

REPORT NUMBER TR-P25007-02-NC

FMVSS 301-FUEL SYSTEM INTEGRITY

GM DAEWOO AUTO & TECHNOLOGY COMPANY
2005 CHEVROLET AVEO
4-DOOR SEDAN

NHTSA NUMBER: C50106

PREPARED BY:
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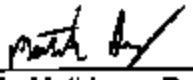
10/04/05

FINAL REPORT

PREPARED FOR:
U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
ENFORCEMENT
OFFICE OF VEHICLE SAFETY COMPLIANCE
ROOM 6115 (NVS-221)
400 SEVENTH STREET, SW
WASHINGTON, D.C. 20590

This final test report was prepared for the U.S. Department of Transportation, National Highway Traffic Safety Administration, in response to Contract Number DTNH22-01-C-31025.

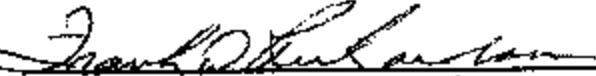
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Date: October 4, 2005

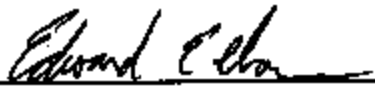
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COTR

10/27/05
Date of Acceptance

4. Title and Subtitle Final Report of FMVSS 301-Fuel System Integrity of a 2005 Chevrolet Aveo 4-Door Sedan NHTSA No. C50105		5. Report Date October 4, 2005	
		6. Performing Organization Code KAR	
7. Authors Mr. Matt Ivory, Project Engineer, Karco Mr. Frank Richardson, Program Manager, Karco		8. Performing Organization Report No. TR-P25007-02-NC	
9. Performing Organization Name and Address Karco Engineering, LLC 9270 Holly Rd. Adelanto, CA, 92301		10. Work Unit No.	
		11. Contract or Grant No. DTNH22-01-C-31025	
12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Administration Enforcement Office of Vehicle Safety Compliance (NSA-31) 400 Seventh Street, SW, Room 6115 Washington, D.C. 20590		13. Type of Report and Period Covered Final Test Report	
		14. Sponsoring Agency Code NSA-31	
15. Supplementary Notes			
16. Abstract This 30 mph rear moving barrier Impact test is a part of the Federal Motor Vehicle Safety Standard (FMVSS) 301 Compliance Test Program conducted for the National Highway Traffic Safety Administration (NHTSA) by KARCO Engineering, LLC Laboratories under Contract No. DTNH22-01-C-31025. The purpose of this test was to determine if the subject vehicle, a 2005 Chevrolet Aveo 4-Door Sedan, meets the performance requirements of FMVSS No. 301, "Fuel System Integrity." The test was conducted on August 12, 2005 in accordance with the Office of Vehicle Safety Compliance Laboratory Test Procedure TP-301-03, dated February 28, 2003. The impact velocity was 47.80 Km/h. The ambient temperature at the time of impact was 36.7 degrees Celsius. The vehicle's maximum post-test static crush was 410 mm right of the vehicle's centerline			
17. Key Words FMVSS 301 2005 Chevrolet Aveo 4-Door Sedan NHTSA No. C50105		18. Distribution of Statement Copies of this report available from: NHTSA Technical Reference Division National Highway Traffic Safety Admin. 400 Seventh St., SW, Room 5108 Washington, D.C. 20590	
19. Security Classification (this report) Unclassified	20. Security Classification (this page) Unclassified	21. No. of Pages 43	22. Price

Form DOT F1700.7 (8-72)

TR-P25007-02-NC

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SECTION 1

PURPOSE OF TEST

1. PURPOSE

The purpose of this test was to determine if the subject vehicle, a 2005 Chevrolet Aveo 4-Door Sedan, meets the performance requirements of FMVSS No. 301, "Fuel System Integrity." The test was conducted in accordance with the Office of Vehicle Safety Compliance Laboratory Test Procedure TP-301-03, dated February 28, 2003.

SECTION 2

SUMMARY OF TEST

2. SUMMARY

A 1313 kg 2005 Chevrolet Aveo 4-Door Sedan was impacted from the rear by a 1789 kg moving barrier at a velocity of 47.80 Km/h (29.71 mph). The test was performed by KARCO Engineering, LLC on August 12, 2006.

The vehicle was prepared and tested following the Office of Vehicle Safety Compliance Test Procedure for Federal Motor Vehicle Safety Standard (FMVSS) 301R (OVSC TP-301-03, dated February 28., 2003).

The crash event was recorded by ten (10) high speed and three (3) real time cameras. Camera locations and other pertinent camera information are found in the data sheets. Appendix A contains Pre- and Post-Test Photographs.

There was no fuel system fluid spillage following the impact event or during any portion of the static rollover test. The maximum longitudinal crush was 410 millimeters. The vehicle appeared to comply with all the requirements of FMVSS No. 301 "Fuel System Integrity."

DATA SHEET NO. 1
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2005 Chevrolet Aveo 4-Door Sedan
 Test Program: FMVSS 301-Fuel System Integrity

NHTSA No.: C50105
 Test Date: 8/12/05

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA No.	C50105
Make	Chevrolet
Model	Aveo
Body Style	4-Door Sedan
Vin No.	KL1TD52605B419159
Color	White
Delivery Date	4/27/05
Odometer	54
Dealer	Crest Chevrolet
Transmission	5 Speed Manual
Final Drive	Front
Type/No. Cyl.	4
Engine Disp. (L)	1.6
Engine Placement	Transverse
Roof Rack	No
Sunroof/T-Top	No
Tinted Glass	No
Traction Control	No
Power Brakes	Yes
Front Disc	Yes
Rear Disc	Yes

Anti-Lock Brakes	No
All Wheel Drive	No
Power Steering	Yes
Driver Front Airbag	Yes
Driver Side Airbag	No
Driver Head Airbag	No
Driver Curtain Airbag	No
Pass. Airbag	Yes
Pass. Side Airbag	No
Pass. Head Airbag	No
Pass. Curtain Airbag	No
Pre-Tensioners	
Load Limiters	
Bucket Seats	Yes
Air. Cond.	No
AM/FM Cassette	Yes
Tilt Steering	Yes
Automatic Door Locks	No
Power Windows	No
Power Seats	No
Other	

DATA FROM CERTIFICATION LABEL

Manufactured By	GM DAEWOO AUTO & TECHNOLOGY CO.
Date of Manufacture	Feb-05

GVWR (kg)	1519
GAWR Front (kg)	830
GAWR Rear (kg)	802

VEHICLE SEATING AND CAPACITY WEIGHT INFORMATION

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Bench	None	
Number of Occupants	2	3	0	5
Capacity Weight (VCW) (kg)				389
Cargo Weight (RCLW) (kg)				49

DATA SHEET NO. 1...(CONTINUED)
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2005 Chevrolet Aveo 4-Door Sedan
 Test Program: FMVSS 301-Fuel System Integrity

NHTSA No.: C50105
 Test Date: 8/12/05

TEST VEHICLE WEIGHTS

	Units	As Delivered Weights (UVW)			As Tested Weights (ATW)		
		Front Axle	Rear Axle	Total	Front Axle	Rear Axle	Total
Left	kg	344	218		369	289	
Right	kg	337	219		374	280	
Ratio	%	60.9%	39.1%		56.6%	43.4%	
Totals	kg	680	436	1117	743	570	1313

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value
Total Delivered Weight (UVW)	kg	1117
Weight of 2 P572 ATD's	kg	152
Rated Cargo/Luggage Wt. (RCLW)	kg	49
Calculated Vehicle Target Wt. (TVTW)	kg	1318

TEST VEHICLE ATTITUDE AND CG

	Units	LF	RF	LR	RR	CG (aft of front axle)
As Delivered	mm	659	669	639	645	991
As Tested	mm	630	635	594	595	1100

Vehicle Wheel Base (mm) 2535

Weight of Ballast Secured in cargo area (kg) 0.0

Vehicle Components Removed Cooling fan, air cleaner, rear side windows, rear window motors.

* Ballast weight does not include cameras, instrumentation and brake abort system.

FUEL SYSTEM DATA

Fuel System Capacity From Owners Manual (L) 44.86

Usable Capacity Furnished by COTR (L) 41.94

Actual Test Volume with entire fuel System Filled (L) 41.94

1/3 of Usable Capacity (L) N/A

Test Fluid Type: Standard Solvent

Kinematic Viscosity: as per ASTM Standard D464-71 Purple

Is Vehicle Fuel Pump Electric or Mechanical? Electric

If electric, does pump operate with ignition switch "On" & engine "OFF" Yes

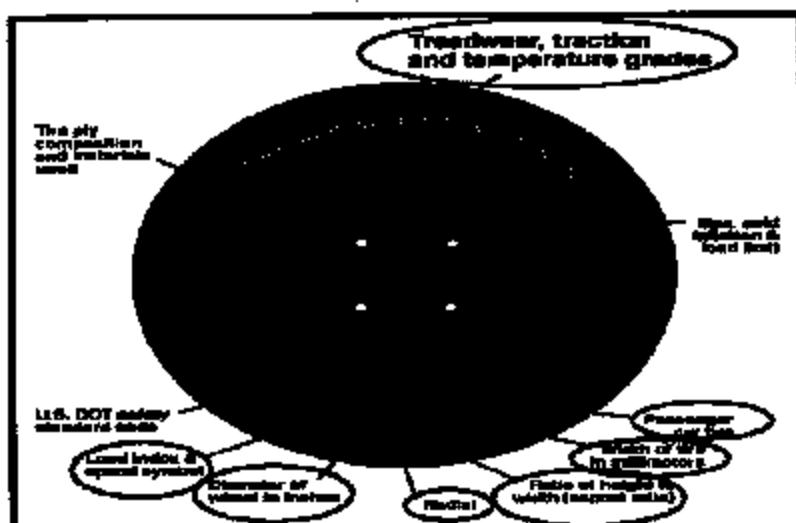
Fuel System Particulars: The fuel filler door is located on the right rear fender.
The standard fuel tank occupies the area under the rear seat.

DATA SHEET NO. 1...(CONTINUED)
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2005 Chevrolet Aveo 4-Door Sedan
 Test Program: FMVSS 301-Fuel System Integrity

NHTSA No.: C50105
 Test Date: 8/12/05

Collect year, make, model, VIN, items circled in red, and tire manufacturer and tire name.



TIRE INFORMATION

Measured Parameter	Front	Rear
Max. Tire Pressure (kpa)	310	310
Cold Pressure (kpa)	210	210
Recommended Tire Size	P185/60R14	P185/60R14
Tire Size on Vehicle	P185/60R14	P185/60R14
Tire Manufacturer	Kumho	Kumho
Treadwear	380	380
Traction	A	A
Temperature Grades	A	A
Tire Piles Sidewall	1 Polyester	1 Polyester
Tire Piles Body	2 Steel, 1 Polyester	2 Steel, 1 Polyester
Load Index/Speed Symbol	82H	82H
Tire Material	Steel, Polyester	Steel, Polyester
DOT Safety Code Right	Y0R8 YPIA 0705	Y0R8 YPIA 0705
DOT Safety Code Left	Y0R8 YPIA 0705	Y0R8 YPIA 0705

**DATA SHEET NO. 2
MOVING BARRIER DATA**

Test Vehicle: 2005 Chevrolet Aveo 4-Door Sedan
Test Program: FMVSS 301-Fuel System Integrity

NHTSA No.: C50105
Test Date: 8/12/05

BARRIER SPECIFICATIONS

Measurement Description	mm
Barrier Face Height	1525
Barrier Face Width	1980
Barrier Face Ground Clearance	115
Tread Width	200
Wheelbase	3045
Tread Width	1530

LOCATION OF BARRIER CG

Measurement Description	mm
X-distance rearward of front wheel center	1372
Y-distance from longitudinal-vertical plane of symmetry	1523

BARRIER WEIGHTS

	Units	Front Axle	Rear Axle	Total
Left	kg	494	405	
Right	kg	494	408	
Ratio	%	54.9%	45.1%	
Totals	kg	988	811	1799

BARRIER TIRES

Manufacturer	Maximum II
Model	Remington
Size	205-75-R15
Pressure (kPa)	241

BARRIER IMPACT VELOCITY

Measured Parameter	Units	Requirement	Value
Trap No. 1 Velocity (Primary)	km/h	46.51 to 48.12	47.80
Trap No. 2 Velocity (Redundant)	km/h	46.51 to 48.12	47.77

DATA SHEET NO. 3
FUEL SYSTEM INTEGRITY POST- IMPACT DATA

Test Vehicle: 2005 Chevrolet Aveo 4-Door Sedan

NHTSA No.: C50105

Test Program: FMVSS 301-Fuel System Integrity

Test Date: 8/12/05

Test Time: 1:42 PM

Temperature: 36.7 Deg. C.

STODDARD SOLVENT SPILLAGE MEASUREMENTS

A. From Impact until vehicle motion ceases: 0.0 oz.
(Maximum Allowable = 1 ounce)

B. For the 5 minute period after motion ceases: 0.0 oz.
(Maximum Allowable = 5 ounces)

C. For the following 25 minutes: 0.0 oz.
(Maximum Allowable = 1 oz./minute)

D. Spillage Location Details: No leakage occurred

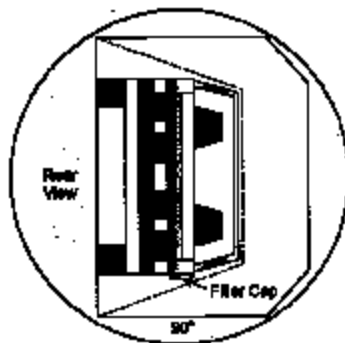
DATA SHEET NO. 4
STATIC ROLLOVER DATA

Test Vehicle: 2005 Chevrolet Aveo 4-Door Sedan
Test Program: FMVSS 301-Fuel System Integrity

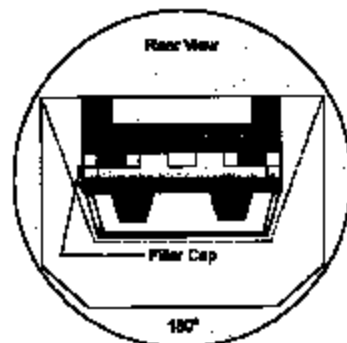
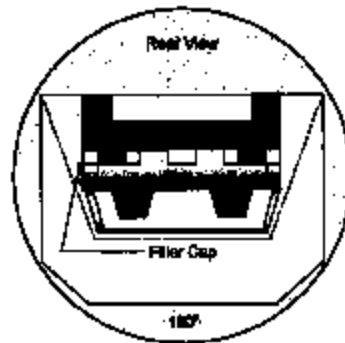
NHTSA No.: C50105
Test Date: 8/12/05



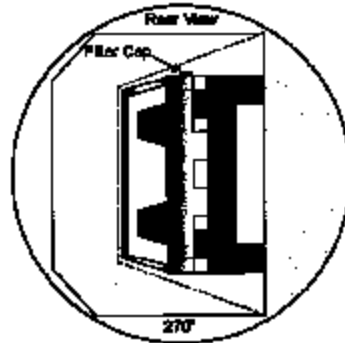
0° to 90°



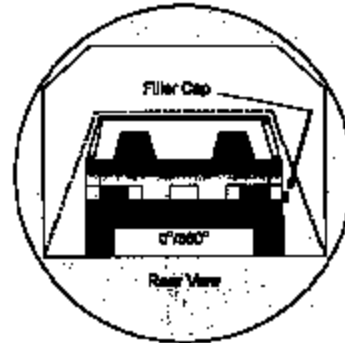
90° to 180°



180° to 270°



270° to 360°



1. The specified fixture rollover rate for each 90° of rotation is 80 to 120 seconds.
2. The position hold time at each position is 300 seconds (minimum).
3. No solvent leakage occurred during rollover.

DATA SHEET NO. 4...(CONTINUED)
STATIC ROLLOVER DATA

Test Vehicle: 2005 Chevrolet Aveo 4-Door Sedan
 Test Program: FMVSS 301-Fuel System Integrity

NHTSA No.: C50105
 Test Date: 8/12/05

SOLVENT COLLECTION TIME TABLE IN SECONDS

Test Phase	Rotation Time	Hold Time	Total Time
0° to 90°	87	300	387
90° to 180°	100	300	400
180° to 270°	79	300	379
270° to 360°	78	300	378

FMVSS 301 SPILLAGE TABLE REQUIREMENT (oz.)

First 5 Minutes	5.0
Sixth Minute	1.0
Seventh Minute	1.0
Eighth Minute	1.0

ACTUAL TEST VEHICLE SOLVENT SPILLAGE TABLE (oz.)

Test Phase	First 5 Minutes	Sixth Minute	Seventh Minute	Eighth Minute
0° to 90°	0	0	0	0
90° to 180°	0	0	0	0
180° to 270°	0	0	0	0
270° to 360°	0	0	0	0

SOLVENT SPILLAGE LOCATION TABLE

Test Phase	Spillage Location
0° to 90°	None
90° to 180°	None
180° to 270°	None
270° to 360°	None

**DATA SHEET NO. 5
CAMERA LOCATIONS**

Test Vehicle: 2005 Chevrolet Aveo 4-Door Sedan
Test Program: FMVSS 301-Fuel System Integrity

NHTSA No.: C50105
Test Date: 8/12/05

VEHICLE CAMERA MEASUREMENT TABLE

No.	Camera View	Location (mm)			Angle (deg.)	Lens (mm)	Speed (fps)
		X	Y	Z			
1	Real Time, Documentary	2078	1500	-1878	-7.0	Zoom	30
2	Left Side	572	-12185	-1700	0.0	35mm	1000
3	Right Side	2286	-11858	-1700	0.0	35mm	1000
4	Overhead	1220	2860	-5486	-90.0	20mm	1000
5	Moving Barrier	0	0	-2340	84.0	7mm	830
6	Rear Underside	632	0	1843	90.0	13mm	1000
7	Mid Underside	1865	0	1858	90.0	12mm	1000
8	Front Underside	3043	0	1821	90.0	12mm	1000
9	Underside Close-Up	770	288	1863	84.0	25mm	1000
10	Driver Side On-Board	-1648	83	-1158	-2.0	14mm	1000
11	Passenger On-Board	-1642	-86	-1162	-2.0	8mm	1000
12	Real Time Left Side	622	-12350	-1520	-2.0	Zoom	30
13	Real Time Right Side	2462	11230	-1500	-2.0	Zoom	30

X = Monorail Centerline Y = Impact Location Z = Ground DNR = Did Not Run NTM = No Timing Marks

DATA SHEET NO. 8
ACCIDENT INVESTIGATION DIVISION DATA

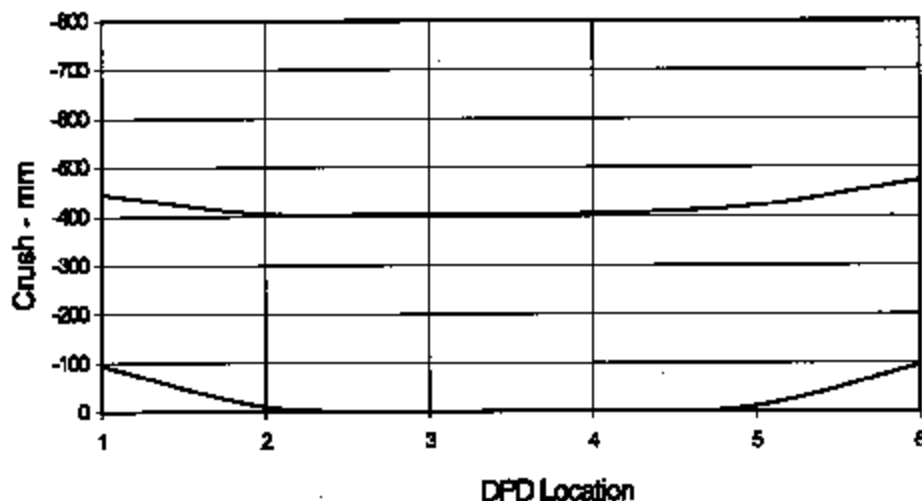
Test Vehicle: 2005 Chevrolet Aveo 4-Door Sedan
 Test Program: FMVSS 301-Fuel System Integrity

NHTSA No.: C50105
 Test Date: 8/12/05

CRUSH PROFILE

Damage Region Length (mm): 1271 Midpoint of Damage: Centerline
 Impact Mode: Rear Impact (0 Deg.)

No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
C1	Crush zone 1 at left side	mm	-94	-445	351
C2	Crush zone 2 on left side	mm	-11	-405	394
C3	Crush zone 3 on left side	mm	0	-405	405
C4	Crush zone 4 on right side	mm	0	-405	405
C5	Crush zone 5 on right side	mm	-11	-421	410
C6	Crush zone 6 at right side	mm	-94	-472	378



APPENDIX A
PHOTOGRAPHS

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A-1

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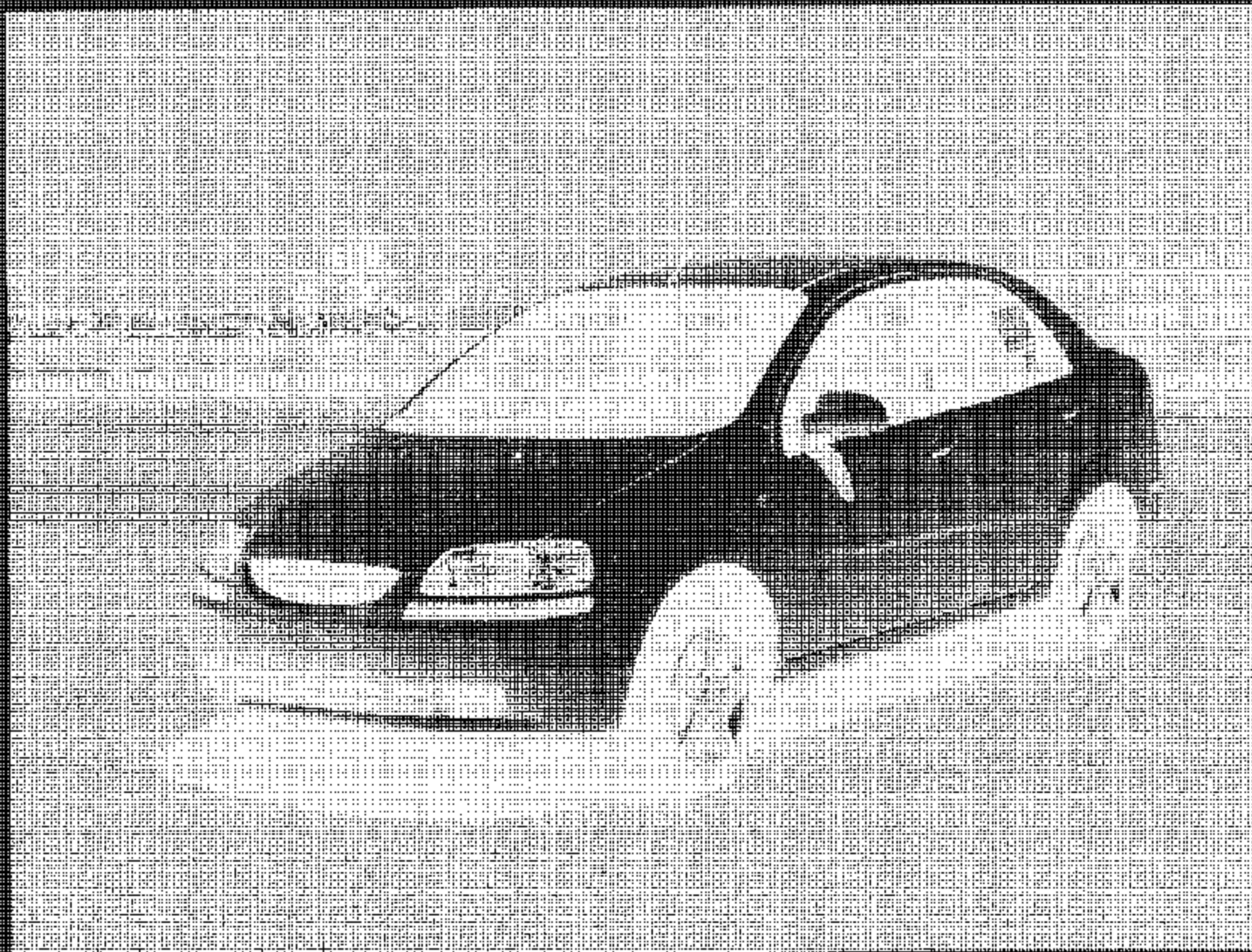


Figure A-1. Left Front ¾ View, As Received



Figure A-2. Right Rear $\frac{1}{4}$ View, as Received

A-3

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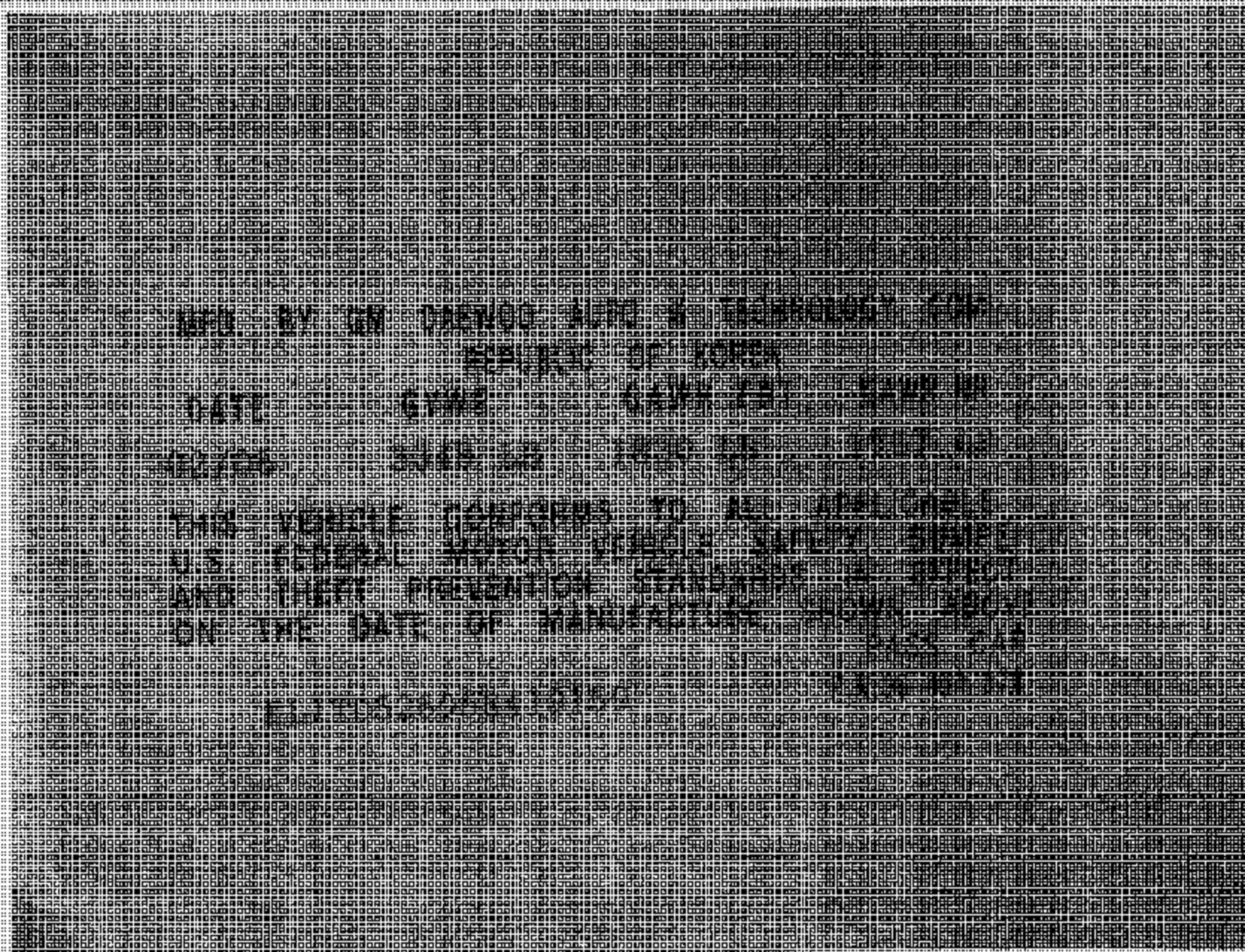


Figure A-3: Vehicle Certification Label

A-1

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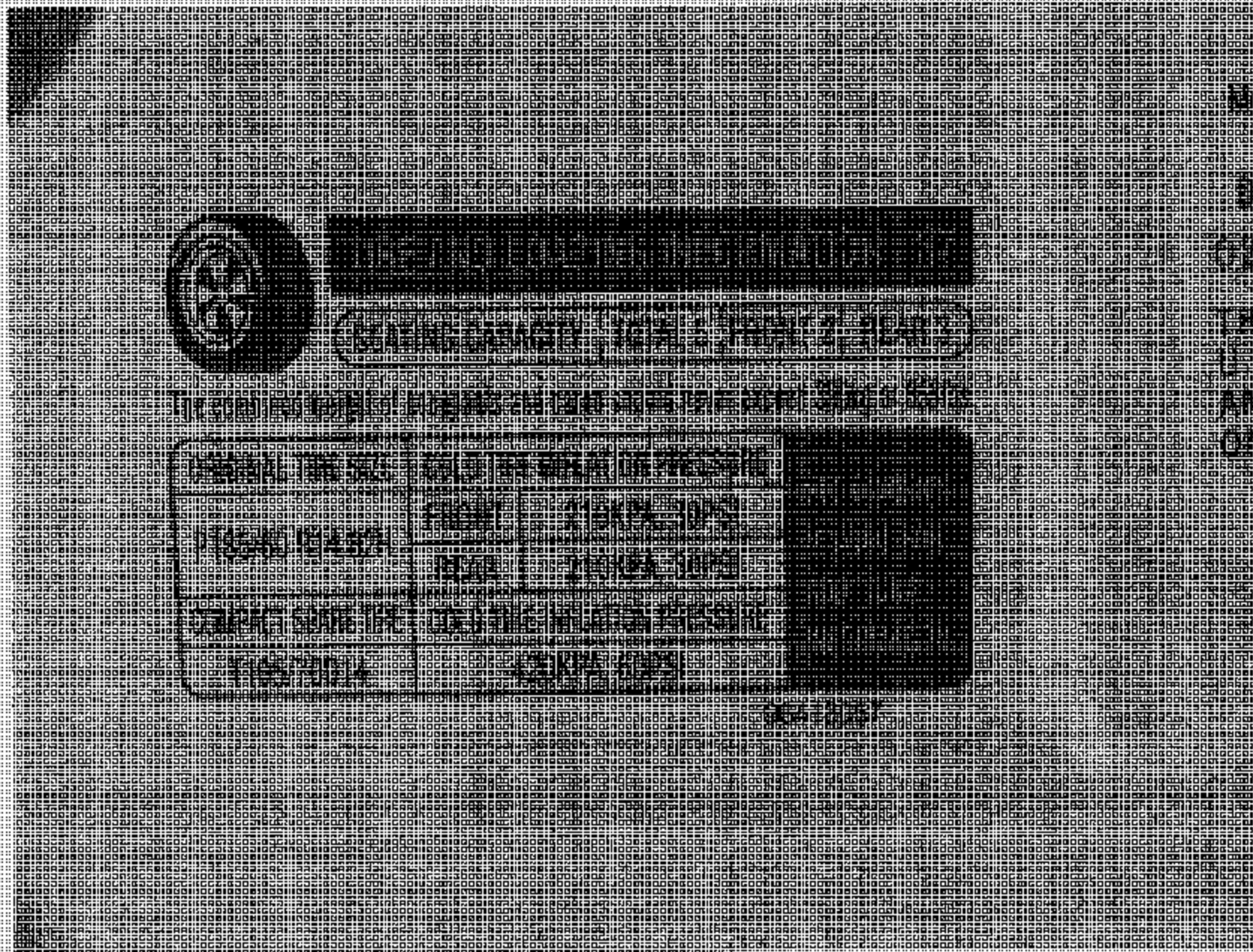


Figure A-4. Vehicle Tire Label



Figure A-5. Pre-Test Front View



Figure A-5: Post-Test Front View

A-7

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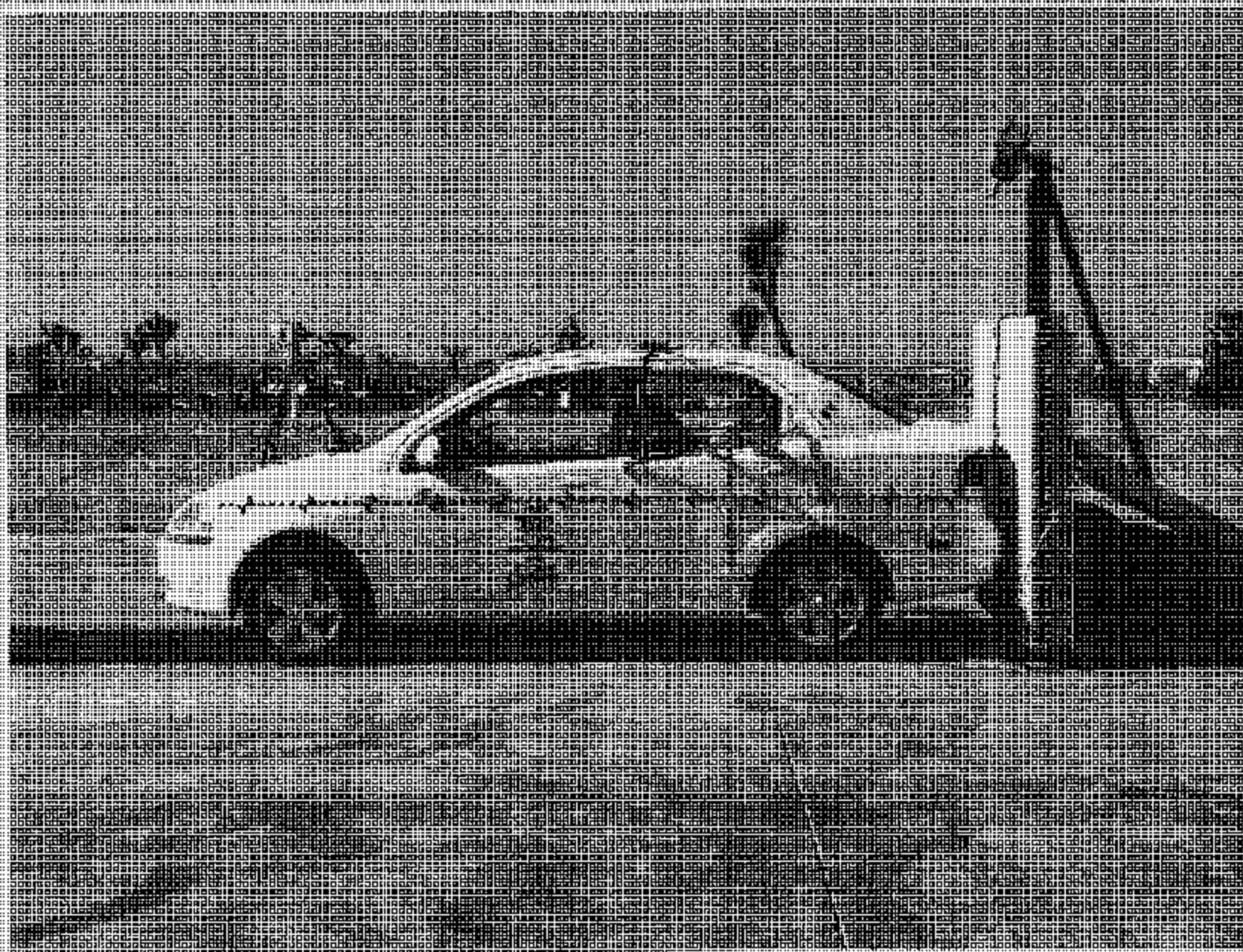


Figure A-7. Pre-Test Left Side View

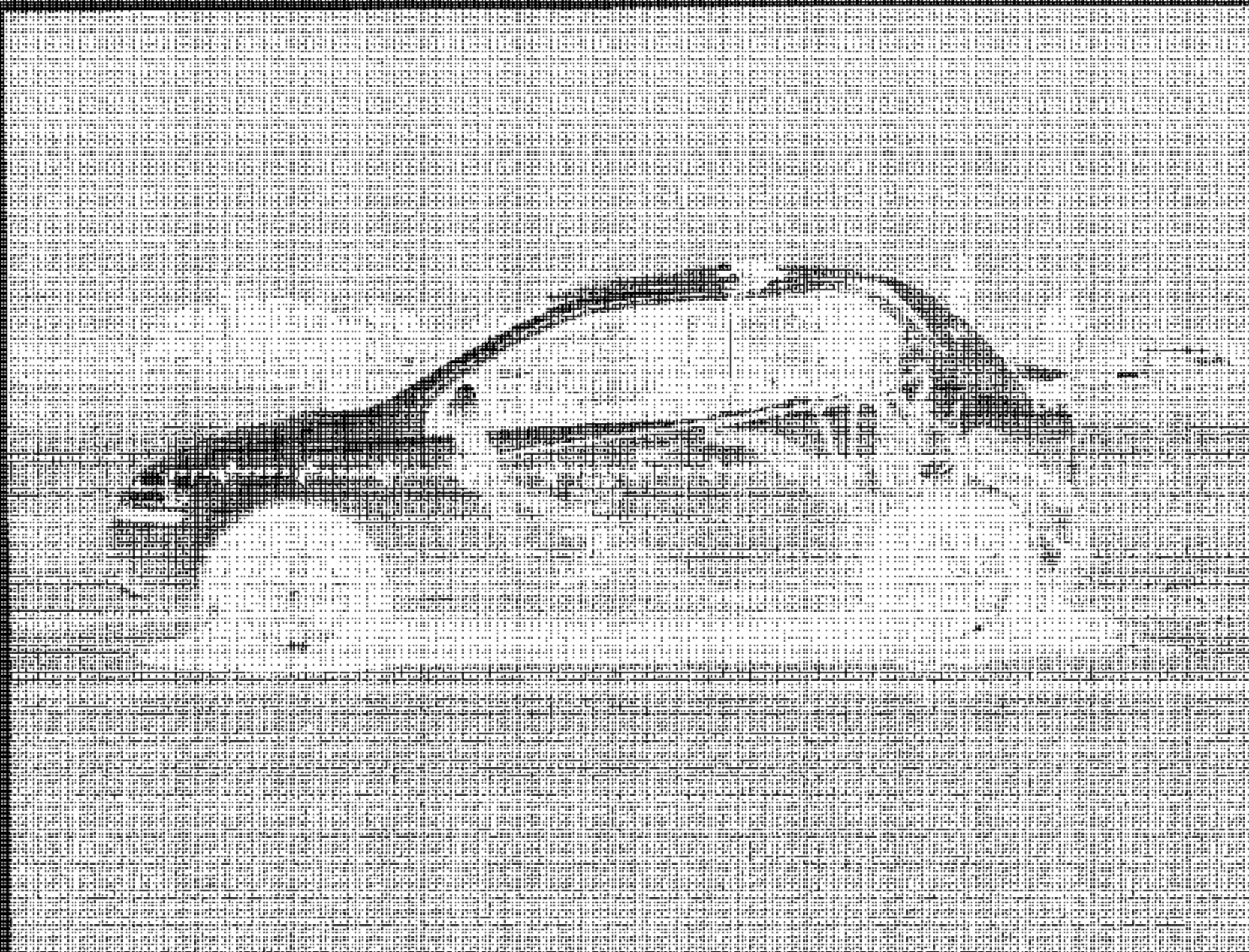


Figure A-8: Post-Test Left Side View

A-8

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A-9

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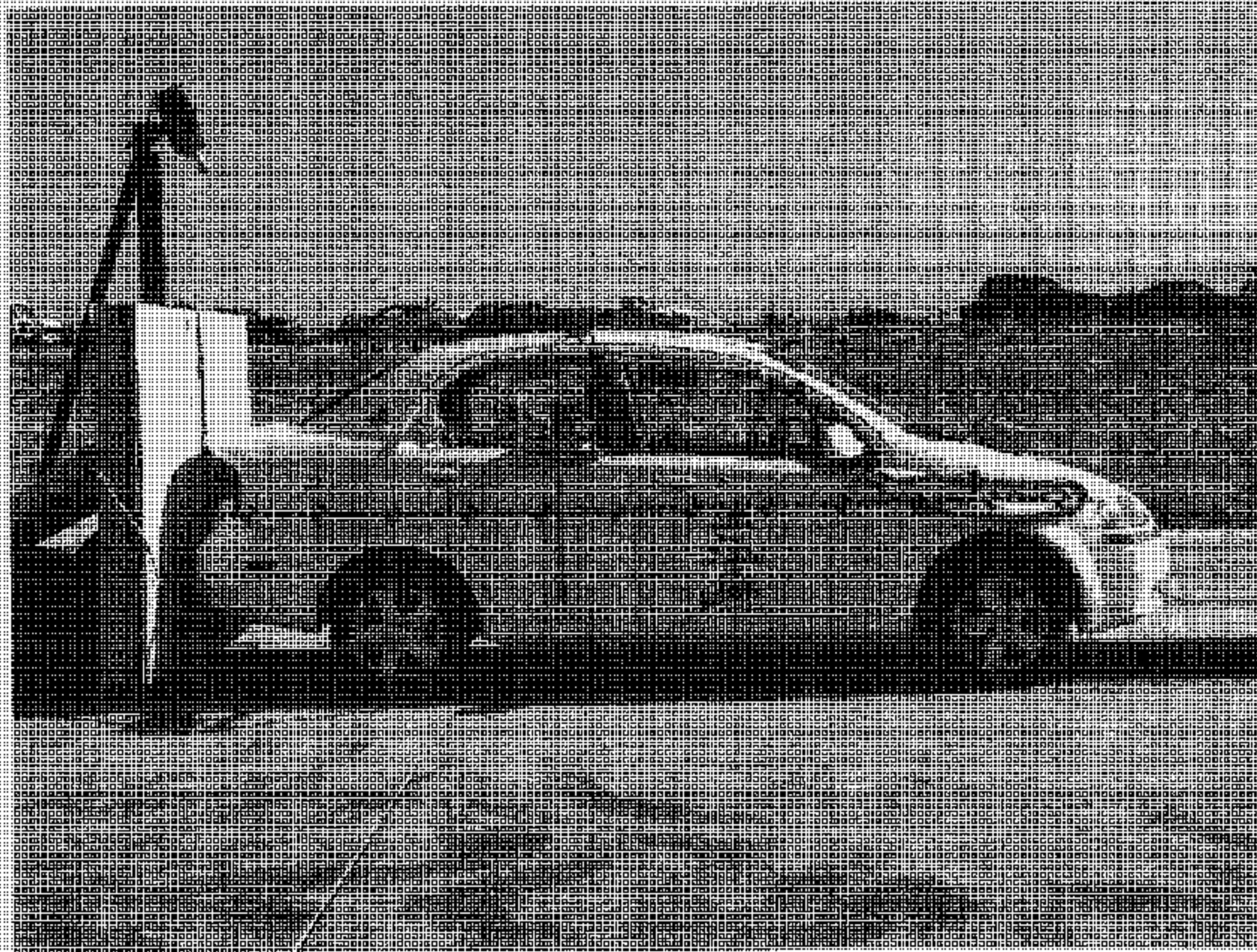


Figure A-9. Pre-Tax: Right Side View



Figure A-10. Post-Test Right Side View

A-10

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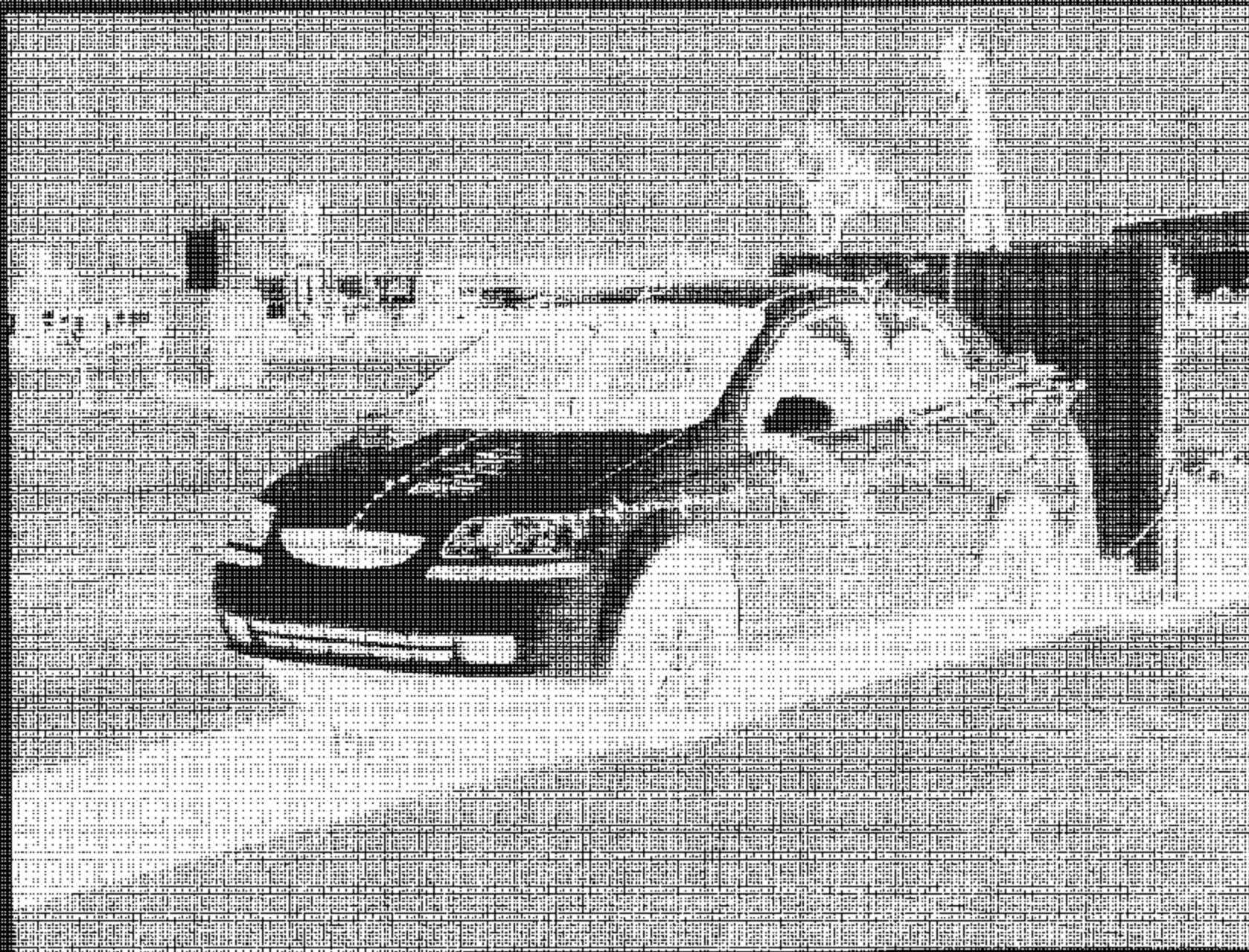


Figure A-11. Pre-Test Left Front ¾ View

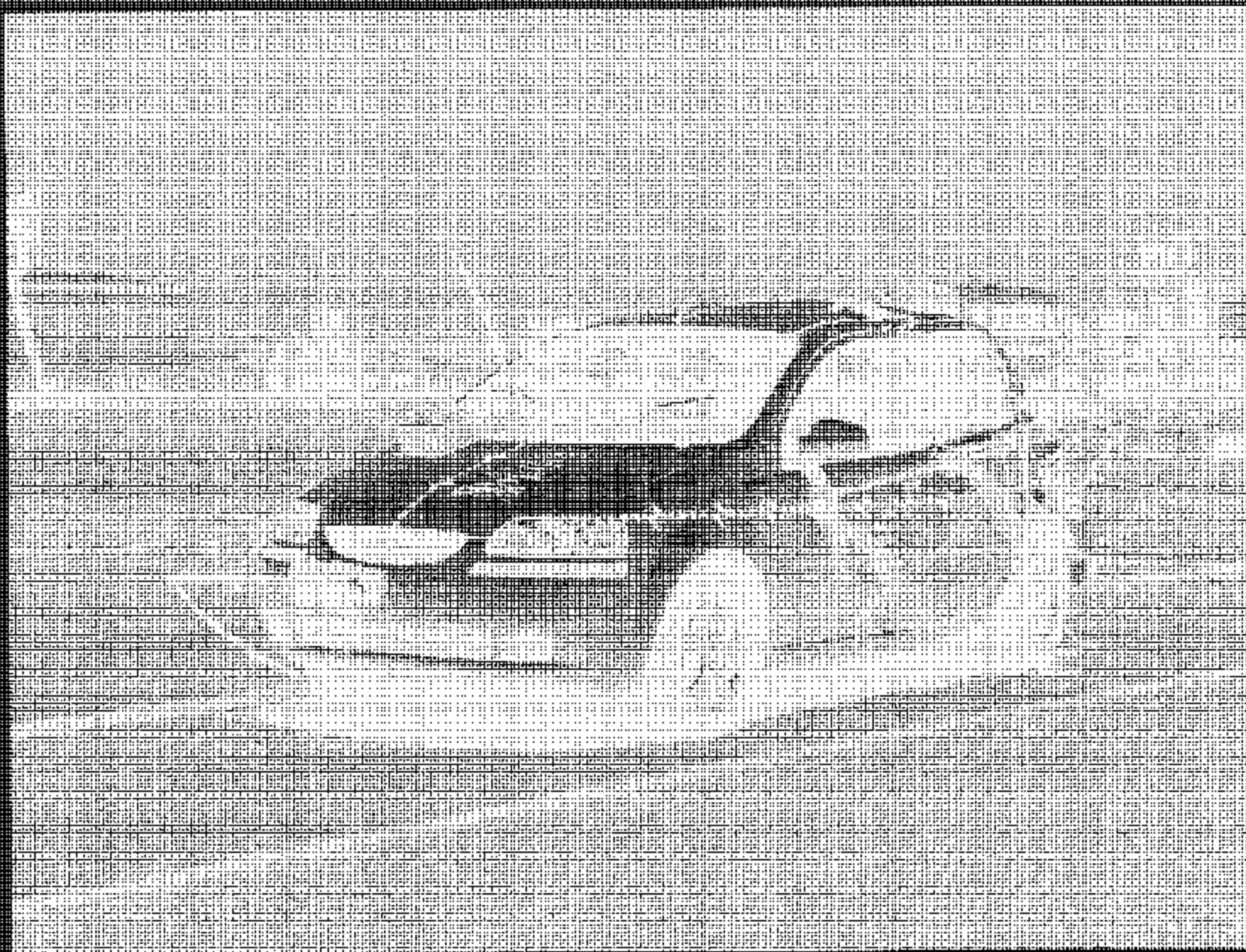


Figure A-12: Post-Test Left Front $\frac{1}{4}$ View (Vehicle Moved)

A-13

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Figure A-13: Pre-Test Right Rear $\frac{3}{4}$ View

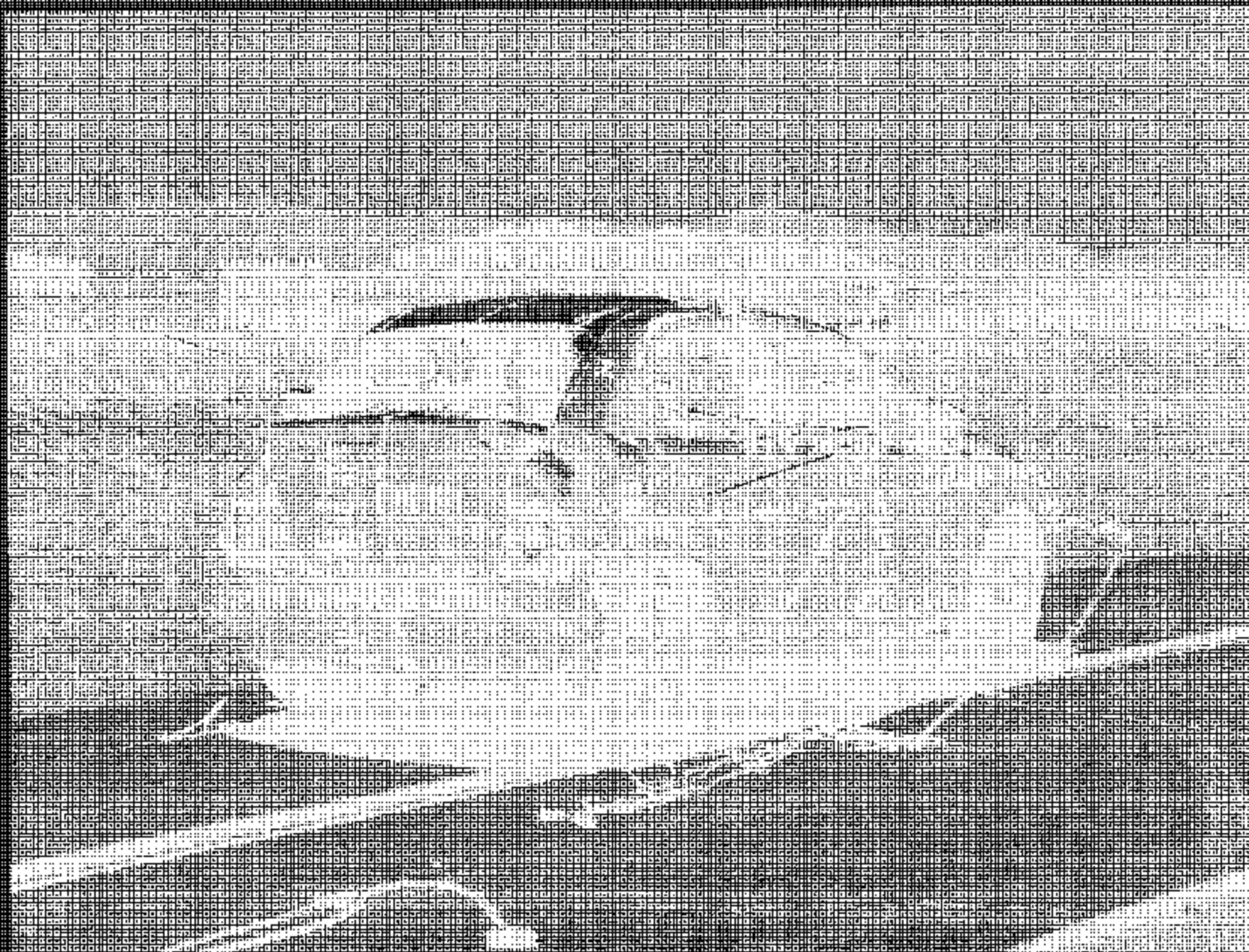


Figure A-14: Post-Test Right Rear $\frac{3}{4}$ View

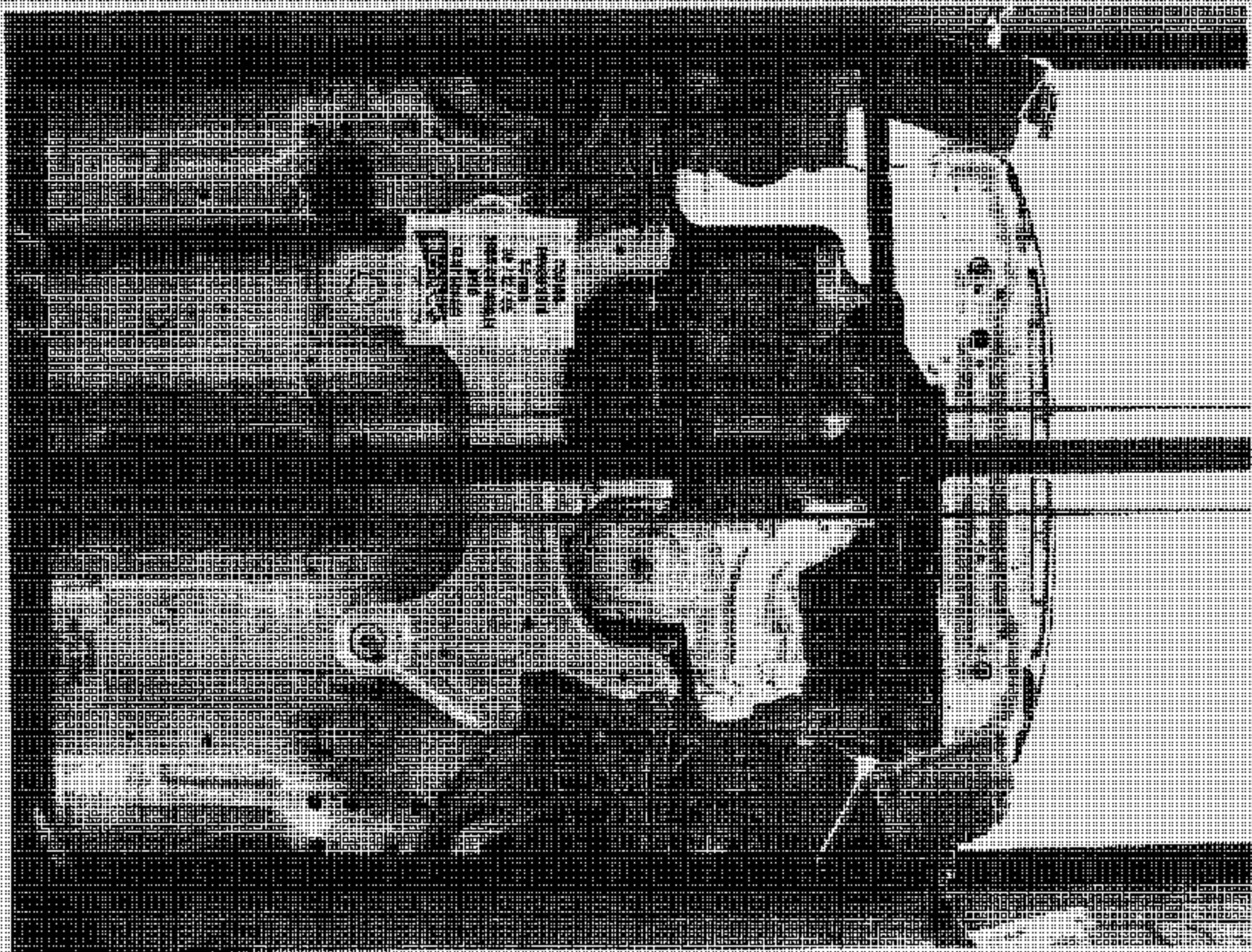


Figure A-15: Pre-Test Front Underbody

A-16

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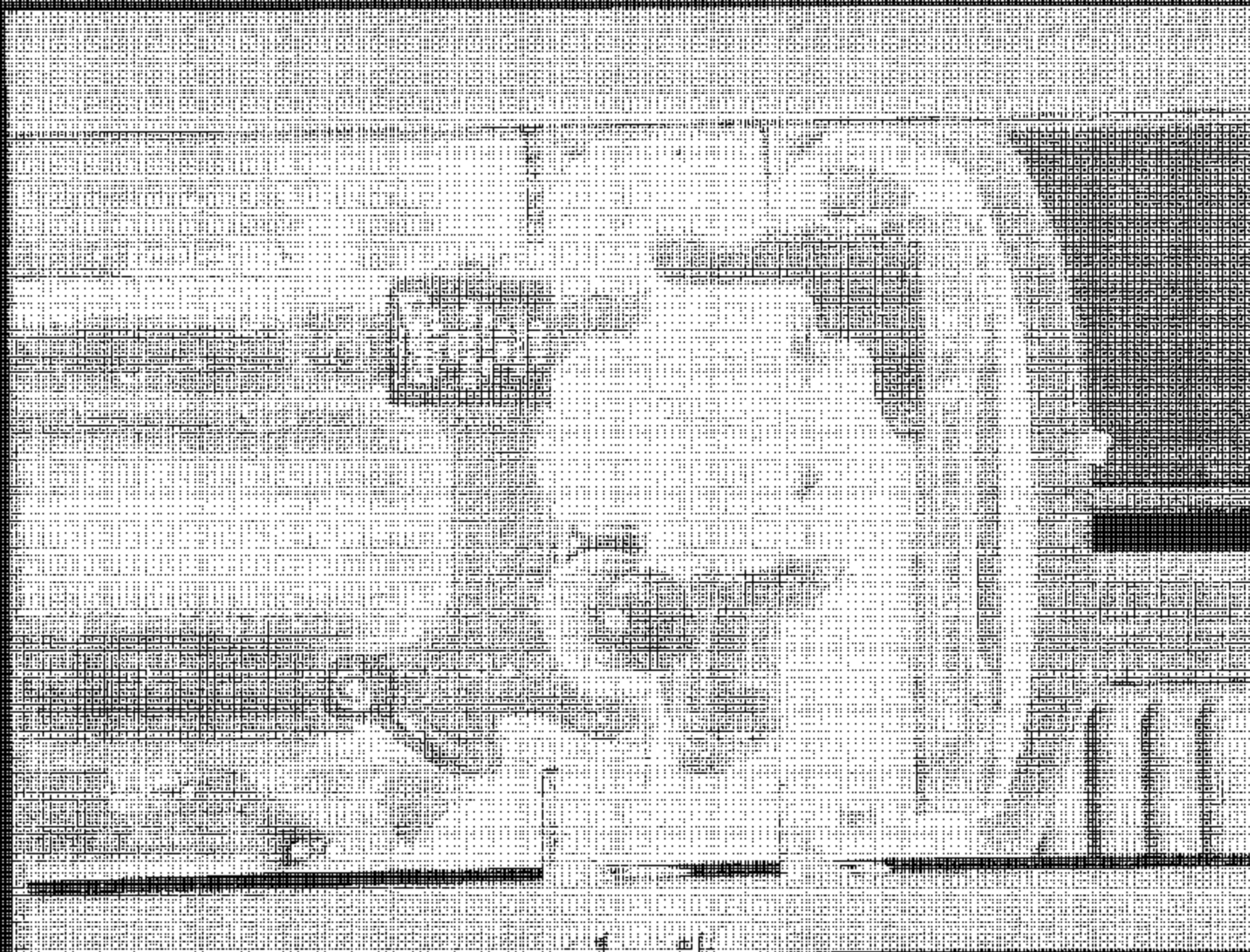


Figure A-16: Post-Test Front Underbody

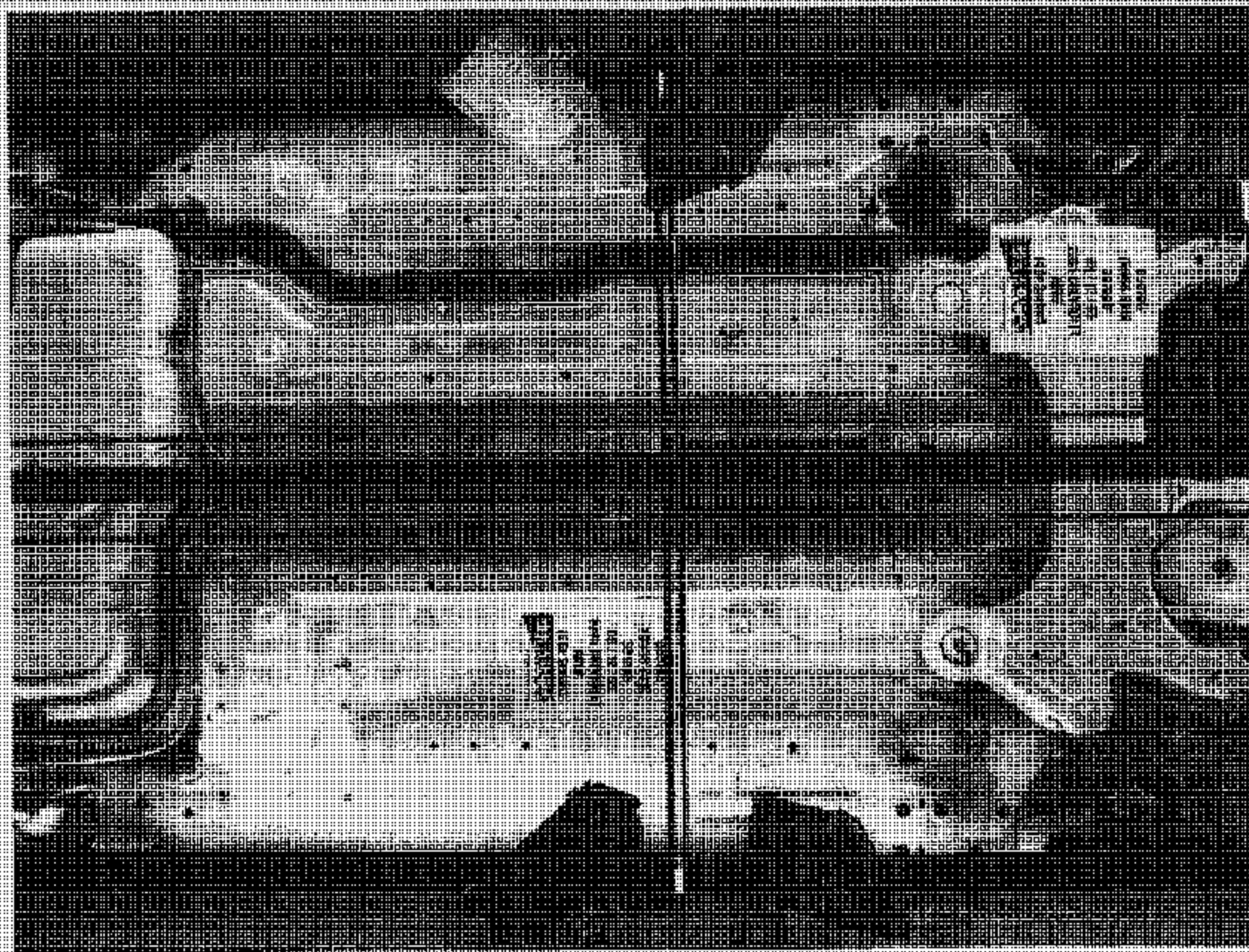


Figure A-17: Pre-Test Mid Underbody

A-17

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A-18

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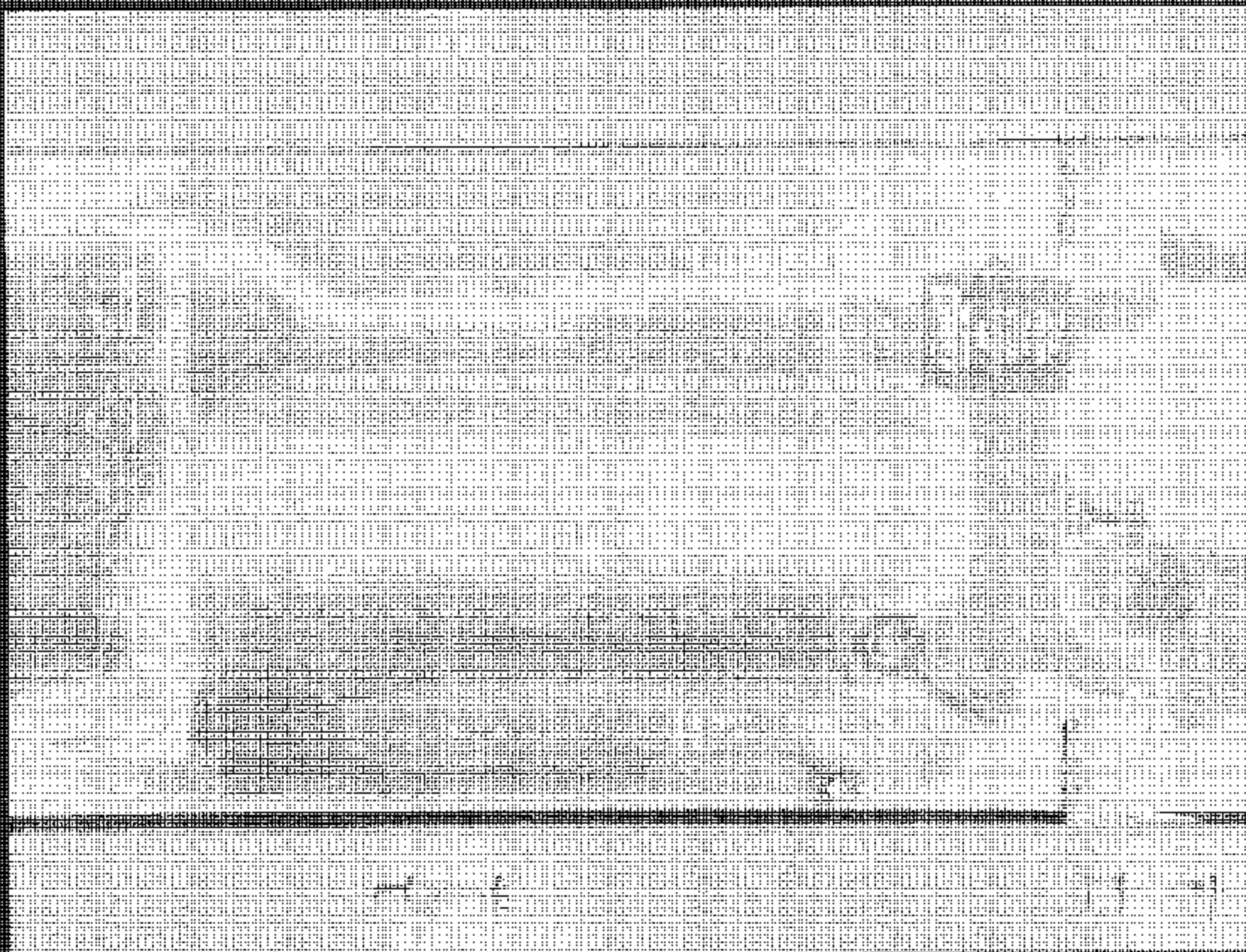


Figure A-15. Post-Test Mid Underbody

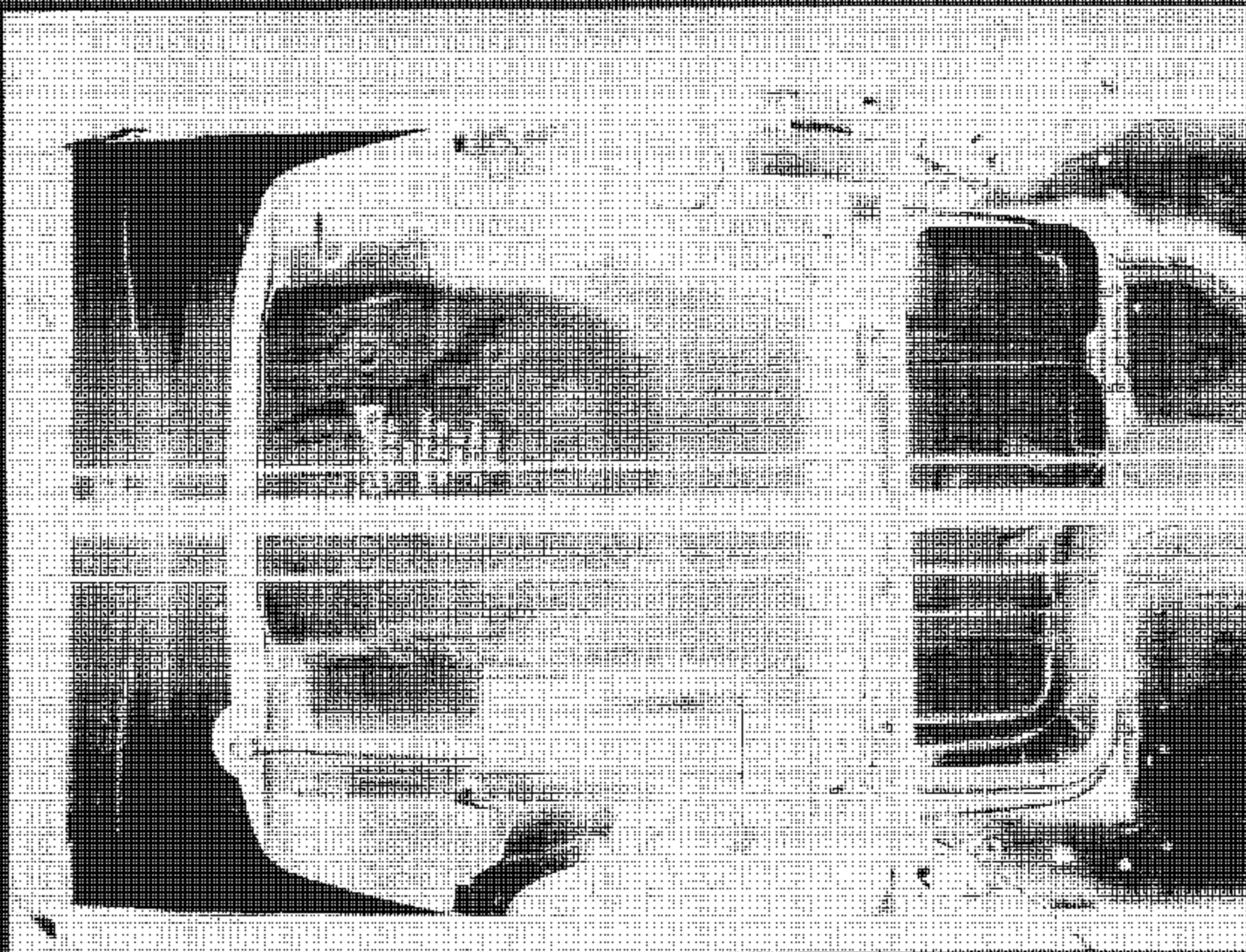


Figure A-19. Pre-Test Rear Underbody

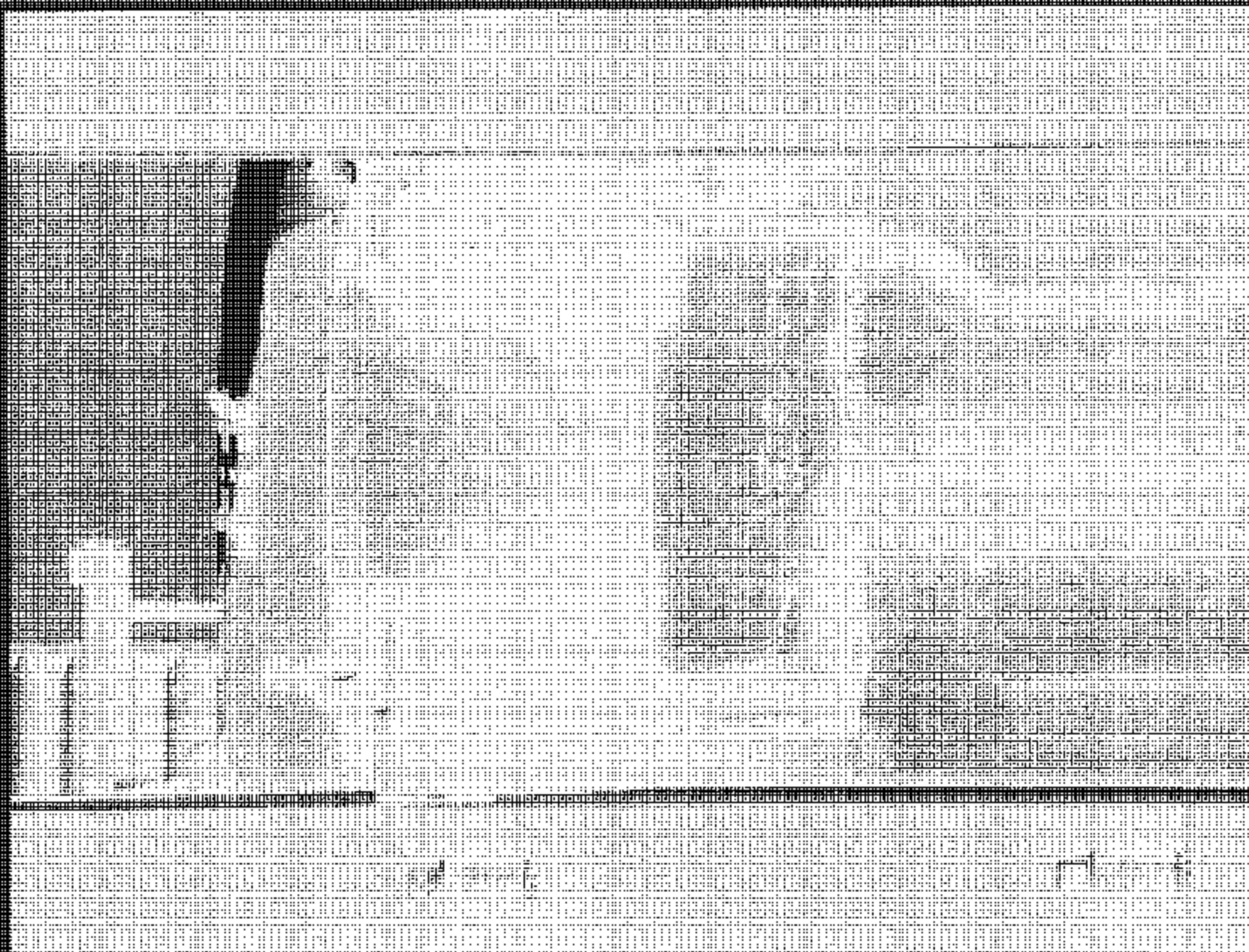


Figure A-20: Post-Test Rear Underbody

A-20

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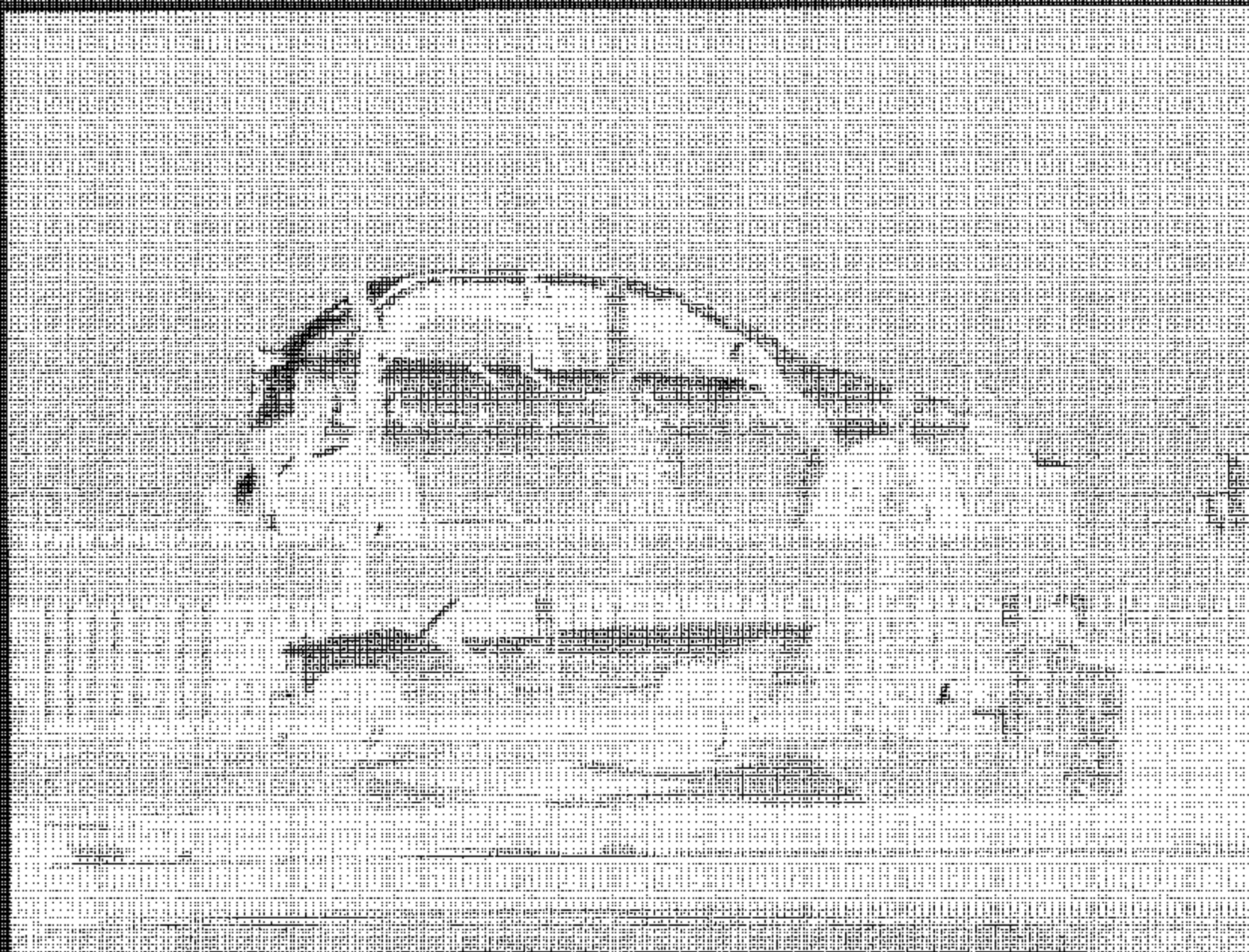


Figure A-21. Vehicle on Rollover Device at 0°

A-22

TR-2200-12-NC

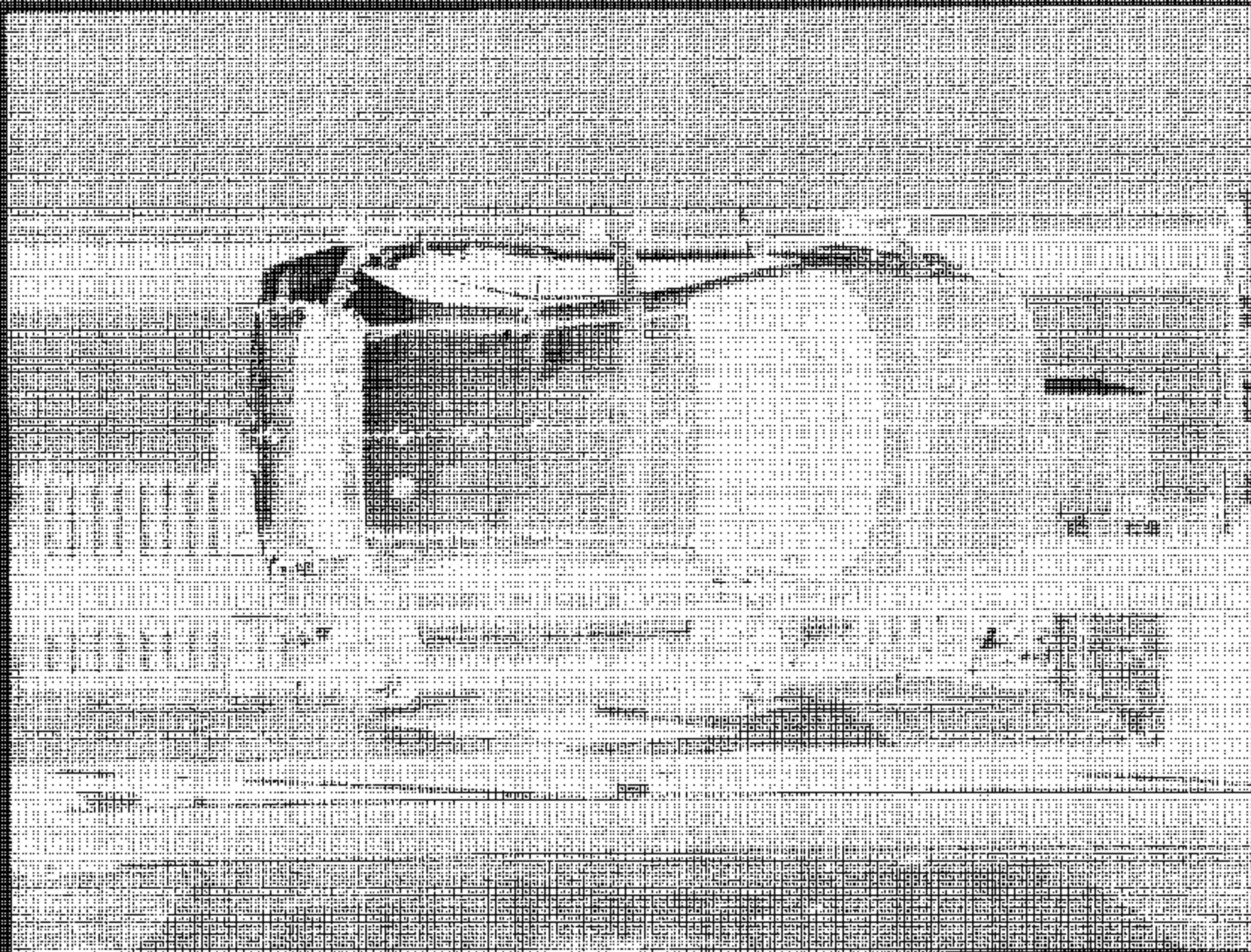


Figure A-22. Vehicle on Rollover Device at 90°

A-23

TP-25007-02 NC

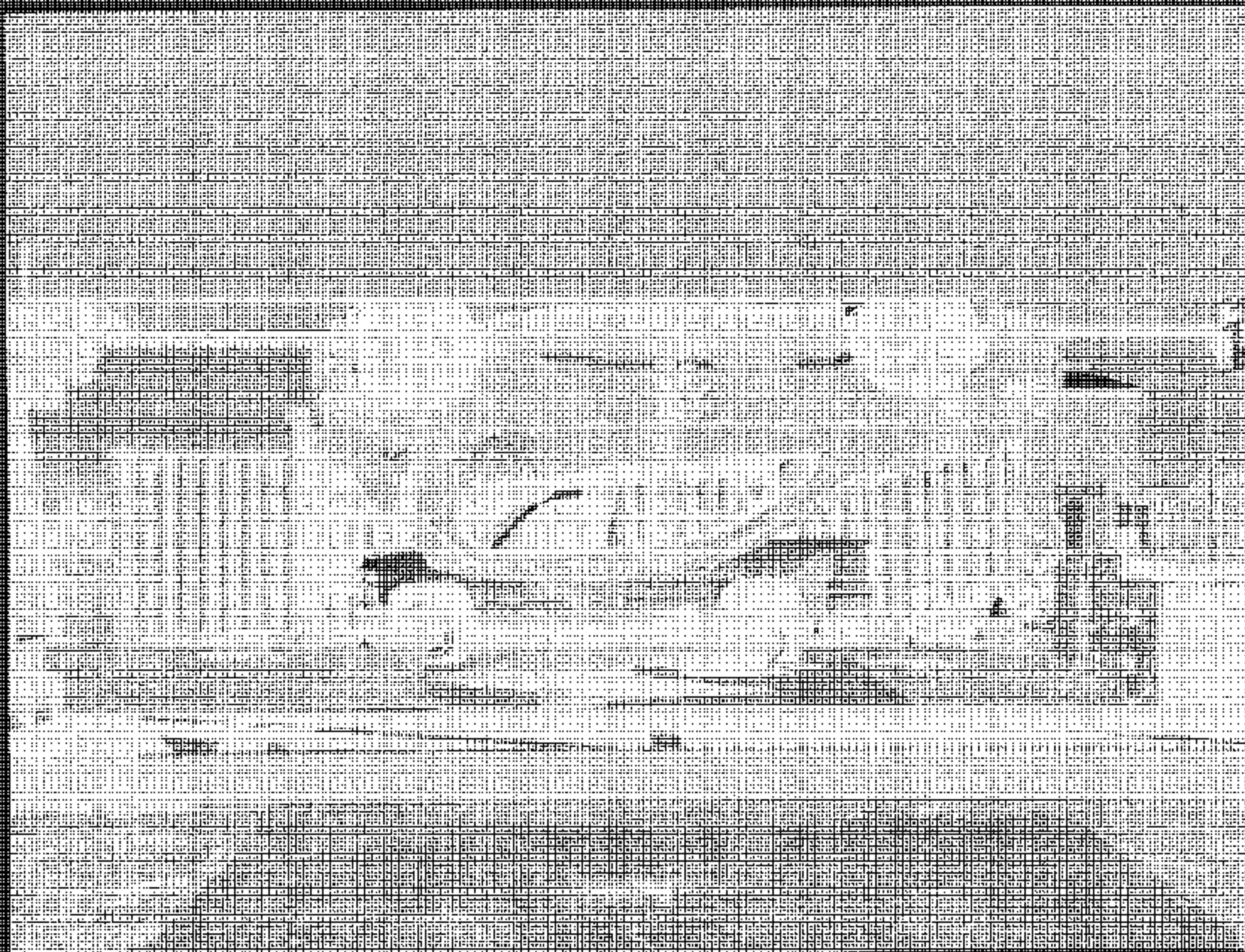


Figure A-23. Vehicle on Rollover Device at 180°

A-24

11-17-2007 02:10

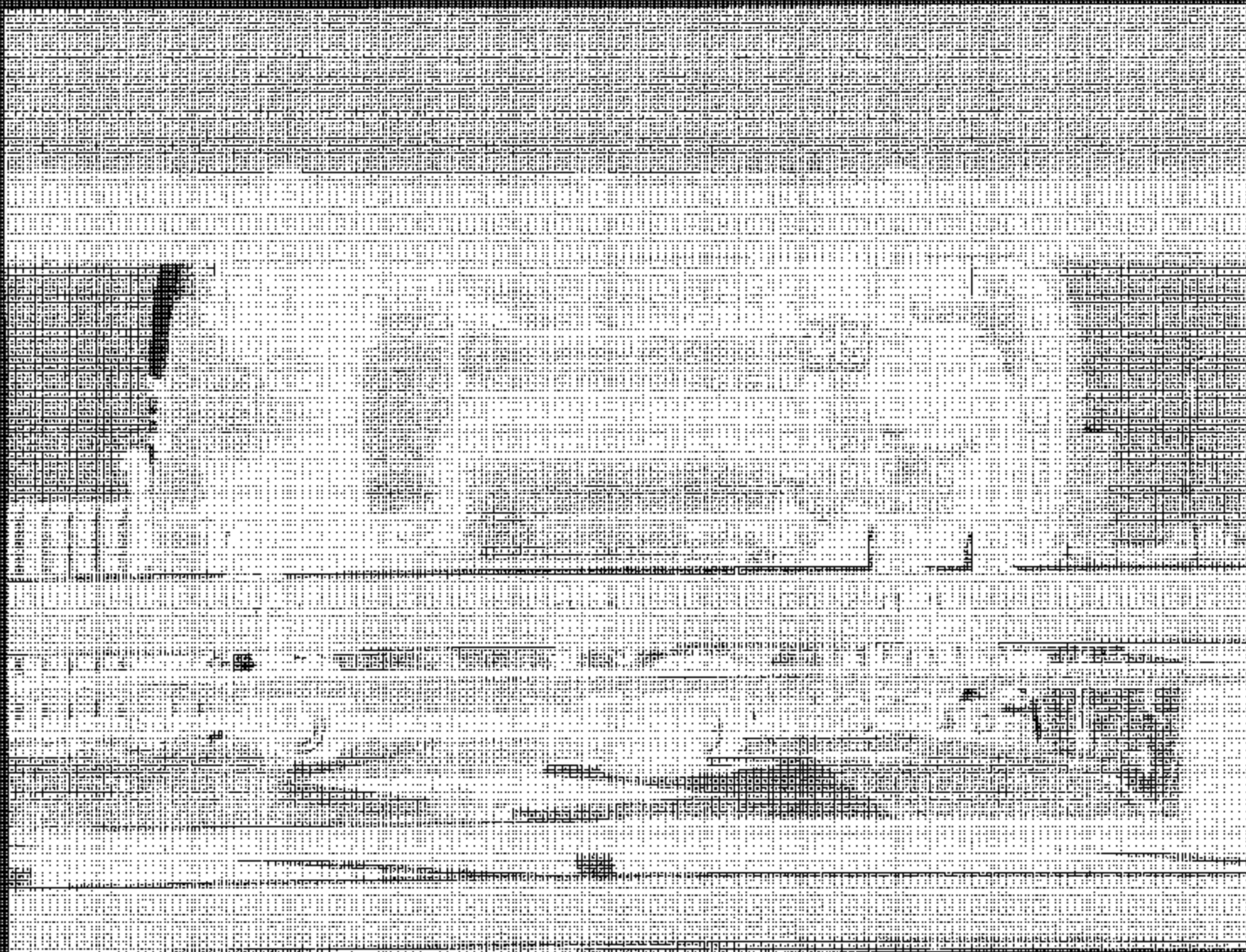


Figure A-24: Vehicle on Rollover Device at 270°

A-25

TR-P2607-02-MC



Figure A-25: Vehicle During Impact

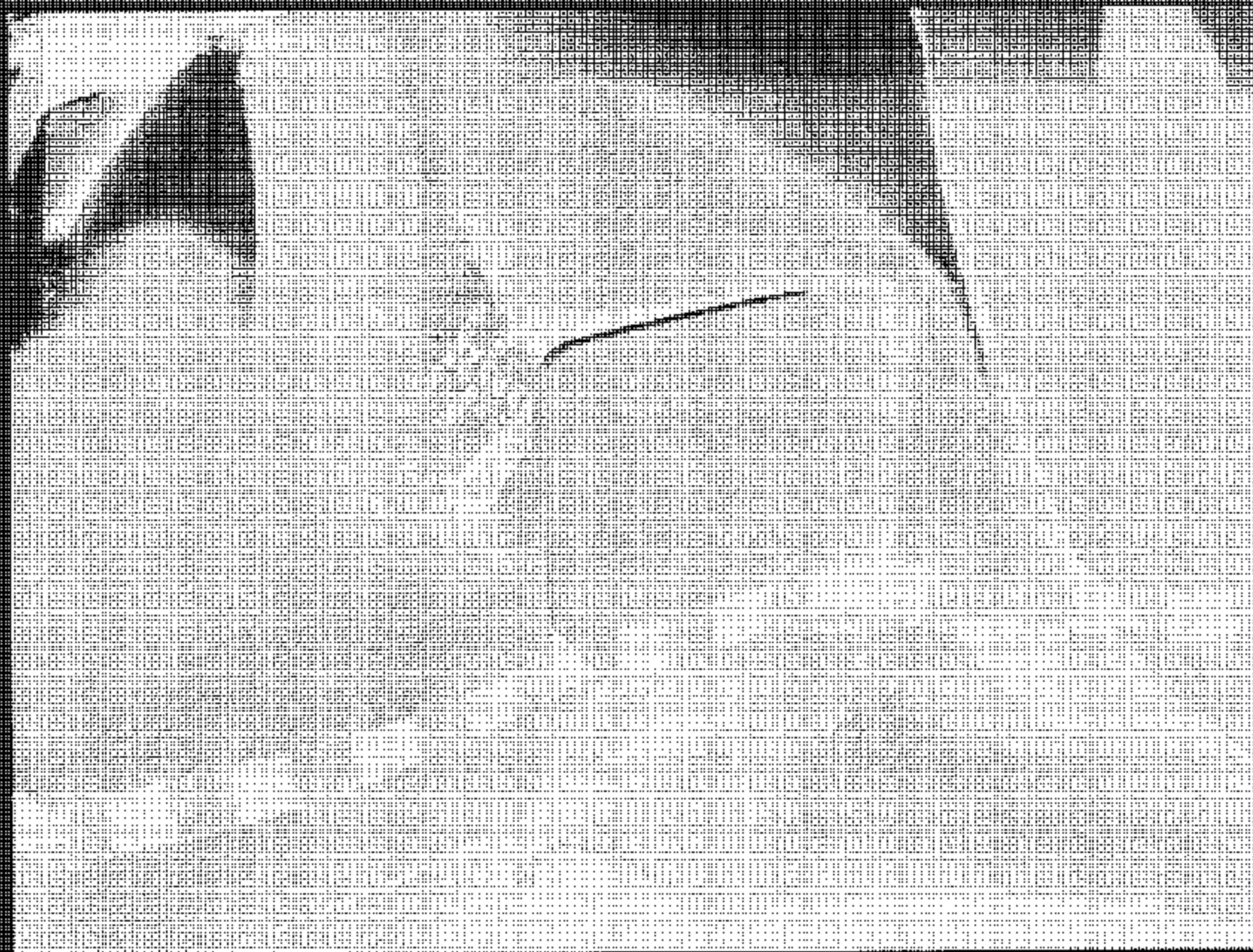


Figure A-25. Post-Test Fuel Door