

**AIR BAG FLEET RETROFIT PROGRAM
CRASH TESTS**

**TEST NO. 3154-4
1982 FORD LTD
4-DOOR SEDAN**

Prepared by:

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



DECEMBER 1983

TEST REPORT

Prepared for:

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

Prepared for the Department of Transportation, National Highway Traffic Safety Administration, under Contract No. DTNH22-82-A-17148. This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no liability for the contents or use thereof.

Prepared by Matthew J. Peaves

Approved by Roel Garm

Date 4 Jan. 1984

Report Accepted by:

Contract Technical Manager
Office of Vehicle Safety Compliance

Date

TECHNICAL REPORT STANDARD TITLE PAGE

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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 1982 Ford LTD 4-Door Sedan at Dynamic Science, Inc. on December 1, 1983. Impact speed was 30.06 mph.			
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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

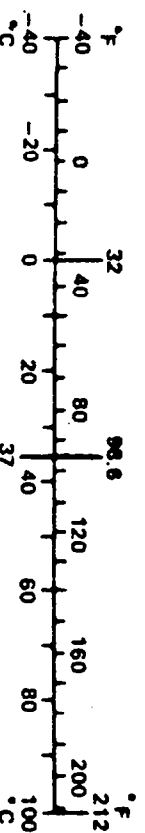


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1.0 PURPOSE AND TEST PROCEDURE

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. Five of the planned tests will be 90° flat frontal barrier impacts, with the remaining test being a 12-inch diameter pole barrier impact.

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 1982 Ford LTD 4-Door Sedan, at Dynamic Science, Inc. on December 1, 1983. Impact speed was 30.06 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: Ford LTD
Body Style: 4-Door Sedan Model Year 1982
NHTSA No. NA DSI No. 1395 Color: White

DATA FROM CERTIFICATION LABEL

Vehicle Manufacturer: Ford Motor Company of Canada
Date of Manufacture: 3/82; VIN: 2FABP31G8CB157396
GVWR: 5346 lb; GAWR: Front = 2680 lb; Rear = 2716 lb

DATA FROM "RECOMMENDED TIRE PRESSURE" LABEL

Vehicle Capacity: FRONT REAR RECOMMENDED LOAD RANGE:
Tire Pressure: Max 32 psi 32 psi TIRE SIZE: Standard
P225/70R15

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: 351 C.I. V8-HO ENGINE POLICE PACKAGE
Transmission: 4-Speed Automatic Rear Wheel Drive
Date Vehicle Received by Laboratory: 11/14/83; Odometer 1186
Dealer Name & Address: Earnhardt Ford Sales
777 E. Baseline, Tempe, AZ 85281

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

Right Front 1149 lb Right Rear = 854 lb
Left Front = 1122 lb Left Rear = 861 lb
TOTAL FRONT WEIGHT = 2271 lb (57 % of Total Vehicle Weight)
TOTAL REAR WEIGHT = 1715 lb (43 % of Total Vehicle Weight)
TOTAL DELV. WEIGHT = 3986 lb

TARGET WEIGHT = UDW + Cargo Load + 164 lb Dummy = 4350 lb

WEIGHT OF TEST VEHICLE WITH REQUIRED DUMMIES AND 206 LB CARGO:

Right Front = 1148 lb Right Rear = 985 lb
Left Front = 1171 lb Left Rear = 1052 lb
TOTAL FRONT WEIGHT = 2319 lb (53 % of Total Vehicle Weight)
TOTAL REAR WEIGHT = 2037 lb (47 % of Total Vehicle Weight)
TOTAL TEST WEIGHT = 4356 lb

Weight of ballast secured in vehicle trunk area = 0 lb

VEHICLE ATTITUDE: (inches)

Delivered Attitude: RF 30.0 LF 30.0 RR 30.0 LR 30.0
Test Attitude: RF 30.0 LF 30.0 RR 28.2 LR 28.4

REMARKS:

GENERAL TEST AND VEHICLE PARAMETER DATA (CONT)

POST-IMPACT DATA

Type of Test: Frontal Pole Barrier Impact

Date of Test: 12/1/83 Time: 1418 Temperature 62 °F

Required Impact Velocity Range: 28.5 to 30.5 mph

Impact Velocity: Primary = 30.06 mph Secondary = N/A 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 206.3 C 209.0 L 206.1

Post-test = R NA C 177.6 L NA

Crush = R - C 31.4 L -

Distance from front of test vehicle to point of impact:

R NA C 35.5 L NA

VISIBLE DUMMY CONTACT POINTS

	Driver	Passenger
Head	<u>Air bag</u>	
Chest	<u>Air bag</u>	
Abdomen	<u>Air bag, lower steering wheel rim</u>	
Left Knee	<u>Knee bolster</u>	
Right Knee	<u>Knee bolster</u>	

DOOR OPENING

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

SEAT MOVEMENT

Seat Back Failure	<u>None</u>	<u>None</u>		
Seat Shift (in.)	<u>None</u>	<u>None</u>		

GLAZING DAMAGE

Backlight/Windshield Windshield cracked mid-center position on driver side; all other windows intact.

OTHER NOTABLE IMPACT EFFECTS: Left and right side conformed around impact pole; extensive rebound occurred.

PART 572 DUMMY IN-VEHICLE POSITION RECORDING SHEET

PRE-IMPACT DATA

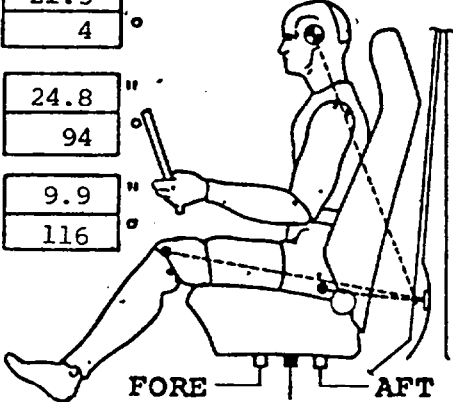
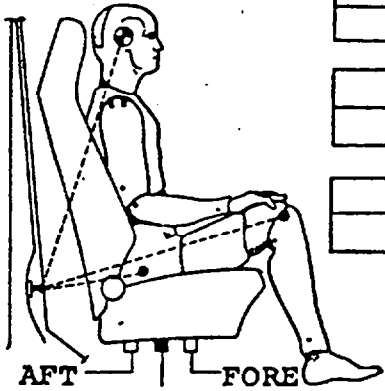
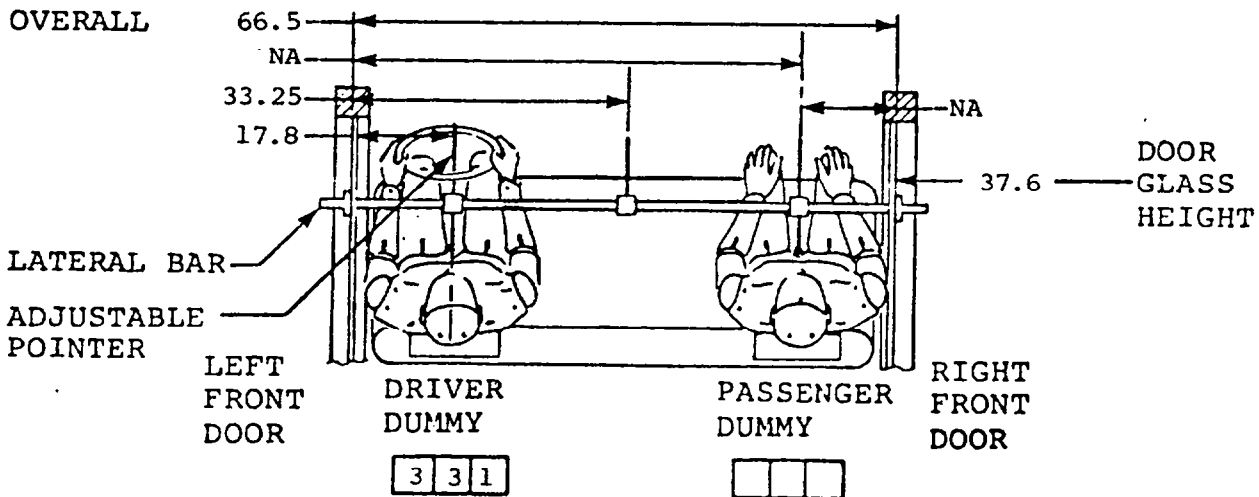
Make/Model: Ford LTD
 Body Style: 4-Door Sedan Model Year: 1982
 NHTSA No. NA DSI No. 1395 Color: White

DATA FROM CERTIFICATION LABEL

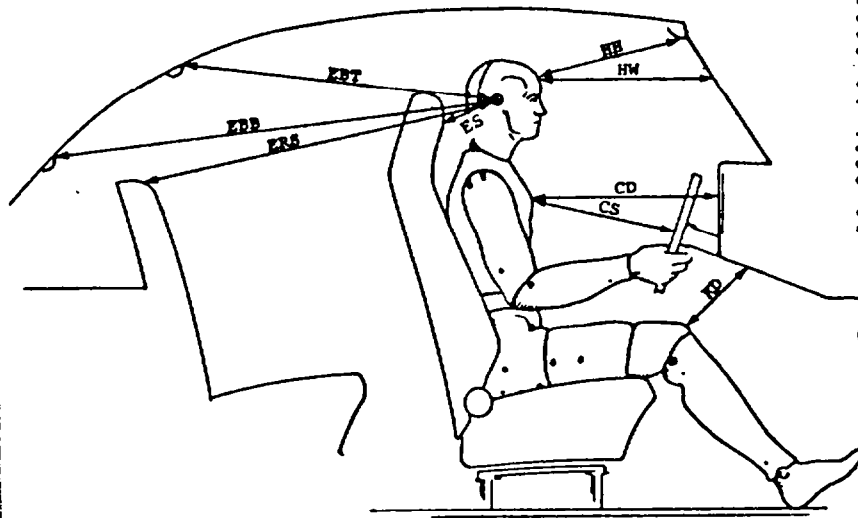
Vehicle Manufacturer: Ford Motor Company of Canada Ltd
 Date of Manufacture: 3/82; VIN: 2FABP31G8CB157432
 GVWR: 5346 lb; GAWR: Front = 2680 lb; Rear = 2716 lb

POST-IMPACT DATA

Type of Test: Frontal Pole Barrier Impact
 Date of Test: 12/1/83 Time: 1418 Temperature 62 °F
 Required Impact Velocity Range: 28.5 to 30.5 mph
 Impact Velocity: Primary = 30.06 mph Secondary = NR mph
 Seat Type: Split back bench Adjuster Type: 10 position manual
 Bucket Seat Type Back: Low back with adjustable head rest
 Technicians: M. Reaves, R. Garn

DRIVER DUMMY# 331 HEAD TARGET 21.5" 4° KNEE JOINT 24.8" 94° APPROXIMATE "H" POINT 9.9" 116°  FORE MIDPOINT AFT	PASSENGER DUMMY # HEAD TARGET KNEE JOINT APPROXIMATE "H" POINT  AFT MIDPOINT FORE
OVERALL  DRIVER DUMMY 331 PASSENGER DUMMY 	

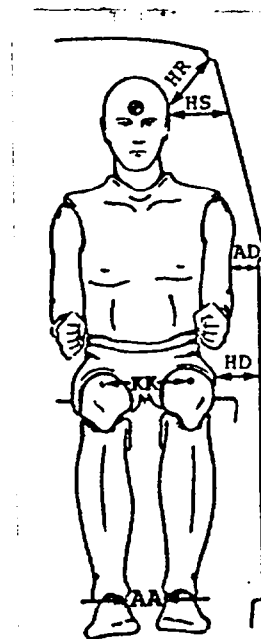
PART 572 DUMMY IN-VEHICLE POSITION RECORDING SHEET



80 8314 40 00302

	Driver	Passenger
HH	15.0	
HW	21.0	
CD	19.8	
CS	8.9	
KD L	4.8	
KD R	4.3	
Torso Angle	26°	Torso Angle °
Seat Back Angle	25°	Seat Back Angle °
HSW	15.5	

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.



80 8314 40 00303

	Driver	Passenger
HR	6.1	
HS	9.8	
AD	5.7	
HD	8.0	
KK	10.5	
AA	10.0	

SUMMARY OF VEHICLE ACCELEROMETER DATA

Vehicle: 1982 Ford LTD 4-Door Test Date: 12/1/83
 Test No.: 3154-4 Pole Impact Test Speed: 30.06 mph

Accelerometer		Maximum Acceleration				
No.	Location	Scale	+A (g)	T (msec)	-A (g)	T (msec)
1X	Left front air bag sensor	±250g	40.0	32	70.5	77
1Y	Left front air bag sensor	±250g	102.3	40	74.6	46
2X	Right front air bag sensor	±250g	64.5	29	98.0	78
2Y	Right front air bag sensor	±250g	50.7	15	77.5	51
3X	Diagnostic module (steering column)	±250g	29.9	94	54.5	70
4X	Driver side B-pillar	±250g	13.5	100	40.1	72
$\Delta V = 32.3 \text{ mph @ } 188 \text{ msec}$						

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	6.7	165	39.9	128				
Lateral	9.1	26	14.0	30				
Vertical	26.3	111	13.4	29				
Resultant	45.9	109	-	-				
HIC	305.7 between 89 and 136 msec							
Chest Acceleration								
Longitudinal	11.5	26	31.7	119				
Lateral	4.1	124	10.3	127				
Vertical	27.0	108	17.0	151				
Resultant (Max)	35.8	108	-	-				
Resultant (clip)	29.9	-	-	-				
TIME > 60 G	0 msec							
SEVERITY INDEX	213.7 @ 320 msec							
	Peak (lb)	Time (msec)	Peak (lb)	Time (msec)	Peak (lb)	Time (msec)	Peak (lb)	Time (msec)
Femur Loads								
Left	699.3	26	1846.0	95				
Right	373.5	28	2211.1	92				
Belt Loads								
Lap	Not instrumented							
Torso								
Vehicle Impact Speed (mph): 30.06								
$\Delta V = 32.3$ mph								
*Longitudinal:	Forward				**Longitudinal:	Rearward		
Lateral:	Rightward				Lateral:	Leftward		
Vertical:	Downward				Vertical:	Upward		

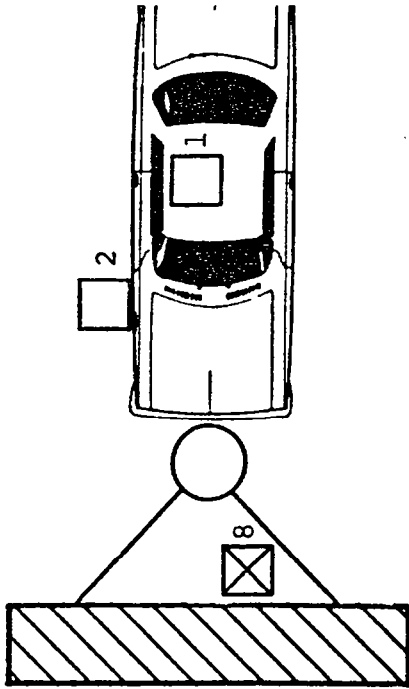
Test No: 3154-4 Test Date: 12-1-83

Test Type: 90° Frontal Pole Barrier

Vehicle A (Away): 1982 Ford Ltd 4-Door Sedan

Vehicle B (Barrier):

Comments: Air bag test



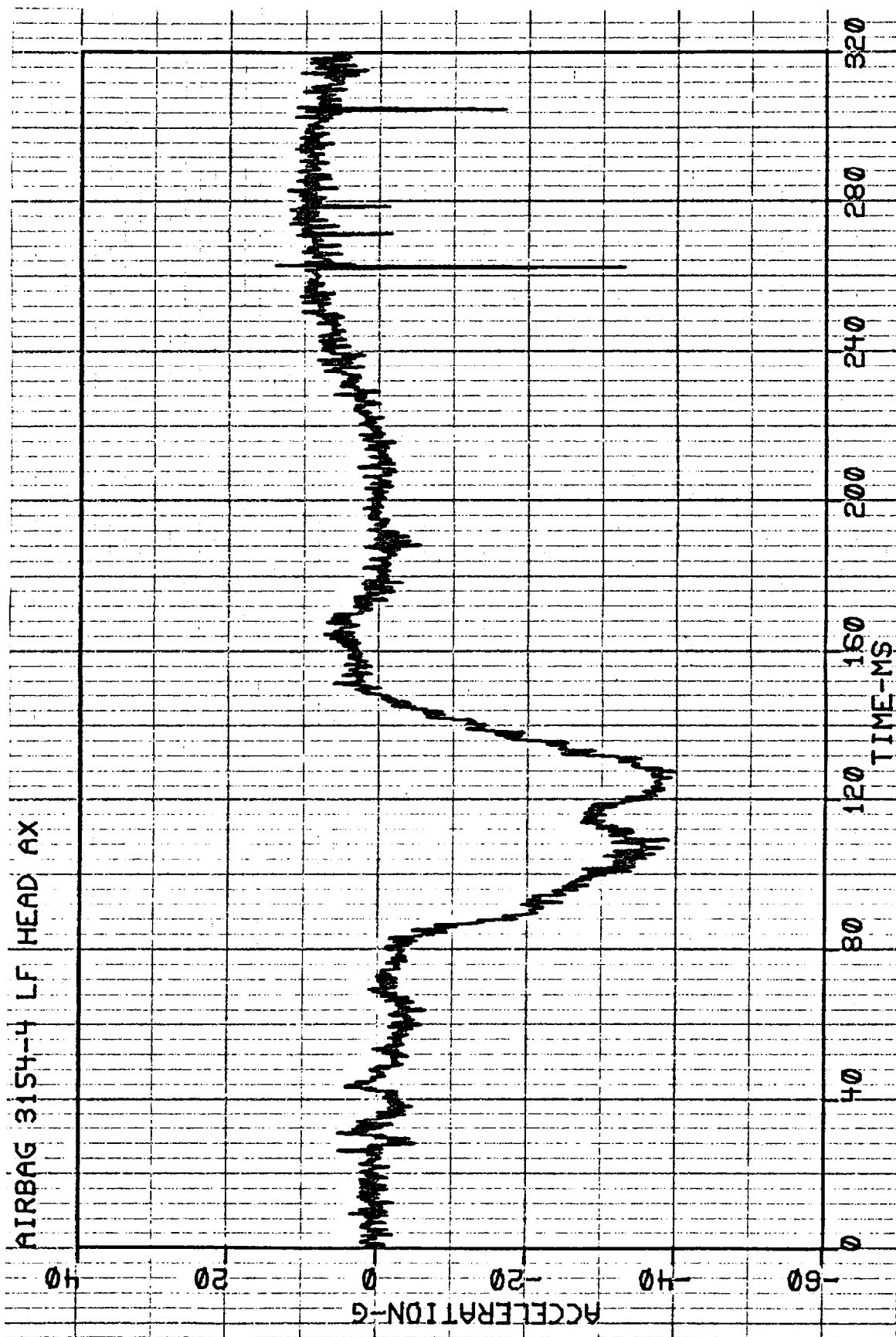
CAMERA SYMBOLS		FRAME RATE	
☐ PIT		1. 1000 fr/sec	
☐ GROUND		2. 200 fr/sec	
☐ BARRIER		3. Other <u>24 fr/sec</u>	
☐ OVERHEAD		4. 400 fr/sec	
☐ ON-BOARD		5. 500 fr/sec	
TIMING LIGHT SPEED			
		1. 100 Hz (10 msec/light)	
		2. 200 Hz (5 msec/light)	
		3. Other <u></u>	

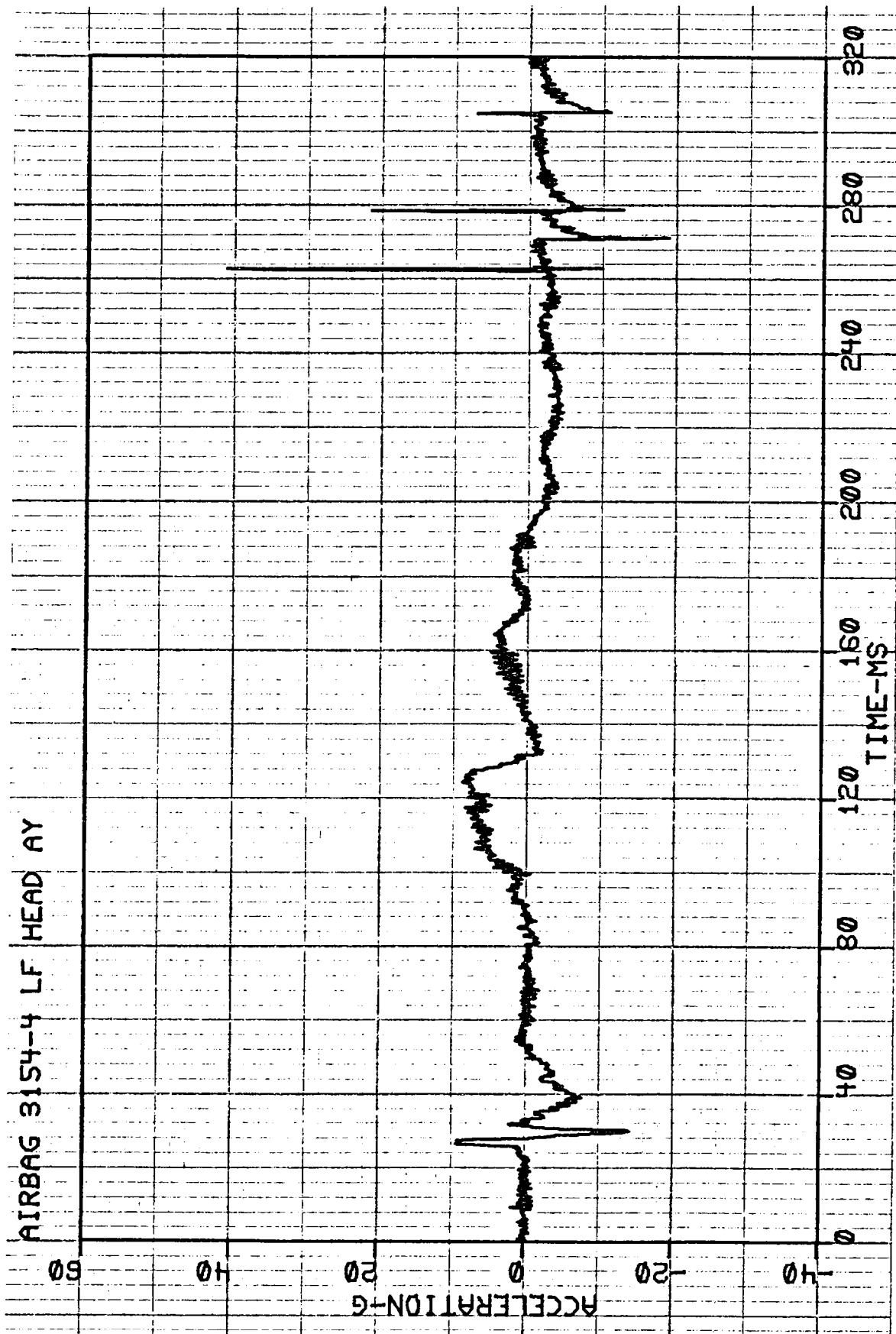
CAMERA	YES
STILLS	
SLIDES	
MOVIE	
POLAROID	
VIDEO	

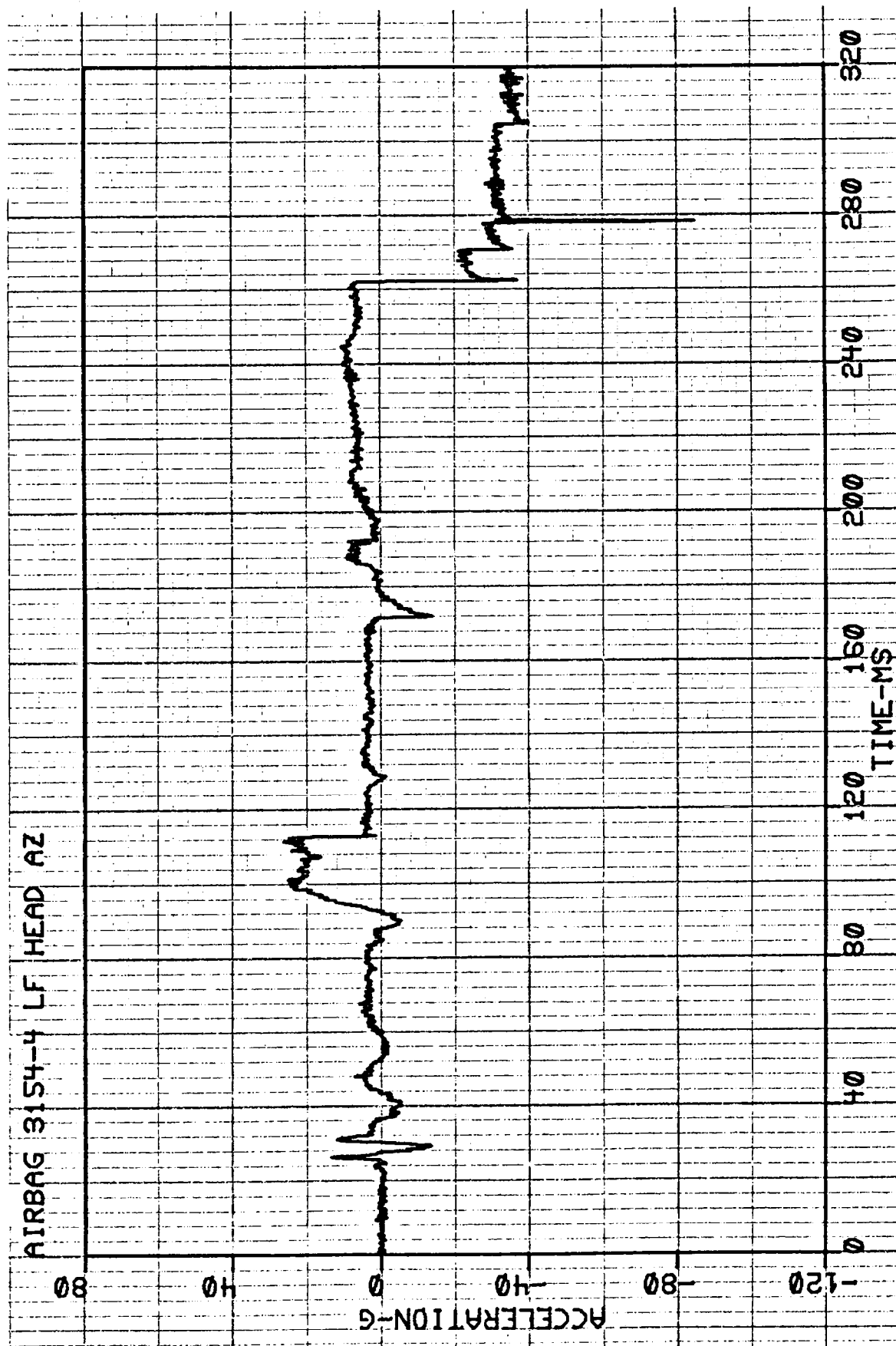


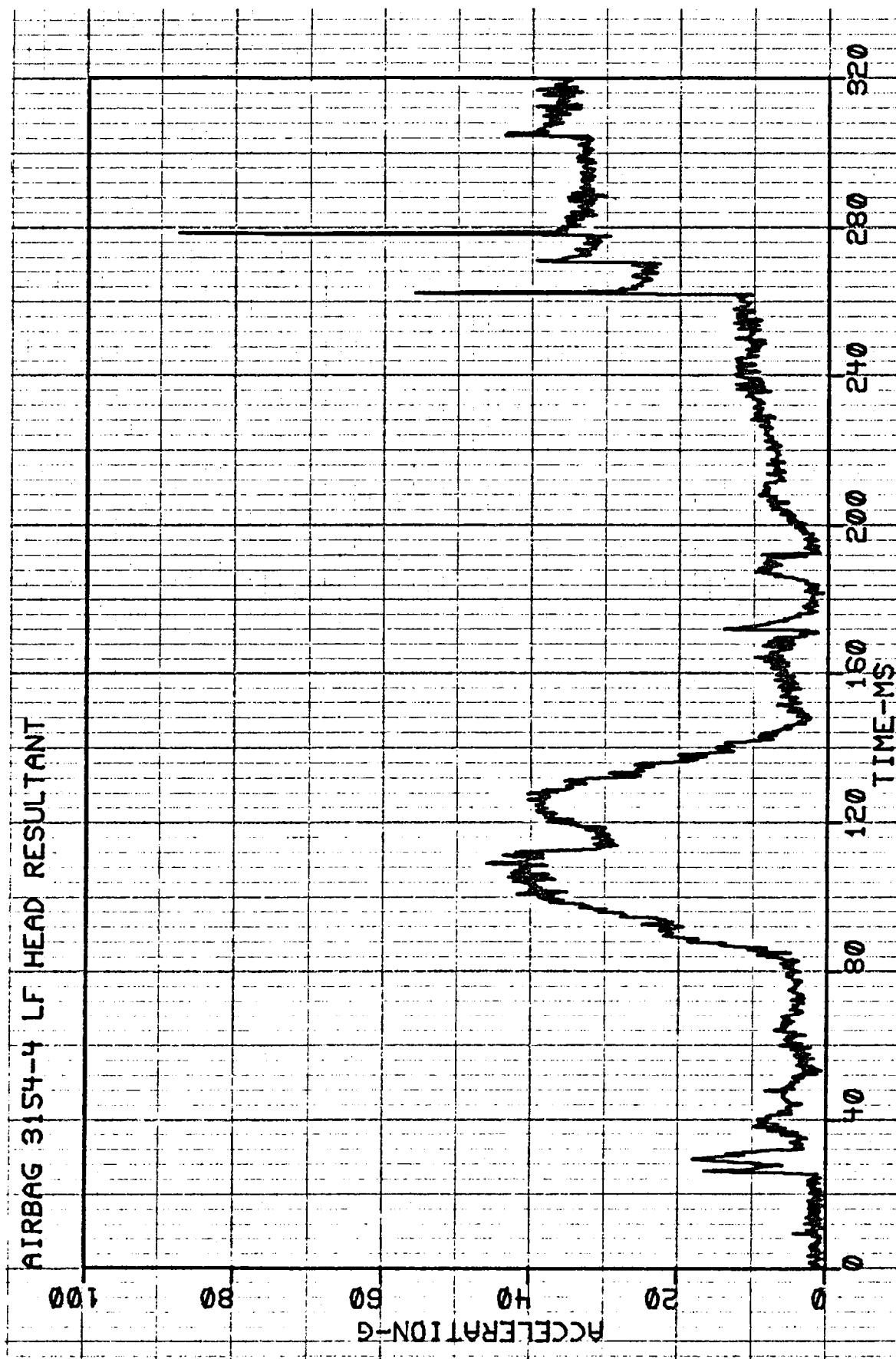
Loc. No.	Location	Field of View	Lens Size	Frm Rate	Tmng Spd	Ser No	Impact Dist-X	C.L. Dist-Y	CA High
1	On-board vehicle roof	Over driver shoulder-view dummy and air bag	8	5	1	12	NA	NA	NA
2	On-board pass. door	90° view of dummy and air bag deployment	8	5	1	6	NA	NA	NA
3	Right side ground base	Overall of vehicle throughout impact event	25	5	1	M7	0"	576"	46"
4	Left side ground base	Overall of vehicle throughout impact event	25	5	1	H168	84"	540"	34"
5	Left side ground base	View of impact event	15	5	1	11	96"	516"	48"
6	Left side ground base	Oblique view of air bag deployment	25	5	1	10	168"	408"	48"
7	Left side ground base	Close-up oblique view of air bag deployment	50	5	1	5	144"	240"	48"
8	Barrier overhead	View of air bag deployment through windshield	13	5	1	8	72"	60"	111
9	Left side ground based	Panning	Var	3	-	Scoptic			

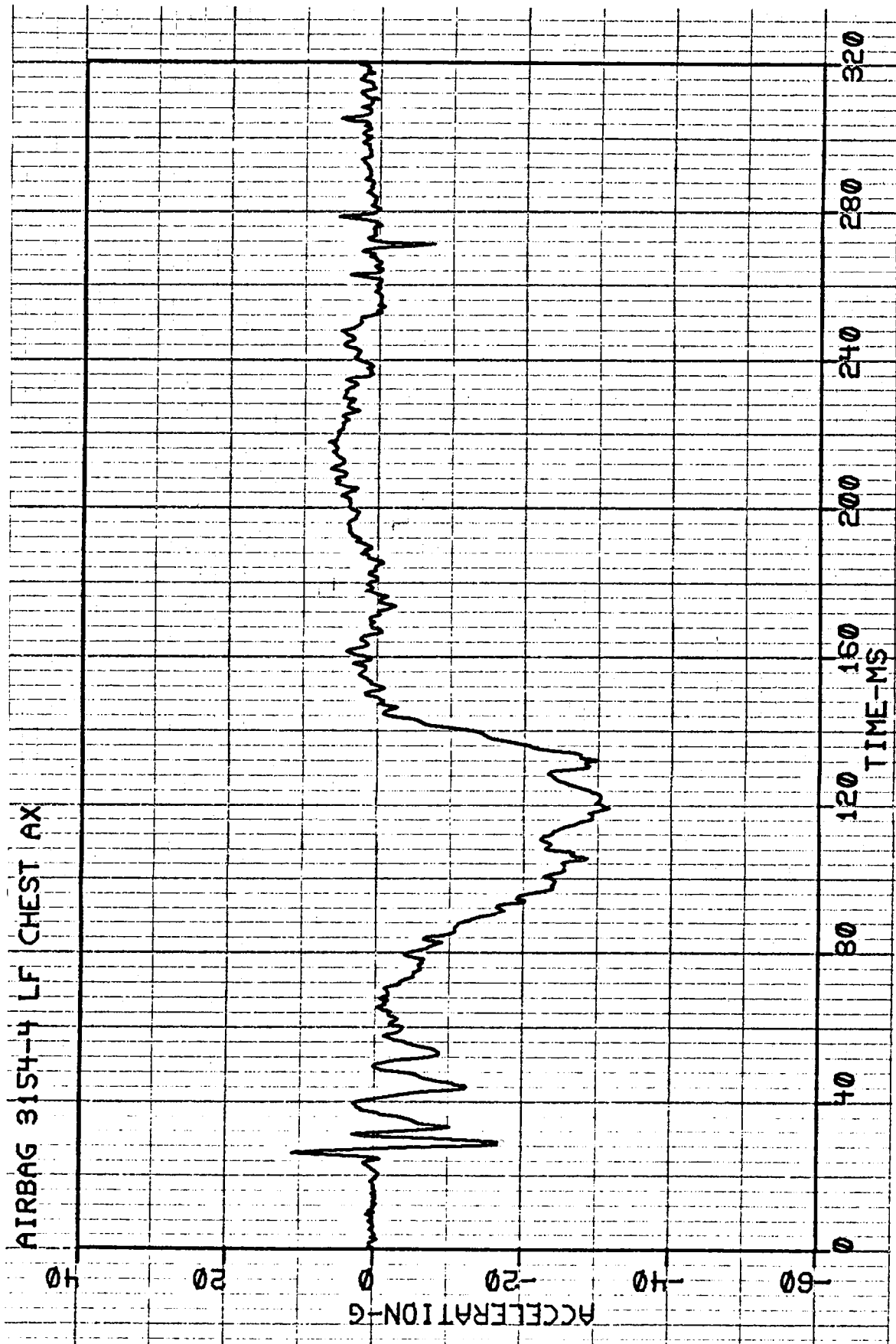
APPENDIX A
CALCOMP PLOTS OF ELECTRONIC DATA

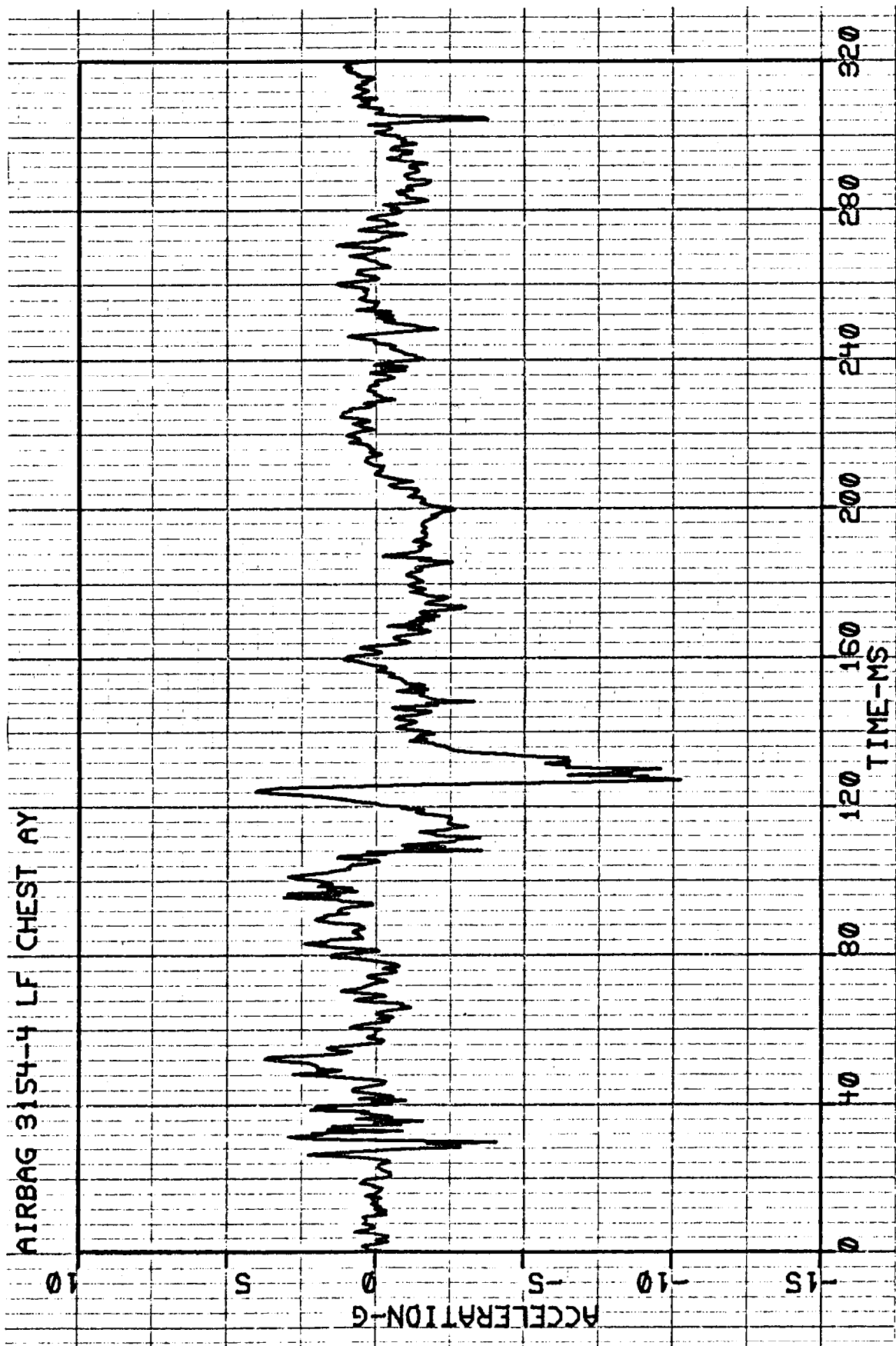


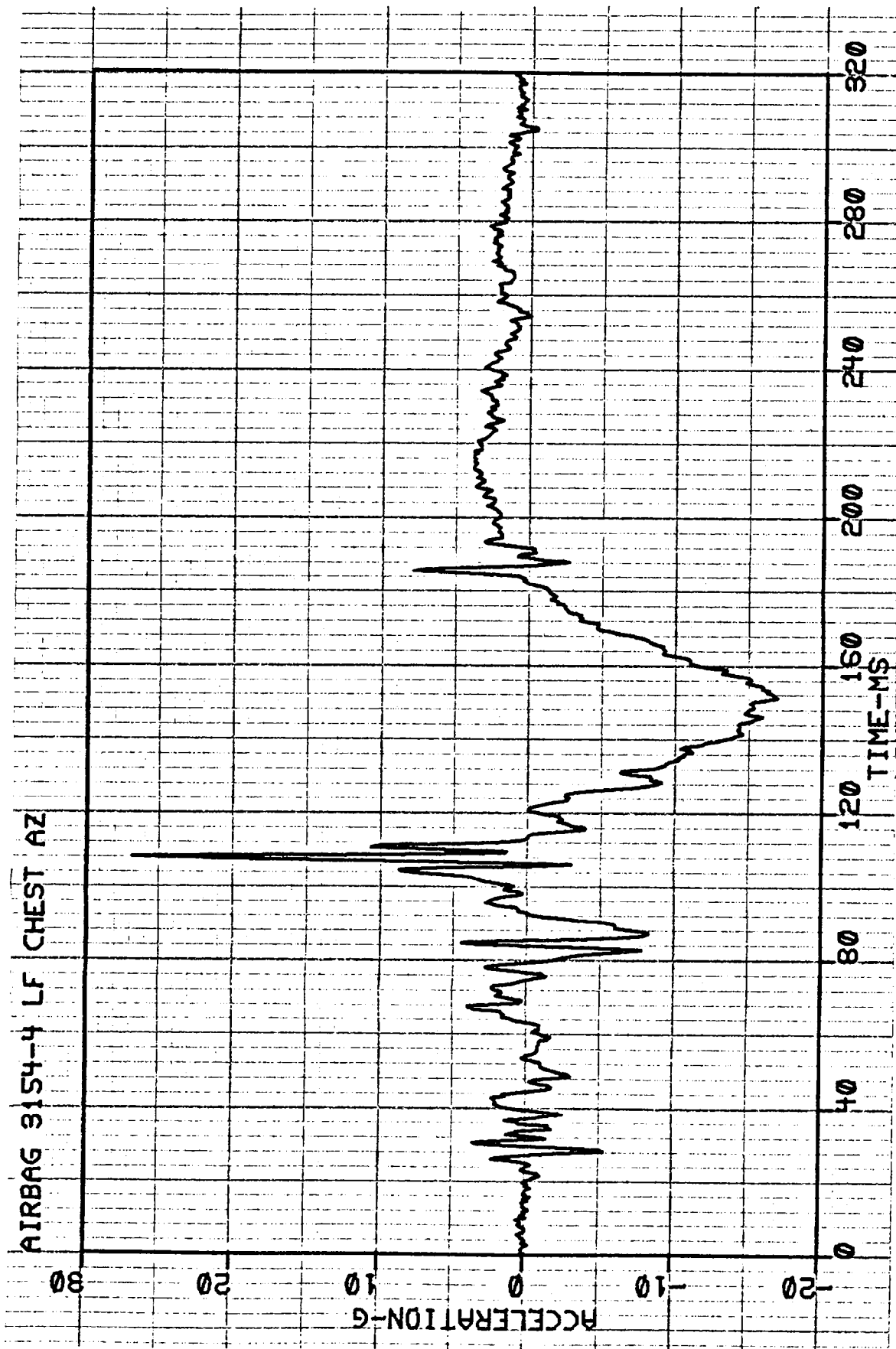


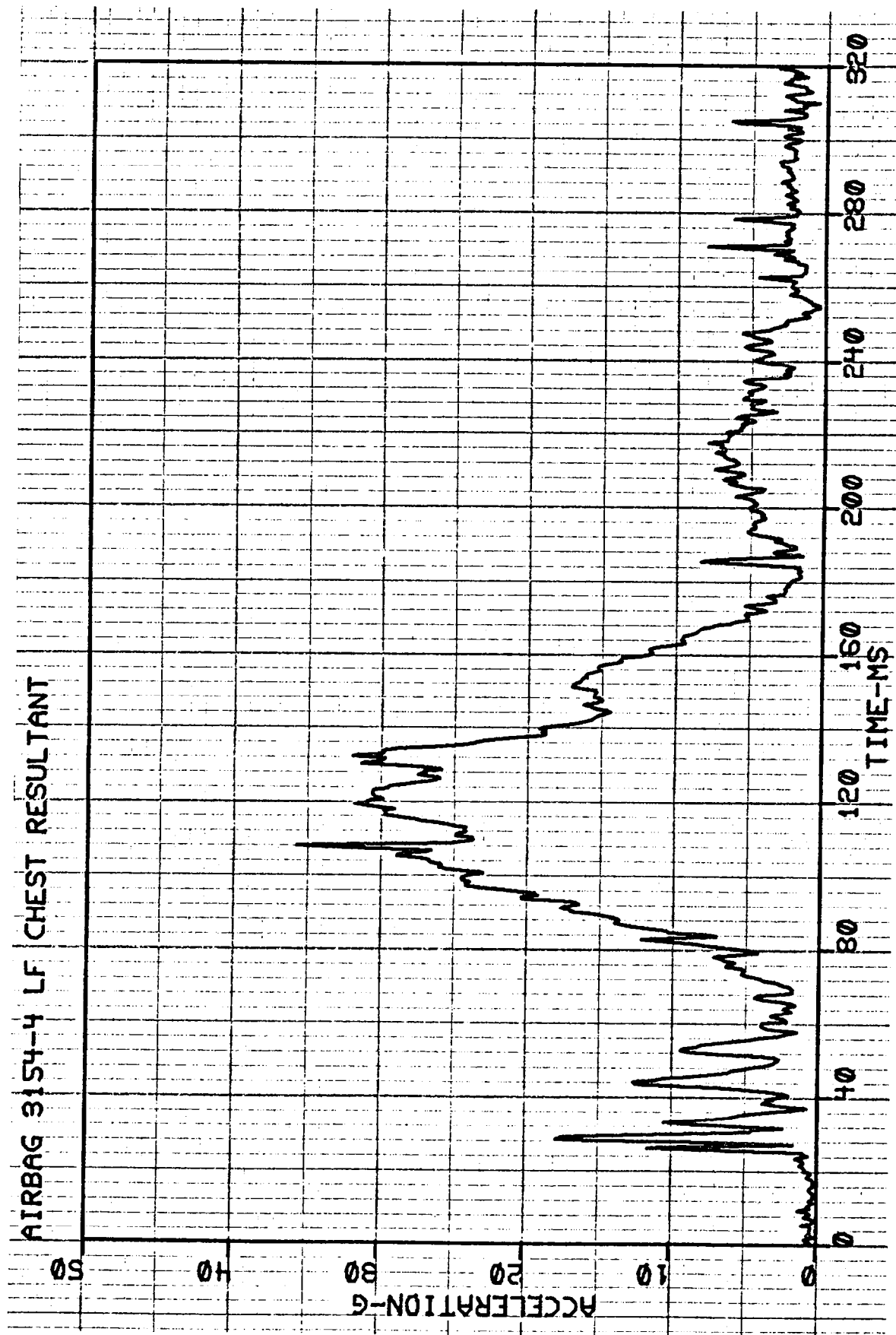


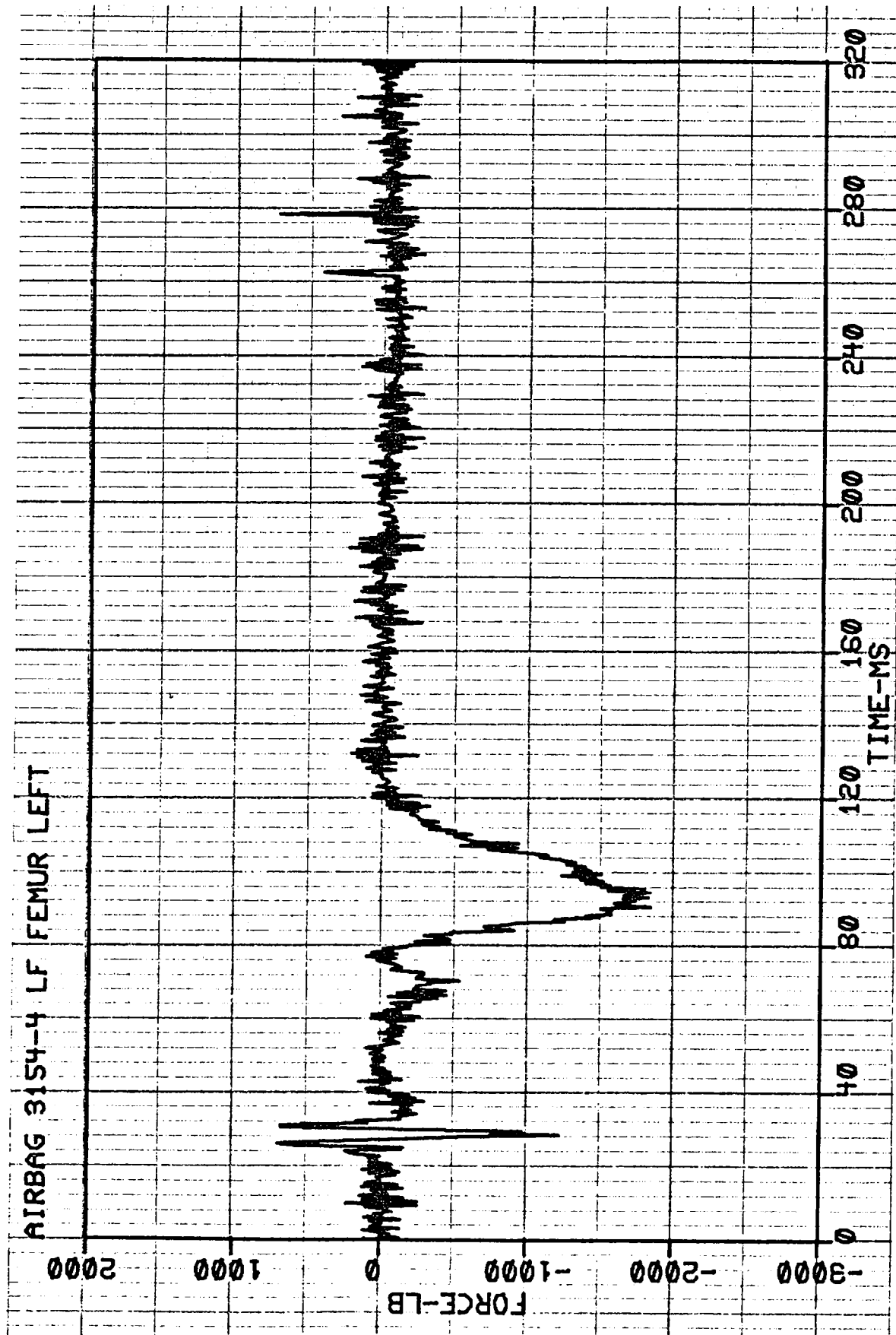


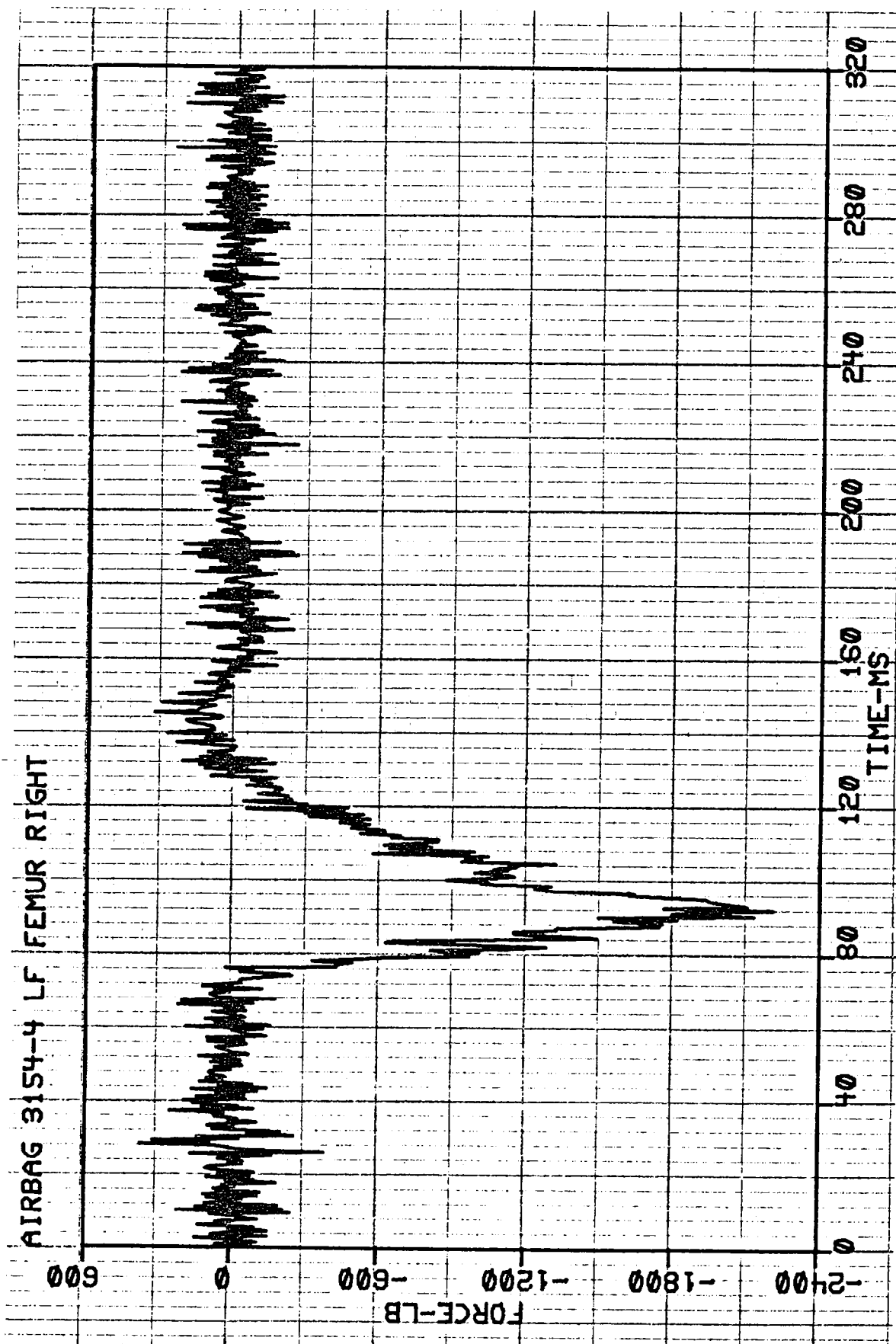


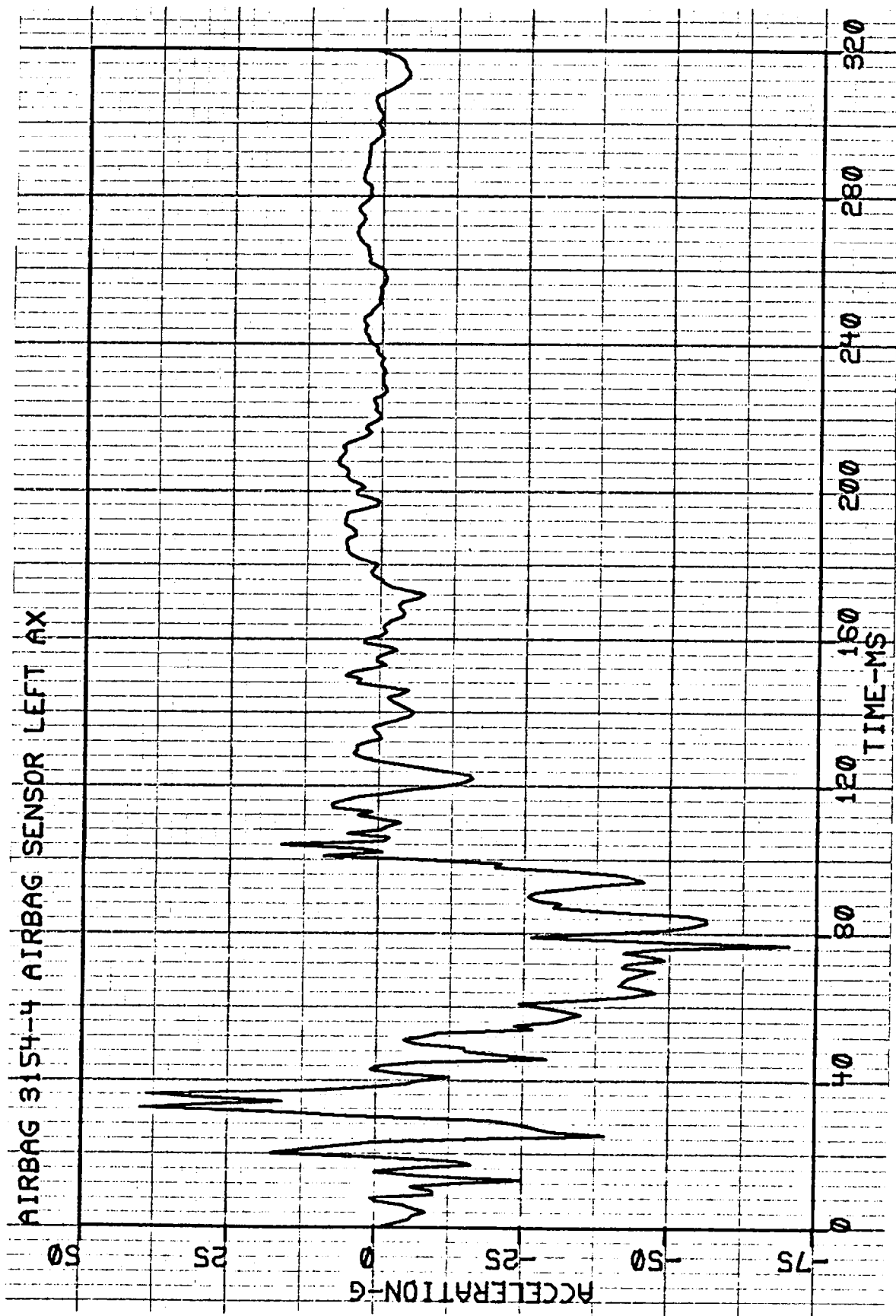


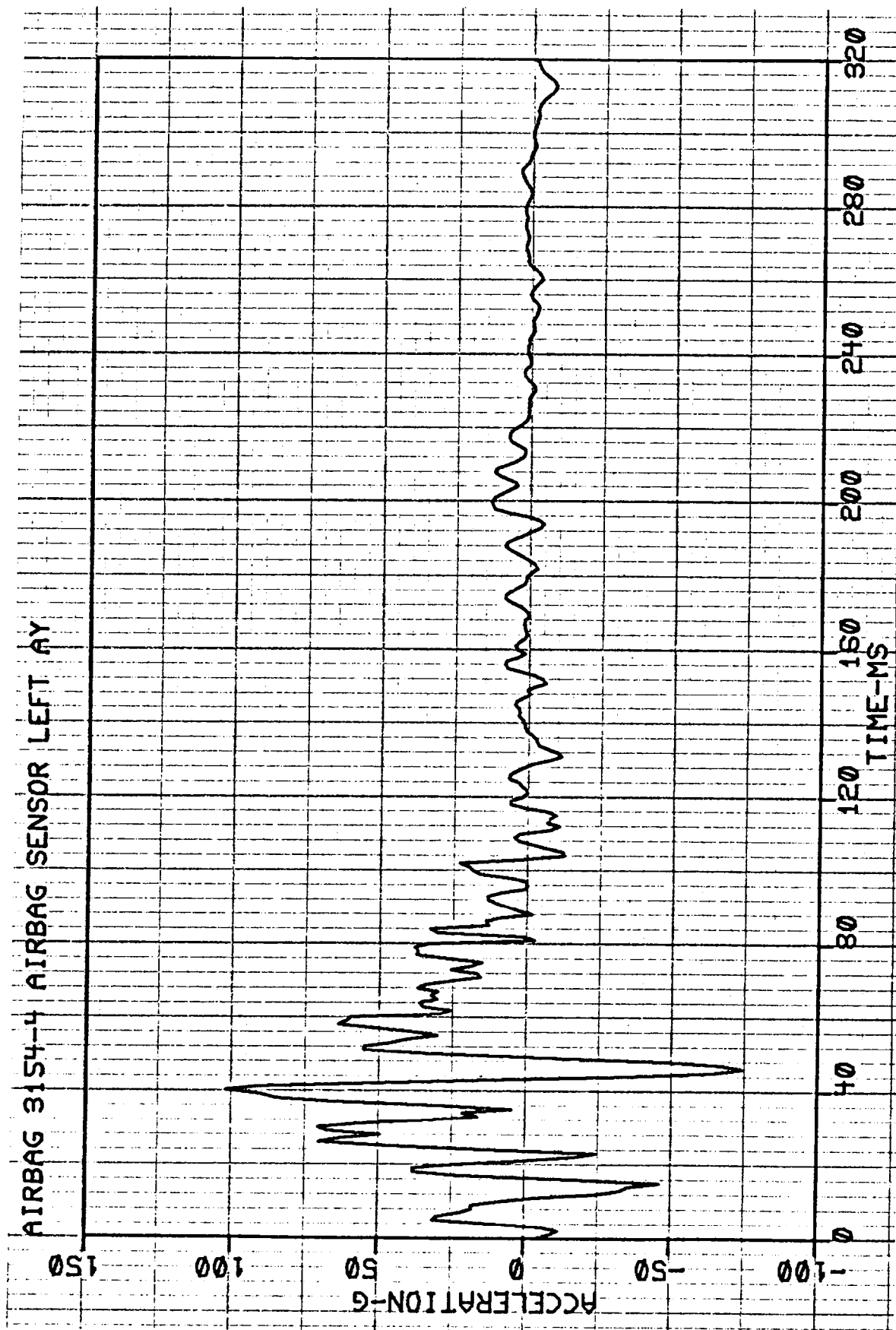


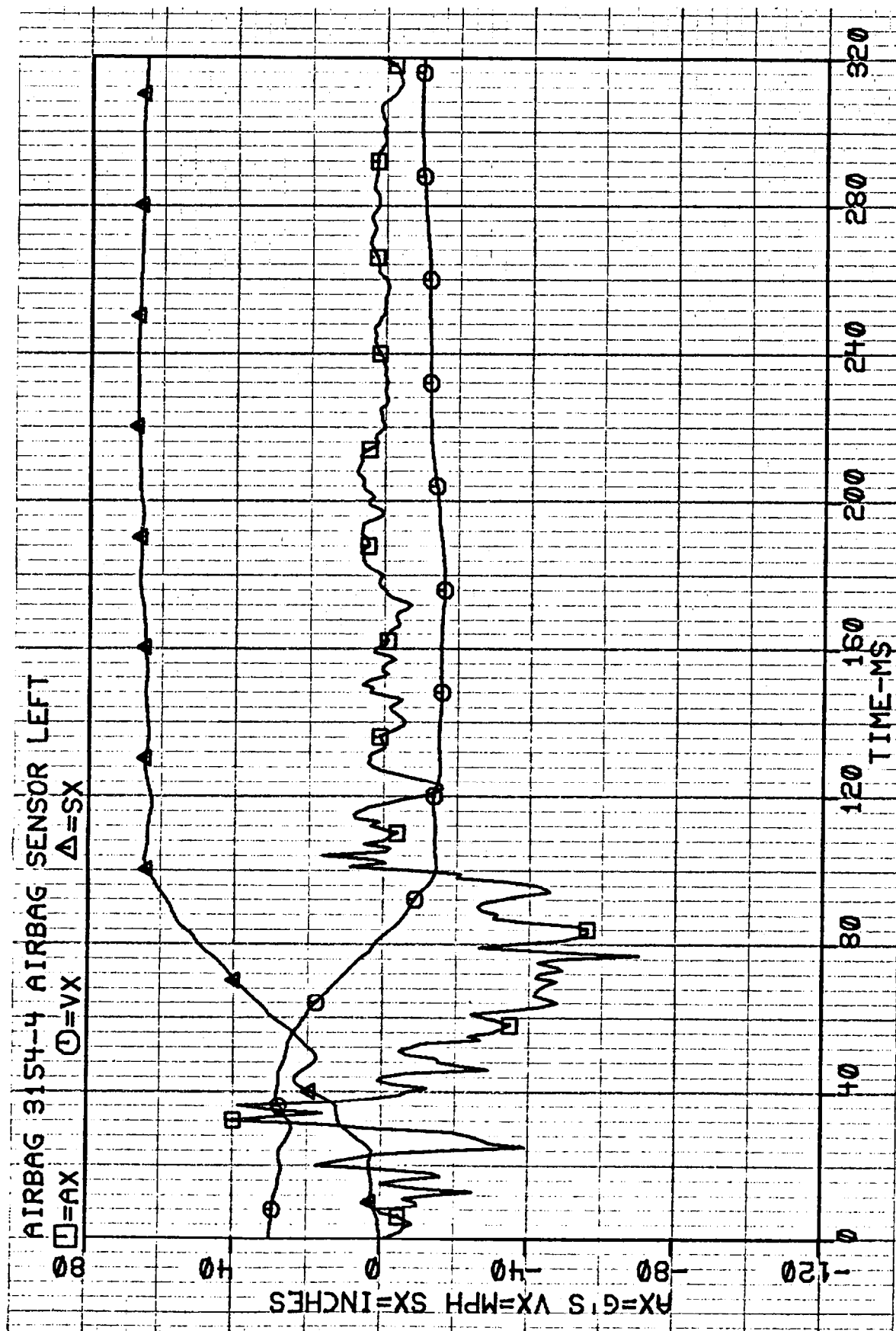


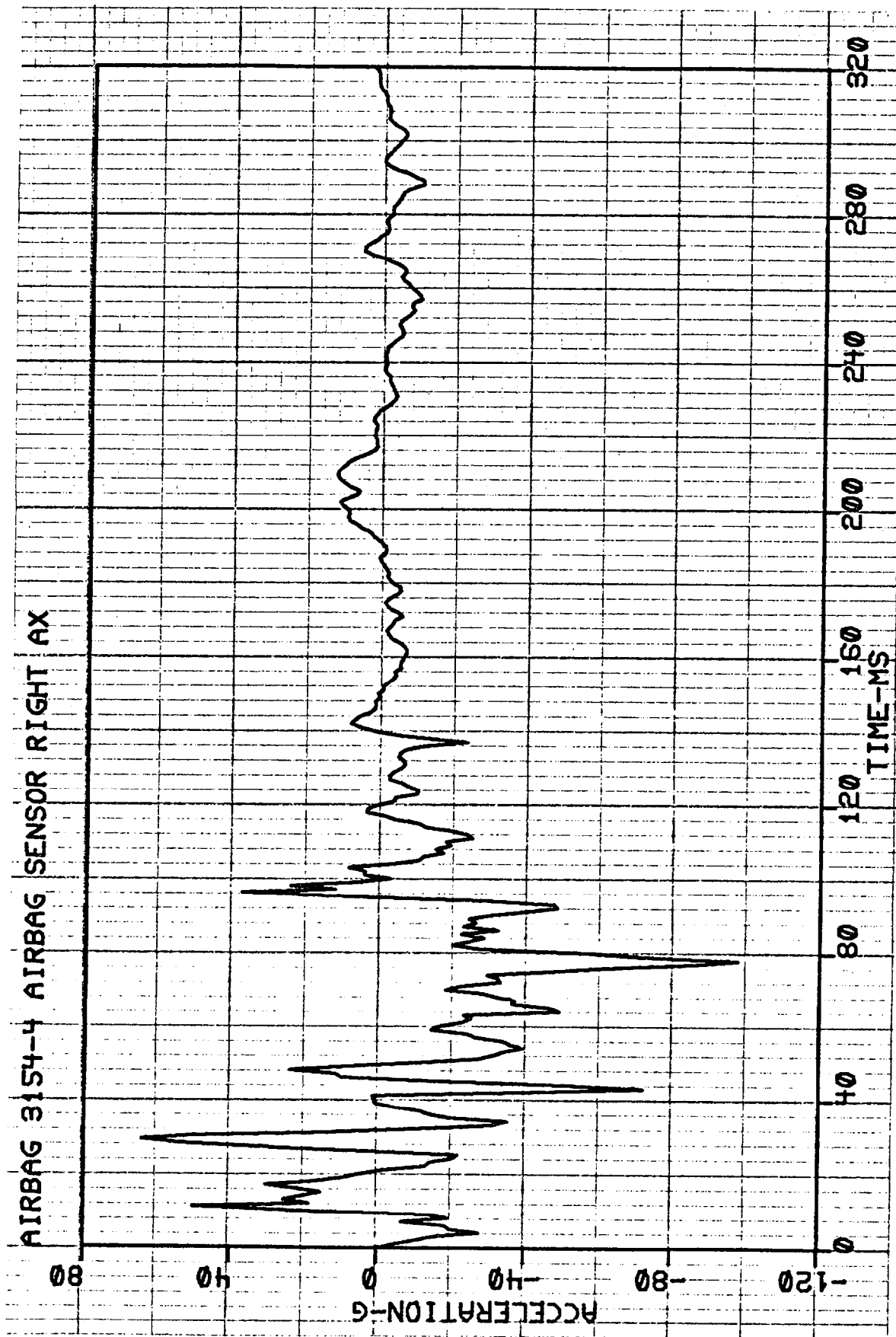


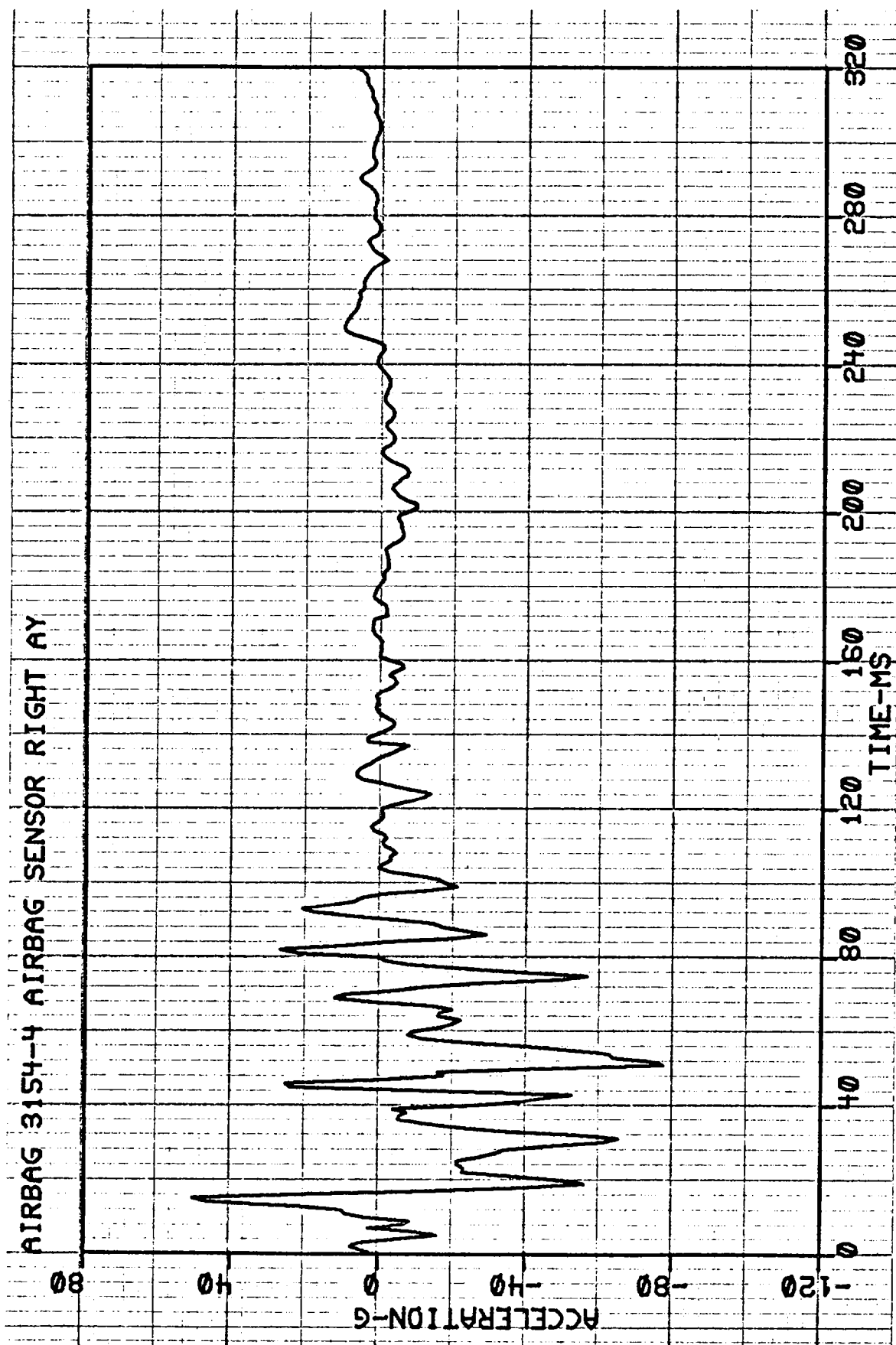


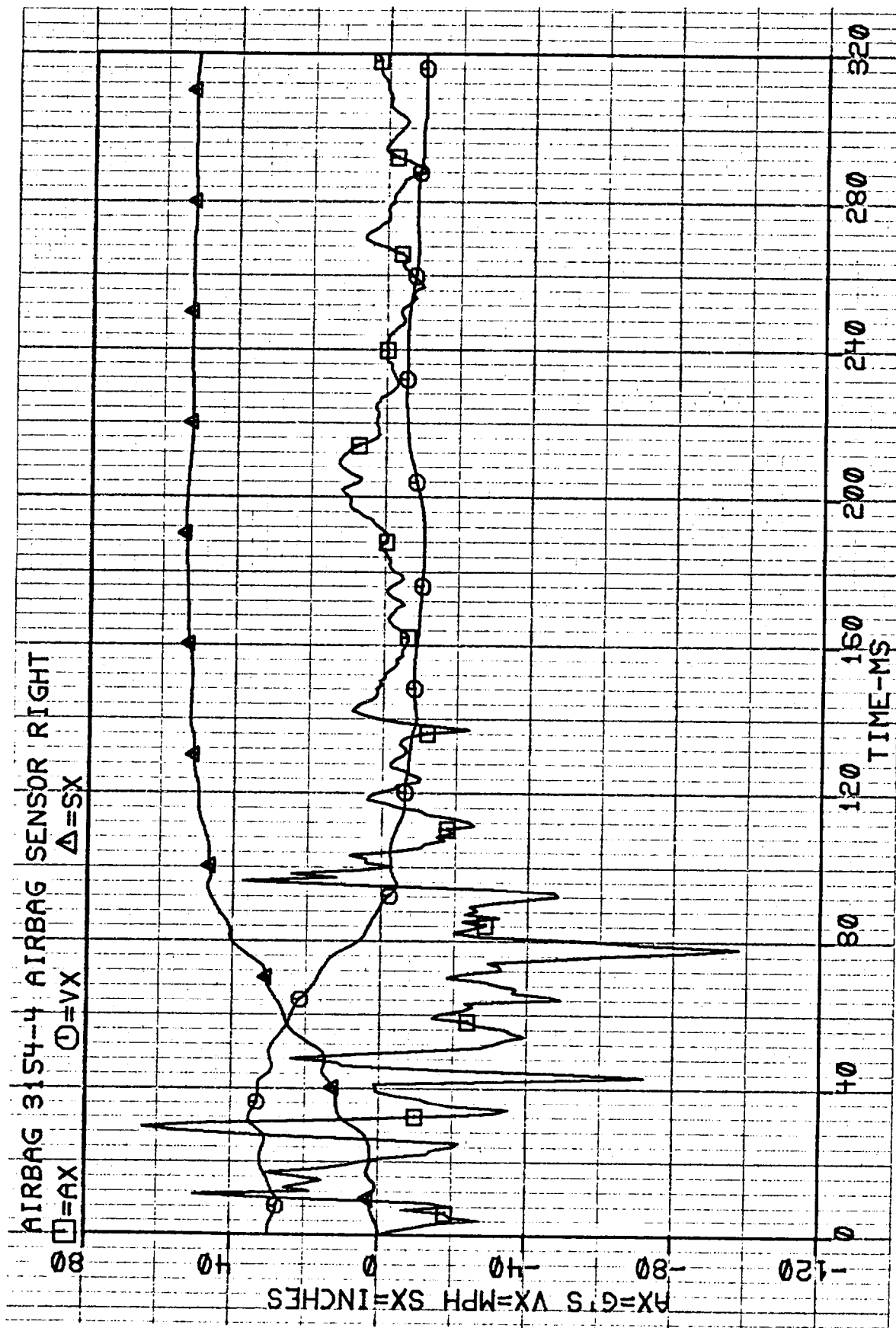


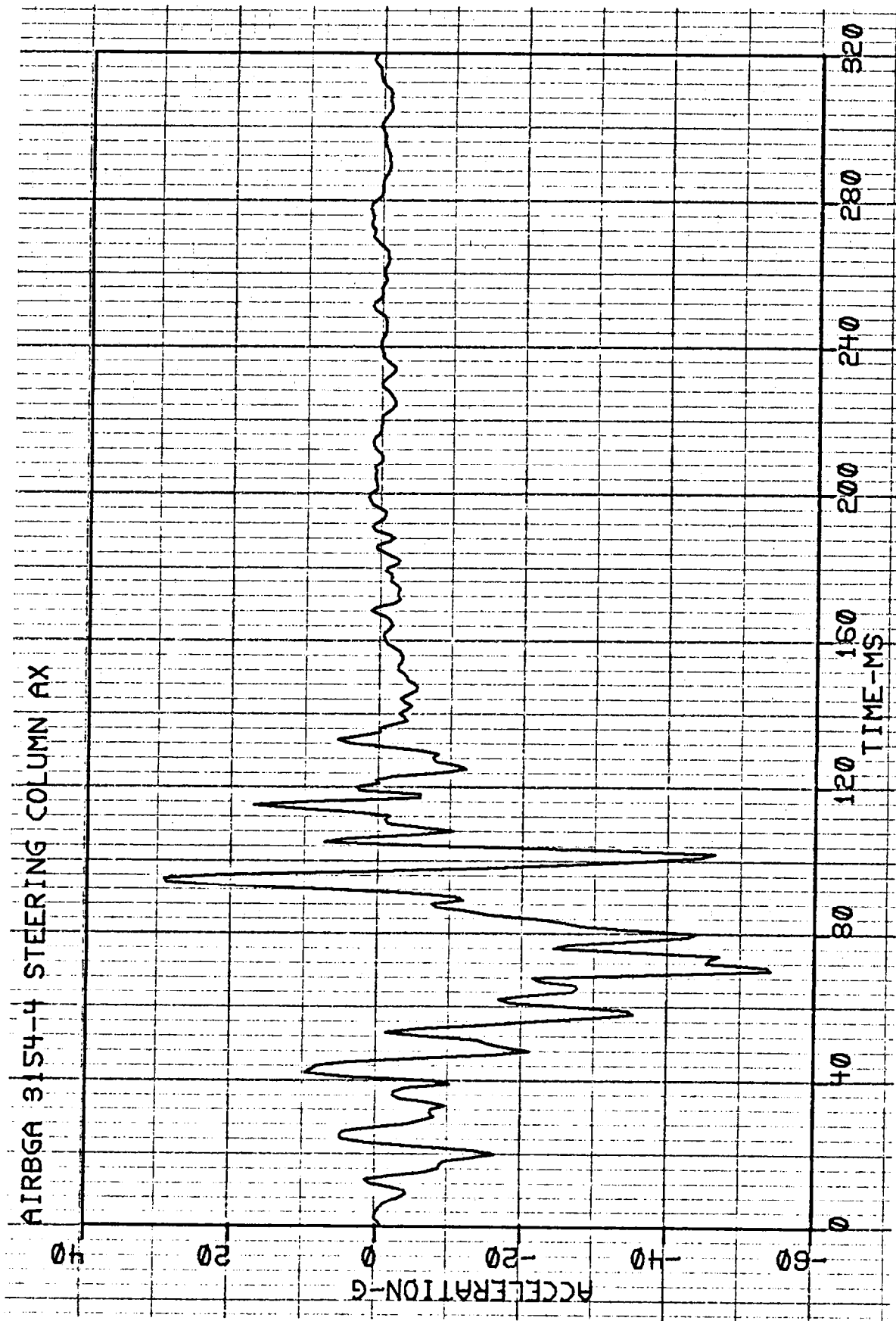


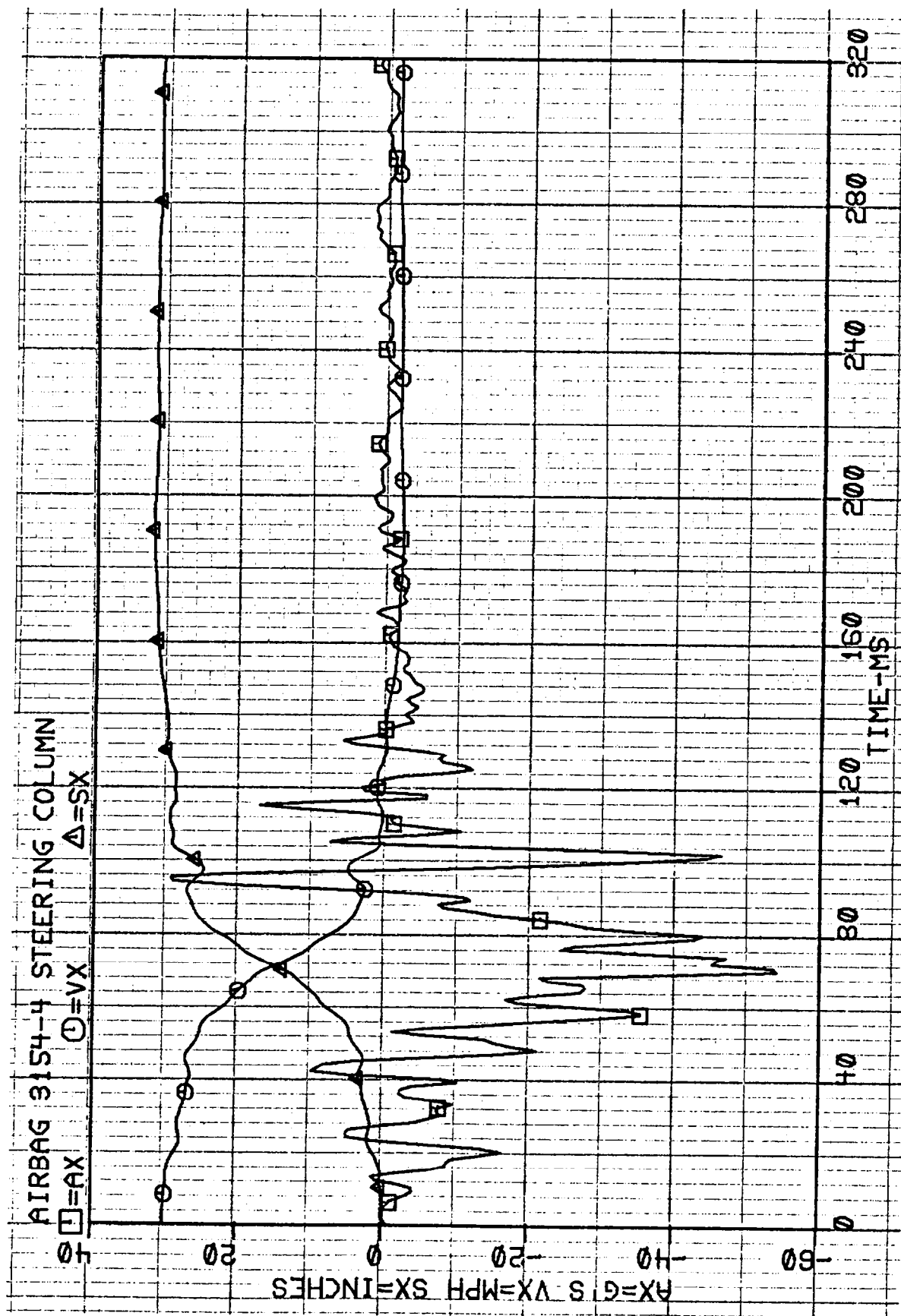


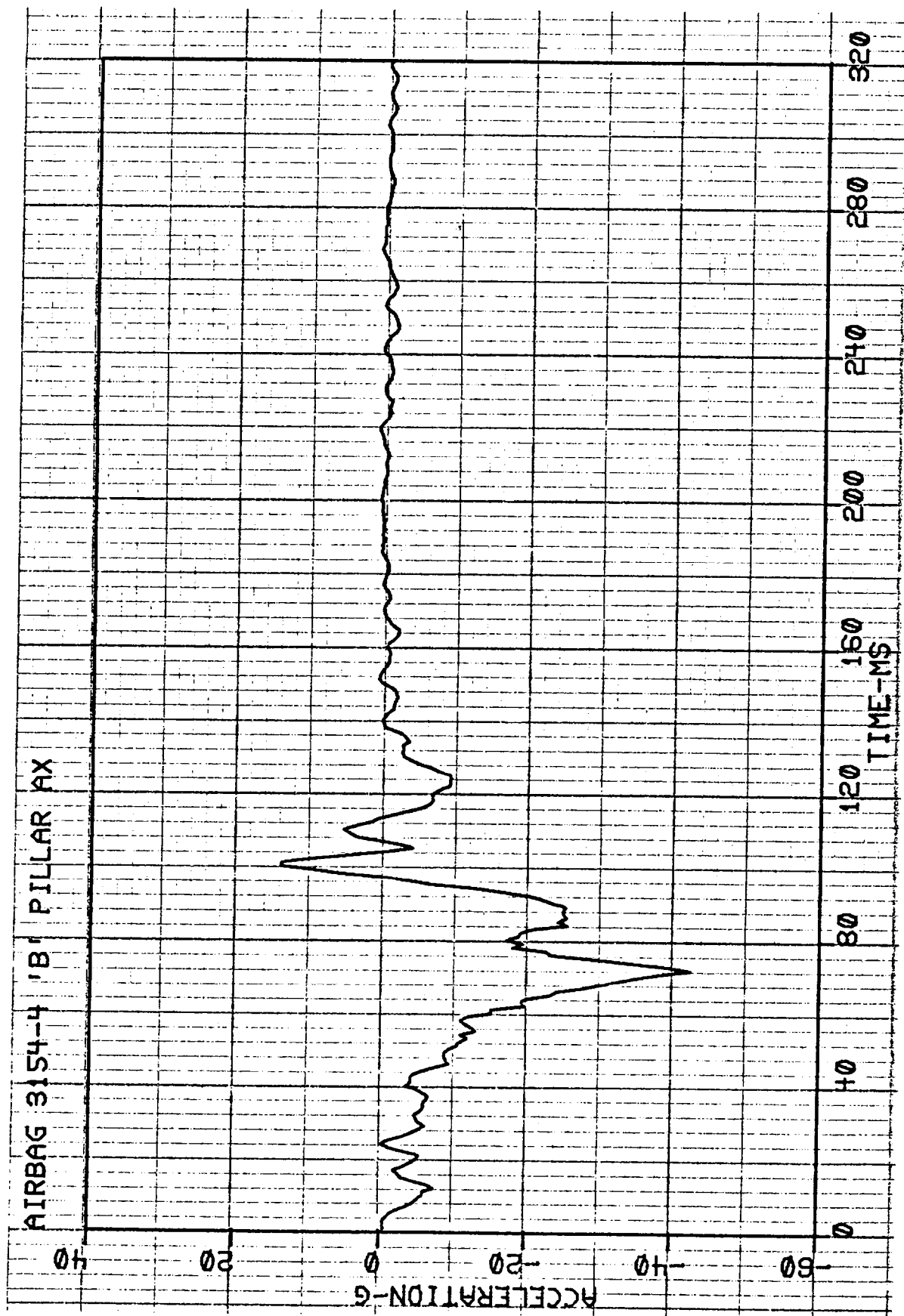


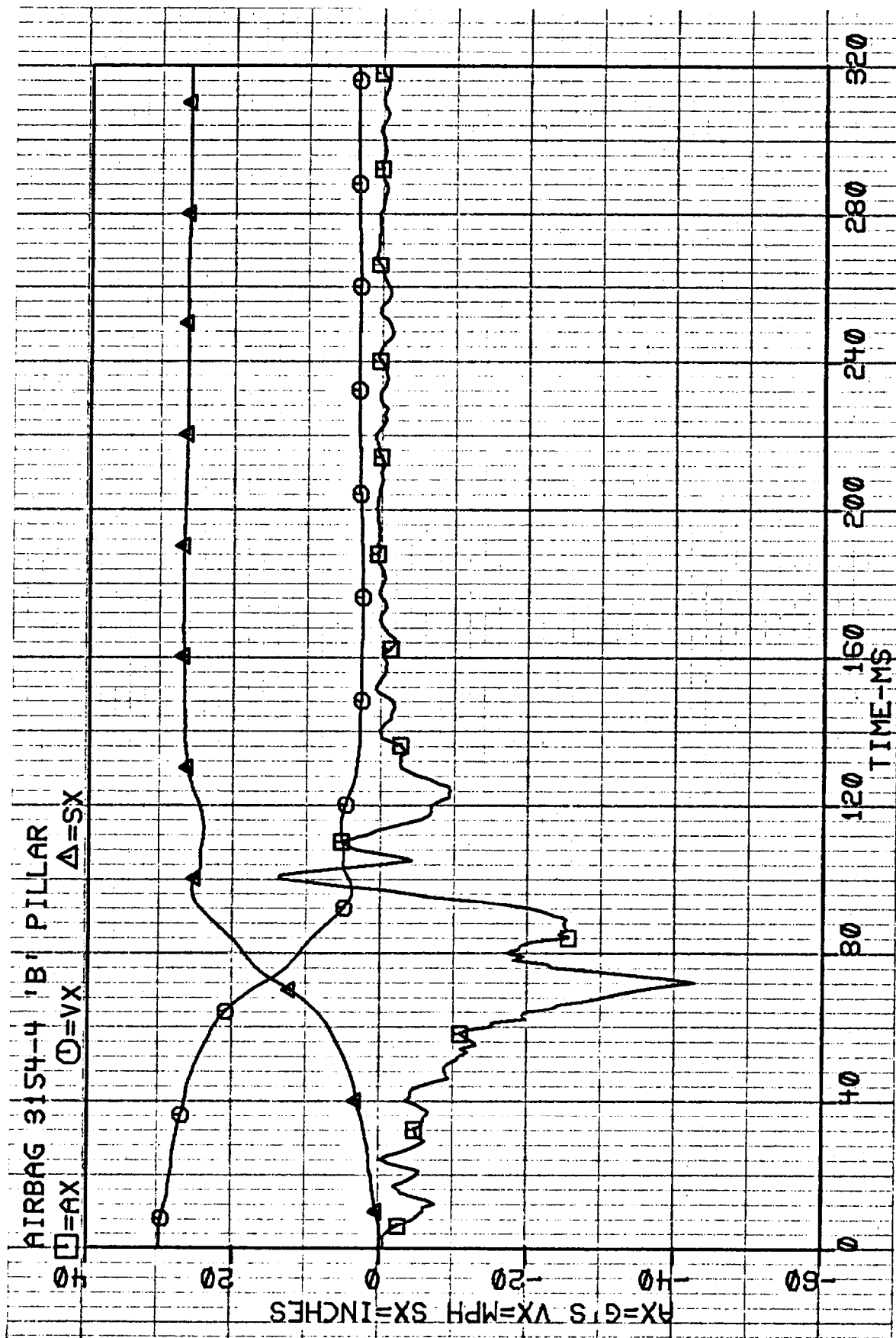


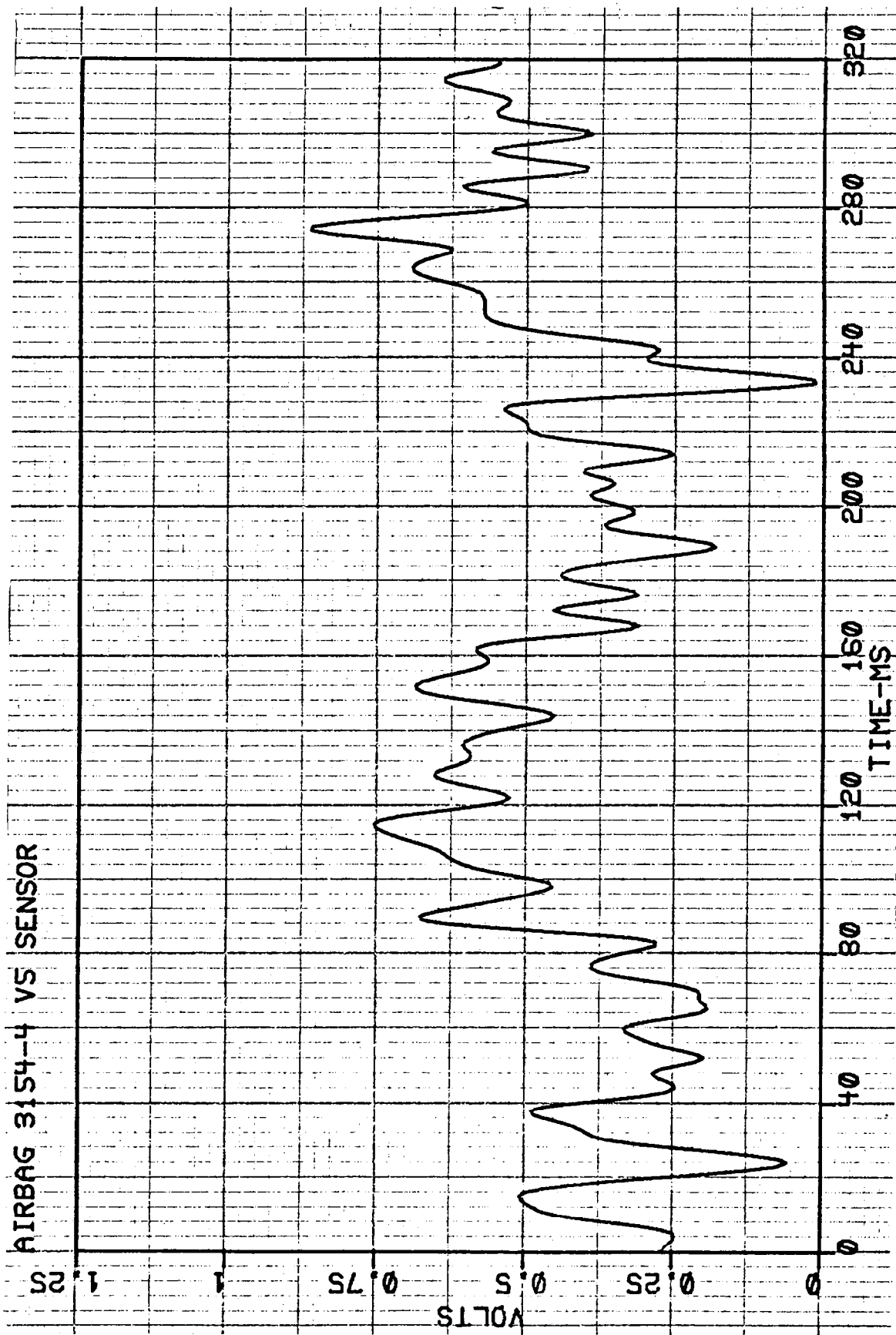


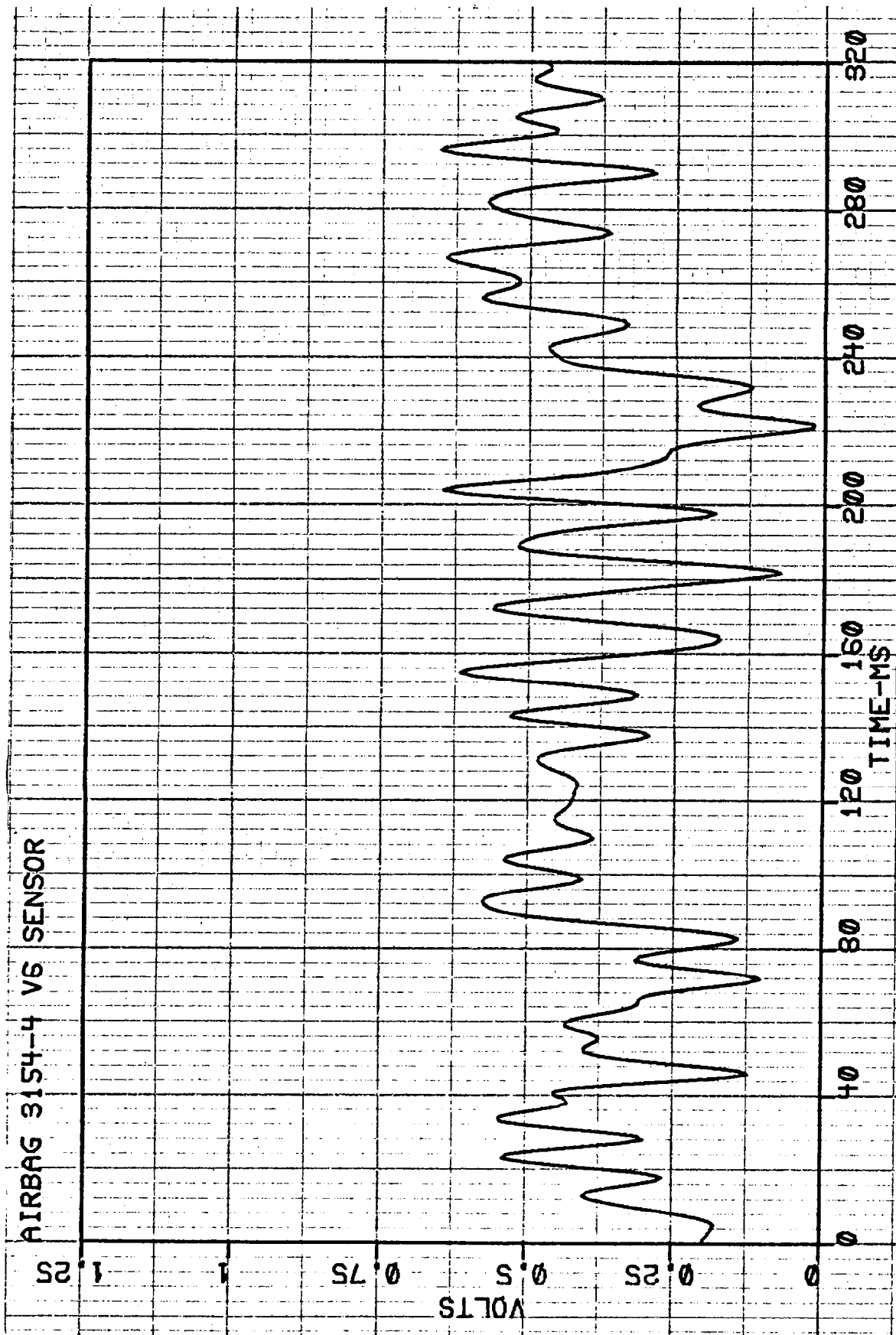


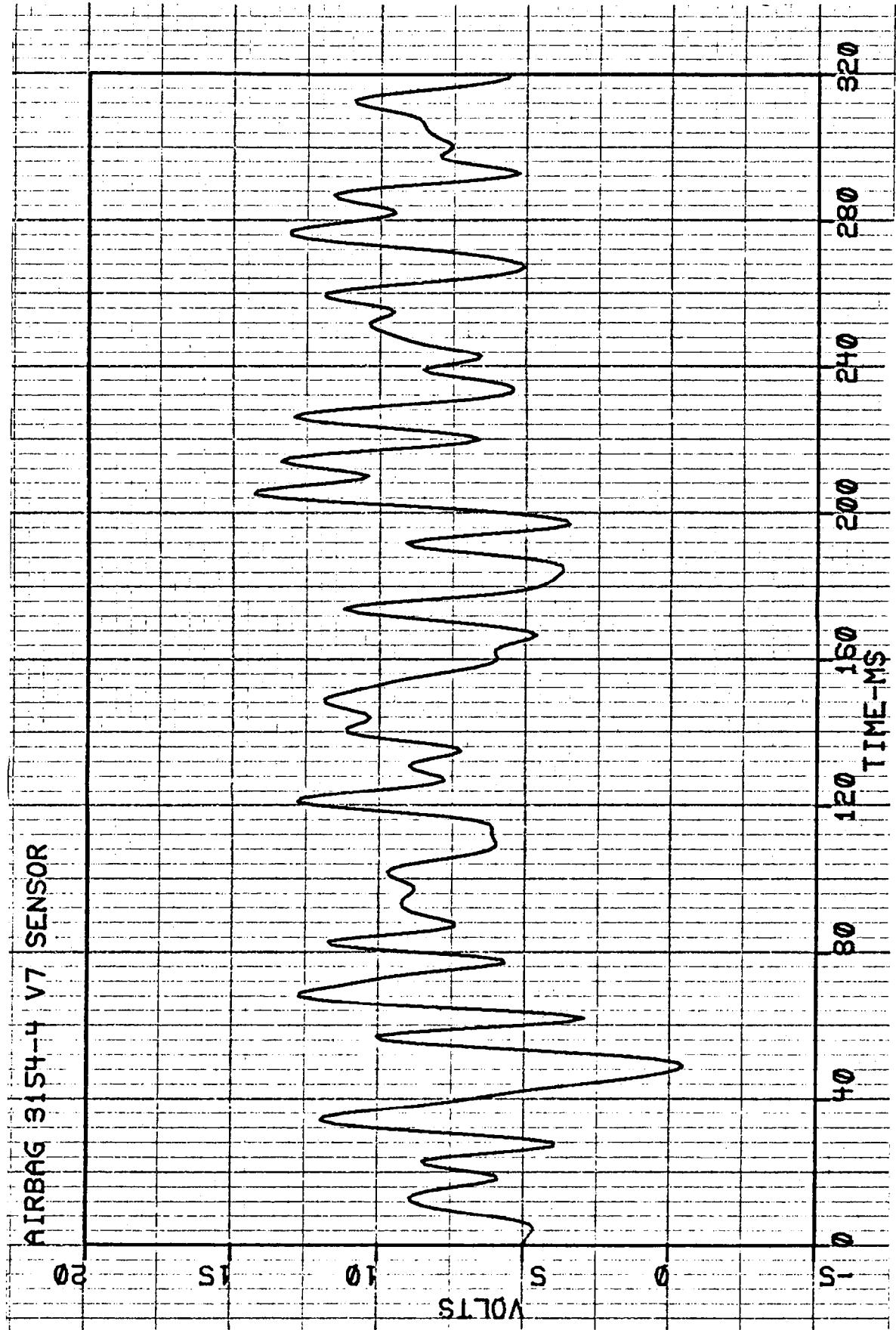


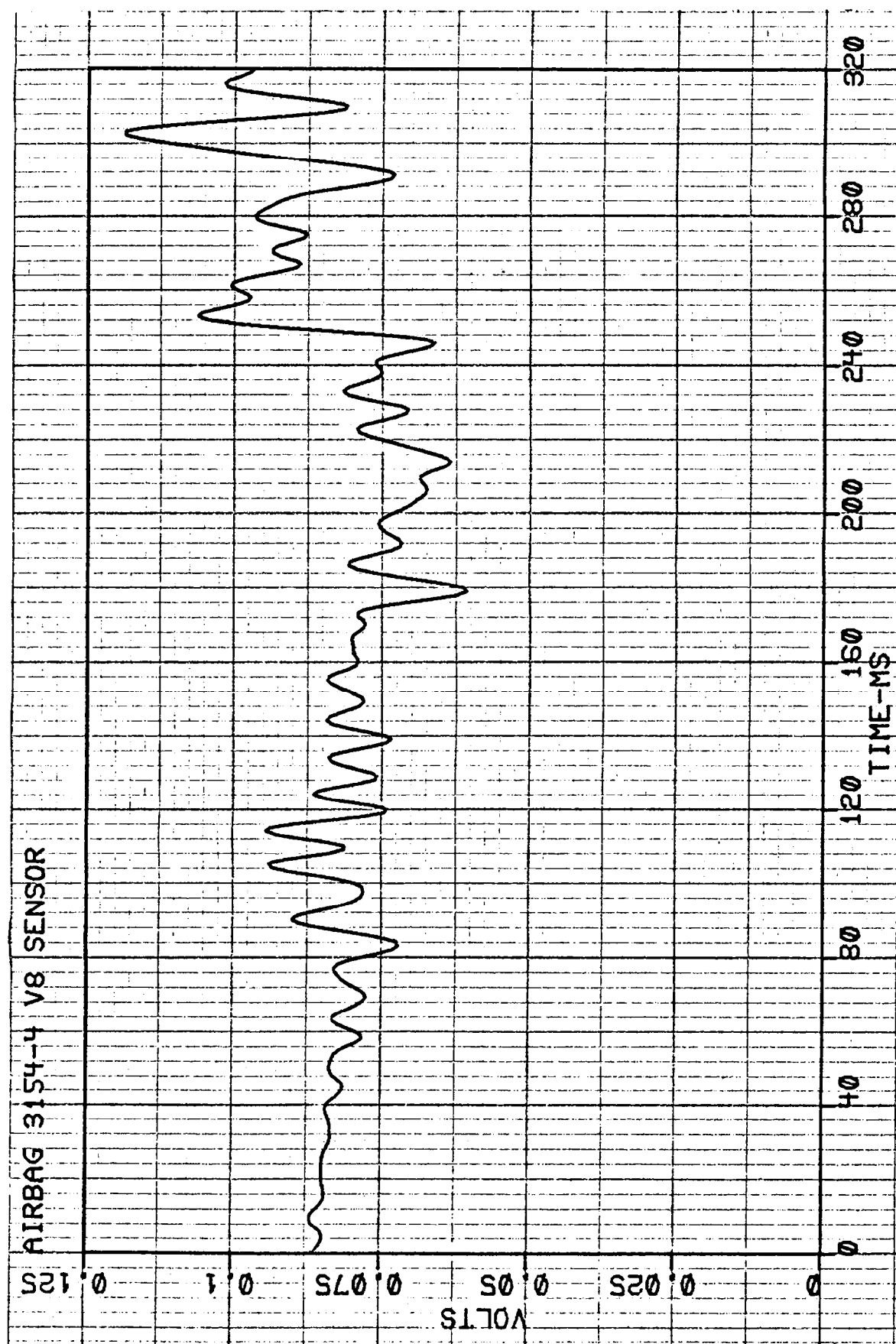












APPENDIX B
PHOTOGRAPHS



FIGURE B-1. PRE-TEST OVERALL VIEW OF VEHICLE.

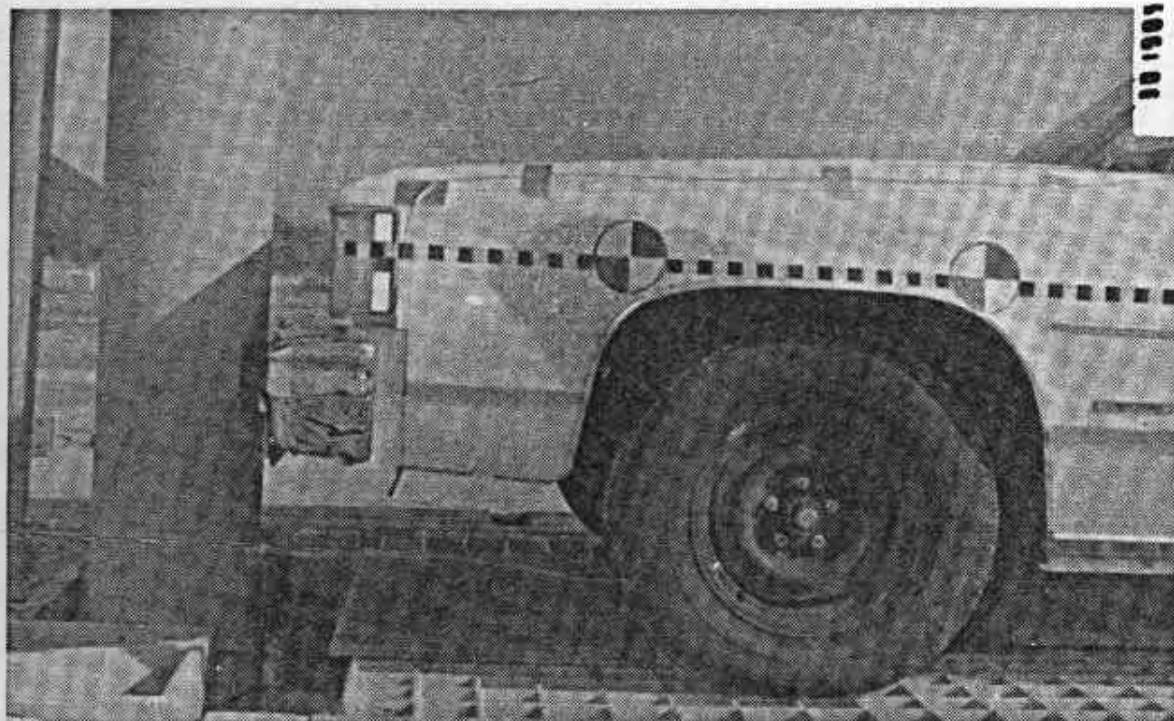


FIGURE B-2. PRE-TEST LEFT SIDE CLOSE-UP VIEW OF VEHICLE.



FIGURE B-3. POST-TEST LEFT SIDE VIEW OF VEHICLE.

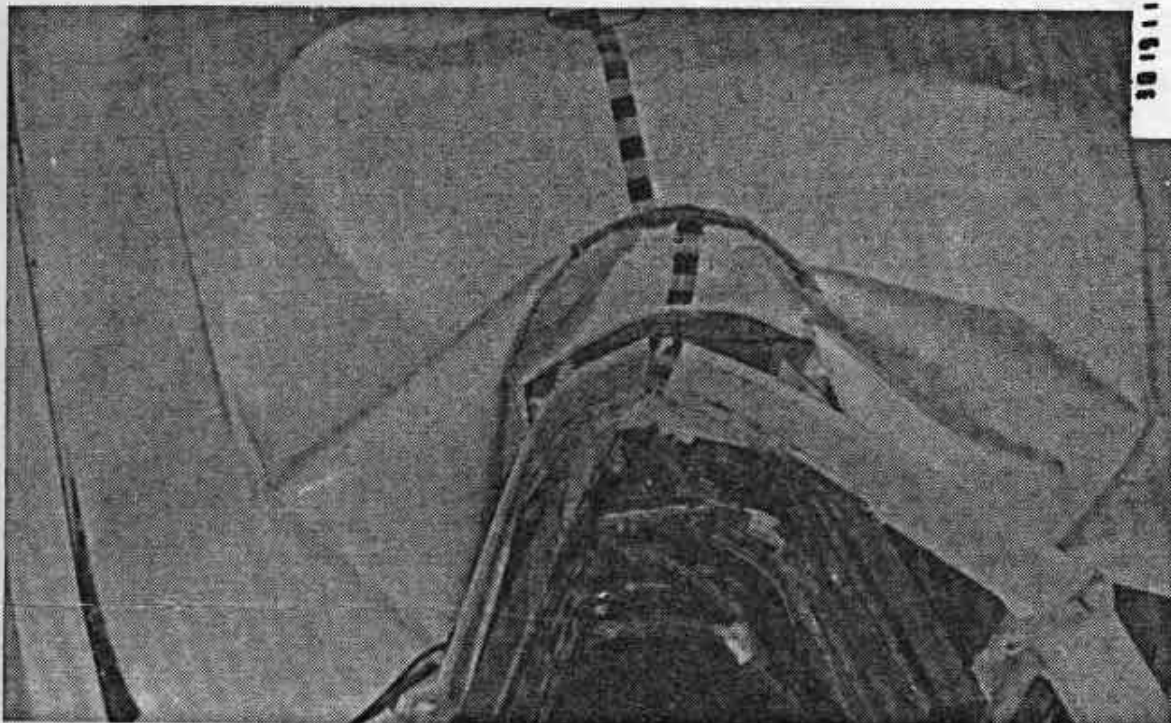


FIGURE B-4. POST-TEST OVERHEAD VIEW OF CRUSH AREA.

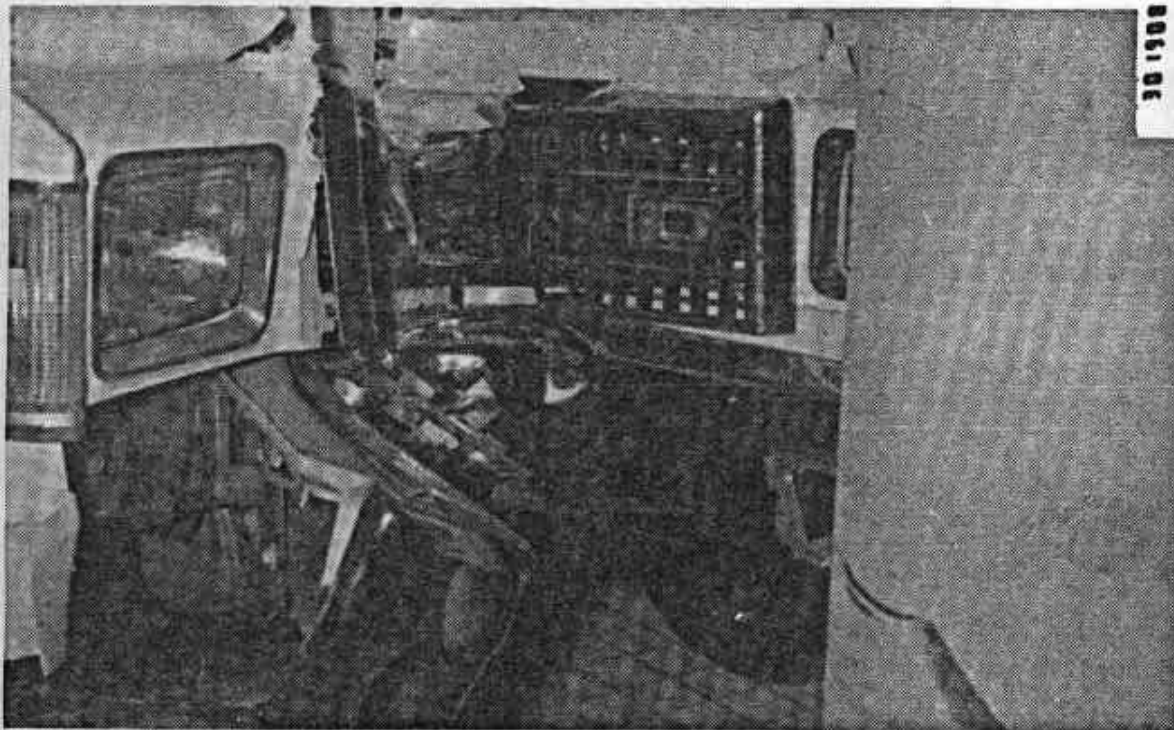


FIGURE B-5. POST-TEST OBLIQUE FRONTAL VIEW OF CRUSH AREA.

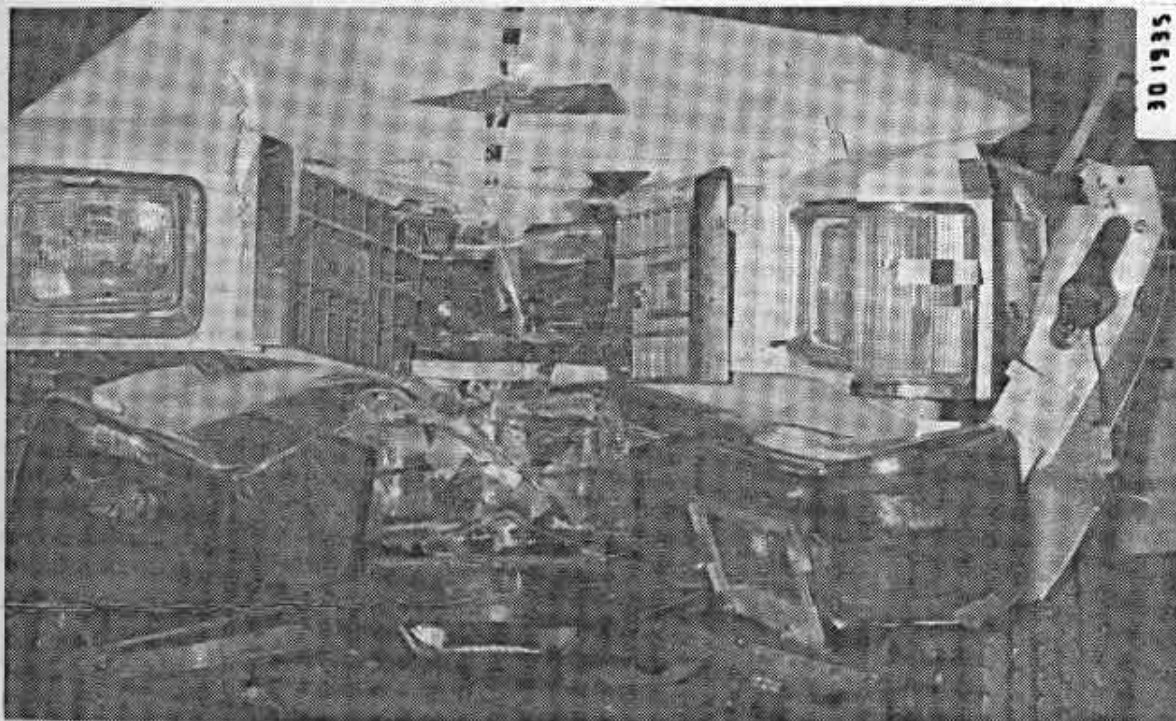


FIGURE B-6. POST-TEST FRONT VIEW OF VEHICLE.

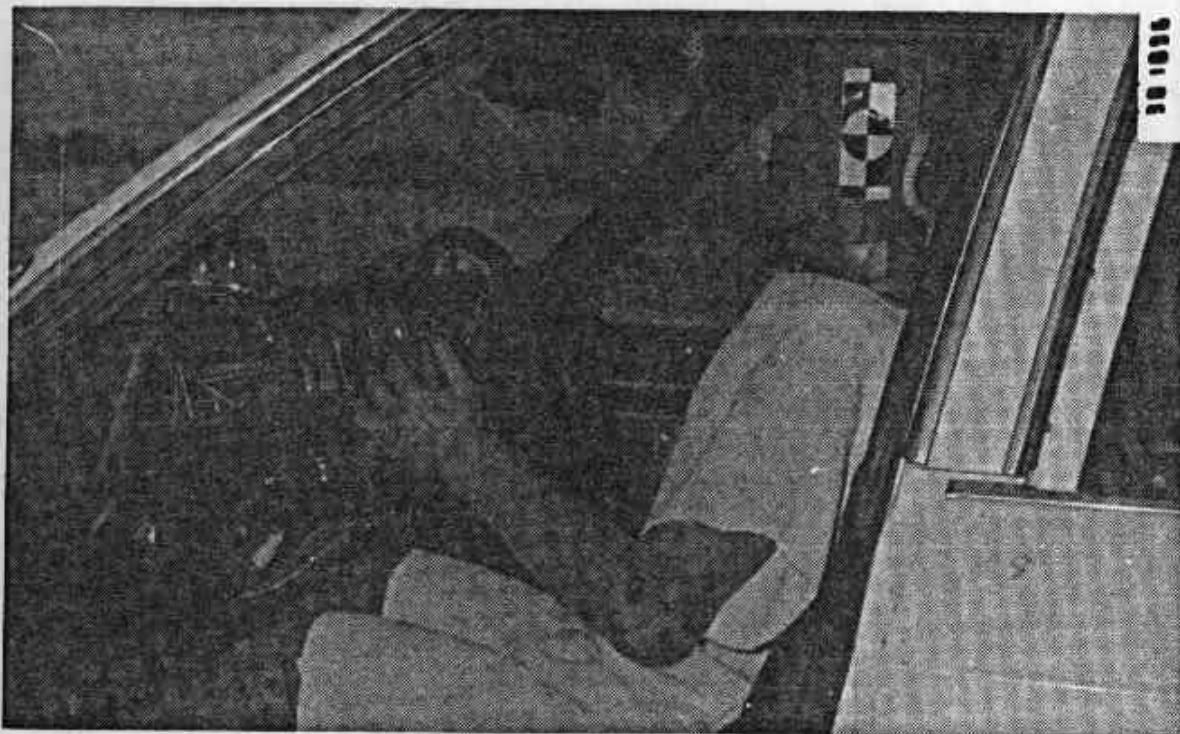


FIGURE B-7. PRE-TEST VIEW OF DRIVER.



FIGURE B-8. POST-TEST VIEW OF DRIVER.