DOT Ø68Ø

Dynamic Science Report No. 3154-84-001/2118

AIR BAG FLEET RETROFIT PROGRAM
CRASH TESTS

TEST NO. 3154-6
1981 DODGE DIPLOMAT
4-DOOR SEDAN

Prepared by:

DYNAMIC SCIENCE, INC.
An Exodyne Company
1850 West Pinnacle Peak Road
Phoenix, Arizona 85027

JANUARY 1984

TEST REPORT

Prepared for:

U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
400 SEVENTH STREET, S.W.
WASHINGTON, D.C. 20590

dsi Dynamic Science, Inc.
an Exodyne Company
1850 West Pinnacle Peak Road • Phoenix, Arizona 85027-1399 • (602) 869-9331

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Prepared by Matthew L. Reaves

Approved by Rod Garn

Date 12 Jan. 1984

Report Accepted by:

_____

Contract Technical Manager
Office of Vehicle Safety Compliance

_____

Date

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.

4. Title and Subtitle	5. Report Date
AIR BAG FLEET RETROFIT PROGRAM CRASH TESTS - TEST NO. 3154-6 - 1981 DODGE DIPLOMAT 4-DOOR SEDAN	January 1984
	6. Performing Orgn Code
7. Author(s) R. Garn, M. Reaves	8. Performing Orgn Rpt No. 3154-84-001/2118
9. Performing Organization Name and Address Dynamic Science, Inc. An Exodyne Company 1850 West Pinnacle Peak Road Phoenix, Arizona 85027	10. Work Unit No.
	11. Contract or Grant No. DTNH22-82-A-17148
12. Sponsoring Agency Name and Address United States Department of Transportation National Highway Traffic Safety Administration 400 Seventh Street, S.W. Washington, DC 20590	13. Type of Report and Period Covered Test Report January 1984
	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

The objective of this program is to obtain performance data on a driver air bag restraint system retrofitted in police vehicles.

One calibrated 50th percentile Part 572 dummy was utilized to obtain occupant response data relative to FMVSS 208 requirements. Various vehicle mounted accelerometers were utilized to monitor vehicle response to the impact environment. Air bag crash sensor actuation, firing squib current, and diagnostic system power source were electronically monitored throughout the impact event.

The report contains results of all electronic data obtained during frontal pole barrier crash testing of a 1981 Dodge Dipolmat at Dynamic Science, Inc. on January 6, 1984. Impact speed was 29.98 mph.

17. Key Words	18. Distribution Statement
Frontal Barrier Testing, Air Cushion Restraint System	Copies available from Technical Reference Division, National Highway Traffic Safety Administration, 400 7th Street, S.W., Washington, D.C. 20590

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. Pages	22. Price
Unclassified	Unclassified		

Form DOT F 1700.7 (8-69)

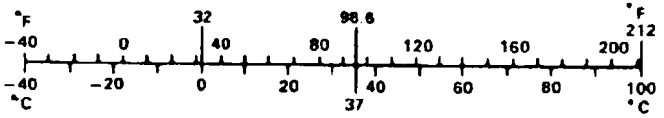
METRIC CONVERSION FACTORS

Approximate Conversions to 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	metric ton	t
	VOLUME			
tsp	teaspoons	5	milliliters	mL
Tbsp	tablespoons	15	milliliters	mL
in^3	cubic inches	16	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	degrees Fahrenheit	5/9 (after subtracting 32)	degrees Celsius	°C

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
m	meters	1.1	yards	yd
km	kilometers	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	metric ton (1000 kg)	1.1	short tons	
	VOLUME			
mL	milliliters	0.03	fluid ounces	fl oz
mL	milliliters	0.06	cubic inches	in^3
L	liters	2.1	pints	pt
L	liters	1.06	quarts	qt
L	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
	TEMPERATURE (exact)			
°C	degrees Celsius	9/5 (then add 32)	degrees Fahrenheit	°F



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1.0 PURPOSE AND TEST PROCEDURE

1.1 PURPOSE

A series of six tests is planned for inclusion in this program; the objective of each being to obtain performance data on a driver air bag restraint system retrofitted into selected police vehicles. Planned tests include 90° flat frontal barrier impacts, and 14-inch diameter pole barrier impacts.

1.2 TEST PROCEDURE

One complete air bag restraint system, including steering wheel, inflator, air bag, and auxiliary knee bolster will be retrofitted into each candidate vehicle. Installation will be accomplished in conjunction with, and under the direction of, the air bag system development contractor, Romeo Kojyo Company Ltd.

One 50th percentile Part 572 dummy will be utilized in each test to obtain occupant response data relative to FMVSS 208 requirements. Various vehicle mounted accelerometers will be utilized to monitor vehicle response to the impact environment. Air bag crash sensor actuation, firing squib current, and diagnostic system power source will be electronically monitored throughout the impact event.

Actual test procedures utilized will be in general accordance with NHTSA Laboratory Procedure TP-219-02 with modifications and substitutions as directed by the Statement of Work for Contract No. DTNH22-82-A-17148 and the designated NHTSA Contract Technical Monitor.

2.0 REPORT ORGANIZATION

This report contains results of all electronic data obtained during frontal pole barrier crash testing of a 1981 Dodge Diplomat 4-Door Sedan, at Dynamic Science, Inc. on January 6, 1984. Impact speed was 29.98 mph.

Summary results are presented in tabulated format in the following data sheets:

- General Test and Vehicle Parameter Data
- Part 572 Dummy In-Vehicle Position Recording Sheet
- Summary of Vehicle Accelerometer Data
- FMVSS 208 Dummy Data Summary
- Camera Locations

Calcomp plots of electronic data from the entire impact event are included in Appendix A. Selected pre- and post-test photographs are presented in Appendix B.

GENERAL TEST AND VEHICLE PARAMETER DATA

PRE-IMPACT DATA

Make/Model: Dodge Diplomat
Body Style: 4-Door Sedan Model Year 1981
NHTSA No. NA DSI No. 1408 Color: Black/White Top

DATA FROM CERTIFICATION LABEL

Vehicle Manufacturer: Chrysler Corporation
Date of Manufacture: 2/81 ; VIN: 1B3BM46N8BG151445
GVWR: 5250 lb; GAWR: Front = 2605 lb; Rear = 2650 lb

DATA FROM "RECOMMENDED TIRE PRESSURE" LABEL

Vehicle Capacity: FRONT REAR RECOMMENDED LOAD RANGE:
Tire Pressure: Max 32 psi 32 psi TIRE SIZE: Standard
P215/70R14

Designated Seating: 3 Front 3 Rear 6 Total
Cargo load = 200 lb Is Spare Tire: Space Saver? No
TOTAL =1100 lb Standard Equipment? Yes
Engine: 318 C.U. O.H.V. V-8
Transmission: 3-Speed Automatic Rear Wheel Drive
Date Vehicle Received by Laboratory: 12/16/83 ; Odometer 88807
Dealer Name & Address: Furnished by Romeo Kojyo Company Ltd

WEIGHT (LB) OF TEST VEHICLE AS RECEIVED (WITH MAX. FLUIDS) = UDW

Right Front 1110 lb Right Rear = 913 lb
Left Front = 1097 lb Left Rear = 871 lb
TOTAL FRONT WEIGHT = 2207 lb (55 % of Total Vehicle Weight)
TOTAL REAR WEIGHT = 1784 lb (45 % of Total Vehicle Weight)
TOTAL DELV. WEIGHT = 3991 lb

TARGET WEIGHT = UDW + Cargo Load + 164 lb Dummy = 4355 lb

WEIGHT OF TEST VEHICLE WITH REQUIRED DUMMIES AND 200 LB CARGO:

Right Front = 1133 lb Right Rear = 969 lb
Left Front = 1131 lb Left Rear = 1038 lb
TOTAL FRONT WEIGHT = 2264 lb (53 % of Total Vehicle Weight)
TOTAL REAR WEIGHT = 2007 lb (47 % of Total Vehicle Weight)
TOTAL TEST WEIGHT = 4271 lb
Weight of ballast secured in veh. right rear floor panel 61 lb

VEHICLE ATTITUDE: (inches)

Delivered Attitude: RF 31.0 LF 31.0 RR 31.0 LR 31.0
Test Attitude: RF 31.3 LF 31.5 RR 28.8 LR 29.5

REMARKS: Vehicle was tested at less than target weight to more closely approximate the test weight of the Dodge Diplomat utilized in an earlier test in this same program.

GENERAL TEST AND VEHICLE PARAMETER DATA (CONT)

POST-IMPACT DATA

Type of Test: Frontal Pole Barrier (0°) Impact

Date of Test: 1/6/84 Time: 1239 Temperature 67 °F

Required Impact Velocity Range: 28.5 to 30.5 mph

Impact Velocity: Primary = 29.98 mph Secondary = NR mph

Distance from the vehicle's front bumper to barrier face entering the vehicle velocity measurement device is 5.0 feet and distance exiting the vehicle velocity measurement device is 1.0 foot.

VEHICLE REBOUND AND CRUSH (in.)

Vehicle Length:	Pre-test =	R	201.7	℄	204.8	L 202.1
	Post-test =	R	NR	℄	175.5	L NR
	Crush =	R	NA	℄	21.3	L NA

Distance from front of test vehicle to point of impact:

R NA ℄ 9.5 L NA

VISIBLE DUMMY CONTACT POINTS

	Driver	Passenger
Head	Air bag	
Chest	Air bag	
Abdomen	Air bag	
Left Knee	Knee bolster	
Right Knee	Knee bolster	

DOOR OPENING	Front		Rear	
	Left	Right	Left	Right
	Tools required	Tools required	Difficult	Difficult

SEAT MOVEMENT

Seat Back Failure	Tilted forward	Rear seat cushion
Seat Shift (in.)	Shifted forward 1 in.	dislodged

GLAZING DAMAGE

Backlight/Windshield: Windshield cracked from concentrated stresses in lower section.

OTHER NOTABLE IMPACT EFFECTS:

PART 572 DUMMY IN-VEHICLE POSITION RECORDING SHEET

PRE-IMPACT DATA

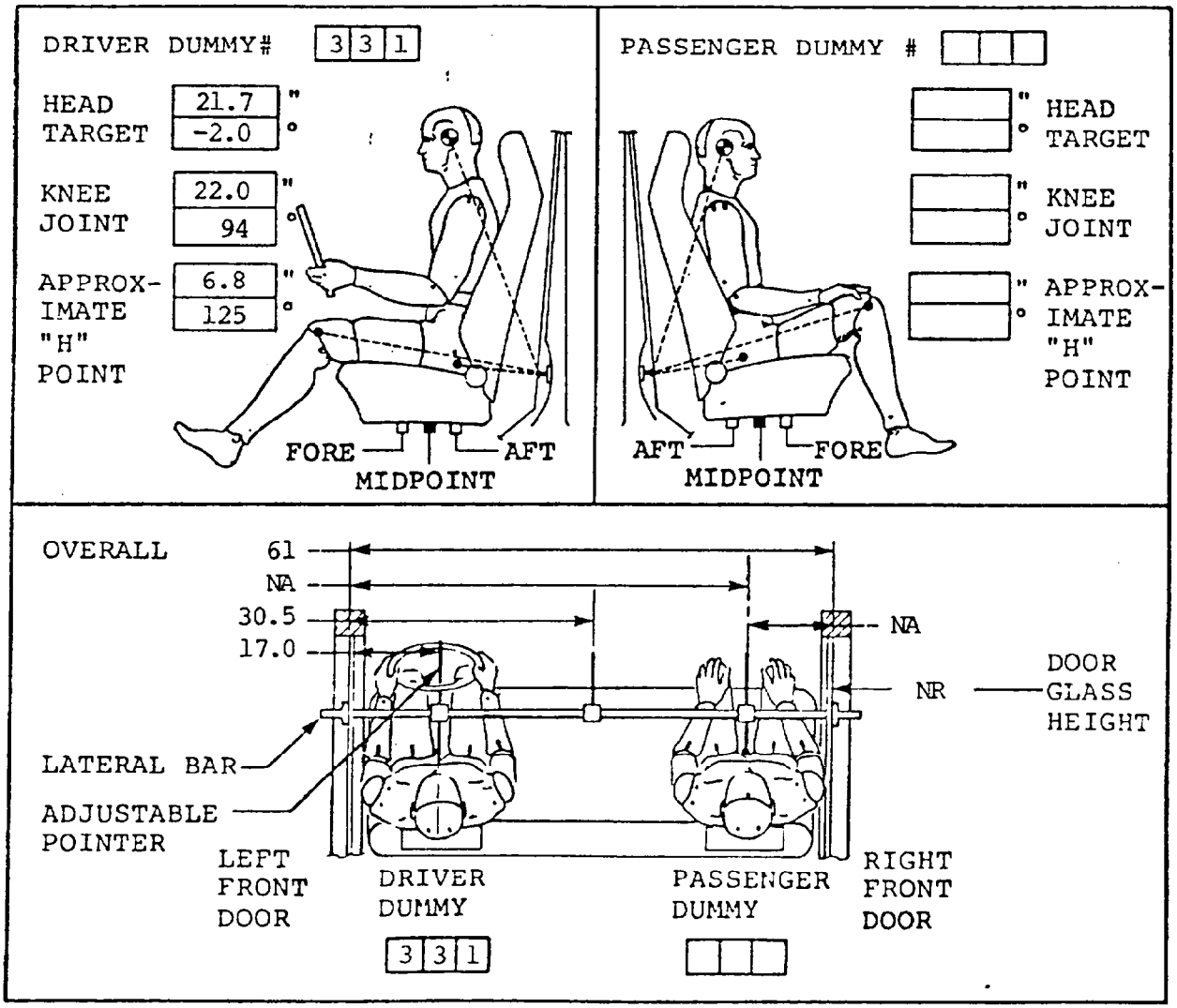
Make/Model: Dodge Diplomat
Body Style: 4-Door Sedan Model Year: 1981
NHTSA No. NA DSI No. 1408 Color: Black/White Top

DATA FROM CERTIFICATION LABEL

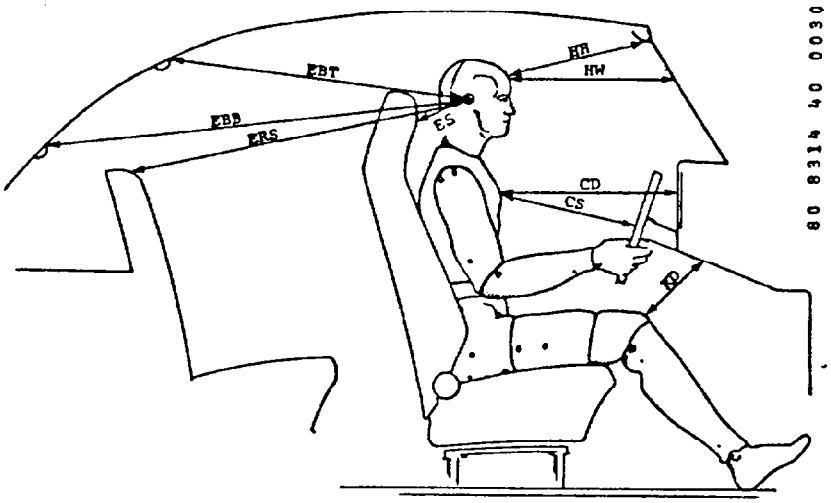
Vehicle Manufacturer: Chrysler Corporation
Date of Manufacture: 2/81 ; VIN: 1B3BM46N8BG151445
GVWR: 5250 lb; GAWR: Front = 2605 lb; Rear = 2650 lb

POST-IMPACT DATA

Type of Test: Frontal Pole Barrier (0°) Impact
Date of Test: 1/6/84 Time: 1239 Temperature 67 °F
Required Impact Velocity Range: 28.5 to 30.5 mph
Impact Velocity: Primary = 29.98 mph Secondary = NR mph
Seat Type: Bucket Adjuster Type: Electric
Bucket Seat Type Back: Low back with head rest extended
Technicians: M. Reaves, R. Garn



PART 572 DUMMY IN-VEHICLE POSITION RECORDING SHEET

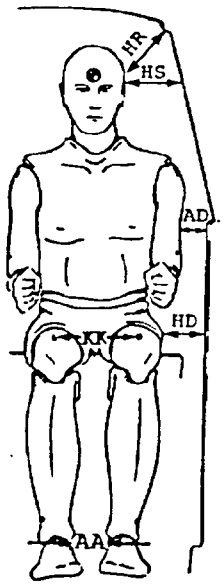


80 8314 40 00302

	Driver	Passenger
HH	14.6	
HW	20.5	
CD	20.6	
CS	11.8	
KD L	6.8	
KD R	6.0	
Torso Angle	23°	Torso Angle °
Seat Back Angle	21°	Seat Back Angle °
HSW	18.0	

HH = Head to Windshield Header
HW = Head to Windshield
CD = Chest to Dash
CS = Chest to Steering Wheel
KD = Knees to Dash
HR = Head to Side Roof
HS = Head to Side Window
AD = Arm to Door
HD = Hip to Door
KK - Knee to Knee
Torso and seat back angles are relative to vertical.

Remarks: Dummies positioned with reference to OVSC recommended procedure for positioning Part 572 dummies in test vehicle.



80 8314 40 00303

	Driver	Passenger
HR	6.8	
HS	8.9	
AD	3.7	
HD	4.8	
KK	10.5	
AA	11.0	

SUMMARY OF VEHICLE ACCELEROMETER DATA

Vehicle: 1981 Dodge Diplomat 4-Door Test Date: 1/6/84

Test No.: 3154-6 Pole Impact Test Speed: 29.98 mph

Accelerometer		Maximum Acceleration				
No.	Location	Scale	+A (g)	T (msec)	-A (g)	T (msec)
1X	Left front air bag sensor	±250g	81.3	12.0	171.4	67.8
1Y	Left front air bag sensor	±250g	207.7	62.8	120.2	69.6
2X	Right front air bag sensor	±250g	119.8	36.0	103.8	23.0
2Y	Right front air bag sensor	±250g	103.1	14.9	134.3	74.3
3X	Diagnostic module	±250g	37.8	94.1	70.5	65.3
4X	Driver side B-pillar	±250g	13.6	11.3	33.8	74.4
		ΔV = 30.29 mph @ 155 msec				

Positive Direction: X = Forward, Y = Rightward, Z = Downward

FMVSS 208 DUMMY DATA SUMMARY

	Driver Dummy				Passenger Dummy			
	Positive Direction*		Negative Direction**		Positive Direction*		Negative Direction**	
	Peak (G)	Time (msec)	Peak (G)	Time (msec)	Peak (G)	Time (msec)	Peak (G)	Time (msec)
Head Acceleration								
Longitudinal	13.5	170.0	77.2	113.6				
Lateral	7.9	121.5	6.9	242.3				
Vertical	39.9	109.0	15.7	143.4				
Resultant	80.3	113.6	-	-				
HIC	991 between 99.1 and 128.2 msec							
Chest Acceleration								
Longitudinal	9.2	206.3	64.5	106.5				
Lateral	6.5	21.5	4.9	31.1				
Vertical	14.3	102.9	14.3	139.6				
Resultant (Max)	64.9	105.3	-	-				
Resultant (clip)	63.0	-	-	-				
TIME > 60 G	4.125 msec							
SEVERITY INDEX	585.73 @ 320 msec							
	Peak (lb)	Time (msec)	Peak (lb)	Time (msec)	Peak (lb)	Time (msec)	Peak (lb)	Time (msec)
Femur Loads								
Left	251.8	82.0	1660.5	99.0				
Right	392.6	73.0	2354.0	90.5				
Belt Loads								
Lap	Not instrumented							
Torso								

Vehicle Impact Speed (mph): 29.98

ΔV = 30.29 mph

*Longitudinal:	Forward	**Longitudinal:	Rearward
Lateral:	Rightward	Lateral:	Leftward
Vertical:	Downward	Vertical:	Upward

FMVSS 208 DUMMY DATA SUMMARY

	Driver Dummy				Passenger Dummy			
	Positive Direction*		Negative Direction**		Positive Direction*		Negative Direction**	
	Peak (G)	Time (msec)	Peak (G)	Time (msec)	Peak (G)	Time (msec)	Peak (G)	Time (msec)
Head Acceleration								
Longitudinal	13.5	170.0	77.2	113.6				
Lateral	7.9	121.5	6.9	242.3				
Vertical	39.9	109.0	15.7	143.4				
Resultant 80.3 → 74.6		113.8	-	-				
HIC 991 → 950 between 99.1 and 128.2 msec ?								
Chest Acceleration								
Longitudinal	9.2	206.3	64.5	106.5				
Lateral	6.5	21.5	4.9	31.1				
Vertical	14.3	102.9	14.3	139.6				
Resultant (Max) 64.9 → 61.2		105.5	-	-				
Resultant (clip) 63.0 → 58.7		-	-	-				
TIME > 60 G 4.1 → 2.6 msec								
SEVERITY INDEX	585.73 @ 320 msec							
	Peak (lb)	Time (msec)	Peak (lb)	Time (msec)	Peak (lb)	Time (msec)	Peak (lb)	Time (msec)
Femur Loads								
Left	251.8	82.0	1660.5	99.0				
Right	392.6	73.0	2354.0	90.5				
Belt Loads								
Lap	Not instrumented							
Torso								

Vehicle Impact Speed (mph): 29.98
ΔV = 30.29 mph

*Longitudinal:	Forward	**Longitudinal:	Rearward
Lateral:	Rightward	Lateral:	Leftward
Vertical:	Downward	Vertical:	Upward

CAMERA LOCATIONS

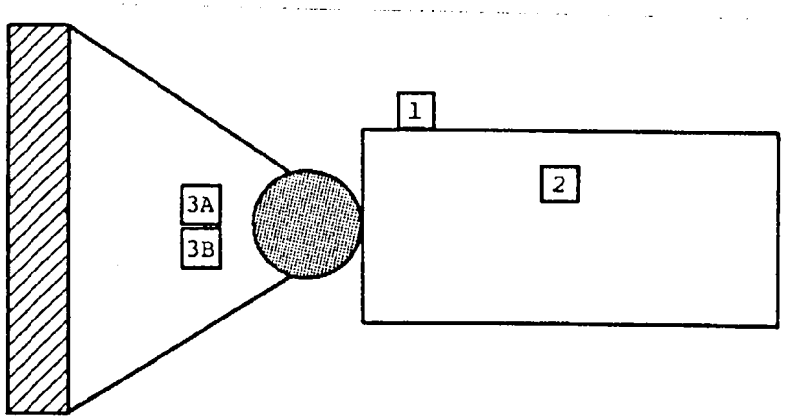
Test No: 3154-6 **Test Date:** 1-6-84

Test Type: 0° Frontal Pole Barrier

Vehicle A (Away): 1981 Dodge Diplomat 4-Door

Vehicle B (Barrier):

Comments: Air bag retrofit test



CAMERA	YES
STILLS	
SLIDES	
MOVIE	
POLAROID	
VIDEO	

CAMERA SYMBOLS

- ⊙ PIT
- ↑ GROUND
- △ BARRIER
- ⊠ OVERHEAD
- □ ON-BOARD

FRAME RATE

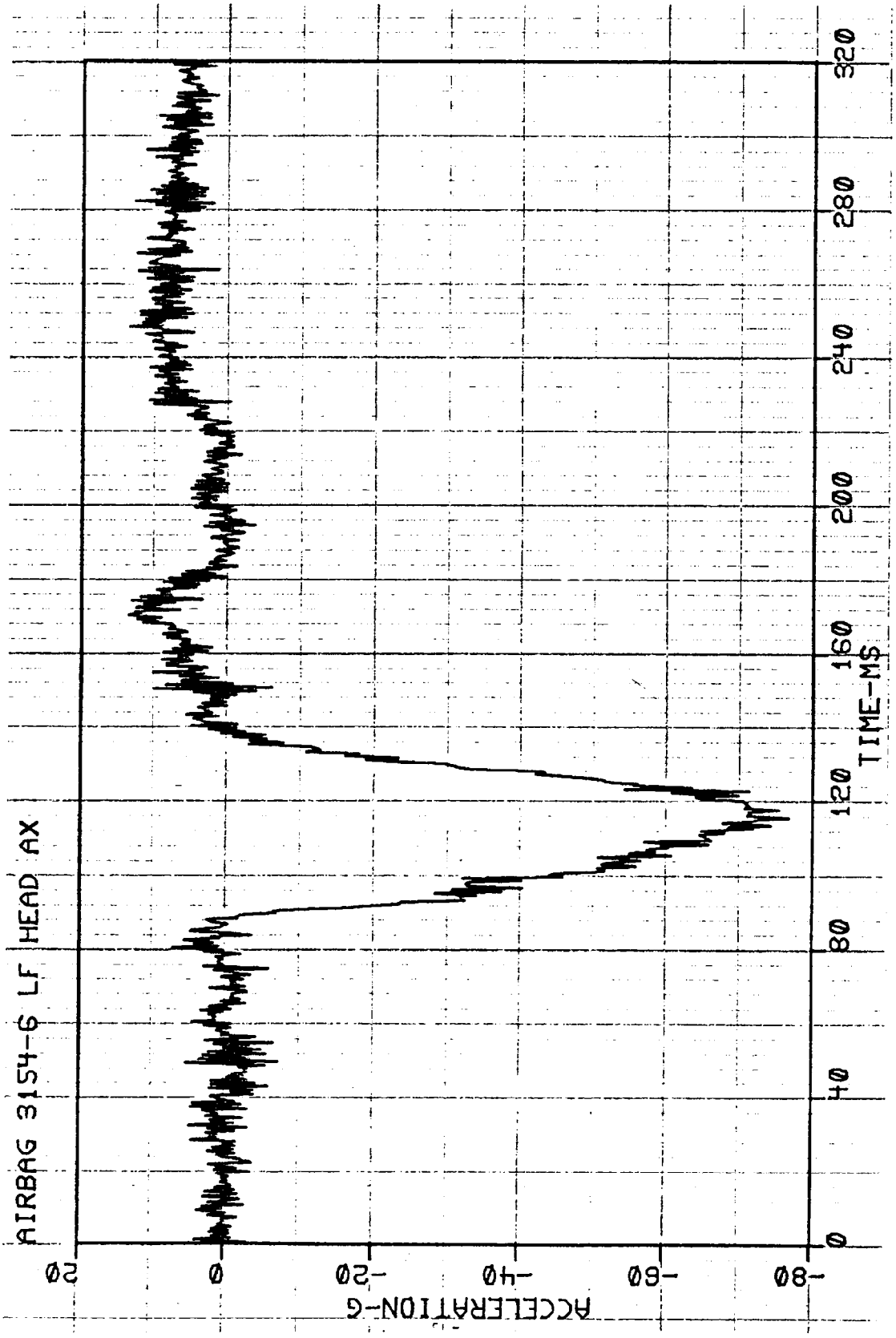
1. 1000 fr/sec
2. 200 fr/sec
3. Other 24 fr/sec
4. 400 fr/sec
5. 500 fr/sec

TIMING LIGHT, SPEED

1. 100 Hz (10 msec/light)
2. 200 Hz (5 msec/light)
3. Other

Loc. No.	Location	Field of View	Lens Size	Frm Rate	Tmng Spd	Ser No	Impact Dist-X	C.L. Dist-Y	CAM Hght-Z
1	Rt side pass. door	Steering wheel hub and driver	8	5	1	PS6	NR	NR	NR
2	Vehicle roof	Over shoulder of driver	8	5	1	PS11	NR	NR	NR
3A	Barrier overhead	Windshield and driver	12.5	5	1	M7	1.0'	1.5'	96"
3B	Barrier redundant	Windshield and driver	13	5	1	PS8	0.5'	1.0'	96"
4A	Lt side oblique	Left side of vehicle and driver	25	5	1	M3	-8.0'	18.5'	44"
4B	Lt side oblique	Left side of vehicle and driver	50	5	1	PS5	-8.0'	19.0'	44"
5A	Lt side overall	Barrier and vehicle	40	5	1	M9	6.0'	32.0'	44"
5B	Lt side overall	Barrier and vehicle	13	5	1	PS7	6.0'	32.0'	44"
6	Left side	Panning	17.5	3	-	-	5.5	33.0'	48"

APPENDIX A
CALCOMP PLOTS OF ELECTRONIC DATA


AIRBAG 3154-6 LF HEAD AX
ACCELERATION-G
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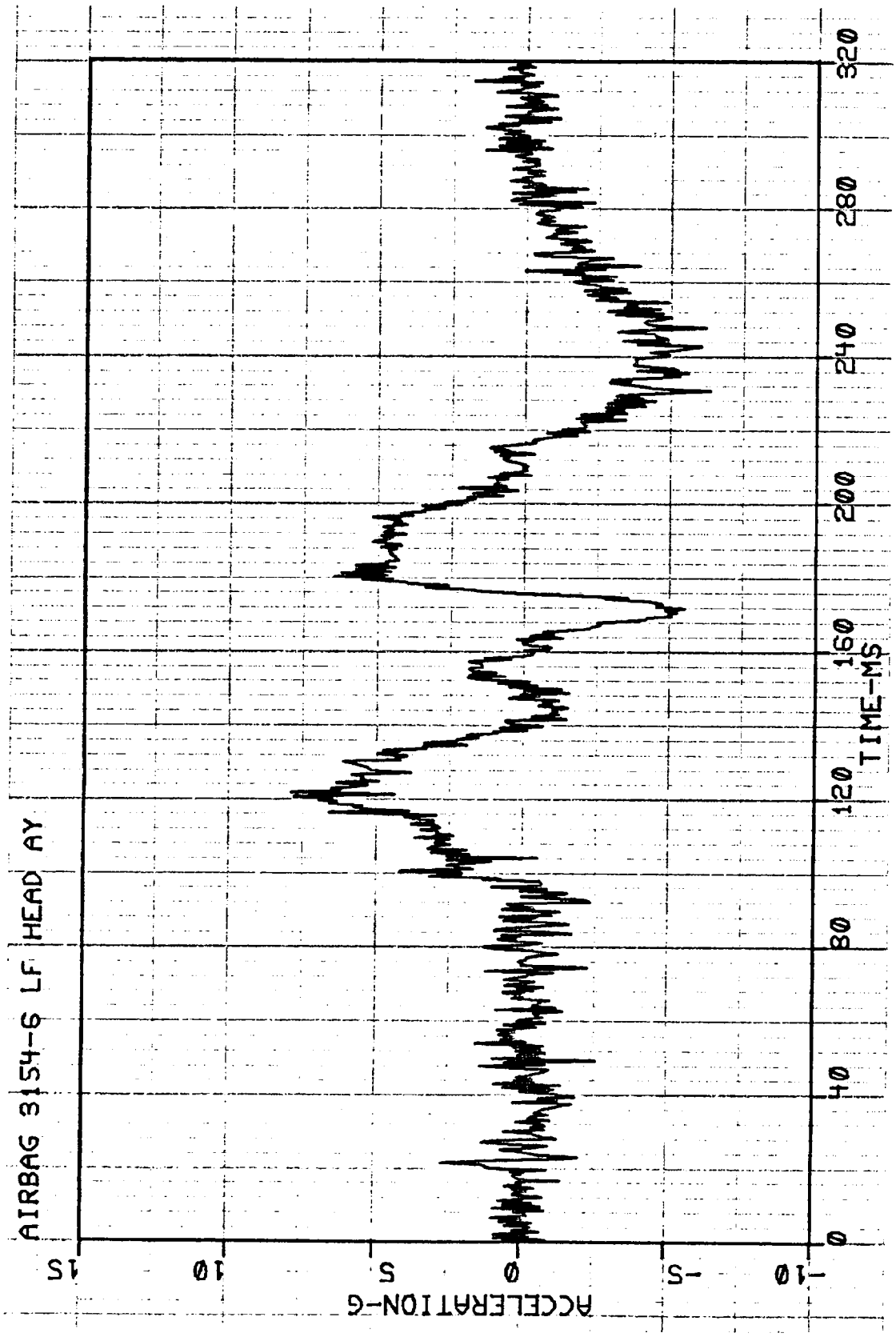
0
-20
-40
-60
-80
0
40
80
120
160
200
240
280
320
TIME-MS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ACCELERATION-G
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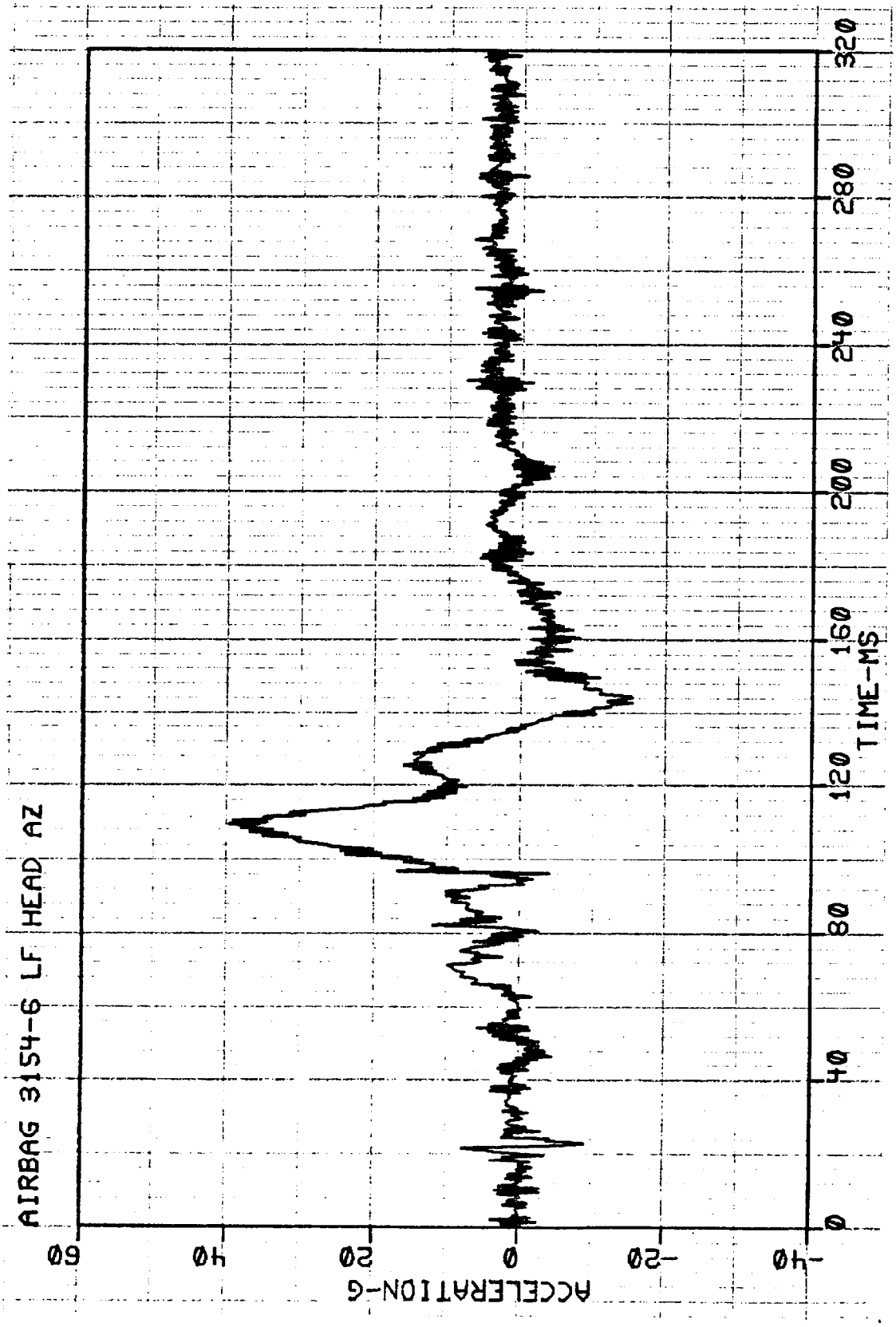
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ACCELERATION-G
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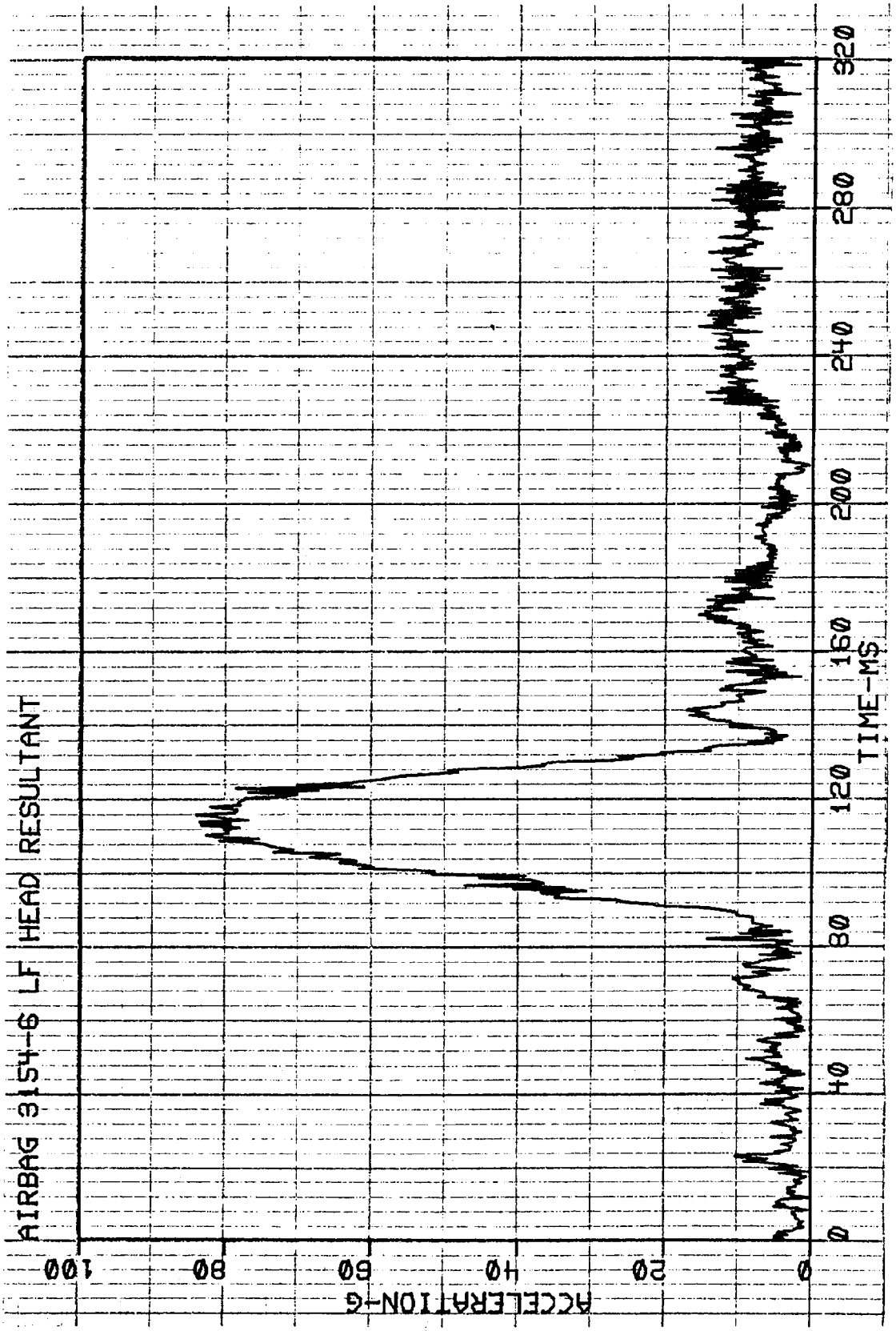
280
320
TIME-MS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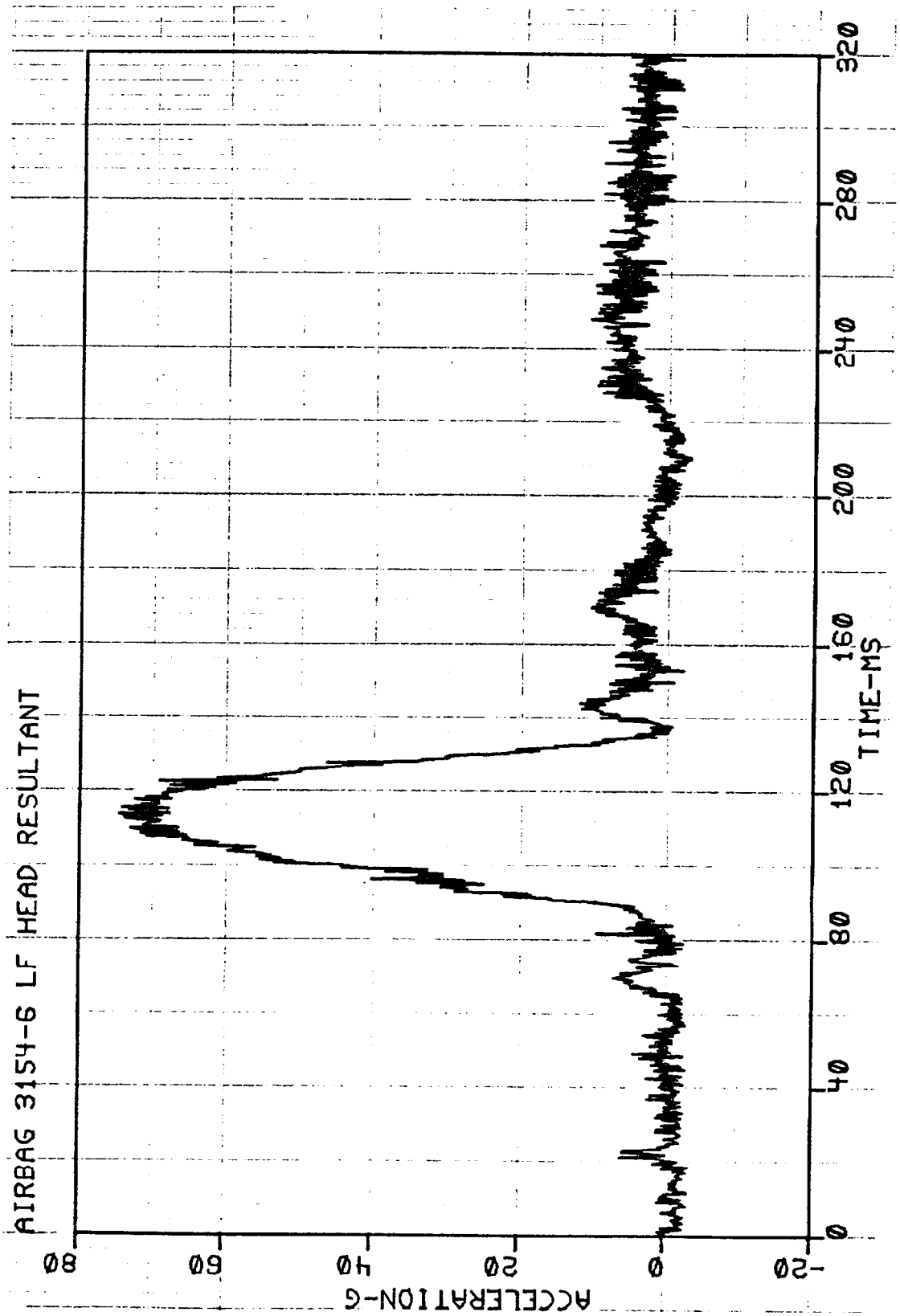
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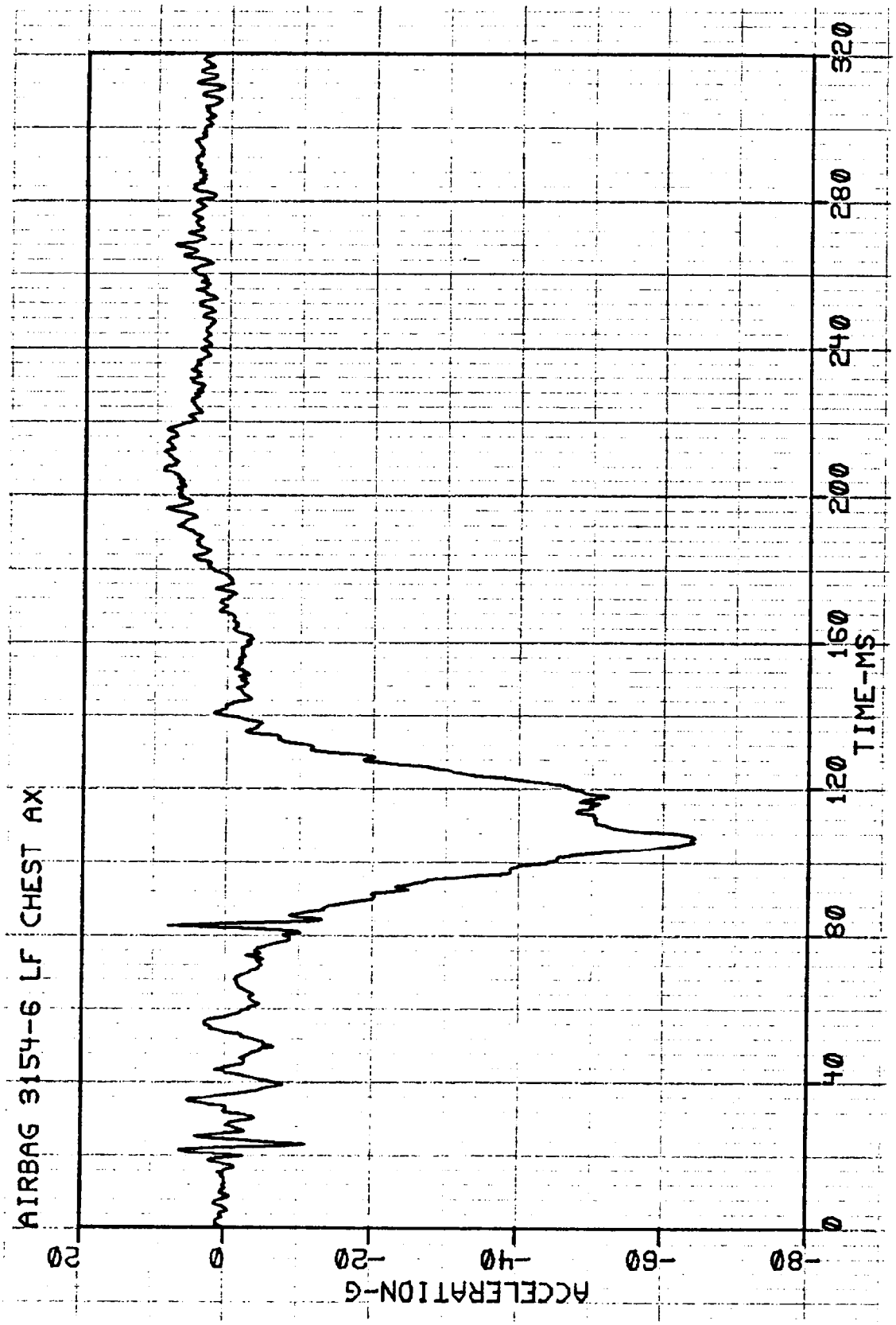
280
320
TIME-MS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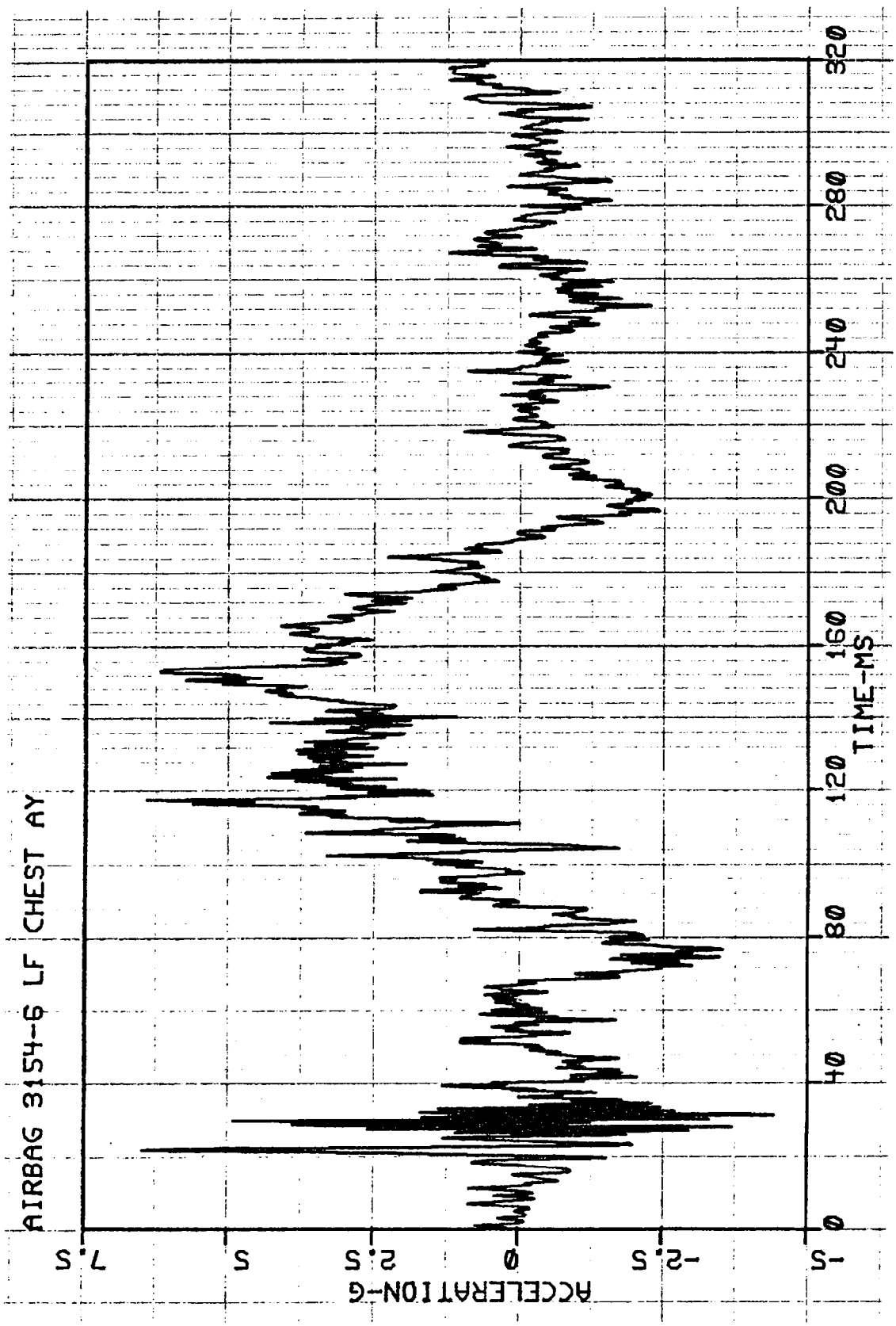
AIRBAG 3154-6 LF CHEST AY
ACCELERATION-G
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7.5
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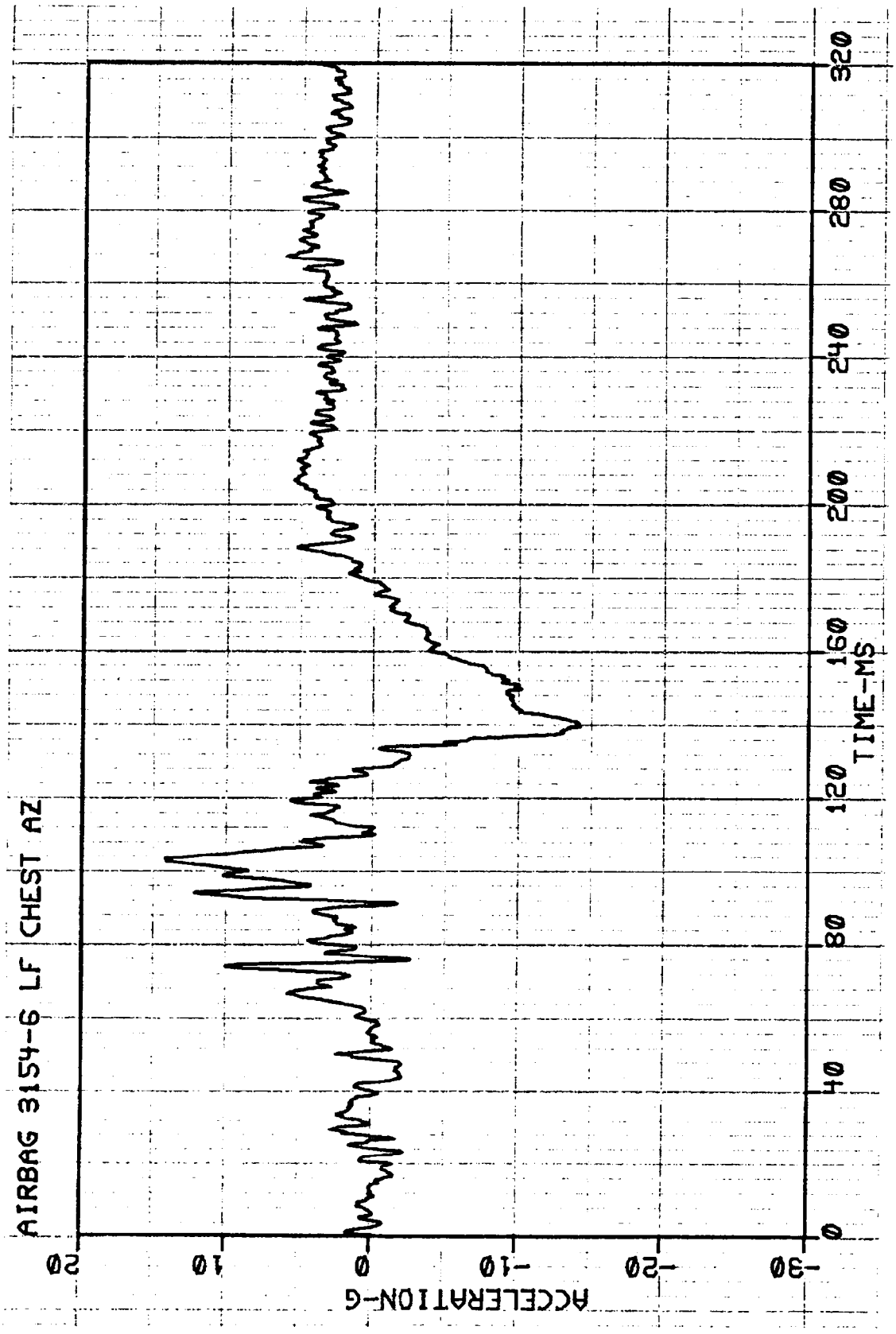
TIME-MS


AIRBAG 3154-6 LF CHEST AZ
ACCELERATION-G
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TIME-MS
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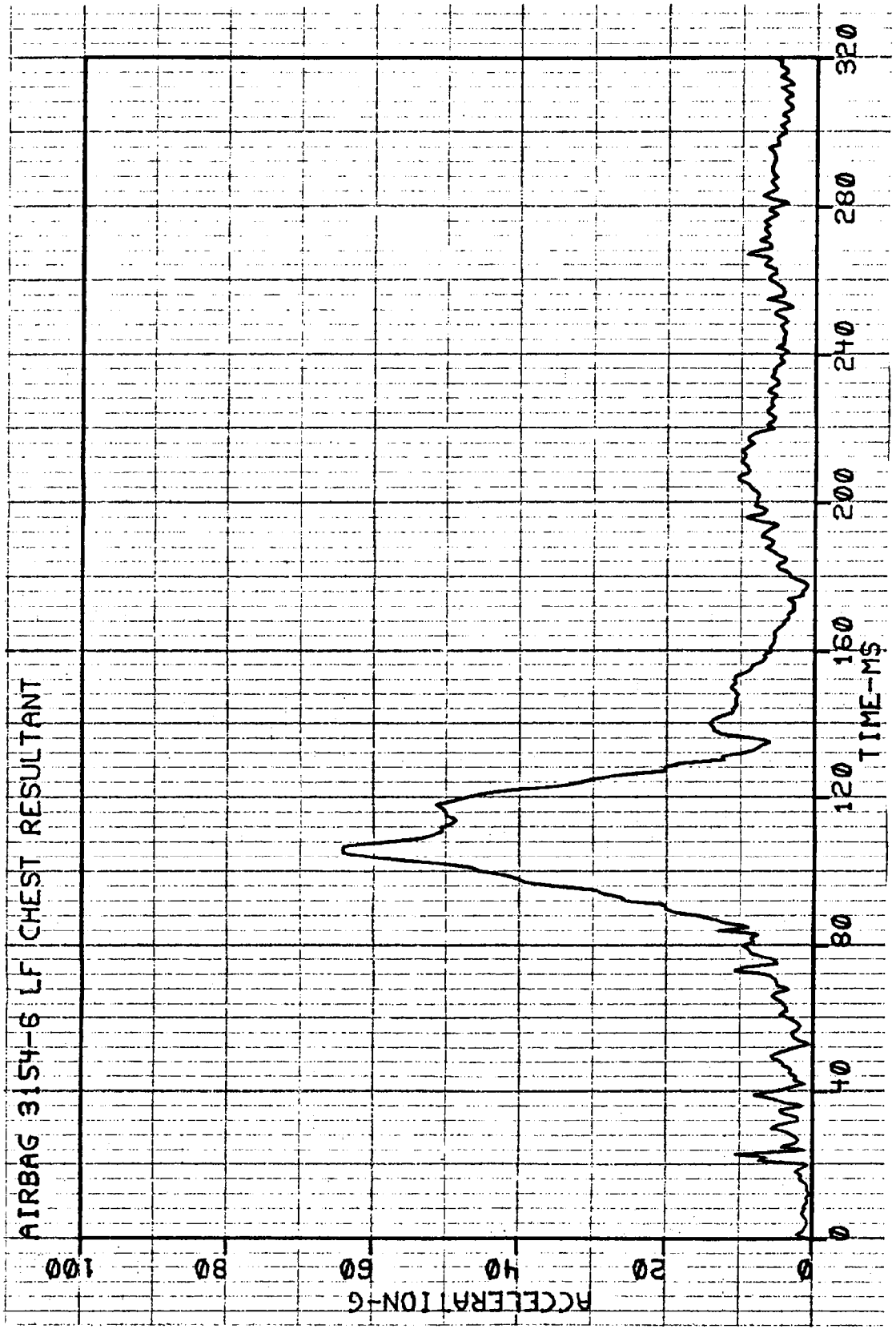
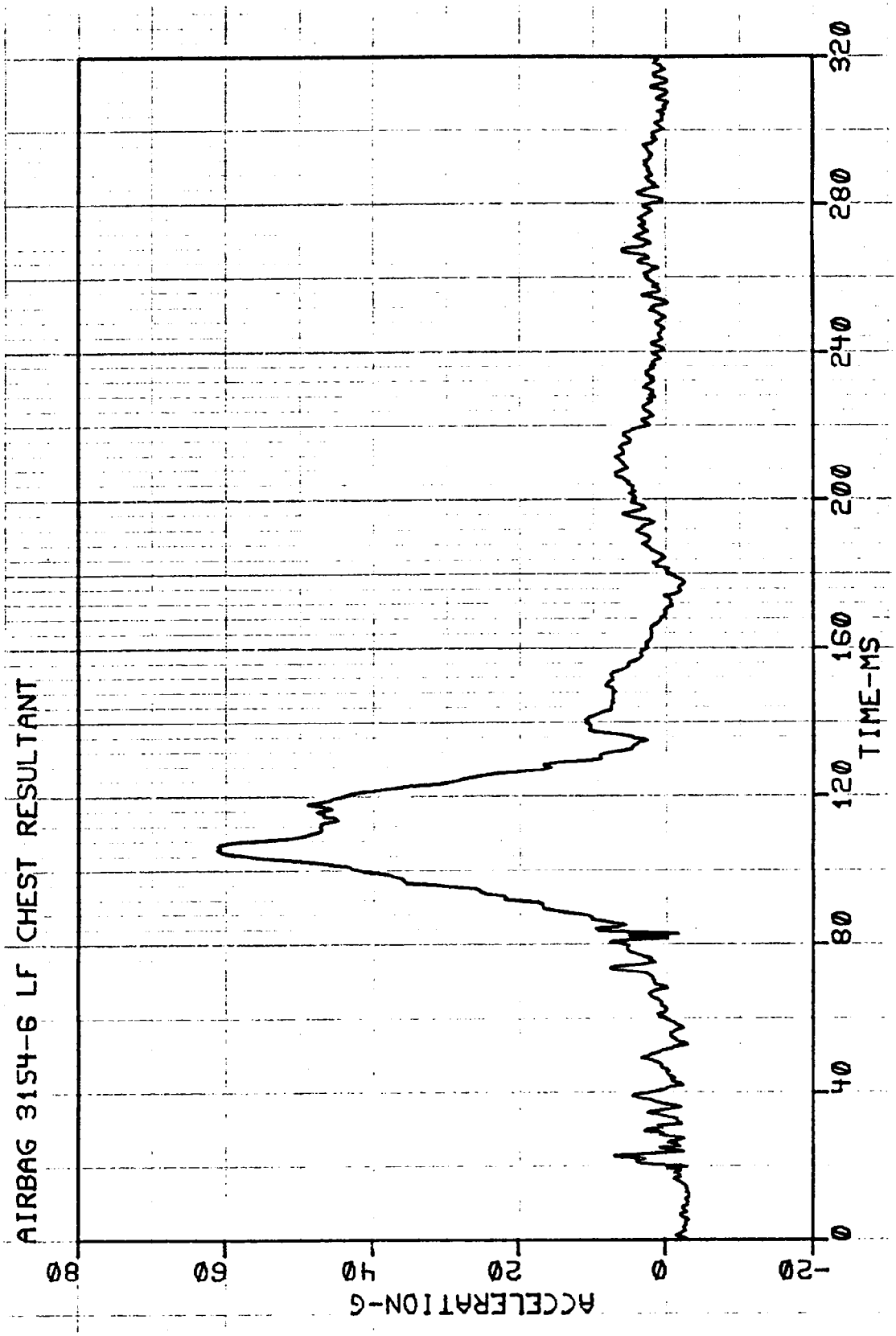
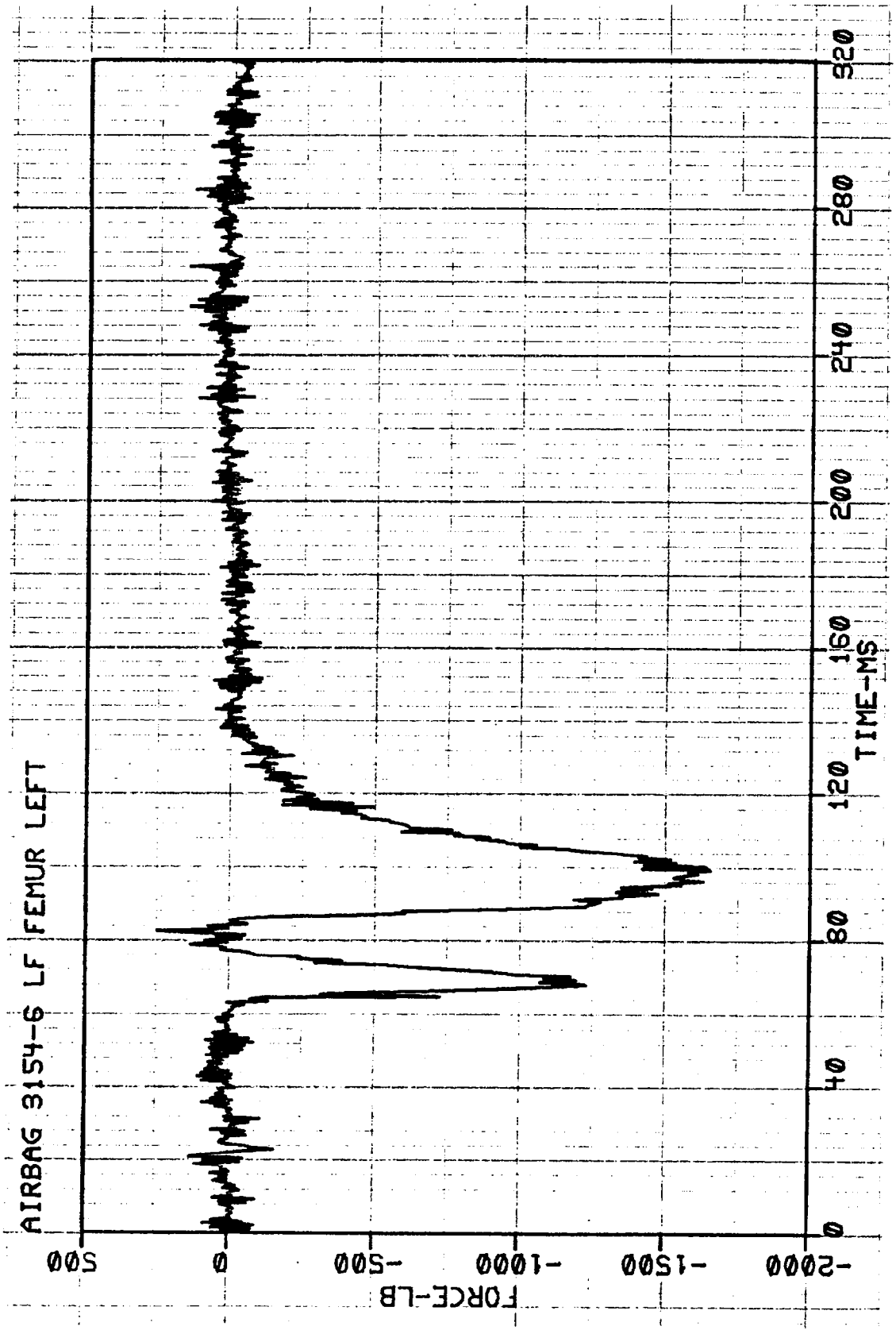
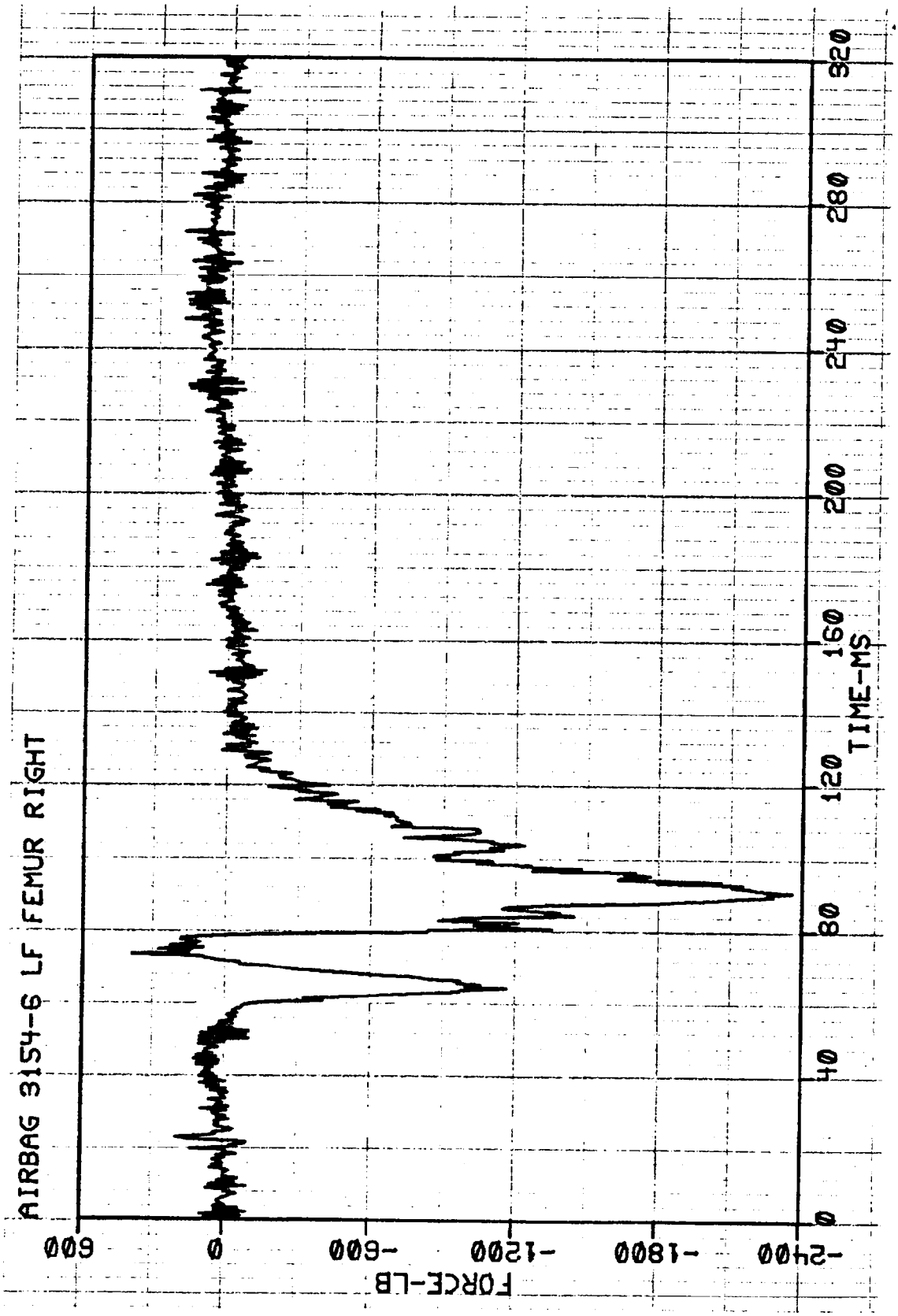
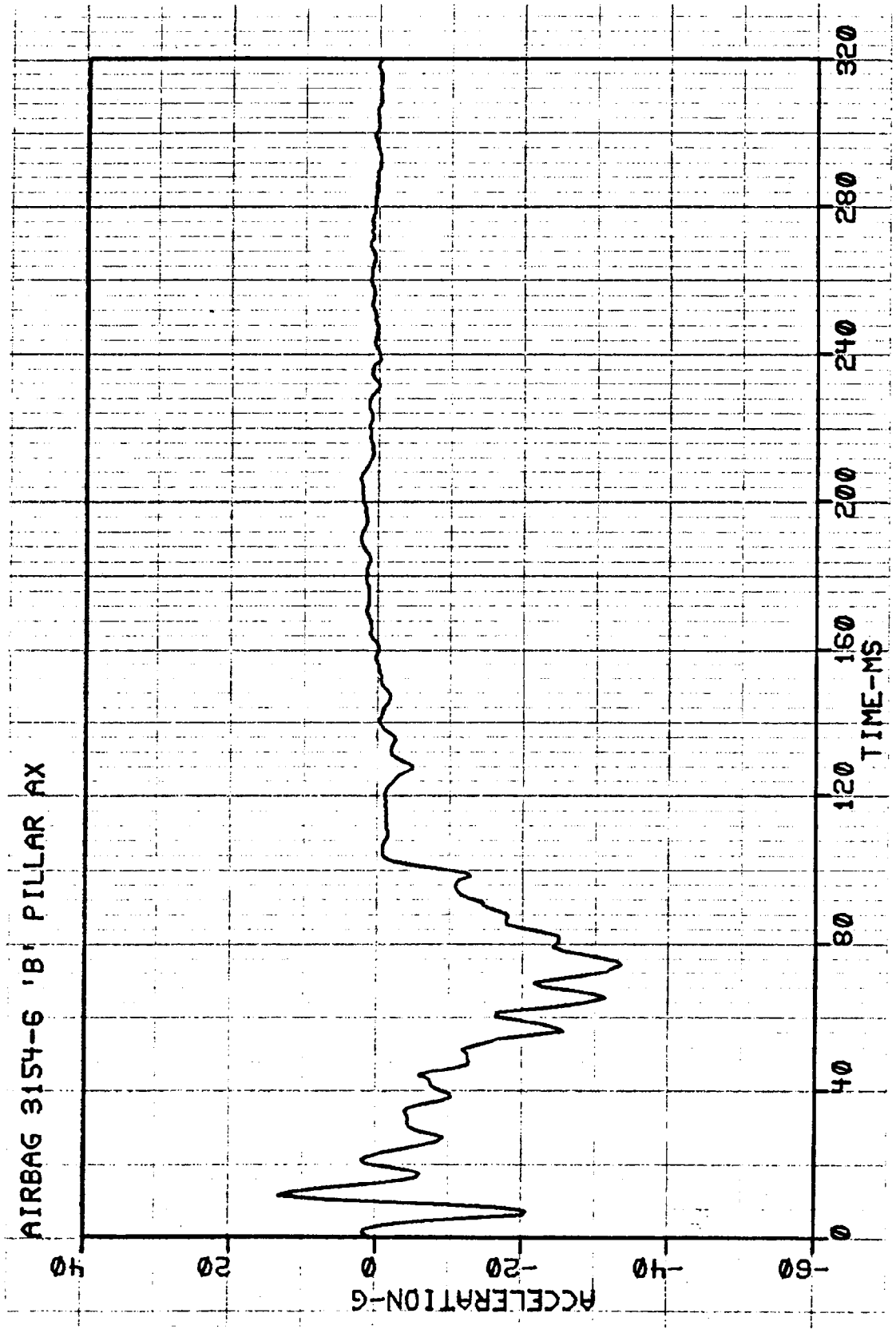
240
280
320

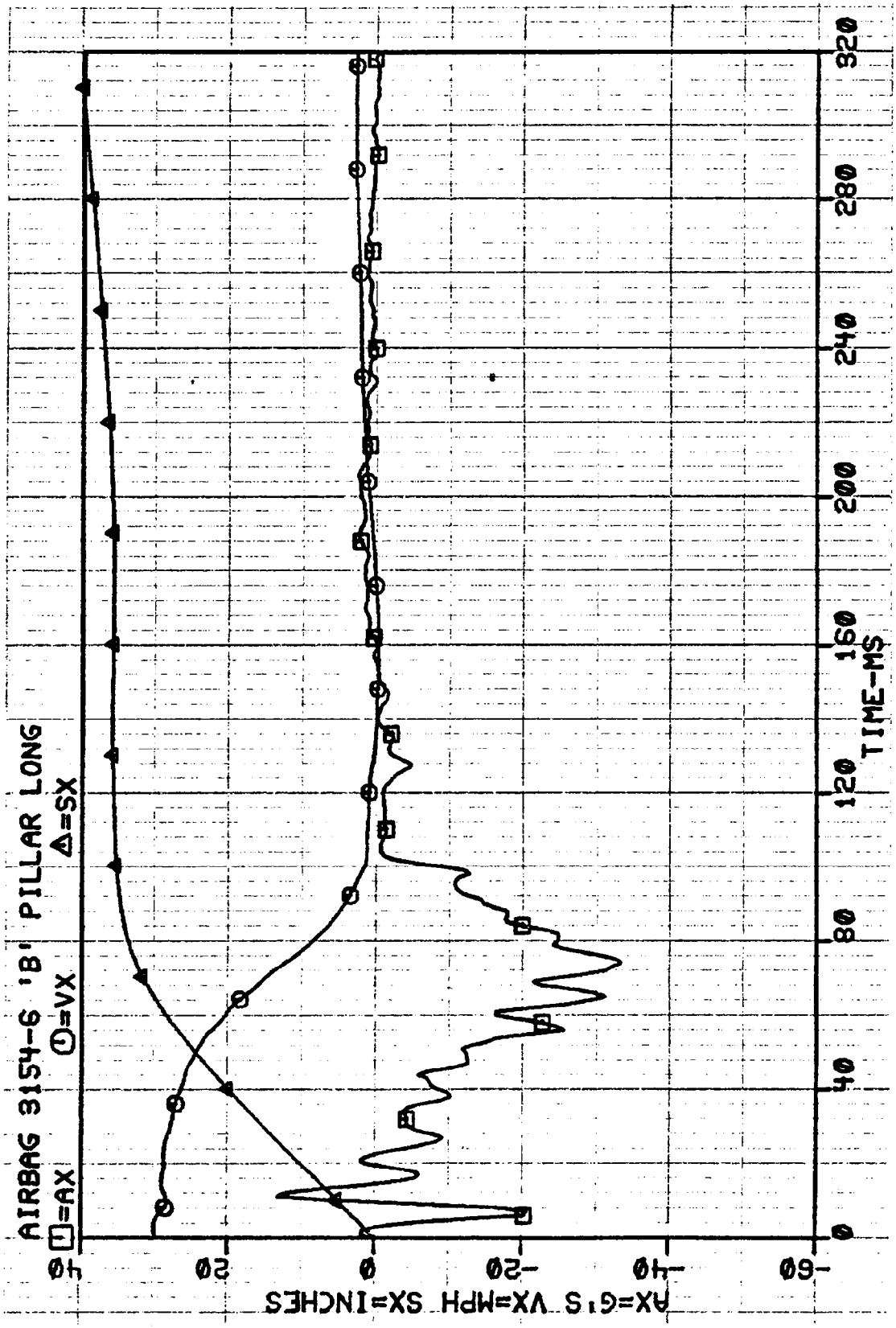

AIRBAG 3154-6 LF CHEST RESULTANT
ACCELERATION-G
0
20
40
60
80
100
TIME-MS
0
40
80
120
160
200
240
280
320

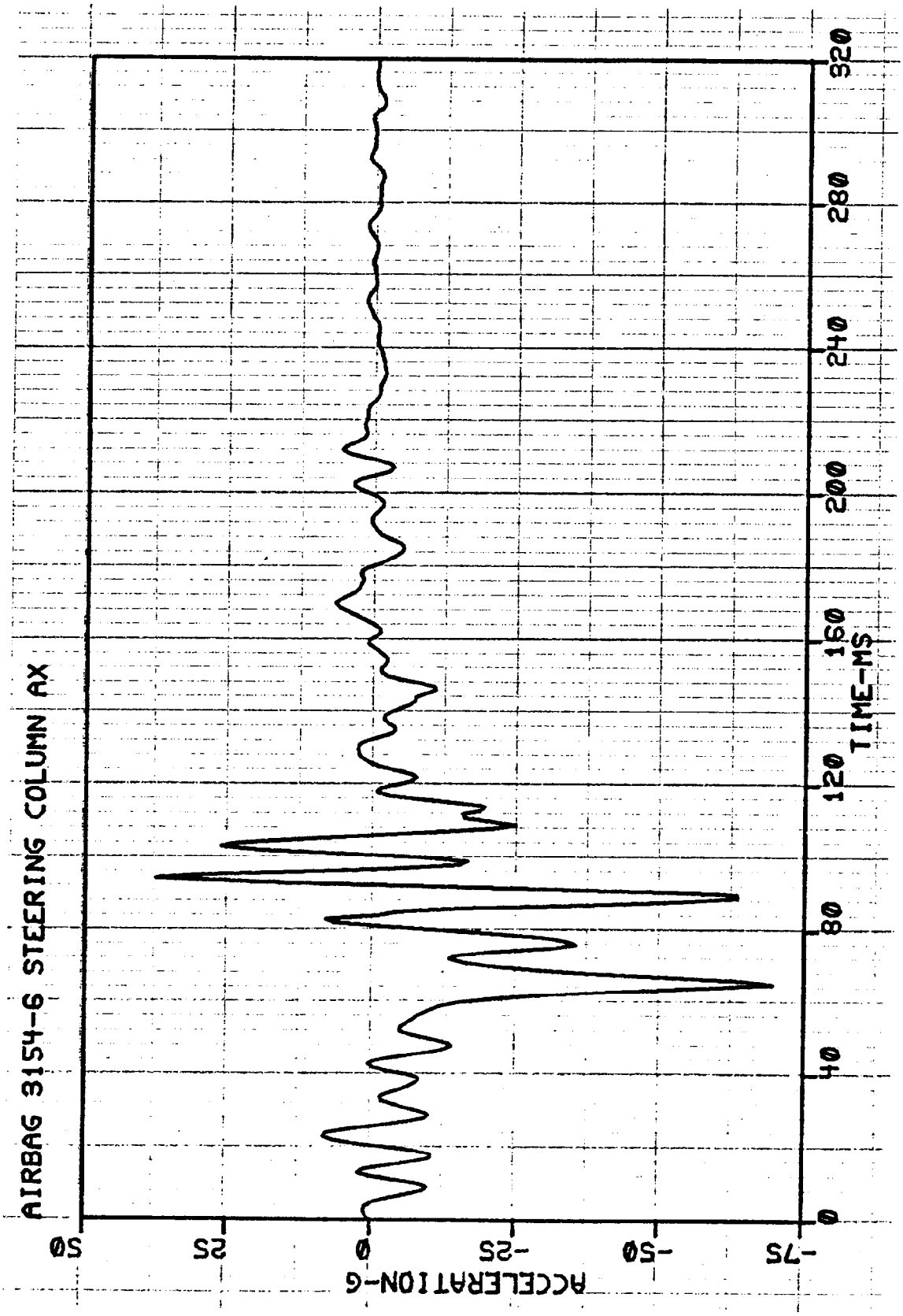

AIRBAG 3154-6 LF CHEST RESULTANT
ACCELERATION-G
80
60
40
20
0
-20
TIME-MS
0
40
80
120
160
200
240
280
320

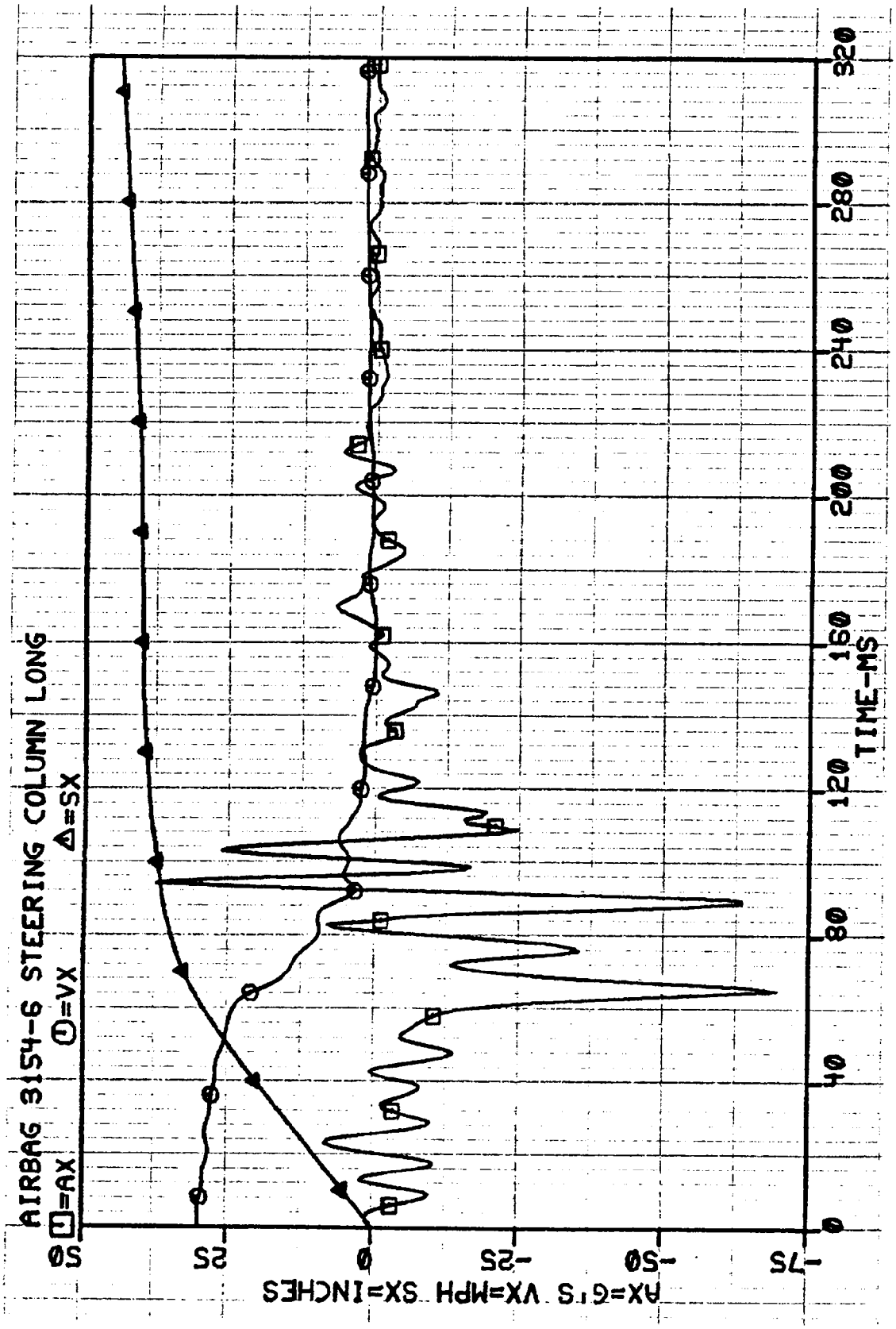

AIRBAG 3154-6 LF FEMUR LEFT
FORCE-LB
500
0
-500
-1000
-1500
-2000
TIME-MS
0
40
80
120
160
200
240
280
320

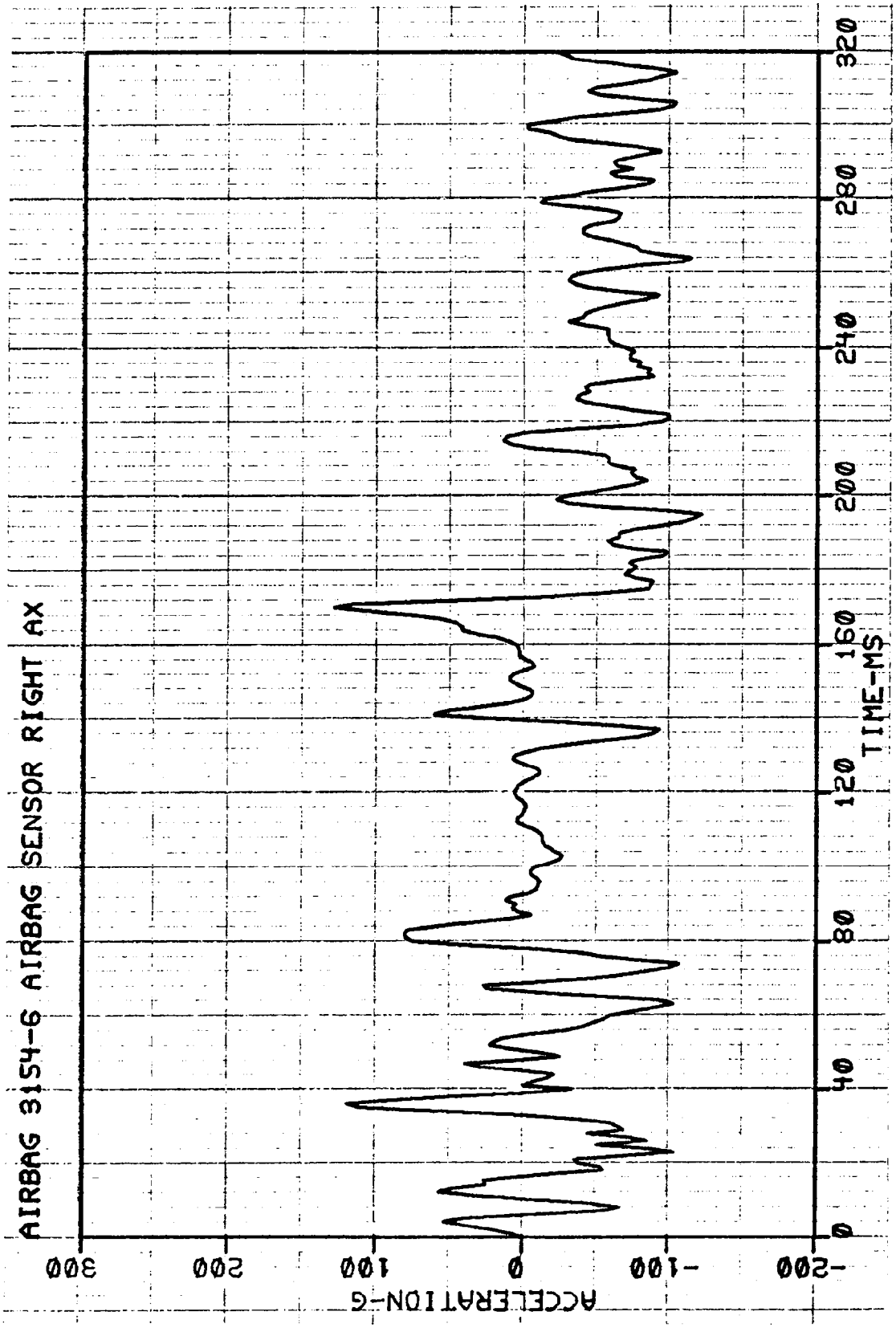

AIRBAG 3154-6 LF FEMUR RIGHT
FORCE-LB
600
0
-600
-1200
-1800
-2400
TIME-MS
0
40
80
120
160
200
240
280
320

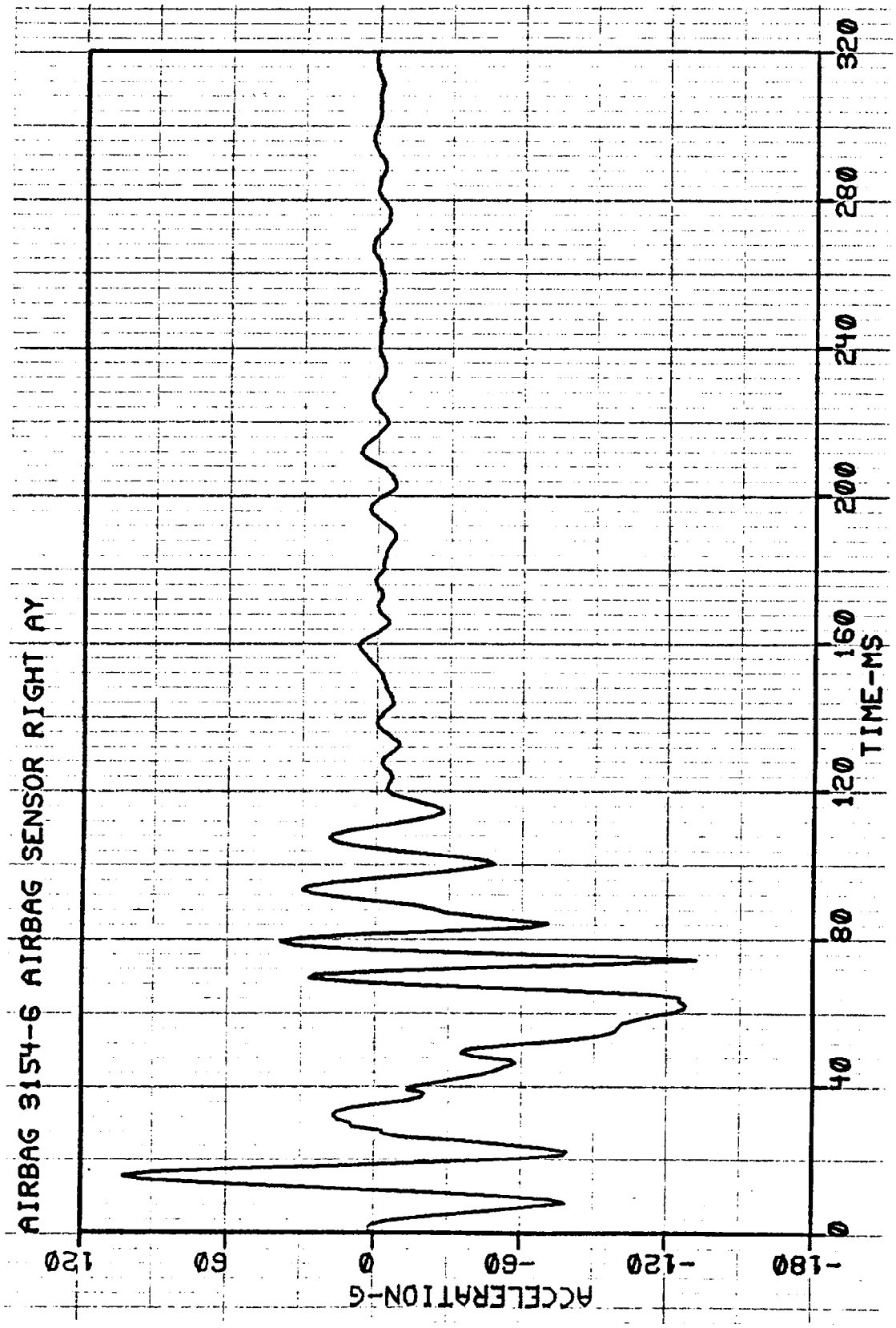

AIRBAG 3154-6 'B' PILLAR AX
ACCELERATION-G
TIME-MS
40
20
0
-20
-40
-60
0
40
80
120
160
200
240
280
320

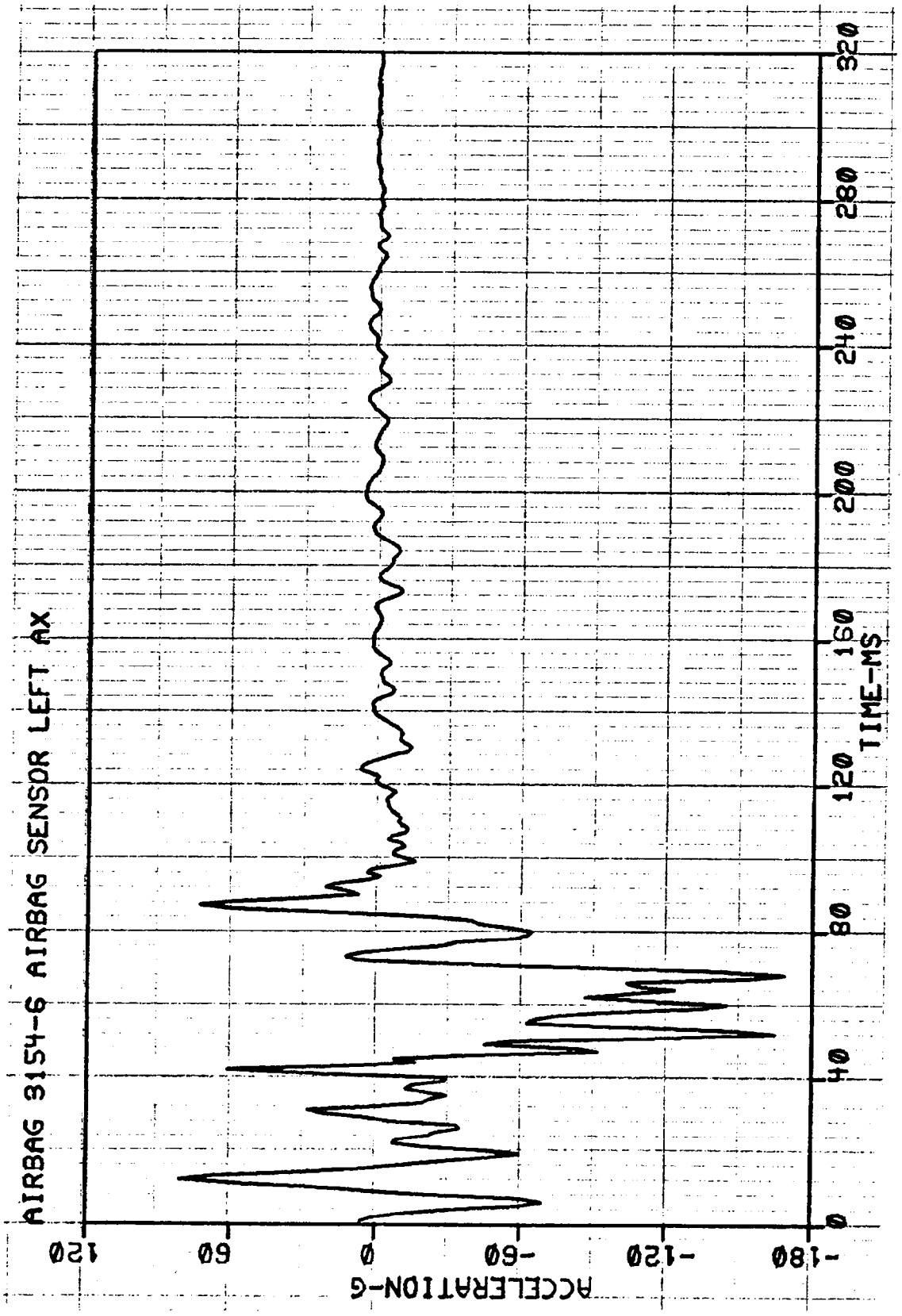

AIRBAG 3154-6 'B' PILLAR LONG
□=AX
○=VX
Δ=SX
AX=G'S VX=MPH SX=INCHES
TIME-MS
40
20
0
-20
-40
-60
0
40
80
120
160
200
240
280
320

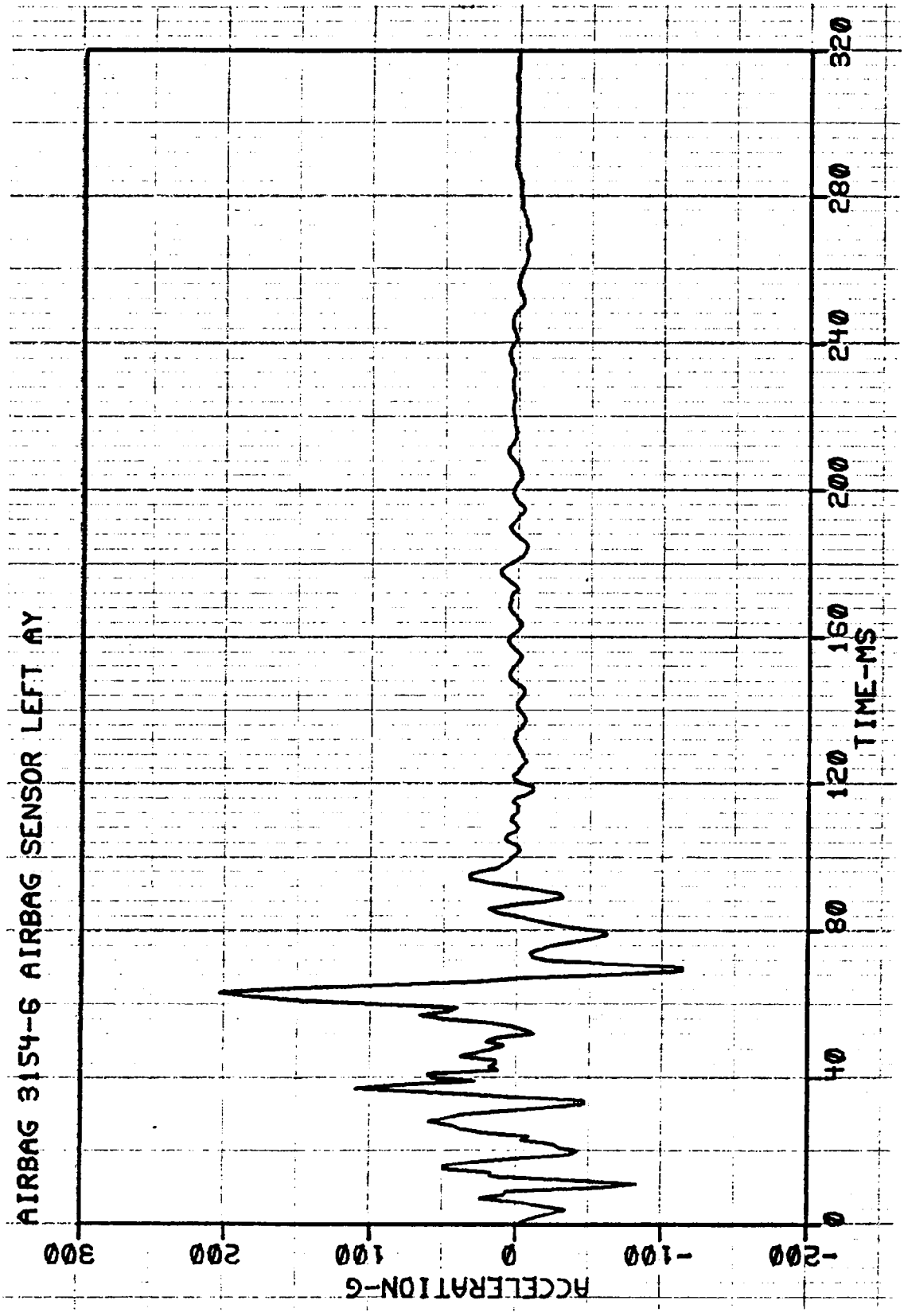

AIRBAG 3154-6 STEERING COLUMN AX
ACCELERATION-G
50
25
0
-25
-50
-75
TIME-MS
0
40
80
120
160
200
240
280
320

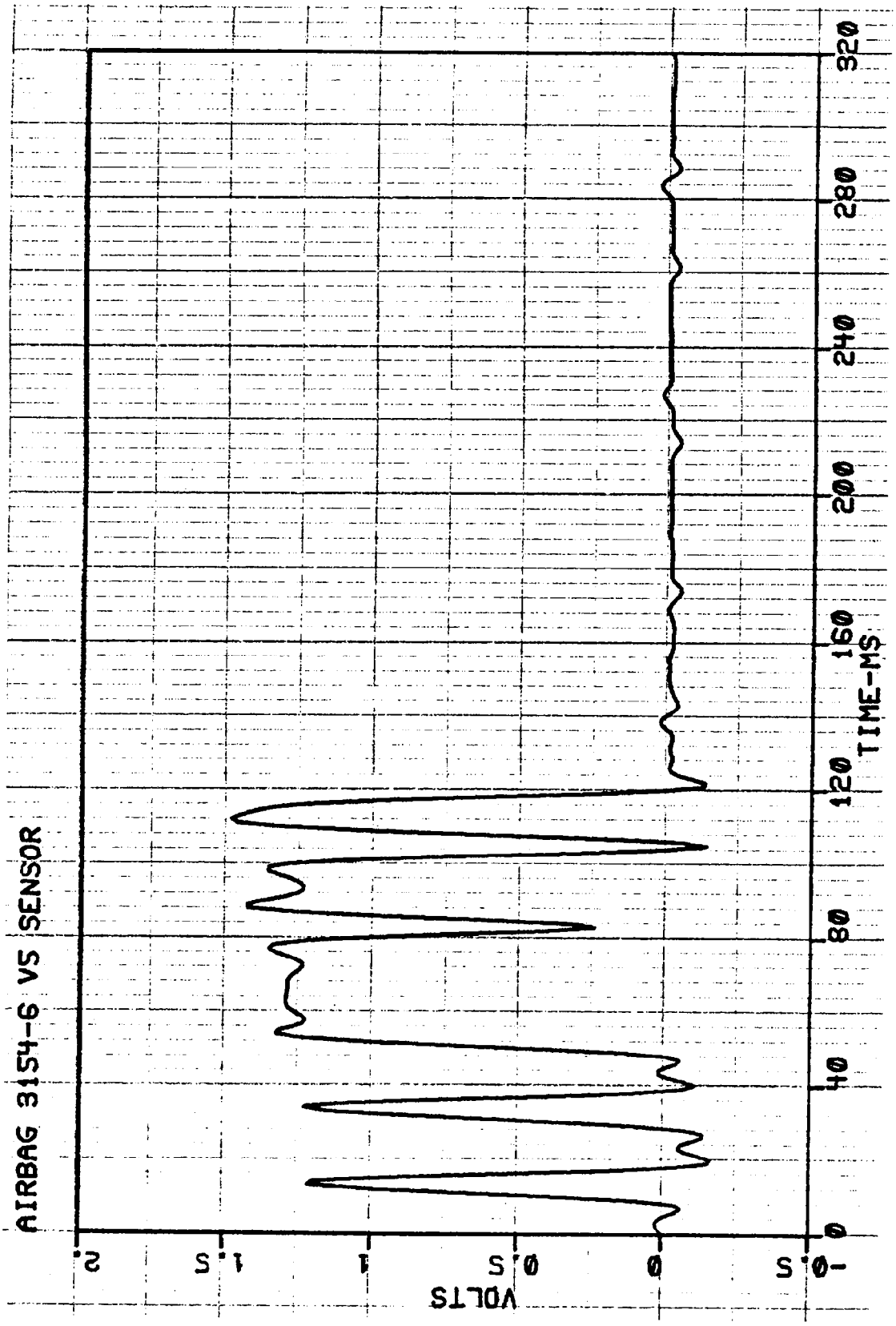

AIRBAG 3154-6 STEERING COLUMN LONG
□=AX
○=VX
Δ=SX
AX=G'S VX=MPH SX=INCHES
TIME-MS
75
50
25
0
-25
-50
-75
0
40
80
120
160
200
240
280
320

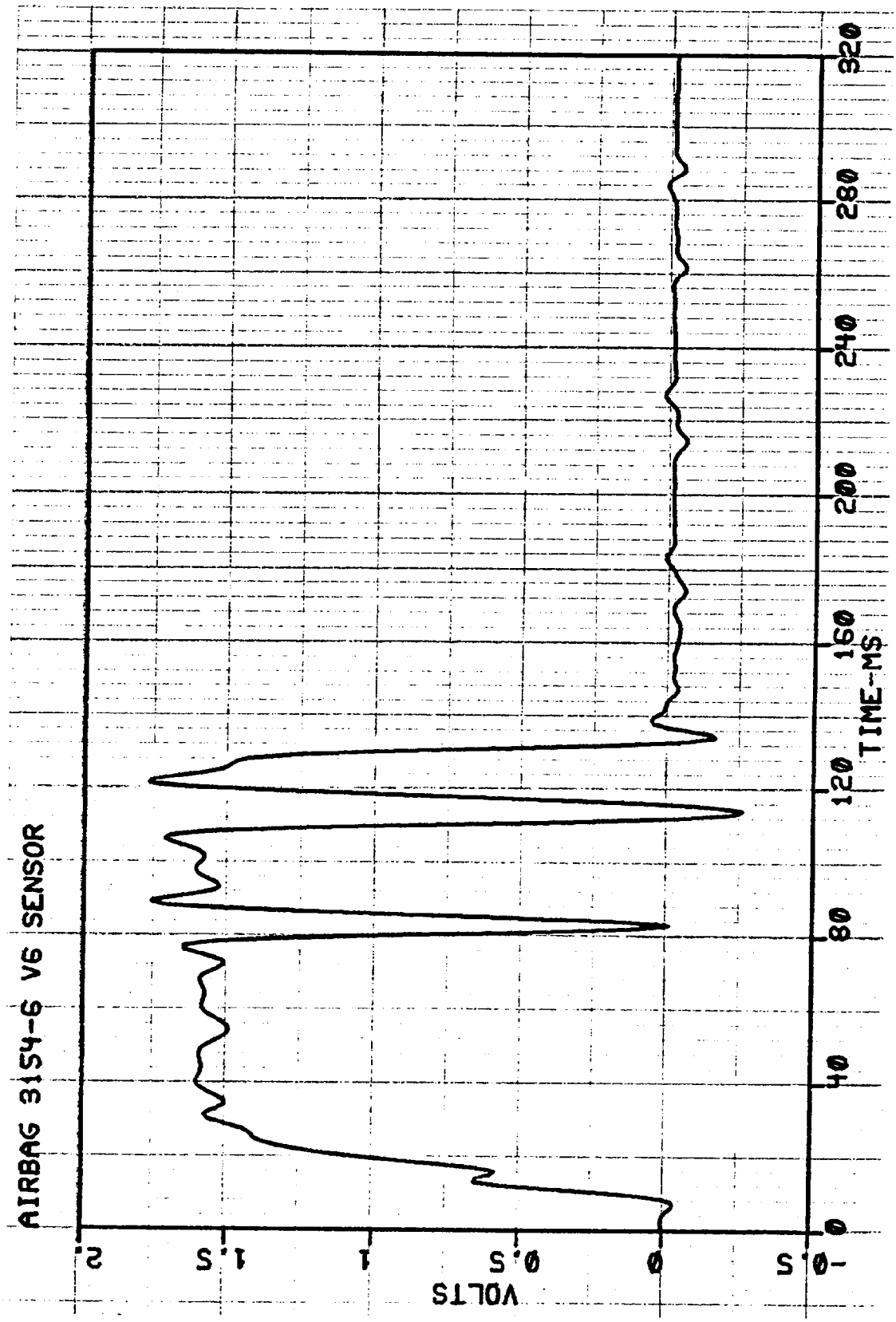

AIRBAG 3154-6 AIRBAG SENSOR RIGHT AX
ACCELERATION-G
300
200
100
0
-100
-200
TIME-MS
0
40
80
120
160
200
240
280
320

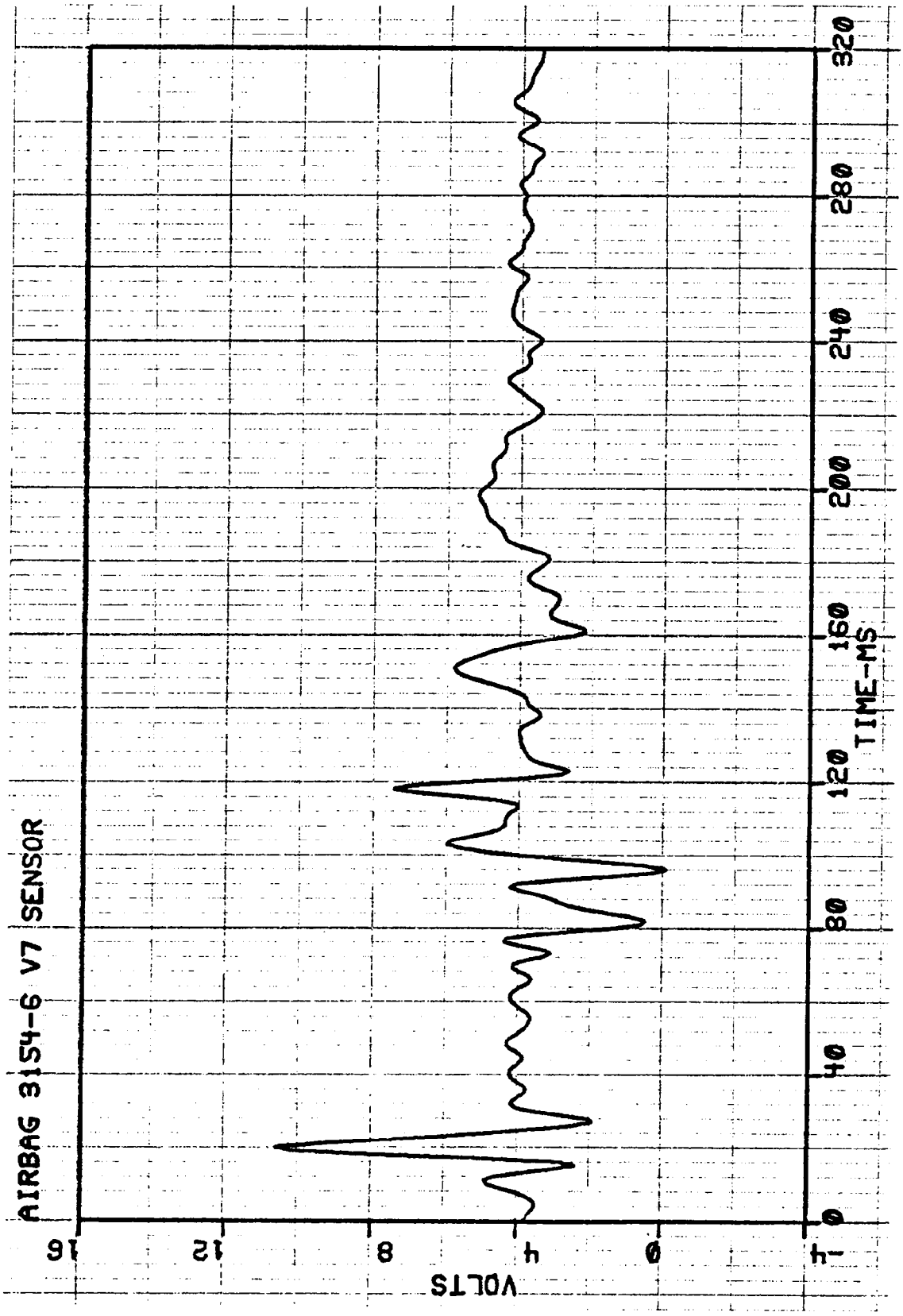

AIRBAG 3154-6 AIRBAG SENSOR RIGHT AY
ACCELERATION-G
120
60
0
-60
-120
-180
0
40
80
120
160
200
240
280
320
TIME-MS

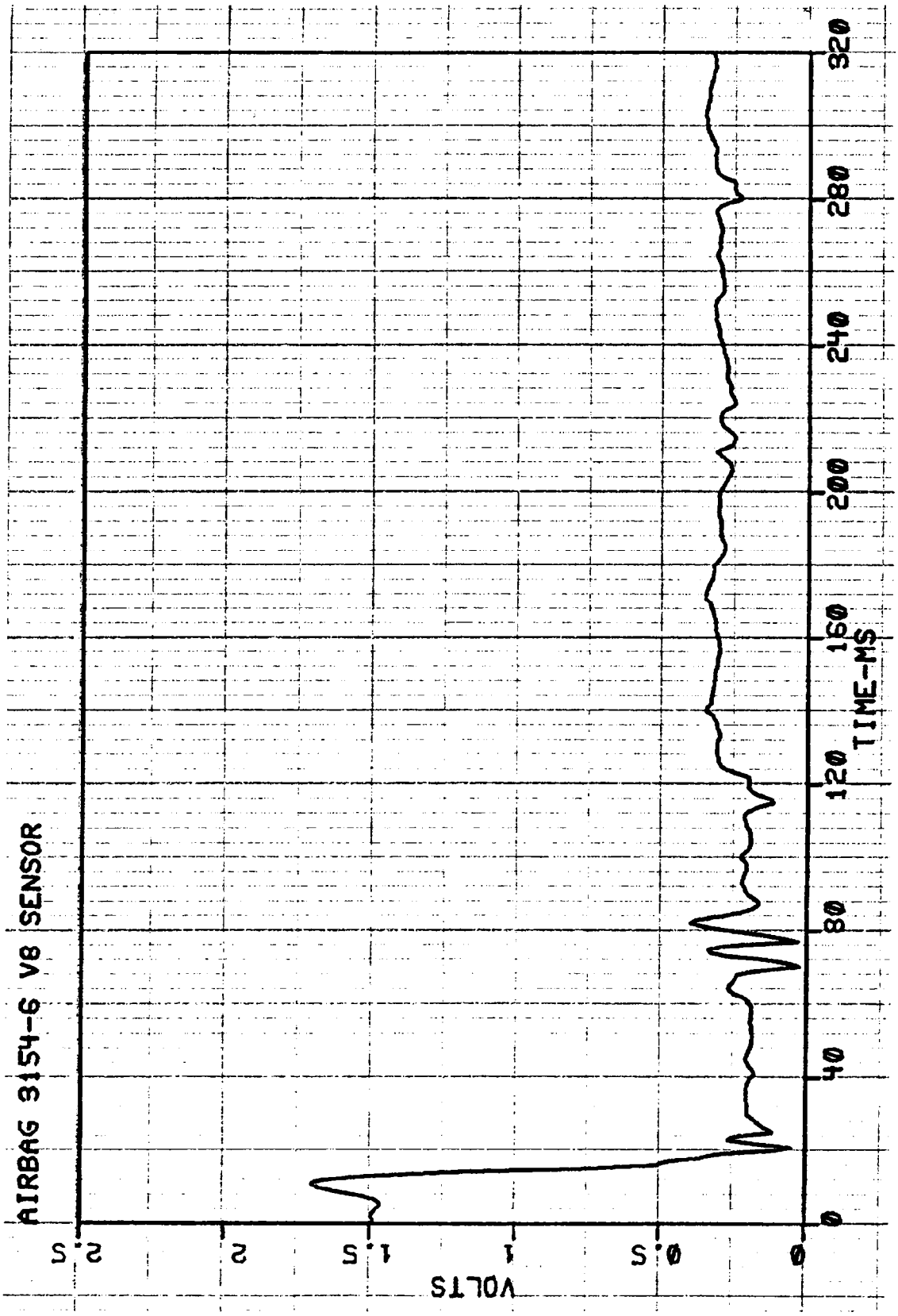

AIRBAG 3154-6 AIRBAG SENSOR LEFT AX
ACCELERATION-G
120
60
0
-60
-120
-180
TIME-MS
0
40
80
120
160
200
240
280
320


AIRBAG 3154-6 AIRBAG SENSOR LEFT AY
ACCELERATION-G
300
200
100
0
-100
-200
TIME-MS
0
40
80
120
160
200
240
280
320


AIRBAG 3154-6 VS SENSOR
VOLTS
-0.5
0
0.5
1
1.5
2
TIME-MS
0
40
80
120
160
200
240
280
320


AIRBAG 3154-6 V6 SENSOR
VOLTS
-.5
0
.5
1
1.5
2
TIME-MS
0
40
80
120
160
200
240
280
320


AIRBAG 3154-6 V7 SENSOR
VOLTS
-4
0
4
8
12
16
TIME-MS
0
40
80
120
160
200
240
280
320


AIRBAG 3154-6 V8 SENSOR
VOLTS
0
0.5
1
1.5
2
2.5
TIME-MS
0
40
80
120
160
200
240
280
320

APPENDIX B
PHOTOGRAPHS

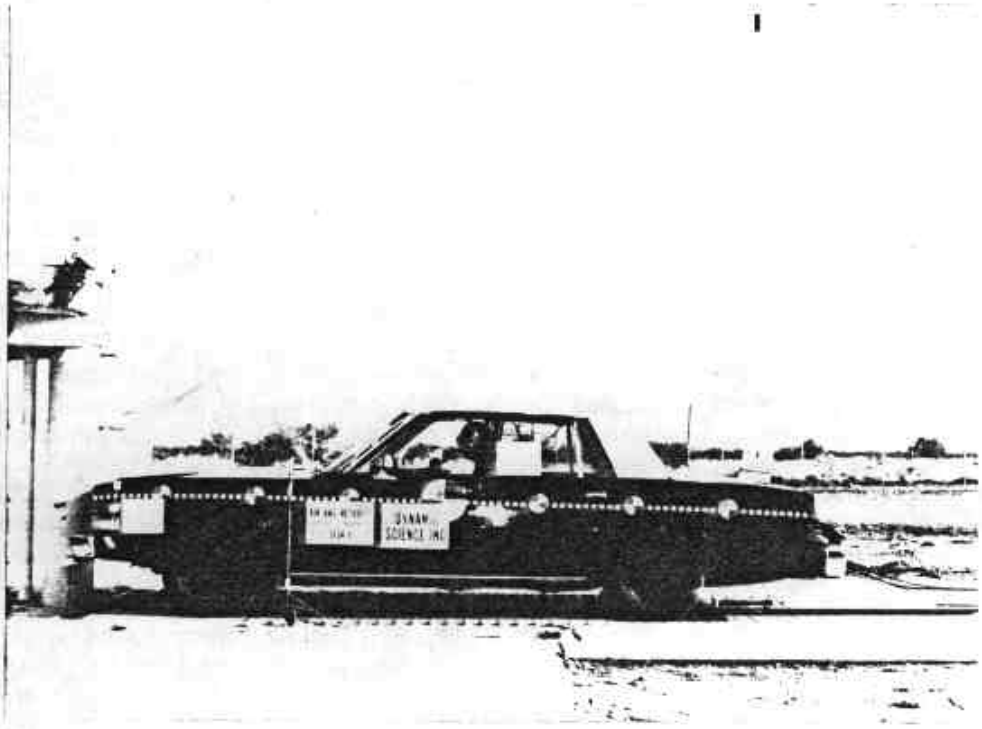


FIGURE B-1. LEFT SIDE OVERALL VIEW OF VEHICLE.

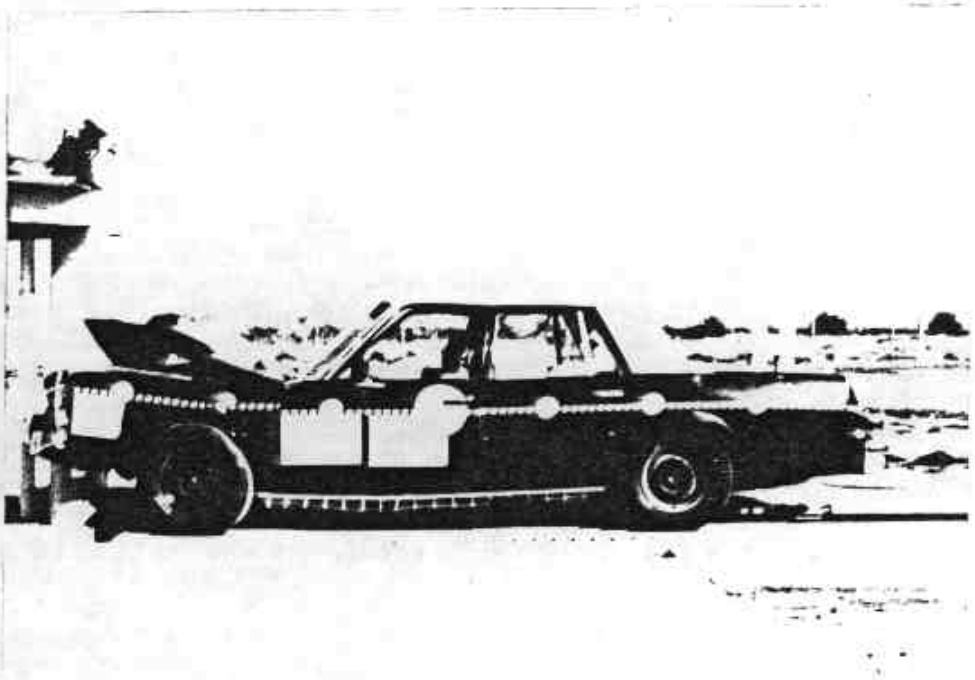


FIGURE B-2. POST-TEST OVERALL VIEW OF VEHICLE.

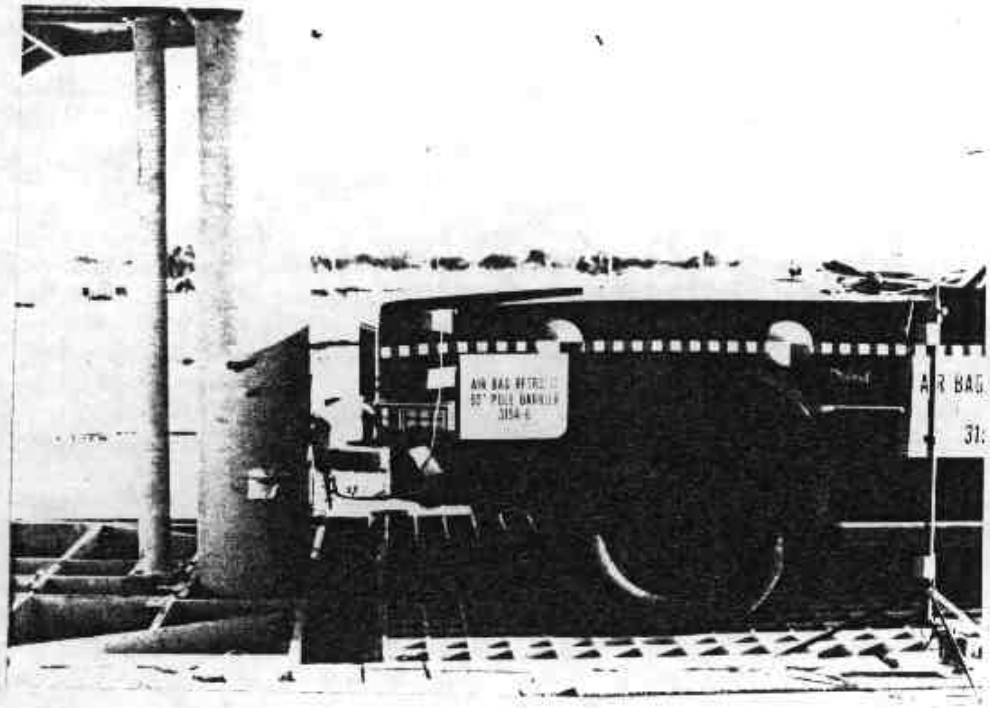


FIGURE B-3. PRE-TEST CLOSE-UP VIEW - LEFT SIDE OF VEHICLE.

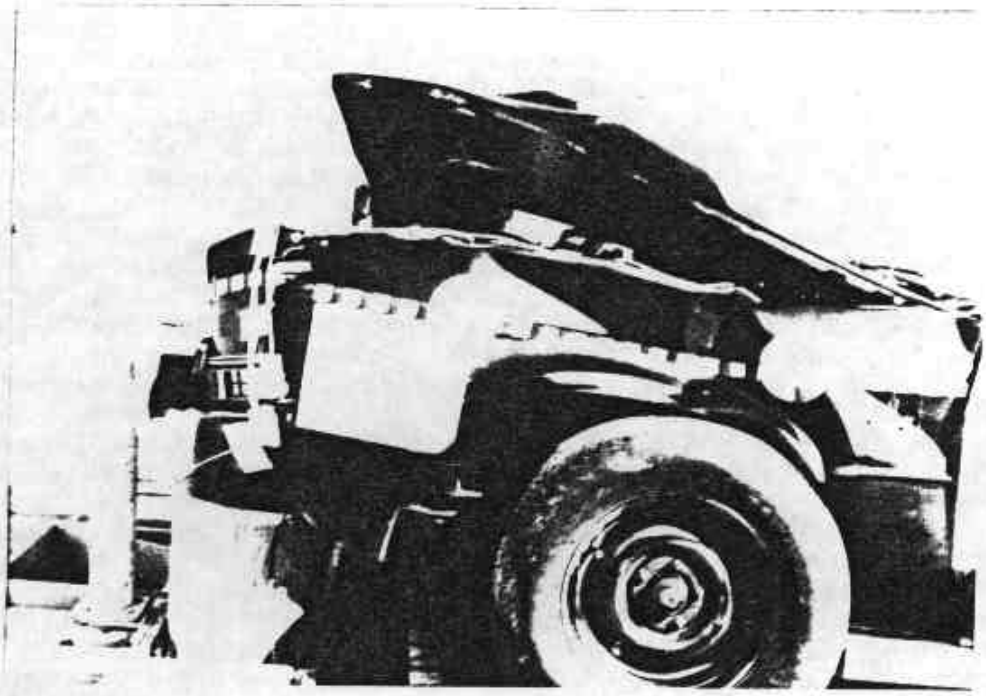


FIGURE B-4. POST-TEST CLOSE-UP VIEW - LEFT SIDE OF VEHICLE.

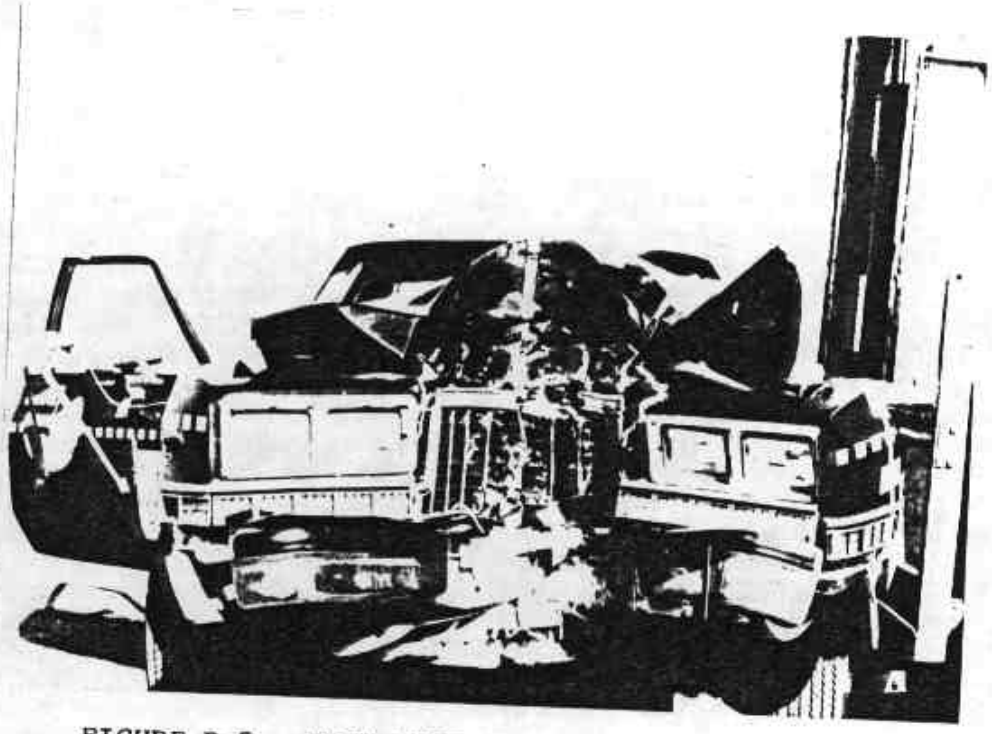


FIGURE B-5. POST-TEST FRONTAL VIEW OF VEHICLE.

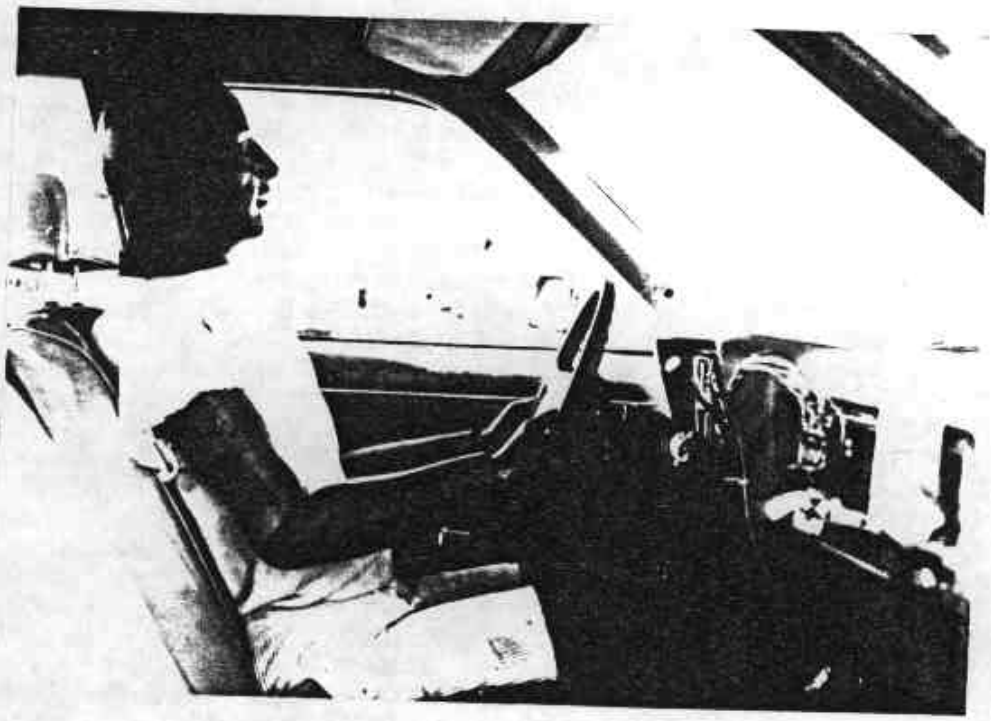


FIGURE B-6. PRE-TEST VIEW OF DRIVER FROM PASSENGER POSITION.

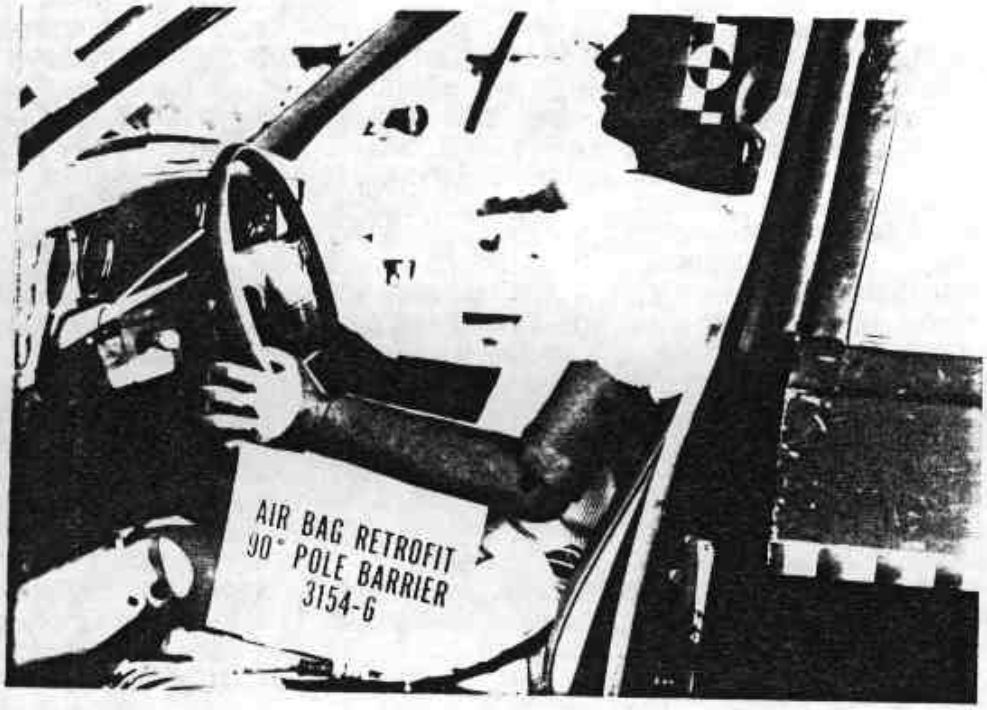


FIGURE B-7. PRE-TEST LEFT SIDE VIEW OF DRIVER POSITION.

FIGURE B-8. POST-TEST LEFT SIDE VIEW OF DRIVER POSITION.

FIGURE B-9. POST-TEST VIEW OF AIR BAG AND KNEE BOLSTER.

FIGURE B-10. CLOSE-UP VIEW OF KNEE BOLSTER.