HSN₀: 637989

REPORT NUMBER: 221-MGA-05-001

SAFETY COMPLIANCE TESTING FOR FMVSS NO. 221 SCHOOL BUS BODY JOINT STRENGTH

US Bus Corporation
2005 US Bus Sturdibus HD School Bus
NHTSA No.: C50900

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

Final Report Date: August 4, 2005

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-224)
WASHINGTON, D.C. 20590

This publication is distributed by the U.S. Department of Transportation, National Highway Traffic Safety Administration, in the interest of information exchange. The opinions, findings and conclusions expressed in this publication are those of the author(s) and not necessarily those of the Department of Transportation or the National Highway Traffic Safety Administration. The United States Government assumes no liability for its contents or use thereof. If trade or manufacturers' names or products are mentioned it is only because they are considered essential to the object of the publication and should not be construed as an endorsement. The United States Government does not endorse products or manufacturers.

Prepared by: _____ Date: August 4, 2005
James Hansen, Program Manager

Reviewed by: _____ Date: August 4, 2005
John Roberts, Project Engineer

FINAL REPORT ACCEPTED BY:

_____

08/16/2005
Date of Acceptance

Technical Report Documentation Page

1. Report No. 221-MGA-05-001	*2. Government Accession No.*	*3. Recipient's Catalog No.*	
4. Title and Subtitle Final Report of FMVSS 221 Compliance Testing of 2005 US Bus Sturdibus HD School Bus NHTSA No.:C50900		*5. Report Date* August 4, 2005 *6. Performing Organization Code* MGA	
7. Author(s) John Roberts, Project Engineer James Hansen, Project Manager		*8. Performing Organization Report No.* 221-MGA-05-001	
9. Performing Organization Name and Address MGA Research Corporation 5000 Warren Road Burlington, WI 53105		*10. Work Unit No.* *11. Contract or Grant No.* DTNH22-02-D-01057	
12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Administration Enforcement Office of Vehicle Safety Compliance (NVS-224) 400 Seventh St., S.W. Room 6115 Washington, D.C. 20590		*13. Type of Report and Period Covered* Final Report 07/06/05 – 08/04/05 *14. Sponsoring Agency Code* NVS-224	
15. Supplementary Notes			
16. Abstract Compliance tests were conducted on the subject 2005 US Bus Sturdibus HD School Bus, NHTSA No. C50900 in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP-221-02 for the determination of compliance with FMVSS 221 requirements. Test Failures were as follows: See Summary in Section 3.			
17. Key Words Compliance Testing Safety Engineering FMVSS 221		*18. Distribution Statement* Copies of this report are available from: NHTSA Technical Information Services (TIS) Room 2336, (NPO-405) 400 Seventh Street, S.W. Washington, D.C. 20590 (202) 366-4946	
19. Security Classif. (of this report) Unclassified	*20. Security Classif. (of this page)* Unclassified	*21. No. of Pages* 73	22. Price

Form DOT F1700.7 (8-72)

SECTION 4
COMPLIANCE TEST DATA

The following data sheets document the results of FMVSS 221 testing on the MY2005 US Bus Sturdibus HD School Bus, NHTSA No. C50900.

DATA SHEET 1
ADMINISTRATIVE DATA SHEET

Test Vehicle: **2005 US Bus Sturdibus HD** NHTSA No.: **C50900**
Test Lab: **MGA Research-Wisconsin Operations** Test Date: **07/07/05**

INCOMPLETE VEHICLE (IF APPLICABLE)

Manufacturer:	GM
Model:	Sturdibus HD
VIN:	1GBE6V1255F515430
Build Date:	3/05
Certification Date:	N/A

COMPLETED VEHICLE (SCHOOL BUS)

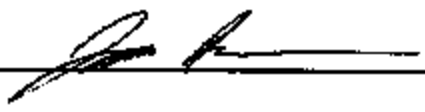
Manufacturer:	US Bus
Make/Model:	Sturdibus HD
VIN:	1GBE6V1255F515430
NHTSA No.:	C50900
Color:	Yellow
GVWR:	8,845 kg / 19,500 lbs
Build Date:	03/05
Certification Date:	03/05

DATES

Vehicle Receipt:	03/21/05
Start of Compliance Test:	07/06/05
Completion of Compliance Test:	07/07/05

COMPLIANCE TEST:
All tests were performed in accordance with the references outlined in TP-221-02.

Recorded By: 

Approved By:  Date: 07/07/05

DATA SHEET 2

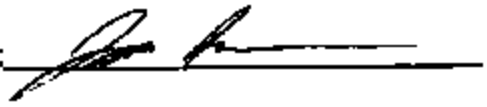
SUMMARY OF DATA

Test Vehicle: **2005 US Bus Sturdibus HD** NHTSA No.: **C50900**
Test Lab: **MGA Research-Wisconsin Operations** Test Date: **07/07/05**

Joint Specimen I.D.	Joint Location	Joint Load Reqmt (60%) (N)	Max. Load at Joint Separation (N)	Calculated Material Strength (N)	PASS/FAIL
ULSRME184BAH	Right Mid-Side Exterior	18132	37331	30221	PASS
ULSRMI282BRH	Right Mid-Side Interior	12978	3437	21630	FAIL
ULHRMI384BBH	Mid-Roof Interior	15794	6403	26323	FAIL
ULRRME483BAH	Mid-Roof Exterior	19742	6593	32903	FAIL
ULSLRE584BAH	Left Mid-Side Exterior	18133	56703	30221	PASS
ULSLMI684BRH	Left Mid-Side Interior	12978	3753	21630	FAIL

Comments: NONE

Recorded By: 

Approved By:  Date: 07/07/06

DATA SHEET 3

JOINT STRENGTH WHEN ASTM MATERIAL PROPERTIES ARE KNOWN

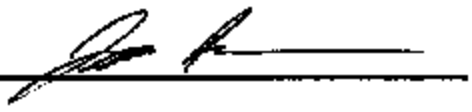
Test Vehicle: **2005 US Bus Sturdibus HD** NHTSA No.: **C50900**
Test Lab: **MGA Research-Wisconsin Operations** Test Date: **07/07/05**

Specimen Description:	Right Mid-Side Exterior		
Joint Number:	ULSRME184BAH	Test Number:	1

	Weaker Member	Stronger Member
Material	3003 H-14 Aluminum	N/A
Tensile Strength (MPa)	137.9	N/A
Gage/Thickness (mm)	-- / 1.27	N/A
Fastener Holes (No./Diameter – mm.)	6 / 5.1	N/A
Net Area (Sq. mm.)	156.8	N/A
Material Strength (N)	30221	N/A
60% of Material Strength (N)	18132.69	N/A
Maximum Load From Tensile Test of Joint (N)	37331.4	N/A
PASS/FAIL	**PASS**	N/A

Comments: NONE

Recorded By: 

Approved By:  Date: 07/07/05

DATA SHEET 3... (Continued)

JOINT STRENGTH WHEN ASTM MATERIAL PROPERTIES ARE KNOWN

Test Vehicle: 2005 US Bus Sturdibus HD
Test Lab: MGA Research-Wisconsin Operations

NHTSA No.: C50900
Test Date: 07/07/05

Specimen Description:	Right Mid-Side Interior		
Joint Number:	ULSRMI282BRH	Test Number:	2

	Weaker Member	Stronger Member
Material	3003 H-14 Aluminum	N/A
Tensile Strength (MPa)	137.9	N/A
Gage/Thickness (mm)	– / .81	N/A
Fastener Holes (No./Diameter – mm.)	2 / 5.1	N/A
Net Area (Sq. mm.)	156.9	N/A
Material Strength (N)	21630.4	N/A
60% of Material Strength (N)	12978.1	N/A
Maximum Load From Tensile Test of Joint (N)	3437.2	N/A
PASS/FAIL	FAIL	N/A

Comments: NONE

Recorded By: _____

Approved By: _____ Date: 07/07/05

DATA SHEET 3... (Continued)

JOINT STRENGTH WHEN ASTM MATERIAL PROPERTIES ARE KNOWN

Test Vehicle: **2005 US Bus Sturdibus HD** NHTSA No.: **C50900**
Test Lab: **MGA Research-Wisconsin Operations** Test Date: **07/07/05**

Specimen Description:	Mid-Roof Interior		
Joint Number:	ULHRMI384BBH	Test Number:	3

	Weaker Member	Stronger Member
Material	3003 H-14 Aluminum	N/A
Tensile Strength (MPa)	137.9	N/A
Gage/Thickness (mm)	– / 1.02	N/A
Fastener Holes (No./Diameter – mm.)	3 / 5.1	N/A
Net Area (Sq. mm.)	190.9	N/A
Material Strength (N)	26322.8	N/A
60% of Material Strength (N)	15793.8	N/A
Maximum Load From Tensile Test of Joint (N)	6402.8	N/A
PASS/FAIL	FAIL	N/A

Comments: NONE

Recorded By: _____

Approved By: _____ Date: 07/07/05

DATA SHEET 3... (Continued)

JOINT STRENGTH WHEN ASTM MATERIAL PROPERTIES ARE KNOWN

Test Vehicle: **2005 US Bus Sturdibus HD** NHTSA No.: **C50900**
Test Lab: **MGA Research-Wisconsin Operations** Test Date: **07/07/05**

Specimen Description:	Mid-Roof Exterior		
Joint Number:	ULRRME483BAH	Test Number:	4

	Weaker Member	Stronger Member
Material	3003 H-14 Aluminum	N/A
Tensile Strength (MPa)	137.9	N/A
Gage/Thickness (mm)	– / 1.27	N/A
Fastener Holes (No./Diameter – mm.)	3 / 5.1	N/A
Net Area (Sq. mm.)	238.61	N/A
Material Strength (N)	32903.5	N/A
60% of Material Strength (N)	19742.1	N/A
Maximum Load From Tensile Test of Joint (N)	6593.2	N/A
PASS/FAIL	**FAIL**	N/A

Comments: NONE

Recorded By: _____

Approved By: _____ Date: 07/07/05

DATA SHEET 3... (Continued)

JOINT STRENGTH WHEN ASTM MATERIAL PROPERTIES ARE KNOWN

Test Vehicle: **2005 US Bus Sturdibus HD** NHTSA No.: **C60900**
Test Lab: **MGA Research-Wisconsin Operations** Test Date: **07/07/05**

Specimen Description:	Left Mid-Side Exterior		
Joint Number:	ULSLRE584BAH	Test Number:	5

	Weaker Member	Stronger Member
Material	3003 H-14 Aluminum	N/A
Tensile Strength (MPa)	137.9	N/A
Gage/Thickness (mm)	-- / 1.27	N/A
Fastener Holes (No./Diameter – mm.)	6 / 5.1	N/A
Net Area (Sq. mm.)	219.2	N/A
Material Strength (N)	30221.2	N/A
60% of Material Strength (N)	18132.7	N/A
Maximum Load From Tensile Test of Joint (N)	56703.3	N/A
PASS/FAIL	PASS	N/A

Comments: NONE

Recorded By: _____

Approved By: _____ Date: 07/07/05

DATA SHEET 3... (Continued)

JOINT STRENGTH WHEN ASTM MATERIAL PROPERTIES ARE KNOWN

Test Vehicle: **2005 US Bus Sturdibus HD** NHTSA No.: **C50900**
Test Lab: **MGA Research-Wisconsin Operations** Test Date: **07/07/05**

Specimen Description:	Left Mid-Side Interior		
Joint Number:	ULSLMI684BRH	Test Number:	6

	Weaker Member	Stronger Member
Material	3003 H-14 Aluminum	N/A
Tensile Strength (MPa)	137.9	N/A
Gage/Thickness (mm)	– / .81	N/A
Fastener Holes (No./Diameter – mm.)	2 / 5.1	N/A
Net Area (Sq. mm.)	156.9	N/A
Material Strength (N)	21630	N/A
60% of Material Strength (N)	12978.1	N/A
Maximum Load From Tensile Test of Joint (N)	3753.1	N/A
PASS/FAIL	FAIL	N/A

Comments: NONE

Recorded By: _____

Approved By: _____ Date: 07/07/05

SECTION 5

INSTRUMENTATION AND EQUIPMENT LIST

Test Vehicle: **2006 US Bus Sturdibus HD** NHTSA No.: **C60900**
Test Lab: **MGA Research-Wisconsin Operations** Test Date: **07/07/06**

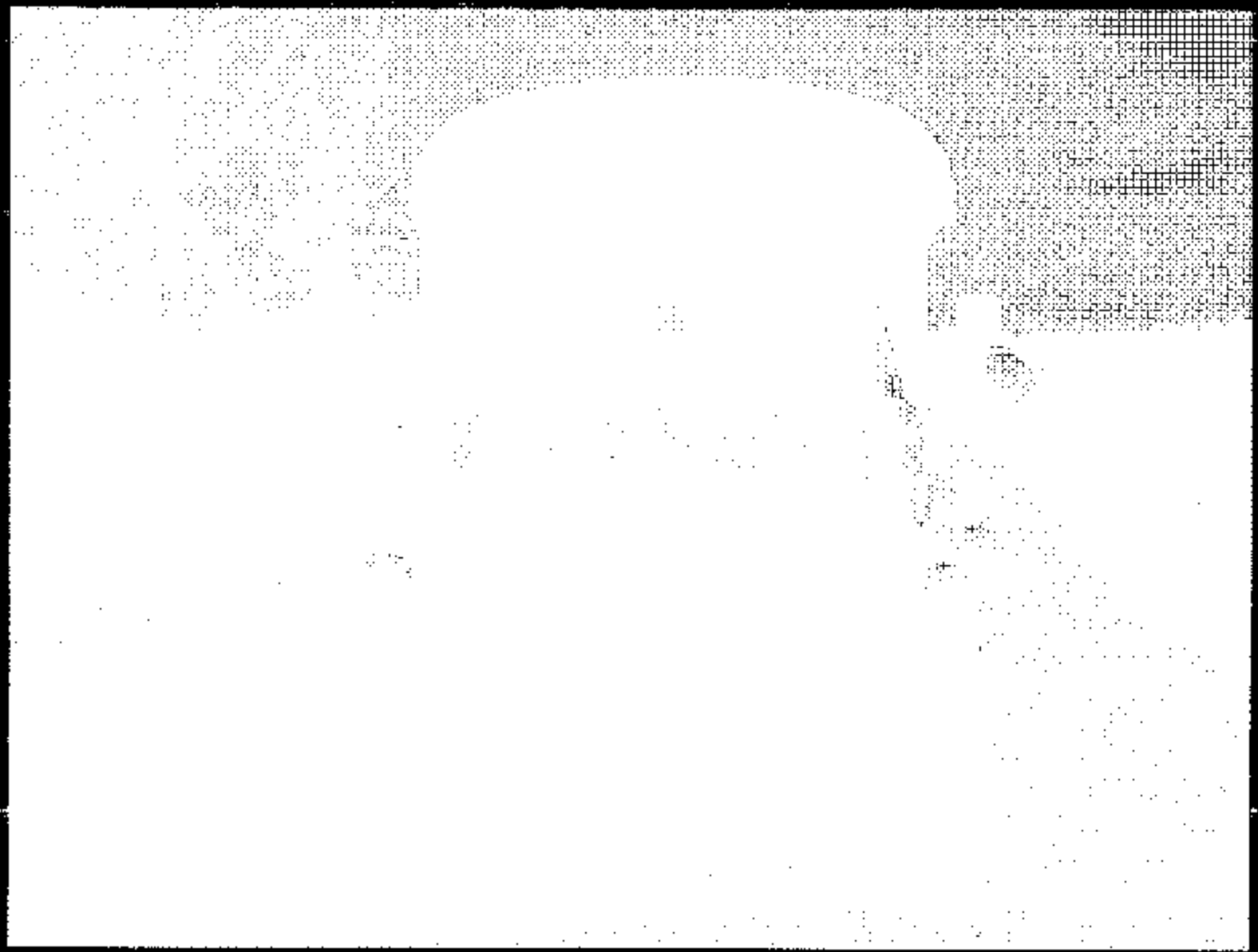
Equipment	Description	Model/Serial No.	Cal. Date	Next Cal. Date
Load Cell	Interface	1220AF / 137778	3/31/05	9/30/05
Linear Potentiometer	Patriot	P40A / 21783	7/1/05	1/1/06
Steel Tape	Stanley	Powerlock / 101	05/31/06	11/31/05
Digital Calipers	Mitutoyo	CD-6" cs/ 0441288	04/01/05	10/01/05
Temp. Stickers	McMaster Carr	60° C / 5952K21	One Time Use	—

SECTION 6
PHOTOGRAPHS

TABLE OF PHOTOGRAPHS

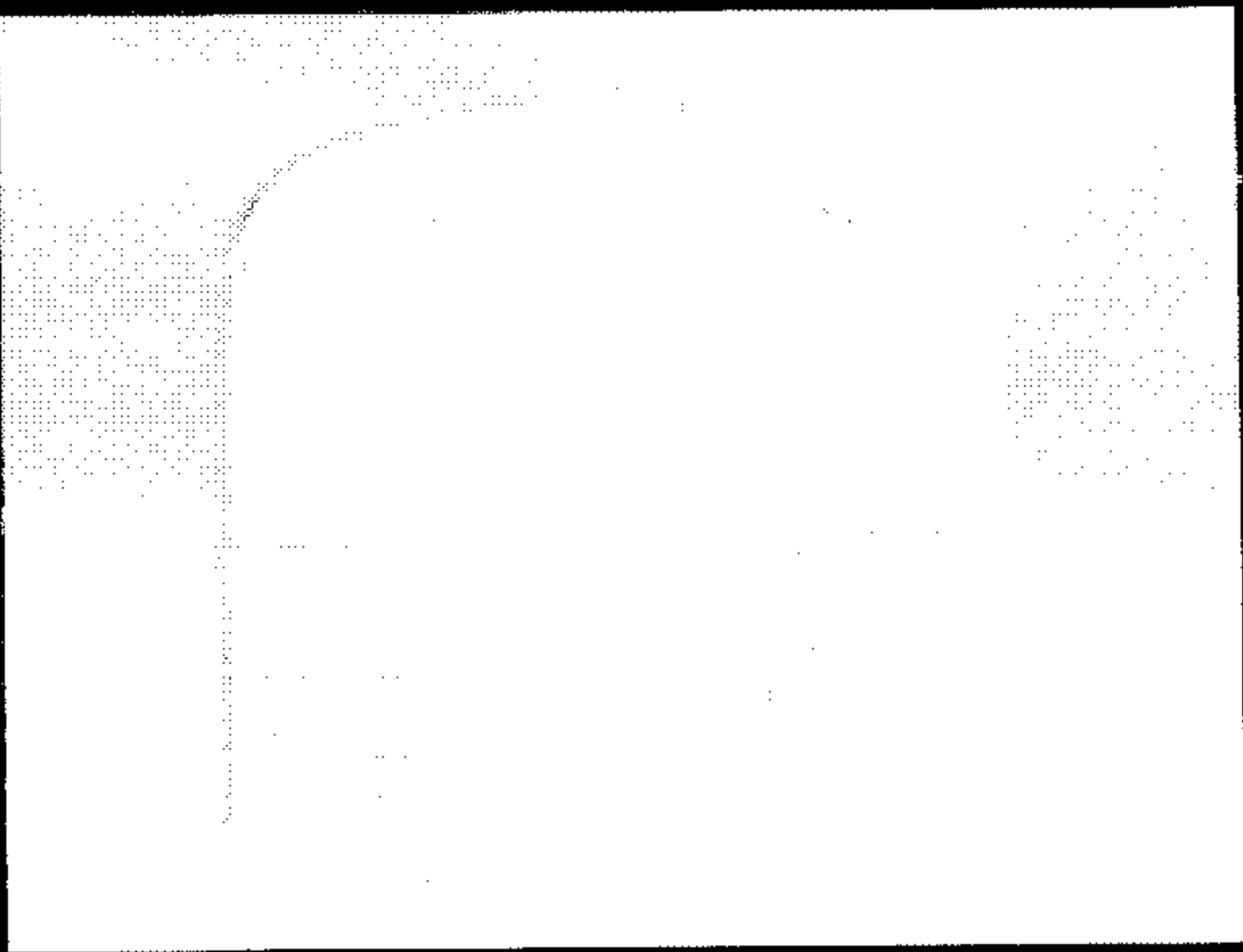
Test Vehicle: 2005 US Bus Sturdibus School Bus

Procedure: FMVSS 221 NHTSA No.: C50500



Front View of School Bus

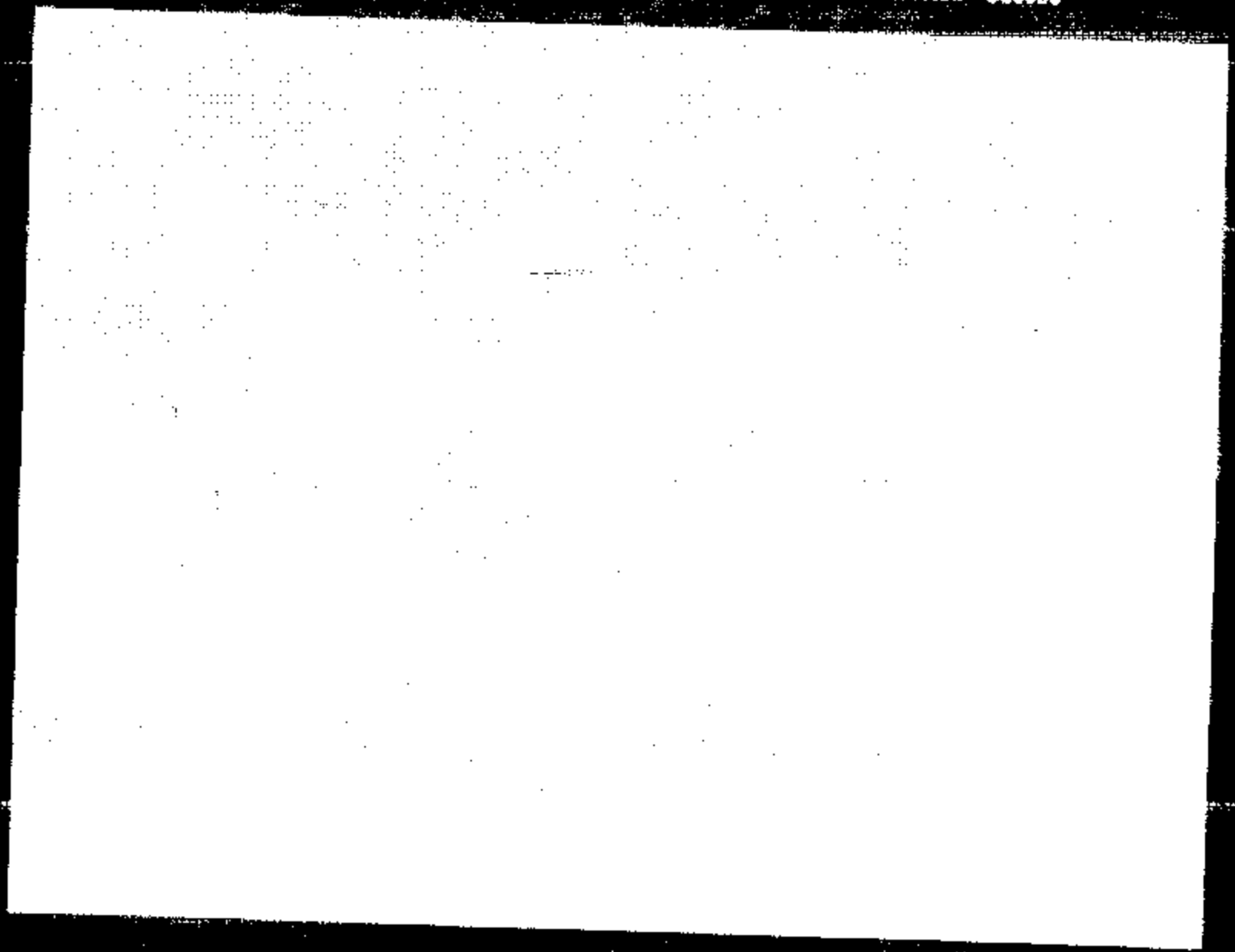
Test Vehicle: 2005 US Bus Sturdibus School Bus
Procedure: FMVSS 221 NHTSA No.: C50900



Rear View of School Bus

Test Vehicle: 2006 US Bus Sturdibus School Bus
Procedure: FMVSS 222

NHTSA No.: C50900



Left Side View of School Bus

Test Vehicle: **2005 US Bus Sturdibus School Bus**
Procedure: **FMVSS 221**

NHTSA No.: **C50900**

Right Side View of School Bus

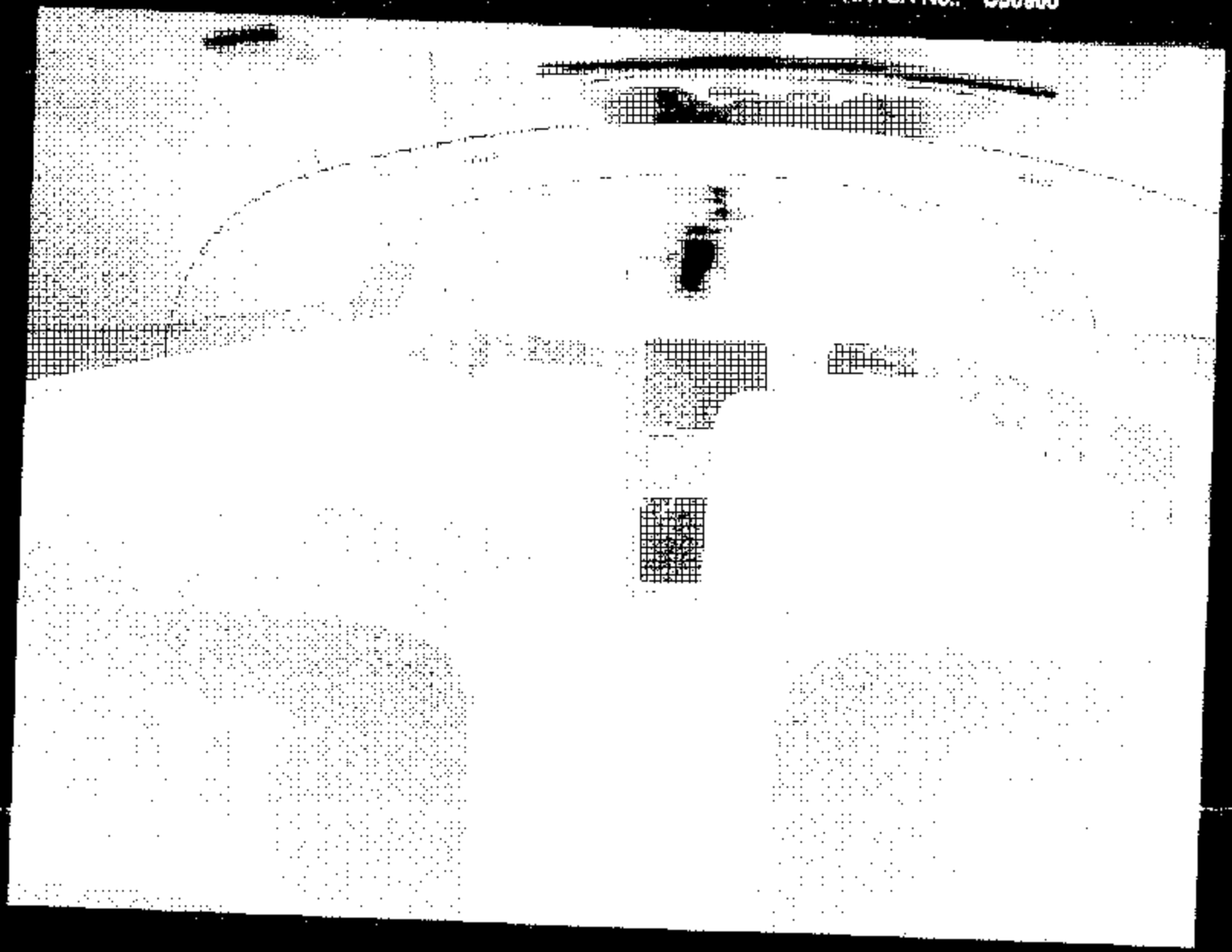
Test Vehicle: 2008 US Bus Sturdibus School Bus
Procedure: FMVSS 221 NHTSA No.: C80910

Close up View of Certification Label

Test Vehicle: 2006 US Bus StarBus School Bus
Procedure: FMVSS 221

NHTSA No.: C50600

Tire Information Label



Vehicle Interior View Front to Rear

Test Vehicle: 2005 US Bus Sturdibus School Bus
Procedure: FMVSS 221

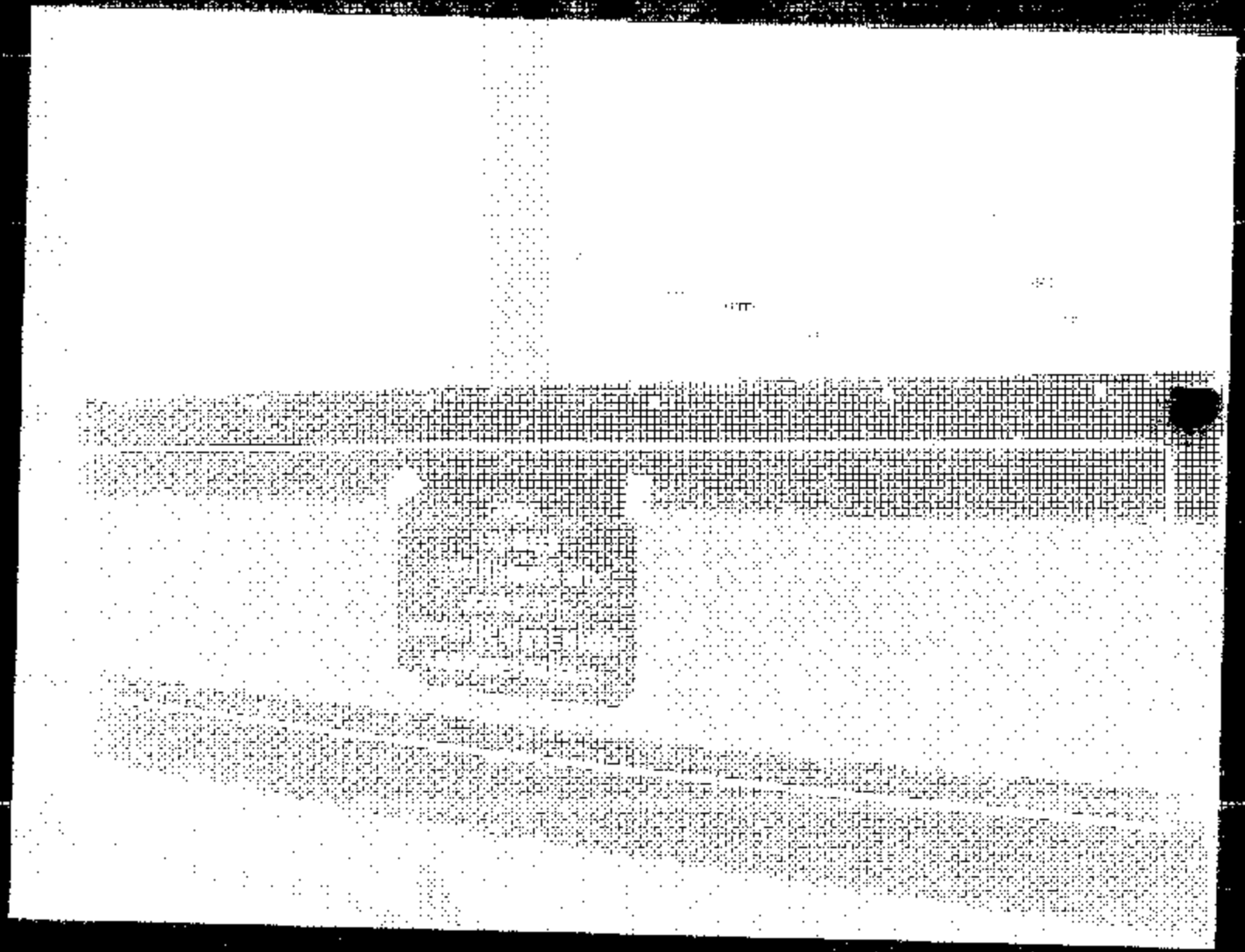
NHTSA No.: C60800

Vehicle Interior View Rear to Front

Test Vehicle: 2005 US Bus Sturdibus School Bus

Procedure: FMVSS-221

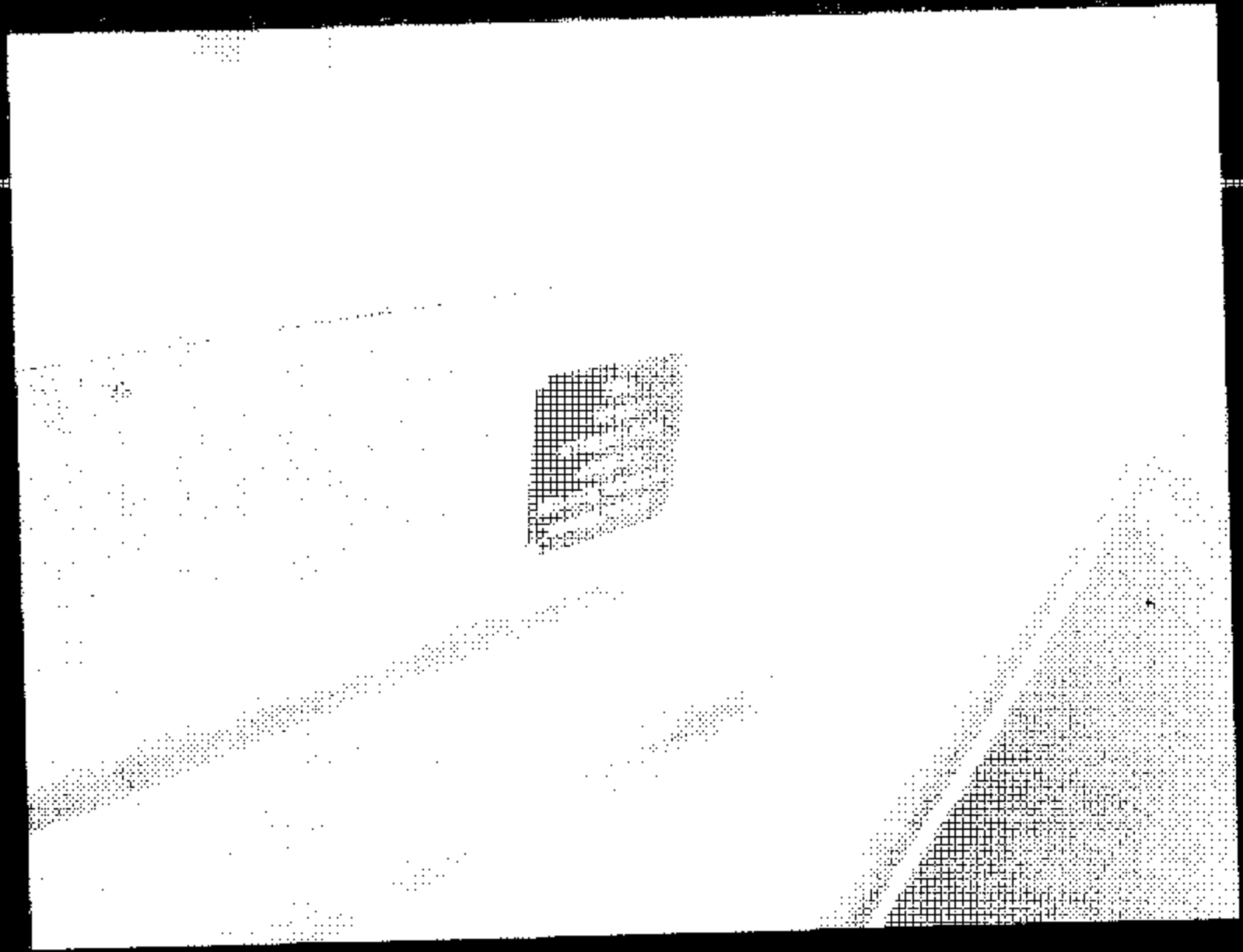
NHTSA No.: C60900



Location of Joint #1

Test Vehicle: 2005 US Bus Sturdibus School Bus
Procedure: FMVSS 221

NHTSA No.: C60600

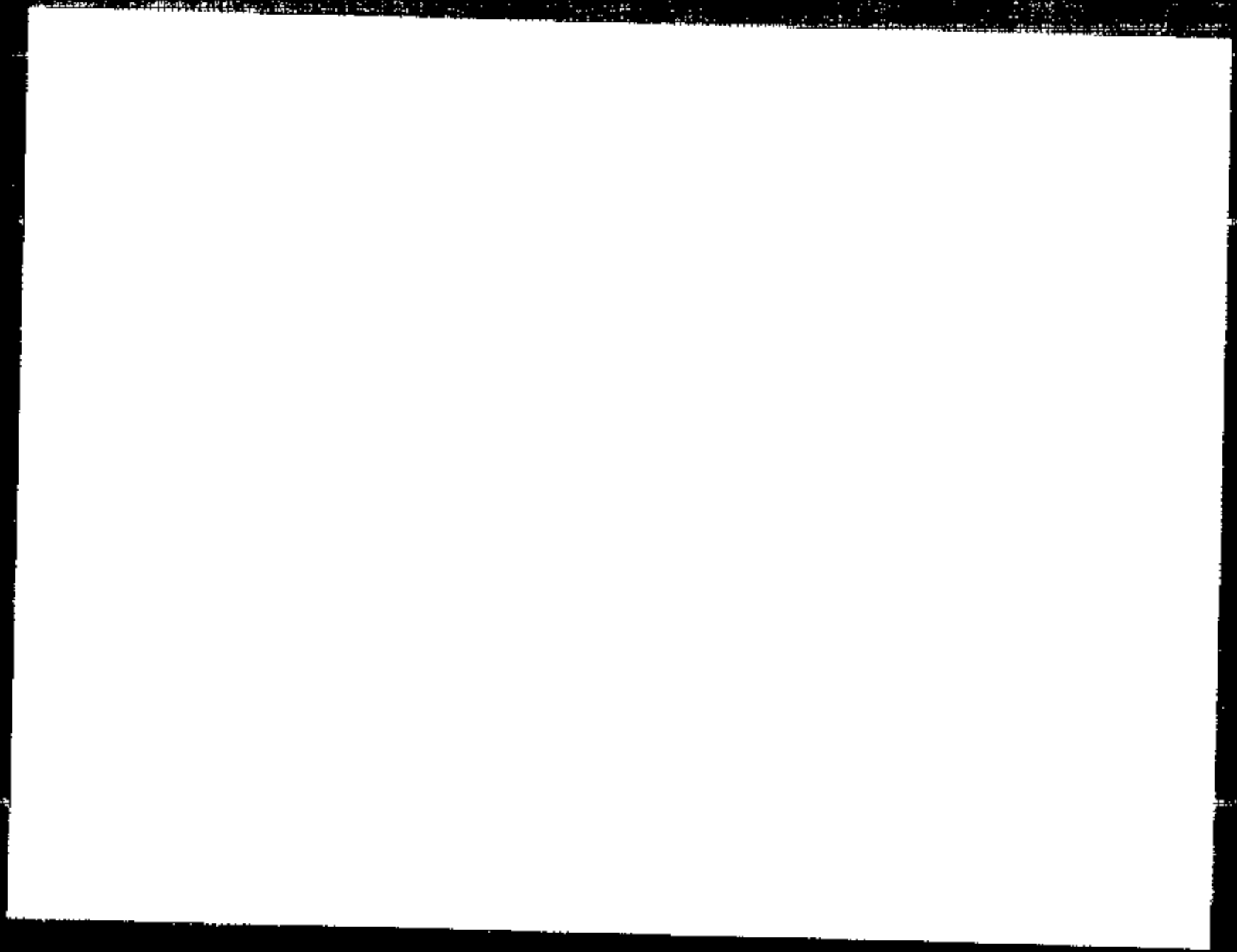


Location of Joint #2

Test Vehicle: 2006 US Bus Sturdibus School Bus

Procedure: [redacted]

NHTSA No.: C60900

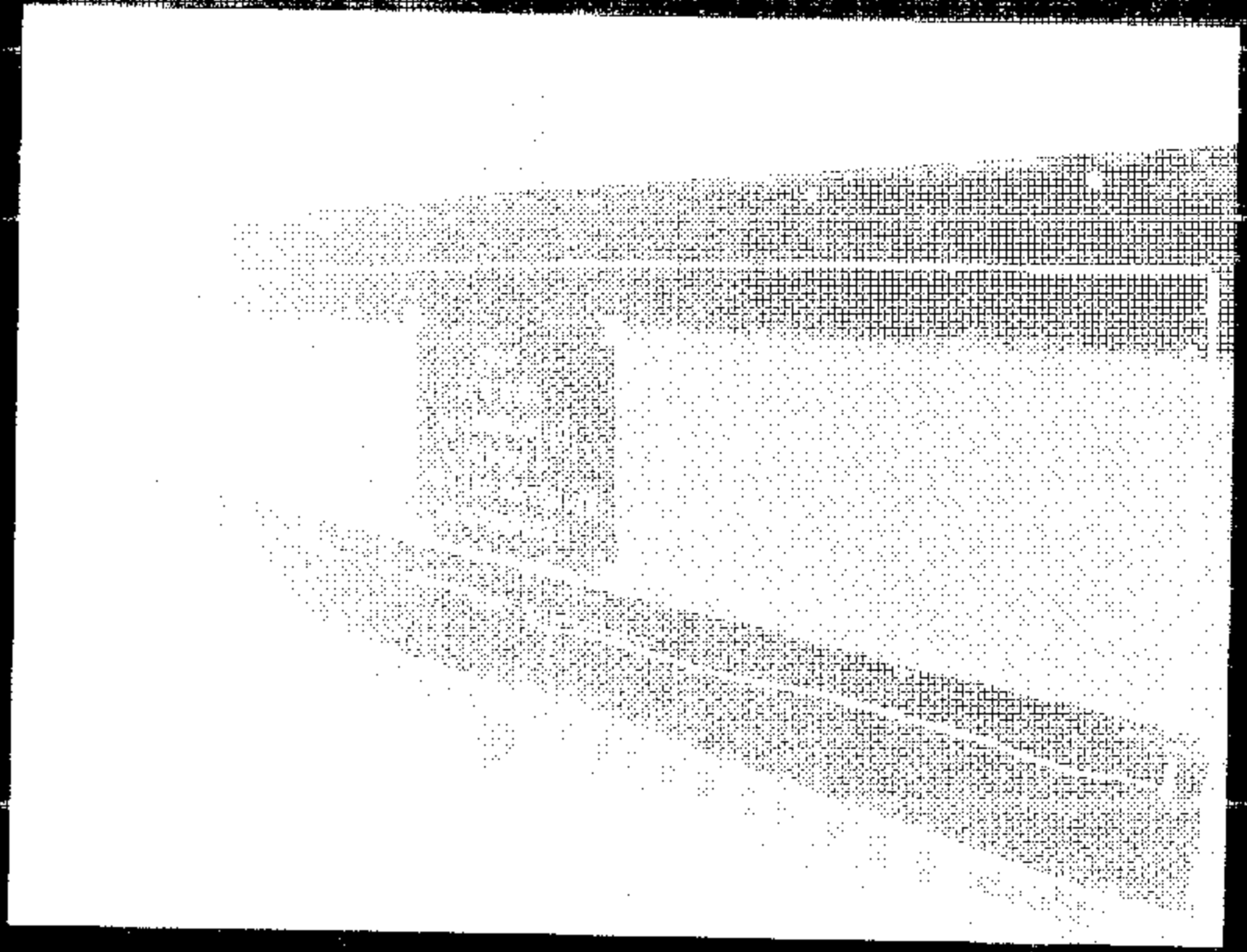


Location of Joint #3

Test Vehicle: 2005 US Bus Sturdibus School Bus
Procedure: FMVSS 221

NHTSA No.: C50900

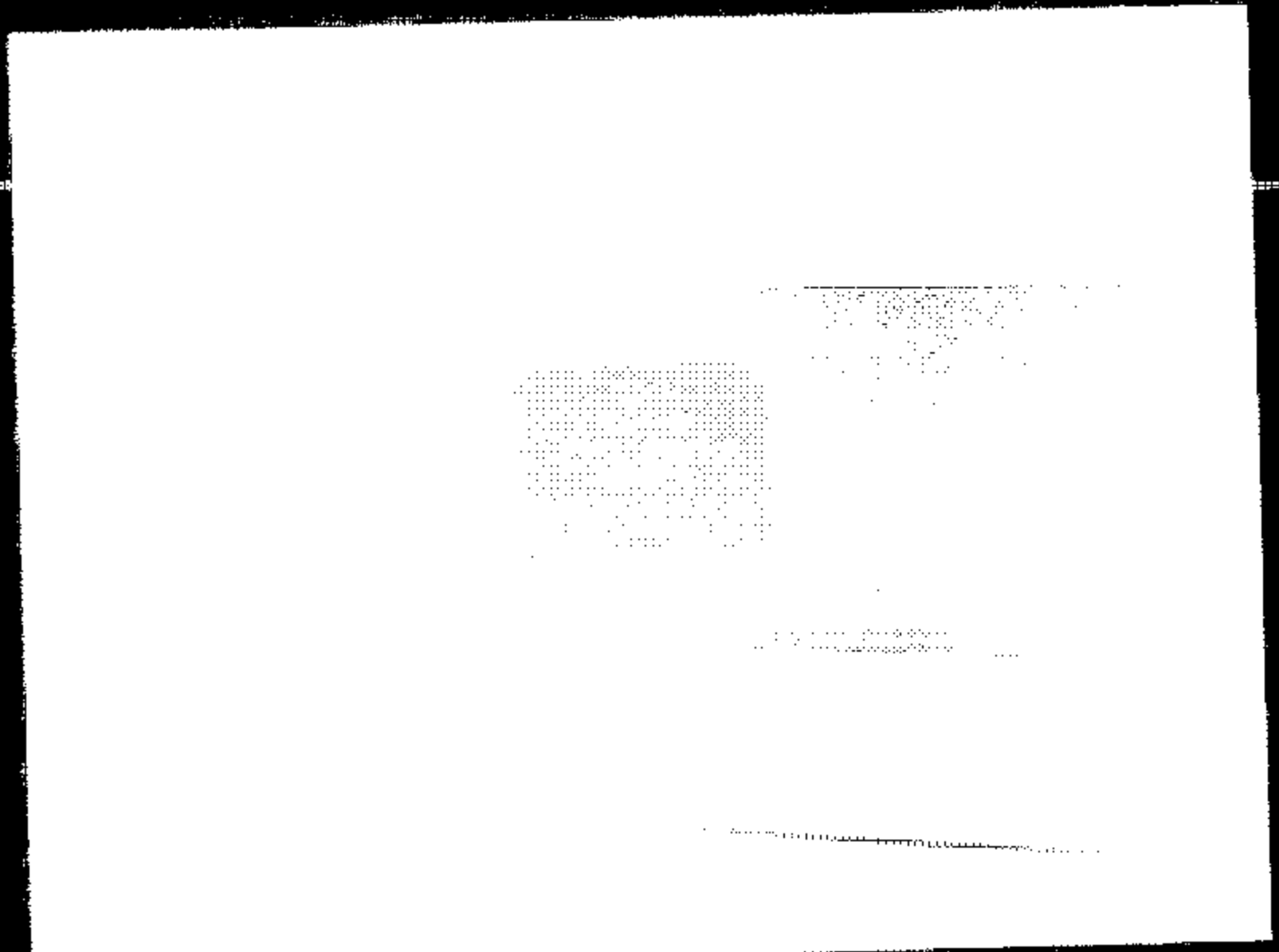
Location of Joint #4



Location of Joint #5

Test Vehicle: 2005 US Bus Sturdibus School Bus
Procedure: FMVSS 221

NHTSA No.: C50900

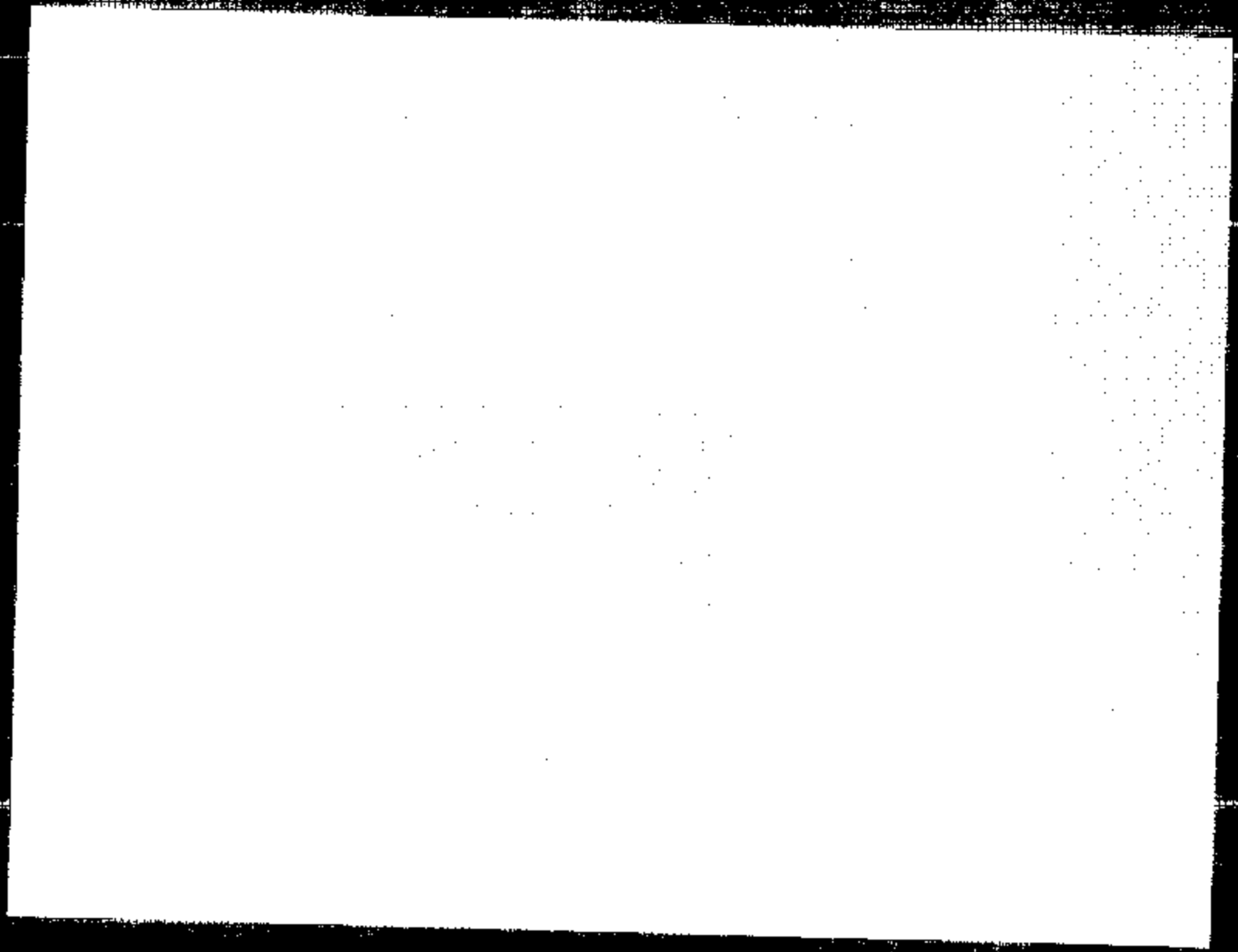


Location of Joint #6

Test Vehicle: 2006 US Bus Sturdibus School Bus

Procedure: [redacted]

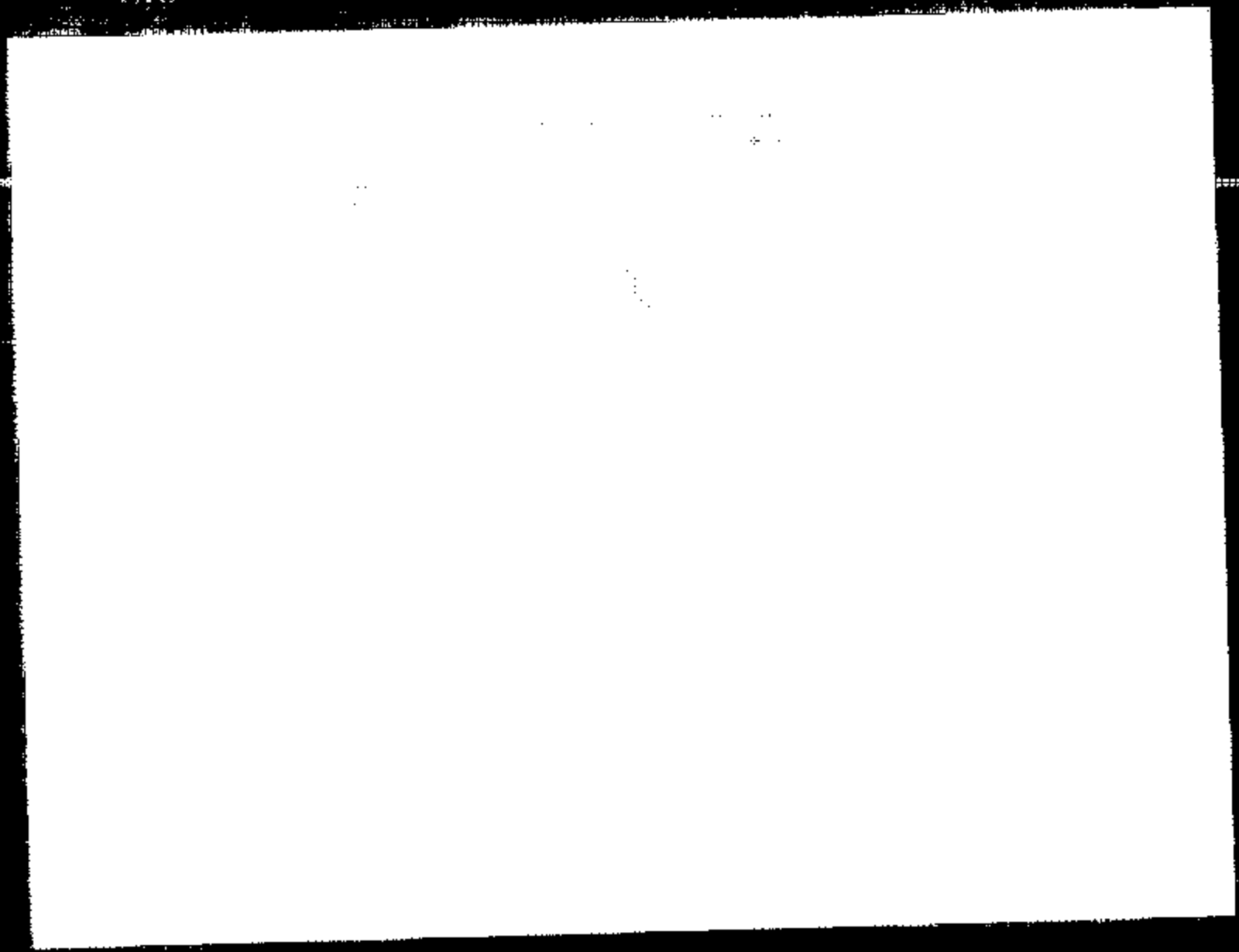
NHTSA No.: C60606



Pre-Test of Joint #1

Test Vehicle: 2005 US Bus Sturdibus School Bus
Procedure: FMVSS 221

NHTSA No.: C50980

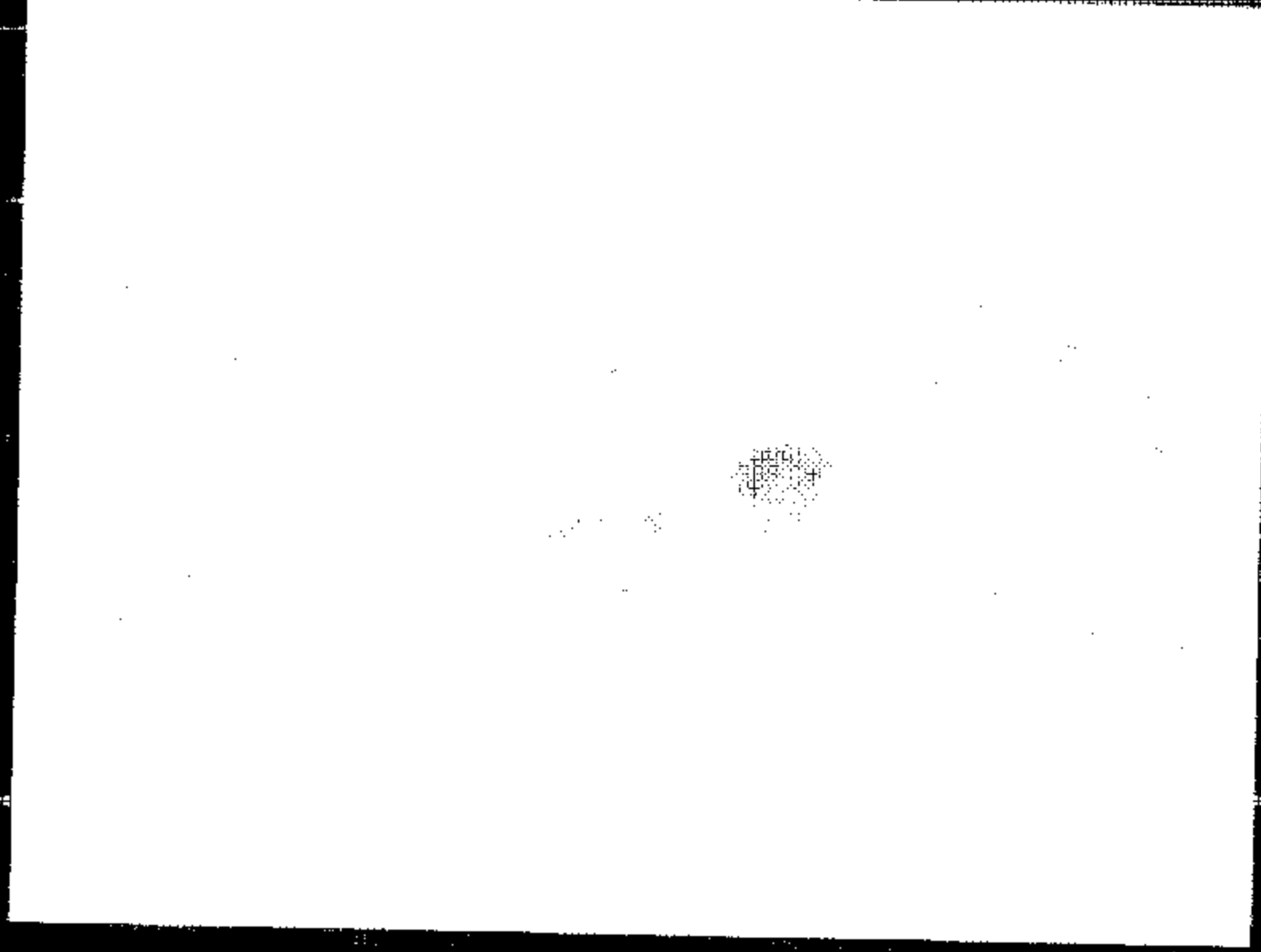


Post-Test of Joint #1

Test Vehicle: 2005 US Bus Sturdibus School Bus

Procedure: [illegible]

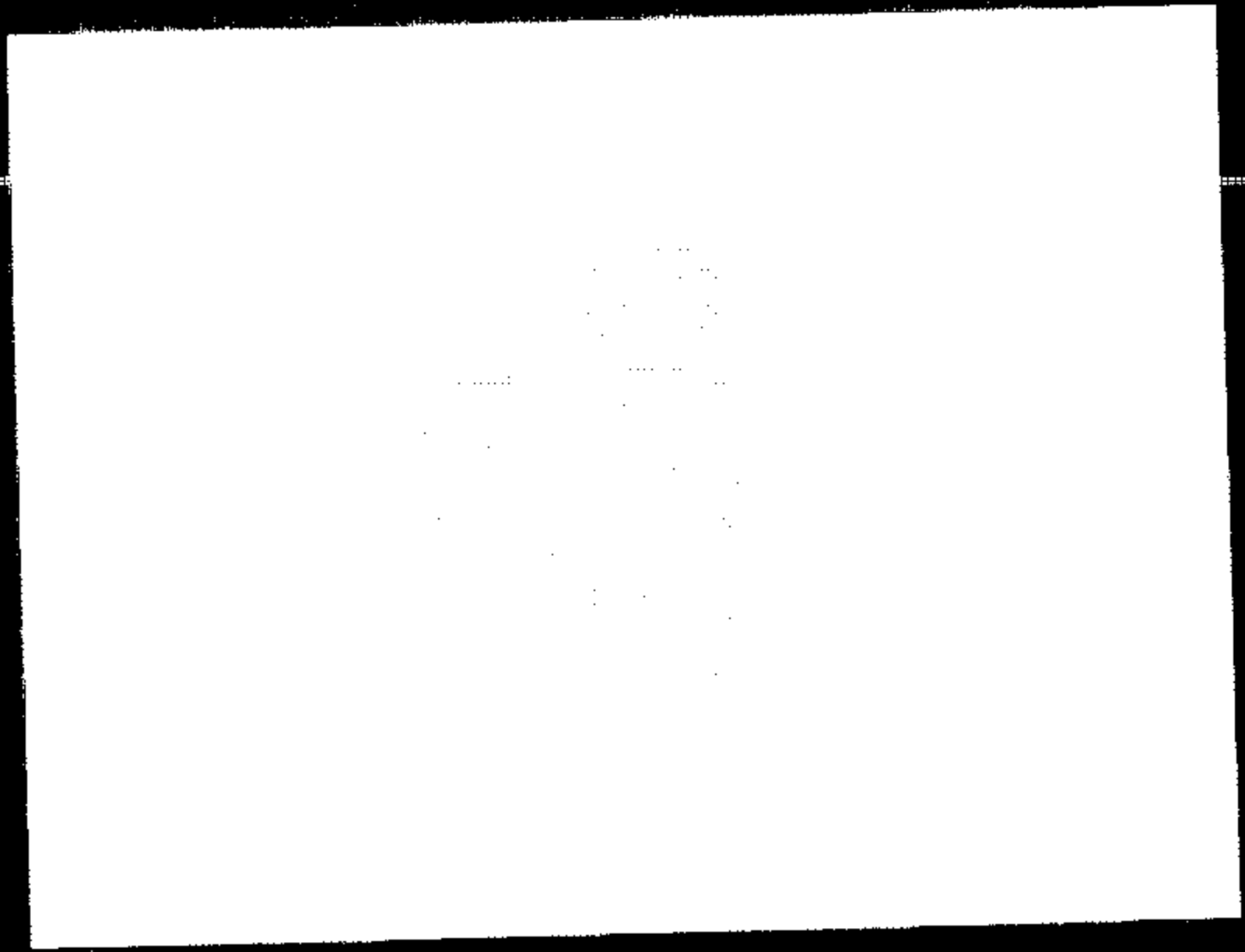
NHTSA No.: C60500



Post-Test of Joint #1 view 2

Test Vehicle: 2006 US Bus Sturdibus School Bus
Procedure: FMVSS 221

NHTSA No.: C50900

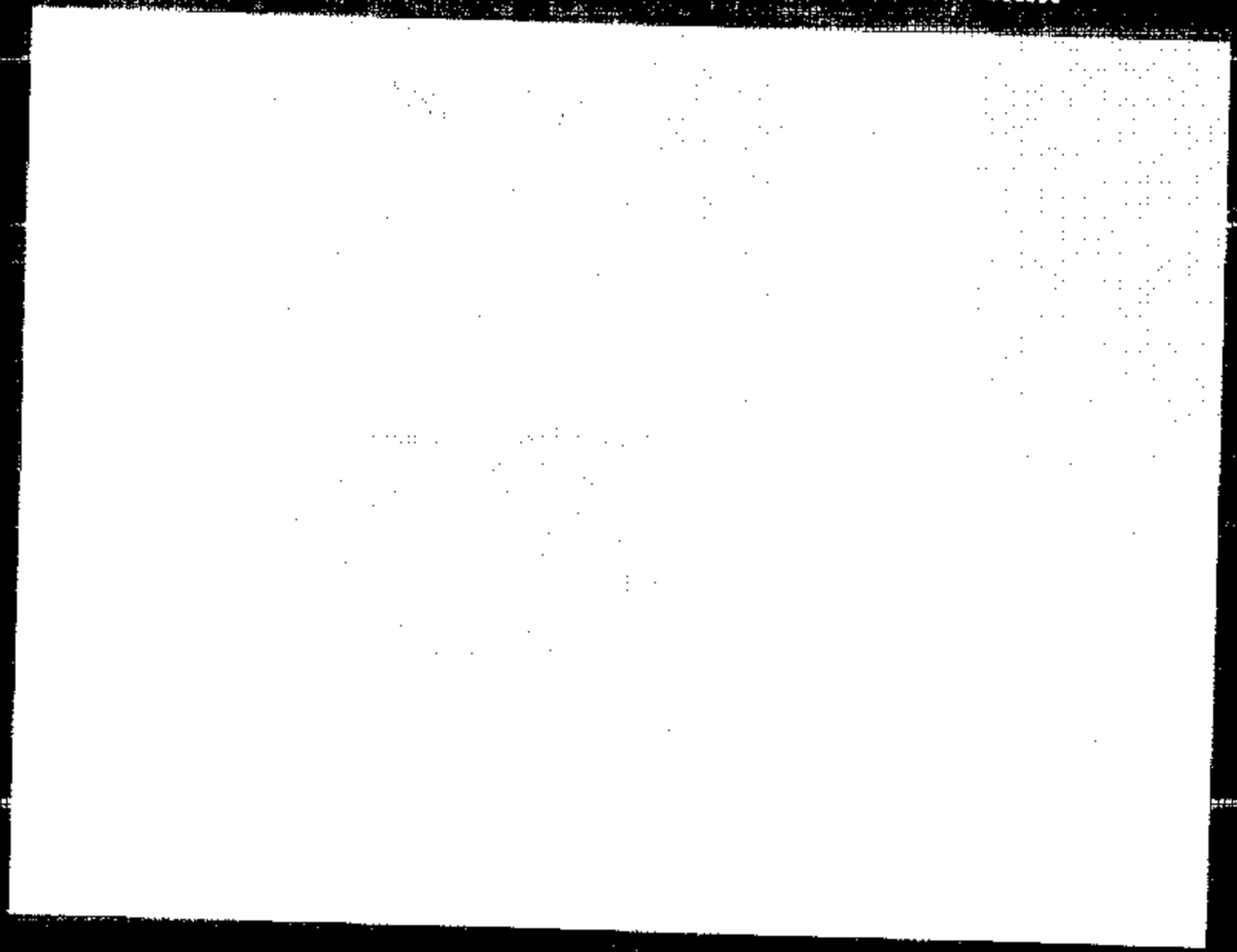


Pre-Test of Joint #2

Test Vehicle: 2006 US Bus Sturdibus School Bus

Procedure: [redacted]

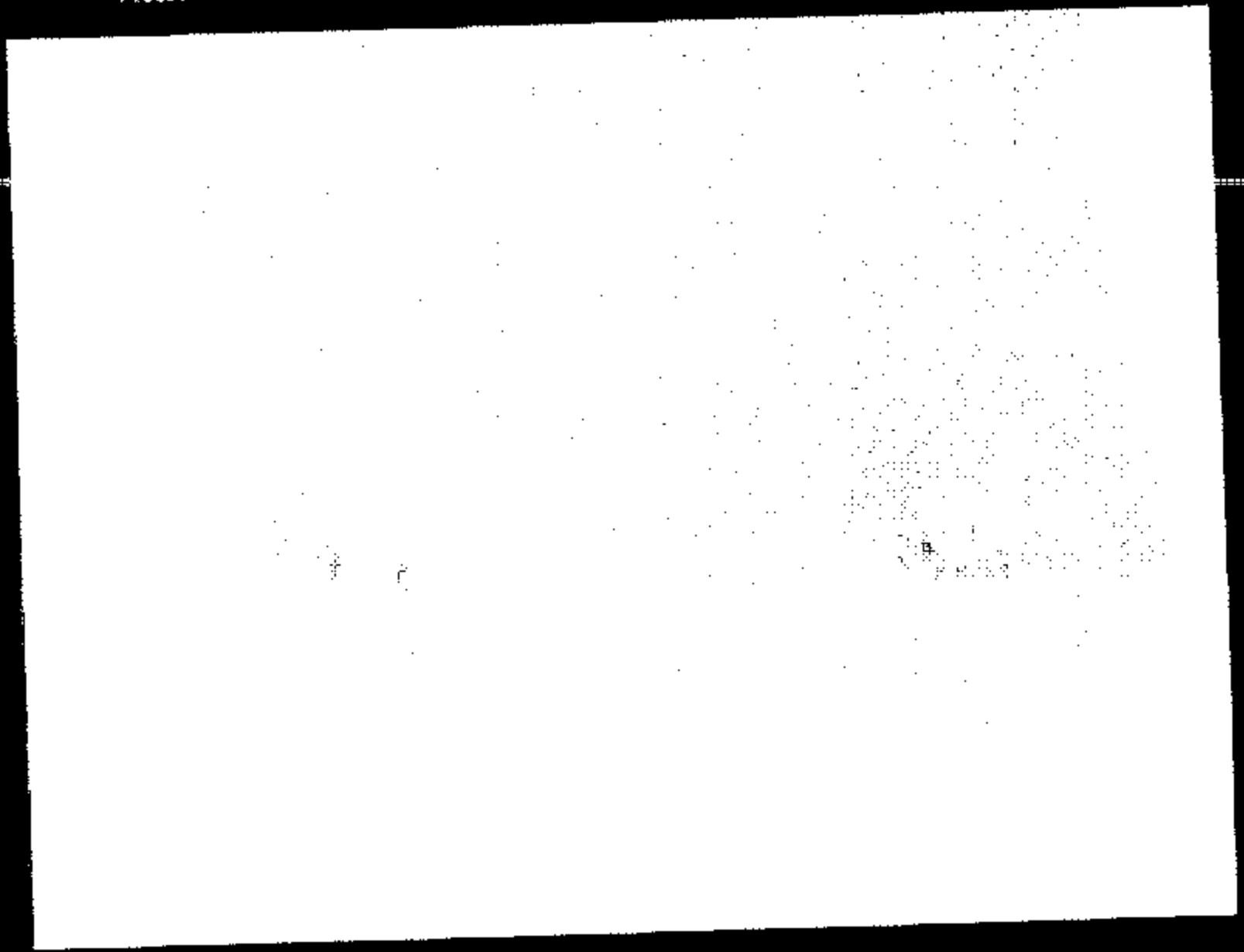
NHTSA No.: C60900



Post-Test of Joint #2

Test Vehicle: 2005 US Bus Sturdibus School Bus
Procedure: FMVSS 221

NHTSA No.: C50900

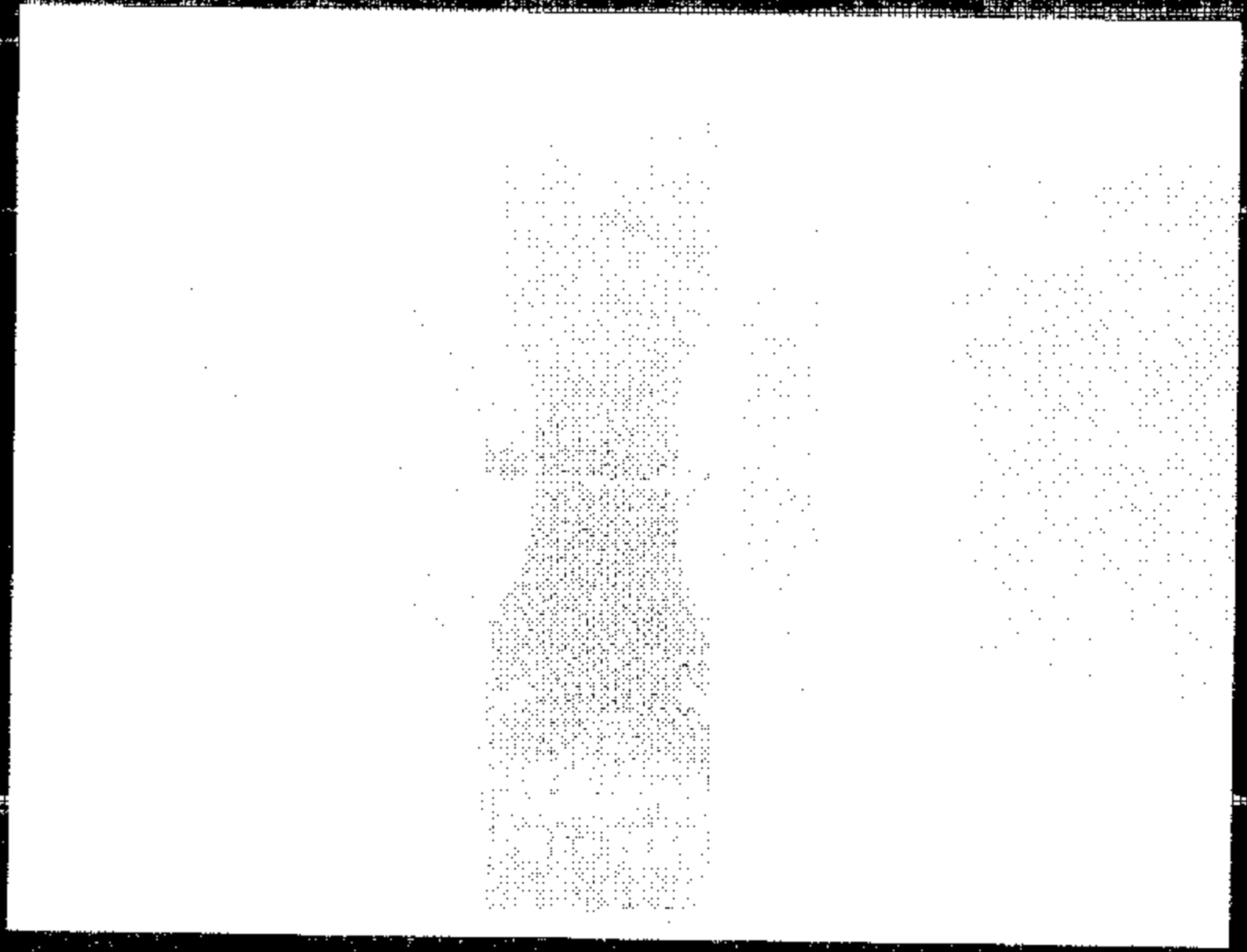


Post-Test of Joint #2 view 2

Test Vehicle: 2005 US Bus Sturdibus School Bus

Procedure: FMVSS 221

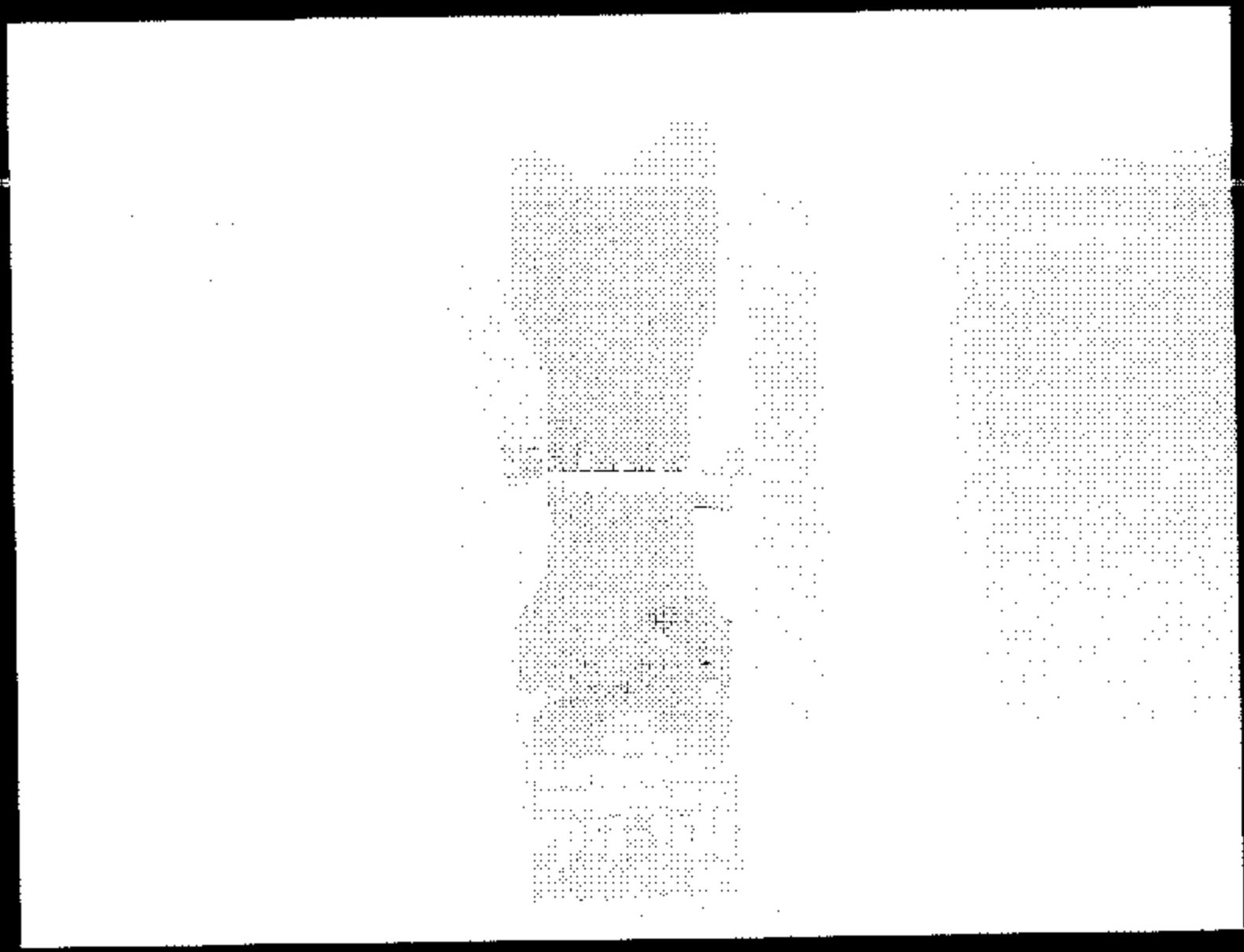
NHTSA No.: C50500



Pre-Test of Joint #3

Test Vehicle: **2005 US Bus Sturdibus School Bus**
Procedure: **FMVSS 221**

NHTSA No.: **C60900**

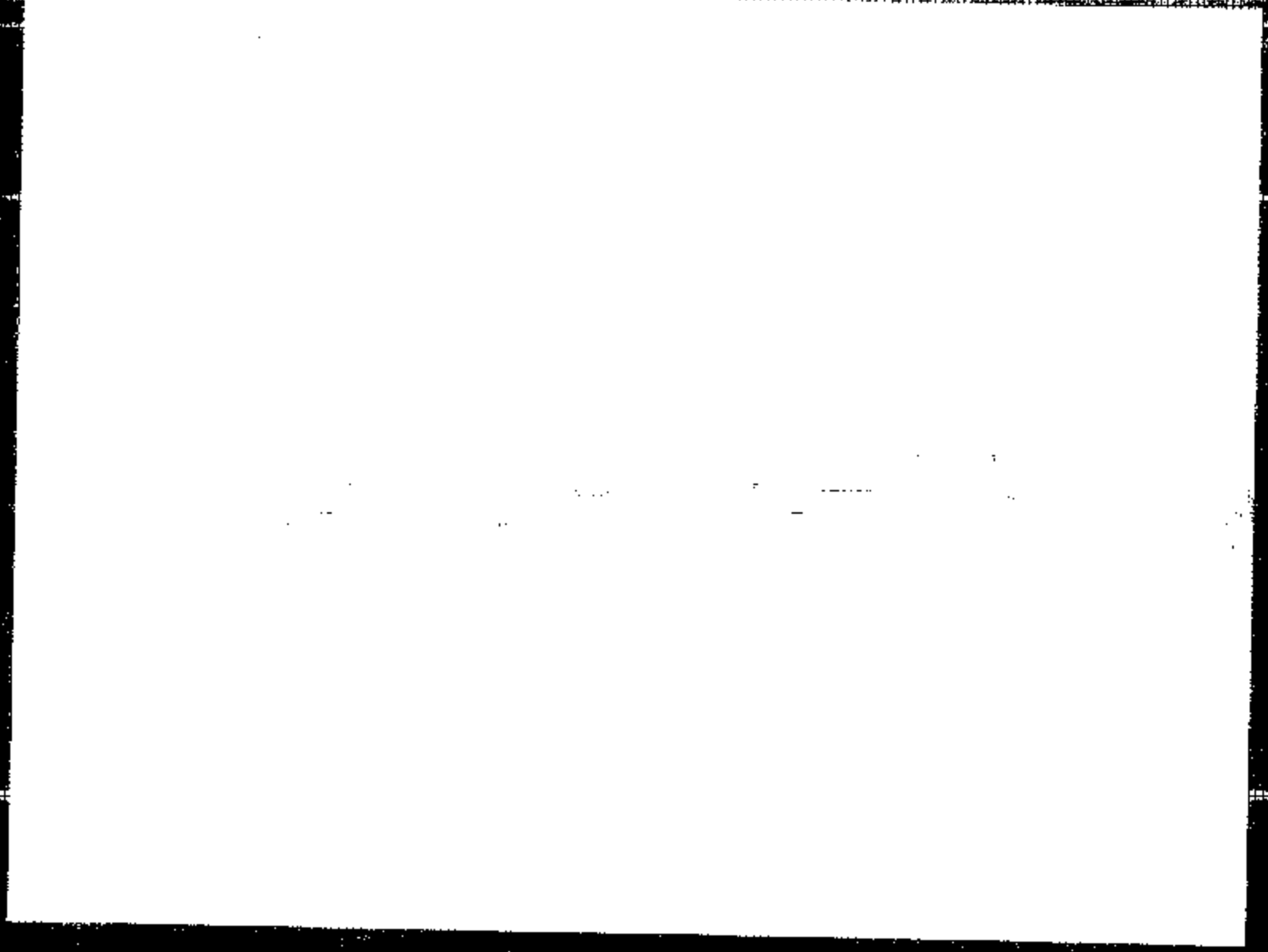


Post-Test of Joint #3

Test Vehicle: 2006 US Bus Sturdibus School Bus

Procedure: FMVSS 221

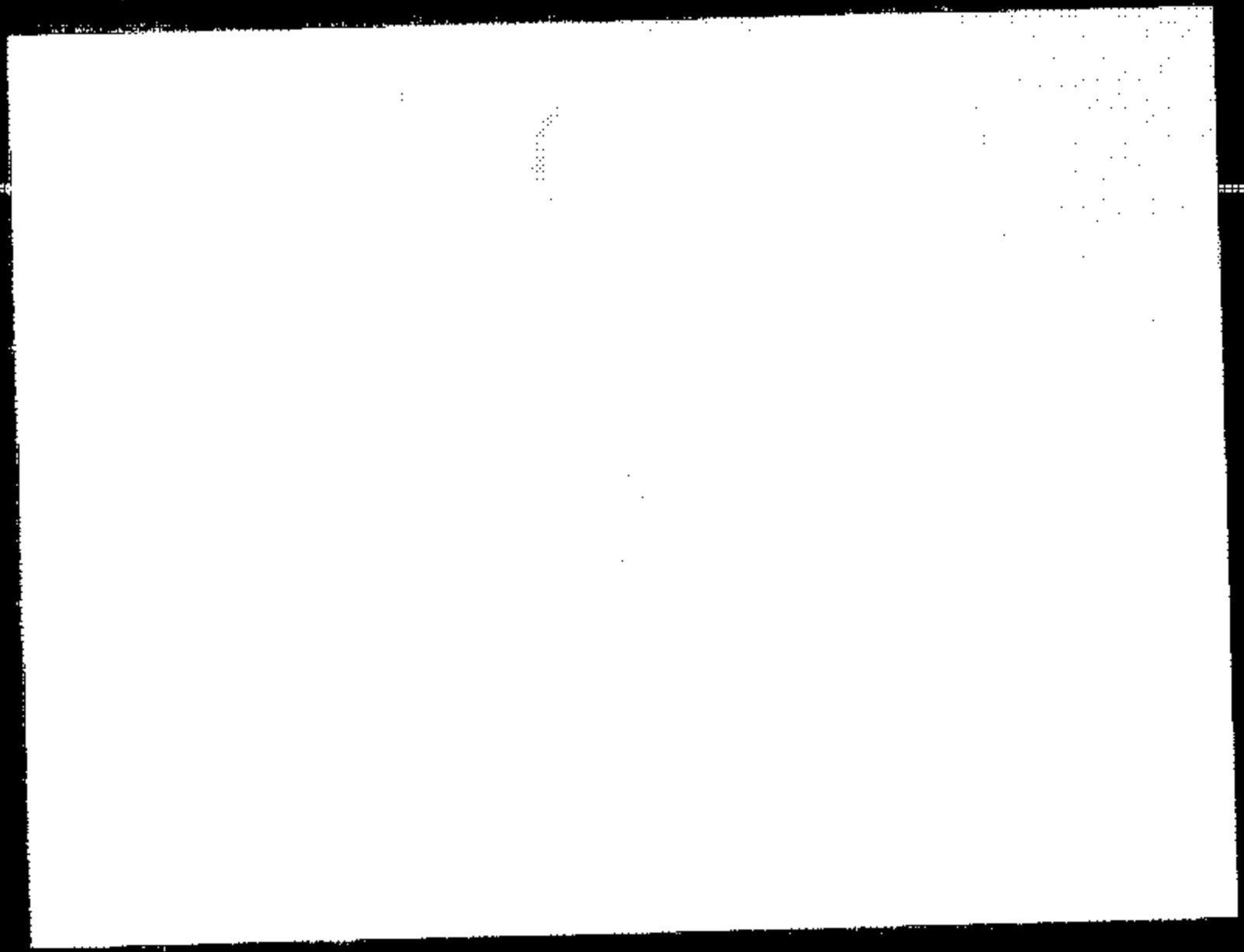
NHTSA No.: C50900



Post-Test of Joint #3 view 2

Test Vehicle: 2006 US Bus Sturdibus School Bus
Procedure: FMVSS 221

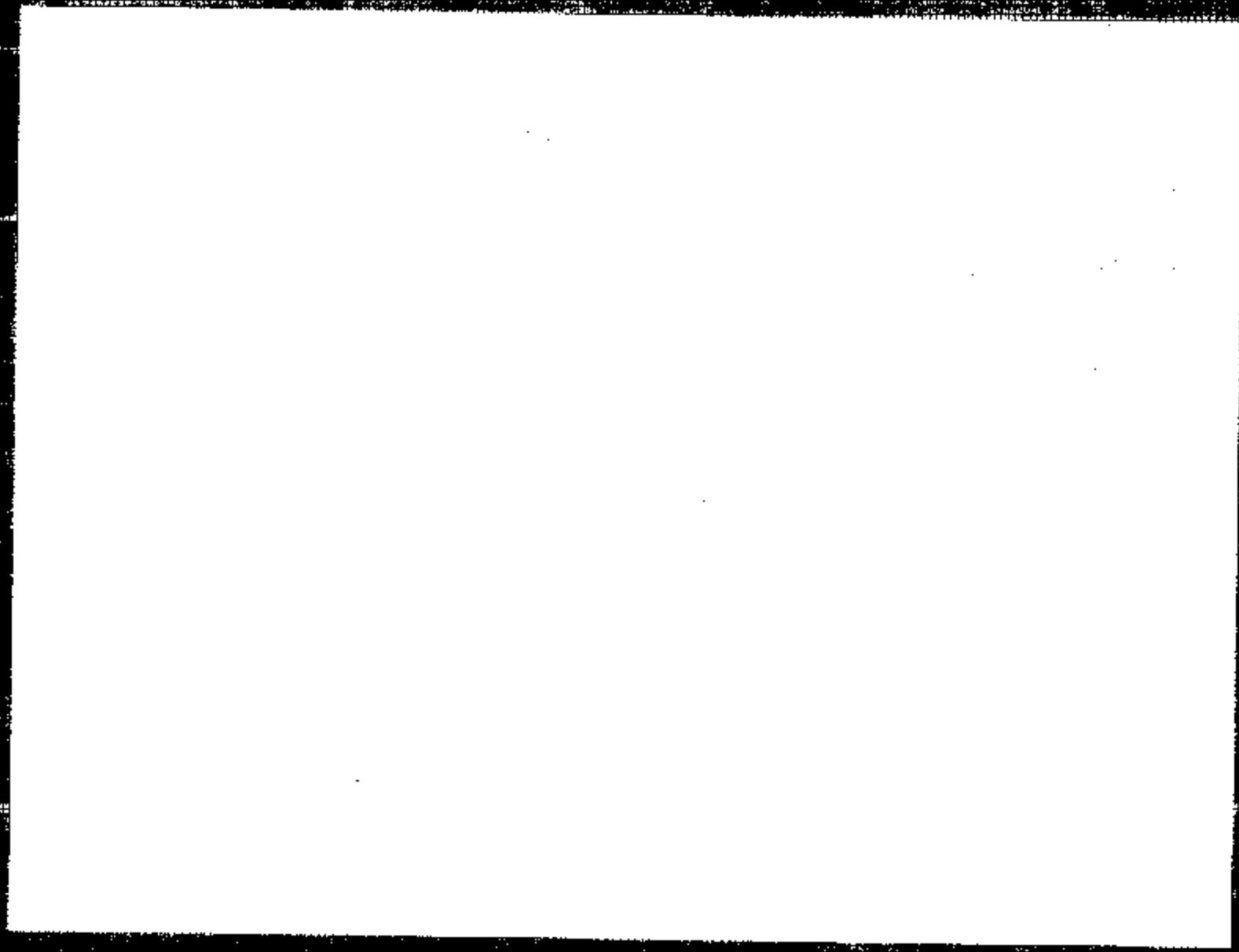
NHTSA No.: C60900



Pre-Test of Joint #4

Test Vehicle: 2005 UD Bus Sturdibus School Bus

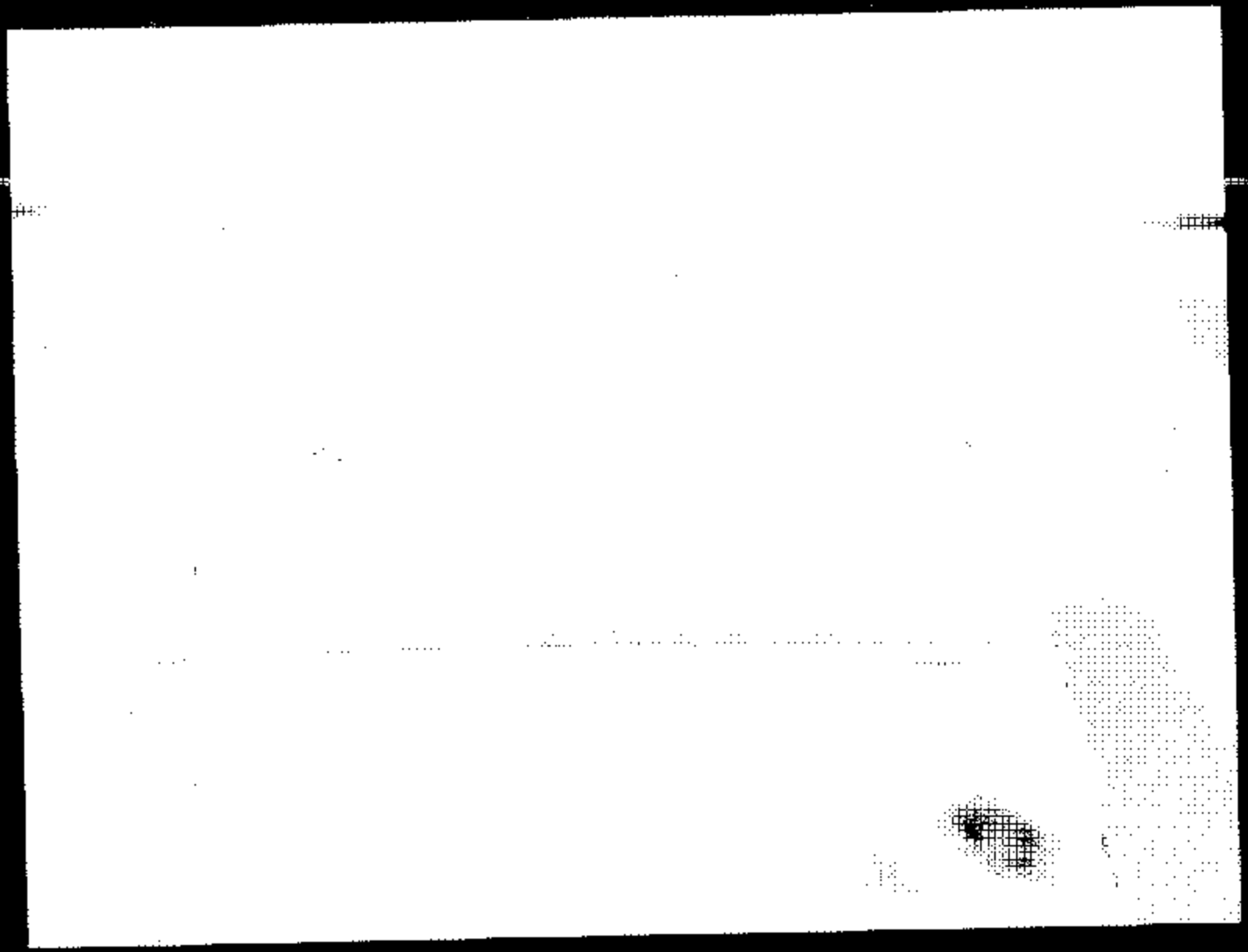
Procedure: FMVSS 221 NHTSA No.: C66600



Post-Test of Joint #4

Test Vehicle: 2006 US Bus Sturdibus School Bus
Procedure: FMVSS 221

NHTSA No.: C50900



Post-Test of Joint #4 view 2

Pre-Test of Joint #5

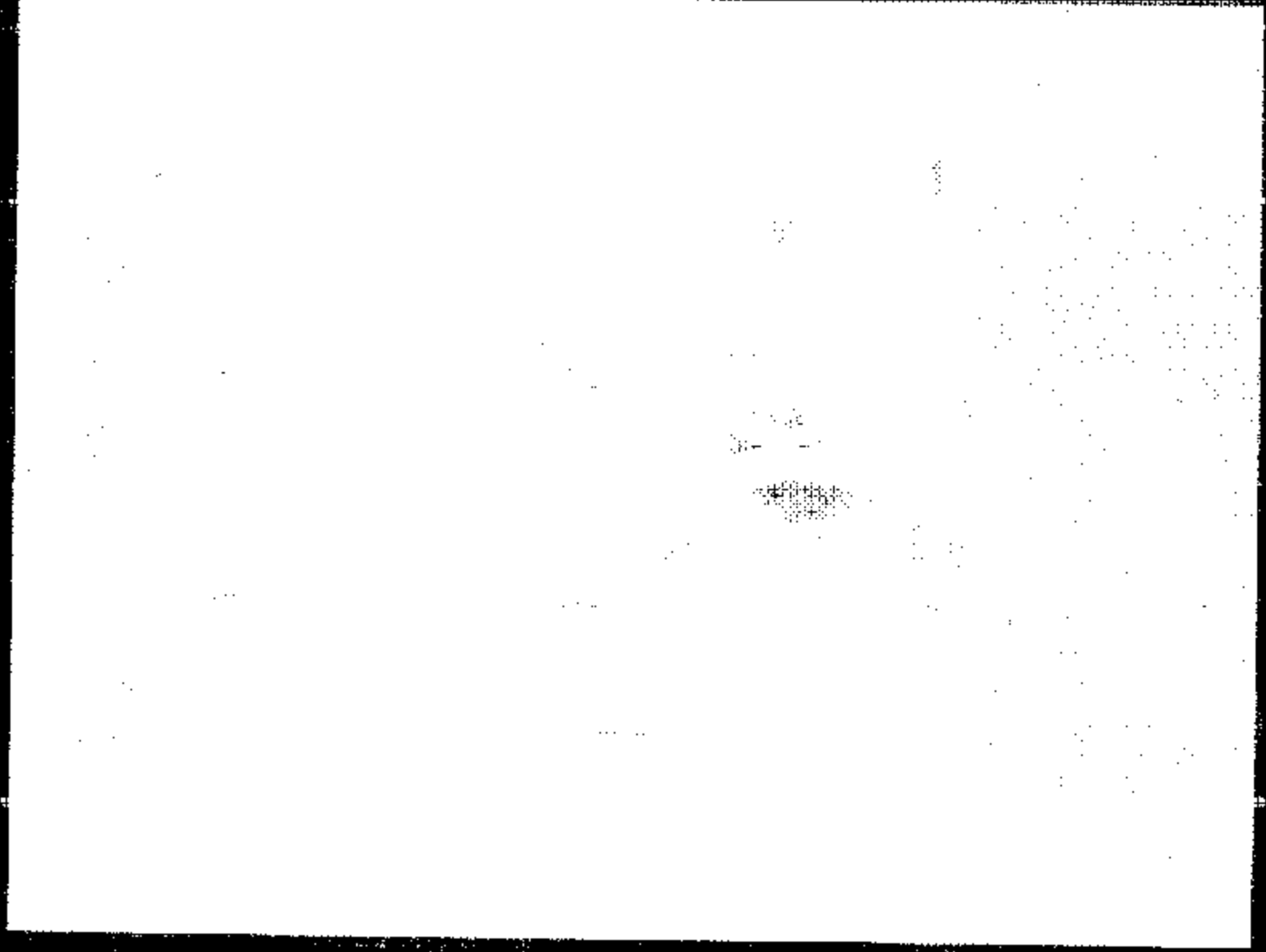
Test Vehicle: 2005 US Bus Sturdibus School Bus
Procedure: FMVSS 221

NHTSA No.: C50900

Post-Test of Joint #5

Test Vehicle: 2005 US Bus Sturdibus School Bus

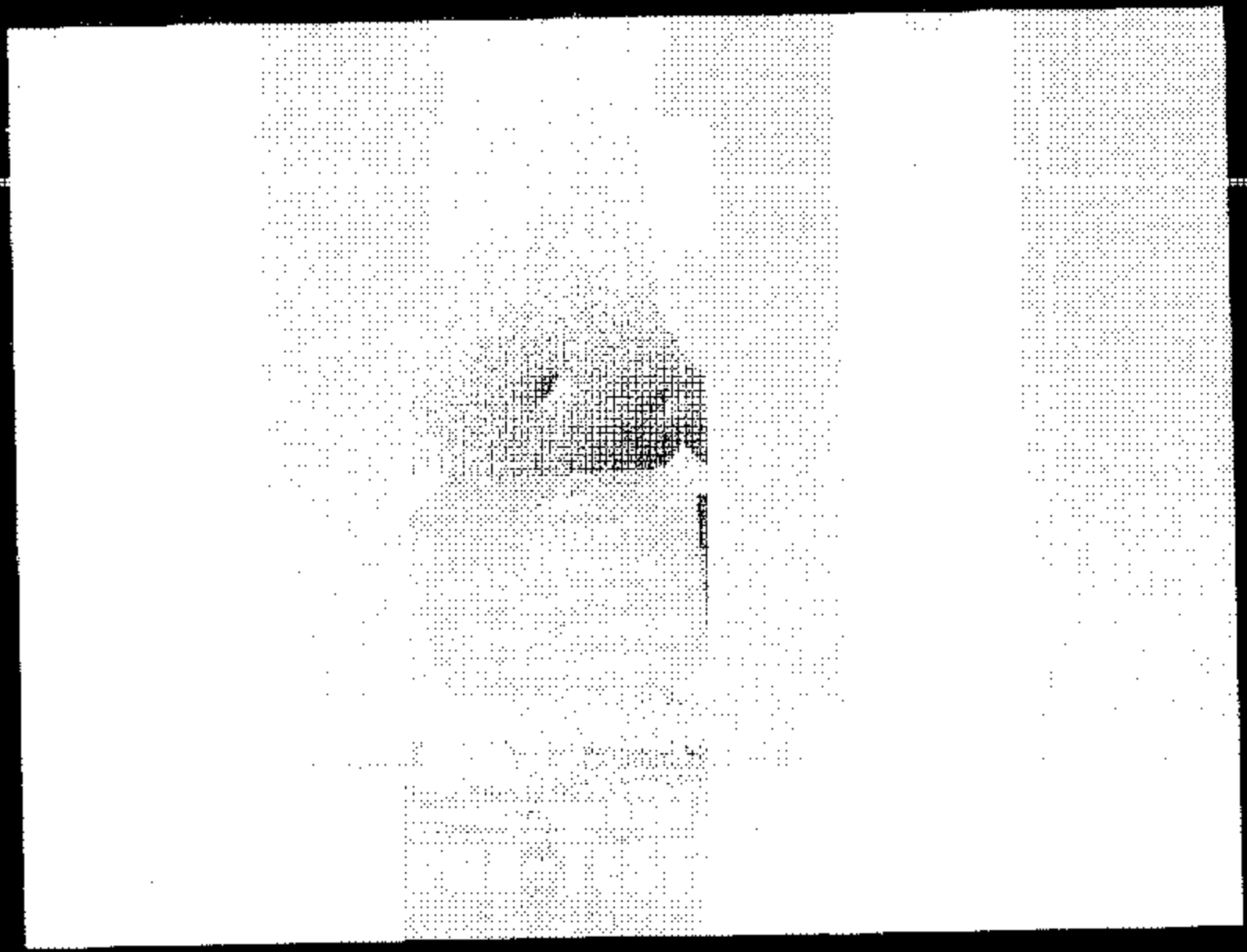
Procedure: MVSS 221 NHTSA No.: C60900



Post-Test of Joint #5 view 2

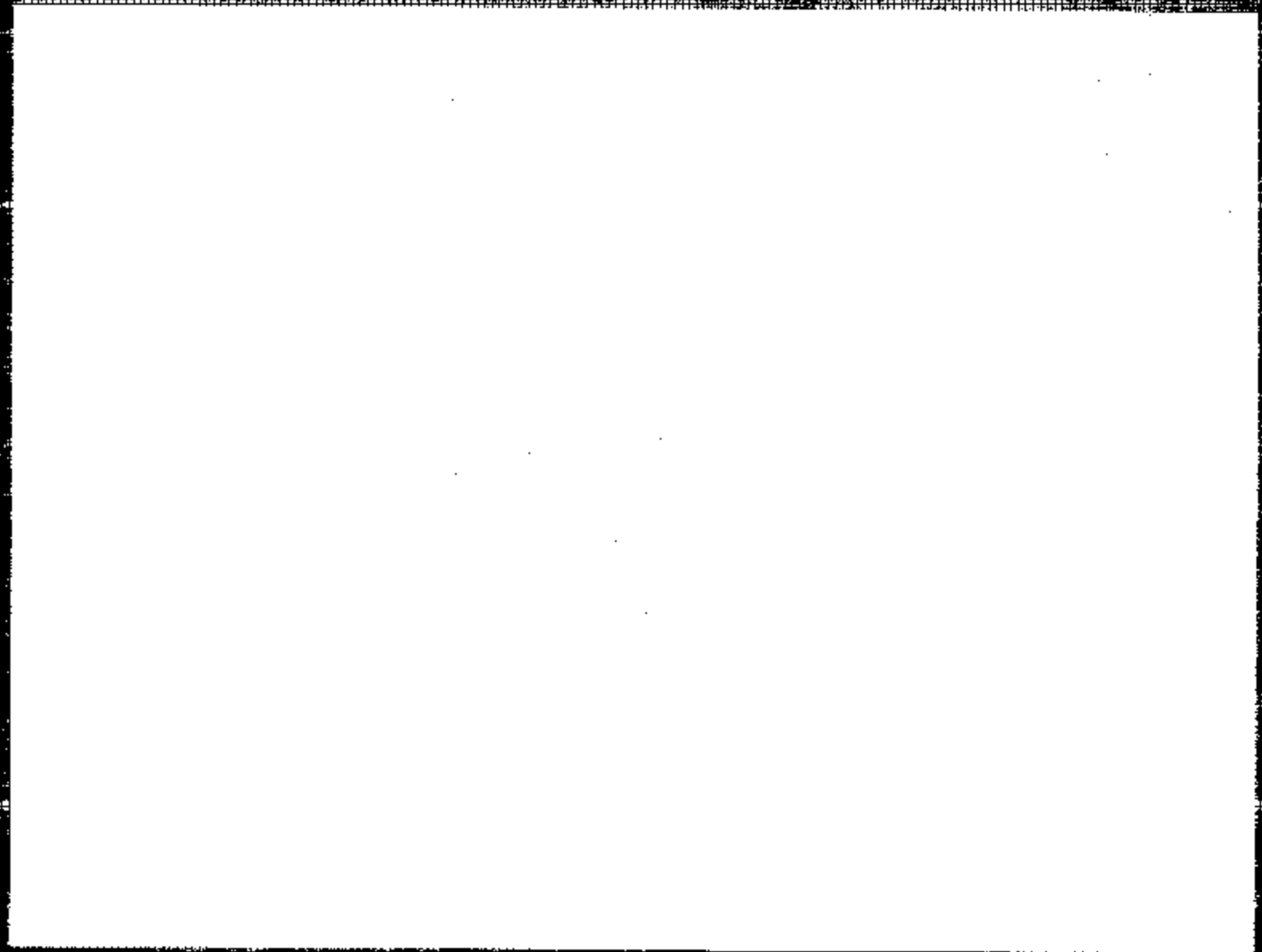
Test Vehicle: 2005 US Bus Sturdibus School Bus
Procedure: FMVSS 221

NHTSA No.: C50900



Pre-Test of Joint #6

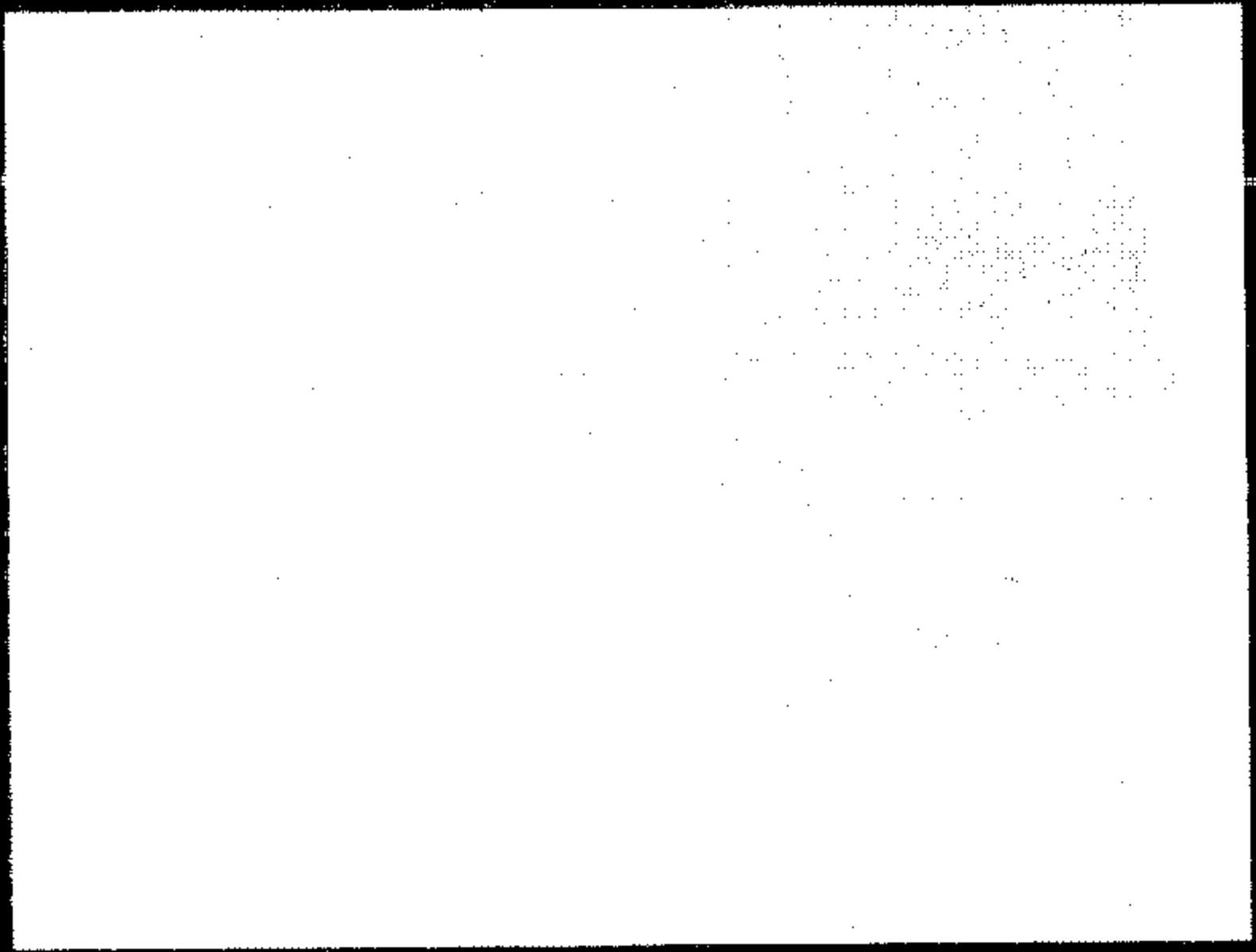
Test Vehicle: 2006 US Bus Sturdibus School Bus
Procedure: FMVSS 221 NHTSA No.: C56500



Post-Test of Joint #6

Test Vehicle: 2006 US Bus Sturdibus School Bus
Procedure: FMVSS 221

NHTSA No.: C50900



Post-Test of Joint #6 view 2

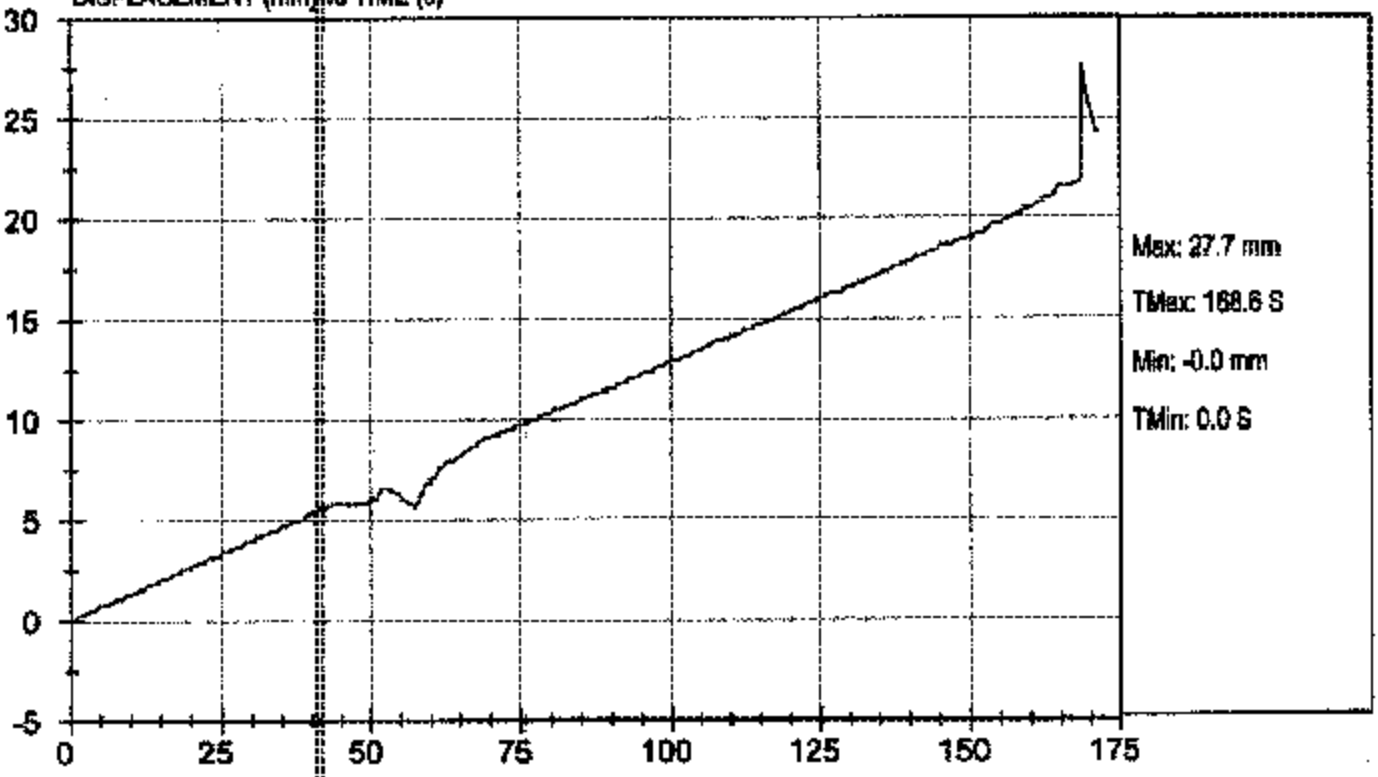
SECTION 7
TEST PLOTS

TABLE OF TEST PLOTS

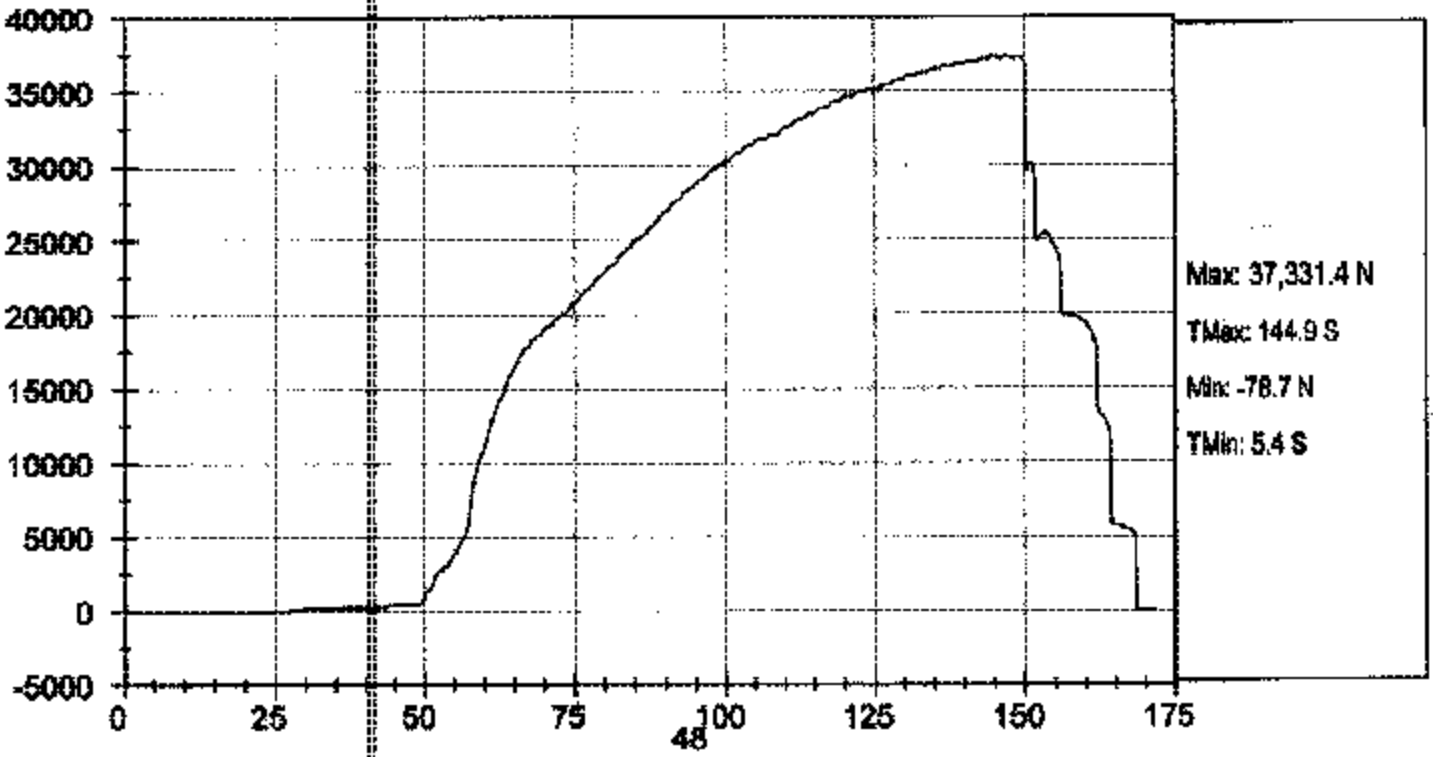
Test Desc: FMVSS 221 (Required Load 18132N)
Sample: US Bus Sample 1

Test Date: 7-6-05
NHTSA#: C50900

DISPLACEMENT (mm) vs TIME (s)



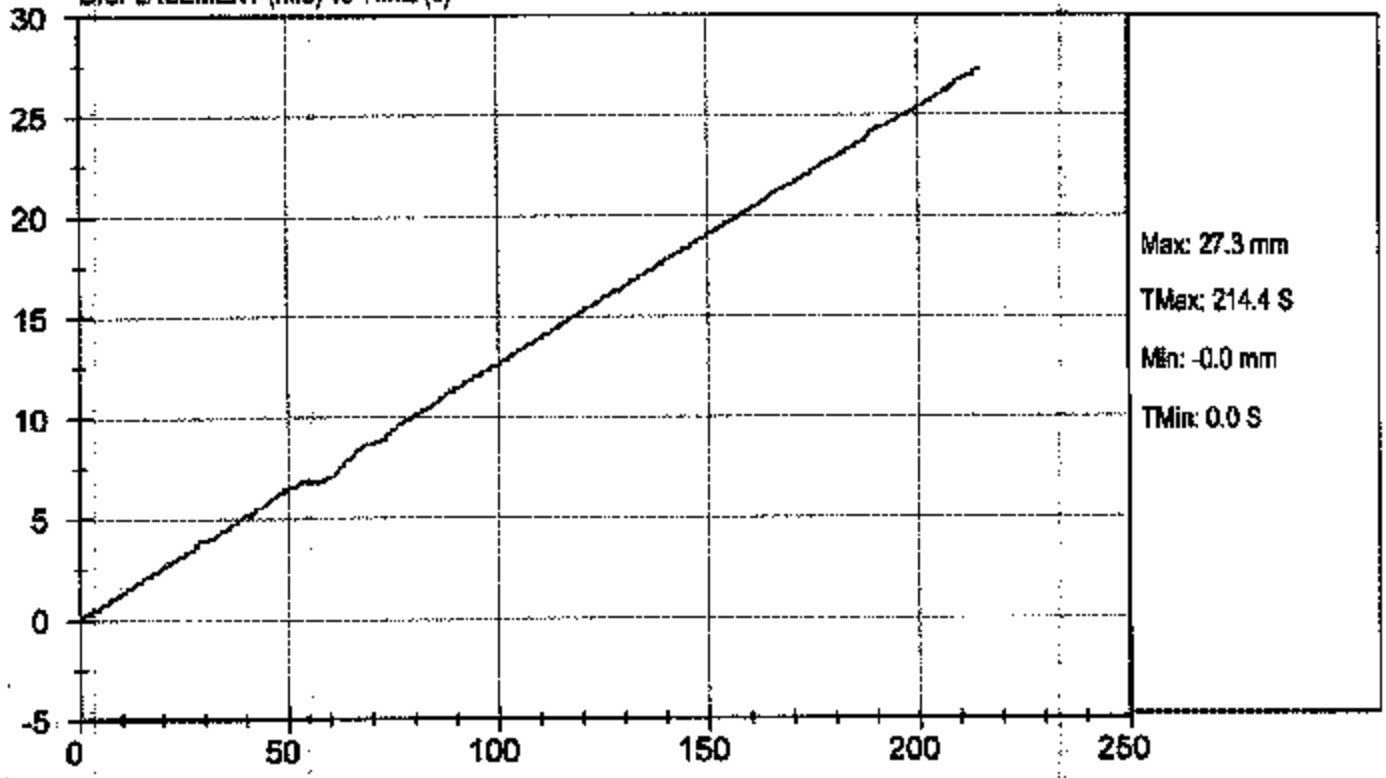
FORCE (N) vs TIME (s)



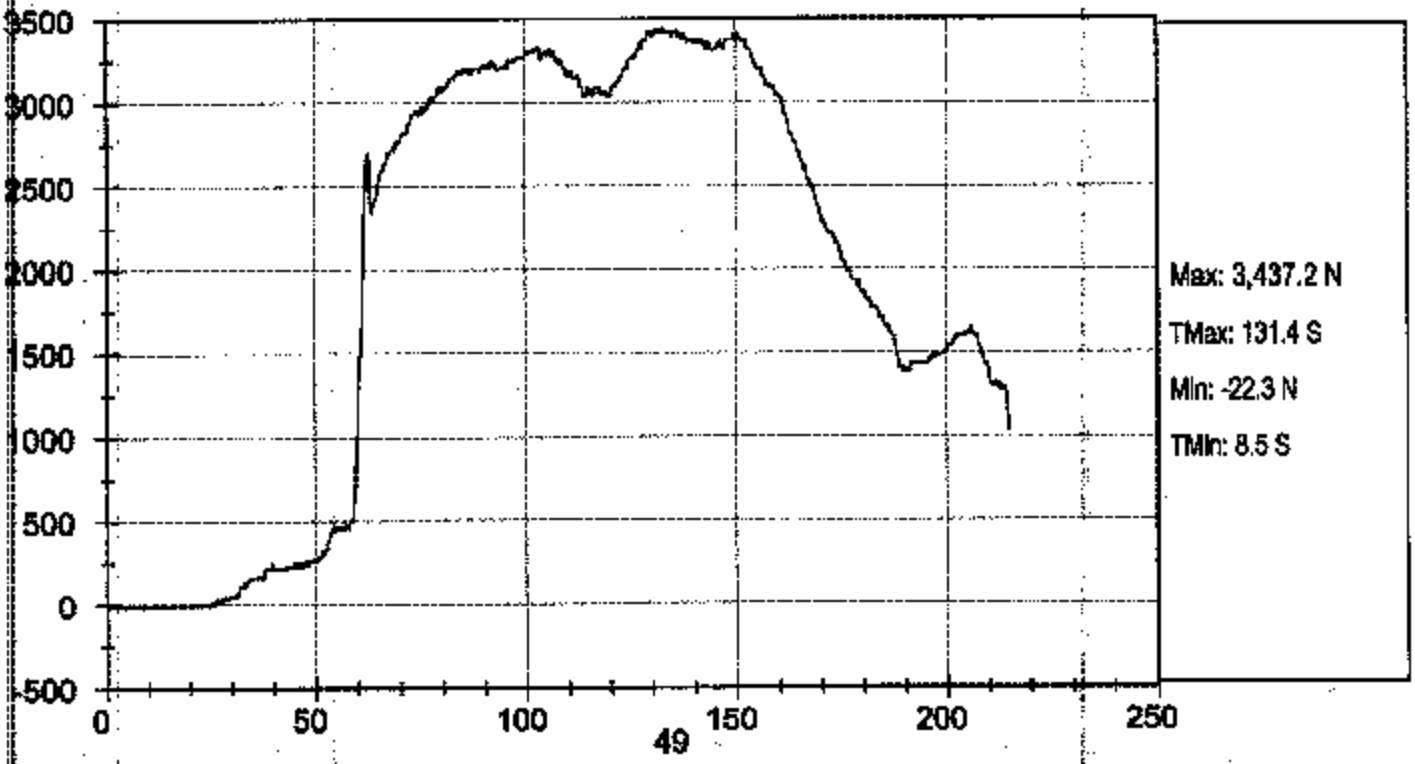
Test Desc: FMVSS 221 (Required Load 12978N)
Sample: US Bus Sample 2

Test Date: 7-6-05
NHTSA#: CS0900

DISPLACEMENT (mm) vs TIME (s)



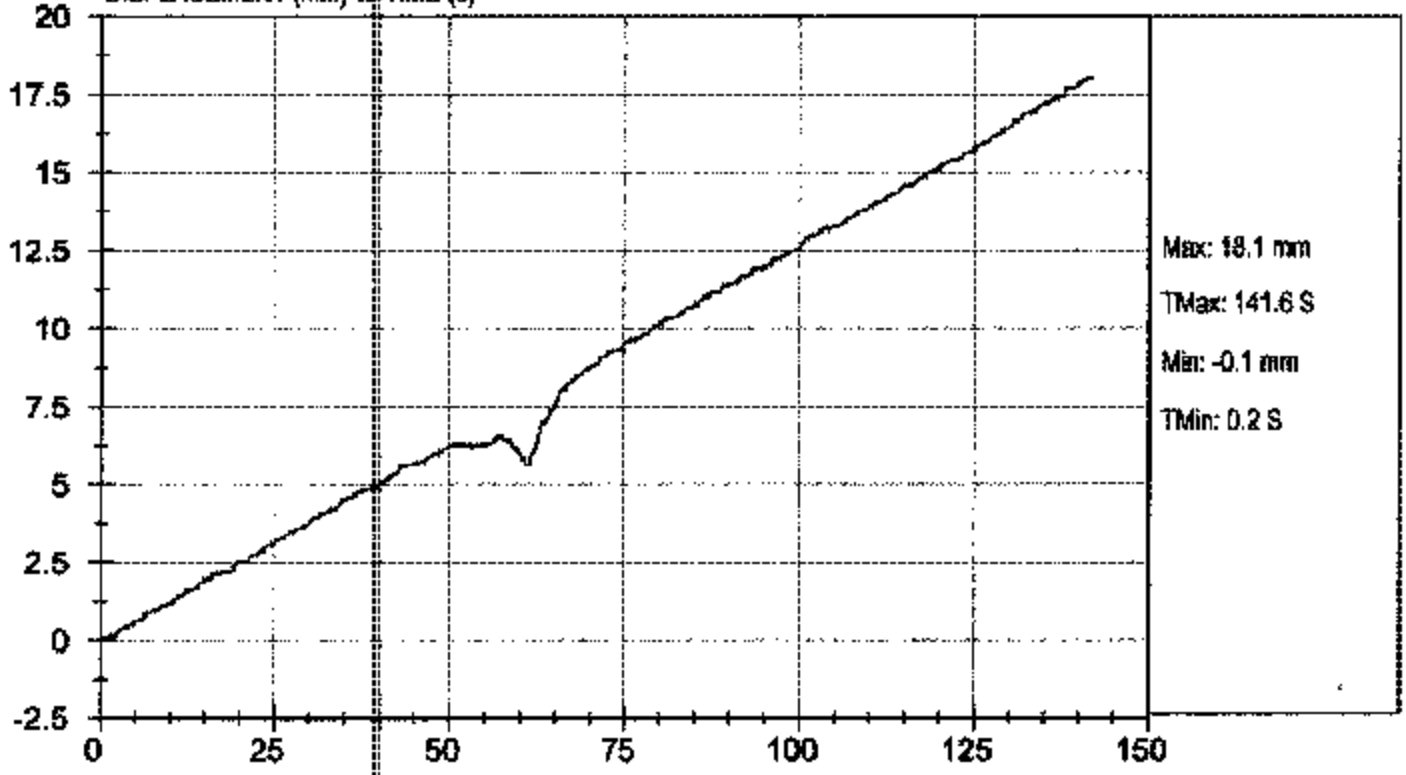
FORCE (N) vs TIME (s)



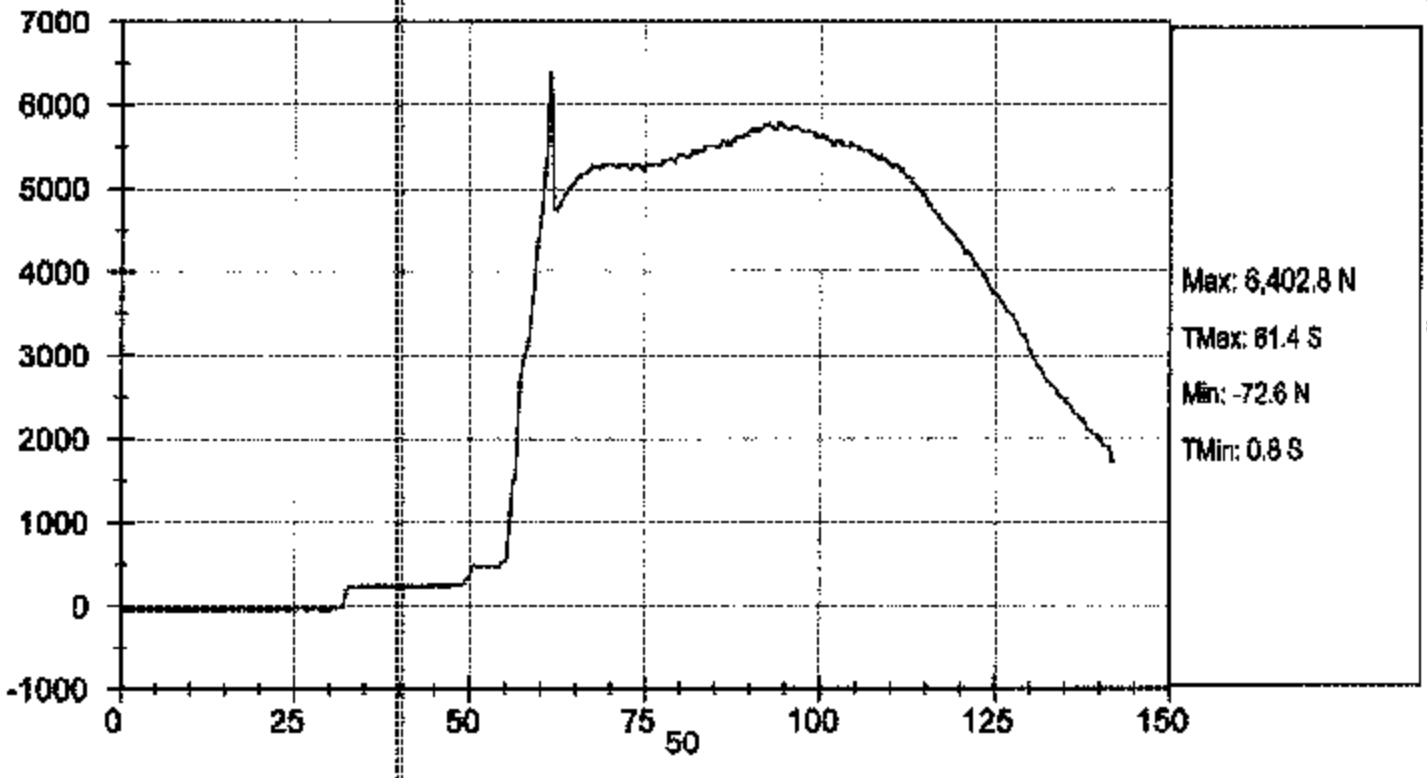
Test Desc: FMVSS 221 (Required Load 15794N)
Sample: US Bus Sample 3

Test Date: 7-7-05
NHTSA#: C50900

DISPLACEMENT (mm) vs TIME (s)



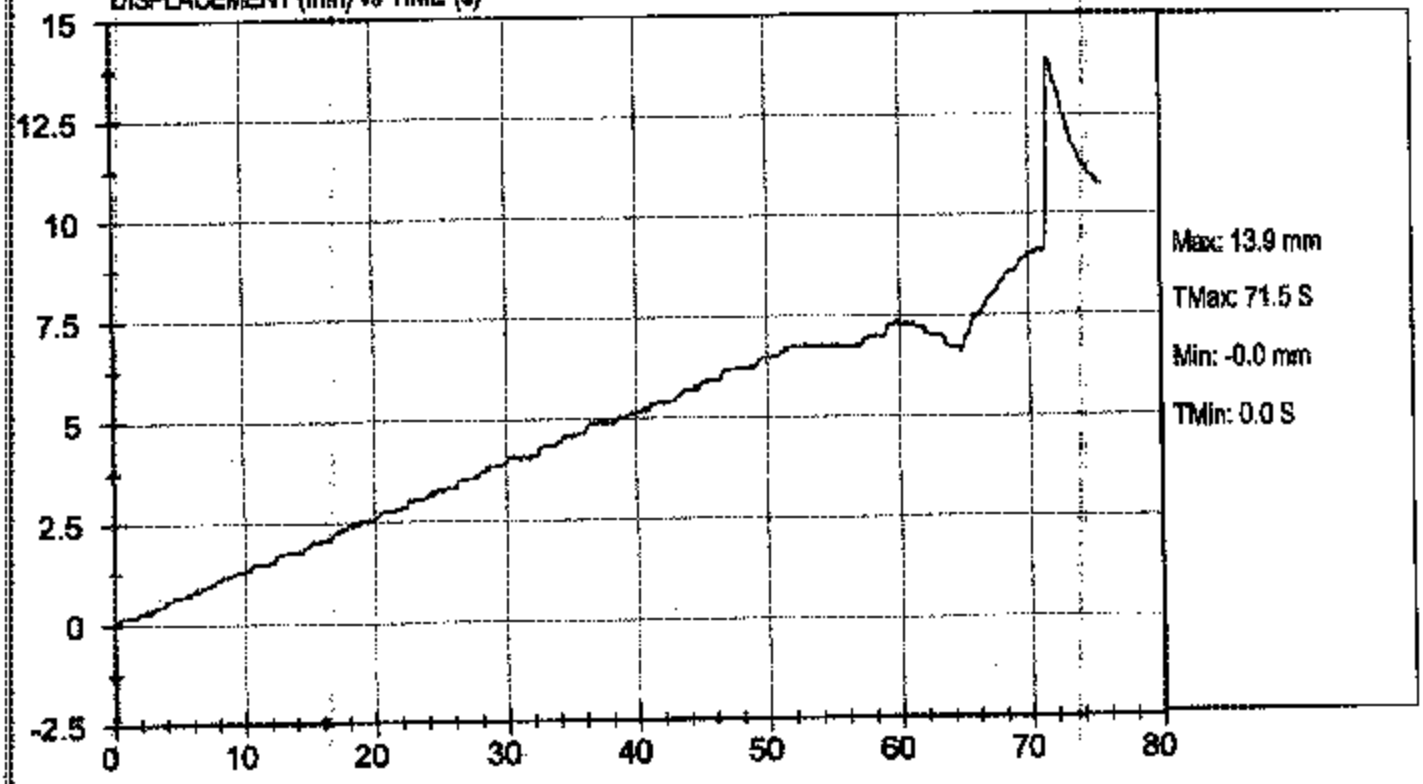
FORCE (N) vs TIME (s)



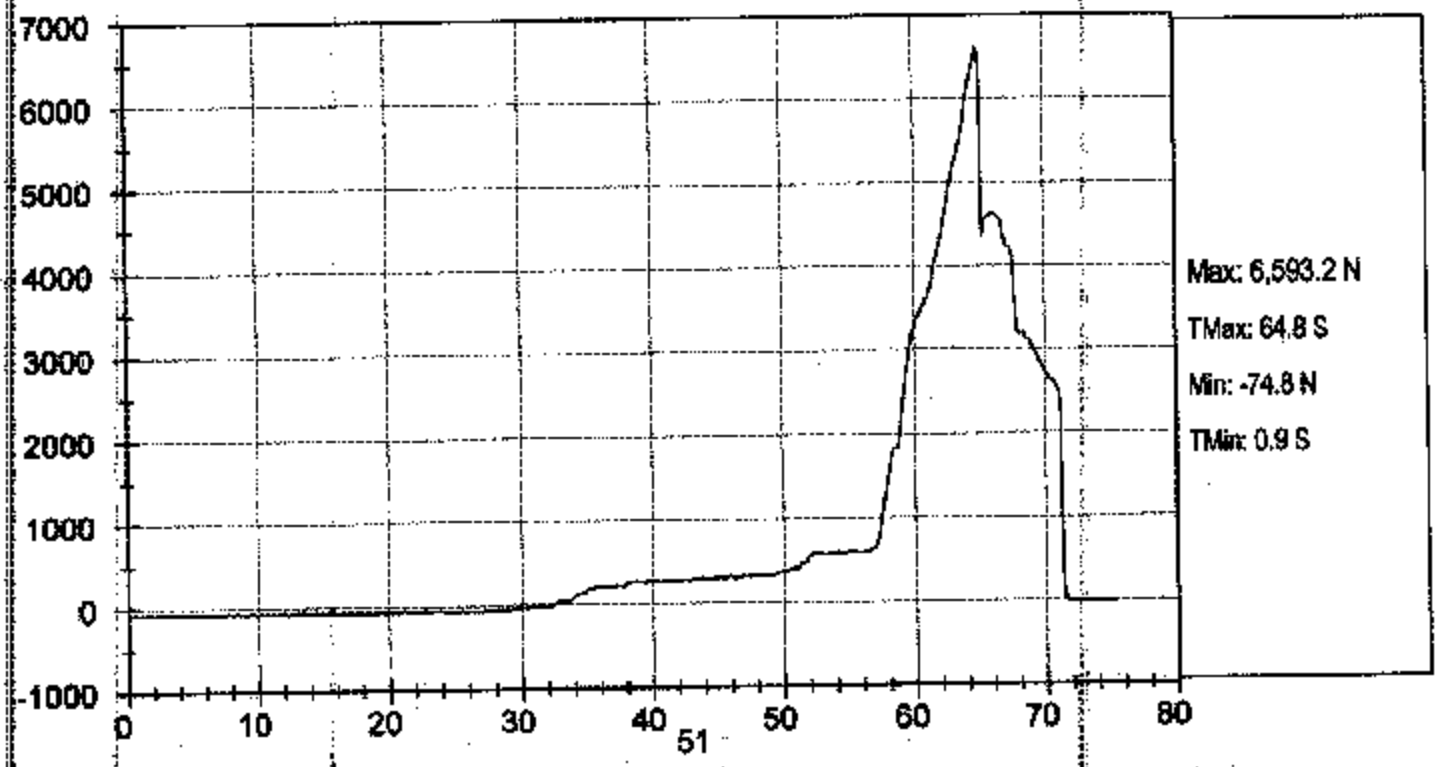
Test Desc: FMVSS 221 (Required Load 19742N)
Sample: US Bus Sample 4

Test Date: 7-6-05
NHTSA#: C50900

DISPLACEMENT (mm) vs TIME (s)

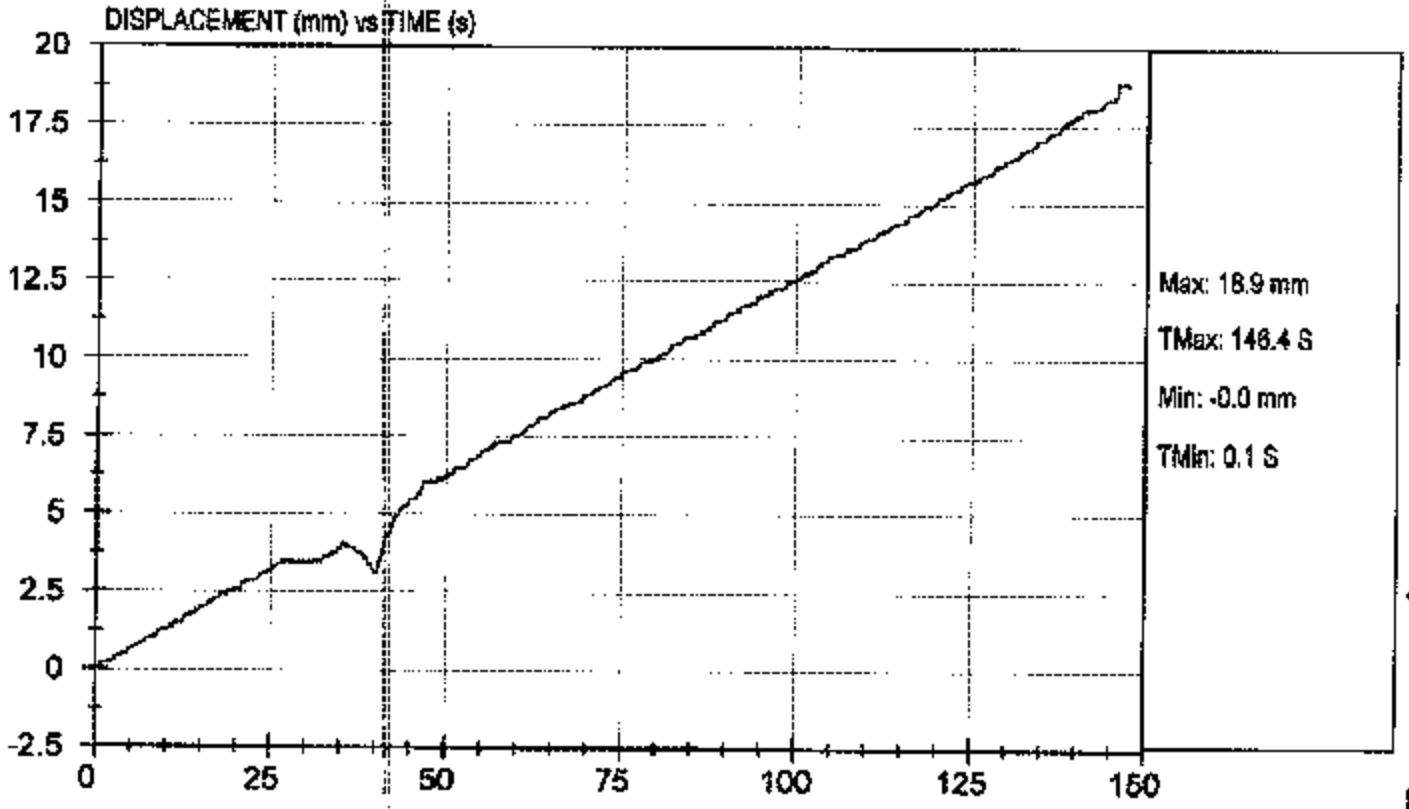


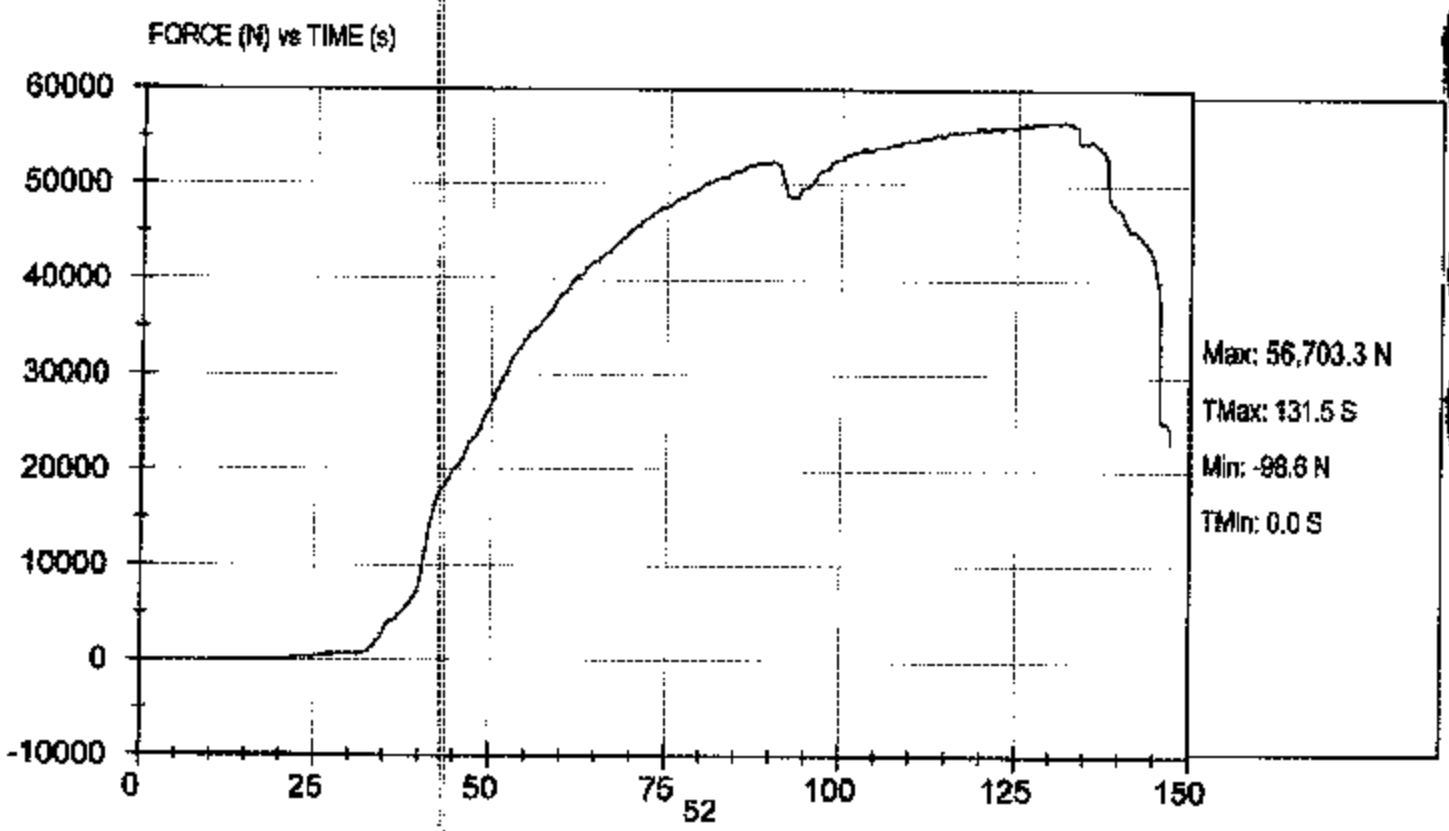
FORCE (N) vs TIME (s)



Test Desc: FMVSS 221 (Required Load 16133N)
Sample: US Bus Sample 5

Test Date: 7-6-05
NHTSA#: C50900

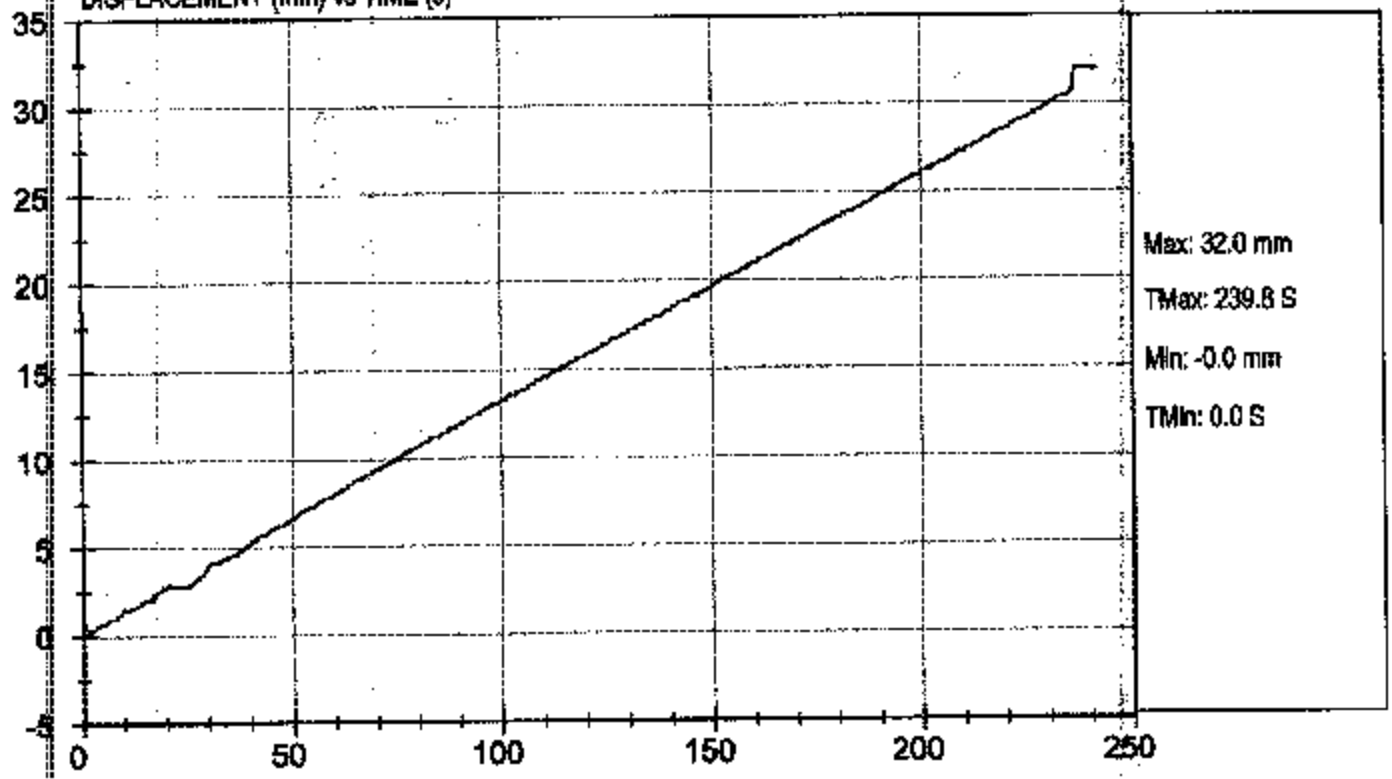




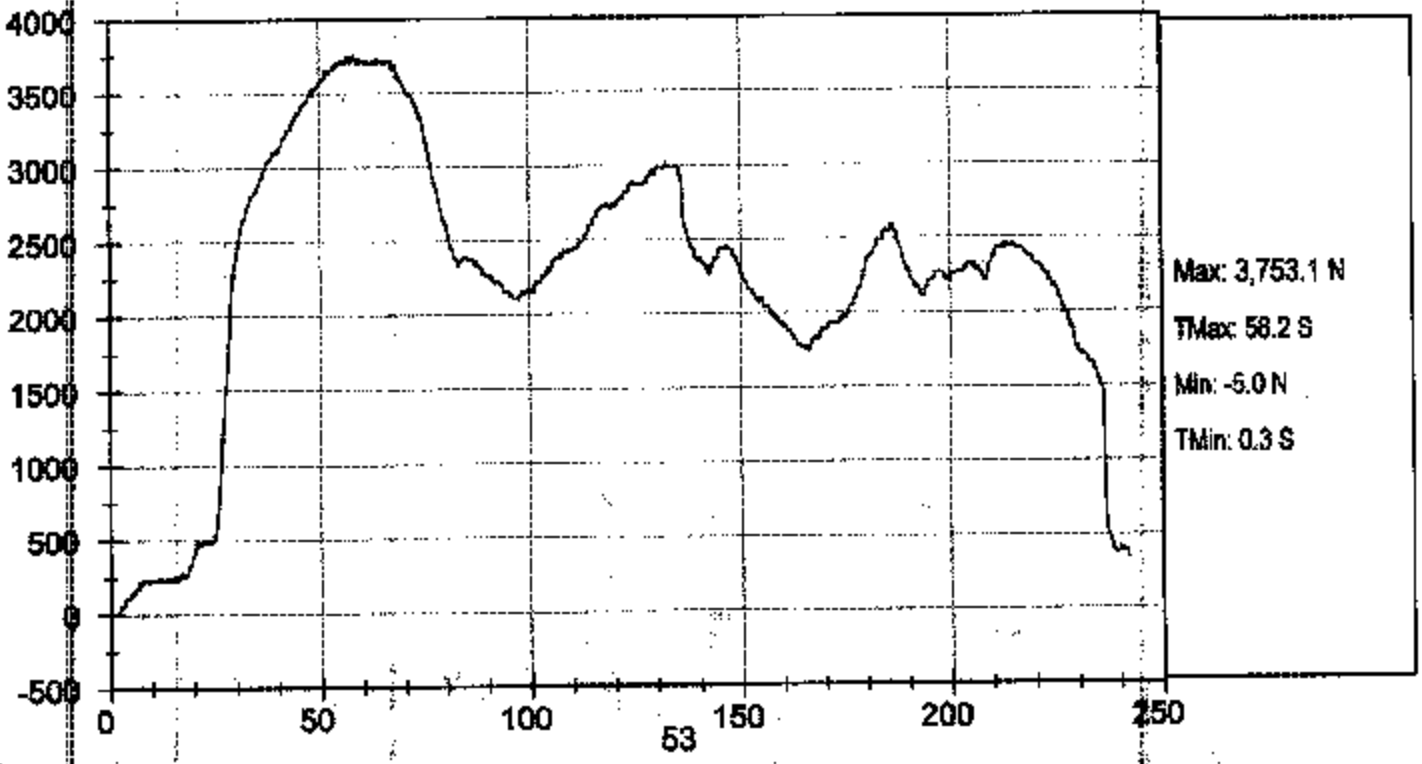
Test Desc: FMVSS 221 (Required Load 12978N)
Sample: US Bus Sample 6

Test Date: 7-6-05
NHTSA#: C50900

DISPLACEMENT (mm) vs TIME (s)



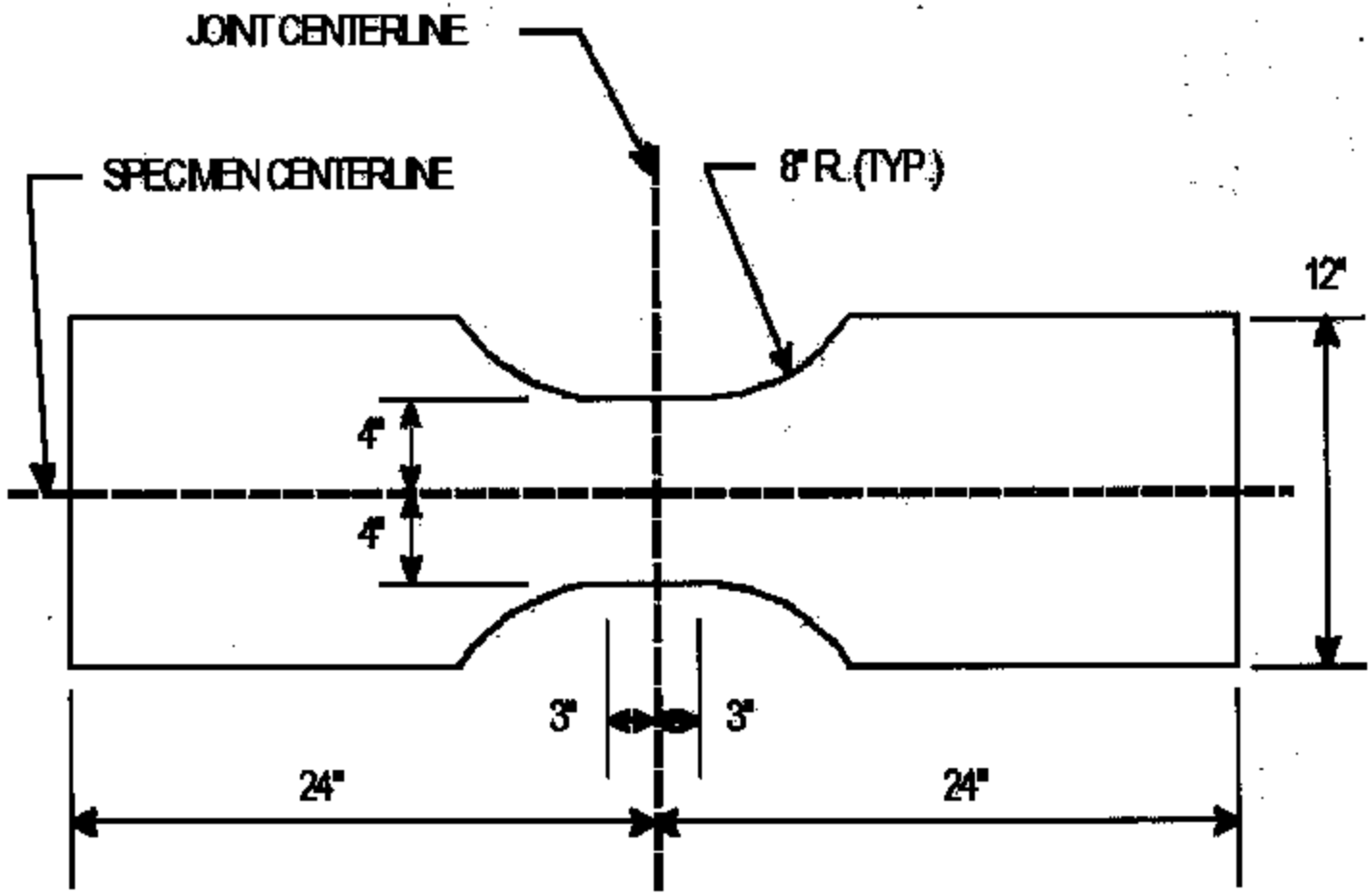
FORCE (N) vs TIME (s)



SECTION 8

JOINT CONFIGURATIONS

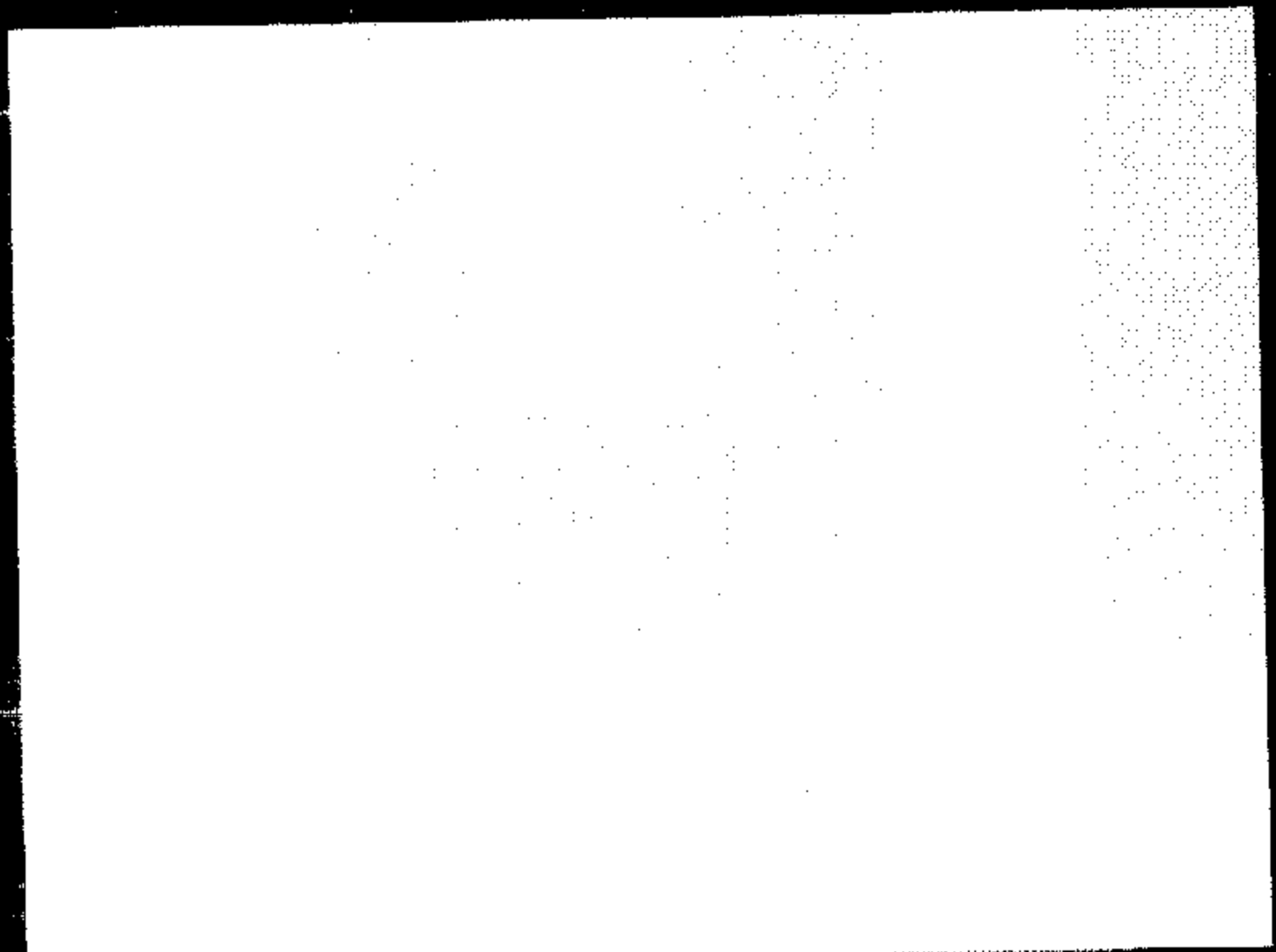
DIMENSION REQUIREMENTS OF BODY PANEL SPECIMEN WHOSE JOINT SEGMENT IS 8 INCHES LONG



Typical Test Sample Configuration

Test Vehicle: 2005 US Bus Sturdibus School Bus
Procedure: FMVSS 221

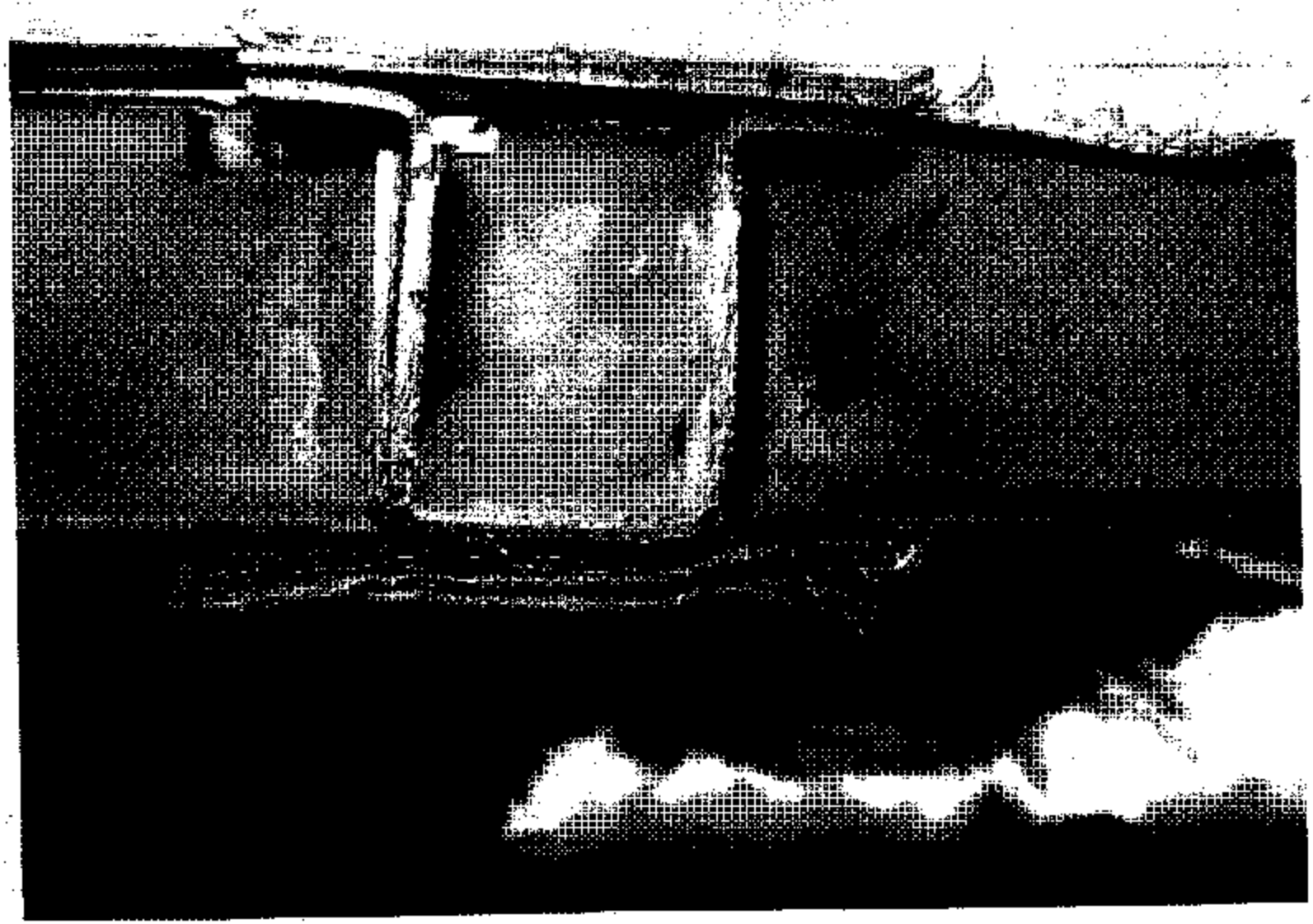
NHTSA No.: C50900



Front View of Joint

Test Vehicle: **2005 US Bus Sturdibus School Bus**
Procedure: **FMVSS 221**

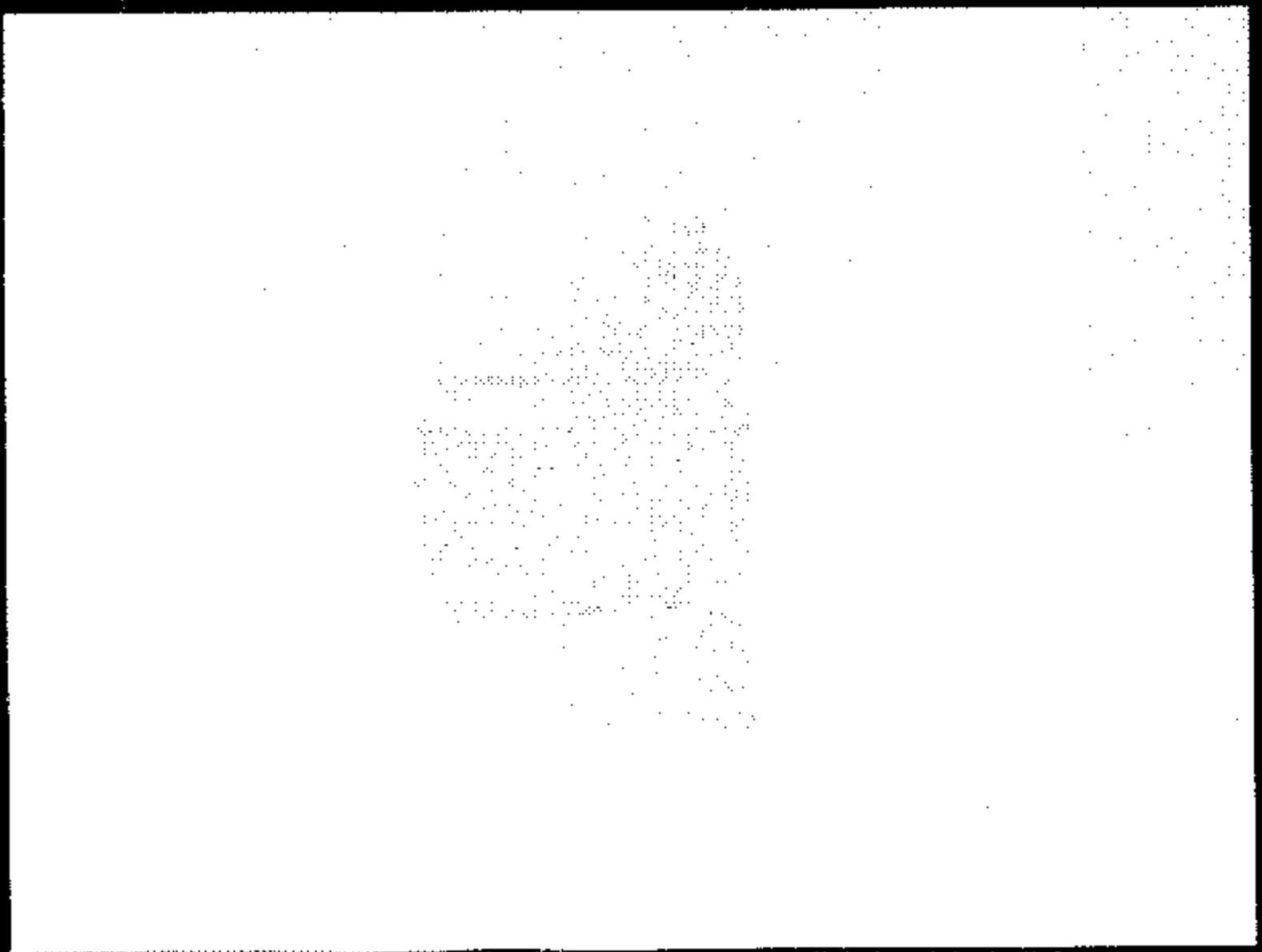
NHTSA No.: **C50900**



End View of Joint #1

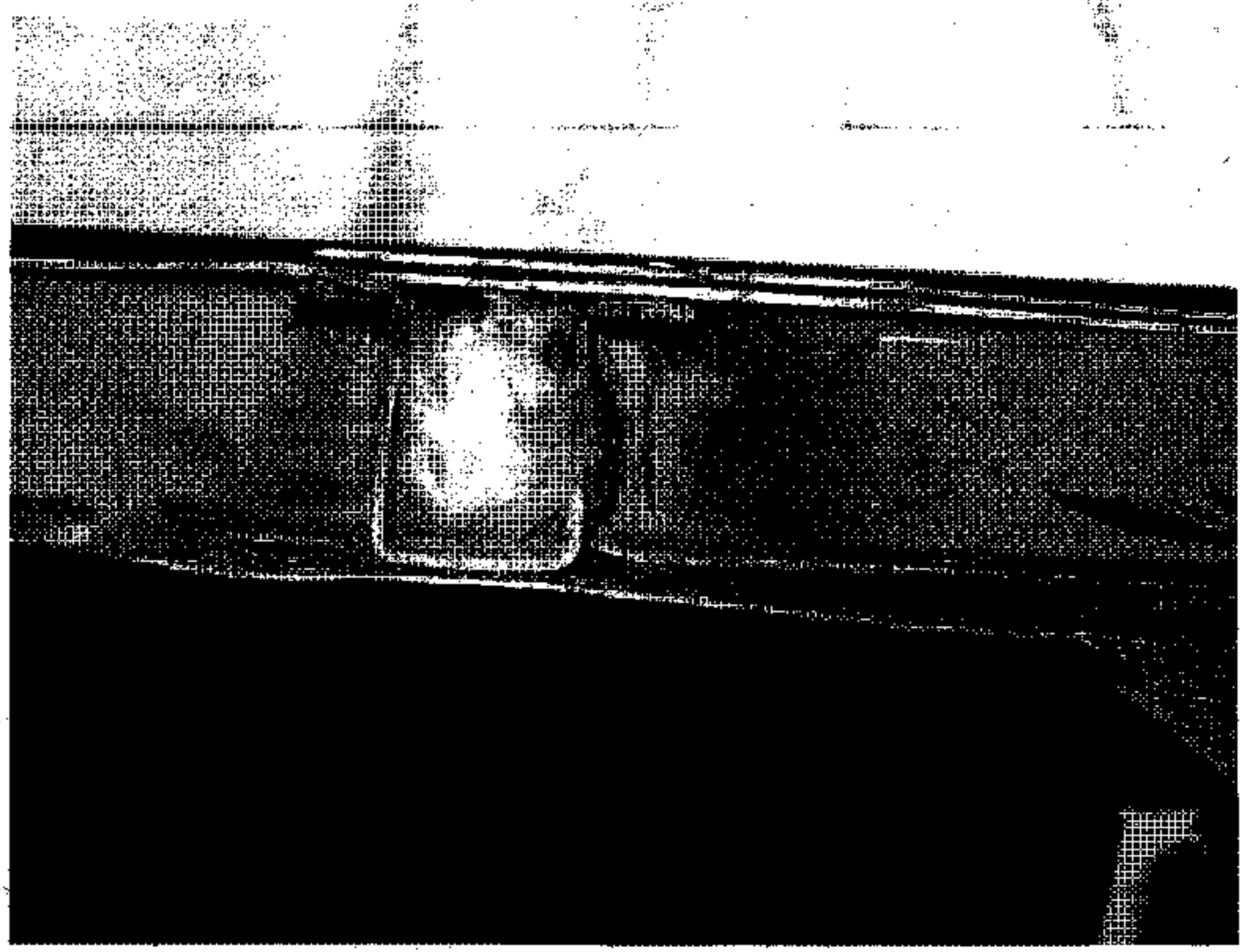
Test Vehicle: 2006 US Bus Sturdibus School Bus
Procedure: FMVSS 221

NHTSA No.: C50900



Front View of Joint #2

Test Vehicle: **2005 US Bus Sturdibus School Bus**
Procedure: **FMVSS 221** NHTSA No.: **C50900**



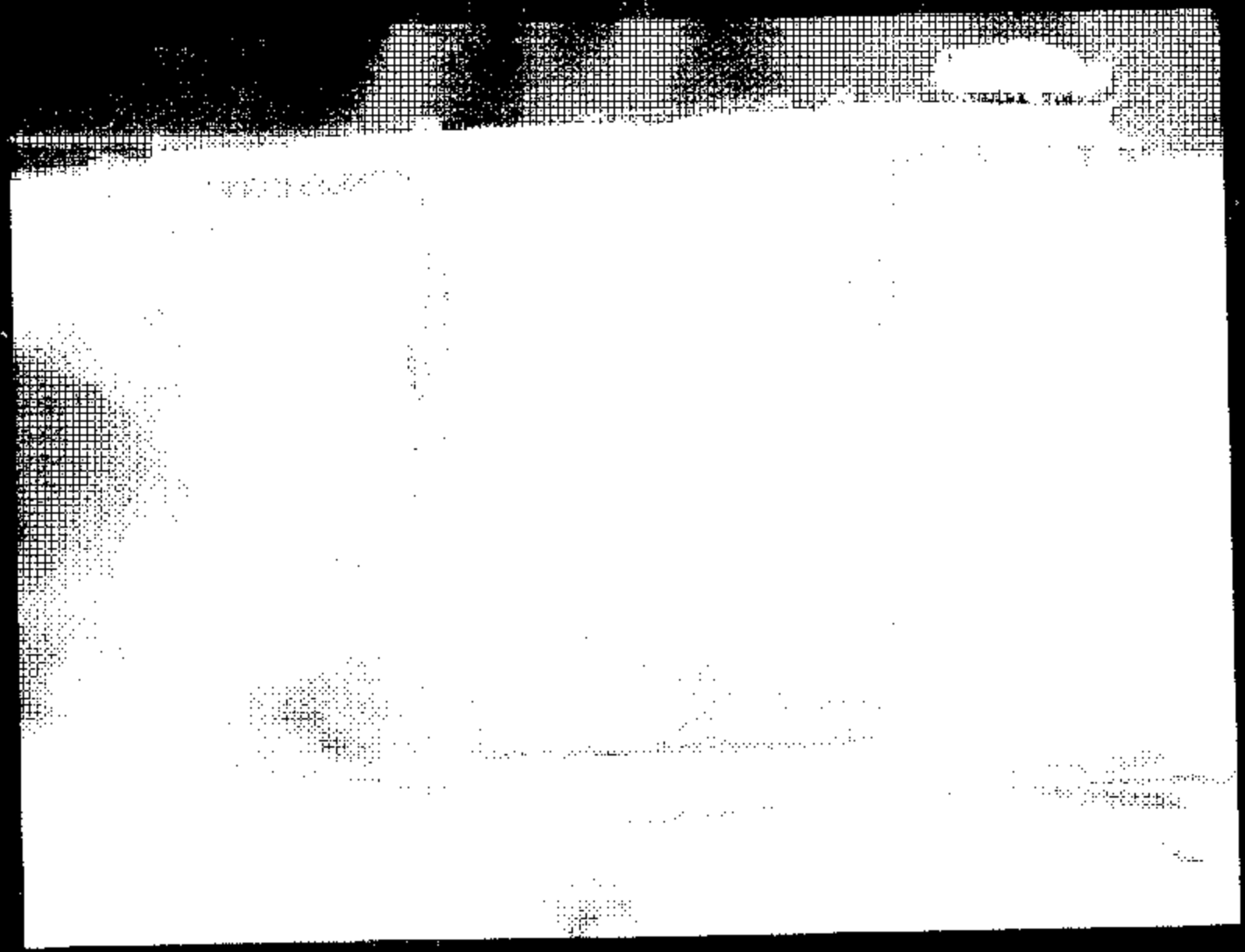
End View of Joint #2

Test Vehicle: **2006 US Bus Sturdibus School Bus**
Procedure: **FMVSS 221**

NHTSA No.: **C60900**

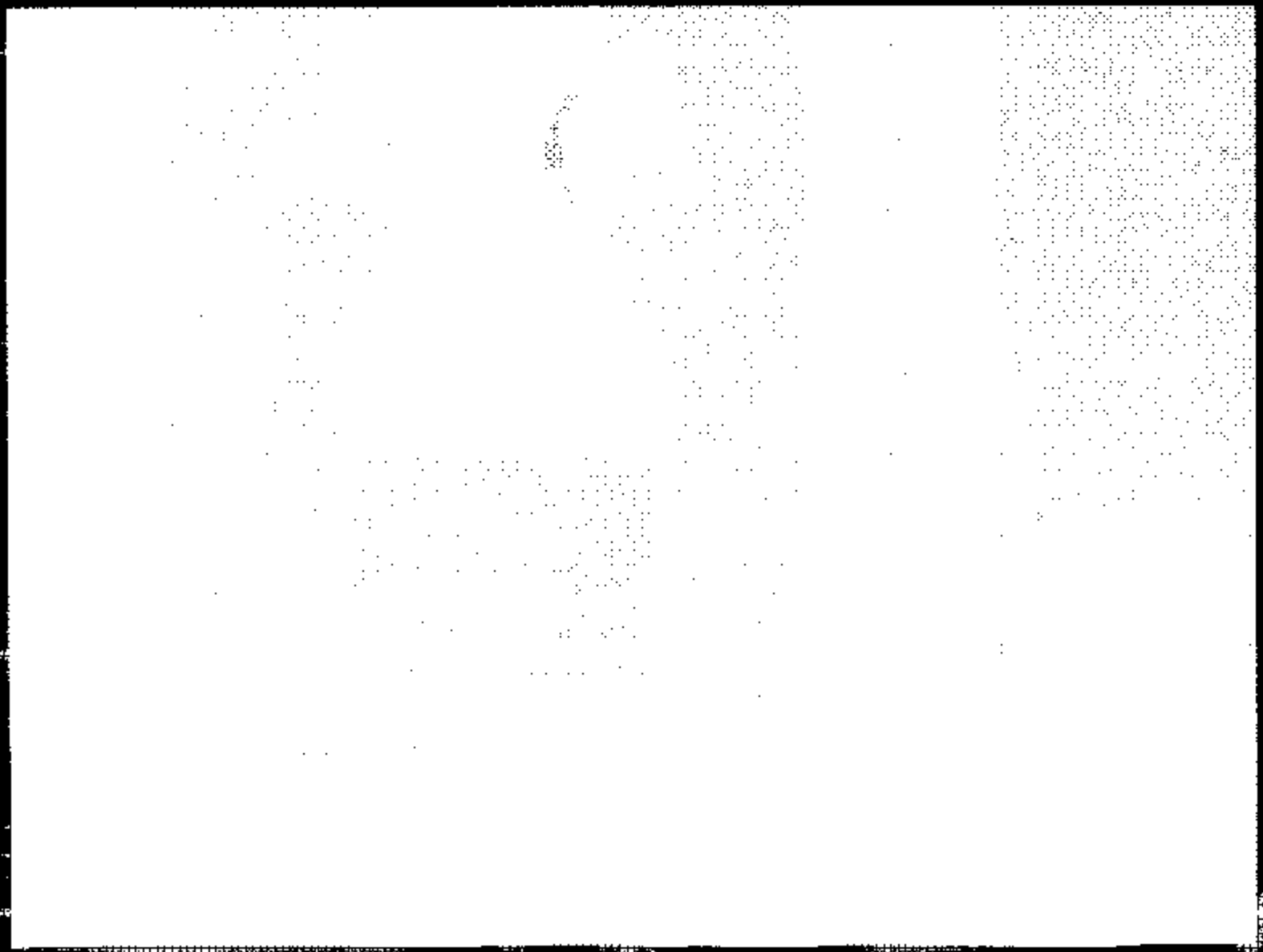
Test Vehicle: 2006 US Bus Sturdibus School Bus
Procedure: FMVSS 221

NHTSA No.: C60900



End View of Joint #3

Test Vehicle: **2005 US Bus Sturdibus School Bus**
Procedure: **FMVSS 221** NHTSA No.: **C50900**



Front View of Joint #4

Test Vehicle: 2005 US Bus Sturdibus School Bus
Procedure: FMVSS 221

NHTSA No.: C50900

End View of Joint #4

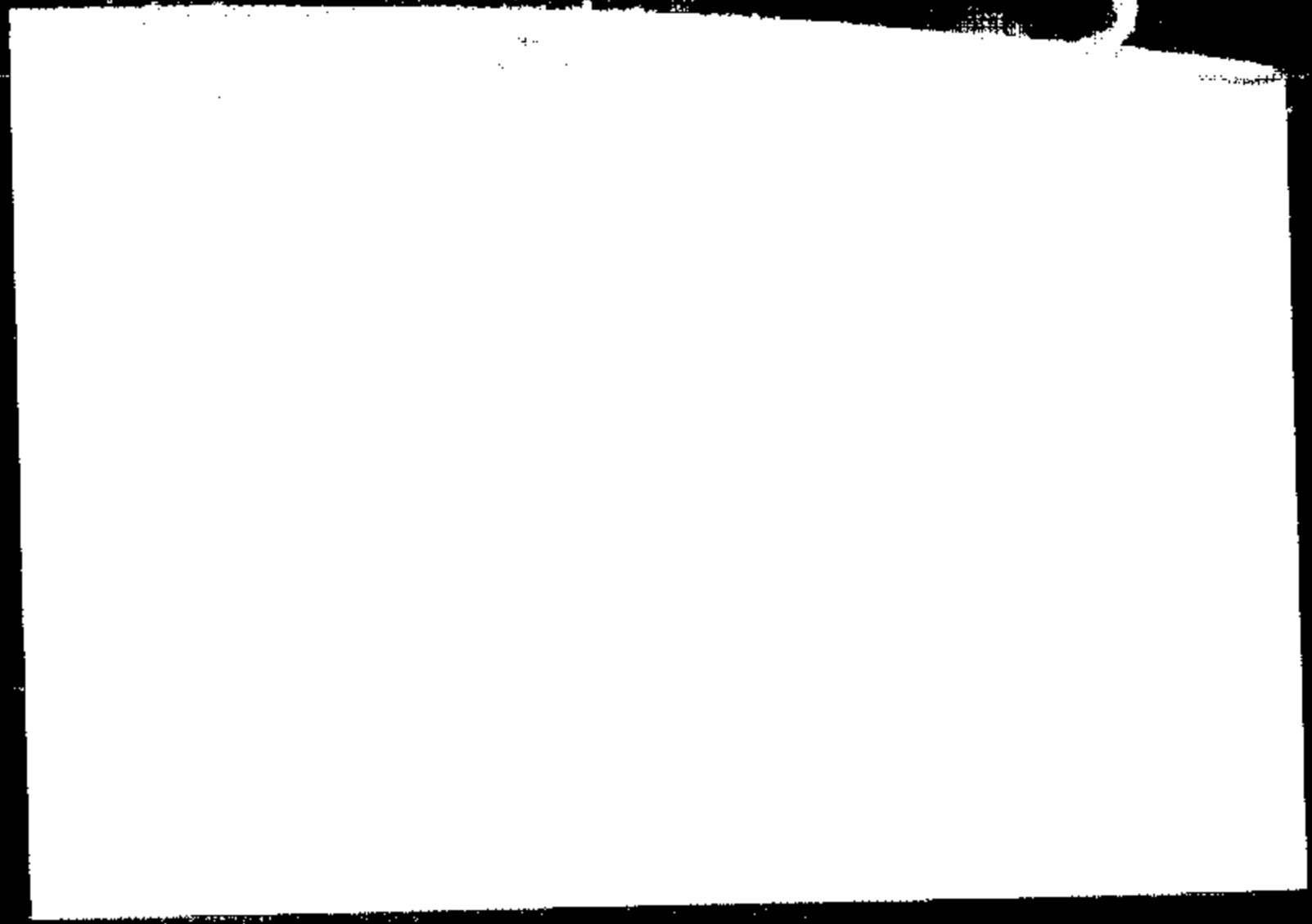
Test Vehicle: 2005 US Bus Sturdibus School Bus
Procedure: FMVSS 221

NHTSA No.: C50900

Front View of Joint #5

Test Vehicle: 2006 US Bus Sturdibus School Bus
Procedure: FMVSS 221

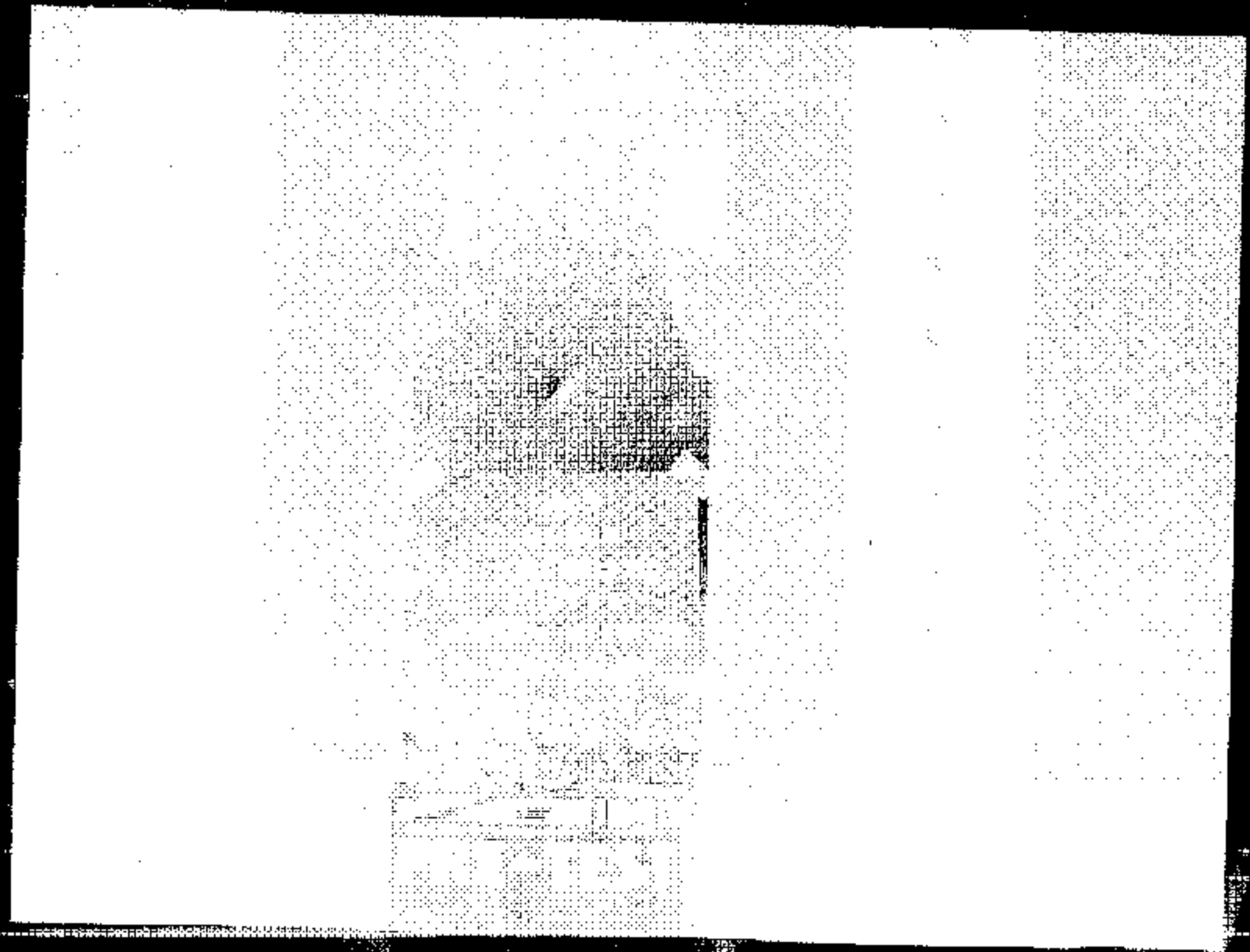
NHTSA No.: C50900



End View of Joint #5

Test Vehicle: 2005 US Bus Sturdibus School Bus
Procedure: FMVSS 221

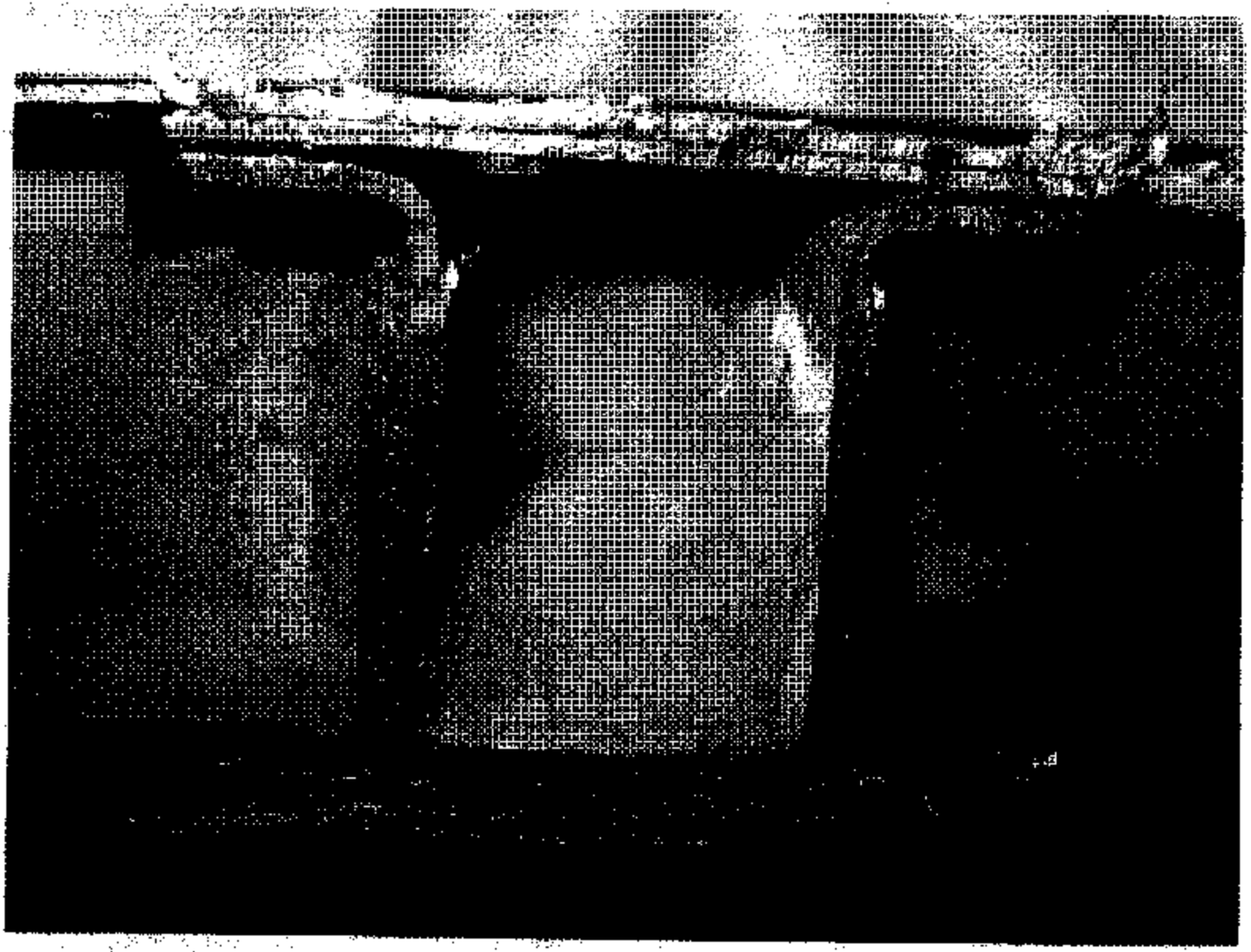
NHTSA No.: C50900



Front View of Joint #6

Test Vehicle: **2005 US Bus Sturdibus School Bus**
Procedure: **FMVSS 221**

NHTSA No.: **C50900**



End View of Joint #6

SECTION 9
LABORATORY TEST FAILURE

mga research corporation

LABORATORY NOTICE OF TEST FAILURE TO OVSC

Test Procedure:	FMVSS 221	Test Date:	July 6, 2005
Test Vehicle:	US Bus	Test Lab:	MGA Research Corp.
NHTSA No.:	C50900	Project Engineer:	Jim Hansen
Contract No.:	DTNH22-02-D-01057	Delivery Order No.:	2
MFR.:	US Bus	VIN:	1GBE5V1255F515430
Build Date:	03/05		

TEST FAILURE DESCRIPTION

The following body joint panels were tested and failed to meet the requirements of FMVSS 221:

Sample #	ID #	Required Load	Actual Load
2	ULSRMI282BRH	12978 N	3437 N
3	ULHRMI384BBH	15794 N	6403 N
4	ULRRME483BAH	19742 N	6593 N
6	ULSLMI684BRH	12978 N	3753 N

FMVSS REQUIREMENTS DESCRIPTION

Paragraph S5.1.2: "When tested in accordance with the procedure of S6, each body panel joint shall hold each body panel to the component to which it is joined when subjected to a force that equates to 60 percent of the tensile strength of the weakest joined body panel, determined pursuant to S6.2."

Remarks: No remarks.

Notification to NHTSA (COTR): Amanda Prescott

Date: July 8, 2005

By: _____