

Dynamic Science Report No. 301-DYS-82-001

DOT 0419

1-20-82

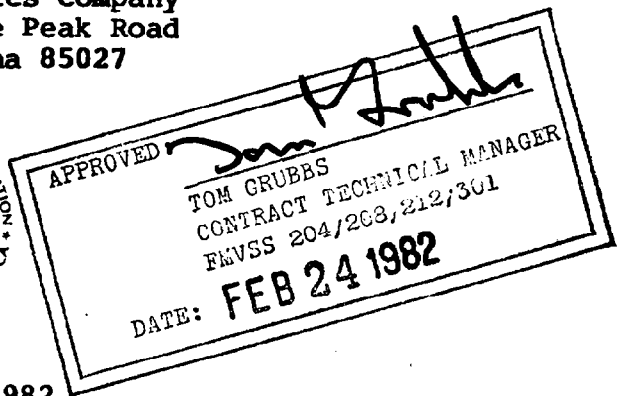
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DOT-HS-9-0274

FMVSS 301
STANDARDS ENFORCEMENT TESTING
TESTING OF FUEL SYSTEM INTEGRITY
CHRYSLER CORPORATION
1982 DODGE 400
NHTSA 820309

Prepared by:

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



February 1982

FINAL REPORT

Prepared for:

U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
-----ENFORCEMENT-----
OFFICE OF VEHICLE SAFETY COMPLIANCE
400 SEVENTH STREET, S.W.
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Prepared by Michael J. Rodack

Approved by Rod Garm

Date 2-4-82

Report Accepted by:

TOM GRUBBS

Contract Technical Manager
Office of Vehicle Safety Compliance

FEB 24 1982

Date _____

TECHNICAL REPORT STANDARD TITLE PAGE

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16. Abstract Standards Enforcement Testing of a 1982 Dodge 400, NHTSA 820309, VIN 1B3BV41BXCG102498, was conducted at Dynamic Science, Inc. to determine compliance with the requirements of FMVSS 301. The moving barrier impacted the rear of the vehicle at a speed of 29.70 mph. Test date was January 20, 1982, with ambient temperature of 62°F. The 1982 Dodge 400 appeared to comply with the requirements of FMVSS 301 as specified for the vehicle manufacture date.					
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METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
LENGTH				
in	inches	2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
AREA				
in ²	square inches	6.5	square centimeters	cm ²
ft ²	square feet	0.09	square meters	m ²
yd ²	square yards	0.8	square meters	m ²
mi ²	square miles	2.6	square kilometers	km ²
acres	acres	0.4	hectares	ha
MASS (weight)				
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
short tons	short tons	0.9	metric ton	t
(2000 lb)				
VOLUME				
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
in ³	cubic inches	16	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	L
pt	pints	0.47	liters	L
qt	quarts	0.95	liters	L
gal	gallons	3.8	liters	L
ft ³	cubic feet	0.03	cubic meters	m ³
yd ³	cubic yards	0.76	cubic meters	m ³
TEMPERATURE (exact)				
°F	degrees Fahrenheit	5/9 (after subtracting 32)	degrees Celsius	°C

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
LENGTH				
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
AREA				
cm ²	square centimeters	0.16	square inches	in ²
m ²	square meters	1.2	square yards	yd ²
km ²	square kilometers	0.4	square miles	mi ²
ha	hectares	2.5	acres	
(10 000 m ²)				
MASS (weight)				
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	metric ton	1.1	short tons	
(1000 kg)				
VOLUME				
ml	milliliters	0.03	fluid ounces	fl oz
ml	milliliters	0.06	cubic inches	in ³
L	liters	2.1	pints	pt
L	liters	1.06	quarts	qt
L	liters	0.26	gallons	gal
m ³	cubic meters	35	cubic feet	ft ³
m ³	cubic meters	1.3	cubic yards	yd ³
TEMPERATURE (exact)				
°C	degrees Celsius	9/5 (then add 32)	degrees Fahrenheit	°F

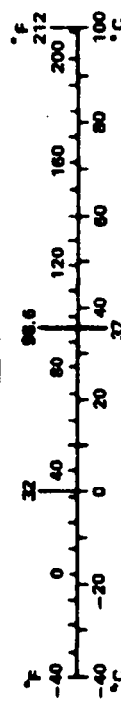


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1.0 PURPOSE AND TEST PROCEDURE

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) entitled "Fuel System Integrity."

1.2 TEST PROCEDURE

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

2.0 SUMMARY OF VEHICLE PERFORMANCE

The vehicle tested was a 1982 Dodge 400 2-Door Hardtop Sedan, NHTSA 820309. The rear of the vehicle was impacted at a velocity of 29.70 mph. Calcomp plots for the Dodge 400 and the moving barrier are contained in Appendix B.

2.1 PRIMARY RESULTS

No fuel spillage occurred during or following barrier impact, or during the static rollover. The vehicle therefore appeared to comply with the requirements of FMVSS 301 as specified on the vehicle manufacture date.

2.2 SECONDARY RESULTS

The vehicle's maximum static crush was 18.5 inches. Ambient temperature at time of impact and for several hours prior was 62°F.

The door locks were set in the unlocked position prior to the test. However, the left door was noted to be locked post-test. Both doors opened easily post-test.

Both front seats exhibited noticeable damage, with both seat backs reclining post-test. The left seat was 0.2 inch aft of the pre-test position, and the right seat was 0.5 inch aft.

3.0 TEST RESULTS AND IMPACT EFFECTS

The following data sheets report:

- Test conditions
- Post-impact data
- Fuel system leakage data
- Dummy kinematic survey

GENERAL TEST AND VEHICLE PARAMETER DATA

PRE-IMPACT DATA

Make/Model: Dodge 400
 Body Style: 2-Door Hardtop Sedan Model Year 1982
 NHTSA No. 820309 DSI No. 1232 Color: Grey

DATA FROM CERTIFICATION LABEL

Vehicle Manufacturer: Chrysler Corporation
 Date of Manufacture: 9/81; VIN: 1B3BV41BXCG102498
 GVWR: 3825 lb; GAWR: Front = 2120 lb; Rear = 1755 lb

DATA FROM "RECOMMENDED TIRE PRESSURE" LABEL

Vehicle Capacity: FRONT REAR RECOMMENDED LOAD RANGE:
 Tire Pressure: 26 psi 29 psi TIRE SIZE: B
P185-70R14

Designated Seating: 2 Front 3 Rear 5 Total
 Cargo load = 115 lb Is Spare Tire: Space Saver? Yes
 TOTAL = 865 lb Standard Equipment? Yes

Engine: 4 Cylinder, transverse-mounted, 2.2 liter displacement
 Transmission: Automatic Front Wheel Drive
 Date Vehicle Received by Laboratory: 11/9/81; Odometer 44.0
 Dealer Name & Address: Valley Dodge, 4240 W. Glendale Avenue
Phoenix, Arizona

WEIGHT (LB) OF TEST VEHICLE AS RECEIVED (WITH MAX. FLUIDS) = UDW

Right Front = 824 lb Right Rear = 430 lb
 Left Front = 855 lb Left Rear = 456 lb
 TOTAL FRONT WEIGHT = 1679 lb (65 % of Total Vehicle Weight)
 TOTAL REAR WEIGHT = 886 lb (35 % of Total Vehicle Weight)
 TOTAL DELV. WEIGHT = 2565 lb

TARGET WEIGHT = UDW + Cargo Load + 328 lbs Dummies = 3008 lb

WEIGHT OF TEST VEHICLE WITH REQUIRED DUMMIES AND 115 LB CARGO:

Right Front = 928 lb Right Rear = 585 lb
 Left Front = 909 lb Left Rear = 586 lb
 TOTAL FRONT WEIGHT = 1837 lb (61 % of Total Vehicle Weight)
 TOTAL REAR WEIGHT = 1171 lb (39 % of Total Vehicle Weight)
 TOTAL TEST WEIGHT = 3008 lb

Weight of ballast secured in vehicle trunk area = 115 lb

VEHICLE ATTITUDE: (inches)

Delivered Attitude: RF 30.0 LF 30.0 RR 30.0 LR 30.0
 Test Attitude: RF 29.2 LF 29.5 RR 29.6 LR 28.5

REMARKS: Vehicle has standard 3-point restraint system

GENERAL TEST AND VEHICLE PARAMETER DATA (CONT)

POST-IMPACT DATA

Type of Test: Rear (180°) Impact
 Date of Test: 1/20/82 Time: 1430 Temperature 62 °F
 Required Impact Velocity Range: 28.9 to 29.9 mph
 Impact Velocity: Primary = 29.70 mph Secondary = 29.77 mph

Distance from the vehicle's front bumper to barrier face entering the vehicle velocity measurement device is 5.0 feet and distance exiting the vehicle velocity measurement device is 1.0 foot.

VEHICLE REBOUND AND CRUSH (in.)

Vehicle Length: Pre-test = R 175.5 C 180.4 L 175.0
 Post-test = R 157.0 C 162.2 L 157.0
 Crush = R 18.5 C 18.2 L 18.0
 Distance from front of test vehicle to point of impact:
 R 60.9 ft C 60.5 ft L 60.1 ft

VISIBLE DUMMY CONTACT POINTS

	Driver	Passenger
Head	<u>Back of seat</u>	<u>Back of seat and rear seat back</u>
Chest	<u>None</u>	<u>None</u>
Abdomen	<u>Sack popped out</u>	<u>Sack popped out</u>
Left Knee	<u>None</u>	<u>None</u>
Right Knee	<u>None</u>	<u>None</u>

DOOR OPENING

	Front		Rear	
	Left	Right	Left	Right
	<u>Easily,</u>	<u>Easily</u>		
	<u>after un-</u>			
	<u>locked</u>			

SEAT MOVEMENT

Seatback Failure	<u>Yes</u>	
Seat Shift (in.)	<u>0.2</u>	<u>0.5</u>

GLAZING DAMAGE

Backlight/Windshield Backlight shattered

OTHER NOTABLE IMPACT EFFECTS: Left rear coil spring came off vehicle; right rear shock absorber base sheared off. Left rear bumper shock leaked hydraulic fluid. Rear of fuel tank dented forward by spare tire well. Steering wheel hub cover found under car midway between wheels.

SUMMARY OF FMVSS 301 DATA

PRE-IMPACT DATA

Make/Model: Dodge 400
Body Style: 2-Door Hardtop Sedan Model Year: 1982
NHTSA No.: 820309 DSI No. 1232 Color: Grey

DATA FROM CERTIFICATION LABEL

Vehicle Manufacturer: Chrysler Corporation
Date of Manufacture: 9/81; VIN: 1B3BV41BXCGL02498
GVWR: 3825 lb; GAWR: Front = 2120 lb; Rear = 1755 lb

POST-IMPACT DATA

Type of Test: Rear (180°) Impact
Date of Test: 1/20/82 Time: 1430 Temperature 62 °F
Required Impact Velocity Range: 28.9 to 29.9 mph
Impact Velocity: Primary = 29.70 mph Secondary = 29.77 mph
Test Weight 3008 lb Static Crush 18.5 in. Rebound N/A in.

FUEL SYSTEM DATA

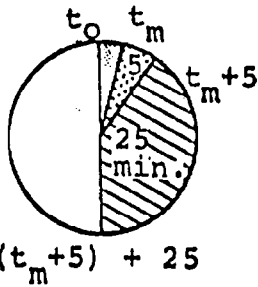
Test fluid: Red Stoddard Solvent Specific Gravity: 0.764
Temperature: 62 °F
Kinematic Viscosity: 0.99 centistokes Test Volume: 12.2 U.S. gal

Test vehicle fuel tank filled to 93% of "usable" plus "unusable" capacity with Stoddard Solvent and with electric fuel pump operating (if it will operate without engine operation) until start of static roll.

Details of fuel system: Rectangular metal tank, approximately 29 x 20 inches, fastened to vehicle by two 1-inch metal straps 16 inches apart. Filler neck on right rear quarter-panel drops down under wheel well and enters tank in upper right rear corner; plastic threaded cap with ratcheting mechanism. Fuel lines exit tank 4 inches left of center in rear panel, and head right. They run along the lower right edge of the frame forward to the right edge of the firewall. The lines traverse up the firewall and partially around the shock tower. At this point, rubber fuel lines lead to the valve cover. Metal lines traverse the front of the valve cover, then down front of block, then back along front edge of the oil pan where they link to the mechanical fuel pump located below and to the right of the oil filter. One line then traverses same route back to right front of valve cover (through a fuel filter which is vented back to tank) and across valve cover to carburetor.

SUMMARY OF FMVSS 301 DATA (CONTD)

FUEL SPILLAGE MEASUREMENT

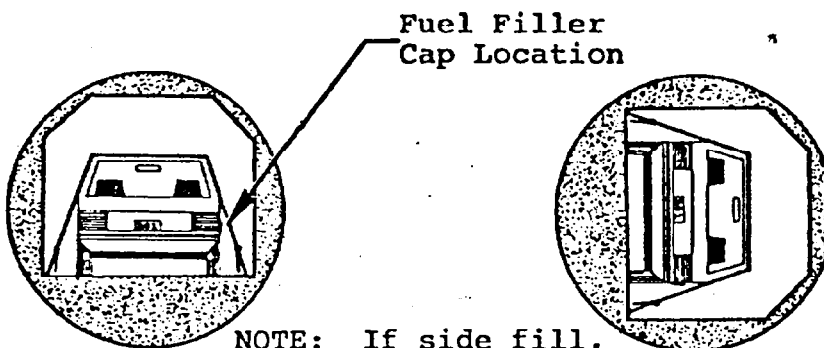


	ACTUAL	MAXIMUM ALLOWABLE
1. From impact until vehicle motion ceases. . . .	0	1 oz
2. For 5-minute period after vehicle motion ceases	0	5 oz
3. For next 25 minutes. . .	0	1 oz/1 min

SOLVENT SPILLAGE DETAILS: None

FMVSS NO. 301 STATIC ROLLOVER DATA SHEET

TEST PHASE: 0° to 90° VEHICLE NHTSA NO. 820309



NOTE: If side fill, rotate so that filler cap is down.

DETERMINATION OF SOLVENT COLLECTION TIME PERIOD:

Rollover Fixture 90° Rotation Time.... = 1 min, 39 sec +
 (Spec. Range = 1 to 3 min)
 FMVSS 301 Position Hold Time..... = 5 min, 40 sec =
 Total..... = 7 min, 19 sec
 Next Whole Minute Interval..... = 8 min

FMVSS 301 REQUIREMENTS AND ACTUAL TEST RESULTS:

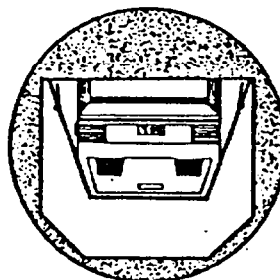
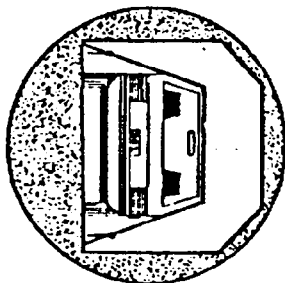
Time Period	First 5 min (from onset)	6th min	7th min	8th min (if req'd)
Maximum Spillage Allowed (oz)	5	1	1	1
Actual Spillage Recorded	0	0	0	0

NOTE: Spillage is recorded in whole minute intervals only - as determined above.

SOLVENT SPILLAGE LOCATION(S): None.

FMVSS NO. 301 STATIC ROLLOVER DATA SHEET

TEST PHASE: 90° to 180° VEHICLE NHTSA NO. 820309



DETERMINATION OF SOLVENT COLLECTION TIME PERIOD:

Rollover Fixture 90° Rotation Time.... = 1 min, 39 sec +
 (Spec. Range = 1 to 3 min)
 FMVSS 301 Position Hold Time..... = 5 min, 02 sec =
 Total..... = 6 min, 41 sec
 Next Whole Minute Interval..... = 7 min

FMVSS 301 REQUIREMENTS AND ACTUAL TEST RESULTS:

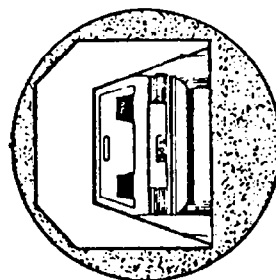
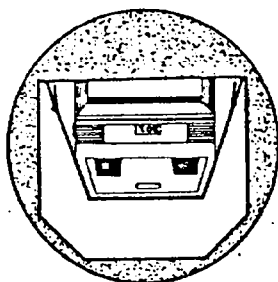
Time Period	First 5 min (from onset)	6th min	7th min	8th min (if req'd)
Maximum Spillage Allowed (oz)	5	1	1	1
Actual Spillage Recorded	0	0	0	

NOTE: Spillage is recorded in whole minute intervals only - as determined above.

SOLVENT SPILLAGE LOCATION(S): None.

FMVSS 301-75 INDICANT STATIC ROLLOVER DATA SHEET

TEST PHASE: 180° to 270° VEHICLE NHTSA NO. 820309



DETERMINATION OF SOLVENT COLLECTION TIME PERIOD:

Rollover Fixture 90° Rotation Time.... = 1 min, 37 sec +
 (Spec. Range = 1 to 3 min)
 FMVSS 301 Position Hold Time..... = 5 min, 01 sec =
 Total..... = 6 min, 38 sec
 Next Whole Minute Interval..... = 7 min

FMVSS 301 REQUIREMENTS AND ACTUAL TEST RESULTS:

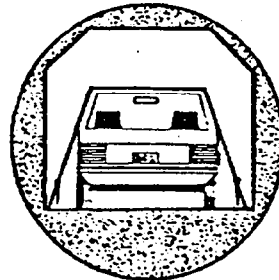
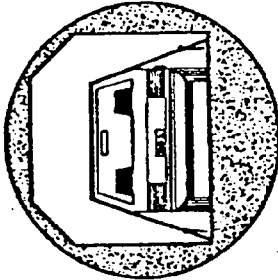
Time Period	First 5 min (from onset)	6th min	7th min	8th min (if req'd)
Maximum Spillage Allowed (oz)	5	1	1	1
Actual Spillage Recorded	0	0	0	

NOTE: Spillage is recorded in whole minute intervals only - as determined above.

SOLVENT SPILLAGE LOCATION(S): None.

FMVSS NO. 301 STATIC ROLLOVER DATA SHEET

TEST PHASE: 270° to 360° VEHICLE NHTSA NO. 820309



DETERMINATION OF SOLVENT COLLECTION TIME PERIOD:

Rollover Fixture 90° Rotation Time.... = 1 min, 38 sec +
 (Spec. Range = 1 to 3 min)
 FMVSS 301 Position Hold Time..... = 5 min, 06 sec =
 Total..... = 6 min, 44 sec
 Next Whole Minute Interval..... = 7 min

FMVSS 301 REQUIREMENTS AND ACTUAL TEST RESULTS:

Time Period	First 5 min (from onset)	6th min	7th min	8th min (if req'd)
Maximum Spillage Allowed (oz)	5	1	1	1
Actual Spillage Recorded	0	0	0	

NOTE: Spillage is recorded in whole minute intervals only - as determined above.

SOLVENT SPILLAGE LOCATION(S): None.

VEHICLE PROFILE DATA SHEET

PRE-IMPACT DATA

Make/Model: Dodge 400

Body Style: 2-Door Hardtop

Model Year: 1982

NHTSA No.: 820309

DSI No. 1232

Color: Grey

DATA FROM CERTIFICATION LABEL

Vehicle Manufacturer: Chrysler Corporation

Date of Manufacture: 9/81; VIN: 1B3BV41BXCG102498

GVWR: 3825 lb; GAWR: Front = 2120 lb; Rear = 1755 lb

POST-IMPACT DATA

Type of Test: Rear (180°) Impact

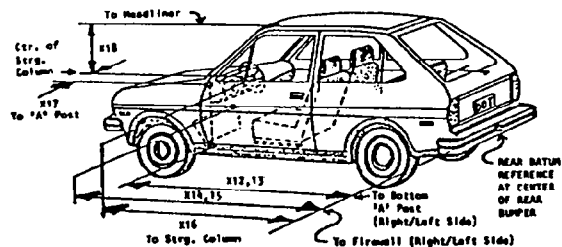
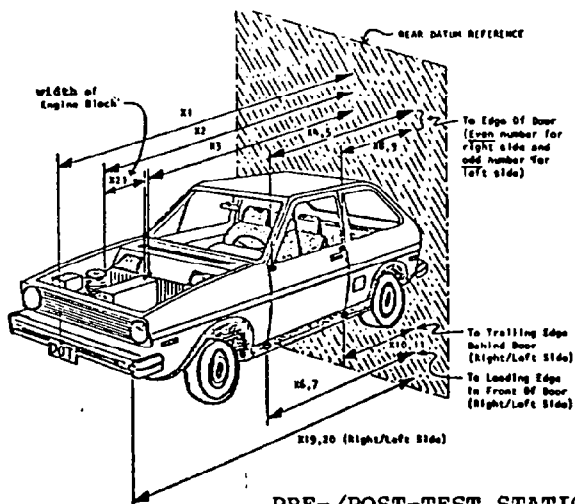
Date of Test: 1/20/82 Time: 1430 Temperature 62 °F

Required Impact Velocity Range: 28.9 to 29.9 mph

Impact Velocity: Primary = 29.70 mph Secondary = 29.77 mph

Measurements Referenced to Plane 16 Feet Forward of Front Bumper C

Loc.	Height										
	Vehicle Left (in.)						Vehicle Right (in.)				
	32	30	24	16	8	C	8	16	24	30	32
Pre-test Profile (in.)											
Top of Rear Bumper	12.6	12.2	12.1	12.0	11.9	11.8	11.8	12.0	12.1	12.1	12.5
Top of Trunk	-	17.9	17.6	17.5	17.4	17.3	17.4	17.5	17.6	18.0	-
Post-test Profile (in.)											
Top of Rear Bumper	24.7	27.2	27.6	28.0	28.4	28.6	28.7	29.0	29.1	29.0	29.1
Middle of Trunk	-	31.8	31.4	31.9	32.3	32.7	32.9	33.3	33.6	33.1	-
Post-test Static Crush (in.)											
Top of Rear Bumper	14.8	15.0	15.5	16.0	16.5	16.8	16.9	17.0	17.0	16.9	16.6
Middle of Trunk	-	13.9	13.8	14.4	14.9	15.4	15.5	15.8	16.0	15.1	-



PRE-/POST-TEST STATIC MEASUREMENT DATA

Vehicle: Dodge 400

NHTSA No.: 820309

Test Date: 1/20/82

D.S. No.: 1232

Reference Dimension	Pre-test Measurement	Post-test Measurement	Change
X ₁ *	180.4 in.	164.2 in.	16.2 in.
X ₂			
X ₃			
X ₄			
X ₅			
X ₆			
X ₇			
X ₈ *	113.5 in.	113.5 in.	0.0 in.
X ₉ *	113.4 in.	113.4 in.	0.0 in.
X ₁₀			
X ₁₁			
X ₁₂			
X ₁₃			
X ₁₄			
X ₁₅			
X ₁₆			
X ₁₇			
X ₁₈			
X ₁₉ *	179.4 in.	165.1 in.	14.3 in.
X ₂₀ *	179.7 in.	163.3 in.	16.4 in.
X ₂₁			

*Rear Impact Data Requirements.

Part 572 DUMMY IN-VEHICLE POSITION RECORDING SHEET

PRE-IMPACT DATA

Make/Model: Dodge 400
 Body Style: 2-Door Hardtop Sedan Model Year: 1982
 NHTSA No.: 820309 DSI No. 1232 Color: Grey

DATA FROM CERTIFICATION LABEL

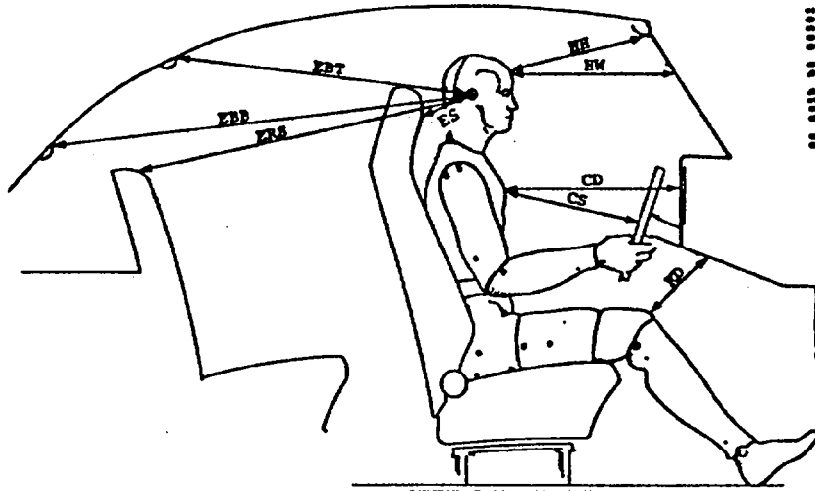
Vehicle Manufacturer: Chrysler Corporation
 Date of Manufacture: 9/81; VIN: 1B3BV41BXCG102498
 GVWR: 3825 lb; GAWR: Front = 2120 lb; Rear = 1755 lb

POST-IMPACT DATA

Type of Test: Rear (180°) Impact
 Date of Test: 1/20/82 Time: 1430 Temperature 62 °F
 Required Impact Velocity Range: 28.9 to 29.9 mph
 Impact Velocity: Primary = 29.70 mph Secondary = 29.77 mph
 Seat Type: Bucket Adjuster Type: Manual
 Bucket Seat Back Type: Adjustable
 Technicians: M. Rodack

DRIVER DUMMY# <u>S 4 5</u>		PASSENGER DUMMY # <u>S 5 5</u>	
HEAD TARGET <u>26.5"</u> <u>35</u>		HEAD TARGET <u>25.0"</u> <u>38</u>	
KNEE JOINT <u>36.0"</u> <u>90</u>		KNEE JOINT <u>36.0"</u> <u>90</u>	
APPROX- IMATE "H" POINT <u>23.0"</u> <u>102</u>		APPROX- IMATE "H" POINT <u>21.5"</u> <u>96</u>	
OVERALL <u>59.0</u> <u>42.0</u> <u>29.5</u> <u>16.0</u>			
LATERAL BAR ADJUSTABLE POINTER		DOOR GLASS HEIGHT <u>35.0</u> <u>17.0</u>	
LEFT FRONT DOOR	DRIVER DUMMY <u>S 4 5</u>	PASSENGER DUMMY <u>S 5 5</u>	RIGHT FRONT DOOR

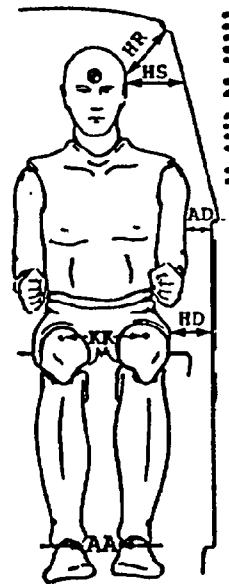
PART 572 DUMMY IN-VEHICLE POSITION RECORDING SHEET



	Driver	Passenger
HH	16.0	16.5
HW	21.0	21.0
CD	21.0	21.5
CS	13.5	N/A
KD	R-5.0	R-6.5
KD	L-5.3	L-6.3
Torso		Torso
Angle	24°	Angle 24°
Seat Back		Seat Back
Angle	21°	Angle 21°
HSW	20.0	N/A
HSW (Hub)	22.4	N/A

HH = Head to Windshield Header
 HW = Head to Windshield
 CD = Chest to Dash
 CS = Chest to Steering Wheel
 KD = Knees to Dash
 HR = Head to Side Roof
 HS = Head to Side Window
 AD = Arm to Door
 HD = Hip to Door
 KK = Knee to Knee
 Torso and seat back angles are relative to vertical.

REMARKS: Dummies positioned according to OVSC recommended procedure for positioning Part 572 dummies in test vehicle.



	Driver	Passenger
HR	6.0	7.4
HS	8.0	9.7
AD	4.5	5.4
HD	6.8	6.4
KK	10.0	10.0
AA	11.0	11.0

DUMMY KINEMATIC SUMMARY

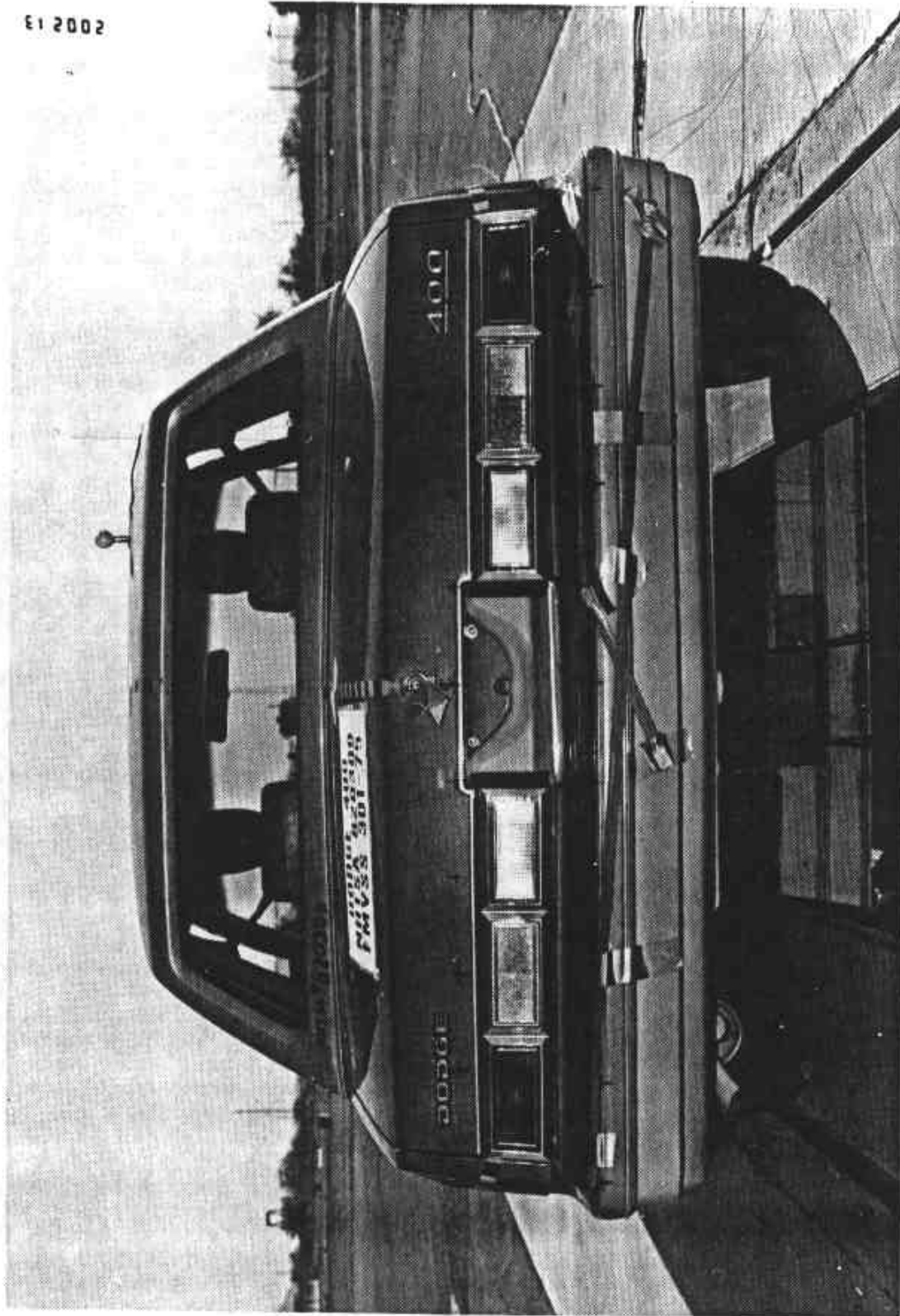
DODGE 400

DRIVER - The driver dummy reclined during the initial part of the impact sequence. The dummy continued rearward into the rear seating area with the head and upper torso disappearing below the view of the rear window. It rebounded with the head momentarily appearing above the rear window and came to rest horizontally against the seat back.

PASSENGER - The passenger dummy behaved much like the driver dummy. The dummy's left foot appeared moving upwards above the dash after the head had disappeared below the rear window. The dummy rebounded with the head momentarily appearing above the rear window and came to rest horizontally against the seat back with the left foot resting on the dash panel.

4.0 PHOTOGRAPHIC COVERAGE

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



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FIGURE 1. PRE-TEST REAR VIEW - 1982 DODGE 400 - NHTSA 820309.

91 2002

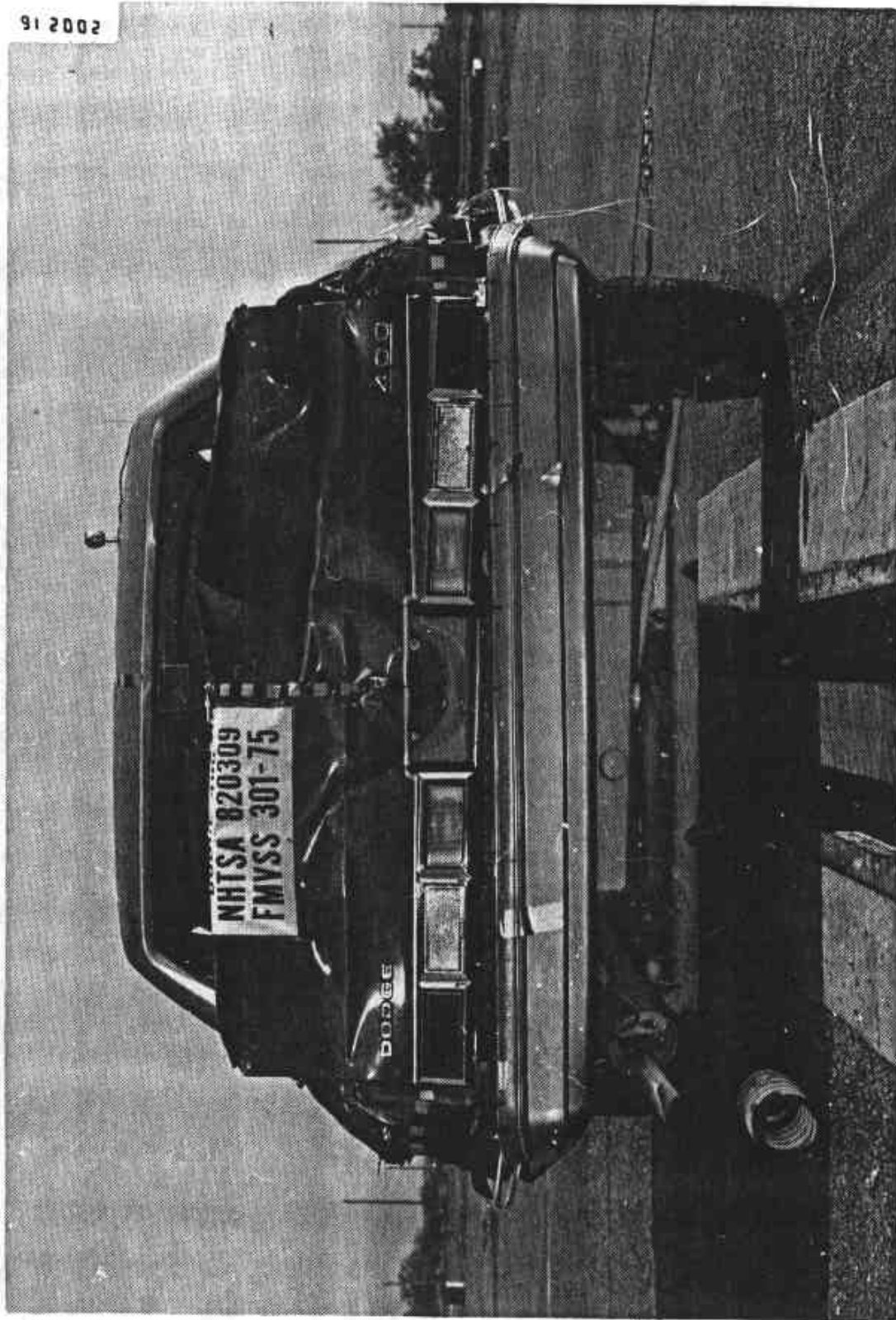


FIGURE 2. POST-TEST REAR VIEW - 1982 DODGE 400 - NHTSA 820309.

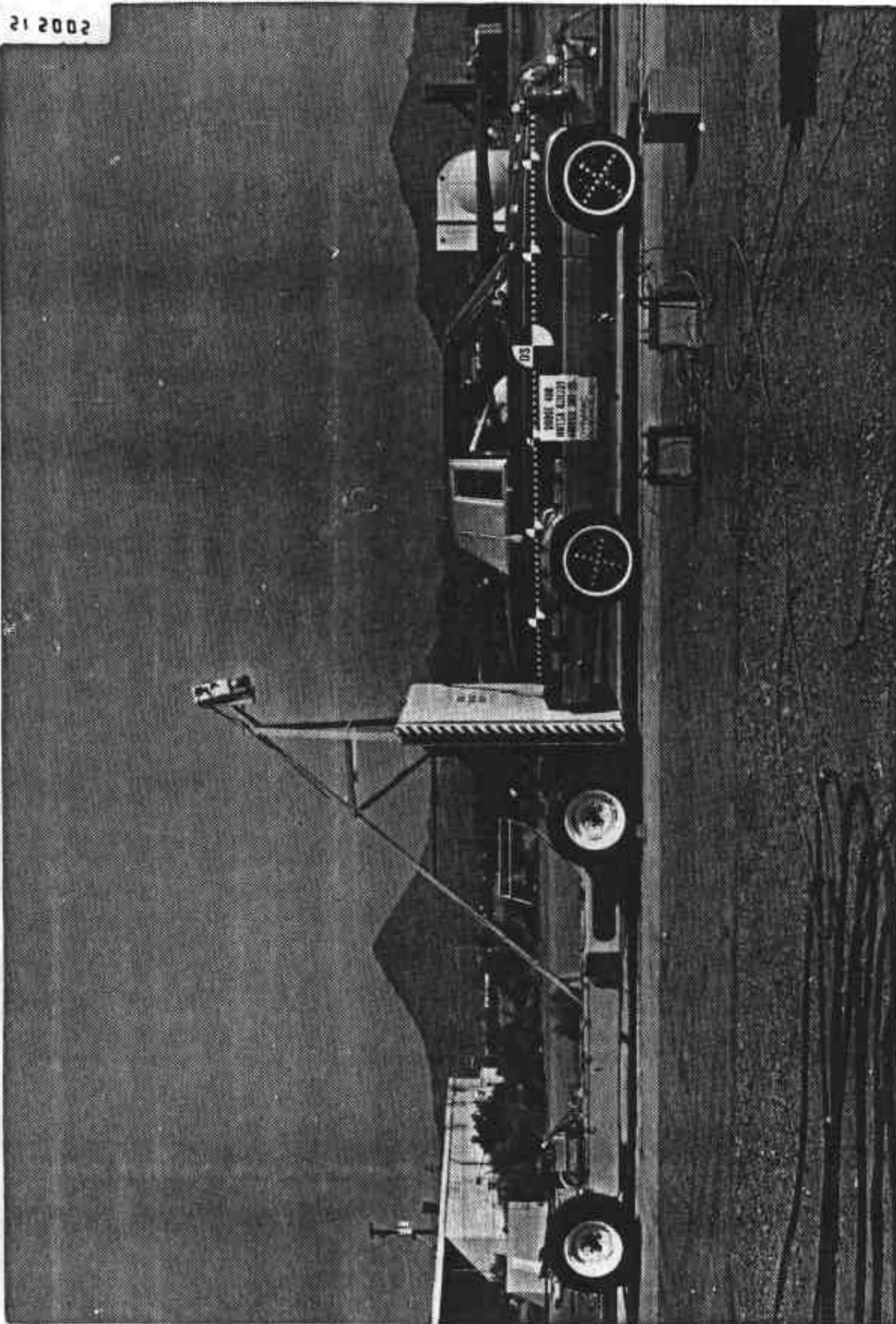


FIGURE 3. PRE-TEST SIDE VIEW - 1982 DODGE 400 - NHTSA 820309.

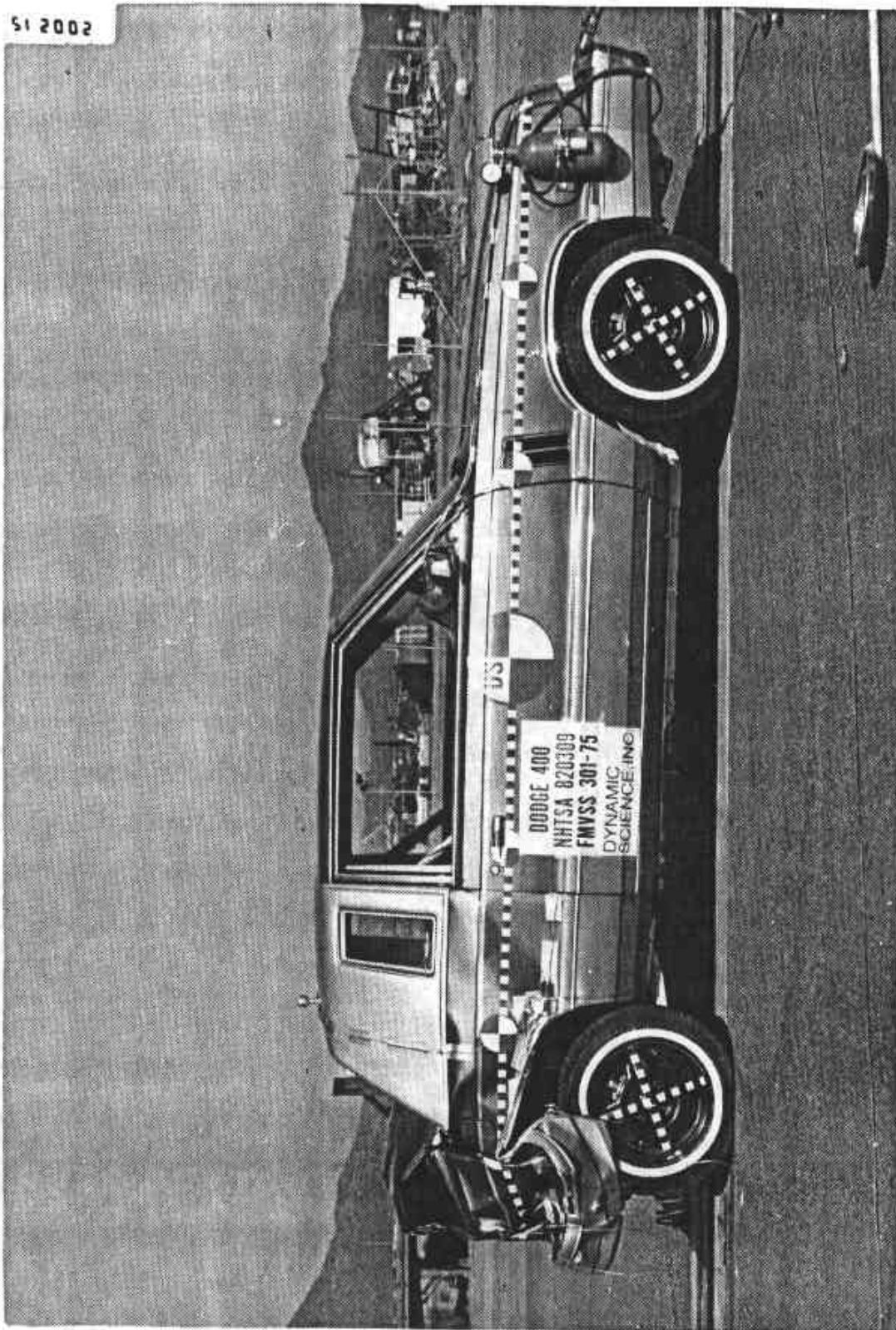


FIGURE 4. POST-TEST SIDE VIEW - 1982 DODGE 400 - NHTSA 820309.

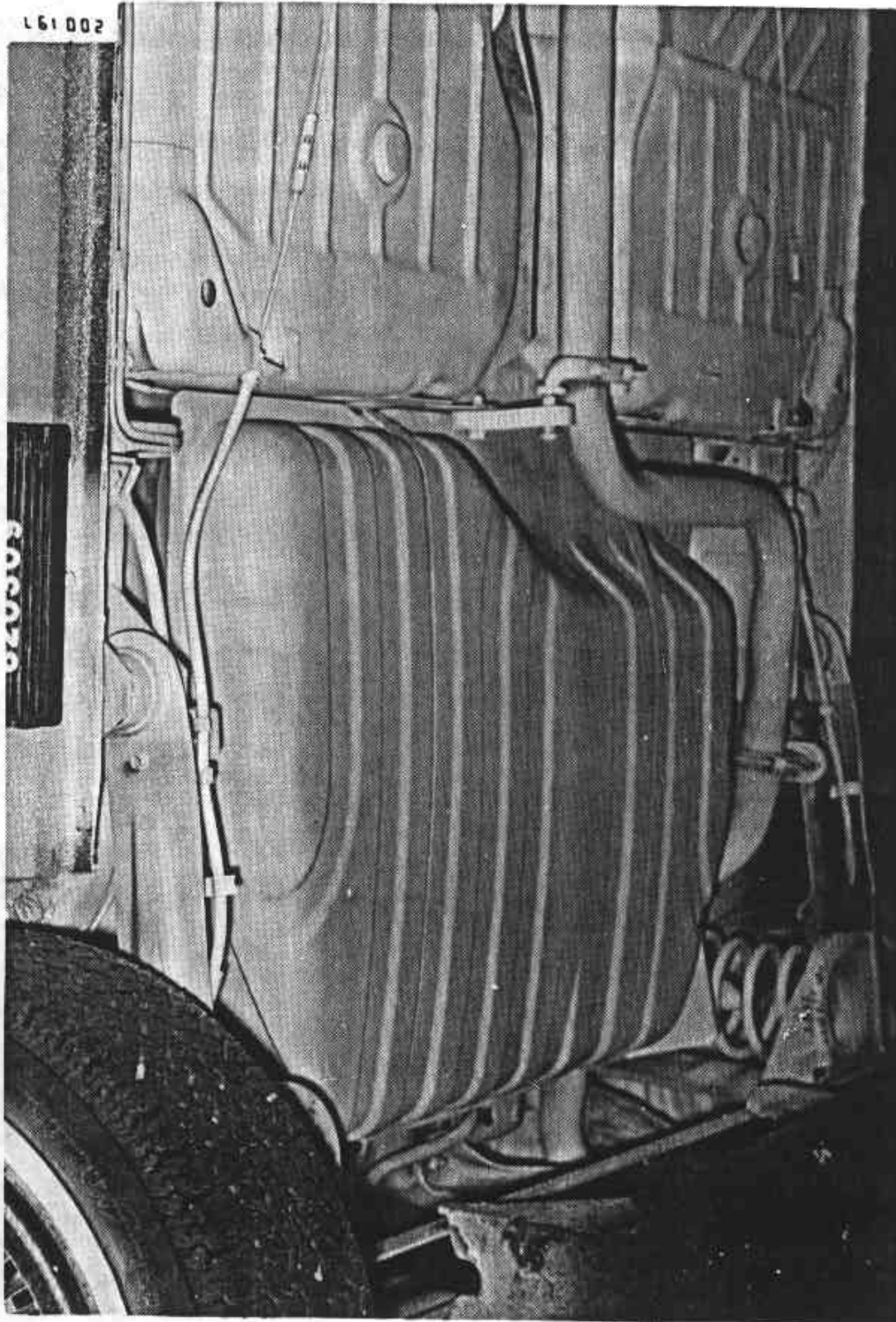


FIGURE 5. PRE-TEST VIEW OF FUEL TANK - 1982 DODGE 400 - NHTSA 820309.

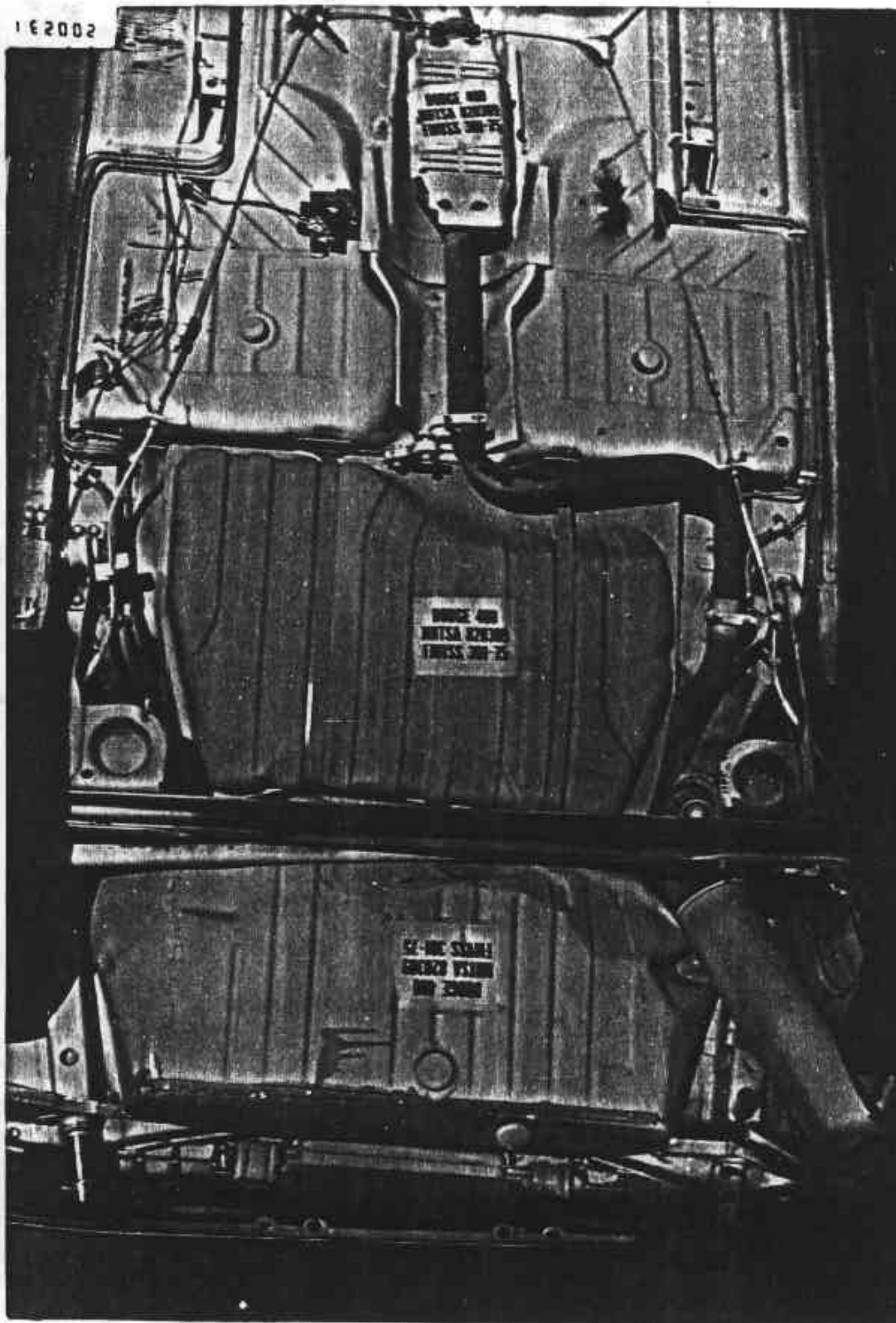


FIGURE 6. POST-TEST VIEW OF FUEL TANK - 1982 DODGE 400 - NHTSA 820309.

APPENDIX A
TEST FACILITIES AND PROCEDURE

APPENDIX A
TEST FACILITY AND EQUIPMENT FOR
FMVSS 301 (REAR) IMPACT TESTS

General Test Facility Description

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

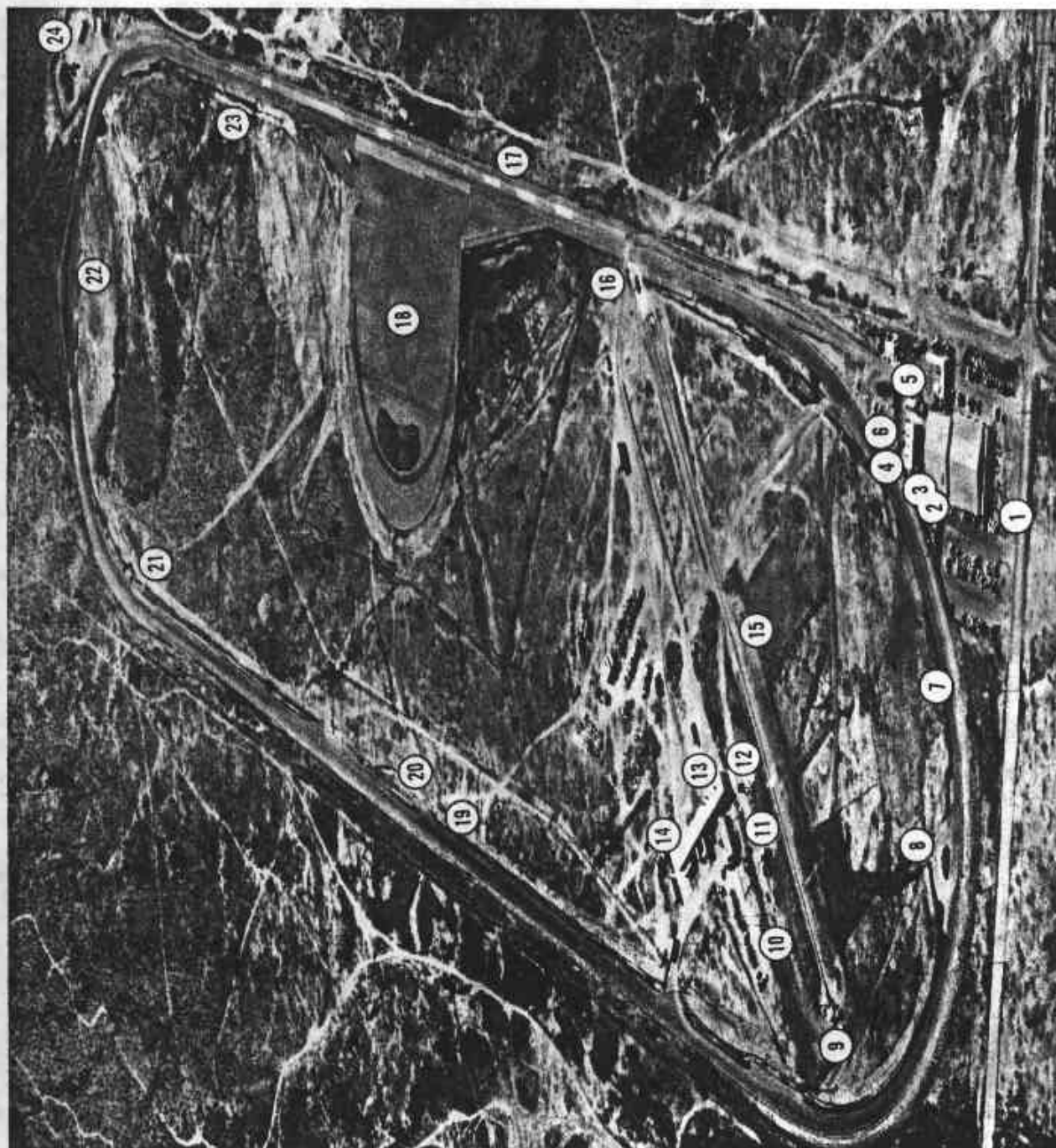
More specifically, the Monorail Impact Facility shown schematically in Figure A-2 is used. As indicated in Figure A-2, the Monorail Impact Facility accommodates a variety of test modes and configurations.

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



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 A-1. THE DYNAMIC SCIENCE, INC. PHOENIX FACILITY.

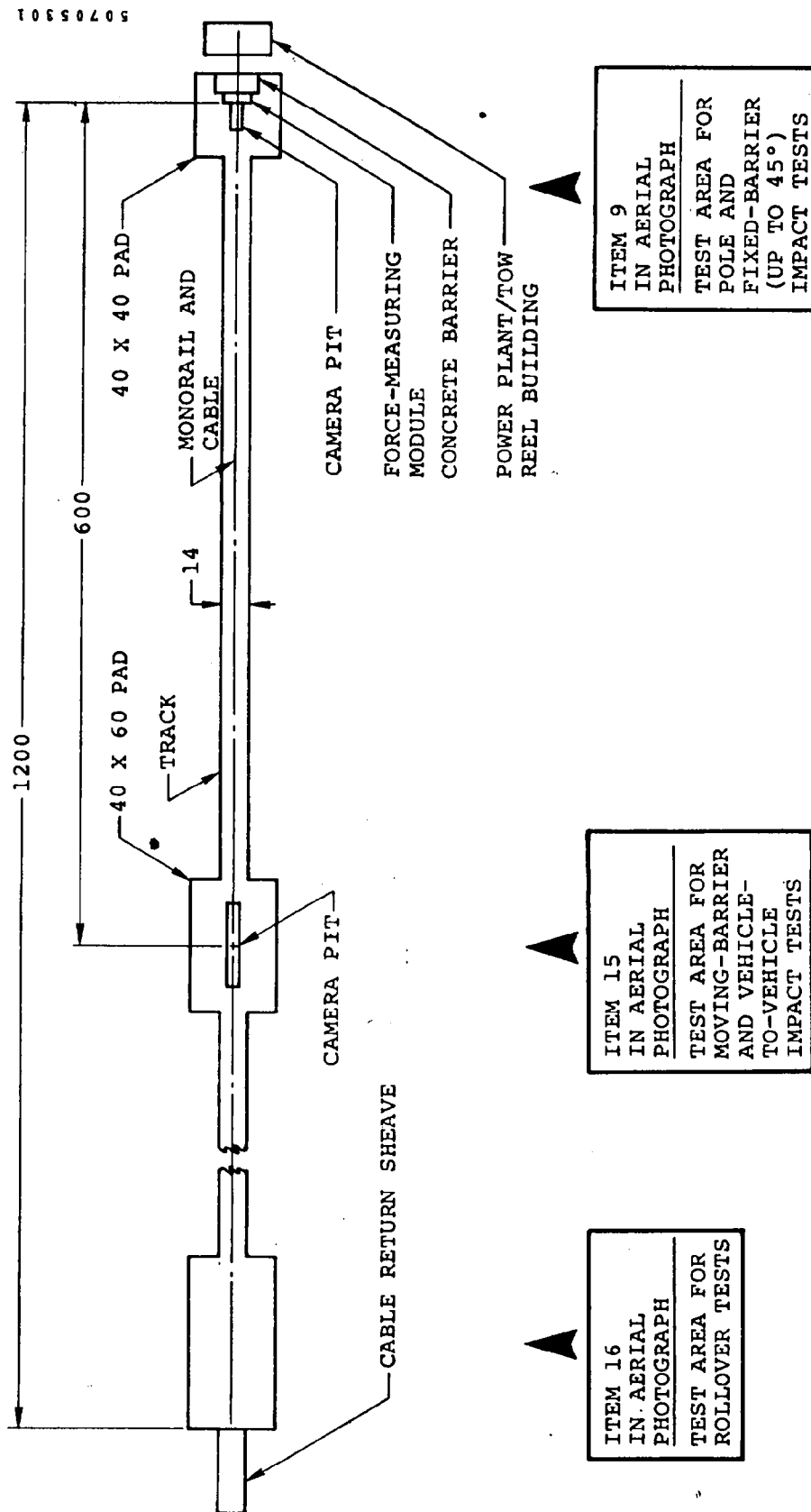


FIGURE A-2. MONORAIL IMPACT FACILITY.

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.

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 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 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 75°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 A-3. Precise positioning is accomplished through bore sighting with the vehicle at the impact point prior to the test.

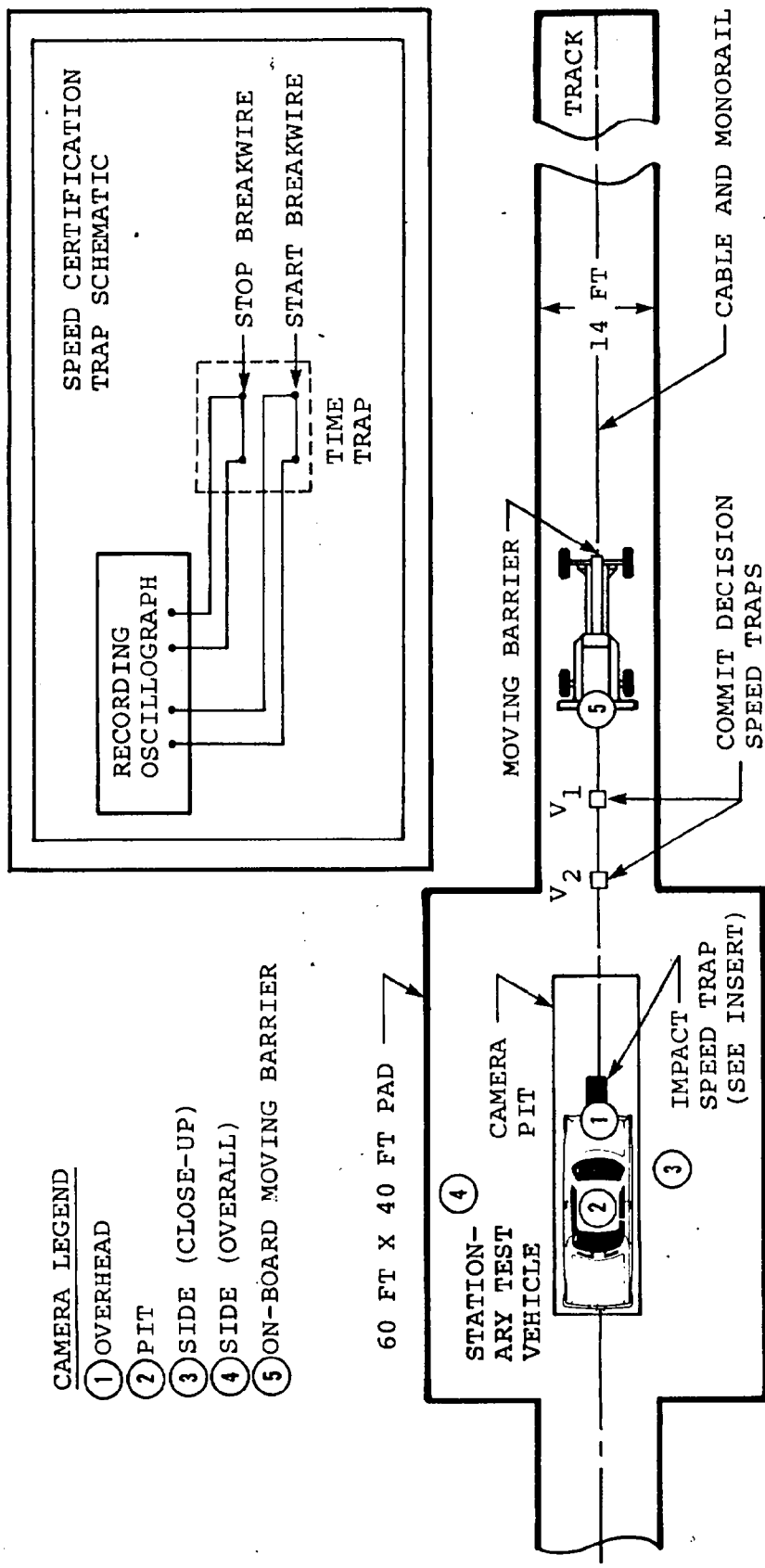


FIGURE A-3. REAR MOVING BARRIER IMPACT TEST SITE LAYOUT.

Ballast Weight

The ballast used in this program is weighed on a Howe platform scale prior to installation in the test vehicle.

The platform scale is calibrated by placing precision weights thereon and recording the scale reading. The accuracy of the ballast weights is:

- $\pm 1/2$ pound for 0 to 300-pound weights
- ± 1 pound for 300 to 1000-pound weights

Vehicle Weight

The weights of the test vehicle are determined by placing each wheel on a Western Model WP 2000 beam scale, certified with test weights scaled to National Bureau of Standards Class B tolerances.

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 Milliken Red Lake Labs	16-1B 5A 164-5AC	Used for front, side, overhead, and underside film coverage.
Motion Picture Camera	Canon Scoopic		Panning and documentation.
Still Camera	Mamiya	RB 67	Documentary photographic 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	Alderson Research Labs	Hybrid II	To ballast the vehicle and to gather occupant response data.

APPENDIX B
CALCOMP PLOT PRESENTATION

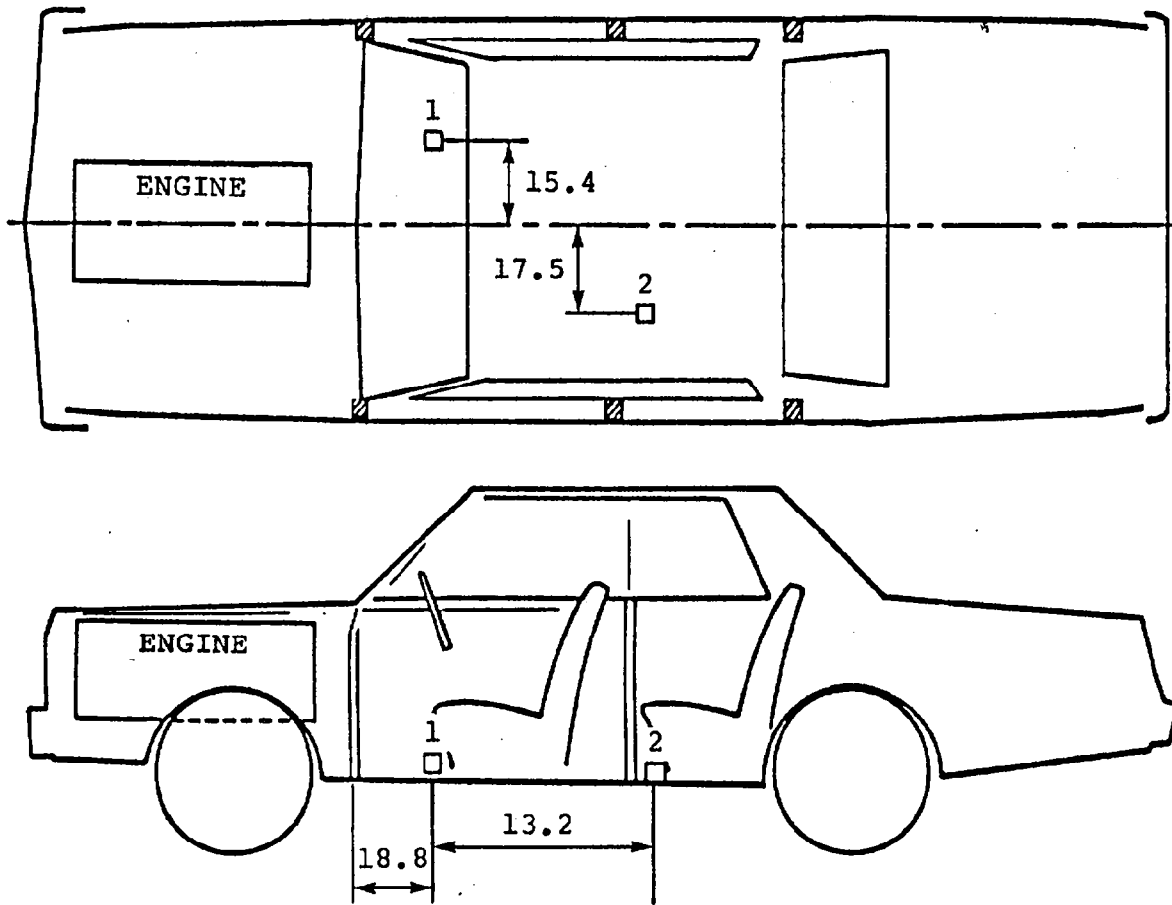
Calcomp plots generated from the crash test data are presented on the following pages. All data will be recorded on magnetic tape for inclusion in the NHTSA crash test data base system. All data was filtered according to SAE J211. Plot legends and test anomalies are listed below:

PLOT LEGEND

<u>Vehicle Data</u>	<u>Location</u>
Location 1	Front Seat Area Acceleration (G)
Location 2	Rear Seat Area Acceleration (G)
Location 8	Moving Barrier C.G. Acceleration (G)

Test Anomalies: None.

VEHICLE ACCELEROMETER LOCATION AND DATA SUMMARY



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VEHICLE ACCELEROMETER SUMMARY		DIRECTION			PEAK ACCELERATION (G) @ msec		
No.	Description of Location	X	Y	Z	+	X -	+ Z -
1	Front Seat Crossbeam	✓			26.14 8	6.5 105	
2	Rear Seat Crossbeam	✓			26.6 14	9.0 17	

