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A NATIONAL TECHNICAL SERVICES COMPANY

REPORT NO. 301-AETL-79-083-671-1489-83

**NEW VEHICLE ASSESSMENT AND STANDARDS
ENFORCEMENT INDICANT TESTING
OF
FMVSS 301-75
FUEL SYSTEM INTEGRITY**

**FORD MOTOR COMPANY
1979 FORD THUNDERBIRD - 2 DOOR HARDTOP
NHTSA 790209**

**APPROVED ENGINEERING TEST LABORATORIES
1536 EAST VALENCIA DRIVE
FULLERTON, CALIFORNIA 92631**



OCTOBER 1979

FINAL REPORT

PREPARED FOR

**U. S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
- ENFORCEMENT -
OFFICE OF VEHICLE SAFETY COMPLIANCE
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Final Report Accepted By:

Robert Krauss

NHTSA Contract Technical Manager

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15. Supplementary Notes Approved: <i>[Signature]</i> Mechanical Dept. Supervisor Approved Engineering Test Labs.			
16. Abstract A 1979 Ford Thunderbird - 2 Door Hardtop, NHTSA 790209, was impact tested for compliance indicant with FMVSS 301-75 (Fuel System Integrity) and vehicle assessment data. As a parallel effort with FMVSS 301-75 vehicle safety test, the anthropomorphic dummies and the test vehicle were instrumented with accelerometers to measure occupant response and vehicle acceleration. The average moving barrier impact speed was 35.190 mph in the rear (0°) mode. Test date was September 19, 1979, and the ambient temperature was 100°F.			
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TABLE OF CONTENTS

<u>Section</u>	<u>Paragraph</u>	<u>Description</u>	<u>Page</u>
1	1.0	Introduction	8
	1.1	Administrative Data	9
2	2.0	Test Data	12
3	3.0	Occupant Response and Vehicle Acceleration Data	19
	3.1	Instrumentation Malfunction	19
4	4.0	Test Results and Photographs	26
5	5.0	Test Facilities and Equipment	59
	5.1	Frontal Collision Barrier Facility	59
	5.2	Oblique Angle Collision Barrier	61
	5.3	Moving Collision Barrier	62
	5.4	Vehicle Static Rollover Machine	63
	5.5	Impact Velocity Measurement	63
	5.6	Photographic Coverage	65
	5.7	Data Acquisition and Reduction	67
Appendix A		Computer Plots	77

TABLES

9

<u>Tables</u>	<u>Description</u>	<u>Page</u>
I	Summary of Test Conditions	13
III	Post-Impact Summary	16
VI	Post-Impact Summary	17
3-1	Part 572 Dummy Data	20
3-2	Vehicle Structural Data	21
3-3	Vehicle Measurement Data	22
3-4	Vehicle Measurement Data	23
5-1	Instrumentation for Crash Test	73
5-2	Data Acquisition and Reduction Process	74
5-3	Data Designations for Vehicle Crash Impact Data Acquisition	75

ILLUSTRATIONS

<u>Figure</u>	<u>Description</u>	<u>Page</u>
4-1	Pre-Test, Left Side View	28
4-2	Pre-Test, Full Rear View	30
4-3	Pre-Test, Right Side View	32
4-4	Pre-Test, Driver Dummy View	34
4-5	Pre-Test, Passenger Dummy View	36
4-6	Pre-Test, Fuel Tank View	38
4-7	Pre-Test, Fuel Tank Left Side View	40
4-8	Pre-Test, Fuel Tank Left Front View	42
4-9	Post-Impact, Left Side View	44
4-10	Post-Impact, Full Rear View	46
4-11	Post-Impact, Driver Dummy View	48
4-12	Post-Impact, Passenger Dummy View	50
4-13	Post-Impact, Fuel Spillage	52
4-14	Post-Impact, Fuel Tank Deformation	54
4-15	Post-Impact, Fuel Tank Rupture Area View	56
5-1	Vehicle and Occupant Crash Impact Data Acquisition	72
5-2	Comparison Plot of SAE Class 60, 180, 600 and 1000 Filters	76



APPROVED ENGINEERING TEST LABORATORIES

SECTION 1



APPROVED ENGINEERING TEST LABORATORIES

SECTION 1

1.0 INTRODUCTION

This report contains information regarding a joint program for the Office of Vehicle Safety Compliance (OVSC), Office of Automotive Ratings (OAR), and Research and Development (R & D) for a vehicle assessment and standards enforcement indicant test of fuel system integrity relative to Federal Motor Vehicle Safety Standard (FMVSS) No. 301-75. This test was performed under Contract Number DOT-HS-6-01477 by Approved Engineering Test Laboratories, 1536 East Valencia Drive, Fullerton, California in accordance with the Office of Vehicle Safety Compliance (OVSC) Laboratory Procedures (TP212-01).

The specific purpose of this test was to obtain research and vehicle rating data in conjunction with fuel system integrity indicant data, when a vehicle is impacted in excess of the velocity (30 mph) requirement of FMVSS 301-75.

Section 2 contains vehicle fuel system compliance related data, while Section 3 contains occupant response and vehicle acceleration summary data. Section 4 is the test results and photographs. Section 5 discusses AETL's test facilities and data acquisition and reduction system.



APPROVED ENGINEERING TEST LABORATORIES

1.1 ADMINISTRATIVE DATA

A. References:

1. Federal Motor Vehicle Safety Standard 301-75
"Fuel System Integrity" as published in the
Federal Register, Volume 38, No. 22397, dated
August 20, 1979
2. National Highway Traffic Safety Administration -
Office of Vehicle Safety Compliance Laboratory
Procedures for Vehicle Assessment and Indicant
Testing for "Windshield Mounting", FMVSS 212 -
"Windshield Zone Intrusion", FMVSS 219 - "Fuel
System Integrity", FMVSS 301-75, TP212-01, dated
March 20, 1979.

B. Description of Test Vehicle

1. 1979 Ford Thunderbird - 2 Door Hardtop
2. Vehicle Identification No.: 9J87H135770
3. NHTSA No.: 790209
4. Manufactured Date: December 1978
5. GVWR: 5,816 pounds



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C. Dates

1. Vehicle Received: March 23, 1979
2. Start of Test: September 4, 1979
3. Completion of Test: September 19, 1979



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SECTION 2



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SECTION 2

2.0 TEST DATA

The 1979 Ford Thunderbird - 2 Door Hardtop was subjected to a rear moving barrier impact as required by Federal Motor Vehicle Safety Standard 301-75.

Color motion picture coverage of the impact test are considered part of the accumulated pertinent data. Where applicable, still photographs are presented in this report; while the motion picture coverage is submitted separately.

TABLE I

SUMMARY OF TEST CONDITIONS

TEST VEHICLE INFORMATION:

Manufacturer: Ford Motor Company
Make/Model: Ford Thunderbird
Body Style: 2 Door Hardtop Model Year: 1979
VIN: 9J87H135770 Build Date: December 1978
NHTSA No.: 790209 Color: White w/Blue Vinyl Roof
Engine Data: Eight (8) Cylinders; 351 Cu. In. Displ.
Transmission Data: Three (3) Speed () Manual (XXX) Automatic
Major Options: Tilt Steering Wheel, Cruise Control, Air Condition

VEHICLE ATTITUDE:

Delivered Attitude: LF 28.75 in.; RF 29.50 in.; LR 29.00 in.; RR 29.50 in.
Test Attitude: LF 28.50 in.; RF 29.25 in.; LR 27.20 in.; RR 27.75 in.

VEHICLE TIRE DATA:

Recommended Cold Tire Pressure: Front = 30 psi
(Up to Vehicle Load Capacity) Rear = 30 psi

Recommended Tire Size: GR78-15 Load Range: B

Tires on Vehicle: GR78-15 - w/s/w - Michelin

Spare Tire: X Yes; No; Space Saver: Yes; X No

TABLE Ia

SUMMARY OF TEST CONDITIONS (Cont'd)

TEST CONDITIONS:

Date of Test: September 19, 1979 Time of Test: 1518
Ambient Temperature: 100 °F at Impact Area

VEHICLE CAPACITY:

Type of Seats: Bench; Bucket; X Split Bench

Designated Seating Capacity:	Front	<u>3</u>
	Center	<u>0</u>
	Rear	<u>3</u>
	Total	<u>6</u>

Cargo: 200 lbs.

Total 1,100 lbs. (Vehicle Capacity Weight)

GVWR: 5,816 lbs. (Taken From Certification Label)

GAWR: Front 2,957 lbs.; Rear 2,909 lbs.

VEHICLE DELIVERED WEIGHT: (Fluids to Capacity)

Left Front	<u>1,242</u> lbs.	Left Rear	<u>958</u> lbs.
Right Front	<u>1,196</u> lbs.	Right Rear	<u>946</u> lbs.
Total Front Weight	<u>2,438</u> lbs.	(<u>56.1</u> % of Total Vehicle Weight)	
Total Rear Weight	<u>1,904</u> lbs.	(<u>43.9</u> % of Total Vehicle Weight)	
Total Delivered Weight	<u>4,342</u> lbs.		

CALCULATED VEHICLE TEST WEIGHT: 4,870 lbs.
(With Required Dummies and 200 lbs. Cargo)

ACTUAL VEHICLE TEST WEIGHT:

Left Front	<u>1,320</u> lbs.	Left Rear	<u>1,149</u> lbs.
Right Front	<u>1,237</u> lbs.	Right Rear	<u>1,148</u> lbs.
Total Front Weight	<u>2,557</u> lbs.	(<u>52.7</u> % of Total Vehicle Weight)	
Total Rear Weight	<u>2,297</u> lbs.	(<u>47.3</u> % of Total Vehicle Weight)	
Total Test Weight	<u>4,854</u> lbs.		

TABLE Ib

SUMMARY OF TEST CONDITIONS (Cont'd)

TEST FLUID DATA:

Test Fluid Type: Red Stoddard Solvent; Specific Gravity: 0.764

Kinematic Viscosity: 1.31

Spill Point Volume: 30.60 gals. (SPV)

Test Volume: 27.54 gals. (90-93% of SPV)

Fuel System Capacity: 21.0 (27.5 RPO) gals.
(Data from Owner's Manual)

Electric Fuel Pump: Yes; X No; Fuel Injection: Yes; X No

Does Electric Fuel Pump Operate with Ignition Switch "On"

And the Engine Not Operating: Yes; No; X N/A

Details of Fuel System: Fuel filler located on left rear fender aft of
rear wheel opening recessed behind a hinged door, fuel tank located
horizontally between frame side rails aft of differential under trunk
floor pan.

VEHICLE CRUSH AND REBOUND:

Overall Length of Test Vehicle: Pre-Test = Left 213.0 in.; Right 213.0 in.

Post-Test = Left 195.5 in.; Right 196.0 in.

Crush: Left 17.5 in.; Right 17.0 in.

Rebound (From Rigid Barrier Only): N/A in.

TABLE III

POST IMPACT SUMMARYVehicle 1979 Ford ThunderbirdNHTSA No. 790209Test Date September 19, 1979TYPE OF TEST: ☐ 0° Frontal Impact☐ 30° Oblique Impact (Driver/Passenger) Side☒ Rear ImpactREQUIRED IMPACT VELOCITY RANGE: 34.5 to 35.5 mphIMPACT VELOCITY: (Traps within 5 feet of impact event)Trap 1 = 35.15 mphTrap 2 = 35.23 mphAverage 35.190 mphActual distance from impact point to midpoint of Traps = .2.0 ft.VEHICLE STATIC CRUSH: Driver's Side = 17.50 inchesPassenger's Side = 17.00 inchesAverage = 17.25 inches

Crush Details: Both rear wheels were jammed, both frame rails buckled over rear axle, fuel tank was nearly touching the ground, both front seat backs bent onto rear seat cushion.

VEHICLE REBOUND: (From rigid barrier only)Driver's Side = N/A inchesPassenger's Side = N/A inchesAverage = N/A inches

TABLE VI

POST IMPACT SUMMARY

FUEL SYSTEM INTEGRITY - FMVSS 301-75

Vehicle 1979 Ford Thunderbird

NHTSA No. 790209

Test Date September 19, 1979

	Actual	Max. Allow.
Fuel spillage from impact until vehicle motion ceases.	immeasurable	1 ounce
Fuel spillage for 5 minute period following cessation of vehicle motion after impact.	27.0 oz.	5 ounces
Fuel spillage for next 25 minute period.	109.0 oz. (4.4 oz./min.)	1 ounce/ 1 minute
Time duration from impact until start of rollover test periods.	N/A	30 minutes

Fuel Spillage Location: Upper left front corner of fuel tank was ruptured.

NOTE: No rollover test was conducted - test terminated at conclusion of the thirty (30) minute post-impact period.



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SECTION 3



SECTION 3

3.0 OCCUPANT RESPONSE AND VEHICLE ACCELERATION SUMMARY DATA

The following data sheets summarize:

- A. The occupant response data (Part 572 Dummy Data Sheet)
- B. The vehicle acceleration data (Vehicle Structural Data Sheet)
- C. The Pre and Post-Test vehicle dimensions data (Vehicle Measurement Data Sheets)

More comprehensive data is presented in Appendix A in the form of computer-generated plots.

3.1 INSTRUMENTATION MALFUNCTION

The driver dummy lateral chest accelerometer response (Tape 1, channel 6) and passenger dummy lateral chest accelerometer response (Tape 2, channel 6) data was not acquired after impact initiation due to apparent accelerometer/cable failure.

TABLE 3-1
PART 572 DUMMY DATA

Vehicle 1979 Ford Thunderbird

NHTSA No. 790209

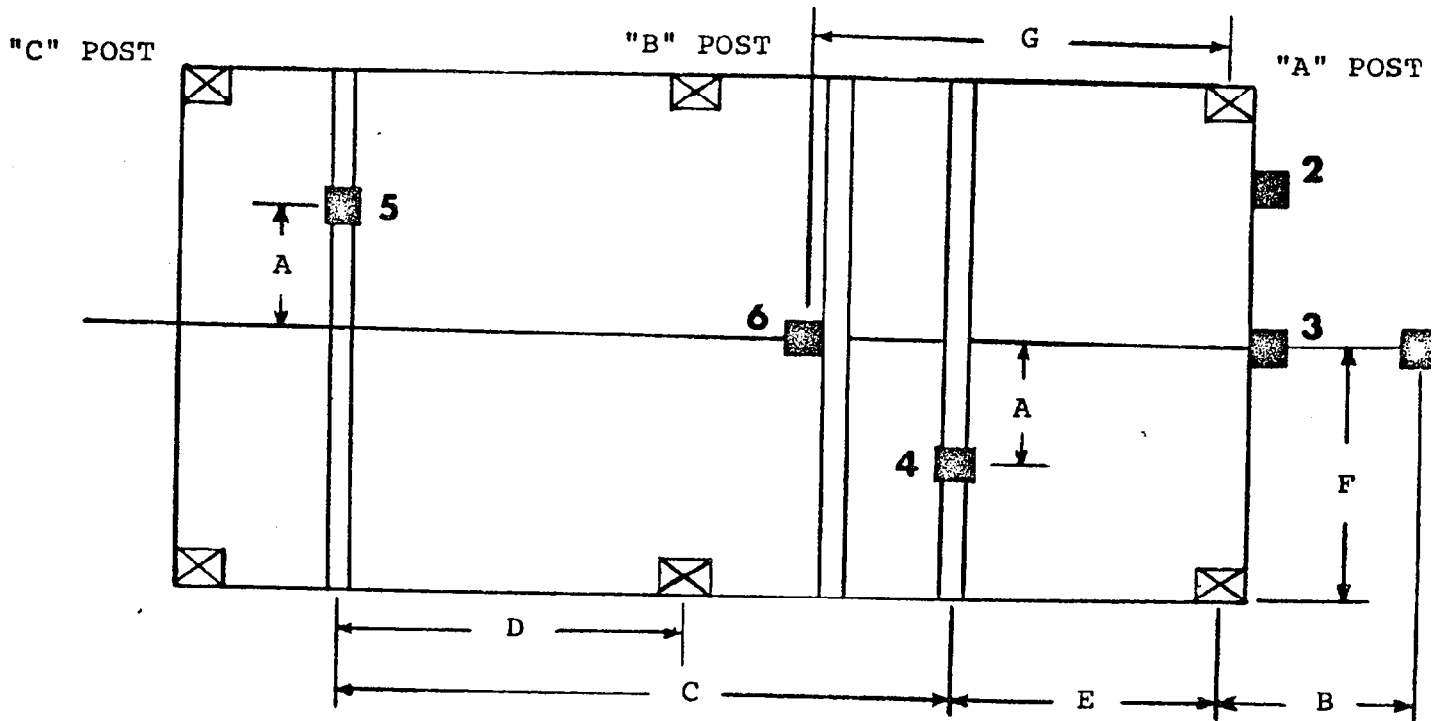
Driver S/N <u>0353</u> Passenger S/N <u>0354</u>	DRIVER				PASSENGER			
	Positive* Direction		Negative* Direction		Positive* Direction		Negative* Direction	
	Peak G	Time (msec)	Peak G	Time (msec)	Peak G	Time (msec)	Peak G	Time (msec)
Head Acceleration								
Longitudinal	18.7	146.5	0.7	89.5	15.3	132.5	5.3	265.0
Lateral	5.3	154.5	2.0	85.0	3.0	334.0	5.5	145.0
Vertical	2.4	293.5	13.5	122.0	2.1	46.5	17.1	122.5
Resultant	21.4	146.5			22.0	132.0		
HIC	52.5 (105-204 msec)				70.9 (100-182 msec)			
Chest Acceleration								
Longitudinal	13.5	114.5	3.3	435.5	11.9	102.5	2.6	475.5
Lateral	No Data Acquired					No Data Acquired		
Vertical	2.7	291.5	10.2	119.5	2.4	413.0	7.0	145.0
Resultant	15.9	114.5			13.7	102.5		
Severity Index	26.6 (13.9g - 3 msec clip)				25.4 (13.4g - 3 msec clip)			
Femur Loads	(lb)	Time (msec)	(lb)	Time (msec)	(lb)	Time (msec)	(lb)	Time (msec)
Left	90	89.5	204	66.5	86	373.5	184	57.0
Right	40	353.0	151	62.5	78	506.5	200	51.0
Belt Load								
Torso	10	140.0	8	234.0		Unknown		

Average Vehicle Impact Speed 35.190 mph

```
*Positive Direction - Longitudinal: Forward
                      Lateral: Leftward
                      Vertical: Upward
                      Femur: Tension
```

```
*Negative Direction - Longitudinal: Rearward
                      Lateral: Rightward
                      Vertical: Downward
                      Femur: Compression
```

TABLE 3-2
VEHICLE STRUCTURAL DATA



DIMENSIONS			
LOCATION	MEASUREMENT (IN.)	LOCATION	MEASUREMENT (IN.)
A	15.3	E	12.5
B	N/A	F	38.0
C	26.0	G	26.5
D	-8.5 (ahead of "B" post)		

ACCELERATION PEAKS				
ACCELEROMETER LOCATION	POSITIVE* DIRECTION		NEGATIVE* DIRECTION	
	PEAK "G"	TIME (MSEC)	PEAK "G"	TIME (MSEC)
NO. 1 LONGITUDINAL	N/A	N/A	N/A	N/A
NO. 1 VERTICAL	N/A	N/A	N/A	N/A
NO. 2 LONGITUDINAL	N/A	N/A	N/A	N/A
NO. 2 VERTICAL	N/A	N/A	N/A	N/A
NO. 3 LONGITUDINAL	N/A	N/A	N/A	N/A
NO. 3 VERTICAL	N/A	N/A	N/A	N/A
NO. 4 LONGITUDINAL	15.0	14.5	4.1	347.5
NO. 4 VERTICAL	16.8	34.5	12.1	16.0
NO. 5 LONGITUDINAL	16.6	58.0	4.3	232.0
NO. 5 VERTICAL	15.9	21.5	16.7	58.5
NO. 6 LONGITUDINAL	N/A	N/A	N/A	N/A
NO. 6 LATERAL	N/A	N/A	N/A	N/A
NO. 6 VERTICAL	N/A	N/A	N/A	N/A

*POSITIVE - LONGITUDINAL: Forward DIRECTION LATERAL: Leftward VERTICAL: Upward	*NEGATIVE - LONGITUDINAL: Rearward DIRECTION LATERAL: Rightward VERTICAL: Downward
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TABLE 3-3
PRE-TEST
VEHICLE MEASUREMENT DATA

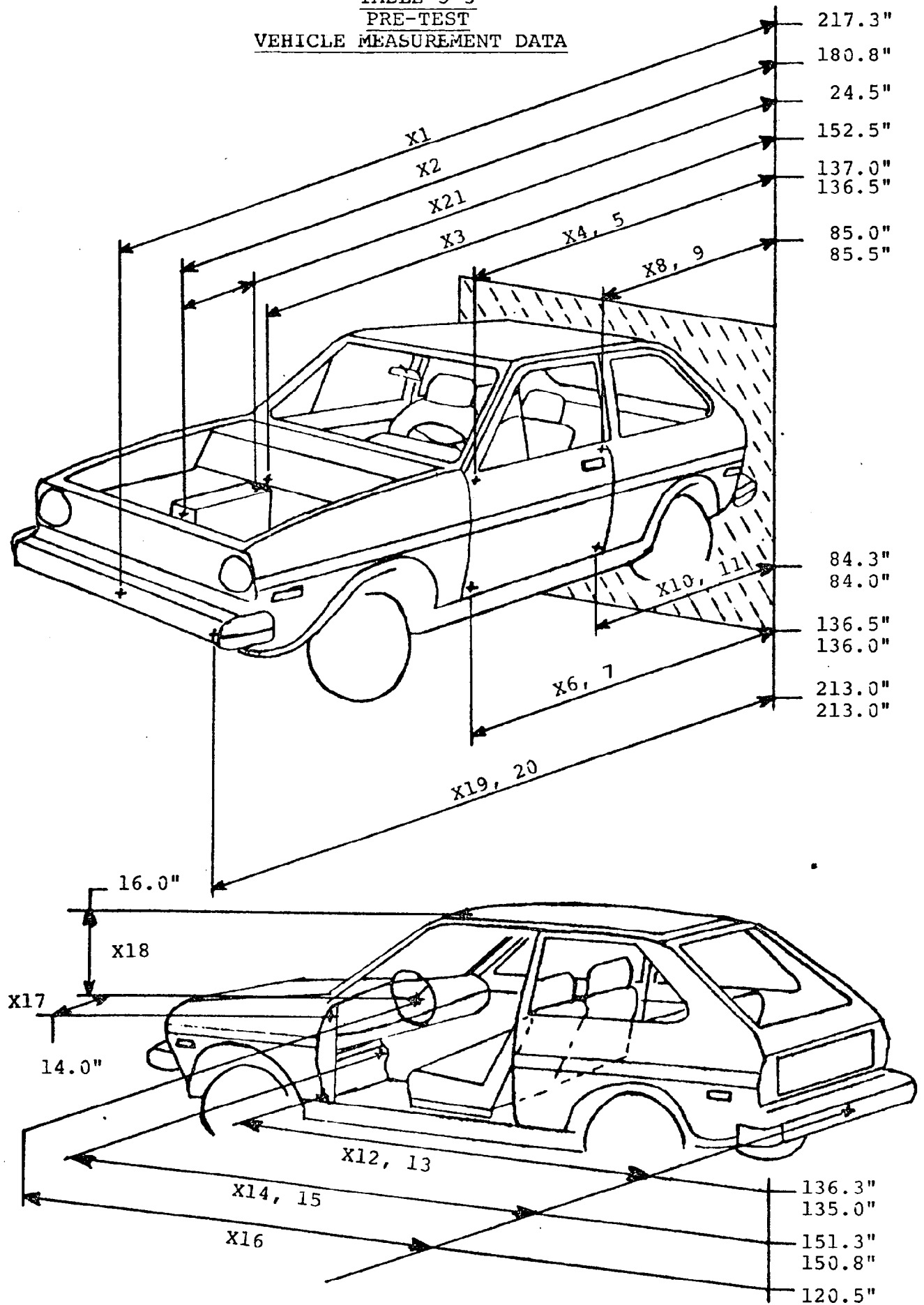
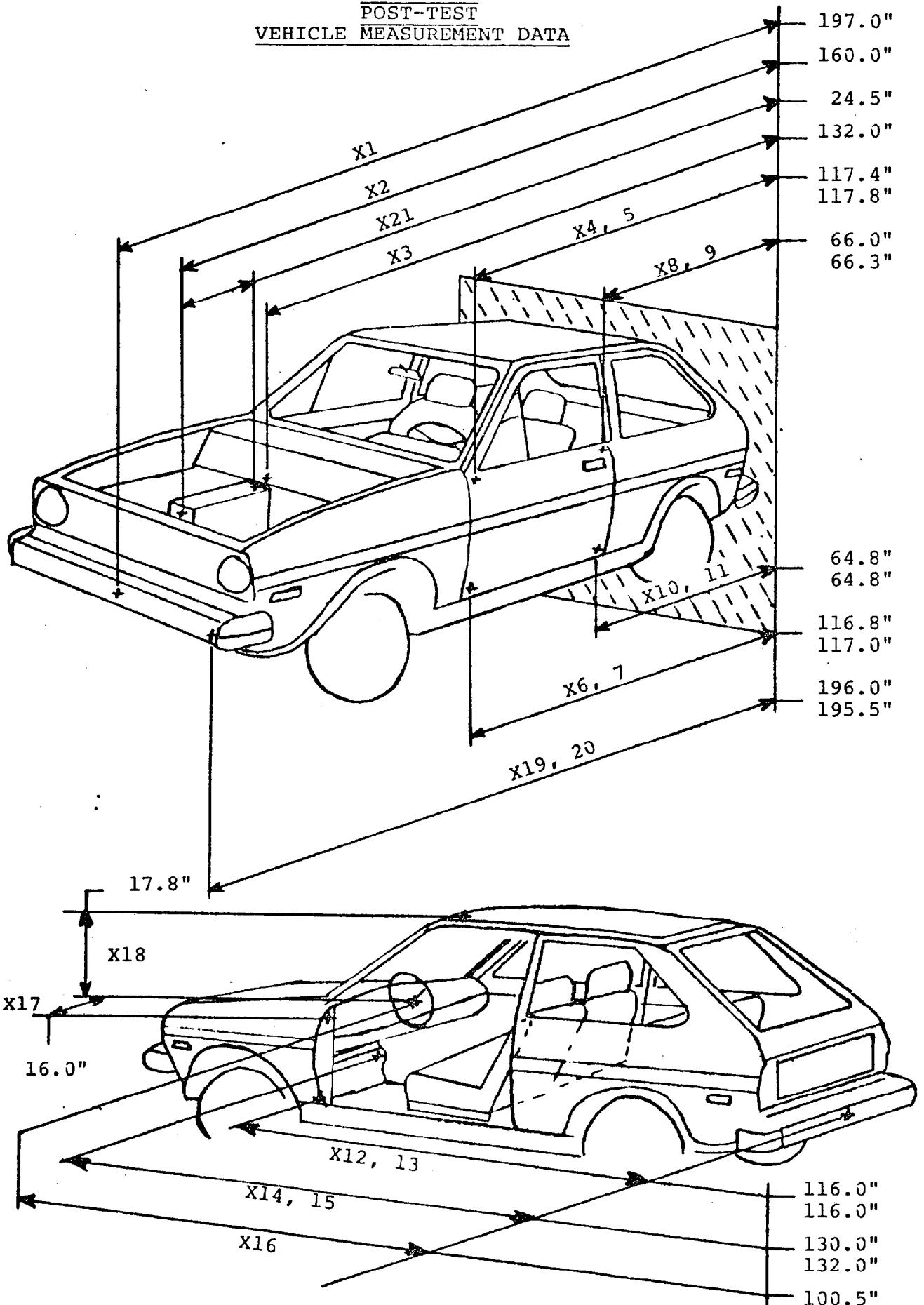


TABLE 3-4
POST-TEST
VEHICLE MEASUREMENT DATA





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SUMMARY

PRE-TEST AND POST-TEST VEHICLE DIMENSIONS

<u>Measurement Point</u>	<u>Pre-Test</u>	<u>Post-Test</u>	<u>Difference</u>
X1	217.3"	197.0"	20.3"
X2	180.8"	160.0"	20.8"
X3	152.5"	132.0"	20.5"
X4	137.0"	117.4"	19.6"
X5	136.5"	117.8"	18.7"
X6	136.5"	116.8"	19.7"
X7	136.0"	117.0"	19.0"
X8	85.0"	66.0"	19.0"
X9	85.5"	66.3"	19.2"
X10	84.3"	64.8"	19.5"
X11	84.0"	64.8"	19.2"
X12	136.3"	116.0"	20.3"
X13	135.0"	116.0"	19.0"
X14	151.3"	130.0"	21.3"
X15	150.8"	132.0"	18.8"
X16	120.5"	100.5"	20.0"
X17	14.0"	16.0"	2.0"
X18	16.0"	17.8"	1.8"
X19	213.0"	196.0"	17.0"
X20	213.0"	195.5"	17.5"
X21	24.5"	24.5"	0.0"



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SECTION 4



SECTION 4

4.0 TEST RESULTS AND PHOTOGRAPHS

The test vehicle performance was determined by a rear moving barrier impact at an average speed of 35.190 mph. No static rollover test was conducted due to excessive fuel spillage following the barrier impact.

Two (2) Part 572 test dummies were positioned in each designated outboard seating position and were restrained by the belt system in the test vehicle. Just prior to the impact event the driver dummy head was painted with white chalk and the passenger dummy head was painted with red chalk to provide post-impact visual inspection of possible dummy head contact with interior components during the impact event.

Post-impact inspection of the test vehicle revealed almost all crush occurred rearward of the front doors. All windows remained unbroken and both rear fenders yielded forward leaving the outer door shells overlapping the fenders. The left and right door were unlatched easily and required moderate effort to open. Both rear wheels were jammed and the left and right frame rails buckled over the rear axle. The rear portion of the vehicle rotated downward leaving the gas tank nearly touching the ground surface. Both front seat assemblies deformed and the seat backs bent backward onto the rear seat cushion.



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SECTION 4

The upper left front corner of the fuel tank ruptured allowing more fuel spillage than the collected quantity stated herein. The test was terminated at the conclusion of the allowable thirty (30) minute time duration from impact to start of the rollover test.



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Figure 4-1

1979 Ford Thunderbird - 2 Door Hardtop

NHTSA 790209

Pre-Test, Left Side View





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Figure 4-2
1979 Ford Thunderbird - 2 Door Hardtop
NHTSA 790209
Pre-Test, Full Rear View





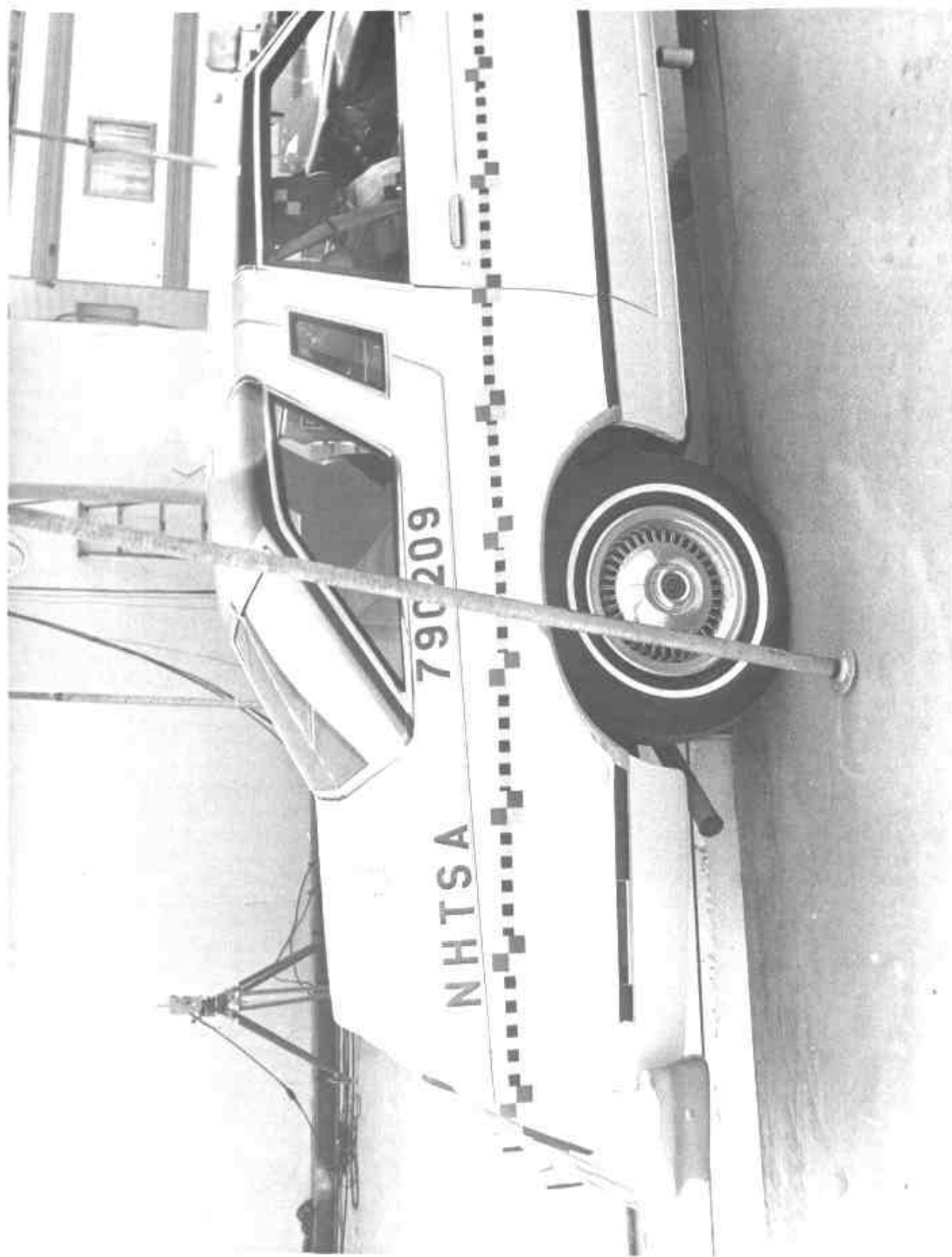
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Figure 4-3

1979 Ford Thunderbird - 2 Door Hardtop

NHTSA 790209

Pre-Test, Right Side View





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Figure 4-4
1979 Ford Thunderbird - 2 Door Hardtop
NHTSA 790209
Pre-Test, Driver Dummy View





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Figure 4-5
1979 Ford Thunderbird - 2 Door Hardtop
NHTSA 790209
Pre-Test, Passenger Dummy View





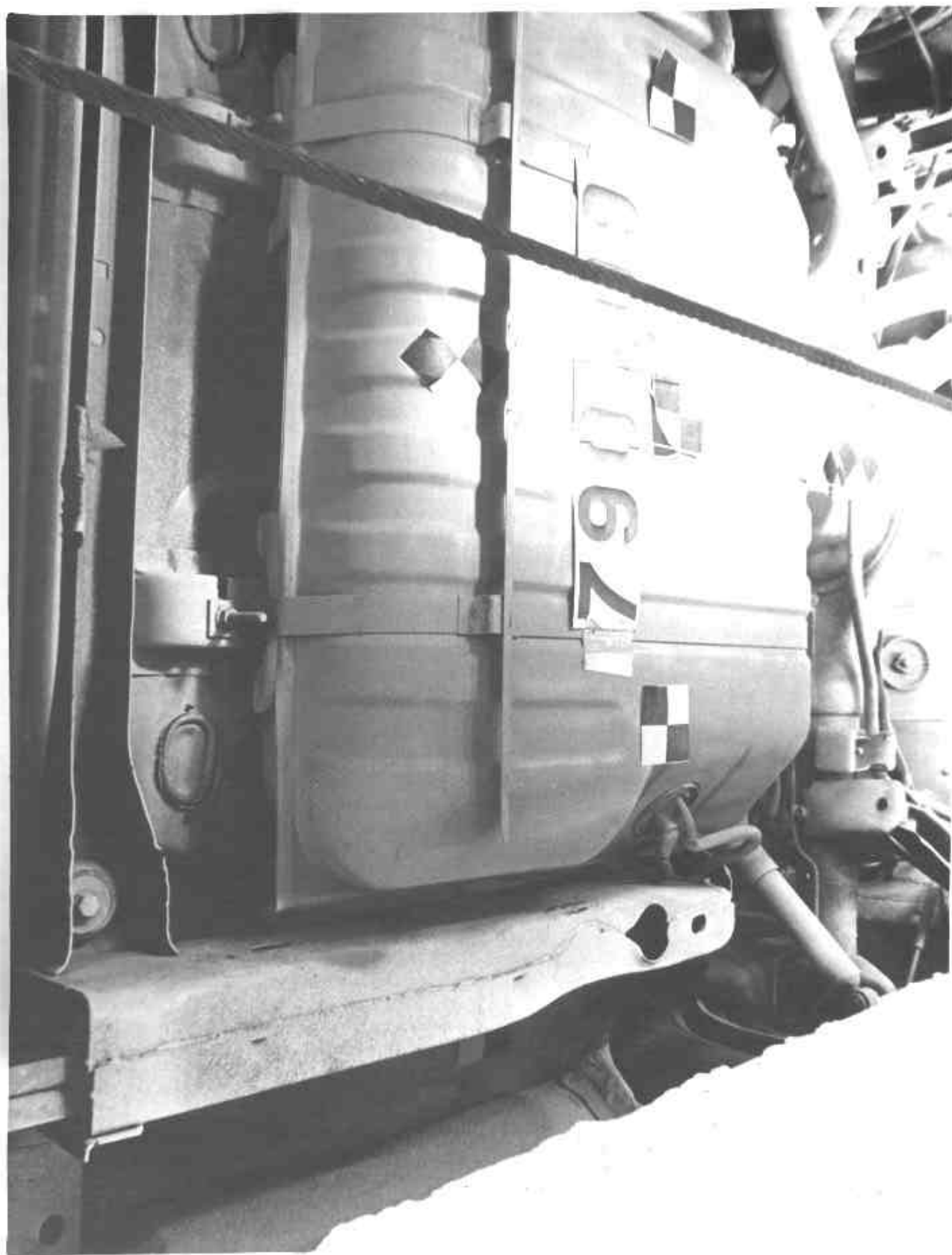
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Figure 4-6

1979 Ford Thunderbird - 2 Door Hardtop

NHTSA 790209

Pre-Test, Fuel Tank View





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Figure 4-7

1979 Ford Thunderbird - 2 Door Hardtop

NHTSA 790209

Pre-Test, Fuel Tank Left Side View





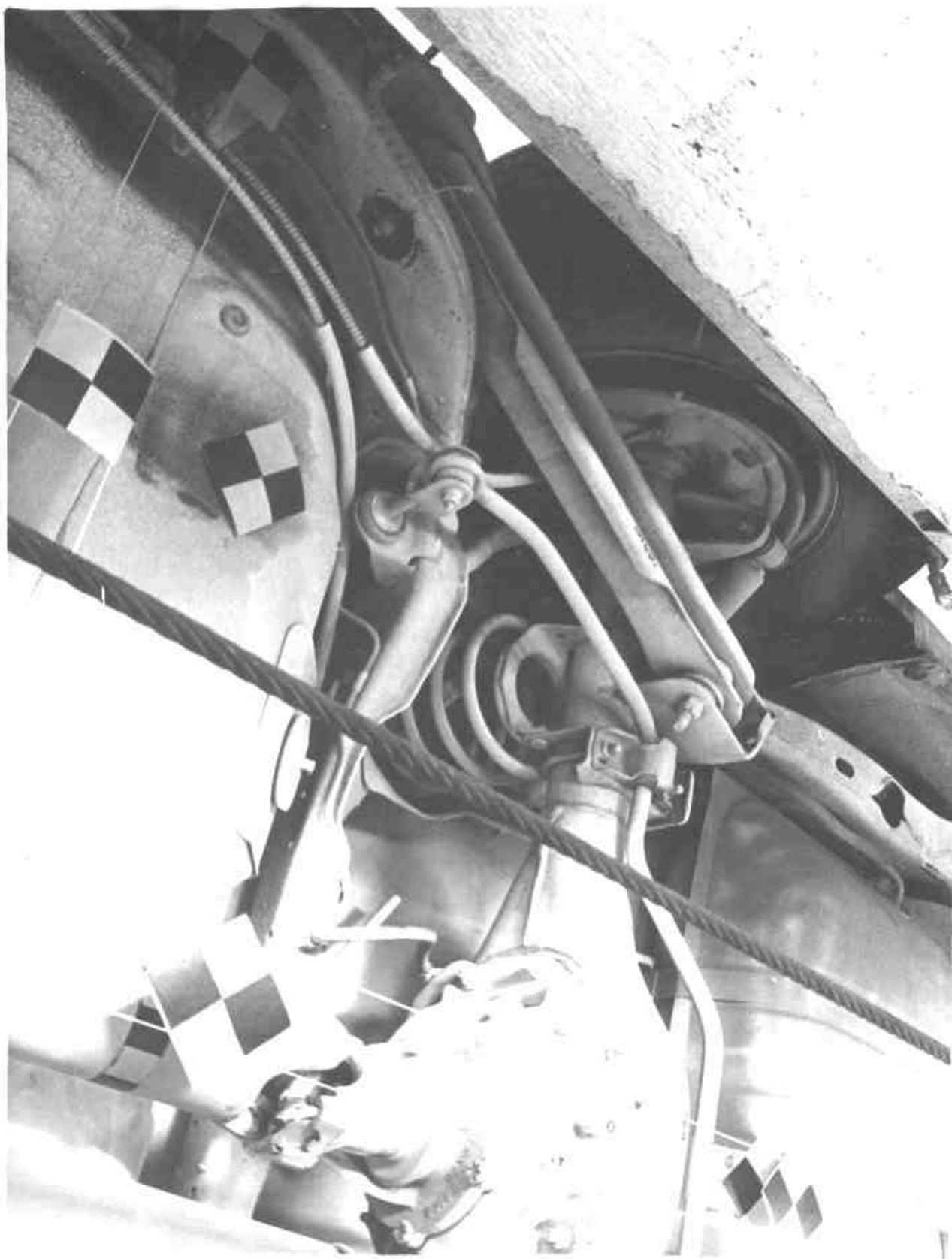
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Figure 4-8

1979 Ford Thunderbird - 2 Door Hardtop

NHTSA 790209

Pre-Test, Fuel Tank Left Front View





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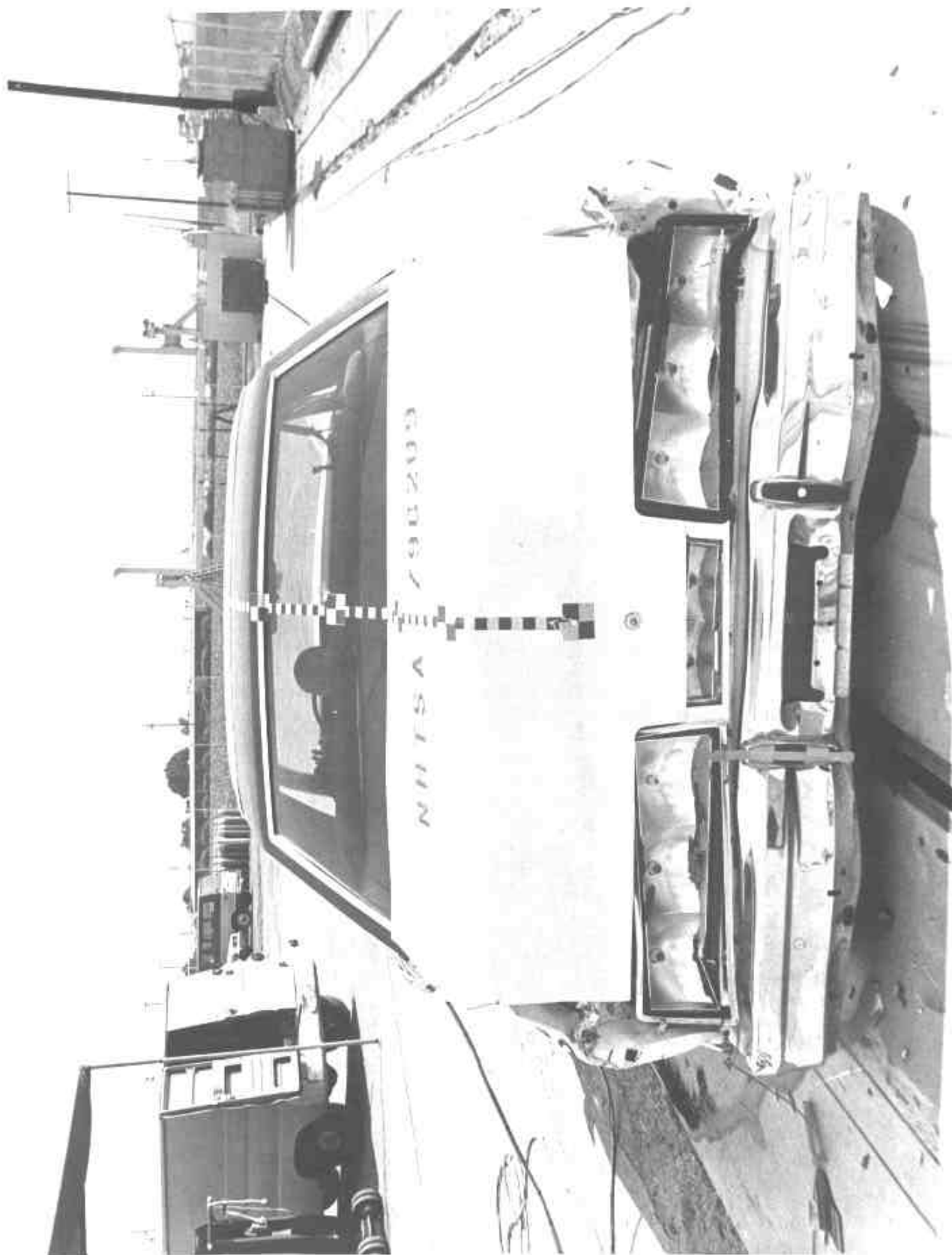
Figure 4-9
1979 Ford Thunderbird - 2 Door Hardtop
NHTSA 790209
Post-Impact, Left Side View





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Figure 4-10
1979 Ford Thunderbird - 2 Door Hardtop
NHTSA 790209
Post-Impact, Full Rear View





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Figure 4-11
1979 Ford Thunderbird - 2 Door Hardtop
NHTSA 790209
Post-Impact, Driver Dummy View





APPROVED ENGINEERING TEST LABORATORIES

Figure 4-12
1979 Ford Thunderbird - 2 Door Hardtop
NHTSA 790209
Post-Impact, Passenger Dummy View





APPROVED ENGINEERING TEST LABORATORIES

Figure 4-13

1979 Ford Thunderbird - 2 Door Hardtop

NHTSA 790209

Post-Impact, Fuel Spillage





APPROVED ENGINEERING TEST LABORATORIES

Figure 4-14

1979 Ford Thunderbird - 2 Door Hardtop

NHTSA 790209

Post-Impact, Fuel Tank Deformation





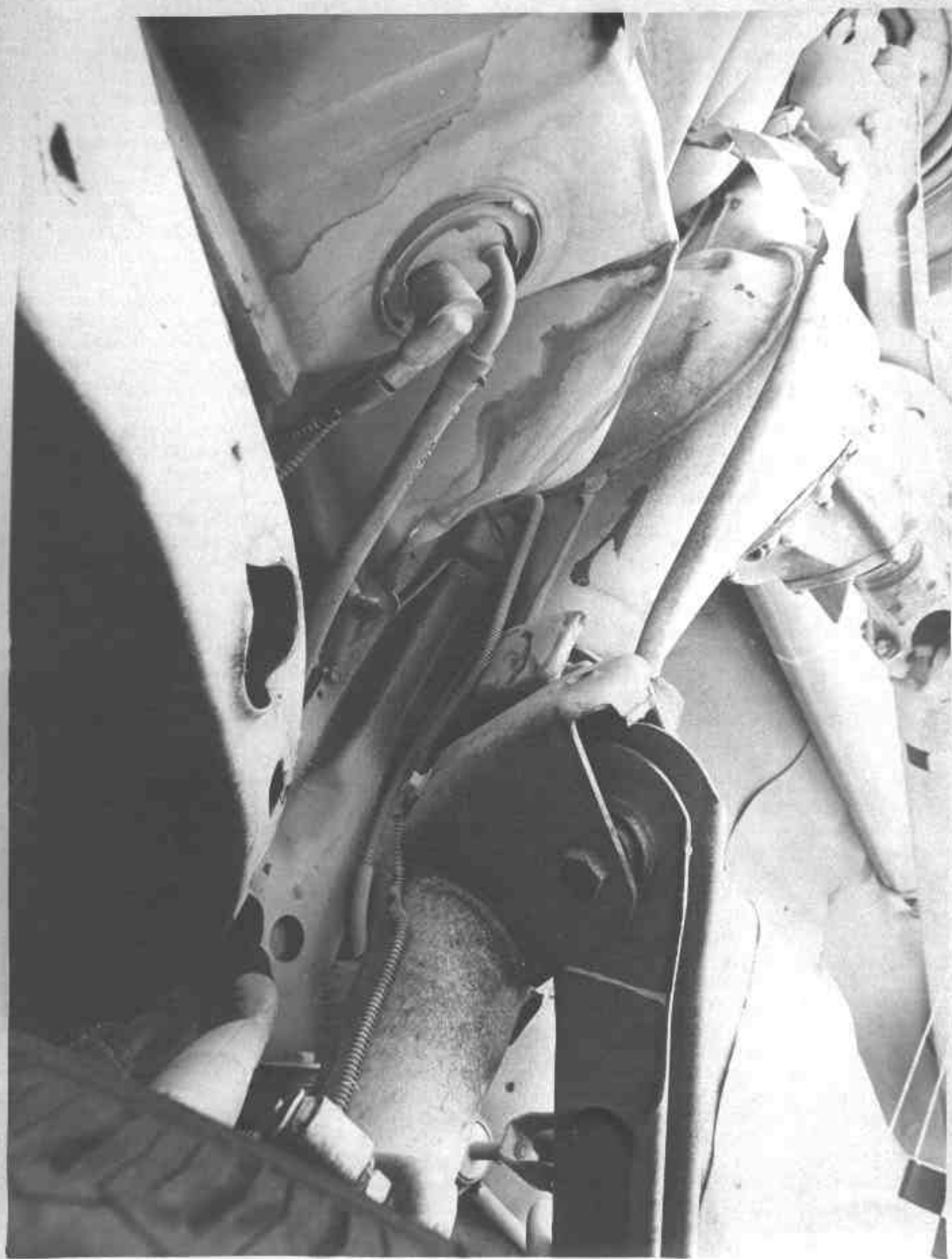
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Figure 4-15

1979 Ford Thunderbird - 2 Door Hardtop

NHTSA 790209

Post-Impact, Fuel Tank Rupture Area View





APPROVED ENGINEERING TEST LABORATORIES

SECTION 5



SECTION 5

5.0 TEST FACILITIES AND EQUIPMENT

Approved Engineering Test Laboratories (AETL) collision barriers, vehicle static rollover machine, and data processing/computer analysis test facilities are located at the Fullerton, California Division.

This section discusses these specialized facilities, along with associated equipment and instrumentation required for the performance of this test.

5.1 FRONTAL COLLISION BARRIER FACILITY

5.1.1 The frontal (fixed) collision barrier conforms to the requirements as set by the NHTSA Office of Vehicle Safety Compliance (OVSC) and as defined in the Laboratory Procedures for FMVSS 212/219/301-75, TP219-02, dated January 9, 1979, with the following special characteristics.

5.1.2 The fixed collision barrier is a steel clad, steel reinforced concrete block with a 6'4" X 12' face. The face is 1" steel plate faced with 3/4 inch plywood. The total mass of the structure is approximately 200,000 pounds, with a substantial portion below ground to provide resistance against sliding or tipping of the barrier during impact.



SECTION 5

5.1.3 The facility consists of a 500 foot concrete paved runway, with a steel monorail embedded in the approach surface. Two camera pits are provided to allow photographing the test vehicle at impact. One pit is located immediately in front of the fixed collision barrier and is 36 inches wide (expandable to 48 inches), 7 feet deep, and 23 feet long (3 feet of the pit length extends under the barrier face). The second (mid) pit with removable monorail section is located approximately 160 feet from the fixed collision barrier and is 43 inches wide, 7 feet deep, and 23 feet long.

5.1.4 Tow propulsion is provided by a fixed prime mover and continuous cable drive system located near the mid camera pit position. The power plant for the tow cable system is a 200 h.p. synchronous electric motor, coupled to an electronically controlled Eddy Current Clutch and a 4:1 gear reduction transfer assembly.

The endless 1/2 inch diameter steel tow cable is wrapped around the drive pulley and is tensioned by a pneumatic loaded idler wheel. The tow cable passes through the fixed collision barrier and around fixed idler pulleys to complete the loop. The test vehicle or moving collision barrier is towed by a dolly assembly attached to the vehicle



SECTION 5

or moving collision barrier by a shear pin release mechanism. For a fixed collision barrier test, the test vehicle is towed within 20 feet of the fixed barrier, at which point the towing dolly assembly is disconnected from the test vehicle and the test vehicle proceeds under its own momentum for the final 20 feet to impact. For a moving collision barrier test, the moving collision barrier is towed within 5 feet of the test vehicle, at which point the towing dolly is disconnected from the moving collision barrier and the moving collision barrier proceeds under its own momentum for the final 5 feet to impact. Heavy steel stops actuate the tow cable release mechanism and prevent the towing dolly from continuing past the point of impact. The towing dolly is designed to fit inside the monorail such that it is constrained in the vertical and lateral directions, and capable of sliding freely along the monorail.

5.2 OBLIQUE ANGLE COLLISION BARRIER

- 5.2.1 The oblique angle collision barrier conforms to the requirements as set by NHTSA Office of Vehicle Safety Compliance (OVSC) Laboratory Procedures TP219-02, with the following special characteristics.



SECTION 5

5.2.2 The oblique angle collision barrier is constructed of a flat 1 1/2 inch steel plate faced with 3/4 inch plywood. The barrier face is 6' x 12' and is adjustable for left or right angle impacts by means of seven tubular gussets that attach to the standard fixed frontal collision barrier to form a rigid buttress structure.

5.3 MOVING COLLISION BARRIER

5.3.1 The moving collision barrier conforms to the requirements as set by Federal Motor Vehicle Safety Standard No. 208, Paragraph S8.2 with the following special characteristics.

5.3.2 The chassis is constructed of 12 inch steel channel with tubular frame gussets. The flat impacting face plate is 1/2 inch steel plate faced with 3/4 inch plywood. The face plate is reinforced with 6 inch steel channel horizontally welded to the chassis to form a rigid symmetrical structure. A camera boom extends above the barrier face plane to provide a view of barrier to vehicle impact. The barrier assembly weighs 3,977 pounds and has a four wheel electric brake system.



SECTION 5

5.4 VEHICLE STATIC ROLLOVER MACHINE

5.4.1 The vehicle static rollover machine conforms to the requirements as set by the NHTSA Office of Vehicle Safety Compliance (OVSC) Laboratory Procedures TP219-02 with the following special characteristics.

5.4.2 The vehicle static rollover machine is constructed of 10 inch square tube with adjustable wheelbase and tread width platforms to accommodate the various test vehicles. The total usable platform area is 8 feet wide and 25 feet long with special design feature to accomodate vehicles with a gross vehicle weight rating (GVWR) of 10,000 pounds or less with various body configuration heights to 12 feet. The test vehicle can be rotated left or right and can turn each 90° rotational increment in approximately two (2) minutes.

5.5 IMPACT VELOCITY MEASUREMENT

The test vehicle impact velocity is measured by two (2) separate certification timing trap systems located within five (5) feet of the fixed collision barrier face and to one side on the approach apron. Each trap contains two (2)



SECTION 5

carbon rods, mounted twenty-four (24) inches apart, in a mechanical housing assembly providing start and stop circuits to two (2) independant digital display counters. As the test vehicle traverses the impact apron, a blade attached to the test vehicle fender breaks each carbon rod providing the precise measurement of time interval for the test vehicle to advance the known distance. Each interval time measurement is stored in the digital display counters and photographically recorded.

The moving collision barrier impact velocity is measured by two (2) separate certification timing trap systems located within five (5) feet of the barrier to vehicle impact location. Each timing trap system is controlled by a twelve (12) inch long target blade attached to the moving collision barrier to provide the precise measurement of time interval required for the target blade to pass through an optical beam. Each interval of time measurement is stored in a digital display counter and photographically recorded.



SECTION 5

5.6 PHOTOGRAPH COVERAGE

5.6.1 Because FMVSS 212/219/301-75 may be a combined test, it is necessary that all photographic coverage of the test vehicle be done at one time with specific photographs to document the areas for Vehicle Safety Compliance consideration; windshield area and the fuel system. Each report will utilize only those photographs pertaining to the Vehicle Safety Compliance Test being reported.

5.6.2 FIXED BARRIER IMPACT TEST

Motion picture coverage of the event employs four (4) 16mm 1B Photo-Sonics cameras and two (2) 16mm 51 Redlake Locam cameras using color film at 500 frames per second (fps). Also a 16mm Canon Scoopic 24 frames per second (fps) camera with color film is used to record vehicle pre-test condition, vehicle in-run, impact, and post-impact vehicle conditions including the rollover increments for documentary purposes. The six (6) high speed cameras are located at stationary positions near the point of impact. One is an overhead camera mounted on a tower above the fixed barrier face on centerline of the test vehicle at impact. Its field of view includes the barrier face and the front of the vehicle to a point about one foot aft of the windshield. A second camera is mounted on top of the fixed barrier with its field



SECTION 5

of view concentrating on the windshield area (FMVSS 212/219). The third and fourth cameras each have a side view of the test vehicle at impact. The fifth and sixth cameras are located in the pit and positioned to photograph the underside of the engine compartment and fuel tank area.

5.6.3 MOVING BARRIER IMPACT TEST

Motion picture coverage of the event employs four (4) 16mm 1B Photo Sonics cameras and two (2) 16mm 51 Redlake Locam cameras using color film at 500 frames per second (fps). Also a 16mm Canon Scoopic 24 frames per second (fps) camera with color film is used to record vehicle pre-test condition, barrier in-run, impact, and post-impact vehicle conditions including the rollover increments for documentary purposes. Five (5) of the high speed cameras are located at stationary positions near the point of impact. Three (3) cameras are located in the pit and positioned to photograph the underside of the engine compartment, with overlapping field of views, aft to the fuel tank area. The fourth and fifth cameras each have a side view of the test vehicle at impact. The sixth camera is attached to the moving collision barrier to photograph the contact between the barrier and the test vehicle.



SECTION 5

5.6.4 Time data from two (2) sources are contained in the high speed film coverage. The first time reference is a 100 pps timing pulse along the film edge. This pulse is generated by a pulse generator and fed to all high speed cameras. Thus, it is possible to relate film data to a real time base. The second time record is an indication of time zero (moment of impact). This is accomplished by a trip switch and strobe light system. The trip switch is positioned at the impact point so that it triggers the strobe light system at the moment of bumper-barrier contact. Thus, the particular film frame corresponding to the point of impact is clearly indicated on all the high speed film

5.7 DATA ACQUISITION AND REDUCTION

The data acquisition and analysis system used for acquiring occupant response and vehicle acceleration are shown schematically in Figure 5-1. A complete list of instrumentation is provided in Table 5-1. An itemized procedure for acquiring data is provided on Table 5-2.

Prior to the vehicle impact test the onboard instrumentation package is installed and a calibration and null reference check is performed to checkout all data analog devices including the FM magnetic tape recorders. The moment of impact trigger switch attached to the vehicle



SECTION 5

is also checked out. Immediately following vehicle impact a post-impact calibration and null reference check is performed.

The analog data is then played back into a Hewlett Packard Digital Fourier Analyzer (DFA) system using a HP 2100S mini computer with 32K word core storage. This system uses four program controlled analog filters which provides predigitizing filter capability of 60 db/octave above 1250 Hz.

The DFA is a hard disc based system with standard HP design software for performing data acquisition and analysis functions. The HP software is programmed using direct keyboard functions to automate the data reduction process. The data is entered into temporary storage, four channels (one set) at a time with eight total sets. Table 5-3 defines each data channel and data set. The data sets are divided into driver and passenger tape recorder groups to facilitate simultaneous data acquisition for the head, chest and vehicle accelerometers to assure appropriate calibration of injury criteria and vehicle dynamics. At the time of entry, test personnel enter the appropriate calibration for each data channel and the computer then scales the data appropriately. When all data has been acquired it is moved as a vehicle set to permanent storage on a removable magnetic



SECTION 5

disc. (Eight vehicle sets are stored on each magnetic disc. All magnetic discs and FM recorder tapes are retained on file at AETL).

The only modifications to the data at the time of permanent storage is the filtering and digitizing process of the FM tape recorder (2500 Hz) and the DFA (2000 Hz sampling for a 500 ms window). After the data is moved to permanent storage it is recalled by test personnel and plotted with the appropriate labels and vehicle designation. As the data is recalled, the DFA is programmed to automatically apply the appropriate SAE filter where applicable.

A 1250 Hz predigitizing analog filter with a rolloff of 60 db/octave, shown in figure 5-2, was applied to all data. Also shown in figure 5-2 are SAE class 60 and class 180 filters. These filters are in accordance with SAE J211a, Instrumentation for Impact Tests. These SAE recommended filters are quadratic double pole with 65% damping and a 12 db/octave rolloff. They are applied using a fast fourier transform of the data, frequency domain multiplication, and an inverse fast fourier transform of the product. The class 60 filters is applied to vehicle acceleration and belt restraint forces. The class 180 filter is applied to chest acceleration. SAE filters were not applied to head accelerations and femur forces.



SECTION 5

5.7.1 IMPACT DATA

All impact data is presented in computer plots of data digitized at 500 microseconds. Special SAE filters are applied to appropriate data sets. Each data plot includes labeling, defining the test vehicle, filter class, and the complete identification of the data plotted.

5.7.1.2 DUMMY HEAD DATA

The dummy head accelerations are processed and the Head Injury Criteria (HIC) calculation is performed. The HIC calculations are maximized for start time (T1) and end time (T2), using a manual iteration routine, usually requiring about ten iterations and between 5,000 and 10,000 combinations of start and end times. Data output is in the form of computer plots with the final HIC calculations. Listing of data value and HIC calculations are available, but not provided in the final report.



SECTION 5

5.7.1.3 DUMMY CHEST DATA

The dummy chest accelerations are processed as class 180 data, and direct Chest Severity Index (CSI) calculations are performed. Data output is in the form of computer plots with the CSI calculations.

5.7.1.4 FEMUR LOAD DATA

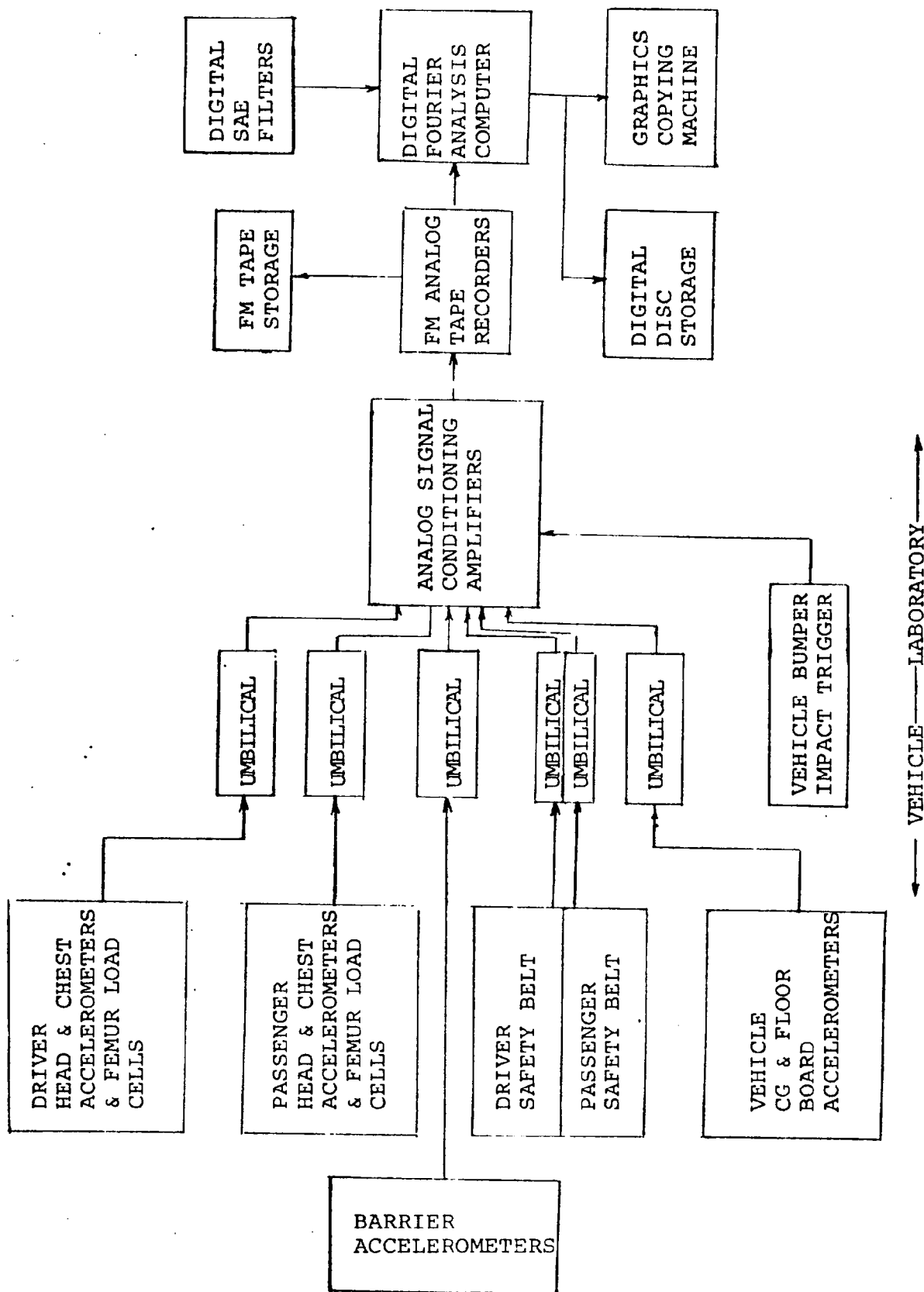
The dummy femur loads are processed and presented as computer plots.

5.7.1.5 RESTRAINT LOAD DATA

The dummy restraint loads are processed as class 60 data, and presented as computer plots.

5.7.1.6 VEHICLE ACCELERATION DATA

The vehicle accelerations are processed as class 60 data, and presented as computer plots.



VEHICLE AND OCCUPANT CRASH IMPACT DATA ACQUISITION SYSTEM

FIGURE 5-1

TABLE 5.1 INSTRUMENTATION FOR CRASH TEST

<u>Instrument</u>	<u>Manufacturer</u>	<u>Model No.</u>	<u>Full Scale</u>	<u>Accuracy</u>	<u>Frequency Max.</u>
Accelerometers, Head, Chest, Vehicle	Endevco	2262C-200	200g	±1%	3600 Hz
Load Cells, Femurs	GSE	2430	3000 lb	±1%	>3600 Hz
Load Cells, Safety Belts	GSE	2500	3000 lb	±1%	>3600 Hz
Contact Switch, Impact	AETL	-	2 V	-	<200 us rise time
FM Tape Recorder	Bell & Howell	4020	±2.8 V	47 db SNR	2500 Hz WB
Programmable Filter, All Data	Hewlett Packard	54440A	-	0.5%	1250 Hz, 60 db/oct
Analog-Digital Converter, All Data	Hewlett Packard	5466B	-	0.5%	200 us sampling
Analysis Computer, All Analysis	Hewlett Packard	2100S	32 K Words	16 Bit Word	-
Disc Drive	Hewlett Packard	7900A	5 Meg Words	-	-



APPROVED ENGINEERING TEST LABORATORIES

TABLE 5-2

DATA ACQUISITION AND REDUCTION PROCESS

<u>STEP</u>	<u>DESCRIPTION</u>
1	DA System Installation
2	DA System Pre-Impact Calibration
3	Impact Trigger Checkout
4	Vehicle Impact Performed
5	DA System Post-Impact Calibration
6	Data Reproduced From FM Tape Into Computer a) Data analog filtered at 1250 Hz b) Data digitized at 500 ms sample rate c) Data sychronized by impact trigger signal
7	Digitized Data Examined
8	Data Transferred Permanent Disc Storage
9	Appropriate SAE Filters Are Applied
10	Each Data Signal Plotted With Lables
11	Chest Severity Index Values Determined
12	Head Injury Criteria Values Determined

TABLE 5-3

DATA DESIGNATIONS FOR VEHICLE CRASH IMPACT DATA ACQUISITION

DATA SET	TAPE NO.	CHANNEL NO.	DESCRIPTION
1	1	1	Driver Longitudinal Head Acceleration Ax
1	1	2	Driver Lateral Head Acceleration Ay
1	1	3	Driver Vertical Head Acceleration Az
1	1	4	Driver Right Femur Force
2	1	5	Driver Longitudinal Chest Acceleration Ax
2	1	6	Driver Lateral Chest Acceleration Ay
2	1	7	Driver Vertical Chest Acceleration Az
2	1	8	Driver Left Femur Force
3	1	9	Driver Restraint Belt Force
3	1	10	Vehicle Vertical CG Acceleration Az
3	1	11	Vehicle Lateral CG Acceleration Ay
3	1	12	Vehicle Longitudinal CG Acceleration Ax
4	1	13	Left Rear Floor Pan Longitudinal Acceleration Ax
4	1	14	Left Rear Floor Pan Vertical Acceleration Az
5	2	1	Passenger Longitudinal Head Acceleration Ax
5	2	2	Passenger Lateral Head Acceleration Ay
5	2	3	Passenger Vertical Head Acceleration Az
5	2	4	Passenger Right Femur Force
6	2	5	Passenger Longitudinal Chest Acceleration Ax
6	2	6	Passenger Lateral Chest Acceleration Ay
6	2	7	Passenger Vertical Chest Acceleration Az
6	2	8	Passenger Femur Force
7	2	9	Passenger Restraint Belt Force
7	2	10	Barrier Lateral Acceleration Ay
7	2	11	Barrier Longitudinal Acceleration Ax
7	2	12	Barrier Vertical Acceleration Az
8	2	13	Right Front Floor Pan Longitudinal Acceleration Ax
8	2	14	Right Front Floor Pan Vertical Acceleration Az

HP 5451 DATA PLOT

APPROVED ENGINEERING TEST LABS

COMPARISON PLOT OF SAE CLASS 60, 180, 600, 1000 FILTERS AND
THE DATA ANALYSIS 1250 HZ PREDIGITIZING ANALOG FILTER.

SAE FILTERS ROLL OFF IS 12DB/OCT, ANALOG FILTER ROLL OFF IS 60DB/OCT

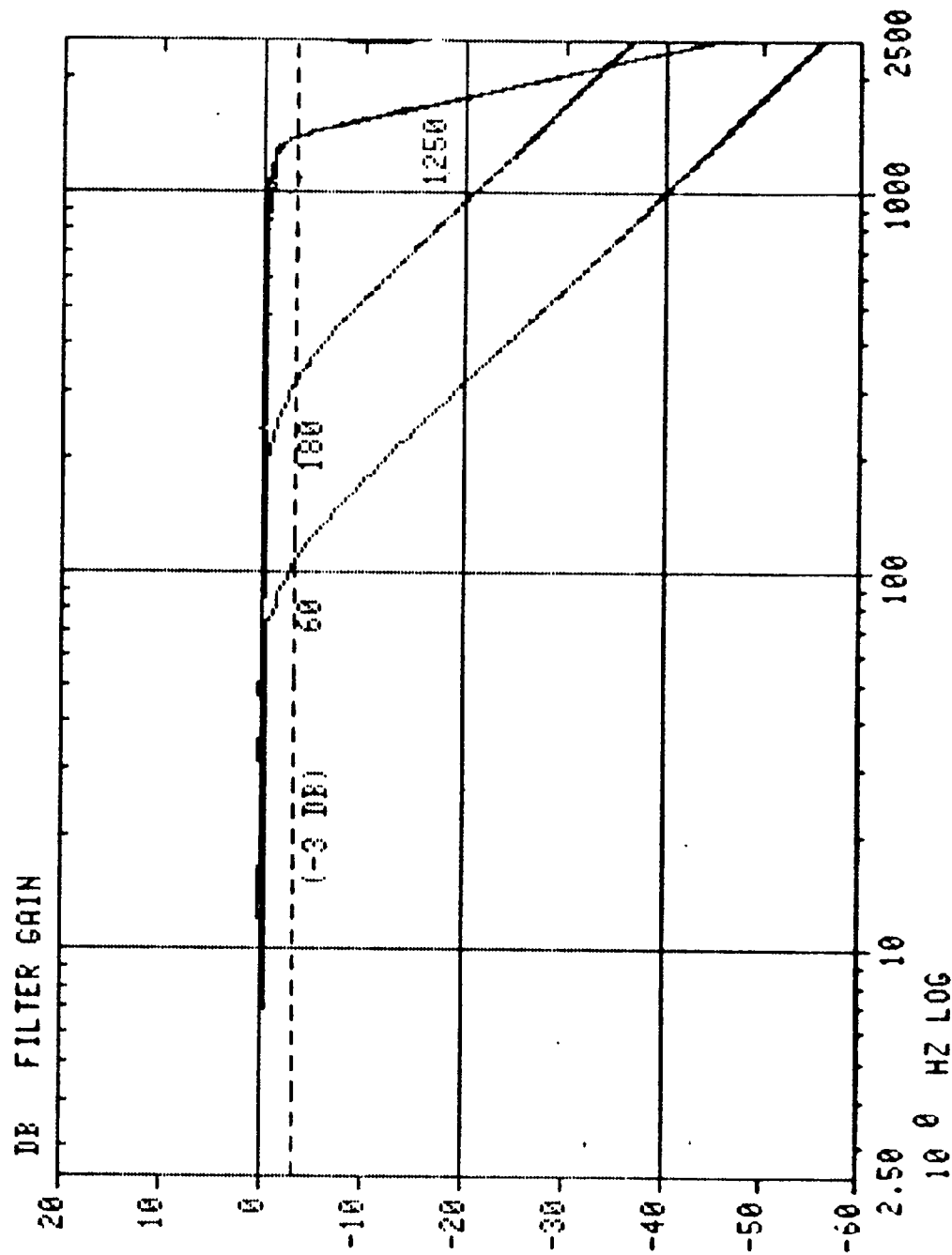


FIGURE 5-2



APPROVED ENGINEERING TEST LABORATORIES

APPENDIX A



APPROVED ENGINEERING TEST LABORATORIES

APPENDIX A

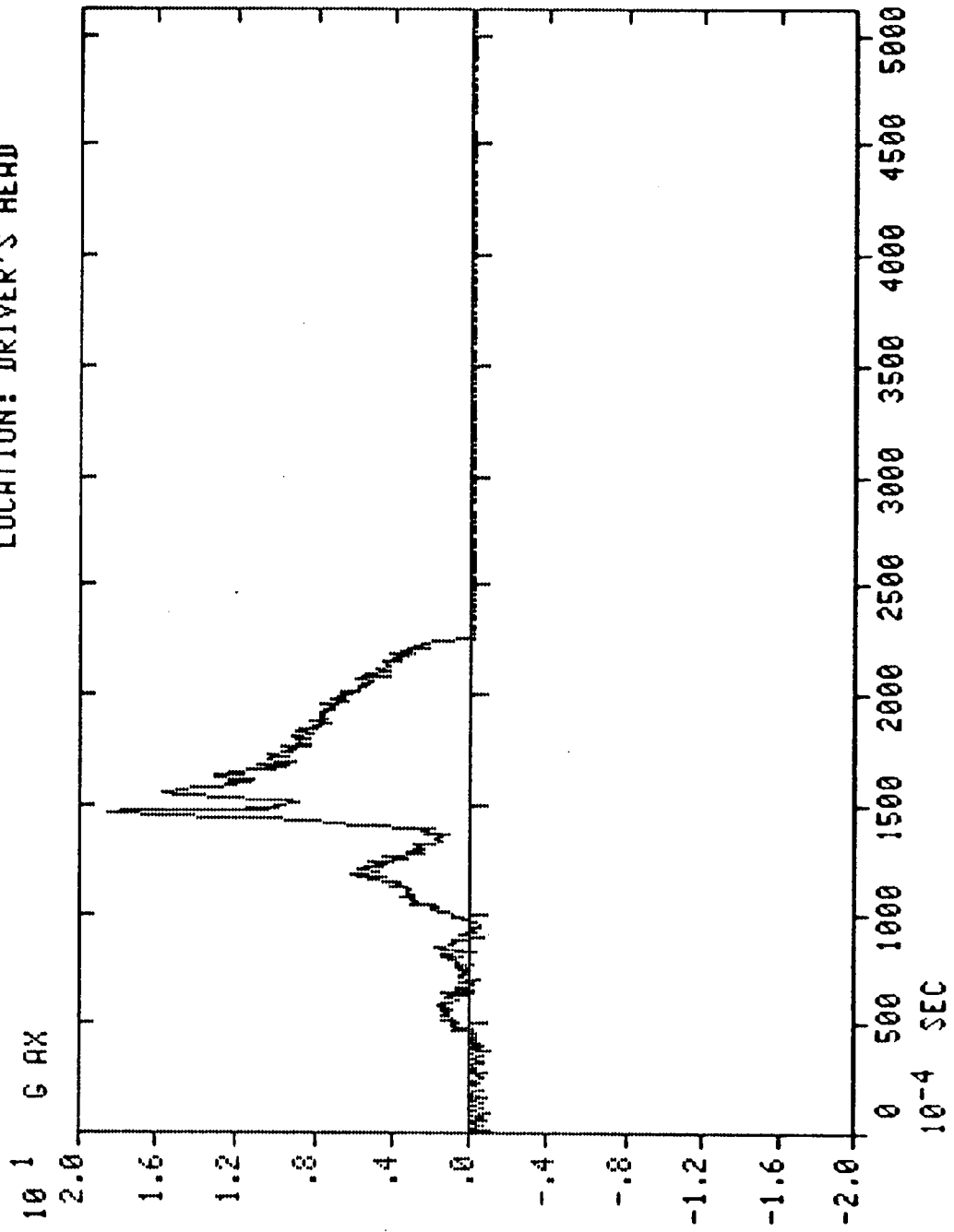
The following computer plots provide complete and comprehensive occupant response and vehicle acceleration during this rear impact event of the 1979 Ford Thunderbird - 2 Door Hardtop, NHTSA 790209.

DOT CRASH PROGRAM

APPROVED ENGINEERING TEST LABS

VEHICLE: FORD THUNDERBIRD
VEHICLE ID: NHTSA 790209
TEST FILE NO.: 51 REAR
DATE: SEPTEMBER 19, 1979

MJO NO.: 671-1489-83
FILTER: CLASS 1000
ACCELEROMETER: TAPE 1, CH 1
DIRECTION: FORWARD
LOCATION: DRIVER'S HEAD

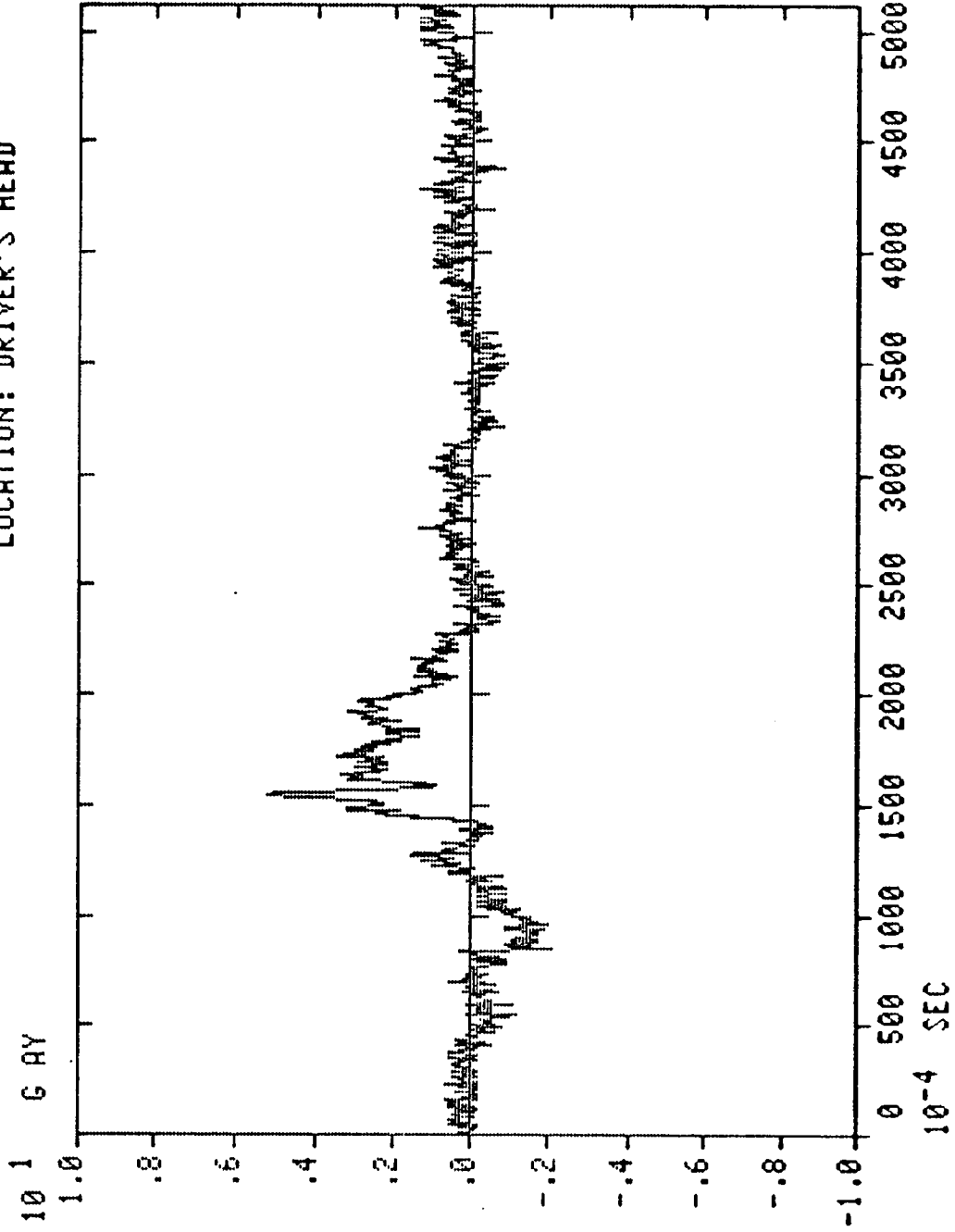


DOT CRASH PROGRAM

APPROVED ENGINEERING TEST LABS

VEHICLE: FORD THUNDERBIRD
VEHICLE ID: NHTSA 790209
TEST FILE NO.: 51 REAR
DATE: SEPTEMBER 19, 1979

MJO NO.: 671-1489-83
FILTER: CLASS 1000
ACCELEROMETER: TAPE 1, CH 2
DIRECTION: LEFT
LOCATION: DRIVER'S HEAD

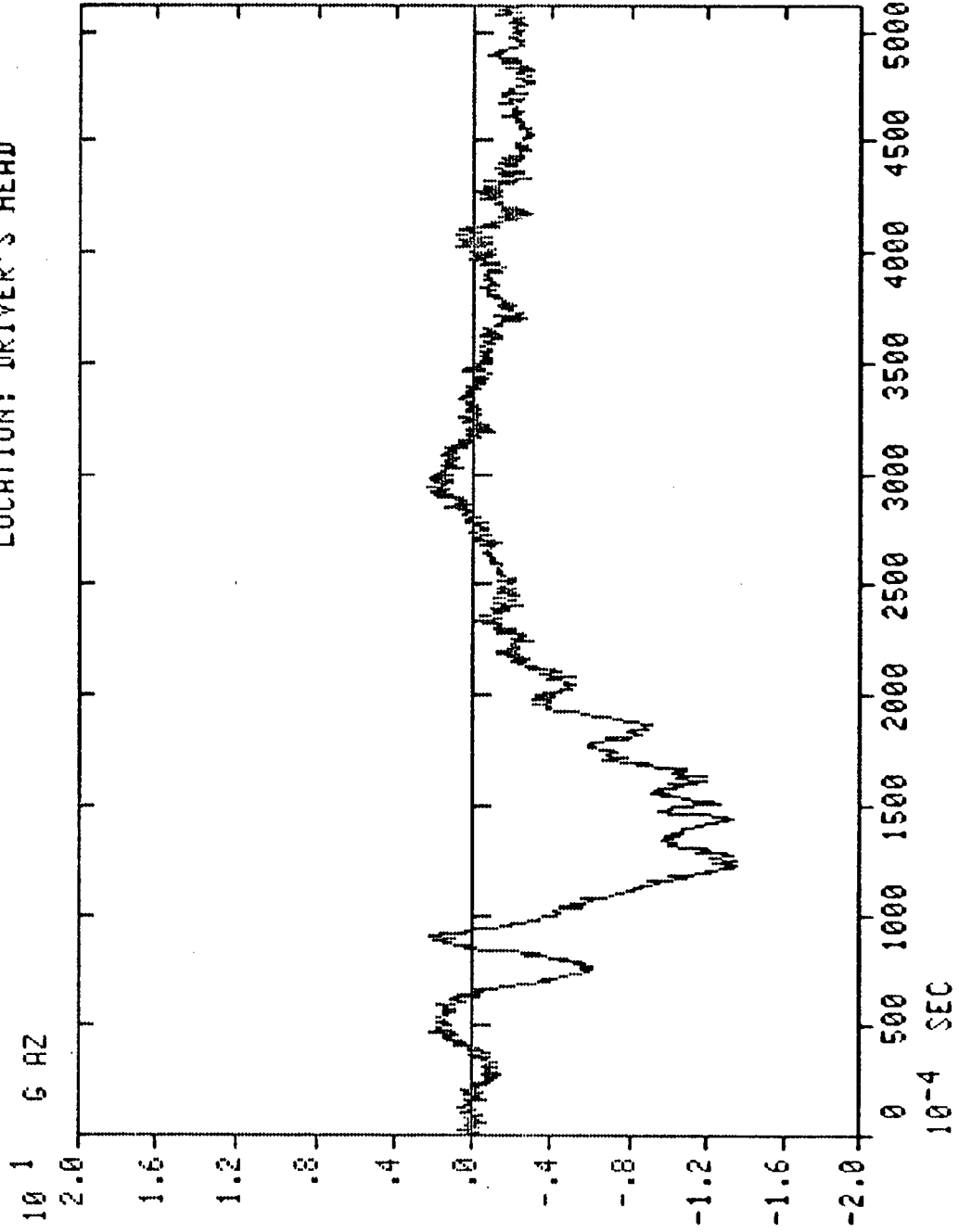


DOT CRASH PROGRAM

APPROVED ENGINEERING TEST LABS

VEHICLE: FORD THUNDERBIRD
VEHICLE ID: NHTSA 790209
TEST FILE NO.: 51 REAR
DATE: SEPTEMBER 19, 1979

MJO NO.: 671-1489-83
FILTER: CLASS 1000
ACCELEROMETER: TAPE 1, CH 3
DIRECTION: UPWARD
LOCATION: DRIVER'S HEAD

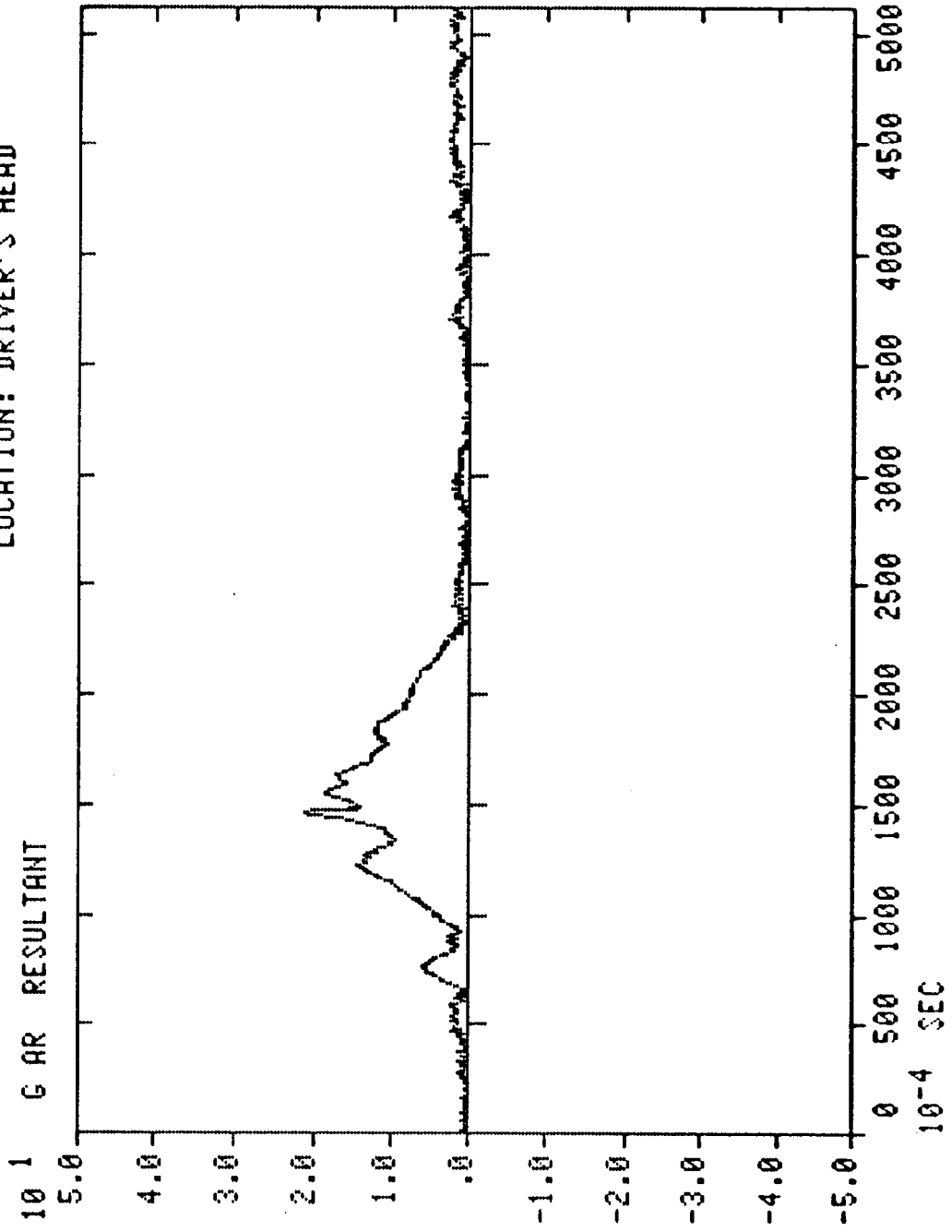


DOT CRASH PROGRAM

APPROVED ENGINEERING TEST LABS

VEHICLE: FORD THUNDERBIRD
VEHICLE ID: NHTSA 790209
TEST FILE NO.: 51 REAR
DATE: SEPTEMBER 19, 1979

MJO NO. : 671-1489-83
FILTER: CLASS 1000
ACCELEROMETER: TAPE 1, CH 1-3
DIRECTION: RESULTANT OF XYZ
LOCATION: DRIVER'S HEAD

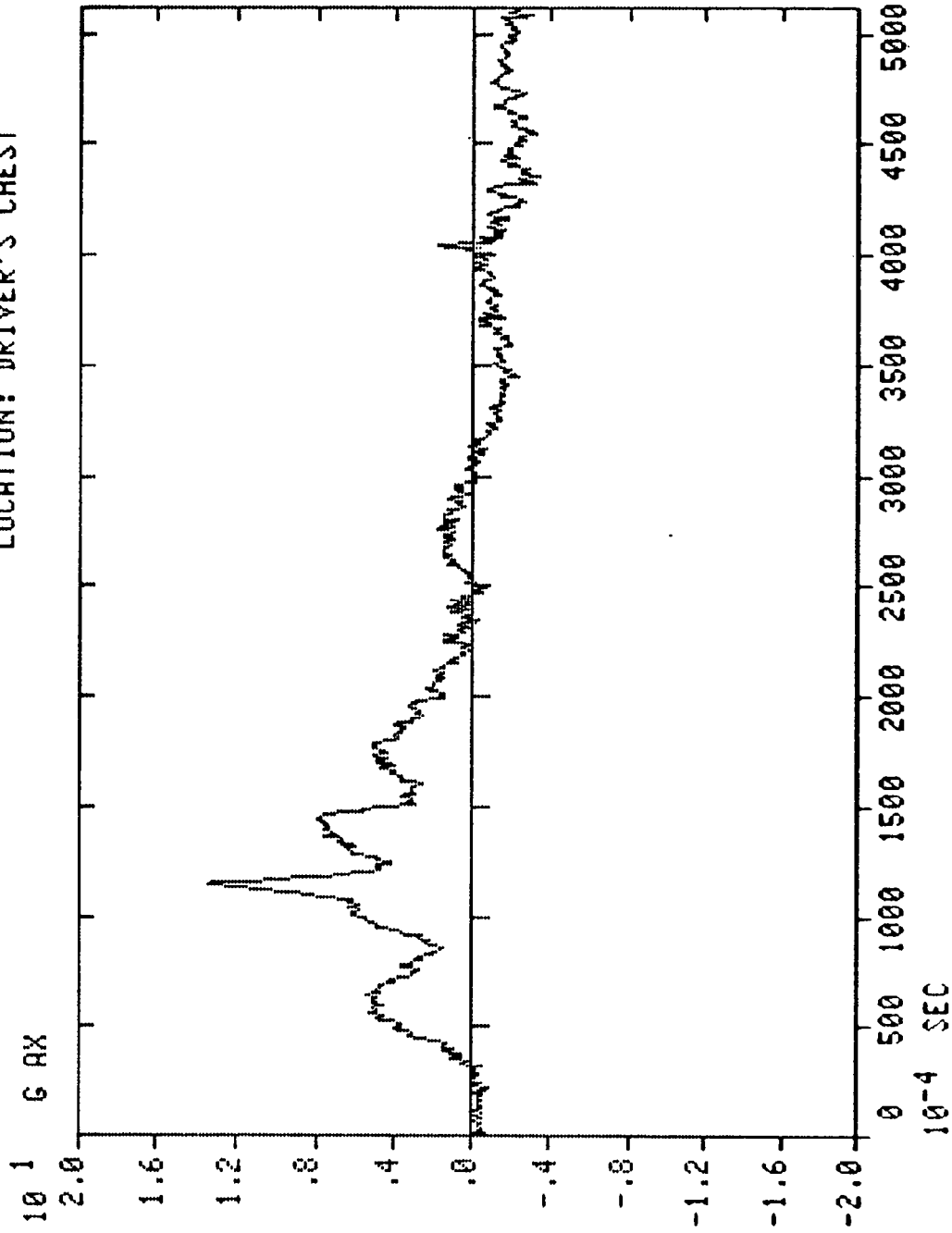


DOT CRASH PROGRAM

APPROVED ENGINEERING TEST LABS

VEHICLE: FORD THUNDERBIRD
VEHICLE ID: NHTSA 790209
TEST FILE NO.: 51 REAR
DATE: SEPTEMBER 19, 1979

MJO NO.: 671-1489-83
FILTER: CLASS 180
ACCELEROMETER: TAPE 1, CH 5
DIRECTION: FORWARD
LOCATION: DRIVER'S CHEST

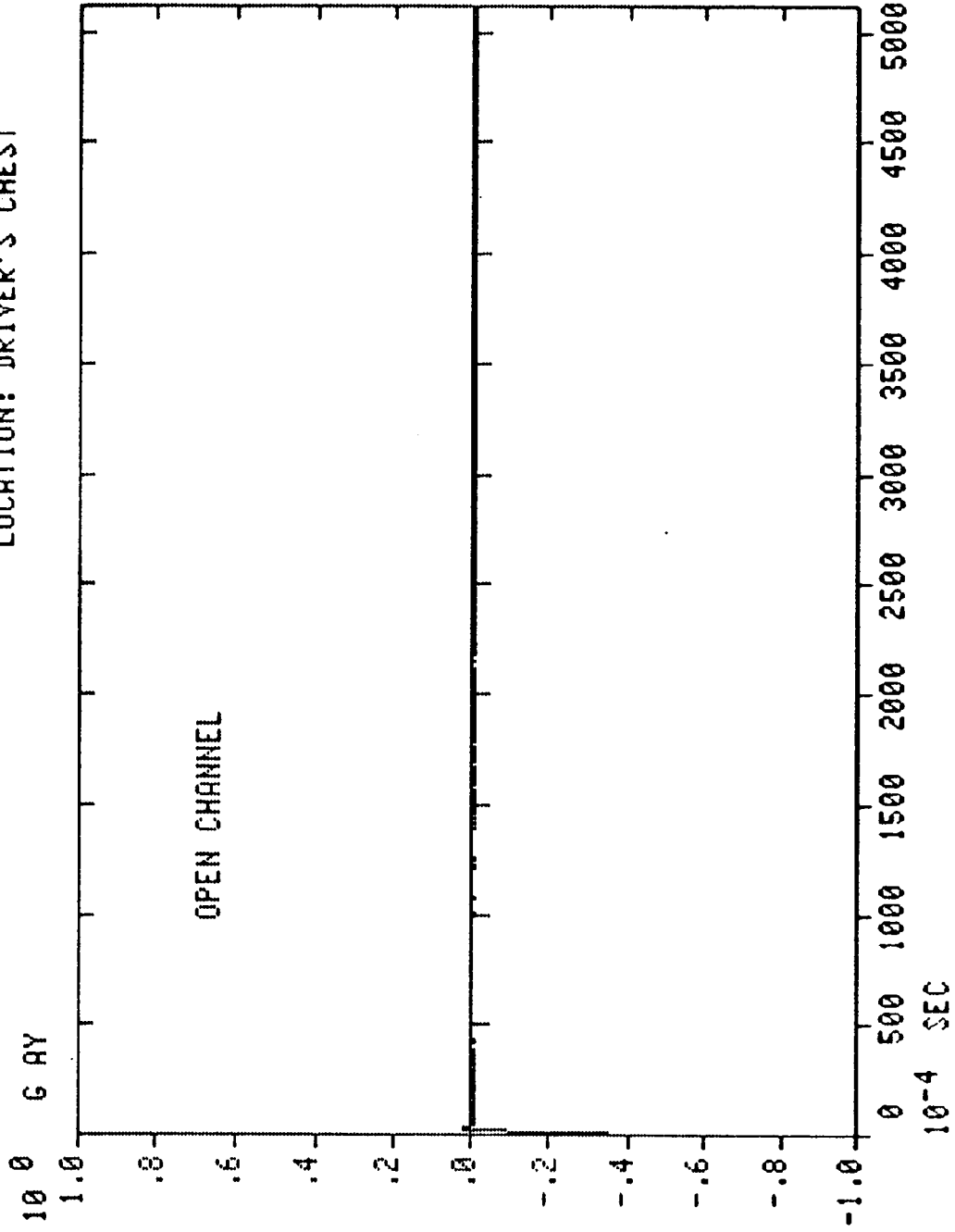


DOT CRASH PROGRAM

VEHICLE: FORD THUNDERBIRD
VEHICLE ID: NHTSA 790209
TEST FILE NO.: 51 REAR
DATE: SEPTEMBER 19, 1979

APPROVED ENGINEERING TEST LABS

MJO NO.: 671-1489-83
FILTER: CLASS 180
ACCELEROMETER: TAPE 1, CH 6
DIRECTION: LEFT
LOCATION: DRIVER'S CHEST

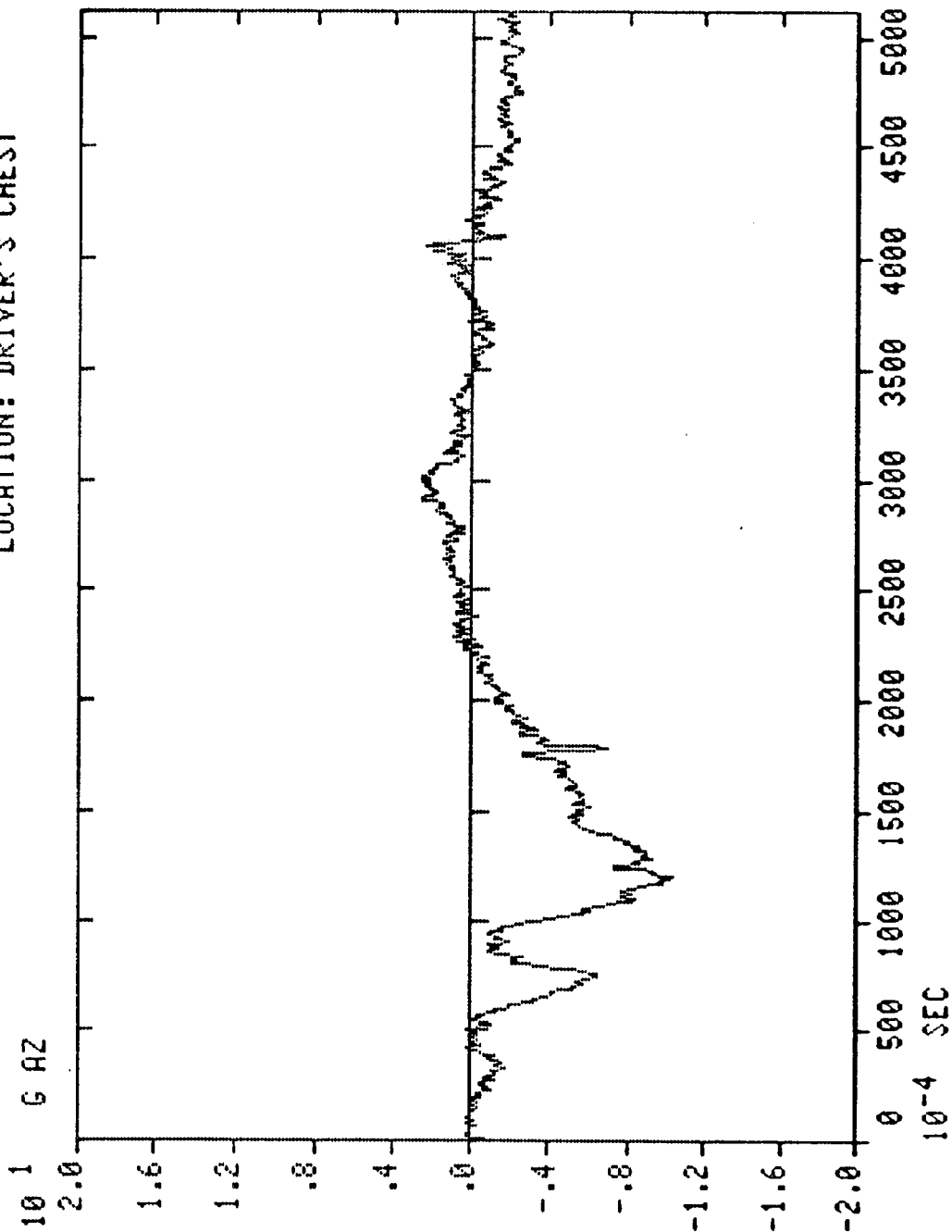


DOT CRASH PROGRAM

APPROVED ENGINEERING TEST LABS

VEHICLE: FORD THUNDERBIRD
VEHICLE ID: NHTSA 790209
TEST FILE NO.: 51 REAR
DATE: SEPTEMBER 19, 1979

MJO NO.: 671-1489-83
FILTER: CLASS 180
ACCELEROMETER: TAPE 1, CH 7
DIRECTION: UPWARD
LOCATION: DRIVER'S CHEST

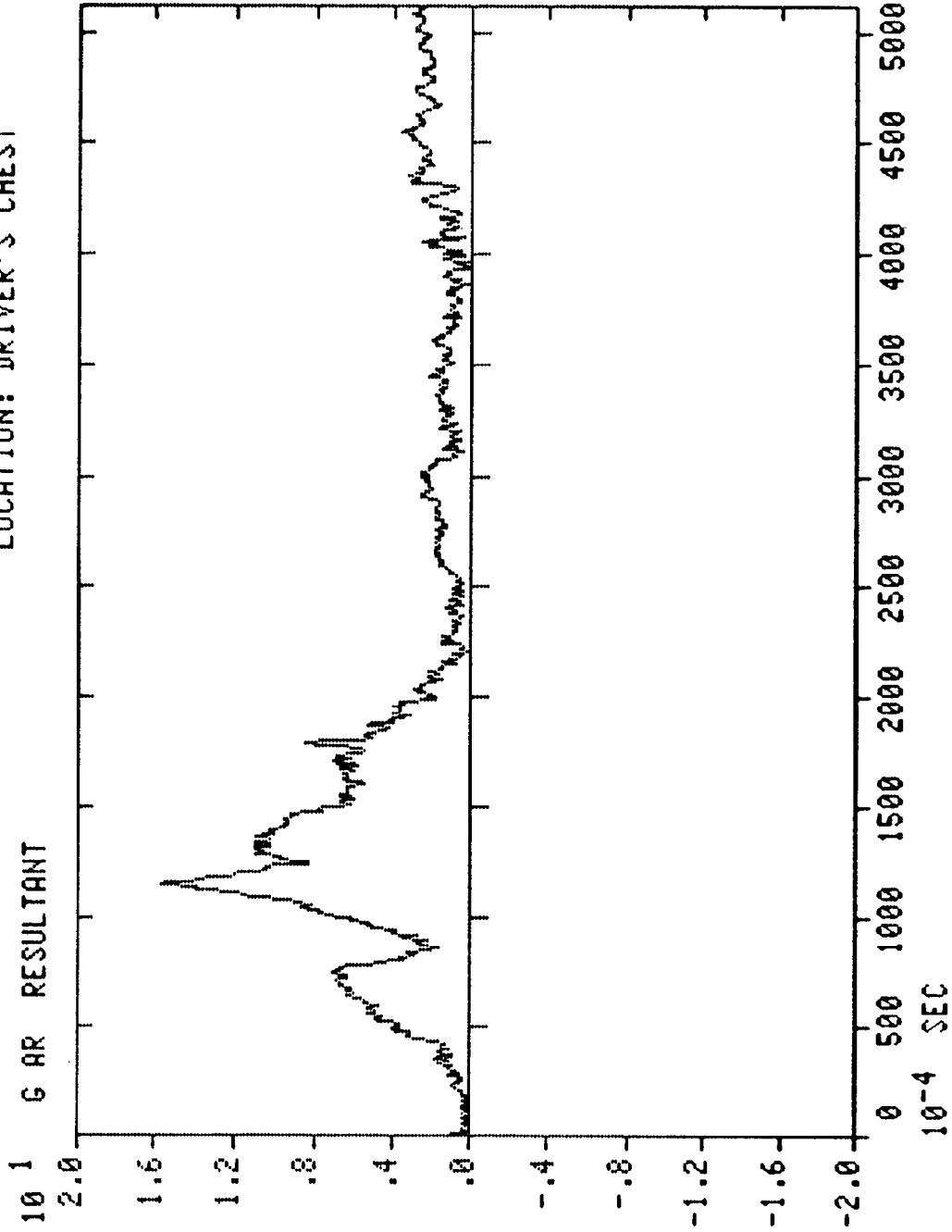


DOT CRASH PROGRAM

VEHICLE: FORD THUNDERBIRD
VEHICLE ID: NHTSA 790209
TEST FILE NO.: 51 REAR
DATE: SEPTEMBER 19, 1979

APPROVED ENGINEERING TEST LABS

MJO NO. : 671-1489-83
FILTER: CLASS 180
ACCELEROMETER: TAPE 1, CH 5-7
DIRECTION: RESULTANT OF XYZ
LOCATION: DRIVER'S CHEST

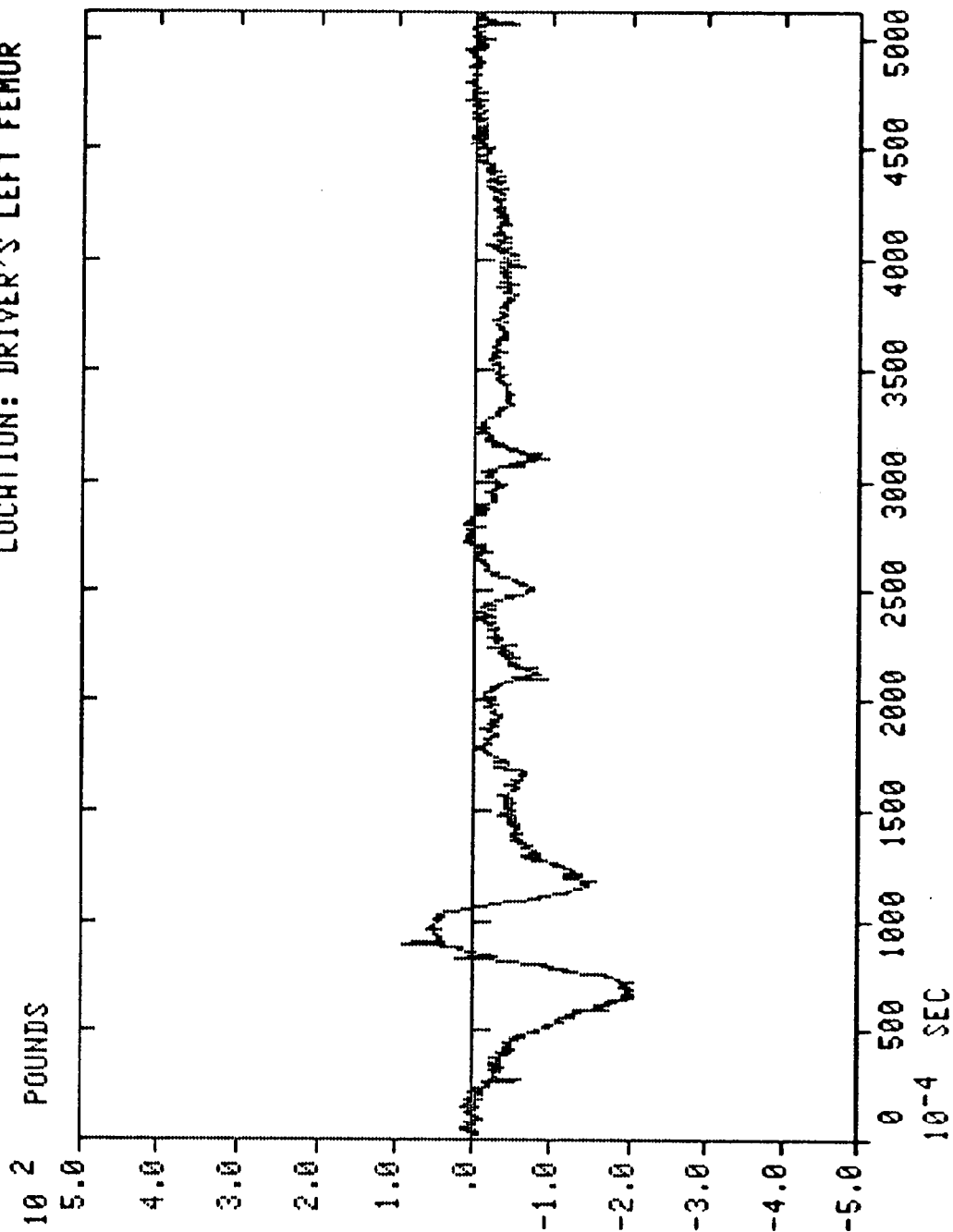


DOT CRASH PROGRAM

VEHICLE: FORD THUNDERBIRD
VEHICLE ID: NHTSA 790209
TEST FILE NO.: 51 REAR
DATE: SEPTEMBER 19, 1979

APPROVED ENGINEERING TEST LABS

MJO NO.: 671-1489-83
FILTER: CLASS 600
LOAD CELL: TAPE 1, CH 8
DIRECTION: TENSION
LOCATION: DRIVER'S LEFT FEMUR

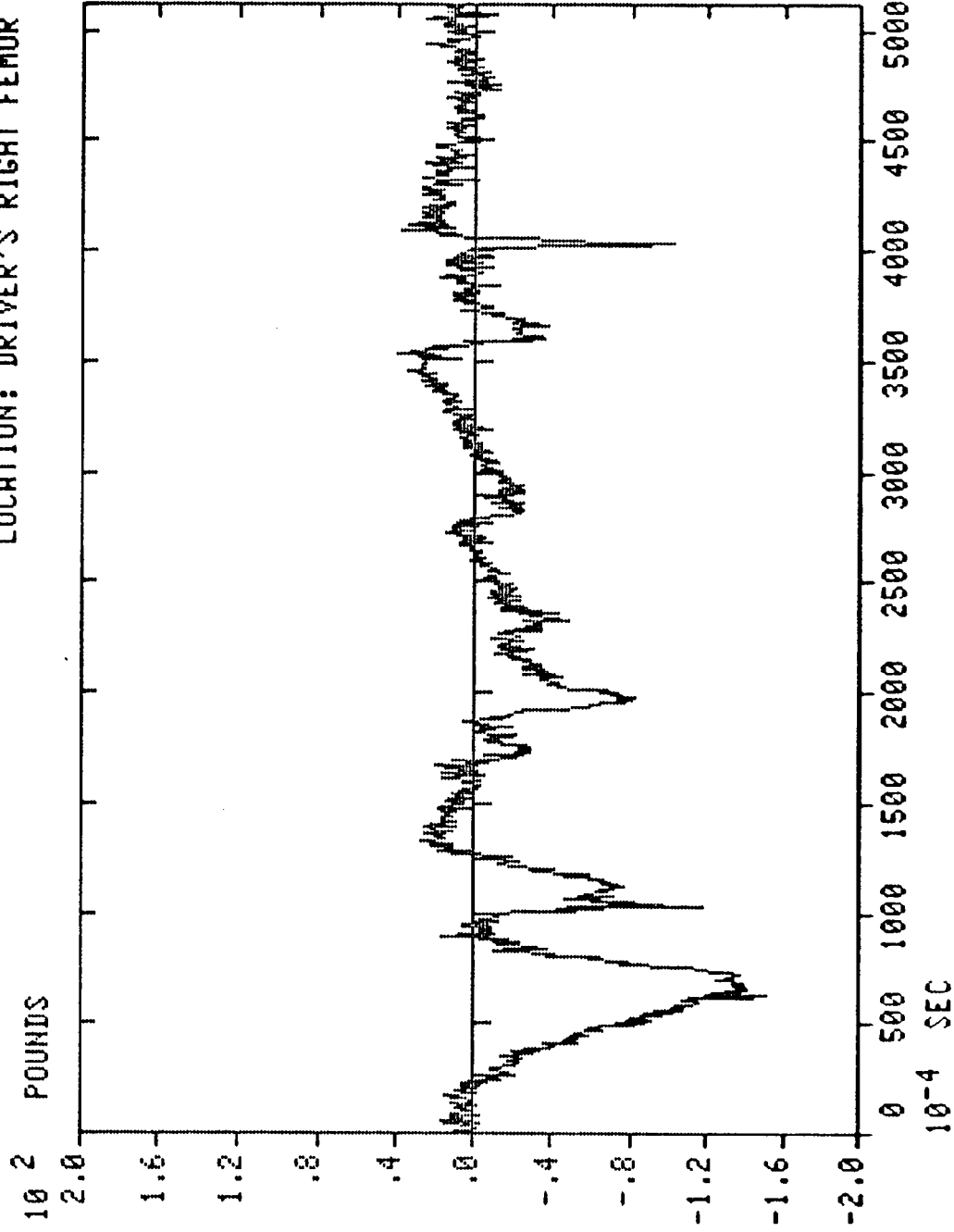


DOT CRASH PROGRAM

VEHICLE: FORD THUNDERBIRD
VEHICLE ID: NHTSA 790209
TEST FILE NO.: 51 REAR
DATE: SEPTEMBER 19, 1979

APPROVED ENGINEERING TEST LABS

MJO NO. : 671-1489-83
FILTER: CLASS 600
LOAD CELL: TAPE 1, CH 4
DIRECTION: TENSION
LOCATION: DRIVER'S RIGHT FEMUR

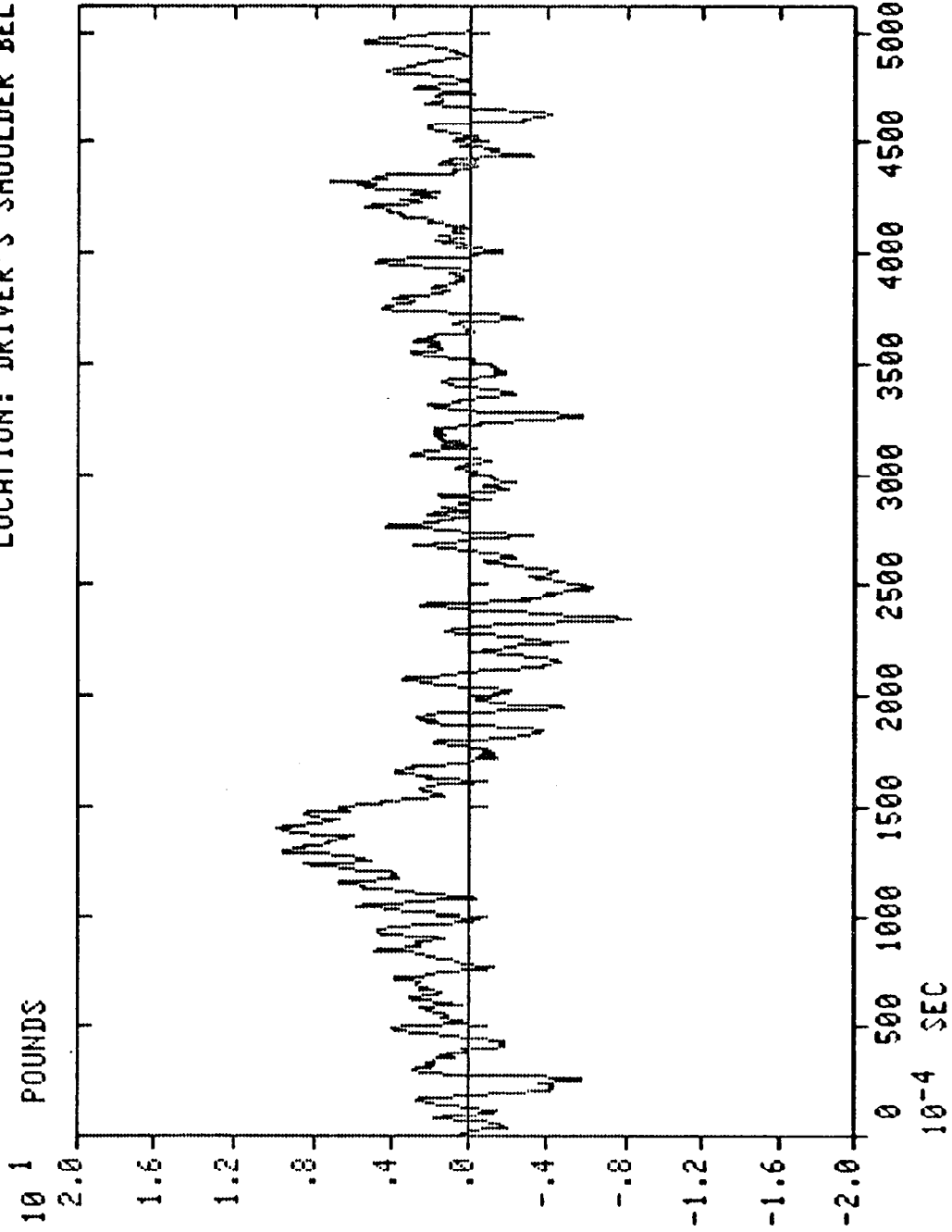


DOT CRASH PROGRAM

APPROVED ENGINEERING TEST LABS

VEHICLE: FORD THUNDERBIRD
VEHICLE ID: NHTSA 790209
TEST FILE NO.: 51 REAR
DATE: SEPTEMBER 19, 1979

MJO NO.: 671-1489-83
FILTER: CLASS 60
LOAD CELL: TAPE 1, CH 9
DIRECTION: TENSION
LOCATION: DRIVER'S SHOULDER BELT

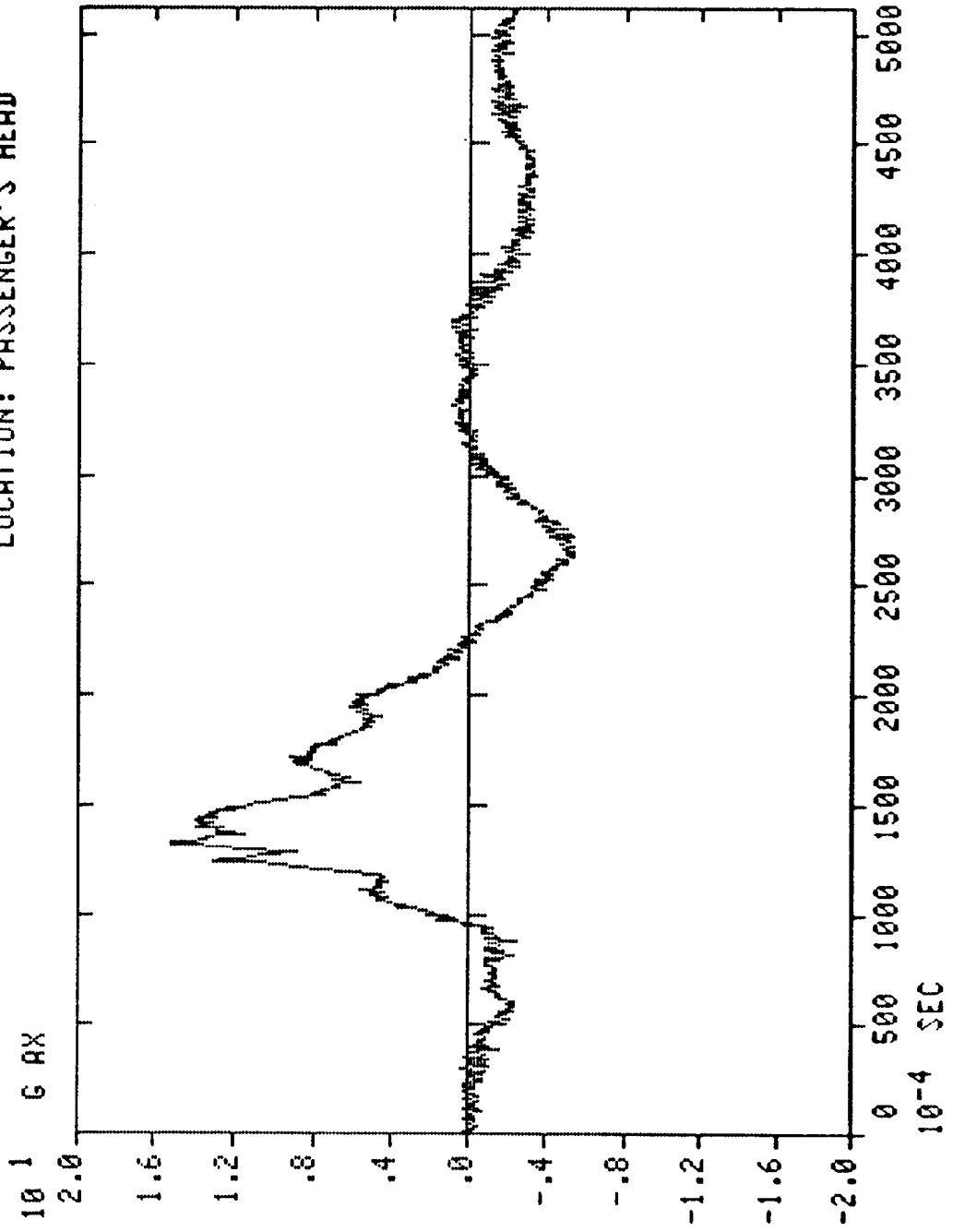


DOT CRASH PROGRAM

APPROVED ENGINEERING TEST LABS

VEHICLE: FORD THUNDERBIRD
VEHICLE ID: NHTSA 790209
TEST FILE NO.: 51 REAR
DATE: SEPTEMBER 19, 1979

MJO NO.: 671-1489-83
FILTER: CLASS 1000
ACCELEROMETER: TAPE 2, CH 1
DIRECTION: FORWARD
LOCATION: PASSENGER'S HEAD

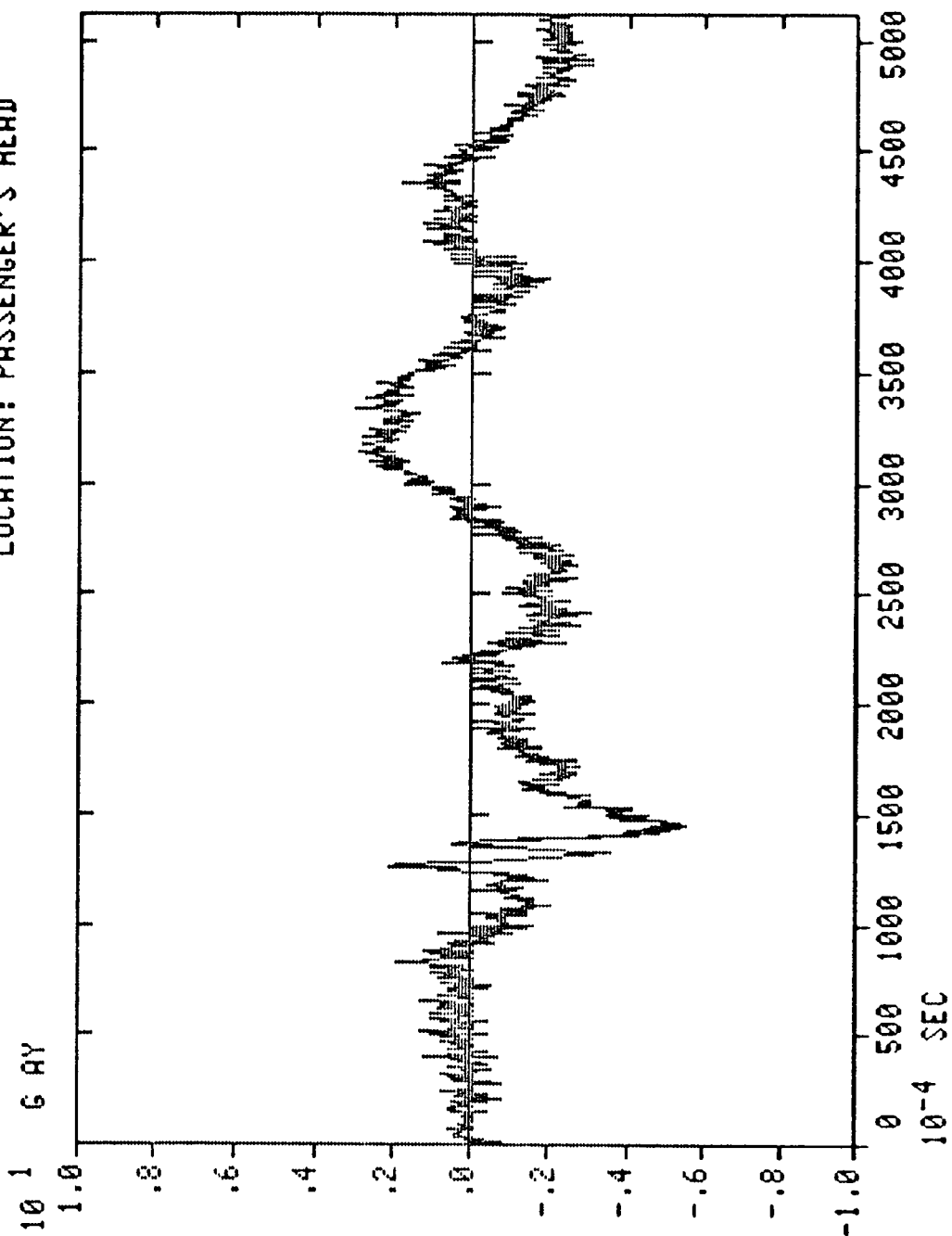


DOT CRASH PROGRAM

APPROVED ENGINEERING TEST LABS

VEHICLE: FORD THUNDERBIRD
VEHICLE ID: NHTSA 790209
TEST FILE NO.: 51 REAR
DATE: SEPTEMBER 19, 1979

MJO NO.: 671-1489-83
FILTER: CLASS 1000
ACCELEROMETER: TAPE 2, CH 2
DIRECTION: LEFT
LOCATION: PASSENGER'S HEAD

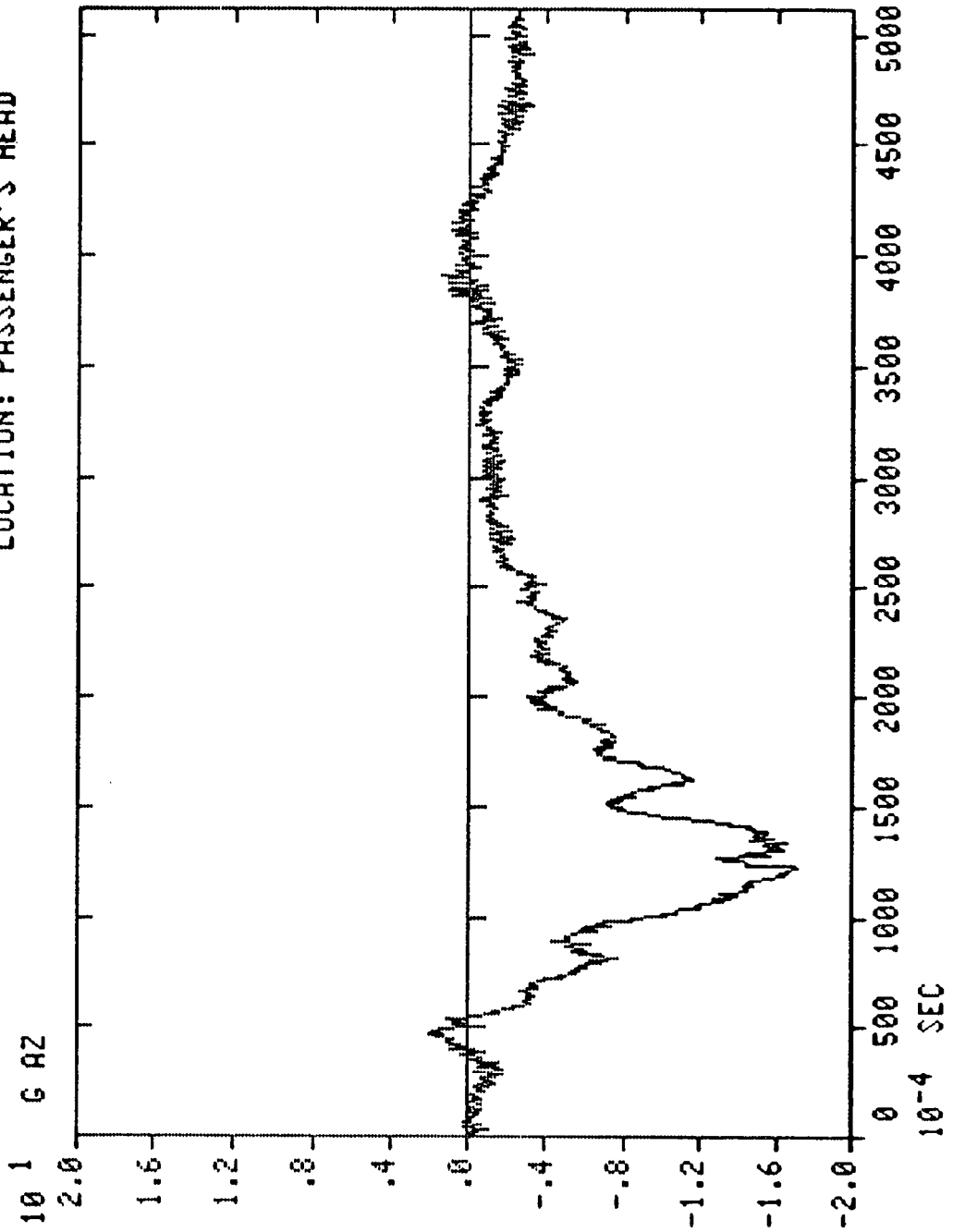


DOT CRASH PROGRAM

APPROVED ENGINEERING TEST LABS

VEHICLE: FORD THUNDERBIRD
VEHICLE ID: NHTSA 790209
TEST FILE NO.: 51 REAR
DATE: SEPTEMBER 19, 1979

MJO NO.: 671-1489-83
FILTER: CLASS 1000
ACCELEROMETER: TAPE 2, CH 3
DIRECTION: UPWARD
LOCATION: PASSENGER'S HEAD

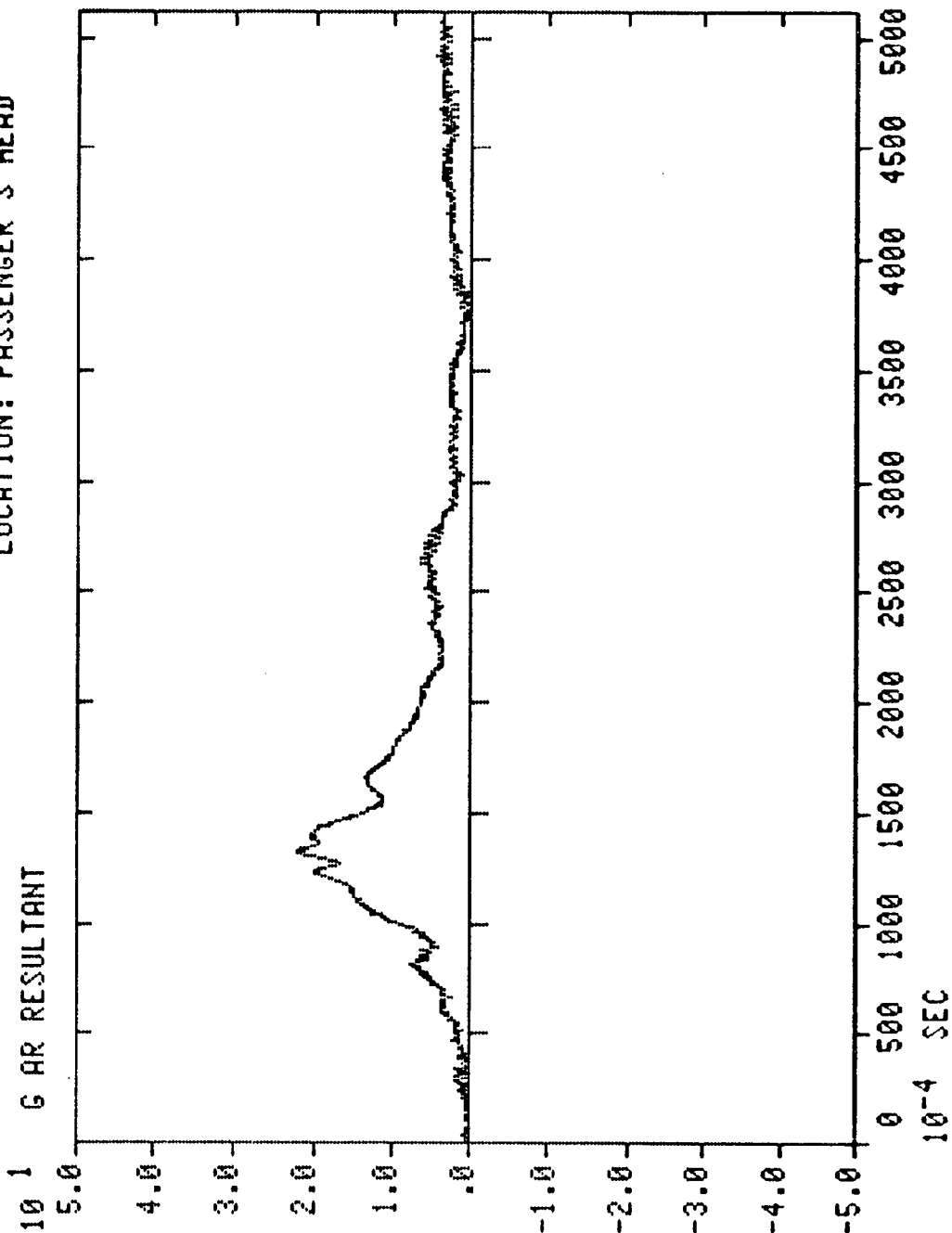


DOT CRASH PROGRAM

VEHICLE: FORD THUNDERBIRD
VEHICLE ID: NHTSA 790209
TEST FILE NO.: 51 REAR
DATE: SEPTEMBER 19, 1979

APPROVED ENGINEERING TEST LABS

MJO NO.: 671-1489-83
FILTER: CLASS 1000
ACCELEROMETER: TAPE 2, CH 1-3
DIRECTION: RESULTANT OF XYZ
LOCATION: PASSENGER'S HEAD

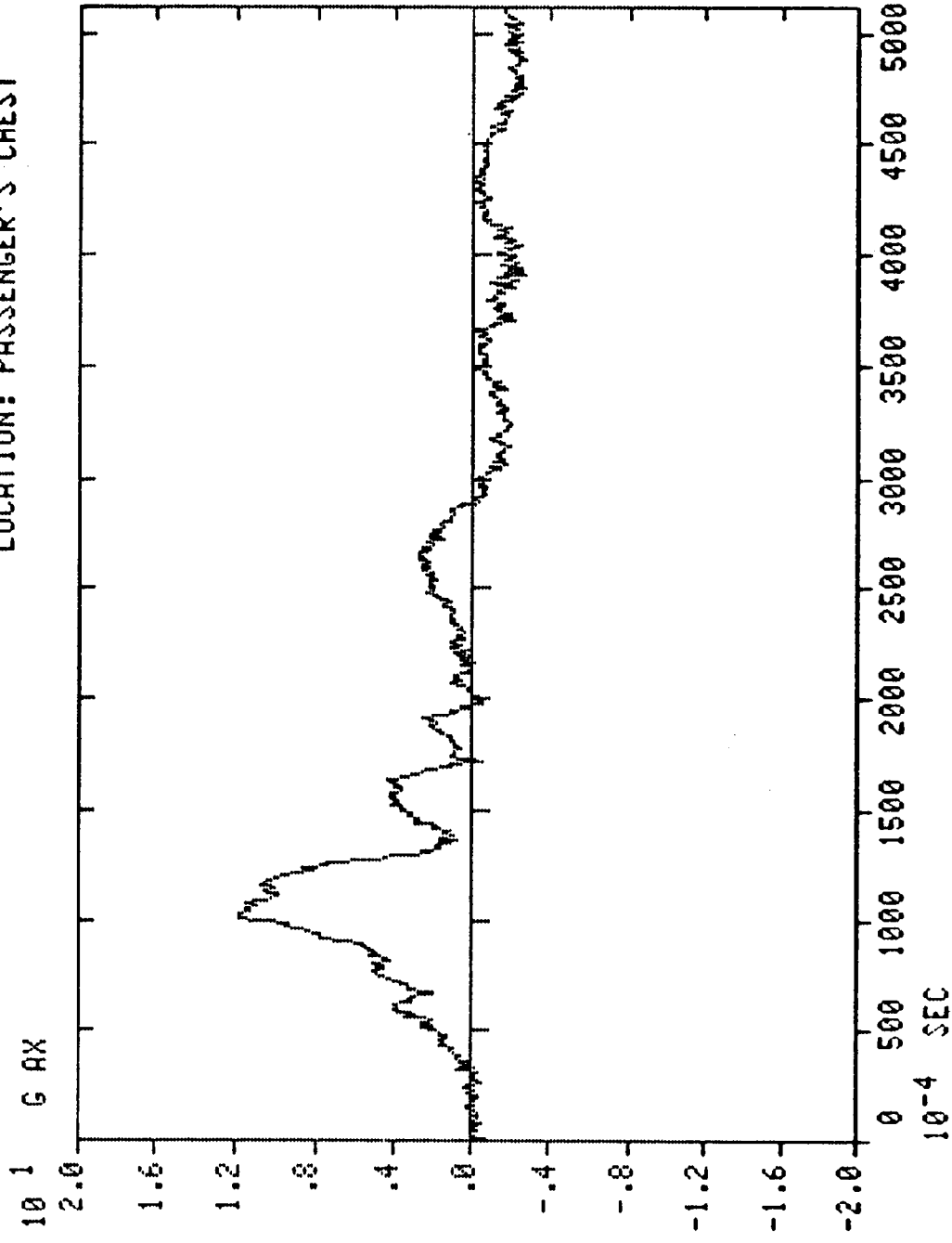


DOT CRASH PROGRAM

APPROVED ENGINEERING TEST LABS

VEHICLE: FORD THUNDERBIRD
VEHICLE ID: NHTSA 790209
TEST FILE NO.: 51 REAR
DATE: SEPTEMBER 19, 1979

MJO NO. : 671-1489-83
FILTER: CLASS 180
ACCELEROMETER: TAPE 2, CH 5
DIRECTION: FORWARD
LOCATION: PASSENGER'S CHEST

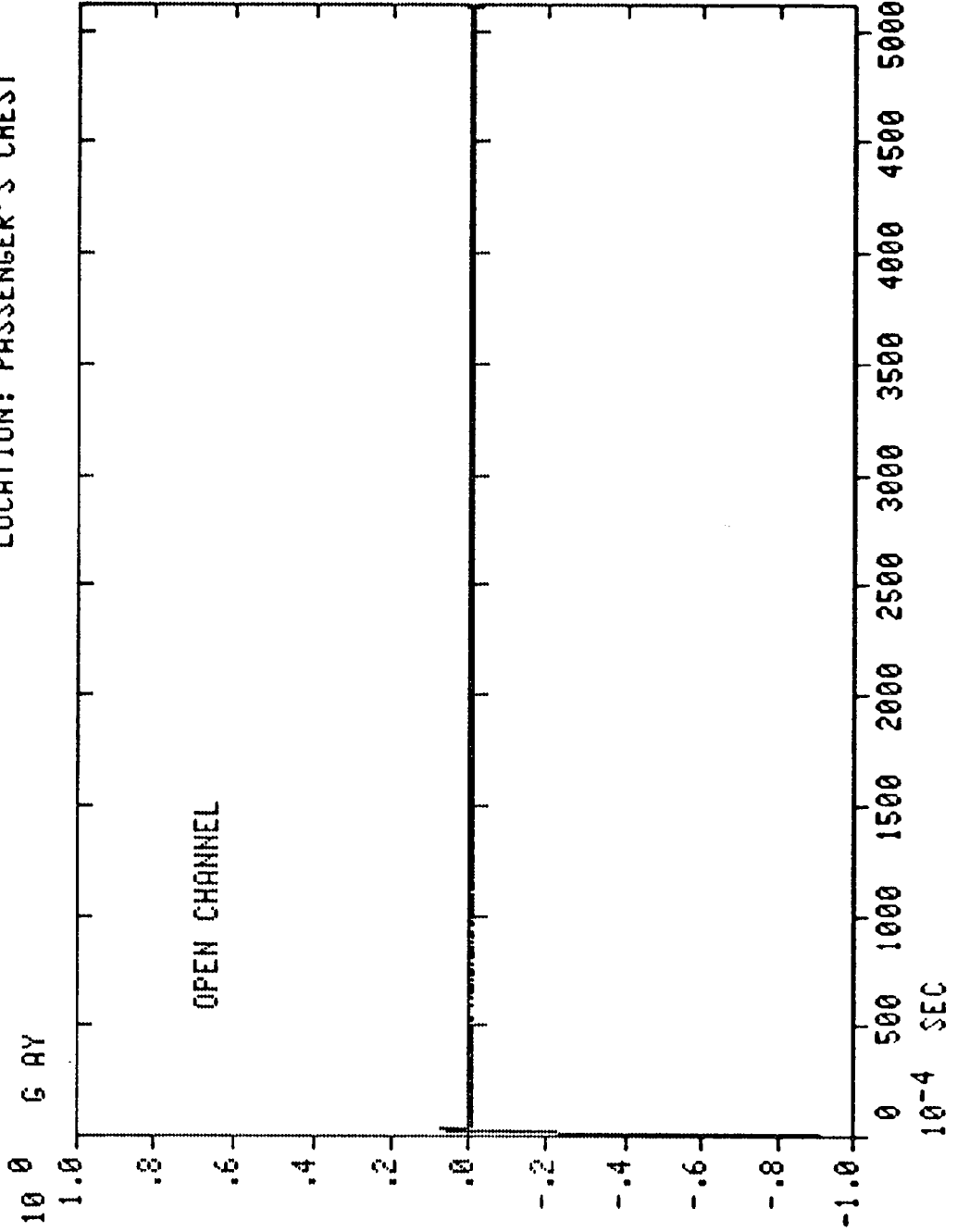


DOT CRASH PROGRAM

VEHICLE: FORD THUNDERBIRD
VEHICLE ID: NHTSA 790209
TEST FILE NO.: 51 REAR
DATE: SEPTEMBER 19, 1979

APPROVED ENGINEERING TEST LABS

MJO NO.: 671-1489-83
FILTER: CLASS 180
ACCELEROMETER: TAPE 2, CH 6
DIRECTION: LEFT
LOCATION: PASSENGER'S CHEST

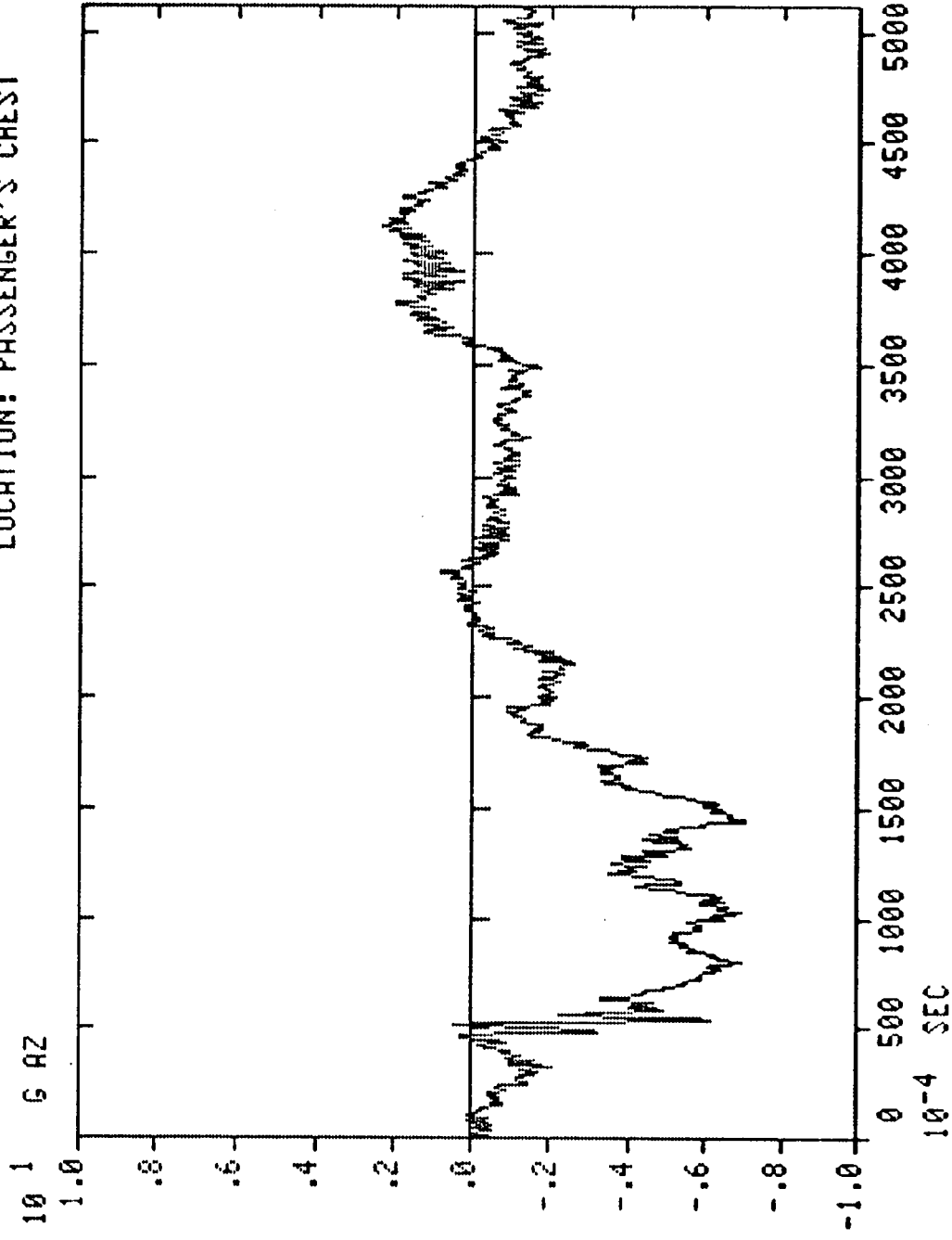


DOT CRASH PROGRAM

APPROVED ENGINEERING TEST LABS

VEHICLE: FORD THUNDERBIRD
VEHICLE ID: NHTSA 790209
TEST FILE NO.: 51 REAR
DATE: SEPTEMBER 19, 1979

MJO NO. : 671-1489-83
FILTER: CLASS 180
ACCELEROMETER: TAPE 2, CH 7
DIRECTION: UPWARD
LOCATION: PASSENGER'S CHEST

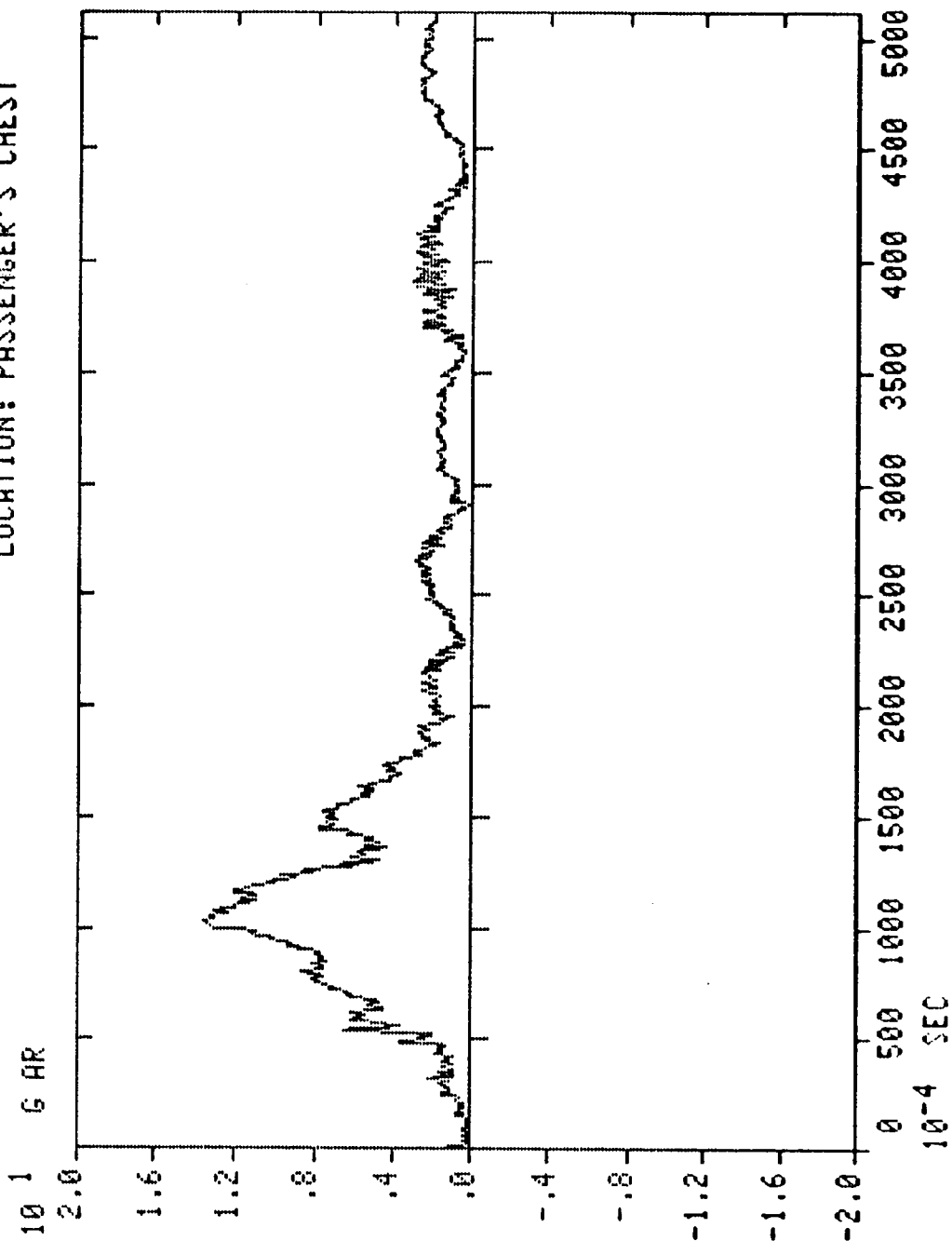


DOT CRASH PROGRAM

VEHICLE: FORD THUNDERBIRD
VEHICLE ID: NHTSA 790209
TEST FILE NO.: 51 REAR
DATE: SEPTEMBER 19, 1979

APPROVED ENGINEERING TEST LABS

MJO NO.: 671-1489-83
FILTER: CLASS 1000
ACCELEROMETER: TAPE 2, CH 5-7
DIRECTION: RESULTANT OF XYZ
LOCATION: PASSENGER'S CHEST

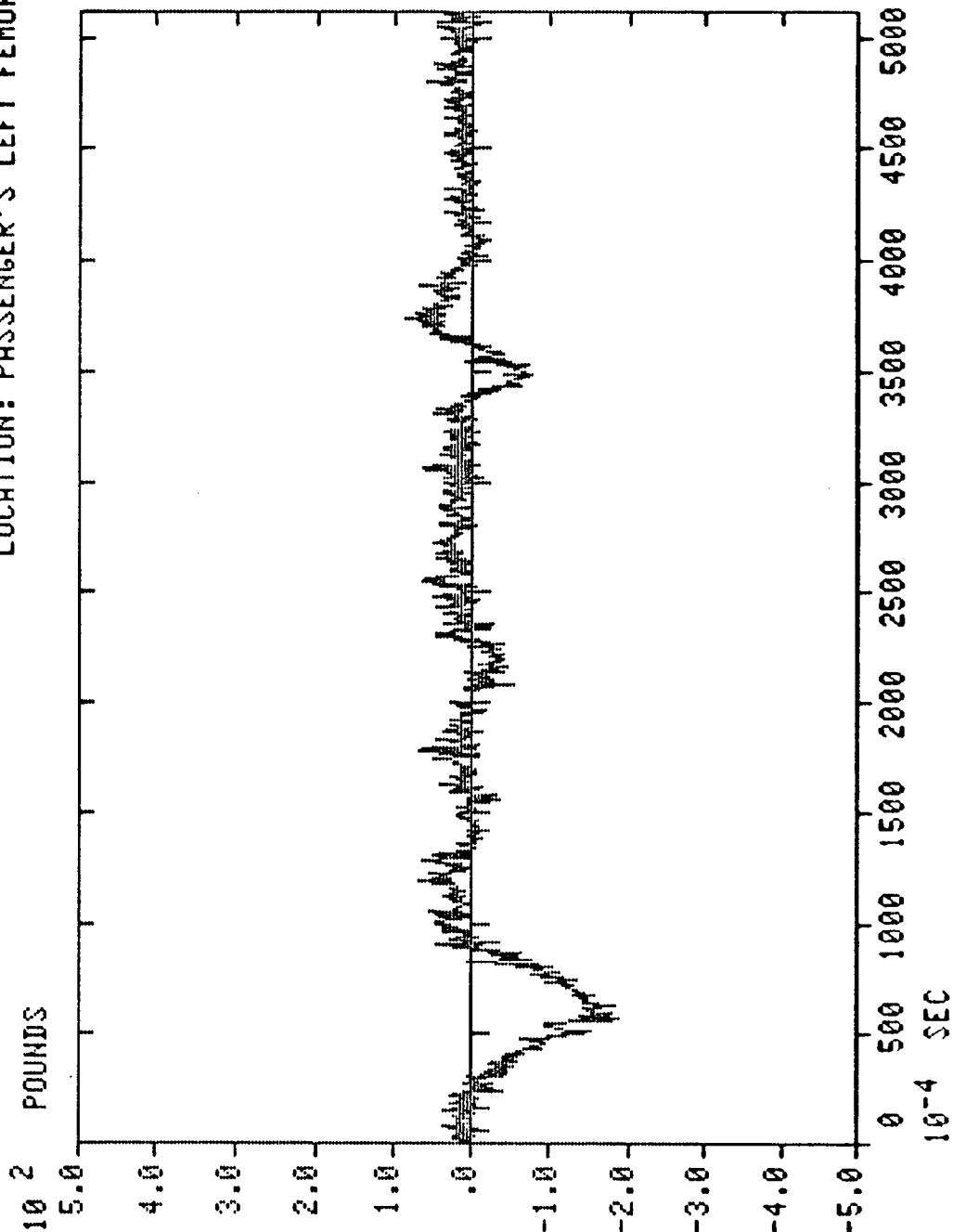


DOT CRASH PROGRAM

VEHICLE: FORD THUNDERBIRD
VEHICLE ID: NHTSA 790209
TEST FILE NO.: 51 REAR
DATE: SEPTEMBER 19, 1979

APPROVED ENGINEERING TEST LABS

MJO NO.: 671-1489-83
FILTER: CLASS 600
LOAD CELL: TAPE 2, CH 8
DIRECTION: TENSION
LOCATION: PASSENGER'S LEFT FEMUR

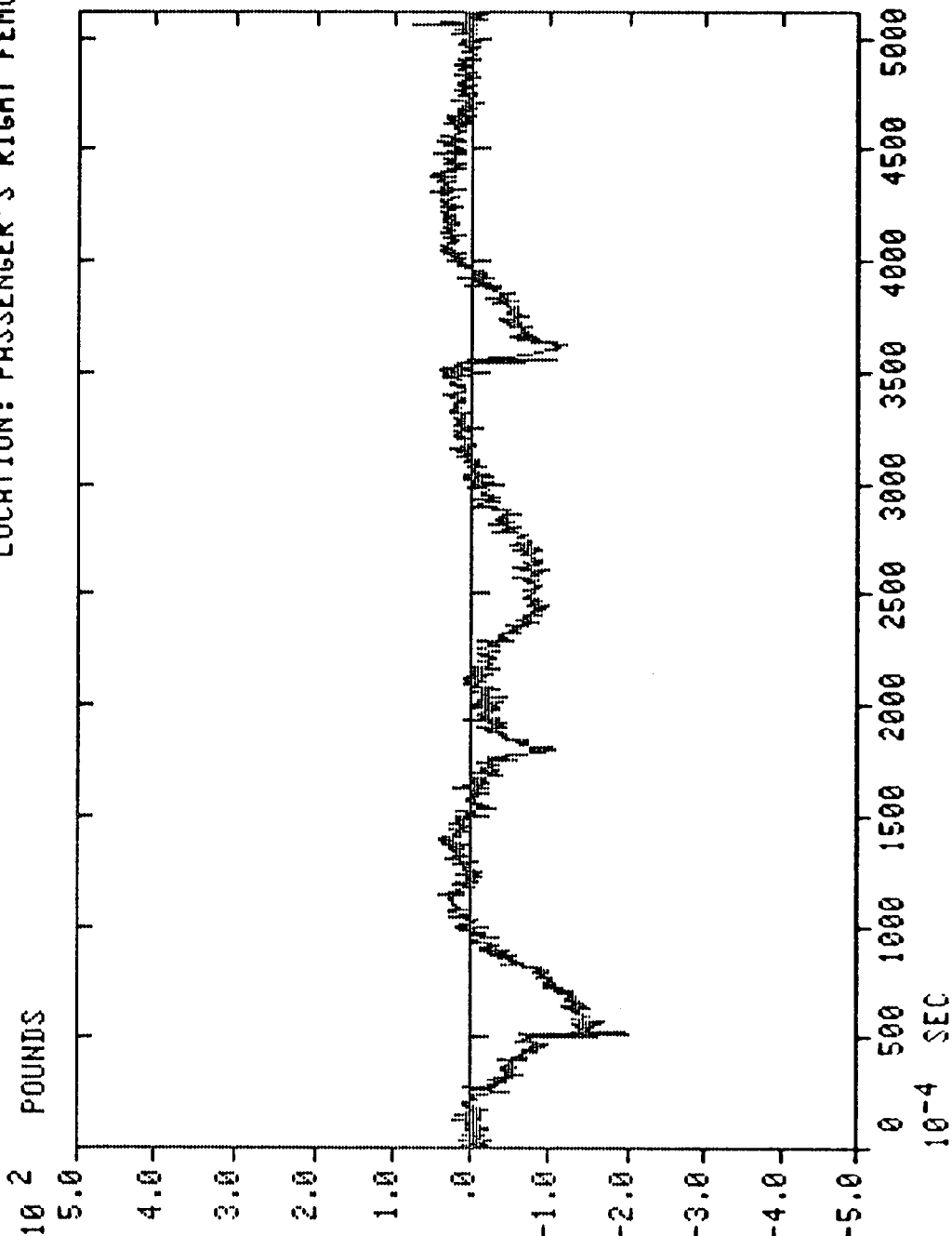


DOT CRASH PROGRAM

VEHICLE: FORD THUNDERBIRD
VEHICLE ID: NHTSA 790209
TEST FILE NO.: 51 REAR
DATE: SEPTEMBER 19, 1979

APPROVED ENGINEERING TEST LABS

MJO NO.: 671-1489-83
FILTER: CLASS 600
LOAD CELL: TAPE 2, CH 4
DIRECTION: TENSION
LOCATION: PASSENGER'S RIGHT FEMUR

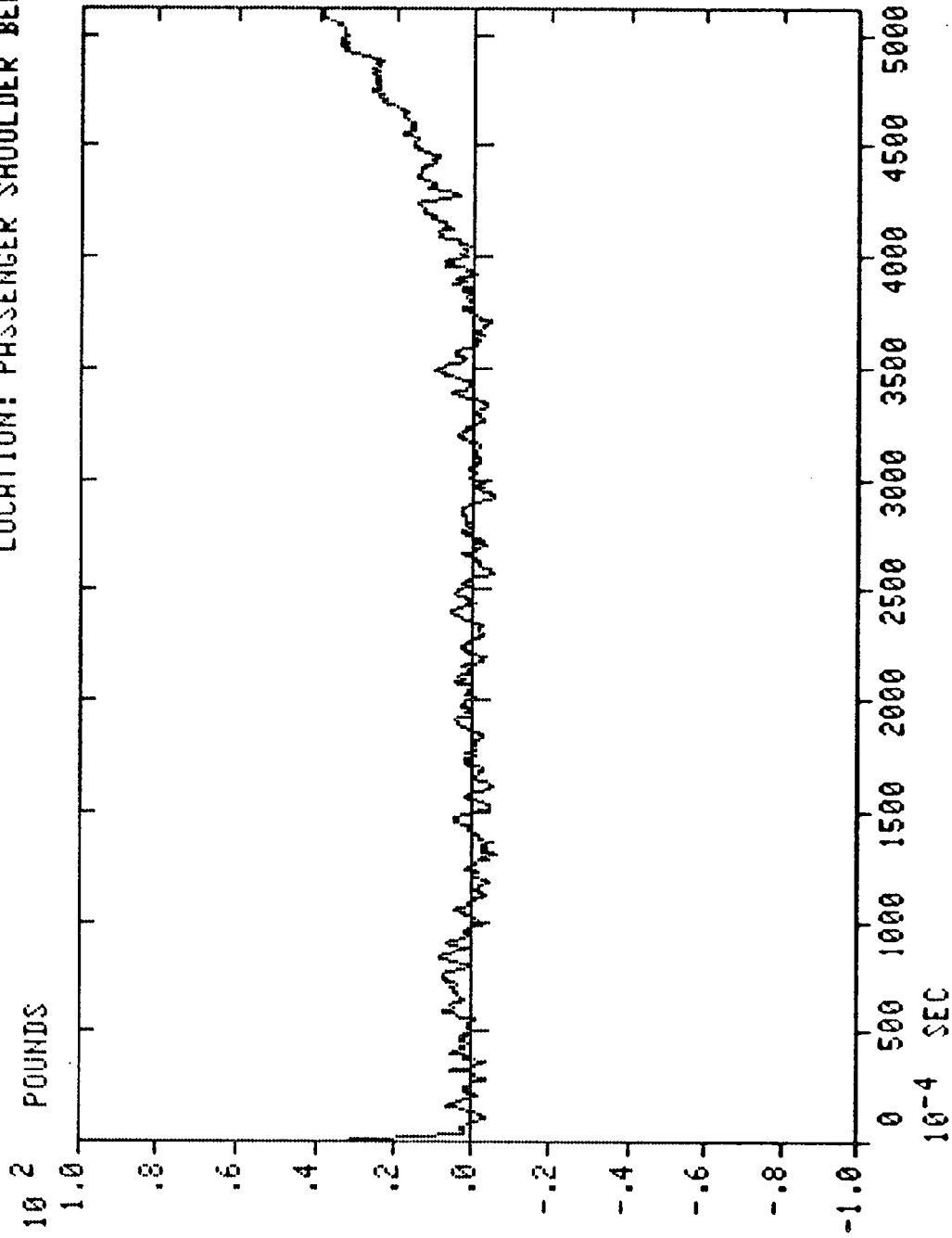


DOT CRASH PROGRAM

VEHICLE: FORD THUNDERBIRD
VEHICLE ID: NHTSA 790209
TEST FILE NO.: 51 REAR
DATE: SEPTEMBER 19, 1979

APPROVED ENGINEERING TEST LABS

MJO NO.: 671-1489-83
FILTER: CLASS 60
LOAD CELL: TAPE 2, CH 9
DIRECTION: TENSION
LOCATION: PASSENGER SHOULDER BELT

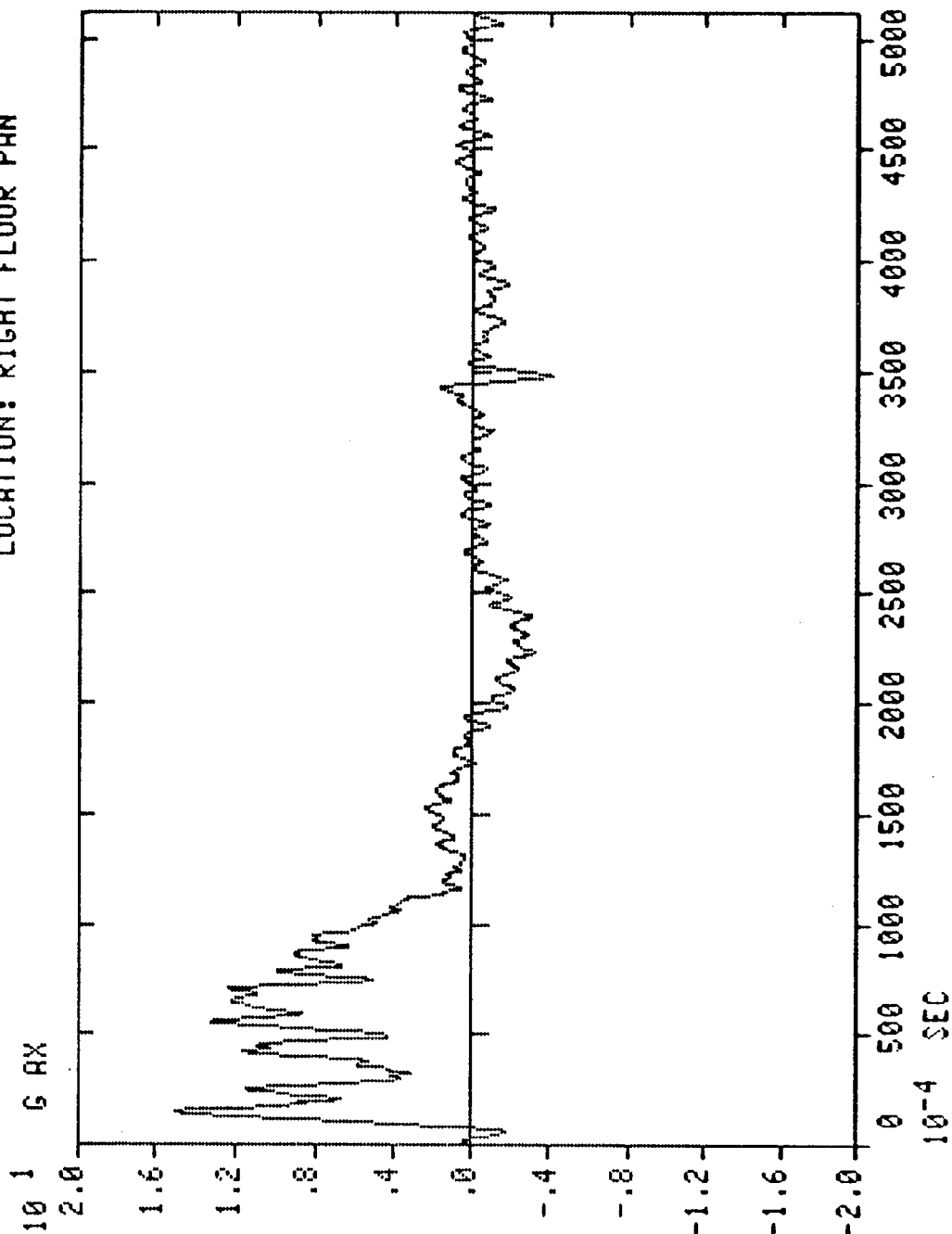


DOT CRASH PROGRAM

VEHICLE: FORD THUNDERBIRD
VEHICLE ID: NHTSA 790209
TEST FILE NO.: 51 REAR
DATE: SEPTEMBER 19, 1979

APPROVED ENGINEERING TEST LABS

MJO NO.: 671-1489-83
FILTER: CLASS 60
ACCELEROMETER: TAPE 2, CH 13
DIRECTION: FORWARD
LOCATION: RIGHT FLOOR PAN

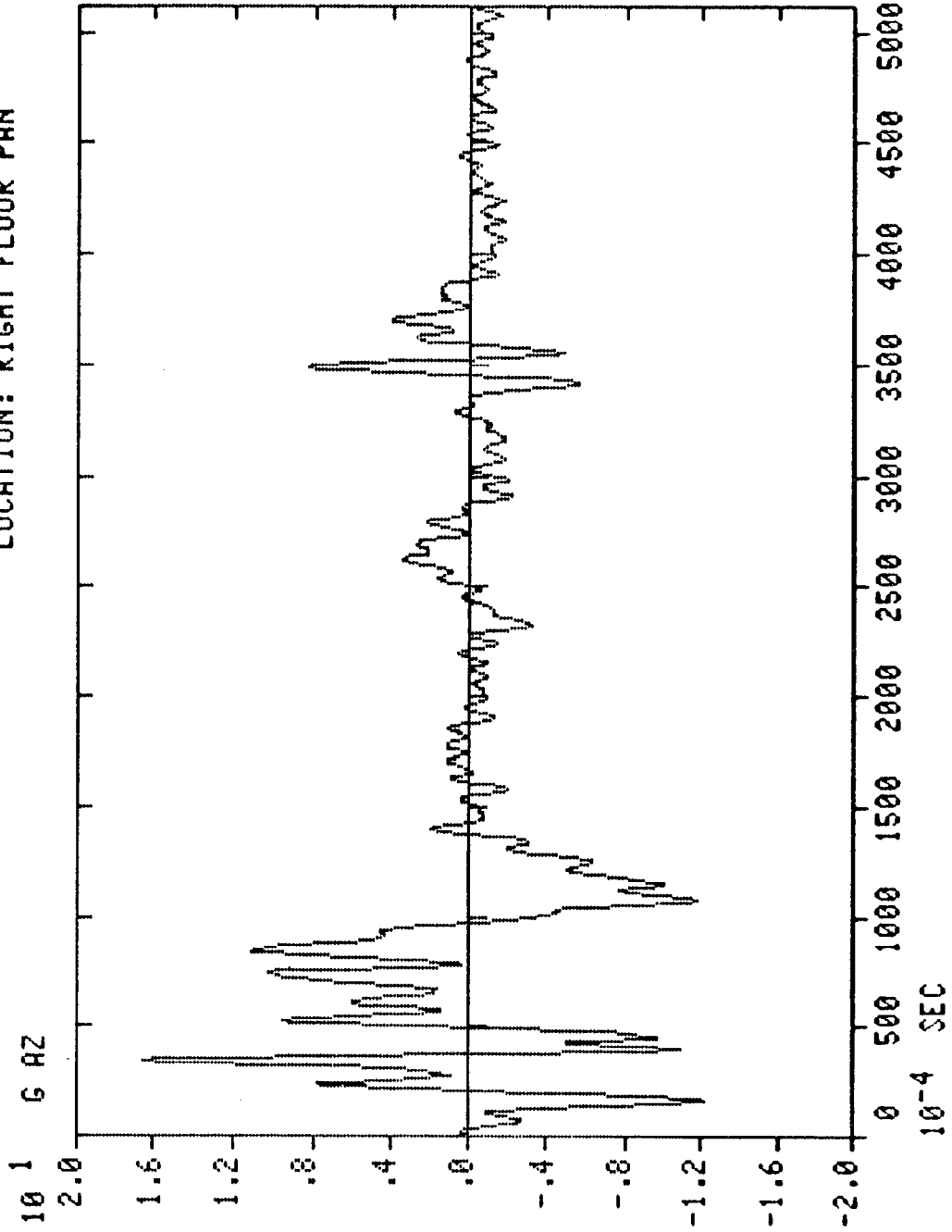


DOT CRASH PROGRAM

APPROVED ENGINEERING TEST LABS

VEHICLE: FORD THUNDERBIRD
VEHICLE ID: NHTSA 790209
TEST FILE NO.: 51 REAR
DATE: SEPTEMBER 19, 1979

MJO NO.: 671-1489-83
FILTER: CLASS 60
ACCELEROMETER: TAPE 2, CH 14
DIRECTION: UPWARD
LOCATION: RIGHT FLOOR PAN

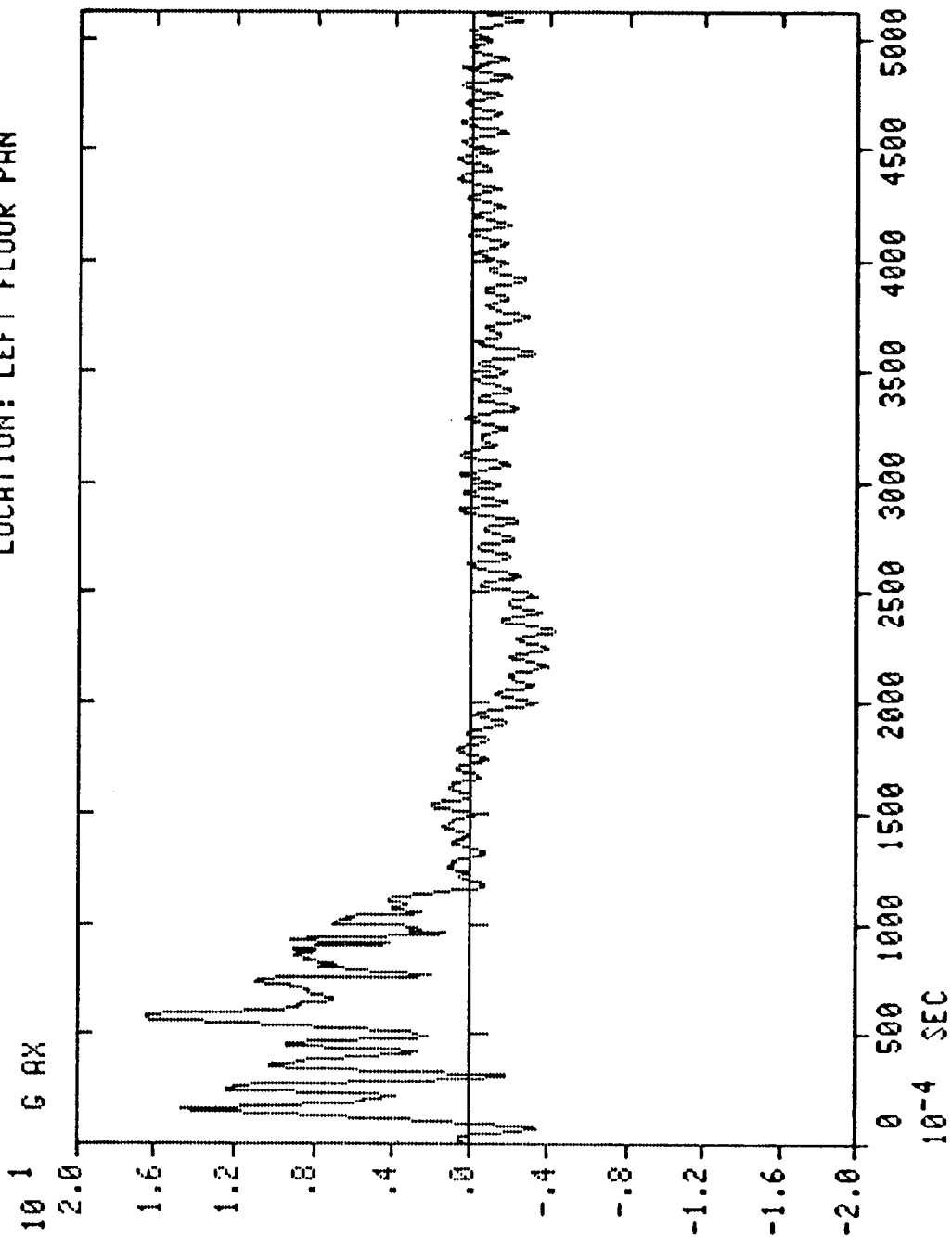


DOT CRASH PROGRAM

APPROVED ENGINEERING TEST LABS

VEHICLE: FORD THUNDERBIRD
VEHICLE ID: NHTSA 790209
TEST FILE NO.: 51 REAR
DATE: SEPTEMBER 19, 1979

MJO NO.: 671-1489-83
FILTER: CLASS 60
ACCELEROMETER: TAPE 1, CH 13
DIRECTION: FORWARD
LOCATION: LEFT FLOOR PAN

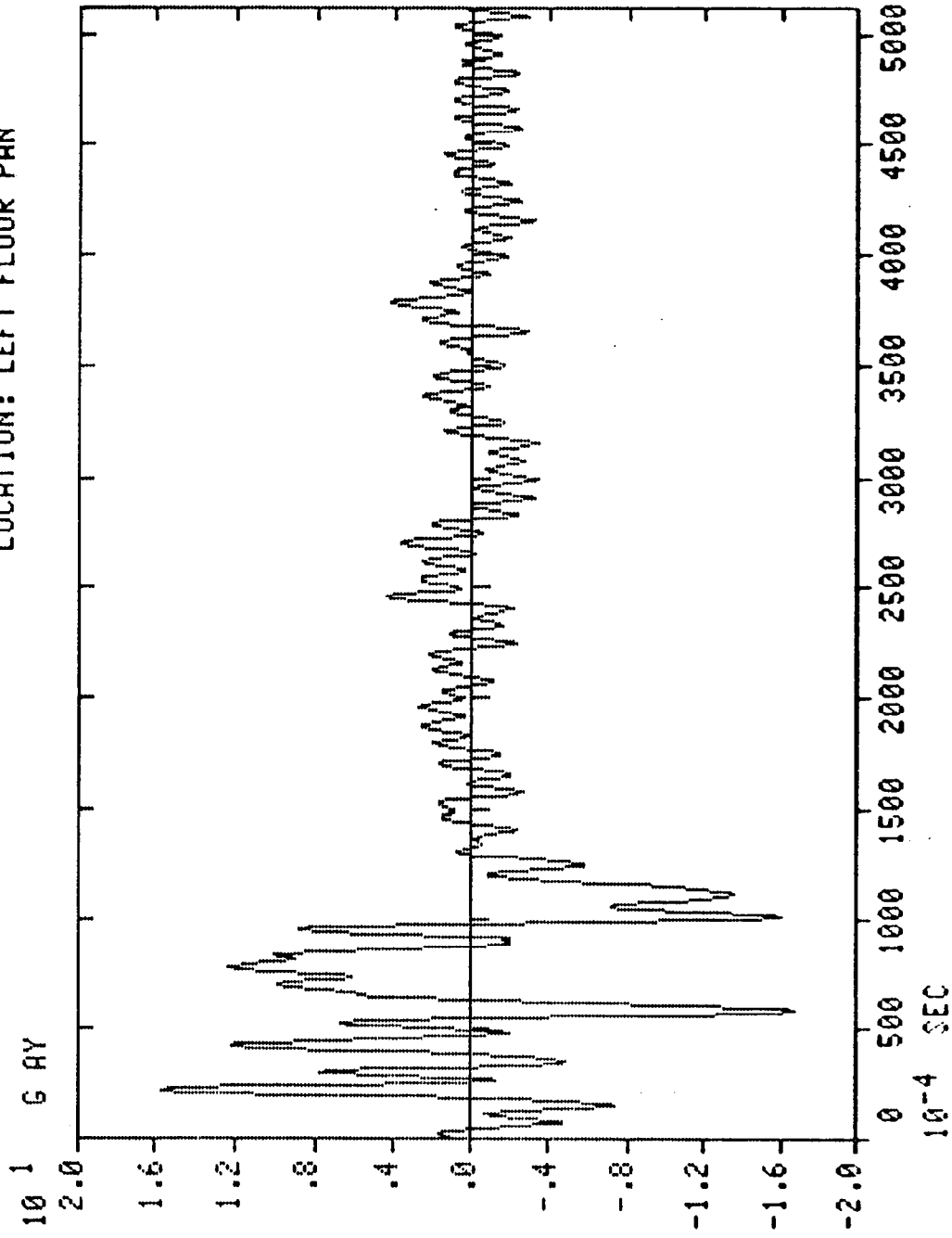


DOT CRASH PROGRAM

APPROVED ENGINEERING TEST LABS

VEHICLE: FORD THUNDERBIRD
VEHICLE ID: NHTSA 790209
TEST FILE NO.: 51 REAR
DATE: SEPTEMBER 19, 1979

MJO NO. : 671-1489-83
FILTER: CLASS 60
ACCELEROMETER: TAPE 1, CH 14
DIRECTION: UPWARD
LOCATION: LEFT FLOOR PAN





APPROVED ENGINEERING TEST LABORATORIES

SERVICE FOR:

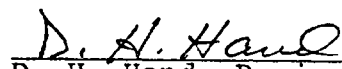
U. S. Department of Transportation
National Highway Traffic Safety Administration
Enforcement
Office of Vehicle Safety Compliance
400 Seventh Street S.W.
Washington, D. C. 20590

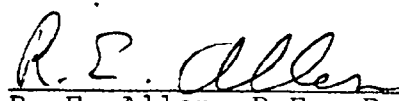
PURCHASE ORDER NUMBER: DOT-HS-6-01477

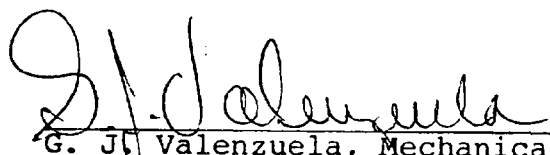
I hereby certify that the preceding report is true and correct to the best of my knowledge.

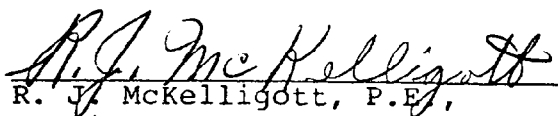
APPROVED ENGINEERING TEST LABORATORIES


R. D. Short, Division Manager


D. H. Hand, Project Engineer


R. E. Allen, P.E., Dynamics
R & D Department Manager


G. J. Valenzuela, Mechanical
Department Supervisor


R. J. McKelligott, P.E.,
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