

Report Number 301-75-DYS-78-023

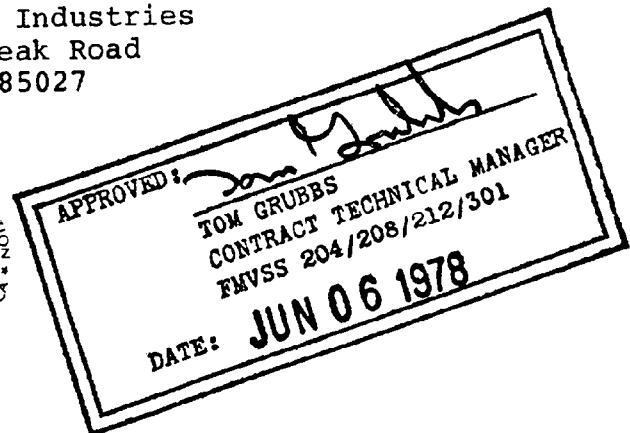
CIR No. 1999

DOT 6108

FMVSS 301-75 STANDARDS ENFORCEMENT TESTING
OF FUEL SYSTEM INTEGRITY

Chrysler Corporation
1978 Plymouth Horizon Four-Door Hatchback
NHTSA 780311

Dynamic Science, Inc.
A Subsidiary of Talley Industries
1850 West Pinnacle Peak Road
Phoenix, Arizona 85027



May 1978

FINAL REPORT

Prepared for:

U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
MOTOR VEHICLE PROGRAMS
Office of Vehicle Safety Compliance
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FINAL REPORT ACCEPTED BY:

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NHTSA Contract Technical Manager
FMVSS 219/301-75

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16. Abstract FMVSS 301-75 Standards Enforcement Test of a 1978 Plymouth Horizon Four-Door Hatchback, NHTSA 780311, VIN ML44A8D109434, was conducted at the Dynamic Science, Inc. Deer Valley facility in Phoenix, Arizona, to determine compliance with the requirements of Standard 301-75. The moving barrier impacted the rear of the vehicle at a speed of 29.44 mph. The test date was April 8, 1978 and the ambient temperature was 59°F. The subject vehicle appeared to fail to meet the requirements of FMVSS 301-75, as specified for the vehicle manufacture date. CIR No. 1949					
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1.0 PURPOSE AND TEST PROCEDURE

1.1 PURPOSE

The purpose of the test was to evaluate the integrity of the vehicle fuel system in accordance with the requirements of Federal Motor Vehicle Safety Standard (FMVSS) 301-75 entitled "Fuel System Integrity."

1.2 TEST PROCEDURE

The Dynamic Science, Inc. Test Procedure for FMVSS 301-75 submitted to and approved by the Contract Technical Monitor (CTM) contains the specific procedures used to conduct this test.

2.0 SUMMARY OF VEHICLE PERFORMANCE

1978 Plymouth Horizon Four-Door Hatchback, NHTSA 780311.

2.1 PRIMARY RESULTS

The impact velocity was 29.44 mph.

No fuel spillage occurred during and following barrier impact. Fuel spillage during the static rollover exceeded the amount allowed. Details of this apparent noncompliance are discussed in Section 2.3.

The vehicle therefore appears to fail to meet the requirements of FMVSS 301-75 as specified for the vehicle manufacture date.

2.2 SECONDARY RESULTS

The vehicle maximum static crush was 15.2 inches.

The ambient temperature at the time of the test was 59°F and the vehicle had been in that environment for several hours prior to the test.

The door locks were set in the unlocked position prior to the test and they remained unlocked during the test. Following the test, the driver door opened easily; the passenger door and both rear doors required tools to open.

2.3 DETAILS OF NONCOMPLIANCE WITH FMVSS 301

Following the moving barrier test, the vehicle was placed in the static rollover fixture. When rolling from 0° to 90°, slight leakage occurred from the carburetor; however the amount was well within the allowable limits of the standard.

When rolling from 90° to 180°, profuse leakage began from the filler cap (see Figure 2-1). Leakage of 158.7 oz was measured during the first five minutes of this period. Since this rate exceeds the 5 oz allowed by the standard, the vehicle appears to be in noncompliance with the standard. The foregoing data is illustrated graphically in Figure 2-2.

The filler cap was later removed for examination and showed no obvious damage. The high-speed film was reviewed and it was noted that the tire well bore directly against the filler tube (see Figures 2-3 and 2-4) during impact. The filler tube was brushed forward during this contact and the seating of the filler cap may have been affected by this action.

On April 12, under the direction of Mr. Alfred Kazmierczak (NHTSA) and Mr. Arvan Kent (Chrysler Corporation), the vehicle fuel tank was refilled with Stoddard Solvent and the vehicle was again placed in the static rollover device. The rollover test up to the 180° position was repeated and there was no leakage of fuel during this test. It appears that during the many removals and examinations of the filler cap following the first test, the operation of the filler cap had corrected itself.

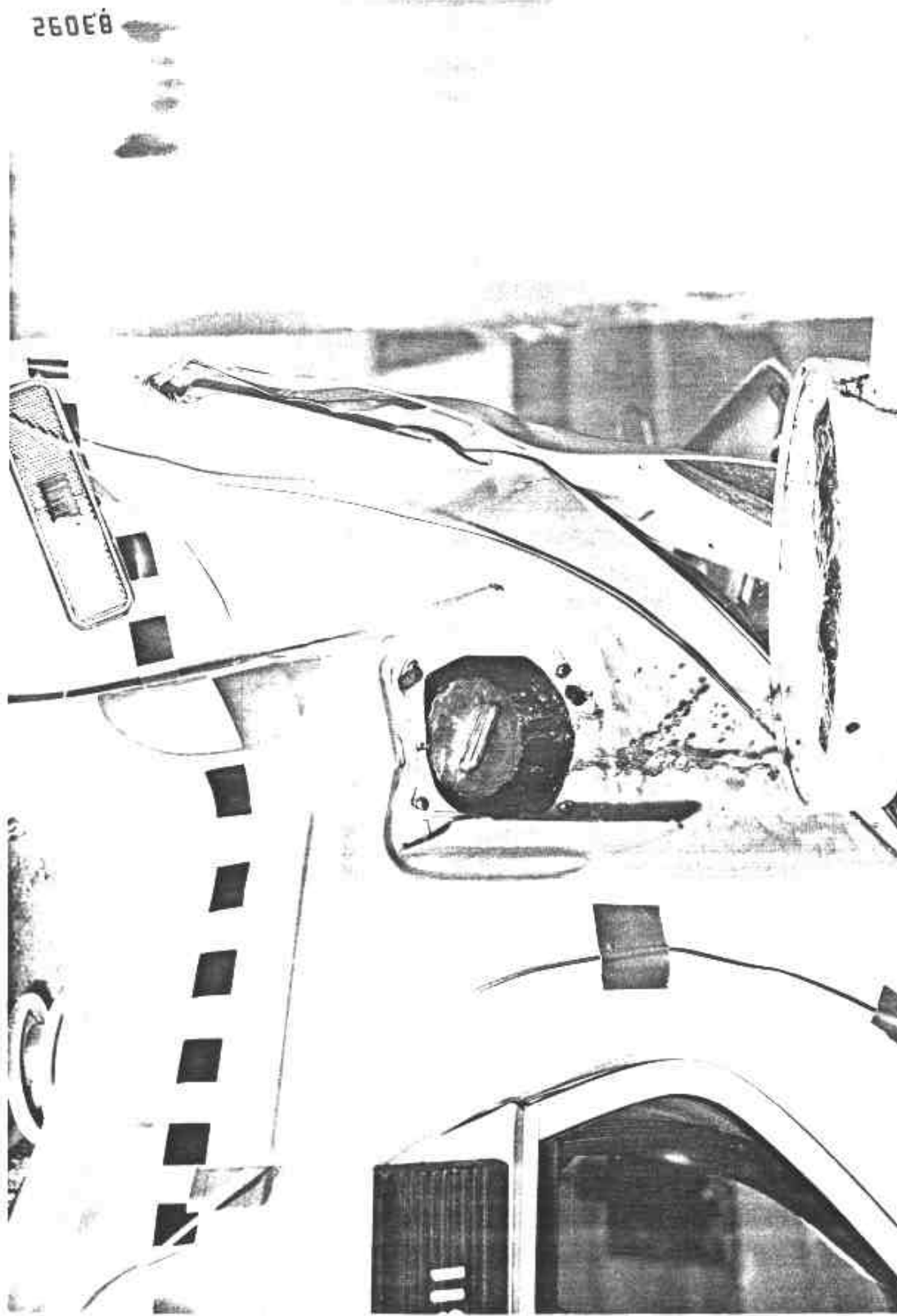
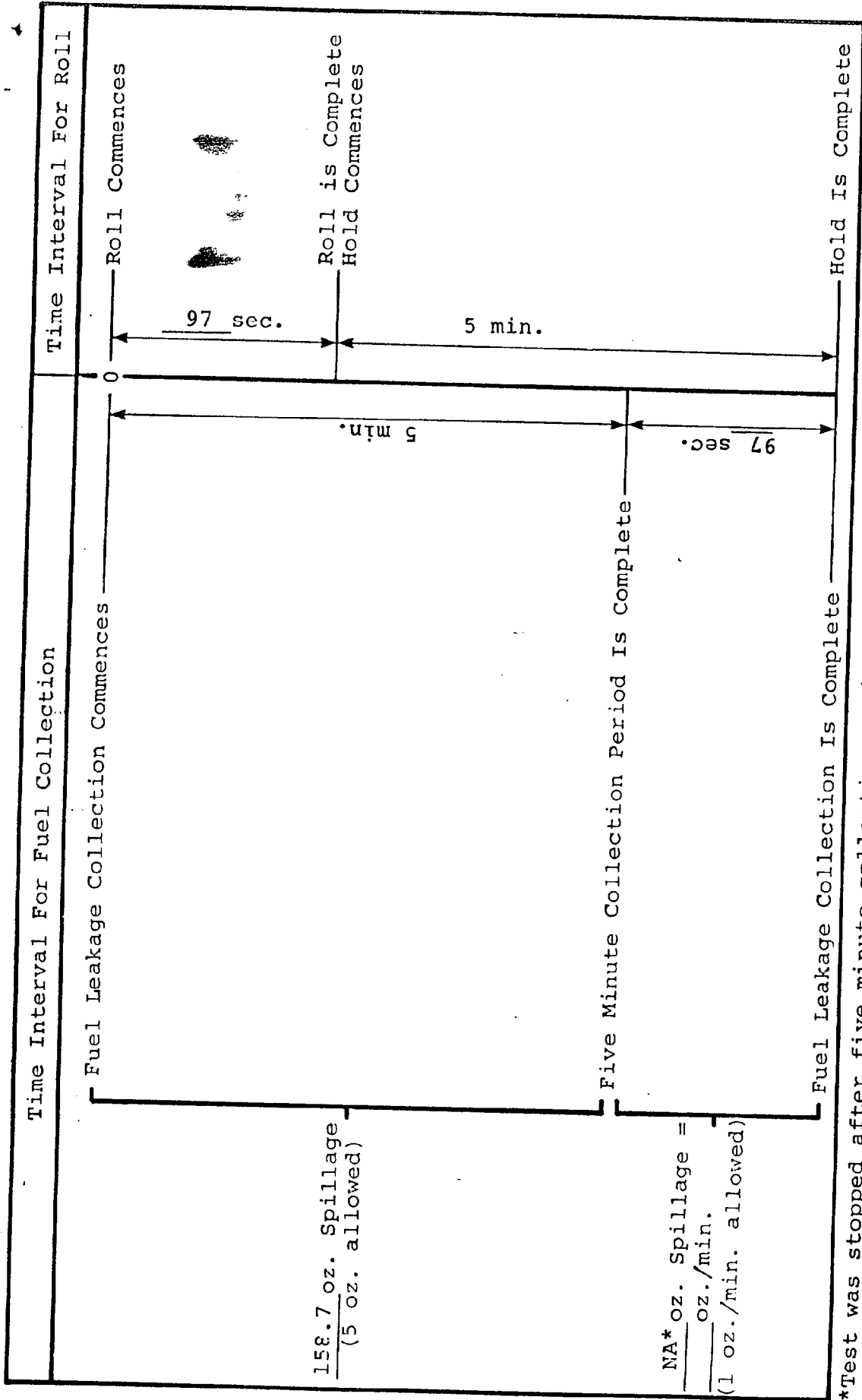


Figure 2-1. Post-test Close-up View of Filler Cap Leakage During Static Rollover - 1978 Plymouth Horizon Four-Door Hatchback - NHTSA 780311.



*Test was stopped after five minute collection period, due to massive leakage.

Figure 2-2. Time Relationship Between Fuel Collection Period and 90° to 180° Static Roll Period - 1978 Plymouth Horizon Four-Door Hatchback, NHTSA 780311.

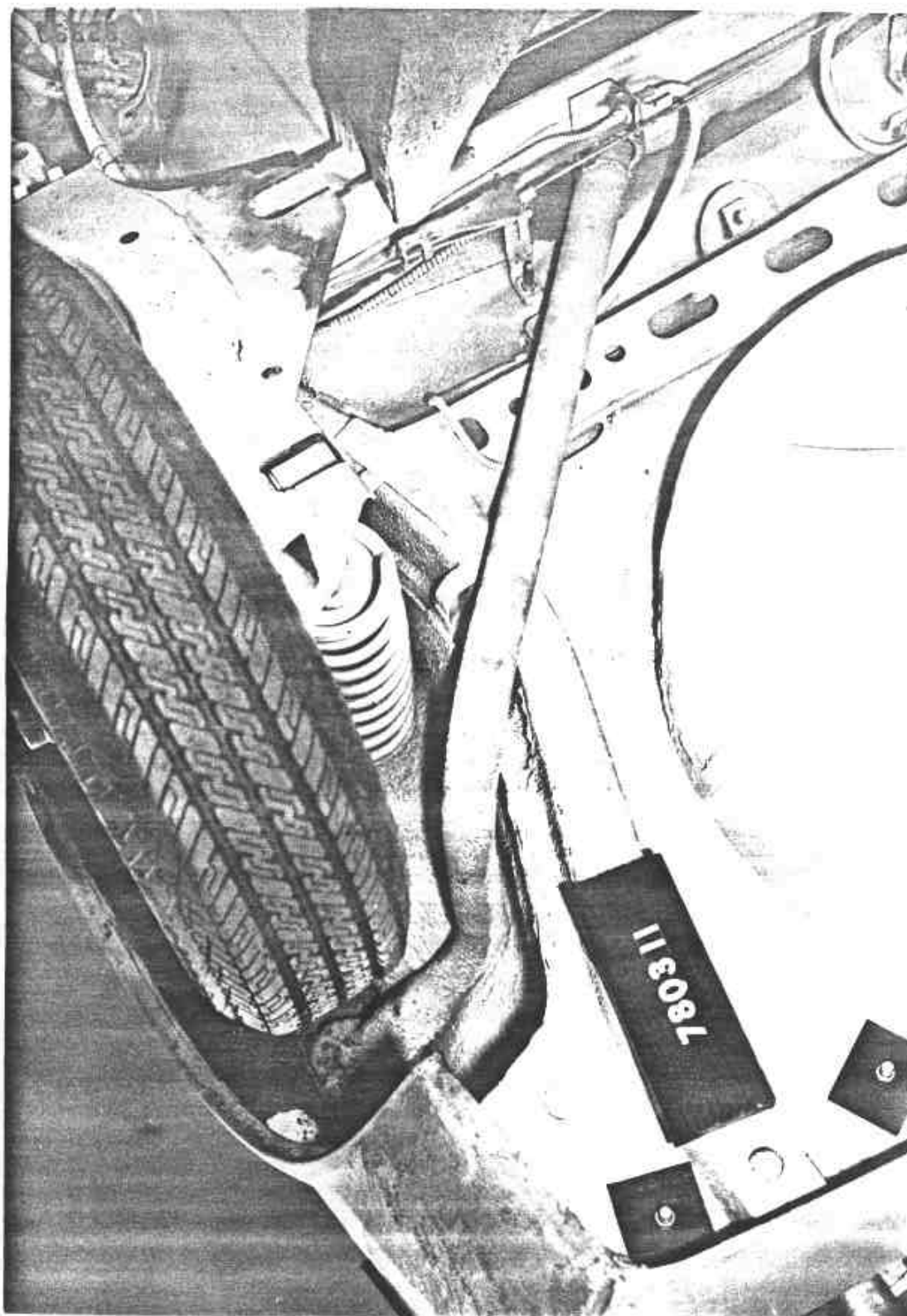


Figure 2-3. Overall View of Filler Tube - 1978 Plymouth Horizon Four-Door Hatchback - NHTSA 780311.

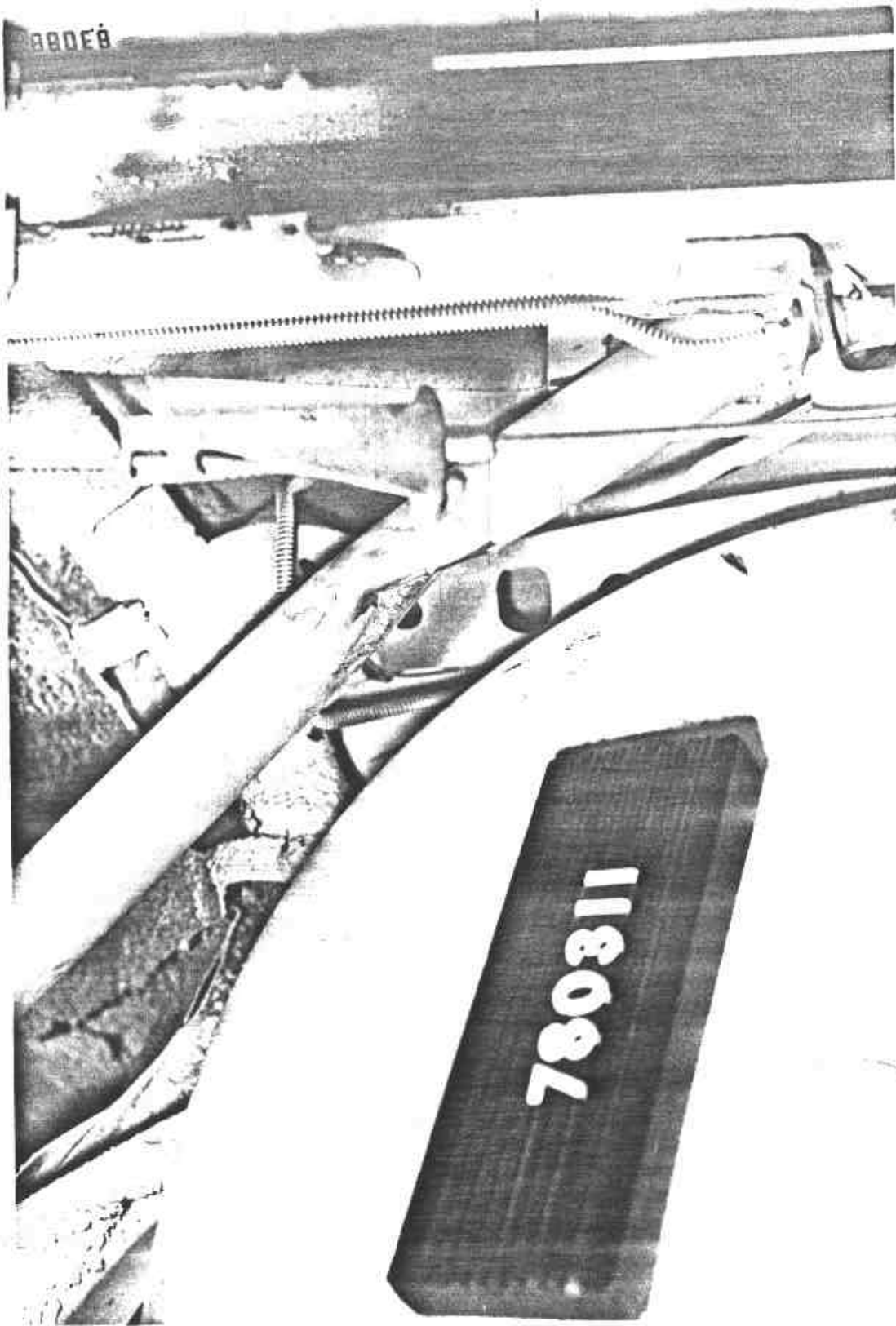


Figure 2-4. Post-test Close-up of Damage to Filler Tube - 1978 Plymouth Horizon Four-Door Hatchback - NHTSA 780311.

3.0 TEST RESULTS AND IMPACT EFFECTS

The following data sheets report:

- Test conditions (pages 3-2 and 3-3)
- Post-impact data (page 3-4)
- Fuel system leakage data (page 3-5).

A description of the impact effects follows the data sheets (page 3-6).

SUMMARY OF TEST CONDITIONS
1978 Plymouth Horizon Four-Door Hatchback, NHTSA 780311

TEST VEHICLE IDENTIFICATION

Manufacturer: Chrysler Corporation
Make/Model: Plymouth Horizon
Body Style: Four-Door Hatchback Model Year: 1978
VIN: ML44A8D109434; Build Date: 12/77
NHTSA No.: 780311; Color: Tan
Engine Data: 4 cylinders; 105 c.i.d.
Transmission Data: 4 speed
☒ Manual ☐ Automatic
Major Options: Tinted Glass, Radio

TEST CONDITIONS

Date of Test: April 8, 1978; Time of Test: 1517
Ambient Temperature 59 °F at impact area

TEST VEHICLE WEIGHT (data taken from tire pressure placard)

Vehicle Capacity Weight: 715 lb
Designated Seating Capacity: Front 2
Rear 2
Total 4
GVWR (taken from Certification Label): 3165 lb
GAWR Front: 1715 lb
GAWR Rear: 1500 lb
Vehicle Delivered Weight (fluids to capacity) Front: 1318 lb
Rear: 811 lb
Total: 2129 lb
Calculated Vehicle Test Weight: 2572 lb
Actual Vehicle Test Weight Front: 1475 lb
Rear: 1104 lb
Total: 2579 lb

REMARKS: _____

SUMMARY OF TEST CONDITIONS (CONTD)
1978 Plymouth Horizon Four-Door Hatchback, NHTSA 780311

VEHICLE ATTITUDE: (all dimensions in inches)

Delivered Attitude: RF 29.0 LF 29.0 RR 29.0 LR 29.0
Test Attitude: RF 28.0 LF 27.8 RR 27.1 LR 27.1

VEHICLE TIRE DATA

Recommended Cold Tire Pressure: Front 29 psi
Rear 29 psi

Recommended Tire Size: P155-80R13

Load Range: B

Tires on Vehicle: P155-80R13

Is Spare Tire a "Space Saver": No (yes/no)

TEST FLUID DATA

Test Fluid Type: Stoddard Solvent No. 2; Spec. Grav.: 0.764

Spill Point Volume: 14.9 gallons

Test Volume: 14.0 gallons

Fuel System Capacity
(data from Owner's Manual): 13 gallons

Details of fuel system: _____

POST-IMPACT DATA SHEET
1978 Plymouth Horizon Four-Door Hatchback, NHTSA 780311

TYPE OF TEST: Rear IMPACT

DATE OF TEST: April 8, 1978

REQUIRED VELOCITY RANGE (mph): 28.9 to 29.9

IMPACT VELOCITY (mph):

Primary 29.44, Secondary 29.44

VEHICLE STATIC CRUSH (in.):

1.* Driver Side: 14.8 Passenger Side: 14.0

Average: 14.4

Detail: _____

2.** Amount of Crush: _____ on _____ side

Detail: _____

VEHICLE REBOUND*** (in.):

Driver Side: _____, Passenger Side: _____

Average: _____

REMARKS: _____

*For frontal and rear impacts only.

**For side impacts only.

***For rigid barrier only.

POST-IMPACT DATA SHEET
1978 Plymouth Horizon Four-Door Hatchback, NHTSA 780311

A. AT IMPACT SITE

Fuel Spillage Measurement	Actual	Allowed	Spillage Location
From impact until vehicle motion ceases	0	1 oz	
For 5-minute period after vehicle motion ceases	0	5 oz	
For next 25 minutes	0	1 oz/min	

B. AT STATIC ROLLOVER FIXTURE

Roll		Actual	Allowed	Spillage Location
0° to 90°	Roll Time	99 sec	1-3 min	
	Spillage for 5-minute period from onset of rotation	.05 oz	5 oz	Carburetor
	Spillage for remainder of hold (equals roll time)	0	1 oz/min (1.65 oz)	
90° to 180°	Roll Time	97 sec	1-3 min	
	Spillage for 5-minute period from onset of rotation	158.7 oz*	5 oz	Filler cap
	Spillage for remainder of hold (equals roll time)	NA	1 oz/min	
180° to 270°	Roll Time	NA	1-3 min	
	Spillage for 5-minute period from onset of rotation	NA	5 oz	
	Spillage for remainder of hold (equals roll time)	NA	1 oz/min	
270° to 360°	Roll Time	NA	1-3 min	
	Spillage for 5-minute period from onset of rotation	NA	5 oz	
	Spillage for remainder of hold (equals roll time)	NA	1 oz/min	

*Due to massive leakage, test was stopped at the end of the five-minute period.

IMPACT EFFECTS
1978 Plymouth Horizon Four-Door Hatchback, NHTSA 780311

VISIBLE DUMMY CONTACT POINTS

	<u>Driver</u>	<u>Passenger</u>
Head	<u>None</u>	<u>None</u>
Chest	<u>None</u>	<u>None</u>
Abdomen	<u>None</u>	<u>None</u>
Left Knee	<u>None</u>	<u>None</u>
Right Knee	<u>None</u>	<u>None</u>

	<u>Front</u>		<u>Rear</u>	
	<u>Left</u>	<u>Right</u>	<u>Left</u>	<u>Right</u>
<u>DOOR OPENING</u>				
Easy	<u>X</u>	<u> </u>	<u> </u>	<u> </u>
Difficult	<u> </u>	<u> </u>	<u> </u>	<u> </u>
Tools Required	<u> </u>	<u>X</u>	<u>X</u>	<u>X</u>

<u>SEAT BACK</u>		
Failure	<u>Yes</u>	<u>Yes</u>

<u>GLAZING DAMAGE</u>				
Windshield	<u>None</u>		<u>Shattered</u>	
Backlight				
Others	<u>None</u>	<u>None</u>	<u>None</u>	<u>None</u>

OTHER NOTABLE IMPACT EFFECTS: Both rear fenders locked up the rear wheels.

Body buckled up to front of rear wheels.

Both seat backs failed at left side mount attachment point.

Right rear bumper absorber leaked hydraulic fluid.

Passenger seat moved rearward 1.5 inches.

Right side of driver seat track moved out of mid position.

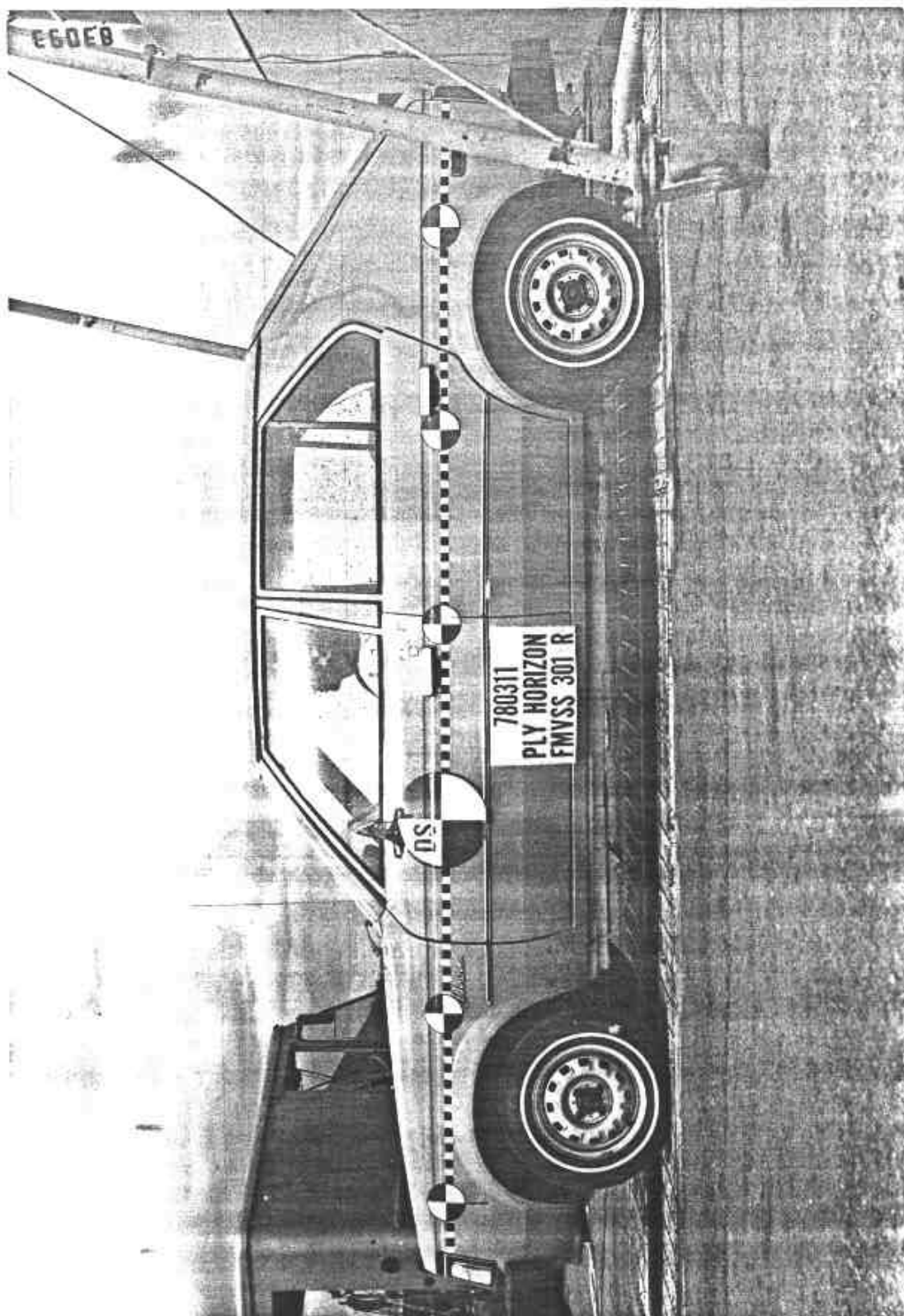


Figure 4-1. Pre-test Side View - 1978 Plymouth Horizon Four-Door Hatchback -
NHTSA 780311.

160E8

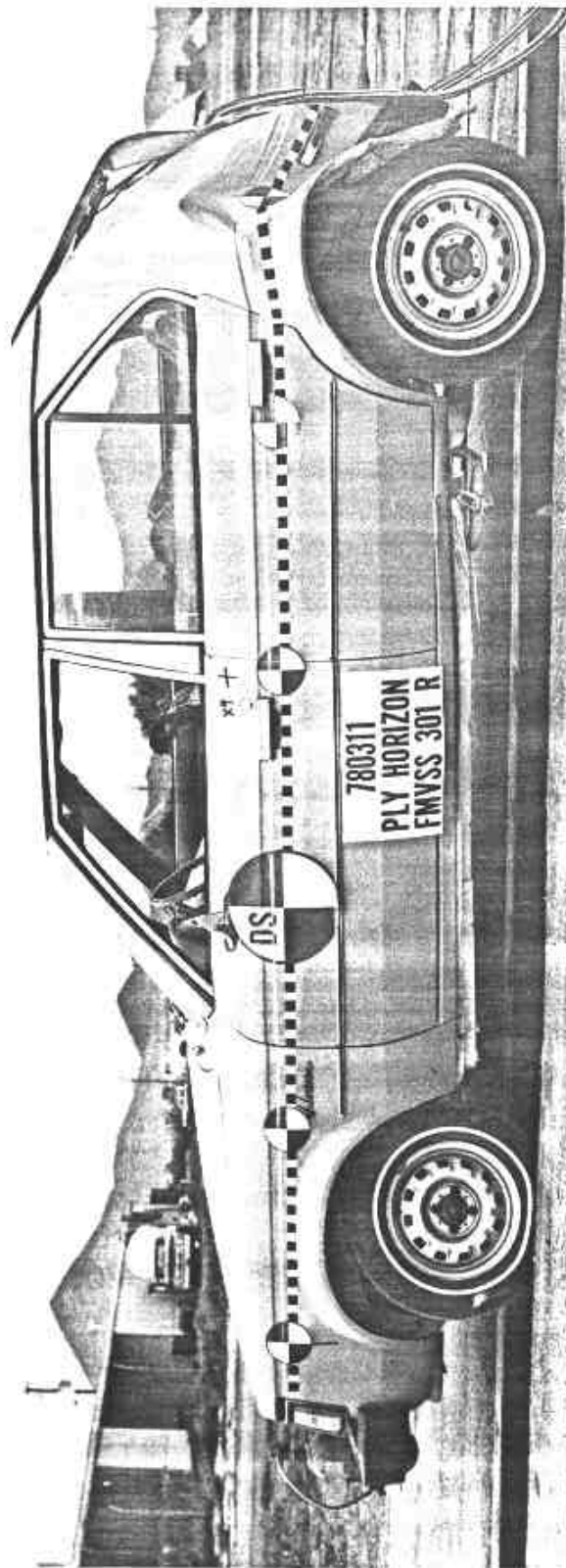


Figure 4-2. Post-test Side View - 1978 Plymouth Horizon Four-Door Hatchback - NHTSA 780311.

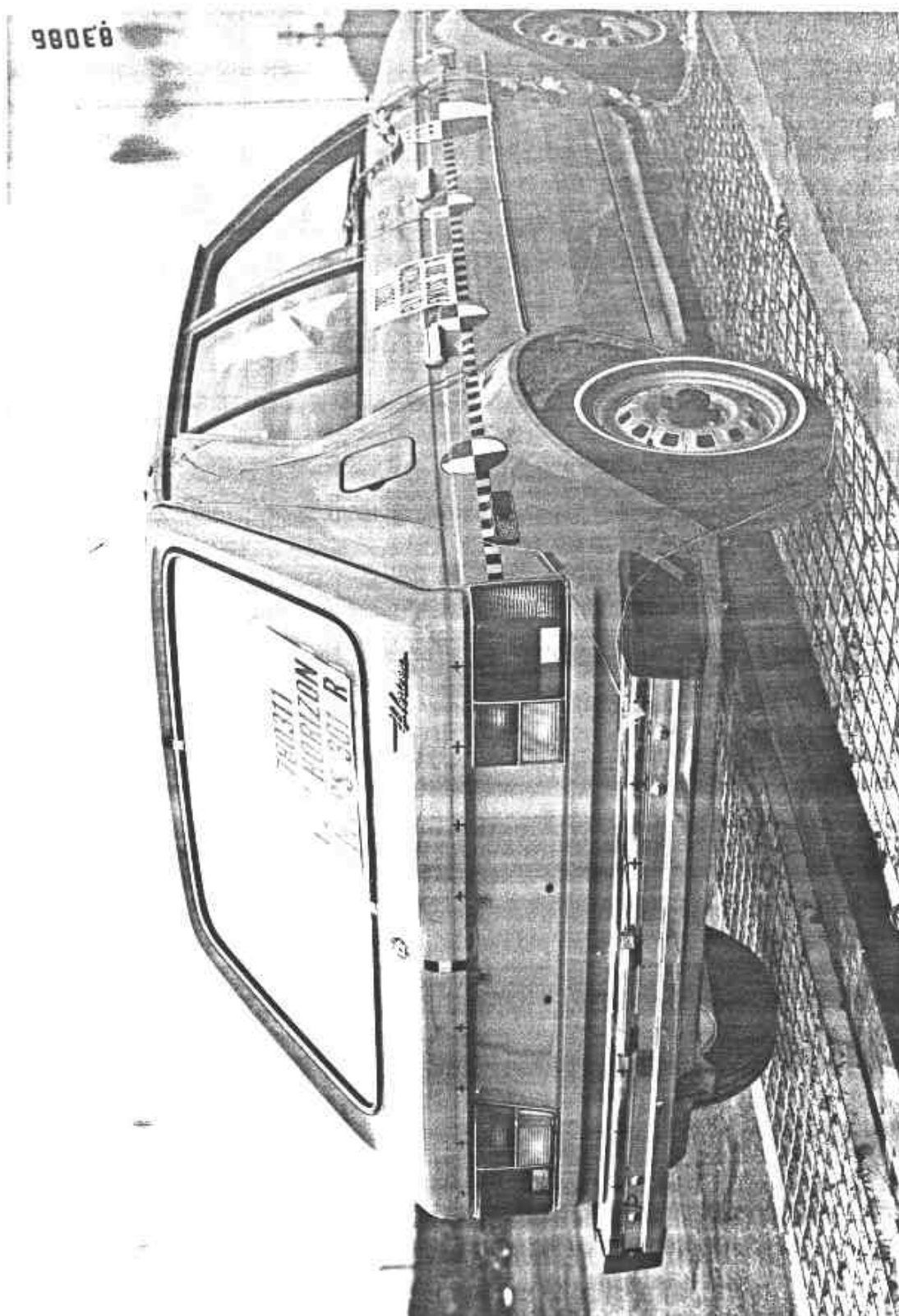


Figure 4-3. Pre-test Rear View - 1978 Plymouth Horizon Four-Door Hatchback -
NHTSA 780311.

860E8

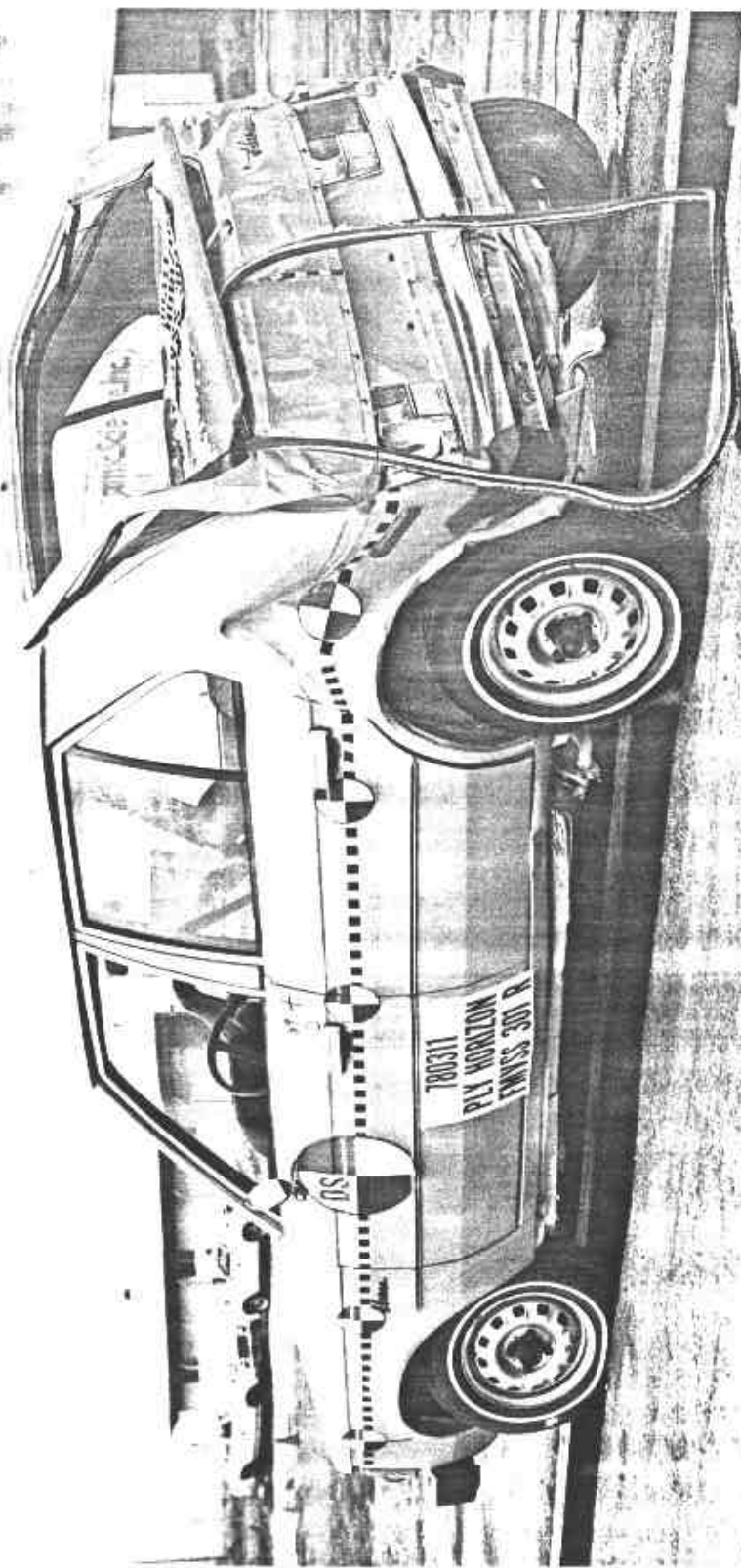


Figure 4-4. Post-test Rear View - 1978 Plymouth Horizon Four-Door Hatchback - NHTSA 780311.

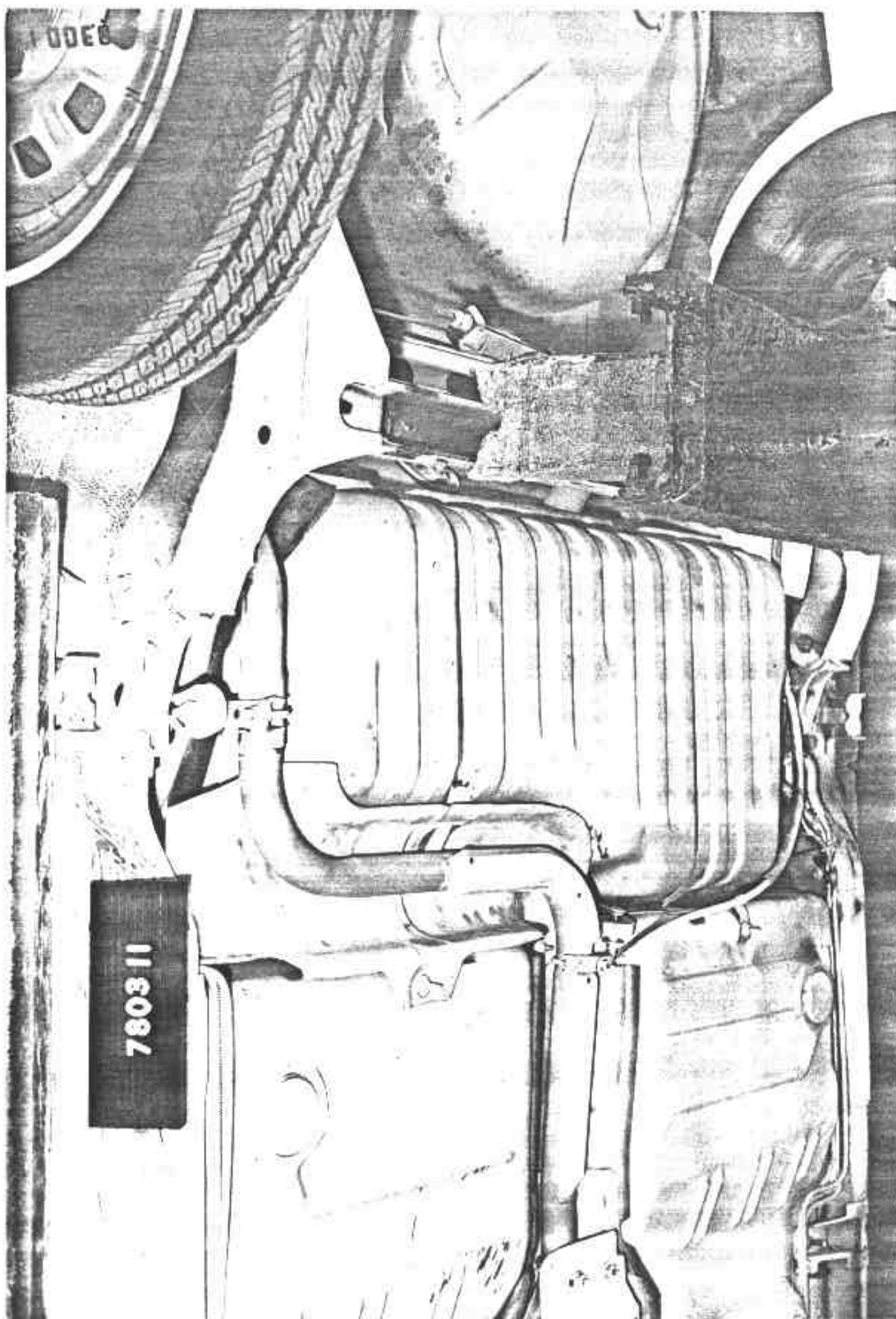


Figure 4-5. Pre-test View of Fuel Tank - 1978 Plymouth Horizon Four-Door Hatchback - NHTSA 780311.

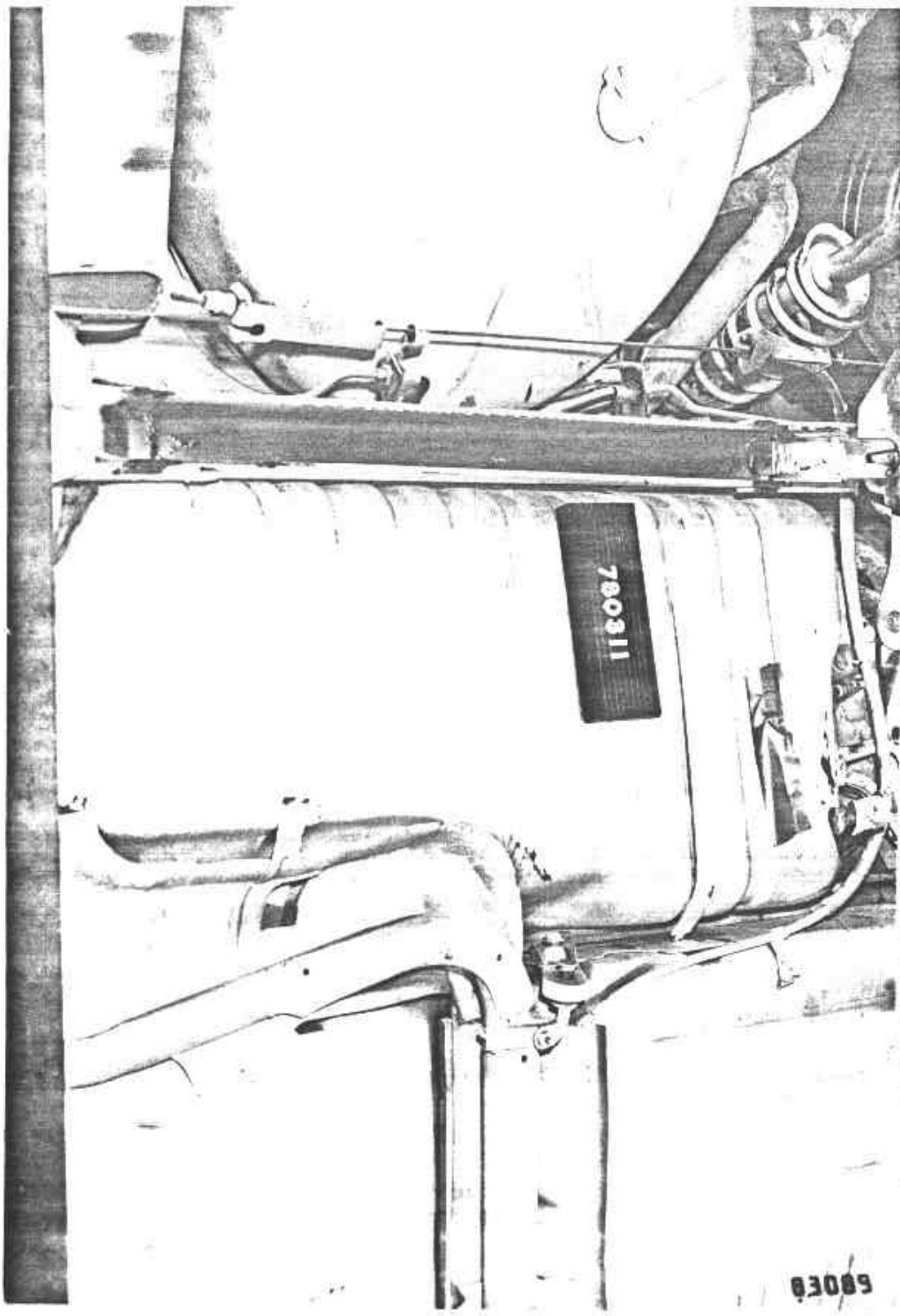


Figure 4-6. Post-test View of Fuel Tank - 1978 Plymouth Horizon Four-Door Hatchback - NHTSA 780311.

03089



Figure 4-7. Post-test View of Dummies - 1978 Plymouth Horizon Four-Door Hatchback - NHTSA 780311.

5.0 TEST FACILITY AND EQUIPMENT FOR FMVSS 301-75 (REAR) IMPACT TESTS

General Test Facility Description

FMVSS 301-75 impact tests are conducted at the Dynamic Science, Inc. Deer Valley Facility in Phoenix, Arizona. Figure 5-1 is an overall aerial view of that facility.

More specifically, the Monorail Impact Facility shown schematically in Figure 5-2 is used. As indicated in Figure 5-2, the Monorail Impact Facility accommodates a variety of test modes and configurations.

Test Track and Guidance System

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

Tow System and Velocity Control

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



5-2

1. ENGINEERING/ADMINISTRATION CENTER
2. MECHANICAL/INSTRUMENTATION SHOPS
3. DUMMY CALIBRATION LABORATORY
4. GARAGE/MAINTENANCE SHOP
5. ENVIRONMENTAL CHAMBER
6. STATIC CRUSH FACILITY
7. TWO-MILE OVAL
8. TURNAROUND (TYPICAL OF TWO)
9. BARRIER IMPACT FACILITY
10. DROP TOWER/SLED TEST FACILITY
11. CENTRAL DATA ACQUISITION AND CONTROL STATION
12. PENDULUM FACILITY
13. NONMETALLICS LABORATORY
14. TEST SERVICE FACILITY
15. VEHICLE-TO-VEHICLE TEST FACILITY
16. ROLLOVER TEST FACILITY
17. RIDE QUALITY COURSE
18. SKID PAD
19. HIGH AND LOW SKID NUMBER BRAKING LANES
20. SALT WATER TROUGH
21. BELGIAN BLOCK
22. PARKING BRAKE TEST RAMP
23. PULL-OFF AREA (TYPICAL OF THIRTEEN)
24. BALLISTIC TEST RANGE

Figure 5-1. The Dynamic Science, Inc. Deer Valley Facility.

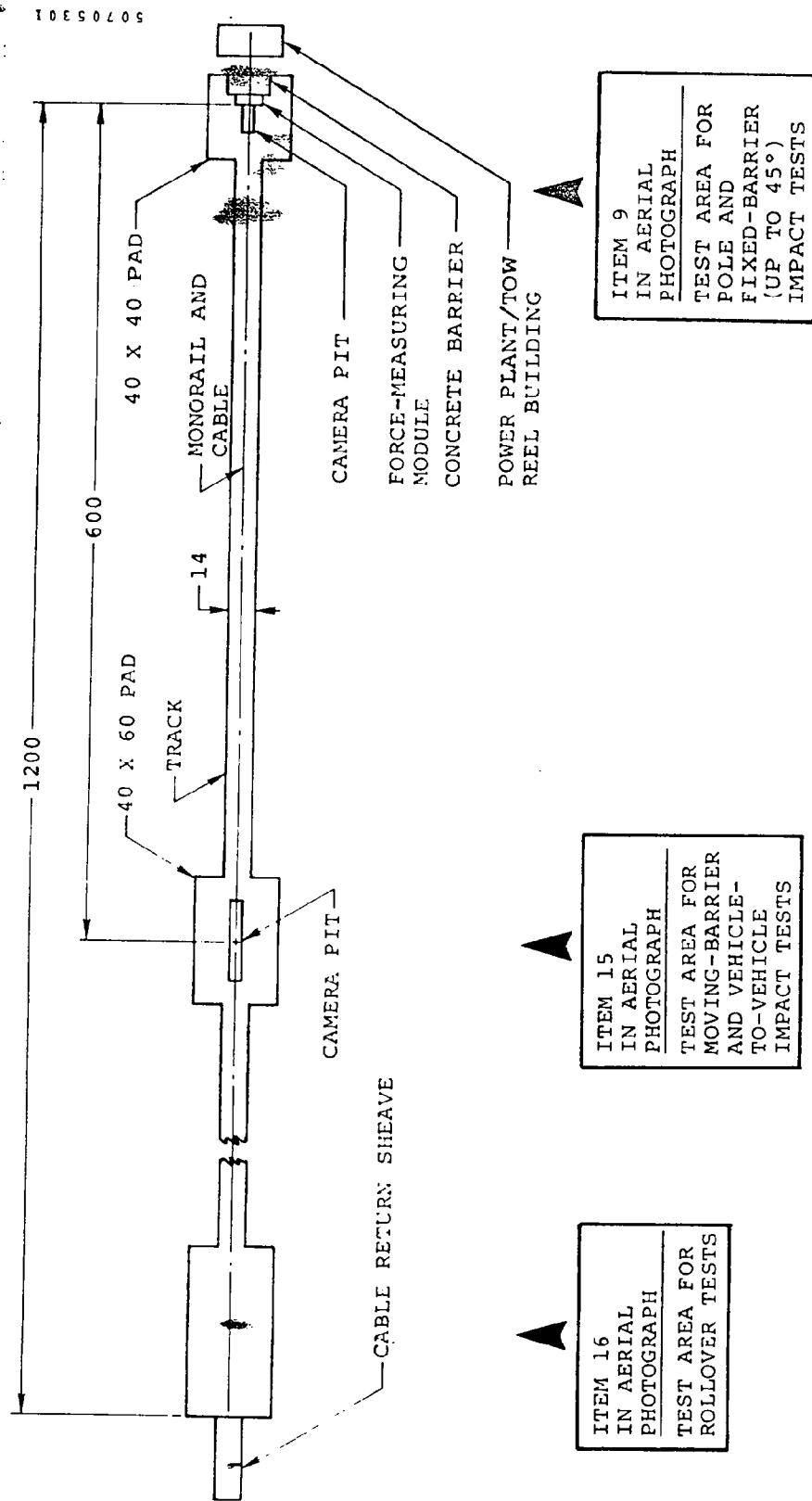


Figure 5-2. Monorail Impact Facility.

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

Control System

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

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

Moving Barrier

The moving barrier used by Dynamic Science conforms to all the requirements of paragraph S8.2 of FMVSS 208, "Occupant Crash Protection". It is rigid and has a solid suspension so it undergoes no significant amount of dynamic or static deformation and absorbs no significant portion of the energy dissipated in the impact.

The impact surface is a vertical, rigid, flat rectangle, 78 inches wide and 60 inches high, perpendicular to the barrier's direction of travel. The lower edge of the barrier face is horizontal and 5 inches above the ground surface.

The nominal weight of the moving barrier is 4,000 pounds. The actual measured weight of the barrier is 3,996 pounds distributed as follows:

LF	1536 lb	RF	1415 lb
LR	427 lb	RR	618 lb

The tires are size J60-15, inflated to 24 psi in the front and 10 psi in the rear.

A guide at the back of the moving barrier which rides along the monorail ensures that the barrier travels in a straight line with no significant lateral, vertical, or rotational movement.

Fuel Simulation

As prescribed in the FMVSS 301-75 Laboratory Procedure, the vehicle fuel system is filled to 90 to 95 percent of capacity with Stoddard Solvent.

The fuel is pumped out of the fuel tank, and the residual fuel in the fuel lines and the carburetor is burned by operating the vehicle engine. The fuel system is filled with Stoddard Solvent No. 2. Stoddard Solvent is then pumped into the fuel lines, up to the carburetor. The weight of the Stoddard Solvent added and removed is determined with two Western Beam Scales (Model No. WP 2000).

The solvent used, Stoddard Solvent No. 2, has a specific gravity of 0.764 at 72°F and a viscosity of 0.99 centistokes.

High-Speed Motion Photography

Five high-speed (1,000 frames per second) motion cameras with 100 Hz timing marks are used for photographic test documentation. The general location of the cameras is diagrammed in Figure 5-3. Precise positioning is accomplished through bore sighting with the vehicle at the impact point prior to the test.

Test Equipment List and Function

<u>Item</u>	<u>Manufacturer</u>	<u>Model</u>	<u>Purpose</u>
Timing Trap	Dynamic Science	None	Determine impact speed by furnishing a start and stop signal to recording oscillograph.
Oscillograph	Bell and Howell	5-134	Records timing start and stop signals from timing traps, cable drum drive rpm, and impact switch.
Speed Control	Dynamic Science	None	Precision control of cable drive drum rpm.
Beam Scales	Western	WP 2000	Used to determine vehicle test weights.
High-speed Motion Picture Cameras	Photosonics	16-1B	Used for side, overhead, and underside film coverage.

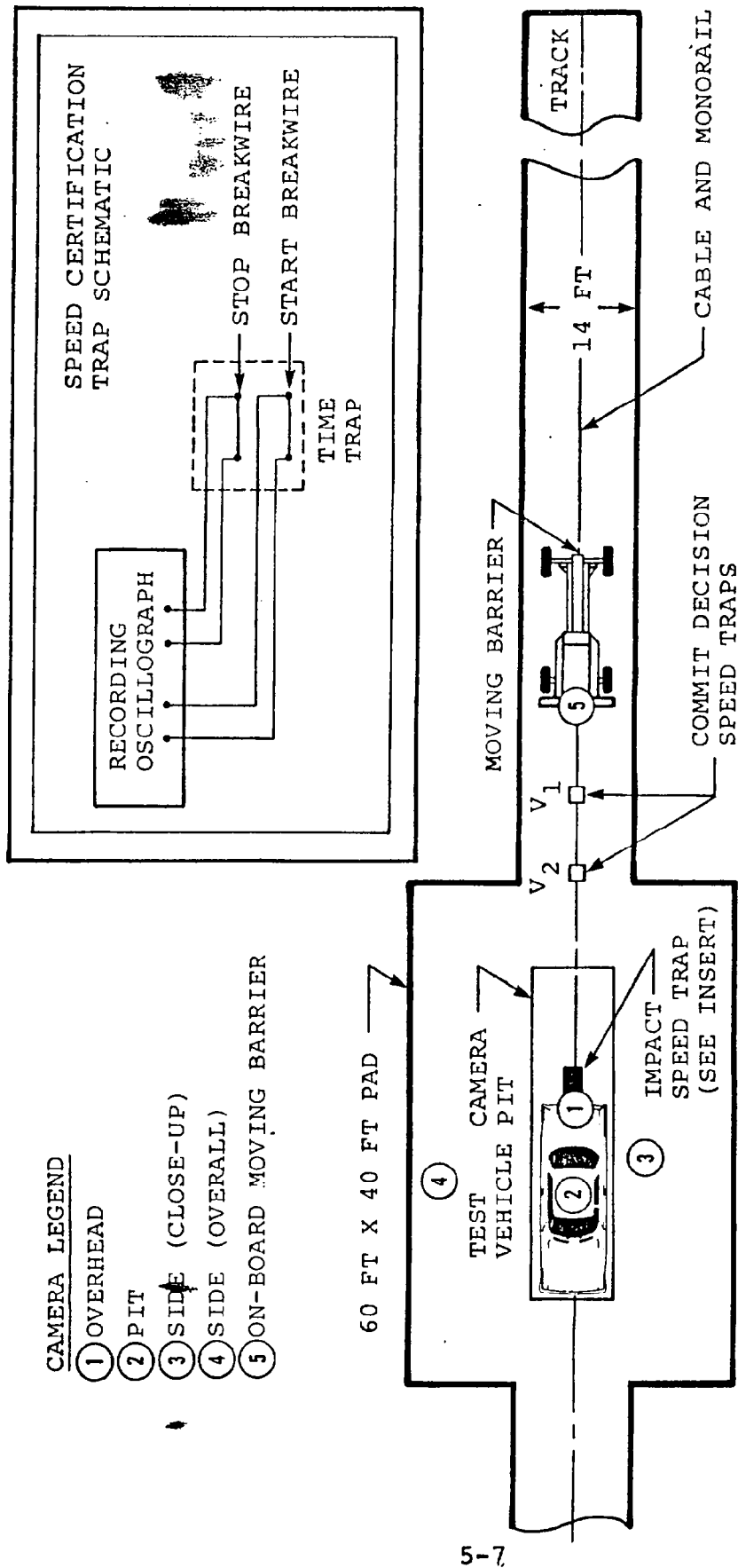


Figure 5-3. FMVSS 301-75 (Rear Impact Test) Moving Barrier Test Site Layout.

<u>Item</u>	<u>Manufacturer</u>	<u>Model</u>	<u>Purpose</u>
Motion Picture Camera	Bolex	H-16	Panning and documentation.
Still Camera	Kowa	6	Documentary photo coverage.
100 and 1000 Hz Time Code Generators	Dynamic Science	None	Furnish timing signal for high-speed cameras and a 1 second timing for velocity determination.
Stop Watch	Brietling	None	Time for collection of fuel leak samples.
Containers	-	-	Collection for fuel leak samples.
Graduated Cylinder	Pyrex	3022	Fuel volume measurement.
Graduated Cylinder	Kimax	-	Fuel volume measurement.
Calibrated Steel Rule	Starret	48 in.	Precision measurement of velocity trap spacing.
Anthropomorphic Dummies	Sierra Engineering Company	292-1050	To ballast the vehicle and to gather occupant response data.