5.5 - DØT0040
5.7 -
5.8 - DØT0160

A SUBSIDIARY OF TALLEY INDUSTRIES

1850 WEST PINNACLE PEAK ROAD · PHOENIX ARIZONA 85027 · (602) 942-3300

TASK 5 REPORT OF TESTS 5.5, 5.7, AND 5.8 FOR DEVELOPMENT OF COMPLIANCE TEST FOR TRUCK REAR UNDERRIDE PROTECTION

DYNAMIC SCIENCE, INC.
A Talley Industries Company
1850 West Pinnacle Peak Road
Phoenix, Arizona 85027

CONTRACT DOT-HS-8-01905

February 1979

INTERIM REPORT

Document is available to the U.S. Public through the National Technical Information Service, Springfield, Virginia 22161

Prepared for:

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

Prepared for the Department of Transportation, National Highway Traffic Safety Administration under Contract No. DOT-HS-8-01905. The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the National Highway Traffic Safety Administration.

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle TASK 5 REPORT OF TESTS 5.5, 5.7 AND 5.8 FOR DEVELOPMENT OF COMPLIANCE TEST FOR TRUCK REAR UNDERRIDE PROTECTION		5. Report Date February 1979 6. Performing Orgn Code
7. Author(s) Baczynski, R., Davis, S., Cropper, R.		8. Performing Orgn Rpt No. 8319-79-43A
9. Performing Organization Name and Address Dynamic Science, Inc. A Talley Industries Company 1850 West Pinnacle Peak Road Phoenix, Arizona 85027		10. Work Unit No. 11. Contract or Grant No. DOT-HS-8-01905
12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Administration Washington, D.C. 20590		13. Type of Report and Period Covered TEST REPORT Dec. 1978 - Feb. 1979 14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

This report presents the results of three of eight passenger car-to-rear underride crash tests conducted in accordance with the requirements of Task 5 of the "Development of Compliance Test for Truck Rear Underride Protection" program. The test vehicles selected for these tests were two 1978 Chevrolet Impalas, and one 1978 Volkswagen Rabbit.

These vehicles were impacted into bolt-on, rigid, cantilevered guards mounted to a truck/trailer body simulator at selected heights above ground level. The impacts were conducted in an offset condition. The centerlines of the cars were aligned 6 inches inboard of the outer edge of the trailer body simulator.

The trailer body simulator used for the tests was a modified, 1977 Fruehauf, 40-foot, heavy duty platform trailer with Select-A-Point tandem rear wheels. For these tests, two instrumented 50th percentile Part 572 anthropomorphic dummies were placed in the driver and front passenger positions in the car. The occupants were restrained with the vehicle's restraint system. The seat tracks were welded in the midposition to prevent breakaway and/or rotation.

17. Key Words	18. Distribution Statement
Underride Guard, Crash Tests	Document is available to the public through the National Technical Information Service, Springfield, Virginia 22161

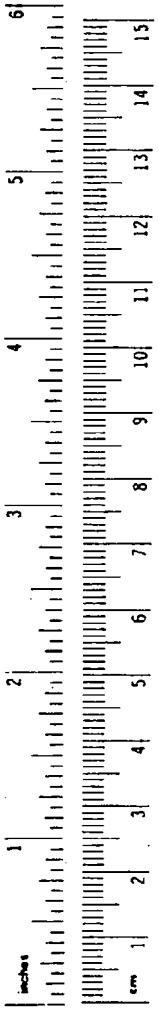
19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. Pages	22. Price
Unclassified	Unclassified	181	

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

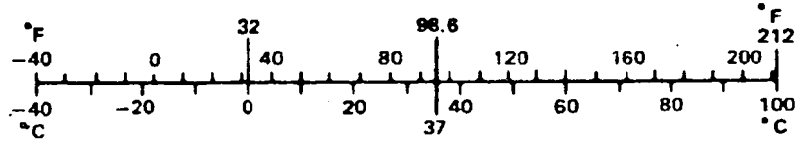


TABLE OF CONTENTS

		Page
1.0	INTRODUCTION.	1-1
	1.1 TEST OBJECTIVES.	1-5
2.0	TEST METHODOLOGY.	2-1
	2.1 DATA ACQUISITION METHODS	2-5
3.0	DATA ACQUISITION.	3-1
	3.1 INSTRUMENTATION.	3-1
	3.1.1 Test Vehicle Instrumentation.	3-1
	3.1.2 Trailer Body Simulator Instrumentation. .	3-4
	3.2 PHOTOGRAPHY REQUIREMENTS	3-4
	3.2.1 Vehicle-to-Trailer Body Simulator Test Photography	3-4
	3.3 VEHICLE STRUCTURAL DEFORMATION DATA.	3-7
	3.3.1 Data Acquisition.	3-7
4.0	SUMMARY OF TEST RESULTS	4-1
	4.1 TEST 5.5	4-1
	4.1.1 Test Conditions - Test 5.5.	4-1
	4.1.2 Test Results - Test 5.5	4-3
	4.2 TEST 5.7	4-4
	4.2.1 Test Conditions - Test 5.7.	4-4
	4.2.2 Test Results - Test 5.7	4-5
	4.3 TEST 5.8	4-6
	4.3.1 Test Conditions - Test 5.8.	4-6
	4.3.2 Test Results - Test 5.8	4-7
	4.4 TEST RESULTS SUMMARY	4-8

TABLE OF CONTENTS (CONTD)

	Page
5.0 TEST FACILITIES AND EQUIPMENT	5-1
5.1 GENERAL.	5-1
5.2 FACILITY AND EQUIPMENT DESCRIPTION	5-1
5.2.1 Test Track and Guidance System.	5-1
5.2.2 Tow System and Velocity Control	5-4
5.2.3 Abort System.	5-4
5.2.4 Master Control System	5-5
5.2.5 High-Speed Photography.	5-5
APPENDIX A - TEST 5.5 TEST DATA SUMMARY, 1978 CHEVROLET IMPALA OFFSET IMPACT @ 40 MPH	A-1
APPENDIX B - TEST 5.7 TEST DATA SUMMARY, 1978 CHEVROLET IMPALA OFFSET IMPACT @ 40 MPH	B-1
APPENDIX C - TEST 5.8 TEST DATA SUMMARY, 1978 VOLKSWAGEN RABBIT @ 40 MPH.	C-1

LIST OF ILLUSTRATIONS

Figure		Page
1-1	Dynamic Science Cantilevered T-1 Steel Guard (A).	1-4
2-1	Trailer Body Interface for Test Guard.	2-2
2-2	Tests 5.5, 5.7, and 5.8 Truck Body Simulator Test Site Layout	2-3
2-3	Task 5 Offset Underride Guard Test Site.	2-4
2-4	Data Acquisition - Vehicle-to-Truck Underride Simulator.	2-6
3-1	1978 Chevrolet Impala Accelerometer Locations. .	3-2
3-2	1978 Volkswagen Rabbit Accelerometer Locations.	3-3
3-3	Tests No. 5.5, 5.7, and 5.8 Underride Guard Instrumentation.	3-5

LIST OF ILLUSTRATIONS (CONTD)

Figure		Page
4-1	Post-test Static Driver Side Compartment Intrusion - Chevrolet Impala.	4-13
4-2	Post-test Static Driver Side Compartment Intrusion - Volkswagen Rabbit	4-14
5-1	Monorail Impact Facility.	5-2

LIST OF TABLES

Table		Page
1-1	Task 5 Crash Test Matrix.	1-2
2-1	Data Requirements	2-7
3-1	Camera Locations.	3-6
3-2	Car-to-Truck Body Simulator Tests Photographic Requirements and Checklist.	3-8
4-1	Summary of Underride Guard Test Results	4-10
4-2	Summary of Underride Test Occupant Response Data - Task 5 Right Offset Tests.	4-11
4-3	Summary of Test Vehicle Static Deformation. . .	4-12
5-1	Test Equipment List and Function.	5-3

1.0 INTRODUCTION

This report presents the results of two full-size, and one small-size passenger car-to-rear truck underride guard crash tests conducted in accordance with the requirements of Task 5 of the "Development of Compliance Test for Truck Rear Underride Protection" program. This program was conducted for the Department of Transportation, National Highway Traffic Safety Administration, under Contract No. DOT-HS-8-01905. The test vehicles for Tests 5.5 and 5.7 were 1978 Chevrolet Impala four-door sedans; the test vehicle for Test 5.8 was a 1978 Volkswagen Rabbit four-door sedan. These vehicles were impacted into a bolt-on, rigid, cantilevered underride guard mounted to a truck/trailer body simulator in an offset condition. The centerlines of the cars were aligned six inches inboard of the outer edge of the trailer body simulator. The test matrix and the conditions for the tests in Task 5 are summarized in Table 1-1. The trailer body simulator used for these tests was a modified, 1977 Fruehauf, 40-foot, heavy duty platform with Select-A-Point tandem rear wheels.

For these tests, two Part 572 instrumented dummies (GFE) were positioned in the left and right front occupant positions in the car. Each occupant was properly restrained with the vehicle's restraint system. The seat tracks were welded in their midposition to prevent breakaway and/or rotation.

TABLE 1-1. TASK 5 CRASH TEST MATRIX

Test No.	Test Date	Struck Object	Bullet Vehicle	Impact Velocity (mph)	Engagement With Guard
5.1	9/07/78	Guard B 24" Height*	1978 Volkswagen Rabbit 4-door Sedan	40.43	Symmetric
5.2	10/03/78	Guard B 22" Height*	1978 Ford Fiesta 2-door Sedan	40.64	Symmetric
5.3	10/26/78	DSI T-1 (A) Guard 20" Height**	1978 Volkswagen Rabbit 4-door Sedan	40.44	Symmetric
5.4	11/22/78	DSI T-1 (B) Guard 24" Height	1978 Chevrolet Impala 4-door Sedan	40.40	Symmetric
5.5	12/28/78	DSI T-1 (B) Guard 24" Height	1978 Chevrolet Impala 4-door Sedan	40.03	Offset
5.6	11/27/78	DSI T-1 (B) Guard Height	1978 Chevrolet Impala 4-door Sedan	40.58	Symmetric
5.7	1/26/79	DSI T-1 (C) Guard 22" Height	1978 Chevrolet Impala 4-door Sedan	38.94	Offset
5.8	1/22/79	DSI T-1 (C) Guard 22" Height	1978 Volkswagen Rabbit 4-door Sedan	40.09	Offset

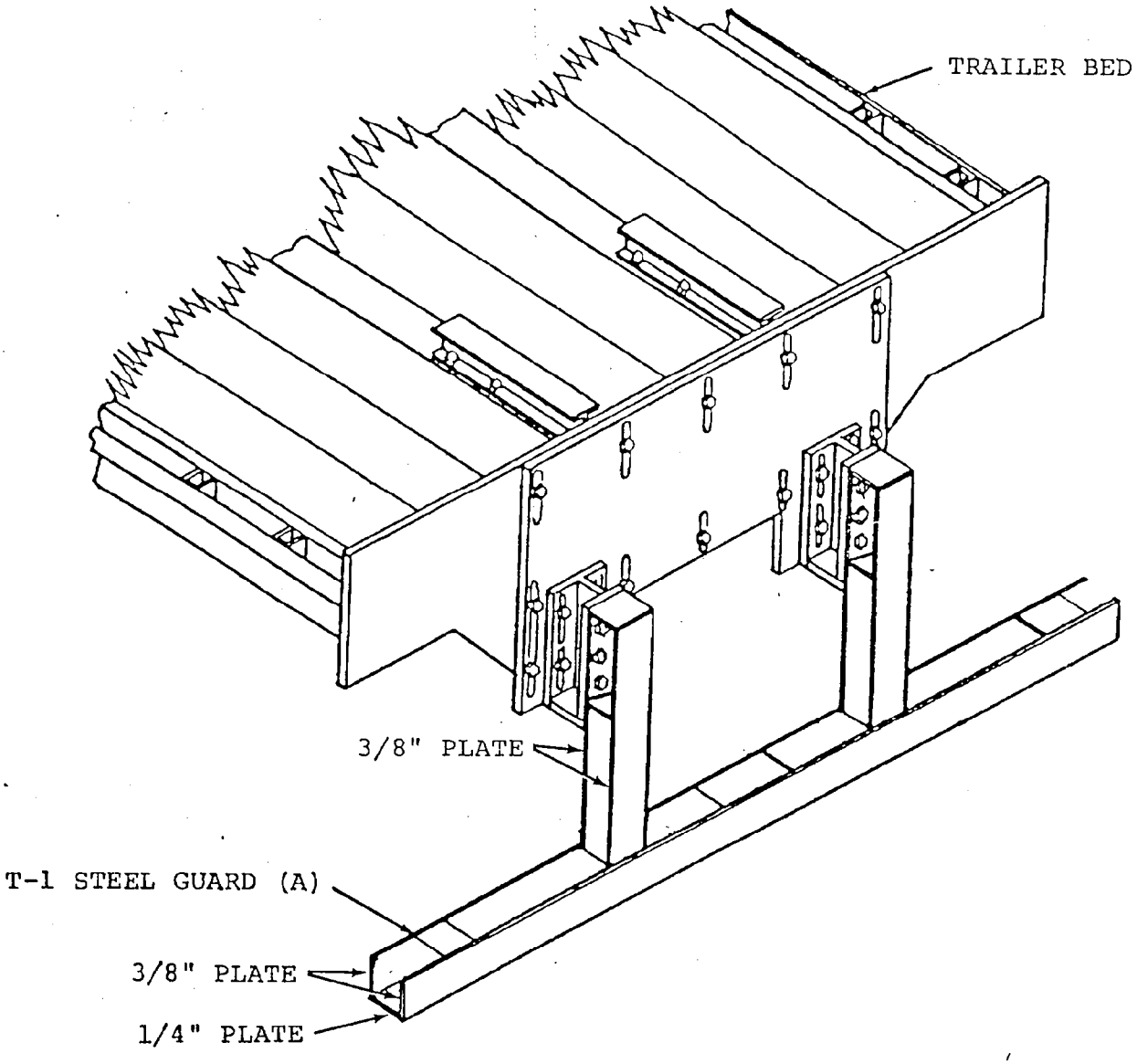
*Guard B is the Fruehauf Guard, used for Task 3 and Task 4, modified to provide greater rigidity and proper height.
**Dynamic Science T-1 steel guard progressively strengthened, as required (Versions A, B, and C).

2/5/79

Starting with Test 5.3, an underride guard (designated T-1 steel guard) was designed by Dynamic Science to provide a rigid cantilevered design adequate to sustain loads as required to obtain data with the small and large passenger cars as defined in the Task 5 test matrix. Three progressively strengthened versions of this design (A, B, and C) were used for the tests in Task 5. It should be noted that these guards were not optimized for weight reduction since Dynamic Science's charter is to develop test procedures, not optimize underride guards.

The T-1 steel guard (Design A) was designed for 100K and 50K ultimate load in the symmetric and offset mode, respectively (see Figure 1-1). The basic design of this guard utilized two vertical I-beams and a horizontal channel section. Because the high strength T-1 steel used for the guard (100 ksi yield strength) is available in flat plate only, the sections were fabricated by saw-cutting to size and welding the sections together with high-strength (103 ksi) welding wire. The weight of Design A was 225 pounds, including all hardware. This Guard (A) was used in Test 5.3.

Due to the high loads (91,000 pounds) generated in Test 5.3 with the small VW Rabbit (symmetric impact at 40 mph), it was obvious that the large car would require a stronger guard. The design was modified (Design B) to withstand an ultimate load of 80 klb in the offset mode. Because the offset-type test requires the guard to withstand high bending moments on the cantilevered horizontal member outboard of the vertical I-beam, designing for this condition will provide a guard that will sustain very high loads in the symmetric impact test. Four bolts (two on each side) were added for mounting of the guard. T-1 steel guard Design B was



9 0 2 0 3 6 0 3 8

Figure 1-1. Dynamic Science Cantilevered T-1 Steel Guard (A).

used for Tests 5.4, 5.5, and 5.6. This Design B weighed 254 pounds, including all hardware.

T-1 steel guard Design B collapsed during the offset impact test with the Chevrolet Impala at 40 mph (24-in. guard ground clearance) because the load reached 94,000 pounds. The T-1 steel guard was modified (Design C) to sustain an ultimate load of 140 klb in the offset mode for Test 5.7. Additional support plates of 36 ksi yield were added to the flanges of the I-beams and channel section. The I-beams were also boxed in at the sides to prevent separation of the I-beam flanges. This Guard C weight was 395 pounds. It should be noted that this weight would have been much less if T-1 steel had been used for structural reinforcement instead of the lower strength 36 ksi steel.

1.1 TEST OBJECTIVES

The object of these tests was to obtain the necessary data for establishing appropriate criteria for development of compliance test parameters and procedures for truck-trailer rear underride protection. The specific object in Task 5 is to test selected new guard designs as to their effectiveness in rear underride collisions with current production full- and small-size passenger cars, and to provide a basis for selecting the best underride guard with regard to critical parameters (geometric design, strength, energy-absorbing capabilities, economic and environmental factors).

2.0 TEST METHODOLOGY

Three vehicle-to-truck rear underride guard tests were conducted at the barrier impact facility. The trailer body simulator developed in Task 3 was utilized for mounting of the selected underride guard in these tests (see Figure 2-1). For all tests, the selected test underride guards were mounted to the trailer body simulator. The layout drawing of the test vehicle and trailer simulator arrangement for these tests is shown in Figure 2-2.

The three tests were conducted in an offset engagement mode. The centerlines of the cars were aligned 6 inches inboard of the outer edge of the trailer body simulator (42 inches off-center) (see Figure 2-3).

To prevent damage to the trailer undercarriage in the event of excessive underride by the test vehicle, a steel plate was mounted just aft of the rear wheels, supported on pivot pins from the trailer main I-beams. The plate was backed up by the tandem wheel tires. The face of the impact plate was covered with honeycomb material to absorb the energy of the vehicle impact.

The vehicle impact velocity (see Table 1-1) was controlled to within ±1 mph. The test vehicle was prepared in accordance with the requirements of the test plan. It was then placed at the head of the test track facing the barrier where it was attached to the tow and guidance system. The trailer body simulator was prepared in accordance with the requirements of the test plan. Upon completion of the pre-crash checkout of the instrumentation, the vehicle

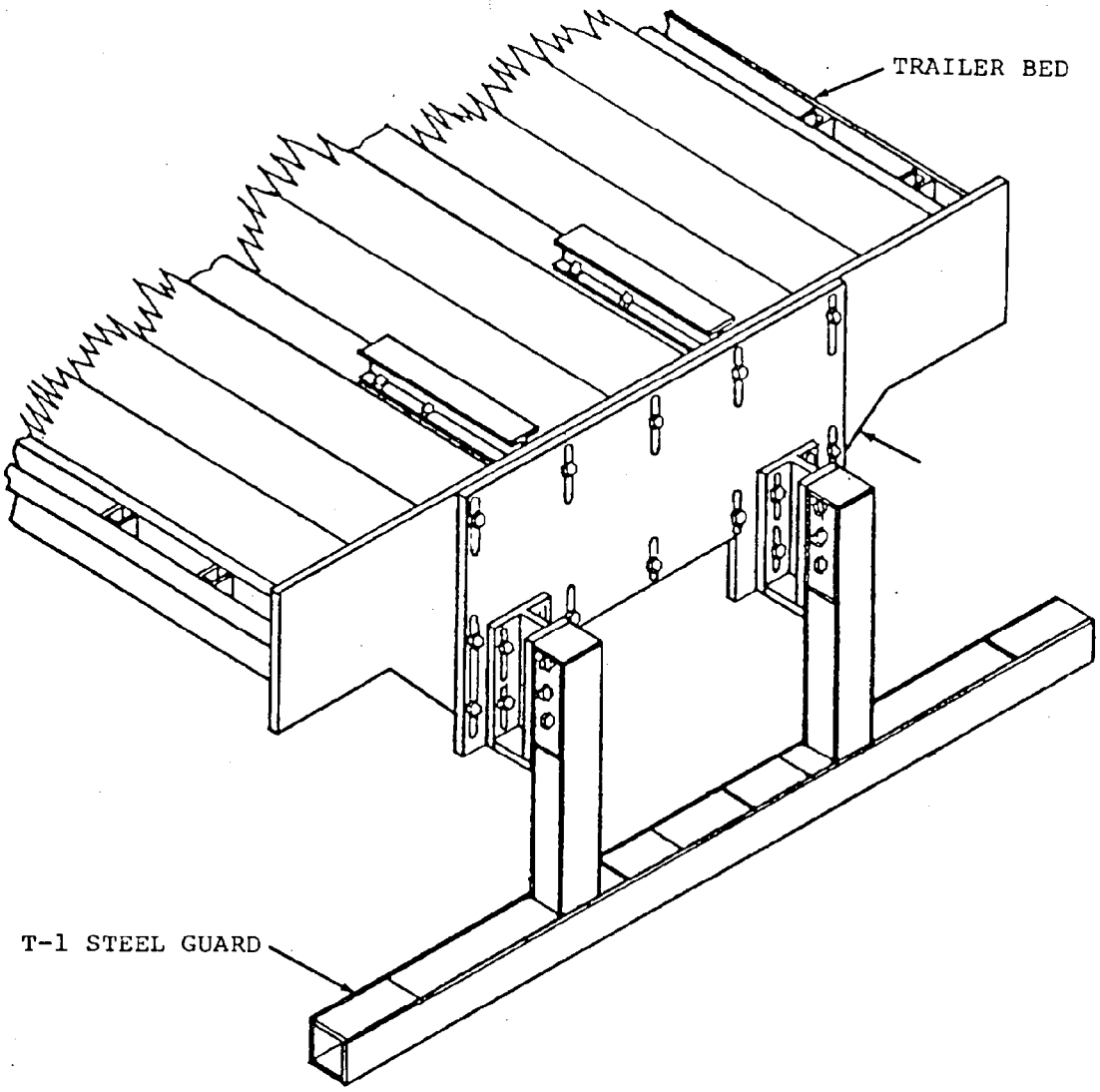
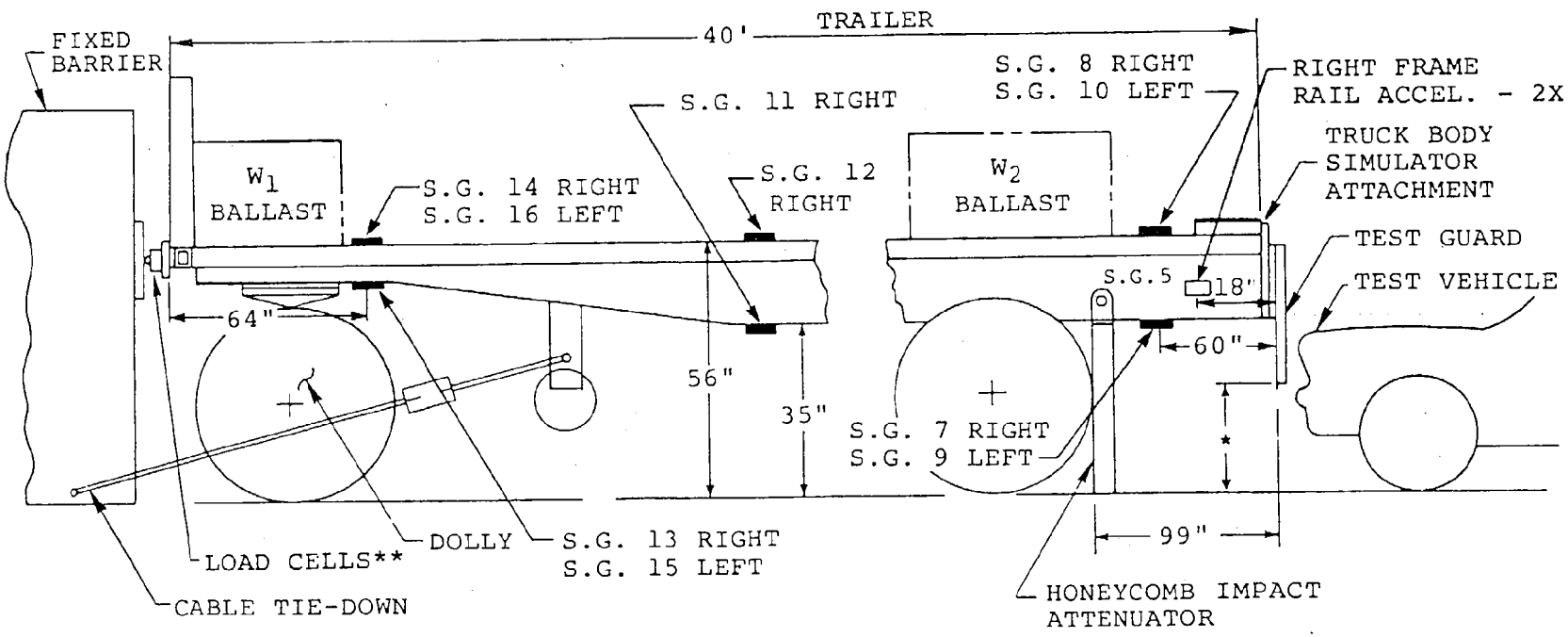


Figure 2-1. Trailer Body Interface for Test Guard.



*See Table 1-1, Test Matrix.
**Four 50 Klb - Test 5.5, Five 50 Klb - Tests 5.7 and 5.8.
NOTE: STRAIN GAUGES 7 THRU 16 MOUNTED ON UPPER AND LOWER FLANGES OF TRAILER SIMULATOR FRAME RAILS.

Figure 2-2. Tests 5.5, 5.7, and 5.8 Truck Body Simulator Test Site Layout.

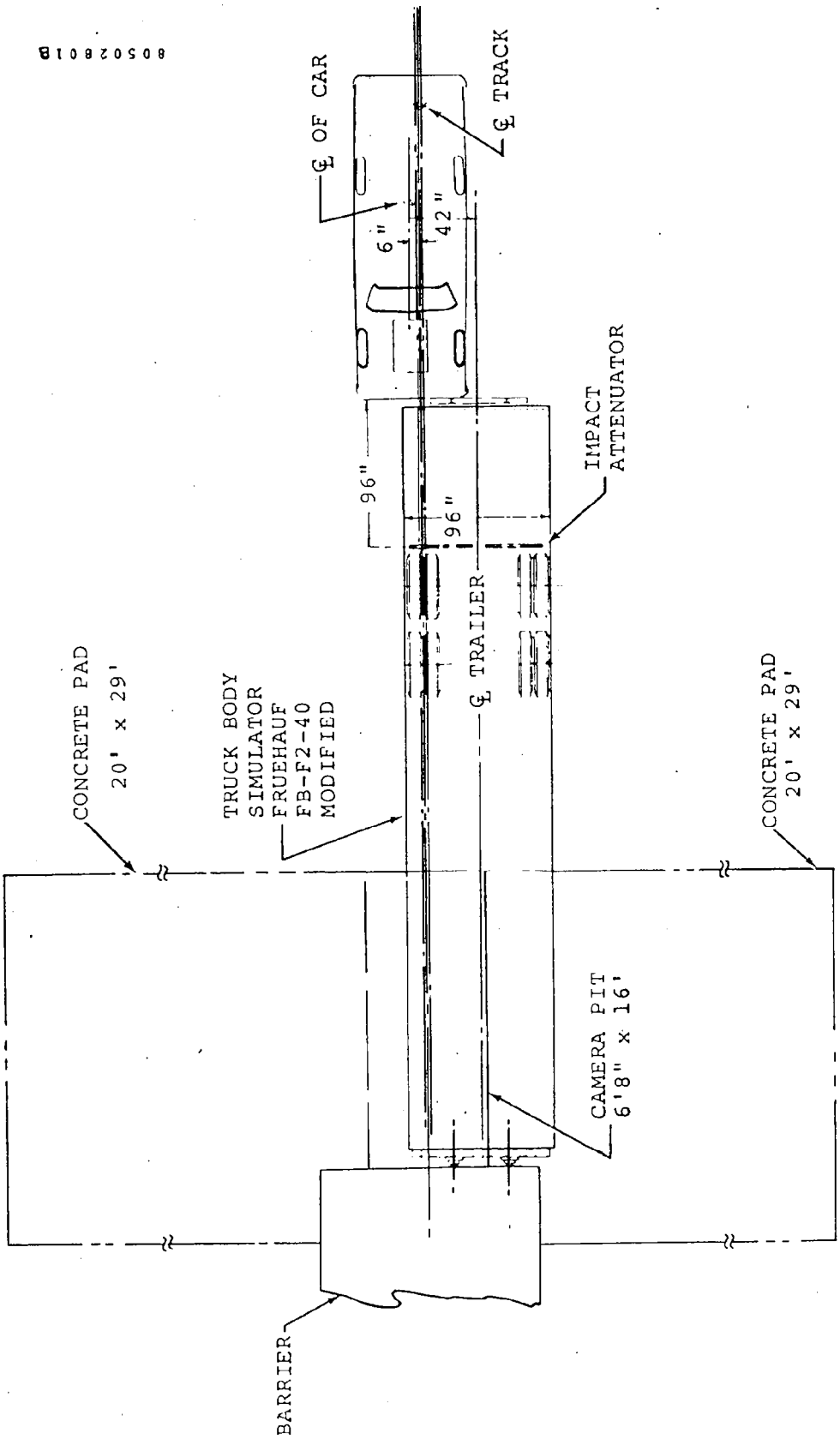


Figure 2-3. Task 5 Offset Underride Guard Test Site.

was towed to the specified test speed and released from the tow system just prior to impact. The data from the test vehicle was transmitted to the data acquisition center via umbilical cable with telemetry as a backup. The data from the trailer body simulator was transmitted by umbilical cable only (see Figure 2-4).

2.1 DATA ACQUISITION METHODS

The overall plan for obtaining the necessary data is outlined in Table 2-1. The table defines the test parameter, measurement method, and recording method used during conduct of these tests.

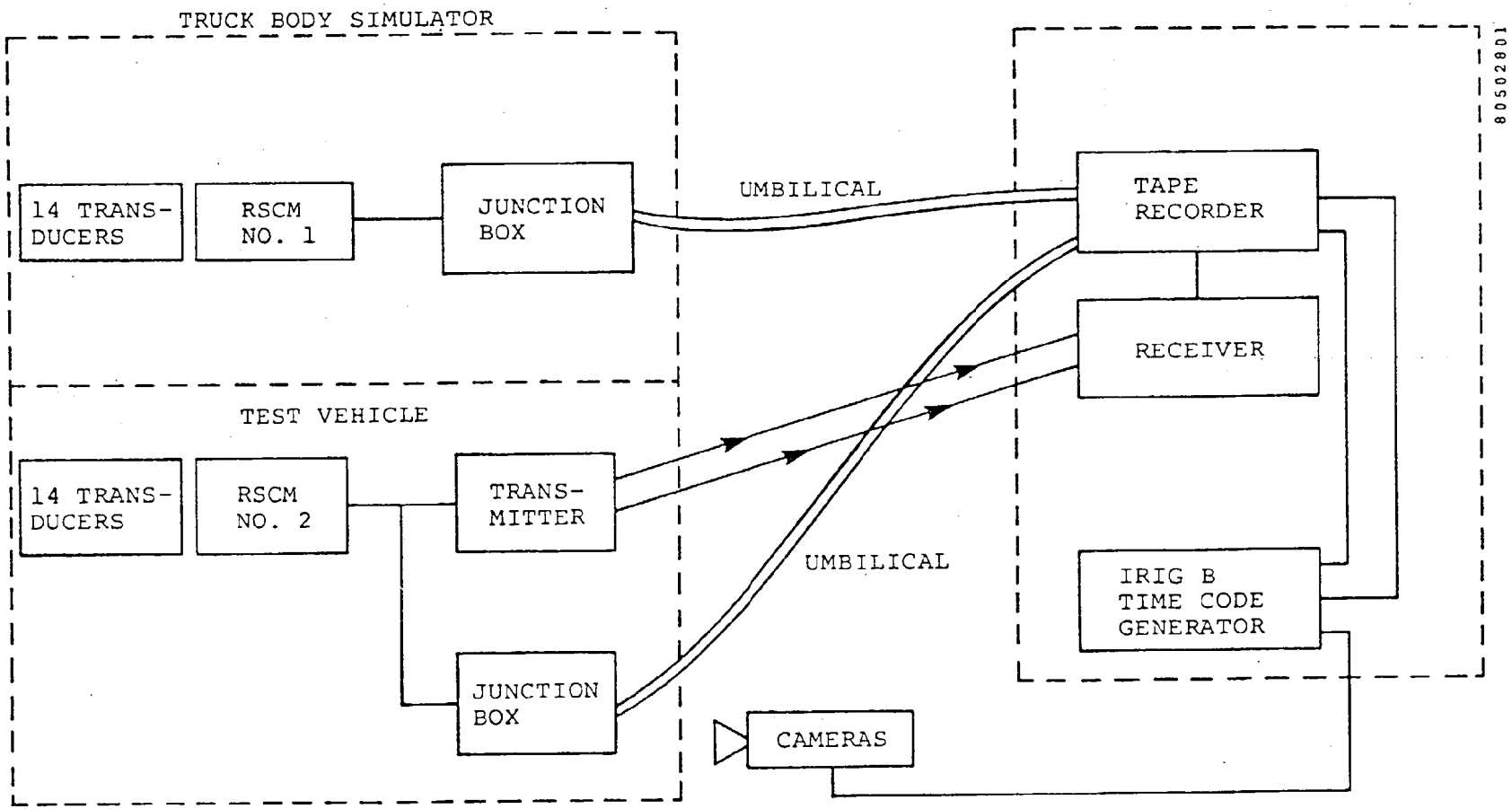


Figure 2-4. Data Acquisition - Vehicle-to-Truck Underride Simulator.

TABLE 2-1. DATA REQUIREMENTS

Test Parameter	Measurement Method	Magnetic Tape	Written Log	Photographic Analysis
Impact time	Contact switch signal impressed on millisecond time base	X		
Approach Velocity	Tow cable velocity sensor	X		
Impact Velocity	Speed trap entrance and exit signals from speed trap	X*		
Rebound Velocity	Calculated from high-speed film analysis	X		X
Vehicle Acceleration Measurements	Accelerometers, unbound strain gauge type	X		
Underride Guard Structural Deformation	String potentiometer and direct linear measurement	X	X	
Stress in Underride Guard	Strain gauges	X		
Forces on Struck Body Simulator - Fixed Barrier Interface	Load cells	X		
Vehicle Structural Deformation	Direct linear measurement		X	
Vehicle Static Crush	Direct linear measurements		X	
Vehicle Dynamic Crush	Film analysis			X
Vehicle Underride Distance	Direct linear measurement and high-speed film analysis		X	X

*Velocity is also measured by electronic counter.

TABLE 2-1. DATA REQUIREMENTS (CONTD)

Test Parameter	Measurement Method	Magnetic Tape	Written Log	Photographic Analysis
Occupant Compartment Intrusion	Direct Linear measurement and high-speed film analysis		X	X
Occupant Dynamic Displacement	High-speed film analysis			X
Vehicle Weight by Wheel	Direct pre-test measurement using balance scales		X	
Ballast Weight	Balance scale		X	

3.0 DATA ACQUISITION

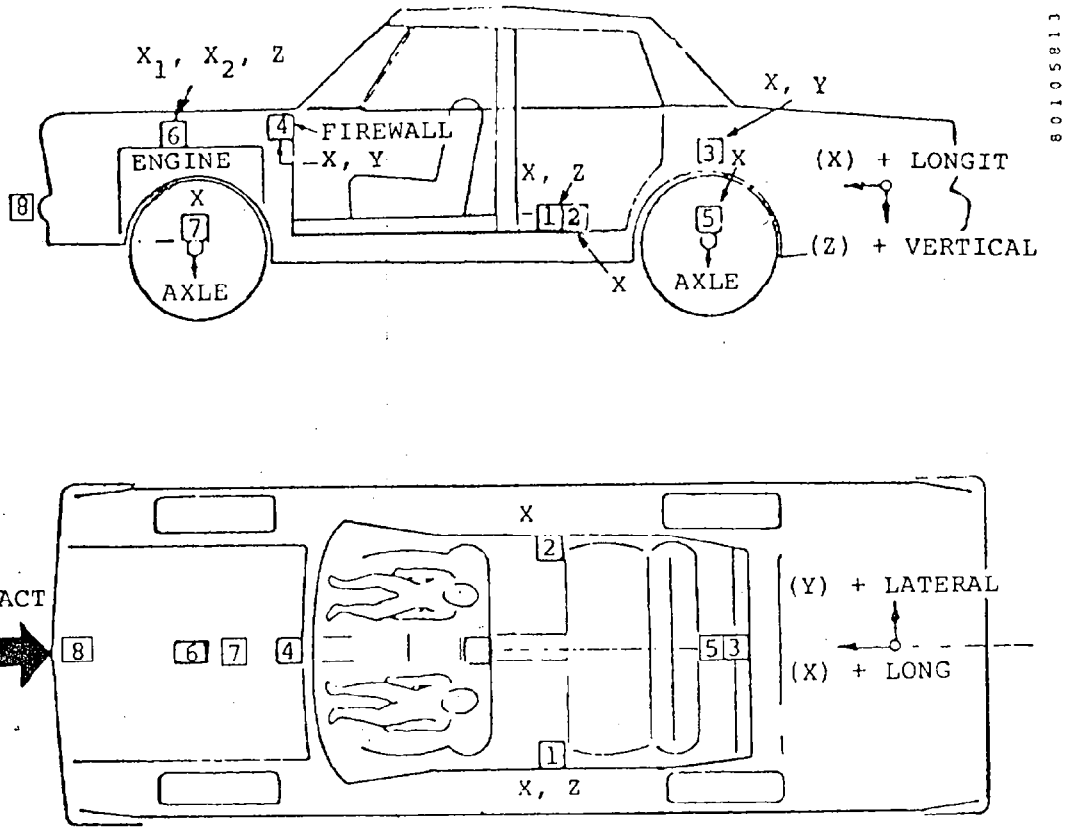
3.1 INSTRUMENTATION

3.1.1 Test Vehicle Instrumentation

The test vehicle had a 50th percentile restrained instrumented dummy positioned in the driver and front passenger locations. Twelve structural accelerometers were installed on the vehicle and consisted of the following (see Figures 3-1 and 3-2):

1. A biaxial (X, Y) mount located on the left rocker panel near the B-pillar to measure accelerations of the occupant compartment.
2. A single (X) mount similar to No. 1, but on the right side of the vehicle.
3. A biaxial mount (X, Y) located on the rear floor structure over the rear axle.
4. A biaxial mount (X, Y) located on the upper centerline of the firewall in the engine compartment to measure acceleration of the forward section of the passenger compartment.
5. A single mount (X) located on the centerline of the rear axle to measure acceleration of the rear drive train and rear suspension assembly.
6. A biaxial mount (X, Z) located on the top of the engine block in a protective case to measure acceleration of the engine.
7. A single mount (X) located on the front frame crossmember in a protective case to measure axial acceleration of the front frame.
8. Two tape switches were mounted on the initial contact point of the car to record impact. The tape switches were installed in parallel, to provide redundancy of data.

The instrumentation requirements for the test vehicles are given in Figures 3-1 and 3-2.

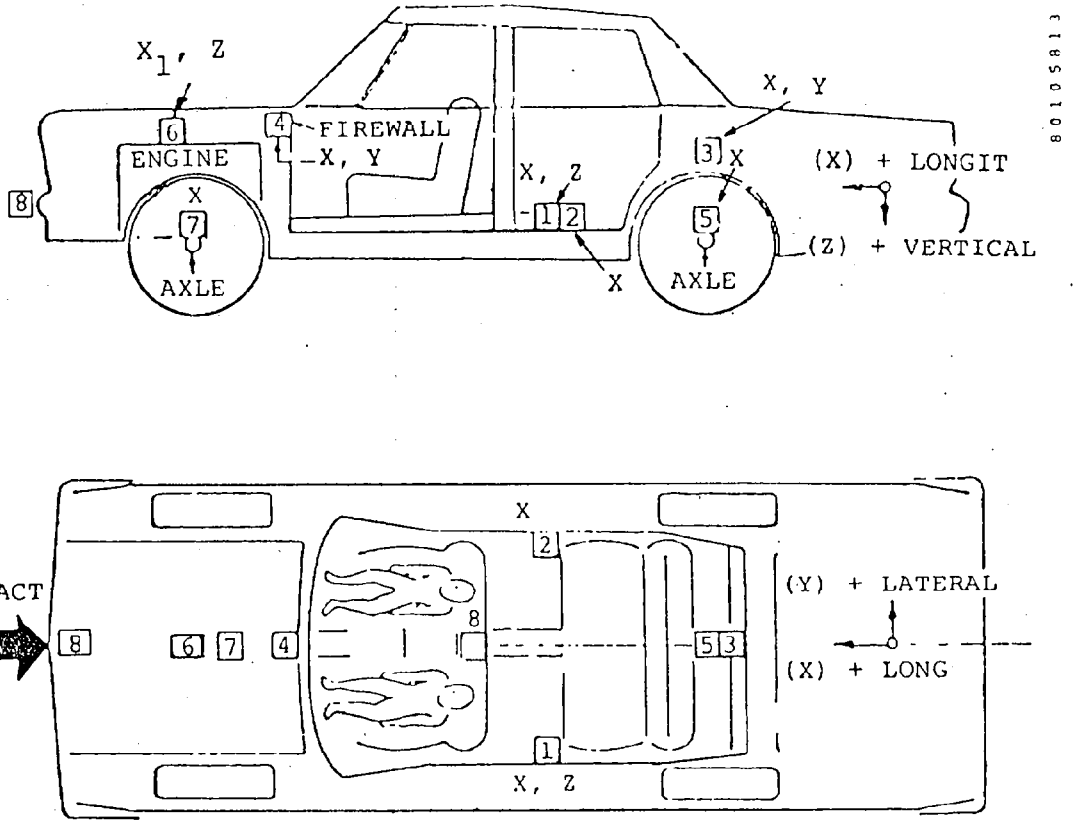


VEHICLE ACCELEROMETER LOCATIONS AND PHYSICAL COORDINATES					MAXIMUM EXPECTED READINGS		
NO.	DESCRIPTION OF LOCATION	X**	Y**	Z**	LONG*	LAT*	VERT*
1	Rocker panel near B-pillar behind driver's seat	111	-24	0	50	50	
2	Rocker panel near B-pillar behind passenger's seat	111	24	0	50		
3	℄ of rear deck above rear axle	153	0	28	50	50	
4	℄ of firewall at A-pillar inside passenger compartment	60	18	6	100	100	
5	℄ of rear axle	156	0	7	100		
6	Engine block (Top ℄) - long. and vert. accelerometers	45	0	17	200		200
7	Front crossmember	30	19	15	200		
8	2 impact switches						

*G

**Reference points:
X - Direction - Centerline of front bumper
Y - Direction - Centerline of vehicle
Z - Direction - Top of driver rocker sill.

Figure 3-1. 1978 Chevrolet Impala Accelerometer Locations.



NO.	VEHICLE ACCELEROMETER LOCATIONS AND PHYSICAL COORDINATES DESCRIPTION OF LOCATION	X**	Y**	Z**	MAXIMUM EXPECTED READINGS LONG*	LAT*	VERT*
1	Rocker panel near B-pillar behind driver's seat	92.5	22.5	-3.5	50	50	
2	Rocker panel near B-pillar behind passenger's seat	92.5	22.5	-3.5	50		
3	℄ of rear deck above rear axle	123.5	15.5	9.0	50	50	
4	℄ of firewall at A-pillar inside passenger compartment	40.5	9.5	10.5	100	100	
5	℄ of rear axle	114.0	4.0	-1.0	100		
6	Engine block (Top ℄) - longitudinal and vertical	32.5	2.0	-2.5	200		200
7	Front crossmember	13.0	13.0	8.0	200		
8	2 impact switches						

*G

**Reference points:
X - Direction - Centerline of front bumper
Y - Direction - Centerline of vehicle
Z - Direction - Top of driver rocker sill.

Figure 3-2. 1978 Volkswagen Rabbit Accelerometer Locations.

3.1.2 Trailer Body Simulator Instrumentation

The instrumentation on the trailer body simulator was the same for the three tests. Figures 2-2 and 3-3 show the location of the instrumentation on the trailer body simulator and on the guard for offset engagement of the underride guard. The instrumentation purposes and locations were as follows:

1. Two strain gauges on Tests 5.5, 5.7, and 5.8 were mounted on selected points of interest of the underride guard to measure strains developed in the structure due to the impact forces.

2. Three string potentiometer displacement transducers mounted on the trailer simulator structure to measure relative displacement of the lower section of the underride guard.

3. Four load cells mounted on the front face of the trailer platform in contact with the face of the fixed barrier to measure dynamic impact forces of Test 5.5. A fifth load cell was added to the right side on Tests 5.7 and 5.8 to distribute the total load without exceeding the capacity of the individual load cells.

4. One longitudinal accelerometer mounted on the web of the right main frame I-beams of the trailer to measure acceleration of the trailer.

5. On Tests 5.5, 5.7 and 5.8, eight strain gauges were mounted on the upper and lower flanges of both main frame rails of the trailer to measure strains at various points in the trailer body simulator during the crash (see Figure 2-2).

6. Two tape contact switches mounted on the initial contact points of the impact. The switches were connected in parallel to provide redundancy of data.

3.2 PHOTOGRAPHY REQUIREMENTS

3.2.1 Vehicle-to-Trailer Body Simulator Test Photography

Six high-speed cameras (four 1000 fps and two 400 fps) and one panning (24 fps) camera were used, as shown in Table 3-1, for

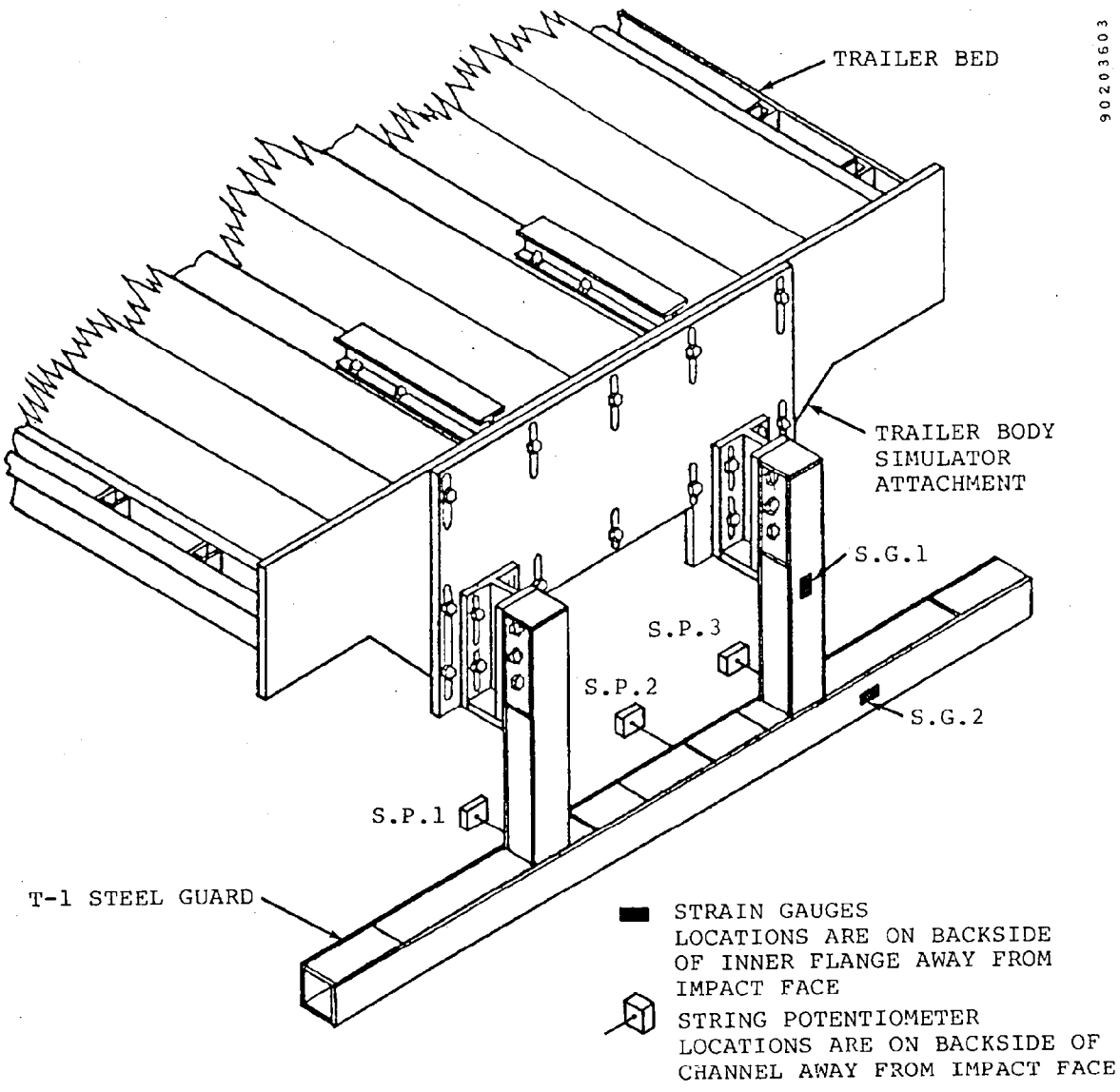


Figure 3-3. Tests No. 5.5, 5.7, and 5.8 Underride Guard Instrumentation.

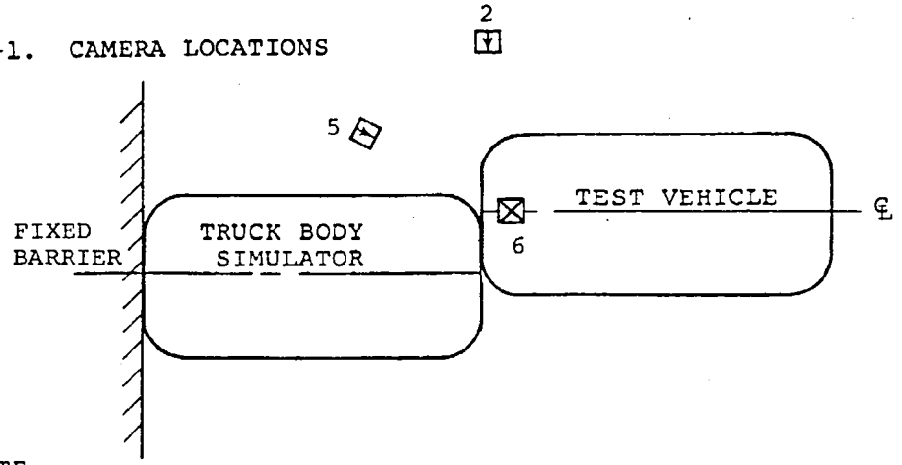
TABLE 3-1. CAMERA LOCATIONS

Test No: 8319 5.1 through 5.8 Test Date: _____

Test Type: Car-to-Stationary Truck Body Simulator

Vehicle A (Away):	1978 Chevrolet 1978 VW Rabbit	
Vehicle B (Barrier):		

Comments: Camera locations are approximate and may be moved at discretion of test engineer.



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	Left Side	Overall of vehicle and truck body	25mm	4	1				
2	Right Side	2/3 of vehicle to rear wheel of truck body	25mm	4	1				
3	Left Side	2/3 of vehicle to rear wheel of truck body	50mm	1	1				
4	Left Side	Close-up - front wheel of vehicle to rear wheel of truck body	25mm	1	1				
5	Left Side	Angled close-up of impact area	13mm	1	1				
6	Rear of truck body	Overhead view of impact area	13mm	1	1				
7	Left Side	Panning test and overall results	Zoom	3					

the vehicle-to-truck underride guard tests. Table 3-2 describes the still camera (B/W and color) photographic fields of view.

The panning camera documented the instrumentation, pre-test and post-test vehicle configurations, pre-test and post-test dummy positions, and the underride guard and test vehicle crush profiles.

3.3 VEHICLE STRUCTURAL DEFORMATION DATA

3.1.1 Data Acquisition

Pre-test and post-test measurements of the test vehicle and underride guard were made under the direction of the Test Engineer and were taken at the appropriate stage of vehicle testing.

TABLE 3-2. CAR-TO-TRUCK BODY SIMULATOR TESTS PHOTOGRAPHIC REQUIREMENTS AND CHECKLIST

Color Negatives (6cm x 7cm)	Color Slides (35mm)	Black and White	Field of View	Pre-test	Post-test
	X	X	Front View of Car	____	____
		X	Left Front Three-Quarter View of Car	____	____
	X	X	Left Side View of Car	____	____
		X	Right Front Three-Quarter View of Car	____	____
	X	X	Right Side View of Car	____	____
	X	X	Front View of Underride Guard	____	____
X	X	X	Overall View of Car and Truck Body Interface - Left Side	____	____
X		X	Overall View of Car and Truck Body Interface - Right Side	____	____
	X	X	Document Photos (2) of Truck Body Simulator	____	____
	X	X	Closeup of Bumper/Underride Guard Match-up	____	____
		X	Closeup of Dummy Contact Points	____	____
		X	Overall Forward Occupant Compartment With Dummy	____	____
		X	Document Photos (3) of Truck Body/Fixed Barrier Interface	____	____
X			Time of Maximum Structural Collapse (100 msec)	____	____

4.0 SUMMARY OF TEST RESULTS

This section of the report presents the discussion of the test conditions and test results of the three Task 5 vehicle-to-underride guard offset impacts (Tests 5.5, 5.7, and 5.8). The data summary tables and data plots, along with photographs of the pre-test and post-test documentation for Tests 5.5, 5.7, and 5.8 are provided in Appendices A, B, and C, respectively.

The test conditions and test results for Test 5.5 are presented in Section 4.1. The test conditions and test results for Test 5.7 are presented in Section 4.2. The test conditions and test results for Test 5.8 are presented in Section 4.3.

A summary of the pertinent crash data for the three tests is presented in Section 4.4.

4.1 TEST 5.5

4.1.1 Test Conditions - Test 5.5

The test vehicle longitudinal centerline was offset 42 inches to the right of the trailer body centerline. This was accomplished by moving the trailer body centerline 36 inches to the left of the track centerline, and moving the test vehicle centerline six inches right. The test vehicle was a 1978 Chevrolet Impala four-door sedan. The Chevrolet Impala test weight was a summation of the curb weight with all fluids removed, except engine coolant, plus the weight of the on-board instrumentation

and the instrumented dummies in the driver and right front passenger positions. The dummies were restrained with the vehicle restraint systems.

The trailer body simulator was ballasted with concrete blocks totaling 9,250 pounds over the front dolly wheel centerline and 9,250 pounds over the rear tandem wheel centerline. The front ballast was added to prevent lifting of the front of the trailer during impact and maintain continuous contact of the load cells with the fixed barrier. (The rear ballast was used to level the trailer fore and aft for proper orientation of the underride guard prior to the test.) Through angled cable tiedown of the forward section of the trailer, the load cells were pre-loaded to approximately 2,000 pounds each. This pre-load was electrically set to zero during calibration setup to provide zero reference impact loads during the test.

The modified DSI T-1 guard (B) was used for this test. This rigid cantilevered guard design consists of two vertical I-beams and a horizontal channel section. The guard width was 84 inches. Since the material used for the guard is available only in flat stock (100 klb psi yield strength T-1 steel), the sections were fabricated by sawing the components to size and joined by welding with high strength weld wire. Stiffener plates were added between the flanges of the I-beams and channel at anticipated areas requiring added strength. The underride guard was installed on the rear of the trailer body simulator. The guard height from the ground was set at 24.0 inches. Ground level was established from the contact points of the test vehicle front tires.

4.1.2 Test Results - Test 5.5

In Test 5.5, the 1978 Chevrolet Impala, weighing 4,229 pounds, impacted the guard at 42-inch right offset at 40.03 mph. The underride guard overrode the car bumper by 1.4 inches. A small bracket was added to the front face of the bumper for the contact switches to indicate time zero for the data plots and high-speed films. The maximum dynamic vehicle underride on the left side of the vehicle was 90.8 inches. The passenger side of the vehicle underrode the trailer a greater distance, although crush damage was not as severe, due to the vehicle/guard offset and rotation of the vehicle. The vehicle rotated to the right approximately 10 degrees. Vehicle rebound was 2.5 inches.

There was extensive damage to the underride guard. See Appendix A for photographs of the guard damage. It should be noted that the guard was designed for 60,000-pound yield strength (approximately 80,000-pound ultimate strength) and the peak loads recorded exceeded 94,000 pounds.

Due to the excessive loading on the right side of the guard, the right vertical I-beam (built-up and welded together using 100 k psi yield flat stock) initially started to separate at the upper joint between the web and rear flange of the beam. In turn, the left I-beam sheared at the bottom of the main trailer I-beam, allowing further underride of the right side of the vehicle. The right end of the guard horizontal member impacted the engine block at the water pump shaft. The engine block was pushed rearward causing firewall intrusion of 5.7 inches.

The driver dummy struck the steering wheel hub with its chest, and its head went over the steering wheel upper rim and struck the dash. The passenger dummy struck the top of the dash with its head. Both dummies struck the lower dash area with their knees. Static deformation of the pertinent areas of the vehicle (including steering wheel movement), and photographs of the pre- and post-test crash damage documentation are shown in Appendix A.

4.2 TEST 5.7

4.2.1 Test Conditions - Test 5.7

The test configuration for Test 5.7 was identical to Test 5.5, wherein the offset was 42 inches to the right of the trailer body centerline. The test vehicle was also a 1978 Chevrolet Impala four-door sedan. The Chevrolet Impala test weight was a summation of the curb weight with all fluids removed, except engine coolant, plus the weight of the on-board instrumentation and the instrumented dummies in the driver and right front passenger positions. The dummies were restrained with the vehicle restraint systems.

The trailer body simulator was ballasted much like it was in Test 5.5. One additional 50 Klb load cell was installed on the right side of the trailer body simulator. The assembly of three load cells on the impacted side of the trailer was to distribute the anticipated higher loads without exceeding the capacity of the individual load cells. Through angled cable tiedown of the forward section of the trailer, the five load cells were pre-loaded

to approximately 2,000 pounds each. This pre-load was electrically set to zero during calibration setup to provide zero reference impact loads during the test. A small bracket was added to the front face of the bumper for the contact switches to indicate time zero for the data plots and high-speed films.

Due to the greater than expected maximum loads generated by the vehicle causing collapse of the guard in Test 5.5, the guard was strengthened to withstand a vehicle load of 140 Klb (ultimate) in the offset mode. This was accomplished by adding stiffening plates between the flanges of the vertical I-beams and horizontal channel, in addition to welding steel plates to the fore and aft faces of the guard. This guard was designated as (C) modification of the basic DSI T-1 guard. The guard was installed on the rear of the trailer body simulator and set at 22 inches above ground level. The car bumper was lowered approximately 2 inches to avoid guard contact with the bumper.

4.2.2 Test Results - Test 5.7

In Test 5.7, the 1978 Chevrolet Impala weighing 4,264 pounds impacted the guard in the offset mode at 38.94 mph. The underride guard overrode the car bumper by 0.6 inch. The maximum dynamic vehicle underride on the left side of the vehicle was 54.9 inches (obtained from high-speed film analysis). The maximum penetration of the guard at the extreme right side was 51.0 inches, measured from the front bumper. The vehicle rotated 12 degrees to the right.

There was some permanent damage to the underride guard. It should be noted that the peak load recorded exceeded 120,000 pounds, which resulted in guard yield, but not failure. See Appendix B for photographs of the guard damage.

The right front face of the horizontal beam was deformed. The top two bolts, of six, securing the mounting plate and right adapter, yielded causing a slight bowing along the width of the guard. The horizontal beam of the guard struck the vehicle at the bottom of the grille, pushing the radiator and air conditioning condenser into the engine block. The engine block was struck between the water pump and the crankshaft drive pulley. The engine was pushed backward into the firewall, breaking the motor mounts and rupturing the sheet metal of the firewall. The drive shaft failed aft of the transmission tail shaft.

The driver dummy head struck the steering wheel hub; the chest struck the lower rim of the steering wheel, and the knees struck the dash. The passenger dummy head struck the upper dash and the knees struck the lower dash. Static deformation of pertinent areas of the vehicle (including steering wheel movement) and photographs of the pre- and post-test crash damage documentation are shown in Appendix B.

4.3 TEST 5.8

4.3.1 Test Conditions - Test 5.8

As in Tests 5.5 and 5.7, the test vehicle centerline was aligned 42 inches to the right of the trailer body centerline.

The test vehicle was a 1978 Volkswagen Rabbit four-door sedan. It should be noted that Test 5.8 was performed before Test 5.7.

The ballasting of the trailer body simulator was identical to that in Tests 5.5 and 5.7. The fifth load cell was added to the right side of the trailer interface with the barrier to distribute the added load expected on the right side of the trailer. The five load cells were pre-loaded to 2000 pounds each. This pre-load was electrically set to zero during calibration to provide a zero reference for impact loads during the test. A bracket was added to the front face of the bumper for contact switches to indicate time zero for the data plots and the high-speed films.

The modified DSI T-1 guard (C) was used for this test (this was the first test wherein this design was used). The guard height from ground level was set at 22 inches.

4.3.2 Test Results - Test 5.8

In Test 5.8, the 1978 Volkswagen weighing 2,496 pounds impacted the guard in an offset mode at 40.09 mph. The underride guard overrode the car bumper by 2.6 inches. The maximum dynamic vehicle underride on the left side of the vehicle was 60.5 inches obtained from high-speed film analysis. The maximum guard penetration at its right end was 69.5 inches from the front bumper. The vehicle rotated to the right and settled at 47 degrees from its initial impact position.

There was no visible damage to the guard, as expected, since the maximum load was less than 60,000 pounds.

The horizontal beam of the guard struck the center of the grille, striking the radiator and air conditioning condenser. The horizontal guard channel contacted the transverse-mounted engine at the cylinder head, rotating the engine 60 degrees rearward. The guard cammed over the engine and struck the upper firewall. The dash panel broke in half at the center. The firewall separated from the body at the windshield and the right end of the guard protruded into the passenger compartment.

The driver dummy head struck the roof above the windshield, the windshield, and then the hood that had buckled into the windshield. The driver chest struck the steering wheel hub; its knees struck the knee bolster and slid underneath it. The passenger dummy head hit the sun visor and header first, then the windshield, then the hood. The passenger chest hit the dash; its knees hit the knee bolster and slid underneath it.

The driver was pinned in the seat by the steering wheel. After the removal of the dummy, the lower rim of the steering wheel was 5 inches from the back of the seat, the front of the seat was 1.5 inches from the knee bolster.

The passenger seat was 1.5 inches from the knee bolster on the left, and 4.0 inches on the right.

4.0 TEST RESULTS SUMMARY

This section summarizes pertinent data for Tests 5.5, 5.7, and 5.8 of Task 5. Table 4-1 includes the vehicle description,

test conditions, vehicle underride, and maximum loads. Table 4-2 provides the critical parameters for defining occupant injury criteria. Table 4-3 presents the list of pertinent static deformation at various areas of the vehicle. Figures 4-1 and 4-2 are point-to-point graphs of the data presented in Table 4-3 for the Chevrolet Impala and Volkswagen Rabbit.

TABLE 4-1. SUMMARY OF UNDERRIDE GUARD TEST RESULTS

Test No.	Test Vehicle	Test Weight (lb)	Guard Height (in.)	Impact Velocity (mph)	Maximum Truck Underride (in.)*	Maximum Force Load** (lb)
5.5	1978 Chevrolet Impala	4229	24.0	40.03	90.8**** (65.4)***	94,483
5.7	1978 Chevrolet Impala	4264	22.0	38.94	54.9 (65.4)***	120,373
5.8	1978 VW Rabbit	2496	22.0	40.09	60.5 (44.4)***	59,433

*Based on high-speed film analysis.
**Sum of four or five load cells on time basis.
***Front bumper to centerline of windshield at hood level.
****Guard failure during crash.

TABLE 4-2. SUMMARY OF UNDERRIDE TEST OCCUPANT RESPONSE DATA - TASK 5 RIGHT OFFSET TESTS

Parameter	Test 5.5	Test 5.7	Test 5.8	Injury Criteria
Driver HIC	435	1380*	4424*	1000
Driver Head SI/G**	557/59	2096*/109	5748*/219	1000/None
Passenger HIC	227	189	452	1000
Passenger Head SI/G**	352/48	247/40	751/65	1000/None
Driver Chest SI/G**	207/47	623/60*	350/44	1000/60G
Passenger Chest SI/G**	87/21	348/38	197/36	1000/60G
Driver Left Femur	463	-1358	-1549	2250 lb
Driver Right Femur	-1582	-2788*	-1988	2250 lb
Passenger Left Femur	93	-1179	-1183	2250 lb
Passenger Right Femur	107	-860	-1089	2250 lb

*Exceeds Injury Criteria defined in FMVSS 208.
**G level defined as value for cumulative duration of at least 3 msec.
Note: Guard failed in Test 5.5.

TABLE 4-3. SUMMARY OF TEST VEHICLE STATIC DEFORMATION

Vehicle Locations	Static Change		
	Test 5.5	Test 5.7	Test 5.8
Centerline Windshield Opening (top)	1.4	0.6	3.0
Top of "A" Pillar (left)	1.1	0.3	0.6
Top of "A" Pillar (right)	-0.2	-0.2	-0.6
Bottom of "A" Pillar (left)	8.2	2.7	10.9
Bottom of "A" Pillar (right)	0.1	0.8	1.3
Rear Edge Dash Panel (left)	9.3	4.3	6.4
Rear Edge Dash Panel (right)	1.5	5.3	1.6
Steering Column Hub (horizontal)	7.9	4.5	10.7
Steering Column Lower Rim (horizontal)	8.5	-0.2	8.9
Steering Column Hub (vertical)	5.0	-3.6	5.4
Steering Column Lower Rim (vertical)	8.1	-2.4	2.1
Knee Bolster* (left)	14.3	6.2	6.4
Knee Bolster* (right)	4.8	1.4	1.6
Firewall, Driver Centerline	4.7	7.1	8.3
Firewall, Passenger Centerline	1.0	16.8	2.8
Firewall, Vehicle Centerline	5.3	16.5	3.1
Water Pump	10.7	18.3	-
Front Engine Block (valve cover)	10.7	18.3	8.8
Front Edge Shock/Strut Tower (left)	None	None	26.6
Vehicle Maximum Underride	90.8**	54.9**	60.5**

*No knee bolster in Chevrolet Impalas. Used dash at knee level.
**Vehicle left side underride. Guard failed in Test 5.5.
NOTES: Minus sign indicates forward or upward movement from original position. All dimensions are changes in longitudinal direction unless noted.

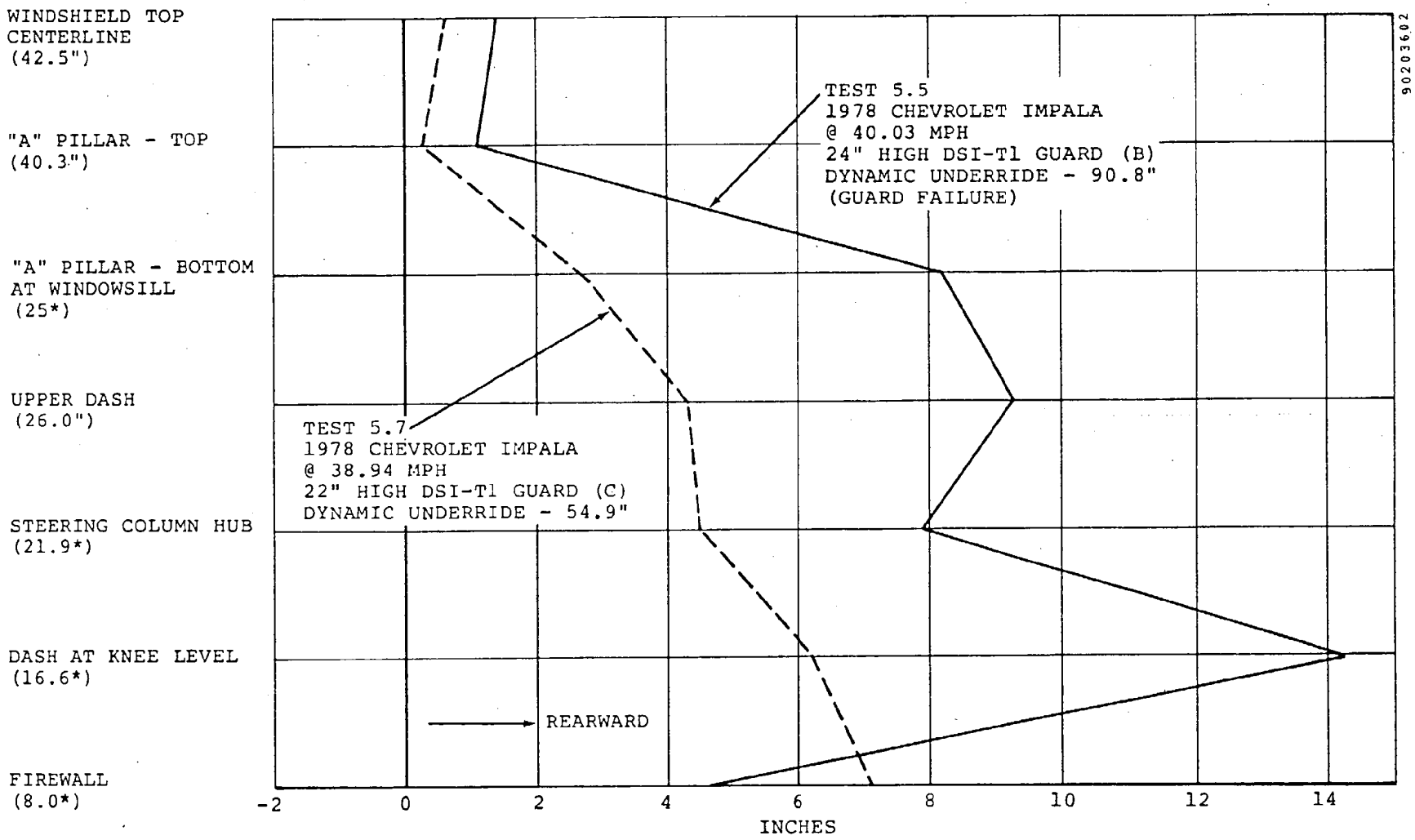


Figure 4-1. Post-test Static Driver Side Compartment Intrusion - Chevrolet Impala.

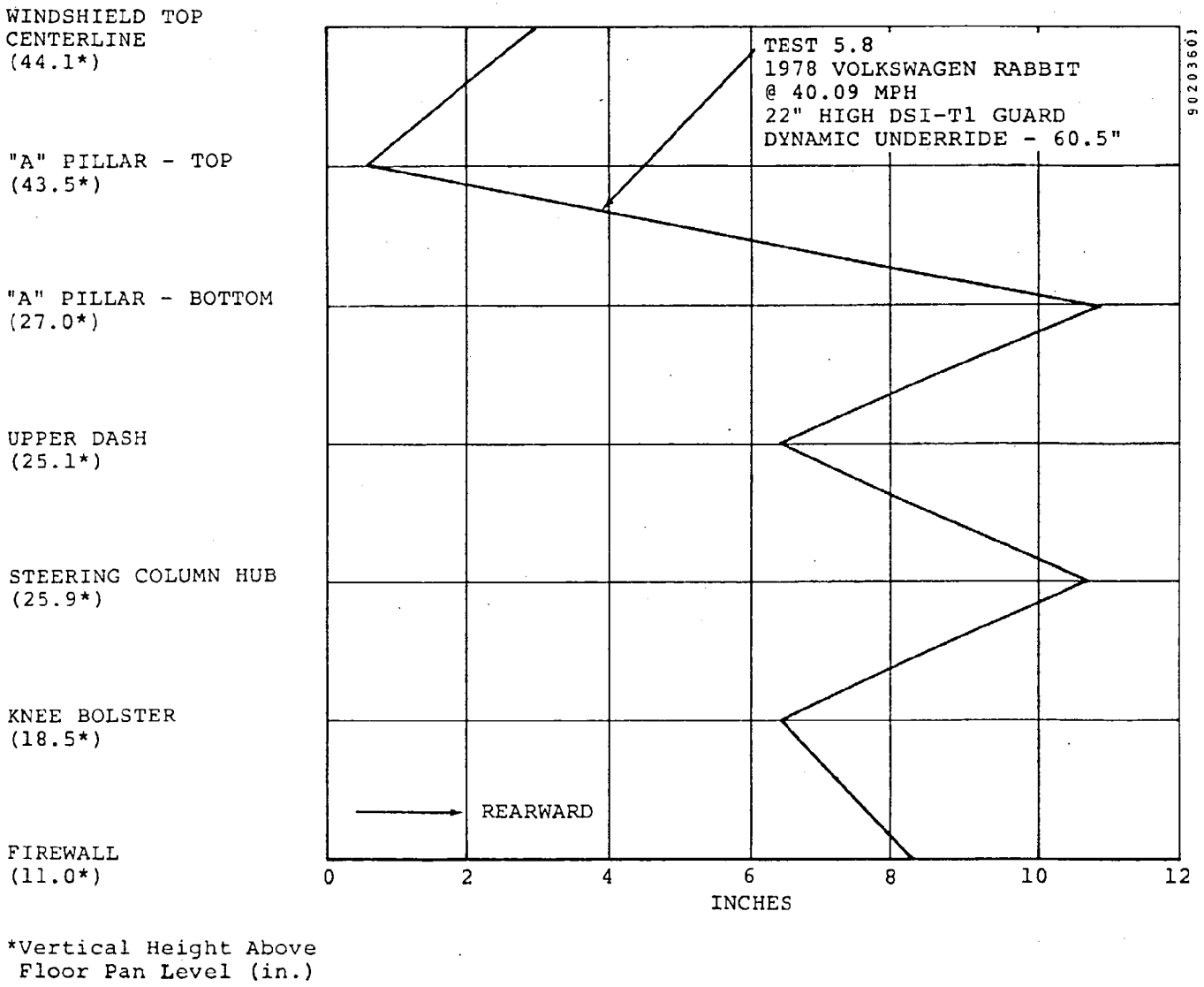


Figure 4-2. Post-test Static Driver Side Compartment Intrusion - V.W. Rabbit.

5.0 TEST FACILITIES AND EQUIPMENT

5.1 GENERAL

The impact tests in this program were conducted at the Monorail Impact Facility, shown in Figure 5-1. The fixed barrier impact site was used for the vehicle-to-trailer body simulator tests.

Table 5-1 describes the test equipment and its function as it applies to the test parameters.

5.2 FACILITY AND EQUIPMENT DESCRIPTION

The following paragraphs briefly describe the track facility and equipment, their function, and mode of operation.

5.2.1 Test Track and Guidance System

The test track consists of 1,200 feet of asphalt pavement (SN = 75 ±5), 14 feet in width. The length allows sufficient acceleration distance to accommodate impact speeds in excess of 60 mph with sufficient distance remaining to abort the test if necessary. Guidance for the test vehicle is provided by a sliding shoe attached to the vehicle. The sliding shoe rides on the monorail embedded in the test track. Prior to impact, the shoe is mechanically released from the test vehicle.

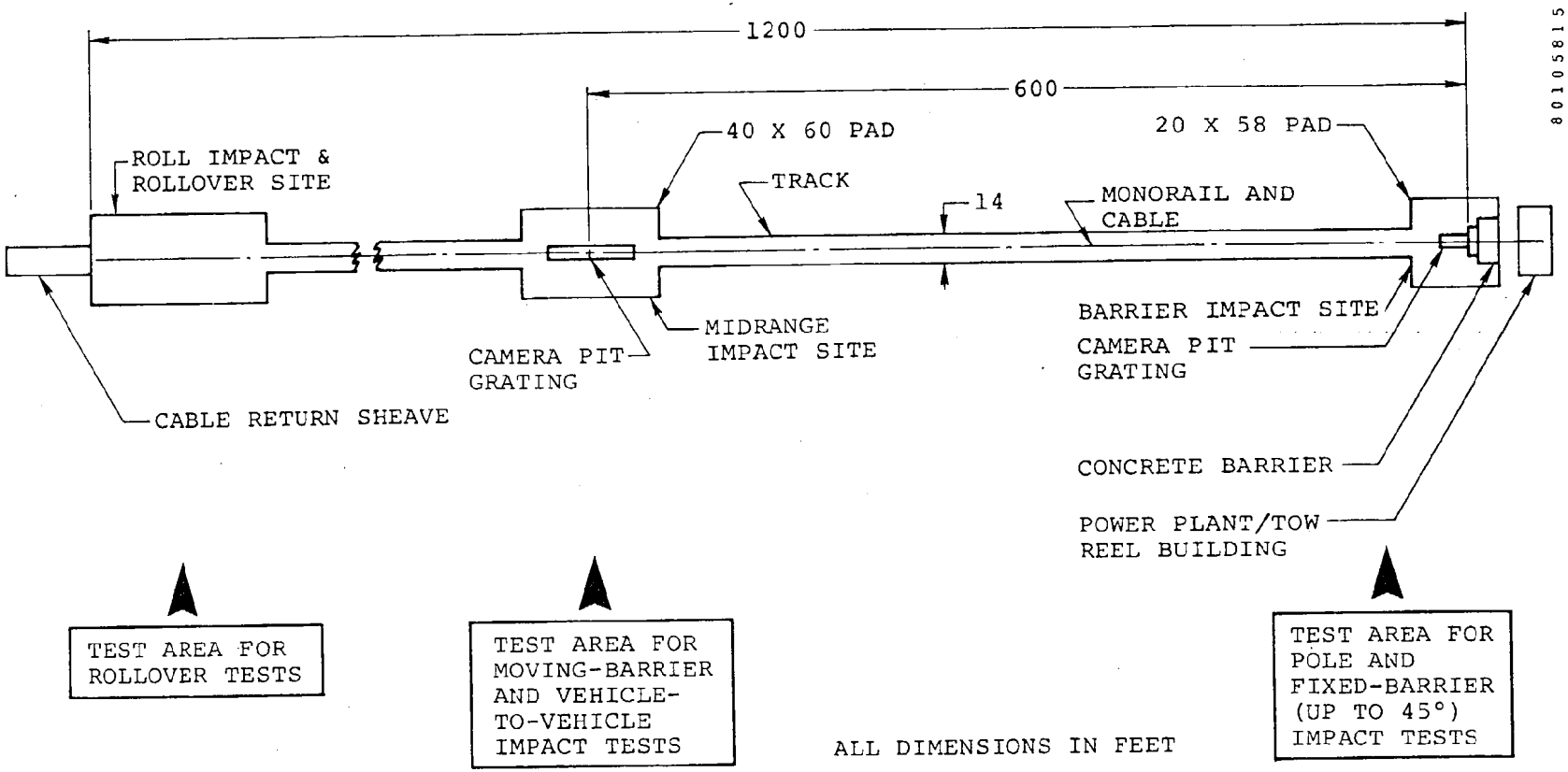


Figure 5-1. Monorail Impact Facility.

TABLE 5-1. TEST EQUIPMENT LIST AND FUNCTION

Item	Manufacturer	Model	Purpose
Timing Trap	Dynamic Science	None	Determine impact speed by furnishing a start and stop signal to recording oscillograph.
Oscillograph	Bell and Howell	5-134	Records timing start and stop signals from timing traps, cable drum drive rpm, and impact switch.
Speed Control	Dynamic Science	None	Precision control of cable drive drum rpm.
Beam Scales	Western	WP2000	Used to determine vehicle test weights.
High-speed Motion Picture Cameras	Photosonic, Milliken, Fairchild	16-1B DBM-5A HS-100	Used for side, overhead, and on-board film coverage as required.
Motion Picture Camera	Canon Scoopic		Panning and documentation.
Still Camera	Mamiya	RB47	Documentary photo coverage.
100 and 1000 Hz Time Code Generators	Dynamic Science	None	Furnish timing signal for high-speed cameras and a 1-millisecond timing for velocity determination.
Calibrated Steel Rule	Starret	48 in.	Precision measurement of velocity trap spacing.
Anthropomorphic Dummies		Part 572	To ballast the vehicle and to observe occupant dynamic movement.
Vehicle Accelerometers	Statham	A69TC-200	Measures vehicle acceleration.
Strain Gauges	BLH	FAE-25-35-P	Measure underride guard component strain.
String Potentiometers	Celesco	PT-101-30	Measures displacement.
50 Klb Load Cells	Interface	1320AF	Force on truck body simulator-fixed barrier interface.
Tape Recorder	Sangamo	Sabre III	Records instrumentation signals.
Oscillograph	Bell and Howell	5-134	Records real-time quick-look data.
Signal Conditioner	Ectron	M140	Conditions instrument output signal for recording.

5.2.2 Tow System and Velocity Control

The tow system consists of a drum-driven endless cable powered by a pair of 390-cubic-inch engines driven in tandem driving a modified three-speed C-6 automatic truck transmission. The tow system can propel a 6,000-pound vehicle into the fixed barrier at 75 mph or two 4,000-pound vehicles into each other at a closing speed of 90 mph. Velocity control is achieved through a manually controlled throttle system. A visual readout of speed versus distance is provided and compared with the "ideal curve." Velocity control under ±0.5 mph is realizable down to 20 mph and ±2.0 percent down to zero mph.

5.2.3 Abort System

Automatic abort capability is provided through the vehicle service brakes which are actuated by releasing high-pressure air into the hydraulic system. Abort criteria consist of vehicle speed, data acquisition and instrumentation system readiness, and stability of the vehicle on the test track. The first two criteria are automatically monitored by the test control system while the third criterion is visually monitored by the test conductor. Manual abort provisions are available to the test conductor. Upon verifying vehicle speed, the test control system automatically deactivates the abort system to preclude an inadvertent test abort immediately prior to impact.

5.2.4 Master Control System

The master control system used for impact tests controls and monitors all primary system functions that must operate throughout a predetermined interval during a test. This includes the starting and stopping of the tape recorder, high-speed cameras, and oscillograph, and the control of the power winch which propels the test vehicle. The operation of the various devices is confirmed, including vehicle velocity and tape recorder speed synchronization, before it passes through a "commit" window. When the vehicle is committed, the abort system is disarmed, preventing an accidental abort after the point of no return is reached.

Any system malfunction, including improper vehicle velocity up to the commit window, generates an abort. The control system uses the pulse output from the IRIG time base generator as a clock with a manual push button defining time zero. The logic circuits compare pulse counts from time zero to preset values dialed in at the control panel. As each control circuit gets an equal comparison, that circuit is turned on. If the self-test circuit does not verify, the abort system is automatically activitated. After a successful vehicle test, the last control circuit shuts the entire system down. The manual backup control system provides the test conductor with the option of manually aborting the test if the need arises.

5.2.5 High-speed Photography

Six high-speed (four 1000 and two 400 fps) motion 16 mm cameras with 100 Hz timing marks were used for photographic test documentation. Precise field of view monitoring is accomplished by bore sighting with the vehicle at the impact site prior to the test.

APPENDIX A

TEST 5.5 TEST DATA SUMMARY
1978 CHEVROLET IMPALA
OFFSET IMPACT @ 40 MPH

TABLE A-1. RECEIVING INSPECTION OF VEHICLES

Contractor: Dynamic Science Contract No.: DOT-HS-8-01905

VIN NO.: 1L69L8C129192 Make: Chevrolet

NHTSA No.: R & D

Year: 1978 Color: Brown Model: Impala

Auto Trans:	(yes)	no	Pwr Steering:	(yes)	no	Seats: (front) Bench:	X
Pwr Brakes:	(yes)	no	Auto Speed Cont:	yes	(no)	Bucket:	
Pwr Seats:	(yes)	no	Anti Skid Brake:	yes	(no)	Split Bench:	
Pwr Windows:	yes	(no)	Air Conditioning:	(yes)	no		
Tinted Glass:	(yes)	no	Rear Window Def.:	yes	(no)	Split Back Bench:	
Radio:	(yes)	no	Brakes: drum: R		disc: F		
Clock:	yes	(no)					

Tire Size: FR-78-15 Ply Rating: 4 Mfg. & Line: Uniroyal PR 6

Bias Ply: ____ Belted: ____ Radial X /Eng.Type: ____ Cylinders: 8 Total Displ: 305

Trans, # Fwd. Speeds: Auto Weight: 3890 GVWR Odometer: 48

Dealer (name, address, and phone number)
Courtesy Chevrolet 602-279-3232
1233 East Camelback Road
P. O. Box 7709, Phoenix, Arizona 85011

Remarks (list additional accessories not listed above)

Date of Manufacture: 6-78 Dynamic Science No.: 750 Date Received: 9-21-78

Tilting Steering Wheel: (yes) no Telescoping Steering Wheel: yes (no)

Fuel Capacity: ____ (from owner's manual) "Space Saver" Spare Tire yes (no)

Restraint System: Std. 3 point

1. Is the vehicle stock throughout? Describe: Yes, new production vehicle.

2. Does vehicle show evidence of prior accident history? Describe: None

3. Does vehicle show any significant corrosion? Describe: None

4. Check condition of the front bumper and frame: O.K. No bumper guards.

TABLE A-2. SUMMARY OF PRE-TEST AND POST-TEST VEHICLE ENGINE/BUMPER/FIREWALL CHARACTERISTICS

Test No. 5.5 Type Underride 42-Inch Offset

Car Model 1978 Chevrolet Impala Dynamic Science No. 750

Engine Size	305 CID
Engine Height/Width (in.)	29.5/21
Bumper to Engine (in.)	31.5
Engine Length (in.)	25
Engine to Firewall (in.)	4
Bumper to Firewall (in.)	60.5
Bumper to "Hard Point" (Engine) (in.)	31.5
Initial Impact Point to Front Bumper (in.)	5.0
Height From Top of Front Bumper to Lowest Point of Underride Guard (in.)	1.4
Horizontal Dimension From Centerline of Vehicle to Extreme Left Edge of Guard (in.)	84
Horizontal Dimension From Centerline of Vehicle to Extreme Right Edge of Guard (in.)	0

TABLE A-3. SUMMARY OF CAR ACCELEROMETER DATA

Accelerometer Number	Plot Location Number	Maximum Acceleration A (G)	Maximum Acceleration Time (msec)
1X	101	-33.1	65
1Y	101	17.8	75
2X	102	-32.8	64
3X	103	-28.7	65
3Y	103	11.5	62
4X	104	-89.0	60
4Y	104	-27.5	60
5X	105	83.6	63
6X	106	-99.8	48
6Z	106	21.	65
7X	107	-30.9	51

TABLE A-4. SUMMARY OF CAR ACCELEROMETER DATA

Accelerometer Number	Plot Location Number	Maximum Acceleration A (G)	Maximum Acceleration Time (msec)
2X	202	10.9	70

TABLE A-5. SUMMARY OF COMPARTMENT AND ENGINE ACCELEROMETER DATA

Accelerometer Number	PLOT LOCATION NUMBER	Maximum Acceleration A (G)	Maximum Acceleration Time (msec)
Average of 1X and 2X	401	-31.9	65
6X	106	-99.8	48

TABLE A-6. SUMMARY OF UNDERRIDE GUARD STRING POTENTIOMETER DATA

Displacement Potentiometer (Number)	Displacement Potentiometer (Location)	PLOT LOCATION NUMBER	Maximum Dynamic Displacement D (in.)	Maximum Dynamic Displacement Time (msec)
SP1	Left	4300	-3.9	234
SP2	Center	4301	-9.0	172
SP3	Right	4302	-10.7	171

TABLE A-7. COMPARISON OF TOTAL INTERFACE FORCE FROM LOAD CELL AND ACCELEROMETER DATA

Parameter	Trailer Force Data*	Car Acceleration Data**
Force (klb)	94,483	111,045
Time (msec)	55	57

*Sum of 4 load cells.
**Average of car accelerometers 1 and 2 x vehicle minus engine weight + engine acceleration x (engine weight of 675 lb)

TABLE A-8. SUMMARY OF UNDERRIDE GUARD AND TRAILER STRAIN GAUGE DATA

Strain Gauge (Number)	Strain Gauge Plot Location Number**	Maximum Strain* (μin./in.)	Maximum Time (msec)
SG1	4212	783.1	47
SG2	4212	-711.2	52
SG8	4408	-348.4	53
SG10	4408	-176.1	170
SG11	4212	-436.8	165
SG12	4212	391.7	167
SG13	4434	476.8	55
SG14	4434	338.8	180
SG15	4256	-205.5	170
SG16	4256	171.9	126

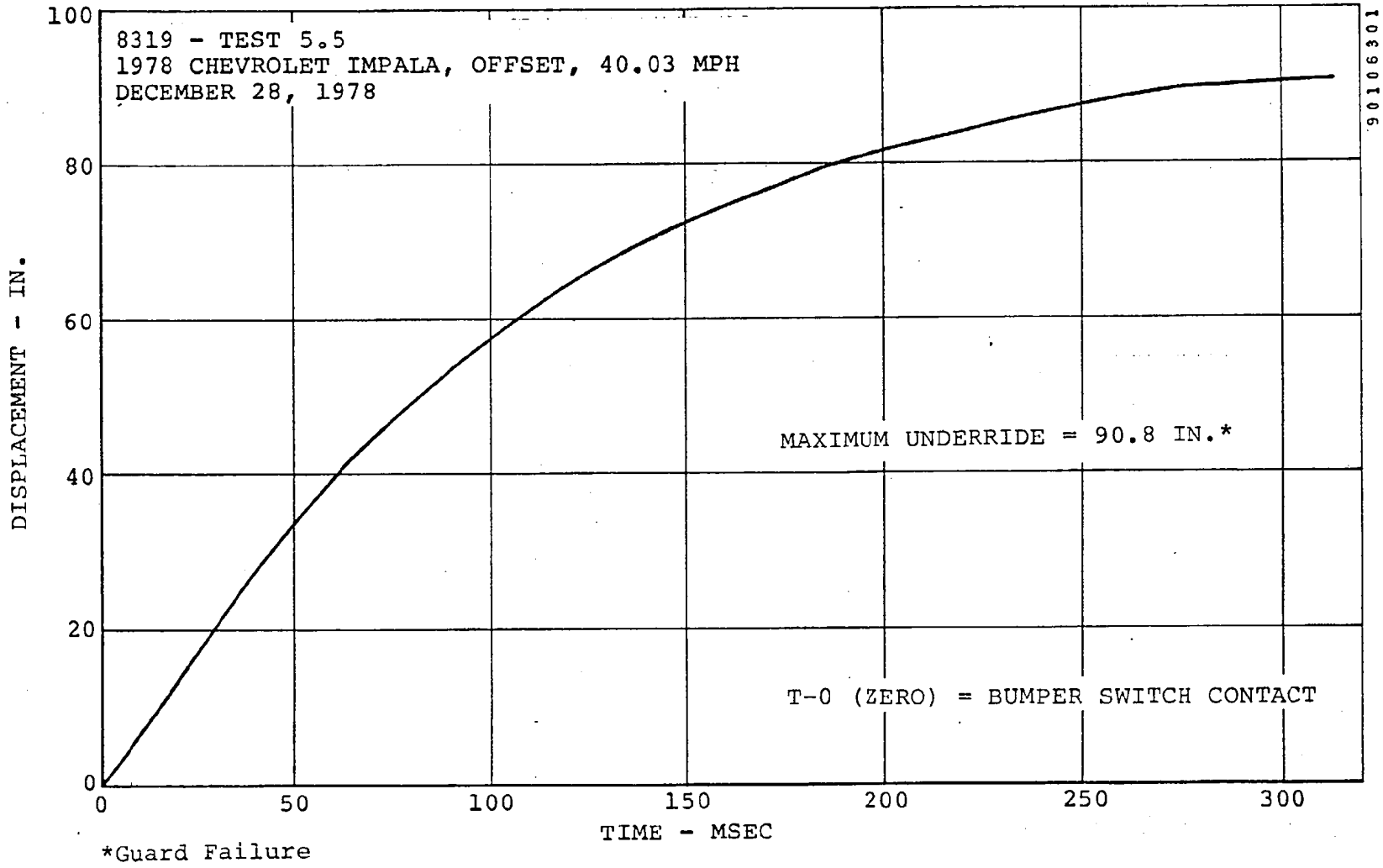
*STRESS = STRAIN (in./in.) x E(30×10^6 lb/in. for steel)
Tensile strain and stress are negative.

**For location of strain gauges 1-3, see Figure 3-3, location of strain gauges 7-17, see Figure 2-2.

TABLE A-9. SUMMARY OF PRE-TEST AND POST-TEST VEHICLE STATIC MEASUREMENTS

TEST NO. 5.5 VEHICLE 1978 Chevrolet Impala

Location	Dimension Pre	Post	Reference	Difference
Front Edge of Water Pump Casting	161.6	150.9	Target 192"	10.7
Bottom of "A" Pillar (Left)	119.3	111.1	Target 192"	8.2
Bottom of "A" Pillar (Right)	119.2	119.1	Target 192"	0.1
Rear Top Edge of Panel (Left)	109.8	100.5	Target 192"	9.3
Rear Top Edge of Panel (Right)	110.0	108.5	Target 192"	1.5
Steering Column Hub (Horizontal)	105.7	97.8	Target 192"	7.9
Steering Column Lower Rim (Horizontal)	103.2	94.7	Target 192"	8.5
Steering Column Hub (Vertical)	21.9	16.9	Rocker Sill	5.0
Steering Column Lower Rim (Vertical)	15.6	7.5	Rocker Sill	8.1
Top of "A" Pillar (Left)	100.6	99.5	Target 192"	1.1
Top of "A" Pillar (Right)	100.3	100.5	Target 192"	-0.2
Centerline Windshield Opening (Top)	105.5	104.1	Target 192"	1.4
Dash Panel at Knee Height (Left)	120.1	105.8	Target 192"	14.3
Dash Panel at Knee Height (Right)	119.9	115.1	Target 192"	4.8
Firewall - Driver Centerline	134.3	129.6	Target 192"	4.7
Firewall - Passenger Centerline	131.9	130.9	Target 192"	1.0
Firewall - Vehicle Centerline	132.1	126.8	Target 192"	5.3
Shocktower Left	NONE	-	-	-
Shocktower Right	NONE	-	-	-



*Guard Failure

Figure A-1. Test 5.5 Vehicle Underride Versus Time - Driver Side 1978 Chevrolet Impala - 42-in. Right Offset Impact at 40 mph.

TABLE A-10. SUMMARY OF PRE-TEST DUMMY POSITION DATA CHARACTERISTICS

Test No. 5.5 Type Underride 42-Inch Offset

Car Model Chevrolet Impala Dynamic Science No. 750

	Left Front Occupant	Right Front Occupant
Seat Range (in.)	6.1	6.1
Seat Position* (in.)	3.0	3.0
Front Seat to Firewall (in.)	25.7	25.6
Forehead to Windshield (in.)	21.6	20.3
Torso to Steering Wheel** (in.)	13.5	21.1
Left/Right Knee to Dash Panel (in.)	8.1/8.0	7.0/6.7

Dummy Type: Alderson Part 572

Locations: Left Front Occupant - No. 759

Right Front Occupant - No. 760

Restraint Type: LF Std. 3 Pt. Belts w/ELR***

RF Std. 3 Pt. Belts w/ELR

*From rearmost position to midpoint seat position.

**To dash panel for right front occupant.

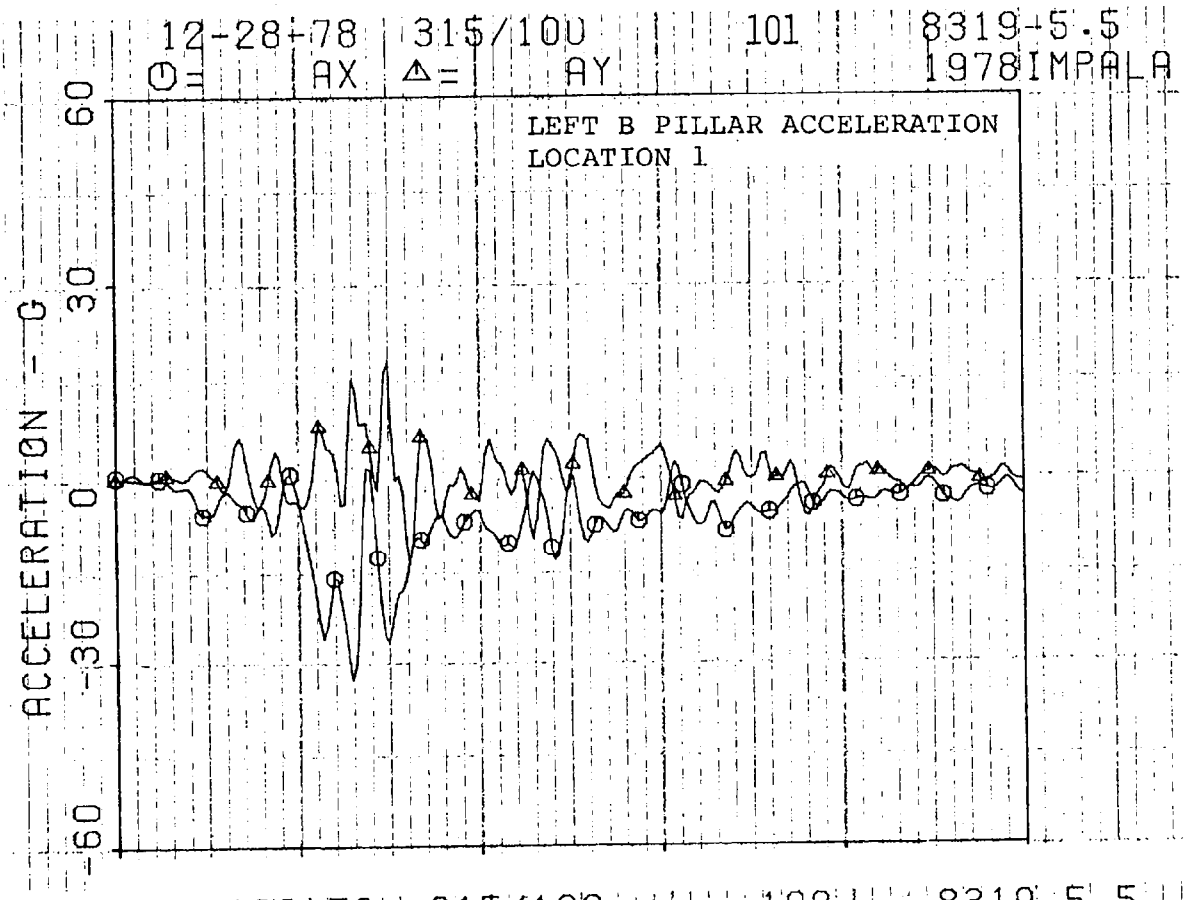
***ELR - Emergency Locking Retractor

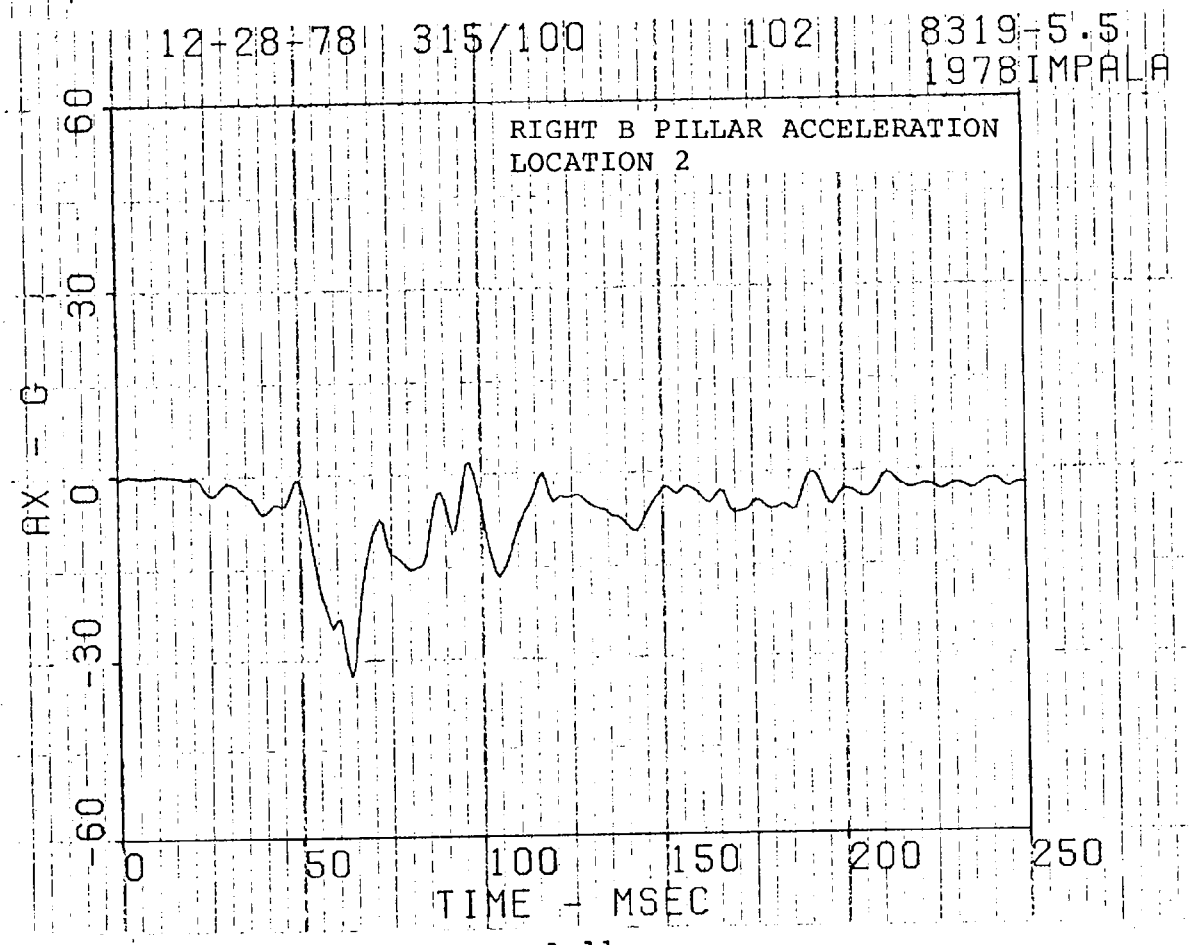
TABLE A-11. SUMMARY OF OCCUPANT RESPONSE DATA FOR TEST 5.5

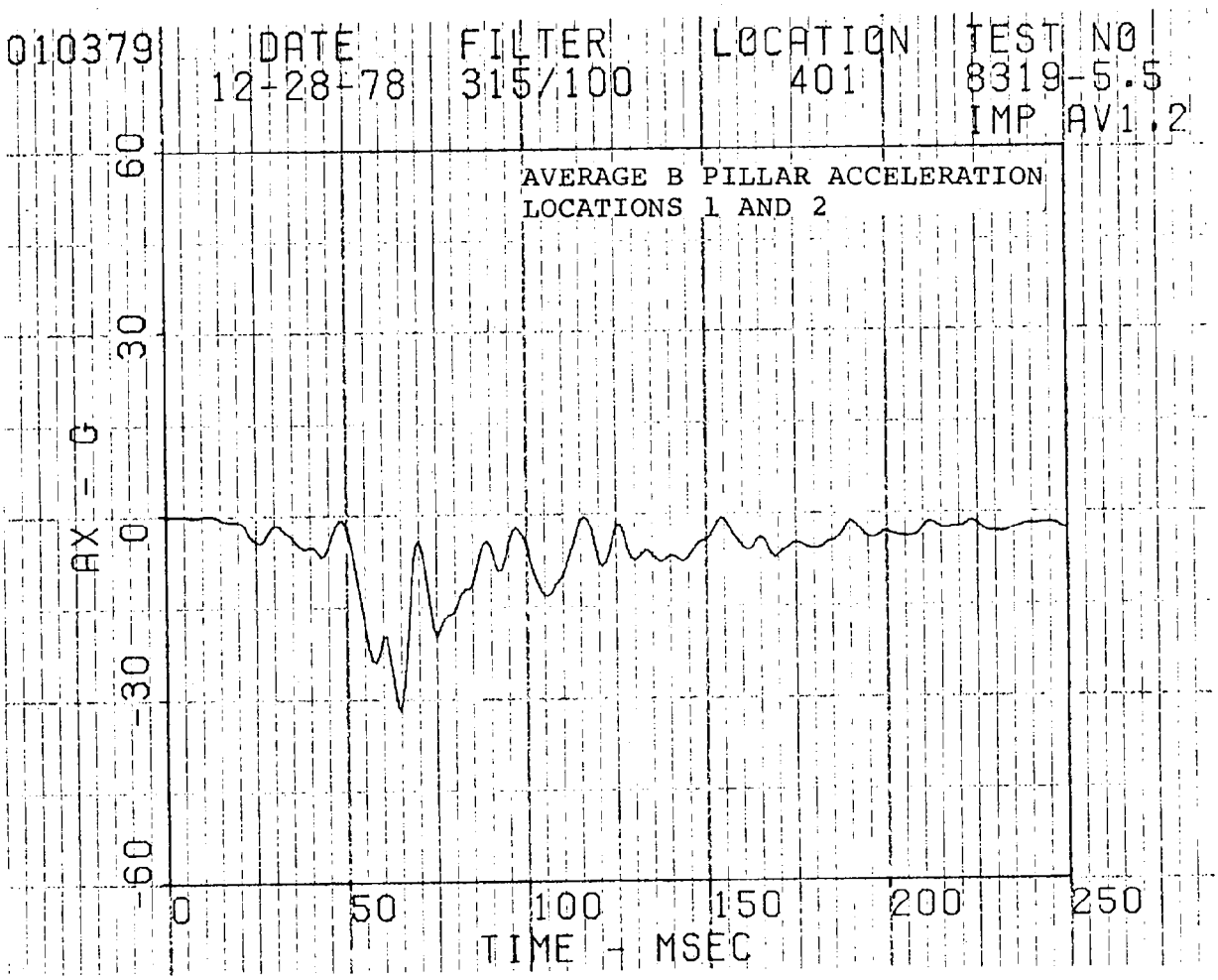
Response Parameter		Filter (Hz)	Left Front Dummy (Driver) Maximum Value A (G)	Left Front Dummy (Driver) Maximum Value T (msec)	Right Front Dummy (Passenger) Maximum Value A (G)	Right Front Dummy (Passenger) Maximum Value T (msec)
Head	X	1600	-48.7	134	-39.3	141
	Y	1600	-34.6	139	34.3	143
	Z	1600	42.3	129	51.0	140
	-R	1600	64.8	134	70.1	140
SI/Time			557	200	352	200
HIC/Time			435	112 - 147	227	94 - 156
Head Acceleration*	R	1600	59*		48*	
Chest	X	315	-48.9	121	-19.7	96
	Y	315	-21.4	119	8.2	111
	Z	315	13.4	73	7.8	80
	R	315	49.2	121	21.3	105
SI/Time			207	200	87	200
Chest Acceleration*			47*		31*	
Femur Loads** (lb)	L	1000	463	93	-525	189
	R	1000	-1582	107	-429	72

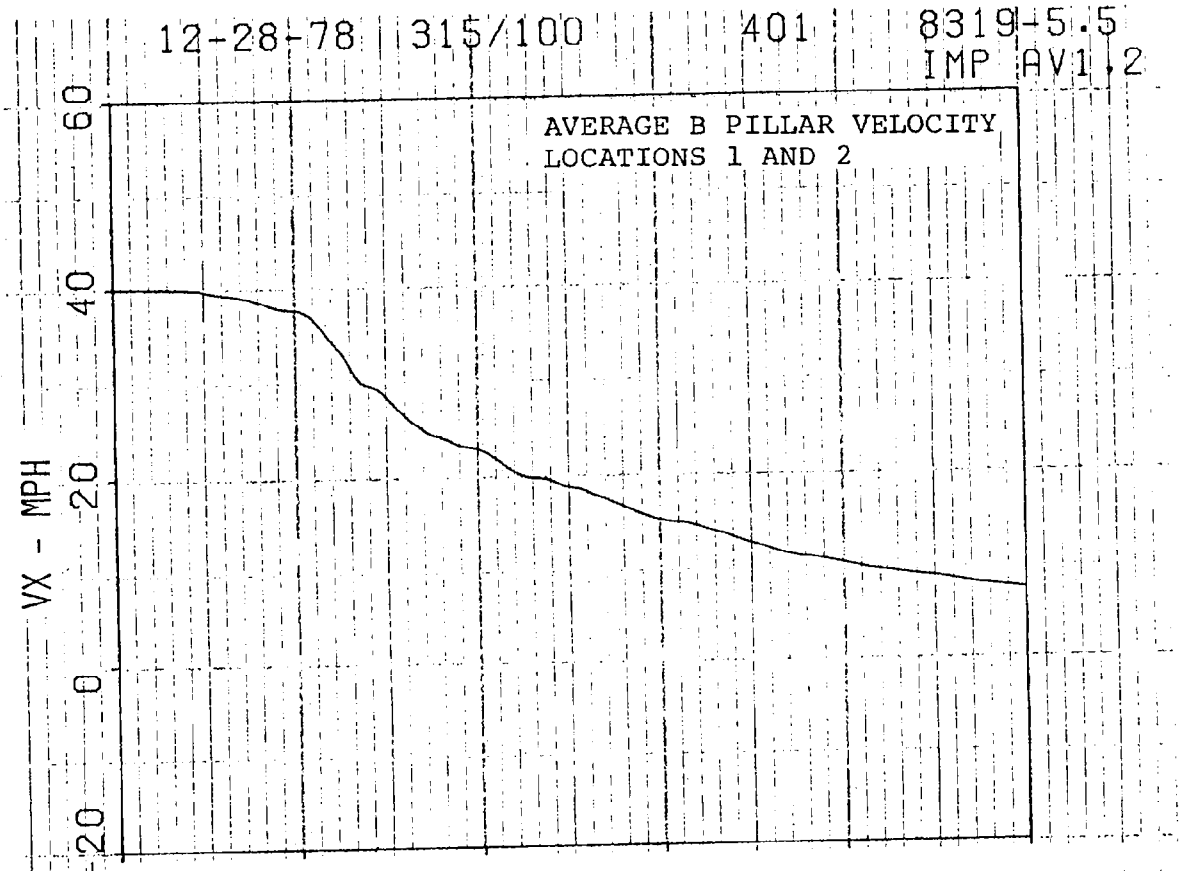
*G values defined as value for a cumulative duration of at least 3 msec.

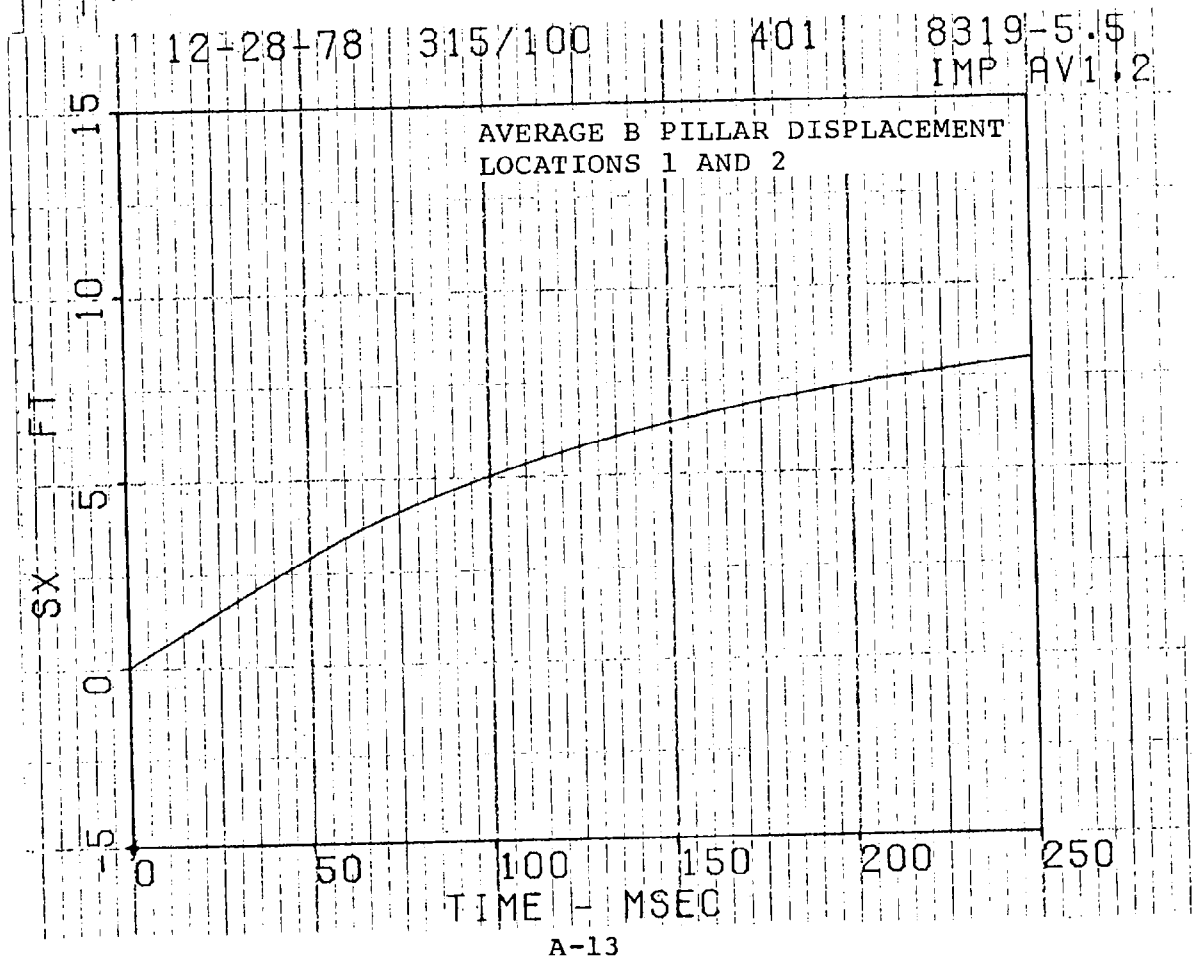
**Negative loads are compression; positive loads are tension.

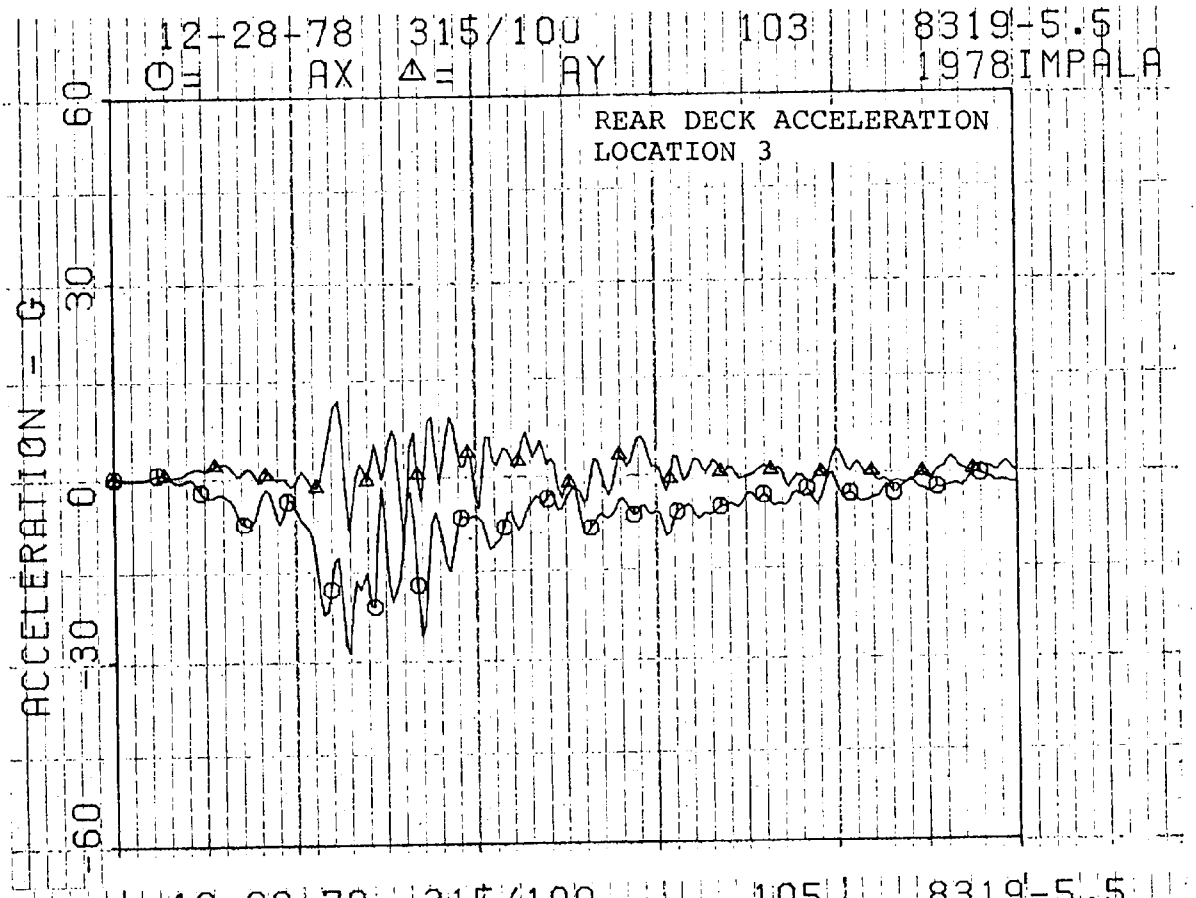

12-28-78 315/100 101 8319-5.5
1978IMPALA
LEFT B PILLAR ACCELERATION
LOCATION 1
ACCELERATION - G
60
30
0
-30
-60

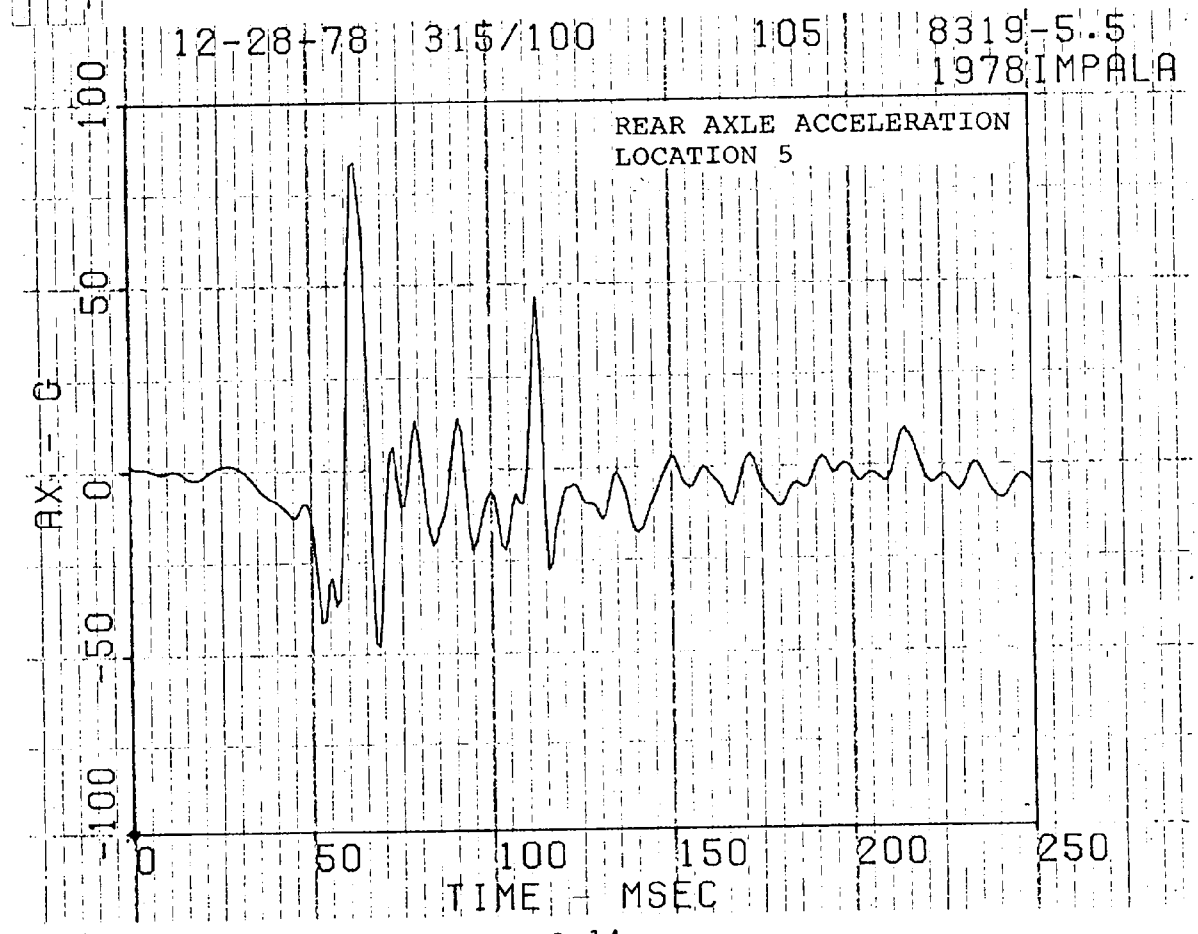

12-28-78 315/100 102 8319-5.5
1978IMPALA
RIGHT B PILLAR ACCELERATION
LOCATION 2
AX - G
60
30
0
-30
-60
0
50
100
150
200
250
TIME - MSEC

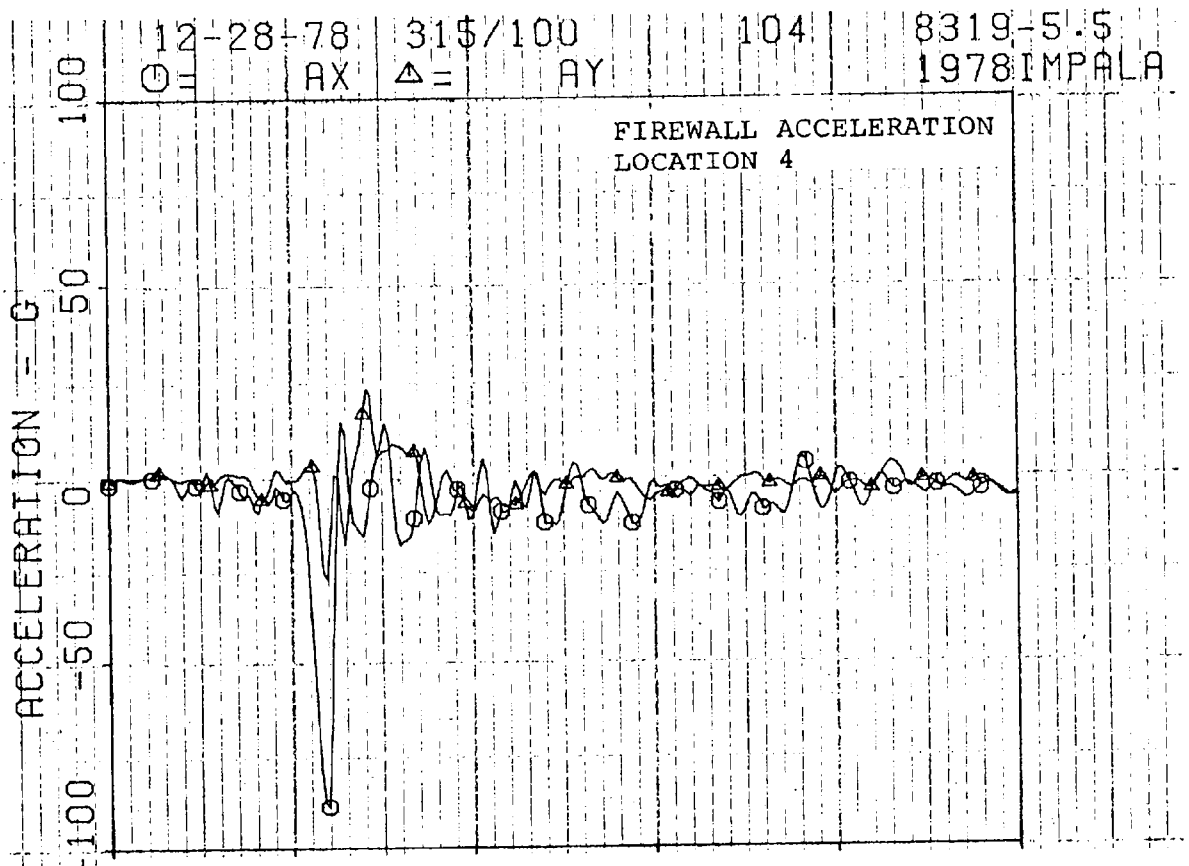

010379
DATE
12-28-78
FILTER
315/100
LOCATION
401
TEST NO
8319-5.5
IMP AV1.2
AVERAGE B PILLAR ACCELERATION
LOCATIONS 1 AND 2
AX - G
60
30
0
-30
-60
0
50
100
150
200
250
TIME - MSEC

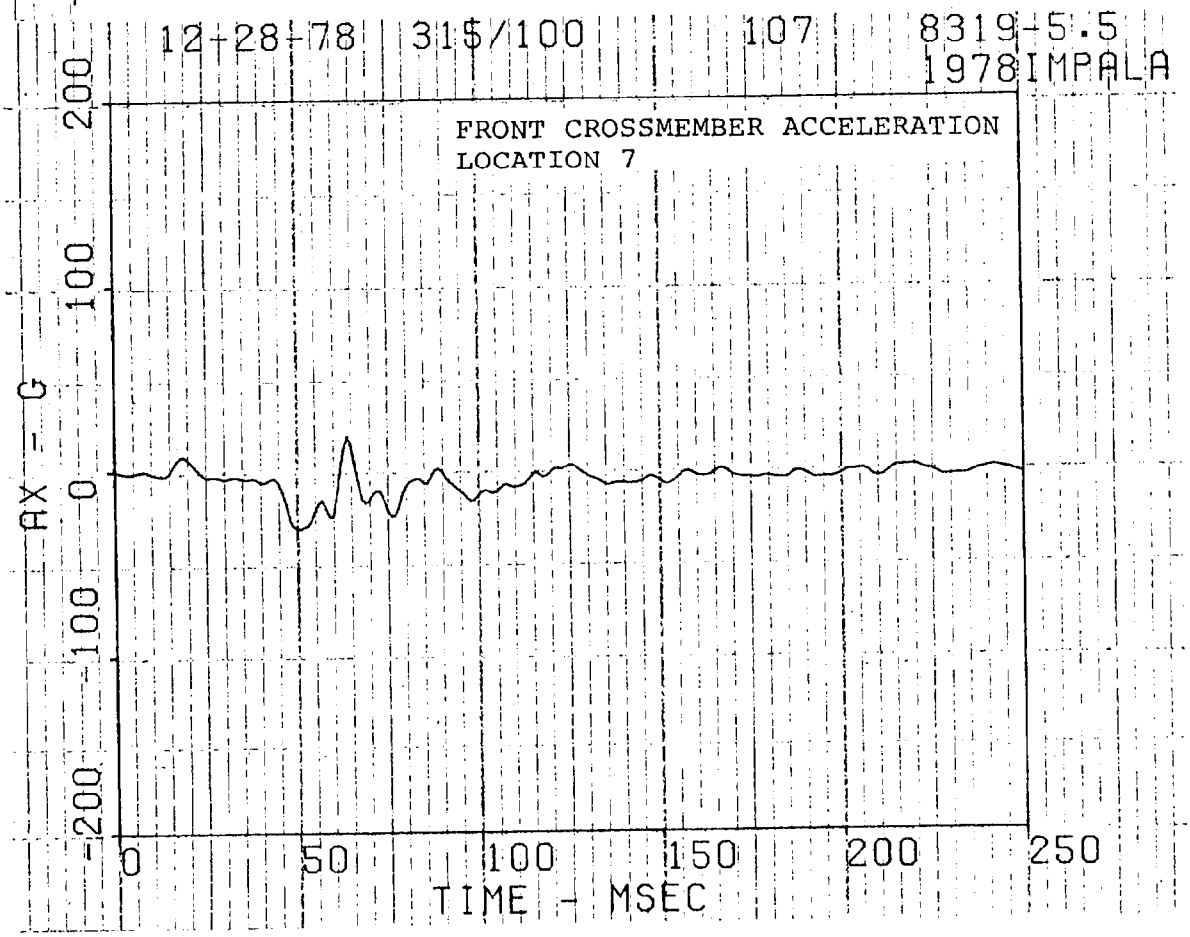

12-28-78 315/100 401 8319-5.5
IMP AV1.2
AVERAGE B PILLAR VELOCITY
LOCATIONS 1 AND 2
VX - MPH
60
40
20
0
-20

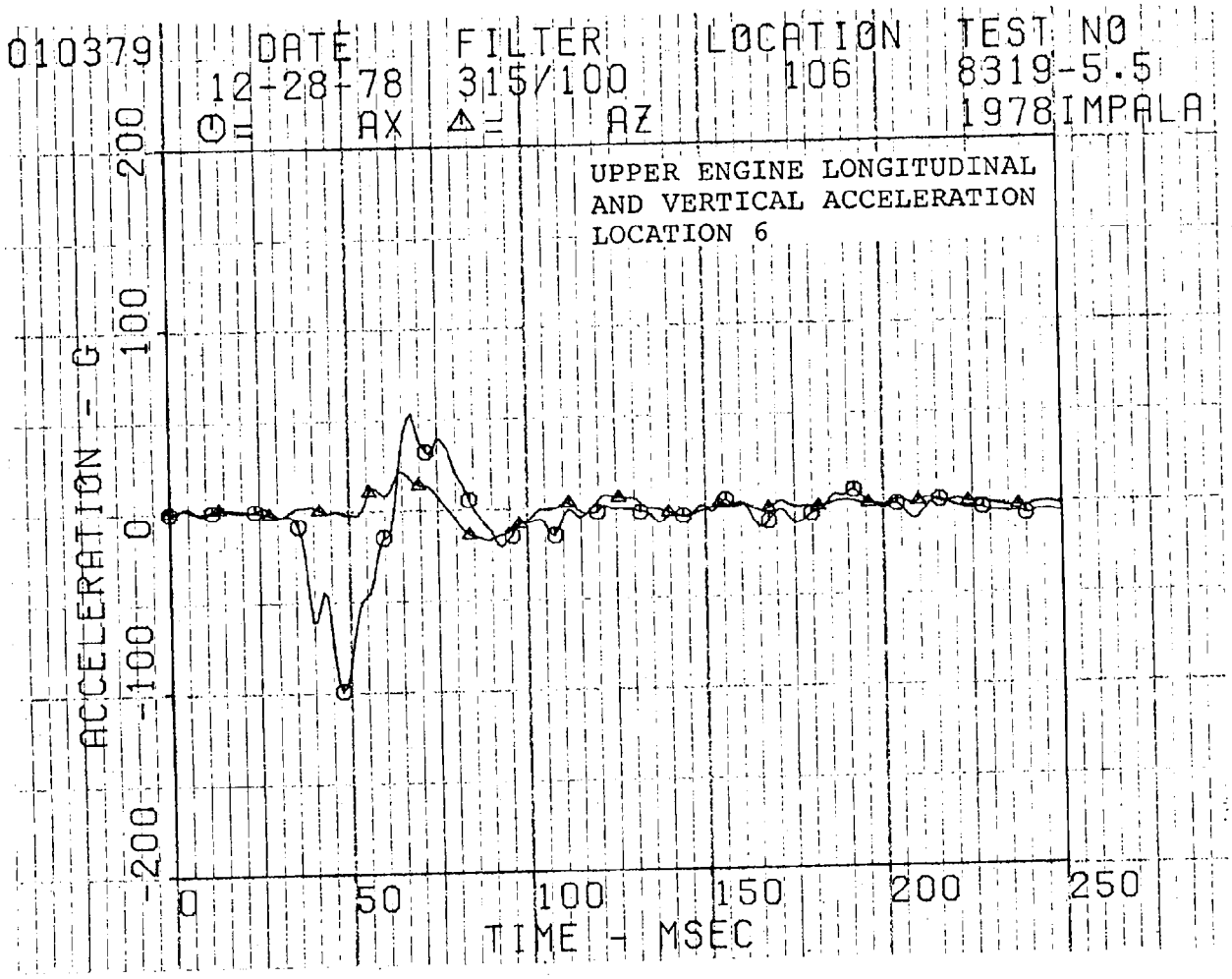

12-28-78 315/100 401 8319-5.5
IMP AV1.2
AVERAGE B PILLAR DISPLACEMENT
LOCATIONS 1 AND 2
SX - FT
15
10
5
0
-5
0
50
100
150
200
250
TIME - MSEC

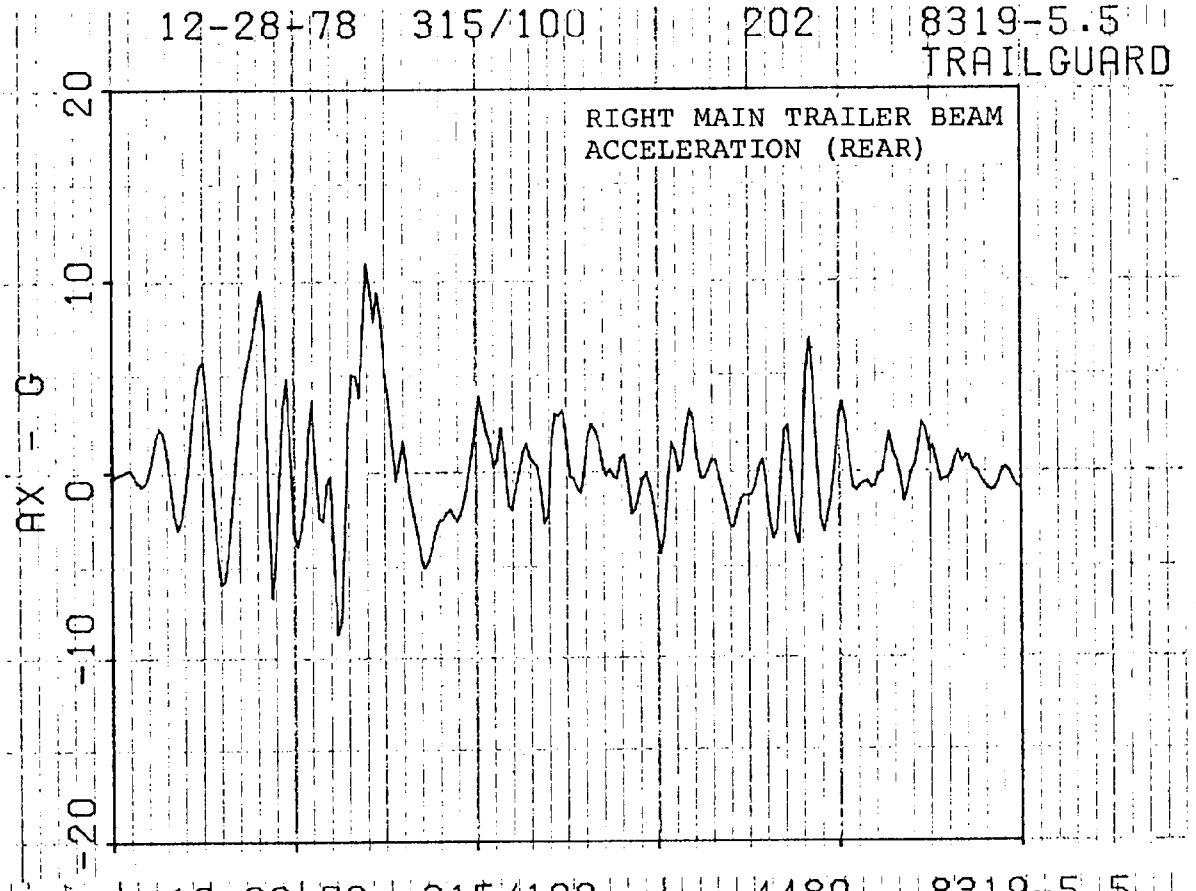

12-28-78 315/100 103 8319-5.5
○= AX △= AY 1978IMPALA
REAR DECK ACCELERATION
LOCATION 3
ACCELERATION - G
60
30
0
-30
-60

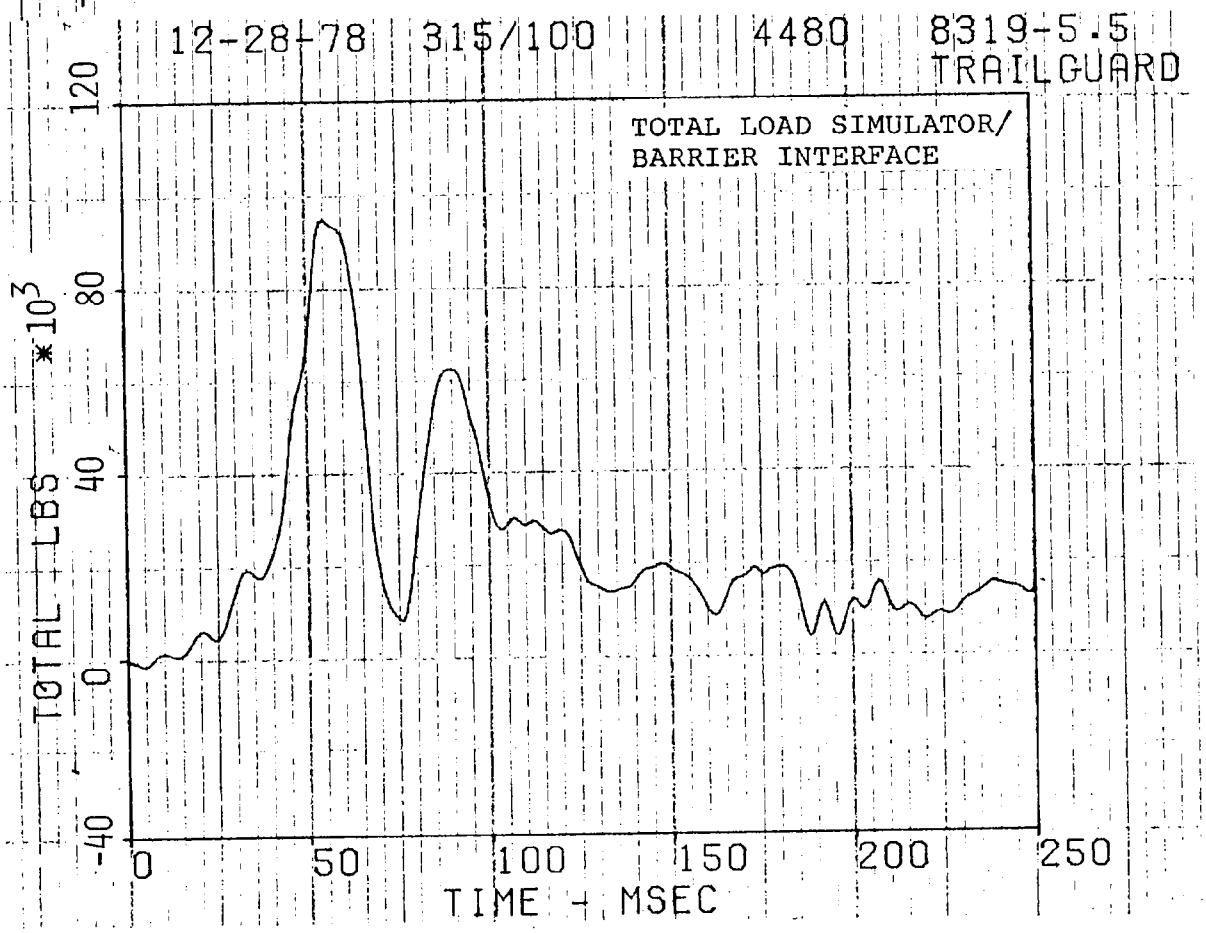

12-28-78 315/100 105 8319-5.5
1978IMPALA
REAR AXLE ACCELERATION
LOCATION 5
AX - G
100
50
0
-50
-100
0
50
100
150
200
250
TIME - MSEC

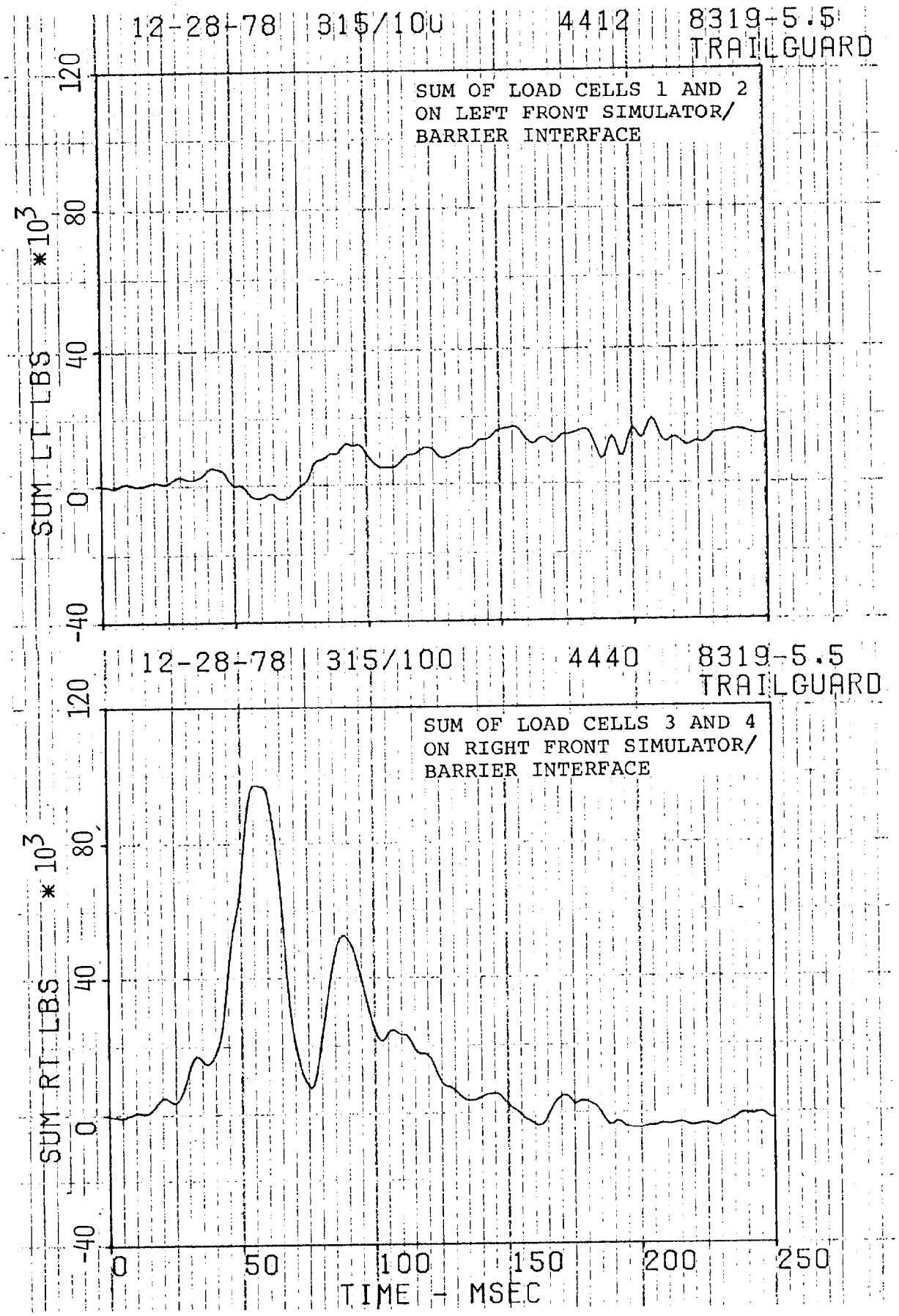

12-28-78 31$/100 104 8319-5.5
○= AX △= AY 1978IMPALA
FIREWALL ACCELERATION
LOCATION 4
ACCELERATION = G
100
50
0
-50
-100

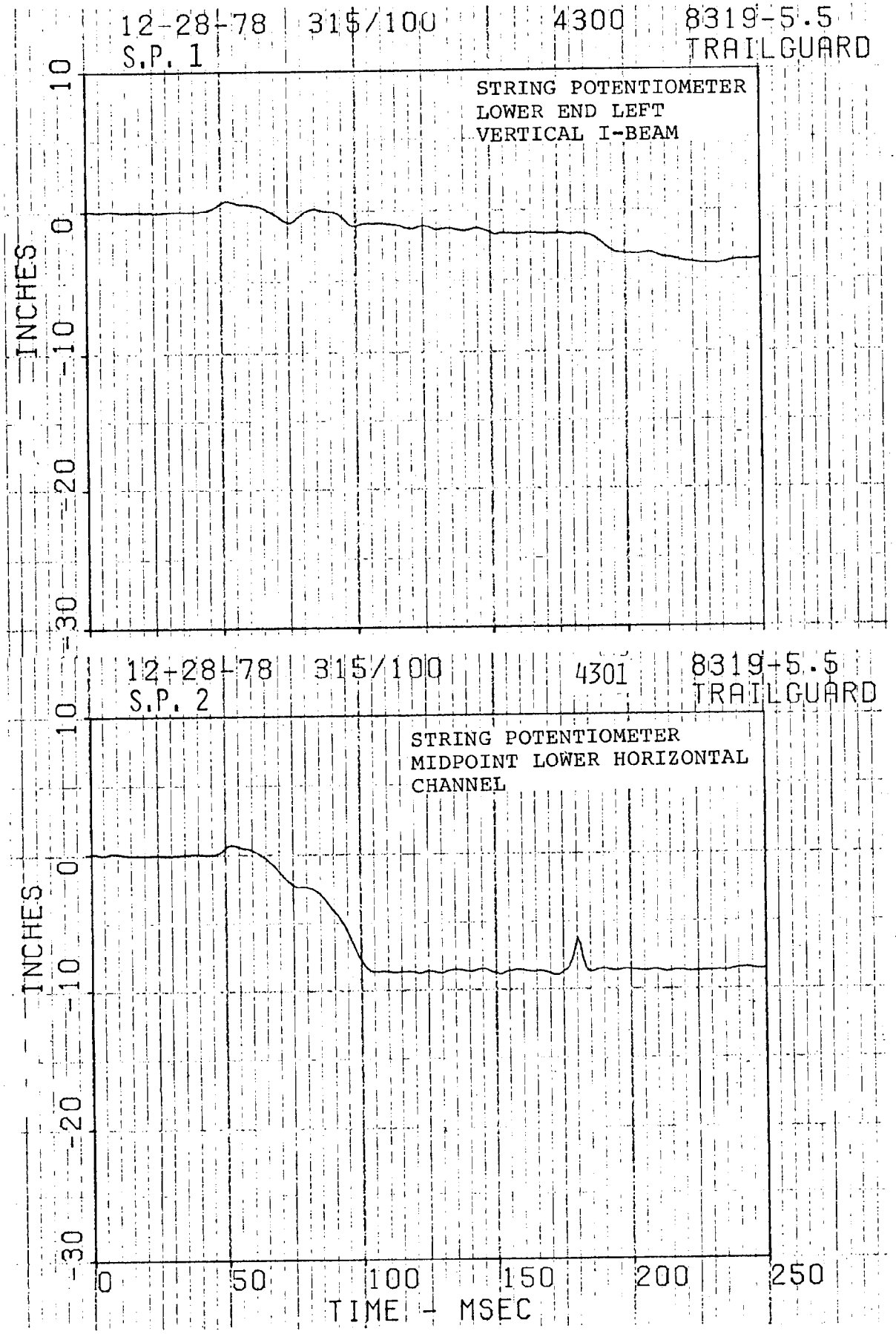

12-28-78 31$/100 107 8319-5.5
1978IMPALA
FRONT CROSSMEMBER ACCELERATION
LOCATION 7
AX = G
200
100
0
-100
-200
0
50
100
150
200
250
TIME - MSEC

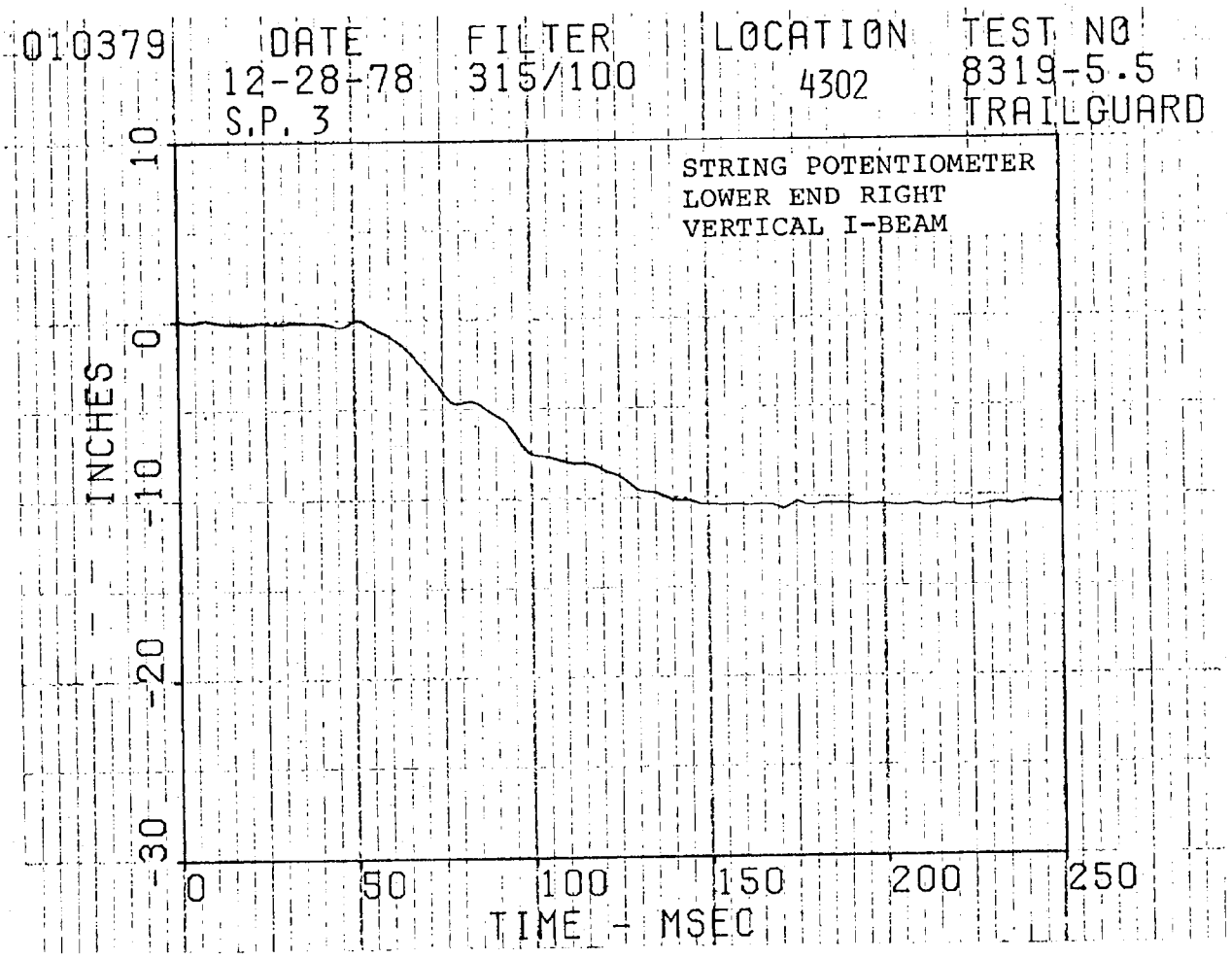

010379
DATE
12-28-78
FILTER
315/100
LOCATION
106
TEST NO
8319-5.5
1978 IMPALA
AX
AZ
UPPER ENGINE LONGITUDINAL
AND VERTICAL ACCELERATION
LOCATION 6
ACCELERATION - G
200
100
0
-100
-200
0
50
100
150
200
250
TIME - MSEC

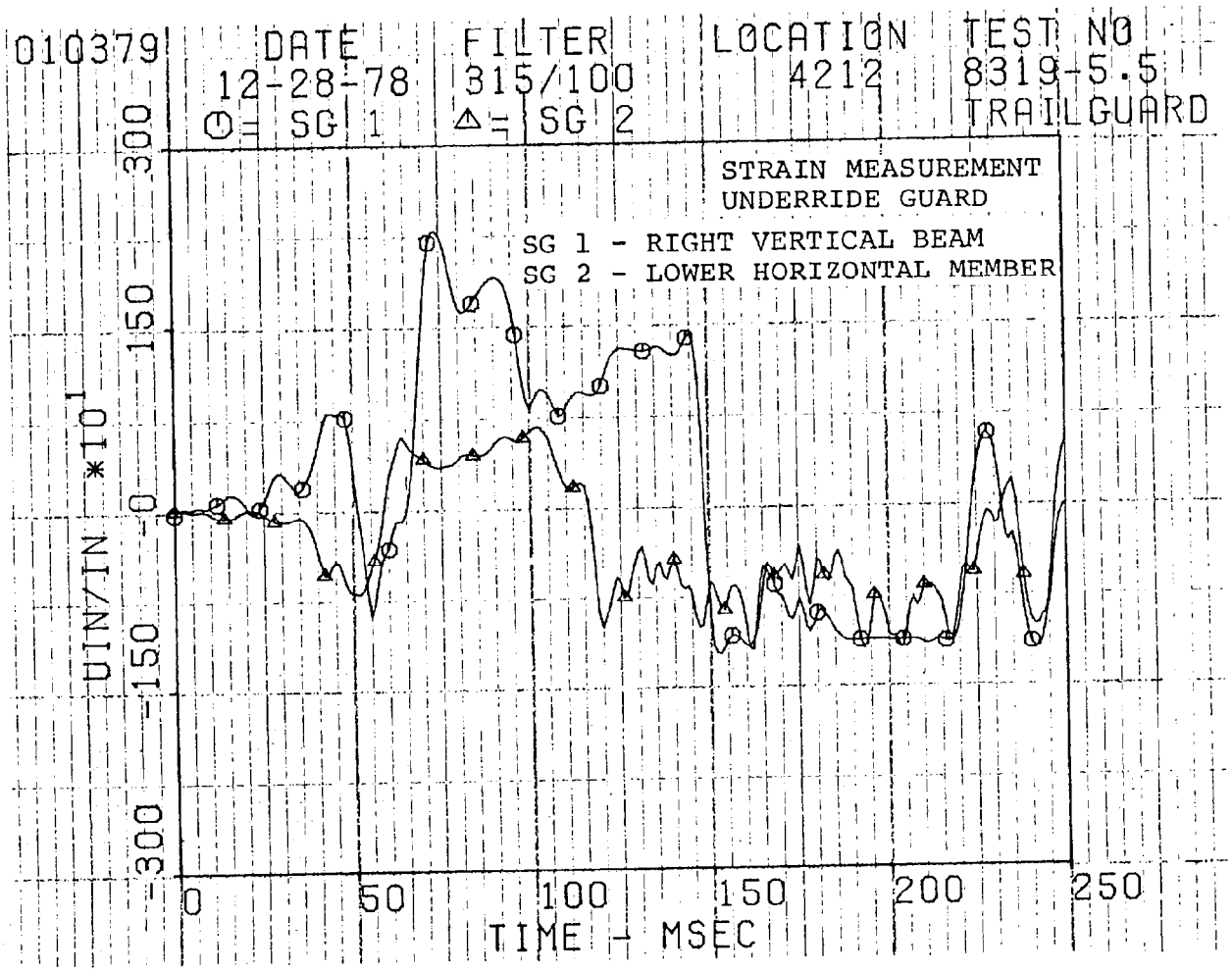

12-28-78 315/100 202 8319-5.5
TRAILGUARD
RIGHT MAIN TRAILER BEAM
ACCELERATION (REAR)
AX - G
20
10
0
-10
-20

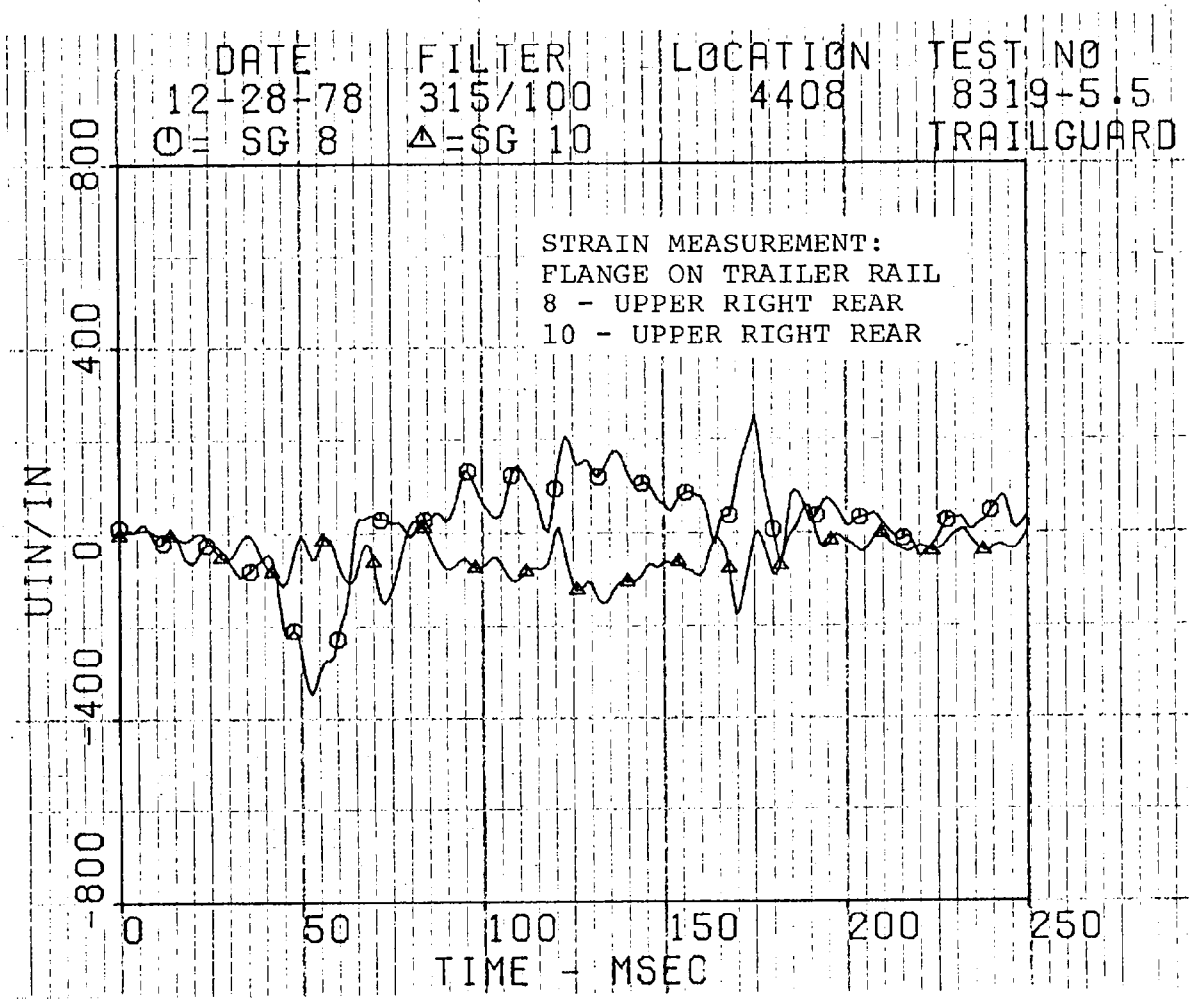

12-28-78 315/100 4480 8319-5.5
TRAILGUARD
TOTAL LOAD SIMULATOR/
BARRIER INTERFACE
TOTAL LBS *10^3
120
80
40
0
-40
0
50
100
150
200
250
TIME - MSEC

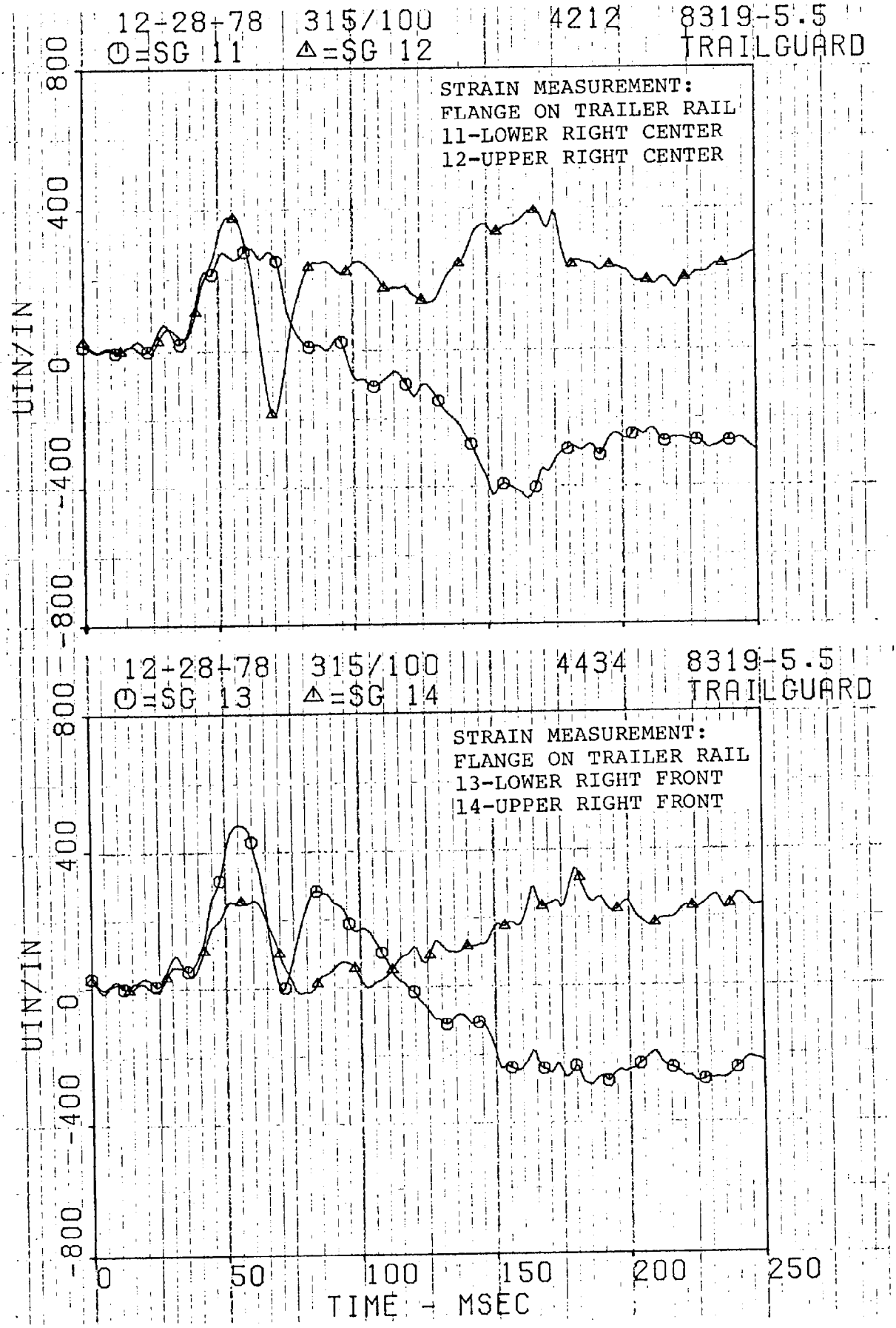

12-28-78 315/100 4412 8319-5.5
TRAILGUARD
SUM OF LOAD CELLS 1 AND 2
ON LEFT FRONT SIMULATOR/
BARRIER INTERFACE
SUM LT LBS *10^3
120
80
40
0
-40
12-28-78 315/100 4440 8319-5.5
TRAILGUARD
SUM OF LOAD CELLS 3 AND 4
ON RIGHT FRONT SIMULATOR/
BARRIER INTERFACE
SUM RT LBS *10^3
120
80
40
0
-40
0
50
100
150
200
250
TIME - MSEC

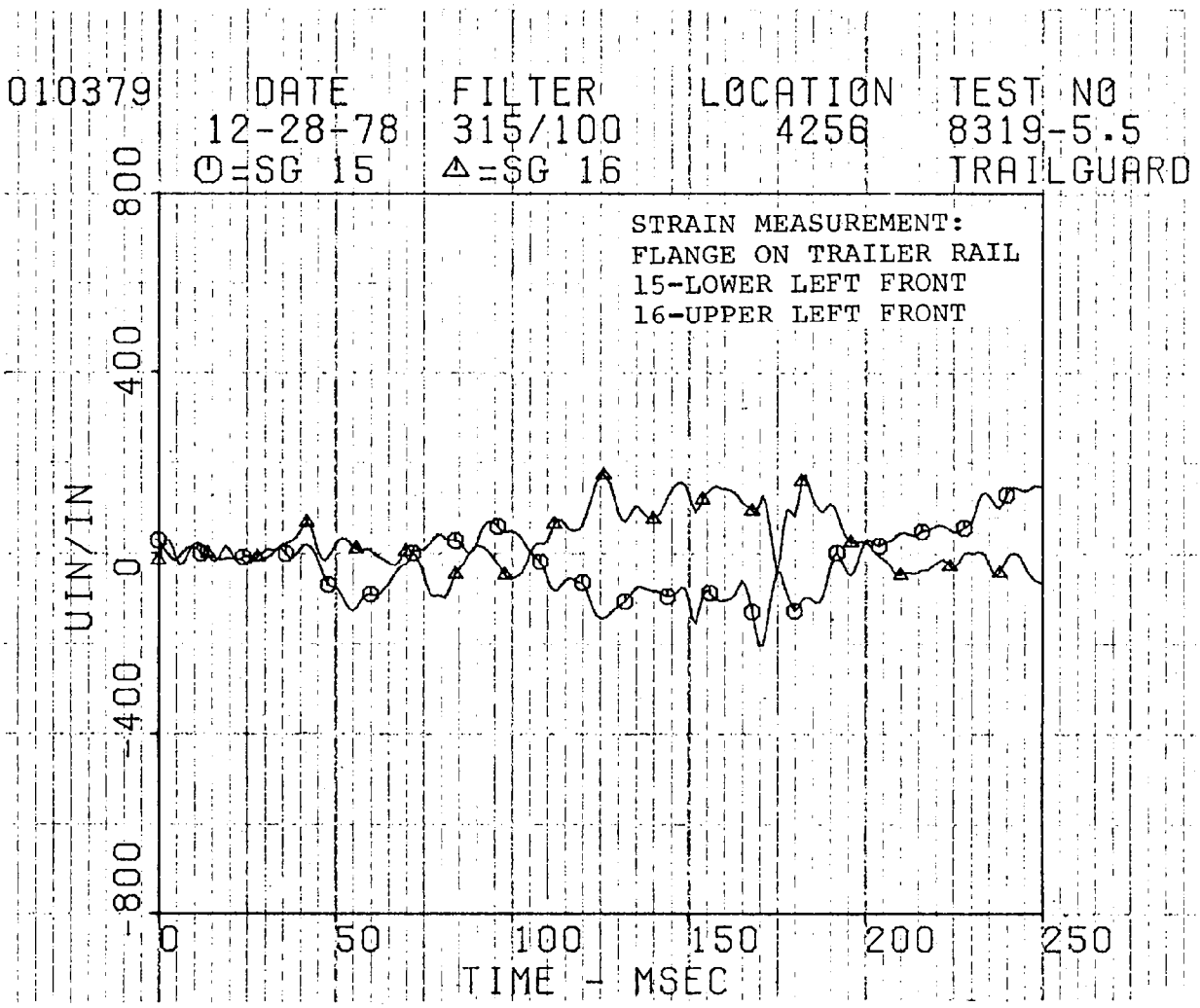

12-28-78 315/100 4300 8319-5.5
S.P. 1
TRAILGUARD
STRING POTENTIOMETER
LOWER END LEFT
VERTICAL I-BEAM
INCHES
10
0
-10
-20
-30
12-28-78 315/100 4301 8319-5.5
S.P. 2
TRAILGUARD
STRING POTENTIOMETER
MIDPOINT LOWER HORIZONTAL
CHANNEL
INCHES
10
0
-10
-20
-30
0
50
100
150
200
250
TIME - MSEC

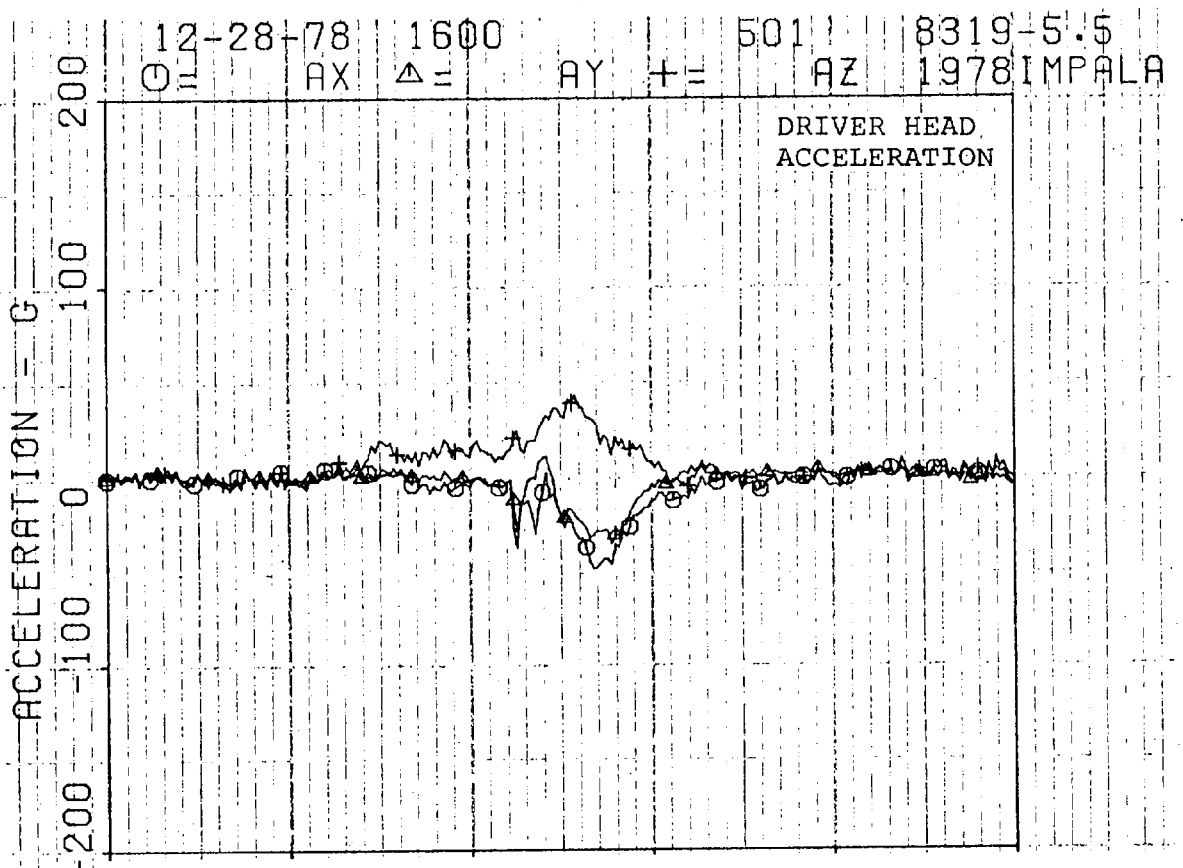

010379
DATE
12-28-78
S.P. 3
FILTER
315/100
LOCATION
4302
TEST NO
8319-5.5
TRAILGUARD
STRING POTENTIOMETER
LOWER END RIGHT
VERTICAL I-BEAM
INCHES
10
0
-10
-20
-30
0
50
100
150
200
250
TIME - MSEC

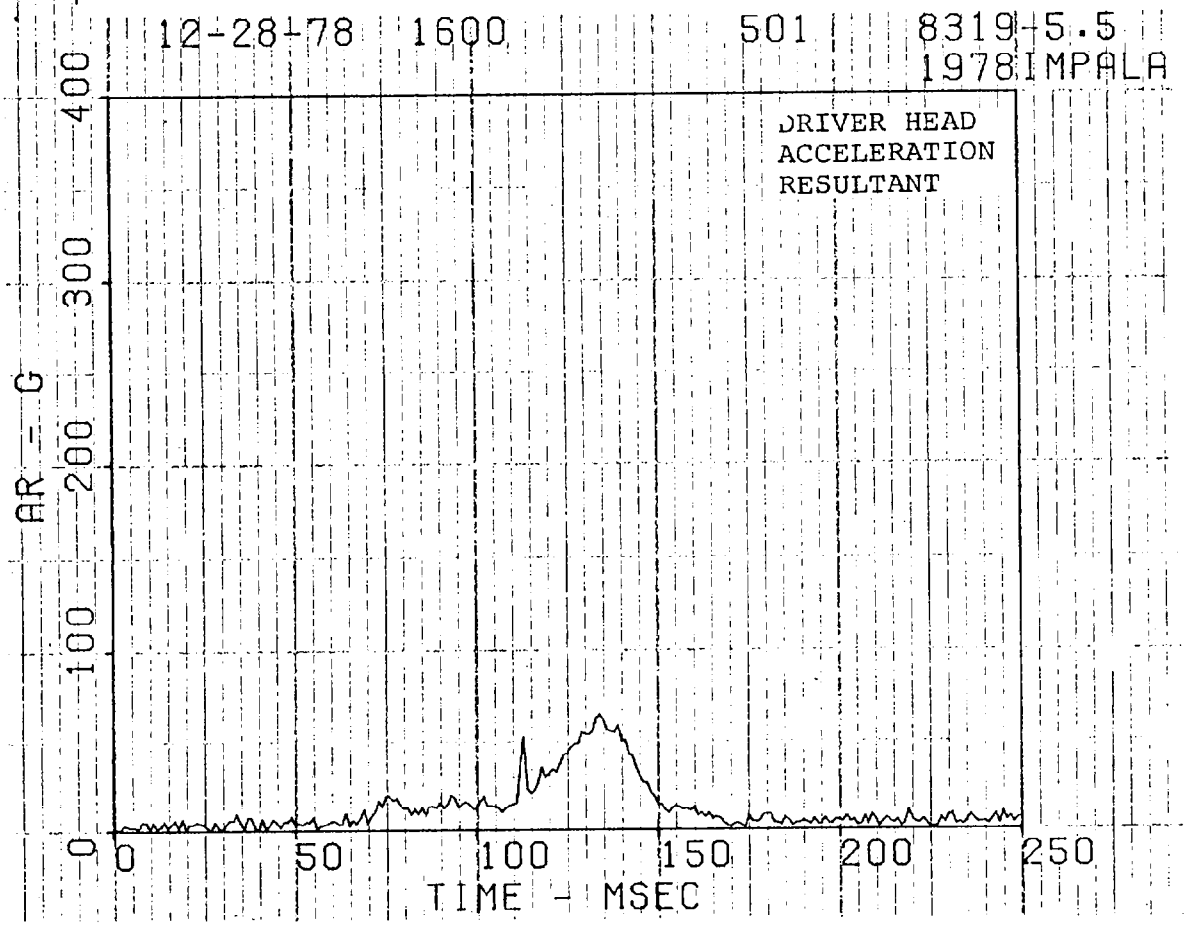

010379
DATE
12-28-78
FILTER
315/100
LOCATION
4212
TEST NO
8319-5.5
TRAILGUARD
O = SG 1
Δ = SG 2
STRAIN MEASUREMENT
UNDERRIDE GUARD
SG 1 - RIGHT VERTICAL BEAM
SG 2 - LOWER HORIZONTAL MEMBER
UIN/IN *10^-1
300
150
0
-150
-300
0
50
100
150
200
250
TIME - MSEC

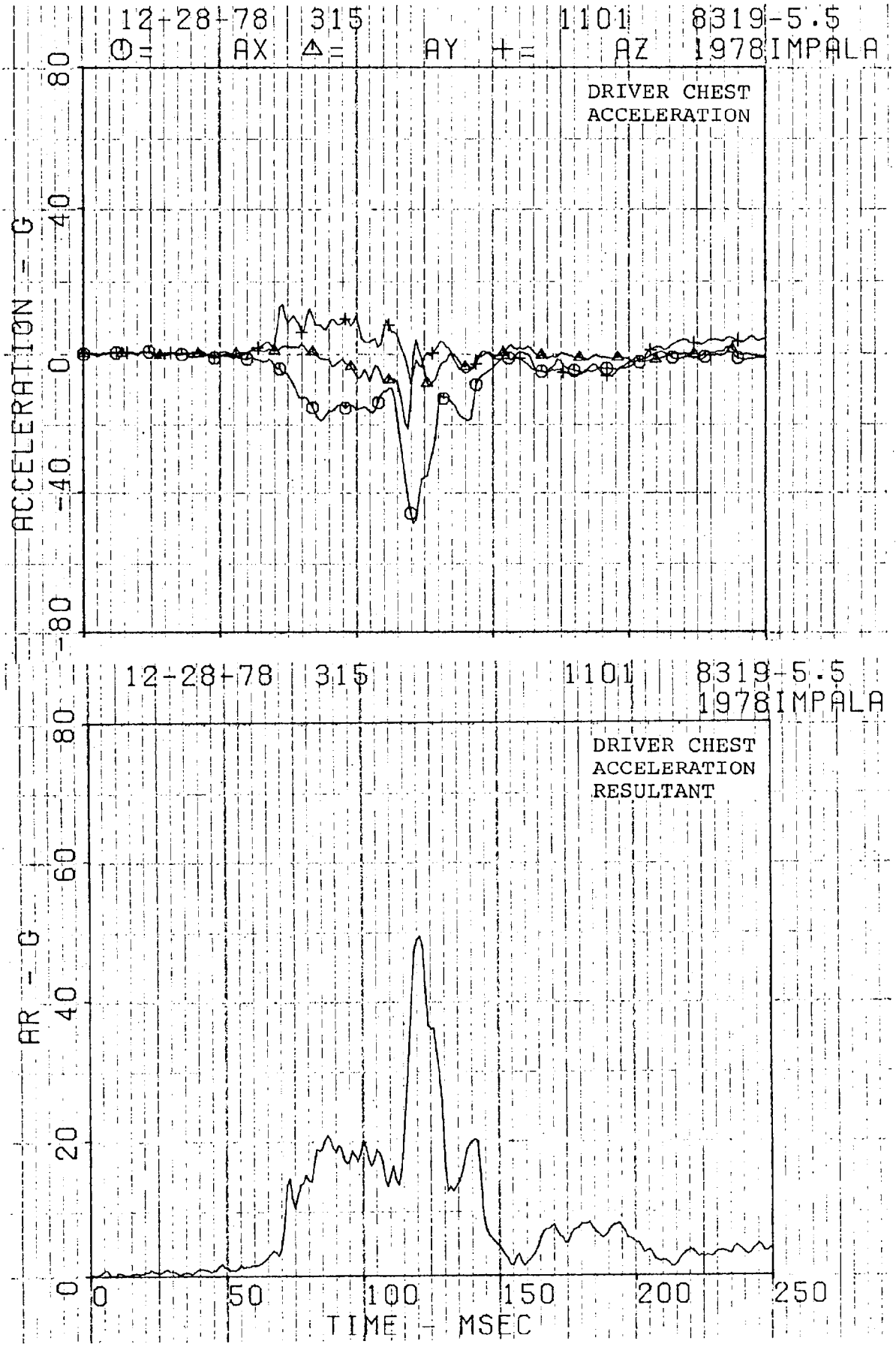

DATE
12-28-78
FILTER
315/100
LOCATION
4408
TEST NO
8319-5.5
TRAILGUARD
○= SG 8
△=SG 10
STRAIN MEASUREMENT:
FLANGE ON TRAILER RAIL
8 - UPPER RIGHT REAR
10 - UPPER RIGHT REAR
800
400
0
-400
-800
UIN/IN
0
50
100
150
200
250
TIME - MSEC

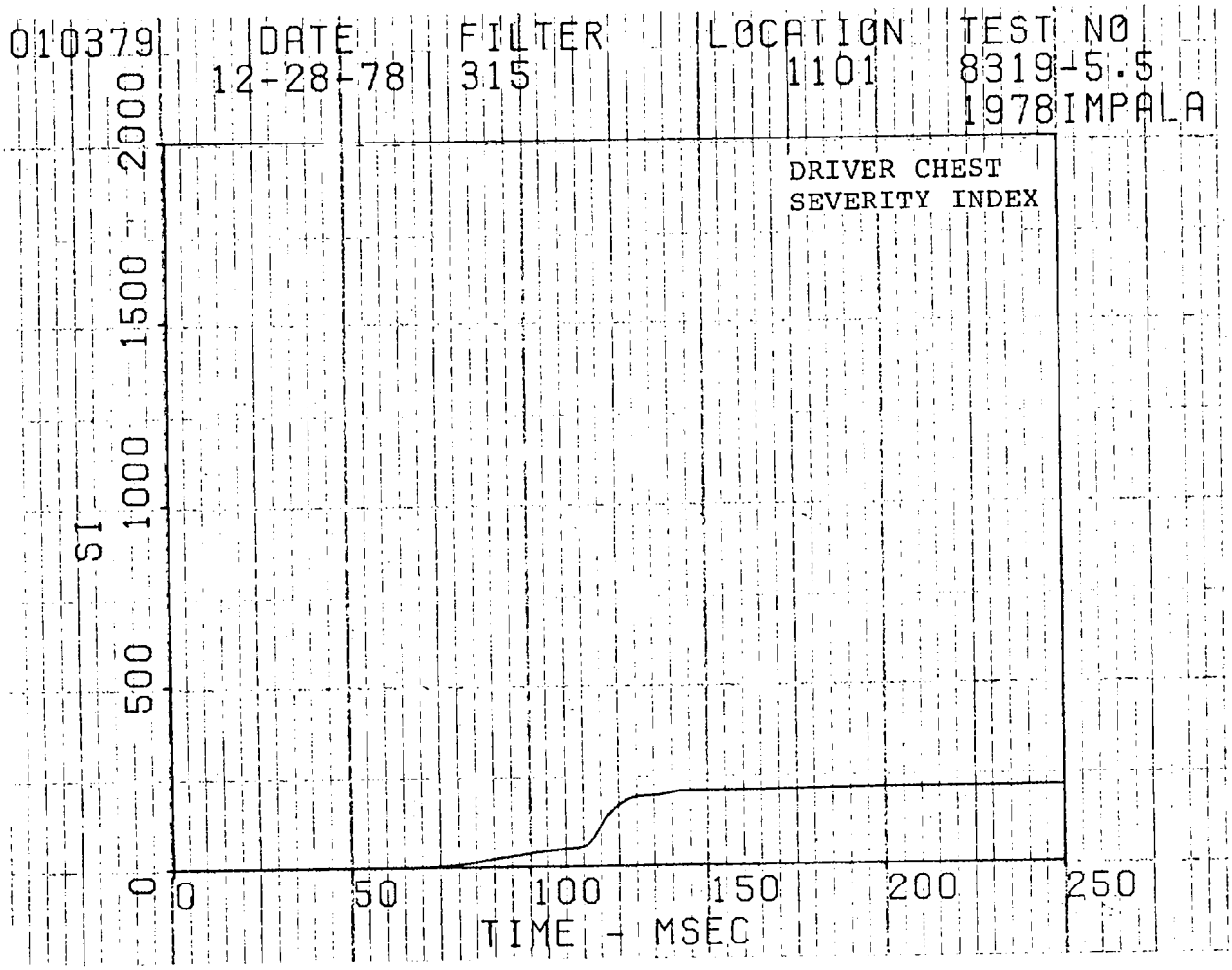

12-28-78 315/100 4212 8319-5.5
⏲=SG 11 △=SG 12 TRAILGUARD
STRAIN MEASUREMENT:
FLANGE ON TRAILER RAIL
11-LOWER RIGHT CENTER
12-UPPER RIGHT CENTER
UIN/IN
800
400
0
-400
-800
12-28-78 315/100 4434 8319-5.5
⏲=SG 13 △=SG 14 TRAILGUARD
STRAIN MEASUREMENT:
FLANGE ON TRAILER RAIL
13-LOWER RIGHT FRONT
14-UPPER RIGHT FRONT
UIN/IN
800
400
0
-400
-800
0
50
100
150
200
250
TIME - MSEC

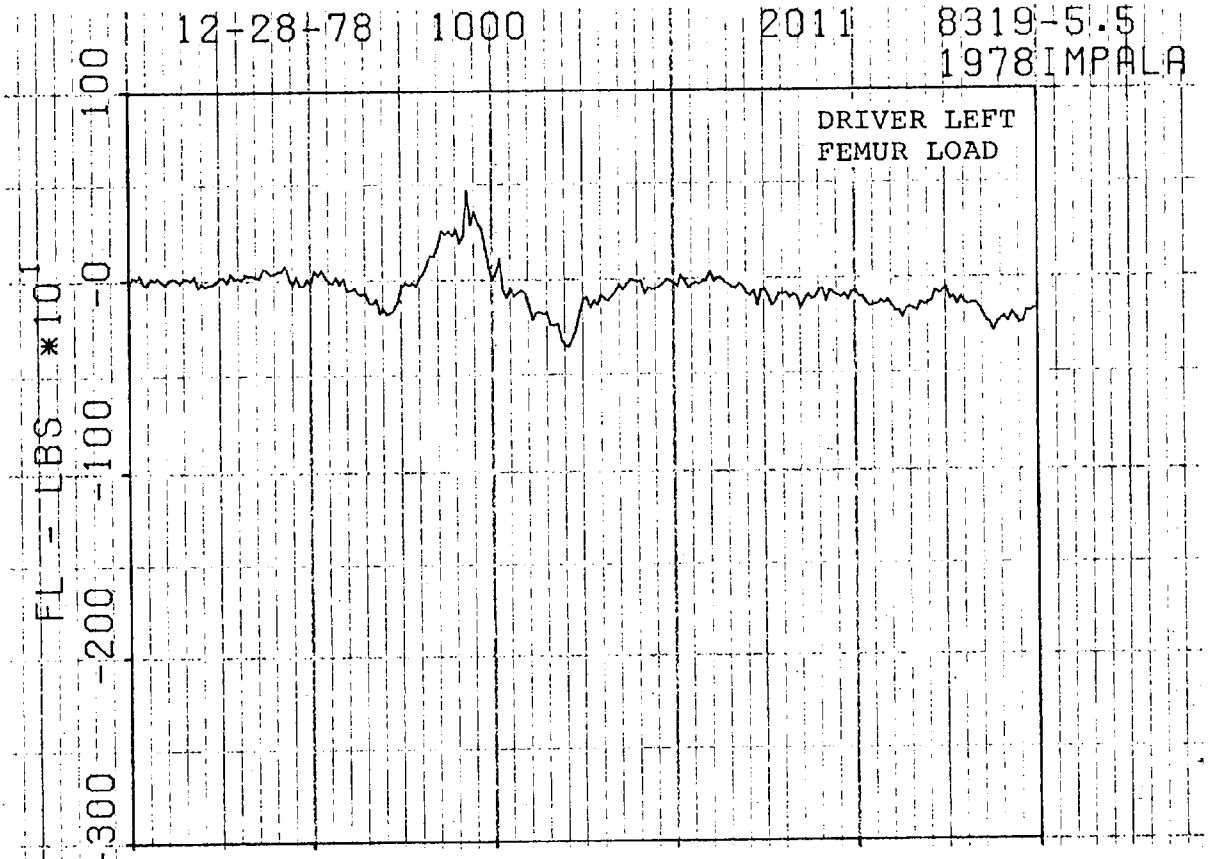

010379
DATE
12-28-78
FILTER
315/100
LOCATION
4256
TEST NO
8319-5.5
TRAILGUARD
⊙=SG 15
△=SG 16
STRAIN MEASUREMENT:
FLANGE ON TRAILER RAIL
15-LOWER LEFT FRONT
16-UPPER LEFT FRONT
UIN/IN
800
400
0
-400
-800
0
50
100
150
200
250
TIME - MSEC

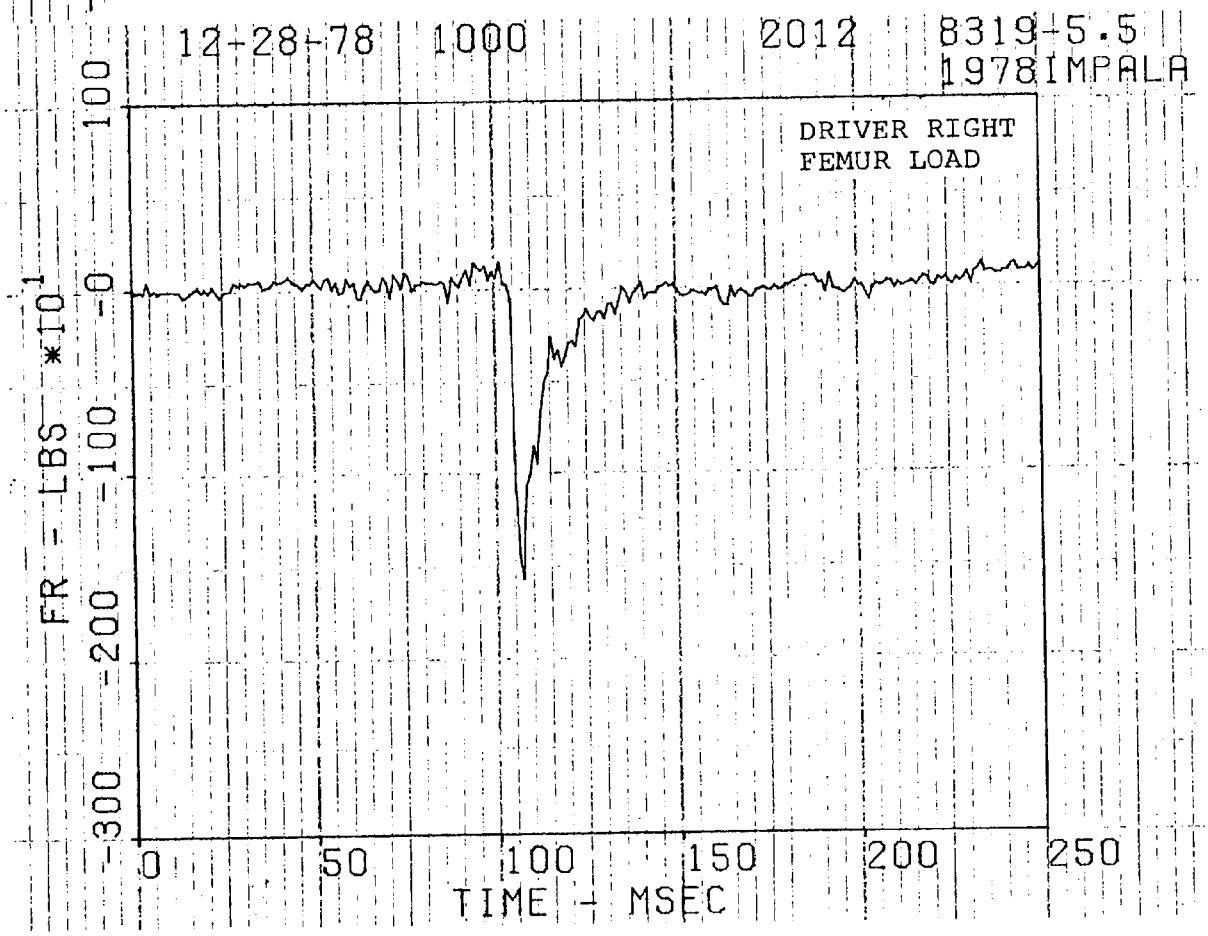

12-28-78 1600 501 8319-5.5
○ = AX △ = AY + = AZ 1978IMPALA
DRIVER HEAD ACCELERATION
ACCELERATION = G
200
100
0
-100
-200

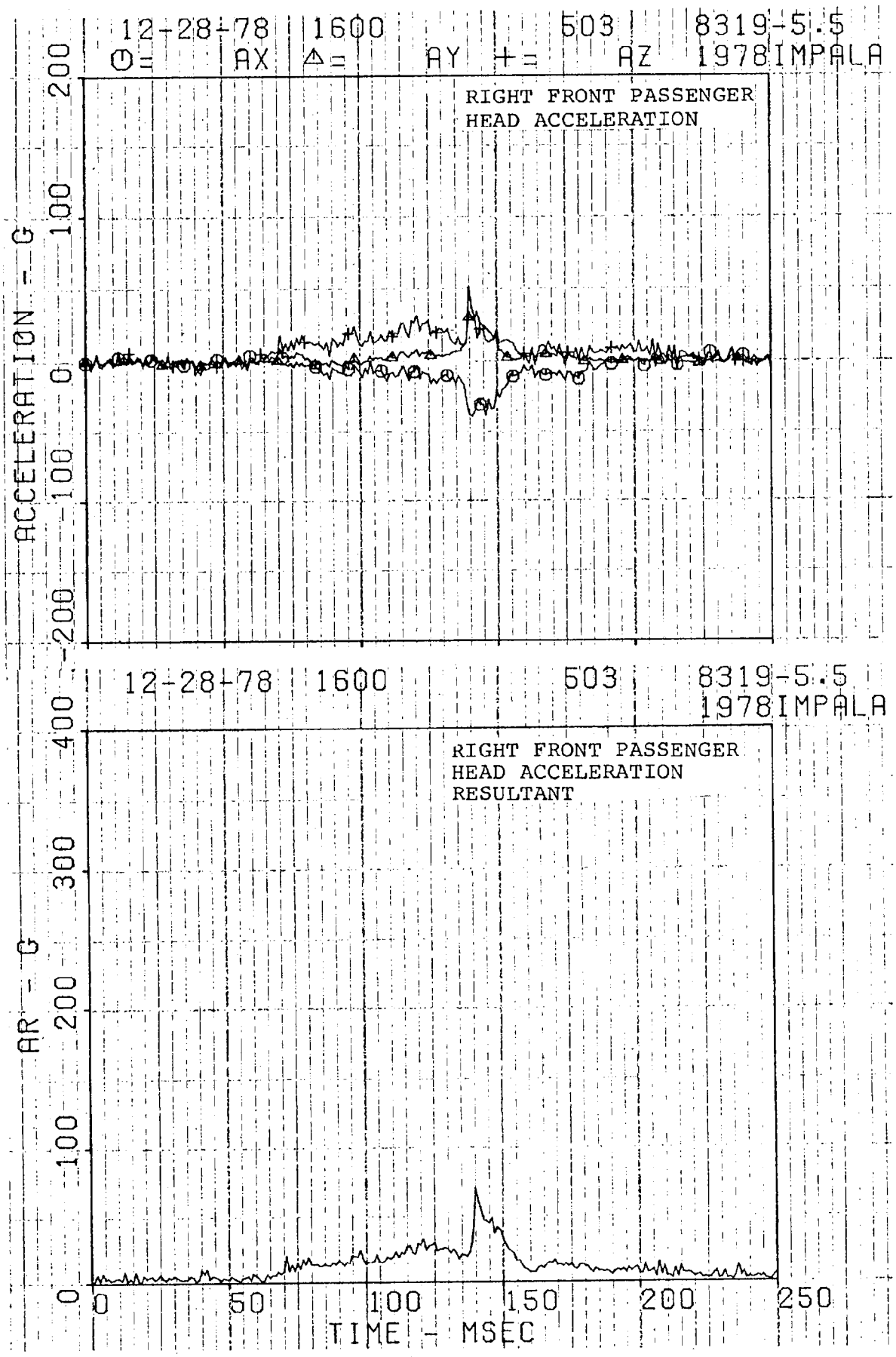

12-28-78 1600 501 8319-5.5
1978IMPALA
DRIVER HEAD ACCELERATION RESULTANT
AR = G
400
300
200
100
0
0
50
100
150
200
250
TIME - MSEC

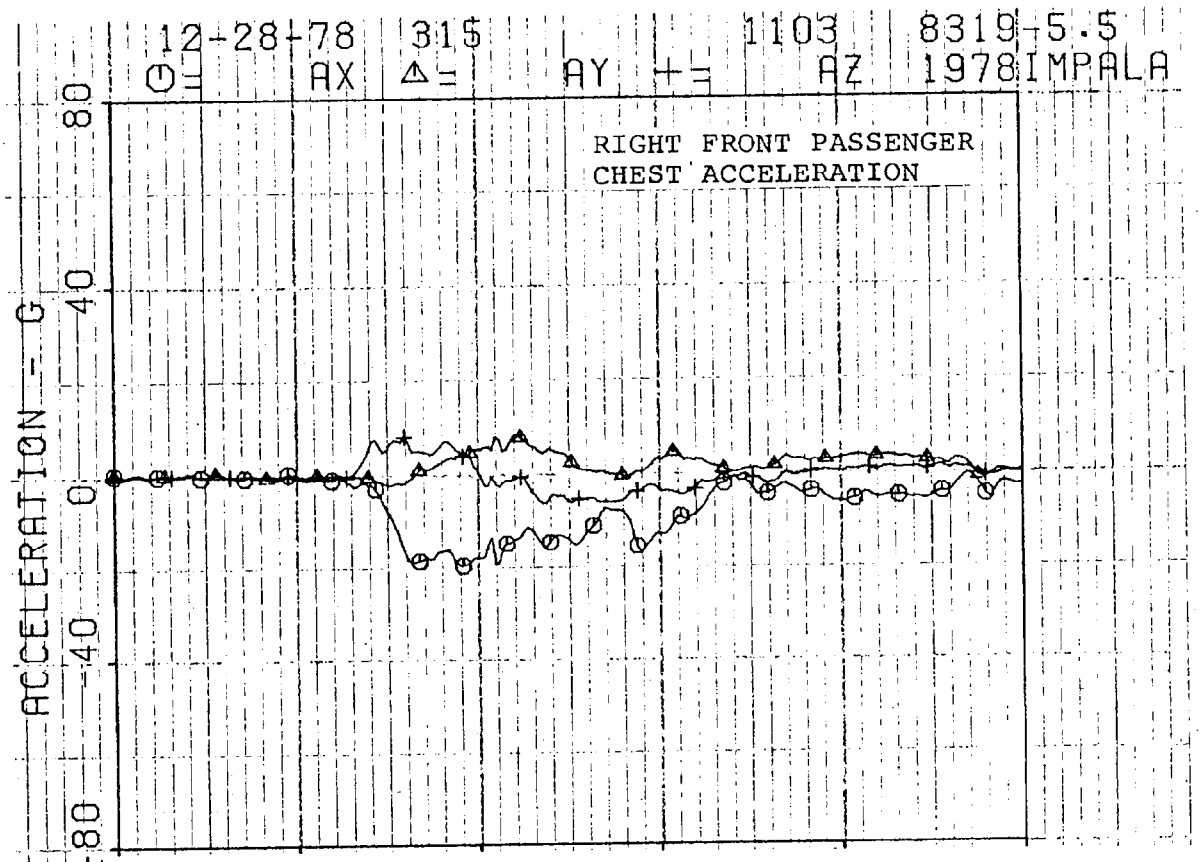

12-28-78 315 1101 8319-5.5
○= AX △= AY += AZ 1978IMPALA
DRIVER CHEST
ACCELERATION
ACCELERATION = G
80
40
0
-40
-80
12-28-78 315 1101 8319-5.5
1978IMPALA
DRIVER CHEST
ACCELERATION
RESULTANT
AR - G
80
60
40
20
0
0
50
100
150
200
250
TIME - MSEC

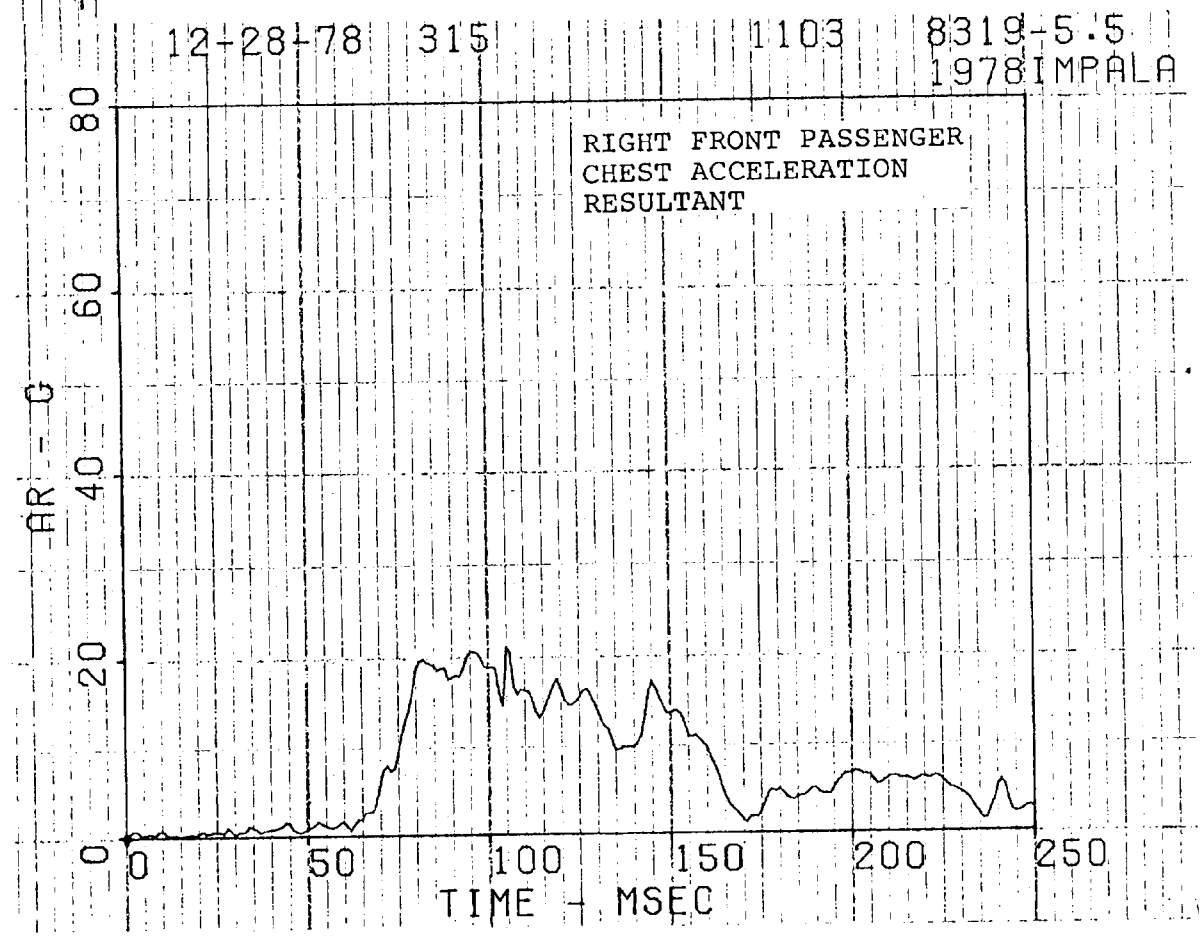

010379
DATE
12-28-78
FILTER
315
LOCATION
1101
TEST NO
8319-5.5
1978 IMPALA
DRIVER CHEST
SEVERITY INDEX
SI
2000
1500
1000
500
0
0
50
100
150
200
250
TIME - MSEC

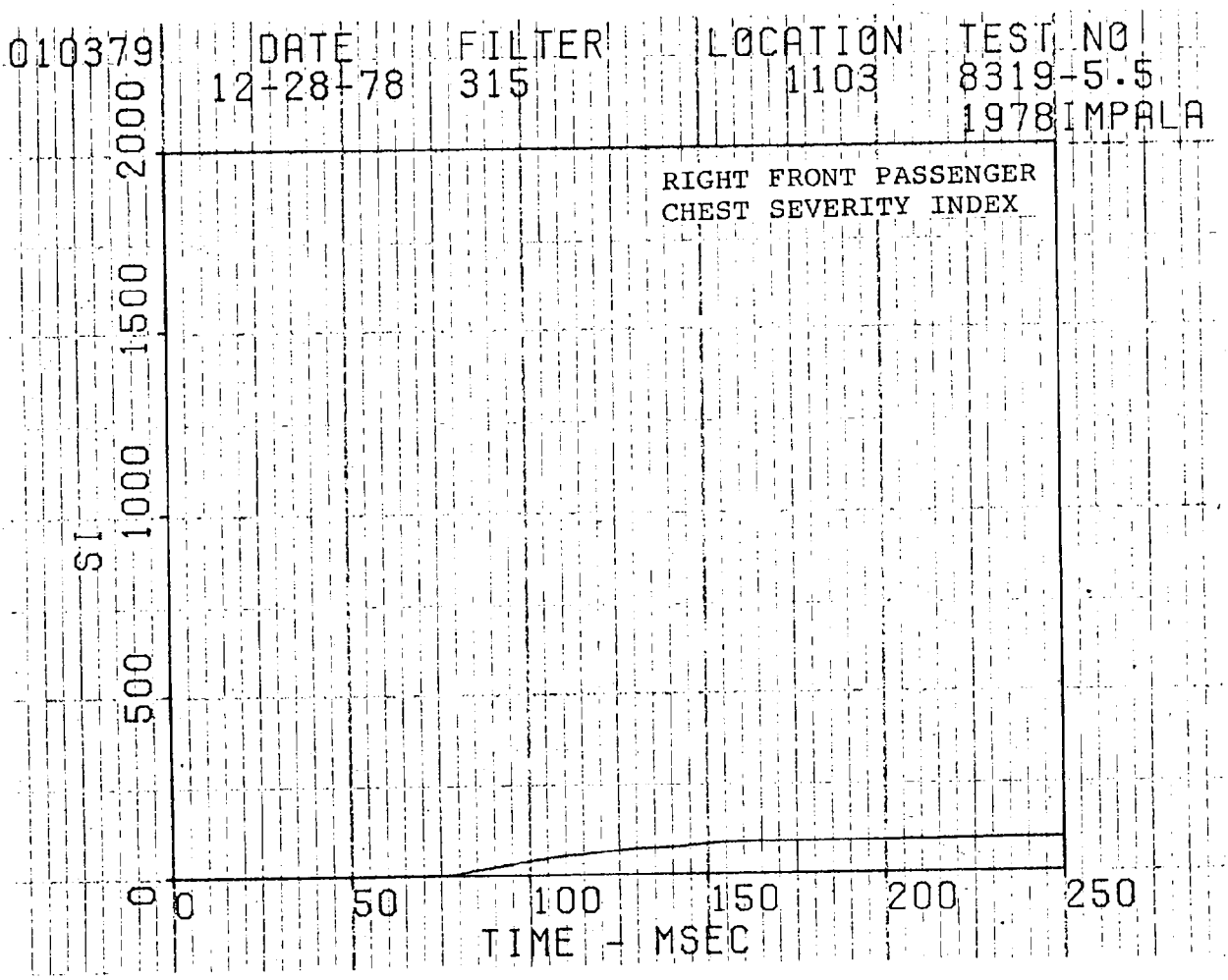

12-28-78 1000 2011 8319-5.5
1978 IMPALA
DRIVER LEFT
FEMUR LOAD
FL = LBS *10^1
100
-0
-100
-200
-300

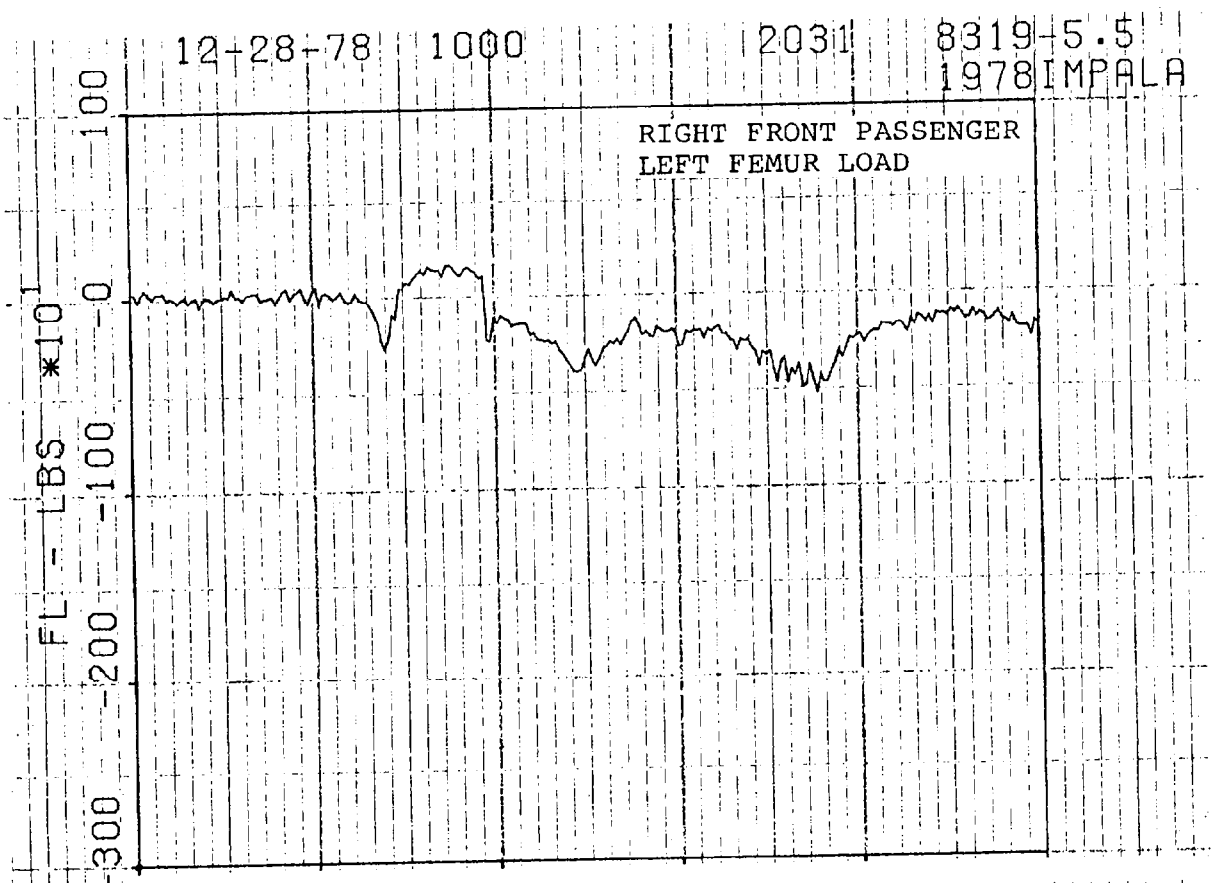

12-28-78 1000 2012 8319-5.5
1978 IMPALA
DRIVER RIGHT
FEMUR LOAD
FR = LBS *10^1
100
-0
-100
-200
-300
0
50
100
150
200
250
TIME - MSEC

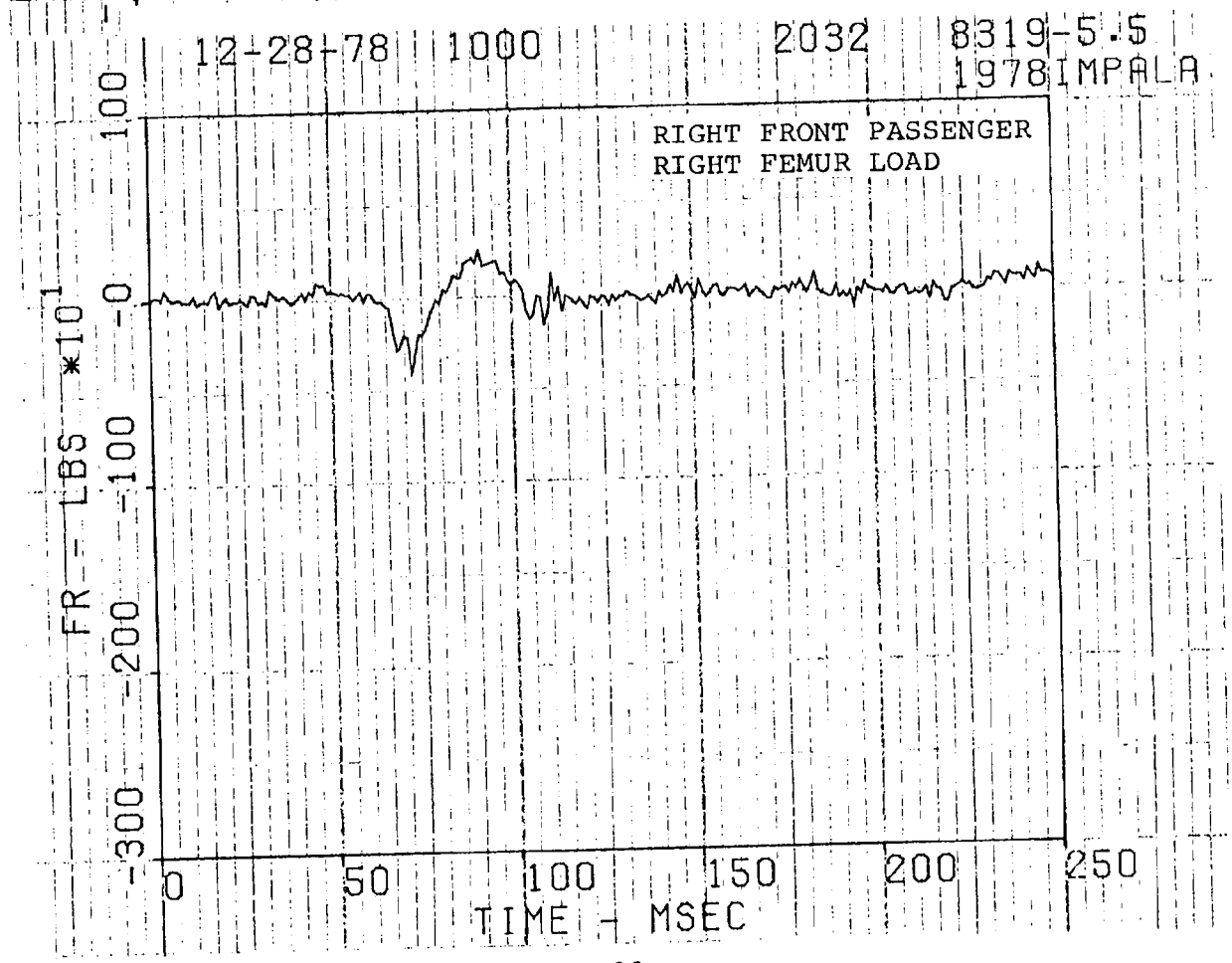

12-28-78 1600 503 8319-5.5
⊖= AX △= AY += AZ 1978IMPALA
RIGHT FRONT PASSENGER
HEAD ACCELERATION
ACCELERATION - G
200
100
0
-100
-200
12-28-78 1600 503 8319-5.5
1978IMPALA
RIGHT FRONT PASSENGER
HEAD ACCELERATION
RESULTANT
AR - G
400
300
200
100
0
0
50
100
150
200
250
TIME - MSEC


12-28-78 315 1103 8319-5.5
O= AX Δ= AY += AZ 1978IMPALA
RIGHT FRONT PASSENGER
CHEST ACCELERATION
ACCELERATION - G
80
40
0
-40
-80

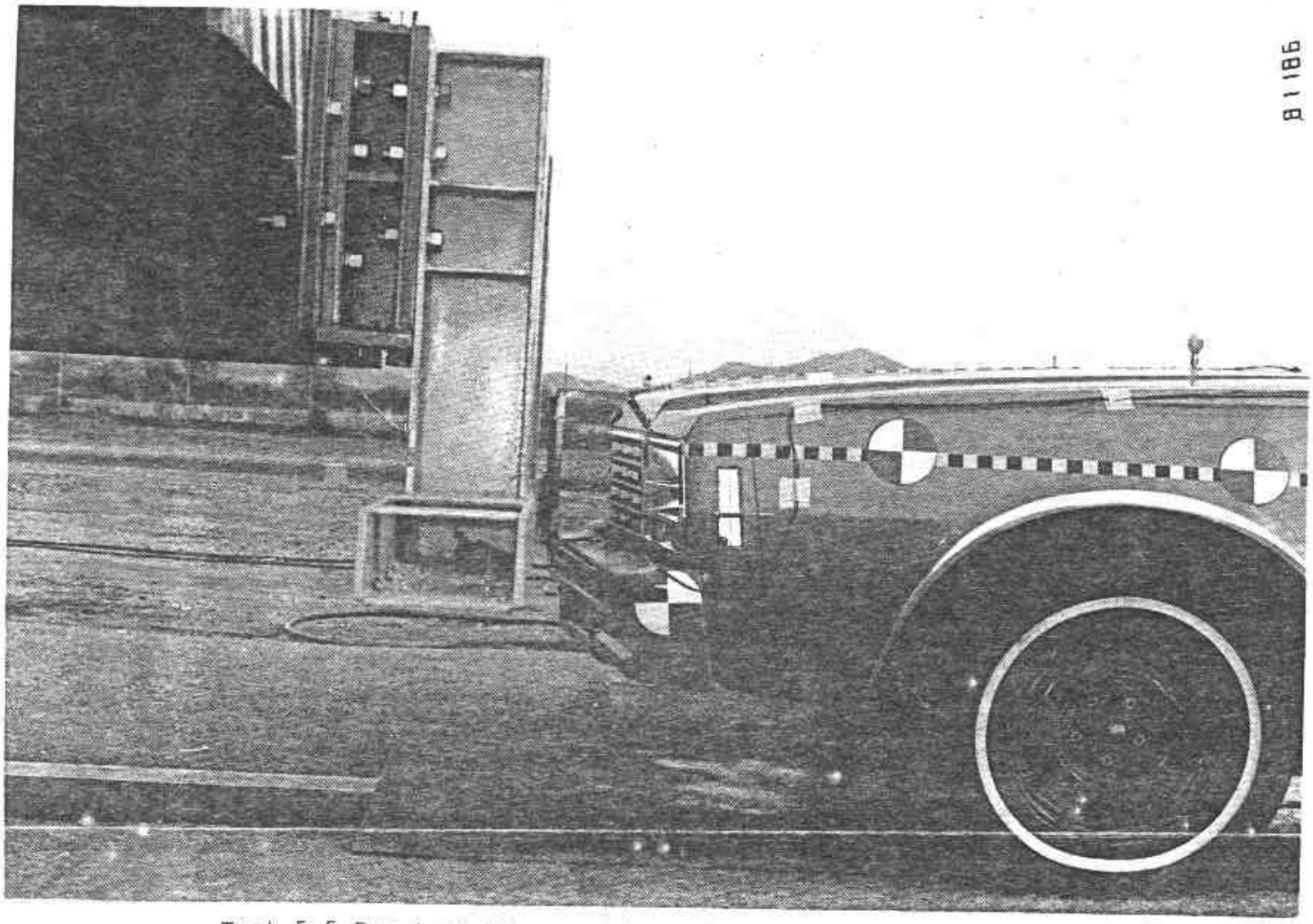

12-28-78 315 1103 8319-5.5
1978IMPALA
RIGHT FRONT PASSENGER
CHEST ACCELERATION
RESULTANT
AR - G
80
60
40
20
0
0
50
100
150
200
250
TIME - MSEC


010379
DATE
12-28-78
FILTER
315
LOCATION
1103
TEST NO
8319-5.5
1978 IMPALA
RIGHT FRONT PASSENGER
CHEST SEVERITY INDEX
SI
0
500
1000
1500
2000
0
50
100
150
200
250
TIME - MSEC


12-28-78 1000 2031 8319-5.5
1978 IMPALA
RIGHT FRONT PASSENGER
LEFT FEMUR LOAD
FL - LBS *10^1
100
0
-100
-200
-300


12-28-78 1000 2032 8319-5.5
1978 IMPALA
RIGHT FRONT PASSENGER
RIGHT FEMUR LOAD
FR - LBS *10^1
100
0
-100
-200
-300
0
50
100
150
200
250
TIME - MSEC

Test 5.5 Overall Pre-test View of 1978 Chevrolet Impala/
24-in. High T-1 Guard Crash.

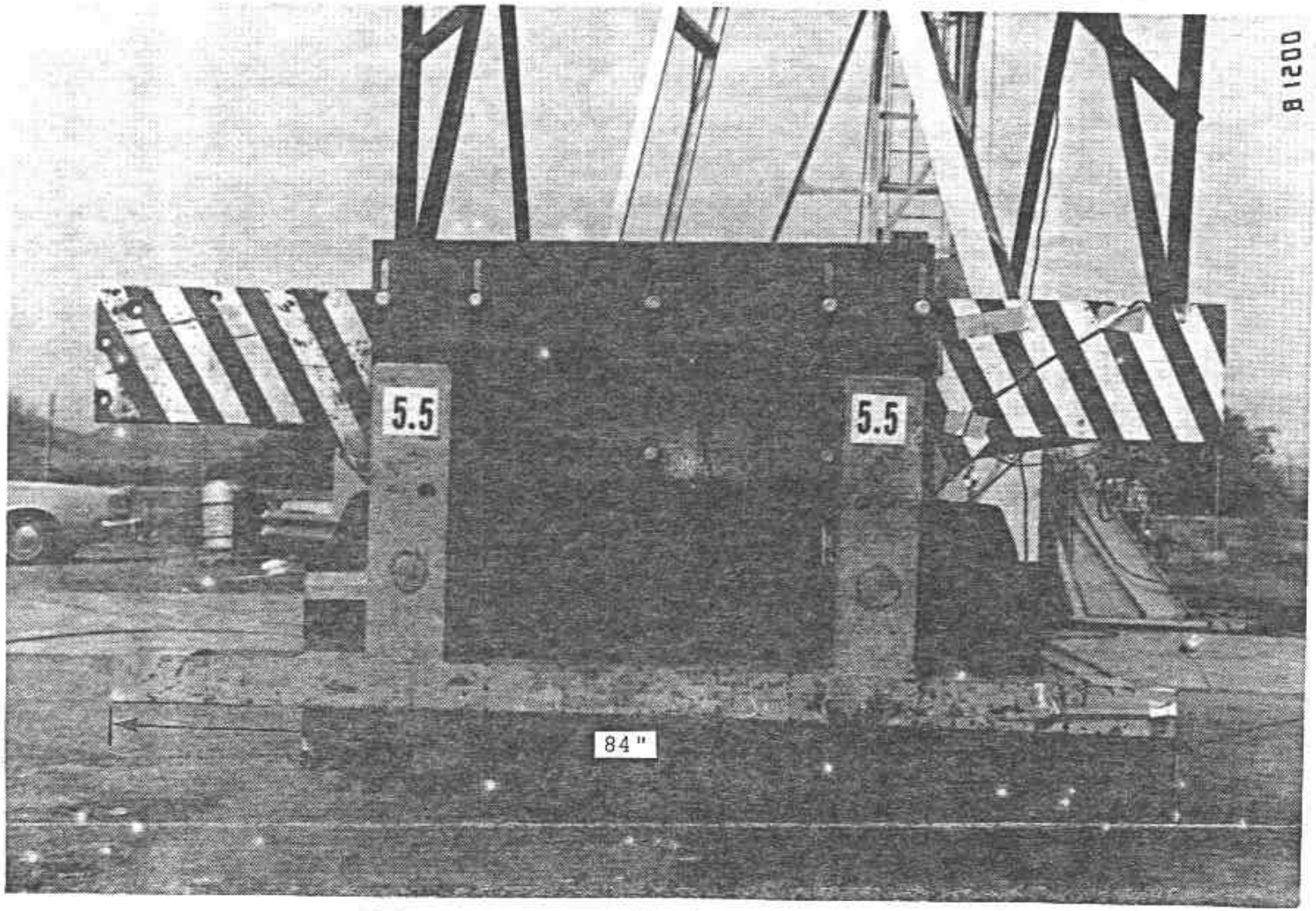


Test 5.5 Pre-test Closeup View of Vehicle/Guard Engagement.

Test 5.5 Pre-test View of Vehicle and Guard (Front).

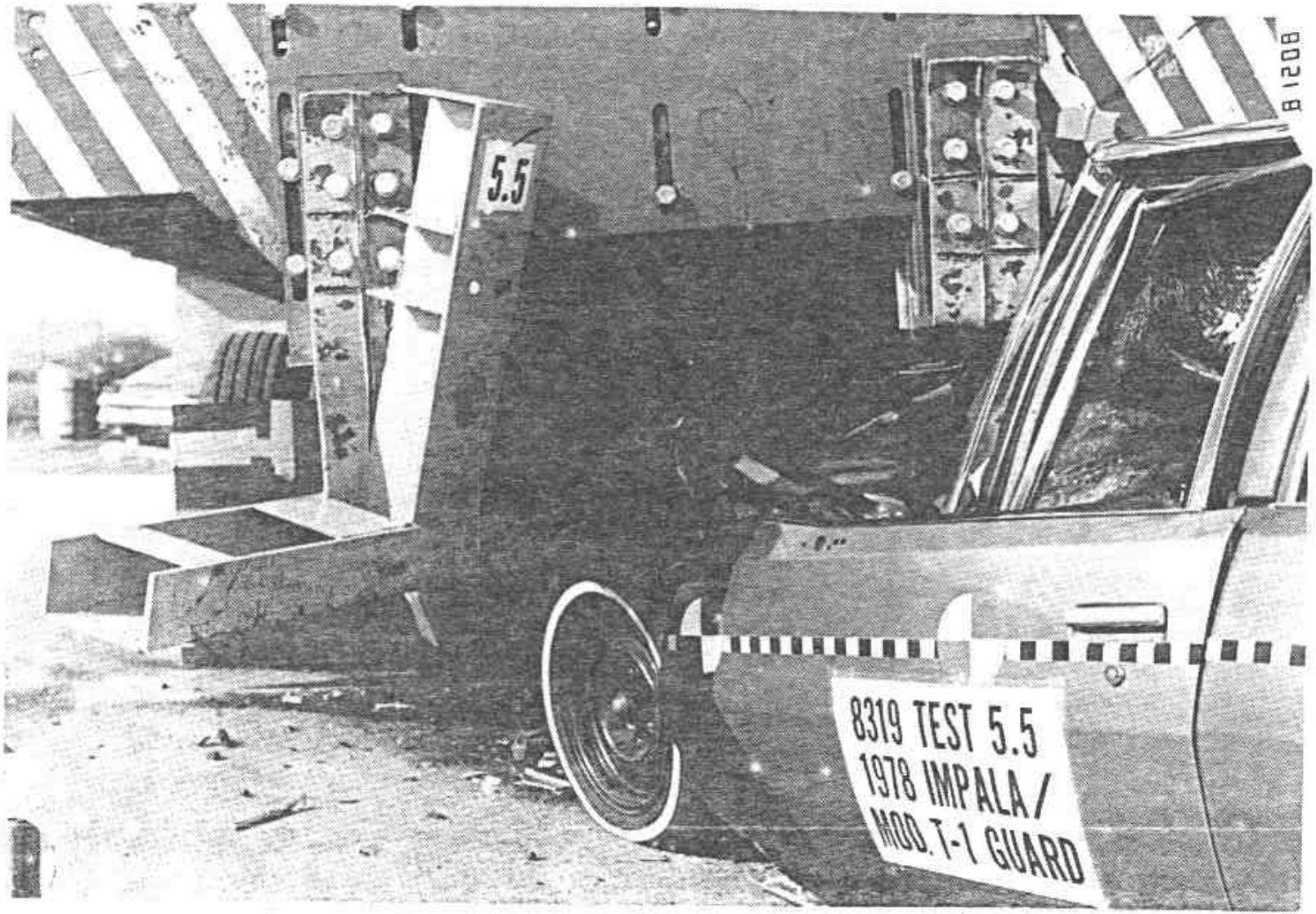
Test 5.5 Pre-test View of Driver Dummy.

Test 5.5 Pre-test View of Passenger Dummy.

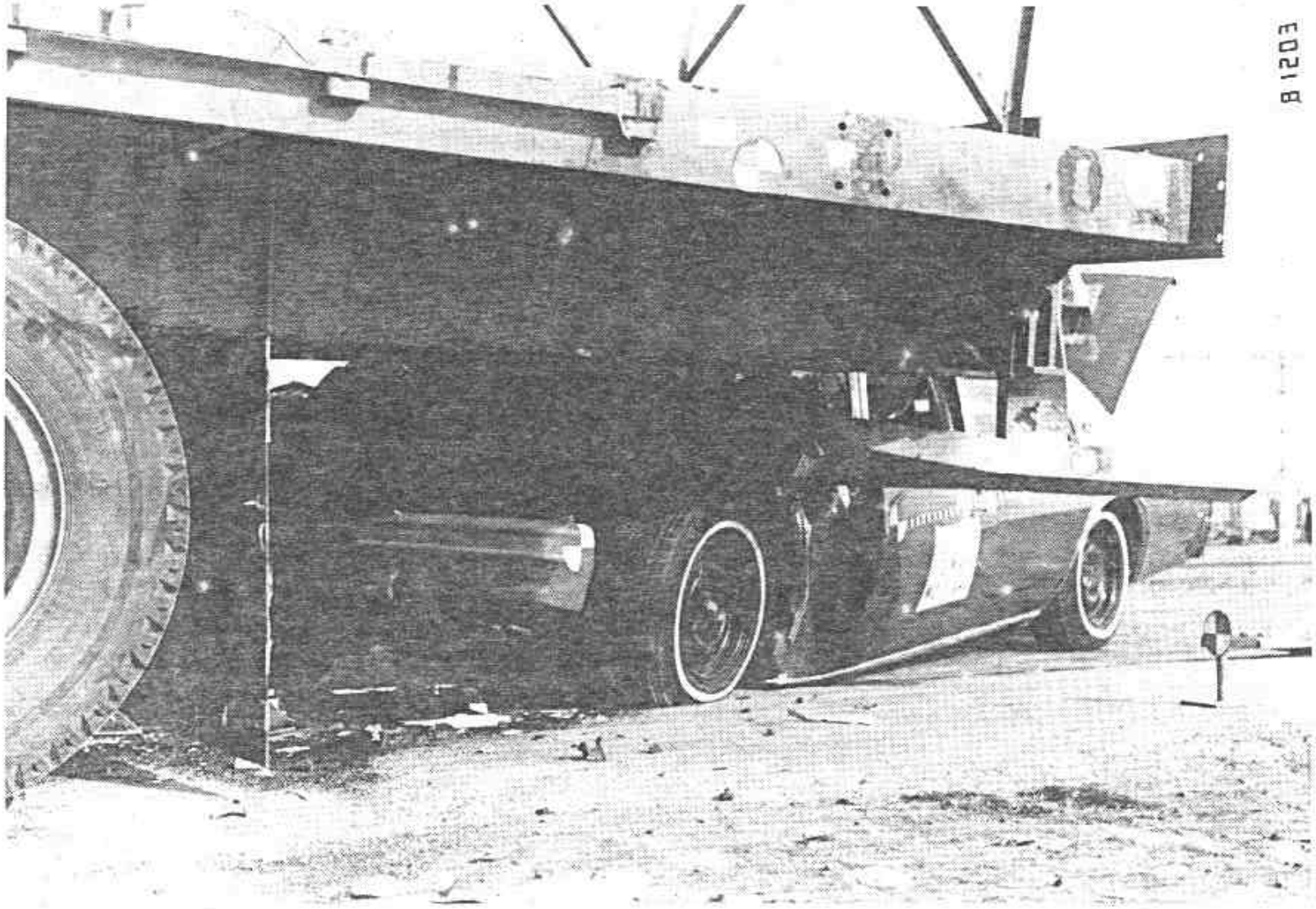


Test 5.5 Pre-test Overall View of Underride Guard.

Test 5.5 Overall Post-test View of 1978 Chevrolet Impala/
24-in. High T-1 Guard Crash.



Test 5.5 Post-test Closeup View of Impact Area.



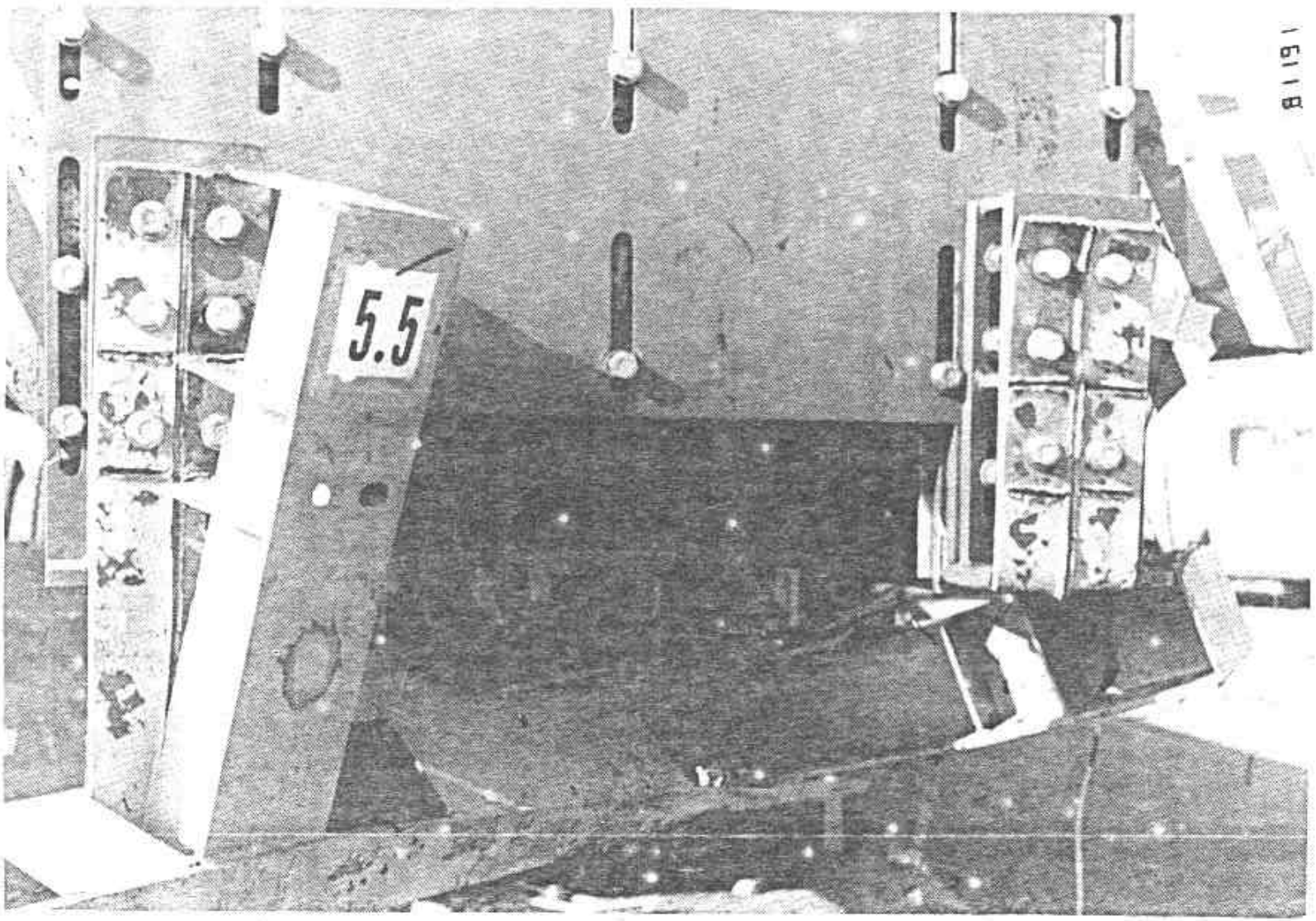
Test 5.5 Post-test View of Vehicle and Guard (Front).

Test 5.5 Post-Test View of Driver Dummy.

Test 5.5 Post-test View of Passenger Dummy.

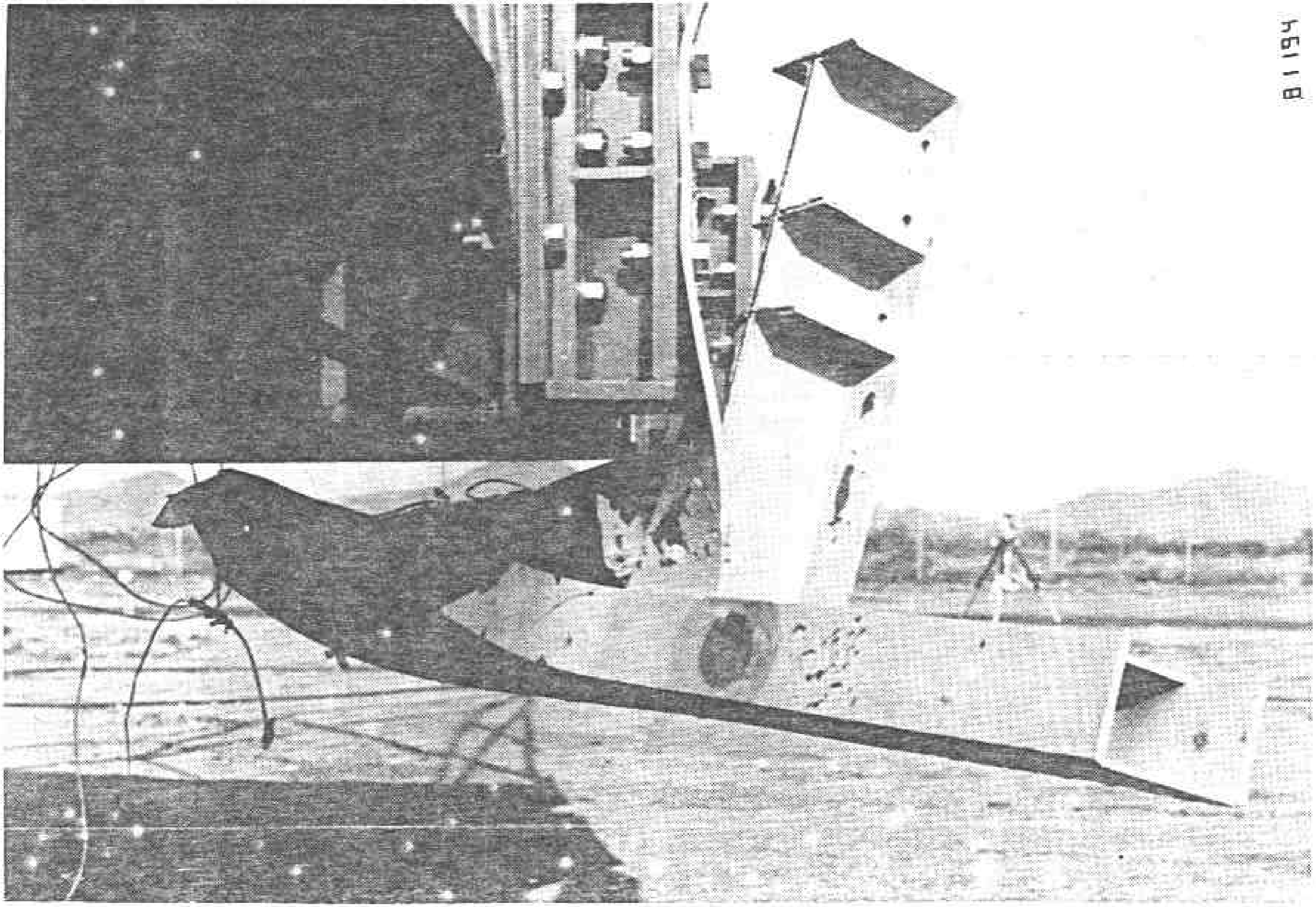
Test 5.5 Post-test View of Driver Compartment Damage.

Test 5.5 Post-test View of Passenger Compartment Damage.



Test 5.5 Post-test View of Underride Guard (Front).

B1194



Test 5.5 Post-test Left Side View of Underride Guard.

APPENDIX B

TEST 5.7 TEST DATA SUMMARY
1978 CHEVROLET IMPALA
OFFSET IMPACT @ 40 MPH

TABLE B-1. RECEIVING INSPECTION OF VEHICLES

Contractor: Dynamic Science Contract No.: DOT-HS-8-01905

VIN NO.: 1L69V8S131132 Make: Chevrolet

NHTSA No.: R & D

Year: 1978 Color: Green Model: 4-Door

Auto Trans:	(yes)	no	Pwr Steering:	(yes)	no	Seats: (front)	Bench: X
Pwr Brakes:	(yes)	no	Auto Speed Cont:	yes	(no)		Bucket:
Pwr Seats:	yes	(no)	Anti Skid Brake:	yes	(no)		Split Bench:
Pwr Windows:	yes	(no)	Air Conditioning:	(yes)	no		
Tinted Glass:	(yes)	no	Rear Window Def.:	yes	(no)		Split Back Bench:
Radio:	(yes)	no	Brakes: drum: R	disc: F			
Clock:	yes	(no)					

Tire Size: FR78-15 Ply Rating: 4 Mfg. & Line: Uniroyal

Bias Ply: Belted: X Radial X /Eng.Type: Cylinders: 8 Total Displ: 305

Trans, # Fwd. Speeds: 3 Auto Weight: 3890 GVWR Odometer: 21720.5

Dealer (name, address, and phone number)
Courtesy Chevrolet (Telephone: 602-279-3232)
1233 E. Camelback Rd.
Phoenix, Arizona 85011

Remarks (list additional accessories not listed above)

Date of Manufacture: 9/77 Dynamic Science No.: 790 Date Received: 11/27/78

Tilting Steering Wheel: yes (no) Telescoping Steering Wheel: yes (no)

Fuel Capacity: (from owner's manual) "Space Saver" Spare Tire yes (no)

Restraint System: Std. 3 point

1. Is the vehicle stock throughout? Describe: Yes, New Production Vehicle

2. Does vehicle show evidence of prior accident history? Describe: None

3. Does vehicle show any significant corrosion? Describe: None

4. Check condition of the front bumper and frame: Satisfactory, no bumper guards.

TABLE B-2. SUMMARY OF PRE-TEST AND POST-TEST VEHICLE ENGINE/BUMPER/FIREWALL CHARACTERISTICS

Test No. 5.7 Type Underride 42-Inch Offset

Car Model 1978 Chevrolet Impala Dynamic Science No. 715

	Pre-test
Engine Size	305 CID
Engine Height/Width (in.)	29.5/21
Bumper to Engine (in.)	31.5
Engine Length (in.)	25
Engine to Firewall (in.)	4
Bumper to Firewall (in.)	60.5
Bumper to "Hard Point" (Engine) (in.)	31.5
Initial Impact Point to Front Bumper (in.)	5.0
Height From Top of Front Bumper to Lowest Point of Underride Guard (in.)	0.5
Horizontal Dimension From Centerline of Vehicle to Extreme Left Edge of Guard (in.)	84.0
Horizontal Dimension From Centerline of Vehicle to Extreme Right Edge of Guard (in.)	0

TABLE B-3. SUMMARY OF CAR ACCELEROMETER DATA

Accelerometer Number	Plot Location Number	Maximum Acceleration A (G)	Maximum Acceleration Time (msec)
1X	101	-47.5	65
1Y	101	23.6	69
2X	102	-43.5	64
3X	103	-38.7	71
3Y	103	19.6	80
4X	104	-117.0	60
4Y	104	-40.9	88
5X	105	141.1	83
$6X_1$	106	56.1	101
$6X_2$	NA	NA	
6Z	106	-204.6	93
7X	107	-63.0	92

TABLE B-4. SUMMARY OF TRAILER ACCELEROMETER DATA

Accelerometer Number	Plot Location Number	Maximum Acceleration A (G)	Maximum Acceleration Time (msec)
2X	202	11.2	41

TABLE B-5. SUMMARY OF COMPARTMENT AND ENGINE ACCELEROMETER DATA

Accelerometer Number	PLOT LOCATION NUMBER	Maximum Acceleration	
		A (G)	Time (msec)
Average of 1X and 2X	401	-44.0	64
Average of $6X_1$ and $6X_2$	106	-102.5	49

TABLE B-6. SUMMARY OF UNDERRIDE GUARD STRING POTENTIOMETER DATA

Displacement Potentiometer		PLOT LOCATION NUMBER	Maximum Dynamic Displacement	
(Number)	(Location)		D (in.)	Time (msec)
SP1	Left	4300	1.0	75
SP2	Center	4301	0.2	52
SP3	Right	4302	-0.8	73

TABLE B-7. COMPARISON OF TOTAL INTERFACE FORCE FROM LOAD CELL AND ACCELEROMETER DATA

Parameter	Trailer Force Data*	Car Acceleration Data**
Force (lb)	120373	187279
Time (msec)	65	64

*Sum of 5 load cells.

**Average of car accelerometers 1 and 2 x (vehicle minus engine weight) + engine acceleration x (engine weight of 675 lb)

TABLE B-8. SUMMARY OF UNDERRIDE GUARD AND TRAILER STRAIN GAUGE DATA

Strain Gauge (Number)	Plot Location Number**	Maximum Strain* (μin./in.)	Maximum Time (msec)
SG1	4213	1484.3	65
SG2	4213	1109.4	43
SG3	NOT USED		
SG7	4278	1265.6	63
SG8	4278	-320.8	57
SG9	NOT USED		
SG10	4210	-176.4	67
SG11	4212	321.3	67
SG12	4212	364.6	61
SG13	4234	357.3	62
SG14	4234	265.4	70
SG15	4456	99.3	133
SG16	4456	99.0	130

*STRESS = STRAIN (in./in.) x E(30 x 10^6 lb/in. for steel) Tensile strain and stress are negative.

**For location of strain gauges 1-3, see Figure 3-3, for location of strain gauges 7-16, see Figure 2-2.

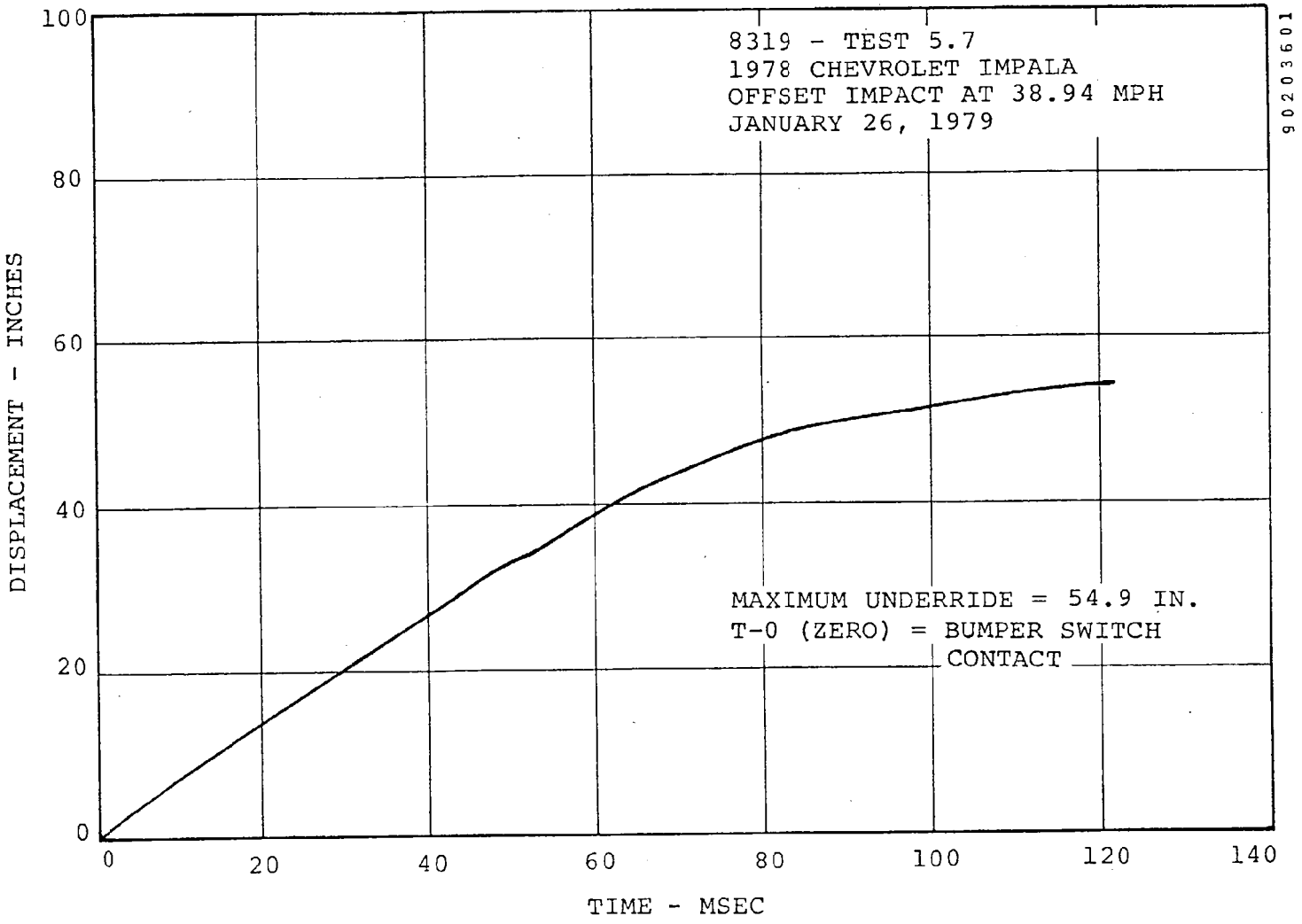


Figure B-1. Test 5.7 Vehicle Underride Versus Time - Driver Side 1978 Chevrolet Impala - 42-in. Right Offset Impact at 40 mph.

TABLE B-9. SUMMARY OF PRE-TEST AND POST-TEST VEHICLE STATIC MEASUREMENTS

TEST NO. 5.7 VEHICLE 1978 Chevrolet Impala

Location	Dimension Pre	Post	Reference	Difference
Front Edge of Water Pump Casting	161.6	143.3	TARGET 192	18.3
Bottom of "A" Pillar (Left)	119.3	116.6	TARGET 192	2.7
Bottom of "A" Pillar (Right)	119.2	118.4	TARGET 192	0.8
Rear Top Edge of Panel (Left)	109.8	105.5	TARGET 192	4.3
Rear Top Edge of Panel (Right)	110.0	104.7	TARGET 192	5.3
Steering Column Hub (Horizontal)	105.7	101.2	TARGET 192	4.5
Steering Column Lower Rim (Horizontal)	103.2	103.4	TARGET 192	-0.2
Steering Column Hub (Vertical)	21.9	25.5	ROCKER SILL	-3.6
Steering Column Lower Rim (Vertical)	15.6	18.0	ROCKER SILL	-2.4
Top of "A" Pillar (Left)	100.6	100.3	TARGET 192	0.3
Top of "A" Pillar (Right)	100.3	100.5	TARGET 192	-0.2
Centerline Windshield Opening (Top)	105.5	104.9	TARGET 192	0.6
Dash Panel at Knee Height (Left)	120.1	113.9	TARGET 192	6.2
Dash Panel at Knee Height (Right)	119.9	118.5	TARGET 192	1.4
Firewall - Driver Centerline	134.3	127.2	TARGET 192	7.1
Firewall - Passenger Centerline	131.9	115.1	TARGET 192	16.8
Firewall - Vehicle Centerline	132.1	115.6	TARGET 192	16.5
Shocktower Left	NONE		TARGET 192	
Shocktower Right	NONE			

TABLE B-10. SUMMARY OF PRE-TEST DUMMY POSITION DATA CHARACTERISTICS

Test No. 5.7 Type Underride 42-Inch Offset

Car Model 1978 Chevrolet Impala Dynamic Science No. 715

	Left Front Occupant	Right Front Occupant
Seat Range (in.)	6.0	6.1
Seat Position* (in.)	3.0	3.1
Front Seat to Firewall (in.)	25.0	24.8
Forehead to Windshield (in.)	20.4	20.8
Torso to Steering Wheel** (in.)	14.7	19.4
Left/Right Knee to Dash Panel (in.)	6.9/7.0	7.5/7.2

Dummy Type Alderson 572

Locations: Left Front Occupant - No. 759

Right Front Occupant - No. 760

Restraint Type: LF Std. 3 point belts w/ELR***

RF Std. 3 point belts w/ELR

*From rearmost position to midpoint seat position.

**To dash panel for right front occupant.

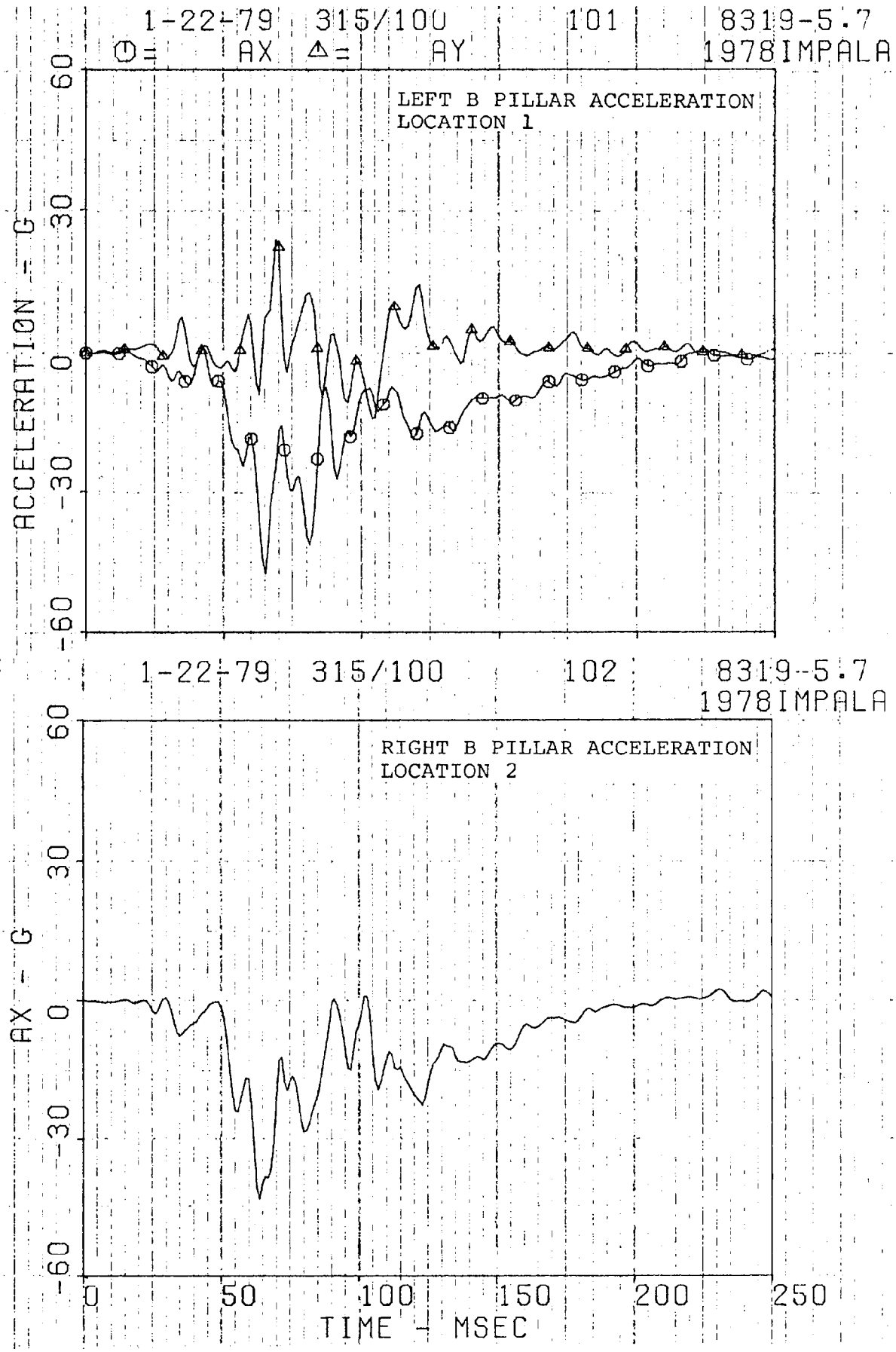
***Emergency locking retractor.

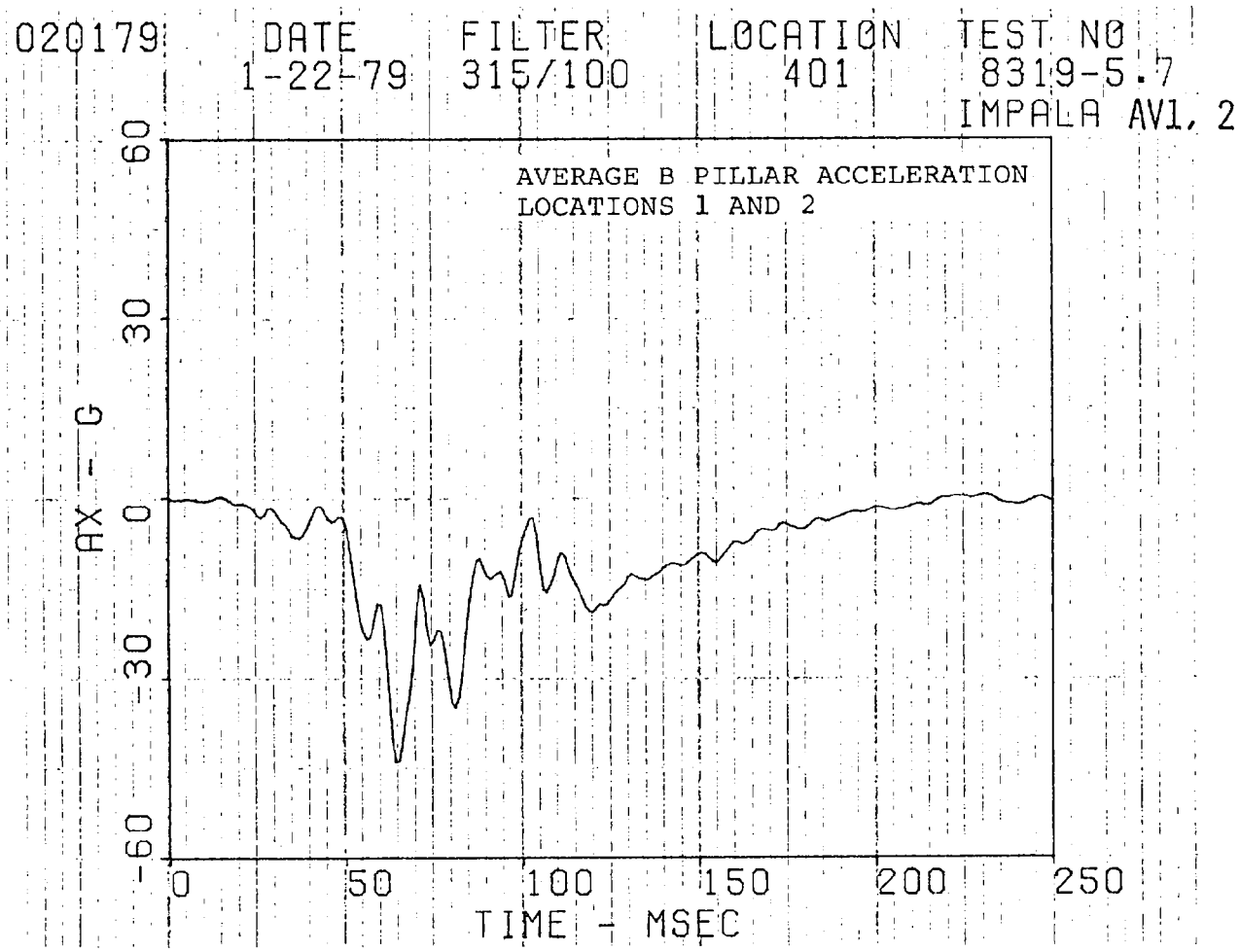
TABLE B-11. SUMMARY OF OCCUPANT RESPONSE DATA FOR TEST 5.7

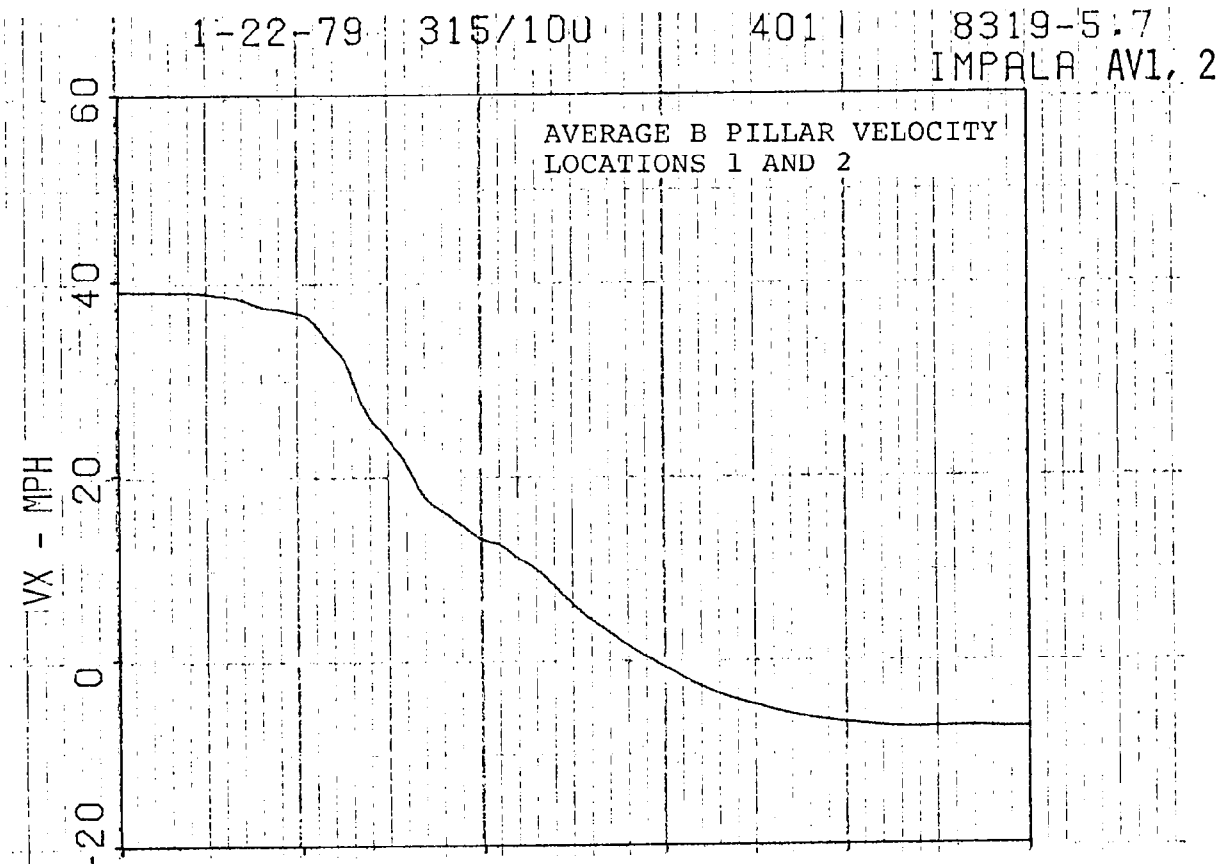
Response Parameter		Filter (Hz)	Left Front Dummy (Driver) Maximum Value A (G)	Left Front Dummy (Driver) Maximum Value T (msec)	Right Front Dummy (Passenger) Maximum Value A (G)	Right Front Dummy (Passenger) Maximum Value T (msec)
Head	X	1600	-195.1	108	-109.6	128
	Y	1600	-31.7	115	33.5	128
	Z	1600	77.1	112	38.4	111
	-R	1600	196.	108	116.7	128
SI/Time			2096	200	247	200
HIC/Time			1380	104/125	189	89/137
Head Acceleration*	R	1600	109*		40*	
Chest	X	315	-67.9	114	-35.4	134
	Y	315	-28.8	112	21.8	128
	Z	315	21.0	86	19.6	70
	R	315	73.0	114	39.7	128
SI/Time			623	200	348	200
Chest Acceleration*	R	315	60*		38*	
Femur Loads** (lb)	L	1000	-1358	96	-1179	67
	R	1000	-2788	96	-860	73

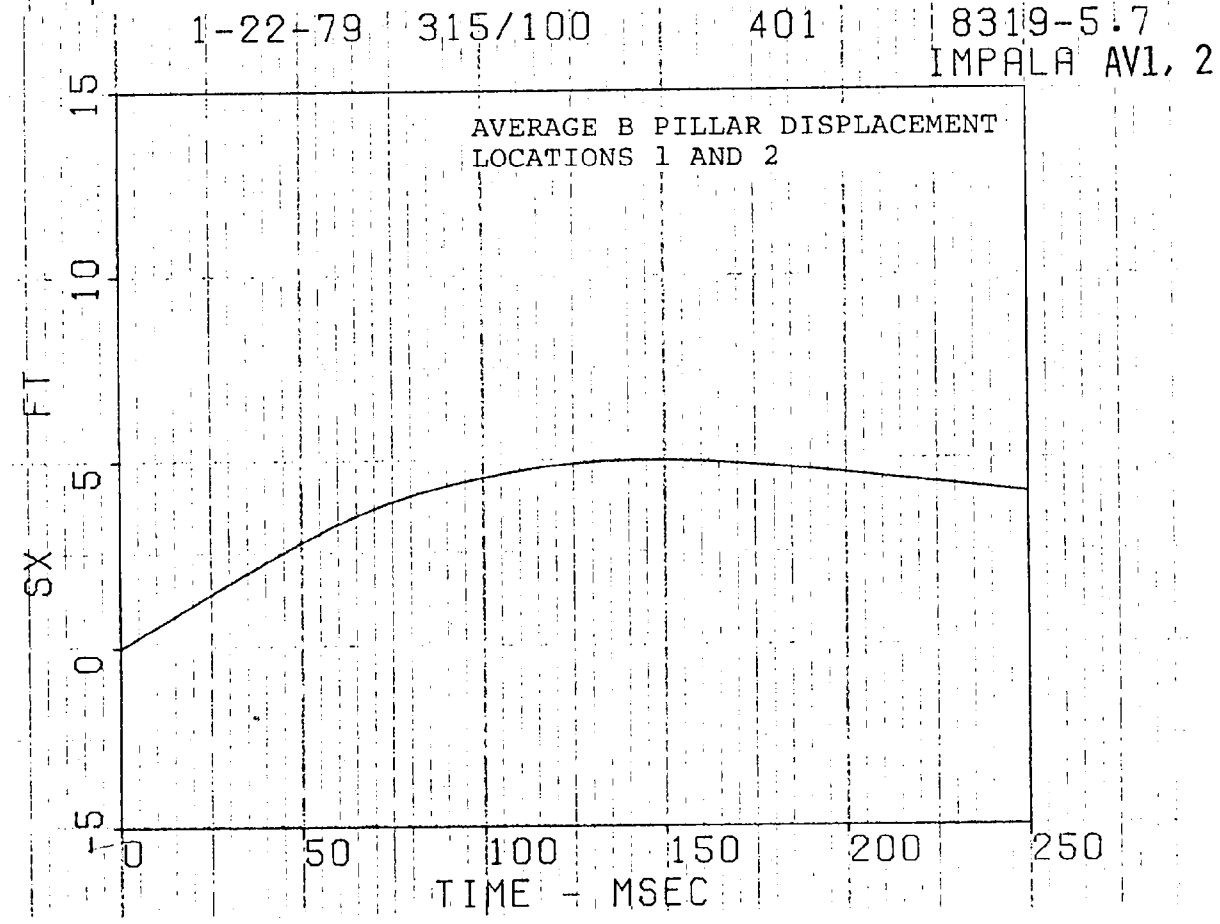
*G values defined as value for a cumulative duration of at least 3 msec.

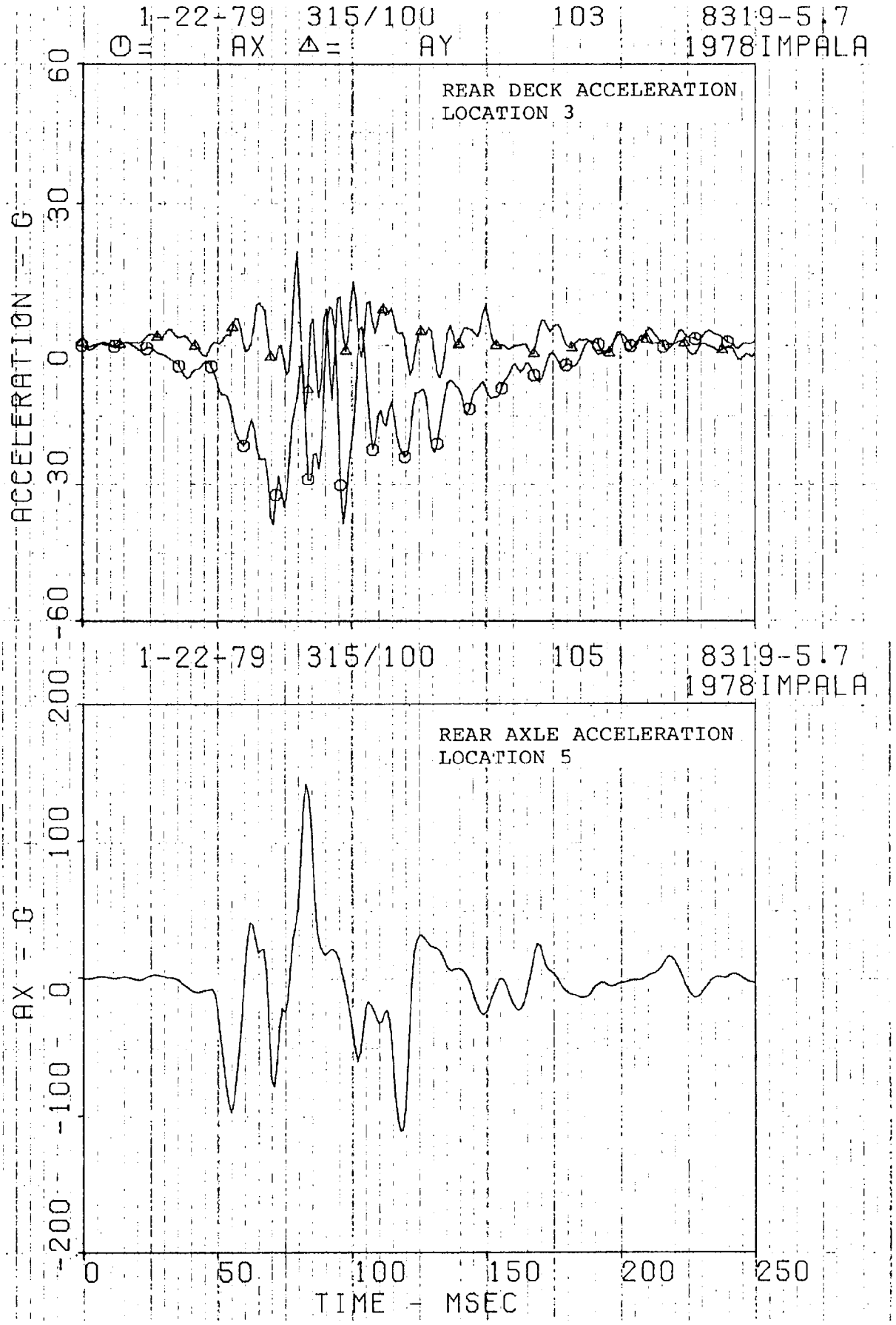
**Negative loads are compression; positive loads are tension.

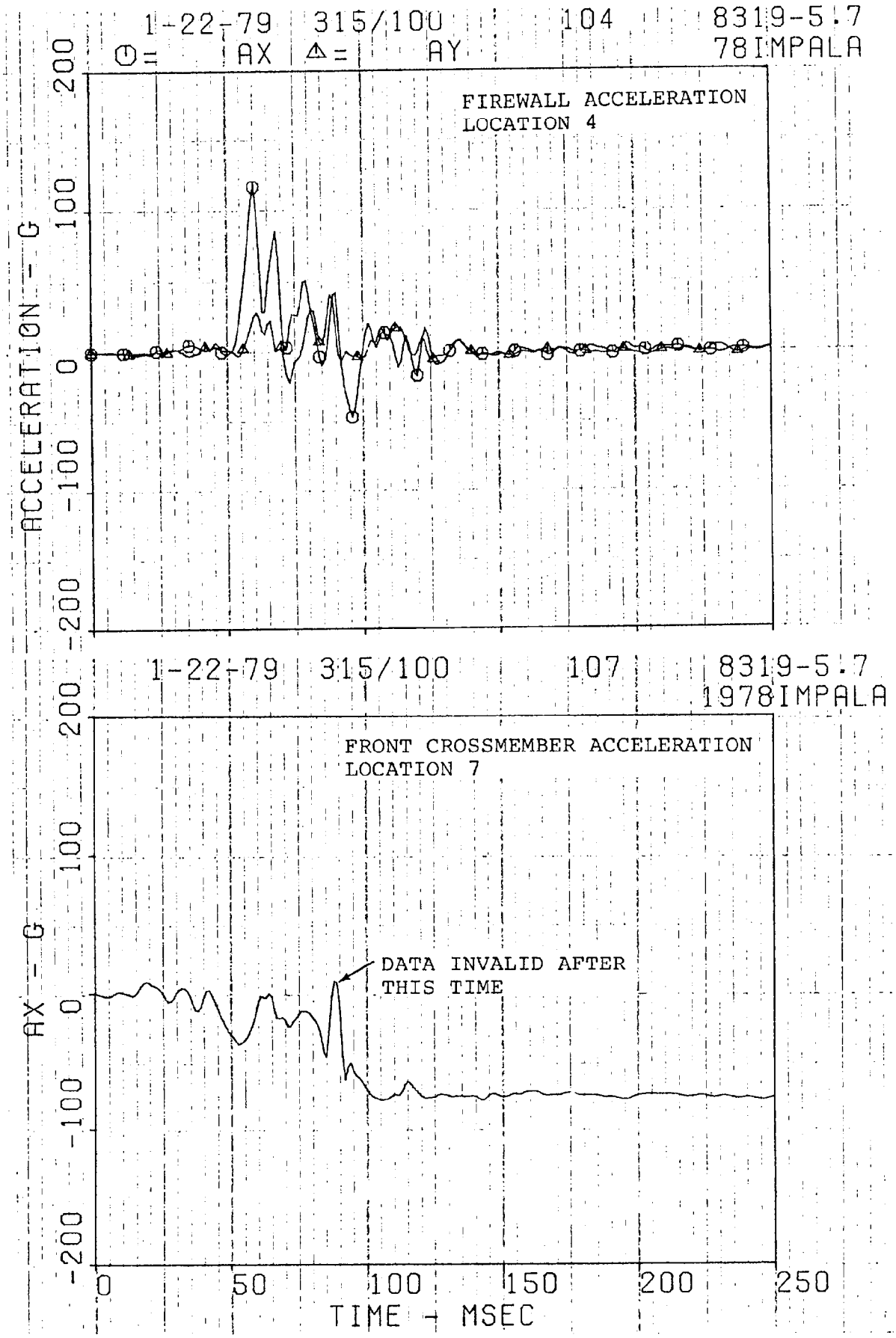

1-22-79 315/100 101 8319-5.7
1978IMPALA
AX AY
LEFT B PILLAR ACCELERATION
LOCATION 1
ACCELERATION - G
60
30
0
-30
-60
1-22-79 315/100 102 8319-5.7
1978IMPALA
RIGHT B PILLAR ACCELERATION
LOCATION 2
AX - G
60
30
0
-30
-60
0
50
100
150
200
250
TIME - MSEC

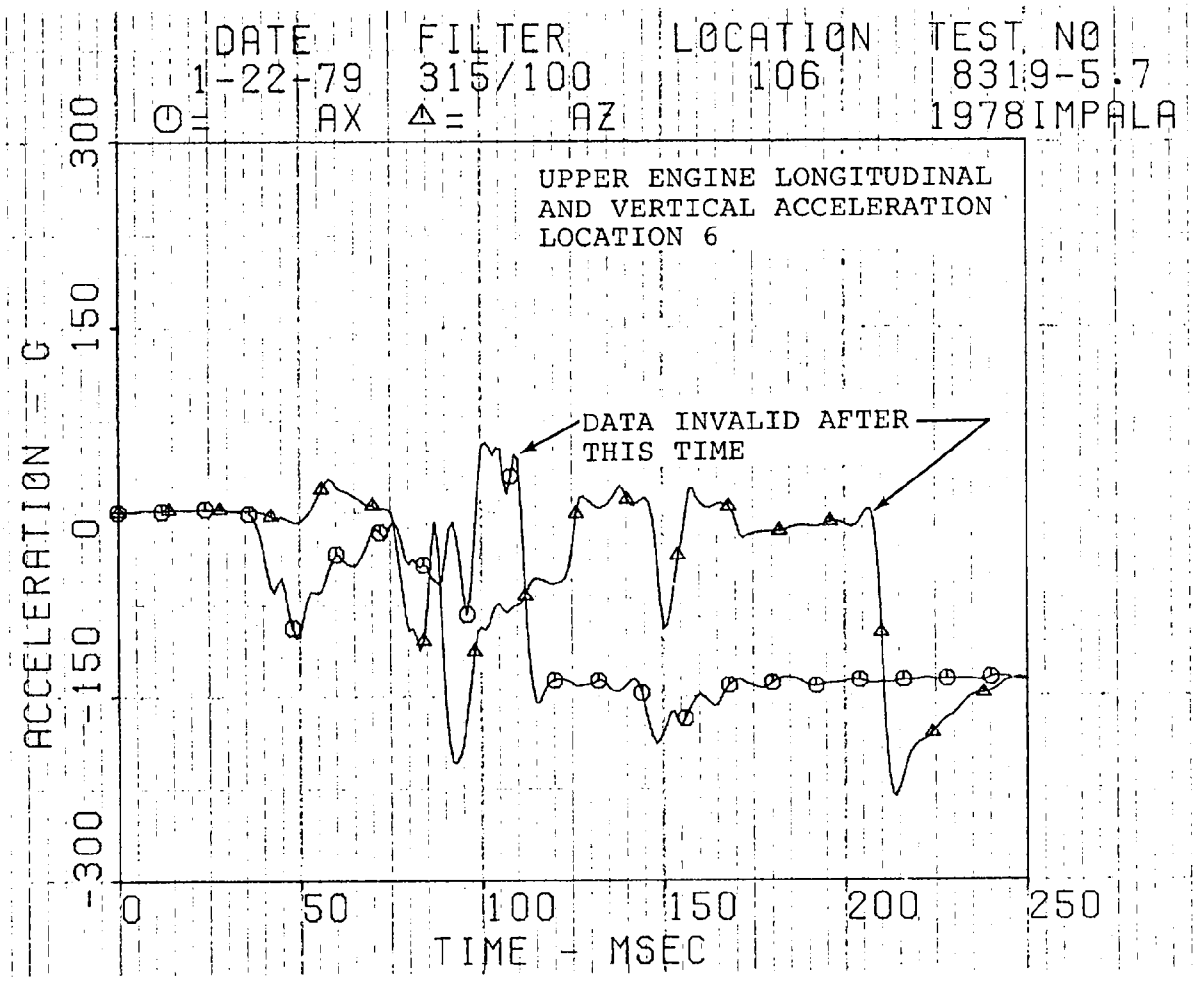

020179
DATE
1-22-79
FILTER
315/100
LOCATION
401
TEST NO
8319-5.7
IMPALA AV1, 2
AVERAGE B PILLAR ACCELERATION
LOCATIONS 1 AND 2
AX - G
60
30
0
-30
-60
0
50
100
150
200
250
TIME - MSEC

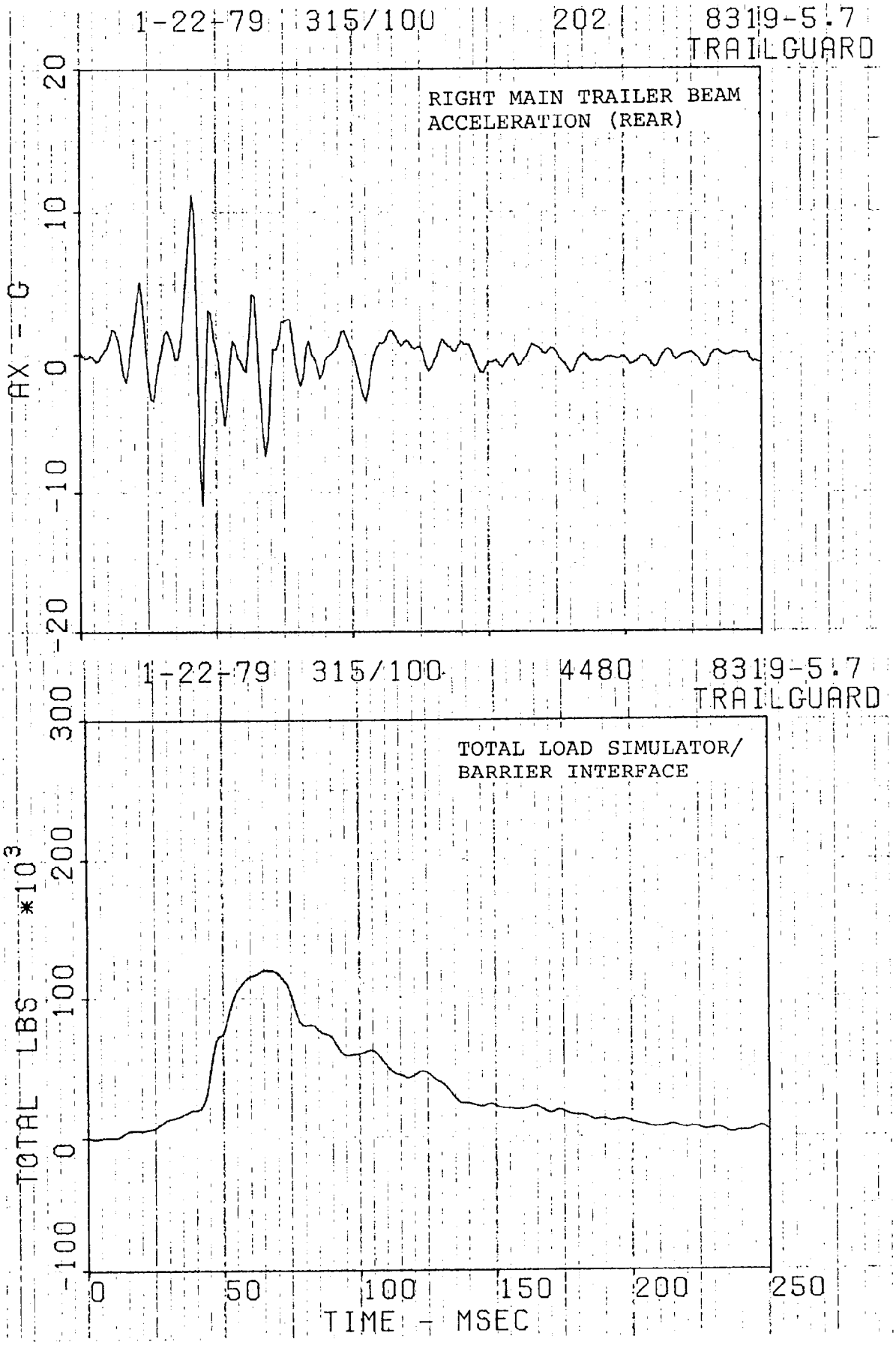

1-22-79 315/100 401 8319-5.7
IMPALA AV1, 2
AVERAGE B PILLAR VELOCITY
LOCATIONS 1 AND 2
VX - MPH
60
40
20
0
-20

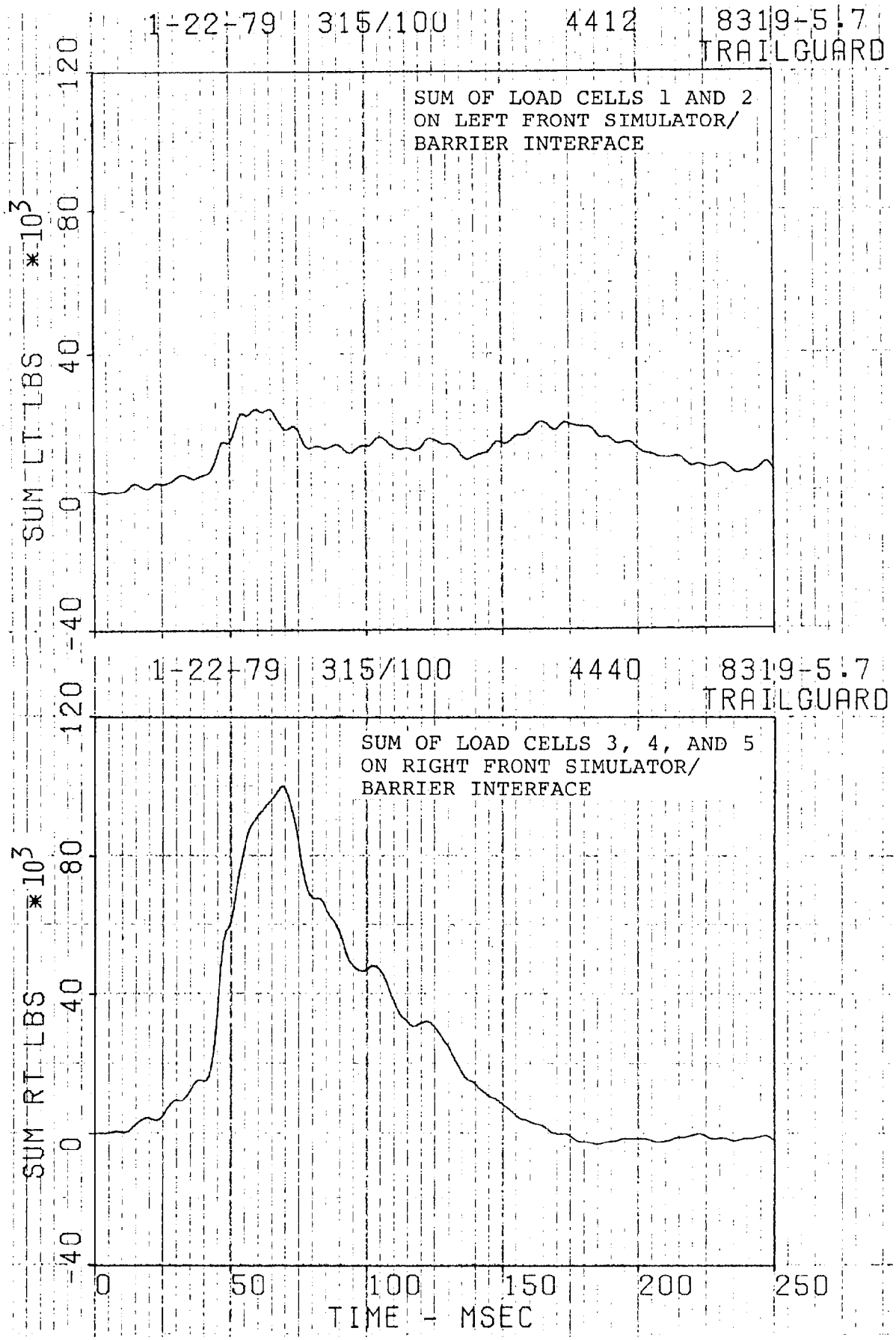

1-22-79 315/100 401 8319-5.7
IMPALA AV1, 2
AVERAGE B PILLAR DISPLACEMENT
LOCATIONS 1 AND 2
SX - FT
15
10
5
0
-5
0
50
100
150
200
250
TIME - MSEC

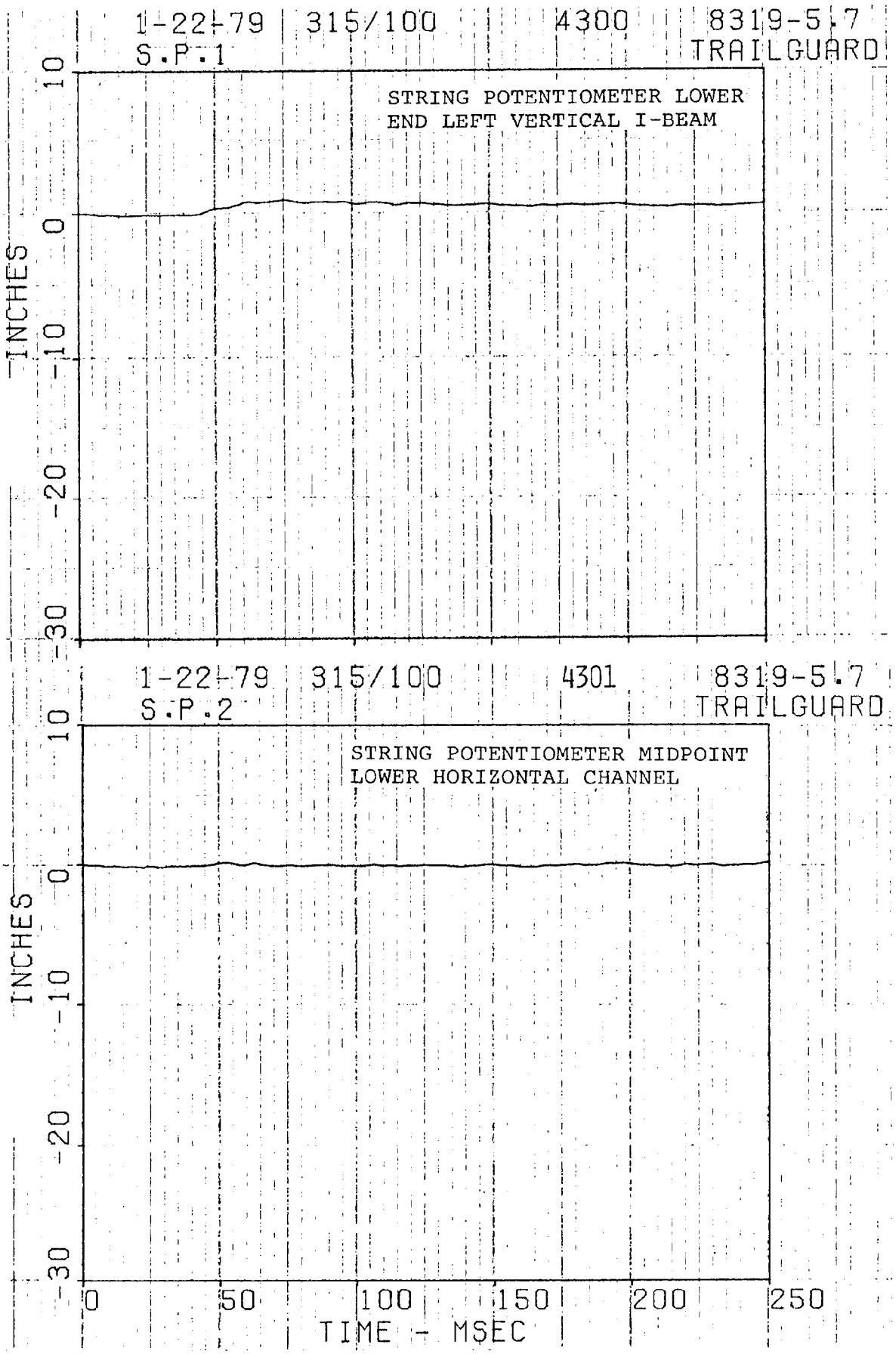

1-22-79 315/100 103 8319-5.7
○= AX △= AY 1978IMPALA
REAR DECK ACCELERATION
LOCATION 3
ACCELERATION — G
60
30
0
-30
-60
1-22-79 315/100 105 8319-5.7
1978IMPALA
REAR AXLE ACCELERATION
LOCATION 5
AX - G
200
100
0
-100
-200
0
50
100
150
200
250
TIME - MSEC

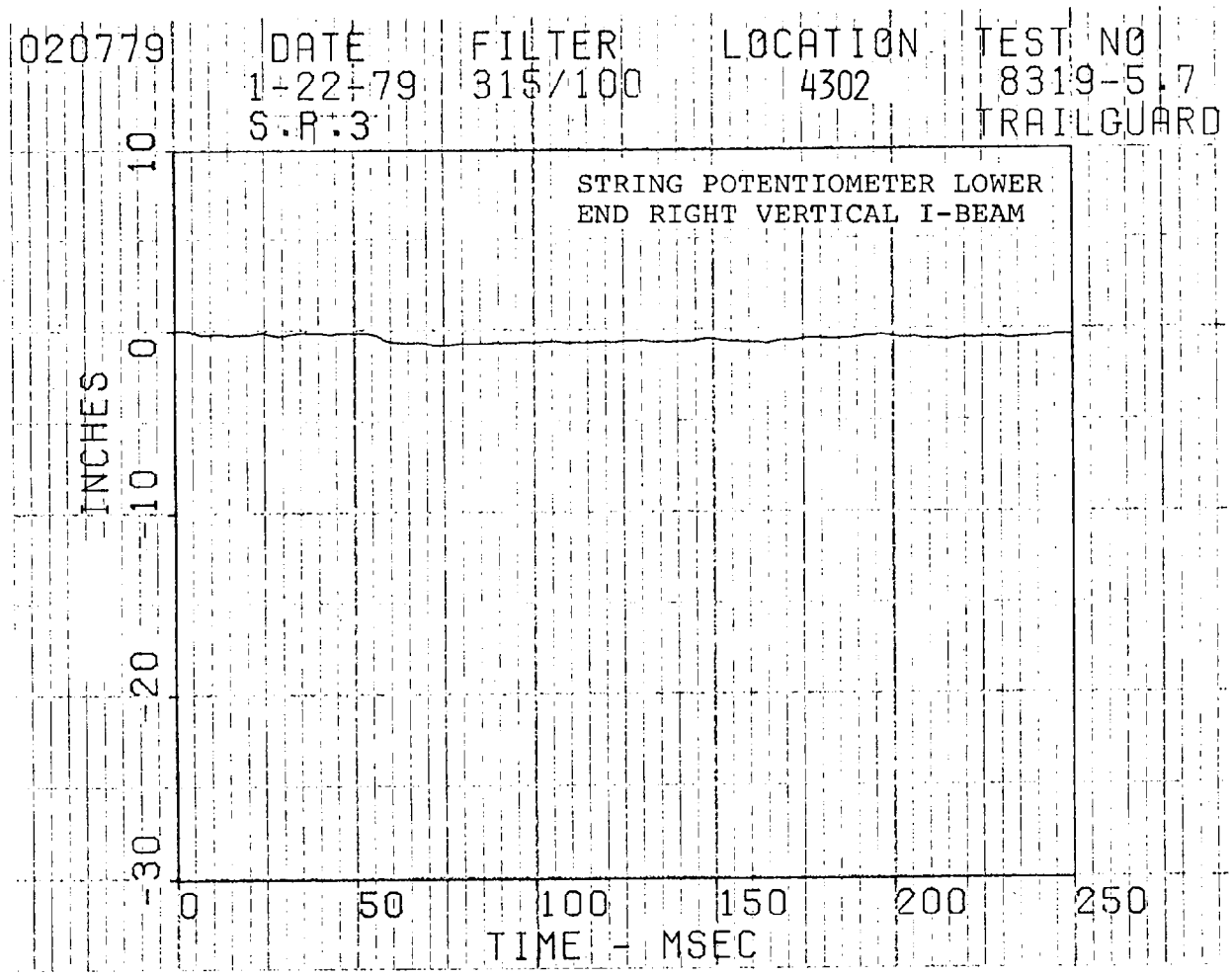

1-22-79 315/100 104 8319-5.7
○= AX △= AY 78IMPALA
FIREWALL ACCELERATION
LOCATION 4
ACCELERATION - G
200
100
0
-100
-200
1-22-79 315/100 107 8319-5.7
1978IMPALA
FRONT CROSSMEMBER ACCELERATION
LOCATION 7
DATA INVALID AFTER
THIS TIME
AX - G
200
100
0
-100
-200
0
50
100
150
200
250
TIME - MSEC

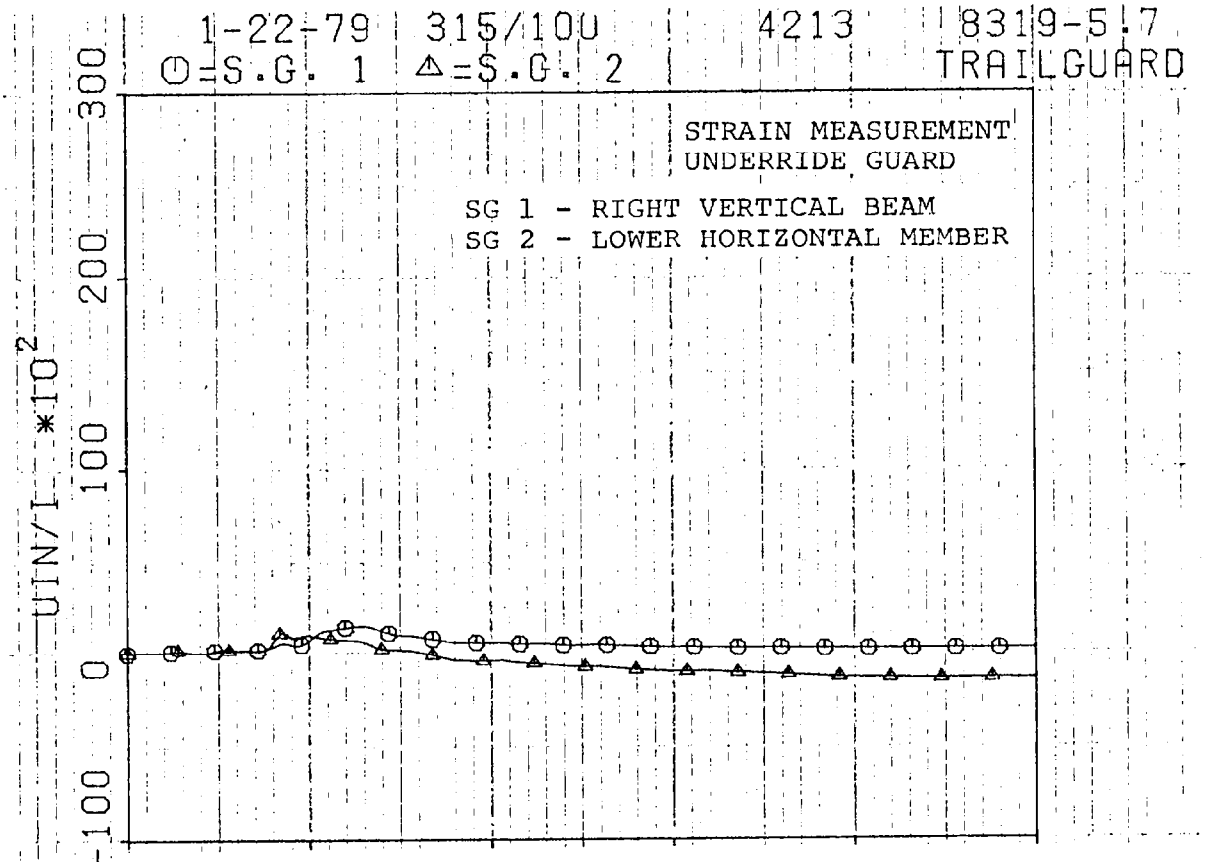

DATE
1-22-79
FILTER
315/100
LOCATION
106
TEST NO
8319-5.7
1978 IMPALA
O = AX
Δ = AZ
UPPER ENGINE LONGITUDINAL AND VERTICAL ACCELERATION LOCATION 6
DATA INVALID AFTER THIS TIME
ACCELERATION = G
300
150
0
-150
-300
0
50
100
150
200
250
TIME - MSEC

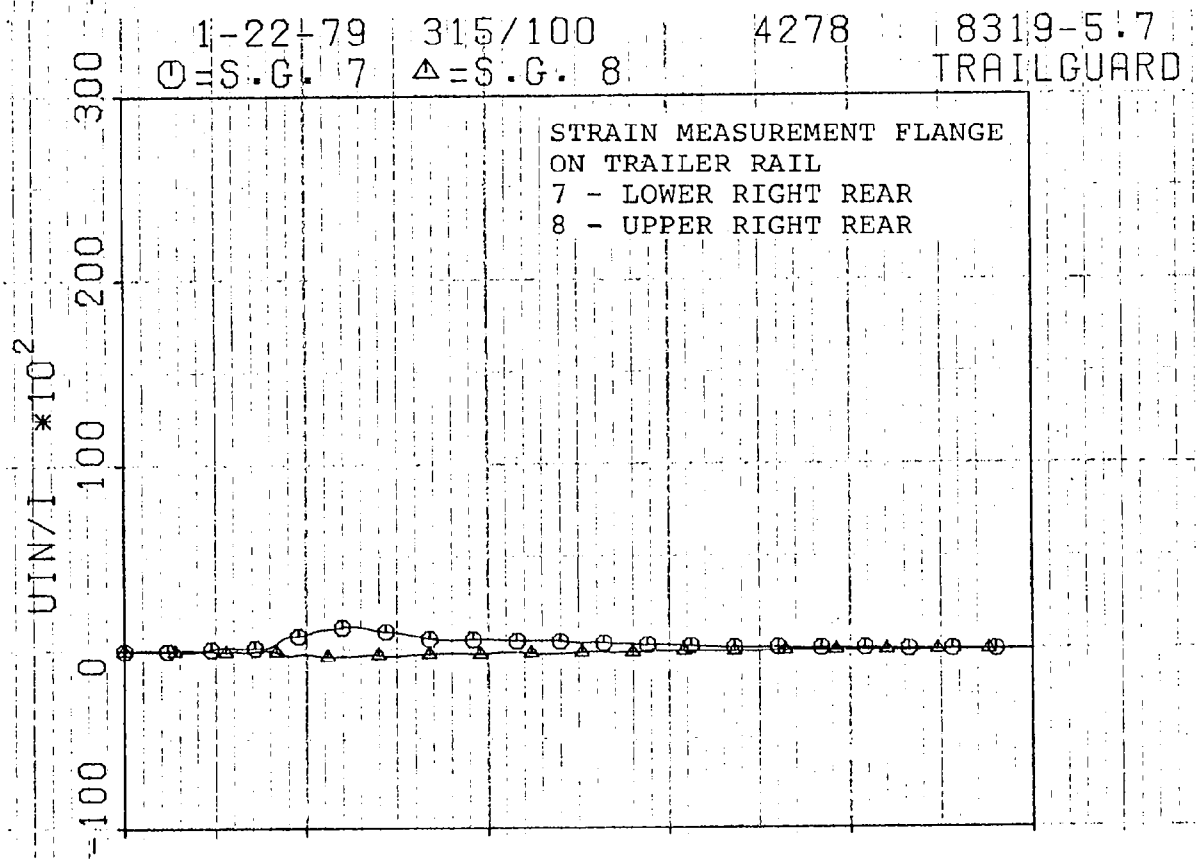

1-22-79 315/100 202 8319-5.7
TRAILGUARD
RIGHT MAIN TRAILER BEAM
ACCELERATION (REAR)
AX - G
20
10
0
-10
-20
1-22-79 315/100 4480 8319-5.7
TRAILGUARD
TOTAL LOAD SIMULATOR/
BARRIER INTERFACE
TOTAL LBS *10^3
300
200
100
0
-100
0
50
100
150
200
250
TIME - MSEC

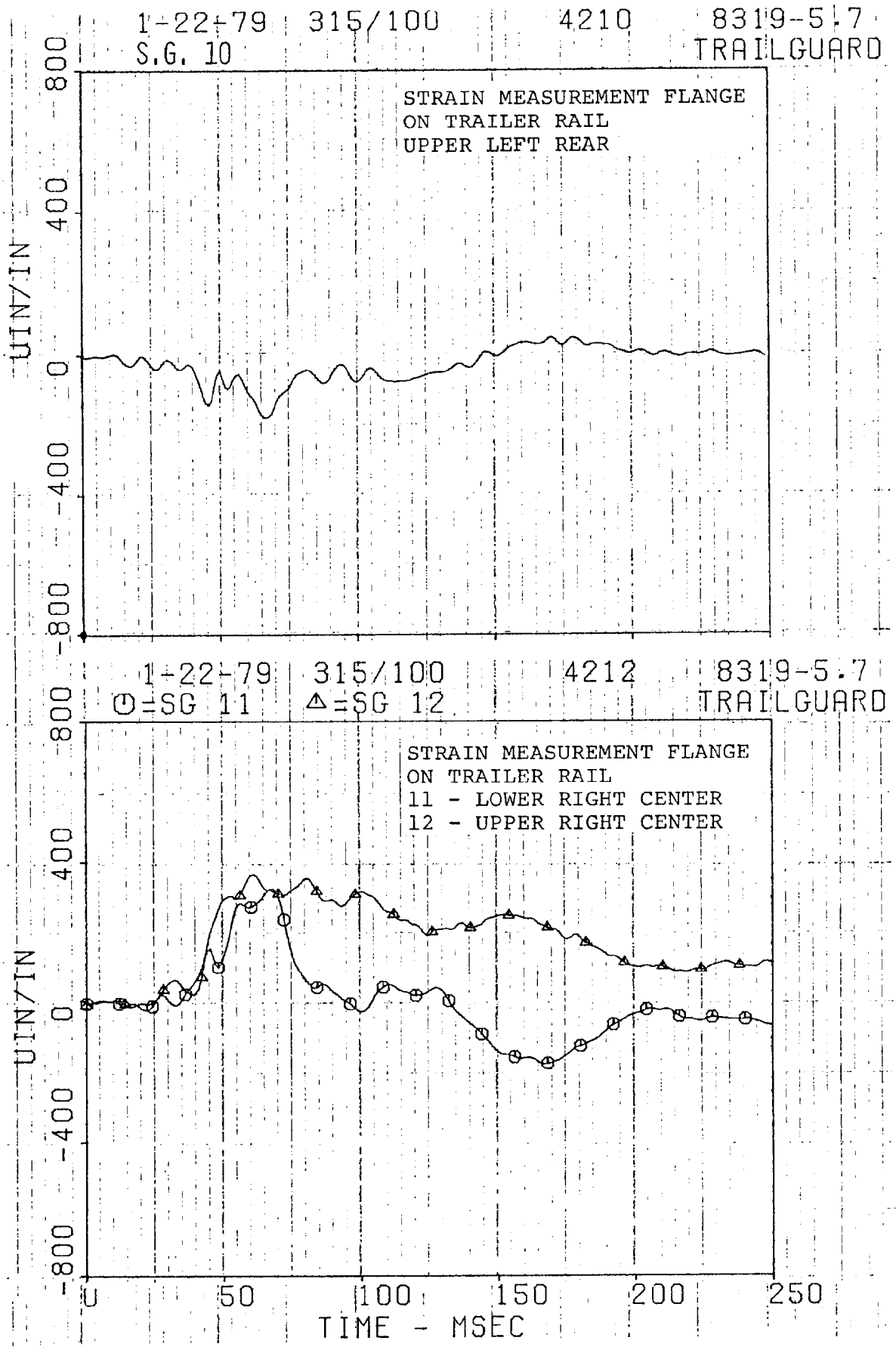

1-22-79 315/100 4412 8319-5.7
TRAILGUARD
SUM OF LOAD CELLS 1 AND 2
ON LEFT FRONT SIMULATOR/
BARRIER INTERFACE
SUM LT LBS *10³
120
80
40
0
-40
1-22-79 315/100 4440 8319-5.7
TRAILGUARD
SUM OF LOAD CELLS 3, 4, AND 5
ON RIGHT FRONT SIMULATOR/
BARRIER INTERFACE
SUM RT LBS *10³
120
80
40
0
-40
0
50
100
150
200
250
TIME - MSEC

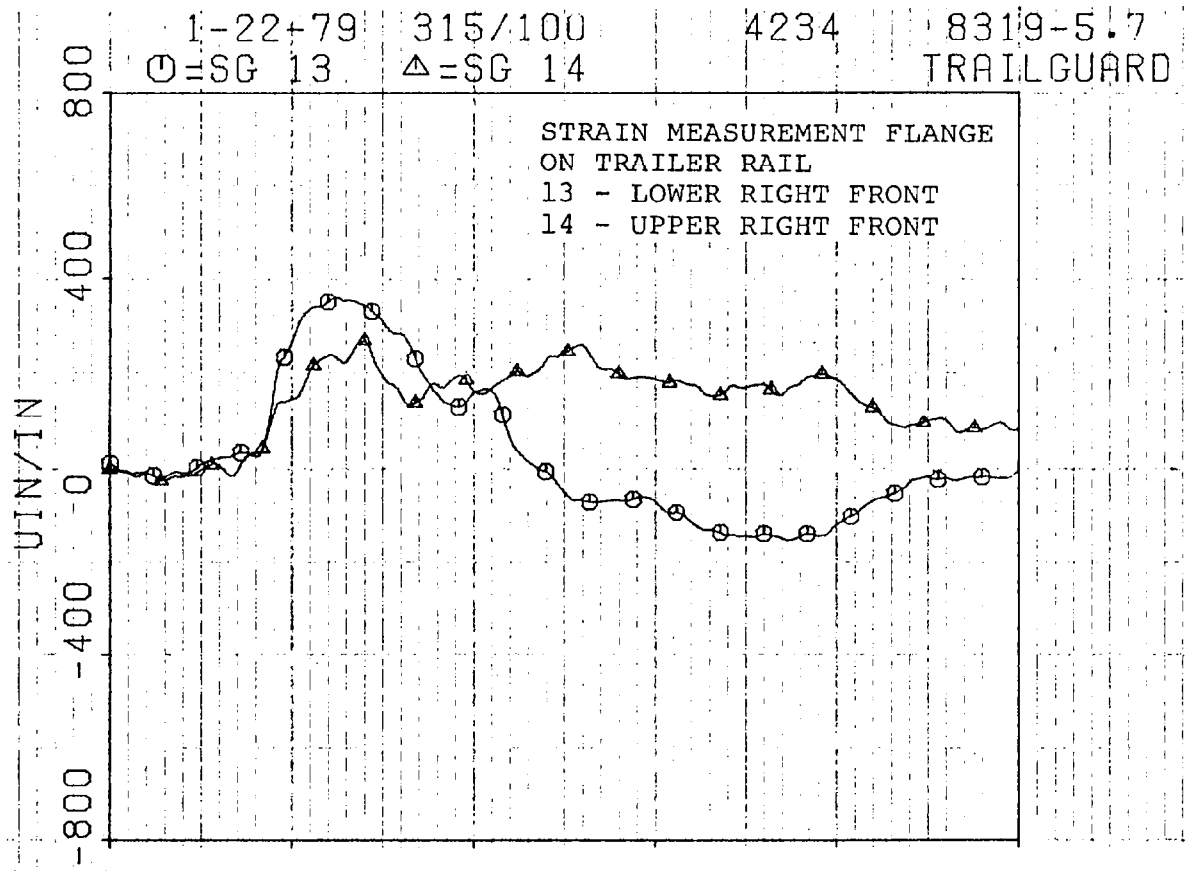

1-22-79 315/100 4300 8319-5.7
S.P.1
TRAILGUARD
STRING POTENTIOMETER LOWER
END LEFT VERTICAL I-BEAM
INCHES
10
0
-10
-20
-30
1-22-79 315/100 4301 8319-5.7
S.P.2
TRAILGUARD
STRING POTENTIOMETER MIDPOINT
LOWER HORIZONTAL CHANNEL
INCHES
10
0
-10
-20
-30
0
50
100
150
200
250
TIME - MSEC

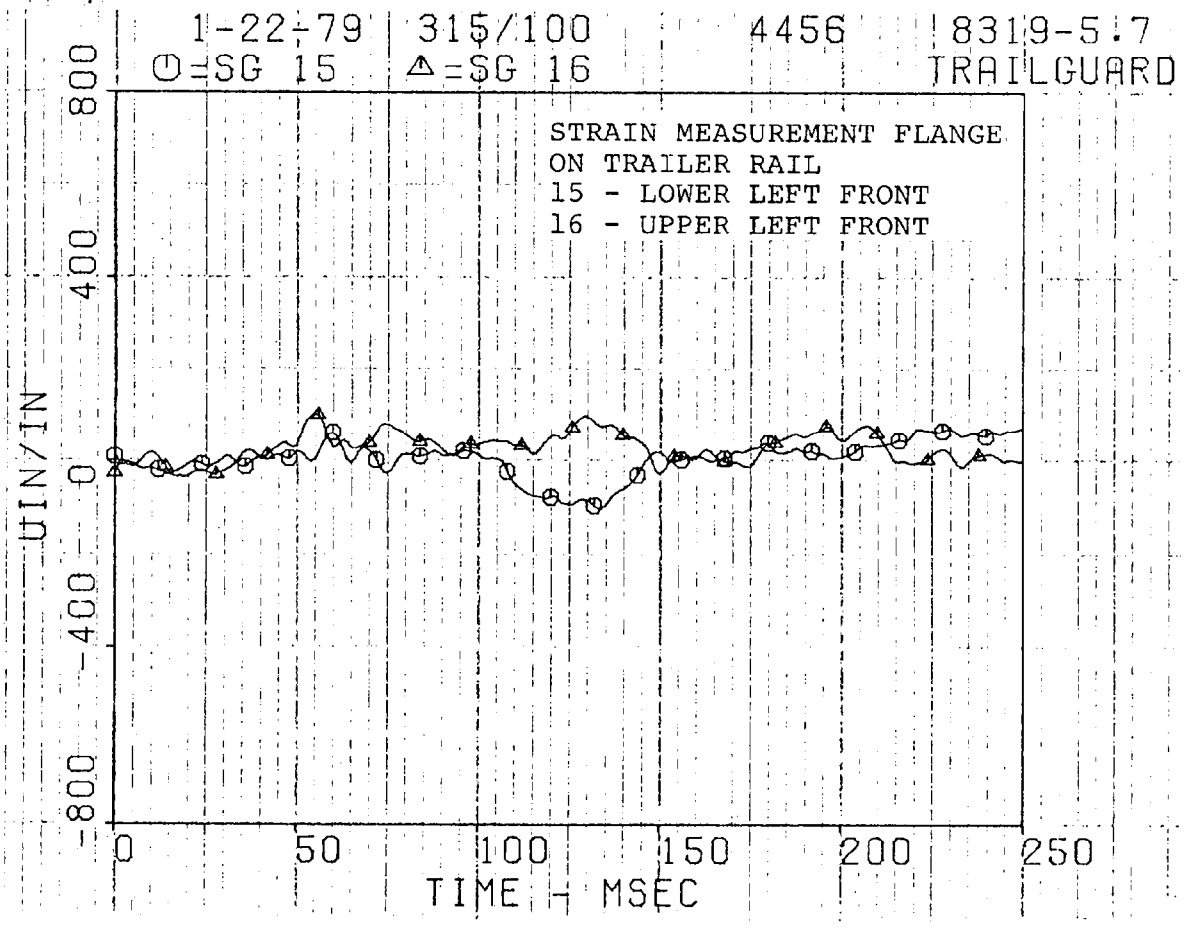

020779
DATE
1-22-79
S.R.3
FILTER
315/100
LOCATION
4302
TEST NO
8319-5.7
TRAILGUARD
STRING POTENTIOMETER LOWER
END RIGHT VERTICAL I-BEAM
INCHES
10
0
-10
-20
-30
0
50
100
150
200
250
TIME - MSEC

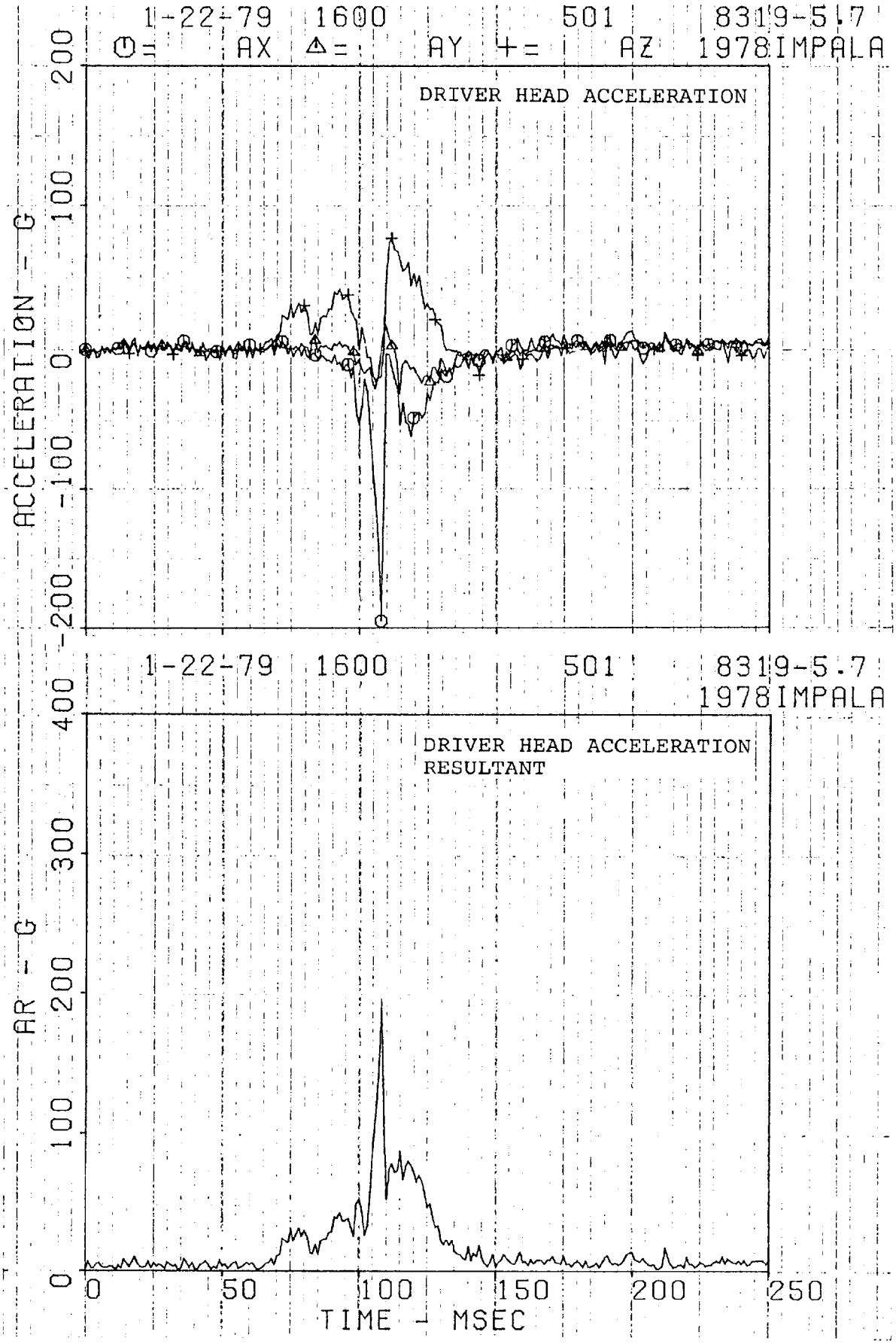

1-22-79 315/100 4213 8319-5.7
⊙=S.G. 1 △=S.G. 2 TRAILGUARD
STRAIN MEASUREMENT
UNDERRIDE GUARD
SG 1 - RIGHT VERTICAL BEAM
SG 2 - LOWER HORIZONTAL MEMBER
UIN/I *10²
300
200
100
0
-100

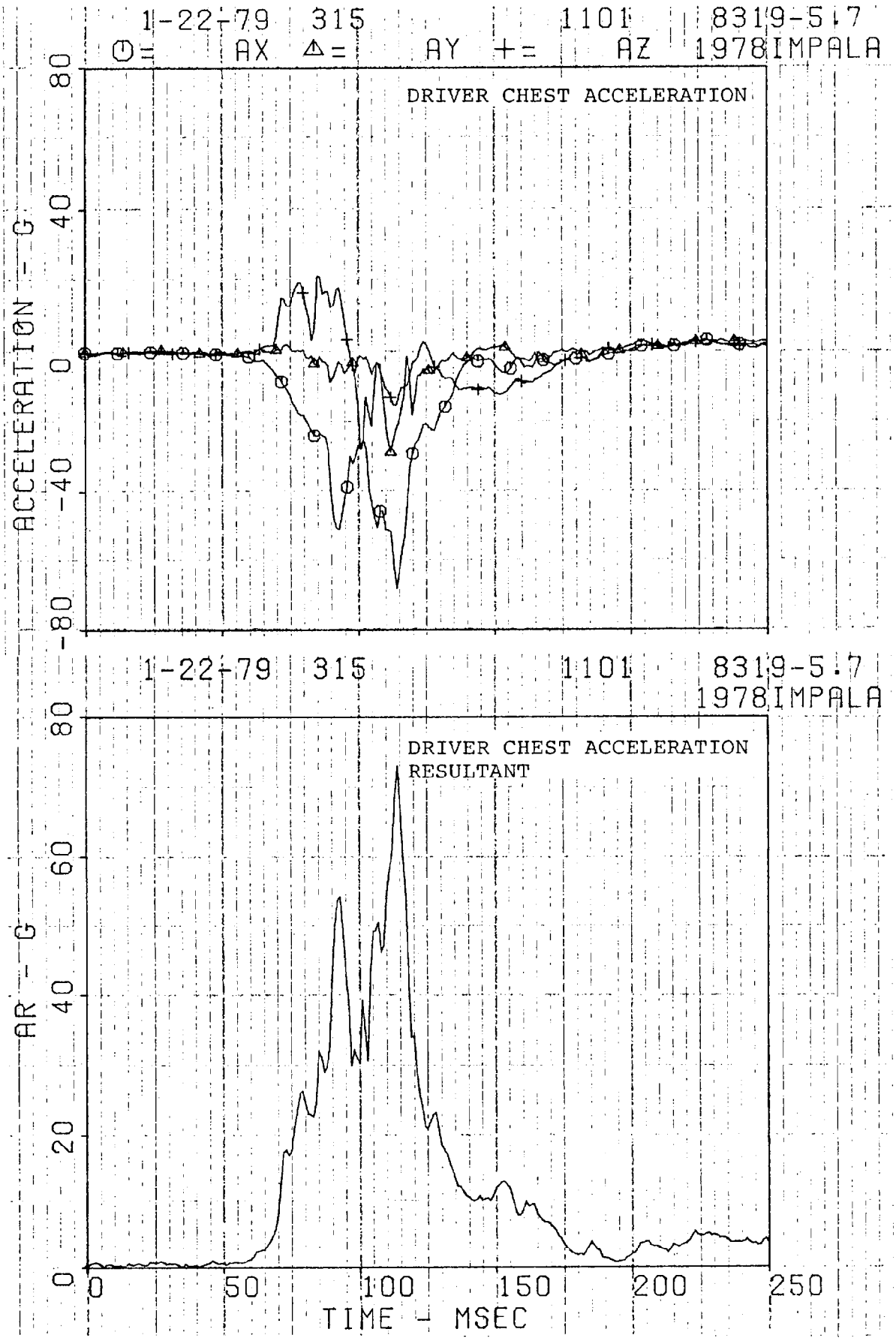

1-22-79 315/100 4278 8319-5.7
⊙=S.G. 7 △=S.G. 8 TRAILGUARD
STRAIN MEASUREMENT FLANGE
ON TRAILER RAIL
7 - LOWER RIGHT REAR
8 - UPPER RIGHT REAR
UIN/I *10²
300
200
100
0
-100

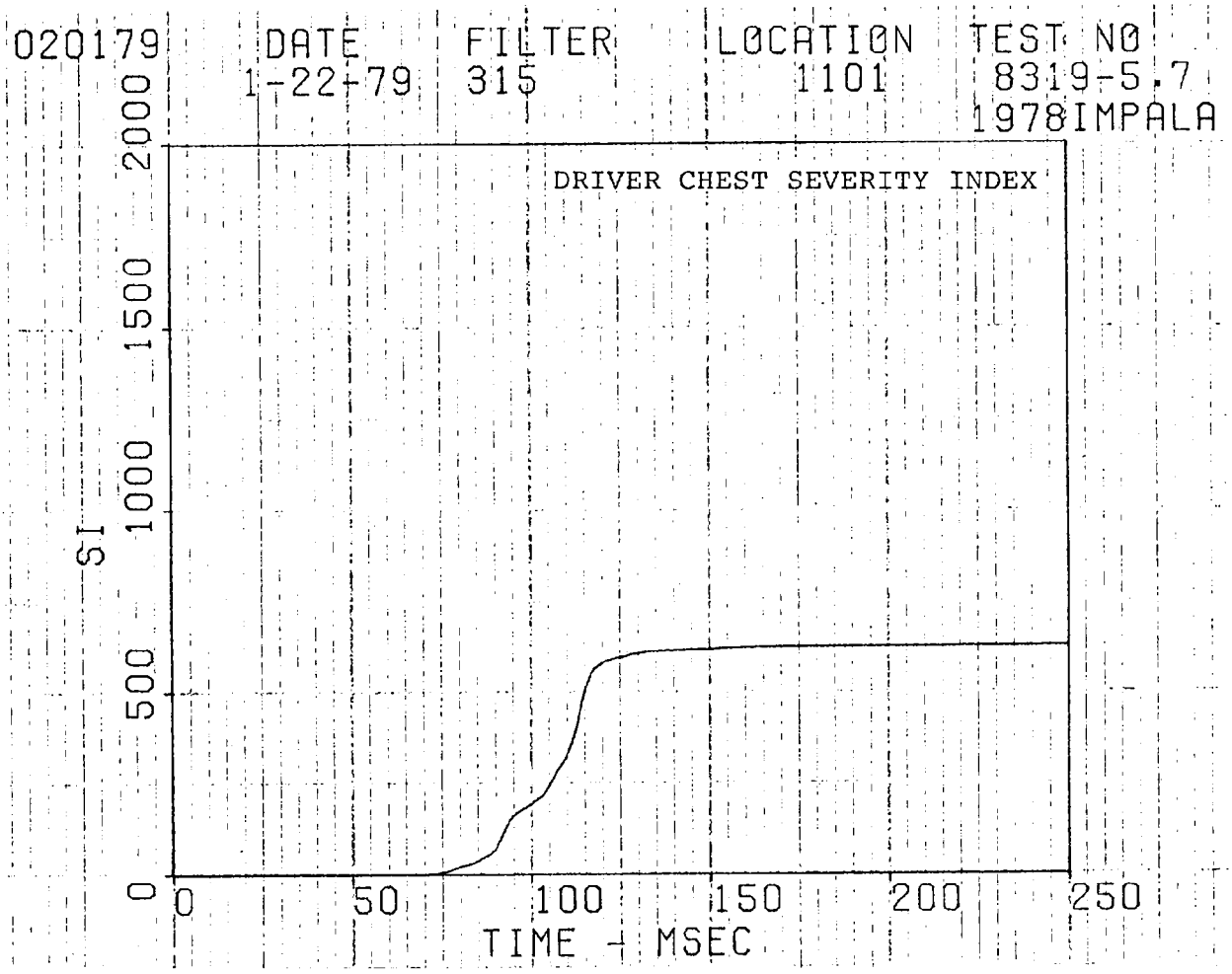

1-22-79 315/100 4210 8319-5.7
S.G. 10
TRAILGUARD
STRAIN MEASUREMENT FLANGE
ON TRAILER RAIL
UPPER LEFT REAR
UIN/IN
800
400
0
-400
-800
1-22-79 315/100 4212 8319-5.7
⏲=SG 11 △=SG 12
TRAILGUARD
STRAIN MEASUREMENT FLANGE
ON TRAILER RAIL
11 - LOWER RIGHT CENTER
12 - UPPER RIGHT CENTER
UIN/IN
800
400
0
-400
-800
0
50
100
150
200
250
TIME - MSEC

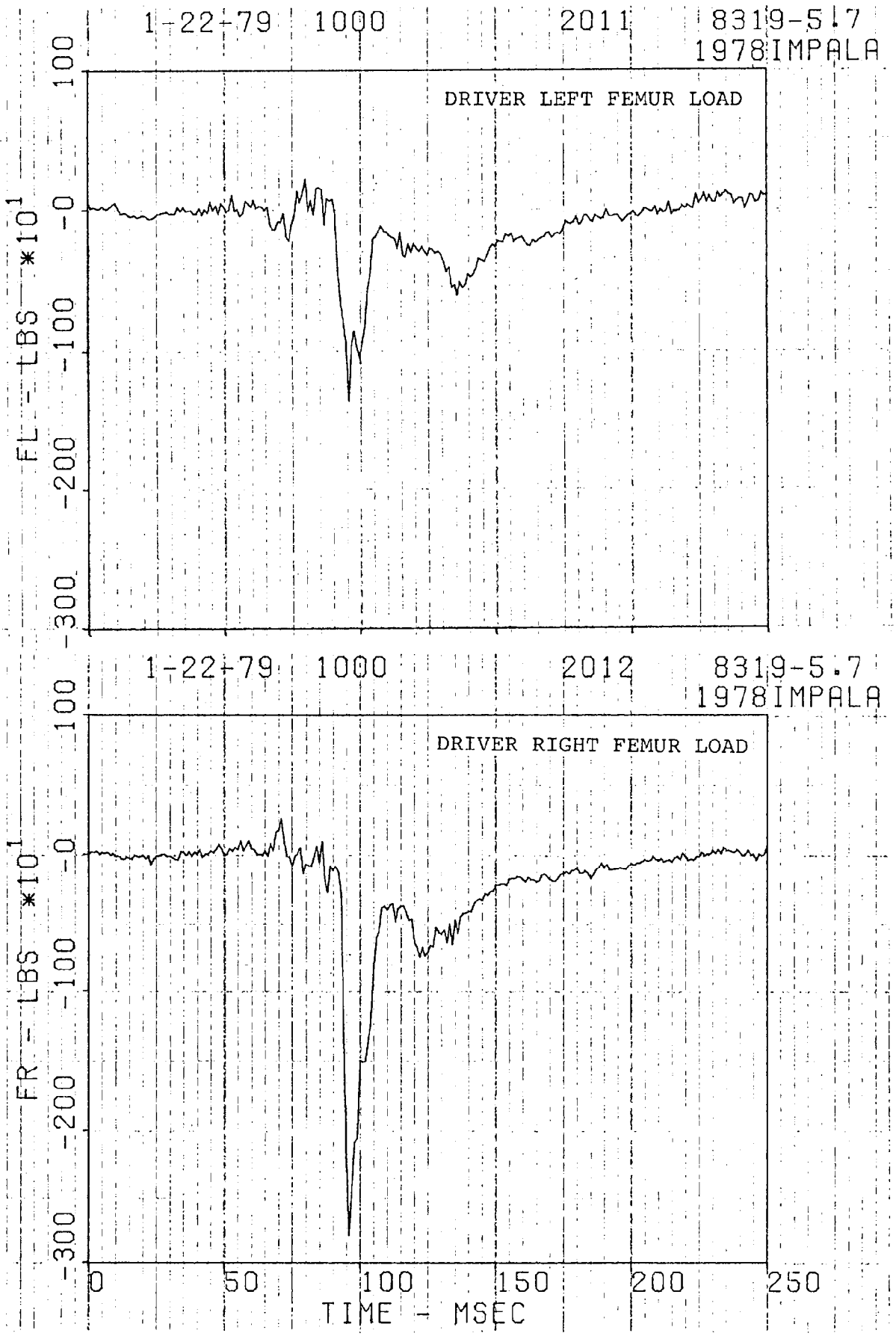

1-22-79 315/100 4234 8319-5.7
⏲=SG 13 △=SG 14 TRAILGUARD
STRAIN MEASUREMENT FLANGE
ON TRAILER RAIL
13 - LOWER RIGHT FRONT
14 - UPPER RIGHT FRONT
800
400
0
-400
-800
UIN/IN

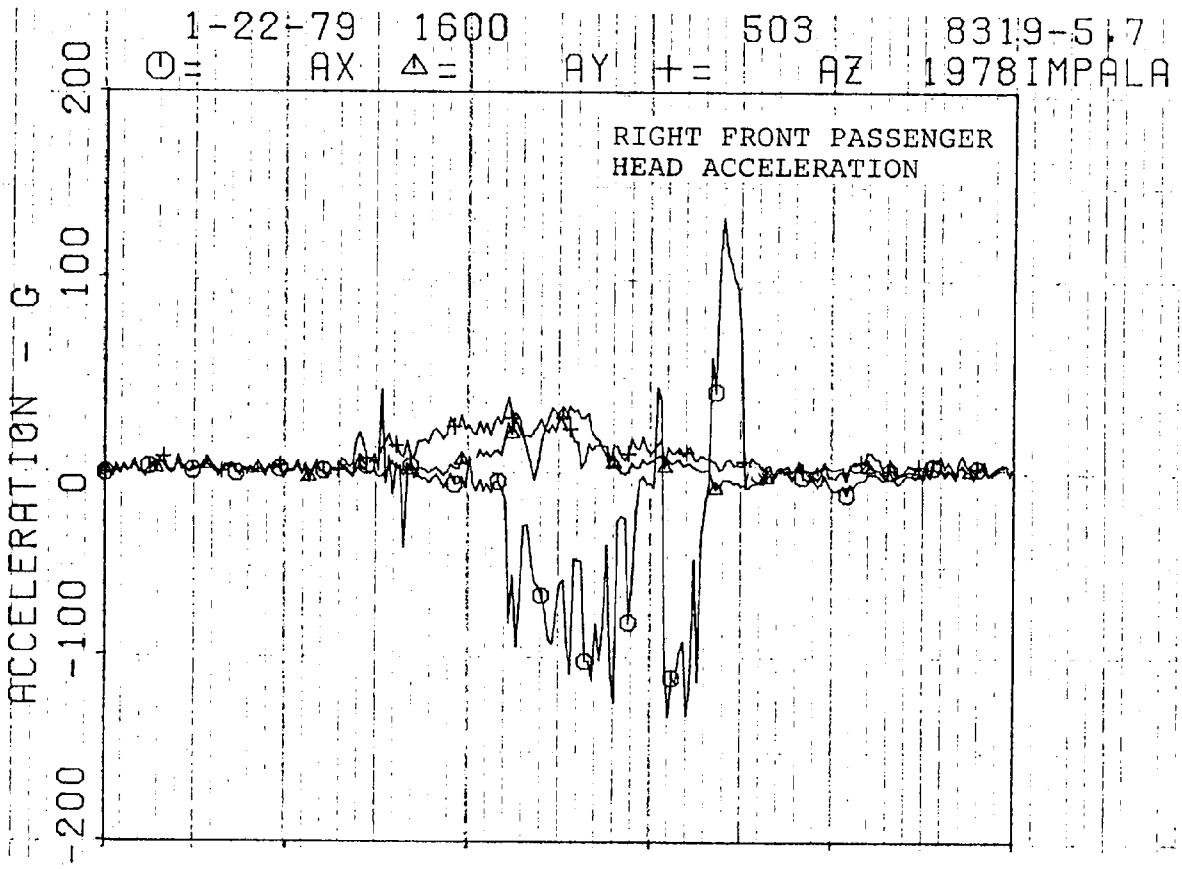

1-22-79 315/100 4456 8319-5.7
⏲=SG 15 △=SG 16 TRAILGUARD
STRAIN MEASUREMENT FLANGE
ON TRAILER RAIL
15 - LOWER LEFT FRONT
16 - UPPER LEFT FRONT
800
400
0
-400
-800
UIN/IN
0
50
100
150
200
250
TIME - MSEC

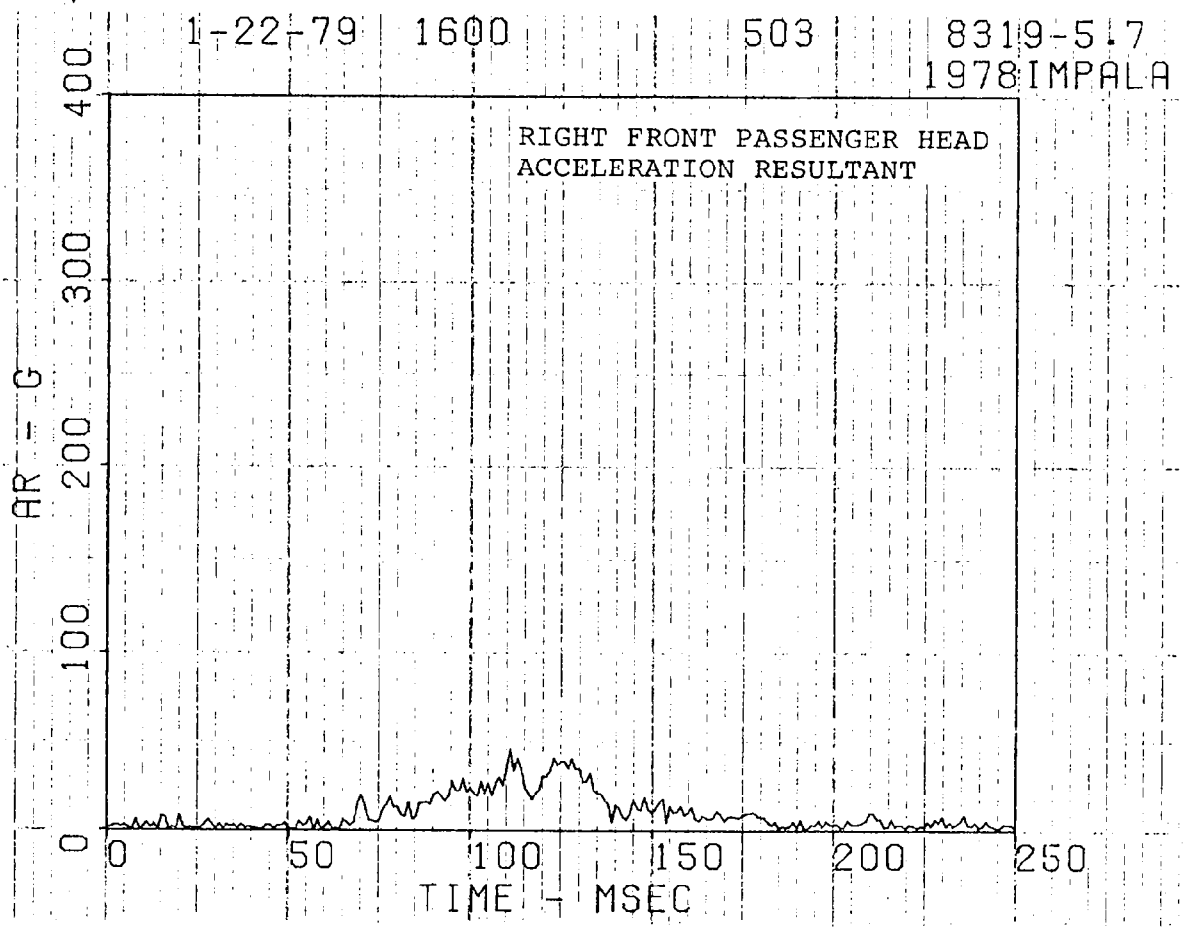

1-22-79 1600 501 8319-5.7
○= AX △= AY += AZ 1978 IMPALA
DRIVER HEAD ACCELERATION
ACCELERATION - G
200
100
0
-100
-200
1-22-79 1600 501 8319-5.7
1978 IMPALA
DRIVER HEAD ACCELERATION
RESULTANT
AR - G
400
300
200
100
0
0
50
100
150
200
250
TIME - MSEC

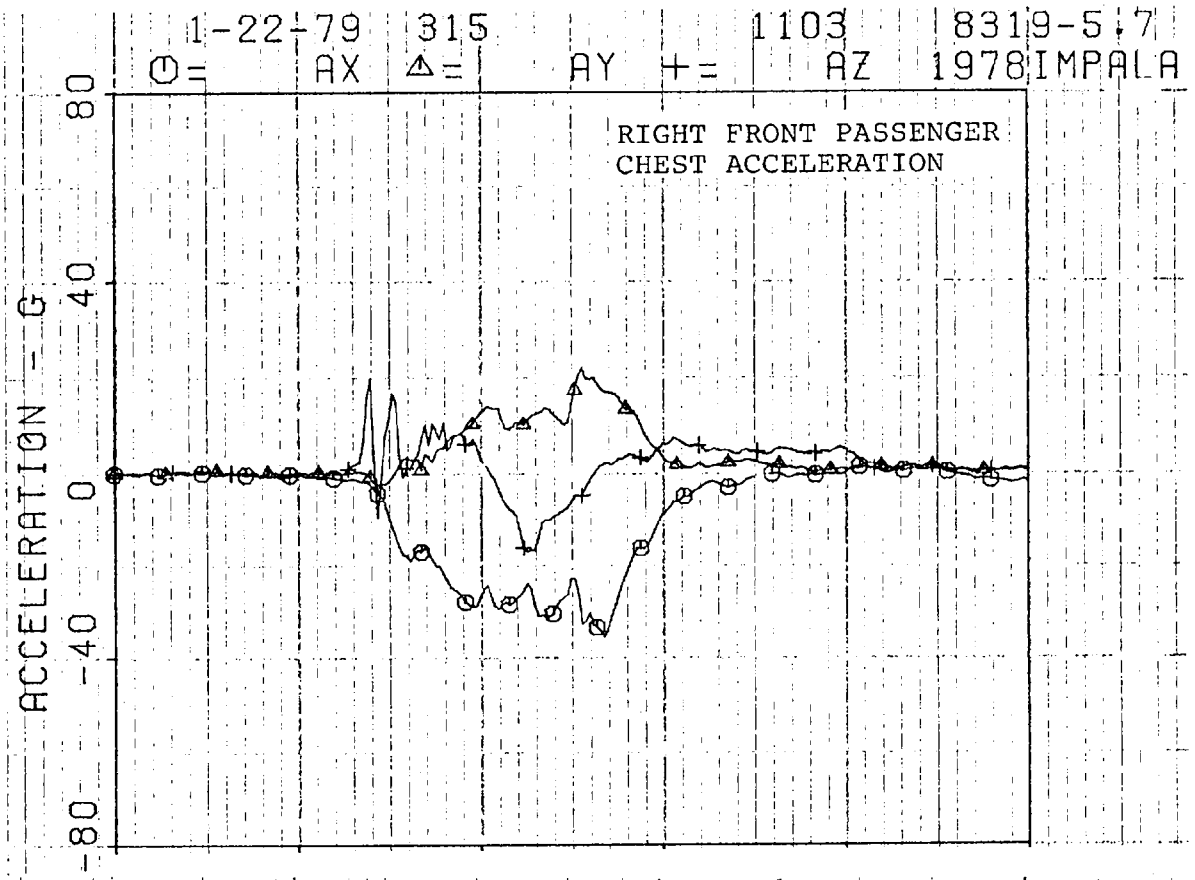

1-22-79 315 1101 8319-5:7
○= AX △= AY += AZ 1978IMPALA
DRIVER CHEST ACCELERATION
ACCELERATION - G
80
40
0
-40
-80
1-22-79 315 1101 8319-5:7
1978IMPALA
DRIVER CHEST ACCELERATION
RESULTANT
AR - G
80
60
40
20
0
0
50
100
150
200
250
TIME - MSEC

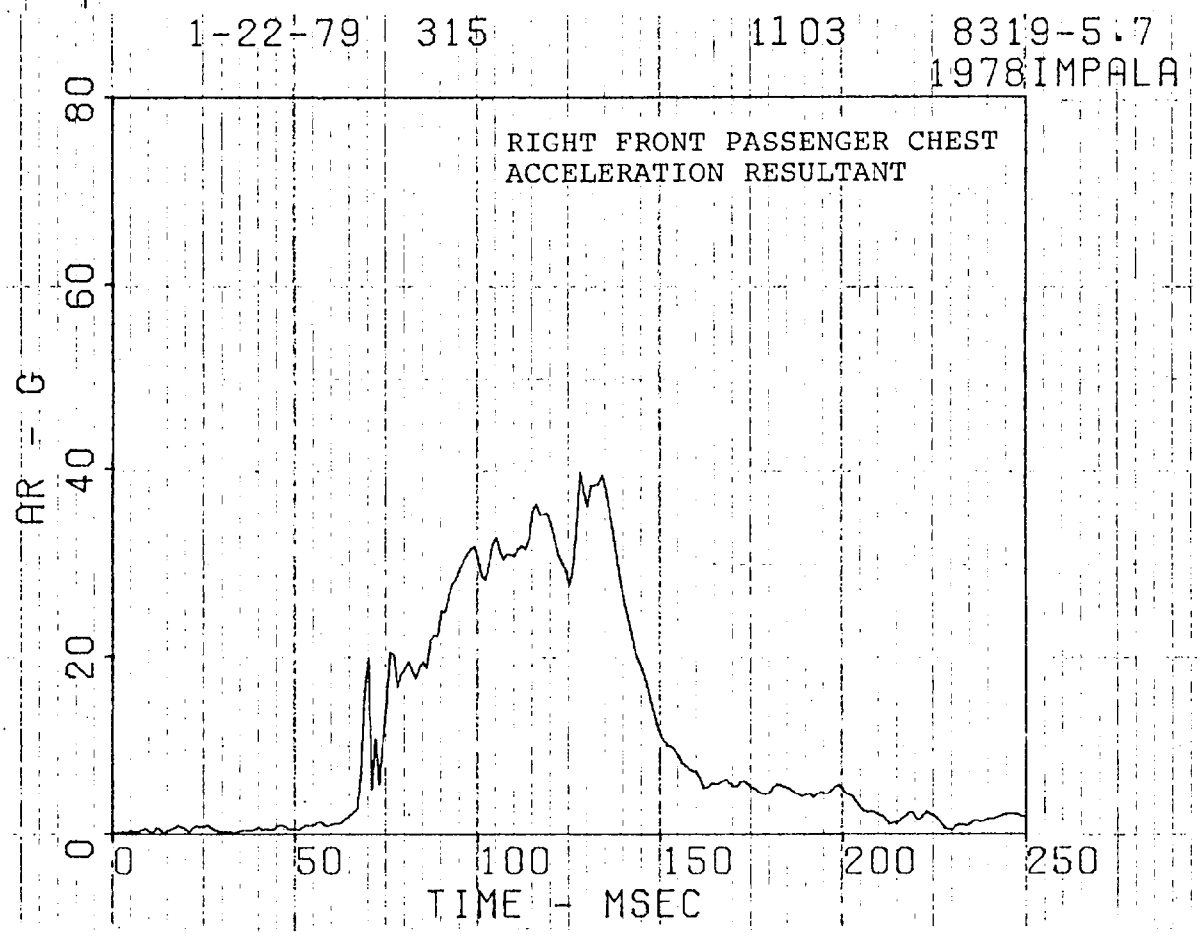

020179
DATE
1-22-79
FILTER
315
LOCATION
1101
TEST NO
8319-5.7
1978IMPALA
DRIVER CHEST SEVERITY INDEX
SI
0
500
1000
1500
2000
0
50
100
150
200
250
TIME - MSEC

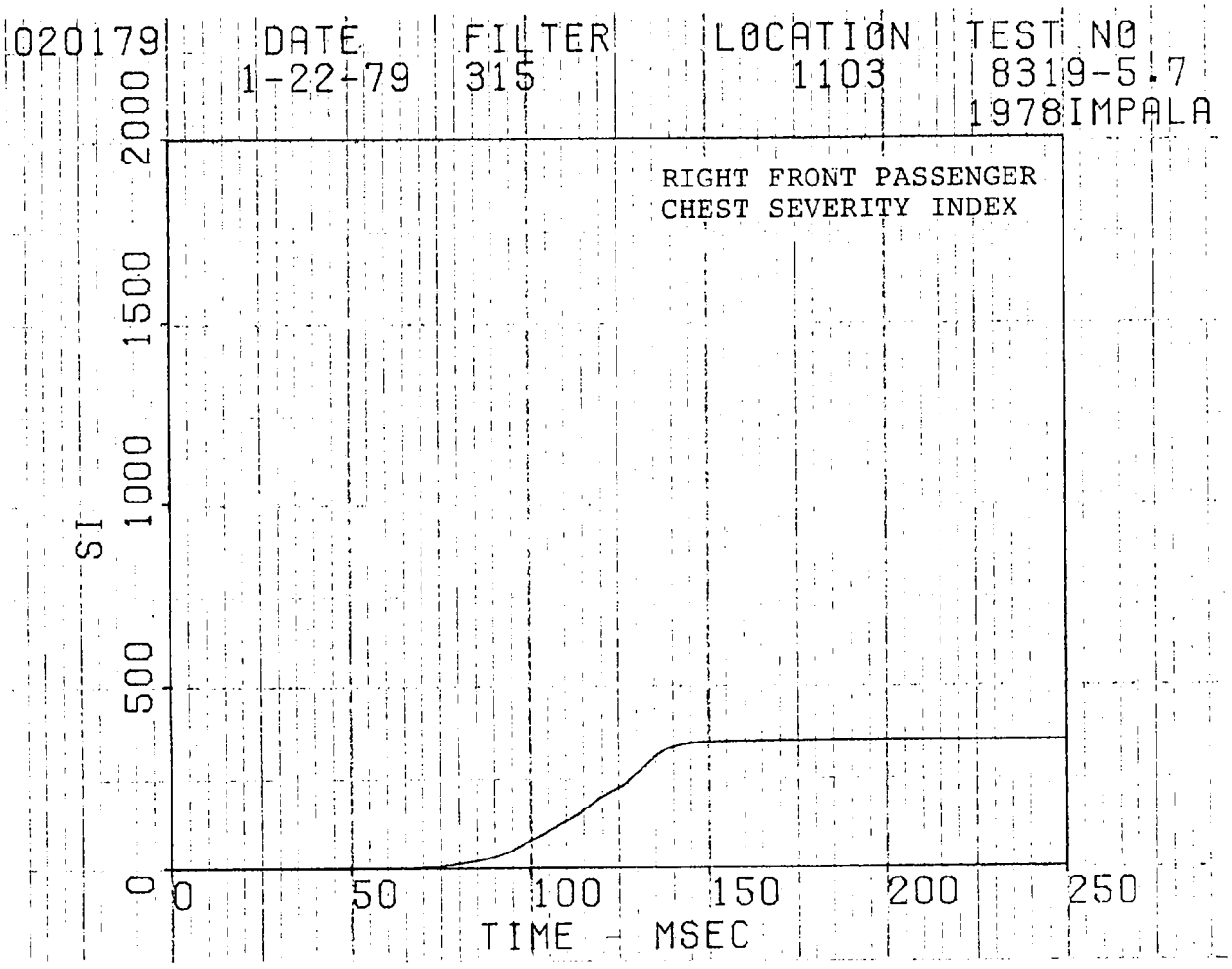

1-22-79 1000 2011 8319-5.7
1978 IMPALA
DRIVER LEFT FEMUR LOAD
FL - LBS *10^1
100
-0
-100
-200
-300
1-22-79 1000 2012 8319-5.7
1978 IMPALA
DRIVER RIGHT FEMUR LOAD
FR - LBS *10^1
100
-0
-100
-200
-300
0
50
100
150
200
250
TIME - MSEC

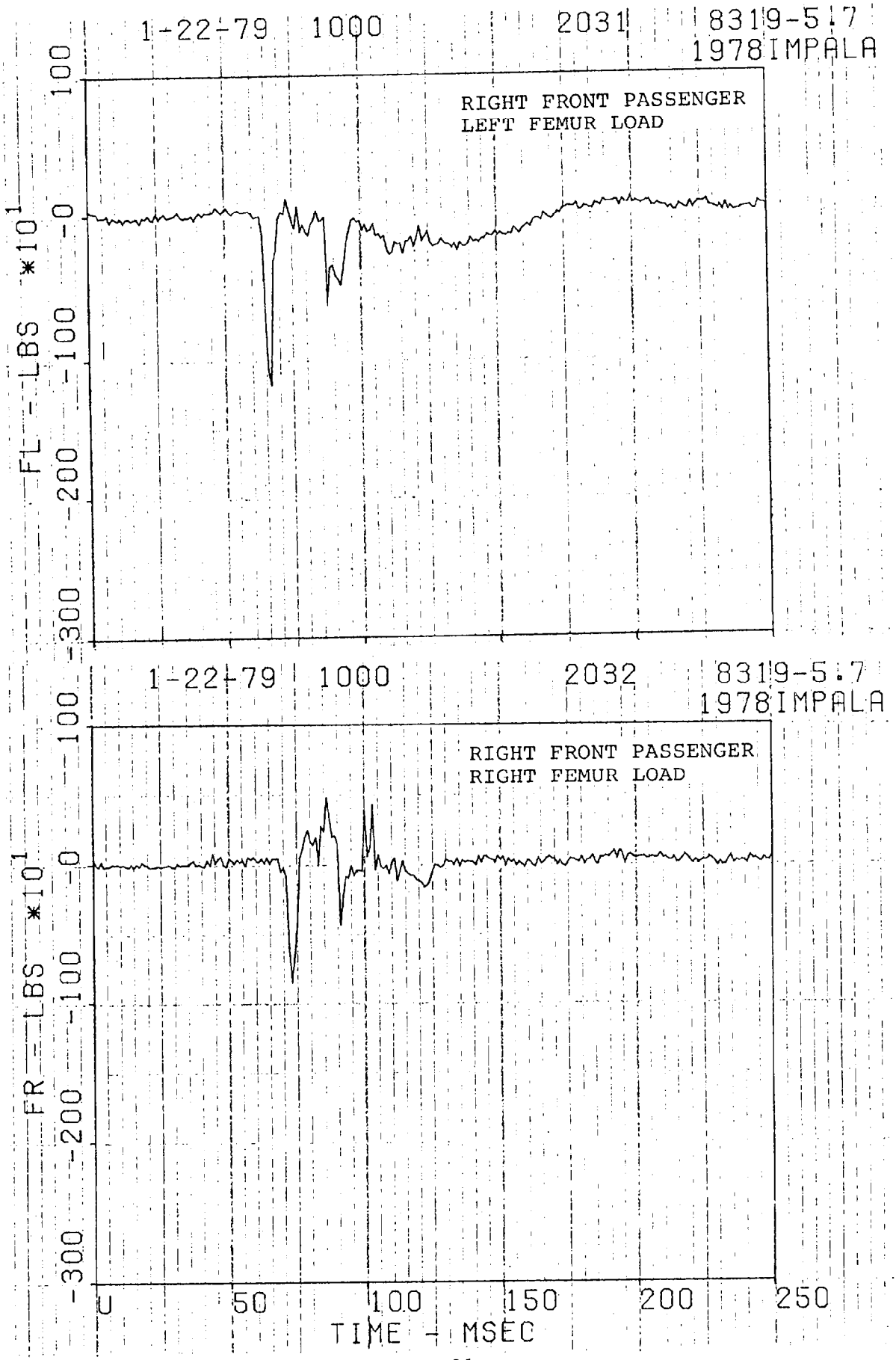

1-22-79 1600 503 8319-5.7
AX AY AZ 1978 IMPALA
RIGHT FRONT PASSENGER HEAD ACCELERATION
ACCELERATION - G
200
100
0
-100
-200

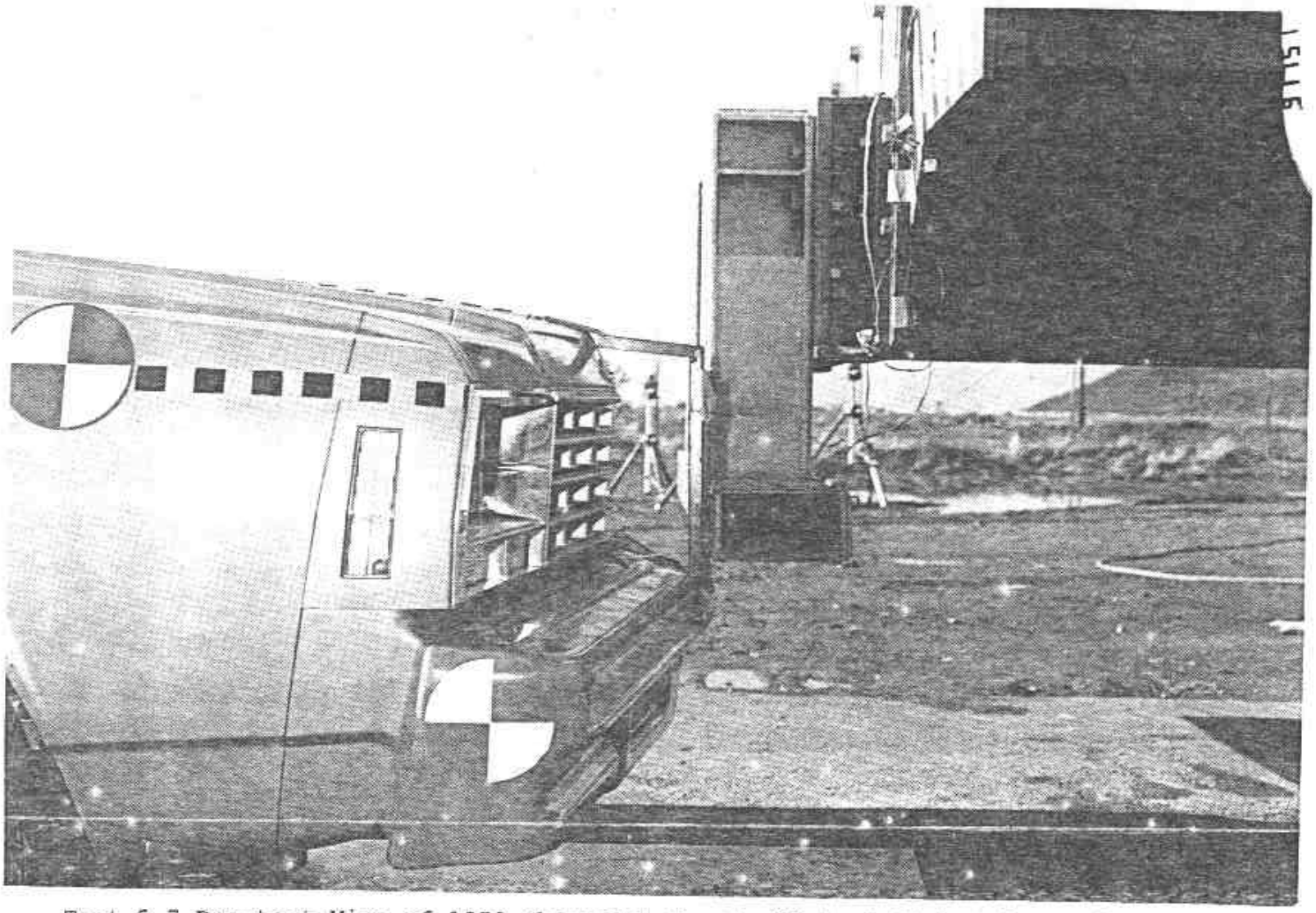

1-22-79 1600 503 8319-5.7
1978 IMPALA
RIGHT FRONT PASSENGER HEAD ACCELERATION RESULTANT
AR - G
400
300
200
100
0
0
50
100
150
200
250
TIME - MSEC


1-22-79 315 1103 8319-5.7
○= AX △= AY += AZ 1978 IMPALA
RIGHT FRONT PASSENGER CHEST ACCELERATION
ACCELERATION - G
80
40
0
-40
-80

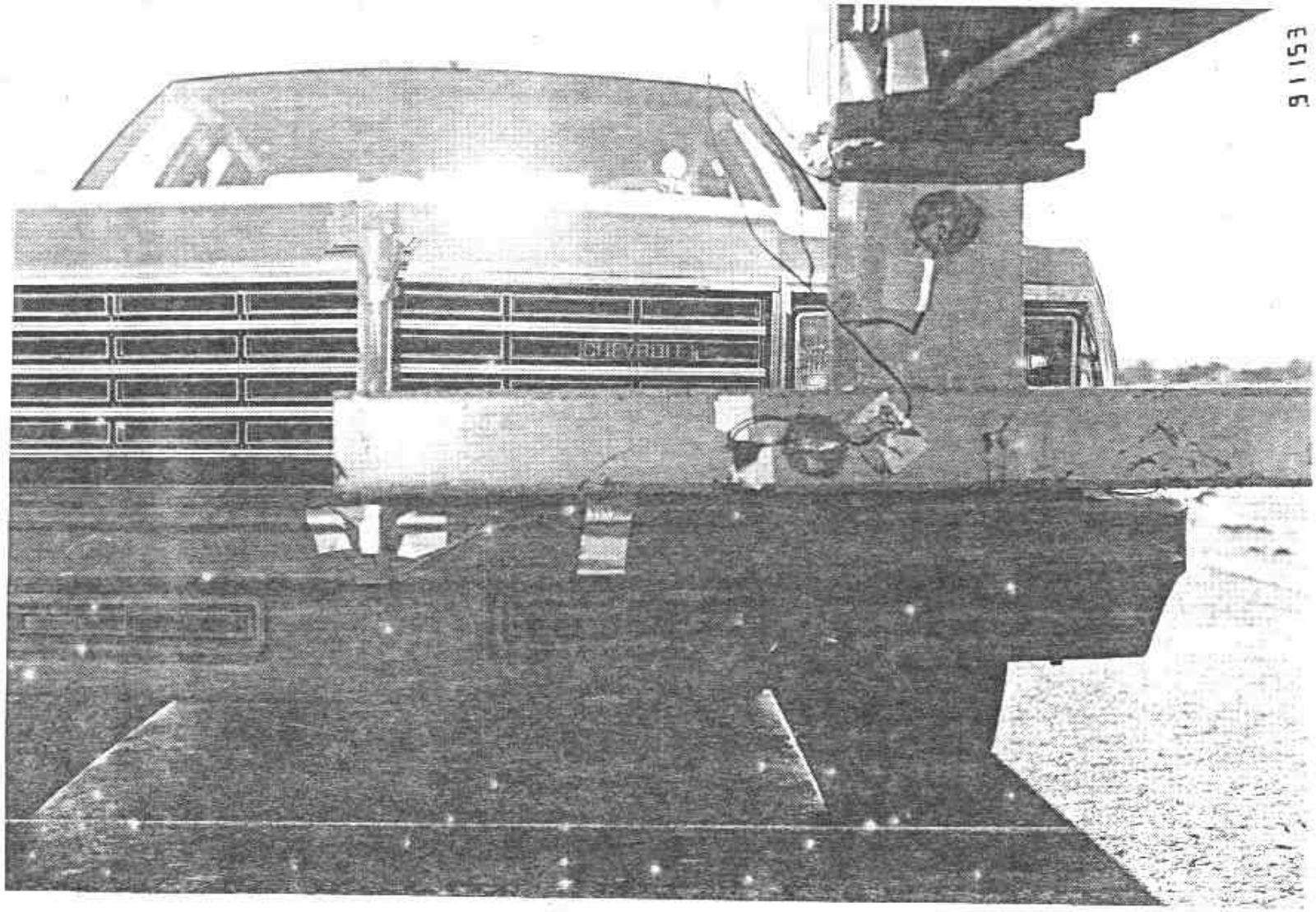

1-22-79 315 1103 8319-5.7
1978 IMPALA
RIGHT FRONT PASSENGER CHEST ACCELERATION RESULTANT
AR - G
80
60
40
20
0
0
50
100
150
200
250
TIME - MSEC


020179
DATE
1-22-79
FILTER
315
LOCATION
1103
TEST NO
8319-5.7
1978 IMPALA
RIGHT FRONT PASSENGER
CHEST SEVERITY INDEX
SI
2000
1500
1000
500
0
0
50
100
150
200
250
TIME - MSEC

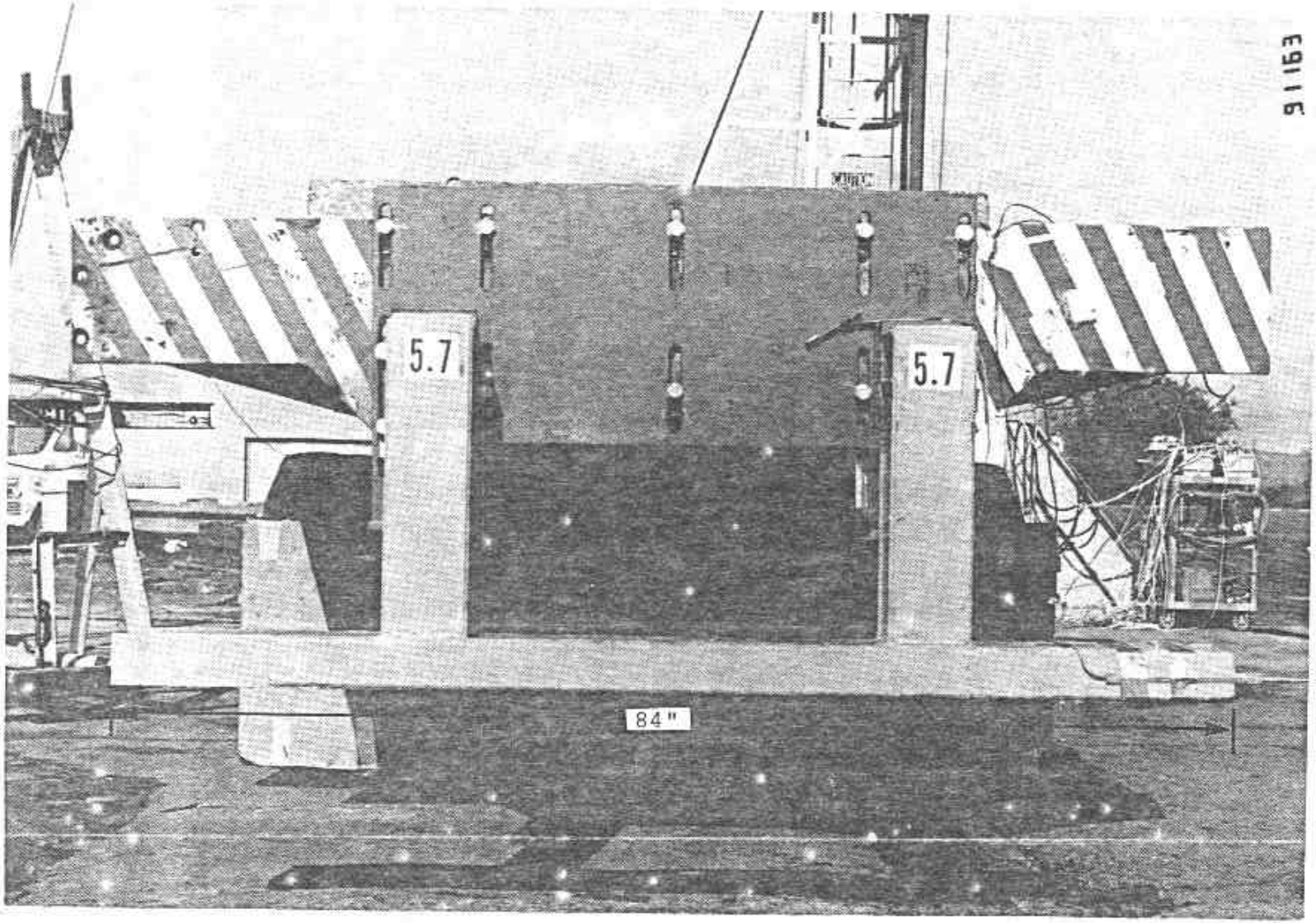

1-22-79 1000 2031 8319-5.7
1978 IMPALA
RIGHT FRONT PASSENGER
LEFT FEMUR LOAD
FL = LBS *10^1
100
0
-100
-200
-300
1-22-79 1000 2032 8319-5.7
1978 IMPALA
RIGHT FRONT PASSENGER
RIGHT FEMUR LOAD
FR = LBS *10^1
100
0
-100
-200
-300
0
50
100
150
200
250
TIME - MSEC



Test 5.7 Pre-test View of 1978 Chevrolet Impala/22-inch High T-1 Guard Crash.

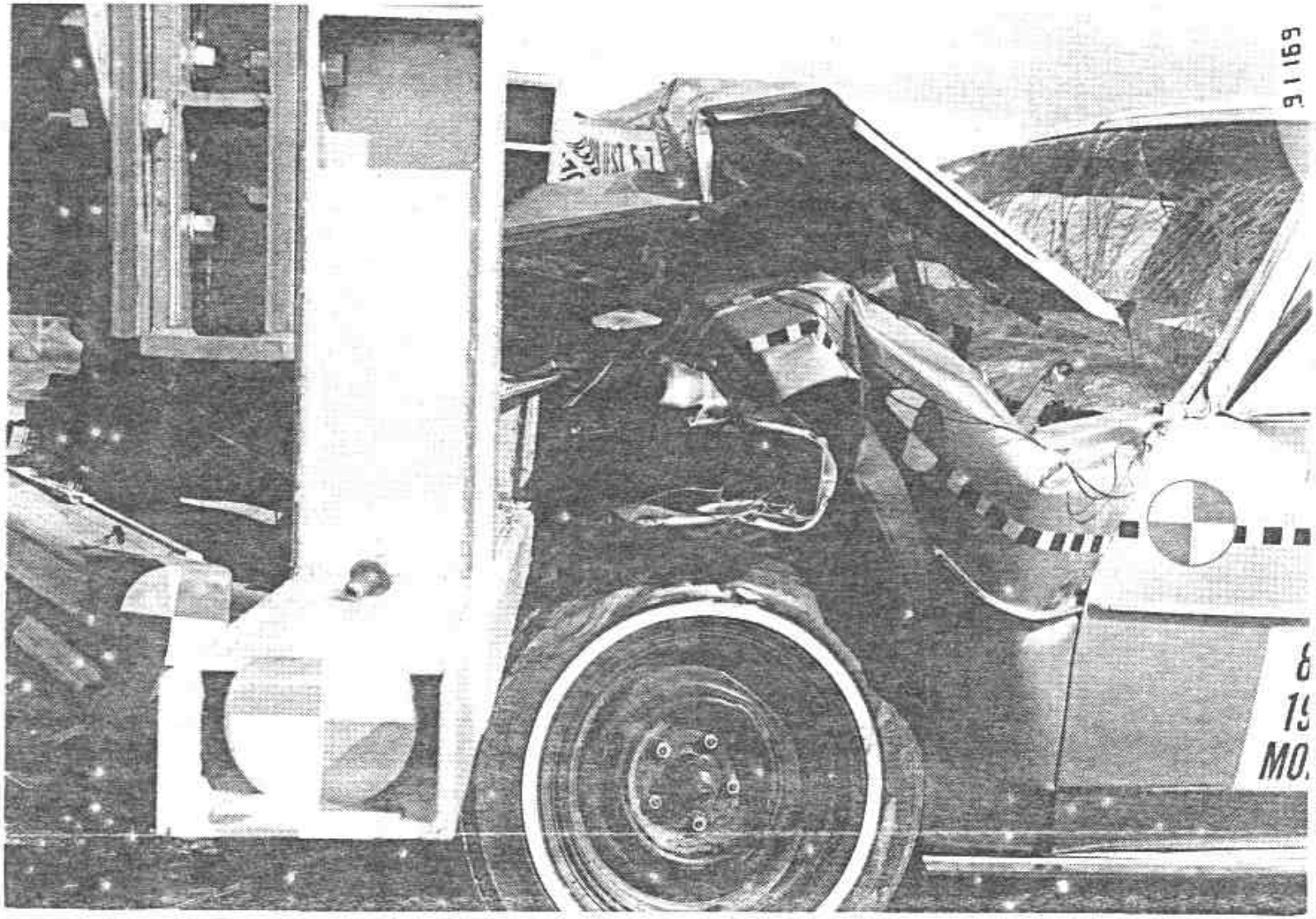


Test 5.7 Pre-test Closeup View of Vehicle/Guard Engagement.



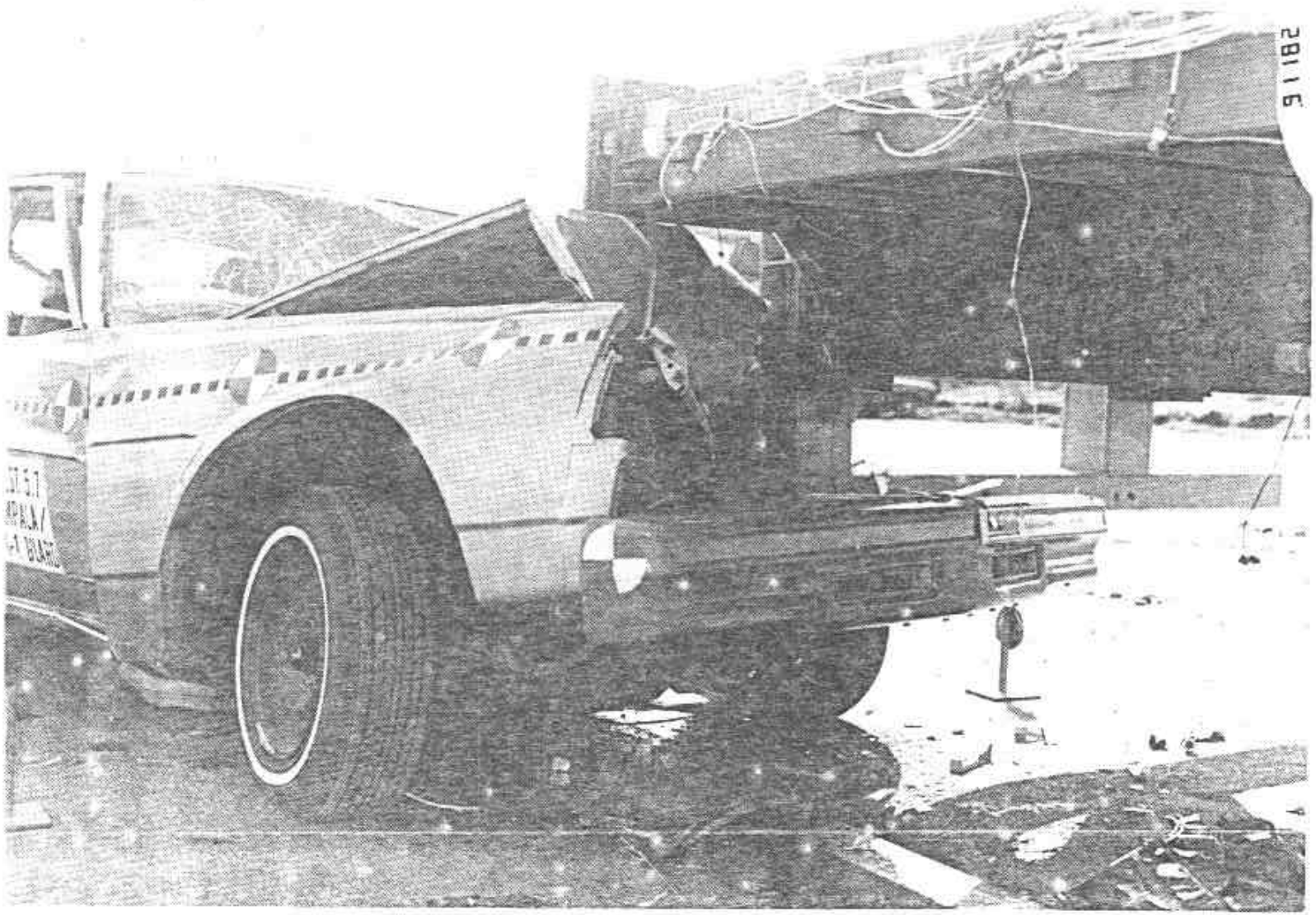
Test 5.7 Pre-test Overall View of Underride Guard.

Test 5.7 Overall Post-test View of 1978 Chevrolet Impala/
22-inch High T-1 Guard Crash.



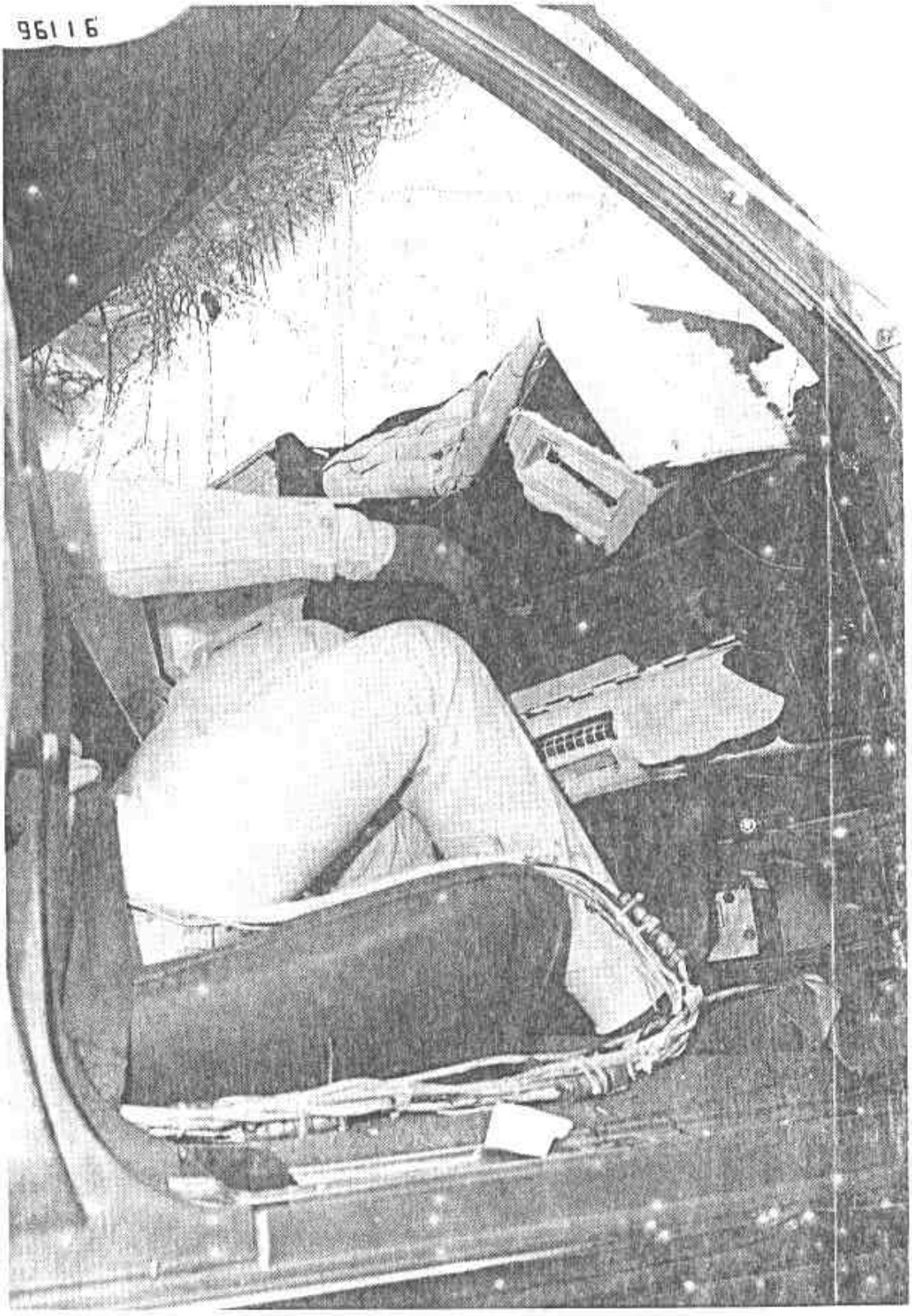
Test 5.7 Post-test Closeup View of Impact Area.

Test 5.7 Post-test View of Vehicle Rotation.



Test 5.7 Post-test View of Guard Penetration.

Test 5.7 Post-test View of Driver Dummy.

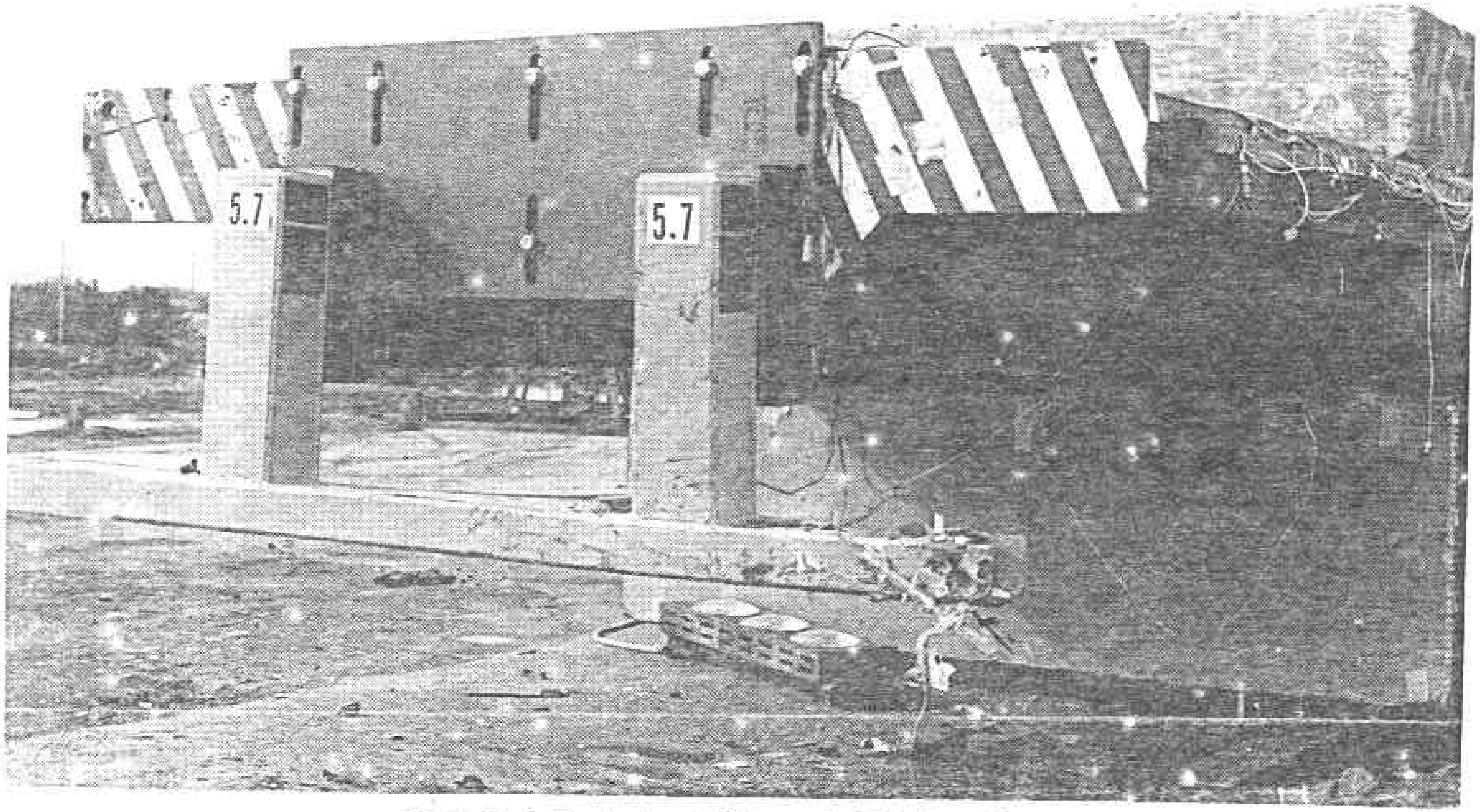


Test 5.7 Post-test View of Passenger Dummy.

Test 5.7 Post-test View of Driver Compartment.

Test 5.7 Post-test View of Passenger Compartment.

91191



Test 5.7 Post-test View of T-1 Guard.

APPENDIX C

TEST 5.8 TEST DATA SUMMARY
1978 VOLKSWAGEN RABBIT
OFFSET IMPACT @ 40 MPH

TABLE C-1. RECEIVING INSPECTION OF VEHICLES

Contractor: Dynamic Science Contract No.: DOT-HS-8-01905

VIN NO.: 17S341653 Make: Volkswagen

NHTSA No.: R & D

Year: 1978 Color: Cream Model: Rabbit 4-Door

Auto Trans:	(yes)	no	Pwr Steering:	yes	(no)	Seats: (front) Bench:	
Pwr Brakes:	(yes)	no	Auto Speed Cont:	yes	(no)	Bucket:	X
Pwr Seats:	yes	(no)	Anti Skid Brake:	yes	(no)	Split Bench:	
Pwr Windows:	yes	(no)	Air Conditioning:	(yes)	no		
Tinted Glass:	yes	(no)	Rear Window Def.:	(yes)	no	Split Back Bench:	
Radio:	yes	(no)	Brakes: drum: R	disc: F			
Clock:	(yes)	no					

Tire Size: 155SR-13 Ply Rating: 4 Mfg. & Line: Michelin X

Bias Ply: Belted: X Radial X /Eng.Type: IC Cylinders: 4 Total Displ: 89 CID

Trans, # Fwd. Speeds: GVWR Weight: 2125 Odometer: 27.0

Dealer (name, address, and phone number)

AZTEC Volkswagen (Telephone: 602-264-0811)
2020 E. Indian School Rd.
Phoenix, Arizona 85011

Remarks (list additional accessories not listed above)

Date of Manufacture: 3/78 Dynamic Science No.: 715 Date Received: 5/31/78

Tilting Steering Wheel: yes (no) Telescoping Steering Wheel: yes (no)

Fuel Capacity: (from owner's manual) "Space Saver" Spare Tire yes (no)

Restraint System: Passive Shoulder Belt & Knee Bolsters

1. Is the vehicle stock throughout? Describe: Yes, New Production Vehicle

2. Does vehicle show evidence of prior accident history? Describe: None

3. Does vehicle show any significant corrosion? Describe: None

4. Check condition of the front bumper and frame: Satisfactory, no bumper guards

TABLE C-2. SUMMARY OF PRE-TEST AND POST-TEST VEHICLE ENGINE/BUMPER/FIREWALL CHARACTERISTICS

Test No. 8319-5.8 Type Underride 42-inch offset

Car Model V.W. Rabbit Dynamic Science No. 715

	Pre-test
Engine Size	89 CID
Engine Height/Width (in.)	28/31*
Bumper to Engine (in.)	26
Engine Length (in.)	15
Engine to Firewall (in.)	5.5
Bumper to Firewall (in.)	41.5
Bumper to "Hard Point" (A/C Comp) (in.)	17
Initial Impact Point to Front Bumper (in.)	6.1
Height From Top of Front Bumper to Lowest Point of Underride Guard (in.)	2.6
Horizontal Dimension From Centerline of Vehicle to Extreme Left Edge of Guard (in.)	84
Horizontal Dimension From Centerline of Vehicle to Extreme Right Edge of Guard (in.)	0

*Transverse mounted engine.

TABLE C-3. SUMMARY OF CAR ACCELEROMETER DATA

Accelerometer Number	Plot Location Number	Maximum Acceleration A (G)	Maximum Acceleration Time (msec)
1X	101	-26.2	40
1Y	101	-5.6	50
2X	102	-24.2	55
3X	103	-25.6	54
3Y	103	-6.2	58
4X	104	-55.6	44
4Y	104	-17.8	66
5X	105	-28.8	46
$6X_1$	106	-126.1	111
$6X_2$	NA	NA	
6Z	106	-102.4	56
7X	107	-77.5	200

TABLE C-4. SUMMARY OF TRAILER ACCELEROMETER DATA

Accelerometer Number	Plot Location Number	Maximum Acceleration A (G)	Maximum Acceleration Time (msec)
2X	202	-4.7	48

TABLE C-5. SUMMARY OF COMPARTMENT AND ENGINE ACCELEROMETER DATA

Accelerometer Number	PLOT LOCATION NUMBER	Maximum Acceleration A (G)	Maximum Acceleration Time (msec)
Average of 1X and 2X	401	-22.9	41
$6X_1$	106	-126.1	111

TABLE C-6. SUMMARY OF UNDERRIDE GUARD STRING POTENTIOMETER DATA

Displacement Potentiometer (Number)	Displacement Potentiometer (Location)	PLOT LOCATION NUMBER	Maximum Dynamic Displacement D (in.)	Maximum Dynamic Displacement Time (msec)
SP1	Left	4300	.16	41
SP2	Center	4301	-.21	66
SP3	Right	4302	-.2	45

TABLE C-7. COMPARISON OF TOTAL INTERFACE FORCE FROM LOAD CELL AND ACCELEROMETER DATA

Parameter	Trailer Force Data*	Car Acceleration Data**
Force (lb)	59433	75364
Time (msec)	51	111

*Sum of 5 load cells.

**Average of car accelerometers 1 and 2 x (vehicle minus engine weight) + engine acceleration x (engine weight of 450 lb)

TABLE C-8. SUMMARY OF UNDERRIDE GUARD AND TRAILER STRAIN GAUGE DATA

Strain Gauge (Number)	Strain Gauge Plot Location Number**	Maximum Strain* (μin./in.)	Maximum Time (msec)
SG1	4213	469.1	46
SG2	4213	875.5	43
SG3	NOT USED	-	-
SG7	NOT USED	-	-
SG8	4208	-119.7	25
SG9	NOT USED	-	-
SG10	4210	-105.0	37
SG11	4212	-150.6	73
SG12	4212	200.6	76
SG13	4234	156.4	51
SG14	4234	180.7	98
SG15	NOT USED	-	-
SG16	4216	107.6	100

*STRESS = STRAIN (in./in.) x E(30×10^6 lb/in. for steel) Tensile strain and stress are negative.

**For location of strain gauges 1-3, see Figure 3-3, for location of strain gauges 7-16, see Figure 2-2.

TABLE C-9. SUMMARY OF PRE-TEST AND POST-TEST VEHICLE STATIC MEASUREMENTS

TEST NO. 5.8 VEHICLE 1978 VW Rabbit

Location	Dimension Pre	Post	Reference	Difference
Front of Engine block at valve cover	118.3	109.5	Target 144	8.8
Front edge of A/C compressor	127.0	115.6	Target 144	11.4
Front edge of shock/ strut tower (left)	113.6	87.0	Target 144	26.6
Bottom of "A" pillar (left)	92.9	82.0	Target 144	10.9
Bottom of "A" pillar (right)	92.5	91.2	Target 144	1.3
Rear edge of dash panel (left)	86.8	74.5	Target 144	12.3
Rear edge of dash panel (right)	87.2	84.2	Target 144	3.0
Steering column hub (horizontal)	77.2	66.5	Target 144	10.7
Steering column lower rim (horizontal)	73.0	64.1	Target 144	8.9
Steering column hub (vertical)	21.9	16.5	Rocker Sill	5.4
Steering column lower rim (vertical)	13.0	10.9	Rocker Sill	2.1
Top of "A" pillar (left)	77.5	76.9	Target 144	0.6
Top of "A" pillar (right)	77.5	78.1	Target 144	-0.6
℄ of windshield opening (top)	80.5	77.5	Target 144	2.5
Knee bolster (left)	84.5	78.1	Target 144	6.4
Knee bolster (right)	84.7	83.1	Target 144	1.6
Firewall, Driver ℄	103.4	95.1	Target 144	8.3
Firewall, Passenger ℄	102.5	99.7	Target 144	2.8
Firewall, Vehicle ℄	102.5	99.4	Target 144	3.1

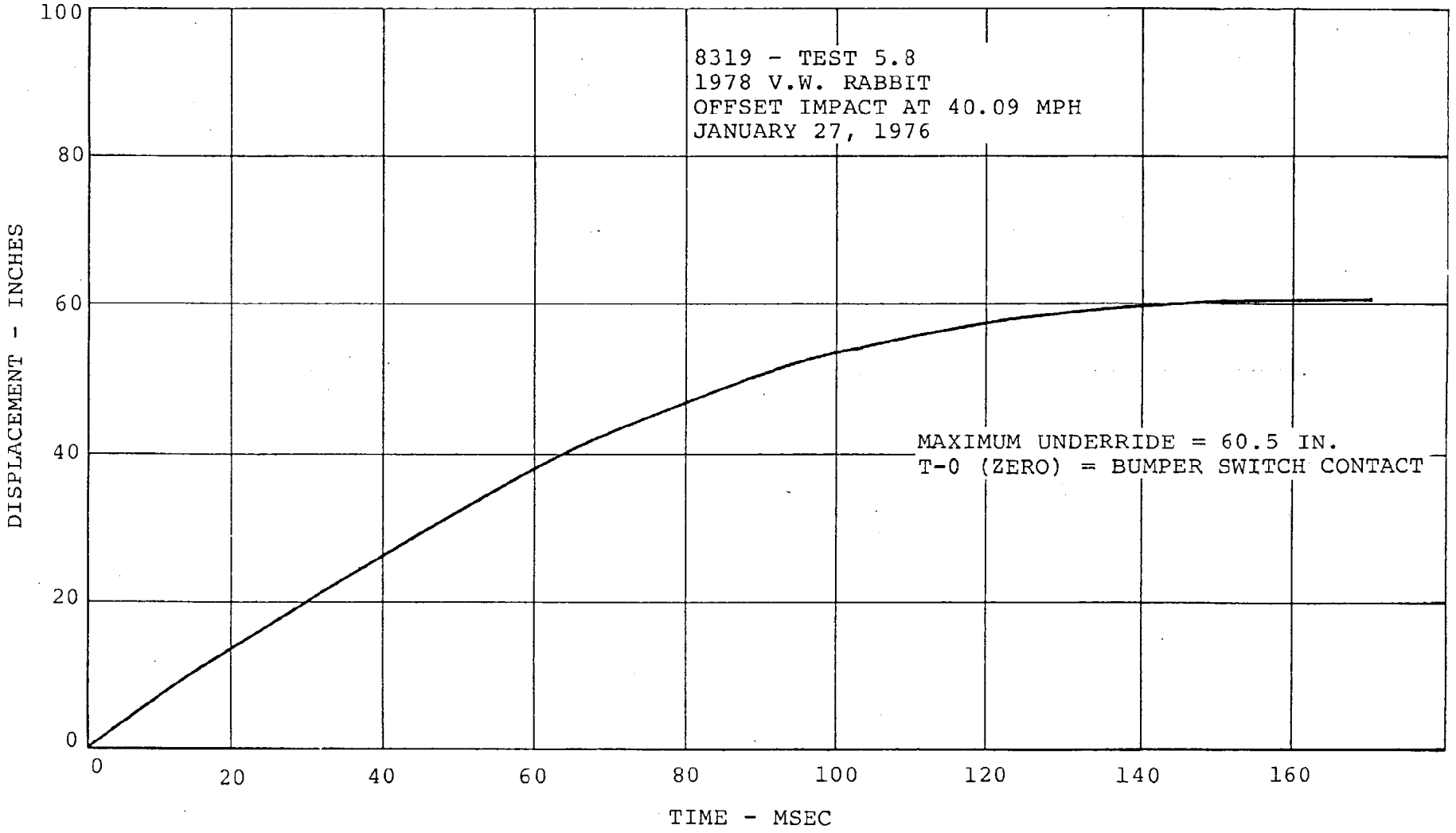


Figure C-1. Test 5.8 Vehicle Underride Versus Time - Driver Side - 1978 VW Rabbit 42-inch Right Offset Impact at 40 mph.

TABLE C-10. SUMMARY OF PRE-TEST DUMMY POSITION DATA CHARACTERISTICS

Test No. 8319-5.8 Type Underride Offset

Car Model V.W. Rabbit Dynamic Science No. 715

	Left Front Occupant	Right Front Occupant
Seat Range (in.)	6.1	6.0
Seat Position* (in.)	3.0	3.0
Front Seat to Firewall (in.)	24.6	24.0
Forehead to Windshield (in.)	26.3	23.5
Torso to Steering Wheel** (in.)	14.3	22.1
Left/Right Knee to Dash Panel (in.)	2.0/2.1	1.5/1.4

Dummy Type Alderson 572

Locations: Left Front Occupant - No. 759

Right Front Occupant - No. 760

Restraint Type: LF Passive Shoulder Belt & Knee Bolsters

RF Passive Shoulder Belt & Knee Bolsters

*From rearmost position to midpoint seat position.

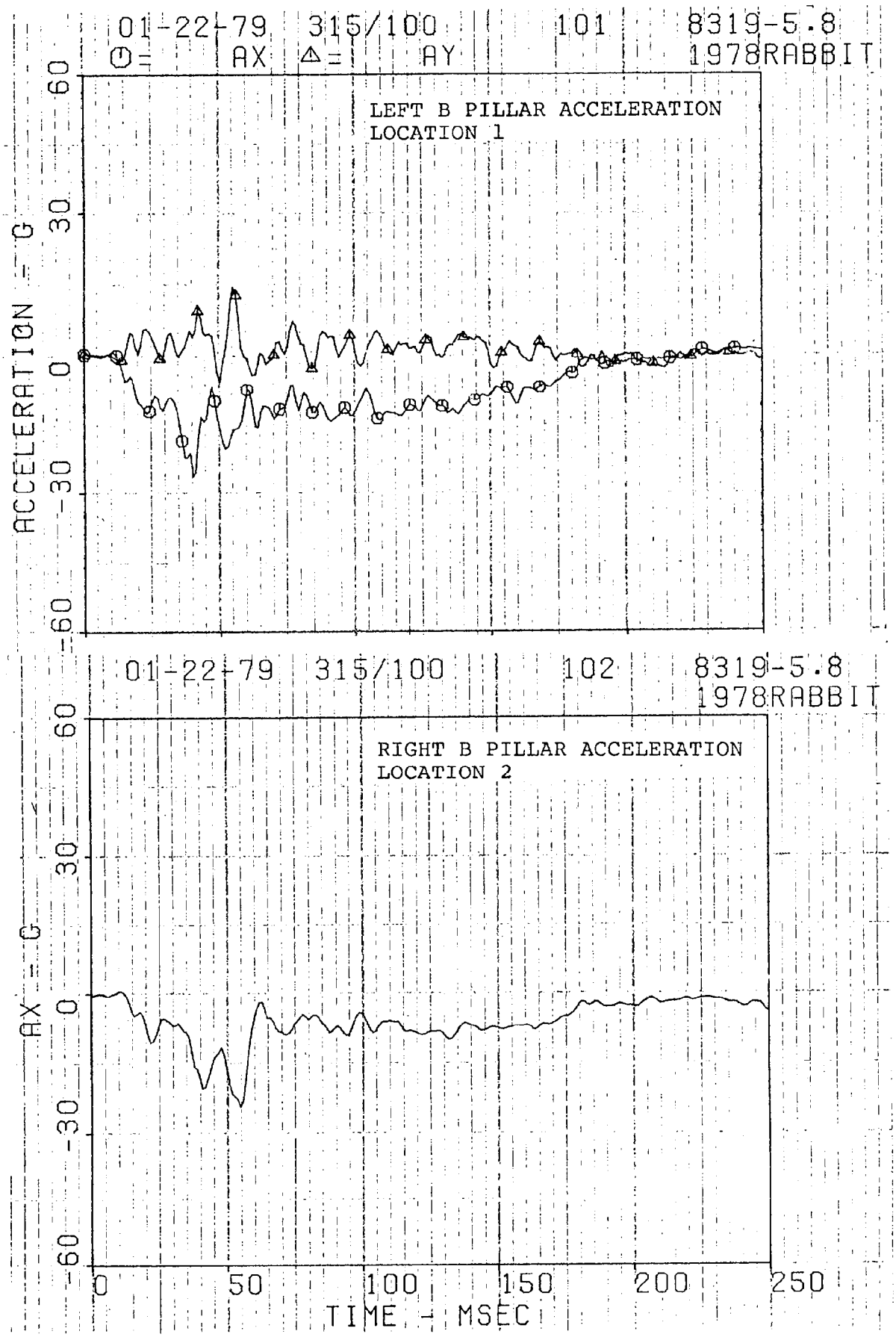
**To dash panel for right front occupant.

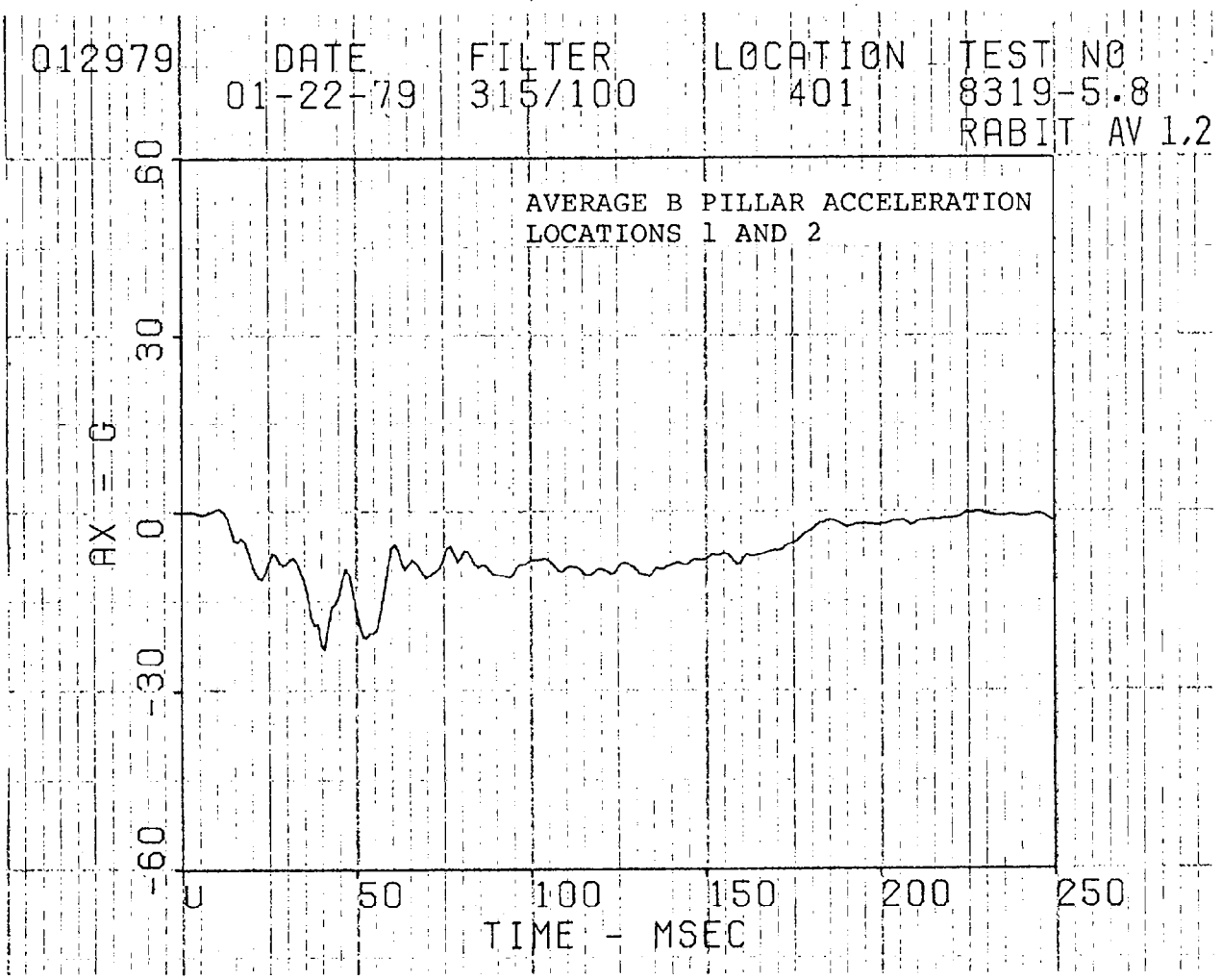
TABLE C-11. SUMMARY OF OCCUPANT RESPONSE DATA FOR TEST

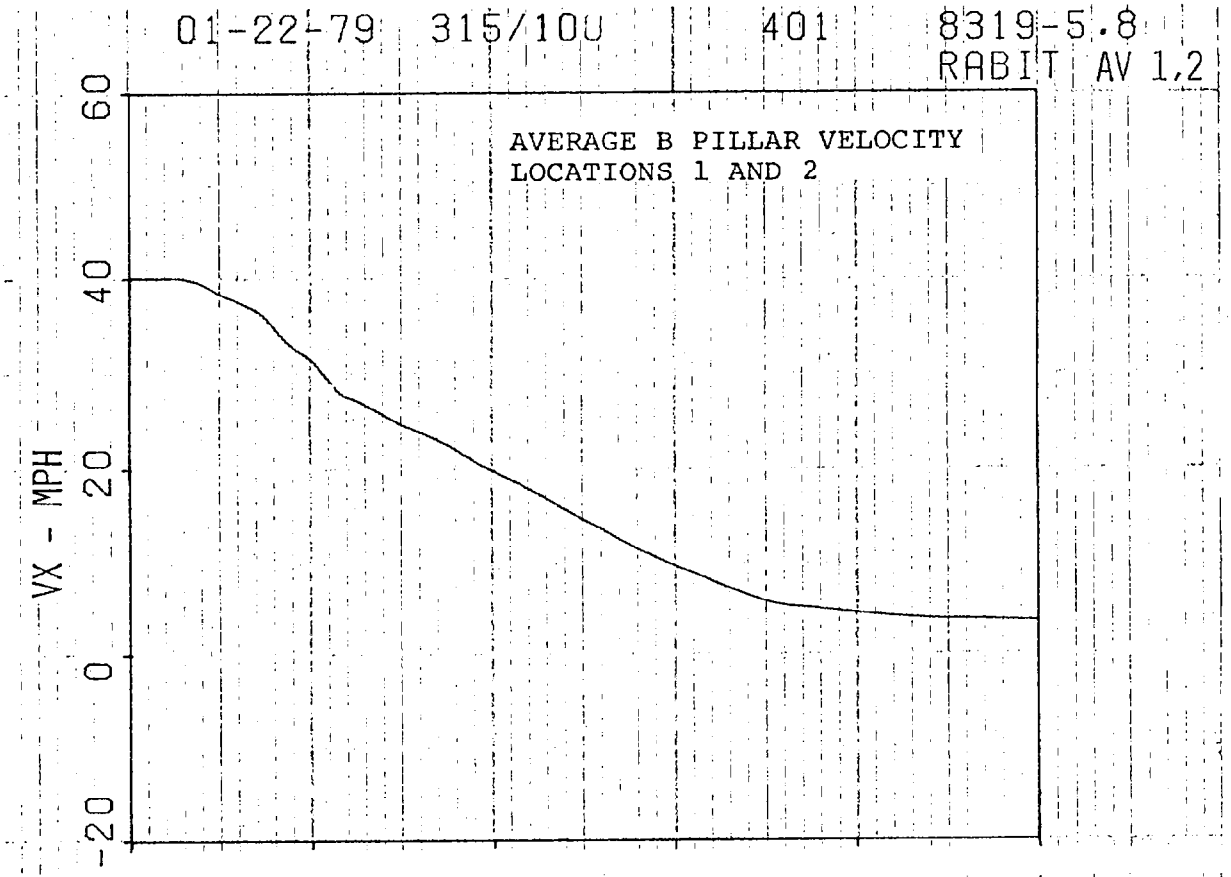
Response Parameter		Filter (Hz)	Left Front Dummy (Driver) Maximum Value A (G)	Left Front Dummy (Driver) Maximum Value T (msec)	Right Front Dummy (Passenger) Maximum Value A (G)	Right Front Dummy (Passenger) Maximum Value T (msec)
Head	X	1600	-210.4	121	-62.3	87
	Y	1600	-108.5	122	20.7	190
	Z	1600	153.3	121	44.6	152
	-R	1600	262.8	121	71.0	153
SI/Time			5748	200	751	200
HIC/Time			4424	119/129	452	85/183
Head Acceleration*	R	1600	219*		65*	
Chest	X	315	-45.0	99	-34.4	109
	Y	315	-14.3	137	54.9	106
	Z	315	28.5	129	-11.8	105
	R	315	46.9	99	56.6	106
SI/Time			350	200	197	200
Chest Acceleration*	R	315	44*		36*	
Femur Loads** (lb)	L	1000	-1549	72	-1183	60
	R	1000	-1988	65	-1089	56

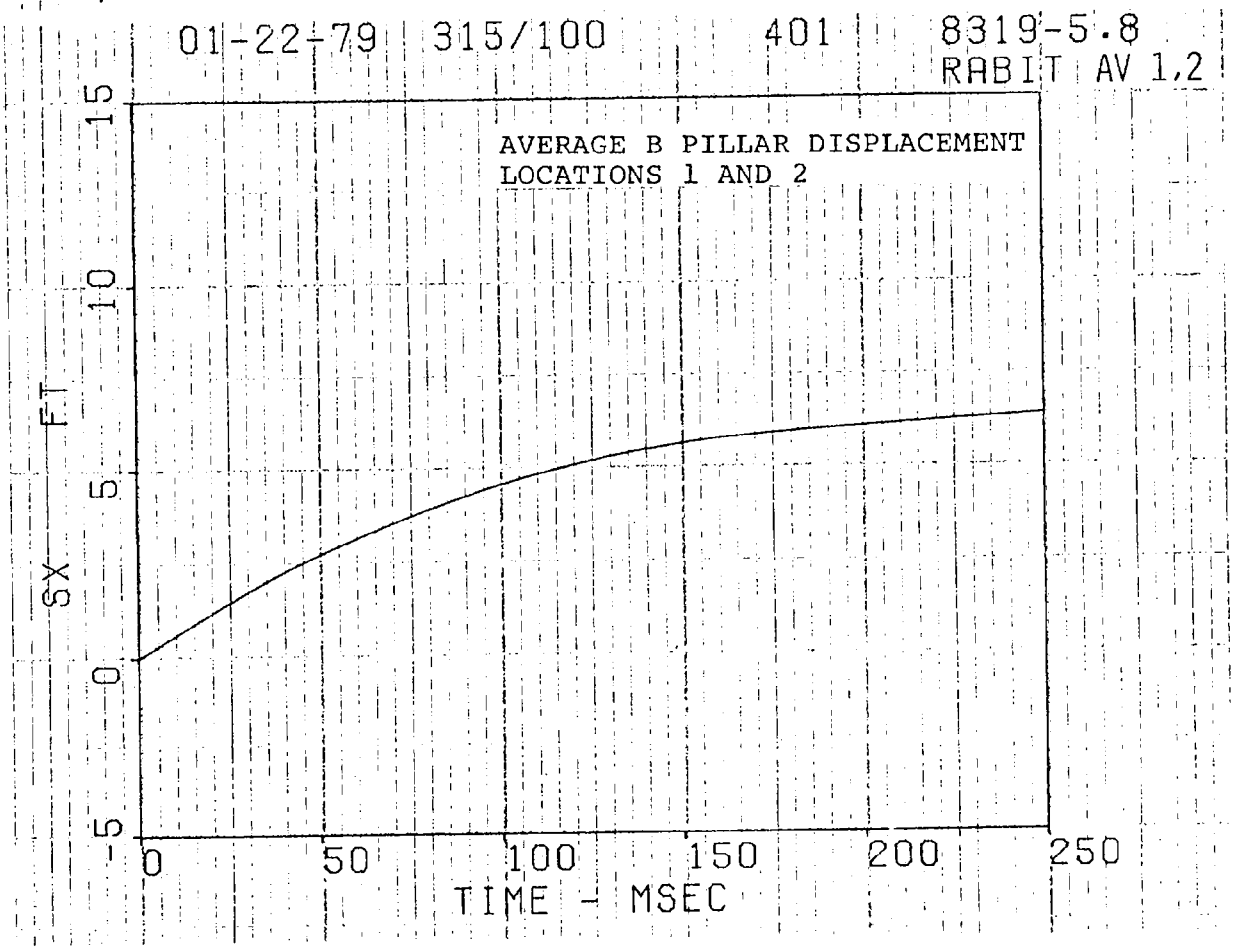
*G values defined as value for a cumulative duration of at least 3 msec.

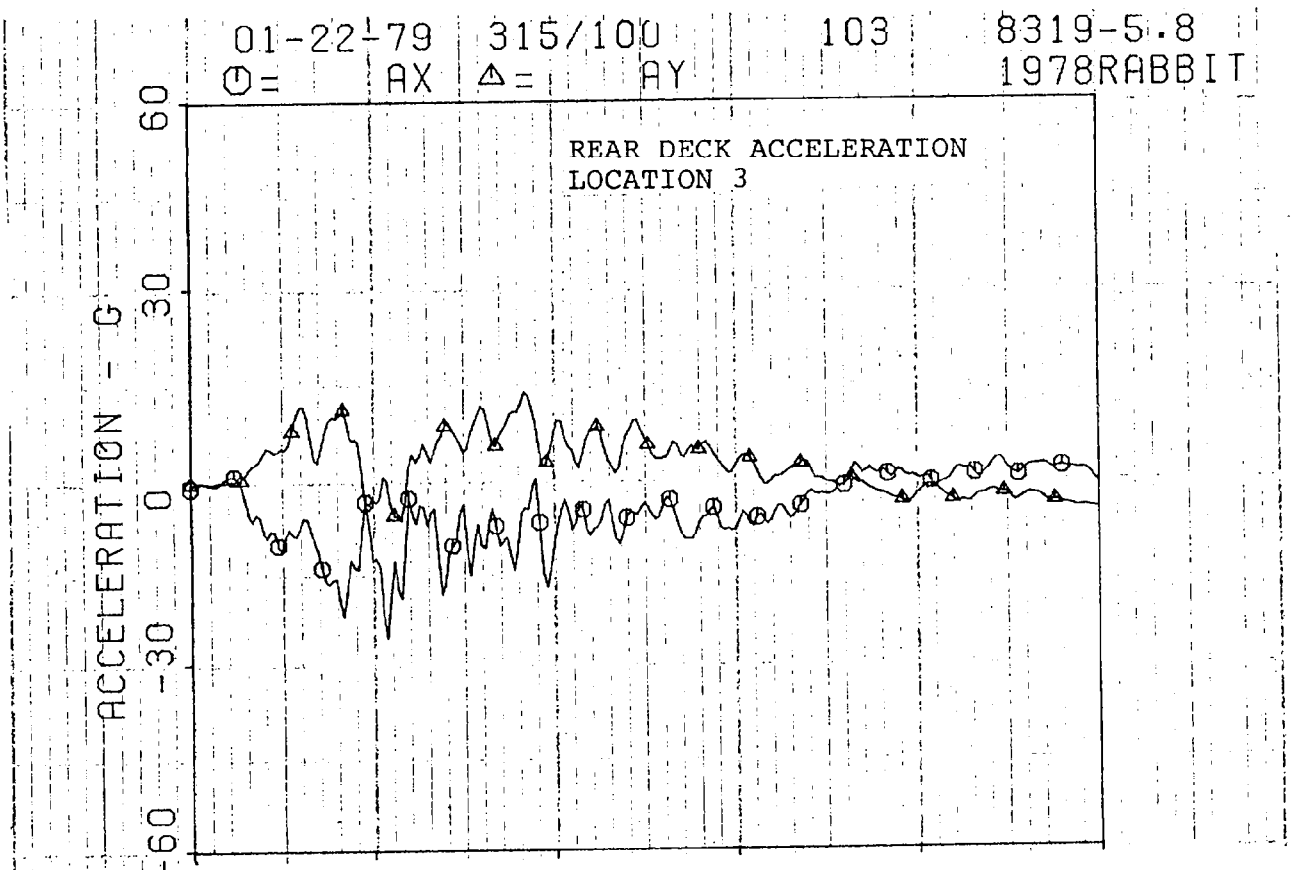
**Negative loads are compression; positive loads are tension.

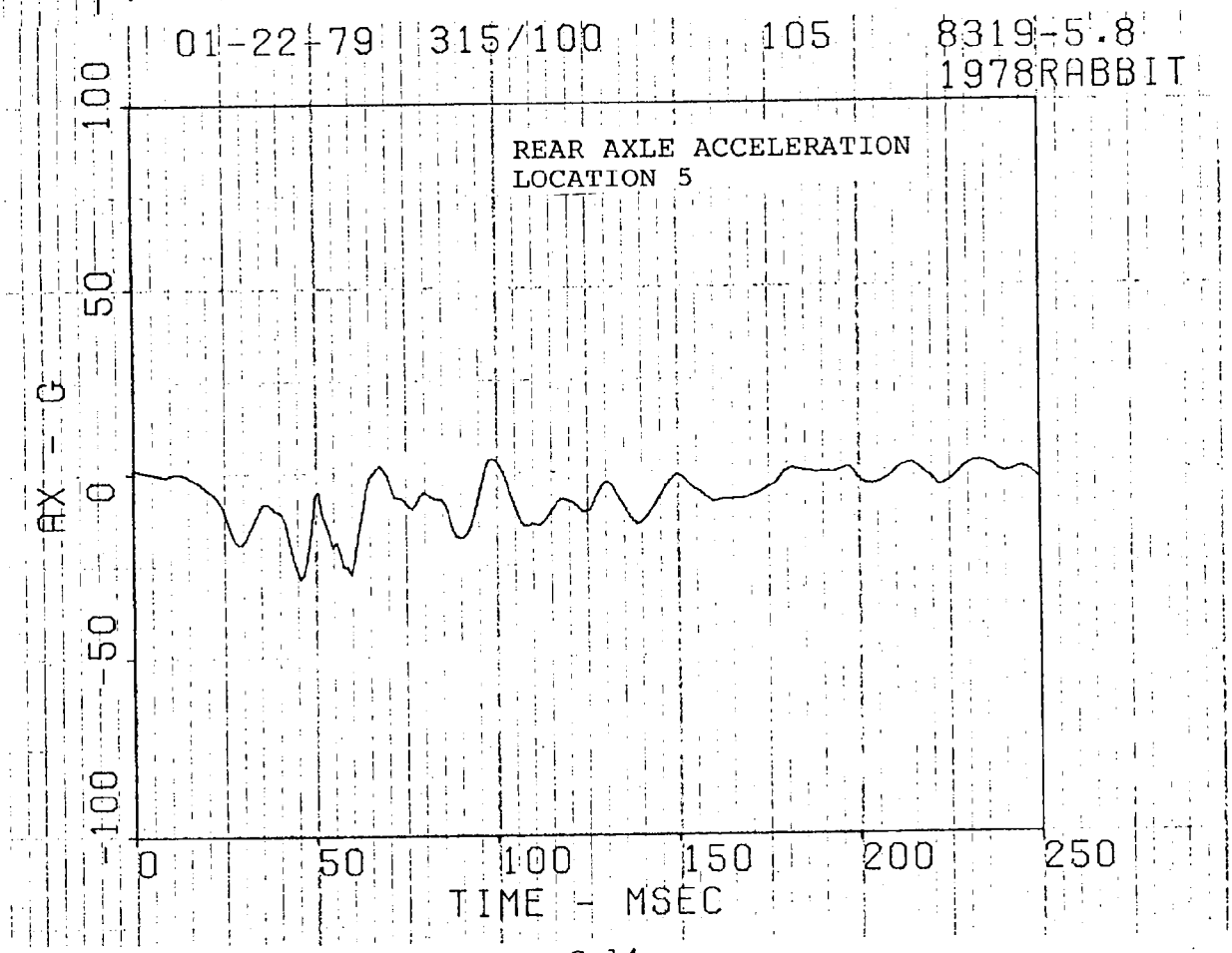

01-22-79 315/100 101 8319-5.8
O= AX Δ= AY 1978RABBIT
LEFT B PILLAR ACCELERATION
LOCATION 1
ACCELERATION = G
60
30
0
-30
-60
01-22-79 315/100 102 8319-5.8
1978RABBIT
RIGHT B PILLAR ACCELERATION
LOCATION 2
AX = G
60
30
0
-30
-60
0
50
100
150
200
250
TIME - MSEC

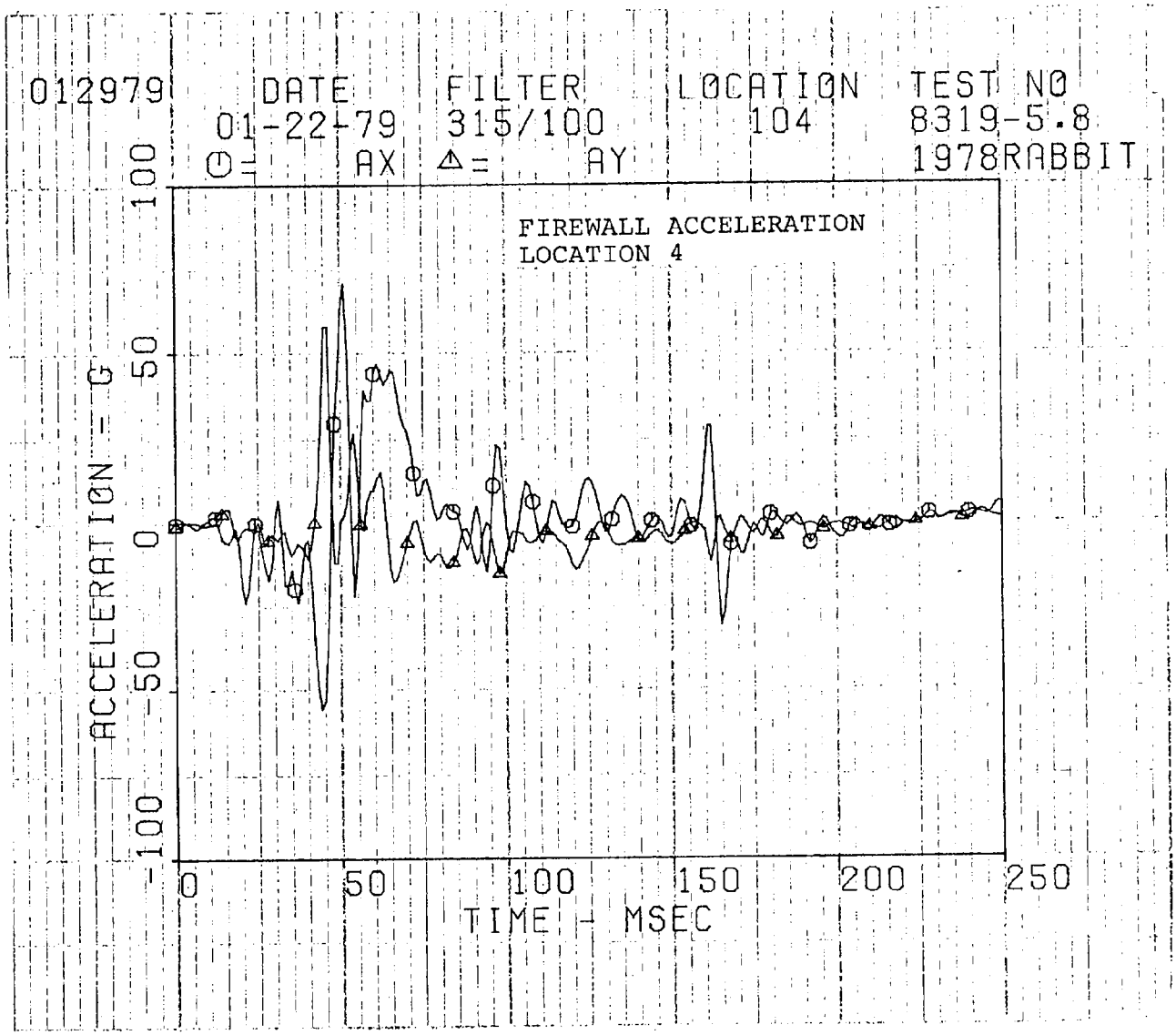

012979
DATE
01-22-79
FILTER
315/100
LOCATION
401
TEST NO
8319-5.8
RABIT AV 1,2
AVERAGE B PILLAR ACCELERATION
LOCATIONS 1 AND 2
AX = G
60
30
0
-30
-60
0
50
100
150
200
250
TIME - MSEC

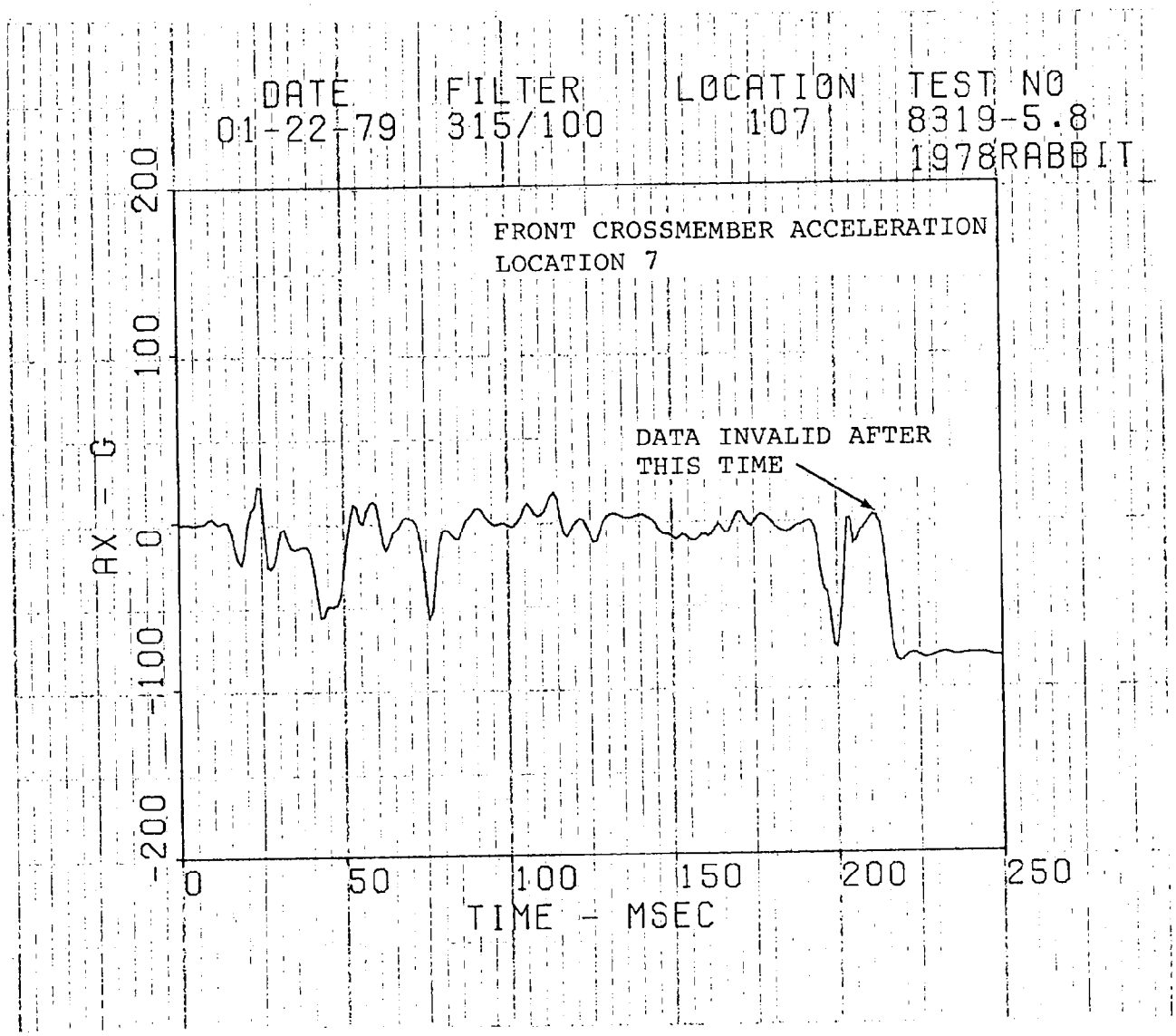

01-22-79 315/100 401 8319-5.8
RABIT AV 1,2
AVERAGE B PILLAR VELOCITY
LOCATIONS 1 AND 2
VX - MPH
60
40
20
0
-20

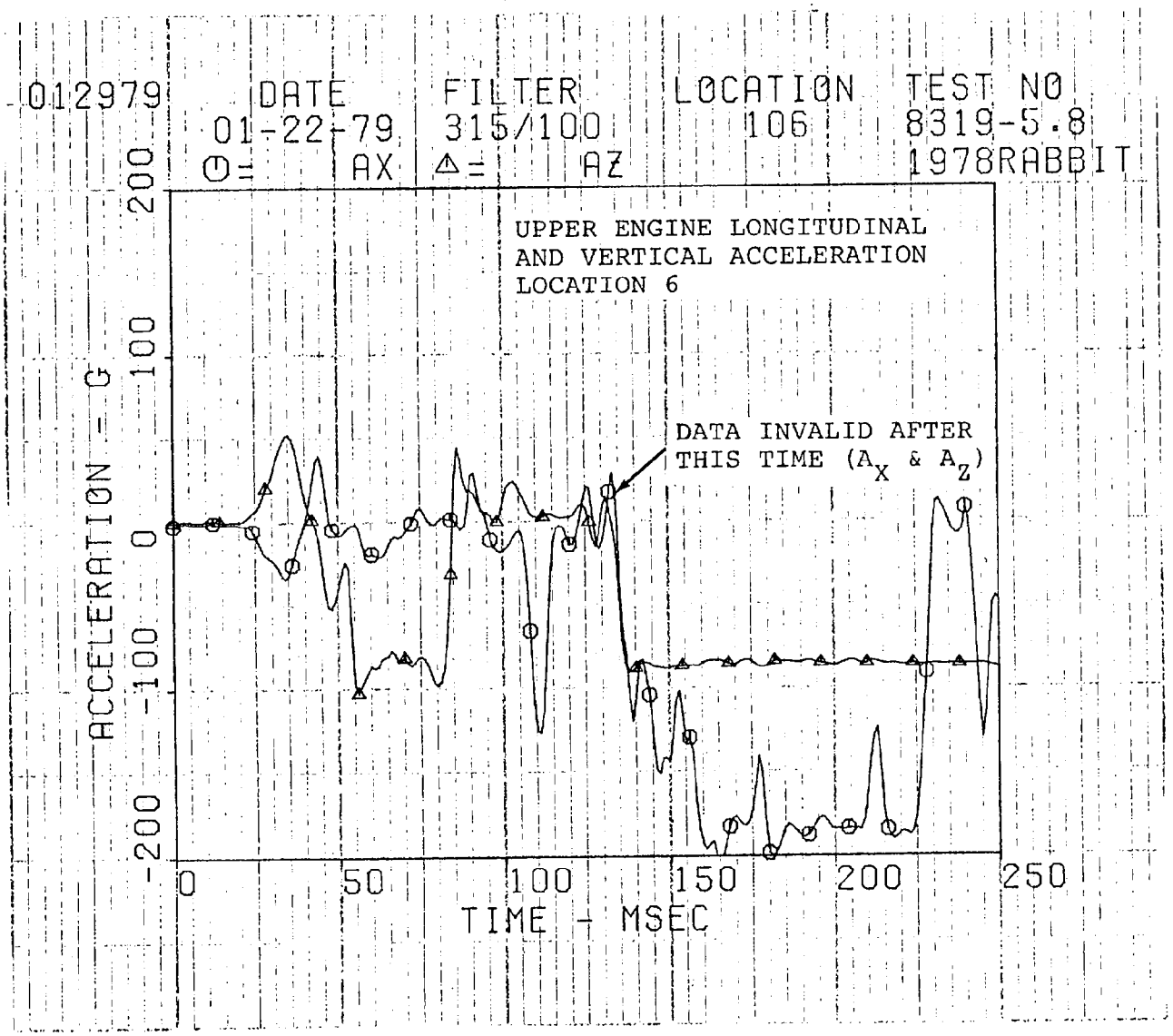

01-22-79 315/100 401 8319-5.8
RABIT AV 1,2
AVERAGE B PILLAR DISPLACEMENT
LOCATIONS 1 AND 2
SX - FT
15
10
5
0
-5
0
50
100
150
200
250
TIME - MSEC

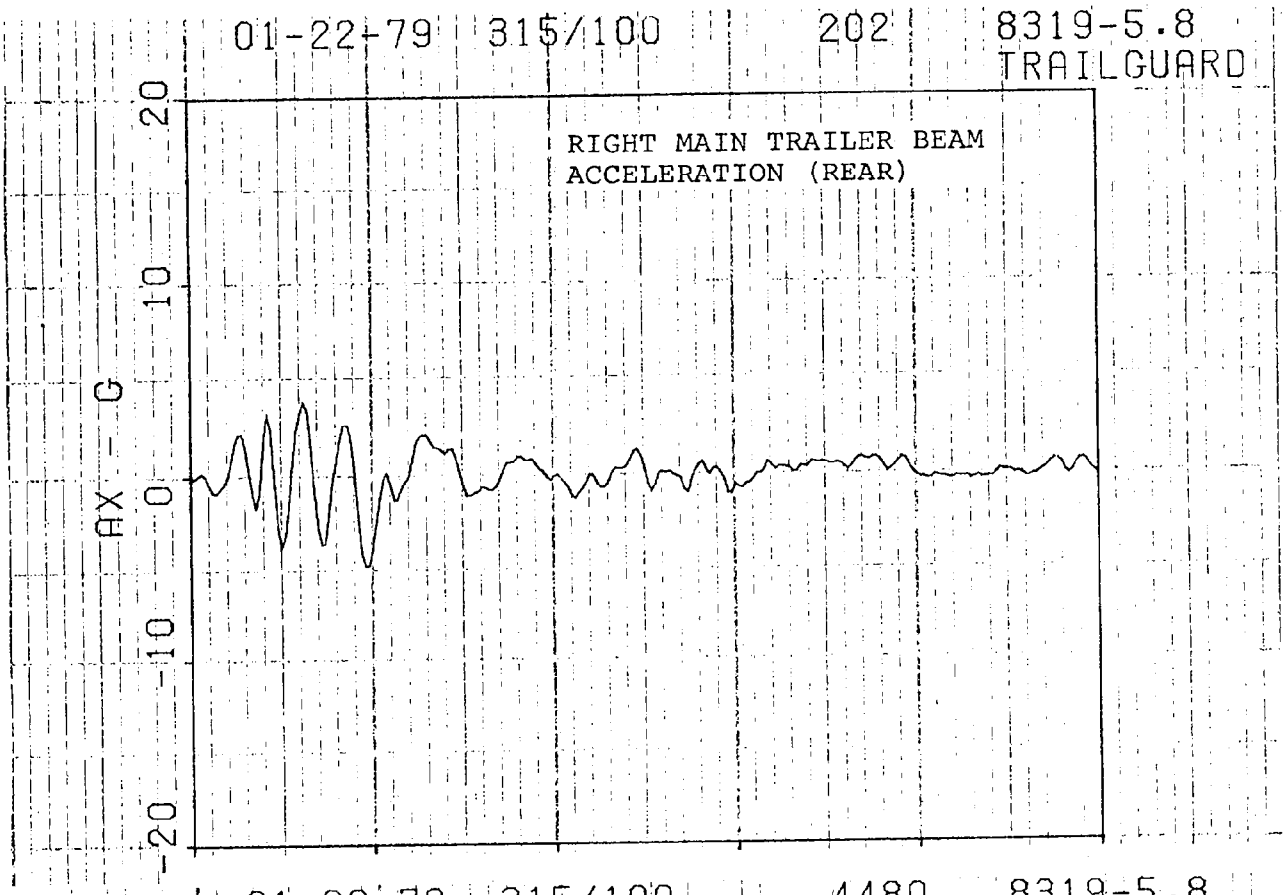

01-22-79 315/100 103 8319-5.8
⊙= AX △= AY 1978RABBIT
REAR DECK ACCELERATION
LOCATION 3
ACCELERATION - G
60
30
0
-30
-60

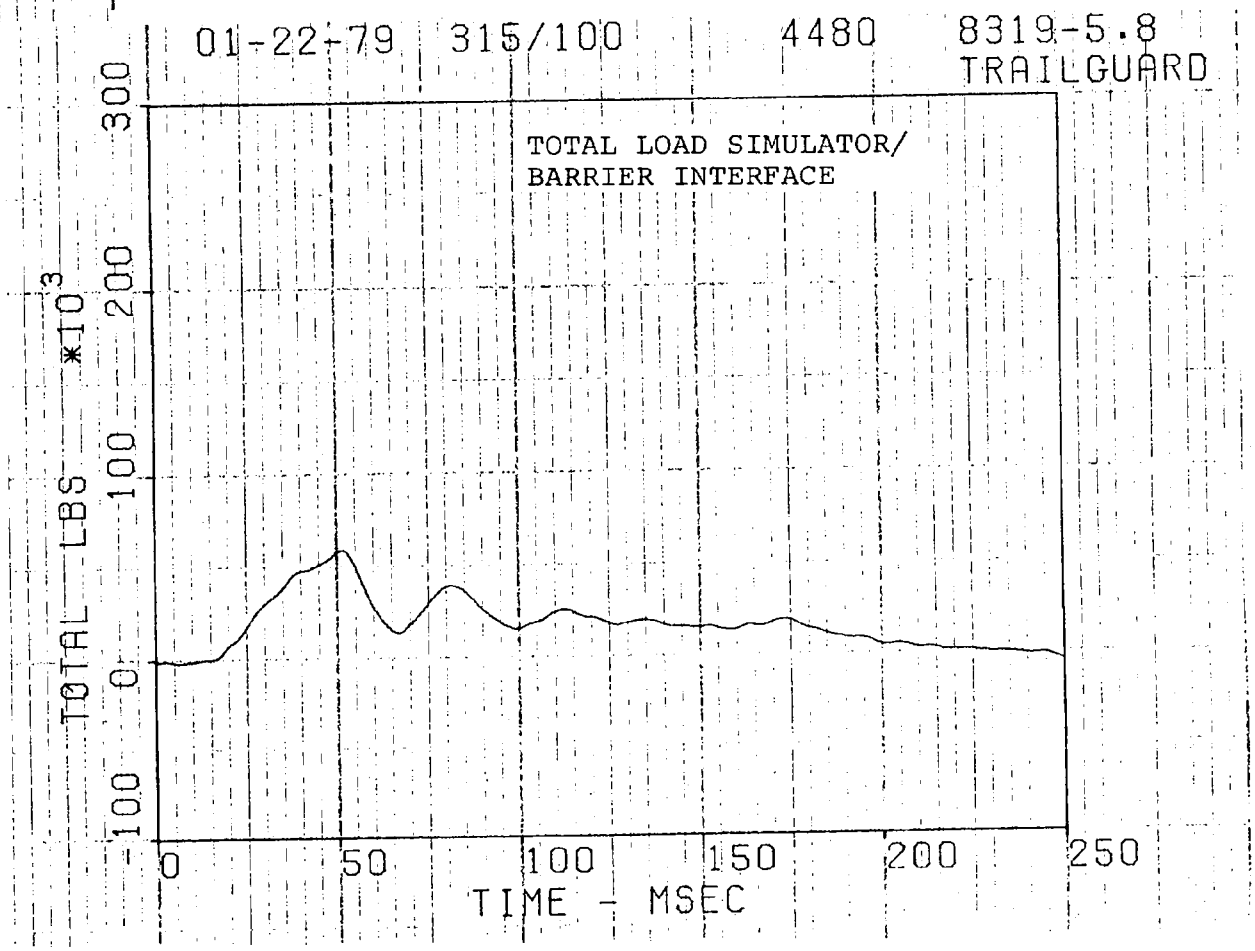

01-22-79 315/100 105 8319-5.8
1978RABBIT
REAR AXLE ACCELERATION
LOCATION 5
AX - G
100
50
0
-50
-100
0
50
100
150
200
250
TIME - MSEC

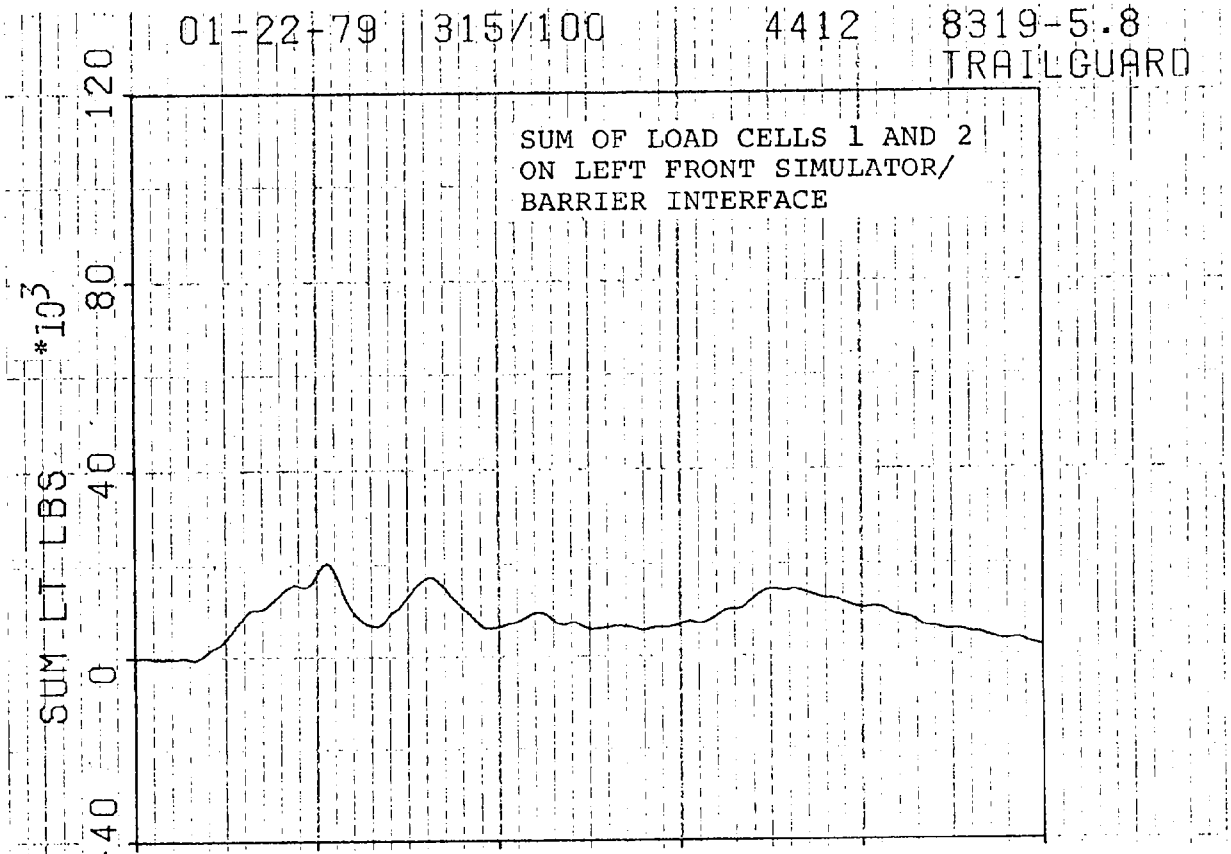

012979
DATE
01-22-79
FILTER
315/100
LOCATION
104
TEST NO
8319-5.8
1978RABBIT
AX
AY
FIREWALL ACCELERATION
LOCATION 4
ACCELERATION = G
100
50
0
-50
-100
0
50
100
150
200
250
TIME - MSEC

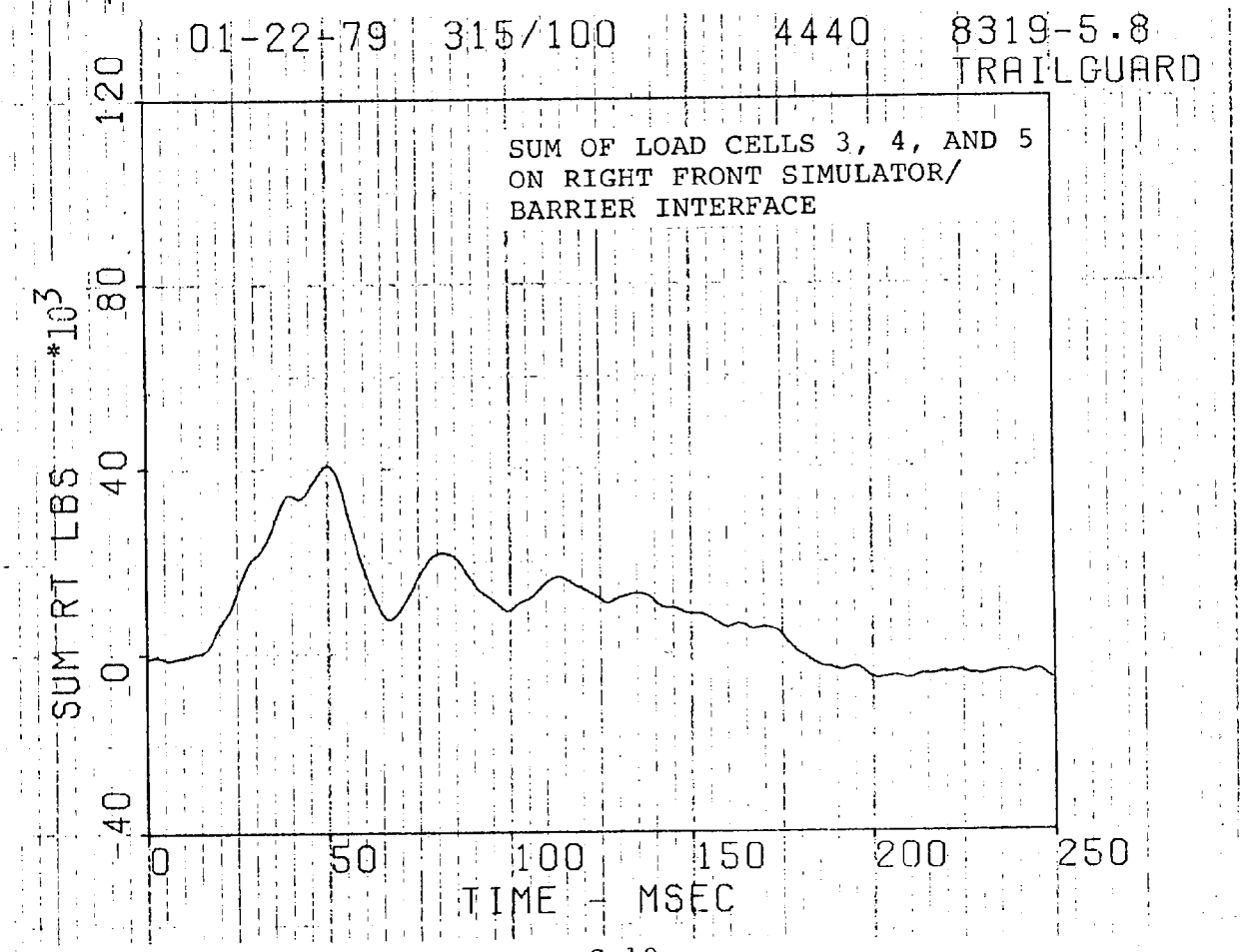

DATE
01-22-79
FILTER
315/100
LOCATION
107
TEST NO
8319-5.8
1978RABBIT
FRONT CROSSMEMBER ACCELERATION
LOCATION 7
DATA INVALID AFTER
THIS TIME
AX - G
200
100
0
-100
-200
0
50
100
150
200
250
TIME - MSEC

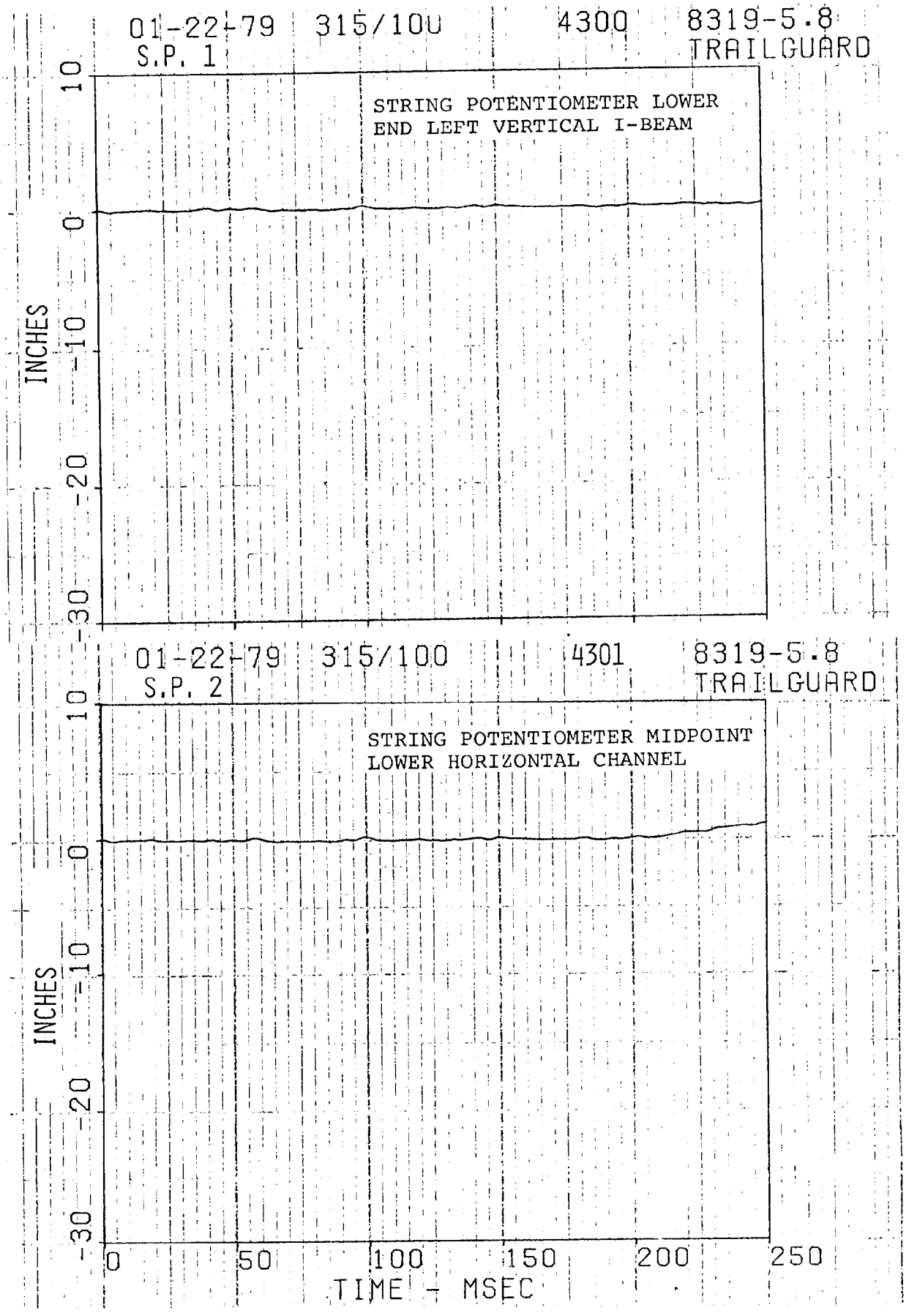

012979
DATE
01-22-79
FILTER
315/100
LOCATION
106
TEST NO
8319-5.8
1978RABBIT
○= AX
△= AZ
UPPER ENGINE LONGITUDINAL
AND VERTICAL ACCELERATION
LOCATION 6
DATA INVALID AFTER
THIS TIME (A_X & A_Z)
ACCELERATION = G
200
100
0
-100
-200
0
50
100
150
200
250
TIME - MSEC

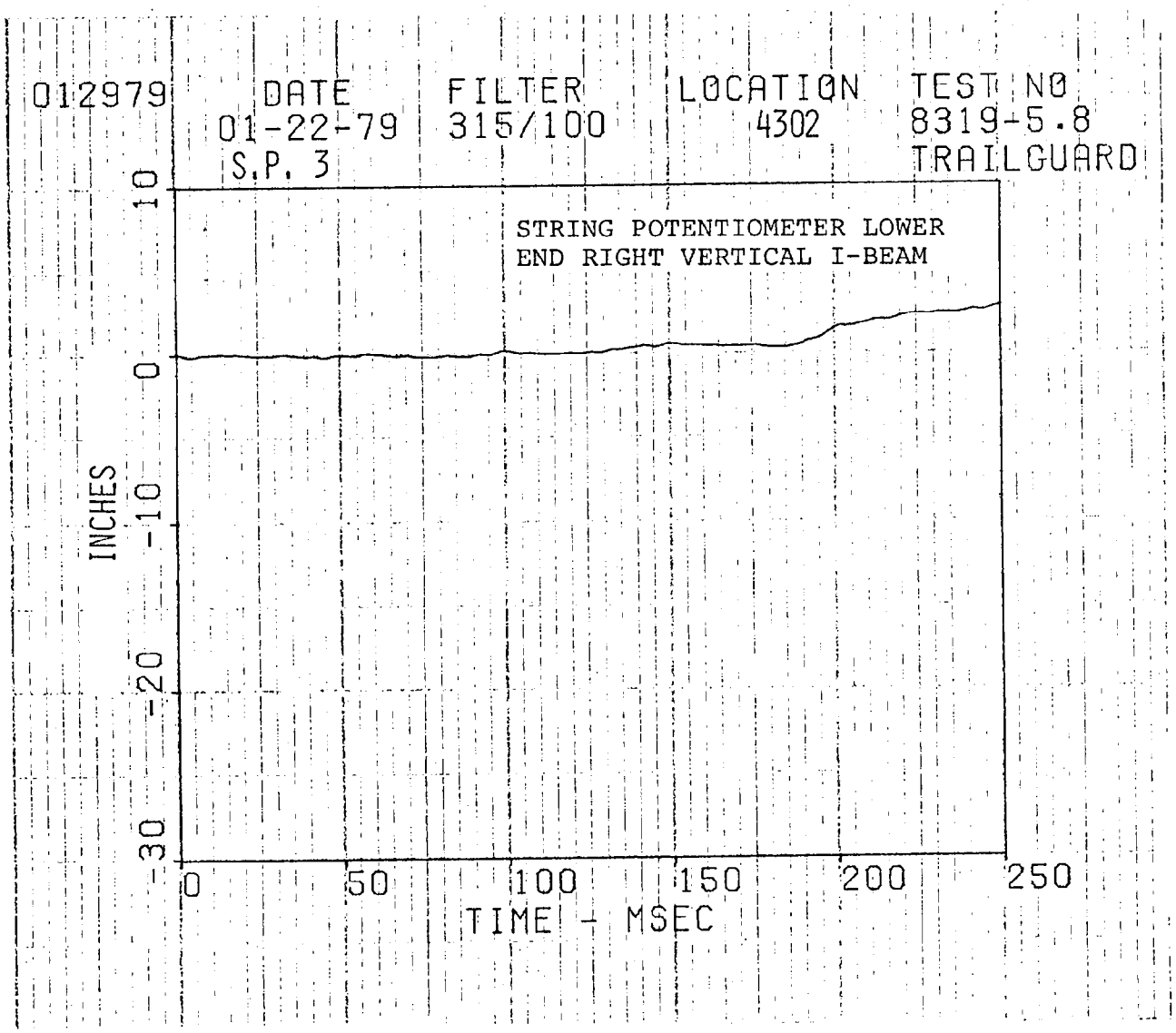

01-22-79 315/100 202 8319-5.8
TRAILGUARD
RIGHT MAIN TRAILER BEAM
ACCELERATION (REAR)
AX - G
20
10
0
-10
-20

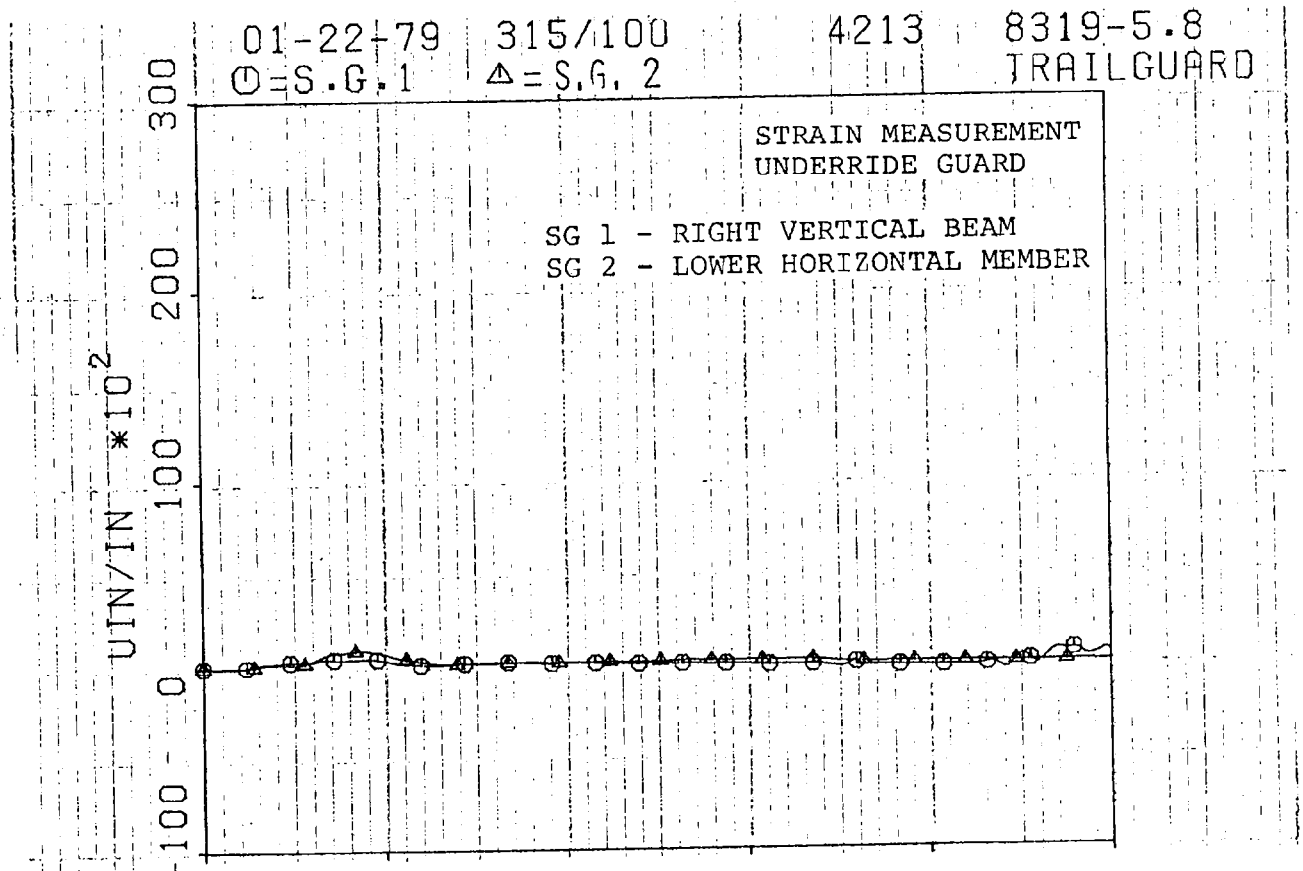

01-22-79 315/100 4480 8319-5.8
TRAILGUARD
TOTAL LOAD SIMULATOR/
BARRIER INTERFACE
TOTAL LBS *10^3
300
200
100
0
-100
0
50
100
150
200
250
TIME - MSEC

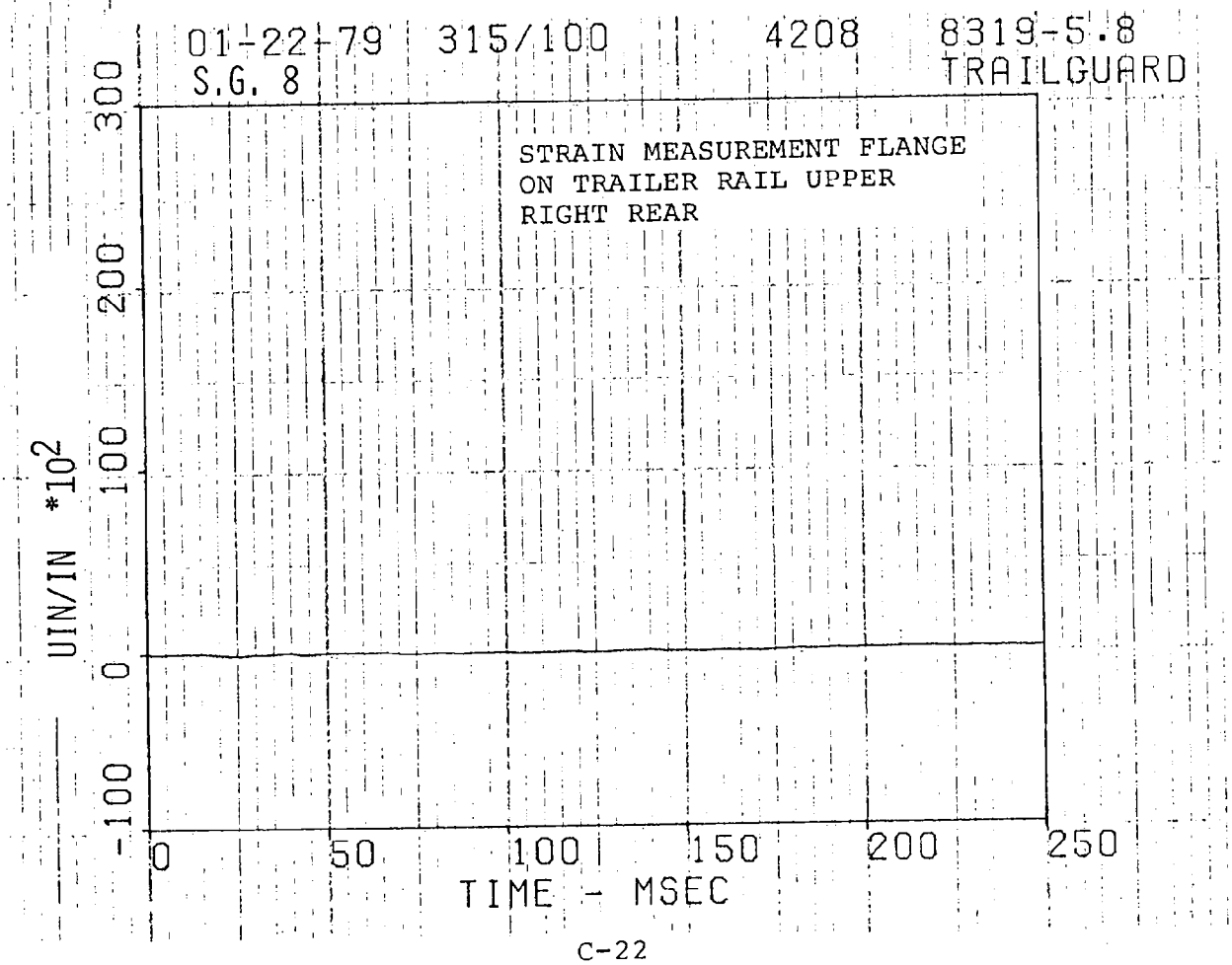

01-22-79 315/100 4412 8319-5.8
TRAILGUARD
SUM OF LOAD CELLS 1 AND 2
ON LEFT FRONT SIMULATOR/
BARRIER INTERFACE
SUM LT LBS *10^3
120
80
40
0
-40

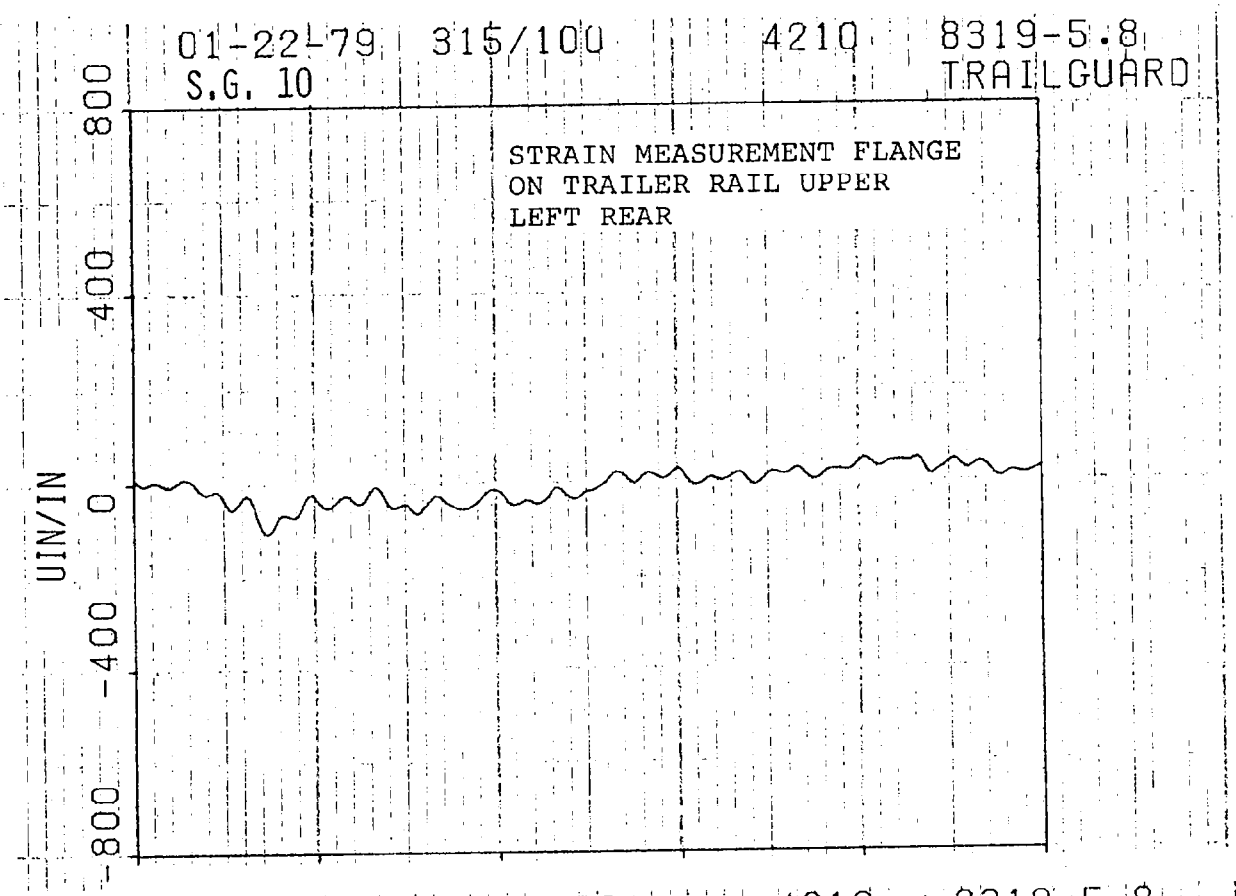

01-22-79 315/100 4440 8319-5.8
TRAILGUARD
SUM OF LOAD CELLS 3, 4, AND 5
ON RIGHT FRONT SIMULATOR/
BARRIER INTERFACE
SUM RT LBS *10^3
120
80
40
0
-40
0
50
100
150
200
250
TIME - MSEC

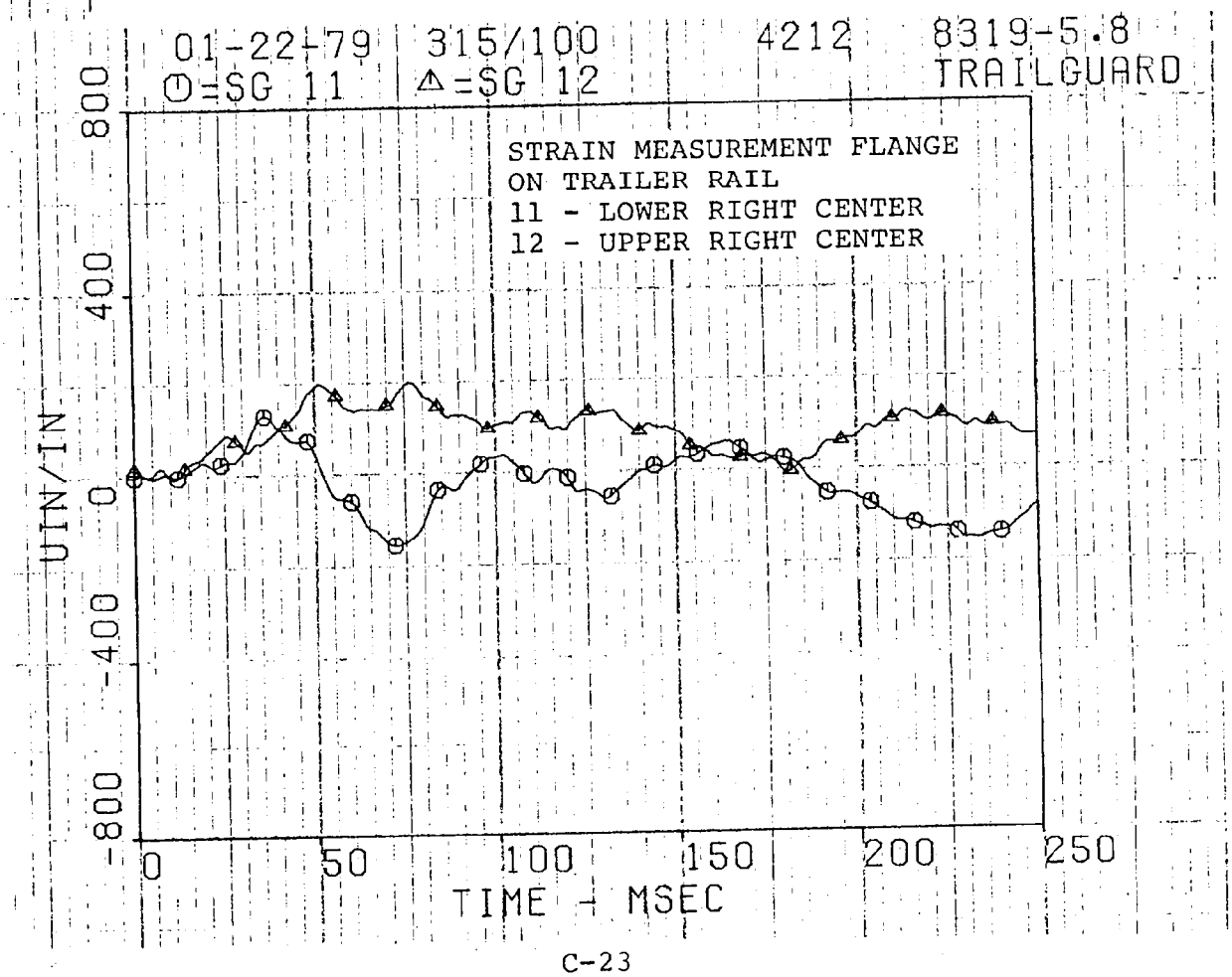

01-22-79 315/100 4300 8319-5.8
S.P. 1
TRAILGUARD
STRING POTENTIOMETER LOWER
END LEFT VERTICAL I-BEAM
INCHES
10
0
-10
-20
-30
01-22-79 315/100 4301 8319-5.8
S.P. 2
TRAILGUARD
STRING POTENTIOMETER MIDPOINT
LOWER HORIZONTAL CHANNEL
INCHES
10
0
-10
-20
-30
0
50
100
150
200
250
TIME - MSEC

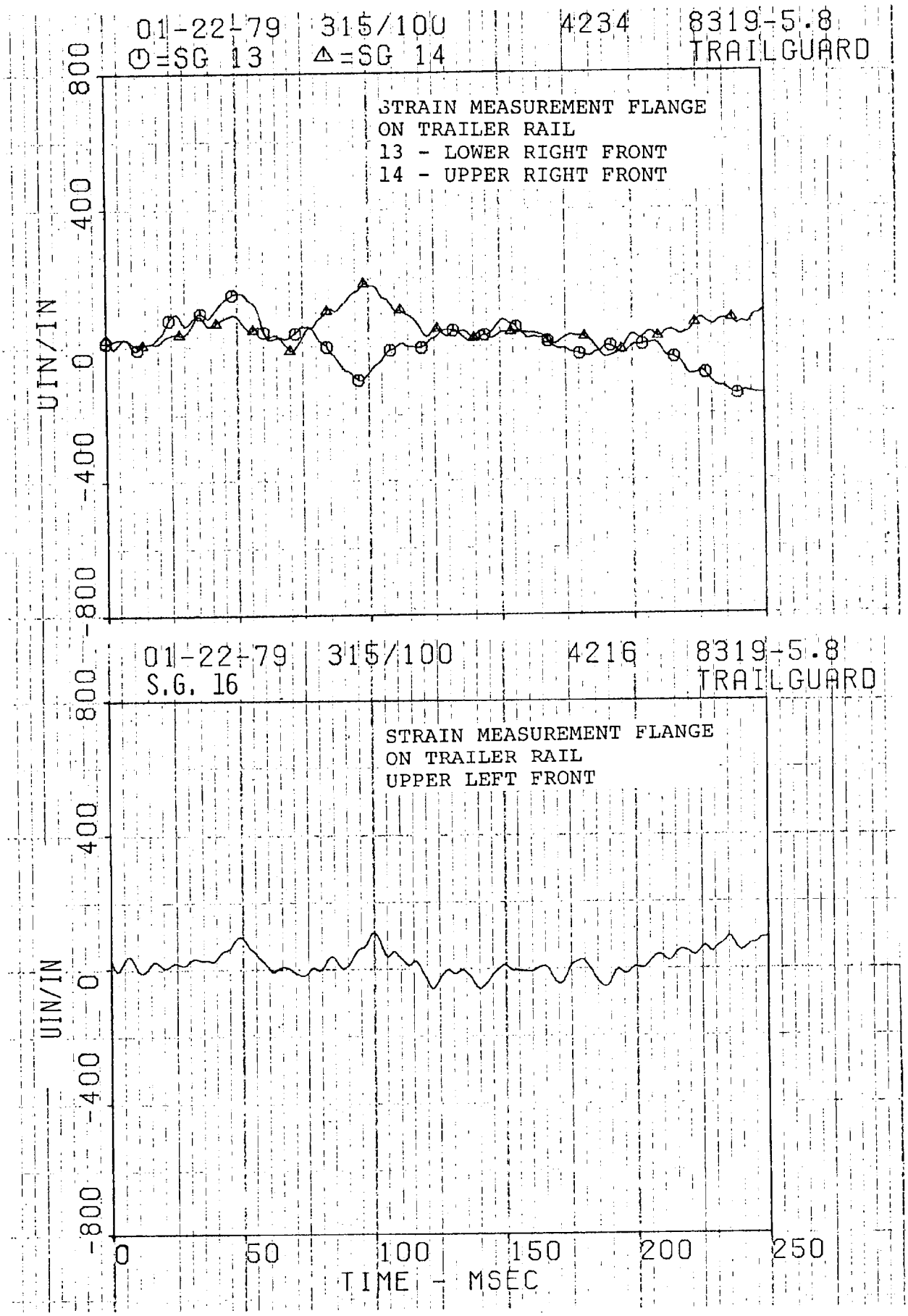

012979
DATE
01-22-79
S.P. 3
FILTER
315/100
LOCATION
4302
TEST NO
8319-5.8
TRAILGUARD
STRING POTENTIOMETER LOWER
END RIGHT VERTICAL I-BEAM
INCHES
10
0
-10
-20
-30
0
50
100
150
200
250
TIME - MSEC

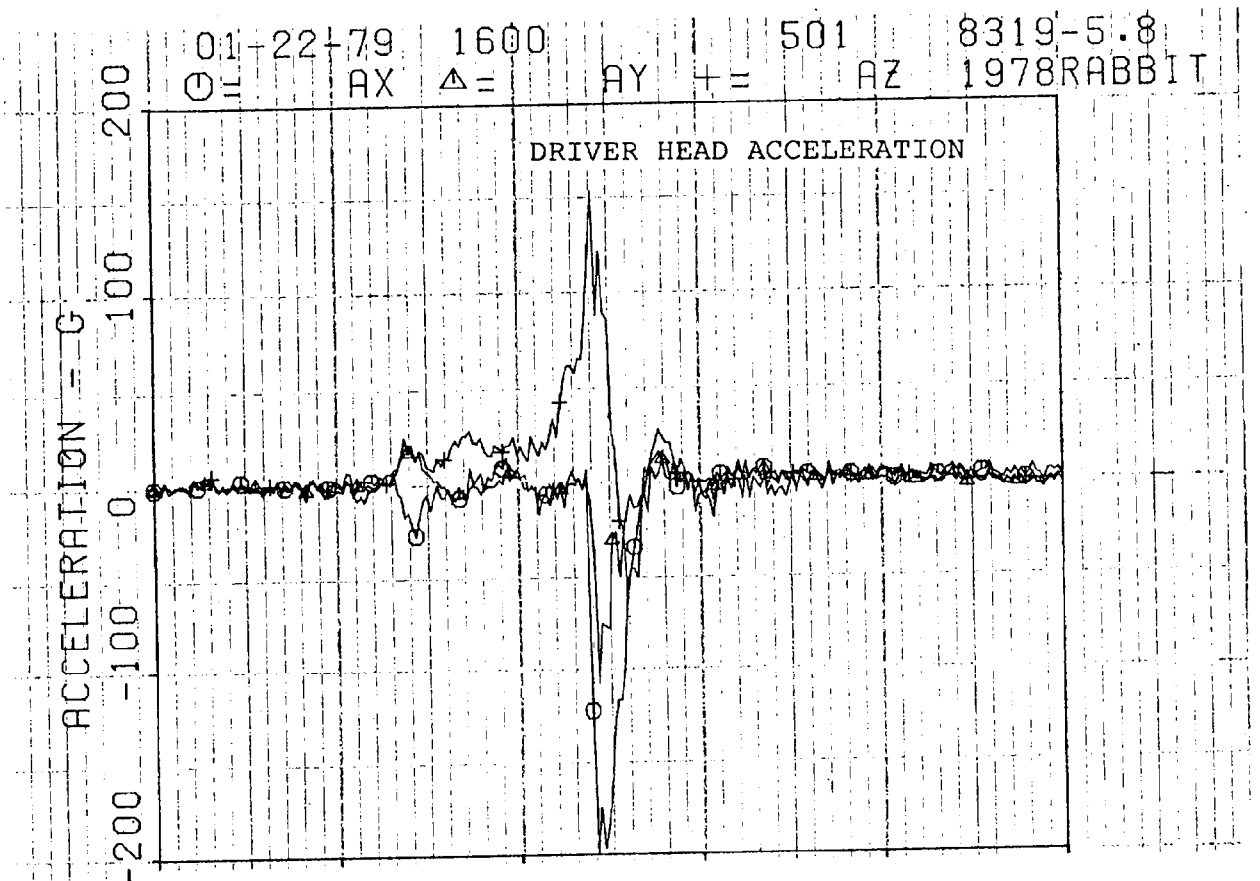

01-22-79 315/100 4213 8319-5.8
⊙=S.G.1 △=S.G. 2 TRAILGUARD
STRAIN MEASUREMENT
UNDERRIDE GUARD
SG 1 - RIGHT VERTICAL BEAM
SG 2 - LOWER HORIZONTAL MEMBER
UIN/IN *10²
300
200
100
0
-100

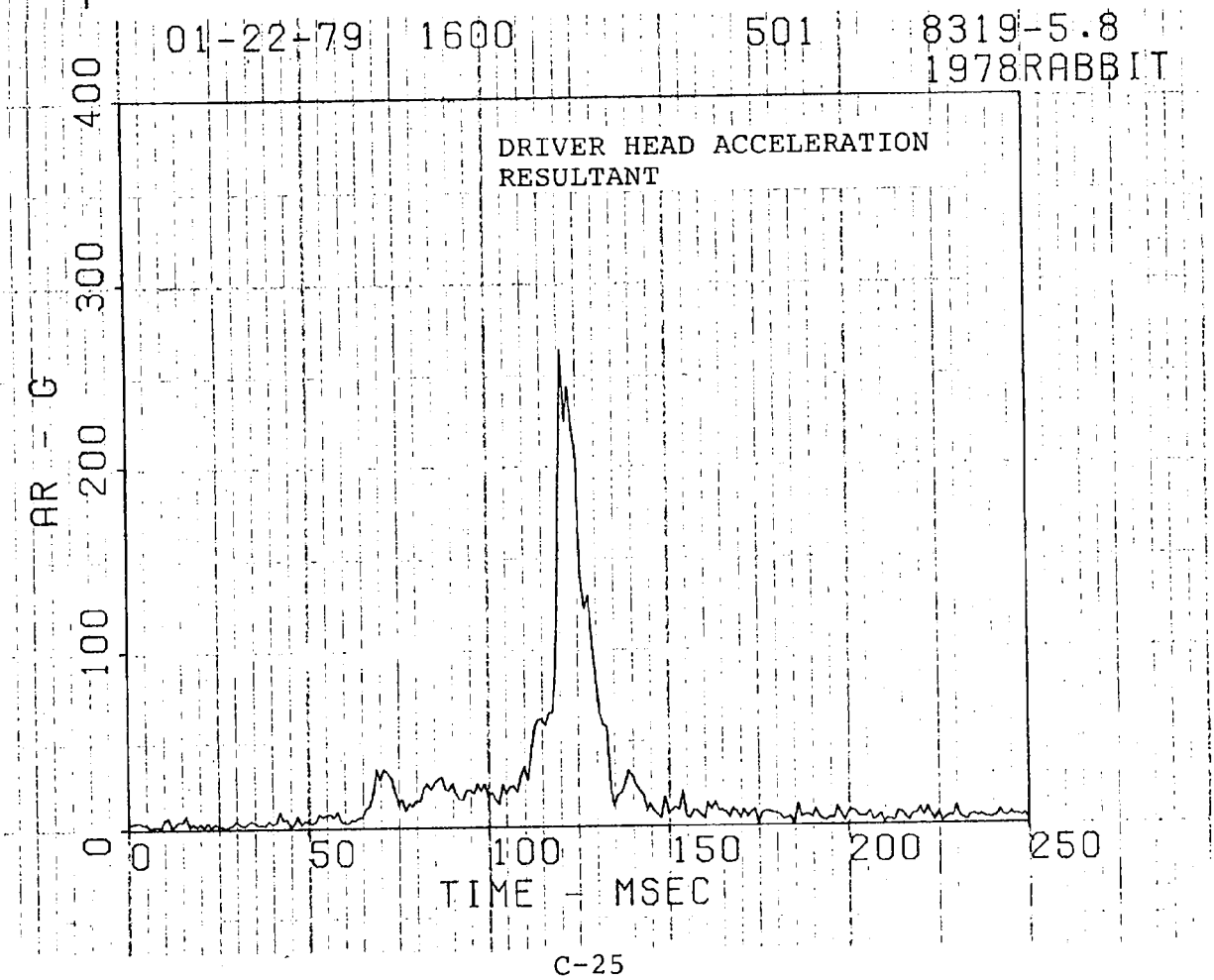

01-22-79 315/100 4208 8319-5.8
S.G. 8 TRAILGUARD
STRAIN MEASUREMENT FLANGE
ON TRAILER RAIL UPPER
RIGHT REAR
UIN/IN *10²
300
200
100
0
-100
0
50
100
150
200
250
TIME - MSEC

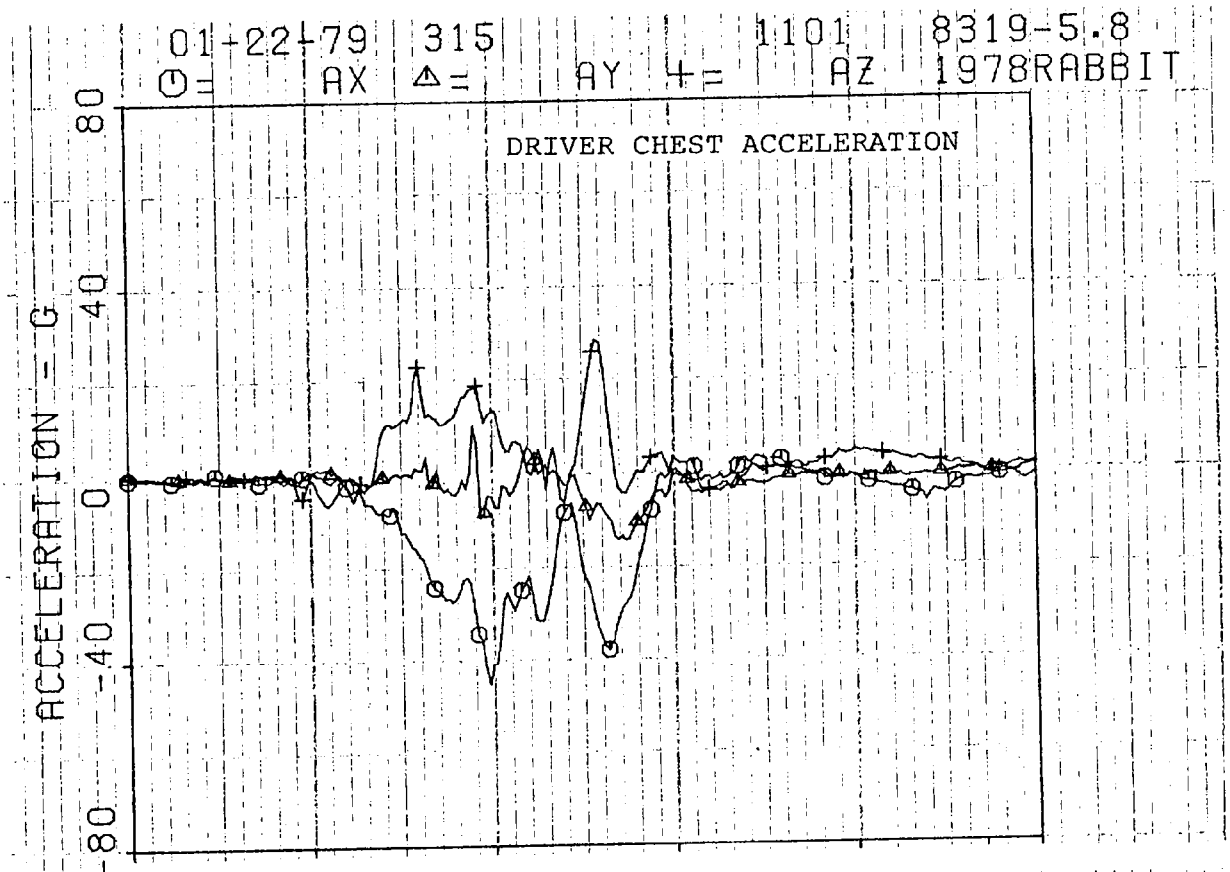

01-22-79 315/100 4210 8319-5.8
S.G. 10
TRAILGUARD
STRAIN MEASUREMENT FLANGE
ON TRAILER RAIL UPPER
LEFT REAR
UIN/IN
800
400
0
-400
-800

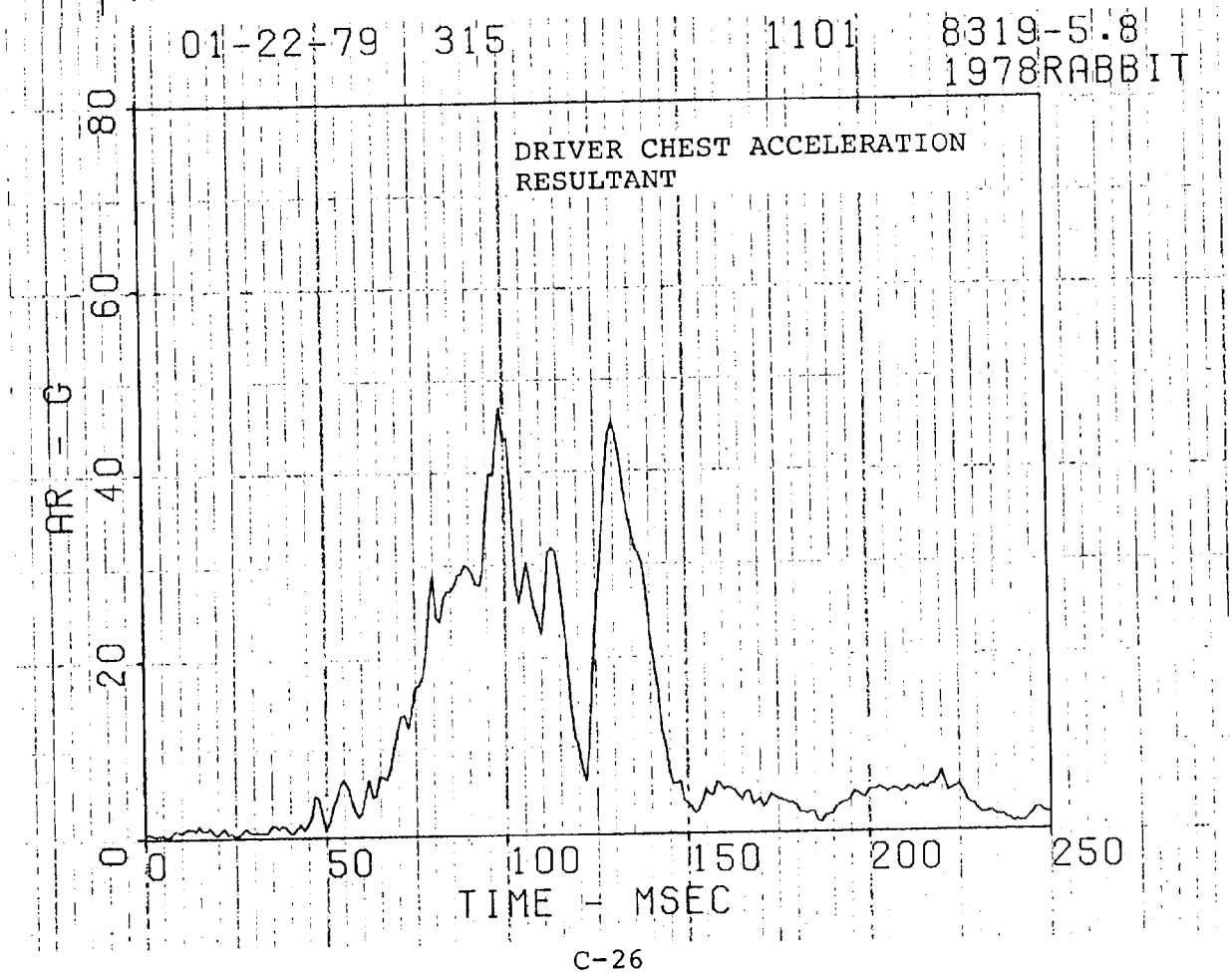

01-22-79 315/100 4212 8319-5.8
⊖=SG 11 △=SG 12
TRAILGUARD
STRAIN MEASUREMENT FLANGE
ON TRAILER RAIL
11 - LOWER RIGHT CENTER
12 - UPPER RIGHT CENTER
UIN/IN
800
400
0
-400
-800
0
50
100
150
200
250
TIME - MSEC

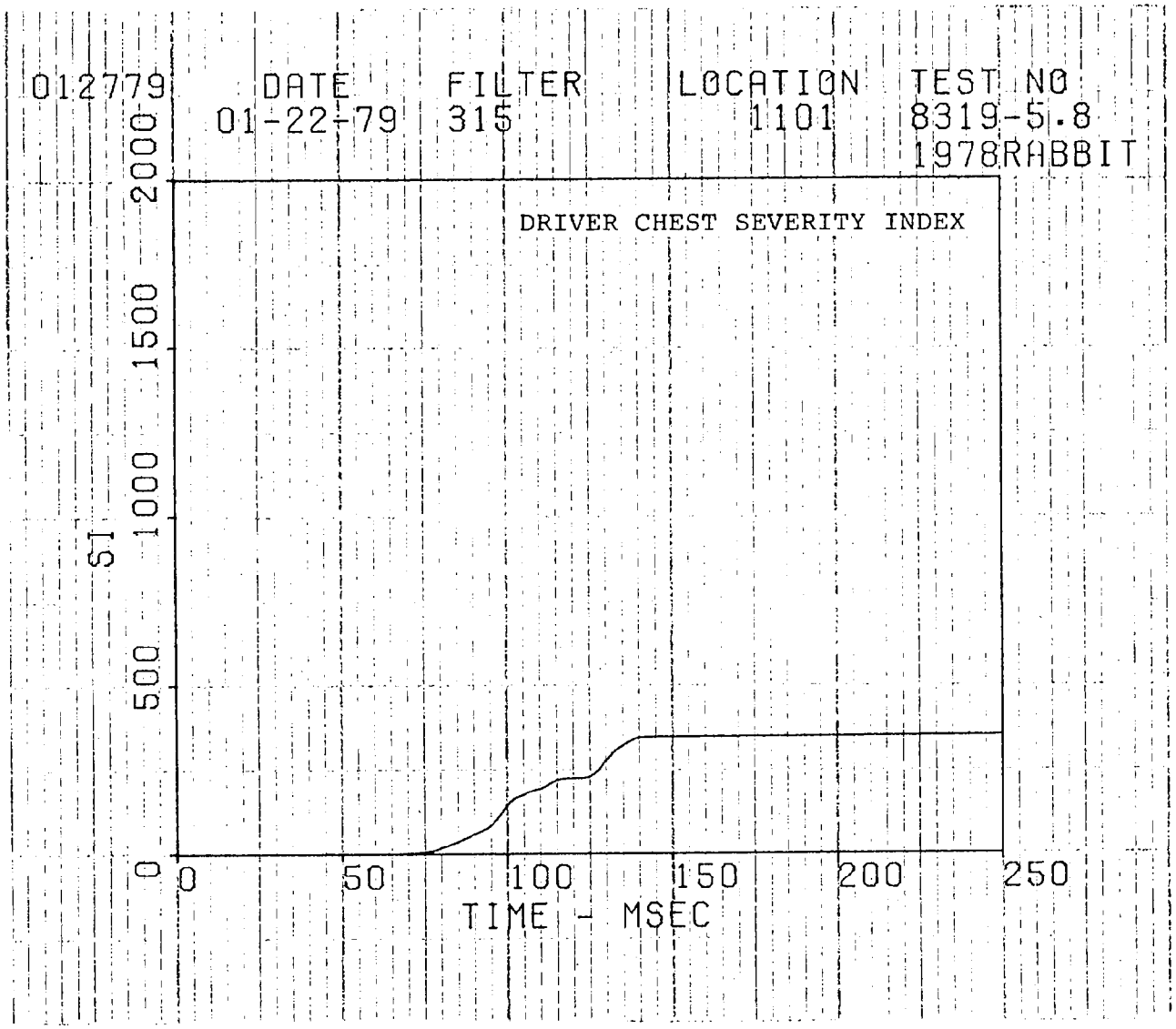

01-22-79 315/100 4234 8319-5.8
⏱=SG 13 △=SG 14 TRAILGUARD
STRAIN MEASUREMENT FLANGE
ON TRAILER RAIL
13 - LOWER RIGHT FRONT
14 - UPPER RIGHT FRONT
UIN/IN
800
400
0
-400
-800
01-22-79 315/100 4216 8319-5.8
S.G. 16 TRAILGUARD
STRAIN MEASUREMENT FLANGE
ON TRAILER RAIL
UPPER LEFT FRONT
UIN/IN
800
400
0
-400
-800
0
50
100
150
200
250
TIME - MSEC

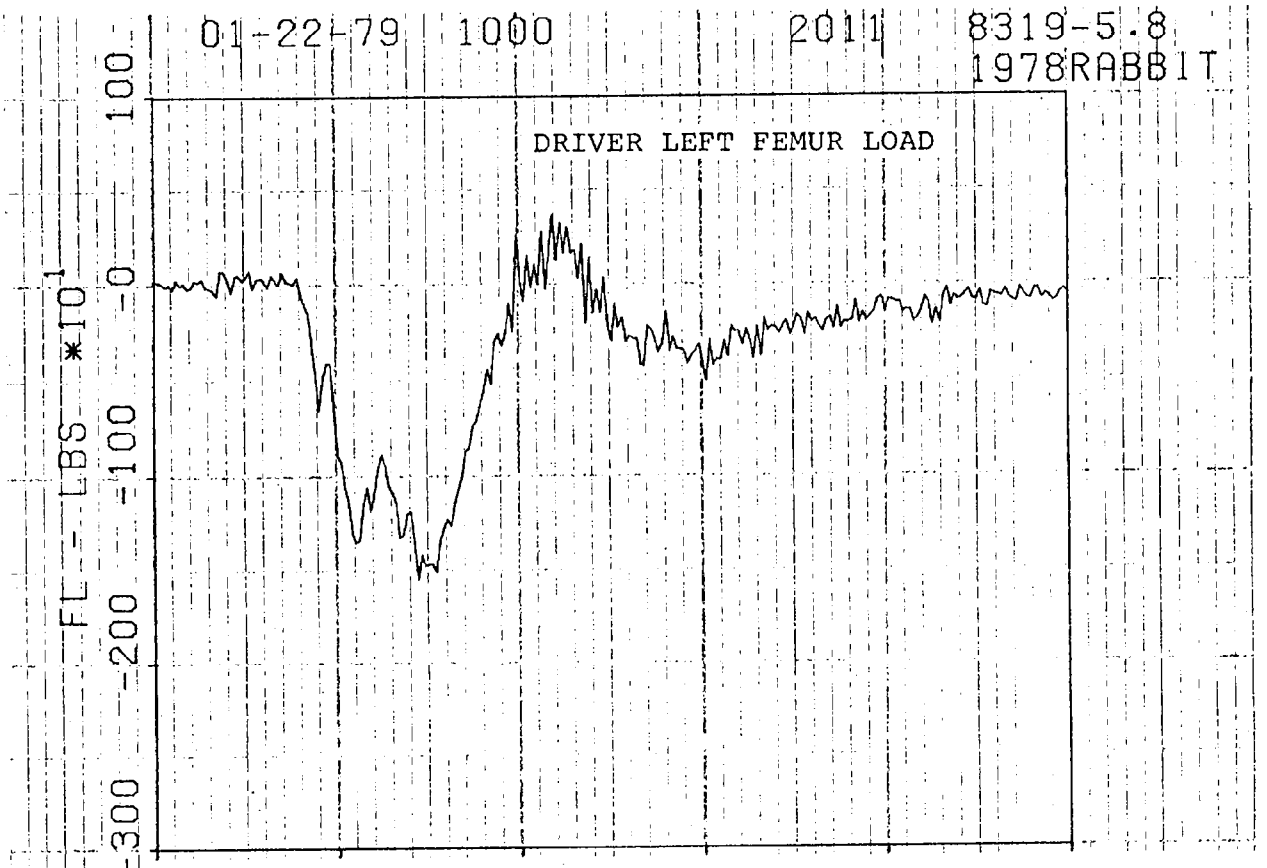

01-22-79 1600 501 8319-5.8
⊖= AX △= AY += AZ 1978RABBIT
DRIVER HEAD ACCELERATION
ACCELERATION = G
200
100
0
-100
-200

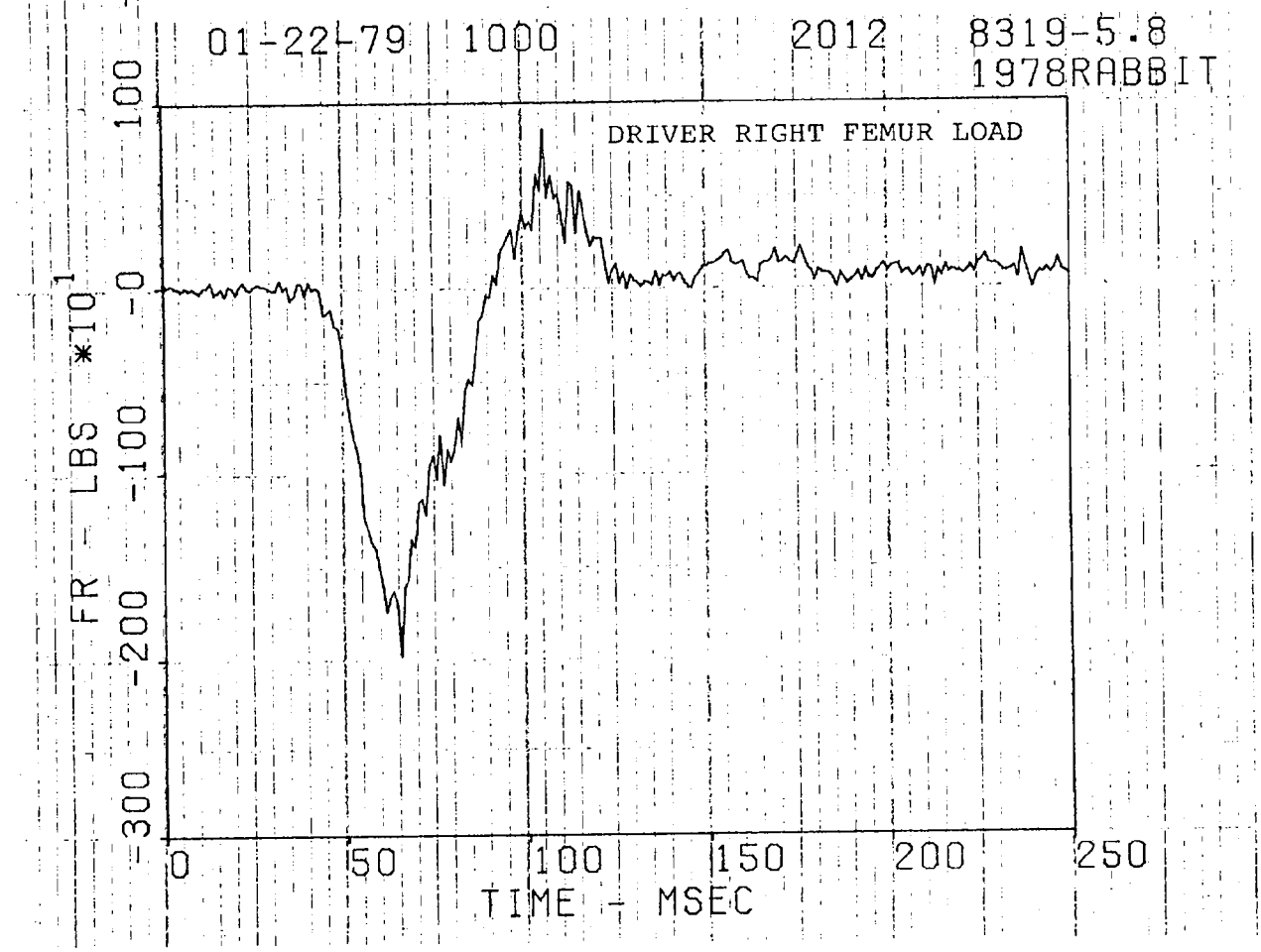

01-22-79 1600 501 8319-5.8
1978RABBIT
DRIVER HEAD ACCELERATION
RESULTANT
AR - G
400
300
200
100
0
0
50
100
150
200
250
TIME - MSEC

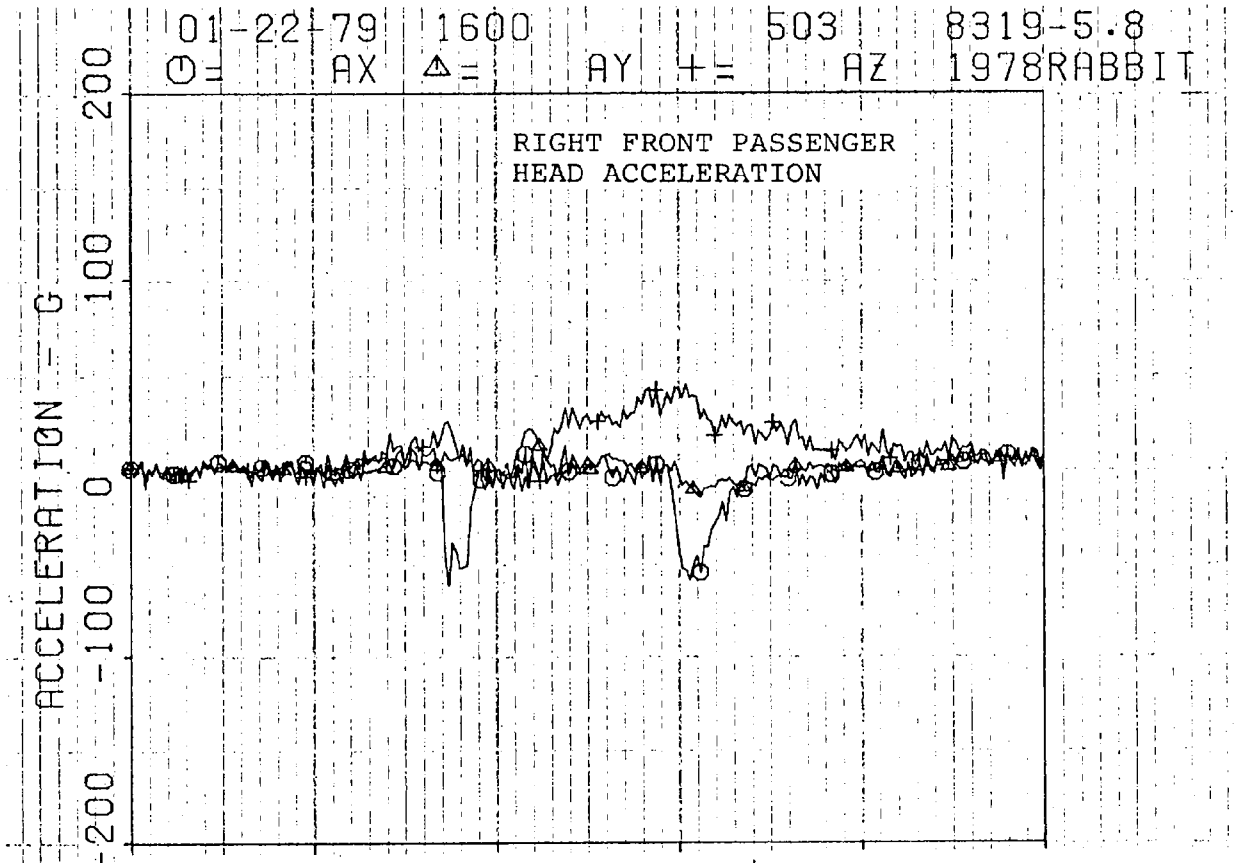

01-22-79 315 1101 8319-5.8
AX AY AZ 1978RABBIT
DRIVER CHEST ACCELERATION
ACCELERATION = G
80
40
0
-40
-80

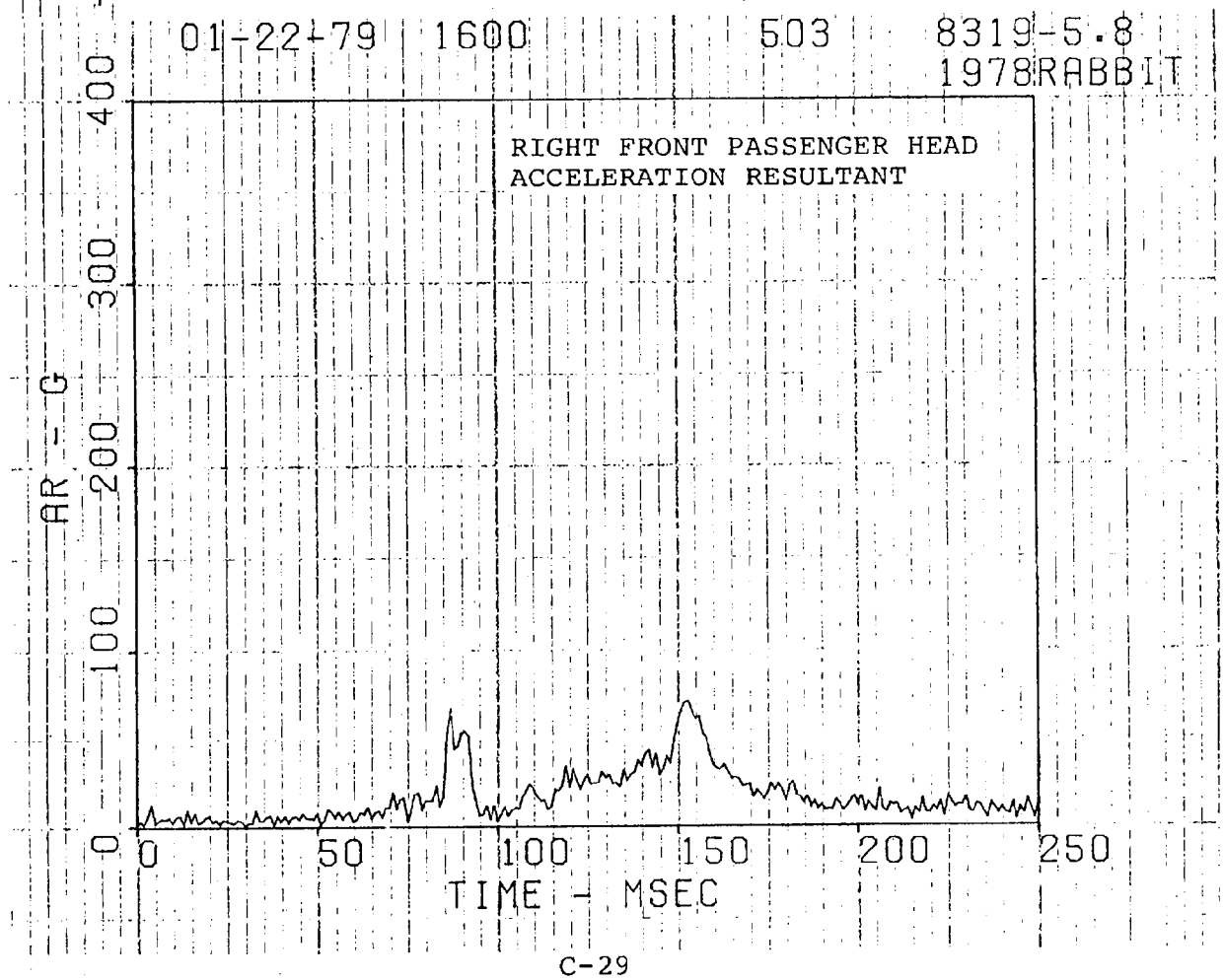

01-22-79 315 1101 8319-5.8
1978RABBIT
DRIVER CHEST ACCELERATION
RESULTANT
AR = G
80
60
40
20
0
0
50
100
150
200
250
TIME - MSEC

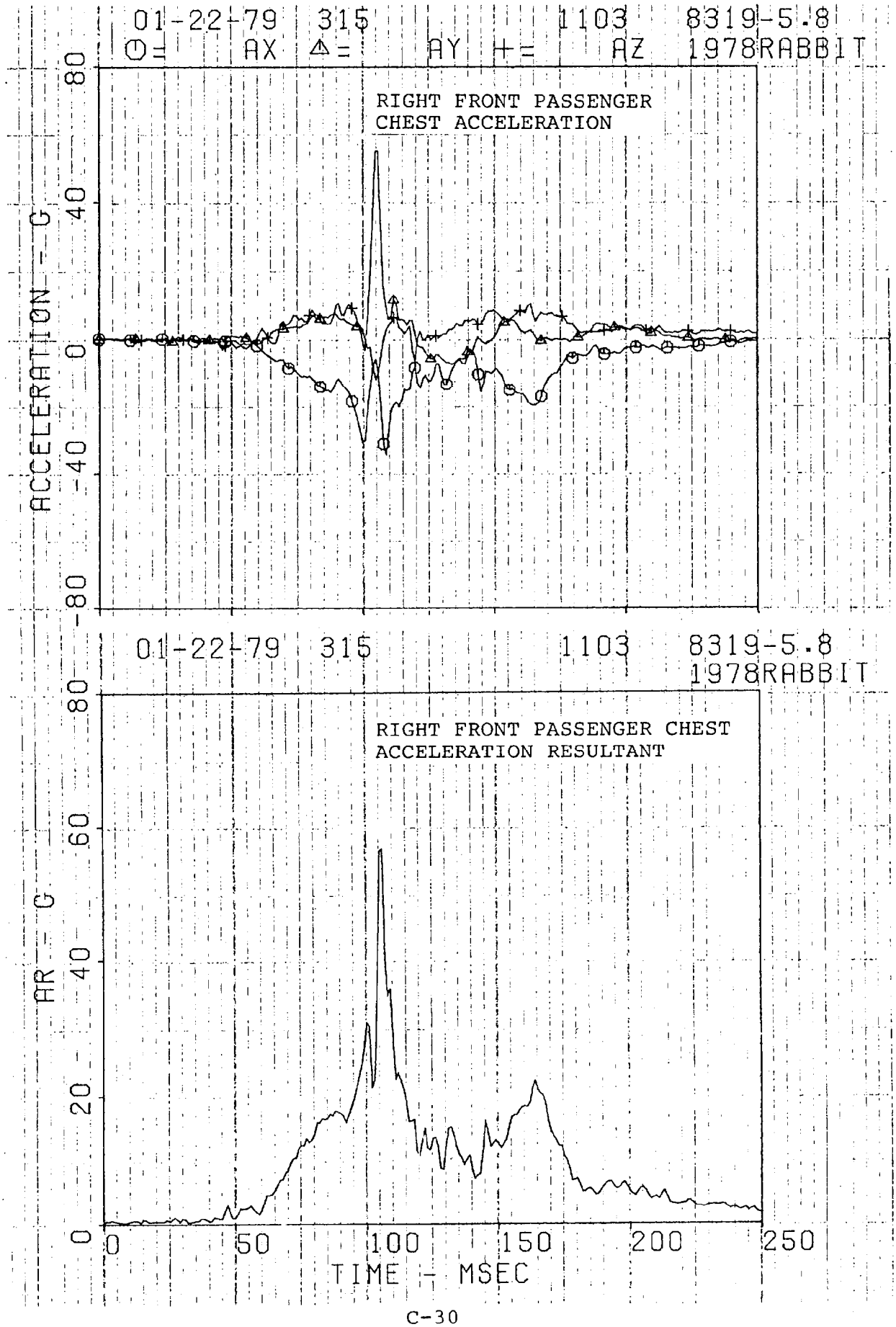

012779
DATE
01-22-79
FILTER
315
LOCATION
1101
TEST NO
8319-5.8
1978RABBIT
DRIVER CHEST SEVERITY INDEX
SI
2000
1500
1000
500
0
0
50
100
150
200
250
TIME - MSEC

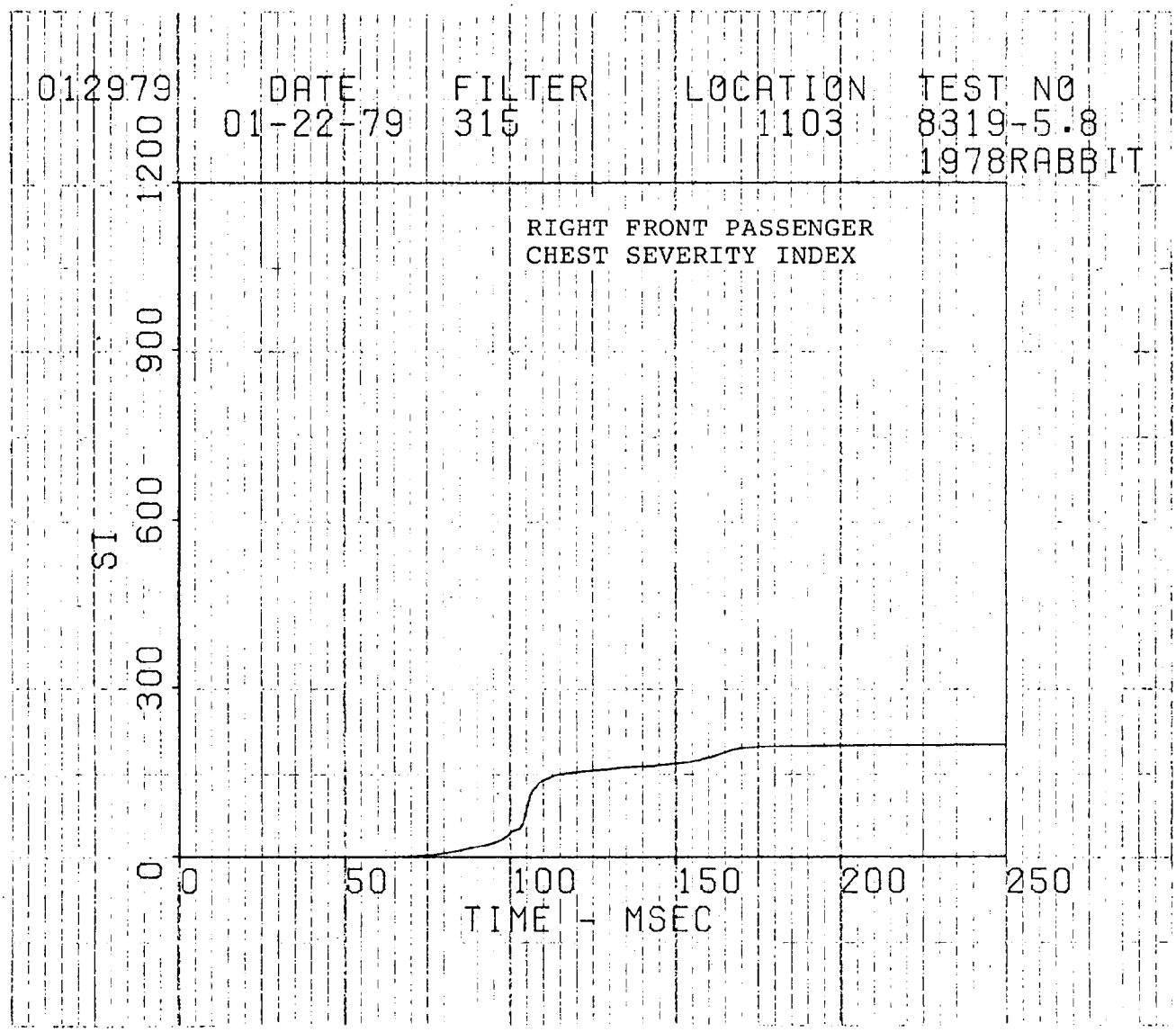

01-22-79 1000 2011 8319-5.8
1978RABBIT
DRIVER LEFT FEMUR LOAD
FL - LBS *10^1
100
-0
-100
-200
-300

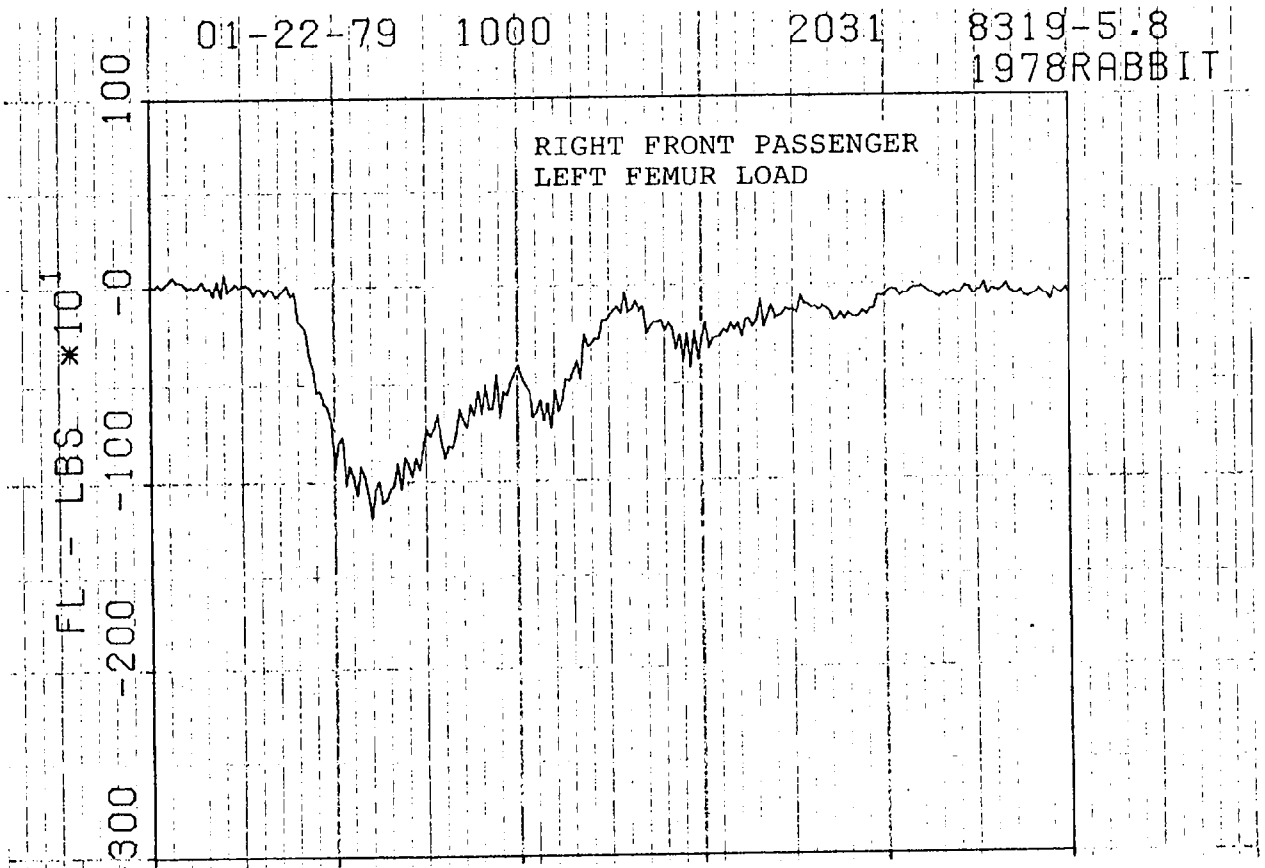

01-22-79 1000 2012 8319-5.8
1978RABBIT
DRIVER RIGHT FEMUR LOAD
FR - LBS *10^1
100
-0
-100
-200
-300
0
50
100
150
200
250
TIME - MSEC

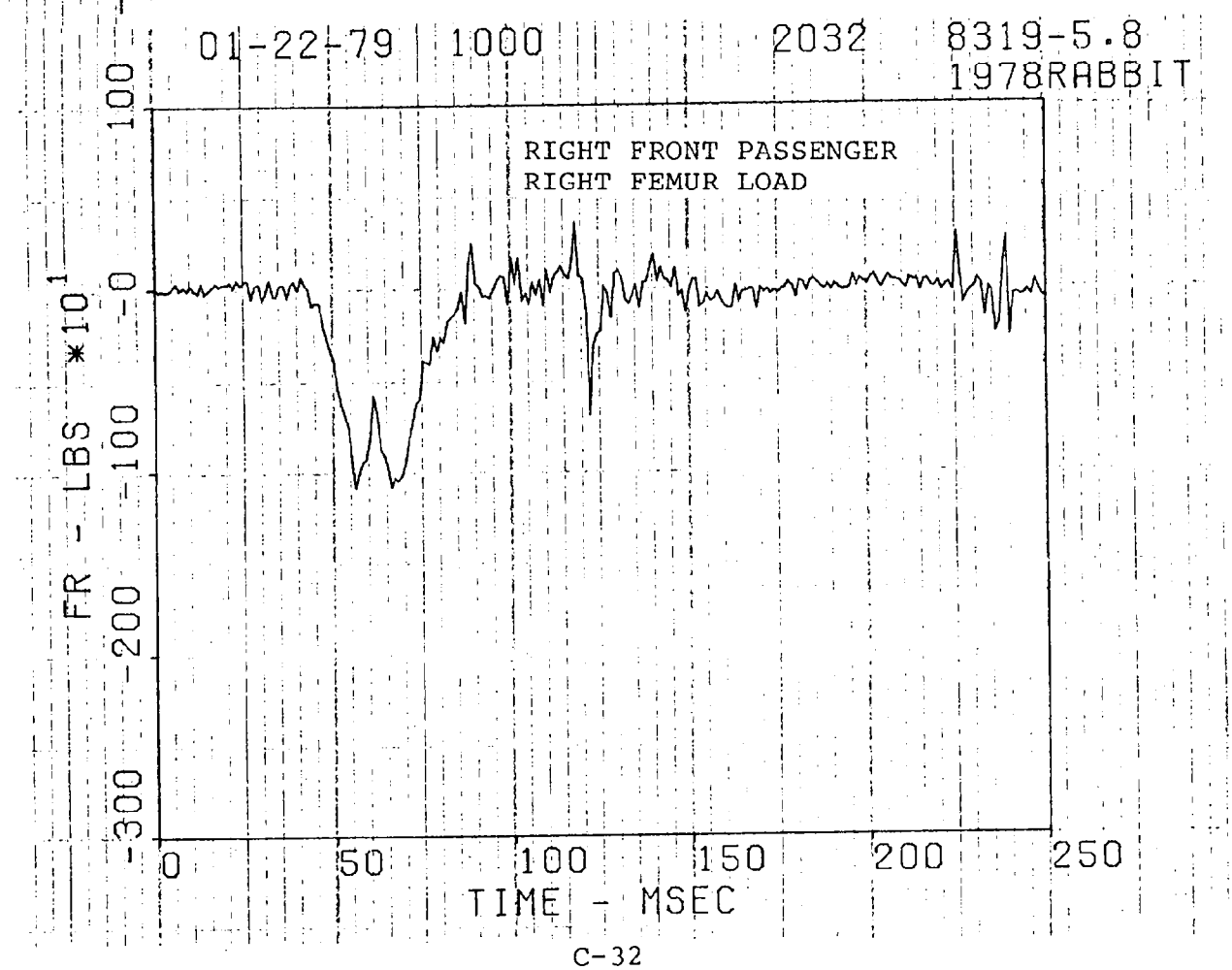

01-22-79 1600 503 8319-5.8
⊖= AX Δ= AY += AZ 1978RABBIT
RIGHT FRONT PASSENGER
HEAD ACCELERATION
ACCELERATION - G
200
100
0
-100
-200


01-22-79 1600 503 8319-5.8
1978RABBIT
RIGHT FRONT PASSENGER HEAD
ACCELERATION RESULTANT
AR - G
400
300
200
100
0
0
50
100
150
200
250
TIME - MSEC


01-22-79 315 1103 8319-5.8
○= AX △= AY += AZ 1978RABBIT
RIGHT FRONT PASSENGER CHEST ACCELERATION
ACCELERATION - G
80
40
0
-40
-80
01-22-79 315 1103 8319-5.8
1978RABBIT
RIGHT FRONT PASSENGER CHEST ACCELERATION RESULTANT
AR - G
80
60
40
20
0
0
50
100
150
200
250
TIME - MSEC

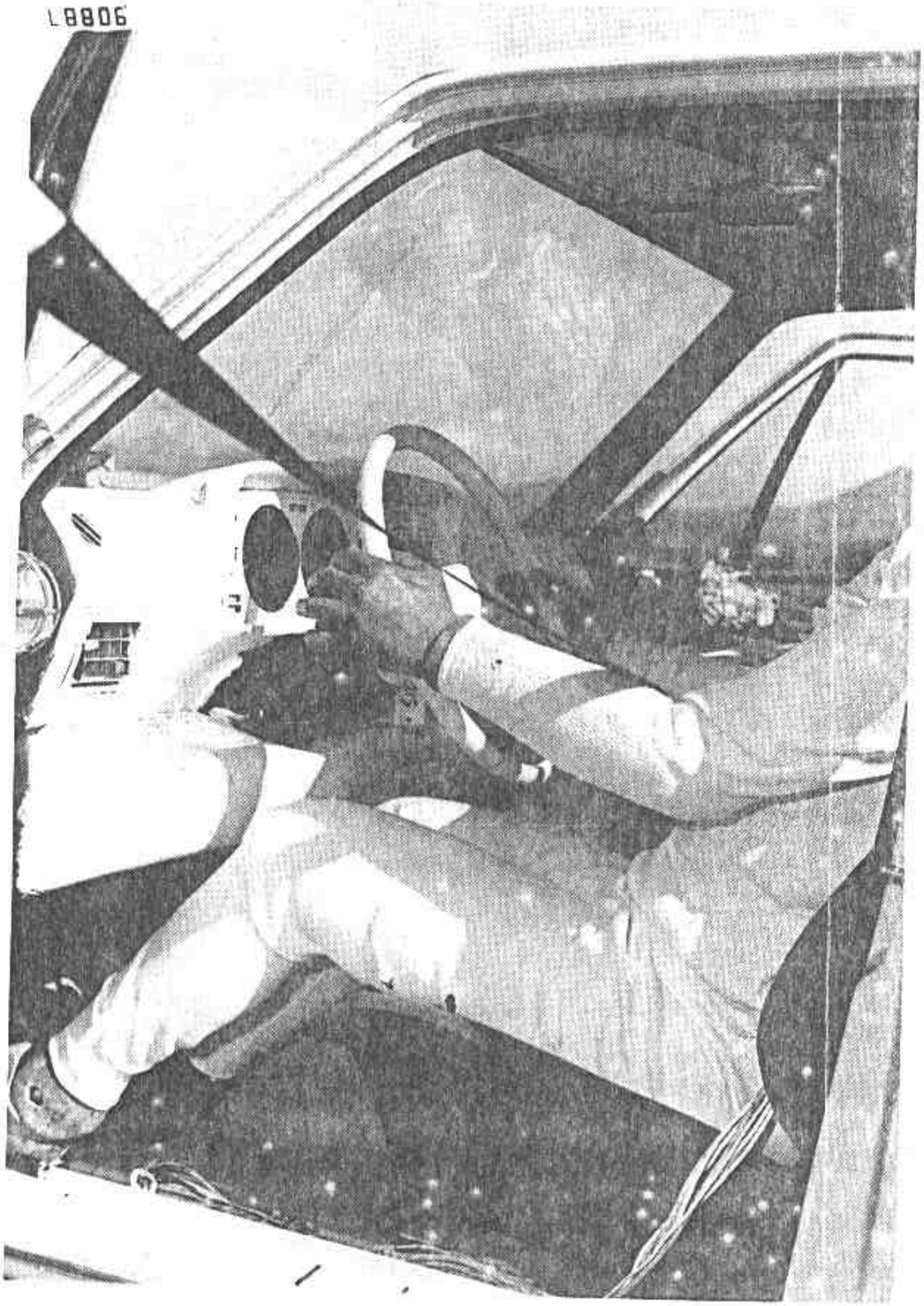

012979
DATE
01-22-79
FILTER
315
LOCATION
1103
TEST NO
8319-5.8
1978RABBIT
RIGHT FRONT PASSENGER
CHEST SEVERITY INDEX
SI
1200
900
600
300
0
0
50
100
150
200
250
TIME - MSEC


01-22-79 1000 2031 8319-5.8
1978RABBIT
RIGHT FRONT PASSENGER
LEFT FEMUR LOAD
FL - LBS *10^1
100
-0
-100
-200
-300


01-22-79 1000 2032 8319-5.8
1978RABBIT
RIGHT FRONT PASSENGER
RIGHT FEMUR LOAD
FR - LBS *10^1
100
-0
-100
-200
-300
0
50
100
150
200
250
TIME - MSEC

Test 5.8 Overall Pre-test View of 1978 VW Rabbit/
22-inch High T-1 Guard 42-inch Right Offset Crash.

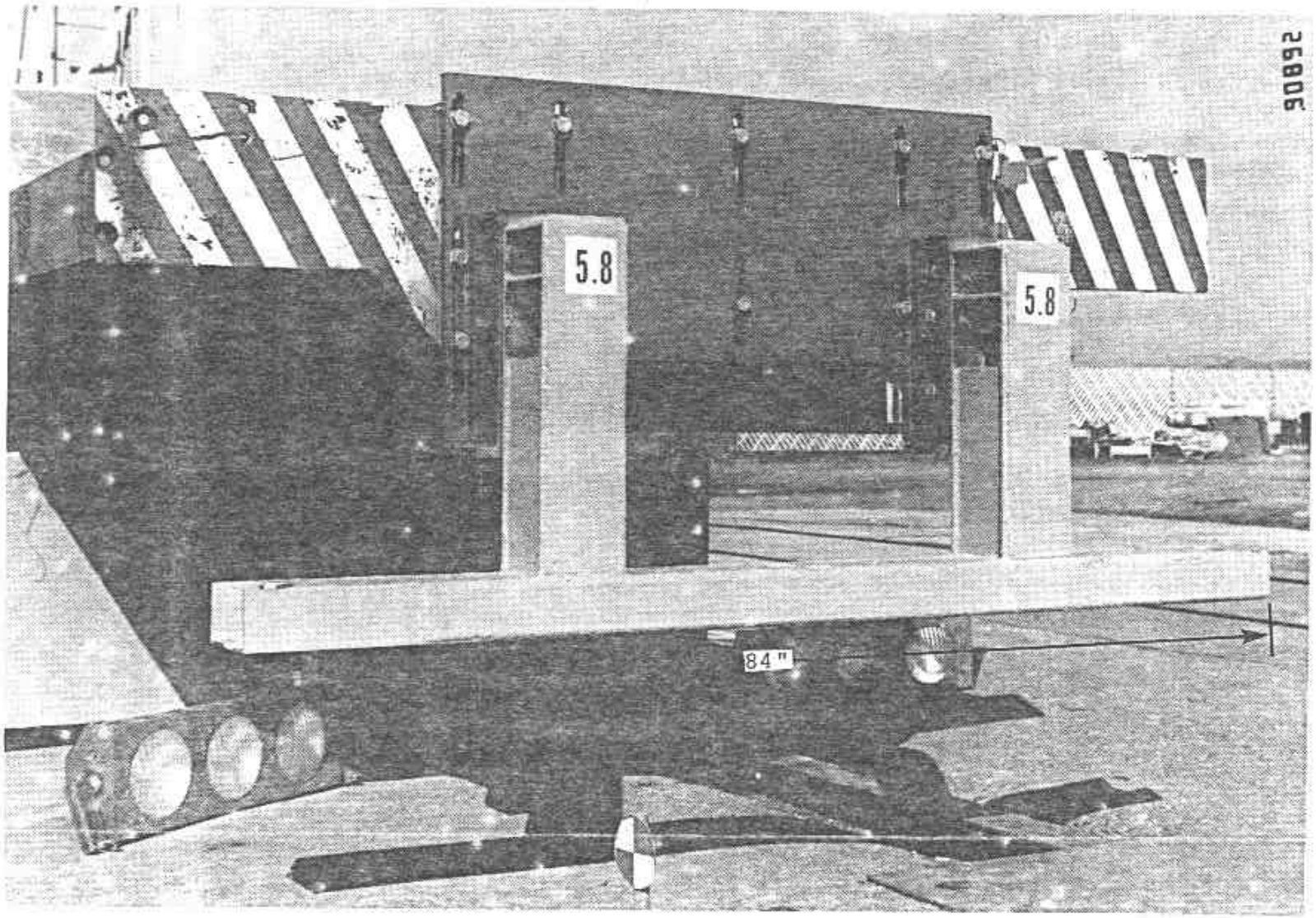
Test 5.8 Pre-test Front View of Test Vehicle and Guard.



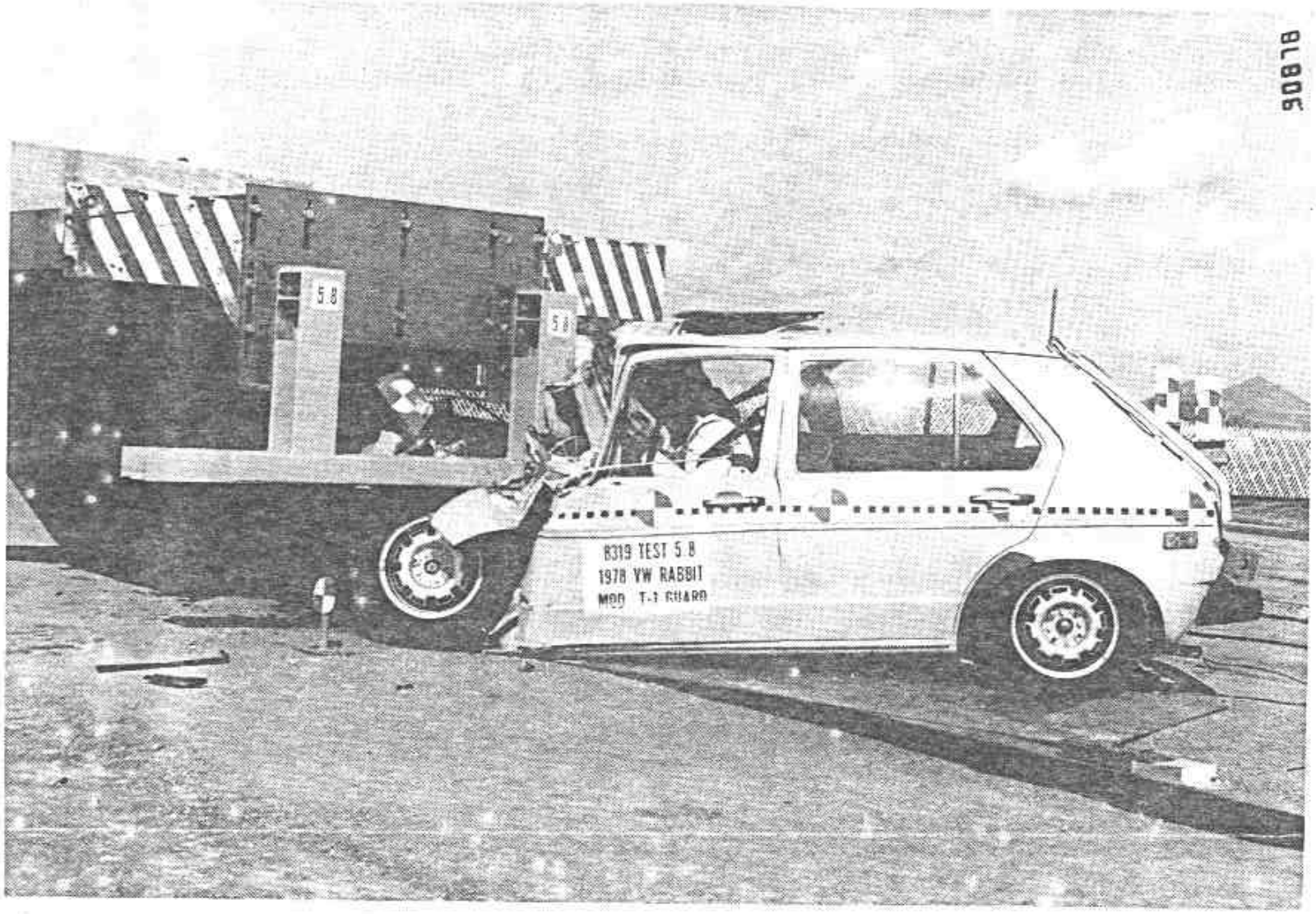
Test 5.8 Pre-test View of Driver Compartment and Dummy.

88806

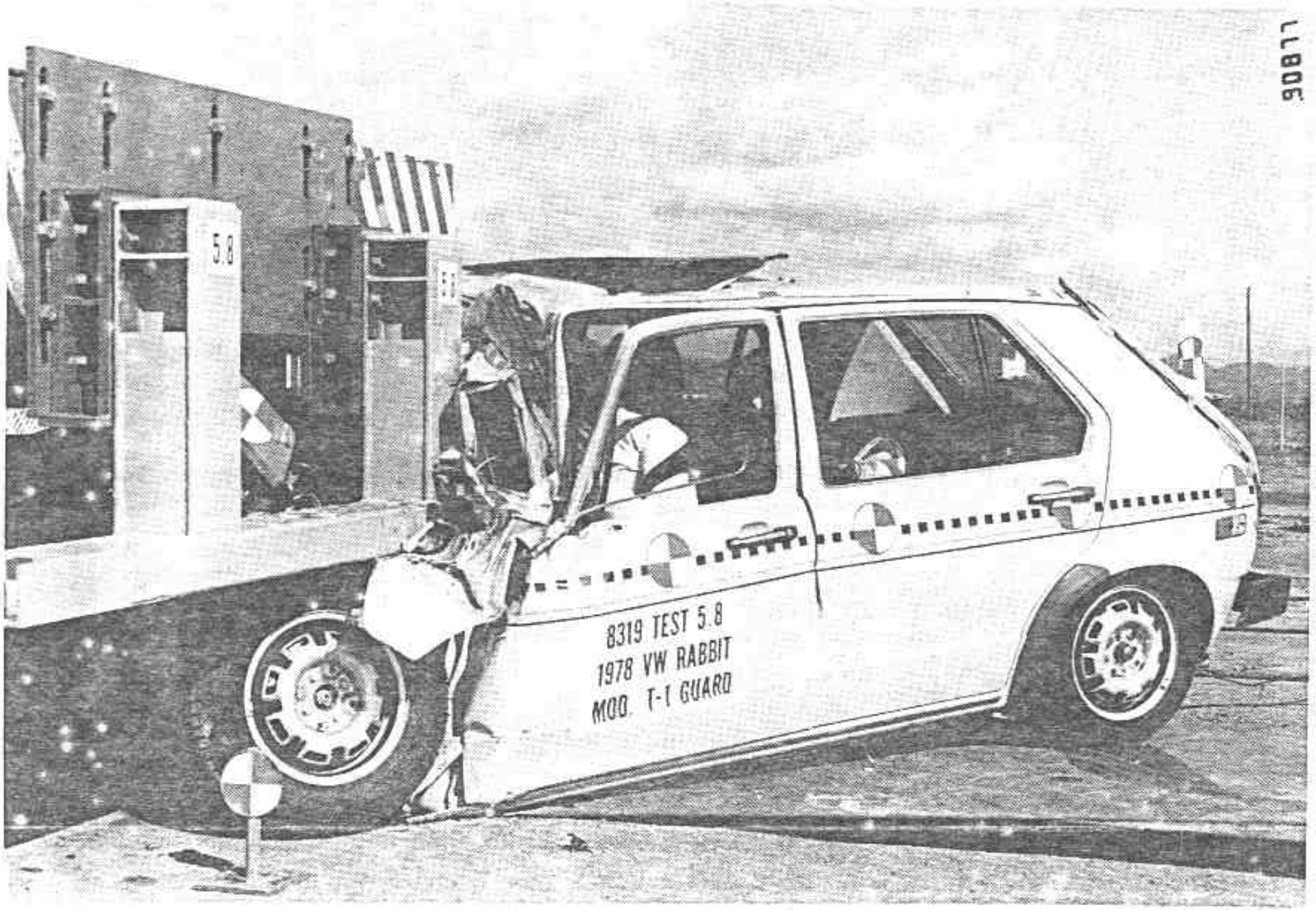
Test 5.8 Pre-test View of Passenger Compartment and Dummy.



Test 5.8 Pre-test Overall View of Underride Guard.



Test 5.8 Overall Post-test View of 1978 VW Rabbit/
22-inch High T-1 Guard 42-inch Right Offset Crash.



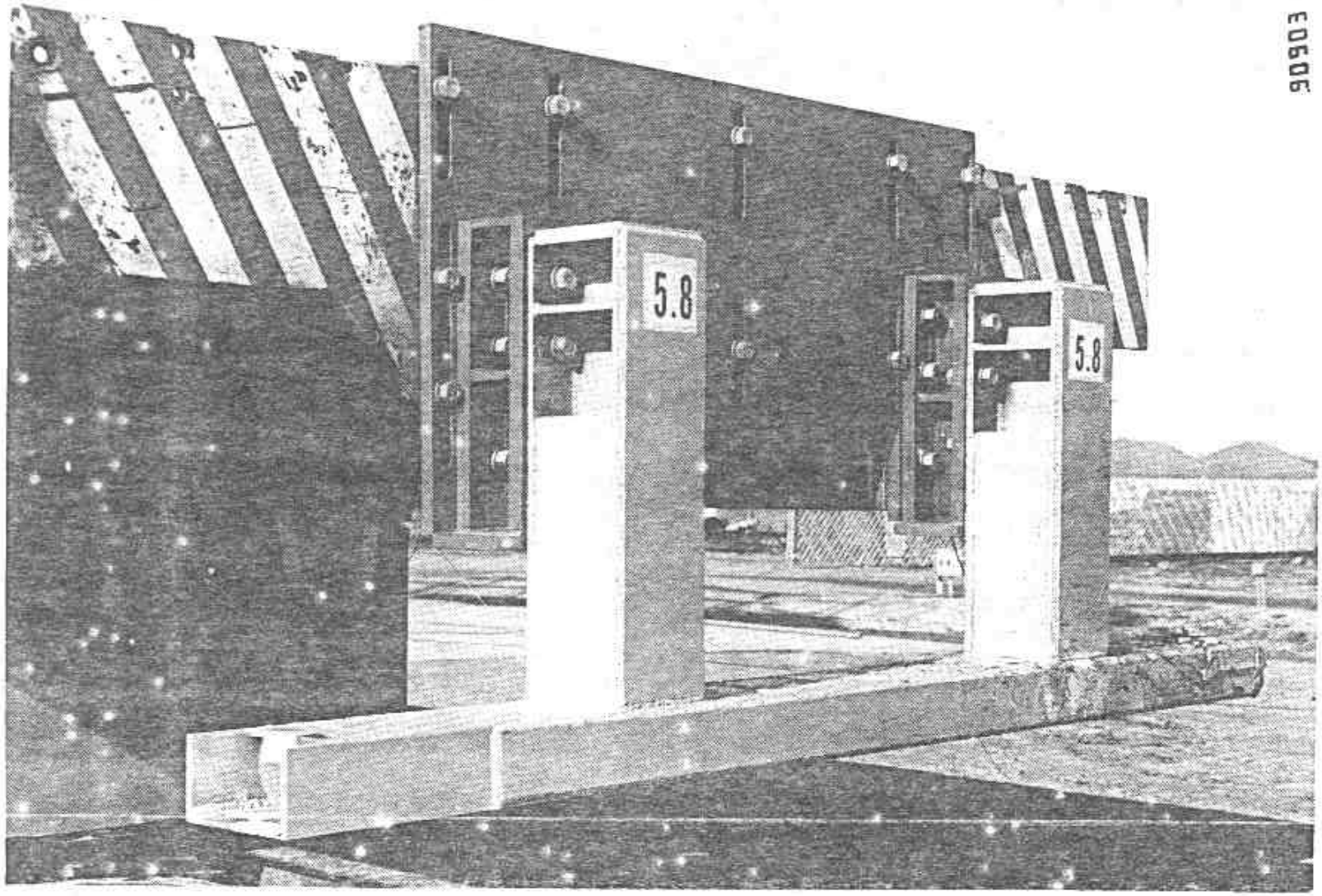
Test 5.8 Post-test Closeup View of Vehicle/Guard Engagement.

Test 5.8 Post-test View of Driver Compartment and Dummy.

Test 5.8 Post-test View of Passenger Compartment and Dummy.

Test 5.8 Post-test View of Driver Compartment Damage.

Test 5.8 Post-test View of Passenger Compartment Damage.



Test 5.8 Post-test Overall View of Underride Guard.

dsi DynamicScience Inc.
a TALLEY INDUSTRIES Company

April 11, 1979

Mr. Gary Bell (NRD-12)
Contract Technical Manager
National Highway Traffic
Safety Administration
Trans Point Building
2100 Second Street, S.W.
Washington, D.C. 20590

Subject: Transmittal of Reproducible Report for Task 5 Tests 5.5, 5.7, and 5.8.

Reference: Contract DOT-HS-8-01905, "Development of Compliance Test for Truck Rear Underride Protection"

Dear Mr. Bell:

In accordance with the requirements of Task 5 of the referenced contract, enclosed are the reproducible and eight copies of the Test Report for Task 5, Tests 5.5, 5.7, and 5.8.

Very truly yours,

Sol D.

Sol Davis
Manager, Special
Projects Department

SD:drt

Enclosures

cc: Ms. Lauraline Clark (NAD-30)
Contracting Officer
Office of Contracts and
Procurement
National Highway Traffic
Safety Administration
400 Seventh Street, S.W.
Washington, D.C. 20590