REPORT NUMBER: 111SB-MGA-2007-005

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

Thomas Built Buses Inc. 2007 Thomas Saf-T-Liner C2 School Bus NHTSA No. C70900

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Final Report Date: February 28, 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
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WASHINGTON, D.C. 20590

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February 28, 2007

Date of Acceptance

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1. Report No. 111SB-MGA-2007-005	2. Government Accession No.	3. Recipient's Ca	talog No.		
4. Title and Subtitle Final Report of FMVSS 111 2007 Thomas Saf-T-Liner C	5. Report Date February 28, 2	007			
NHTSA No.:C70900		6. Performing Org	ganization Code		
7. Author(s)		8. Performing Or	ganization Report		
Jeff Koehler, Project Engine	eer	No.	,		
Michael Janovicz, Project N	<i>l</i> lanager	111SB-MGA-2	007-005		
9. Performing Organization I		10. Work Unit No).		
MGA Research Corporation	l.				
5000 Warren Road					
Burlington, WI 53105		11. Contract or G DTNH22-02-D			
12. Sponsoring Agency Nam	ne and Address	13. Type of Repo	ort and Period		
		Covered			
U.S. Department of Transpo		Final Report			
National Highway Traffic Sat	ety Administration	12/15/06 to 02/	28/07		
Enforcement					
Office of Vehicle Safety Com	ipiiance	14. Sponsoring A NVS-220	igency Code		
Mail Code: (NVS-220) 400 Seventh Street, S.W. Ro	20m 6115	NVS-220			
Washington, D.C. 20590	JOIII 61 15				
15. Supplementary Notes					
NHTSA No. C70900 in acco	ucted on the subject 2007 The rdance with the specifications No. TP-111SB-00 for the dete	of the Office of Vel	hicle Safety		
Test failures were as follows	: NONE				
17. Key Words		18. Distribution S	tatement		
17. Ney Words		Copies of this rep			
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		400 Seventh Stre	et, S.W.		
	Washington, D.C	•			
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Unclassified Form DOT F1700.7 (8-72)

TABLE OF CONTENTS

<u>Section</u>		Page No
1	Purpose of Compliance Test	1
2	Test Data Summary	2
3	Compliance Test Data	5
	Data Sheet 1 - School Bus Inspection and Identification	6
	Data Sheet 2 - Mirror Location and Field of View	7
	Data Sheet 3 - Field of View Test	10
	Data Sheet 4 - Mounting Adequacy Test	11
	Data Sheet 5 - Reflectance Test	12
	Data Sheet 6 - Unit Magnification/Convex Mirror Test	13
	Data Sheet 7 - Mirror Reflective Surface Area Test	17
4	Instrumentation and Equipment List	18
5	Photographs	19

SECTION 1 PURPOSE OF COMPLIANCE TEST

Tests were conducted on a 2007 Thomas Saf-T-Liner C2 School Bus, NHTSA No. C70900, 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) 111, "School Bus Rearview Mirrors."

This program is sponsored by the National Highway Traffic Safety Administration (NHTSA), under Contract No. DTNH22-02-D-01057.

SECTION 2 TEST DATA SUMMARY

Based on the tests performed, the 2007 Thomas Saf-T-Liner C2 School Bus, NHTSA No. C70900, appears to meet all of the requirements of FMVSS 111. See Test Summary Data Sheets on the following pages.

FMVSS 111SB, SCHOOL BUS REARVIEW MIRRORS <u>TEST SUMMARY DATA SHEET</u>

Test Vehicle: 2007 Thomas Saf-T-Liner C2 School Bus NHTSA No.: C70900 Test Lab: MGA Research-Wisconsin Operations Test Date: 12/15/06

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	1
Surface Area	PASS	1
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 <u>TEST SUMMARY DATA SHEET...continued</u>

Test Vehicle: 2007 Thomas Saf-T-Liner C2 School Bus NHTSA No.: C70900 Test Lab: MGA Research-Wisconsin Operations Test Date: 12/15/06

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: 2007 Thomas Saf-T-Liner C2 School Bus NHTSA No.: C70900 Test Lab: MGA Research-Wisconsin Operations Test Date: 12/15/06

GENERAL VEHICLE IDENTIFICATION

Final Stage	Thomas Built	Date of Mfg.	07/2006
Manufacturer	Buses, Inc.		01.12000
Incomplete Vehicle	Freightliner	Date of Mfg.	07/2006
Manufacturer	rreignantei		
GVWR (kg)	11569	GAWR Front (kg)	3630
		GAWR Rear (kg)	7940

DESCRIPTION OF MIRRORS

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

Recorded By:

Approved By:

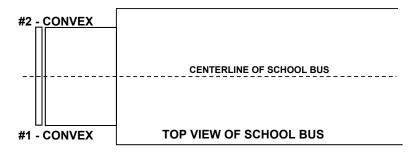
FMVSS 111SB – DATA SHEET 2 MIRROR LOCATION AND FIELD OF VIEW

Test Vehicle: 2007 Thomas Saf-T-Liner C2 School Bus NHTSA No.: C70900 Test Lab: MGA Research-Wisconsin Operations Test Date: 12/15/06

MIRROR DIAGRAM

#6 LOWERMIRROR CONVEX

#4 UPPERMIRROR UNIT



#3 UPPERMIRROR UNIT

#5 LOWERMIRROR CONVEX

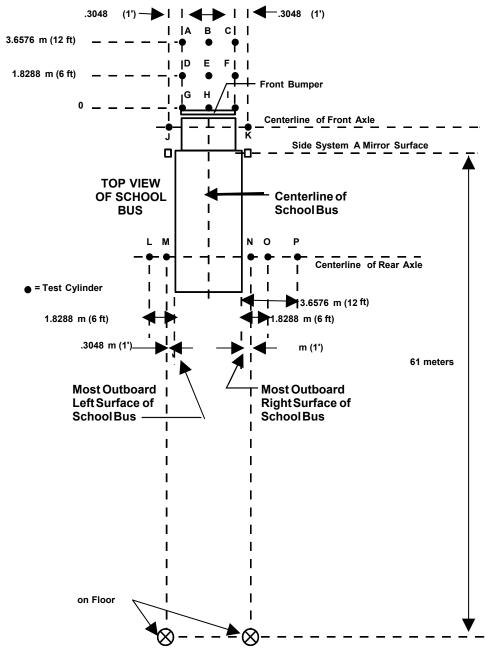
MIRROR NO.	TYPE	MIRROR SYSTEM	CYLINDERS VIEWED (entire top surface)
1	CROSS VIEW/CONVEX	В	B,C,E,F,H,I,J,L,M
2	CROSS VIEW/CONVEX	В	A,B,D,E,F,G,H,K,N,O,P
3	UNIT MAGNIFICATION	Α	61 Meter INDICATOR
4	UNIT MAGNIFICATION	Α	61 Meter INDICATOR
5	CONVEX	Α	L,M, 61 Meter INDICATOR
6	CONVEX	А	N,O, 61 Meter INDICATOR

SEE FIGURE ON NEXT PAGE

FMVSS 111SB – DATA SHEET 2...continued MIRROR LOCATION AND FIELD OF VIEW

Test Vehicle: 2007 Thomas Saf-T-Liner C2 School Bus NHTSA No.: C70900 Test Lab: MGA Research-Wisconsin Operations Test Date: 12/15/06

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: 2007 Thomas Saf-T-Liner C2 School Bus NHTSA No.: C70900 Test Lab: MGA Research-Wisconsin Operations Test Date: 12/15/06

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	Left Front	233	0.203	
#2	Right Front	278	0.242	0.727

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	233 cm	PASS
Distance between center of System B mirror #2 and driver's eye point	278 cm	PASS

Recorded By:

Approved By:

FMVSS 111SB DATA SHEET 3 FIELD OF VIEW TEST – PHOTOGRAPHS System B

Test Vehicle: 2007 Thomas Saf-T-Liner C2 School Bus NHTSA No.: C70900 Test Lab: MGA Research-Wisconsin Operations Test Date: 12/15/06

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

Recorded By:

Approved By:

FMVSS 111SB DATA SHEET 4 MOUNTING ADEQUACY TEST

Test Vehicle: 2007 Thomas Saf-T-Liner C2 School Bus NHTSA No.: C70900 Test Lab: MGA Research-Wisconsin Operations Test Date: 12/15/06

MOUNTING SUPPORT OF ALL MIRRORS

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

FMVSS 111SB DATA SHEET 5 REFLECTANCE TEST – ALL MIRRORS

Test Vehicle: 2007 Thomas Saf-T-Liner C2 School Bus NHTSA No.: C70900 Test Lab: MGA Research-Wisconsin Operations Test Date: 12/15/06

Mirror No.	Туре	Light meter reading from calibration (FC)	Light meter reading from light reflected by mirror (FC)	Pass/Fail	Observations
1	Crossview/Convex	101.3	62.7	PASS	
2	Crossview/Convex	97	59.7	PASS	
3	Unit	98	53.7	PASS	
4	Unit	99	56	PASS	
5	Convex	95.7	53.7	PASS	
6	Convex	99.3	54.3	PASS	

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

Mirror No.	Туре	Reflectance	Requirement
1	Crossview/Convex	62%	>35%
2	Crossview/Convex	62%	>35%
3	Unit	55%	>35%
4	Unit	57%	>35%
5	Convex	56%	>35%
6	Convex	55%	>35%

Recorded By:

Approved By:

FMVSS 111SB DATA SHEET 6 UNIT MAGNIFICATION/CONVEX MIRROR TEST – ALL MIRRORS

Test Vehicle: 2007 Thomas Saf-T-Liner C2 School Bus NHTSA No.: C70900 Test Lab: MGA Research-Wisconsin Operations Test Date: 12/15/06

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	0.04325	165.7	27.1	14.1%
2	0.03360	213.0	-20.2	-10.5%
3	0.02990	239.3	-46.4	-24.1%
4	0.04360	164.4	28.5	14.8%
5	0.04335	165.3	27.5	14.3%
6	0.03450	207.5	-14.6	-7.6%
7	0.04200	170.6	22.2	11.5%
8	0.03080	232.3	-39.5	-20.5%
9	0.04475	160.2	32.7	16.9%
10	0.03405	210.2	-17.4	-9.0%
Avg. Radius of Curvature – the Summation of Column 3 divided by 10: 192.9 mm		Greatest Percent Deviation from the Average Radius of Curvature, Column 5: 24.1%		

MIRROR NO. 2 (CONVEX)

MINITAGE NO	. <u>Z (CONVLX)</u>	i e		
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	0.04350	164.8	31.0	15.8%
2	0.03365	212.7	-16.9	-8.6%
3	0.02920	245.0	-49.2	-25.1%
4	0.04165	172.0	23.7	12.1%
5	0.04410	162.5	33.2	17.0%
6	0.03435	208.4	-12.6	-6.4%
7	0.04185	171.2	24.6	12.5%
8	0.02880	248.4	-52.6	-26.9%
9	0.04480	160.0	35.8	18.3%
10	0.03365	212.7	-16.9	-8.6%
Avg. Radius of Curvature – the Summation of Column 3 divided by 10: 195.8 mm		Greatest Percent Deviation from Curvature, Colum 26.9%		

FMVSS 111SB DATA SHEET 6...continued UNIT MAGNIFICATION/CONVEX MIRROR TEST – ALL MIRRORS

Test Vehicle: 2007 Thomas Saf-T-Liner C2 School Bus NHTSA No.: C70900 Test Lab: MGA Research-Wisconsin Operations Test Date: 12/15/06

CONVERSION DATA TABLE FROM SPHEROMETER DIAL READING TO RADIUS OF CURVATURE

MIRROR NO. 3 (UNIT MAGNIFICATION)

WIRKUR NO.	<u>3 (UNIT MAC</u>	<u> MIFICATION</u>		
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 fro Radius of Curvature, Co N/A	•	

MIRROR NO. 4 (UNIT MAGNIFICATION)

MINISTON NO.	1 (01111 1117 11			
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 fro Radius of Curvature, Co N/A	•	

FMVSS 111SB DATA SHEET 6...continued UNIT MAGNIFICATION/CONVEX MIRROR TEST – ALL MIRRORS

Test Vehicle: 2007 Thomas Saf-T-Liner C2 School Bus NHTSA No.: C70900 Test Lab: MGA Research-Wisconsin Operations Test Date: 12/15/06

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	0.01225	583.3	-17.4	-3.1%
2	0.01275	560.5	5.5	1.0%
3	0.01230	580.9	-15.0	-2.6%
4	0.01335	535.3	30.7	5.4%
5	0.01290	553.9	12.0	2.1%
6	0.01245	574.0	-8.0	-1.4%
7	0.01290	553.9	12.0	2.1%
8	0.01225	583.3	-17.4	-3.1%
9	0.01275	560.5	5.5	1.0%
10	0.01245	574.0	-8.0	-1.4%
Avg. Radius of Curvature – the Summation of Column 3 divided by 10: 566 mm		Greatest Percent Deviation from the Average Radius of Curvature, Column 5: 5.4%		

MIRROR NO. 6 (CONVEX)

MINITAL TO	C (CCITTER)			
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	0.01280	558.3	-5.6	-1.0%
2	0.01285	556.1	-3.4	-0.6%
3	0.01255	569.4	-16.7	-3.0%
4	0.01400	510.4	42.2	7.6%
5	0.01240	576.3	-23.6	-4.3%
6	0.01260	567.1	-14.4	-2.6%
7	0.01445	494.6	58.1	10.5%
8	0.01270	562.7	-10.0	-1.8%
9	0.01255	569.4	-16.7	-3.0%
10	0.01270	562.7	-10.0	-1.8%
Avg. Radius of Curvature – the Summation of Column 3 divided by 10: 552.7 mm Greatest Percent Deviation from the Average of Curvature, Column 5: 10.5%		•		

FMVSS 111SB DATA SHEET 6...continued UNIT MAGNIFICATION/CONVEX MIRROR TEST – ALL MIRRORS

Test Vehicle: 2007 Thomas Saf-T-Liner C2 School Bus NHTSA No.: C70900 Test Lab: MGA Research-Wisconsin Operations Test Date: 12/15/06

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	192.9 mm	PASS
2	195.8 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."

Recorded By:

Annroved By:

FMVSS 111SB DATA SHEET 7 MIRROR REFLECTIVE SURFACE AREA TEST SYSTEM A & B

Test Vehicle: 2007 Thomas Saf-T-Liner C2 School Bus NHTSA No.: C70900 Test Lab: MGA Research-Wisconsin Operations Test Date: 12/15/06

DATA TABLE FOR SURFACE AREA

System A Mirrors Mirror No.	Area	Requirement Min. 323 cm ²	Pass/Fail
3	484 cm ²	323 cm ²	PASS
4	489 cm ²	323 cm ²	PASS
System B Mirrors Mirror No.	Area	Requirement Min. 258 cm ²	Pass/Fail
1	618 cm ²	258 cm ²	PASS
2	623 cm ²	258 cm ²	PASS

Recorded By:

Approved By:

SECTION 4 INSTRUMENTATION AND EQUIPMENT LIST

Test Vehicle: 2007 Thomas Saf-T-Liner C2 School Bus
Test Lab: MGA Research-Wisconsin Operations NHTSA No.: C70900
Test Date: 12/15/06

	Digital Caliper	Light Meter	Tape Measure	Spherometer
Make	Mitutoyo	AEMC	Stanley	MGA
Model	ID-F150HE	CA813	Powerlock	001
Serial # (s)	001462	04L1017Y	SN101	001
Range	0-50.8 mm	2000fc, 2000lux	0-8 m	2.25 x 10 ¹³ (cm * Hz ^{1/2}) ÷ W
Accuracy	.001 mm	0.0 fc or 0.01 lux	1 mm	1.1 x 10 ⁻¹³ W/H ^{1/2}
Cal. Date	7/26/06	4/18/06	8/16/06	Daily when used
Cal. Due Date	7/26/07	4/18/07	2/16/07	N/A

SECTION 5 PHOTOGRAPHS

TABLE OF PHOTOGRAPHS

<u>No.</u>		<u>Page No.</u>
1	Three-Quarter Left Front View of School Bus	21
2	Three-Quarter Left Rear View of School Bus	22
3	Vehicle Certification Label	23
4	Right Front Cross View Mirror and Mounting	24
5	Passenger Side Rearview Mirror and Mounting	25
6	Inside Rearview Mirror and Mounting	26
7	Left Front Cross View Mirror and Mounting	27
8	Driver Side Rearview Mirror and Mounting	28
9	Field of View Instrument Setup	29
10	Field of View without Mirrors	30
11	Mirror #2 System B Field of View	31
12	Mirror #1 System B Field of View	32
13	Mirror #4 System A Field of View	33
14	Mirror #3 System A Field of View	34
15	Mirror #6 System A Field of View	35
16	Mirror #5 System A Field of View	36
17	View of Cylinder Setup from Front	37
18	Three-Quarter Left Front View of Cylinder Setup	38
19	Three-Quarter Right Front View of Cylinder Setup	39
20	Reflectance Test Set-up	40
21	Label for Cross View Mirror Warning	41

2007 Thomas Saf-T-Liner C2 Test Vehicle:



Three-Quarter Left Front View of School Bus



Three-Quarter Left Rear View of School Bus





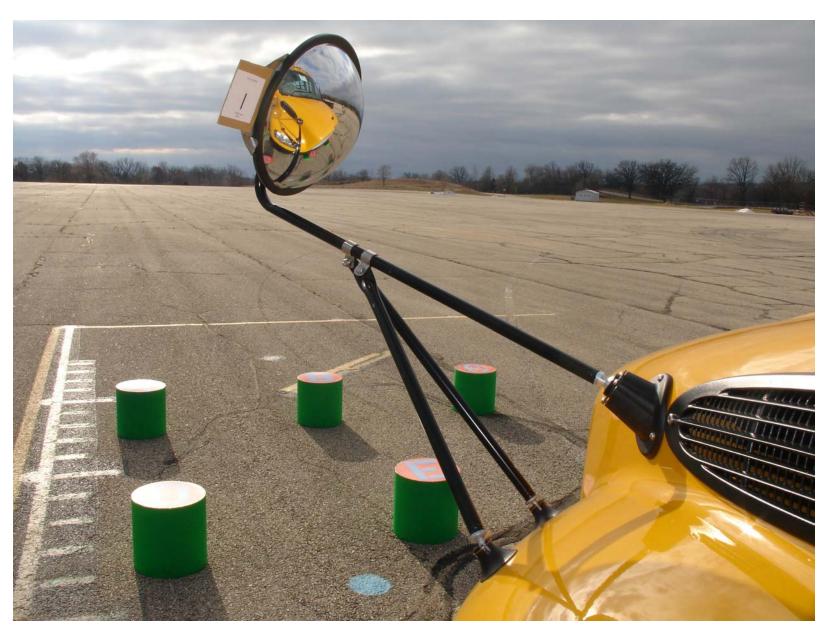
Right Front Cross View Mirror and Mounting



Passenger Side Rearview Mirror and Mounting



Inside Rearview Mirror and Mounting



Left Front Cross View Mirror and Mounting



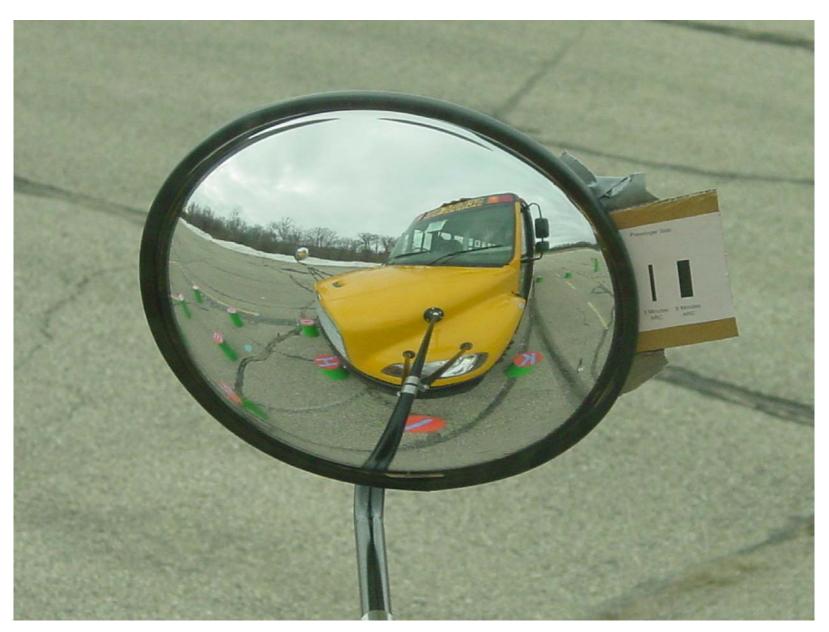
Driver Side Rearview Mirror and Mounting



Field of View Instrument Setup



Field of View without Mirrors



Mirror #2 System B Field of View



Mirror #1 System B Field of View



Mirror #4 System A Field of View



Mirror #3 System A Field of View



Mirror #6 System A Field of View



Mirror #5 System A Field of View



View of Cylinder Setup from Front

C70900 NHTSA No.: **FMVSS 111** Procedure: Test Date: 12/15/06



Three-Quarter Left Front View of Cylinder Setup

NHTSA No.: C70900 **FMVSS 111** 12/15/06 Procedure: Test Date:



Three-Quarter Right Front View of Cylinder Setup



Reflectance Test Set-up

4

Test Vehicle:

2007 Thomas Saf-T-Liner C2

Procedure: FMVSS 111

NHTSA No.:

C70900 12/15/06

Test Date:

