

REPORT NUMBER: 221-MGA-2007-002

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

**MID BUS INC.
2006 MID BUS GUIDE DW SCHOOL BUS
NHTSA NO.: C60901**

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





FINAL REPORT DATE: AUGUST 16, 2007

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.
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: 
James Hansen, Project Engineer Date: August 16, 2007

Reviewed by: 
Michael Janovicz, Program Manager Date: August 16, 2007

FINAL REPORT ACCEPTED BY:


August 16, 2007
Date of Acceptance

Technical Report Documentation Page

1. Report No. 221-MGA-2007-002	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Final Report of FMVSS 222 Compliance Testing of 2006 Mid Bus Guide DW School Bus NHTSA No.:C60901		5. Report Date August 16, 2007	
		6. Performing Organization Code MGA	
7. Author(s) James Hansen, Project Engineer Michael Janovicz, Program Manager		8. Performing Organization Report No. 221-MGA-2007-002	
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 Mail Code: NVS-220 1200 New Jersey Avenue, S.E. Washington, D.C. 20590		13. Type of Report and Period Covered Final Report 07/25/07 - 08/16/07	
		14. Sponsoring Agency Code NVS-220	
15. Supplementary Notes			
16. Abstract Compliance tests were conducted on the subject 2006 Mid Bus Guide DW School Bus, NHTSA No. C60901, 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: 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 Telephone No.: (202)493-2833 E-mail: tis@dot.gov	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 43	22. Price

TABLE OF CONTENTS

<u>Section</u>		<u>Page No</u>
1	Purpose of Compliance Test	1
2	Test Procedure	2
3	Test Data Summary	3
4	Compliance Test Data	4
	Data Sheet 1 – Administrative Data	5
	Data Sheet 2 – Summary of Data	6
	Data Sheet 3 – Joint Strength When ASTM Material Properties Are Known	7
5	Instrumentation and Equipment List	10
6	Photographs	11
7	Test Plots	31
8	Joint Configurations	35

SECTION 1
PURPOSE OF COMPLIANCE TEST

Tests were conducted on a MY 2006 Mid Bus Guide DW School Bus, NHTSA No. C60901, 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 MY 2006 Mid Bus Guide DW School Bus, NHTSA No. C60901 was subjected to FMVSS 221 testing.

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

	Maximum Load (N)	60% of Material Strength (N)	PASS/FAIL
Roof Mid Exterior	48459.4	18242.5	PASS
Roof Rear Interior	35889.6	10376.5	PASS
Left Side Interior	38696.0	10376.5	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 MY 2006 Mid Bus Guide DW School Bus, NHTSA No. C60901.

DATA SHEET 1
ADMINISTRATIVE DATA SHEET

Test Vehicle: **2006 MID BUS GUIDE DW SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C60901**
Test Date: **07/25/07**

INCOMPLETE VEHICLE (IF APPLICABLE)

Manufacturer:	CHEVROLET MOTOR DIVISION
Model:	CSD-7450-C-063336
VIN:	1GBJG31U461237309
Build Date:	4/2006
Certification Date:	

COMPLETED VEHICLE (SCHOOL BUS)

Manufacturer:	MID BUS INC.
Make/Model:	CHEVROLET MID BUS GUIDE
VIN:	1GBJG31U461237309
NHTSA No.:	C60901
Color:	Yellow
GVWR:	5,579 kg / 12,300 lbs
Build Date:	9/2006
Certification Date:	4/2006

DATES

Vehicle Receipt:	10/06/2006
Start of Compliance Test:	07/25/07
Completion of Compliance Test:	07/25/07

COMPLIANCE TEST:

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

Recorded By: 

Approved By: 

Date: 07/25/07

DATA SHEET 2
SUMMARY OF DATA

Test Vehicle: **2006 MID BUS GUIDE DW SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C60901**
Test Date: **07/25/07**

Joint Specimen I.D.	Joint Location	Joint Load Reqmt (60%) (N)	Max. Load at Joint Separation (N)	Calculated Material Strength (N)	PASS/ FAIL
MSRCME182BAH	Roof Mid Exterior	18242.5	48459.4	30404.2	PASS
MSRCRI284BAH	Roof Rear Interior	21853.5	36826.1	36422.4	PASS
MSSLRI384BAV	Left Side Interior	10376.5	35889.6	17294.1	PASS

Comments: NONE

Recorded By: 

Approved By: 

Date: 07/25/07

DATA SHEET 3

JOINT STRENGTH WHEN ASTM MATERIAL PROPERTIES ARE KNOWN

Test Vehicle: **2006 MID BUS GUIDE DW SCHOOL BUS**
 Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C60901**
 Test Date: **07/25/07**

Specimen Description:	Roof Mid Exterior		
Joint Number:	MSRCME182BAH	Test Number:	1

	Weaker Member	Stronger Member
Material	CS Type B 1008 ASTM 653	N/A
Tensile Strength (MPa)	206.8	N/A
Gage/Thickness (mm)	22 / 0.759	N/A
Fastener Holes (No./Diameter – mm.)	2 / 4.83	N/A
Net Area (Sq. mm.)	147.0	N/A
Material Strength (N)	30404.2	N/A
60% of Material Strength (N)	18242.5	N/A
Maximum Load From Tensile Test of Joint (N)	48459.4	N/A
PASS/FAIL	PASS	N/A

Comments: NONE

Recorded By: 

Approved By: 

Date: 07/25/07

DATA SHEET 3... (Continued)

JOINT STRENGTH WHEN ASTM MATERIAL PROPERTIES ARE KNOWN

Test Vehicle: **2006 MID BUS GUIDE DW SCHOOL BUS**
 Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C60901**
 Test Date: **07/25/07**

Specimen Description:	Roof Rear Interior		
Joint Number:	MSRCRI284BAH	Test Number:	2

	Weaker Member	Stronger Member
Material	CS Type B 1008 ASTM 653	N/A
Tensile Strength (MPa)	206.8	N/A
Gage/Thickness (mm)	26 / 0.455	N/A
Fastener Holes (No./Diameter – mm.)	4 / 4.83	N/A
Net Area (Sq. mm.)	83.6	N/A
Material Strength (N)	17294.1	N/A
60% of Material Strength (N)	10376.5	N/A
Maximum Load From Tensile Test of Joint (N)	35889.6	N/A
PASS/FAIL	PASS	N/A

Comments: NONE

Recorded By: 

Approved By: 

Date: 07/25/07

DATA SHEET 3... (Continued)

JOINT STRENGTH WHEN ASTM MATERIAL PROPERTIES ARE KNOWN

Test Vehicle: **2006 MID BUS GUIDE DW SCHOOL BUS**
 Test Lab: **MGA RESEARCH CORPORATION**


NHTSA No.: **C60901**
 Test Date: **07/25/07**

Specimen Description:	Left Side Interior		
Joint Number:	MSSLRI384BAV	Test Number:	3

	Weaker Member	Stronger Member
Material	CS Type B 1008 ASTM 653	N/A
Tensile Strength (MPa)	206.8	N/A
Gage/Thickness (mm)	26 / 0.455	N/A
Fastener Holes (No./Diameter – mm.)	4 / 4.83	N/A
Net Area (Sq. mm.)	83.6	N/A
Material Strength (N)	17294.1	N/A
60% of Material Strength (N)	10376.5	N/A
Maximum Load From Tensile Test of Joint (N)	38696.0	N/A
PASS/FAIL	PASS	N/A

Comments: NONE

Recorded By: 

Approved By: 

Date: 07/25/07

**SECTION 5
INSTRUMENTATION AND EQUIPMENT LIST**

Test Vehicle: **2006 MID BUS GUIDE DW SCHOOL BUS**
 Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C60901**
 Test Date: **07/25/07**

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	---

SECTION 6
PHOTOGRAPHS
TABLE OF PHOTOGRAPHS

<u>No.</u>		<u>Page No.</u>
1	Front View of School Bus	12
2	Rear View of School Bus	13
3	Left Side View of School Bus	14
4	Right Side View of School Bus	15
5	Close up View of Certification and Tire Information Label	16
6	Vehicle Interior View Front to Rear	17
7	Vehicle Interior View Rear to Front	18
8	Location of Joint #1	19
9	Location of Joint #2	20
10	Location of Joint #3	21
11	Pre-Test of Joint #1	22
12	Post-Test of Joint #1	23
13	Post-Test of Joint #1 view 2	24
14	Pre-Test of Joint #2	25
15	Post-Test of Joint #2	26
16	Post-Test of Joint #2 view 2	27
17	Pre-Test of Joint #3	28
18	Post-Test of Joint #3	29
19	Post-Test of Joint #3 view 2	30

Test Vehicle: **2006 MID BUS GUIDE DW SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C60901**
Test Date: **07/25/07**



Front View of School Bus

Test Vehicle: **2006 MID BUS GUIDE DW SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C60901**
Test Date: **07/25/07**



Rear View of School Bus

Test Vehicle: **2006 MID BUS GUIDE DW SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C60901**
Test Date: **07/25/07**



Left Side View of School Bus

Test Vehicle: **2006 MID BUS GUIDE DW SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

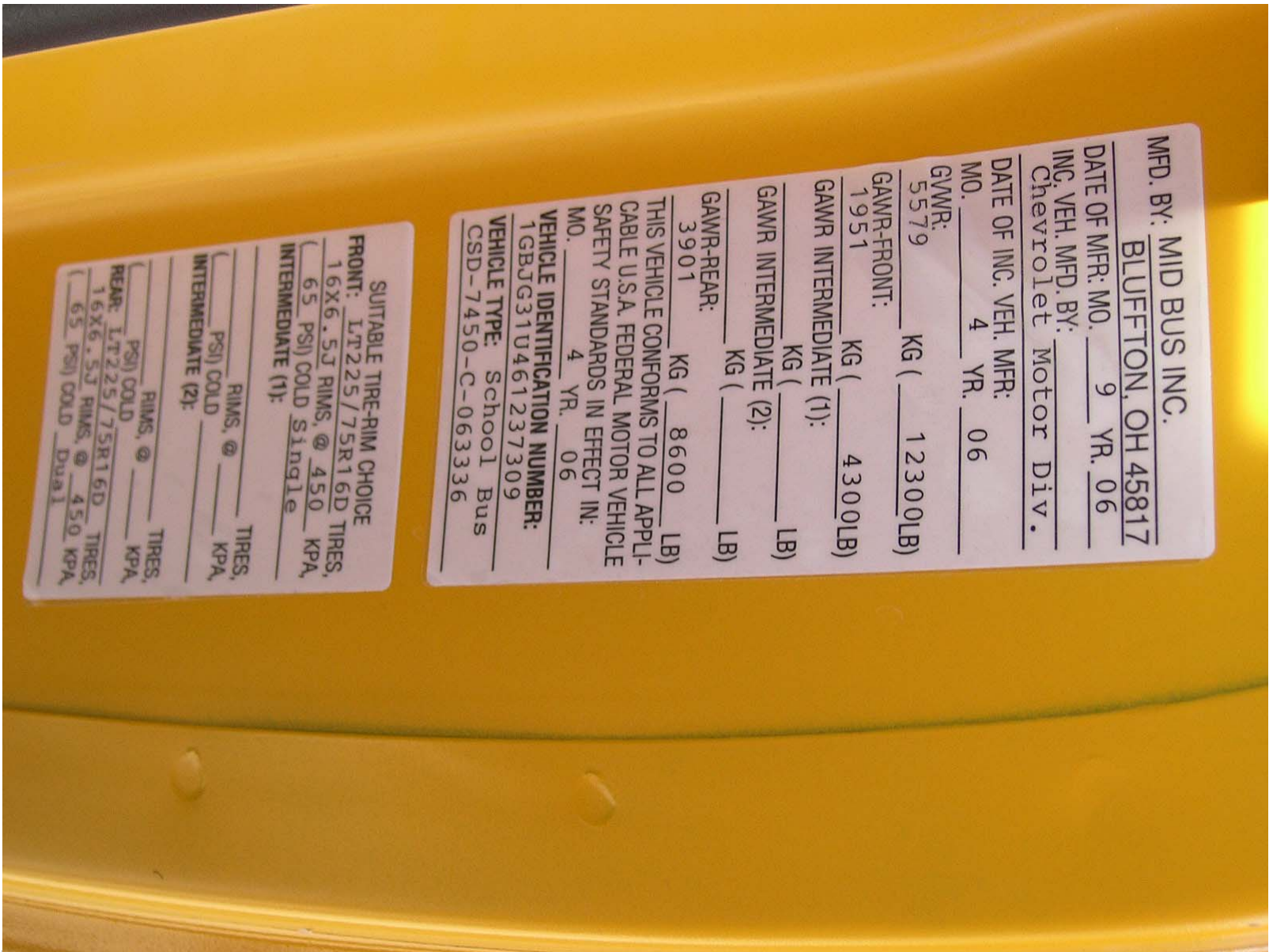
NHTSA No.: **C60901**
Test Date: **07/25/07**



Right Side View of School Bus

Test Vehicle: **2006 MID BUS GUIDE DW SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C60901**
Test Date: **07/25/07**



Close up View of Certification and Tire Information Label

Test Vehicle: **2006 MID BUS GUIDE DW SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C60901**
Test Date: **07/25/07**



Vehicle Interior View Front to Rear

Test Vehicle: **2006 MID BUS GUIDE DW SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C60901**
Test Date: **07/25/07**



Vehicle Interior View Rear to Front

Test Vehicle: **2006 MID BUS GUIDE DW SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C60901**
Test Date: **07/25/07**



Location of Joint #1

Test Vehicle: **2006 MID BUS GUIDE DW SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C60901**
Test Date: **07/25/07**



20

Location of Joint #2

Test Vehicle: **2006 MID BUS GUIDE DW SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C60901**
Test Date: **07/25/07**



Location of Joint #3

Test Vehicle: **2006 MID BUS GUIDE DW SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

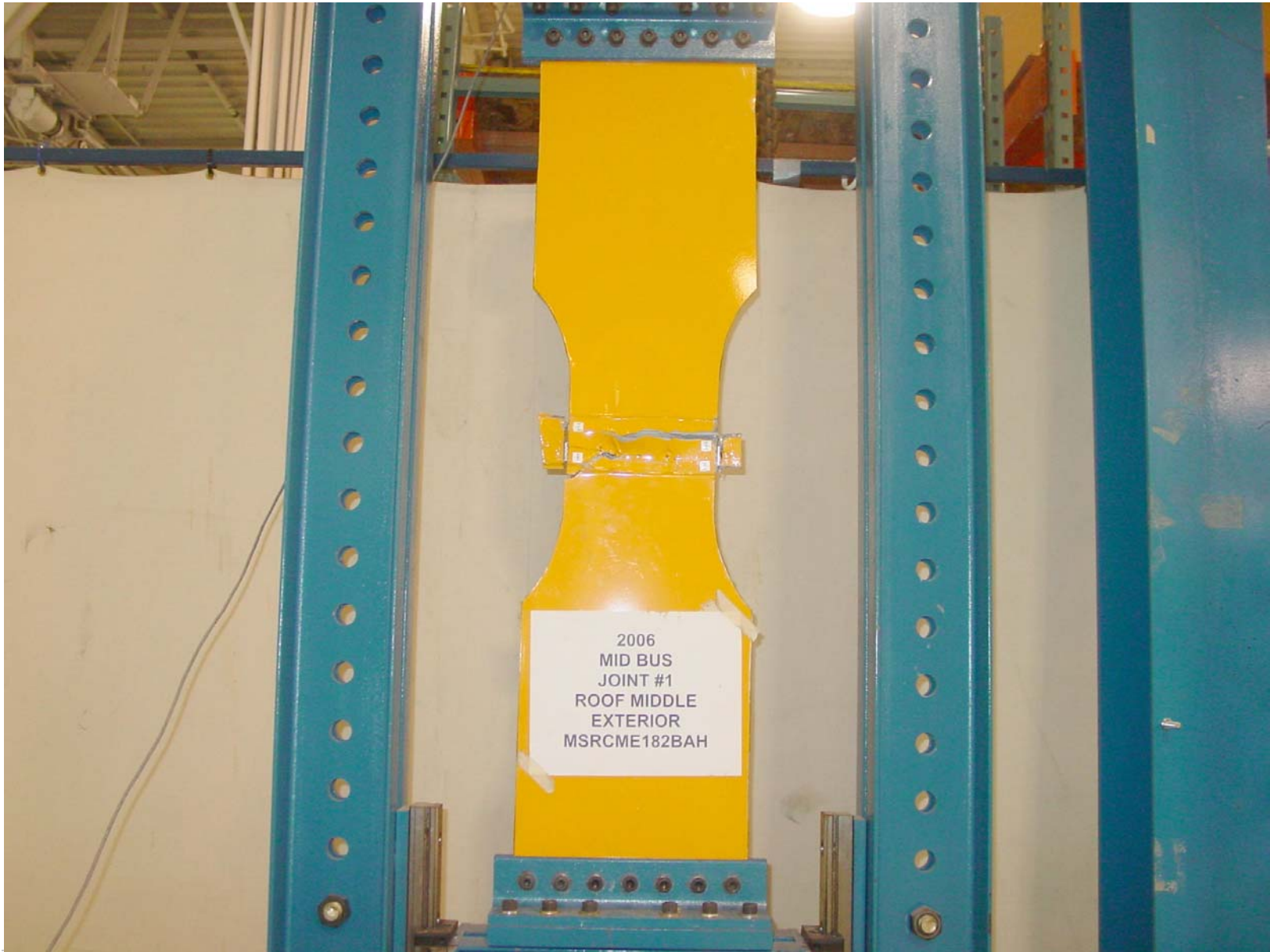
NHTSA No.: **C60901**
Test Date: **07/25/07**



Pre-Test of Joint #1

Test Vehicle: **2006 MID BUS GUIDE DW SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C60901**
Test Date: **07/25/07**



Post-Test of Joint #1

Test Vehicle: **2006 MID BUS GUIDE DW SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

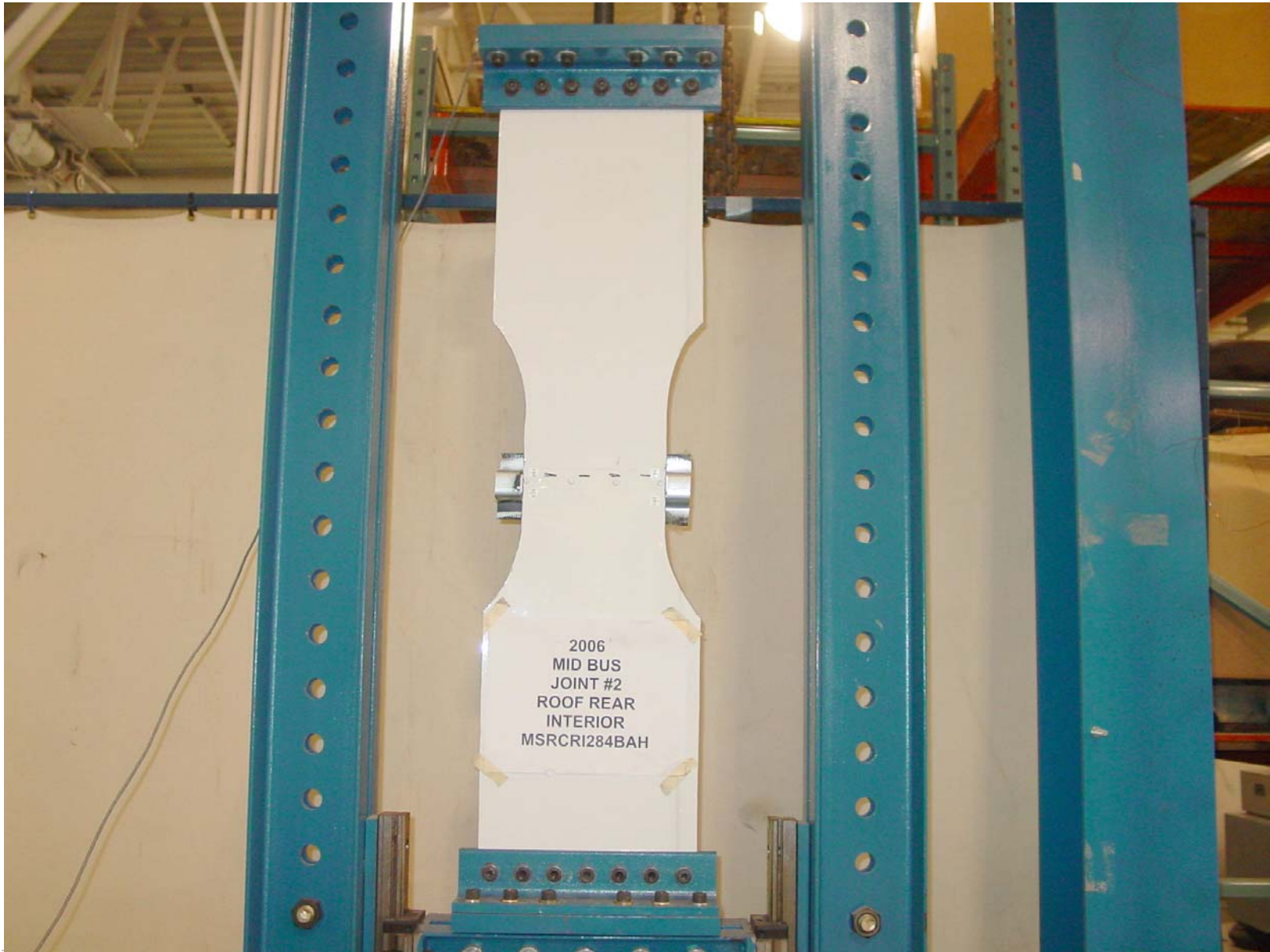
NHTSA No.: **C60901**
Test Date: **07/25/07**



Post-Test of Joint #1 view 2

Test Vehicle: **2006 MID BUS GUIDE DW SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C60901**
Test Date: **07/25/07**



25

Pre-Test of Joint #2

Test Vehicle: **2006 MID BUS GUIDE DW SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C60901**
Test Date: **07/25/07**



Post-Test of Joint #2

Test Vehicle: **2006 MID BUS GUIDE DW SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C60901**
Test Date: **07/25/07**



Post-Test of Joint #2 view 2

Test Vehicle: **2006 MID BUS GUIDE DW SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C60901**
Test Date: **07/25/07**



Test Vehicle: **2006 MID BUS GUIDE DW SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C60901**
Test Date: **07/25/07**



Post-Test of Joint #3

Test Vehicle: **2006 MID BUS GUIDE DW SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C60901**
Test Date: **07/25/07**



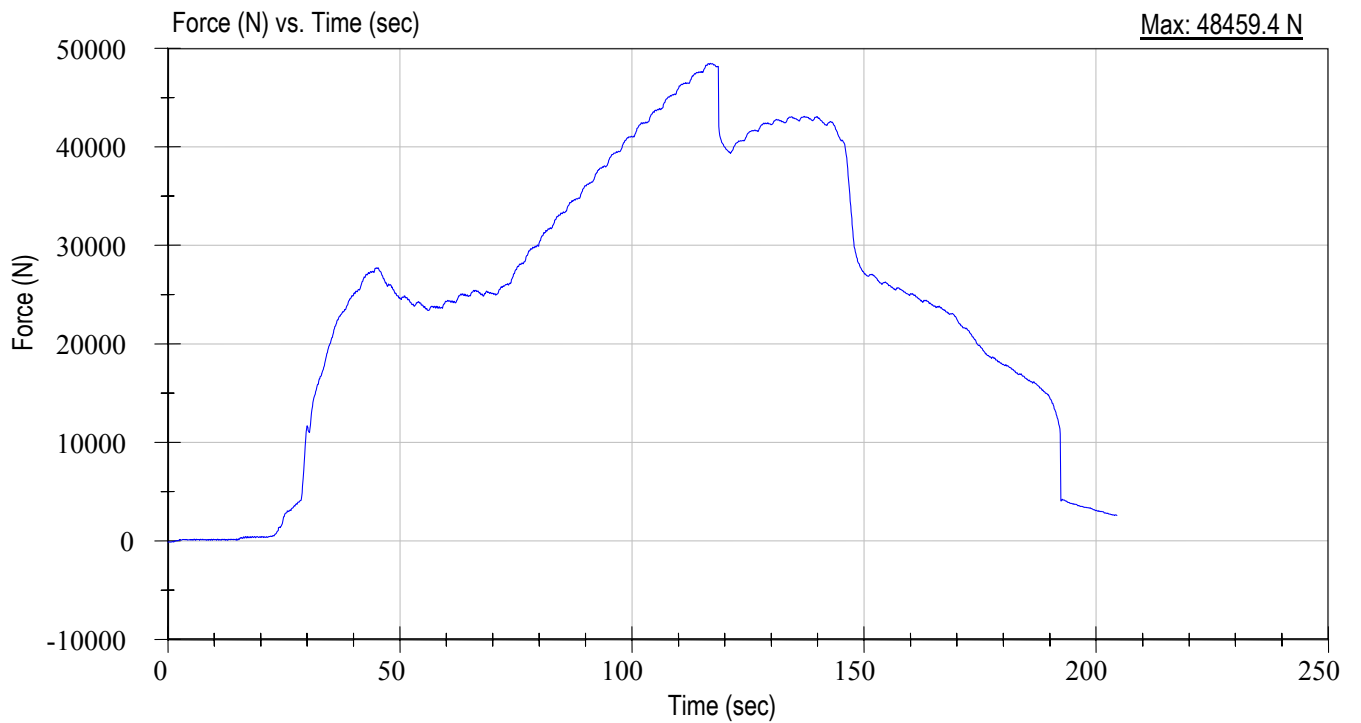
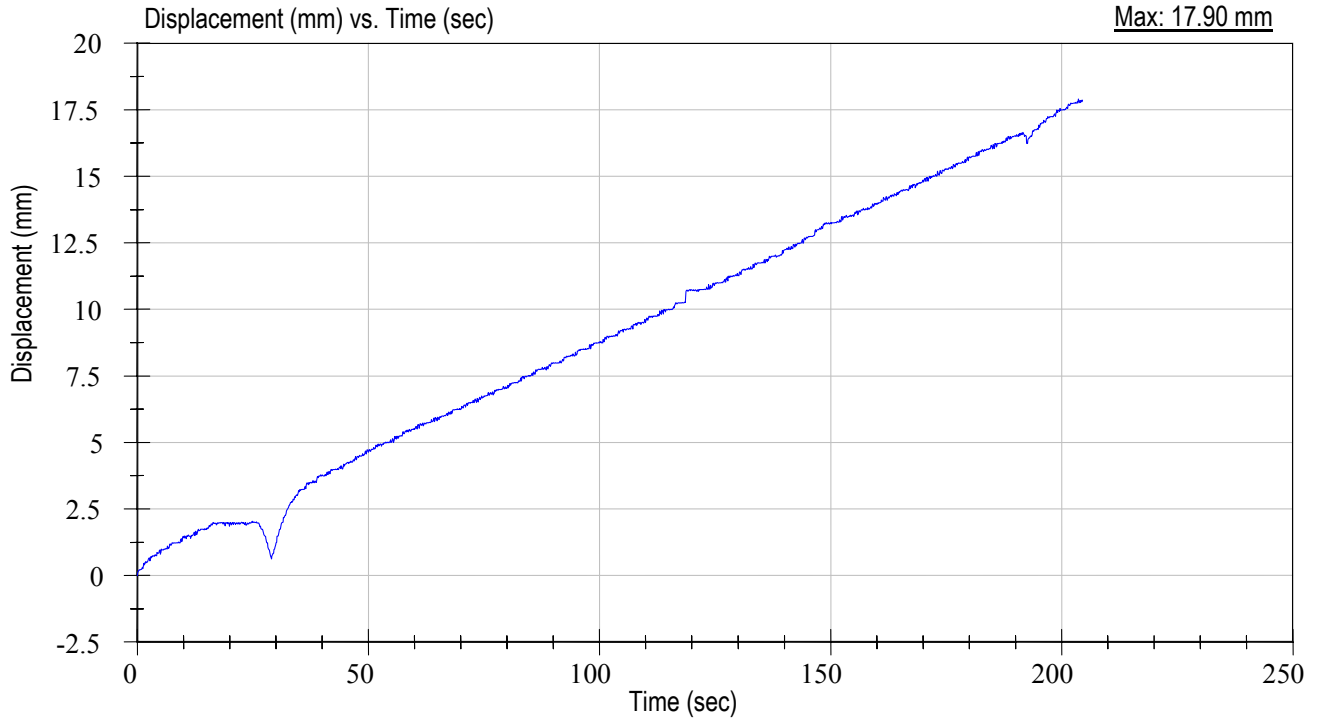
SECTION 7
TEST PLOTS
TABLE OF TEST PLOTS

<u>No.</u>		<u>Page No.</u>
1	Joint Strength, #1	32
2	Joint Strength, #2	33
3	Joint Strength, #3	34



Test Desc: FMVSS 221 (Required Load: 18242.5N)
Sample: 1 – Roof Mid Exterior

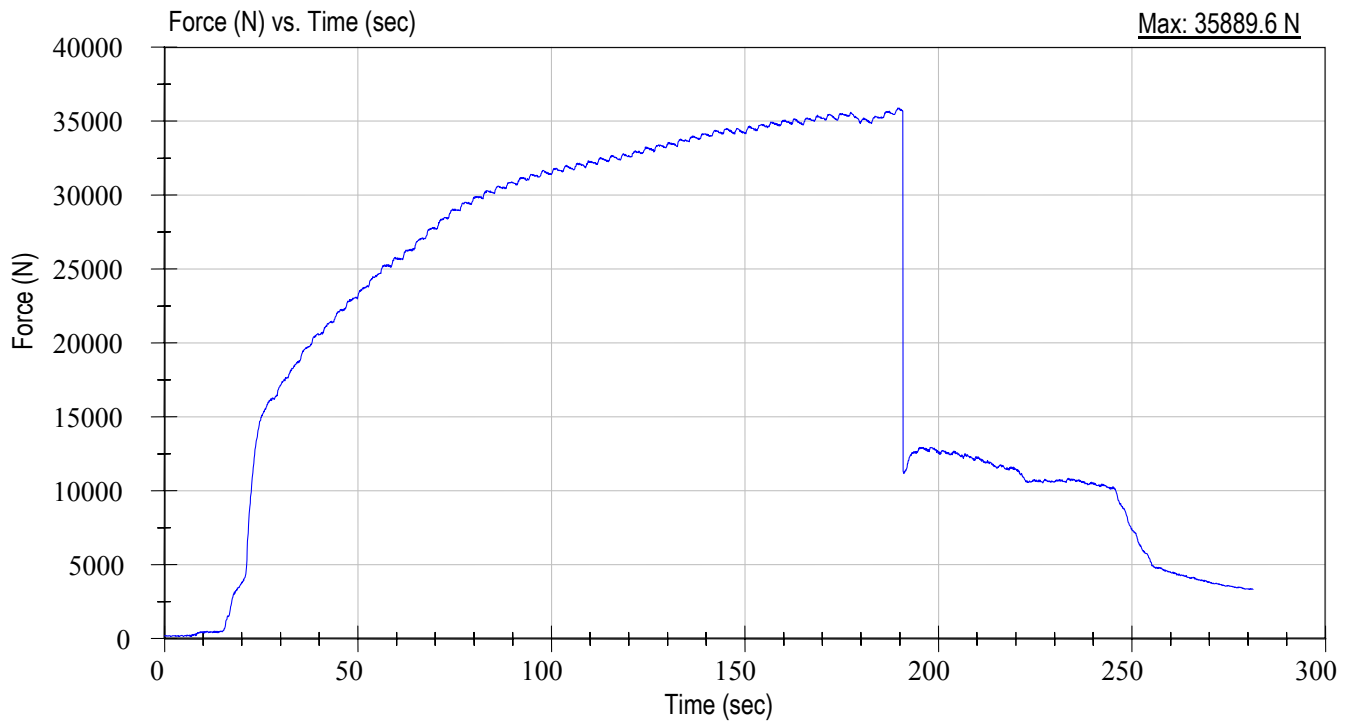
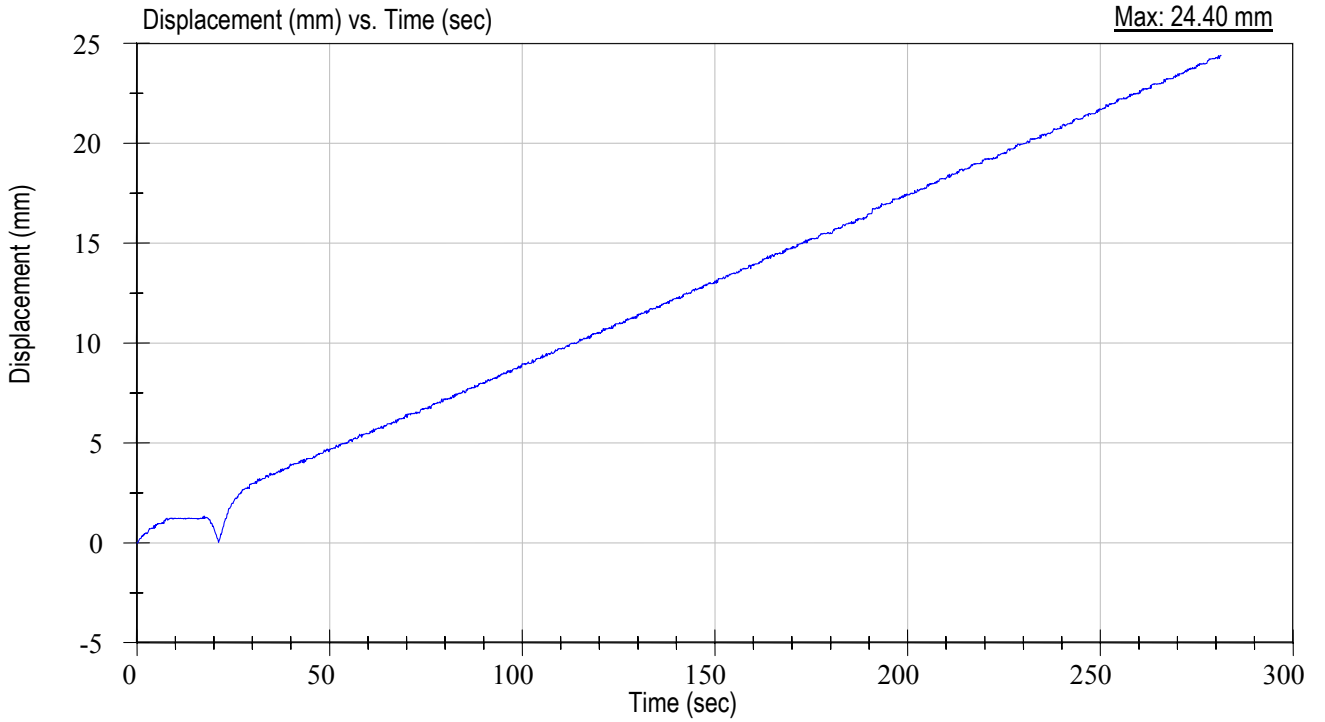
Test Date: 07/25/07
NHTSA No: C60901





Test Desc: FMVSS 221 (Required Load: 10376.5)
Sample: 2 - Roof Rear Interior

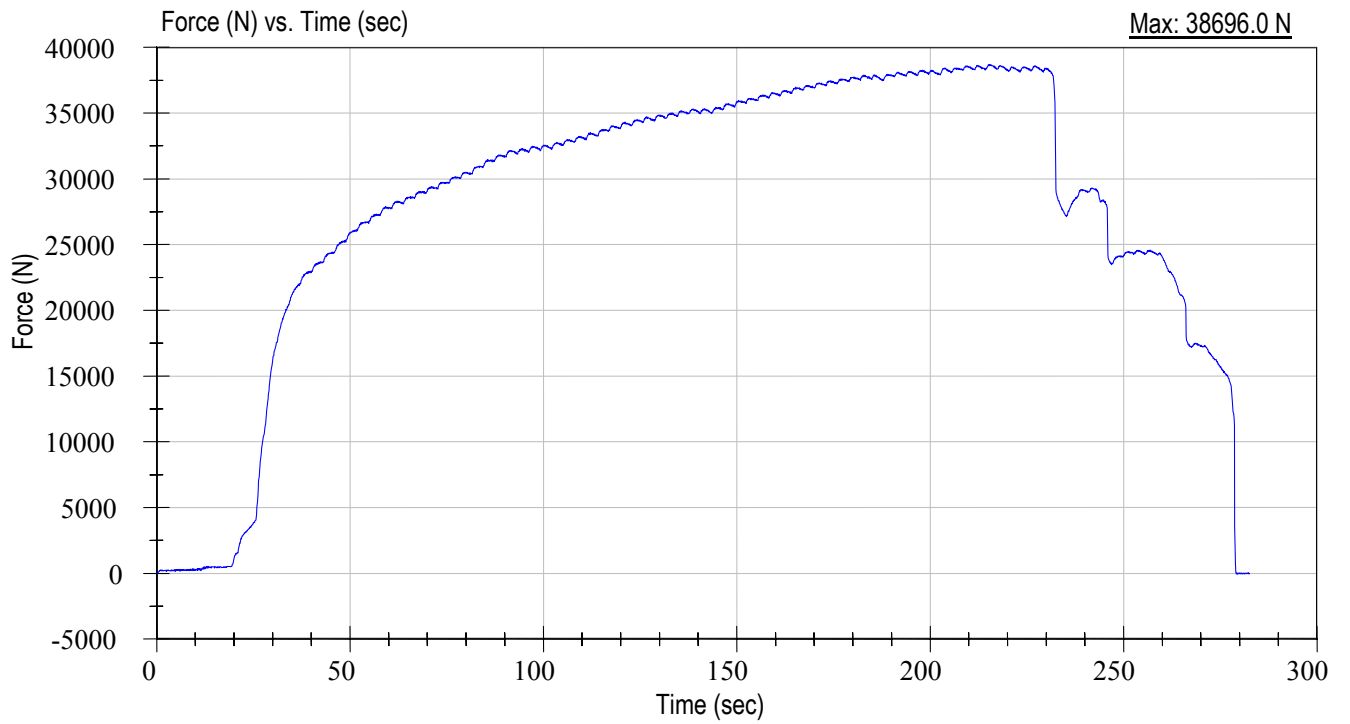
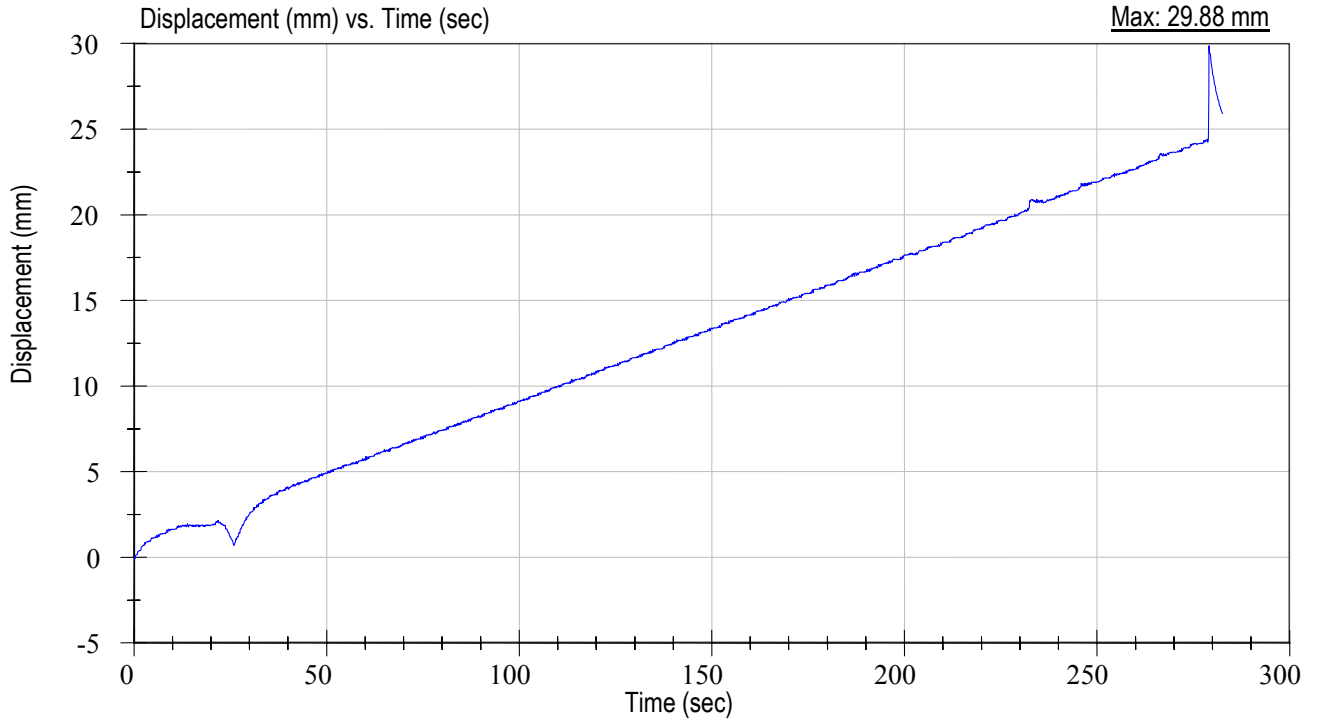
Test Date: 07/25/07
NHTSA No: C60901





Test Desc: FMVSS 221 (Required Load: 10376.5)
Sample: 3 – Left Side Interior

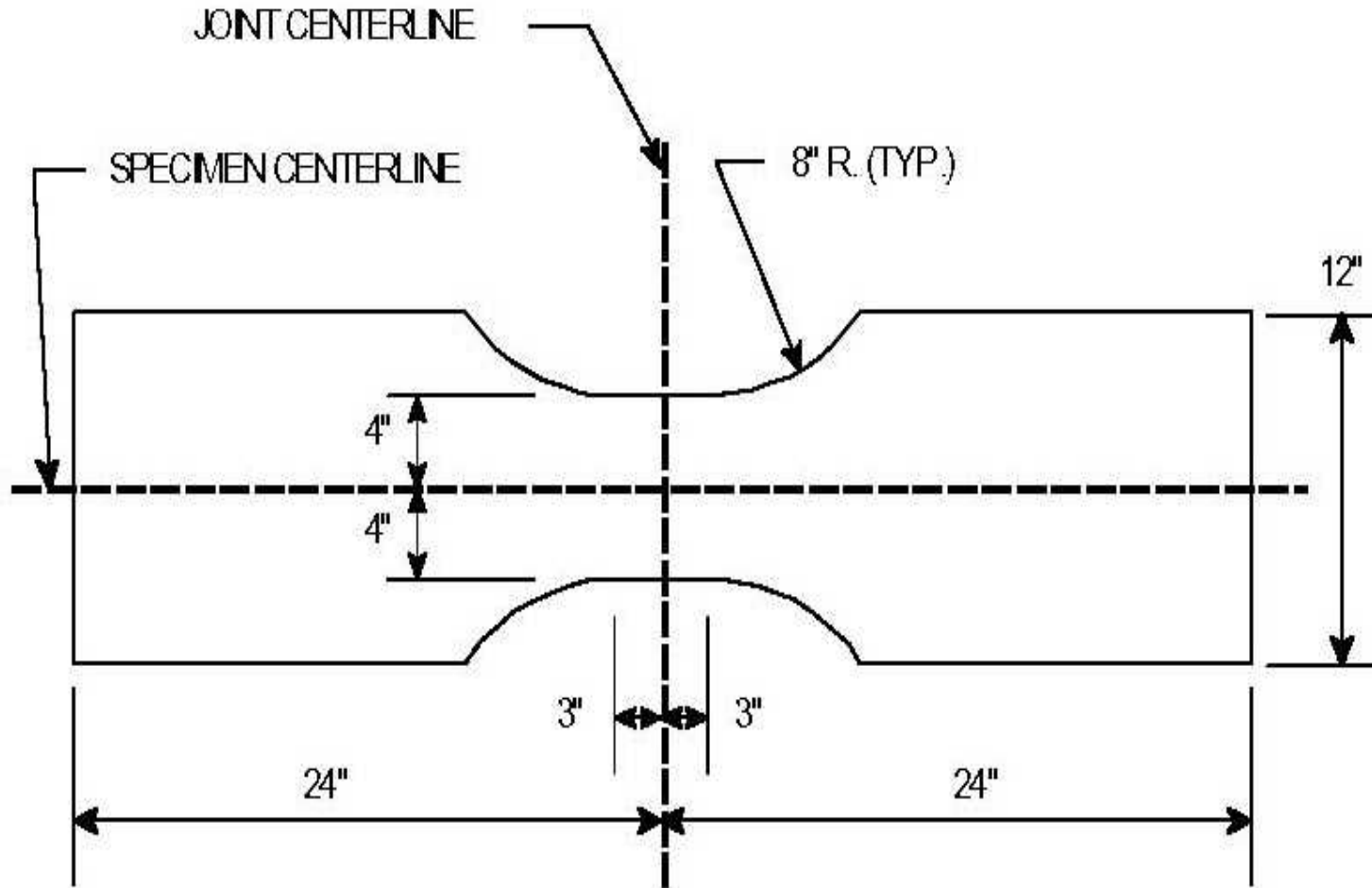
Test Date: 07/25/07
NHTSA No: C60901



SECTION 8
JOINT CONFIGURATIONS
TABLE OF PHOTOGRAPHS

<u>No.</u>		<u>Page No.</u>
1	Typical Test Sample Configuration	36
2	View of Joint #1	37
3	View of Joint #2	38
4	View of Joint #3	39

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



Typical Test Sample Configuration

Test Vehicle: **2006 MID BUS GUIDE DW SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C60901**
Test Date: **07/25/07**



View of Joint #1

Test Vehicle: **2006 MID BUS GUIDE DW SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C60901**
Test Date: **07/25/07**



38

View of Joint #2

Test Vehicle: **2006 MID BUS GUIDE DW SCHOOL BUS**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **C60901**
Test Date: **07/25/07**



View of Joint #3