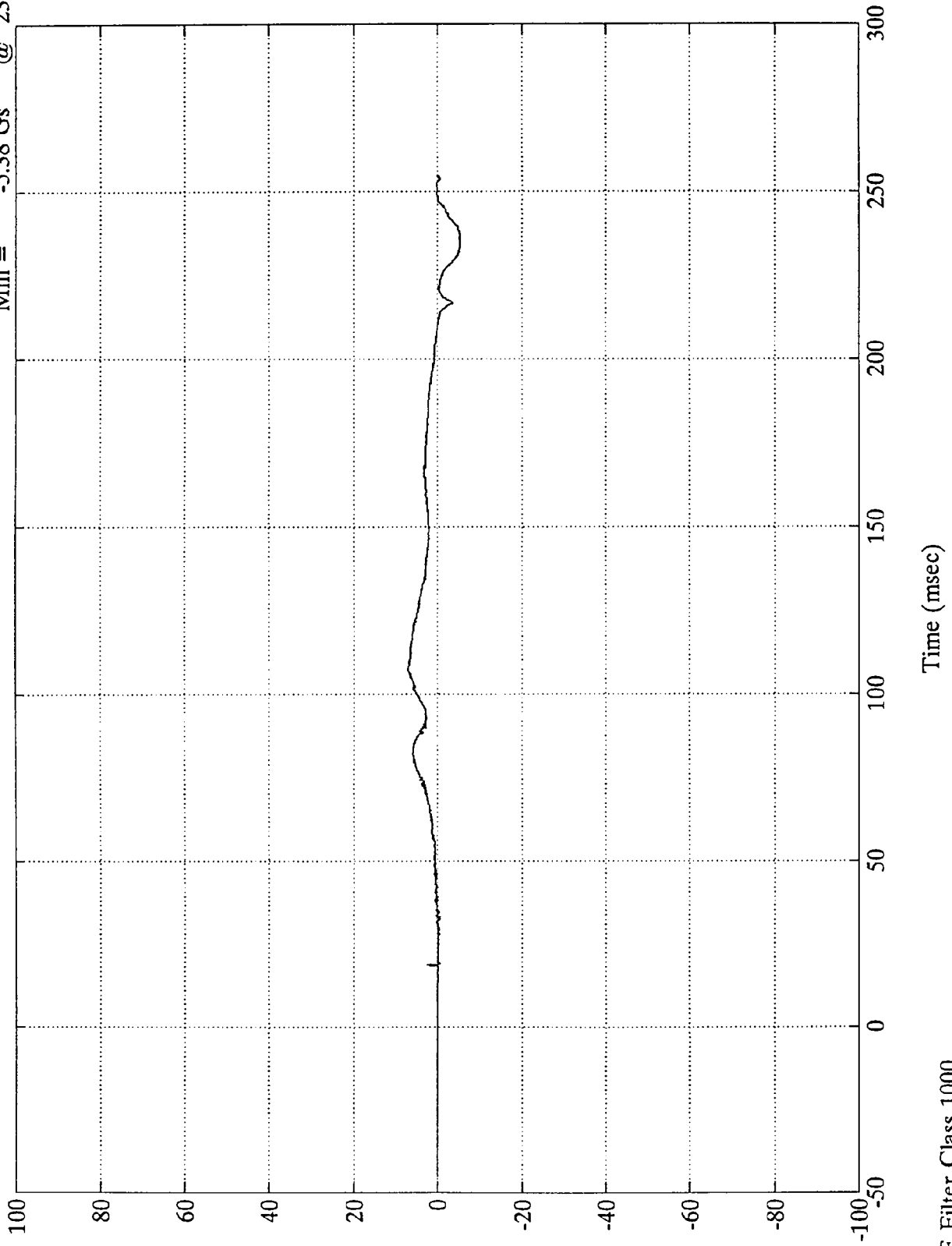
SAE Filter Class 1000



TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 2 Head Y

Max = 7.09 Gs @ 107.51 msec
Min = -5.38 Gs @ 235.08 msec



B-53

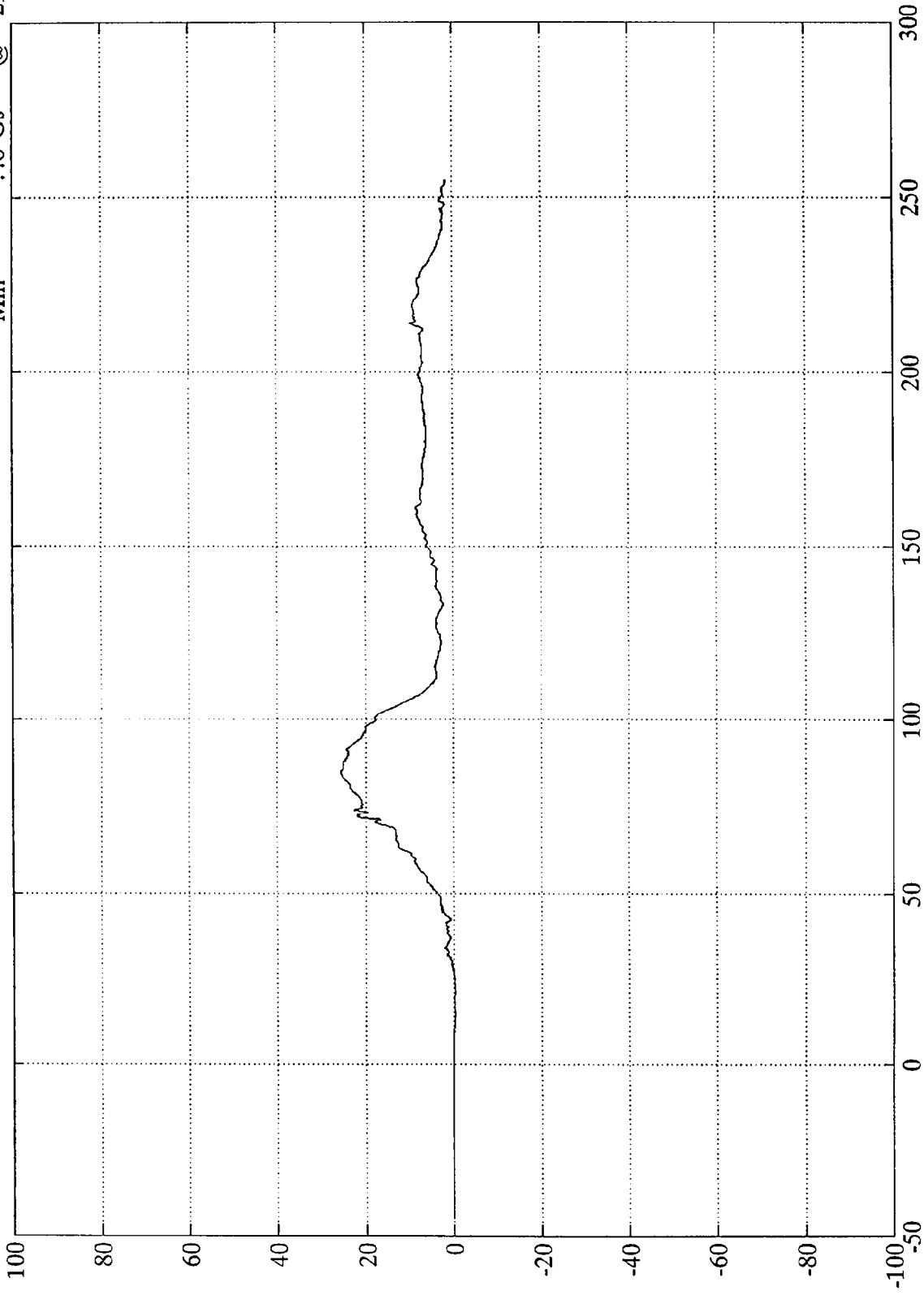
8102-1

SAE Filter Class 1000

TSC 301 TEST 1 - FRONTAL IMPACT

Max = 25.58 Gs @ 84.48 msec
Min = -46 Gs @ 21.00 msec

Pos. 2 Head Z



Time (msec)

SAE Filter Class 1000

59

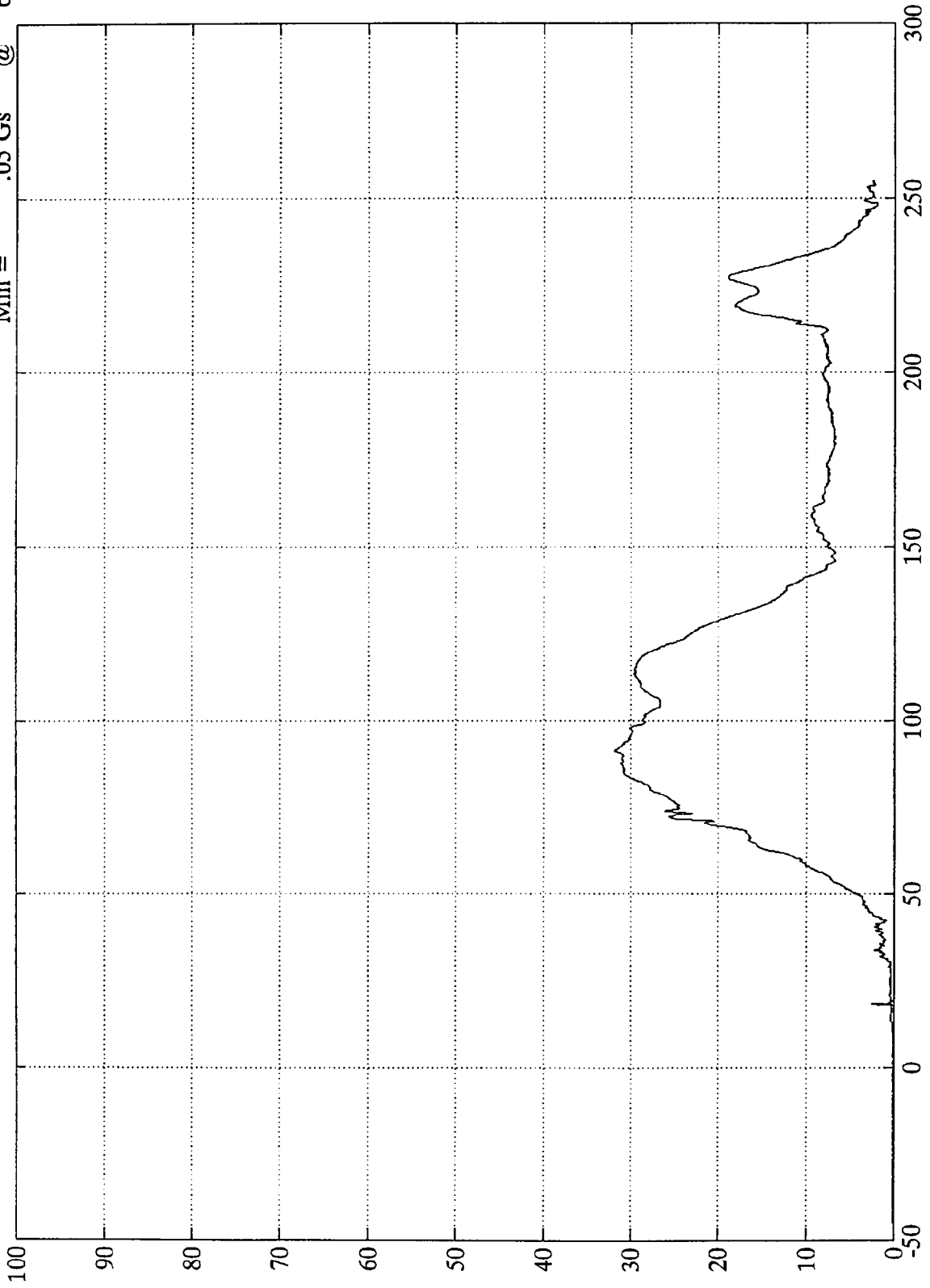
B-54

8102-1

TSC 301 TEST 1 - FRONTAL IMPACT

Max = 31.77 Gs @ 91.20 msec
Min = .05 Gs @ 6.83 msec

Pos. 2 Head Resultant



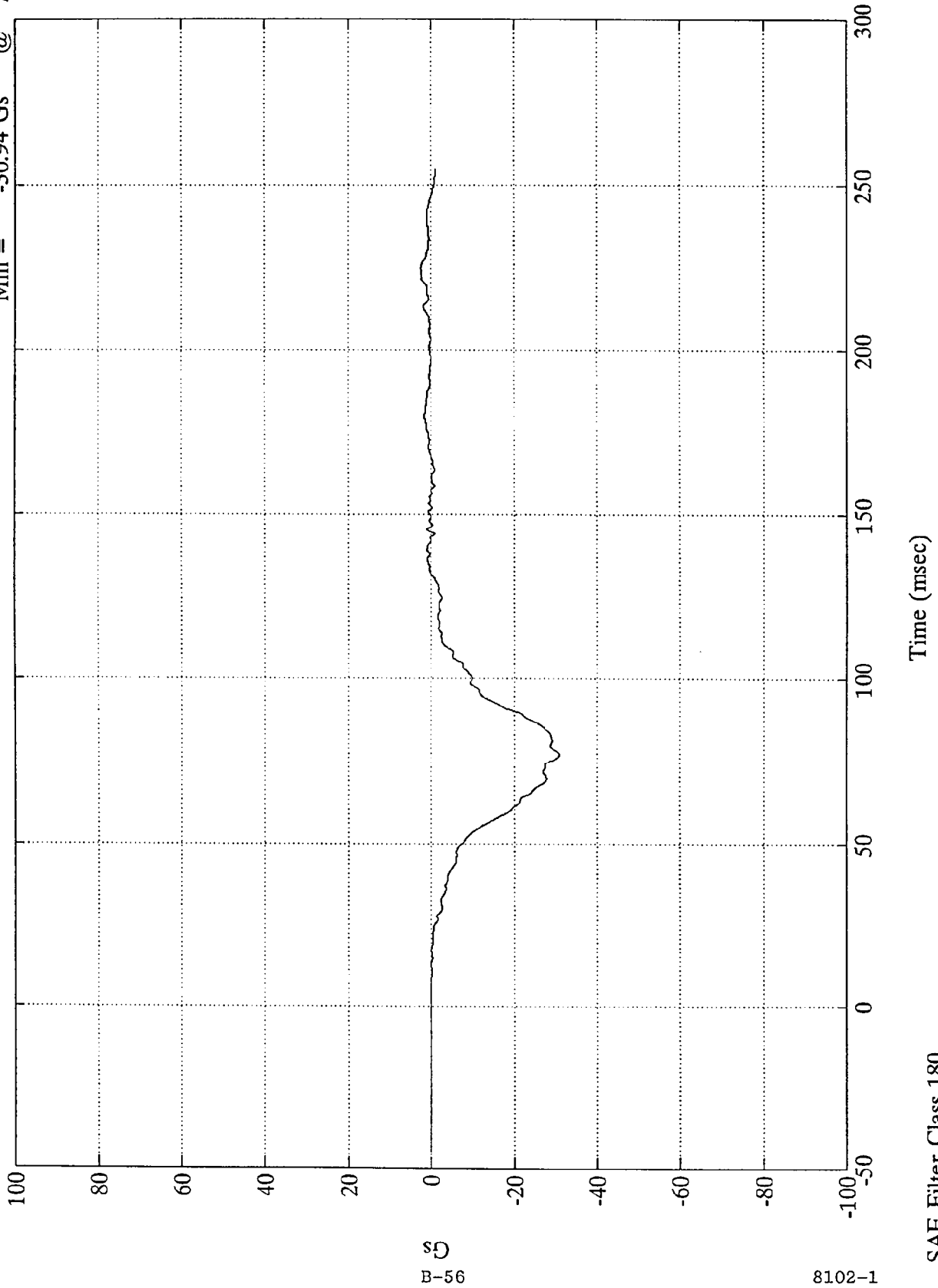
Time (msec)

SAE Filter Class 1000

TSC 301 TEST 1 - FRONTAL IMPACT

Max = 2.39 Gs @ 225.12 msec
Min = -30.94 Gs @ 77.27 msec

Pos. 2 Chest X



8D
B-56

8102-1

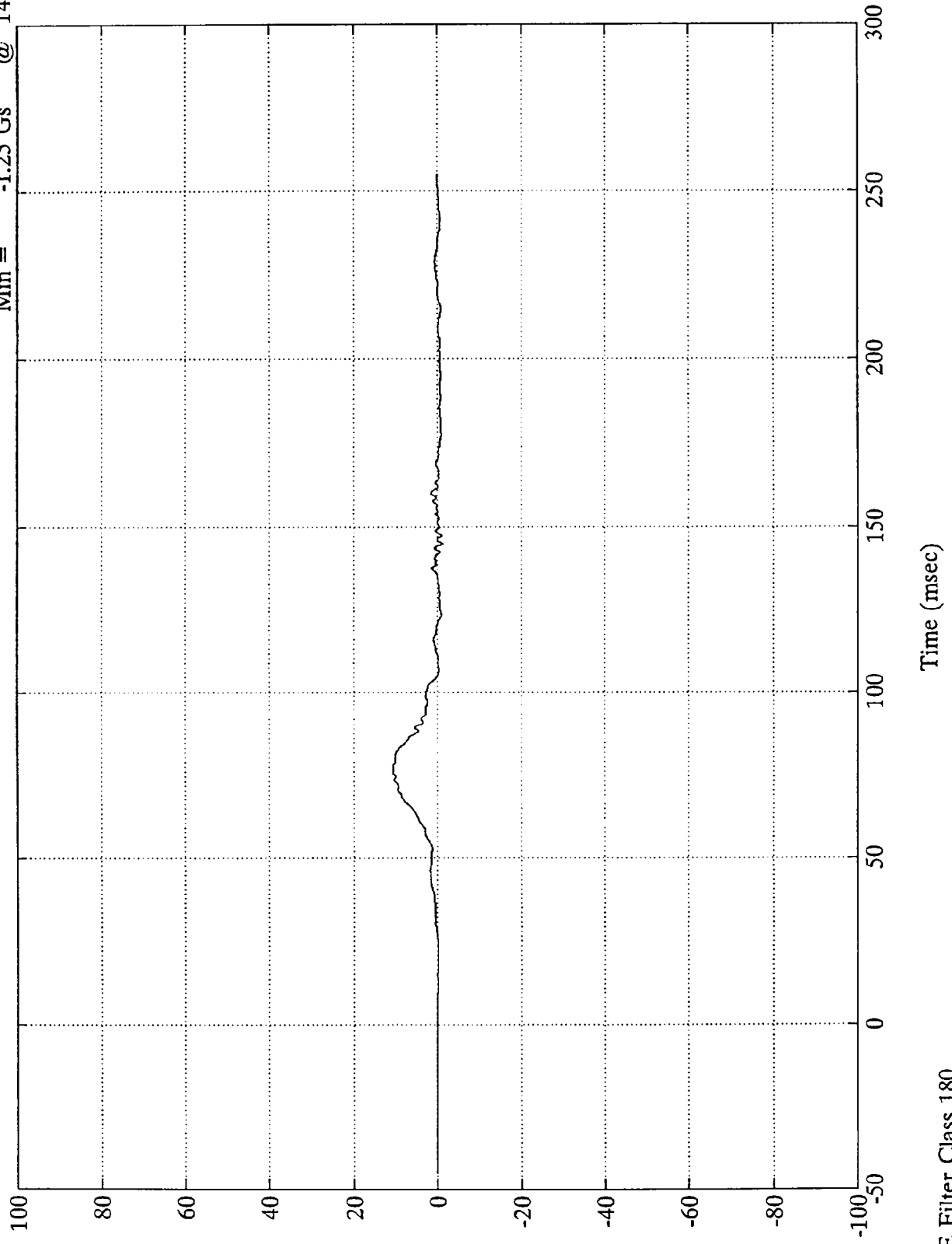
SAE Filter Class 180



TSC 301 TEST 1 - FRONTAL IMPACT

Max = 10.64 Gs @ 77.88 msec
Min = -1.25 Gs @ 144.83 msec

Pos. 2 Chest Y



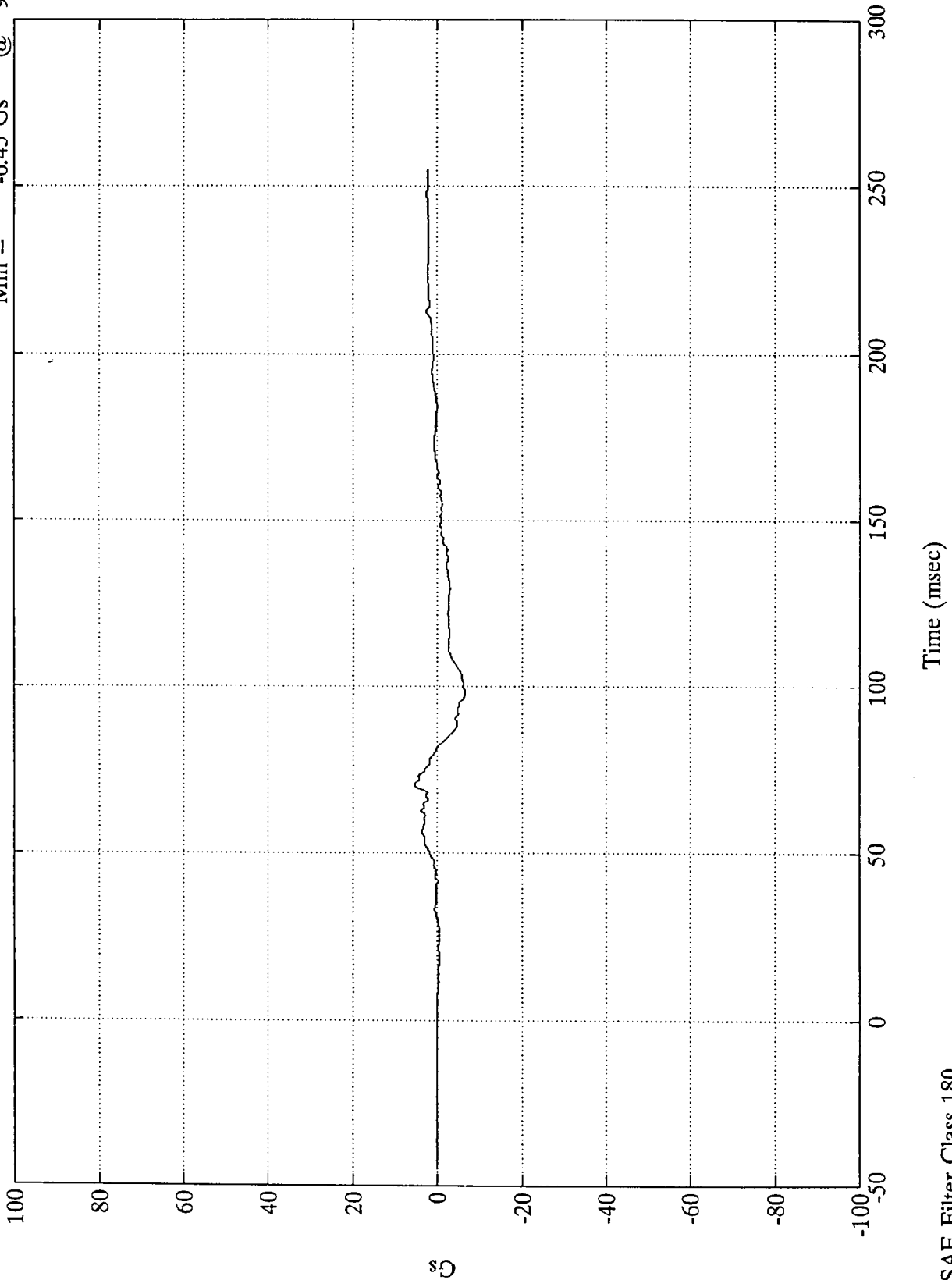
8102-1
B-57

SAE Filter Class 180

TSC 301 TEST 1 - FRONTAL IMPACT

Max = 5.47 Gs @ 70.20 msec
Min = -6.45 Gs @ 98.40 msec

Pos. 2 Chest Z



8102-1
B-58

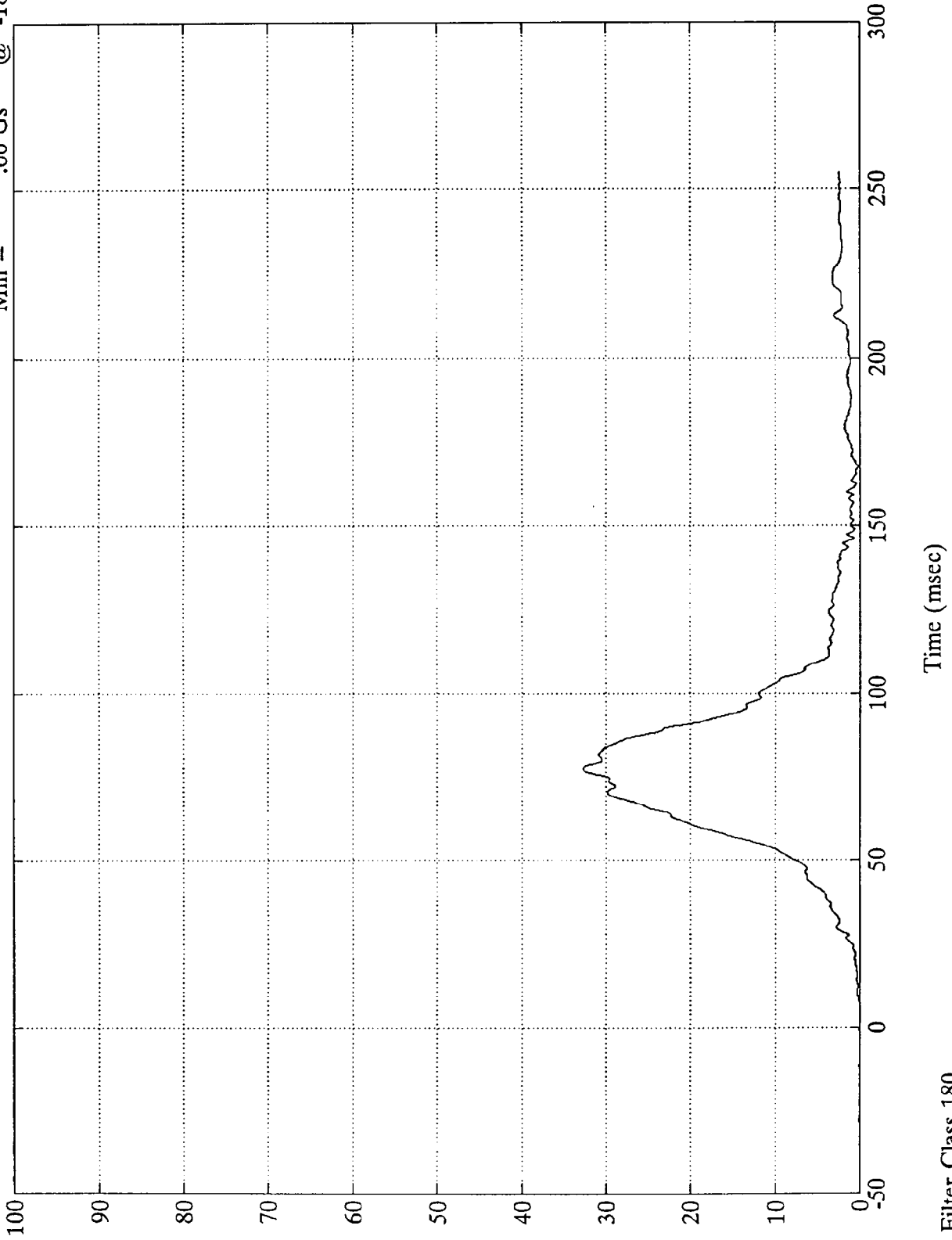
SAE Filter Class 180

Time (msec)

TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 2 Chest Resultant

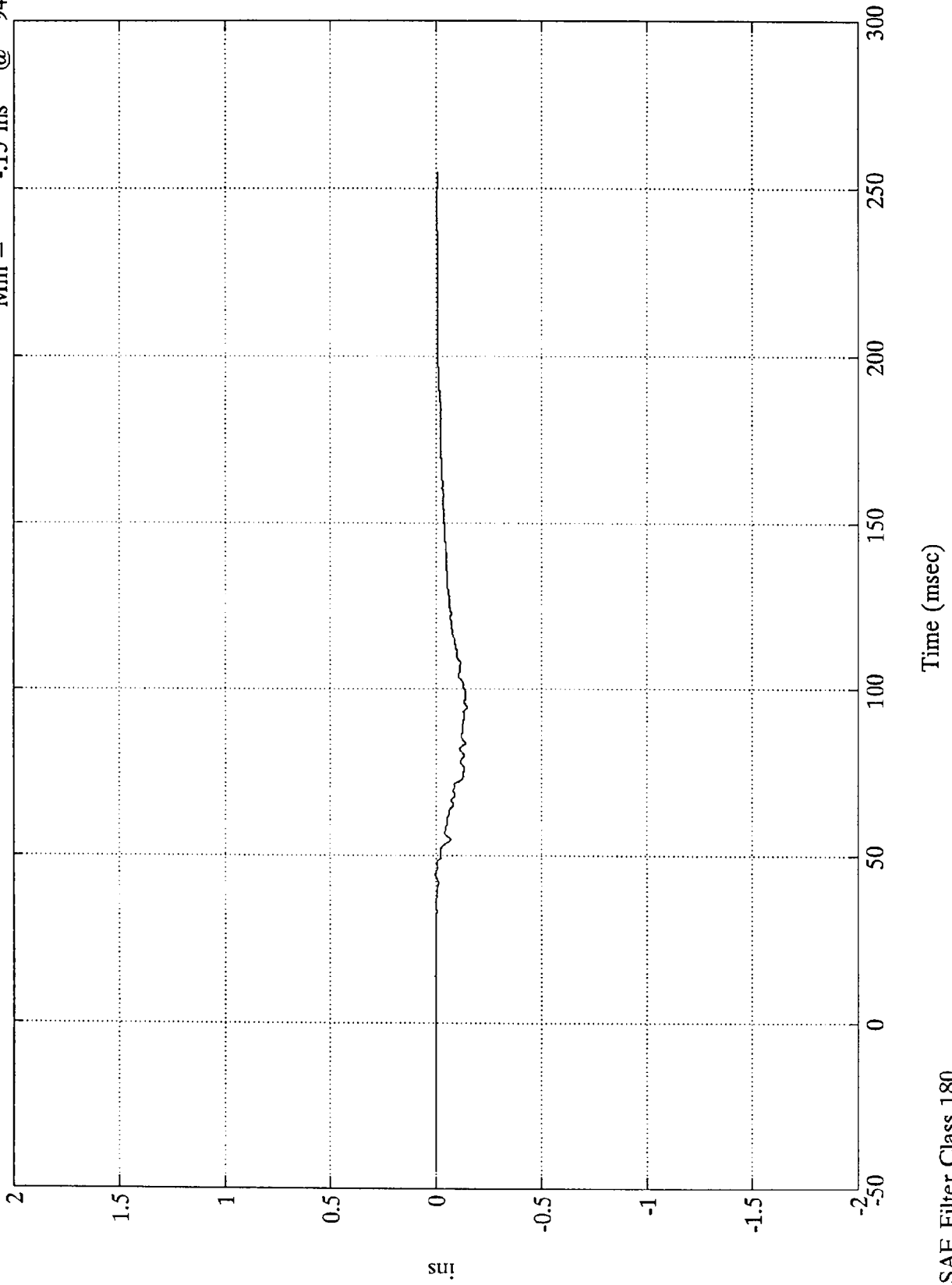
Max = 32.71 Gs @ 77.27 msec
Min = .00 Gs @ -18.84 msec



TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 2 Chest Deflection

Max = .00 ins @ 44.39 msec
Min = -.15 ins @ 94.31 msec



in
B-60

8102-1

SAE Filter Class 180

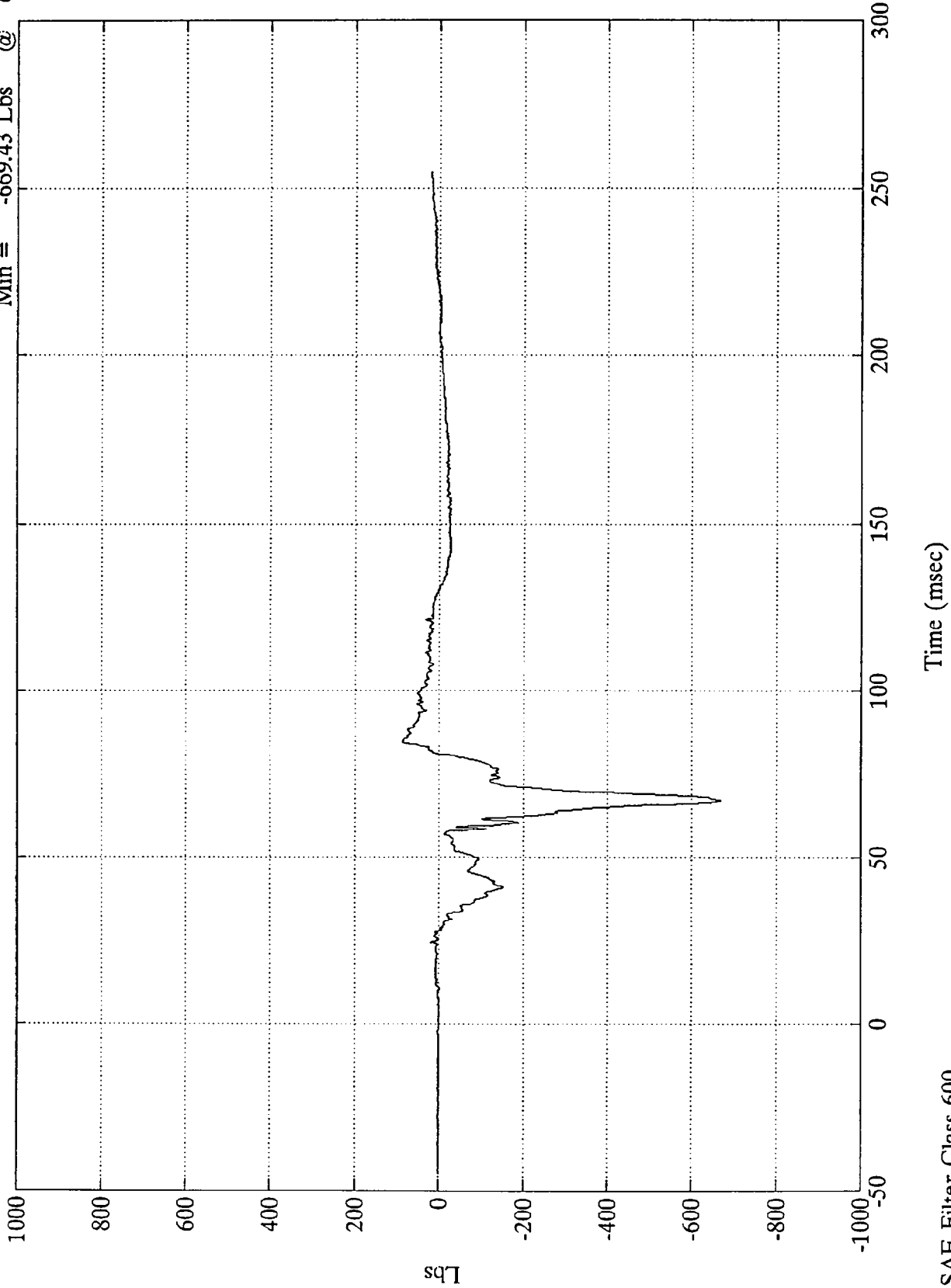
Time (msec)

TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 2 Left Femur

Max = 88.12 Lbs @
Min = -669.43 Lbs @

84.36 msec
67.19 msec



B-61

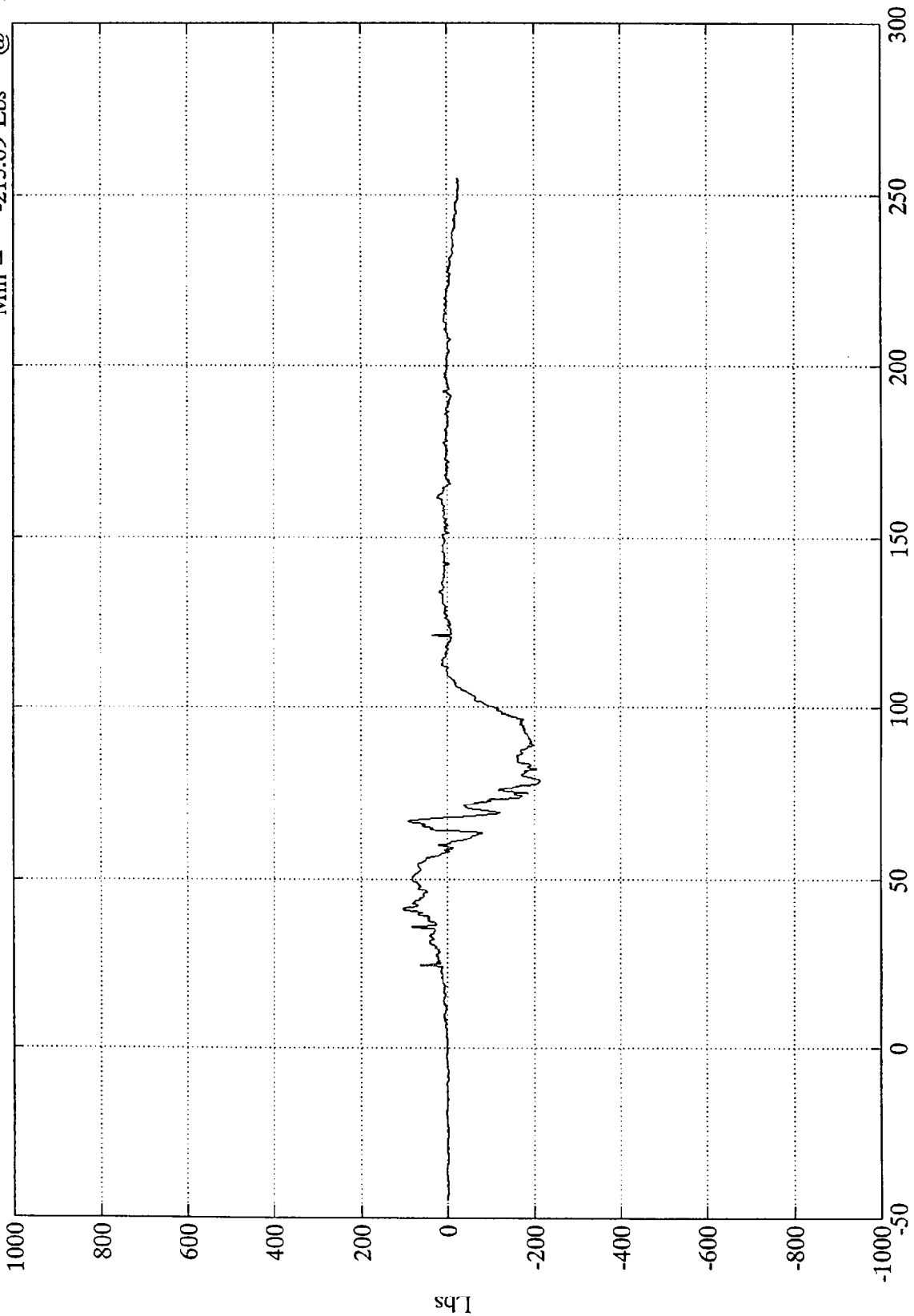
8102-1

SAE Filter Class 600

TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 2 Right Femur

Max = 102.90 Lbs @ 40.92 msec
Min = -215.09 Lbs @ 78.84 msec



B-62

8102-1

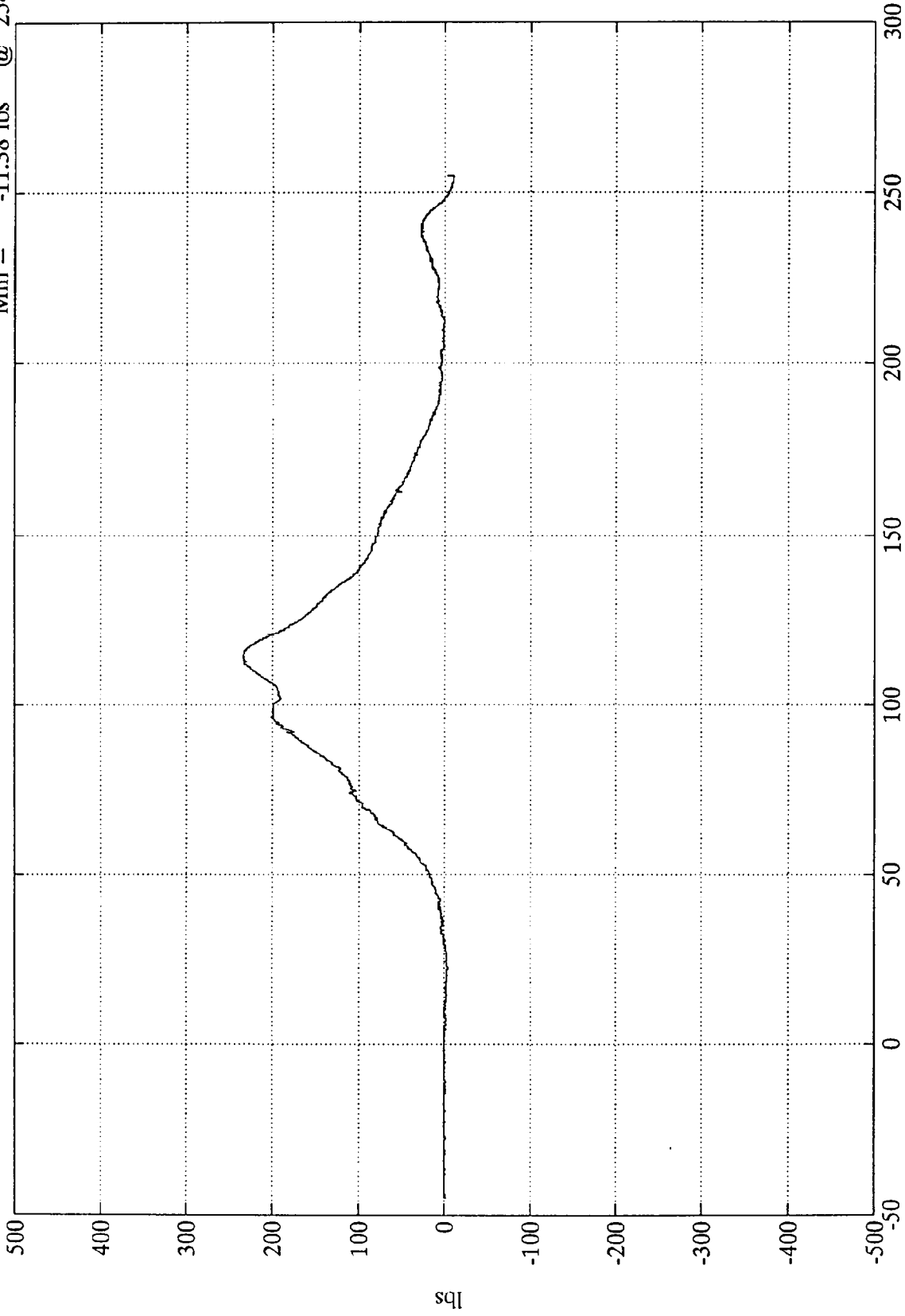
SAE Filter Class 600

Time (msec)

TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 2 Upper Neck Fx

Max = 235.58 lbs @ 114.48 msec
Min = -11.38 lbs @ 254.64 msec

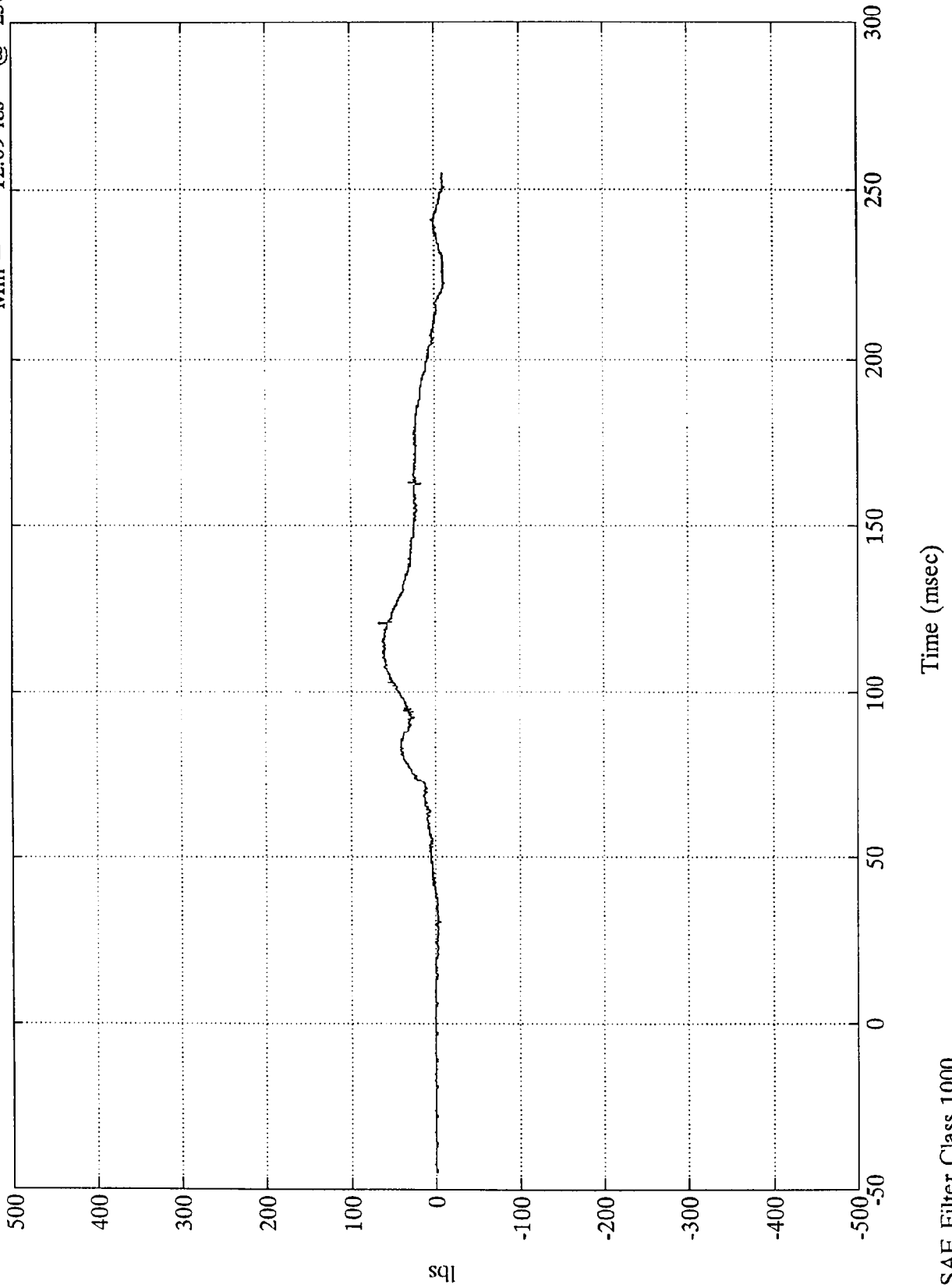


Time (msec)

SAE Filter Class 1000

TSC 301 TEST 1 - FRONTAL IMPACT

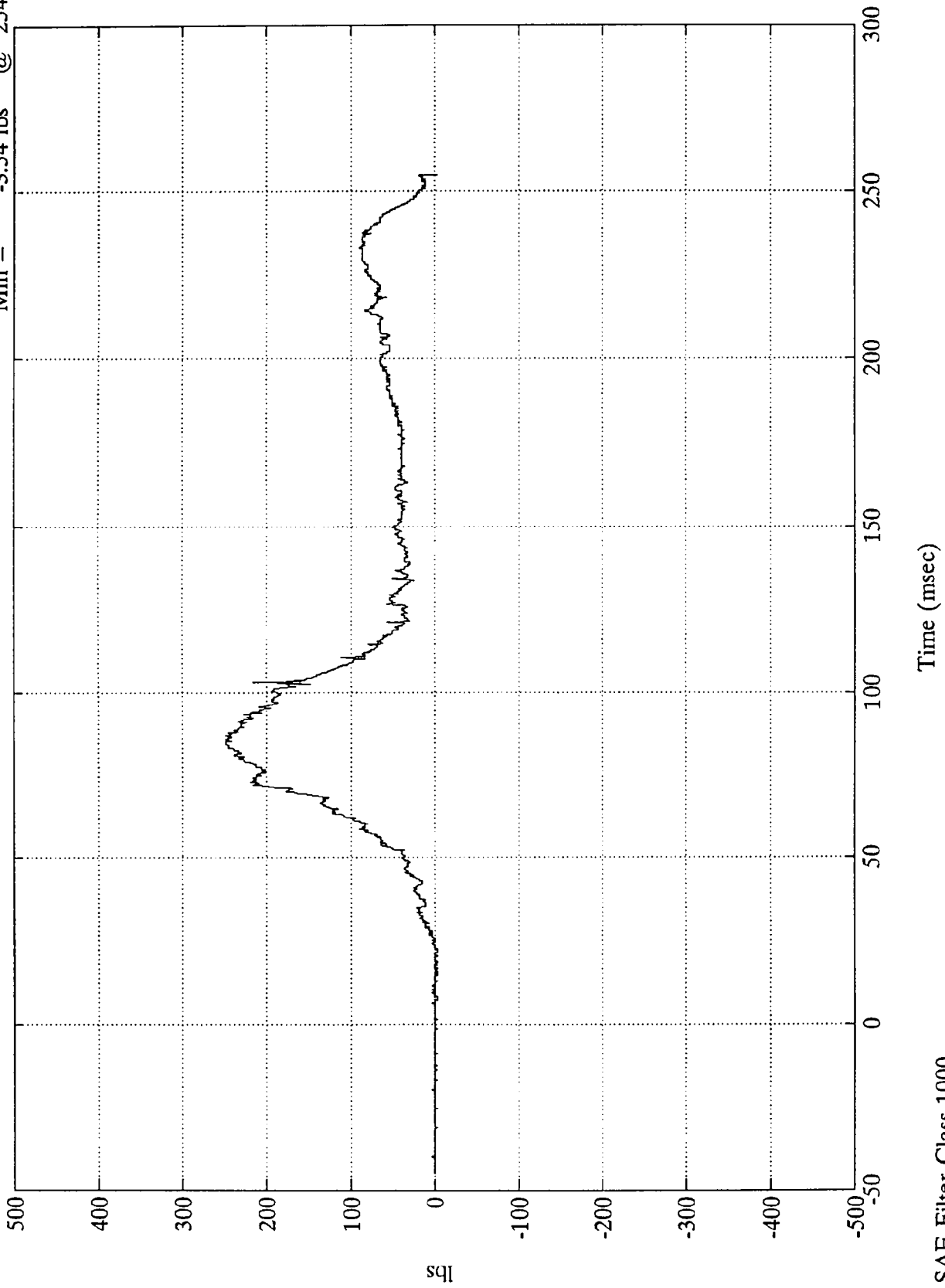
Pos. 2 Upper Neck Fy
Max = 67.75 lbs @ 121.08 msec
Min = -12.09 lbs @ 250.80 msec



TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 2 Upper Neck Fz

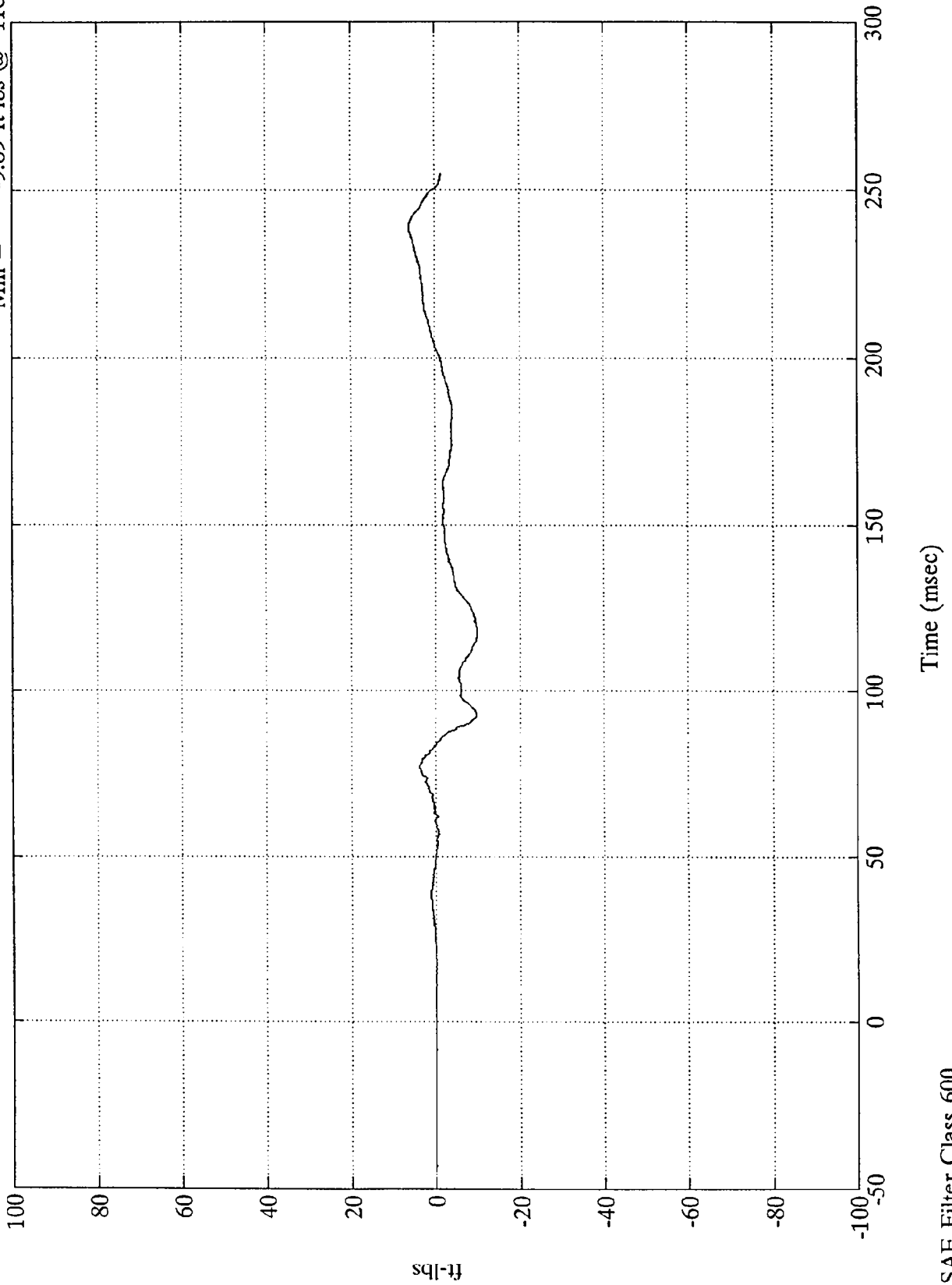
Max = 248.71 lbs @ 86.76 msec
Min = -3.54 lbs @ 254.88 msec



TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 2 Upper Neck Mx

Max = 6.08 ft-lbs @ 239.64 msec
Min = -9.89 ft-lbs @ 118.92 msec



B-66

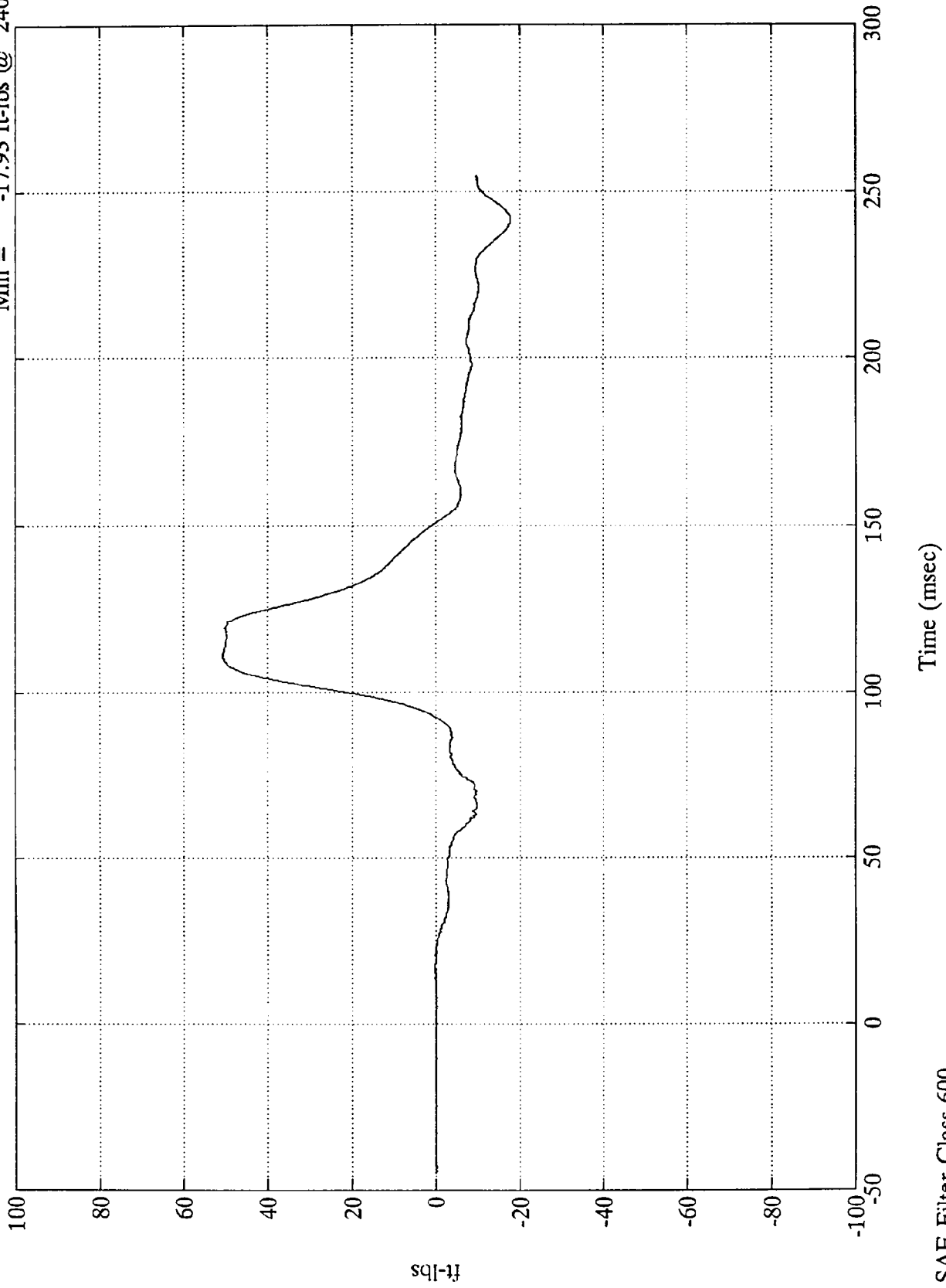
8102-1

SAE Filter Class 600

TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 2 Upper Neck My

Max = 50.87 ft-lbs @ 110.40 msec
Min = -17.93 ft-lbs @ 240.60 msec



B-67

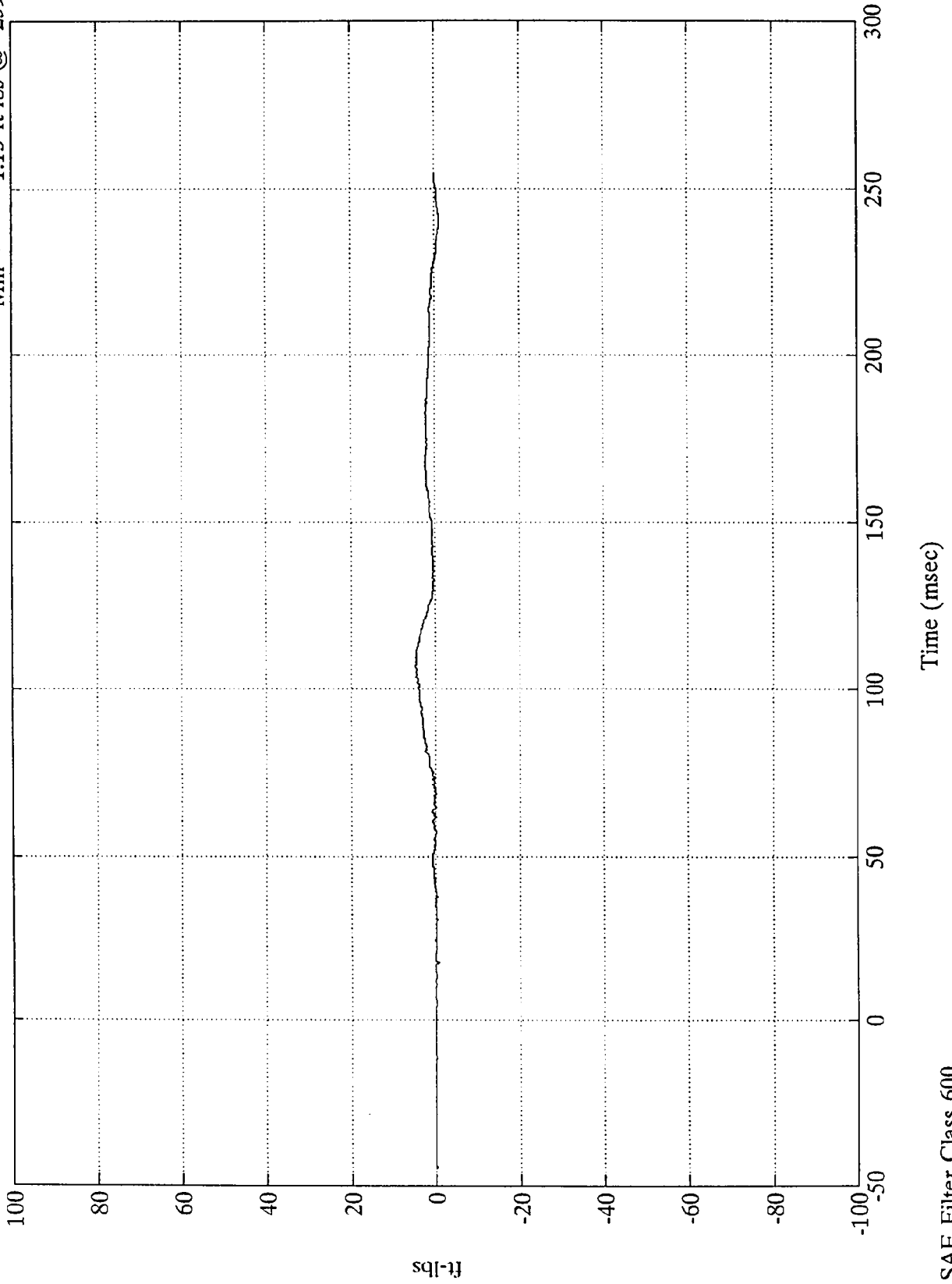
8102-1

SAE Filter Class 600

TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 2 Upper Neck Mz

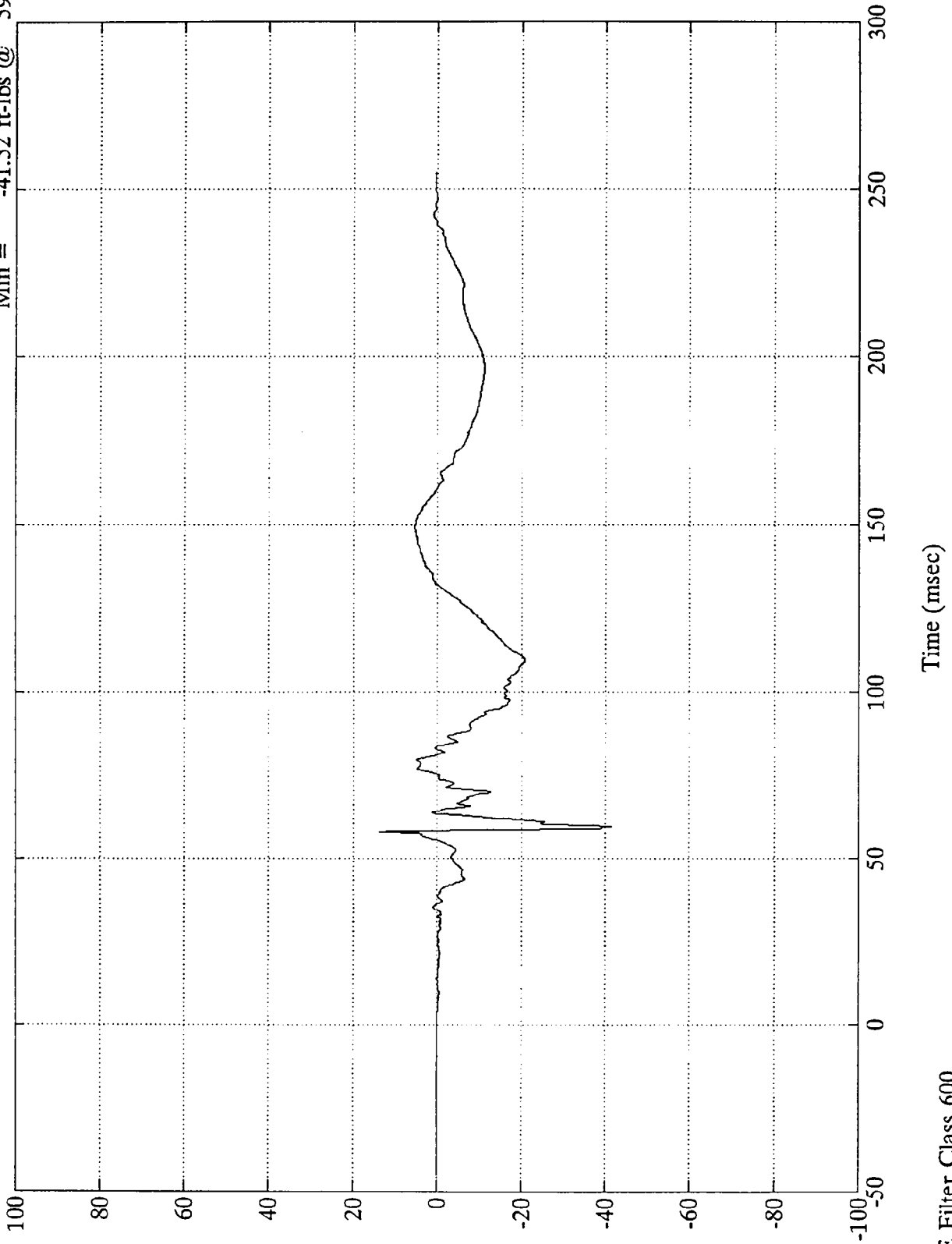
Max = 4.66 ft-lbs @ 106.80 msec
Min = -1.13 ft-lbs @ 239.52 msec



TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 2 Lt Upper Tibia Mx

Max = 13.93 ft-lbs @ 58.08 msec
Min = -41.52 ft-lbs @ 59.64 msec



B-69

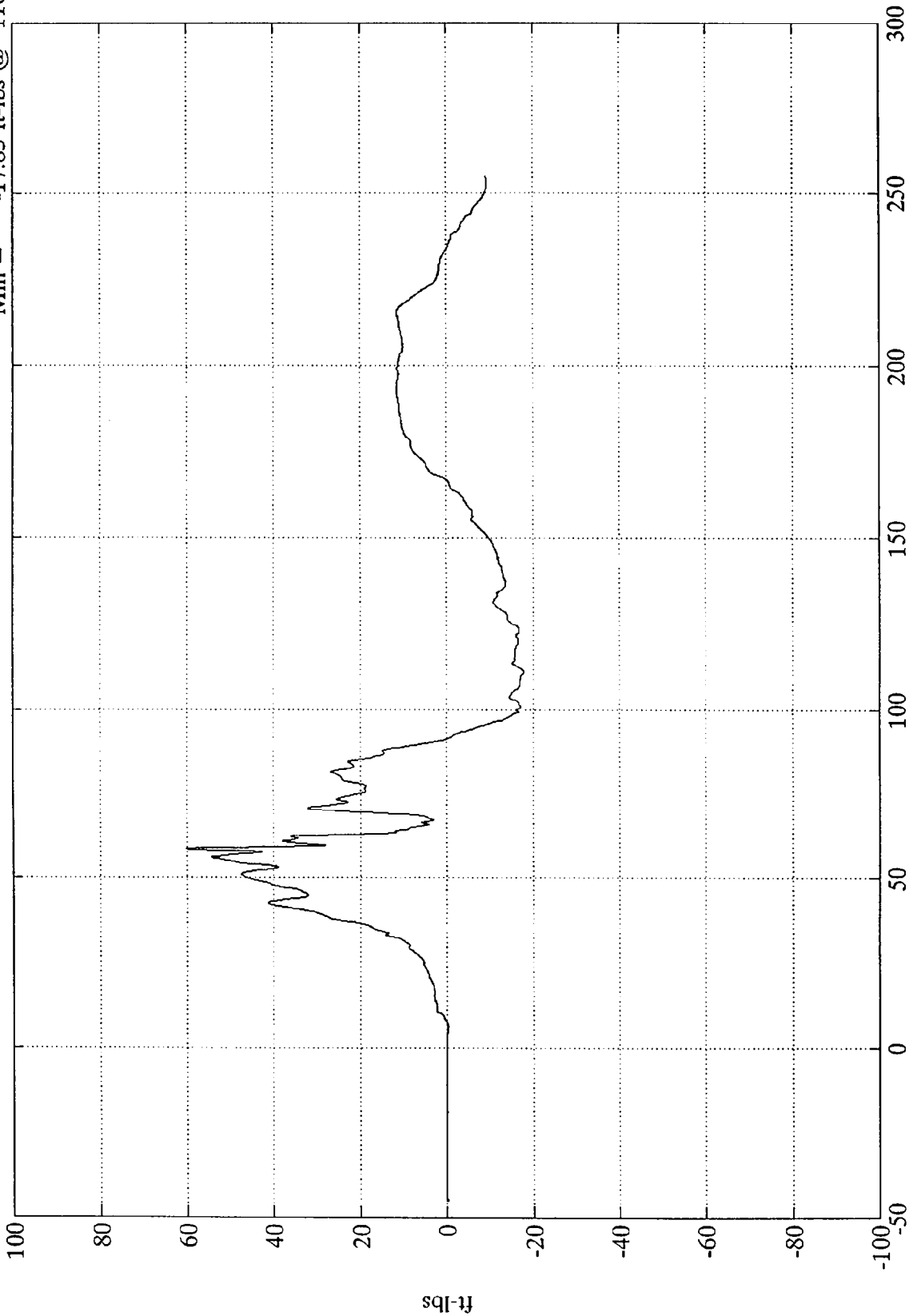
8102-1

SAE Filter Class 600

TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 2 Lt Upper Tibia My

Max = 60.21 ft-lbs @ 58.43 msec
Min = -17.83 ft-lbs @ 110.52 msec



B-70

8102-1

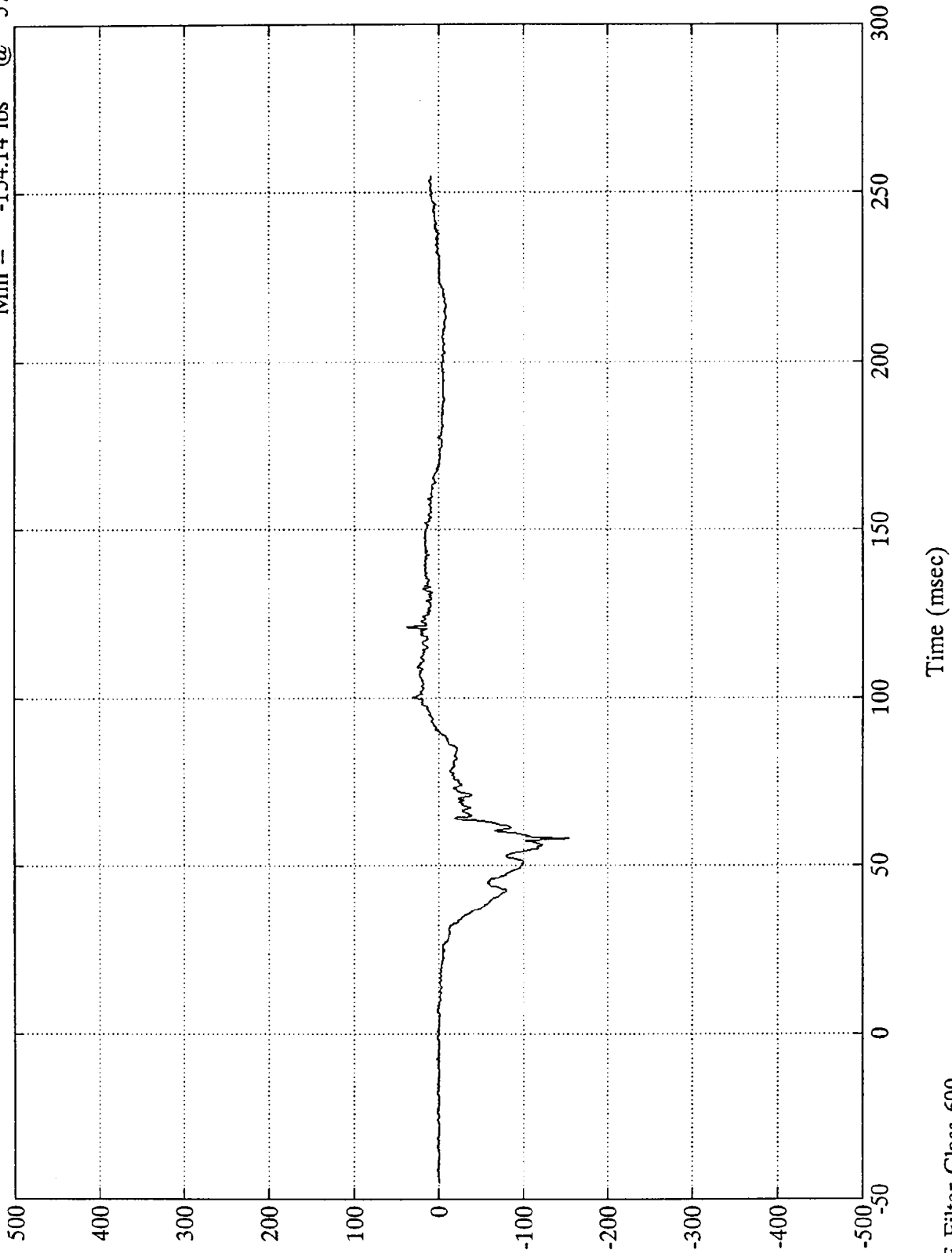
Time (msec)

SAE Filter Class 600

TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 2 Lt Lower Tibia Fy

Max = 38.33 lbs @ 121.08 msec
Min = -154.14 lbs @ 57.84 msec



sqj
B-71

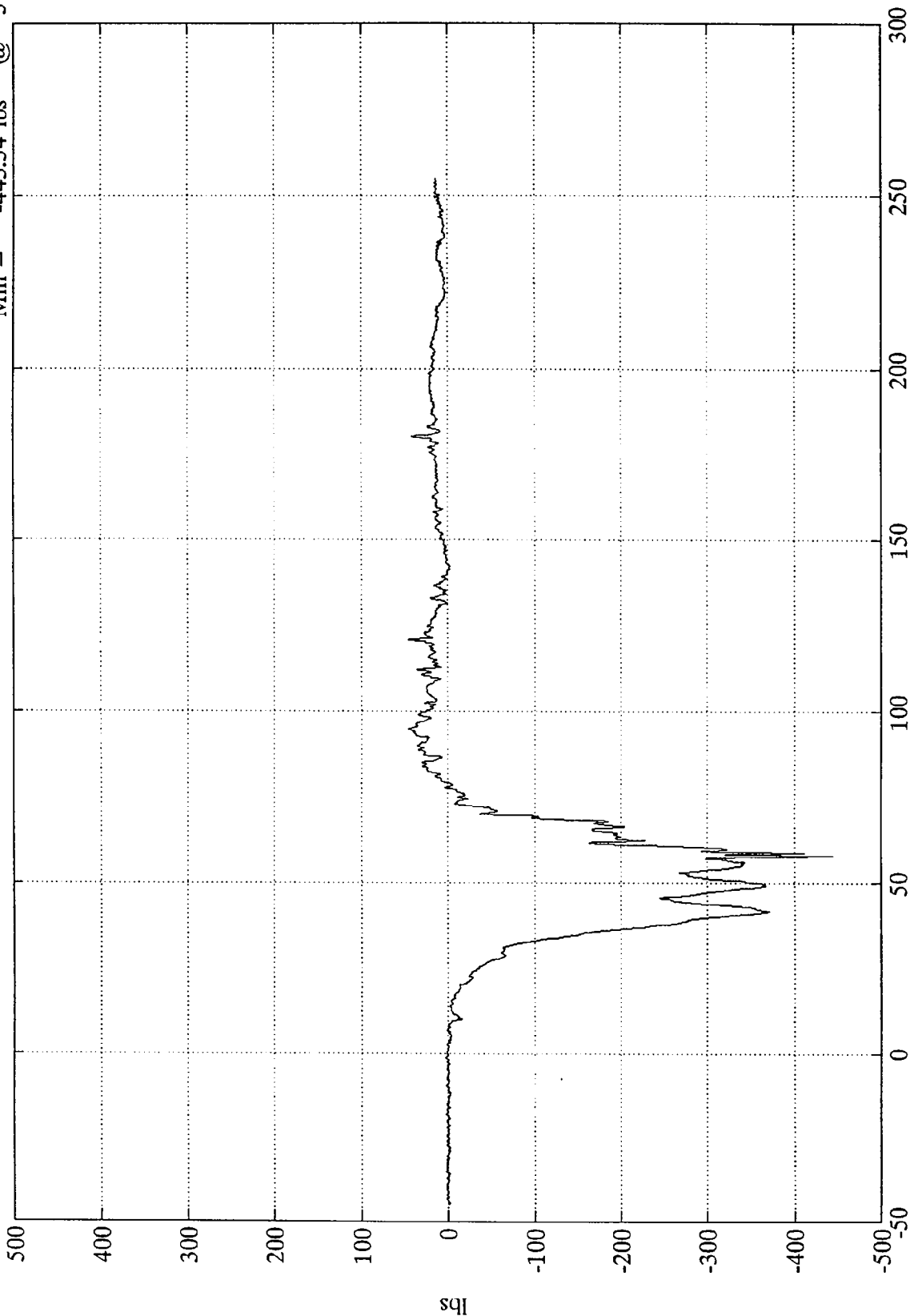
8102-1

SAE Filter Class 600

TSC 301 TEST 1 - FRONTAL IMPACT

Max = 46.35 lbs @ 120.96 msec
Min = -443.54 lbs @ 57.95 msec

Pos. 2 Lt Lower Tibia Fz



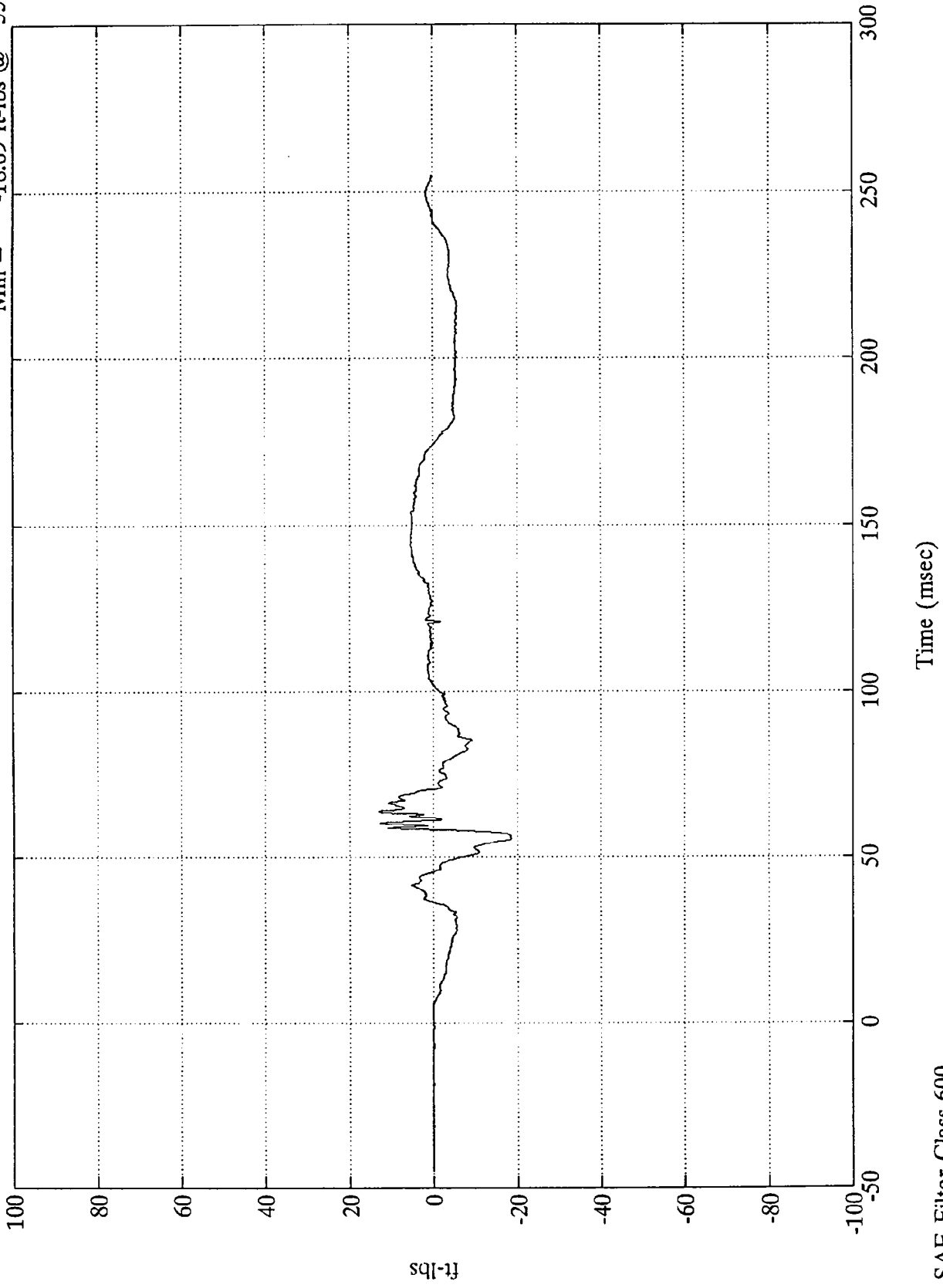
Time (msec)

SAE Filter Class 600

TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 2 Lt Lower Tibia Mx

Max = 13.09 ft-lbs @ 63.84 msec
Min = -18.69 ft-lbs @ 55.56 msec



B-73

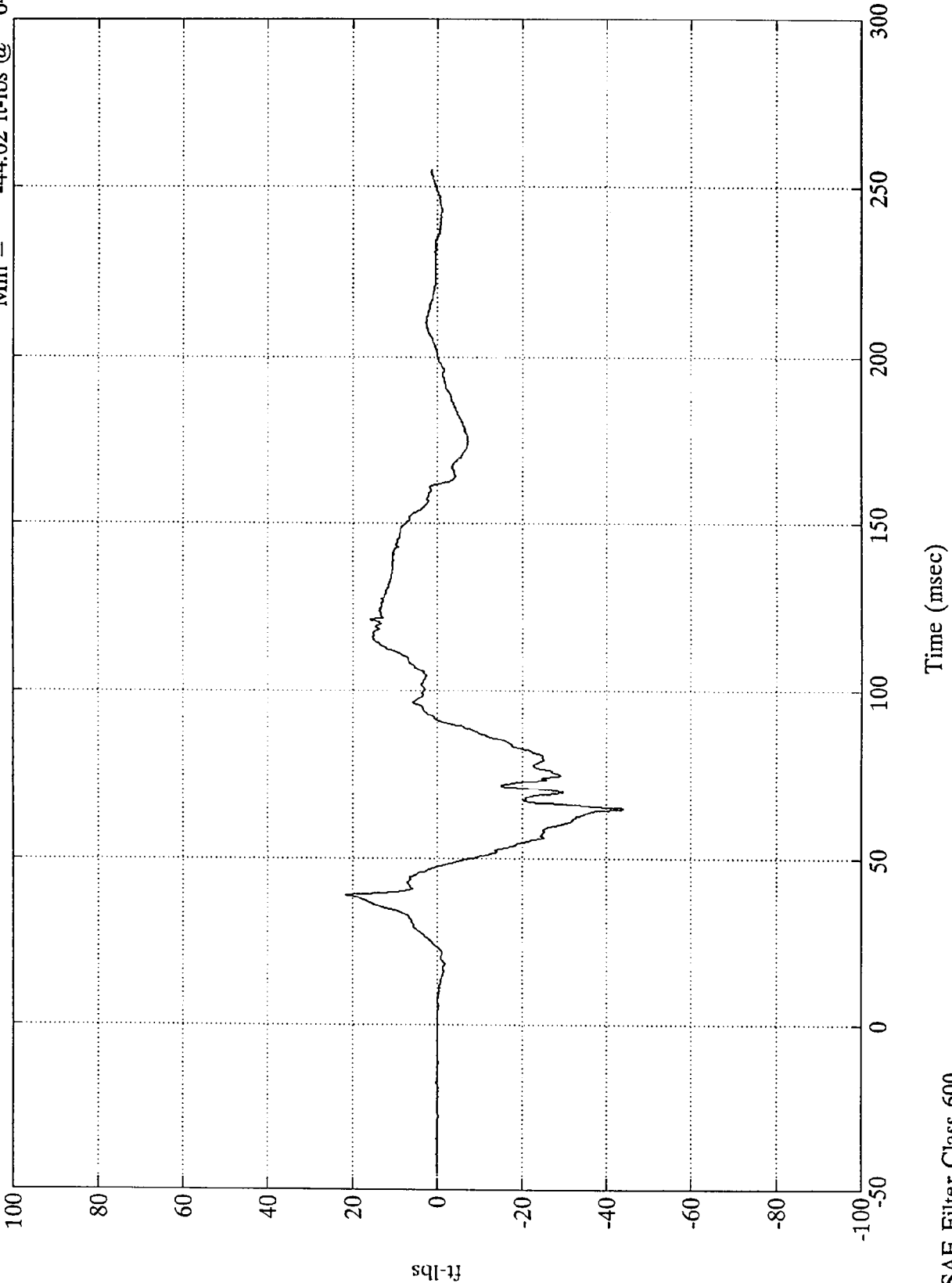
8102-1

SAE Filter Class 600

TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 2 Rt Upper Tibia Mx

Max = 21.80 ft-lbs @ 38.88 msec
Min = -44.02 ft-lbs @ 64.80 msec



sq-lb
B-74

8102-1

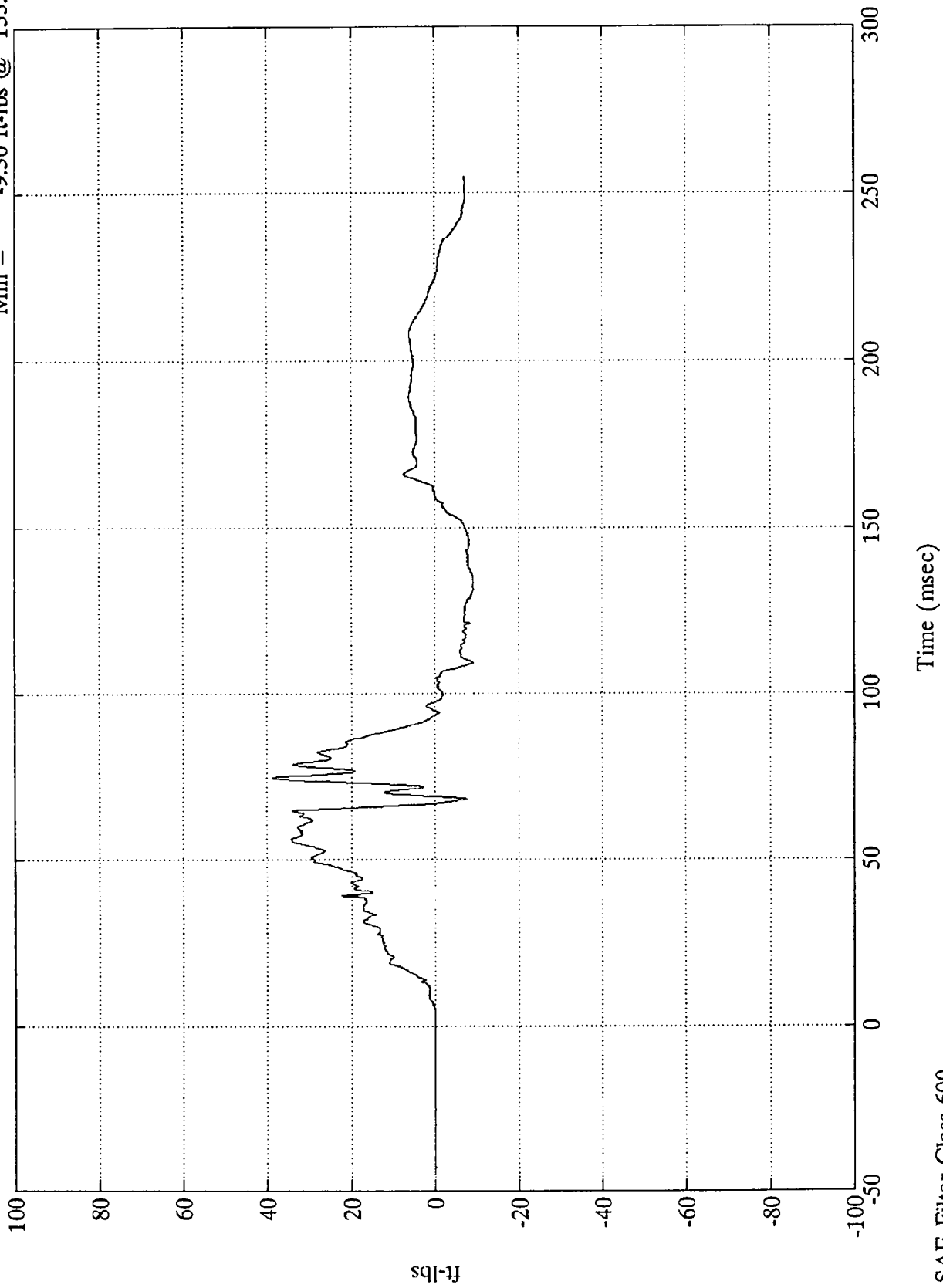
SAE Filter Class 600

Time (msec)

TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 2 Rt Upper Tibia My

Max = 38.76 ft-lbs @ 74.63 msec
Min = -9.30 ft-lbs @ 133.32 msec



sq|-1j
B-75

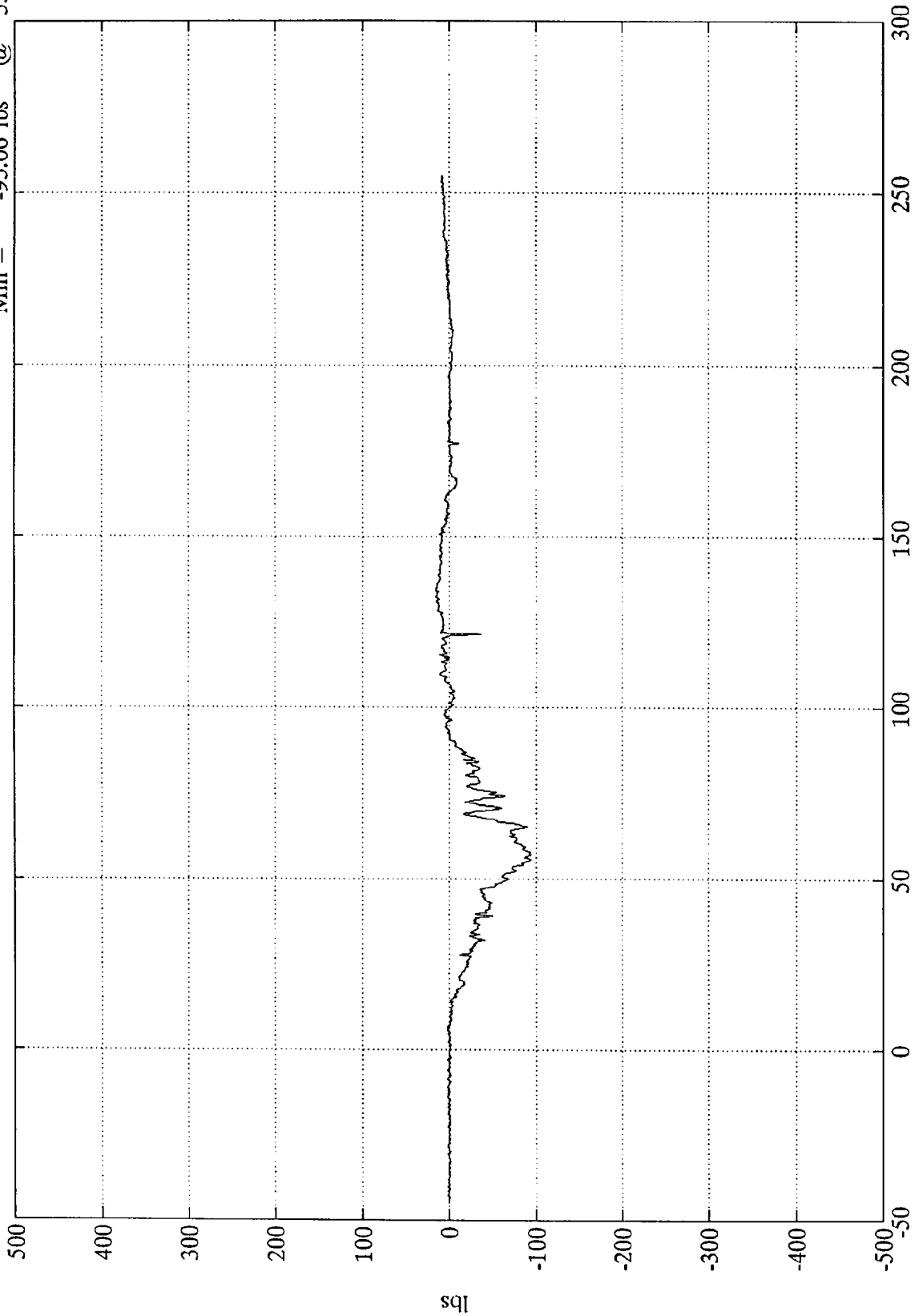
8102-1

SAE Filter Class 600

TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 2 Rt Lower Tibia Fy

Max = 15.37 lbs @ 132.60 msec
Min = -95.06 lbs @ 55.68 msec



sqi

B-76

8102-1

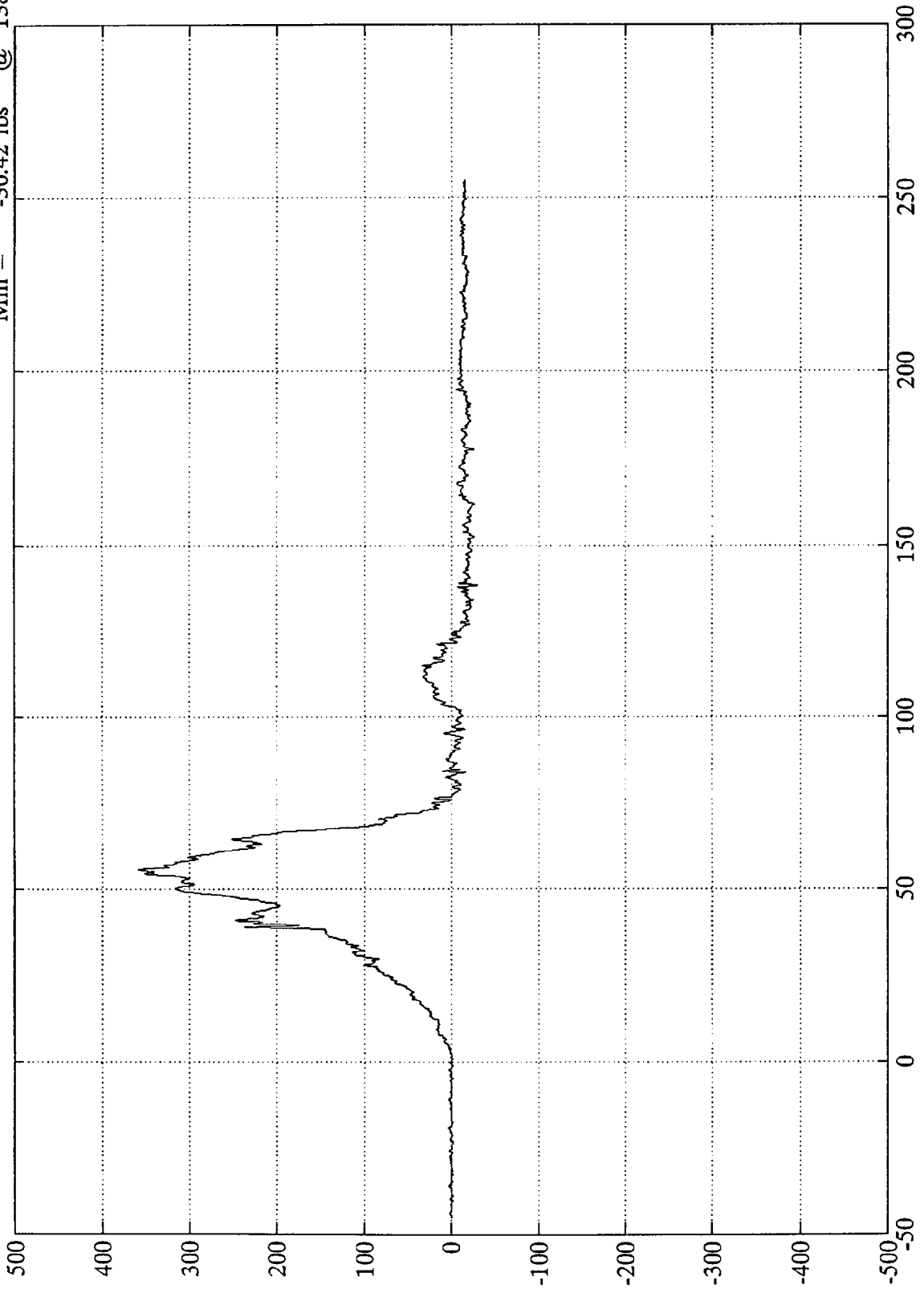
Time (msec)

SAE Filter Class 600

TSC 301 TEST 1 - FRONTAL IMPACT

Pos. 2 Rt Lower Tibia Fz

Max = 357.70 lbs @ 55.68 msec
Min = -30.42 lbs @ 138.36 msec



sqj
B-77

8102-1

SAE Filter Class 600

TSC 301 TEST 1 - FRONTAL IMPACT

Max = 11.50 ft-lbs @ 82.19 msec
Min = -10.58 ft-lbs @ 41.15 msec

Pos. 2 Rt Lower Tibia Mx

