



AETL

DOT 212

APPROVED ENGINEERING TEST LABORATORIES / 1536 EAST VALENCIA / FULLERTON, CALIFORNIA 92631 / TEL. (714) 879-6110
A NATIONAL TECHNICAL SERVICES COMPANY

REPORT NO. 301-AETL-80-011-971-3882-11

NEW VEHICLE ASSESSMENT
AND
STANDARDS ENFORCEMENT INDICANT TESTING

FMVSS 301-75

FUJI HEAVY INDUSTRIES LTD.
1980 SUBARU GL - 4 DOOR SEDAN
NHTSA 800530

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



SEPTEMBER 1980

FINAL REPORT

PREPARED FOR

U. S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
- ENFORCEMENT -
OFFICE OF VEHICLE SAFETY COMPLIANCE
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APPROVED ENGINEERING TEST LABORATORIES

Prepared for the Department of Transportation, National Highway Traffic Safety Administration under Contract No. DOT-HS-9-02273. This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no liability for its contents or use thereof.

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Date 17 September 1980

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Date September 30, 1980

1. Report No. 301-AETL-80-011	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle New Vehicle Assessment and Standards Enforcement Inducant Testing - FMVSS 301-75. 1980 Subaru GL - 4 Door Sedan - NHTSA 800530		5. Report Date September 24, 1980	
		6. Performing Organization Code	
7. Author(s)		8. Performing Organization Report No. 971-3882-11	
9. Performing Organization Name and Address Approved Engineering Test Laboratories 1536 East Valencia Drive Fullerton, California 92631 Phone No.: (714) 879-6110		10. Work Unit. No.	
		11. Contract or Grant No. DOT-HS-9-02273	
12. Sponsoring Agency Name and Address U. S. Department of Transportation National Highway Traffic Safety Admin. Enforcement Office of Vehicle Safety Compliance 400 Seventh Street S. W. Washington, D. C. 20590		13. Type of Report and Period Covered Final Report July 31 - August 7, 1980	
		14. Sponsoring Agency Code	
15. Supplementary Notes			
16. Abstract New Vehicle Assessment and Standards Enforcement Inducant Test to the requirement of FMVSS 301-75 on a 1980 Subaru GL - 4 Door Sedan, NHTSA 800530, VIN-JF17AB21FAG206167 was conducted at Approved Engineering Test Laboratories test facility in Fullerton, California. The moving barrier impact speed was 35.10 mph in the rear (0°) mode. Test date was August 7, 1980, and the ambient temperature was 101°F. The subject test vehicle appears to comply with all the requirements of FMVSS 301-75.			
17. Key Words New Vehicle Assessment FMVSS 301-75 - Fuel System Integrity		18. Distribution Statement	
19. Security Class. (of this report) Unclassified	20. Security Class. (of this page) Unclassified	21. No. of Pages 94	22. Price



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APPROVED ENGINEERING TEST LABORATORIES

SECTION 1



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 tests of fuel system integrity relative to Federal Motor Vehicle Safety Standard (FMVSS) No. 301-75. This test was performed under Contract Number DOT-HS-9-02273 by Approved Engineering Test Laboratories, 1536 East Valencia Drive, Fullerton, California, in accordance with the Office of Vehicle Safety Compliance (OVSC) Laboratory Procedures (TP212-02).

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) requirements of FMVSS 301-75.

Section 2 contains general test and vehicle information, occupant/vehicle acceleration summary data, while Section 3 contains all compliance related data. Section 4 contains test dummy and vehicle measurements, along with camera positions. Section 5 discusses AETL's test facilities and data acquisition and reduction system.



SECTION 1

Appendix A contains additional photographs not related to vehicle compliance. Appendix B contains the computer generated plots, while Appendix C contains the dummy certification reports if applicable.

1.1 ADMINISTRATIVE DATA

A. References

1. Federal Motor Vehicle Safety Standard No. 301-75 "Fuel System Integrity" as published in the Federal Register, Volume 38, No. 22397, dated August 20, 1973.
2. National Highway Traffic Safety Administration - Office of Vehicle Safety Compliance Laboratory Procedures for Vehicle Assessment and Standards Enforcement Indicant Testing for "Windshield Mounting", FMVSS 212 - "Windshield Zone Intrusion", FMVSS 219 - "Fuel System Integrity", FMVSS 301-75, TP212-02, dated April 1, 1980.



APPROVED ENGINEERING TEST LABORATORIES

SECTION 1

B. Description of Test Vehicle

1. 1980 Subaru GL - 4 Door Sedan
2. Vehicle Identification No.: JF17AB21FAG206167
3. NHTSA No.: 800530
4. Manufactured Date: February 1980
5. GVWR: 3,070 pounds

C. Dates

1. Vehicle Received: July 30, 1980
2. Start of Test: July 31, 1980
3. Completion of Test: August 7, 1980



APPROVED ENGINEERING TEST LABORATORIES

SECTION 2

TABLE I

SUMMARY OF TEST CONDITIONS

TEST VEHICLE INFORMATION:

Manufacturer: Fuji Heavy Industries LTD.
Make/Model: Subaru GL
Body Style: 4 Door Sedan Model Year: 1980
VIN: JF17AB21FAG206167 Build Date: February 1980
NHTSA No.: 800530 Color: Silver
Engine Data: Four (4) Cylinders; 97.0 Cu. In. Displ.
Transmission Data: Five (5) Speed (X) Manual () Automatic
Major Options: None

VEHICLE ATTITUDE:

Delivered Attitude: LF 25.3 in.; RF 25.1 in.; LR 24.8 in.; RR 24.5 in.
Test Attitude: LF 24.3 in.; RF 24.1 in.; LR 23.6 in.; RR 23.0 in.

VEHICLE TIRE DATA:

Recommended Cold Tire Pressure: Front = 26 psi
(Up to Vehicle Load Capacity) Rear = 26 psi
Recommended Tire Size: 175/70HR13 Load Range: unknown
Tires on Vehicle: 175/70HR13 - w/s/w - Bridgestone
Spare Tire: X Yes; No; Space Saver: Yes; X No

TABLE 1a

SUMMARY OF TEST CONDITIONS (Cont'd)TEST CONDITIONS:

Date of Test: August 7, 1980 Time of Test: 1336
 Ambient Temperature: 101 °F at Impact Area

VEHICLE CAPACITY:

Type of Seats: Bench; X Bucket; Split Bench

Designated Seating Capacity:	Front	<u>2</u>
	Center	<u>0</u>
	Rear	<u>2</u>
	Total	<u>4</u>

Cargo: 60 lbs.

Total 660 lbs. (Vehicle Capacity Weight)

GVWR: 3,070 lbs. (Taken From Certification Label)

GAWR: Front 1,750 lbs.; Rear 1,320 lbs.

VEHICLE DELIVERED WEIGHT: (Fuel - 93% of NFC)

Left Front <u>678</u> lbs.	Left Rear <u>385</u> lbs.
Right Front <u>651</u> lbs.	Right Rear <u>442</u> lbs.
Total Front Weight <u>1,329</u> lbs. (<u>61.6</u> % of Total Vehicle Weight)	
Total Rear Weight <u>827</u> lbs. (<u>38.4</u> % of Total Vehicle Weight)	
Total Delivered Weight <u>2,156</u> lbs.	

CALCULATED VEHICLE TEST WEIGHT: 2,544 lbs.
 (With Required Dummies and 60 lbs. Cargo)

ACTUAL VEHICLE TEST WEIGHT:

Left Front <u>770</u> lbs.	Left Rear <u>489</u> lbs.
Right Front <u>746</u> lbs.	Right Rear <u>555</u> lbs.
Total Front Weight <u>1,516</u> lbs. (<u>59.2</u> % of Total Vehicle Weight)	
Total Rear Weight <u>1,044</u> lbs. (<u>40.8</u> % of Total Vehicle Weight)	
Total Test Weight <u>2,560</u> lbs.	

TABLE 11

SUMMARY OF TEST CONDITIONS (Cont'd)

TEST FLUID DATA:

Test Fluid Type: Red Stoddard Solvent ; Specific Gravity: 0.764Kinematic Viscosity: 1.11Nominal Fuel Capacity: 13.20 gals. (NFC)Test Volume: 12.28 gals. (92-94% of NFC)Fuel System Capacity: 13.20 gals.
(Data from Owner's Manual)Electric Fuel Pump: X Yes; No; Fuel Injection: X Yes; No

Does Electric Fuel Pump Operate with Ignition Switch "On"

And the Engine Not Operating: Yes; X No; N/ADetails of Fuel System: Fuel filler located on right rear fender above
wheel opening recessed behind a hinged door, fuel tank located hori-
zontally under trunk floor pan between rear axle and bumper.

VEHICLE TEST CONDITIONS:

Temperature in Occupant Compartment: N/A °FTemperature of Windshield Glazing/Moulding: N/A °F

VEHICLE CRUSH AND REBOUND:

Overall Length of Test Vehicle: Pre-Test - Left 164.8 in.; Right 165.0 in.Post-Test - Left 139.8 in.; Right 138.6 in.Crush: Left 25.0 in.; Right 26.4 in.Rebound (From Rigid Barrier Only): N/A in.

TABLE III

POST IMPACT SUMMARY

Vehicle 1980 Subaru GL

NHTSA No. 800530

Test Date August 7, 1980

TYPE OF TEST: ☐ 0° Frontal Impact
☐ 30° Oblique Impact (Driver/Passenger) Side
☒ XXX Rear Impact

REQUIRED IMPACT VELOCITY RANGE: 34.5 to 35.5 mph

IMPACT VELOCITY: (Traps within 5 feet of impact event)

Trap 1 = 35.10 mph

Trap 2 = 35.10 mph

Average = 35.10 mph

Actual distance from vehicle rear bumper to barrier face when entering timing trap 45.5 in.

Actual distance from vehicle rear bumper to barrier face when exiting timing trap 21.5 in.

VEHICLE STATIC CRUSH: Driver's Side - 25.0 inches

Passenger's Side - 26.4 inches

Average = 25.7 inches

Crush Details: Frame buckled under rear doors, rear window shattered,
roof buckled over both "B" and "C" posts, both dummies made contact
with rear seat back cushion.

VEHICLE REBOUND: (From rigid barrier only)

Driver's Side - N/A inches

Passenger's Side - N/A inches

Average = N/A inches



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SECTION 3



SECTION 3

3.0 TEST DATA

The 1980 Subaru GL - 4 Door Sedan was subjected to a rear moving barrier impact and a static rollover maneuver as required by Federal Motor Vehicle Safety Standard No. 301-75.

Color motion picture coverage of the impact along with the static rollover 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 VI

POST IMPACT SUMMARY

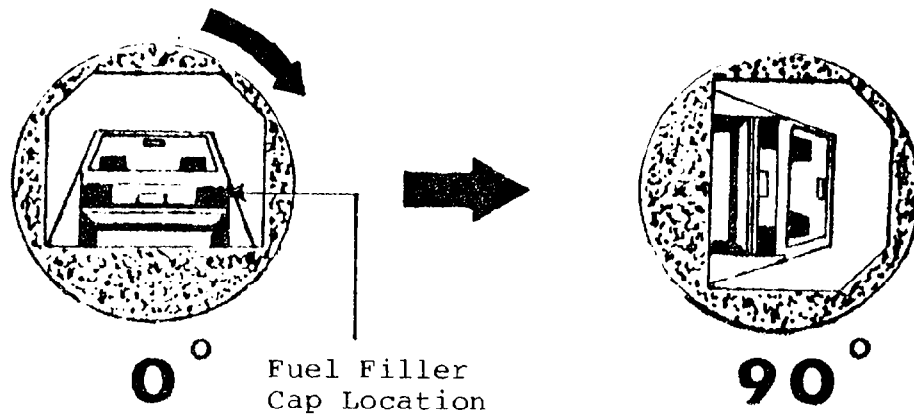
FUEL SYSTEM INTEGRITY - FMVSS 301-75Vehicle 1980 Subaru GLNHTSA No. 800530 Test Date August 7, 1980

	Actual	Max. Allow.
Fuel spillage from impact until vehicle motion ceases.	- 0 -	1 ounce
Fuel spillage for 5 minute period following cessation of vehicle motion after impact.	- 0 -	5 ounces
Fuel spillage for next 25 minute period.	- 0 -	1 ounce/ 1 minute
Time duration from impact until start of rollover test periods.	22 min. 30 sec.	30 minutes

Fuel Spillage Location: Not Applicable

TABLE VII
FUEL SYSTEM INTEGRITY - FMVSS 301-75
STATIC ROLLOVER

Vehicle 1980 Subaru GL NHTSA No. 800530



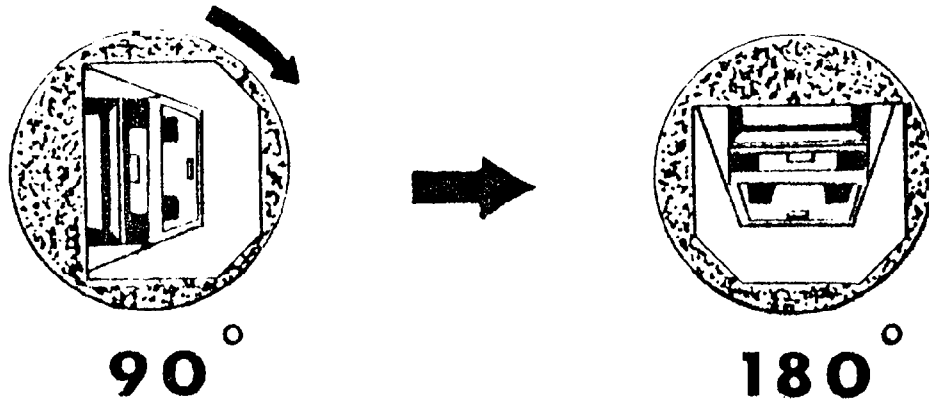
	Actual	Max. Allowed
Rollover fixture 90° rotation time	2 min. 12 sec.	1 to 3 Minutes
Fuel spillage during 5 minute period from onset of rotation	immeasurable	5 ounces
Fuel spillage during 6th minute period from onset of rotation	- 0 -	1 ounce
Fuel spillage during 7th minute period from onset of rotation	- 0 -	1 ounce

Fuel Spillage Location: Carburetor air cleaner assembly area

TABLE VIII

FUEL SYSTEM INTEGRITY - FMVSS 301-75

STATIC ROLLOVER

Vehicle 1980 Subaru GLNHTSA No. 800530

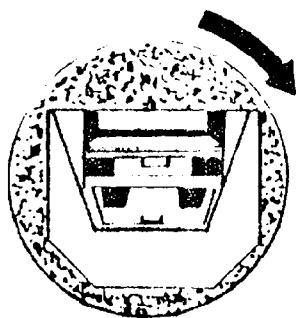
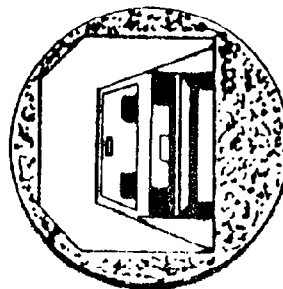
	Actual	Max. Allowed
Rollover fixture 90° rotation time	2 min. 14 sec.	1 to 3 Minutes
Fuel spillage during 5 minute period from onset of rotation	- 0 -	5 ounces
Fuel spillage during 6th minute period from onset of rotation	- 0 -	1 ounce
Fuel spillage during 7th minute period from onset of rotation	- 0 -	1 ounce

Fuel Spillage Location: Not Applicable

TABLE IX

FUEL SYSTEM INTEGRITY - FMVSS 301-75

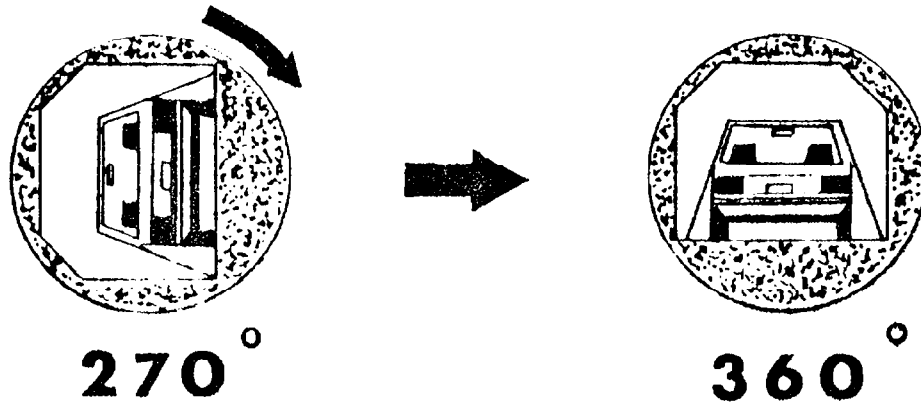
STATIC ROLLOVER

Vehicle 1980 Subaru GLNHTSA No. 800530**180°****270°**

	Actual	Max. Allowed
Rollover fixture 90° rotation time	2 min. 19 sec.	1 to 3 Minutes
Fuel spillage during 5 minute period from onset of rotation	- 0 -	5 ounces
Fuel spillage during 6th minute period from onset of rotation	- 0 -	1 ounce
Fuel spillage during 7th minute period from onset of rotation	- 0 -	1 ounce

Fuel Spillage Location: Not Applicable

TABLE X

FUEL SYSTEM INTEGRITY - FMVSS 301-75STATIC ROLLOVERVehicle 1980 Subaru GL NHTSA No. 800530

	Actual	Max. Allowed
Rollover fixture 90° rotation time	2 min. 20 sec.	1 to 3 Minutes
Fuel spillage during 5 minute period from onset of rotation	- 0 -	5 ounces
Fuel spillage during 6th minute period from onset of rotation	- 0 -	1 ounce
Fuel spillage during 7th minute period from onset of rotation	- 0 -	1 ounce

Fuel Spillage Location: Not Applicable



SECTION 3

3.1 TEST RESULTS AND PHOTOGRAPHS

Post-impact inspection of the test vehicle revealed almost all crush occurred rearward of the front doors. The left and right frame rails buckled under the rear doors and both rear wheels were jammed. The rear window shattered and the roof buckled over both left and right "B" and "C" posts. The rear seat floor pan buckled and all four doors were jammed. Both front seat backs bent backward unto the rear seat cushion and the rear seat assembly was deformed. Both the driver and passenger dummy head made contact with the rear seat back cushion.

No fuel spillage was recorded following the test vehicle impact, nor during the time period before the start of the rollover test. An immeasurable amount of fuel spillage was noted emitting from the carburetor air cleaner assembly during the 90° test increment, however the fuel spillage ceased before the time period was completed. No other fuel spillage was recorded during the subsequent rollover test increment time periods.

The 1980 Subaru GL - 4 Door Sedan test vehicle appears to comply with all the requirements of FMVSS 301-75.



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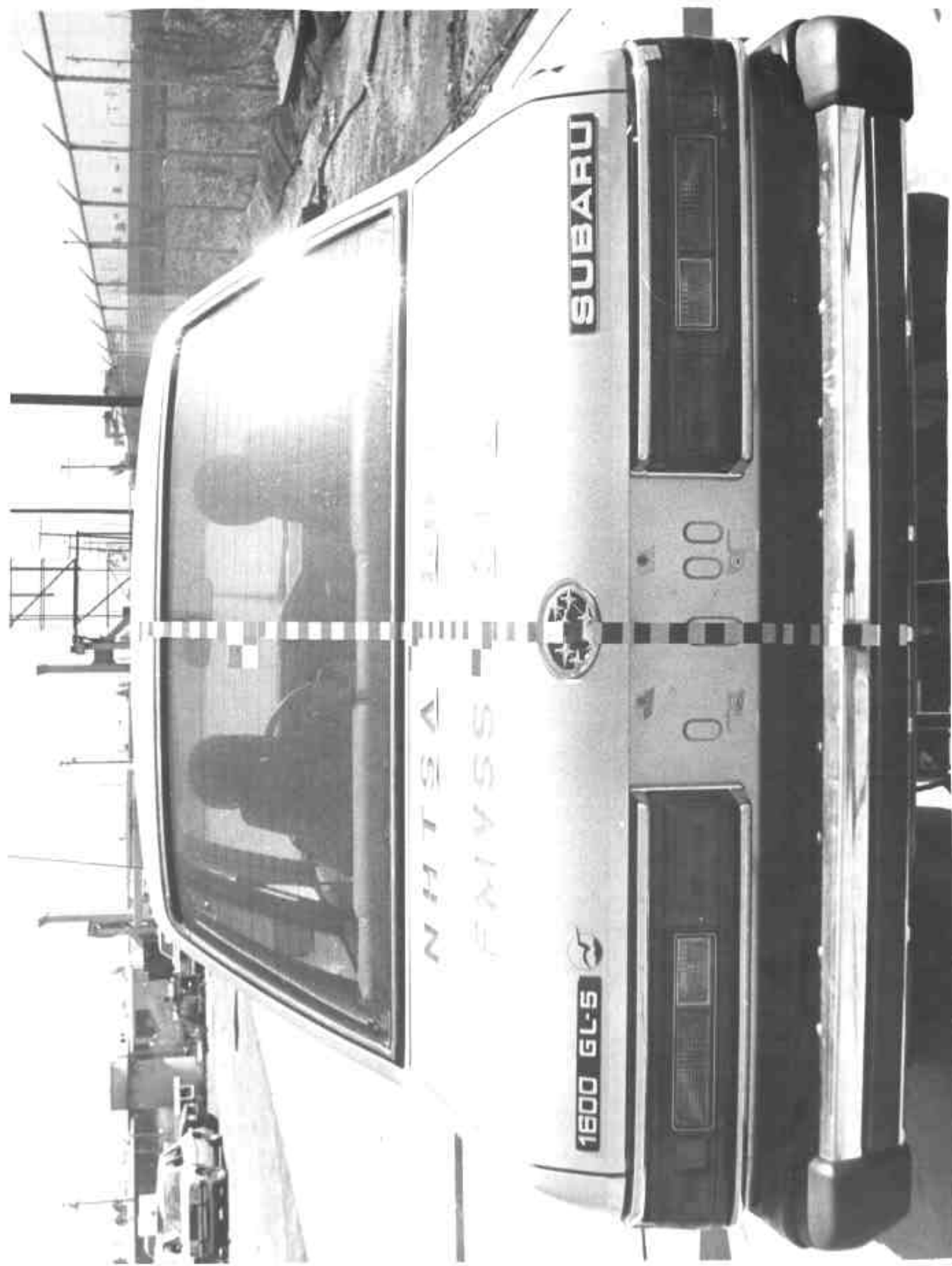
Figure 3-1
1980 Subaru GL - 4 Door Sedan
NHTSA 800530
Pre-Test, Left Side View





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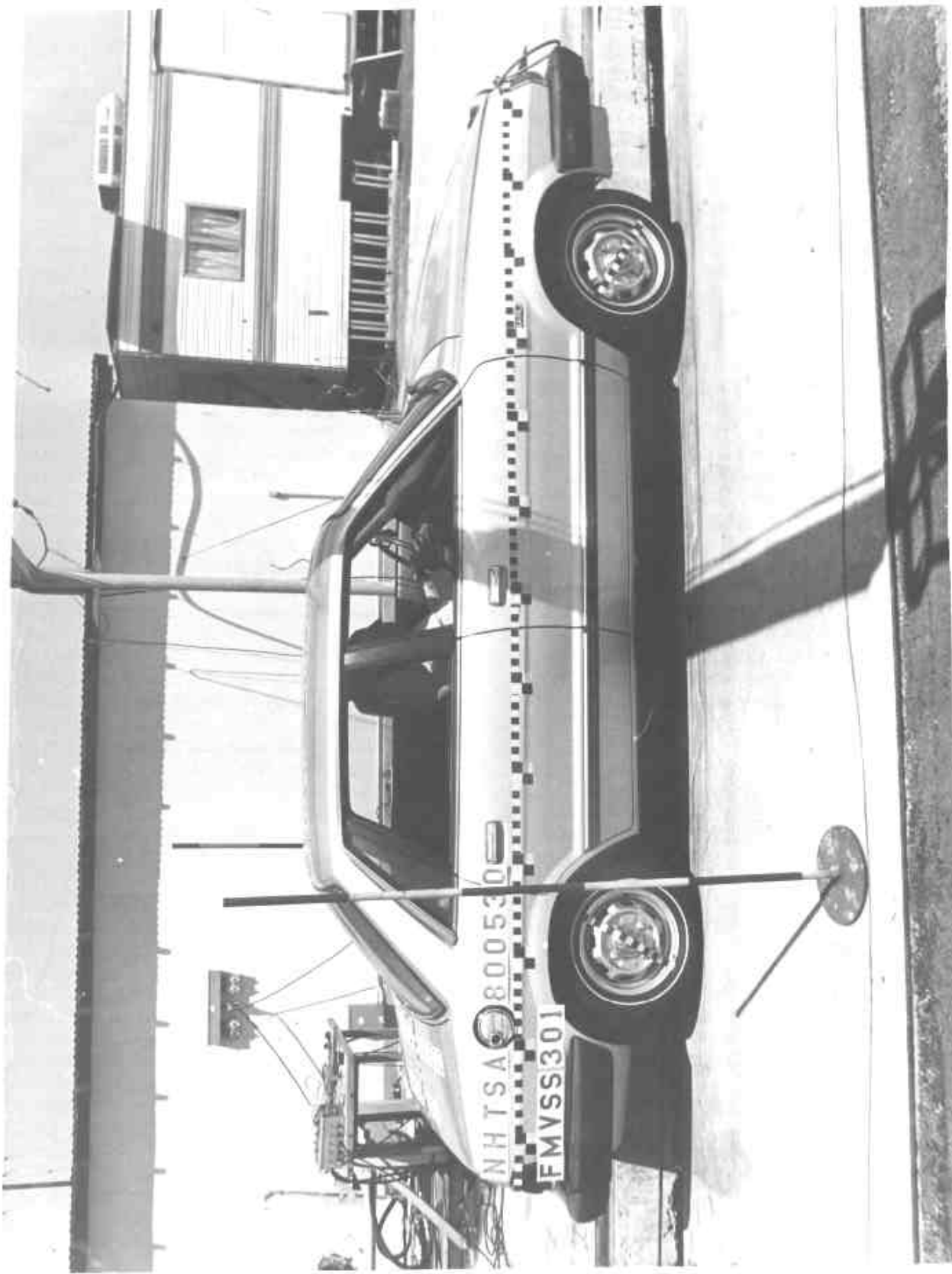
Figure 3-2
1980 Subaru GL - 4 Door Sedan
NHTSA 800530
Pre-Test, Full Rear View





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Figure 3-3
1980 Subaru GL - 4 Door Sedan
NHTSA 800530
Pre-Test, Right Side View





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Figure 3-4
1980 Subaru GL - 4 Door Sedan
NHTSA 800530
Post-Impact, Left Side View





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Figure 3-5
1980 Subaru GL - 4 Door Sedan
NHTSA 800530
Post-Impact, Full Rear View





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Figure 3-6
1980 Subaru GL - 4 Door Sedan
NHTSA 800530
Post-Impact, Right Side View





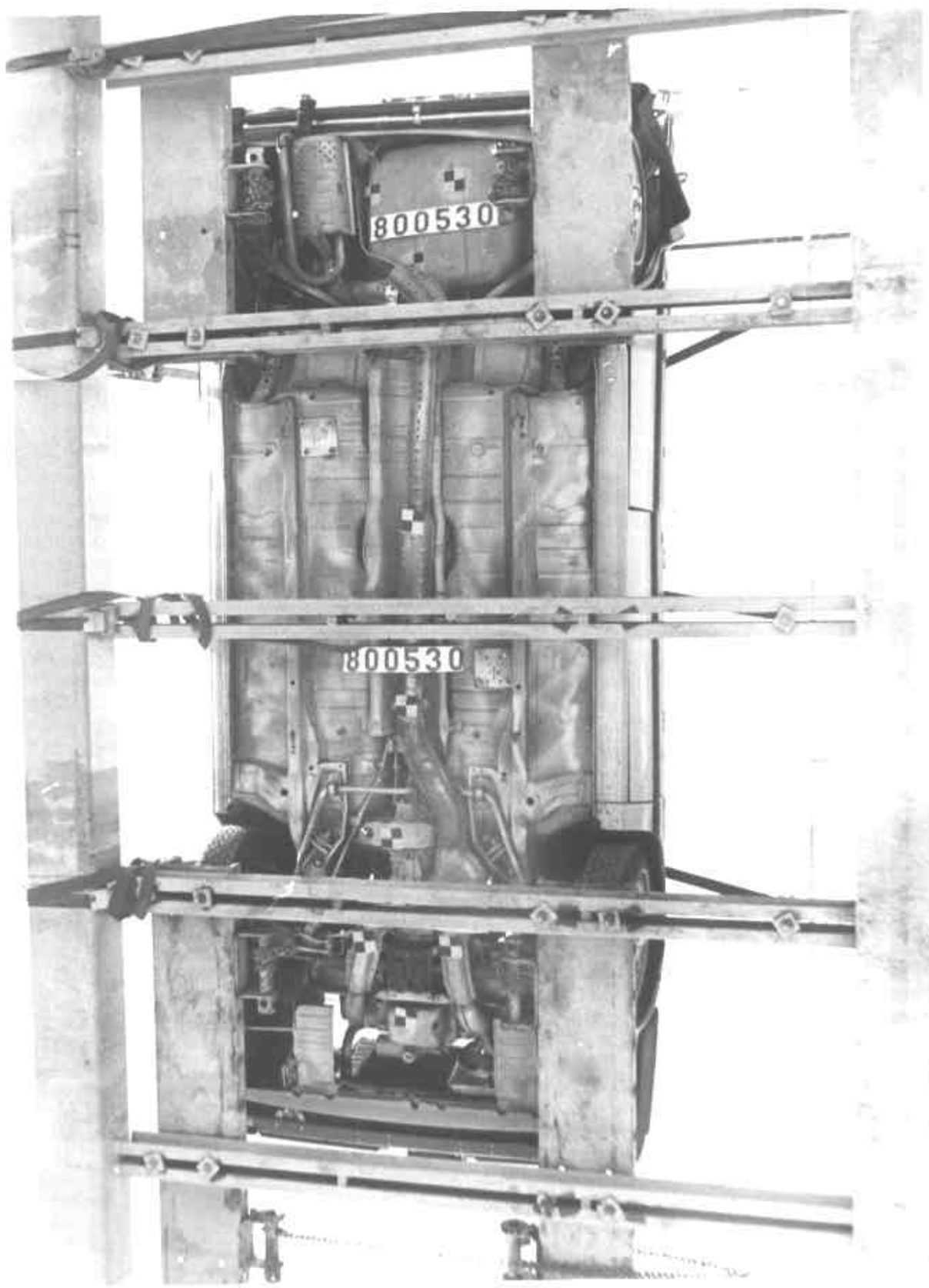
APPROVED ENGINEERING TEST LABORATORIES

Figure 3-7

1980 Subaru GL - 4 Door Sedan

NHTSA 800530

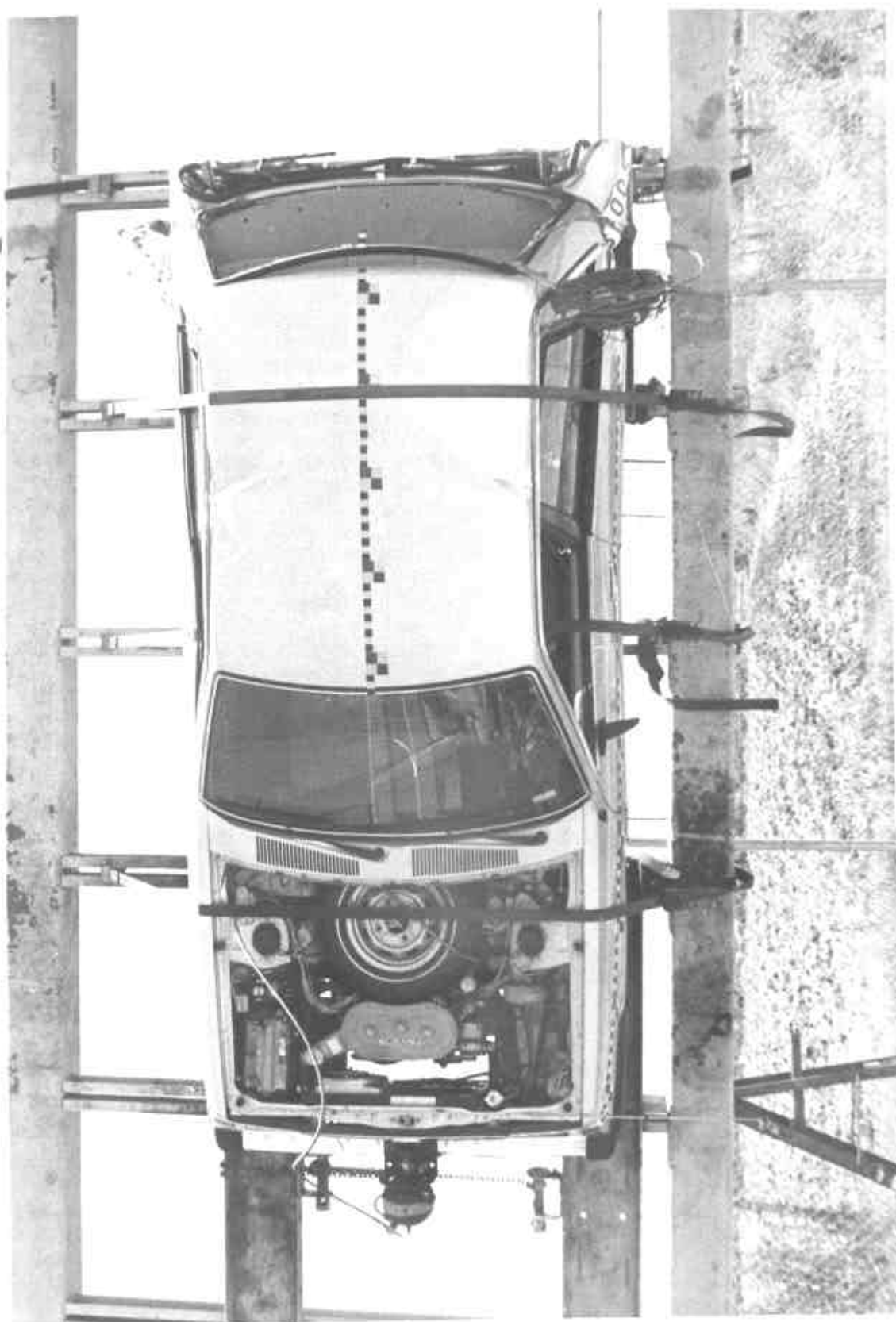
Post-Impact, Rollover Test, 90° Increment





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Figure 3-8
1980 Subaru GL - 4 Door Sedan
NHTSA 800530
Post-Impact, Rollover Test, 270° Increment





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SECTION 4



SECTION 4

4.0 OCCUPANT RESPONSE AND VEHICLE ACCELERATION SUMMARY DATA

The following data sheets summarize:

- A. The dummy position data (Part 572 Dummy Pre-Test Dummy Clearance Distances Sheet)
- B. The vehicle acceleration data (Vehicle Structural Data Sheet)
- C. The pre and post-test vehicle dimensions data (Vehicle Measurement Data Sheet)

More comprehensive data is presented in Appendix B in the form of computer plots.

TABLE 4-1

MANUFACTURERS SEAT BELT INSTRUCTIONS

3. SAFETY SEAT BELTS

FRONT SEAT BELTS

Your car is equipped with a seat belt warning device at the driver's seat in accordance with current safety standards. This device is designed so that the seat-belt warning light on the instrument panel will glow for about six seconds when the driver has turned the ignition starter switch to "ON".

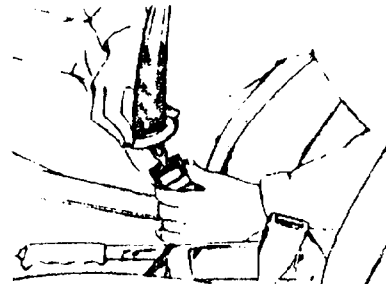
If the driver has not fastened his seat belt, the warning buzzer will sound at the same time.

Make it a rule to have all the passengers including the driver fasten their seat belts before starting the car.

The front seat belts are a three-point type with an emergency locking retractor.

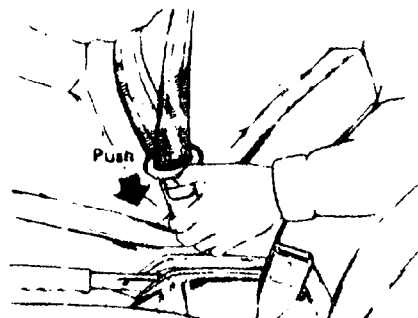
During a quick deceleration as the car stops abruptly, turns sharply, or hits another object in an accident, the seat belt retractor is activated to lock the belts.

To fasten the front seat belt, insert the tongue into the buckle until it snaps.



OM-476

To disconnect the belt, push the button of the buckle.



OM-477

TABLE 4-2

PART 572 DUMMY PRE-TEST CLEARANCE DISTANCES

DRIVER

HH = 16.3 in.

HW = 20.0 in.

HR = 5.2 in.

HS = 8.2 in.

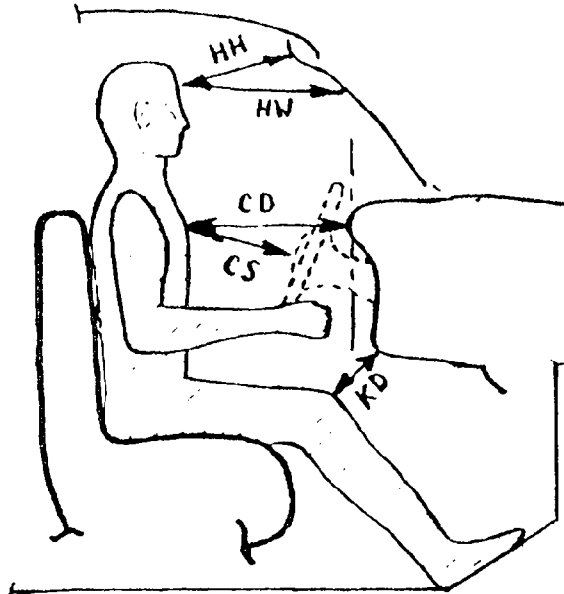
CD = 22.5 in.

CS = 18.4 in.

AD = 2.6 in.

HD = 6.4 in.

KD = 4.8 in.



PASSENGER

HH = 16.5 in.

HW = 20.6 in.

HR = 6.6 in.

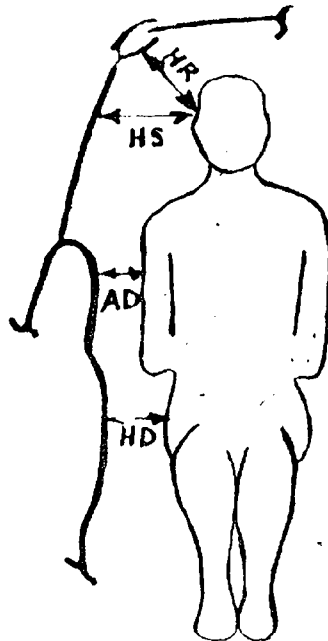
HS = 7.9 in.

CD = 23.0 in.

AD = 3.0 in.

HD = 6.2 in.

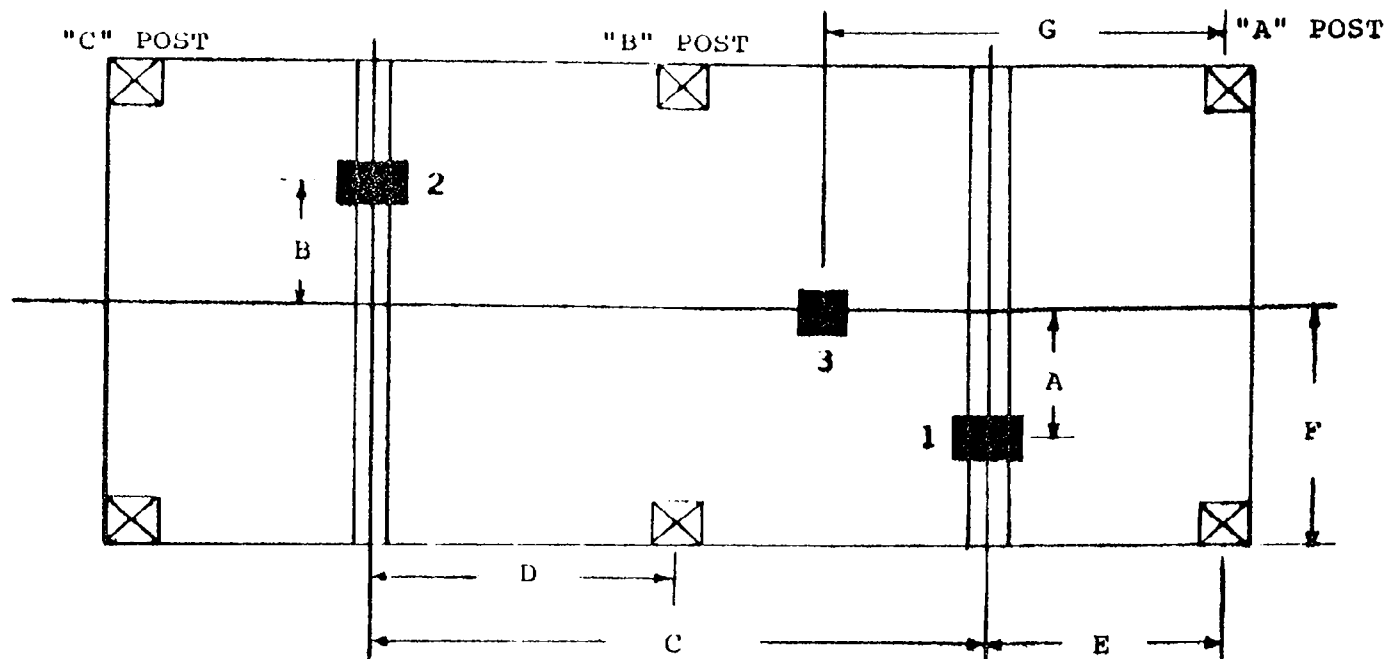
KD = 4.0 in.



VEHICLE STRUCTURAL DATA

VEHICLE 1980 Subaru GL

NHTSA NO. 800530



DIMENSIONS			
LOCATION	MEASUREMENT (IN.)	LOCATION	MEASUREMENT (IN.)
A	12.0	E	16.0
B	11.5	F	31.7
C	29.5	G	22.0
D	6.5		

ACCELERATION PEAKS				
ACCELEROMETER LOCATION	POSITIVE* DIRECTION		NEGATIVE* DIRECTION	
	PEAK "G"	TIME (MSEC)	PEAK "G"	TIME (MSEC)
NO. 1 LONGITUDINAL	31.6	15.0	9.1	12.0
NO. 2 LONGITUDINAL	25.7	9.0	4.4	145.0
NO. 3 LONGITUDINAL	31.4	78.0	6.6	23.0
*POSITIVE - LONGITUDINAL: FORWARD DIRECTION		*NEGATIVE - LONGITUDINAL: REARWARD DIRECTION		

PRE-TEST
VEHICLE MEASUREMENT DATA

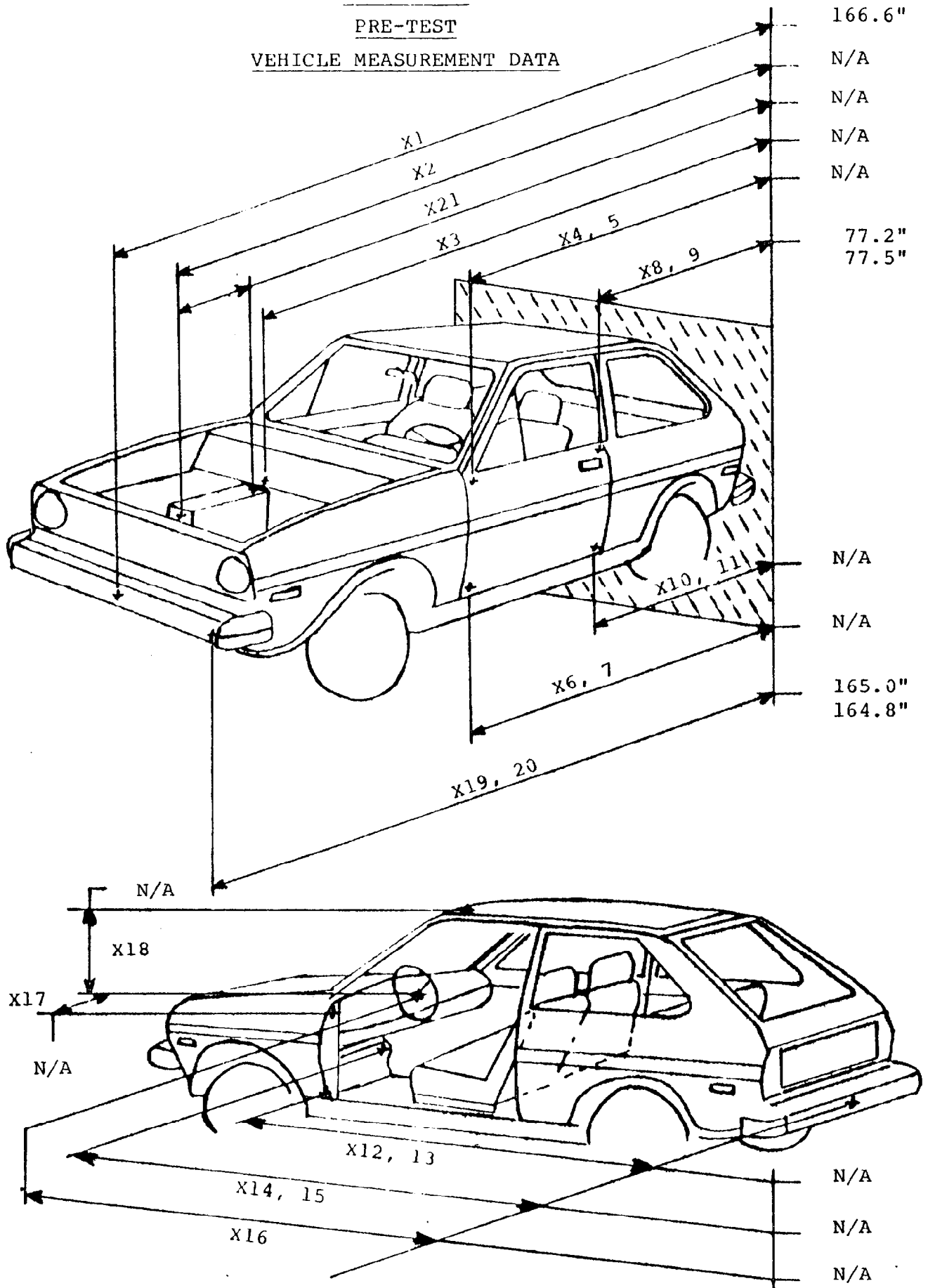
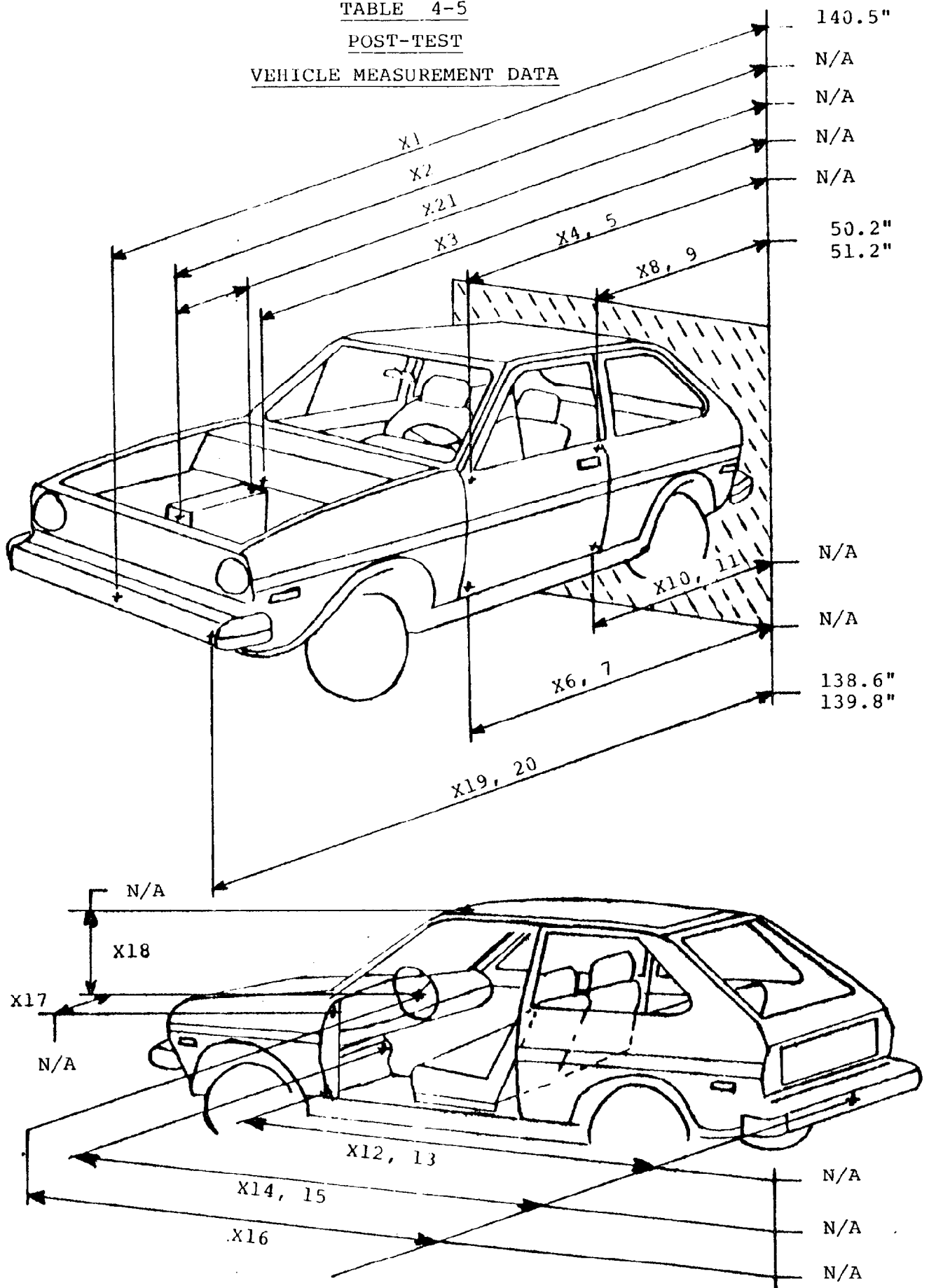


TABLE 4-5
POST-TEST
VEHICLE MEASUREMENT DATA





APPROVED ENGINEERING TEST LABORATORIES

TABLE 4-6

SUMMARY

PRE-TEST AND POST-TEST VEHICLE DIMENSIONS

<u>Measurement Point</u>	<u>Pre-Test</u>	<u>Post-Test</u>	<u>Difference</u>
X1	166.6"	140.5"	26.1"
X8	77.2"	50.2"	27.0"
X9	77.5"	51.2"	26.3"
X19	165.0"	138.6"	26.4"
X20	164.8"	139.8"	25.0"

TABLE 4-7
FMVSS 301-75
CAMERA POSITIONS

VEHICLE 1980 Subaru GL

NHTSA NO. 800530

TEST DATE August 7, 1980

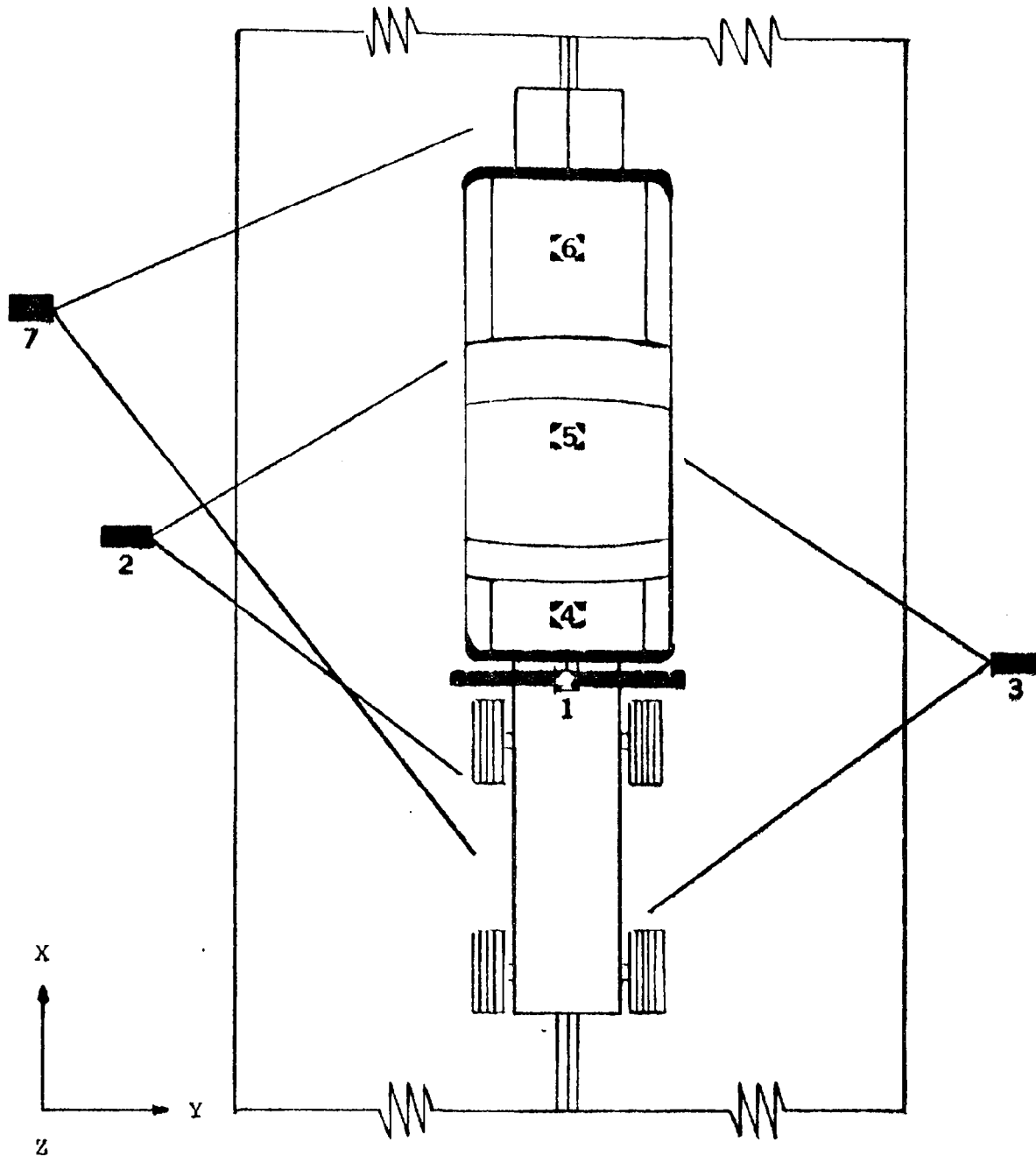


TABLE 4-8

FMVSS 301-75

CAMERA POSITIONS

VEHICLE 1980 Subaru GL

NHTSA NO. 800530 TEST DATE August 7, 1980

1. Photo-Sonics	X	<u>7.5"</u>	2. Photo-Sonics	X	<u>51.0"</u>
13mm 500FPS	Y	<u>- 0 -</u>	13mm 500FPS	Y	<u>219.0"</u>
	Z	<u>99.0"</u>		Z	<u>41.0"</u>
3. Photo-Sonics	X	<u>49.0"</u>	4. Photo-Sonics	X	<u>-4.0"</u>
13mm 500FPS	Y	<u>187.0"</u>	13mm 500FPS	Y	<u>1.8"</u>
	Z	<u>36.0"</u>		Z	<u>-44.0"</u>
5. Photo-Sonics	X	<u>43.0"</u>	6. Photo-Sonics	X	<u>168.0"</u>
13mm 500 FPS	Y	<u>1.5"</u>	13mm 500FPS	Y	<u>0.3"</u>
	Z	<u>-42.7"</u>		Z	<u>-47.3"</u>
7. Canon Scoopic					
12.5 - 75mm 24FPS					
- Documentary -					



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.



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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.



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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.



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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.



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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 accommodate 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 vehicle to fixed collision barrier face and to one side on the approach apron. Each timing



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trap system contains two (2) optical beams, mounted twenty four (24) inches apart, in a mechanical housing assembly providing a start-stop signal to a digital display counter. As the test vehicle traverses the impact apron, a blade attached to the test vehicle rear fender interrupts each optical beam providing the precise measurement of time interval for the test vehicle to advance the known distance between the optical beams. Each interval of time measurement is stored in the digital display counter 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 moving collision barrier to vehicle impact location and to one side on the approach apron. Each timing trap system contains two (2) optical beams, mounted twenty-four (24) inches apart, in a mechanical housing assembly providing a start-stop signal to a digital display counter. As the moving barrier traverses the impact apron, a blade attached to the moving barrier side interrupts each optical beam providing the precise measurement of time interval for the moving barrier to advance the known distance between the optical beams. Each interval of time measurement is stored in the digital display counter and photographically recorded.



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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 seven (7) 16mm 1B Photo-Sonics cameras and four (4) 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 eleven (11) 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 and third camera are mounted on top of the fixed barrier with



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their field of view concentrating on the windshield area (FMVSS 212/219). The fourth and fifth cameras each have a side view of the test vehicle at impact. The sixth, seventh, eighth, and ninth cameras are located adjacent to the test vehicle front passengers compartment and positioned to photograph motion of each test dummy at impact. The tenth and eleventh 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.



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The sixth camera is attached to the moving collision barrier to photograph the contact between the barrier and the test vehicle.

5.6.4 TIME PULSE GENERATOR

Time data from two (2) sources are contained in the high speed film coverage. The first is a time reference of 100 pulse per second (pps) light emitting diode event mark along the film edge. This pulse is generated by the time 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 event mark system. The trip switch is positioned at the impact point so that it triggers the light emitting diode event mark along the film edge 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.



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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 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 pre-digitizing filter capability of 60 db/octave above 1250 Hz.



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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 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 appro-



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priate 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.

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.



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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.

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.



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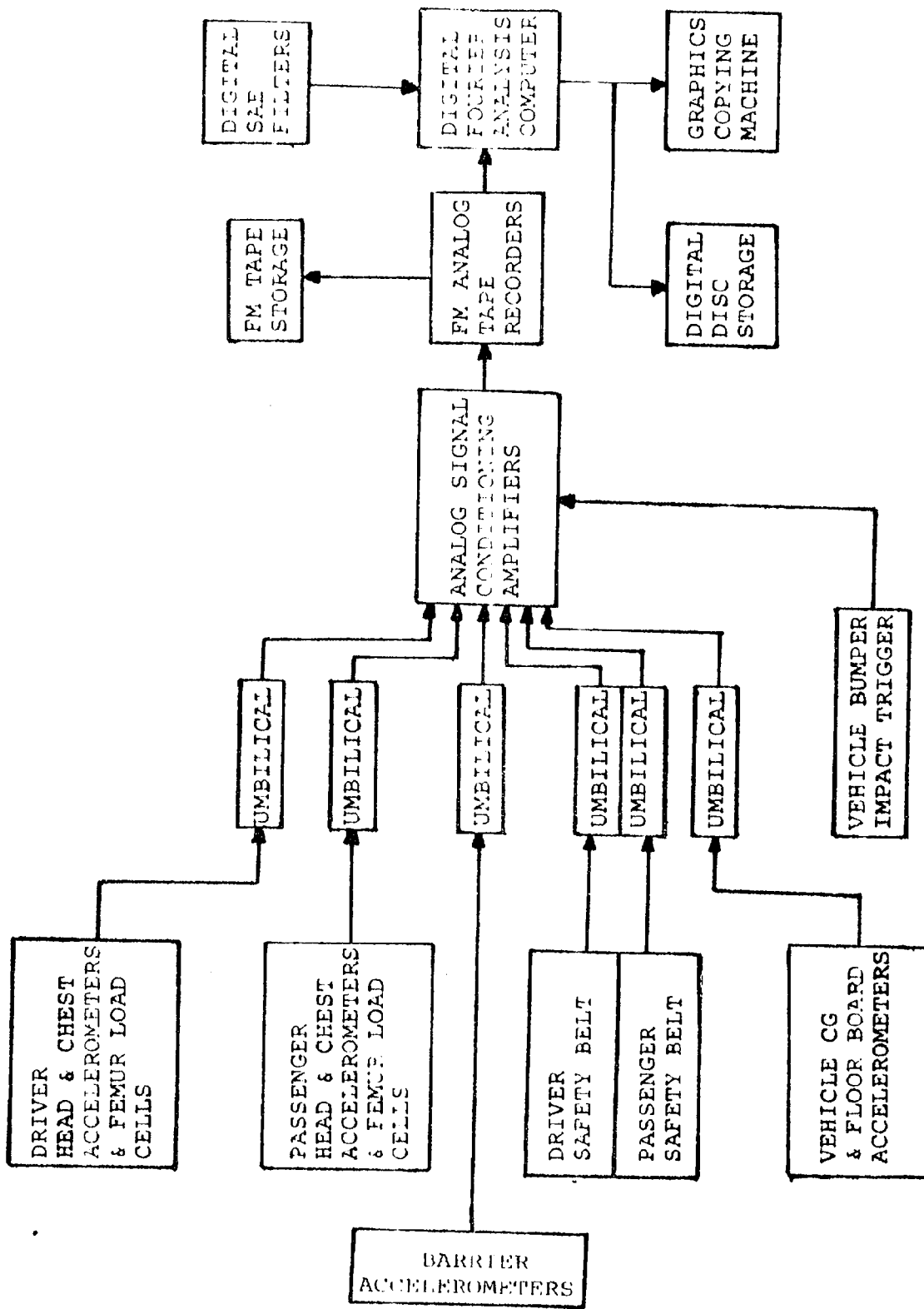
SECTION 5

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 BW
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	-	-



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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 synchronized 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 Labels
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

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

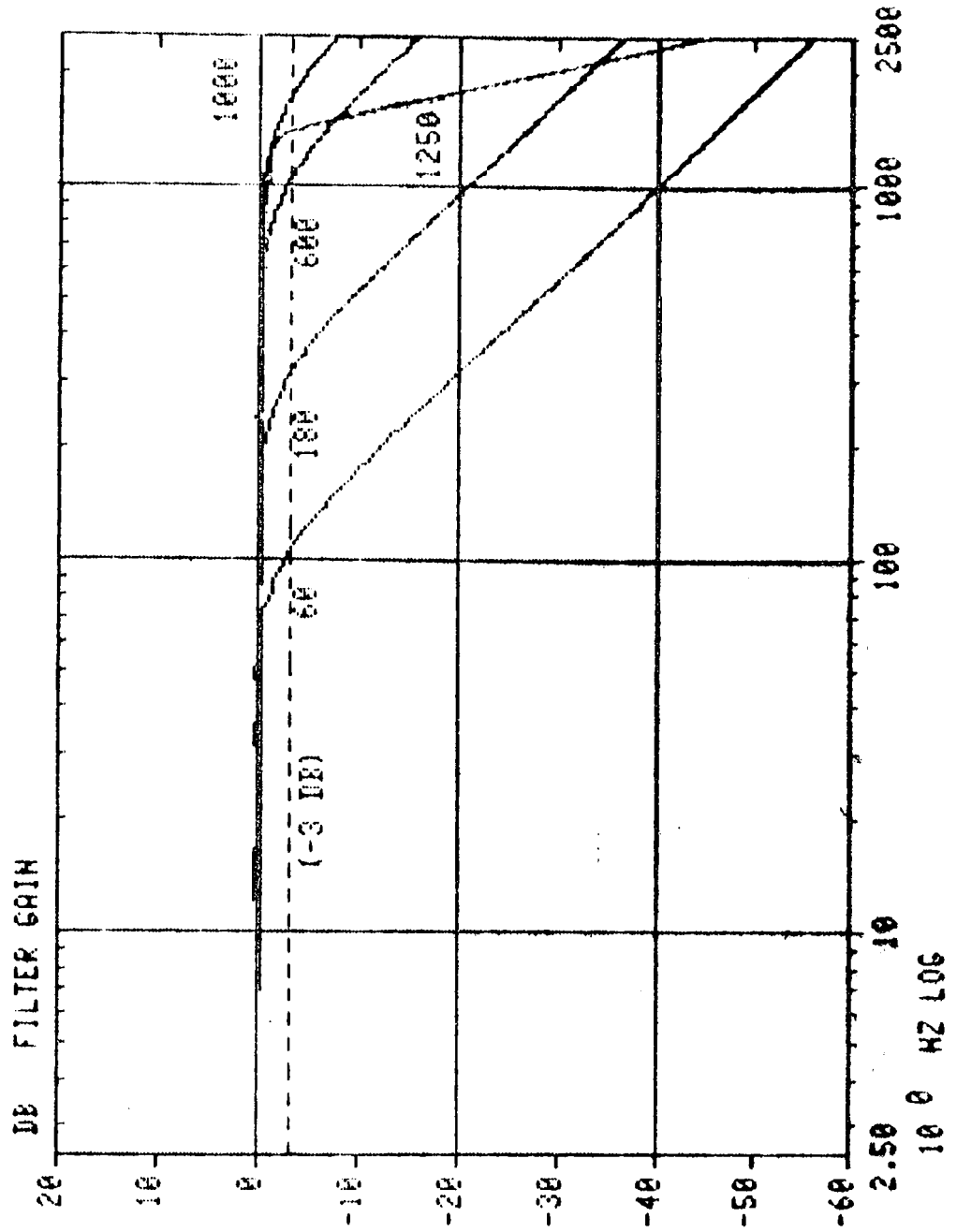


FIGURE 5-2



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APPENDIX A



APPROVED ENGINEERING TEST LABORATORIES

APPENDIX A

The following photographs are pre and post test dummy positions and interior compartment locations of dummy contact during the impact event.



APPROVED ENGINEERING TEST LABORATORIES

Figure A-1

1980 Subaru GL - 4 Door Sedan

NHTSA 800530

Pre-Test, Driver Dummy View





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Figure A-2
1980 Subaru GL - 4 Door Sedan
NHTSA 800530
Pre-Test, Passenger Dummy View





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Figure A-3
1980 Subaru GL - 4 Door Sedan
NHTSA 800530
Post-Impact, Driver Dummy View





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Figure A-4

1980 Subaru GL - 4 Door Sedan

NHTSA 800530

Post-Impact, Driver Dummy Contact Area





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Figure A-5

1980 Subaru GL - 4 Door Sedan

NHTSA 800530

Post-Impact, Passenger Dummy Contact Area





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APPENDIX B



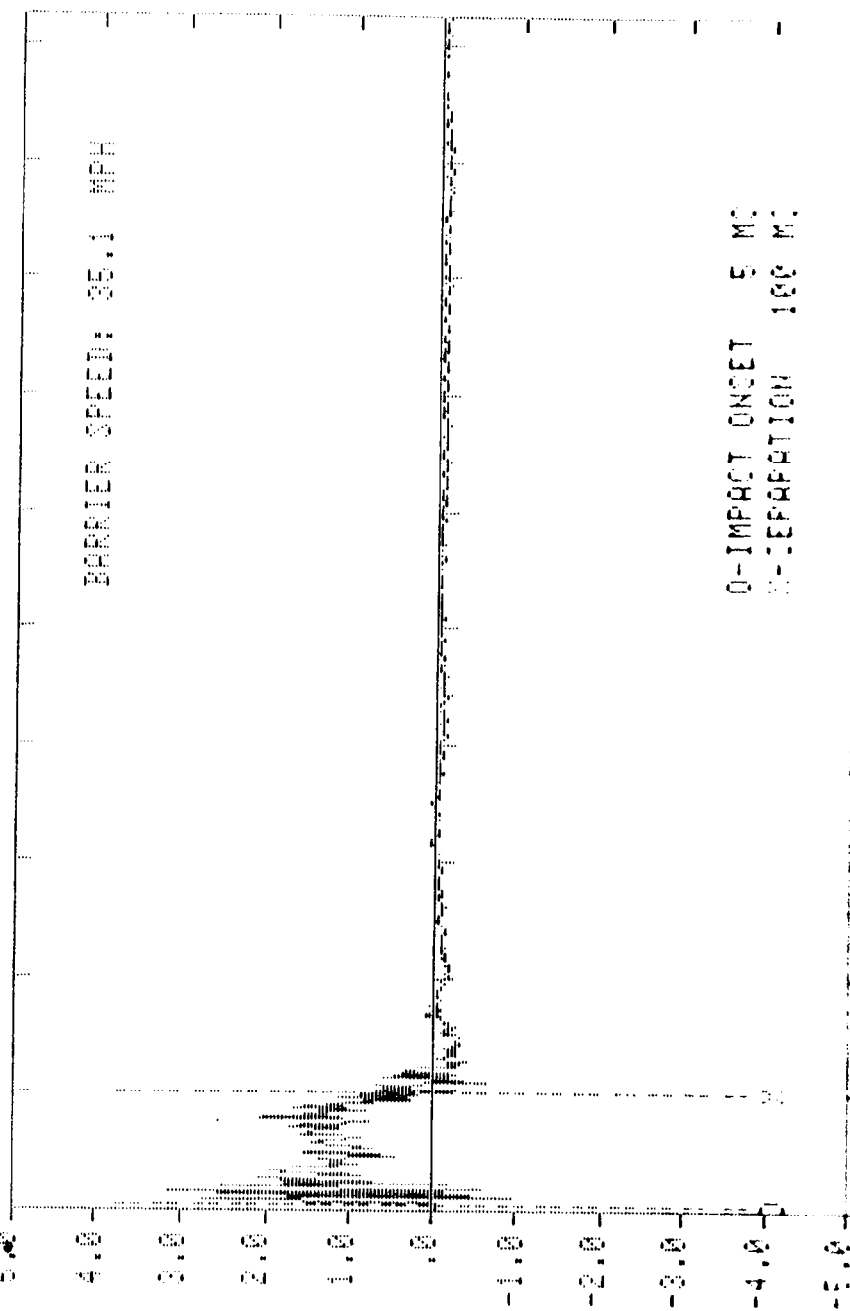
APPROVED ENGINEERING TEST LABORATORIES

APPENDIX B

The following computer plots provide complete and comprehensive vehicle acceleration during the rear moving barrier impact test of a 1980 Subaru GL - 4 Door Sedan, NHTSA 800530.

[illegible][illegible]

Figure 1 shows a schematic diagram of the experimental setup. A subject is seated at a table, viewing a video screen. A camera is positioned above the screen. A target is placed on the table. A ruler is used to measure the distance from the subject's hand to the target. The distance is labeled as 10 cm.

[illegible]

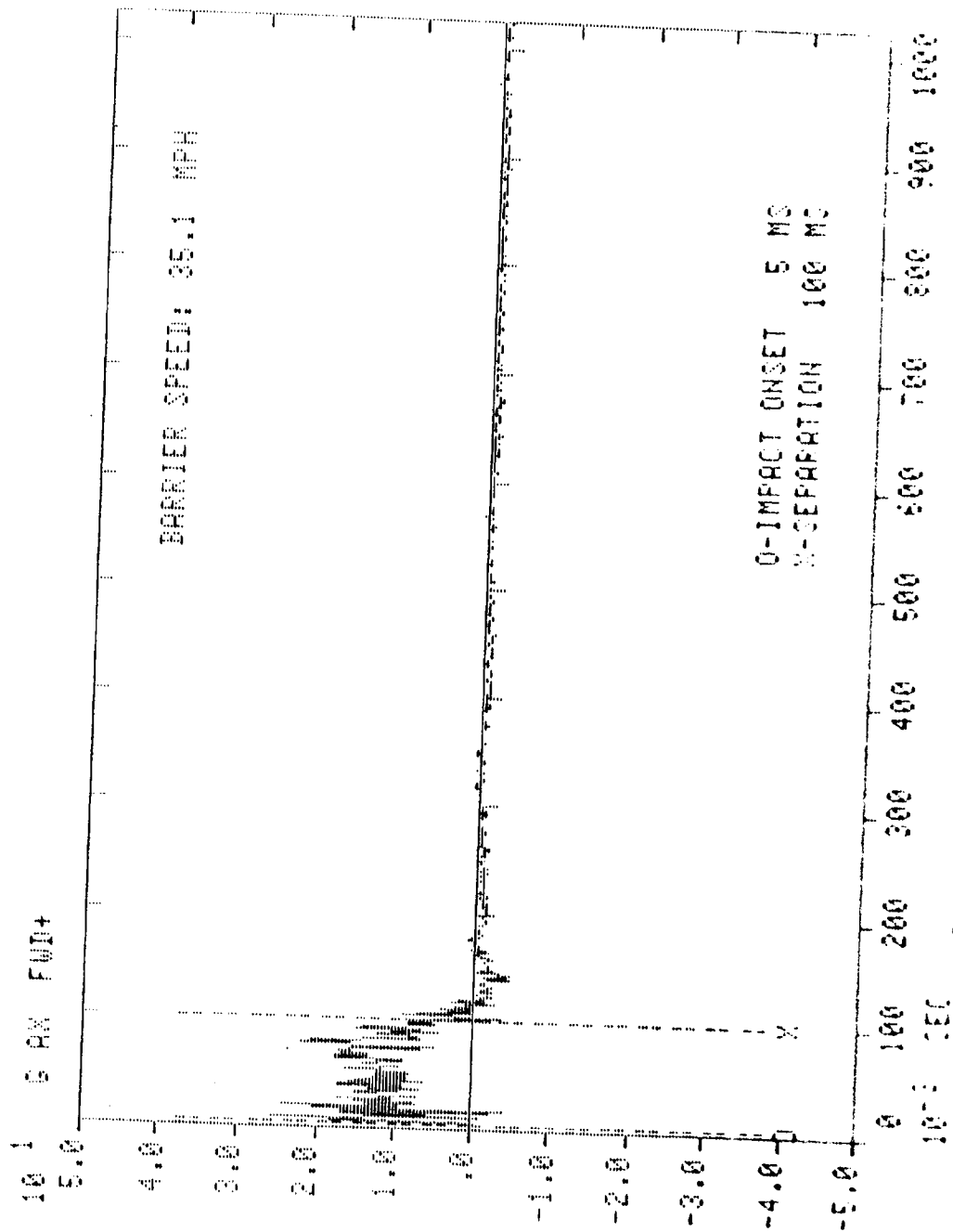
0-IMPACT ONSET 5 MO
0-1600331-100 MO-1600331-100 MO

0001	006	003	005	007	004	002	001
0002	007	004	006	008	005	003	002
0003	008	005	007	009	006	004	003
0004	009	006	008	010	007	005	004
0005	010	007	009	011	008	006	005
0006	011	008	010	012	009	007	006
0007	012	009	011	013	010	008	007
0008	013	010	012	014	011	009	008
0009	014	011	013	015	012	010	009
0010	015	012	014	016	013	011	010
0011	016	013	015	017	014	012	011
0012	017	014	016	018	015	013	012
0013	018	015	017	019	016	014	013
0014	019	016	018	020	017	015	014
0015	020	017	019	021	018	016	015
0016	021	018	020	022	019	017	016
0017	022	019	021	023	020	018	017
0018	023	020	022	024	021	019	018
0019	024	021	023	025	022	020	019
0020	025	022	024	026	023	021	020
0021	026	023	025	027	024	022	021
0022	027	024	026	028	025	023	022
0023	028	025	027	029	026	024	023
0024	029	026	028	030	027	025	024
0025	030	027	029	031	028	026	025
0026	031	028	030	032	029	027	026
0027	032	029	031	033	030	028	027
0028	033	030	032	034	031	029	028
0029	034	031	033	035	032	030	029
0030	035	032	034	036	033	031	030
0031	036	033	035	037	034	032	031
0032	037	034	036	038	035	033	032
0033	038	035	037	039	036	034	033
0034	039	036	038	040	037	035	034
0035	040	037	039	041	038	036	035
0036	041	038	040	042	039	037	036
0037	042	039	041	043	040	038	037
0038	043	040	042	044	041	039	038
0039	044	041	043	045	042	040	039
0040	045	042	044	046	043	041	040
0041	046	043	045	047	044	042	041
0042	047	044	046	048	045	043	042
0043	048	045	047	049	046	044	043
0044	049	046	048	050	047	045	044
0045	050	047	049	051	048	046	045
0046	051	048	050	052	049	047	046
0047	052	049	051	053	050	048	047
0048	053	050	052	054	051	049	048
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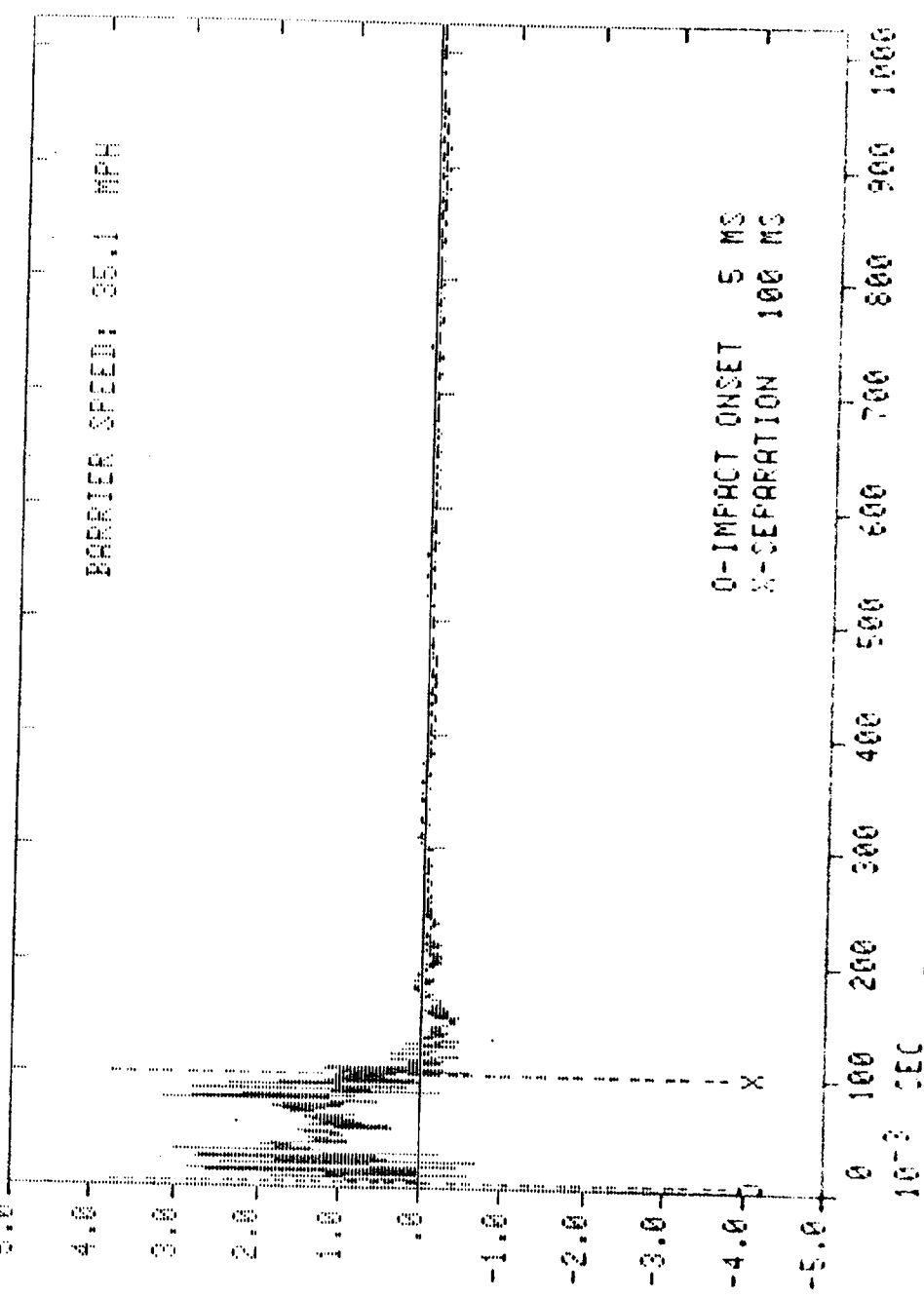
VEHICLE LEFT REAR FLOORPAN LONGITUDINAL ACCELERATION

TEST FILE NO: 81 PEAR

VEHICLE: JAGUAR 1980 3.0
 DATE: AUGUST 7, 1988

TEST FILE NO: 81 PEAR

10.1 G AX FWD+



[illegible]

WFO NO: 971-3882-011
 091 2070: 431713
 51178: 01922 189

[illegible]

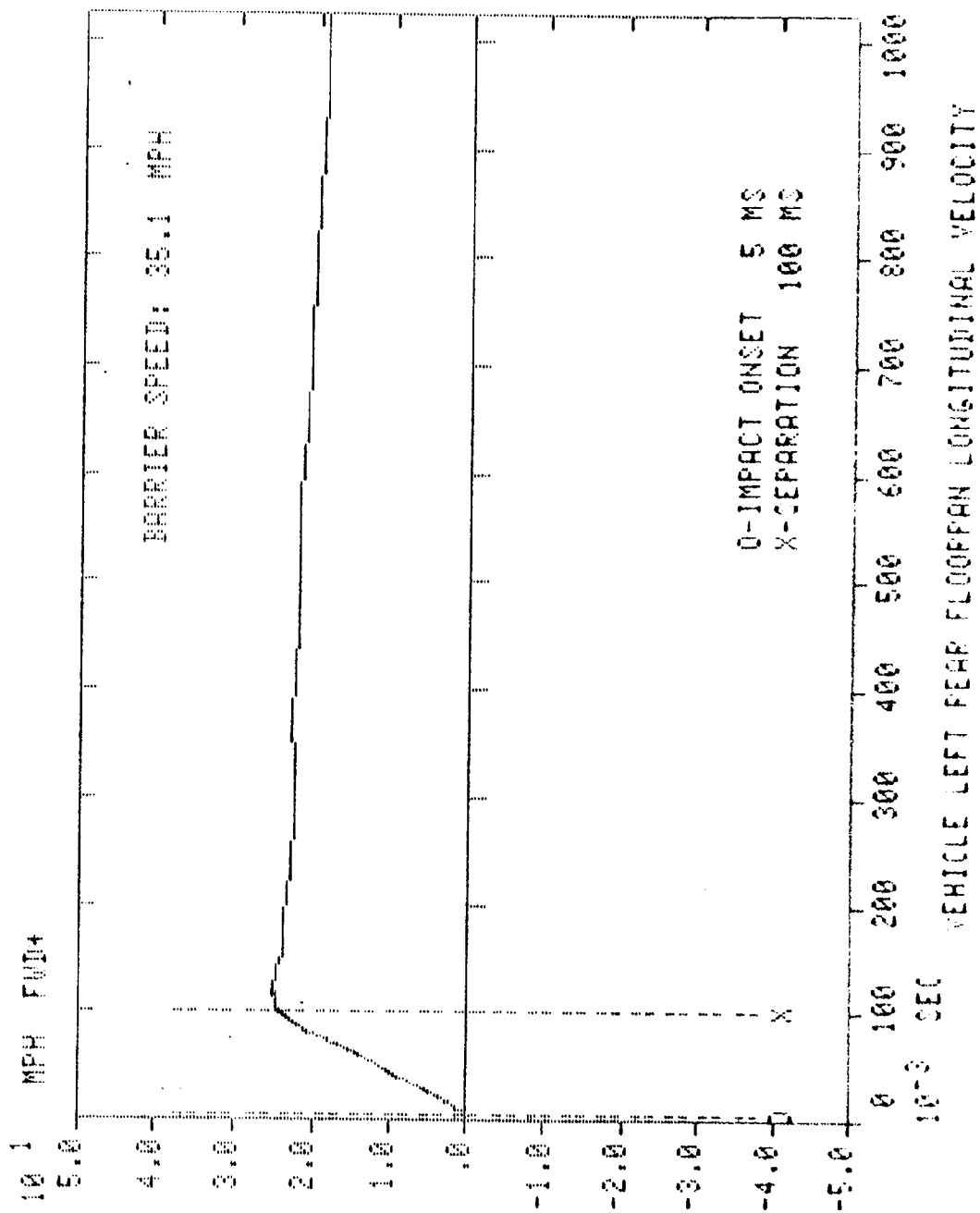
0-IMPACT ONSET	5 MS
X-SEPARATION	100 MS

VEHICLE RIGHT FRONT FLOORPAN LONGITUDINAL VELOCITY

[illegible]

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100-443887-100



TEST FILE NO: 61 REAR

DATE: AUGUST 7, 1980

VEHICLE: CUBARO 1600 GL-5

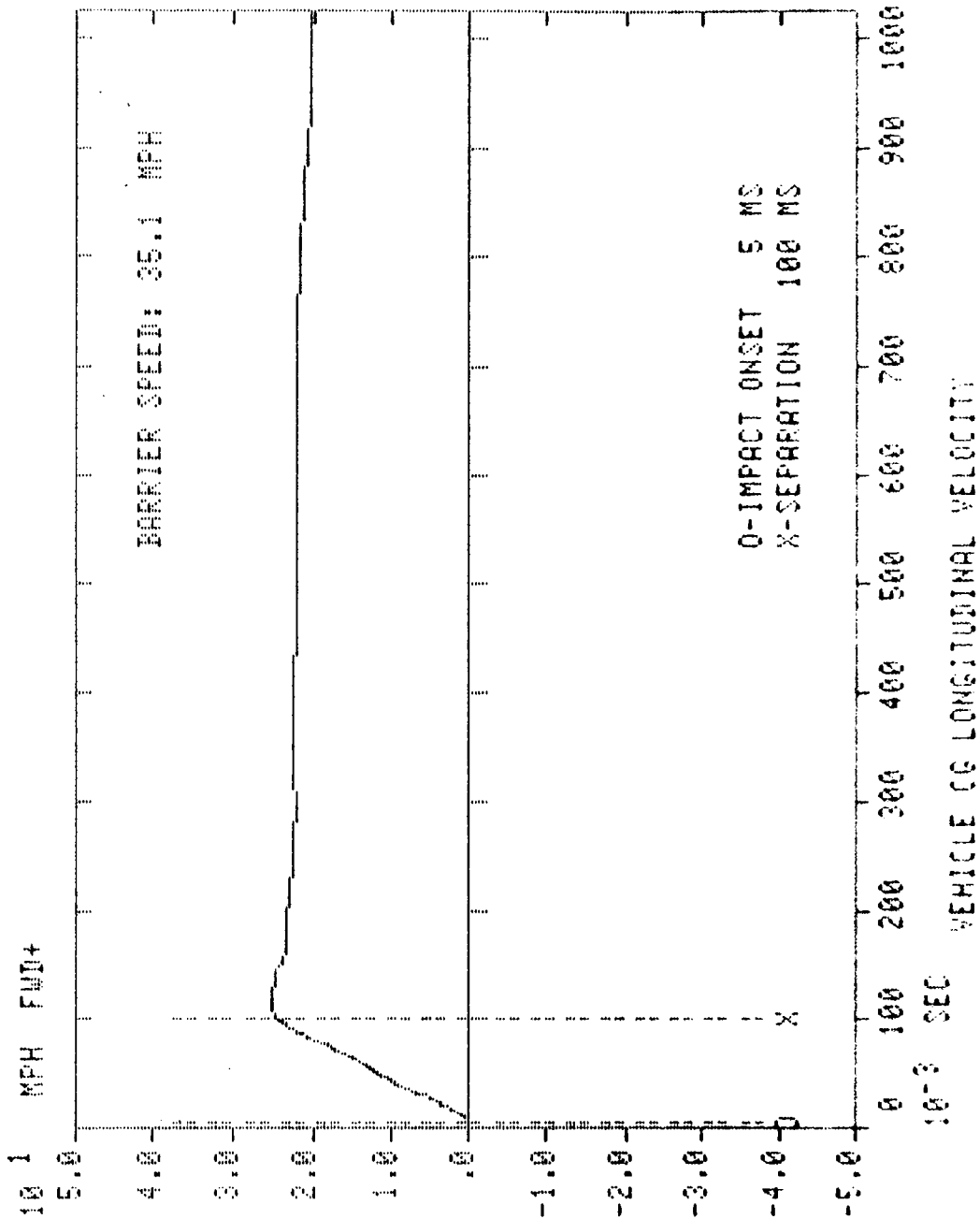
MJO NO: 971-9882-011

VEHICLE ID: WHICA 800530

FILTER: CLACC 100

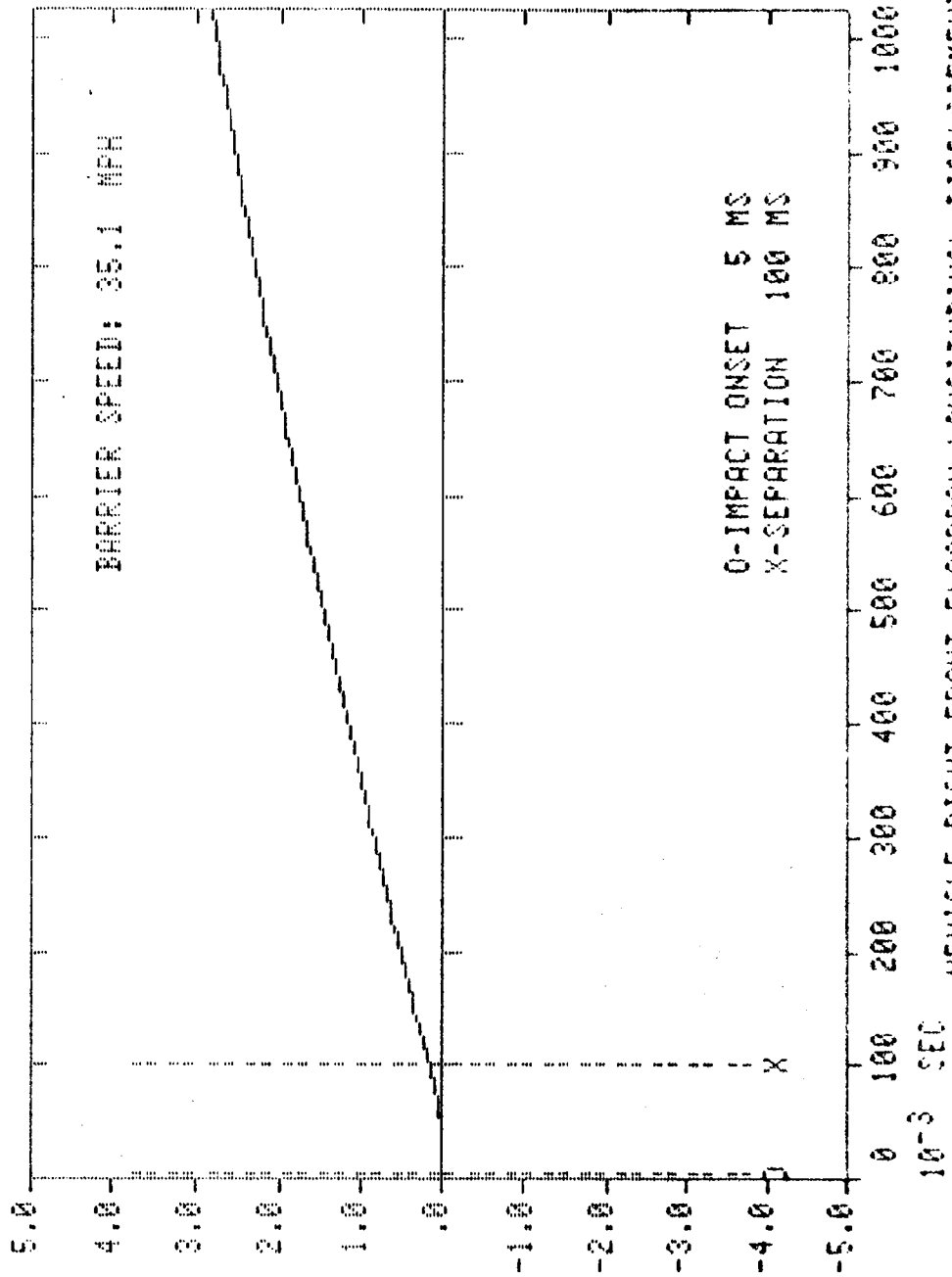
DATE: AUGUST 7, 1980

VEHICLE CG LONGITUDINAL VELOCITY



[illegible]

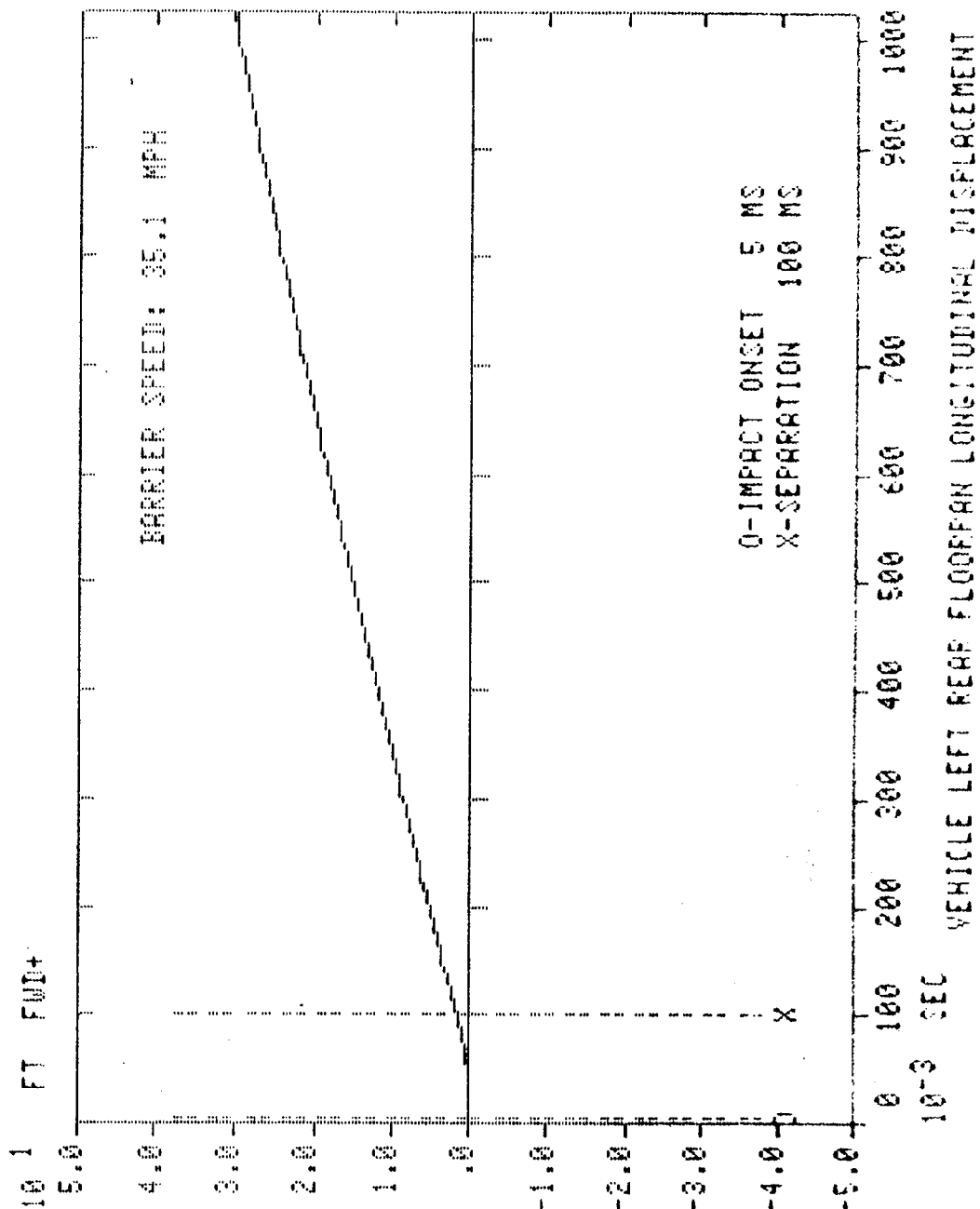
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[illegible]

VEHICLE RIGHT FRONT FLOORPAN LONGITUDINAL DISPLACEMENT

[illegible]

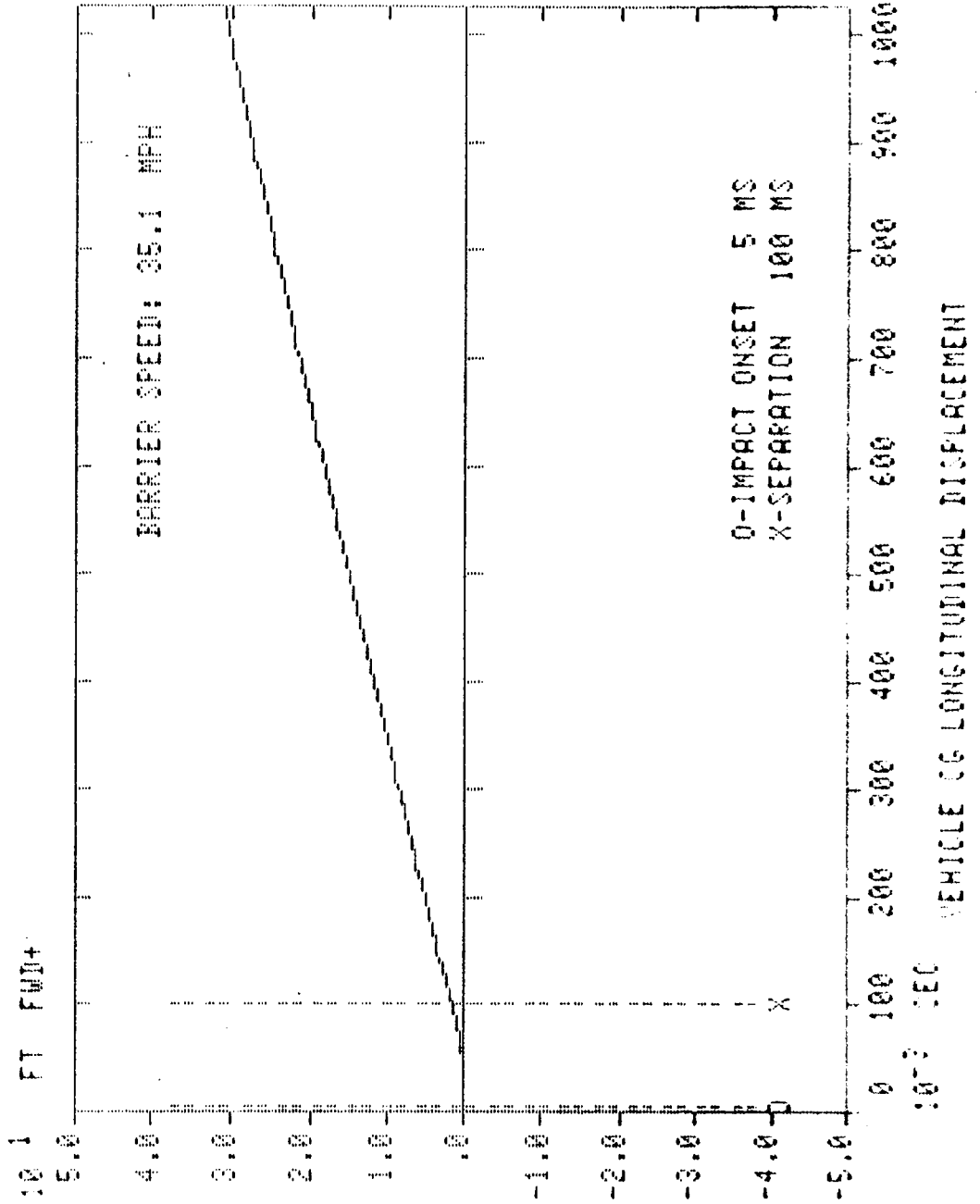
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TEST FILE NO: 61 FEARP

VEHICLE: CUMMINS 1800 GL-5
VEHICLE ID: WTCR 900500
TEST FILE NO: 61 FEARP
DATE: AUGUST 7, 1980

MJO NO: 971-3882-011
FILTER: 12500 180





APPROVED ENGINEERING TEST LABORATORIES

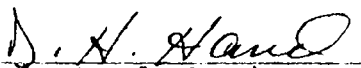
SERVICE FOR: U. S. Department of Transportation
National Highway Traffic Safety Administration
Enforcement
Office of Vehicle Safety Compliance
400 Seventh Street S. W.
Washington, D. C. 20590

CONTRACT NUMBER: DOT-HS-9-02273

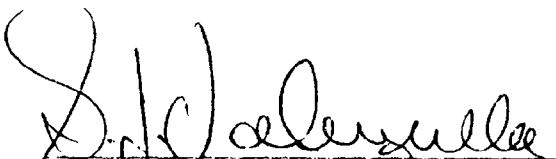
I hereby certify that the preceding report is true and correct to the best of my knowledge.

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.,
Quality Assurance Manager

rmh