

REPORT NUMBER: 221-MGA-2007-001

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

**THOMAS BUILT BUSES INC.
2007 THOMAS SAF-T-LINER C2
NHTSA NO.: C70900**

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



FINAL REPORT DATE: JULY 2, 2007

FINAL REPORT

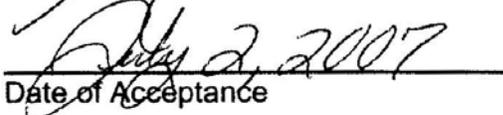
**PREPARED FOR:
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NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
ENFORCEMENT
OFFICE OF VEHICLE SAFETY COMPLIANCE
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Prepared by: 
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Date of Acceptance

Technical Report Documentation Page

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SECTION 1
PURPOSE OF COMPLIANCE TEST

Tests were conducted on a MY2007 Thomas SAF-T-LINER C2 School Bus, NHTSA No. C70900, in accordance with the specifications of the Office of Vehicle Safety Compliance (OVSC) Test Procedures TP-221-02 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. DTNH22-02-D-01057.

SECTION 2

TEST PROCEDURE

The MY2007 Thomas SAF-T-LINER C2 School Bus, NHTSA No. C70900 was subjected to FMVSS 221 testing.

The joint samples were selected in conjunction with the Contract Officer's Technical Representative (COTR). Six 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 six samples were tested for this vehicle. The samples were selected from the right side mid exterior, left side front interior, left side rear exterior, left side mid interior, roof mid exterior and the roof rear interior.

	Maximum Load (N)	60% of Material Strength (N)	PASS/FAIL
Right Side Mid Exterior	66803.3	33622.3	PASS
Left Side Front Interior	36826.1	21853.5	PASS
Left Side Rear Exterior	63416.8	33695.6	PASS
Left Side Mid Interior	45409.7	21853.5	PASS
Roof Mid Exterior	68527.8	33622.3	PASS
Roof Rear Interior	60562.3	24308.6	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 MY2007 Thomas SAF-T-LINER C2 School Bus, NHTSA No. C70900.

**DATA SHEET 1
ADMINISTRATIVE DATA SHEET**

Test Vehicle: **2007 THOMAS SAF-T-LINER C2 SCHOOL BUS** NHTSA No.: **C70900**
 Test Lab: **MGA RESEARCH CORPORATION** Test Date: **05/09/07**

INCOMPLETE VEHICLE (IF APPLICABLE)

Manufacturer:	Freightliner
Model:	89382-0662768-281TS
VIN:	4UZABPDG27CY03914
Build Date:	07/2006
Certification Date:	07/2006

COMPLETED VEHICLE (SCHOOL BUS)

Manufacturer:	Thomas Built Buses Inc.
Make/Model:	Thomas SAF-T-LINER C2
VIN:	4UZABPDG27CY03914
NHTSA No.:	C70900
Color:	Yellow
GVWR:	11,569 kg / 25,500 lbs
Build Date:	07/2006
Certification Date:	07/2006

DATES

Vehicle Receipt:	11/15/2006
Start of Compliance Test:	05/09/07
Completion of Compliance Test:	05/09/07

COMPLIANCE TEST:

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

Recorded By: 

Approved By: 

Date: 05/09/07

DATA SHEET 2
SUMMARY OF DATA

Test Vehicle: **2007 THOMAS SAF-T-LINER C2 SCHOOL BUS** NHTSA No.: **C70900**
 Test Lab: **MGA RESEARCH CORPORATION** Test Date: **05/09/07**

Joint Specimen I.D.	Joint Location	Joint Load Reqmt (60%) (N)	Max. Load at Joint Separation (N)	Calculated Material Strength (N)	PASS/ FAIL
TLSRME181BBH	Right Side Mid Exterior	33622.3	66803.6	56037.2	PASS
TLSLFI281BBH	Left Side Front Interior	21853.5	36826.1	36422.4	PASS
TLSLRE381BBH	Left Side Rear Exterior	33695.6	63416.8	56159.4	PASS
TLSLMI481BBH	Left Side Mid Interior	21853.5	45409.7	36422.4	PASS
TLRCME581BBH	Roof Mid Exterior	33622.3	68527.8	56037.2	PASS
TLRCRI680BBH	Roof Rear Interior	24308.6	60562.3	40514.4	PASS

Comments: NONE

Recorded By: 

Approved By: 

Date: 05/09/07

DATA SHEET 3

JOINT STRENGTH WHEN ASTM MATERIAL PROPERTIES ARE KNOWN

Test Vehicle: **2007 THOMAS SAF-T-LINER C2 SCHOOL BUS** NHTSA No.: **C70900**
 Test Lab: **MGA RESEARCH CORPORATION** Test Date: **05/09/07**

Specimen Description:	Right Side Mid Exterior		
Joint Number:	TLSRME181BBH	Test Number:	1

	Weaker Member	Stronger Member
Material	Galvanized, CS, ASTM A653	N/A
Tensile Strength (MPa)	310.3	N/A
Gage/Thickness (mm)	20 / 0.912	N/A
Fastener Holes (No./Diameter – mm.)	1 / 5.13	N/A
Net Area (Sq. mm.)	180.6	N/A
Material Strength (N)	56037.2	N/A
60% of Material Strength (N)	33622.3	N/A
Maximum Load From Tensile Test of Joint (N)	66803.6	N/A
PASS/FAIL	PASS	N/A

Comments: NONE

Recorded By: 

Approved By: 

Date: 05/09/07

DATA SHEET 3... (Continued)

JOINT STRENGTH WHEN ASTM MATERIAL PROPERTIES ARE KNOWN

Test Vehicle: **2007 THOMAS SAF-T-LINER C2 SCHOOL BUS** NHTSA No.: **C70900**
 Test Lab: **MGA RESEARCH CORPORATION** Test Date: **05/09/07**

Specimen Description:	Left Side Front Interior		
Joint Number:	TLSLFI281BBH	Test Number:	2

	Weaker Member	Stronger Member
Material	Embossed Galvalume, ASTM, A792	N/A
Tensile Strength (MPa)	310.3	N/A
Gage/Thickness (mm)	24 / 0.589	N/A
Fastener Holes (No./Diameter – mm.)	1 / 3.99	N/A
Net Area (Sq. mm.)	117.4	N/A
Material Strength (N)	36422.4	N/A
60% of Material Strength (N)	21853.5	N/A
Maximum Load From Tensile Test of Joint (N)	36826.1	N/A
PASS/FAIL	PASS	N/A

Comments: NONE

Recorded By: 

Approved By: 

Date: 05/09/07

DATA SHEET 3... (Continued)

JOINT STRENGTH WHEN ASTM MATERIAL PROPERTIES ARE KNOWN

Test Vehicle: **2007 THOMAS SAF-T-LINER C2 SCHOOL BUS** NHTSA No.: **C70900**
 Test Lab: **MGA RESEARCH CORPORATION** Test Date: **05/09/07**

Specimen Description:	Left Side Rear Exterior		
Joint Number:	TLSLRE381BBH	Test Number:	3

	Weaker Member	Stronger Member
Material	Galvanized, CS, ASTM, A653	N/A
Tensile Strength (MPa)	310.3	N/A
Gage/Thickness (mm)	20 / 0.912	N/A
Fastener Holes (No./Diameter – mm.)	1 / 4.70	N/A
Net Area (Sq. mm.)	181.0	N/A
Material Strength (N)	56159.4	N/A
60% of Material Strength (N)	33695.6	N/A
Maximum Load From Tensile Test of Joint (N)	63416.8	N/A
PASS/FAIL	PASS	N/A

Comments: NONE

Recorded By: 

Approved By: 

Date: 05/09/07

DATA SHEET 3... (Continued)

JOINT STRENGTH WHEN ASTM MATERIAL PROPERTIES ARE KNOWN

Test Vehicle: **2007 THOMAS SAF-T-LINER C2 SCHOOL BUS** NHTSA No.: **C70900**
 Test Lab: **MGA RESEARCH CORPORATION** Test Date: **05/09/07**

Specimen Description:	Left Side Mid Interior		
Joint Number:	TLSLMI481BBH	Test Number:	4

	Weaker Member	Stronger Member
Material	Embossed Galvalume, ASTM, A792	N/A
Tensile Strength (MPa)	310.3	N/A
Gage/Thickness (mm)	24 / 0.589	N/A
Fastener Holes (No./Diameter – mm.)	1 / 3.99	N/A
Net Area (Sq. mm.)	117.4	N/A
Material Strength (N)	36422.4	N/A
60% of Material Strength (N)	21853.5	N/A
Maximum Load From Tensile Test of Joint (N)	45409.7	N/A
PASS/FAIL	PASS	N/A

Comments: NONE

Recorded By: 

Approved By: 

Date: 05/09/07

DATA SHEET 3... (Continued)

JOINT STRENGTH WHEN ASTM MATERIAL PROPERTIES ARE KNOWN

Test Vehicle: **2007 THOMAS SAF-T-LINER C2 SCHOOL BUS** NHTSA No.: **C70900**
 Test Lab: **MGA RESEARCH CORPORATION** Test Date: **05/09/07**

Specimen Description:	Roof Mid Exterior		
Joint Number:	TLRCME581BBH	Test Number:	5

	Weaker Member	Stronger Member
Material	Galvanized, CS, ASTM, A653	N/A
Tensile Strength (MPa)	310.3	N/A
Gage/Thickness (mm)	20 / 0.912	N/A
Fastener Holes (No./Diameter – mm.)	1 / 5.13	N/A
Net Area (Sq. mm.)	180.6	N/A
Material Strength (N)	56037.2	N/A
60% of Material Strength (N)	33622.3	N/A
Maximum Load From Tensile Test of Joint (N)	68527.8	N/A
PASS/FAIL	PASS	N/A

Comments: NONE

Recorded By: 

Approved By: 

Date: 05/09/07

DATA SHEET 3... (Continued)

JOINT STRENGTH WHEN ASTM MATERIAL PROPERTIES ARE KNOWN

Test Vehicle: **2007 THOMAS SAF-T-LINER C2 SCHOOL BUS** NHTSA No.: **C70900**
 Test Lab: **MGA RESEARCH CORPORATION** Test Date: **05/09/07**

Specimen Description:	Roof Rear Interior		
Joint Number:	TLRCRI680BBH	Test Number:	6

	Weaker Member	Stronger Member
Material	Galvanized, SS, ASTM, A653	N/A
Tensile Strength (MPa)	310.3	N/A
Gage/Thickness (mm)	22 / 0.0253	N/A
Fastener Holes (No./Diameter – mm.)	0 / 0	N/A
Net Area (Sq. mm.)	130.6	N/A
Material Strength (N)	40514.4	N/A
60% of Material Strength (N)	24308.6	N/A
Maximum Load From Tensile Test of Joint (N)	60562.3	N/A
PASS/FAIL	PASS	N/A

Comments: NONE

Recorded By: 

Approved By: 

Date: 05/09/07

SECTION 5
INSTRUMENTATION AND EQUIPMENT LIST

Test Vehicle: **2007 THOMAS SAF-T-LINER C2 SCHOOL BUS** NHTSA No.: **C70900**
 Test Lab: **MGA RESEARCH CORPORATION** Test Date: **05/09/07**

Equipment	Description	Model/Serial No.	Cal. Date	Next Cal. Date
Load Cell	Interface	1220AF / 152051A	02/22/07	08/22/07
Linear Potentiometer	Patriot	P40A / 21783	05/08/07	11/08/07
Steel Tape	Stanley	Powerlock / 281	02/27/07	08/27/07
Digital Calipers	Mitutoyo	CD-6" cs/ 0441288	09/11/06	09/11/07
Temp. Stickers	McMaster Carr	60° C / 5952K21	One Time Use	---

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Test Vehicle: **2007 THOMAS SAF-T-LINER C2 SCHOOL BUS** NHTSA No.: **C70900**
Test Lab: **MGA RESEARCH CORPORATION** Test Date: **05/09/07**



Front View of School Bus

Test Vehicle: **2007 THOMAS SAF-T-LINER C2 SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C70900**
Test Date: **05/09/07**



Rear View of School Bus

Test Vehicle: **2007 THOMAS SAF-T-LINER C2 SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C70900**
Test Date: **05/09/07**



Left Side View of School Bus

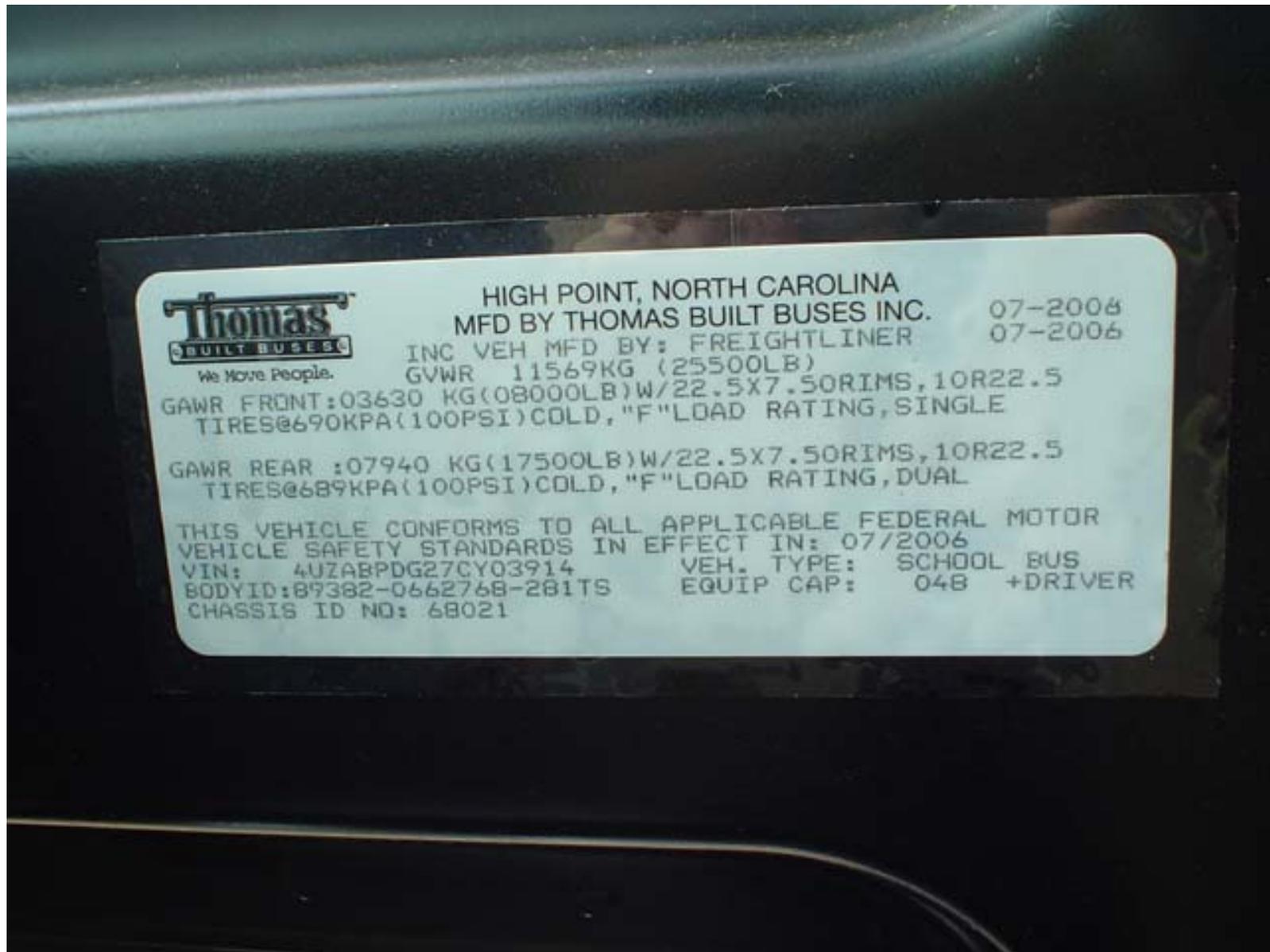
Test Vehicle: **2007 THOMAS SAF-T-LINER C2 SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C70900**
Test Date: **05/09/07**



Right Side View of School Bus

Test Vehicle: 2007 THOMAS SAF-T-LINER C2 SCHOOL BUS NHTSA No.: C70900
Test Lab: MGA RESEARCH CORPORATION Test Date: 05/09/07



Close up View of Certification and Tire Information Label

Test Vehicle: **2007 THOMAS SAF-T-LINER C2 SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C70900**
Test Date: **05/09/07**



Vehicle Interior View Front to Rear

Test Vehicle: **2007 THOMAS SAF-T-LINER C2 SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C70900**
Test Date: **05/09/07**



Vehicle Interior View Rear to Front

Test Vehicle: 2007 THOMAS SAF-T-LINER C2 SCHOOL BUS
Test Lab: MGA RESEARCH CORPORATION

NHTSA No.: C70900
Test Date: 05/09/07



Location of Joint #1

Test Vehicle: **2007 THOMAS SAF-T-LINER C2 SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C70900**
Test Date: **05/09/07**



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Location of Joint #2

Test Vehicle: **2007 THOMAS SAF-T-LINER C2 SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C70900**
Test Date: **05/09/07**



Location of Joint #3

Test Vehicle: 2007 THOMAS SAF-T-LINER C2 SCHOOL BUS
Test Lab: MGA RESEARCH CORPORATION

NHTSA No.: C70900
Test Date: 05/09/07



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Location of Joint #4

Test Vehicle: **2007 THOMAS SAF-T-LINER C2 SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

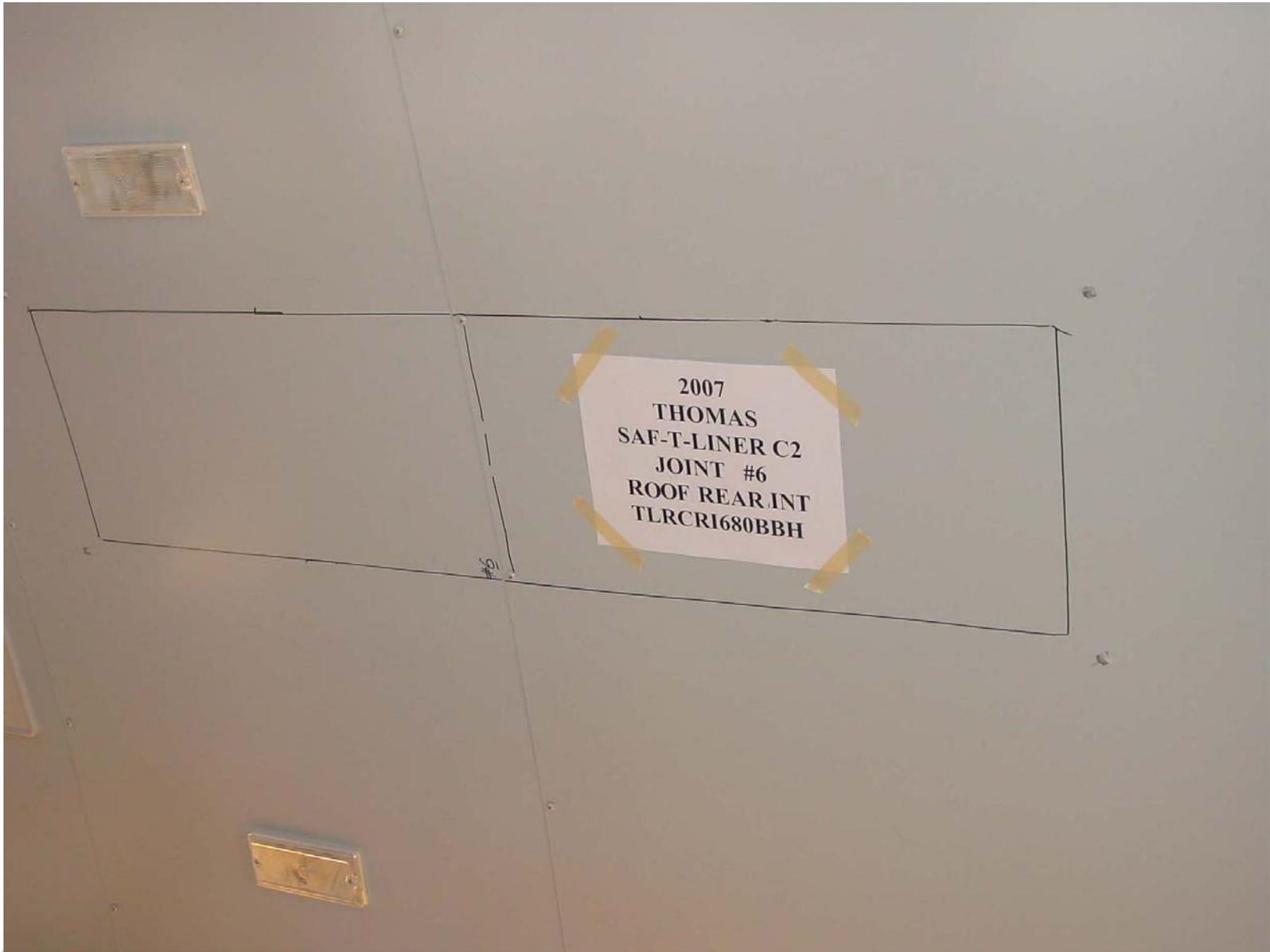
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Test Date: **05/09/07**



Location of Joint #5

Test Vehicle: **2007 THOMAS SAF-T-LINER C2 SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C70900**
Test Date: **05/09/07**



Location of Joint #6

Test Vehicle: 2007 THOMAS SAF-T-LINER C2 SCHOOL BUS
Test Lab: MGA RESEARCH CORPORATION

NHTSA No.: C70900
Test Date: 05/09/07



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Pre-Test of Joint #1

Test Vehicle: 2007 THOMAS SAF-T-LINER C2 SCHOOL BUS
Test Lab: MGA RESEARCH CORPORATION

NHTSA No.: C70900
Test Date: 05/09/07



Post-Test of Joint #1

Test Vehicle: 2007 THOMAS SAF-T-LINER C2 SCHOOL BUS NHTSA No.: C70900
Test Lab: MGA RESEARCH CORPORATION Test Date: 05/09/07



Test Vehicle: **2007 THOMAS SAF-T-LINER C2 SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C70900**
Test Date: **05/09/07**



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Pre-Test of Joint #2

Test Vehicle: **2007 THOMAS SAF-T-LINER C2 SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C70900**
Test Date: **05/09/07**



Post-Test of Joint #2

Test Vehicle: 2007 THOMAS SAF-T-LINER C2 SCHOOL BUS
Test Lab: MGA RESEARCH CORPORATION

NHTSA No.: C70900
Test Date: 05/09/07



Post-Test of Joint #2 view 2

Test Vehicle: **2007 THOMAS SAF-T-LINER C2 SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C70900**
Test Date: **05/09/07**



Test Vehicle: 2007 THOMAS SAF-T-LINER C2 SCHOOL BUS
Test Lab: MGA RESEARCH CORPORATION

NHTSA No.: C70900
Test Date: 05/09/07



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Post-Test of Joint #3

Test Vehicle: **2007 THOMAS SAF-T-LINER C2 SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C70900**
Test Date: **05/09/07**



Test Vehicle: **2007 THOMAS SAF-T-LINER C2 SCHOOL BUS** NHTSA No.: **C70900**
Test Lab: **MGA RESEARCH CORPORATION** Test Date: **05/09/07**



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Pre-Test of Joint #4

Test Vehicle: **2007 THOMAS SAF-T-LINER C2 SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C70900**
Test Date: **05/09/07**



Post-Test of Joint #4

Test Vehicle: **2007 THOMAS SAF-T-LINER C2 SCHOOL BUS** NHTSA No.: **C70900**
Test Lab: **MGA RESEARCH CORPORATION** Test Date: **05/09/07**



Test Vehicle: **2007 THOMAS SAF-T-LINER C2 SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C70900**
Test Date: **05/09/07**



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Pre-Test of Joint #5

Test Vehicle: **2007 THOMAS SAF-T-LINER C2 SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C70900**
Test Date: **05/09/07**



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Post-Test of Joint #5

Test Vehicle: **2007 THOMAS SAF-T-LINER C2 SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

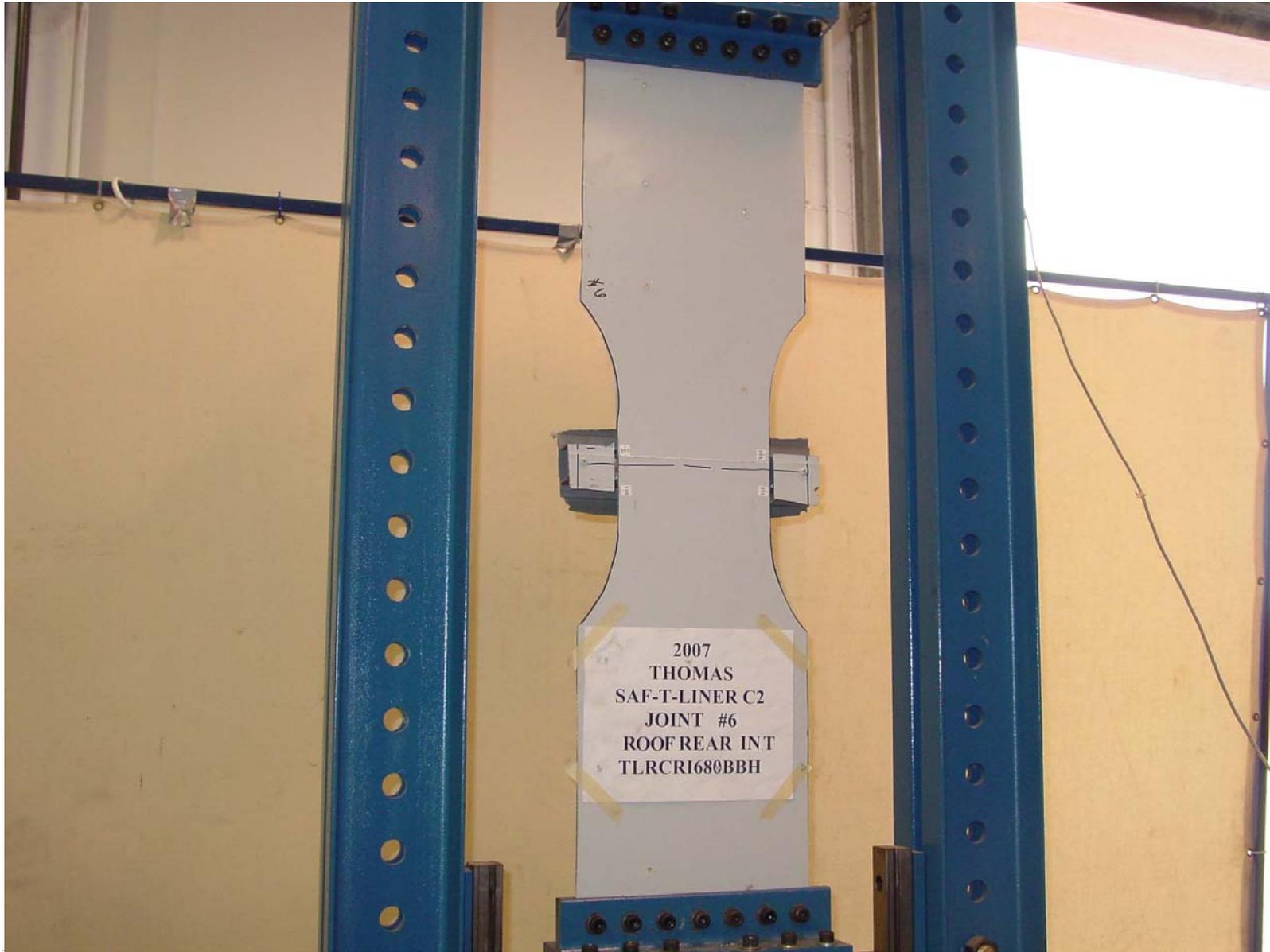
NHTSA No.: **C70900**
Test Date: **05/09/07**



Post-Test of Joint #5 view 2

Test Vehicle: **2007 THOMAS SAF-T-LINER C2 SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

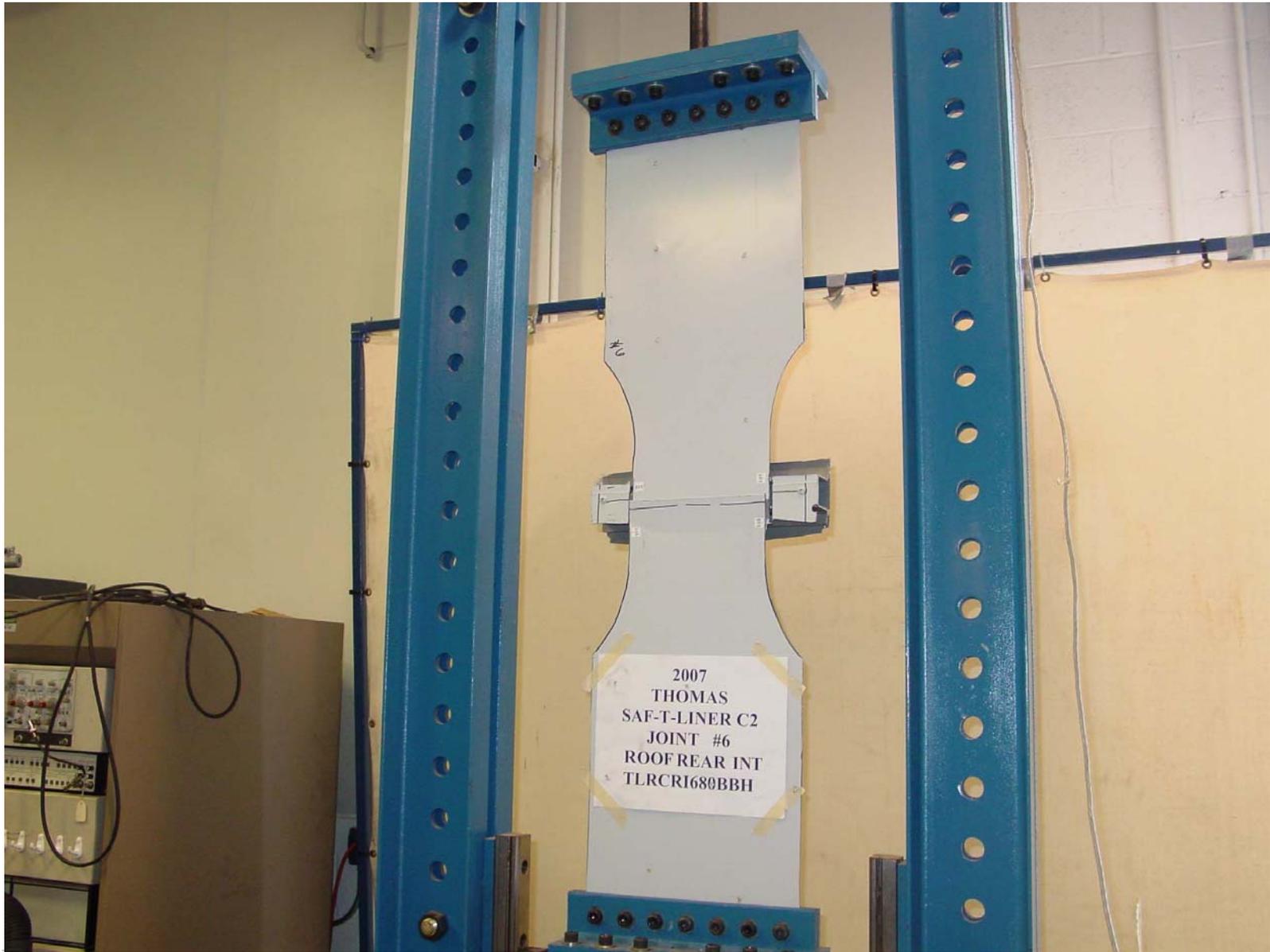
NHTSA No.: **C70900**
Test Date: **05/09/07**



Pre-Test of Joint #6

Test Vehicle: **2007 THOMAS SAF-T-LINER C2 SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C70900**
Test Date: **05/09/07**



Post-Test of Joint #6

Test Vehicle: **2007 THOMAS SAF-T-LINER C2 SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C70900**
Test Date: **05/09/07**



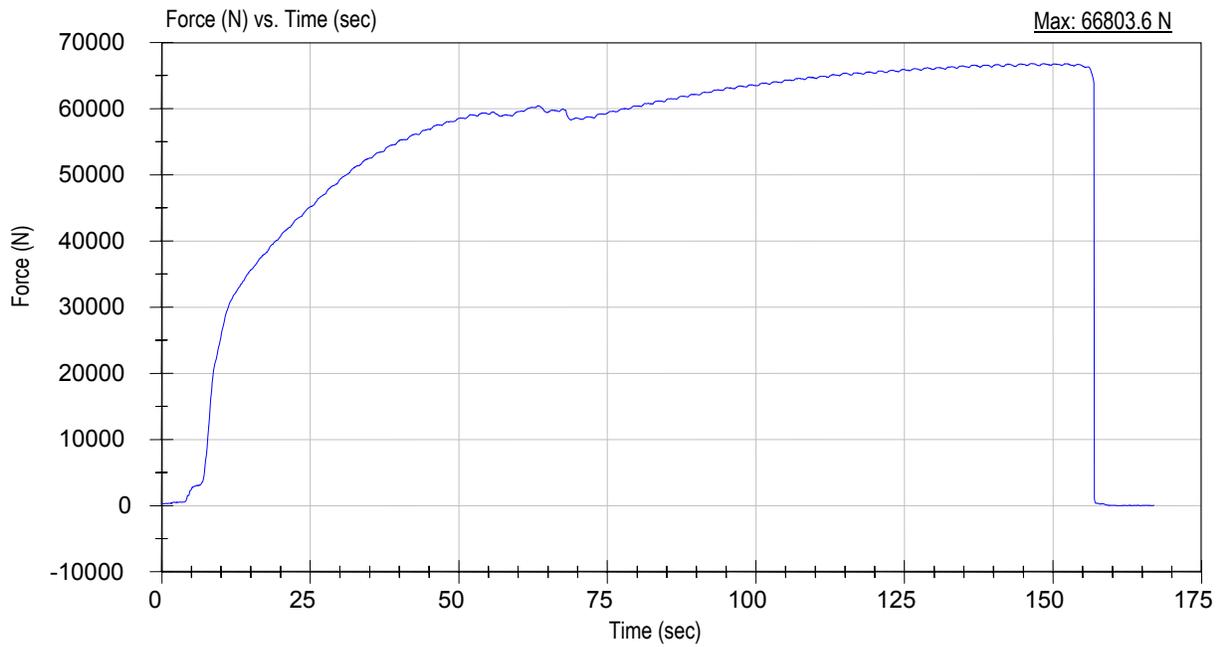
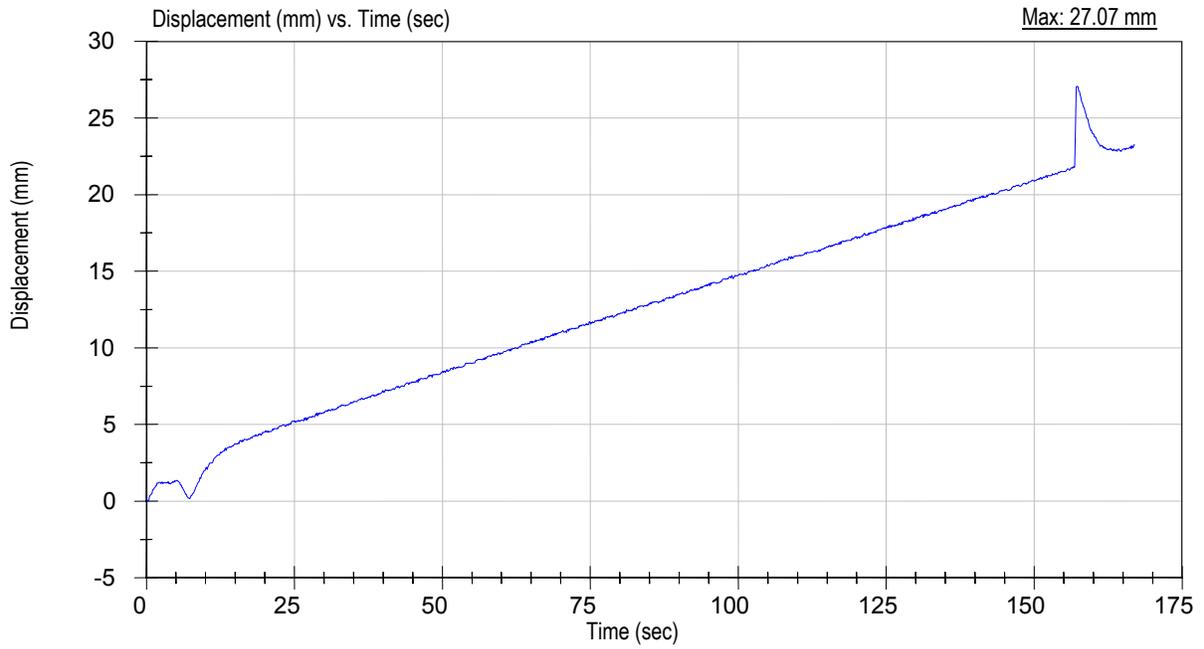
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Test Desc: FMVSS 221 (Required Load: 33622.3 N)
Sample: 1- Right Side Mid Exterior

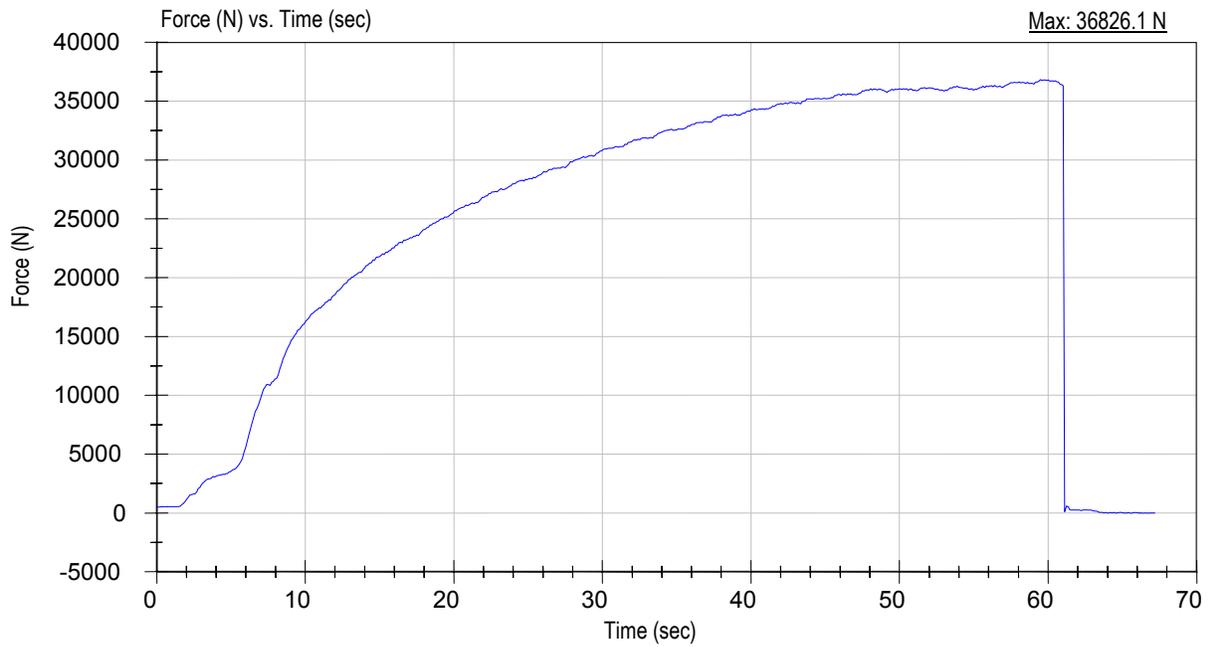
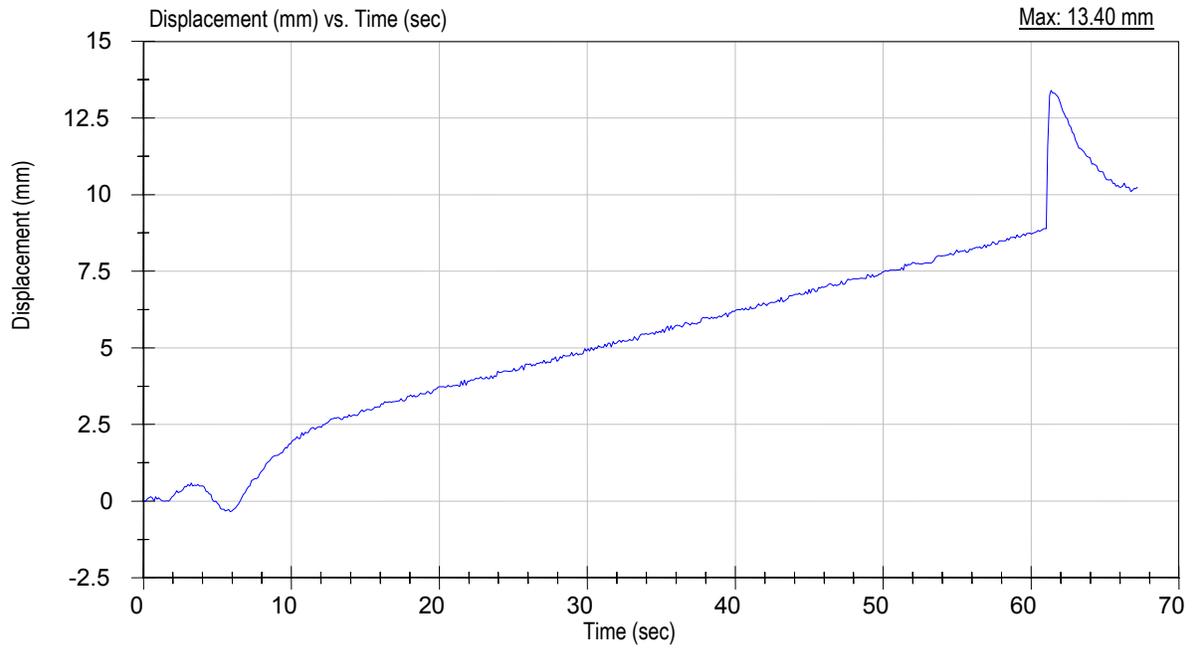
Test Date: 05/09/07
NHTSA No: C70900





Test Desc: FMVSS 221 (Required Load: 21853.5 N)
Sample: 2 -Left Side Front Interior

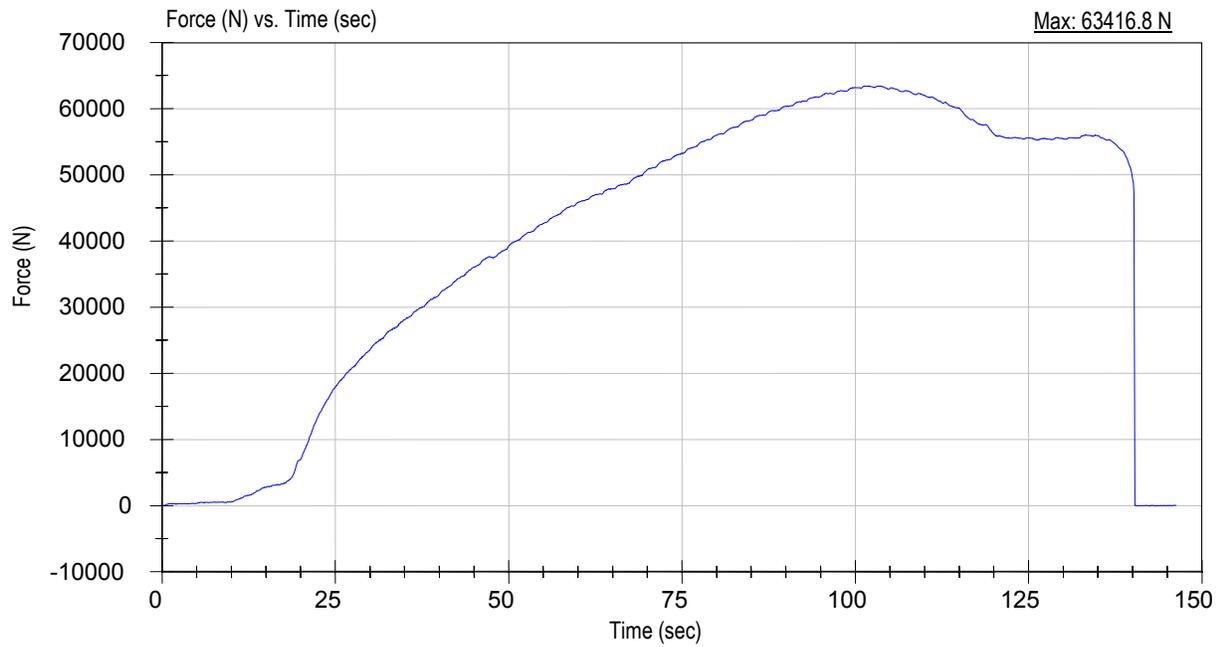
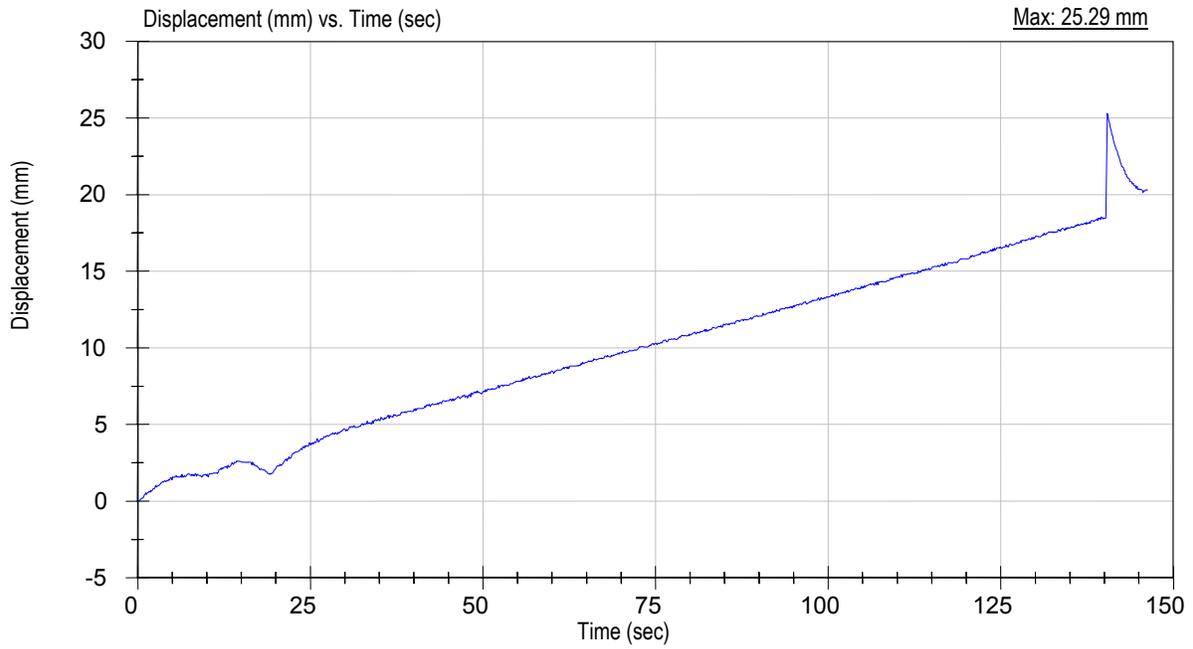
Test Date: 05/09/07
NHTSA No: C70900





Test Desc: FMVSS 221 (Required Load: 33695.6 N)
Sample: 3- Left Side Rear Exterior

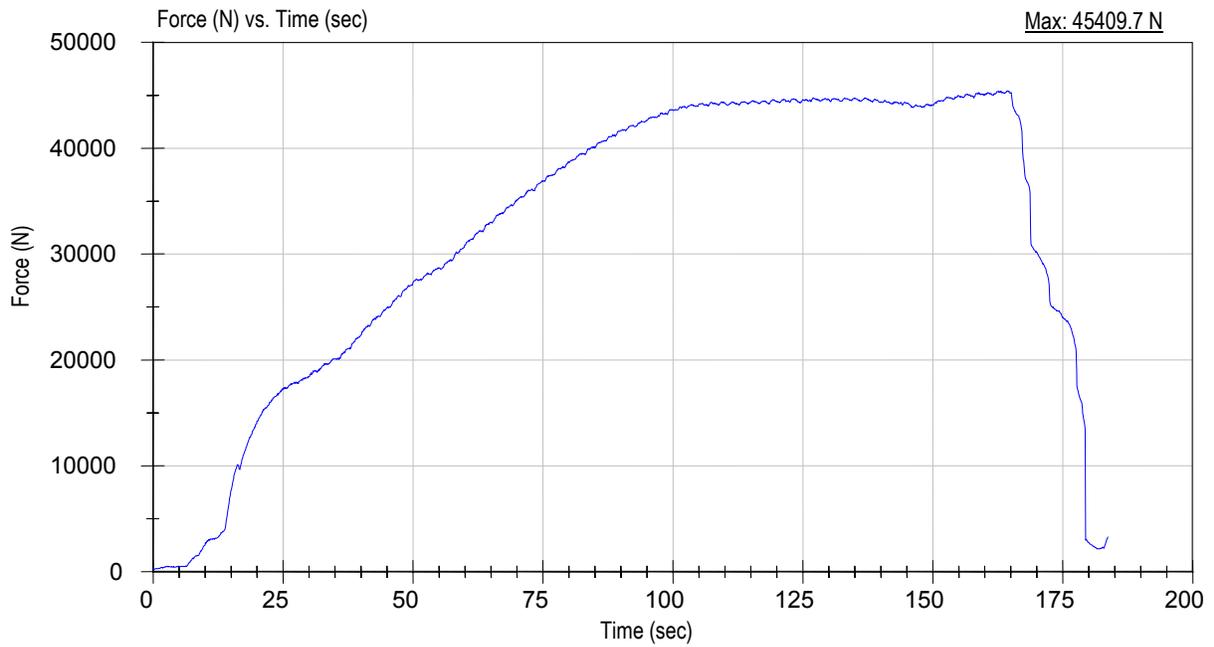
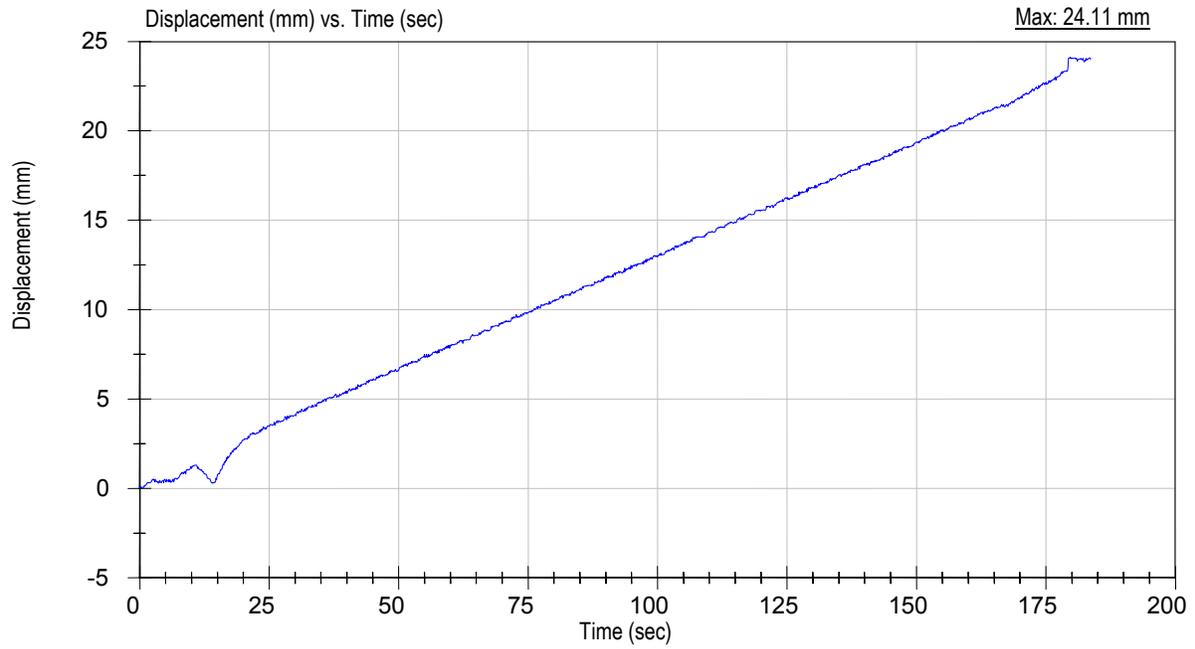
Test Date: 05/09/07
NHTSA No: C70900





Test Desc: FMVSS 221 (Required Load: 21853.5 N)
Sample: 4 - Left Side Mid Interior

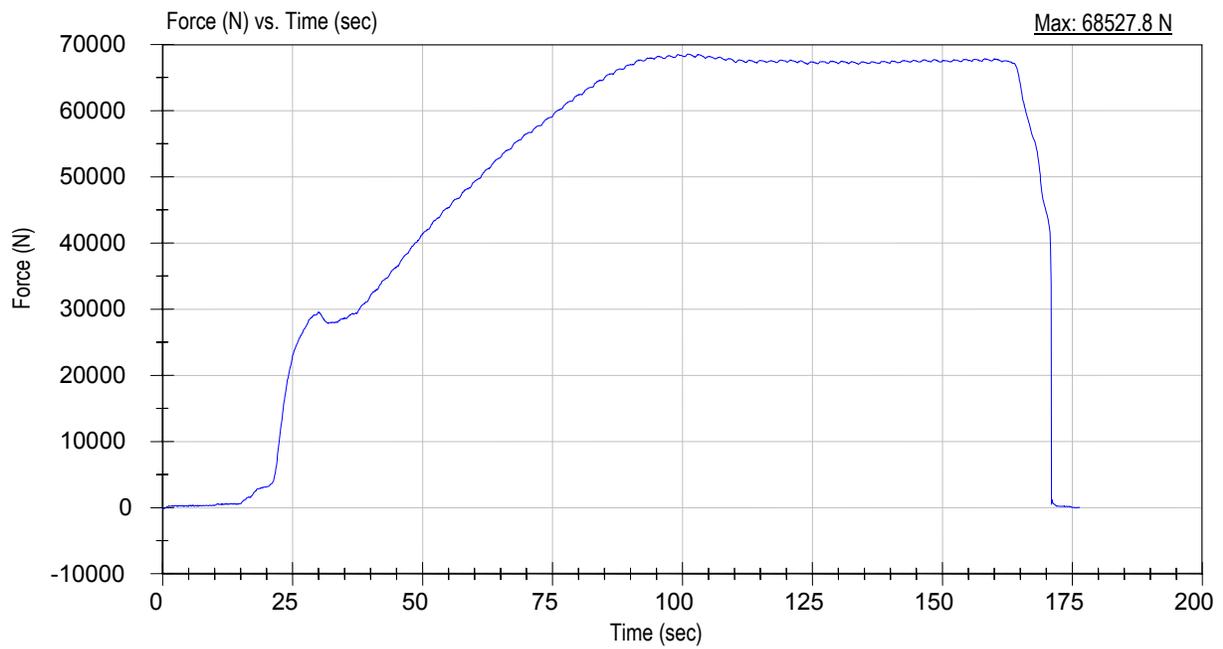
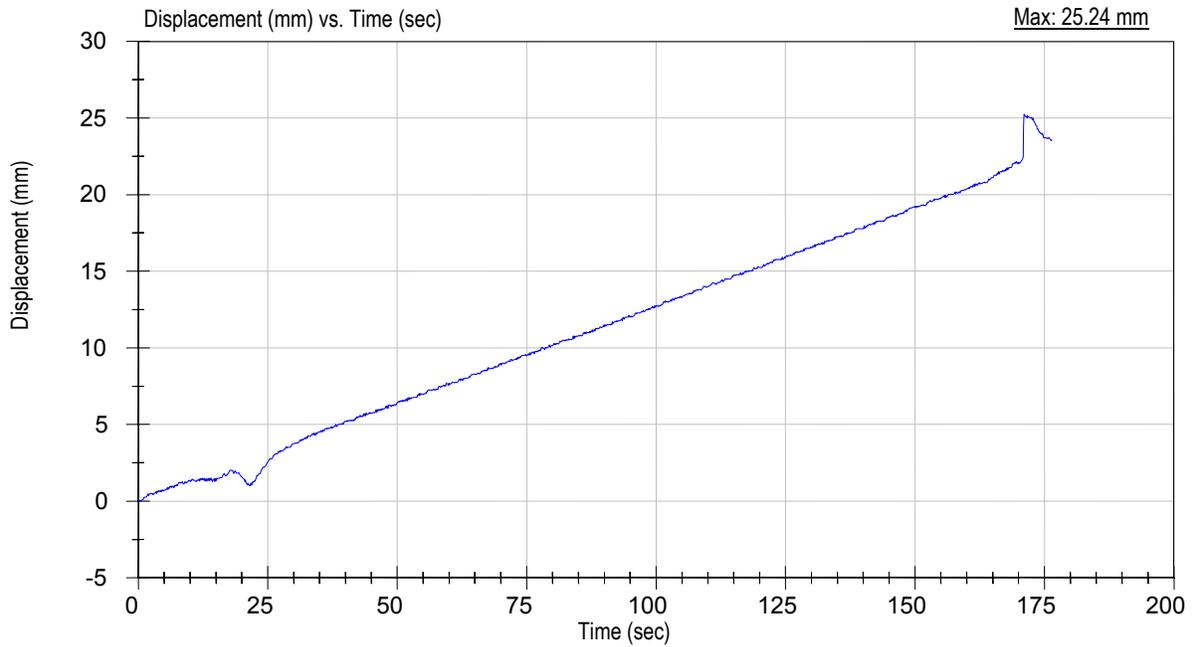
Test Date: 05/09/07
NHTSA No: C70900





Test Desc: FMVSS 221 (Required Load: 33622.3 N)
Sample: 5 - Roof Mid Exterior

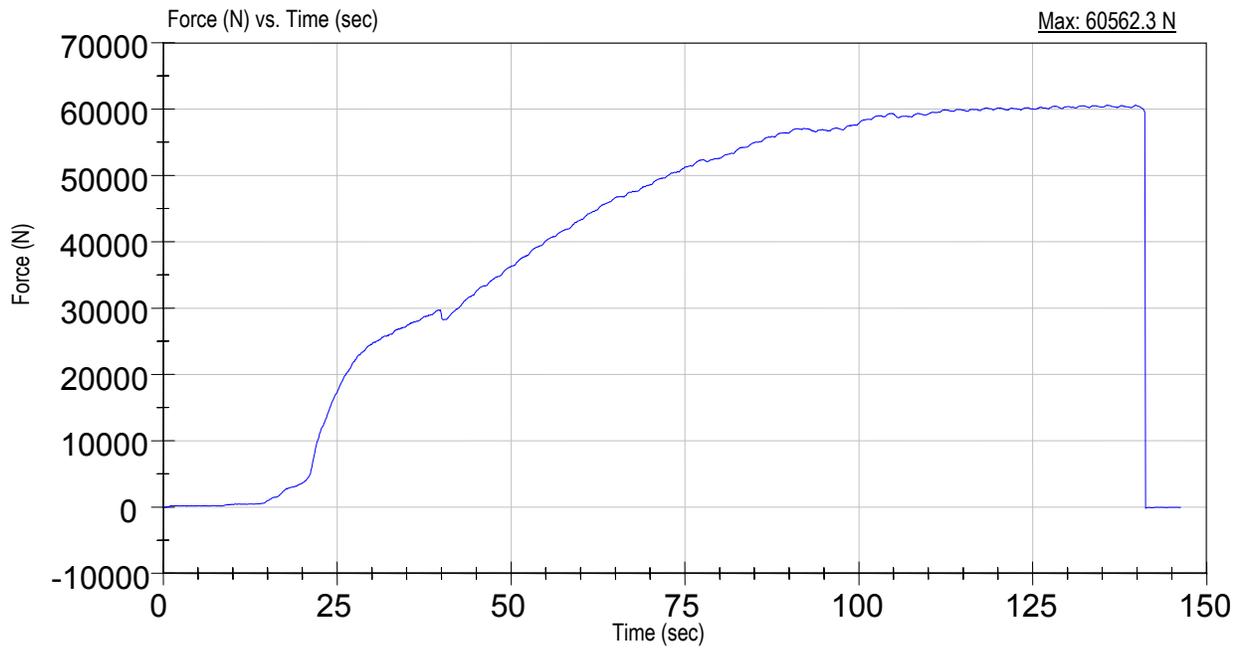
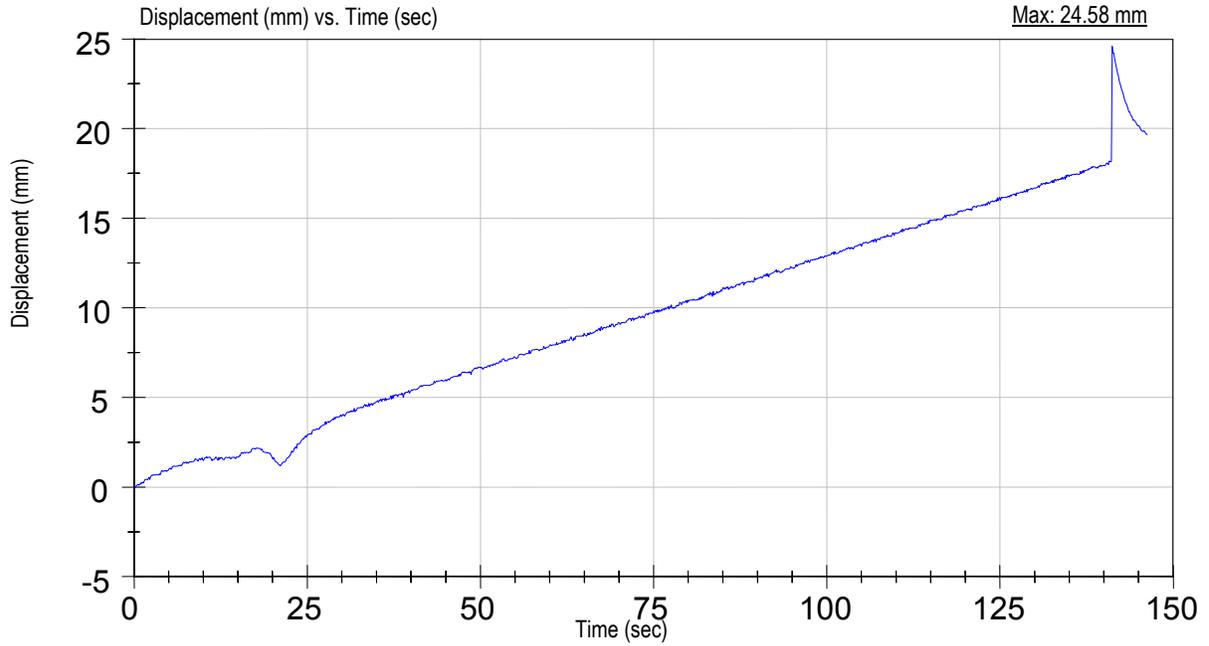
Test Date: 05/09/07
NHTSA No: C70900





Test Desc: FMVSS 221 (Required Load: 24308.6 N)
Sample: 6 – Roof Rear Interior

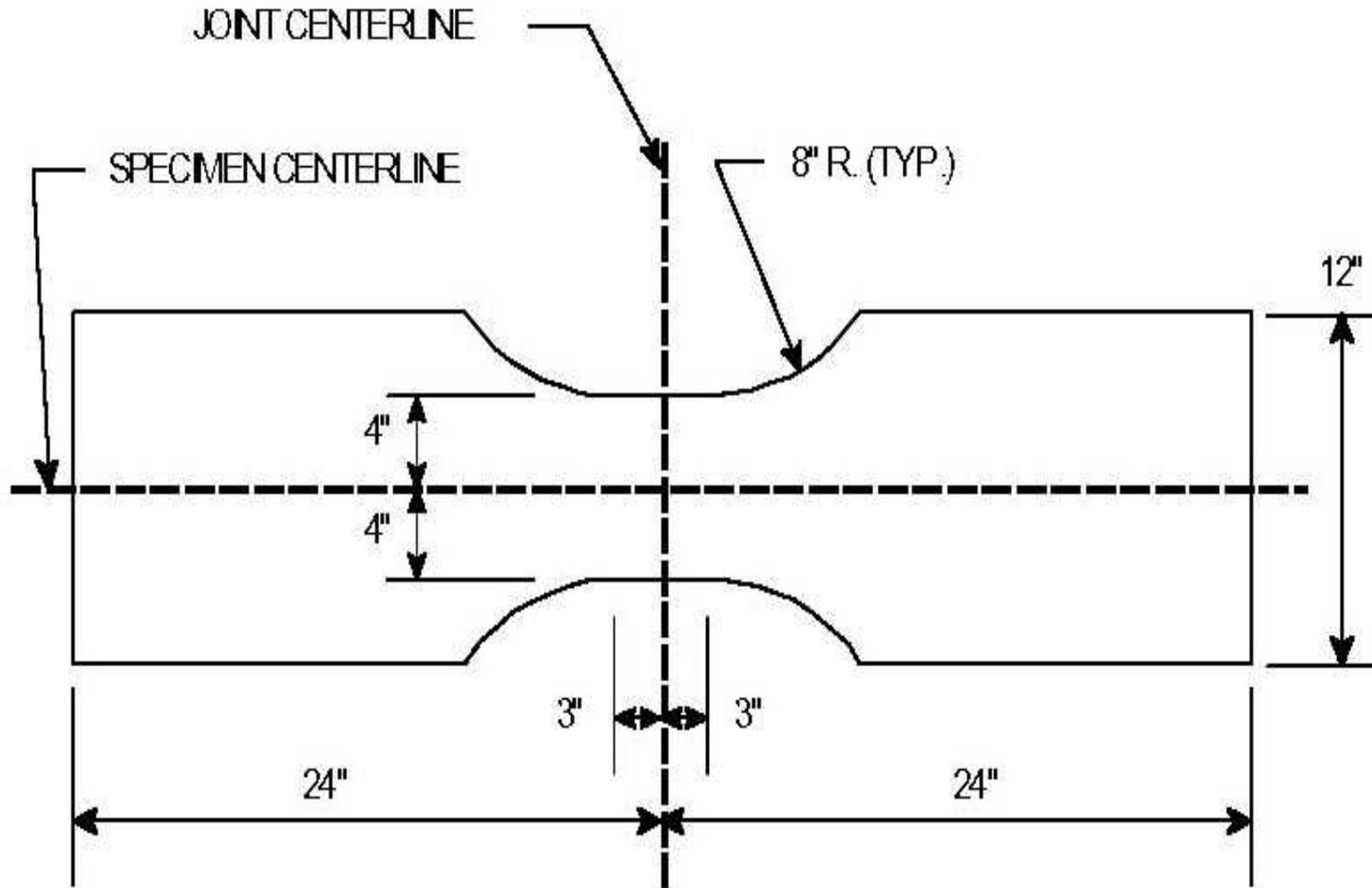
Test Date: 05/09/07
NHTSA No: C70900



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



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Typical Test Sample Configuration

Test Vehicle: **2007 THOMAS SAF-T-LINER C2 SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C70900**
Test Date: **05/09/07**

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View of Joint #1

Test Vehicle: **2007 THOMAS SAF-T-LINER C2 SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C70900**
Test Date: **05/09/07**



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View of Joint #2

Test Vehicle: **2007 THOMAS SAF-T-LINER C2 SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C70900**
Test Date: **05/09/07**

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View of Joint #3

Test Vehicle: **2007 THOMAS SAF-T-LINER C2 SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C70900**
Test Date: **05/09/07**

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View of Joint #4

Test Vehicle: **2007 THOMAS SAF-T-LINER C2 SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C70900**
Test Date: **05/09/07**

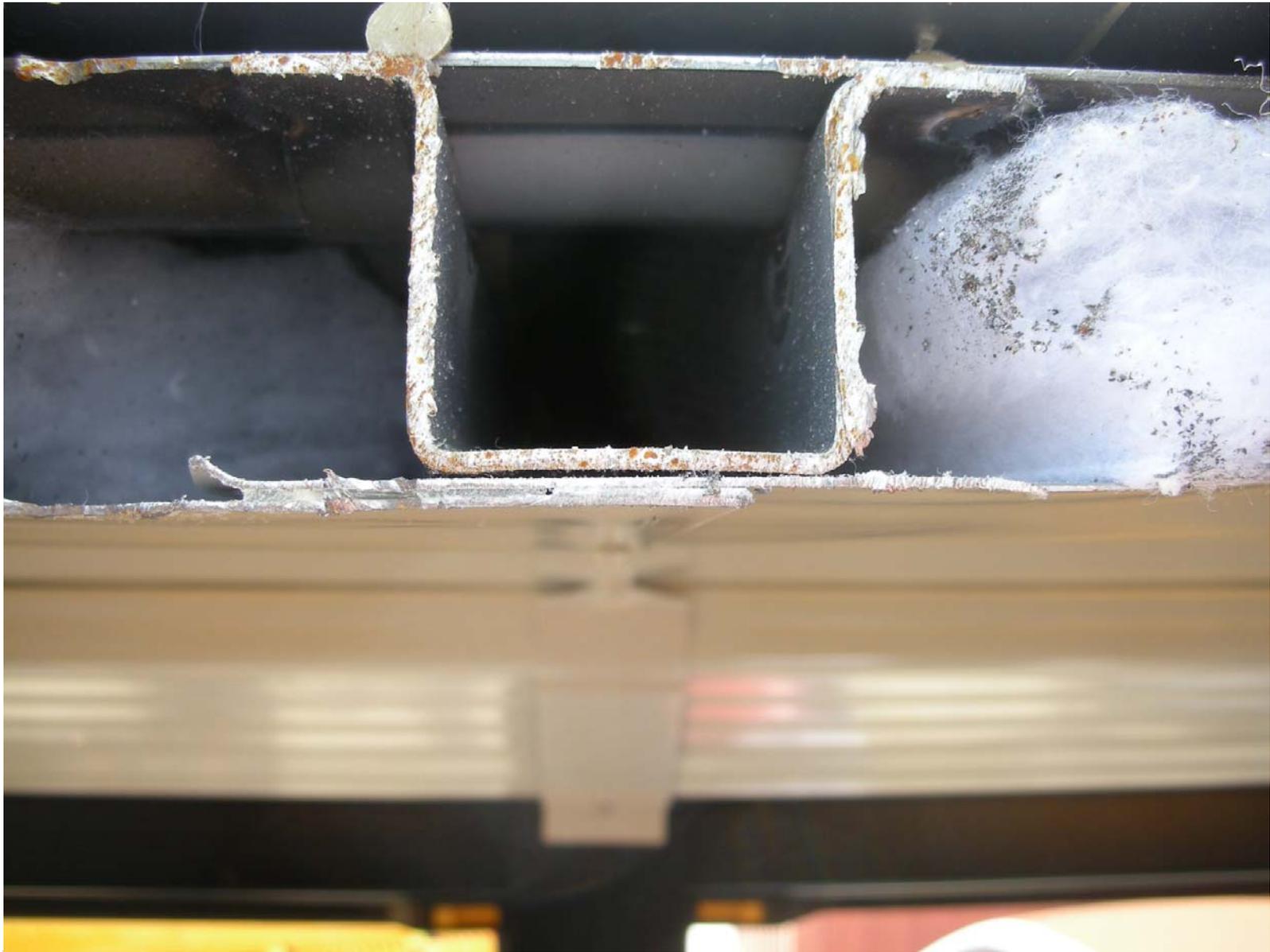


View of Joint #5

Test Vehicle: **2007 THOMAS SAF-T-LINER C2 SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C70900**
Test Date: **05/09/07**

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View of Joint #6