

REPORT NUMBERS: 208-CAL-91-10  
212-CAL-91-10  
301-CAL-91-10

VEHICLE SAFETY COMPLIANCE TESTING FOR OCCUPANT CRASH PROTECTION,  
WINDSHIELD MOUNTING, WINDSHIELD ZONE INTRUSION (PARTIAL)  
AND FUEL SYSTEM INTEGRITY

1991 VOLVO 240  
4-DOOR SEDAN

NHTSA NUMBER: CM5901

CALSPAN TEST NUMBER: 7853-12

May 24, 1991

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



FINAL REPORT

PREPARED FOR:

U. S. Department of Transportation  
National Highway Traffic Safety Administration  
ENFORCEMENT  
Office of Vehicle Safety Compliance  
400 Seventh Street, S.W.  
Room No. 6115 (NEF-30)  
Washington, DC 20590

This Final Test Report was prepared for the U.S. Department of Transportation, National Highway Traffic Safety Administration, under Contract No. DTNH22-90-C-01003. This document is disseminated under the sponsorship of the U.S. Department of Transportation in the interest of information exchange. The United States Government assumes no liability for its contents or use thereof.

Prepared: David J. Travale

David J. Travale, Project Engineer

Approved: Walter E. Levan

Walter E. Levan, Program Manager  
Transportation Sciences Center

FINAL REPORT ACCEPTED BY:

John Brammer  
Contracting Office's Technical Representative  
(COTR), NHTSA, Office of Vehicle Safety Compliance

August 13, 1991  
Date of Report Acceptance

# TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No. 208-CAL-91-10 212-CAL-91-10 301-CAL-91-10		2. Government Accession No.		3. Recipient's Catalog No.	
4. Title and Subtitle Final Report of FMVSS 208, 212, 219 (Partial) and 301 Compliance Testing of a 1991 Volvo 240 4-Door Sedan				5. Report Date May 24, 1991	
				6. Performing Organization Code CAL	
7. Author(s) Vincent M. Paolini, Engineer David J. Travale, Project Engineer Walter E. Levan, Program Manager				8. Performing Organization Report No. 7853-12	
9. Performing Organization Name and Address Calspan Advanced Technology Center P.O. Box 400 Buffalo, New York 14225				10. Work Unit No. J22-10-1077	
				11. Contract or Grant No. DTNH22-90-C-01003	
12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Administration Office of Vehicle Safety Compliance (NEF-30) 400 Seventh St., S.W., Rm. 6115, Washington, DC 20590				13. Type of Report and Period Covered Final Report May-June 1991	
				14. Sponsoring Agency Code DOT/NHTSA/NEF/OVSC	
15. Supplementary Notes					
<p>16. Abstract</p> <p>A 30 mph vehicle safety compliance test was conducted on a 1991 Volvo 240 4-Door Sedan.</p> <p>This test was performed at the Calspan Advanced Technology Center in Buffalo, New York on May 24, 1991. The purpose of this test was to determine compliance with the performance requirements of the following Federal Motor Vehicle Safety Standards:</p> <ol style="list-style-type: none"> <li>1. FMVSS No. 208, "Occupant Crash Protection"</li> <li>2. FMVSS No. 212, "Windshield Mounting"</li> <li>3. FMVSS No. 219 (partial), "Windshield Zone Intrusion"</li> <li>4. FMVSS No. 301, "Fuel System Integrity"</li> </ol> <p>The test mode was perpendicular (0°) and the impact velocity was 29.1 mph. The ambient temperature at the impact face was 72°F.</p> <p>The subject test vehicle appears to comply with the requirements of FMVSS Nos. 208, 212, 219 (partial) and 301.</p> <p><u>Type of Restraint System:</u> The test vehicle was equipped with a driver side supplemental restraint system and manual 3-point continuous loop seat belt restraint on the passenger side. The driver manual 3-point seat belt was not used for this test.</p>					
17. Key Words 30 mph Vehicle Safety Compliance Testing FMVSS 208, "Occupant Crash Protection" FMVSS 212, "Windshield Mounting" FMVSS 219, "Windshield Zone Intrusion" FMVSS 301, "Fuel System Integrity" Frontal Impact			18. Distribution Statement Copies of this report are available from: Technical Reference Division National Highway Traffic Safety Admin. Nassif Building, Room 5108 (NAD-52) 400 Seventh St., S.W., Washington, DC 20590		
19. Security Classif. (of this report) UNCLASSIFIED		20. Security Classif. (of this page) UNCLASSIFIED		21. No. of Pages 22. Price	

Form DOT F1700.7 (8-69)

## TABLE OF CONTENTS

<u>Section</u>		<u>Page No.</u>
1	PURPOSE AND TEST PROCEDURE	1-1
2	SUMMARY OF FRONTAL BARRIER IMPACT TEST	2-1
3	OCCUPANT AND VEHICLE INFORMATION	3-1
4	SUMMARY OF RESULTS FOR: FMVSS 208, "Occupant Crash Protection" FMVSS 212, "Windshield Mounting" FMVSS 219 (Partial), "Windshield Zone Intrusion" FMVSS 301, "Fuel System Integrity"	
APPENDIX A	PHOTOGRAPHS	A-1
APPENDIX B	VEHICLE AND DUMMY RESPONSE DATA	B-1
APPENDIX C	VEHICLE OWNER'S MANUAL OCCUPANT RESTRAINT SYSTEM INSTRUCTIONS	C-1

# LIST OF FIGURES

<u>Figure No.</u>		<u>Page No.</u>
1	TEST VEHICLE INFORMATION	3-2
2	PART 572 DUMMY IN-VEHICLE POSITION	3-3
3	OCCUPANT CLEARANCE DIMENSIONS	3-4
4	DRIVER DUMMY TO STEERING COLUMN/WHEEL ASSEMBLY REFERENCE DIMENSIONS	3-5
5	SEAT BELT POSITIONING DATA	3-6
6	VEHICLE ACCELEROMETER LOCATIONS	3-7
7	CAMERA POSITIONS FOR FRONTAL IMPACTS	3-9
8	VEHICLE TARGET LOCATIONS	3-11
9	TEST VEHICLE MEASUREMENTS	3-12
10	FMVSS NO. 212 - "WINDSHIELD MOUNTING" DATA SHEET	4-12
11	FMVSS NO. 219 (PARTIAL) - "WINDSHIELD ZONE INTRUSION" DATA SHEET	4-13

# LIST OF TABLES

<u>Table No.</u>		<u>Page No.</u>
1	Crash Test Summary	2-2
2	General Test and Vehicle Parameter Data	2-3
3	Post-Impact Data	2-5
4	Vehicle Accelerometer Locations and Data Summary	3-8
5	High Speed Camera Locations	3-10
6	Vehicle Measurements	3-13
7	Dummy Injury Criteria Values	4-2
8	FMVSS No. 208 - Seat Belt Warning System check	4-3
9	FMVSS No. 208 - Labeling and Driver's Manual Information	4-4
10	FMVSS No. 208 - Readiness Indicator	4-5
11	FMVSS No. 208 - Comfort and Convenience Test Summary	4-6
12	FMVSS No. 301 - "Fuel System Integrity" Post-Impact Test Data	4-14
13	FMVSS No. 301 - Static Rollover Data Sheet	4-15
14	Test Vehicle Noncompliance Notice	4-19

Section I  
PURPOSE AND TEST PROCEDURE

This 30 mph frontal barrier impact test is part of the Federal Motor Vehicle Safety Standard (FMVSS) 208, 212, 219 (partial) and 301 compliance test program conducted for the National Highway Traffic Safety Administration (NHTSA) by Calspan Advanced Technology Center under Contract No. DTNH22-90-C-01003. The purpose of this test was to determine if the subject vehicle, a 1991 Volvo 240 4-Door Sedan, meets the performance requirements of FMVSS 208, "Occupant Crash Protection"; FMVSS No. 212, "Windshield Mounting"; FMVSS No. 219 (partial), "Windshield Zone Intrusion"; and FMVSS No. 301, "Fuel System Integrity". This compliance test was conducted using the requirements found in the OVSC Laboratory Test Procedure No. TP-208-08, dated September 8, 1989.

## Section 2

### SUMMARY OF TEST NUMBER CM5901

A frontal barrier was impacted by a Volvo 240 4-Door Sedan at a velocity of 29.1 mph. The test was performed at the Calspan Corporation Advanced Technology Center on May 24, 1991. Pre- and post-test photographs of the vehicle and dummies can be found in Appendix A.

The frontal barrier impact event was documented by one real-time camera and 14 high-speed cameras. Camera locations and other pertinent camera information can be found in this report.

One Part 572E, 50th percentile male anthropomorphic test device (ATD), was placed in the driver seating position and one part 572B ATD was placed in the right front passenger seating position according to dummy placement instructions specified in the OVSC Laboratory Test Procedure.

Both ATDs were fully instrumented with head and chest triaxial accelerometers and left/right femur load cells. The driver ATD also had a chest deflection potentiometer. These ATDs had been certified prior to the test.

The 24 channels of data were recorded on two 14-channel FM tape recorders. Appendix B contains the vehicle and dummy response data traces. A delayed zero trigger occurred just after initial contact. The data has been shifted to account for the delay.

The driver's HIC was 181. The maximum chest deceleration over 3 milliseconds was 37.6 g's with 2.0 inches of deflection. The maximum force on the driver's left femur was 1240 pounds and 1129 pounds on the right femur.

The right front passenger's HIC was 199. The maximum chest deceleration over 3 milliseconds was ~~31.4~~<sup>26.0</sup> g's and loads were 165 and 38 on the left and right femurs respectively.



Table 1

CRASH TEST SUMMARY

Vehicle NHTSA No.: CM5901 Test Mode: 30 mph Frontal Barrier

Test Date.: 05-24-91 Time: 11:40 Temperature: 72°F

Vehicle Make/Model/Body Style: 1991 Volvo 240 4-Door Sedan

Vehicle Test Weight: 3450 lbs.

Vehicle/Barrier Impact Angle: 0

Impact Velocity: 29.1 mph

Maximum Static Crush: 21.0 in.

Vehicle Rebound: 6.6 in.

DUMMIES:DRIVERPASSENGER

Type:

Part 572EPart 572B

Restraint System:

Supplement  
Restraint System3-Point  
Continuous BeltNumber of Data Channels: 24Number of Cameras: 1 Real Time14 High SpeedDOOR OPENING DATA: Operable - Left FrontOperable - Right Front

Front Seat(s) Data:

DRIVERPASSENGER

Seat Track Failure:

0.00.0

inches of shift

Seat Back Failure:

NoneNoneVISIBLE DUMMY CONTACT POINTS:DRIVERPASSENGER

Head:

AirbagChin Contacted Chest

Abdomen

No ContactNo Contact

Chest

AirbagNo Contact

Knees

Lower DashpanelNo Contact

Table 2

GENERAL TEST AND VEHICLE PARAMETER DATATEST VEHICLE INFORMATION:

Year/Make/Model/Body Style: 1991 Volvo 240 4-Door Sedan  
 NHTSA No. CM5901 ; VIN: YV1AA8248M1444026 ; Color; Blue  
 Engine Data: 4 cylinders; - CID; 2.3 Litres; - cc  
 Placement X Longitudinal or In-Line; - Transverse or Lateral  
 Transmission Data: 5 speeds; X Manual; - Automatic; - Overdrive  
 Final Drive: X Rear Wheel Drive; - Front Wheel Drive; - Four Wheel Drive  
 Major Options: X A/C; X Pwr. Strg.; X Pwr. Brakes; X Pwr. Windows  
X Power Door Locks  
 Date Received: 03-25-91 ; Odometer Reading 34 miles  
 Selling Dealer: Jim Culligan Inc.  
 & Address 8129 Main St., Williamsville, NY 14221

DATA FROM VEHICLE'S CERTIFICATION LABEL:

Vehicle Manufactured by: Volvo Car Corp. Sweden  
 Date of Manufacture: 12-90  
 GVWR: 4030 lbs.; GAWR: 1885 lbs. FRONT; 2180 lbs. REAR

DATA FROM TIRE PLACARD:

Tire Pressure with Maximum Capacity Vehicle Load: 36 psi FRONT  
36 psi REAR  
 Recommended Tire Size: 185/70R14 Load Range: 1210  
 Recommended Cold Tire Pressure: 35 psi FRONT; 35 psi REAR  
 Size of Tires on Test Vehicle: 185/70R14 ; Manufacturer: Michelin  
 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) = 945 lbs.  
 No. of Occupants x 150 lbs. = 750 lbs.  
 Rated Cargo/Luggage Weight (RCLW) = 195 lbs. (Difference)

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

Right Front = 760 lbs. Right Rear = 690 lbs.  
 Left Front = 800 lbs. Left Rear = 690 lbs.  
 TOTAL FRONT = 1560 lbs. TOTAL REAR = 1380 lbs.  
 % of Total Vehicle Weight = 53.1 % of Total Weight = 46.9  
 TOTAL DELIVERED WEIGHT = 2940 lbs.

Table 2

GENERAL TEST AND VEHICLE PARAMETER DATA (cont.)

CALCULATION OF VEHICLE'S TARGET TEST WEIGHT:

Total Delivered Weight	=	<u>2940</u>	lbs.
Rated Cargo/Luggage Weight (RCLW)	=	<u>195</u>	lbs.
*Weight of 2 P.572 Dummies @ 164 & 167 ea.	=	<u>331</u>	lbs.
TARGET TEST WEIGHT	=	<u>3466</u>	lbs. (sum)

WEIGHT OF TEST VEHICLE WITH TWO DUMMIES AND 0 POUNDS OF CARGO WEIGHT:

Right Front =	<u>810</u>	lbs.	Right Rear =	<u>880</u>	lbs.
Left Front =	<u>880</u>	lbs.	Left Rear =	<u>880</u>	lbs.
TOTAL FRONT =	<u>1690</u>	lbs.	TOTAL REAR =	<u>1760</u>	lbs.
% of Total Weight =	<u>49.0</u>	%	% of Total Weight =	<u>51.0</u>	%
TOTAL TEST WEIGHT =	<u>3450</u>	lbs.			
Weight of Ballast Secured in Vehicle Trunk Area =	<u>0</u>	lbs.			
Vehicle Components Removed for Weight Reduction	<u>None</u>				

VEHICLE ATTITUDE (all dimensions in inches):

AS DELIVERED:	RF <u>27.1"</u>	LF <u>27.0"</u>	RR <u>25.2"</u>	LR <u>24.7"</u>
FULLY LOADED:	RF <u>26.1"</u>	LF <u>26.0"</u>	RR <u>22.8"</u>	LR <u>22.7"</u>
AS TESTED:	RF <u>27.1"</u>	LF <u>27.0"</u>	RR <u>23.7"</u>	LR <u>23.8"</u>
Vehicle's Wheel Base:	<u>104.3</u>	in.		
Location of Vehicle's C.G.:	<u>53.2 inches rearward of front axle centerline.</u>			

FUEL SYSTEM DATA:

Fuel System Capacity From Owner's Manual =	<u>15.8</u>	gallons
Usable Capacity Figure Furnished by COTR =	<u>N/A</u>	gallons
Test Volume Range (92 to 94% of Usable Capacity) =	<u>14.5</u> to <u>14.9</u>	gallons
ACTUAL TEST VOLUME =	<u>14.7</u>	gallons (with entire fuel system filled)

\*Part 572E Hybrid III used as driver and Part 572B Hybrid II used as passenger.

Table 3

POST IMPACT DATATYPE OF TEST:

Type of Test: Frontal Barrier Impact Angle: 0°  
 Test Date: 05-24-91 Time: 11:40 Temperature: 72 °F  
 Vehicle NHTSA No.: CM5901  
 Required Impact Velocity Range: 28.9 to 29.9 mph

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

Trap No. 1 = 29.1 mph; Trap No. 2 = 29.1 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 = 186.8 ; C/L = 189.5 ; Left = 187.1  
 Post-Test Right = 167.2 ; C/L = 168.5 ; Left = 168.2  
 Crush Right = 19.6 ; C/L = 21.0 ; Left = 18.9  
 AVERAGE = 19.8 inches

VEHICLE REBOUND: (From rigid barrier only.)

Distance from front of test vehicle to impact point:

Right = 6.2 ; C/L = 5.9 ; Left = 7.6  
 AVERAGE = 6.6 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 inches</u>
Rear	<u>-</u>	<u>-</u>

Table 3

POST IMPACT DATA (cont.)

GLAZING DAMAGE: None.

---

---

---

---

OTHER NOTABLE IMPACT FEATURES: None.

---

---

---

---

Section 3  
OCCUPANT AND VEHICLE DATA

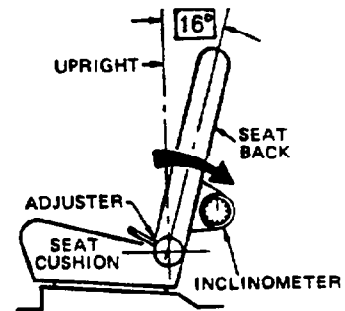
Figure 1

TEST VEHICLE INFORMATION

VEHICLE IDENTIFICATION:

Model Year: 1991 Vehicle Model: Volvo 240 Body Style: 4-Door Sedan

1. Nominal Design Riding Position for adjustable driver and passenger seat backs. Please describe how to position the inclinometer to measure the seat back angle. Include description of the location of the adjustment latch detent, if applicable



LEFT SIDE VIEW

Seat back angle for driver's seat 16°

Measurement instructions: Press inclinometer against top and bottom metal-frame of the seatback.

Seat back angle for passenger's seat: 16°

Measurement instructions: Same as driver.

2. Seat Fore and Aft Positioning

Provide instructions for positioning the driver and front outboard passenger seat(s) in the center of fore and aft travel. For example, provide information to locate the detent in which the seat track is to be locked.

Positioning of the driver's seat: Seat placed in 9th detent (first detent rearward of mid-position) out of 18 total detents.

Positioning of the passenger's seat (if applicable): Seat placed in 5th detent (mid-position) out of 9 total detents.

3. Fuel Tank Capacity Data

A. "Usable Capacity" of the standard equipment fuel tank is 15.8 gallons

B. "Usable Capacity" of the optional equipment fuel tank is - gallons

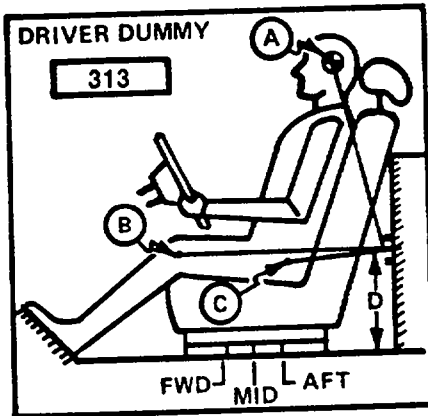
Additional Instructions: None

Figure 2

PART 572 DUMMY IN-VEHICLE POSITION

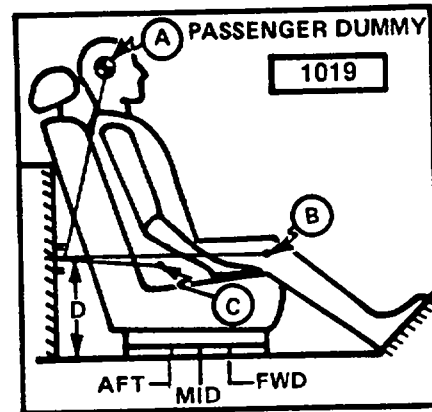
Test No.: CM5901 Vehicle: 1991 Volvo 240 4-Door Sedan

<u>SEAT TYPE:</u>	<u>ADJUSTER TYPE:</u>	<u>SEAT BACK TYPE:</u>
<u>-</u> Bench	<u>X</u> Manual	<u>-</u> Fixed
<u>X</u> Bucket	<u>-</u> Power	<u>X</u> Adjustable Reclining
<u>-</u> Split Bench		



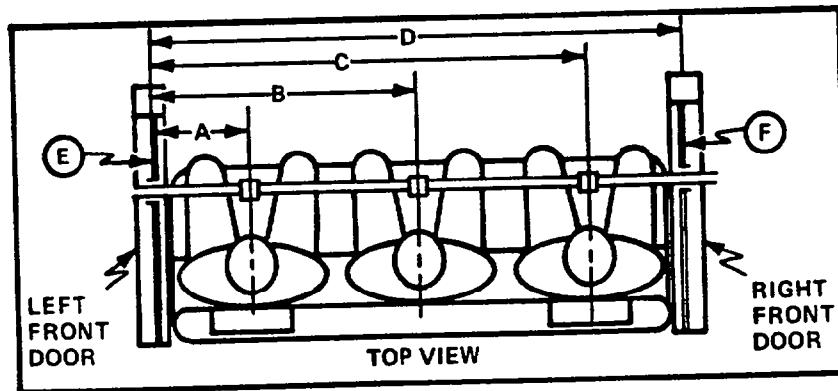
MEASUREMENT LOCATION

- A - Head Target
- B - Knee Joint
- C - Approximate 'H' Point
- D - Sill to Reference Point



A = 18.9 in. 9 Degrees  
 B = 22.4 in. 99 Degrees  
 C = 8.8 in. 132 Degrees  
 D = 15.7 in.

A = 20.7 in. -3 Degrees  
 B = 21.6 in. 99 Degrees  
 C = 8.4 in. 135 Degrees  
 D = 15.7 in.



S/N 313

DUMMY ID

S/N 1019

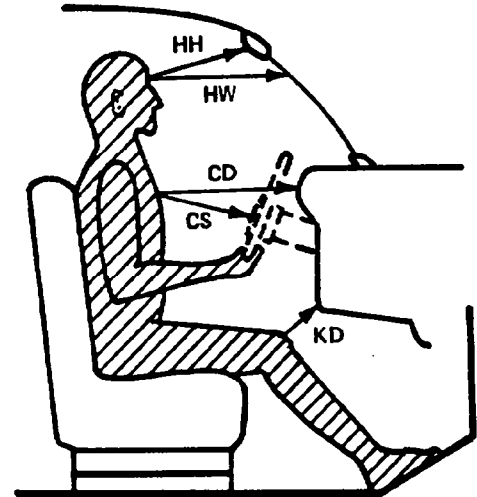
A = Left Door to Driver Centerline	<u>11.9</u> in.
B = Left Door to Center Passenger Centerline	<u>-</u> in.
C = Left Door to Right Passenger Centerline	<u>39.5</u> in.
D = Left Door to Right Door	<u>51.1</u> in.
E,F = Window Glass Height (Right and Left Must Be Equal)	<u>10.2</u> in.



Figure 3

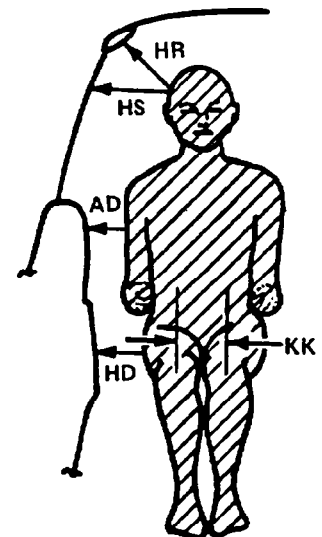
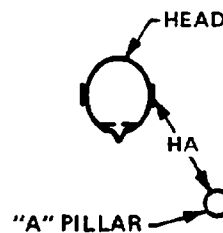
OCCUPANT CLEARANCE DIMENSIONS

	DRIVER Part 572E	PASSENGER Part 572B
HH	15.5	18.5
HW	21.7	23.1
CD	18.8	21.5
CS	10.0	-
KDL	3.8	6.0
KDR	3.7	5.7
SA	16°	16°
TA	-	22°
PA	22°	-



HH = Head to Windshield Header  
 HW = Head to Windshield  
 CD = Chest to Dash  
 CS = Chest to Steering Wheel  
 KD(L/R) = Knee to Dash (Left/Right)  
 SA = Seat Back Angle  
 TA = Torso Angle  
 PA = Pelvic Angle

HA = Head Target to "A" Pillar  
 HR = Head to Side Roof  
 HS = Head to Side Window  
 AD = Arm to Door  
 HD = Hip to Door  
 KK = Knee to Knee

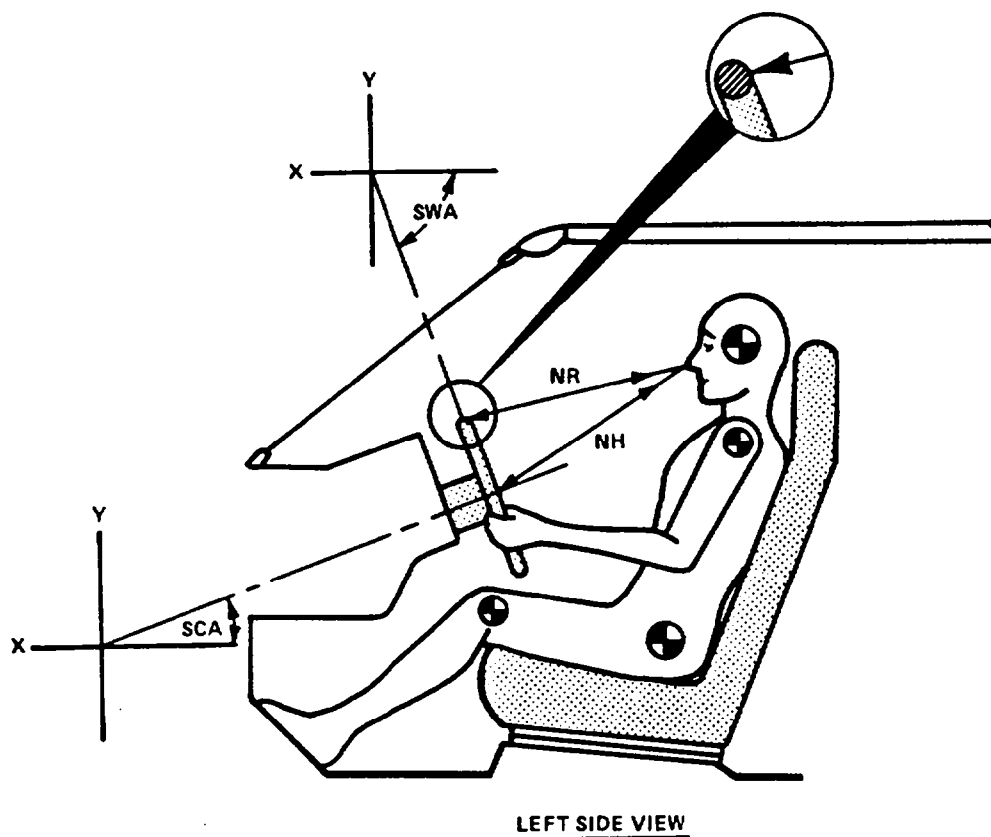


	DRIVER	PASSENGER
HR	6.7	6.1
HS	8.8	8.7
AD	4.1	3.9
HD	7.6	7.3
KK	8.6	7.6
HA	18.9	21.5

Driver H-point: Z - 0.3" above target  
 X - 0.1" behind target

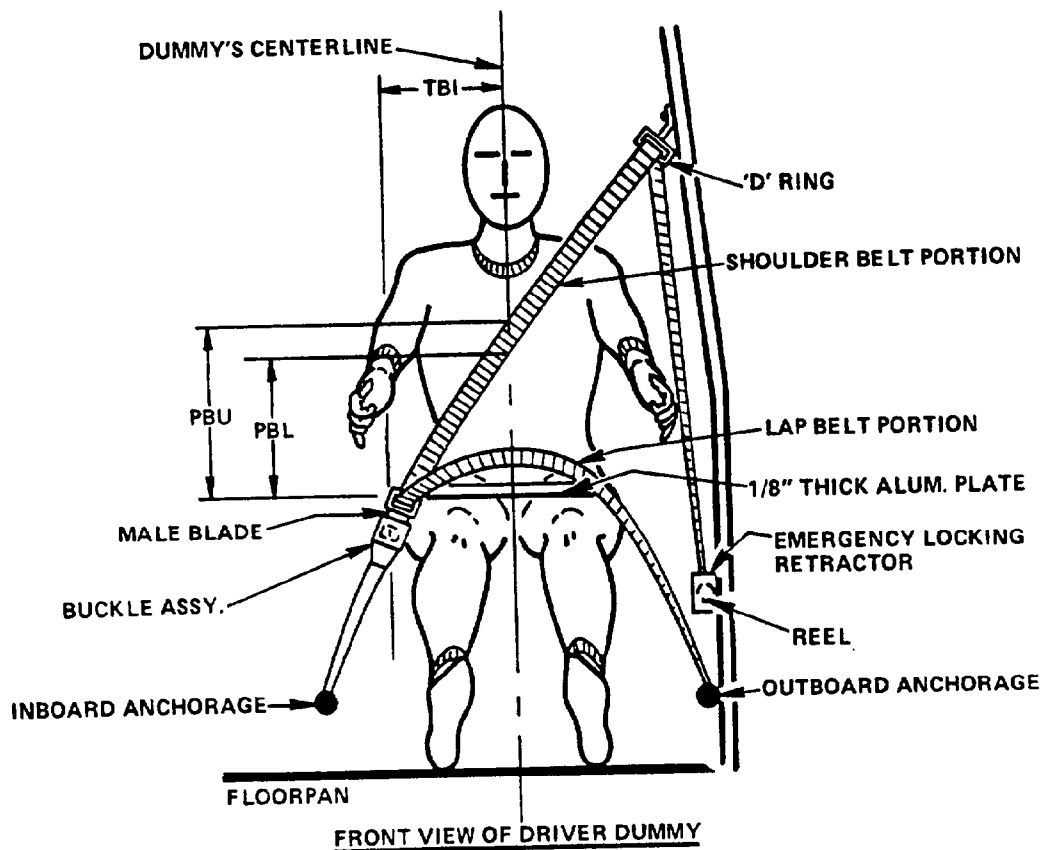
Figure 4

DRIVER DUMMY TO STEERING COLUMN/WHEEL ASSY. REFERENCE DIMENSIONS



		MEASUREMENTS	
<u>NR</u>	-- Distance from tip of dummy's nose to Top Rear surface of steering wheel rim	14.3	Inches
<u>NH</u>	-- Distance from tip of dummy's nose to center of steering wheel hub	15.1	Inches
<u>SCA</u>	-- Angle of steering column relative to the horizontal X axis	22	Degrees
<u>SWA</u>	-- Angle of steering wheel relative to the horizontal X axis	-68	Degrees

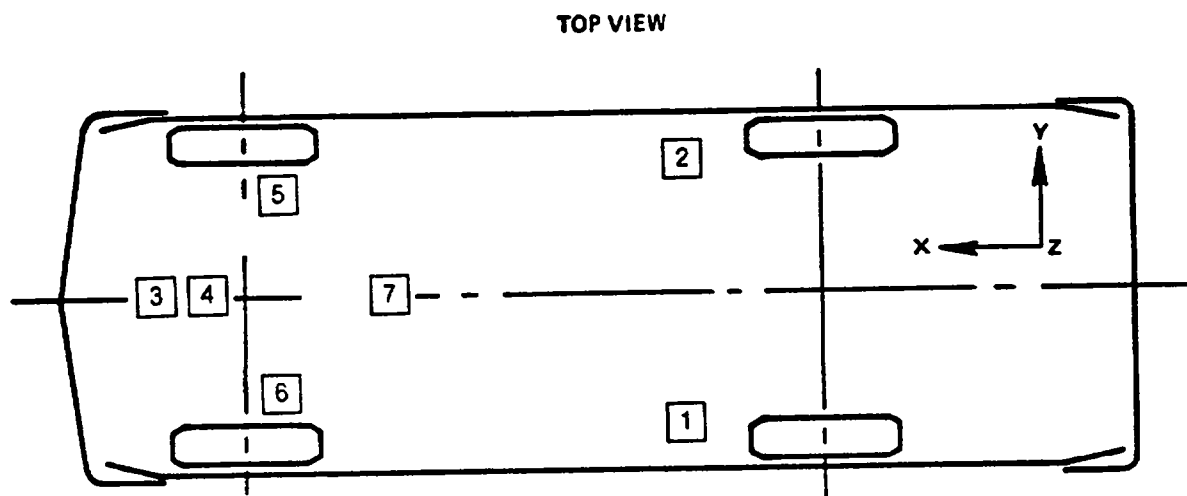
Figure 5  
SEAT BELT POSITIONING DATA



	DRIVER DUMMY (inches)	PASSENGER DUMMY (inches)
<u>PBU</u> -- Top surface of alum. plate to upper edge	*	13.3
<u>PBL</u> -- Top surface of alum. plate to belt lower edge	*	10.7
<u>TBI</u> -- Distance from torso centerline to buckle	*	10.1

\*Driver 3-point seat belt not used for this test.

Figure 6  
VEHICLE ACCELEROMETER LOCATIONS



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

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

### VEHICLE ACCELEROMETER LOCATIONS AND DATA SUMMARY

		**	<u>POSITIVE</u>	<u>NEGATIVE</u>
*X +	Forward from rear bumper	LONGITUDINAL:	FORWARD	REARWARD
Y +	Left from vehicle centerline	LATERAL:	LEFTWARD	RIGHTWARD
Z +	Up from ground	VERTICAL:	UPWARD	DOWNWARD

7853-12

Figure 7  
CAMERA POSITIONS FOR FRONTAL IMPACTS

NOTE: Camera Information Shown on Table 5.

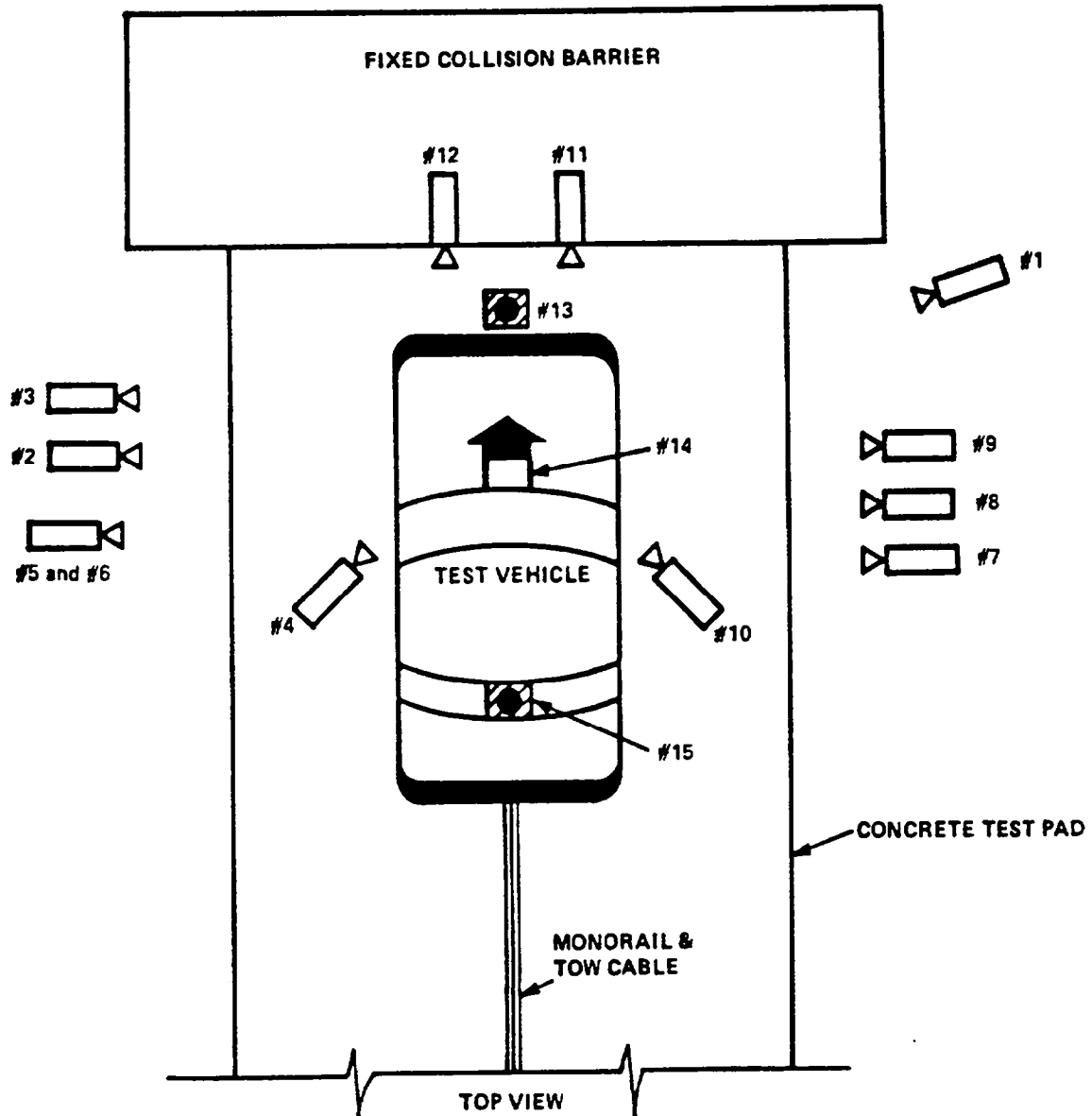
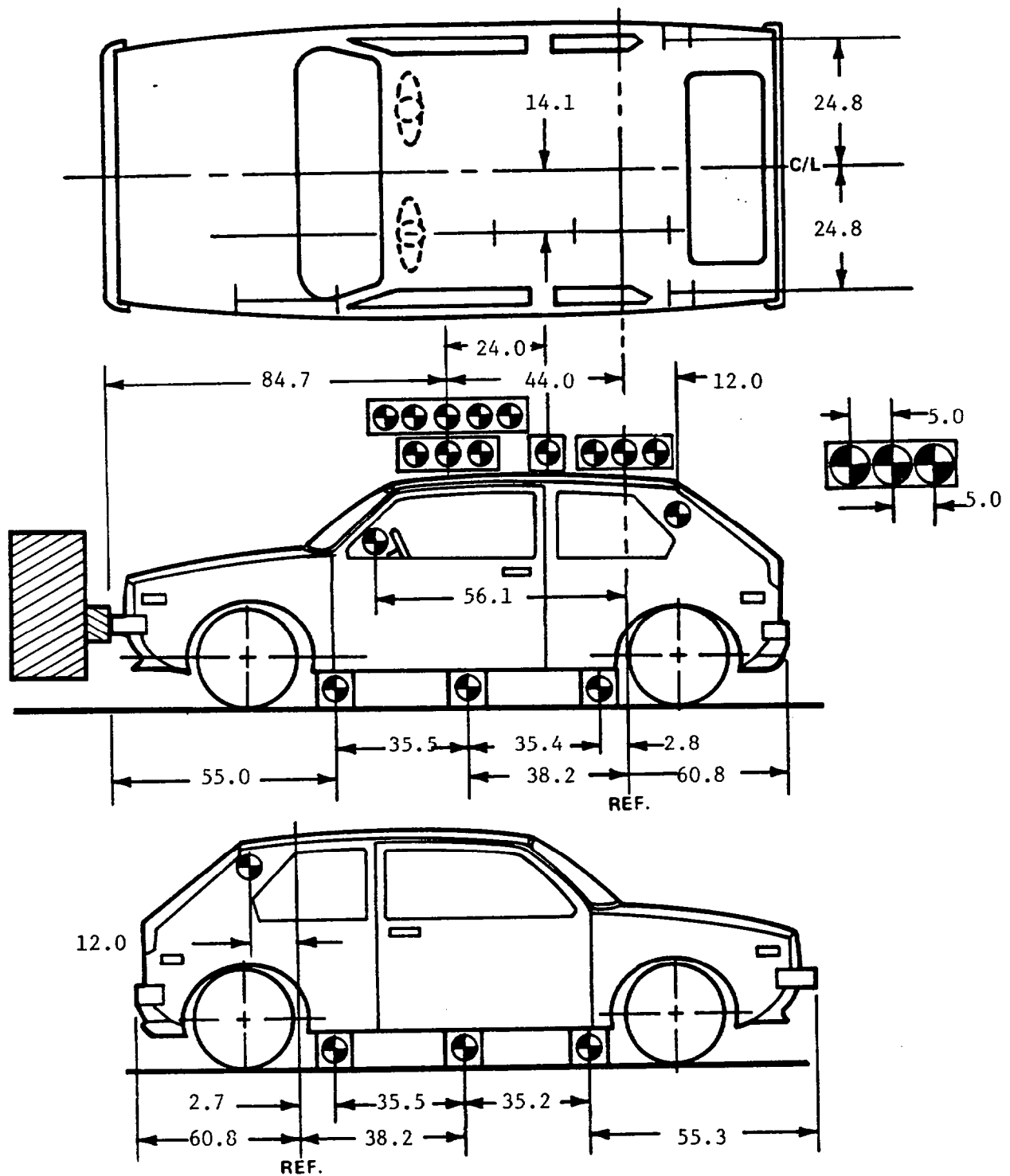


Table 5  
HIGH-SPEED CAMERA LOCATIONS

CAMERA NO.	VIEW	CAMERA POSITIONS (in)*			ANGLE** (deg)	FILM PLANE TO HEAD TARGET	LENS (mm)	SPEED (fps)
		X	Y	Z				
1	Real-Time Camera	-	-	-	-	-	-	24
2	Overall Left Side	219	63	41	-6	202	13	545
3	Left Side View	294	35	41	-2	277	25	565
4	Driver and Interior View	101	98	69	-21	-	13	650
5	Steering Column (Bottom)	267	78	46	-4	250	25	545
6	Steering Column (Top)	267	78	70	-9	250	25	570
7	Overall Right Side	226	66	42	-1	209	13	545
8	Right Side View	291	45	40	-1	274	25	625
9	Right Passenger View	289	74	54	-2	272	35	540
10	Passenger and Interior View	101	96	67	-19	-	13	530
11	Passenger Front View	22	19	76	-42	-	13	540
12	Driver Front View	22	19	76	-42	-	13	530
13	Windshield View	0	0	131	-53	-	13	545
14	Pit View of Engine	0	35	-120	90	-	13	780
15	Pit View of Fuel Tank	0	133	-120	90	-	13	695

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

Figure 8  
VEHICLE TARGET LOCATIONS



(DIMENSIONS IN INCHES)



Figure 9  
TEST VEHICLE MEASUREMENTS

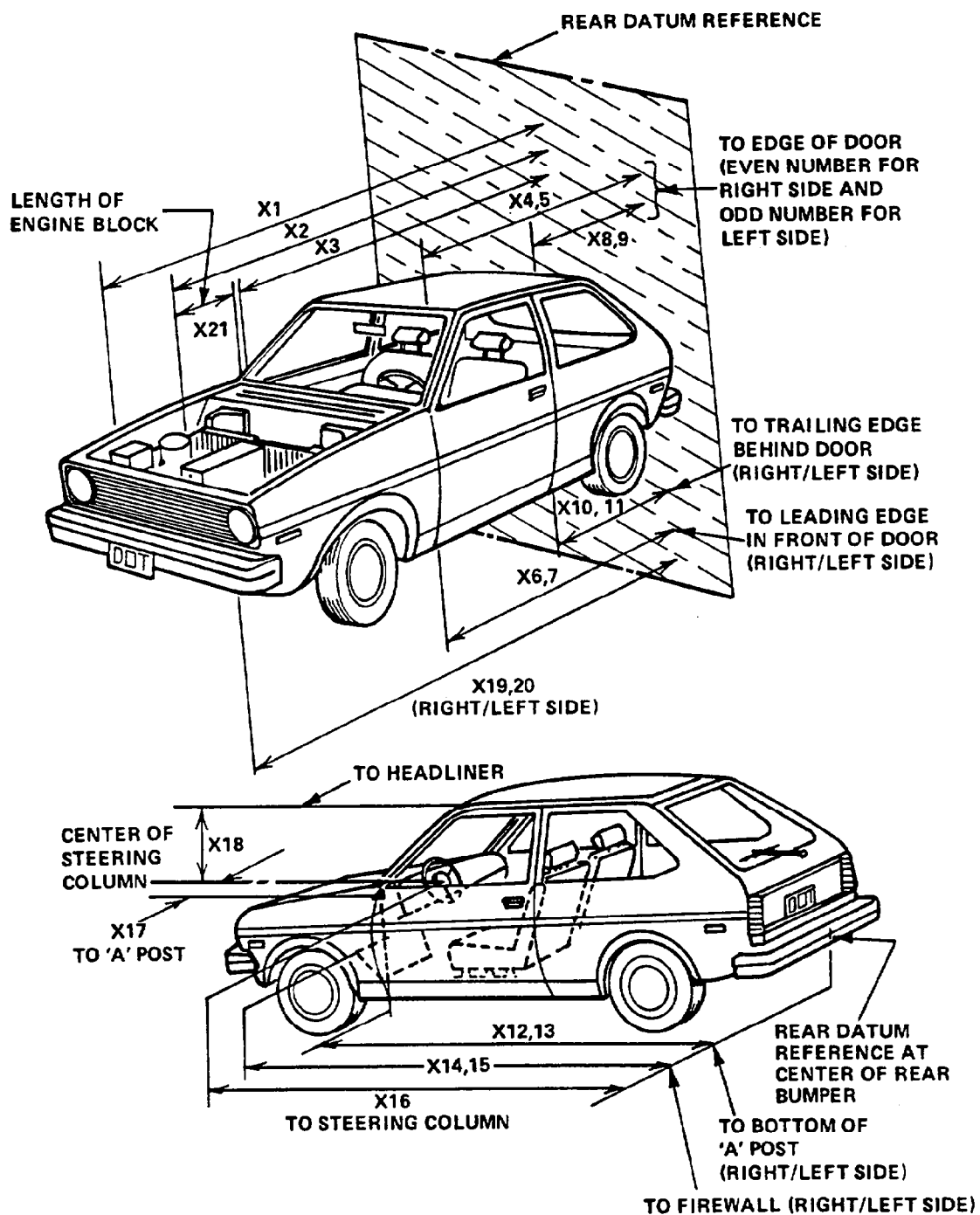


Table 6

VEHICLE MEASUREMENTS

No.		All Dimensions in Inches		
		Pre-Test	Post-Test	Differences
X1	Total Length of Vehicle at Centerline	189.5	168.5	21.0
X2	Rear Surface of Vehicle to Front of Engine	159.8	157.0	2.8
X3	Rear Surface of Vehicle to Firewall	138.2	137.0	1.2
X4	Rear Surface of Vehicle to Upper Leading Edge of Right Door	124.9	124.5	0.4
X5	Rear Surface of Vehicle to Upper Leading Edge of Left Door	125.3	125.3	0.0
X6	Rear Surface of Vehicle to Lower Leading Edge of Right Door	125.4	125.6	-0.2
X7	Rear Surface of Vehicle to Lower Leading Edge of Left Door	125.9	126.0	-0.1
X8	Rear Surface of Vehicle to Upper Trailing Edge of Right Door	90.2	89.9	0.3
X9	Rear Surface of Vehicle to Upper Trailing Edge of Left Door	90.8	90.6	0.2
X10	Rear Surface of Vehicle to Lower Trailing Edge of Right Door	90.2	90.5	-0.3
X11	Rear Surface of Vehicle to Lower Trailing Edge of Left Door	90.9	90.5	0.4
X12	Rear Surface of Vehicle to Bottom of "A" Post of Right Side	125.4	125.5	-0.1
X13	Rear Surface of Vehicle to Bottom of "A" Post of Left Side	125.9	126.0	-0.1
X14	Rear Surface of Vehicle to Firewall, Right Side	137.2	136.2	1.0
X15	Rear Surface of Vehicle to Firewall, Left Side	137.0	135.5	1.5
X16	Rear Surface of Vehicle to Steering Column	110.4	111.6	-1.2
X17	Center of Steering Column to "A" Post	15.2	16.3	-0.9
X18	Center of Steering Column to Headliner	16.6	16.3	0.3
X19	Rear Surface of Vehicle to Right Side of Front Bumper	186.8	167.2	19.6
X20	Rear Surface of Vehicle to Left Side of Front Bumper	187.1	168.2	18.9
X21	Length of Engine Block	20.3	20.3	0.0

#### Section 4

##### SUMMARY OF RESULTS OF FMVSS NOS. 208, 212, 219 AND 301-75

- "Occupant Crash Protection," FMVSS No. 208 Data
- "Windshield Mounting," FMVSS No. 212 Data
- "Windshield Zone Intrusion," FMVSS No. 219 (Partial) Data
- "Fuel System Integrity," FMVSS No. 301-75

Table 7

DUMMY INJURY CRITERIA VALUESNHTSA No.: CM5901 Vehicle: 1991 Volvo 240 4-Door Sedan

	MAXIMUM ACCELERATION (g's)							
	HEAD				CHEST			
	X	Y	Z	R	X	Y	Z	R*
Dummy (1)	-34	11	10	34	-37	2	10	37.6
Dummy (2)	-12	15	36	37	-25	13	-13	25.5

	MAXIMUM FORCE - FEMUR LOAD (lbs.)	
	LEFT FEMUR	RIGHT FEMUR
Dummy (1)	1240	1129
Dummy (2)	165	38

	HEAD INJURY CRITERIA**			
	HIC	36 millisecond Maximum		Avg. Acc. (g) t <sub>1</sub> TO t <sub>2</sub>
		t <sub>1</sub> (SEC)	t <sub>2</sub> (SEC)	
Dummy (1)	180.5	.07296	.10884	30.3
Dummy (2)	198.8	.08508	.12096	31.4

\*Defined as exceeding 0.003 sec. duration

\*\*As defined in FMVSS No. 208

Table 8

FMVSS NO. 208 - SEAT BELT WARNING SYSTEM CHECK

With occupant in driver's position, the lap belt in stowed position, and ignition switch placed in "Start/On" position:

Log time duration of audible warning signal = 6.0 sec.

Log time duration of reminder light operation = 6.0 sec.

With occupant in driver's position, lap belt in use, and the ignition switch placed in "Start/On" position:

Log time duration of audible warning signal = - sec.

(audible warning should not operate)

Log time duration of reminder light operation = 6.0 sec.

Note wording of visual warning:

Fasten Seat Belt -

Fasten Belt -

Symbol 101-80 X

Table 9

FMVSS NO. 208 - LABELING AND DRIVER'S MANUAL INFORMATION

Locate label which describes manufacturers maintenance or replacement schedule for crash-deployed occupant protection system.

Describe location: B-pillar on left side of vehicle.

The manufacturers recommended schedule is to replace or service this system:

- a. by Jan. month, 2000 year
- b. by - miles
- c. or after a time interval of - months or - years.

Were appropriate instructions concerning maintenance and/or replacement of this system provided? YES X NO -

Was a description of the functional operation of the system provided? YES X NO -

Is there a reference to the instructions and description of the system on the label? YES X NO -

Was an owner's manual provided? YES X NO -

Did the owner's manual contain appropriate information concerning maintenance and/or replacement and a description of the functional operation of the systems? YES X NO -

Table 10

FMVSS NO. 208 - READINESS INDICATOR

An occupant restraint system that deploys in the event of a crash shall have a monitoring system with a readiness indicator. A totally mechanical system is exempt from this requirement.

Is the system totally mechanical?    YES\_\_\_\_\_ -    NO\_\_\_\_\_ X\_\_\_\_\_

Describe the location of the readiness indicator:

Bottom center of instrument cluster.

Is the readiness indicator clearly visible to the driver?

YES\_\_\_\_\_ X\_\_\_\_\_    NO\_\_\_\_\_ -\_\_\_\_\_

Is a list of the elements in the occupant restraint system, being monitored by the readiness indicator, provided?

YES\_\_\_\_\_ X\_\_\_\_\_    NO\_\_\_\_\_ -\_\_\_\_\_

Table 11

FMVSS NO. 208 - COMFORT AND CONVENIENCE TEST SUMMARY

Test Vehicle NHTSA No.: CM5901

Make/Model: 1991 Volvo 240

Date of Comfort/Convenience Check: May 23, 1991

Technician Performing Check: VMP

GVWR: 4030

Seat belt comfort and convenience requirements cover vehicles manufactured on or after September 1, 1986, which have a gross vehicle weight rating of 10,000 pounds or less. Exemptions to this rule are belts installed in a walk-in, van-type vehicle and manual Type 2 belt systems installed in the front outboard seating positions of passenger automobiles. On or after September 1, 1989, the exemption of the type 2 manual seat belts installed in the front outboard seating positions of passenger automobiles will change depending on the states' enactment of mandatory usage laws.

Was vehicle built after or on September 1, 1986, and is it equipped with:

1. Automatic seat belts YES \_\_\_\_\_ NO X

If yes, go to requirements D1, D2 and D3

2. Manual seat belts\* YES X\*\* NO \_\_\_\_\_

a. The seat belts, other than Type 2 lap/shoulder belts, are located in the front outboard seating positions of a passenger automobile.

YES \_\_\_\_\_ NO X

(Go to requirements D3, D4, D5, and D6)

b. The seat belt system is Type 2 lap/shoulder belt in the front outboard seating positions or the seat belts are located in a walk-in van.

STOP

\*If the seat belts are voluntarily installed by the manufacturer they do not have to comply.

\*\*Driver side equipped with supplemental restraint system.



Table 11 (cont.)

D1

CONVENIENCE HOOKS

A convenience hook or other device is provided to stow seat belt webbing to facilitate entering or exiting the vehicle.

YES   X   NO       

Check the option which applies to this test vehicle:

1. A convenience hook or other device automatically releases the webbing when the automatic belt system is operational and remains in the released mode as long as the vehicle's ignition switch is moved to the "on" or "start" position and the vehicle's drivetrain is engaged.

YES   N/A   NO   N/A  

2. A convenience hook or other device automatically releases the webbing when the automatic belt system is operational and remains in the released mode as long as the vehicle's ignition switch is moved to the "on" or "start" position and the vehicle's parking brake is in the released mode (nonengaged).

YES   N/A   NO   N/A  

D2

WEBBING TENSION - RELIEVING DEVICE

The seat belt assembly installed in the outboard designated seating position has either manual or automatic tension relieving devices permitting the introduction of slack in the webbing of the shoulder belt ("comfort clips" or "window shade" devices).

YES        NO   X  

Check the owner's manual and determine the maximum amount of slack recommended by the manufacturer in inches. The recommended slack is   -   inches. Introduce this slack into the shoulder belt before testing the vehicle to comply with the requirements of FMVSS 208 S5.1. A warning is included in the owner's manual that introducing slack beyond the amount specified can significantly reduce the effectiveness of the shoulder belt.

YES   N/A   NO   N/A  

(If NO, provide explanation.)

Check the option which applies to this test vehicle:

1. This vehicle is equipped with automatic seat belts and the tension relieving device is cancelled each time the adjacent door is opened.

YES   N/A   NO   N/A  

(If NO, provide explanation.)

Table 11 (cont.)

2. This vehicle is equipped with manual belts, required to meet FMVSS 208 S4.6, and the tension relieving device is cancelled each time one of the following options occurs:
- a. The adjacent door is opened.
- YES   N/A   NO   N/A
- b. The latch plate is released from the buckle.
- YES   N/A   NO   N/A
3. This is an open-body vehicle, without doors. Does the manual mean to cancel any shoulder belt slack introduced by a tension relieving device operate properly?
- YES   N/A   NO   N/A

(If NO, provide explanation.)

D3

BELT CONTACT FORCE

1. Do not measure the belt contact force if the manual or automatic seat belt assemblies in this vehicle incorporate a webbing tension relieving device. Does the vehicle incorporate a tension relieving device?
- YES   -   NO   X
2. Seats are adjusted according to instructions in Appendix B.
- YES   X   NO   -
3. The test dummies are positioned according to dummy position placement instructions in Appendix B and Appendix C.
- YES   X   NO   -
4. Close the vehicle's adjacent door, pull either 12 inches of belt webbing or the maximum available amount of belt webbing, whichever is less, from the retractor and then release it, allowing the belt webbing to return to the dummy's chest, then fasten the latch. Locate the point where the centerline of the upper torso belt webbing crosses the midsagittal line on the dummy's chest. At that point, pull the belt webbing out 3 inches from the dummy's chest and release until it is within one inch from the dummy's chest. Measure the contact force exerted by the belt webbing on the dummy's chest. The contact for is 0.5 pounds. Contact the COTR if the contact force exceeds 0.7 pounds.

Table 11 (cont.)

D4

1. Position the test dummy in the driver's seat or passenger's seat in its forward most adjustment position.

YES   X   NO   -  

2. Attach the inboard and outboard reach string.

YES   X   NO   -  

3. Extend each line backward and outboard to generate arcs of the reach envelope of the test dummy's arms. With the latchplate in the normal stowed position, check to assure that the latchplates are within the reach envelope.

YES   X   NO   -  

4. Using the clearance test block, determine if there is sufficient clearance between the vehicle seat and the side of vehicle interior to allow the test block to move unhindered to the latchplate or buckle.

YES   X   NO   -  

D5

RETRACTION

1. Seats and seat backs are adjusted according to instructions in Appendix B "General Test Conditions" in TP-208-8.

YES   X   NO   -  

2. Use anthropomorphic test dummies whose arms have been removed and position the dummies in the front outboard designated seating positions according to instructions in Appendix B and restrain the dummies, using the belt systems for the positions being tested.

YES   X   NO   -  

3. Outboard armrests which are capable of being stowed on vehicle seats shall be placed in their stowed positions.

YES   N/A   NO   N/A  

4. Check the option which applies to this test vehicle:

- a. The torso and lap belt webbing of the seat belt system automatically retract to a stowed position when the adjacent vehicle door is in an open position and the seat belt latch plate is released.

YES   X   NO   -

Table 11 (cont.)

- b. The torso and lap belt webbing of the seat belt system automatically retract when the seat belt latch plate is released.

YES   X   NO       

5. With the webbing and hardware in the stowed position, close the door to assure that the webbing and hardware are prevented from being pinched.

YES   X   NO       

6. If this test vehicle has an open body (without doors) and has a belt system with a tension-relieving device, check to assure that the belt system fully retracts when the tension-relief device is manually deactivated.

YES   N/A   NO   N/A  

D8

ACCESSIBILITY

The requirements for accessibility do not apply to:

1. Seats whose seat cushions are removable so that the seat back serves a function other than seating;
2. Seats which are removable;
3. Seats which are movable so that the space formerly occupied by the seat can be used for a secondary function.

If the seats in this vehicle are different than the criteria above, then determine if:

1. Each manual seat belt assembly whose webbing is designed to pass through the seat cushion or between the seat cushion and seat back has one of the following three parts (the seat belt latchplate, the buckle, or the seat belt webbing) on top of or above the seat cushion under normal conditions (i.e., conditions other than when belt hardware is intentionally pushed behind the seat by a vehicle occupant).

YES   X   NO       

2. The remaining two seat belt parts are accessible under normal conditions.

YES   X   NO

Table 11 (cont.)

3. The buckle and latchplate do not pass through the guides or conduits provided and fall behind the seat when the following events occur in order:

- a. The belt is completely retracted or, if the belt is nonretractable, the belt is unattached.

YES \_\_\_\_\_ NO   X  

- b. The seat is moved to any position to which it is designed to be adjusted.

YES \_\_\_\_\_ NO   X  

- c. The seat back, if foldable, is folded forward as far as possible and then moved backward into positions.

YES   N/A   NO   N/A  

4. Is the inboard receptacle end of the seat belt assembly which is installed in the outboard designated seating position accessible with the center arm rest in any position to which it can be adjusted without moving the armrest?

YES   N/A   NO   N/A  

D7

LATCH MECHANISM

A seat belt assembly installed in a passenger car except an automatic belt assembly, shall have a latch mechanism:

1. Whose components are accessible to a seated occupant in both the stowed and operational positions.

YES   X   NO \_\_\_\_\_

2. That releases both the upper torso restraint and the lap belt simultaneously, if the assembly has a lap belt and an upper torso restraint that require unlatching for release of the occupant.

YES   X   NO \_\_\_\_\_

3. That releases at a single point by a push button action.

YES   X   NO \_\_\_\_\_

Figure 10

FMVSS NO. 212 - "WINDSHIELD MOUNTING" DATA SHEET

DETAILS OF WINDSHIELD MOUNTING SUCH AS RETENTION METHOD, TRIM TYPE, ETC.:

Windshield is bonded in place with a 0.7" soft rubber trim along with a 0.3" hard rubber trim around the entire windshield perimeter.

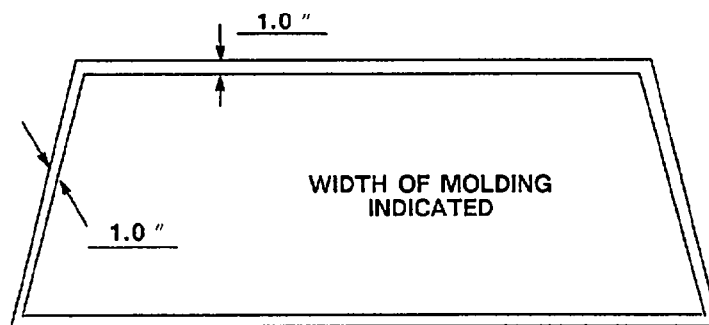
FMVSS 212 REQUIREMENTS:

The Post-Test periphery retention amount must be at least 75% of the Pre-Test periphery measurement for vehicles NOT equipped with automatic restraints, and 50% for each side of windshield for vehicles equipped with automatic restraint systems for front occupants.

FMVSS 212 TEST DATA:

	WINDSHIELD PERIPHERY		PERCENT RETENTION
	PRE-TEST (in.)	POST-TEST (in.)	
RIGHT SIDE	76.9	76.9	100%
LEFT SIDE	76.9	76.9	100%
TOTAL	153.8	153.8	100%

AREA OF RETENTION FAILURE:



FRONT VIEW

FAILURE DETAILS:

None.

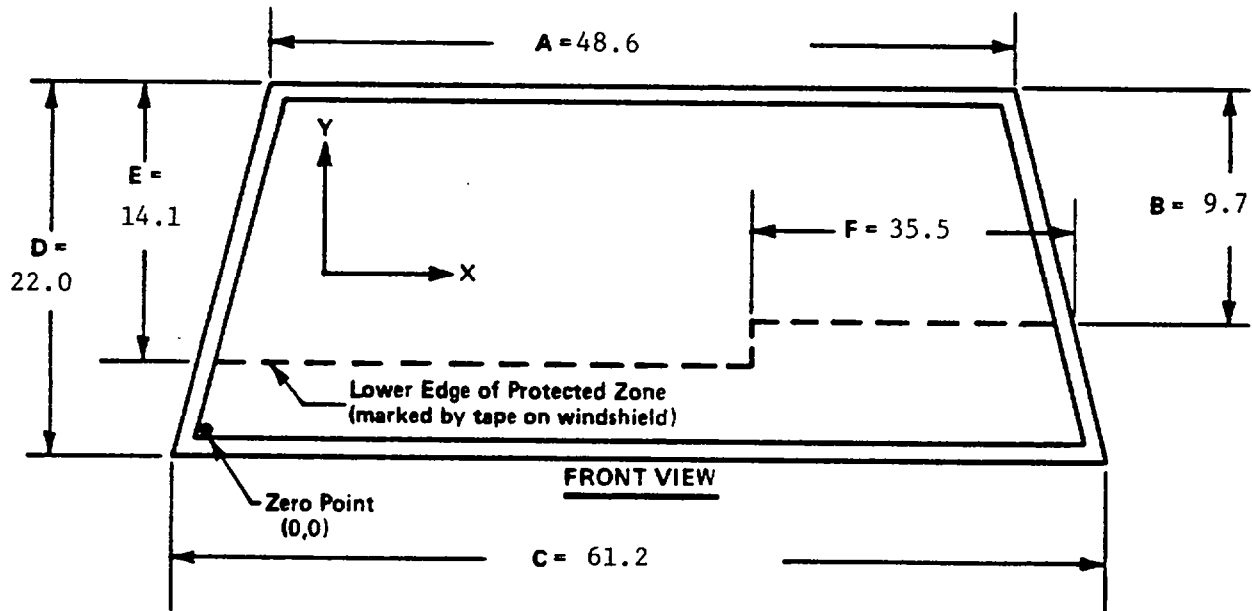
Figure 11

FMVSS NO. 219 (PARTIAL) - "WINDSHIELD ZONE INTRUSION" DATA SHEET

PROTECTED ZONE LOWER EDGE REQUIREMENT:

The lower edge of the protected zone is determined by placing a 6.5" dia. rigid sphere weighing 15 pounds in a position such that it simultaneously contacts the inner surface of the windshield and the top surface of the instrument panel including padding. the locus of points is drawn on the inner surface of the windshield contacted by the sphere across the width of the instrument panel. From the outermost contactable points, extend the locus line horizontally to the edges of the windshield, and then draw a line on the inner surface of the windshield below and 1/2" distant from the locus line. The LOWER EDGE OF THE PROTECTED ZONE is the longitudinal projection of this line onto the outer surface of the windshield.

FMVSS 219 TEST DATA: (Dimensions in inches.)



DETAILS OF WINDSHIELD GLASS PENETRATION GREATER THAN 1/4":

(Show location of penetration on above sketch)

None.

COORDINATES		
	X	Y
1.		
2.		
3.		
4.		

Table 12

FUEL SYSTEM INTEGRITY POST IMPACT TEST DATA

FMVSS NO. 301

TEST VEHICLE NHTSA NO.:

C	M	5	9	0	1
---	---	---	---	---	---

TEST DATE: May 24, 1991

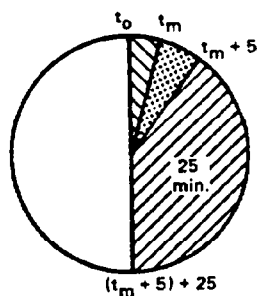
Vehicle Mfr./Make/Model: 1991 Volvo 240 4-Door Sedan

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  
☐ Rear Moving Barrier (30 mph)  
☐ 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	1 oz.
0	5 oz.
0	1 oz./1 min.

SOLVENT SPILLAGE DETAILS:

None.



Table 13

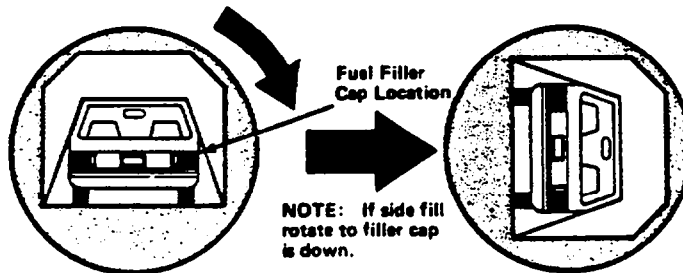
FMVSS NO. 301 STATIC ROLLOVER DATA SHEETTEST PHASE:

0°

90°

Vehicle NHTSA ID No.:

CM5901

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   minutesII. 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
---	---	---	---

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

IV. SOLVENT SPILLAGE LOCATION(S):

None

Table 13

FMVSS NO. 301 STATIC ROLLOVER DATA SHEET (cont.)

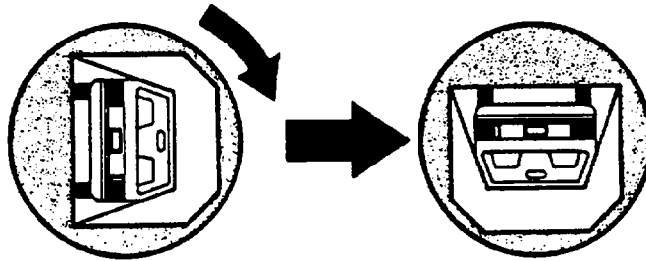
TEST PHASE:

90°

180°

Vehicle NHTSA ID No.:

CM5901



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
---	---	---	---

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

IV. SOLVENT SPILLAGE LOCATION(S):

None.

Table 13

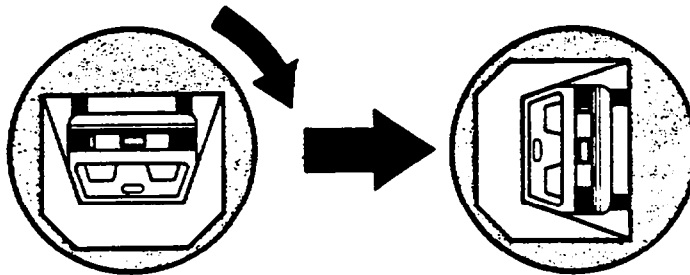
FMVSS NO. 301 STATIC ROLLOVER DATA SHEET (cont.)

TEST PHASE:

**180°****270°**

Vehicle NHTSA ID No.:

CM5901

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 minutesII. 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
---	---	---	---

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

IV. SOLVENT SPILLAGE LOCATION(S):

None.

Table 13

FMVSS NO. 301 STATIC ROLLOVER DATA SHEET (cont.)

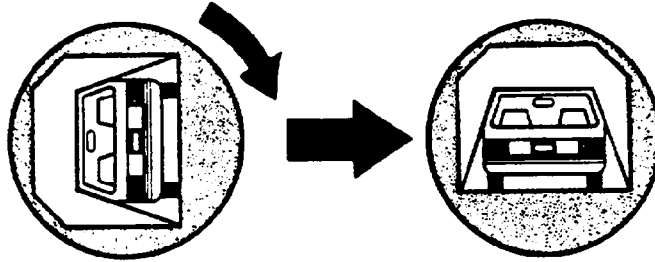
TEST PHASE:

**270°**

**360°**

Vehicle NHTSA ID No.:

CM5901



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
---	---	---	---

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

IV. SOLVENT SPILLAGE LOCATION(S):

None.

Table 14

TEST VEHICLE NONCOMPLIANCE NOTICE

NHTSA Contract Lab: Calspan Advanced Technology Center

Lab Project Manager & Telephone No.: Walter E. Levan (716) 632-7500

Date of Test: May 24, 1991 Vehicle NHTSA No.: CM5901

Vehicle Manufacturer: Volvo Car Corporation

Model Year: 1991 VIN: YV1AA8248M1444026

Body Style: 4-Door Sedan Build Date: 12-90

Dummy Stabilized Temperature at Time of Test: 72 °F (Spec. = 66-78°F)

Impact Velocity: 29.1 mph Time of Test: 11:40

Type of Restraint System: Driver side supplemental restraint system and  
passenger 3-point manual seat belt restraint system used for test.

Failure Details:

Vehicle appears to comply with requirements of FMVSS 208, 212, 219 (Partial),  
and 301.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Appendix A

PHOTOGRAPHS

# LIST OF PHOTOGRAPHS

<u>Figure</u>	<u>Photograph Title</u>	<u>Page No.</u>
Figure A-1	PRE-TEST FRONT VIEW .....	A-3
Figure A-2	POST TEST FRONT VIEW .....	A-4
Figure A-3	PRE-TEST LEFT SIDE VIEW .....	A-5
Figure A-4	POST TEST LEFT SIDE VIEW .....	A-6
Figure A-5	PRE-TEST RIGHT SIDE VIEW .....	A-7
Figure A-6	POST-TEST RIGHT SIDE VIEW .....	A-8
Figure A-7	PRE-TEST RIGHT FRONT THREE-QUARTER VIEW .....	A-9
Figure A-8	POST-TEST RIGHT FRONT THREE-QUARTER VIEW .....	A-10
Figure A-9	PRE-TEST LEFT REAR THREE-QUARTER VIEW .....	A-11
Figure A-10	POST-TEST LEFT REAR THREE-QUARTER VIEW .....	A-12
Figure A-11	POST TEST TOP VIEW .....	A-13
Figure A-12	PRE-TEST WINDSHIELD VIEW .....	A-14
Figure A-13	POST-TEST WINDSHIELD VIEW .....	A-15
Figure A-14	PRE-TEST ENGINE COMPARTMENT VIEW .....	A-16
Figure A-15	POST-TEST ENGINE COMPARTMENT VIEW .....	A-17
Figure A-16	PRE-TEST FUEL FILLER CAP PHOTO .....	A-18
Figure A-17	POST-TEST FUEL FILLER CAP PHOTO .....	A-19
Figure A-18	PRE-TEST FRONT UNDERBODY VIEW .....	A-20
Figure A-19	POST-TEST FRONT UNDERBODY VIEW .....	A-21
Figure A-20	PRE-TEST FRONT SIDE UNDERBODY VIEW .....	A-22
Figure A-21	POST-TEST FRONT SIDE UNDERBODY VIEW .....	A-23
Figure A-22	PRE-TEST REAR UNDERBODY VIEW .....	A-24
Figure A-23	POST-TEST REAR UNDERBODY VIEW .....	A-25
Figure A-24	CERTIFICATION LABEL .....	A-26
Figure A-25	TIRE PLACARD .....	A-27
Figure A-26	PRE-TEST DRIVER DUMMY POSITION .....	A-28
Figure A-27	POST-TEST DRIVER DUMMY POSITION .....	A-29
Figure A-28	PRE-TEST PASSENGER DUMMY POSITION .....	A-30
Figure A-29	POST-TEST PASSENGER DUMMY POSITION .....	A-31
Figure A-30	PRE-TEST DRIVER DUMMY AND INTERIOR VIEW .....	A-32
Figure A-31	POST-TEST DRIVER DUMMY AND INTERIOR VIEW .....	A-33
Figure A-32	PRE-TEST PASSENGER DUMMY AND INTERIOR VIEW .....	A-34
Figure A-33	POST-TEST PASSENGER DUMMY AND INTERIOR VIEW .....	A-35
Figure A-34	POST-TEST DRIVER AIRBAG VIEW .....	A-36
Figure A-35	VEHICLE IMPACT .....	A-37



Figure A-1 PRE-TEST FRONT VIEW



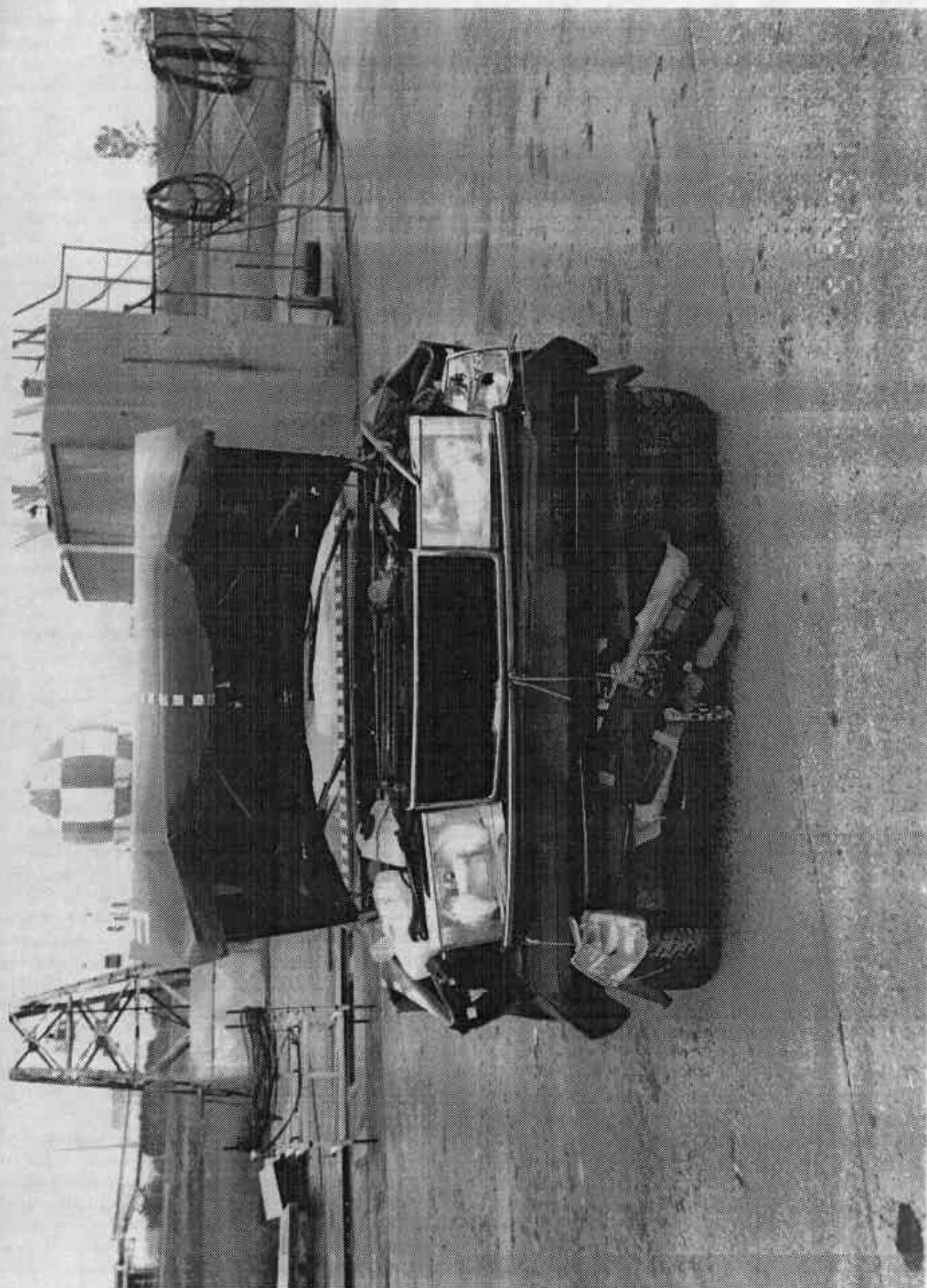


Figure A-2 POST TEST FRONT VIEW

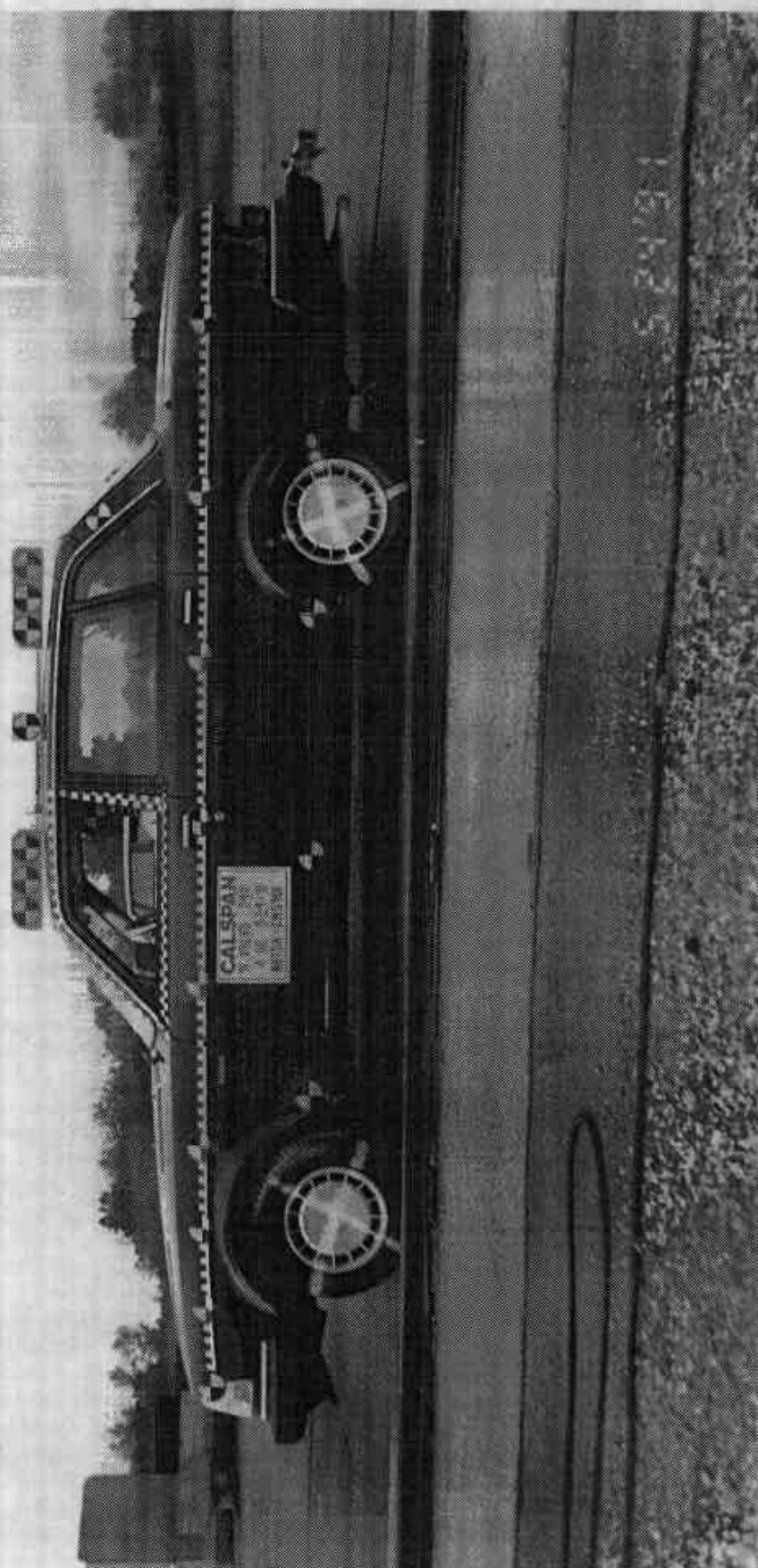


Figure A-3 PRE-TEST LEFT SIDE VIEW

A-5

7853-12

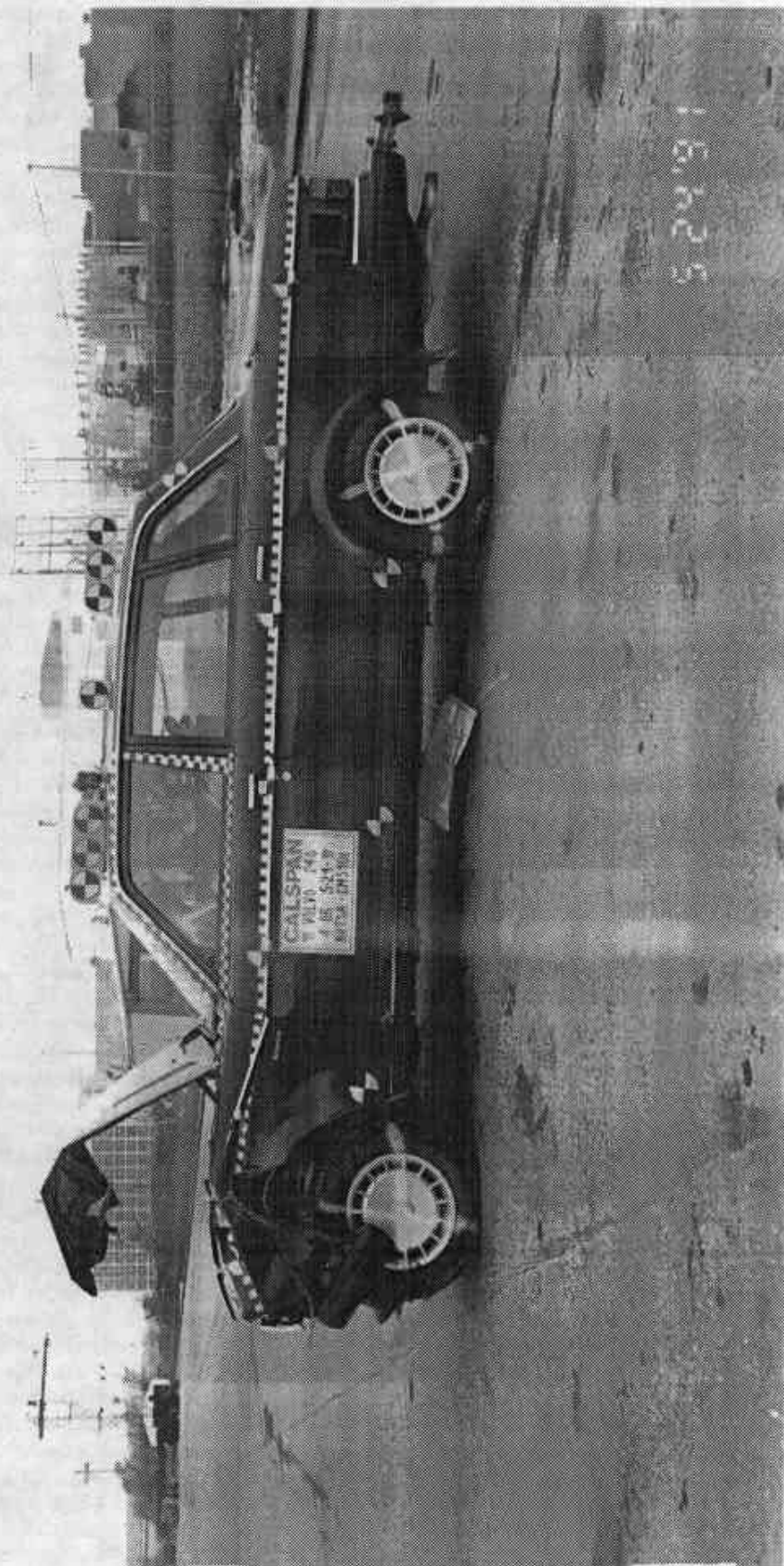


Figure A-4 POST TEST LEFT SIDE VIEW

A-6

7853-12



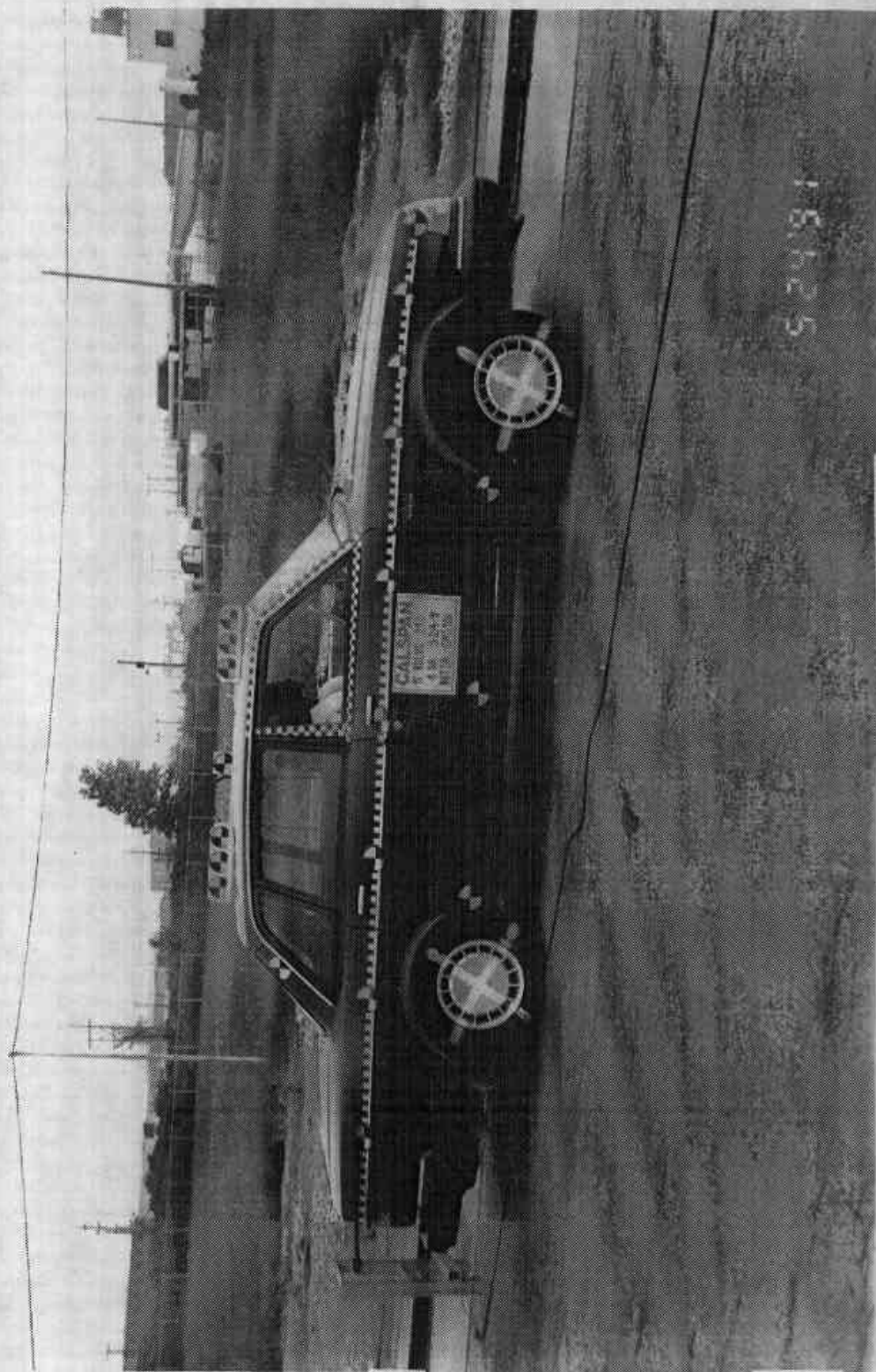


Figure A-5 PRE-TEST RIGHT SIDE VIEW

A-7

7853-12

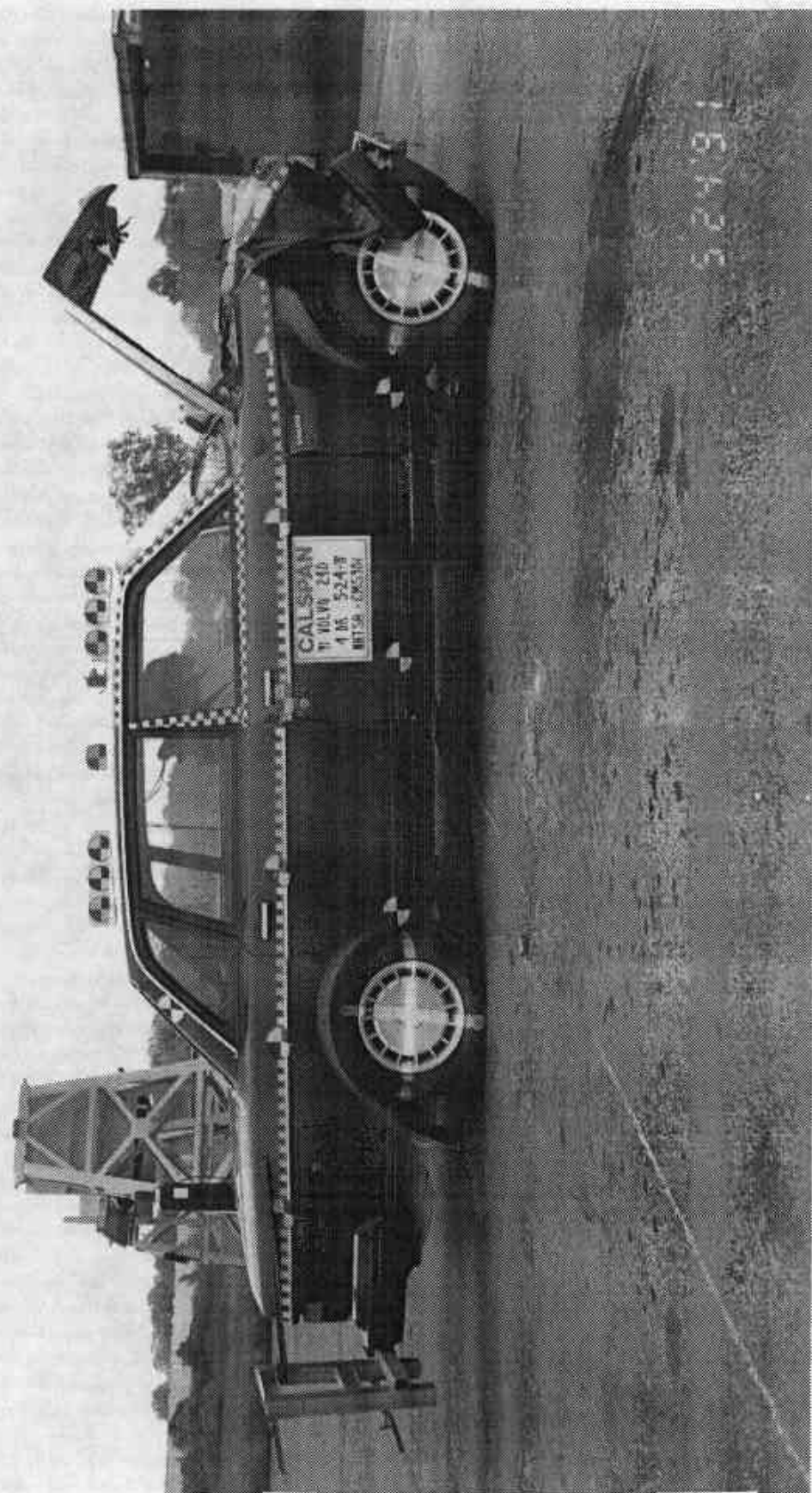


Figure A-6 POST-TEST RIGHT SIDE VIEW



Figure A-7 PRE-TEST RIGHT FRONT THREE-QUARTER VIEW

A-9

7853-12

52491



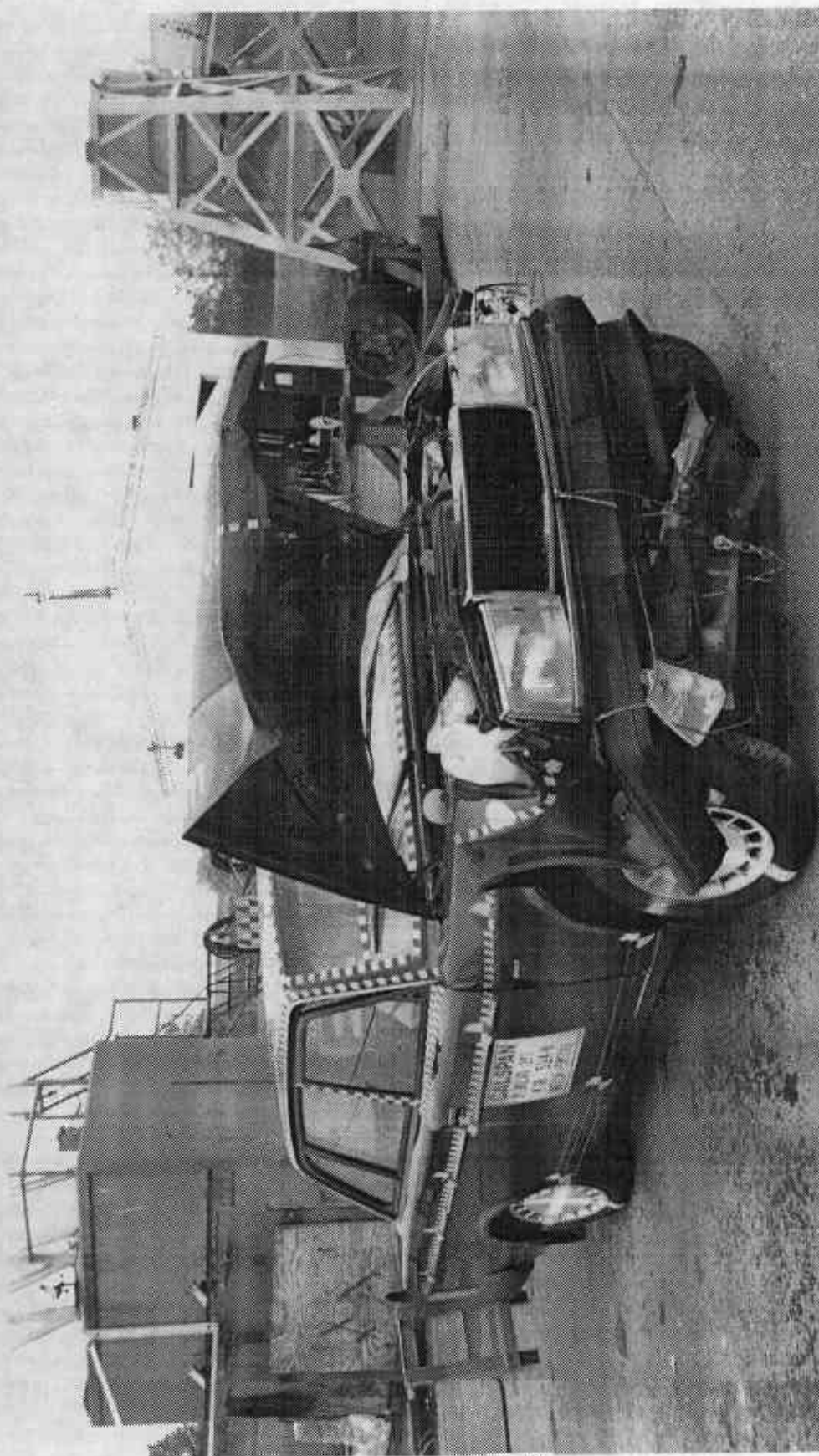


Figure A-8 POST-TEST RIGHT FRONT THREE-QUARTER VIEW

A-10

7853-12



A-11

7853-12

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

524931





16425

Figure A-10 POST-TEST LEFT REAR THREE-QUARTER VIEW

A-12

7853-12

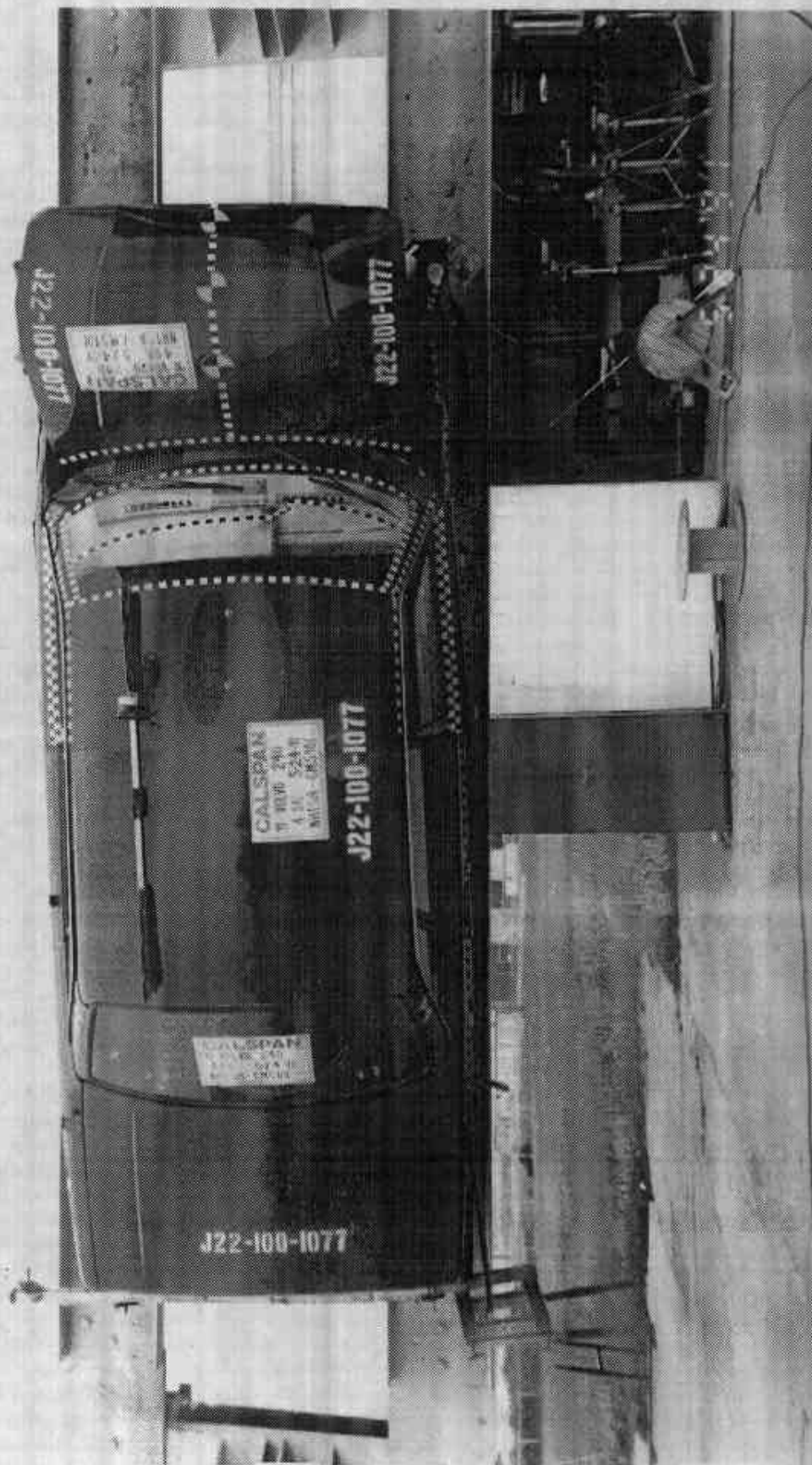


Figure A-11 POST TEST TOP VIEW

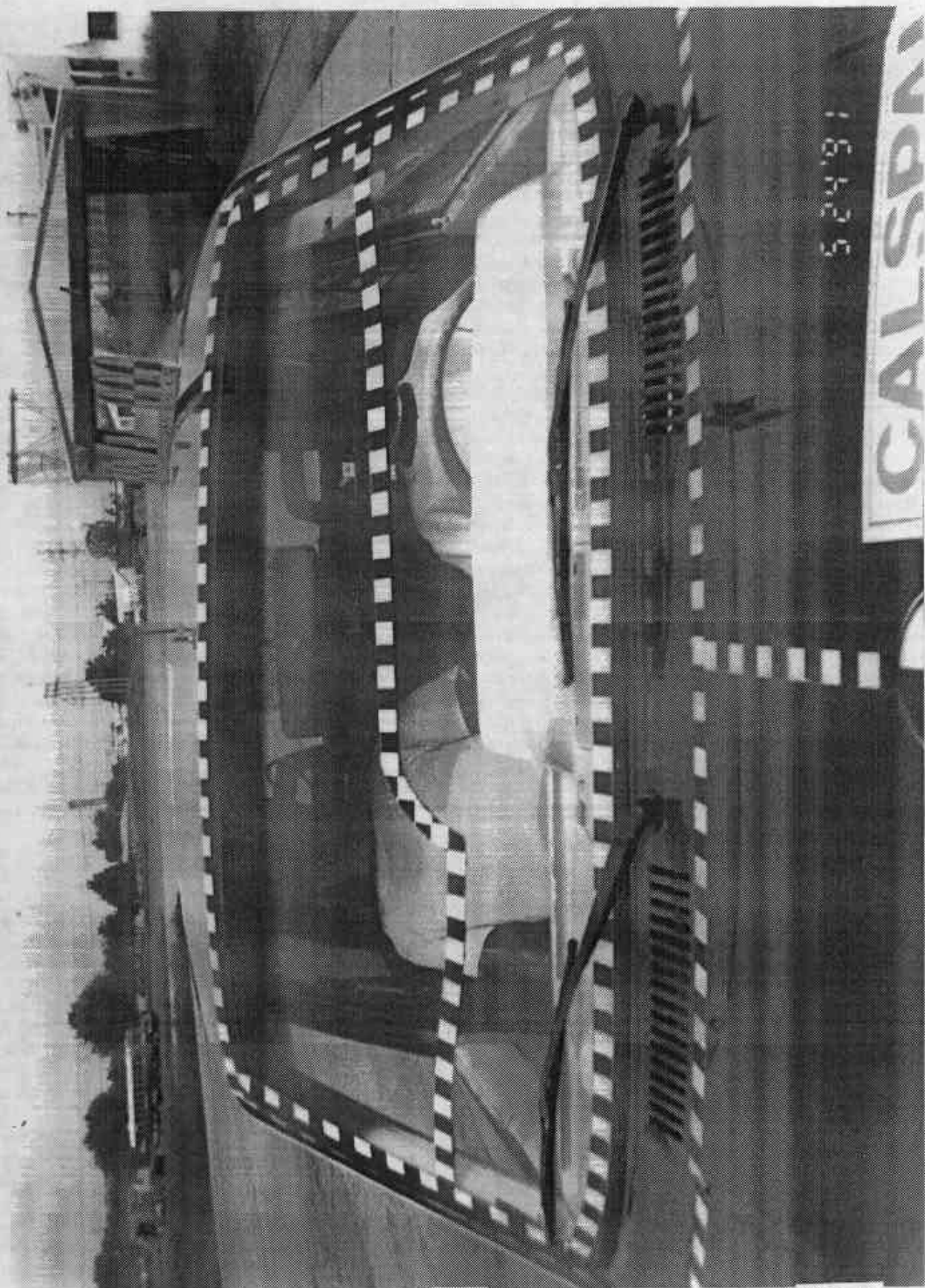


Figure A-12 PRE-TEST WINDSHIELD VIEW





Figure A-13 POST-TEST WINDSHIELD VIEW

A-15

7853-12

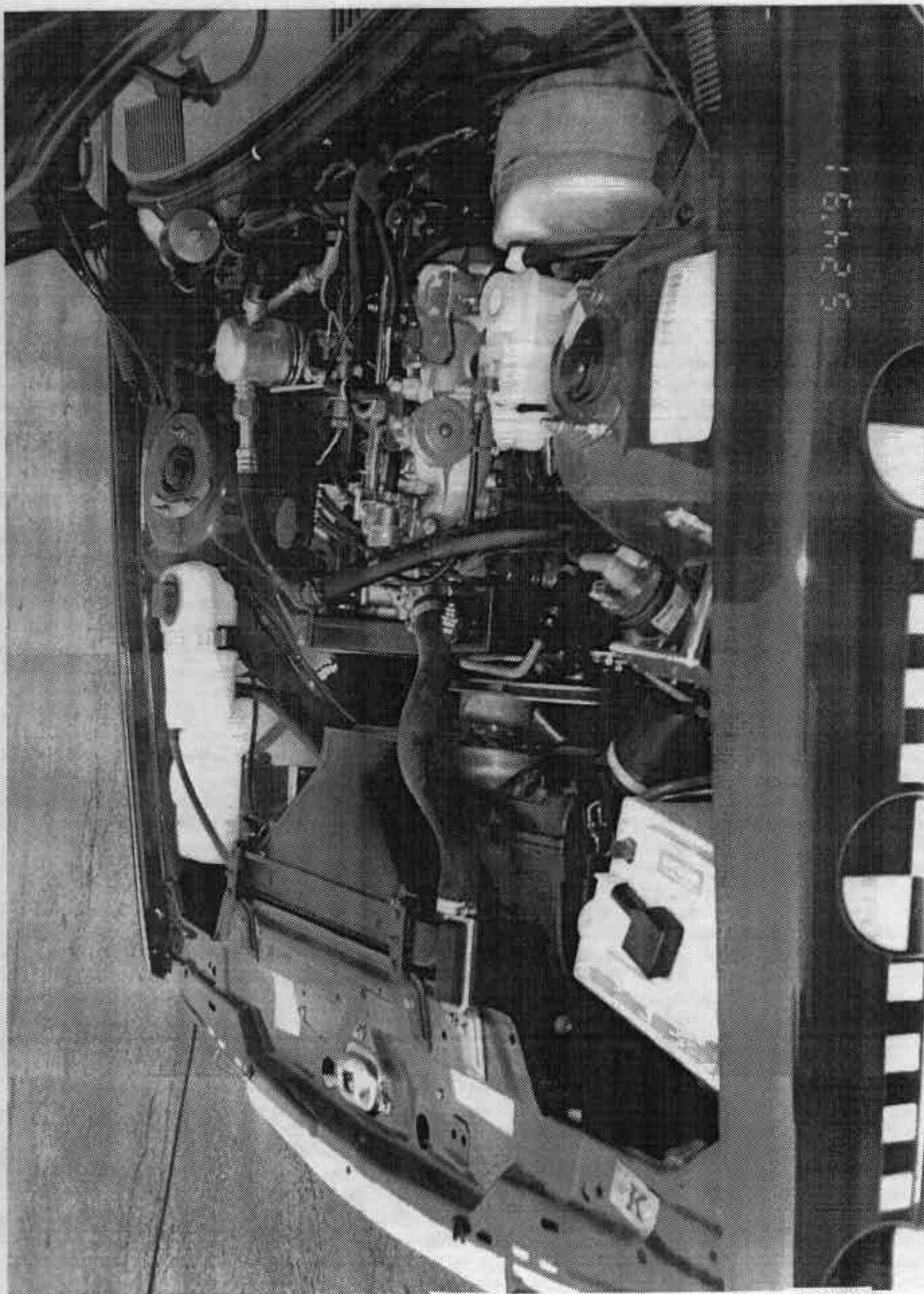


Figure A-14 PRE-TEST ENGINE COMPARTMENT VIEW

A-16

7853-12



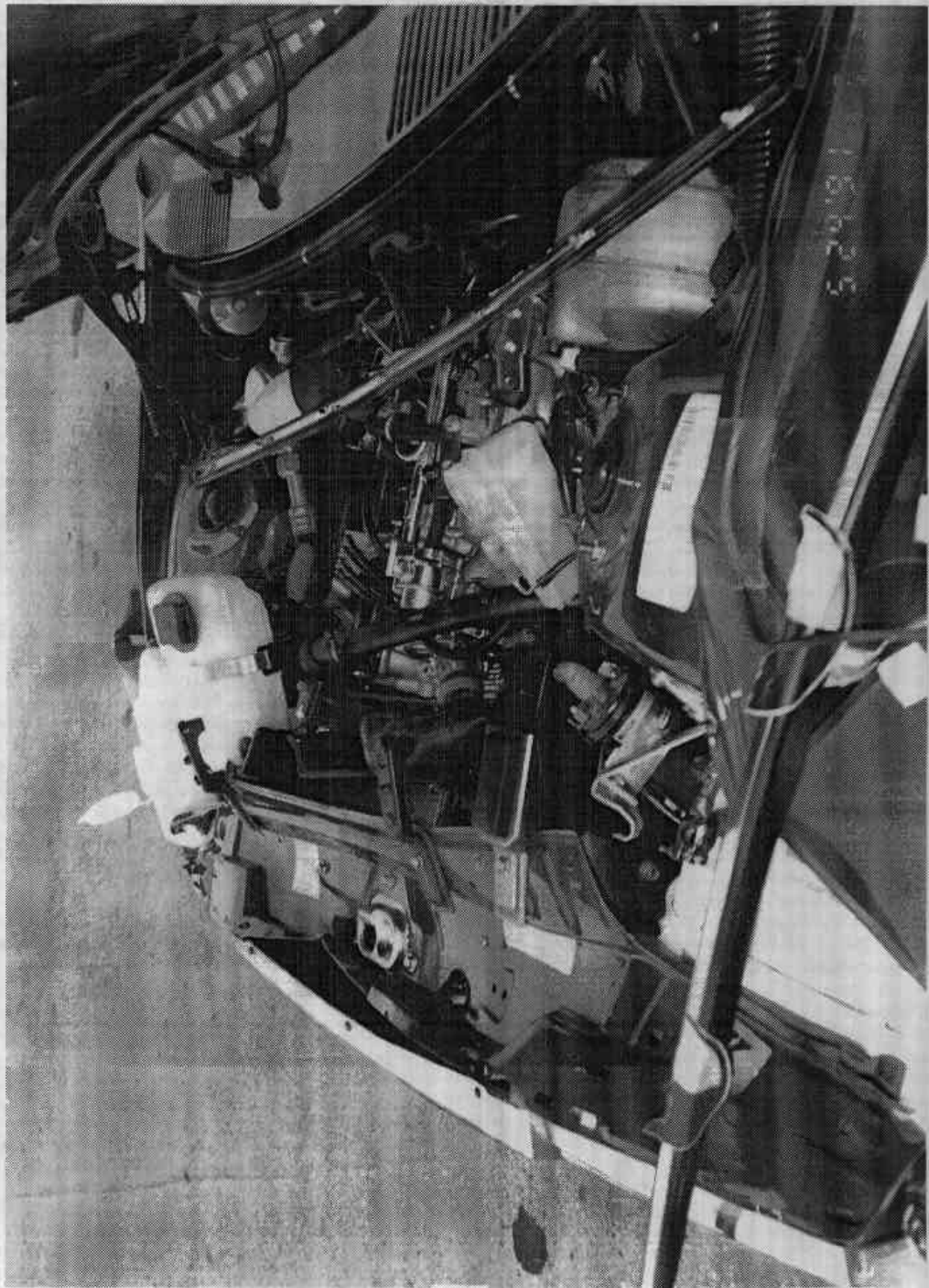


Figure A-15 POST-TEST ENGINE COMPARTMENT VIEW

A-17

7853-12

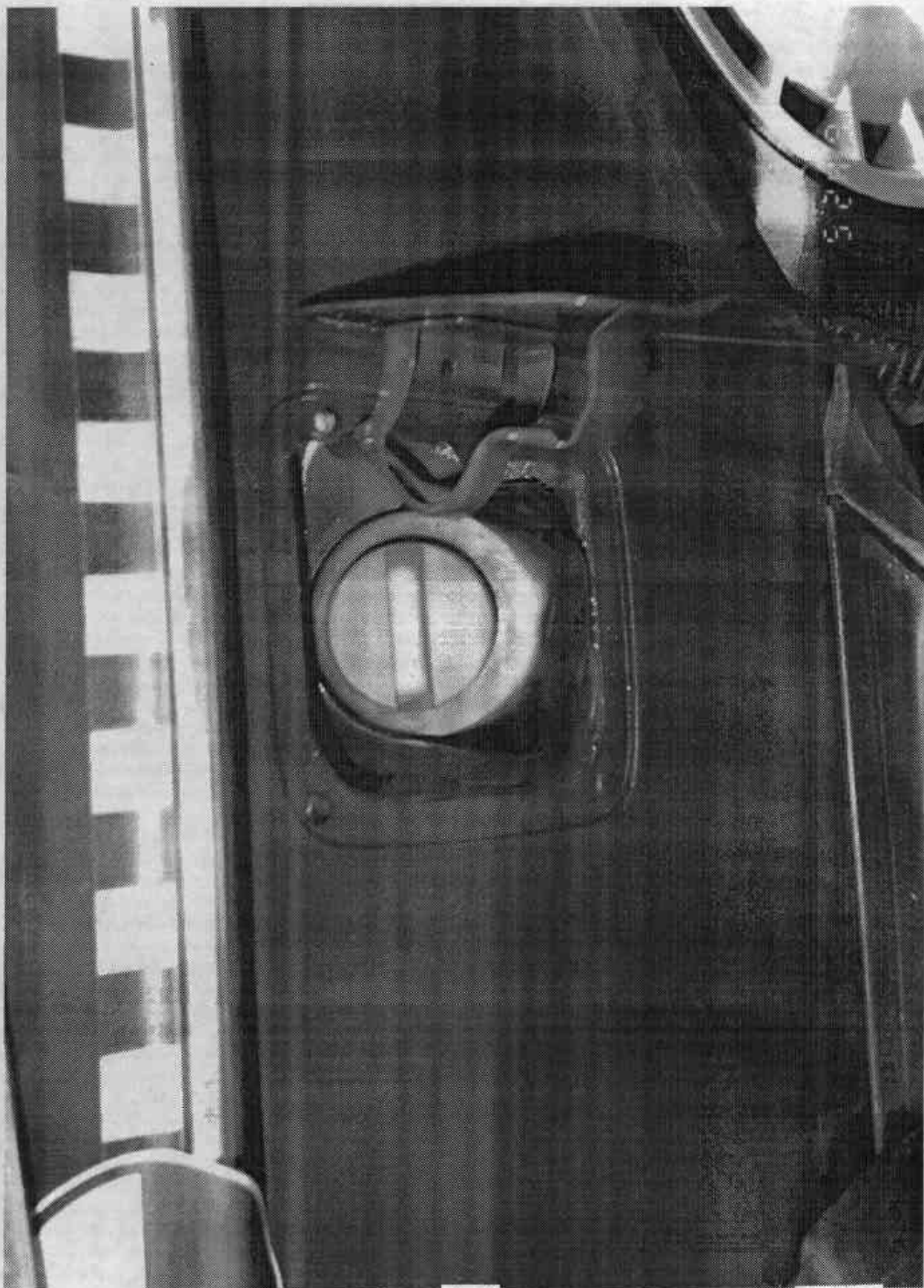


Figure A-16 PRE-TEST FUEL FILLER CAP PHOTO





Figure A-17 POST-TEST FUEL FILLER CAP PHOTO

A-19

7853-12



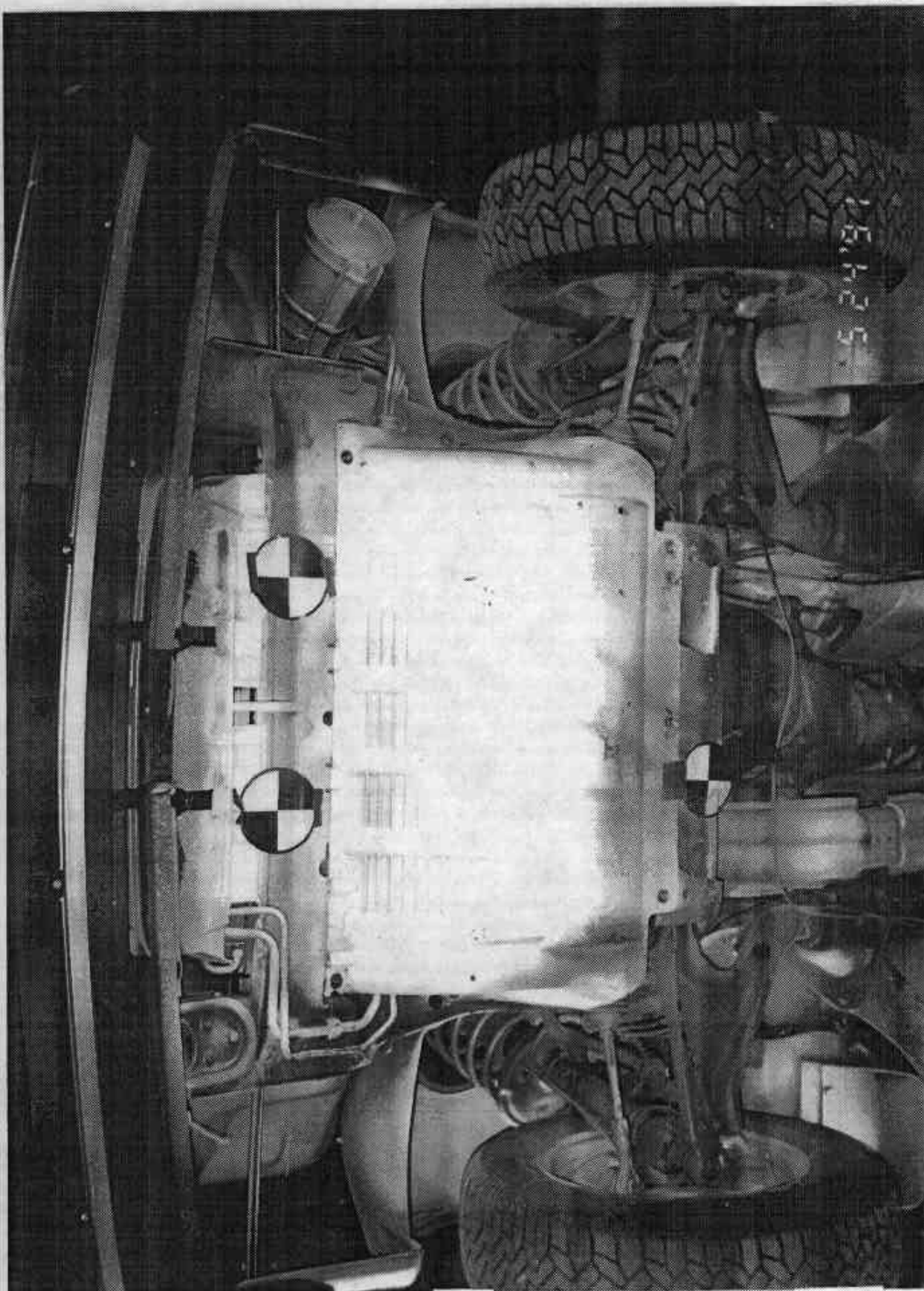


Figure A-18 PRE-TEST FRONT UNDERBODY VIEW

A-20

7853-12

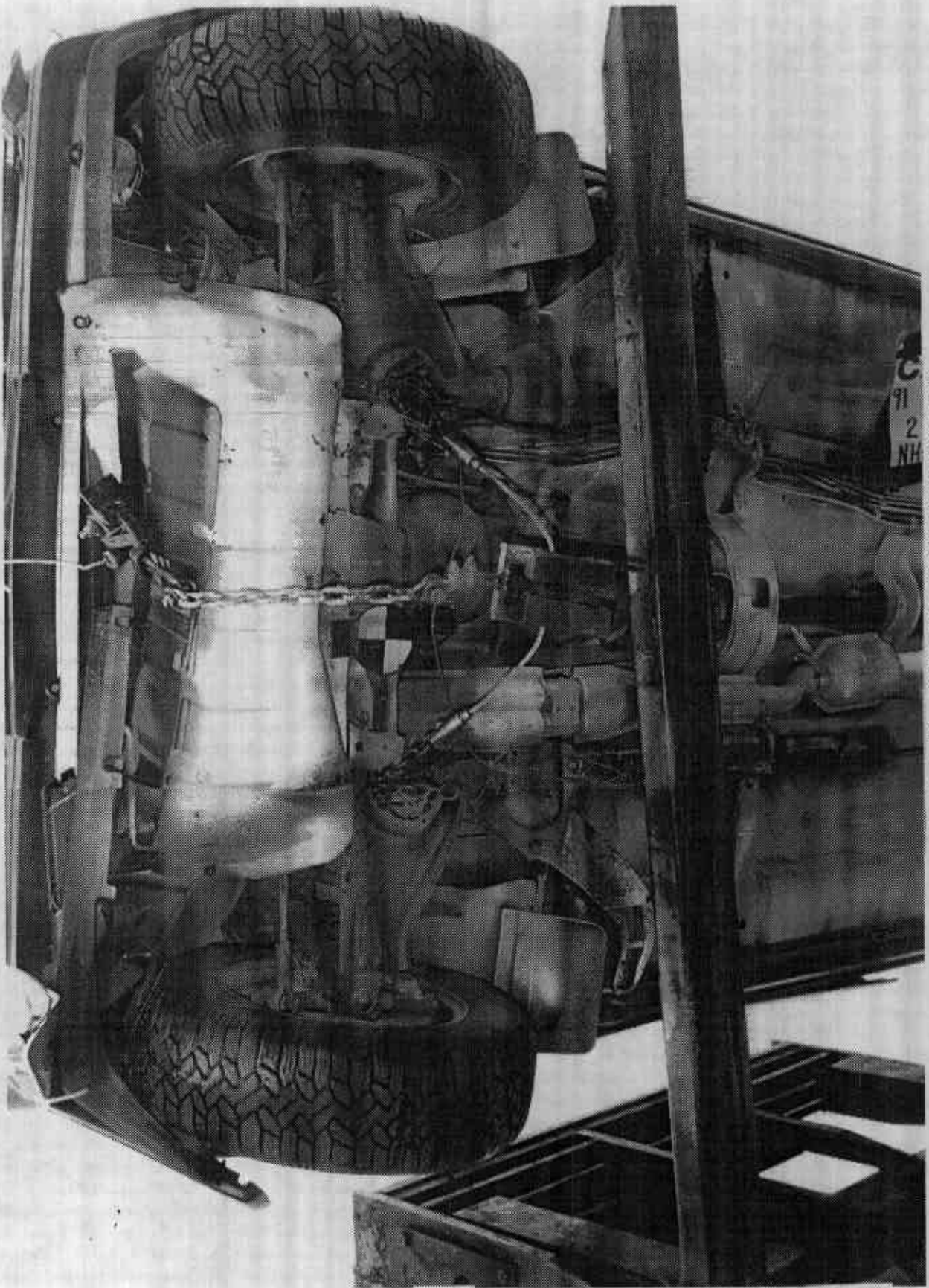


Figure A-19 POST-TEST FRONT UNDERBODY VIEW

A-21

7853-12

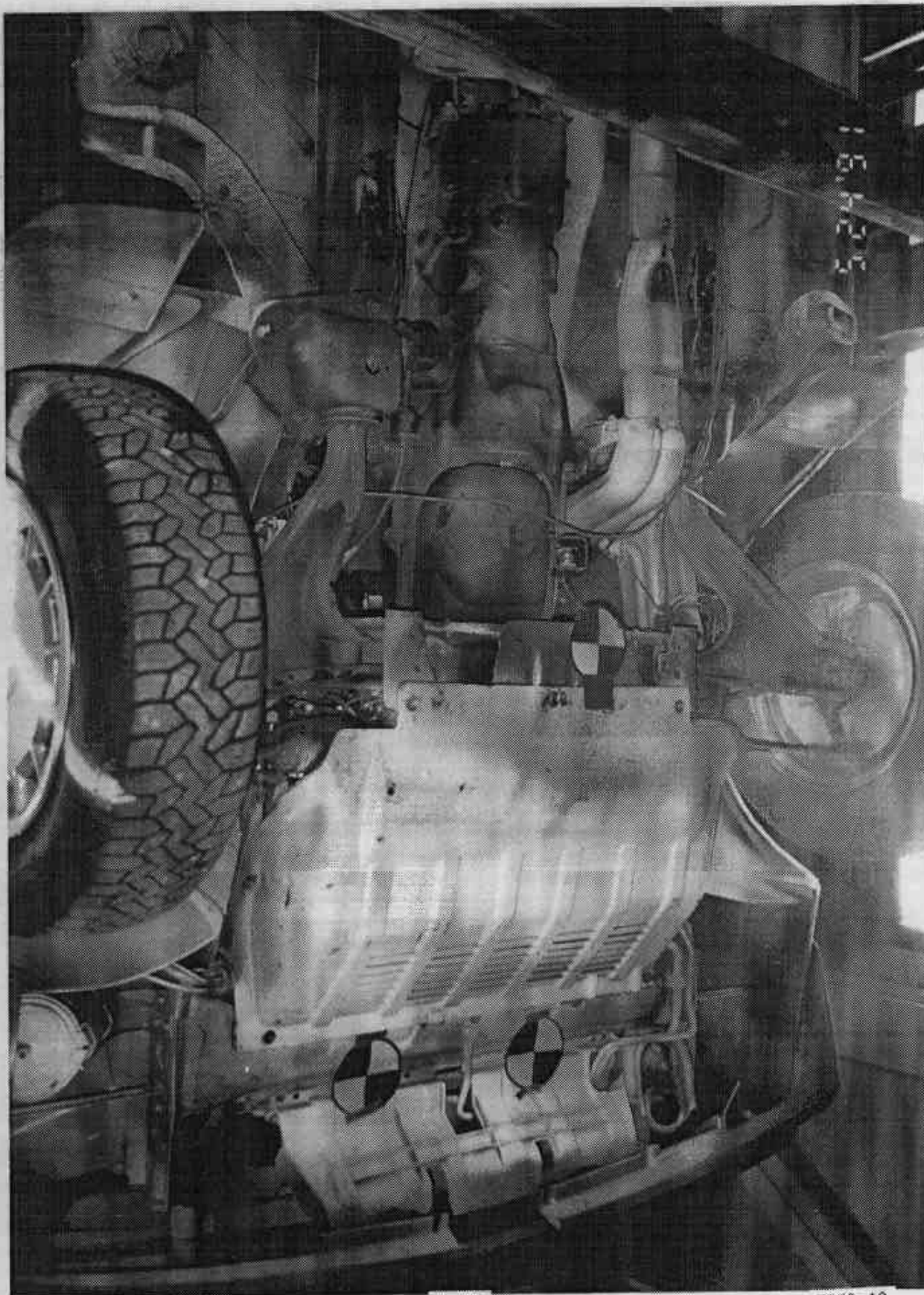


Figure A-20 PRE-TEST FRONT SIDE UNDERBODY VIEW

A-22

7853-12



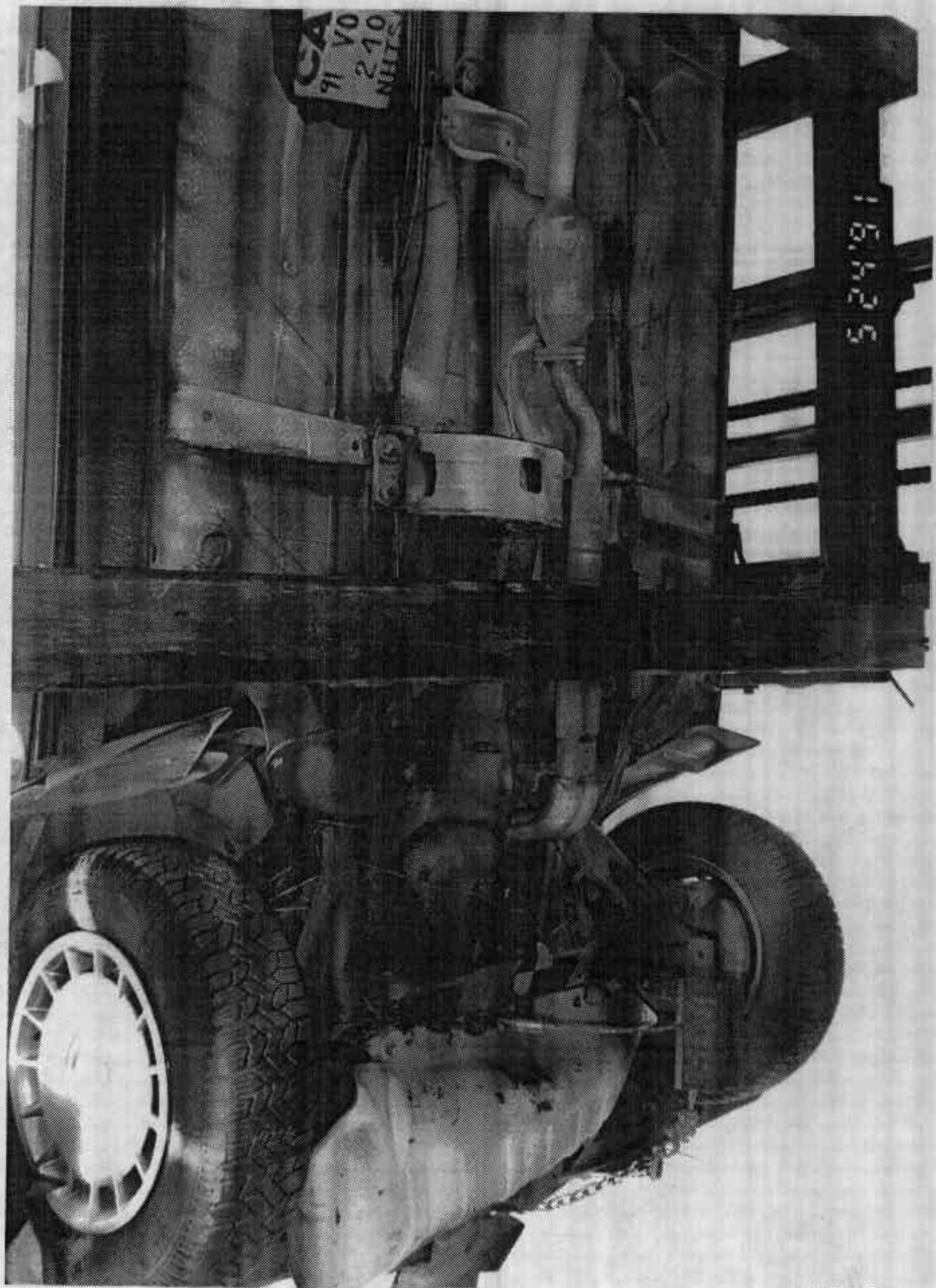


Figure A-21 POST-TEST FRONT SIDE UNDERBODY VIEW

A-23

7853-12

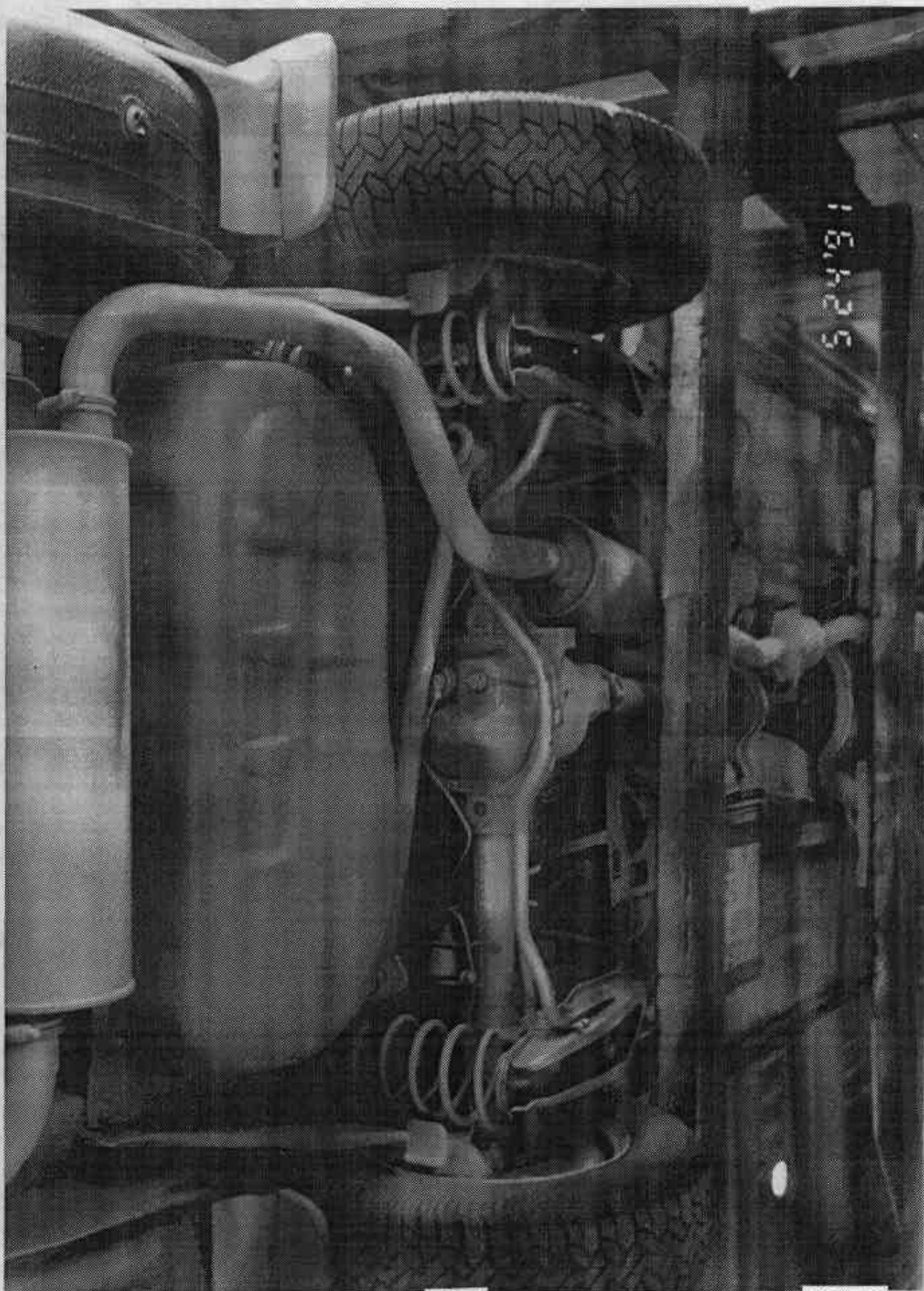


Figure A-22 PRE-TEST REAR UNDERBODY VIEW

A-24

7853-12



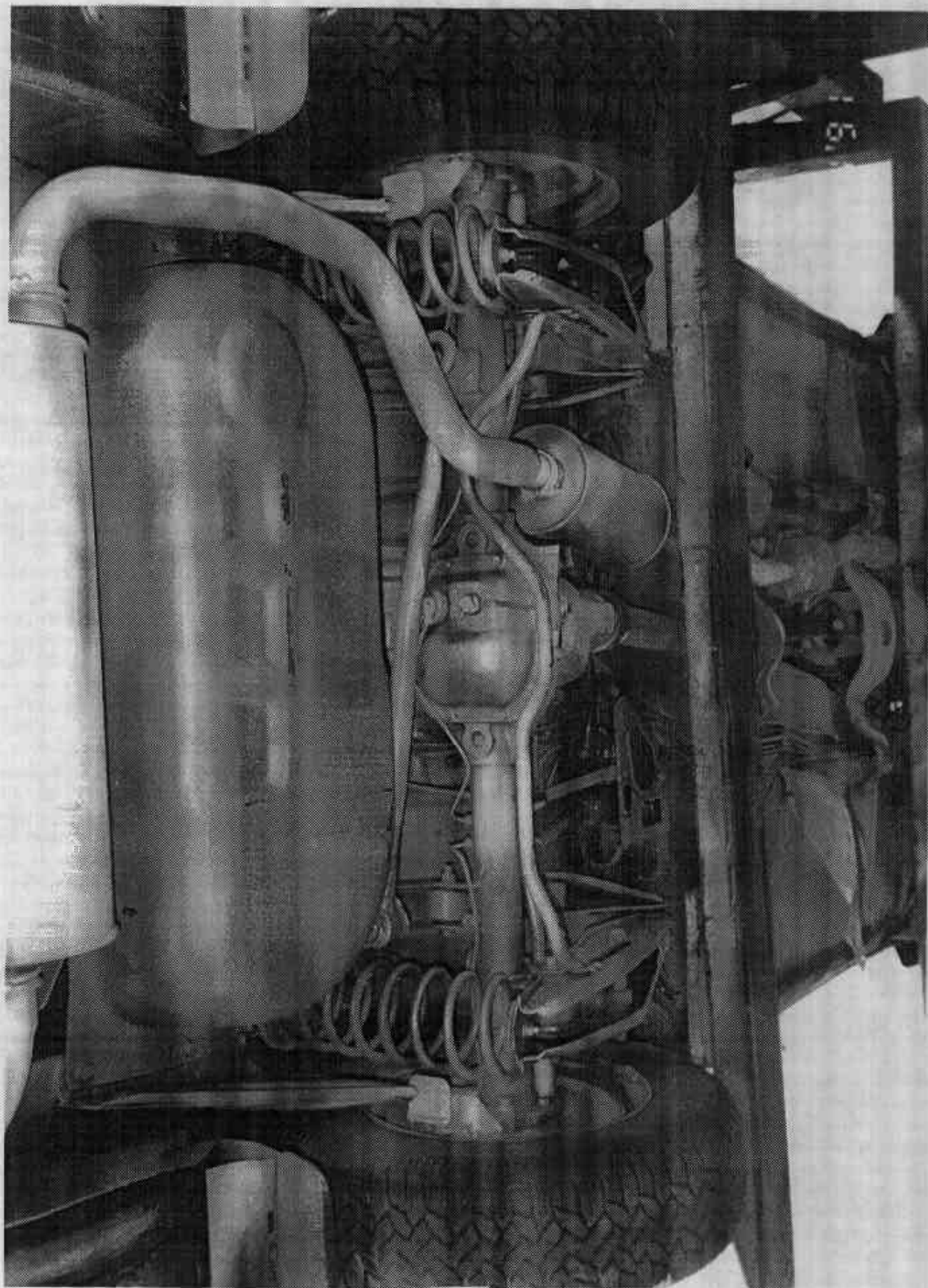


Figure A-23 POST-TEST REAR UNDERBODY VIEW

A-25

7853-12



Figure A-24 CERTIFICATION LABEL







Figure A-26 PRE-TEST DRIVER DUMMY POSITION

A-28

7853-12



Figure A-27 POST-TEST DRIVER DUMMY POSITION

A-29

7853-12



FIGURE A-28 PRE-TEST PASSENGER DUMMY POSITION

A-30

7853-12





Figure A-29 POST-TEST PASSENGER DUMMY POSITION

A-31

7853-12

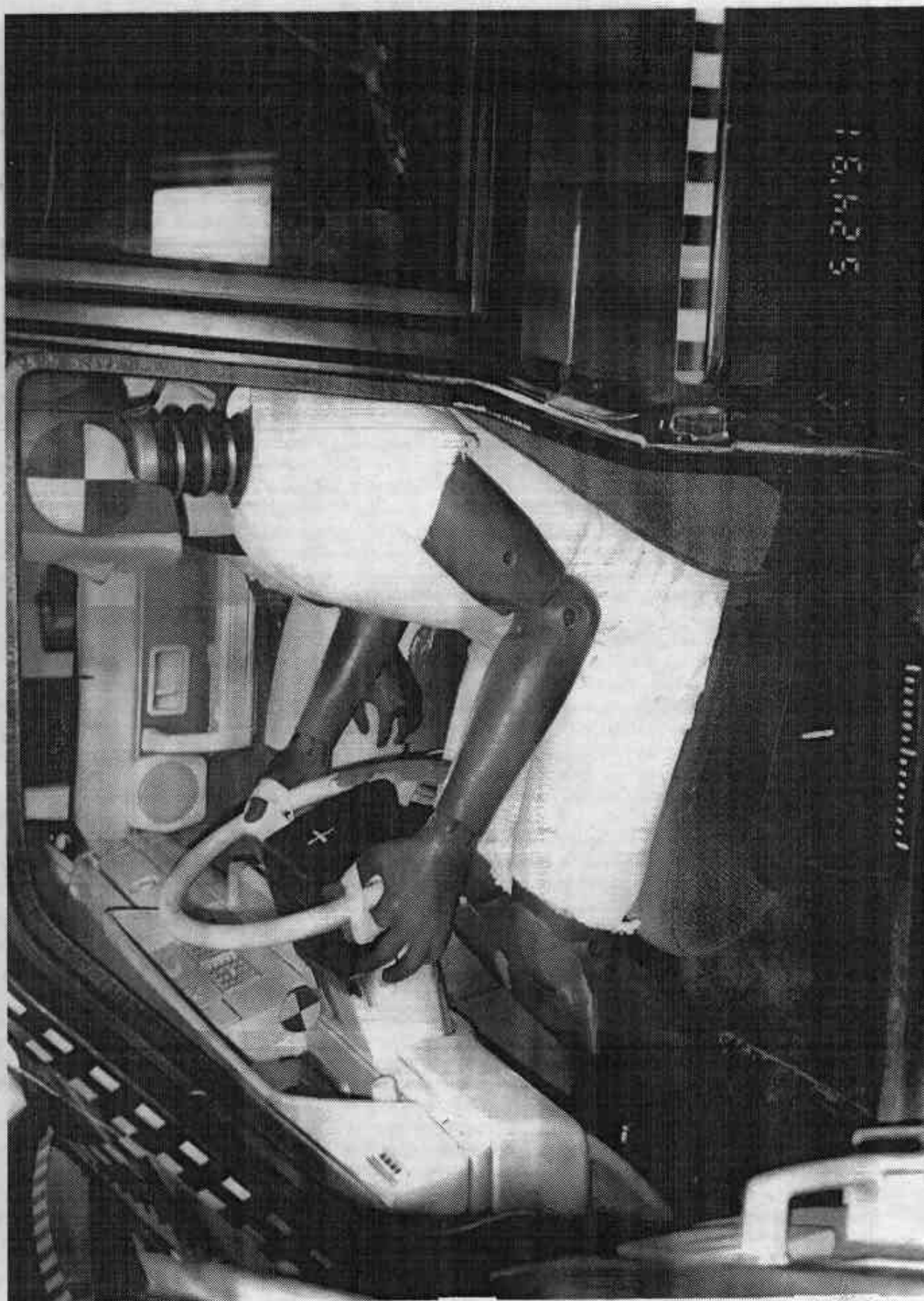


Figure A-30. PRE-TEST DRIVER DUMMY AND INTERIOR VIEW



FIGURE A-31 POST-TEST DRIVER DUMMY AND INTERIOR VIEW

A-33

7853-12





Figure A-32 PRE-TEST PASSENGER DUMMY AND INTERIOR VIEW



Figure A-33 POST-TEST PASSENGER DUMMY AND INTERIOR VIEW



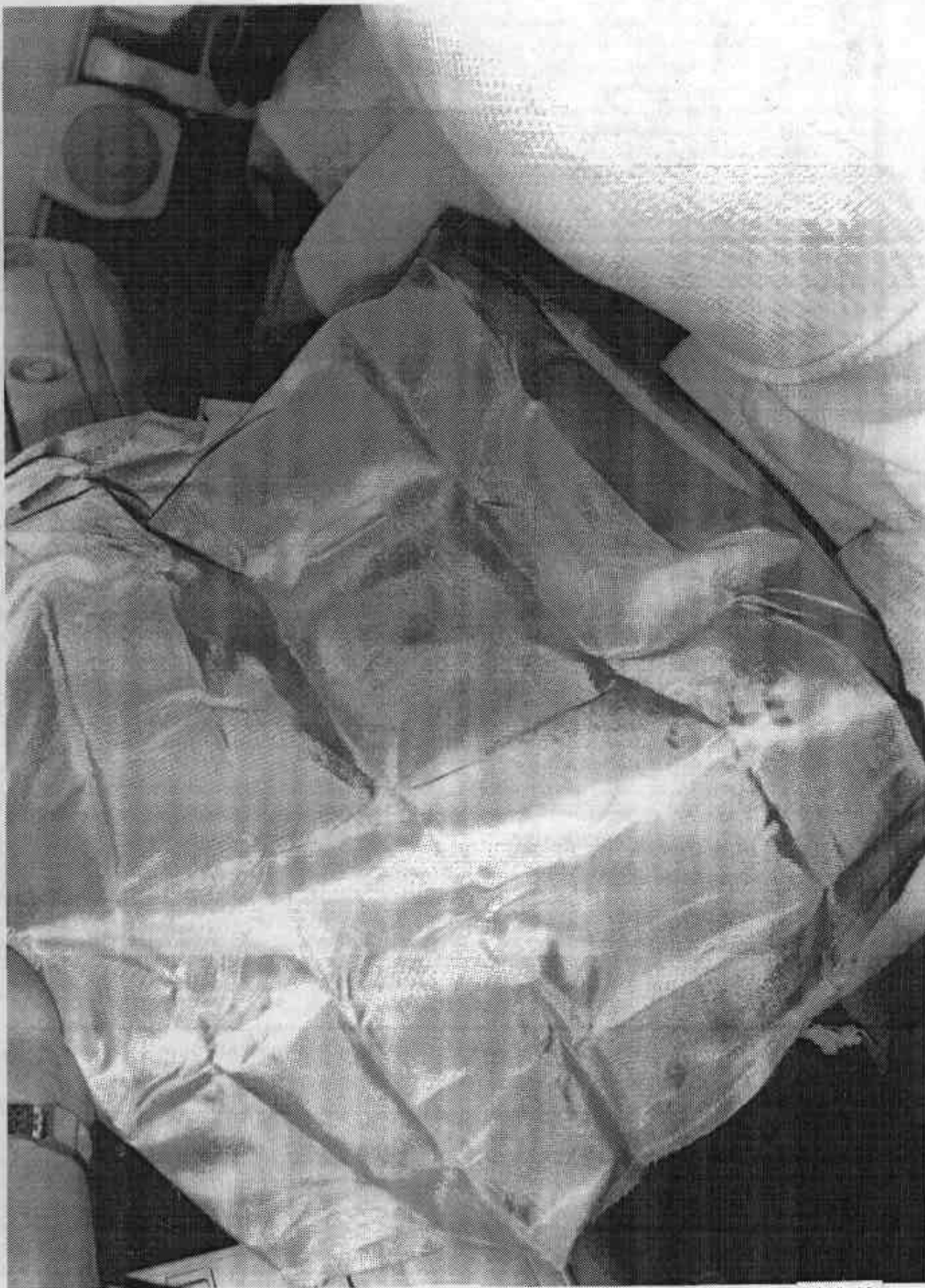


Figure A-34 POST-TEST DRIVER AIRBAG VIEW

A-36

7853-12

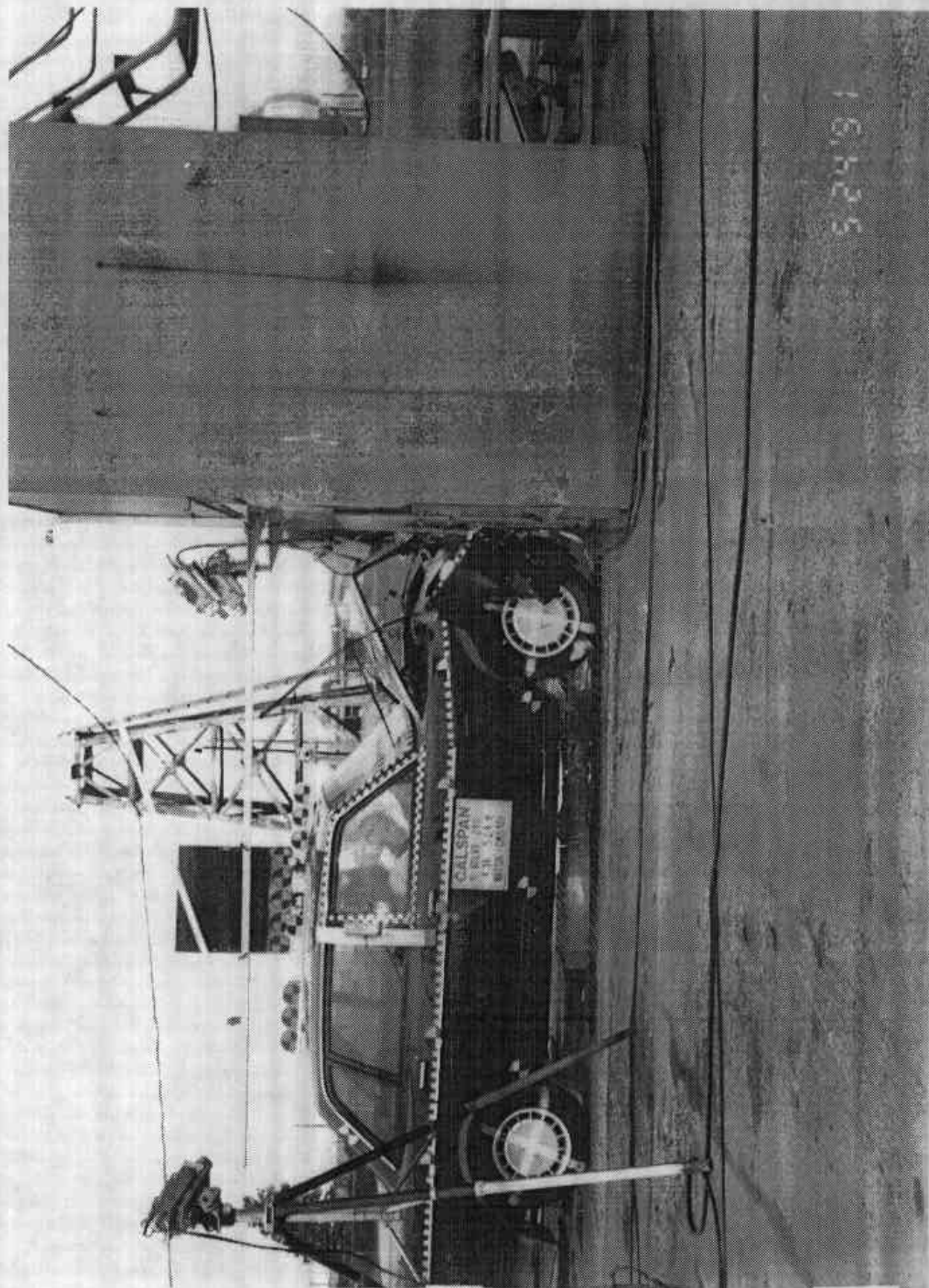


Figure A-35 VEHICLE IMPACT

A-37

7853-12

Appendix B

VEHICLE AND DUMMY RESPONSE DATA

TEST NO. CM5901

VEHICLE DATA

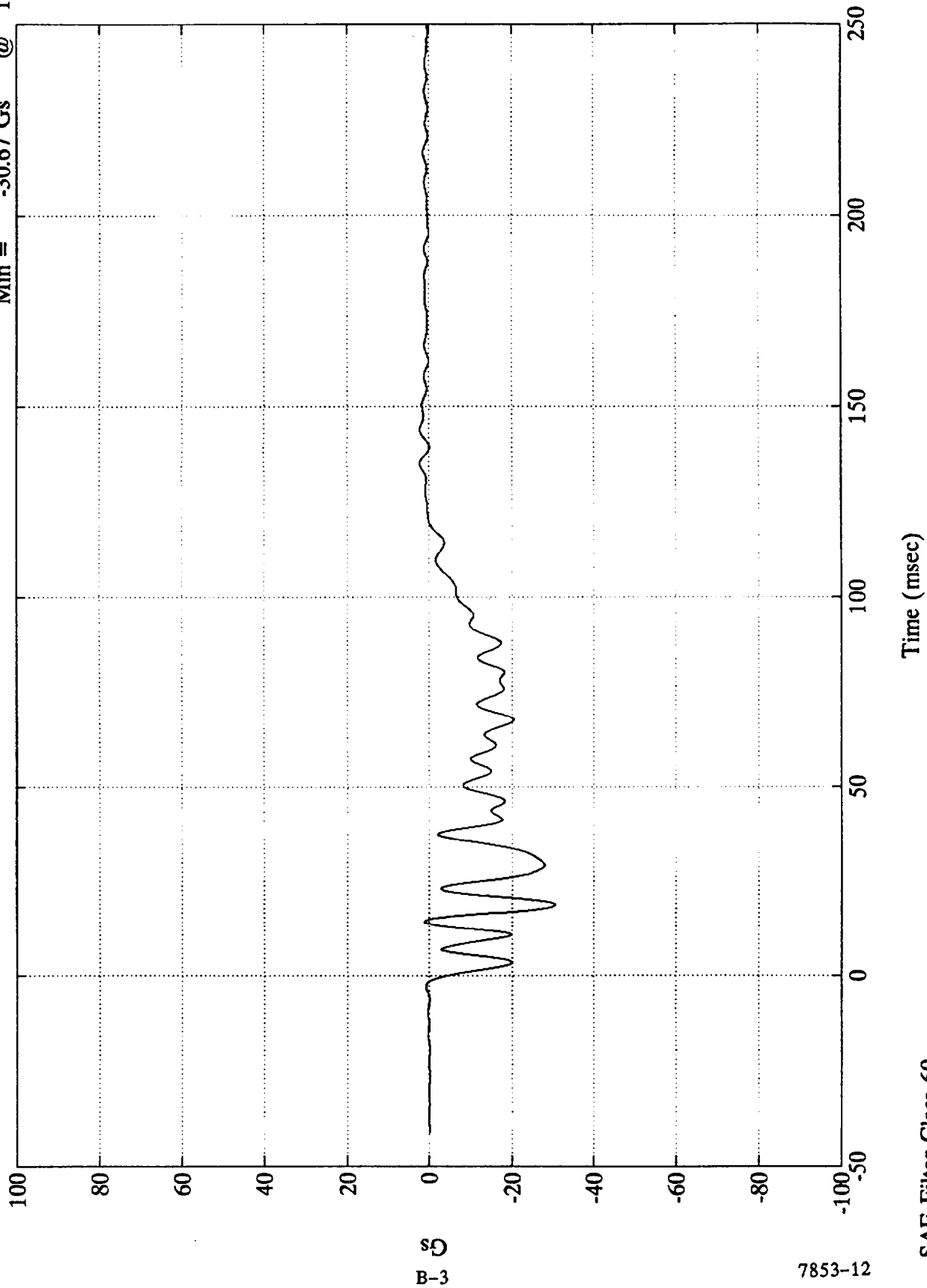
FILTER CHANNEL CLASS

60

Test 1077

L. Rear X-member X (#1)

Max = 2.24 Gs @ 135.24 msec  
Min = -30.67 Gs @ 18.96 msec



B-3

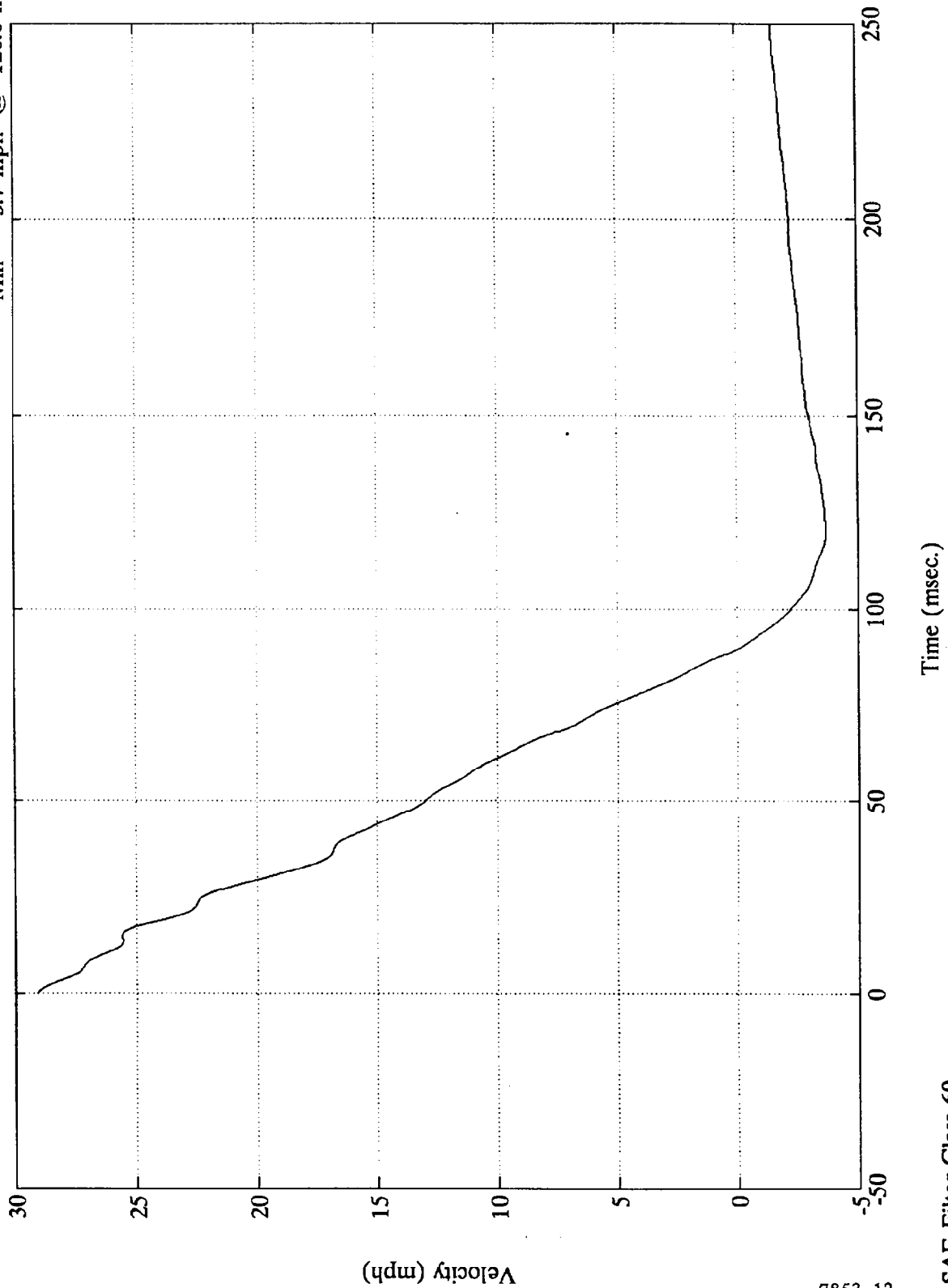
7853-12

SAE Filter Class 60

Test 1077

L. Rear X-Member X (#1)

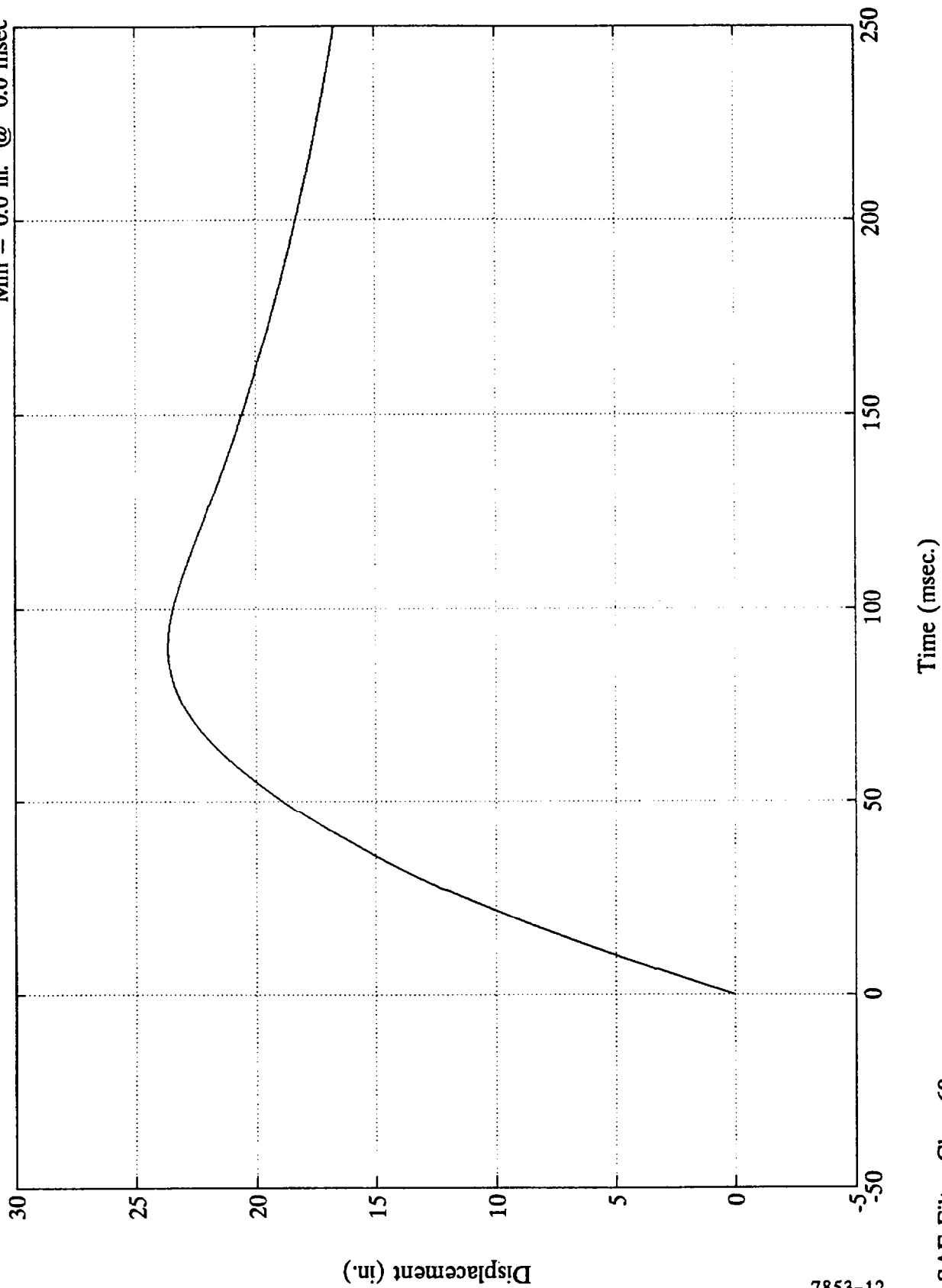
Max = 29.1 mph @ 0.0 msec  
Min = -3.7 mph @ 120.0 msec



Test 1077

L Rear X-Member X (#1)

Max = 23.7 in. @ 91.4 msec  
Min = 0.0 in. @ 0.0 msec



B-5

7853-12

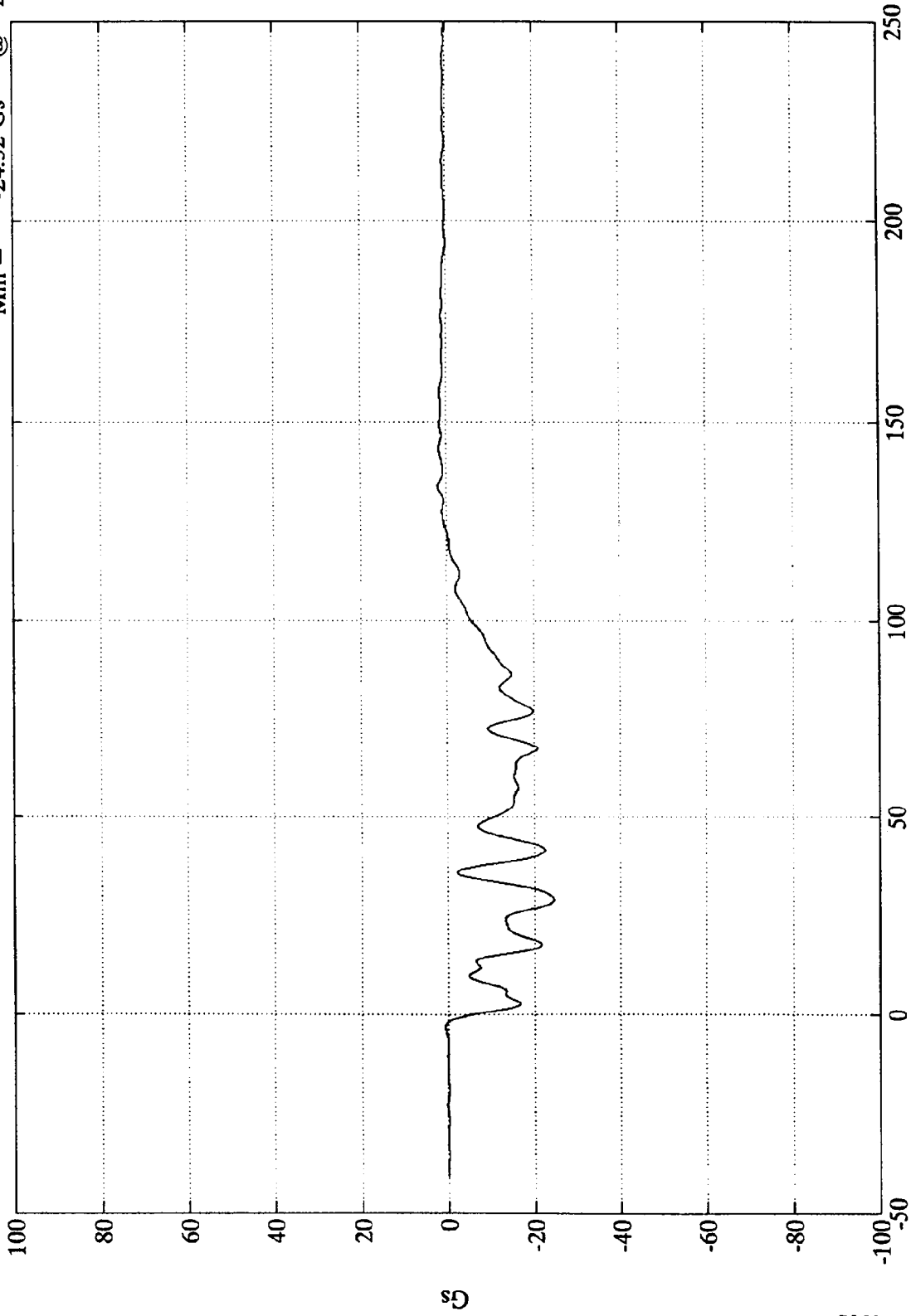
SAE Filter Class 60



Test 1077

R. Rear X-member X (#2)

Max = 2.03 Gs @ 133.68 msec  
Min = -24.52 Gs @ 29.28 msec



Time (msec)

SAE Filter Class 60

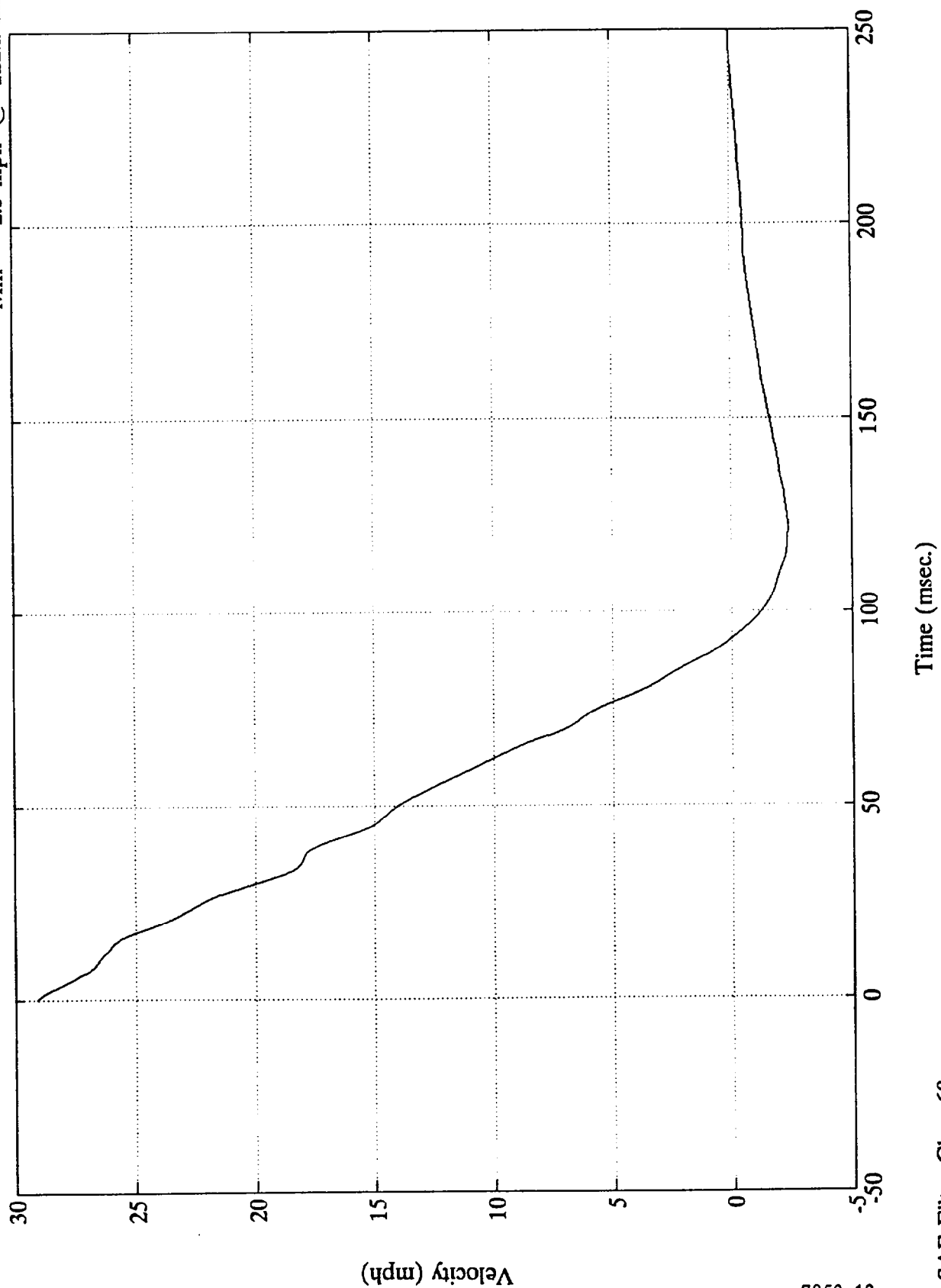
B-6

7853-12

Test 1077

R. Rear X-Member X (#2)

Max = 29.1 mph @ 0.0 msec  
Min = -2.3 mph @ 122.2 msec



B-7

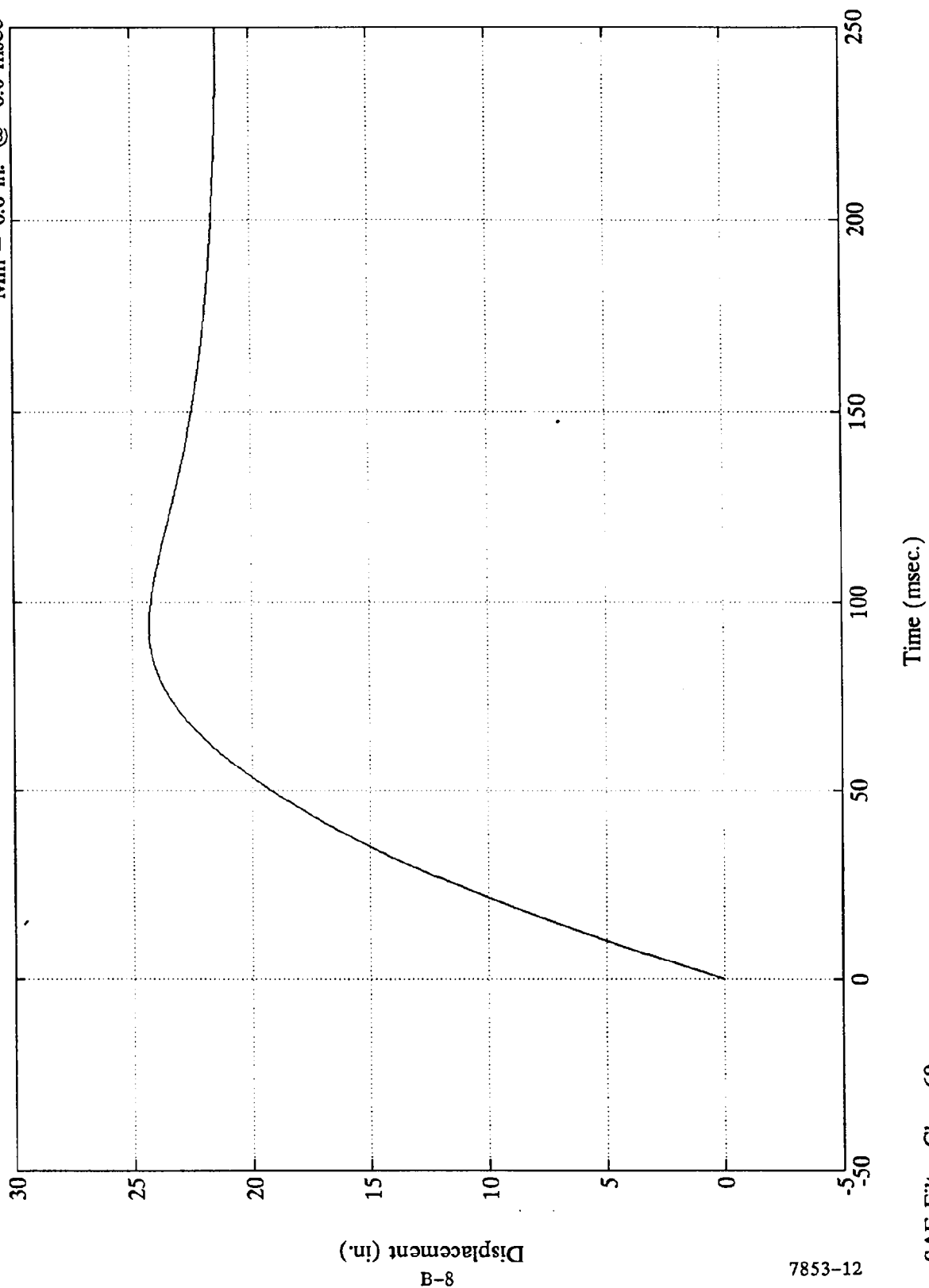
7853-12

SAE Filter Class 60

Test 1077

R. Rear X-Member X (#2)

Max = 24.3 in. @ 94.8 msec  
Min = 0.0 in. @ 0.0 msec



7853-12

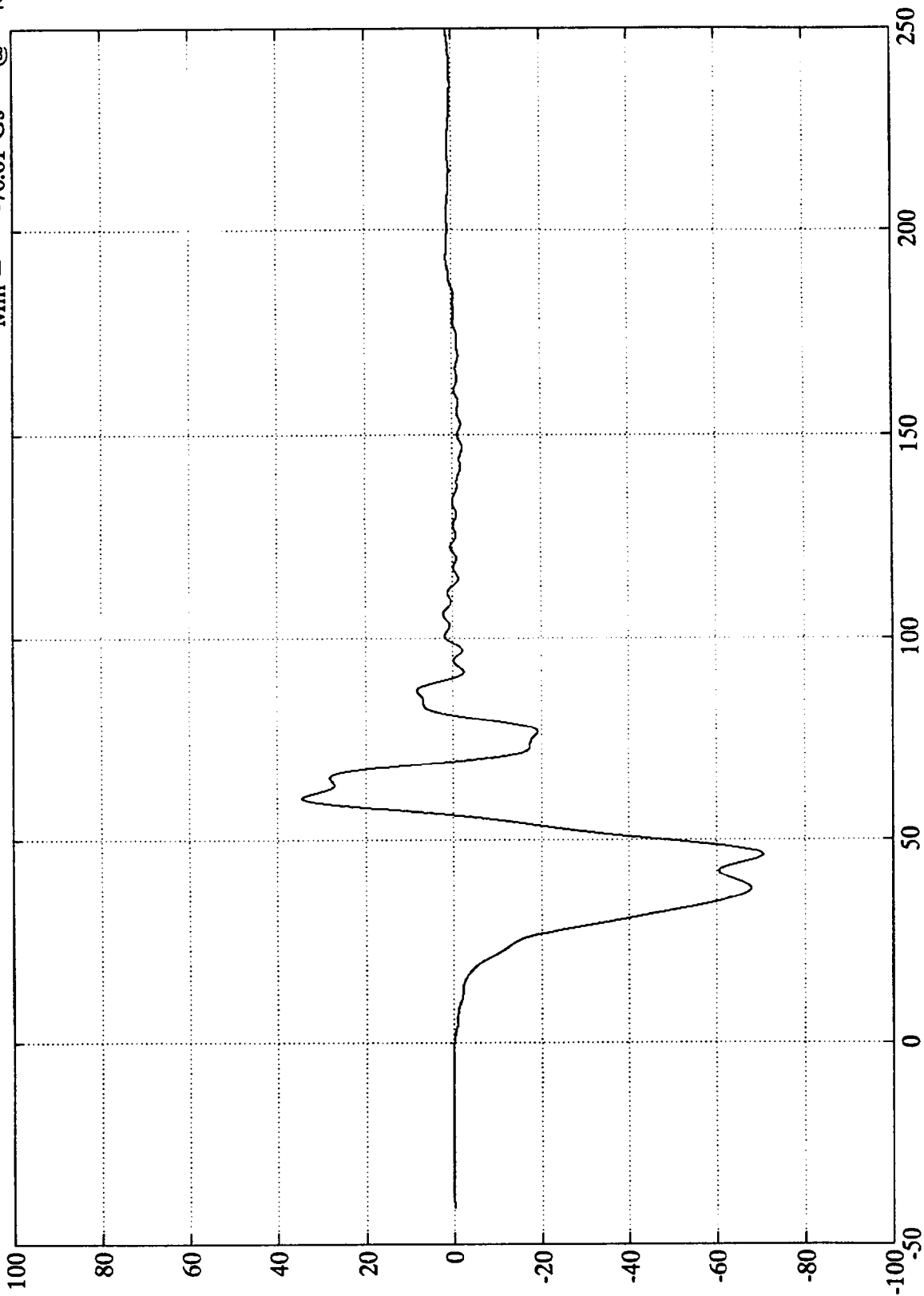
8-B

SAE Filter Class 60

Test 1077

Engine Top X (#3)

Max = 34.40 Gs @ 60.48 msec  
Min = -70.61 Gs @ 46.32 msec



Time (msec)

SAE Filter Class 60

B-9

7853-12

Test 1077

Engine Top X (#3)

Max = 29.1 mph @ 1.2 msec  
Min = -5.5 mph @ 56.2 msec



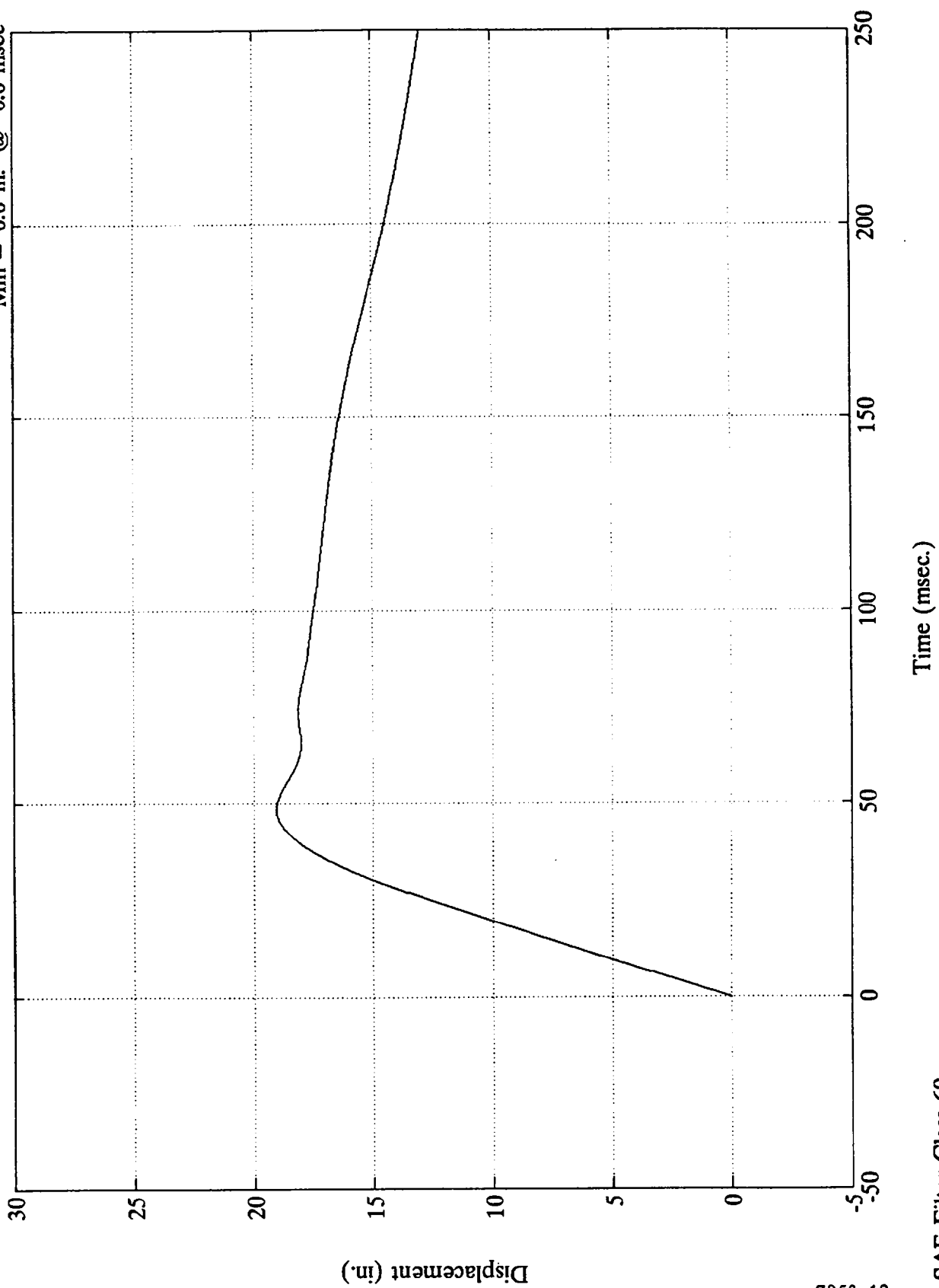
Time (msec.)

SAE Filter Class 60

Test 1077

Engine Top X (#3)

Max = 19.1 in. @ 48.5 msec  
Min = 0.0 in. @ 0.0 msec



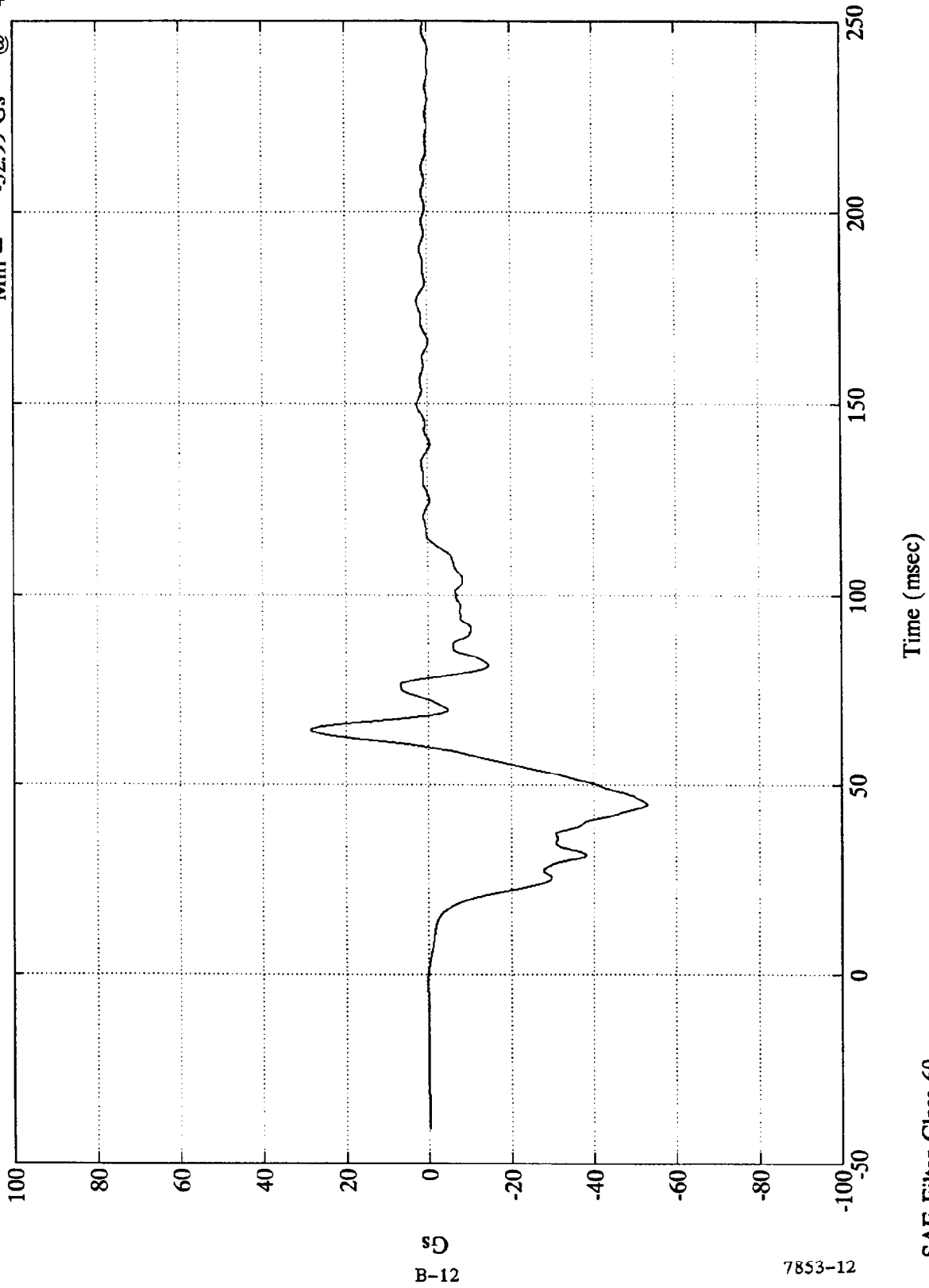
B-11

7853-12

SAE Filter Class 60

Test 1077

Engine Bottom X (#4)      Max = 28.48 Gs @ 64.32 msec  
Min = -52.99 Gs @ 45.00 msec



B-12

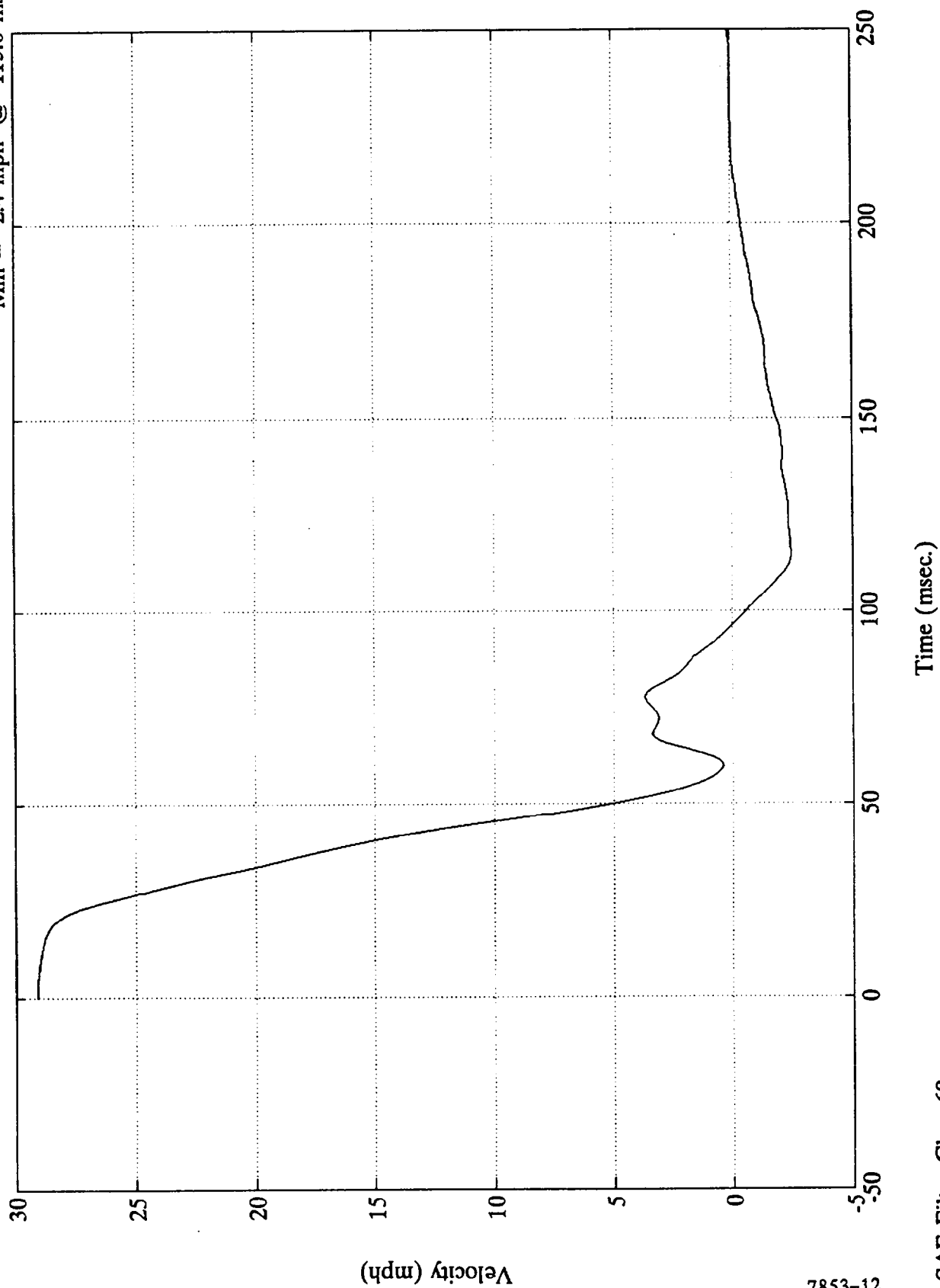
7853-12

SAE Filter Class 60



Test 1077

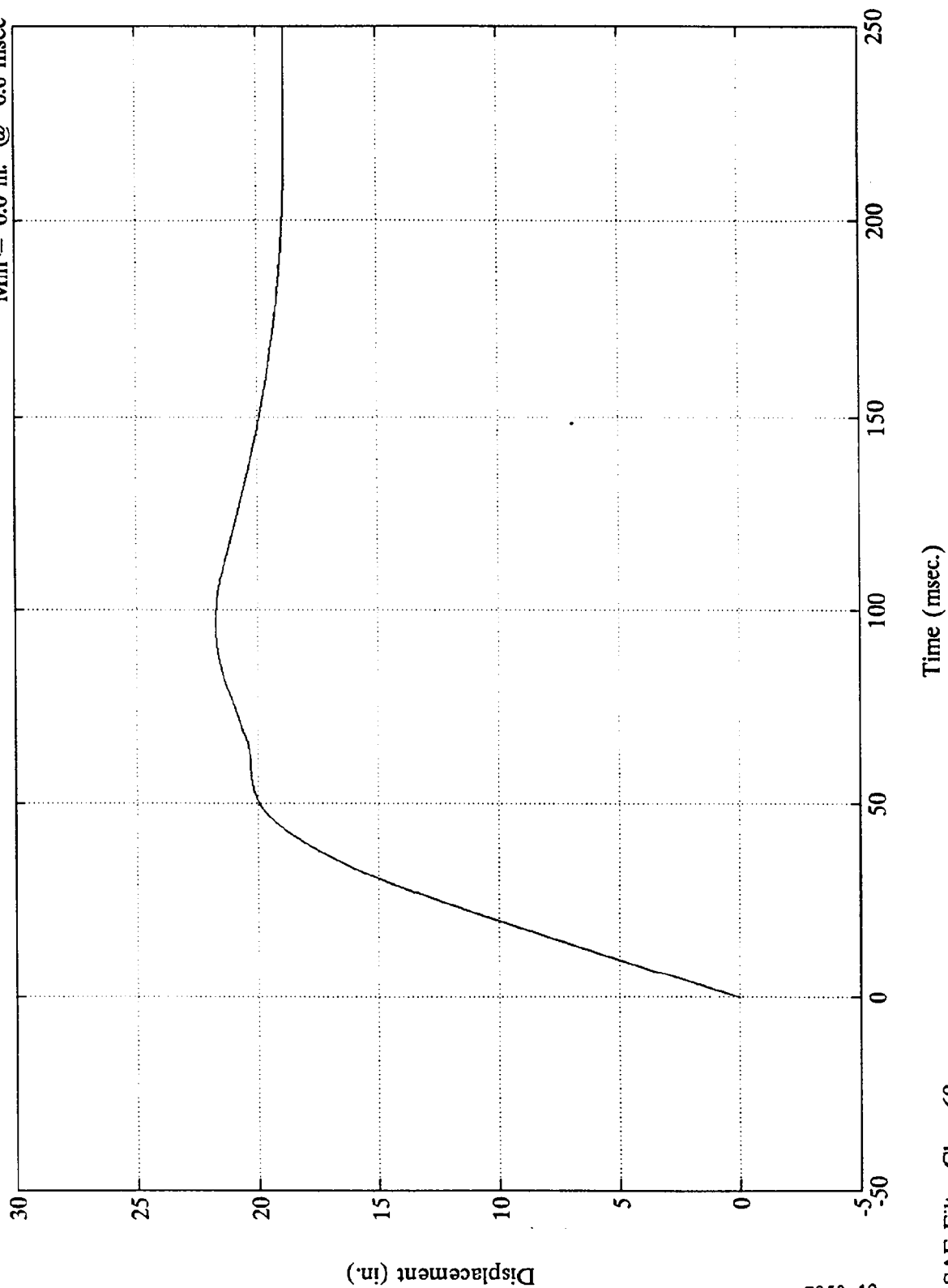
Engine Bottom X (#4)  
Max = 29.1 mph @ 3.4 msec  
Min = -2.4 mph @ 115.0 msec



Test 1077

Engine Bottom X (#4)

Max = 21.7 in. @ 98.9 msec  
Min = 0.0 in. @ 0.0 msec



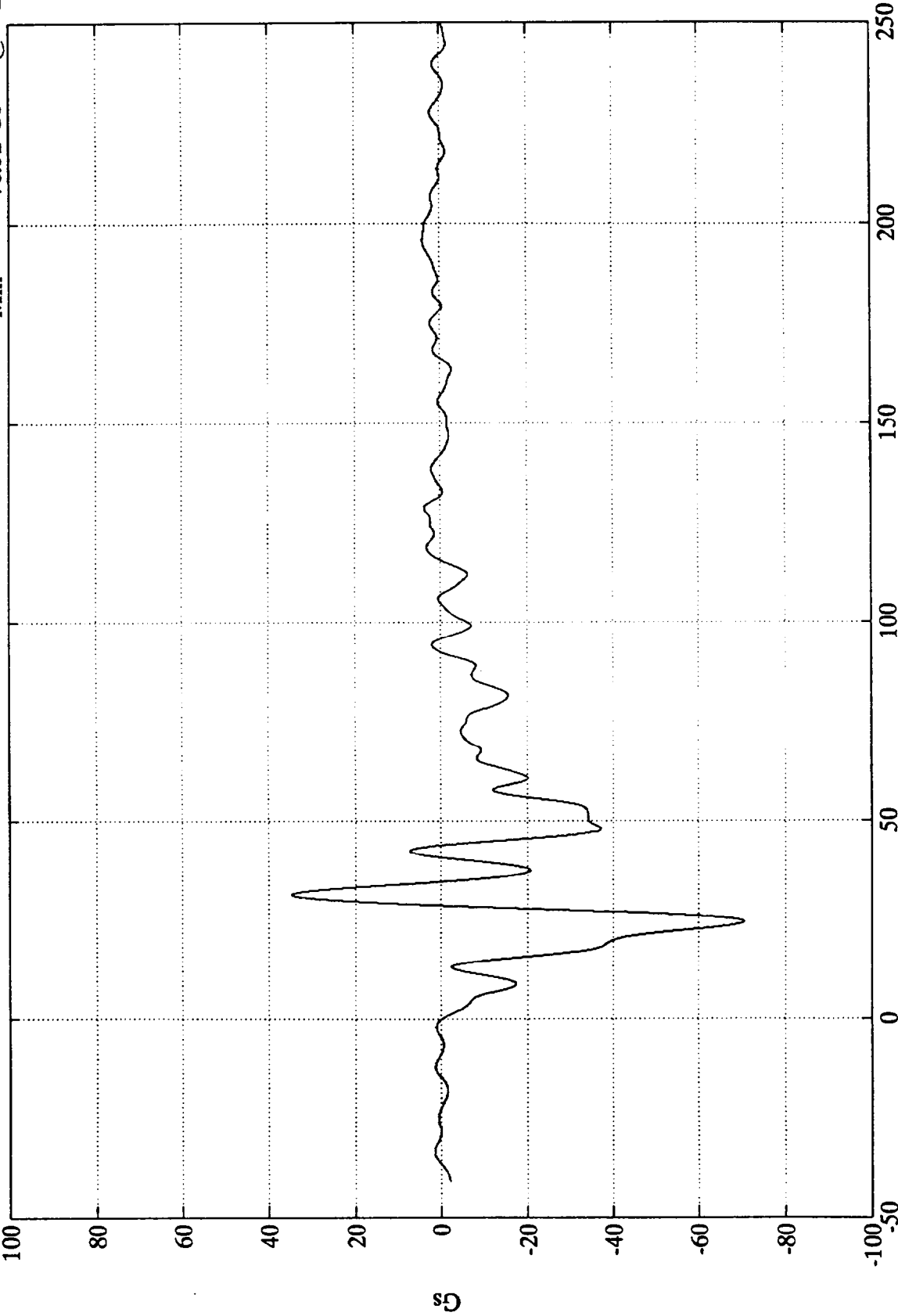
B-14

7853-12

SAE Filter Class 60

R. Brake Caliper X (#5)

Max = 34.68 Gs @ 31.32 msec  
Min = -70.52 Gs @ 24.36 msec

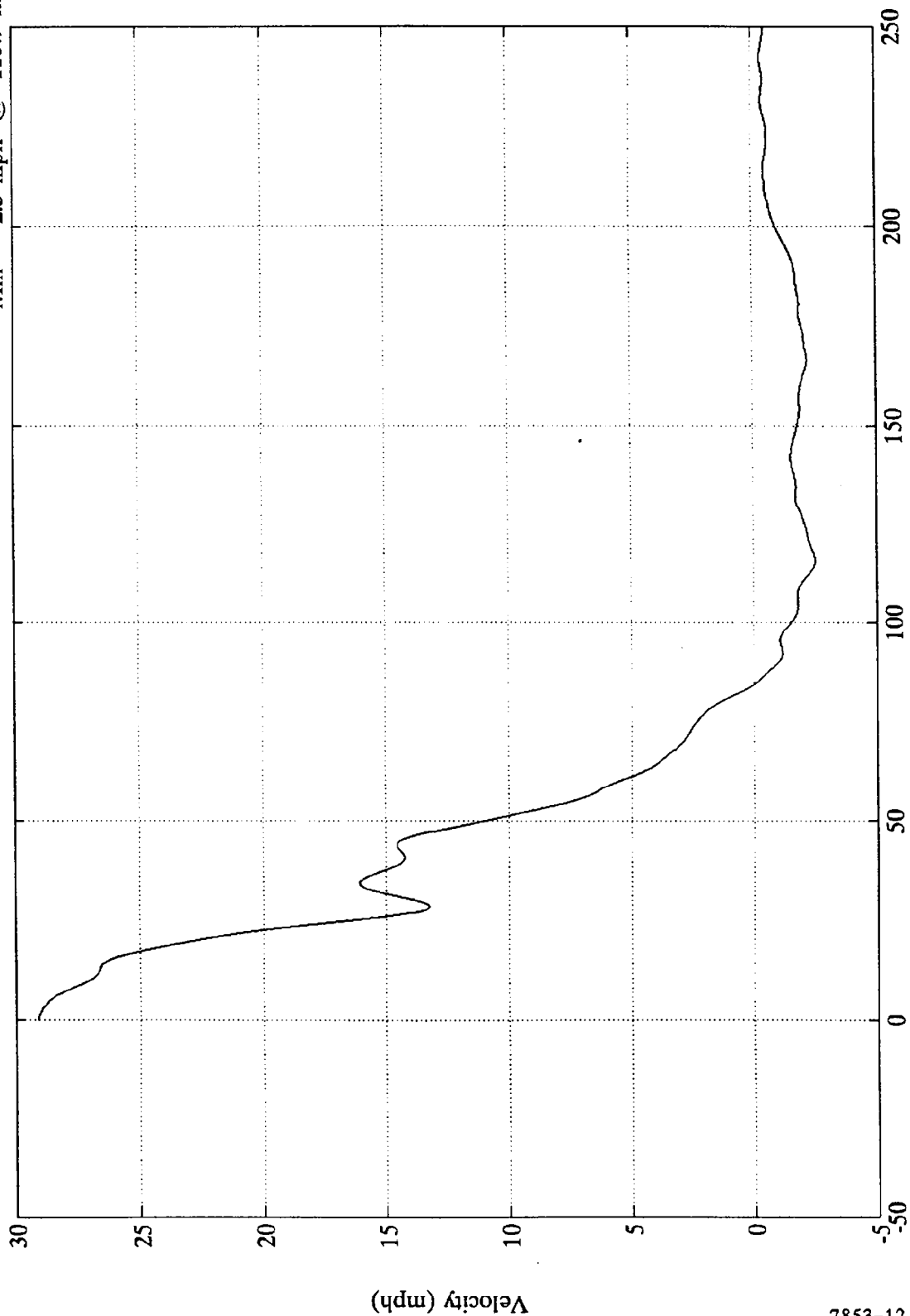


Time (msec)

SAE Filter Class 60

Test 1077

R. Brake Caliper X (#5)  
Max = 29.1 mph @ 0.2 msec  
Min = -2.5 mph @ 115.9 msec



B-16

7853-12

SAE Filter Class 60

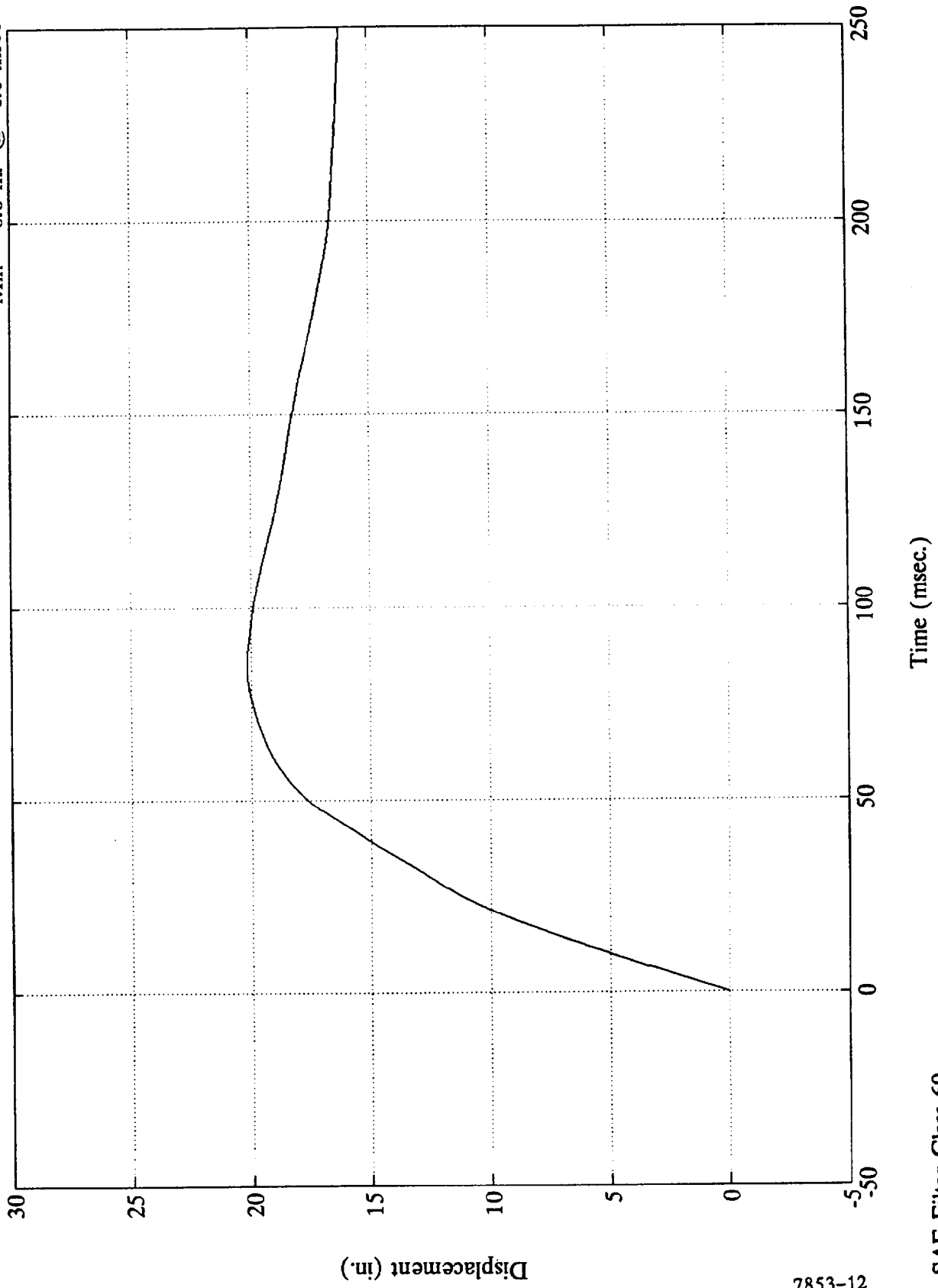
Time (msec.)

Velocity (mph)

Test 1077

R. Brake Caliper X (#5)

Max = 20.2 in. @ 85.7 msec  
Min = 0.0 in. @ 0.0 msec



B-17

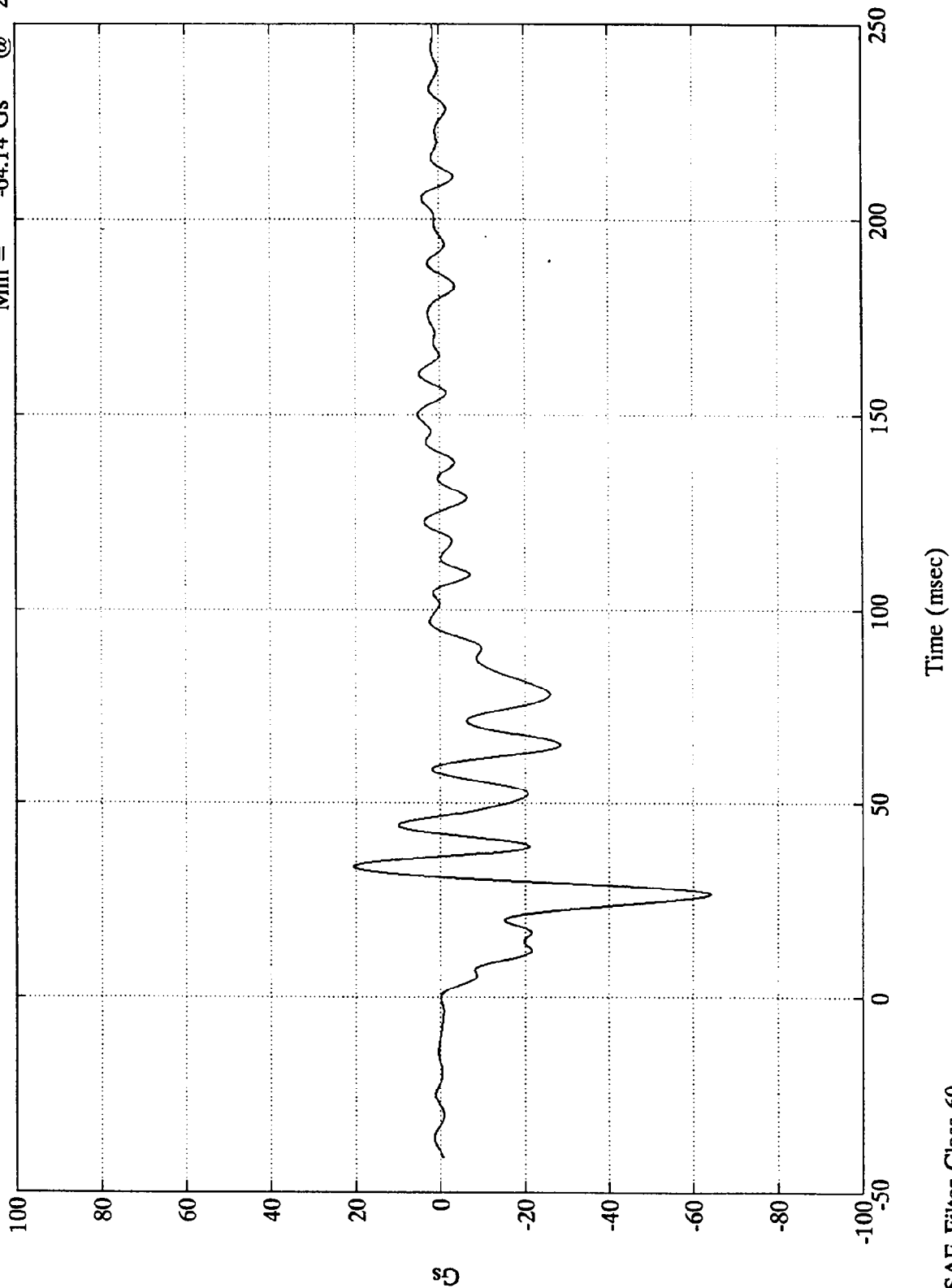
7853-12

SAE Filter Class 60

Test 1077

L. Brake Caliper X (#6)

Max = 20.68 Gs @ 33.72 msec  
Min = -64.14 Gs @ 26.76 msec



B-18

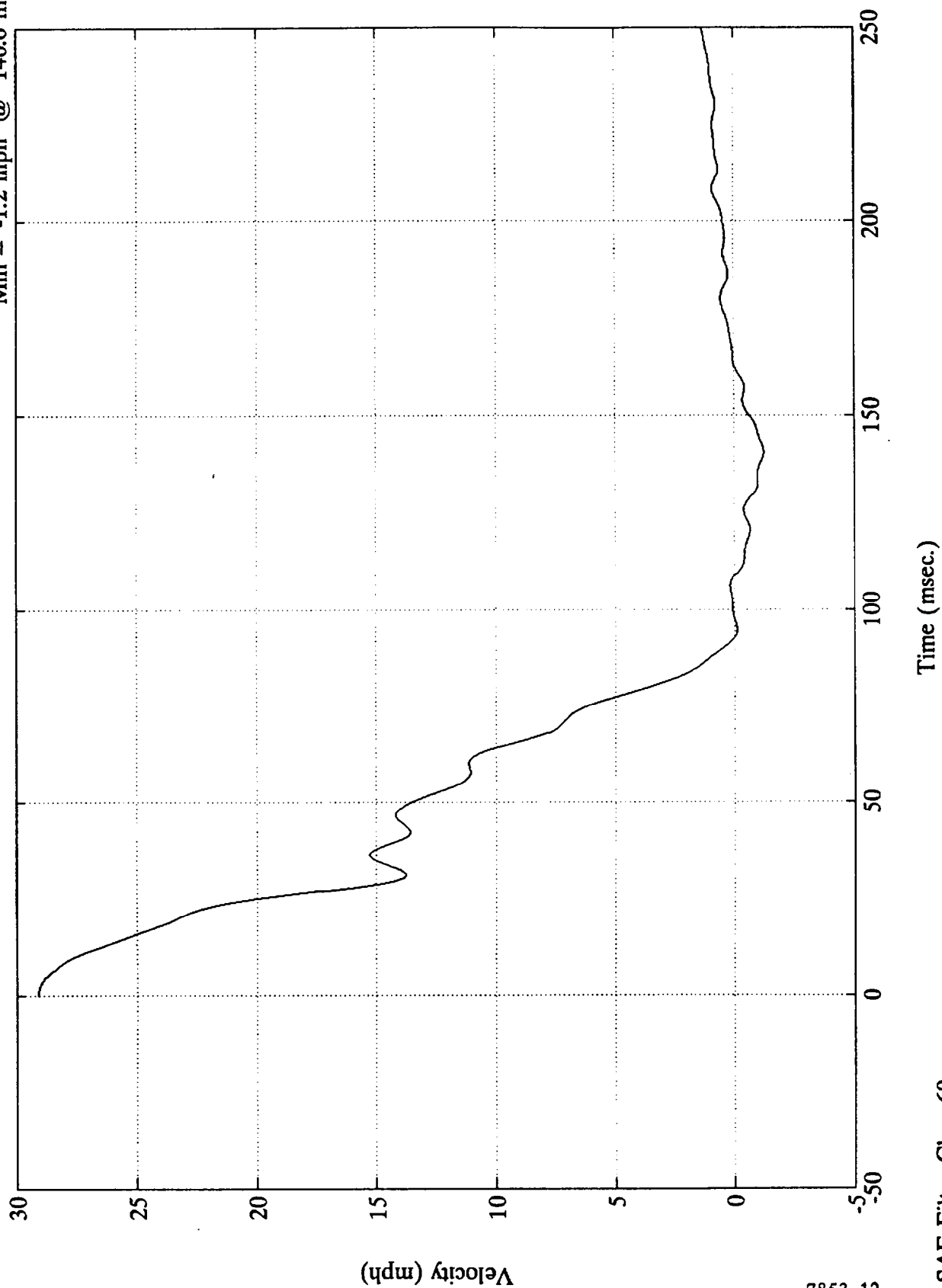
7853-12

SAE Filter Class 60

Test 1077

L. Brake Caliper X (#6)

Max = 29.1 mph @ 0.7 msec  
Min = -1.2 mph @ 140.6 msec



B-19

7853-12

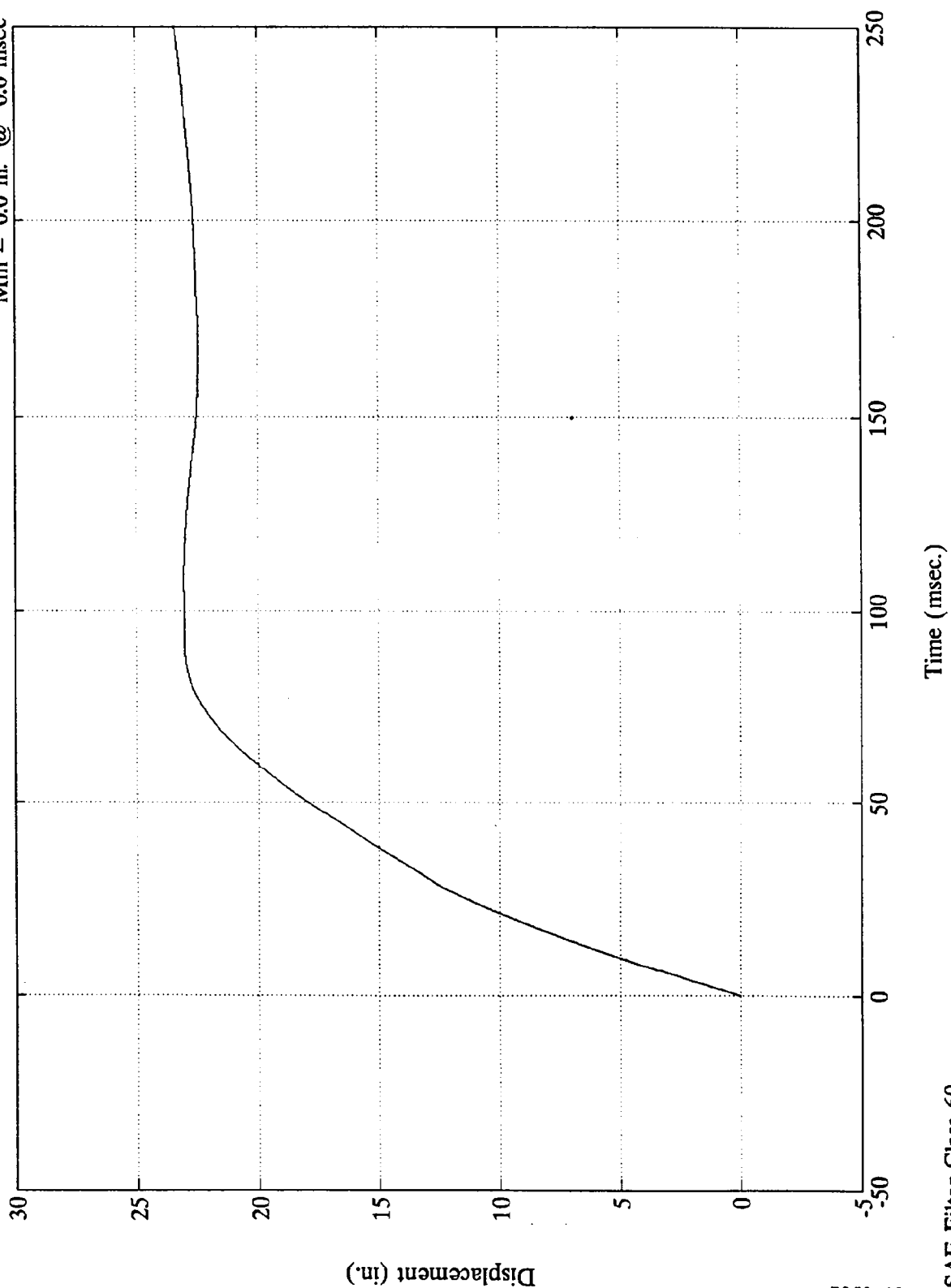
SAE Filter Class 60



Test 1077

L. Brake Caliper X (#6)

Max = 23.6 in. @ 258.7 msec  
Min = 0.0 in. @ 0.0 msec



B-20

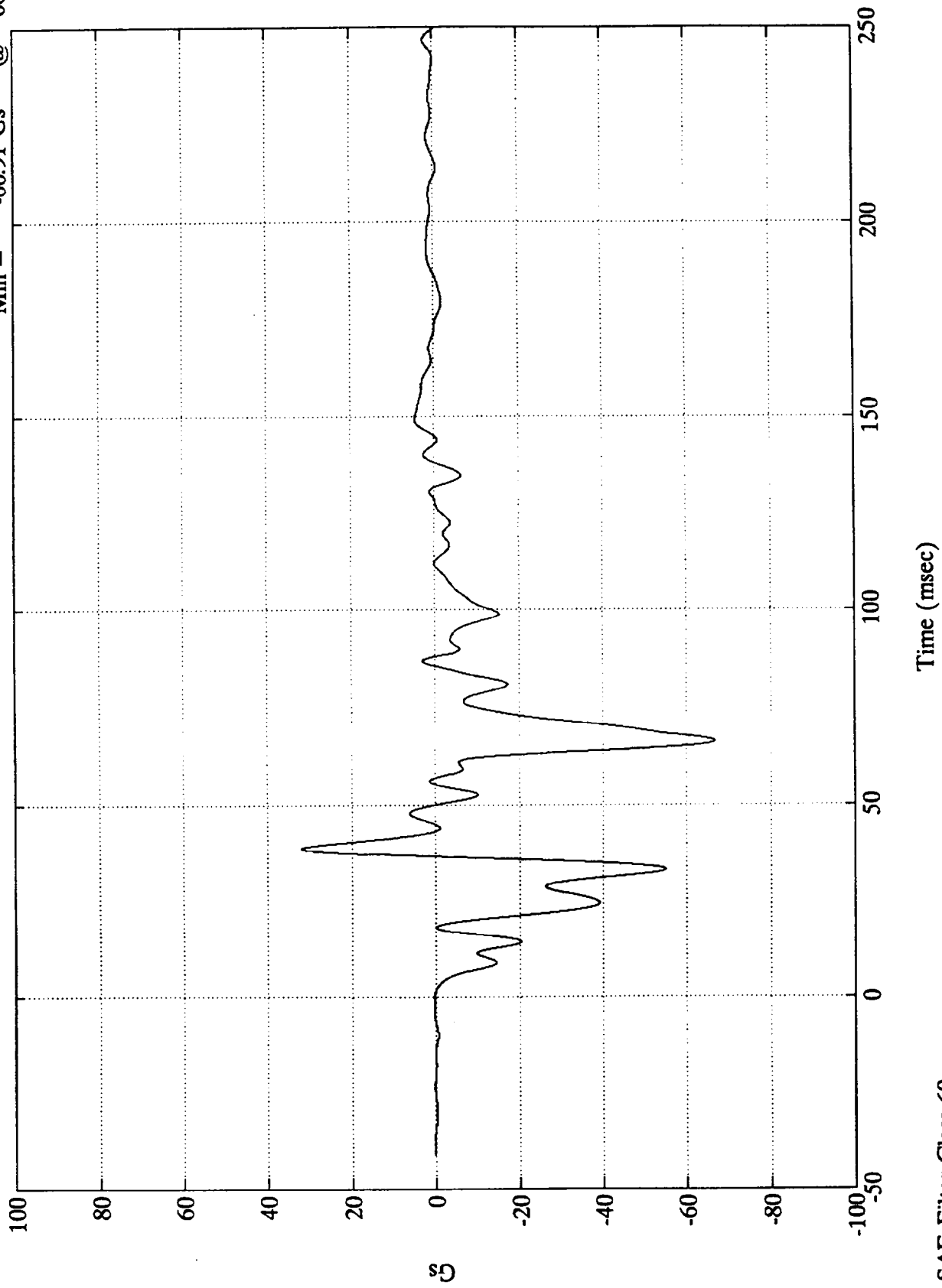
7853-12

SAE Filter Class 60

Test 1077

Instrument Panel X (#7)

Max =	31.96 Gs	@	38.76 msec
Min =	-66.91 Gs	@	66.24 msec



B-21

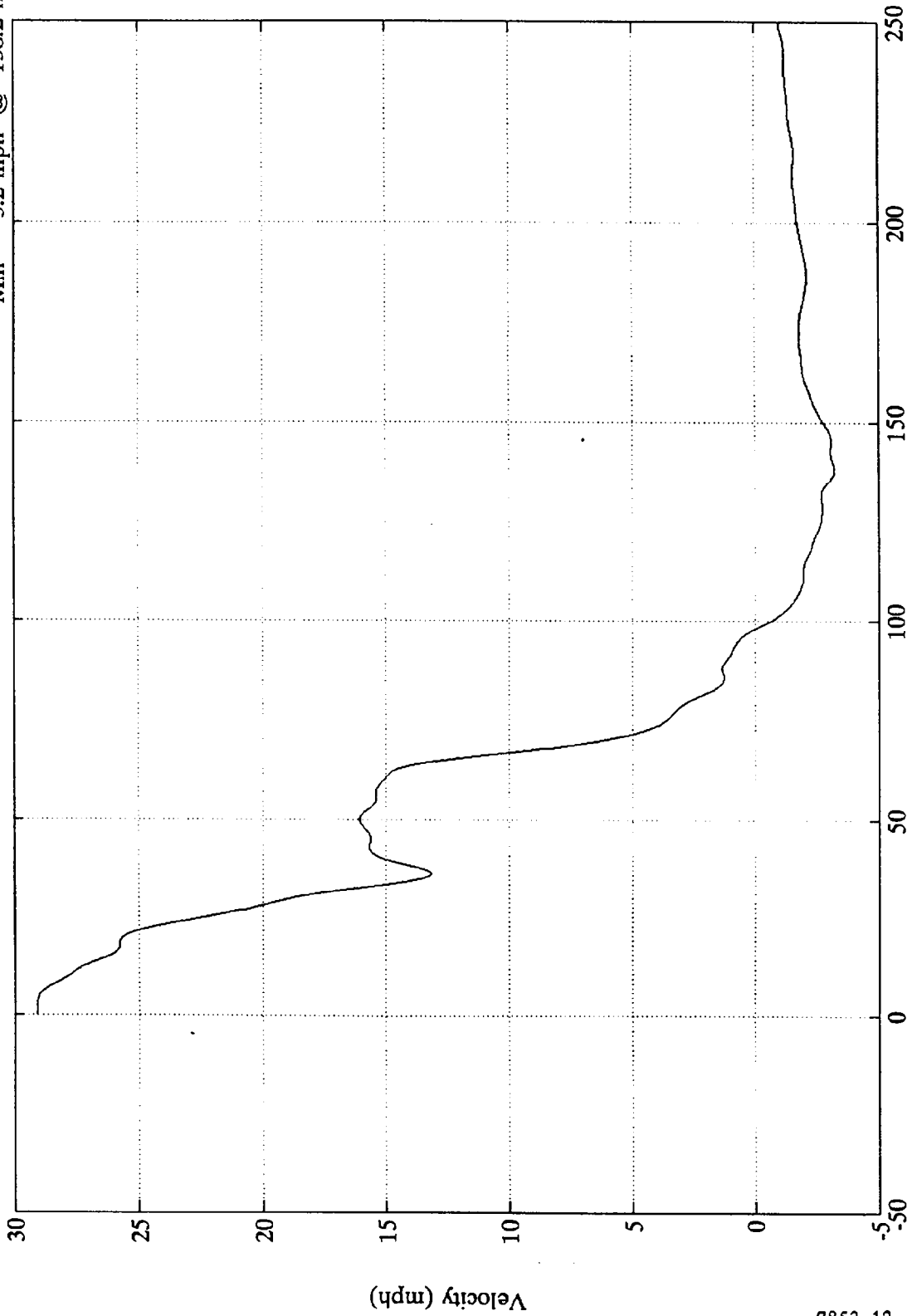
7853-12

SAE Filter Class 60

Test 1077

Instrument Panel X (#7)

Max = 29.1 mph @ 2.4 msec  
Min = -3.2 mph @ 138.2 msec



B-22

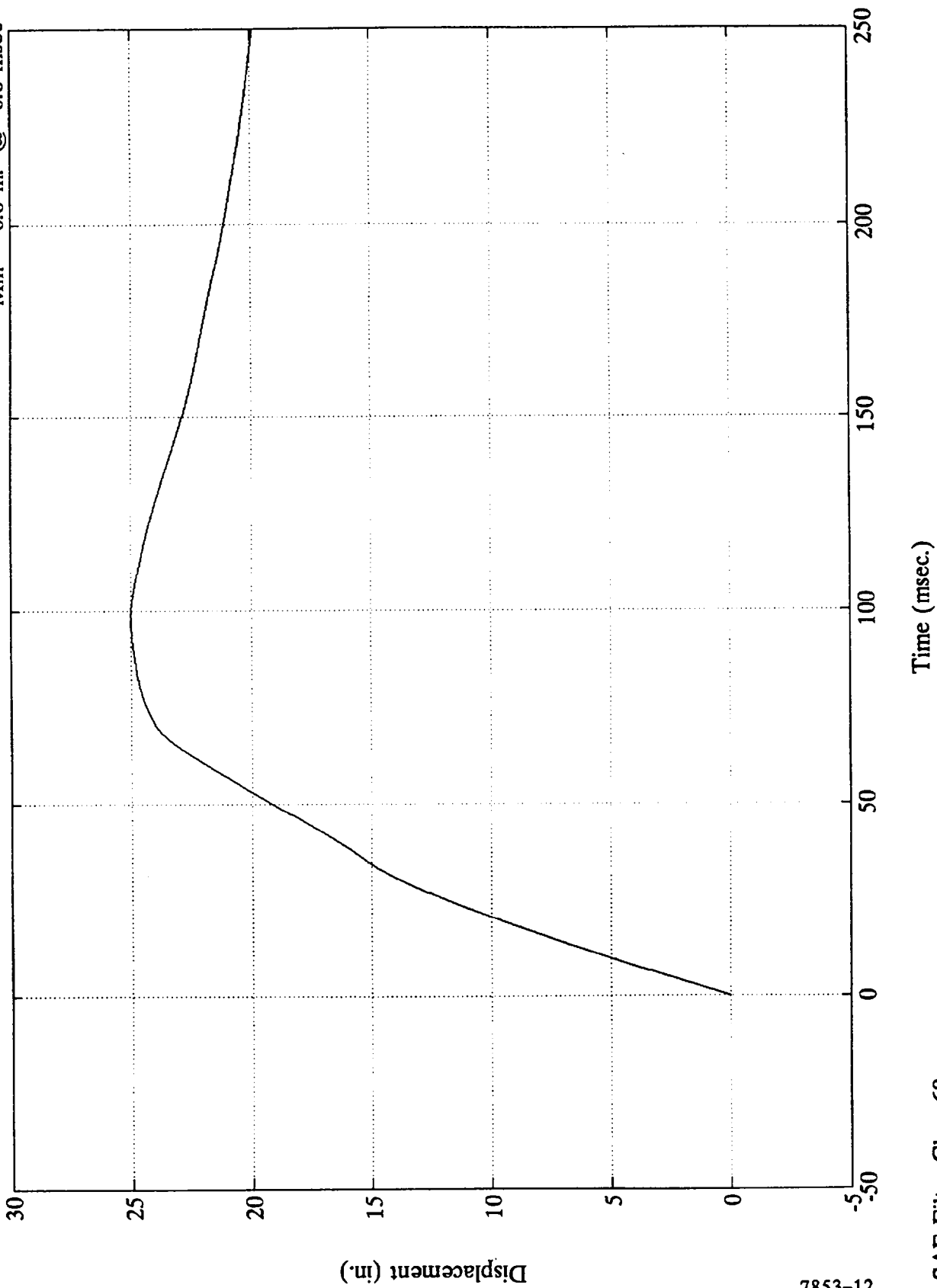
7853-12

Time (msec.)

SAE Filter Class 60

Test 1077

Instrument Panel X (#7)  
Max = 25.0 in. @ 99.4 msec  
Min = 0.0 in. @ 0.0 msec



B-23

7853-12

SAE Filter Class 60

TEST NO. CM5901

DUMMY DATA	FILTER CHANNEL CLASS
Head Accelerations	1000
Chest Accelerations	180
Chest Displacement	180
Femur Forces	600

HIC SUMMARY: Pos. 1 Head Resultant

hic: 180.53  
t1 = 72.960 msec  
t2 = 108.840 msec  
Average G's Over Hic Duration = 30.25

HIC SUMMARY: Pos. 2 Head Resultant

hic: 198.79  
t1 = 85.080 msec  
t2 = 120.960 msec  
Average G's Over Hic Duration = 31.44

CLIP SUMMARY: Pos. 1 Chest Resultant

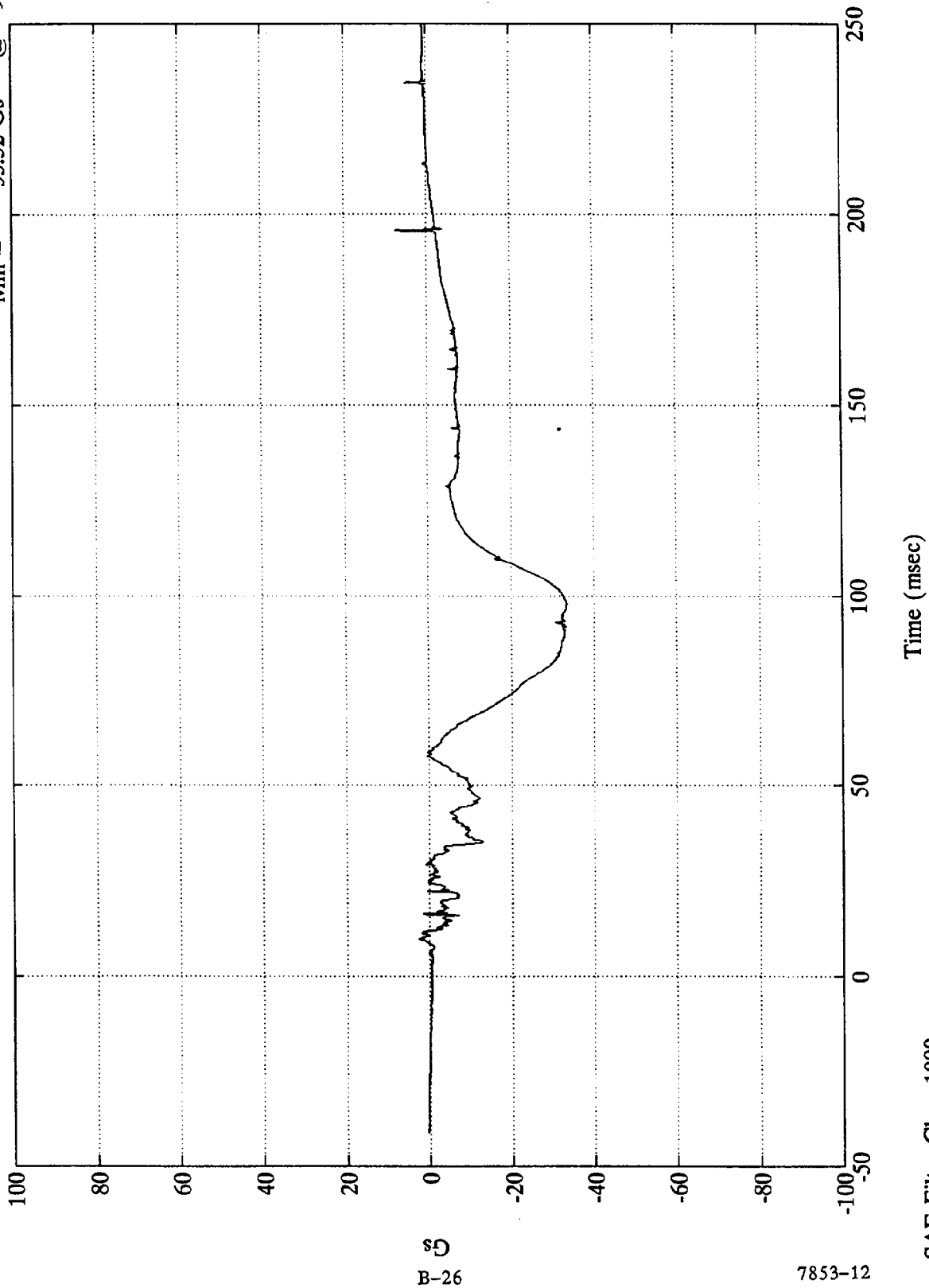
Peak Resultant (3 ms CLIPPED DURATION) = 37.597 G's  
Tstart = 84.7200 ms  
Tend = 87.7200 ms  
CSI = 242.210

CLIP SUMMARY: Pos. 2 Chest Resultant

Peak Resultant (3 ms CLIPPED DURATION) = 25.546 G's  
Tstart = 54.9600 ms  
Tend = 57.9600 ms  
CSI = 135.268

Test 1077

Pos. 1 Head X  
Max = 7.46 Gs @ 195.72 msec  
Min = -33.52 Gs @ 98.16 msec



B-26

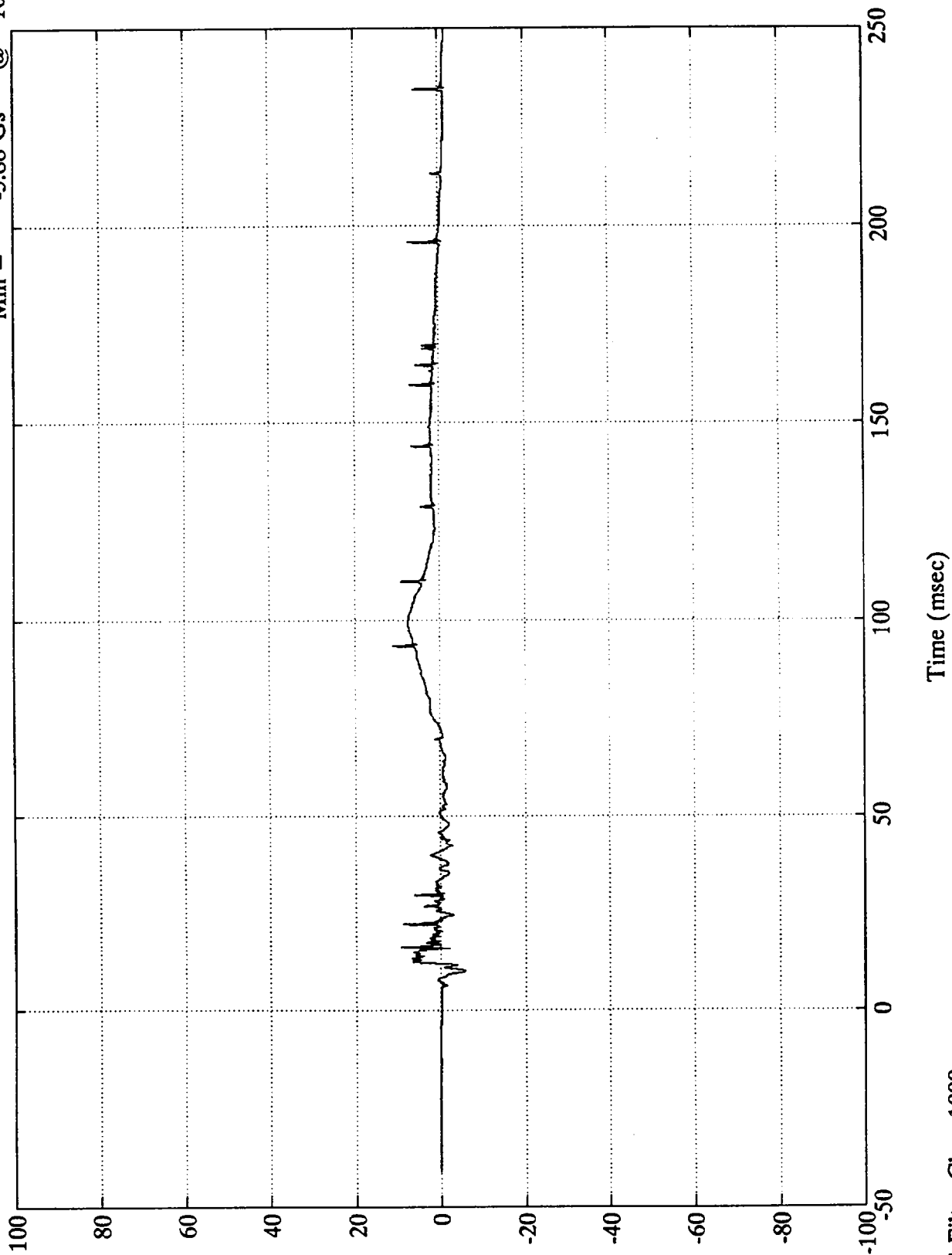
7853-12

SAE Filter Class 1000



Test 1077

Pos. 1 Head Y  
Max = 10.96 Gs @ 93.24 msec  
Min = -5.88 Gs @ 10.08 msec



SD  
B-27

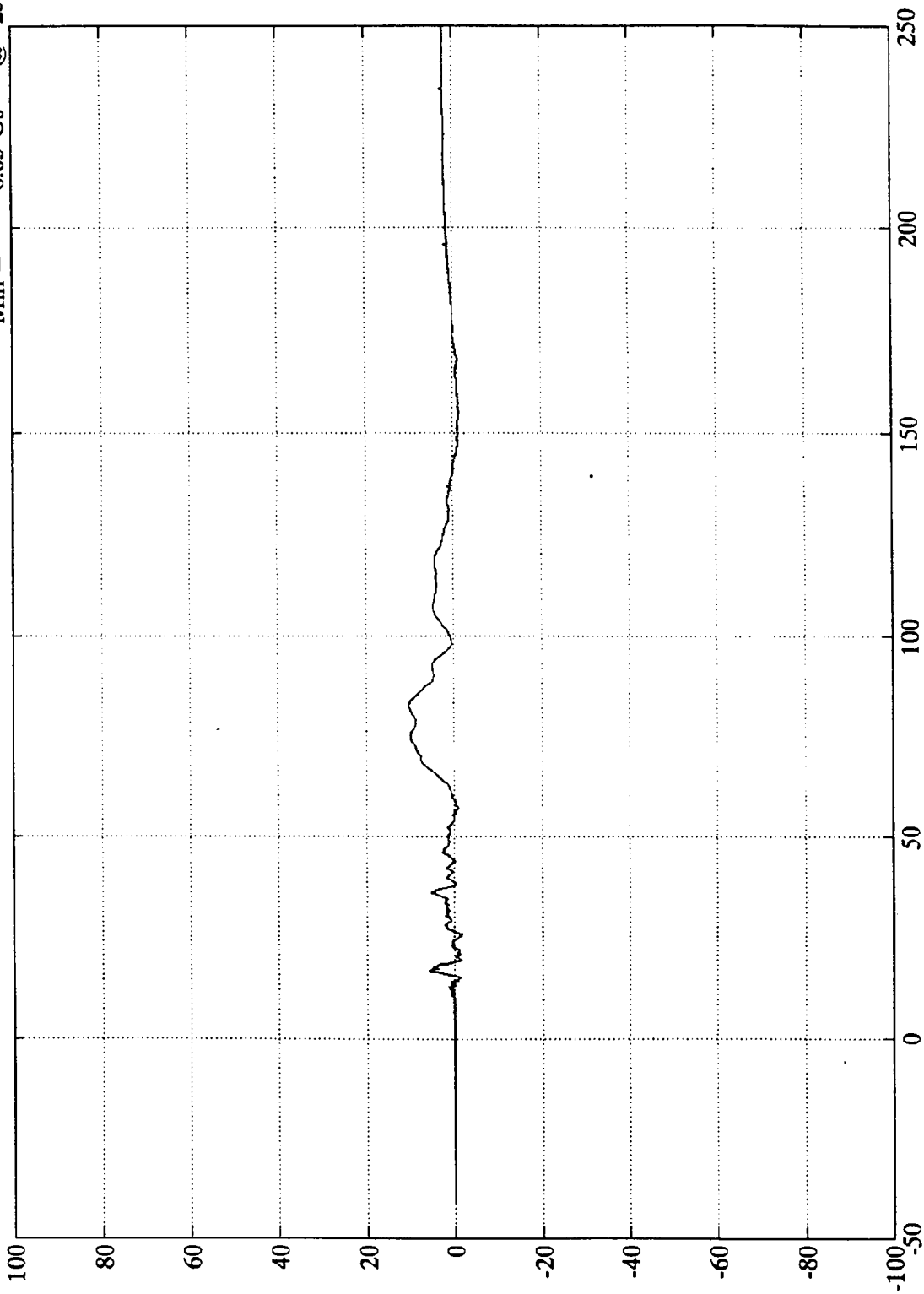
7853-12

SAE Filter Class 1000

Test 1077

Pos. 1 Head Z

Max =	10.41 Gs	@	82.80 msec
Min =	-6.05 Gs	@	258.84 msec



SD  
B-28

7853-12

Time (msec)

SAE Filter Class 1000

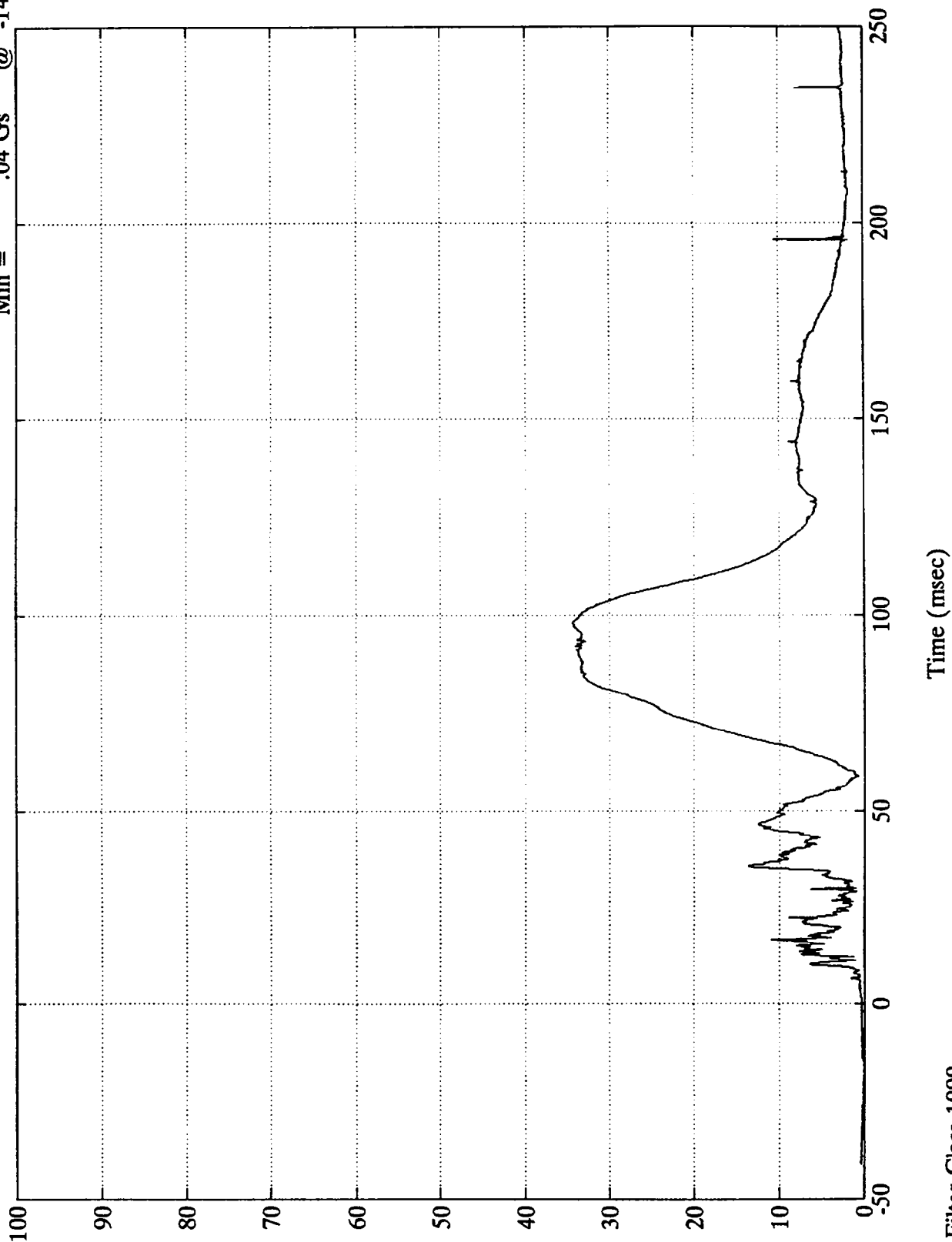
Test 1077

B-29

7853-12

Pos. 1 Head Resultant

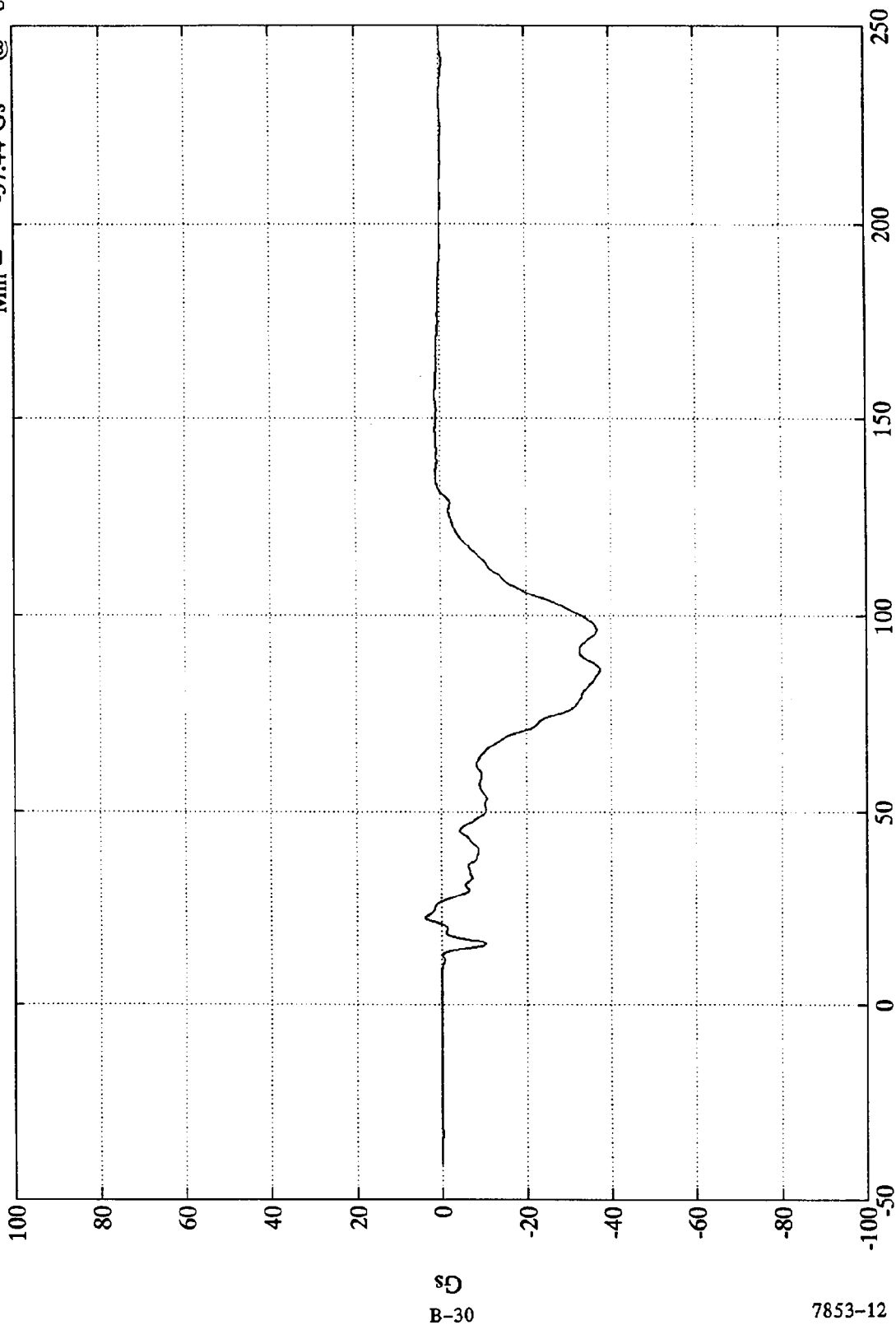
Max = 34.30 Gs @ 97.92 msec  
Min = .04 Gs @ -14.51 msec



SAE Filter Class 1000

Test 1077

Pos. 1 Chest X  
Max = 3.84 Gs @ 22.56 msec  
Min = -37.44 Gs @ 86.52 msec



B-30

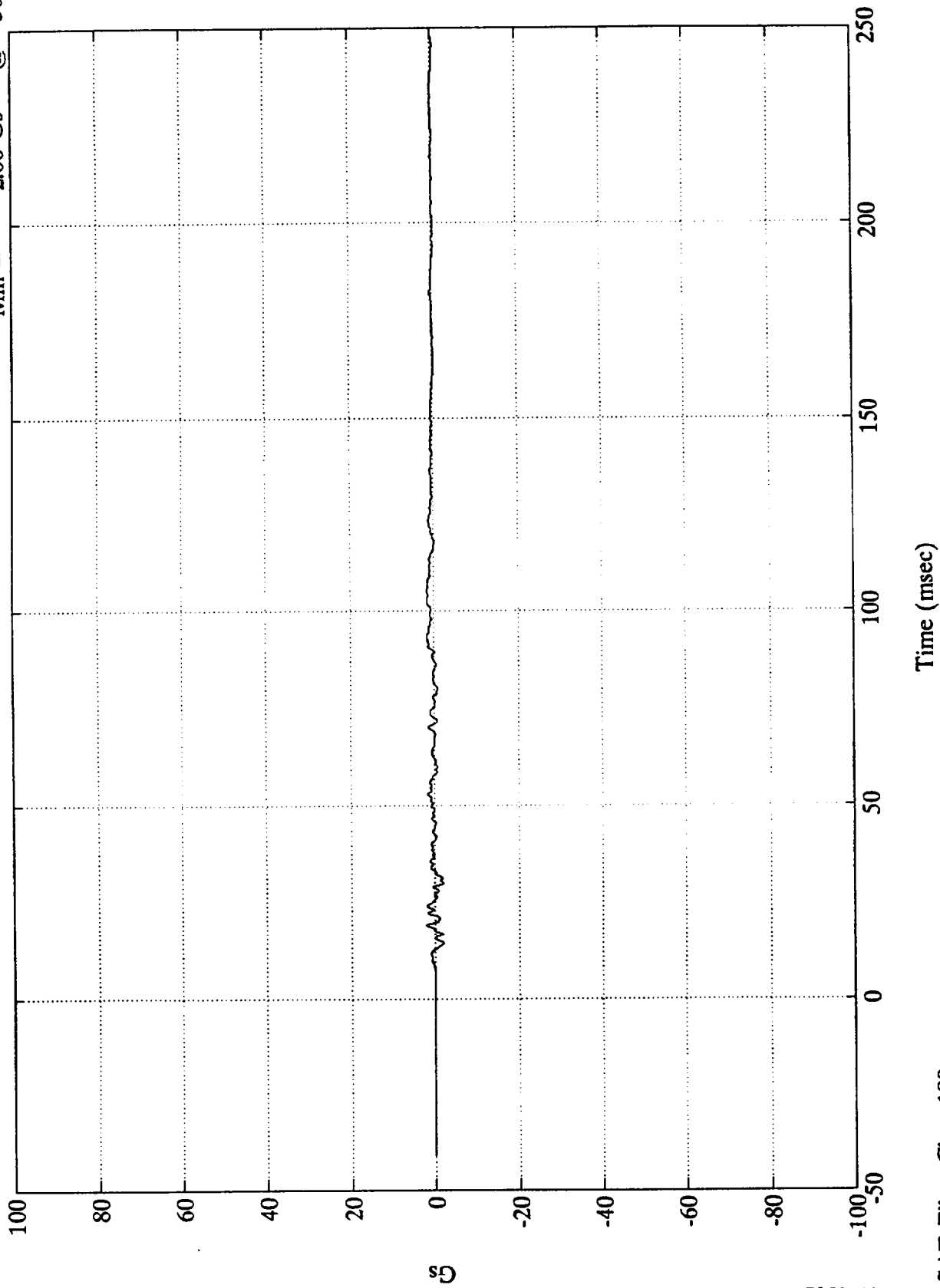
7853-12

Time (msec)

SAE Filter Class 180

Test 1077

Pos. 1 Chest Y  
Max = 1.99 Gs @ 19.08 msec  
Min = -2.00 Gs @ 30.12 msec



B-31

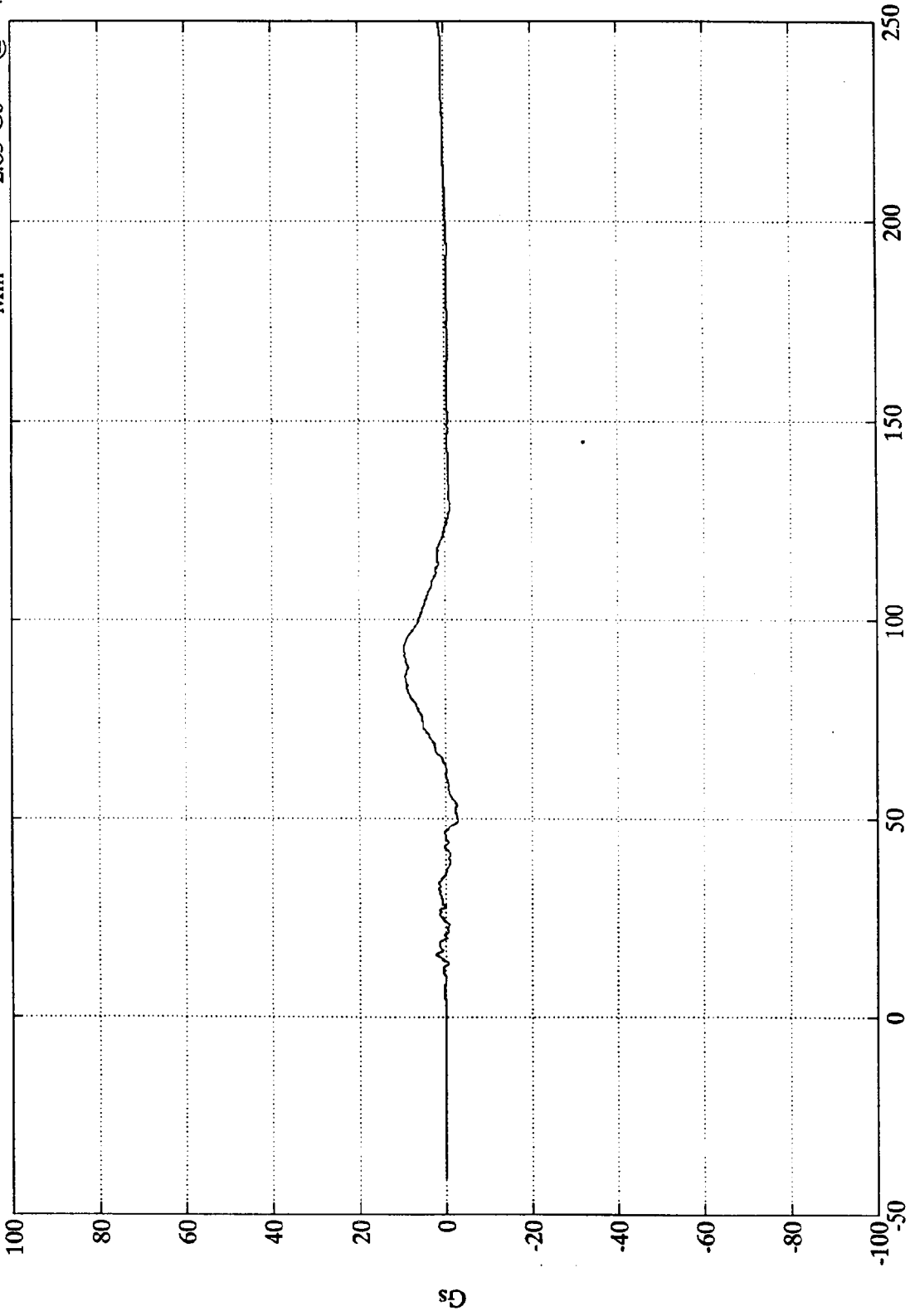
7853-12

SAE Filter Class 180

Test 1077

Pos. 1 Chest Z

Max = 9.69 Gs @ 92.28 msec  
Min = -2.85 Gs @ 49.79 msec



Time (msec)

SAE Filter Class 180

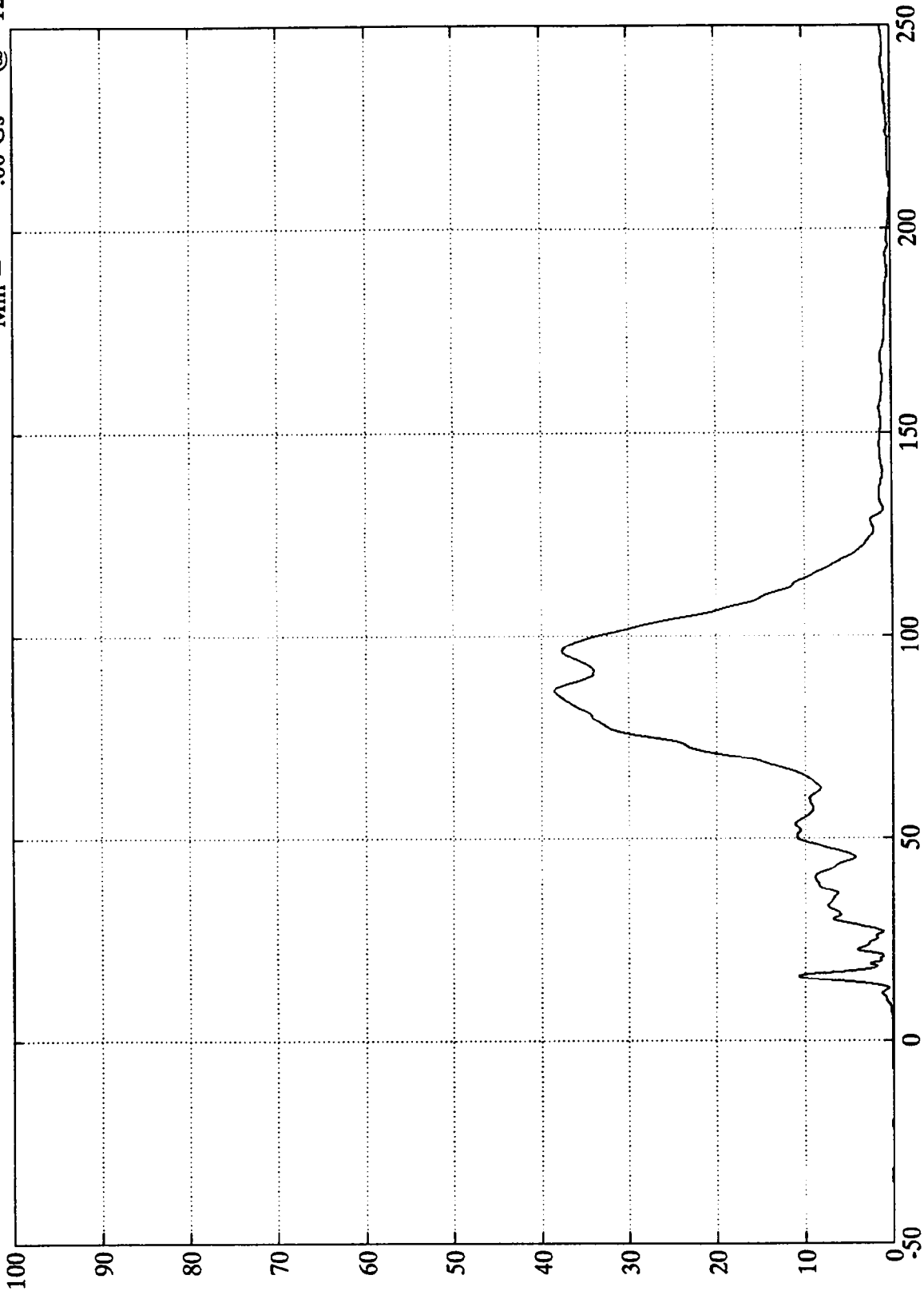
B-32

7853-12

Test 1077

Pos. 1 Chest Resultant

Max = 38.52 Gs @ 86.52 msec  
Min = .00 Gs @ -12.96 msec



Time (msec)

B-33

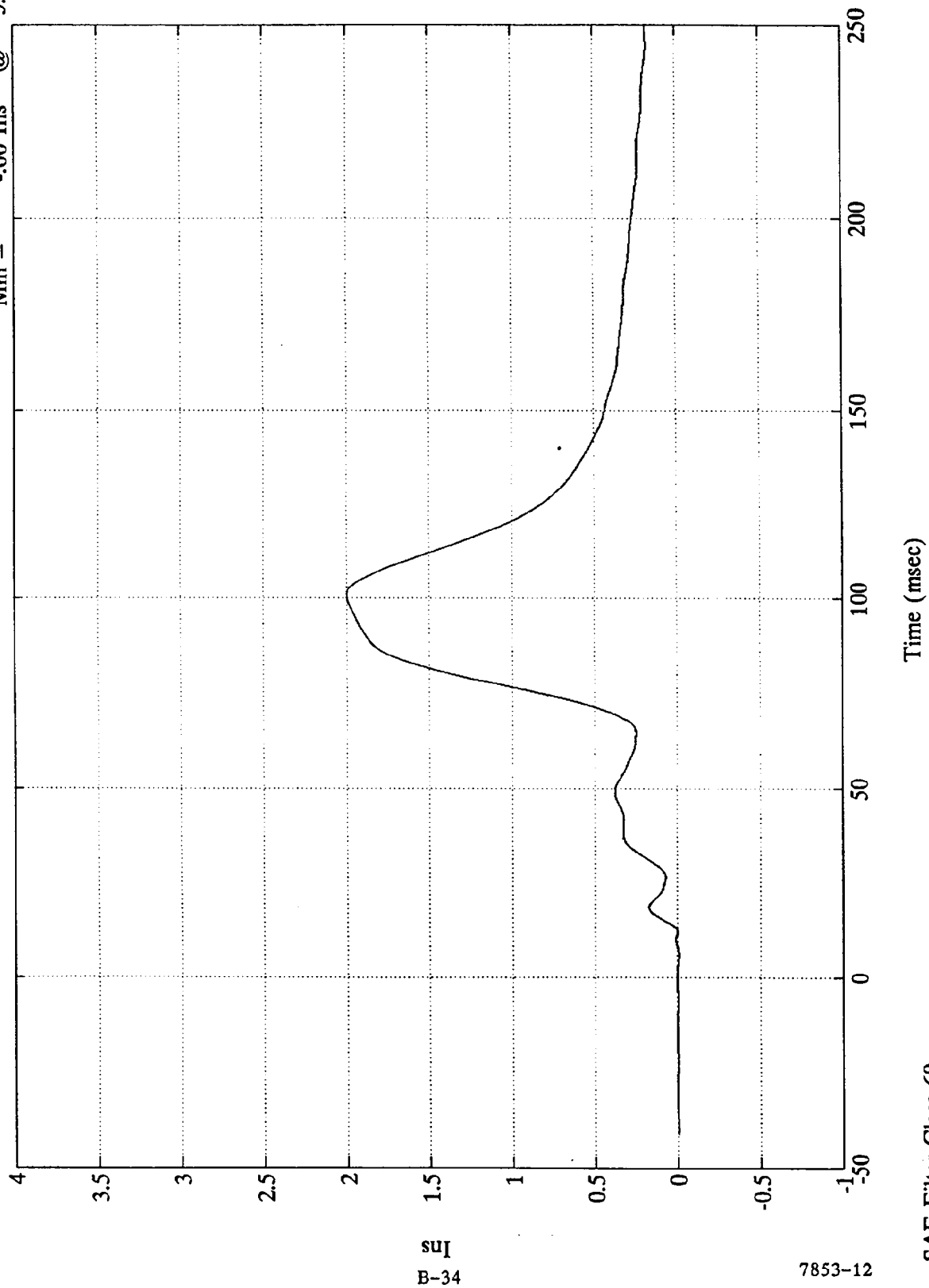
7853-12

SAE Filter Class 180



Test 1077

Pos. #1 Chest Disp.      Max = 1.99 Ins @ 100.92 msec  
Min = -.00 Ins @ 5.88 msec



Ins  
B-34

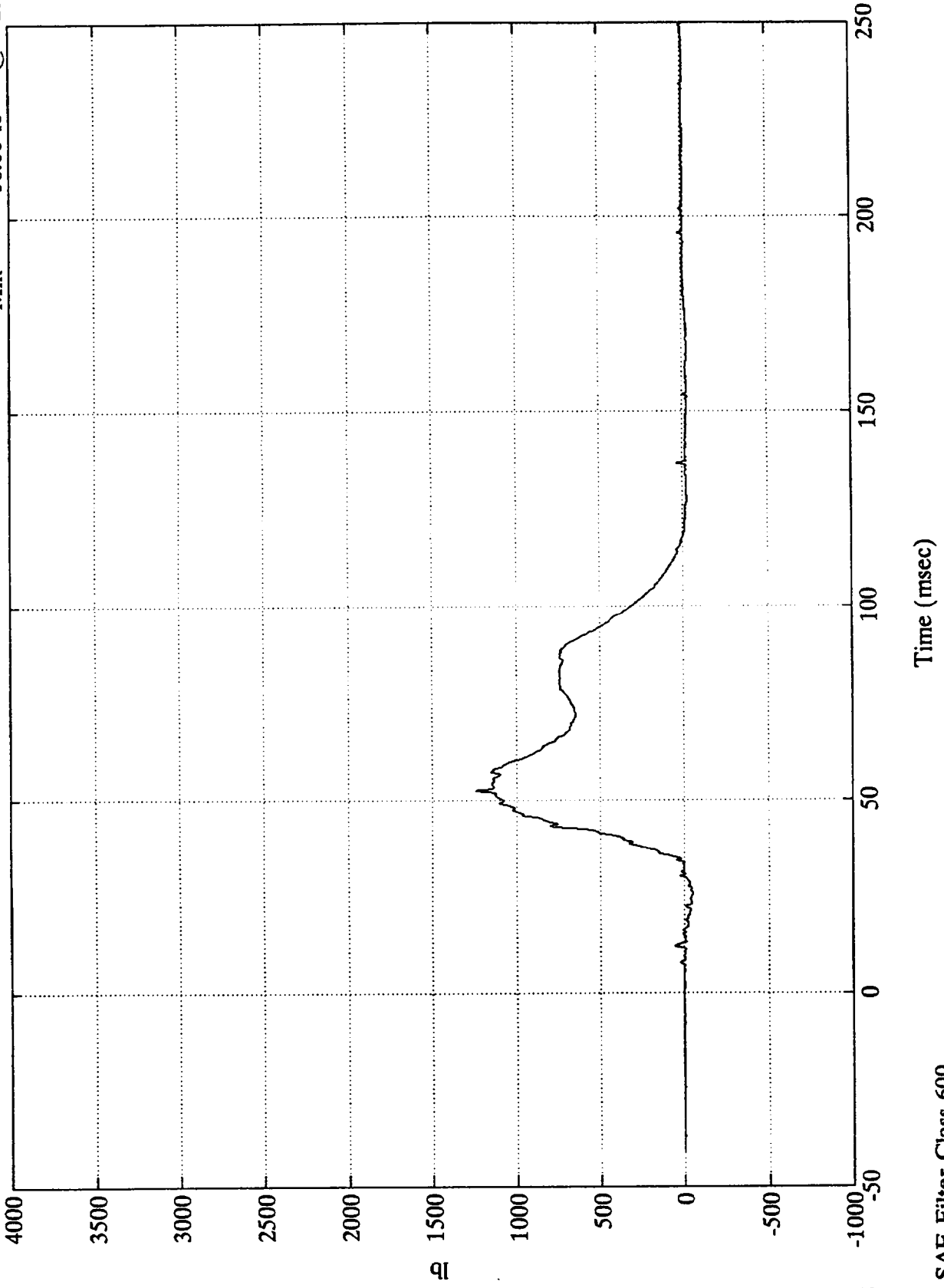
7853-12

SAE Filter Class 60

Test 1077

Pos. 1 Left Femur

Max = 1239.95 lb @ 52.56 msec  
Min = -50.00 lb @ 25.80 msec



B-35

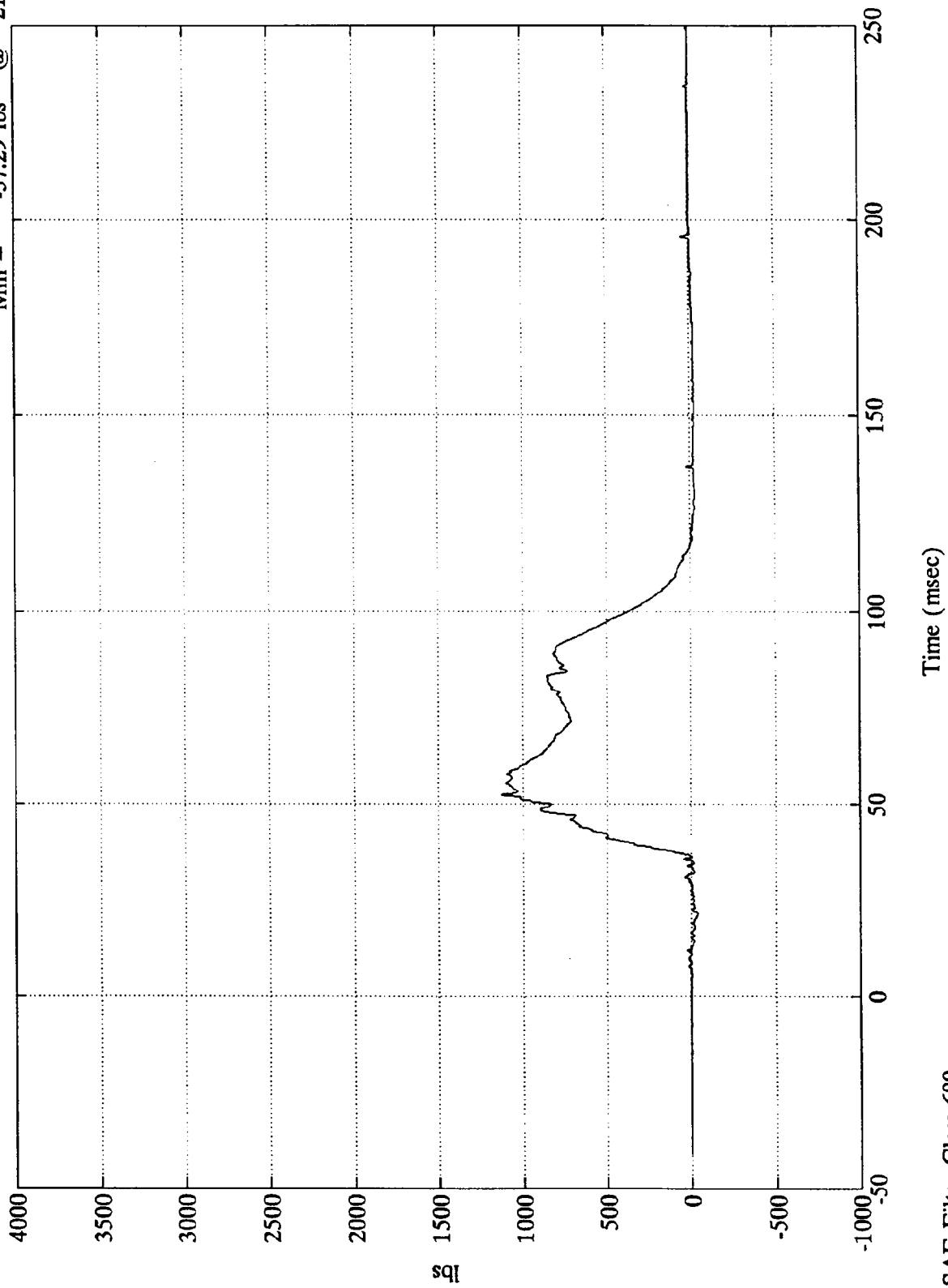
7853-12

SAE Filter Class 600

Test 1077

Pos. 1 Right Femur

Max = 1128.63 lbs @ 52.56 msec  
Min = -37.29 lbs @ 21.72 msec



B-36

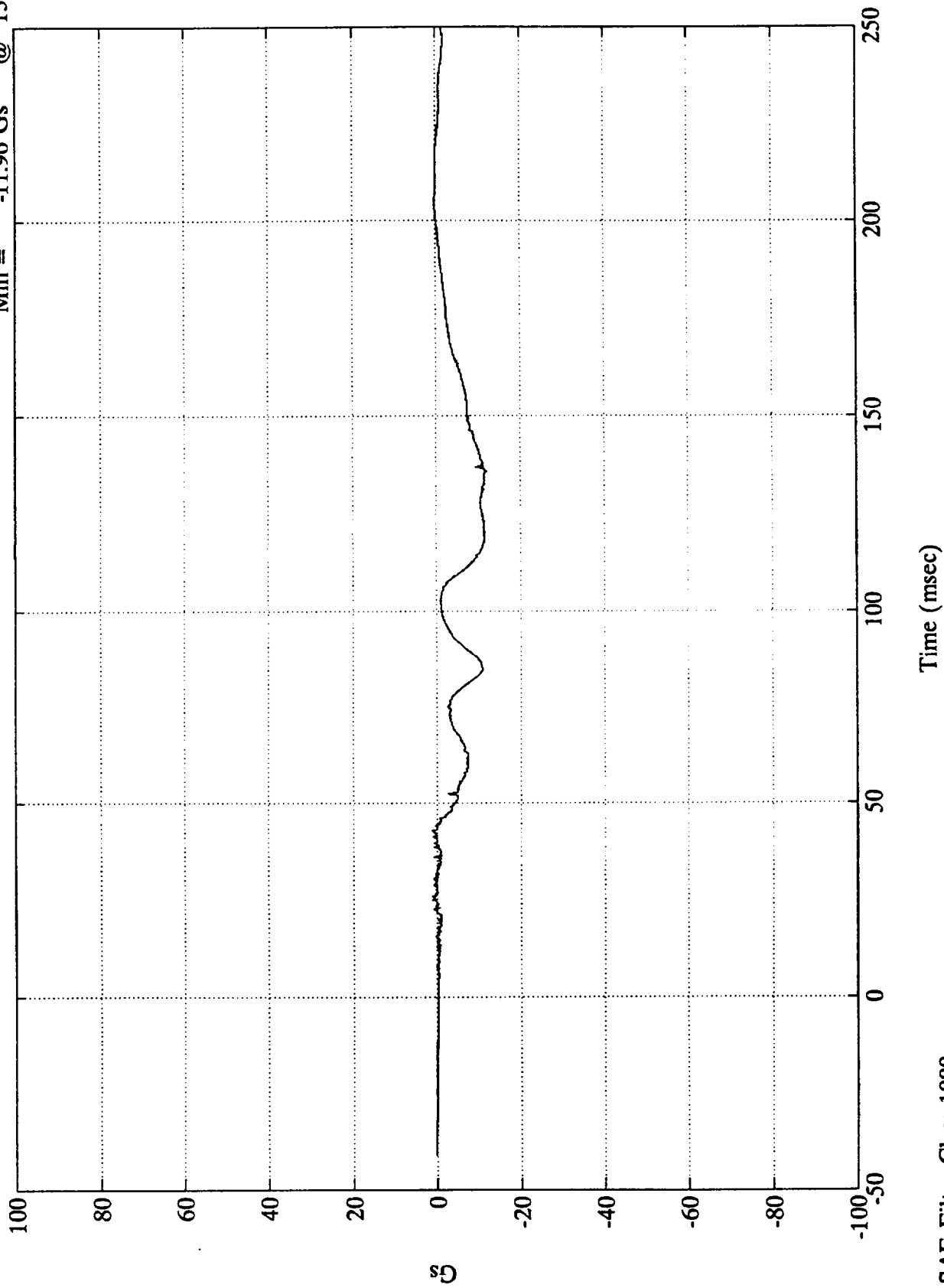
7853-12

SAE Filter Class 600

Test 1077

Pos. 2 Head X

Max = 1.10 Gs @ 42.96 msec  
Min = -11.96 Gs @ 135.72 msec



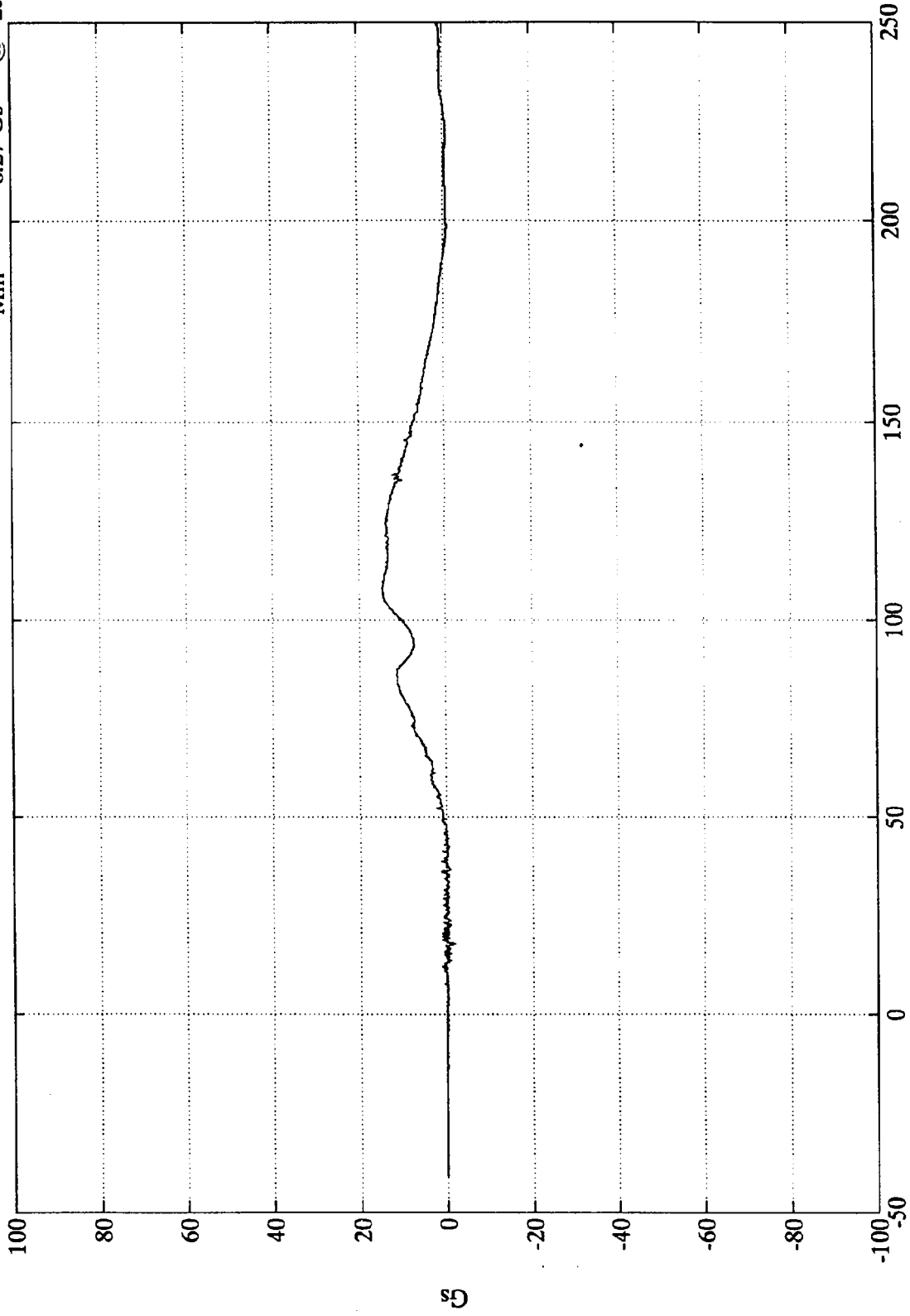
B-37

7853-12

SAE Filter Class 1000

Test 1077

Pos. 2 Head Y      Max = 14.64 Gs @ 108.00 msec  
Min = -6.27 Gs @ 258.84 msec



B-38

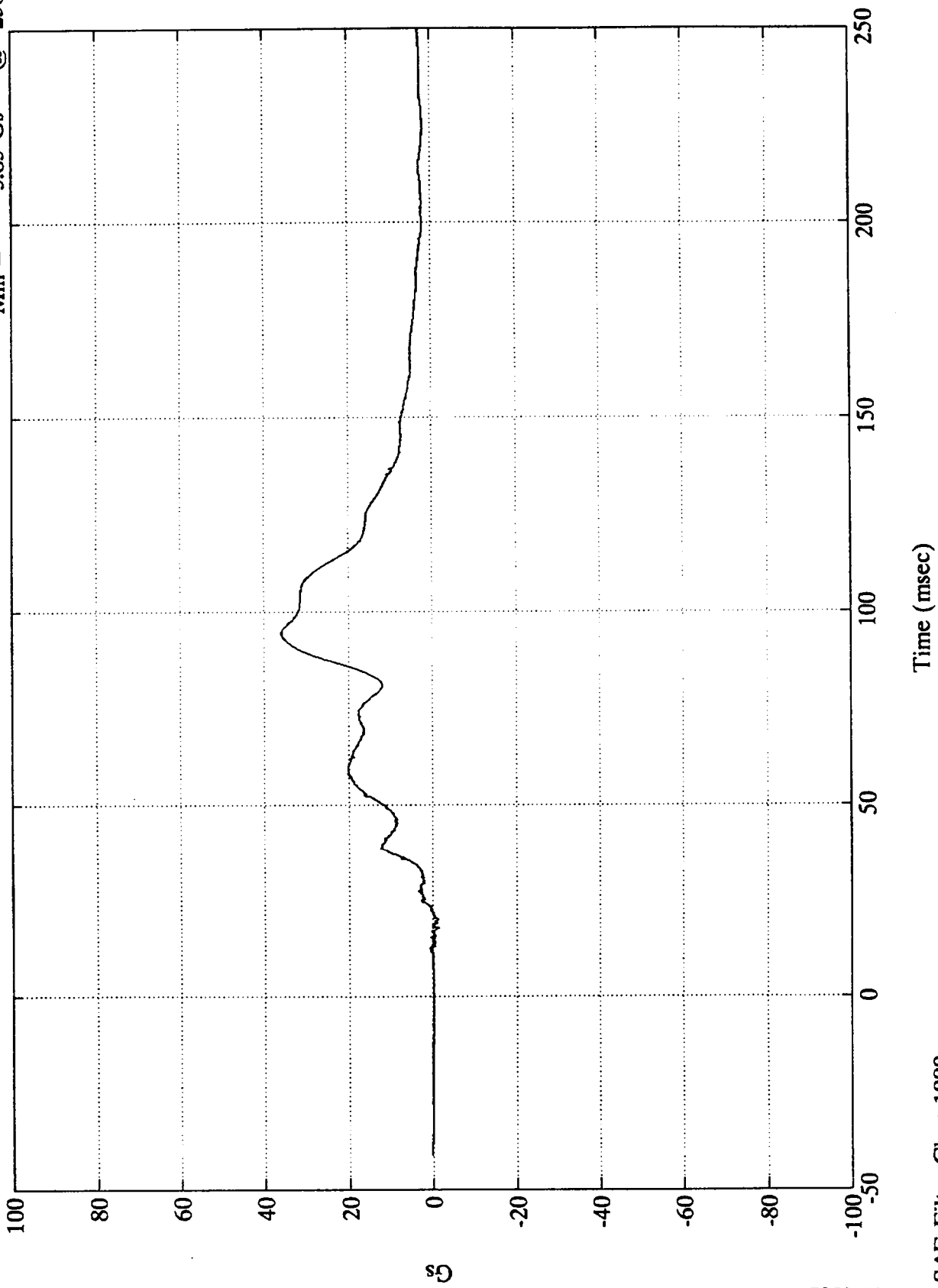
7853-12

Time (msec)

SAE Filter Class 1000

Test 1077

Pos. 2 Head Z  
Max = 35.93 Gs @ 94.68 msec  
Min = -5.85 Gs @ 258.84 msec



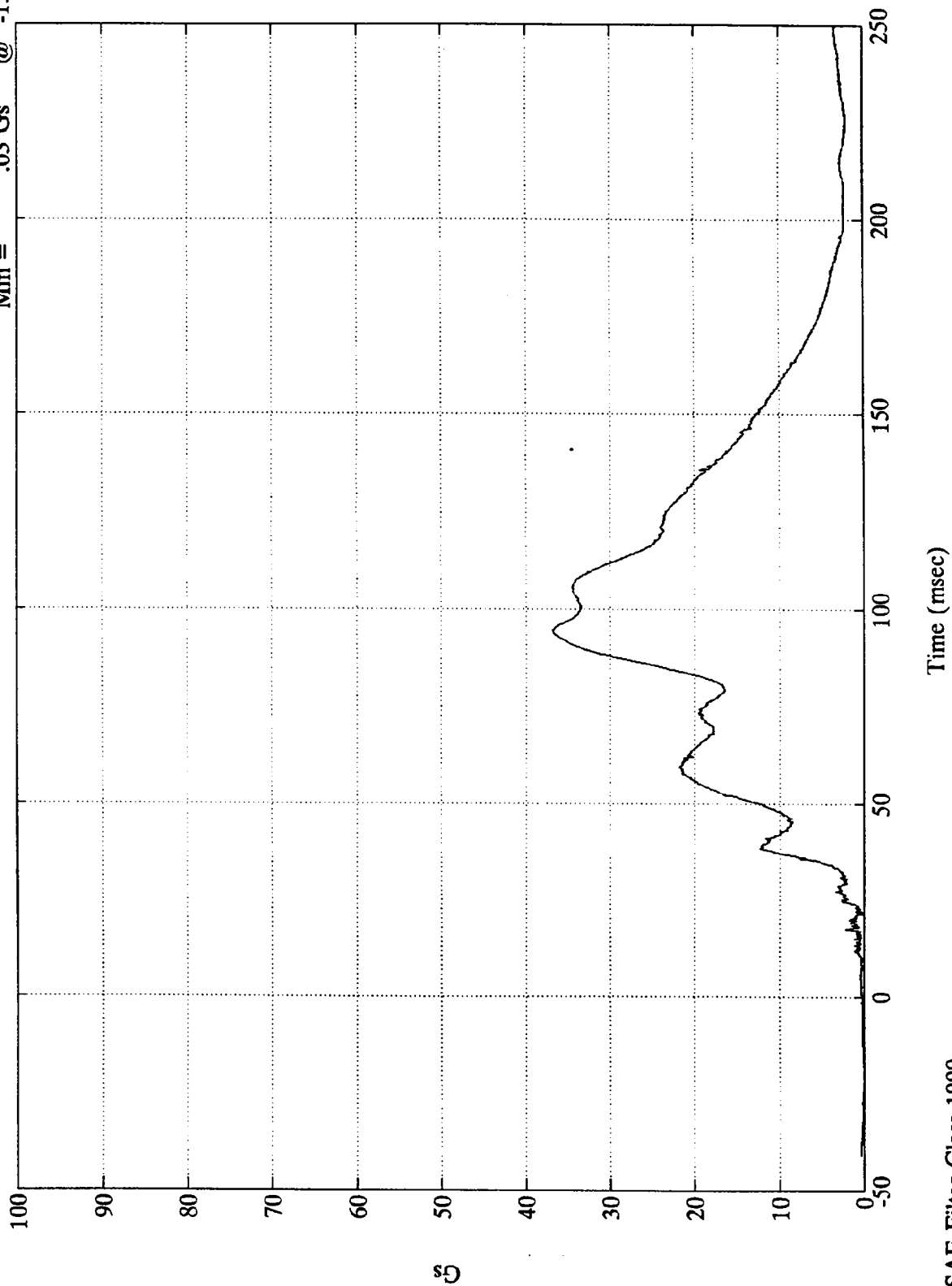
B-39

7853-12

SAE Filter Class 1000

Test 1077

Pos. 2 Head Resultant  
Max = 36.85 Gs @ 94.68 msec  
Min = .03 Gs @ -15.59 msec



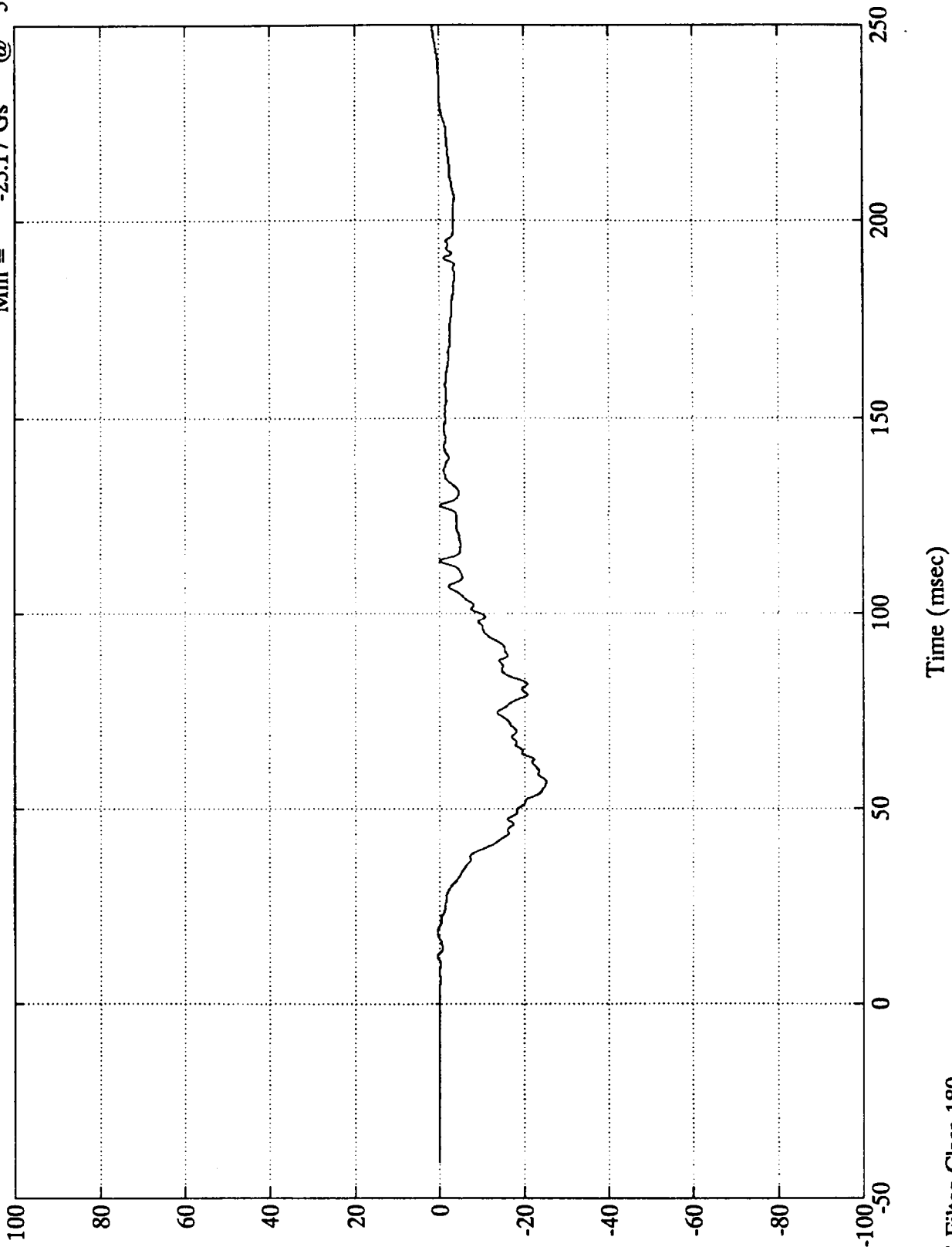
B-40

7853-12

SAE Filter Class 1000

Test 1077

Pos. 2 Chest X  
Max = 1.76 Gs @ 258.11 msec  
Min = -25.17 Gs @ 56.76 msec



B-41

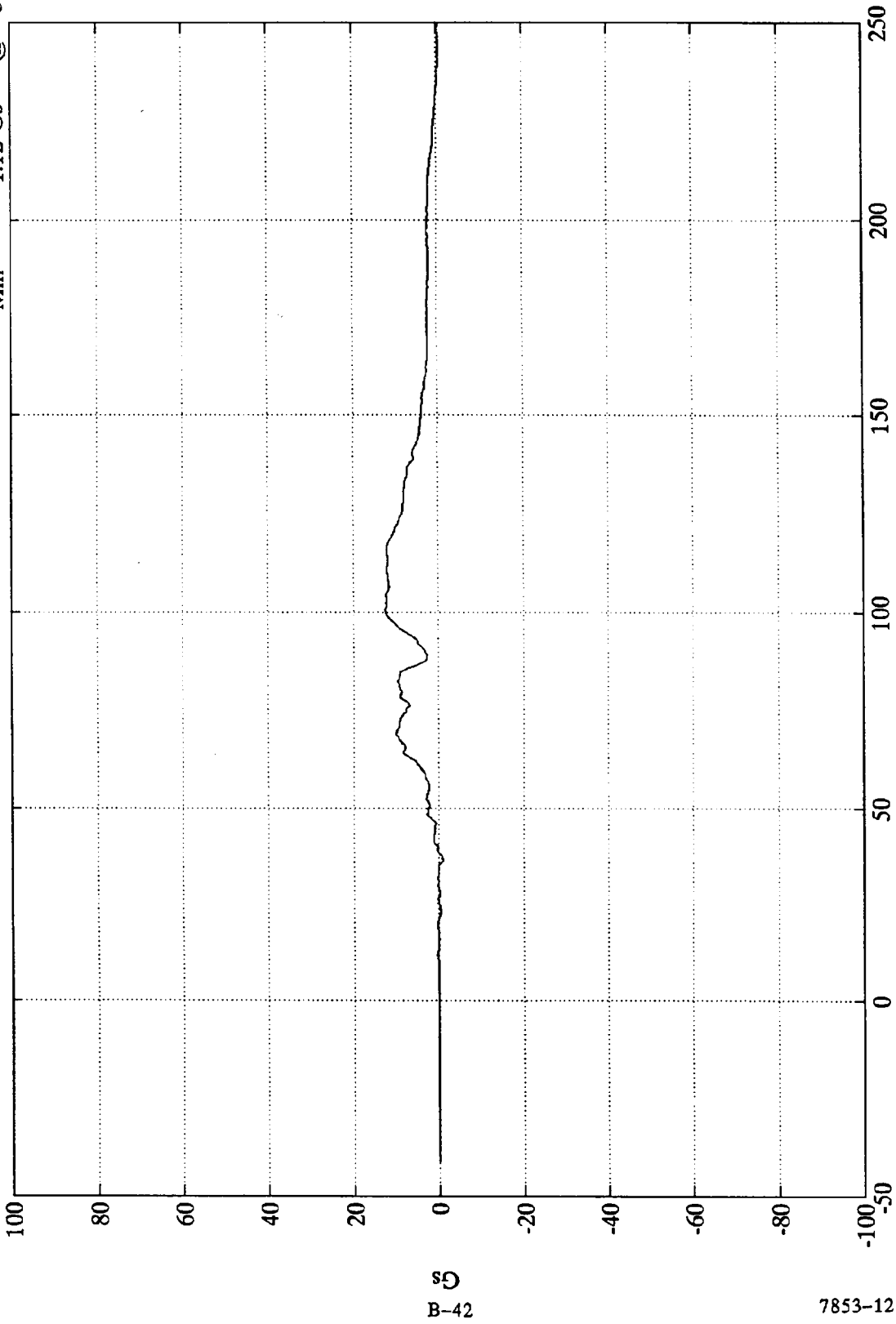
7853-12

SAE Filter Class 180



Test 1077

Pos. 2 Chest Y  
Max = 12.46 Gs @ 100.80 msec  
Min = -1.12 Gs @ 36.72 msec



Time (msec)

SAE Filter Class 180

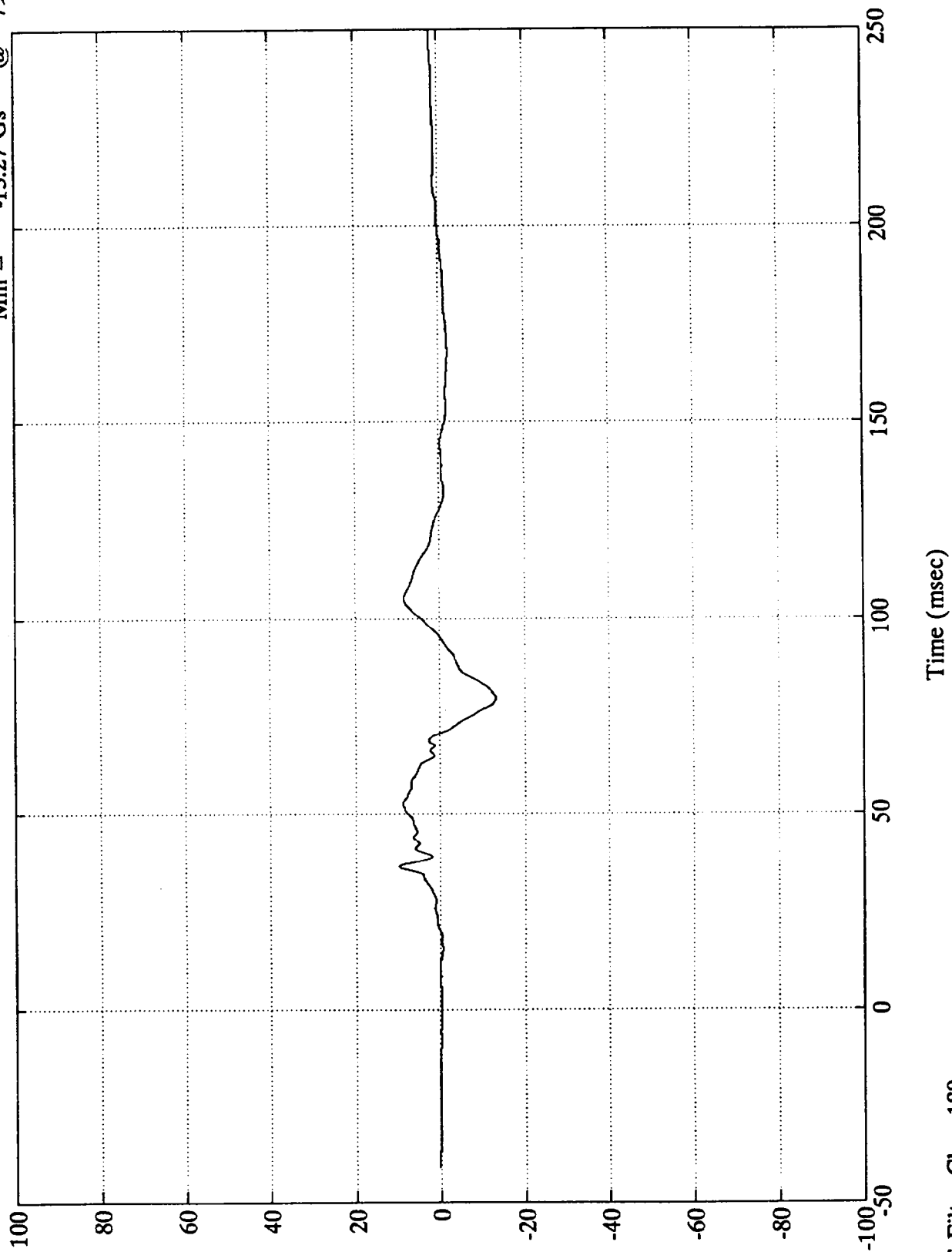
B-42

7853-12

Test 1077

Pos. 2 Chest Z

Max =	9.60 Gs	@	36.36 msec
Min =	-13.27 Gs	@	79.80 msec



B-43

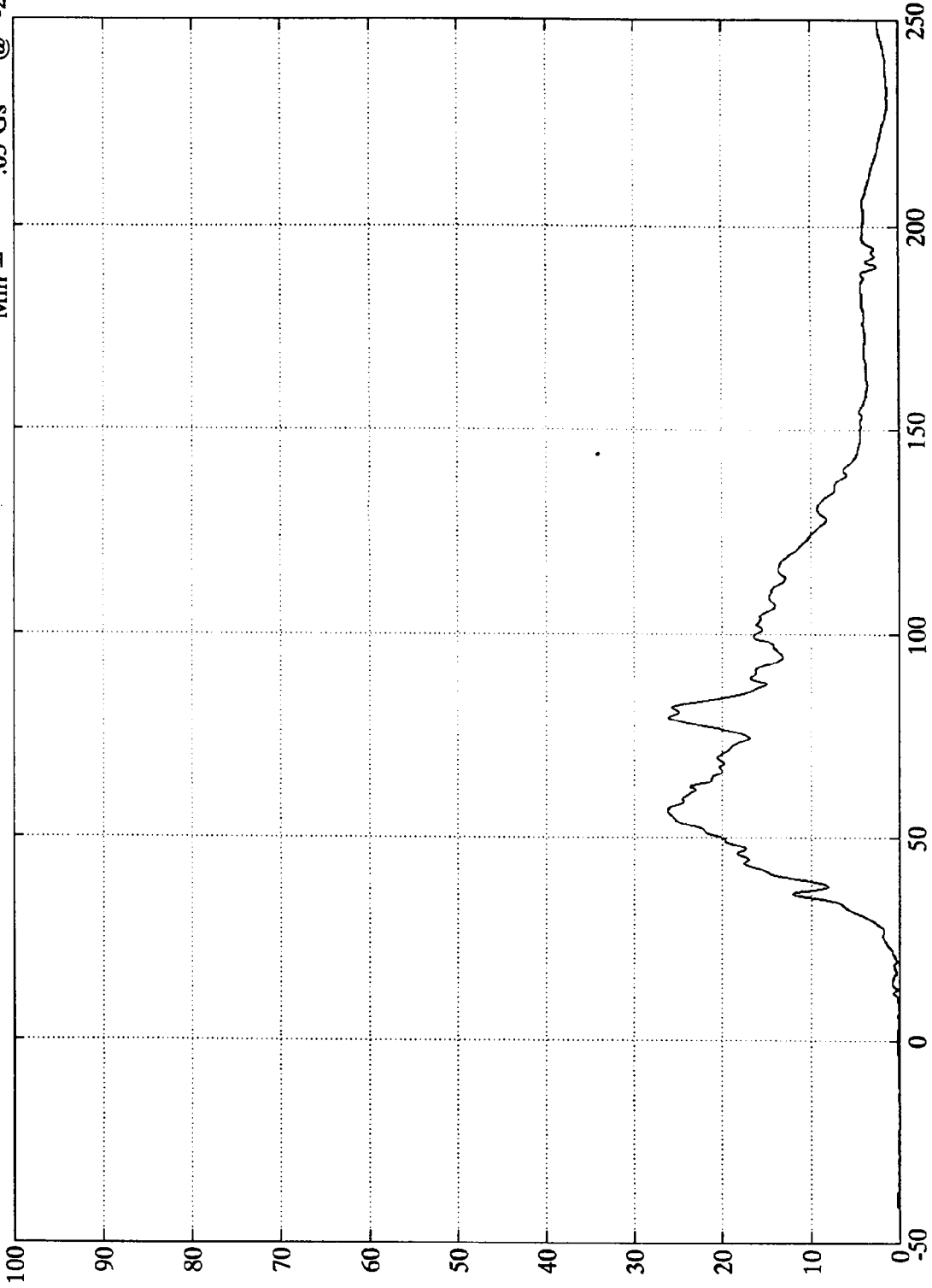
7853-12

SAE Filter Class 180

Test 1077

Pos. 2 Chest Resultant

Max = 26.17 Gs @ 56.64 msec  
Min = .03 Gs @ -21.00 msec



B-44

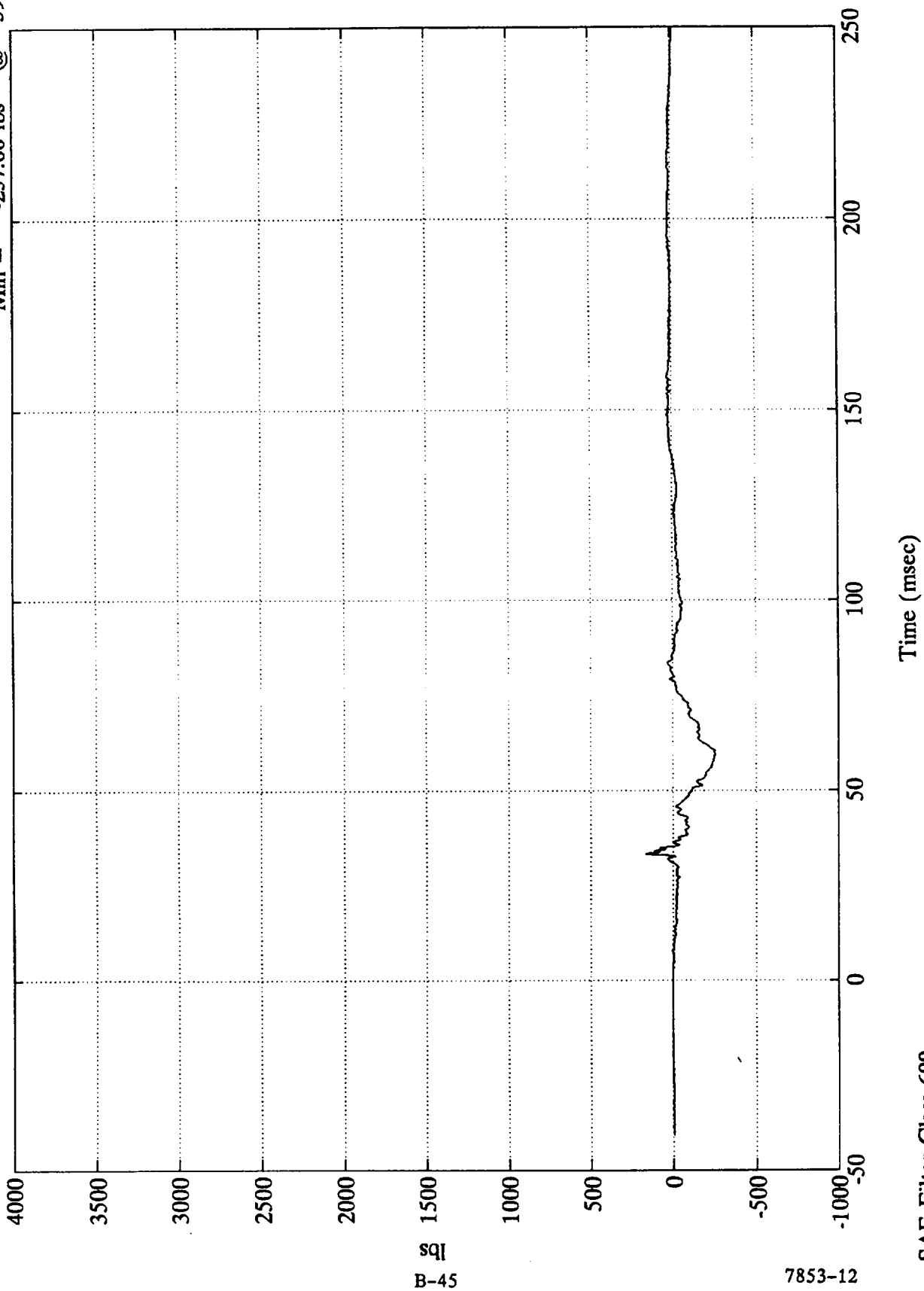
7853-12

Time (msec)

SAE Filter Class 180

Test 1077

Pos. 2 Left Femur  
Max = 164.72 lbs @ 33.36 msec  
Min = -257.06 lbs @ 59.64 msec



B-45

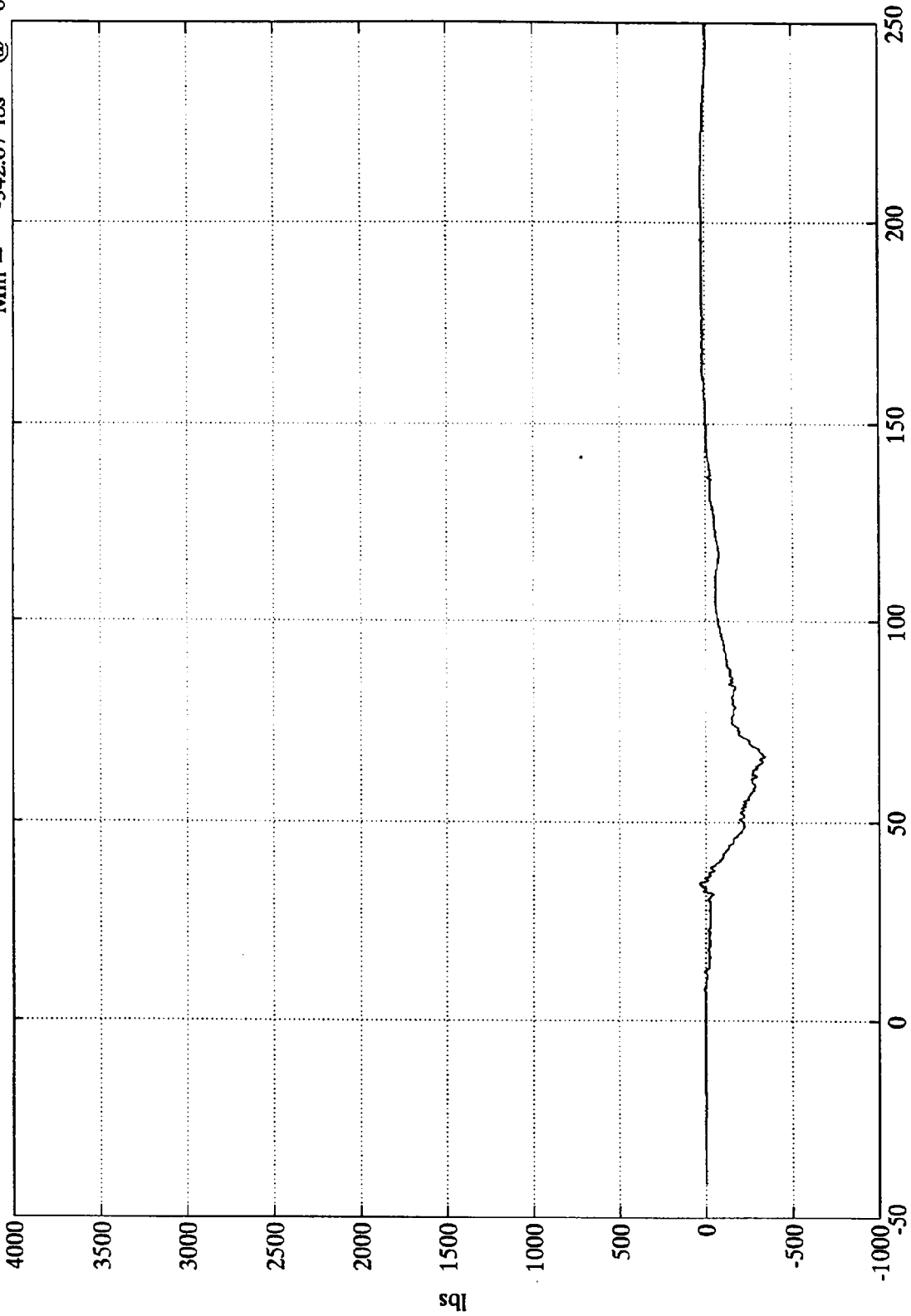
7853-12

SAE Filter Class 600

Test 1077

Pos. 2 Right Femur

Max = 37.47 lbs @ 34.44 msec  
Min = -342.67 lbs @ 66.48 msec



B-46

7853-12

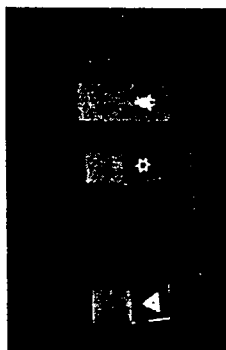
SAE Filter Class 600

Time (msec)

## Appendix C

### VEHICLE OWNERS MANUAL OCCUPANT RESTRAINT SYSTEM INSTRUCTIONS

## Seat belts



54738

### Seat belts, retractable

Always fasten the seat belts before you drive or ride.

Two lights will be illuminated for 4–8 seconds after the starting (ignition) key is turned to driving position. One light is located in the instrument cluster and one in the console between the front seats.

A chime will sound at the same time if the driver has not fastened his seat belt. The front and rear outboard seats are provided with self-retracting inertia-reel belts.



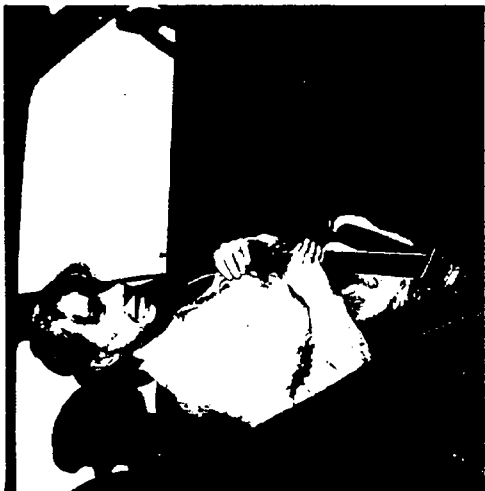
Release buttons, front seats

### To buckle:

Pull the belt out from the retractor far enough to insert the latch into the buckle until a distinct snapping sound is heard. The belt should not be twisted or turned.

**Note:** The lap belt should sit low and tight under abdomen.

To unfasten, depress red pushbutton in buckle and let the belts rewind into their retractors. Before exiting the car, check that the seat belt retracts fully after being unbuckled. If necessary, guide the belt back into its retractor slot.



The seat belt retractors are normally "unlocked".

The retractors will lock up as follows:

- if belt is pulled out rapidly
- during braking and acceleration
- if the vehicle is leaning excessively
- when driving in turns

Check seat belt mechanism function as follows:

- 1 Attach the seat belt. Pull rapidly on the strap.
- 2

**WARNING! Check other traffic before performing this check.**

Brake firmly from approximately 30 mph (50 km/h) or turn in a tight circle while pulling on the belt.

In all the above checks you should not be able to pull the belt out.

**WARNING:** Never use any single seat belt for more than one occupant.

Never wear the shoulder portion of the belt under the arm or otherwise out of position. Such use could, in event of accident, cause injury.

Volvo recommends that all occupants fasten their seat belts. Aftermarket devices used to induce slack into the shoulder belt portion of Volvo's three-point belt system will have a detrimental effect on the amount of protection available to you in the event of a collision.

**Note:** Legislation in your state or province may mandate seat belt usage.

## Maintenance

Check periodically that the anchor bolts are secure and that the belts are in good condition. Use water and a mild detergent for cleaning.

**As the seat belts lose much of their strength when stretched, they should be replaced after collision, even though they may appear to be undamaged.**

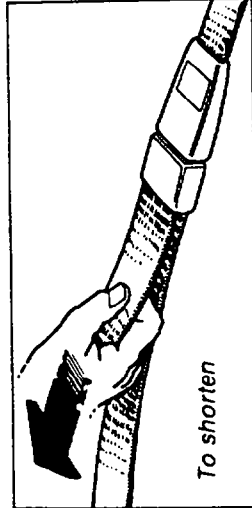
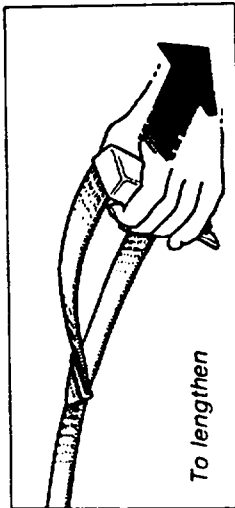
Never modify or repair the belt on your own. If repair is required, have the work performed by an authorized Volvo dealer.



*The lap belt should sit low under abdomen*

## During pregnancy

Pregnant women should always wear seat belts. Remember that the belt should always be positioned in such a way as to avoid any possible pressure on the abdomen. The lap portion of the belt should be located low, as shown in the above illustration.



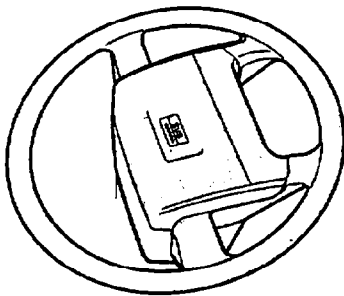
58405

## Seat belts, manually adjustable

The center-rear seat belt is manually adjustable. It should always be adjusted to fit snugly across the lap.



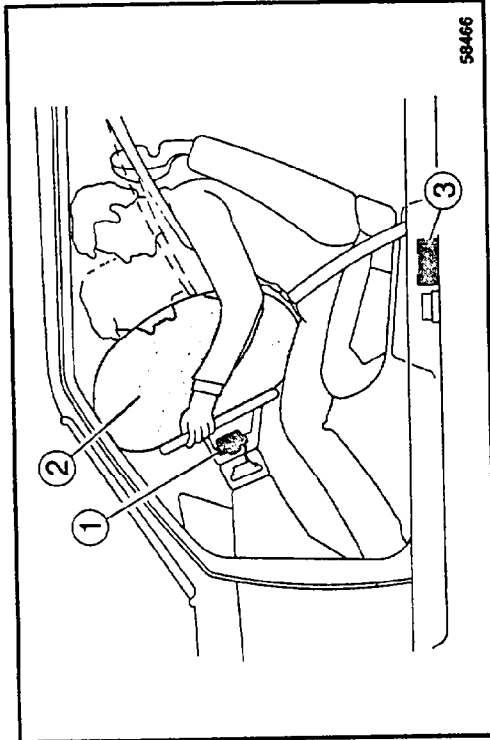
## Supplemental Restraint System (optional in Canada)



As an enhancement to the three-point seat belt system, your Volvo is equipped with a Supplemental Restraint System (SRS). The Volvo SRS consists of a driver's side airbag with a driver's side knee bolster. The system is designed to supplement the protection provided by the three-point seat belt system.

The interior of an SRS-equipped Volvo looks very much the same as any other. The only indications of the system's presence are the "SRS" embossed on the steering wheel pad, and the knee bolster beneath the steering column. Also, the SRS diagnostic receptacle is indicated on the center dash panel.

The airbag is folded and located in the center of the steering wheel. It is released only during certain frontal or front-angular collisions, depending upon the crash severity, angle, speed, and object impacted.



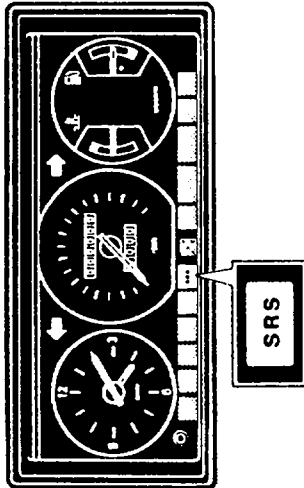
The airbag system includes a gas generator (1), surrounded by the airbag itself (2). To deploy the system, the sensor (3) activates the gas generator causing the airbag to be inflated with nitrogen gas. As the movement of the driver compresses the airbag, some of the gas is expelled at a controlled rate to provide better cushioning. The entire process, including inflation and deflation of the airbag takes approximately two-tenths of a second.

### WARNING:

When installing any accessories make sure that the SRS system is not damaged. Do not attempt to service any component of the SRS yourself. Attempting to do so may result in serious personal injury. If a problem arises, take your car to the nearest authorized Volvo Dealer for inspection as soon as possible.

**WARNING!** As its name implies, SRS is designed to be a SUPPLEMENT to – not a replacement for – the three-point belt system. The airbag is not designed to be released in the event of a side or rear-end collision, or during a rollover situation. For maximum protection, wear seat belts at all times. Be aware that no system can prevent all possible injuries that may occur in an accident.

## Supplemental Restraint System



A self-diagnostic system incorporated in the sensor monitors the SRS. If a fault is detected, the "SRS" warning light will illuminate. The light is included in the warning/indicator light cluster in the instrument panel. Normally, the SRS warning light will be illuminated along with the other warning/indicator lights when the ignition key is turned to the ON position (position II), and go out a short time after the engine has been started. Check that this light is functioning properly every time the car is started.

The following items are monitored by the diagnostic system:

- Sensor unit electronics integrity.
- Reserve energy supply.
- Diagnostic output circuit.
- System voltage.
- Integrity of system connectors.
- Mercury switch closure.
- Gas generator ignitor.

**WARNING!** If the SRS warning light stays on after the engine has started or if it comes on while you are driving, drive the car to the nearest authorized Volvo Dealer for inspection as soon as possible.

**ATTENTION! SRS VEHICLE!**  
THIS CAR IS EQUIPPED WITH A SUPPLEMENTAL RESTRAINT SYSTEM. TO PROVIDE CONTINUED RELIABILITY, CERTAIN ELEMENTS OF THE SUPPLEMENTAL RESTRAINT SYSTEM SHALL BE SERVICED OR REPLACED BY 2000. SEE OWNERS MANUAL FOR FURTHER INFORMATION.

**VOLVO**

58468

*This decal can be found on the lefthand door pillar.*

There is no maintenance to perform on the SRS yourself. The only periodic maintenance recommended on the SRS is that the air bag module and the sensor unit should be replaced every ten years and that the other components in the system (wiring, connectors, etc.) should also be inspected at this time. This service must be performed by an authorized Volvo Dealer.

Should you have any questions about the SRS system, please contact your authorized Volvo Dealer or the Consumer Affairs Department:

In the U.S.A.

Volvo Cars of North America  
One Volvo Drive,  
Rockleigh, New Jersey 07647  
201-767-4737

In Canada:

Volvo Canada Ltd.  
175 Gordon Baker Road  
Willowdale, Ontario M2H 2N7  
416-493-3700