HSNO 637260

REPORT NUMBER: 301-CAL-04-03

SAFETY COMPLIANCE TESTING FOR FMVSS 301 FUEL SYSTEM INTEGRITY

TOYOTA MOTOR MANUFACTURING INDIANA INC.
2004 TOYOTA SIENNA
MINIVAN

NHTSA NUMBER: C45103

GDAIS TEST NUMBER: 8655-F301-20

June 28, 2004

GENERAL DYNAMICS
ADVANCED INFORMATION ENGINEERING SERVICES
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BUFFALO, NEW YORK 14225

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.
Room No. 6115 (NVS-220)
Washington, DC 20590

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Approval Date: July 13, 2004

FINAL REPORT ACCEPTANCE BY OVSC:

Accepted By: _____

Acceptance Date: 7/29/04

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No. 301-CAL-04-03	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle Final Report of FMVSS 301 Compliance Testing of a 2004 Toyota Sienna Minivan NHTSA No. C45103		5. Report Date June 28, 2004 6. Performing Organization Code CAL
7. Author(s) Patrick G. MacDiarmid, Jr., Project Engineer David J. Travale, Program Manager		8. Performing Organization Report No. 8655-F301-20
9. Performing Organization Name and Address Advance Information Engineering Services 4455 Genesee Street Buffalo, New York 14225		10. Work Unit No. 11. Contract or Grant No. DTNH22-01-C-01025
12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Administration Office of Vehicle Safety Compliance (NVS-220) 400 Seventh St., S.W., Rm. 6115, Washington, D.C. 20590		13. Type of Report and Period Covered Final Test Report June – July 2004 14. Sponsoring Agency Code NVS-220
15. Supplementary Notes		

16. Abstract

Compliance tests were conducted on the subject 2004 Toyota Sienna Minivan 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:

The test vehicle appeared to comply with all requirements of FMVSS 301 "Fuel System Integrity."

17. Key Words Compliance Testing Safety Engineering FMVSS 301	18. Distribution Statement Copies of this report are available from: NHTSA Technical Reference Division Room 5108 (NPO-230), 400 Seventh, S.W., Washington, D.C. 20590 Telephone No. (202) 366-4946		
19. Security Classif. (of this report) UNCLASSIFIED	20. Security Classif. (of this page) UNCLASSIFIED	21. No. of Pages 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 Advanced Information Engineering Services under Contract No. DTNH22-01-C-01025. The purpose of this test was to determine if the subject vehicle, a 2004 Toyota Sienna Minivan, 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 2071.0 kg 2004 Toyota Sienna Minivan was impacted from the rear by an 1797 kg moving barrier at a velocity of 46.51 kph (28.9 mph). The test was performed by Advanced Information Engineering Services on June 28, 2004.

The test vehicle was equipped with a 79.5 liter fuel tank which was filled to 94 percent capacity with stoddard fluid prior to impact. Additional ballast (10.5 kg) was secured in the vehicle cargo area. 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 E 50th percentile male ATD were placed in the Left Front and third row Right Rear occupant seating positions 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 280 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: 2004 Toyota Sienna Minivan

NHTSA No.: C45103 ; Color: Silver

Engine Data: 6 Cylinders; - CID; 3.3 Liters; - cc

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

Transmission Data: 5 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: 10/22/2003 ; Odometer Reading 138 km

Selling Dealer: Lia Toyota of Schenectady

& Address: 2116 Central Avenue RTE 5 Schenectady, NY 12304

DATA FROM VEHICLE'S CERTIFICATION LABEL:

Vehicle Manufactured by: Toyota Motor Manufacturing Indiana Inc.

Date of Manufacture: 09/03

VIN: 5TDZA23C34S070133

GVWR: 2580 kg; GAWR-FRONT: 1290 kg; GAWR-REAR: 1290 kg

DATA FROM VEHICLE'S TIRE LABEL:

Location of Placard on Vehicle: Left B-Pillar

Recommended Tire Size: P215/65R16 96T

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

DATA FROM TIRE SIDEWALL:

Size of Tires on Test Vehicle: P215/65R16 96T Manufacturer: Michelin

Tire Pressure with Maximum Capacity Vehicle Load: FRONT: 240 kPa; REAR: 240 kPa

Type of Spare Tire: T155/65R16 96T

VEHICLE CAPACITY DATA:

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

Number of Occupants: 2 Front; 5 Rear; 7 Total

Vehicle Capacity Weight (VCW) = 526 kg

No. of Occupants x 68.04 kg = 476.3 kg

Rated Cargo/Luggage Weight (RCLW) = 49.7 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 =	541.0 kg	Right Rear =	381.0 kg
Left Front =	545.0 kg.	Left Rear =	414.0 kg
TOTAL FRONT =	1086.0 kg	TOTAL REAR =	795.0 kg

TOTAL DELIVERED WEIGHT = 1881.0 kg

% of Total Front of Vehicle Weight = 57.7% of Total Rear Weight = 42.3%

CALCULATION OF VEHICLE'S TARGET TEST WEIGHT:

Total Delivered Weight	=	1881.0 kg
Rated Cargo/Luggage Weight (RCLW)	=	49.7 kg
Weight of 2 p.572 Dummies, 74.4 kg	=	148.8 kg
TARGET TEST WEIGHT	=	2079.5 kg

WEIGHT OF TEST VEHICLE WITH TWO DUMMIES AND 11.2 KG OF CARGO WEIGHT:

Right Front =	590.5 kg	Right Rear =	441.5 kg
Left Front =	589.5 kg	Left Rear =	449.5 kg
TOTAL FRONT =	1180.0 kg	TOTAL REAR =	891.0 kg

TOTAL TEST WEIGHT = 2071.0 kg

% of Total Front of Vehicle Weight = 57.8% of Total Rear Weight = 42.2%

* Weight of Ballast Secured in Vehicle Trunk Area = 10.5 kg

Type of Ballast: Lead Shot

Method of Securing Ballast: Secured to Floor

Vehicle Components Removed for Weight Reduction: Right Front Passenger Seat

VEHICLE ATTITUDE (all dimension in millimeters):

AS DELIVERED:	RF	783	LF	775	RR	789	LR 778
AS TESTED:	RF	765	LF	759	RR	771	LR 761

Vehicle's Wheel Base: 3025 mm

Location of Vehicle's C.G.: 1276 millimeters rearward of front wheel center.

FUEL SYSTEM DATA:

Fuel System Capacity From Owner's Manual = 79.5 liters

Usable Capacity Figure Furnished by COTR = 79.5 liters

Test Volume Range (91 to 94% of Usable Capacity) = 72.35 to 74.73 liters

ACTUAL TEST VOLUME= 74.6 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 filler neck is located on the left side above the rear axle; The fuel lines are located along the inside of the left frame stiffener; The fuel tank is located along the left side of the vehicle forward of the rear axle.

Comments: The rear hatch window glass shattered during the event. The driver's seat cushion base deformed during the event.

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: Dunlop

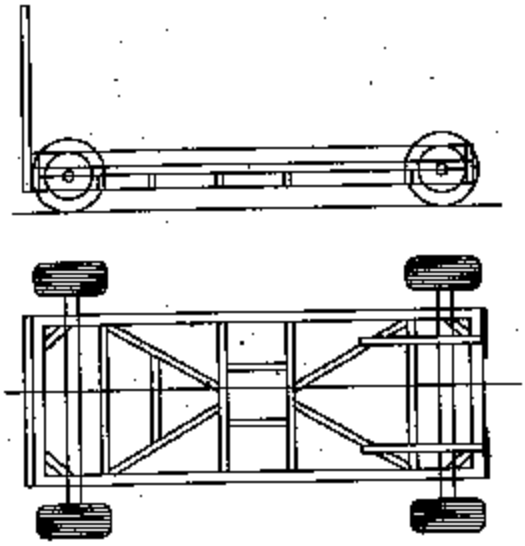
Model: AT Radial Rover

Size: P205/75R15

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: June 28, 2004 Time:: 11:30 Temperature: 21.7 °C

Vehicle NHTSA No.: C45103 VIN: 5TDZA23C34S070133

Required Impact Velocity Range: 46.51 to 48.12 kph

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

Trap No. 1 = 46.51 kph; Trap No. 2 = 46.51 kph

Average Impact Speed = 46.51 kph

VEHICLE STATIC CRUSH:

Vehicle Length:

Pre-Test	Left =	4980	; C/L =	5075	Right =	4980
Post-Test	Left =	4695	; C/L =	4796	Right =	4703
Crush	Left =	285	; C/L =	279	Right =	277

AVERAGE = 280 millimeters

DATA SHEET 4 (continued)

POST TEST DATA

TEST VEHICLE NHTSA NO.: C45103 TEST DATE: June 28, 2004

Vehicle Mfgr./Make/Model: 2004 Toyota Sienna Minivan

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.

****

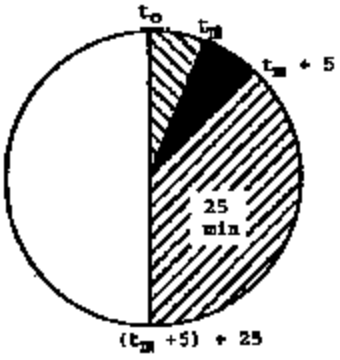
TEST VEHICLE IMPACT TYPE:

- 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:



	ACTUAL	MAX ALLOWED
1. From impact until vehicle motion ceases	0	28 g
2. For five minute period after vehicle motion ceases	0	28 g.
3. For next 25 minutes	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: 2004 Toyota Sienna Minivan NHTSA No.: C45103

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	10	seconds	5	minutes	6	minutes	10	seconds	7	minutes
90° - 180°	1	minutes	02	seconds	5	minutes	6	minutes	2	seconds	7	minutes
180°-270°	1	minutes	05	seconds	5	minutes	6	minutes	5	seconds	7	minutes
270°-360°	1	minutes	40	seconds	5	minutes	6	minutes	40	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)
142 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

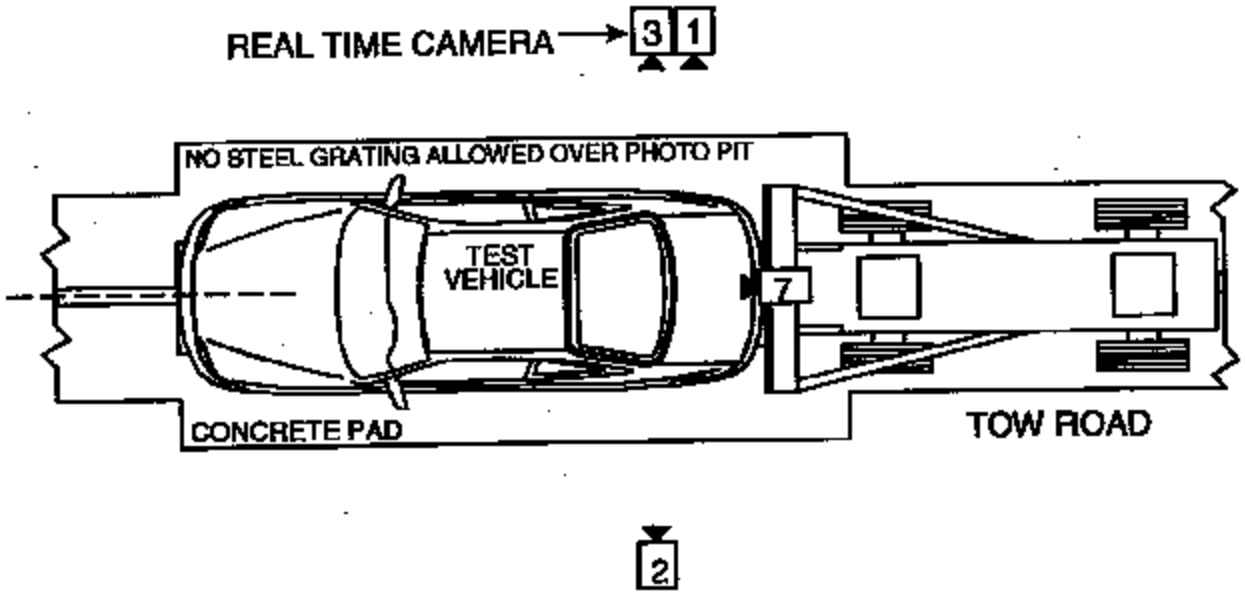
Note: Record spillage for whole minute intervals only as determined above.

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



DATA SHEET 6 (continued)

HIGH SPEED CAMERA LOCATIONS

NHTSA No.: C45103 Vehicle: 2004 Toyota Sienna Minivan

CAMERA NO.	VIEW	CAMERA POSITIONS (mm)*			ANGLE** (degrees)	LENS (mm)	SPEED (fps)
		X	Y	Z			
1	Real-Time Camera	-	-	-	-	-	24
2	Left Side View	17870	2495	1095	0	25	1010
3	Right Side View	18185	1829	1095	0	25	1005
4	Overhead Overall View	-508	0	9804	-90	13	1000
5	Overhead Close View	-508	0	9804	-105	13	1005
6†	Onboard Driver View	955	2949	1215	-10	8	1000
7†	Onboard Passenger View	895	954	1365	-9	8	860
8	Vehicle Rear Underbody View	0	1696	-1956	90	13	1040
9	Vehicle Mid-Section Underbody View	0	2495	-1956	90	13	1000
10	Vehicle Front Underbody View	0	4050	-1956	90	13	1010

* X = film plant 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 – X distance is measured to the reference target plane.

Appendix A

PHOTOGRAPHS

LIST OF PHOTOGRAPHS

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-TEST LEFT SIDE VIEW

Figure A-5 PRE-TEST RIGHT SIDE VIEW

PHOTOGRAPH IS NOT AVAILABLE

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 A-10 POST-TEST LEFT FRONT THREE-QUARTER VIEW

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

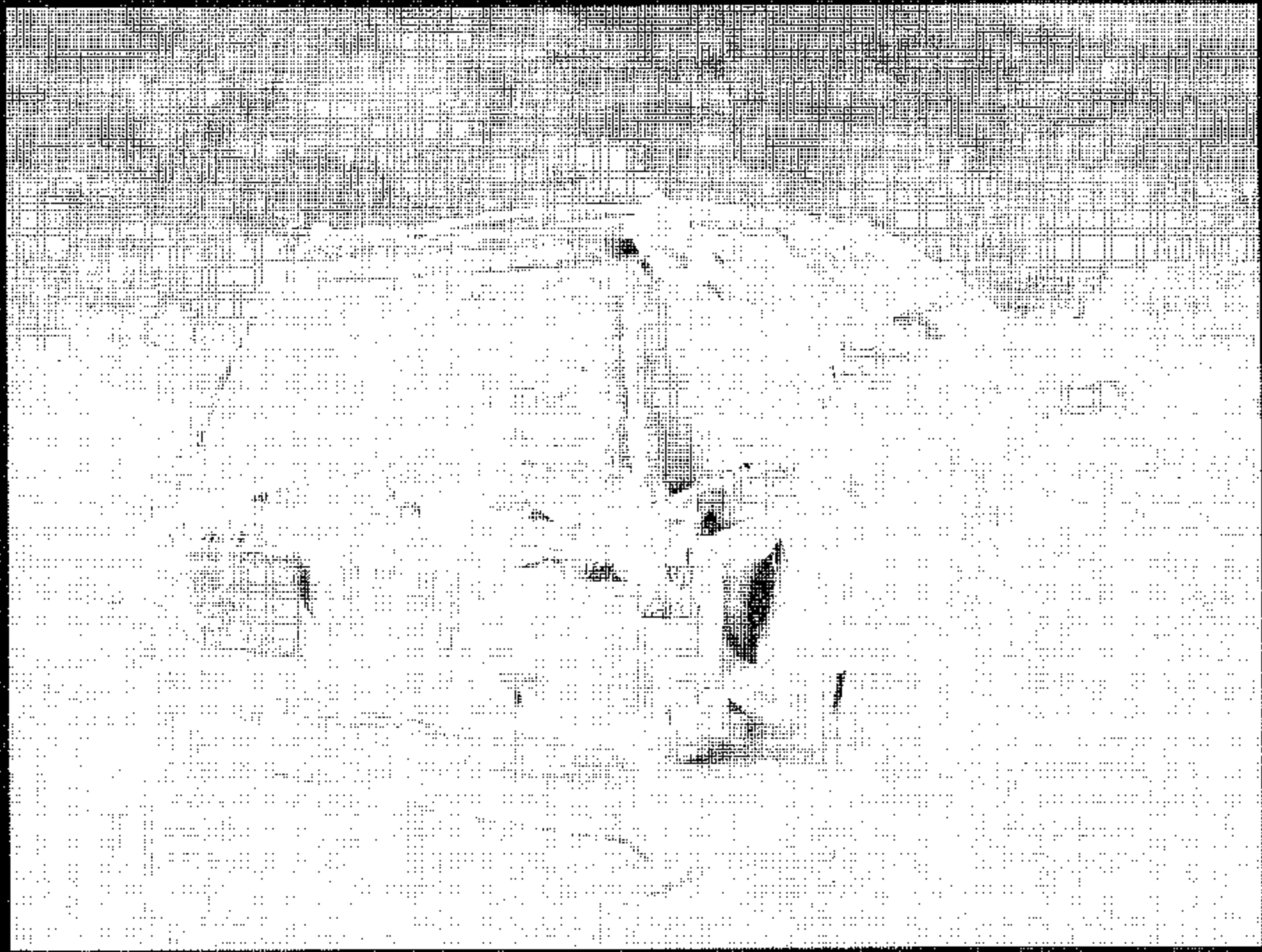


Figure A-12 POST-TEST RIGHT REAR THREE-QUARTER VIEW

Figure A-13 PRE-TEST FRONT UNDERBODY VIEW

Figure A-14 POST-TEST FRONT UNDERBODY VIEW

Figure A-15 PRE-TEST REAR UNDERBODY VIEW

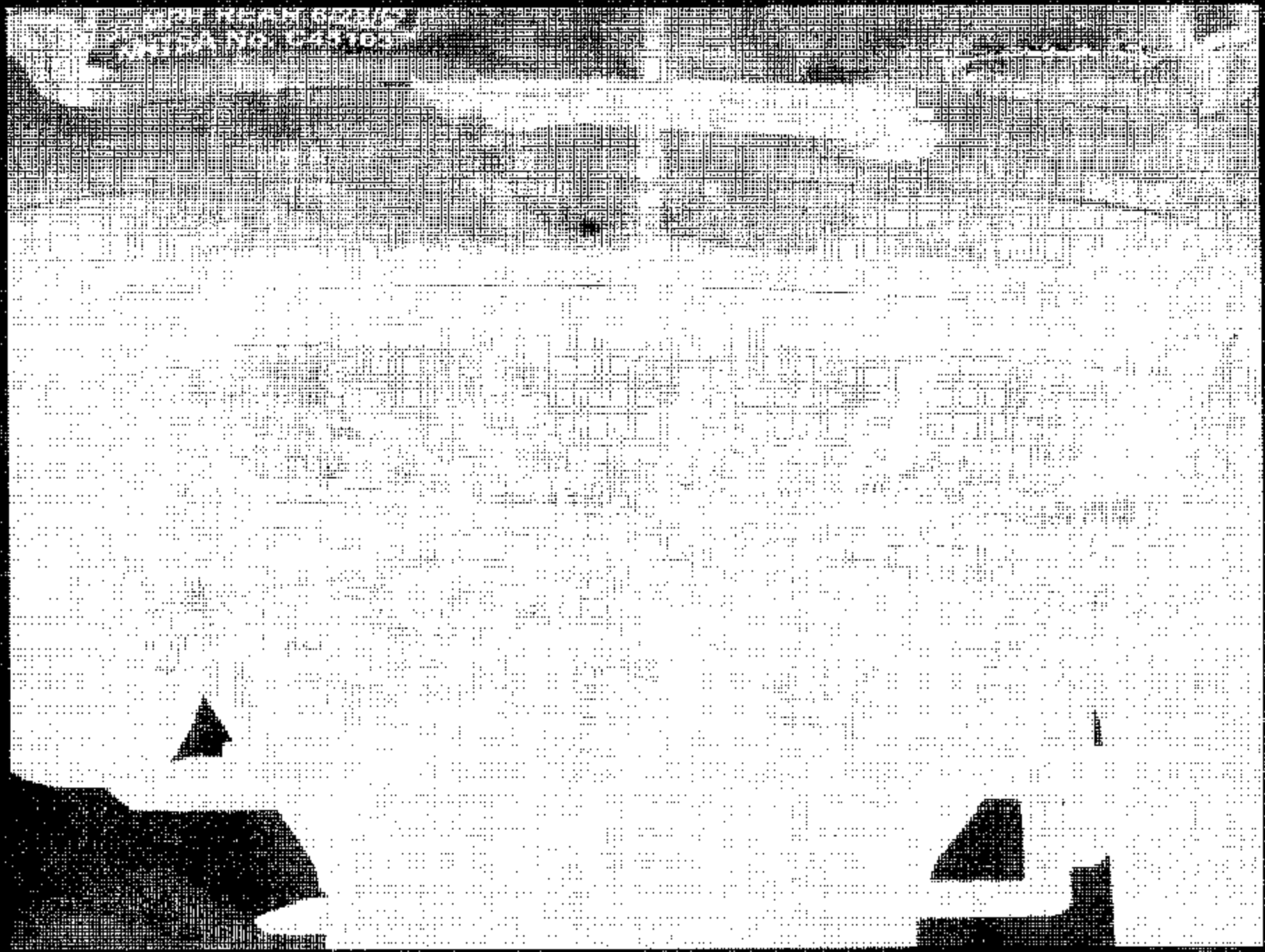


Figure A-16 POST-TEST REAR UNDERBODY VIEW

Figure A-17 CERTIFICATION PLACARD

Figure A-18 TIRE PLACARD

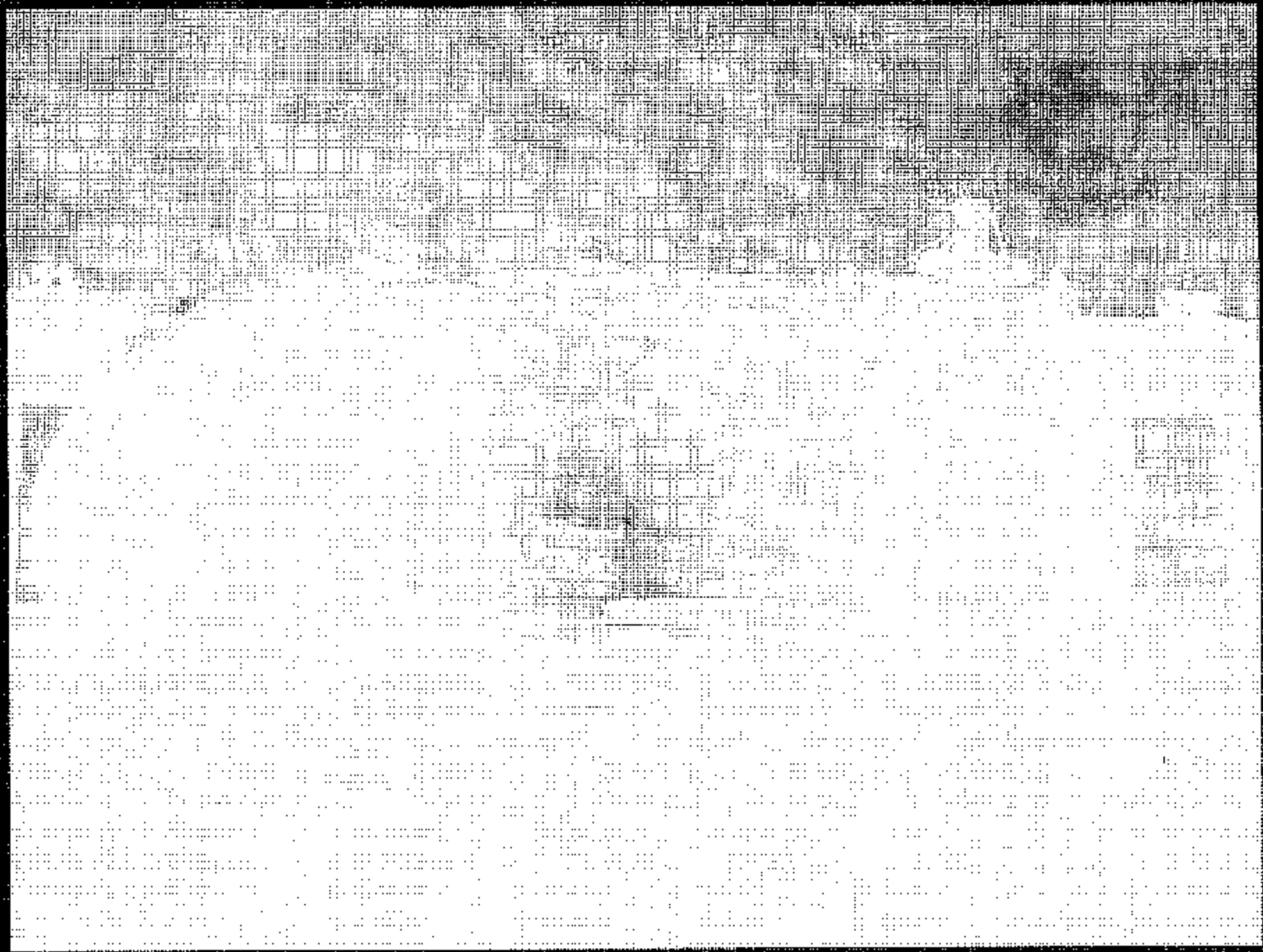


Figure A-19 ROLLOVER 90°

Figure A-20 ROLLOVER 180°

Figure A-21 ROLLOVER 270°

Figure A-22 ROLLOVER 360°