Report Number 301-75-DYS-78-025

DOT 0171

FMVSS 301-75 STANDARDS ENFORCEMENT TESTING OF FUEL SYSTEM INTEGRITY

Mazda Motors of America
1978 Mazda Cosmo Two-Door Sedan
NHTSA 780518

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
2100 Second Street, S.W.
Washington, D.C. 20590

dsi Dynamic Science Inc.
A SUBSIDIARY OF TALLEY INDUSTRIES
1850 WEST PINNACLE PEAK ROAD • PHOENIX, ARIZONA

This final test report was prepared for the U.S. Department of Transportation, National Highway Traffic Safety Administration, under Contract No. DOT-HS-6-01478. This document is disseminated under the sponsorship of the U.S. Department of Transportation in the interest of information exchange. The United States Government assumes no liability for its contents or use thereof.

FINAL REPORT ACCEPTED BY:

TOM GRUBBS

NHTSA Contract Technical Manager
FMVSS 219/301-75

JUN 06 1978

Date of Report Acceptance

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No. 301-75-DYS-78-025	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle FINAL REPORT OF FMVSS 301-75 STANDARDS ENFORCEMENT TESTING OF FUEL SYSTEM INTEGRITY - 1978 MAZDA COSMO TWO-DOOR SEDAN - NHTSA 780518		5. Report Date April 1978 6. Performing Orgn Code
7. Author(s) L. C. Bergmann, Project Engineer		8. Performing Orgn Rpt No. 3005-78-45
9. Performing Organization Name and Address Dynamic Science, Inc. A Subsidiary of Talley Industries 1850 West Pinnacle Peak Road Phoenix, Arizona 85027 Telephone No.: 942-3300		10. Work Unit No. 11. Contract or Grant No. DOT-HS-6-01478 13. Type of Report and Period Covered FINAL TEST REPORT JAN - APRIL 1978
12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Administration Office of Standards Enforcement 2100 Second St., S.W. Washington, D.C. 20590		14. Sponsoring Agency Code

15. Supplementary Notes
Approved: E. Grosenick, Director of Technical Support Operations

16. Abstract

FMVSS 301-75 Standards Enforcement Test of a 1978 Mazda Cosmo Two-Door Sedan, NHTSA 780518, VIN CD23C-709911, 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 29.00 mph.

The test date was April 8, 1978 and the ambient temperature was 58°F.

The subject vehicle appeared to comply with the requirements of FMVSS 301-75, as specified for the vehicle manufacture date.

17. Key Words FMVSS 301-75 Standards Enforcement Testing, Fuel Tanks, Fuel Tank Filler Pipes, Fuel Tank Connections, Fuel System Integrity, Rear End Impact	18. Distribution Statement Copies of this report are available from Technical Reference Division, National Highway Traffic Safety Administration, Room 5108, Nassif Building, 400 7th Street, S.W., Washington, D.C. 20590		
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. Pages 30	22. Price

Form DOT F 1700.7 (8-69)

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

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 Mazda Cosmo Two-Door Sedan, NHTSA 780518.

2.1 PRIMARY RESULTS

The impact velocity was 29.0 mph.

No fuel spillage occurred during and following barrier impact or the static rollover. An example of the procedure used to determine the collection time period is illustrated graphically in Figure 2-1.

The vehicle therefore appeared to comply with the requirements of FMVSS 301-75 as specified for the vehicle manufacture date.

2.2 SECONDARY RESULTS

The vehicle maximum static crush was 13.5 inches.

The ambient temperature at the time of the test was 58°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 left door opened easily; the right door opened with some difficulty.

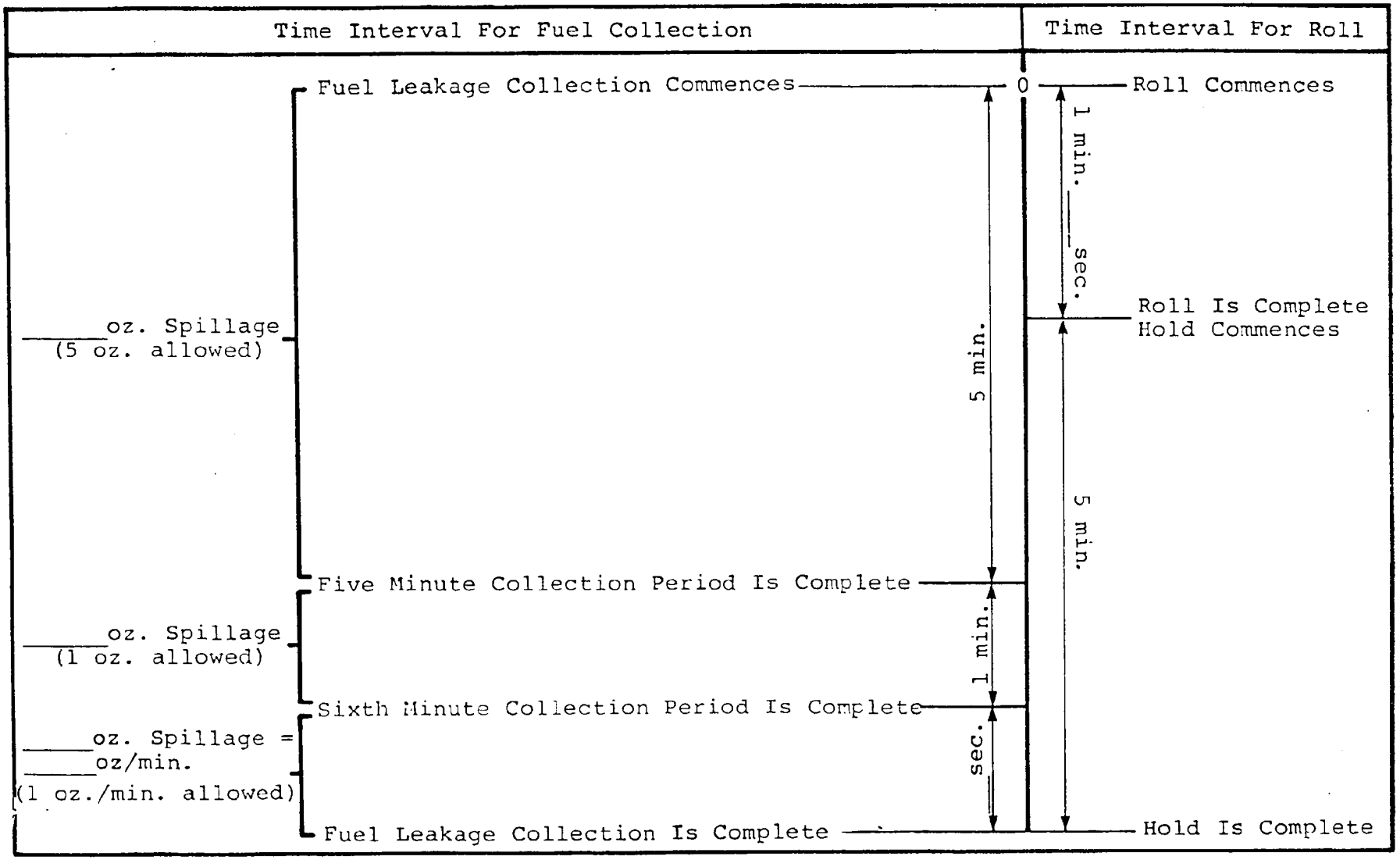


Figure 2-1. An Example of the Time Relationship Between Fuel Collection Period and Each 90° Static Roll Period - 1978 Mazda Cosmo Two-Door Sedan - NHTSA 780518.

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 Mazda Cosmo Two-Door Sedan, NHTSA 780518

TEST VEHICLE IDENTIFICATION

Manufacturer: Mazda Motors of America

Make/Model: Mazda Cosmo

Body Style: Two-Door Sedan Model Year: 1978

VIN: CD23C-709911 ; Build Date: 9/77

NHTSA No.: 780518 ; Color: White

Engine Data: 2 cylinders; 80 c.i.d.

Transmission Data: 5 speed

[X] Manual [ ] Automatic

Major Options: Power brakes, power steering, power windows, air conditioning, rear window defrost, tinted glass, radio, clock

TEST CONDITIONS

Date of Test: April 8, 1978 ; Time of Test: 1308

Ambient Temperature 58 °F at impact area

TEST VEHICLE WEIGHT (data taken from tire pressure placard)

Vehicle Capacity Weight:	680	lb
Designated Seating Capacity: Front	2	
Rear	2	
Total	4	
GVWR (taken from Certification Label):	3550	lb
GAWR Front:	2205	lb
GAWR Rear:	2205	lb
Vehicle Delivered Weight (fluids to capacity) Front:	1532	lb
Rear:	1195	lb
Total:	2727	lb
Calculated Vehicle Test Weight:	3135	lb
Actual Vehicle Test Weight Front:	1661	lb
Rear:	1462	lb
Total:	3123	lb

REMARKS:

SUMMARY OF TEST CONDITIONS (CONTD)
1978 Mazda Cosmo Two-Door Sedan, NHTSA 780518

VEHICLE ATTITUDE: (all dimensions in inches)

Delivered Attitude: RF 31.0 LF 31.0 RR 31.0 LR 31.0

Test Attitude: RF 31.0 LF 31.0 RR 30.5 LR 30.3

VEHICLE TIRE DATA

Recommended Cold Tire Pressure: Front 26 psi

Rear 26 psi

Recommended Tire Size: 185/70 SR14

Load Range: B

Tires on Vehicle: 185/70 SR14

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: 16.0 gallons

Test Volume: 14.9 gallons

Fuel System Capacity (data from Owner's Manual): 16.4 gallons

Details of fuel system:

POST-IMPACT DATA SHEET
1978 Mazda Cosmo Two-Door Sedan, NHTSA 780518

TYPE OF TEST: Rear IMPACT

DATE OF TEST: April 8, 1978

REQUIRED VELOCITY RANGE (mph): 28.9 to 29.9

IMPACT VELOCITY (mph):

Primary 29.00, Secondary 29.04

VEHICLE STATIC CRUSH (in.):

1.* Driver Side: 10.8 Passenger Side: 12.8

Average: 11.8

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.

FUEL SYSTEM LEAKAGE DATA SHEET
1978 Mazda Cosmo Two-Door Sedan, NHTSA 780518

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		1 min 39 sec	1-3 min	
	Spillage for 5-minute period from onset of rotation		0	5 oz	
	Spillage for remainder of hold time*	1 min	0	1 oz	
		39 sec	0	.65 oz**	
90° to 180°	Roll Time		1 min 38 sec	1-3 min	
	Spillage for 5-minute period from onset of rotation		0	5 oz	
	Spillage for remainder of hold time*	1 min	0	1 oz	
		38 sec	0	.63 oz**	
180° to 270°	Roll Time		1 min 37 sec	1-3 min	
	Spillage for 5-minute period from onset of rotation		0	5 oz	
	Spillage for remainder of hold time*	1 min	0	1 oz	
		37 sec	0	.62 oz**	
270° to 360°	Roll Time		1 min 36 sec	1-3 min	
	Spillage for 5-minute period from onset of rotation		0	5 oz	
	Spillage for remainder of hold time*	1 min	0	1 oz	
		36 sec	0	.60 oz**	

*Equals roll time.
**1 oz/minute.

IMPACT EFFECTS

1978 Mazda Cosmo Two-Door Sedan, NHTSA 780518

VISIBLE DUMMY CONTACT POINTS

	Driver	Passenger
Head	None	None
Chest	None	None
Abdomen	None	None
Left Knee	None	None
Right Knee	None	None

	Front		Rear	
	Left	Right	Left	Right
DOOR OPENING				
Easy	X			
Difficult		X		
Tools Required				
SEAT BACK				
Failure	Yes	Yes		
GLAZING DAMAGE				
Windshield	None			
Backlight			None	
Others	None	None	None	None

OTHER NOTABLE IMPACT EFFECTS:

Both seat backs collapsed to rear seat bottom.

Vehicle buckled to "B" pillar.

4.0 PHOTOGRAPHIC COVERAGE

This section consists of pre-test and post-test photographs of the vehicle and fuel system.

83036

Figure 4-1. Pre-test Side View - 1978 Mazda Cosmo Two-Door Sedan - NHTSA 780518.

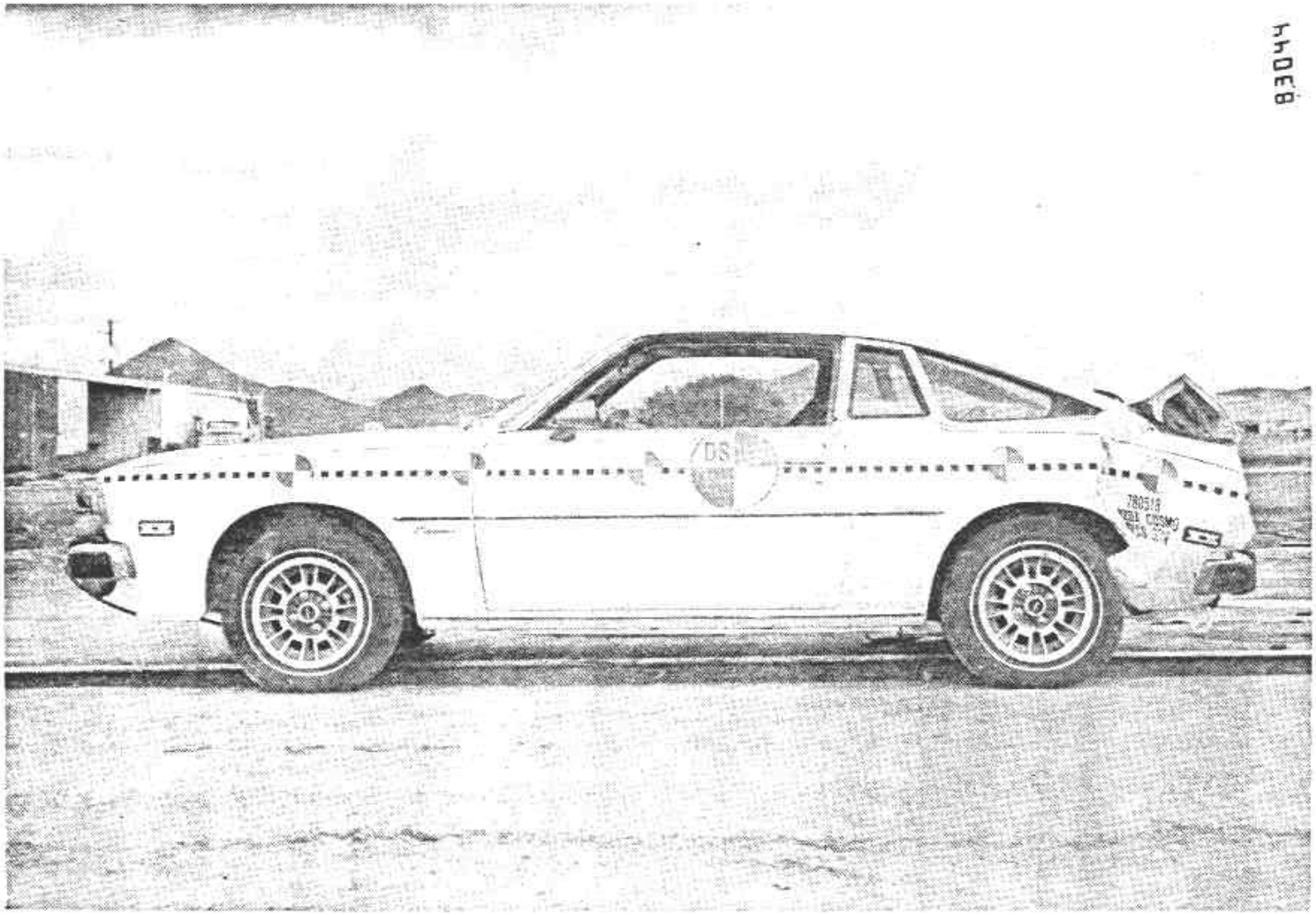


Figure 4-2. Post-test Side View - 1978 Mazda Cosmo Two-Door Sedan - NHTSA 780518.

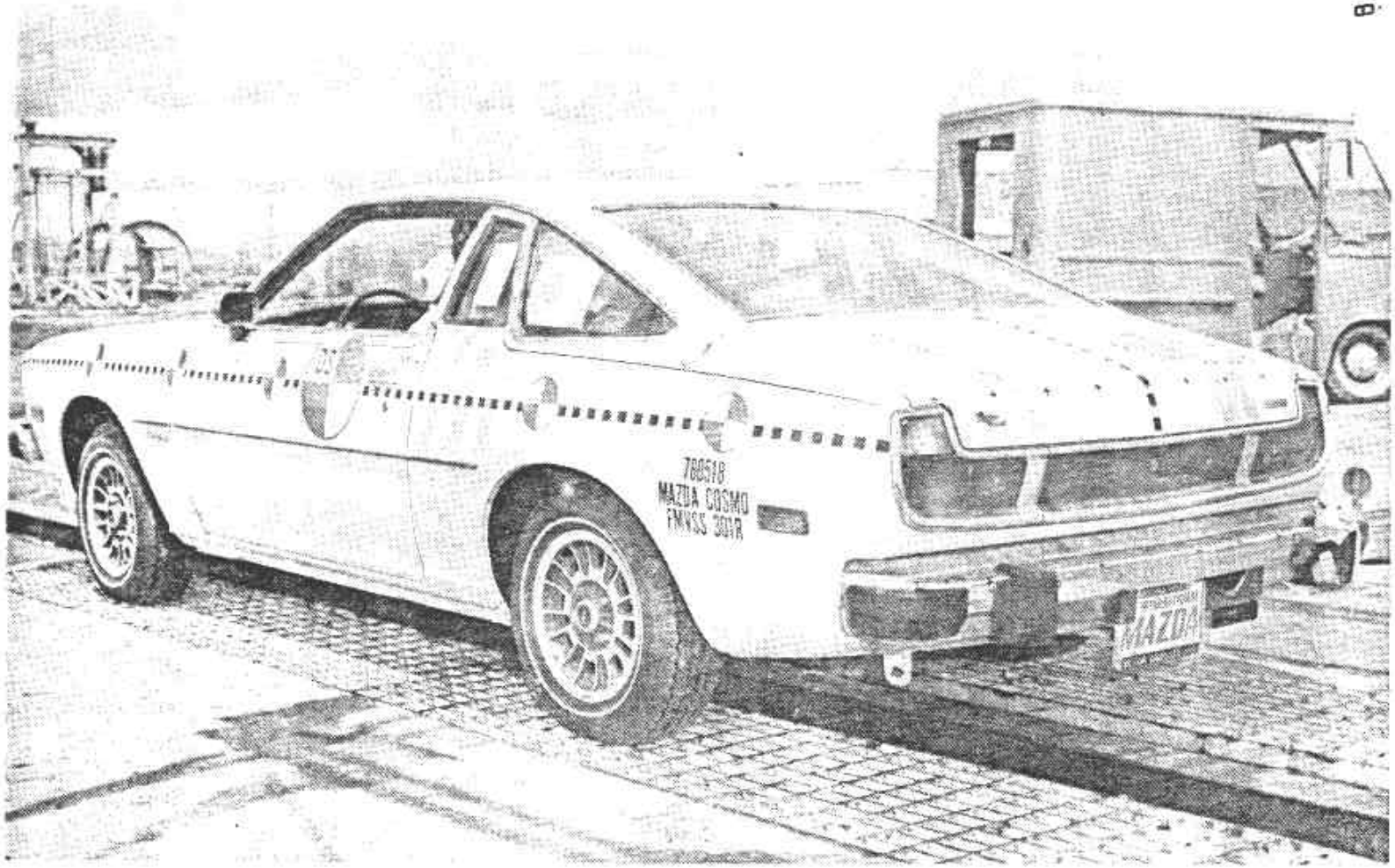


Figure 4-3. Pre-test Rear View - 1978 Mazda Cosmo Two-Door Sedan - NHTSA 780518.

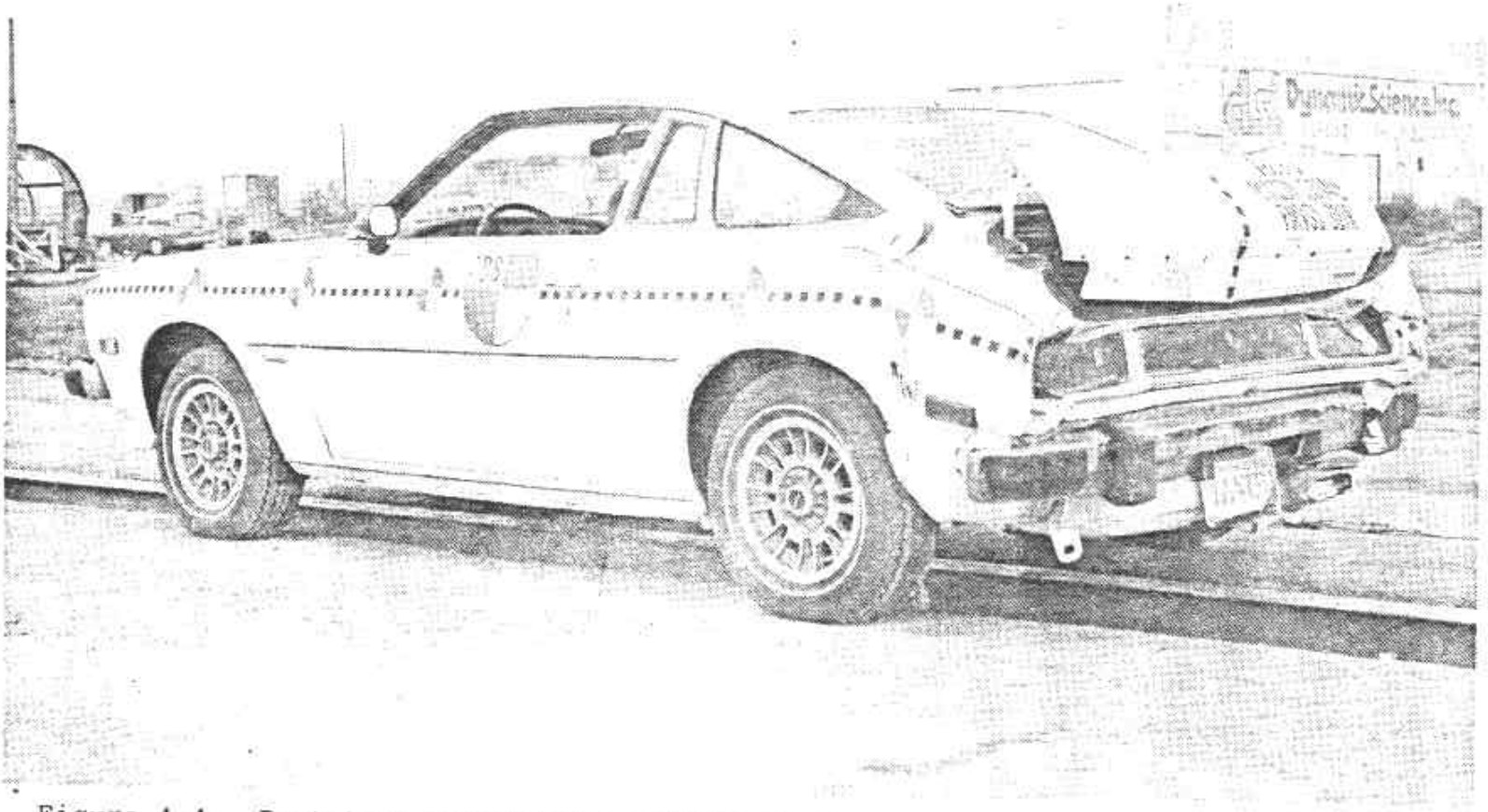


Figure 4-4. Post-test Rear View - 1978 Mazda Cosmo Two-Door Sedan - NHTSA 780518.

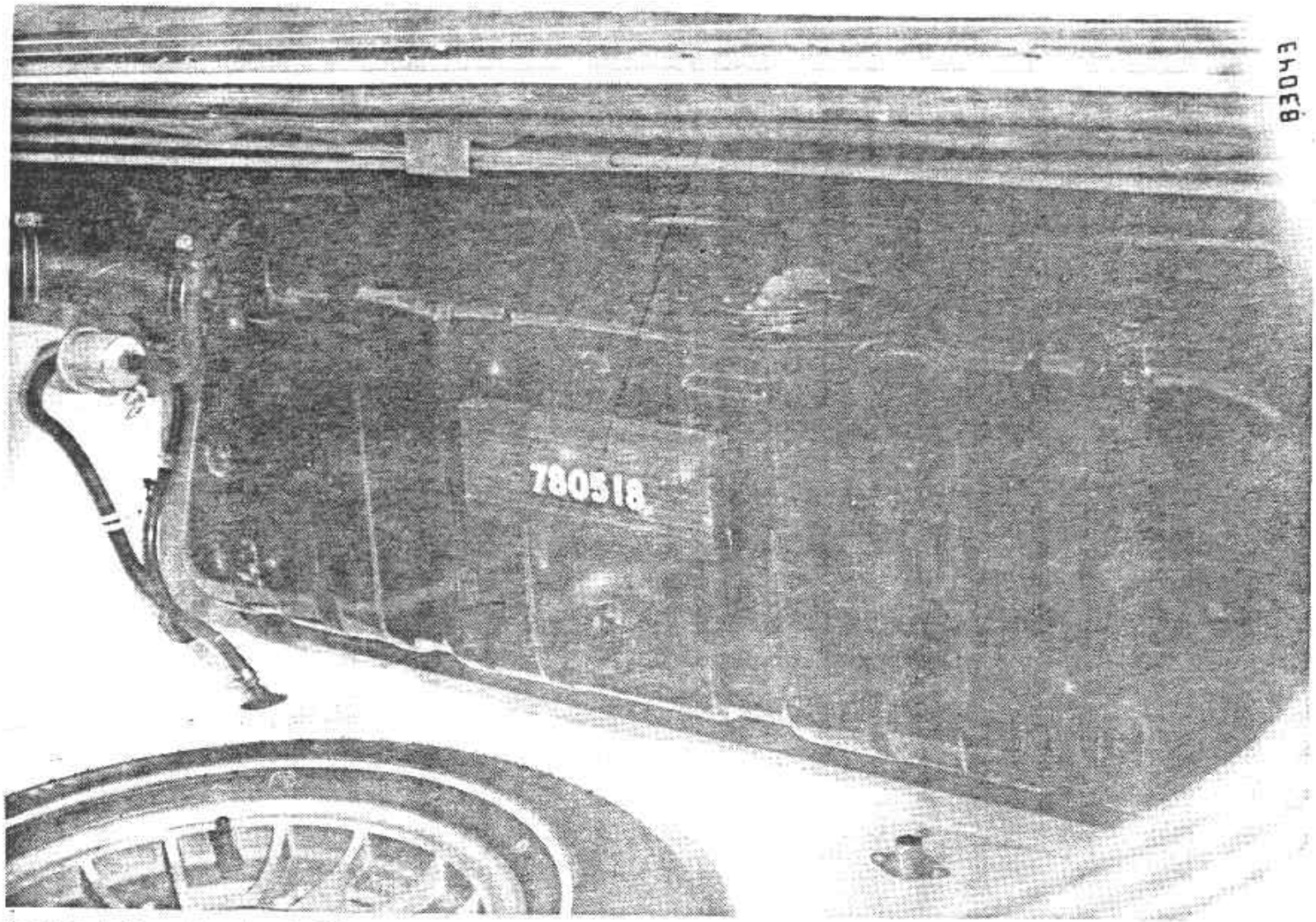


Figure 4-5. Pre-test View of Fuel Tank - 1978 Mazda Cosmo Two-Door Sedan - NHTSA 780518.

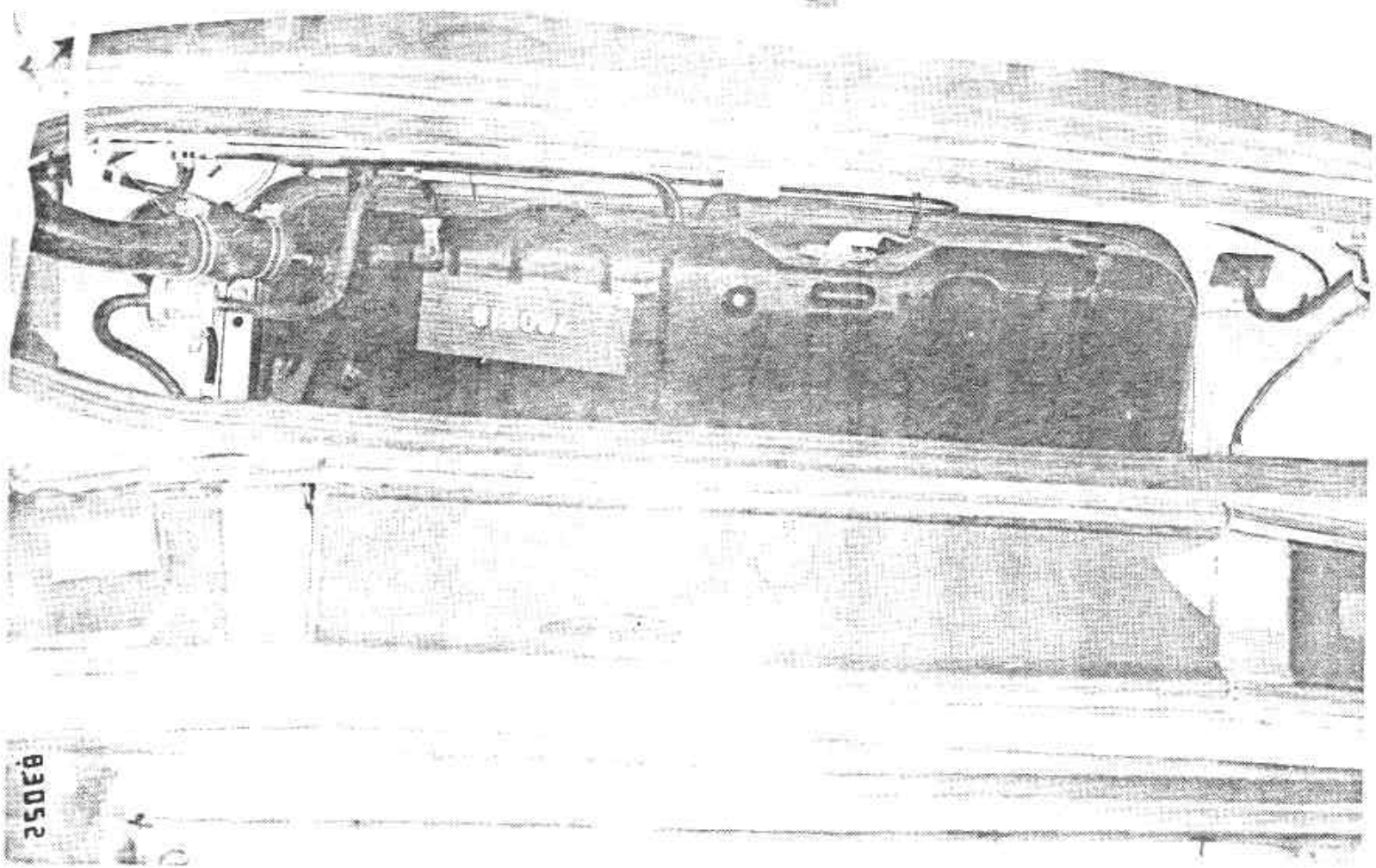


Figure 4-6. Post-test View of Fuel Tank - 1978 Mazda Cosmo Two-Door Sedan - NHTSA 780518.

Figure 4-7. Post-test View of Dummies - 1978 Mazda Cosmo Two-Door Sedan - NHTSA 780518.

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.

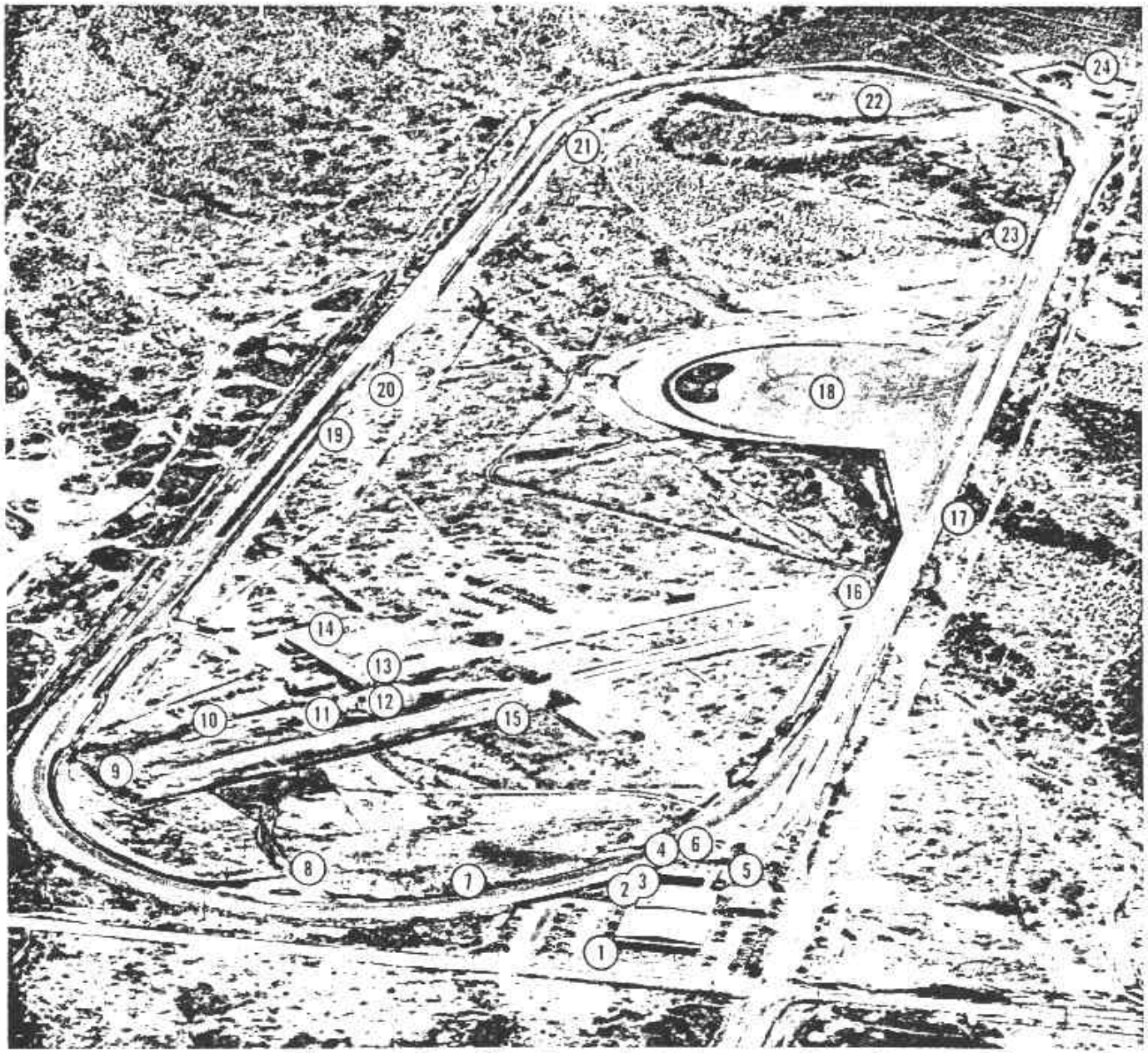
More specifically, the Monorail Impact Facility shown schematically in Figure 5-2 is used. As indicated in Figure 5-2, the Monorail Impact Facility accommodates a variety of test modes and configurations.

Test Track and Guidance System

The test track consists of 1,200 feet of asphalt pavement (SN = 75 ±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.



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.

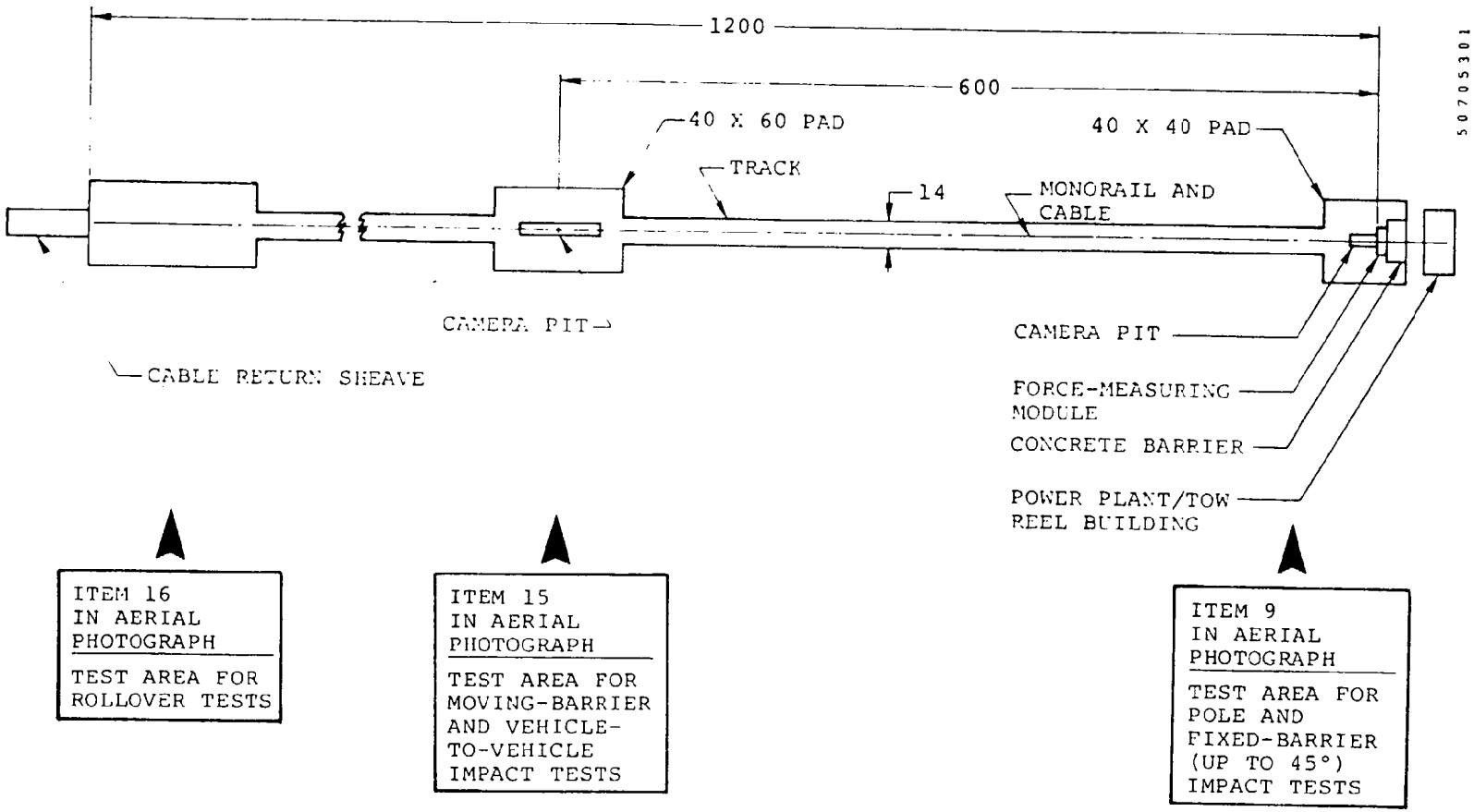


Figure 5-2. Monorail Impact Facility.

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

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

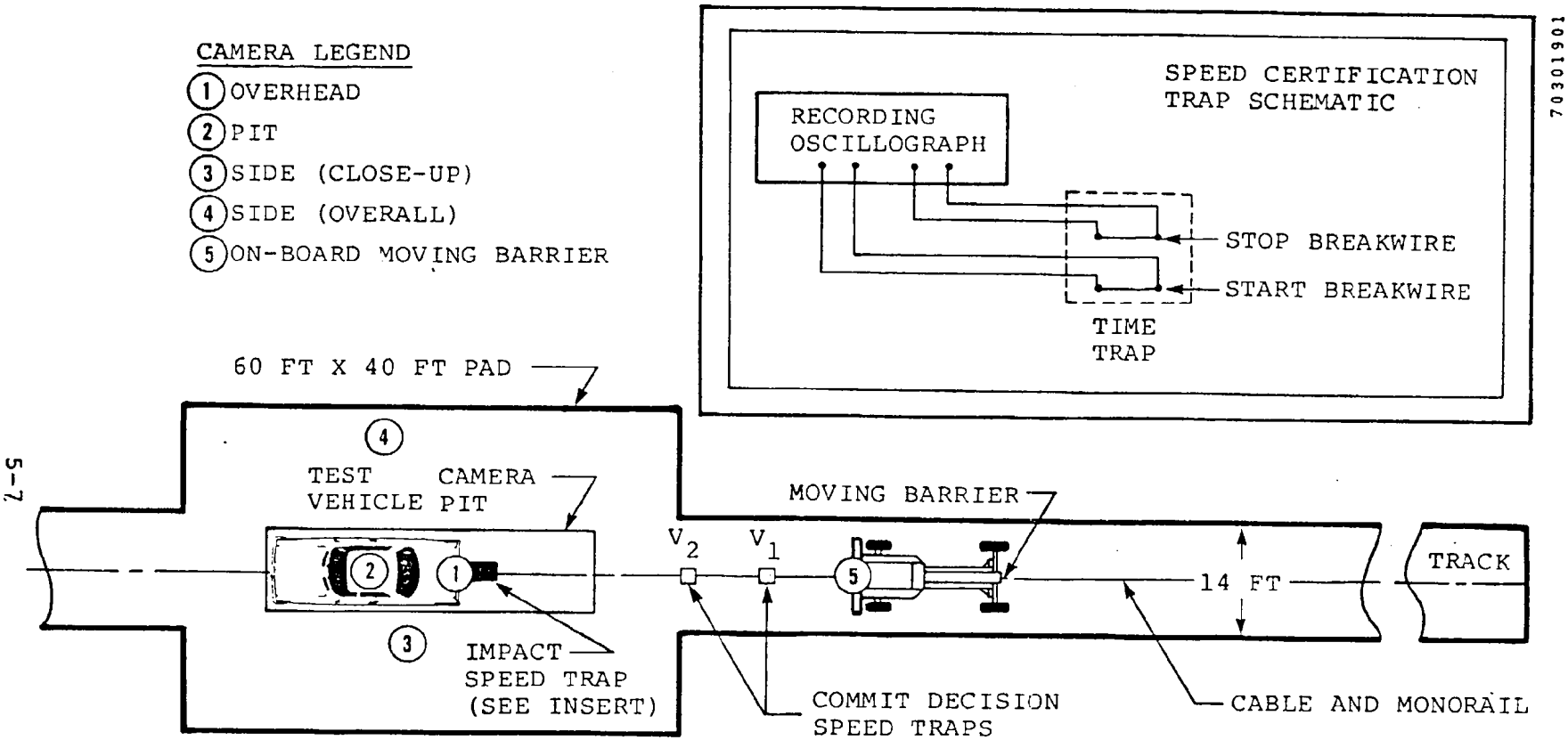


Figure 5-3. FMVSS 301-75 (Rear Impact Test) Moving Barrier Test Site Layout.

Item	Manufacturer	Model	Purpose
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.
Anthropo-morphic Dummies	Sierra Engineering Company	292-1050	To ballast the vehicle and to gather occupant response data.