

REPORT NUMBER: 220-MGA-03-003

**SAFETY COMPLIANCE TESTING FOR
FMVSS NO. 220
SCHOOL BUS ROLLOVER PROTECTION**

Liberty Bus Inc.
2003 Liberty Freedom School Bus
NHTSA No.: C30901

PREPARED BY:
MGA RESEARCH CORPORATION
5000 WARREN ROAD
BURLINGTON, WI 53105



Final Report Date: October 7, 2003

FINAL REPORT

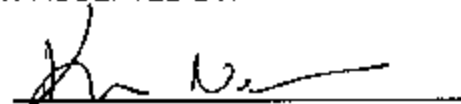
PREPARED FOR:
U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
ENFORCEMENT
OFFICE OF VEHICLE SAFETY COMPLIANCE
400 SEVENTH STREET, SW, ROOM 6115 (NVS-220)
WASHINGTON, D.C. 20590

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FINAL REPORT ACCEPTED BY:



10/14/2003
Date of Acceptance

Technical Report Documentation Page

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12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Administration Enforcement Office of Vehicle Safety Compliance (NVS-220) 400 Seventh St., S.W. Room 6115 Washington, D.C. 20590		13. Type of Report and Period Covered Final Report 8/21/03 to 10/07/03		14. Sponsoring Agency Code NVS-220	
		15. Supplementary Notes			
16. Abstract Compliance tests were conducted on the subject 2003 Liberty Bus Freedom School Bus, NHTSA No. C30901 in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP-220-02 for the determination of FMVSS 220 compliance. FAILURES: NONE					
17. Key Words Compliance Testing Safety Engineering FMVSS 220		18. Distribution Statement Copies of this report are available from: NHTSA Technical Information Services (TIS) Room 5108, (NPO-230) 400 Seventh Street, S.W. Washington, D.C. 20590 (202) 366-4946			
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SECTION 1
PURPOSE OF COMPLIANCE TEST

Tests were conducted on a MY2003 Liberty Bus Freedom School Bus, NHTSA No. C30901, in accordance with the specifications of the Office of Vehicle Safety Compliance (OVSC) Test Procedure, TP-220-02, to determine compliance to the requirements of Federal Motor Vehicle Safety Standards (FMVSS) 220, "School Bus Rollover Protection".

This program is sponsored by the National Highway Traffic Safety Administration (NHTSA), under Contract No. DTNH22-02-D-01057.

SECTION 2
TEST DATA SUMMARY

Based on the tests performed, the MY2003 Liberty Bus Freedom School Bus, NHTSA No. C30901 appears to meet the requirements of FMVSS 220. The ambient temperature during testing was 30° C.

TEST RESULTS

S4.a	The downward vertical movement of any point on the application plate shall not exceed 130 mm.	PASS
S4.b	Each emergency exit shall be capable of:	
	Unlatching per FMVSS 217	PASS
	Opening per FMVSS 217	PASS

**DATA SHEET 1
VEHICLE INFORMATION**

Contract No.:	DTNH22-02-D-01057
Laboratory Name:	MGA Research Corporation

INCOMPLETE VEHICLE (if applicable)	
Manufacturer:	GMC
Model:	3500
VIN:	1GBHG39U831110237
Build Date:	10/02
Certification Date:	---

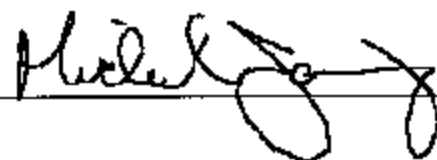
COMPLETED VEHICLE (SCHOOL BUS)	
Manufacturer:	Liberty Bus
Make/Model:	School Bus/Freedom
VIN:	1GBHG39U831110237
NHTSA No.:	C30901
Color:	Yellow
GVWR (kg/lb):	4,335 kg / 9,600 lbs
Build Date:	02/03
Certification Date:	02/03

DATES	
Vehicle Receipt:	June 11, 2003
Start of Compliance Test:	August 21, 2003
Completion of Compliance Test:	August 21, 2003

COMPLIANCE TEST:
All tests were performed in accordance with the references outlined in: TP-220-02.

COMMENTS: NONE

Recorded By: 

Approved By: 

Date: October 7, 2003

DATA SHEET 1 (CONTINUED)

VEHICLE INFORMATION

SCHOOL BUS UNLOADED VEHICLE WEIGHT (UVW)

Units	LF	RF	LR	RR	TOTAL
kg	826	780	724	728	3058

SCHOOL BUS ROOF AND APPLICATION PLATE DATA

Dimensions	School Bus Roof	Calculated Roof Plate	Actual Roof Plate
Length (mm):	3962	4088	4572 ⁽¹⁾
Width (mm):	1524	1651	2616 ⁽²⁾

Notes:

- (1) The actual roof plate length was 483 mm longer than calculated length.
- (2) The actual roof plate width was 965 mm wider than calculated length.

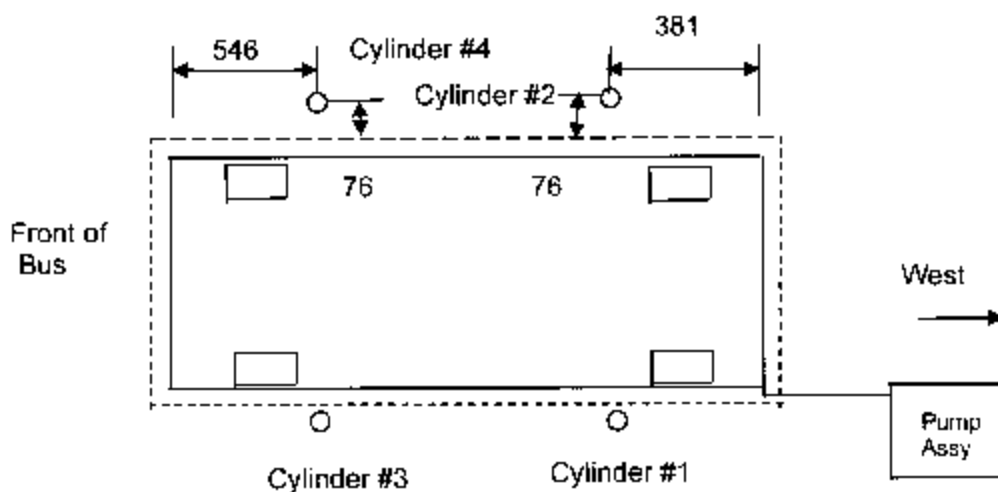
School Bus Has: Rigid Frame; Unibody

Components Removed From Vehicle Before Testing: The seats were removed because of previous testing on the vehicle.

DATA SHEET 1 (CONTINUED)
VEHICLE INFORMATION

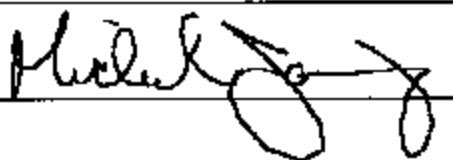
LINEAR DISPLACEMENT TRANSDUCER LOCATION (inches)

Description	LF	RF	LR	RR
From closest corner of load application plate (mm)	546	546	381	381
From closest outside edge of load application plate (mm)	76	76	76	76



COMMENTS: NONE

Recorded By: 

Approved By: 

Date: October 7, 2003

SECTION 3
COMPLIANCE TEST DATA

The following data sheets document the results of testing on the 2003 Liberty Bus Freedom School Bus, NHTSA No. C30901.

DATA SHEET 2
FORCE APPLICATION AND DEFLECTION INFORMATION

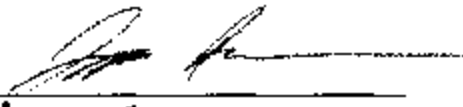
Test Vehicle: **2003 Liberty Bus Freedom School Bus**
 Test Lab: **MGA Research-Wisconsin Operations**


NHTSA No.: **C30901**
 Test Date: **8/21/03**

Unloaded Delivered Weight (UDW): (kg)	3,058 kg
Calculated Test Load = 1.5 * UDW	4,587 kg
Range of Test Load (-1% to -3%)	4,449 kg to 4,541 kg
Maximum Deflection at Full Load:	15.0 mm

		Pre-Load (227 kg)	Max. Load		PASS/FAIL
		Deflection (mm)	Deflection (mm)	Load (kg)	
Cylinder	1	0	13.5	1150	PASS
	2	0	13.6	1153	PASS
	3	0	8.5	1150	PASS
	4	0	15.0	1159	PASS
Total Load				4613 kg	
Average Deflection			12.7		
Backup Measurement	1	0	6.0		
	2	0	6.0		
	3	0	7.0		
	4	0	10.0		

COMMENTS: 1) Backup measurements taken at the four most outboard and longitudinal locations of the bus roof. Primary cylinder deflections were measured at the locations identified in the diagram on page 5. Maximum deflection allowed = 130 mm.

Recorded By: 

Approved By: 

Date: October 7, 2003

**DATA SHEET 3
FORCE AND OPENING AREA TEST OF EMERGENCY EXITS**

Test Vehicle: **2003 Liberty Bus Freedom School Bus**
 Test Lab: **MGA Research-Wisconsin Operations**

NHTSA No.: **C30901**
 Test Date: **8/21/03**

	PASS/FAIL
Can all exits be manually released and extended by a single person without tools, remove controls, and without the engine running?	PASS

NOTE: BEFORE, DURING & AFTER, refer to the point in time in relation to the load applied to the load application plate on the school bus roof.

					PASS/FAIL
BEFORE LOAD:	X	Yes		No	PASS
DURING LOAD:	X	Yes		No	PASS
AFTER LOAD:	X	Yes		No	PASS

Is emergency exit door releasable from outside the school bus?					PASS/FAIL
BEFORE LOAD:	X	Yes		No	PASS
DURING LOAD:	X	Yes		No	PASS
AFTER LOAD:	X	Yes		No	PASS

DATA SHEET 4

FORCE AND OPENING AREA TEST OF EMERGENCY EXITS (INTERIOR)

Test Vehicle: 2003 Liberty Bus Freedom School Bus NHTSA No.: C30901
 Test Lab: MGA Research-Wisconsin Operations Test Date: 8/21/03

FORCE TEST TO UNLATCH THE EMERGENCY EXITS:

Exit Location	Maximum Force	Actual Before (N)	PASS/FAIL	Actual During (N)	PASS/FAIL	Actual After (N)	PASS/FAIL	Type of Motion
Left Rear Emergency Door ⁽¹⁾	178 N	1. 69.0	PASS	1. 96.0	PASS	1. 51.0	PASS	Pull
		2. 57.5		2. 89.0		2. 58.0		
		3. 65.5		3. 81.0		3. 55.5		
		Average: 64.0		Average: 88.7		Average: 54.8		
Right Rear Emergency Door	178 N	1. 54.0	PASS	1. 26.0	PASS	1. 24.5	PASS	Pull
		2. 47.0		2. 24.0		2. 22.0		
		3. 56.0		3. 25.0		3. 19.5		
		Average: 52.3		Average: 25.0		Average: 22.0		

Note: The "Actual Before" test results were obtained from the FMSSS 217 performed on this vehicle.
 The "Actual During" and "Actual After" test results were obtained during the FMVSS 220 testing.

⁽¹⁾The Left Rear Emergency Door uses the same handle to unlatch the exit from both the interior and exterior of the bus.

DATA SHEET 4 (CONTINUED)
FORCE AND OPENING AREA TEST OF EMERGENCY EXITS (INTERIOR)

Test Vehicle: 2003 Liberty Bus Freedom School Bus NHTSA No.: C30901
 Test Lab: MGA Research-Wisconsin Operations Test Date: 8/21/03

FORCE TESTS TO OPEN THE EMERGENCY EXITS

Exit Location	Maximum Force	Actual Before (N)	PASS/FAIL	Actual During (N)	PASS/FAIL	Actual After (N)	PASS/FAIL	Type of Motion
Left Rear Emergency Door	178 N	1. 20.5	PASS	1. 18.0	PASS	4. 16.0	PASS	Straight and Perpendicular to the undisturbed surface
		2. 21.0		2. 20.0		5. 19.0		
		3. 18.0		3. 20.0		6. 19.5		
		Average: 19.8		Average: 19.3		Average: 18.2		
Right Rear Emergency Door	178 N	1. 16.0	PASS	1. 76.0	PASS	1. 18.0	PASS	Straight and Perpendicular to the undisturbed surface
		2. 17.0		2. 71.0		2. 19.5		
		3. 13.5		3. 58.0		3. 19.5		
		Average: 15.5		Average: 68.3		Average: 19.0		

Note: The "Actual Before" test results were obtained from the FMSSS 217 performed on this vehicle.
 The "Actual During" and "Actual After" test results were obtained during the FMVSS 220 testing.

DATA SHEET 5
FORCE AND OPENING AREA TEST OF EMERGENCY EXITS (EXTERIOR)

Test Vehicle: 2003 Liberty Bus Freedom School Bus NHTSA No.: C30901
 Test Lab: MGA Research-Wisconsin Operations Test Date: 8/21/03

FORCE TEST TO UNLATCH THE EMERGENCY EXITS:

Exit Location	Maximum Force	Actual Before (N)	PASS/FAIL	Actual During (N)	PASS/FAIL	Actual After (N)	PASS/FAIL	Type of Motion
Left Rear Emergency Door ⁽¹⁾	178 N	1. 69.0	PASS	1. 96.0	PASS	1. 51.0	PASS	Pull
		2. 57.5		2. 89.0		2. 58.0		
		3. 65.5		3. 81.0		3. 55.5		
		Average: 64.0		Average: 88.7		Average: 54.8		
Right Rear Emergency Door	178 N	1. 59.0	PASS	1. 65.0	PASS	1. 61.5	PASS	Pull
		2. 64.5		2. 83.0		2. 64.0		
		3. 55.0		3. 81.0		3. 66.5		
		Average: 59.5		Average: 76.3		Average: 64.0		

Note: The "Actual Before" test results were obtained from the FMSSS 217 performed on this vehicle.
 The "Actual During" and "Actual After" test results were obtained during the FMVSS 220 testing.

⁽¹⁾The Left Rear Emergency Door uses the same handle to unlatch the exit from both the interior and exterior of the bus.

DATA SHEET 5 (CONTINUED)
FORCE AND OPENING AREA TEST OF EMERGENCY EXITS (EXTERIOR)

Test Vehicle: 2003 Liberty Bus Freedom School Bus NHTSA No.: C30901
 Test Lab: MGA Research-Wisconsin Operations Test Date: 8/21/03

FORCE TESTS TO OPEN THE EMERGENCY EXITS

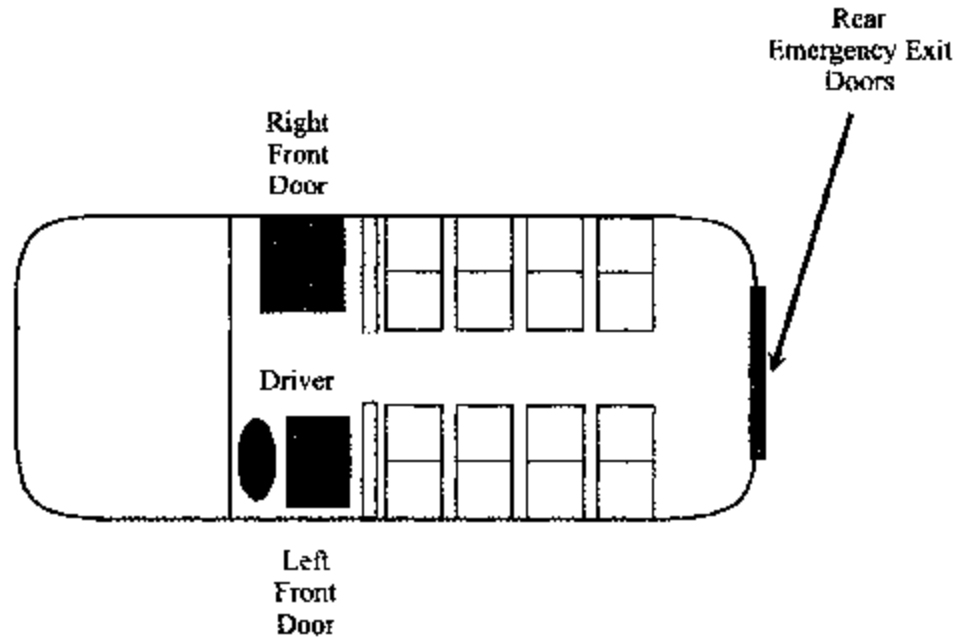
Exit Location	Maximum Force	Actual Before (N)	PASS/FAIL	Actual During (N)	PASS/FAIL	Actual After (N)	PASS/FAIL	Type of Motion
Left Rear Emergency Door	178 N	1. 18.0	PASS	1. 20.5	PASS	1. 22.0	PASS	Straight and Perpendicular to the undisturbed surface
		2. 18.5		2. 22.0		2. 26.5		
		3. 23.0		3. 20.0		3. 19.0		
		Average: 19.8		Average: 20.8		Average: 22.5		
Right Rear Emergency Door	178 N	1. 13.0	PASS	1. 101.5	PASS	1. 25.0	PASS	Straight and Perpendicular to the undisturbed surface
		2. 12.0		2. 75.0		2. 32.5		
		3. 12.0		3. 58.0		3. 27.0		
		Average: 12.3		Average: 78.1		Average: 28.5		

Note: The "Actual Before" test results were obtained from the FMSSS 217 performed on this vehicle.
 The "Actual During" and "Actual After" test results were obtained during the FMVSS 220 testing.

**DATA SHEET 6
EMERGENCY EXIT MEASUREMENTS**


Test Vehicle: **2003 Liberty Bus Freedom School Bus**
 Test Lab: **MGA Research-Wisconsin Operations**


NHTSA No.: **C30901**
 Test Date: **8/21/03**



		Height (mm)	Width (mm)
1	Rear Exit Door (Right Door Only)	1260	683
2	Rear Exit Door (Both Doors Open)	1260	1452

COMMENTS: NONE

Recorded By: 

Approved By: 

Date: October 7, 2003

**SECTION 4
INSTRUMENTATION AND EQUIPMENT LIST**

Test Vehicle: **2003 Liberty Bus Freedom School Bus**
 Test Lab: **MGA Research-Wisconsin Operations**

NHTSA No.: **C30901**
 Test Date: **8/21/03**

Equipment	Description	Model/Serial No.	Cal. Date	Next Cal. Date
Computer	HP	Vectra / US03263612	—	—
Steel Tape	Stanley	Powerlock / 148	5/30/03	11/30/03
Scale	GSE	PRO-WEIGH 84 212091/212092	6/9/03	12/9/03
Cylinder #1 Load Cell	Interface	137782	5/1/03	11/1/03
Cylinder #1 Displacement Pot.	Patriot	20650	7/21/03	1/21/04
Cylinder #2 Load Cell	Interface	137781	5/1/03	11/1/03
Cylinder #2 Displacement Pot.	Interface	1202-19368	7/21/03	1/21/04
Cylinder #3 Load Cell	Interface	137778	5/1/03	11/1/03
Cylinder #3 Displacement Pot	Interface	1102-19181	7/21/03	1/21/04
Cylinder #4 Load Cell	Interface	137783	5/1/03	11/1/03
Cylinder #4 Displacement Pot.	Interface	1202-19364	7/21/03	1/21/04
Ellipsoid	MGA	ELLIP - 1A	12/4/02	12/4/03
Parallelepiped	MGA	PARA - 1A	12/4/02	12/4/03
Force Gauge	CHATILLON	DFGS-R-ND/ F31754	6/17/03	12/17/03
Temperature Recorder	DICKSON	TR320 S/N: 03039010	2/2003	2/2004

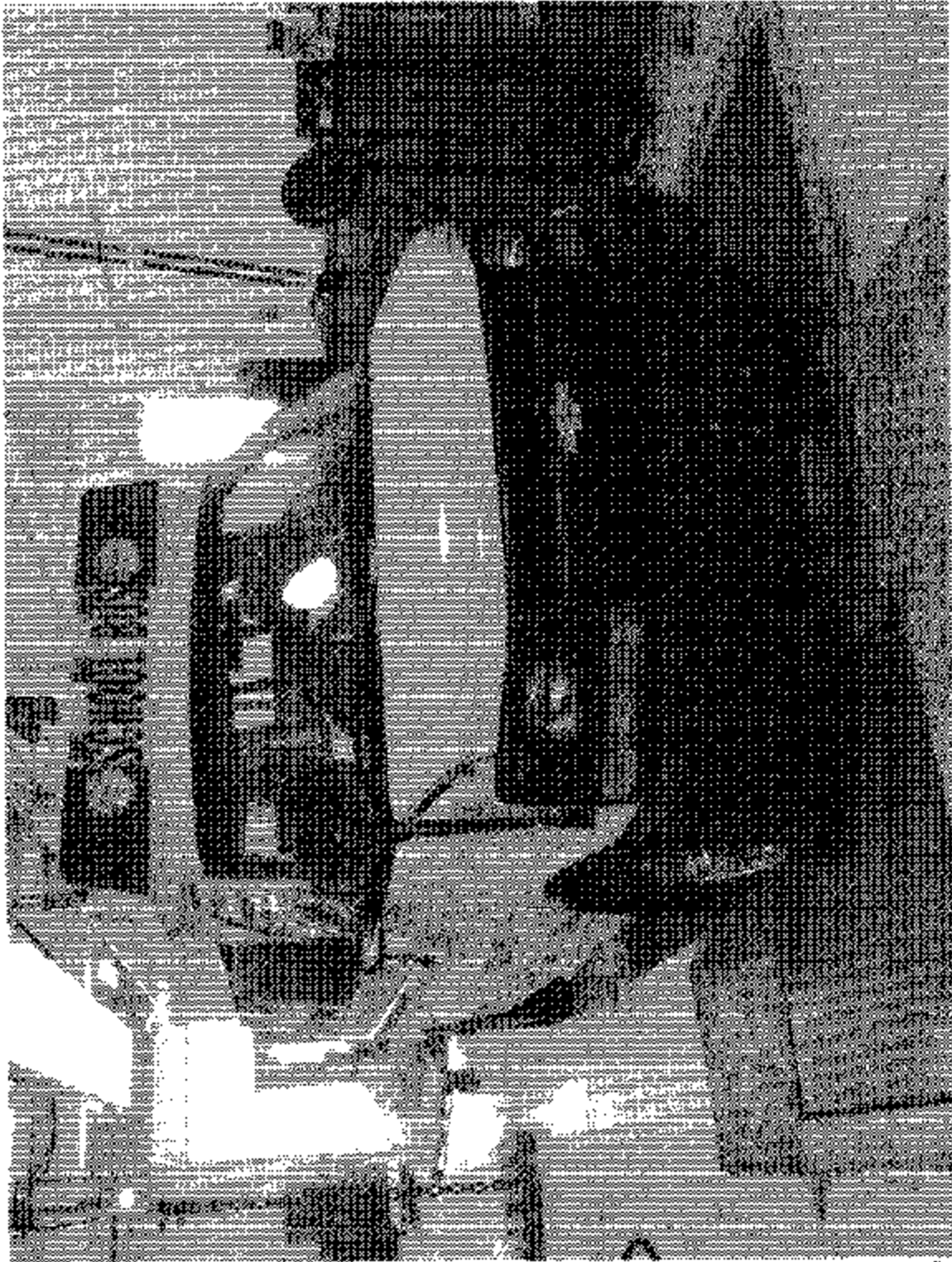
**SECTION 5
PHOTOGRAPHS**

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Test Vehicle: 2003 Liberty Bus Freedom School Bus
Procedure: FMVSS 220

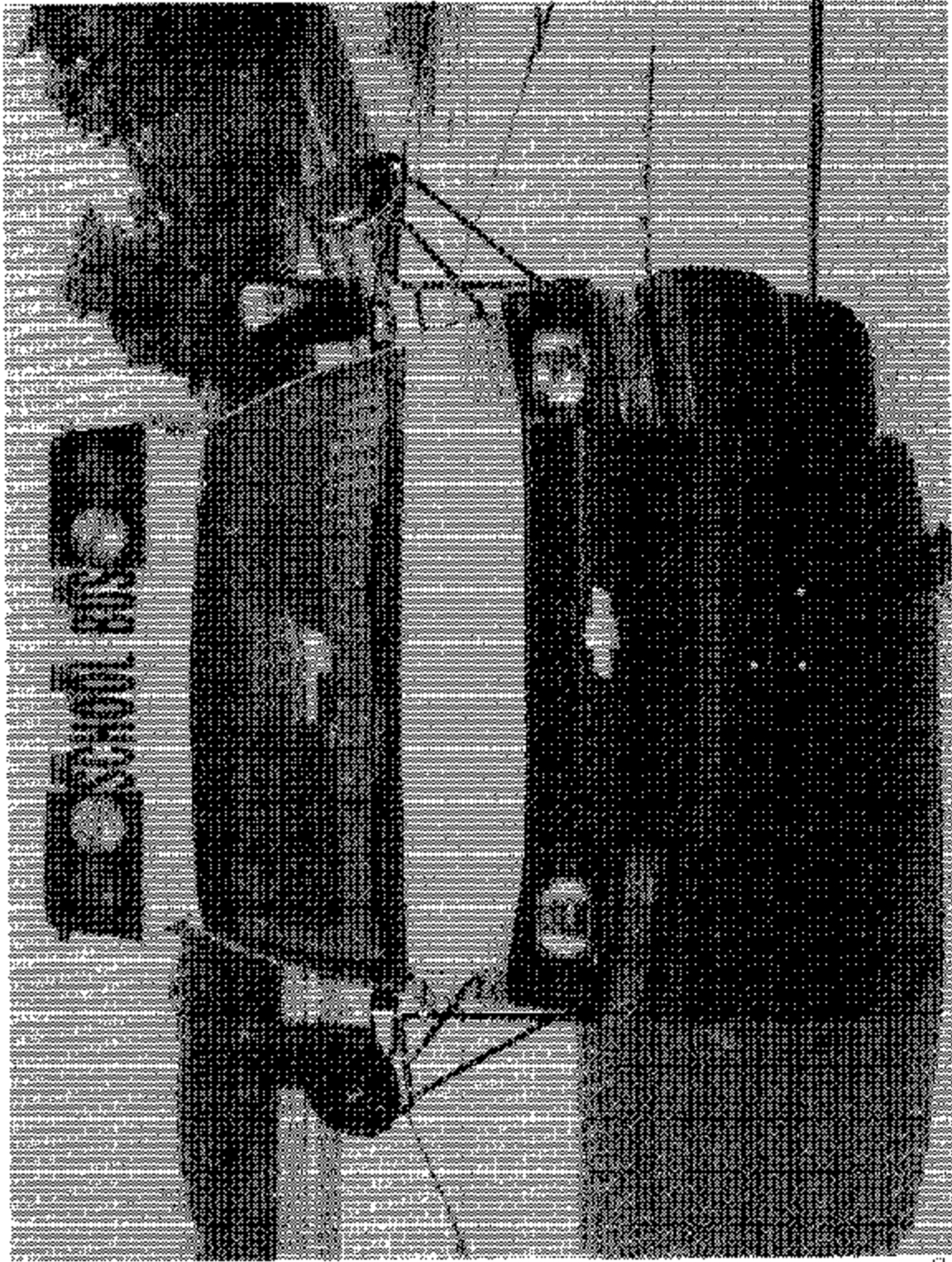
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School Bus Being Weighed

Test Vehicle: 2003 Liberty Bus Freedom School Bus
Procedure: FMVSS 220

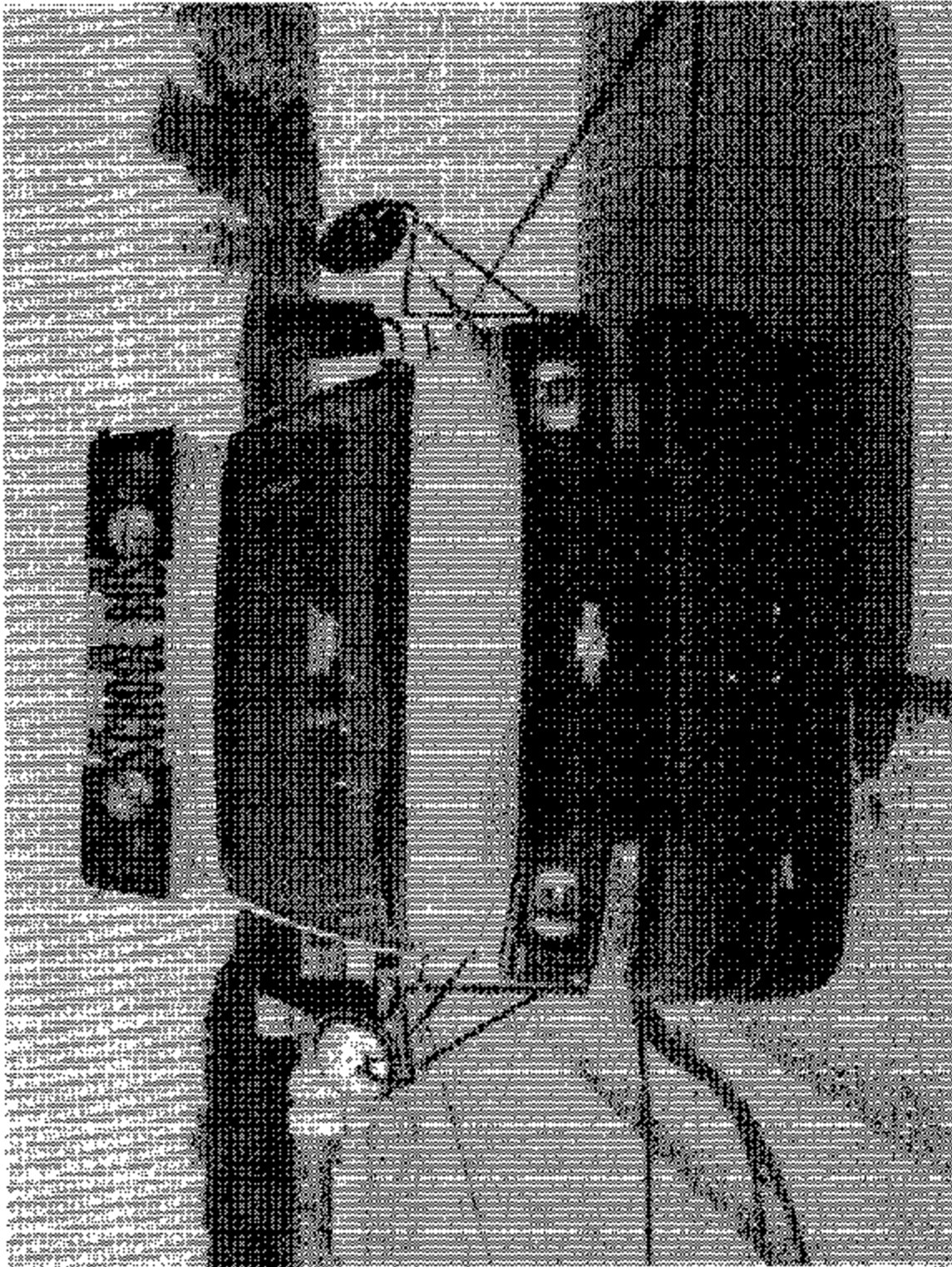
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Frontal View of School Bus Before Testing

Test Vehicle: 2003 Liberty Bus Freedom School Bus
Procedure: FMVSS 220

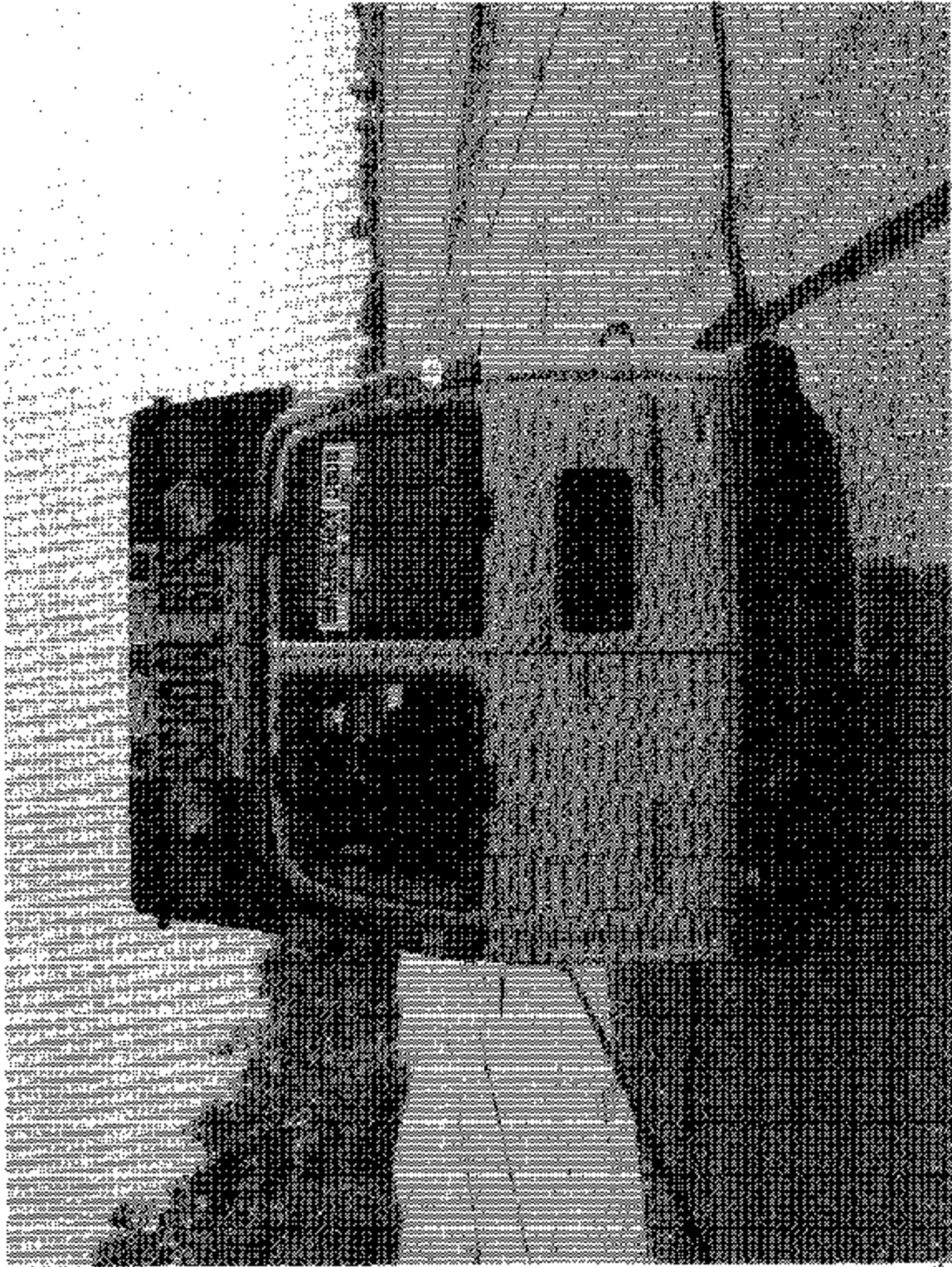
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Frontal View of School Bus After Testing

Test Vehicle: 2003 Liberty Bus Freedom School Bus
Procedure: FMVSS 220

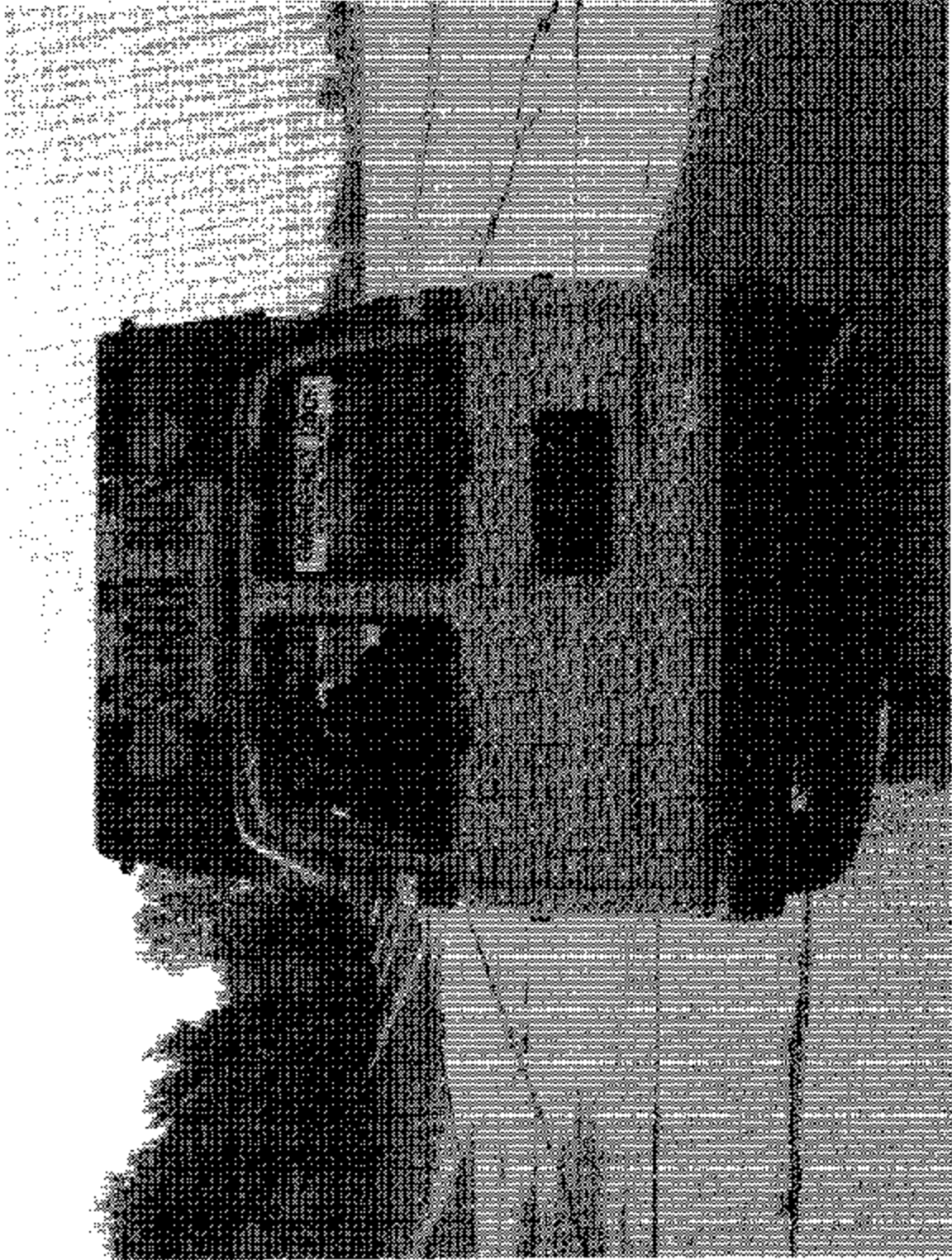
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Rear View of School Bus Before Testing

Test Vehicle: 2003 Liberty Bus Freedom School Bus
Procedure: FMVSS 220

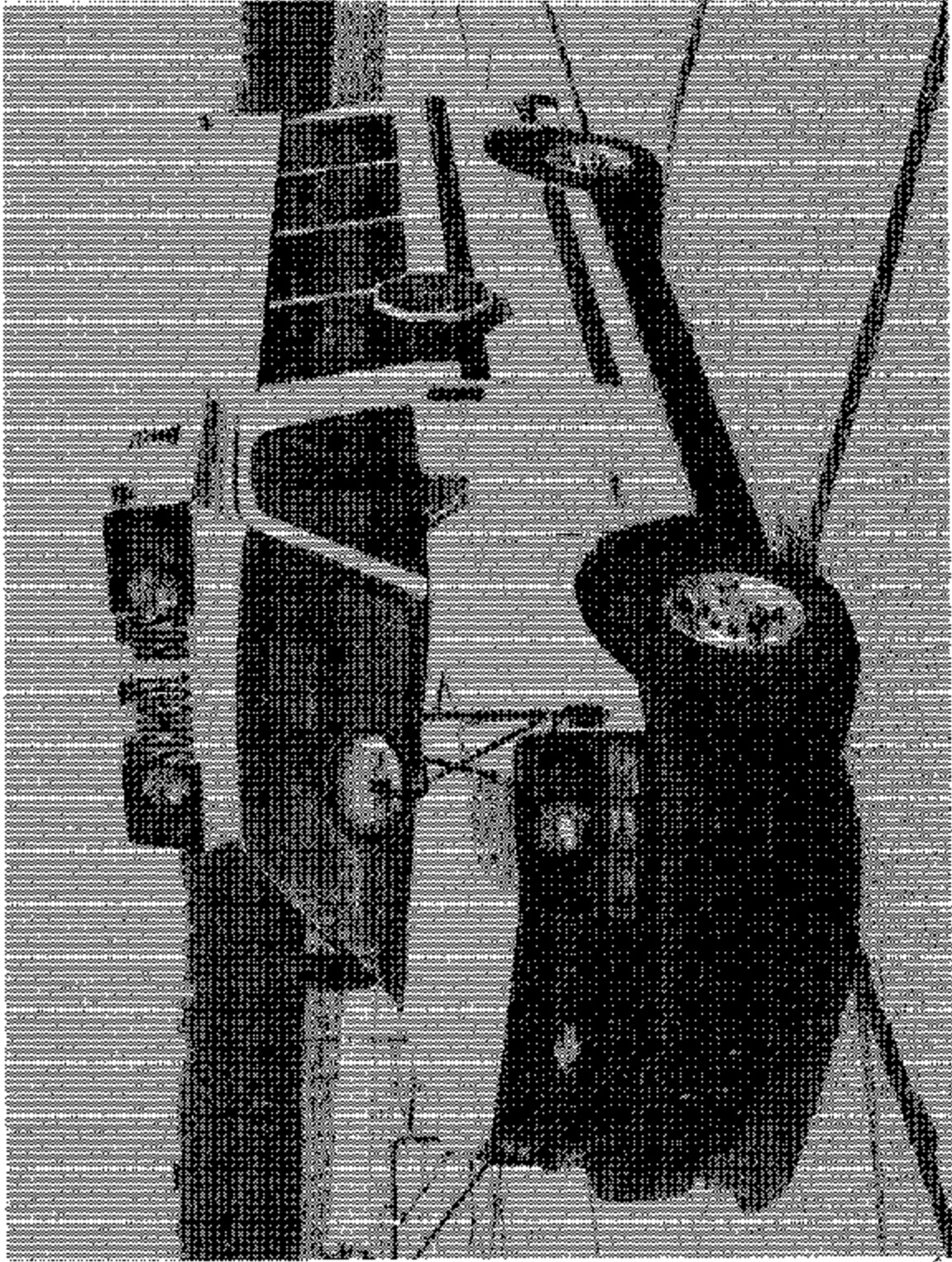
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Rear View of School Bus After Testing

Test Vehicle: 2003 Liberty Bus Freedom School Bus
Procedure: FMVSS 220

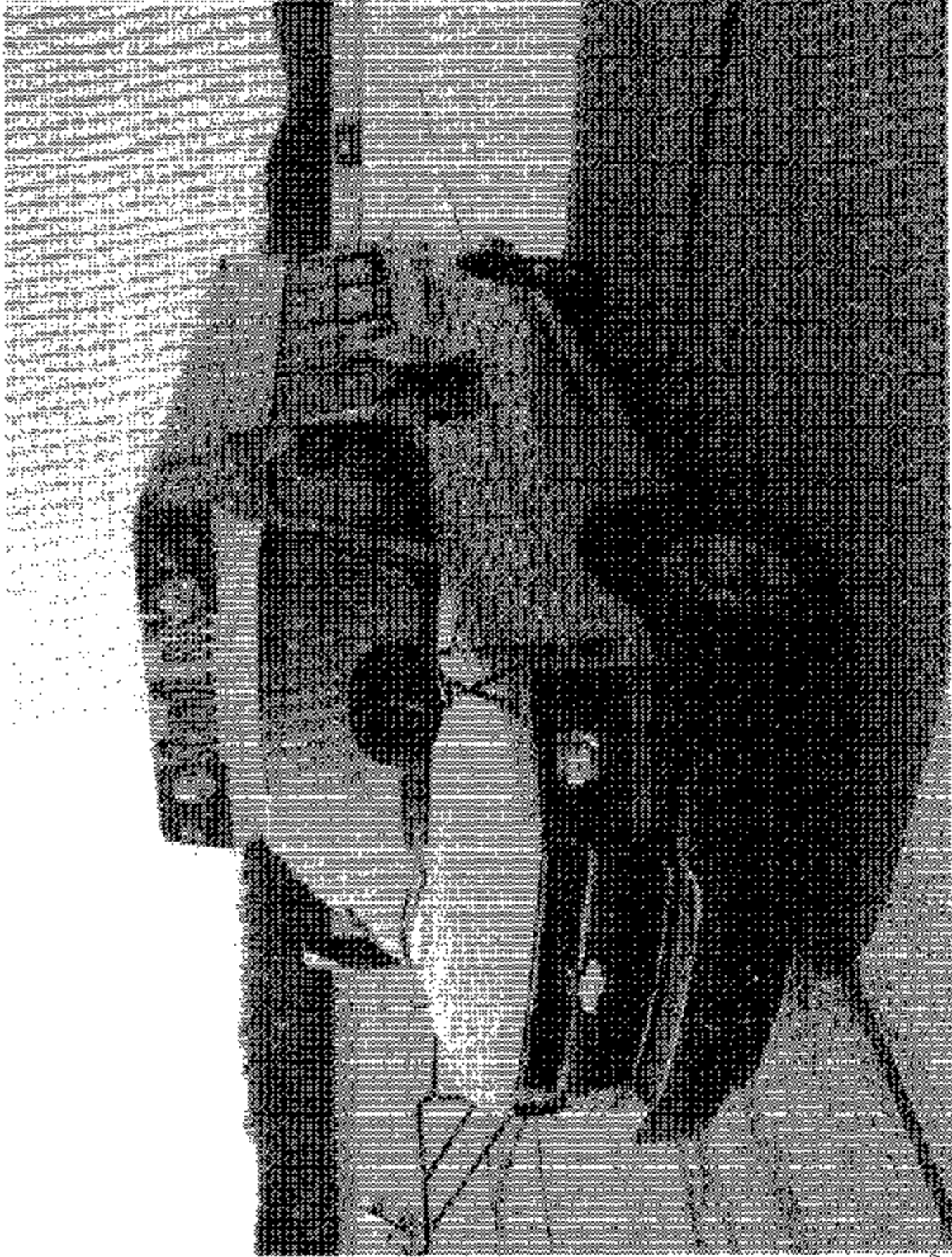
NHTSA No. C30901



¼ Forward View of School Bus Before Testing

Test Vehicle: 2003 Liberty Bus Freedom School Bus
Procedure: FMVSS 220

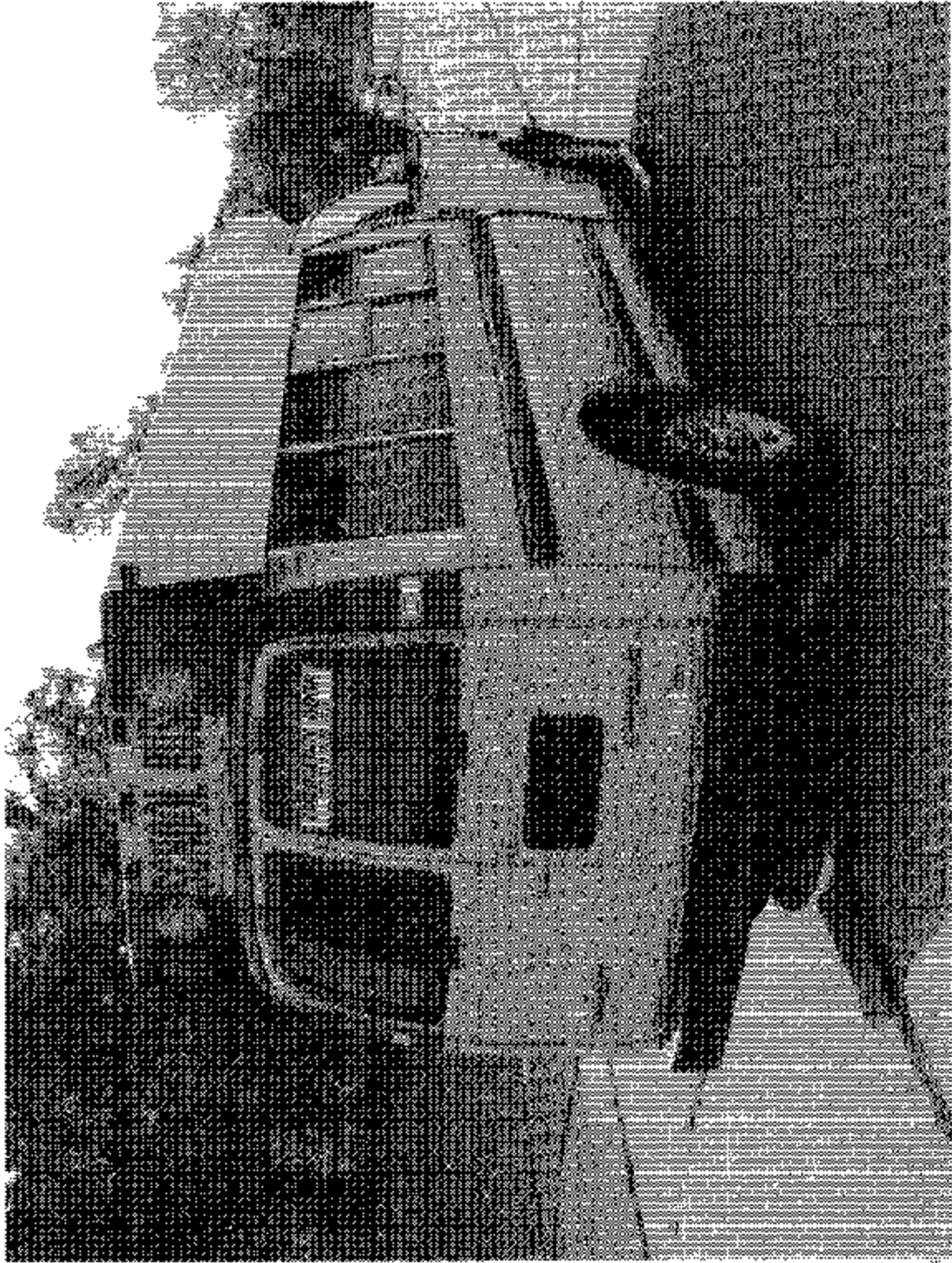
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¾ Forward View of School Bus After Testing

Test Vehicle: 2003 Liberty Bus Freedom School Bus
Procedure: FMVSS 220

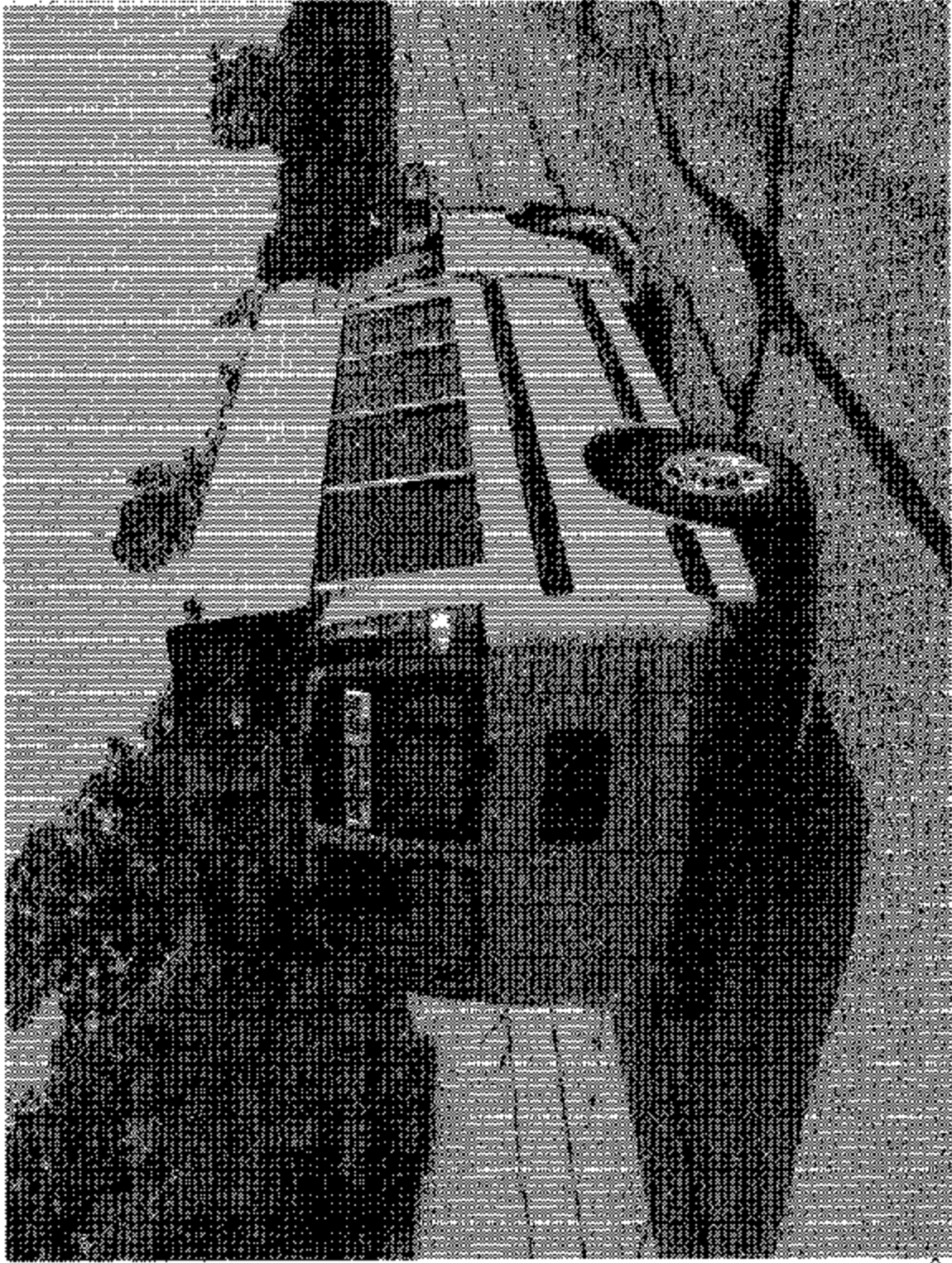
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¾ Rearward View of School Bus Before Testing

Test Vehicle: 2003 Liberty Bus Freedom School Bus
Procedure: FMVSS 220

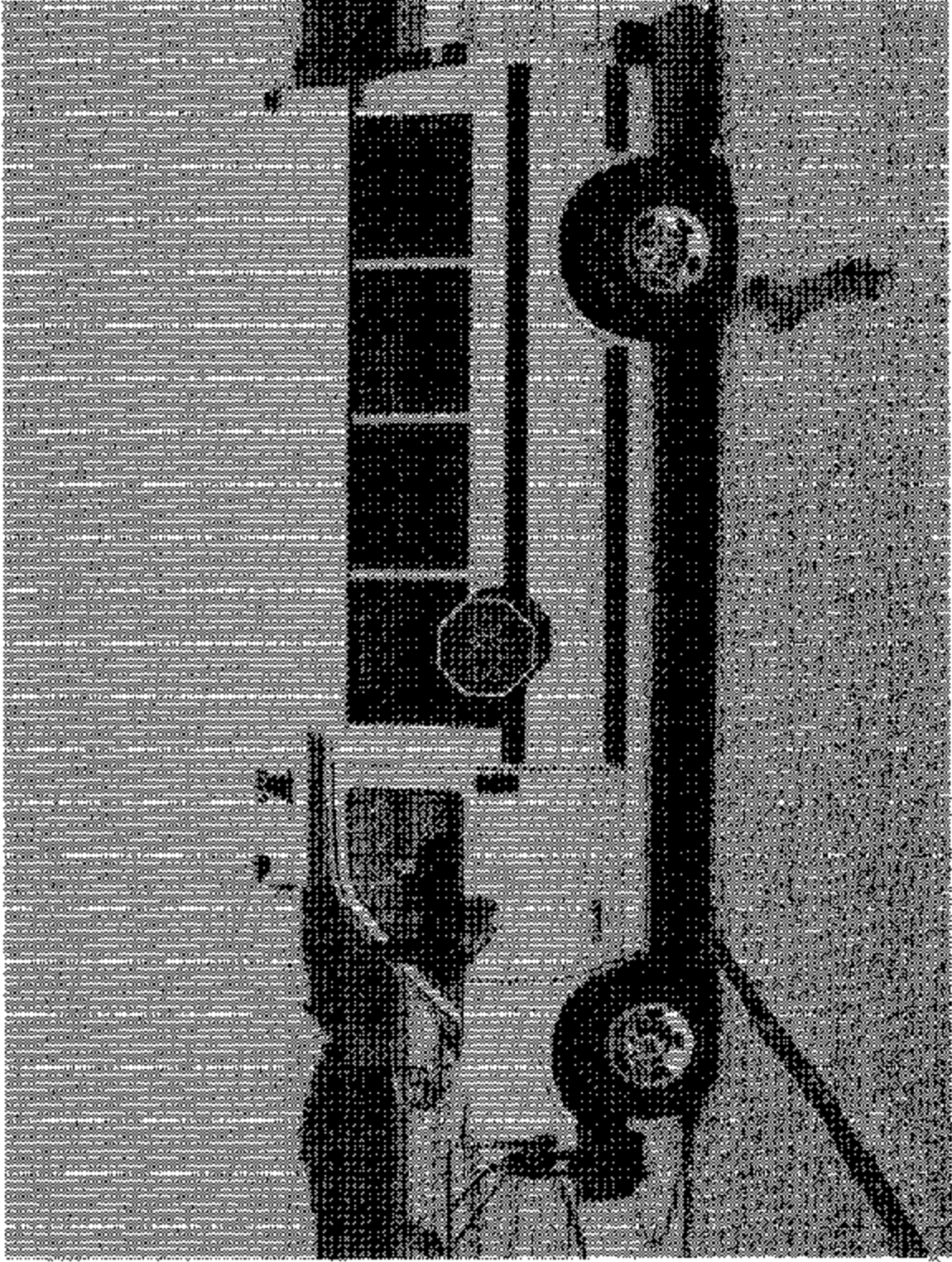
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¾ Rearward View of School Bus After Testing

Test Vehicle: 2003 Liberty Bus Freedom School Bus
Procedure: FMVSS 220

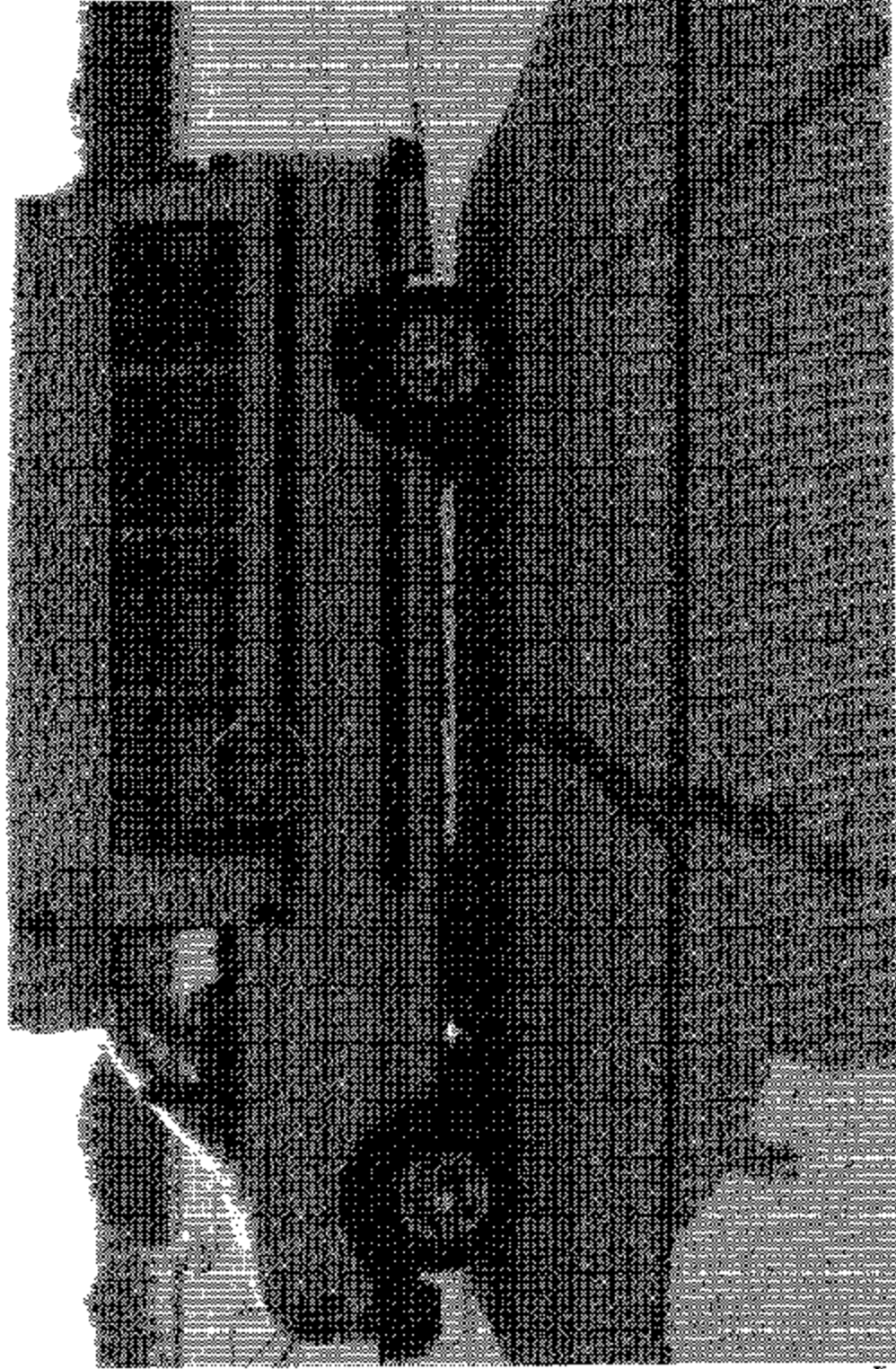
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Full View of Left Side of School Bus Before Testing

Test Vehicle: 2003 Liberty Bus Freedom School Bus
Procedure: FMVSS 220

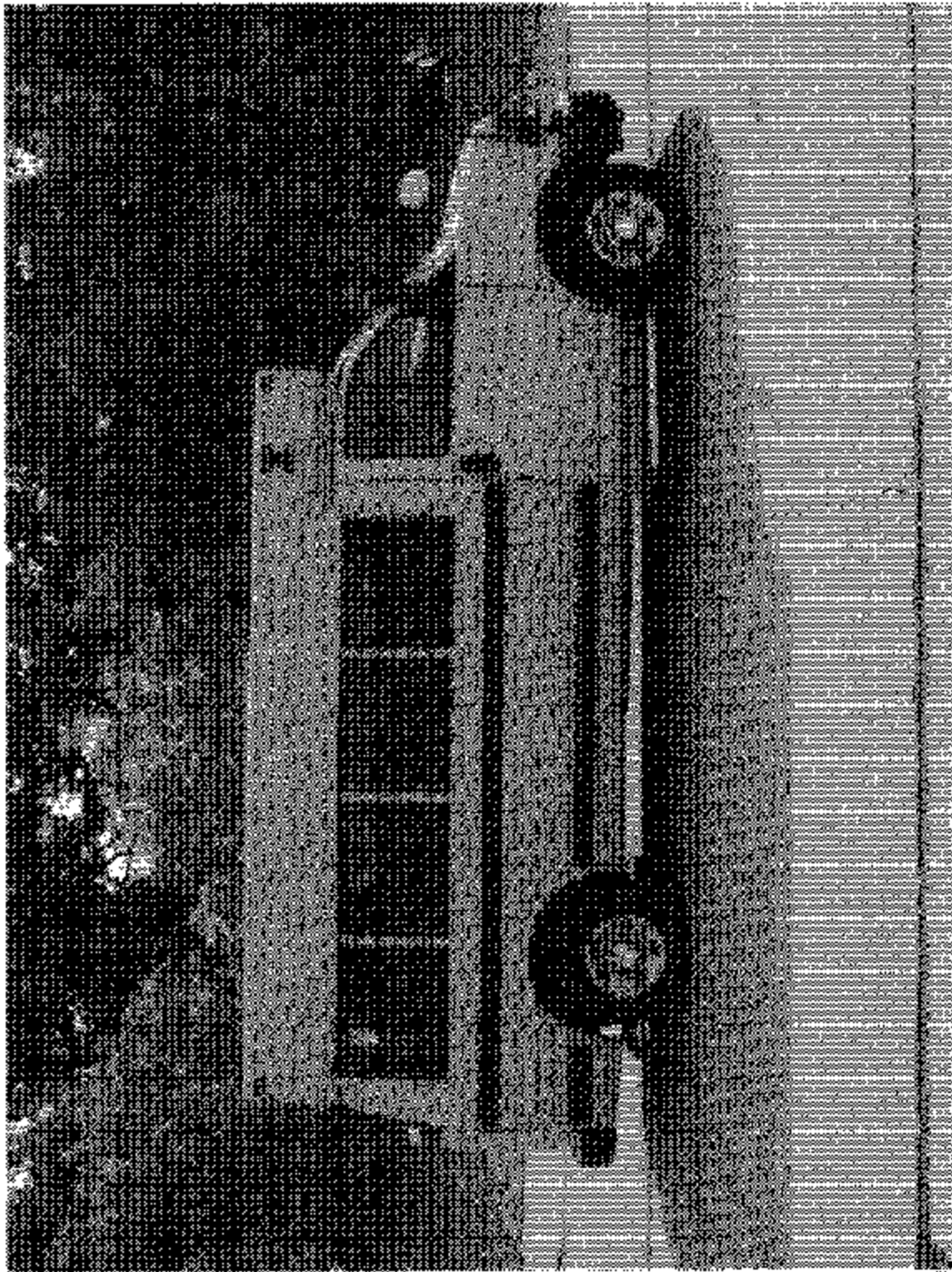
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Full View of Left Side of School Bus After Testing

Test Vehicle: 2003 Liberty Bus Freedom School Bus
Procedure: FMVSS 220

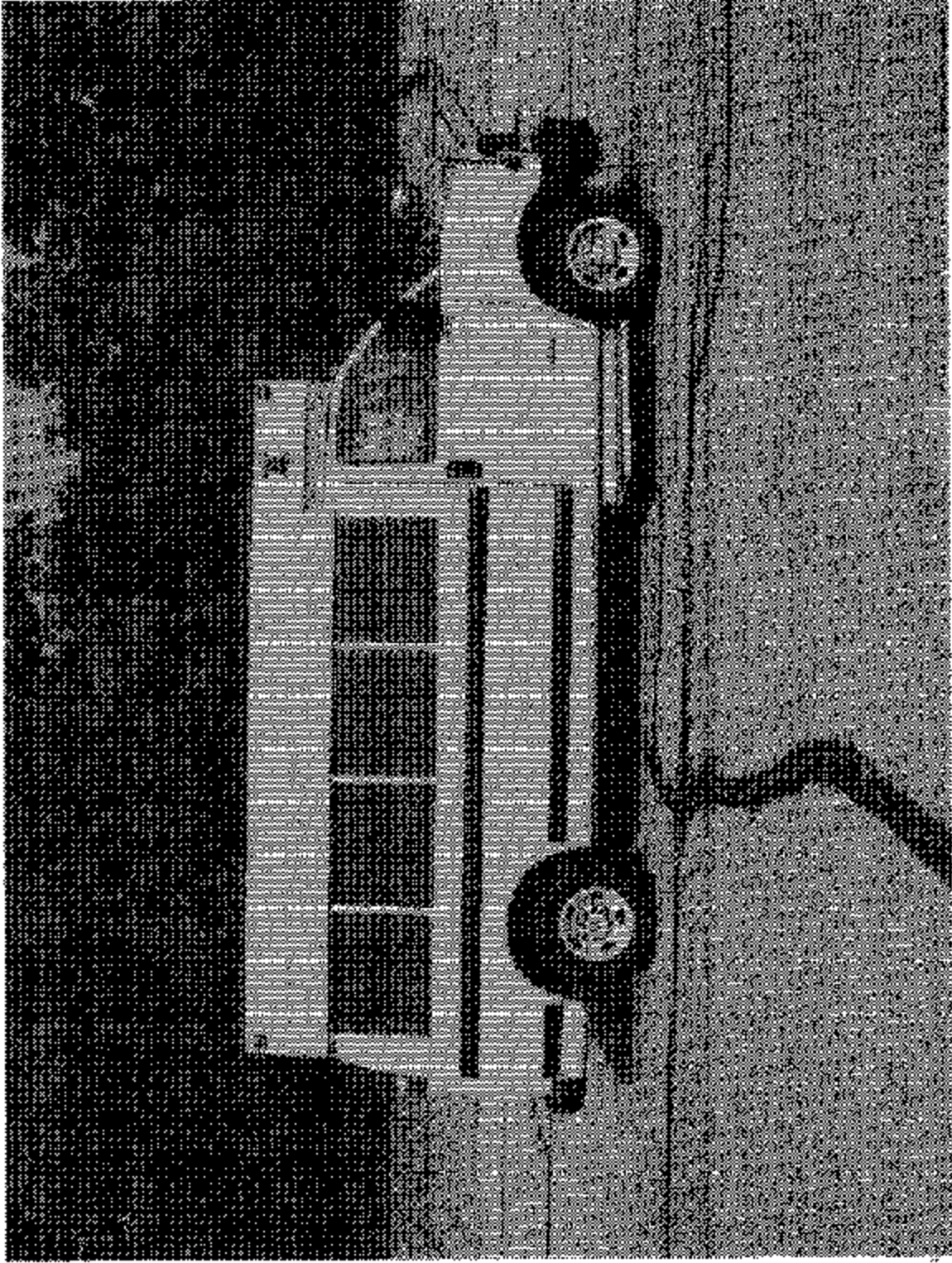
NHTSA No.: C30901



Full View of Right Side of School Bus Before Testing

Test Vehicle: 2003 Liberty Bus Freedom School Bus
Procedure: FMVSS 220

NHTSA No., C30901



Full View of Right Side of School Bus After Testing

Test Vehicle: 2003 Liberty Bus Freedom School Bus
Procedure: FMVSS 220

NHTSA No.: C30901

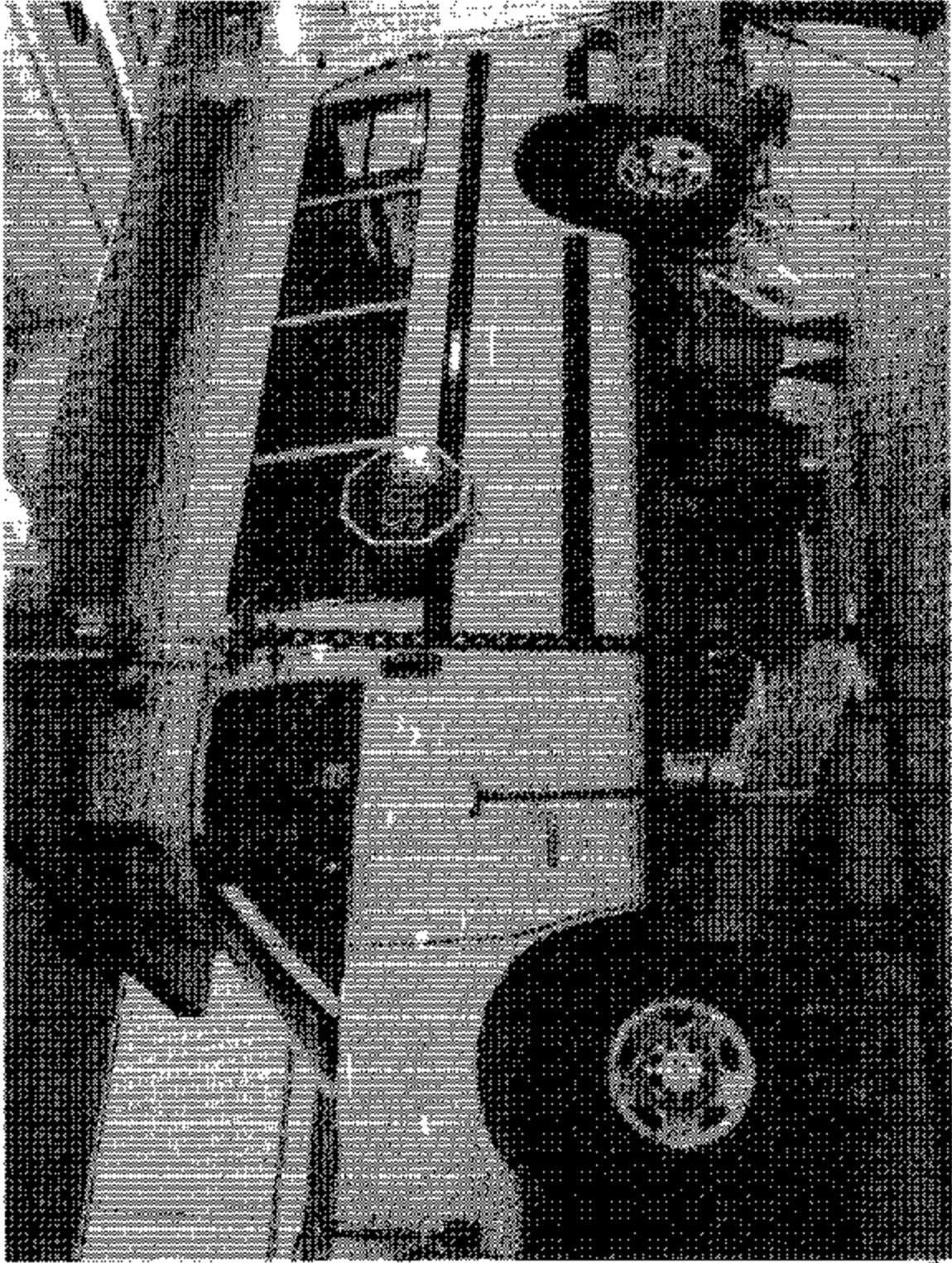


Photo of Loading Device Placed Against Bus's Roof at Beginning of Test

Test Vehicle: 2003 Liberty Bus Freedom School Bus
Procedure: FMVSS 220

NHTSA No.: C30901

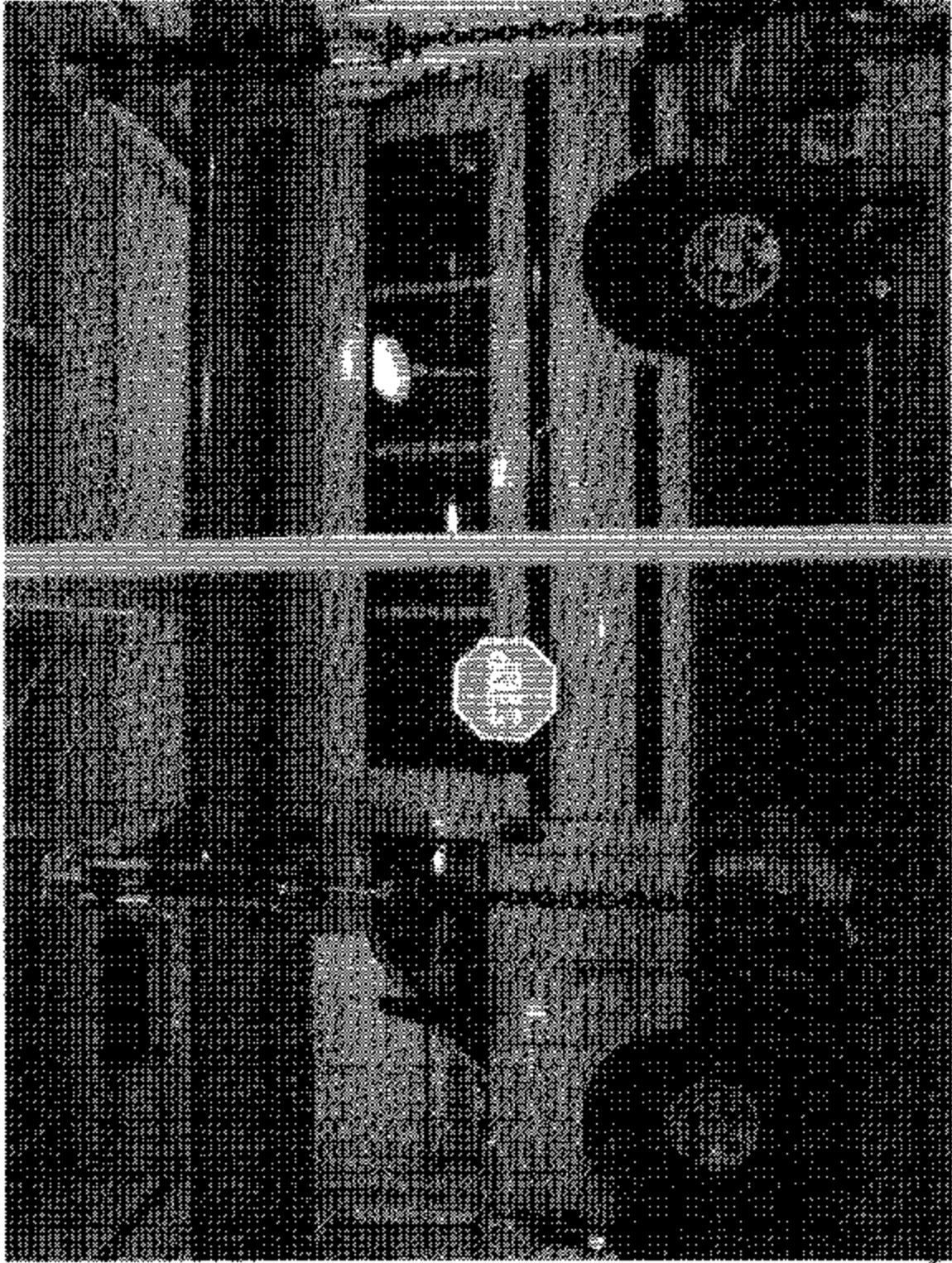
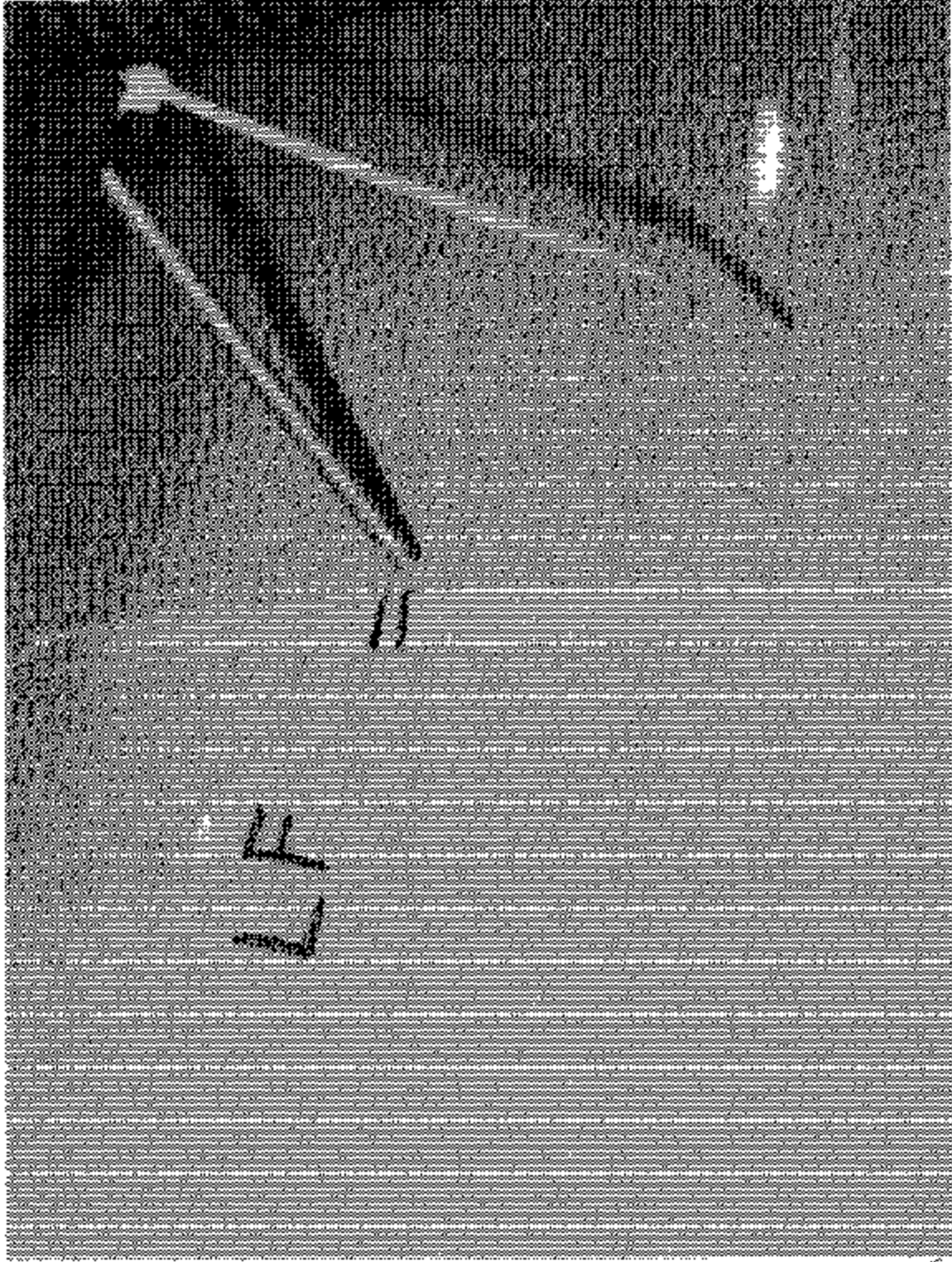


Photo of Loading Device Placed Against Bus's Roof at Max Load Condition

Test Vehicle: 2003 Liberty Bus Freedom School Bus
Procedure: FMVSS 220

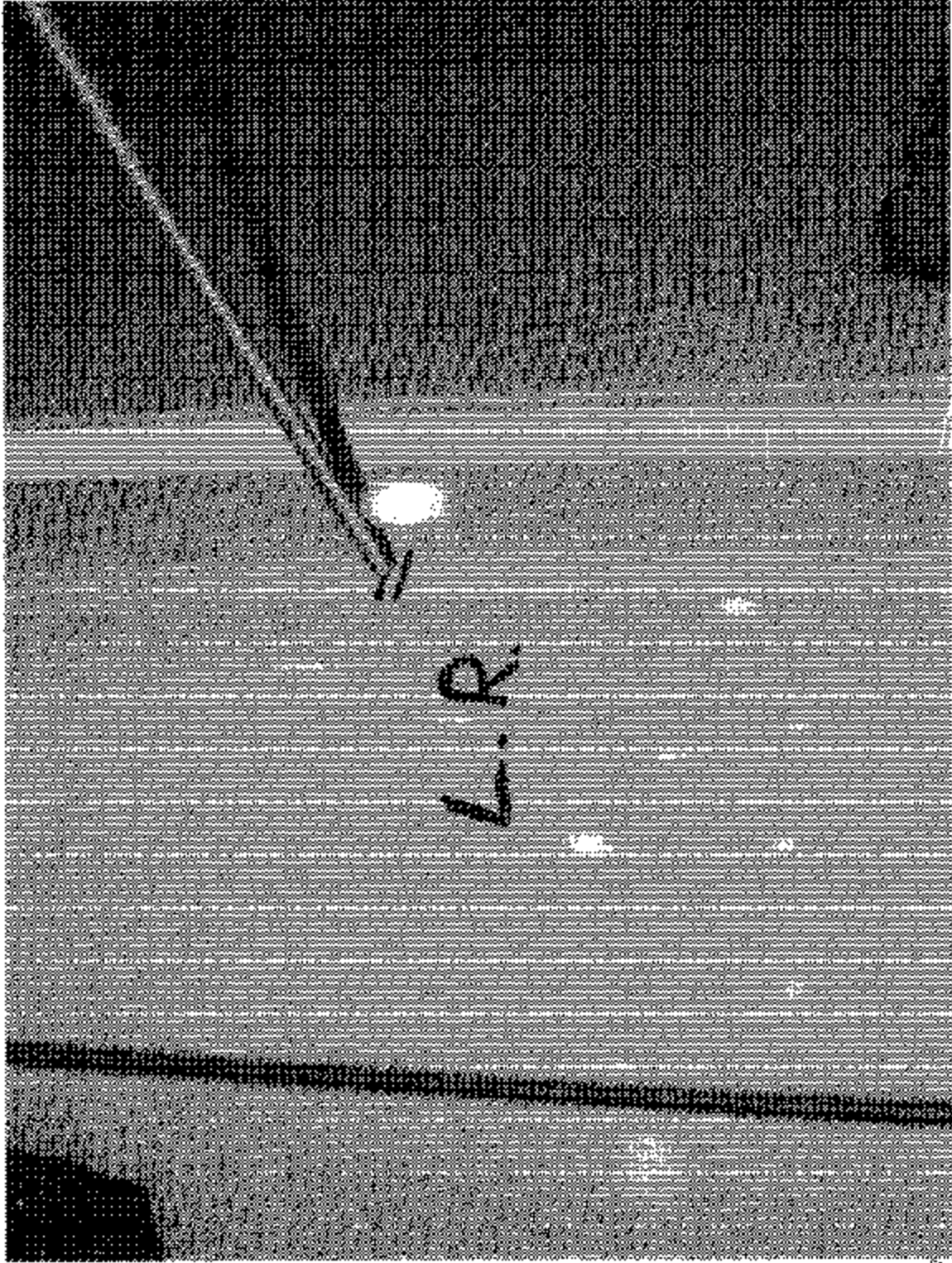
NHTSA No.: C30901



Left Front Backup Measuring Device at Maximum Load

Test Vehicle: 2003 Liberty Bus Freedom School Bus
Procedure: FMVSS 220

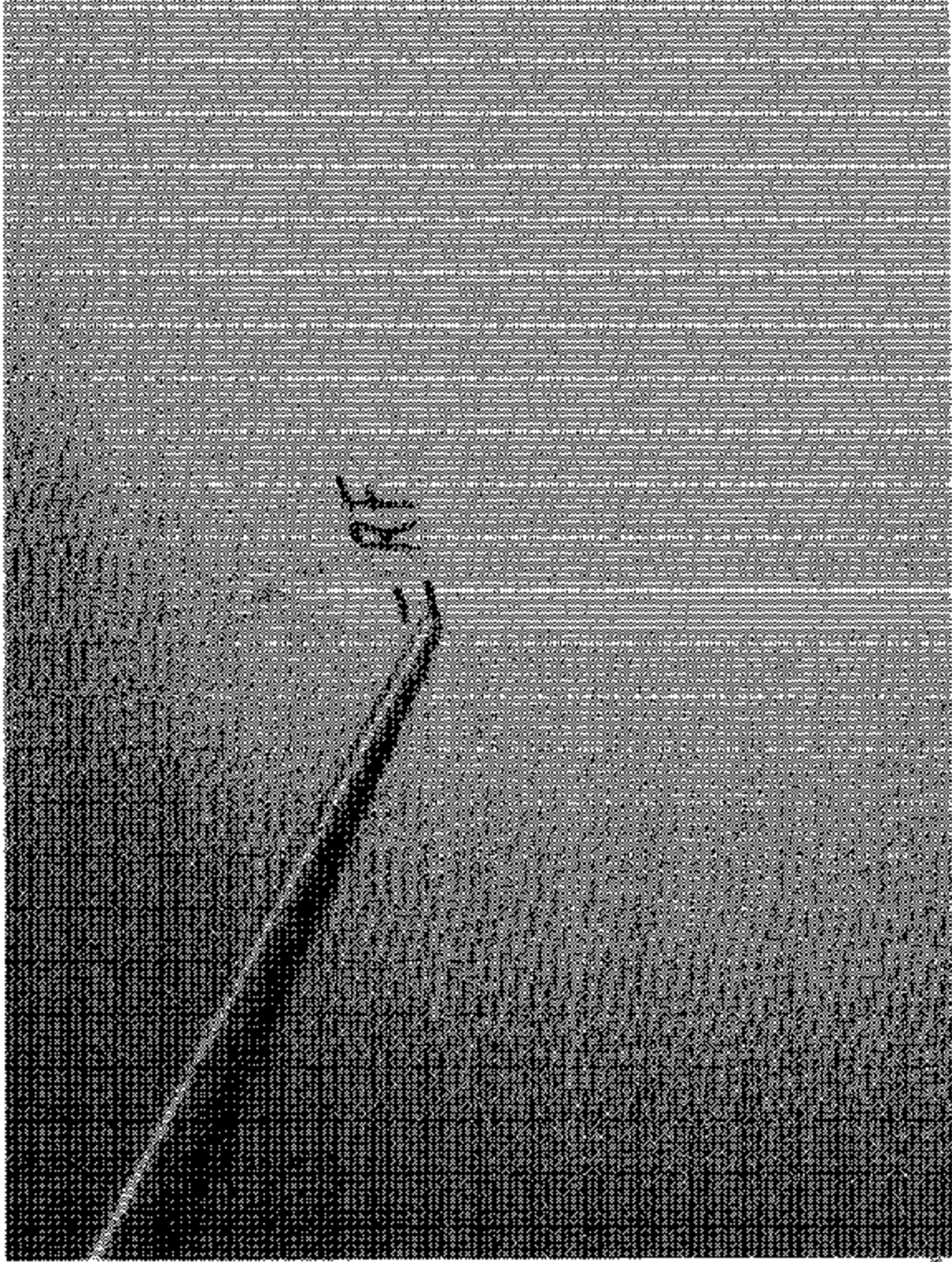
NHTSA No.: C30901



Left Rear Backup Measuring Device at Maximum Load

Test Vehicle: 2003 Liberty Bus Freedom School Bus
Procedure: FMVSS 220

NHTSA No.: C30901



Right Front Backup Measuring Device at Maximum Load

Test Vehicle: 2003 Liberty Bus Freedom School Bus
Procedure: FMVSS 220

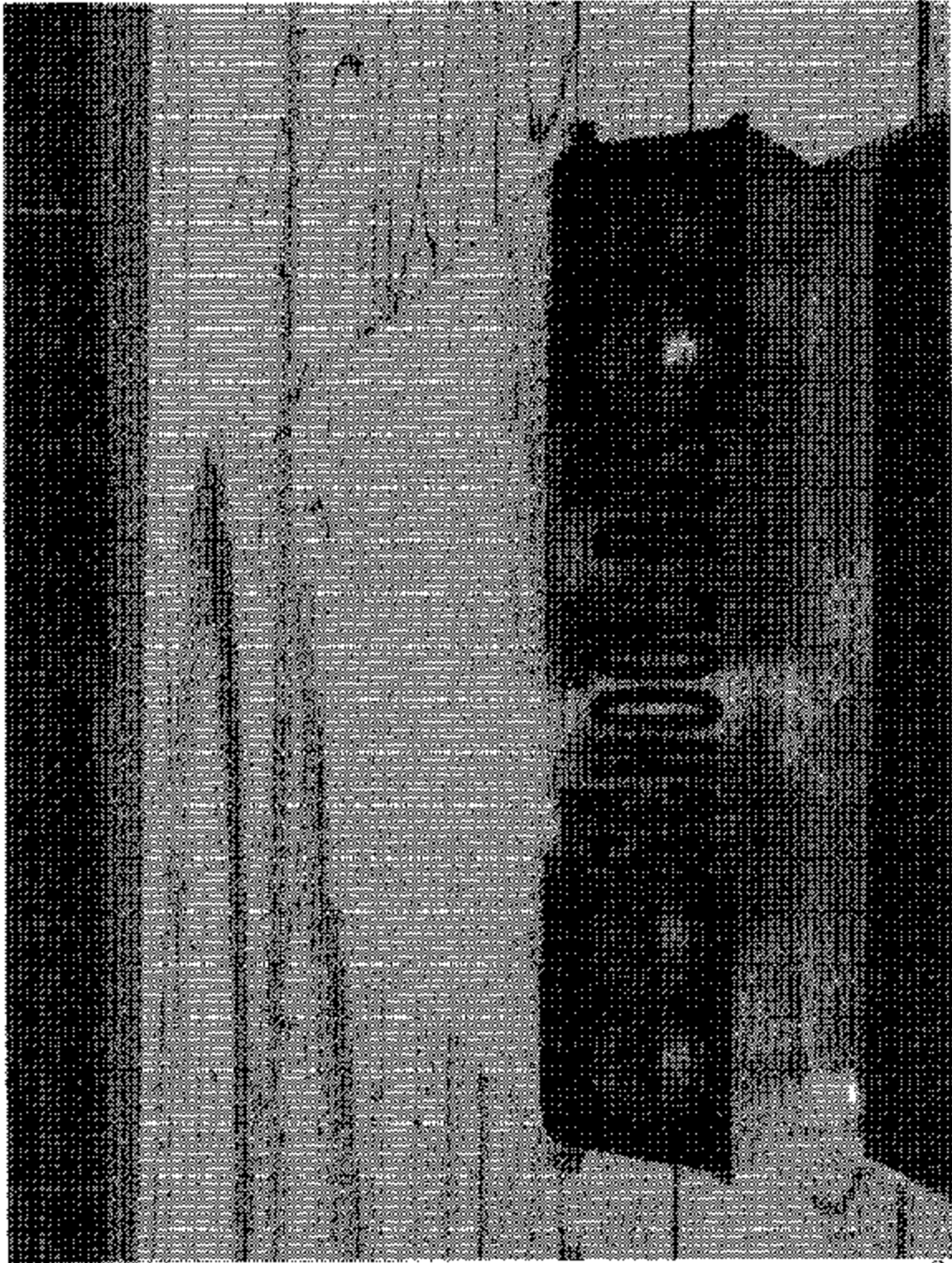
NHTSA No.: C30901



Right Rear Backup Measuring Device at Maximum Load

Test Vehicle: 2003 Liberty Bus Freedom School Bus
Procedure: FMVSS 220

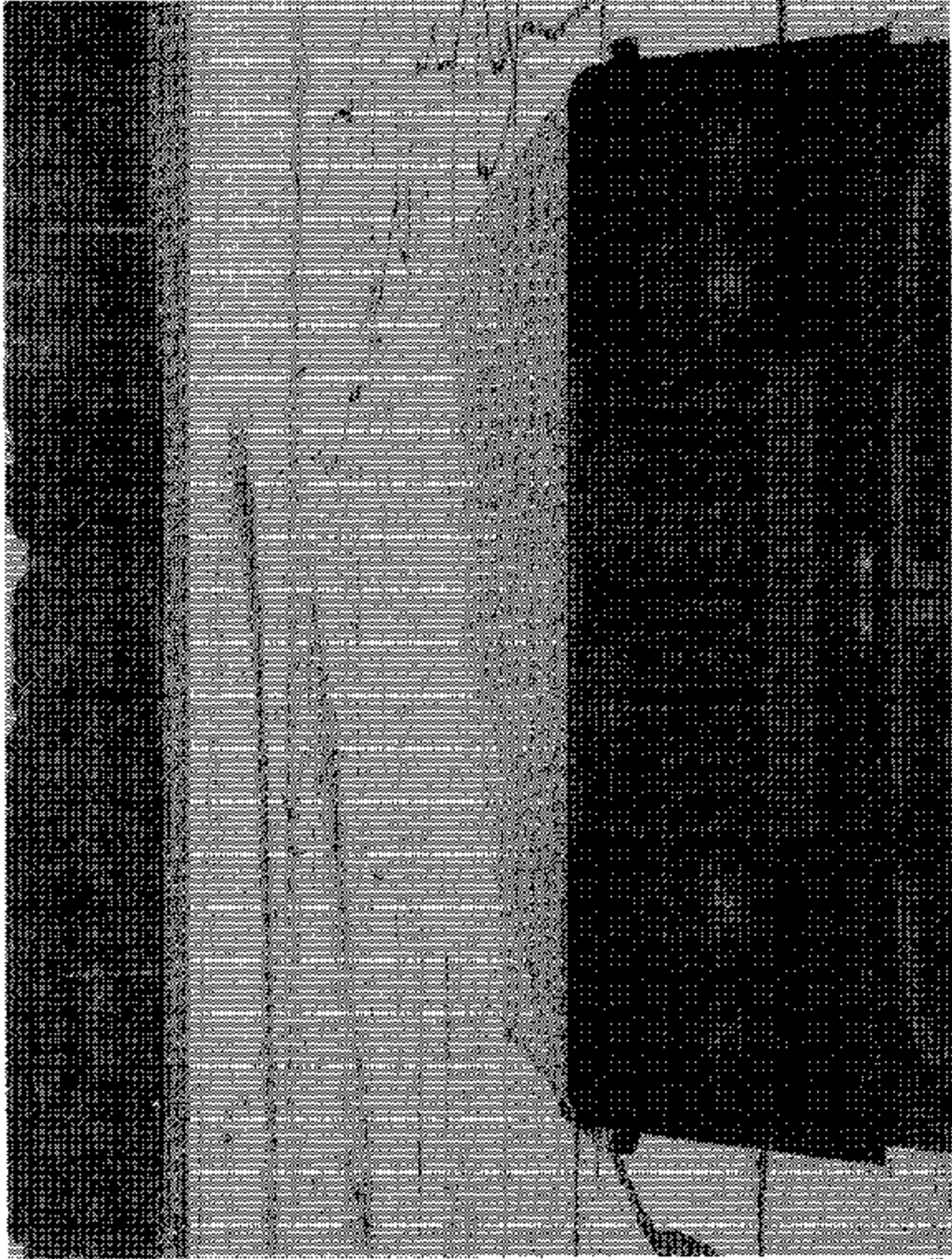
NHTSA No.: C189D1



Pre-Test Front View of Bus Roof

Test Vehicle: 2003 Liberty Bus Freedom School Bus
Procedure: FMVSS 220

NHTSA No.: C30904



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Pre-Test Rear View of Bus Roof

Test Vehicle: 2003 Liberty Bus Freedom School Bus
Procedure: FMVSS 220

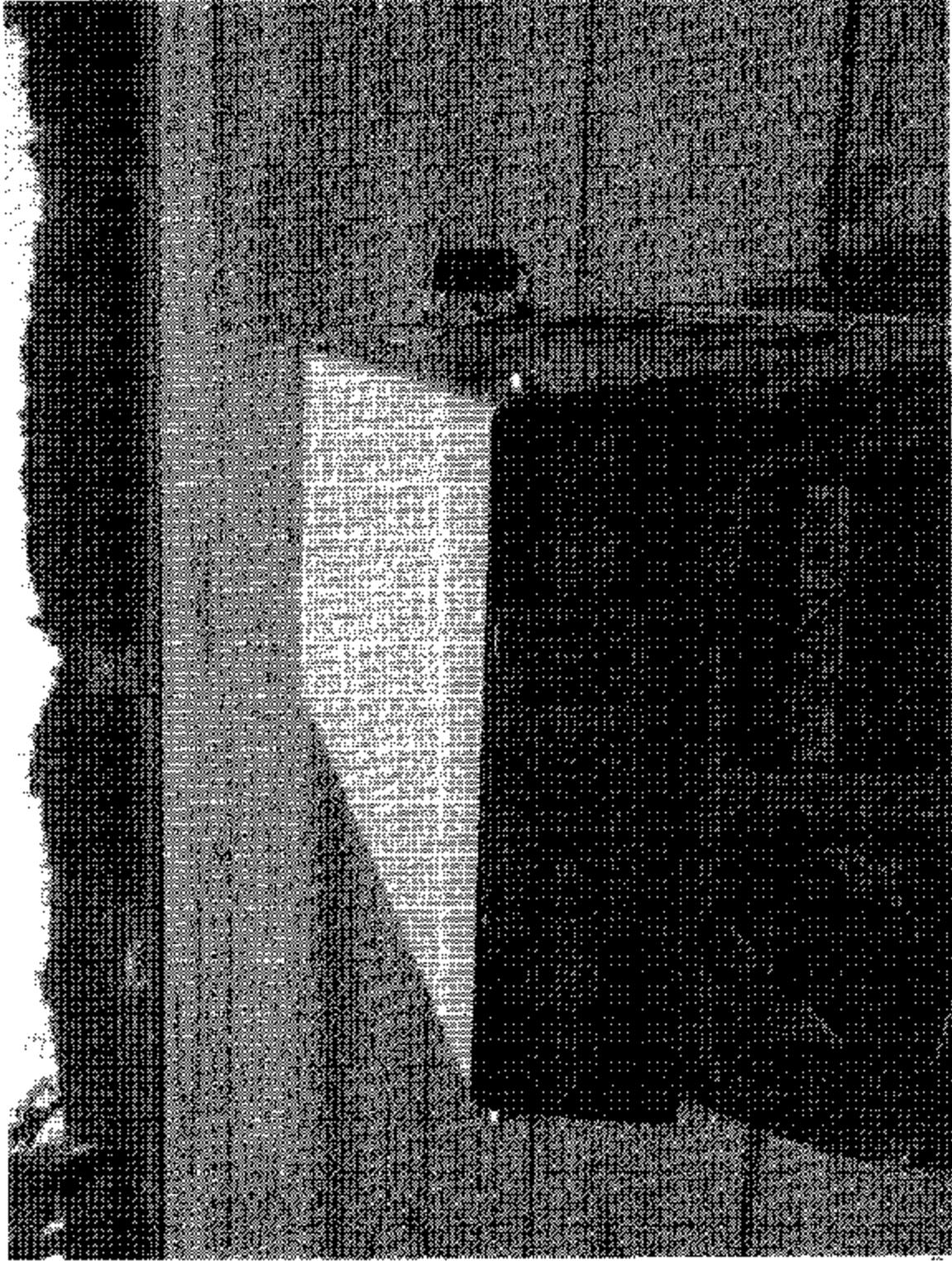
NHTSA No.: C30901



Post-Test Front View of Bus Roof

Test Vehicle: 2003 Liberty Bus Freedom School Bus
Procedure: FMVSS 220

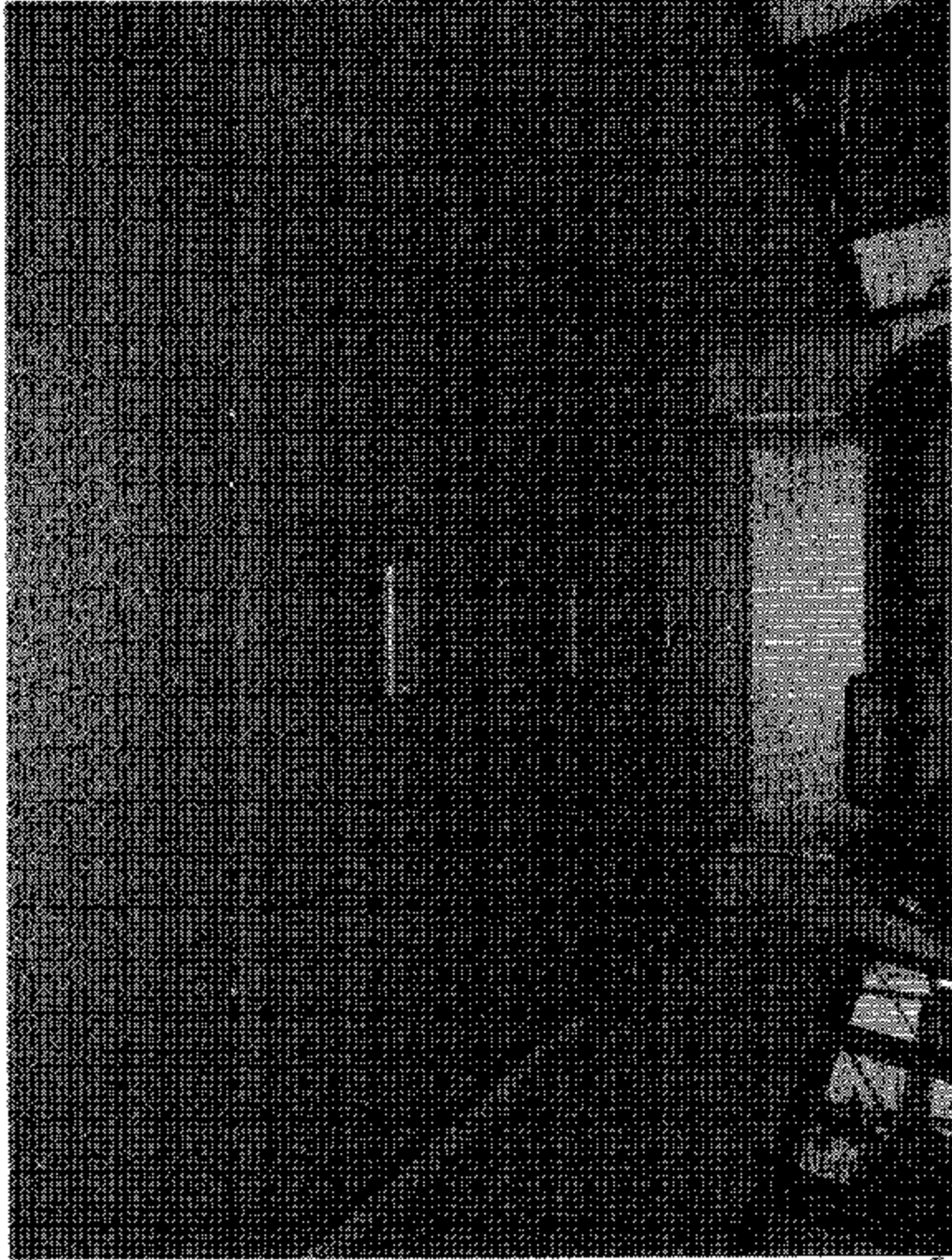
NHTSA No.: C30981



Post-Test Rear View of Bus Roof

Test Vehicle: 2003 Liberty Bus Freedom School Bus
Procedure: FMVSS 220

NHTSA No: C30901



Pre-Test Interior View of Bus Roof

Test Vehicle: 2003 Liberty Bus Freedom School Bus
Procedure: FMVSS 220

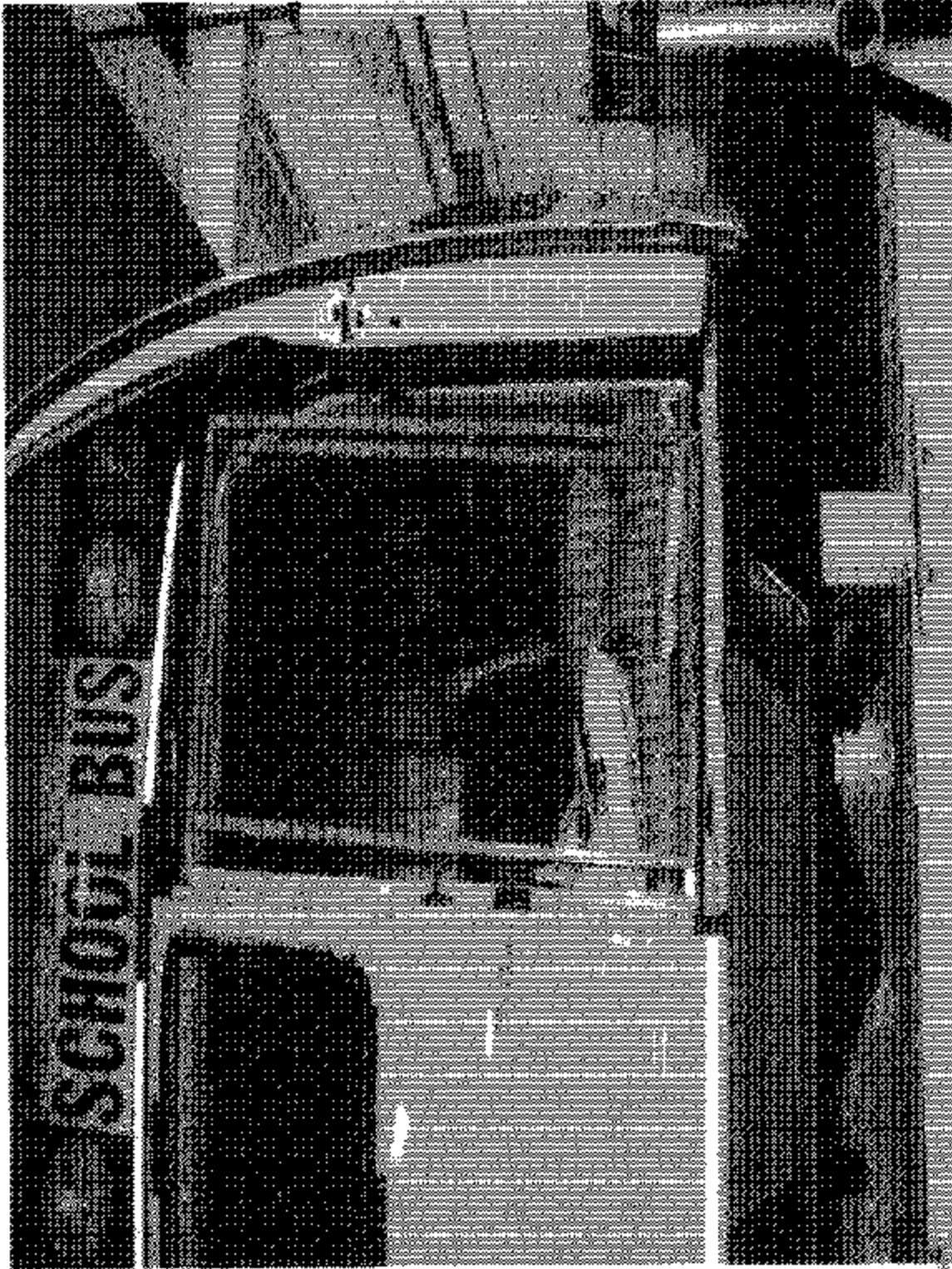
NHTSA No: C30801



Post-Test Interior View of Bus Roof

Test Vehicle: 2003 Liberty Bus Freedom School Bus
Procedure: FMVSS 220

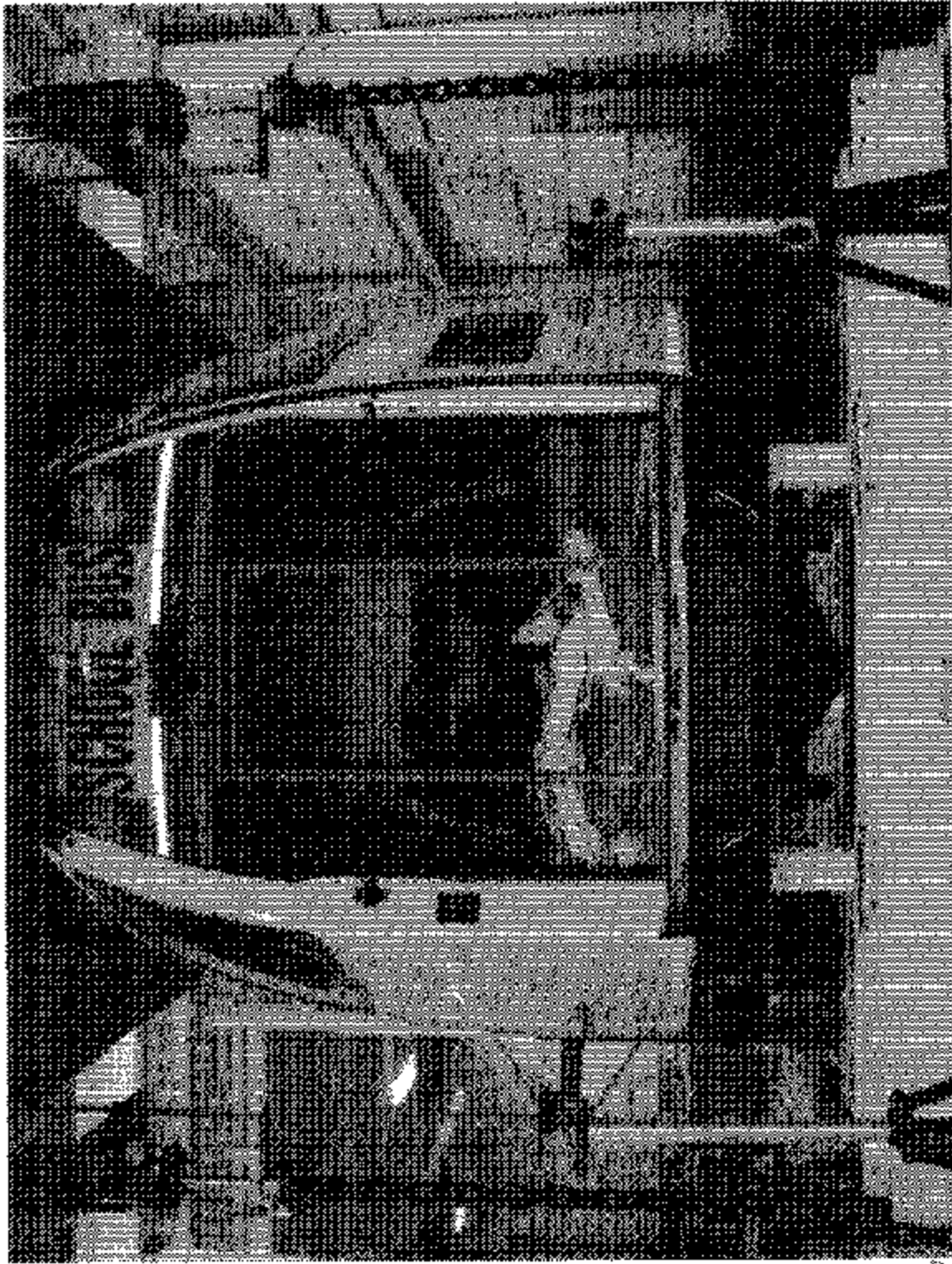
NHTSA No.: CJ0901



Exit Opening After Roof Loading with Parallelepiped in Place (Right Rear Door)

Test Vehicle: 2003 Liberty Bus Freedom School Bus
Procedure: FMVSS 220

NHTSA No.: C30901



Exit Opening After Roof Loading with Parallelepiped in Place (Both Doors)

**SECTION 6
TEST PLOTS**

