REPORT NUMBER: 221-MGA-2009-003

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

THOMAS BUILT BUSES
2009 THOMAS MINOTOUR SCHOOL BUS
NHTSA NO.: C90901

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

FINAL REPORT DATE: OCTOBER 18, 2010

FINAL REPORT

PREPARED FOR:
U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
ENFORCEMENT
OFFICE OF VEHICLE SAFETY COMPLIANCE
MAIL CODE: NVS-220
1200 NEW JERSEY AVENUE, S.E.
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Prepared by: _____ Date: October 18, 2010
Eric Peschman, Project Engineer

Reviewed by: _____ Date: October 18, 2010
Michael Janovicz, Program Manager

FINAL REPORT ACCEPTED BY:

October 18, 2010
Date of Acceptance

Technical Report Documentation Page

1. Report No.: 221-MGA-2009-003	*2. Government Accession No.:*	*3. Recipient's Catalog No.:*
4. Title and Subtitle: Final Report of FMVSS 221 Compliance Testing of 2009 Thomas Minotour School Bus NHTSA No.: C90901		*5. Report Date:* October 18, 2010 *6. Performing Organization Code* MGA
7. Author(s): Eric Peschman, Project Engineer Michael Janovicz, Program Manager		*8. Performing Organization Report No.:* 221-MGA-2009-003
9. Performing Organization Name and Address: MGA Research Corporation 5000 Warren Road Burlington, WI 53105		*10. Work Unit No.:* *11. Contract or Grant No.:* DTNH22-08-D-00075
12. Sponsoring Agency Name and Address: U.S. Department of Transportation National Highway Traffic Safety Administration Enforcement Office of Vehicle Safety Compliance Mail Code: NVS-220 1200 New Jersey Avenue, S.E. Washington, D.C. 20590		*13. Type of Report and Period Covered* Final Report 06/25/09 – 10/13/09 *14. Sponsoring Agency Code:* NVS-220
15. Supplementary Notes		
16. Abstract Compliance tests were conducted on the subject 2009 Thomas Minotour School Bus, NHTSA No.: C90901, in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No.: TP-221-03 for the determination of Compliance with FMVSS 221 requirements. Test Failures: None		
17. Key Words Compliance Testing Safety Engineering FMVSS 221		*18. Distribution Statement* Copies of this report are available from: NHTSA, Technical Information Services (TIS) Mail Code: NPO-411 1200 New Jersey Avenue, S.E. Washington, D.C. 20590 FAX No.: (202) 493-2833 E-mail: tis@dot.gov
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Form DOT F1700.7 (8-72)

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SECTION 1
PURPOSE OF COMPLIANCE TEST

Tests were conducted on a 2009 Thomas Minotour School Bus, NHTSA No.: C90901, in accordance with the specifications of the Office of Vehicle Safety Compliance (OVSC) Test Procedures TP-221-03 to determine compliance with the requirements of Federal Motor Vehicle Safety Standards (FMVSS) 221, “School Bus Body Joint Strength”.

This program is sponsored by the National Highway Traffic Safety Administration (NHTSA), under Contract No.: DTNH22-08-D-00075.

SECTION 2
TEST PROCEDURE

The 2009 Thomas Minotour School Bus, NHTSA No.: C90901 was subjected to FMVSS 221 testing.

The joint samples were selected in conjunction with the Contract Officer's Technical Representative (COTR). Four 12 x 48 inch samples were selected. They were removed from the bus using a metal shear and/or SawzAll type of cutter.

After each sample area had been removed from the bus, the sample was cut to the specific selected dimensions. Each specimen was carefully shaped to the final size using supports as specified in FMVSS 221. Additionally, temperature monitoring stickers were placed at the specified locations of each sample to ensure the sample temperature did not exceed 140°F during the shaping operation.

The samples were tested using the MGA 50,000 pound tensile tester. The force applied was measured directly at the upper clamp. The upper clamp was attached to the load cell and the lower clamp was attached to the load frame.

The gripping devices were fabricated from 3" x 3" angle iron. Slots were milled on the face that mounted to the machine, in order to allow for fore and aft movement of the clamps. This allowed the specimens to be fixtured so that the axis of the test specimen coincided with the centerline axis of the tensile tester heads.

The test specimen was inserted in between the grips, and the grips were then bolted together using 7 size ½" bolts. The bolts were inserted through one grip, through the test specimen, and then through the other grip. This prevented any slipping of the test sample in the grips, while fully distributing the clamping force across the entire end width of the test sample. Post test examination of the specimens indicated that no loads were applied to the clamp mounting holes.

The rate of load application was ¼ inch per minute. The force and displacement were recorded and displacement vs. time was plotted to monitor the displacement rate.

SECTION 3
TEST DATA SUMMARY

A total of four samples were tested for this vehicle. The samples were selected from the rear roof exterior, right side interior, front roof exterior and front roof interior.

Joint Location	Joint Specimen I.D.	Maximum Load (N)	60% of Material Strength (N)	PASS/FAIL
Rear Roof Exterior	TSRRRE189BAH	31,641	28,905	**PASS**
Right Side Interior	TSSRMI189BSV	10,540	7,847	**PASS**
Front Roof Exterior	TSRRFE189BAH	32,436	24,746	**PASS**
Front Roof Interior	TSRCFI189BSV	21,927	14,726	**PASS**

The maximum forces measured, and the displacement rate used, are provided in Section 7.

The photographs taken from the samples are provided in Section 6 and Section 8.

SECTION 4
COMPLIANCE TEST DATA

The following data sheets document the results of FMVSS 221 testing on the 2009 Thomas Minotour School Bus, NHTSA No.: C90901.

DATA SHEET 1

ADMINISTRATIVE DATA SHEET

Test Vehicle:	**2009 THOMAS MINOTOUR SCHOOL BUS**	NHTSA No.:	**C90901**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**6/25/09**

INCOMPLETE VEHICLE (IF APPLICABLE)

Manufacturer:	General Motors Corporation
VIN:	1GBHG31C181210142
Build Date:	06/08
Certification Date:	06/08

COMPLETED VEHICLE (SCHOOL BUS)

Manufacturer:	Thomas Built Buses Inc.
Make/Model:	Thomas Minotour
VIN:	1GBHG31C181210142
NHTSA No.:	C90901
Color:	Yellow
GVWR:	4,356 kg / 9,600 lbs
Build Date:	07/08
Certification Date:	07/08

DATES

Vehicle Receipt:	08/19/08
Start of Compliance Test:	06/25/09
Completion of Compliance Test:	06/25/09

COMPLIANCE TEST:
All tests were performed in accordance with the references outlined in TP-221-03.

Recorded By:_____

Approved By:_____ Date: 06/25/09

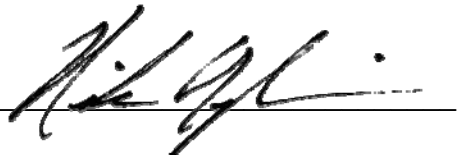
DATA SHEET 2

SUMMARY OF DATA

Test Vehicle: **2009 THOMAS MINOTOUR SCHOOL BUS** NHTSA No.: **C90901**
Test Lab: **MGA RESEARCH CORPORATION** Test Date: **6/25/09**

Joint Specimen I.D.	Joint Location	Joint Load Reqmt (60%) (N)	Max. Load at Joint Separation (N)	Calculated Material Strength (N)	PASS/ FAIL
TSRRRE189BAH	Rear Roof Exterior	28,905	31,641	48,175	**PASS**
TSSRMI189BSV	Right Side Interior	7,847	10,540	13,079	**PASS**
TSRRFE189BAH	Front Roof Exterior	24,746	32,436	41,243	**PASS**
TSRCFI189BSV	Front Roof Interior	14,726	21,927	24,543	**PASS**

Comments: None

Recorded By: 

Approved By:  Date: 06/25/09

DATA SHEET 3

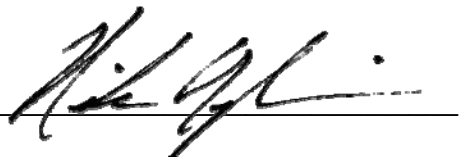
JOINT STRENGTH WHEN ASTM MATERIAL PROPERTIES ARE KNOWN

Test Vehicle: **2009 THOMAS MINOTOUR SCHOOL BUS** NHTSA No.: **C90901**
Test Lab: **MGA RESEARCH CORPORATION** Test Date: **6/25/09**

Specimen Description:	Rear Roof Exterior		
Joint Number:	TSRRRE189BAH	Test Number:	Q09214

	Weaker Member	Stronger Member
Material	ASTM B209 5052-H32 (Coil 10500008)	ASTM B209 5052-H32 (Coil 10500007)
Tensile Strength (MPa)	217.2	233.7
Gage/Thickness (mm)	16 / 1.27	16 / 1.27
Fastener Holes (No./Diameter – mm.)	6 / 4.76	6 / 4.76
Net Area (Sq. mm.)	221.8	221.8
Material Strength (N)	48,175.0	51,834.7
60% of Material Strength (N)	28,905.0	31,100.8
Maximum Load From Tensile Test of Joint (N)	31,641.0	N/A
PASS/FAIL	**PASS**	N/A

Comments: None

Recorded By: 

Approved By:  Date: 06/25/09

DATA SHEET 3… (Continued)

JOINT STRENGTH WHEN ASTM MATERIAL PROPERTIES ARE KNOWN

Test Vehicle: **2009 THOMAS MINOTOUR SCHOOL BUS** NHTSA No.: **C90901**
Test Lab: **MGA RESEARCH CORPORATION** Test Date: **6/25/09**

Specimen Description:	Right Side Interior		
Joint Number:	TSSRMI189BSV	Test Number:	Q09215

	Weaker Member	Stronger Member
Material	ASTM B209 3105-H154	N/A
Tensile Strength (MPa)	151.7	N/A
Gage/Thickness (mm)	24 / 0.511	N/A
Fastener Holes (No./Diameter – mm.)	7 / 4.90	N/A
Net Area (Sq. mm.)	86.2	N/A
Material Strength (N)	13,078.6	N/A
60% of Material Strength (N)	7,847.2	N/A
Maximum Load From Tensile Test of Joint (N)	10,540.0	N/A
PASS/FAIL	**PASS**	N/A

Comments: None

Recorded By:_____

Approved By:_____ Date: 06/25/09

DATA SHEET 3… (Continued)

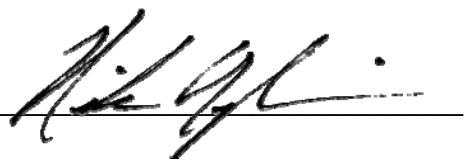
JOINT STRENGTH WHEN ASTM MATERIAL PROPERTIES ARE KNOWN

Test Vehicle: **2009 THOMAS MINOTOUR SCHOOL BUS** NHTSA No.: **C90901**
Test Lab: **MGA RESEARCH CORPORATION** Test Date: **6/25/09**

Specimen Description:	Front Roof Exterior		
Joint Number:	TSRRFE189BAH	Test Number:	Q09126

	Weaker Member	Stronger Member
Material	ASTM D638 Reinforced Fiberglass	ASTM B209 5052-H36 (Coil 10500006)
Tensile Strength (MPa)	48.3	255.1
Gage/Thickness (mm)	- / 4.76	16 / 1.27
Fastener Holes (No./Diameter – mm.)	5 / 4.76	5 / 4.76
Net Area (Sq. mm.)	853.9	227.8
Material Strength (N)	41,243.4	58,111.8
60% of Material Strength (N)	24,746.0	34,867.1
Maximum Load From Tensile Test of Joint (N)	32,436.0	N/A
PASS/FAIL	**PASS**	N/A

Comments: None

Recorded By: 

Approved By:  Date: 06/25/09

DATA SHEET 3… (Continued)

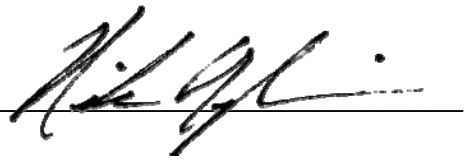
JOINT STRENGTH WHEN ASTM MATERIAL PROPERTIES ARE KNOWN

Test Vehicle: **2009 THOMAS MINOTOUR SCHOOL BUS** NHTSA No.: **C90901**
Test Lab: **MGA RESEARCH CORPORATION** Test Date: **6/25/09**

Specimen Description:	Front Roof Interior		
Joint Number:	TSRCFI189BSV	Test Number:	Q09127

	Weaker Member	Stronger Member
Material	ASTM B209 5052-H32	N/A
Tensile Strength (MPa)	213.7	N/A
Gage/Thickness (mm)	22 / 0.643	N/A
Fastener Holes (No./Diameter – mm.)	5 / 4.90	N/A
Net Area (Sq. mm.)	114.8	N/A
Material Strength (N)	24,543.3	N/A
60% of Material Strength (N)	14,726.0	N/A
Maximum Load From Tensile Test of Joint (N)	21,927.0	N/A
PASS/FAIL	**PASS**	N/A

Comments: None

Recorded By: 

Approved By:  Date: 06/25/09

SECTION 5

INSTRUMENTATION AND EQUIPMENT LIST

Test Vehicle: **2009 THOMAS MINOTOUR SCHOOL BUS** NHTSA No.: **C90901**
Test Lab: **MGA RESEARCH CORPORATION** Test Date: **6/25/09**

Equipment	Description	Model/Serial No.	Cal. Date	Next Cal. Date
Load Cell	Interface	1210AF / 137781	05/13/09	11/13/09
Linear Potentiometer	Ametek	P25A / 1202-19365	05/25/09	11/25/09
Steel Tape	Stanley	Powerlock / 184	04/09/09	10/09/09
Temp. Stickers	McMaster Carr	60° C / 5952K21	One Time Use	---

SECTION 6

PHOTOGRAPHS

TABLE OF PHOTOGRAPHS

Test Vehicle:	**2009 THOMAS MINOTOUR SCHOOL BUS**	NHTSA No.:	**C90901**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**06/25/09**

Front View of School Bus

Test Vehicle:	**2009 THOMAS MINOTOUR SCHOOL BUS**	NHTSA No.:	**C90901**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**06/25/09**

Rear View of School Bus

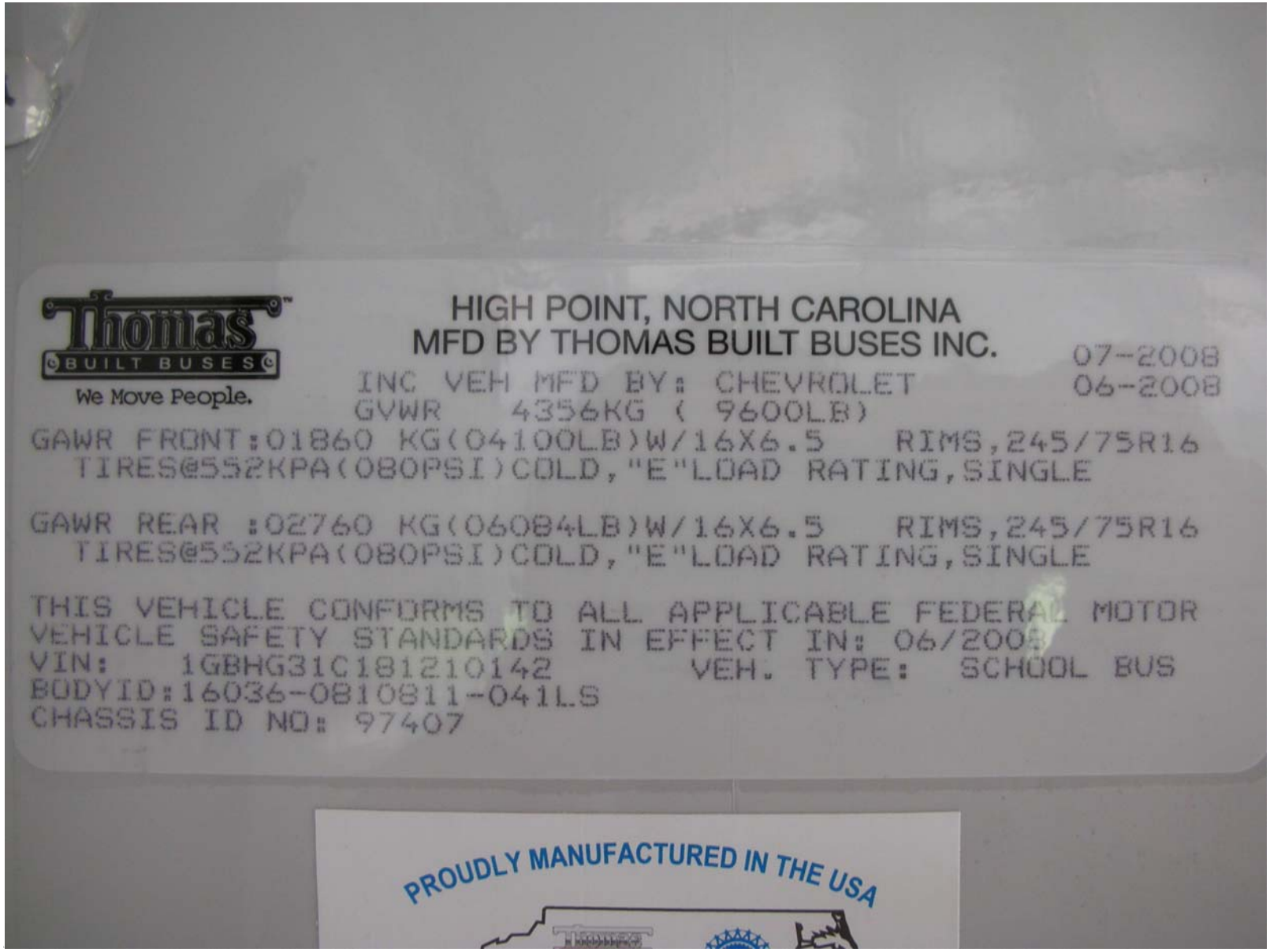
Test Vehicle:	**2009 THOMAS MINOTOUR SCHOOL BUS**	NHTSA No.:	**C90901**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**06/25/09**

Left Side View of School Bus

Test Vehicle:	**2009 THOMAS MINOTOUR SCHOOL BUS**	NHTSA No.:	**C90901**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**06/25/09**

Right Side View of School Bus

Test Vehicle:	**2009 THOMAS MINOTOUR SCHOOL BUS**	NHTSA No.:	**C90901**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**06/25/09**



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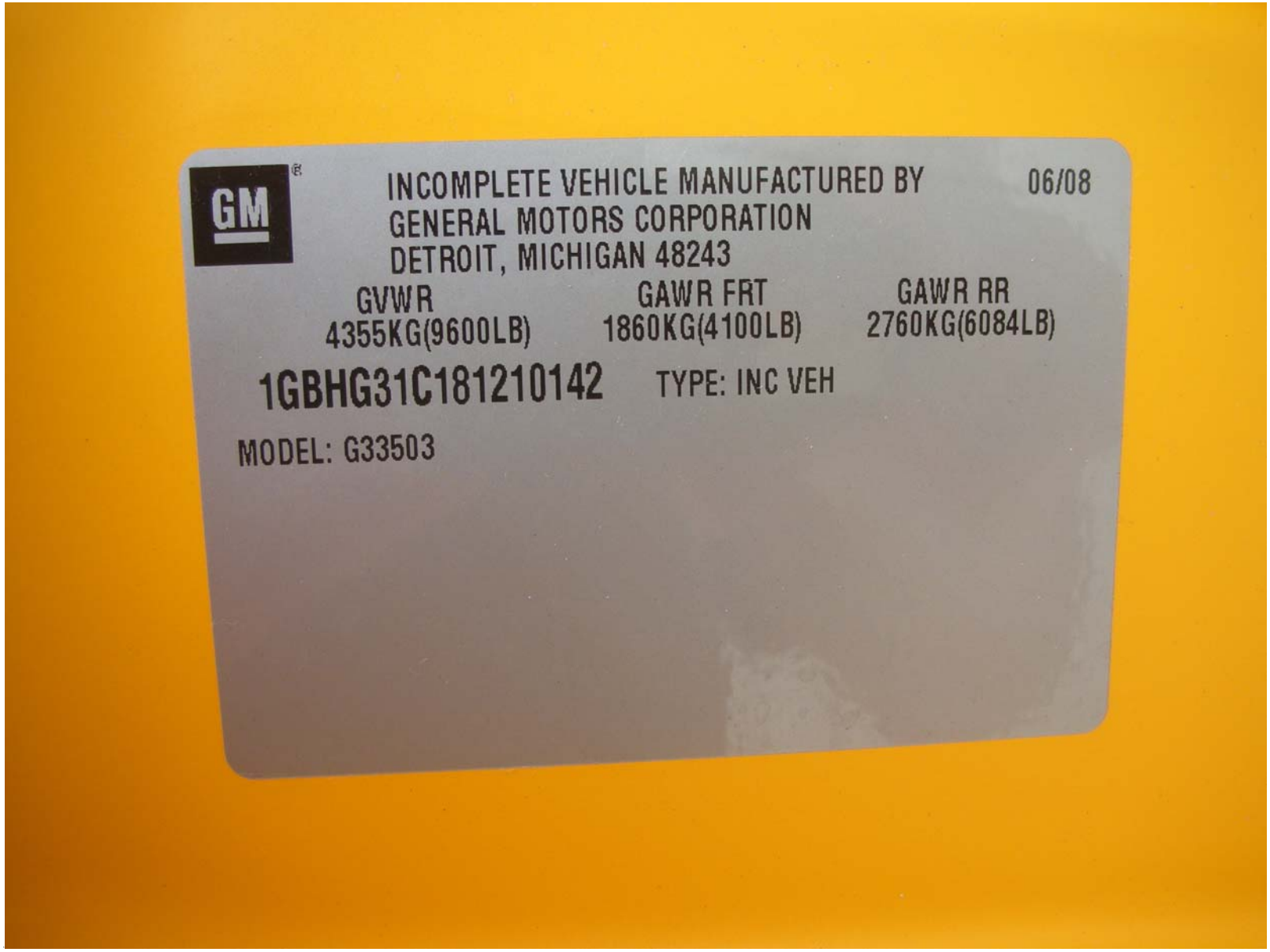


Incomplete Certification Label

Test Vehicle:	**2009 THOMAS MINOTOUR SCHOOL BUS**	NHTSA No.:	**C90901**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**06/25/09**

Vehicle Interior View Front to Rear

Test Vehicle:	**2009 THOMAS MINOTOUR SCHOOL BUS**	NHTSA No.:	**C90901**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**06/25/09**

Vehicle Interior View Rear to Front

Test Vehicle:	**2009 THOMAS MINOTOUR SCHOOL BUS**	NHTSA No.:	**C90901**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**06/25/09**

Location of Joint ID Number TSRRRE189BAH

Location of Joint ID Number TSSRMI189BSV

Test Vehicle:	**2009 THOMAS MINOTOUR SCHOOL BUS**	NHTSA No.:	**C90901**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**06/25/09**

Location of Joint ID Number TSRRFE189BAH

Test Vehicle:	**2009 THOMAS MINOTOUR SCHOOL BUS**	NHTSA No.:	**C90901**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**06/25/09**

Location of Joint ID Number TSRCFI189BSV

Test Vehicle:	**2009 THOMAS MINOTOUR SCHOOL BUS**	NHTSA No.:	**C90901**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**06/25/09**

Pre-Test of Joint ID Number TSRRRE189BAH

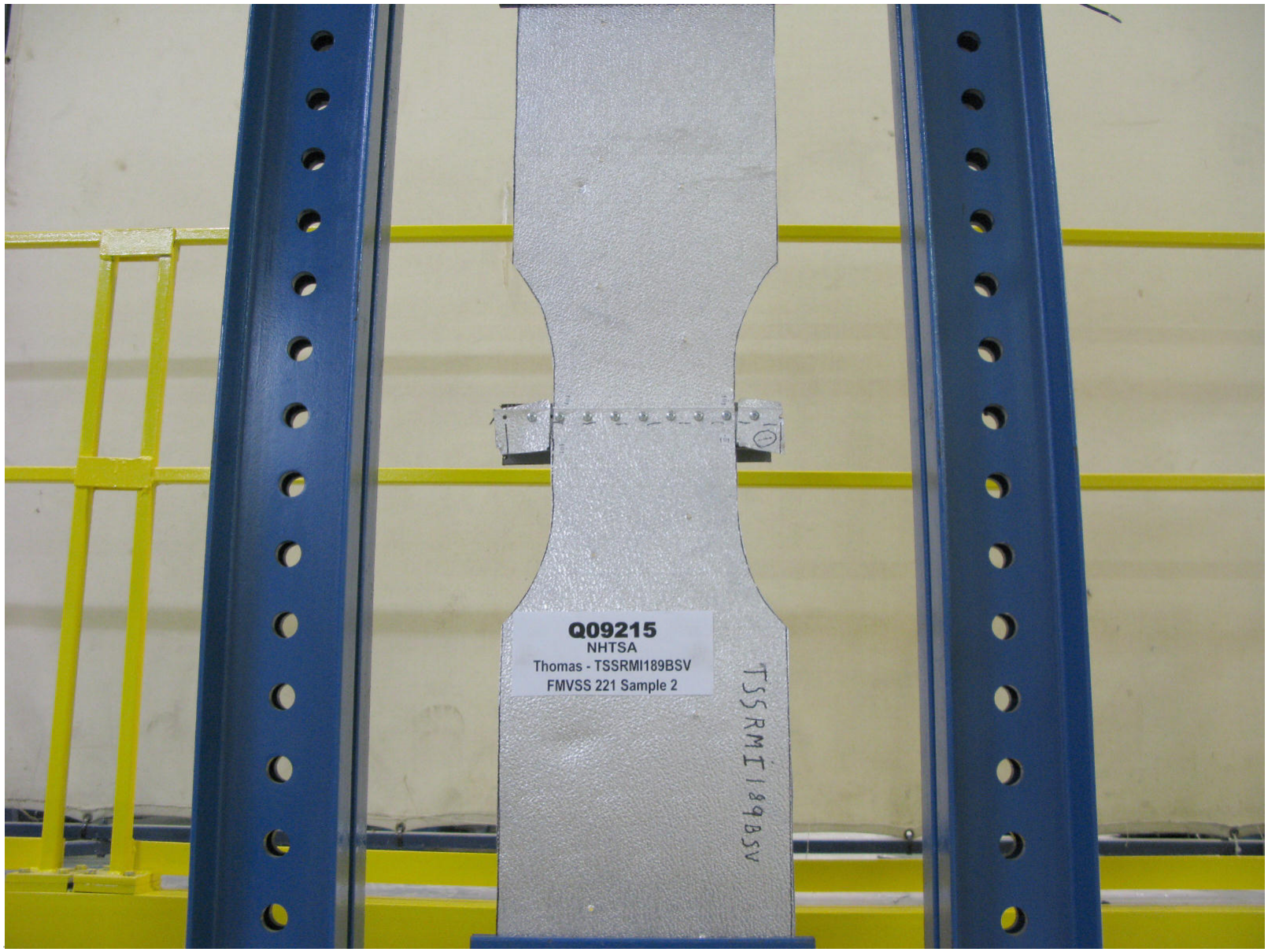
Test Vehicle:	**2009 THOMAS MINOTOUR SCHOOL BUS**	NHTSA No.:	**C90901**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**06/25/09**

Post-Test of Joint ID Number TSRRRE189BAH

Test Vehicle:	**2009 THOMAS MINOTOUR SCHOOL BUS**	NHTSA No.:	**C90901**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**06/25/09**

Post-Test of Joint ID Number TSRRRE189BAH, Close Up View

Test Vehicle:	**2009 THOMAS MINOTOUR SCHOOL BUS**	NHTSA No.:	**C90901**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**06/25/09**



Pre-Test of Joint ID Number TSSRMI189BSV

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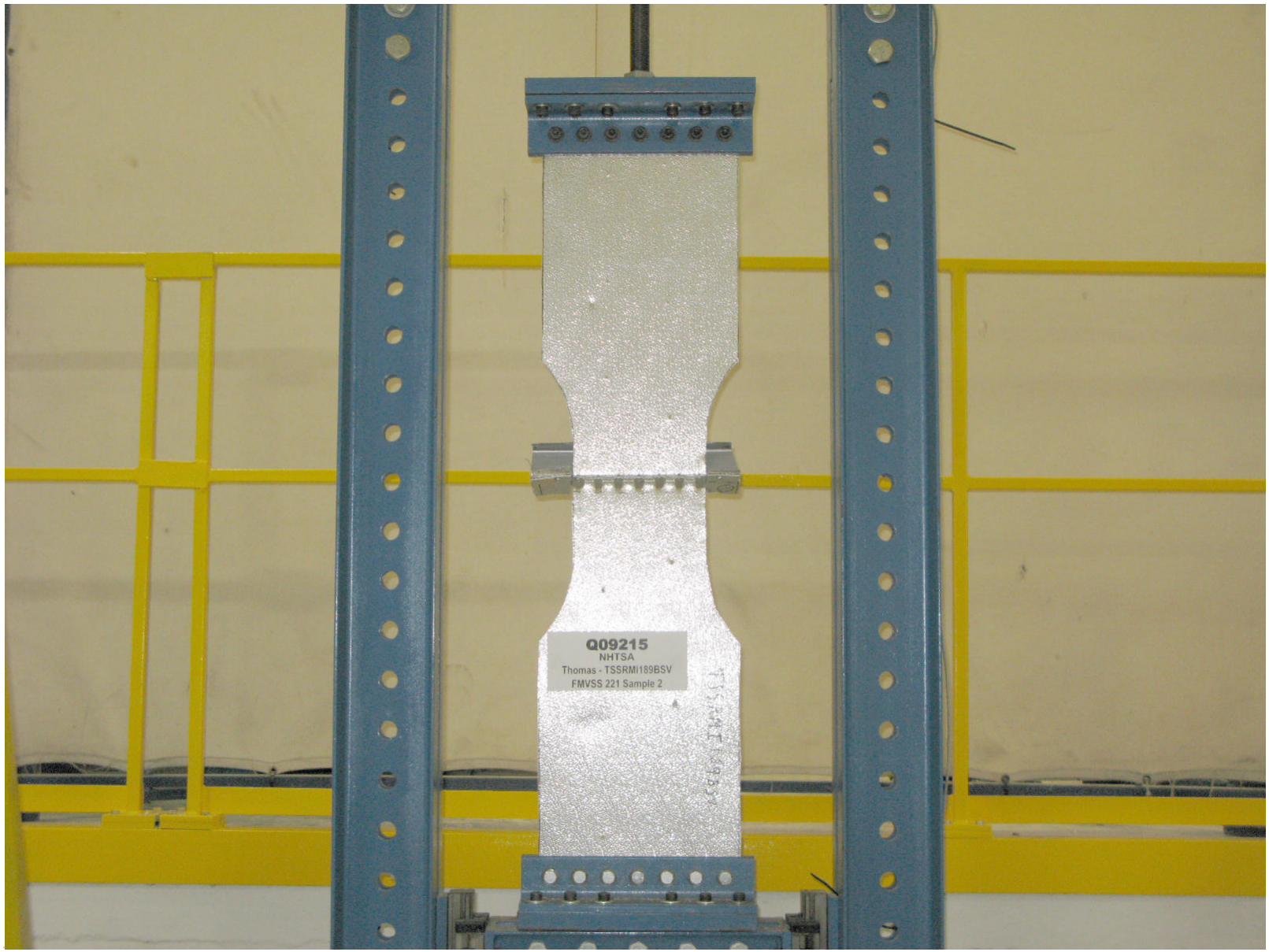
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**06/25/09**



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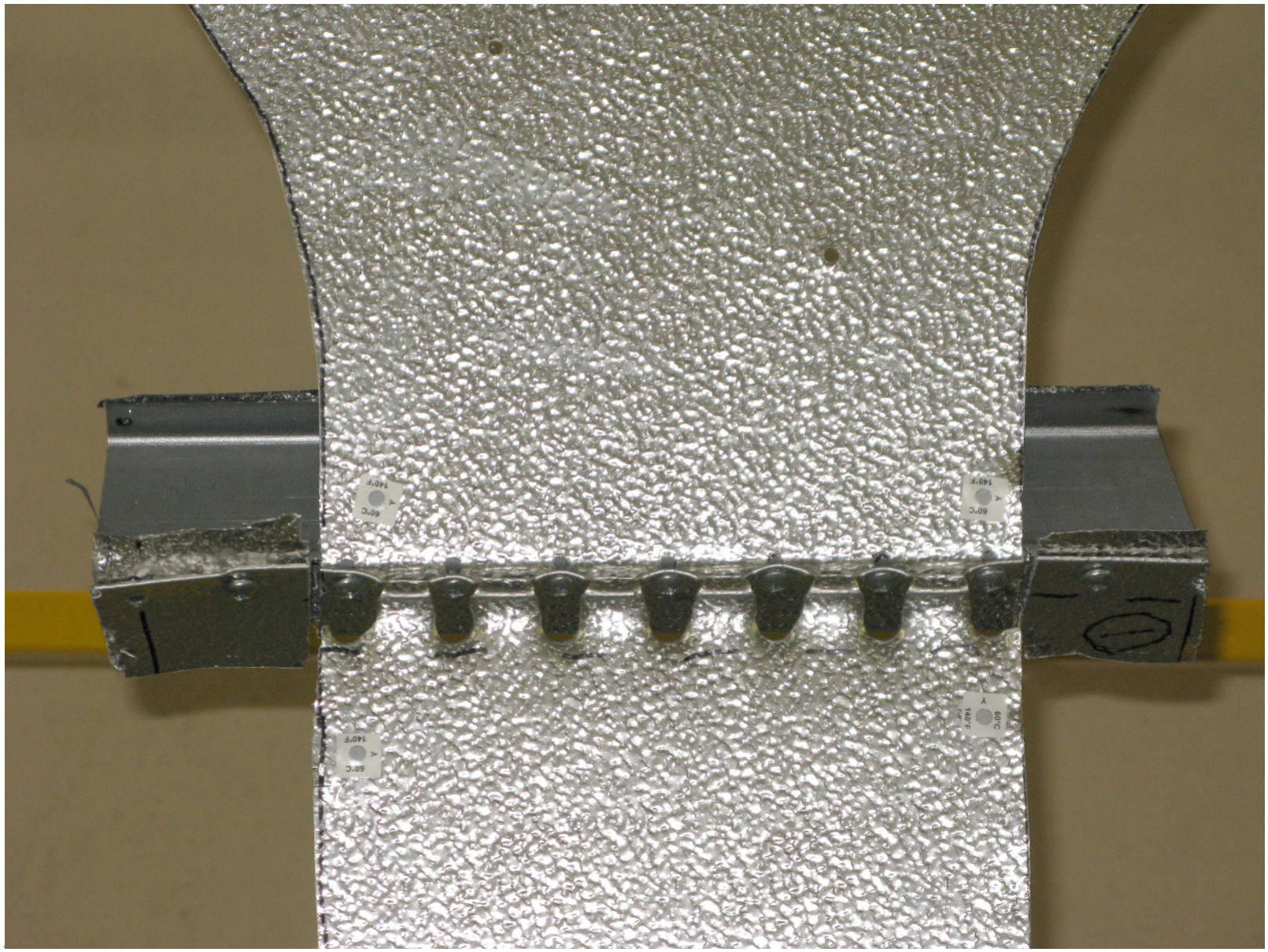
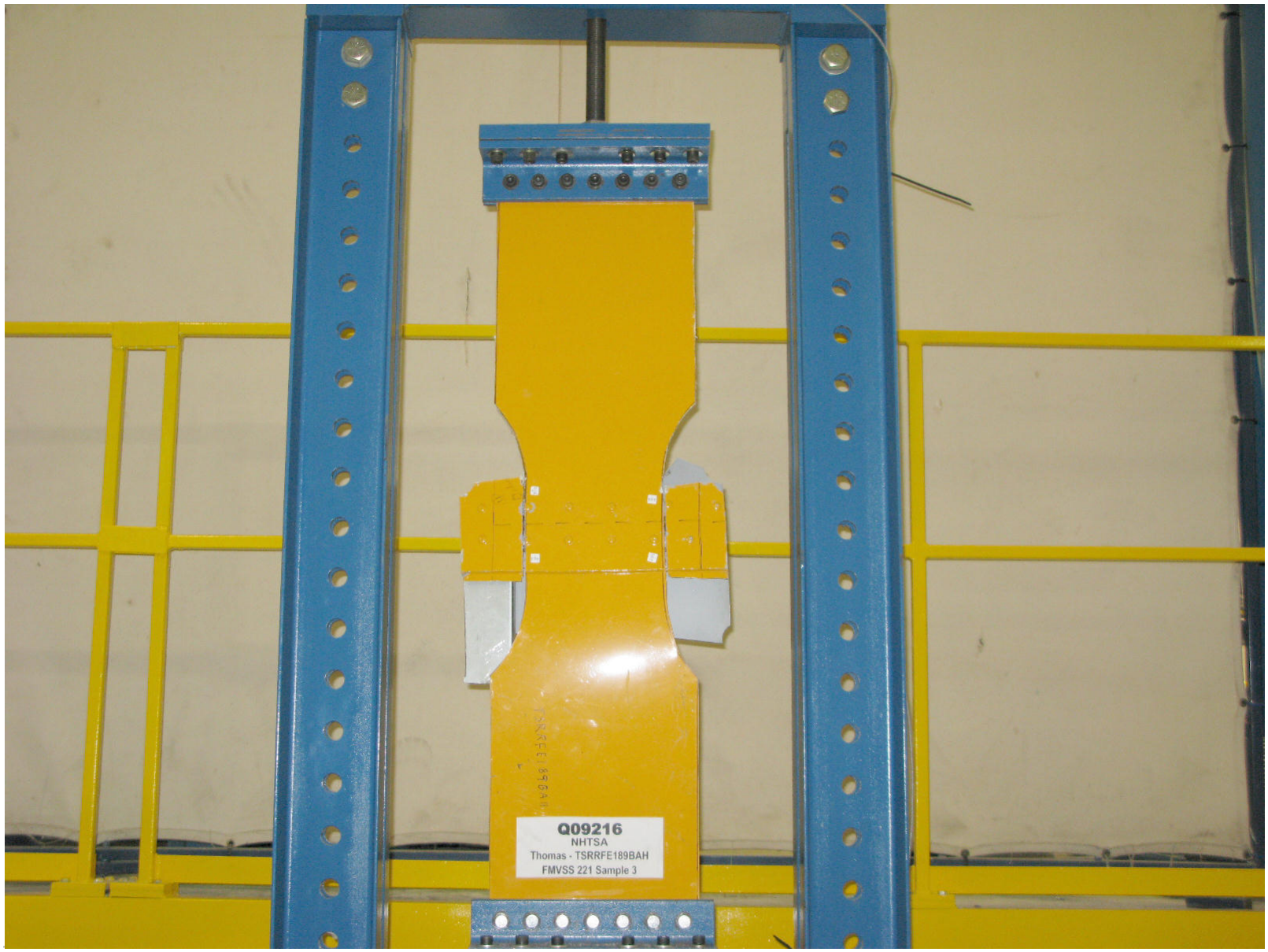
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**06/25/09**



Post-Test of Joint ID Number TSSRMI189BSV, Close Up View

Test Vehicle:	**2009 THOMAS MINOTOUR SCHOOL BUS**	NHTSA No.:	**C90901**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**06/25/09**



Pre-Test of Joint ID Number TSRRFE189BAH

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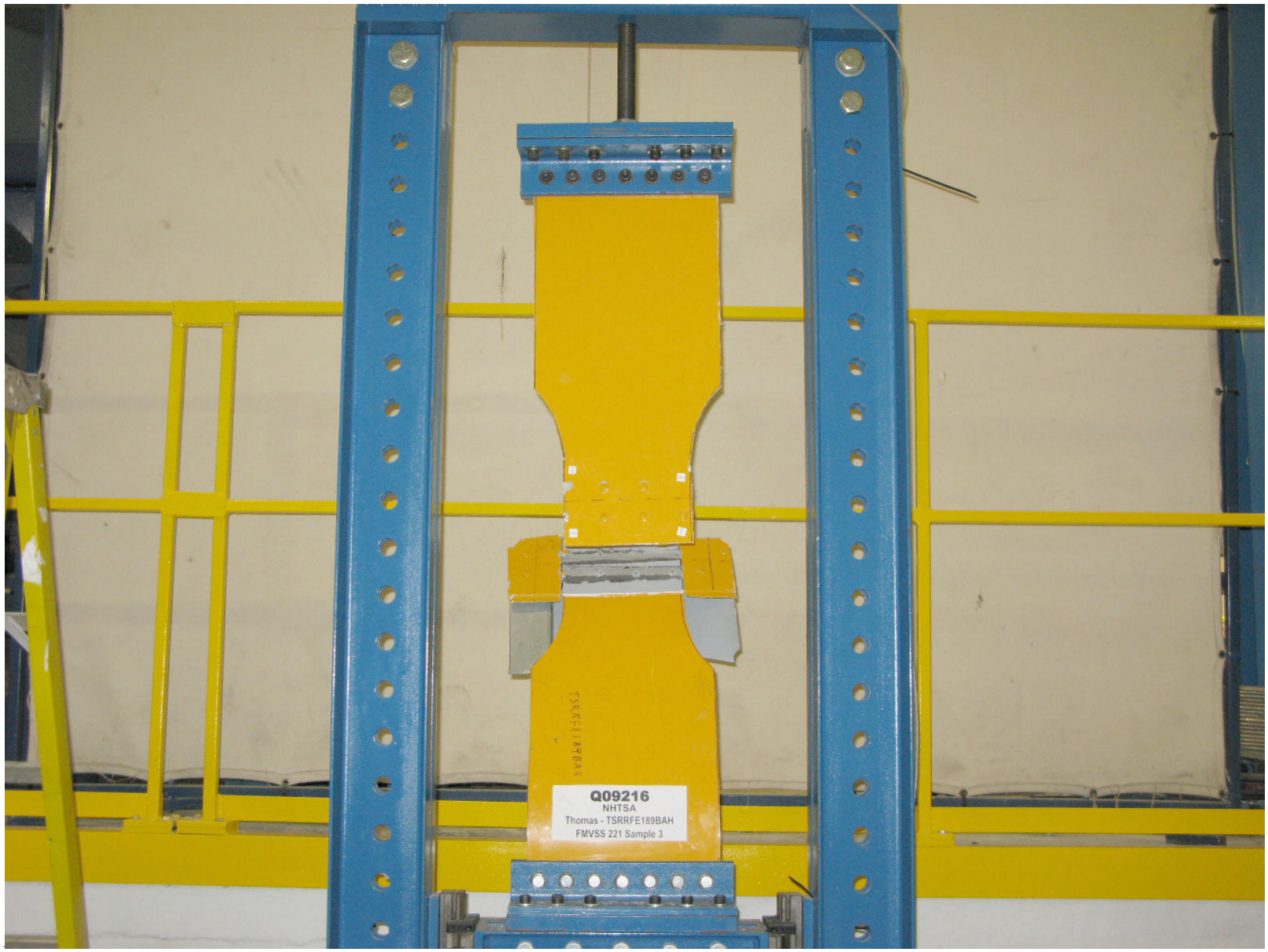
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**06/25/09**



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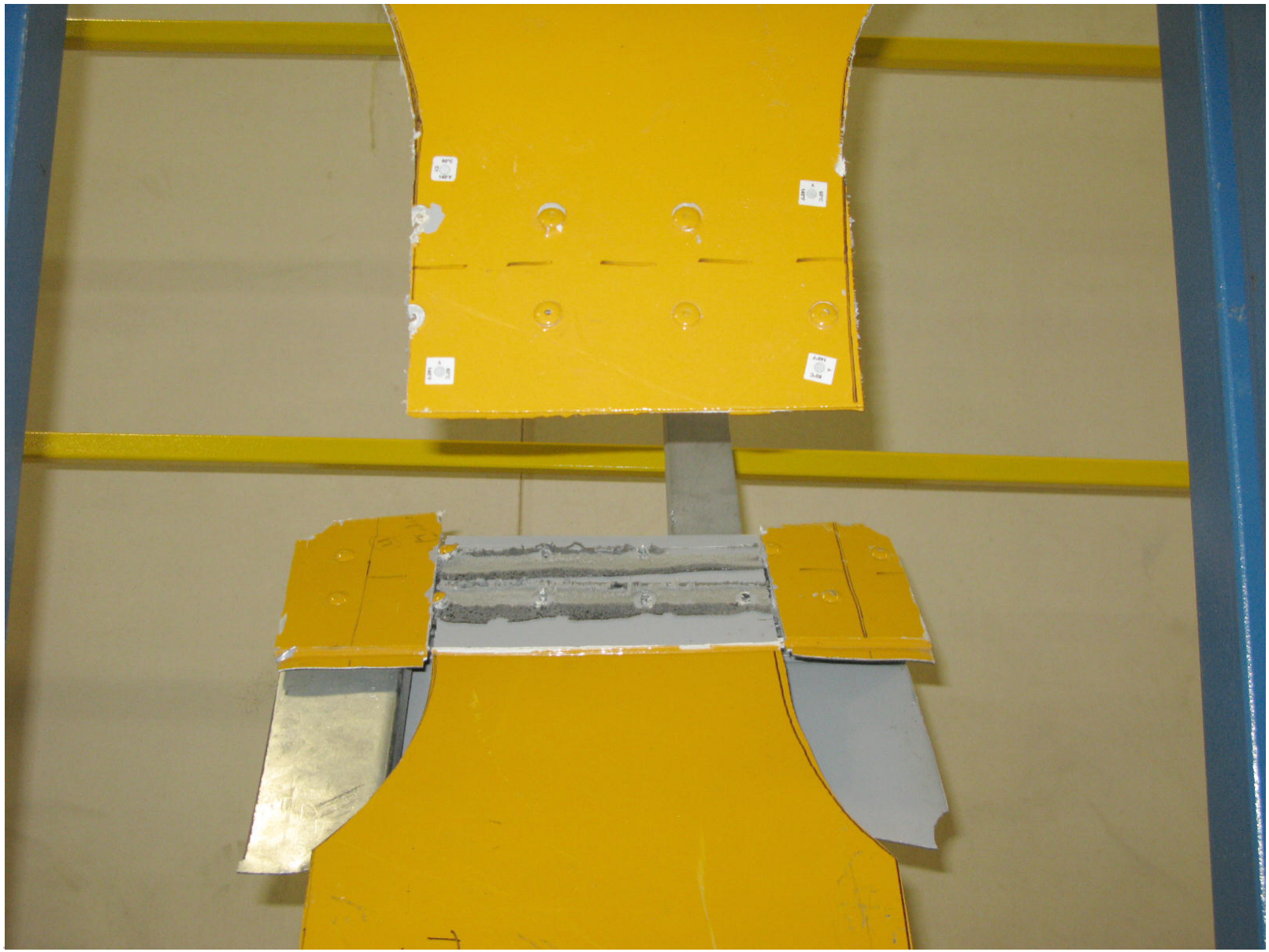


Post-Test of Joint ID Number TSRRFE189BAH, Close Up View

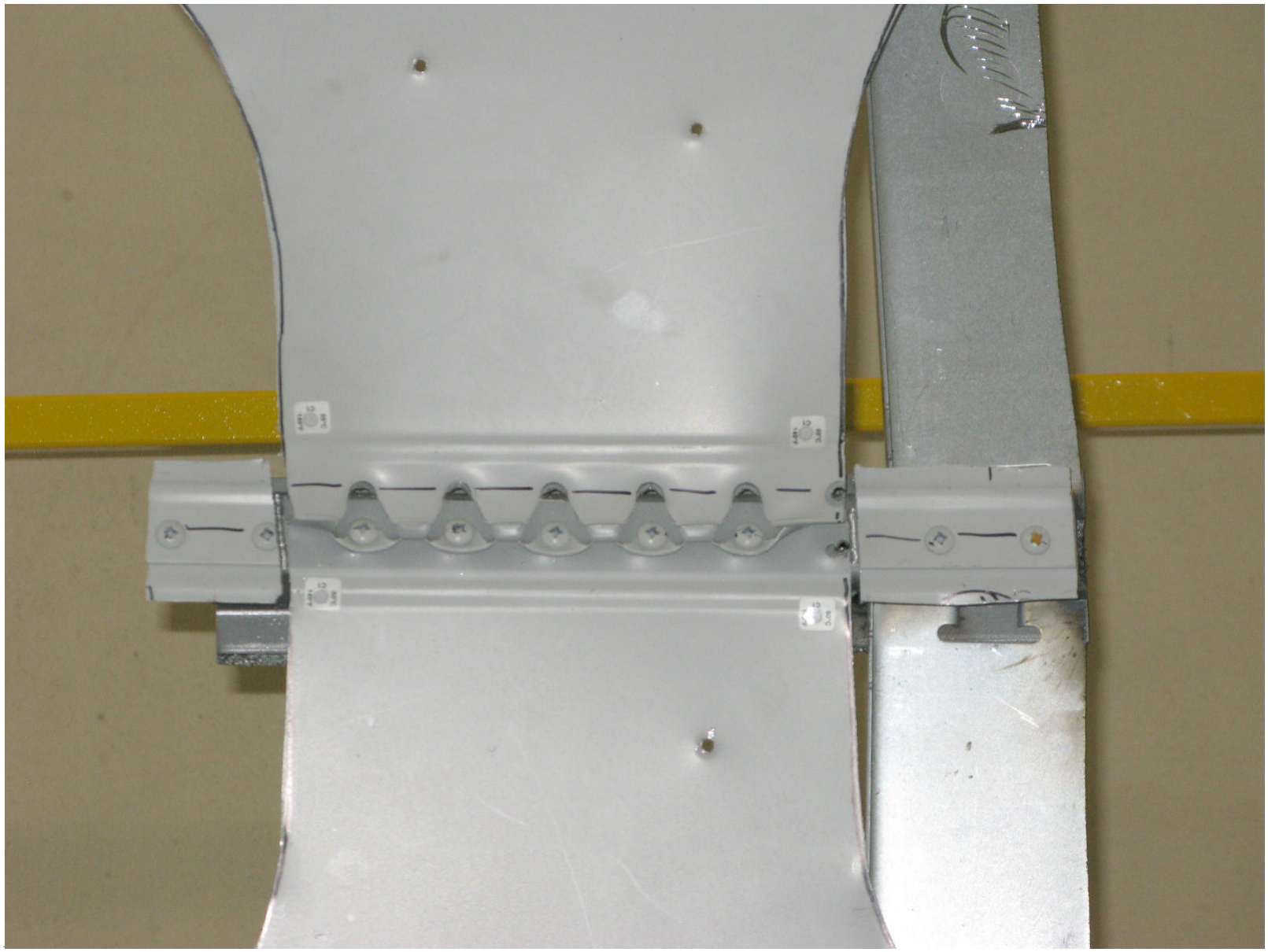
Test Vehicle:	**2009 THOMAS MINOTOUR SCHOOL BUS**	NHTSA No.:	**C90901**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**06/25/09**

Pre-Test of Joint ID Number TSRCFI189BSV

Test Vehicle:	**2009 THOMAS MINOTOUR SCHOOL BUS**	NHTSA No.:	**C90901**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**06/25/09**

Post-Test of Joint ID Number TSRCFI189BSV

Test Vehicle:	**2009 THOMAS MINOTOUR SCHOOL BUS**	NHTSA No.:	**C90901**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**06/25/09**



Post-Test of Joint ID Number TSRCFI189BSV, Close Up View

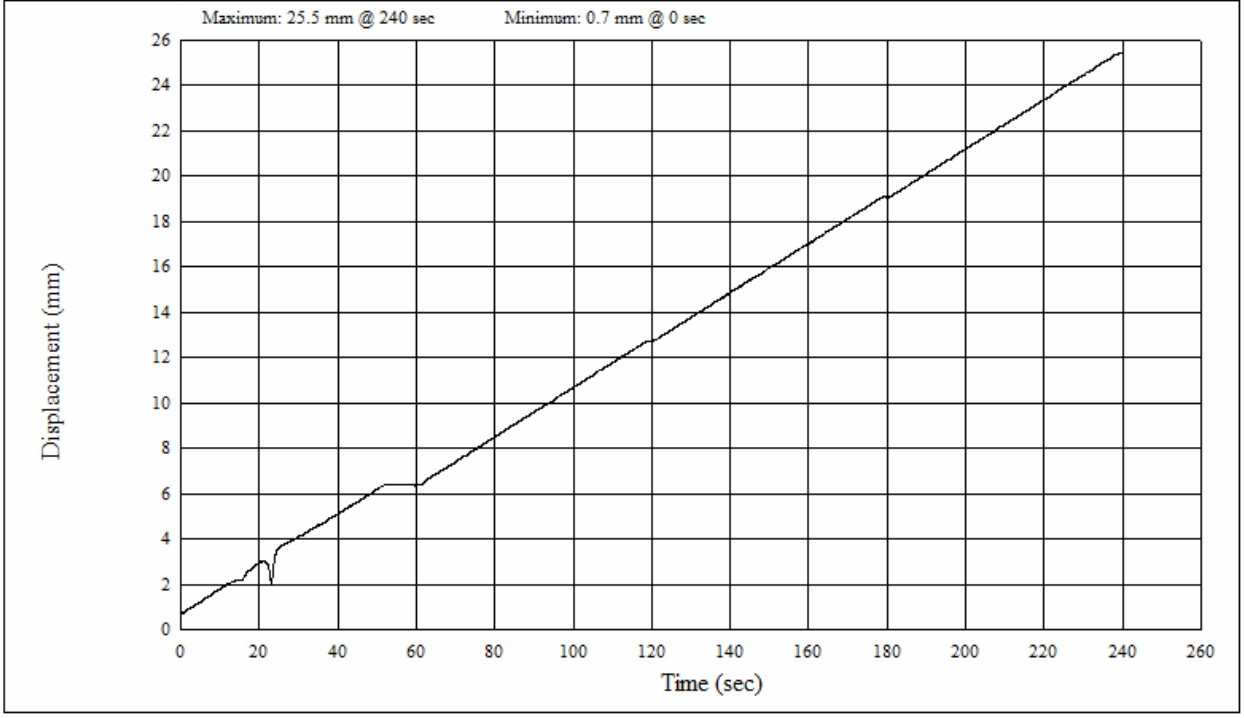
SECTION 7

TEST PLOTS

TABLE OF TEST PLOTS

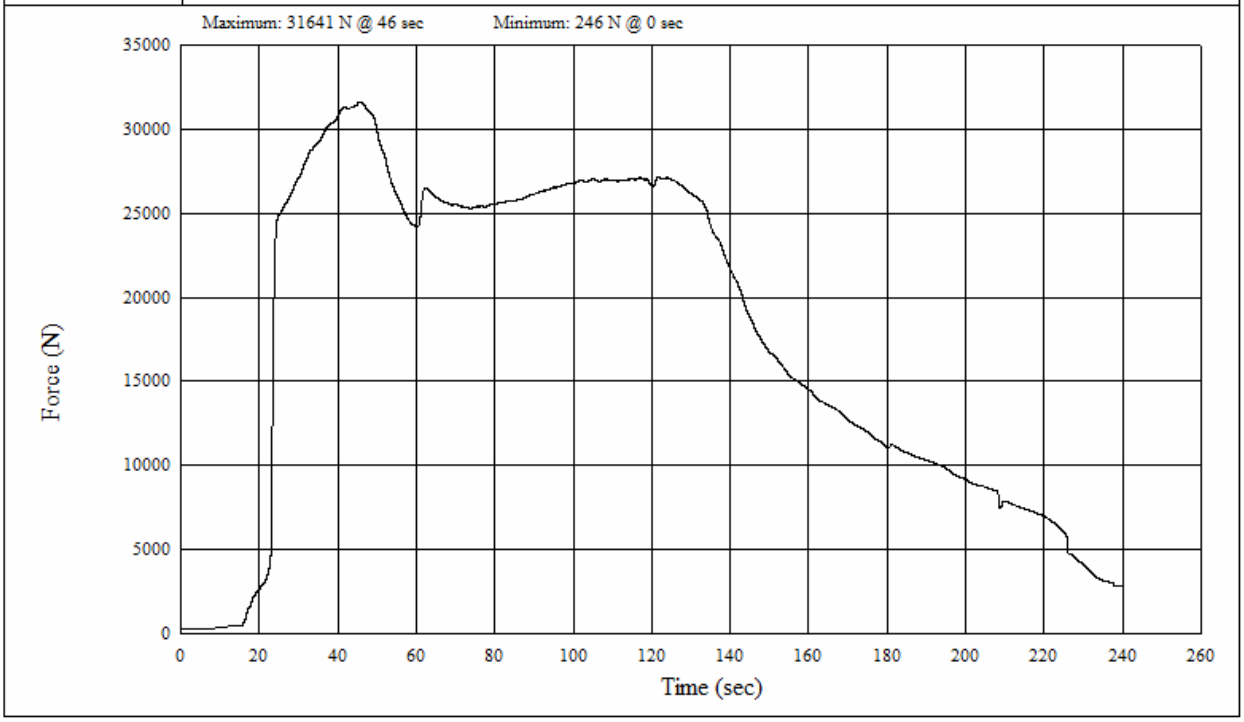
Displacement (mm) vs Time (sec)

Test Description: FMVSS 221
Component ID: 2009 Thomas Minotour School Bus, NHTSA No.: C90901
Sample No.:TSRRRE189BAH
Test Date: June 25, 2009



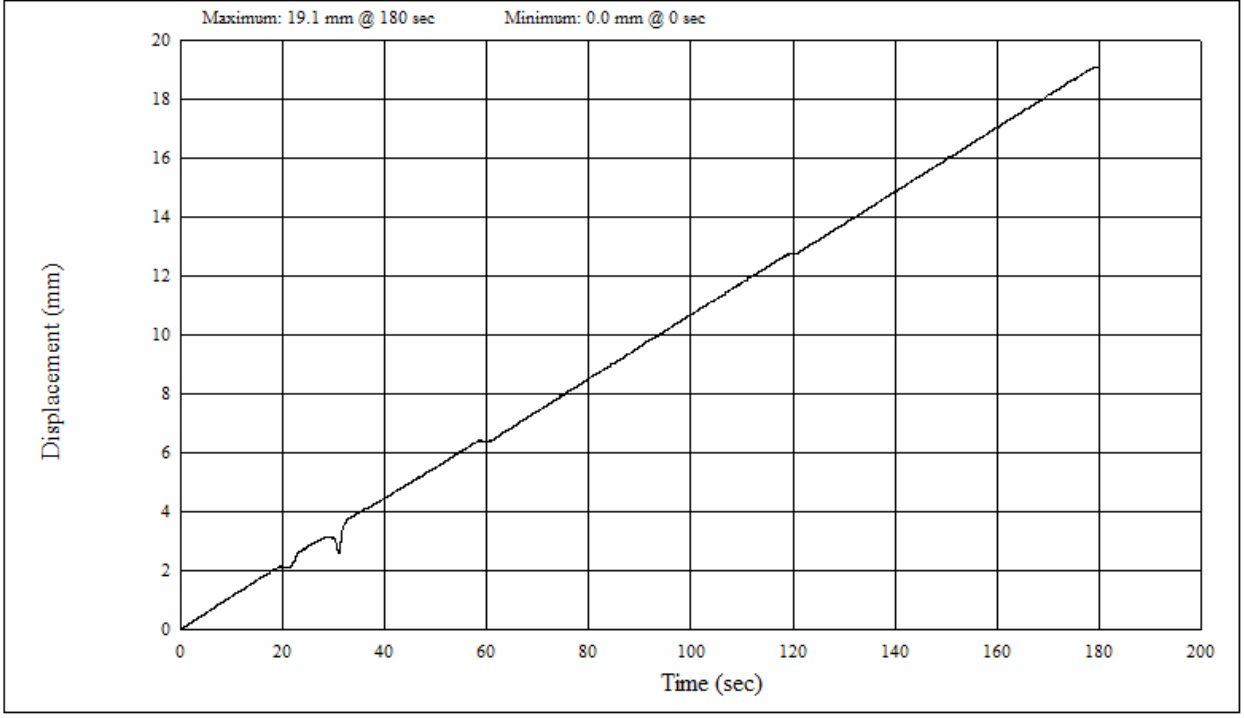
Force (N) vs Time (sec)

Test Description: FMVSS 221
Component ID: 2009 Thomas Minotour School Bus, NHTSA No.: C90901
Sample No.:TSRRRE189BAH
Test Date: June 25, 2009



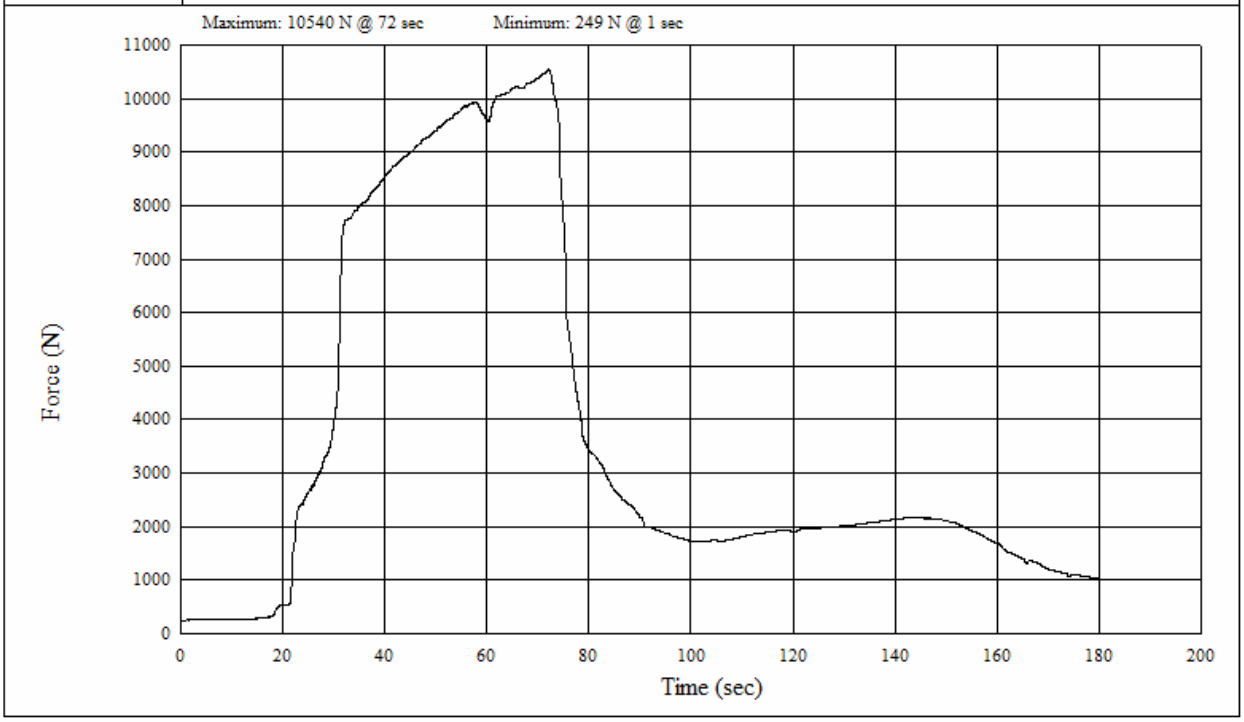
Displacement (mm) vs Time (sec)

Test Description: FMVSS 221
Component ID: 2009 Thomas Minotour School Bus, NHTSA No.: C90901
Sample No.: TSSRMI189BSV
Test Date: June 25, 2009



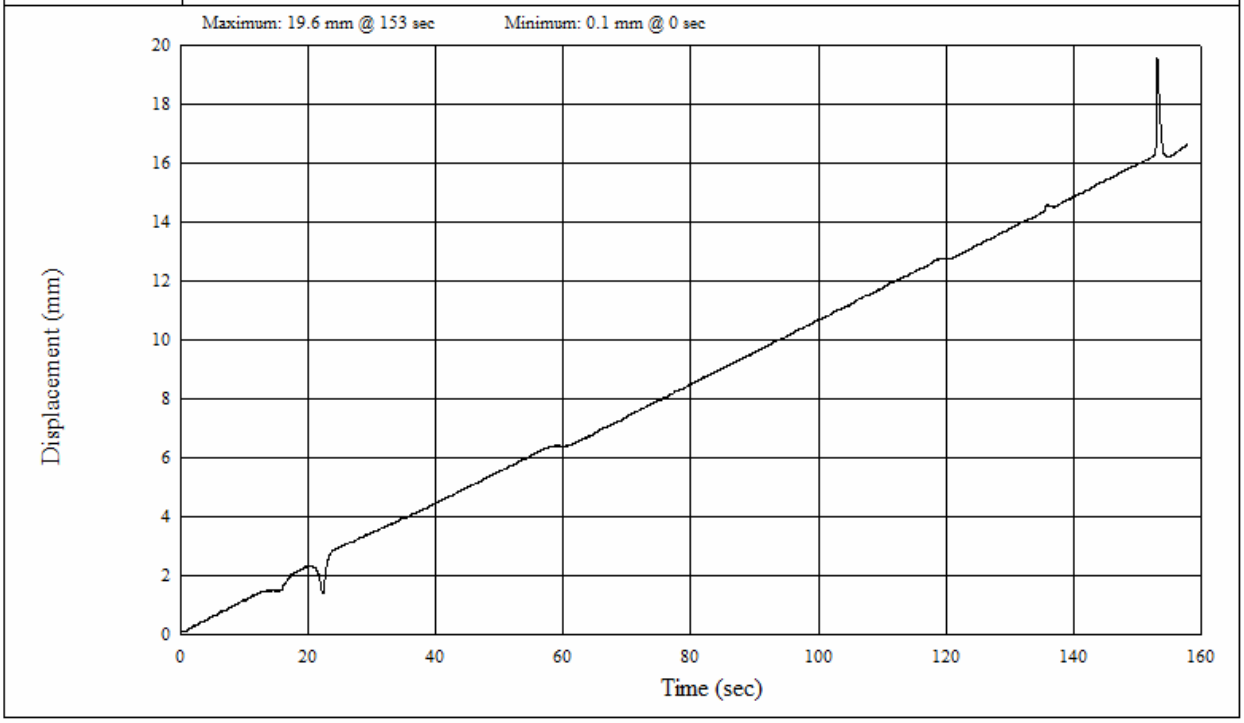
Force (N) vs Time (sec)

Test Description: FMVSS 221
Component ID: 2009 Thomas Minotour School Bus, NHTSA No.: C90901
Sample No.:TSSRMI189BSV
Test Date: June 25, 2009



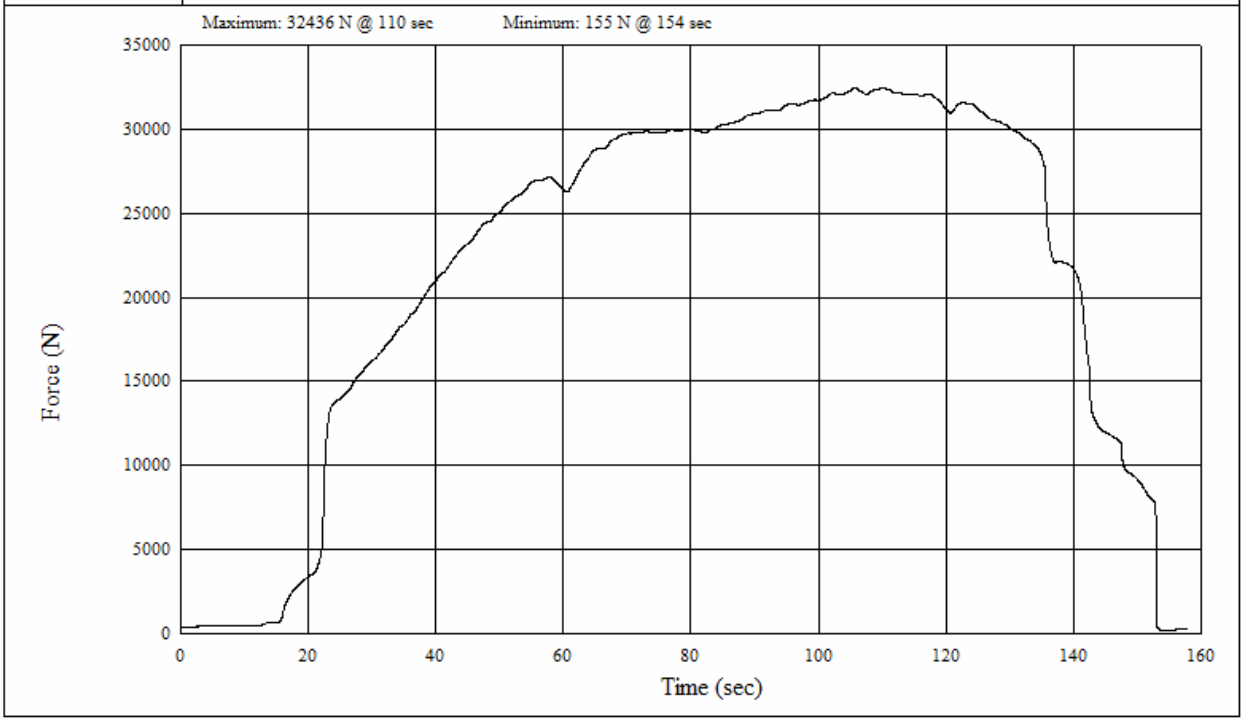
Displacement (mm) vs Time (sec)

Test Description: FMVSS 221
Component ID: 2009 Thomas Minotour School Bus, NHTSA No.: C90901
Sample No.: TSRRFE189BAH
Test Date: June 25, 2009



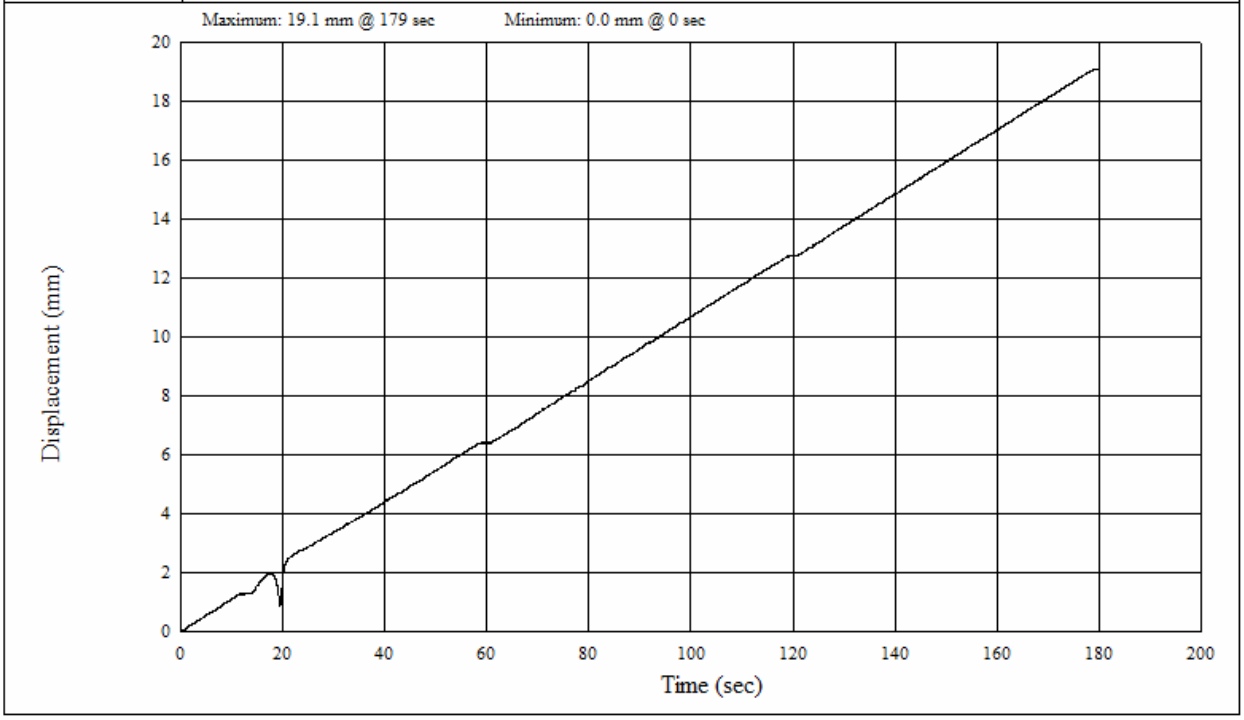
Force (N) vs Time (sec)

Test Description: FMVSS 221
Component ID: 2009 Thomas Minotour School Bus, NHTSA No.: C90901
Sample No.: TSRRFE189BAH
Test Date: June 25, 2009



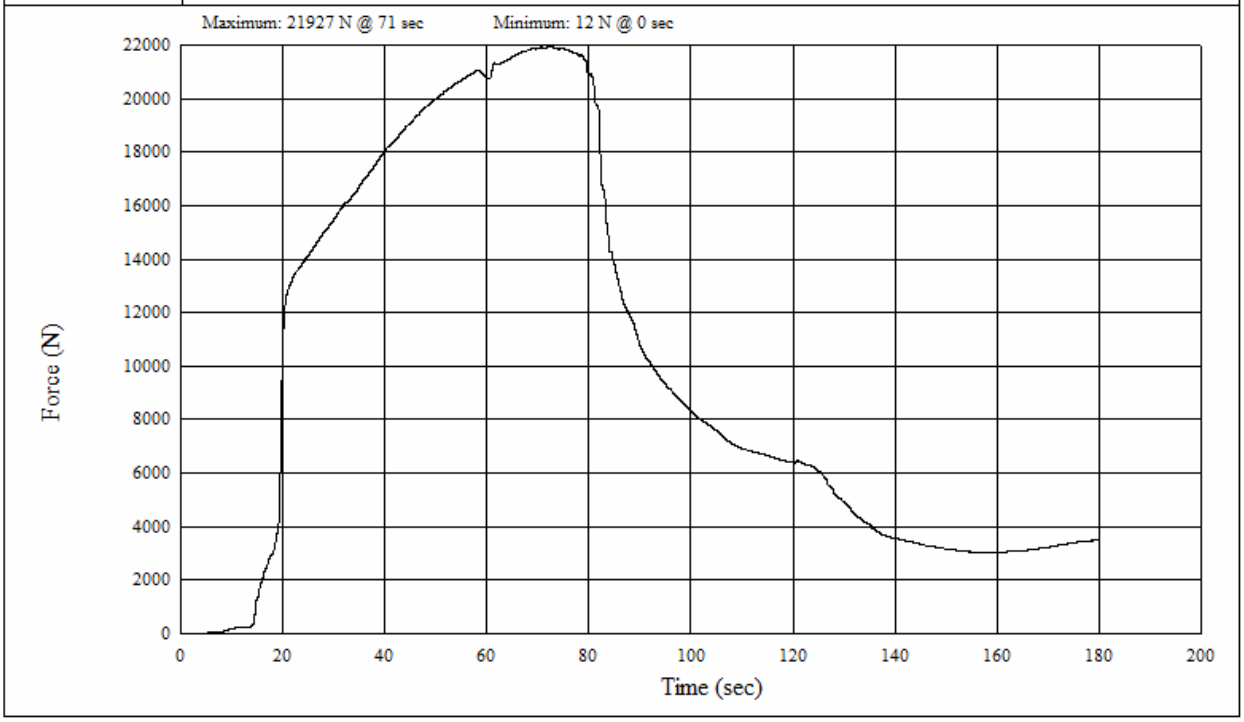
Displacement (mm) vs Time (sec)

Test Description: FMVSS 221
Component ID: 2009 Thomas Minotour School Bus, NHTSA No.: C90901
Sample No.: TSRCFI189BSV
Test Date: June 25, 2009



Force (N) vs Time (sec)

Test Description: FMVSS 221
Component ID: 2009 Thomas Minotour School Bus, NHTSA No.: C90901
Sample No.: TSRCFI189BSV
Test Date: June 25, 2009

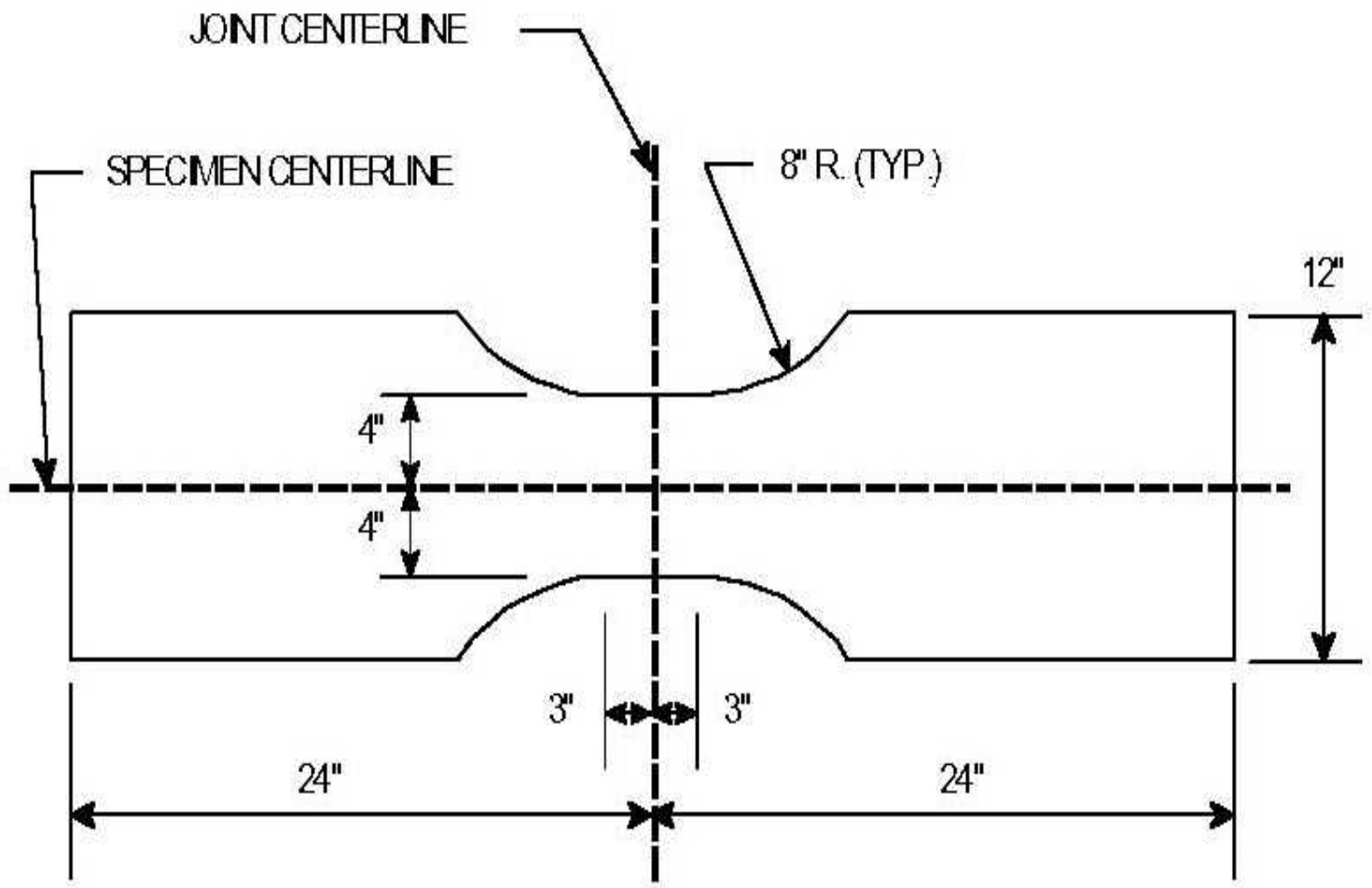


SECTION 8

JOINT CONFIGURATIONS

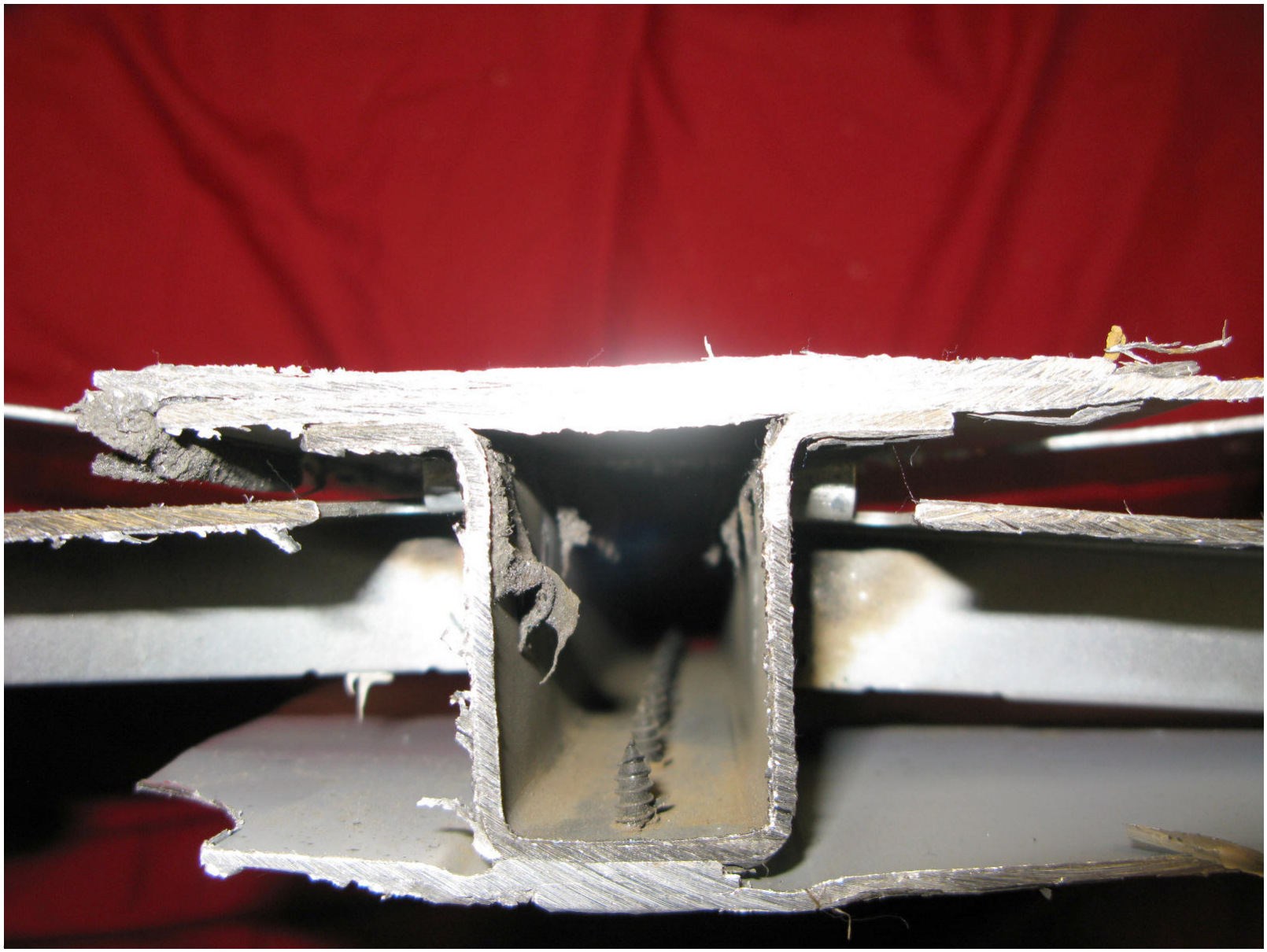
TABLE OF PHOTOGRAPHS

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



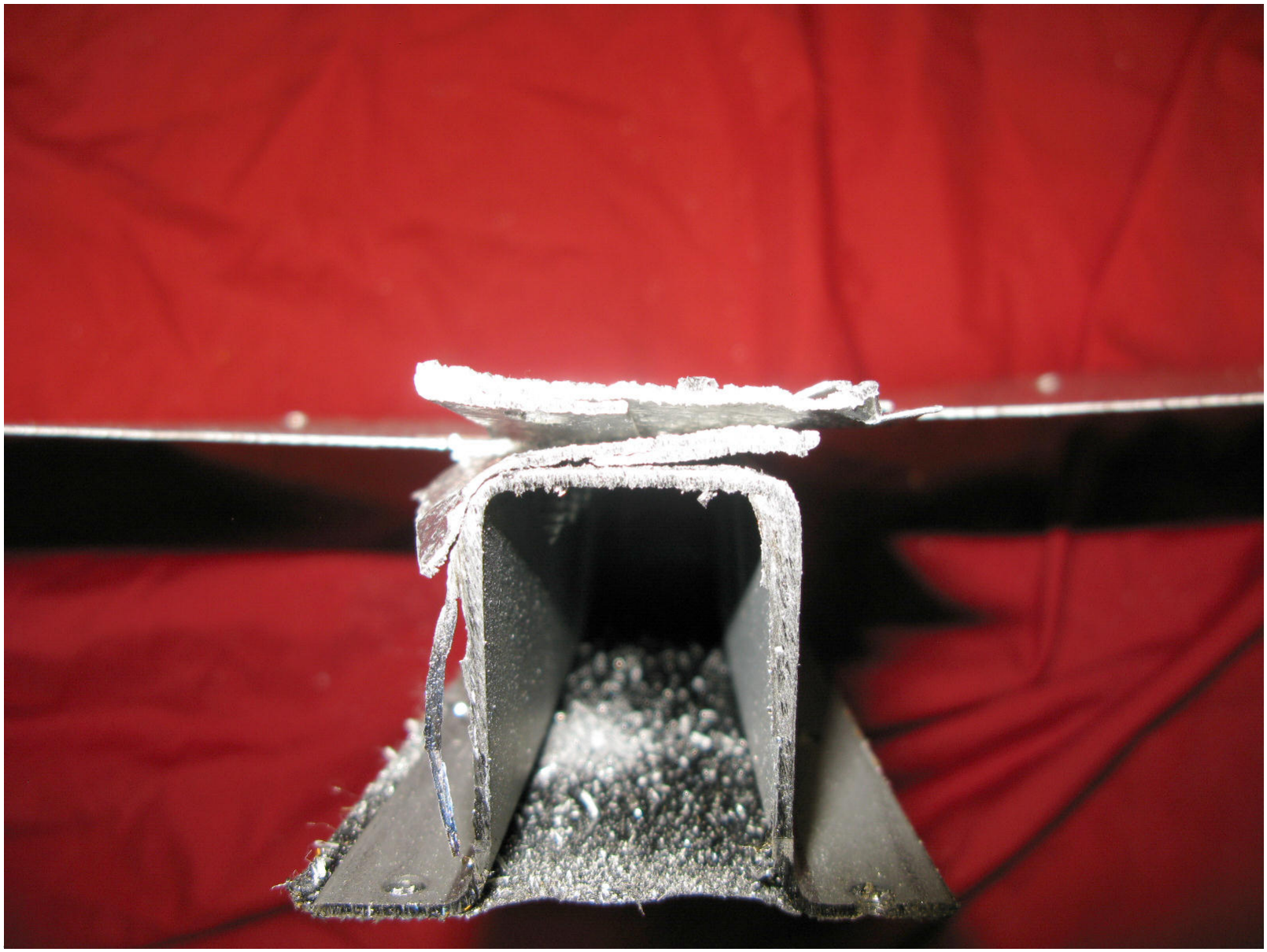
Typical Test Sample Configuration

Test Vehicle:	**2009 THOMAS MINOTOUR SCHOOL BUS**	NHTSA No.:	**C90901**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**06/25/09**

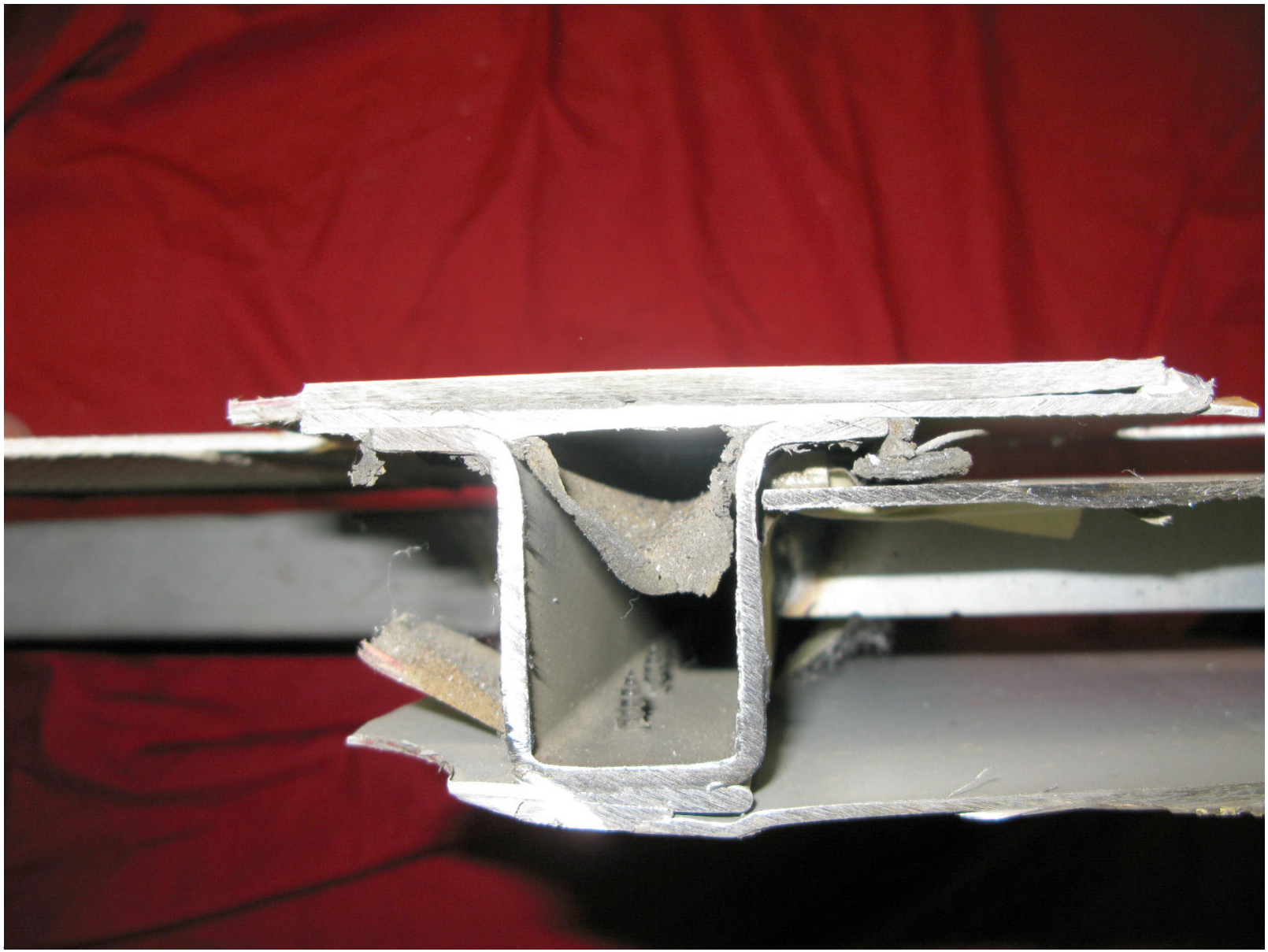


View of Joint ID Number TSRRRE189BAH

Test Vehicle:	**2009 THOMAS MINOTOUR SCHOOL BUS**	NHTSA No.:	**C90901**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**06/25/09**

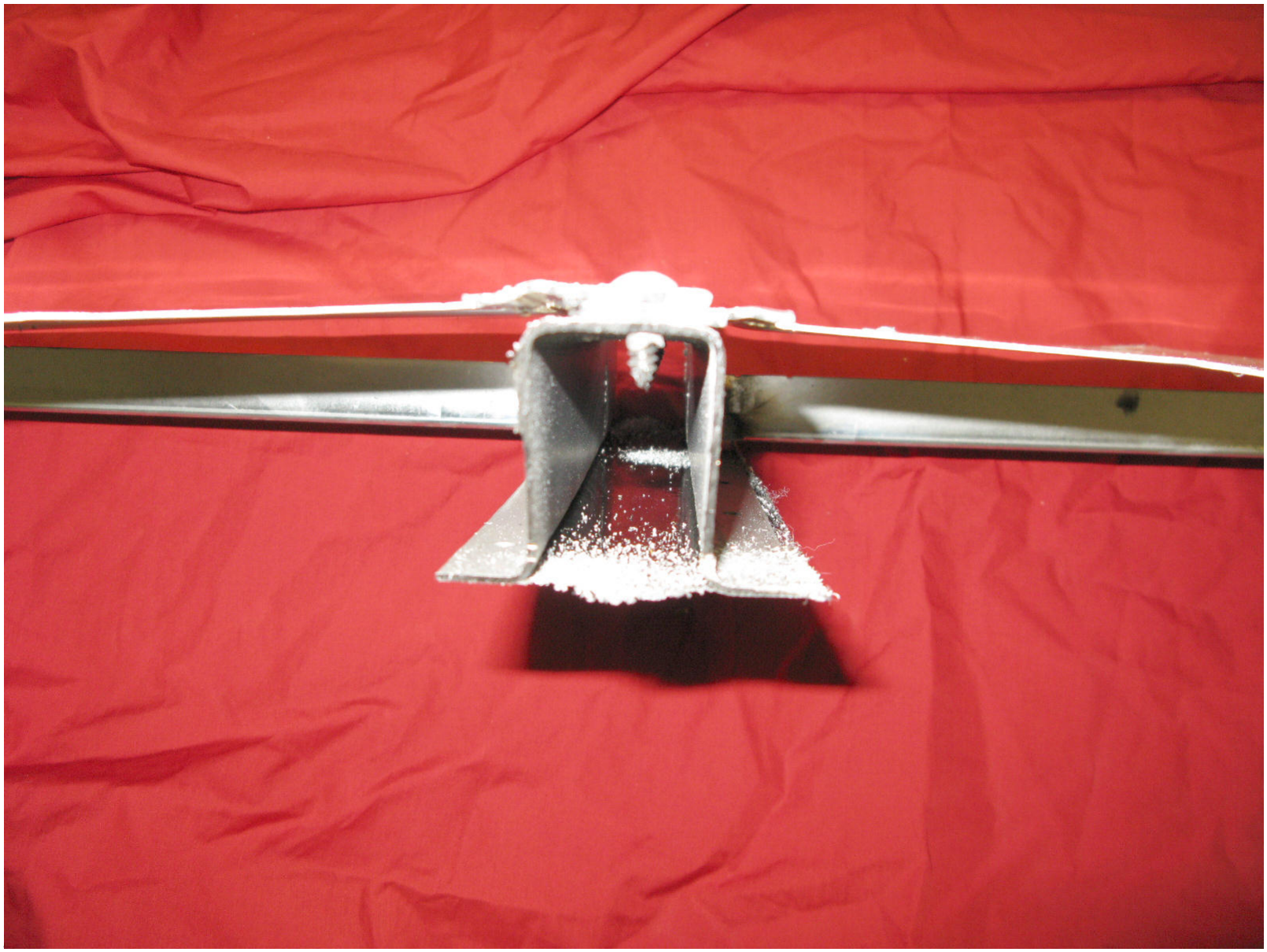


View of Joint ID Number TSSRMI189BSV



View of Joint ID Number TSRRFE189BAH

Test Vehicle:	**2009 THOMAS MINOTOUR SCHOOL BUS**	NHTSA No.:	**C90901**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**06/25/09**



View of Joint ID Number TSRCFI189BSV