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MOVING DEFORMABLE BARRIER
SIDE IMPACT TEST
FOR FUEL SYSTEM INTEGRITY

1993 TOYOTA COROLLA
4-DOOR SEDAN

CALSPAN TEST NUMBER: Y47-050-1287

MAY 21, 1993

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



FINAL REPORT

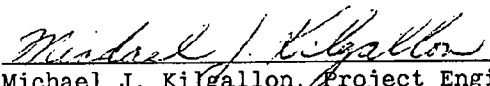
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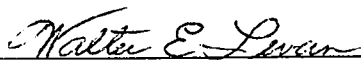
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16. Abstract A Crabbed Moving Deformable Barrier Test was conducted on the subject 1993 Toyota Corolla 4-Door Sedan in accordance with the specifications of the Office of Market Incentives Test Procedure. The test was conducted at the Calspan Corporation Advanced Technology Center Crash Test Facility in Buffalo, New York on May 21, 1993. The impact velocity of the Moving Deformable Barrier (MDB) was 54.1 mph, and the ambient temperature at the struck side (driver's) of the target vehicle at the time of impact was 62°F. The target vehicle post-test maximum crush was 15.7 inches at level 3. The test or target vehicle's performance is given below: <table border="1"> <thead> <tr> <th></th> <th>Driver SID</th> <th>Left Rear SID</th> </tr> </thead> <tbody> <tr> <td>Left Upper Rib Acceleration</td> <td>38.7 g's</td> <td>131.5 g's</td> </tr> <tr> <td>Left Lower Rib Acceleration</td> <td>35.0 g's</td> <td>92.3 g's</td> </tr> <tr> <td>Lower Spine Acceleration</td> <td>29.0 g's</td> <td>95.6 g's</td> </tr> <tr> <td>Thoracic Trauma Index (TTI)</td> <td>33.8 g's</td> <td>113.6 g's</td> </tr> <tr> <td>Pelvis Acceleration</td> <td>29.8 g's</td> <td>92.6 g's</td> </tr> </tbody> </table> The two doors on the struck side of the vehicle did not separate from the body at the hinges or latches and the opposite doors did not open during side impact event.							Driver SID	Left Rear SID	Left Upper Rib Acceleration	38.7 g's	131.5 g's	Left Lower Rib Acceleration	35.0 g's	92.3 g's	Lower Spine Acceleration	29.0 g's	95.6 g's	Thoracic Trauma Index (TTI)	33.8 g's	113.6 g's	Pelvis Acceleration	29.8 g's	92.6 g's
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Section 1

PURPOSE AND TEST PROCEDURE

This side impact test is part of a test program sponsored by the National Highway Traffic Safety Administration (NHTSA) through the Research and Special Programs Administration, Volpe National Transportation Systems Center under Contract No. DTRS57-90-C-00104. The purpose of this test was to evaluate side impact protection in a 1993 Toyota Corolla 4-Door Sedan

The side impact test was conducted in accordance with the Office of Market Incentive (OMI) Laboratory Indicant Test Procedure.

Section 2

SUMMARY OF SIDE IMPACT TEST

A stationary 1993 Toyota Corolla 4-Door Sedan was impacted on the left or driver's side by a Moving Deformable Barrier (MDB) which was moving forward in a 19° crabbed position to the monorail at a velocity of 54.1 mph on May 21, 1993. The orientation angle of the striking vehicle was 60° counterclockwise with respect to the longitudinal axis of the struck vehicle. Pre- and post-test photographs of the test vehicle, the moving deformable barrier (MDB), and the side impact dummies (SIDs) are shown in Appendix A.

Two restrained Side Impact Dummies (SIDs) were placed in the driver (Pos. #1) and left rear (Pos. #4) designated seating positions according to instructions specified in the OMI Side Impact Protection Laboratory Test Procedure. The side impact event was documented by nine high speed cameras. Camera locations and other pertinent camera information can be found in this report.

The SIDs were instrumented with the following accelerometers.

1. Left Upper Rib (LUR) uniaxial accelerometer (Y-direction)
2. Left Lower Rib (LLR) uniaxial accelerometer (Y-direction)
3. Lower Thoracic Spine (T₁₂) uniaxial accelerometer (Y-direction)
4. Head assembly triaxial accelerometer (X,Y,Z-directions)
5. Pelvic (PEV) section uniaxial accelerometer (Y-direction)

A total of 34 channels of data were recorded. Appendix B contains the vehicle and dummy response data traces.

The driver's HIC was 468.9 and a Thoracic Trauma Index (TTI) of 33.8 g's. Maximum pelvic Y acceleration was 29.8.

The left rear passenger's HIC was 1965.4 and a TTI of 113.6 g's. Maximum pelvic Y acceleration was 92.6 g's.

Section 3

SUMMARY OF TEST RESULTS

Table 1

GENERAL TEST AND VEHICLE PARAMETER DATA

TEST VEHICLE INFORMATION:

Year/Make/Model/Body Style: 1993 Toyota Corolla 4-Door Sedan
 Test No.: 1287 VIN: 2T1AE04E2PC010895
 Vehicle Body Color: Silver Month & Year of Manufacture: 2/93
 Engine Data: 4 cylinders; - CID; - Liters; 1587 cc
 Placement - Longitudinal; or X Lateral
 Transmission: 5 speed; X Manual; - Automatic; X Overdrive
 Final Drive: - Rear Wheel Drive; X Front Wheel Drive; - Four Wheel Drive
 Odometer Reading 00071 miles
 Options: - A/C; X Power Steering.; X Pwr. Brakes; - Pwr. Windows

DATA FROM TIRE PLACARD:

Tire Pressure (at capacity): 30 psi FRONT
30 psi REAR
 Recommended Tire Size: P175/65R1481S
 Tires on Test Vehicle: P175/65R1481S; Manufacturer: Goodyear
 Vehicle Capacity Data:
 Number of Occupants: 2 Front; 3 Rear; - 3rd Seat 5 Total
 Type of Front Seats: X Bucket; - Bench; - Split Bench
 Type of Front Seat Back: - Fixed; X Adjustable with X Lever
 Vehicle Maximum Capacity Loading = 850 lbs. (A)
 No. of Occupants x 150 lbs. = 750 lbs. (B)
 Cargo Capacity (A-B) = 100 lbs.

WEIGHT OF TEST VEHICLE WITH MAXIMUM FLUIDS:

Right Front = 690 lbs. Right Rear = 480 lbs.
 Left Front = 690 lbs. Left Rear = 500 lbs.
 TOTAL FRONT = 1380 lbs. TOTAL REAR = 980 lbs.
 % of Total Vehicle Weight = 58 %; % of Total Weight = 42 %
 TOTAL WEIGHT = 2360 lbs.

Table 2

TEST VEHICLE DATA

CALCULATION OF VEHICLE'S TARGET TEST WEIGHT:

Total Test Vehicle Delivered Weight with Maximum Fluids	=	<u>2360</u> lbs.
Maximum Cargo Carrying Capacity of Test Vehicle	=	<u>100</u> lbs.
Weight of 2 Side Impact Dummies (2 x <u>168</u> lbs.)	=	<u>336</u> lbs.
TEST VEHICLE TARGET WEIGHT:	=	<u>2796</u> lbs.

ACTUAL WEIGHT OF TEST VEHICLE WITH 2 DUMMIES AND CARGO:

Right Front	=	<u>800</u> lbs.	Right Rear	=	<u>640</u> lbs.
Left Front	=	<u>750</u> lbs.	Left Rear	=	<u>640</u> lbs.
TOTAL FRONT	=	<u>1550</u> lbs.	TOTAL REAR	=	<u>1280</u> lbs.
% of Total Weight	=	<u>55</u> %	% of Total Weight	=	<u>45</u> %
TOTAL TEST WEIGHT	=	<u>2830</u> lbs.			

TEST VEHICLE ATTITUDE (all dimensions in inches):

AS DELIVERED:

right front 25.7 left front 25.7 right rear 25.1 left rear 24.9

FULLY LOADED:

right front 24.3 left front 24.5 right rear 23.0 left rear 23.0

READY FOR TEST:

right front 24.6 left front 25.4 right rear 23.6 left rear 23.1

Test Vehicle Wheelbase: 97 inches

C.G. = 43.9 inches rearward of front wheel centerline

TOTAL VEHICLE LENGTH:

Right Side	=	<u>171.0</u> inches
Left Side	=	<u>171.0</u> inches
Centerline	=	<u>172.0</u> inches

Figure 1
PRE-TEST CONDITIONS

VEHICLE IDENTIFICATION:

Vehicle: 1993 Toyota Corolla 4-Door Sedan

Test No. 1287

FRONT SEAT CUSHION PLACEMENT: Seats are in mid-position

Total Number of Adjustment Positions or Detents: 17

FRONT SEAT BACK ADJUSTMENT POSITION: 4th notch from full upright

Seat Back Torso Angle = 27 degrees

SECOND POSITION SEAT:

Total Length of Fore/Aft Adjustment Travel: not adjustable inches

Seat Back Adjustment Position: not adjustable

ADJUSTABLE STEERING COLUMN POSITION:

Steering column is not adjustable

WINDOW POSITIONS: Left Front closed Left Rear closed

Right Front open Right Rear open

Note: Windows will be in closed position on struck side
of test vehicle and in open position on opposite side.

AMOUNT OF STODDARD SOLVENT IN FUEL TANK:

46.5 gallons

LOCATION OF IMPACT POINT ON TEST VEHICLE SIDE TO BE IMPACTED:

Wheelbase: = 97.0 inches

Impact Point is 18.5 inches forward of rear wheel

Table 3

CRASH TEST SUMMARY FOR TEST VEHICLE

VEHICLE IDENTIFICATION:

Vehicle Year/Make/Model: 1993 Toyota Corolla 4-Door Sedan

Body Style: 4-Door Sedan VIN: 2T1AE04E2PC010895

Test No.: 1287 Test Date: May 21, 1993

Overall Length = 172.0 inches; Overall Width = 66.3 inches

TEST WEIGHT:

Left Front = 800 lbs. Left Rear = 640 lbs.

Right Front = 750 lbs. Right Rear = 640 lbs.

TOTAL FRONT = 1550 lbs. TOTAL REAR = 1280 lbs.

TOTAL VEHICLE WEIGHT 2830 lbs.

Wheelbase = 97.0 inches

Longitudinal C.G. from Center of Front Axle = 43.9 inches

Impact Angle with Respect to Impactor = 60 degrees

MAXIMUM EXTERIOR STATIC CRUSH:

1. LEVEL 1 (10.5 in. above ground) = 5.3 inches

2. LEVEL 2 (18.5 in. above ground) = 15.3 inches

3. LEVEL 3 (23.3 in. above ground) = 15.7 inches

4. LEVEL 4 (33.0 in. above ground) = 13.2 inches

5. LEVEL 5 (50.5 in. above ground) = -1.7 inches

Maximum Post-Test Intrusion = 15.7 inches

OCCUPANTS:

Front Passenger

Rear Passenger

Type of Dummy SID SID

Restraints Used 3-point restraint system 3-point restraint system
with supplemental airbag

INSTRUMENTATION:

Number of Vehicle Data Channels: = 31

Number of Cameras: Onboard = 3

Offboard = 7

TOTAL = 10

Table 4

CRASH TEST SUMMARY FOR SIDE IMPACTOR

POSITION OF IMPACT (MDB) ON MONORAIL:

Crabbed 19° to left

MDB DETAILS:

Overall Width of Framework Carriage	=	<u>49.3</u> inches
Overall Length of MDB (incl. honeycomb impact face)	=	<u>162.0</u> inches
Wheelbase of Framework Carriage	=	<u>102.0</u> inches
Tread of Framework Carriage (Front & Rear)	=	<u>74.0</u> inches
C.G. Location Rearward of Front Axle	=	<u>40.4</u> inches

MDB WEIGHT:

Left Front	=	<u>940</u> lbs.	Left Rear	=	<u>550</u> lbs.
Right Front	=	<u>860</u> lbs.	Right Rear	=	<u>630</u> lbs.
TOTAL FRONT	=	<u>1800</u> lbs.	TOTAL REAR	=	<u>1180</u> lbs.
TOTAL MDB WEIGHT <u>2980</u> lbs.					

Impact Angle (MDB C/L to Target Vehicle C/L) = 60° degrees

Impact Speed = 54.1 mph

MAXIMUM STATIC CRUSH OF HONEYCOMB IMPACT FACE:

1. Row A at Bumper Level	=	<u>12.5</u> inches
2. Row B at Mid-Stack Level	=	<u>7.7</u> inches
3. Row C at Top of Stack Level	=	<u>8.5</u> inches

INSTRUMENTATION:

Number of MDB Data Channels = 3

Table 5

POST-TEST OBSERVATIONS

TEST VEHICLE: 1993 Toyota Corolla 4-Door Sedan NHTSA No. 1287

VISIBLE DUMMY CONTACT POINTS:

	<u>LEFT FRONT SID</u>	<u>LEFT REAR SID</u>
Head	<u>Left roof rail</u>	<u>Left "C" pillar</u>
Chest	<u>Left front door</u>	<u>Left rear door</u>
Abdomen	<u>Left front door arm rest</u>	<u>Left rear door arm rest</u>
Left Knee	<u>Left front door</u>	<u>Left rear door</u>
Right Knee	<u>No contact</u>	<u>No contact</u>

DOOR OPENING:

	<u>LEFT SIDE</u>	<u>RIGHT SIDE</u>
Front	<u>Closed-operable</u>	<u>Closed-operable</u>
Rear	<u>Closed-operable</u>	<u>Closed-operable</u>

MDB DISTANCE FROM TARGET IMPACT POINT:

	<u>0.5 inches forward of target</u>
	<u>0.5 inches below target</u>

ARM REST LOCATIONS:

Front: Located data height between ribs and pelvis

Rear: Same as front

SEAT MOVEMENT:

No seat movement in front seat area

Left rear seat pushed inward

GLAZING DAMAGE:

Left rear window glass broken

Rear window broken

PILLAR FAILURE:

Left rear "C" pillar separated from left rear sill

SILL SEPARATION:

Left rear sill separated from "C" pillar

OTHER NOTABLE IMPACT EFFECTS:

Left rear wheel and suspension severely damaged

Airbag deployed

Section 4

OCCUPANT AND VEHICLE INFORMATION

Table 6
SIDE IMPACT DUMMY (SID) TEST DATA SUMMARY

Vehicle: 1993 Toyota Corolla 4-Door Sedan Test Date: May 21, 1993

	Front Dummy ID #904				Rear Dummy ID #906			
	Pos. Direct.		Neg. Direct		Pos. Direct.		Neg. Direct	
	Max (g)	Time (msec)	Max (g)	Time (msec)	Max (g)	Time (msec)	Max (g)	Time (msec)
HEAD ACCELERATIONS:								
Longitudinal X	36.5	139.4	-41.8	71.5	17.8	184.4	-61.2	47.8
Lateral Y	82.2	70.3	-45.7	210.7	242.6	47.0	-10.9	32.4
Vertical Z	54.5	69.2	-40.4	76.9	36.1	47.2	-44.2	52.4
RESULTANT R	99.4	69.5	-	-	250.1	47.0	-	-
HIC	468.9	-	-	-	1965.4	-	-	-
RIB ACCELERATIONS:								
Upper Rib Lateral Y	38.7	86.9	-2.4	150.6	131.5	28.8	-21.2	41.3
Upper Rib Lateral .. Y(R)	38.3	86.9	-1.0	158.1	118.6	29.4	-14.0	41.9
Lower Rib Lateral Y	35.0	76.3	-2.8	158.1	92.3	27.5	-4.0	21.9
Lower Rib Lateral .. Y(R)	36.7	75.6	-3.1	152.5	131.4	27.5	-11.0	81.3
SPINE ACCELERATIONS:								
Lower Lateral Y	53.4	85.6	-10.6	74.4	78.0	43.1	-20.3	66.3
Upper Lateral Y(R)	53.1	85.0	-10.3	74.4	80.4	43.1	-14.1	66.3
Lower Lateral Y	29.0	86.3	-9.8	72.5	95.6	31.9	-12.0	73.8
Lower Lateral Y(R)	28.5	86.9	-11.3	72.5	96.0	32.5	-53.7	56.3
PELVIC ACCELERATIONS:								
Lateral Y	29.8	75.0	-0.04	-1.3	92.6	28.8	-10.0	73.1
Lateral Y(R)	27.0	75.6	-4.4	160.6	84.0	27.5	-4.3	74.4

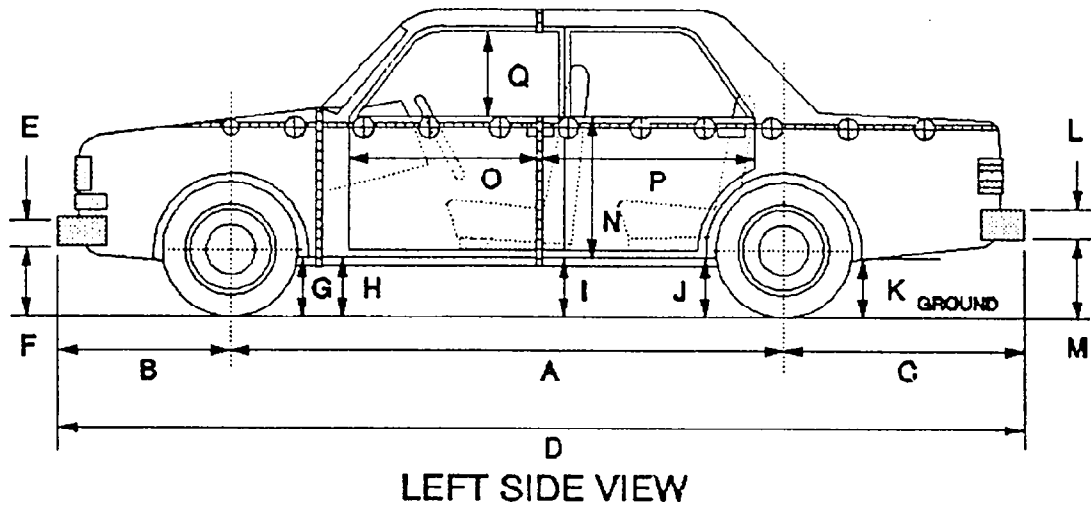
REFERENCE: Positive Direction - Longitudinal (X) = forward
Lateral (Y) = to right
Vertical (Z) = up

Negative Direction - Longitudinal (X) = rearward
Lateral (Y) = to left
Vertical (Z) = down

Note: Y(R) denotes redundant Y direction accelerometer.

Figure 2

PRE- AND POST-TEST MEASUREMENTS

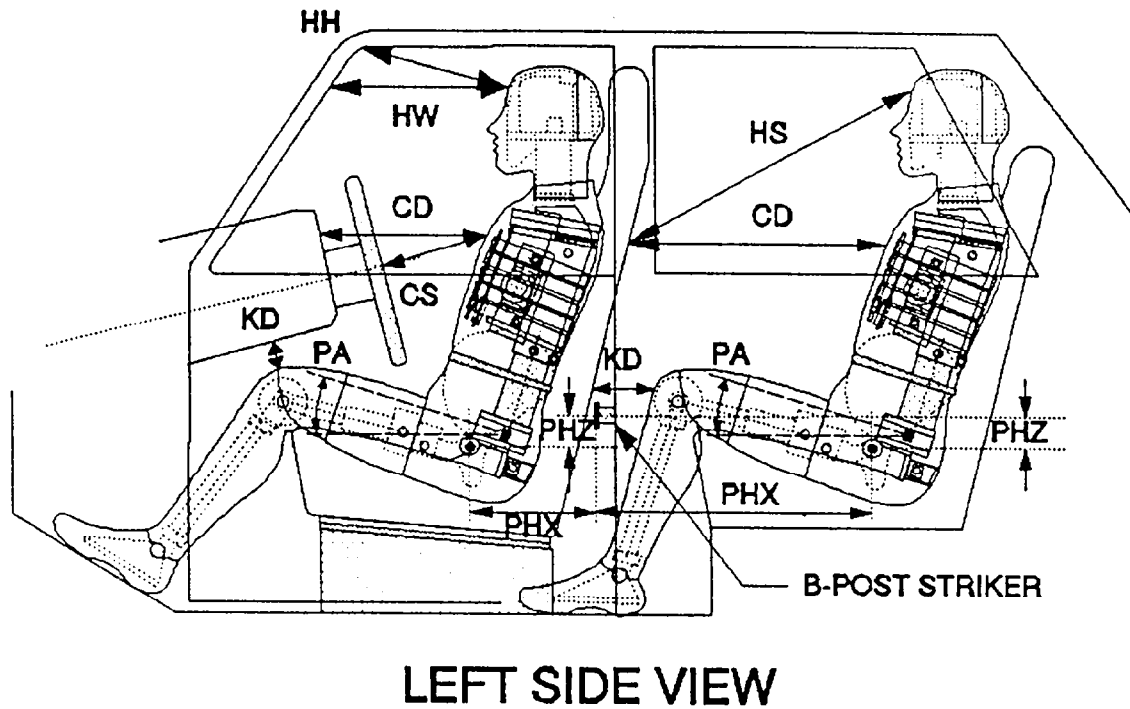


NOTE: All dimensions are in inches

	PRE-TEST	POST-TEST	Δ CHANGE
A	97.0	98.6	-1.6
B	33.8	35.6	-1.8
C	41.3	41.2	0.1
D	172.0	175.3	-3.3
E	10.0	10.0	0.0
F	12.5	12.5	0.0
G	11.6	10.5	1.1
H	11.5	10.5	1.0
I	11.5	9.5	2.0
J	11.5	N/A	N/A
K	13.4	N/A	N/A
L	11.5	11.5	0.0
M	12.0	10.0	2.0
N	25.1	21.7	3.4
O	N/A	N/A	N/A
P	N/A	N/A	N/A
Q	16.5	16.5	0.0

Figure 3

SIDE IMPACT DUMMY (SID) LONGITUDINAL CLEARANCE DIMENSIONS



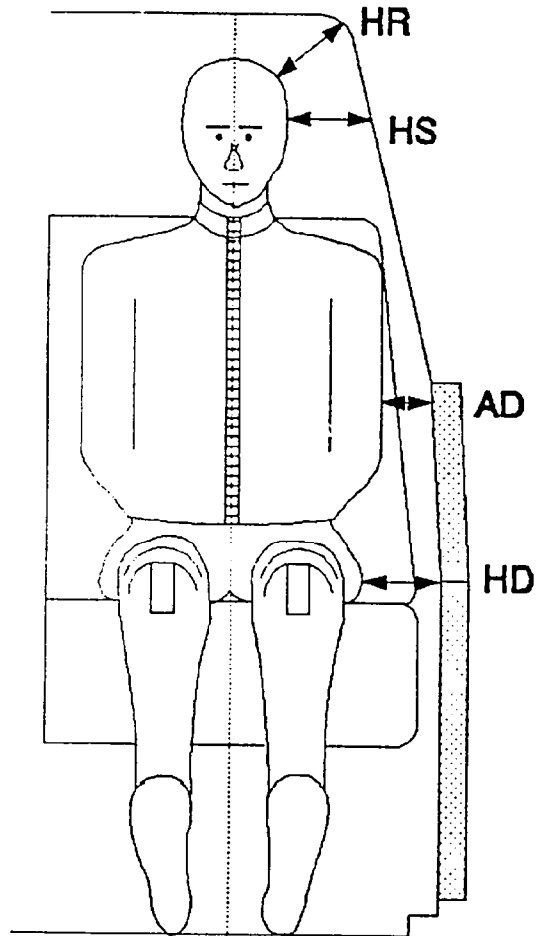
NOTE: All dimensions are in inches

	DRIVER ID #904	LEFT REAR PASSENGER ID #906
HH	14.1	-
HW	22.4	-
HS	-	26.6
CD	20.7	-
CS	13.0	19.0
KDL	3.7	4.3
KDR	2.9	4.7
PA	24°	24°
PHX	8.7	9.9
PHZ	5.1	10.7

Note: 2-door vehicle shown. Rear dummy PHX & PHZ measurements for 4-door vehicle would use the C-post striker as a reference point.

Figure 4

SIDE IMPACT DUMMY (SID) LATERAL CLEARANCE DIMENSIONS

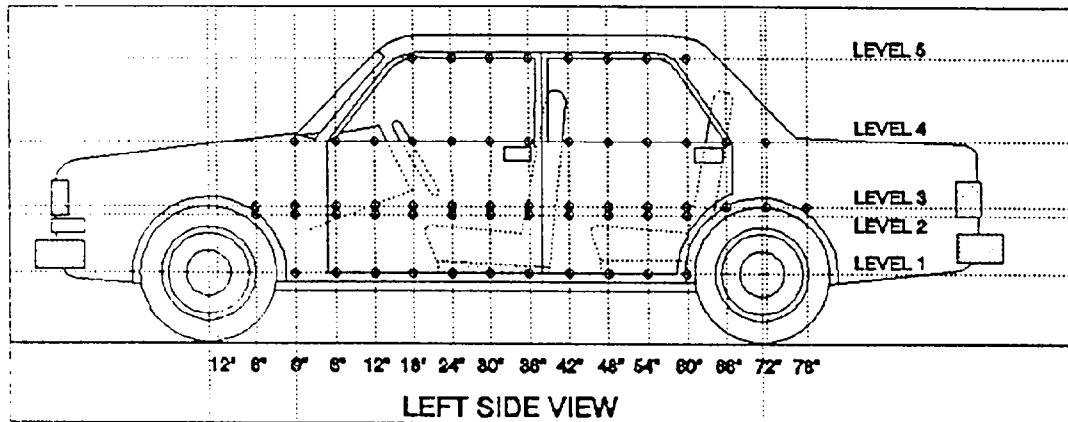


NOTE: All dimensions are in inches

	DRIVER ID #904	LEFT REAR PASSENGER ID #906
HR	5.9	5.2
HS	9.0	5.8
AD	3.3	3.9
HD	6.5	7.8

Figure 5

VEHICLE SIDE MEASUREMENT



Measurements Along the Vertical 30" Line Shown Above:

	<u>30" Side Profile</u>
Level 5 @ Window Top	= <u>50.5</u> inches
Level 4 @ Window Sill	= <u>33.0</u> inches
Level 3 @ Mid Door	= <u>23.3</u> inches
Level 2 @ Occupant H-Point	= <u>18.5</u> inches
Level 1 @ Axle Centerline Height (or Sill Top Height)	= <u>10.5</u> inches

Table 7

TEST VEHICLE EXTERIOR PROFILES FROM REFERENCE PLANE* AND STATIC CRUSH DATA

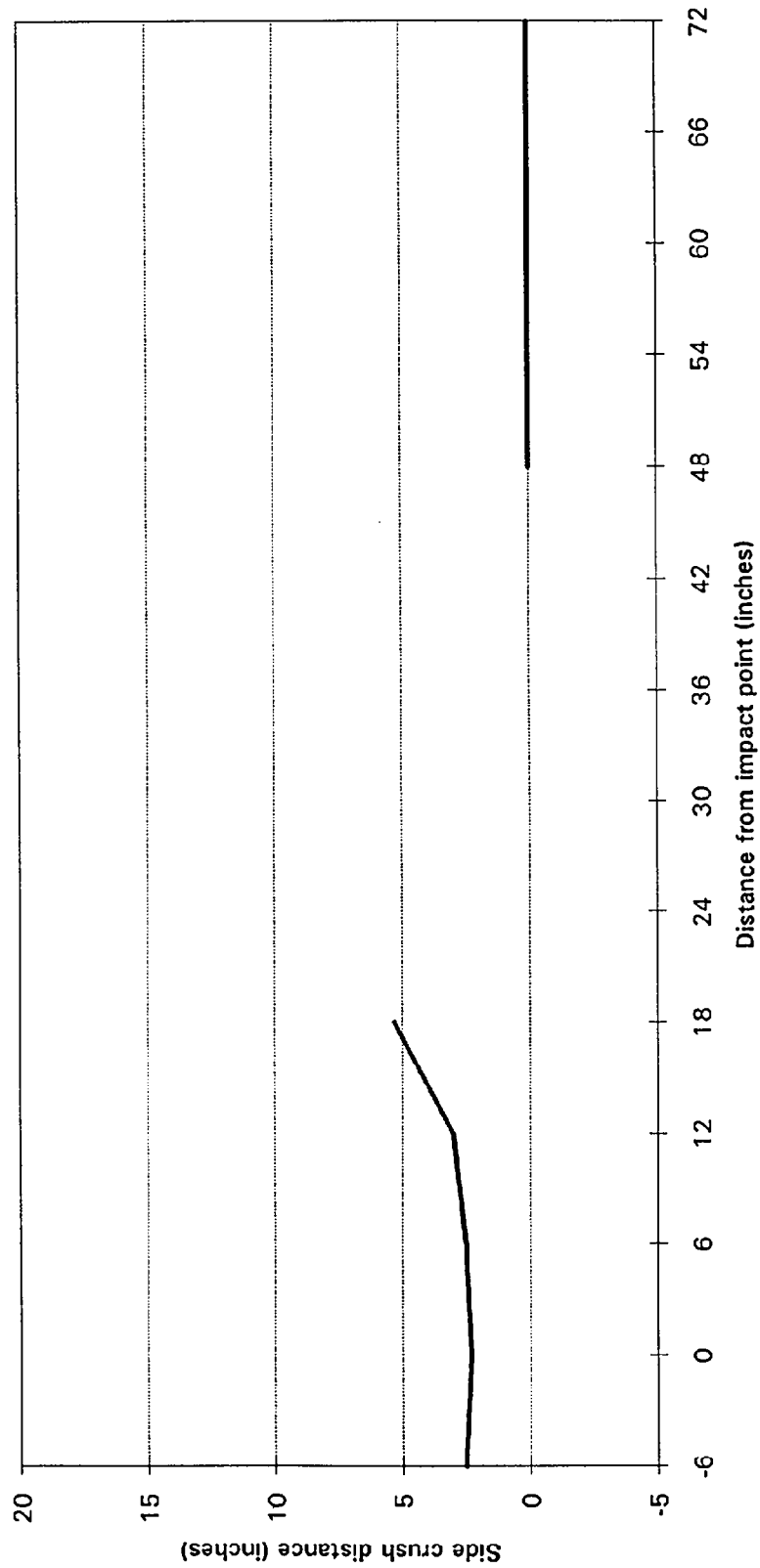
Test Date: May 21, 1993

Vehicle: 1993 Toyota Corolla 4-Door Sedan

▼———— Impact Point																
Location	Height (in)	Profiles/Crush	6"	0	6"	12"	18"	24"	30"	36"	42"	48"	54"	60"	66"	72"
1. Side Sill		Post-Test	19.8	19.6	19.8	20.2	22.3	-	-	-	-	-	-	-	-	-
	10.5	Pre-Test	17.3	17.3	17.3	17.2	17.0	-	-	-	-	-	-	-	-	-
		Static Crush	2.5	2.3	2.5	3.0	5.3	-	-	-	-	-	-	-	-	-
2. H-Point		Post-Test	17.1	21.0	25.0	28.3	29.8	-	-	-	-	25.8	25.2	23.2	-	-
	18.5	Pre-Test	14.7	14.7	14.7	14.7	14.5	-	-	-	-	14.6	15.0	15.5	-	-
		Static Crush	2.4	6.3	10.3	13.6	15.3	-	-	-	-	11.2	10.2	7.7	-	-
3. Mid-Door		Post-Test	16.7	19.5	22.7	25.5	29.0	30.0	-	-	25.5	24.8	25.0	23.0	-	-
	23.3	Pre-Test	14.6	14.6	14.6	14.6	14.6	14.3	-	-	14.4	15.2	15.9	16.5	-	-
		Static Crush	2.1	4.9	8.1	10.9	14.4	15.7	-	-	11.1	9.6	9.1	6.5	-	-
4. Window		Post-Test	17.6	19.0	22.4	25.2	27.4	28.5	29.4	28.6	28.0	25.3	23.4	21.4	22.0	-
	33.0	Pre-Test	16.6	16.4	16.4	16.2	16.1	16.0	16.2	16.2	16.5	16.8	17.4	18.0	19.0	-
		Static Crush	1.0	2.6	6.0	9.0	11.3	12.5	13.2	12.4	11.5	8.5	6.0	3.5	3.0	-
5. Window		Post-Test	25.2	24.5	24.1	23.8	-	-	-	-	-	-	-	-	-	-
	50.5	Pre-Test	25.6	25.6	25.6	25.5	-	-	-	-	-	-	-	-	-	-
		Static Crush	-0.4	-1.1	-1.5	-1.7	-	-	-	-	-	-	-	-	-	-

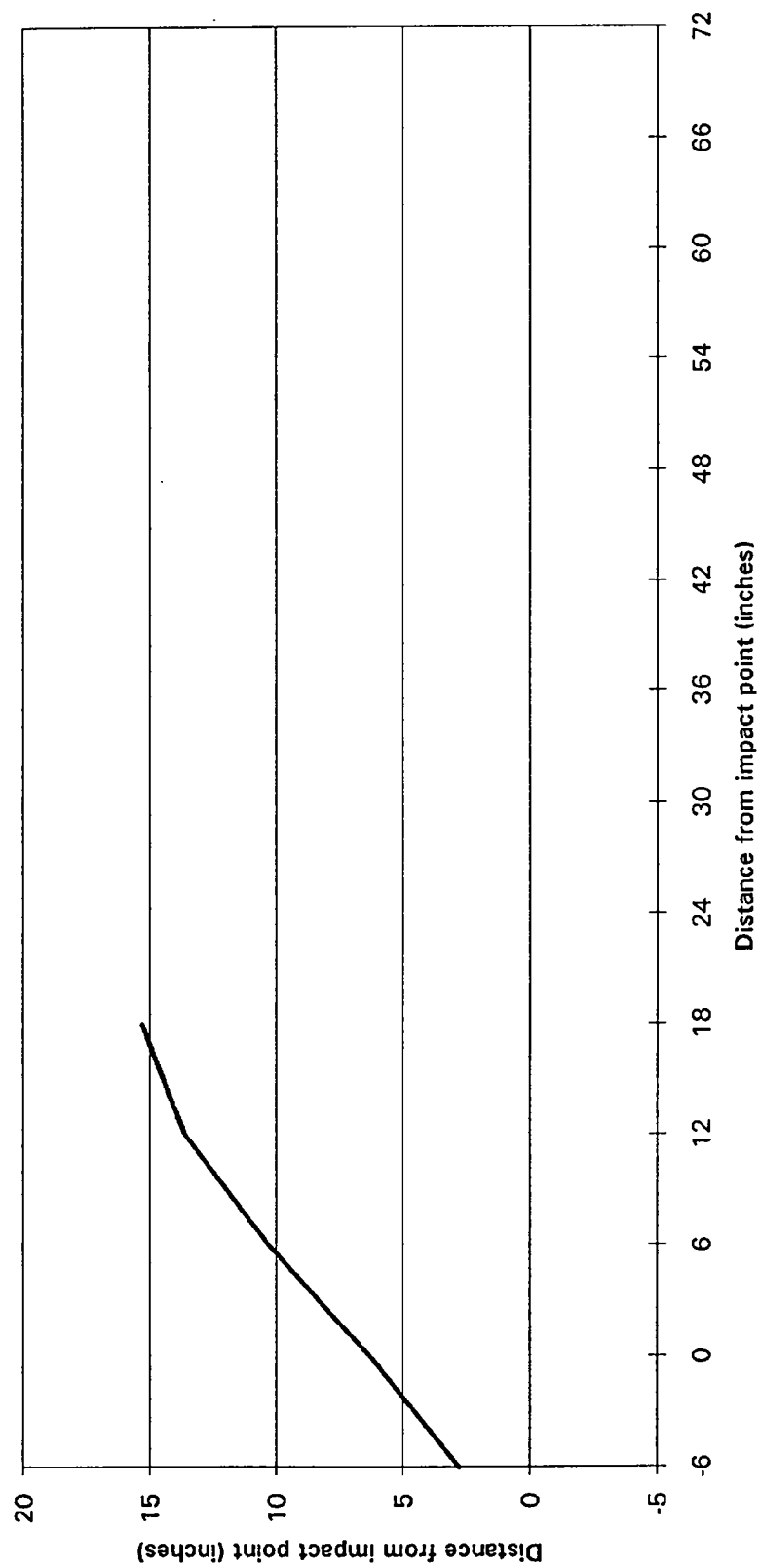
*Reference plane is parallel to and 48 inches from test vehicle longitudinal centerline
 Given Dimensions = Reference Plane to Car Body.

Figure 6
 VEHICLE EXTERIOR STATIC CRUSH
 10.5 inches above ground level
 Level 1



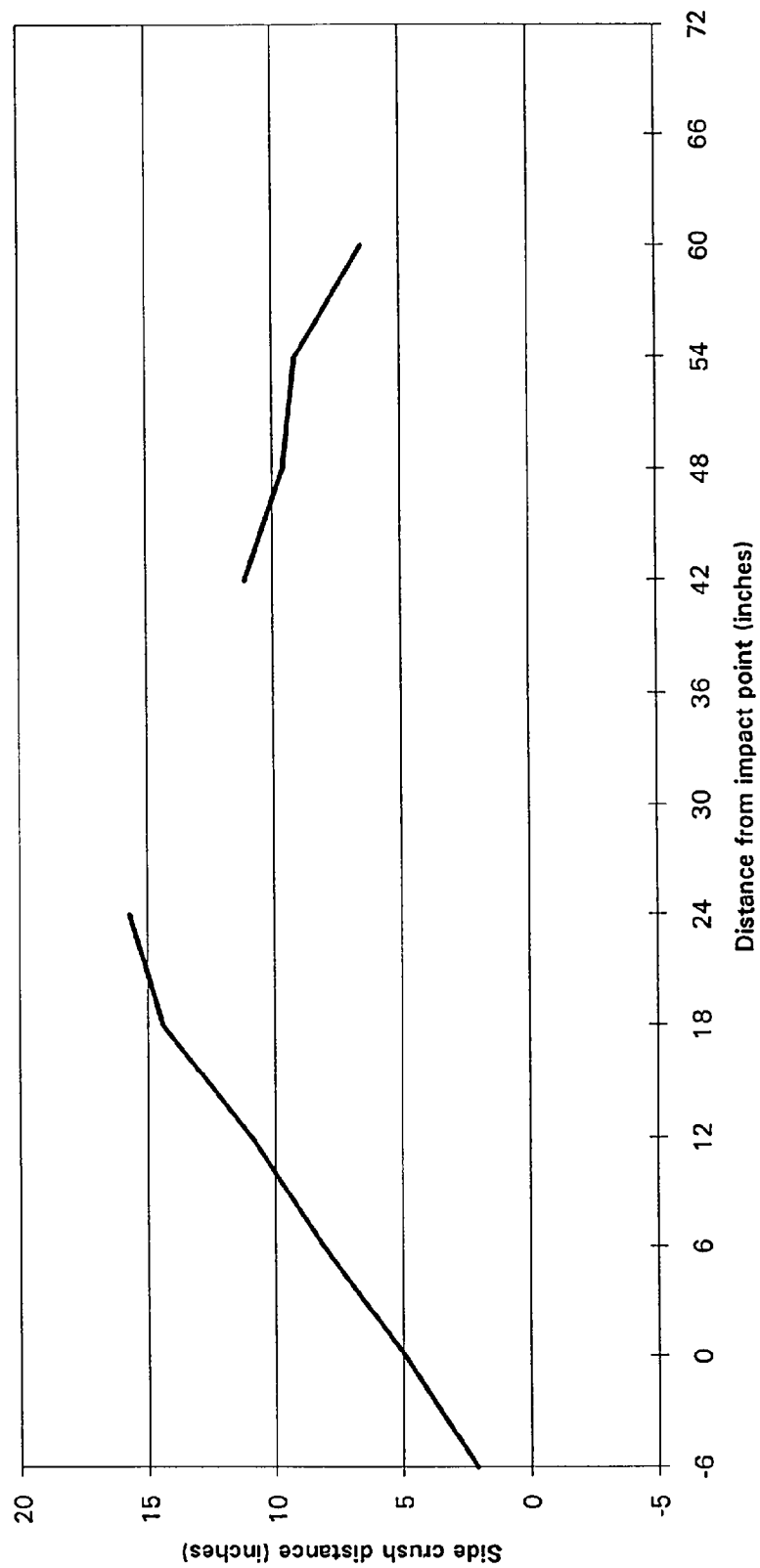
Note: All measurements in inches
 Left side of vehicle only

Figure 6
VEHICLE EXTERIOR STATIC CRUSH (cont.)
18.5 inches above ground level
Level 2



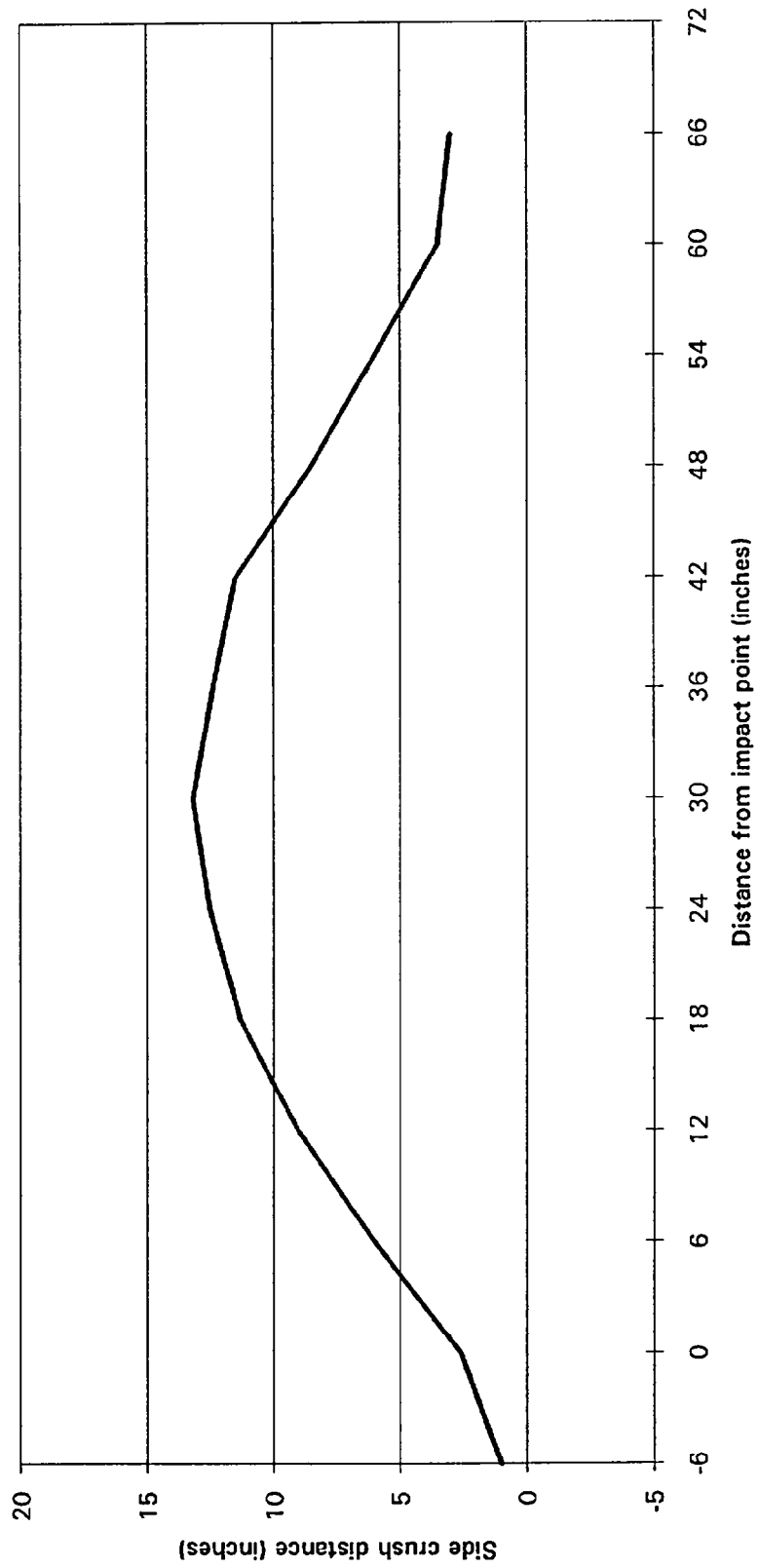
Note: All measurements in inches
 Left side of vehicle only

Figure 6
VEHICLE EXTERIOR STATIC CRUSH (cont.)
 23.3 inches above ground level
 Level 3



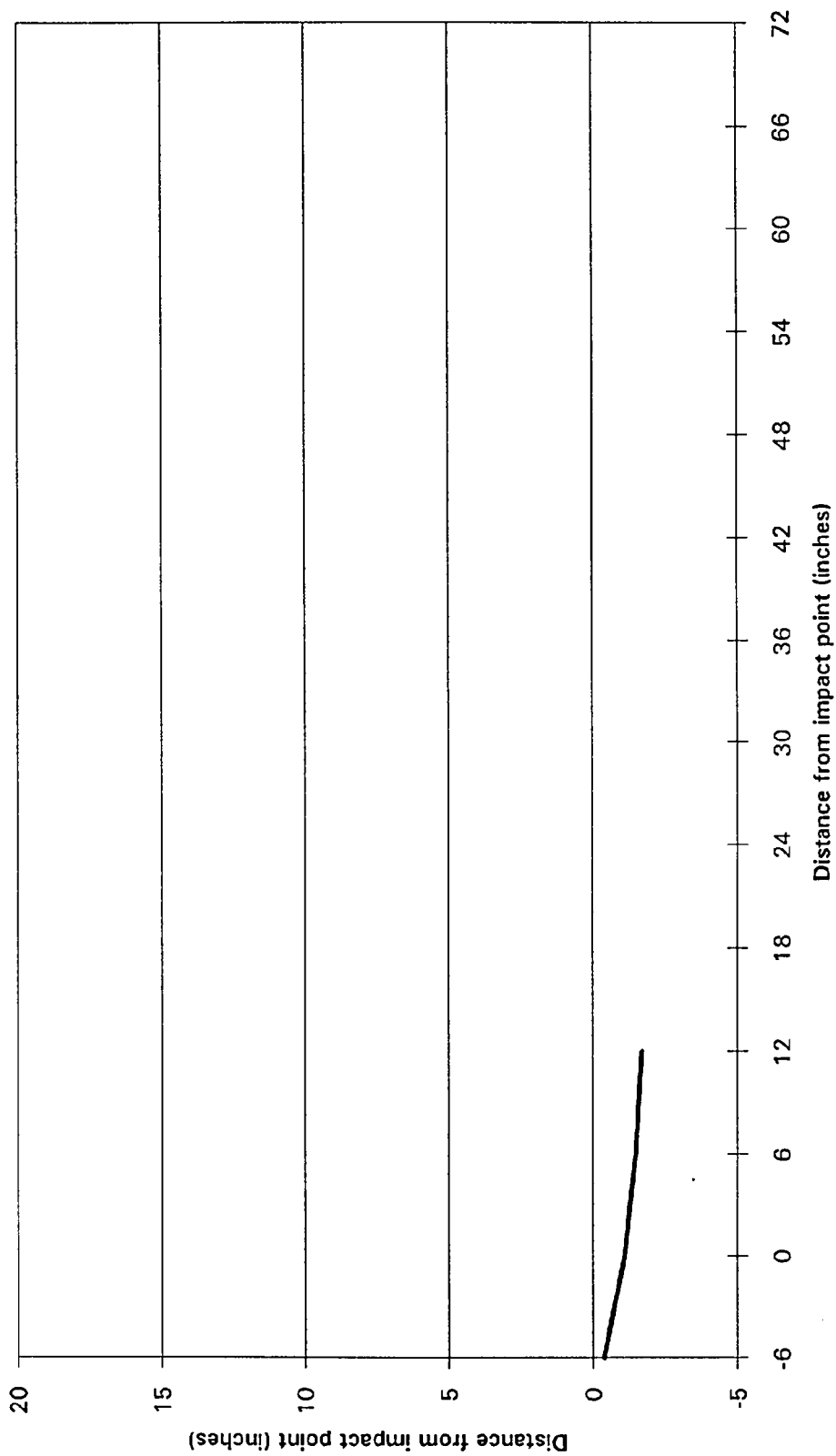
Note: All measurements in inches
 Left side of vehicle only

Figure 6
VEHICLE EXTERIOR STATIC CRUSH (cont.)
 33 inches above ground level
 Level 4



Note: All measurements in inches
 Left side of vehicle only

Figure 6
VEHICLE EXTERIOR STATIC CRUSH (cont.)
50.5 inches above ground level
 Level 5



Note: All measurements in inches
 Left side of vehicle only

Table 8

EXTERIOR STATIC CRUSH FOR SIDE IMPACTOR

(Grid as looking at MDB from front.)

Test Date: May 21, 1993

Vehicle: 1993 Toyota Corolla 4-Door Sedan

		Distances Right of Center									Distances Left of Center							
		32"	28"	24"	20"	16"	12"	8"	4"		0"	4"	8"	12"	16"	20"	24"	28"
Location	Height at C _L *																	
Top of Stack Level	32"	-7.2	-6.5	-5.8	-5.2	-4.5	-3.9	-3.2	-2.5	-1.7	-0.5	-0.1	-0.8	1.7	2.6	4.0	6.1	8.5
Mid-Stack Level	22"	-8.0	-7.2	-6.4	-5.5	-4.6	-3.7	-2.8	-2.0	-1.5	-0.7	0.0	0.9	2.0	3.1	4.2	5.2	7.7
Bumper Level	17"	-6.5	-6.4	-5.4	-4.5	-3.5	-2.7	-1.7	-0.7	0.7	1.4	2.8	5.0	6.5	8.0	9.5	10.7	12.5

*Heights measured above ground level.

**Impact side.

Figure 7

TEST VEHICLE ACCELEROMETER LOCATIONS AND DATA SUMMARY

Test Vehicle: 1993 Toyota Corolla, 4-Door Sedan Test No.: 1287

Test Date: May 21, 1993

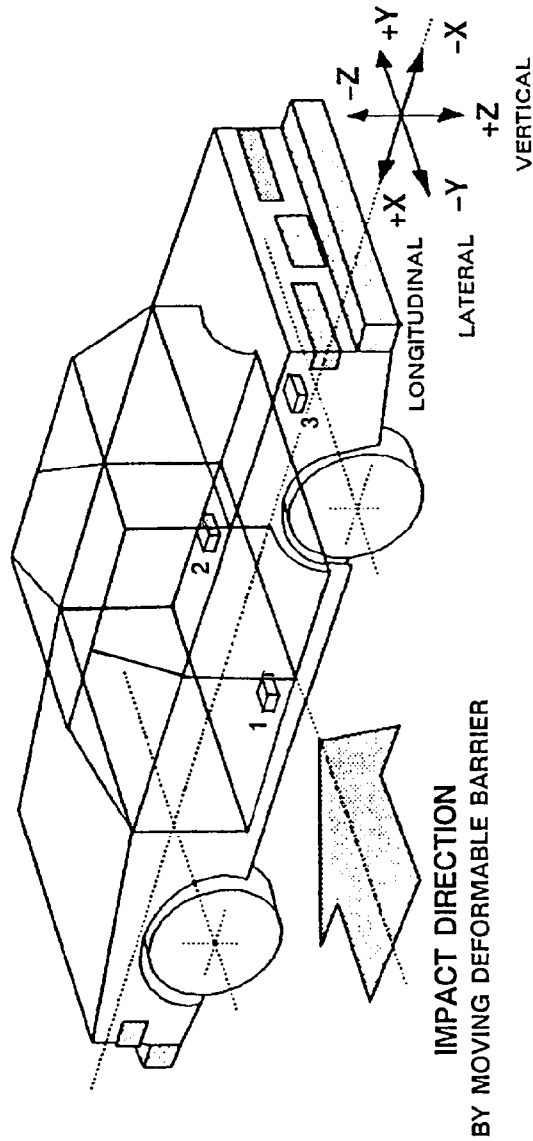


Table 9
TEST VEHICLE ACCELEROMETER LOCATIONS AND DATA SUMMARY

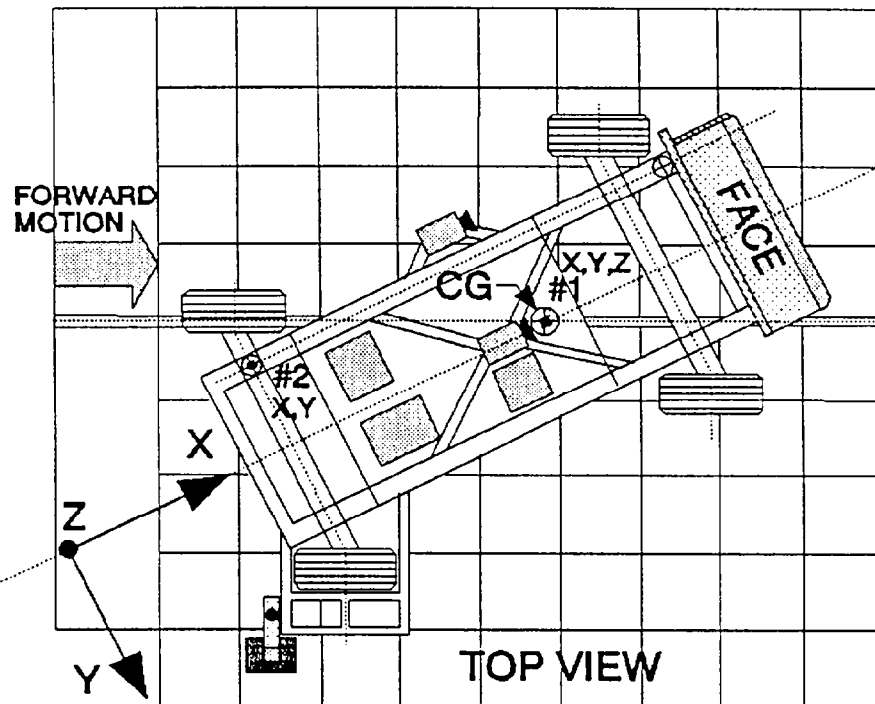
Accel. Time No.	Location	Long. (X) Pos./Neg.		Lat. (Y) Pos./Neg.		Vert. (Z) Pos./Neg.		Resultant Pos./Neg.	
		Max (g)	Time (msec)	Max (g)	Time (msec)	Max (g)	Tim (msec)	Max (g)	(msec)
1	Left B Pillar	30.8	49.2	N/A	N/A	N/A	N/A	N/A	N/A
2	Right B Pillar	139.4	46.9	23.7	55.6	N/A	N/A	N/A	N/A
3	Rear Floorpan Above Axle	N/A	N/A	53.0	46.1	N/A	N/A	N/A	N/A

*Reference: X - Rear Bumper (+ Forward)
Y - Vehicle Centerline (+ To right)
Z - Ground Level (+ Up)

Figure 8

MOVING DEFORMABLE BARRIER (MDB) ACCELEROMETER LOCATIONS

Test Vehicle: 1993 Toyota Corolla 4-Door Sedan Test Date: 1287



Accel. No.	Location	Pos. Direct.		Neg. Direct.	
		Max (g)	Time (msec)	Max (g)	Time (msec)
1	MDB Center of Gravity				
	Longitudinal ... X	1.4	133.3	-15.5	47.2
	Lateral Y	3.0	27.6	-4.2	87.1
	Vertical Z	14.5	84.5	-10.9	110.5

*Reference: X = Rear Bumper (+Forward)
 Y = Vehicle Centerline (+ To Right)
 Z = Ground Level (+ Up)

Figure 9
HIGH SPEED CAMERA LOCATIONS

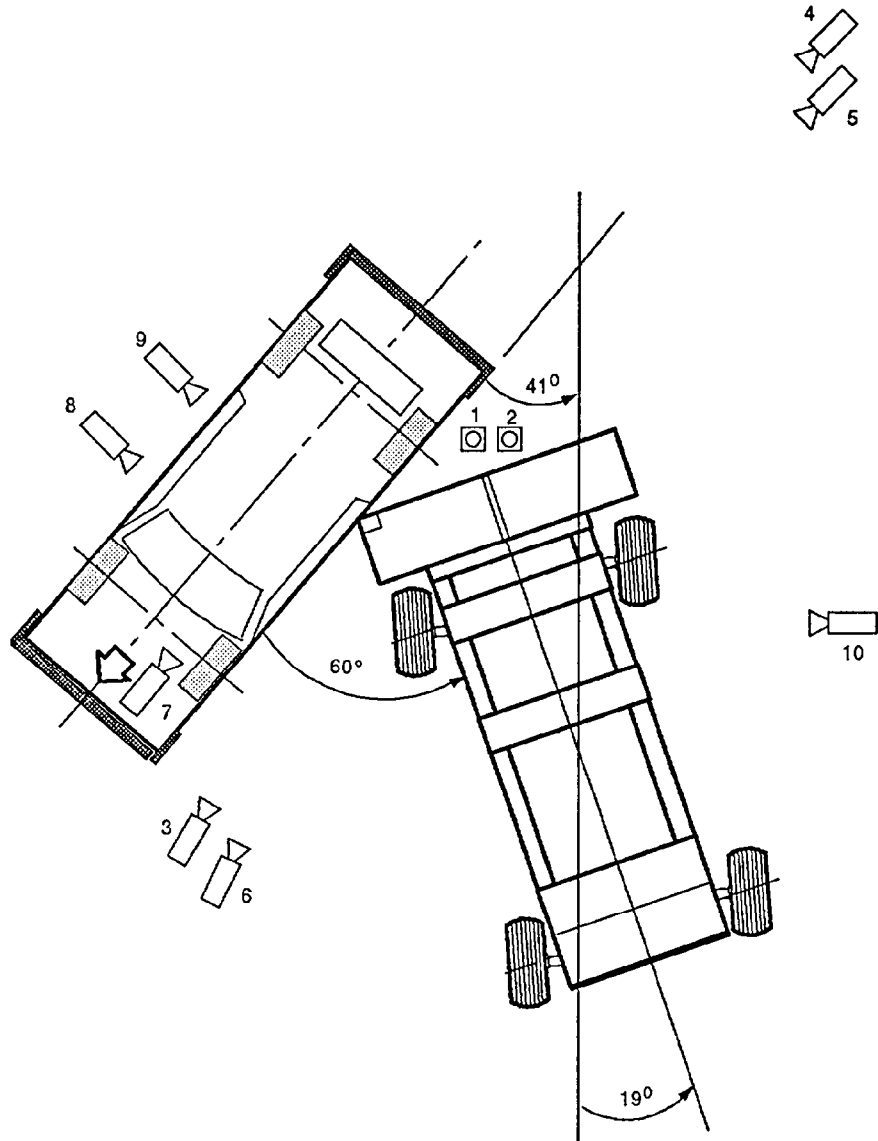


Table 10

HIGH SPEED CAMERA DATA

Camera No.	View	Coordinates (mm)			Angle	Lens (mm)	Film Speed (fps)
		X*	Y*	Z*			
1	Overhead Overall View	0	33	386	-90	13	580
2	Overhead Closeup View of Impact	0	39	386	-90	25	590
3	Left Side Closeup View	-63	-335	40	-1	25	760
4	Right Side Closeup View	-116	357	41	-1	25	620
5	Right Side Ground Overall View	-96	371	42	-2	13	550
6	Left Side Ground Overall View	-9	-356	42	+1	13	600
7	Test Vehicle Onboard Driver Front View	-	-	-	-	13	610
8	Test Vehicle Onboard Driver Side View	-	-	-	-	13	580
9	Test Vehicle Onboard Passenger Side View	-	-	-	-	13	590
10	Real Time	-	-	-	-	-	24

*Reference: (from point of impact)

+X = Forward

+Y = To Right

+Z = Upward

Appendix A
PHOTOGRAPHS

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Figure A-1 PRE-TEST OVERHEAD VIEW OF TEST VEHICLE

A-3

8102-5



Figure A-2 POST-TEST OVERHEAD VIEW OF TEST VEHICLE

A-4

8102-5



Figure A-3 PRE-TEST FRONT VIEW OF TEST VEHICLE

A-5

8102-5



Figure A-4 POST TEST FRONT VIEW OF TEST VEHICLE

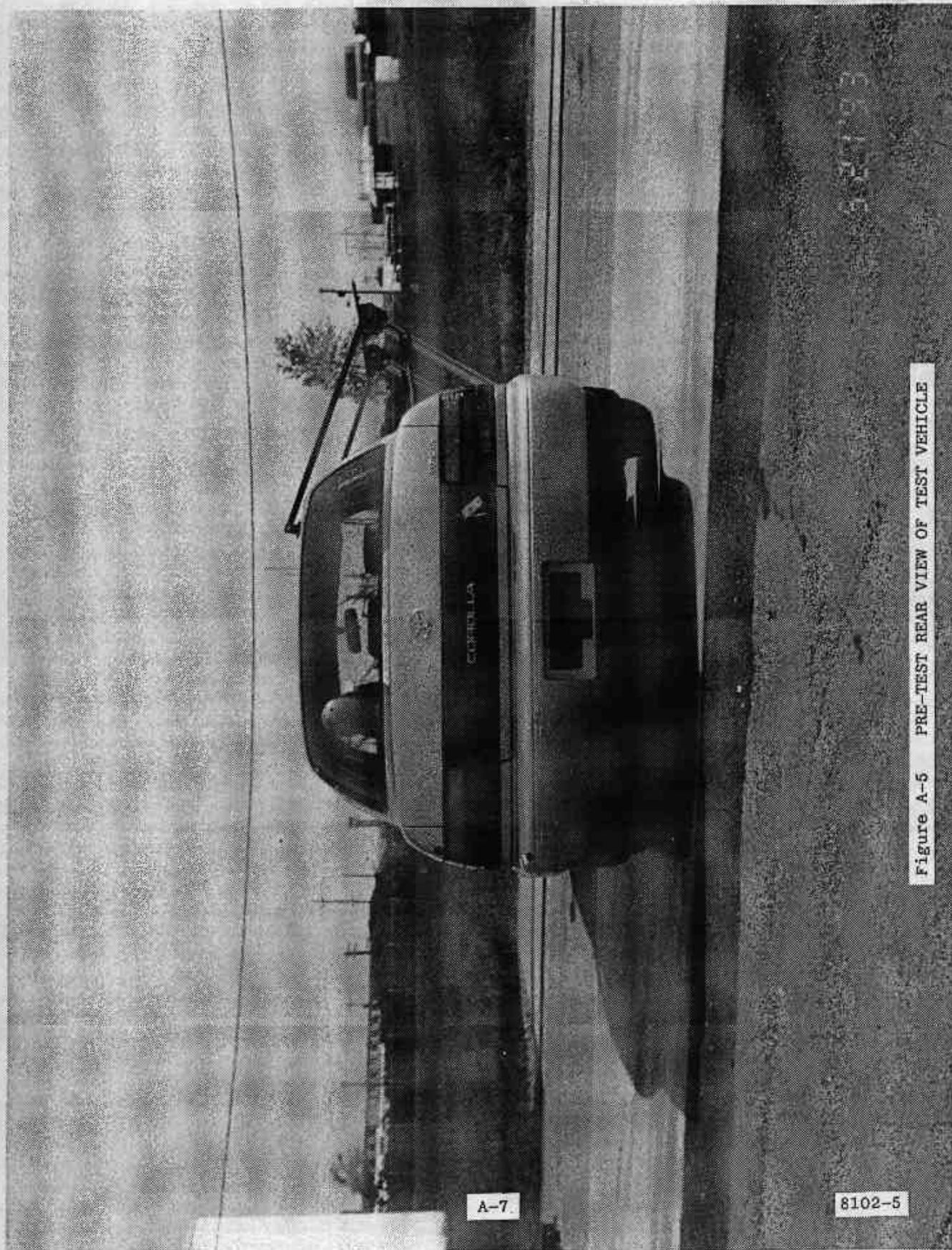


Figure A-5 PRE-TEST REAR VIEW OF TEST VEHICLE

A-7

8102-5

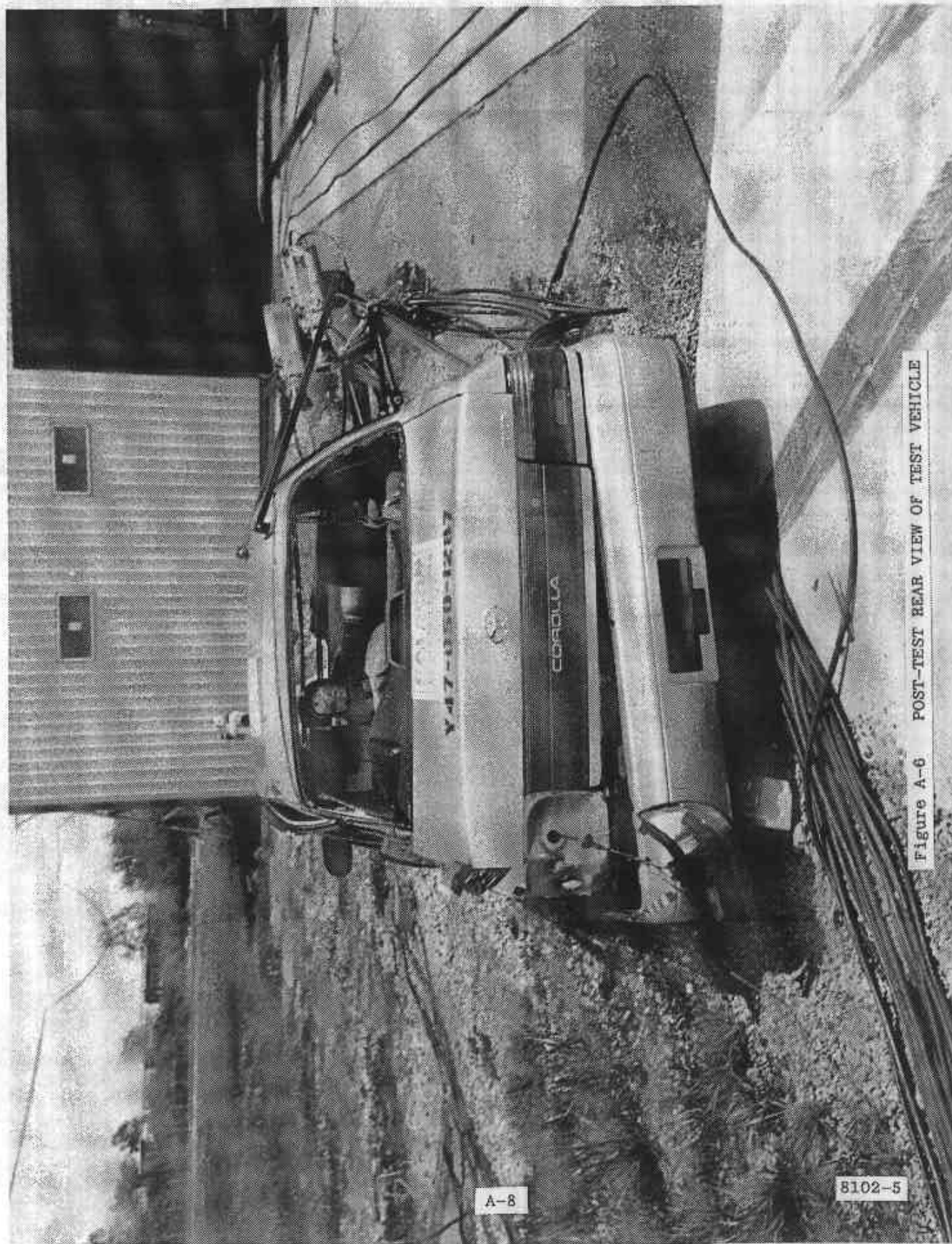


Figure A-6 POST-TEST REAR VIEW OF TEST VEHICLE

A-8

8102-5

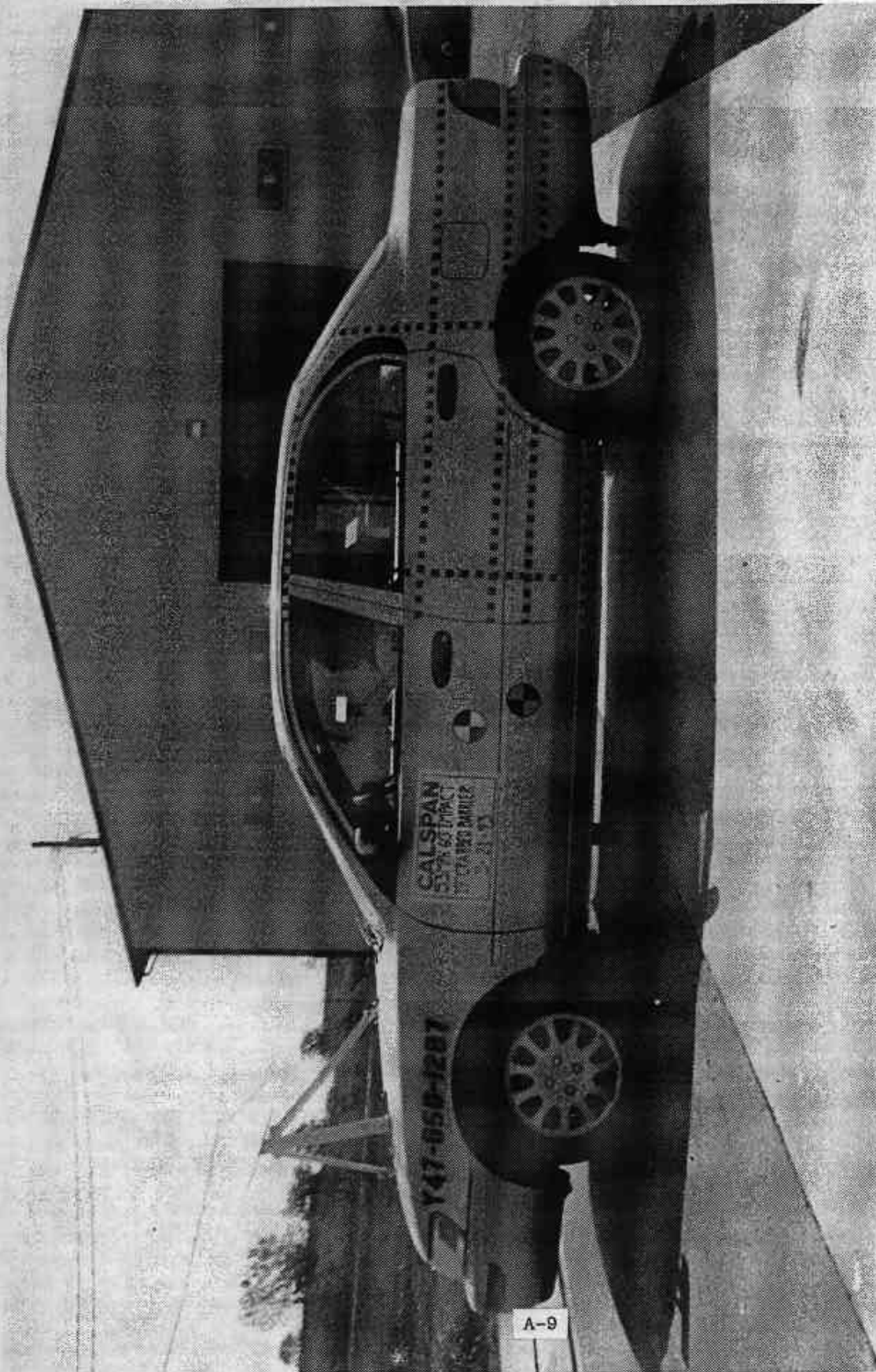


Figure A-7 PRE-TEST LEFT SIDE VIEW OF TEST VEHICLE

A-9

8102-5

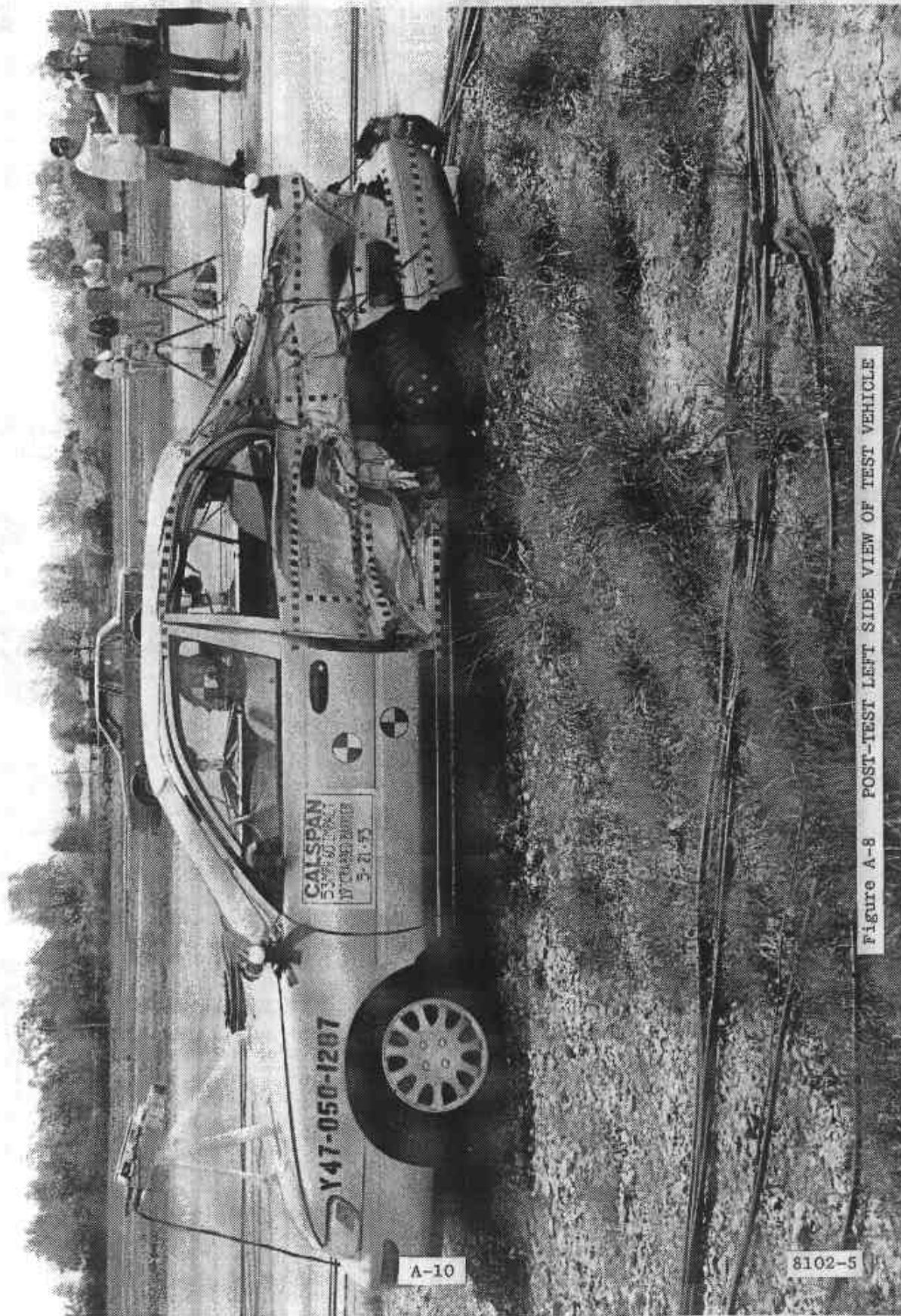


Figure A-8 POST-TEST LEFT SIDE VIEW OF TEST VEHICLE

A-10

8102-5



Figure A-9 PRE-TEST LEFT FRONT CONFIGURATION VIEW

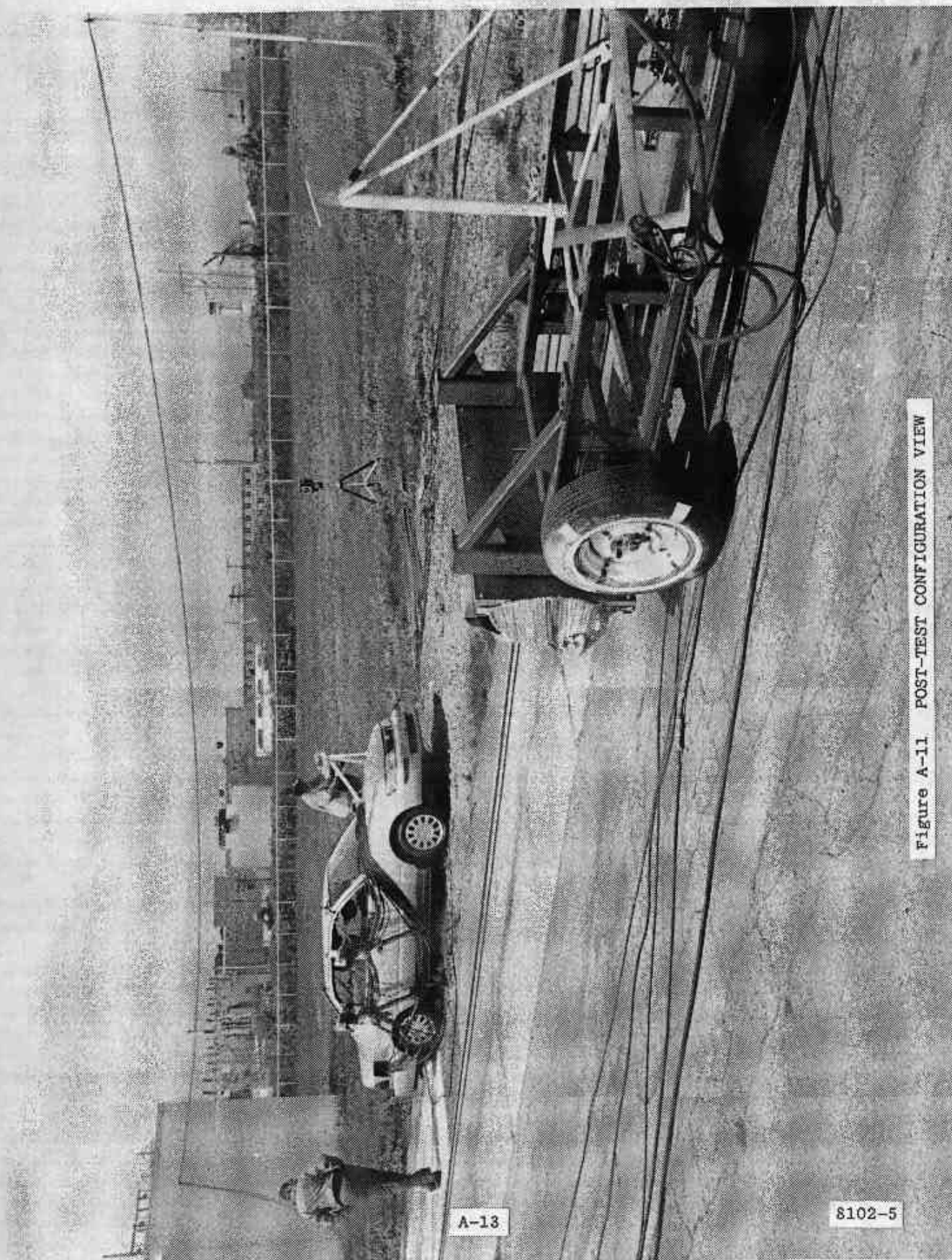


Figure A-10 PRE-TEST LEFT REAR CONFIGURATION VIEW

A-12

8102-5

Figure A-11 POST-TEST CONFIGURATION VIEW



A-13

8102-5

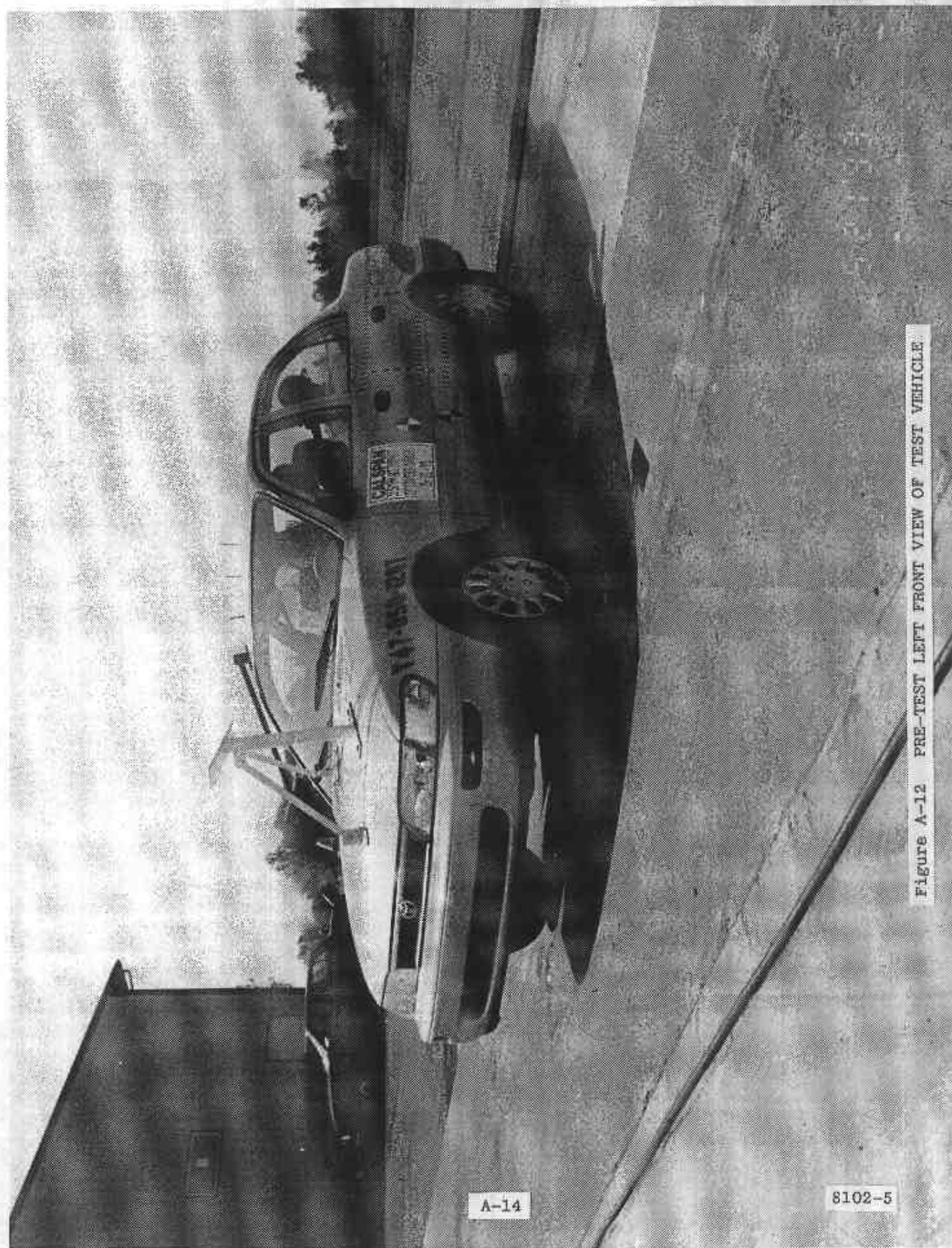


Figure A-12 PRE-TEST LEFT FRONT VIEW OF TEST VEHICLE

A-14

8102-5



Figure A-13 POST-TEST LEFT FRONT VIEW OF TEST VEHICLE



Figure A-14 PRE-TEST LEFT REAR VIEW OF TEST VEHICLE

A-18

8102-5

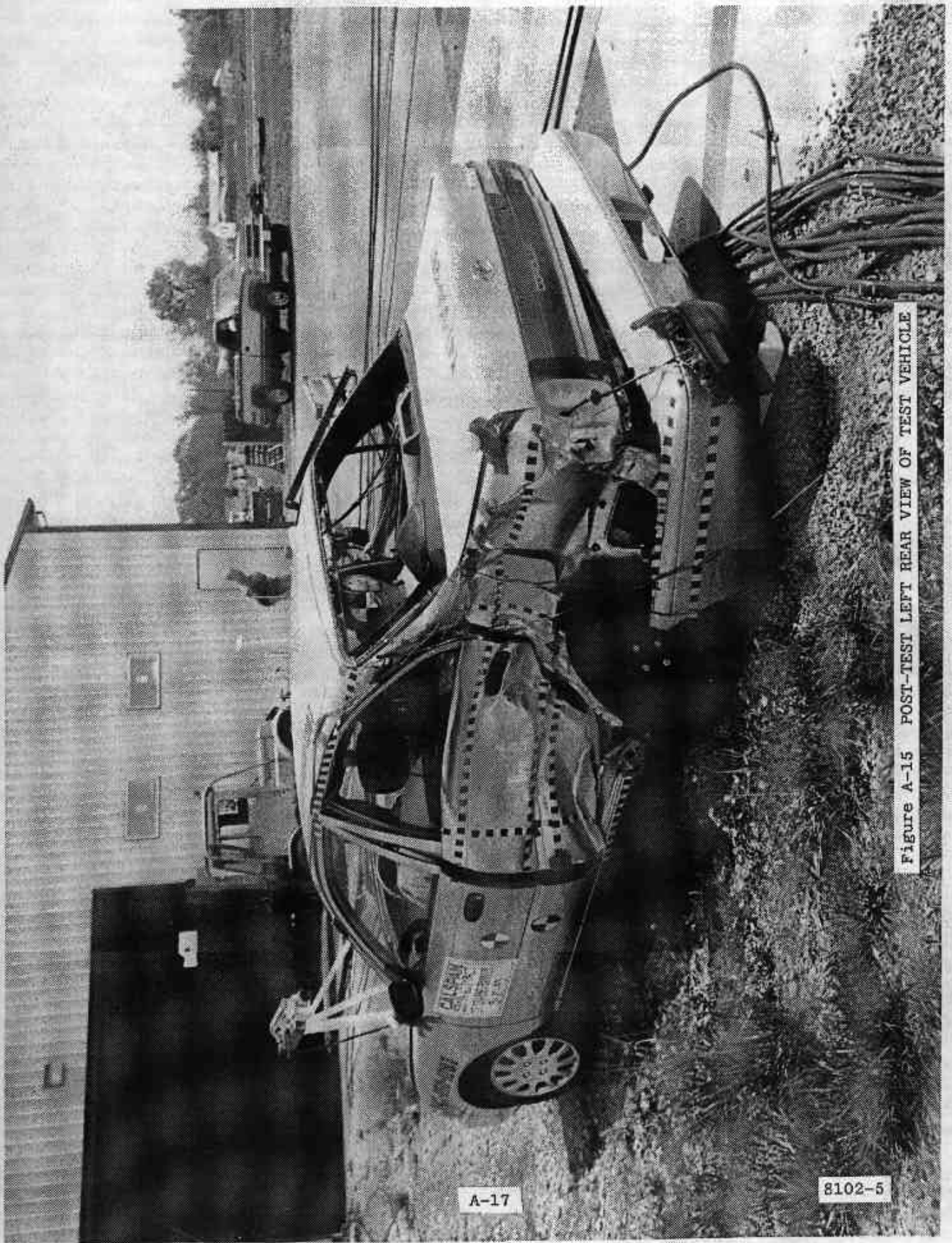


Figure A-15 POST-TEST LEFT REAR VIEW OF TEST VEHICLE

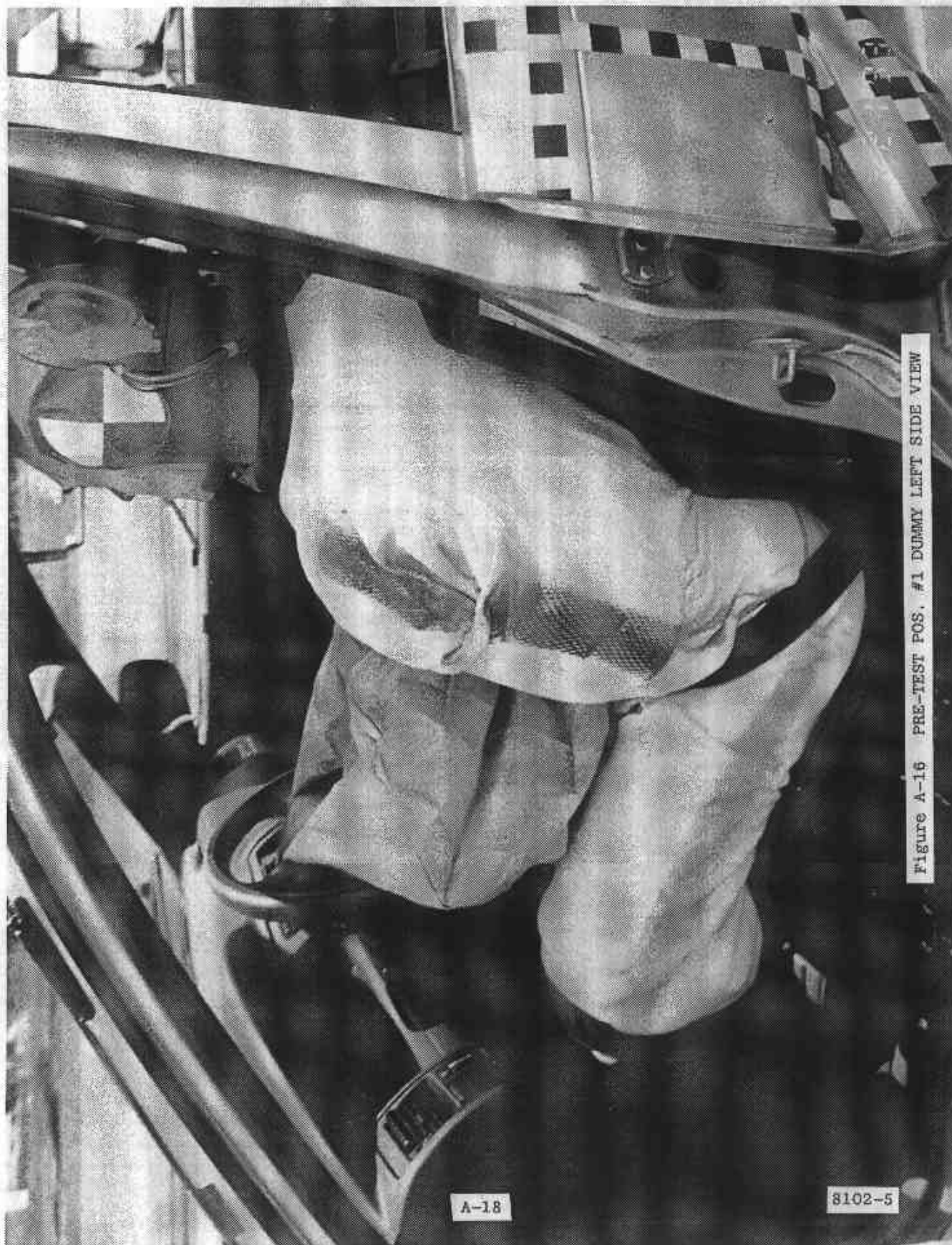


Figure A-16 PRE-TEST POS. #1 DUMMY LEFT SIDE VIEW

A-18

8102-5



Figure A-17 POST-TEST POS. #1 DUMMY LEFT SIDE VIEW.

A-19

8102-5



Figure A-18 PRE-TEST POS. #1 DUMMY RIGHT SIDE VIEW

A-20

8102-5



Figure A-19 POST-TEST POS. #1 DUMMY RIGHT SIDE VIEW

A-21

8102-5



Figure A-20 PRE-TEST POS. #4 DUMMY LEFT SIDE VIEW

A-22

8102-5

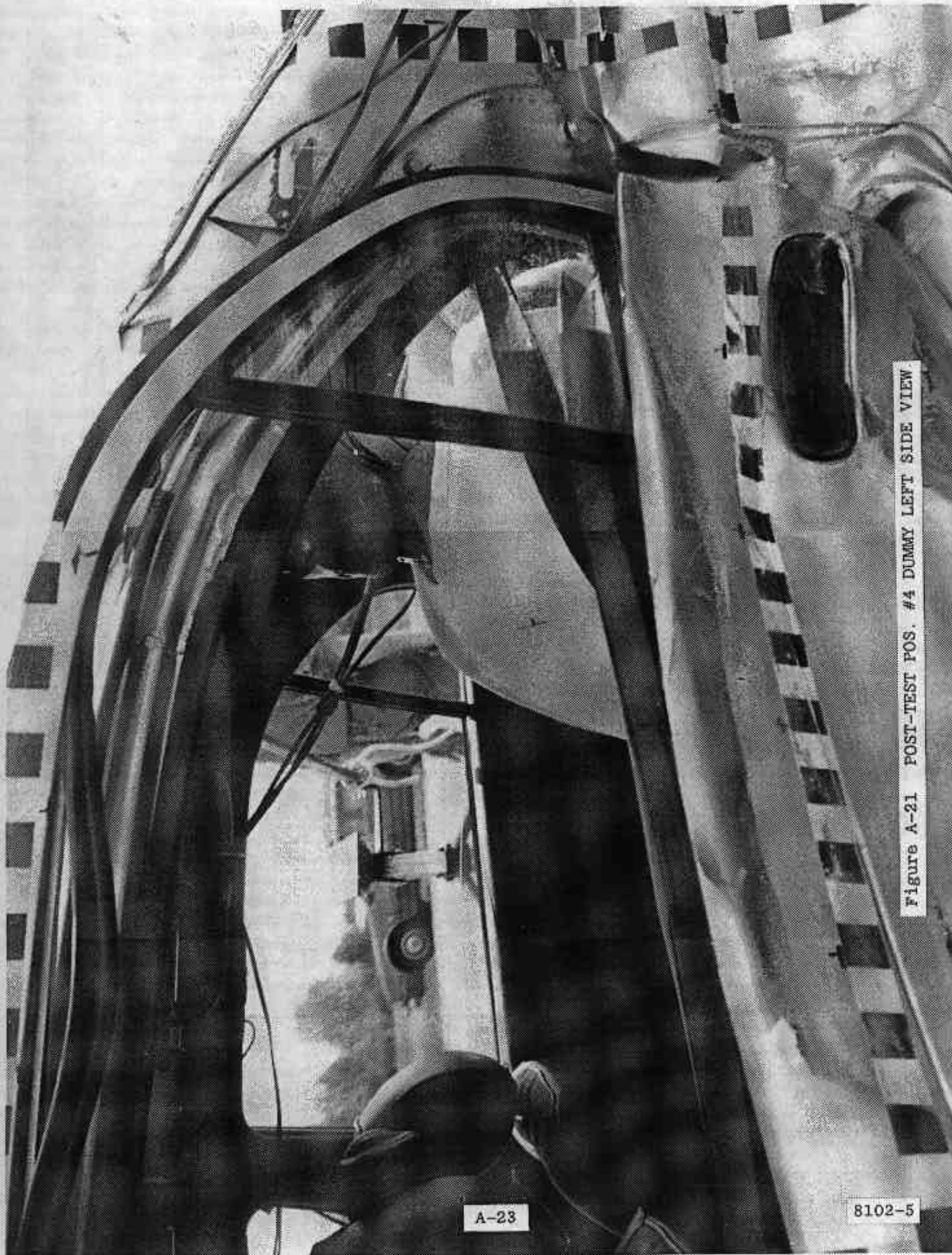


Figure A-21 POST-TEST POS. #4 DUMMY LEFT SIDE VIEW.

A-23

8102-5



Figure A-22 PRE-TEST POS. #4 DUMMY RIGHT SIDE VIEW

A-24

8102-5

92193

Figure A-23 POST-TEST POS. #4 DUMMY RIGHT SIDE VIEW

A-25

8102-5

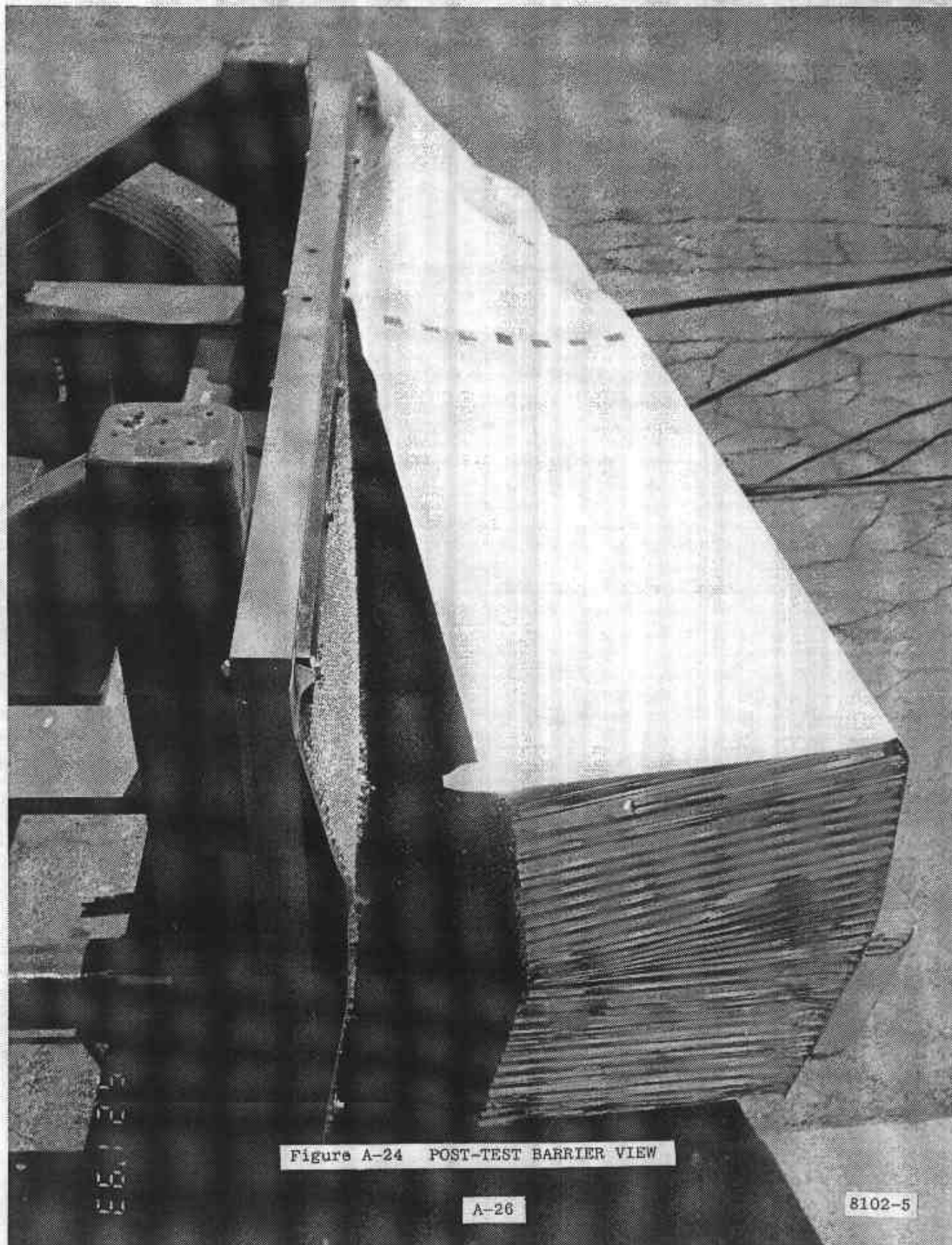
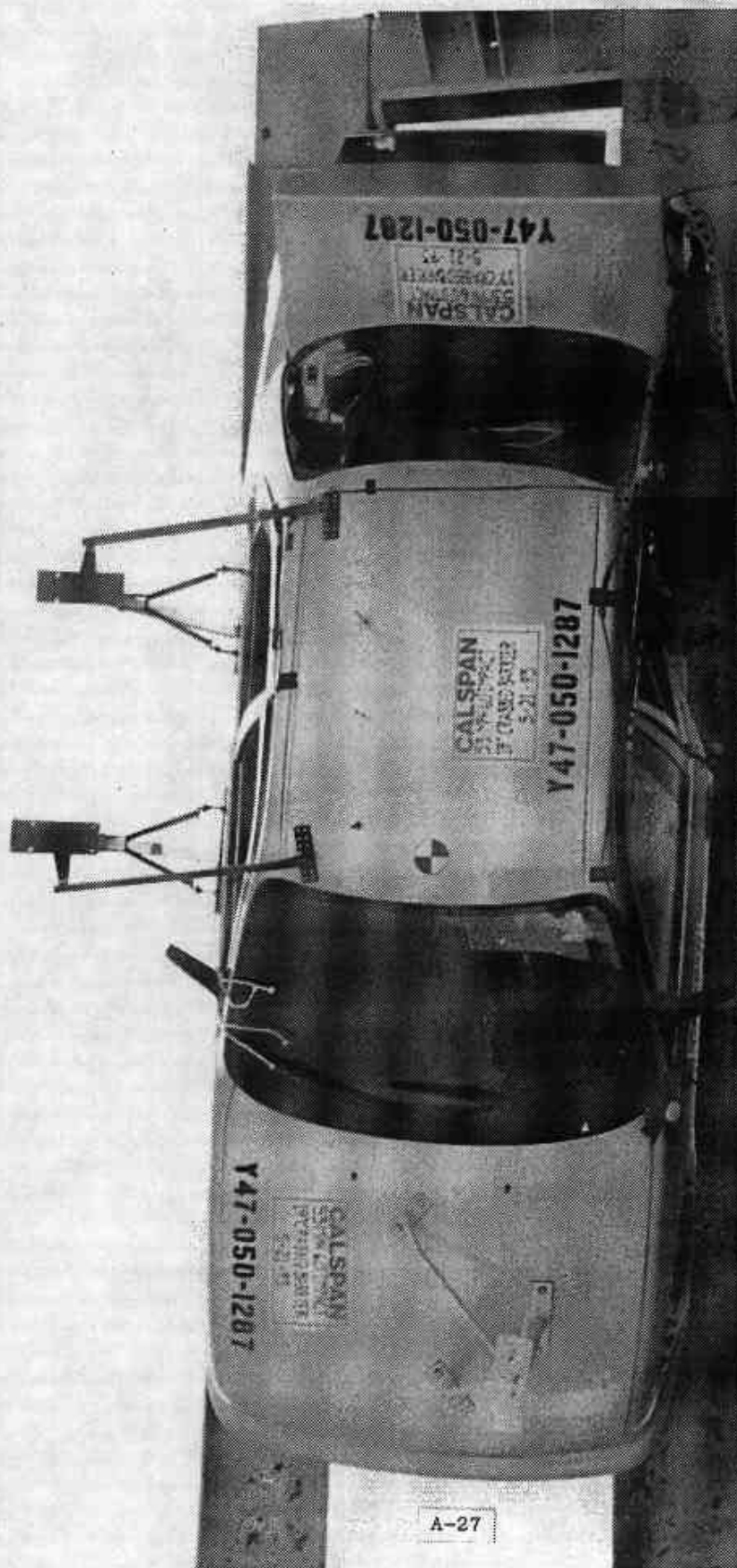


Figure A-24 POST-TEST BARRIER VIEW

A-26

8102-5



A-27

8102-5

Figure A-25 POST-TEST ROLLOVER VIEW

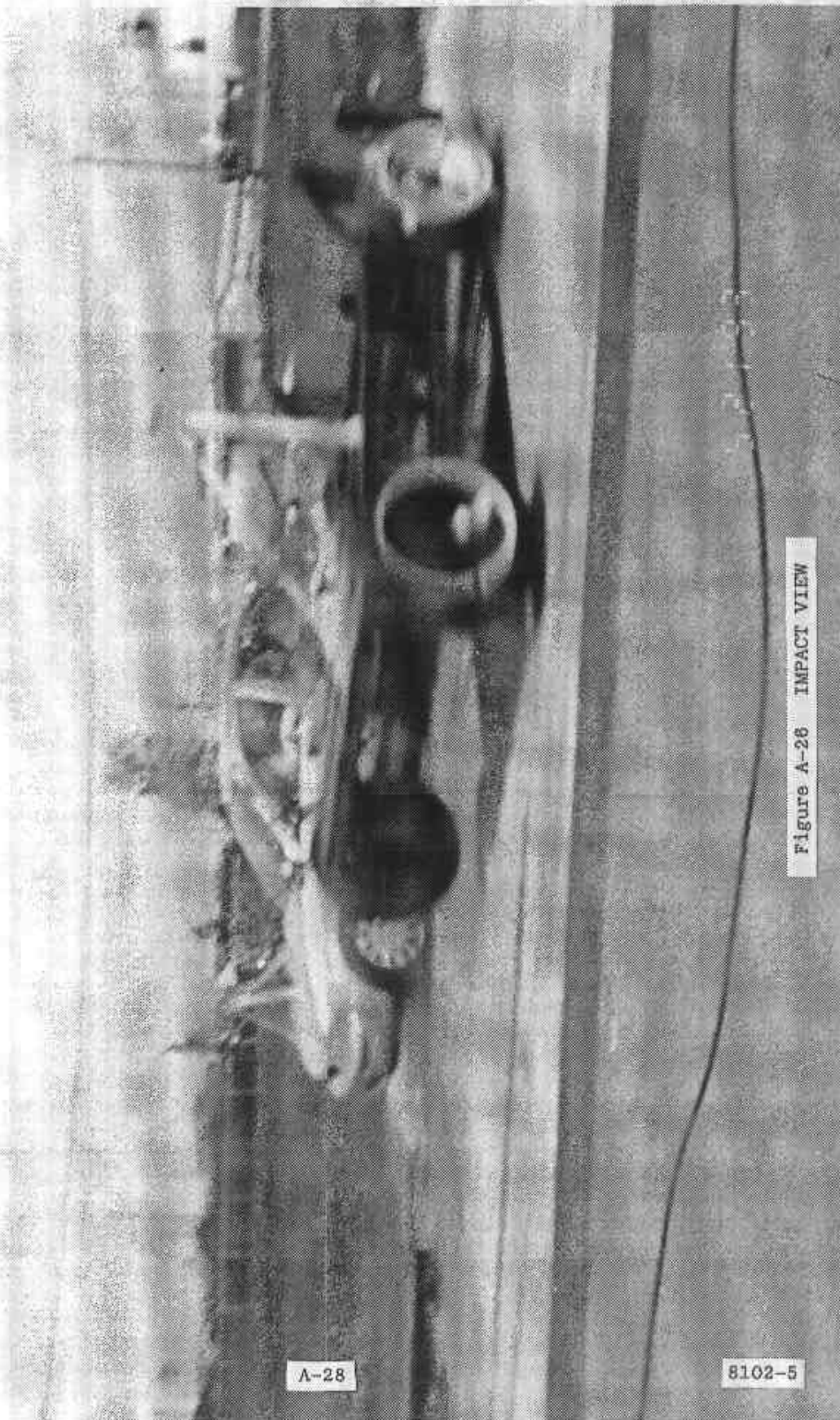


Figure A-28 IMPACT VIEW

A-28

8102-5

Appendix B

DATA PLOTS

All vehicle data and dummy head and chest deflection data were filtered following SAE J211b. Data from the Side Impact Dummies' thorax and pelvis were filtered in the following manner:

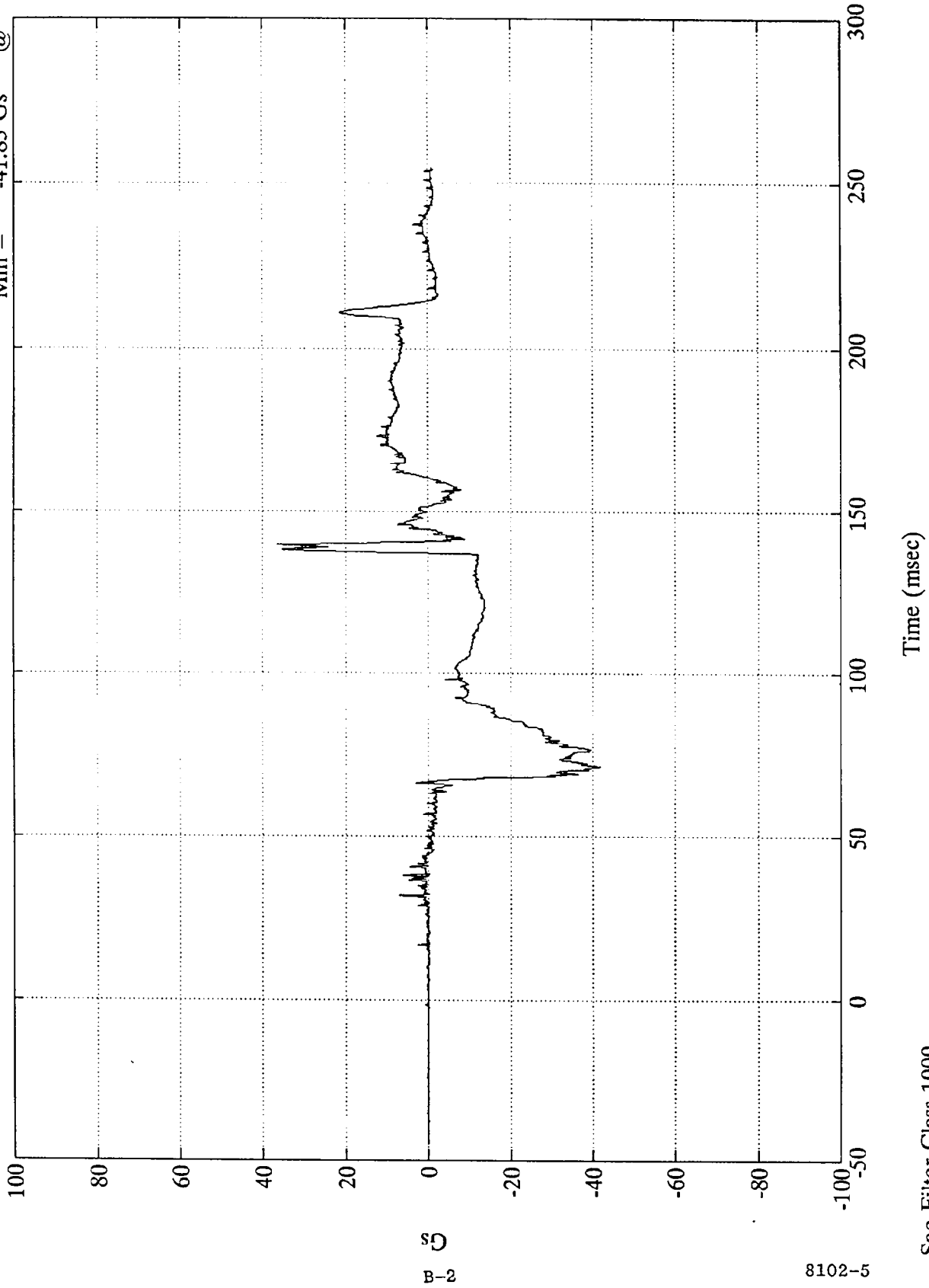
- a. Filter the data with a 300 Hz SAE Class 180 filter;
- b. Subsample the data to a 1600 Hz sampling rate; and
- c. Filter the data with a Finite Impulse Response (FIR) filter having the following characteristics:
 1. Passband frequency 100 Hz
 2. Stopband frequency 189 Hz
 3. Stopband gain -50 dB
 4. Passband ripple 0.0225 dB

FIR filtered data is so noted in this appendix.

TSC 301 Test 5 - Side Impact

Max = 36.49 Gs @ 139.44 msec
Min = -41.83 Gs @ 71.52 msec

P1 Head X

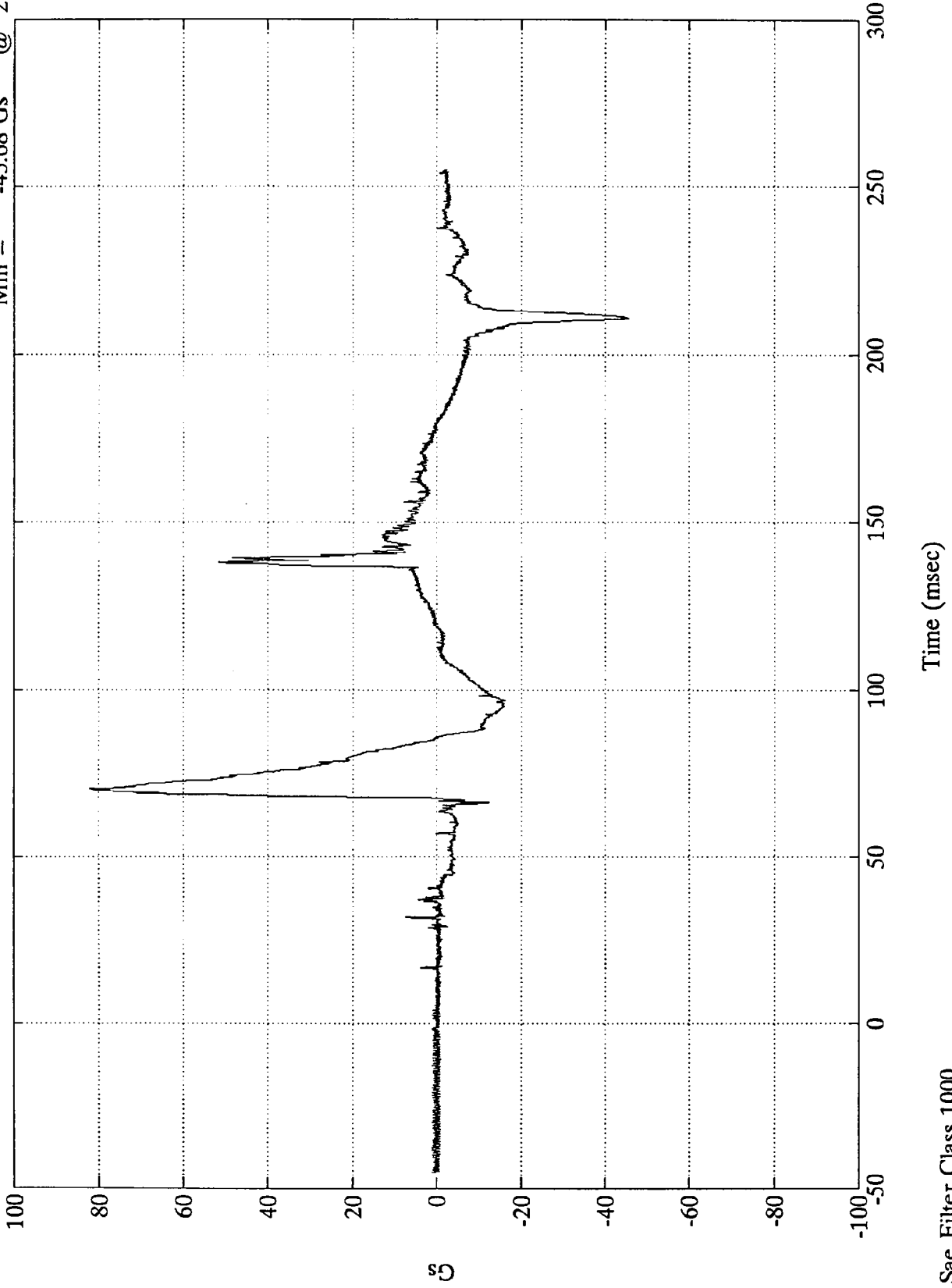


Sae Filter Class 1000

TSC 301 Test 5 - Side Impact

Max = 82.24 Gs @ 70.31 msec
Min = -45.68 Gs @ 210.72 msec

P1 Head Y



B-3

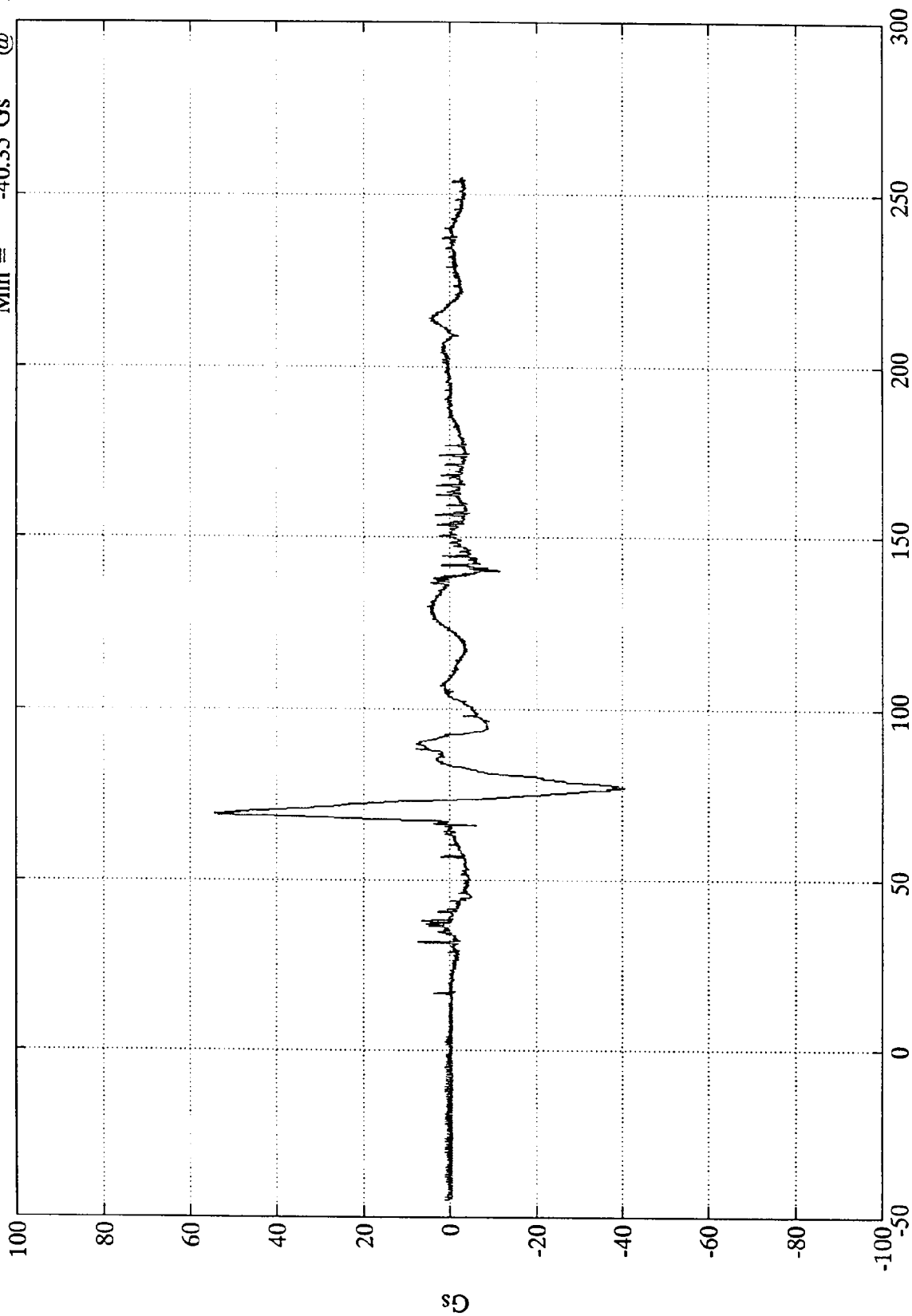
8102-5

Sae Filter Class 1000

TSC 301 Test 5 - Side Impact

Max = 54.46 Gs @ 69.24 msec
Min = -40.35 Gs @ 76.92 msec

P1 Head Z



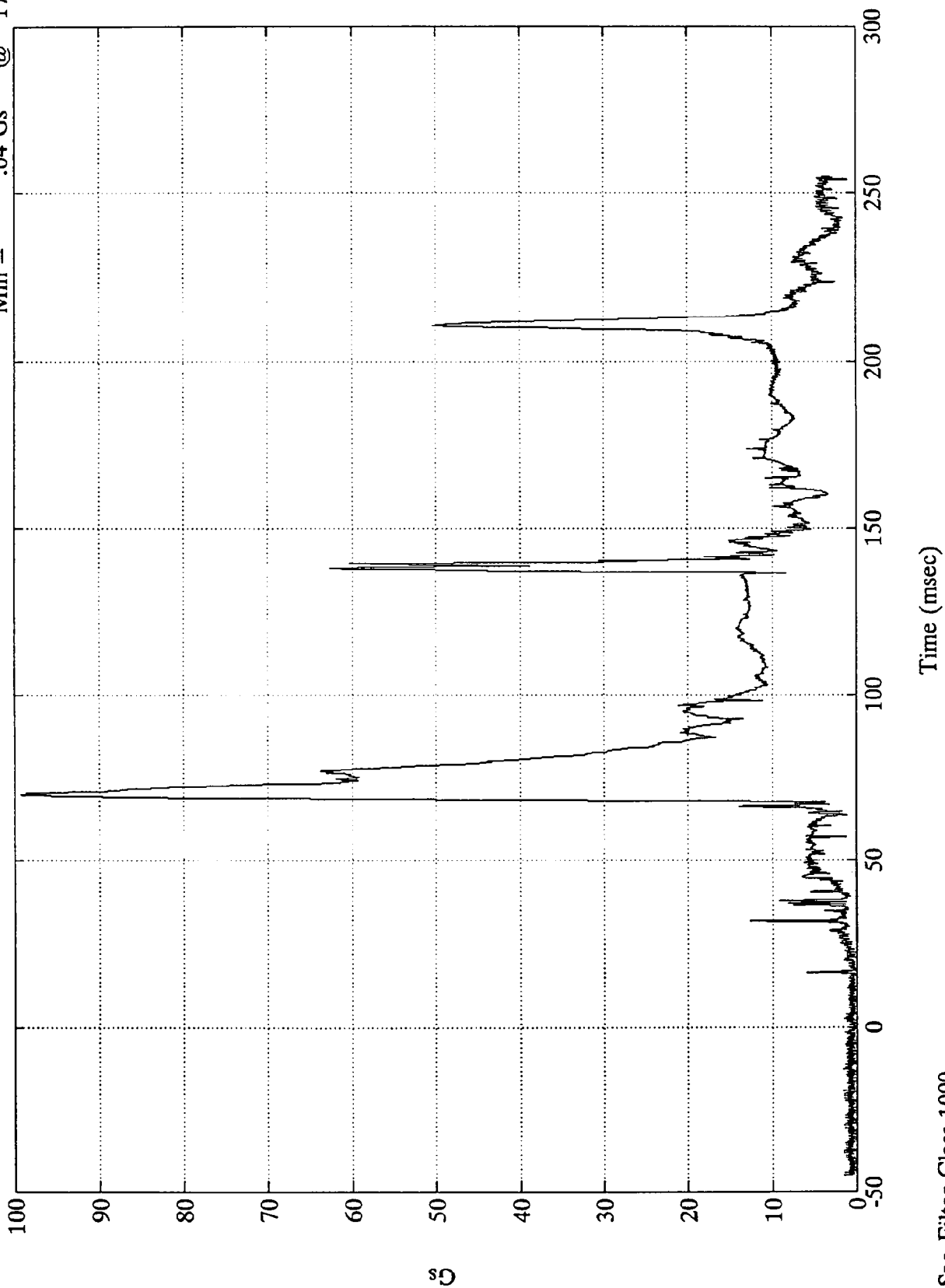
Time (msec)

Sae Filter Class 1000

TSC 301 Test 5 - Side Impact

P1 Head Resultant

Max = 99.35 Gs @ 69.48 msec
Min = .04 Gs @ 17.51 msec

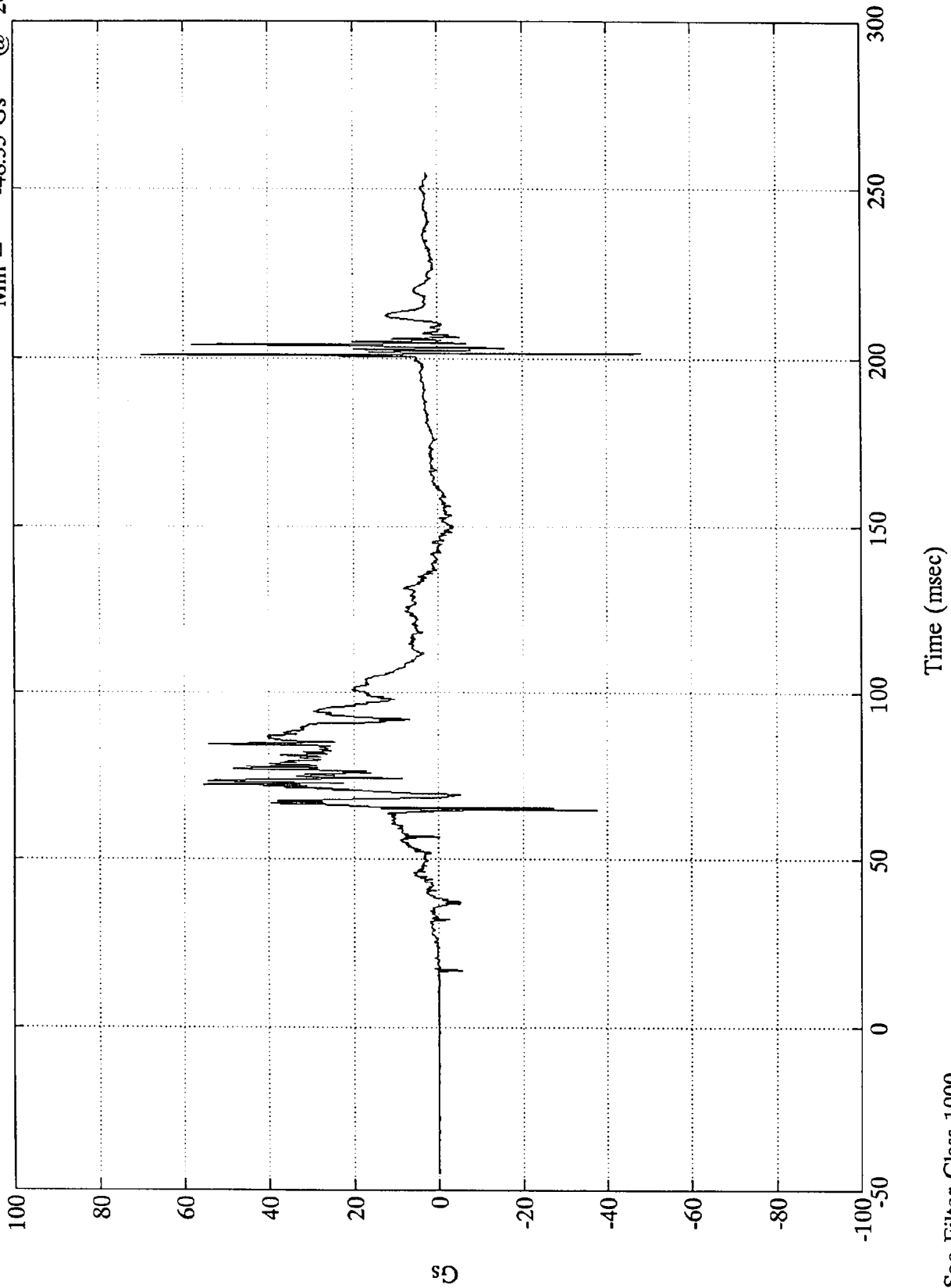


Sac Filter Class 1000

TSC 301 Test 5 - Side Impact

Max = 69.81 Gs @ 200.88 msec
Min = -48.33 Gs @ 201.47 msec

P1 Upper Rib Y



5G
B-6

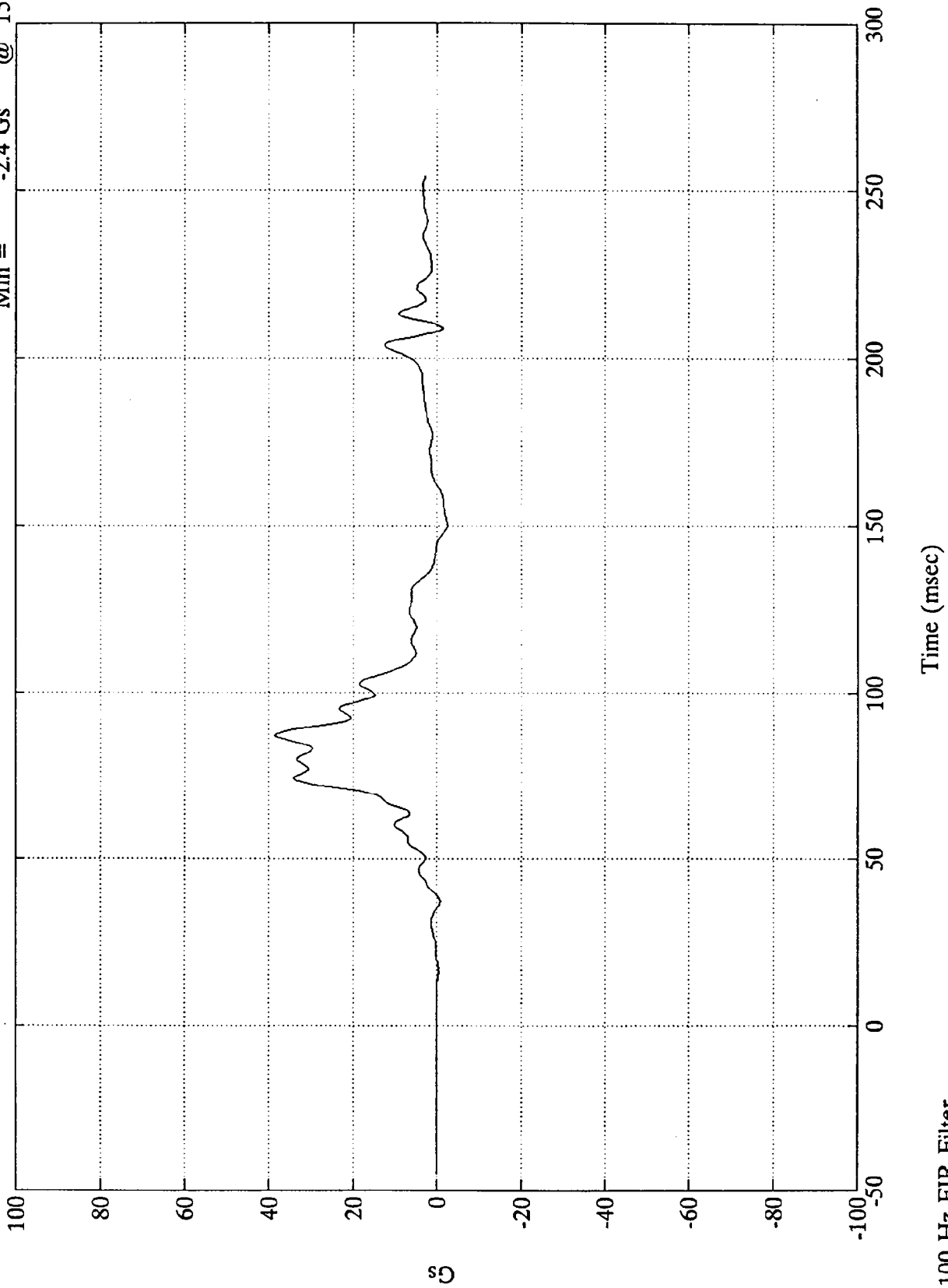
8102-5

Sae Filter Class 1000

TSC 301 Test 5 - Side Impact

P1 Upper Rib Y

Max = 38.7 Gs @ 86.875 msec
Min = -2.4 Gs @ 150.62 msec



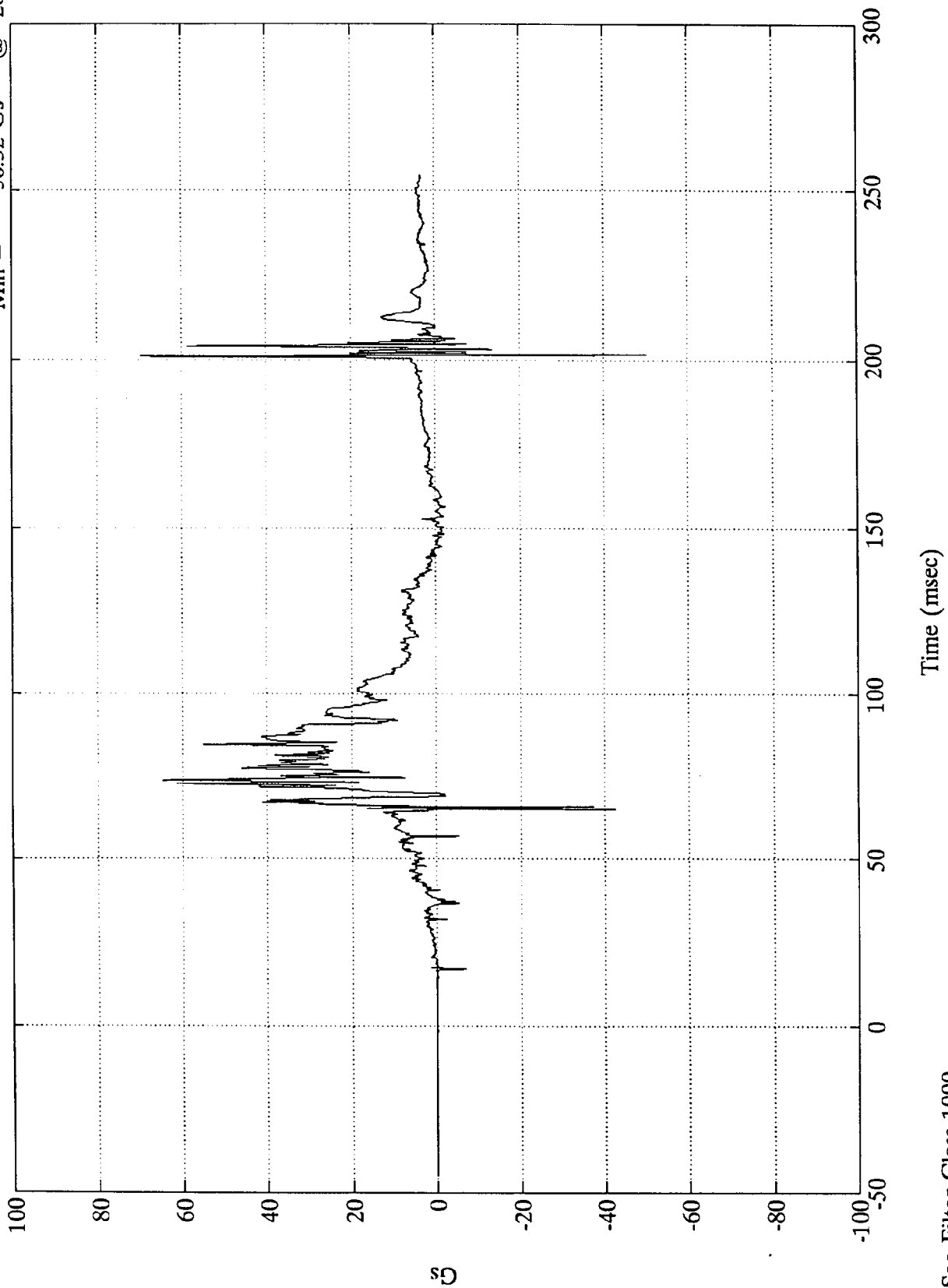
Gs
B-7

8102-5

TSC 301 Test 5 - Side Impact

Max = 69.50 Gs @ 201.00 msec
Min = -50.32 Gs @ 201.47 msec

P1 Upper Rib Y(R)



B-8

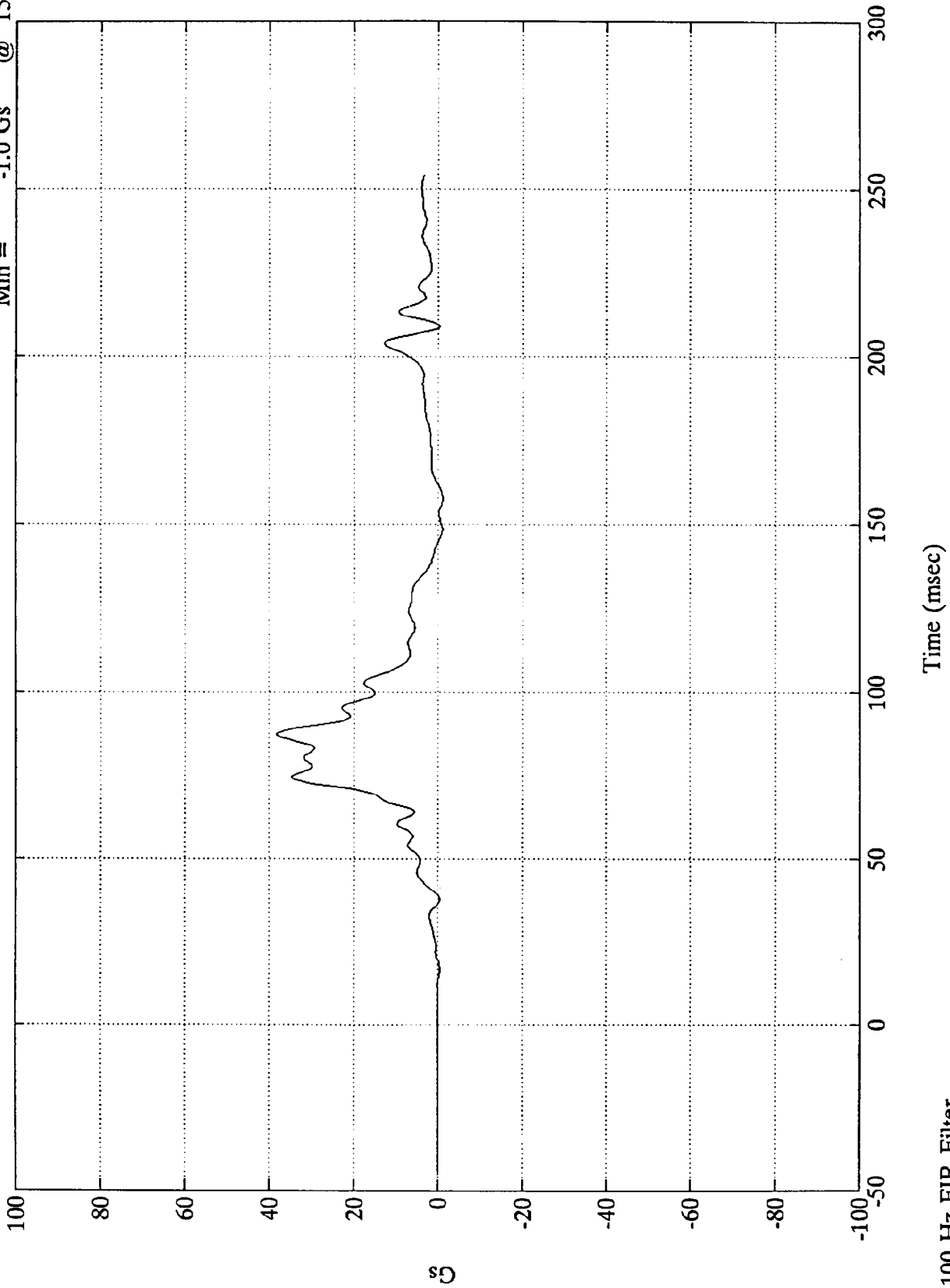
8102-5

Sae Filter Class 1000

TSC 301 Test 5 - Side Impact

P1 Upper Rib Y(R)

Max = 38.3 Gs @ 86.875 msec
Min = -1.0 Gs @ 158.12 msec



B-9

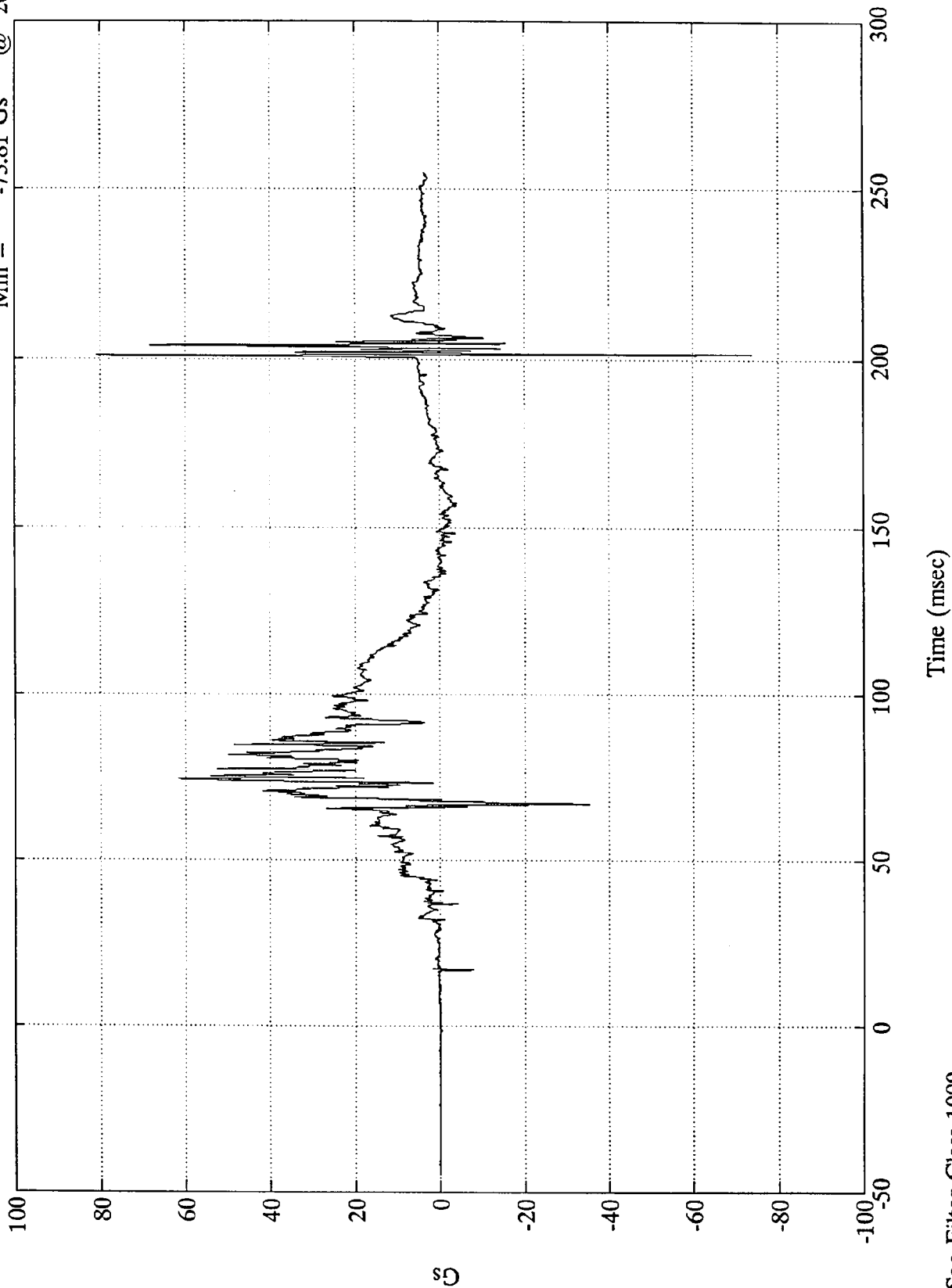
8102-5

100 Hz FIR Filter

TSC 301 Test 5 - Side Impact

Max = 80.70 Gs @ 201.00 msec
Min = -73.81 Gs @ 201.47 msec

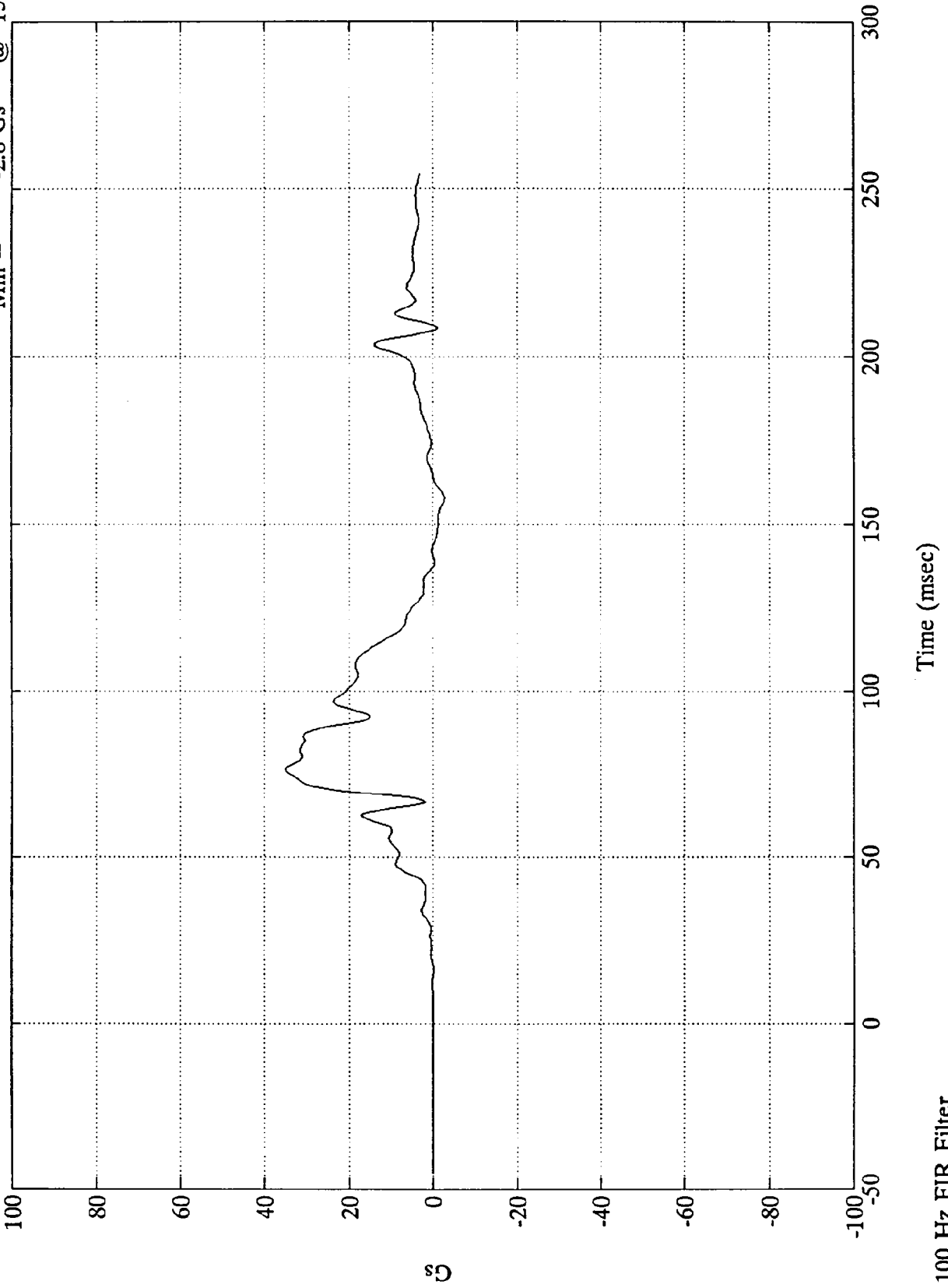
P1 Lower Rib Y



TSC 301 Test 5 - Side Impact

P1 Lower Rib Y

Max = 35.0 Gs @ 76.250 msec
Min = -2.8 Gs @ 158.12 msec

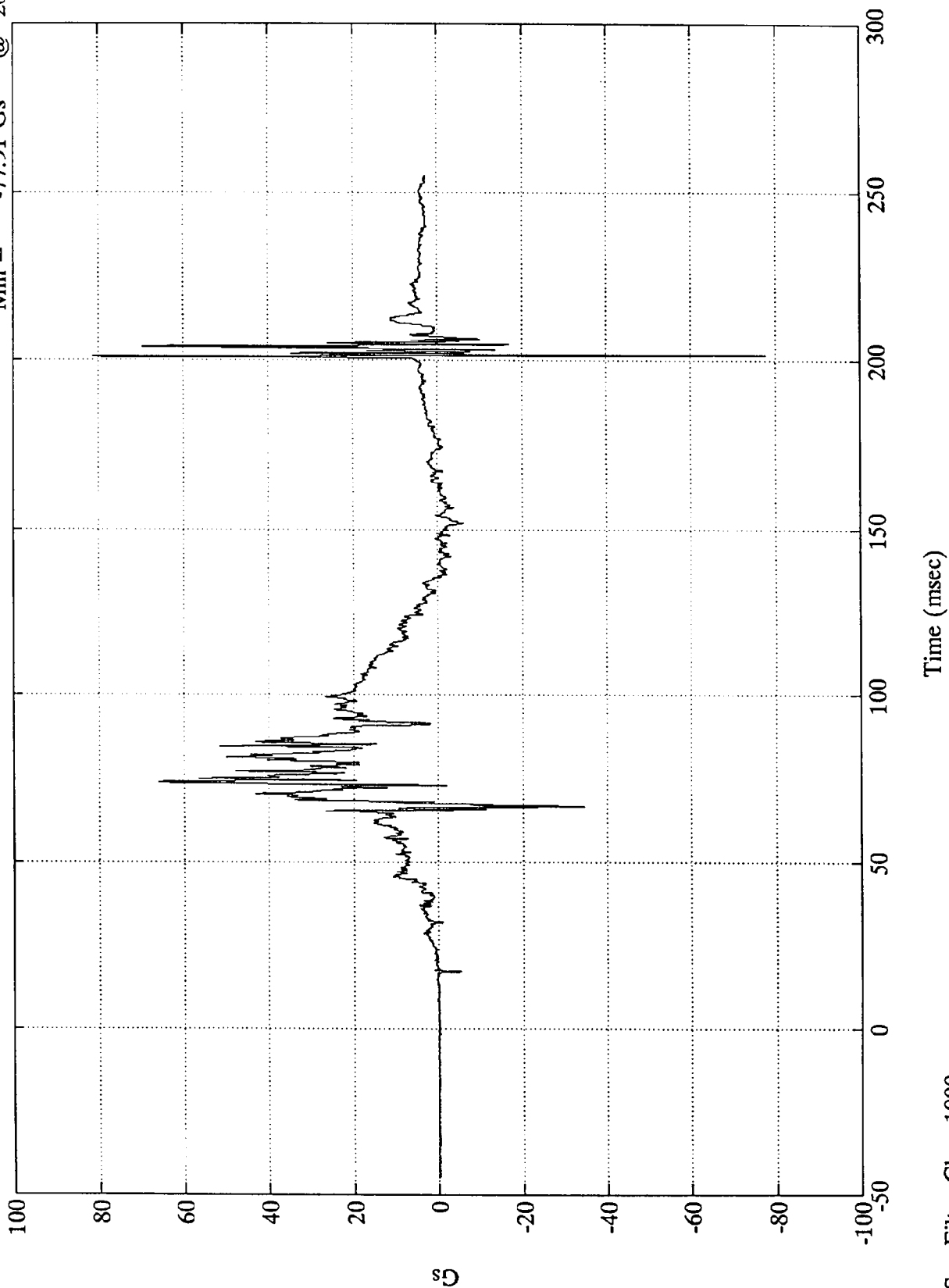


8102-5
B-11

TSC 301 Test 5 - Side Impact

Max = 81.16 Gs @ 201.00 msec
Min = -77.91 Gs @ 201.47 msec

P1 Lower Rib Y(R)

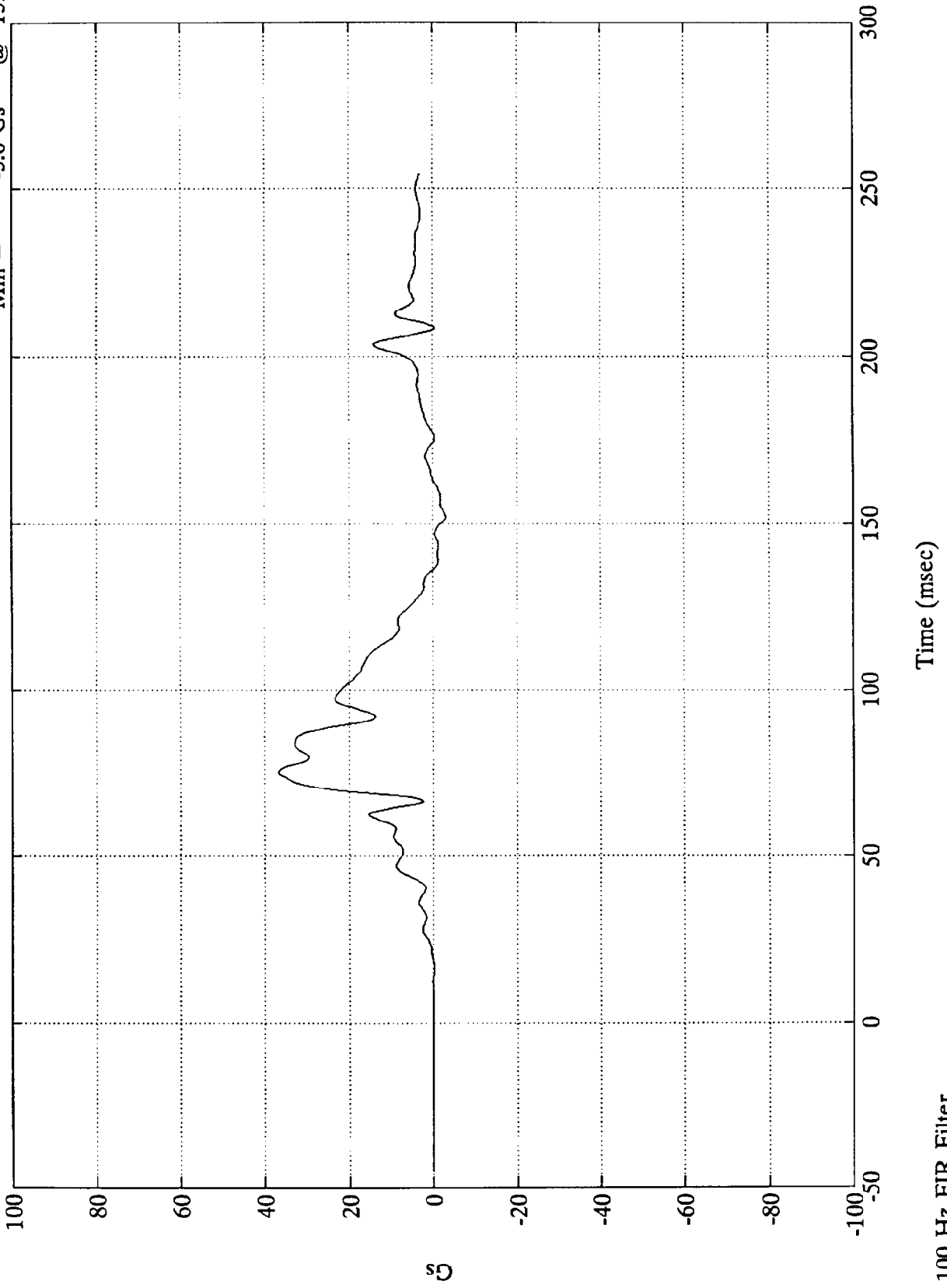


8102-5
B-12

Sae Filter Class 1000

TSC 301 Test 5 - Side Impact

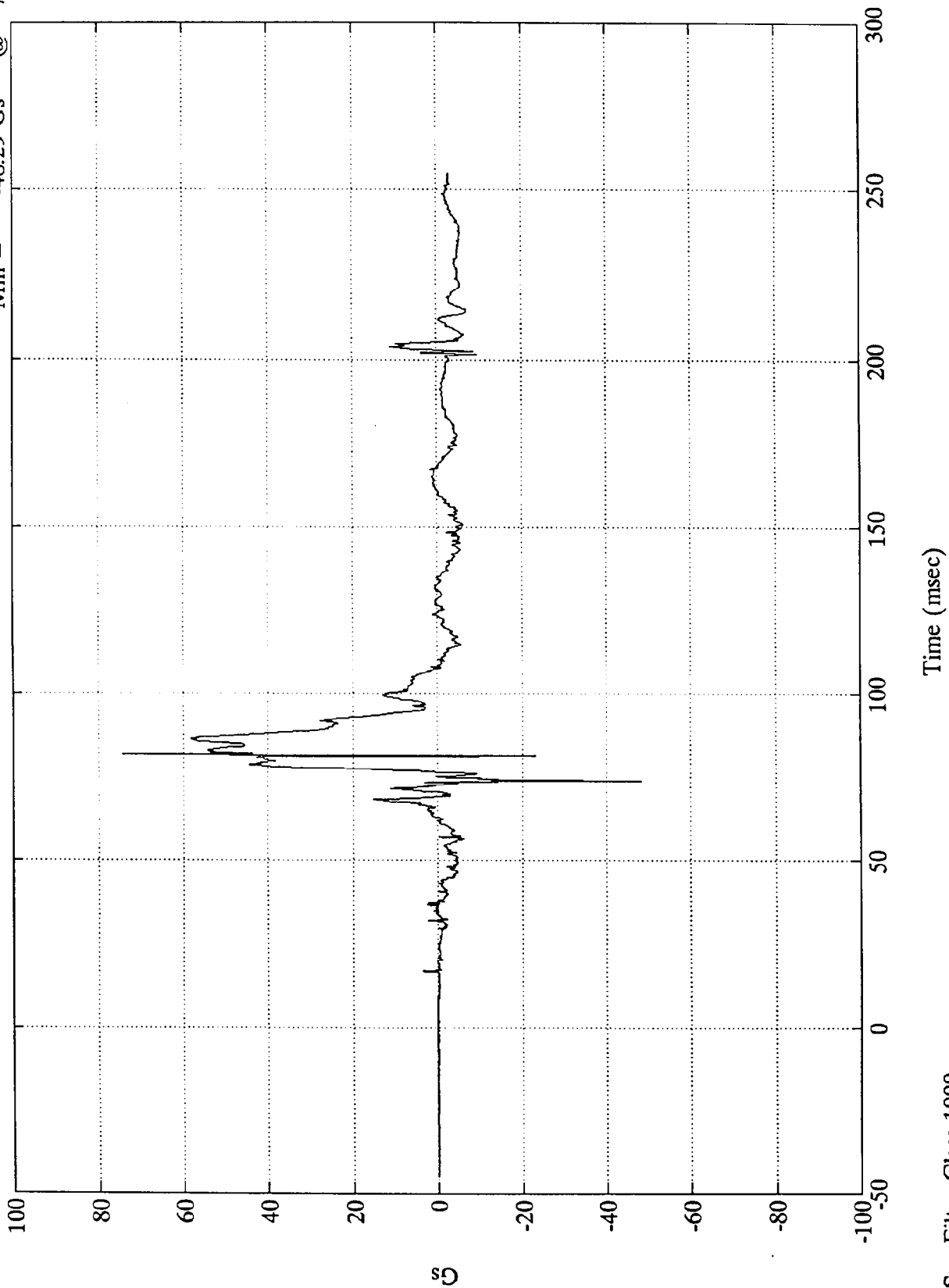
P1 Lower Rib Y(R)
Max = 36.6 Gs @ 75.625 msec
Min = -3.0 Gs @ 152.50 msec



TSC 301 Test 5 - Side Impact

Max = 74.36 Gs @ 81.48 msec
Min = -48.29 Gs @ 73.55 msec

P1 Upper Spine Y

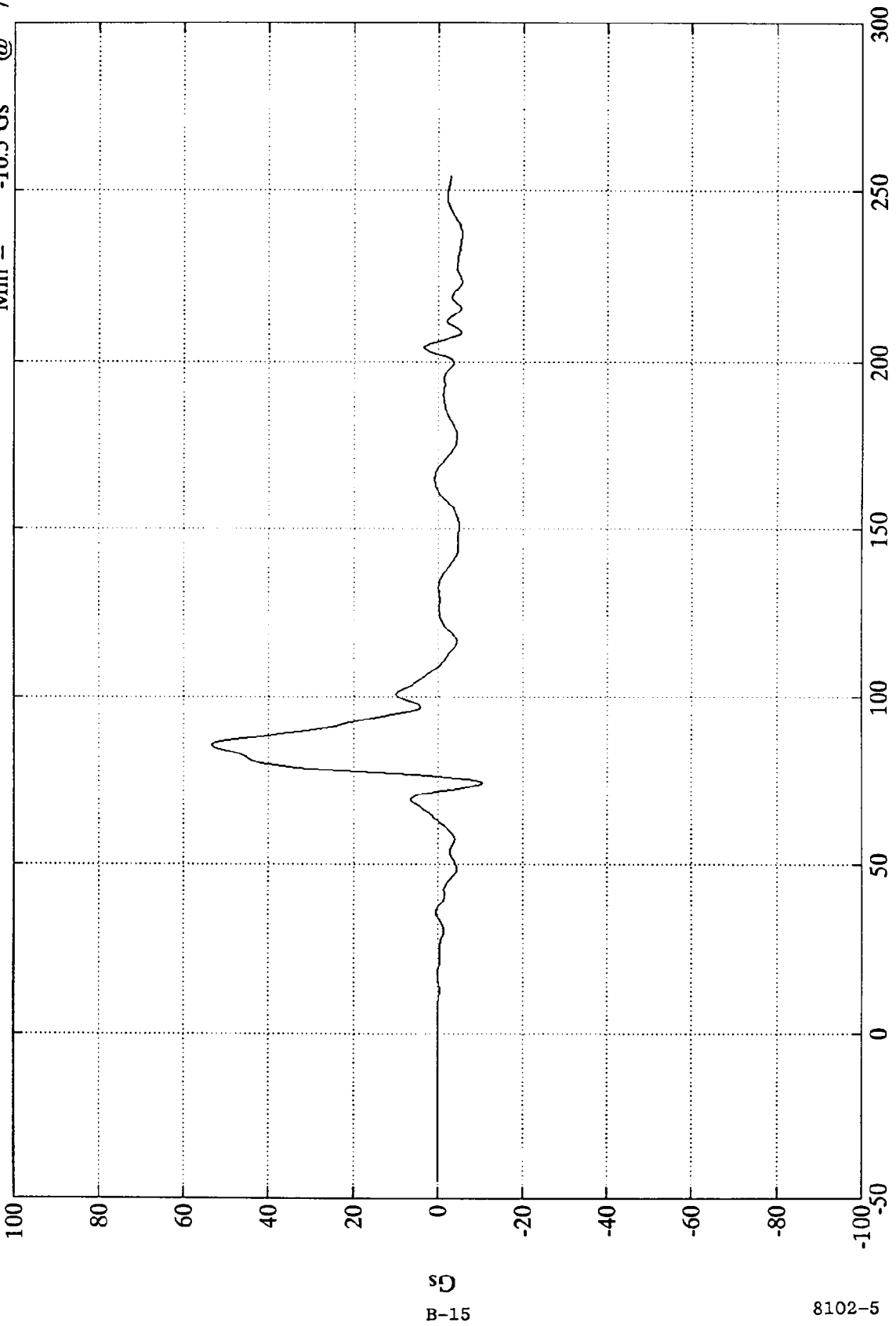


Sae Filter Class 1000

TSC 301 Test 5 - Side Impact

P1 Upper Spine Y

Max = 53.4 Gs @ 85.625 msec
Min = -10.5 Gs @ 74.37 msec



Time (msec)

100 Hz FIR Filter

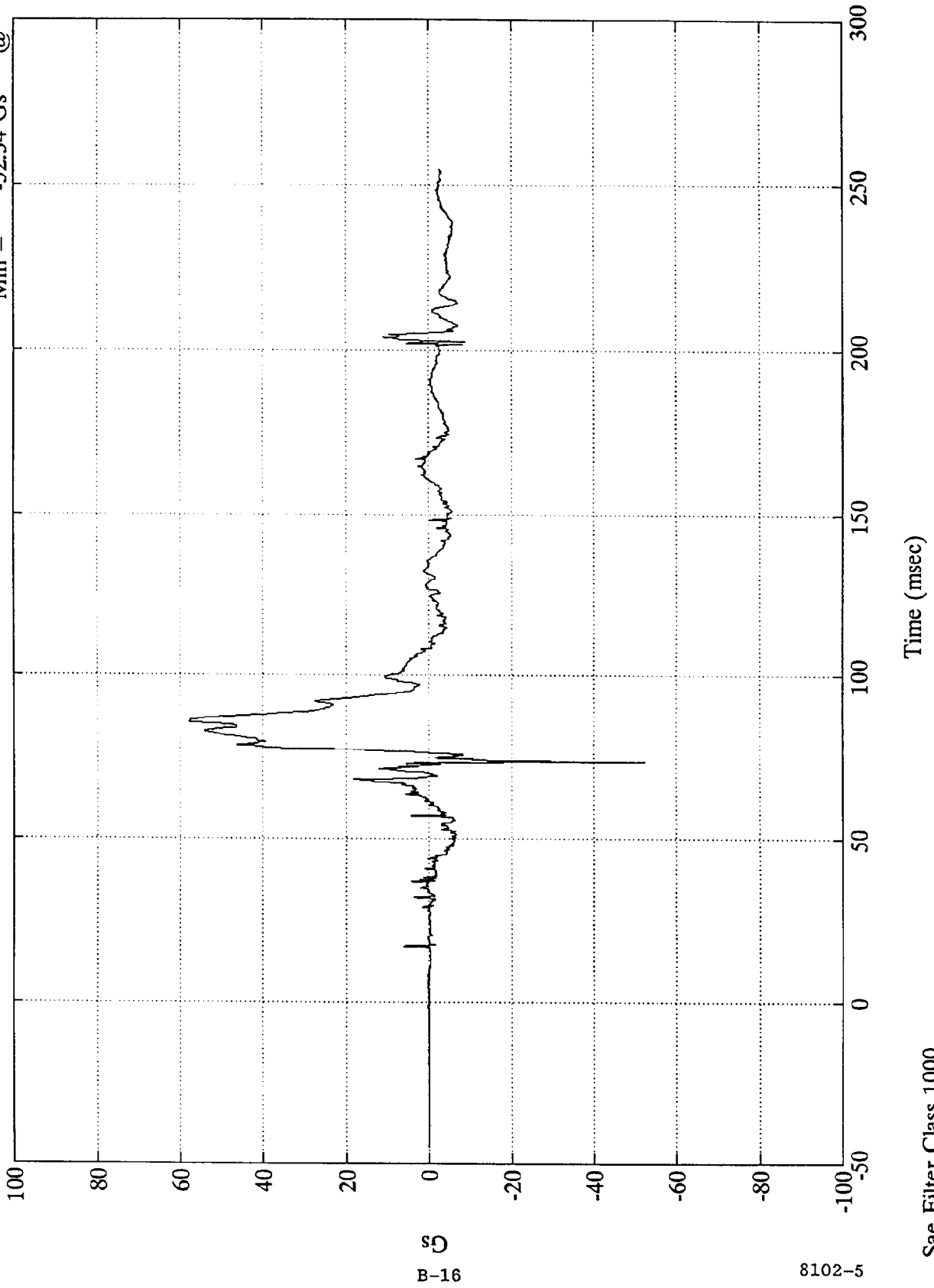
B-15
Gs

8102-5

TSC 301 Test 5 - Side Impact

Max = 57.79 Gs @ 85.80 msec
Min = -52.34 Gs @ 73.55 msec

P1 Upper Spine Y(R)



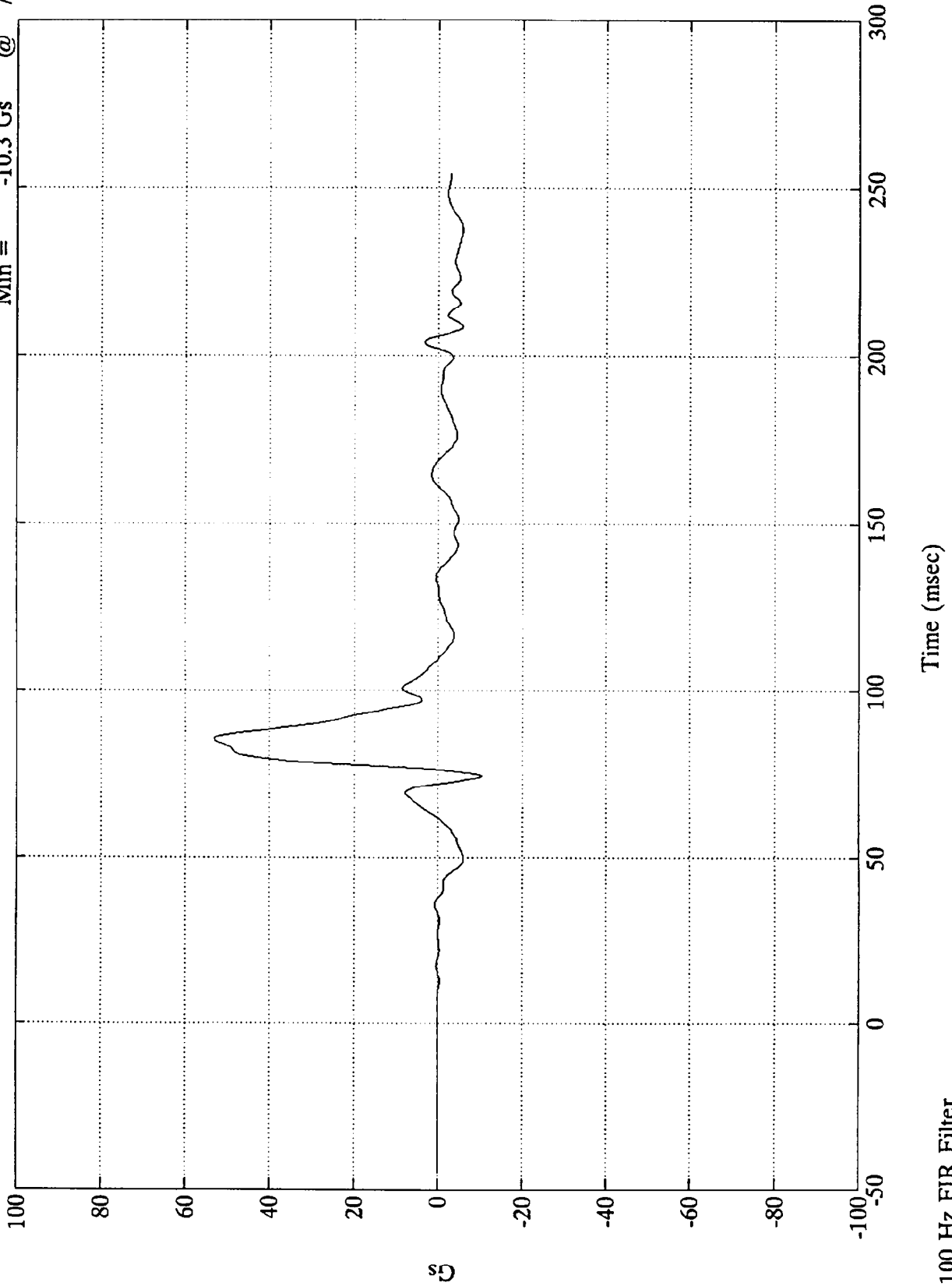
B-16

8102-5

Sae Filter Class 1000

TSC 301 Test 5 - Side Impact

P1 Upper Spine Y(R) Max = 53.1 Gs @ 85.000 msec
Min = -10.3 Gs @ 74.37 msec



B-17
Gs

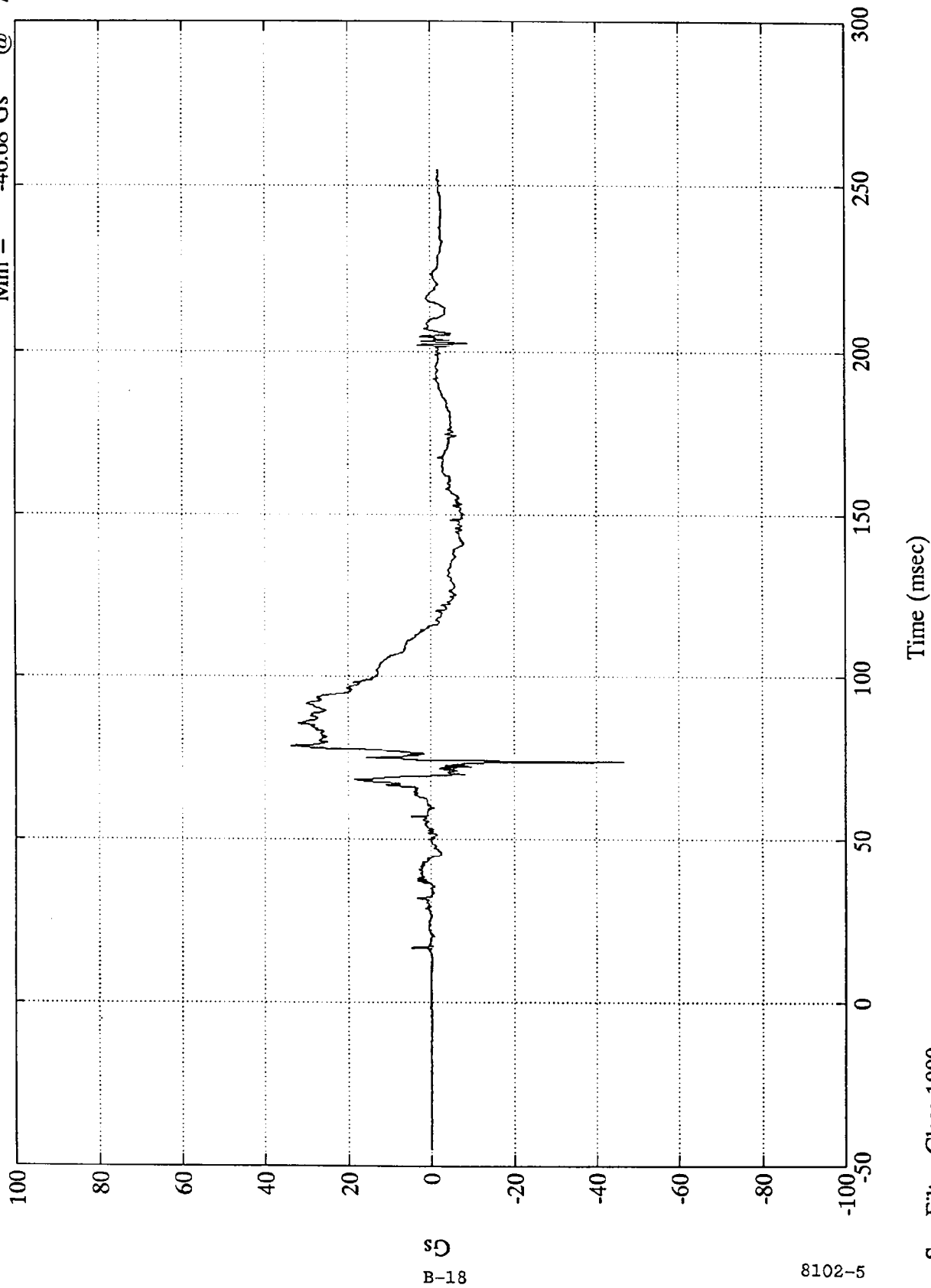
8102-5

100 Hz FIR Filter

TSC 301 Test 5 - Side Impact

Max = 33.80 Gs @ 78.48 msec
Min = -46.68 Gs @ 73.44 msec

P1 Lower Spine Y



B-18

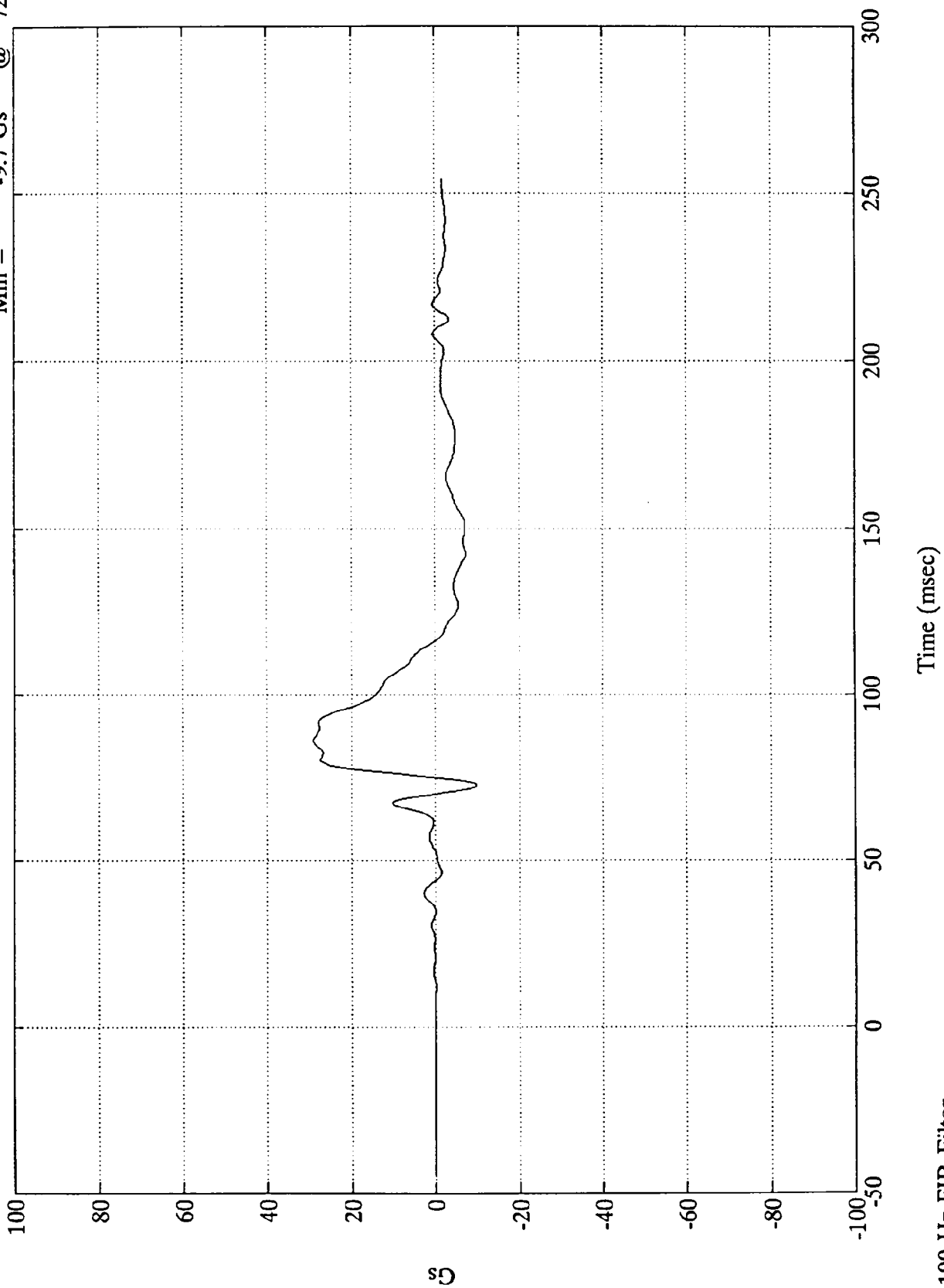
8102-5

Sae Filter Class 1000

TSC 301 Test 5 - Side Impact

P1 Lower Spine Y

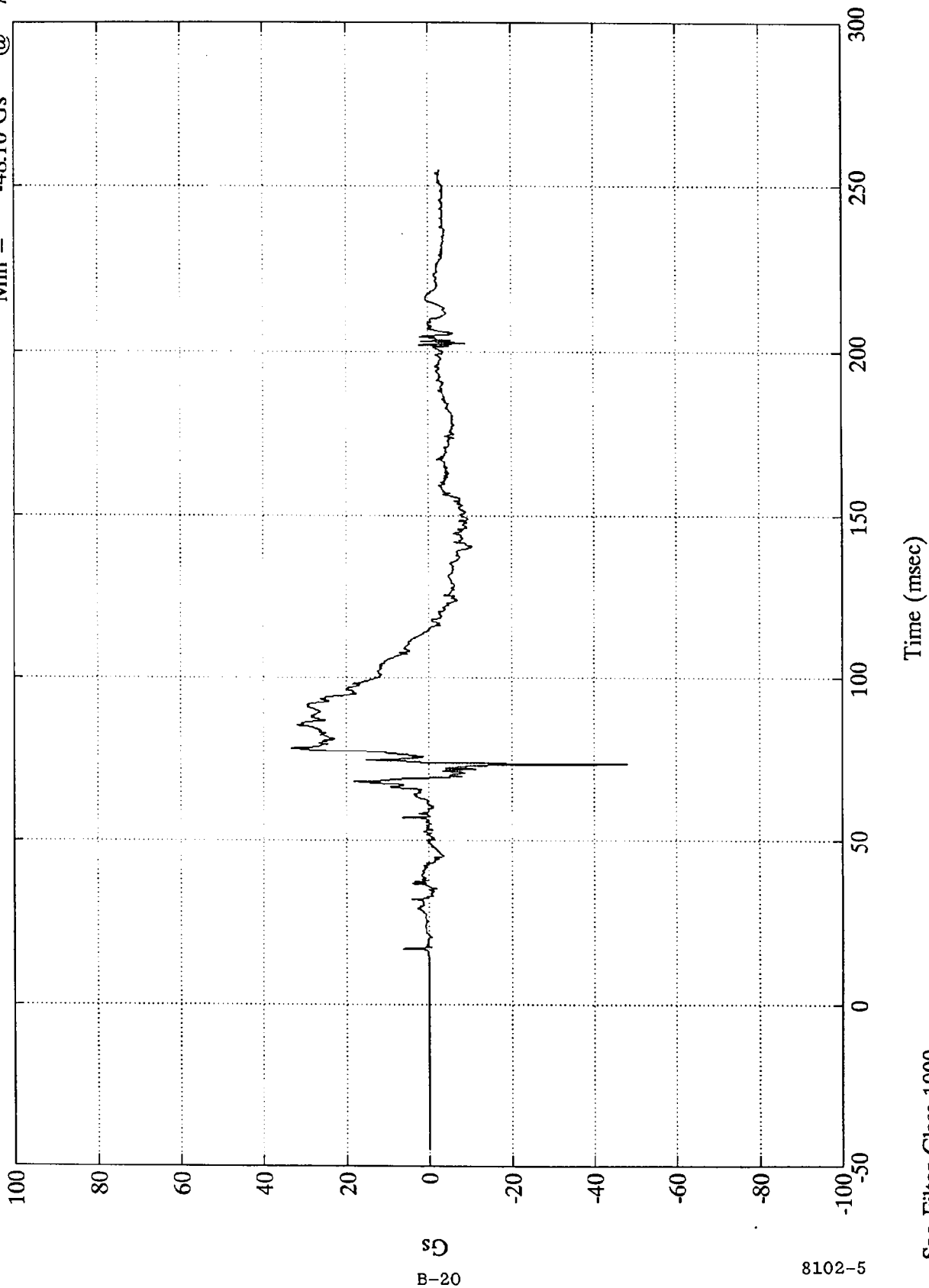
Max = 29.0 Gs @ 86.250 msec
Min = -9.7 Gs @ 72.50 msec



TSC 301 Test 5 - Side Impact

Max = 33.29 Gs @ 78.48 msec
Min = -48.10 Gs @ 73.44 msec

P1 Lower Spine Y(R)



B-20

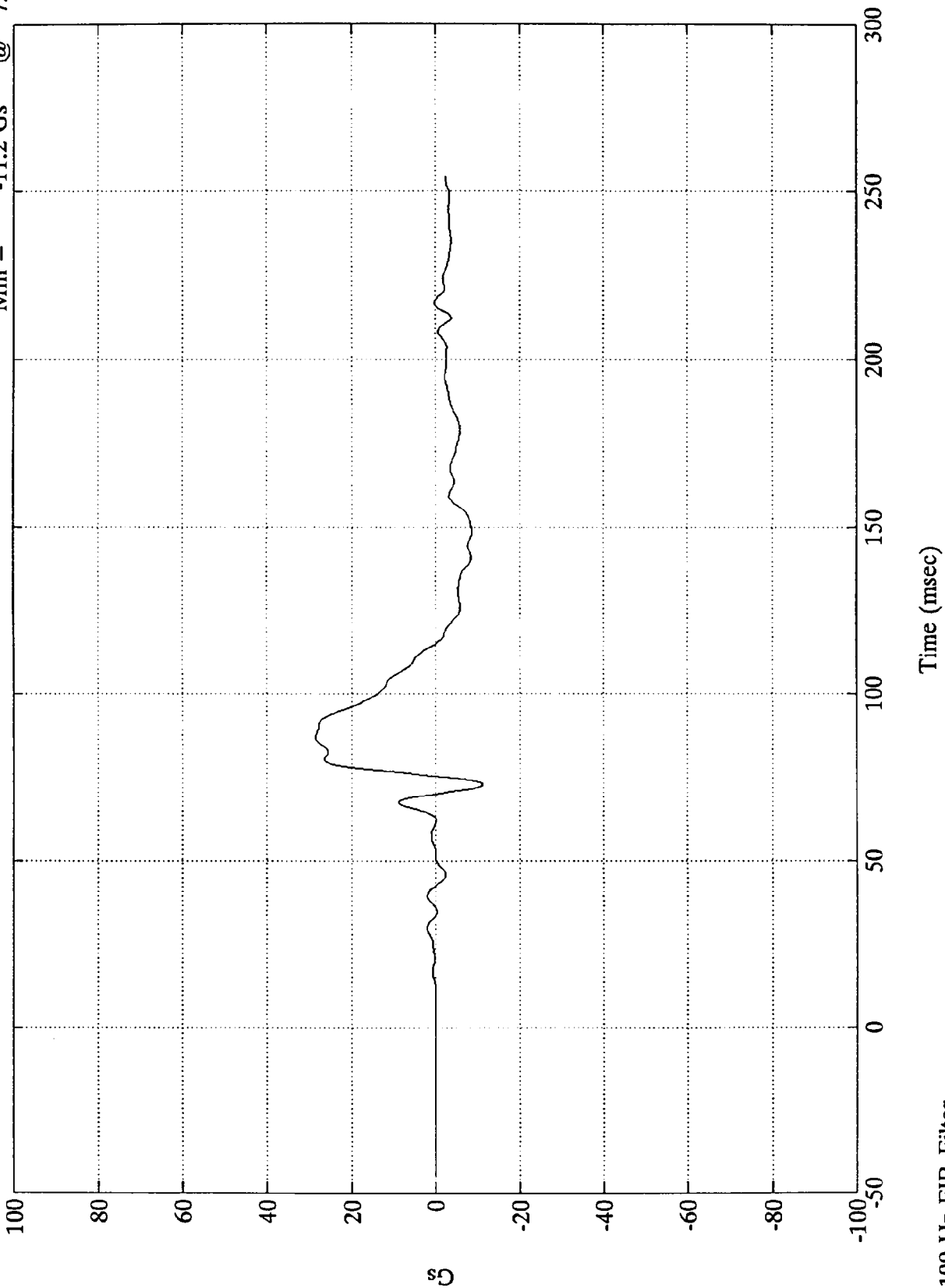
8102-5

Sae Filter Class 1000

TSC 301 Test 5 - Side Impact

P1 Lower Spine Y(R)

Max = 28.5 Gs @ 86.875 msec
Min = -11.2 Gs @ 72.50 msec



B-21

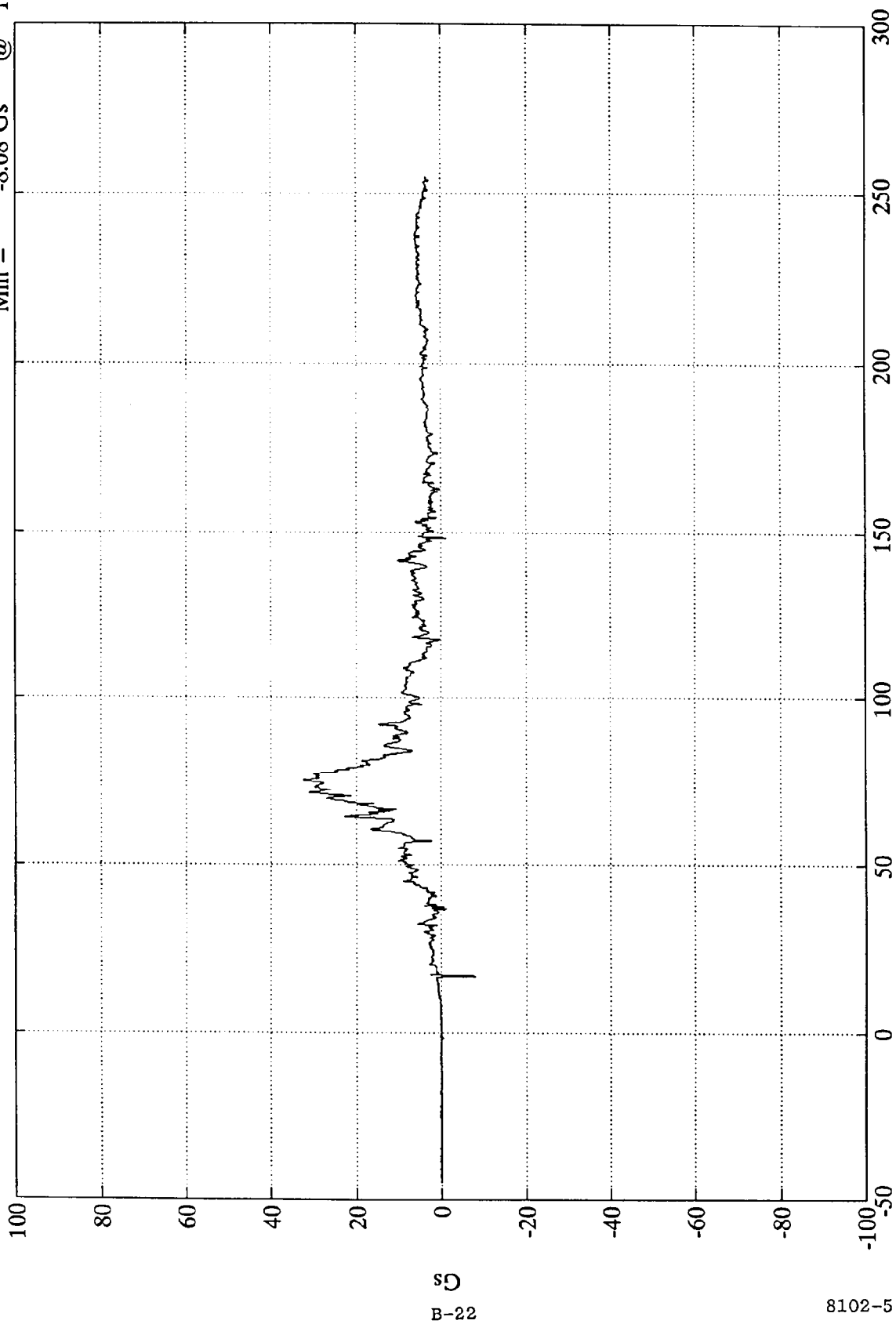
8102-5

100 Hz FIR Filter

TSC 301 Test 5 - Side Impact

Max = 32.42 Gs @ 75.12 msec
Min = -8.08 Gs @ 16.68 msec

P1 Pelvic Y



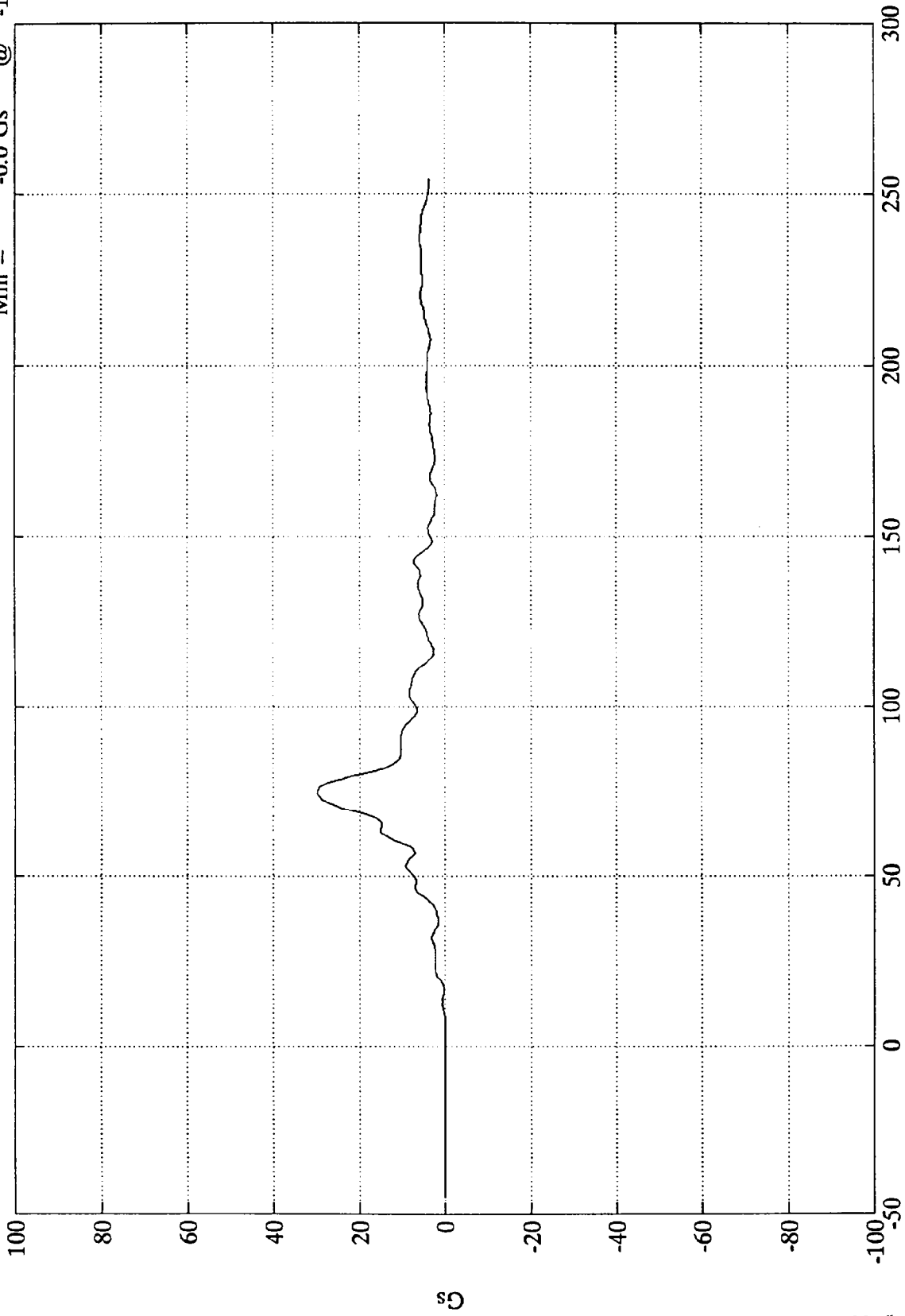
Time (msec)

Sae Filter Class 1000

TSC 301 Test 5 - Side Impact

Max = 29.8 Gs @ 75.000 msec
Min = -0.0 Gs @ -1.25 msec

P1 Pelvic Y



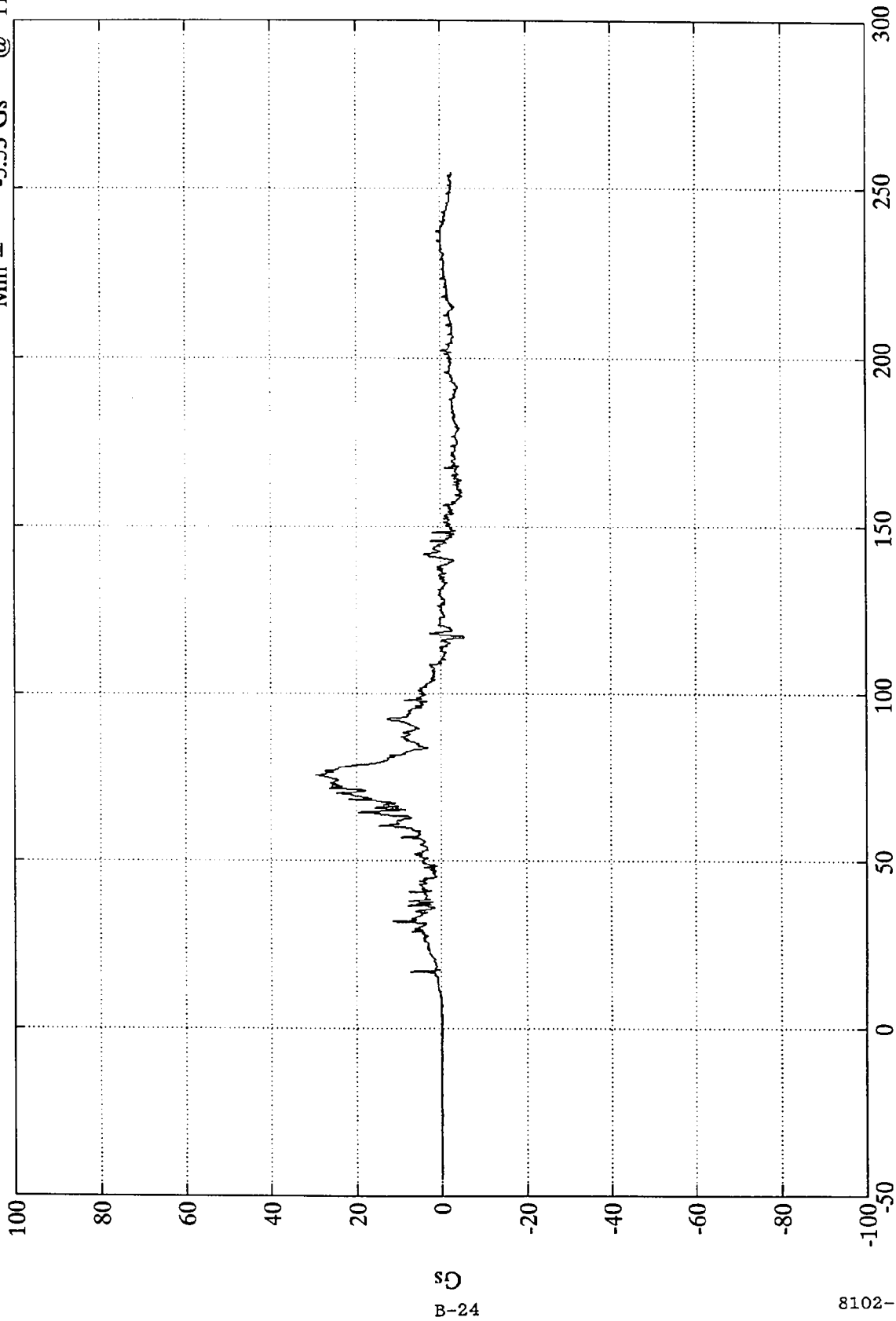
Time (msec)

100 Hz FIR Filter

TSC 301 Test 5 - Side Impact

Max = 29.61 Gs @ 75.23 msec
Min = -5.53 Gs @ 117.12 msec

P1 Pelvic Y(R)



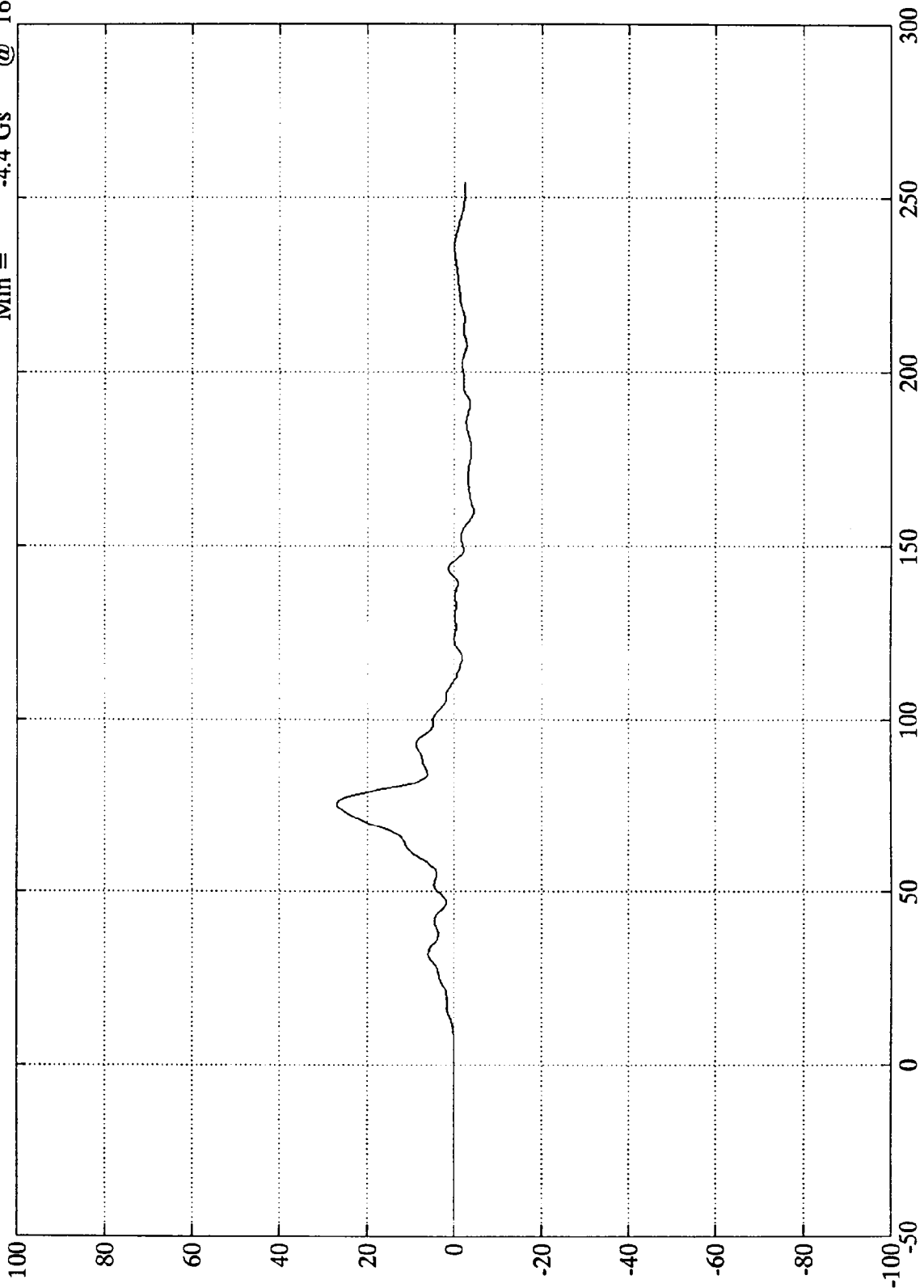
Time (msec)

Sae Filter Class 1000

TSC 301 Test 5 - Side Impact

Max = 26.9 Gs @ 75.625 msec
Min = -4.4 Gs @ 160.62 msec

P1 Pelvic Y(R)



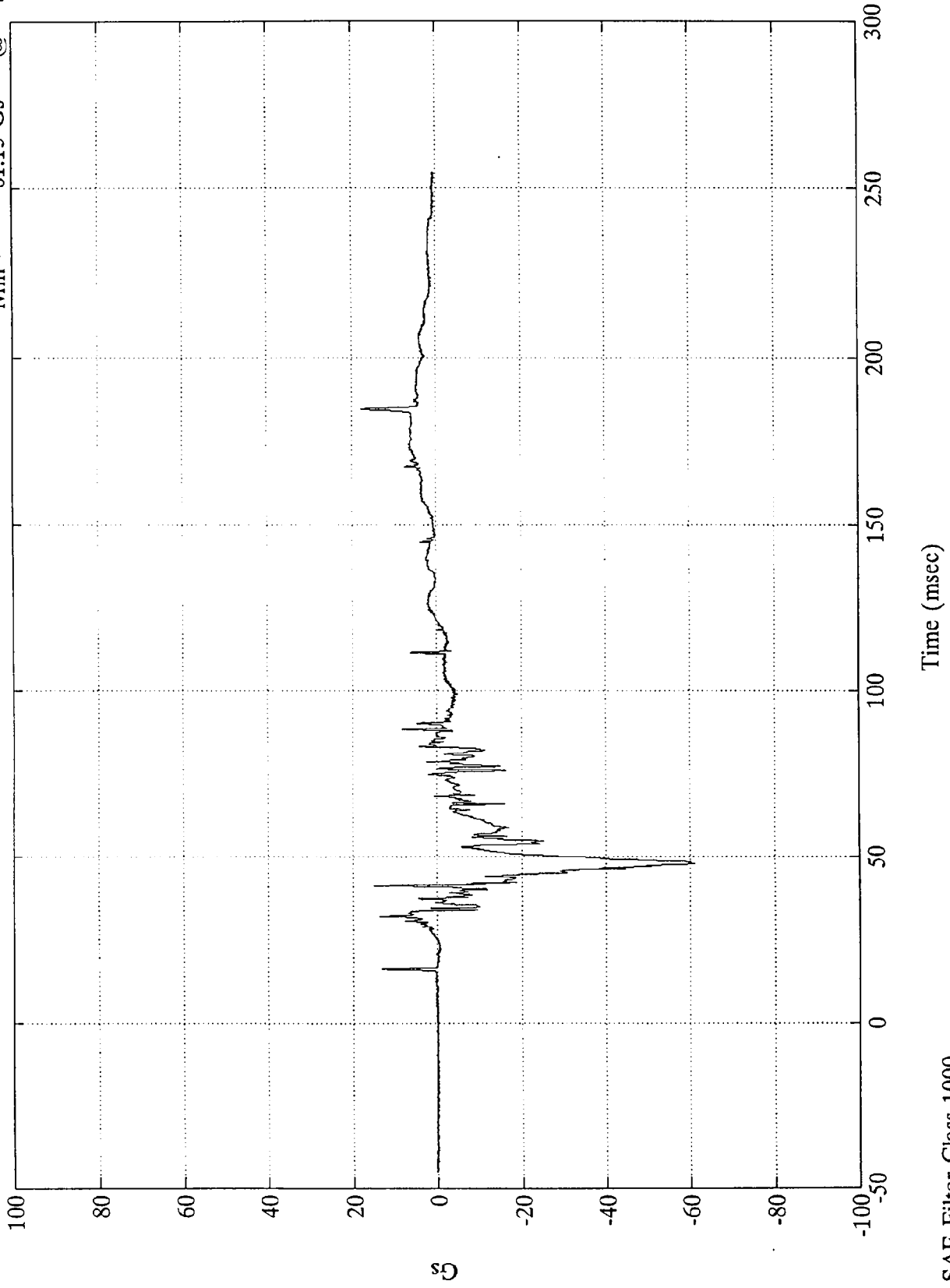
Time (msec)

100 Hz FIR Filter

TSC 301 Test 5 - Side Impact

Max = 17.78 Gs @ 184.44 msec
Min = -61.15 Gs @ 47.76 msec

P4 Head X



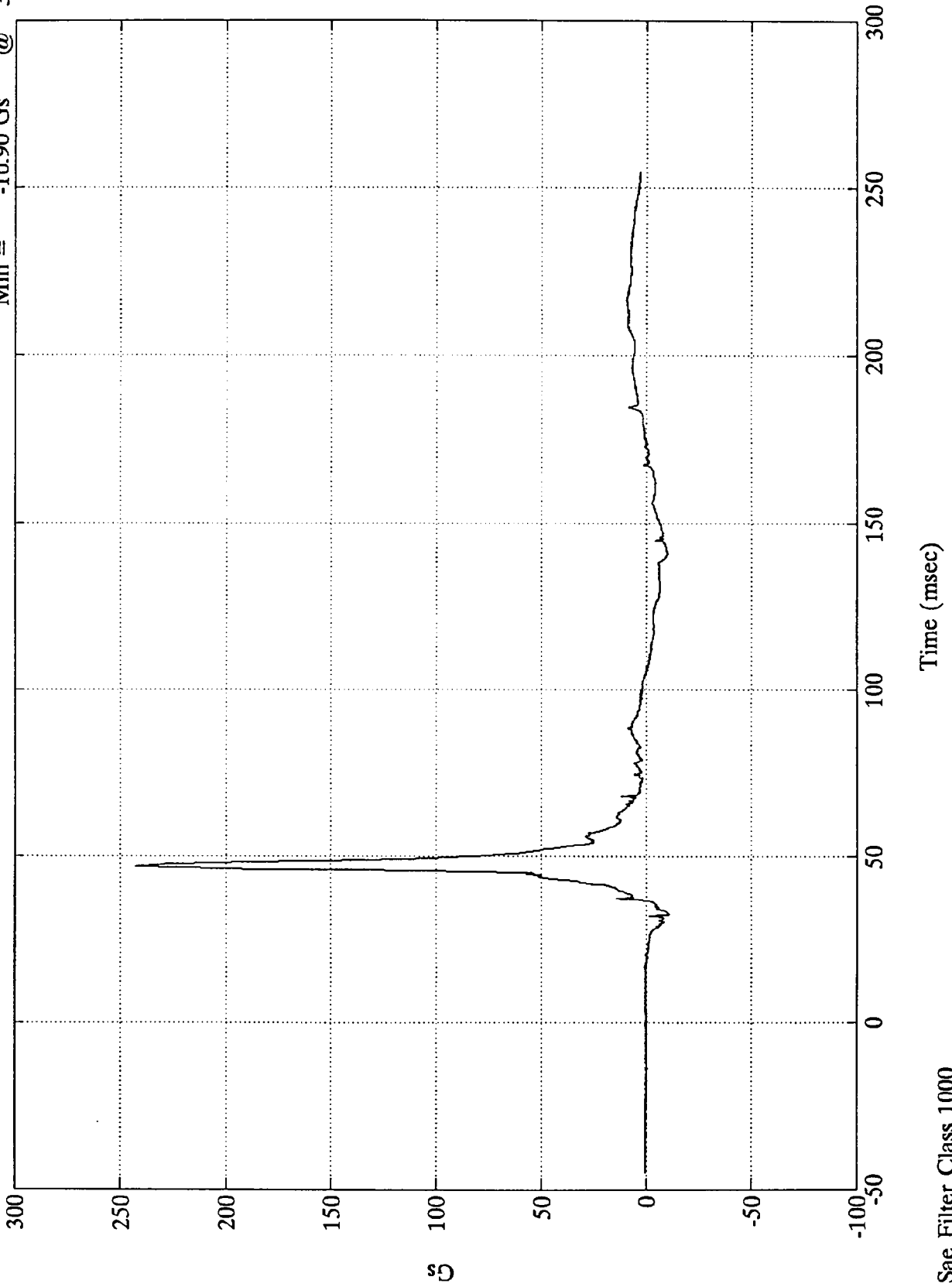
Time (msec)

SAE Filter Class 1000

TSC 301 Test 5 - Side Impact

P4 Head Y

Max = 242.65 Gs @ 47.04 msec
Min = -10.90 Gs @ 32.40 msec

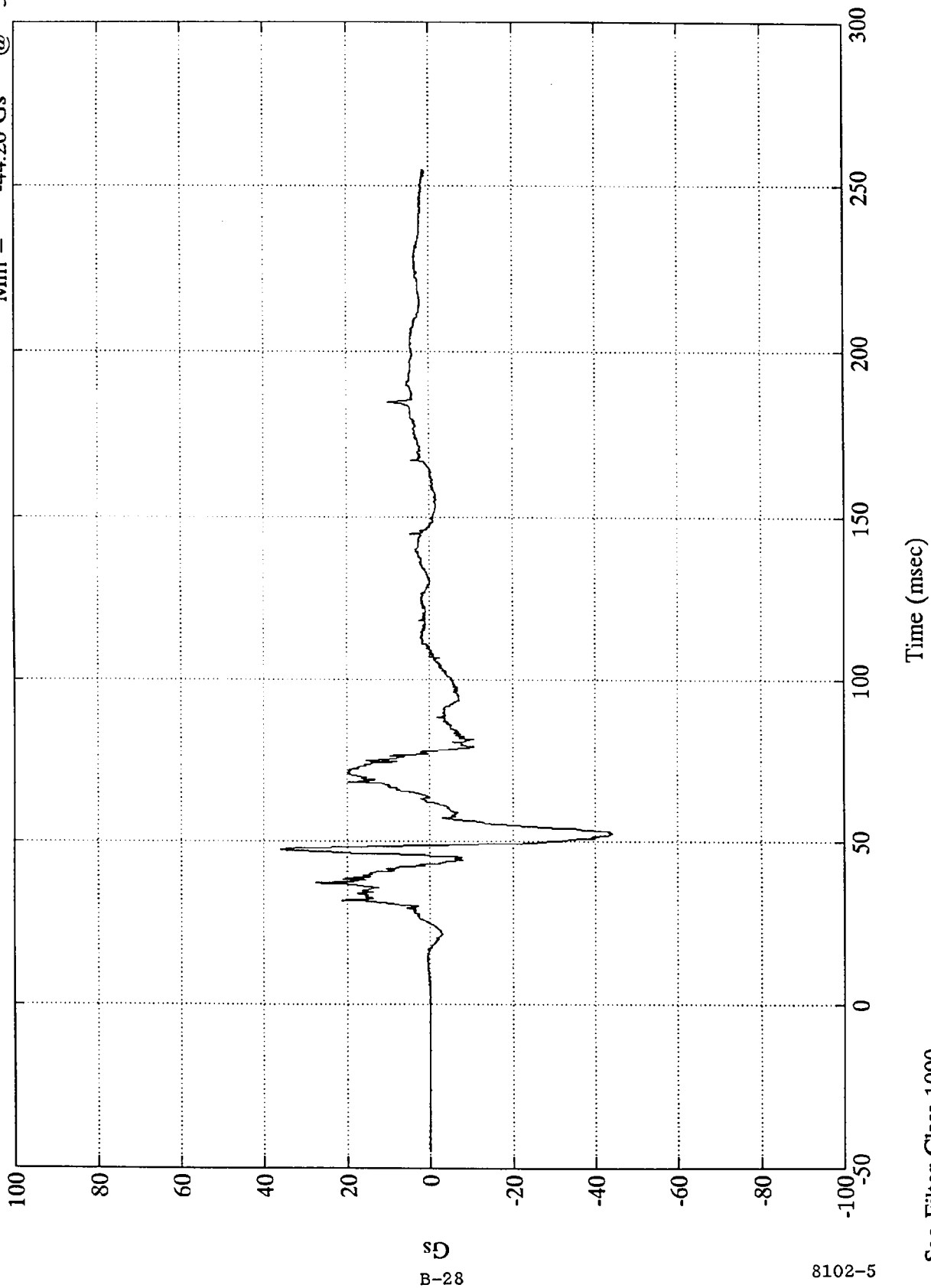


8102-5
B-27

TSC 301 Test 5 - Side Impact

Max = 36.10 Gs @ 47.15 msec
Min = -44.20 Gs @ 52.44 msec

P4 Head Z



B-28

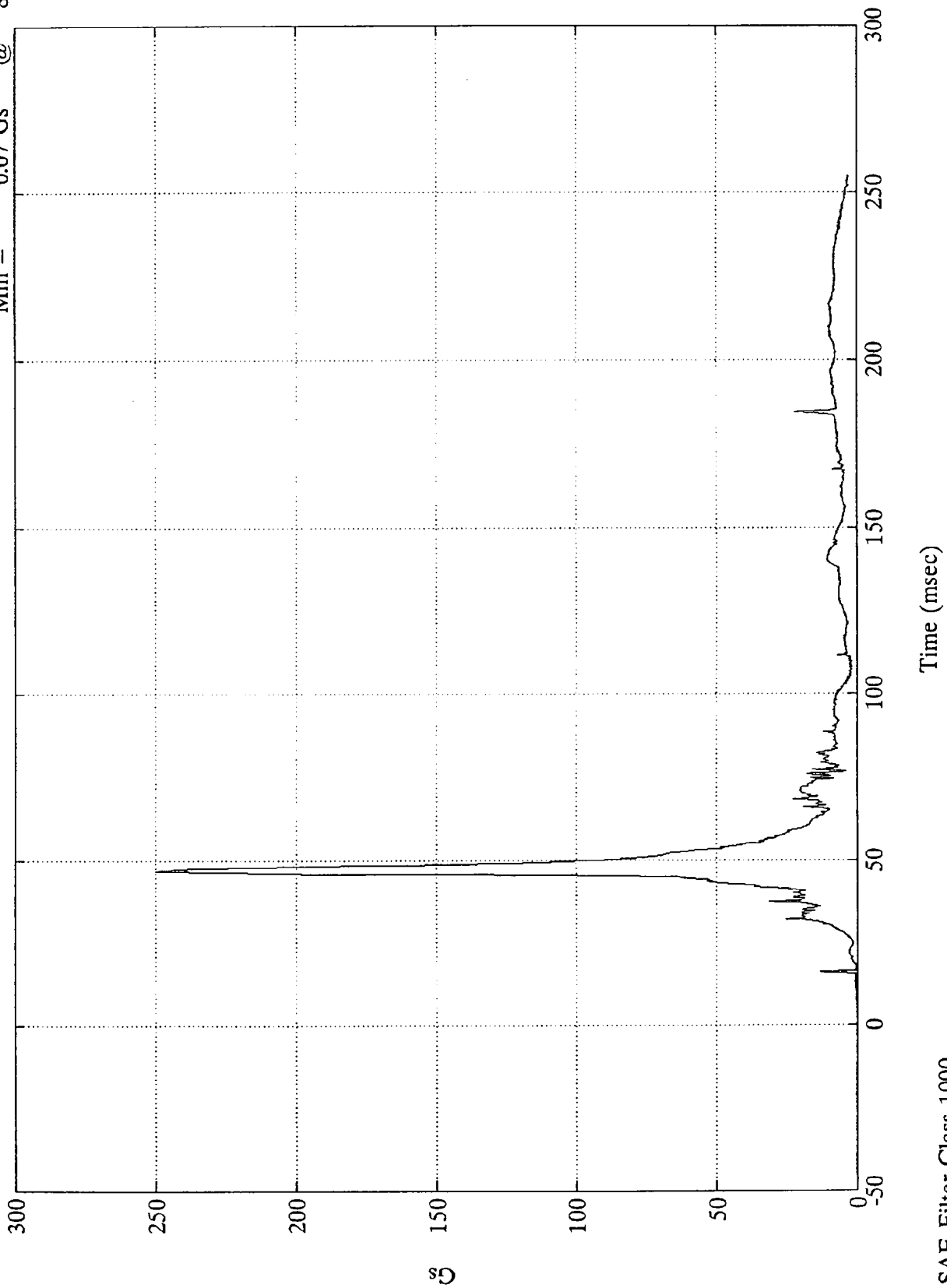
8102-5

Sae Filter Class 1000

TSC 301 Test 5 - Side Impact

P4 Head Resultant

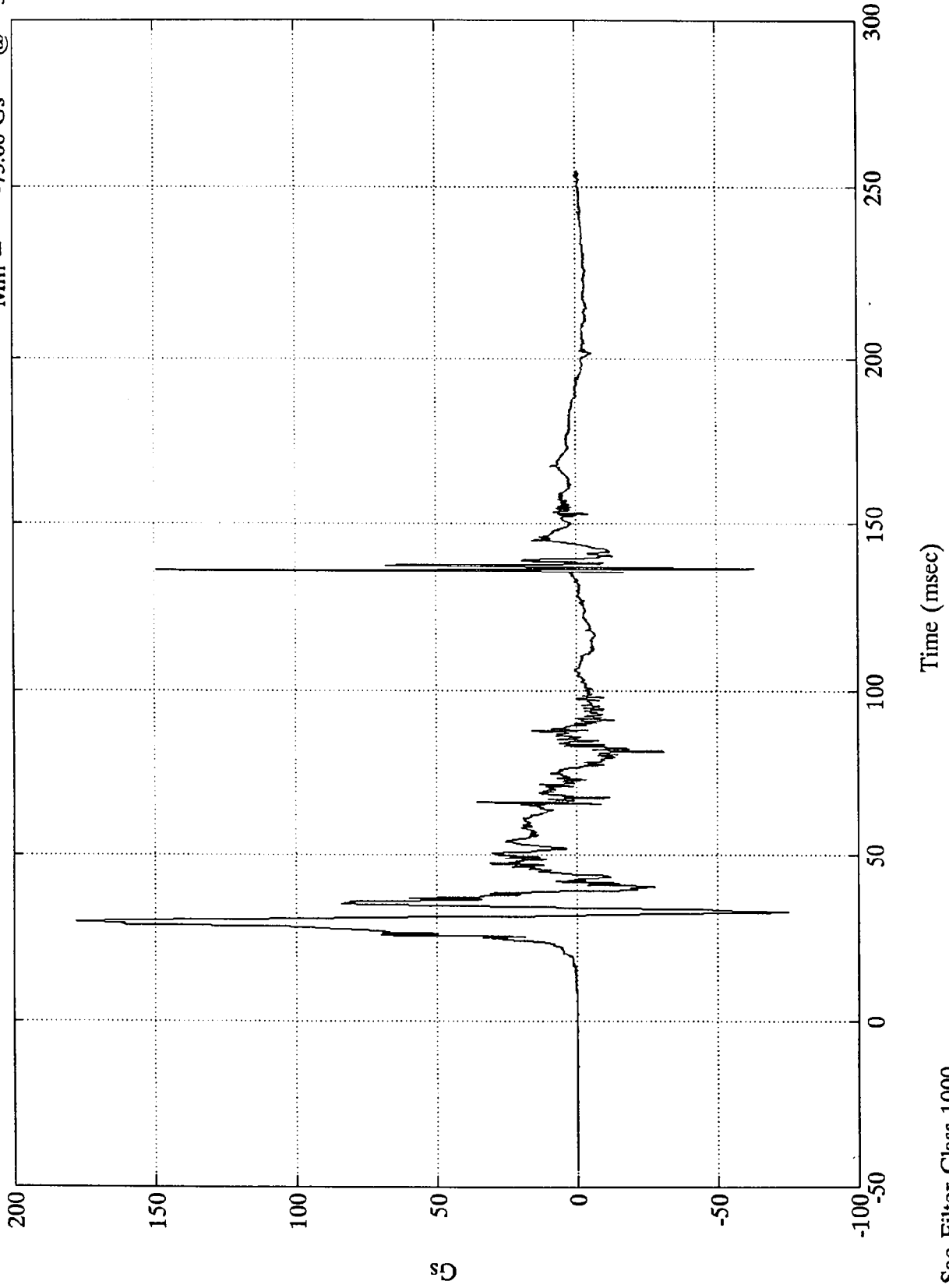
Max = 250.11 Gs @ 47.04 msec
Min = 0.07 Gs @ 8.28 msec



TSC 301 Test 5 - Side Impact

Max = 178.10 Gs @ 29.88 msec
Min = -75.00 Gs @ 32.76 msec

P4 Upper Rib Y



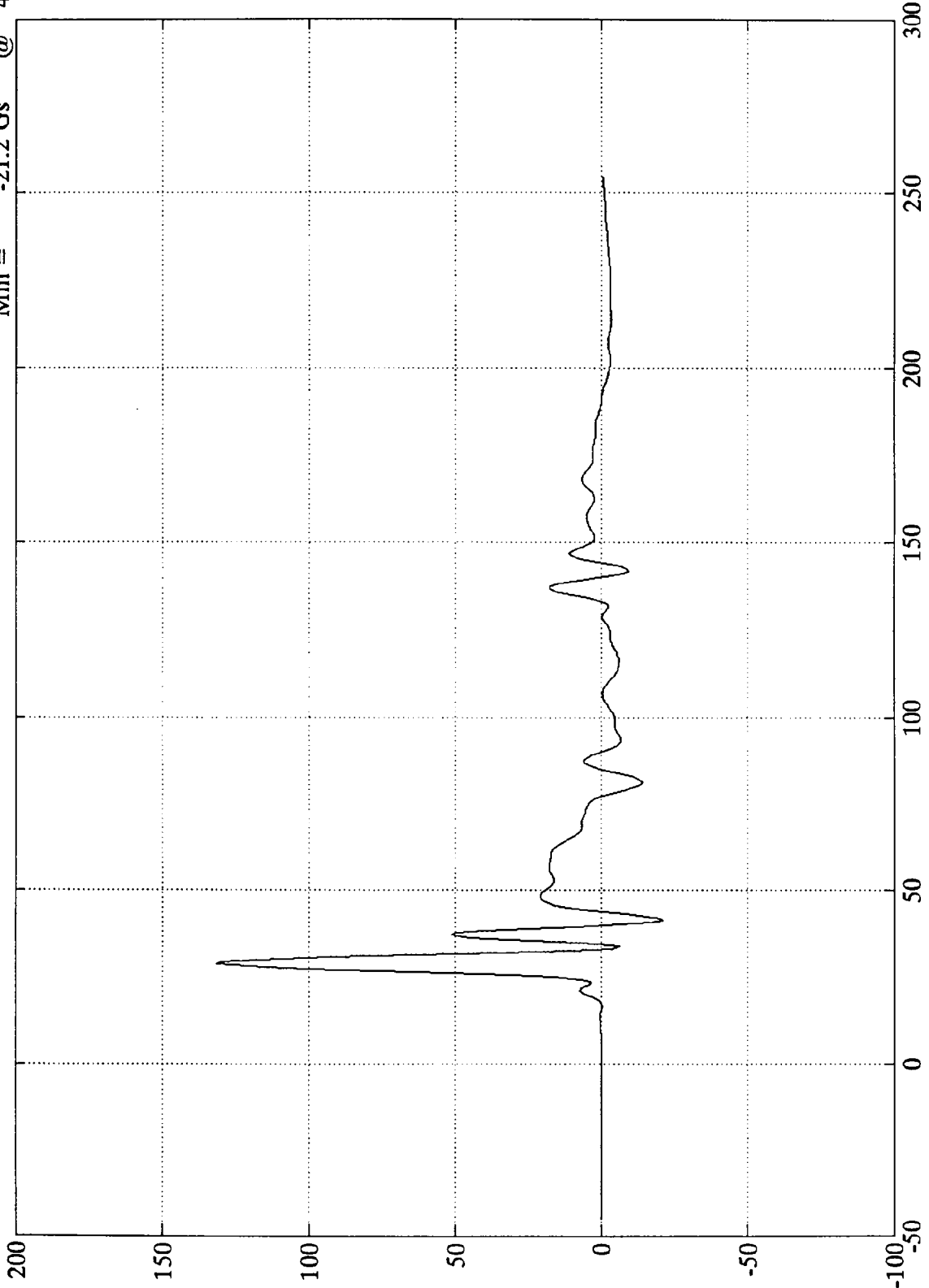
B-30

8102-5

TSC 301 Test 5 - Side Impact

Max = 131.4 Gs @ 28.750 msec
Min = -21.2 Gs @ 41.25 msec

P4 Upper Rib Y



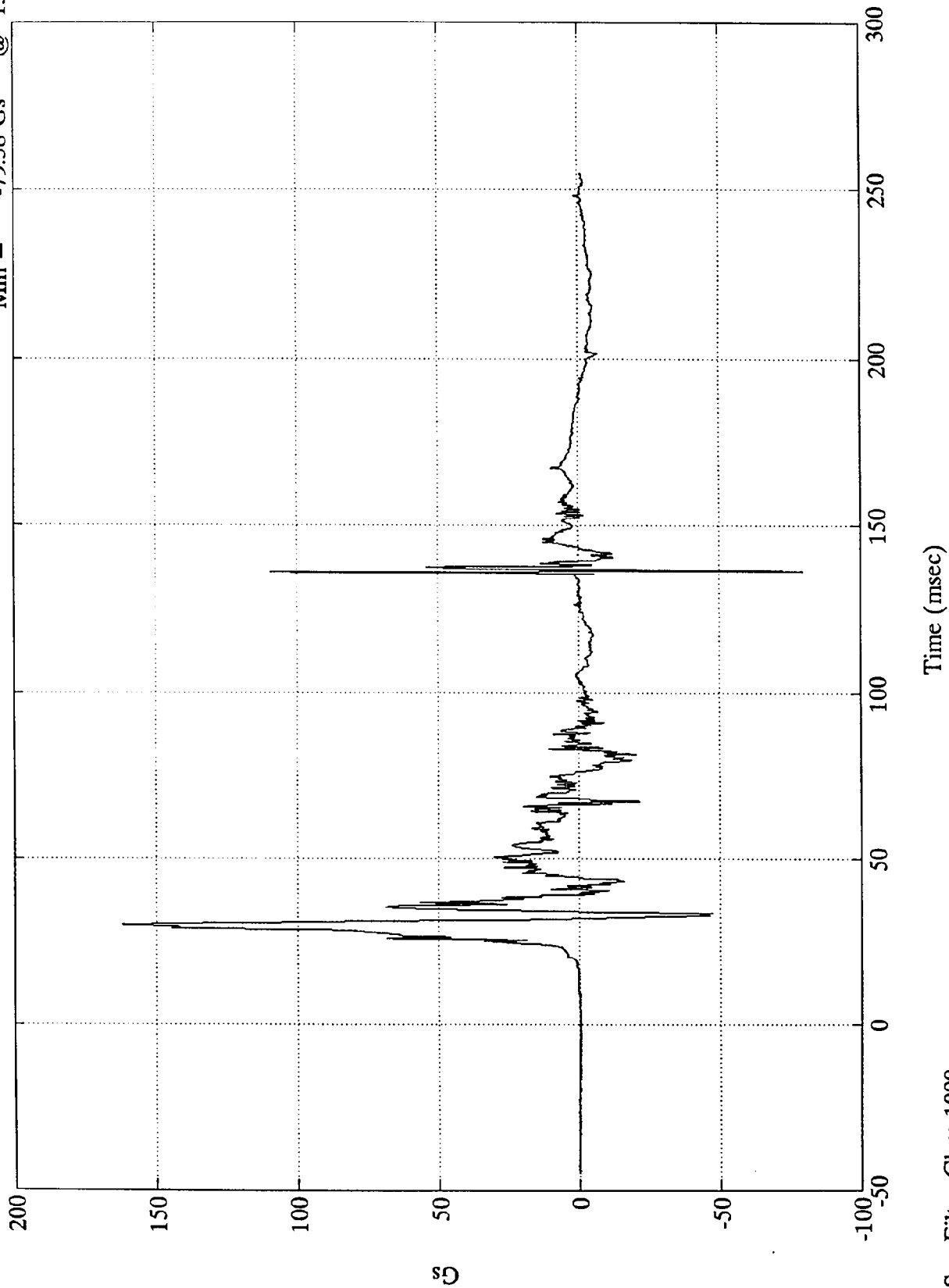
Time (msec)

100 Hz FIR Filter

TSC 301 Test 5 - Side Impact

Max = 162.08 Gs @ 29.88 msec
Min = -79.58 Gs @ 136.56 msec

P4 Upper Rib Y(R)

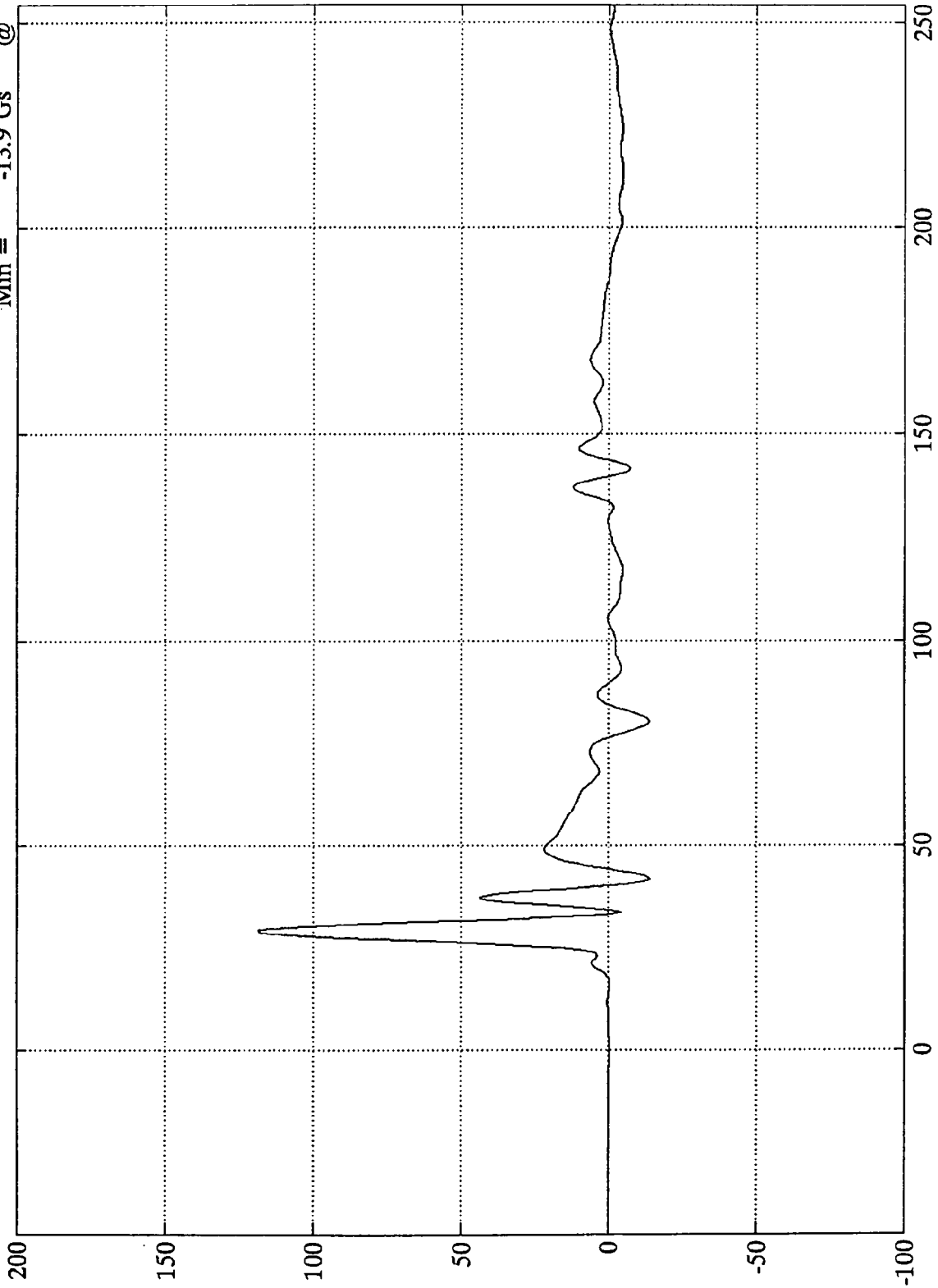


Sae Filter Class 1000

TSC 301 Test 5 - Side Impact

P4 Upper Rib Y(R)

Max = 118.6 Gs @ 29.375 msec
Min = -13.9 Gs @ 41.87 msec



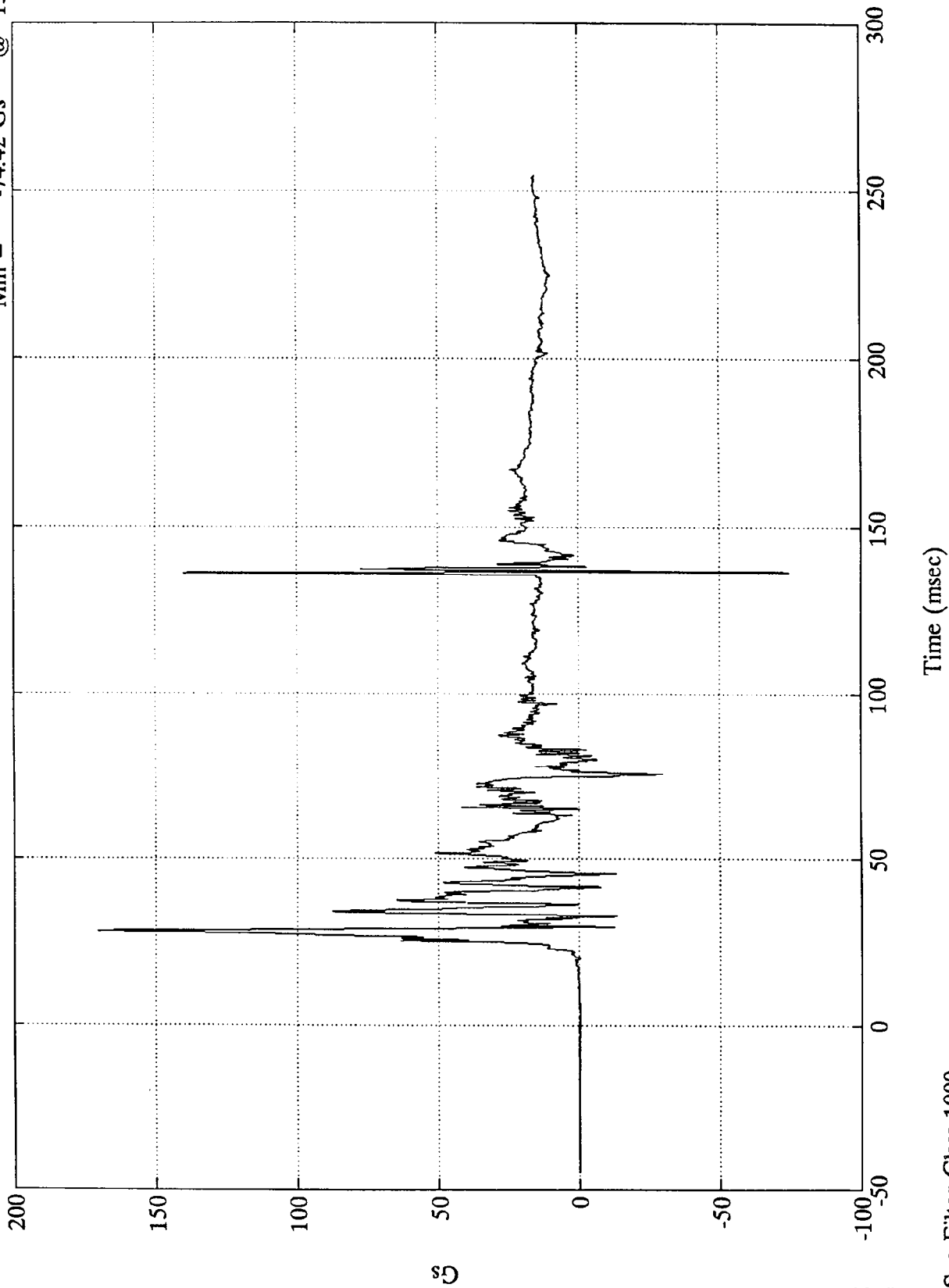
Time (msec)

100 Hz FIR Filter

TSC 301 Test 5 - Side Impact

Max = 170.42 Gs @ 27.96 msec
 Min = -74.42 Gs @ 136.56 msec

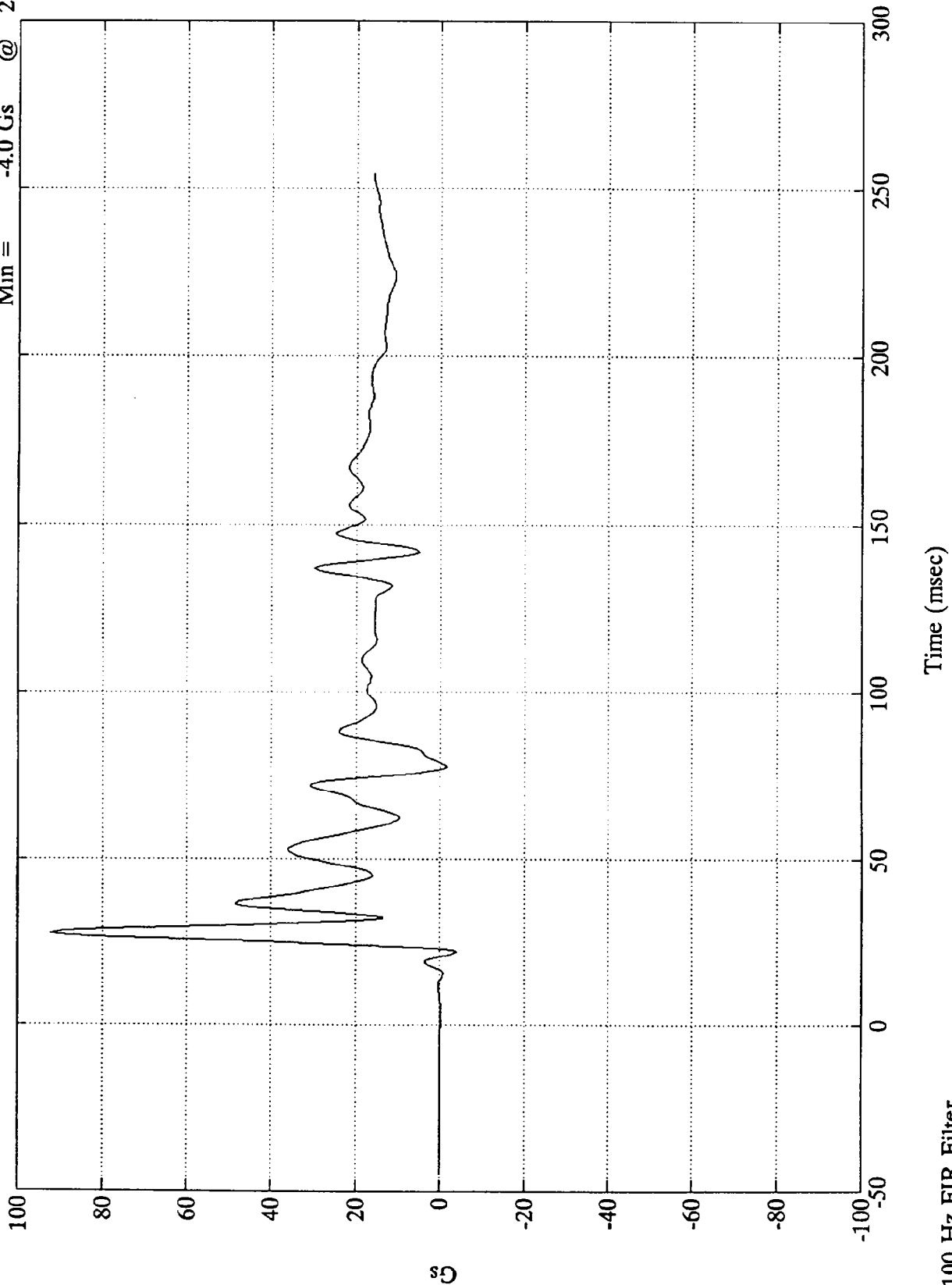
P4 Lower Rib Y



TSC 301 Test 5 - Side Impact

Max = 92.2 Gs @ 27.500 msec
Min = -4.0 Gs @ 21.87 msec

P4 Lower Rib Y



B-35

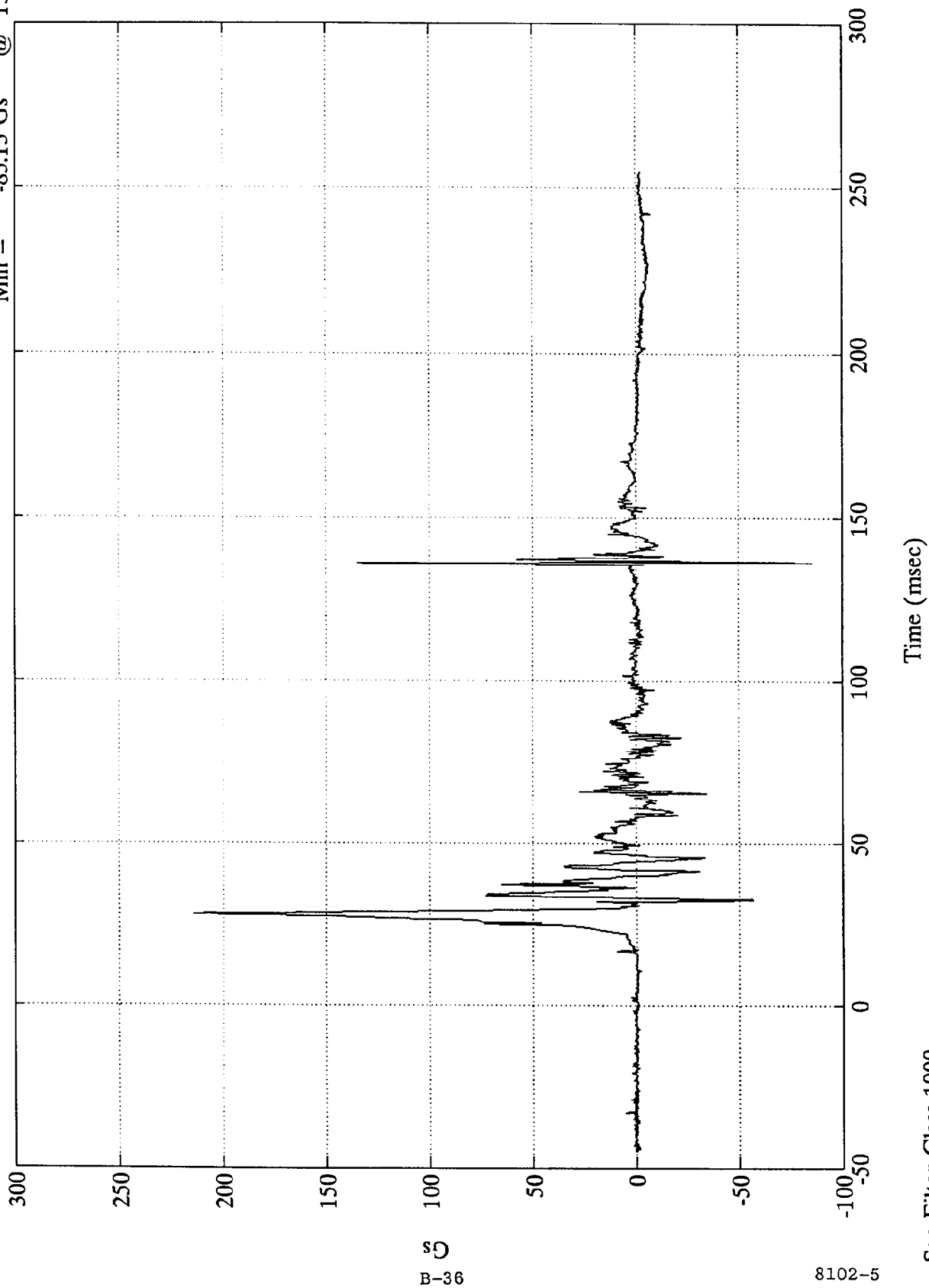
8102-5

100 Hz FIR Filter

TSC 301 Test 5 - Side Impact

Max = 214.15 Gs @ 27.96 msec
Min = -85.13 Gs @ 136.56 msec

P4 Lower Rib Y(R)



B-36

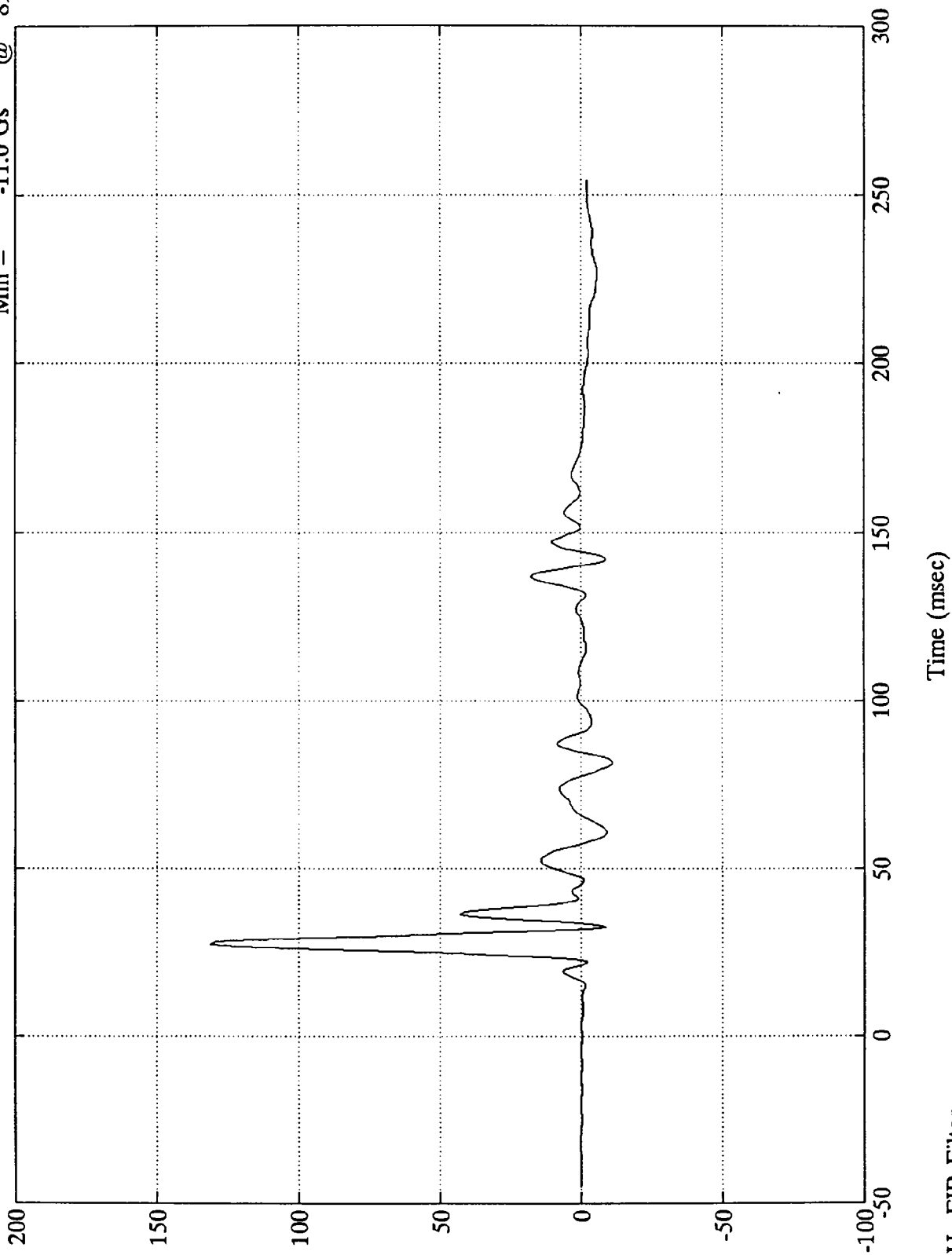
8102-5

Sae Filter Class 1000

TSC 301 Test 5 - Side Impact

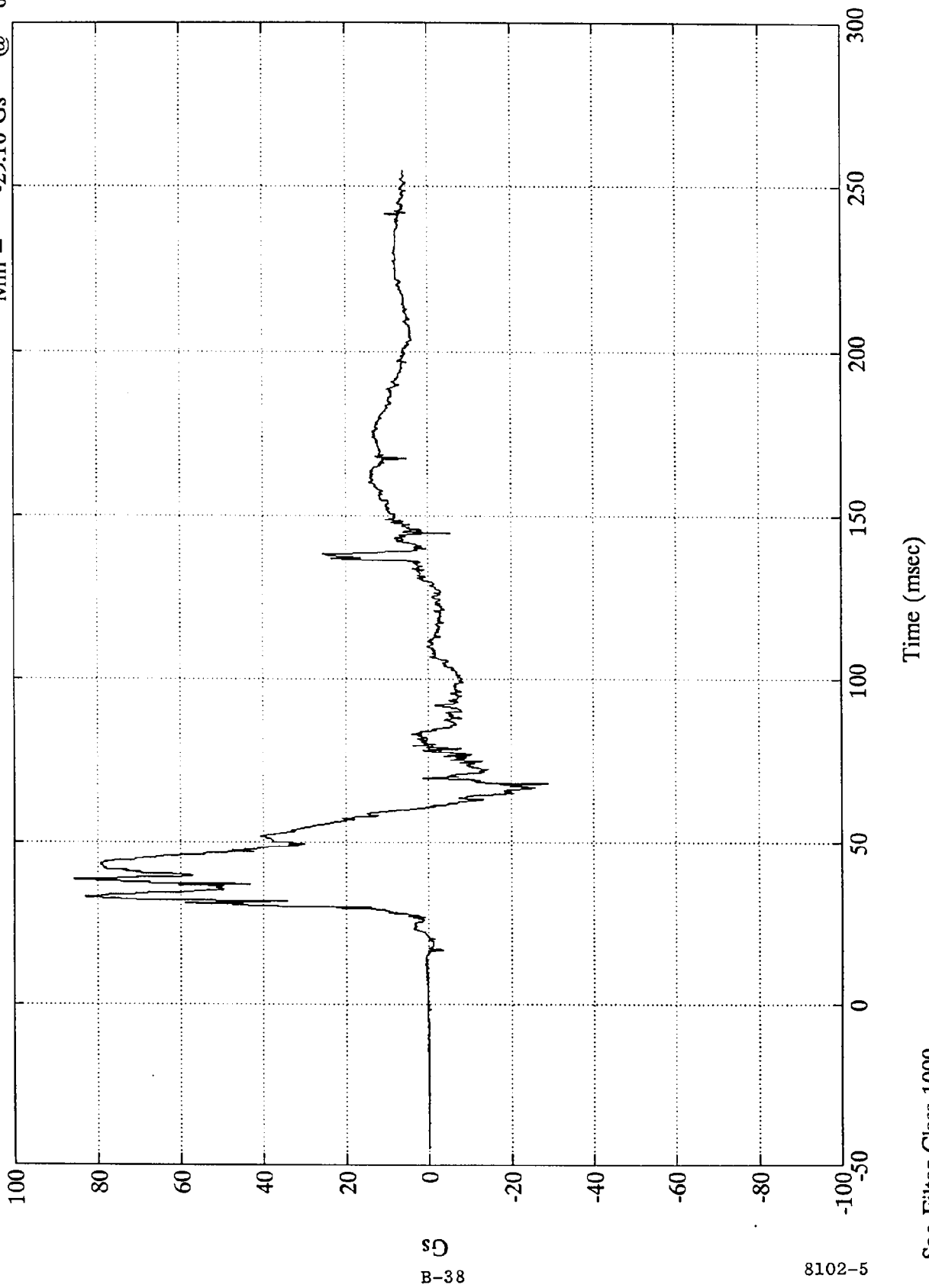
P4 Lower Rib Y(R)

Max = 131.3 Gs @ 27.500 msec
Min = -11.0 Gs @ 81.25 msec



TSC 301 Test 5 - Side Impact

P4 Upper Spine Y
Max = 85.76 Gs @ 38.63 msec
Min = -29.10 Gs @ 68.04 msec



SD
B-38

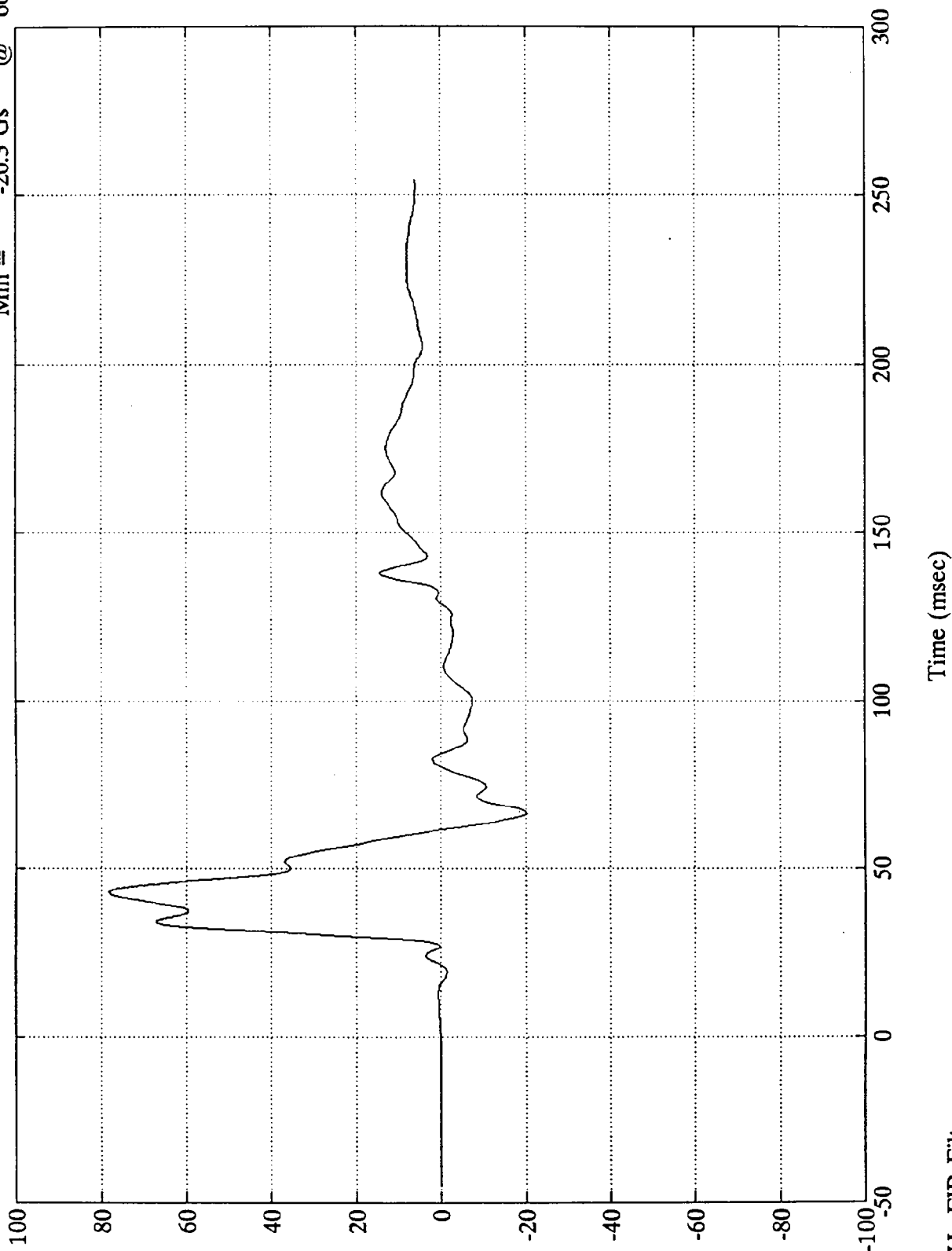
8102-5

Sae Filter Class 1000

TSC 301 Test 5 - Side Impact

Max = 78.0 Gs @ 43.125 msec
Min = -20.3 Gs @ 66.25 msec

P4 Upper Spine Y



B-39

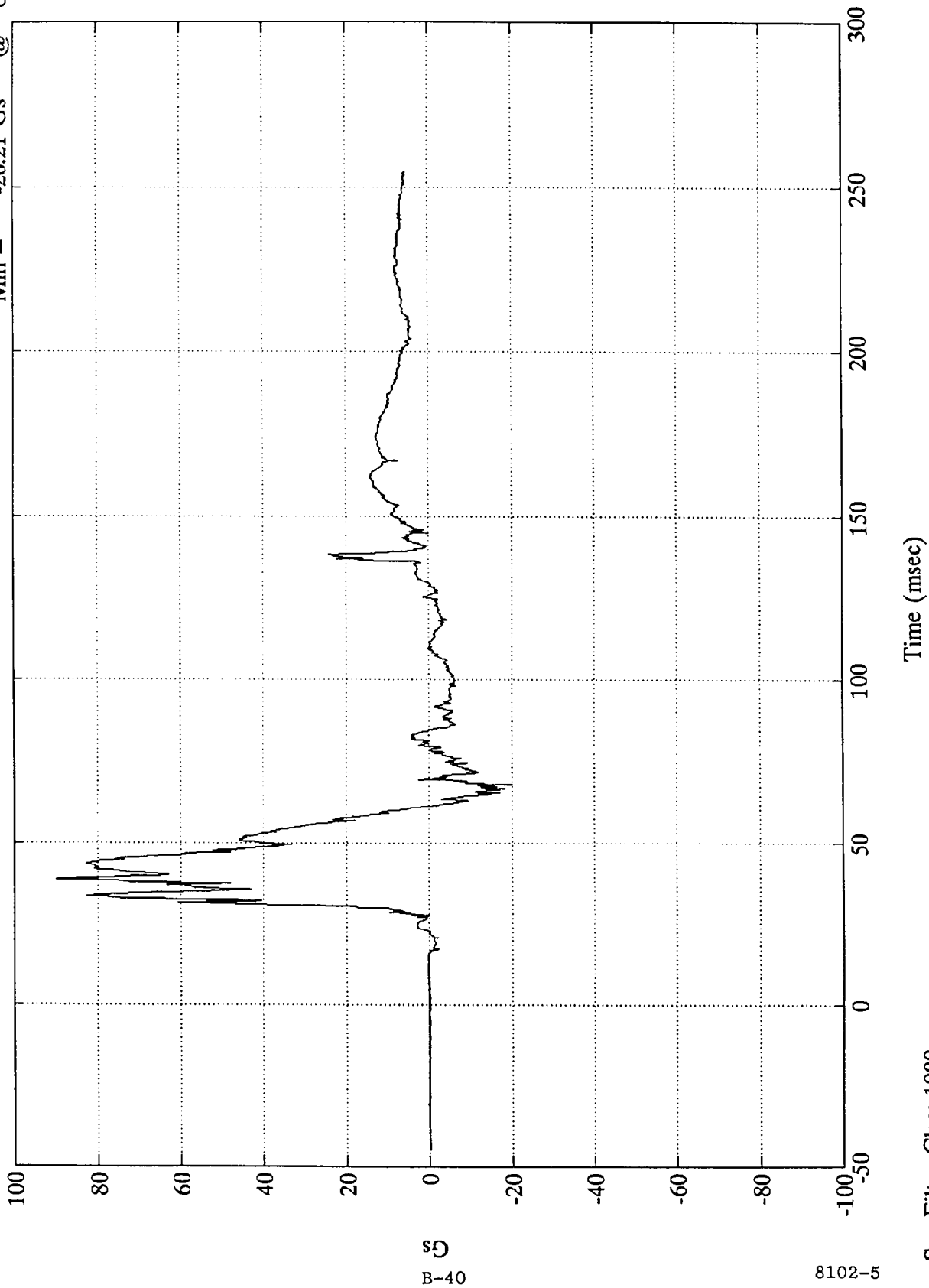
8102-5

100 Hz FIR Filter

TSC 301 Test 5 - Side Impact

Max = 89.95 Gs @ 38.52 msec
Min = -20.21 Gs @ 68.16 msec

P4 Upper Spine Y(R)



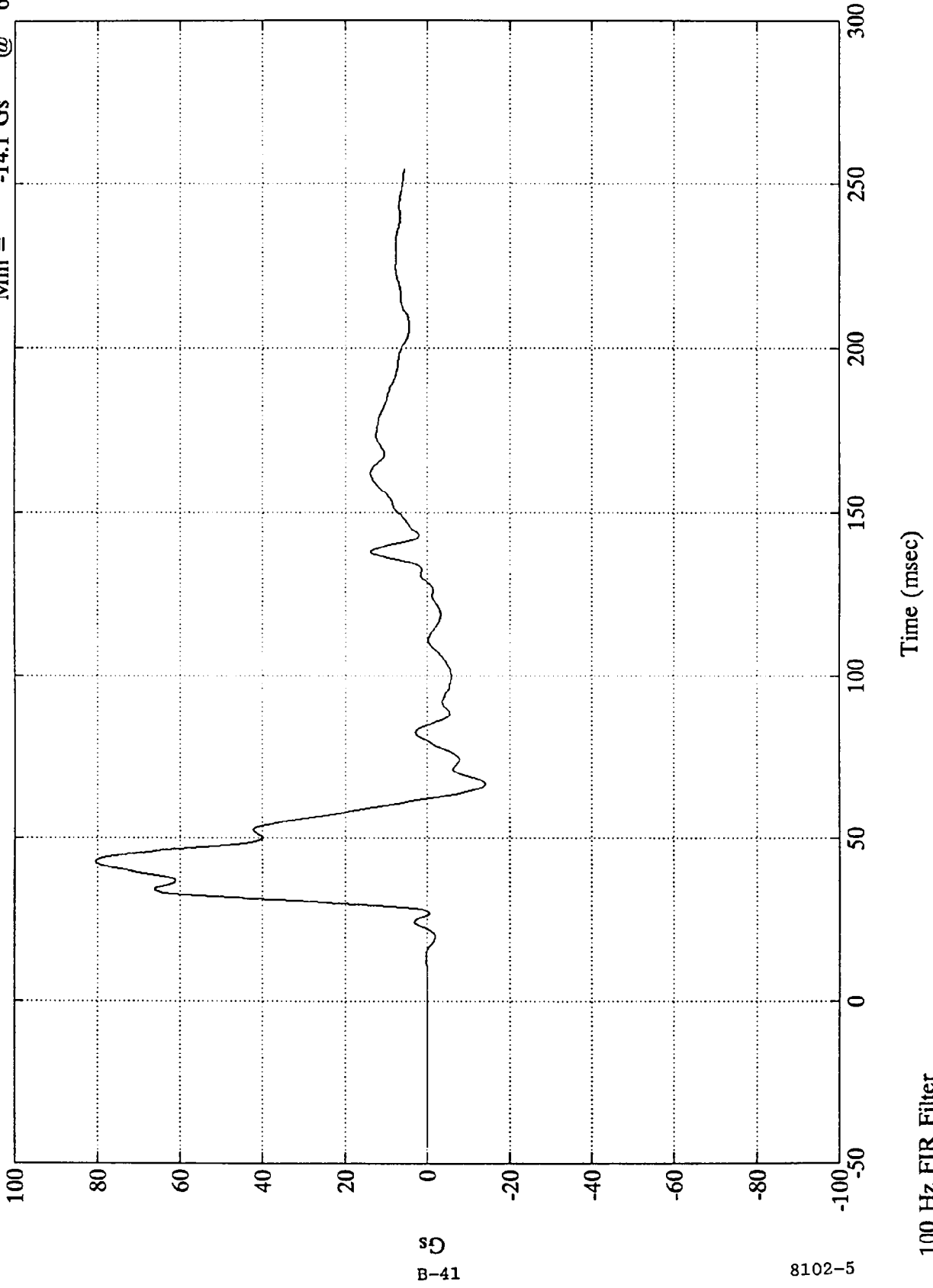
Sae Filter Class 1000

8102-5

B-40

TSC 301 Test 5 - Side Impact

P4 Upper Spine Y(R)
Max = 80.4 Gs @ 43.125 msec
Min = -14.1 Gs @ 66.25 msec



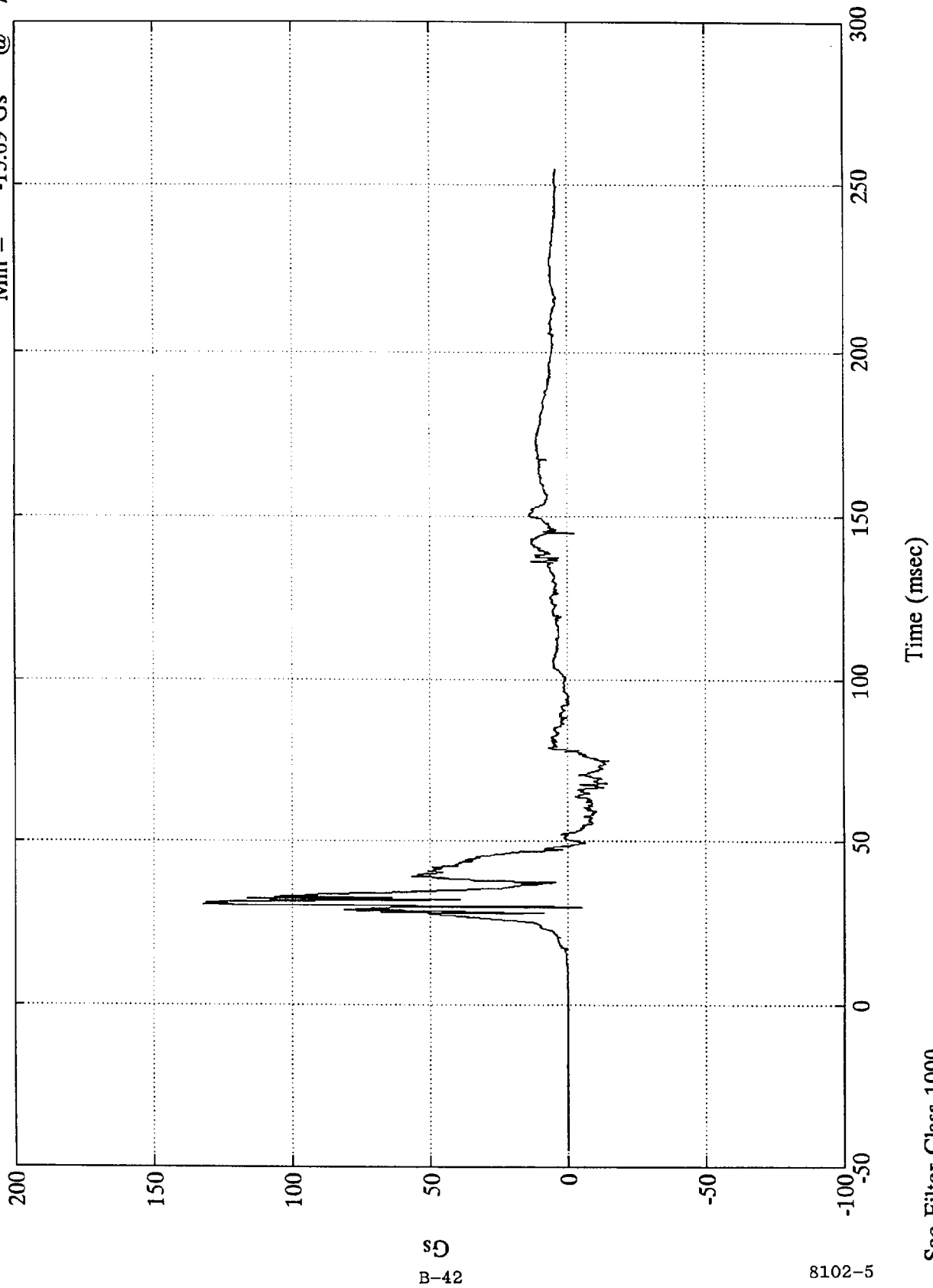
B-41

8102-5

100 Hz FIR Filter

TSC 301 Test 5 - Side Impact

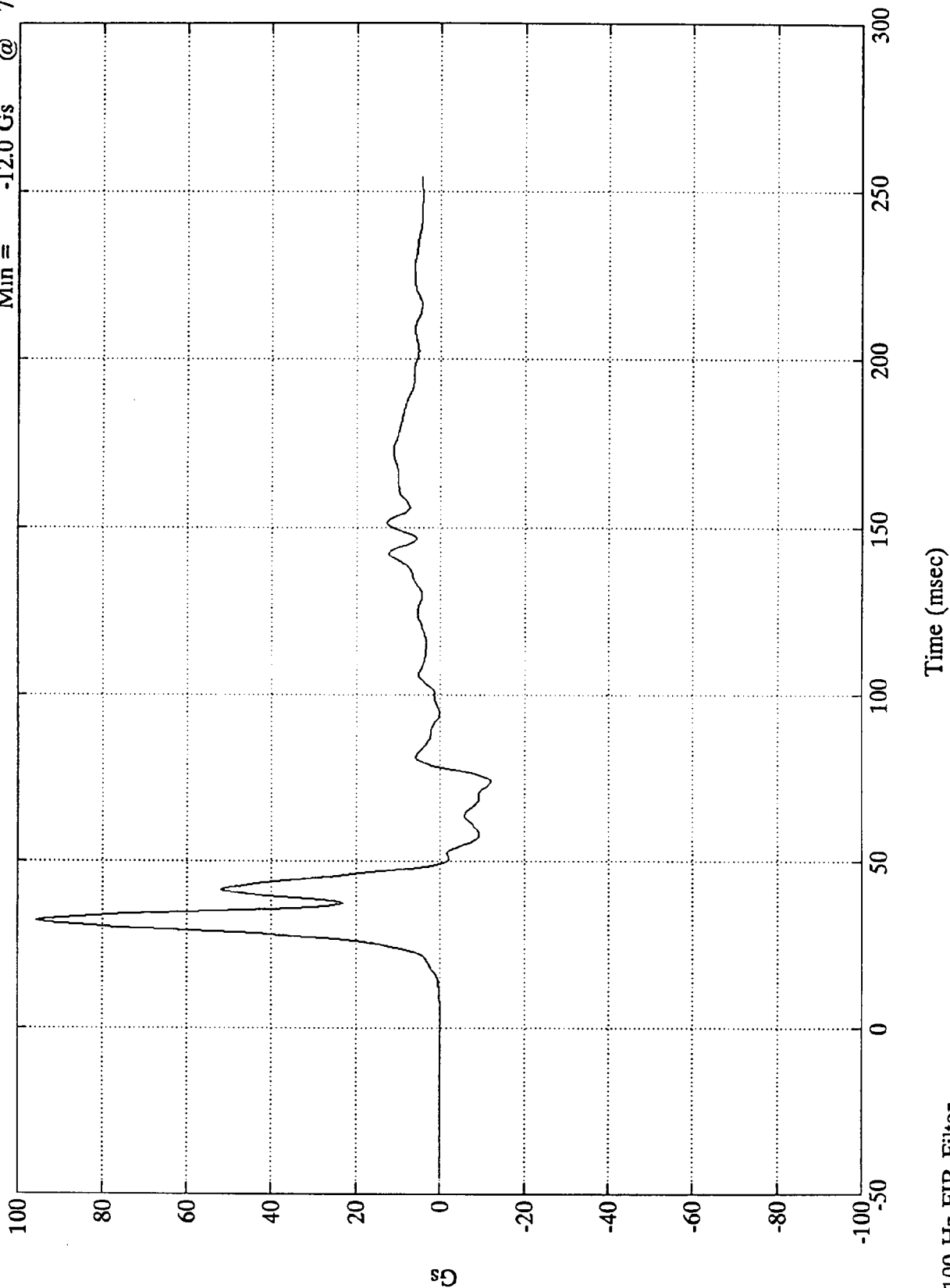
P4 Lower Spine Y
Max = 132.20 Gs @ 30.36 msec
Min = -15.09 Gs @ 74.63 msec



TSC 301 Test 5 - Side Impact

P4 Lower Spine Y

Max = 95.5 Gs @ 31.875 msec
Min = -12.0 Gs @ 73.75 msec



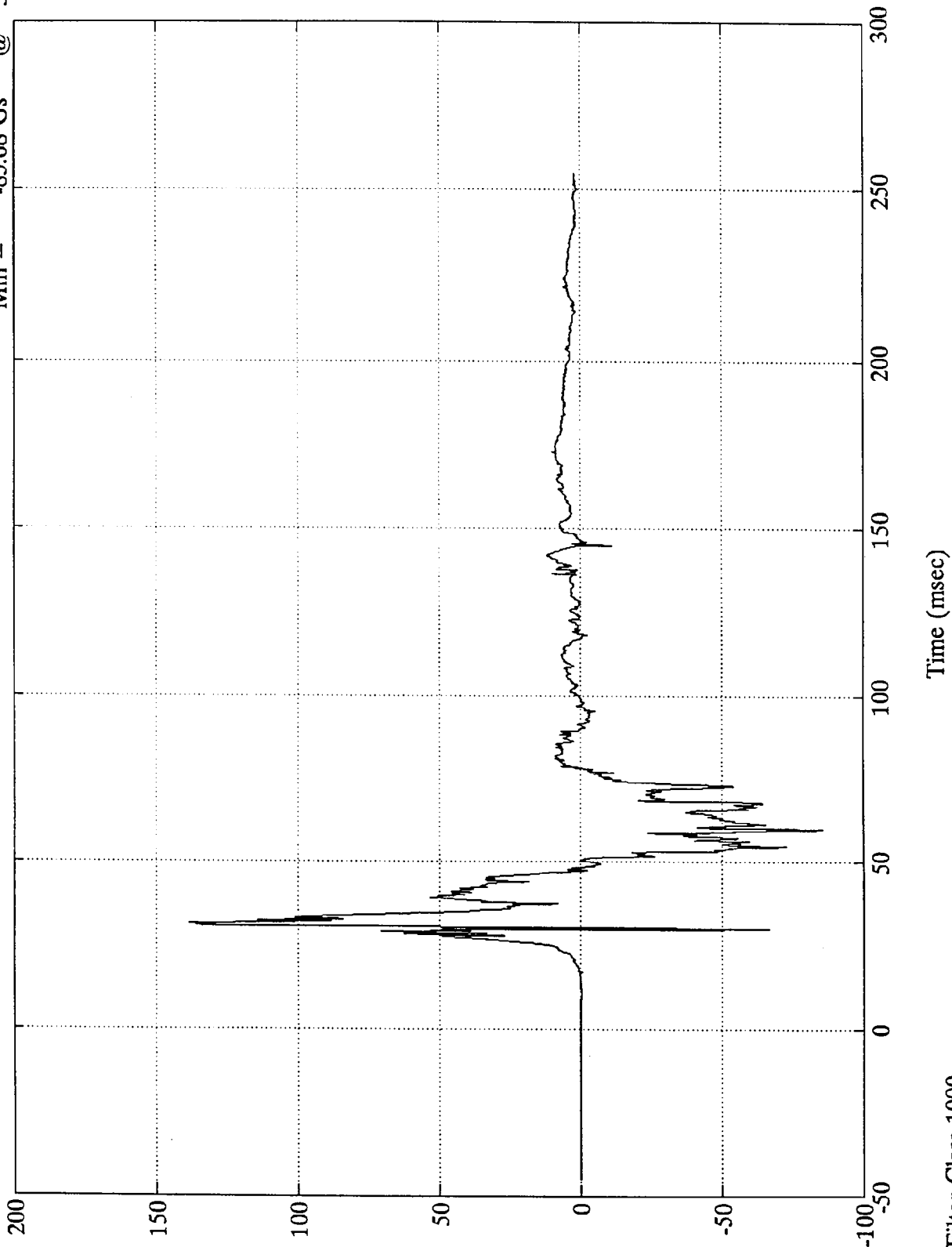
B-43

8102-5

100 Hz FIR Filter

TSC 301 Test 5 - Side Impact

P4 Lower Spine Y(R) Max = 138.50 Gs @ 31.19 msec
Min = -85.68 Gs @ 59.88 msec



SD
B-44

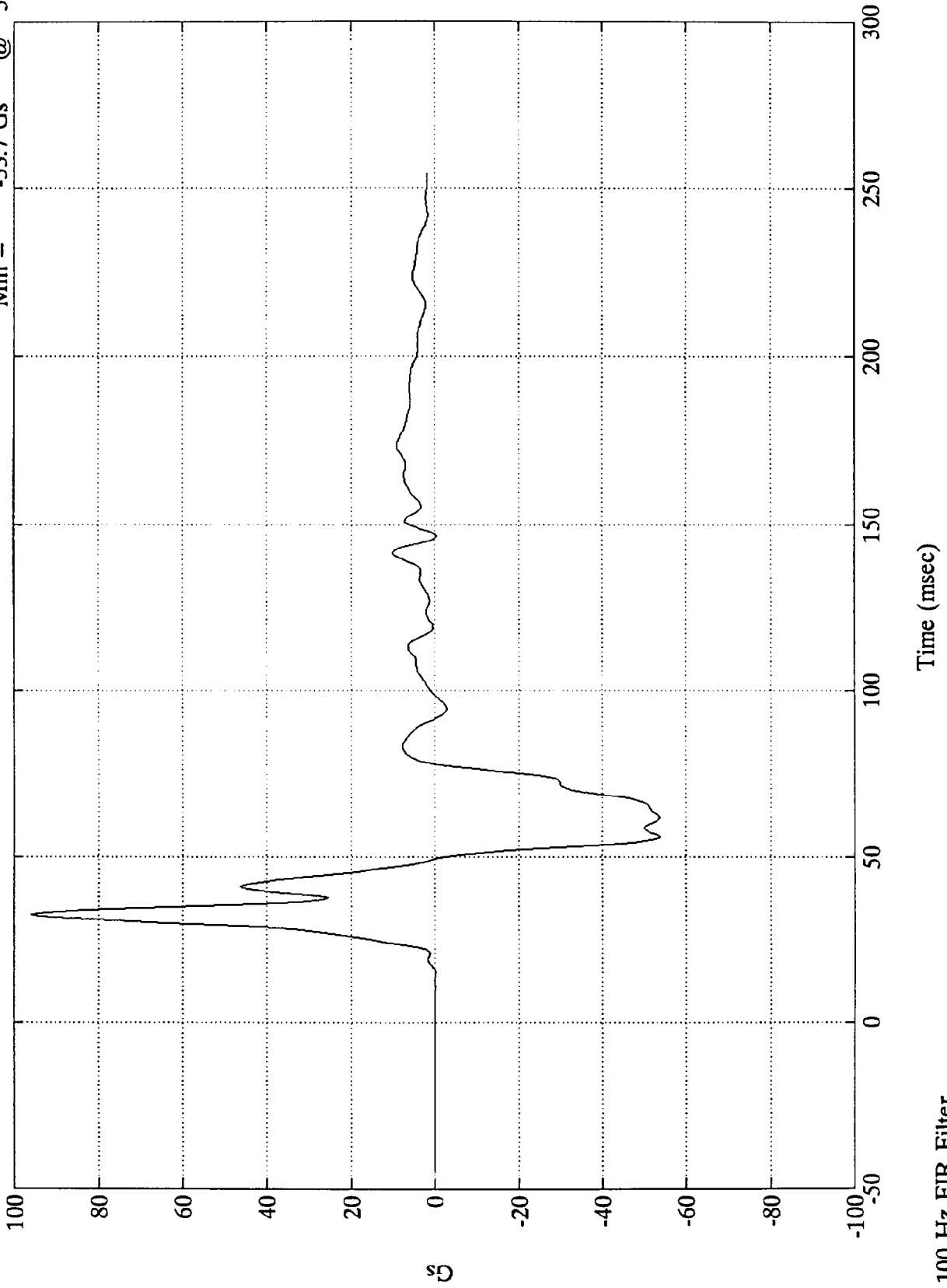
8102-5

Sae Filter Class 1000

TSC 301 Test 5 - Side Impact

P4 Lower Spine Y(R)

Max = 95.9 Gs @ 32.500 msec
Min = -53.7 Gs @ 56.25 msec



B-45

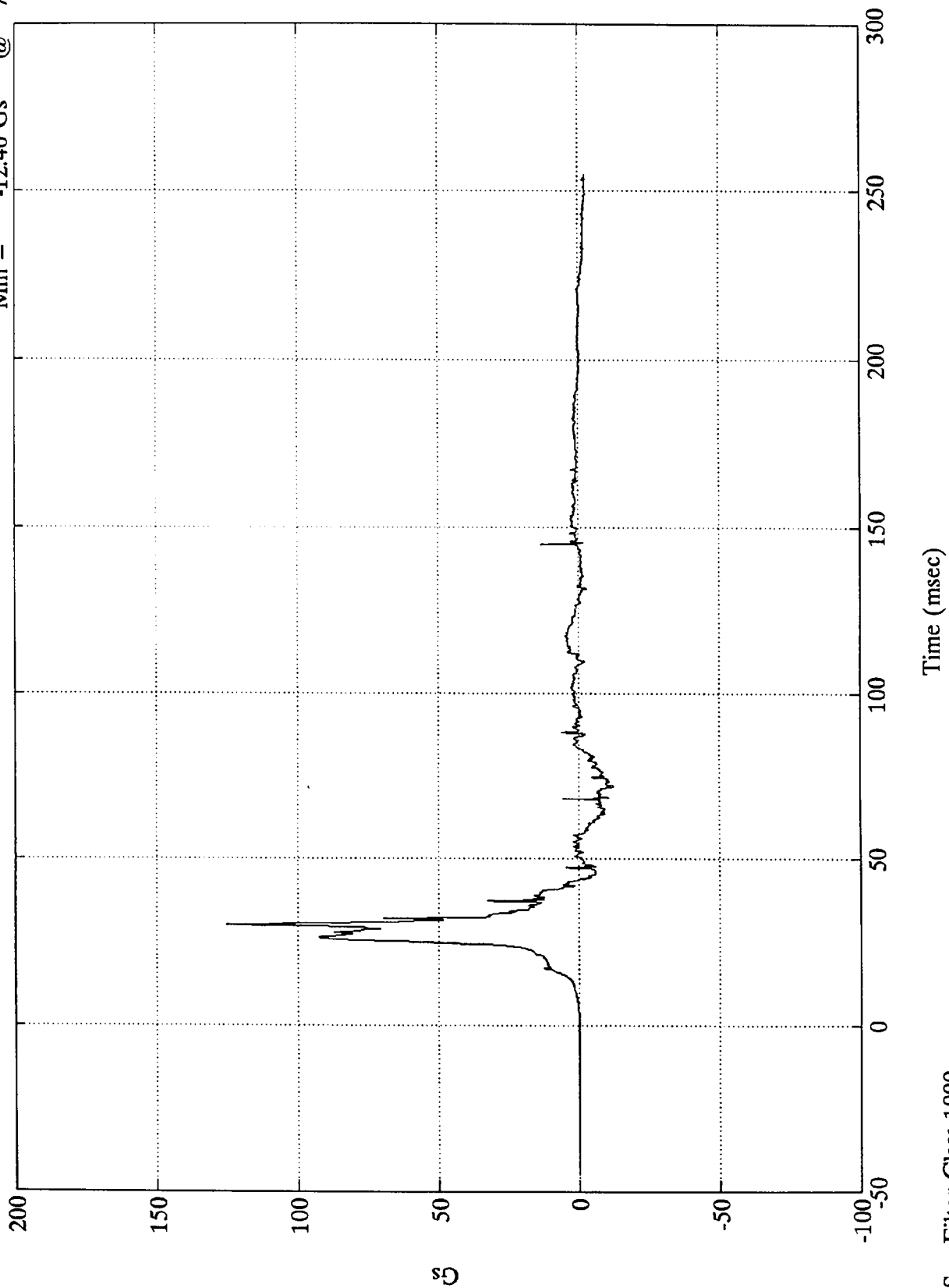
8102-5

100 Hz FIR Filter

TSC 301 Test 5 - Side Impact

Max = 125.69 Gs @ 29.88 msec
Min = -12.40 Gs @ 71.87 msec

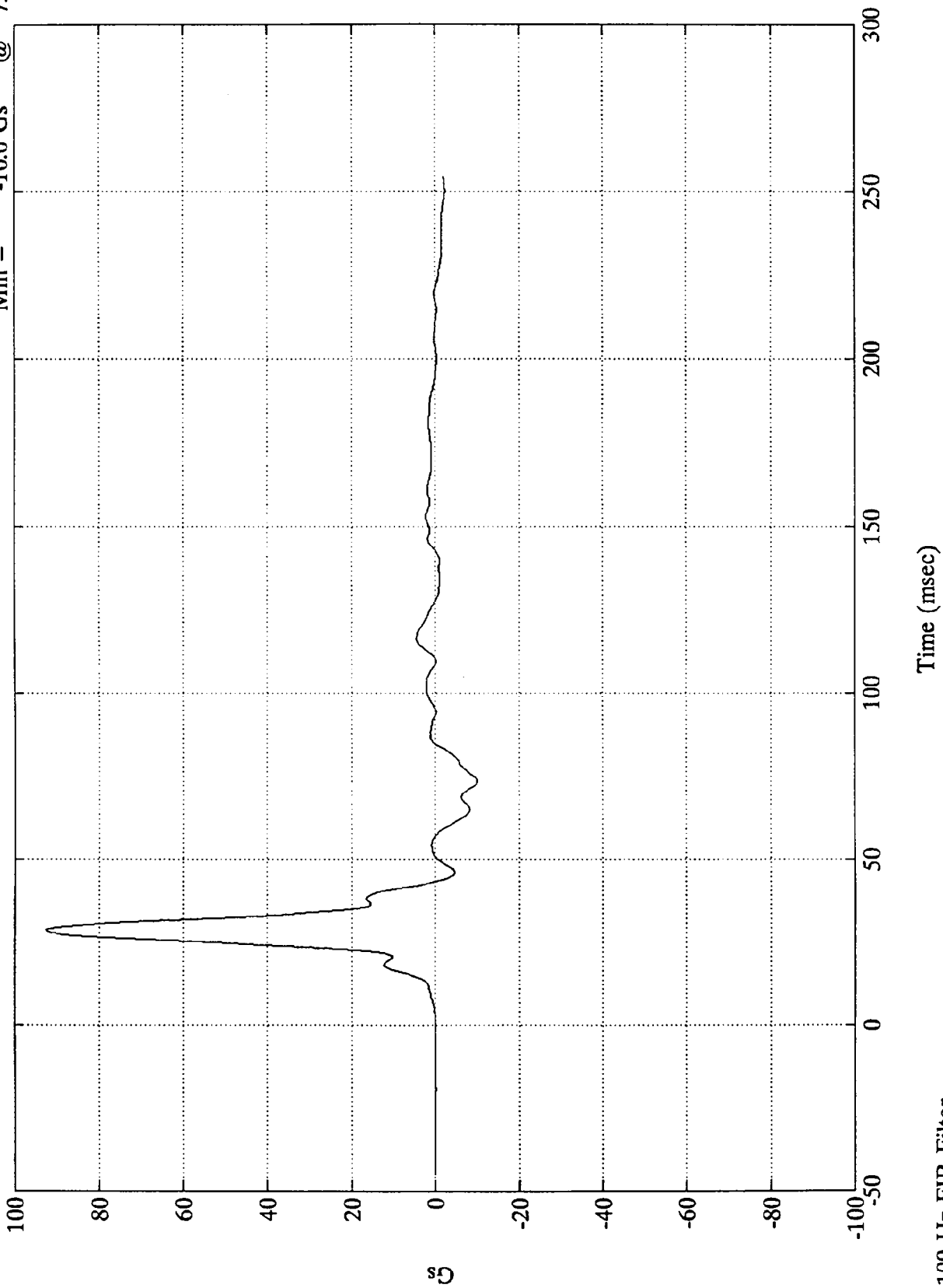
P4 Pelvic Y



TSC 301 Test 5 - Side Impact

P4 Pelvic Y

Max = 92.6 Gs @ 28.750 msec
Min = -10.0 Gs @ 73.12 msec



Gs
B-47

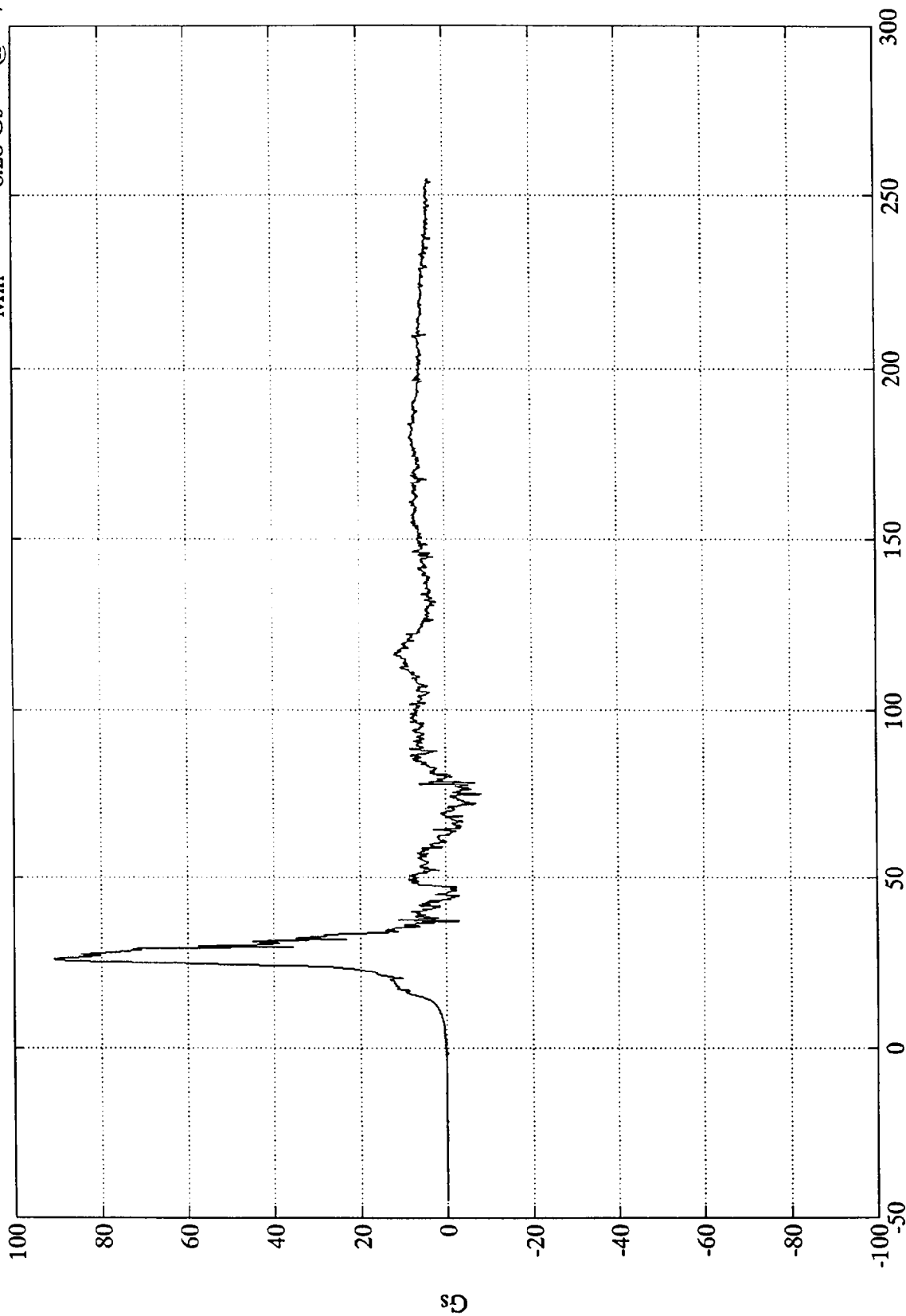
8102-5

100 Hz FIR Filter

TSC 301 Test 5 - Side Impact

Max = 90.88 Gs @ 26.15 msec
Min = -8.28 Gs @ 74.63 msec

P4 Pelvic Y(R)



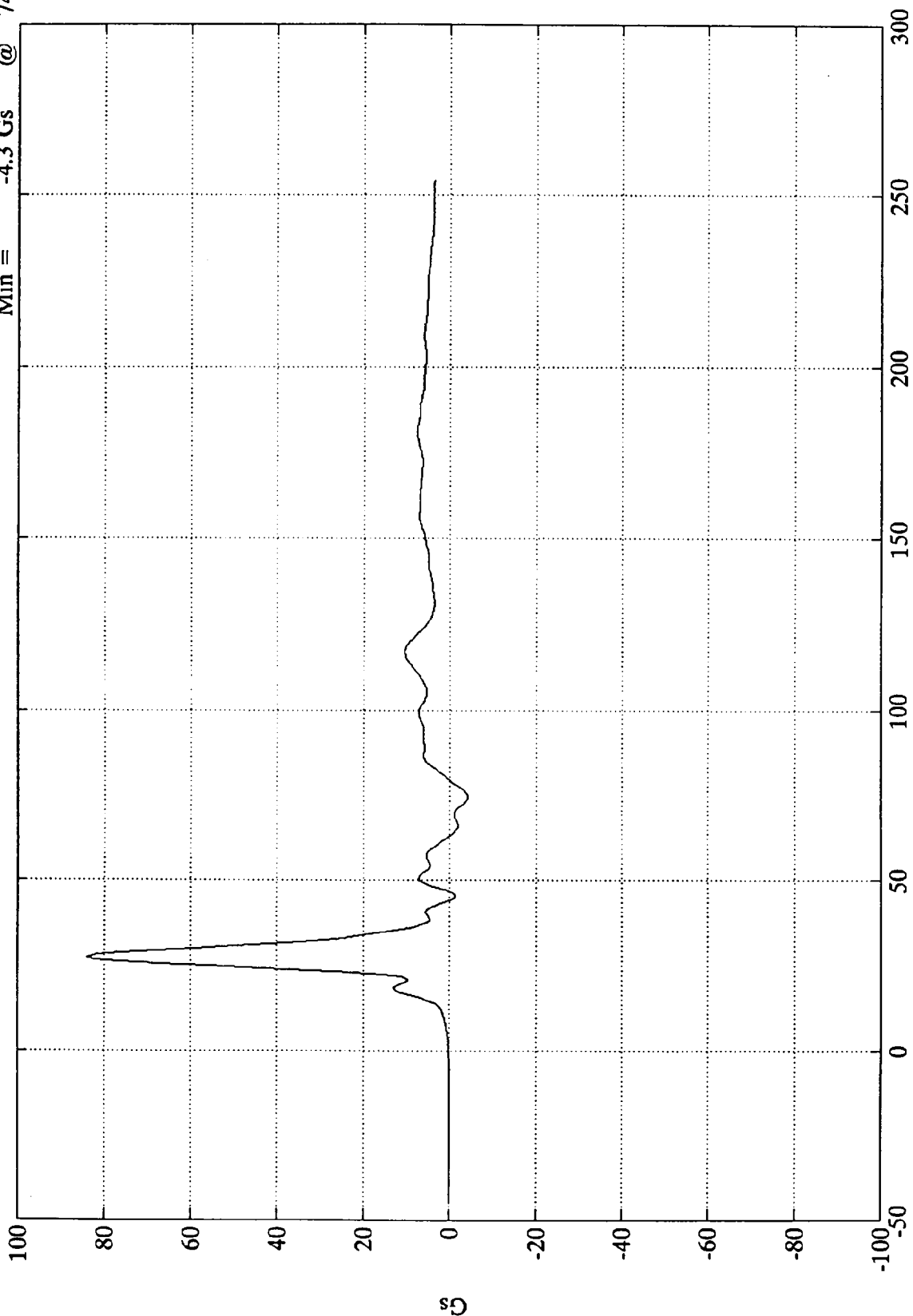
Time (msec)

Sae Filter Class 1000

TSC 301 Test 5 - Side Impact

Max = 84.0 Gs @ 27.500 msec
Min = -4.3 Gs @ 74.37 msec

P4 Pelvic Y(R)



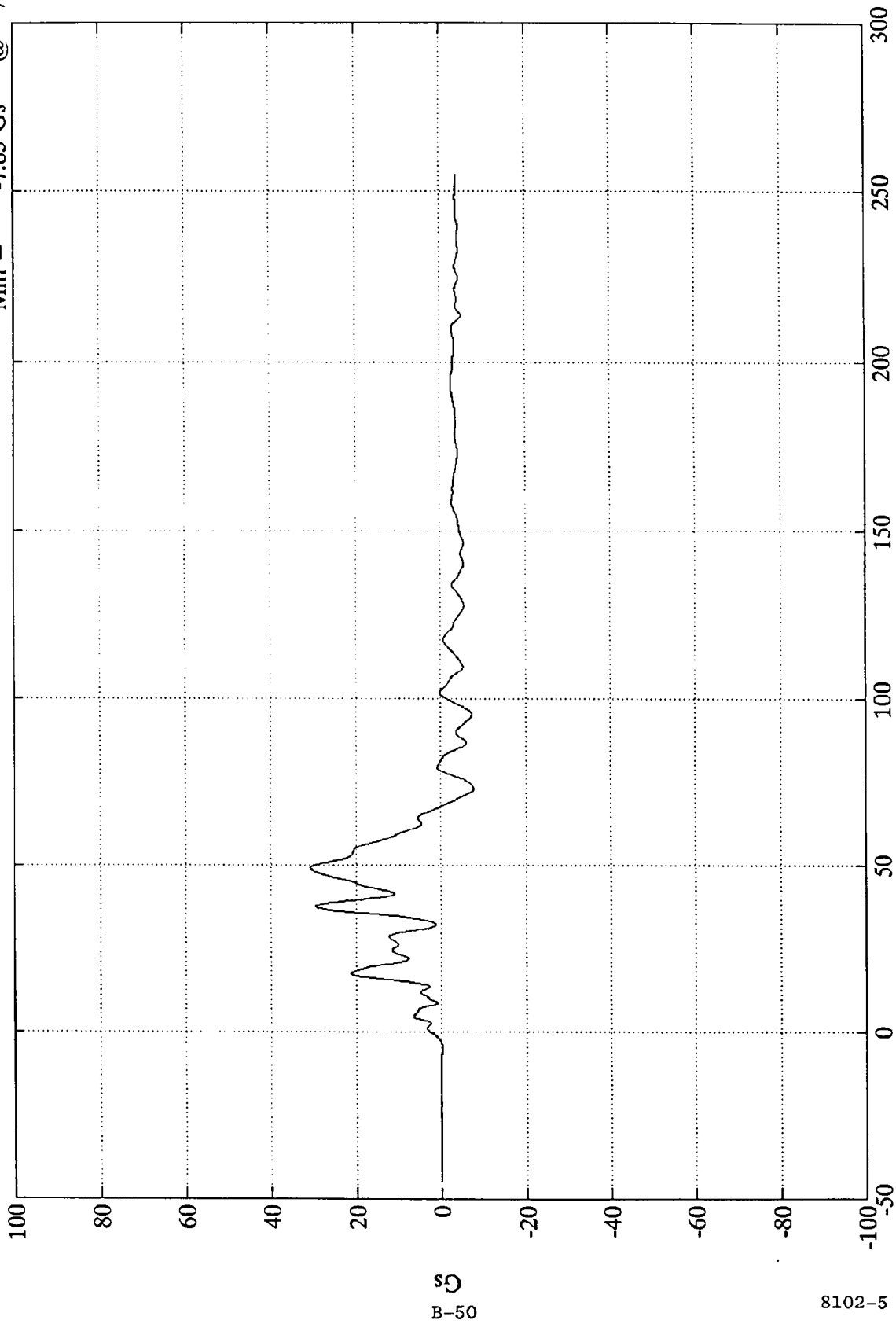
Time (msec)

100 Hz FIR Filter

TSC 301 Test 5 - Side Impact

Max = 30.81 Gs @ 49.20 msec
Min = -7.83 Gs @ 73.08 msec

V1 Left B Pillar X



Time (msec)

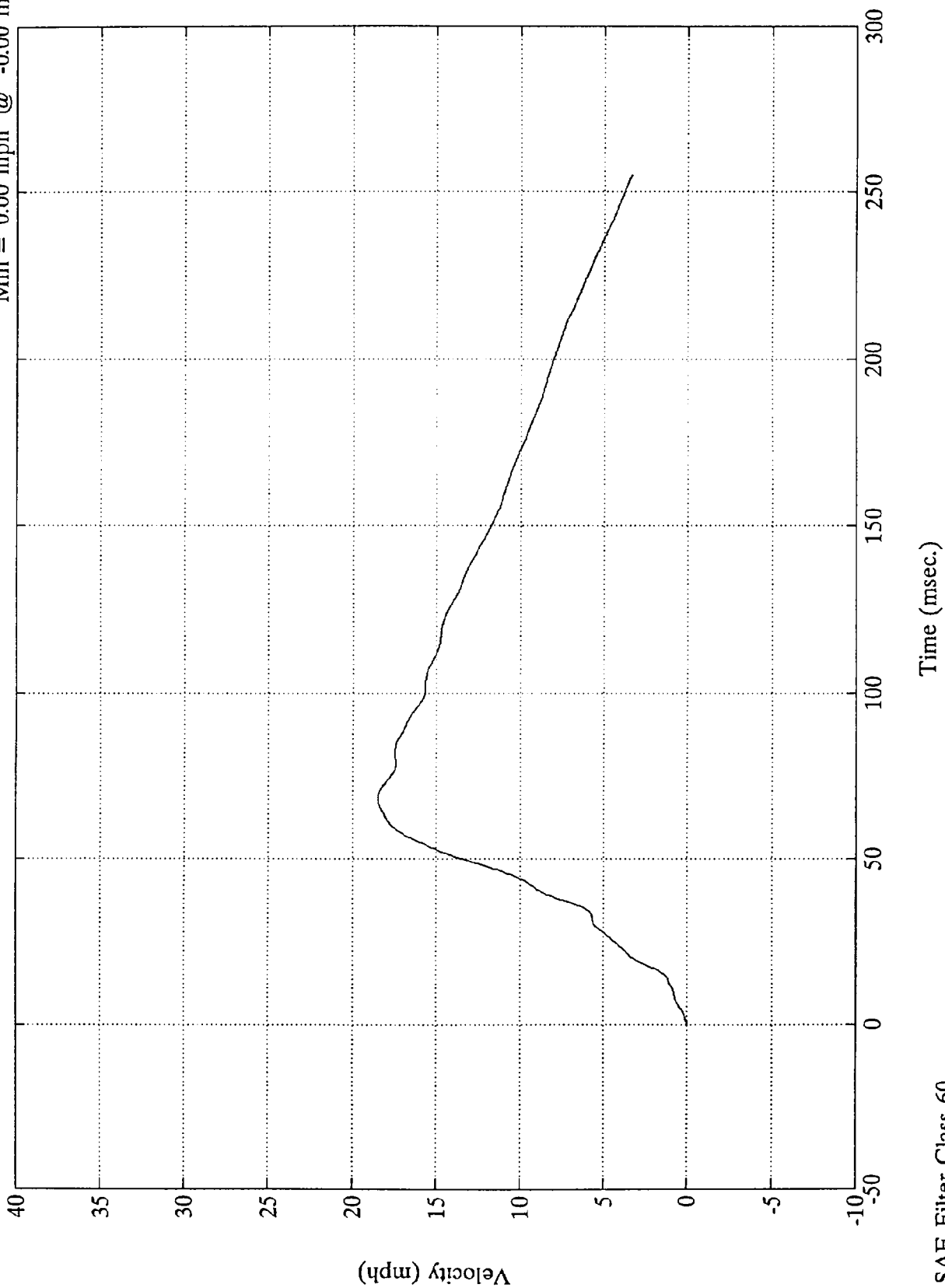
Sae Filter Class 60

8102-5
B-50

TSC 301 Test 5 - Side Impact

Max = 18.49 mph @ 67.92 msec
Min = 0.00 mph @ -0.00 msec

V1 Left B Pillar X



B-51

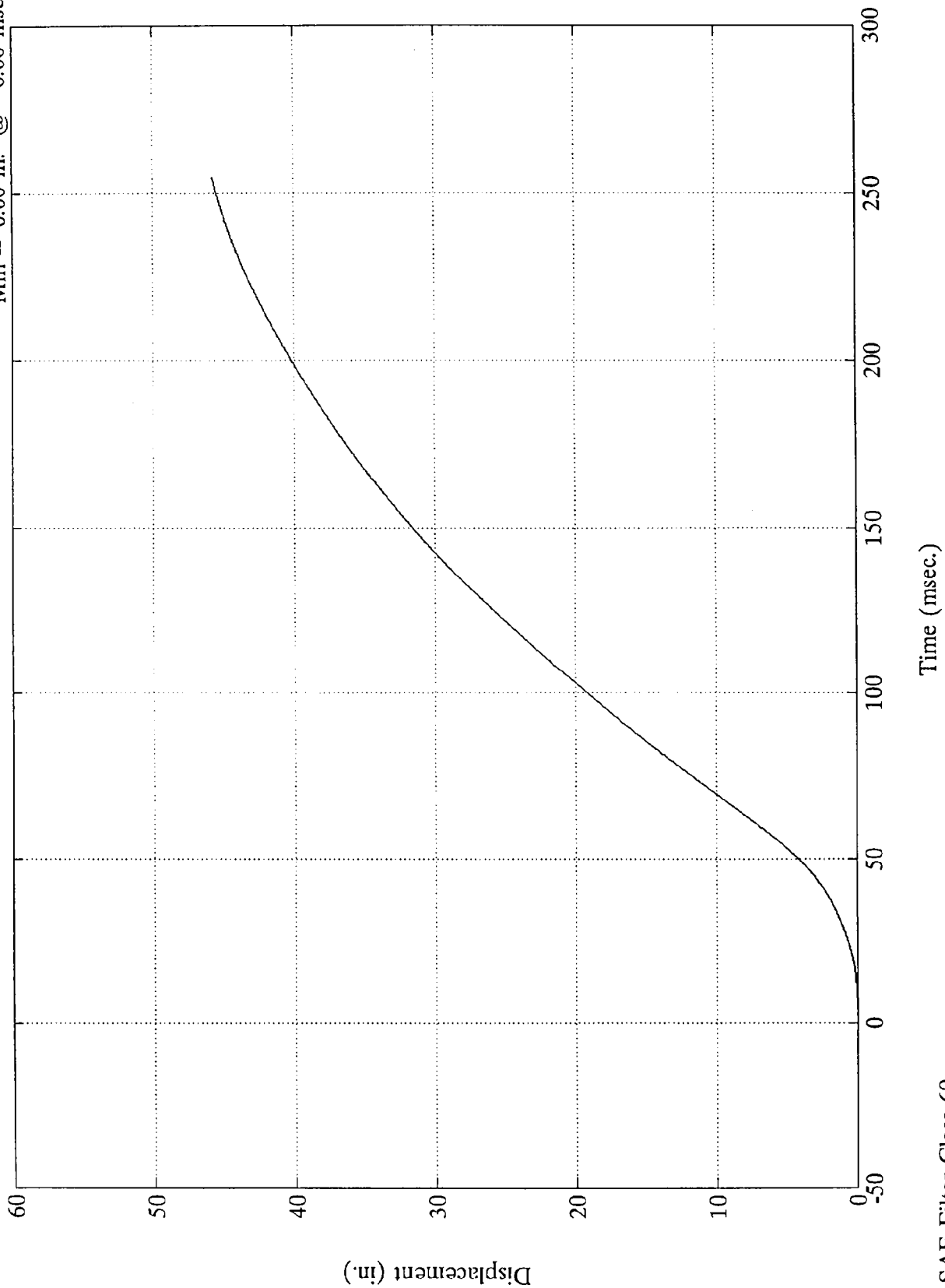
8102-5

SAE Filter Class 60

TSC 301 Test 5 - Side Impact

V1 Left B Pillar X

Max = 45.77 in. @ 254.88 msec
Min = 0.00 in. @ -0.00 msec

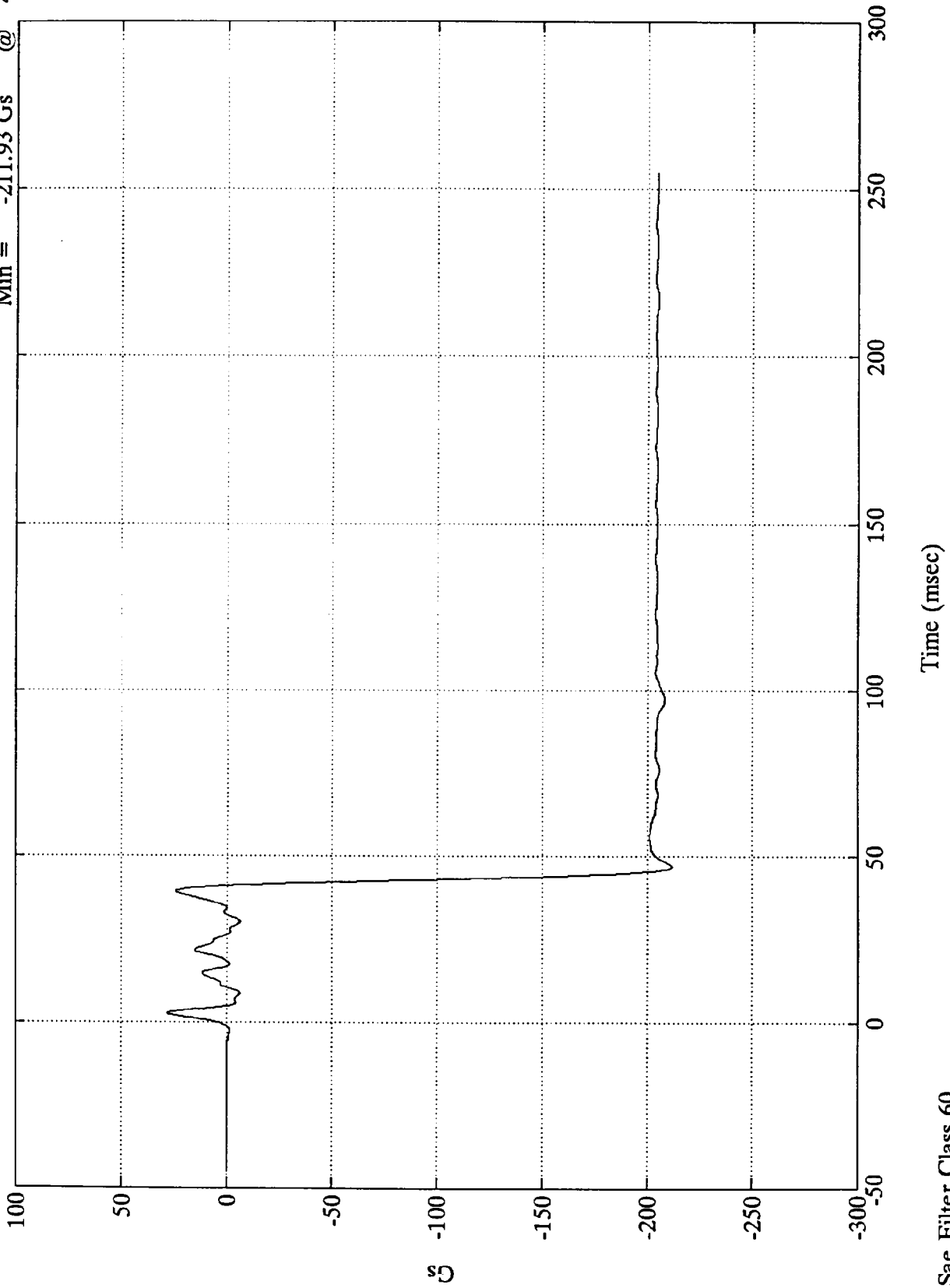


SAE Filter Class 60

TSC 301 Test 5 - Side Impact

Max = 28.00 Gs @ 2.51 msec
Min = -211.93 Gs @ 47.04 msec

V1 Left B Pillar Y



B-53

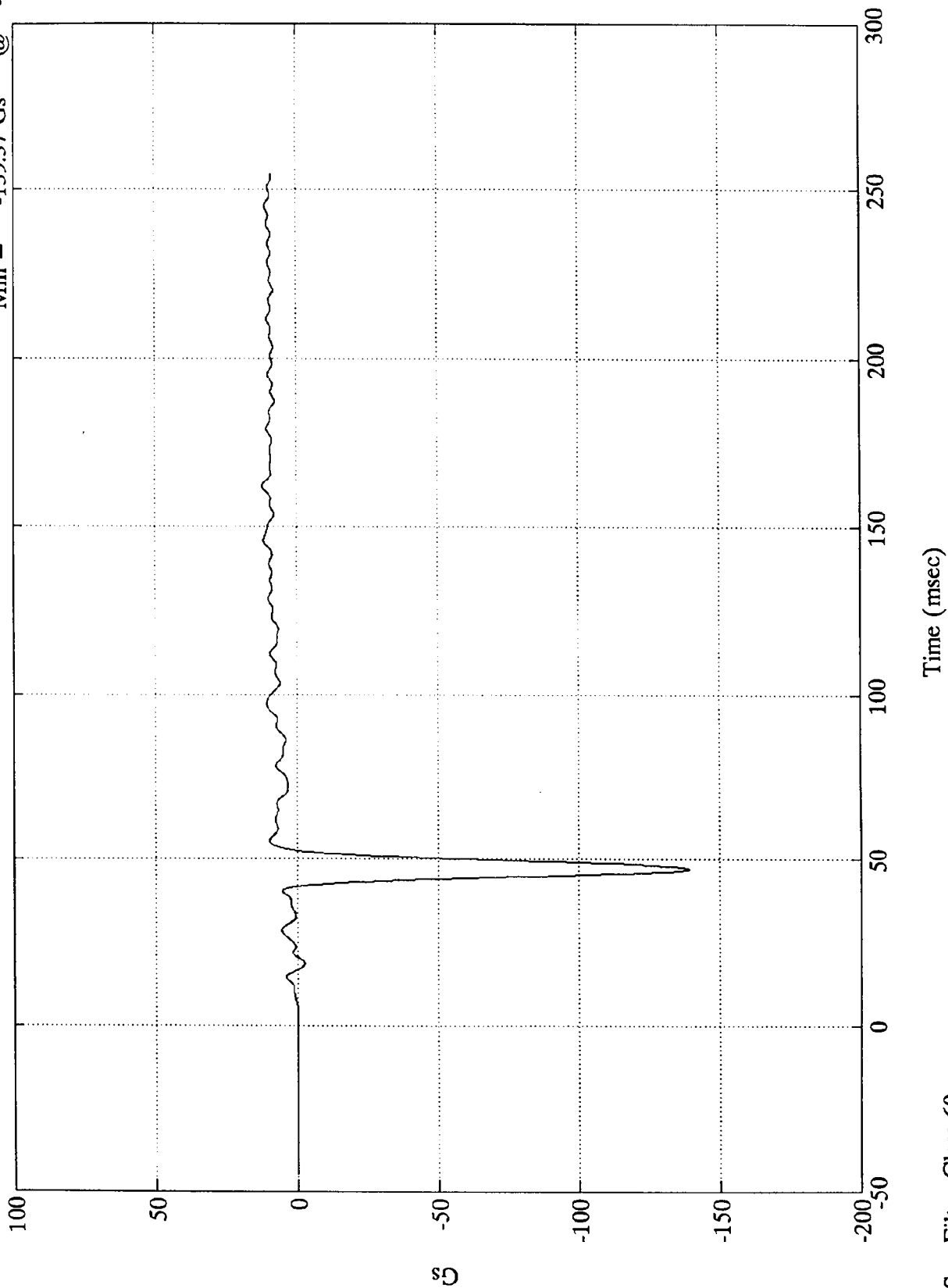
8102-5

Sae Filter Class 60

TSC 301 Test 5 - Side Impact

Max = 12.17 Gs @ 162.00 msec
Min = -139.37 Gs @ 46.92 msec

V1 Right B Pillar X



B-54

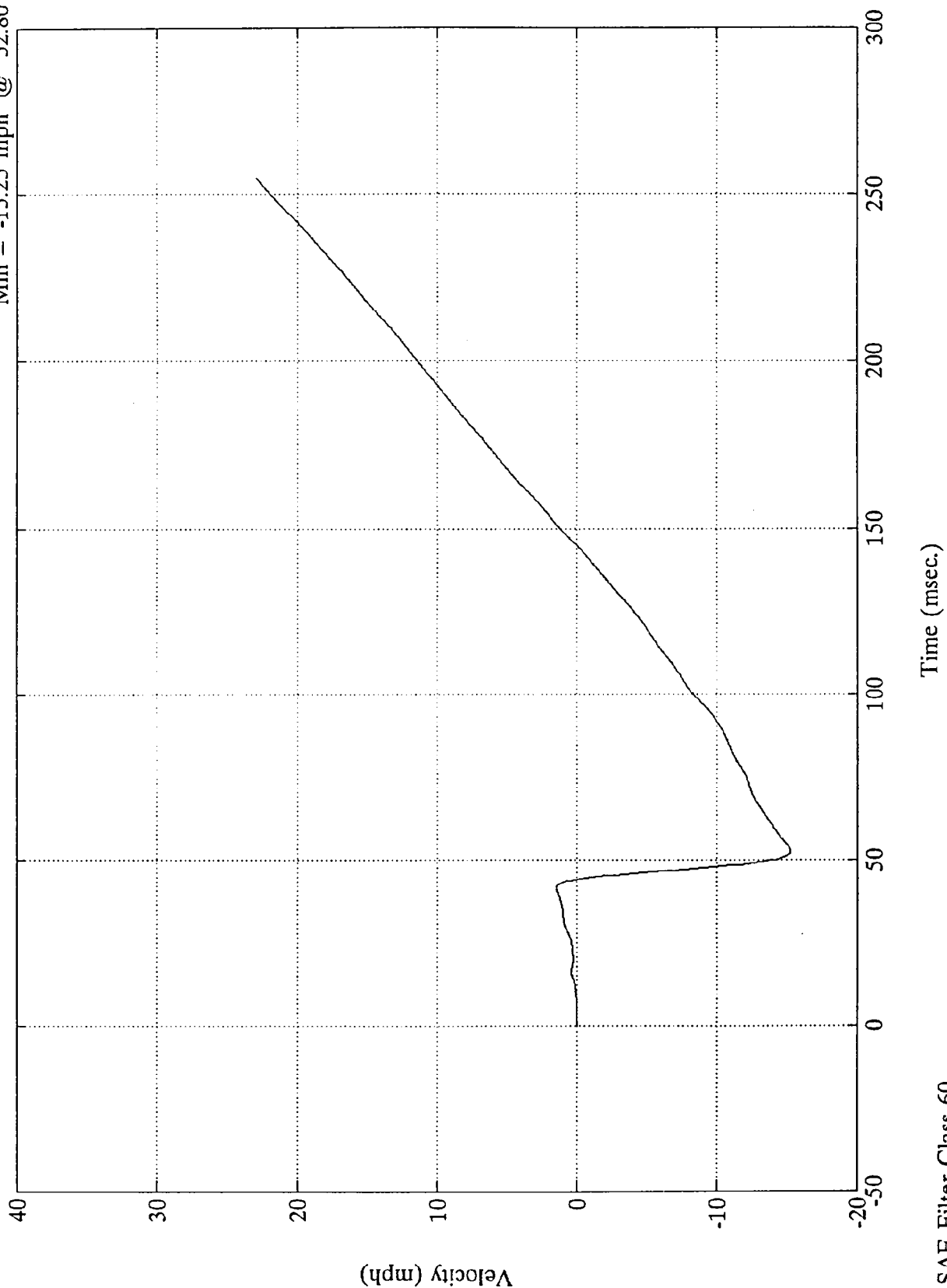
8102-5

Sae Filter Class 60

TSC 301 Test 5 - Side Impact

V1 Right B Pillar X

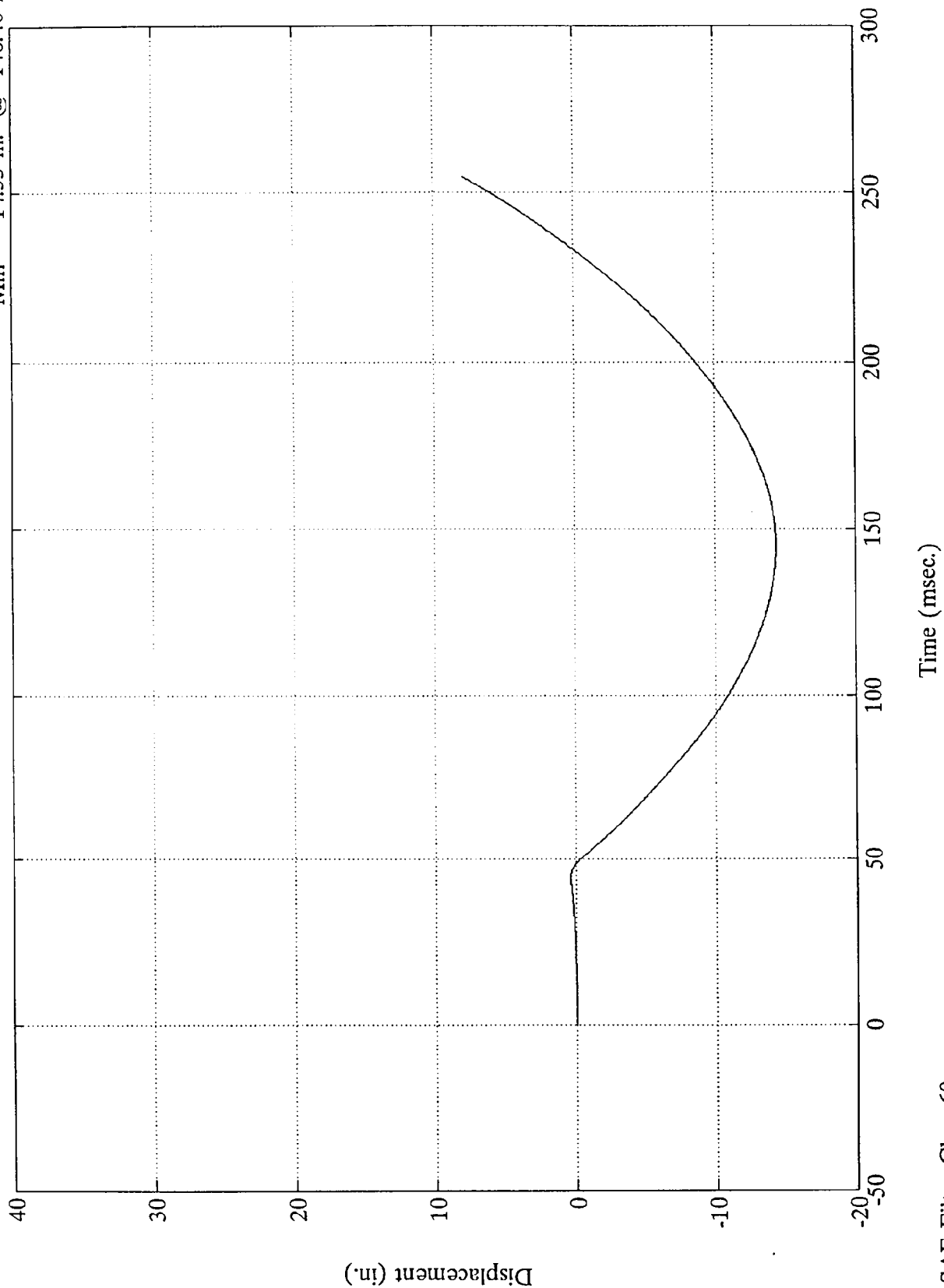
Max = 22.93 mph @ 254.88 msec
Min = -15.25 mph @ 52.80 msec



TSC 301 Test 5 - Side Impact

V1 Right B Pillar X

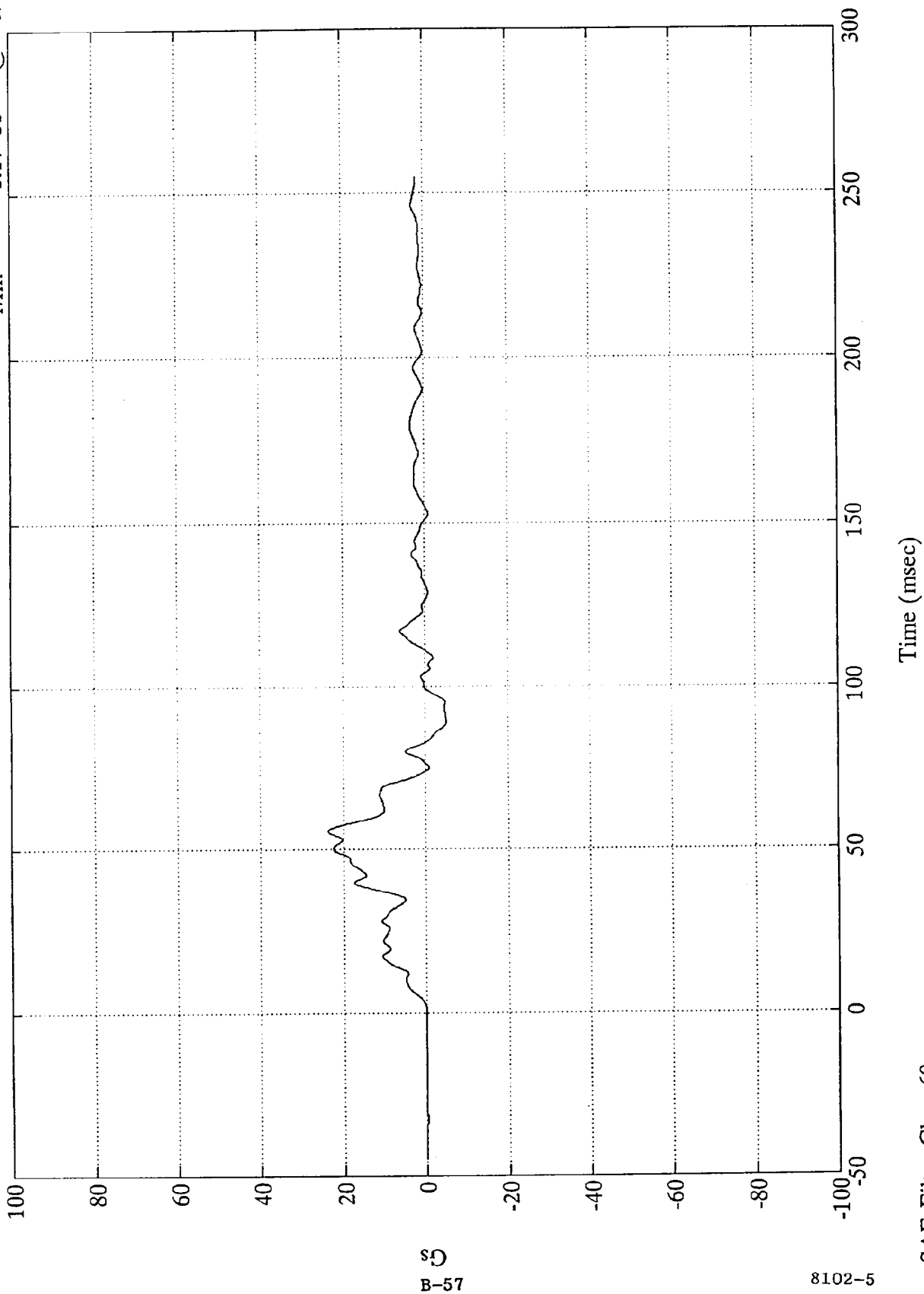
Max = 7.86 in. @ 254.88 msec
Min = -14.35 in. @ 146.40 msec



TSC 301 Test 5 - Side Impact

V1 Right B Pillar Y

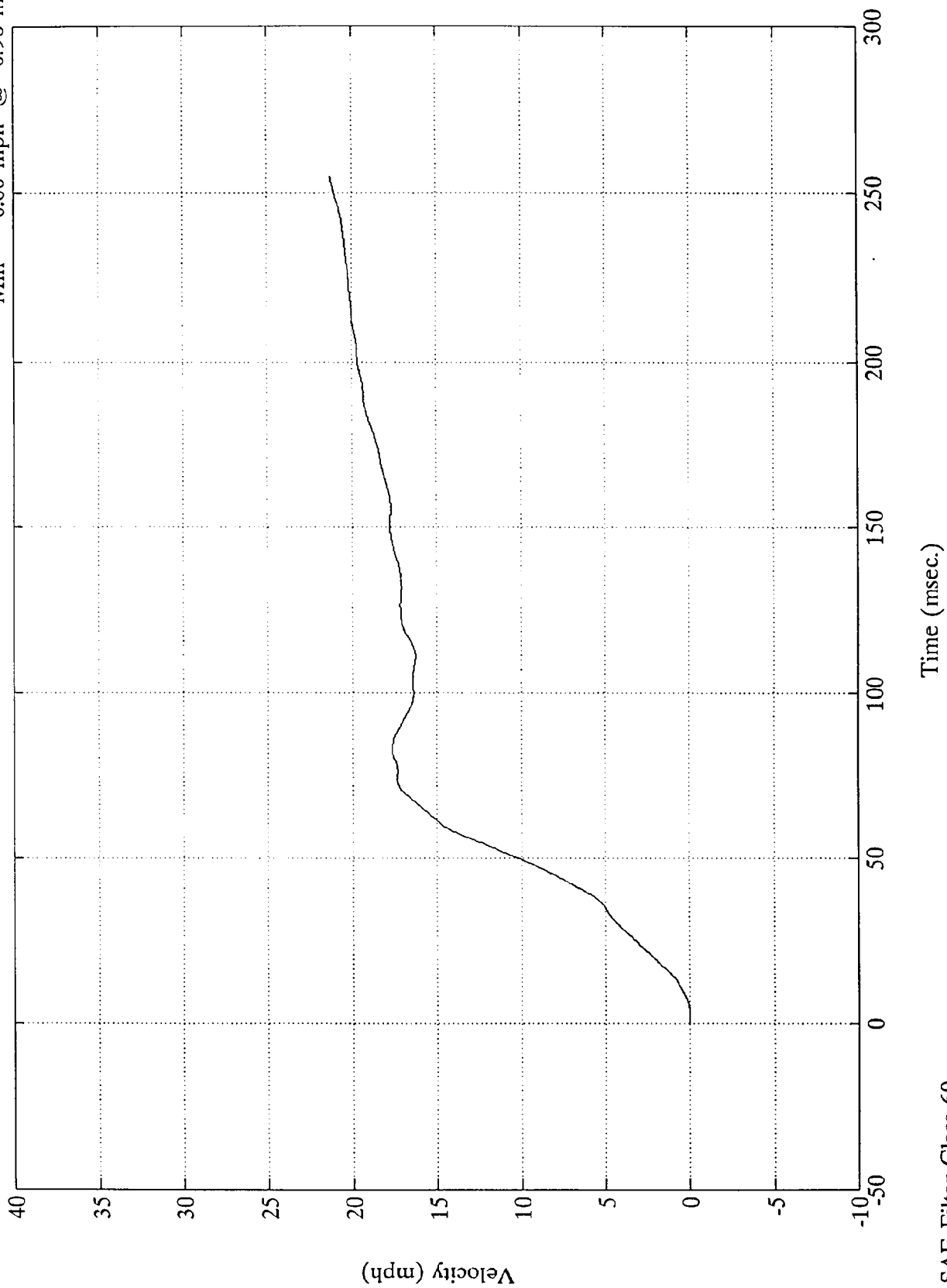
Max = 23.71 Gs @ 55.56 msec
Min = -5.17 Gs @ 89.27 msec



TSC 301 Test 5 - Side Impact

V1 Right B Pillar Y

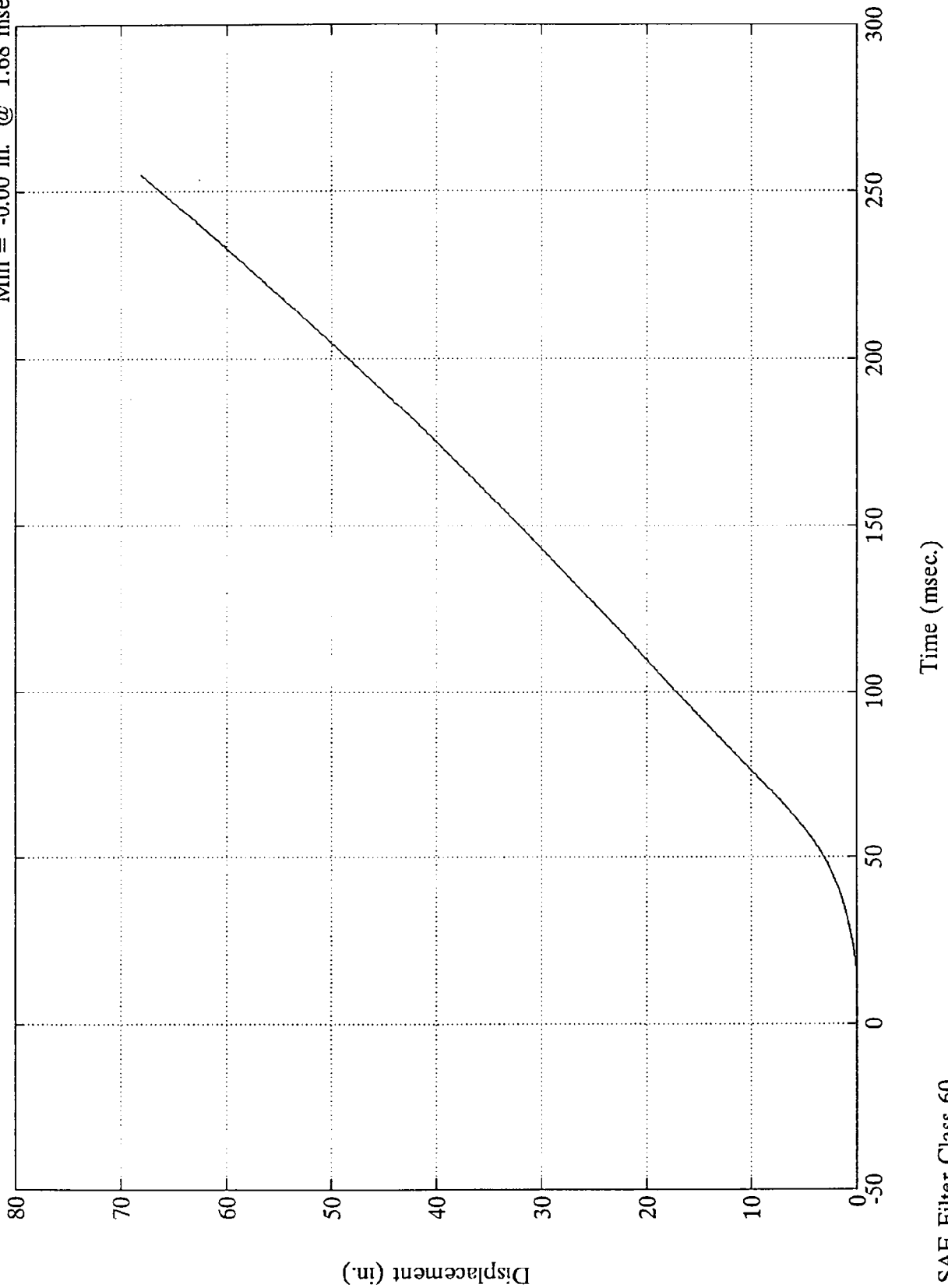
Max = 21.25 mph @ 254.88 msec
Min = -0.00 mph @ 0.96 msec



TSC 301 Test 5 - Side Impact

V1 Right B Pillar Y

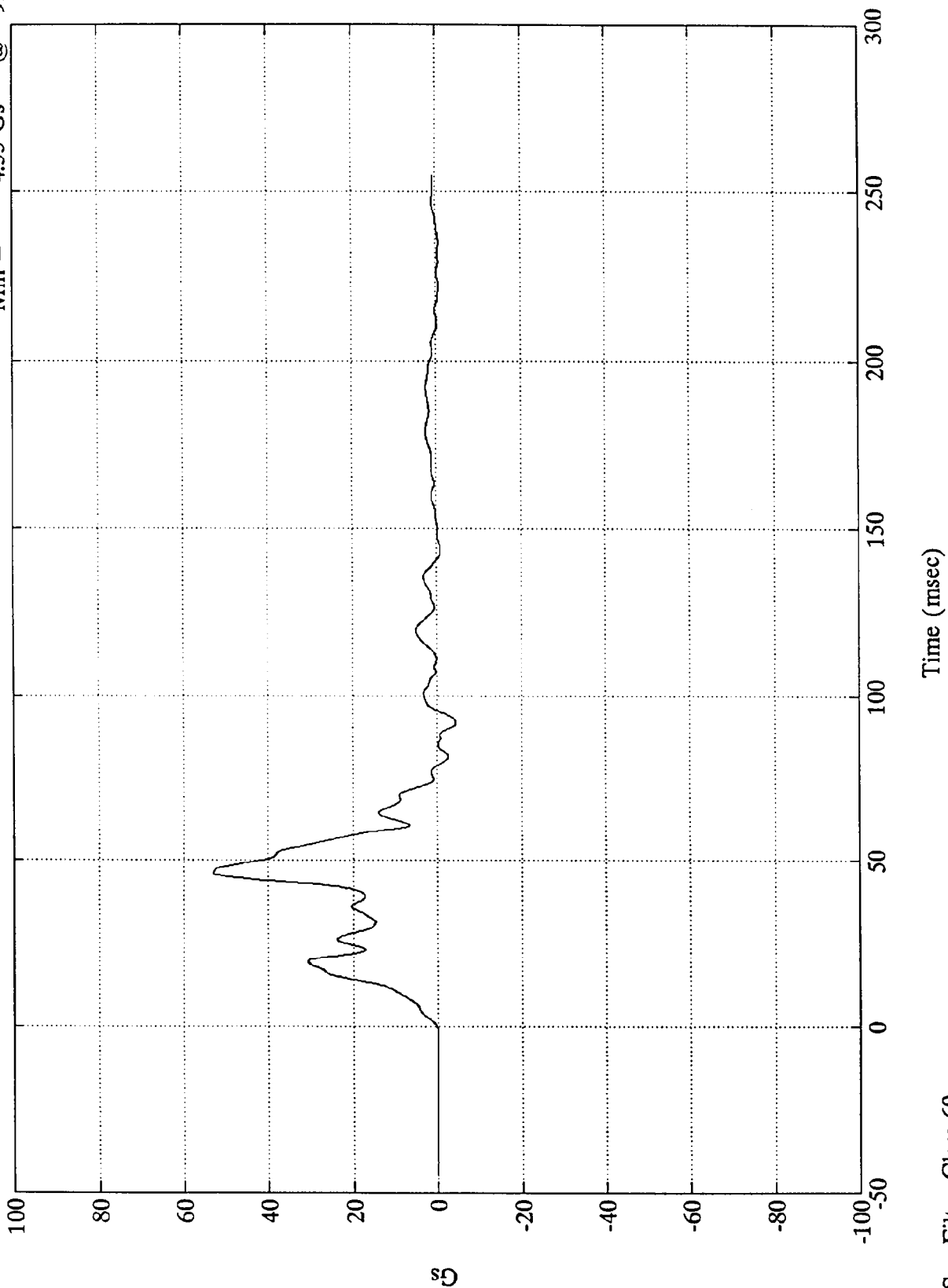
Max = 68.09 in. @ 254.88 msec
Min = -0.00 in. @ 1.68 msec



TSC 301 Test 5 - Side Impact

Max = 53.01 Gs @ 46.08 msec
Min = -4.55 Gs @ 91.80 msec

V1 Rear Axle Y



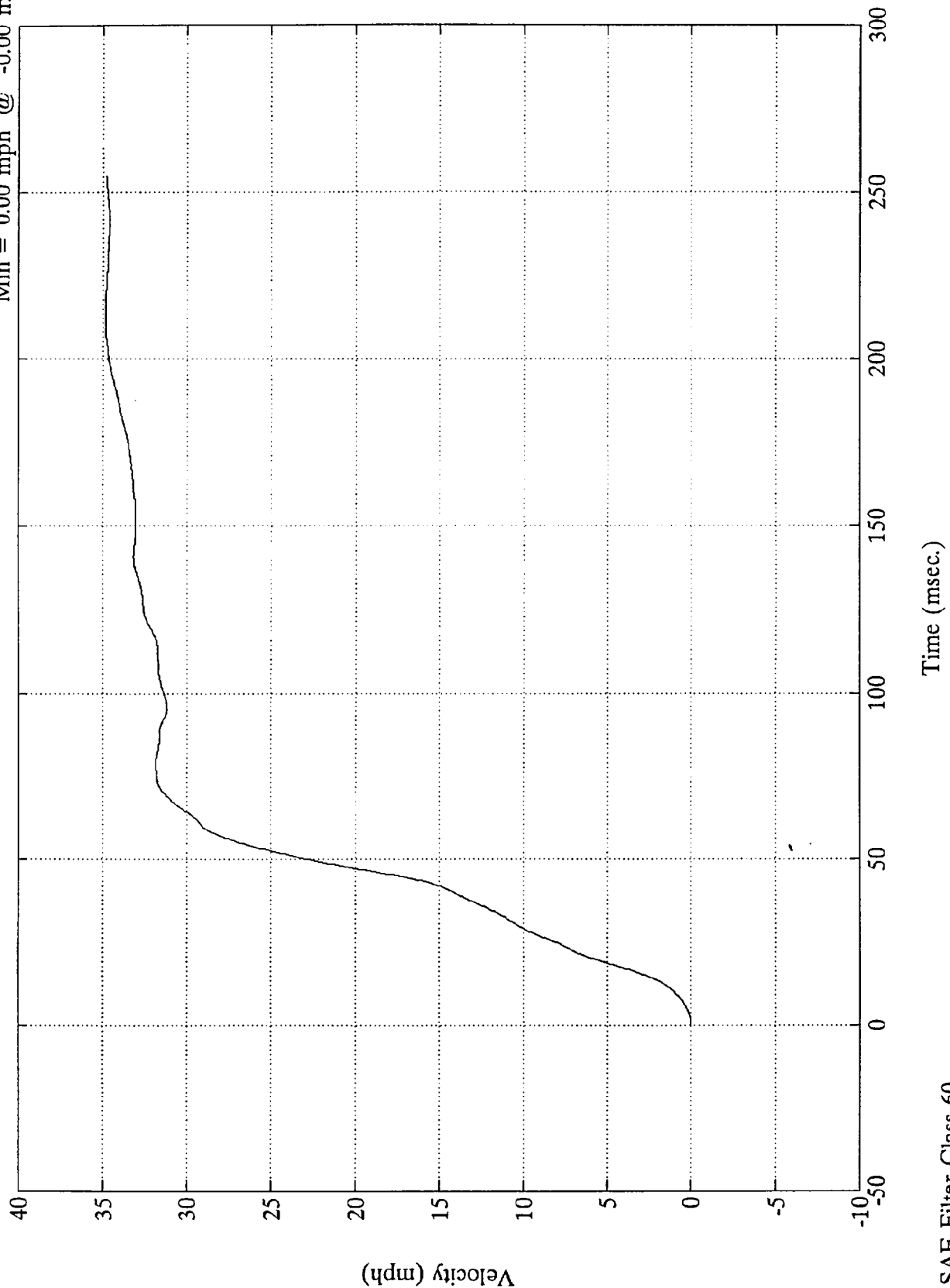
8102-5
B-60

Sae Filter Class 60

TSC 301 Test 5 - Side Impact

Max = 34.82 mph @ 209.52 msec
Min = 0.00 mph @ -0.00 msec

V1 Rear Axle Y



B-61

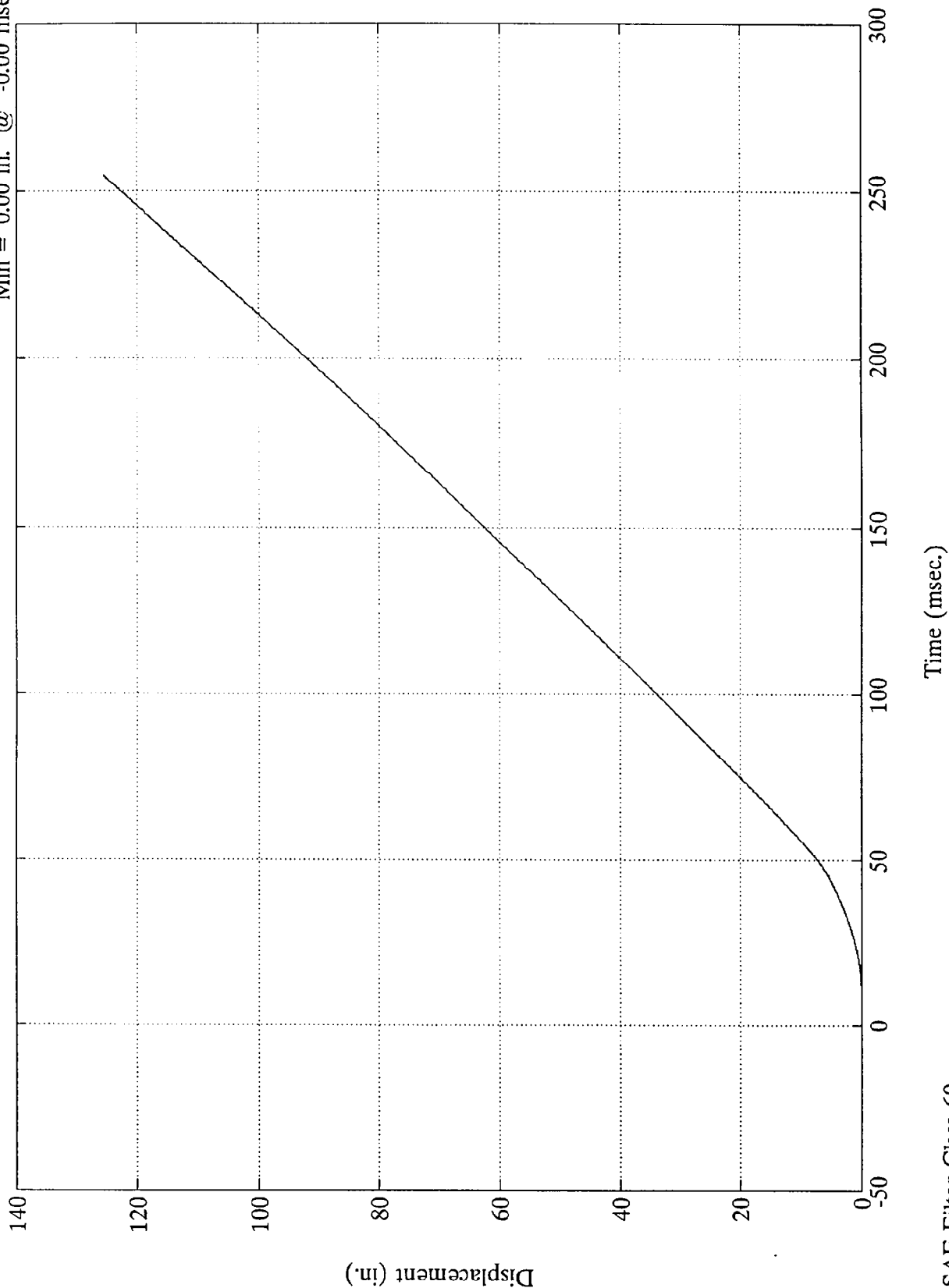
8102-5

SAE Filter Class 60

TSC 301 Test 5 - Side Impact

Max = 125.50 in. @ 254.88 msec
Min = 0.00 in. @ -0.00 msec

V1 Rear Axle Y

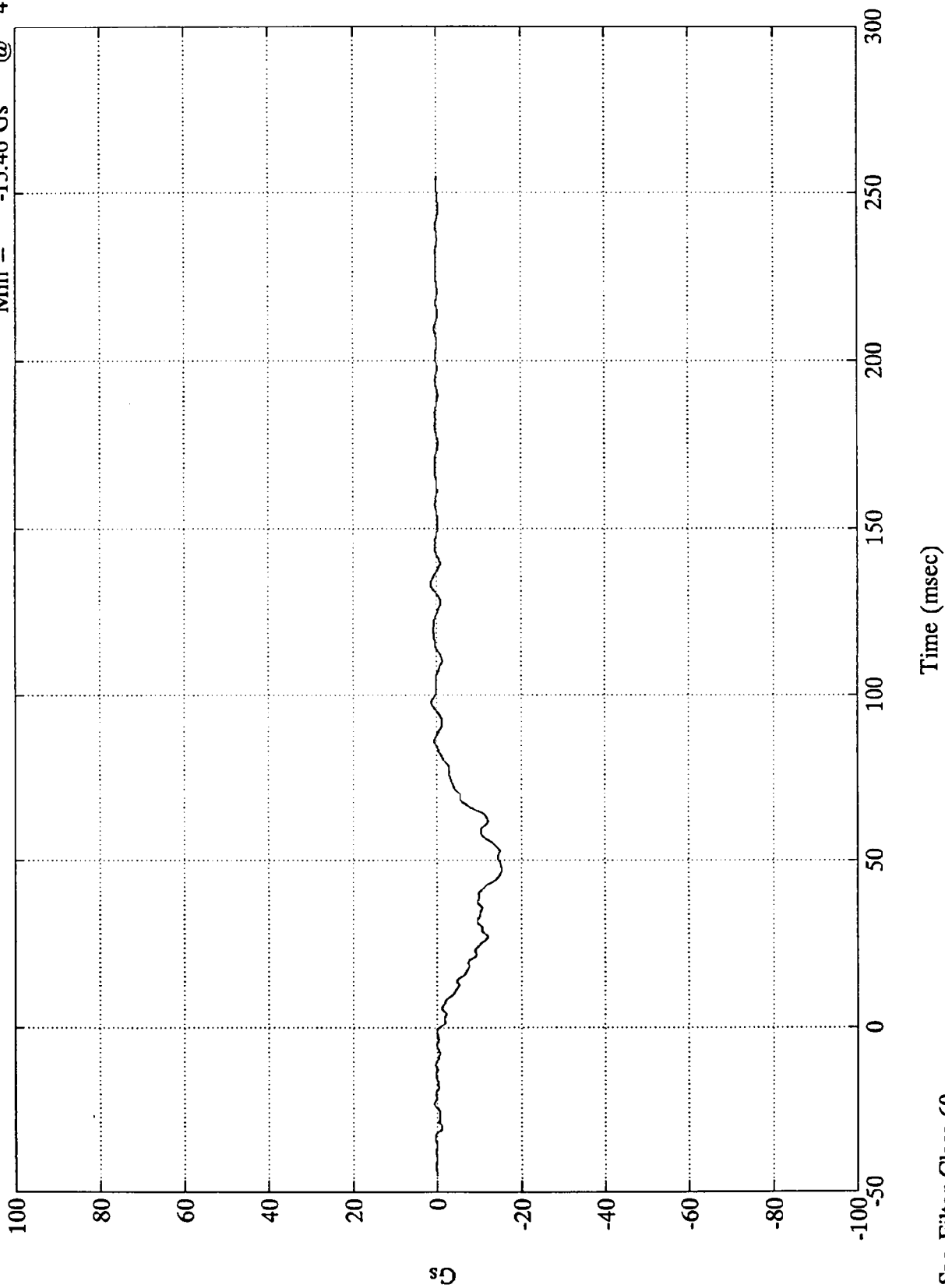


SAE Filter Class 60

TSC 301 Test 5 - Side Impact

V2 C.G. X

Max = 1.42 Gs @ 133.32 msec
Min = -15.46 Gs @ 47.15 msec



Gs
B-63

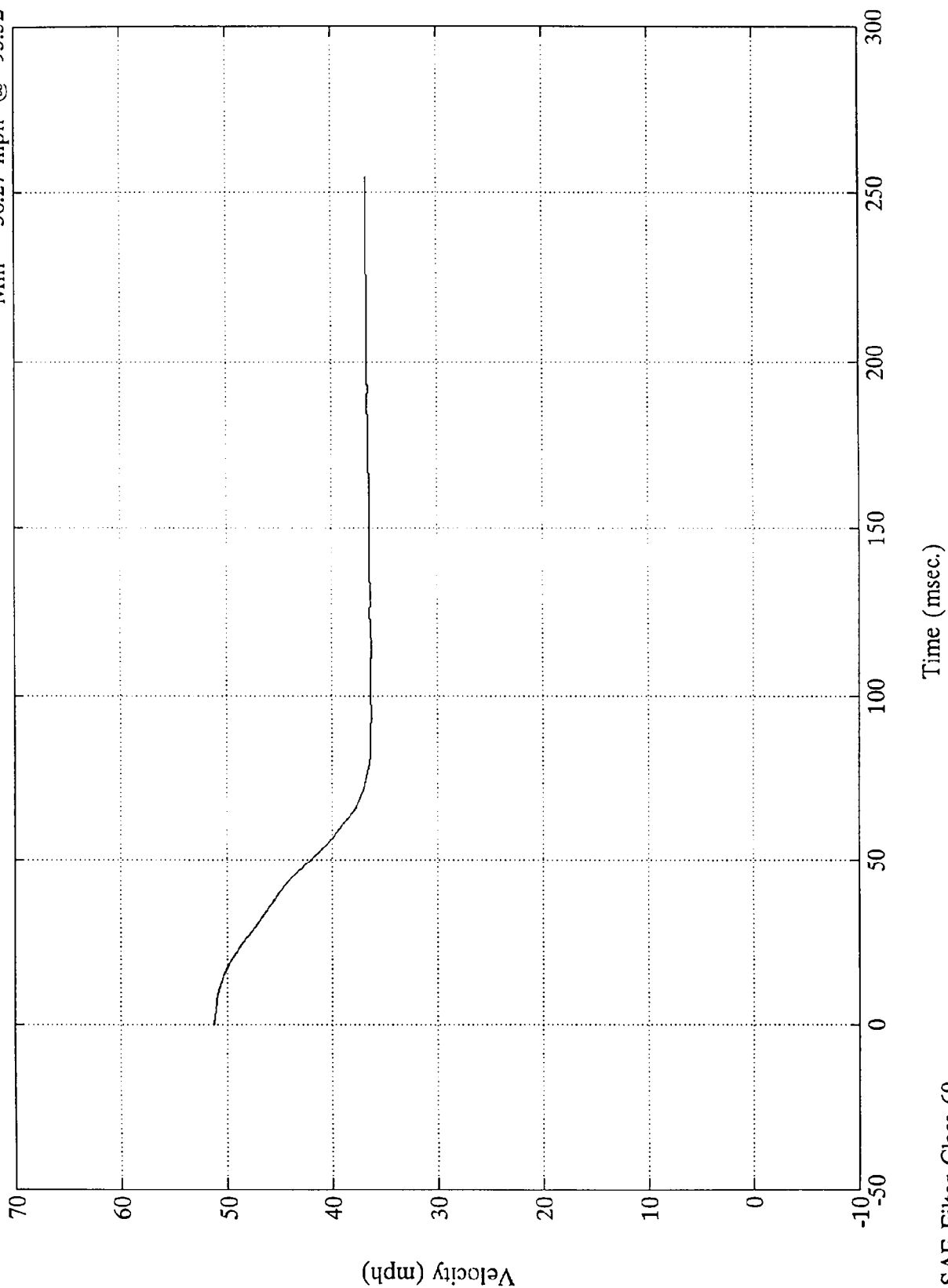
8102-5

Sae Filter Class 60

TSC 301 Test 5 - Side Impact

Max = 51.20 mph @ 0.24 msec
Min = 36.27 mph @ 95.52 msec

V2 C.G. X

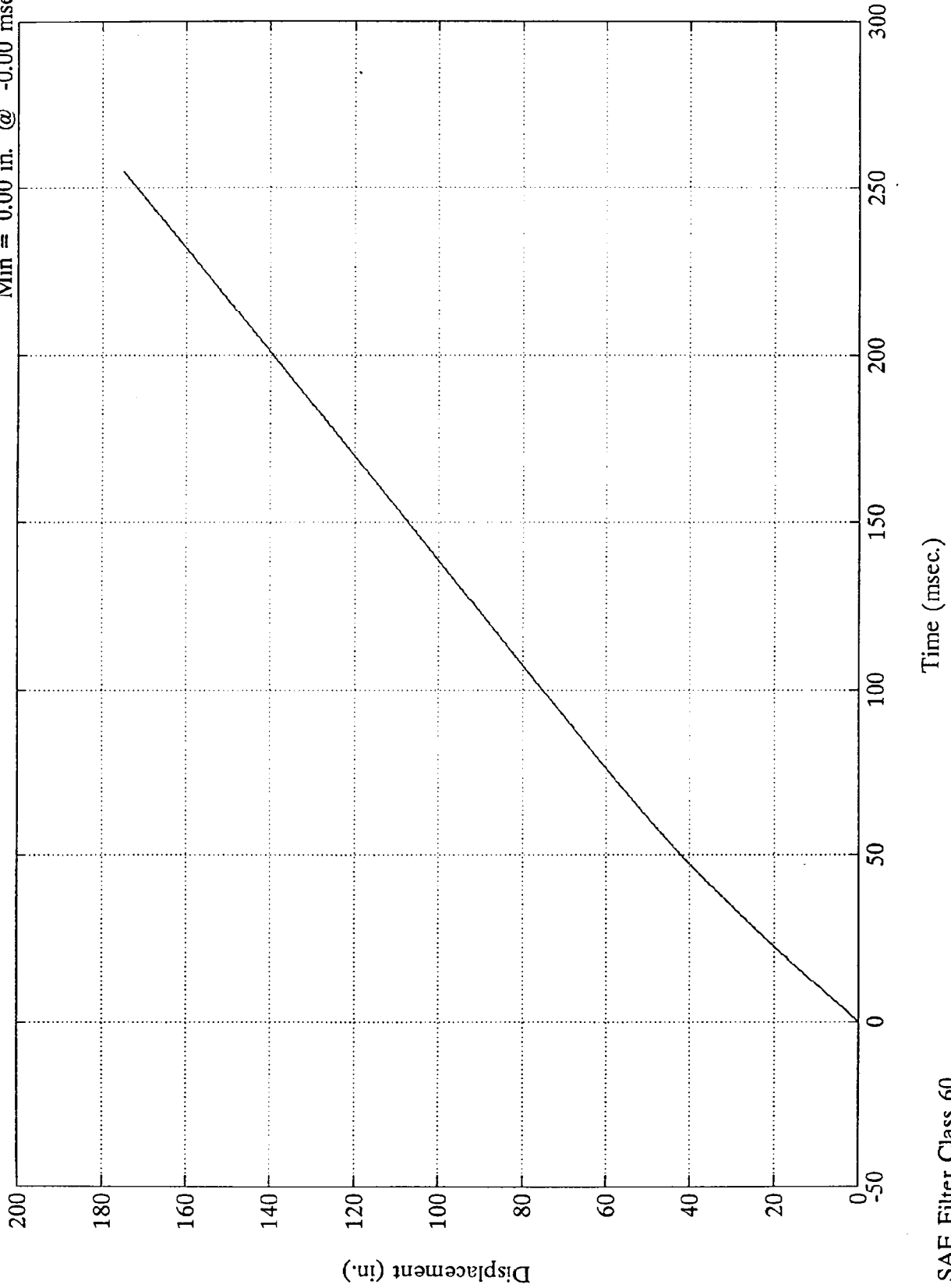


SAE Filter Class 60

TSC 301 Test 5 - Side Impact

V2 C.G. X

Max = 174.80 in. @ 254.88 msec
Min = 0.00 in. @ -0.00 msec



B-65

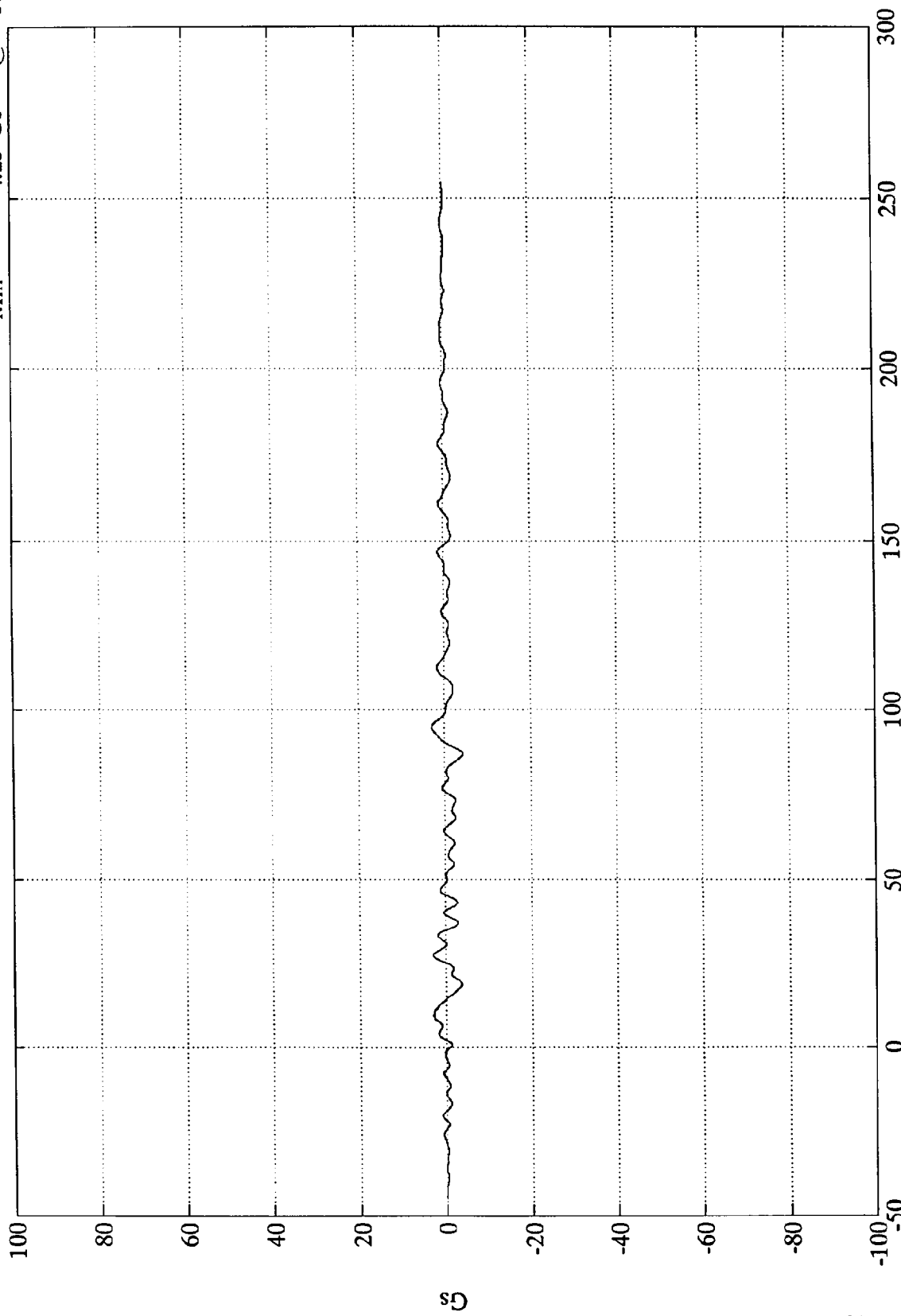
8102-5

SAE Filter Class 60

TSC 301 Test 5 - Side Impact

Max = 2.97 Gs @ 27.60 msec
Min = -4.25 Gs @ 87.12 msec

V2 C.G. Y



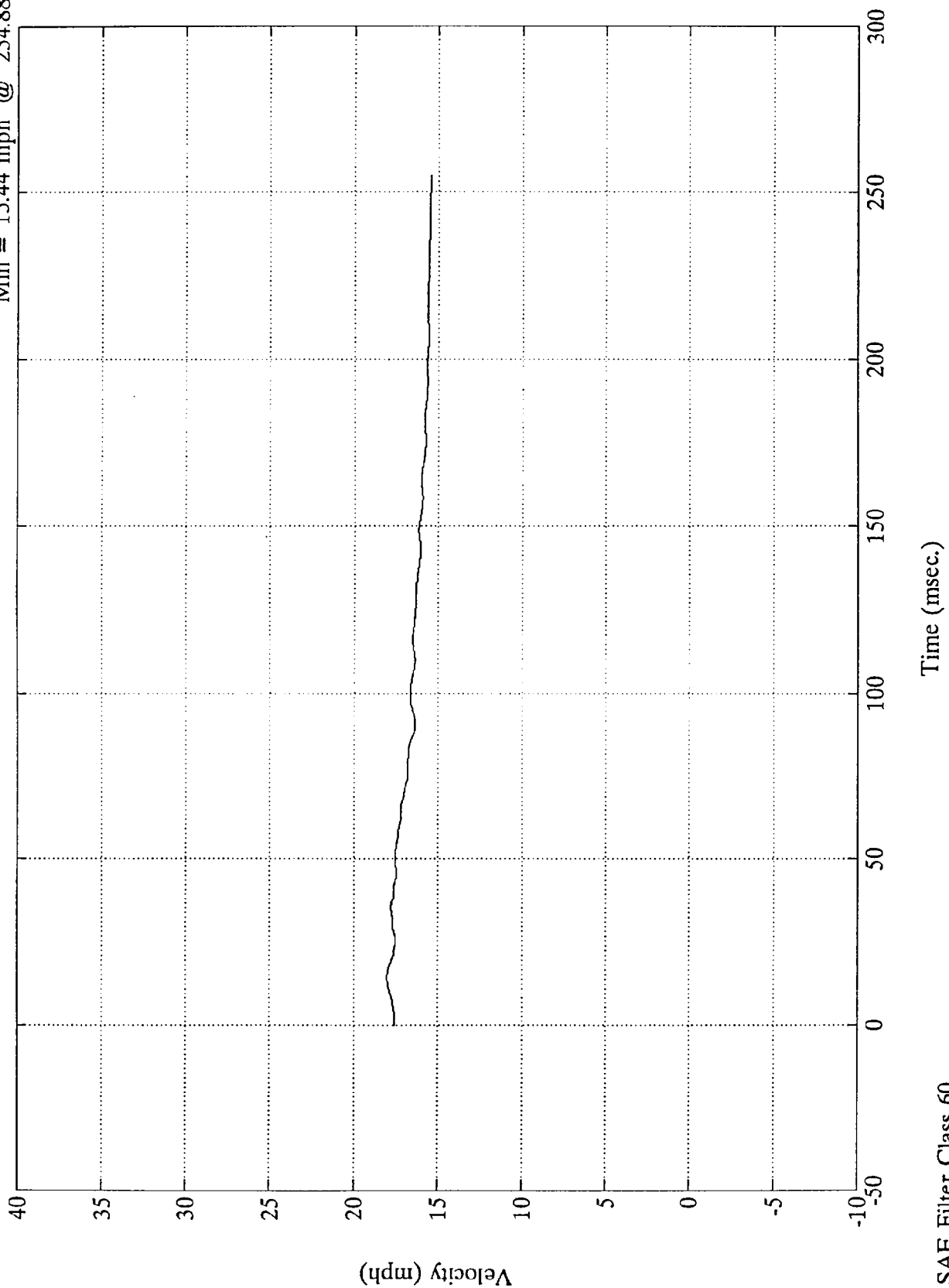
Time (msec)

Sae Filter Class 60

TSC 301 Test 5 - Side Impact

Max = 18.01 mph @ 14.64 msec
Min = 15.44 mph @ 254.88 msec

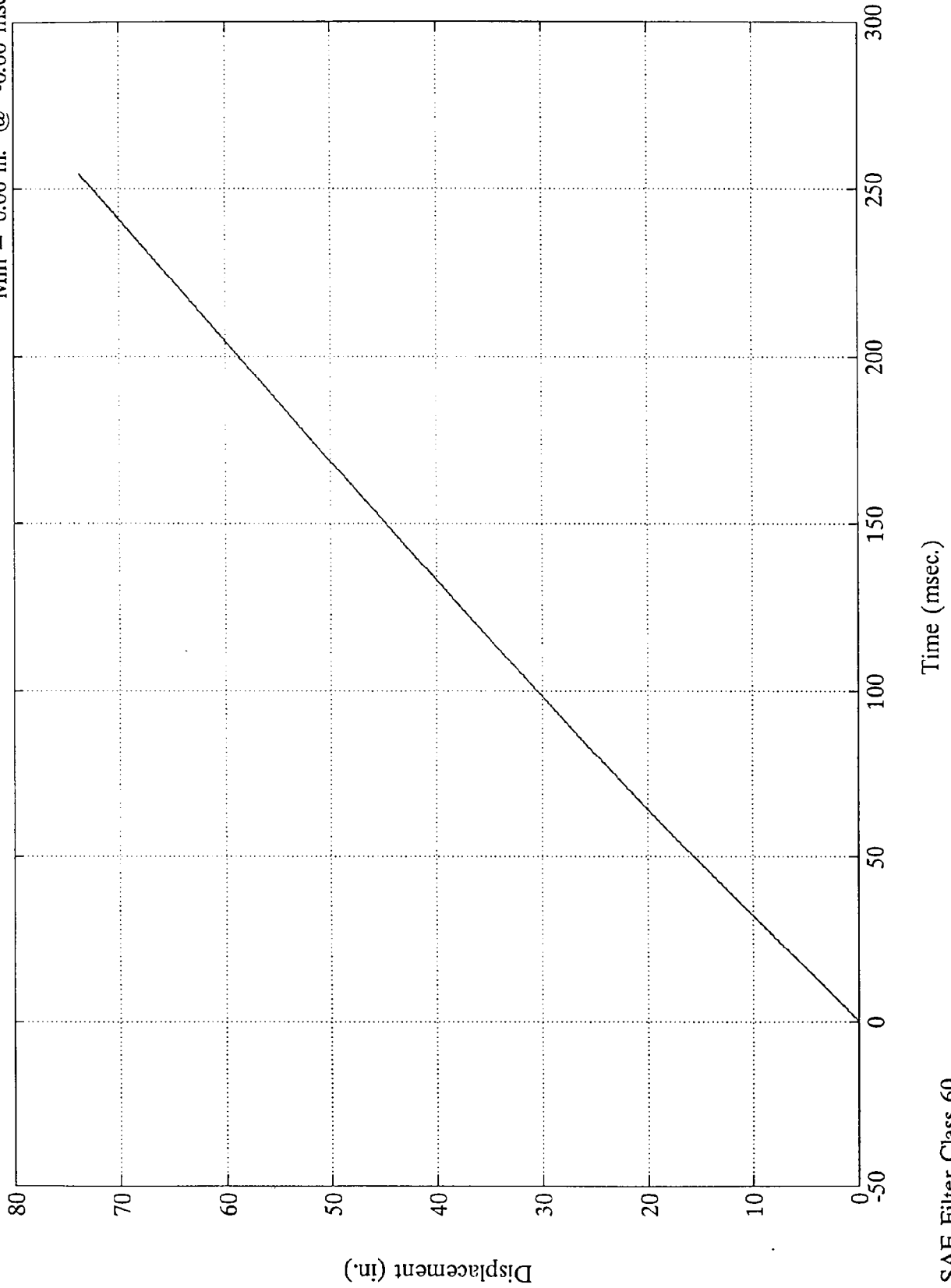
V2 C.G. Y



TSC 301 Test 5 - Side Impact

Max = 73.77 in. @ 254.88 msec
Min = 0.00 in. @ -0.00 msec

V2 C.G. Y

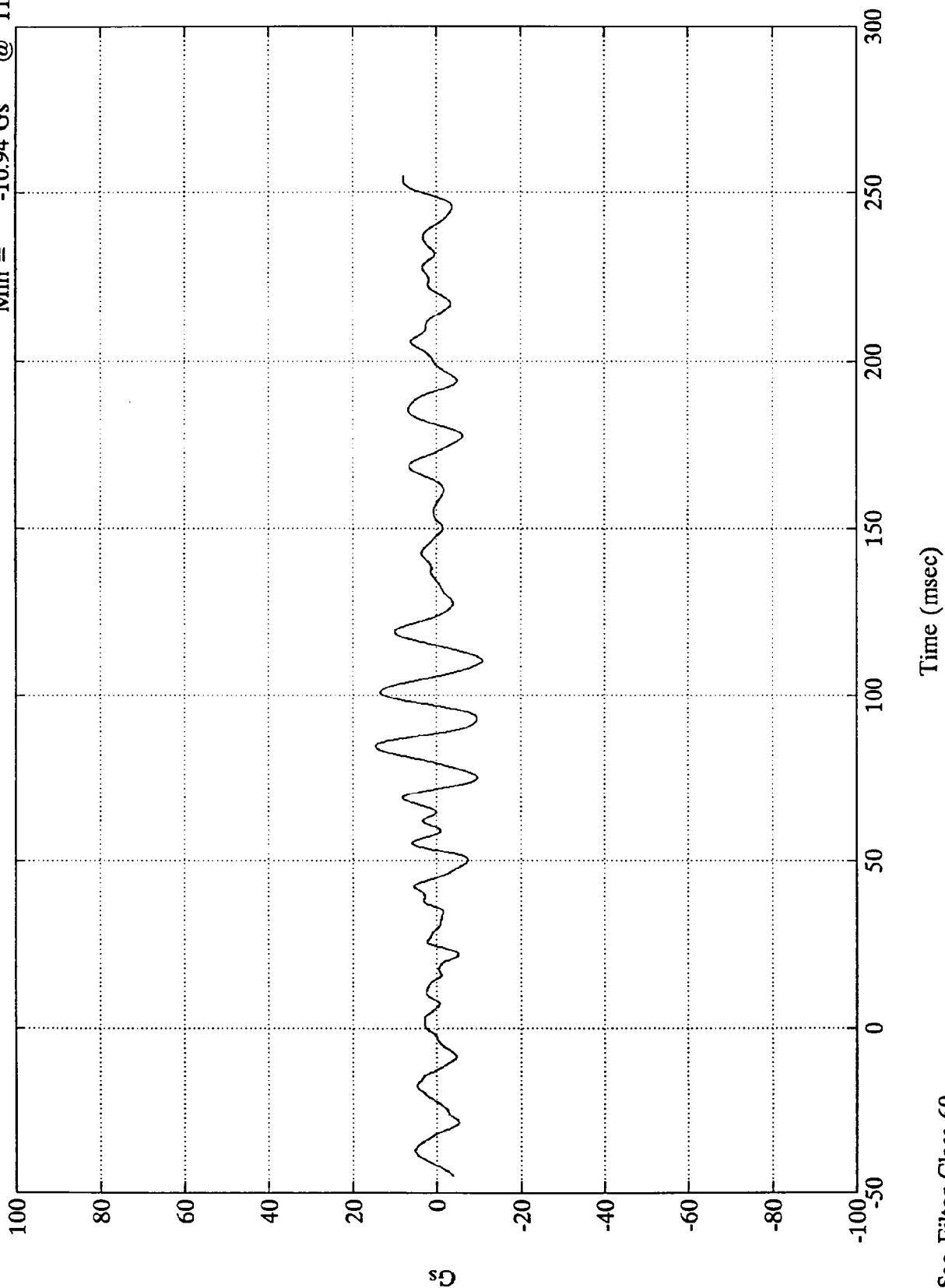


SAE Filter Class 60

TSC 301 Test 5 - Side Impact

V2 C.G. Z

Max = 14.53 Gs @ 84.48 msec
Min = -10.94 Gs @ 110.52 msec



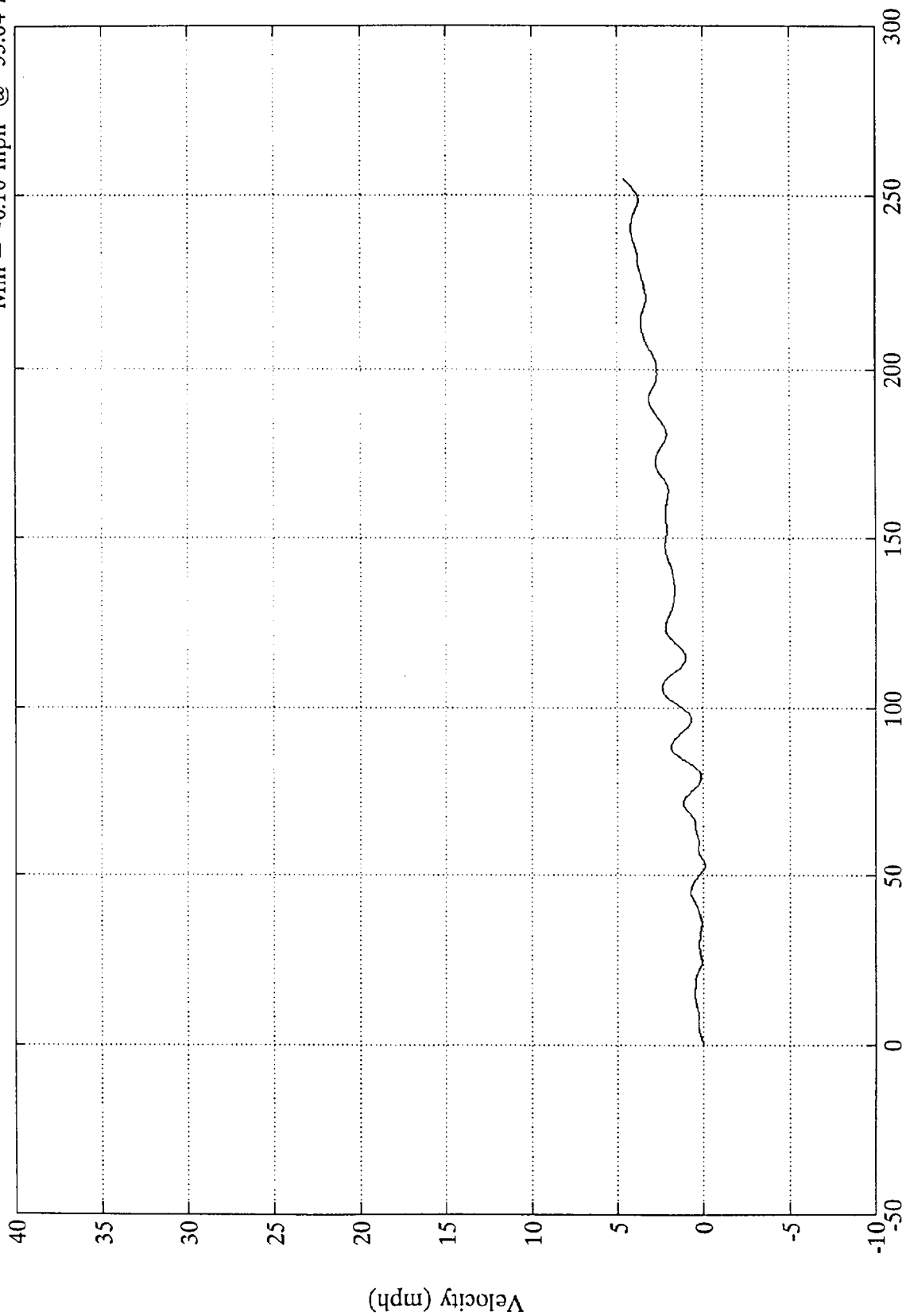
8102-5
B-69

Sae Filter Class 60

TSC 301 Test 5 - Side Impact

Max = 4.59 mph @ 254.88 msec
Min = -0.10 mph @ 53.04 msec

V2 C.G. Z



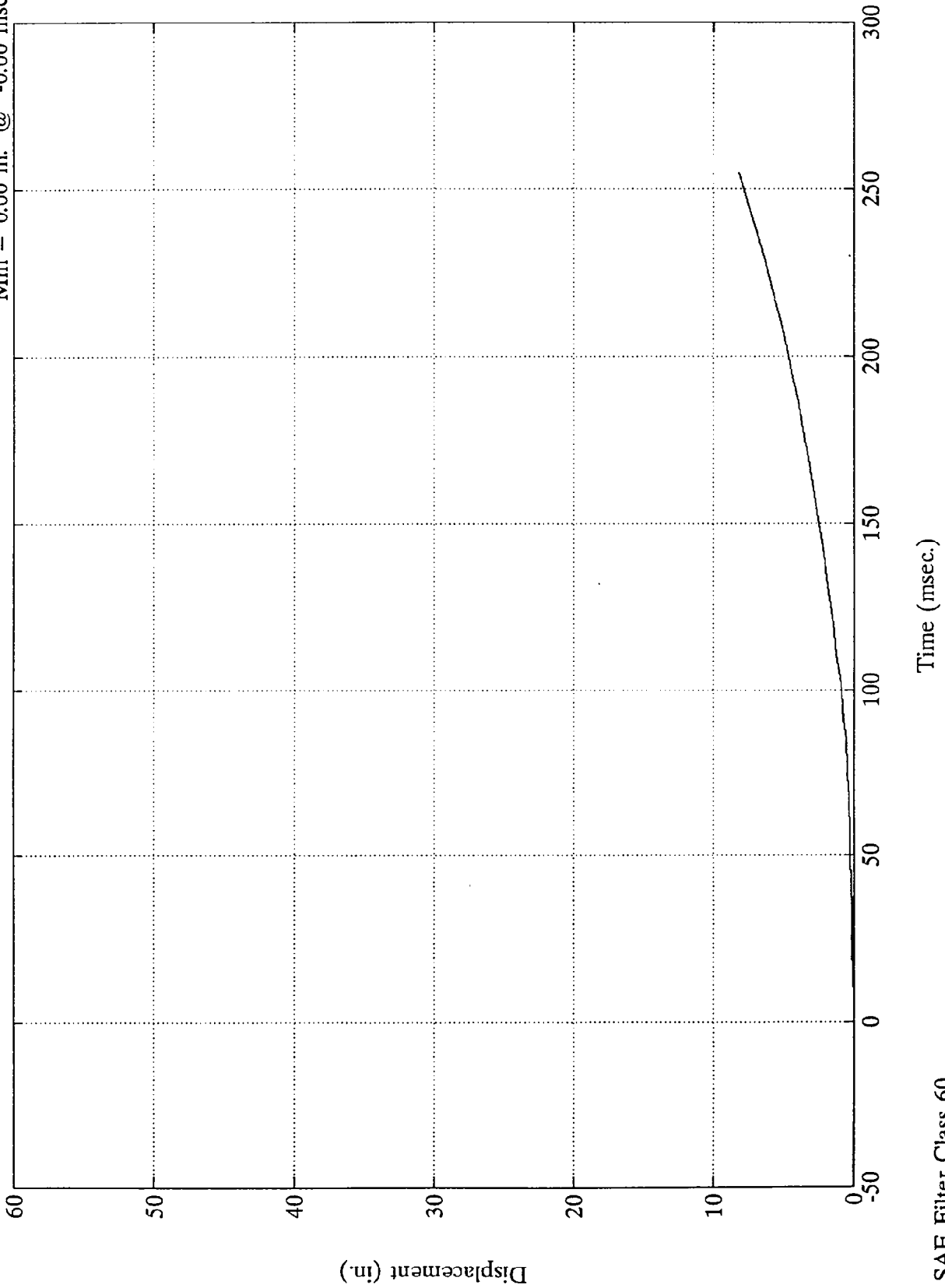
Time (msec.)

SAE Filter Class 60

TSC 301 Test 5 - Side Impact

V2 C.G. Z

Max = 8.19 in. @ 254.88 msec
Min = 0.00 in. @ -0.00 msec



B-71

8102-5

SAE Filter Class 60