REPORT NUMBER: 111SB-MGA-2009-001

SAFETY COMPLIANCE TESTING FOR FMVSS NO. 111SB SCHOOL BUS REARVIEW MIRRORS

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

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

TEST DATES: OCTOBER 9, 2008 - OCTOBER 13, 2008

FINAL REPORT DATE: DECEMBER 3, 2008

FINAL REPORT

PREPARED FOR:
U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
ENFORCEMENT
OFFICE OF VEHICLE SAFETY COMPLIANCE
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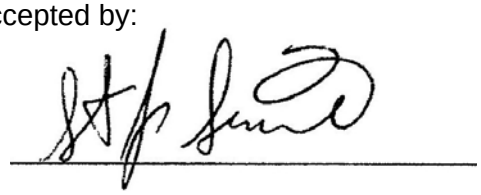
Prepared by:  Date: December 3, 2008

Eric Peschman, Project Engineer

Reviewed by:  Date: December 3, 2008

Michael Janovicz, Program Manager

Final report accepted by:



December 3, 2008

Date of Acceptance

Technical Report Documentation Page

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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-111SB-00 for the determination of FMVSS 111 compliance. Test failures identified were as follows: None			
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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 Procedure TP-111SB-00 to determine compliance to the requirements of Federal Motor Vehicle Safety Standard (FMVSS) 111SB, “School Bus Rearview Mirrors.”

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

SECTION 2
TEST DATA SUMMARY

Based on the tests performed, the 2009 Thomas Minotour School Bus, NHTSA No.: C90901, appears to meet all of the requirements of FMVSS 111SB. See Test Summary Data Sheets on the following pages.

FMVSS 111SB - SCHOOL BUS REARVIEW MIRRORS

TEST SUMMARY DATA SHEET

Test Vehicle: **2009 Thomas Minotour School Bus** NHTSA No.: **C90901**
Test Lab: **MGA Research Corporation** Test Date: **10/9/2008 – 10/13/2008**

System A Mirrors

A. Driver Side Mirror #3 - Unit Magnification

	Pass/Fail	Comments
Mounting	**Pass**	--
Field of View	**Pass**	--
Surface Area	**Pass**	--
Reflectance	**Pass**	--
Unit Magnification	**Pass**	--

B. Passenger Side Mirror #4 - Unit Magnification

	Pass/Fail	Comments
Mounting	**Pass**	--
Field of View	**Pass**	--
Surface Area	**Pass**	--
Reflectance	**Pass**	--
Unit Magnification	**Pass**	--

C. Driver Side Mirror #5 - Convex

	Pass/Fail	Comments
Mounting	**Pass**	--
Field of View	**Pass**	--
Reflectance	**Pass**	--

D. Passenger Side Mirror #6 - Convex

	Pass/Fail	Comments
Mounting	**Pass**	--
Field of View	**Pass**	--
Reflectance	**Pass**	--

FMVSS 111SB - SCHOOL BUS REARVIEW MIRRORS

TEST SUMMARY DATA SHEET…continued

Test Vehicle:	**2009 Thomas Minotour School Bus**	NHTSA No.:	**C90901**
Test Lab:	**MGA Research Corporation**	Test Date:	**10/9/2008 – 10/13/2008**

System B Mirrors

E. Driver Side Front Mirror #1 - Cross View

	Pass/Fail	Comments
Mounting	**Pass**	--
Field of View	**Pass**	--
Overlap with System A	**Pass**	--
Distance to Eye Point	**Pass**	--
No Surface Discontinuities	**Pass**	--
Surface Area	**Pass**	--
If Convex – Radius of Curvature	**Pass**	--
Radius of Curvature Label	**Pass**	--
Arc Separation	**Pass**	--
Reflectance	**Pass**	--

F. Passenger Side Front Mirror #2 - Cross View

	Pass/Fail	Comments
Mounting	**Pass**	--
Field of View	**Pass**	--
Overlap with System A	**Pass**	--
Distance to Eye Point	**Pass**	--
No Surface Discontinuities	**Pass**	--
Surface Area	**Pass**	--
If Convex – Radius of Curvature	**Pass**	--
Radius of Curvature Label	**Pass**	--
Arc Separation	**Pass**	--
Reflectance	**Pass**	--

SECTION 3
COMPLIANCE TEST DATA

FMVSS 111SB - DATA SHEET 1

SCHOOL BUS INSPECTION AND IDENTIFICATION

Test Vehicle: **2009 Thomas Minotour School Bus** NHTSA No.: **C90901**
Test Lab: **MGA Research Corporation** Test Date: **10/9/2008 – 10/13/2008**

GENERAL VEHICLE IDENTIFICATION

Final Stage Manufacturer	Thomas Built Buses	Date of Mfg.	07/2008
Incomplete Vehicle Manufacturer	Chevrolet	Date of Mfg.	06/2008
GVWR (kg)	4356	GAWR Front (kg)	1860
VIN	1GBHG31C181210142	GAWR Rear (kg)	2760

DESCRIPTION OF MIRRORS

Mirror No.	Type			Description	Manufacturer
	Unit Mag	Convex	Cross View		
1		X	X	Driver Side	Rosco Mirror
2		X	X	Passenger Side	
3	X			Driver Side	
4	X			Passenger Side	
5		X		Driver Side	
6		X		Passenger Side	

Recorded By: _____

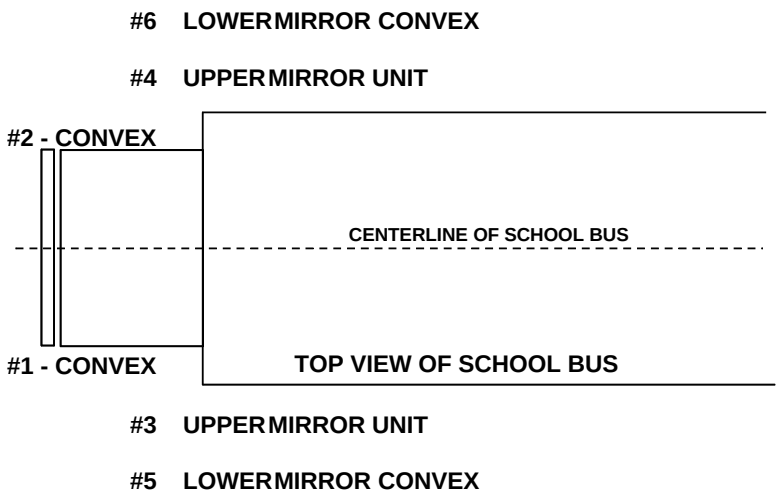
Approved By: _____ Date: October 9, 2008

FMVSS 111SB - DATA SHEET 2

MIRROR LOCATION AND FIELD OF VIEW

Test Vehicle:	**2009 Thomas Minotour School Bus**	NHTSA No.:	**C90901**
Test Lab:	**MGA Research Corporation**	Test Date:	**10/9/2008 – 10/13/2008**

MIRROR DIAGRAM



MIRROR NO.	TYPE	MIRROR SYSTEM	CYLINDERS VIEWED (ENTIRE TOP SURFACE)
1	CROSS VIEW/CONVEX	B	E, C, F, G, H, I, J, L, M
2	CROSS VIEW/CONVEX	B	A, B, D, E, F, G, H, I, K, N, O, P
3	UNIT MAGNIFICATION	A	61 Meter INDICATOR
4	UNIT MAGNIFICATION	A	61 Meter INDICATOR
5	CONVEX	A	L, M 61 Meters INDICATOR
6	CONVEX	A	N, O 61 Meters INDICATOR

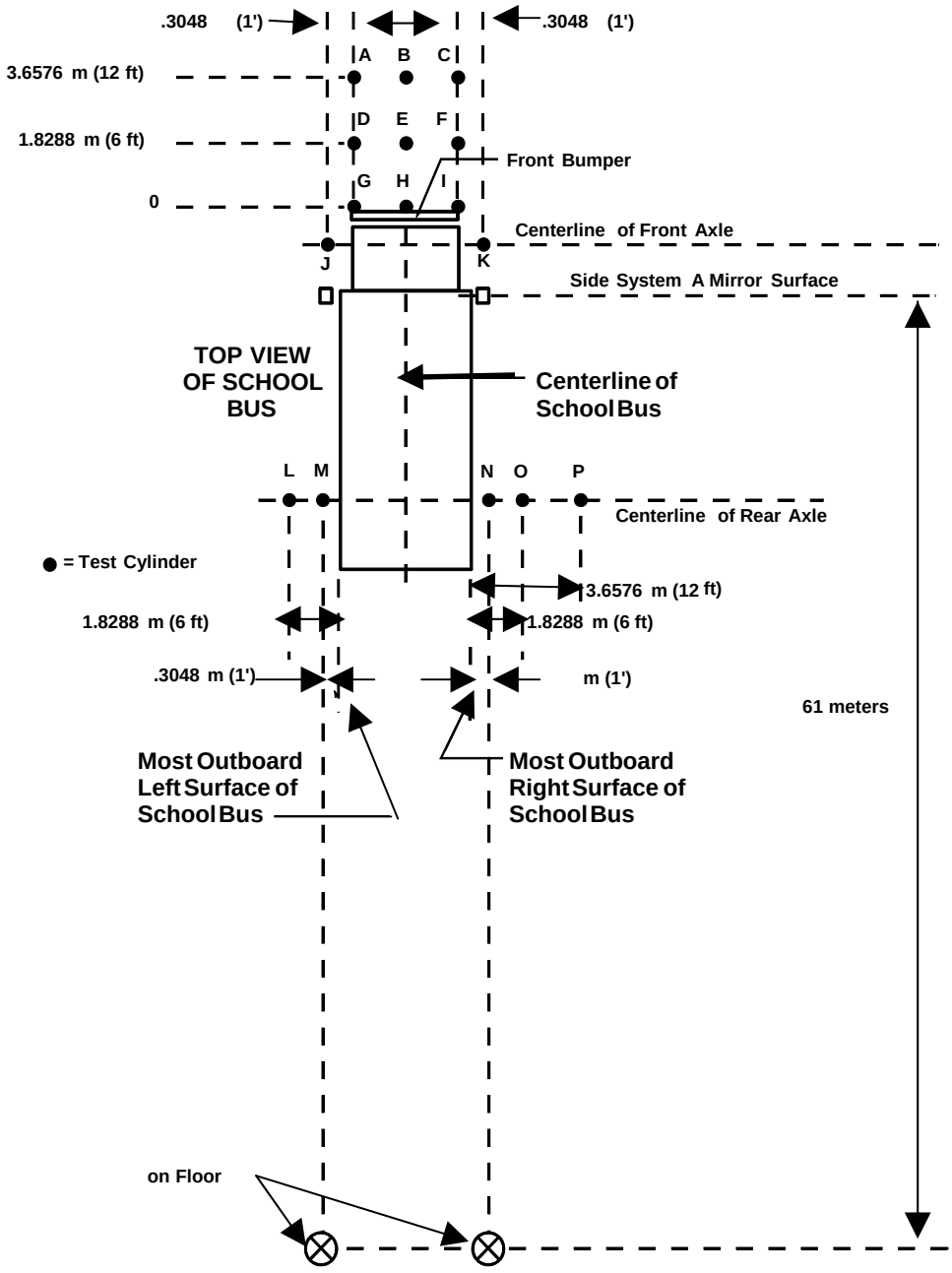
SEE FIGURE ON NEXT PAGE

FMVSS 111SB - DATA SHEET 2…continued

MIRROR LOCATION AND FIELD OF VIEW

Test Vehicle:	**2009 Thomas Minotour School Bus**	NHTSA No.:	**C90901**
Test Lab:	**MGA Research Corporation**	Test Date:	**10/9/2008 – 10/13/2008**

MIRROR LOCATIONS OF TEST CYLINDERS AND INDICATOR



NOTES:

1. The cylinders shall be a color which provides a high contrast with the surface on which the bus is parked (S13.1).
2. The cylinders are 0.3048 m high and 0.3048 m in diameter, except for cylinder P which is 0.9144 m high and 0.3048 m in diameter.

FMVSS 111SB - DATA SHEET 2…continued

MIRROR LOCATION AND FIELD OF VIEW

Test Vehicle:	**2009 Thomas Minotour School Bus**	NHTSA No.:	**C90901**
Test Lab:	**MGA Research Corporation**	Test Date:	**10/9/2008 – 10/13/2008**

SYSTEM A AND DIRECT VISION

System A Mirrors	Pass/Fail
Entire top surface of cylinder N and the indicator 61 meters (200 feet) rearward of the mirror surface can be viewed in the photograph	**Pass**
Entire top surface of cylinder M and indicator 61 meters (200 feet) rearward of the mirror surface can be viewed in the photograph	**Pass**
Which test cylinders A through P can not be photographed directly from the driver's eye location within the semi-circle viewing area using no mirror system:	D, E, F, G, H, I, J, K, L, M, N, O, P

SYSTEM B ARC'S AND DISTANCE

Mirror Number (from data sheet 2)	Mirror Location	Distance from the Driver's Eye Point to the Center of the Mirror (cm)	3 Minutes of Arc (cm)	9 Minutes of Arc (cm)
#1	1	222.9	0.195	--
#2	2	264.1	0.231	0.691

Distance determined in column 3 multiplied by 0.000873 yield 3 minutes of arc, for column 4, for that mirror as viewed from the driver's eye point; the distances determined in column 3 multiplied by 0.002618 yield 9 minutes of arc, for column 5, for that mirror as viewed from the driver's eye point. The minimum distance for any system B mirror between the driver's eye point and the center of the mirror is more than 95 centimeters (37.5 inches):

	Distance	Pass/Fail
Distance between center of System B mirror #1 and driver's eye point	222.9 cm	**Pass**
Distance between center of System B mirror #2 and driver's eye point	264.1 cm	**Pass**

Recorded By: _____

Approved By: Michael Janosz Date: October 9, 2008

FMVSS 111SB - DATA SHEET 3

FIELD OF VIEW TEST – PHOTOGRAPHS System B

Test Vehicle: **2009 Thomas Minotour School Bus** NHTSA No.: **C90901**
Test Lab: **MGA Research Corporation** Test Date: **10/9/2008 – 10/13/2008**

		Pass/Fail
All test cylinders with entire top surface not directly visible from the driver's semi-circle eye location are able to be viewed with System B mirrors from the driver's semi-circle location:		**Pass**
All test cylinders with entire top surface not directly visible from the driver's semi-circle eye location but the image can be viewed with System B mirrors. The image is separated for the edge of the effective mirror surface of the mirror providing that image by a distance of not less than 3 minutes of arc:		**Pass**
If the entire top surface of test cylinder P is not directly visible from the driver's semi-circle eye location, the image can be viewed with System B mirrors from the driver's semi-circle eye location, where the angular size of the shortest dimension of that cylinder's image is not less than 3 minutes of arc, and the angular size of the longest dimension of that cylinder's image is not less than 9 minutes of arc:		**Pass**
Shortest arc length dimension	0.231 cm	
Longest arc length dimension	0.691 cm	
For each of the test cylinders whose entire top surface is not directly visible from the driver's eye location, System B provides a view of the ground that overlaps with the view of the ground provided by System A.		**Pass**

Recorded By: _____

Approved By: _____ Date: October 9, 2008

FMVSS 111SB - DATA SHEET 4

MOUNTING ADEQUACY TEST

Test Vehicle: **2009 Thomas Minotour School Bus** NHTSA No.: **C90901**
Test Lab: **MGA Research Corporation** Test Date: **10/9/2008 – 10/13/2008**

MOUNTING SUPPORT OF ALL MIRRORS

Mirror No. (from data sheet 2)	Type	System	Stable Support Yes/No
1	Cross View/Convex	B	Yes
2	Cross View/Convex	B	Yes
3	Unit Magnification	A	Yes
4	Unit Magnification	A	Yes
5	Convex	A	Yes
6	Convex	A	Yes

	Pass/Fail
Outside mirrors free of sharp points or edges that could contribute to pedestrian injury	**Pass**
System B mirrors have no discontinuities in the slope of the surface of the mirror	**Pass**

Recorded By: _____

Approved By: Michael Janosz

Date: October 9, 2008

FMVSS 111SB - DATA SHEET 5

REFLECTANCE TEST – ALL MIRRORS

Test Vehicle: **2009 Thomas Minotour School Bus** NHTSA No.: **C90901**
Test Lab: **MGA Research Corporation** Test Date: **10/9/2008 – 10/13/2008**

Mirror No.	Type	Light meter reading from calibration (FC)	Light meter reading from light reflected by mirror (FC)	Pass/Fail	Observations
1	Crossview/Convex	57	76	**Pass**	None
2	Crossview/Convex	58	76	**Pass**	None
3	Unit Magnification	44	76	**Pass**	None
4	Unit Magnification	43	76	**Pass**	None
5	Convex	46	76	**Pass**	None
6	Convex	46	76	**Pass**	None

Note: Reflectance % = [Reflectance Reading / Calibration reading] x 100
Minimum Requirement = 35 percent

Mirror No.	Type	Reflectance	Requirement
1	Crossview/Convex	75.1%	>35%
2	Crossview/Convex	76.0%	>35%
3	Unit Magnification	57.8%	>35%
4	Unit Magnification	57.0%	>35%
5	Convex	60.5%	>35%
6	Convex	60.5%	>35%

Recorded By: 

Approved By: 

Date: October 10, 2008

FMVSS 111SB - DATA SHEET 6

UNIT MAGNIFICATION/CONVEX MIRROR TEST – ALL MIRRORS

Test Vehicle:	**2009 Thomas Minotour School Bus**	NHTSA No.:	**C90901**
Test Lab:	**MGA Research Corporation**	Test Date:	**10/9/2008 – 10/13/2008**

CONVERSION DATA TABLE FROM SPHEROMETER DIAL READING TO RADIUS OF CURVATURE

MIRROR NO. 1 (CONVEX)

Test Position	Dial Reading (inches)	Radius of Curvature (mm)	Deviation between the Average Radius of Curvature and the Test Position Radius of Curvature (mm)	Percent Deviation from the Average Radius of Curvature
1	0.05255	136.6	47.5	25.8%
2	0.03600	198.9	-14.8	-8.0%
3	0.02460	290.7	-106.6	-57.9%
4	0.05000	143.5	40.6	22.1%
5	0.05025	142.8	41.3	22.4%
6	0.03555	201.4	-17.3	-9.4%
7	0.04980	144.1	40.0	21.7%
8	0.02810	254.6	-70.5	-38.3%
9	0.05335	134.6	49.5	26.9%
10	0.03690	194.1	-9.9	-5.4%
Avg. Radius of Curvature – The summation of column 3 divided by 10: 184.1 mm			Greatest Percent Deviation from the Average Radius of Curvature, Column 5: -57.9	

MIRROR NO. 2 (CONVEX)

Test Position	Dial Reading (inches)	Radius of Curvature (mm)	Deviation between the Average Radius of Curvature and the Test Position Radius of Curvature (mm)	Percent Deviation from the Average Radius of Curvature
1	0.05265	136.4	48.9	26.4%
2	0.03580	200.0	-14.7	-7.9%
3	0.02365	302.4	-117.1	-63.2%
4	0.05000	143.5	41.8	22.5%
5	0.05075	141.4	43.9	23.7%
6	0.03565	200.8	-15.6	-8.4%
7	0.05090	141.0	44.3	23.9%
8	0.02840	251.9	-66.6	-36.0%
9	0.05325	134.8	50.4	27.2%
10	0.03570	200.6	-15.3	-8.2%
Avg. Radius of Curvature – The summation of column 3 divided by 10: 185.3 mm			Greatest Percent Deviation from the Average Radius of Curvature, Column 5: -63.2%	

FMVSS 111SB - DATA SHEET 6…continued

UNIT MAGNIFICATION/CONVEX MIRROR TEST – ALL MIRRORS

Test Vehicle:	**2009 Thomas Minotour School Bus**	NHTSA No.:	**C90901**
Test Lab:	**MGA Research Corporation**	Test Date:	**10/9/2008 – 10/13/2008**

CONVERSION DATA TABLE FROM SPHEROMETER DIAL READING TO RADIUS OF CURVATURE

MIRROR NO. 3 (UNIT MAGNIFICATION)

Test Position	Dial Reading (inches)	Radius of Curvature (mm)	Deviation between the Average Radius of Curvature and the Test Position Radius of Curvature (mm)	Percent Deviation from the Average Radius of Curvature
1	0.00000	NA	NA	NA
2	0.00000	NA	NA	NA
3	0.00000	NA	NA	NA
4	0.00000	NA	NA	NA
5	0.00000	NA	NA	NA
6	0.00000	NA	NA	NA
7	0.00000	NA	NA	NA
8	0.00000	NA	NA	NA
9	0.00000	NA	NA	NA
10	0.00000	NA	NA	NA
Avg. Radius of Curvature – the Summation of Column 3 divided by 10: N/A			Greatest Percent Deviation from the Average Radius of Curvature, Column 5: N/A	

MIRROR NO. 4 (UNIT MAGNIFICATION)

Test Position	Dial Reading (inches)	Radius of Curvature (mm)	Deviation between the Average Radius of Curvature and the Test Position Radius of Curvature (mm)	Percent Deviation from the Average Radius of Curvature
1	0.00000	N/A	N/A	N/A
2	0.00000	N/A	N/A	N/A
3	0.00000	N/A	N/A	N/A
4	0.00000	N/A	N/A	N/A
5	0.00000	N/A	N/A	N/A
6	0.00000	N/A	N/A	N/A
7	0.00000	N/A	N/A	N/A
8	0.00000	N/A	N/A	N/A
9	0.00000	N/A	N/A	N/A
10	0.00000	N/A	N/A	N/A
Avg. Radius of Curvature – the Summation of Column 3 divided by 10: N/A			Greatest Percent Deviation from the Average Radius of Curvature, Column 5: N/A	

FMVSS 111SB - DATA SHEET 6…continued

UNIT MAGNIFICATION/CONVEX MIRROR TEST – ALL MIRRORS

Test Vehicle:	**2009 Thomas Minotour School Bus**	NHTSA No.:	**C90901**
Test Lab:	**MGA Research Corporation**	Test Date:	**10/9/2008 – 10/13/2008**

CONVERSION DATA TABLE FROM SPHEROMETER DIAL READING TO RADIUS OF CURVATURE

MIRROR NO. 5 (CONVEX)

Test Position	Dial Reading (inches)	Radius of Curvature (mm)	Deviation between the Average Radius of Curvature and the Test Position Radius of Curvature (mm)	Percent Deviation from the Average Radius of Curvature
1	0.01485	481.2	-6.8	-1.4%
2	0.01510	473.3	1.2	0.2%
3	0.01360	525.4	-51.0	-10.8%
4	0.01635	437.1	37.3	7.9%
5	0.01520	470.2	4.3	0.9%
6	0.01515	471.7	2.7	0.6%
7	0.01505	474.9	-0.4	-0.1%
8	0.01515	471.7	2.7	0.6%
9	0.01530	467.1	7.3	1.5%
10	0.01515	471.7	2.7	0.6%
Avg. Radius of Curvature – the Summation of Column 3 divided by 10: 474.4 mm			Greatest Percent Deviation from the Average Radius of Curvature, Column 5: -10.8%	

MIRROR NO. 6 (CONVEX)

Test Position	Dial Reading (inches)	Radius of Curvature (mm)	Deviation between the Average Radius of Curvature and the Test Position Radius of Curvature (mm)	Percent Deviation from the Average Radius of Curvature
1	0.01445	494.6	-15.2	-3.2%
2	0.01525	468.6	10.8	2.2%
3	0.01525	468.6	10.8	2.2%
4	0.01565	456.7	22.7	4.7%
5	0.01450	492.9	-13.5	-2.8%
6	0.01530	467.1	12.3	2.6%
7	0.01435	498.0	-18.6	-3.9%
8	0.01475	484.5	-5.1	-1.1%
9	0.01450	492.9	-13.5	-2.8%
10	0.01520	470.2	9.2	1.9%
Avg. Radius of Curvature – the Summation of Column 3 divided by 10: 479.4 mm			Greatest Percent Deviation from the Average Radius of Curvature, Column 5: 4.7%	

FMVSS 111SB - DATA SHEET 6…continued

UNIT MAGNIFICATION/CONVEX MIRROR TEST – ALL MIRRORS

Test Vehicle: **2009 Thomas Minotour School Bus** NHTSA No.: **C90901**
Test Lab: **MGA Research Corporation** Test Date: **10/9/2008 – 10/13/2008**

UNIT MAGNIFICATION IN SYSTEM A

	Pass/Fail
At least one System A Mirror on the left and right sides of the bus is unit magnification - (0 Radius of Curvature)	**Pass**

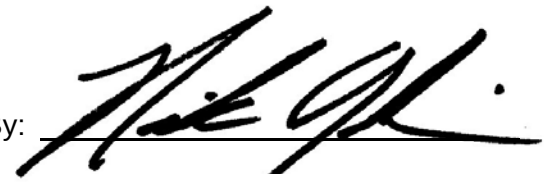
AVERAGE RADIUS OF CURVATURE OF CONVEX MIRRORS USED IN SYSTEM B

Mirror No.	Radius of Curvature	If needed, wording printed properly* Pass/Fail
1	188 mm	**Pass**
2	185 mm	**Pass**

* If any of the Convex Mirrors in System B have an average radius of curvature less than 889 mm, then the following words must be printed on a label in type face and color that are clear and conspicuous to the driver:

> "USE CROSS VIEW MIRRORS TO VIEW PEDESTRIANS WHILE BUS IS STOPPED. DO NOT USE THESE MIRRORS TO VIEW TRAFFIC WHILE BUS IS MOVING, IMAGES IN SUCH MIRRORS DO NOT ACCURATELY SHOW ANOTHER VEHICLE'S LOCATION."

Note: The required label is visible but not legible from the driver seated position due to its location near the passenger exit as shown in attached photographs. The manufacturer has indicated to the NHTSA compliance engineer that a running production change will be made to position the label in closer proximity to the driver.

Recorded By: 

Approved By:  Date: October 13, 2008

FMVSS 111SB - DATA SHEET 7

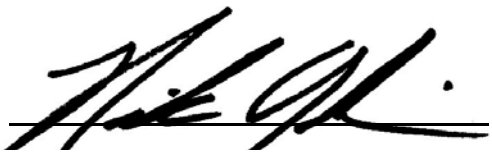
MIRROR REFLECTIVE SURFACE AREA TEST

SYSTEM A & B

Test Vehicle: **2009 Thomas Minotour School Bus** NHTSA No.: **C90901**
Test Lab: **MGA Research Corporation** Test Date: **10/9/2008 – 10/13/2008**

DATA TABLE FOR SURFACE AREA

System A Mirrors Mirror No.	Area	Requirement Min. 323 cm²	Pass/Fail
3	381.9 cm^2	323 cm^2	**Pass**
4	385.2 cm^2	323 cm^2	**Pass**
System B Mirrors Mirror No.	Area	Requirement Min. 258 cm²	Pass/Fail
1	578.5 cm^2	258 cm^2	**Pass**
2	574.0 cm^2	258 cm^2	**Pass**

Recorded By: 

Approved By:  Date: October 13, 2008

SECTION 4

INSTRUMENTATION AND EQUIPMENT LIST

Test Vehicle: **2009 Thomas Minotour School Bus** NHTSA No.: **C90901**
Test Lab: **MGA Research Corporation** Test Date: **10/9/2008 – 10/13/2008**

	Digital Caliper	Light Meter	Tape Measure	Spherometer
Make	Starrett	AEMC	Stanley	MGA
Model	F2730-0	CA813	Powerlock 3M	001
Serial # (s)	021484579	04L1017Y	33-231	001
Range	0-50.8 mm	2000fc, 2000lux	0 to 8 m	2.25×10^{13} $(cm * Hz^{1/2}) \div W$
Accuracy	.001 mm	0.0 fc or 0.01 lux	1 mm	1.1×10^{-13} $W/H^{1/2}$
Cal. Date	09/02/08	04/30/08	08/19/08	Daily when used
Cal. Due Date	09/08/09	04/30/09	02/19/09	N/A

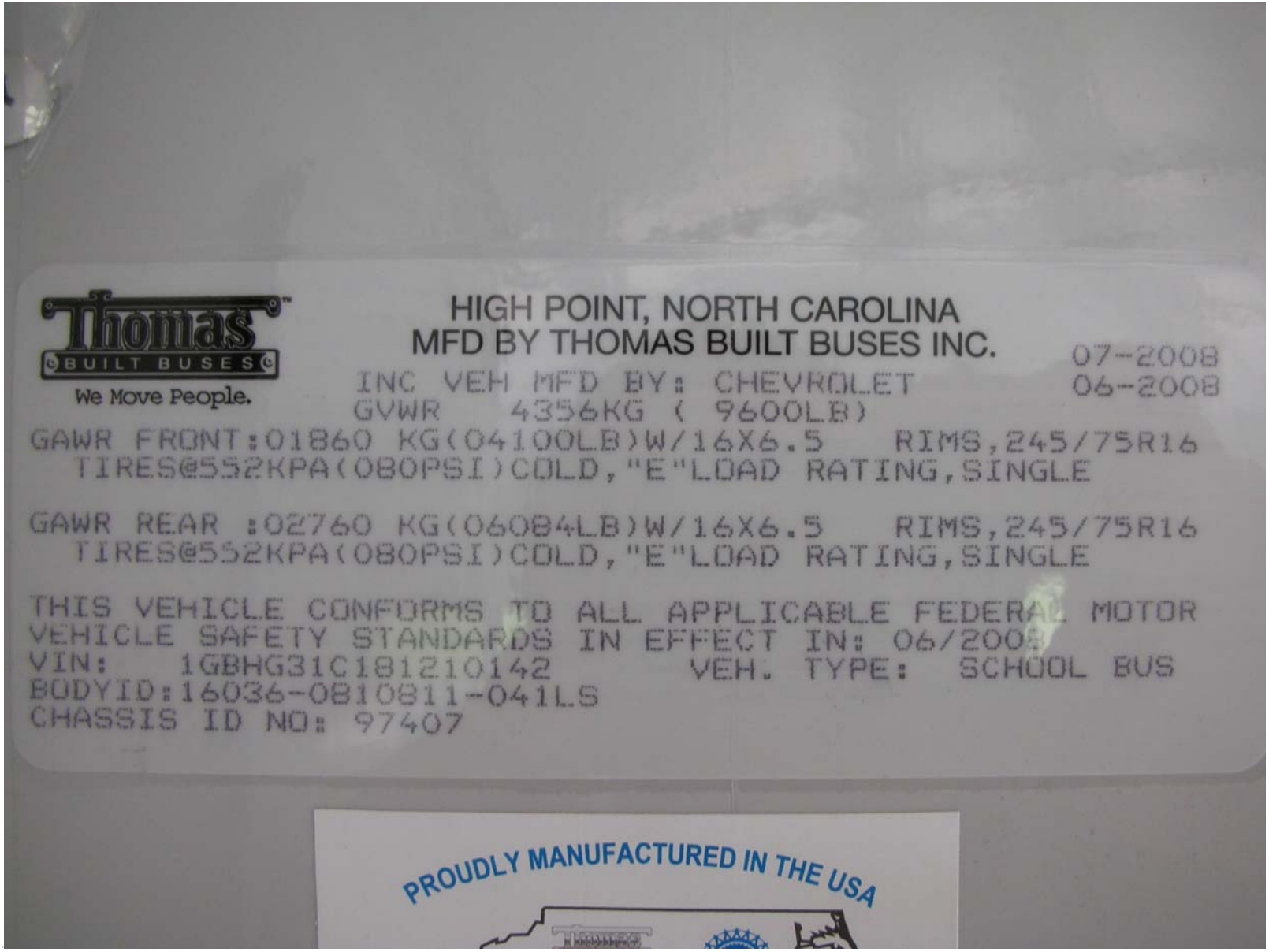
SECTION 5
PHOTOGRAPHS

TABLE OF PHOTOGRAPHS

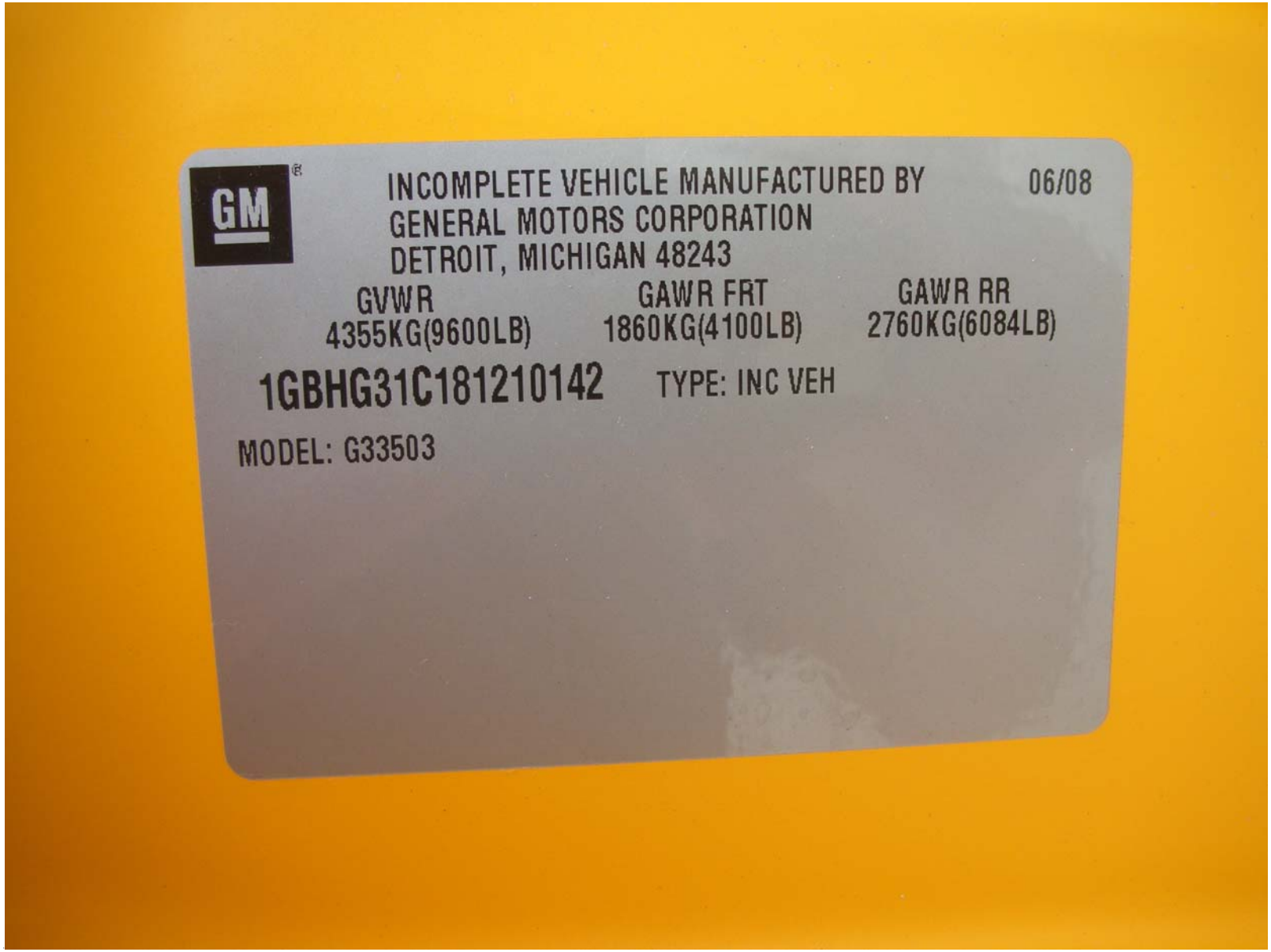
Test Vehicle:	**2009 THOMAS MINOTOUR SCHOOL BUS**	NHTSA No.:	**C90901**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Dates:	**10/9/08 – 10/13/08**

Three-Quarter Left Front View of School Bus

Three-Quarter Left Rear View of School Bus



Vehicle Certification Label



Vehicle Information Label

Vehicle Tire Placard

Right Front Cross View Mirror and Mounting

Passenger Side Rearview Mirror and Mounting

Inside Rearview Mirror and Mounting

Left Front Cross View Mirror and Mounting

Driver Side Rearview Mirror and Mounting

Field of View Instrument Setup

Mirror #2 System B Field of View

Mirror #1 System B Field of View

Mirror #3 and #5 System A Field of View

Mirror #4 and #6 System A Field of View

View of Cylinder Setup from Front

Three-Quarter Left Front View of Cylinder Setup

Three-Quarter Right Front View of Cylinder Setup

Front View Looking Thru the Windshield View of Cylinder Setup

Reflectance Test Set-up

Label for Cross View Mirror Warning

Cross View Mirror With Reference to Seated Driver

Cross View Mirror Label Location