STURAA TEST

7 YEAR

200,000 MILE BUS

from

COACH & EQUIPMENT MANUFACTURING CORP.

MODEL PHOENIX

NOVEMBER 2005

PTI-BT-R0514

PENNSTATE

1855

The Pennsylvania Transportation Institute

201 Research Office Building
The Pennsylvania State University
University Park, PA 16802

(814) 865-1891

Bus Testing and Research Center

2237 Old Route 220 N.
Duncansville, PA 16635

(814) 695-3404

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Coach & Equipment submitted a model Phoenix, diesel-powered 15 seat (including the driver) 25-foot bus, for a 7 yr/200,000 mile STURAA test. The test bus is built on a Ford E-450 Super Duty chassis. The odometer reading at the time of delivery was 595.0 miles. Testing started on August 22, 2005 and was completed on November 11, 2005. 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 1, 2005 and was completed on November 4, 2005.

The interior of the bus is configured with seating for 15 passengers including the driver and 2 wheelchair positions. Free floor space will accommodate 12 standing passengers resulting in a potential capacity of 27 persons and 2 wheelchair positions. At 150 lbs per person and 600 lbs per wheelchair position, this load results in a measured gross vehicle weight of 15,370 lbs. In order to avoid exceeding the GAWR (9,450 lbs) of the rear axle, ballast for all 12 standing passengers and one wheelchair position was eliminated. This reduction from full capacity resulted in an adjusted measured gross vehicle weight of 13,410 lbs and was used for all dynamic testing. The middle SLW segment was performed at the same 13,410 lbs and the final segment was performed at a CW of 10,600 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 are 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), with the exception of the alternator, were found to be readily accessible and no restrictions were noted. Test Technicians encountered limited space when attempting to access the alternator.

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, 2 or 4 failures. Of the seven reported Class 3 failures, five occurred in the suspension system and two with the engine/transmission.

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 16.39 seconds.

The Shakedown Test produced a maximum final loaded deflection of 0.144 inches with a permanent set ranging between -0.003 to 0.005 inches under a distributed

static load of 11,325 lbs. The Distortion Test was completed with all subsystems, doors and escape mechanisms operating properly. Water leakage was observed during the test at the left side emergency window frame and the frame of the roof hatch.

The test bus 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 8.1 inches.

A Fuel Economy Test was run on simulated central business district, arterial, and commuter courses. The results were 6.84 mpg, 7.12 mpg, and 11.16 mpg respectively; with an overall average of 7.78 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 Coach & Equipment, model Phoenix, built on a Ford E-450 Super Duty Chassis. The bus has an OEM driver's door and a passenger door rear of the front axle. A dedicated handicap entrance equipped with a Braun Corp. model NCL917F1BRP wheelchair lift is located at the left rear of the bus, rear of the rear axle. Power is provided by a diesel-fueled, Ford model Power Stroke 6.0 Liter engine coupled to a Ford Motor Co. model Torq Shift (5-speed) transmission.

The measured curb weight is 3,860 lbs for the front axle and 6,740 lbs for the rear axle. These combined weights provide a total measured curb weight of 10,600 lbs. There are 15 seats including the driver, 2 wheelchair positions and room for 12 standing passengers bringing the total passenger capacity to 27 + 2 wheelchair positions. Gross load is 150 lb x 27 = 4,050 lbs + 1,200 lbs (2 wheelchair positions) = 5,250 lbs. At full capacity, the measured gross vehicle weight is 15,370 lbs. This value was used for all static tests. In order to avoid exceeding the GAWR (9,450 lbs) of the rear axle, ballast for all 12 standing passengers and one wheelchair position was eliminated. This reduction from full capacity resulted in an adjusted measured gross vehicle weight of 13,410 lbs and was used for all dynamic testing.

VEHICLE DATA FORM

Bus Number: 0514	Arrival Date: 8-22-05
Bus Manufacturer: Coach & Equipment	Vehicle Identification Number (VIN): 1FDXE45P26HA11956
Model Number: Phoenix	Date: 8-22-05
Personnel: T.S. & S.C.	Chassis: E-450 Super Duty

WEIGHT: *Values in parenthesis indicate the adjusted weights necessary to avoid exceeding the GAWR. These values were used for all dynamic testing.

Individual Wheel Reactions:

Weights (lb)	Front Axle		Middle Axle		Rear Axle	
	Right	Left	Right	Left	Right	Left
CW	2,040	1,820	N/A	N/A	3,540	3,200
SLW	2,080 (2,230)	2,110 (2,080)	N/A	N/A	4,850 (4,660)	4,890 (4,440)
GVW	2,240 (2,230)	2,290 (2,080)	N/A	N/A	5,370 (4,660)	5,470 (4,440)

Total Weight Details:

Weight (lb)	CW	SLW	GVW	GAWR
Front Axle	3,860	4,190 (4,310)	4,530 (4,310)	4,600
Middle Axle	N/A	N/A	N/A	N/A
Rear Axle	6,740	9,740 (9,100)	10,840 (9,100)	9,450
Total	10,600	13,930 (13,410)	15,370 (13,410)	GVWR: 14,050

Dimensions:

Length (ft/in)	25 / 4.5
Width (in)	96.0
Height (in)	111.5
Front Overhang (in)	30.5
Rear Overhang (in)	98.0
Wheel Base (in)	176.0
Wheel Track (in)	Front: 68.5
	Rear: 77.7

Bus Number: 0514	Date: 8-22-05

CLEARANCES:

Lowest Point Outside Front Axle	Location: Steering stabilizer Clearance(in): 11.5
Lowest Point Outside Rear Axle	Location: Fuel tank support bracket Clearance(in): 12.3
Lowest Point between Axles	Location: Battery box Clearance(in): 7.2
Ground Clearance at the center (in)	7.2
Front Approach Angle (deg)	25.0
Rear Approach Angle (deg)	10.9
Ramp Clearance Angle (deg)	4.7
Aisle Width (in)	17.3
Inside Standing Height at Center Aisle (in)	73.3

BODY DETAILS:

Body Structural Type	Integral		
Frame Material	Steel		
Body Material	Steel & fiberglass		
Floor Material	Plywood		
Roof Material	Steel & fiberglass		
Windows Type	□ Fixed	■ Movable	
Window Mfg./Model No.	Clear Vision / AS3 M3 DOT 296		
Number of Doors	1 Front	1 Rear	
Mfr. / Model No.	Ford Motor Co. / O.E.M & Coach & Equipment		
Dimension of Each Door (in)	Driver's – 31.7 x 54.3 Passenger – 32.3 x 79.5 W/C – 46.0 x 70.6 Emergency – 35.5 x 56.6		
Passenger Seat Type	□ Cantilever	■ Pedestal	□ Other (explain)
Mfr. / Model No.	Freedman Seating Co / 81043-L1		
Driver Seat Type	□ Air	□ Spring	■ Other (cushion)
Mfr. / Model No.	Freedman Seating Co / 19507-L1		

Number of Seats (including Driver)	15 + 2 handicap positions

Bus Number: 0514	Date: 8-22-05

BODY DETAILS (Contd..)

Free Floor Space (ft^2)	19.2			
Height of Each Step at Normal Position (in)	Front 1. 10.4	2. 8.0	3. 8.3	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)	N/A			

ENGINE

Type	■ C.I.	□ Alternate Fuel	
	□ S.I.	□ Other (explain)	
Mfr. / Model No.	Ford Power Stroke / 6.0 Liter		
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.	Ford Power Stroke / 6.0 Liter		
Carburetor Mfr. / Model No.	N/A		
Fuel Pump Mfr. / Model No.	Ford Power Stroke / 6.0 Liter		
Alternator (Generator) Mfr. / Model No.	Alternator #1 - OEM-Ford / NA Alternator #2 - OEM-Ford / NA		
Maximum Rated Output (Volts / Amps)	Alternator #1 – 12 volts / 110 amps Alternator #2 – 12 volts / 110 ams		
Air Compressor Mfr. / Model No.	N/A		
Maximum Capacity (ft^3 / min)	N/A		
Starter Type	■ Electrical	□ Pneumatic	□ Other (explain)
Starter Mfr. / Model No.	Visteon / 12V 914457		

Bus Number: 0514	Date: 8-22-05

TRANSMISSION

Transmission Type	□ Manual	■ Automatic	
Mfr. / Model No.	Ford Motor Co. / Torq Shift		
Control Type	■ Mechanical	□ Electrical	□ Other
Torque Converter Mfr. / Model No.	Ford Motor Co. / Torq Shift		
Integral Retarder Mfr. / Model No.	N/A		

SUSPENSION

Number of Axles	2		
Front Axle Type	■ Independent	□ Beam Axle	
Mfr. / Model No.	Ford Motor Co. / Twin I-Beam		
Axle Ratio (if driven)	N/A		
Suspension Type	□ Air	■ Spring	□ Other (explain)
No. of Shock Absorbers	2		
Mfr. / Model No.	Motorcraft / C24-180-45-AA		
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 / M70HD		
Axle Ratio (if driven)	4:1		
Suspension Type	□ Air	■ Spring	□ Other (explain)

No. of Shock Absorbers	2
Mfr. / Model No.	Motorcraft / XC25-180-80-EA

Bus Number: 0514	Date: 8-22-05

WHEELS & TIRES

Front	Wheel Mfr./ Model No.	Accuride / 16 x 6
	Tire Mfr./ Model No.	Michelin LTX / LT 225/75R 16
Rear	Wheel Mfr./ Model No.	Accuride / 16 x 6
	Tire Mfr./ Model No.	Michelin LTX / LT 225/75R 16

BRAKES

Front Axle Brakes Type	□ Cam	■ Disc	□ Other (explain)
Mfr. / Model No.	TRW / 13.03”		
Middle Axle Brakes Type	□ Cam	□ Disc	□ Other (explain)
Mfr. / Model No.	N/A		
Rear Axle Brakes Type	□ Cam	■ Disc	□ Other (explain)
Mfr. / Model No.	Kelsey Hayes / 12.90”		
Retarder Type	N/A		
Mfr. / Model No.	N/A		

HVAC

Heating System Type	□ Air	■ Water	□ Other
Capacity (Btu/hr)	Ford Motor Co. / OEM		
Mfr. / Model No.	Ford Motor Co. / Proair		
Air Conditioner	■ Yes	□ No	
Location	Front dash & interior roof		
Capacity (Btu/hr)	67,000		
A/C Compressor Mfr. / Model No.	Carrier Corp. / TM-16		

STEERING

Steering Gear Box Type	Hydraulic gear

Mfr. / Model No.	XR-50 / Ford OEM
Steering Wheel Diameter	15.5
Number of turns (lock to lock)	4.0

Bus Number: 0514	Date: 8-22-05

OTHERS

Wheel Chair Ramps	Location: N/A	Type: N/A
Wheel Chair Lifts	Location: Right rear	Type: Lift
Mfr. / Model No.	The Braun Corporation / NCL917E1BRP	
Emergency Exit	Location: Windows Doors Roof hatch	Number: 2 2 1

CAPACITIES

Fuel Tank Capacity (units)	57 gals
Engine Crankcase Capacity (gallons)	3.75
Transmission Capacity (gallons)	2.375
Differential Capacity (gallons)	1.0
Cooling System Capacity (gallons)	6.9
Power Steering Fluid Capacity (gallons)	.5

VEHICLE DATA FORM

Bus Number: 0514	Date: 8-22-05

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

Part Number	Description	Qty.
Fl-2016	Oil filter	1
AT-163-G	Shock absorbers	2
AT-164-G	Shock absorbers	2
Michelin LTX 225/75R 16	Tires	6
Accuride wheels	Wheels	6

COMPONENT/SUBSYSTEM INSPECTION FORM

Bus Number: 0514	Date: 8-22-05

Subsystem	Checked	Comments
Air Conditioning Heating and Ventilation		One A/C compressor not completely secured to the engine block.
Body and Sheet Metal		
Frame		
Steering		
Suspension		
Interior/Seating		
Axles		
Brakes		
Tires/Wheels		
Exhaust		
Fuel System		Diesel
Power Plant		
Accessories		
Lift System		
Interior Fasteners		
Batteries		

CHECK - IN

COACH & EQUIPMENT'S
MODEL PHOENIX

CHECK - IN CONT.

COACH & EQUIPMENT'S
MODEL PHOENIX EQUIPPED WITH A BRAUN
MODEL NCL917F1BRP HANDICAP LIFT

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), with the exception of the alternator, were found to be readily accessible and no restrictions were noted. Test technicians encountered limited space when attempting to access the alternator.

ACCESSIBILITY DATA FORM

Bus Number: 0514	Date: 11/11/05

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		Limited access.
Diagnostic Interface Connector		
TRANSMISSION :		
Fluid Dip-Stick		
Filler Hole		Fill through dip tube.
Drain Plug		
SUSPENSION :		
Bushings		
Shock Absorbers		
Air Springs		
Leveling Valves	N/A	
Grease Fittings		

ACCESSIBILITY DATA FORM

Bus Number: 0514	Date: 11/11/05

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

Coach and Equipment 0514

DATE	TEST MILES	SERVICE	ACTIVITY	DOWN TIME	HOURS
09-09-05	1,443	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
09-22-05	2,381	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
10-10-05	3,159	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
10-13-05	4,097	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
10-20-05	5,205	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
10-28-05	6,276	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
11-04-05	7,500	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00

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.

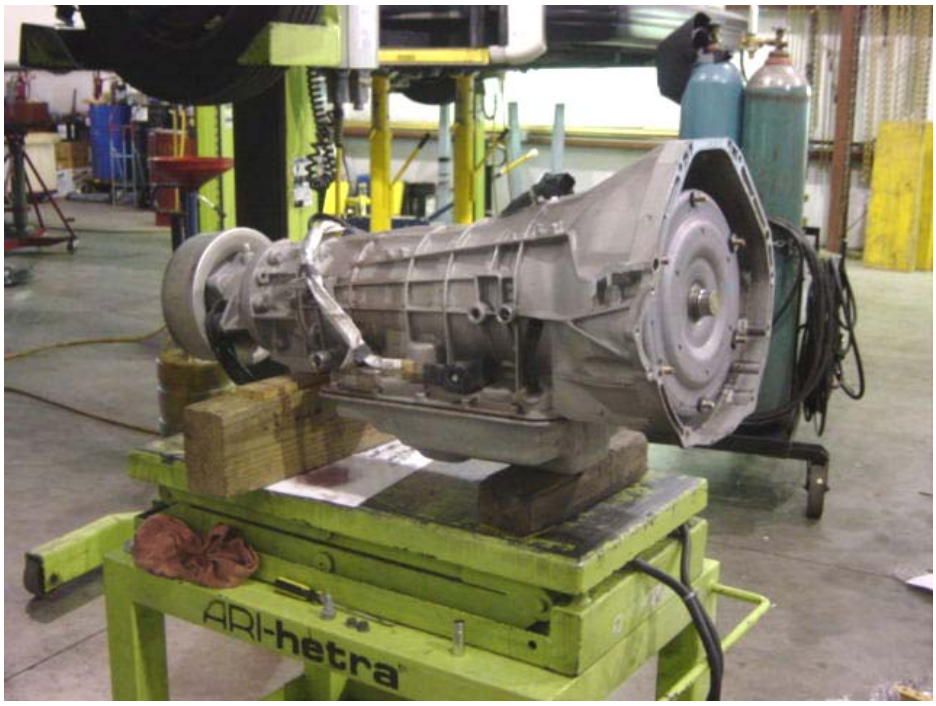
	MAN HOURS
Transmission solenoid.	3.00
All four rear spring bushings.	3.50
Left rear spring beam center bolt.	2.00

At the end of the test, the remaining items on the list were removed and replaced. The transmission assembly took 6.00 man-hours (two men 3.00 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	6.00 man hours
Wiper Motor	0.50 man hours
Starter	1.00 man hours
Alternator	1.50 man hours
Batteries	0.75 man hours

1.3 REPLACEMENT AND/OR REPAIR OF SELECTED SUBSYSTEMS

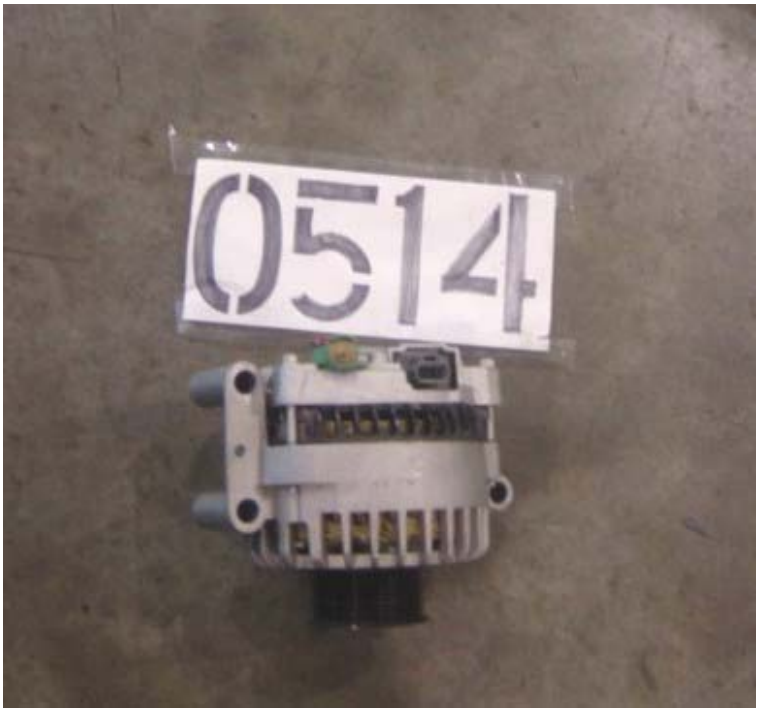


TRANSMISSION REMOVAL AND REPLACEMENT (6.00 MAN HOURS)

WIPER MOTOR REMOVAL AND REPLACEMENT (0.50 MAN HOURS)

1.3 REPLACEMENT AND/OR REPAIR OF SELECTED SUBSYSTEMS CONT.

STARTER REMOVAL AND REPLACEMENT (1.00 MAN HOURS)



ALTERNATOR REMOVAL AND REPLACEMENT (1.50 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, 2 or 4 failures. Of the seven Class 3 failures, five involved the suspension system and two occurred with the engine/transmission. These are available for review in the Unscheduled Maintenance List, located in Section 5.7 Structural Durability.

RELIABILITY DATA FORMS

Bus Number: 0514	Date: 11-04-05
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
Engine/Transmission		1,443			3.00	80.00
		5,175			0.50	4.00
Suspension		2,381			3.50	48.00
		2,381			1.00	6.00
		2,640			2.00	5.00
		3,159			0.50	16.00
		5,683			1.50	4.00

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: 0514	Date: 11-2-05
Personnel: B.S. & S.C.	

Temperature (°F): 46	Humidity (%): 56
Wind Direction: SW	Wind Speed (mph): 5
Barometric Pressure (in.Hg): 30.09	

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 16.39 seconds.

PERFORMANCE DATA FORM

Bus Number: 0514	Date: 11-2-05
Personnel: B.S., S.C. & G.M.	

Temperature (°F): 46	Humidity (%): 56
Wind Direction: SW	Wind Speed (mph): 5
Barometric Pressure (in.Hg): 30.09	

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	3.53	3.18	3.24
20 mph	4.79	5.09	4.93
30 mph	7.45	7.36	7.43
40 mph	11.61	11.27	11.27
Top Test Speed(mph) 50	17.08	16.64	17.05

Clockwise Recorded Interval Times

Speed	Run 1	Run 2	Run 3
10 mph	3.42	3.09	2.89
20 mph	4.84	4.74	4.52
30 mph	7.09	6.96	6.82
40 mph	10.93	10.65	10.36
Top Test Speed(mph) 50	16.01	15.68	15.89

0514.ACC

PERFORMANCE SUMMARY SHEET

BUS MANUFACTURER :Coach & Equipment
BUS MODEL :Phoenix

BUS NUMBER :0514
TEST DATE :11/2/05

TEST CONDITIONS :

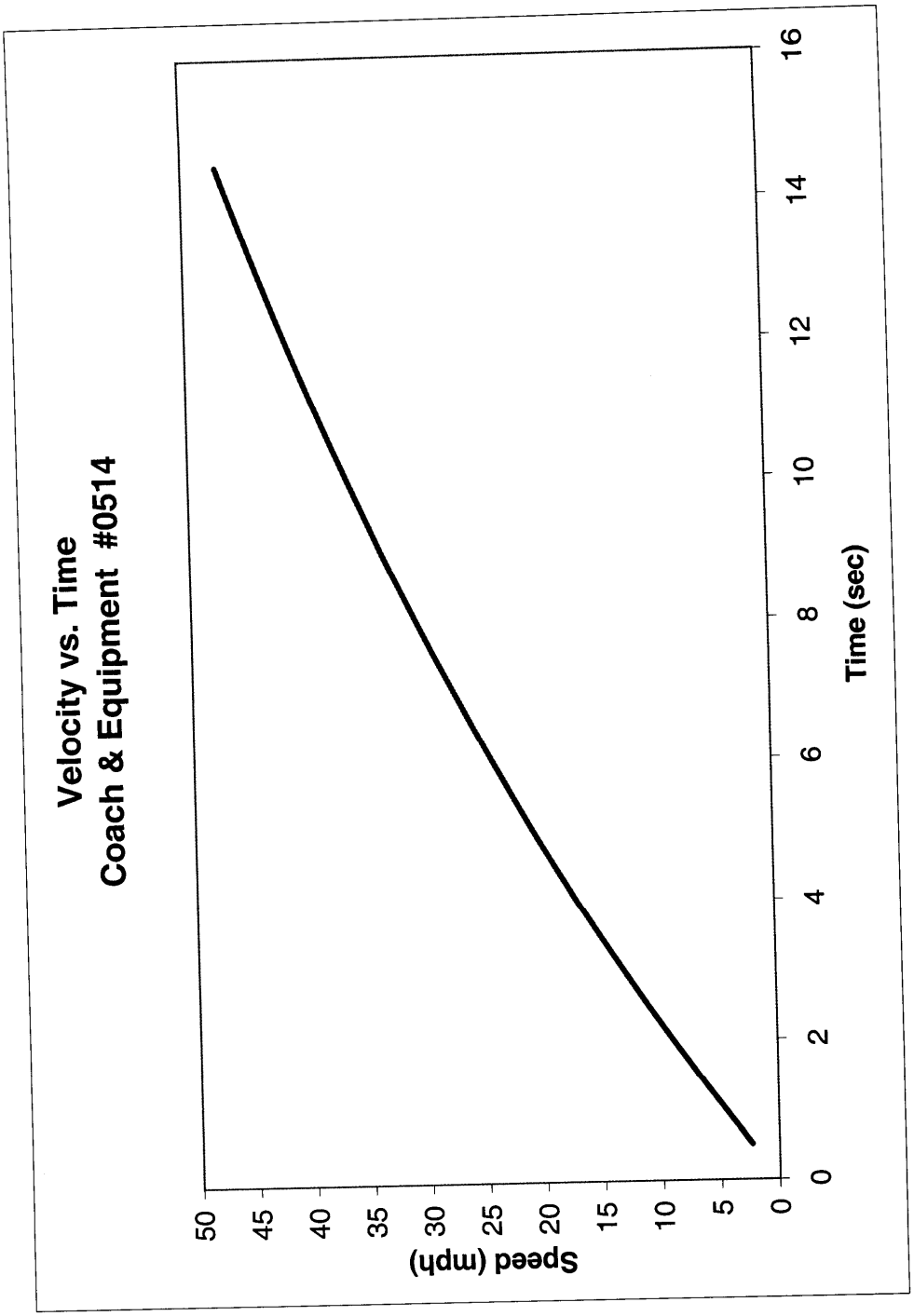
TEMPERATURE (DEG F)	: 46.0
WIND DIRECTION	: SW
WIND SPEED (MPH)	: 5.0
HUMIDITY (%)	: 56
BAROMETRIC PRESSURE (IN. HG)	: 30.1

VEHICLE SPEED	AVERAGE TIME (SEC)		
(MPH)	CCW DIRECTION	CW DIRECTION	TOTAL
10.0	3.32	3.13	3.23
20.0	4.94	4.70	4.82
30.0	7.41	6.96	7.19
40.0	11.38	10.65	11.02
50.0	16.92	15.86	16.39

TEST SUMMARY :

VEHICLE SPEED (MPH)	TIME (SEC)	ACCELERATION (FT/SEC^2)	MAX. GRADE (%)
1.0	.21	6.9	22.0
5.0	1.08	6.6	20.8
10.0	2.24	6.1	19.4
15.0	3.48	5.7	18.0
20.0	4.82	5.3	16.6
25.0	6.27	4.8	15.2
30.0	7.85	4.4	13.9
35.0	9.58	4.0	12.7
40.0	11.49	3.7	11.4
45.0	13.60	3.3	10.3
50.0	15.95	2.9	9.2

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
Coach & Equipment #0514
Speed (mph)
0
5
10
15
20
25
30
35
40
45
50
Time (sec)
0
2
4
6
8
10
12
14
16

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 27 people including the driver + 2 wheel chair positions. The resulting test load is (27 x 375 lb) = 10,125 lb + 1,200 lbs (2 wheel chair positions) = 11,325 lbs. 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 0.144 inches at reference point 6. The maximum permanent deflection after the final loading sequence ranged from -.003 inches at reference points 8, 9, and 10 to 0.005 inches at reference point 6.

STRUCTURAL SHAKEDOWN DATA FORM

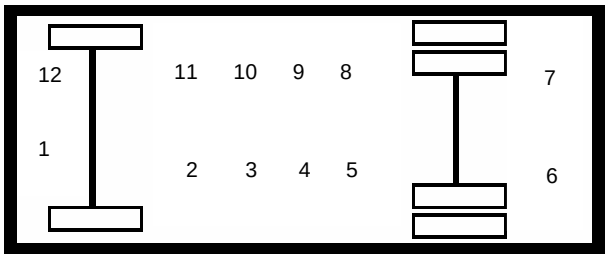
Bus Number: 0514	Date: 8-30-05
Personnel: T.S., E.L., D.L., S.C. & C.S.	Temperature (°F):
Loading Sequence: ■ 1 □ 2 □ 3 (check one) Test Load (lbs): 11,325	

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	.042	.042	.012	.012
2	0	.053	.053	.011	.011
3	0	.095	.095	.011	.011
4	0	.107	.107	.019	.019
5	0	.072	.072	.008	.008
6	0	.156	.156	.006	.006
7	0	.099	.099	.009	.009
8	0	.081	.081	.012	.012
9	0	.092	.092	.014	.014
10	0	.084	.084	.014	.014
11	0	.050	.050	.011	.011
12	0	.090	.090	.011	.011

STRUCTURAL SHAKEDOWN DATA FORM

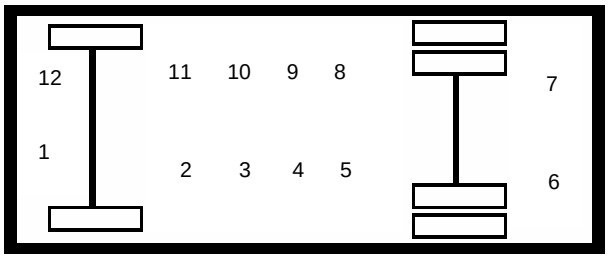
Bus Number: 0514	Date: 8-30-05
Personnel: T.S., E.L., D.L., S.C. & C.S.	Temperature (°F):
Loading Sequence: □ 1 ■ 2 □ 3 (check one) Test Load (lbs): 11,325	

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	.012	.046	.034	.014	.002
2	.011	.055	.044	.010	-.001
3	.011	.097	.086	.009	-.002
4	.019	.116	.097	.022	.003
5	.008	.077	.069	.008	.000
6	.006	.150	.144	.011	.005
7	.009	.131	.122	.011	.002
8	.012	.085	.073	.009	-.003
9	.014	.098	.084	.011	-.003
10	.014	.088	.074	.011	-.003
11	.011	.053	.042	.009	-.002
12	.011	.092	.081	.011	.000

5.1 STRUCTURAL SHAKEDOWN TEST

TEST BUS LOADED TO 2.5 TIMES GVL
(11,325 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. Water leakage was observed during the test at the left side emergency window frame and the frame of the roof hatch. 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: 0514	Date: 8-31-05
Personnel: T.S., D.L., E.L. & S.C.	Temperature(°F): 74

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: 0514	Date: 8-31-05
Personnel: T.S., D.L., E.L. & S.C.	Temperature(°F): 74

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: 0514	Date: 8-31-05
Personnel: T.S., D.L., E.L. & S.C.	Temperature(°F): 74

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	Slight leak around the frame of the roof hatch.
■ 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: 0514	Date: 8-31-05
Personnel: T.S., D.L., E.L. & S.C.	Temperature(°F): 74

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	Slight leak around the frame of the roof hatch.
■ 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: 0514	Date: 8-31-05
Personnel: T.S., D.L., E.L. & S.C.	Temperature(°F): 74

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	Slight leak around the frame of the roof hatch.
■ 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: 0514	Date: 8-31-05
Personnel: T.S., D.L., E.L. & S.C.	Temperature(°F): 74

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	Slight leak around the frame of the roof hatch.
■ Engine	No deficiencies.
■ Handicapped Device/ Special Seating	No deficiencies.
■ Undercarriage	No deficiencies.
■ Service Doors	No deficiencies.
■ Body	No deficiencies.
	Slight leak around the frame of the

▪ Windows/ Body Leakage	emergency window.
▪ Steering Mechanism	No deficiencies.

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

Bus Number: 0514	Date: 8-31-05
Personnel: T.S., D.L., E.L. & S.C.	Temperature(°F): 74

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	Slight leak around the frame of the roof hatch.
■ Engine	No deficiencies.
■ Handicapped Device/ Special Seating	No deficiencies.
■ Undercarriage	No deficiencies.
■ Service Doors	No deficiencies.
■ Body	No deficiencies.
	Slight leak around the frame of the

▪ Windows/ Body Leakage	emergency window.
▪ Steering Mechanism	No deficiencies.

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

Bus Number: 0514	Date: 8-31-05
Personnel: T.S., D.L., E.L. & S.C.	Temperature(°F): 74

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	Slight leak around the frame of the roof hatch.
■ Engine	No deficiencies.
■ Handicapped Device/ Special Seating	No deficiencies.
■ Undercarriage	No deficiencies.
■ Service Doors	No deficiencies.
■ Body	No deficiencies.
	No deficiencies.

▪ Windows/ Body Leakage	
▪ Steering Mechanism	Slight leak around the frame of the emergency window.

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

Bus Number: 0514	Date: 8-31-05
Personnel: T.S., D.L., E.L. & S.C.	Temperature(°F): 74

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	Slight leak around the frame of the roof hatch.
■ 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: 0514	Date: 8-31-05
Personnel: T.S., D.L., E.L. & S.C.	Temperature(°F): 74

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	Slight leak around the frame of the roof hatch.
■ Engine	No deficiencies.
■ Handicapped Device/ Special Seating	No deficiencies.
■ Undercarriage	No deficiencies
■ Service Doors	No deficiencies.
■ Body	No deficiencies.
	No deficiencies.

▪ Windows/ Body Leakage	
▪ Steering Mechanism	Slight leak around the frame of the emergency window.

5.2 STRUCTURAL DISTORTION TEST

LEFT FRONT WHEEL SIX INCHES HIGHER

RIGHT REAR WHEEL SIX INCHES HIGHER

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 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: 0514	Date: 11/11/05
Personnel: E.L. & D.L.	

Temperature (°F): 40	Humidity (%): 70
Wind Direction: SSW	Wind Speed (mph): Variable @ 3 - 5
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 life tow was performed incorporating a hydraulic under lift wrecker. No problems were encountered with the towing interface.
Description and location of any structural damage: No damage or deformation was observed.
General Comments: A safe and adequate tow interface was accomplished. No damage or deformation was observed and no problems with the towing interface were encountered.

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 8.1 inches to 19.0 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	13.8”
Rear axle – one tire flat	18.6”
Rear axle – two tires flat	16.9”

JACKING TEST DATA FORM

Bus Number: 0514	Date: 8-22-05
Personnel: T.S. & S.C.	Temperature (°F): 75

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	15.5 " I 13.8 " D	10.8 " I 8.1 " D	None noted.
Left front	15.9 " I 14.0 " D	11.0 " I 8.3 " D	None noted.
Right rear—outside	19.3 " I 18.6 " D	11.6 " I 10.9 " D	None noted.
Right rear—both	19.3 " I 16.9 " D	11.6 " I 9.0 " D	None noted.
Left rear—outside	19.6 " I 19.0 " D	11.6 " I 11.0 " D	None noted.
Left rear—both	19.6 " I 17.0 " D	11.6 " I 9.1 " D	None noted.
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: 0514	Date: 8-22-05
Personnel: T.S. & S.C.	Temperature (°F): 78

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.

5.6 HOISTING TEST

TEST BUS STABLE ON JACK STANDS

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 1, 2005 and was conducted until November 4, 2005. The first 3,000 miles were performed at a GVW of 13,410 lbs. The number of standing passengers was reduced from 12 to 0 plus the elimination of one wheelchair position. The ballast for all 12 standing passengers and one wheelchair position was eliminated. This reduction in passenger weight was necessary to avoid exceeding the GAWR (9,450 lbs) of the rear axle. The GVW segment was completed on September 22, 2005. The next 1,500 mile SLW segment was performed at the same 13,410 lbs. The ballast for one wheelchair position (600 lbs) was eliminated to avoid exceeding the GAWR (9,450 lbs) of the rear axle. The SLW segment was completed on October 11, 2005 and the final 3,000 mile segment was performed at a CW of 10,600 lbs and completed on November 4, 2005.

COACH & EQUIPMENT - TEST BUS #0514

MILEAGE DRIVEN/RECORDED FROM DRIVERS= LOGS

DATE	TOTAL DURABILITY TRACK	TOTAL OTHER MILES	TOTAL
08/29/05 TO 09/04/05	425.00	68.00	493.00
09/05/05 TO 09/11/05	860.00	90.00	950.00
09/12/05 TO 09/18/05	390.00	103.00	493.00
09/19/05 TO 09/25/05	325.00	120.00	445.00
09/26/05 TO 10/02/05	291.00	75.00	366.00
10/03/05 TO 10/09/05	394.00	18.00	412.00
10/10/05 TO 10/16/05	780.00	574.00	1354.00
10/17/05 TO 10/23/05	883.00	132.00	1015.00
10/24/05 TO 10/30/05	652.00	246.00	898.00
10/31/05 TO 11/06/05	0.00	1075.00	1075.00
TOTAL	5000.00	2501.00	7501.00

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

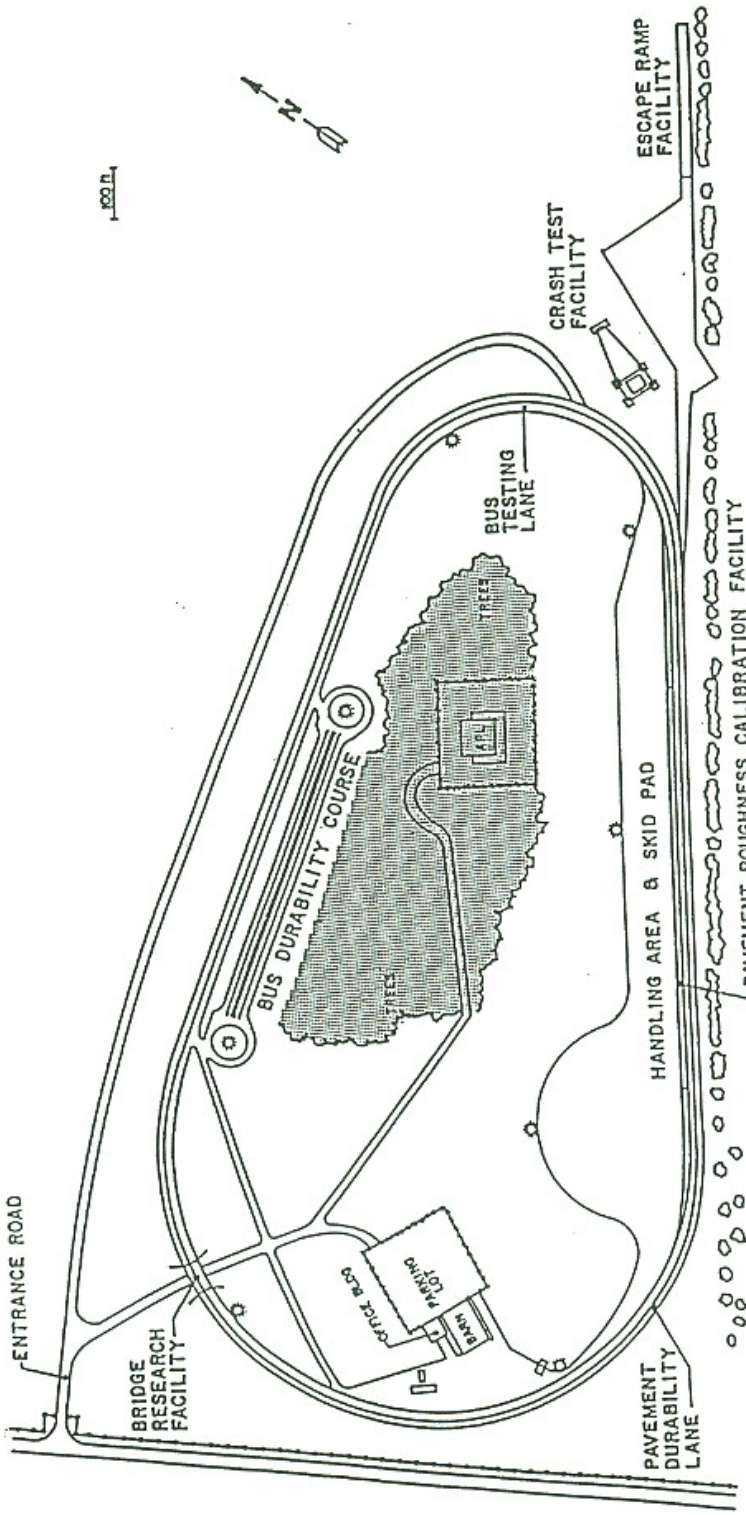
STANDARD OPERATING SCHEDULE

Monday through Friday

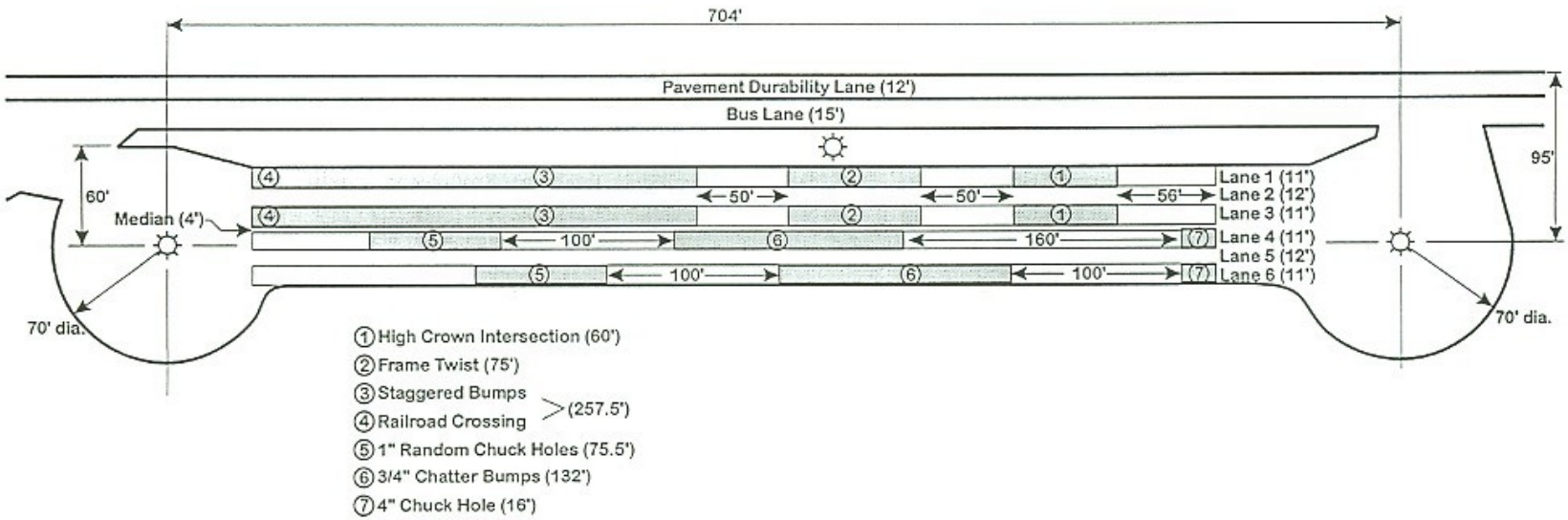
	HOUR	ACTION
Shift 1	midnight	D
	1:40 am	C
	1:50 am	B
	2:00 am	D
	3:35 am	C
	3:45 am	B
	4:05 am	D
	5:40 am	C
	5:50 am	B
	6:00 am	D
	7:40 am	C
	7:50 am	F
Shift 2	8:00 am	D
	9:40 am	C
	9:50 am	B
	10:00 am	D
	11:35 am	C
	11:45 am	B
	12:05 pm	D
	1:40 pm	C
	1:50 pm	B
	2:00 pm	D
	3:40 pm	C
	3:50 pm	F
Shift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



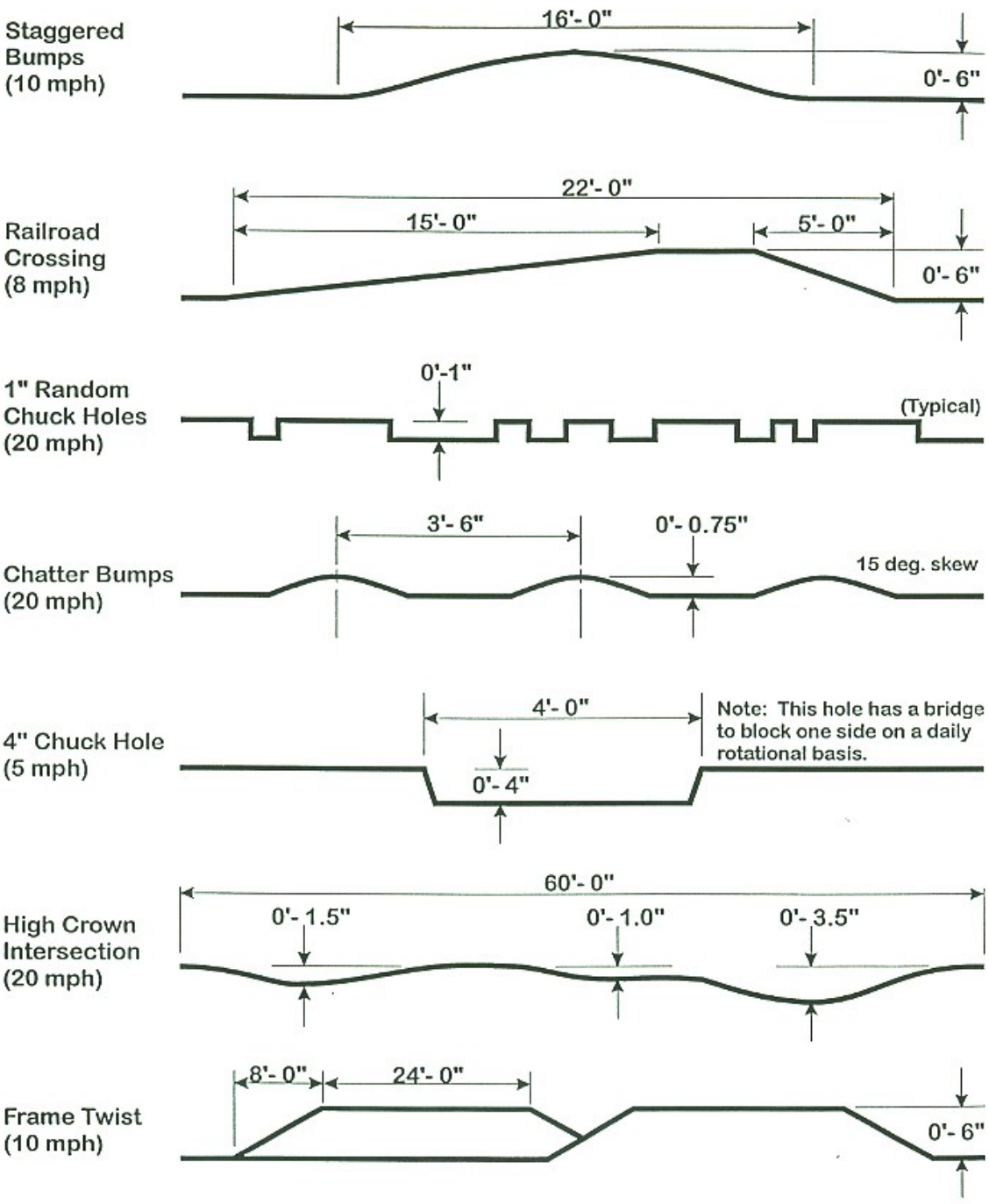
BUS TESTING AND RESEARCH TEST TRACK
UNIVERSITY PARK, PA



Plan View

Vehicle Durability Test Track

The Pennsylvania Transportation Institute
Penn State



Durability Element Profiles

The Pennsylvania Transportation Institute
Penn State

UNSCHEDULED MAINTENANCE

Coach and Equipment 0514

DATE	TEST MILES	SERVICE	ACTIVITY	DOWN TIME	HOURS
09-15-05	1443	The transmission will not shift properly.	Warranty dealer replaced failed solenoid.	80.00	3.00
09-22-05	2381	All four rear spring bushings are worn.	Warranty dealer replaced all four rear spring bushings.	48.00	3.50
09-22-05	2381	Right rear spring, forward shackle; one rivet is broken and three are loose.	Broken and loose rivet removed and replaced with bolts.	6.00	1.00
09-30-05	2640	The center bolt in the left rear spring beam is broken.	Center bolt replaced in the left rear spring beam.	5.00	2.00
10-10-05	3159	The nut has come off the left rear spring eye-bolt.	Nut reinstalled and torqued.	16.00	0.50
10-20-05	5175	Coolant leak in the engine compartment—found the over flow pipe broken off at the radiator.	Radiator plugged and hose to surge tank capped.	4.00	0.50
10-25-05	5683	The center bolt in the right rear spring beam is broken.	Spring removed. Center bolt replaced and spring reinstalled.	4.00	1.50

UNSCHEDULED MAINTENANCE

FAILED LEFT REAR SPRING CENTER BOLT (2,640 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 $\forall$ 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, 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 60EF and multiply by the density of water at 60EF

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

where **Gs** = Specific gravity of test fuel at 60EF (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 EF).

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 diesel fuel with a heating value of 24,214.0 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 – 6.84 mpg, ART – 7.12 mpg, and COM – 11.16 mpg. Average fuel consumption at idle was 5.55 lb/hr (0.89 gph).

FUEL ECONOMY PRE-TEST MAINTENANCE FORM

Bus Number: 0514	Date: 10-31-05	SLW (lbs): 13,410
Personnel: T.S. & S.C.		

FUEL SYSTEM	OK	Date	Initials
Install fuel measurement system		10/31/05	S.C.
Replace fuel filter		10/31/05	T.S.
Check for fuel leaks		10/31/05	S.C.
Specify fuel type (refer to fuel analysis)	Diesel		
Remarks: None noted.			
BRAKES/TIRES	OK	Date	Initials
Inspect hoses		10/31/05	S.C.
Inspect brakes		10/31/05	S.C.
Relube wheel bearings		10/31/05	T.S.
Check tire inflation pressures (mfg. specs.)		10/31/05	S.C.
Remarks: None noted.			
COOLING SYSTEM	OK	Date	Initials
Check hoses and connections		10/31/05	S.C.
Check system for coolant leaks		10/31/05	S.C.
Remarks: None noted.			

FUEL ECONOMY PRE-TEST MAINTENANCE FORM (page 2)

Bus Number: 0514	Date: 10/31/05
Personnel: T.S. & S.C.	

ELECTRICAL SYSTEMS	OK	Date	Initials
Check battery		10/31/05	S.C.
Inspect wiring		10/31/05	S.C.
Inspect terminals		10/31/05	S.C.
Check lighting		10/31/05	S.C.
Remarks: None noted.			
DRIVE SYSTEM	OK	Date	Initials
Drain transmission fluid		10/31/05	T.S.
Replace filter/gasket		10/31/05	T.S.
Check hoses and connections		10/31/05	T.S.
Replace transmission fluid		10/31/05	T.S.
Check for fluid leaks		10/31/05	T.S.
Remarks: None noted.			
LUBRICATION	OK	Date	Initials
Drain crankcase oil		10/31/05	T.S.
Replace filters		10/31/05	T.S.
Replace crankcase oil		10/31/05	T.S.
Check for oil leaks		10/31/05	T.S.
Check oil level		10/31/05	T.S.
Lube all chassis grease fittings		10/31/05	T.S.
Lube universal joints		10/31/05	T.S.
Replace differential lube including axles		10/31/05	T.S.
Remarks: None noted.			

FUEL ECONOMY PRE-TEST MAINTENANCE FORM (page 3)

Bus Number: 0514	Date: 10/31/05
Personnel: T.S. & S.C.	

EXHAUST/EMISSION SYSTEM	OK	Date	Initials
Check for exhaust leaks		10/31/05	S.C.
Remarks: None noted.			

ENGINE	OK	Date	Initials
Replace air filter		10/31/05	S.C.
Inspect air compressor and air system	N/A	10/31/05	S.C.
Inspect vacuum system, if applicable		10/31/05	S.C.
Check and adjust all drive belts		10/31/05	S.C.
Check cold start assist, if applicable		10/31/05	S.C.
Remarks: None noted.			

STEERING SYSTEM	OK	Date	Initials
Check power steering hoses and connectors		10/31/05	S.C.
Service fluid level		10/31/05	S.C.
Check power steering operation		10/31/05	S.C.
Remarks: None noted.			

	OK	Date	Initials
Ballast bus to seated load weight		10/31/05	S.C.

TEST DRIVE	OK	Date	Initials
Check brake operation		10/31/05	S.C.
Check transmission operation		10/31/05	S.C.
Remarks: None noted.			

FUEL ECONOMY PRE-TEST INSPECTION FORM

Bus Number: 0514	Date: 11-1-05
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 82 Middle N/A Rear 83	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: 0514	Manufacturer: Coach & Equipment	Date: 11/1/05
Run Number: 1	Personnel: T.S., B.S. & S.C.	
Test Direction: □CW or ■CCW	Temperature (°F): 63	Humidity (%): 42
SLW (lbs): 13,410	Wind Speed (mph) & Direction: 10/SSW	Barometric Pressure (in.Hg): 29.97

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	8:53	8:53	20.5	0	1.75	1.75
ART #1	0	4:01	4:01	21.0	0	1.74	1.74
CBD #2	0	8:45	8:45	21.0	0	1.78	1.78
ART #2	0	3:54	3:54	23.0	0	1.78	1.78
CBD #3	0	8:30	8:30	27.5	0	1.80	1.80
COMMUTER	0	6:04	6:04	27.5	0	2.20	2.20
							Total Fuel = 11.05 lbs

20 minute idle : Total Fuel Used = 1.88 lbs

Heating Value = 20,214.0 BTU/LB

Comments: None

FUEL ECONOMY DATA FORM (Liquid Fuels)

Bus Number: 0514	Manufacturer: Coach & Equipment	Date: 11-1-05
Run Number: 2	Personnel: T.S., B.S. & S.C.	
Test Direction: ■CW or □CCW	Temperature (°F): 64	Humidity (%): 42
SLW (lbs): 13,410	Wind Speed (mph) & Direction: 10/SSW	Barometric Pressure (in.Hg): 29.97

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	8:42	8:42	30.0	0	1.73	1.73
ART #1	0	3:57	3:57	30.0	0	1.65	1.65
CBD #2	0	8:30	8:30	30.0	0	1.73	1.73
ART #2	0	3:56	3:56	29.5	0	1.68	1.68
CBD #3	0	8:44	8:44	31.0	0	1.78	1.78
COMMUTER	0	6:02	6:02	31.5	0	2.12	2.12
							Total Fuel = 10.69 lbs

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

Heating Value = 20,214.0 BTU/LB

Comments: None

FUEL ECONOMY DATA FORM (Liquid Fuels)

Bus Number: 0514	Manufacturer: Coach & Equipment	Date: 11-1-05
Run Number: 3	Personnel: T.S., B.S. & S.C.	
Test Direction: □CW or ■CCW	Temperature (°F): 64	Humidity (%): 42
SLW (lbs): 13,410	Wind Speed (mph) & Direction: 10/SSW	Barometric Pressure (in.Hg): 29.91

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	8:28	8:28	30.5	0	1.81	1.81
ART #1	0	3:56	3:56	32.0	0	1.68	1.68
CBD #2	0	8:26	8:26	32.0	0	1.75	1.75
ART #2	0	4:04	4:04	32.5	0	1.68	1.68
CBD #3	0	8:25	8:25	32.5	0	1.79	1.79
COMMUTER	0	6:08	6:08	33.0	0	2.19	2.19
							Total Fuel = 10.90 lbs

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

Heating Value = 20,214.0 BTU/LB

Comments: None

FUEL ECONOMY DATA FORM (Liquid Fuels)

Bus Number: 0514	Manufacturer: Coach & Equipment	Date: 11-1-05
Run Number: 4	Personnel: T.S., B.S. & S.C.	
Test Direction: ■CW or □CCW	Temperature (°F): 65	Humidity (%): 42
SLW (lbs): 13,410	Wind Speed (mph) & Direction: 10/SSW	Barometric Pressure (in.Hg): 29.91

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	8:24	8:24	30.5	0	1.71	1.71
ART #1	0	4:01	4:01	32.0	0	1.63	1.63
CBD #2	0	8:23	8:23	32.0	0	1.75	1.75
ART #2	0	4:03	4:03	32.5	0	1.63	1.63
CBD #3	0	8:25	8:25	32.5	0	1.64	1.64
COMMUTER	0	6:20	6:20	33.0	0	2.08	2.08
							Total Fuel = 10.44 lbs

20 minute idle : Total Fuel Used = 1.82 lbs

Heating Value = 20,214.0 BTU/LB

Comments: None

0514.FUL
FUEL ECONOMY SUMMARY SHEET

BUS MANUFACTURER :Coach & Equipment
BUS MODEL :Phoenix
BUS NUMBER :0514
TEST DATE :11/1/05

FUEL TYPE : DIESEL
SP. GRAVITY : .8095
HEATING VALUE : 20214.00 BTU/Lb
Standard Conditions : 60 deg F and 14.7 psi
Density of Water : 8.3373 lb/gallon at 60 deg F

CYCLE	TOTAL FUEL USED (Lb)	TOTAL MILES	FUEL ECONOMY M/Lb(Measured)	FUEL ECONOMY MPG(Corrected)
Run # :1, CCW				
CBD	5.33	5.73	1.08	6.74
ART	3.52	3.82	1.09	6.80
COM	2.20	3.82	1.74	10.88
TOTAL	11.05	13.37	1.21	7.58
Run # :2, CW				
CBD	5.24	5.73	1.09	6.85
ART	3.33	3.82	1.15	7.19
COM	2.12	3.82	1.80	11.29
TOTAL	10.69	13.37	1.25	7.84
Run # :3, CCW				
CBD	5.35	5.73	1.07	6.71
ART	3.36	3.82	1.14	7.13
COM	2.19	3.82	1.74	10.93
TOTAL	10.90	13.37	1.23	7.69
Run # :4, CW				
CBD	5.10	5.73	1.12	7.04
ART	3.26	3.82	1.17	7.34
COM	2.08	3.82	1.84	11.51
TOTAL	10.44	13.37	1.28	8.03

IDLE CONSUMPTION

First 20 Minutes Data : 1.88 Lb Last 20 Minutes Data : 1.82 Lb
Average Idle Consumption : 5.55 Lb/Hr

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

Run 1 : -2.6 Run 2 : .7 Run 3 : -1.2 Run 4 : 3.1

SUMMARY

Average Idle Consumption : .89 G/Hr
Average CBD Phase Consumption : 6.84 MPG
Average Arterial Phase Consumption : 7.12 MPG
Average Commuter Phase Consumption : 11.16 MPG
Overall Average Fuel Consumption : 7.78 MPG
Overall Average Fuel Consumption : 57.06 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 52.7 dB(A); ranging from 51.2 dB(A) at the driver's seat to 53.5 dB(A) in line with the middle speaker. The interior ambient noise level for this test was 34.0 dB(A).

The second test measures interior noise during acceleration from 0 to 35 mph. This noise level ranged from 67.7 dB(A) at the rear passenger seats to 74.5 dB(A) at the driver's seat. The overall average was 70.1 dB(A). The interior ambient noise level for this test was 36.2 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: 0514	Date: 8-22-05
Personnel: S.C. & T.S.	
Temperature (°F): 65	Humidity (%): 55
Wind Speed (mph): Calm	Wind Direction: Calm
Barometric Pressure (in.Hg): 30.11	
Initial Sound Level Meter Calibration: ■ checked by: S.C.	
Interior Ambient Noise Level dB(A): 34.0	Exterior Ambient Noise Level dB(A): 44.9
Microphone Height During Testing (in): 48.0	

Measurement Location	Measured Sound Level dB(A)
Driver's Seat	51.2
Front Passenger Seats	52.7
In Line with Front Speaker	53.3
In Line with Middle Speaker	53.5
In Line with Rear Speaker	53.1
Rear Passenger Seats	52.5

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: 0514	Date: 11-2-05
Personnel: S.C., B.C. & G.M.	
Temperature (°F): 46	Humidity (%): 56
Wind Speed (mph): 5	Wind Direction: SW
Barometric Pressure (in.Hg): 30.09	
Initial Sound Level Meter Calibration: ■ checked by: S.C.	
Interior Ambient Noise Level dB(A): 36.2	Exterior Ambient Noise Level dB(A): 39.0
Microphone Height During Testing (in): 48.0	

Measurement Location	Measured Sound Level dB(A)
Driver's Seat	74.5
Front Passenger Seats	70.1
Middle Passenger Seats	68.0
Rear Passenger Seats	67.7

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

Comments: All readings taken in the center aisle.

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

Bus Number: 0514	Date: 11-2-05
Personnel: S.C.	
Temperature (°F): 46	Humidity (%): 56
Wind Speed (mph): 5	Wind Direction: SW
Barometric Pressure (in.Hg): 30.09	

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 39.5 dB(A), the average test result obtained while accelerating from a constant speed was 73.9 dB(A) on the right side and 75.1 dB(A) on the left side.

When accelerating from a standstill with an exterior ambient noise level of 39.0 dB(A), the average of the results obtained were 73.0 dB(A) on the right side and 74.6 dB(A) on the left side.

With the vehicle stationary and the engine, accessories, and air conditioning on, the measurements averaged 59.6 dB(A) at low idle, 64.8 dB(A) at high idle, and 74.6 dB(A) at wide open throttle. With the accessories and air conditioning off, the readings averaged 1.0 dB(A) lower at low idle, 4.4 dB(A) lower at high idle, and 1.6 dB(A) lower at wide open throttle. The exterior ambient noise level measured during this test was 39.7 dB(A).

EXTERIOR NOISE TEST DATA FORM
Accelerating from Constant Speed

Bus Number: 0514	Date: 11-2-05
Personnel: B.S. & S.C.	
Temperature (°F): 52	Humidity (%): 51
Wind Speed (mph): 5 to 8	Wind Direction: SW
Barometric Pressure (in.Hg): 30.10	
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): 39.5	

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	73.5	1	74.4
2	74.3	2	74.8
3	73.4	3	74.6
4	73.4	4	75.0
5	73.4	5	75.1
Average of two highest actual noise levels = 73.9 dB(A)		Average of two highest actual noise levels = 75.1 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: 0514	Date: 11-2-05
Personnel: B.S. & S.C.	
Temperature (°F): 53	Humidity (%): 51
Wind Speed (mph): 5 to 8	Wind Direction: SW
Barometric Pressure (in.Hg): 30.10	
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): 39.0	

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	73.6
2	73.0	2	74.3
3	72.5	3	74.5
4	72.6	4	74.7
5	72.5	5	73.9
Average of two highest actual noise levels = 73.0 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
Stationary

Bus Number: 0514	Date: 11-2-05
Personnel: B.S., S.C. & G.M.	
Temperature (°F): 53	Humidity (%): 51
Wind Speed (mph): 5 to 8	Wind Direction: SW
Barometric Pressure (in.Hg): 30.10	

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): 39.7

Accessories and Air Conditioning ON

Throttle Position	Engine RPM	Curb (Right) Side dB(A)	Street (Left) Side db(A)
		Measured	Measured
Low Idle	700	59.4	59.7
High Idle	1,200	64.1	65.5
Wide Open Throttle	4,000	74.8	74.3

Accessories and Air Conditioning OFF

Throttle Position	Engine RPM	Curb (Right) Side dB(A)	Street (Left) Side db(A)
		Measured	Measured
Low Idle	750	59.1	58.1
High Idle	1,250	60.6	60.2
Wide Open Throttle	4,000	74.3	71.3

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

Comments: None noted.

Filename: Report.0514.doc
Directory: E:
Template: C:\Documents and Settings\vnocek\Application Data\Microsoft\Templates\Normal.dot
Title: 5
Subject:
Author: Sondra Hoover
Keywords:
Comments:
Creation Date: 12/7/2005 2:35:00 PM
Change Number: 3
Last Saved On: 12/7/2005 2:37:00 PM
Last Saved By: PTI
Total Editing Time: 7 Minutes
Last Printed On: 3/6/2007 10:24:00 AM
As of Last Complete Printing
Number of Pages: 110
Number of Words: 14,973 (approx.)
Number of Characters: 73,970 (approx.)