

V1281

R7050-04

SIDE IMPACT PROTECTION
IN PRODUCTION VEHICLES

MDB-TO-VAN SIDE IMPACT TEST OF
A 26° CRABBED MOVING DEFORMABLE BARRIER
TO A 1988 DODGE CARAVAN
AT 33.5 MPH

MOBILITY SYSTEMS AND EQUIPMENT COMPANY
9920 LA CIENEGA BOULEVARD SUITE 708
INGLEWOOD, CALIFORNIA 90301



MARCH 1989

TEST REPORT

Prepared Under Contract No. DTNH22-87-C-07168

For

U.S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Office of Crashworthiness Research
400 Seventh Street, S.W.
Washington, DC 20590

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PREPARED BY: S. Pruitt/D. Gokhale/T. Kippen

APPROVED BY: *Anil V. Khadilkar*
Dr. Anil V. Khadilkar

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Contracting Officer Technical Representative
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16. Abstract This test report documents a crash test to evaluate side impact protection. Testing was conducted on a 1988 Dodge Caravan pickup at the Mobility Systems and Equipment Company Test Facility, Mira Loma, California. The test vehicle was impacted on the left side by a moving deformable barrier, crabbled to 26°, at 33.5 mph. The test was a simulation of a 90° intersection collision with the striking vehicle traveling at 30 mph and the struck vehicle traveling at 15 mph. Occupant response of two side impact dummies were measured. The dummies were located in the driver's designated seating position and the left rear designated position. The test date was 03 February 1989.			
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METRIC CONVERSION FACTORS

APPROXIMATE CONVERSIONS FROM METRIC MEASURES

SYMBOL WHEN YOU KNOW MULTIPLY BY TO FIND SYMBOL

LENGTH

in	inches	2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km

AREA

in ²	square inches	6.5	square centimeters	cm ²
ft ²	square feet	0.09	square meters	m ²
yd ²	square yards	0.8	square meters	m ²
mi ²	square miles	2.6	square kilometers	km ²
	acres	0.4	hectares	ha

MASS (weight)

oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t

VOLUME

tsp	teaspoons	5	milliliters	ml
tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft ³	cubic feet	0.03	cubic meters	m ³
yd ³	cubic yards	0.76	cubic meters	m ³

TEMPERATURE (exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C
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APPROXIMATE CONVERSIONS FROM METRIC MEASURES

SYMBOL WHEN YOU KNOW MULTIPLY BY TO FIND SYMBOL

LENGTH

mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
km	kilometers	1.1	yards	yd
		0.6	miles	mi

AREA

cm ²	square centimeters	0.16	square inches	in ²
m ²	square meters	1.2	square yards	yd ²
km ²	square kilometers	0.4	square miles	mi ²
ha	hectares (10,000 m ²)	2.5	acres	

MASS (weight)

g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	

VOLUME

ml	milliliters	8.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
		1.06	quarts	qt
		0.26	gallons	gal
m ³	cubic meters	36	cubic feet	ft ³
m ³	cubic meters	1.3	cubic yards	yd ³

TEMPERATURE (exact)

°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F
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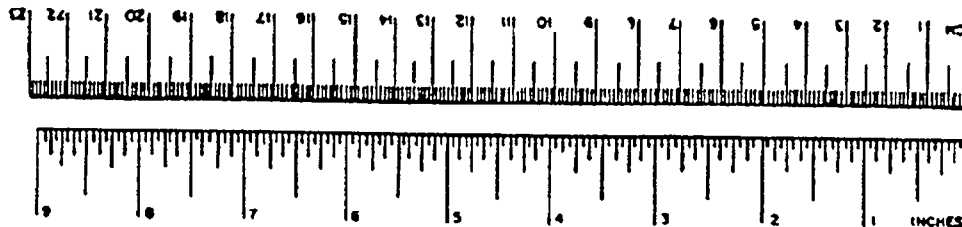


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SECTION 1

PURPOSE AND INTRODUCTION

This testing program is an investigation and evaluation of side impact protection in production light trucks and vans. The test is specifically intended to simulate a 90° intersection collision with the striking vehicle moving at 30 mph and the struck vehicle traveling at 15 mph. This is accomplished by towing a Moving Deformable Barrier (MDB) crabbed at a 26° angle into the struck test vehicle which is placed in a stationary position. The velocity of the MDB is to be 33.5 ± 0.5 mph.

The subject vehicle for this test was a 1988 Dodge Caravan. The test was performed on 03 February 1989 at an actual impact speed of 33.6 mph. The leading left-hand edge of the MDB contacted the test vehicle 37.0 inches forward of the midpoint between the axles.

Section 2 contains a general test summary and vehicle information data sheets. Section 3 contains the test results. Appendix A contains pretest and posttest vehicle and dummy photographs and Appendix B contains data plots for transducers. Appendix C contains side impact dummy certification data and Appendix D has the side impact dummy positioning procedure.

SECTION 2

TEST SUMMARY AND VEHICLE INFORMATION

The 1988 Dodge Caravan, Test No. 4, was tested on 03 February 1989. General test vehicle information and pretest conditions are given in Tables 2-1 and 2-2. A crash test summary is shown in Table 2-3. The vehicle was instrumented with 10 accelerometer channels and three onboard high-speed movie cameras. Accelerometer locations and peak values are shown in Table 2-4. All pretest measurements were made detailing the left side vehicle profile. The impact point was marked on the vehicle 37 inches forward of the midpoint of the wheelbase.

One side impact anthropomorphic dummy (SID) was placed in the vehicle's driver seat and one SID was placed in the left rear DSP. Both were positioned using the side impact dummy seating procedure (Appendix D). SID position measurements are shown in Table 2-5. The SID were instrumented with 12 accelerometers and one displacement transducer each. A summary of the SID accelerometer data is given in Table 2-6. Colored chalk was applied to the two SID's head, left shoulder, left hip and his knees to help determine dummy contact points during the test.

The MDB was crabbed at 26° and instrumented with five (5) accelerometers and two (2) high-speed movie cameras. A general crash test summary and accelerometer locations with peak values for the MDB are shown in Tables 2-7 and 2-8.

Additional film coverage of the test was also provided by two (2) overhead and two (2) ground high-speed movie cameras and one real-time camera. Camera locations are given in Table 2-9. A total of 41 channels of information were recorded on two (2) FM data tapes.

TABLE 2-1 TEST VEHICLE DATA

VEHICLE YEAR/MAKE/MODEL/BODY STYLE: 1988/DODGE/CARAVAN
 VEHICLE NHTSA NO.: TEST 04 VIN: 2B4FK21K5JR600890
 VEHICLE BODY COLOR: BRONZE; MONTH & YEAR OF MANUFACTURE: 12/87
 ENGINE: Cyl.; C.I.D. 2.2 Liters; Placement; Longitudinal; X Lateral
X Gas; Diesel; Turbocharged
 TRANSMISSION: 5 Speed; Manual; Automatic; X Overdrive
 FINAL DRIVE: X Front Wheel Drive; Rear Wheel Drive; Four Wheel Drive
 DATE VEHICLE AVAILABLE FOR SIDE IMPACT TESTING: 12/88
 ODOMETER READING: 78 miles; OPTIONS: A/C; X P/S; P/Wdo;
 Tilt Whl.; Cruise Control

DATA RECORDED FROM VEHICLE'S TIRE PLACARD:

Tire Pressure (at capacity): 35 psi Front; 35 psi Rear
 Recommended Tire Size: P195/75R14
 Tires On Vehicle: P195/75R14; Manufacturer: GOODYEAR
 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: X Fixed; Adjustable With Lever/ Rotating Knob
 Vehicle Maximum Capacity Loading = 1585* lb (A)
 No. Of Occupants x 150 lb - - - = 750 lb (B)
 Cargo Capacity (A - B) - - - - = 835 lb

*GVWR - Delivered Weight

TEST VEHICLE DELIVERED WEIGHT WITH MAXIMUM FLUIDS:

Right Front = <u>917</u> lb	TOTAL FRONT = <u>1870</u> lb (60.0% of TOTAL)
Left Front = <u>953</u> lb	
Right Rear = <u>612</u> lb	TOTAL REAR = <u>1245</u> lb (40.0% of TOTAL)
Left Rear = <u>633</u> lb	
TOTAL WEIGHT = <u>3115</u> lb	

TABLE 2-1 TEST VEHICLE DATA (Cont'd)

CALCULATION OF TEST VEHICLE TARGET WEIGHT:

Total Test Vehicle Delivered Weight With Maximum Fluids = 3115 lb
Maximum Cargo Carrying Capacity Of Test Vehicles* - - - = 300 lb
Weight Of Two P.572 Dummies (1 x 174 lb) - - - - - = 348 lb
TEST VEHICLE TARGET WEIGHT- - - - - = 3763 lb

* 300 lb for light trucks and MPVs

ACTUAL WEIGHT OF TEST VEHICLE WITH 1 DUMMY AND CARGO:

Right Front = 1096 lb
Left Front = 1148 lb
Right Rear = 767 lb
Left Rear = 752 lb
TOTAL FRONT = 2244 lb (59.6% of TOTAL)
TOTAL REAR = 1519 lb (40.4% of TOTAL)
TOTAL WEIGHT = 3763 lb (which includes 37 lb of cargo ballast weight)

TEST VEHICLE ATTITUDE:

As Delivered -- Right Front = 30.1 in Ready For Test -- Right Front = 28.7 in
Left Front = 29.9 in Left Front = 29.0 in
Right Rear = 30.7 in Right Rear = 28.6 in
Left Rear = 30.6 in Left Rear = 29.1 in
Test Vehicle Wheelbase: 111.8 in; C.G. = 45.2 in rearward of front wheel

TOTAL VEHICLE LENGTH:

Right Side = 173.8 in
Left Side = 173.8 in
Centerline = 176.5 in

TABLE 2-2 PRETEST CONDITIONS

VEHICLE YEAR/MAKE/MODEL/BODY STYLE: 1988/DODGE/CARAVAN

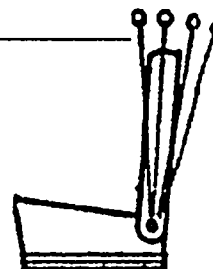
VEH. NHTSA NO. N/A; TEST DATE: 02/03/88

FRONT SEAT CUSHION PLACEMENT: Midpoint of forward/aft travel (6th notch rearward

TOTAL NUMBER OF ADJUSTMENT POSITIONS OR DETENTS: 10 notches

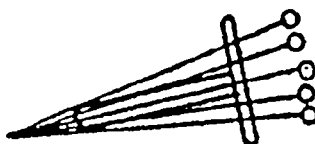
FRONT SEAT BACK ADJUSTMENT POSITION: Not Adjustable

(latch position, knob rotations, etc.)



ADJUSTABLE STEERING COLUMN POSITION:

X Not Applicable



Midpoint of swing

WINDOW POSITIONS: Left Front -- closed

Left Rear --- closed

Right Front - open

Right Rear -- glass removed

NOTE: Window 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: Front Standard Tank 14.0 Gal

Rear Optional Tank N/A Gal

(92 to 94% of USABLE CAPACITY)

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

Wheelbase = 111.8 in

Impact point is 18.9 inches Rearward of front axle centerline (which is 37 inches forward of the wheelbase midpoint).

TABLE 2-3 CRASH TEST SUMMARY FOR TEST VEHICLE

VEHICLE YEAR/MAKE/MODEL/BODY STYLE: 1988/DODGE/CARAVAN

VEH. NHTSA NO. TEST 04; VIN: 2B4FK21K5JR600890

TEST DATE: 02/03/89 BUILD DATE: 12/87

OVERALL LENGTH = 176.5 inches; OVERALL WIDTH = 69.3 inches

TEST WEIGHT: Left Front = 1148 lb; Left Rear = 752 lb

Right Front = 1096 lb; Right Rear = 767 lb

SUBTOTALS - - - Front = 2244 lb Rear = 1519 lb

TOTAL VEHICLE WEIGHT - - - - - 3763 lb

WHEELBASE = 111.8 inches

LONGITUDINAL C.G. FROM CENTER OF FRONT AXLE = 45.2 inches

IMPACT ANGLE WITH RESPECT TO IMPACTOR = 90 degrees

MAXIMUM EXTERIOR STATIC CRUSH:

1. LEVEL 1 (18.2" above ground) = 9.4 inches

2. LEVEL 2 (36.1" above ground) = 20.6 inches

3. LEVEL 3 (33.6" above ground) = 20.2 inches

4. LEVEL 4 (49.0" above ground) = 16.2 inches

5. LEVEL 5 (67.5" above ground) = 3.2 inches

MAXIMUM POSTTEST INTRUSION = 20.6 inches

OCCUPANTS:

DRIVER

LEFT REAR

TYPE OF DUMMY - - - - SID

SID

RESTRAINT USED- - - - None

None

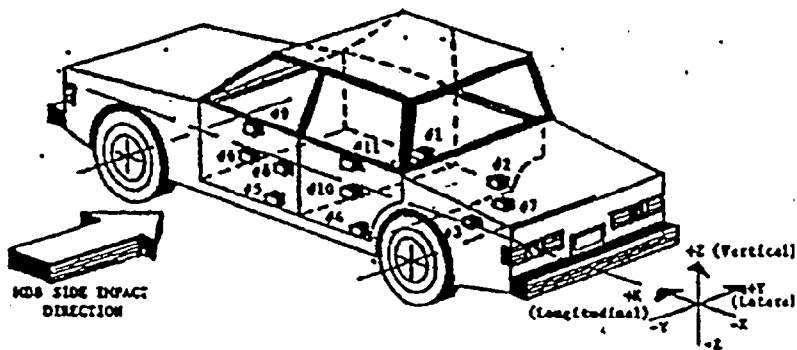
INSTRUMENTATION:

NUMBER OF DATA CHANNELS = 41

NUMBER OF CAMERAS: ONBOARD = 5 High-speed

OFFBOARD = 4 High-speed, 1 Real-time

TABLE 2-4 TEST VEHICLE ACCELEROMETER LOCATIONS AND DATA SUMMARY

TEST VEHICLE: 1988/DODGE/CARAVANNHTSA NO.: TEST 04TEST DATE: 02/03/89

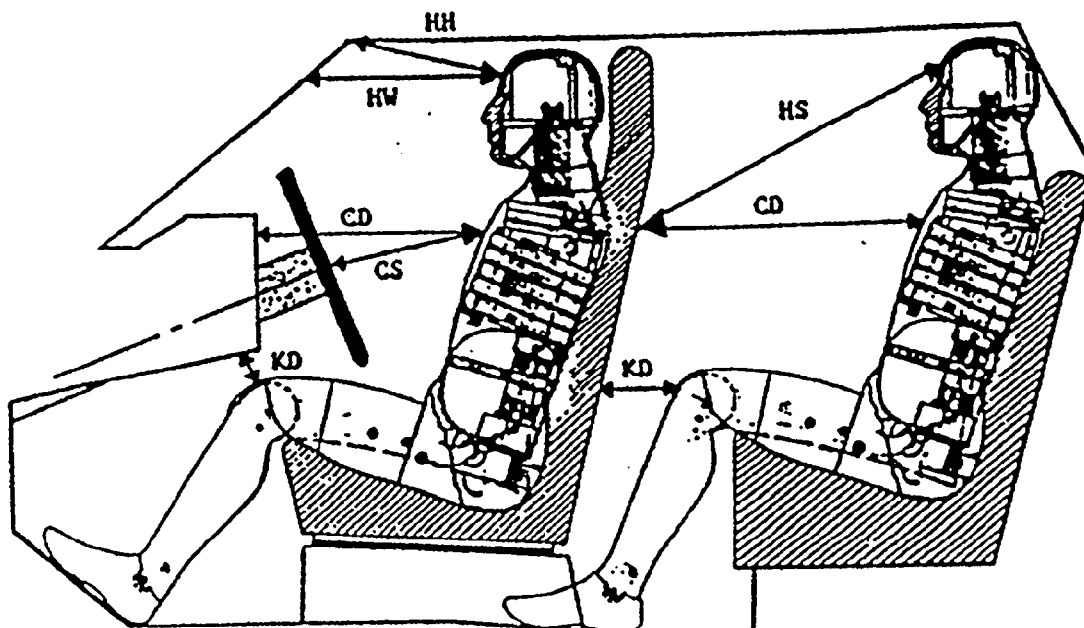
ACCEL NO.	LOCATION	COORDINATES (")			LONG. (X)		LAT. (Y)		VERT. (Z)		RESULTANT	
		X*	Y*	Z*	POS. /	NEG.	POS. /	NEG.	POS. /	NEG.	POS. /	NEG.
					MAX (g)	TIME (msec)	MAX (g)	TIME (msec)	MAX (g)	TIME (msec)	MAX (g)	TIME (msec)
1	Right Side Sill At Front Seat	108.1	25.0	16.0	-5.6	29.3	10.0	17.9	9.1	21.1	13.0	21.1
2	Right Side Sill At Rear Seat	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3	Right Floorpan Above Axle	30.0	0.0	20.5	-9.7	42.9	18.2	46.8	16.4	39.5	22.2	46.7
4	Left Side Sill At Rear Seat	NA	NA	NA			NA	NA				
5	Left Side Sill At Front Seat	98.5	-27.0	16.0			72.3	15.3				
6	Left Front Door on Centerline	103.7	-30.5	34.2			221.9	12.7				
7	Right Rear Occ. Compartment	NA	NA	NA	NA	NA						
8	Midrear of Left Front Door	89.2	-30.5	34.2			141.7	9.0				
9	Left Front Door Upper Centerline	104.9	-30.5	41.0			234.7	14.8				
10	Midrear of Left Rear Door	NA	NA	NA			NA	NA				
11	Left Rear Door Upper Centerline	NA	NA	NA			NA	NA				

* Reference: X - Rear Bumper (+ Forward)

Y - Vehicle Centerline (+ To Right)

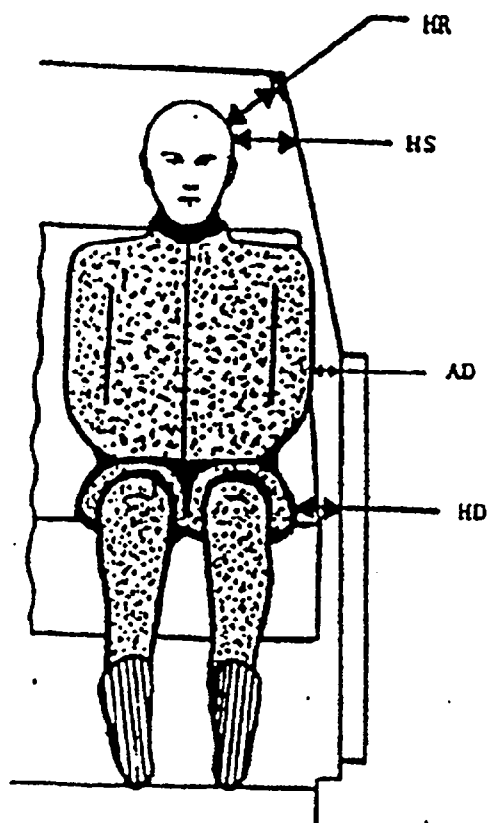
Z - Ground Level (+ Up)

TABLE 2-5 SIDE IMPACT DUMMY (SID) LONGITUDINAL CLEARANCE DIMENSIONS



	DRIVER ID # 137	REAR PASSENGER ID # 319
HH	19.0 in	NA in
HW	24.0 in	NA in
HS	NA in	30.0 in
CD	20.4 in	23.4 in
CS	12.8 in	NA in
KDL	4.7 in	10.2 in
KDR	4.0 in	10.8 in

TABLE 2-5 SIDE IMPACT DUMMY (SID) LONGITUDINAL CLEARANCE DIMENSIONS (Cont'd)



	DRIVER ID # 137	REAR PASSENGER ID # 319
HR	6.3 in	6.3 in
HS	8.0 in	11.0 in
AD	3.6 in	0.0 in
HD	5.7 in	11.8 in

TABLE 2-6 SIDE IMPACT DUMMY (SID) TEST DATA SUMMARY

TEST DATE: 02/03/89

TEST DATE: 02/03/89	FRONT DUMMY -- ID # 137				REAR DUMMY -- ID # 319			
	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	3.1	119.1	-12.1	63.5	5.9	93.8	-68.5	173.7
Lateral ----- Y	25.3	43.5	-9.7	226.1	69.5	67.7	-15.0	48.1
Vertical ----- Z	12.0	28.8	-51.3	57.5	26.6	77.7	-63.7	69.7
RESULTANT ----- R	52.8	57.5	0.0	0.0	94.0	69.3	0.0	0.0
HIC -----*		177.3			274.1			
RIB ACCELERATIONS:								
1. Upper Rib Lateral Y*	77.8	28.1	-10.9	70.0	61.9	49.4	-7.5	71.9
2. Upper Rib Lateral Y*	80.2	28.7	-10.5	69.4	61.8	49.4	-9.1	71.3
1. Lower Rib Lateral Y*	86.3	27.5	-12.0	68.1	71.6	38.8	-12.8	72.5
2. Lower Rib Lateral Y*	84.6	27.5	-12.7	68.1	70.4	38.8	-14.2	72.5
SPINE ACCELERATIONS:								
1. Upper Lateral Y*	75.5	36.9	-38.3	63.1	56.5	53.7	-11.0	75.6
2. Upper Lateral Y*	72.1	36.9	-38.0	63.1	54.0	53.7	-12.6	76.3
1. Lower Lateral Y*	95.8	33.7	-19.6	63.1	100.2	45.6	-13.5	78.1
2. Lower Lateral Y*	94.0	33.7	-21.2	63.1	99.6	45.0	-11.6	78.1
PELVIS ACCELERATIONS:								
Lateral Y*	119.8	29.4	-6.5	98.7	110.8	43.1	-5.4	140.0
RIB DEFLECTION:	0.26	227.9	-1.65	62.7	.12	207.6	-1.49	78.4
	in		in		in		in	

Data Required (other data to be used by R & D)

REFERENCE: Positive Direction -- Longitudinal (X) = forward

Lateral (Y) = to right

Vertical (Z) = up

Positive Direction -- Longitudinal (X) = rearward

Lateral (Y) = to left

Vertical (Z) = down

TABLE 2-7 CRASH TEST SUMMARY FOR SIDE IMPACTOR

TYPE OF TEST: 30/15 90 IMPACT TEST DATE 02/03/89

NHTSA NO. FOR TARGET VEHICLE: TEST 04

POSITION OF IMPACTOR (MDB) ON MONORAIL: CRABBED 26° TO RIGHT (CLOCKWISE)

MDB DETAILS: Overall Width of Framework Carriage = 49.35 in.

Overall Length of MDB = 162 in. (including honeycomb impact face)

Wheelbase of Framework Carriage = 102 in.

Tread of Framework Carriage (Front & Rear) = 72 in.

C.G. location rearward of front axle = 50 in.

MDB Weight -- Left Front = 1123 lb; Left Rear = 884 lb

Right Front = 1127 lb; Right Rear = 896 lb

SUBTOTAL: Front = 2200 lb; Rear = 1780 lb

TOTAL MDB WEIGHT = 3980 lb

IMPACT ANGLE (MDB C/L to Target Vehicle C/L) = 90

IMPACT SPEED = 33.6 MPH

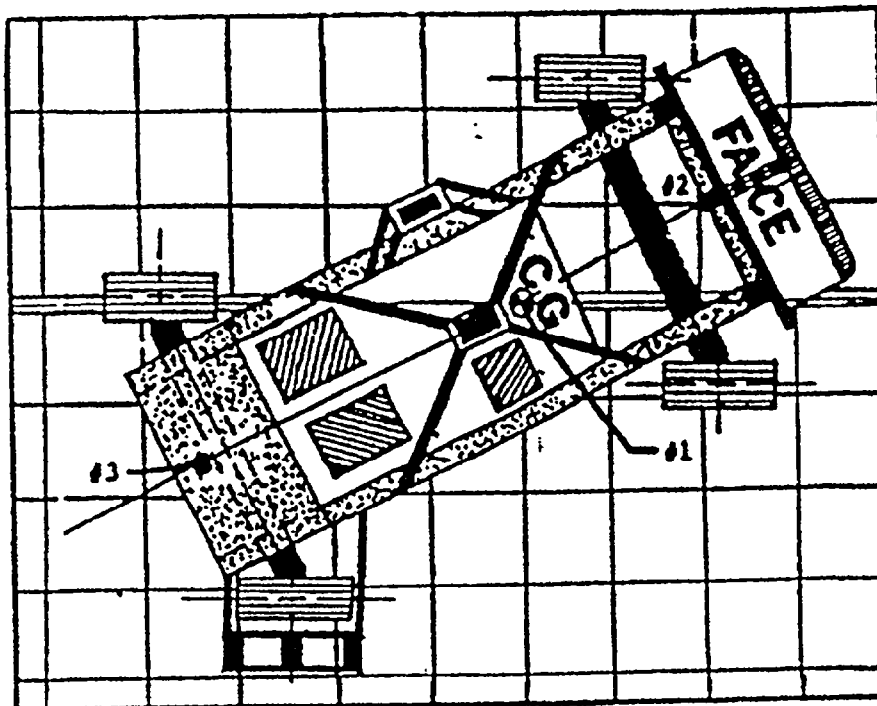
MAXIMUM STATIC CRUSH OF HONEYCOMB IMPACT FACE:

1. ROW A at bumper level = 5.0 in.
2. ROW B at mid-stack level = 1.5 in.
3. ROW C at top of stack level = 3.0 in.

INSTRUMENTATION:

Number of MDB Data Channels = 5 accelerometer channels

TABLE 2-8 MOVING DEFORMABLE BARRIER (MDB) ACCELEROMETER LOCATIONS AND SAMPLE DATA SUMMARY



ACCEL. NO.	LOCATION	Coordinates			POS. MAX (g)	DIRECT. TIME (msec)	NEG. MAX (g)	DIRECT. TIME (msec)
		X*	Y*	Z*				
1	MDB Center of Gravity							
	Longitudinal X				1.5	174.6	-9.5	38.1
	Lateral Y				5.7	48.5	-0.9	104.3
	Vertical Z	56.4	0.0	12.0	10.4	25.7	-9.6	47.7
	Resultant R				13.7	47.6	-0.0	0.0
2	Front Frame Member Longitudinal X	121.4	0.0	9.8	2.5	-----CHANNEL FAILED----		
3	Rear Frame Member Longitudinal X	2.5	0.0	14.0	2.8	129.8	-10.4	28.5

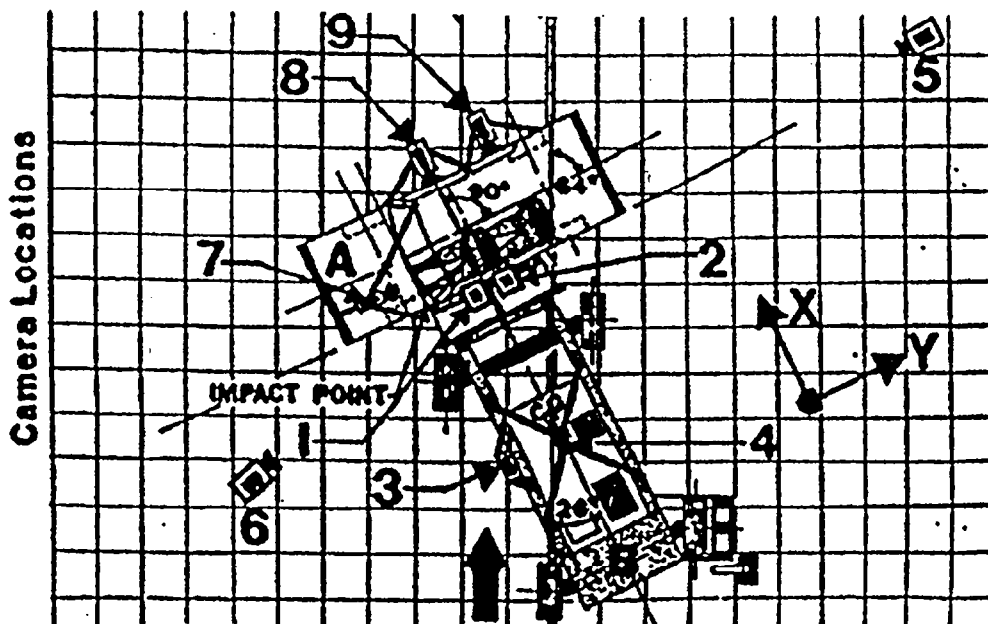
*Reference: X - Rearmost Frame Point (+ Forward)
Y - Centerline of MDB (+ Right)
Z - ground Level (+Up)

TABLE 2-9 HIGH-SPEED CAMERA LOCATIONS AND DATA

CAMERA NO.	LOCATION	TYPE	LENS (mm)	SPEED (fps)	COORDINATES (in)		
					X*	Y*	Z*
1	Overhead view of test vehicle dynamics	Fastex	8	600	0	0	252
2	Overhead Closeup view of impact plane	Fastex	8	600	0	0	252
3	MDB Onboard Closeup view of impact point	Himac	25	600	-88	18	49
4	MDB Onboard view of driver dummy kinematics	Himac	13	600	-118	33	80
5	Overhead view of test Level--Overall View	Photo-sonic	25	600	-18	648	39
6	Left Side Ground Level--Overall View	Himac	17	600	0	-208	48
7	Test Vehicle Onboard-driver dummy front view kinematics	Fastex	8	600	54	16	58
8	Test Vehicle Onboard-driver dummy side view kinematics	Fastex	8	600	-30	86	55
9	Test Vehicle Onboard-pass. dummy side view kinematics	Fastex	8	600	-70	86	56

NOTE: Real time (24 fps) film coverage of pre-test test, and post-test events included in final print

* Reference (from point of impact
+X = Forward
+Y = To Right
+Z = Upward
SAMPLE



ANGLES INDICATED ARE HYPOTHETICAL

SECTION 3

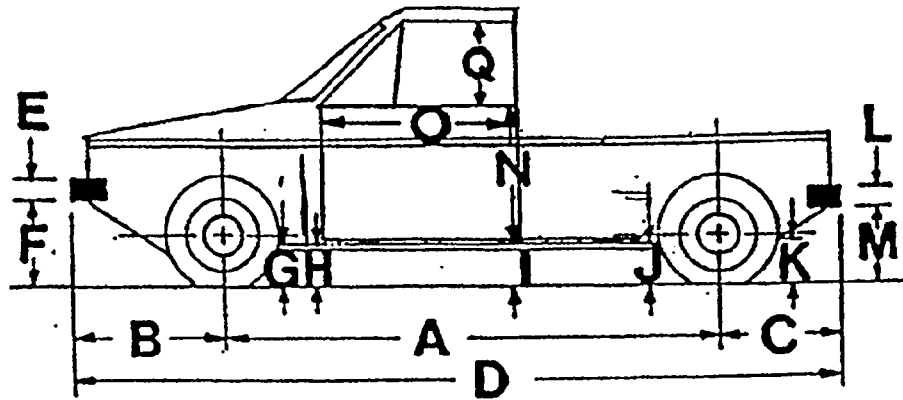
TEST RESULTS

The 1988 Dodge Caravan was impacted at 33.6 mph by the 26° crabbed MDB on 03 February 1989. The MDB's left edge contacted the test vehicle 0.0 inches rearward of the impact line. The test vehicle was spun around counterclockwise, the lighter back end of the vehicle pivoting around the heavier front. The vehicle left side was crushed inwards a maximum of 20.6 inches. Pretest and posttest vehicle dimensions are shown in Tables 3-1 to 3-5.

The front SID impacted the driver door with the left knee, hip and shoulder. The neck and body were rotated far enough by the impact force to allow the SID head to go through the driver side window. The SID head contacted the aluminum barrier during this action. The SID then rotated to its left while being thrown across the cab interior. The front SID's left foot and ankle were pinned by the driver door during the initial impact. This caused the bolt securing the left leg above the knee joint to be sheared off as the SID body was rotated and thrown across the vehicle. The left lower leg remained in the driver footwell area. The front SID came to rest straddling the right front window sill with his right leg inside the vehicle and head against the passenger seat.

The rear SID impacted the left side van interior with the left knee, hip and shoulder. The neck and body were rotated far enough by the impact force to allow the SID head to go through the left side window. The SID head contacted the upper, then lower portions of the window sill during this action. The SID then rotated to its left while being thrown across the rear passenger compartment. A combination of the SID momentum and the vehicle moving underneath him caused the SID to fall over the rear seat into the rear cargo

TABLE 3-1 PRE AND POSTTEST MEASUREMENTS



NOTE: All dimensions are in inches

	PRETEST	POSTTEST	CHANGE
A	111.8	111.5	0.3
B	31.8	31.8	0.0
C	29.8	29.81	0.0
D	173.4	173.1	0.3
E	6.5	6.5	0.0
F	14.9	15.2	-0.3
G	12.6	13.3	-0.7
H	14.3	18.6	-4.3
I	14.7	22.3	-7.6
J	13.3	17.8	-4.5
K	14.8	15.0	-0.2
L	5.8	5.8	0.0
M	16.0	16.0	0.0
N	20.0	20.0	8.3
O	42.8	42.2	0.6
P	77.0	75.5	1.5
Q	20.0	19.8	0.2

TABLE 3-2 VEHICLE SIDE MEASUREMENT

TEST VEHICLE NHTSA NO.: TEST #04	
LEVEL 5 • Window Top	62.1 in
LEVEL 4 • Window Sill	42.3 in
LEVEL 3 • Mid Door	28.4 in
LEVEL 2 • Occupant H-Point	31.1 in
LEVEL 1 • Axle Centerline Height	14.6 in

(or Sill Top Height)

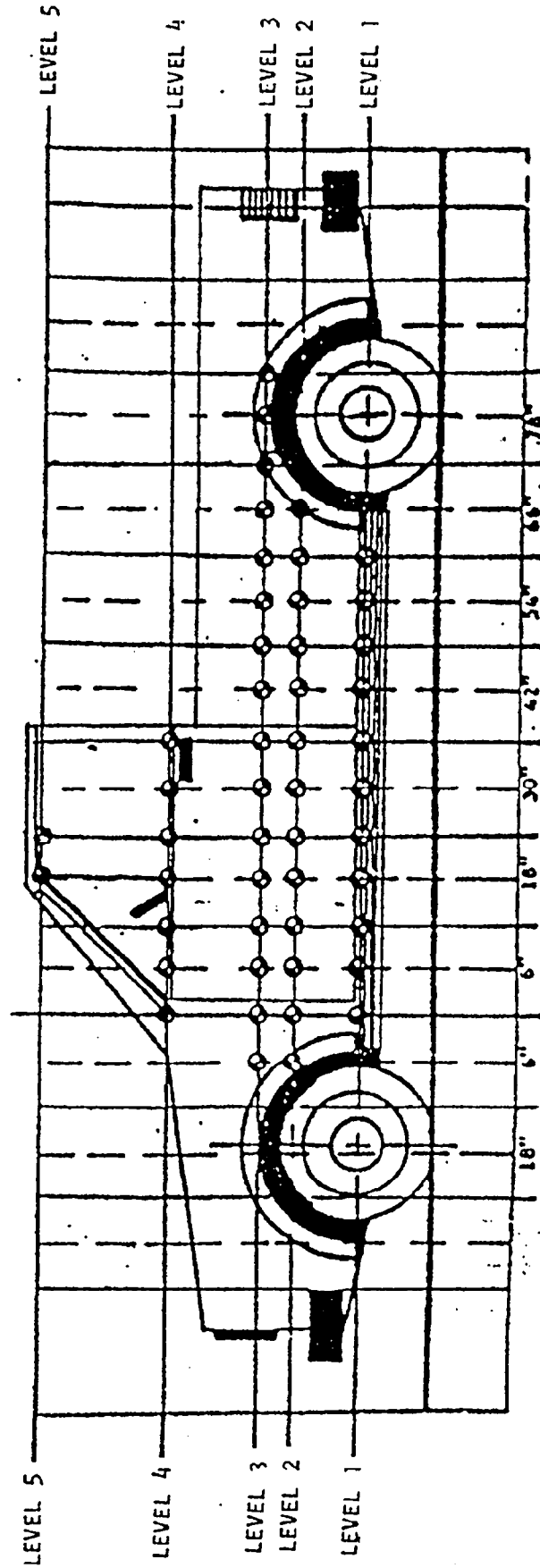


TABLE 3-3 TEST VEHICLE EXTERIOR PROFILES FROM REFERENCE PLANE* AND STATIC CRUSH DATA

TEST DATE		IMPACT POINT													
LOCATION:	HEIGHT (in)	PROFILES/CRUSH	6"	0"	6"	12"	18"	24"	30"	36"	42"	48"	54"	60"	72"
1. Window Top	62.1	Posttest- - - Pretest - - - Static Crush- -	NA NA NA	NA NA NA	NA NA NA	NA NA NA	21.7 20.8 0.9	21.5 20.8 0.7	21.2 20.7 0.5	21.9 20.7 1.2	21.5 20.6 0.9	23.7 20.5 3.2	23.4 20.6 2.8	23.3 20.6 2.7	22.9 20.6 2.7
2. Window Sill	42.3	Posttest- - - Pretest - - - Static Crush- -	17.0 15.6 1.4	21.7 15.1 6.6	19.0 15.0 4.0	25.4 14.9 10.5	29.8 14.6 15.2	29.7 14.5 15.2	29.6 14.5 15.1	29.8 14.4 15.4	29.7 14.3 15.4	30.4 14.2 16.2	29.9 14.1 15.8	29.9 14.0 15.9	30.0 14.0 16.0
3. Mid-Door	28.4	Posttest- - - Pretest - - - Static Crush- -	16.0 13.9 2.1	21.0 13.7 7.3	23.3 13.5 9.8	32.7 13.3 19.4	33.4 13.2 20.2	32.5 13.1 19.4	31.7 13.0 18.7	30.9 12.9 18.0	30.0 12.8 17.2	32.5 12.7 19.8	31.9 12.6 19.3	31.5 12.6 18.9	30.0 12.6 17.4
4. H-Point	31.1	Posttest- - - Pretest - - - Static Crush- -	16.0 13.9 2.1	18.8 13.7 5.1	22.5 13.5 9.0	30.5 13.3 17.2	33.5 13.2 20.3	33.3 13.1 20.2	33.5 12.9 20.6	30.3 12.9 17.4	32.0 12.8 19.2	31.8 12.7 19.1	31.5 12.6 18.9	30.0 12.6 17.4	29.8 12.6 16.9
5. Axle Centerline	14.6	Posttest- - - Pretest - - - Static Crush- -	NA NA NA	17.5 15.9 1.6	19.0 15.8 3.2	23.0 15.6 7.4	22.9 15.4 7.5	23.5 15.4 8.1	23.8 15.4 8.4	24.8 15.4 9.4	24.5 15.1 9.4	21.8 15.0 6.8	21.0 15.0 6.0	19.5 15.0 4.5	19.3 15.0 4.3

*Reference Plane is parallel to and 48 inches from test vehicle longitudinal centerline

TABLE 3-4A PRE AND POSTTEST EXTERIOR PROFILE AT LEVEL 1 - WINDOW TOP - 14.6" ABOVE GROUND LEVEL

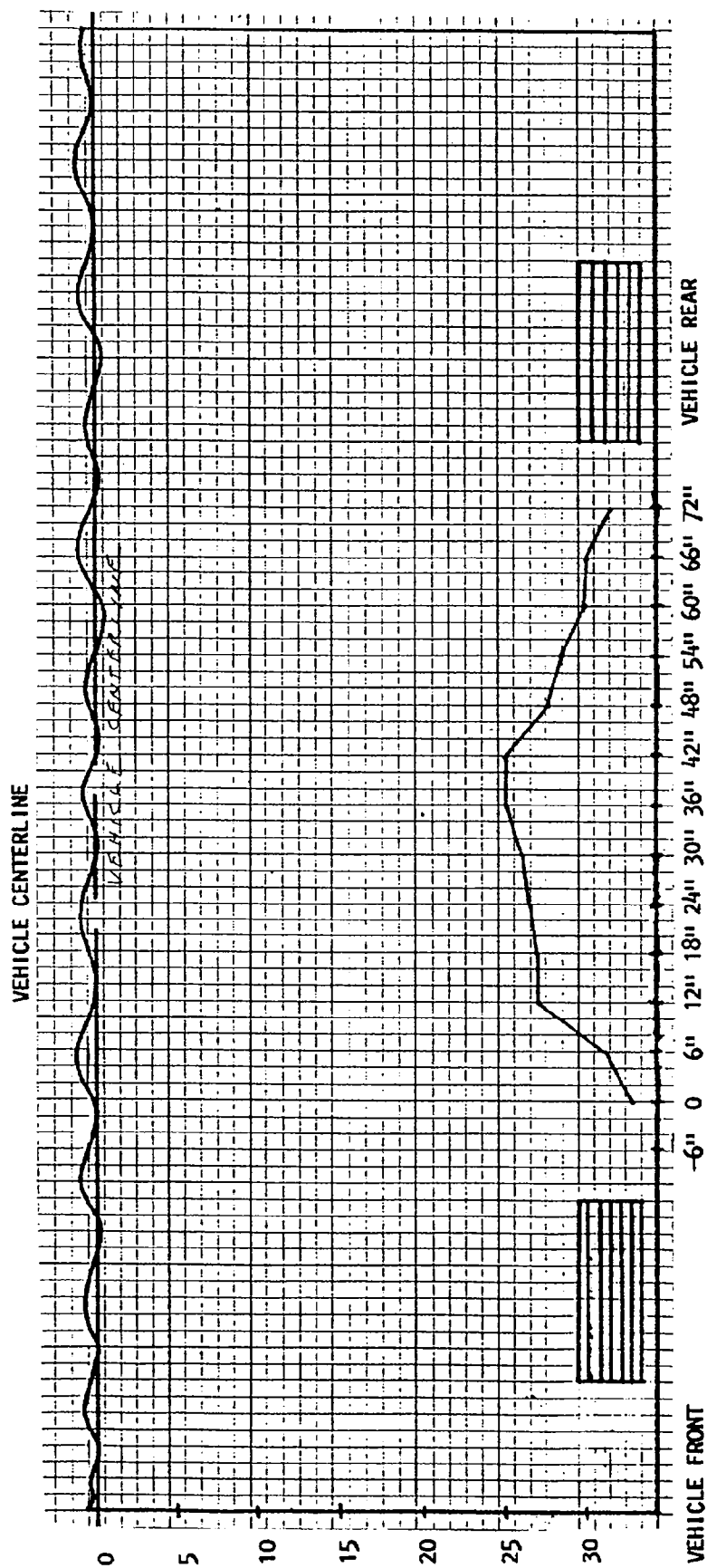


TABLE 3-4B PRE AND POSTTEST EXTERIOR PROFILE AT LEVEL 2 - WINDOW SILL - 31.1" ABOVE GROUND LEVEL

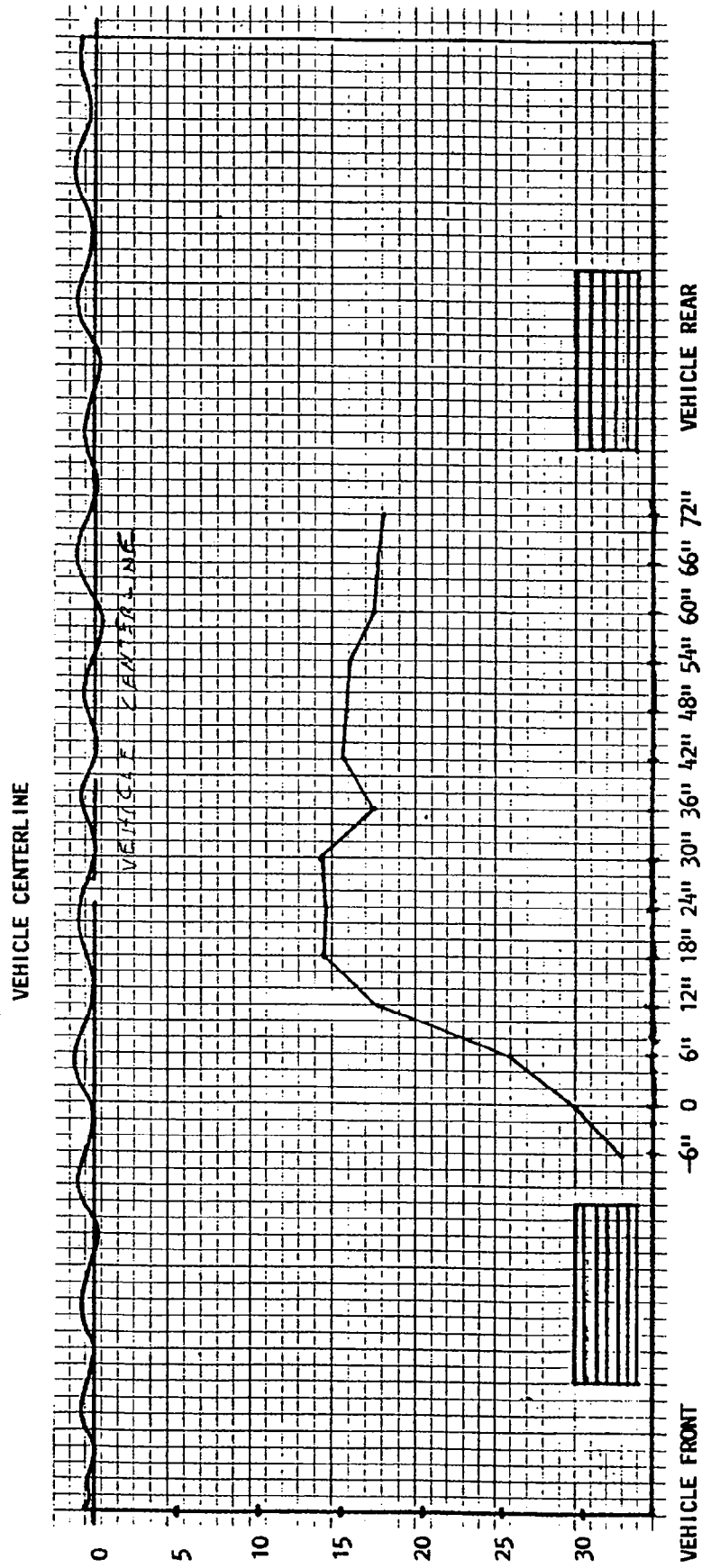


TABLE 3-4C PRE AND POSTTEST EXTERIOR PROFILE AT LEVEL 3 - MID DOOR - 28.4" ABOVE GROUND LEVEL

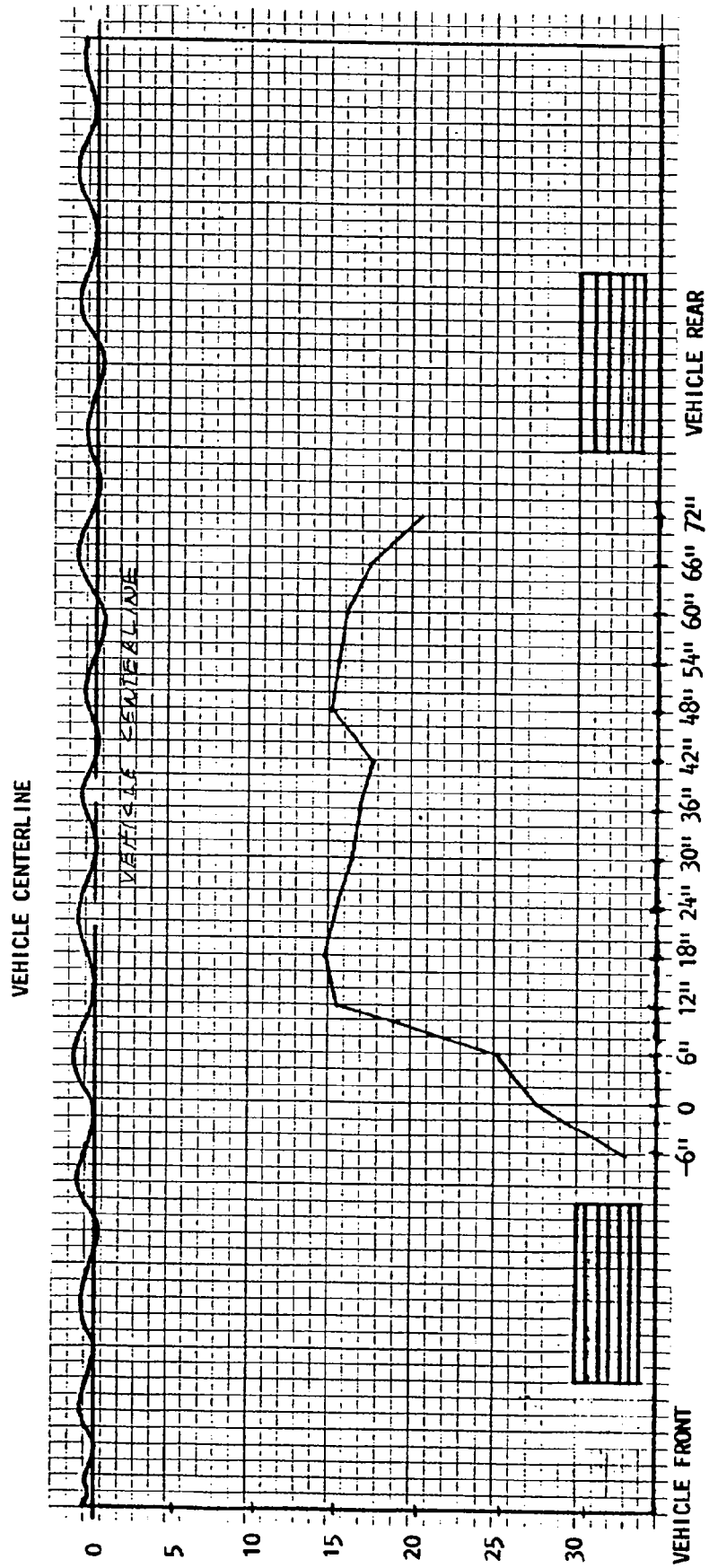


TABLE 3-4D PRE AND POSTTEST EXTERIOR PROFILE AT LEVEL 4 - H POINT - 42.3" ABOVE GROUND LEVEL

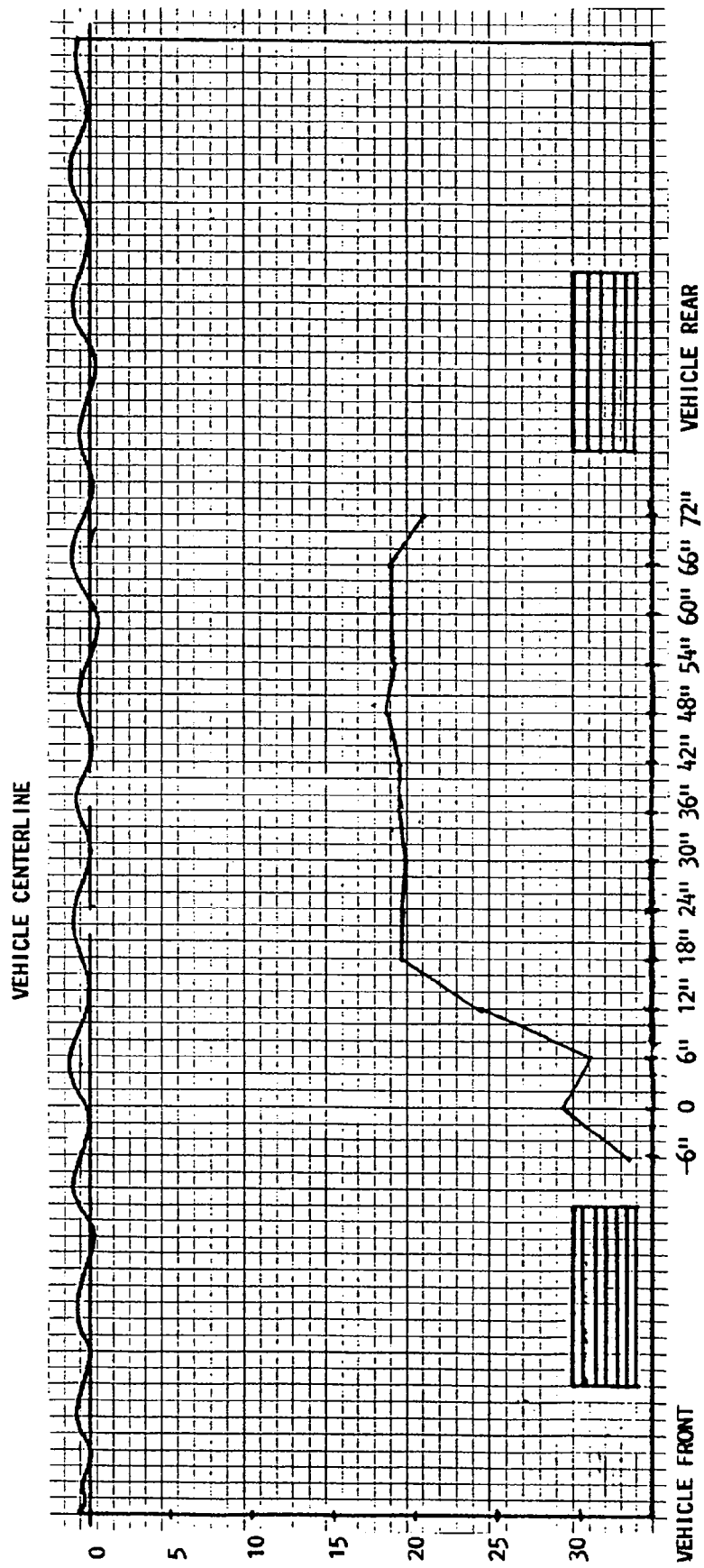


TABLE 3-4E PRE AND POSTTEST EXTERIOR PROFILE AT LEVEL 5 - AXLE CENTERLINE - 42.3" ABOVE GROUND LEVEL

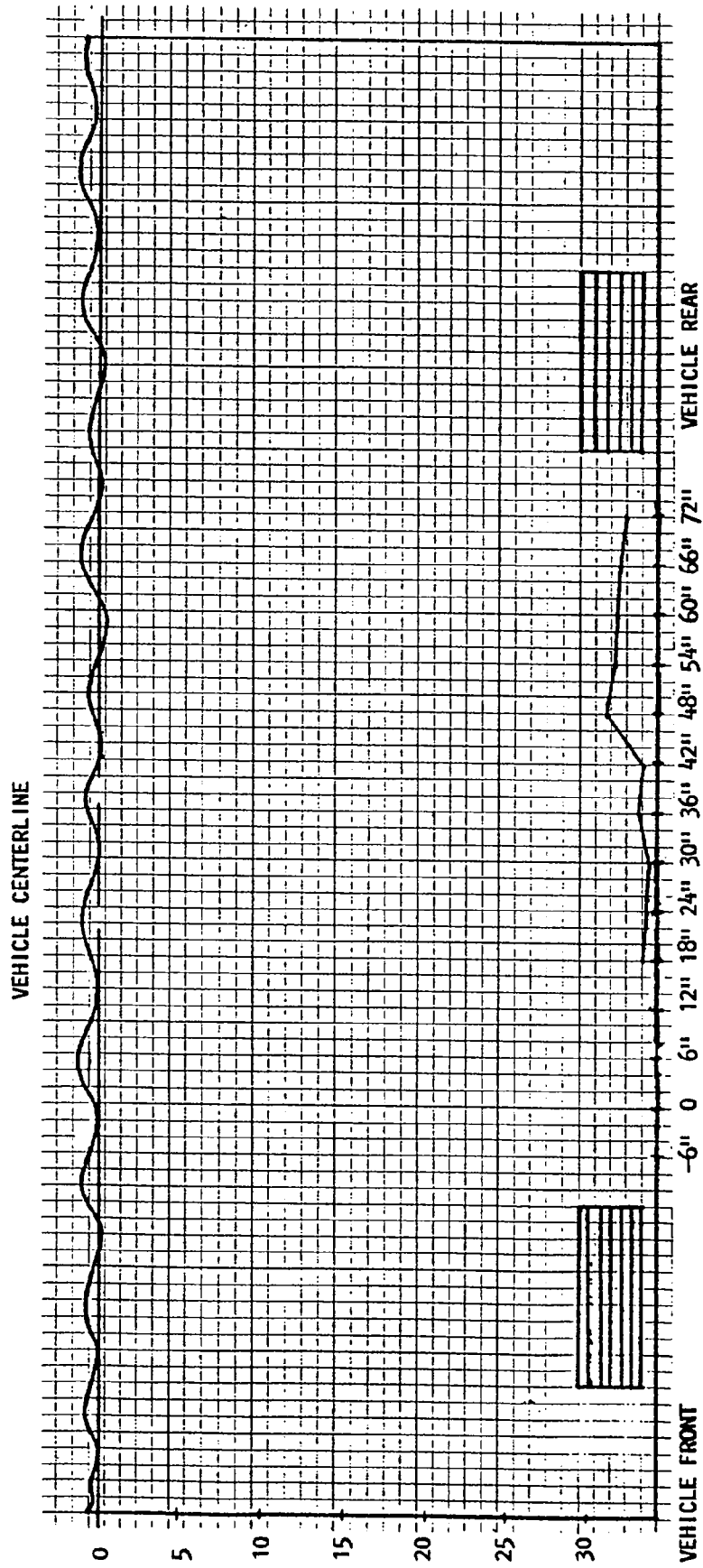


TABLE 3-5 TEST VEHICLE MEASUREMENTS (Cont'd)

NO.	MEASUREMENT DESCRIPTION	Pre-Test (in.)	Post-Test (in.)	Diff. (in.)
X1	Total Length of Test Vehicle at Centerline	176.5	176.5	0.0
X2	Rear Surface of Vehicle to Front of Engine	159.3	159.3	0.0
X3	Rear Surface of Vehicle to Firewall	136.5	136.5	0.0
X4	Rear Surface to Upr. Leading Edge of Right Door	128.0	127.8	0.2
X5	Rear Surface to Upr. Leading Edge of Left Door	128.0	123.3	4.7
X6	Rear Surface to Lwr. Leading Edge of Right Door	124.8	124.3	0.5
X7	Rear Surface to Lwr. Leading Edge of Left Door	124.8	118.8	6.0
X8	Rear Surface to Upr. Trailing Edge of Right Door	85.5	85.0	0.5
X9	Rear Surface to Upr. Trailing Edge of Left Door	85.5	84.3	1.2
X10	Rear Surface to Lwr. Trailing Edge of Right Door	84.8	84.5	0.3
X11	Rear Surface to Lwr. Trailing Edge of Left Door	84.8	86.3	-1.5
X12	Rear Surface to Bottom 'A' Post on Right Side	123.5	123.5	0.0
X13	Rear Surface to Bottom 'A' Post on Left Side	123.5	122.3	1.2
X14	Rear Surface to Firewall on Right Side	133.3	133.3	0.0
X15	Rear Surface to Firewall on Left Side	132.8	132.8	0.0
X16	Rear Surface to Steering Column	111.5	109.3	2.2
X17	Center of Steering Column to 'A' Post	16.8	16.0	0.8
X18	Center Steering Column to Headlining	18.5	18.0	0.5
X19	Rear Surface to Right Side of Front Bumper	173.8	173.8	0.0
X20	Rear Surface to Left Side of Front Bumper	173.8	173.8	0.0

area. The rear SID came to rest lying on its left side in the rear cargo area. SID contact is documented in Table 3-6.

The MDB impacted the test vehicle and was stopped by the remote brake system to prevent a second impact. The aluminum deformable barrier received minor to the front face with a maximum crush of 5.0 inches. The left side of the impactor was momentarily pinned in the vehicle driver door which caused the hexcel face to be ripped from its aluminum backing plate. The crush details for the MDB are given in Table 3-7.

TABLE 3-6 POSTTEST OBSERVATIONS

TEST VEHICLE: 1988 DODGE CARAVAN; NHTSA NO.: TEST 04

<u>VISIBLE DUMMY CONTACT POINT:</u>	<u>FRONT SID</u>	<u>REAR SID</u>
HEAD - - - - -	<u>Passenger Seat back</u>	<u>Left Rear Window Sill</u>
CHEST - - - - -	<u>Driver Door</u>	<u>Left Rear Interior</u>
ABDOMEN - - - - -	<u>Driver Door</u>	<u>Left Rear Interior</u>
LEFT KNEE - - - - -	<u>Driver Door</u>	<u>Left Rear Interior</u>
RIGHT KNEE - - - - -	<u>None</u>	<u>Ceiling Above Rear Seat</u>

<u>DOOR OPENING:</u>	<u>LEFT SIDE</u>	<u>RIGHT SIDE</u>
FRONT - - - - -	<u>Needed Tools to Open</u>	<u>Fully latched</u>
REAR - - - - -	<u>N/A</u>	<u>Fully latched</u>

SEAT MOVEMENT:

Driver seat was pushed across laterally until it contacted the front passenger seat. Driver seat tracks were greatly distorted.

GLAZING DAMAGE:

Very slight cracking of windshield, no separation.

OTHER NOTABLE IMPACT EFFECTS:

Small solvent leak (less than 1 oz./minute) at point where filler neck enters fuel tank.

TABLE 3-7 EXTERIOR STATIC CRUSH FOR SIDE IMPACTOR

LOCATION	HEIGHT at CL*	DISTANCE RIGHT OF CENTER										DISTANCE LEFT OF CENTER**									
		32"	28"	24"	20"	16"	12"	8"	4"	0"	4"	8"	12"	16"	20"	24"	28"	32"			
Top of Stack Level	39"	2.5	1.0	0.5	0.0	0.1	0.1	0.3	0.3	0.3	0.1	0.1	0.0	0.0	0.2	0.4	0.7	3.0			
Mid-Stack Level	29"	1.5	1.0	0.5	0.4	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2			
Bumper Level	24"	5.0	3.5	3.0	2.8	2.2	2.2	1.5	1.7	1.5	1.5	1.4	1.2	1.1	1.0	1.0	1.0	1.2			

* Heights measured above ground level.

** Impact Side

APPENDIX A
PHOTOGRAPHIC COVERAGE

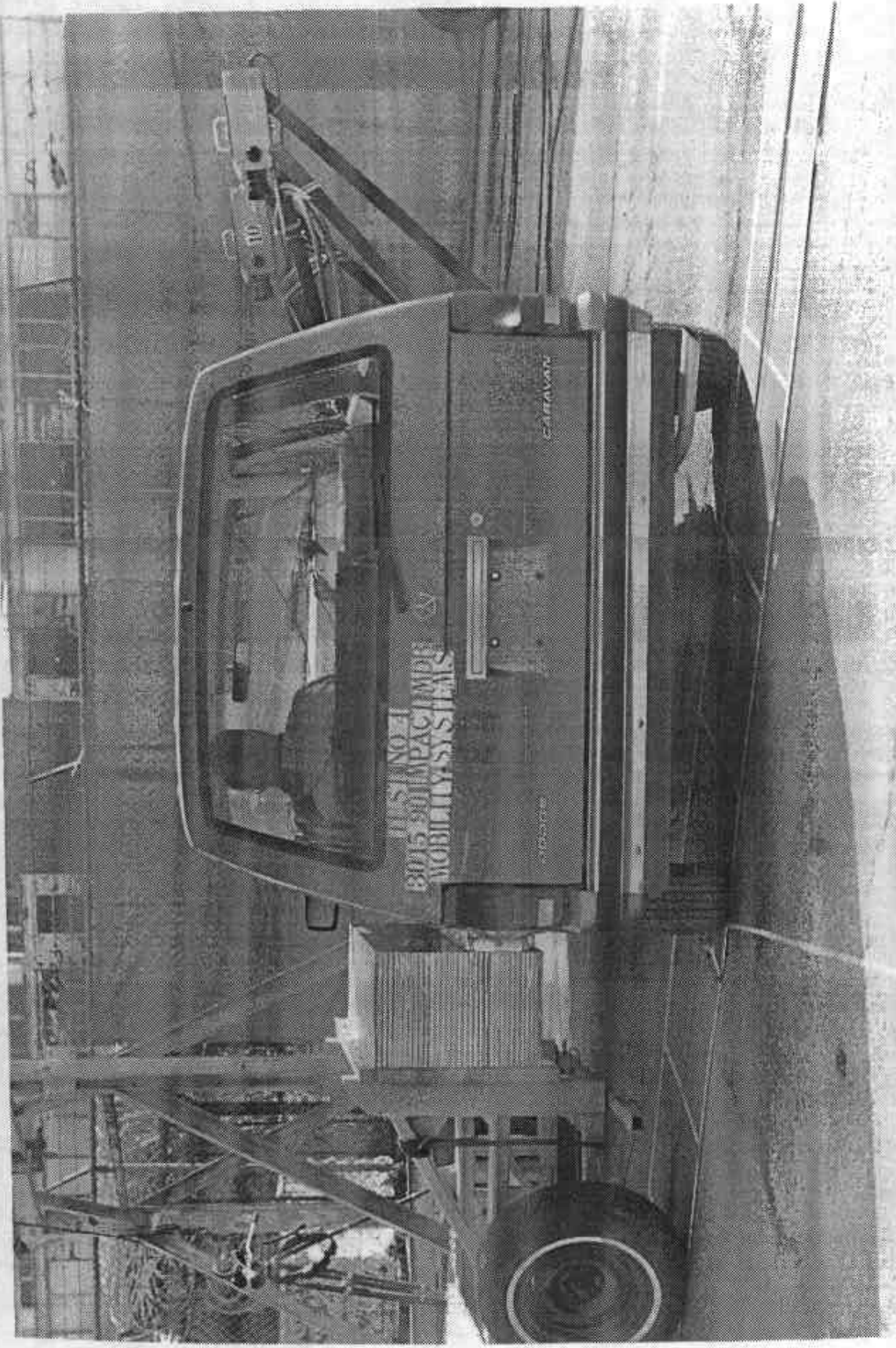


FIGURE A-1 MDB AT TEST VEHICLE, OVERALL VIEW PRETEST

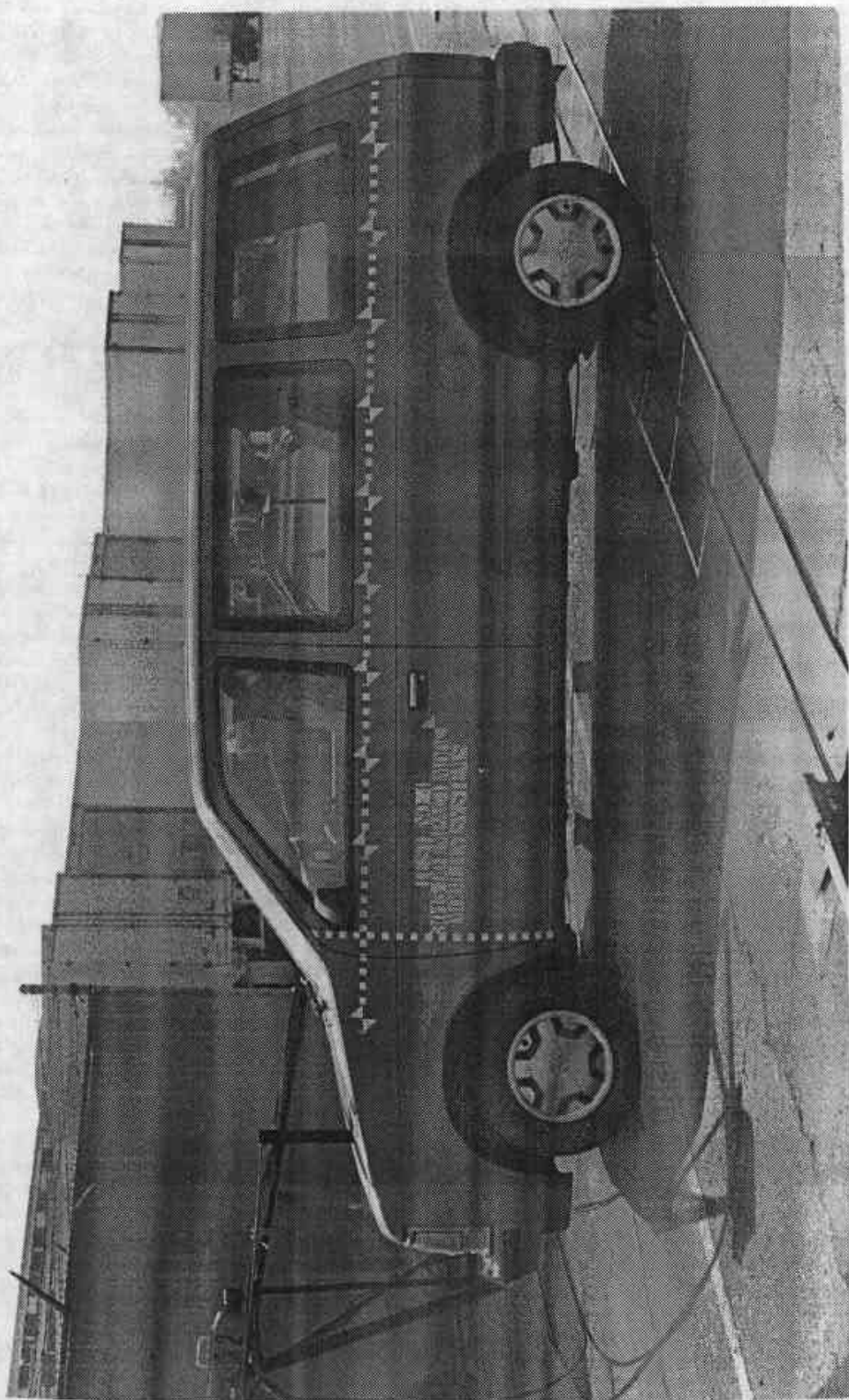


FIGURE A-2 TEST VEHICLE, LEFT SIDE VIEW - PRETEST



FIGURE A-3 TEST VEHICLE AND MDB, FRONT VIEW - PRETEST

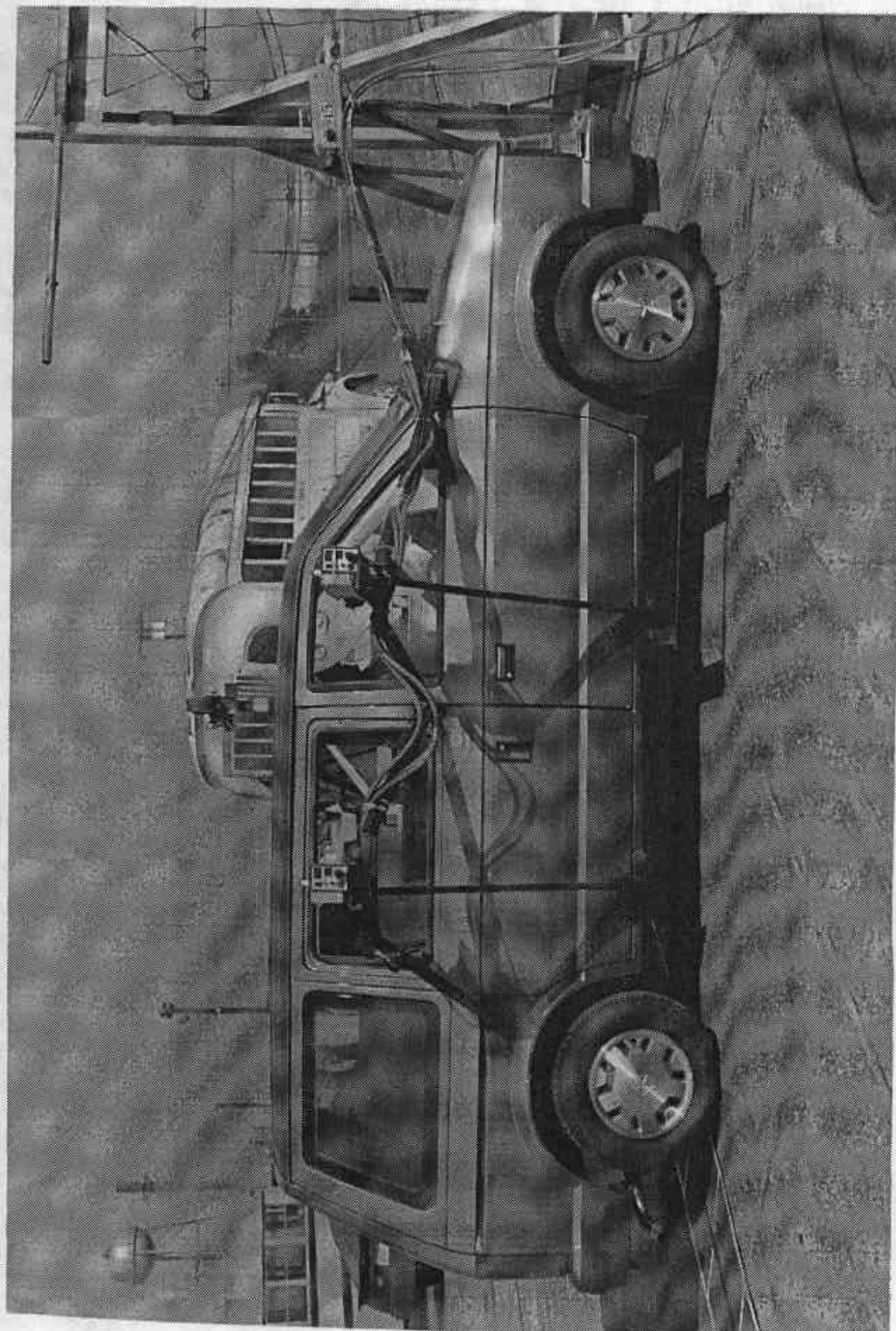


FIGURE A-4 TEST VEHICLE, RIGHT SIDE VIEW - PRETEST



FIGURE A-5 TEST VEHICLE OVERHEAD VIEW - PRETEST

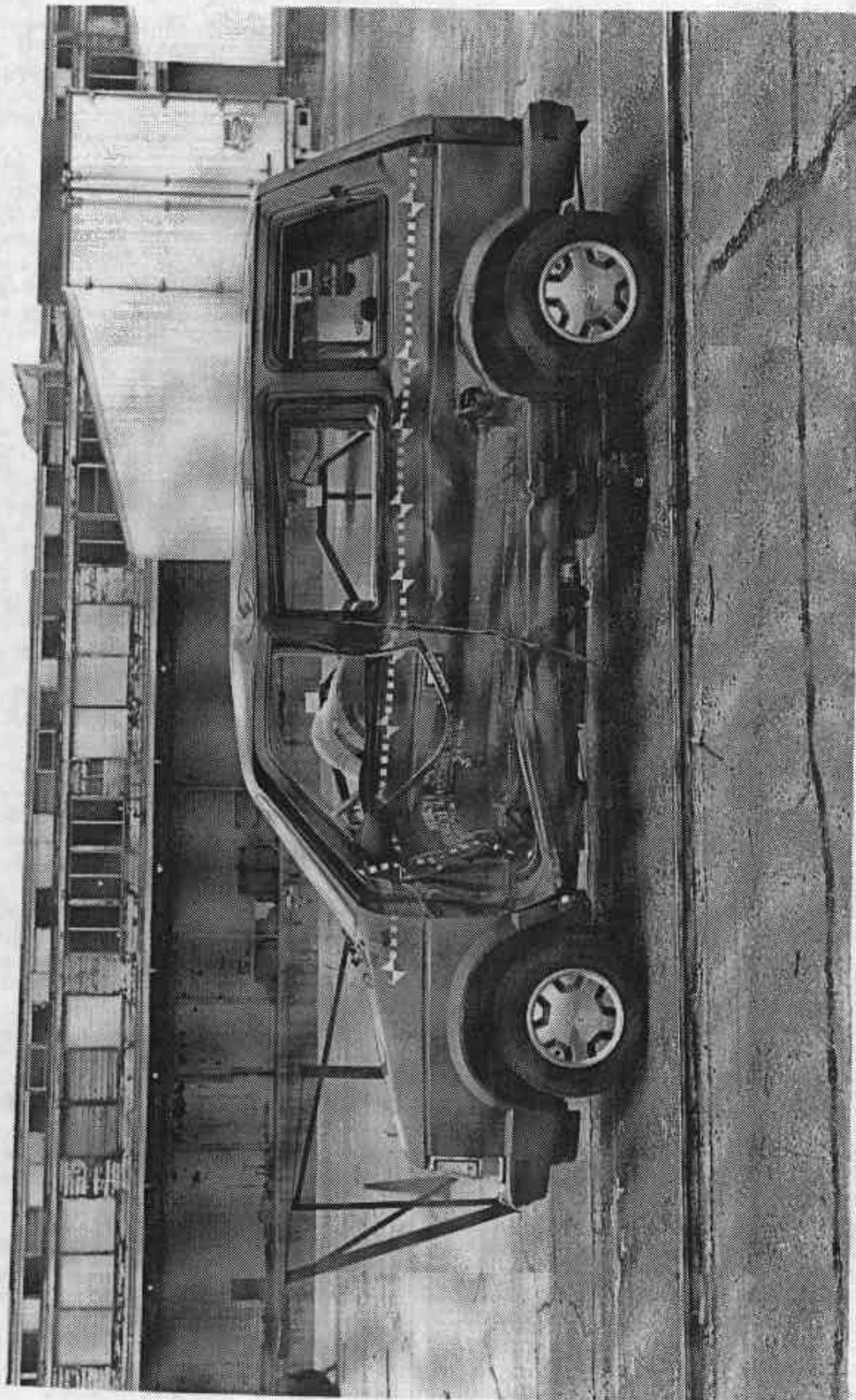


FIGURE A-6. TEST VEHICLE, LEFT SIDE VIEW - POSTTEST

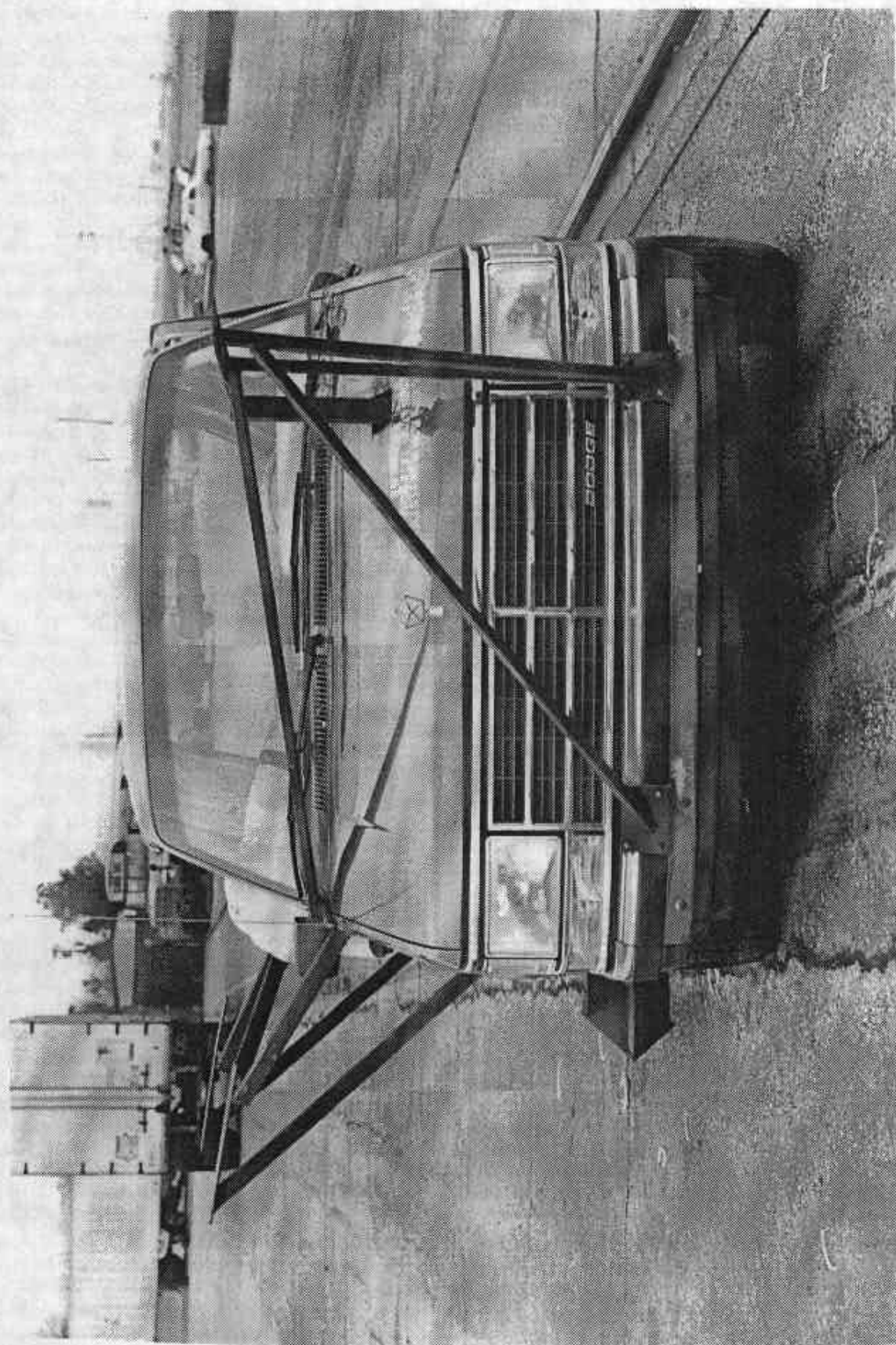


FIGURE A-7 TEST VEHICLE AND MDB, FRONT VIEW -POSTTEST

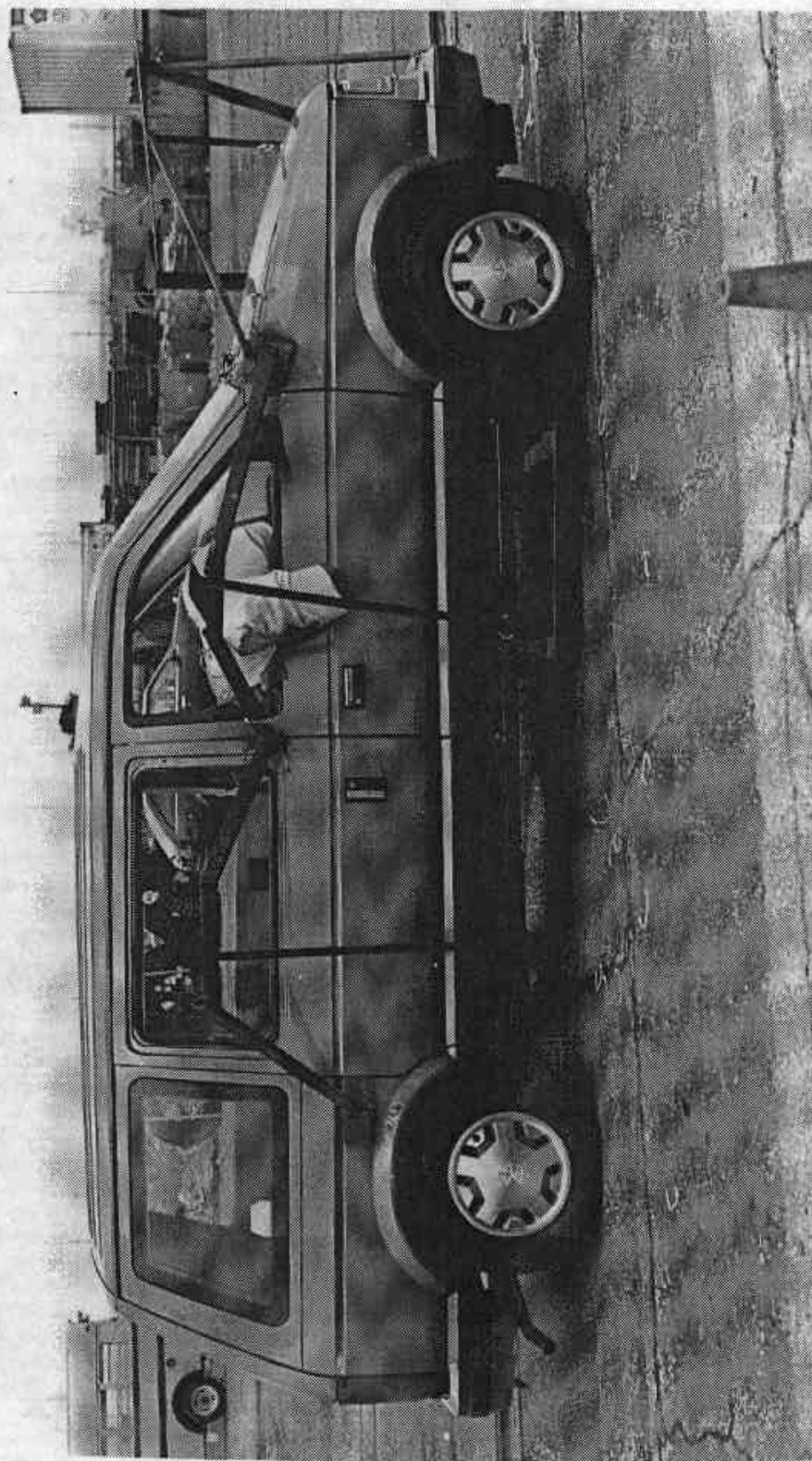


FIGURE A-8 TEST VEHICLE, RIGHT SIDE VIEW - POSTTEST



FIGURE A-9. MDB AND TEST VEHICLE, REAR VIEW - POSTTEST

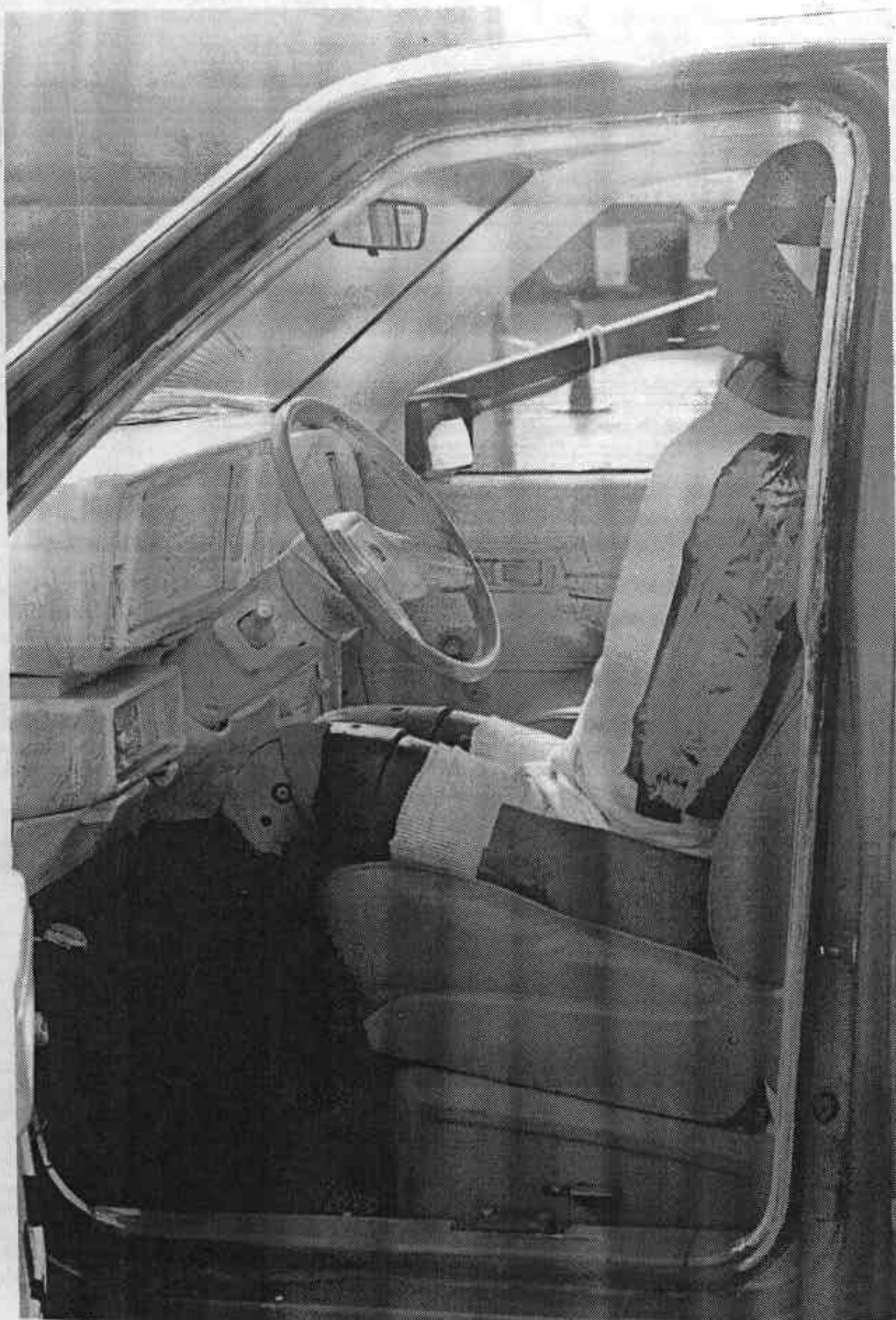


FIGURE A-10 FRONT SID IN DRIVER POSITION - PRETEST



FIGURE A-11 REAR SID IN LEFT REAR PASSENGER POSITION - PRETEST

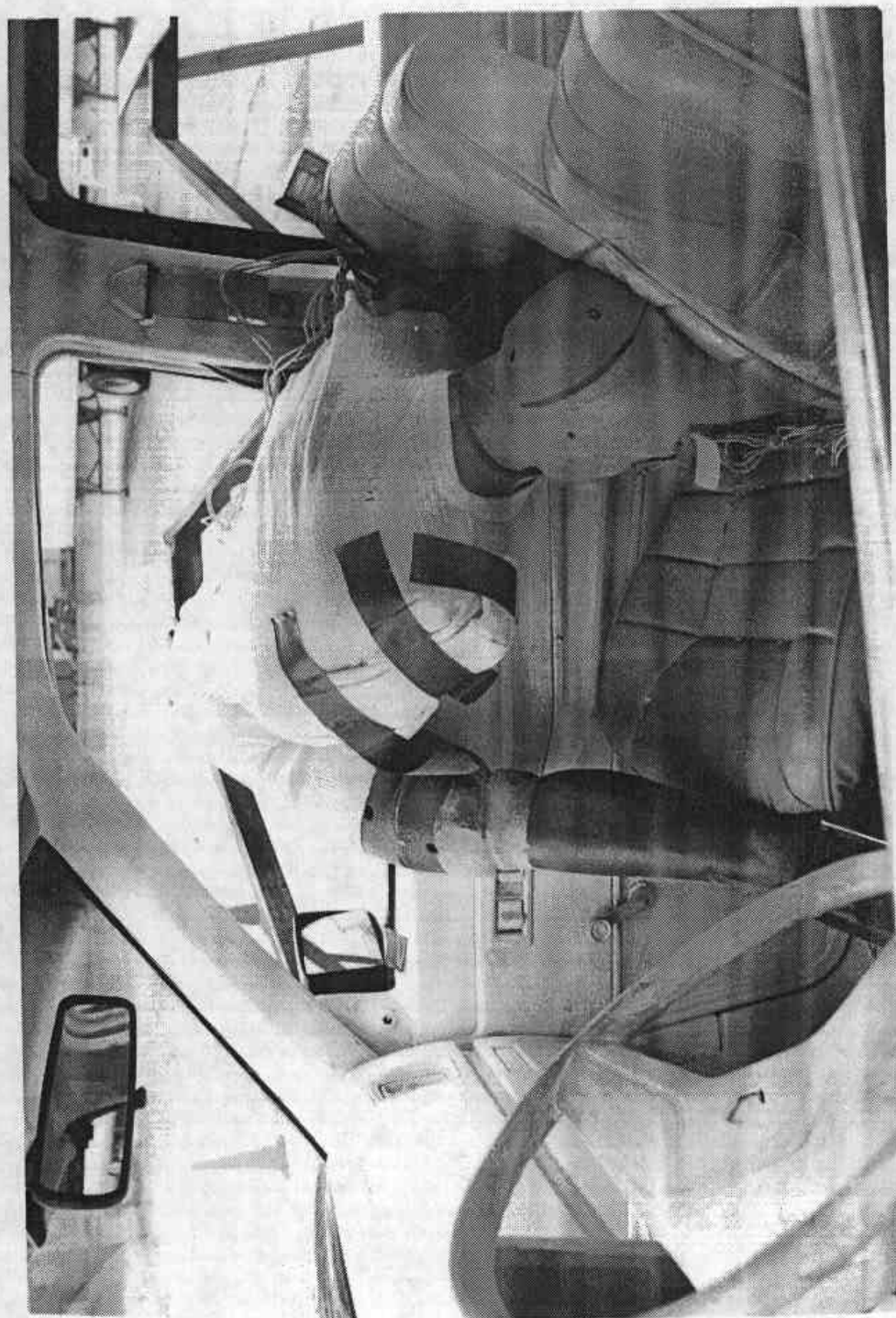


FIGURE A-12 FRONT SID FINAL POSITION - POSTTEST (INTERIOR VIEW)



FIGURE A-13 FRONT SID FINAL POSITION - POSTTEST (EXTERIOR VIEW)

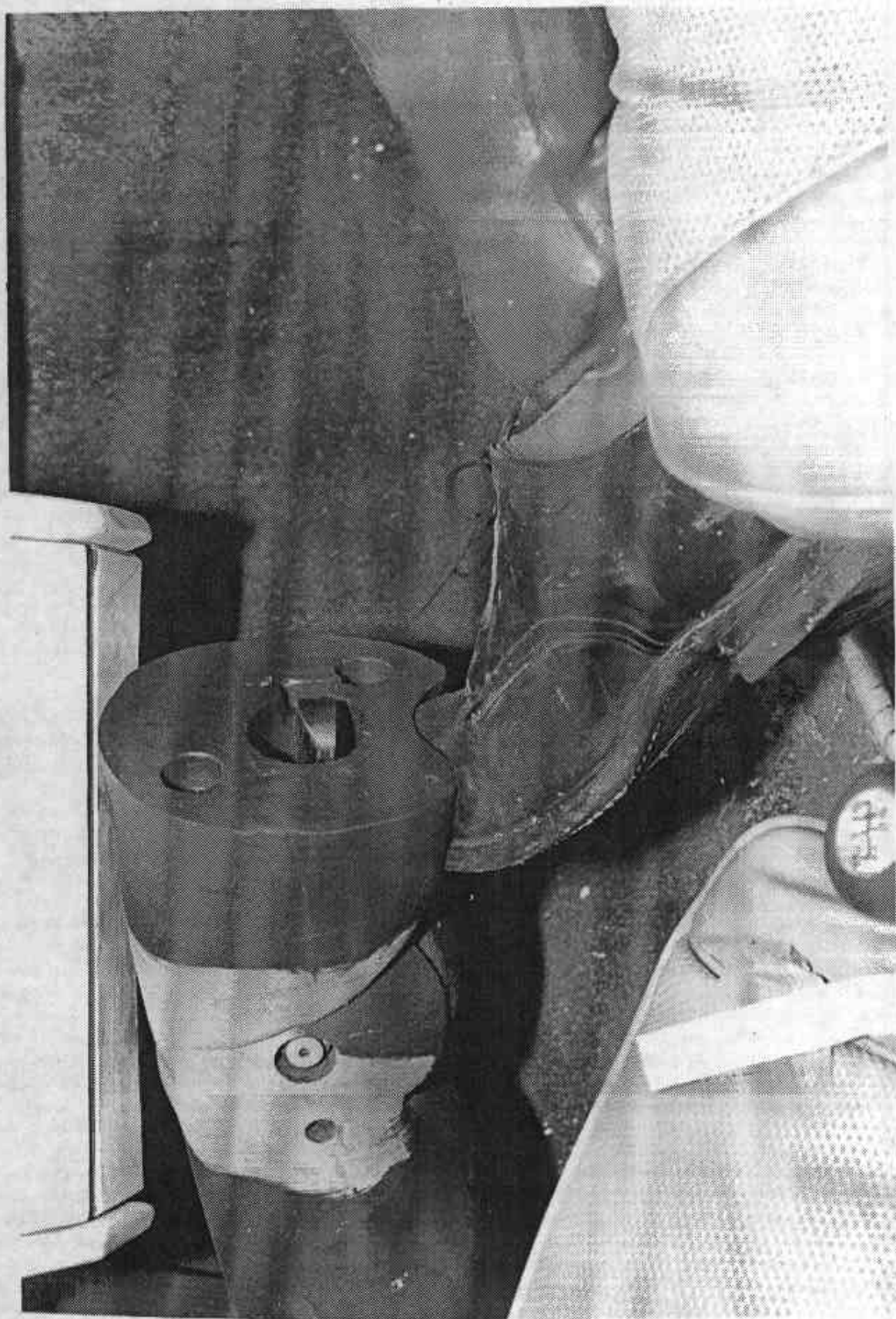


FIGURE A-14 FRONT SID LEFT LOWER LEG CLOSEUP VIEW - POSTTEST

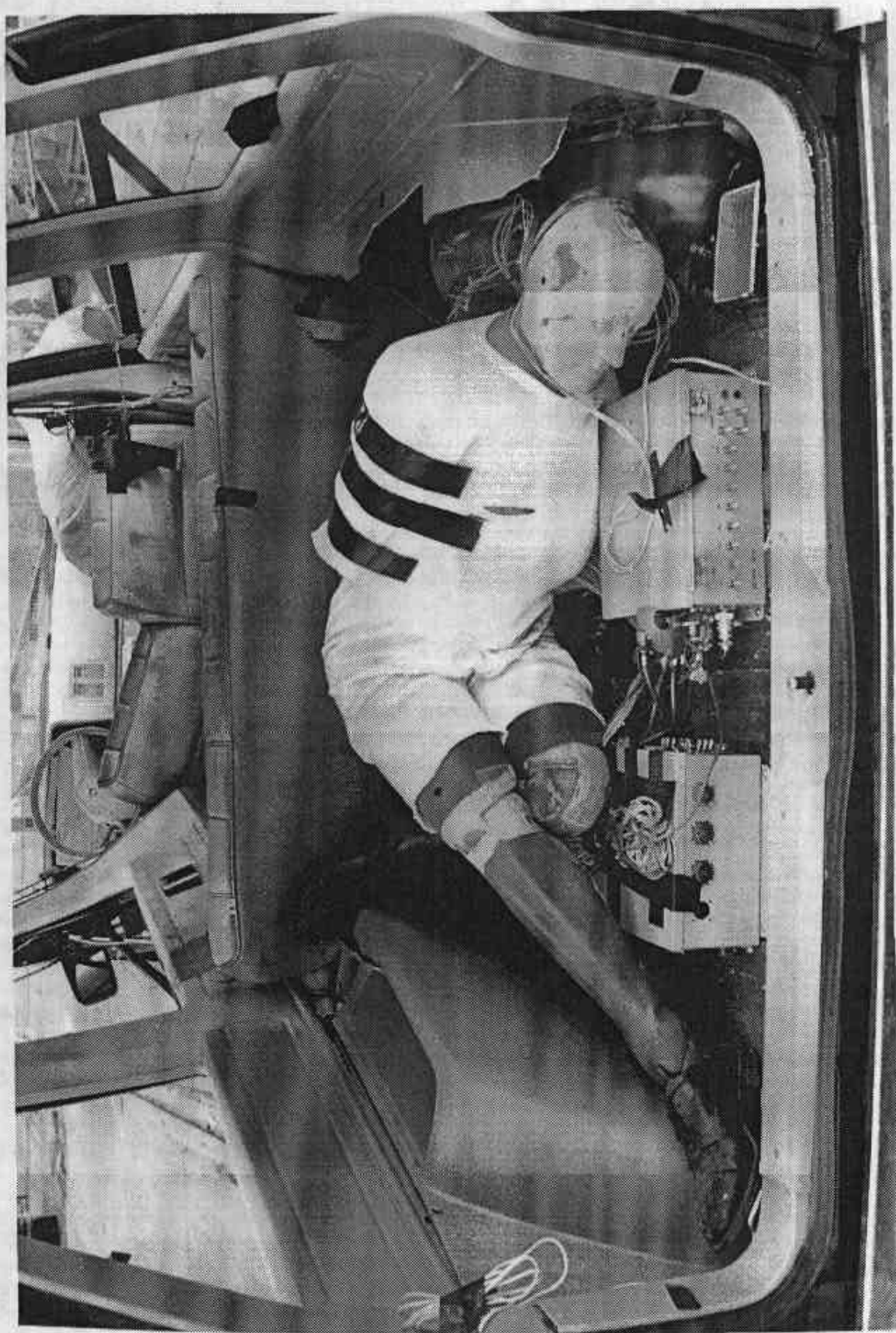


FIGURE A-15 REAR SID FINAL POSITION - POSTTEST



FIGURE A-16 FRONT OCCUPANT COMPARTMENT INTERIOR - POSTTEST



FIGURE A-17 REAR OCCUPANT COMPARTMENT INTERIOR - POSTTEST

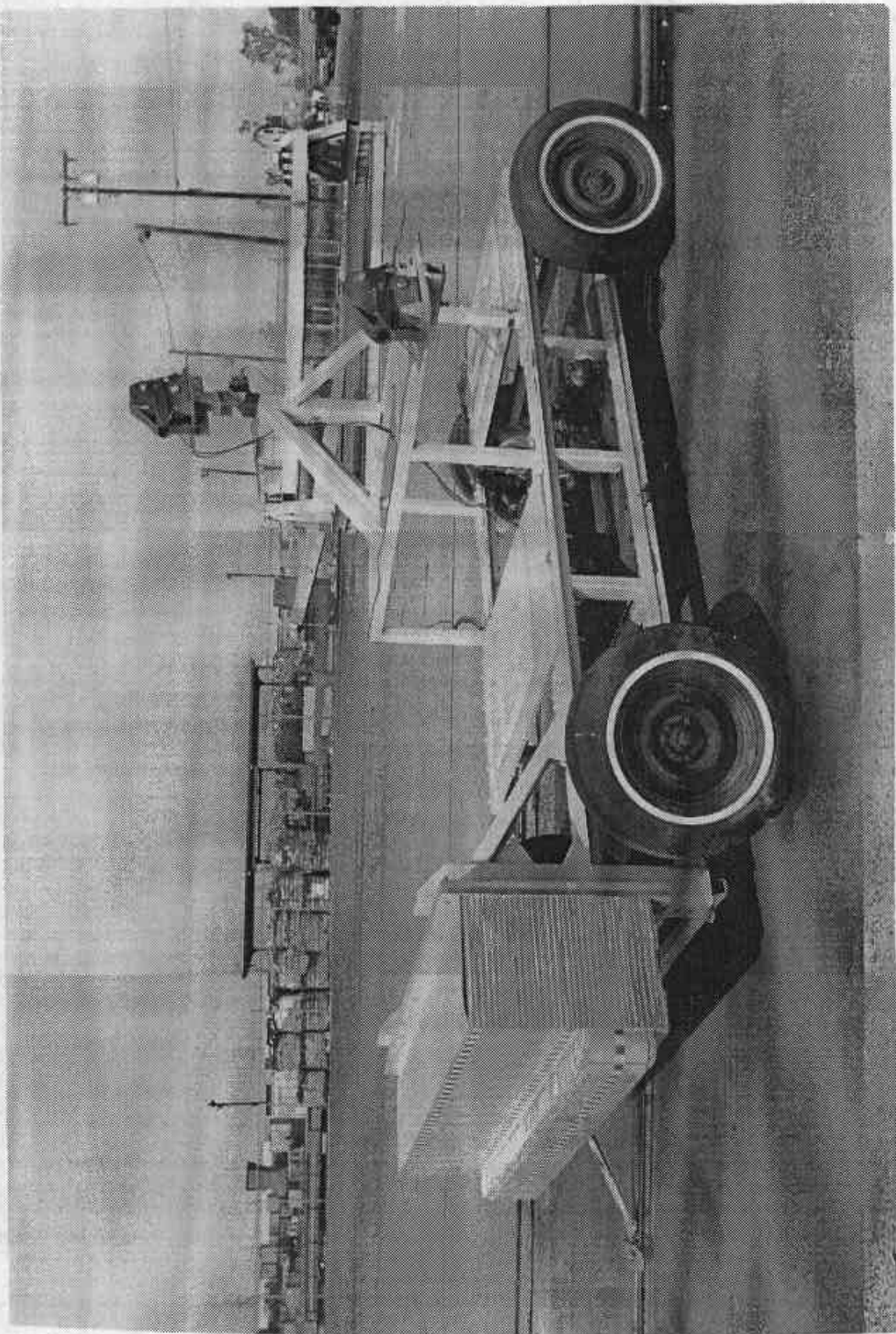


FIGURE A-18 MDR, VIEW NO. 1 - PRETEST

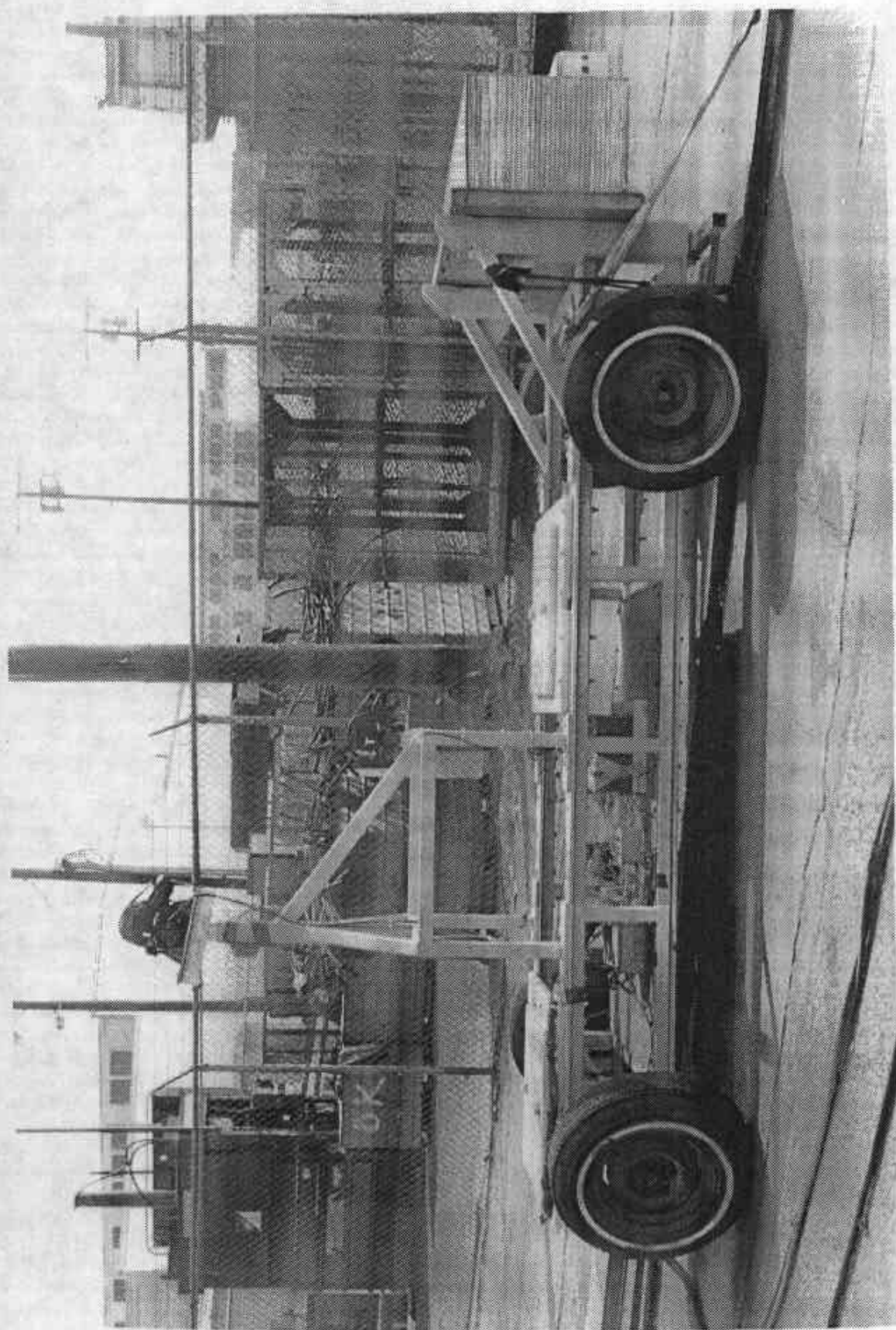


FIGURE A-19 MD8, VIEW NO. 2 - PRETEST

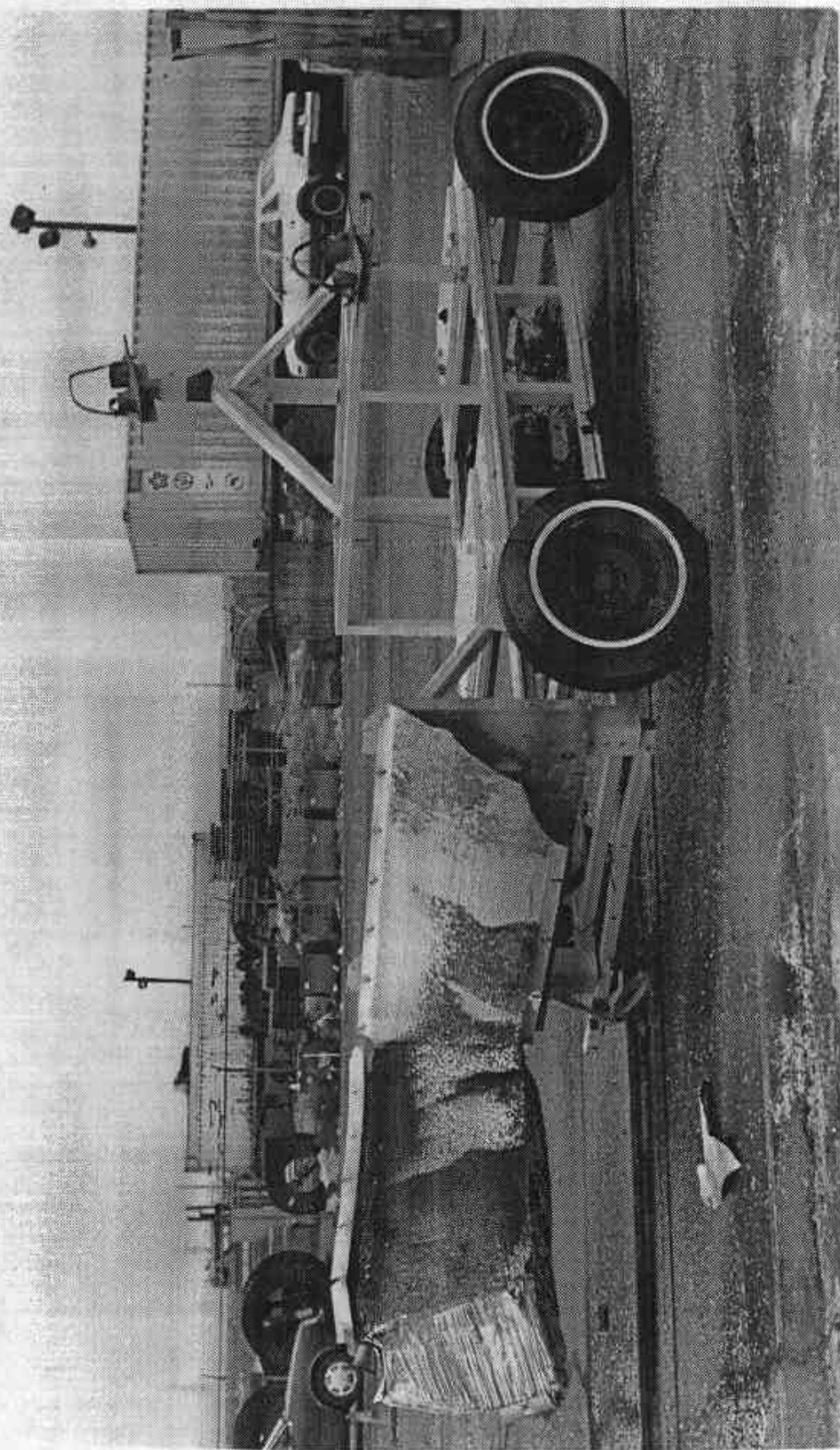


FIGURE A-20 MDB OVERALL VIEW - POSTTEST



FIGURE A-21 MDB CLOSEUP VIEW OF BARRIER FACE - POSTTEST

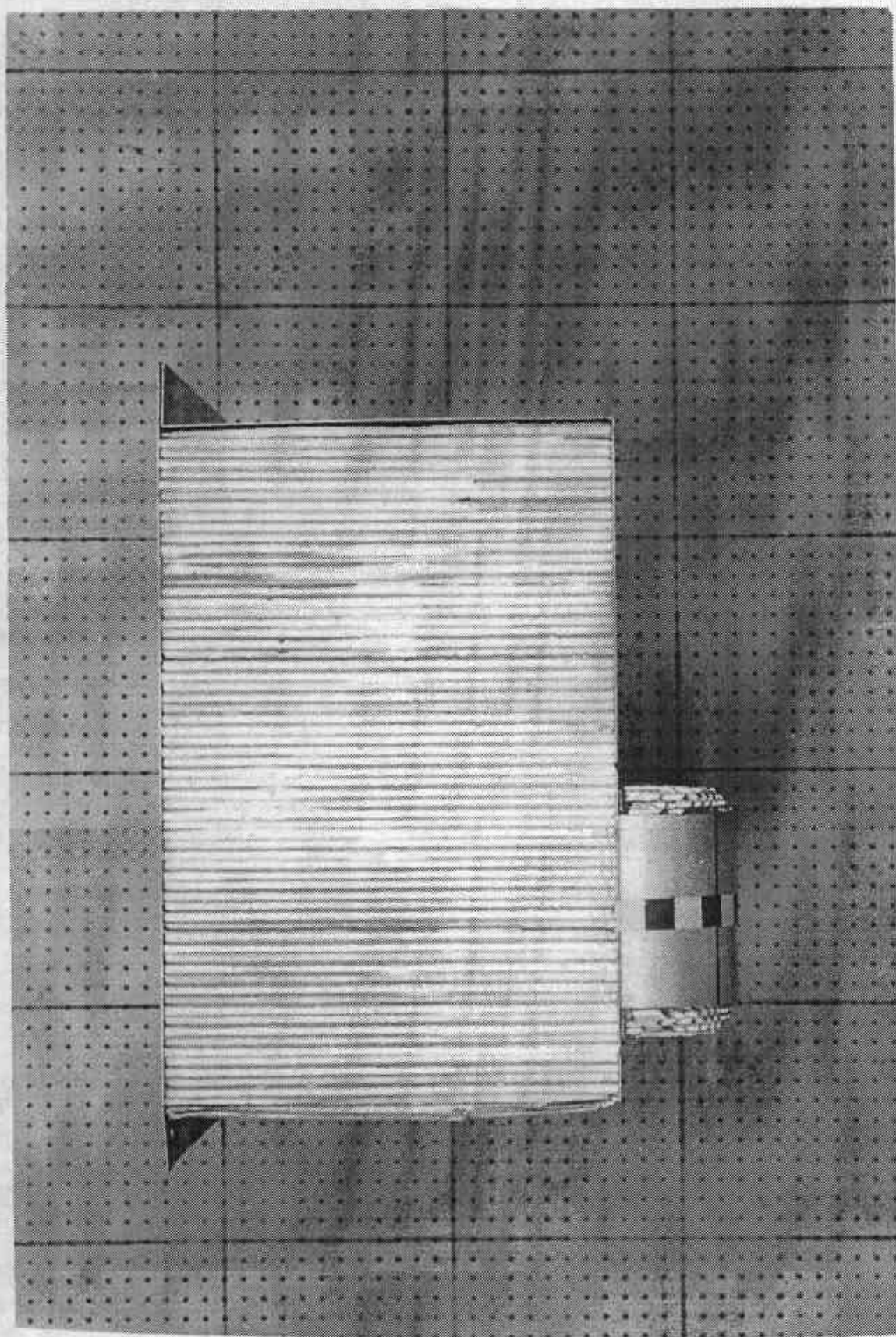


FIGURE A-22 MDB FACE, VIEW NO. 1 - PRETEST

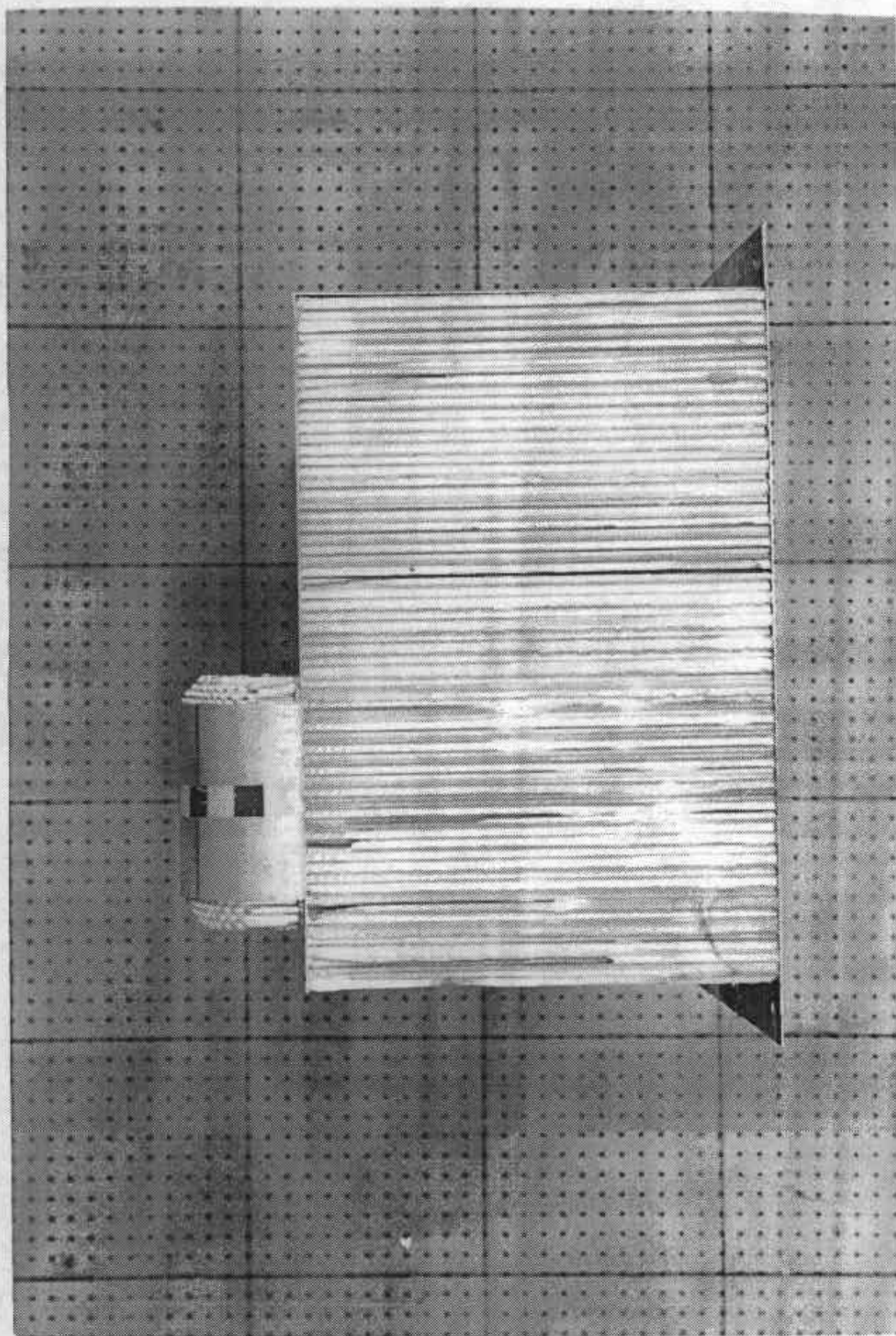


FIGURE A-23 MDB FACE, VIEW NO. 2 - PRETEST

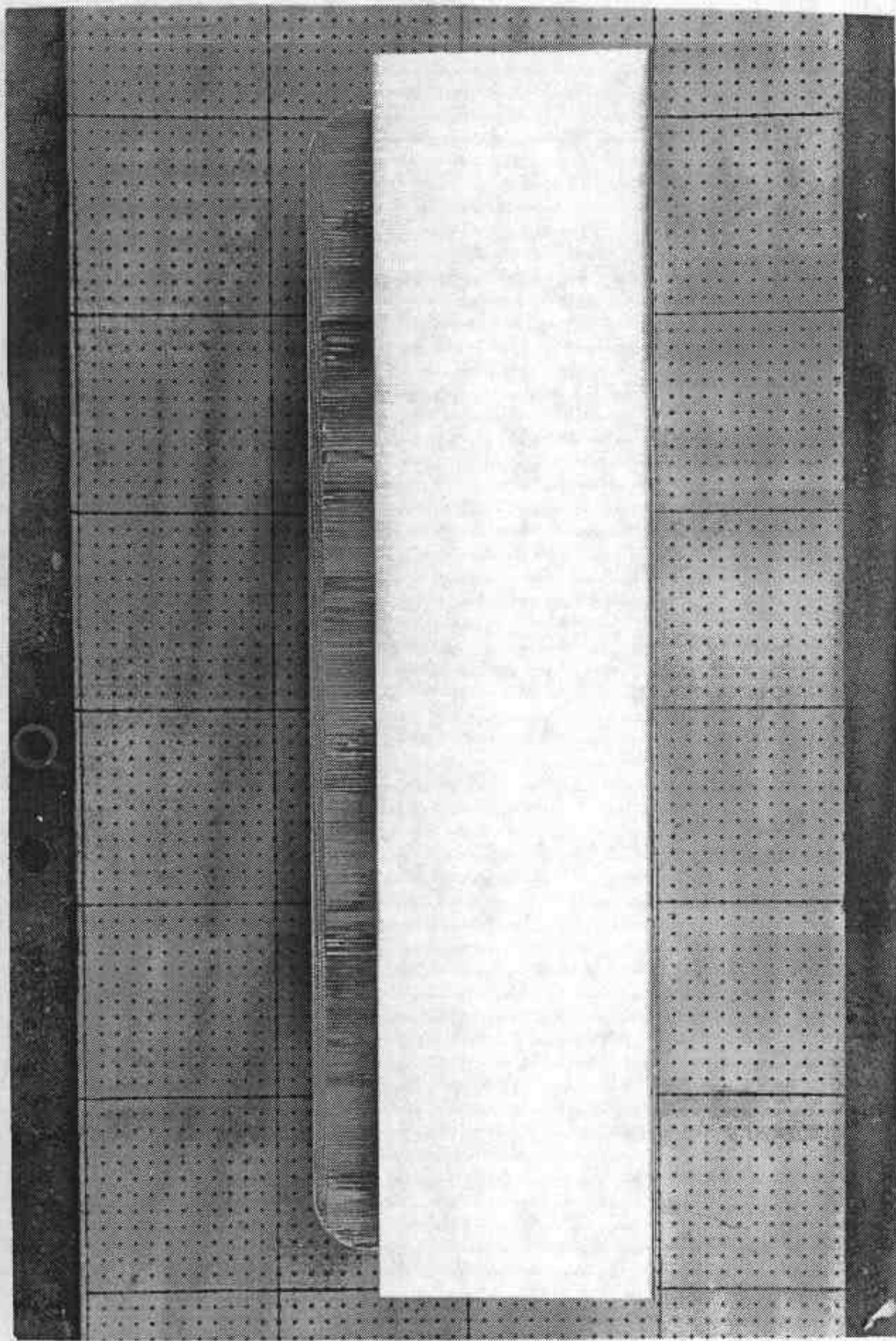


FIGURE A-24 MDB FACE, VIEW NO. 3 - PRETEST

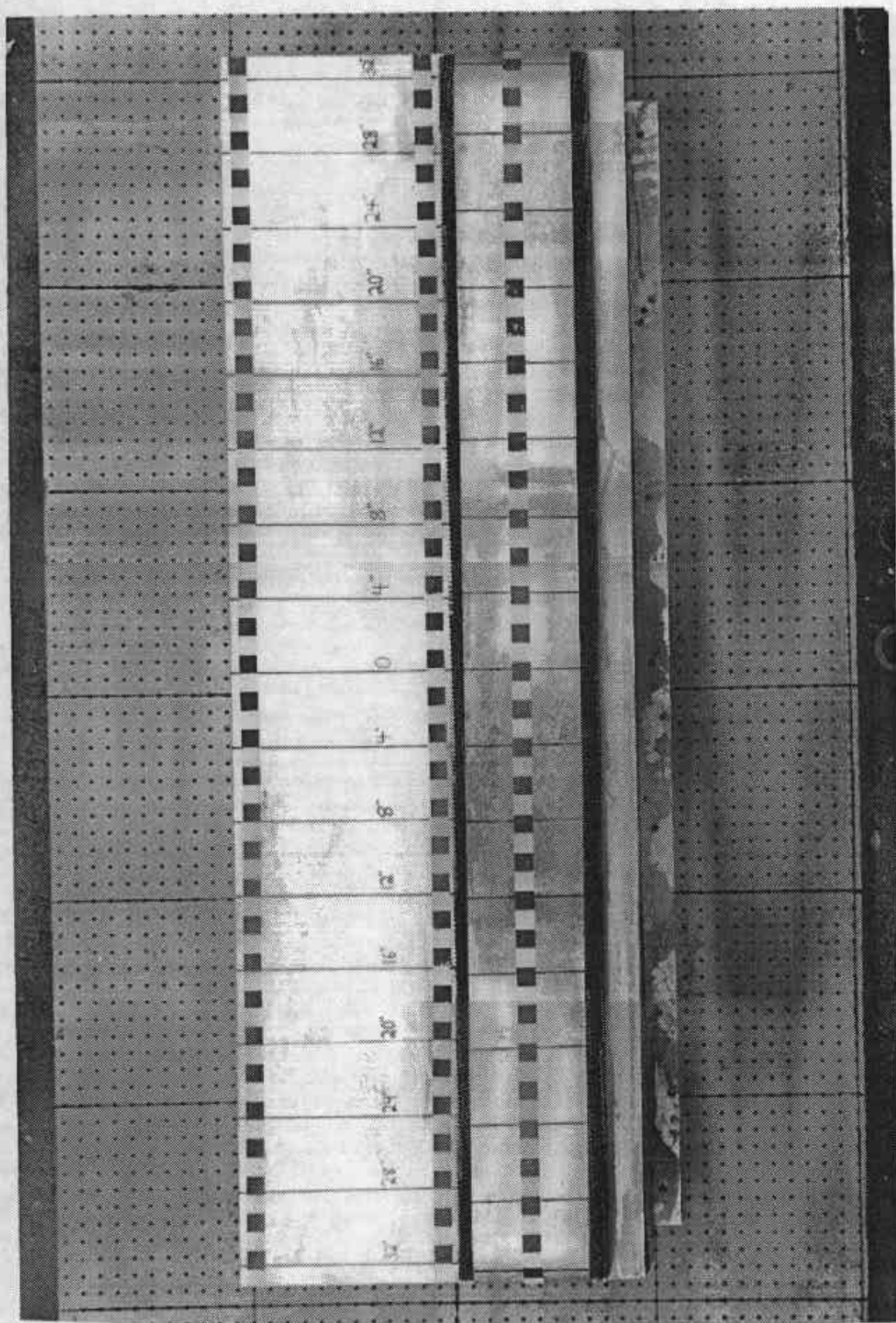


FIGURE A-25 MDB FACE, VIEW NO. 4 - PRETEST



FIGURE A-26 MDB FACE, VIEW NO. 1 - POSTTEST

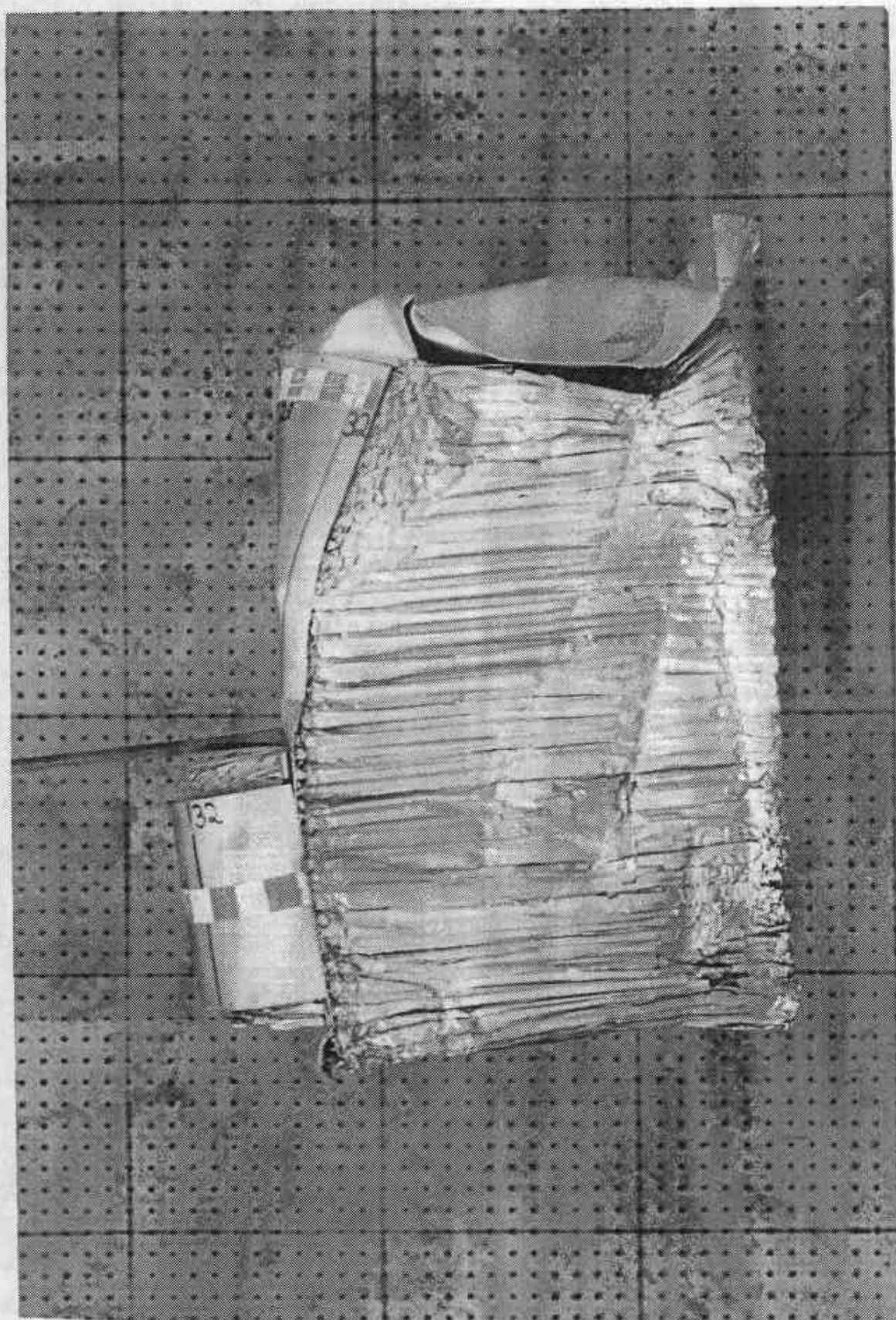


FIGURE A-27 MDB FACE VIEW NO 2 - POSTTEST

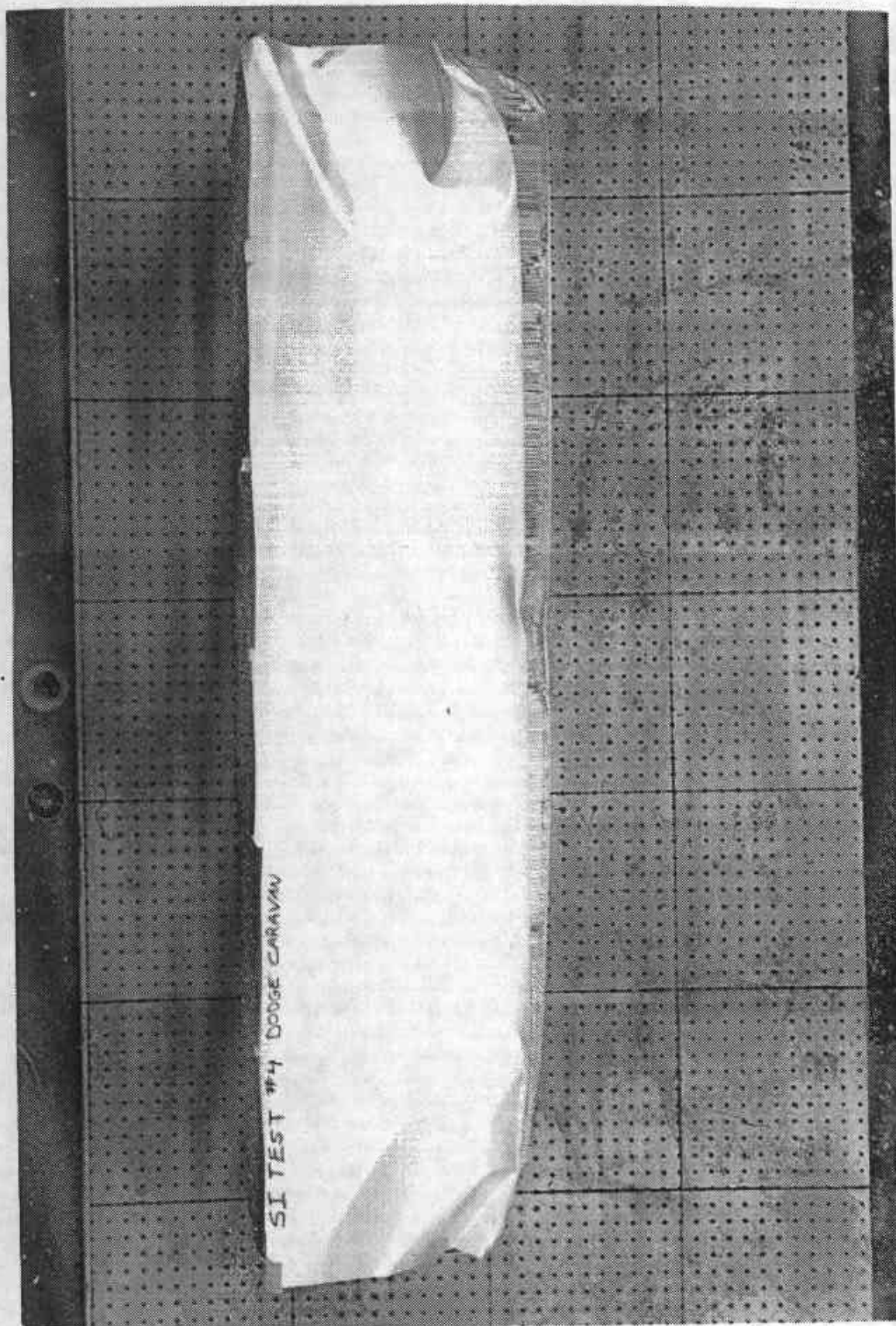


FIGURE A-28 MDB FACE, VIEW NO. 3 - POSTTEST

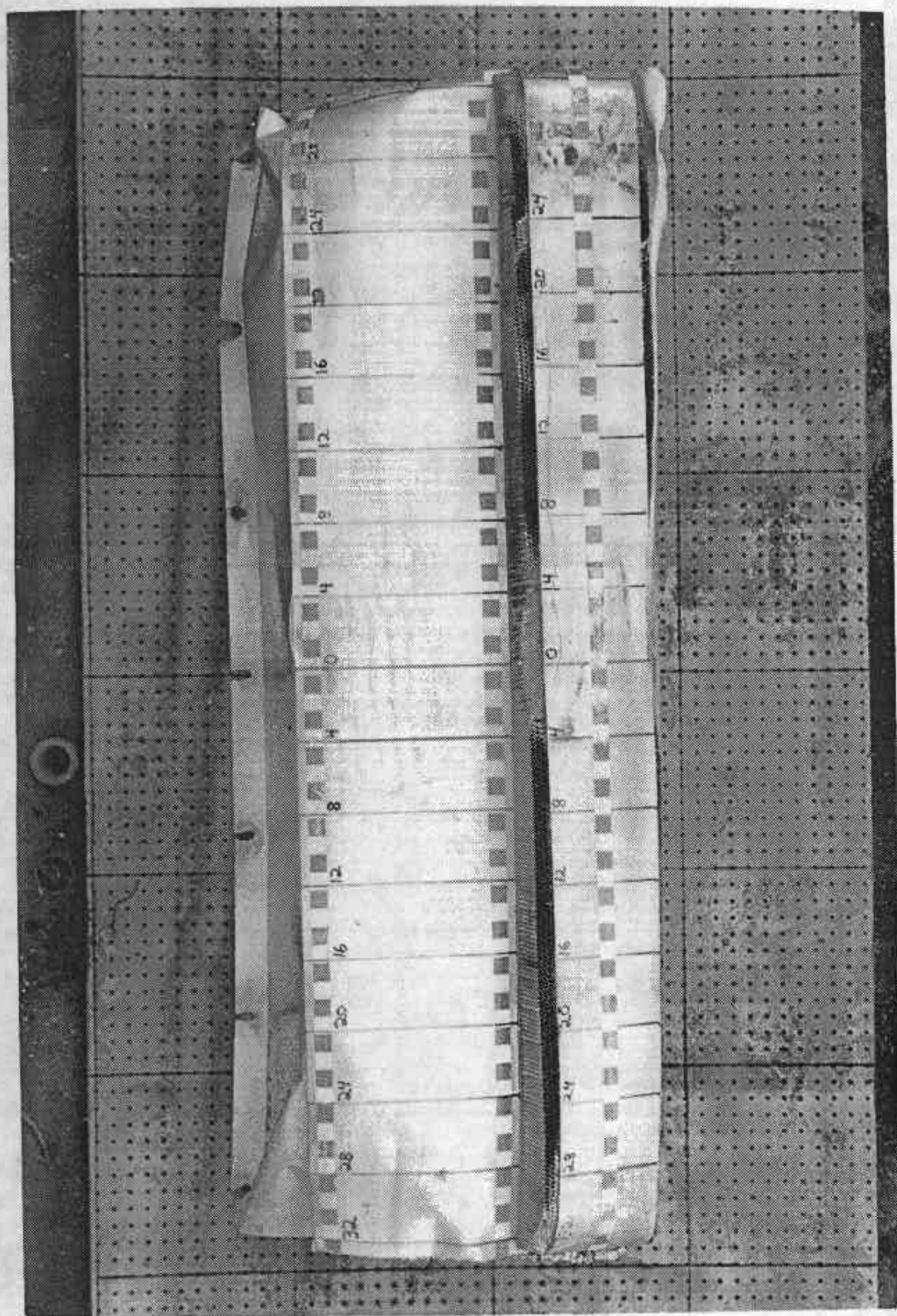
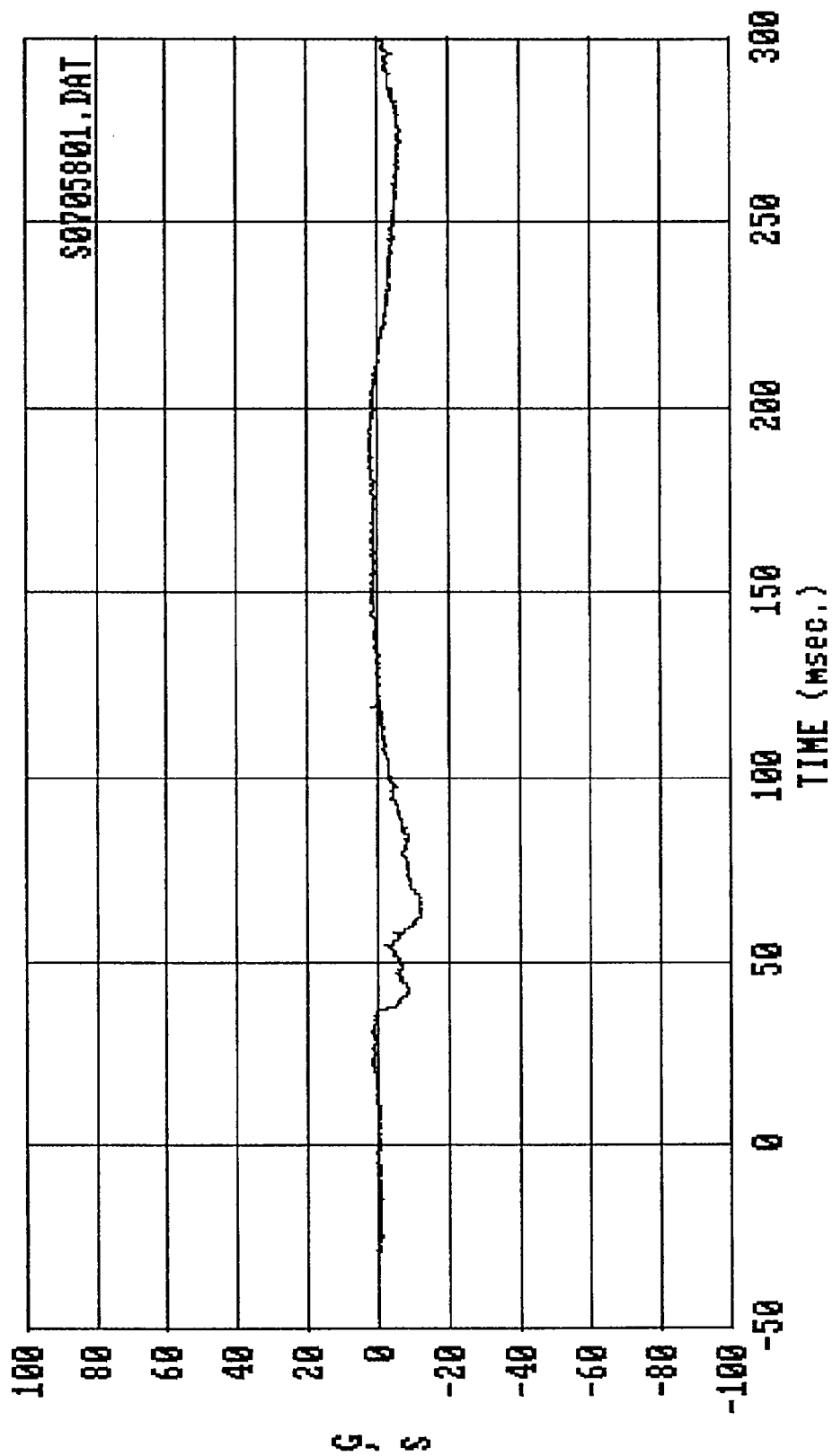


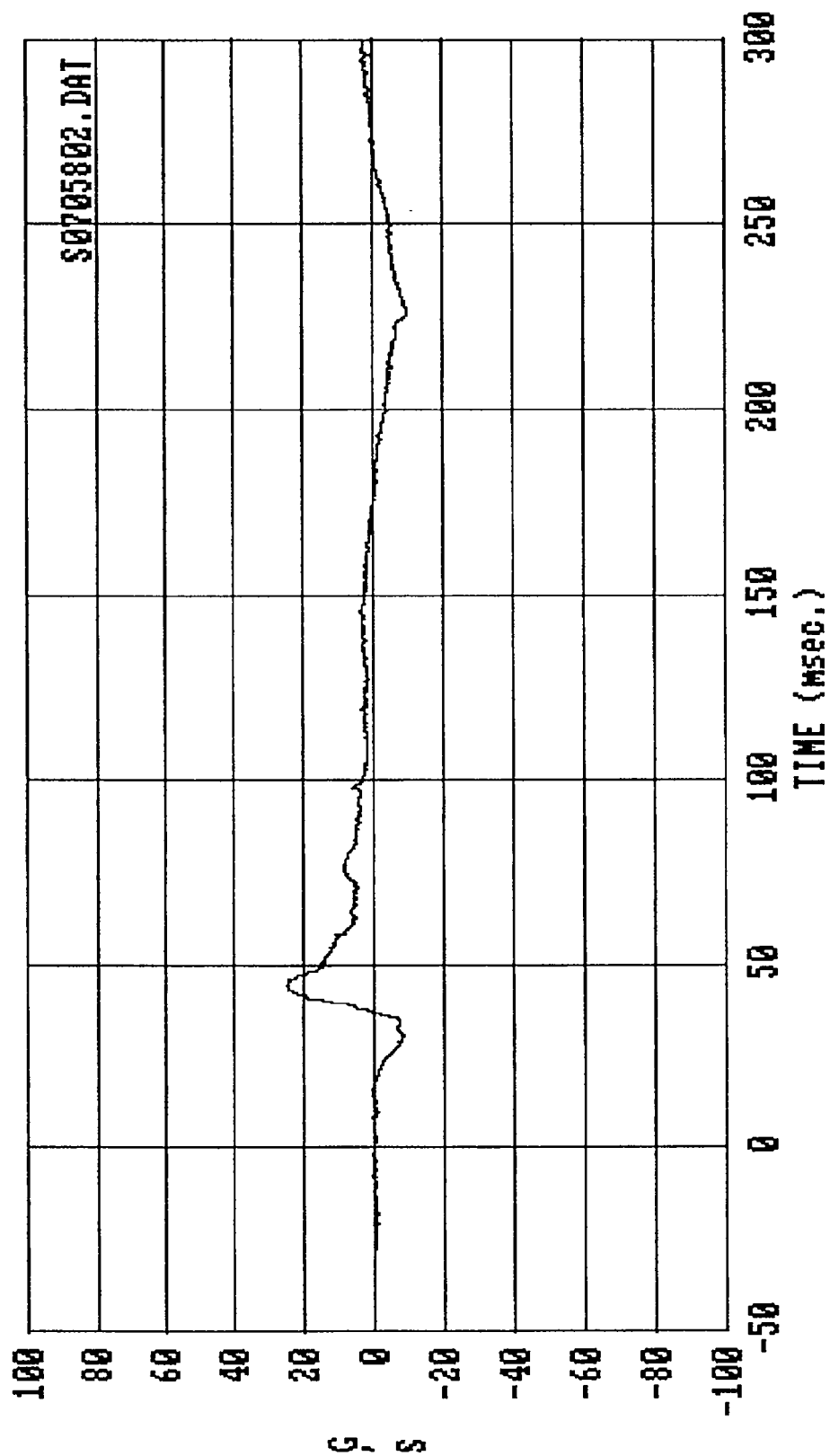
FIGURE A-29 MDB FACE, VIEW NO. 4 - POSTTEST

APPENDIX B
DATA PLOTS FOR TRANSDUCERS

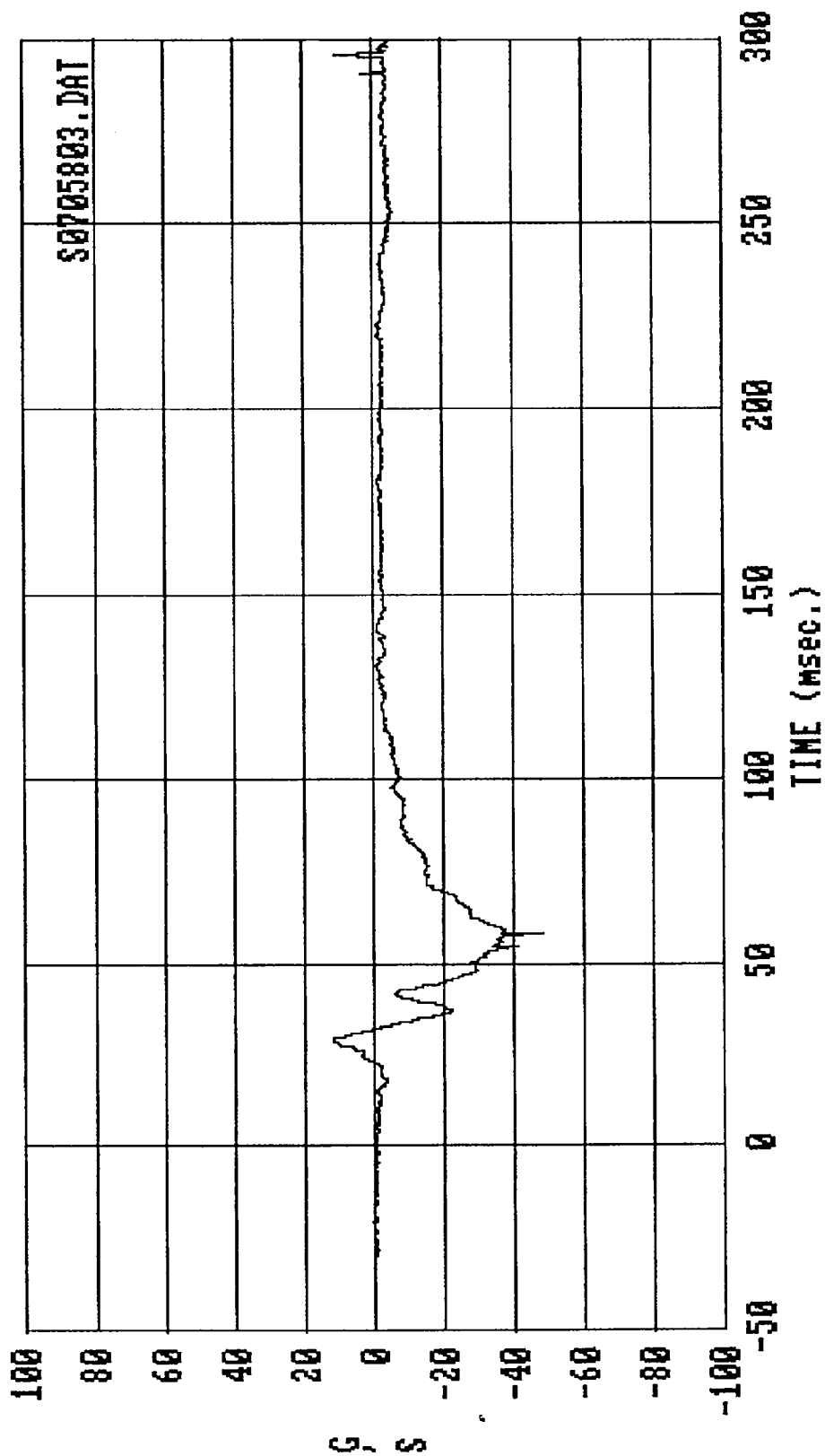


B-1

Filter: SAE CLASS 1000 Max = 3.0697 Min = -12.101
 MSE 02/03/89 -- 1988 Dodge Caravan : Driver Head acceleration, X-axis

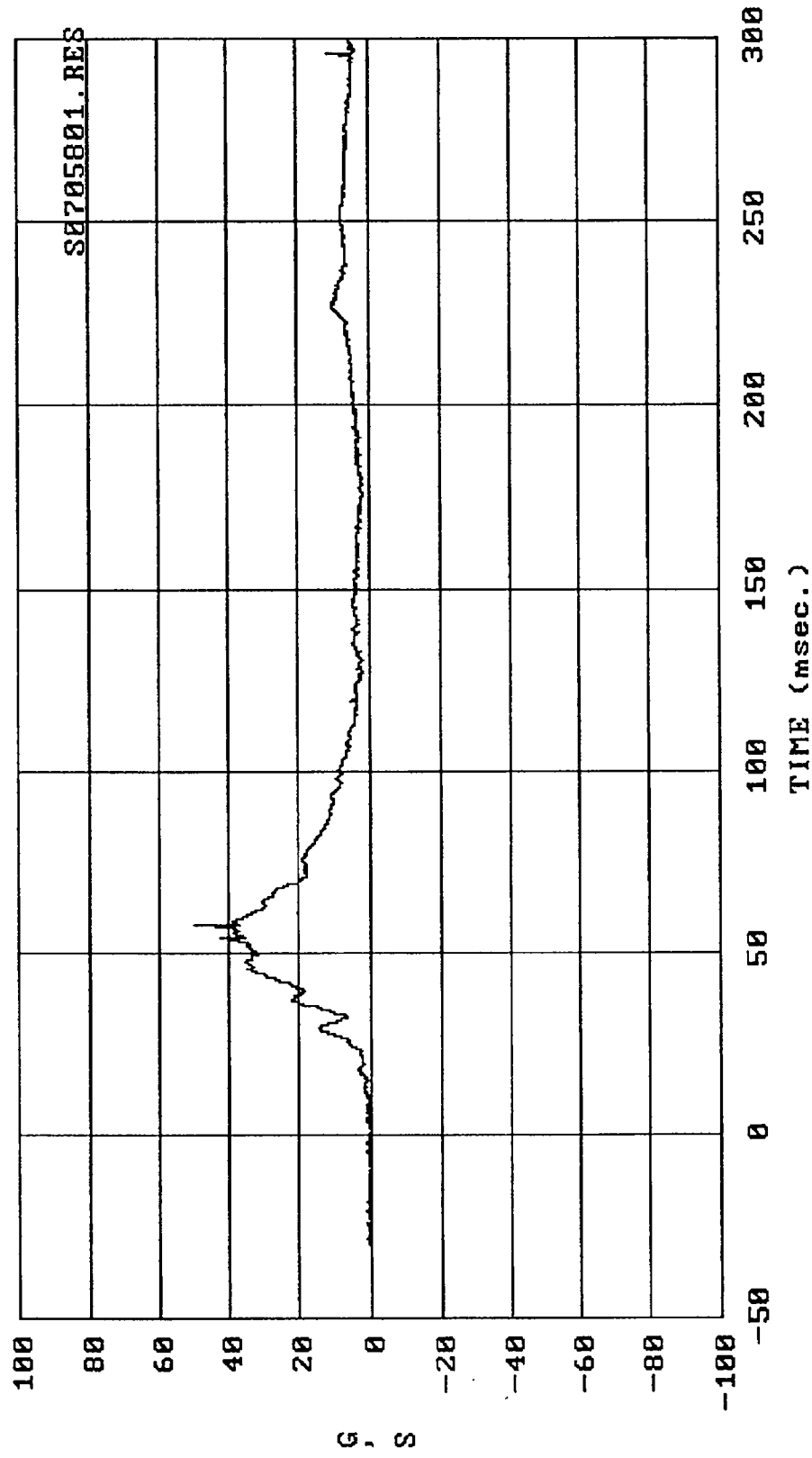


Filter: SAE CLASS 1000 Max = 25.282 Min = -9.6834
MSE 02/03/89 -- 1988 Dodge Caravan : Driver Head acceleration, Y-axis

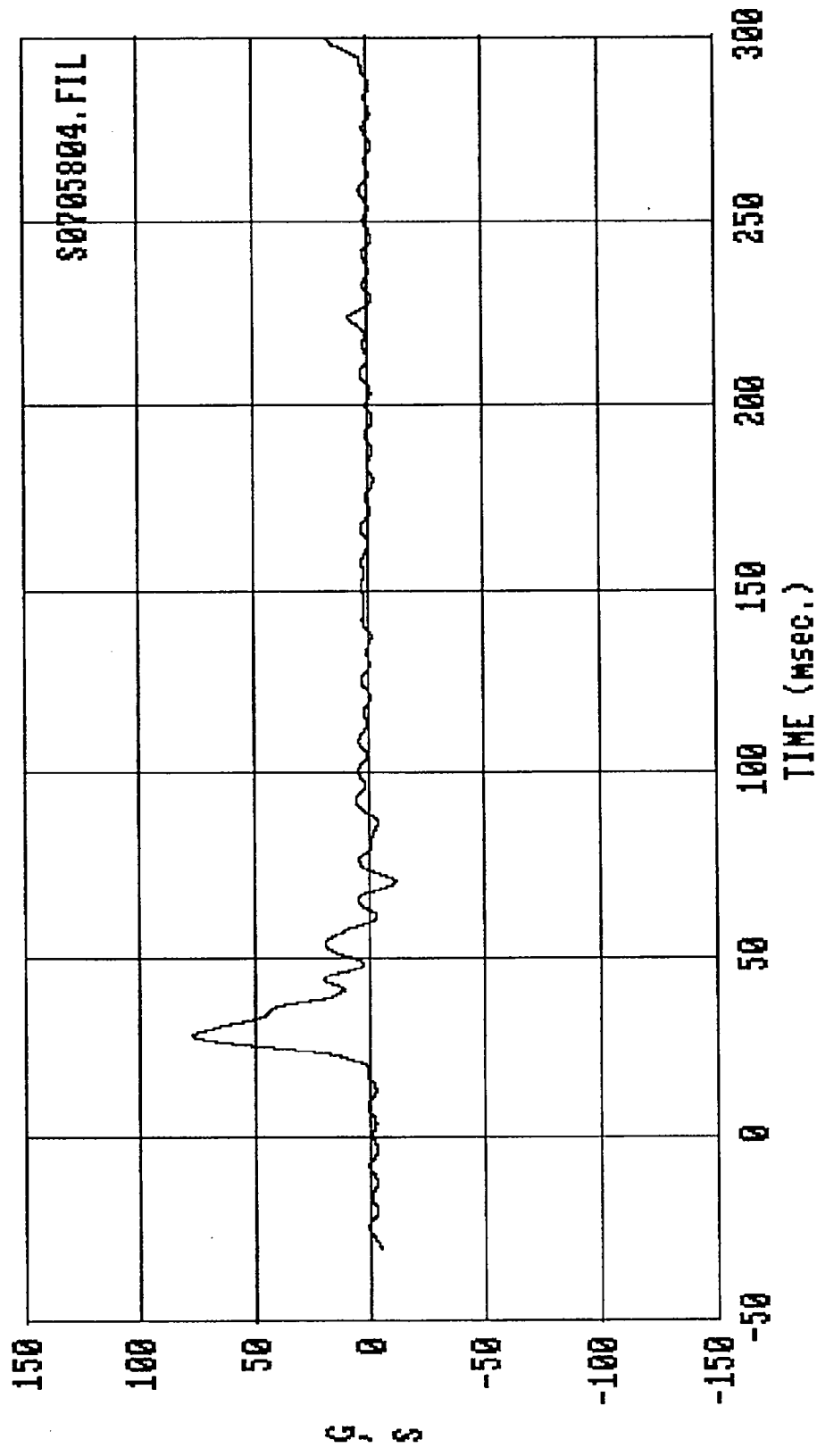


B-3

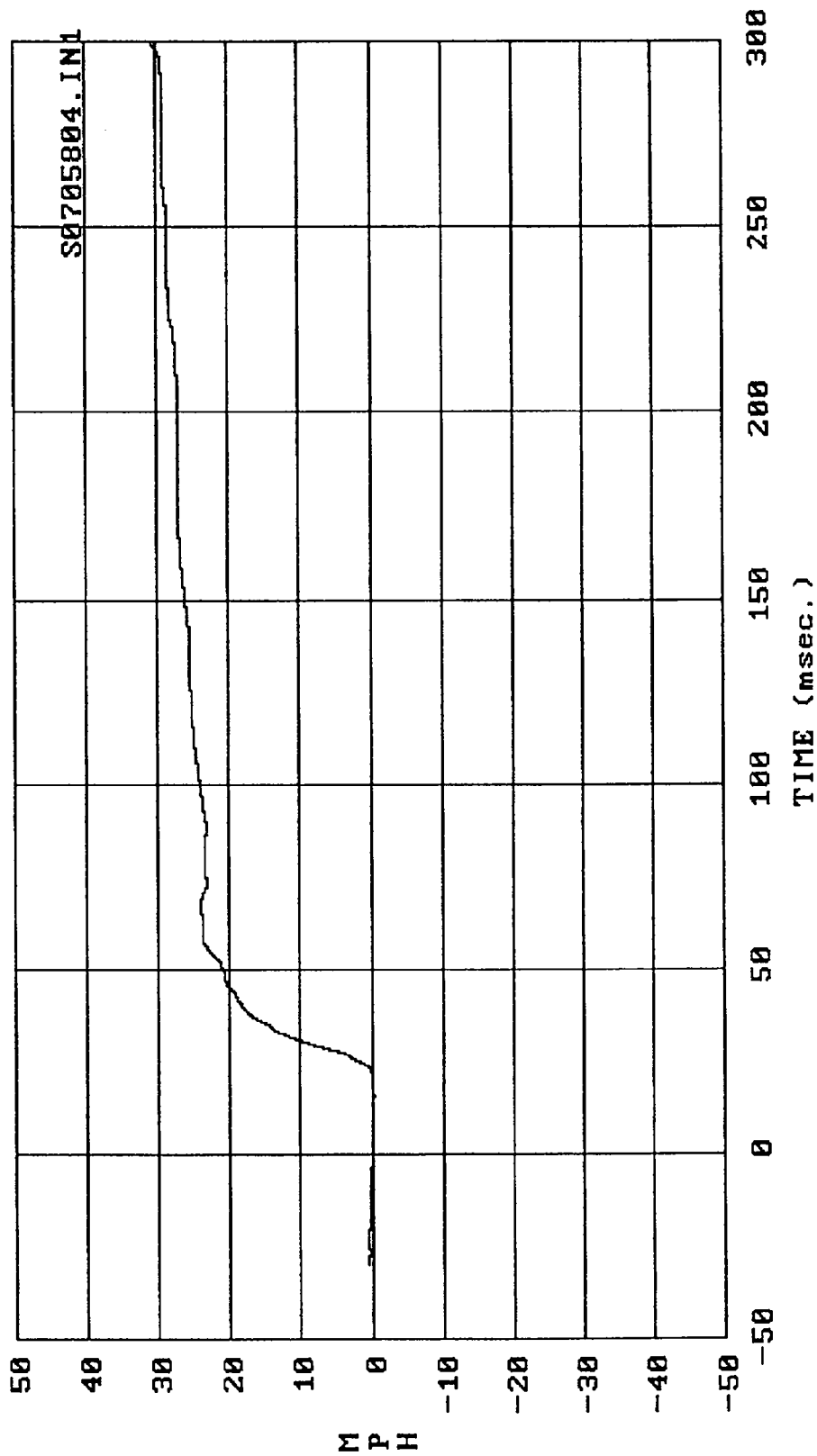
Filter: SAE CLASS 1000 Max = 11.953 Min = -51.301
MSE 02/03/89 -- 1988 Dodge Caravan : Driver Head acceleration, Z-axis



Filter: SAE CLASS 1000 Max = 52.774 Min = .96980E-01
MSE 02/03/89 -- 1988 Dodge Caravan : Driver Head resultant acceleratic

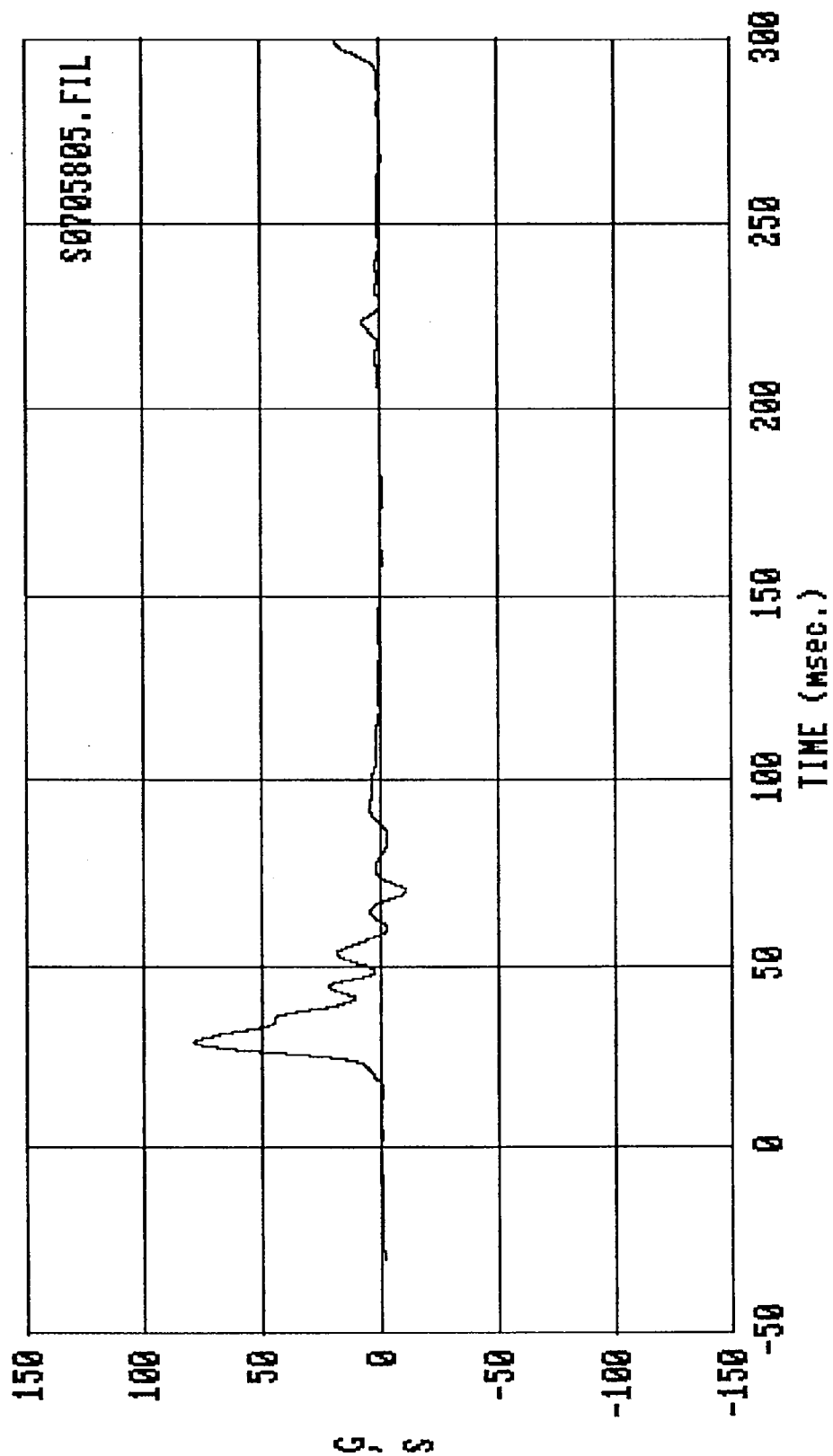


Filter: FIR 100 Max = 77.845 Min = -10.933
 MSE 02/03/89 -- 1988 Dodge Caravan : Driver Upper Rib acc., Y-axis (Primary)

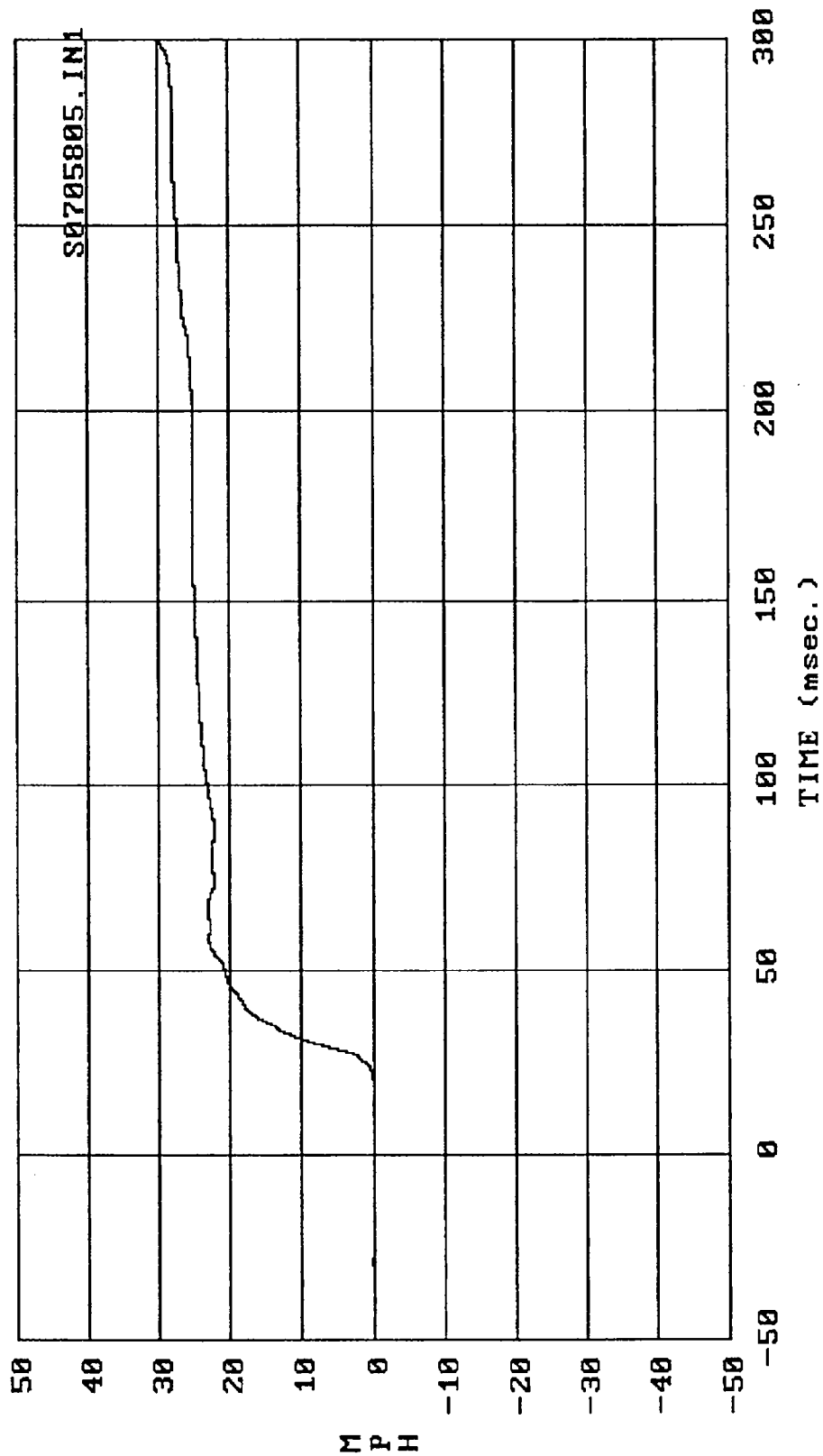


Filter: FIR 100 Max = 30.844 Min = -.15687

MSE 02/03/89 -- 1988 Dodge Caravan : Driver Upper Rib delt U, Y-ax
(Primary)

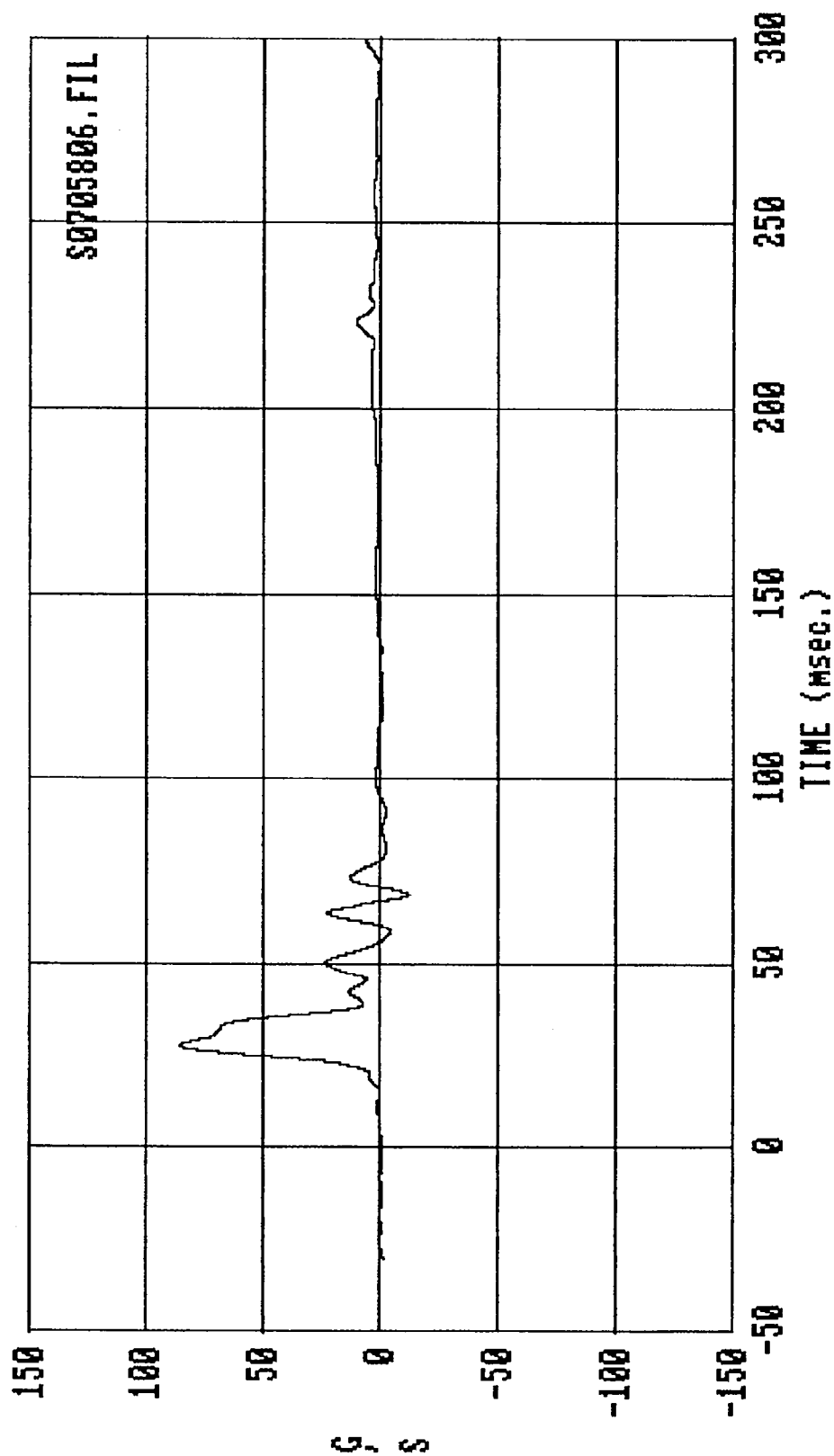


Filter: FIR 100 Max = 80.193 Min = -10.476
MSE 02/03/89 -- 1988 Dodge Caravan : Driver Upper Rib acc., Y-axis (Second)

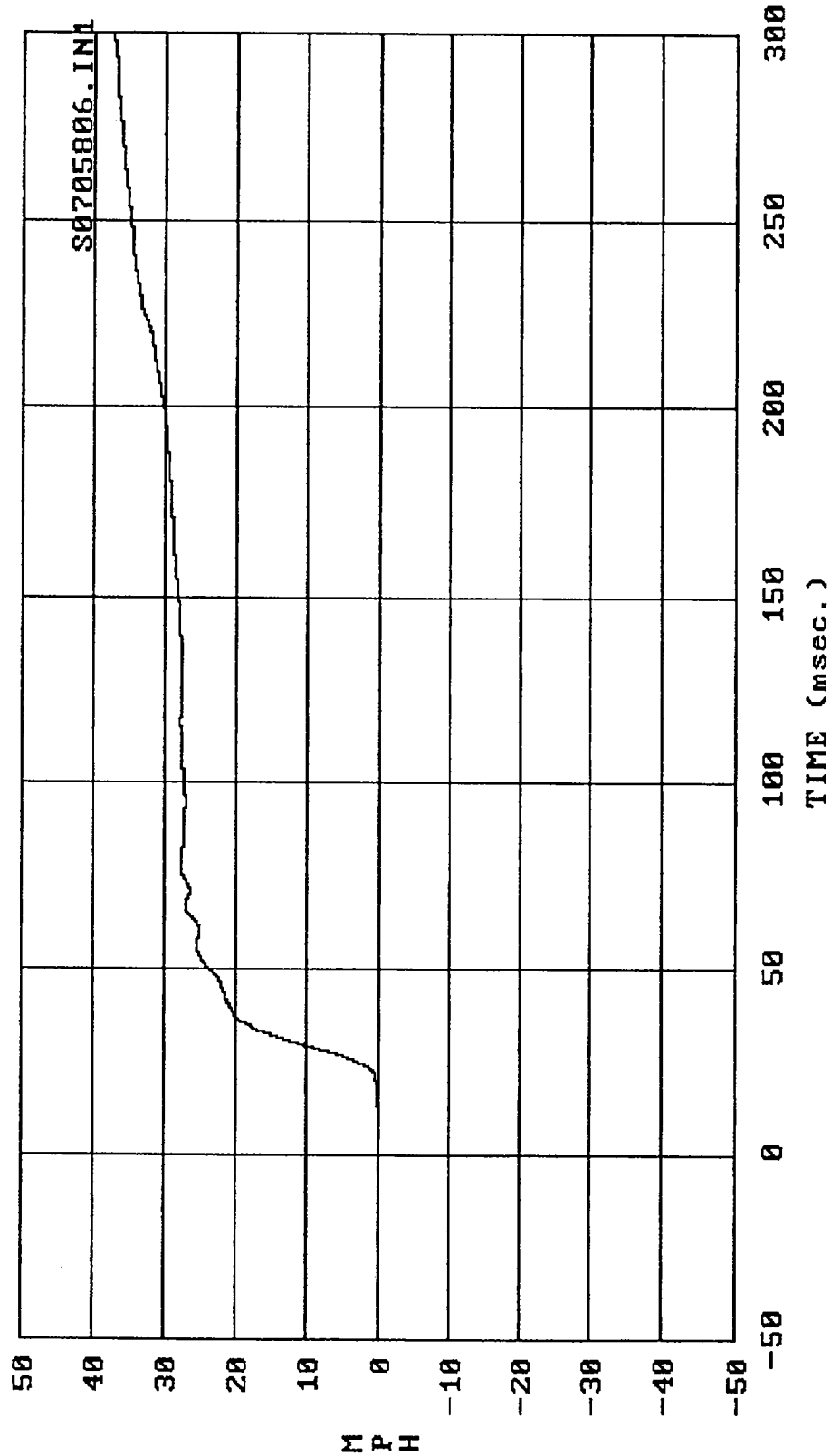


Filter: FIR 100 Max = 30.126 Min = .12722E-02

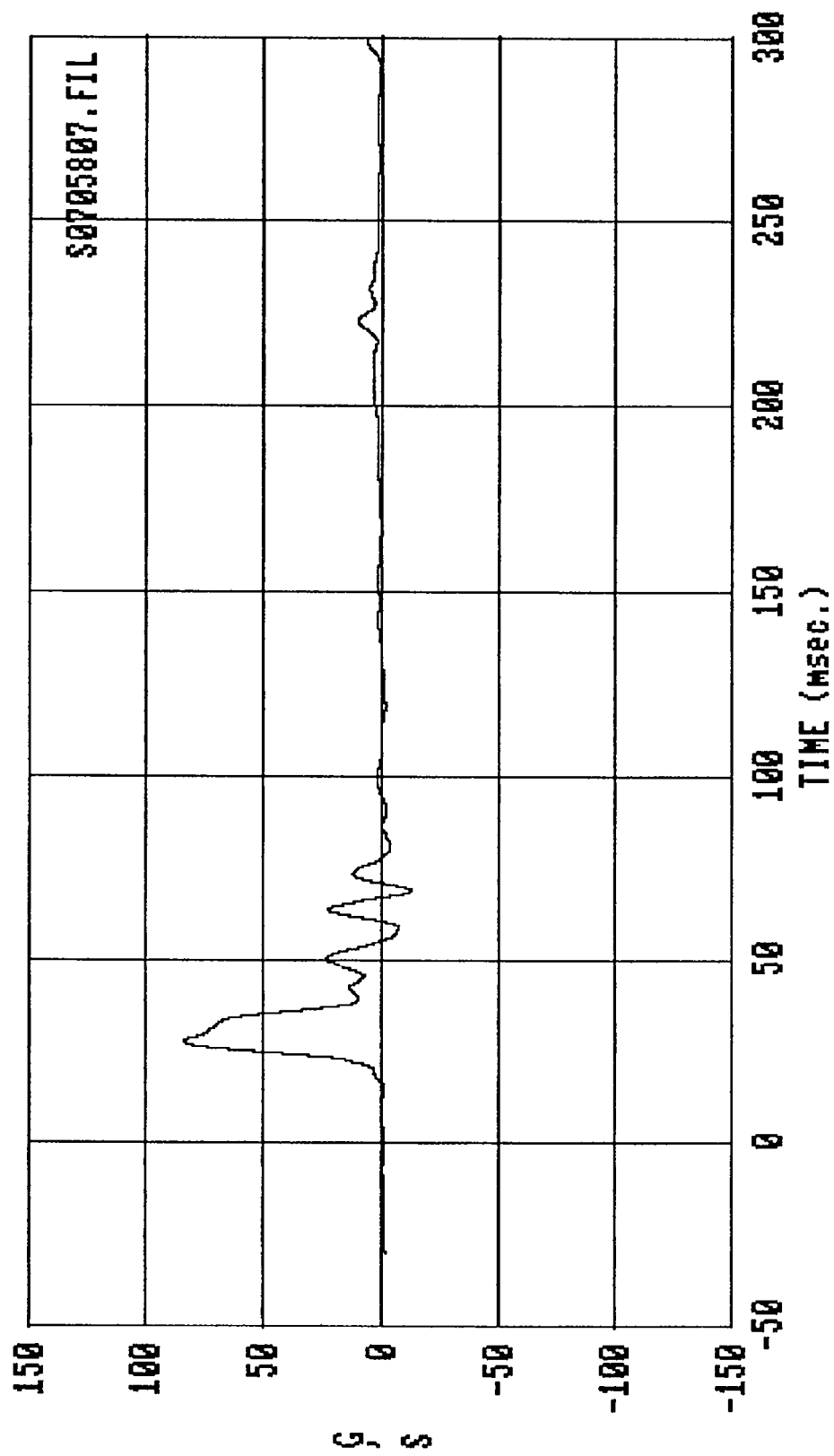
MSE 02/03/89 -- 1988 Dodge Caravan : Driver Upper Rib delt U, Y-ax
(Second)



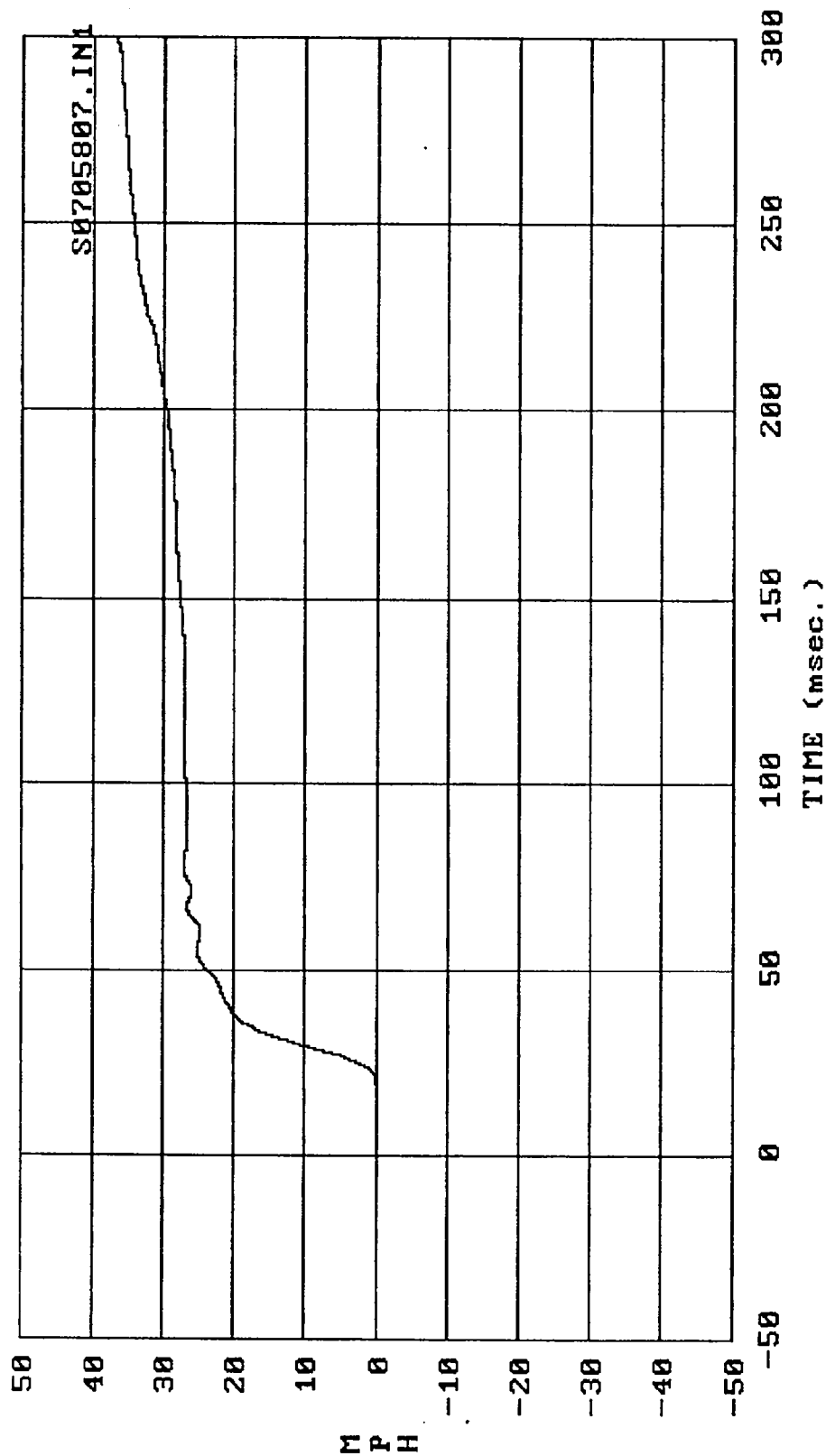
Filter: FIR 100 Max = 86.288 Min = -12.001
MSE 02/03/89 -- 1988 Dodge Caravan : Driver Lower Rib acc., Y-axis (Primary)



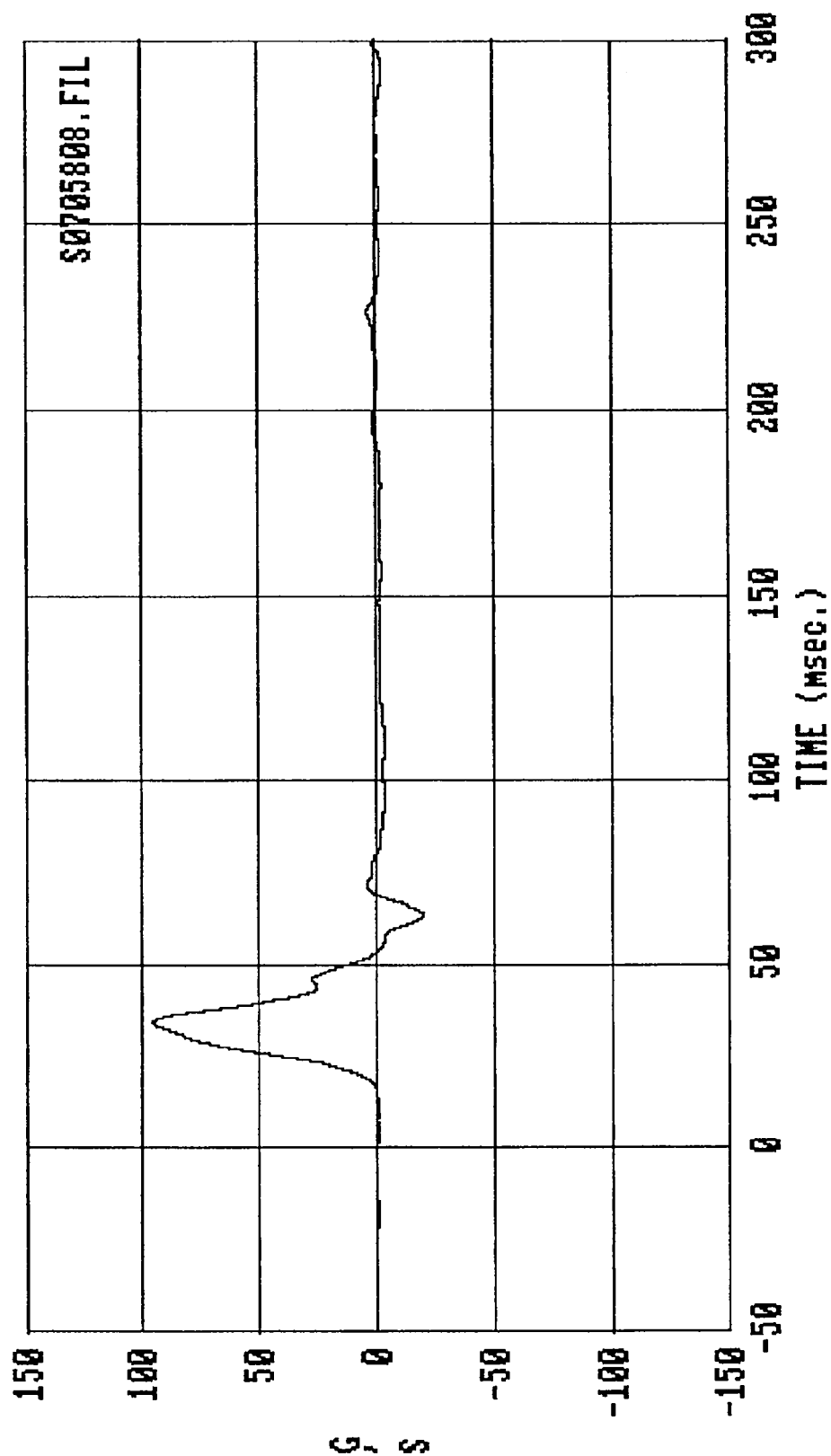
Filter: FIR 100 Max = 37.446 Min = -.42612E-02
 MSE 02/03/89 -- 1988 Dodge Caravan : Driver Lower Rib delt V, Y-ax
 (Primary)



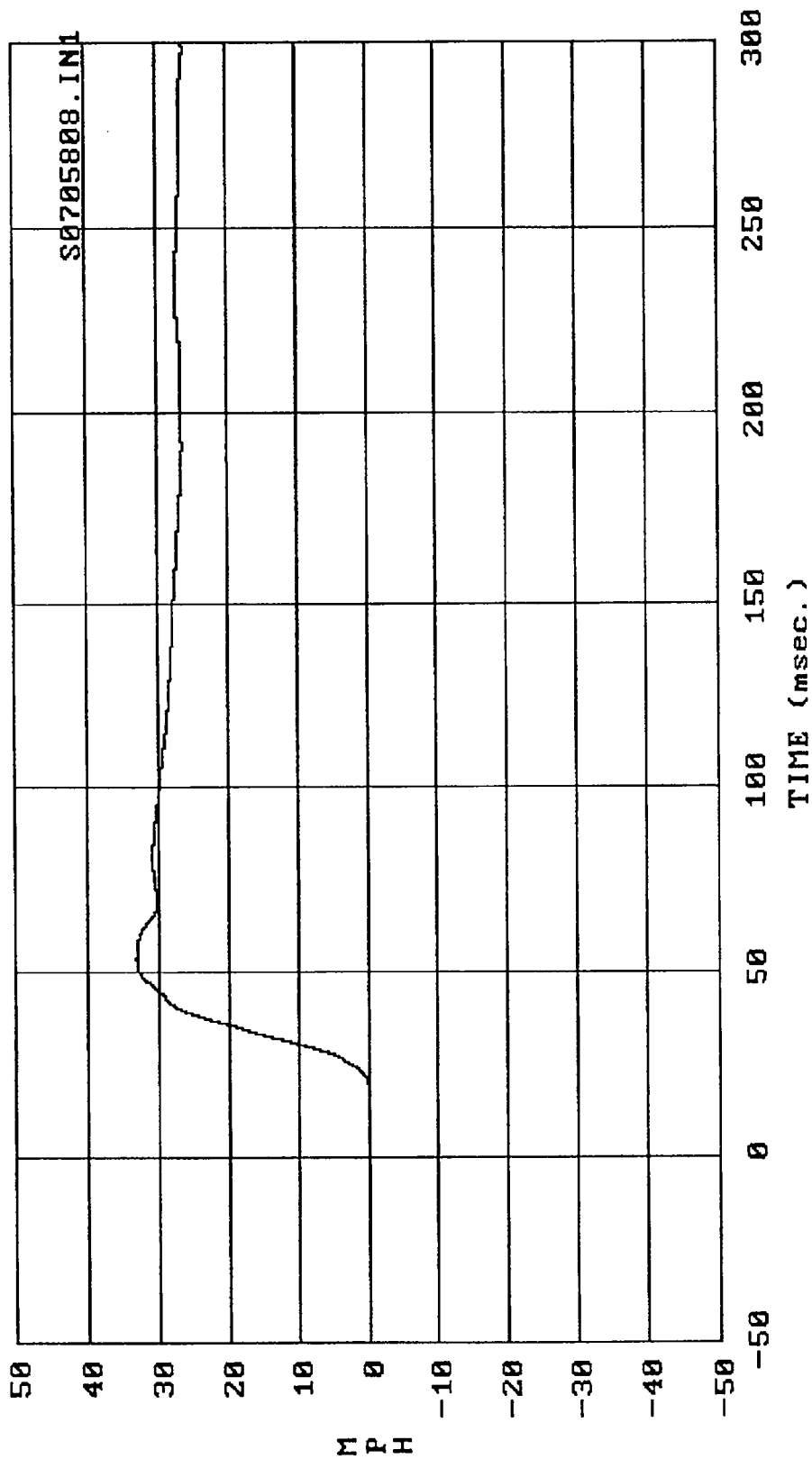
Filter: FIR 100 Max = 84.577 Min = -12.708
MSE 02/03/89 -- 1988 Dodge Caravan : Driver Lower Rib acc., Y-axis (Second)



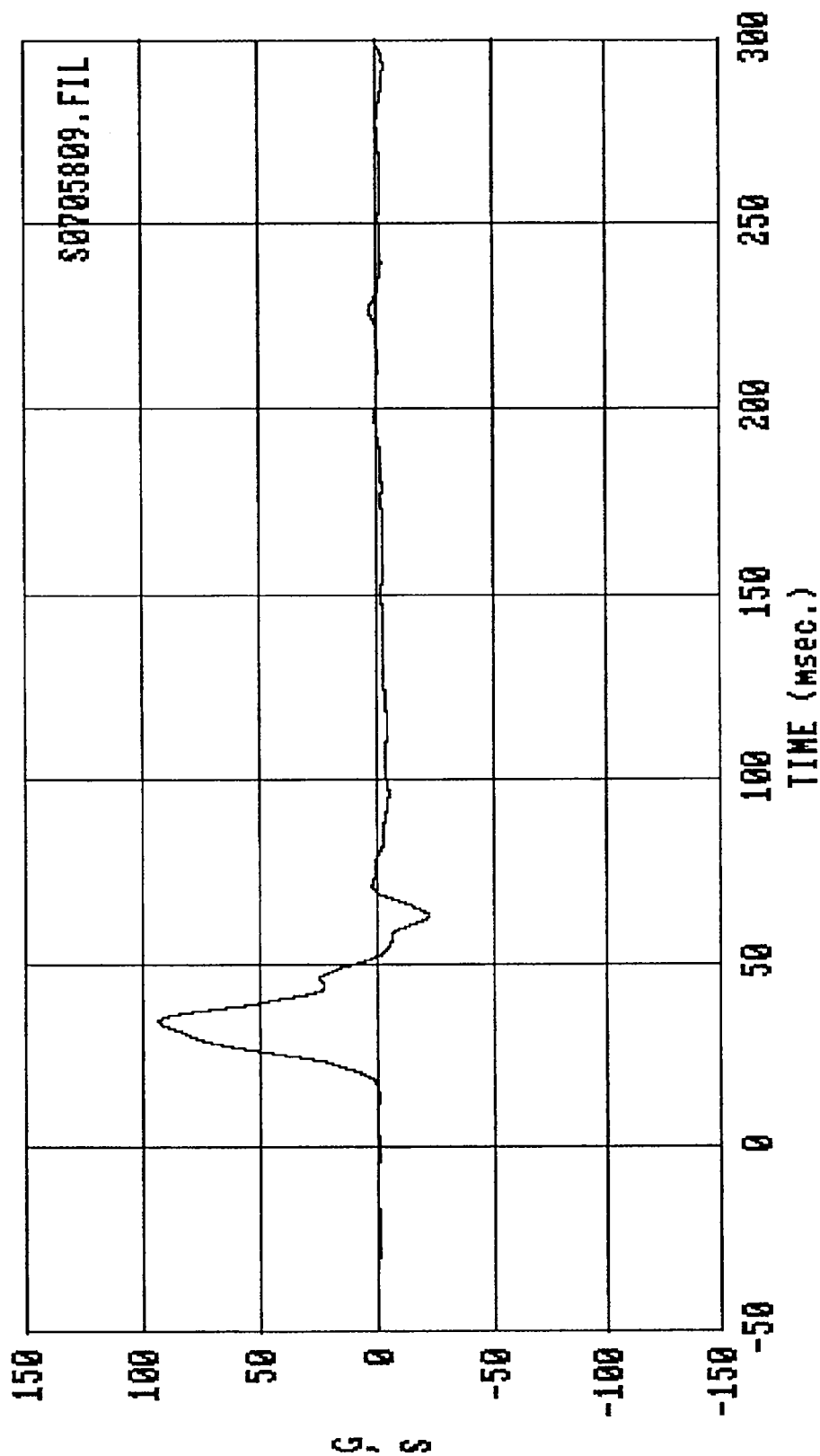
Filter: FIR 100 Max = 36.817 Min = -.76466E-02
 MSE 02/03/89 -- 1988 Dodge Caravan : Driver Lower Rib delt V, Y-ax
 (Second)



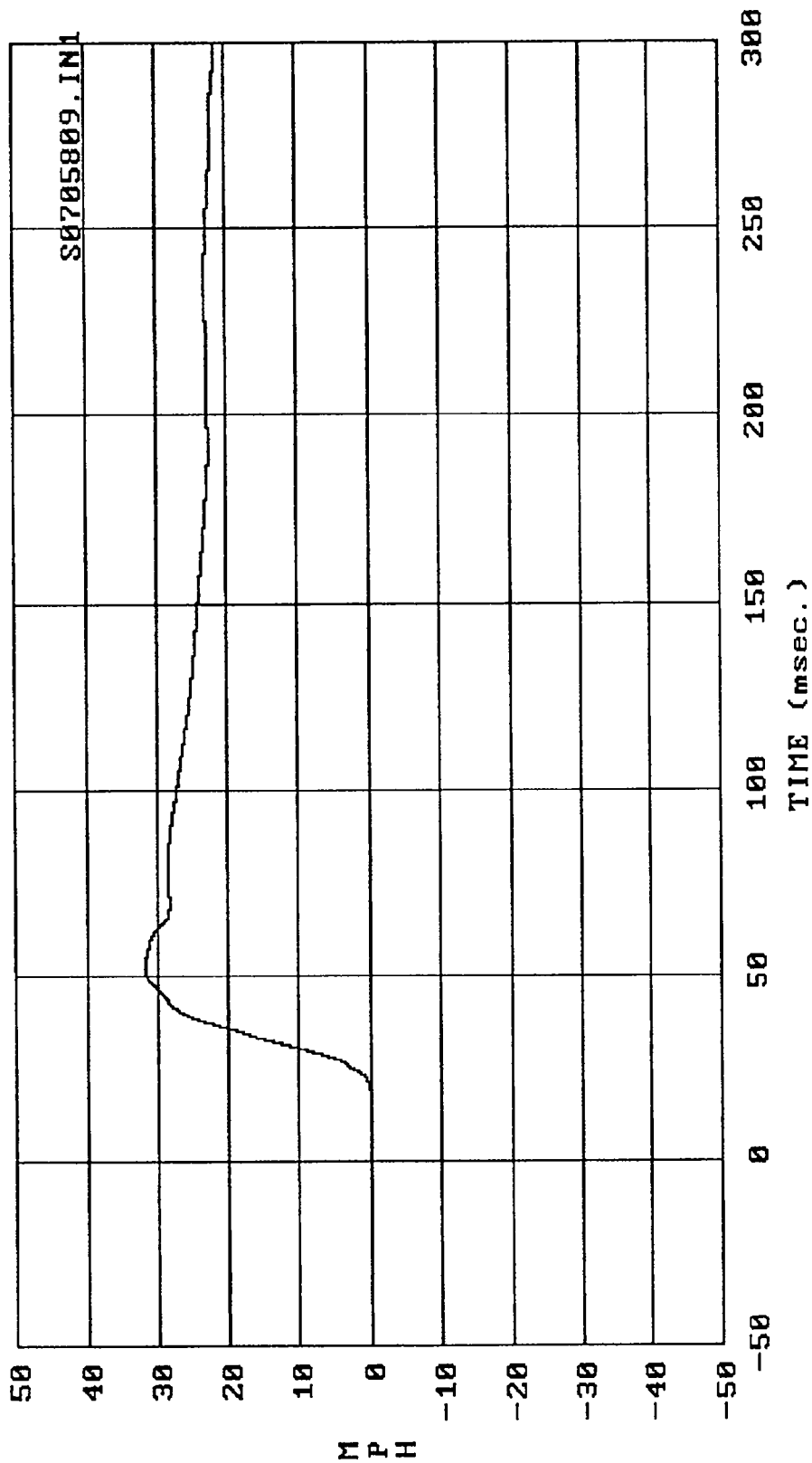
Filter: FIR 100 Max = 95.753 Min = -19.564
MSE 02/03/89 -- 1988 Dodge Caravan : Driver Lower Spine acc., Y-ax.(Primary)



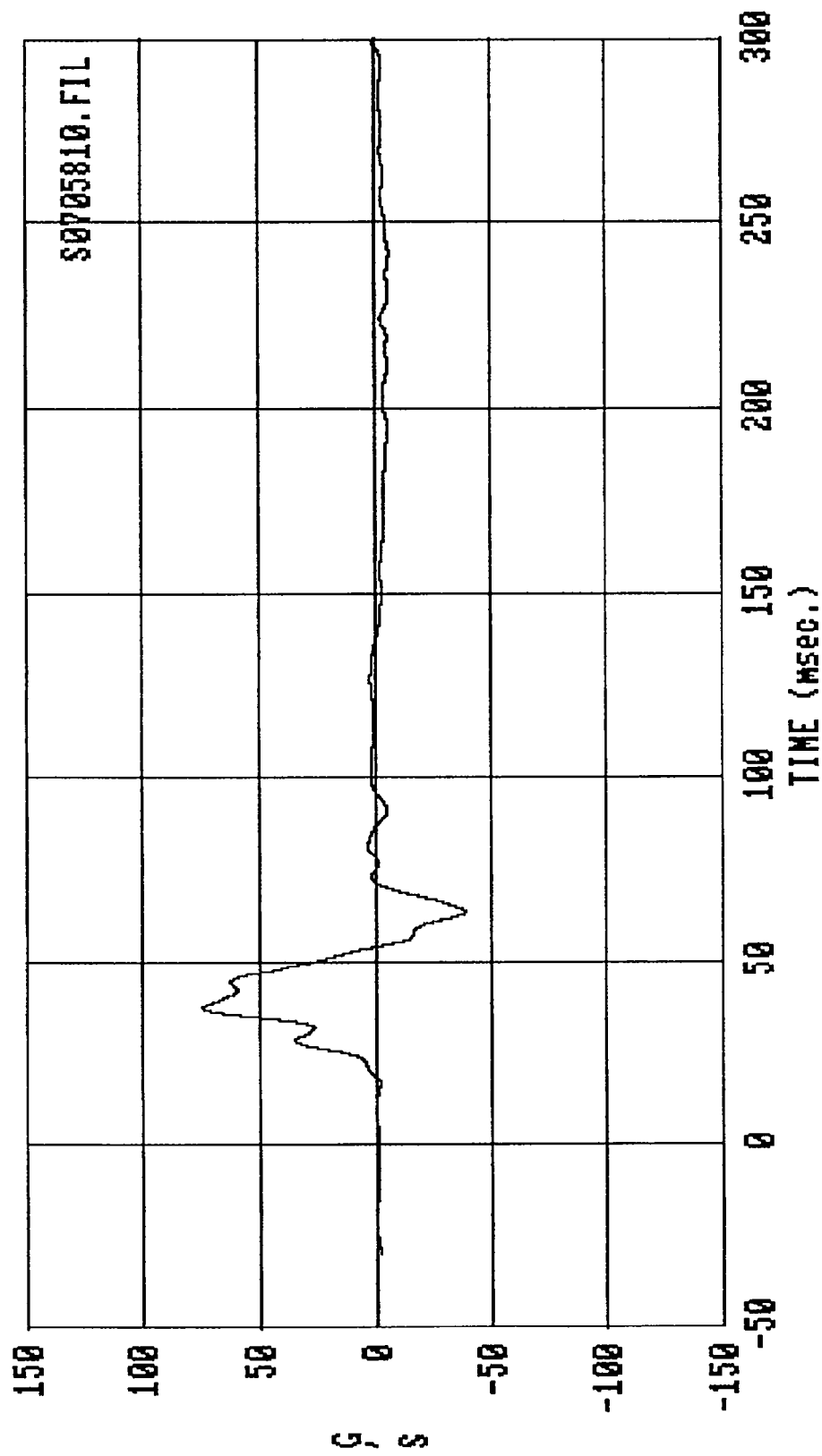
Filter: FIR 100 Max = 33.266 Min = -.23094E-01
 MSE 02/03/89 -- 1988 Dodge Caravan : Driver Lwr Spine delt U, Y-ax
 (Primary)



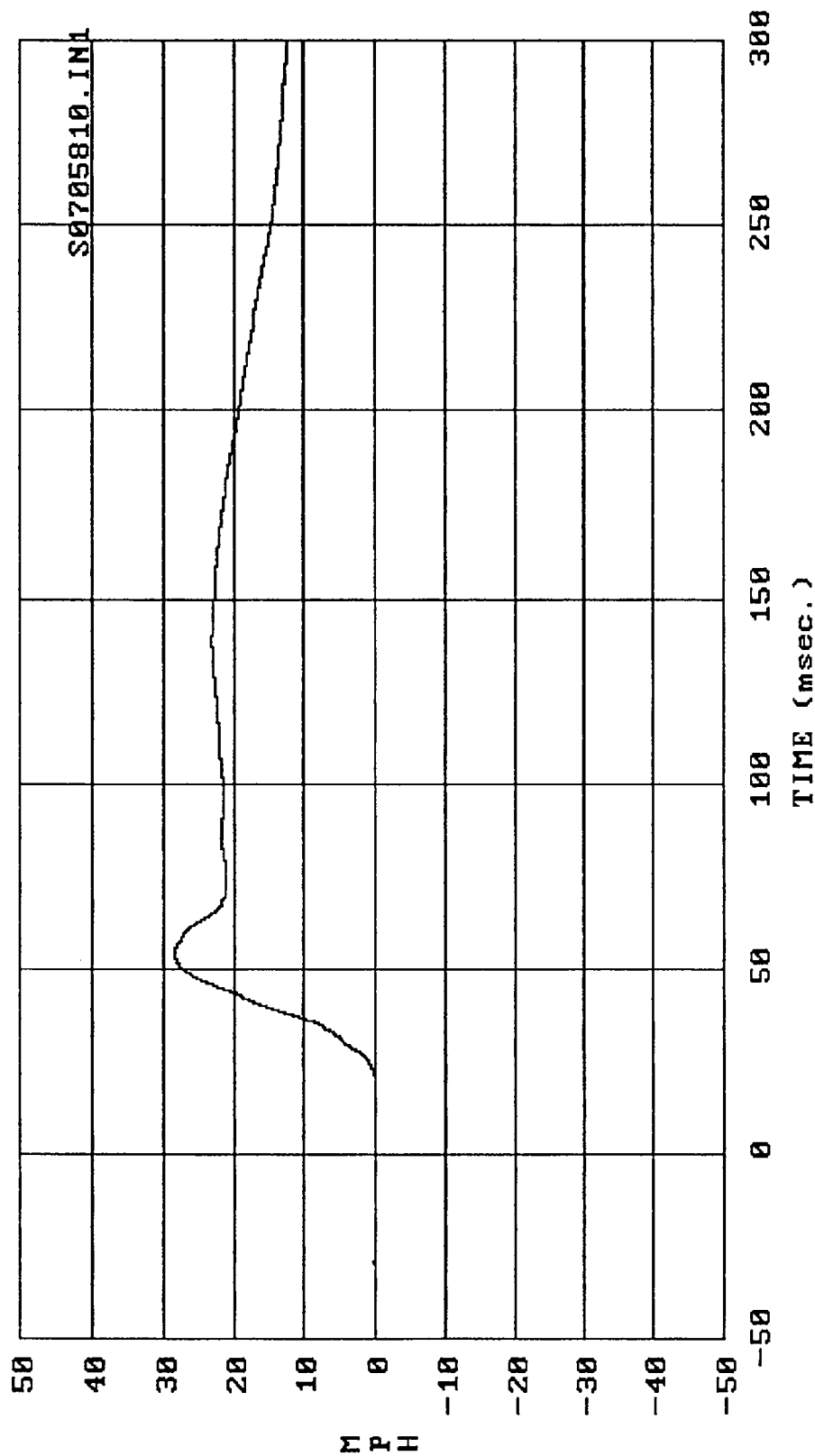
Filter: FIR 100 Max = 93.984 Min = -21.181
MSE 02/03/89 -- 1988 Dodge Caravan : Driver Lower Spine acc., Y-ax. (Second)



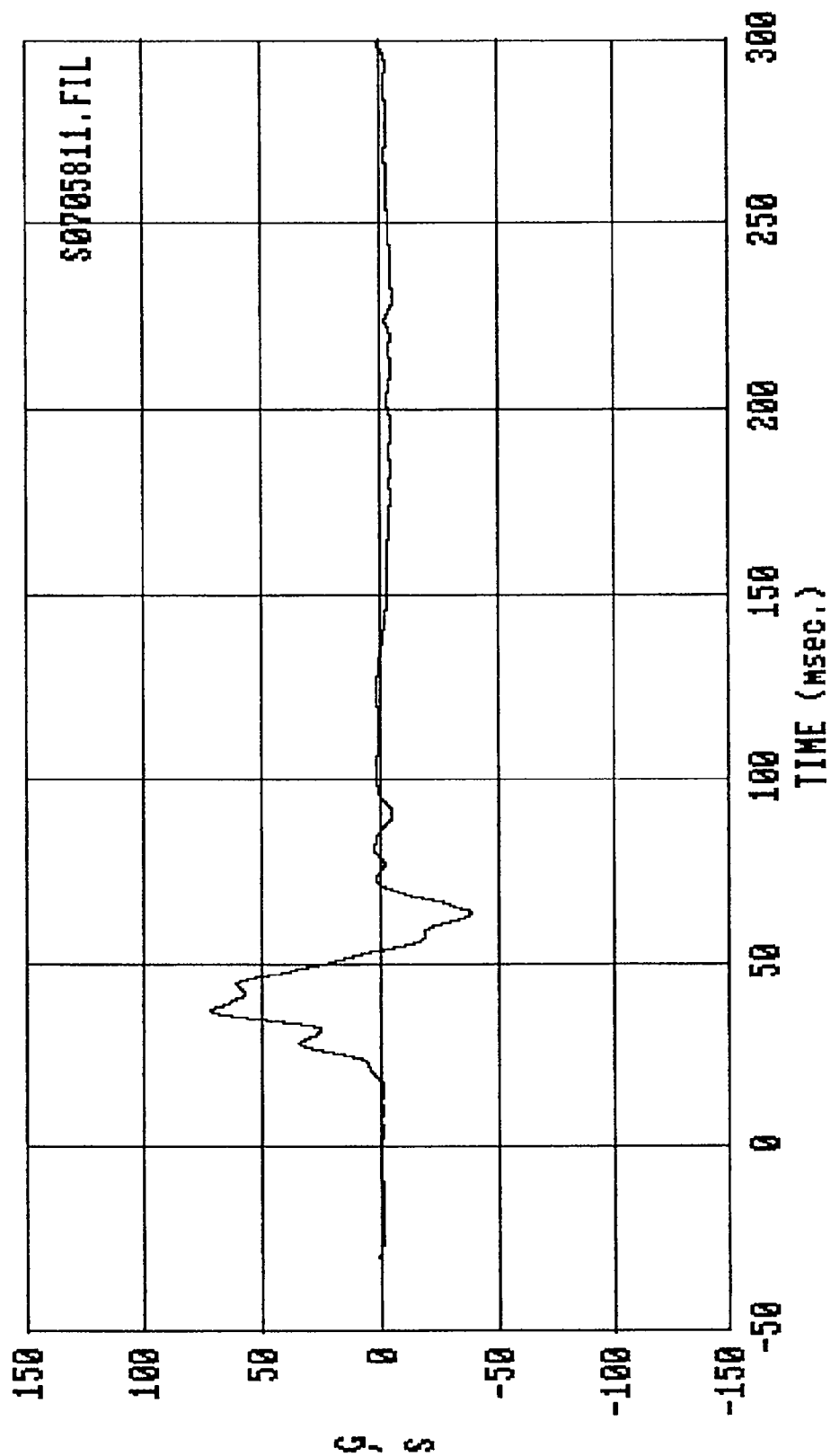
Filter: FIR 100 Max = 31.986 Min = -.23056E-02
 MSE 02/03/89 -- 1988 Dodge Caravan : Driver Lwr Spine delt U, Y-ax
 (Second)



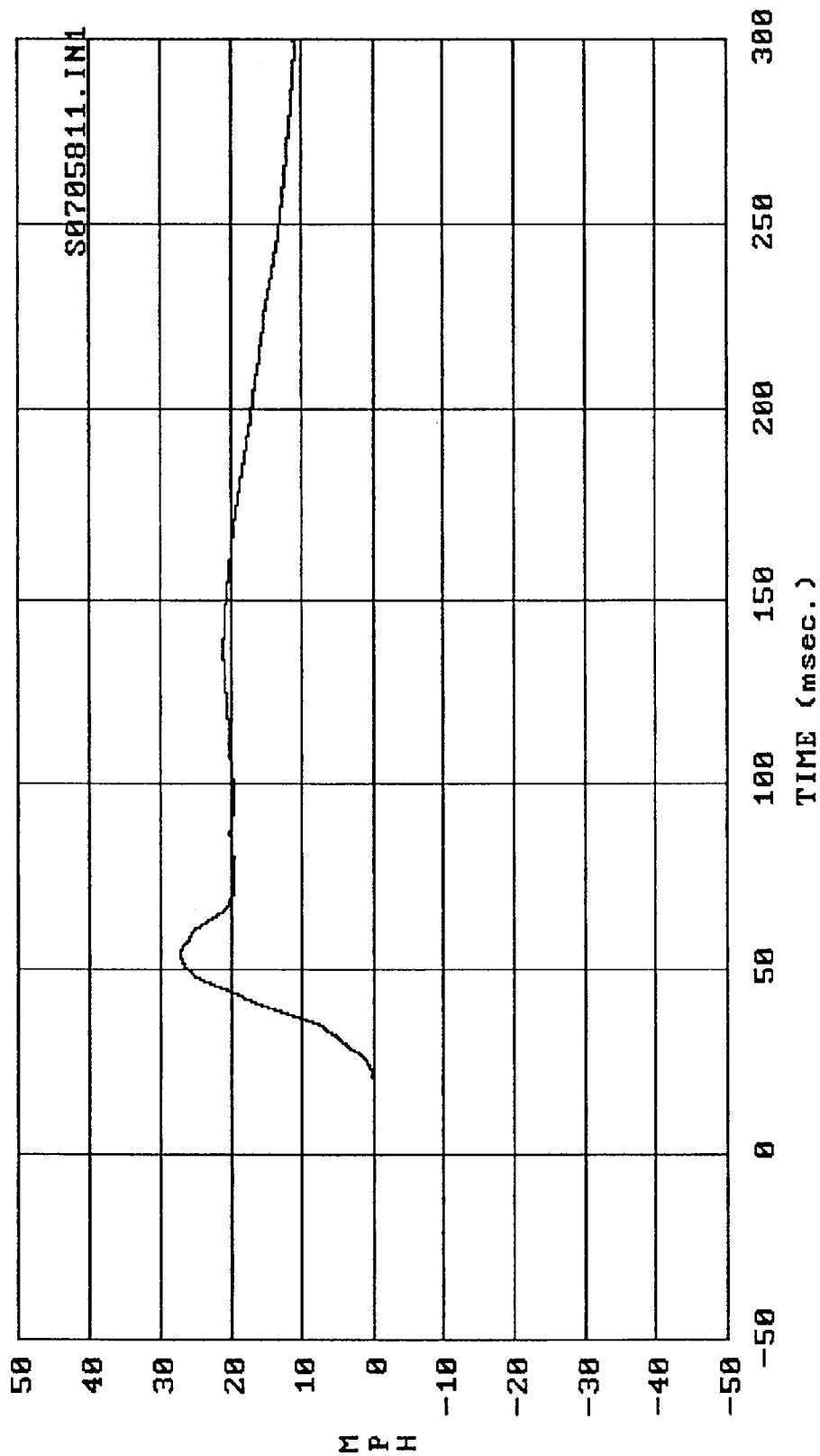
Filter: FIR 100 Max = 75.058 Min = -38.306
MSE 02/03/89 -- 1988 Dodge Caravan : Driver Upper Spine acc., Y-ax.(Primary)



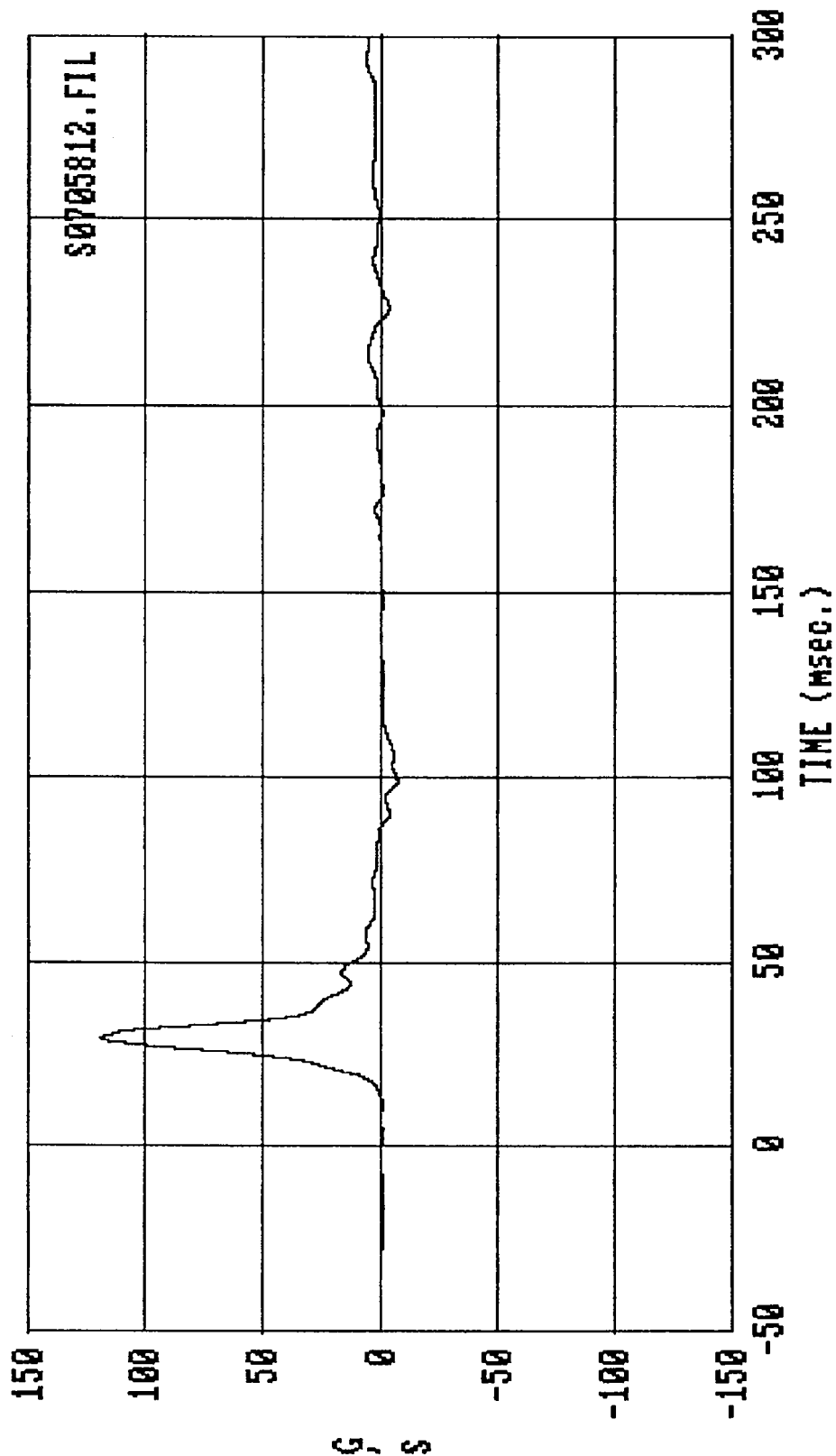
Filter: FIR 100 Max = 28.690 Min = -.39058E-01
MSE 02/03/89 -- 1988 Dodge Caravan : Driver Up Spine delt V, Y-ax
(PPrimary)



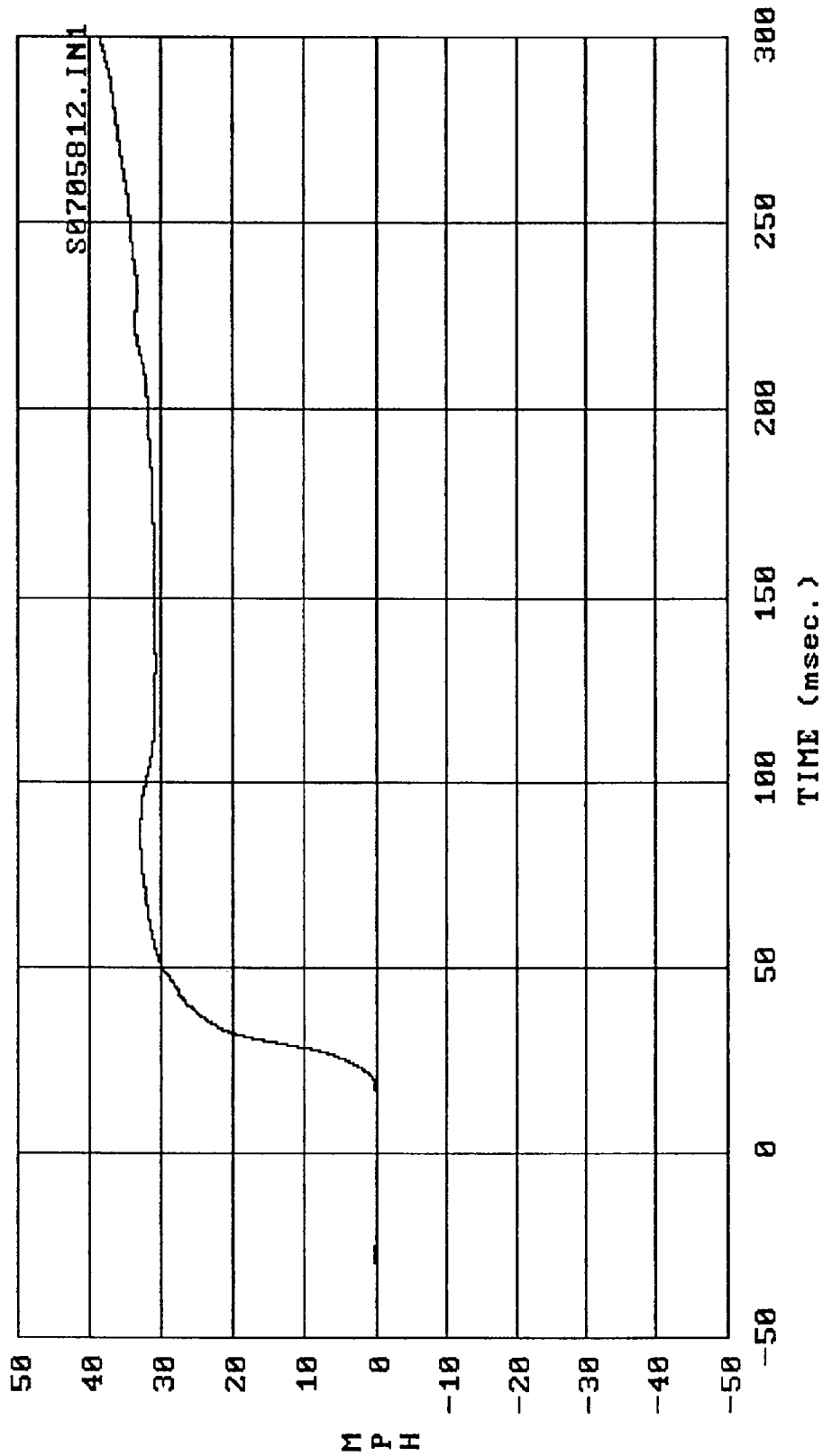
Filter: FIR 100 Max = 72.089 Min = -38.034
MSE 02/03/89 -- 1988 Dodge Caravan : Driver Upper Spine acc., Y-ax. (Second)



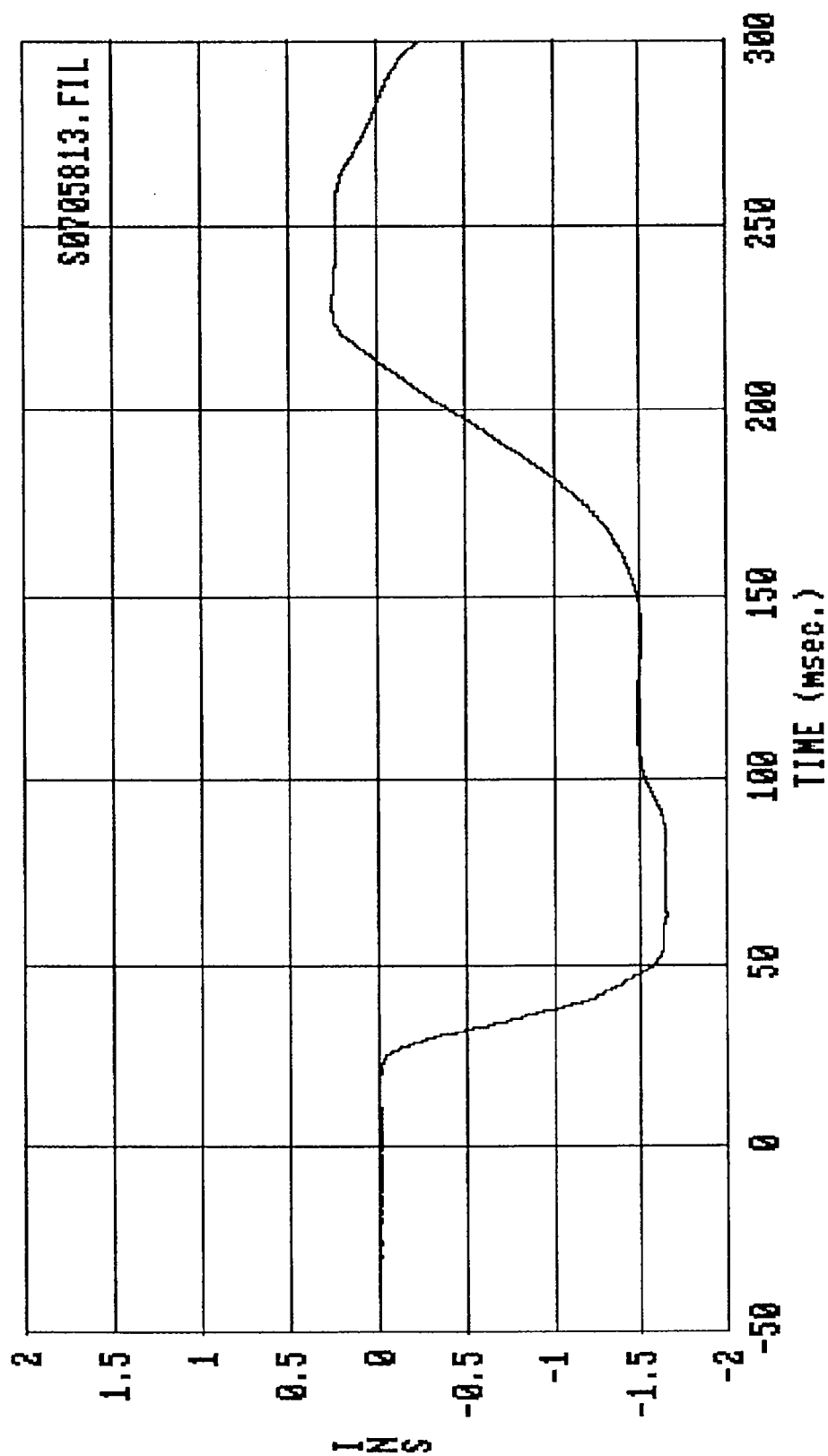
Filter: FIR 100 Max = 27.410 Min = -.28722E-01
 MSE 02/03/89 -- 1988 Dodge Caravan : Driver Upr Spine delt V, Y-ax
 (Second)



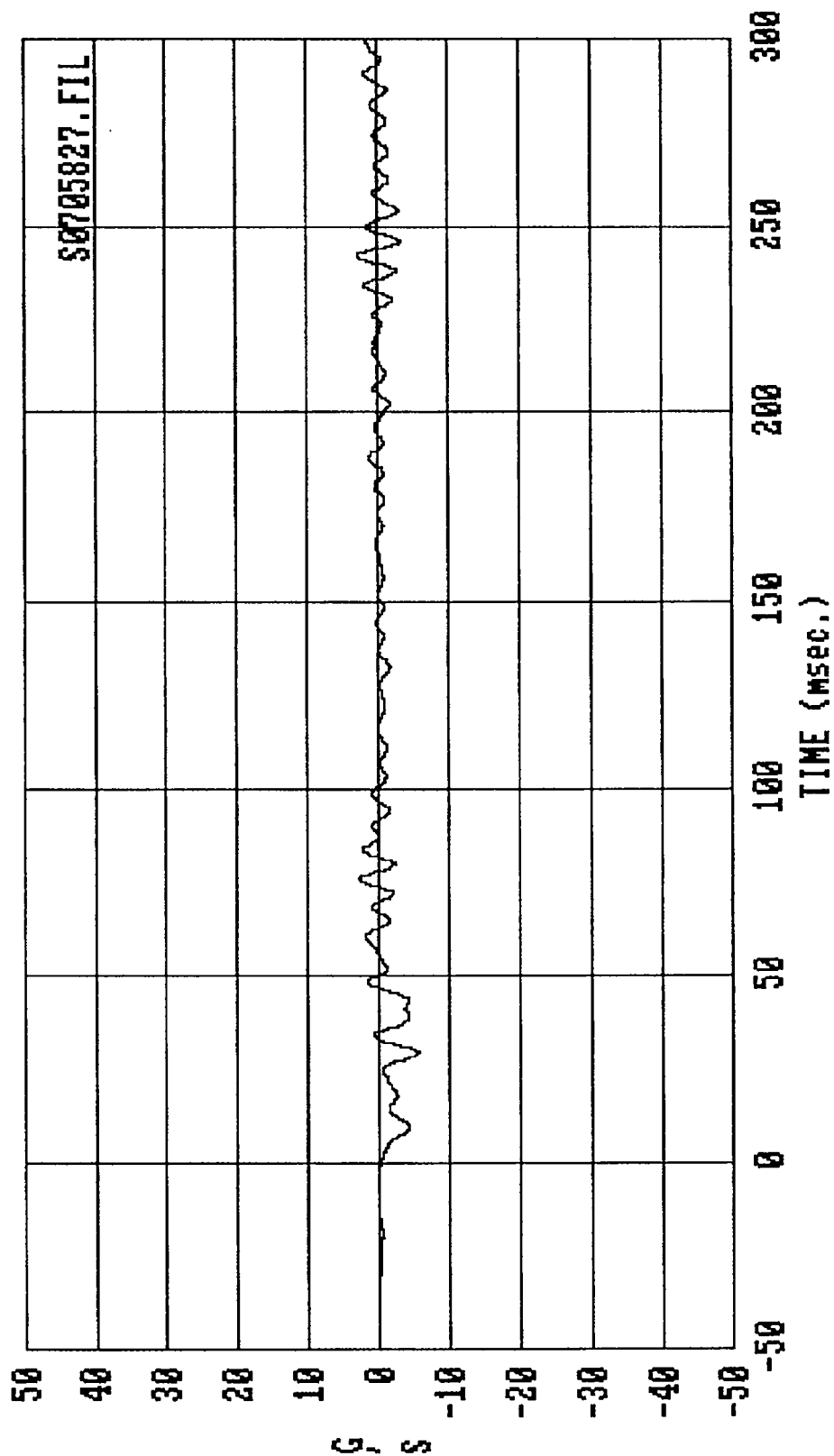
Filter: FIR 100 Max = 119.77 Min = -6.4866
MSE 02/03/89 -- 1988 Dodge Caravan : Driver Pelvis acceleration, Y-axis



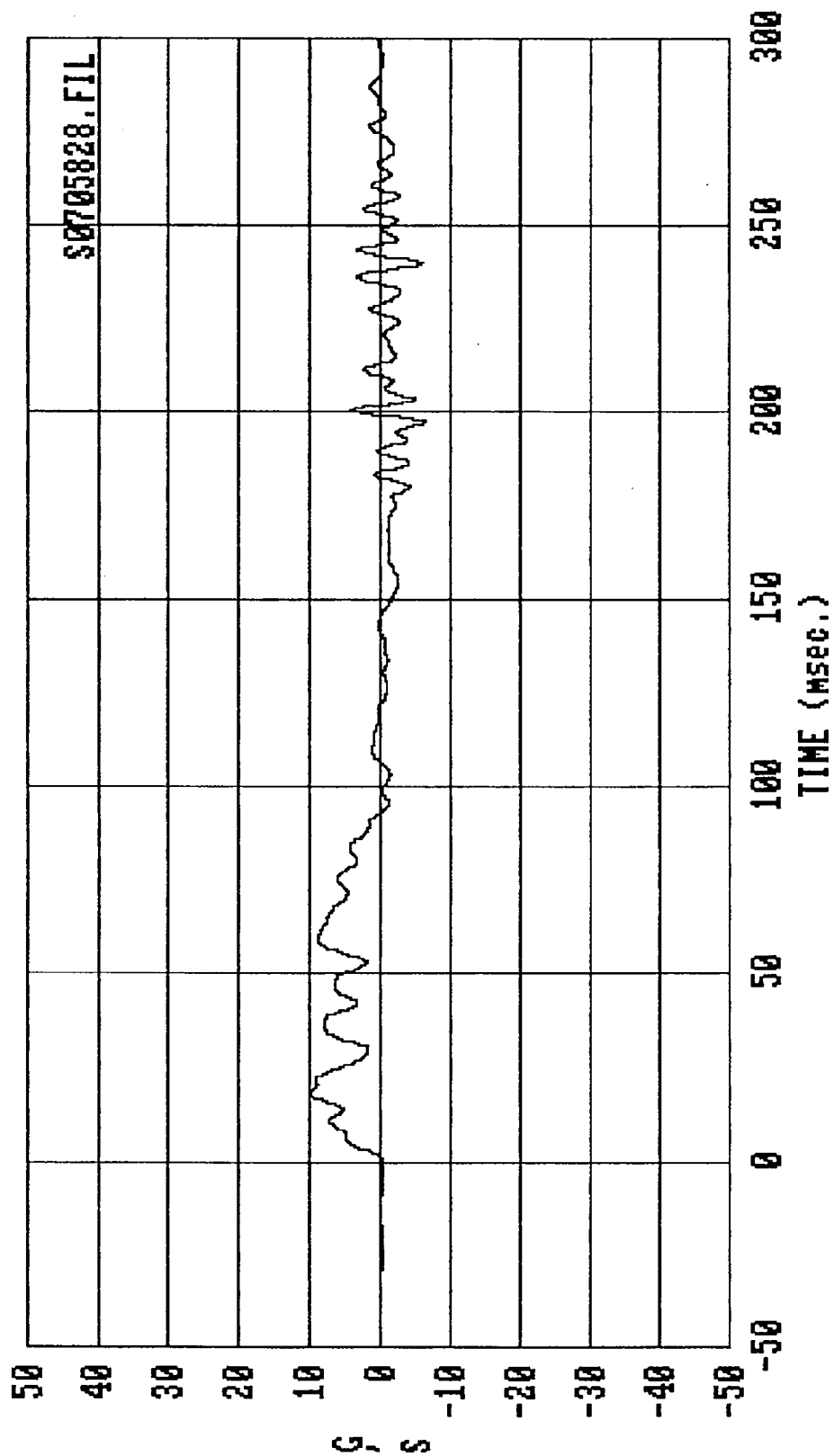
Filter: FIR 100 Max = 38.655 Min = -.45566E-02
MSE 02/03/89 -- 1988 Dodge Caravan : Driver Pelvis delta U, Y-axis



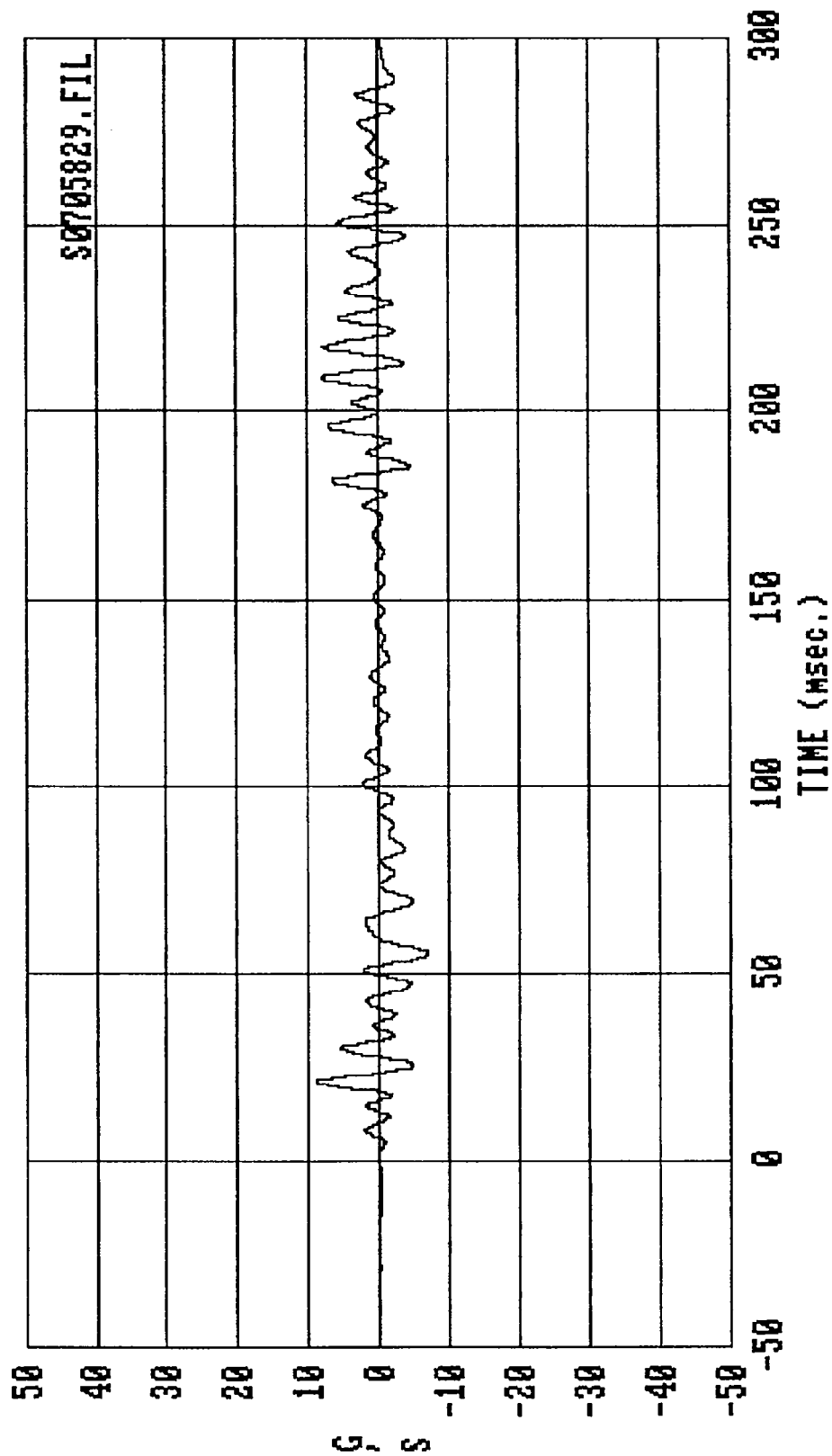
Filter: SAE CLASS 180 Max = .25733 Min = -1.6529
MSE 02/03/89 -- 1988 Dodge Caravan : Driver Chest disp. (Compression is -)



Filter: SAE CLASS 60 Max = 3.0335 Min = -5.5968
 MSE 02/03/89 -- 1988 Dodge Caravan : Front Seat Right Sill, X-axis

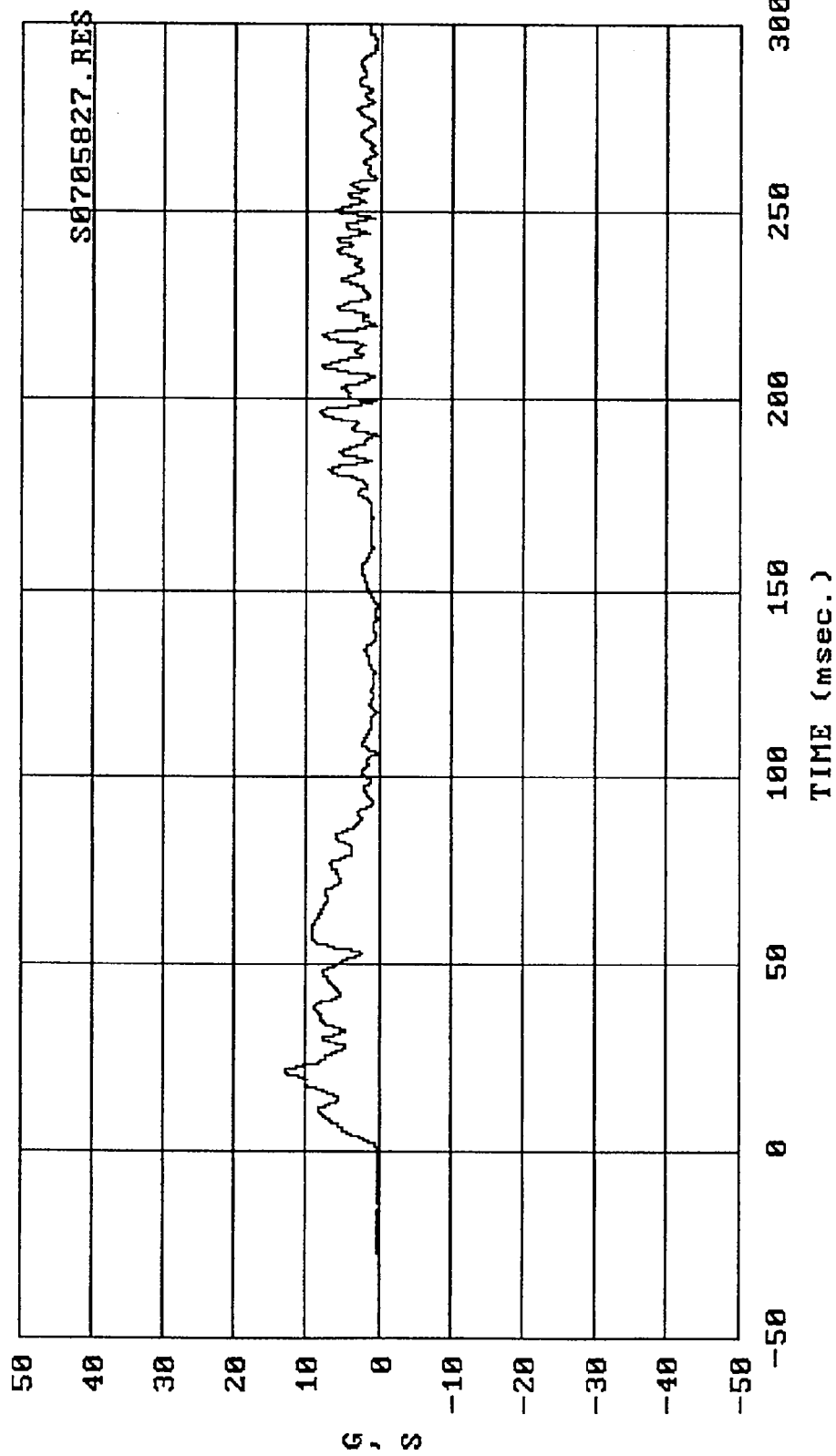


Filter: SAE CLASS 60 Max = 10.018 Min = -6.1006
 MSE 02/03/89 -- 1988 Dodge Caravan : Front Seat Right Sill, Y-axis



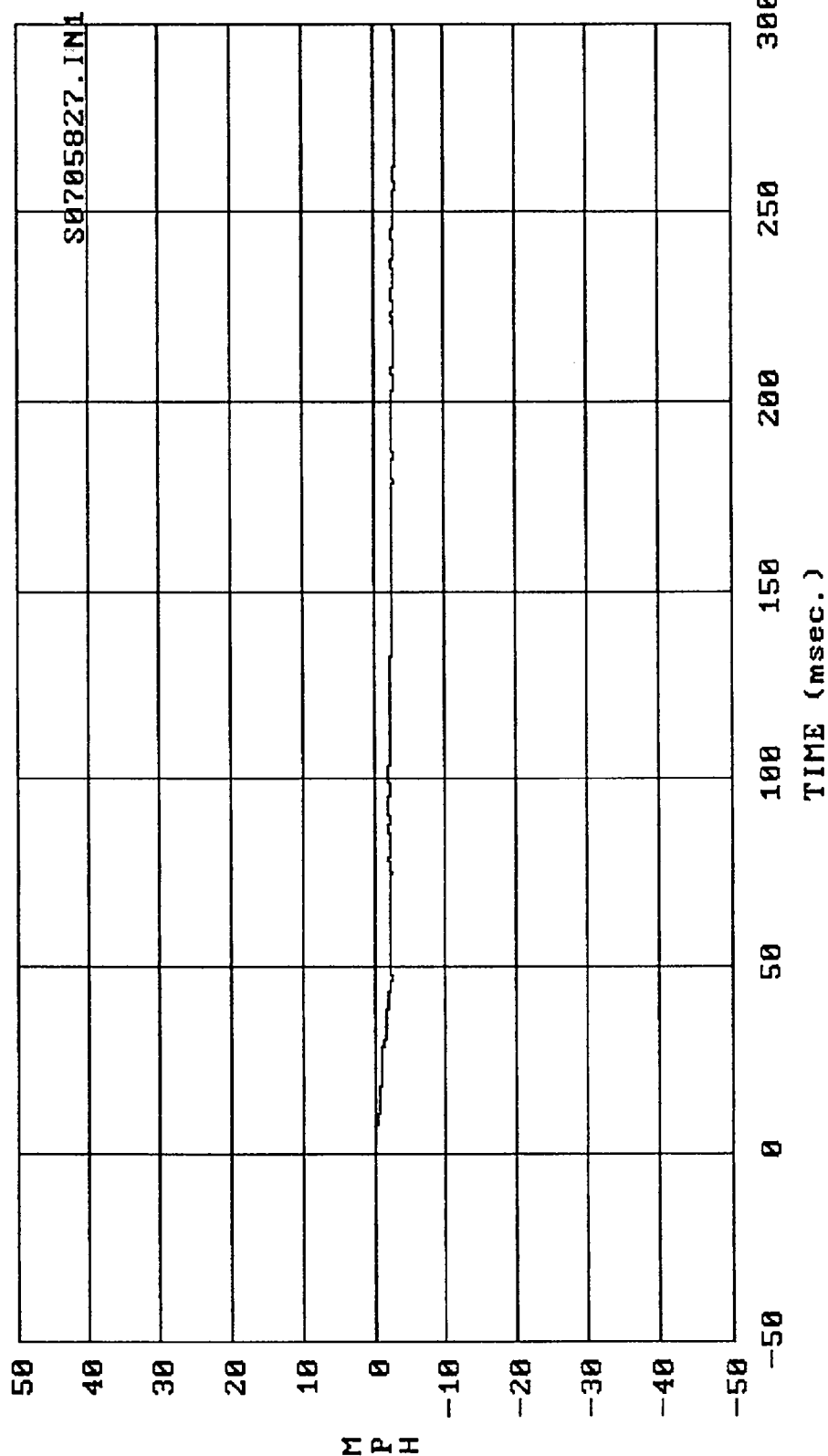
B-26

Filter: SAE CLASS 60 Max = 9.1432 Min = -6.8699
MSE 02/03/89 -- 1988 Dodge Caravan : Front Seat Right Sill, Z-axis



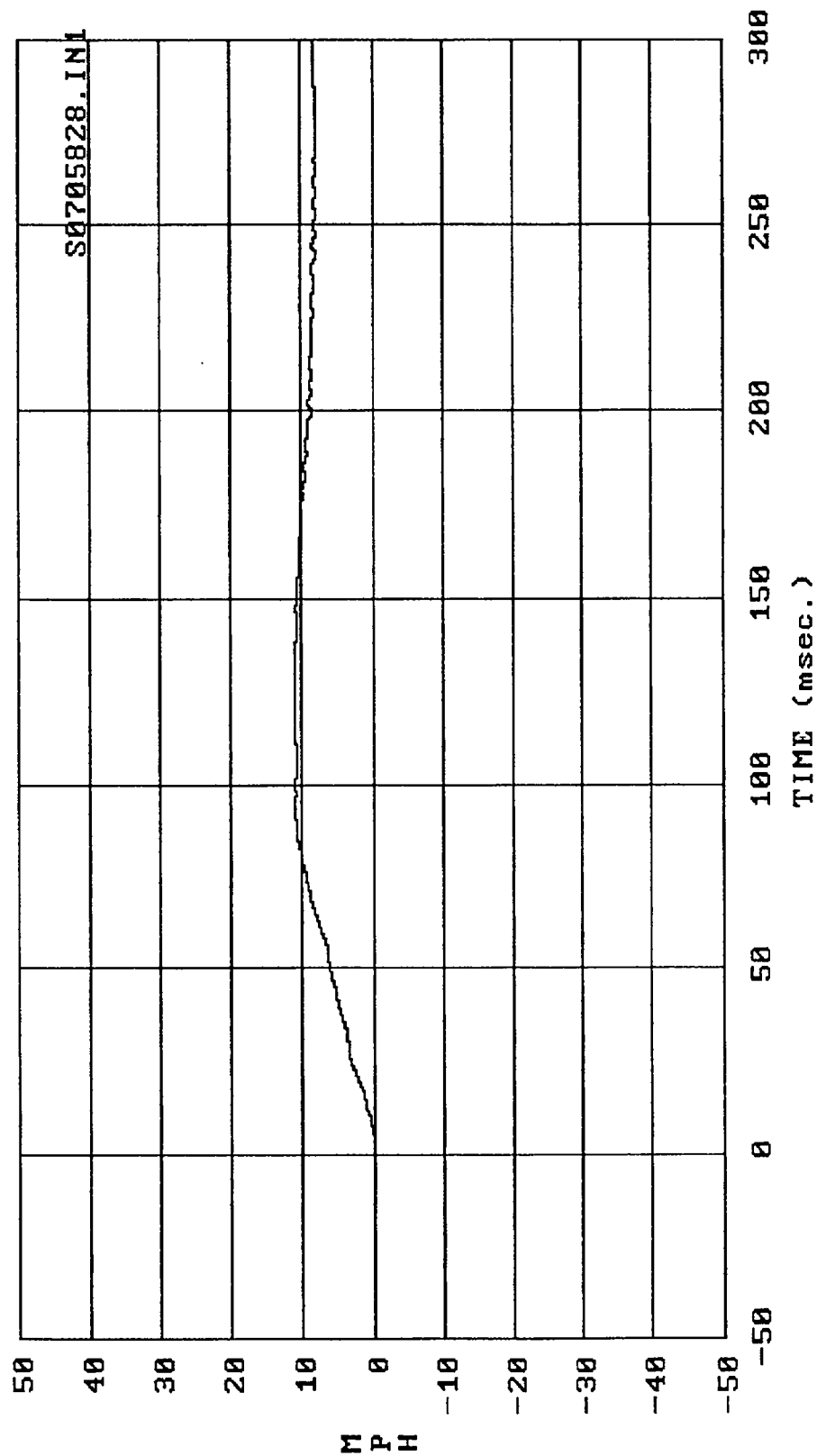
Filter: SAE CLASS 60 Max = 13.007 Min = .21907

MSE 02/03/89 -- 1988 Dodge Caravan : Front Seat Right Sill, resultant accel.

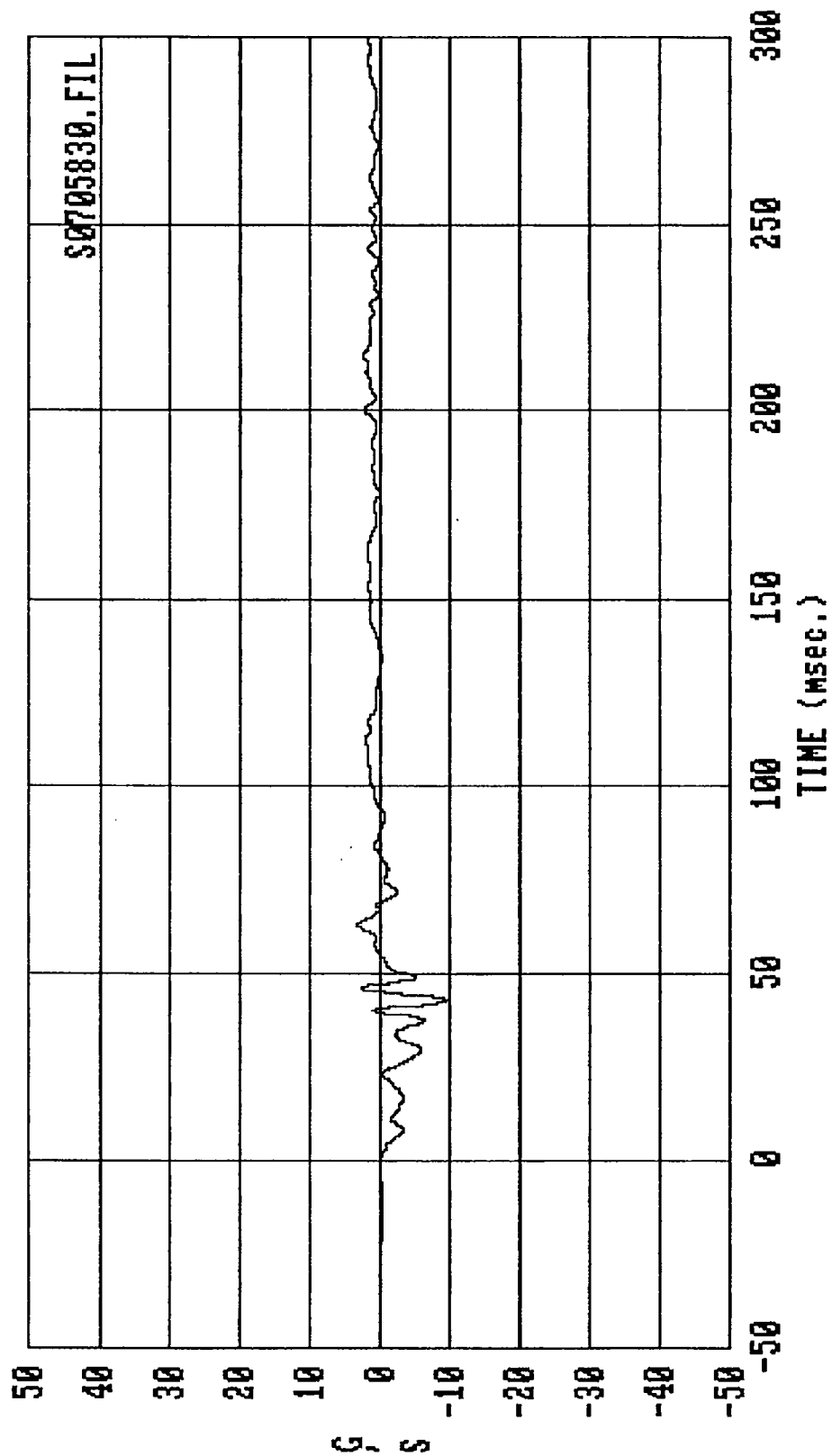


Filter: SAE CLASS 180 Max = -.54438E-03 Min = -3.0942

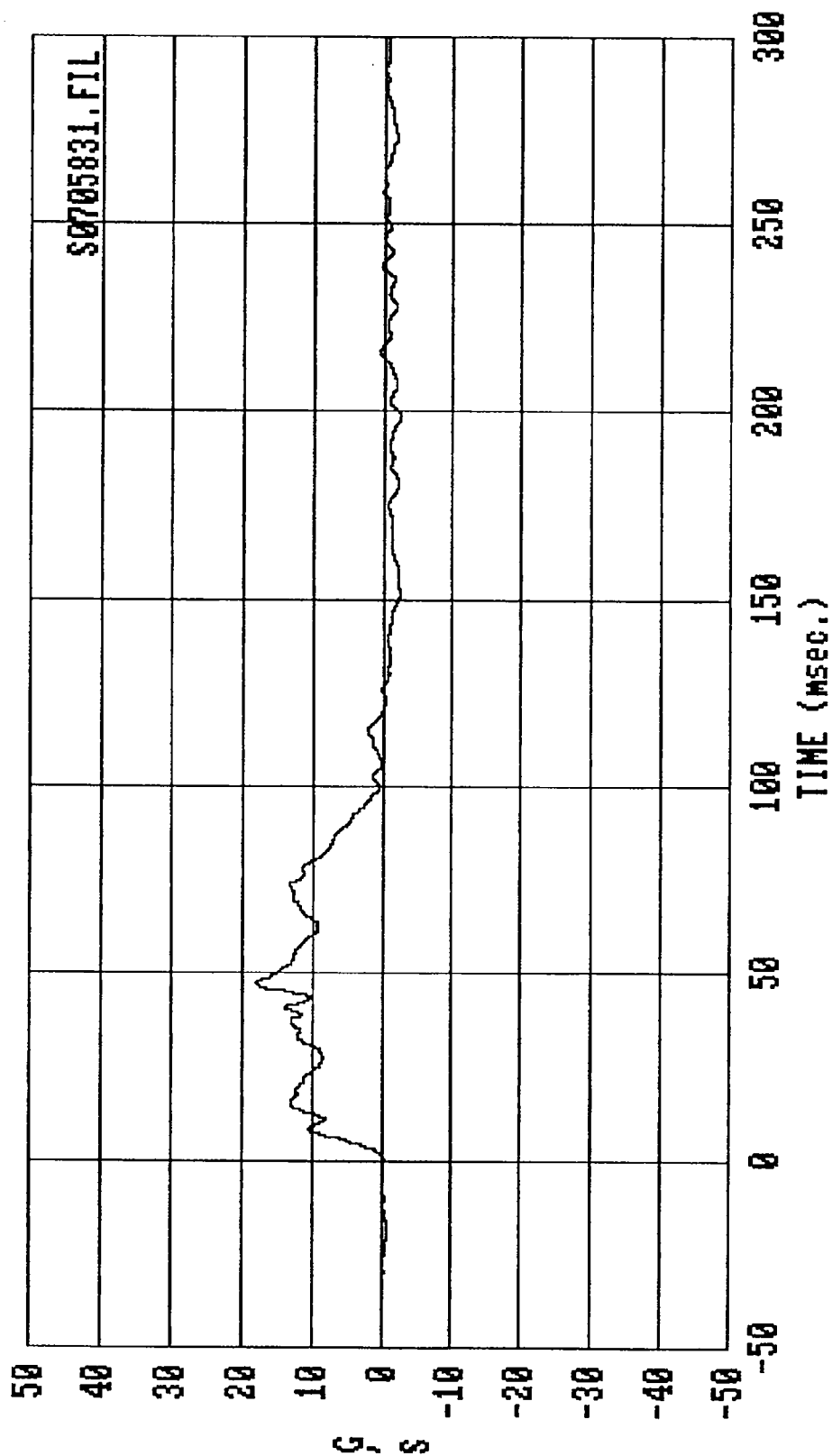
MSE 02/03/89 -- 1988 Dodge Caravan : Front Seat Right Sill delta U, X-axis



Filter: SAE CLASS 180 Max = 11.176 Min = -.11184E-01
MSE 02/03/89 -- 1988 Dodge Caravan : Front Seat Right Sill delta U, Y-axis

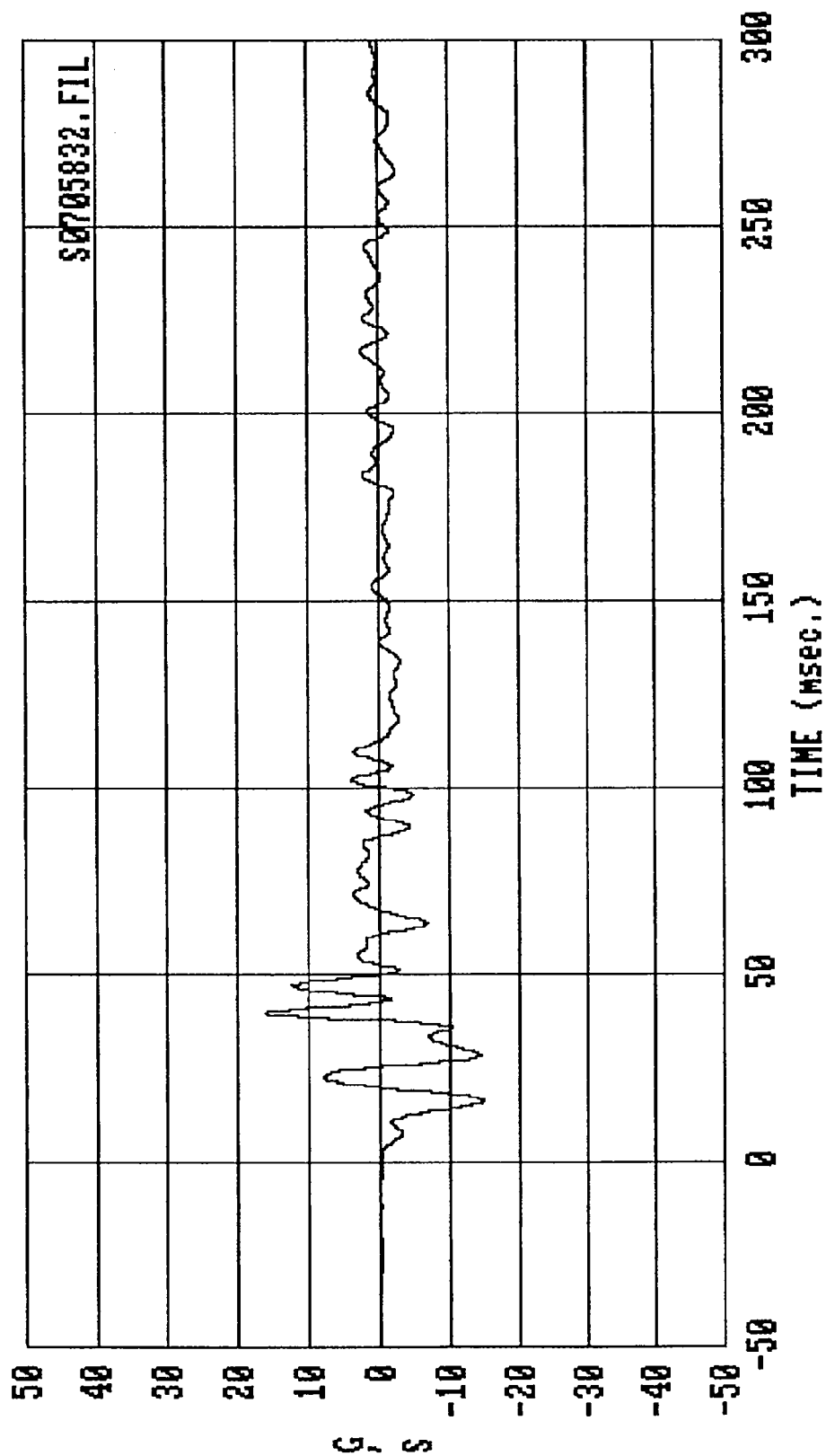


Filter: SAE CLASS 60 Max = 3.5115 Min = -9.6691
 MSE 02/03/89 -- 1988 Dodge Caravan : Rear Floor above axle, X-axis

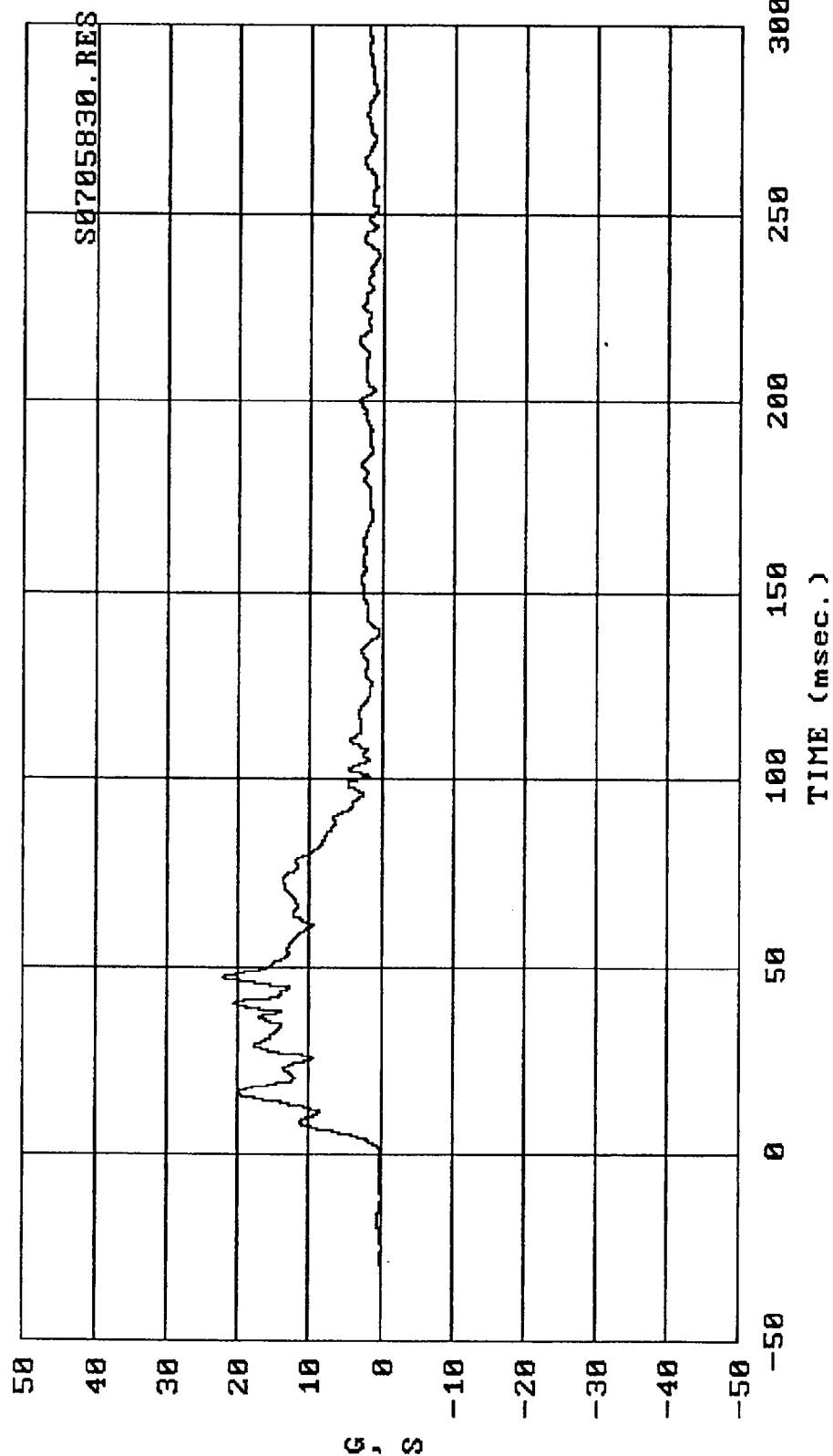


B31

Filter: SAE CLASS 60 Max = 18.264 Min = -2.3364
MSE 02/03/89 -- 1988 Dodge Caravan : Rear Floor above axle, Y-axis

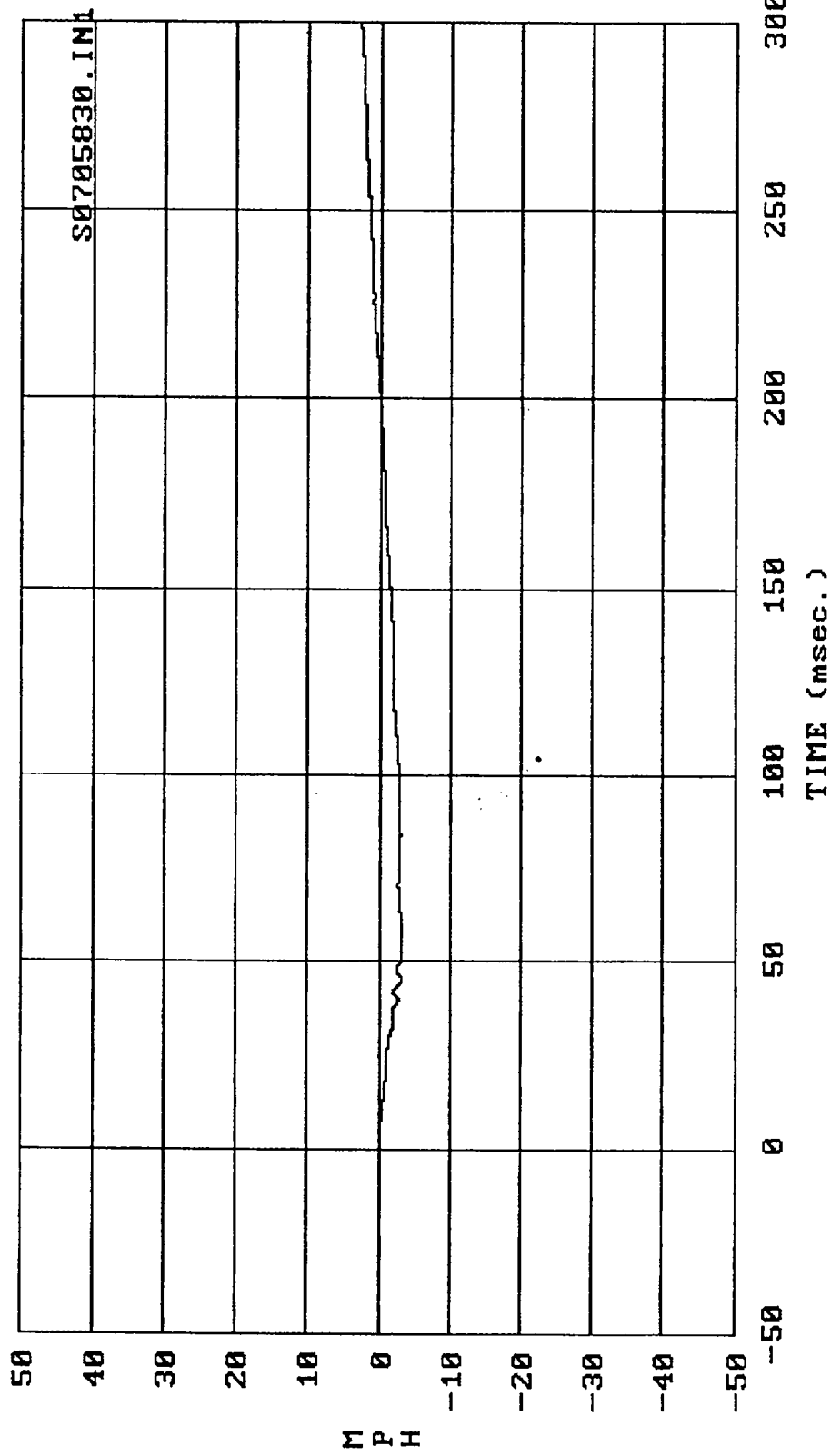


Filter: SAE CLASS 60 Max = 16.428 Min = -14.894
MSE 02/03/89 -- 1988 Dodge Caravan : Rear Floor above axle, Z-axis

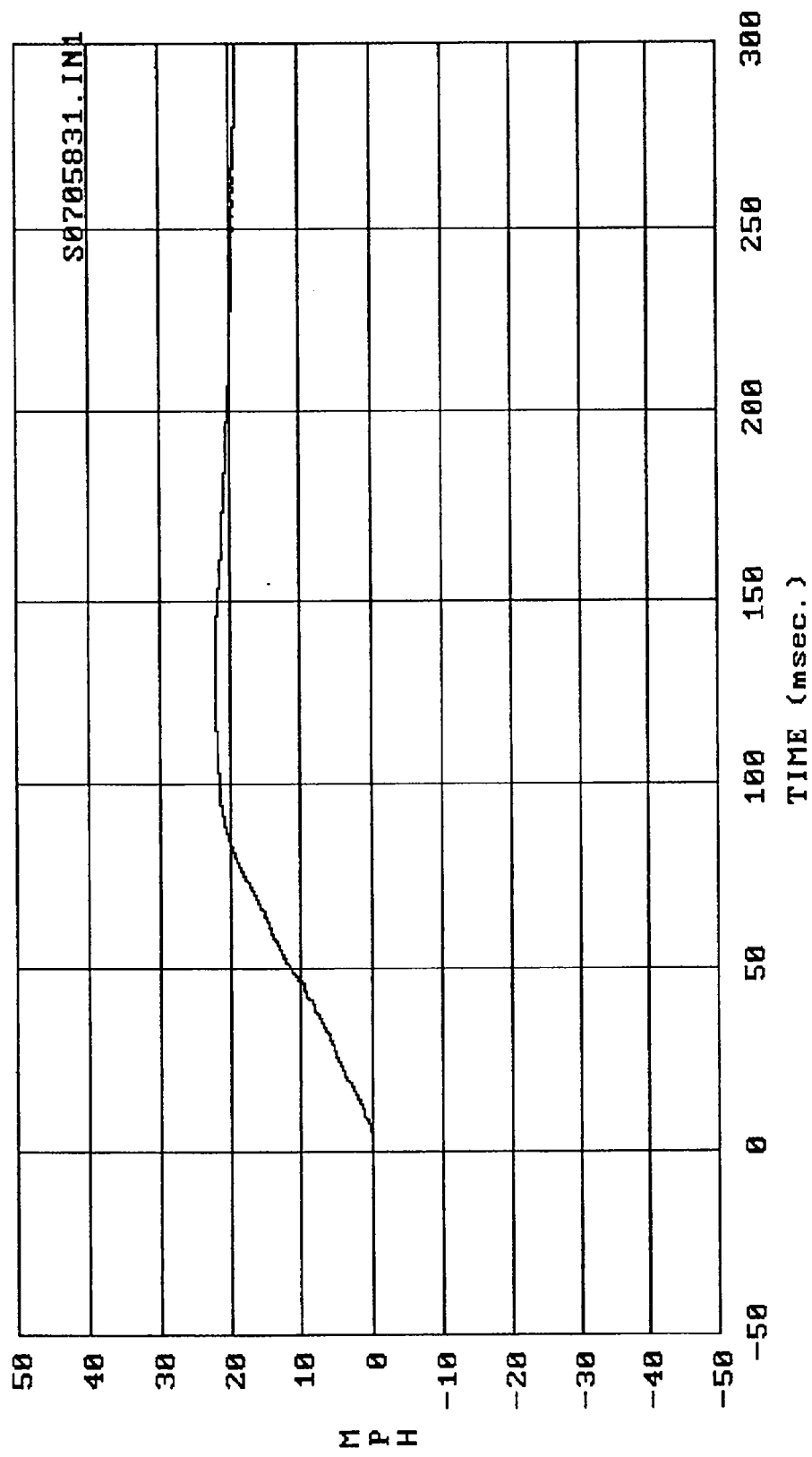


Filter: SAE CLASS 60 Max = 22.234 Min = .20942

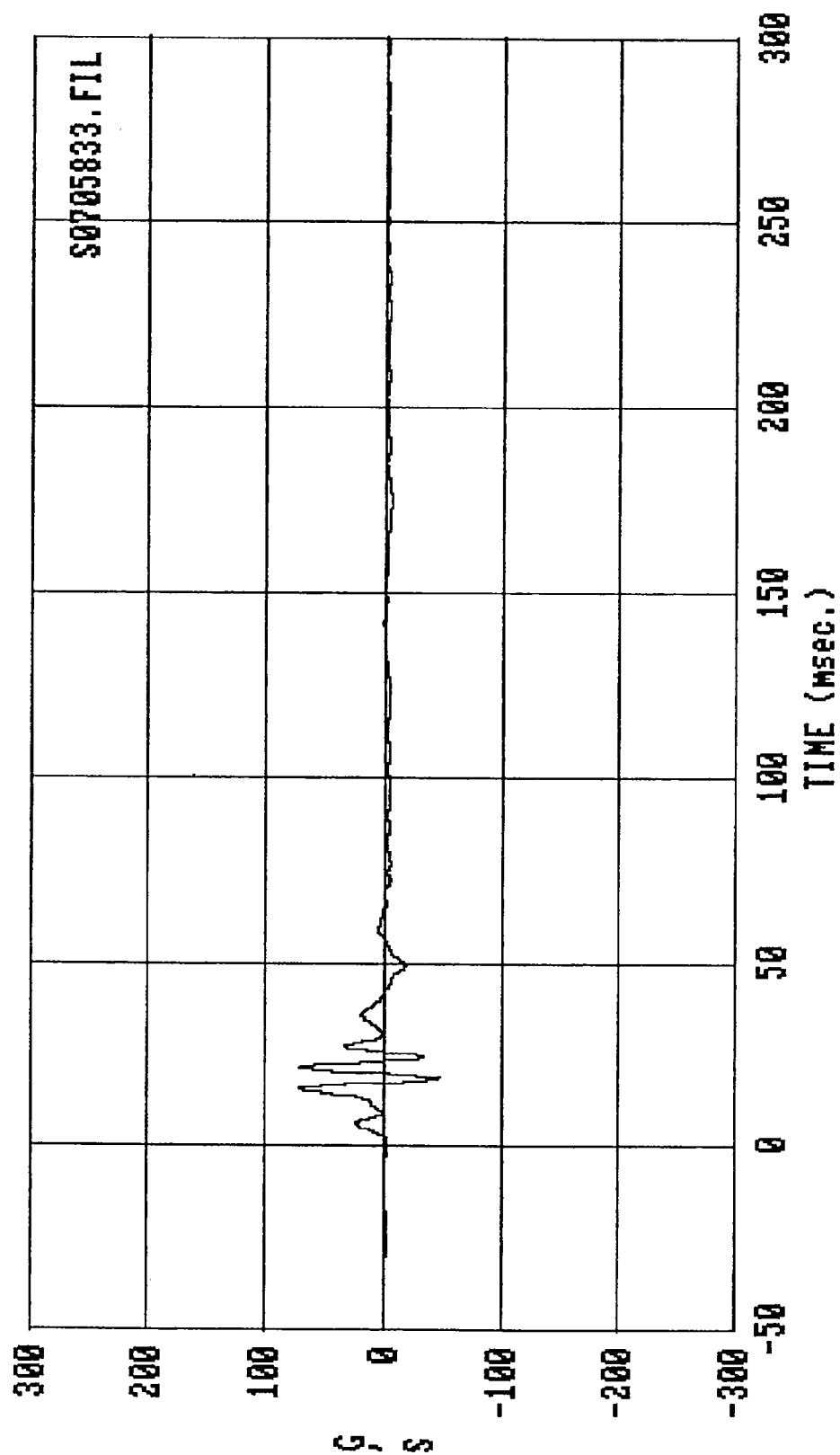
MSE 02/03/89 -- 1988 Dodge Caravan : Rear Floor above axle, resultant accel.



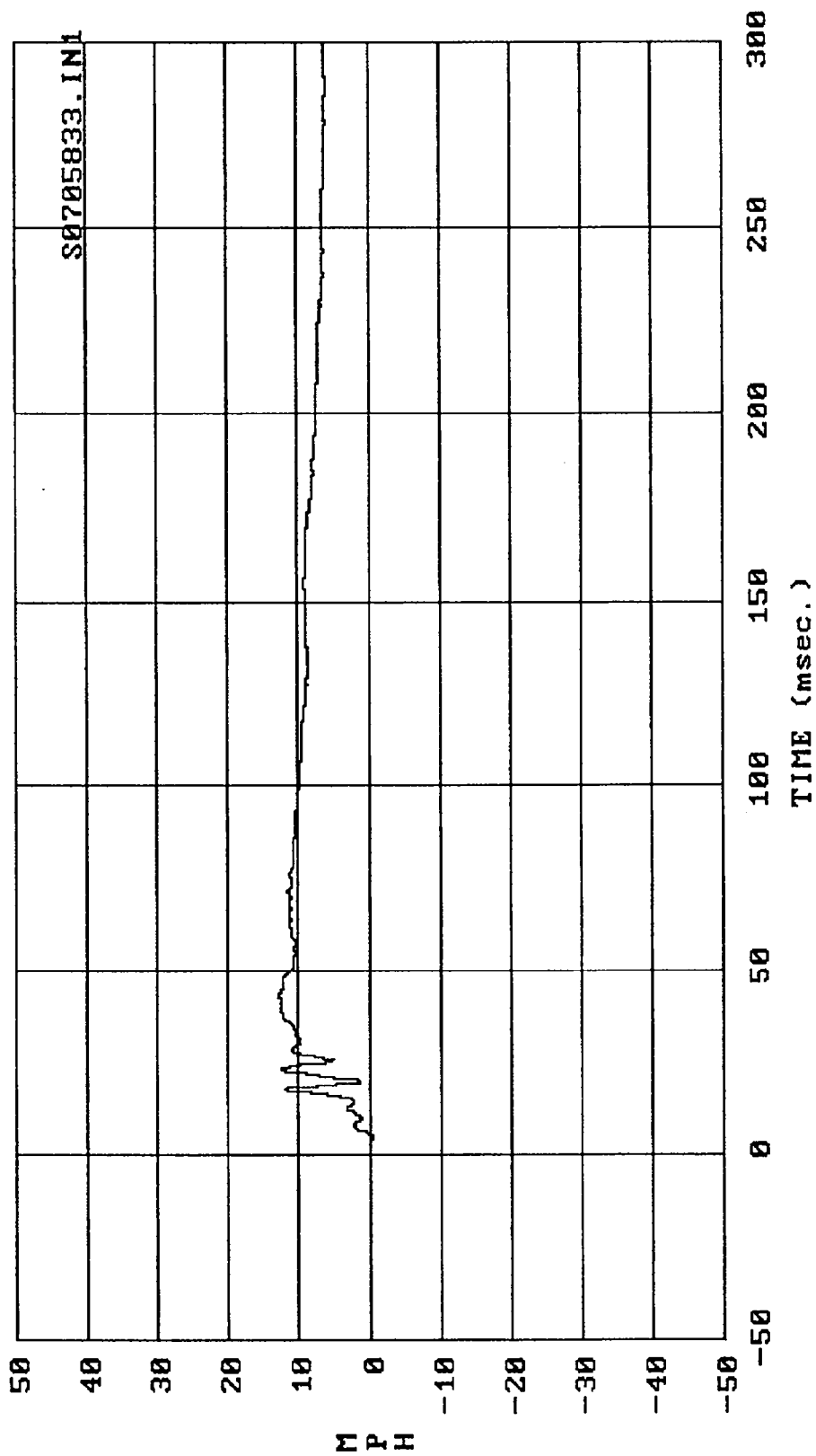
Filter: SAE CLASS 180 Max = 2.9416 Min = -3.0963
MSE 02/03/89 --- 1988 Dodge Caravan : Rear Floor above axle delta U, X-axis



Filter: SAE CLASS 180 Max = 22.406 Min = -.20844E-02
 MSE 02/03/89 --- 1988 Dodge Caravan : Rear Floor above axle delta U, Y-axis



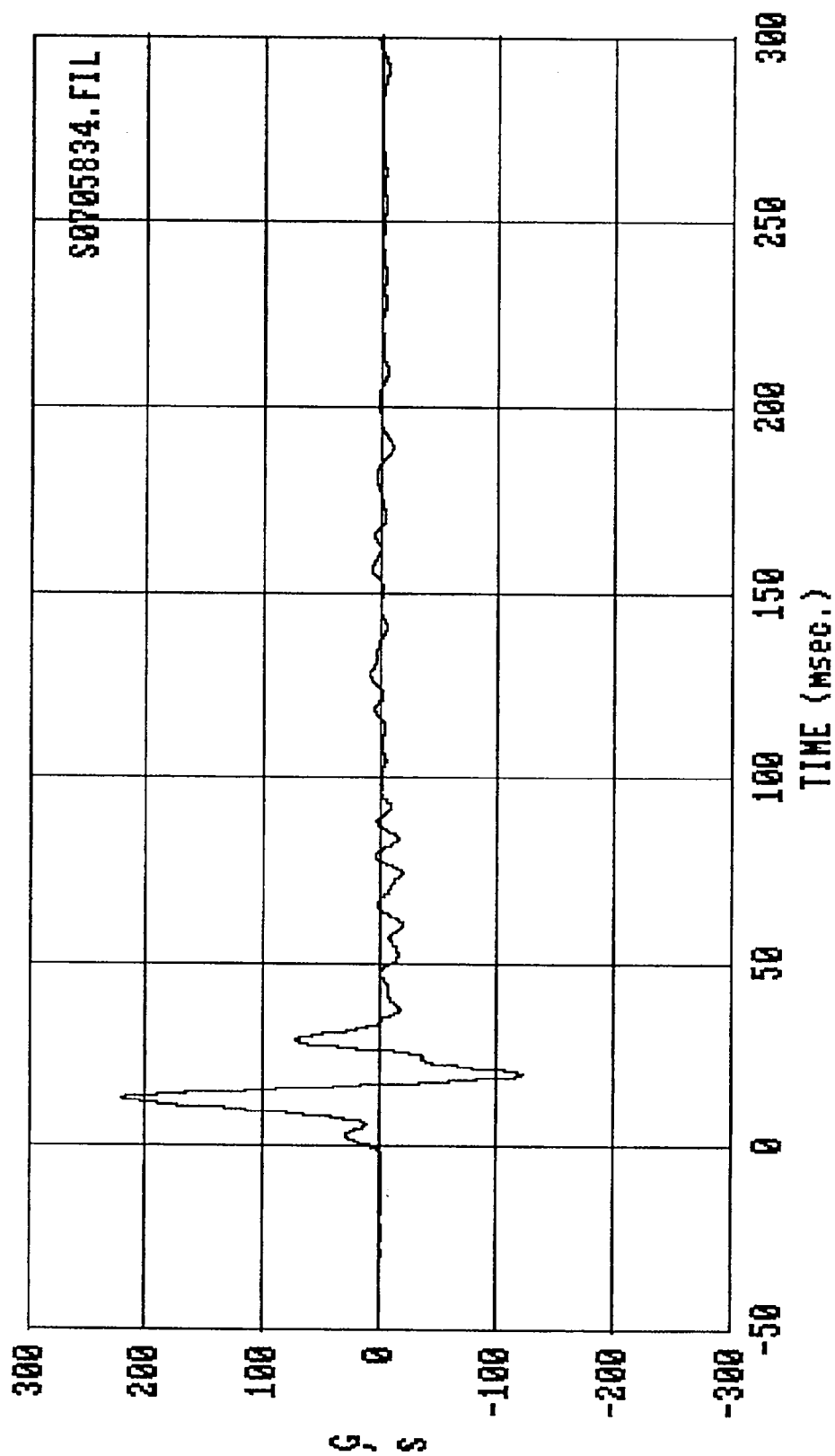
Filter: SAE CLASS 60 Max = 72.322 Min = -46.419
MSE 02/03/89 -- 1988 Dodge Caravan : Front Seat Left Sill, Y-axis



Filter: SAE CLASS 180

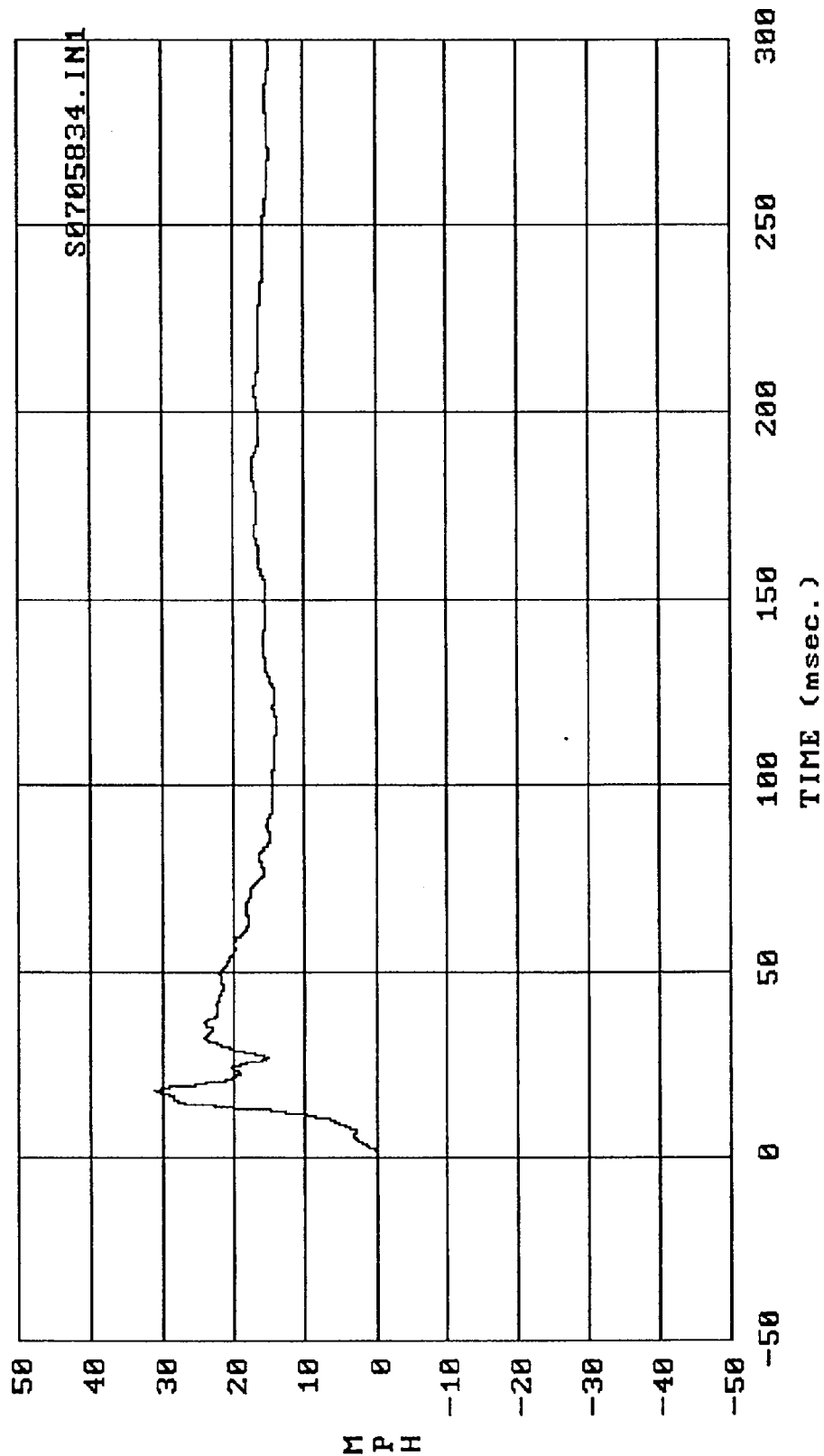
Max = 12.920 Min = -.23916

MSE 02/03/89 -- 1988 Dodge Caravan : Front Seat Left Sill delta U, Y-axis



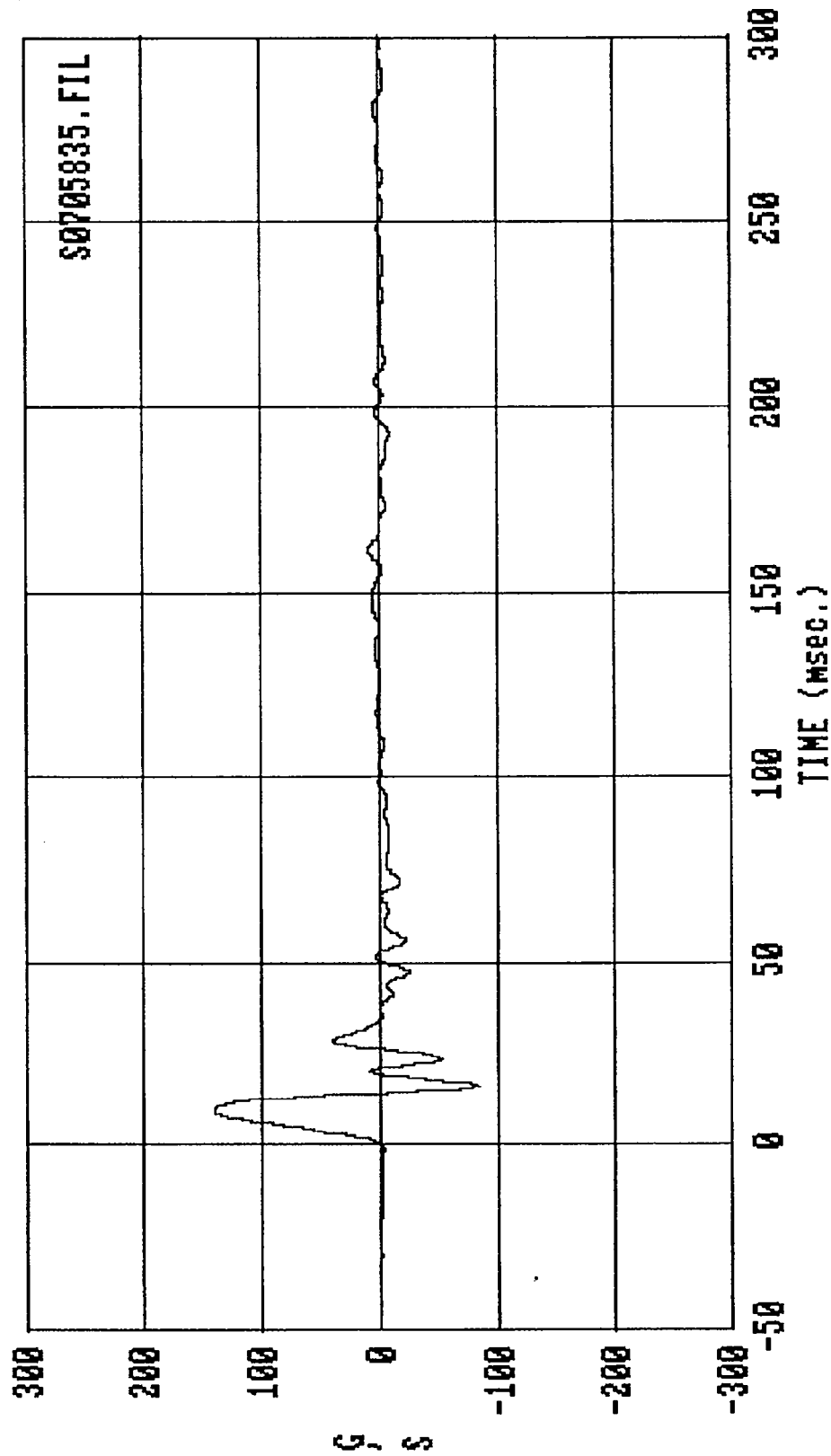
B-38

Filter: SAE CLASS 60 Max = 221.94 Min = -123.56
MSE 02/03/89 -- 1988 Dodge Caravan : Left Front Door centerline, Y-axis

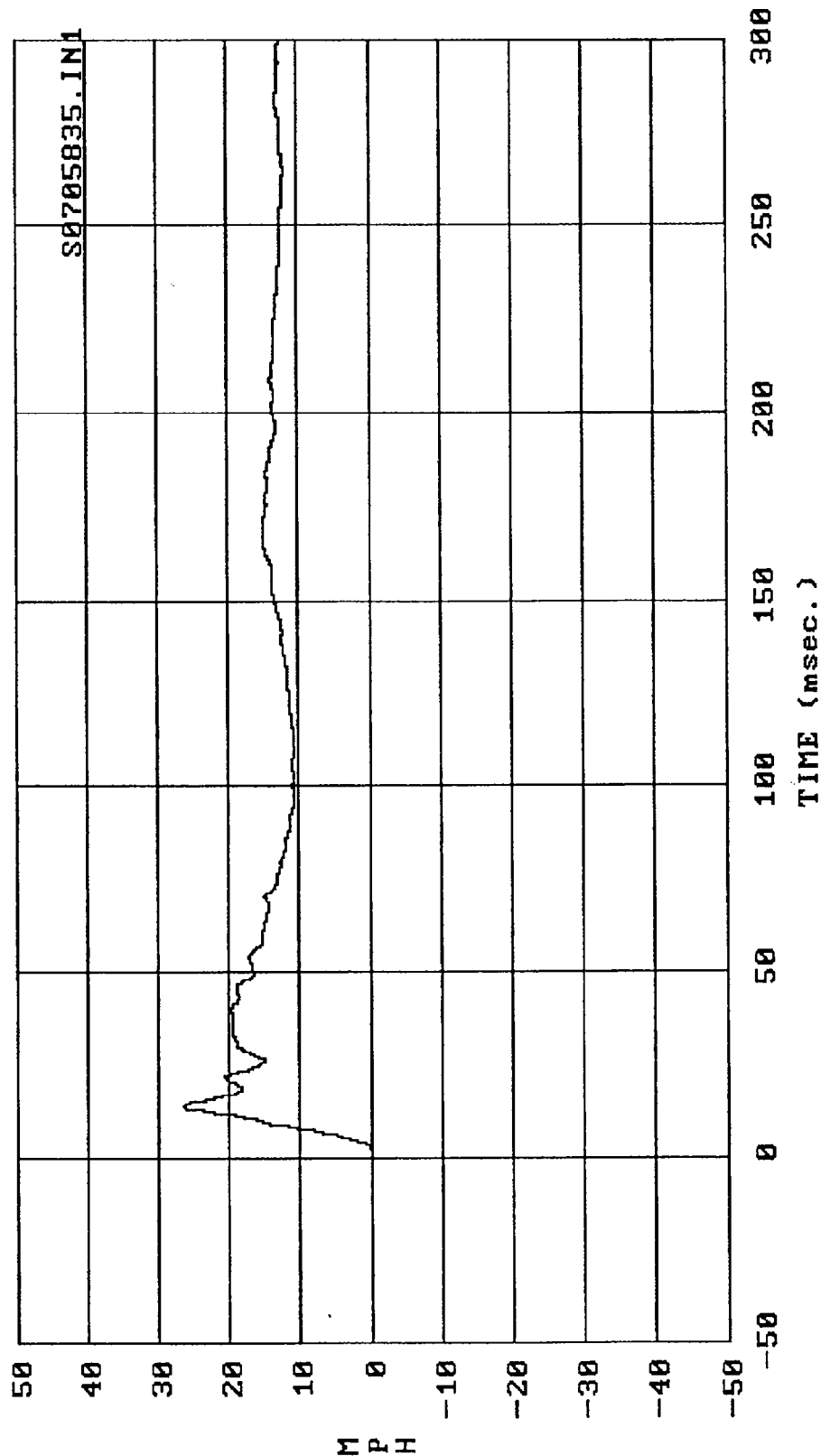


Filter: SAE CLASS 180 Max = 31.297 Min = -.98679E-03

MSE 02/03/89 -- 1988 Dodge Caravan : Left Front Door C/L delta U, Y-axi

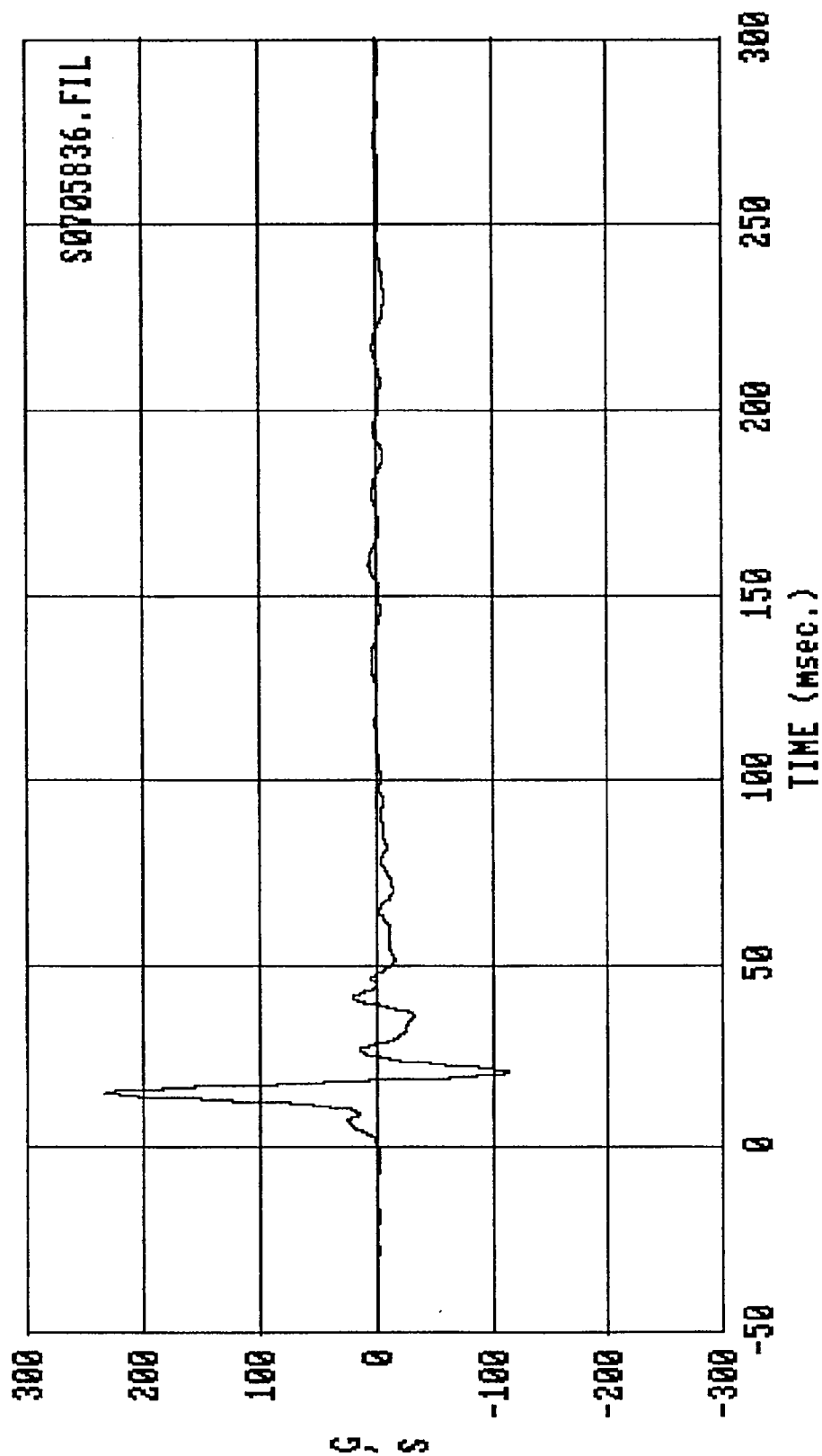


Filter: SAE CLASS 60 Max = 141.72 Min = -83.447
MSE 02/03/89 -- 1988 Dodge Caravan : Left Front Door mid-rear, Y-axis



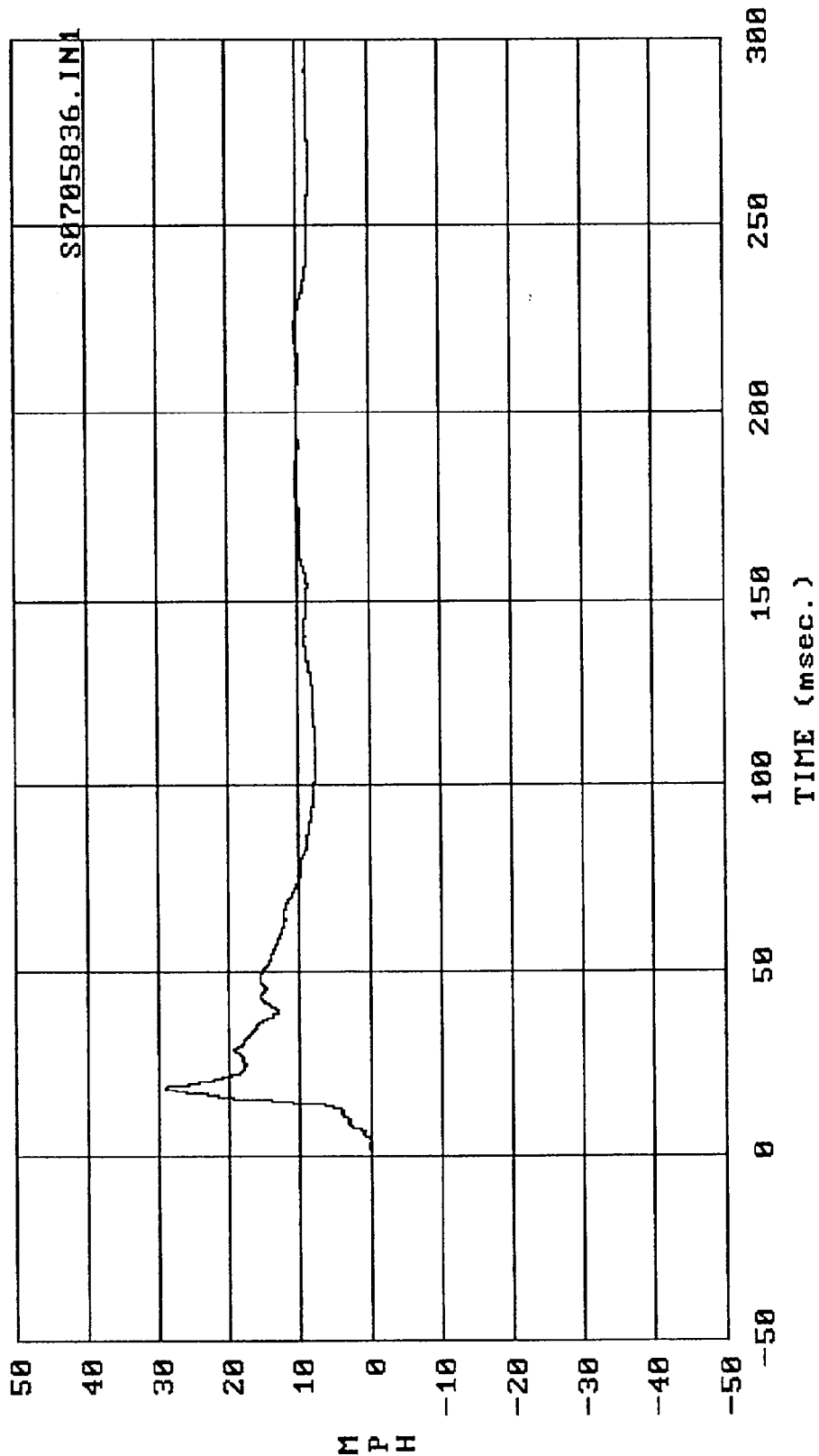
Filter: SAE CLASS 180 Max = 26.643 Min = .42851E-02

MSE 02/03/89 — 1988 Dodge Caravan : Lft Frnt Door mid-rear delta U, Y
axis



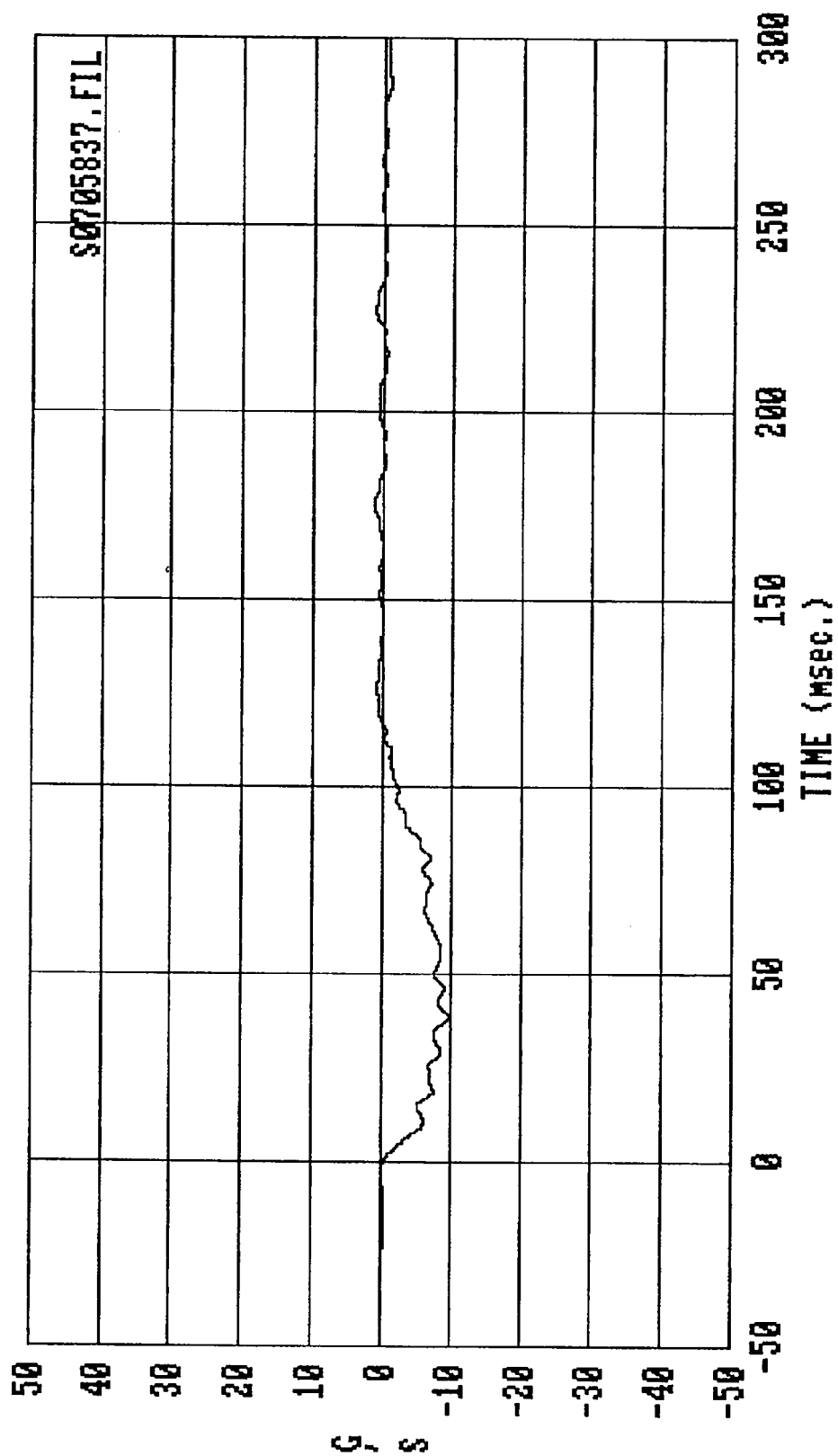
Filter: SAE CLASS 60 Max = 234.71 Min = -112.03

MSE 02/03/89 -- 1988 Dodge Caravan : Left Front Door upper centerline, Y-axis

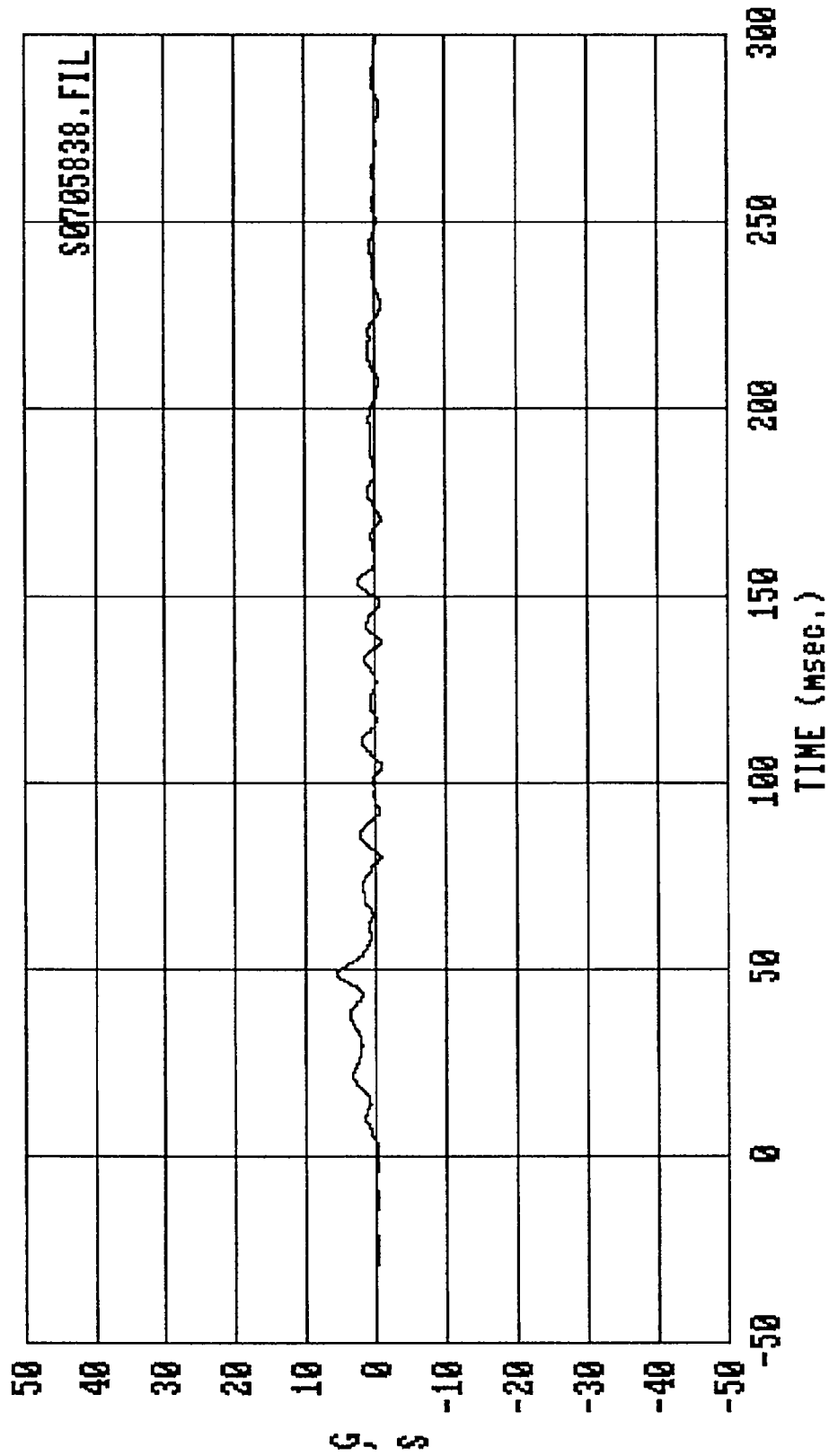


Filter: SAE CLASS 180 Max = 29.392 Min = -.44313E-01

MSE 02/03/89 -- 1988 Dodge Caravan : Lft Frnt Door uppr C/L delta U, Y
axis

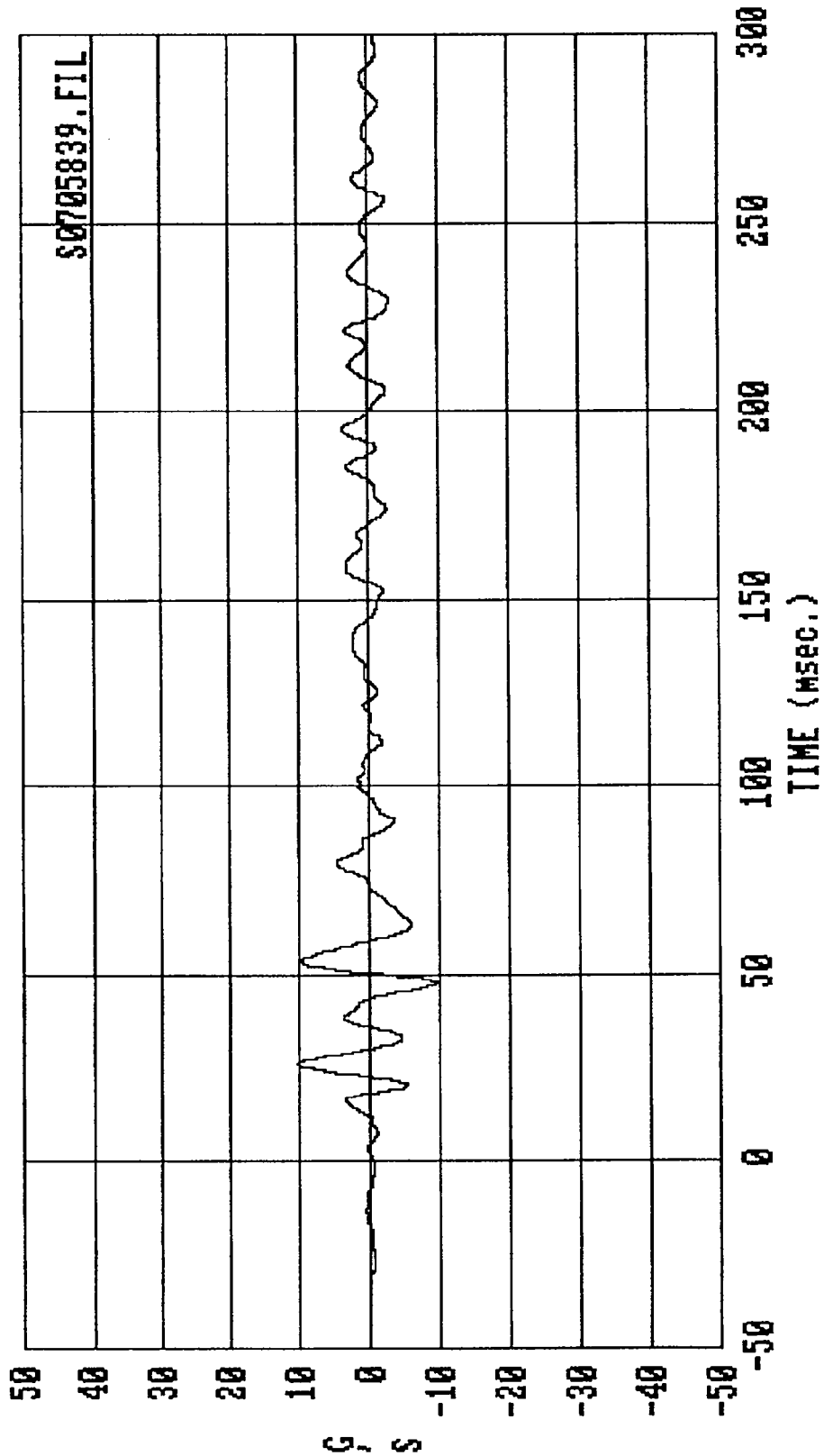


Filter: SAE CLASS 60 Max = 1.5134 Min = -9.4877
 MSE 02/03/89 -- 1988 Dodge Caravan : Moving Deformable Barrier C/G, X-axis



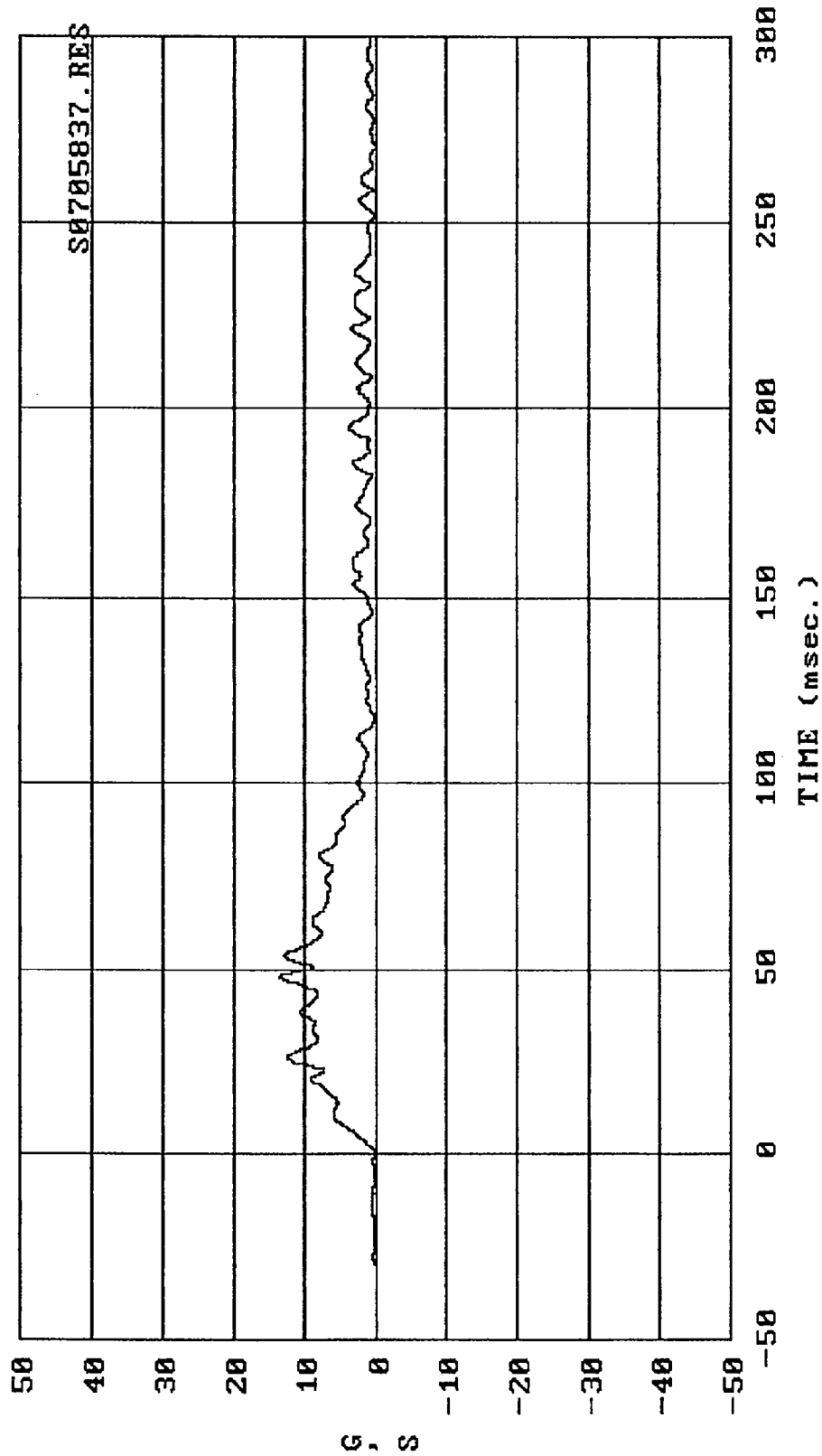
B-45

Filter: SAE CLASS 60 Max = 5.7461 Min = -.86028
 MSE 02/03/89 -- 1988 Dodge Caravan : Moving Deformable Barrier C/G, Y-axis

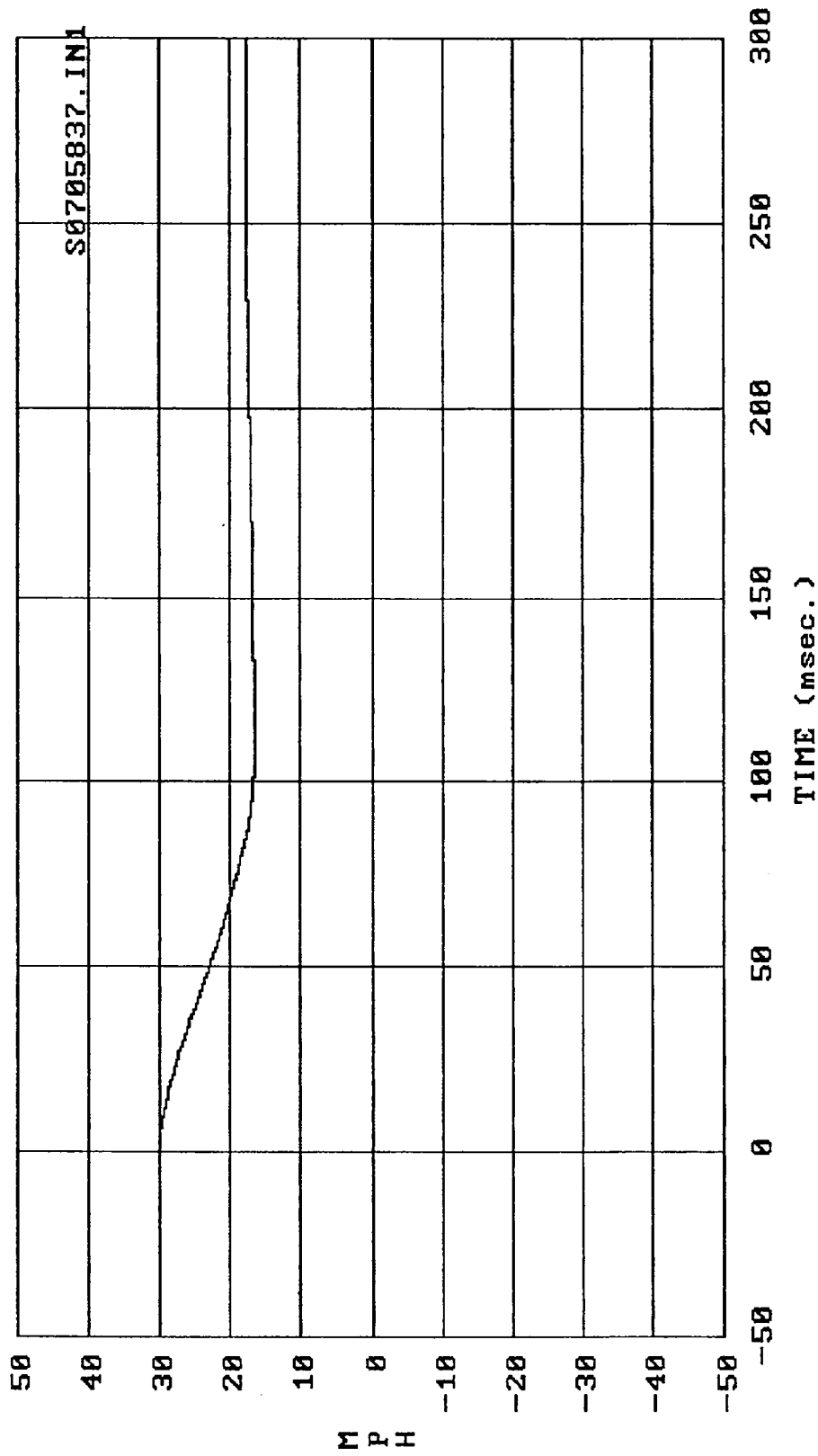


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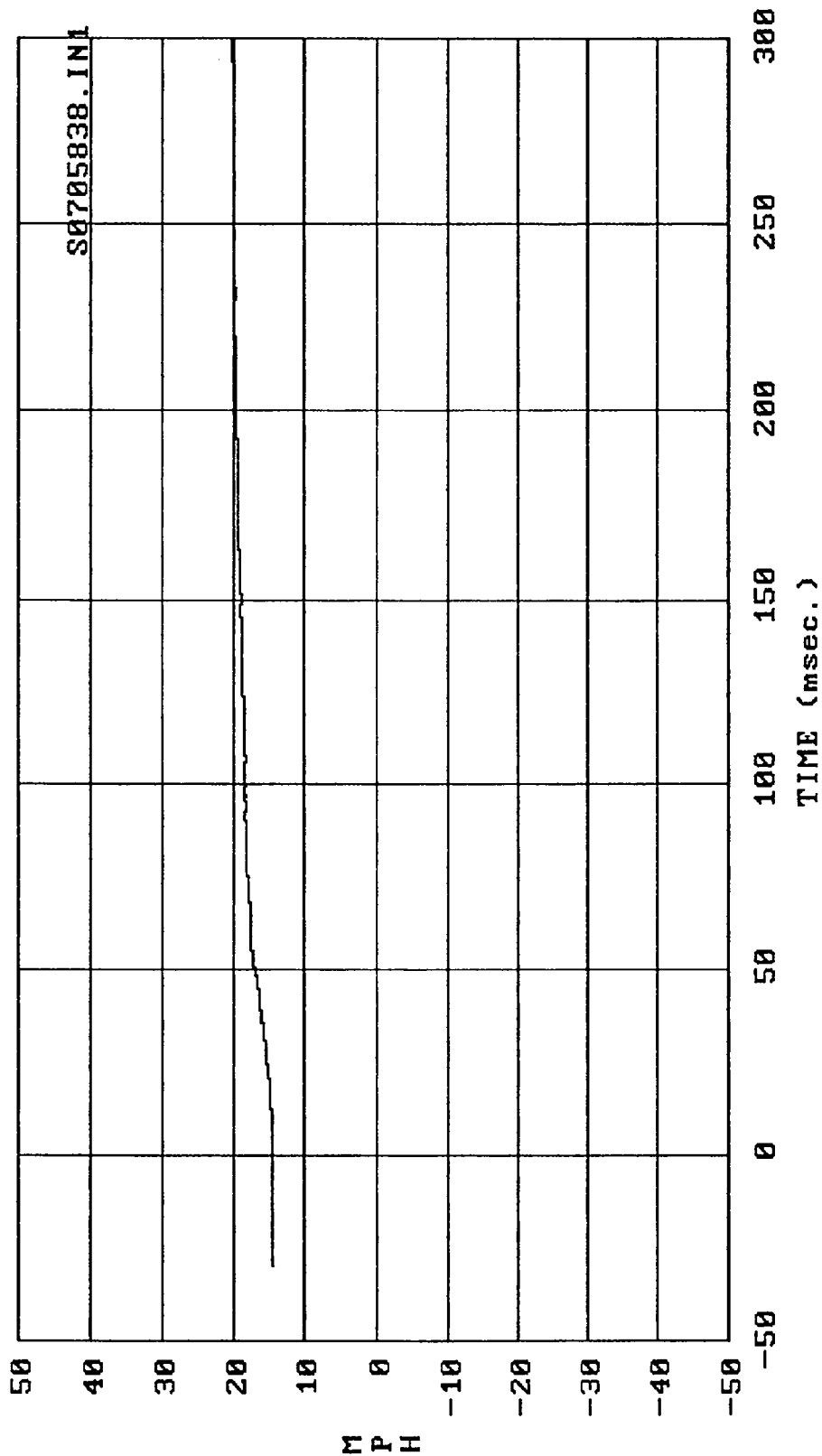
Filter: SAE CLASS 60 Max = 10.419 Min = -9.5782
 MSE 02/03/89 -- 1988 Dodge Caravan : Moving Deformable Barrier C/G, Z-axis



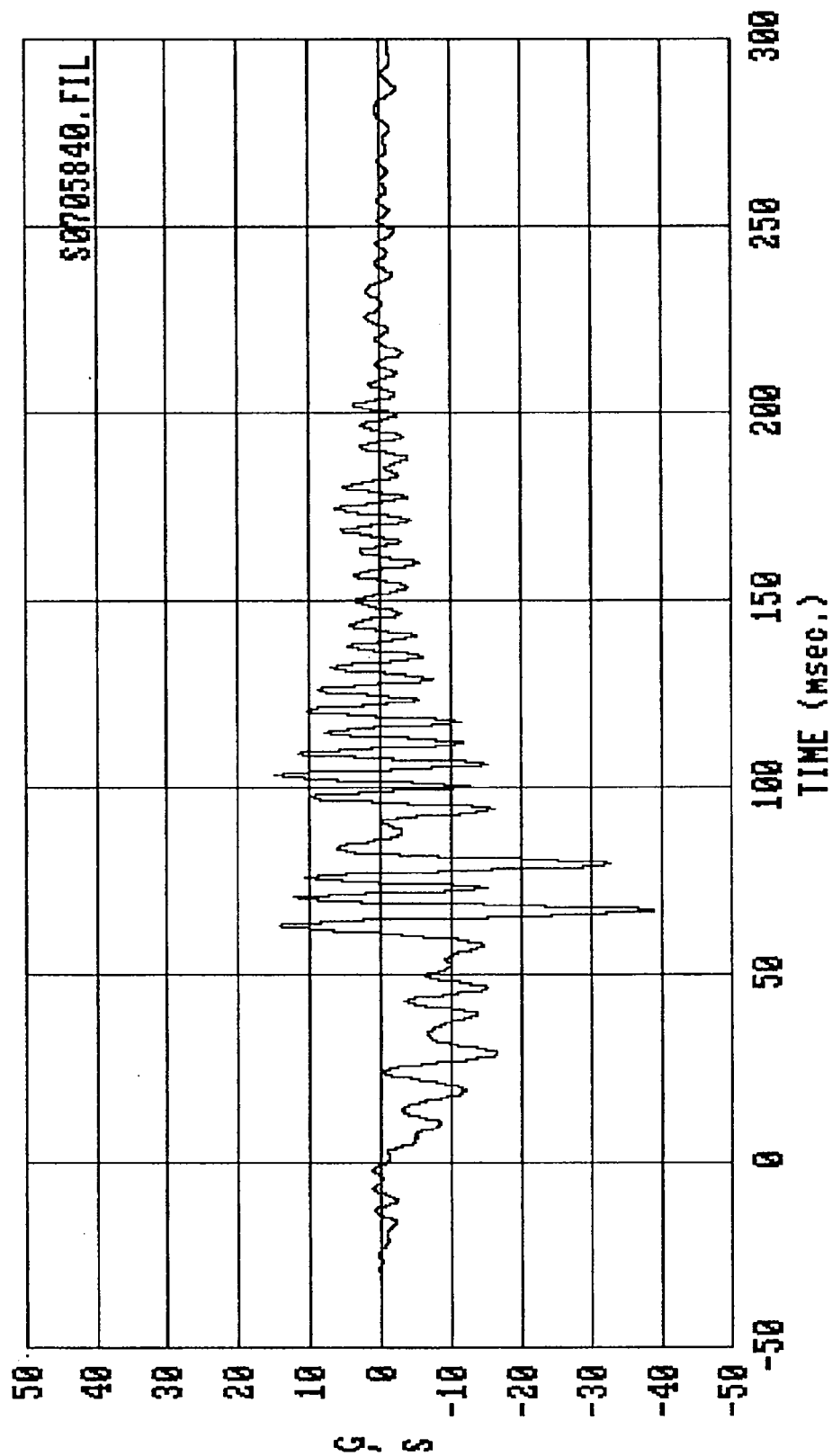
Filter: SAE CLASS 60 Max = 13.722 Min = .35545E-01
 MSE 02/03/89 -- 1988 Dodge Caravan : MDB C/G resultant acceleration



Filter: SAE CLASS 180 Max = 30.200 Min = 16.415
MSE 02/03/89 -- 1988 Dodge Caravan : : Moving Barrier C/G delta U, X-axi

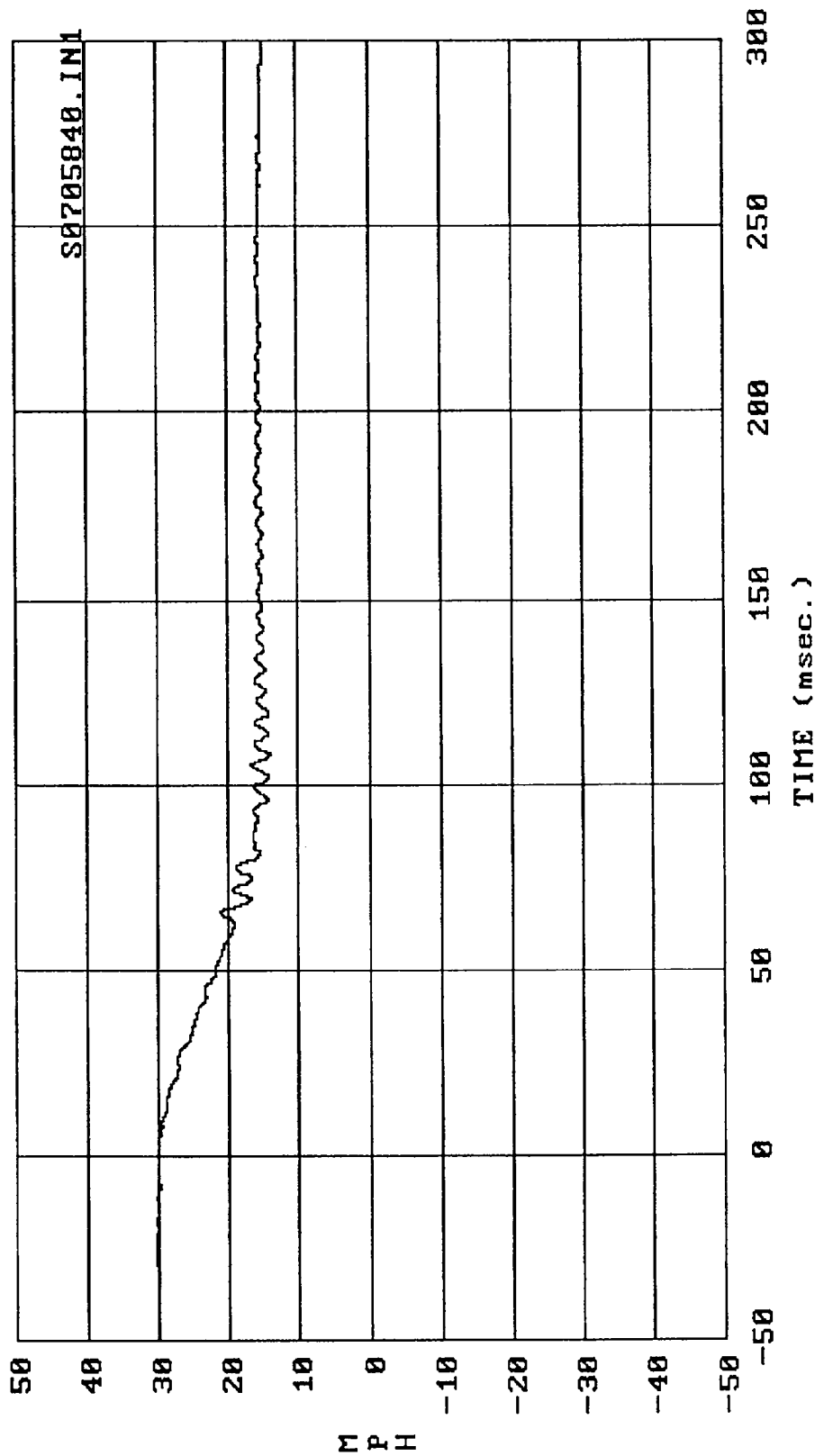


Filter: SAE CLASS 180 Max = 20.352 Min = 14.670
MSE 02/03/89 -- 1988 Dodge Caravan : Moving Barrier C/G delta U, Y-axi



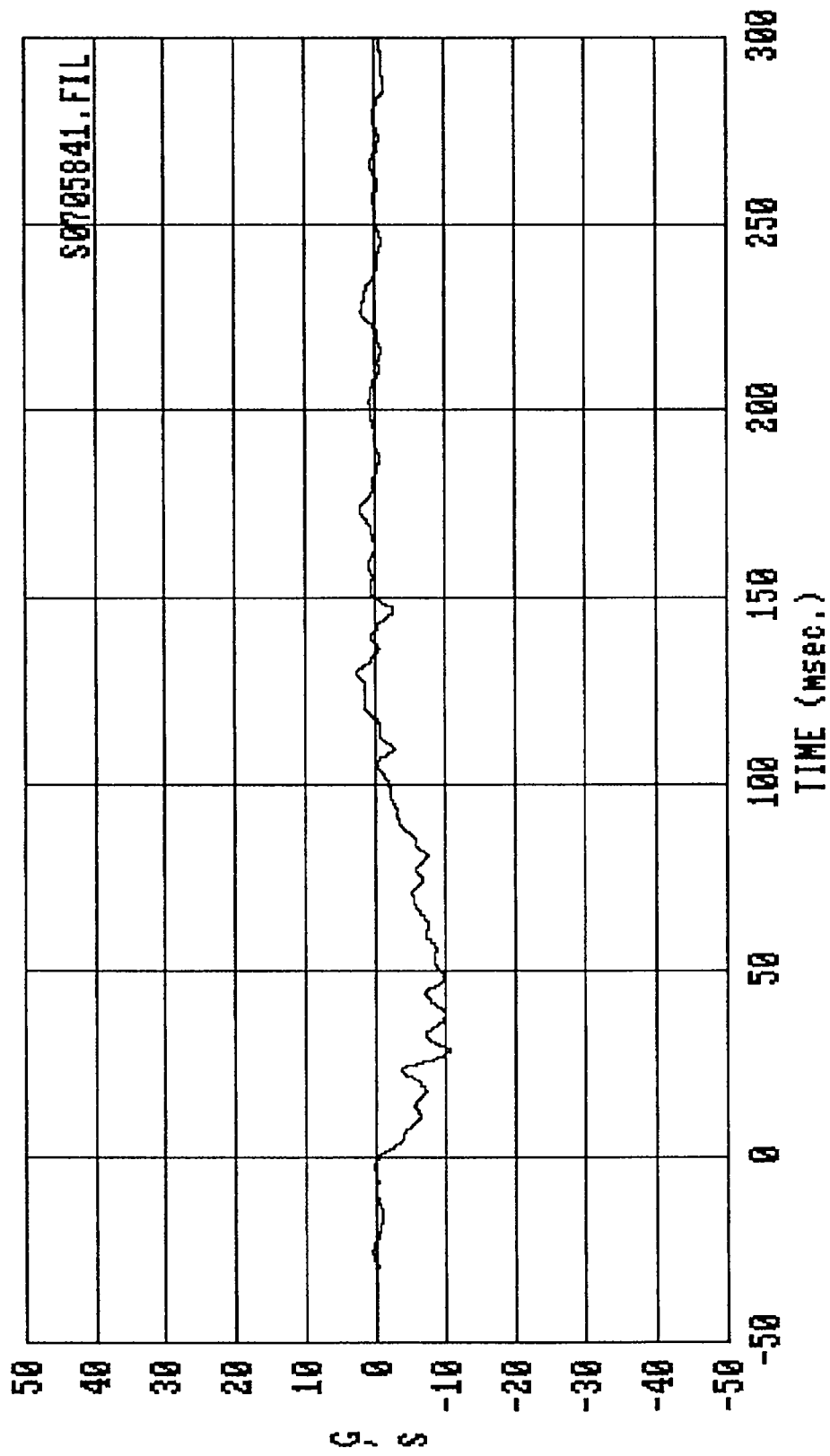
B-50

Filter: SAE CLASS 60 Max = 15.312 Min = -39.145
MSE 02/03/89 -- 1988 Dodge Caravan : MDB Front, X-axis (Channel failed)



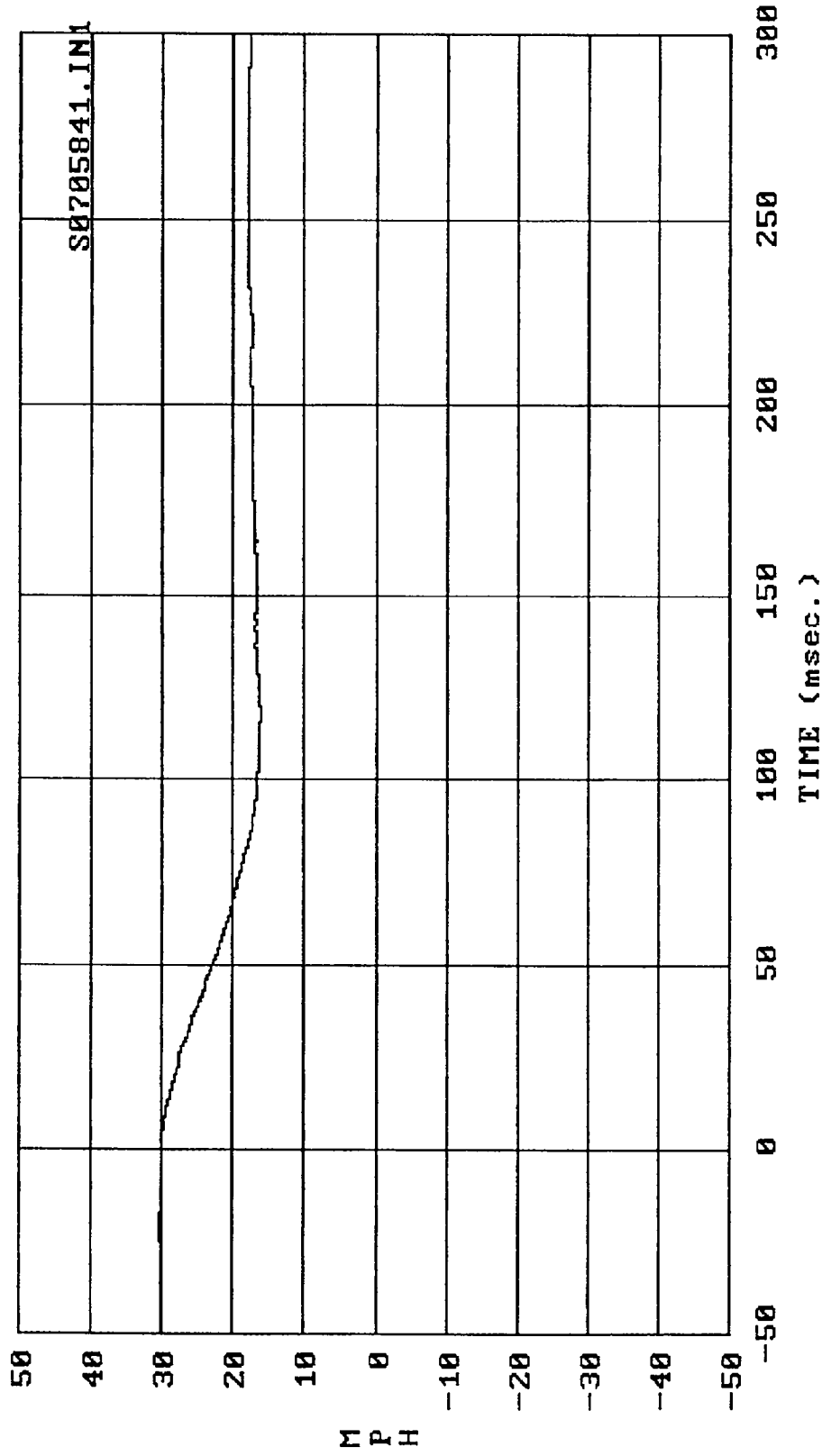
Filter: SAE CLASS 100 Max = 30.189 Min = 14.175

MSE 02/03/89 -- 1988 Dodge Caravan : MDB Front X delta U, (Channel
Failed)



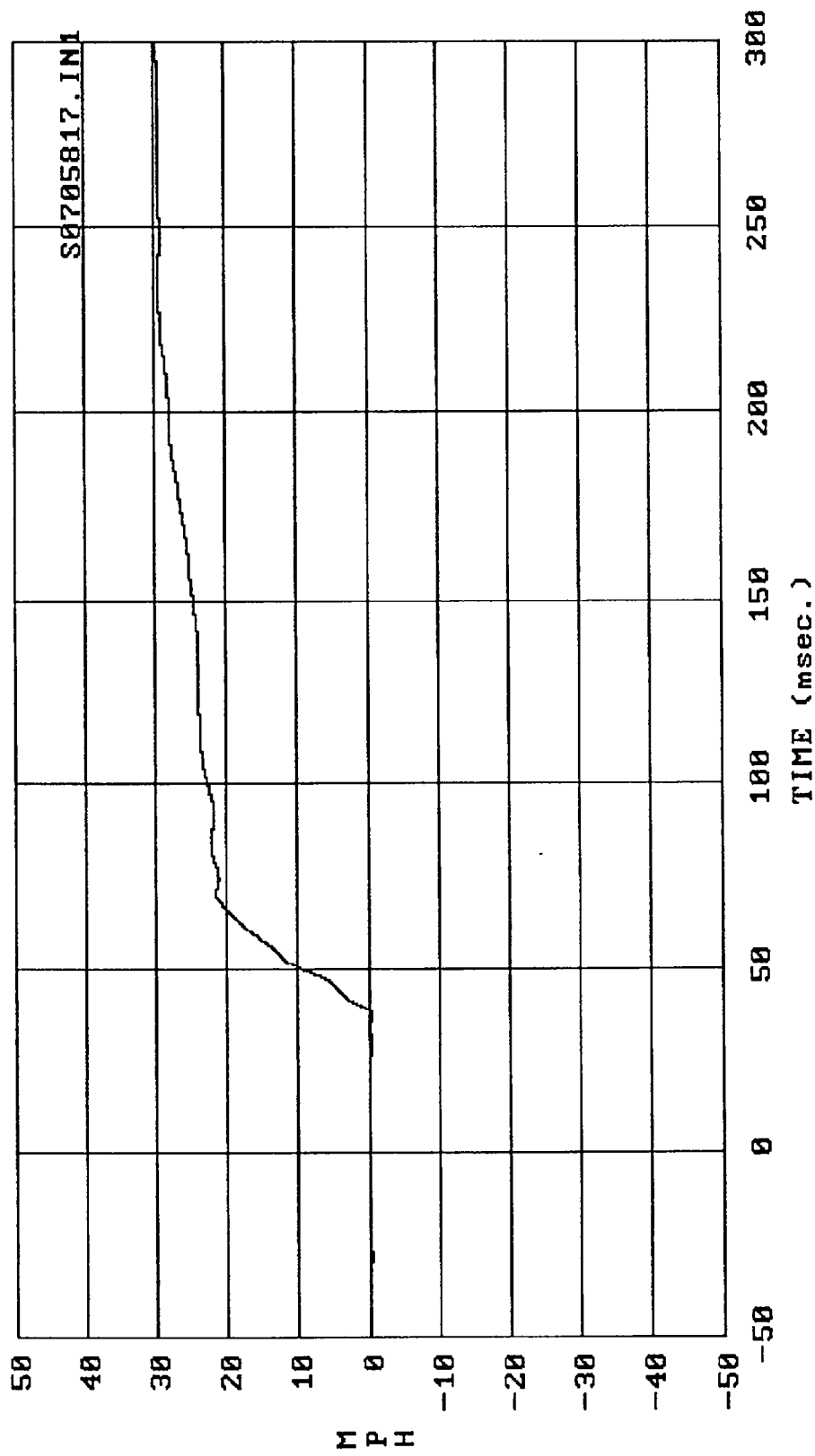
Filter: SAE CLASS 60 Max = 2.7598 Min = -10.391

MSE 02/03/89 -- 1988 Dodge Caravan : MDB Rear, X-axis



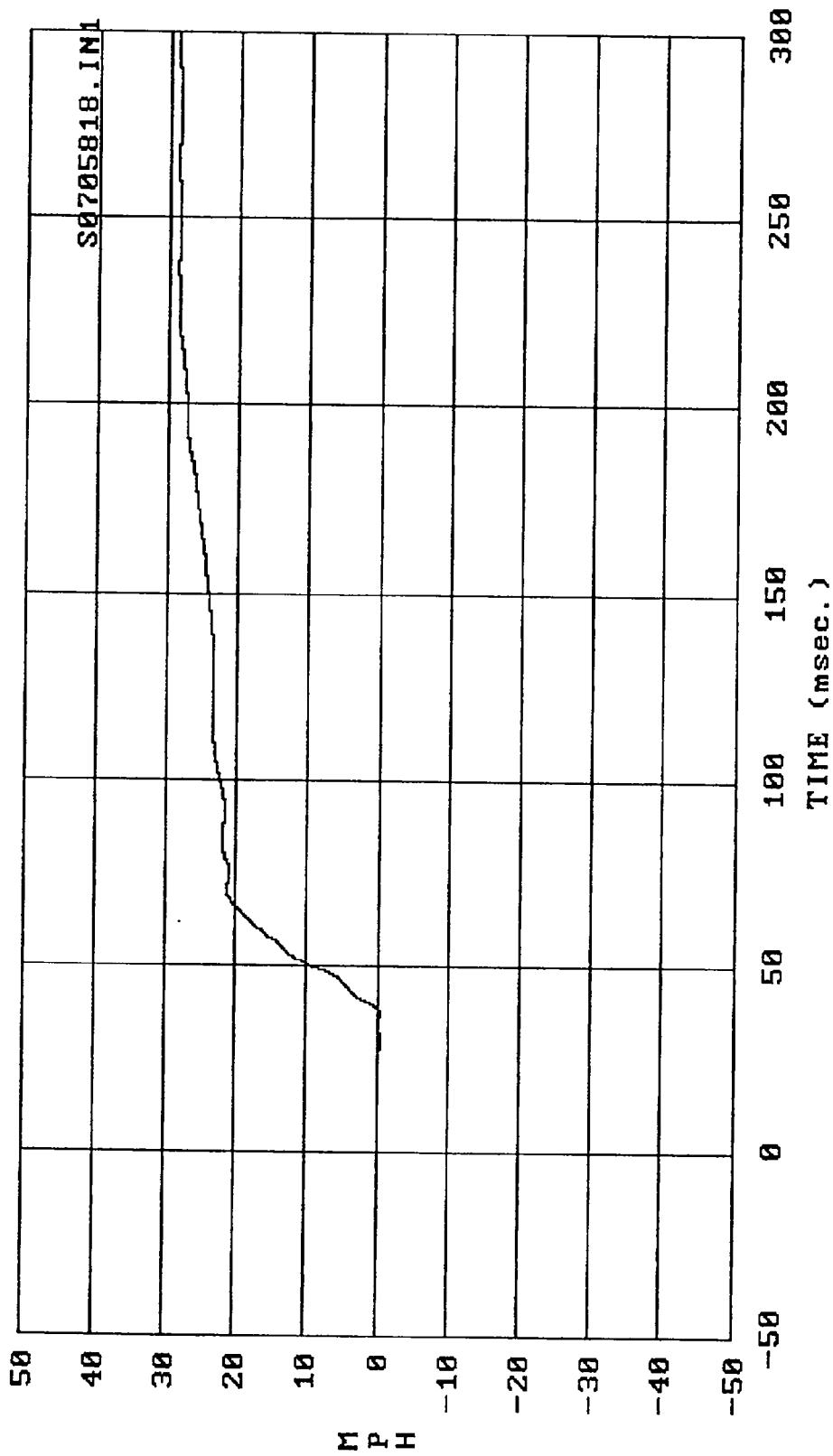
Filter: SAE CLASS 180 Max = 30.214 Min = 16.364

MSE 02/03/89 -- 1988 Dodge Caravan : MDB Rear X delta U



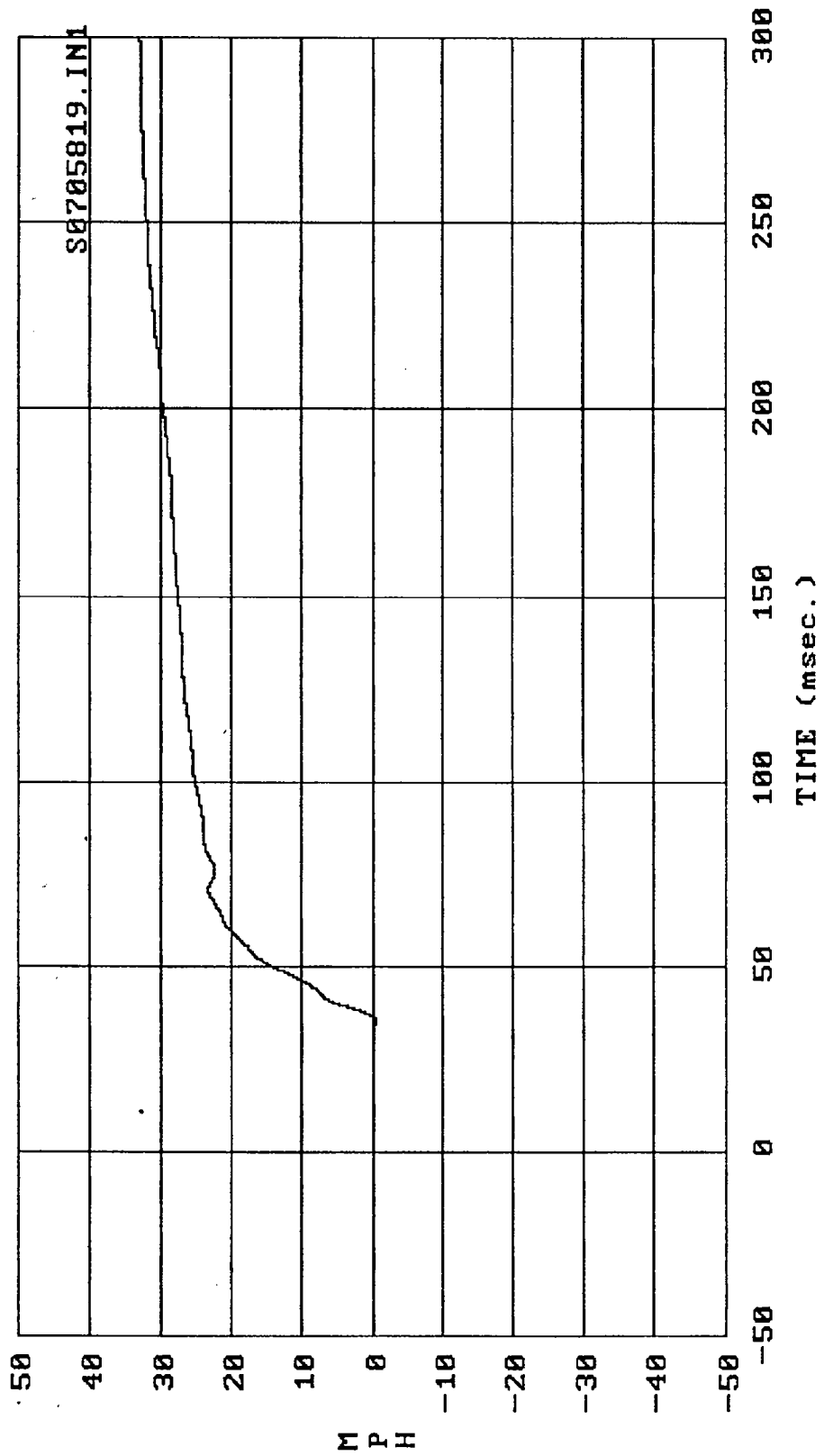
Filter: FIR 100 Max = 29.791 Min = -.28981

MSE 02/03/89 -- 1988 Dodge Caravan : Pasngr Upper Rib delt U, Y-ax
(Primary)



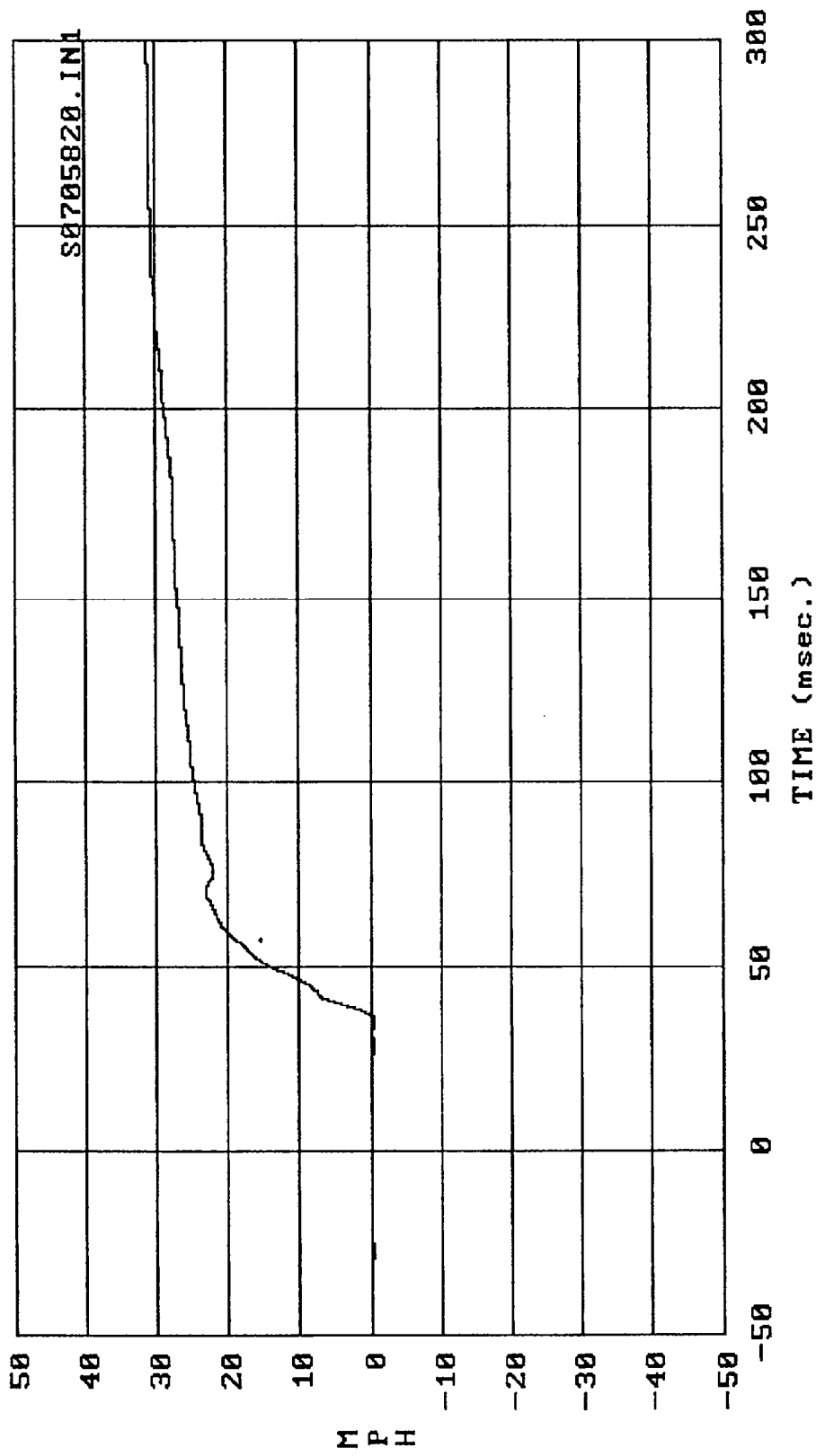
Filter: FIR 100 Max = 28.883 Min = -.19777

MSE 02/03/89 -- 1988 Dodge Caravan : Pasngr Upper Rib delt U, Y-ax
(Second)

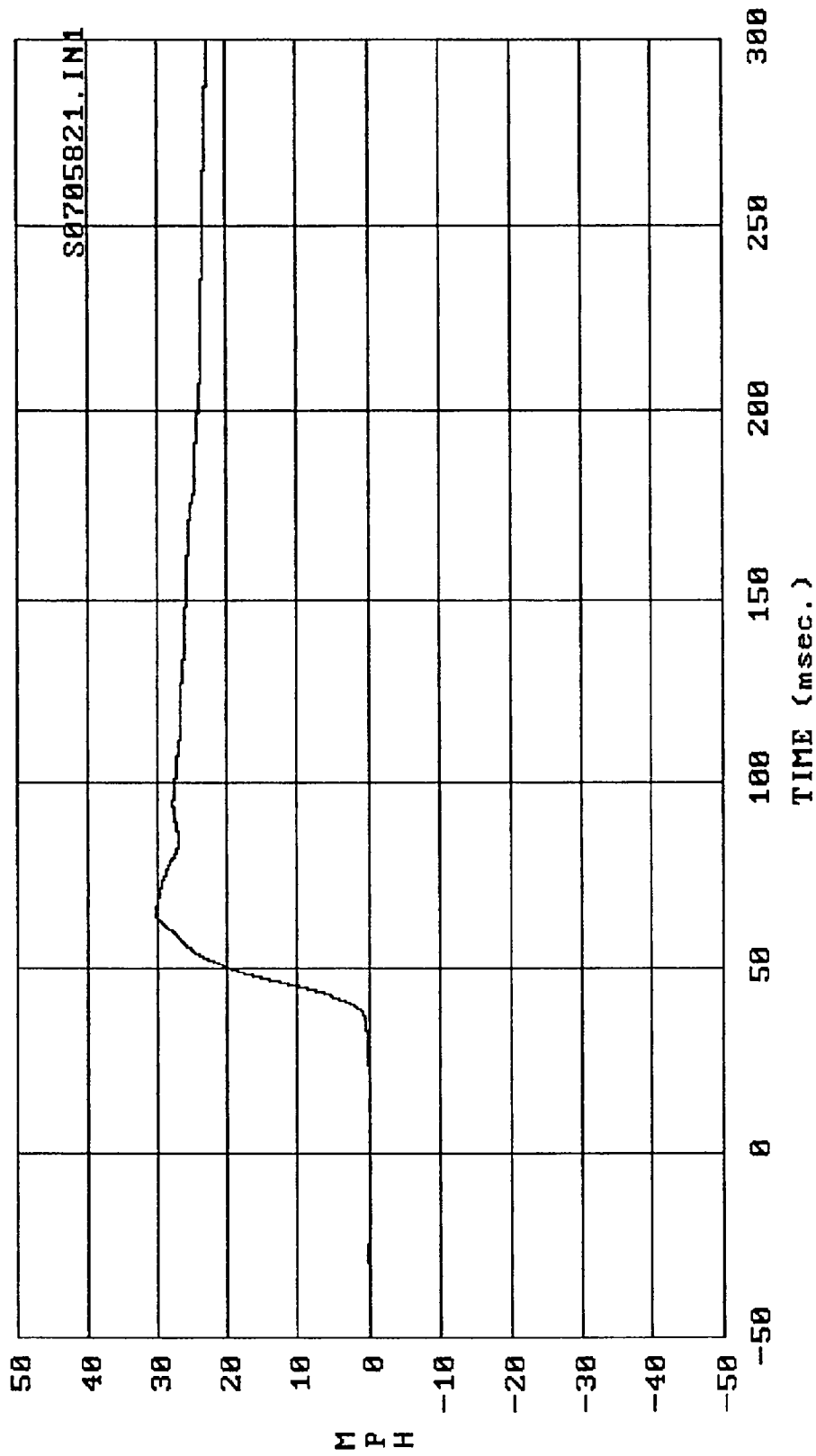


Filter: FIR 100 Max = 32.995 Min = -.20185

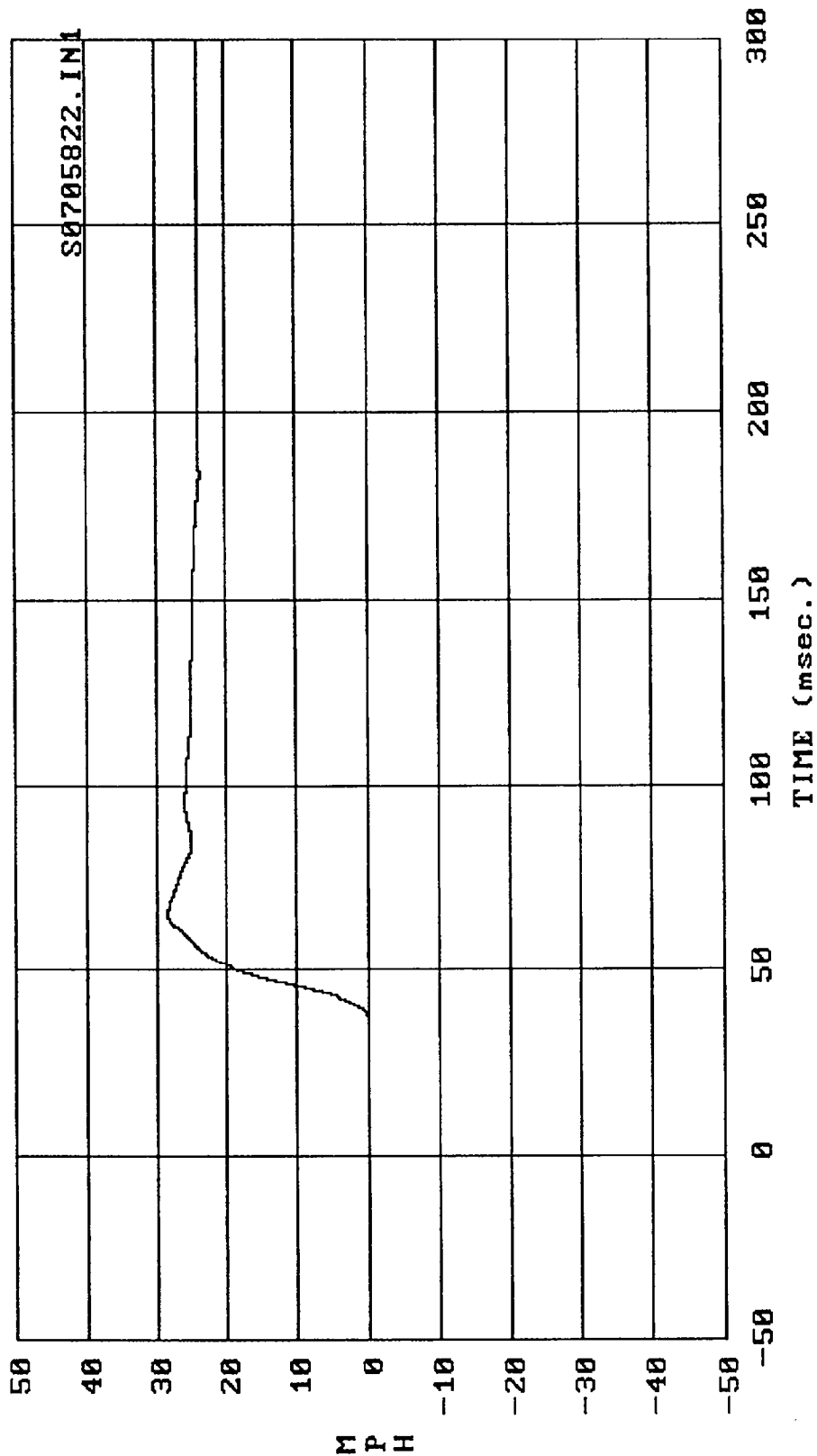
MSE 02/03/89 -- 1988 Dodge Caravan : Pasngr Lower Rib delt U, Y-ax
(Primary)



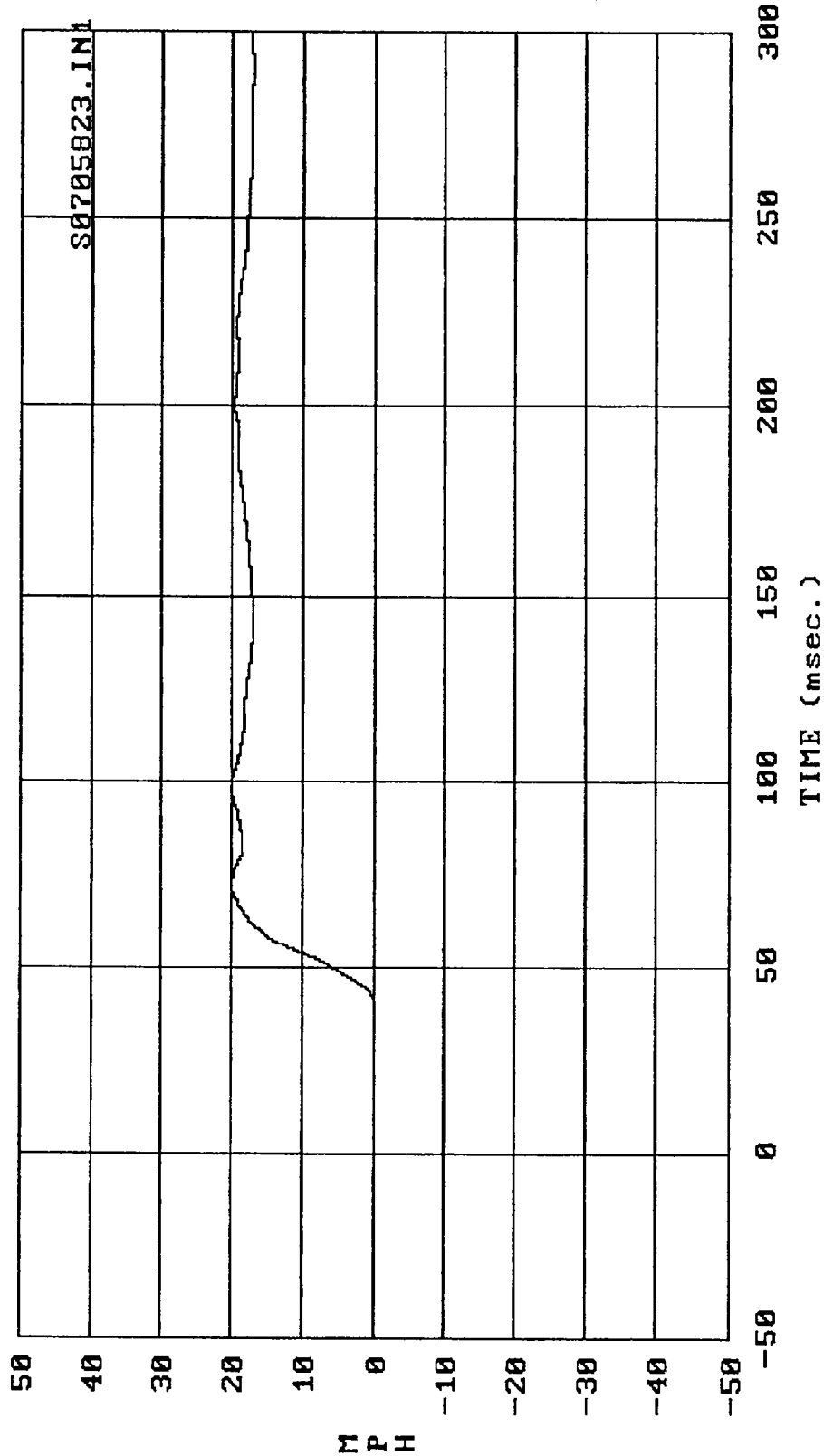
Filter: FIR 100 Max = 31.287 Min = -.32193
 MSE 02/03/89 -- 1988 Dodge Caravan : Pasngr Lower Rib delt V, Y-ax
 (Second)



Filter: FIR 100 Max = 30.442 Min = -.20506E-02
MSE 02/03/89 --- 1988 Dodge Caravan : Pasngr Lwr Spine delt U, Y-ax
(PPrimary)

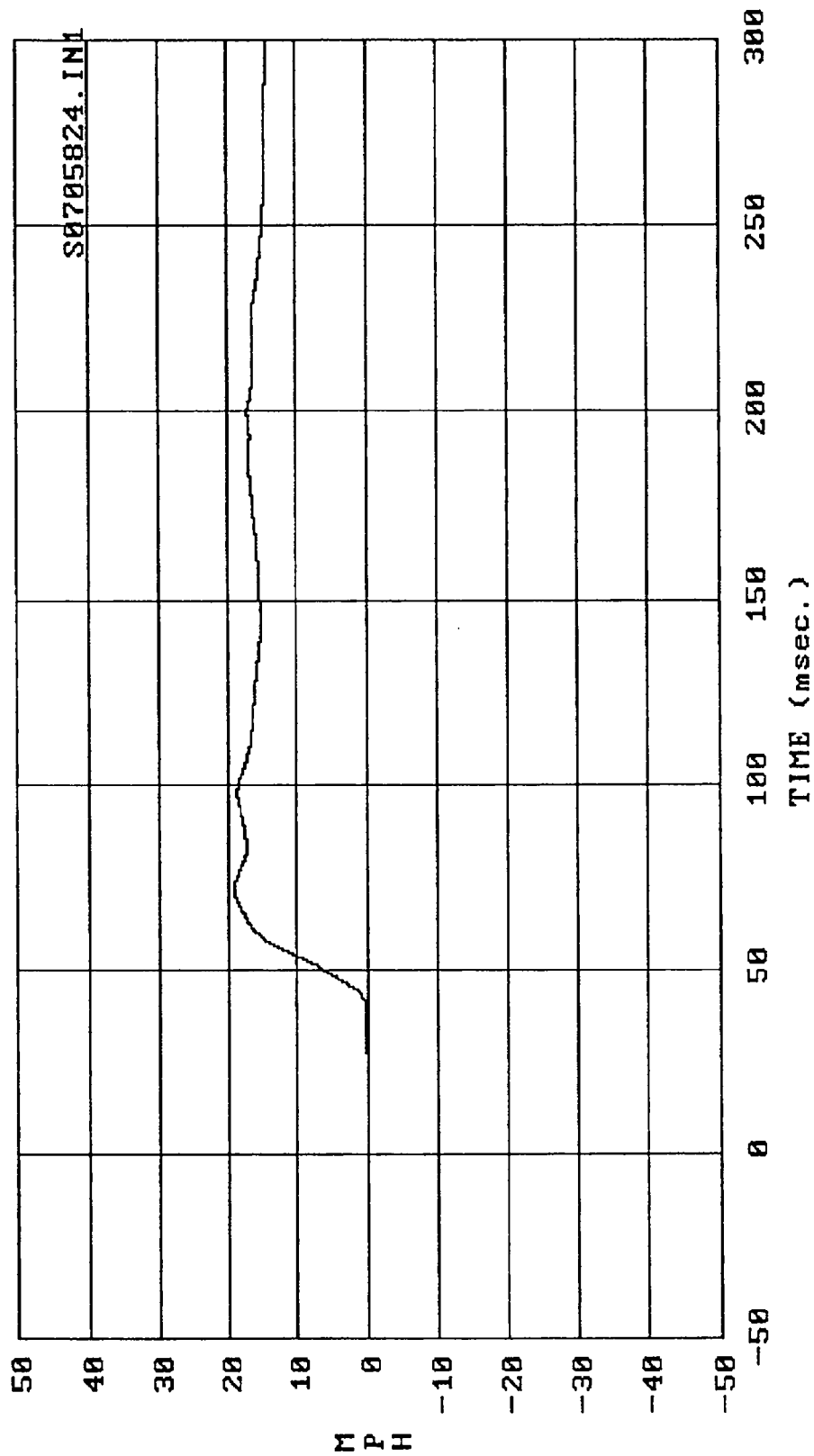


Filter: FIR 100 Max = 28.620 Min = -.12887
 MSE 02/03/89 -- 1988 Dodge Caravan : Pasngr Lwr Spine delt V, Y-ax
 (Second)



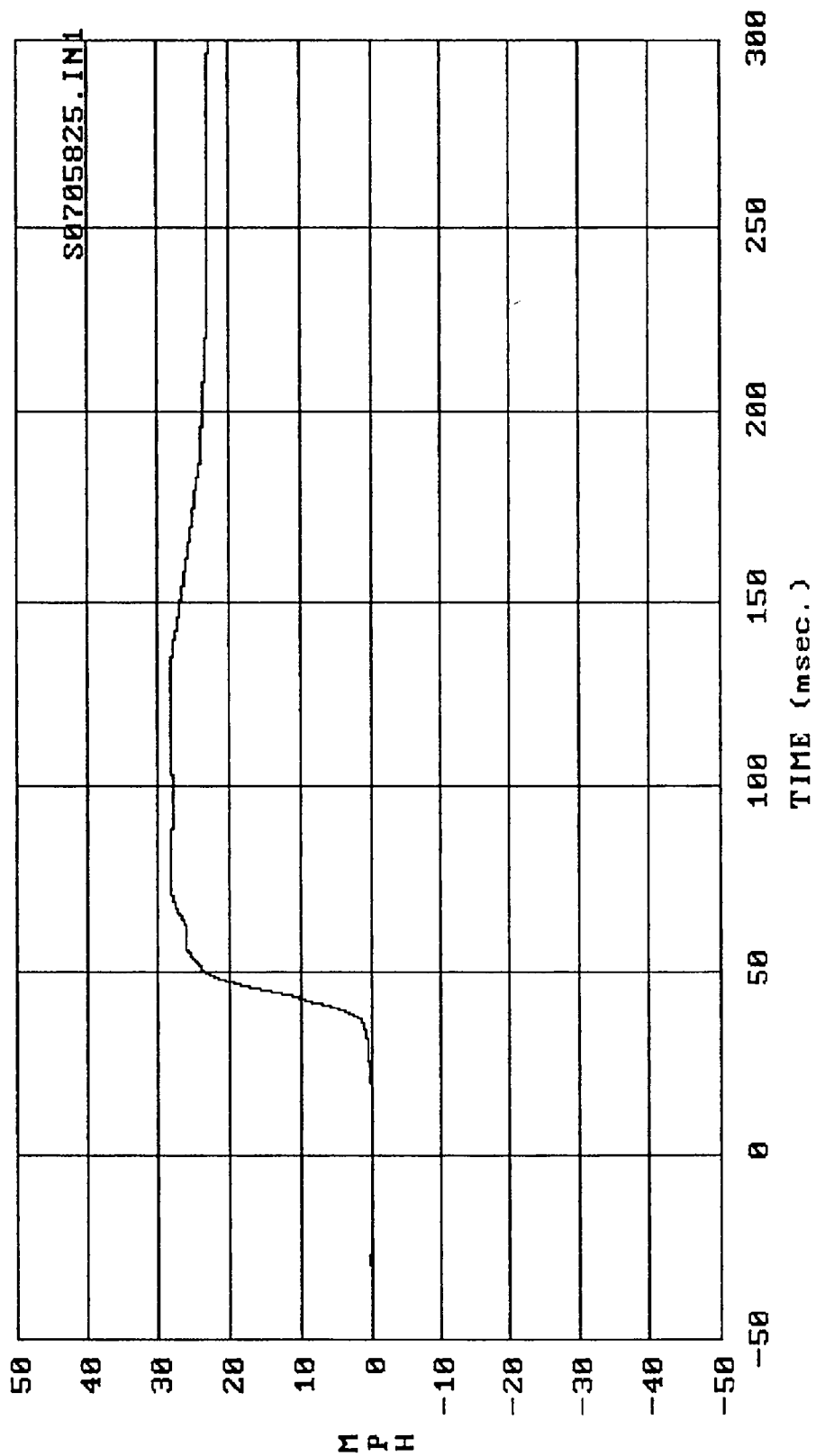
Filter: FIR 100 Max = 20.258 Min = -.14512

MSE 02/03/89 -- 1988 Dodge Caravan : Pasngr Upr Spine delt U, Y-ax
(Primary)

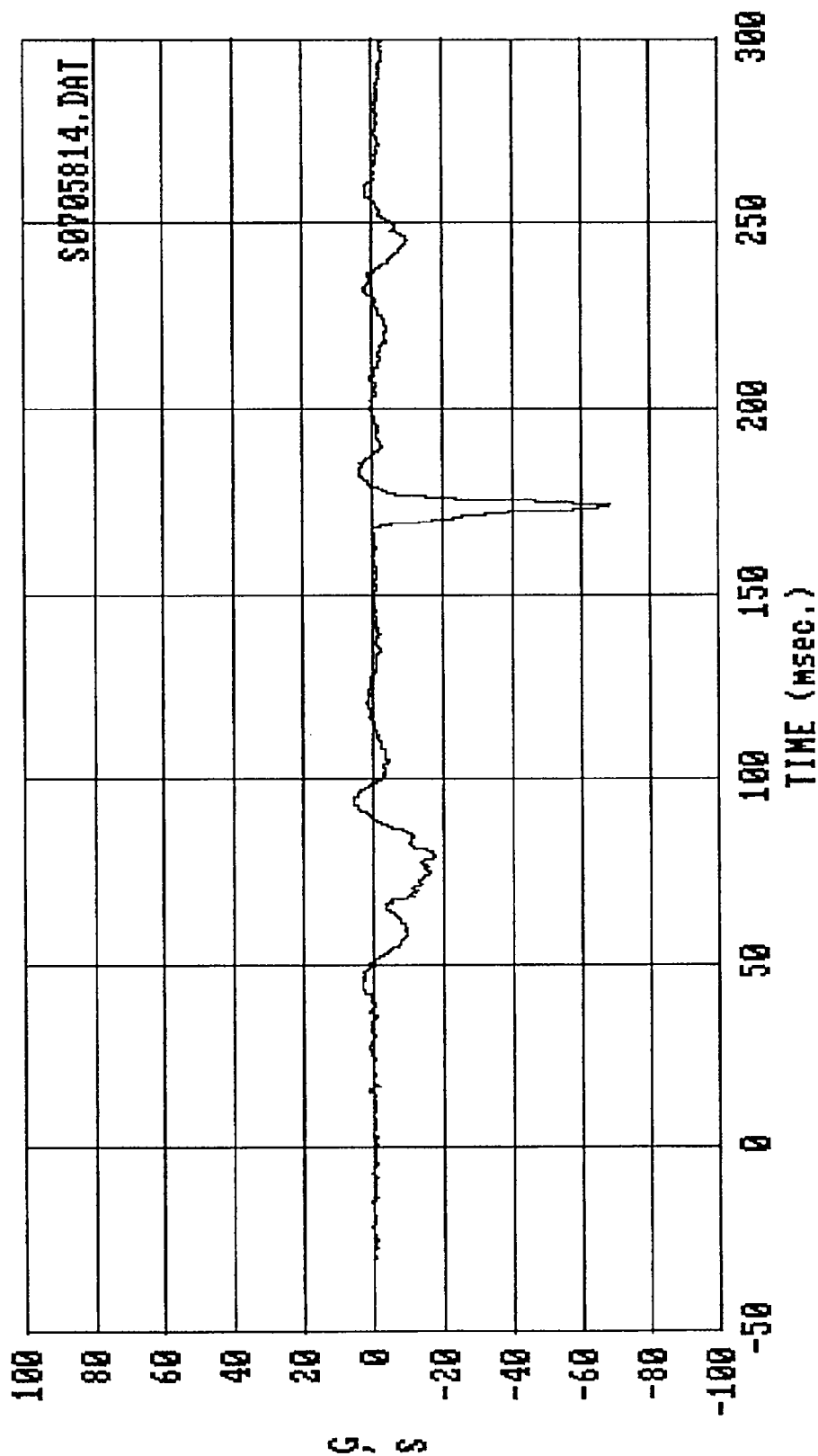


Filter: FIR 100 Max = 19.392 Min = -.63107E-02

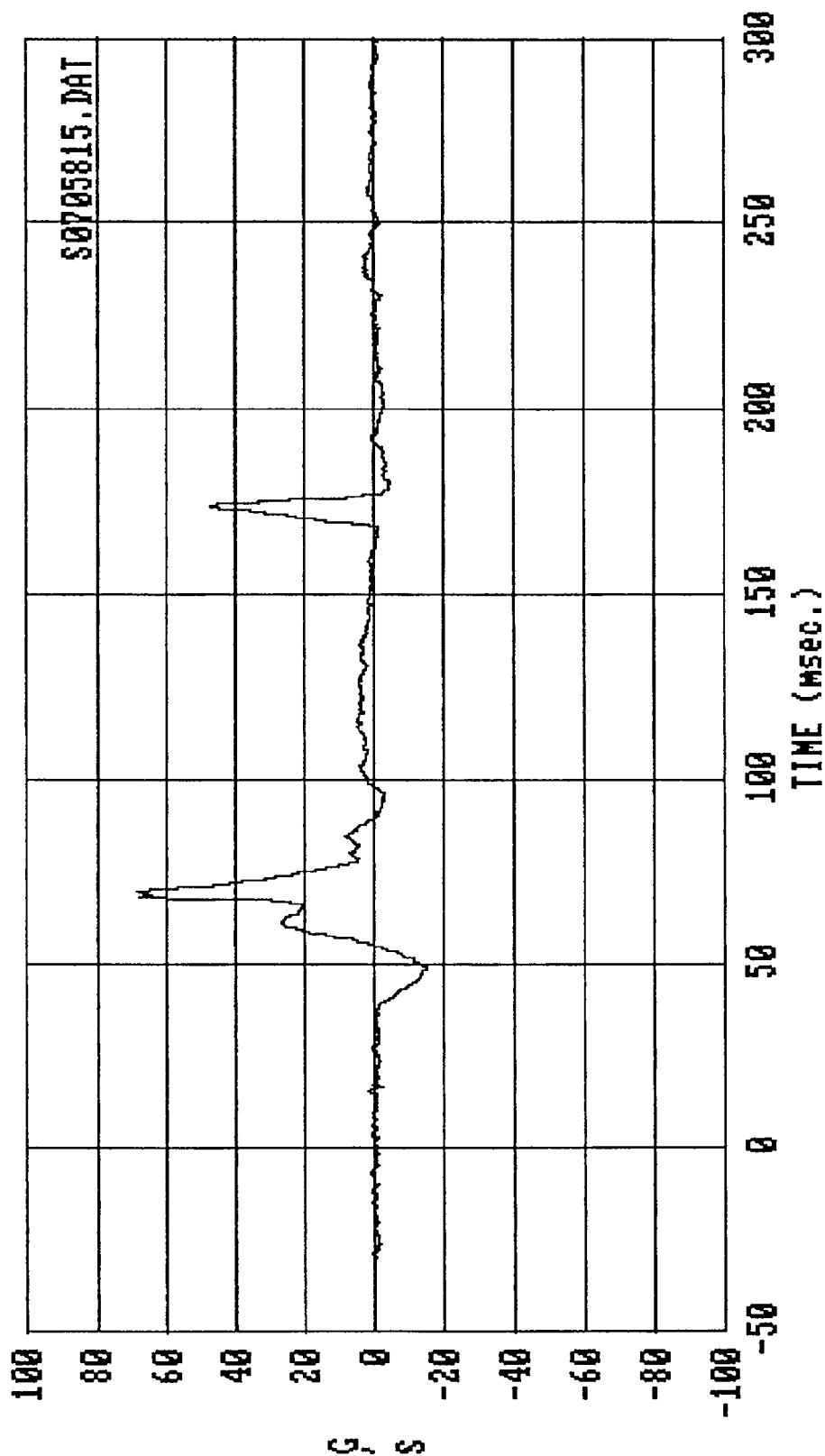
MSE 02/03/89 -- 1988 Dodge Caravan : Pasngr Upr Spine delt U, Y-ax
(Second)



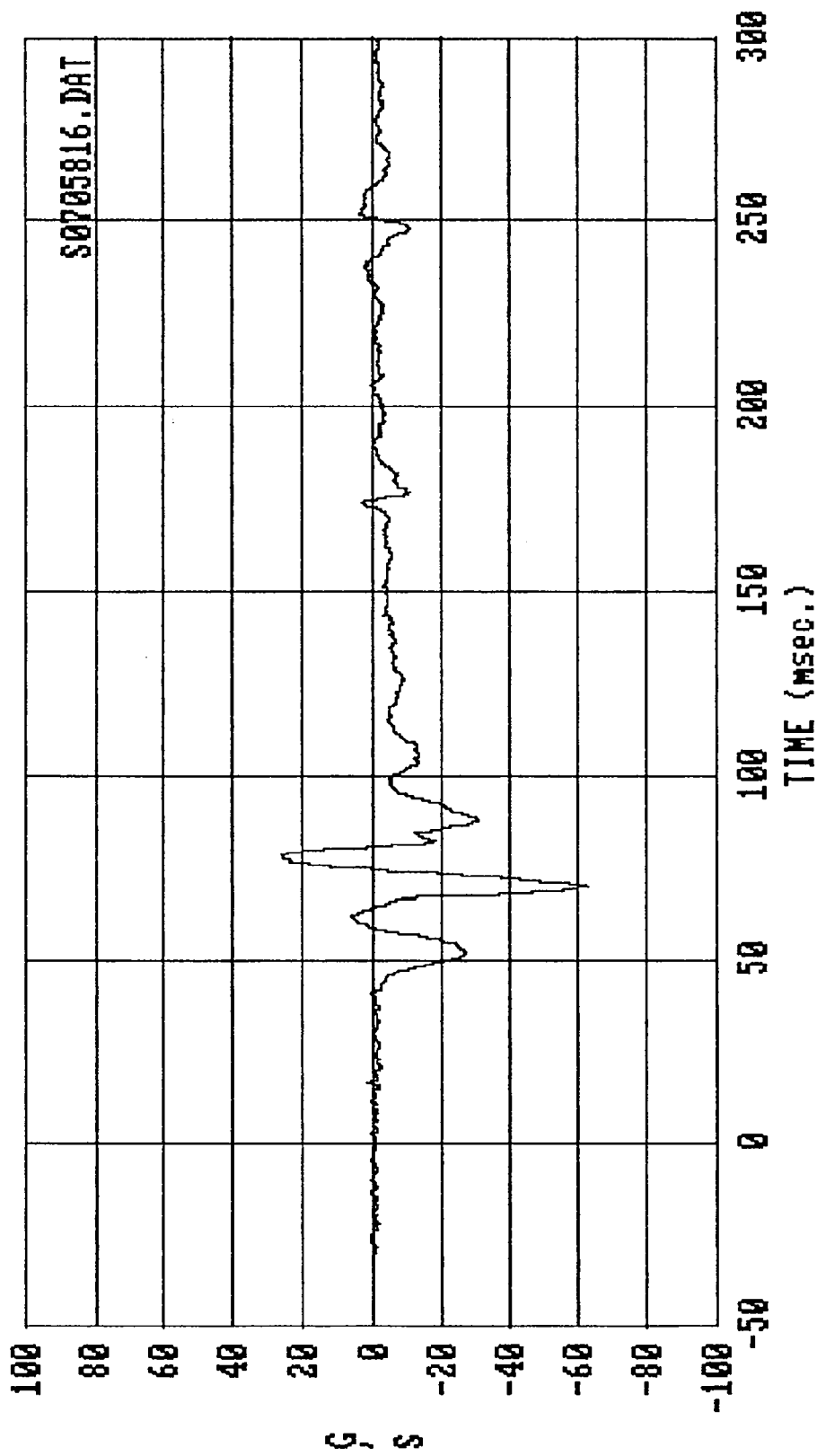
Filter: FIR 100 Max = 28.399 Min = -.26334E-01
MSE 02/03/89 -- 1988 Dodge Caravan : Pasngr Pelvis delta U, Y-axis



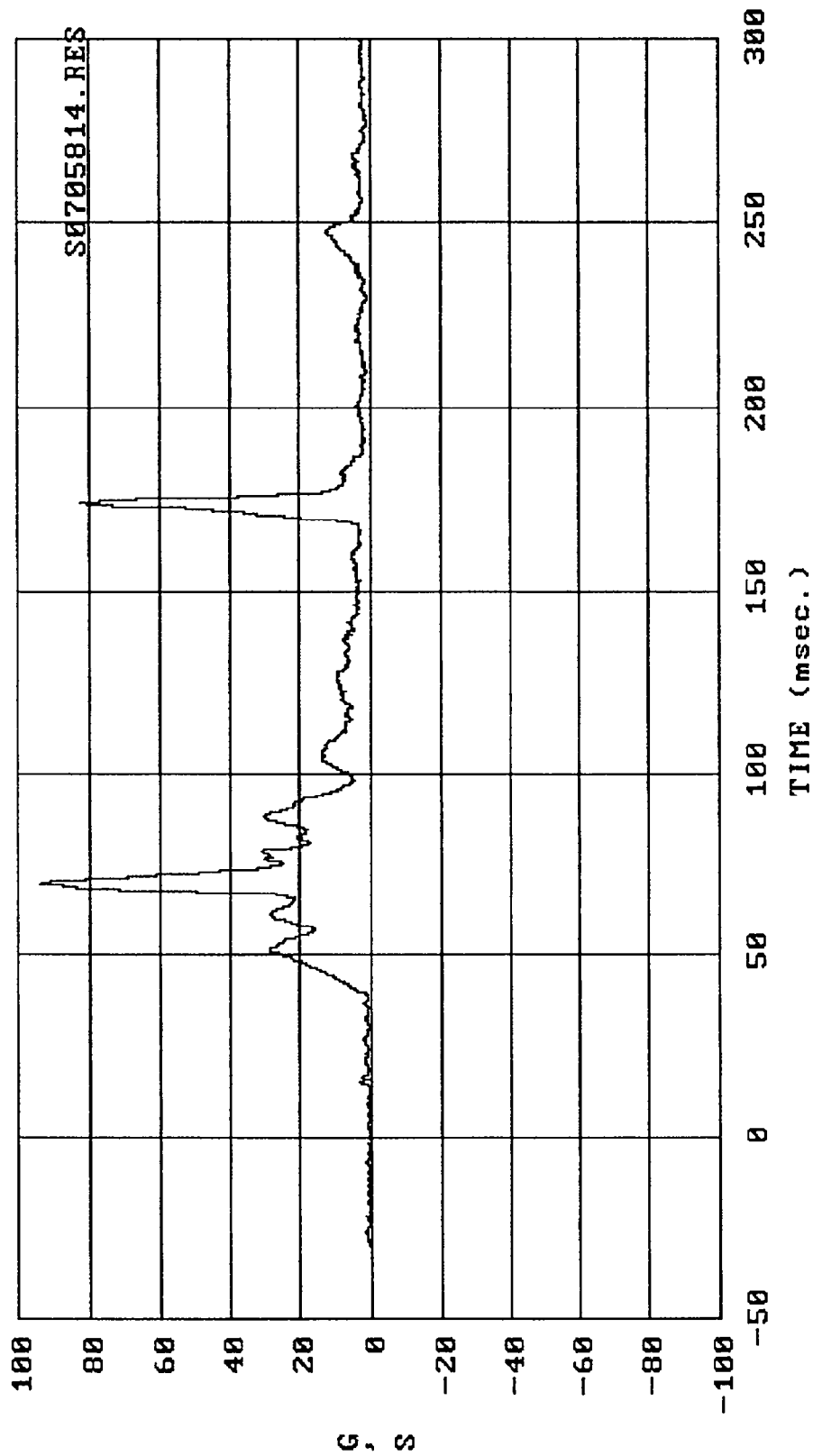
Filter: SAE CLASS 1000 Max = 5.9183 Min = -68.458
MSE 02/03/89 -- 1988 Dodge Caravan : Passenger Head acceleration, X-axis



Filter: SAE CLASS 1000 Max = 69.545 Min = -14.977
MSE 02/03/89 -- 1988 Dodge Caravan : Passenger Head acceleration, Y-axis

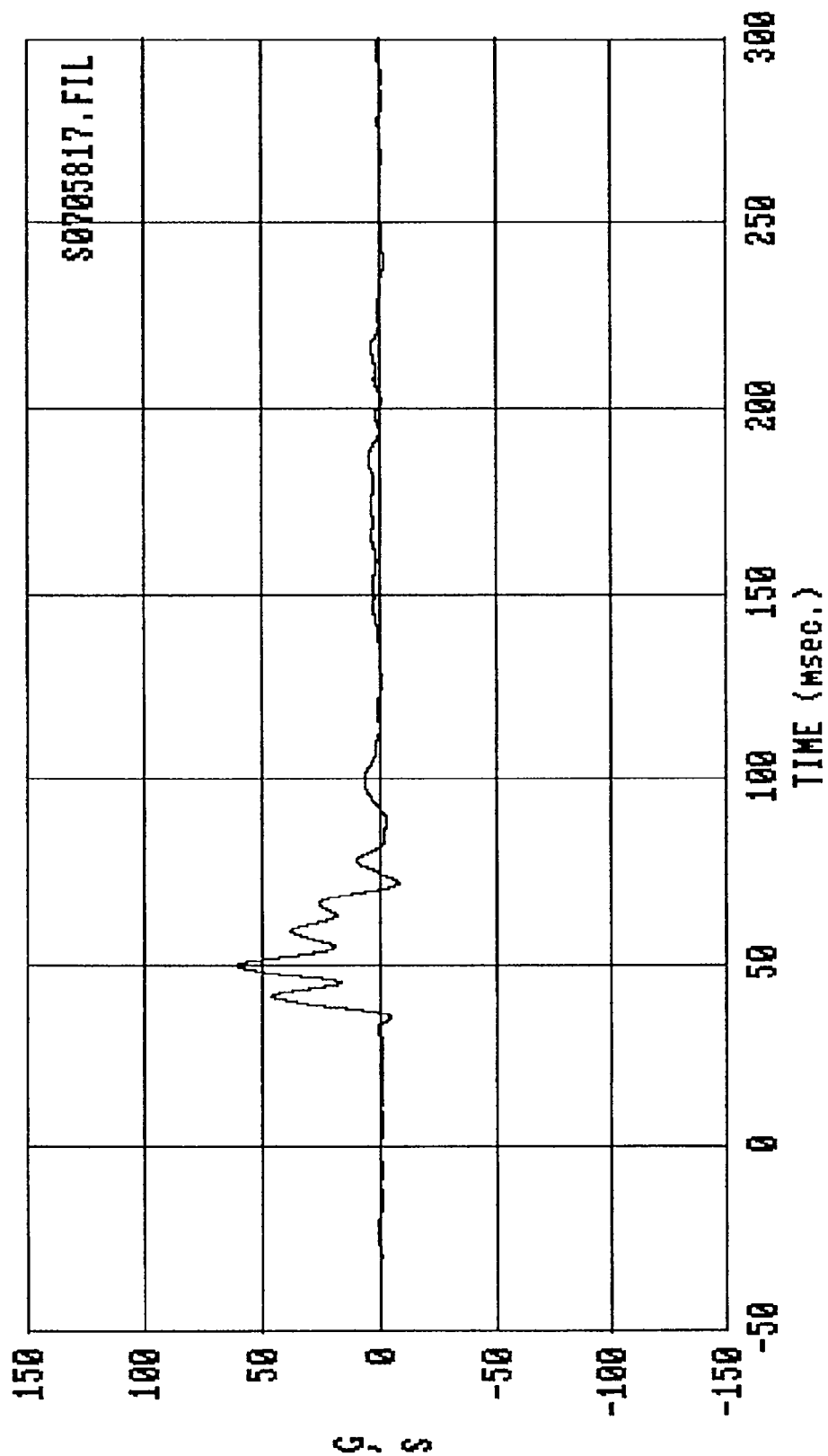


Filter: SAE CLASS 1000 Max = 26.589 Min = -63.709
 MSE 02/03/89 -- 1988 Dodge Caravan : Passenger Head acceleration, Z-axis

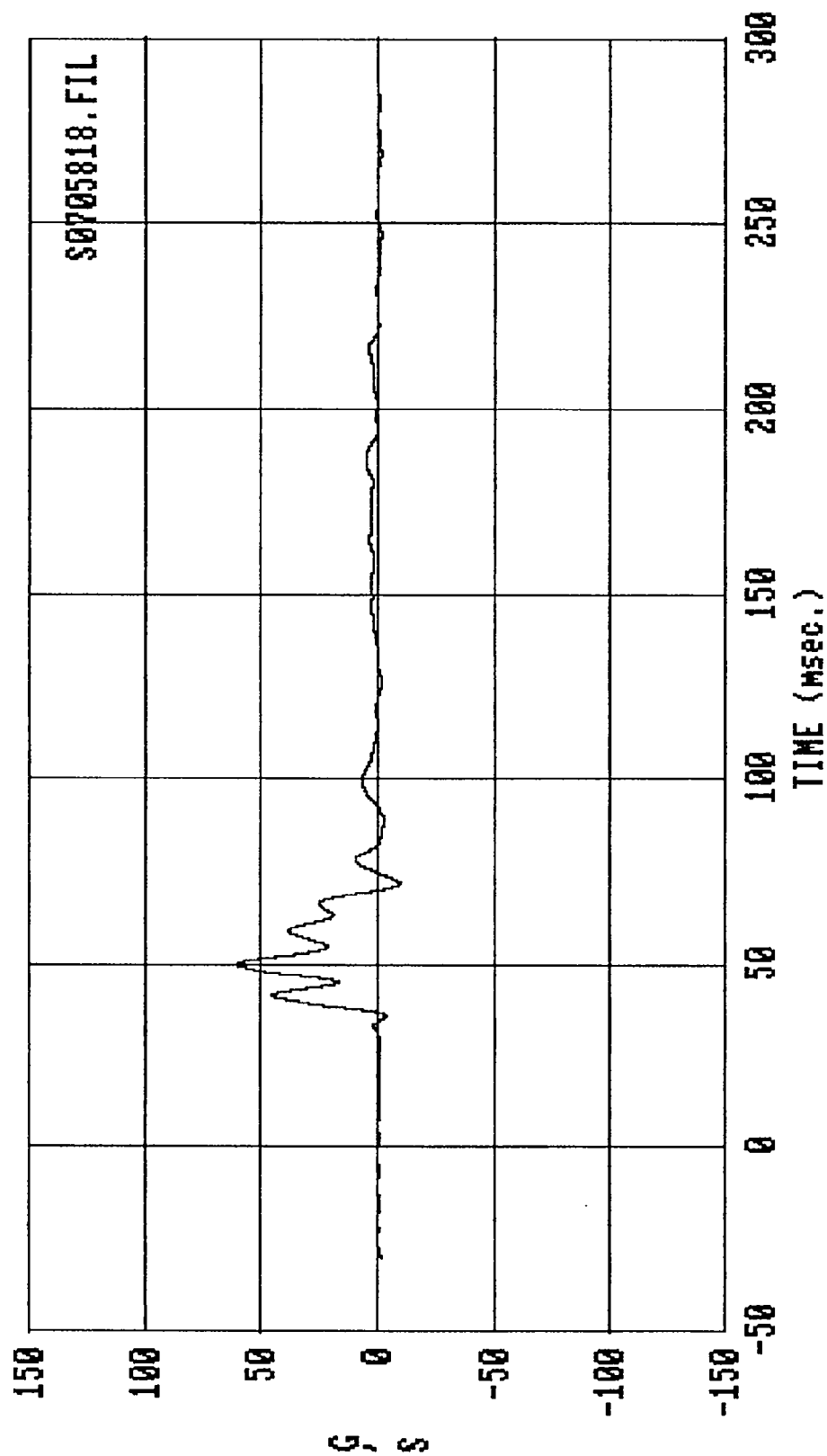


Filter: SAE CLASS 1000 Max = 94.032 Min = .96125E-01

MSE 02/03/89 -- 1988 Dodge Caravan : Pasngr Head resultant acceleratic

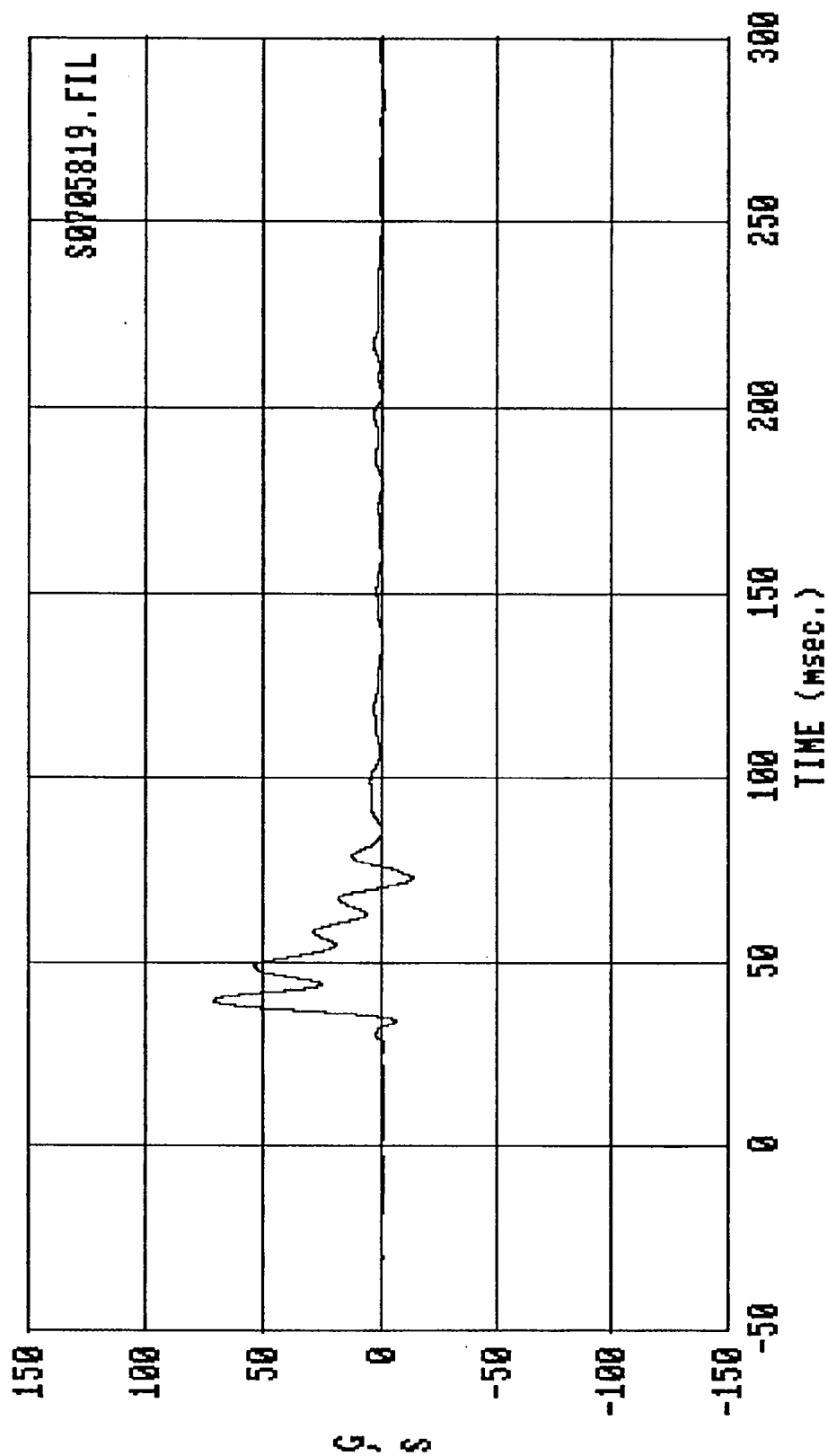


Filter: FIR 100 Max = 61.859 Min = -7.5240
MSE 02/03/89 -- 1988 Dodge Caravan : Pasngr Upper Rib acc., Y-axis (Primary)

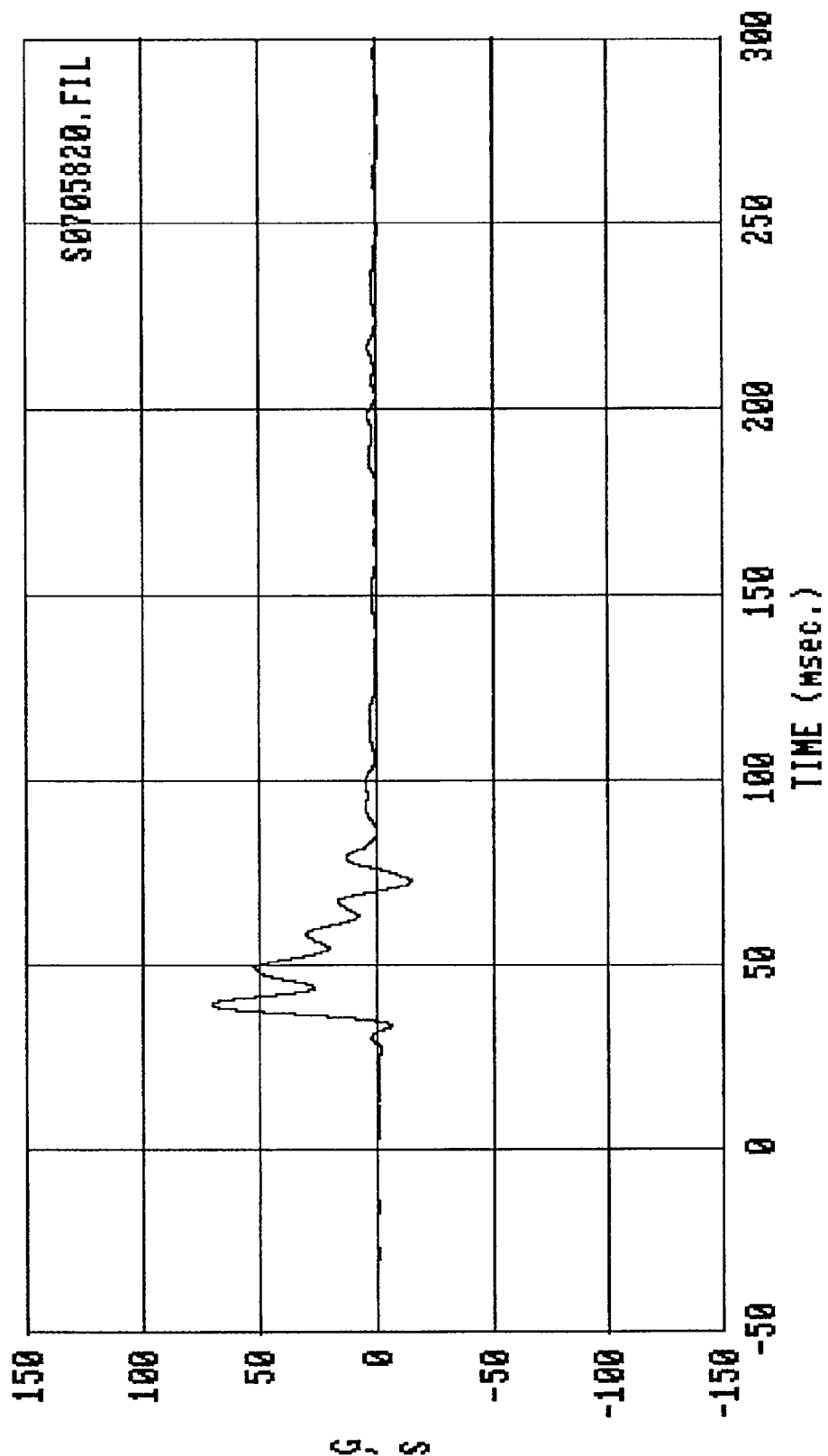


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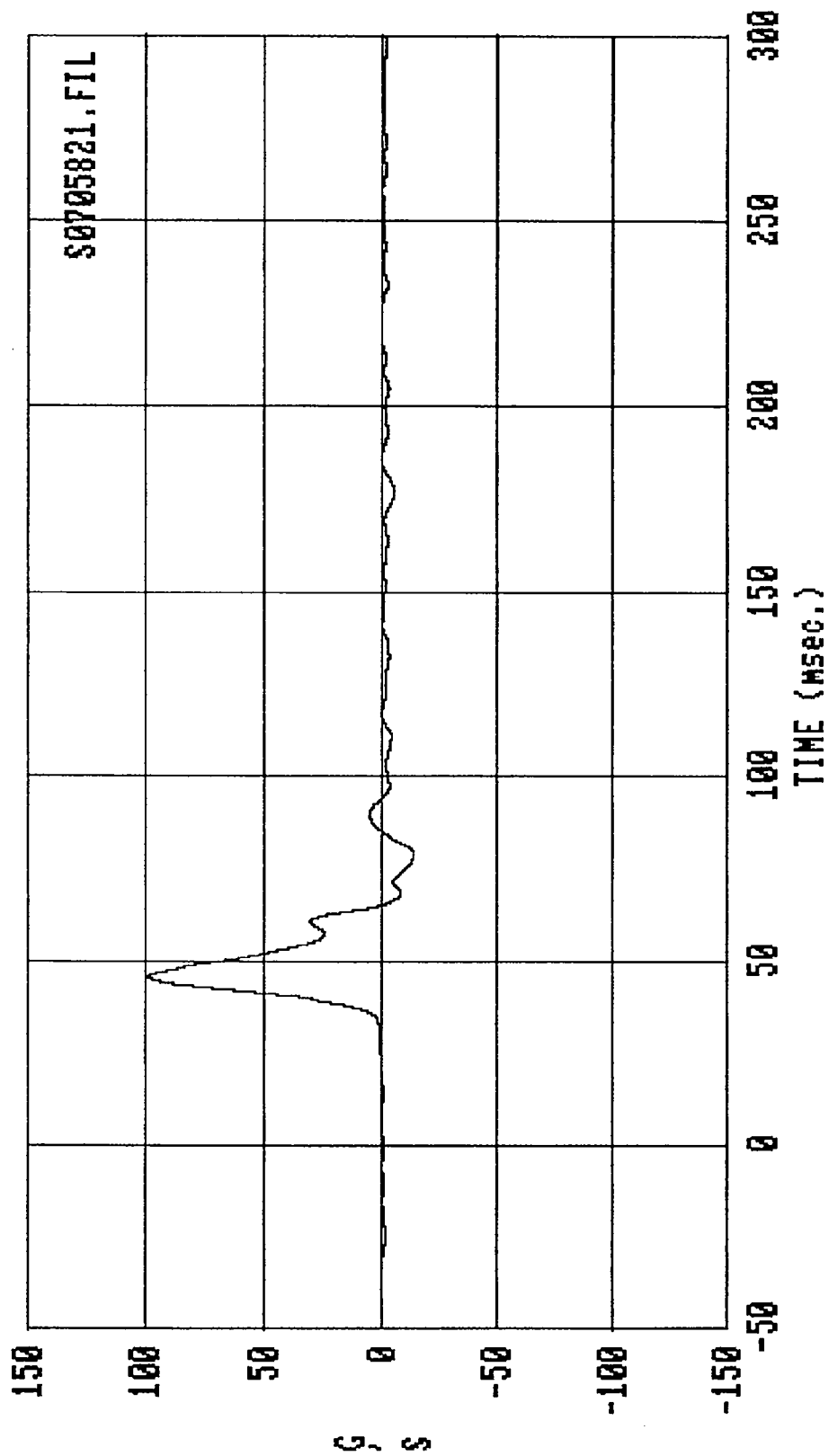
Filter: FIR 100 Max = 61.842 Min = -9.0942
MSE 02/03/89 -- 1988 Dodge Caravan : Pasngr Upper Rib acc., Y-axis (Second)



Filter: FIR 100 Max = 71.567 Min = -12.849
MSE 02/03/89 -- 1988 Dodge Caravan : Pasngr Lower Rib acc., Y-axis (Primary)



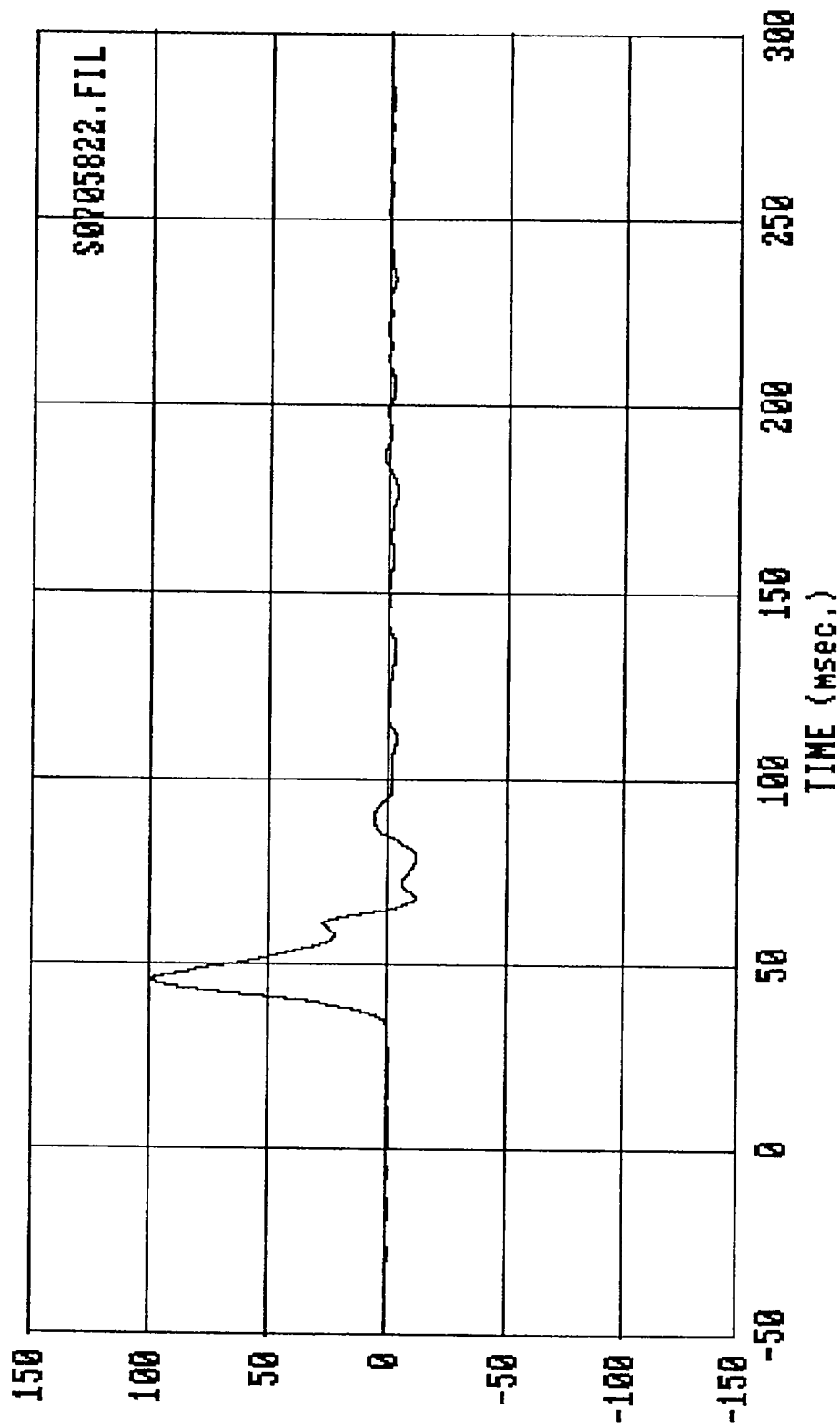
Filter: FIR 100 Max = 70.379 Min = -14.162
MSE 02/03/89 -- 1988 Dodge Caravan : Pasngr Lower Rib acc., Y-axis (Second)



Filter: FIR 100

Max = 100.17 Min = -13.521

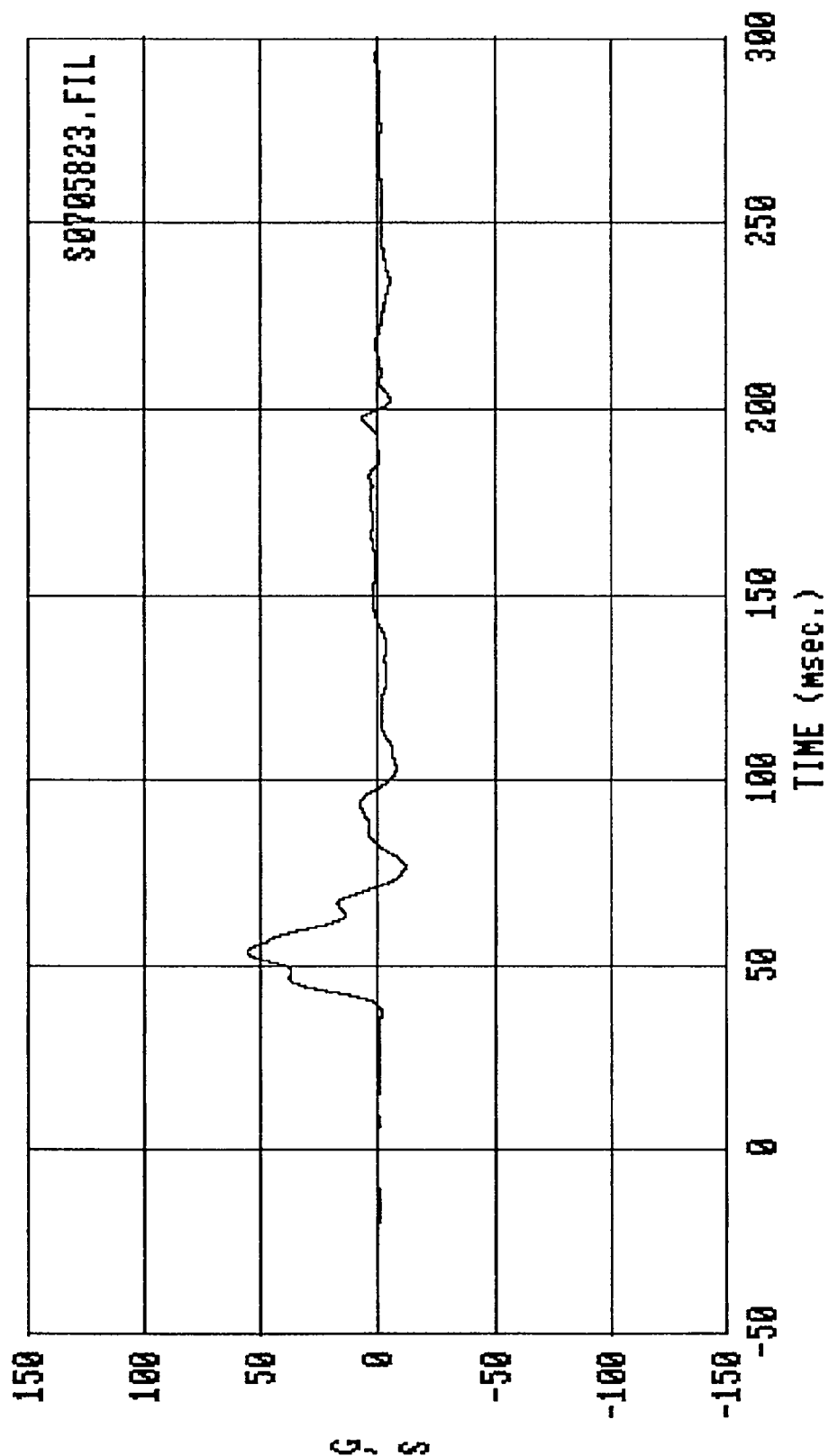
MSE 02/03/89 -- 1988 Dodge Caravan : Pasngr Lower Spine acc., Y-ax.(Primary)



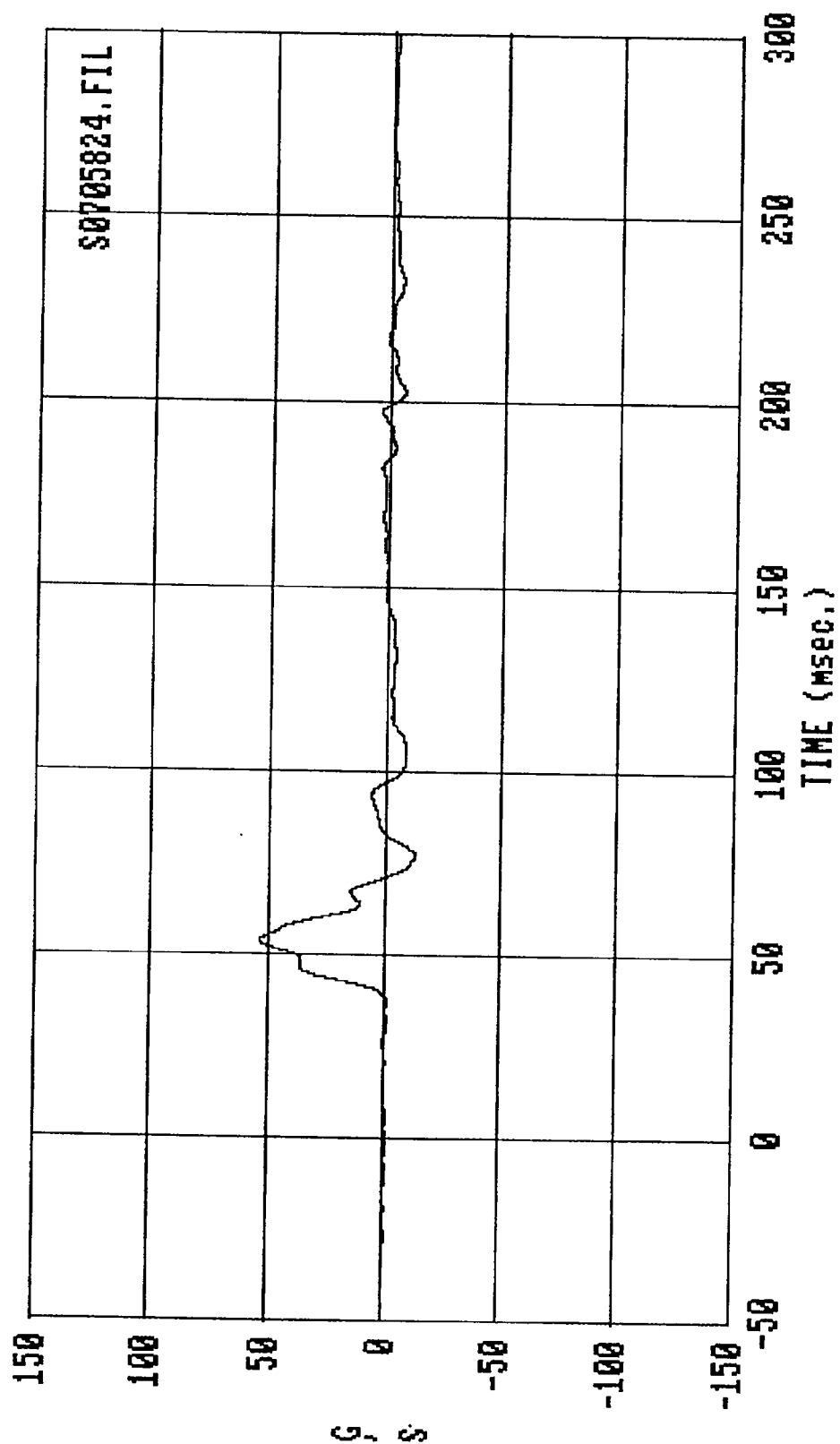
Filter: FIR 100

Max = 99.651 Min = -11.593

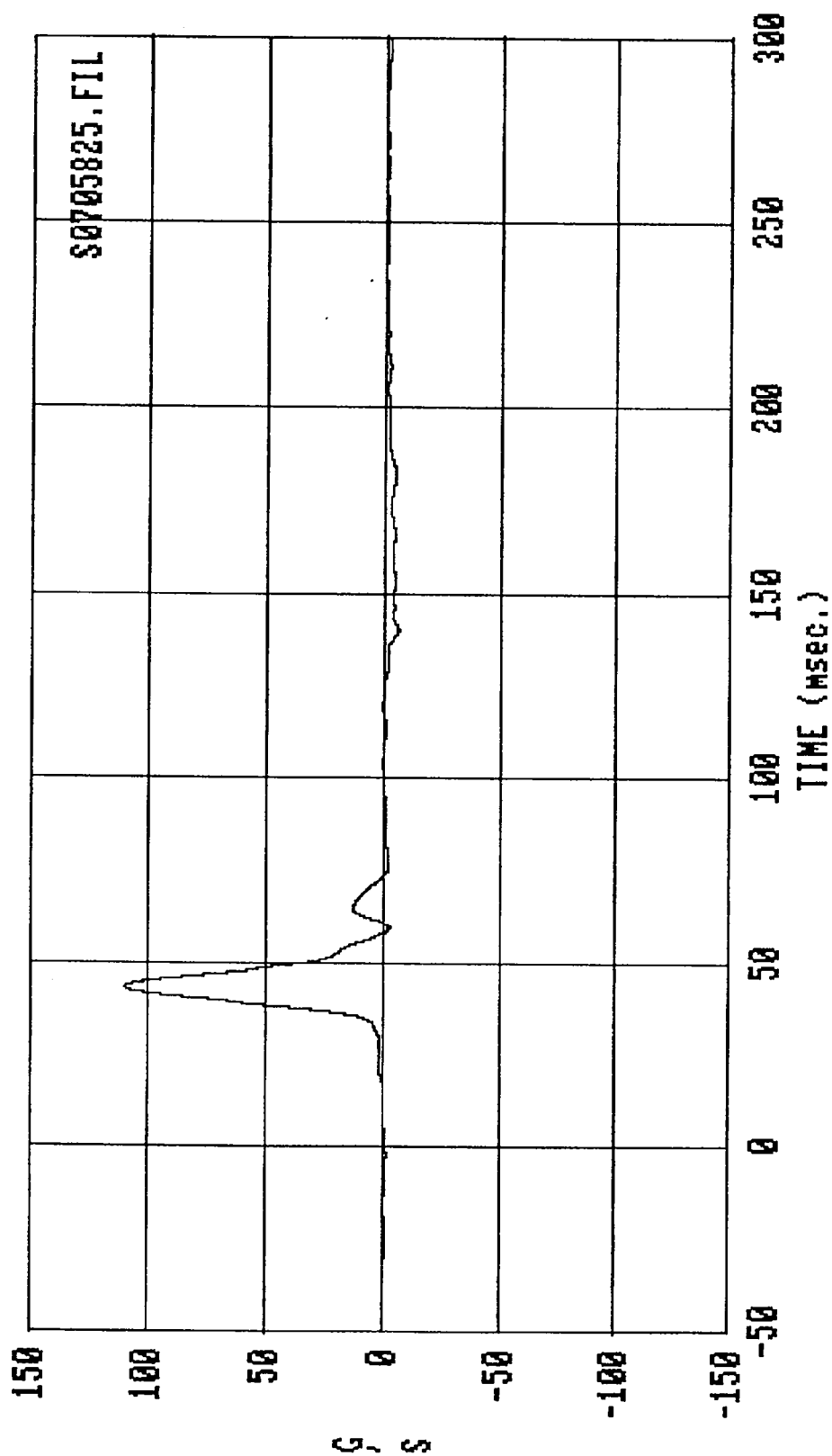
MSE 02/03/89 -- 1988 Dodge Caravan : Pasngr Lower Spine acc., Y-ax. (Second)



Filter: FIR 100 Max = 56.538 Min = -10.995
MSE 02/03/89 -- 1988 Dodge Caravan : Pasngr Upper Spine acc., Y-ax.(Primary)



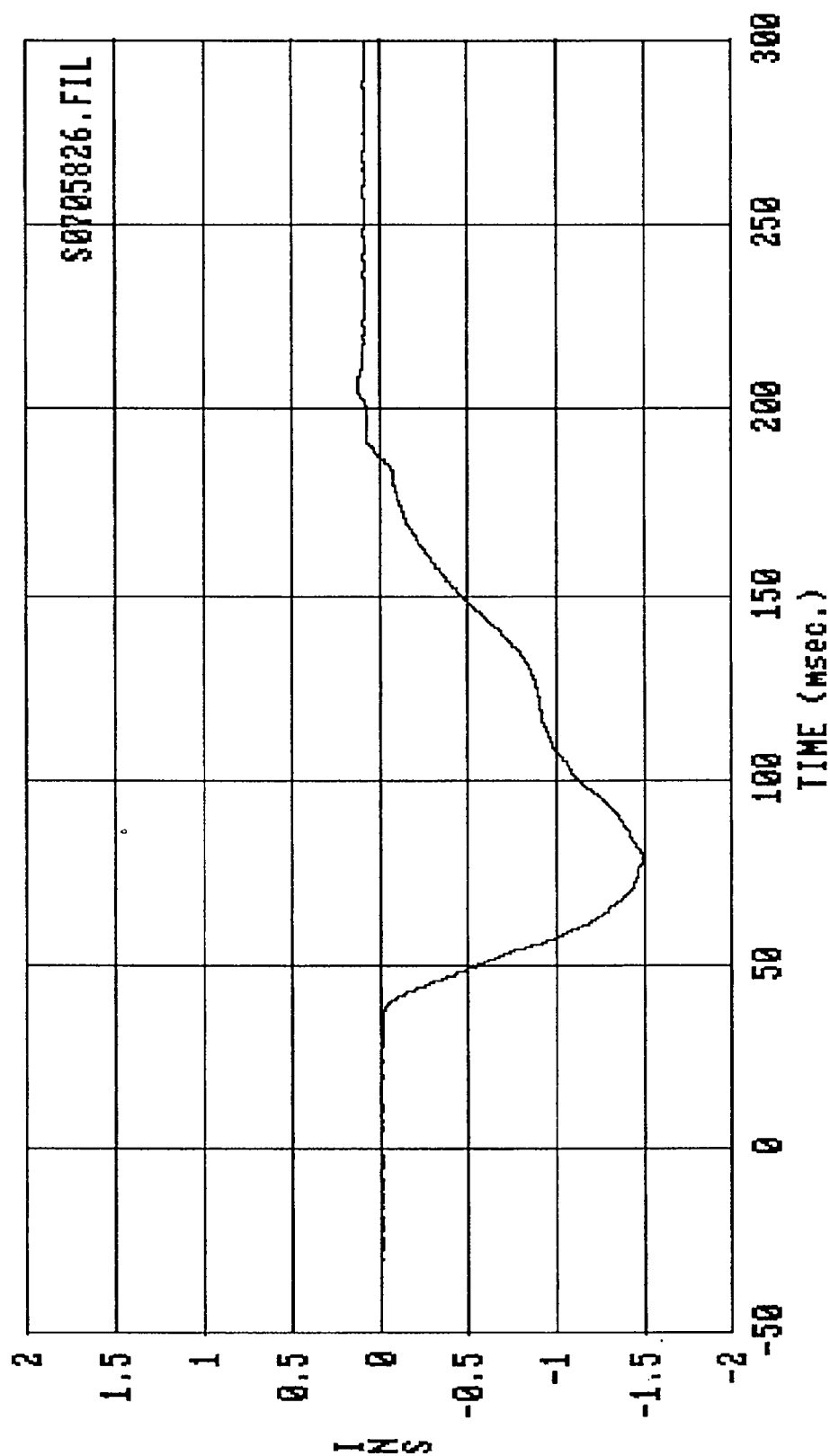
Filter: FIR 100 Max = 54.023 Min = -12.565
MSE 02/03/89 -- 1988 Dodge Caravan : Pasngr Upper Spine acc., Y-ax. (Second)



Filter: FIR 100

Max = 110.80 Min = -5.4320

MSE 02/03/89 -- 1988 Dodge Caravan : Pasngr Pelvis acceleration, Y-axis



Filter: SAE CLASS 180 Max = .12491 Min = -1.4908
MSE 02/03/89 -- 1988 Dodge Caravan : Pasngr Chest disp. (Compression is -)

APPENDIX C
SID CERTIFICATION DATA

SID IMPACT CALIBRATION SUMMARY SHEET

S.I.D. I.D. NO. : 137 and 319

LABORATORY TECHNICIAN: MARK WALKER

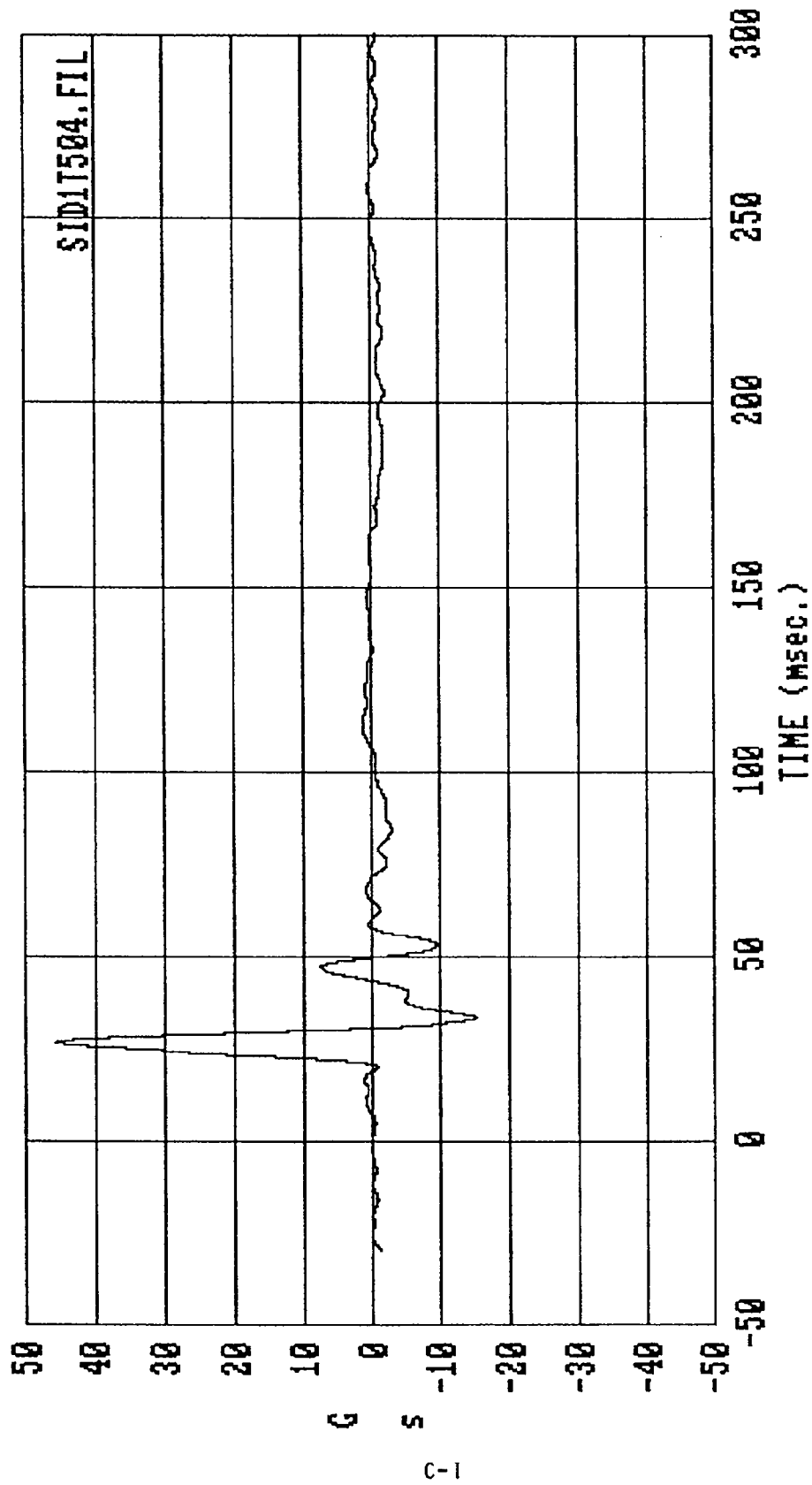
Sheet No. 1 of 3		Pretest Calibration Driver	Posttest Calibration Passenger
Date of SID Calibration - - - - -		01/24-01/30/89	01/24-01/30/89
Calibration Sequential Number for Dummy		5	1
Temperature min Lab. (Spec. = 66 to 78° F) - - -		68°-72°F	68 to 72°F
Relative Humidity in Lab. (Spec. = 10 to 70%)		40 to 60%	40 to 60%
TEST PARAMETER	SPECIFICATION		
1. NECK BENDING TEST:			
a. Pendulum Speed - - -	21.5 to 25.5 fps		
b. Pendulum Avg. Decel (over t3 - t2) - - - -	20 to 24G		
c. Peak Resultant Head Acceleration - - - -	26G maximum		
d. Pendulum Decel. (t2-t1)	3 ms		
e. Pendulum Decel. (t2-t2)	25 to 30 ms		
f. Pendulum Decel. (t2-t3)	10 ms		
g. Pendulum Direction Reversal Time - - - -	123 ms		
h. Max. Head Rotation -	63 to 73°		
i. Chordal Displacement: Head Rotation Angle -			
0° Time	-2 to 2 ms		
Displ.	.5 to .5 in		
30° Time	25.6 to 34.4 ms		
Displ.	2.1 to 3.1 in.		
Time	40.3 to 51.7 ms		
60° Displ.	4.3 to 5.3 in		
Maximum Time	53.2 to 66.8 ms		
(°) Displ.	5.0 to 6.0		
2. NECK BENDING TEST continued:			
i. Chordal Displacement: Head Rotation angle-			
0° Time	67.0 to 83.0 ms		
Displ.	4.3 to 5.3 in.		
30° Time	85.4 to 104.6 ms		
Displ.	2.1 to 3.1 in.		
Time	101.0 to 123.0 ms		
60° Displ.	-.5 to 0.5 in.		

SID IMPACT CALIBRATION SUMMARY SHEET (Continued)

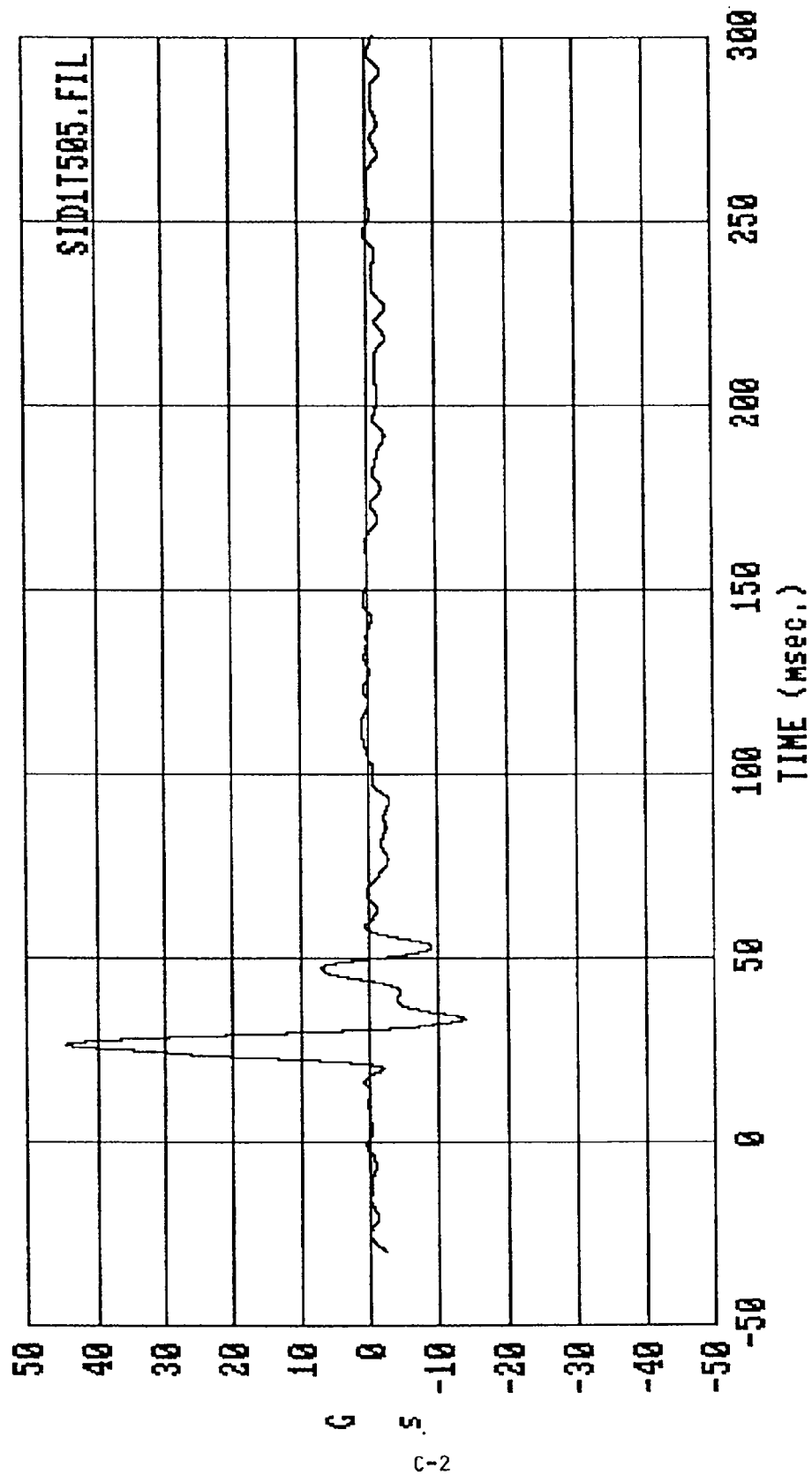
S.I.D. I.D. NO. : 137 and 319

LABORATORY TECHNICIAN: MARK WALKER

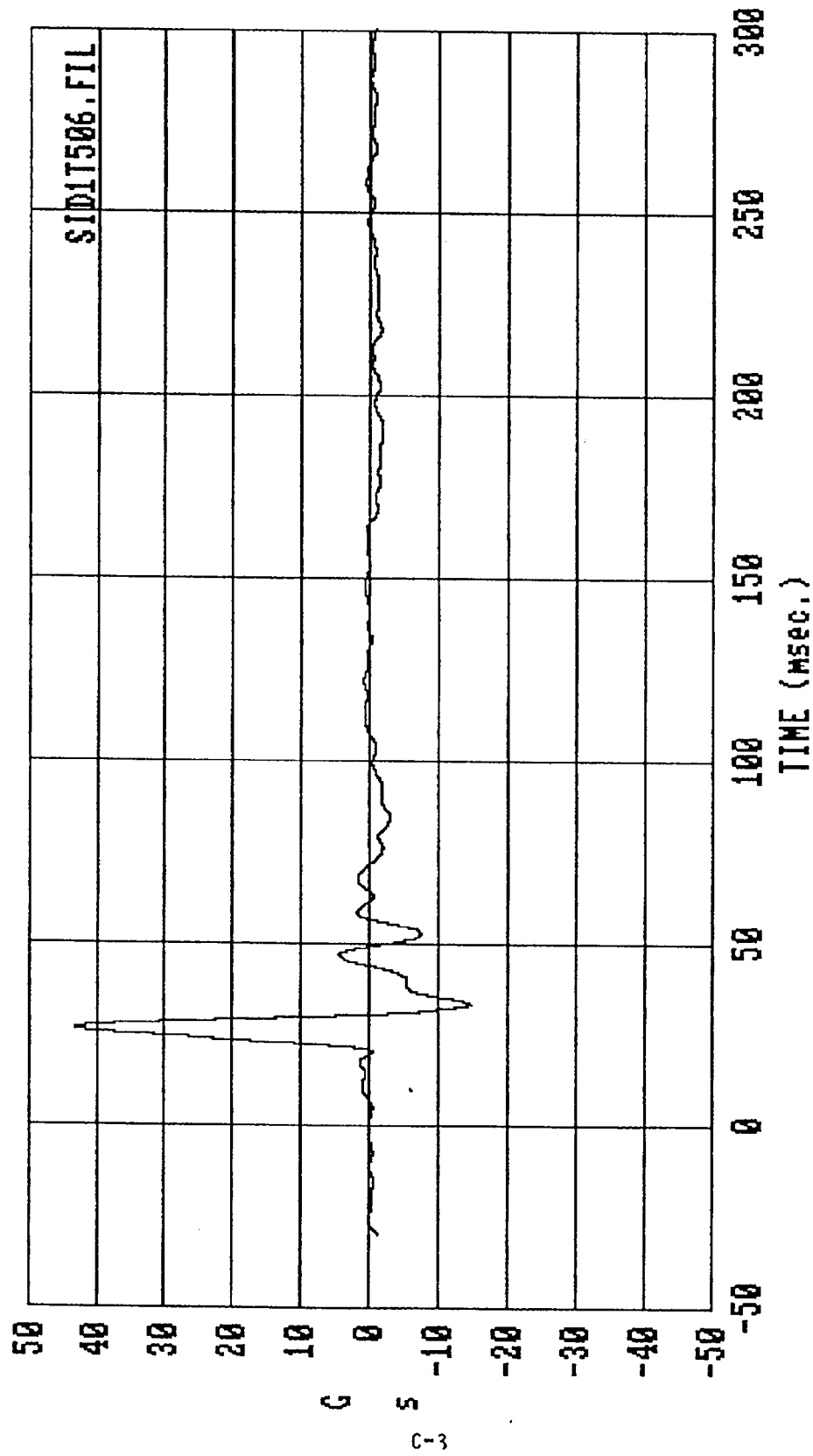
Sheet No. 2 of 3 TEST PARAMETER	SPECIFICATION	Pretest	Pretest
3. ABDOMINAL COMPRESSION TEST (Preload = 10 pounds) a. Force @ .5" - - - - b. Force @ .75" - - - - c. Force @ 1.0" - - - - d. Force @ 1.3" - - - -	23 - 36 lbs. 36 - 50 lbs. 50 - 63 lbs. 73 - 88 lbs.	NA	
4. LUMBAR FLEXION TEST: a. Force @ 20° - - - - b. Force @ 30° - - - - c. Force @ 40° - - - - d. Return Angle - - - -	22 to 34 lbs 34 to 46 lbs 46 to 58 lbs 12 maximum		
5. THORAX IMPACT TEST: a. Upper Rib accel. - - - b. Lower Rib accel. - - - c. Lower Spine accel - -	Primary 37 - 46g's Sec Primary 37 - 46g's Sec Primary 15 - 22 g's Sec	45.797 44.514 43.272 45.084 21.359 21.771	45.792 44.779 43.812 44.208 20.095 26.711
6. PELVIC IMPACT TEST: Pelvic accel. - - - -	40 - 60g's	59.073	45.414



Filter: FIR 100 Max = 45.797 Min = -15.119
MSE 01/30/89 -- SID-137 THORAX CAL5 : Driver Upper Rib acc., Y-axis (Primary)



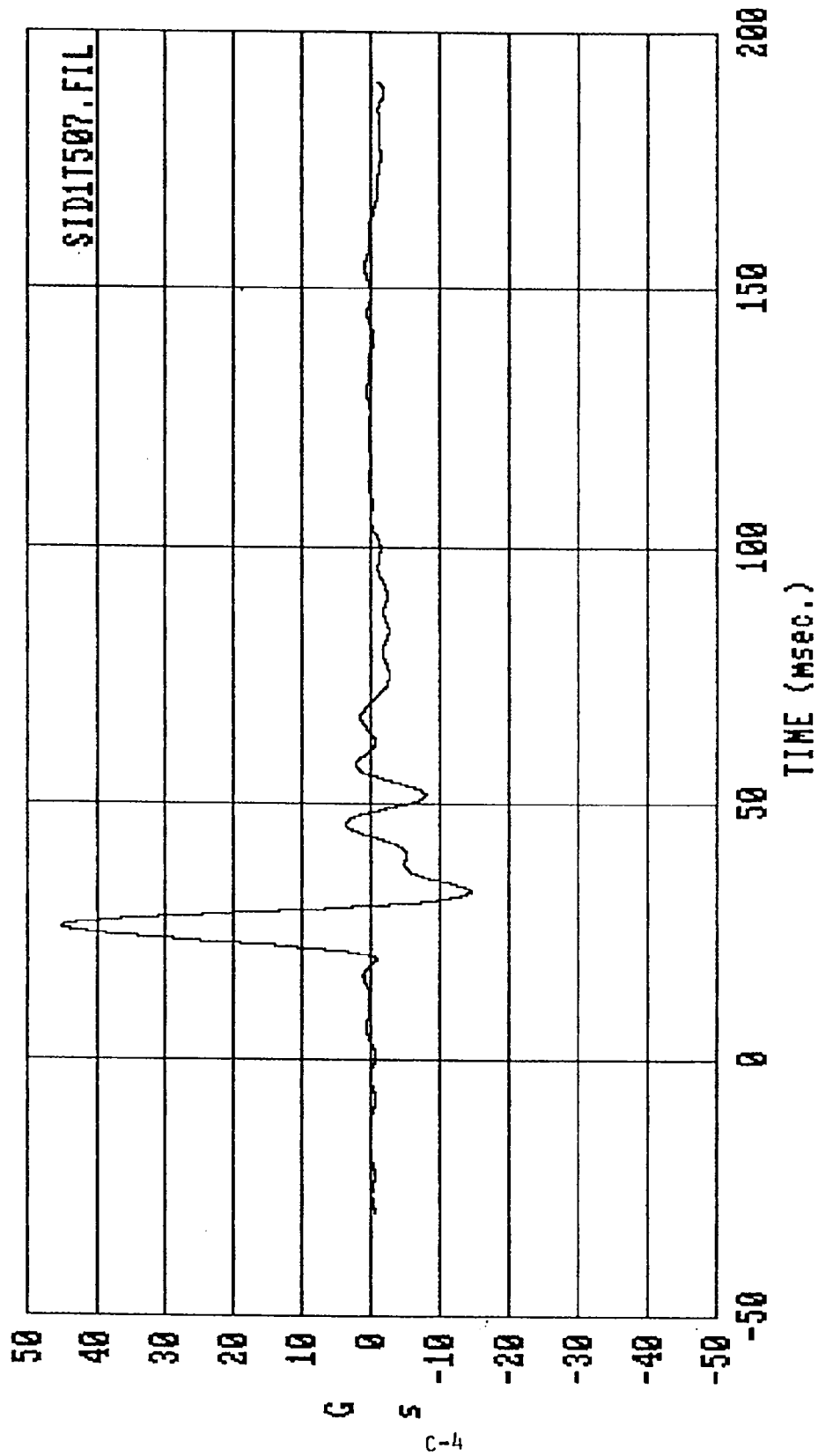
Filter: FIR 100 Max = 44.514 Min = -13.722
MSE 01/30/89 -- SID-137 THORAX CAL5 : Driver Upper Rib acc., y-axis (Second)



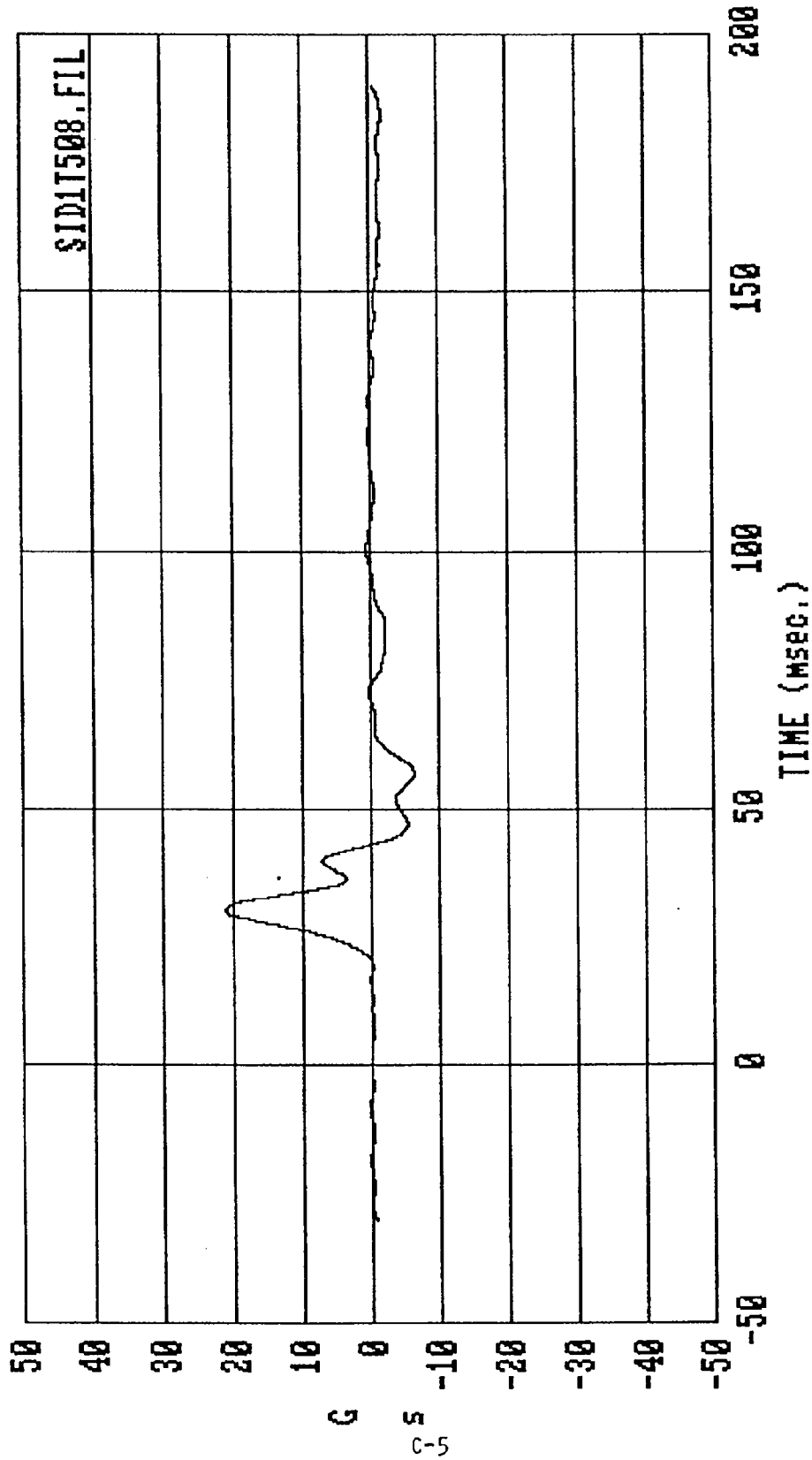
Filter: FIR 100

Max = 43.272 Min = -14.719

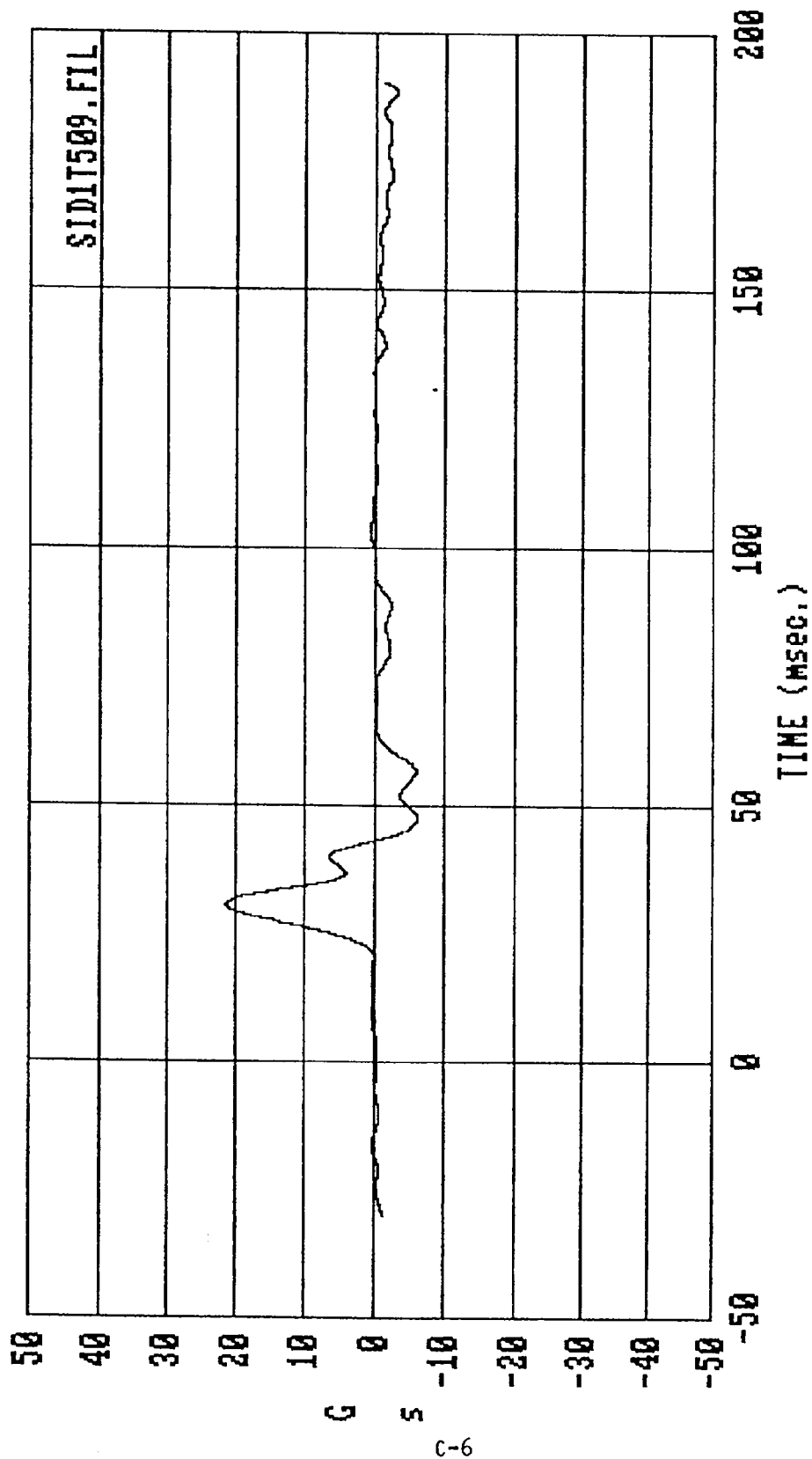
MSE 01/30/89 -- SID-137 THORAX CAL5 : Driver Lower Rib acc., Y-axis (Primary)



Filter: FIR 100 Max = 45.084 Min = -14.416
 MSE 01/30/89 -- SID-137 THORAX CAL5 : Driver Lower Rib acc., Y-axis (Second)

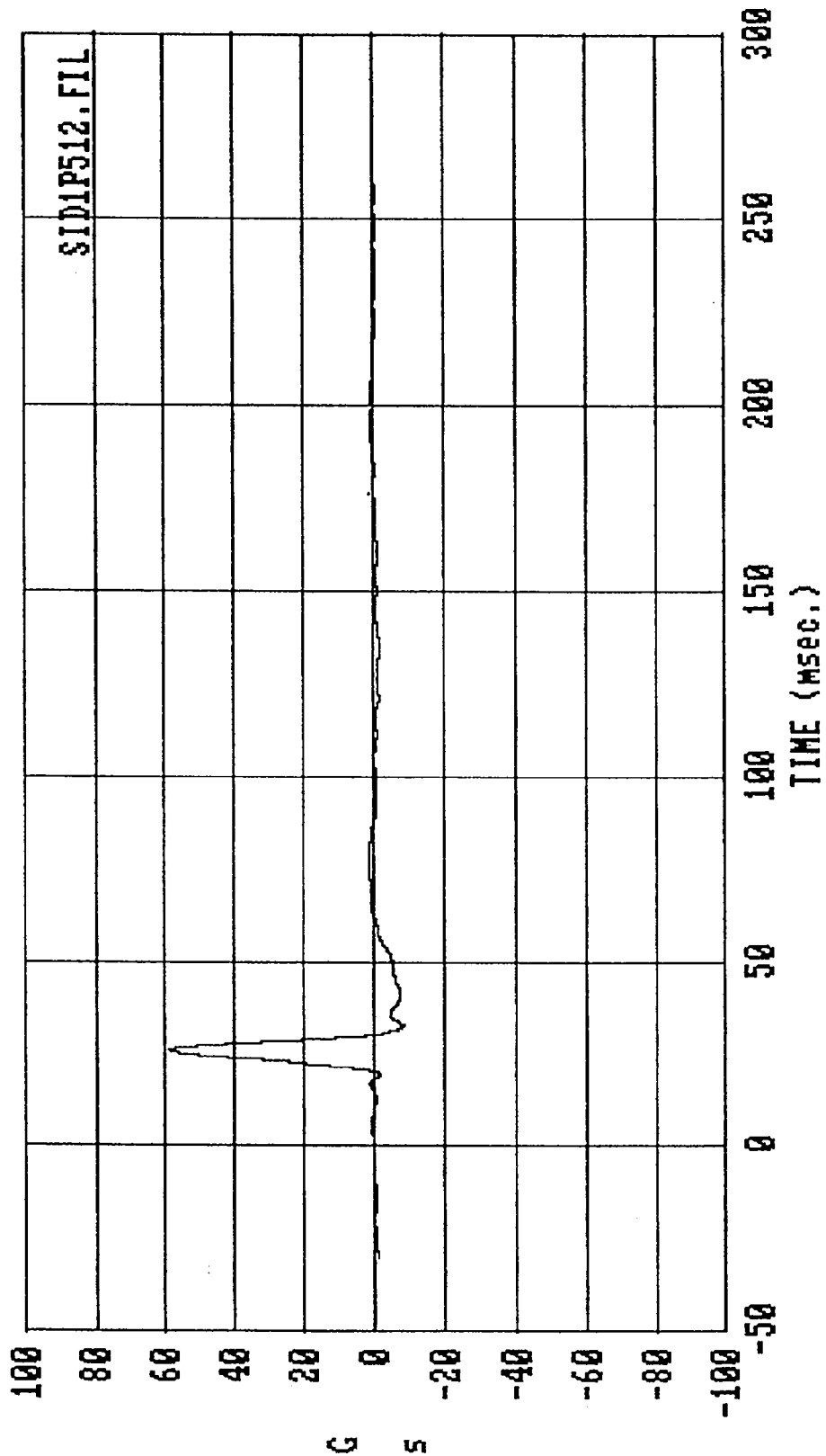


Filter: FIR 100 Max = 21.359 Min = -6.1956
 MSE 01/30/89 -- SID-137 THORAX CAL5 : Driver Lower Spine acc., Y-ax.(Primary)

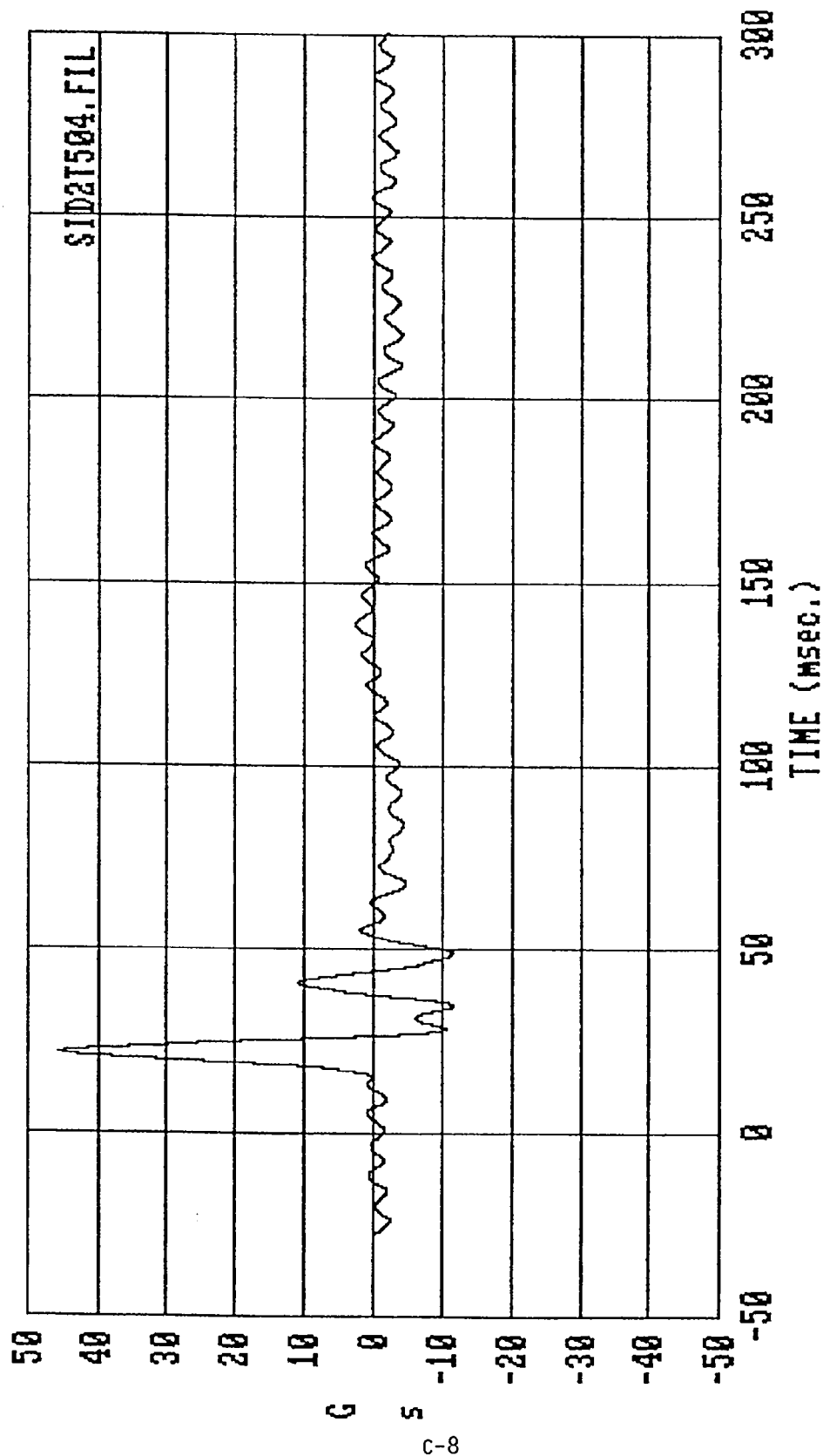


C-6

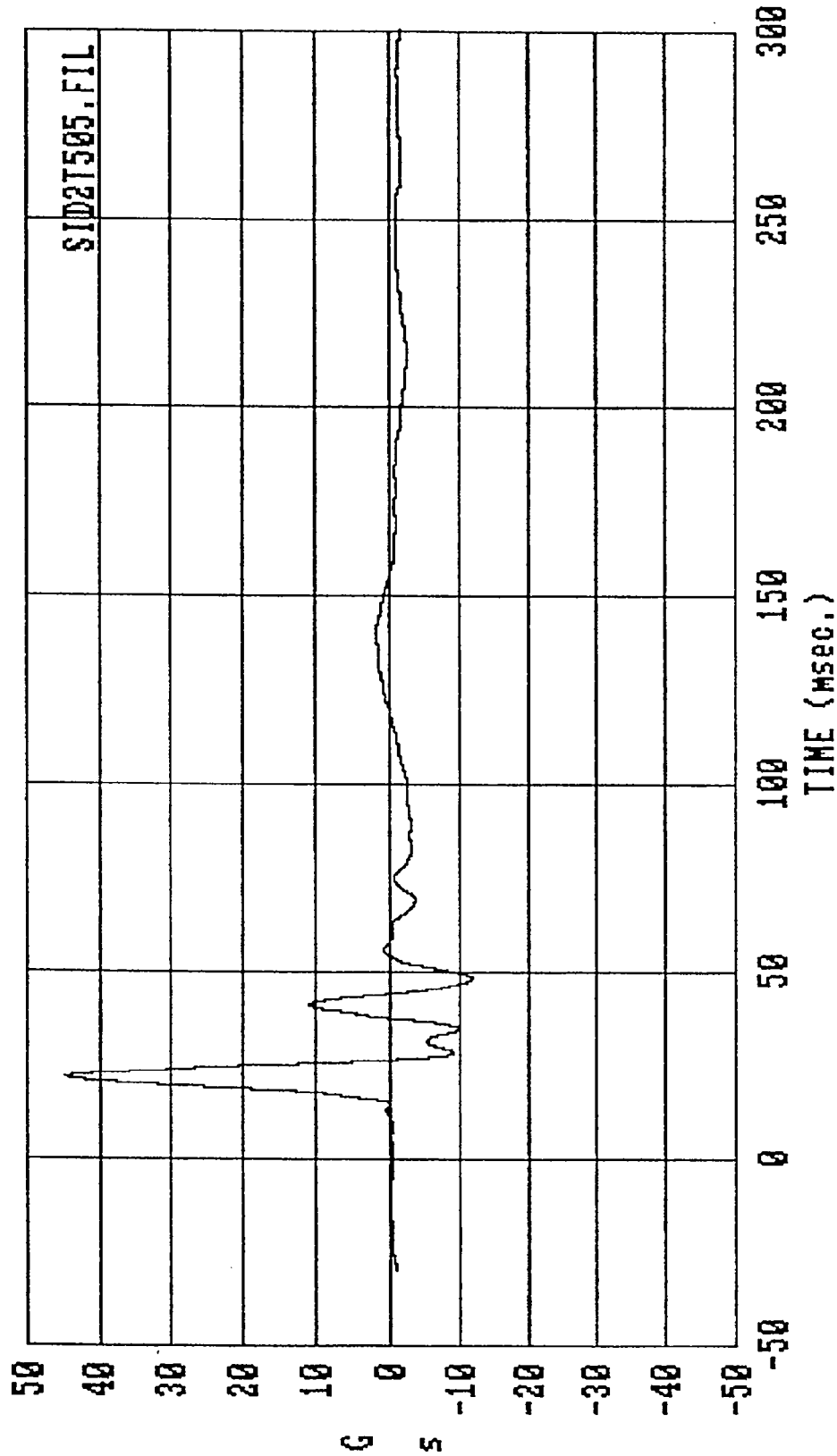
Filter: FIR 100 Max = 21.771 Min = -5.8945
 MSE 01/30/89 -- SID-137 THORAX CAL5 : Driver Lower Spine acc., Y-ax. (Second)



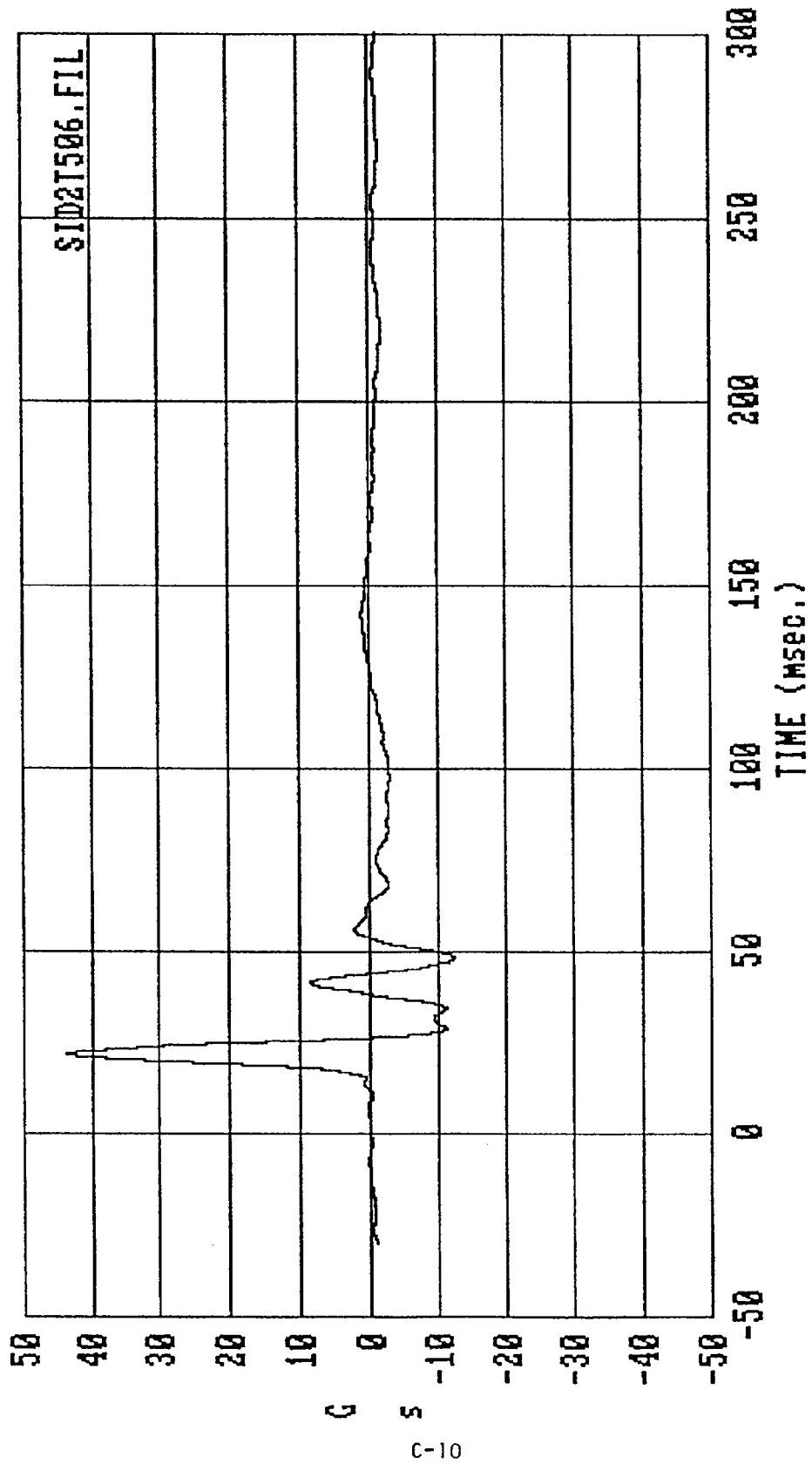
Filter: FIR 100 Max = 59.073 Min = -8.3217
MSE 01/30/89 -- SID-137 PELVIS CAL5 : Driver Pelvis acceleration, Y-axis



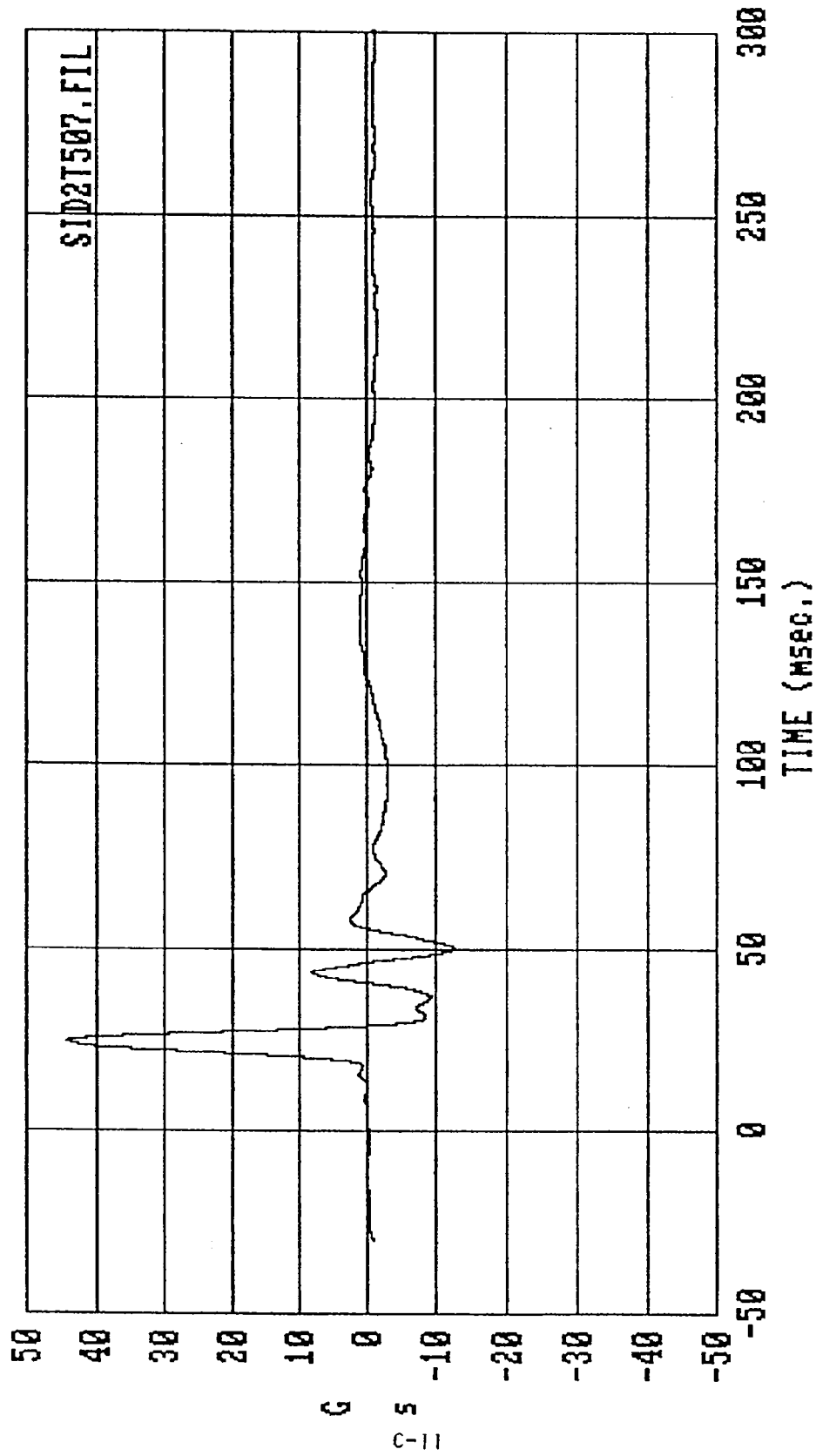
Filter: FIR 100 Max = 45.792 Min = -11.502
 MSE 01/30/89 -- SID-319 THORAX CAL 1 : Passenger Upper Rib acc., Y-axis (Primary)



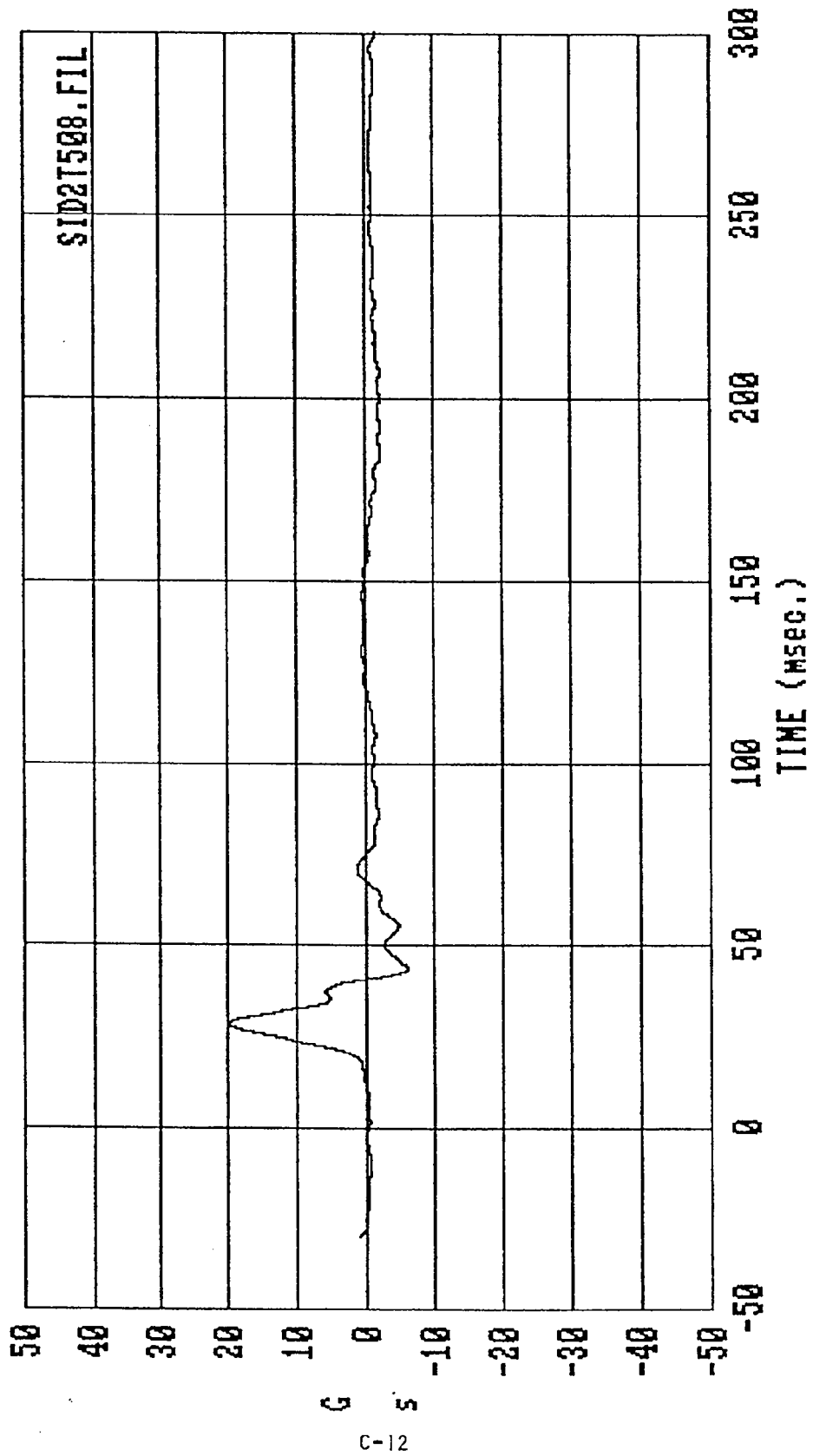
Filter: FIR 100 Max = 44.770 Min = -11.714
MSE 01/30/89 -- SID-319 THORAX CAL 1 : Passenger Upper Rib acc., y-axis (Second)



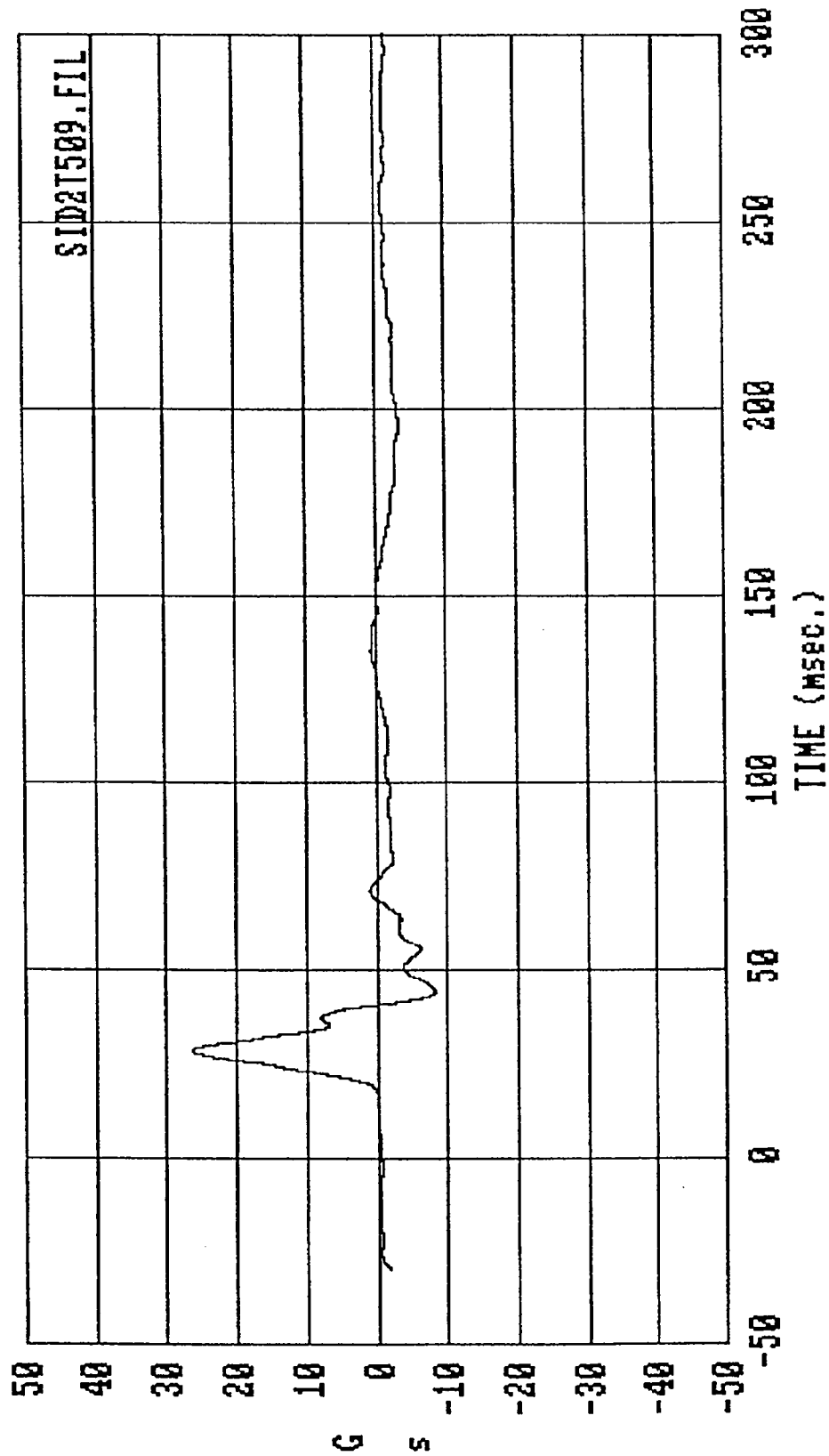
Filter: FIR 100 Max = 43.812 Min = -12.387
MSE 01/30/89 -- SID-319 THORAX CAL 1 : Passenger Lower Rib acc., Y-axis (Primary)



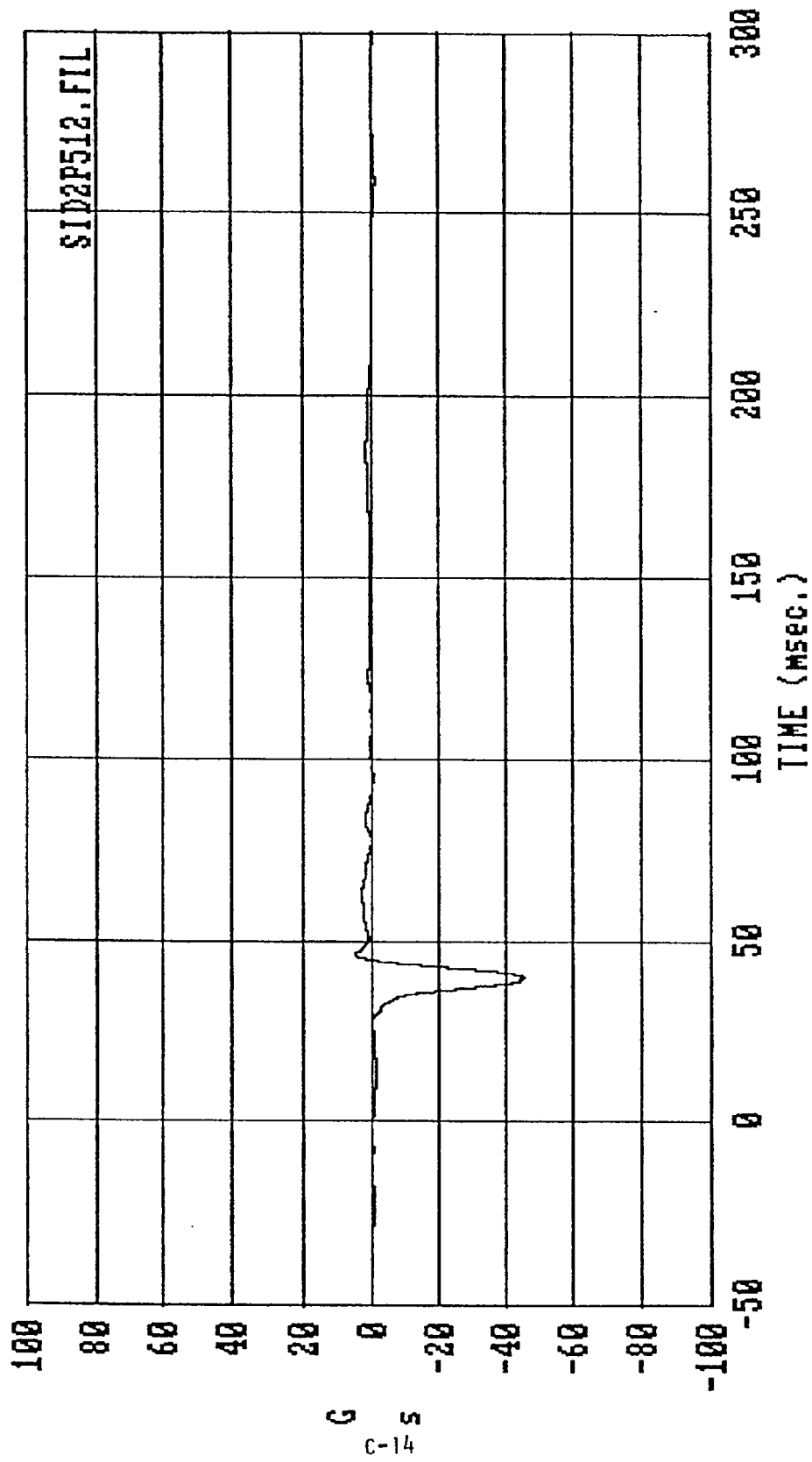
Filter: FIR 100 Max = 44.208 Min = -12.478
MSE 01/30/89 -- SID-319 THORAX CAL1 : Passenger Lower Rib acc., Y-axis (Second)



Filter: FIR 100 Max = 20.095 Min = -5.9935
MSE 01/30/89 -- SID-319 THORAX CAL5 : Passenger Lower Spine acc., Y-ax.(Primary)



Filter: FIR 100 Max = 26.711 Min = -8.2584
MSE 01/30/89 -- SID-319 THORAX CAL: Passenger Lower Spine acc., Y-ax. (Second)



Filter: FIR 100 Max = 5.2457 Min = -45.414
MSE 01/30/89 -- SID-319 PELVIS CAL1 : Passenger Pelvis acceleration, Y-axis

APPENDIX D
SID POSITIONING PROCEDURE

SIDE IMPACT DUMMY SEATING PROCEDURE

1. Seat Positioning

- A. Place seat at the longitudinal midpoint of fore to aft adjustment (forward most locking position to rear most locking position). If no locking position is available at mid-travel, use the position immediately rearward of mid-travel.
- B. If the seat back angle is adjustable, place it in the manufacturer's stated nominal design location. If not specified, set it at the first detent rearward of 25°.
- C. Adjustable head restraints are set such that the top surface of the restraint is level with the c.g. of the dummy's head.
- D. If the seat is equipped with adjustable side or lumbar supports, they are set in their "released" or full back positions.
- E. All other seat adjustments are positioned to their mid-travel locations. If locking positions are not available at these mid-points, use the position immediately rearward, down, left, or clockwise of mid-travel. Clockwise is defined looking rear to front or left to right relative to the vehicle. This also applies to adjustable steering columns.

2. H-point Determination

- A. The SAE three-dimensional H-point machine (SAE J826 APR80 - 50th percentile male configuration) is used to locate the H-point for each surrogate (see Appendix A).

B. The H-point machine is positioned on the seat as follows:

1. Bucket or Contoured Seats - The H-point machine is centered on the bucket or contour such that its midsagittal plane is vertical and longitudinal.

2. Bench Seats

a. Driver position - The H-point machine is positioned such that its midsagittal plane is vertical, longitudinal, and contains the steering wheel center point.

b. Outboard passenger positions - The H-point machine is positioned such that its midsagittal plane is vertical, longitudinal, and the same distance from the longitudinal vehicle centerline as that for the driver position.

c. Center passenger positions - The H-point machine is positioned such that its midsagittal plane is vertical and contains the longitudinal vehicle centerline.

C. Locate the H-point position using the steps outlined in sections 4 through 6 of SAE Standard J826 APR80, unless otherwise specified in section 1 or 2 of this document. Record the coordinates of this point, relative to the vehicle, for use in section 4 of this document.

3. Test Dummies

A. All NHTSA side impact crash test use the NHTSA Side Impact Dummy (SID) as the surrogate(s), unless otherwise specified by the COTR.

- B. All dummy joints are inspected for mobility prior to each test usage and reset to hold between 1 and 2 g's. This amount just barely restrains the weight of the individual limb when it is extended horizontally.
- C. Each test dummy is clothed in form-fitting cotton stretch underwear with short sleeves and mid-calf length pants. Each foot of each dummy is equipped with a size 11EE shoe which meets the configuration, size, sole, and heel thickness specifications of MIL-S-13192 and weighs 1.25 + 0.2 pounds. All the above items are supplied by the contractor.

4. Initial Dummy Placement

The SID dummy(s) is placed in the vehicle seat with its pelvis positioned such that a lateral line passing through the dummy H-point is perpendicular to the longitudinal centerplane of the vehicle.

- A. Bucket or Contoured Seats. The dummy is centered on the bucket or contoured seat such that its midsagittal plane is vertical and longitudinal. The legs are positioned as follows, keeping the femur and tibia centerlines in a plane that is as near to vertical as possible.
 - 1. Driver position placement - The right foot of the dummy is placed on the undepressed accelerator pedal, with the heel resting on the floorpan as far forward as possible. The left knee is positioned such that the distance from the outer surface of the knee pivot bolt to the dummy's midsagittal plane is 6 inches.

2. Passenger positions placement - The knees of the dummy are initially set 11 1/2" apart, measured between the outer surfaces of the knee pivot bolt heads. If a center tunnel prevents this, place the feet on either side of the tunnel.

B. Bench Seats.

1. Driver position placement - The dummy is placed in the seat as outlined in section 4.A.2 except that its midsagittal plane is vertical, longitudinal, and contains the steering wheel center point.
2. Outboard passenger positions - The dummy is placed in the seat as outlined in section 4.A.2 except that its midsagittal plane is vertical, longitudinal, and the same distance from the vehicle centerline as that for the driver position.
3. Center passenger positions - The dummy is positioned in the seat as outlined in section 4.A.2 except that its midsagittal plane is vertical and contains the vehicle centerline.

5. Initial Dummy Positioning

A. H-point Positioning.

1. With the dummy laterally positioned as in section 4, insert the pelvis angle indicator bar in the hole provided above, and to the rear of the dummy H-point. Position the longitudinal pelvis angle between 23° and 25° to the horizontal. This may be accomplished by

raising the legs or flexing the upper torso forward and allowing the pelvis to rotate. The lateral pelvis angle is to be horizontal.

2. Apply sufficient force on the lower torso in a horizontal and vertical direction to place the dummy H-point at the coordinates obtained in section 2.
 3. If the H-point cannot be placed at the desired coordinates, adjust the pelvis angle within the 2° band and reposition to the coordinates. After repositioning the H-point, any deviation from the desired coordinates is recorded and used to indicate actual H-point locations. This deviation is not to exceed 1/2".
- B. Upper Torso Positioning. The dummy's upper torso should rest against the seat back. If not, adjust the upper torso, maintaining the H-point location and pelvis angle, so that the dummy's back rests against the seat back. If this cannot be done, modify the H-point location and/or pelvis angle within the allowable bands until the back rests against the seat.
6. Final Dummy Positioning
- A. Driver Position. Without inducing pelvis or torso movement, the dummy's right foot is placed on the undepressed accelerator pedal with the heel resting as far forward as possible on the floorpan. The left foot is set perpendicular to the lower leg with the heel resting on the floorpan in the same lateral line as the right heel. If possible within these constraints, the dummy's thighs should be in contact with the seatpan.

- B. Front Passenger Positions. Without inducing pelvis or torso movement, place the dummy's feet on the vehicle's toeboard with the heel resting on the floorpan as close as possible to the intersection of the toeboard and floorpan. If the feet cannot be placed on the toeboard, they are set perpendicular to the lower legs and placed as far forward as possible such that the heels rest on the floorpan.
- C. Rear Passenger Positions. Without inducing pelvis or torso movement, the feet are placed flat on the floorpan and beneath the front seat as far forward as possible without front seat interference. If necessary, change the distance between the knees as required to place the feet beneath the seat. Record the new distance.
- D. Vehicles with wheelhouse projections in the passenger compartment. The foot(feet) in question is placed in the well of the floorpan/toeboard and not on the wheelhouse projection. This is done by twisting the foot at the ankle, maintaining the upper and lower leg positions outlined in section 4. If this does not resolve the situation, move the leg of the foot in question just enough to achieve the correct position, keeping the femur and tibia centerlines in a plane that is as near to vertical as possible. Record the new distance between the knees.
- F. Prior to conducting the test, the dummy position is visually checked. The dummy is to be properly positioned laterally with its midsagittal plane vertical and longitudinal, and the upper torso resting against the seat back. The H-point and pelvis angle are to be within the specified ranges and the foot, knee, and leg placements are to be as outlined.

The COTR is to be satisfied with the final dummy position and any deviations from this procedure are to be approved by the COTR.

- G. The final dummy position is recorded. These measurements are to include, but not be limited to, pelvis and head angles as well as actual H-point and head c.g. locations relative to the vehicle. The straight line distance from the H-point to the center of the outer ankle bolt is also recorded for one of the legs (eg. left H-point to left ankle bolt).