

REPORT NUMBER: 301-CAL-03 02

**SAFETY COMPLIANCE TESTING FOR FMVSS 301  
FUEL SYSTEM INTEGRITY**

SAAB AUTOMOBILE AB  
2003 SAAB 9-3  
4-DOOR SEDAN

NHTSA NUMBER: C30510

VERIDIAN TEST NUMBER: 8655-F301-11

July 25, 2003

VERIDIAN ENGINEERING  
P.O. BOX 400  
BUFFALO, NEW YORK 14225



FINAL REPORT

PREPARED FOR:

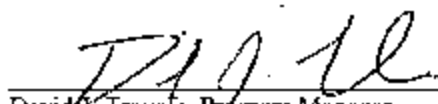
U. S. Department of Transportation  
National Highway Traffic Safety Administration  
Safety Assurance  
Office of Vehicle Safety Compliance  
400 Seventh Street, S. W.  
Room No. 6115 (NVS-220)  
Washington, DC 20590

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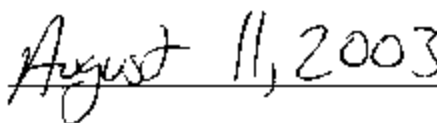
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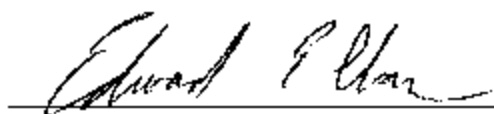
  
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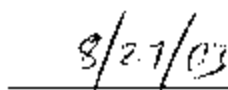
  
August 11, 2003

FINAL REPORT ACCEPTANCE BY OVSC:

Accepted By:



Acceptance Date:

  
8/27/03

# **TECHNICAL REPORT STANDARD TITLE PAGE**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                      |                                                                                                                                                                                                                        |           |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| 1. Report No.<br>301-CAL-03-02                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 2. Government Accession No.                          | 3. Recipient's Catalog No.                                                                                                                                                                                             |           |
| 4. Title and Subtitle<br>Final Report of FMVSS 301 Compliance Testing of a 2003 Saab 9-3 4-Door Sedan<br>NHTSA No. C30510                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                      | 5. Report Date<br>July 25, 2003                                                                                                                                                                                        |           |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                      | 6. Performing Organization Code<br>CAL                                                                                                                                                                                 |           |
| 7. Author(s)<br>Patrick G. MacDiarmid Jr., Project Engineer<br>David J. Travale, Program Manager                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                      | 8. Performing Organization Report No.<br>8655-F301-11                                                                                                                                                                  |           |
| 9. Performing Organization Name and Address<br>Veridian Engineering<br>4455 Genesee Street<br>Buffalo, New York 14225                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                      | 10. Work Unit No.                                                                                                                                                                                                      |           |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                      | 11. Contract or Grant No.<br>DTNH22-01-C-01025                                                                                                                                                                         |           |
| 12. Sponsoring Agency Name and Address<br>U.S. Department of Transportation National Highway Traffic Safety<br>Administration Office of Vehicle Safety Compliance (NVS-220)<br>400 Seventh St., S.W., Rm. 6115, Washington, D.C. 20590                                                                                                                                                                                                                                                                                                                                                                                                            |                                                      | 13. Type of Report and Period Covered<br>Final Test Report<br>July-August 2003                                                                                                                                         |           |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                      | 14. Sponsoring Agency Code<br>NVS-220                                                                                                                                                                                  |           |
| 15. Supplementary Notes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                      |                                                                                                                                                                                                                        |           |
| 16. Abstract<br><p>Compliance tests were conducted on the subject 2003 Saab 9-3 4-Door Sedan in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP-301-03 for the determination of FMVSS 301 compliance. For the purpose of acquiring information for applied research, two instrumented Anthropomorphic Test Devices (ATDs) were placed in the front occupant seating positions and various instrumentation was added to the test vehicle. Test failures identified were as follows:</p> <p>The test vehicle appeared to comply with all requirements of FMVSS 301 "Fuel System Integrity."</p> |                                                      |                                                                                                                                                                                                                        |           |
| 17. Key Words<br>Compliance Testing<br>Safety Engineering<br>FMVSS 301                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                      | 18. Distribution Statement<br>Copies of this report are available from:<br>NHTSA Technical Reference Division<br>Room 5108 (NPC-230), 400 Seventh St., S.W.,<br>Washington, D.C. 20590<br>Telephone No. (202) 366-4946 |           |
| 19. Security Classif. (of this report)<br>UNCLASSIFIED                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 20. Security Classif. (of this page)<br>UNCLASSIFIED | 21. No. of Pages<br>40                                                                                                                                                                                                 | 22. Price |

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## SECTION 1

### PURPOSE OF COMPLIANCE TEST

This 30 mph rear moving barrier impact test is part of the Federal Motor Vehicle Safety Standard (FMVSS) 301 Compliance Test Program conducted for the National Highway Traffic Safety Administration (NHTSA) by Verdian Engineering under Contract No. DTNH22-01-C 01025. The purpose of this test was to determine if the subject vehicle, a 2003 Saab 9 3 4-Door Sedan, meets the performance requirements of FMVSS No. 301, "Fuel System Integrity." This compliance test was conducted using the requirements found in the OVSC Laboratory Test Procedure No. TP-301-03, dated February 28, 2003.

## SECTION 2

### COMPLIANCE TEST RESULTS SUMMARY

A 1732.5 kg 2003 Saab 9-3 4-Door Sedan was impacted from the rear by an 1797 kg moving barrier at a velocity of 47.3 kph (29.4 mph). The test was performed by Veridian Engineering on July 25, 2003.

The test vehicle was equipped with a 62.1 liter fuel tank which was filled to 92.5 percent capacity with stoddard fluid prior to impact. For the purpose of acquiring information for applied research, one instrumented Part 572 E 50th percentile male Anthropomorphic Test Device (ATD) and one instrumented Part 572 C 5th percentile female ATD were placed in the driver and right front occupant seating positions respectively and various instruments were added to the test vehicle. Research data is presented in a separate report.

The crash event was recorded by ten high-speed cameras and one real-time camera. Camera locations and other pertinent camera information are found on pages 3-9 and 3-10 of this report. Pre- and post-test photographs of the vehicle can be found in Appendix A.

There was no fuel system fluid spillage following the impact or during any portion of the static rollover test. The average vehicle longitudinal crush was 237 millimeters. The vehicle appeared to comply with all the requirements of FMVSS No. 301 "Fuel System Integrity."

SECTION 3  
COMPLIANCE TEST DATA

# DATA SHEET 1

## TEST VEHICLE SPECIFICATIONS

### TEST VEHICLE INFORMATION:

Year/Make/Model/Body Style: 2003 Saab 9-3 4-Door Sedan

NHTSA No.: C30510; Color: Gray

Engine Data: 4 Cylinders; CID; 2.0 Liters; - cc

Placement: - Longitudinal or In-Line; X Transverse or Lateral

Transmission Data: 4 Speeds; - Manual; X Automatic; X Overdrive

Final Drive: - Rear Wheel Drive; X Front Wheel Drive; - Four Wheel Drive

Major Options: X A/C; X Power Steering; X Power Brakes

X Power Windows; X Power Door Locks; X Tilt Wheel

Date Received: April 11, 2003; Odometer Reading 217 km

Selling Dealer: The Dorschei Saab Country

& Address: 3317 West Henrietta Road Rochester, NY 14623

### DATA FROM VEHICLE'S CERTIFICATION LABEL:

Vehicle Manufactured by: Saab Automobile AB

Date of Manufacture: Feb 03

VIN: YS3FB49S431033297

GVWR: 1950 kg; GAWR-FRONT: 1125 kg; GAWR-REAR: 1012 kg

### DATA FROM VEHICLE'S TIRE LABEL:

Location of Placard on Vehicle: Driver Door

Recommended Tire Size: P215/55R16 93 H

\* Recommended Cold Tire Pressure: FRONT: 240 kPa; REAR: 220 kPa

### DATA FROM TIRE SIDEWALL:

Size of Tires on Test Vehicle: P215/55R16 93 H Manufacturer: Pirelli

Tire Pressure with Maximum Capacity Vehicle Load: FRONT: 300 kPa; REAR: 300 kPa

Type of Spare Tire: T125/85R16 99M

### VEHICLE CAPACITY DATA:

Type of Front Seats: - Bench; X Bucket; - Split Bench

Number of Occupants: 2 Front; 3 Rear; 5 Total

Vehicle Capacity Weight (VCW) = 421 kg

No. of Occupants x 68.04 kg = 340.2 kg

Rated Cargo/Luggage Weight (RCLW) = 80.8 kg

\*Tire pressure used for test



## DATA SHEET 2

## PRE-TEST DATA

WEIGHT OF TEST VEHICLE AS RECEIVED FROM DEALER (with maximum fluids)= UDW:

|                                    |   |              |    |                      |   |              |    |
|------------------------------------|---|--------------|----|----------------------|---|--------------|----|
| Right Front                        | = | <u>453.5</u> | kg | Right Rear           | = | <u>281.5</u> | kg |
| Left Front                         | = | <u>468.5</u> | kg | Left Rear            | = | <u>308.5</u> | kg |
| TOTAL FRONT                        | = | <u>922</u>   | kg | TOTAL REAR           | = | <u>590</u>   | kg |
| TOTAL DELIVERED WEIGHT             | = | <u>1512</u>  | kg |                      |   |              |    |
| % of Total Front of Vehicle Weight | = | <u>61.0%</u> |    | of Total Rear Weight | = | <u>39.0%</u> |    |

CALCULATION OF VEHICLE'S TARGET TEST WEIGHT:

|                                    |   |               |    |
|------------------------------------|---|---------------|----|
| Total Delivered Weight             | = | <u>1512</u>   | kg |
| Rated Cargo/Luggage Weight (RCLW)  | = | <u>80.8</u>   | kg |
| Weight of 2 p.572 Dummies, 74.4 kg | = | <u>148.8</u>  | kg |
| TARGET TEST WEIGHT                 | = | <u>1741.6</u> | kg |

WEIGHT OF TEST VEHICLE WITH TWO DUMMIES AND 71.7 KG OF CARGO WEIGHT:

|                                    |   |               |    |                      |   |              |    |
|------------------------------------|---|---------------|----|----------------------|---|--------------|----|
| Right Front                        | = | <u>522.0</u>  | kg | Right Rear           | = | <u>321.5</u> | kg |
| Left Front                         | = | <u>546.0</u>  | kg | Left Rear            | = | <u>343.0</u> | kg |
| TOTAL FRONT                        | = | <u>1068</u>   | kg | TOTAL REAR           | = | <u>664.5</u> | kg |
| TOTAL TEST WEIGHT                  | = | <u>1732.5</u> | kg |                      |   |              |    |
| % of Total Front of Vehicle Weight | = | <u>61.6%</u>  |    | of Total Rear Weight | = | <u>38.4%</u> |    |

\* Weight of Ballast Secured in Vehicle Trunk Area = 0 kgType of Ballast: NoneMethod of Securing Ballast: Not ApplicableVehicle Components Removed for Weight Reduction: Vehicle battery

VEHICLE ATTITUDE (all dimension in millimeters):

|                             |    |             |                                             |            |    |            |    |            |
|-----------------------------|----|-------------|---------------------------------------------|------------|----|------------|----|------------|
| AS DELIVERED:               | RF | <u>694</u>  | LF                                          | <u>686</u> | RR | <u>687</u> | LR | <u>683</u> |
| AS TESTED:                  | RF | <u>670</u>  | LF                                          | <u>660</u> | RR | <u>678</u> | LR | <u>674</u> |
| Vehicle's Wheel Base:       |    | <u>2675</u> | mm                                          |            |    |            |    |            |
| Location of Vehicle's C.G.: |    | <u>1026</u> | millimeters rearward of front wheel center. |            |    |            |    |            |

FUEL SYSTEM DATA:

|                                                  |             |                                         |                        |
|--------------------------------------------------|-------------|-----------------------------------------|------------------------|
| Fuel System Capacity From Owner's Manual         | =           | <u>62.1</u>                             | liters                 |
| Usable Capacity Figure Furnished by COTR         | =           | <u>62.1</u>                             | liters                 |
| Test Volume Range (91 to 94% of Usable Capacity) | =           | <u>56.51</u>                            | to <u>58.37</u> liters |
| ACTUAL TEST VOLUME=                              | <u>57.4</u> | liters (with entire fuel system filled) |                        |

\* Ballast weight includes the RCLW, the weight of drained vehicle fluids and the weight of any removed vehicle components less the weight of onboard instrumentation, cameras, and hardware.

DATA SHEET 2 (continued)

PRE-TEST DATA

FUEL SYSTEM DATA (continued):

Test Fluid Type: Stoddard Solution

Test Fluid Specific Gravity: 0.764

Test Fluid Kinematic Viscosity: 0.96 centistokes

Test Fluid Color: Orange ("red" is preferred)

Type of Vehicle Fuel Pump: Electric

Electric Fuel Pump Operation with Ignition Switch ON and Engine OFF -  
Fuel pump operated.

Details of Fuel System: The fuel tank is centered ahead of the rear axle with the fuel lines running inboard of the right frame stiffener. The fuel door is on the right side of the vehicle behind the rear axle.

Comments: None

# DATA SHEET 3

## MOVING BARRIER DATA

### WEIGHT OF MOVING BARRIER:

|                      |   |        |    |            |   |       |    |
|----------------------|---|--------|----|------------|---|-------|----|
| Right Front          | = | 504.9  | kg | Right Rear | = | 393.7 | kg |
| Left Front           | = | 499.9  | kg | Left Rear  | = | 398.3 | kg |
| TOTAL FRONT          | = | 1004.8 | kg | TOTAL REAR | = | 792.0 | kg |
| TOTAL BARRIER WEIGHT | = | 1796.8 | kg |            |   |       |    |

### MOVING BARRIER DIMENSIONS:

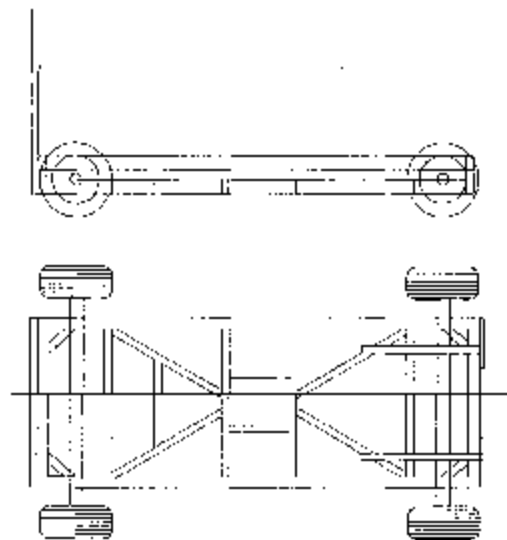
|                                |                                                       |    |
|--------------------------------|-------------------------------------------------------|----|
| Barrier Face Height:           | 1524                                                  | mm |
| Barrier Face Width:            | 1981                                                  | mm |
| Barrier Face Ground Clearance: | 127                                                   | mm |
| Tread Width:                   | 1511                                                  | mm |
| Wheel Base:                    | 3048                                                  | mm |
| Location of C.G.:              | X: 1344 mm rearward of front wheel center.            |    |
|                                | Y: 0 mm from longitudinal-vertical plane of symmetry. |    |
|                                | Z: 414 mm above ground.                               |    |

### MOVING BARRIER TIRES:

|                           |           |
|---------------------------|-----------|
| Manufacturer:             | Classic   |
| Model:                    | Poly IV   |
| Size:                     | 215/75D15 |
| Recommended Max Pressure: | 240 kPa   |

### MOVING BARRIER ABORT SYSTEM:

|       |                |
|-------|----------------|
| Type: | Trailing cable |
|-------|----------------|



DATA SHEET 4  
POST TEST DATA

TYPE OF TEST:

Type of Test: Rear Barrier Impact Angle: 0°  
Test Date: July 25, 2003 Time: 13:17 Temperature: 25.5 °C  
Vehicle NHTSA No.: C30510 VIN: YS3JB49S431033297  
Required Impact Velocity Range: 46.51 to 48.12 kph

BARRIER IMPACT VELOCITY: (Speed traps within 5 feet of impact plane.)

Trap No. 1 = 47.3 kph; Trap No. 2 = 47.3 kph  
Average Impact Speed = 47.3 kph

VEHICLE STATIC CRUSH:

Vehicle Length:

|           |        |             |             |             |         |             |
|-----------|--------|-------------|-------------|-------------|---------|-------------|
| Pre-Test  | Left = | <u>4520</u> | ; C/L =     | <u>4630</u> | Right = | <u>4520</u> |
| Post-Test | Left = | <u>4285</u> | ; C/L =     | <u>4390</u> | Right = | <u>4285</u> |
| Crush     | Left = | <u>235</u>  | ; C/L =     | <u>240</u>  | Right = | <u>235</u>  |
| AVERAGE   | =      | <u>237</u>  | millimeters |             |         |             |

# DATA SHEET 4 (continued)

## POST TEST DATA

TEST VEHICLE NHTSA NO.: C30510 TEST DATE: July 25, 2003

Vehicle Mfg./Make/Model: 2003 Saab 9-3 4-Door Sedan

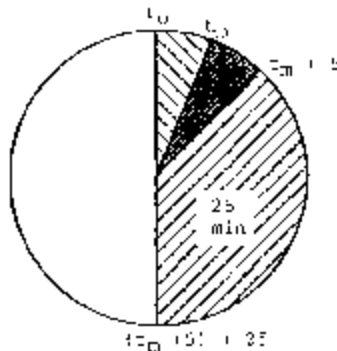
Test vehicle fuel tank filled to 91% to 94% of manufacturer's "usable" capacity and with electric fuel pump operating (if it will operate without engine operation). Part 572 test dummies located at each front designated seating position.

\*\*\*\*\*

TEST VEHICLE IMPACT TYPE:

- Frontal (42.28 kph target velocity)
- Oblique (42.28 kph target velocity) with       ° barrier face first contacting        (driver/passenger) side
- X Rear Moving Barrier (42.28 kph target velocity)
- Lateral Moving Barrier (32.19 kph target velocity)

### FUEL SPILLAGE MEASUREMENT:



1. From impact until vehicle motion ceases
2. For five minute period after vehicle motion ceases
3. For next 25 minutes

| ACTUAL | MAX ALLOWED |
|--------|-------------|
| 0      | 28 g        |
| 0      | 28 g.       |
| 0      | 28 g/min.   |

### SOLVENT SPILLAGE DETAILS:

None

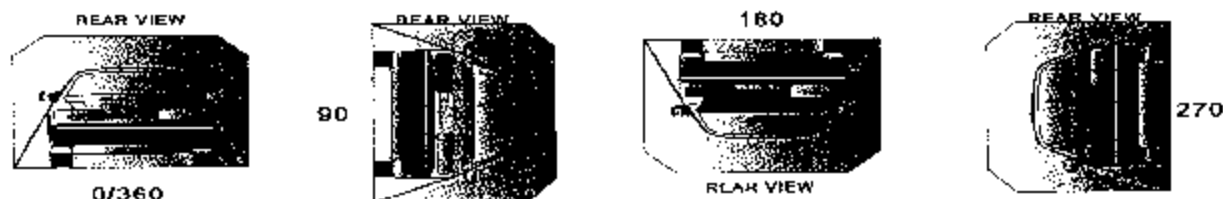
# DATA SHEET 5

## STATIC ROLLOVER TEST DATA

**Table 7 FMVSS NO. 301 - STATIC ROLLOVER DATA SHEET**

Vehicle: 2003 Saab 9-3 4 Door Sedan

NHTSA No.: C30510



### I. DETERMINATION OF SOLVENT COLLECTION TIME PERIOD:

| Rollover Stage | Rotation Time (spec. 1-3 min) |         |    |         | FMVSS 301 Hold Time |         | Total Time |         |    |         | Next Whole Minute Interval |         |
|----------------|-------------------------------|---------|----|---------|---------------------|---------|------------|---------|----|---------|----------------------------|---------|
| 0° - 90°       | 1                             | minutes | 15 | seconds | 5                   | minutes | 6          | minutes | 15 | seconds | 7                          | minutes |
| 90° - 180°     | 1                             | minutes | 06 | seconds | 5                   | minutes | 6          | minutes | 6  | seconds | 7                          | minutes |
| 180° - 270°    | 1                             | minutes | 01 | seconds | 5                   | minutes | 6          | minutes | 1  | seconds | 7                          | minutes |
| 270° - 360°    | 1                             | minutes | 08 | seconds | 5                   | minutes | 6          | minutes | 8  | seconds | 7                          | minutes |

### II. FMVSS 301 REQUIREMENTS: (Maximum allowable solvent spillage):

| First 5 minutes from onset of rotation | 6th min. | 7th min. | 8th min. (if required) |
|----------------------------------------|----------|----------|------------------------|
| 112 g                                  | 28 g     | 28 g     | 28 g                   |

### III. ACTUAL TEST VEHICLE SOLVENT SPILLAGE:

| Rollover Stage | First 5 minutes from onset of rotation (g) | 6th min. (g) | 7th min. (g) | 8th min. (if required) (g) |
|----------------|--------------------------------------------|--------------|--------------|----------------------------|
| 0° - 90°       | 0                                          | 0            | 0            | N/A                        |
| 90° - 180°     | 0                                          | 0            | 0            | N/A                        |
| 180° - 270°    | 0                                          | 0            | 0            | N/A                        |
| 270° - 360°    | 0                                          | 0            | 0            | N/A                        |

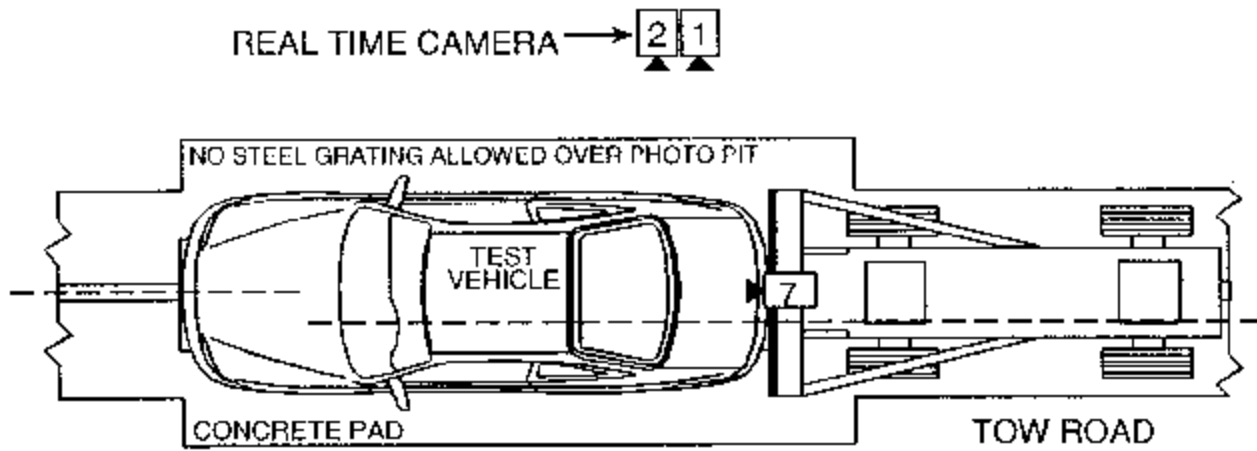
Note: Record spillage for whole minute intervals only as determined above.

### IV. SOLVENT SPILLAGE LOCATION(S):

| Rollover Stage | Spillage Location |
|----------------|-------------------|
| 0° - 90°       | None              |
| 90° - 180°     | None              |
| 180° - 270°    | None              |
| 270° - 360°    | None              |

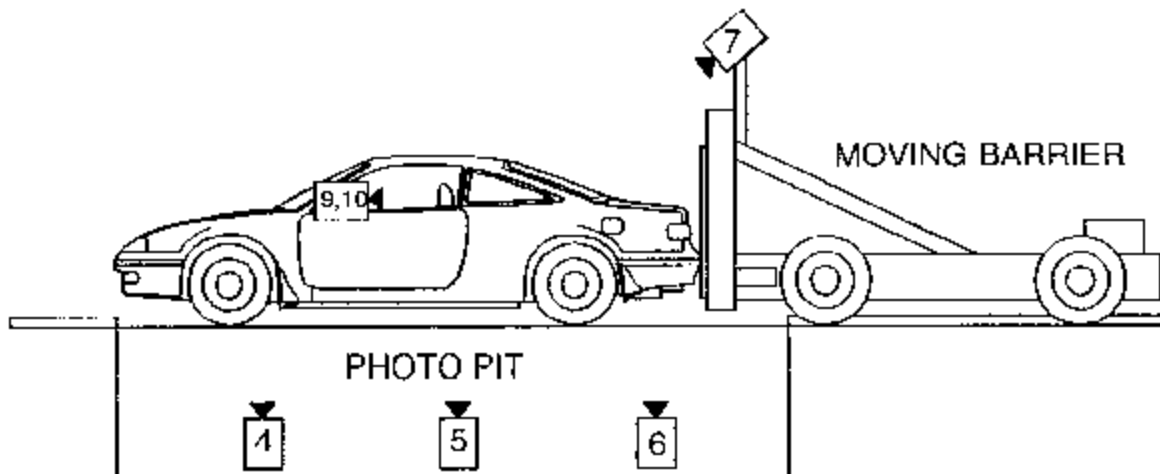
# DATA SHEET 6

## HIGH SPEED CAMERA LOCATIONS



3

TOP VIEW



LEFT SIDE VIEW

## DATA SHEET 6 (continued)

## HIGH SPEED CAMERA LOCATIONS

NHTSA No. : C30510

Vehicle : 2003 Saab 9-3 4-Door Sedan

| CAMERA NO. | VIEW                               | CAMERA POSITIONS (mm)* |      |       | ANGLE** (degrees) | LENS (mm) | SPEED (fps) |
|------------|------------------------------------|------------------------|------|-------|-------------------|-----------|-------------|
|            |                                    | X                      | Y    | Z     |                   |           |             |
| 1          | Real-Time Camera                   |                        |      | -     | -                 | -         | 24          |
| 2          | Right Side View                    | 17323                  | 1958 | 1138  | 0                 | 35        | 1000        |
| 3          | Left Side View                     | 16459                  | 1222 | 1300  | 0                 | 35        | 1000        |
| 4          | Vehicle Front Underbody View       | 0                      | 2600 | -1956 | 90                | 13        | 1000        |
| 5          | Vehicle Mid-Section Underbody View | 0                      | 1825 | -1956 | 90                | 13        | 1030        |
| 6          | Vehicle Rear Underbody View        | 0                      | 755  | -1956 | 90                | 13        | 1005        |
| 7          | Moving Barrier View                | 0                      | 0    | 2515  | -105              | 7.5       | 1000        |
| 8          | Overhead Overall View              | -508                   | 0    | 9804  | -90               | 13        | 1005        |
| 9†         | Onboard Driver View                | -                      | -    | -     | -                 | 8         | 1000        |
| 10†        | Onboard Passenger View             | -                      | -    | -     | -                 | 8         | 1000        |

\* X = film plane to monorail centerline (+ to left of rail)

Y = film plane to impact location (+ ahead of impact location)

Z = film plane to ground (+ above ground)

\*\* = referenced to horizontal plane

† Research cameras.



Appendix A  
PHOTOGRAPHS

# LIST OF PHOTOGRAPHS

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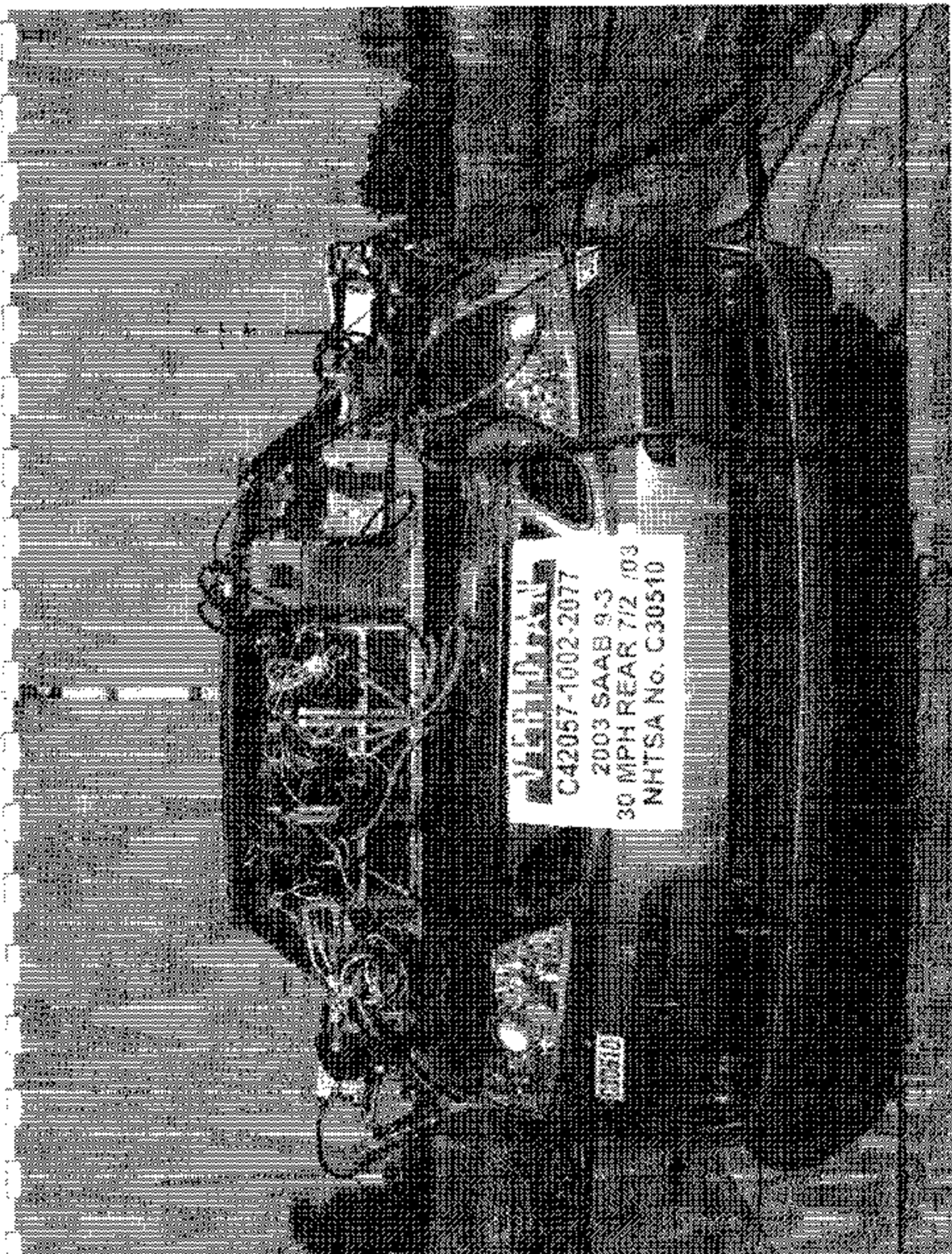


Figure A-1 PRE-TEST FRONT VIEW

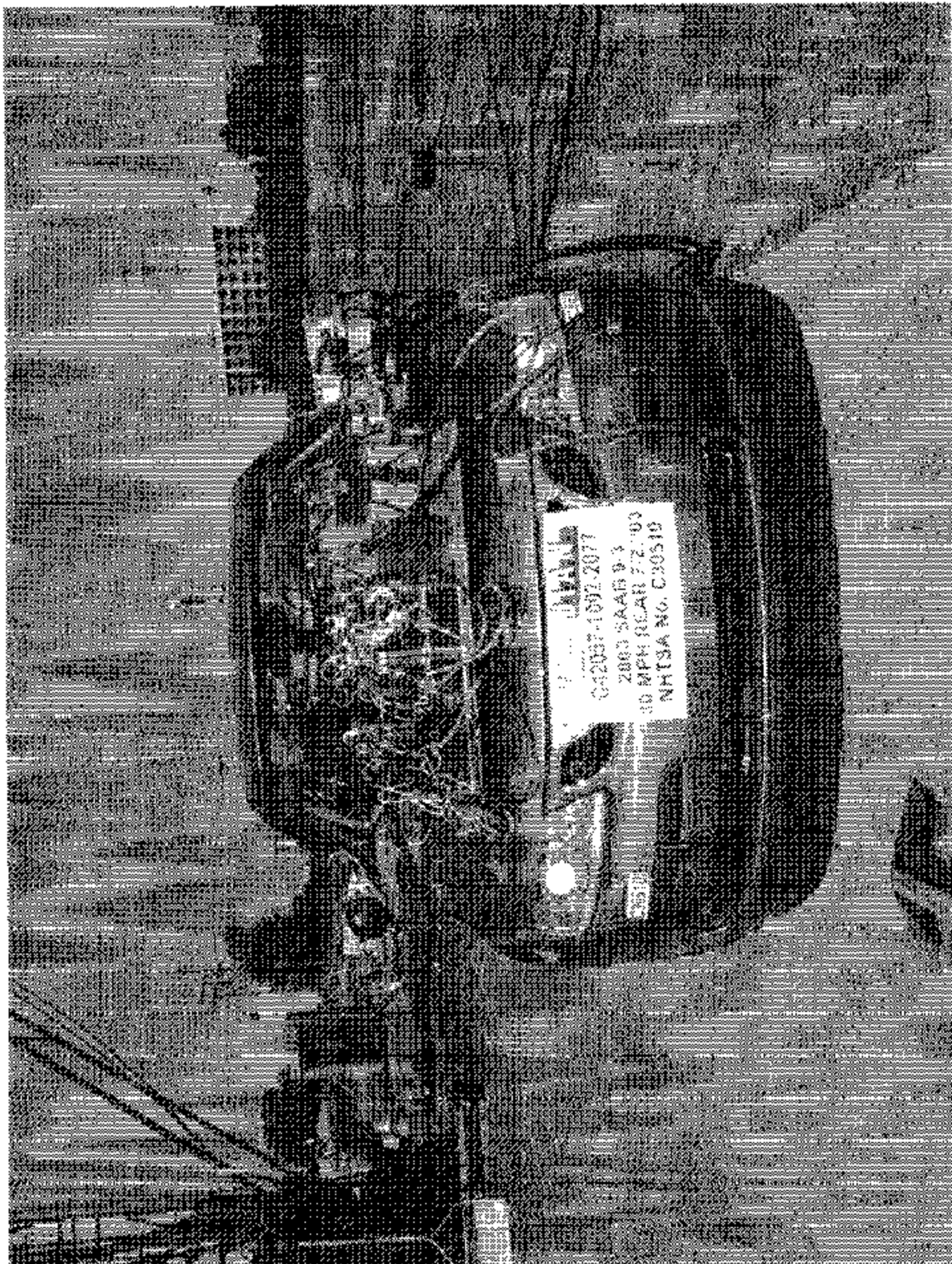


Figure A-2 POST-TEST FRONT VIEW

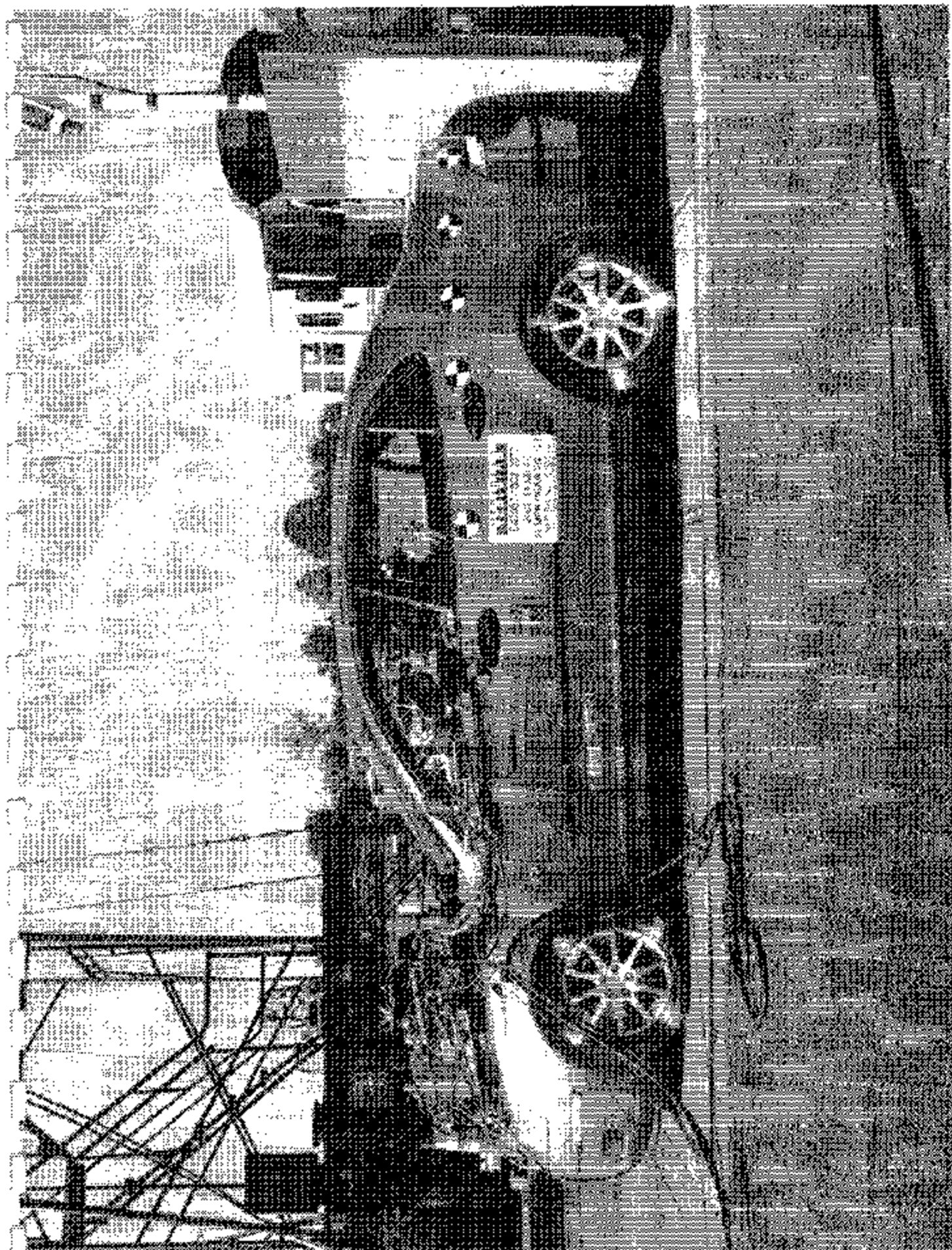


Figure A-3 PRE-TEST LEFT SIDE VIEW

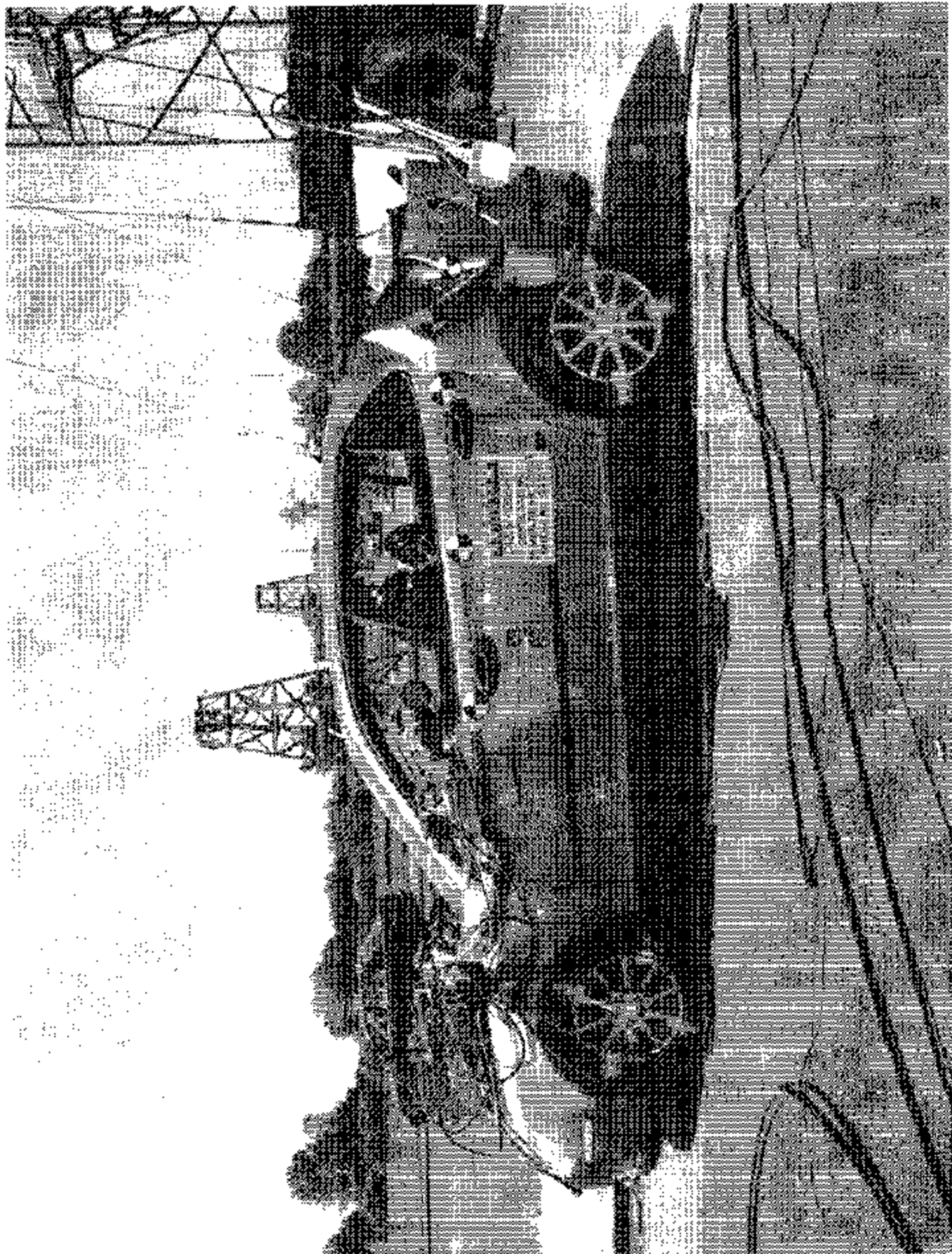


Figure A-4 POST-FEST LEFT SIDE VIEW

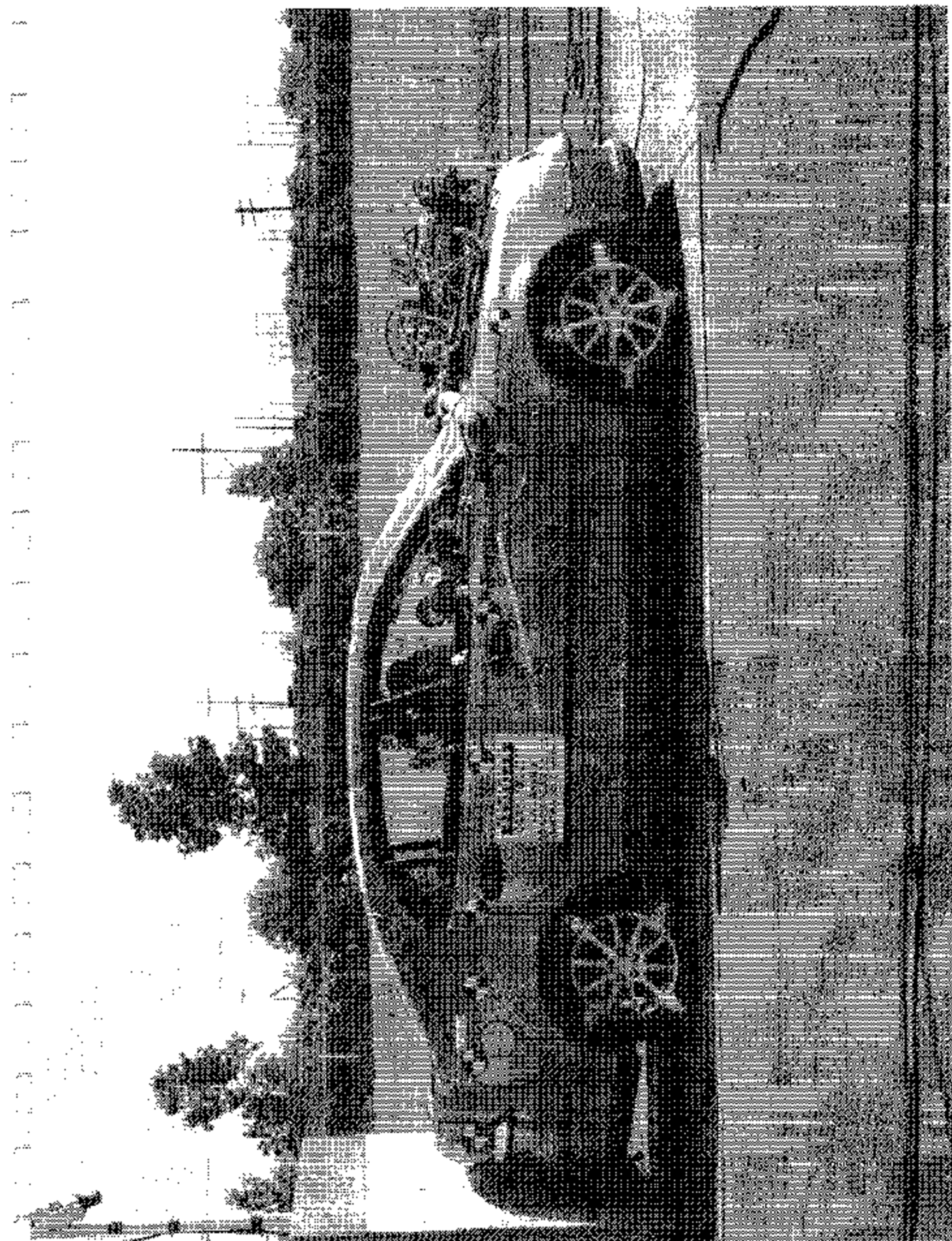


Figure A-5 PRE-TEST RIGHT SIDE VIEW

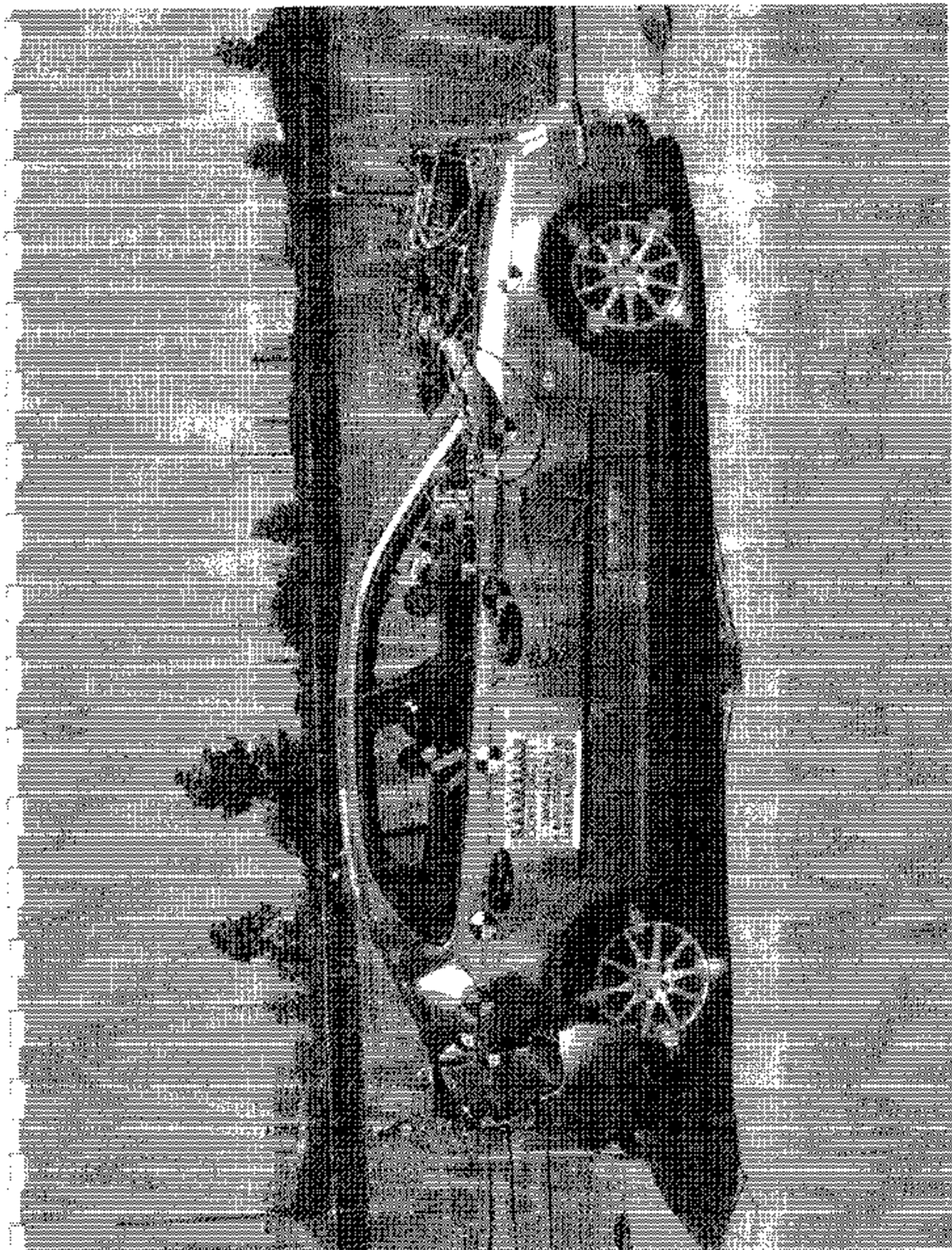


Figure A-6 POST-TEST RIGHT SIDE VIEW





Figure A-7 PRE-TEST REAR VIEW



Figure A-8 POST-TEST REAR VIEW

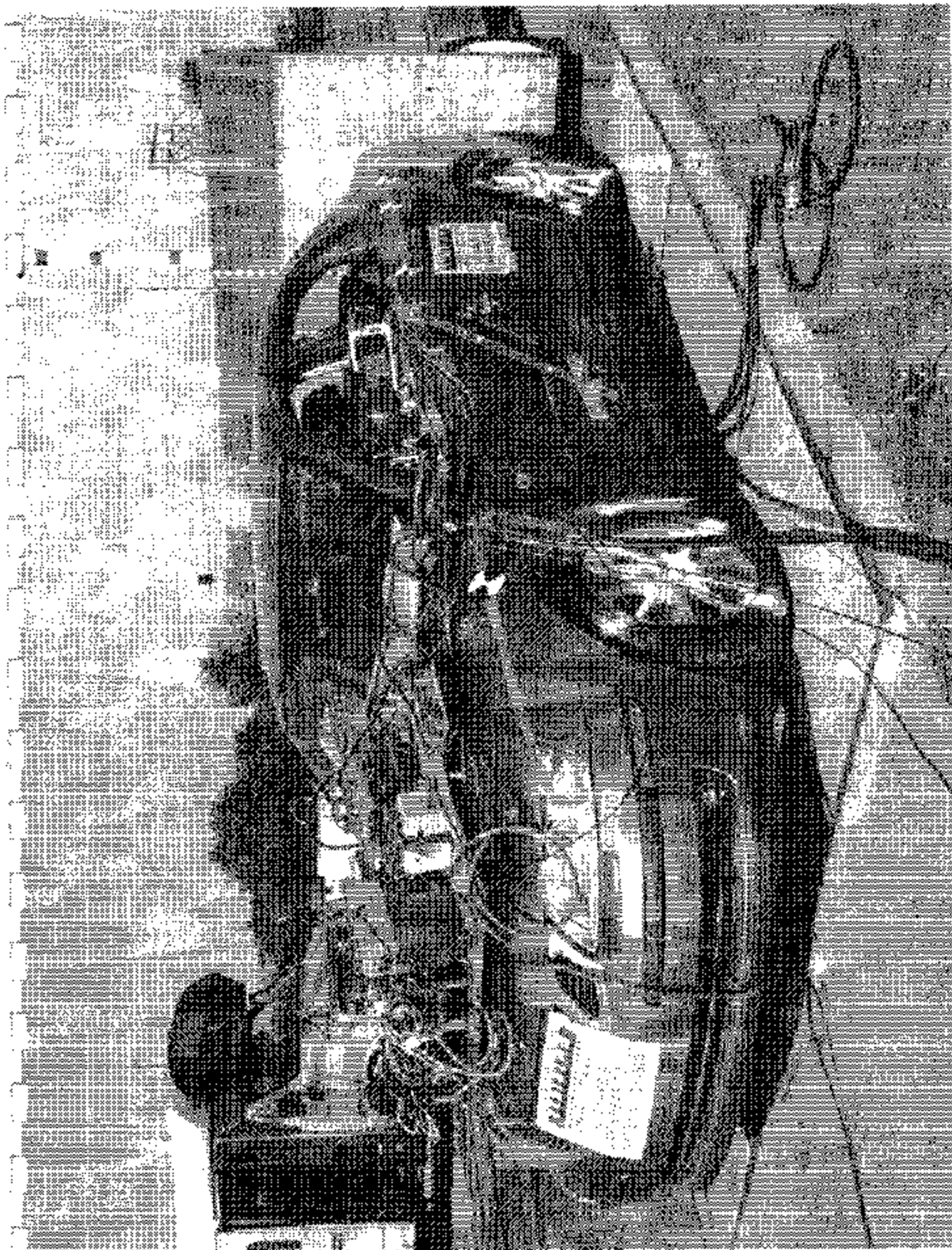


Figure A-9 PRE-TEST LEFT FRONT THREE-QUARTER VIEW

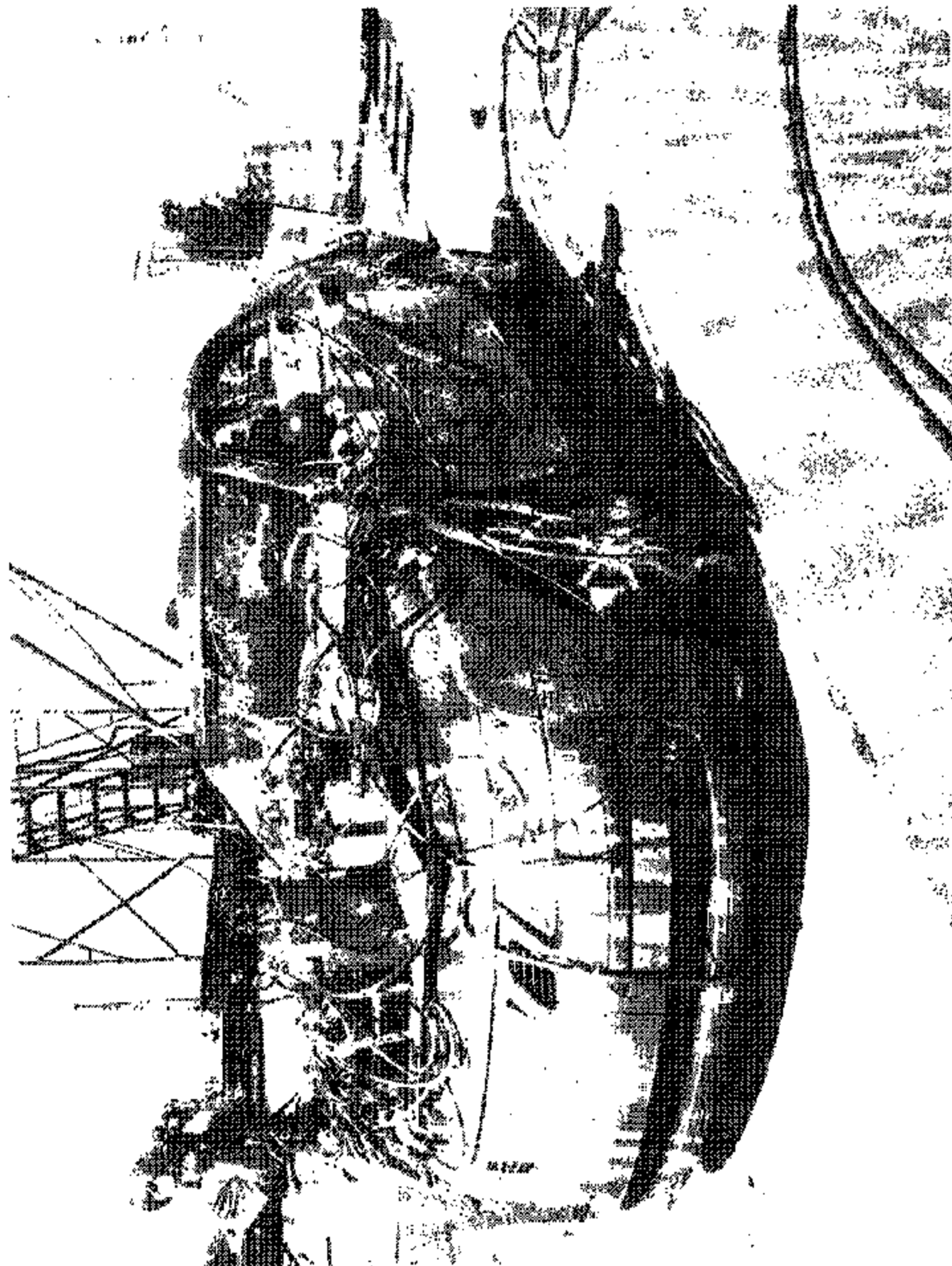


FIGURE 1. FRONT VIEW OF THE SHIP'S HULL

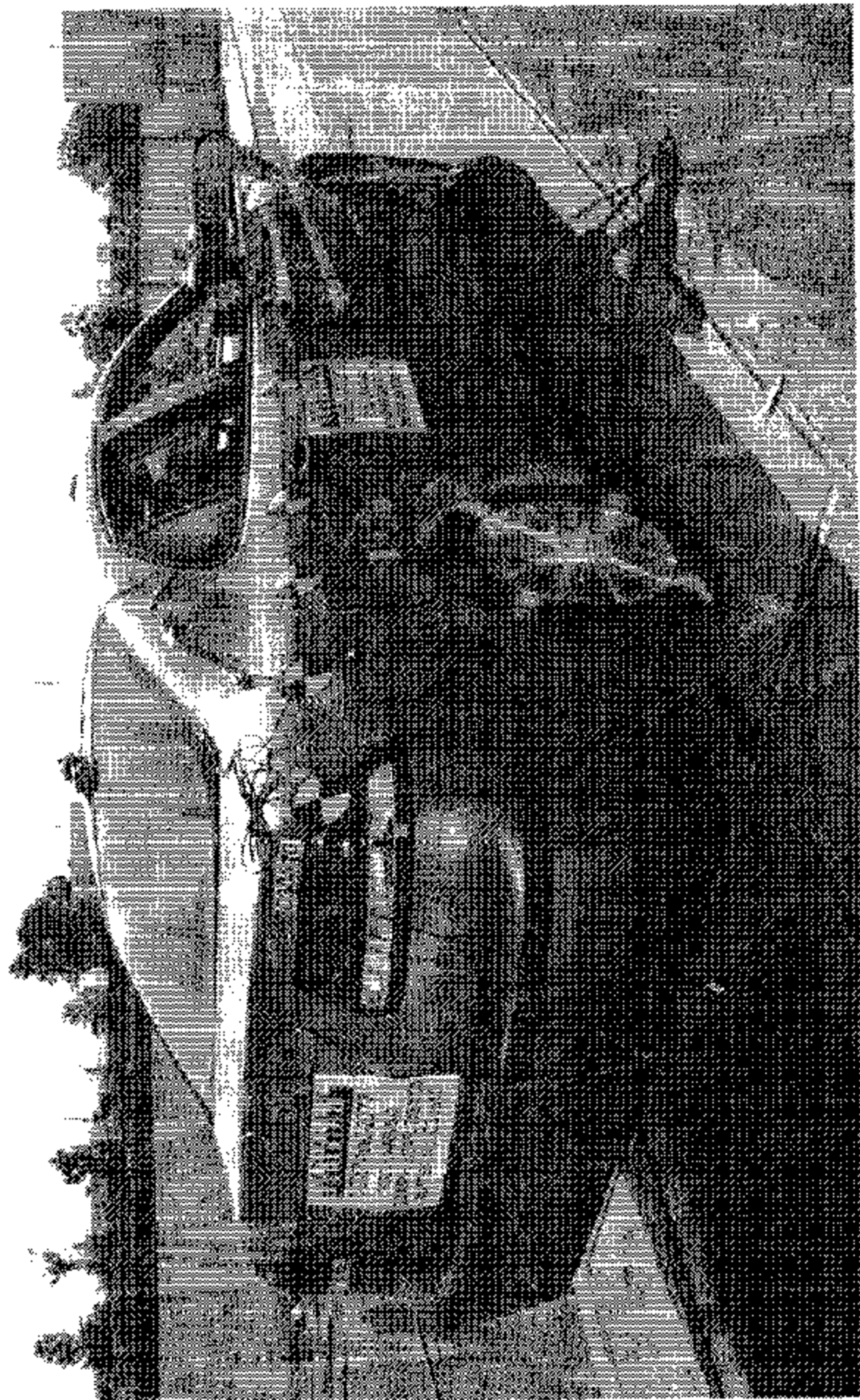


Figure A-11 PRE-TEST RIGHT REAR THREE-QUARTER VIEW



Figure A-12 POST-TEST RIGHT REAR THREE-QUARTER VIEW

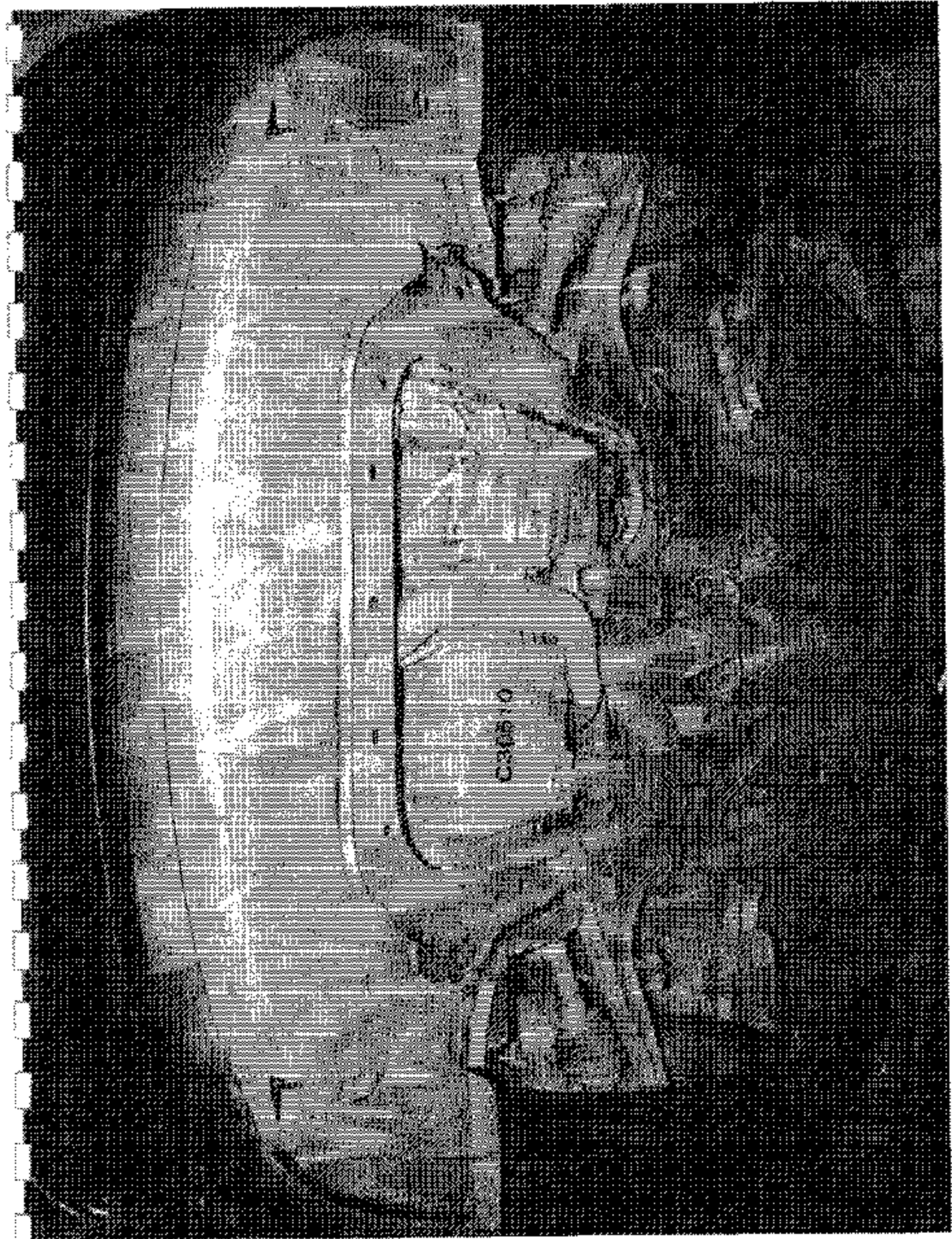


Figure A-13 PRE-TEST FRONT UNDERBODY VIEW



Figure A-14 POST-TEST FRONT UNDERBODY VIEW



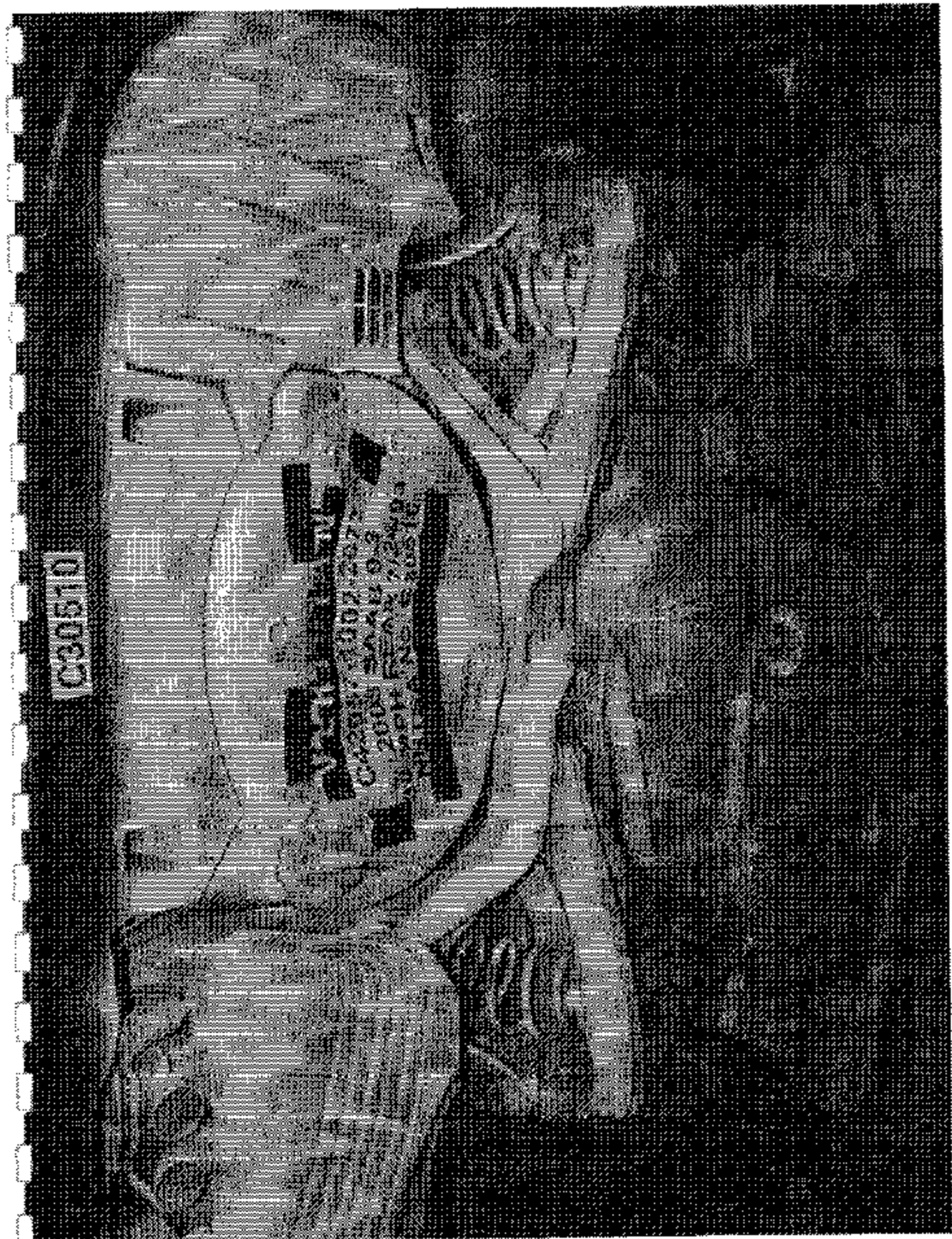


Figure A-15 PRE-TEST REAR UNDERBODY VIEW

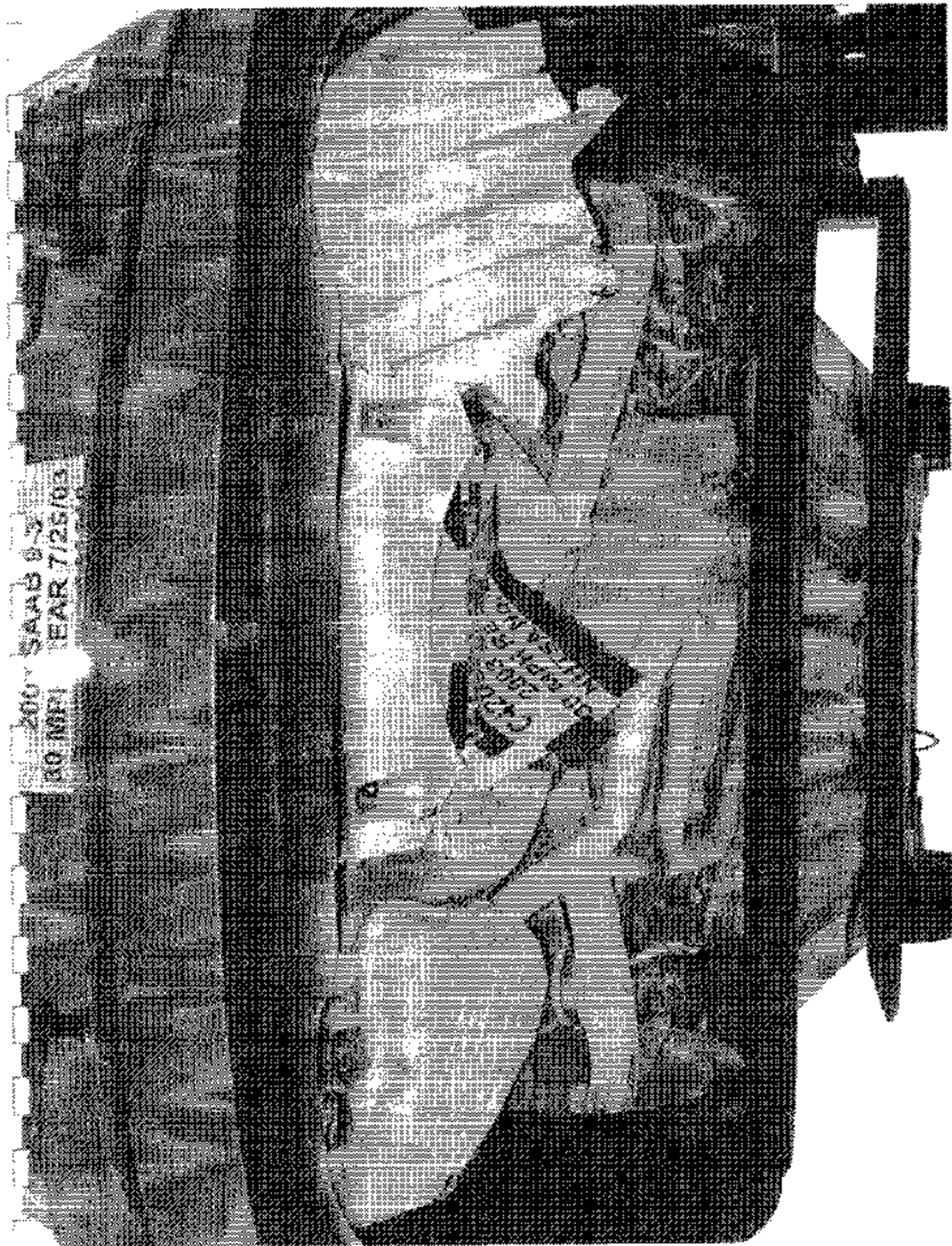


Figure A-16 POST-TEST REAR UNDERBODY VIEW



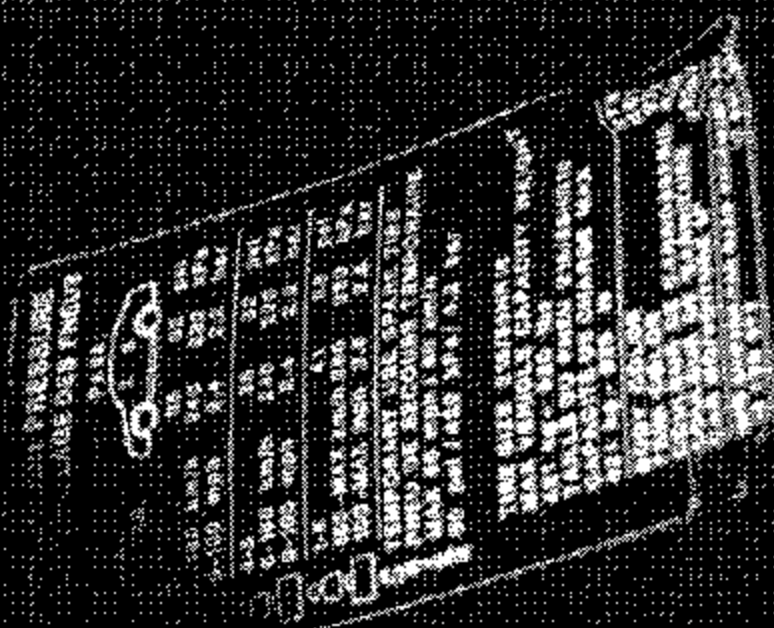


Figure A-18 TIRE PLACARD

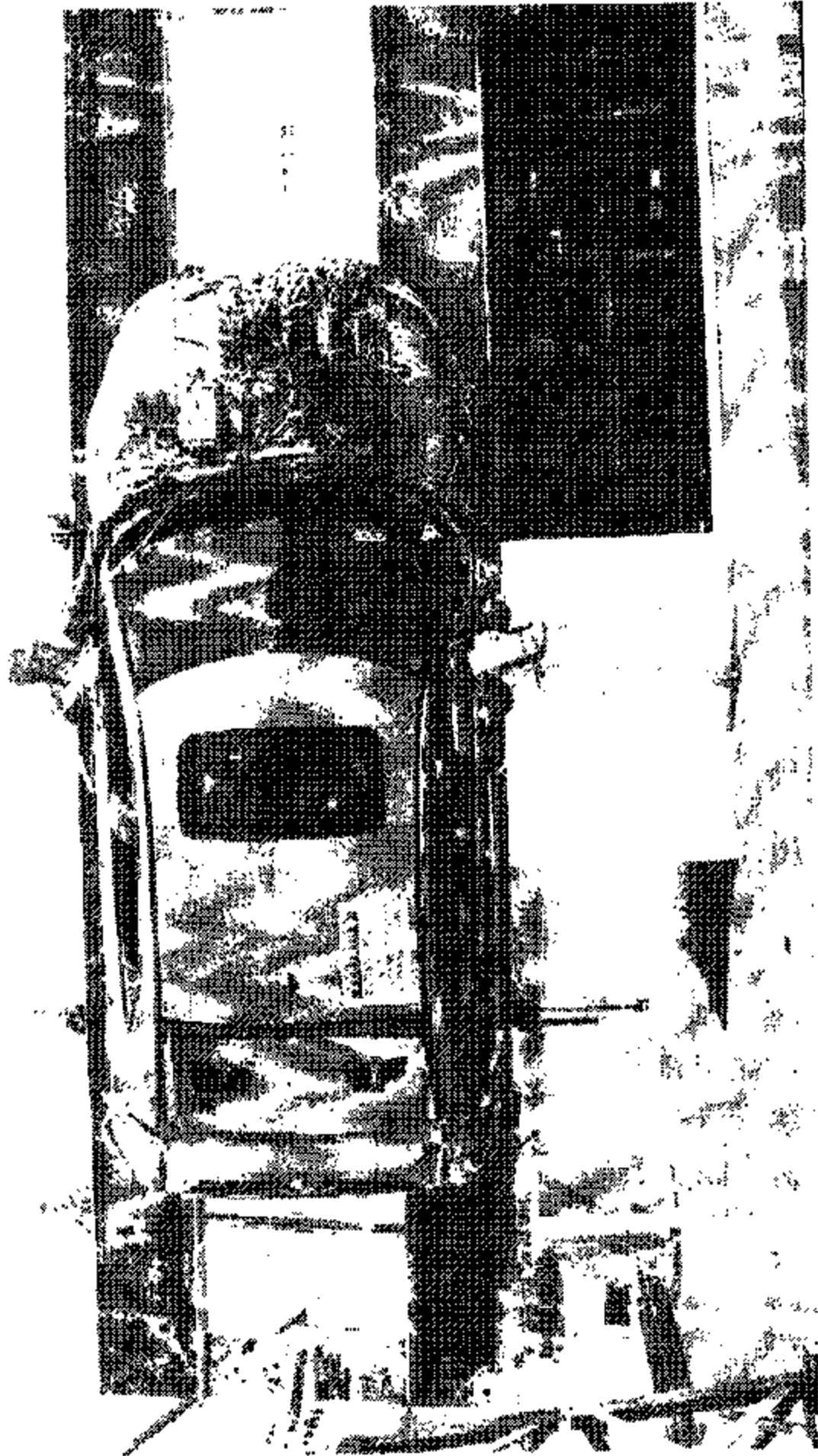


Figure A-10 (b) Front view

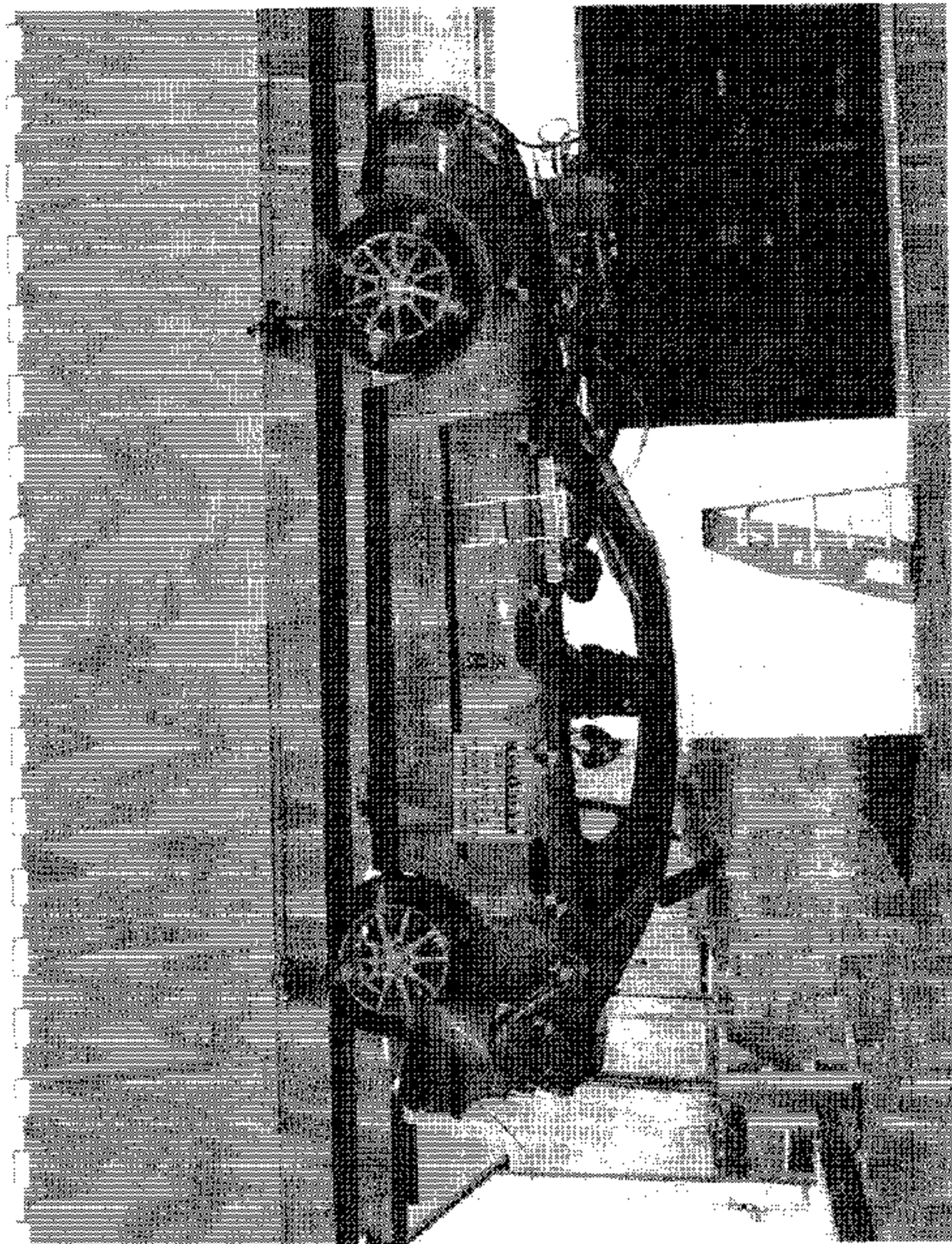


Figure A-20 ROLLOVER 180°

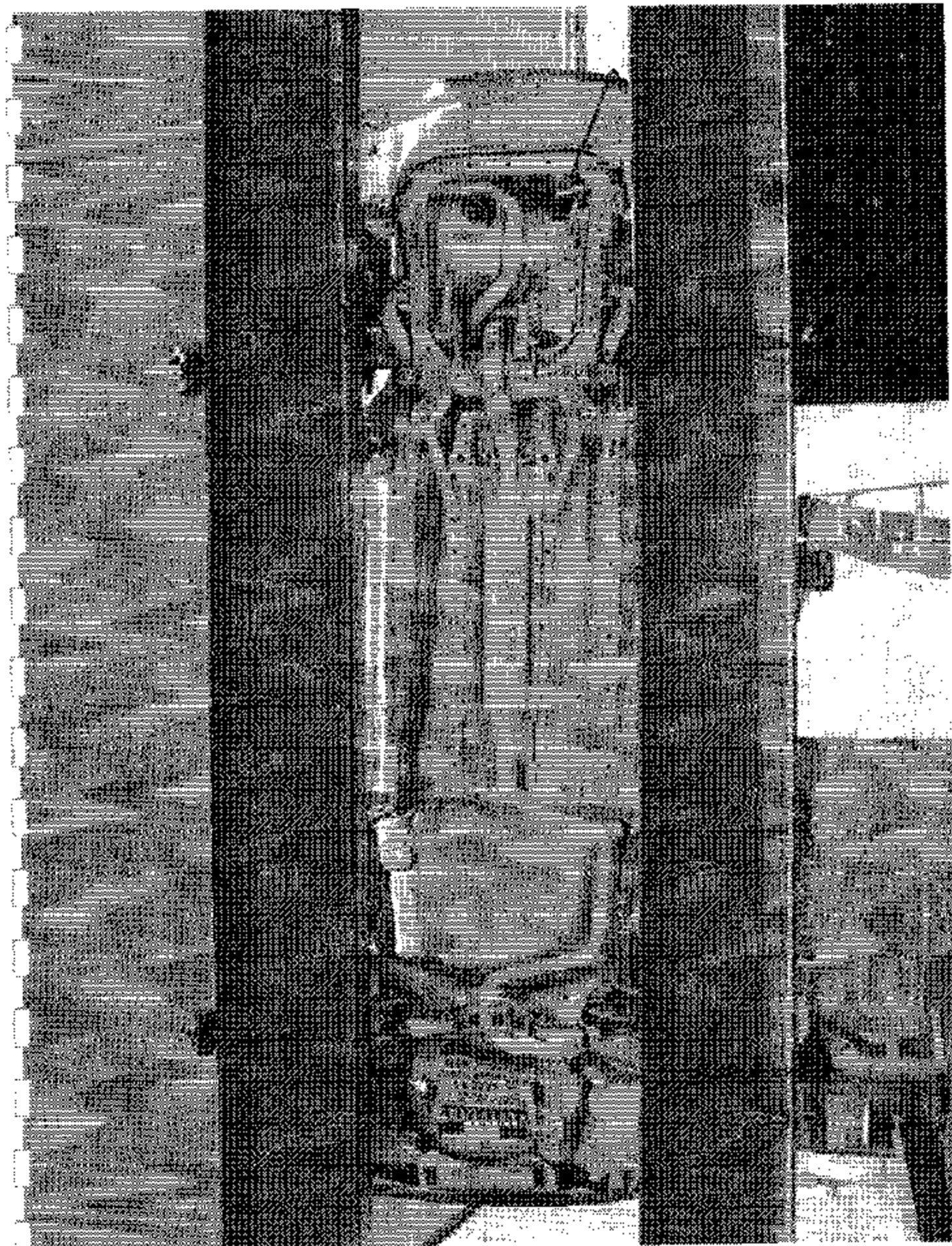


Figure A-21 ROLLOVER 270°

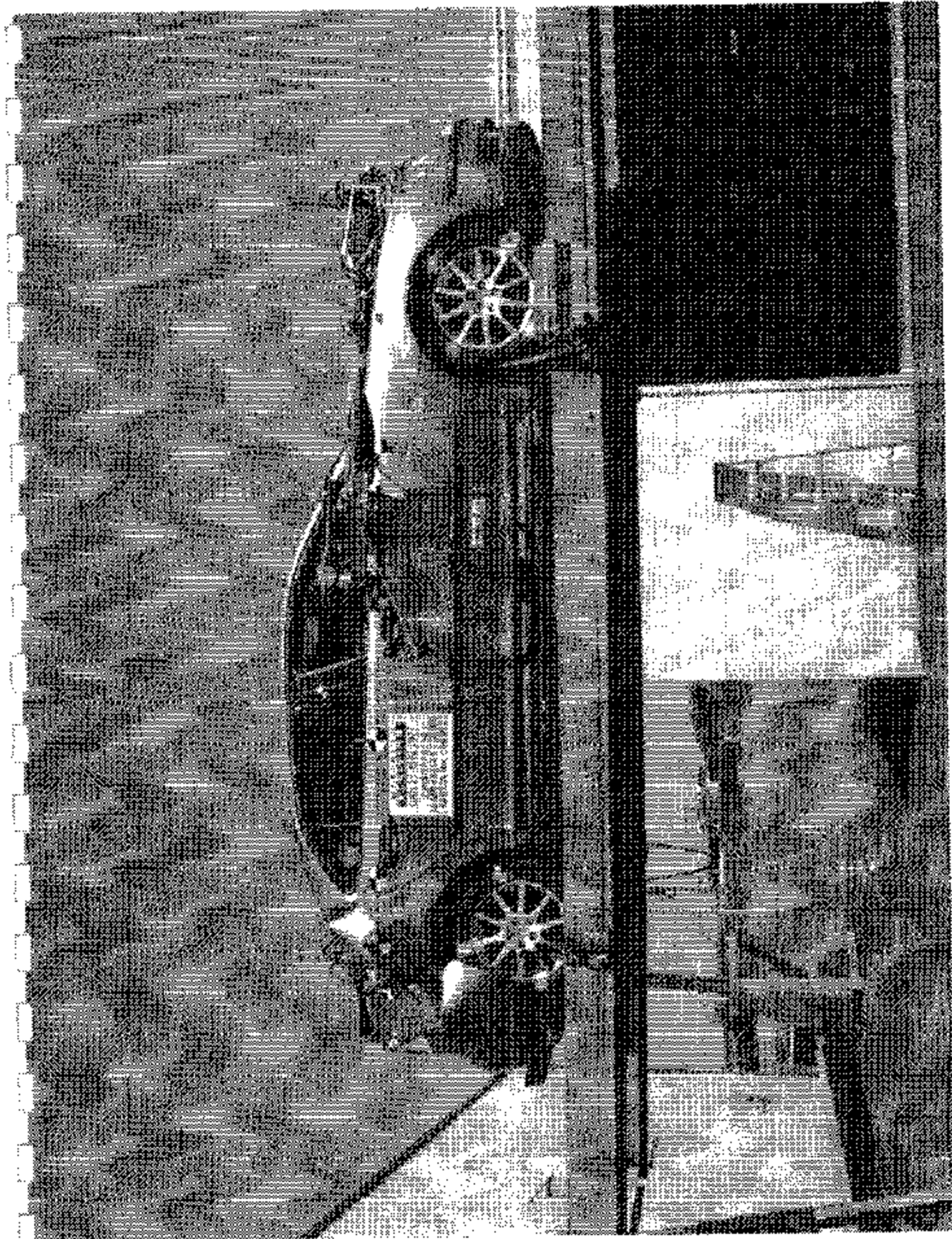


Figure A-27 ROLLOVER 360°