STURAA TEST

7 YEAR

200,000 MILE BUS

from

ARBOC Mobility LLC.

MODEL SOM23G

JANUARY 2009

PTI-BT-R0812

PENNSTATE

1855

The Thomas D. Larson
Pennsylvania Transportation Institute

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The Pennsylvania State University
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Bus Testing and Research Center

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EXECUTIVE SUMMARY

ARBOC Mobility LLC. submitted a model SOM23G, gasoline-powered 20 seat (including the driver) 23-foot bus, built on a GM G3500 chassis for a 7 yr/200,000 mile STURAA test. The odometer reading at the time of delivery was 471 miles. Testing started on July 30, 2008 and was completed on January 9, 2009. The Check-In section of the report provides a description of the bus and specifies its major components.

The primary part of the test program is the Structural Durability Test, which also provides the information for the Maintainability and Reliability results. The Structural Durability Test was started on September 10, 2008 and was completed on November 28, 2008.

The interior of the bus is configured with seating for 20 passengers including the driver. Free floor space will accommodate 9 standing passengers resulting in a potential load of 29 persons. At 150 lbs per person, this load results in a measured gross vehicle weight of 12,960 lbs. The first segment of the Structural Durability Test was performed with the bus loaded to a GVW of 12,960 lbs. The middle segment was performed at a seated load weight of 11,800 lbs and the final segment was performed at a curb weight of 8,870 lbs. Durability driving resulted in unscheduled maintenance and failures that involved a variety of subsystems. A description of failures, and a complete and detailed listing of scheduled and unscheduled maintenance is provided in the Maintainability section of this report.

Accessibility, in general, was adequate, components covered in Section 1.3 (Repair and/or Replacement of Selected Subsystems) along with all other components encountered during testing, were found to be readily accessible and no restrictions were noted.

The Reliability section compiles failures that occurred during Structural Durability Testing. Breakdowns are classified according to subsystems. The data in this section are arranged so that those subsystems with more frequent problems are apparent. The problems are also listed by class as defined in Section 2. The test bus encountered no Class 1 or Class 2 failures. Of the thirty-three reported failures, twenty-three were Class 3 and ten were Class 4.

The Safety Test, (a double-lane change, obstacle avoidance test) was safely performed in both right-hand and left-hand directions up to a maximum test speed of 45 mph. The performance of the bus is illustrated by a speed vs. time plot. Acceleration and gradeability test data are provided in Section 4, Performance. The average time to obtain 50 mph was 15.38 seconds.

The Shakedown Test produced a maximum final loaded deflection of 0.155 inches with a permanent set ranging between -0.006 to 0.006 inches under a distributed static load of 10,875 lbs. The Distortion Test was completed with all subsystems, doors and escape mechanisms operating properly. No water leakage was observed throughout the test. All subsystems operated properly.

The test bus submitted for testing was not equipped with any type of tow eyes or tow hooks, therefore, the Static Towing Test was not performed. The Dynamic Towing Test was performed by means of a front-lift tow. The towing interface was accomplished using a hydraulic under-lift wrecker. The bus was towed without incident and no damage resulted from the test. The manufacturer does not recommend towing the bus from the rear, therefore, a rear test was not performed. The Jacking and Hoisting Tests were also performed without incident. The bus was found to be stable on the jack stands, and the minimum jacking clearance observed with a tire deflated was 4.8 inches.

A Fuel Economy Test was run on simulated central business district, arterial, and commuter courses. The results were 4.35 mpg, 4.77 mpg, and 7.84 mpg respectively; with an overall average of 5.13 mpg.

A series of Interior and Exterior Noise Tests was performed. These data are listed in Section 7.1 and 7.2 respectively.

ABBREVIATIONS

ABTC	-	Altoona Bus Test Center
A/C	-	air conditioner
ADB	-	advance design bus
ATA-MC	-	The Maintenance Council of the American Trucking Association
CBD	-	central business district
CW	-	curb weight (bus weight including maximum fuel, oil, and coolant; but without passengers or driver)
dB(A)	-	decibels with reference to 0.0002 microbar as measured on the "A" scale
DIR	-	test director
DR	-	bus driver
EPA	-	Environmental Protection Agency
FFS	-	free floor space (floor area available to standees, excluding ingress/egress areas, area under seats, area occupied by feet of seated passengers, and the vestibule area)
GVL	-	gross vehicle load (150 lb for every designed passenger seating position, for the driver, and for each 1.5 sq ft of free floor space)
GVW	-	gross vehicle weight (curb weight plus gross vehicle load)
GVWR	-	gross vehicle weight rating
MECH	-	bus mechanic
mpg	-	miles per gallon
mph	-	miles per hour
PM	-	Preventive maintenance
PSBRTF	-	Penn State Bus Research and Testing Facility
PTI	-	Pennsylvania Transportation Institute
rpm	-	revolutions per minute
SAE	-	Society of Automotive Engineers
SCH	-	test scheduler
SEC	-	secretary
SLW	-	seated load weight (curb weight plus 150 lb for every designed passenger seating position and for the driver)
STURAA	-	Surface Transportation and Uniform Relocation Assistance Act
TD	-	test driver
TECH	-	test technician
TM	-	track manager
TP	-	test personnel

TEST BUS CHECK-IN

I. OBJECTIVE

The objective of this task is to log in the test bus, assign a bus number, complete the vehicle data form, and perform a safety check.

II. TEST DESCRIPTION

The test consists of assigning a bus test number to the bus, cleaning the bus, completing the vehicle data form, obtaining any special information and tools from the manufacturer, determining a testing schedule, performing an initial safety check, and performing the manufacturer's recommended preventive maintenance. The bus manufacturer must certify that the bus meets all Federal regulations.

III. DISCUSSION

The check-in procedure is used to identify in detail the major components and configuration of the bus.

The test bus consists of a Spirit of Mobility, model SOM23G by ARBOC Mobility. The bus has an O.E.M. driver's door and a passenger entry door equipped with an ARBOC model 32 x 48 manual fold-out handicap ramp rear of the front axle. Power is provided by a gasoline-fueled, General Motors Co. model 6.0 L Vortec engine coupled to a General Motors Corp. model 4-SPD4L80-E transmission.

The measured curb weight is 3,380 lbs for the front axle and 5,490 lbs for the rear axle. These combined weights provide a total measured curb weight of 8,870 lbs. There are 20 seats including the driver and room for 9 standing passengers bringing the total passenger capacity to 29. Gross load is 150 lb x 29 = 4,350 lbs. At full capacity, the measured gross vehicle weight is 12,960 lbs.

VEHICLE DATA FORM

Bus Number: 0812	Arrival Date: 7-31-08
Bus Manufacturer: ARBOC Mobility LLC.	Vehicle Identification Number (VIN): 1GBKG31K781166323
Model Number: SOM 23C	Date: 7-31-08
Personnel: T.S. & S.C.	Chassis: Workhorse / Heavy Duty G 3500

WEIGHT:

Individual Wheel Reactions:

Weights (lb)	Front Axle		Middle Axle		Rear Axle	
	Right	Left	Right	Left	Right	Left
CW	1,750	1,630	N/A	N/A	2,620	2,870
SLW	1,690	1,650	N/A	N/A	3,980	4,480
GVW	1,700	1,730	N/A	N/A	4,580	4,950

Total Weight Details:

Weight (lb)	CW	SLW	GVW	GAWR
Front Axle	3,380	3,340	3,430	4,600
Middle Axle	N/A	N/A	N/A	N/A
Rear Axle	5,490	8,460	9,530	9,600
Total	8,870	11,800	12,960	GVWR: 14,200

Dimensions:

Length (ft/in)	23 / 6
Width (in)	96.0
Height (in)	111.0
Front Overhang (in)	39.0
Rear Overhang (in)	83.5
Wheel Base (in)	159.5
Wheel Track (in)	Front: 68.1
	Rear: 74.8

Bus Number: 0812	Date: 7-31-08

CLEARANCES:

Lowest Point Outside Front Axle	Location: Frame Clearance(in): 10.3
Lowest Point Outside Rear Axle	Location: Heat shield Clearance(in): 9.4
Lowest Point between Axles	Location: Exhaust pipe Clearance(in): 6.4
Ground Clearance at the center (in)	8.4
Front Approach Angle (deg)	22.9
Rear Approach Angle (deg)	9.4
Ramp Clearance Angle (deg)	6.0
Aisle Width (in)	21.0
Inside Standing Height at Center Aisle (in)	80.2

BODY DETAILS:

Body Structural Type	Integral		
Frame Material	Steel		
Body Material	Steel & fiberglass		
Floor Material	Composite		
Roof Material	Fiberglass		
Windows Type	■ Fixed	□ Movable	
Window Mfg./Model No.	Clear Vision / 36 x 36 egress & 36 x 45 fixed		
Number of Doors	2 Front	1 Rear	
Mfr. / Model No.	A&M Systems / 41”		
Dimension of Each Door (in)	Driver’s – 56.0 x 34.3	Passenger – 77.4 x 38.8	
Passenger Seat Type	□ Cantilever	■ Pedestal	□ Other (explain)
Mfr. / Model No.	Freedman / Low Back		
Driver Seat Type	□ Air	□ Spring	■ Other (cushion)
Mfr. / Model No.	GM / High back /lumbar		
Number of Seats (including Driver)	20		

Bus Number: 0812	Date: 7-31-08

BODY DETAILS (Contd..)

Free Floor Space (ft^2)	14.3			
Height of Each Step at Normal Position (in)	Front 1. 16.5	2. N/A	3. N/A	4. N/A
	Middle 1. N/A	2. N/A	3. N/A	4. N/A
	Rear 1. N/A	2. N/A	3. N/A	4. N/A
Step Elevation Change - Kneeling (in)	4.2			

ENGINE

Type	□ C.I.	□ Alternate Fuel	
	■ S.I.	□ Other (explain)	
Mfr. / Model No.	General Motors Co. / 6.0 L Vortec		
Location	■ Front	□ Rear	□ Other (explain)
Fuel Type	■ Gasoline	□ CNG	□ Methanol
	□ Diesel	□ LNG	□ Other (explain)
Fuel Tank Capacity (indicate units)	57 gals.		
Fuel Induction Type	■ Injected	□ Carburetion	
Fuel Injector Mfr. / Model No.	General Motors Co. / 6.0 L Vortec		
Carburetor Mfr. / Model No.	N/A		
Fuel Pump Mfr. / Model No.	General Motors Co. / 6.0 L Vortec		
Alternator (Generator) Mfr. / Model No.	Delco / 145 amp		
Maximum Rated Output (Volts / Amps)	12 / 145		
Air Compressor Mfr. / Model No.	TCCI / SC 4779227		
Maximum Capacity (ft^3 / min)	5.0		
Starter Type	■ Electrical	□ Pneumatic	□ Other (explain)
Starter Mfr. / Model No.	Mean Green / MG 6492 HD		

Bus Number: 0812	Date: 7-31-08

TRANSMISSION

Transmission Type	□ Manual	■ Automatic	
Mfr. / Model No.	General Motors Corp. / 4-SPD4L80-E		
Control Type	■ Mechanical	□ Electrical	□ Other
Torque Converter Mfr. / Model No.	General Motors Corp. / 4-SPD4L80-E		
Integral Retarder Mfr. / Model No.	N/A		

SUSPENSION

Number of Axles	2		
Front Axle Type	■ Independent	□ Beam Axle	
Mfr. / Model No.	GM/ARBOC air suspension / 4,600 lbs		
Axle Ratio (if driven)	N/A		
Suspension Type	■ Air	□ Spring	□ Other (explain)
No. of Shock Absorbers	2		
Mfr. / Model No.	Tenneco / 65mm (PN 1198729)		
Middle Axle Type	□ Independent	□ Beam Axle	
Mfr. / Model No.	N/A		
Axle Ratio (if driven)	N/A		
Suspension Type	□ Air	□ Spring	□ Other (explain)
No. of Shock Absorbers	N/A		
Mfr. / Model No.	N/A		
Rear Axle Type	□ Independent	■ Beam Axle	
Mfr. / Model No.	Dana Spicer / HD 70		
Axle Ratio (if driven)	4.10		
Suspension Type	■ Air	□ Spring	□ Other (explain)
No. of Shock Absorbers	2		
Mfr. / Model No.	Tenneco / 65mm (1165741)		

Bus Number: 0812	Date: 7-31-08

WHEELS & TIRES

Front	Wheel Mfr./ Model No.	Accuride / 16 x 6.5
	Tire Mfr./ Model No.	Uniroyal Laredo LT225 / 75R 16
Rear	Wheel Mfr./ Model No.	Accuride / 16 x 6.5
	Tire Mfr./ Model No.	Uniroyal Laredo LT225 / 75R 16

BRAKES

Front Axle Brakes Type	□ Cam	■ Disc	□ Other (explain)
Mfr. / Model No.	GM / 12.8" x 1.5"		
Middle Axle Brakes Type	□ Cam	□ Disc	□ Other (explain)
Mfr. / Model No.	N/A		
Rear Axle Brakes Type	□ Cam	■ Disc	□ Other (explain)
Mfr. / Model No.	GM / 13.58" x 1.6"		
Retarder Type	N/A		
Mfr. / Model No.	N/A		

HVAC

Heating System Type	□ Air	■ Water	□ Other
Capacity (Btu/hr)	65,000		
Mfr. / Model No.	Pro Air/Trans Air / 65,000 btu		
Air Conditioner	■ Yes	□ No	
Location	Dash & front ceiling		
Capacity (Btu/hr)	70,000		
A/C Compressor Mfr. / Model No.	Trans Air / 21		

STEERING

Steering Gear Box Type	Hydraulic gear
Mfr. / Model No.	GM / Hydraulic recirc. gear
Steering Wheel Diameter	15.4
Number of turns (lock to lock)	3.25

Bus Number: 0812	Date: 7-31-08

OTHERS

Wheel Chair Ramps	Location: Right front	Type: Manual fold-out ramp
Wheel Chair Lifts	Location: N/a	Type: N/A
Mfr. / Model No.	ARBOC / 32 x 48	
Emergency Exit	Location: Window Door	Number: 3 2

CAPACITIES

Fuel Tank Capacity (units)	57 gals.
Engine Crankcase Capacity (gallons)	1.5
Transmission Capacity (gallons)	1.9
Differential Capacity (gallons)	1.0
Cooling System Capacity (gallons)	4.5
Power Steering Fluid Capacity (quarts)	1.0

HYBRID CONTROL SYSTEM

Hybrid Control System Mfr. / Model No.	Intermotive / ES1A

VEHICLE DATA FORM

Bus Number: 0812	Date: 7-31-08

List all spare parts, tools and manuals delivered with the bus.

Part Number	Description	Qty.
Uni Royal 225/75R 16	Mounted tire.	1
W01-358-5783	Air bag	1
W01-358-7339	Air bag	1
1167218	Shock	2
1165741	Shock	2
na	Leveling arms	2

COMPONENT/SUBSYSTEM INSPECTION FORM

Bus Number: 0812	Date: 7-31-08

Subsystem	Checked	Comments
Air Conditioning Heating and Ventilation	✓	
Body and Sheet Metal	✓	
Frame	✓	
Steering	✓	
Suspension	✓	
Interior/Seating	✓	No wheelchair positions.
Axles	✓	
Brakes	✓	
Tires/Wheels	✓	
Exhaust	✓	
Fuel System	✓	Gasoline.
Power Plant	✓	
Accessories	✓	
Lift System	✓	Manual fold-out ramp.
Interior Fasteners	✓	
Batteries	✓	

CHECK - IN

ARBOC MOBILITY LLC
MODEL SOM23G

ARBOC MOBILITY LLC
MODEL SOM23G EQUIPPED WITH AN ARBOC MODEL 32 X 48 HANDICAP RAMP

CHECK - IN CONT.

FRONT INTERIOR

REAR INTERIOR

CHECK - IN

DRIVER'S STATION

ENGINE COMPARTMENT

1. MAINTAINABILITY

1.1 ACCESSIBILITY OF COMPONENTS AND SUBSYSTEMS

1.1-I. TEST OBJECTIVE

The objective of this test is to check the accessibility of components and subsystems.

1.1-II. TEST DESCRIPTION

Accessibility of components and subsystems is checked, and where accessibility is restricted the subsystem is noted along with the reason for the restriction.

1.1-III. DISCUSSION

Accessibility, in general, was adequate. Components covered in Section 1.3 (repair and/or replacement of selected subsystems), along with all other components encountered during testing, were found to be readily accessible and no restrictions were noted.

ACCESSIBILITY DATA FORM

Bus Number: 0812	Date: 1-8-09

Component	Checked	Comments
ENGINE :		
Oil Dipstick	✓	
Oil Filler Hole	✓	
Oil Drain Plug	✓	
Oil Filter	✓	
Fuel Filter	✓	
Air Filter	✓	
Belts	✓	
Coolant Level	✓	
Coolant Filler Hole	✓	
Coolant Drain	✓	
Spark / Glow Plugs	✓	
Alternator	✓	
Diagnostic Interface Connector	✓	
TRANSMISSION :		
Fluid Dip-Stick	✓	
Filler Hole	✓	
Drain Plug	✓	
SUSPENSION :		
Bushings	✓	
Shock Absorbers	✓	
Air Springs	✓	
Leveling Valves	✓	
Grease Fittings	✓	

ACCESSIBILITY DATA FORM

Bus Number: 0812	Date: 1-8-09

Component	Checked	Comments
HVAC :		
A/C Compressor	✓	
Filters	✓	
Fans	✓	
ELECTRICAL SYSTEM :		
Fuses	✓	
Batteries	✓	
Voltage regulator	✓	
Voltage Converters	✓	
Lighting	✓	
MISCELLANEOUS :		
Brakes	✓	
Handicap Lifts/Ramps	✓	
Instruments	✓	
Axles	✓	
Exhaust	✓	
Fuel System	✓	
OTHERS :		

1.2 SERVICING, PREVENTIVE MAINTENANCE, AND REPAIR AND MAINTENANCE DURING TESTING

1.2-I. TEST OBJECTIVE

The objective of this test is to collect maintenance data about the servicing, preventive maintenance, and repair.

1.2.-II. TEST DESCRIPTION

The test will be conducted by operating the NBM and collecting the following data on work order forms and a driver log.

1. Unscheduled Maintenance
    a. Bus number
    b. Date
    c. Mileage
    d. Description of malfunction
    e. Location of malfunction (e.g., in service or undergoing inspection)
    f. Repair action and parts used
    g. Man-hours required

2. Scheduled Maintenance
    a. Bus number
    b. Date
    c. Mileage
    d. Engine running time (if available)
    e. Results of scheduled inspections
    f. Description of malfunction (if any)
    g. Repair action and parts used (if any)
    h. Man-hours required

The buses will be operated in accelerated durability service. While typical items are given below, the specific service schedule will be that specified by the manufacturer.

A. Service
    1. Fueling
    2. Consumable checks
    3. Interior cleaning

B. Preventive Maintenance
    4. Brake adjustments
    5. Lubrication
    6. 3,000 mi (or equivalent) inspection

7. Oil and filter change inspection
8. Major inspection
9. Tune-up

C. Periodic Repairs
1. Brake reline
2. Transmission change
3. Engine change
4. Windshield wiper motor change
5. Stoplight bulb change
6. Towing operations
7. Hoisting operations

1.2-III. DISCUSSION

Servicing and preventive maintenance were performed at manufacturer-specified intervals. The following Scheduled Maintenance Form lists the mileage, items serviced, the service interval, and amount of time required to perform the maintenance. Table 1 is a list of the lubricating products used in servicing. Finally, the Unscheduled Maintenance List along with Unscheduled Maintenance-related photographs is included in Section 5.7, Structural Durability. This list supplies information related to failures that occurred during the durability portion of testing. The Unscheduled Maintenance List includes the date and mileage at which the malfunction occurred, a description of the malfunction and repair, and the time required to perform the repair.

SCHEDULED MAINTENANCE

ARBOC #0812

DATE	TEST MILES	SERVICE	ACTIVITY	DOWN TIME	HOURS
10-03-08	1,214	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
10-15-08	2,146	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
11-05-08	3,409	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
11-11-08	4,936	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
11-19-08	5,997	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
11-25-08	6,739	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
12-09-08	7,500	P.M. / Inspection Fuel Economy Prep.	Linkage, tie rods, universals/u-joints all lubed. Oil changed. Oil, fuel, and air filters changed. Transmission oil and filter changed.	8.00	8.00

Table 1. STANDARD LUBRICANTS

The following is a list of Texaco lubricant products used in bus testing conducted by the Penn State University Altoona Bus Testing Center:

ITEM	PRODUCT CODE	TEXACO DESCRIPTION
Engine oil	#2112	URSA Super Plus SAE 30
Transmission oil	#1866	Automatic Trans Fluid Mercon/Dexron II Multipurpose
Gear oil	#2316	Multigear Lubricant EP SAE 80W90
Wheel bearing & Chassis grease	#1935	Starplex II

1.3 REPLACEMENT AND/OR REPAIR OF SELECTED SUBSYSTEMS

1.3-I. TEST OBJECTIVE

The objective of this test is to establish the time required to replace and/or repair selected subsystems.

1.3-II. TEST DESCRIPTION

The test will involve components that may be expected to fail or require replacement during the service life of the bus. In addition, any component that fails during the NBM testing is added to this list. Components to be included are:

1. Transmission
2. Alternator
3. Starter
4. Batteries
5. Windshield wiper motor

1.3-III. DISCUSSION

During the test, several additional components were removed for repair or replacement. Following is a list of components and total repair/replacement time.

	MAN HOURS
Trailing arm bushings.	12.0
Left rear sway bar bracket.	1.5
Hadley unit.	8.0
Lower trailing arms.	4.0
Left rear sway bar link.	2.0
Right front sway bar link.	0.5
Left rear marker lamp.	0.25
Battery box.	1.75
Rear lateral bar mount.	2.00
Front sway bar link/bushing.	1.00
Left front sway bar link.	1.00

At the end of the test, the remaining items on the list were removed and replaced. The transmission assembly took 12.0 man-hours (two men 6.0 hrs) to remove and replace. The time required for repair/replacement of the four remaining components is given on the following Repair and/or Replacement Form.

REPLACEMENT AND/OR REPAIR FORM

Subsystem	Replacement Time
Transmission	12.0 man hours
Wiper Motor	0.5 man hours
Starter	0.5 man hours
Alternator	1.0 man hours
Batteries	0.5 man hours

1.3 REPLACEMENT AND/OR REPAIR OF SELECTED SUBSYSTEMS

TRANSMISSION REMOVAL AND REPLACEMENT (12.0 MAN HOURS)

WIPER MOTOR REMOVAL AND REPLACEMENT (0.5 MAN HOURS)

1.3 REPLACEMENT AND/OR REPAIR OF SELECTED SUBSYSTEMS CONT.

STARTER REMOVAL AND REPLACEMENT (0.5 MAN HOURS)

ALTERNATOR REMOVAL AND REPLACEMENT (1.0 MAN HOURS)

2. RELIABILITY - DOCUMENTATION OF BREAKDOWN AND REPAIR TIMES DURING TESTING

2-I. TEST OBJECTIVE

The objective of this test is to document unscheduled breakdowns, repairs, down time, and repair time that occur during testing.

2-II. TEST DESCRIPTION

Using the driver log and unscheduled work order forms, all significant breakdowns, repairs, man-hours to repair, and hours out of service are recorded on the Reliability Data Form.

CLASS OF FAILURES

Classes of failures are described below:

(a) Class 1: Physical Safety. A failure that could lead directly to passenger or driver injury and represents a severe crash situation.

(b) Class 2: Road Call. A failure resulting in an en route interruption of revenue service. Service is discontinued until the bus is replaced or repaired at the point of failure.

(c) Class 3: Bus Change. A failure that requires removal of the bus from service during its assignments. The bus is operable to a rendezvous point with a replacement bus.

(d) Class 4: Bad Order. A failure that does not require removal of the bus from service during its assignments but does degrade coach operation. The failure shall be reported by driver, inspector, or hostler.

2-III. DISCUSSION

A listing of breakdowns and unscheduled repairs is accumulated during the Structural Durability Test. The following Reliability Data Form lists all unscheduled repairs under classes as defined above. These classifications are somewhat subjective as the test is performed on a test track with careful inspections every two hours. However, even on the road, there is considerable latitude on deciding how to handle many failures.

The Unscheduled Repair List is also attached to provide a reference for the repairs that are included in the Reliability Data Forms.

The classification of repairs according to subsystem is intended to emphasize those systems which had persistent minor or more serious problems. There were no Class 1 or 2 failures. Of the twenty-three Class 3 failures, seventeen involved the suspension system, two occurred with the engine/transmission, and one each to the frame, electrical, tire and air compressor. These and the remaining ten Class 4 failures are available for review in the Unscheduled Maintenance List, located in Section 5.7 Structural Durability.

RELIABILITY DATA FORMS

Bus Number: 0812	Date: 11-28-08
Personnel: Bob Reifsteck	

Failure Type			
Class 4 Bad Order	Class 3 Bus Change	Class 2 Road Call	Class 1 Physical Safety

Subsystems	Mileage	Mileage	Mileage	Mileage	Man Hours	Down Time
Suspension		482			2.00	1.00
	630				12.00	4.00
		630			1.50	47.00
	1,253				4.00	2.00
		1,771			2.00	4.00
		1,988			1.00	1.00
		2,202			5.00	70.00
		2,202			1.00	1.00
		2,384			2.00	2.00
		2,585			0.50	2.00
		2,659			4.00	2.00
		2,661			15.00	118.00
		3,008			1.00	0.50
		4,886			1.00	4.00
		5,071			2.00	3.00
		5,291			1.00	2.00
		6,402			2.00	4.00
		6,450			1.00	10.00
		6,450			1.00	0.50

RELIABILITY DATA FORMS

Bus Number: 0812	Date: 11-28-08
Personnel: Bob Reifsteck	

Failure Type			
Class 4 Bad Order	Class 3 Bus Change	Class 2 Road Call	Class 1 Physical Safety

Subsystems	Mileage	Mileage	Mileage	Mileage	Man Hours	Down Time
Body	2,786				1.00	1.00
	3,409				1.00	0.50
	3,409				2.00	2.00
	5,515				2.50	1.00
Engine/Transmission		1,059			2.00	3.00
		2,146			3.00	2.00
	2,786				1.75	4.00
	6,450				1.00	0.50
Electrical	2,786				0.25	0.25
		3,008			4.00	13.00
Frame	630				10.00	123.00
		5,515			2.00	8.00
Air Compressor		1,214			4.00	36.00
Wheels/Tires		2,384			2.00	2.00

3. SAFETY - A DOUBLE-LANE CHANGE (OBSTACLE AVOIDANCE)

3-I. TEST OBJECTIVE

The objective of this test is to determine handling and stability of the bus by measuring speed through a double lane change test.

3-II. TEST DESCRIPTION

The Safety Test is a vehicle handling and stability test. The bus will be operated at SLW on a smooth and level test track. The bus will be driven through a double lane change course at increasing speed until the test is considered unsafe or a speed of 45 mph is reached. The lane change course will be set up using pylons to mark off two 12 foot center to center lanes with two 100 foot lane change areas 100 feet apart. The bus will begin in one lane, change to the other lane in a 100 foot span, travel 100 feet, and return to the original lane in another 100 foot span. This procedure will be repeated, starting first in the right-hand and then in the left-hand lane.

3-III. DISCUSSION

The double-lane change was performed in both right-hand and left-hand directions. The bus was able to safely negotiate the test course in both the right-hand and left-hand directions up to the maximum test speed of 45 mph.

SAFETY DATA FORM

Bus Number: 0812	Date: 12-15-08
Personnel: T.S., E.D. & B.S.	

Temperature (°F): 49	Humidity (%): 81
Wind Direction: SSW	Wind Speed (mph): 11
Barometric Pressure (in.Hg): 30.17	

SAFETY TEST: DOUBLE LANE CHANGE	
Maximum safe speed tested for double-lane change to left	45 mph
Maximum safe speed tested for double-lane change to right	45 mph
Comments of the position of the bus during the lane change: A safe profile was maintained through all portions of testing.	
Comments of the tire/ground contact patch: Tire/ground contact was maintained through all portions of testing.	

3. SAFETY

RIGHT - HAND APPROACH

LEFT - HAND APPROACH

4. PERFORMANCE - AN ACCELERATION, GRADEABILITY, AND TOP SPEED TEST

4-I. TEST OBJECTIVE

The objective of this test is to determine the acceleration, gradeability, and top speed capabilities of the bus.

4-II. TEST DESCRIPTION

In this test, the bus will be operated at SLW on the skid pad at the PSBRTF. The bus will be accelerated at full throttle from a standstill to a maximum "geared" or "safe" speed as determined by the test driver. The vehicle speed is measured using a Correvit non-contacting speed sensor. The times to reach speed between ten mile per hour increments are measured and recorded using a stopwatch with a lap timer. The time to speed data will be recorded on the Performance Data Form and later used to generate a speed vs. time plot and gradeability calculations.

4-III. DISCUSSION

This test consists of three runs in both the clockwise and counterclockwise directions on the Test Track. Velocity versus time data is obtained for each run and results are averaged together to minimize any test variability which might be introduced by wind or other external factors. The test was performed up to a maximum speed of 50 mph. The fitted curve of velocity vs. time is attached, followed by the calculated gradeability results. The average time to obtain 50 mph was 15.38 seconds.

PERFORMANCE DATA FORM

Bus Number: 0812	Date: 12-15-08
Personnel: T.S., E.D. & B.S.	

Temperature (°F): 49	Humidity (%): 81
Wind Direction: SSW	Wind Speed (mph): 11
Barometric Pressure (in.Hg): 30.17	

Air Conditioning compressor-OFF	✓Checked
Ventilation fans-ON HIGH	✓Checked
Heater pump motor-Off	✓Checked
Defroster-OFF	✓ Checked
Exterior and interior lights-ON	✓ Checked
Windows and doors-CLOSED	✓ Checked

ACCELERATION, GRADEABILITY, TOP SPEED

Counter Clockwise Recorded Interval Times

Speed	Run 1	Run 2	Run 3
10 mph	2.76	2.82	2.79
20 mph	4.92	5.20	5.32
30 mph	8.11	8.32	8.38
40 mph	11.01	11.20	11.10
Top Test Speed(mph) 50	15.39	15.54	15.70

Clockwise Recorded Interval Times

Speed	Run 1	Run 2	Run 3
10 mph	2.79	2.66	2.64
20 mph	4.95	5.23	4.95
30 mph	7.88	7.91	7.83
40 mph	10.60	10.66	10.67
Top Test Speed(mph) 50	15.10	15.41	15.14

PERFORMANCE SUMMARY SHEET

BUS MANUFACTURER :ARBOC
BUS MODEL :SOM 23C

BUS NUMBER :0812
TEST DATE :12/15/08

TEST CONDITIONS :

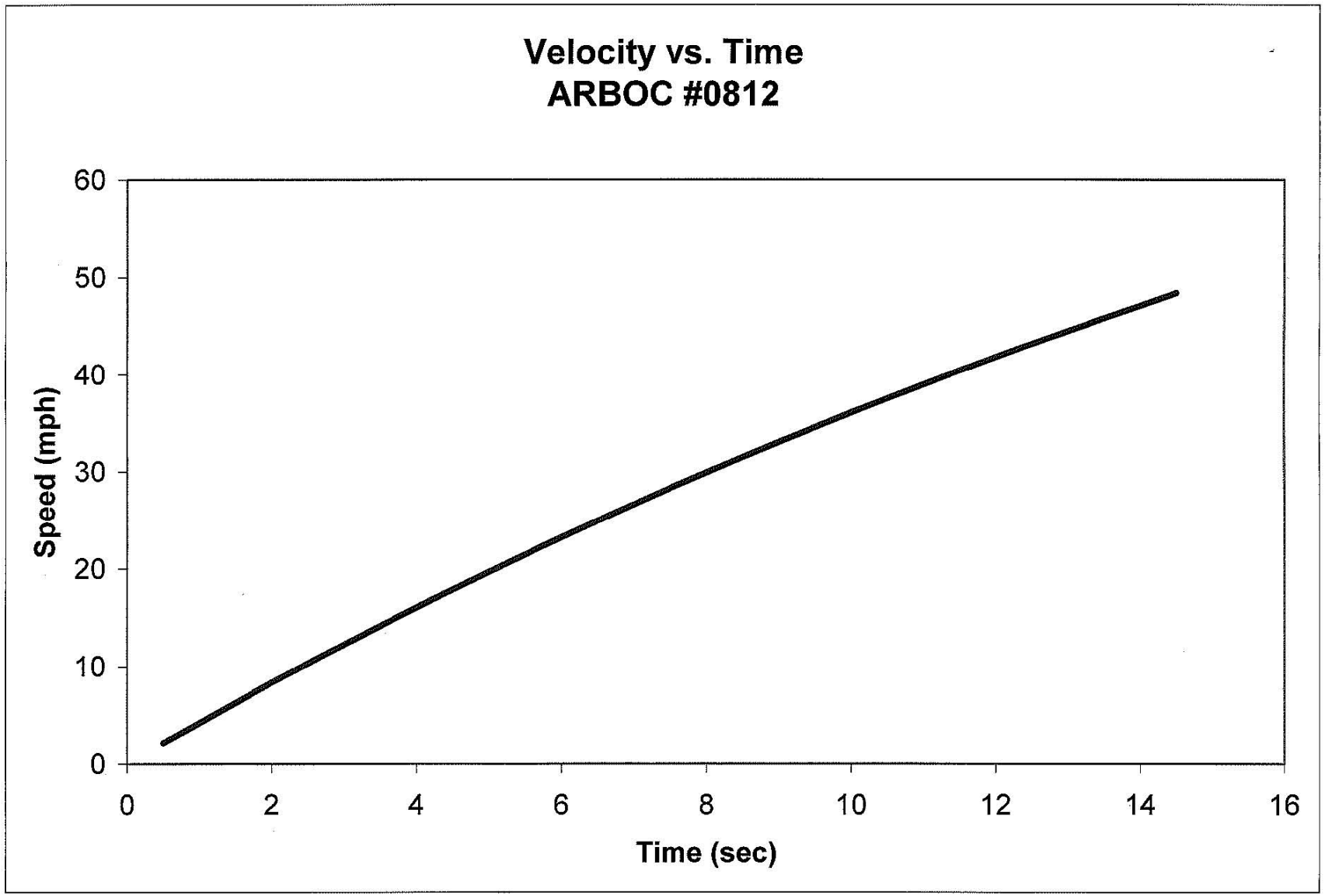
TEMPERATURE (DEG F) : 49.0
WIND DIRECTION : SSW
WIND SPEED (MPH) : 11.0
HUMIDITY (%) : 81
BAROMETRIC PRESSURE (IN. HG) : 30.2

VEHICLE SPEED	AVERAGE TIME (SEC)		
(MPH)	CCW DIRECTION	CW DIRECTION	TOTAL
10.0	2.79	2.70	2.74
20.0	5.15	5.04	5.10
30.0	8.27	7.87	8.07
40.0	11.10	10.64	10.87
50.0	15.54	15.22	15.38

TEST SUMMARY :

VEHICLE SPEED (MPH)	TIME (SEC)	ACCELERATION (FT/SEC^2)	MAX. GRADE (%)
1.0	.23	6.3	20.0
5.0	1.18	6.1	19.2
10.0	2.41	5.8	18.3
15.0	3.71	5.5	17.4
20.0	5.07	5.2	16.5
25.0	6.51	5.0	15.6
30.0	8.03	4.7	14.7
35.0	9.64	4.4	13.8
40.0	11.35	4.2	13.0
45.0	13.18	3.9	12.2
50.0	15.13	3.6	11.4

NOTE : Gradeability results were calculated from performance test data. Actual sustained gradeability performance for vehicles equipped with auto transmission may be lower than the values indicated here.


Velocity vs. Time
ARBOC #0812
Speed (mph)
60
50
40
30
20
10
0
0
2
4
6
8
10
12
14
16
Time (sec)

5. STRUCTURAL INTEGRITY

5.1 STRUCTURAL STRENGTH AND DISTORTION TESTS - STRUCTURAL SHAKEDOWN TEST

5.1-I. DISCUSSION

The objective of this test is to determine certain static characteristics (e.g., bus floor deflection, permanent structural deformation, etc.) under static loading conditions.

5.1-II. TEST DESCRIPTION

In this test, the bus will be isolated from the suspension by blocking the vehicle under the suspension points. The bus will then be loaded and unloaded up to a maximum of three times with a distributed load equal to 2.5 times gross load. Gross load is 150 lb for every designed passenger seating position, for the driver, and for each 1.5 sq ft of free floor space. For a distributed load equal to 2.5 times gross load, place a 375-lb load on each seat and on every 1.5 sq ft of free floor space. The first loading and unloading sequence will "settle" the structure. Bus deflection will be measured at several locations during the loading sequences.

5.1-III. DISCUSSION

This test was performed based on a maximum passenger capacity of 29 people including the driver. The resulting test load is (29 x 375 lb) = 10,875 lb. The load is distributed evenly over the passenger space. Deflection data before and after each loading and unloading sequence is provided on the Structural Shakedown Data Form.

The unloaded height after each test becomes the original height for the next test. Some initial settling is expected due to undercoat compression, etc. After each loading cycle, the deflection of each reference point is determined. The bus is then unloaded and the residual (permanent) deflection is recorded. On the final test, the maximum loaded deflection was 0.155 inches at reference point 2. The maximum permanent deflection after the final loading sequence ranged from -.006 inches at reference point 2 to 0.006 inches at reference point 7.

STRUCTURAL SHAKEDOWN DATA FORM

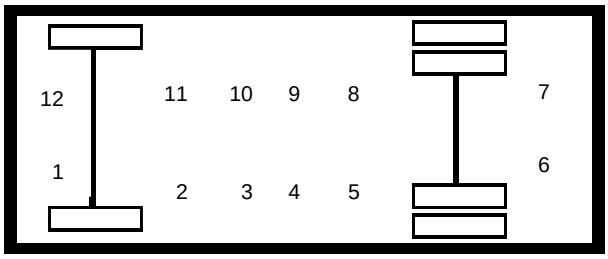
Bus Number: 0812	Date: 8-4-08
Personnel: T.S., E.D., E.L. & S.C.	Temperature (°F): 71
Loading Sequence: ■ 1 □ 2 □ 3 (check one) Test Load (lbs): 10,875	

Indicate Approximate Location of Each Reference Point

Right

Front of Bus

Left



Top View

Reference Point No.	A (in) Original Height	B (in) Loaded Height	B-A (in) Loaded Deflection	C (in) Unloaded Height	C-A (in) Permanent Deflection
1	0	-.068	-.068	-.002	-.002
2	0	.187	.187	.028	.028
3	0	.090	.090	.011	.011
4	0	.116	.116	.022	.022
5	0	.086	.086	.006	.006
6	0	.150	.150	.015	.015
7	0	.139	.139	.015	.015
8	0	.094	.094	.012	.012
9	0	.104	.104	.012	.012
10	0	.090	.090	.010	.010
11	0	.056	.056	.009	.009
12	0	-.080	-.080	-.003	-.003

STRUCTURAL SHAKEDOWN DATA FORM

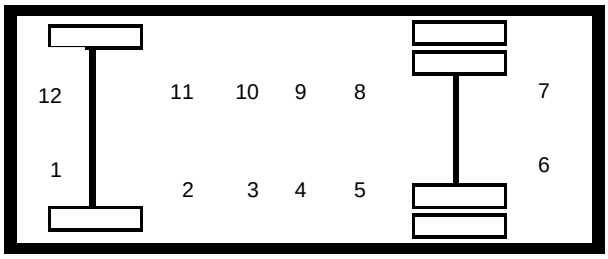
Bus Number: 0812	Date: 8-4-08
Personnel: T.S., E,.D., E.L. & S.C.	Temperature (°F): 76
Loading Sequence: □ 1 ■ 2 □ 3 (check one) Test Load (lbs): 10,875	

Indicate Approximate Location of Each Reference Point

Right

Front of Bus

Left



Top View

Reference Point No.	A (in) Original Height	B (in) Loaded Height	B-A (in) Loaded Deflection	C (in) Unloaded Height	C-A (in) Permanent Deflection
1	-.002	-.067	-.065	-.004	-.002
2	.028	.183	.155	.022	-.006
3	.011	.087	.076	.007	-.004
4	.022	.110	.088	.017	-.005
5	.006	.089	.083	.010	.004
6	.015	.167	.152	.020	.005
7	.015	.165	.150	.021	.006
8	.012	.091	.079	.011	-.001
9	.012	.100	.088	.011	-.001
10	.010	.087	.077	.010	.000
11	.009	.056	.047	.010	.001
12	-.003	-.080	-.077	.000	.003

5.1 STRUCTURAL SHAKEDOWN TEST

BUS LOADED TO 2.5 TIMES GVL
(10,875 LBS)

5.2 STRUCTURAL STRENGTH AND DISTORTION TESTS - STRUCTURAL DISTORTION

5.2-I. TEST OBJECTIVE

The objective of this test is to observe the operation of the bus subsystems when the bus is placed in a longitudinal twist simulating operation over a curb or through a pothole.

5.2-II. TEST DESCRIPTION

With the bus loaded to GVWR, each wheel of the bus will be raised (one at a time) to simulate operation over a curb and the following will be inspected:

1. Body
2. Windows
3. Doors
4. Roof vents
5. Special seating
6. Undercarriage
7. Engine
8. Service doors
9. Escape hatches
10. Steering mechanism

Each wheel will then be lowered (one at a time) to simulate operation through a pothole and the same items inspected.

5.2-III. DISCUSSION

The test sequence was repeated ten times. The first and last test is with all wheels level. The other eight tests are with each wheel 6 inches higher and 6 inches lower than the other three wheels.

All doors, windows, escape mechanisms, engine, steering and handicapped devices operated normally throughout the test. The undercarriage and body indicated no deficiencies. No water leakage was observed during the test. The results of this test are indicated on the following data forms.

DISTORTION TEST INSPECTION FORM
(Note: Ten copies of this data sheet are required)

Bus Number: 0812	Date: 8-5-08
Personnel: T.S., E.L., E.D. & S.C.	Temperature(°F): 73

Wheel Position : (check one)		
All wheels level	■ before	□ after
Left front	□ 6 in higher	□ 6 in lower
Right front	□ 6 in higher	□ 6 in lower
Right rear	□ 6 in higher	□ 6 in lower
Left rear	□ 6 in higher	□ 6 in lower
Right center	□ 6 in higher	□ 6 in lower
Left center	□ 6 in higher	□ 6 in lower

	Comments
■ Windows	No deficiencies.
■ Front Doors	No deficiencies.
■ Rear Doors	No deficiencies.
■ Escape Mechanisms/ Roof Vents	No deficiencies.
■ Engine	No deficiencies.
■ Handicapped Device/ Special Seating	No deficiencies.
■ Undercarriage	No deficiencies.
■ Service Doors	No deficiencies.
■ Body	No deficiencies.
■ Windows/ Body Leakage	No deficiencies.
■ Steering Mechanism	No deficiencies.

DISTORTION TEST INSPECTION FORM
(Note: Ten copies of this data sheet are required)

Bus Number: 0812	Date: 8-5-08
Personnel: T.S., E.L., E.D. & S.C.	Temperature(°F): 73

Wheel Position : (check one)		
All wheels level	□ before	□ after
Left front	■ 6 in higher	□ 6 in lower
Right front	□ 6 in higher	□ 6 in lower
Right rear	□ 6 in higher	□ 6 in lower
Left rear	□ 6 in higher	□ 6 in lower
Right center	□ 6 in higher	□ 6 in lower
Left center	□ 6 in higher	□ 6 in lower

	Comments
■ Windows	No deficiencies.
■ Front Doors	No deficiencies.
■ Rear Doors	No deficiencies.
■ Escape Mechanisms/ Roof Vents	No deficiencies.
■ Engine	No deficiencies.
■ Handicapped Device/ Special Seating	No deficiencies.
■ Undercarriage	No deficiencies.
■ Service Doors	No deficiencies.
■ Body	No deficiencies.
■ Windows/ Body Leakage	No deficiencies.
■ Steering Mechanism	No deficiencies.

DISTORTION TEST INSPECTION FORM
(Note: Ten copies of this data sheet are required)

Bus Number: 0812	Date: 8-5-08
Personnel: T.S., E.L., E.D. & S.C.	Temperature(°F): 73

Wheel Position : (check one)		
All wheels level	□ before	□ after
Left front	□ 6 in higher	□ 6 in lower
Right front	■ 6 in higher	□ 6 in lower
Right rear	□ 6 in higher	□ 6 in lower
Left rear	□ 6 in higher	□ 6 in lower
Right center	□ 6 in higher	□ 6 in lower
Left center	□ 6 in higher	□ 6 in lower

	Comments
■ Windows	No deficiencies.
■ Front Doors	No deficiencies.
■ Rear Doors	No deficiencies.
■ Escape Mechanisms/ Roof Vents	No deficiencies.
■ Engine	No deficiencies.
■ Handicapped Device/ Special Seating	No deficiencies.
■ Undercarriage	No deficiencies.
■ Service Doors	No deficiencies.
■ Body	No deficiencies.
■ Windows/ Body Leakage	No deficiencies.
■ Steering Mechanism	No deficiencies.

DISTORTION TEST INSPECTION FORM
(Note: Ten copies of this data sheet are required)

Bus Number: 0812	Date: 8-5-08
Personnel: T.S., E.L., E.D. & S.C.	Temperature(°F): 73

Wheel Position : (check one)		
All wheels level	□ before	□ after
Left front	□ 6 in higher	□ 6 in lower
Right front	□ 6 in higher	□ 6 in lower
Right rear	■ 6 in higher	□ 6 in lower
Left rear	□ 6 in higher	□ 6 in lower
Right center	□ 6 in higher	□ 6 in lower
Left center	□ 6 in higher	□ 6 in lower

	Comments
■ Windows	No deficiencies.
■ Front Doors	No deficiencies.
■ Rear Doors	No deficiencies.
■ Escape Mechanisms/ Roof Vents	No deficiencies.
■ Engine	No deficiencies.
■ Handicapped Device/ Special Seating	No deficiencies.
■ Undercarriage	No deficiencies.
■ Service Doors	No deficiencies.
■ Body	No deficiencies.
■ Windows/ Body Leakage	No deficiencies.
■ Steering Mechanism	No deficiencies.

DISTORTION TEST INSPECTION FORM
(Note: Ten copies of this data sheet are required)

Bus Number: 0812	Date: 8-5-08
Personnel: T.S., E.L., E.D. & S.C.	Temperature(°F): 73

Wheel Position : (check one)		
All wheels level	□ before	□ after
Left front	□ 6 in higher	□ 6 in lower
Right front	□ 6 in higher	□ 6 in lower
Right rear	□ 6 in higher	□ 6 in lower
Left rear	■ 6 in higher	□ 6 in lower
Right center	□ 6 in higher	□ 6 in lower
Left center	□ 6 in higher	□ 6 in lower

	Comments
■ Windows	No deficiencies.
■ Front Doors	No deficiencies.
■ Rear Doors	No deficiencies.
■ Escape Mechanisms/ Roof Vents	No deficiencies.
■ Engine	No deficiencies.
■ Handicapped Device/ Special Seating	No deficiencies.
■ Undercarriage	No deficiencies.
■ Service Doors	No deficiencies.
■ Body	No deficiencies.
■ Windows/ Body Leakage	No deficiencies.
■ Steering Mechanism	No deficiencies.

DISTORTION TEST INSPECTION FORM
(Note: Ten copies of this data sheet are required)

Bus Number: 0812	Date: 8-5-08
Personnel: T.S., E.L., E.D. & S.C.	Temperature(°F): 73

Wheel Position : (check one)		
All wheels level	□ before	□ after
Left front	□ 6 in higher	□ 6 in lower
Right front	□ 6 in higher	□ 6 in lower
Right rear	□ 6 in higher	□ 6 in lower
Left rear	□ 6 in higher	■ 6 in lower
Right center	□ 6 in higher	□ 6 in lower
Left center	□ 6 in higher	□ 6 in lower

	Comments
■ Windows	No deficiencies.
■ Front Doors	No deficiencies.
■ Rear Doors	No deficiencies.
■ Escape Mechanisms/ Roof Vents	No deficiencies.
■ Engine	No deficiencies.
■ Handicapped Device/ Special Seating	No deficiencies.
■ Undercarriage	No deficiencies.
■ Service Doors	No deficiencies.
■ Body	No deficiencies.
■ Windows/ Body Leakage	No deficiencies.
■ Steering Mechanism	No deficiencies.

DISTORTION TEST INSPECTION FORM
(Note: Ten copies of this data sheet are required)

Bus Number: 0812	Date: 8-5-08
Personnel: T.S., E.L., E.D. & S.C.	Temperature(°F): 73

Wheel Position : (check one)		
All wheels level	□ before	□ after
Left front	□ 6 in higher	□ 6 in lower
Right front	□ 6 in higher	□ 6 in lower
Right rear	□ 6 in higher	■ 6 in lower
Left rear	□ 6 in higher	□ 6 in lower
Right center	□ 6 in higher	□ 6 in lower
Left center	□ 6 in higher	□ 6 in lower

	Comments
■ Windows	No deficiencies.
■ Front Doors	No deficiencies.
■ Rear Doors	No deficiencies.
■ Escape Mechanisms/ Roof Vents	No deficiencies.
■ Engine	No deficiencies.
■ Handicapped Device/ Special Seating	No deficiencies.
■ Undercarriage	No deficiencies.
■ Service Doors	No deficiencies.
■ Body	No deficiencies.
■ Windows/ Body Leakage	No deficiencies.
■ Steering Mechanism	No deficiencies.

DISTORTION TEST INSPECTION FORM
(Note: Ten copies of this data sheet are required)

Bus Number: 0812	Date: 8-5-08
Personnel: T.S., E.L., E.D. & S.C.	Temperature(°F): 73

Wheel Position : (check one)		
All wheels level	□ before	□ after
Left front	□ 6 in higher	□ 6 in lower
Right front	□ 6 in higher	■ 6 in lower
Right rear	□ 6 in higher	□ 6 in lower
Left rear	□ 6 in higher	□ 6 in lower
Right center	□ 6 in higher	□ 6 in lower
Left center	□ 6 in higher	□ 6 in lower

	Comments
■ Windows	No deficiencies.
■ Front Doors	No deficiencies.
■ Rear Doors	No deficiencies.
■ Escape Mechanisms/ Roof Vents	No deficiencies.
■ Engine	No deficiencies.
■ Handicapped Device/ Special Seating	No deficiencies.
■ Undercarriage	No deficiencies.
■ Service Doors	No deficiencies.
■ Body	No deficiencies.
■ Windows/ Body Leakage	No deficiencies.
■ Steering Mechanism	No deficiencies.

DISTORTION TEST INSPECTION FORM
(Note: Ten copies of this data sheet are required)

Bus Number: 0812	Date: 8-5-08
Personnel: T.S., E.L., E.D. & S.C.	Temperature(°F): 73

Wheel Position : (check one)		
All wheels level	□ before	□ after
Left front	□ 6 in higher	■ 6 in lower
Right front	□ 6 in higher	□ 6 in lower
Right rear	□ 6 in higher	□ 6 in lower
Left rear	□ 6 in higher	□ 6 in lower
Right center	□ 6 in higher	□ 6 in lower
Left center	□ 6 in higher	□ 6 in lower

	Comments
■ Windows	No deficiencies.
■ Front Doors	No deficiencies.
■ Rear Doors	No deficiencies.
■ Escape Mechanisms/ Roof Vents	No deficiencies.
■ Engine	No deficiencies.
■ Handicapped Device/ Special Seating	No deficiencies.
■ Undercarriage	No deficiencies.
■ Service Doors	No deficiencies.
■ Body	No deficiencies.
■ Windows/ Body Leakage	No deficiencies.
■ Steering Mechanism	No deficiencies.

DISTORTION TEST INSPECTION FORM
(Note: Ten copies of this data sheet are required)

Bus Number: 0812	Date: 8-5-08
Personnel: T.S., E.L., E.D. & S.C.	Temperature(°F): 73

Wheel Position : (check one)		
All wheels level	□ before	■ after
Left front	□ 6 in higher	□ 6 in lower
Right front	□ 6 in higher	□ 6 in lower
Right rear	□ 6 in higher	□ 6 in lower
Left rear	□ 6 in higher	□ 6 in lower
Right center	□ 6 in higher	□ 6 in lower
Left center	□ 6 in higher	□ 6 in lower

	Comments
■ Windows	No deficiencies.
■ Front Doors	No deficiencies.
■ Rear Doors	No deficiencies.
■ Escape Mechanisms/ Roof Vents	No deficiencies.
■ Engine	No deficiencies.
■ Handicapped Device/ Special Seating	No deficiencies.
■ Undercarriage	No deficiencies
■ Service Doors	No deficiencies.
■ Body	No deficiencies.
■ Windows/ Body Leakage	No deficiencies.
■ Steering Mechanism	No deficiencies.

5.2 STRUCTURAL DISTORTION TEST

RIGHT FRONT WHEEL SIX INCHES HIGHER

LEFT FRONT WHEEL SIX INCHES LOWER

5.3 STRUCTURAL STRENGTH AND DISTORTION TESTS - STATIC TOWING TEST

5.3-I. TEST OBJECTIVE

The objective of this test is to determine the characteristics of the bus towing mechanisms under static loading conditions.

5.3-II. TEST DESCRIPTION

Utilizing a load-distributing yoke, a hydraulic cylinder is used to apply a static tension load equal to 1.2 times the bus curb weight. The load will be applied to both the front and rear, if applicable, towing fixtures at an angle of 20 degrees with the longitudinal axis of the bus, first to one side then the other in the horizontal plane, and then upward and downward in the vertical plane. Any permanent deformation or damage to the tow eyes or adjoining structure will be recorded.

5.3-III. DISCUSSION

The test bus submitted for testing was not equipped with any type of tow eyes or tow hooks, therefore, the Static Towing Test was not performed.

5.4 STRUCTURAL STRENGTH AND DISTORTION TESTS - DYNAMIC TOWING TEST

5.4-I. TEST OBJECTIVE

The objective of this test is to verify the integrity of the towing fixtures and determine the feasibility of towing the bus under manufacturer specified procedures.

5.4-II. TEST DESCRIPTION

This test requires the bus be towed at curb weight using the specified equipment and instructions provided by the manufacturer and a heavy-duty wrecker. The bus will be towed for 5 miles at a speed of 20 mph for each recommended towing configuration. After releasing the bus from the wrecker, the bus will be visually inspected for any structural damage or permanent deformation. All doors, windows and passenger escape mechanisms will be inspected for proper operation.

5.4-III. DISCUSSION

The bus was towed using a heavy-duty wrecker. The towing interface was accomplished by incorporating a hydraulic under lift. A front lift tow was performed. Rear towing is not recommended. No problems, deformation, or damage was noted during testing.

DYNAMIC TOWING TEST DATA FORM

Bus Number: 0812	Date: 12-12-08
Personnel: S.C.	

Temperature (°F): 30	Humidity (%): 68
Wind Direction: W	Wind Speed (mph): 8
Barometric Pressure (in.Hg): 30.05	

Inspect tow equipment-bus interface.
Comments: A safe and adequate connection was made between the tow equipment and the bus.
Inspect tow equipment-wrecker interface.
Comments: A safe and adequate connection was made between the tow equipment and the wrecker.
Towing Comments: A front lift tow was performed incorporation a hydraulic under lift wrecker.
Description and location of any structural damage: None noted.
General Comments: No problems were encountered with the tow or towing interface.

5.4 DYNAMIC TOWING TEST

TOWING INTERFACE

TEST BUS IN TOW

5.5 STRUCTURAL STRENGTH AND DISTORTION TESTS – JACKING TEST

5.5-I. TEST OBJECTIVE

The objective of this test is to inspect for damage due to the deflated tire, and determine the feasibility of jacking the bus with a portable hydraulic jack to a height sufficient to replace a deflated tire.

5.5-II. TEST DESCRIPTION

With the bus at curb weight, the tire(s) at one corner of the bus are replaced with deflated tire(s) of the appropriate type. A portable hydraulic floor jack is then positioned in a manner and location specified by the manufacturer and used to raise the bus to a height sufficient to provide 3-in clearance between the floor and an inflated tire. The deflated tire(s) are replaced with the original tire(s) and the hack is lowered. Any structural damage or permanent deformation is recorded on the test data sheet. This procedure is repeated for each corner of the bus.

5.5-III. DISCUSSION

The jack used for this test has a minimum height of 8.75 inches. During the deflated portion of the test, the jacking point clearances ranged from 11.5 inches to 4.8 inches. No deformation or damage was observed during testing. A complete listing of jacking point clearances is provided in the Jacking Test Data Form.

JACKING CLEARANCE SUMMARY

Condition	Frame Point Clearance
Front axle – one tire flat	9.9”
Rear axle – one tire flat	11.0”
Rear axle – two tires flat	9.3”

JACKING TEST DATA FORM

Bus Number: 0812	Date: 8-1-08
Personnel: E.D.	Temperature (°F): 80

Record any permanent deformation or damage to bus as well as any difficulty encountered during jacking procedure.

Deflated Tire	Jacking Pad Clearance Body/Frame (in)	Jacking Pad Clearance Axle/Suspension (in)	Comments
Right front	11.6 " I 9.9 " D	9.1 " I 6.5 " D	
Left front	12.2 " I 10.6 " D	9.0 " I 6.5 " D	
Right rear—outside	11.5 " I 11.0 " D	6.7 " I 6.4 " D	
Right rear—both	11.5 " I 9.3 " D	6.7 " I 4.9 " D	
Left rear—outside	11.9 " I 11.5 " D	6.7 " I 6.4 " D	
Left rear—both	11.9 " I 9.6 " D	6.7 " I 4.8 " D	
Right middle or tag—outside	NA	NA	
Right middle or tag—both	NA	NA	
Left middle or tag—outside	NA	NA	
Left middle or tag—both	NA	NA	

Additional comments of any deformation or difficulty during jacking:
None noted.

5.6 STRUCTURAL STRENGTH AND DISTORTION TESTS - HOISTING TEST

5.6-I. TEST OBJECTIVE

The objective of this test is to determine possible damage or deformation caused by the jack/stands.

5.6-II. TEST DESCRIPTION

With the bus at curb weight, the front end of the bus is raised to a height sufficient to allow manufacturer-specified placement of jack stands under the axles or jacking pads independent of the hoist system. The bus will be checked for stability on the jack stands and for any damage to the jacking pads or bulkheads. The procedure is repeated for the rear end of the bus. The procedure is then repeated for the front and rear simultaneously.

5.6-III. DISCUSSION

The test was conducted using four posts of a six-post electric lift and standard 19 inch jack stands. The bus was hoisted from the front wheel, rear wheel, and then the front and rear wheels simultaneously and placed on jack stands.

The bus easily accommodated the placement of the vehicle lifts and jack stands and the procedure was performed without any instability noted.

HOISTING TEST DATA FORM

Bus Number: 0812	Date: 8-1-08
Personnel: S.C. & E.D.	Temperature (°F): 80

Comments of any structural damage to the jacking pads or axles while both the front wheels are supported by the jack stands:
None noted.
Comments of any structural damage to the jacking pads or axles while both the rear wheels are supported by the jack stands:
None noted.
Comments of any structural damage to the jacking pads or axles while both the front and rear wheels are supported by the jack stands:
None noted.

5.7 STRUCTURAL DURABILITY TEST

5.7-I. TEST OBJECTIVE

The objective of this test is to perform an accelerated durability test that approximates up to 25 percent of the service life of the vehicle.

5.7-II. TEST DESCRIPTION

The test vehicle is driven a total of 7,500 miles; approximately 5,000 miles on the PSBRTF Durability Test Track and approximately 2,500 miscellaneous other miles. The test will be conducted with the bus operated under three different loading conditions. The first segment will consist of approximately 3,000 miles with the bus operated at GVW. The second segment will consist of approximately 1,500 miles with the bus operated at SLW. The remainder of the test, approximately 3,000 miles, will be conducted with the bus loaded to CW. If GVW exceeds the axle design weights, then the load will be adjusted to the axle design weights and the change will be recorded. All subsystems are run during these tests in their normal operating modes. All recommended manufacturers servicing is to be followed and noted on the vehicle maintainability log. Servicing items accelerated by the durability tests will be compressed by 10:1; all others will be done on a 1:1 mi/mi basis. Unscheduled breakdowns and repairs are recorded on the same log as are any unusual occurrences as noted by the driver. Once a week the test vehicle shall be washed down and thoroughly inspected for any signs of failure.

5.7-III. DISCUSSION

The Structural Durability Test was started on September 10, 2008 and was conducted until November 28, 2008. The first 3,000 miles were performed at a GVW of 12,960 lbs. and completed on October 22, 2008. The next 1,500 mile SLW segment was performed at 11,800 lbs and completed on November 6, 2008 and the final 3,000 mile segment was performed at a CW of 8,870 lbs and completed on November 28, 2008.

The following mileage summary presents the accumulation of miles during the Structural Durability Test. The driving schedule is included, showing the operating duty cycle. A detailed plan view of the Test Track Facility and Durability Test Track are attached for reference. Also, a durability element profile detail shows all the measurements of the different conditions. Finally, photographs illustrating some of the failures that were encountered during the Structural Durability Test are included.

ARBOC - TEST BUS #0812

MILEAGE DRIVEN/RECORDED FROM DRIVER'S LOGS

DATE	TOTAL DURABILITY TRACK	TOTAL OTHER MILES	TOTAL
9/08/2008 TO 09/14/08	456.00	70.00	526.00
9/15/08 TO 09/21/08	52.00	52.00	104.00
9/22/08 TO 09/28/08	264.00	63.00	327.00
9/29/08 TO 10/05/08	282.00	14.00	296.00
10/06/08 TO 10/12/08	123.00	168.00	291.00
10/13/08 TO 10/19/08	416.00	242.00	658.00
10/20/08 TO 10/26/08	438.00	21.00	459.00
10/27/08 TO 11/02/08	333.00	14.00	347.00
11/03/08 TO 11/09/08	704.00	860.00	1564.00
11/10/08 TO 11/16/08	899.00	44.00	943.00
11/17/08 TO 11/23/08	801.00	134.00	935.00
11/24/08 TO 11/30/08	232.00	821.00	1053.00
TOTAL	5000.00	2503.00	7503.00

Table 4. Driving Schedule for Bus Operation on the Durability Test Track.

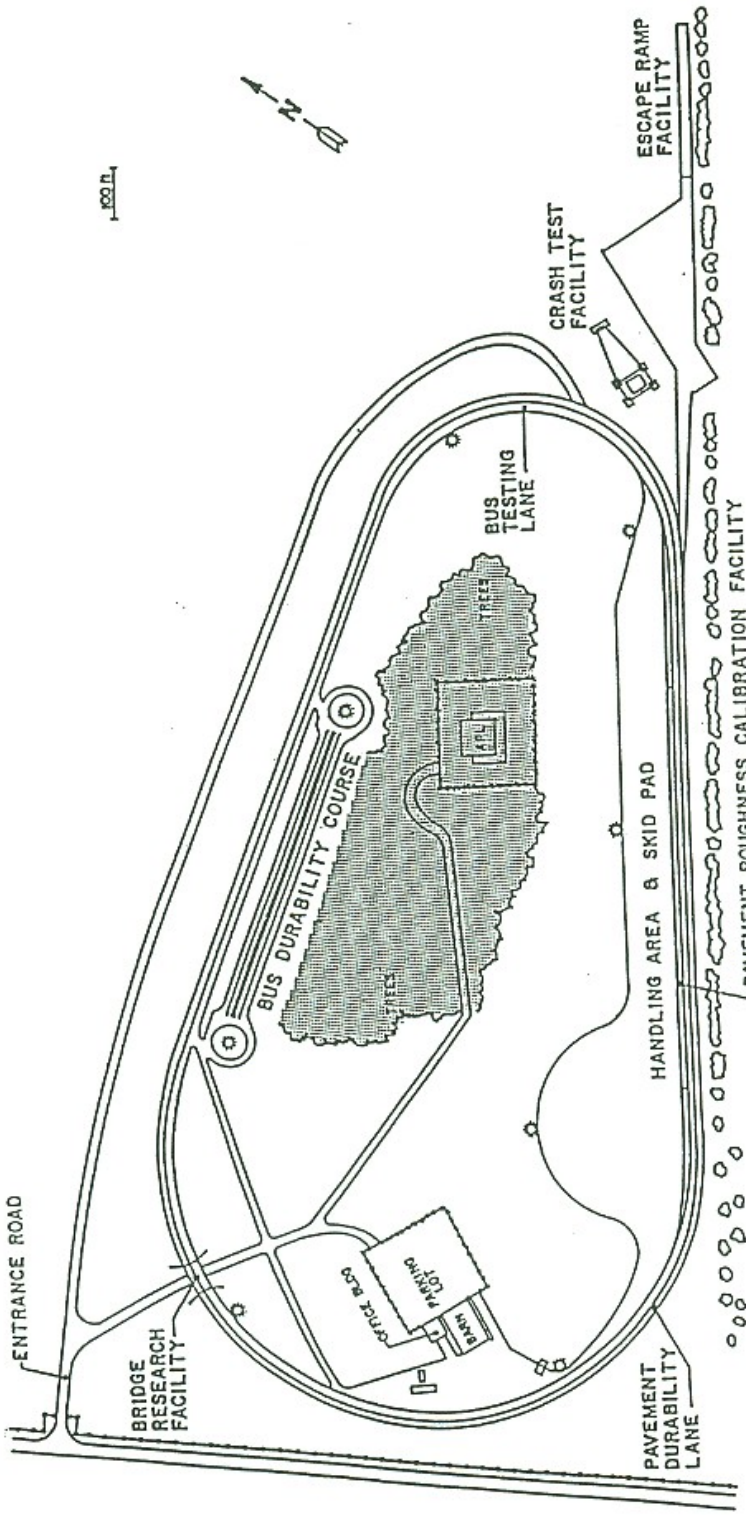
STANDARD OPERATING SCHEDULE

Monday through Friday

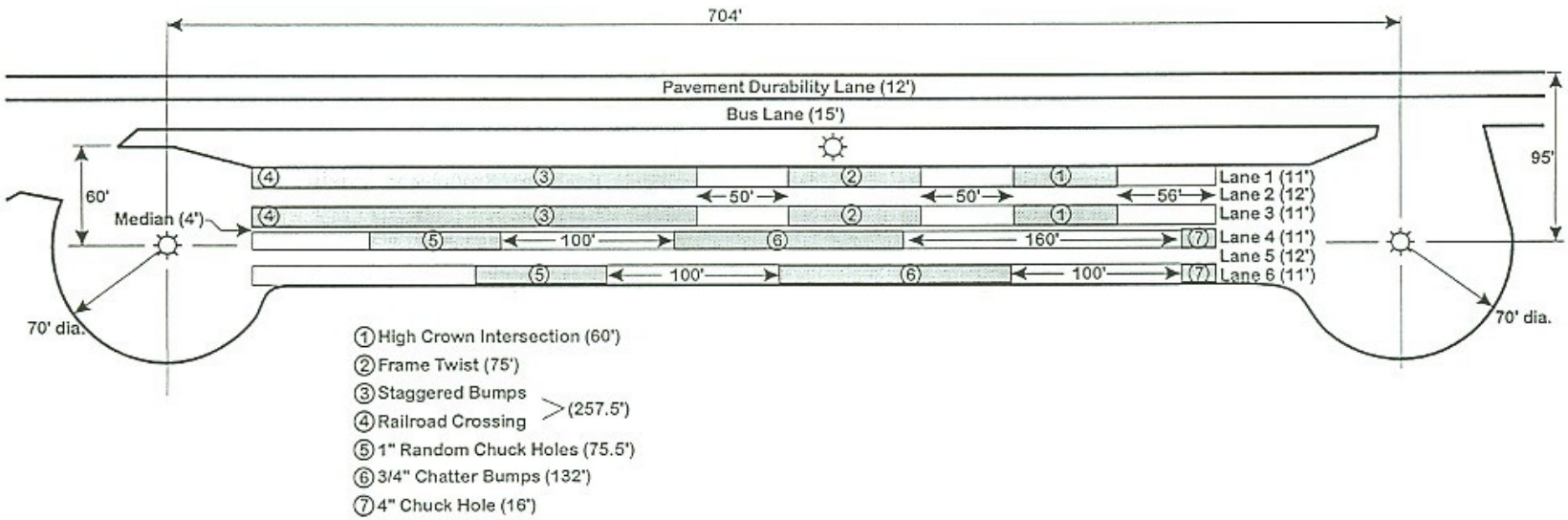
	HOUR	ACTION
Shift 1	midnight	D
	1:40 am	C
	1:50 am	B
	2:00 am	D
	3:35 am	C
	3:45 am	B
	4:05 am	D
	5:40 am	C
	5:50 am	B
	6:00 am	D
	7:40 am	C
	7:50 am	F
Shift 2	8:00 am	D
	9:40 am	C
	9:50 am	B
	10:00 am	D
	11:35 am	C
	11:45 am	B
	12:05 pm	D
	1:40 pm	C
	1:50 pm	B
	2:00 pm	D
	3:40 pm	C
	3:50 pm	F
Shift 3	4:00 pm	D
	5:40 pm	C
	5:50 pm	B
	6:00 pm	D
	7:40 pm	C
	7:50 pm	B
	8:05 pm	D
	9:40 pm	C
	9:50 pm	B
	10:00 pm	D
	11:40 pm	C
	11:50 pm	F

B---Break
C----Cycle all systems five times, visual inspection, driver's log entries
D----Drive bus as specified by procedure
F----Fuel bus, complete driver's log shift entries

"PLAN VIEW OF PENN STATE BUS TESTING AND RESEARCH FACILITY"



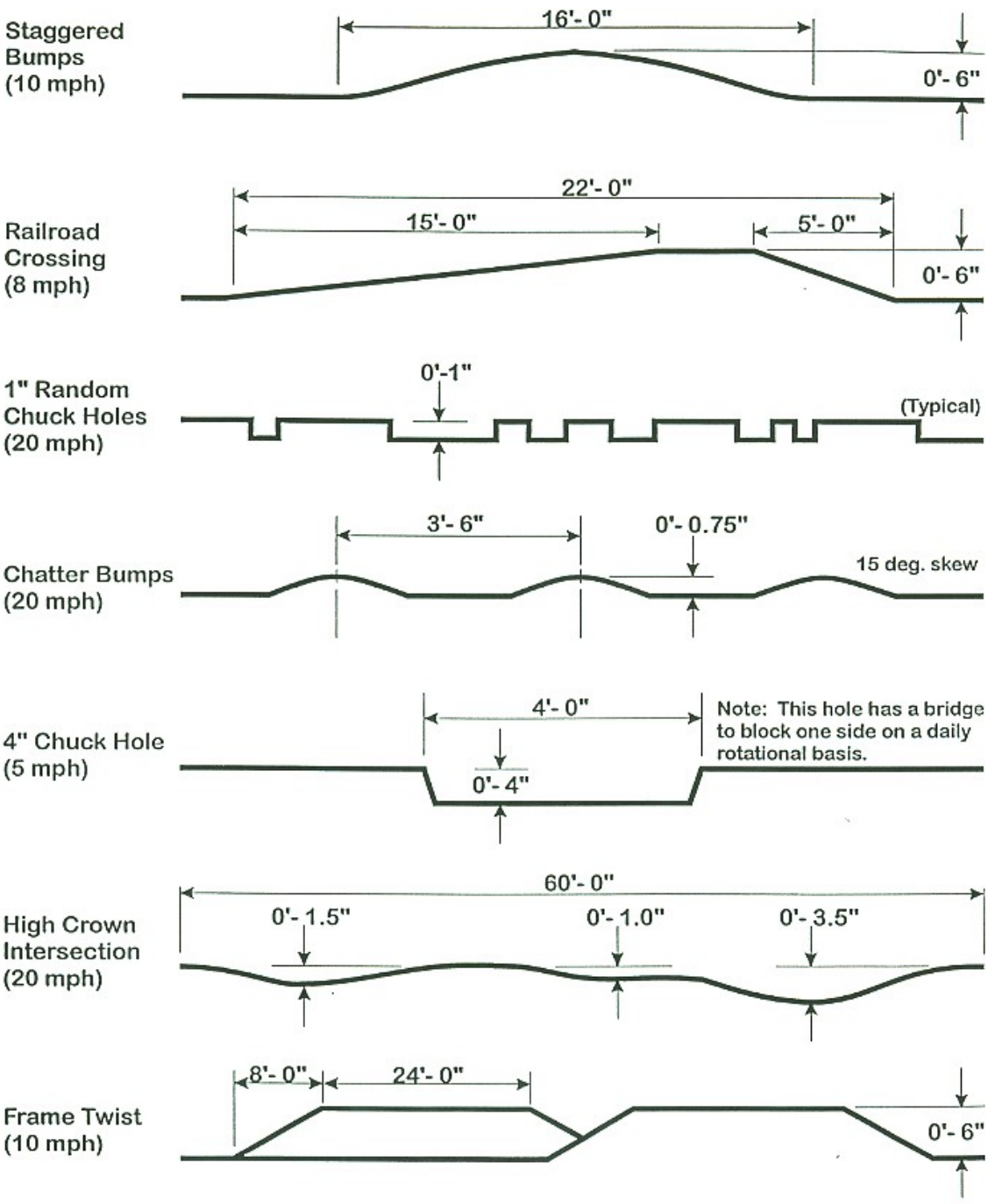
BUS TESTING AND RESEARCH TEST TRACK
UNIVERSITY PARK, PA



Plan View

Vehicle Durability Test Track

The Pennsylvania Transportation Institute
Penn State



Durability Element Profiles

The Pennsylvania Transportation Institute
Penn State

UNSCHEDULED MAINTENANCE

ARBOC Bus #0812

DATE	TEST MILES	SERVICE	ACTIVITY	MAN HOURS	DOWN TIME
09-12-08	482	Both rear sway bar brackets are loose.	Replaced broken mounting bolts.	2.00	1.00
09-19-08	630	The trailing arm bushings are worn.	Replaced trailing arm bushings.	12.00	4.00
09-22-08	630	Both frame rails are cracked in the rear wheel well area. Twenty-two incomplete frame spot welds were found.	Welded/repaired both frame cracks. Rewelded 22 incomplete spot welds on the frame; 19 on the left side and 12 on the right side. Replaced both rear air bags with bases 2 5/8" higher. Repaired small crack at the forward, lower corner of the entrance door and added gusset.	10.00	123.00
09-26-08	630	The left rear sway bar bracket is broken.	Replaced left rear sway bar bracket.	1.50	47.00
09-29-08	1,059	Two bolts are missing from the right side engine mount.	Realigned engine mount and installed new bolts and nuts.	2.00	3.00
10-01-08	1,214	The air system will not build air. Air is exhausting out of the relief valve onto the air control board.	Manufacturer requests oil type be changed. Oil changed and control board replaced.	4.00	36.00
10-07-08	1,253	Air compressor is running, will not build air. Pressure relief valve is exhausting on the Hadley unit.	Replaced Hadley unit.	8.00	126.00

UNSCHEDULED MAINTENANCE

ARBOC Bus #0812

DATE	TEST MILES	SERVICE	ACTIVITY	MAN HOURS	DOWN TIME
10-07-08	1,253	The bushings are worn on the lower trailing arms.	Replaced lower trailing arms.	4.00	2.00
10-13-08	1,771	The welds are cracked on the trailing arm hangers at the rear axle.	Welded/repaired trailing arm hangers cracks.	2.00	4.00
10-14-08	1,988	The rear sway bar clamp bolt is broken at the right lower position.	Replaced bolt, nut and washer.	1.00	1.00
10-15-08	2,146	The battery and battery box are loose.	Installed new fasteners in battery box. Battery box is broken. Ordered new battery box.	3.00	2.00
10-20-08	2,202	The right rear air bag pedestal is broken in two at the sway bar clamp area. The air bag is gent and the way bar clamp is bent.	Replaced air bag pedestal, tie bar, sway bar bushing.	5.00	70.00
10-20-08	2,202	The weld is broken on the left rear suspension hanger.	Welded/repaired suspension hanger.	1.00	1.00
10-21-08	2,384	The left rear sway bar link is broken.	Replaced left rear sway bar link.	2.00	2.00
10-21-08	2,384	The left rear outside tire is flat.	Plugged/repaired left rear outside tire.	2.00	2.00
10-22-08	2,585	The right front sway bar link is broken.	Replaced right front sway bar link.	0.50	2.00

UNSCHEDULED MAINTENANCE

ARBOC Bus #0812

DATE	TEST MILES	SERVICE	ACTIVITY	MAN HOURS	DOWN TIME
10-23-08	2,659	Bus is leaning to the left rear. Rear leveling valve flipped 180 degrees and hung up on emergency brake cable.	Wrapped emergency brake cable tie out of interference with leveling valve and replaced broken bolt in leveling valve.	4.00	2.00
10-28-08 and 10-29-08	2,661	The right rear air bag pedestal is broken causing damage to the right rear sway bar bracket and the air bag tie bar.	Replaced right rear air bag pedestal and right rear sway bar bracket.	15.00	118.00
10-30-08	2,786	The grill fell out.	Repaired grill mounting points with angle brackets. Remounted grill.	1.00	1.00
10-30-08	2,786	The left front marker lamp is burned out.	Replaced left front marker lamp.	0.25	0.25
10-30-08	2,786	New battery box arrived (battery box repaired on 10/15/08).	Replaced damaged battery box.	1.75	4.00
11-03-08	3,008	The left rear sway bar clamp is bent and the lower mounting bolt is missing.	Replaced clamp, bushing and mounting bolts.	1.00	0.50
11-03-08	3,008	The air suspension will not rise after kneeling.	Troubleshooted. Repaired broken wire at the door function switch.	4.00	13.00
11-05-08	3,409	The grill fell off.	Repaired grill mounts and reinstalled grill.	1.00	0.50

UNSCHEDULED MAINTENANCE

ARBOC Bus #0812

DATE	TEST MILES	SERVICE	ACTIVITY	MAN HOURS	DOWN TIME
11-05-08	3,409	The right side exterior rear view mirror is loose.	Disassembled mirror, drilled mounting holes out to 1/4" and larger bolts used for installation.	2.00	2.00
11-11-08	4,886	Front sway bar--left sway bar clamp is broken.	Replaced left sway bar clamp and bolts.	1.00	4.00
11-12-08	5,071	The rear lateral bar mount is cracked.	Replaced rear lateral bar mount.	2.00	3.00
11-13-08	5,291	Front sway bar; the left side bushing link is broken.	Replaced sway bar link/bushing.	1.00	2.00
11-17-08	5,515	The frame by the left rear wheel is cracked.	Welded/repaired crack and added plate.	2.50	8.00
11-17-08	5,515	The front bumper brackets are broken.	Welded/repaired front bumper brackets.	2.50	1.00
11-21-08	6,402	The left front sway bar link is broken.	Manufacturer requests temporary repair with all thread until replacement parts arrive.	2.00	4.00
11-24-08	6,450	The left front sway bar link is broken.	Replaced left front sway bar link.	1.00	10.00

UNSCHEDULED MAINTENANCE

ARBOC Bus #0812

DATE	TEST MILES	SERVICE	ACTIVITY	MAN HOURS	DOWN TIME
11-24-08	6,450	The left rear sway bar clamp is missing one mounting bolt.	Replaced missing bolt.	1.00	0.50
11-24-08	6,450	The battery tray is missing two mounting bolts.	Removed tray to install mounting bolts. Installed bolts and replaced tray.	1.00	0.50

UNSCHEDULED MAINTENANCE

LOOSE REAR SWAY BAR BRACKET BOLTS REPLACED (482 TEST MILES)

WORN TRAILING ARM BUSHING (630 TEST MILES)

UNSCHEDULED MAINTENANCE CONT.

CRACKED FRAME RAIL
(630 TEST MILES)

UNSCHEDULED MAINTENANCE CONT.

FAILED AIR CONTROL BOARD
(1,214 TEST MILES)

FAILED AIR COMPRESSOR
(1,253 TEST MILES)

UNSCHEDULED MAINTENANCE CONT.

WORN BUSHINGS IN LOWER TRAILING ARMS (1,253 TEST MILES)

TRAILING ARMS INSTALLED WITH NEW TYPE BUSHING (1,253 TEST MILES)

UNSCHEDULED MAINTENANCE CONT.

LOOSE BATTERY AND BATTERY BOX
(2,146 TEST MILES)

BROKEN RIGHT REAR AIR BAG PEDESTAL
(2,202 TEST MILES)

UNSCHEDULED MAINTENANCE CONT.

BROKEN RIGHT REAR AIR BAG PEDESTAL
(2,202 TEST MILES)

FAILED LEVELING VALVE
(2,659 TEST MILES)

UNSCHEDULED MAINTENANCE CONT.

BROKEN RIGHT REAR AIR BAG PEDESTAL
(2,661 TEST MILES)

GRILL FELL OFF
(3,409 TEST MILES)

UNSCHEDULED MAINTENANCE

CRACKED REAR LATERAL BAR MOUNT
(5,071 TEST MILES)

BROKEN FRONT BUMPER BRACKET
(5,515 TEST MILES)

6. FUEL ECONOMY TEST - A FUEL CONSUMPTION TEST USING AN APPROPRIATE OPERATING CYCLE

6-I. TEST OBJECTIVE

The objective of this test is to provide accurate comparable fuel consumption data on transit buses produced by different manufacturers. This fuel economy test bears no relation to the calculations done by the Environmental Protection Agency (EPA) to determine levels for the Corporate Average Fuel Economy Program. EPA's calculations are based on tests conducted under laboratory conditions intended to simulate city and highway driving. This fuel economy test, as designated here, is a measurement of the fuel expended by a vehicle traveling a specified test loop under specified operating conditions. The results of this test will not represent actual mileage but will provide data that can be used by recipients to compare buses tested by this procedure.

6-II. TEST DESCRIPTION

This test requires operation of the bus over a course based on the Transit Coach Operating Duty Cycle (ADB Cycle) at seated load weight using a procedure based on the Fuel Economy Measurement Test (Engineering Type) For Trucks and Buses: SAE 1376 July 82. The procedure has been modified by elimination of the control vehicle and by modifications as described below. The inherent uncertainty and expense of utilizing a control vehicle over the operating life of the facility is impractical.

The fuel economy test will be performed as soon as possible (weather permitting) after the completion of the GVW portion of the structural durability test. It will be conducted on the bus test lane at the Penn State Test Facility. Signs are erected at carefully measured points which delineate the test course. A test run will comprise 3 CBD phases, 2 Arterial phases, and 1 Commuter phase. An electronic fuel measuring system will indicate the amount of fuel consumed during each phase of the test. The test runs will be repeated until there are at least two runs in both the clockwise and counterclockwise directions in which the fuel consumed for each run is within ± 4 percent of the average total fuel used over the 4 runs. A 20-minute idle consumption test is performed just prior to and immediately after the driven portion of the fuel economy test. The amount of fuel consumed while operating at normal/low idle is recorded on the Fuel Economy Data Form. This set of four valid runs along with idle consumption data comprise a valid test.

The test procedure is the ADB cycle with the following four modifications:

1. The ADB cycle is structured as a set number of miles in a fixed time in the following order: CBD, Arterial, CBD, Arterial, CBD, and Commuter. A separate idle fuel consumption measurement is performed at the beginning and end of the fuel economy test. This phase sequence permits the reporting of fuel consumption for each of these phases separately, making the data more useful to bus manufacturers and transit properties.

2. The operating profile for testing purposes shall consist of simulated transit type service at seated load weight. The three test phases (figure 6-1) are: a central business district (CBD) phase of 2 miles with 7 stops per mile and a top speed of 20 mph; an arterial phase of 2 miles with 2 stops per mile and a top speed of 40 mph; and a commuter phase of 4 miles with 1 stop and a maximum speed of 40 mph. At each designated stop the bus will remain stationary for seven seconds. During this time, the passenger doors shall be opened and closed.

3. The individual ADB phases remain unaltered with the exception that 1 mile has been changed to 1 lap on the Penn State Test Track. One lap is equal to 5,042 feet. This change is accommodated by adjusting the cruise distance and time.

4. The acceleration profile, for practical purposes and to achieve better repeatability, has been changed to "full throttle acceleration to cruise speed".

Several changes were made to the Fuel Economy Measurement Test (Engineering Type) For Trucks and Buses: SAE 1376 July 82:

1. Sections 1.1, and 1.2 only apply to diesel, gasoline, methanol, and any other fuel in the liquid state (excluding cryogenic fuels).

1.1 SAE 1376 July 82 requires the use of at least a 16-gal fuel tank. Such a fuel tank when full would weigh approximately 160 lb. It is judged that a 12-gal tank weighing approximately 120 lb will be sufficient for this test and much easier for the technician and test personnel to handle.

1.2 SAE 1376 July 82 mentions the use of a mechanical scale or a flowmeter system. This test procedure uses a load cell readout combination that provides an accuracy of 0.5 percent in weight and permits on-board weighing of the gravimetric tanks at the end of each phase. This modification permits the determination of a fuel economy value for each phase as well as the overall cycle.

2. Section 2.1 applies to compressed natural gas (CNG), liquefied natural gas (LNG), cryogenic fuels, and other fuels in the vapor state.

2.1 A laminar type flowmeter will be used to determine the fuel consumption. The pressure and temperature across the flow element will be monitored by the flow computer. The flow computer will use this data to calculate the gas flow rate. The flow computer will also display the flow rate (scfm) as well as the total fuel used (scf). The total fuel used (scf) for each phase will be recorded on the Fuel Economy Data Form.

3. Use both Sections 1 and 2 for dual fuel systems.

FUEL ECONOMY CALCULATION PROCEDURE

A. For diesel, gasoline, methanol and fuels in the liquid state.

The reported fuel economy is based on the following: measured test quantities--distance traveled (miles) and fuel consumed (pounds); standard reference values--density of water at 60EF (8.3373 lbs/gal) and volumetric heating value of standard fuel; and test fuel specific gravity (unitless) and volumetric heating value (BTU/gal). These combine to give a fuel economy in miles per gallon (mpg) which is corrected to a standard gallon of fuel referenced to water at 60EF. This eliminates fluctuations in fuel economy due to fluctuations in fuel quality. This calculation has been programmed into a computer and the data processing is performed automatically.

The fuel economy correction consists of three steps:

1.) Divide the number of miles of the phase by the number of pounds of fuel consumed

phase	miles per phase	total miles per run
CBD	1.9097	5.7291
ART	1.9097	3.8193
COM	3.8193	3.8193

$$\mathbf{FEo_{mi/lb}} = \text{Observed fuel economy} = \frac{\text{miles}}{\text{lb of fuel}}$$

2.) Convert the observed fuel economy to miles per gallon [mpg] by multiplying by the specific gravity of the test fuel Gs (referred to water) at 60°F and multiply by the density of water at 60°F

$$\mathbf{FEo_{mpg}} = \mathbf{FEc_{mi/lb}} \times Gs \times Gw$$

where **Gs** = Specific gravity of test fuel at 60°F (referred to water)
Gw = 8.3373 lb/gal

3.) Correct to a standard gallon of fuel by dividing by the volumetric heating value of the test fuel (H) and multiplying by the volumetric heating value of standard reference fuel (Q). Both heating values must have the same units.

$$\mathbf{FEc} = \mathbf{FEo_{mpg}} \times \frac{Q}{H}$$

where

H = Volumetric heating value of test fuel [BTU/gal]
Q = Volumetric heating value of standard reference fuel

Combining steps 1-3 yields

$$\Rightarrow \quad FEc = \frac{miles}{lbs} \times (Gs \times Gw) \times \frac{Q}{H}$$

4.) Covert the fuel economy from mpg to an energy equivalent of miles per BTU. Since the number would be extremely small in magnitude, the energy equivalent will be represented as miles/BTUx10^6.

Eq = Energy equivalent of converting mpg to mile/BTUx10^6.

Eq = ((mpg)/(H))x10^6

B. CNG, LNG, cryogenic and other fuels in the vapor state.

The reported fuel economy is based on the following: measured test quantities--distance traveled (miles) and fuel consumed (scf); density of test fuel, and volumetric heating value (BTU/lb) of test fuel at standard conditions (P=14.73 psia and T=60°F). These combine to give a fuel economy in miles per lb. The energy equivalent

(mile/BTUx10^6) will also be provided so that the results can be compared to buses that use other fuels.

1.) Divide the number of miles of the phase by the number of standard cubic feet (scf) of fuel consumed.

phase	miles per phase	total miles per run
CBD	1.9097	5.7291
ART	1.9097	3.8193
COM	3.8193	3.8193

$FEo_{mi/scf}$ = Observed fuel economy = $\frac{\text{miles}}{\text{scf of fuel}}$

2.) Convert the observed fuel economy to miles per lb by dividing FEo by the density of the test fuel at standard conditions (Lb/ft^3).

Note: The density of test fuel must be determined at standard conditions as described above. If the density is not defined at the above standard conditions, then a correction will be needed before the fuel economy can be calculated.

$$FEo_{mi/lb} = FEo / Gm$$

where Gm = Density of test fuel at standard conditions

3.) Convert the observed fuel economy (FEomi/lb) to an energy equivalent of (miles/BTUx10^6) by dividing the observed fuel economy (FEomi/lb) by the heating value of the test fuel at standard conditions.

$$Eq = ((FEomi/lb)/H)x10^6$$

where

Eq = Energy equivalent of miles/lb to mile/BTUx10^6
H = Volumetric heating value of test fuel at standard conditions

6-III. DISCUSSION

This is a comparative test of fuel economy using gasoline fuel with a heating value of 20,025.0 btu/lb. The driving cycle consists of Central Business District (CBD), Arterial (ART), and Commuter (COM) phases as described in 6-II. The fuel consumption for each driving cycle and for idle is measured separately. The results are corrected to a reference fuel with a volumetric heating value of 127,700.0 btu/gal.

An extensive pretest maintenance check is made including the replacement of all lubrication fluids. The details of the pretest maintenance are given in the first three Pretest Maintenance Forms. The fourth sheet shows the Pretest Inspection. The next sheet shows the correction calculation for the test fuel. The next four Fuel Economy Forms provide the data from the four test runs. Finally, the summary sheet provides the average fuel consumption. The overall average is based on total fuel and total mileage for each phase. The overall average fuel consumption values were; CBD – 4.35 mpg, ART – 4.77 mpg, and COM – 7.84 mpg. Average fuel consumption at idle was 1.59 gal/hr.

FUEL ECONOMY PRE-TEST MAINTENANCE FORM

Bus Number: 0812	Date: 12-4-08	SLW (lbs): 11,800
Personnel: S.C. & T.S.		

FUEL SYSTEM	OK	Date	Initials
Install fuel measurement system	✓	12/4/08	S.C.
Replace fuel filter	✓	12/4/08	T.S.
Check for fuel leaks	✓	12/4/08	S.C.
Specify fuel type (refer to fuel analysis)	Gasoline		
Remarks: None noted.			
BRAKES/TIRES	OK	Date	Initials
Inspect hoses	✓	12/4/08	S.C.
Inspect brakes	✓	12/4/08	S.C.
Relube wheel bearings	✓	12/4/08	T.S.
Check tire inflation pressures (mfg. specs.)	✓	12/4/08	T.S.
Remarks: None noted.			
COOLING SYSTEM	OK	Date	Initials
Check hoses and connections	✓	12/4/08	S.C.
Check system for coolant leaks	✓	12/4/08	S.C.
Remarks: None noted.			

FUEL ECONOMY PRE-TEST MAINTENANCE FORM (page 2)

Bus Number: 0812	Date: 12-4-80
Personnel: S.C. & T.S.	

ELECTRICAL SYSTEMS	OK	Date	Initials
Check battery	✓	12/4/08	S.C.
Inspect wiring	✓	12/4/08	S.C.
Inspect terminals	✓	12/4/08	S.C.
Check lighting	✓	12/4/08	S.C.
Remarks: None noted.			

DRIVE SYSTEM	OK	Date	Initials
Drain transmission fluid	✓	12/4/08	T.S.
Replace filter/gasket	✓	12/4/08	T.S.
Check hoses and connections	✓	12/4/08	T.S.
Replace transmission fluid	✓	12/4/08	T.S.
Check for fluid leaks	✓	12/4/08	T.S.
Remarks: None noted.			

LUBRICATION	OK	Date	Initials
Drain crankcase oil	✓	12/4/08	T.S.
Replace filters	✓	12/4/08	T.S.
Replace crankcase oil	✓	12/4/08	T.S.
Check for oil leaks	✓	12/4/08	T.S.
Check oil level	✓	12/4/08	T.S.
Lube all chassis grease fittings	✓	12/4/08	T.S.
Lube universal joints	✓	12/4/08	T.S.
Replace differential lube including axles	✓	12/4/08	T.S.
Remarks: None noted.			

FUEL ECONOMY PRE-TEST MAINTENANCE FORM (page 3)

Bus Number: 0812	Date: 12-4-08
Personnel: S.C. & T.S.	

EXHAUST/EMISSION SYSTEM	OK	Date	Initials
Check for exhaust leaks	✓	12/4/08	S.C.
Remarks: None noted.			

ENGINE	OK	Date	Initials
Replace air filter	✓	12/4/08	T.S.
Inspect air compressor and air system	✓	12/4/08	S.C.
Inspect vacuum system, if applicable	✓	12/4/08	S.C.
Check and adjust all drive belts	✓	12/4/08	T.S.
Check cold start assist, if applicable	✓	12/4/08	T.S.
Remarks: None noted.			

STEERING SYSTEM	OK	Date	Initials
Check power steering hoses and connectors	✓	12/4/08	S.C.
Service fluid level	✓	12/4/08	S.C.
Check power steering operation	✓	12/4/08	S.C.
Remarks: None noted.			

	OK	Date	Initials
Ballast bus to seated load weight	✓	12/4/08	S.C.

TEST DRIVE	OK	Date	Initials
Check brake operation	✓	12/4/08	S.C.
Check transmission operation	✓	12/4/08	S.C.
Remarks: None noted.			

FUEL ECONOMY PRE-TEST INSPECTION FORM

Bus Number: 0812	Date:
Personnel: S.C.	

PRE WARM-UP	If OK, Initial
Fuel Economy Pre-Test Maintenance Form is complete	S.C.
Cold tire pressure (psi): Front 80 Middle N/A Rear 80	S.C.
Tire wear:	S.C.
Engine oil level	S.C.
Engine coolant level	S.C.
Interior and exterior lights on, evaporator fan on	S.C.
Fuel economy instrumentation installed and working properly.	S.C.
Fuel line -- no leaks or kinks	S.C.
Speed measuring system installed on bus. Speed indicator installed in front of bus and accessible to TECH and Driver.	S.C.
Bus is loaded to SLW	S.C.
WARM-UP	**If OK, Initial**
Bus driven for at least one hour warm-up	S.C.
No extensive or black smoke from exhaust	S.C.
POST WARM-UP	**If OK, Initial**
Warm tire pressure (psi): Front 80 Middle N/A Rear 82	S.C.
Environmental conditions Average wind speed <12 mph and maximum gusts <15 mph Ambient temperature between 30°F(-1C°) and 90°F(32°C) Track surface is dry Track is free of extraneous material and clear of interfering traffic	S.C.

FUEL ECONOMY DATA FORM (Liquid Fuels)

Bus Number: 0812	Manufacturer: ARBOC	Date: 1-5-09
Run Number: 1	Personnel: M.R., T,.S. & S.C.	
Test Direction: ▫CW or ■CCW	Temperature (°F): 36	Humidity (%): 62
SLW (lbs): 11,800	Wind Speed (mph) & Direction: 10 / W	Barometric Pressure (in.Hg): 30.02

Cycle Type	Time (min:sec)		Cycle Time (min:sec)	Fuel Temperature (°C)	Load Cell Reading (lb)		Fuel Used (lbs)
	Start	Finish		Start	Start	Finish	
CBD #1	0	10:28	10:28	1.4	0	.455	.455
ART #1	0	4:21	4:21	1.4	0	.408	.408
CBD #2	0	10:36	10:36	1.6	0	.472	.472
ART #2	0	4:29	4:29	1.5	0	.415	.415
CBD #3	0	10:34	10:34	1.6	0	.445	.445
COMMUTER	0	5:51	5:51	1.6	0	.513	.513
							Total Fuel = 2.708 lbs

20 minute idle : Total Fuel Used = .572 lbs

Heating Value = 20,025.0 BTU/LB

Comments: 20 minute idle was performed with the passenger door closed so the engine would continue to run.

Engine shuts down with passenger door open.

FUEL ECONOMY DATA FORM (Liquid Fuels)

Bus Number: 0812	Manufacturer: ARBOC	Date: 1-5-09
Run Number: 2	Personnel: M.R., T.S. & S.C.	
Test Direction: ■CW or ▫CCW	Temperature (°F): 36	Humidity (%): 62
SLW (lbs): 11,800	Wind Speed (mph) & Direction: 7 / W	Barometric Pressure (in.Hg): 30.02

Cycle Type	Time (min:sec)		Cycle Time (min:sec)	Fuel Temperature (°C)	Load Cell Reading (lb)		Fuel Used (lbs)
	Start	Finish		Start	Start	Finish	
CBD #1	0	9:50	9:50	1.6	0	.450	.450
ART #1	0	4:18	4:18	1.8	0	.403	.403
CBD #2	0	9:30	9:30	1.8	0	.443	.443
ART #2	0	4:22	4:22	1.7	0	.411	.411
CBD #3	0	9:39	9:39	1.8	0	.452	.452
COMMUTER	0	5:53	5:53	1.8	0	.496	.496
							Total Fuel = 2.655 lbs

20 minute idle : Total Fuel Used = N/A lbs
Heating Value = 20,025.0 BTU/LB
Comments: None noted.

FUEL ECONOMY DATA FORM (Liquid Fuels)

Bus Number: 0812	Manufacturer: ARBOC	Date: 1-5-09
Run Number: 3	Personnel: M.R., T.S. & S.C.	
Test Direction: ▫CW or ■CCW	Temperature (°F): 38	Humidity (%): 62
SLW (lbs): 11,800	Wind Speed (mph) & Direction: 5 / W	Barometric Pressure (in.Hg): 30.02

Cycle Type	Time (min:sec)		Cycle Time (min:sec)	Fuel Temperature (°C)	Load Cell Reading (lb)		Fuel Used (lbs)
	Start	Finish		Start	Start	Finish	
CBD #1	0	10:24	10:24	2.1	0	.442	.442
ART #1	0	4:29	4:29	2.2	0	.412	.412
CBD #2	0	10:31	10:31	2.2	0	.452	.452
ART #2	0	4:31	4:31	2.4	0	.415	.415
CBD #3	0	10:20	10:20	2.4	0	.446	.446
COMMUTER	0	6:01	6:01	2.4	0	.491	.491
							Total Fuel = 2.658 lbs

20 minute idle : Total Fuel Used = N/A lbs

Heating Value = 20,025.0 BTU/LB

Comments: None noted.

FUEL ECONOMY DATA FORM (Liquid Fuels)

Bus Number: 0812	Manufacturer: ARBOC	Date: 1-5-09
Run Number: 4	Personnel: M.R., T.S. & S.C.	
Test Direction: ■CW or □CCW	Temperature (°F): 38	Humidity (%): 62
SLW (lbs): 11,800	Wind Speed (mph) & Direction: 5 / W	Barometric Pressure (in.Hg): 30.02

Cycle Type	Time (min:sec)		Cycle Time (min:sec)	Fuel Temperature (°C)	Load Cell Reading (lb)		Fuel Used (lbs)
	Start	Finish		Start	Start	Finish	
CBD #1	0	9:54	9:54	2.4	0	.444	.444
ART #1	0	4:23	4:23	2.5	0	.407	.407
CBD #2	0	9:41	9:41	2.4	0	.455	.455
ART #2	0	4:19	4:19	2.5	0	.414	.414
CBD #3	0	9:44	9:44	2.5	0	.448	.448
COMMUTER	0	5:59	5:59	2.6	0	.498	.498
							Total Fuel = 2.666 lbs

20 minute idle : Total Fuel Used = .486 lbs
Heating Value = 20,025.0 BTU/LB
Comments: 20 minute idle was performed with the passenger door closed so the engine would continue to run.
Engine shuts down with passenger door open.

0812 .ful
FUEL ECONOMY SUMMARY SHEET

BUS MANUFACTURER :ARBOC
BUS MODEL :Spirit of Mobility
BUS NUMBER :0812
TEST DATE :01/05/09

FUEL TYPE : GASOLINE
SP. GRAVITY : .7400
HEATING VALUE : 20025.00 BTU/Lb
FUEL TEMPERATURE : 60.00 deg F
Standard Conditions : 60 deg F and 14.7 psi
Density of Water : 8.3373 lb/gallon at 60 deg F

CYCLE	TOTAL FUEL USED(GAL)	TOTAL MILES	FUEL ECONOMY MPG(Measured)	FUEL ECONOMY MPG (Corrected)
Run # :1, CCW				
CBD	1.372	5.73	4.176	4.28
ART	.823	3.82	4.642	4.76
COM	.513	3.82	7.446	7.64
TOTAL	2.708	13.37	4.937	5.06
Run # :2, CW				
CBD	1.345	5.73	4.260	4.37
ART	.814	3.82	4.693	4.81
COM	.496	3.82	7.702	7.90
TOTAL	2.655	13.37	5.036	5.16
Run # :3, CCW				
CBD	1.340	5.73	4.276	4.39
ART	.827	3.82	4.619	4.74
COM	.491	3.82	7.780	7.98
TOTAL	2.658	13.37	5.030	5.16
Run # :4, CW				
CBD	1.347	5.73	4.254	4.36
ART	.821	3.82	4.653	4.77
COM	.498	3.82	7.671	7.87
TOTAL	2.666	13.37	5.015	5.14

IDLE CONSUMPTION (MEASURED)

First 20 Minutes Data : .57GAL Last 20 Minutes Data : .49GAL
Average Idle Consumption : 1.59GAL/Hr

RUN CONSISTENCY: % Difference from overall average of total fuel used

Run 1 : -1.4 Run 2 : .6 Run 3 : .5 Run 4 : .2

SUMMARY (CORRECTED VALUES)

Average Idle Consumption : 1.55 G/Hr
Average CBD Phase Consumption : 4.35 MPG
Average Arterial Phase Consumption : 4.77 MPG
Average Commuter Phase Consumption : 7.84 MPG
Overall Average Fuel Consumption : 5.13 MPG
Overall Average Fuel Consumption : 41.54 Miles/ Million BTU

7. NOISE

7.1 INTERIOR NOISE AND VIBRATION TESTS

7.1-I. TEST OBJECTIVE

The objective of these tests is to measure and record interior noise levels and check for audible vibration under various operating conditions.

7.1-II. TEST DESCRIPTION

During this series of tests, the interior noise level will be measured at several locations with the bus operating under the following three conditions:

1. With the bus stationary, a white noise generating system shall provide a uniform sound pressure level equal to 80 dB(A) on the left, exterior side of the bus. The engine and all accessories will be switched off and all openings including doors and windows will be closed. This test will be performed at the ABTC.

2. The bus accelerating at full throttle from a standing start to 35 mph on a level pavement. All openings will be closed and all accessories will be operating during the test. This test will be performed on the track at the Test Track Facility.

3. The bus will be operated at various speeds from 0 to 55 mph with and without the air conditioning and accessories on. Any audible vibration or rattles will be noted. This test will be performed on the test segment between the Test Track and the Bus Testing Center.

All tests will be performed in an area free from extraneous sound-making sources or reflecting surfaces. The ambient sound level as well as the surrounding weather conditions will be recorded in the test data.

7.1-III. DISCUSSION

This test is performed in three parts. The first part exposes the exterior of the vehicle to 80.0 dB(A) on the left side of the bus and the noise transmitted to the interior is measured. The overall average of the six measurements was 52.0 dB(A); ranging from 50.2 dB(A) at the driver's seat to 54.1 dB(A) at the front passenger seats. The interior ambient noise level for this test was 34.1 dB(A).

The second test measures interior noise during acceleration from 0 to 35 mph. This noise level ranged from 68.0 dB(A) at the front passenger seats to 70.9 dB(A) at the driver's seat. The overall average was 69.7 dB(A). The interior ambient noise level for this test was 34.5 dB(A).

The third part of the test is to listen for resonant vibrations, rattles, and other noise sources while operating over the road. No vibrations or rattles were noted.

INTERIOR NOISE TEST DATA FORM
Test Condition 1: 80 dB(A) Stationary White Noise

Bus Number: 0812	Date: 7-30-08
Personnel: S.C. & E.D.	
Temperature (°F): 85	Humidity (%): 50
Wind Speed (mph): 5	Wind Direction: S
Barometric Pressure (in.Hg): 29.84	
Initial Sound Level Meter Calibration: ■ checked by: S.C.	
Interior Ambient Noise Level dB(A): 34.1	Exterior Ambient Noise Level dB(A): 51.1
Microphone Height During Testing (in): 48.0	

Measurement Location	Measured Sound Level dB(A)
Driver's Seat	50.2
Front Passenger Seats	54.1
In Line with Front Speaker	51.8
In Line with Middle Speaker	53.2
In Line with Rear Speaker	52.1
Rear Passenger Seats	50.6

Final Sound Level Meter Calibration: ■ checked by: S.C.

Comments: All readings taken in the center aisle.

INTERIOR NOISE TEST DATA FORM
Test Condition 2: 0 to 35 mph Acceleration Test

Bus Number: 0812	Date: 12-15-08
Personnel: T.S., E.D. & B.S.	
Temperature (°F): 49	Humidity (%): 81
Wind Speed (mph): 11	Wind Direction: SSW
Barometric Pressure (in.Hg): 30.17	
Initial Sound Level Meter Calibration: ■ checked by: T.S.	
Interior Ambient Noise Level dB(A): 34.5	Exterior Ambient Noise Level dB(A): 46.6
Microphone Height During Testing (in): 48	

Measurement Location	Measured Sound Level dB(A)
Driver's Seat	70.9
Front Passenger Seats	68.0
Middle Passenger Seats	70.1
Rear Passenger Seats	69.8

Final Sound Level Meter Calibration: ■ checked by: T.S.

Comments: All readings taken in the center aisle.

INTERIOR NOISE TEST DATA FORM
Test Condition 3: Audible Vibration Test

Bus Number: 0812	Date: 12-15-08
Personnel: T.S., E.D. & B.S.	
Temperature (°F): 49	Humidity (%): 81
Wind Speed (mph): 11	Wind Direction: SSW
Barometric Pressure (in.Hg): 30.17	

Describe the following possible sources of noise and give the relative location on the bus.

Source of Noise	Location
Engine and Accessories	None noted.
Windows and Doors	None noted.
Seats and Wheel Chair lifts	None noted.

Comment on any other vibration or noise source which may have occurred
that is not described above: None noted.

7.1 INTERIOR NOISE TEST

TEST BUS SET-UP FOR 80 dB(A)
INTERIOR NOISE TEST

7.2 EXTERIOR NOISE TESTS

7.2-I. TEST OBJECTIVE

The objective of this test is to record exterior noise levels when a bus is operated under various conditions.

7.2-II. TEST DESCRIPTION

In the exterior noise tests, the bus will be operated at a SLW in three different conditions using a smooth, straight and level roadway:

1. Accelerating at full throttle from a constant speed at or below 35 mph and just prior to transmission up shift.
2. Accelerating at full throttle from standstill.
3. Stationary, with the engine at low idle, high idle, and wide open throttle.

In addition, the buses will be tested with and without the air conditioning and all accessories operating. The exterior noise levels will be recorded.

The test site is at the PSBRTF and the test procedures will be in accordance with SAE Standards SAE J366b, Exterior Sound Level for Heavy Trucks and Buses. The test site is an open space free of large reflecting surfaces. A noise meter placed at a specified location outside the bus will measure the noise level.

During the test, special attention should be paid to:

1. The test site characteristics regarding parked vehicles, signboards, buildings, or other sound-reflecting surfaces
2. Proper usage of all test equipment including set-up and calibration
3. The ambient sound level

7.2-III. DISCUSSION

The Exterior Noise Test determines the noise level generated by the vehicle under different driving conditions and at stationary low and high idle, with and without air conditioning and accessories operating. The test site is a large, level, bituminous paved area with no reflecting surfaces nearby.

With an exterior ambient noise level of 46.8 dB(A), the average test result obtained while accelerating from a constant speed was 73.4 dB(A) on the right side and 74.6 dB(A) on the left side.

When accelerating from a standstill with an exterior ambient noise level of 46.4 dB(A), the average of the results obtained were 73.0 dB(A) on the right side and 74.0 dB(A) on the left side.

With the vehicle stationary and the engine, accessories, and air conditioning on, the measurements averaged 49.2 dB(A) at low idle, 53.6 dB(A) at high idle, and 69.5 dB(A) at wide open throttle. With the accessories and air conditioning off, the readings averaged 0.2 dB(A) higher at low idle, 0.7 dB(A) higher at high idle, and 0.2 dB(A) higher at wide open throttle. The exterior ambient noise level measured during this test was 46.9 dB(A).

EXTERIOR NOISE TEST DATA FORM
Accelerating from Constant Speed

Bus Number: 0812	Date: 12-15-08
Personnel: T.S., E.D. & B.S.	
Temperature (°F): 49	Humidity (%): 81
Wind Speed (mph): 11	Wind Direction: SSW
Barometric Pressure (in.Hg): 30.17	
Verify that microphone height is 4 feet, wind speed is less than 12 mph and ambient temperature is between 30°F and 90°F: ■ checked by: S.C.	
Initial Sound Level Meter Calibration: ■ checked by: S.C.	
Exterior Ambient Noise Level dB(A): 46.8	

Accelerating from Constant Speed Curb (Right) Side		Accelerating from Constant Speed Street (Left) Side	
Run #	Measured Noise Level dB(A)	Run #	Measured Noise Level dB(A)
1	73.6	1	74.5
2	72.7	2	73.2
3	72.5	3	73.6
4	72.3	4	74.2
5	73.2	5	74.7
Average of two highest actual noise levels = 73.4 dB(A)		Average of two highest actual noise levels = 74.6 dB(A)	

Final Sound Level Meter Calibration Check: ■ checked by: S.C.

Comments: None noted.

EXTERIOR NOISE TEST DATA FORM
Accelerating from Standstill

Bus Number: 0812	Date: 12-15-08
Personnel: T.S., E.D. & B.S.	
Temperature (°F): 49	Humidity (%): 81
Wind Speed (mph): 11	Wind Direction: SSW
Barometric Pressure (in.Hg): 30.17	
Verify that microphone height is 4 feet, wind speed is less than 12 mph and ambient temperature is between 30°F and 90°F: ■ checked by: S.C.	
Initial Sound Level Meter Calibration: ■ checked by: S.C.	
Exterior Ambient Noise Level dB(A): 46.4	

Accelerating from Standstill Curb (Right) Side		Accelerating from Standstill Street (Left) Side	
Run #	Measured Noise Level dB(A)	Run #	Measured Noise Level dB(A)
1	73.0	1	73.7
2	72.2	2	73.7
3	71.8	3	73.5
4	71.9	4	73.5
5	73.0	5	74.2
Average of two highest actual noise levels = 73.0 dB(A)		Average of two highest actual noise levels = 74.0 dB(A)	

Final Sound Level Meter Calibration Check: ■ checked by: S.C.

Comments: None noted.

EXTERIOR NOISE TEST DATA FORM
Stationary

Bus Number: 0812	Date: 12-15-08
Personnel: T.S., E.D. & B.S.	
Temperature (°F): 49	Humidity (%): 81
Wind Speed (mph): 11	Wind Direction: SSW
Barometric Pressure (in.Hg): 30.17	

Verify that microphone height is 4 feet, wind speed is less than 12 mph and ambient temperature is between 30°F and 90°F: ■ checked by: S.C.

Initial Sound Level Meter Calibration: ■ checked by: S.C.

Exterior Ambient Noise Level dB(A): 46.9

Accessories and Air Conditioning ON

Throttle Position	Engine RPM	Curb (Right) Side dB(A)	Street (Left) Side db(A)
		Measured	Measured
Low Idle	500	49.1	49.2
High Idle	1,500	53.5	53.7
Wide Open Throttle	3,900	69.4	69.5

Accessories and Air Conditioning OFF

Throttle Position	Engine RPM	Curb (Right) Side dB(A)	Street (Left) Side db(A)
		Measured	Measured
Low Idle	500	49.5	49.2
High Idle	1,500	54.1	54.4
Wide Open Throttle	3,900	69.6	69.8

Final Sound Level Meter Calibration Check: ■ checked by: S.C.

Comments: None noted.

7.2 EXTERIOR NOISE TESTS

TEST BUS UNDERGOING
EXTERIOR NOISE TESTS