STURAA TEST

12 YEAR

500,000 MILE BUS

from

BLUE BIRD CORPORATION

MODEL EXPRESS 4500

NOVEMBER 2004

PTI-BT-R0404

PENNSTATE

The Pennsylvania Transportation Institute

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EXECUTIVE SUMMARY

Blue Bird Corporation submitted a model Express, diesel-powered 54 seat (including the driver) 44-foot bus, for a 12 yr/500,000 mile STURAA test. The odometer reading at the time of delivery was 1,895.0 miles. Testing started on February 5, 2004 and was completed on October 15, 2004. 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 March 8, 2004 and was completed on September 28, 2004.

The interior of the bus is configured with seating for 54 passengers including the driver. Free floor space will accommodate 28 standing passengers resulting in a potential load of 82 persons. At 150 lbs per person, this load results in a measured gross vehicle weight of 48,830 lbs. In order to avoid exceeding the GAWR (13,000 lbs) of the tag axle, ballast for 5 standing passengers was eliminated. This reduction from full capacity resulted in an adjusted measured gross vehicle weight of 48,090 lbs and was used for all dynamic testing. The middle segment was performed at a SLW of 44,905 lbs and the final segment was performed at a CW of 36,865 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 also are listed by class as defined in Section 2. The test bus encountered no Class 1 or Class 2 failures. Of the 57 reported failures, 32 were Class 3 and 25 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 26.86 seconds.

The Shakedown Test produced a maximum final loaded deflection of 0.125 inches with a permanent set ranging between -0.003 to 0.003 inches under a distributed static load of 30,750 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 Static Towing Test was performed using a target load (towing force) of 44,238 lbs. All four front pulls were completed to the full test load with no damage or deformation observed. 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 5.6 inches.

A Fuel Economy Test was run on simulated central business district, arterial, and commuter courses. The results were 2.04 mpg, 2.67 mpg, and 5.40 mpg respectively; with an overall average of 2.70 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 Blue Bird Corporation, model Express 4500. The bus has a front door, forward of the front axle, and a dedicated handicap door forward of the rear axle. Note: the test bus submitted for testing was not equipped with a handicap device. Power is provided by a diesel-fueled, Caterpillar Inc. model C-12 engine coupled to an Allison B500 transmission.

The measured curb weight is 10,880 lbs for the front axle, 15,430 lbs for the rear axle and 10,555 lbs for the tag axle. These combined weights provide a total measured curb weight of 36,865 lbs. There are 54 seats including the driver and room for 28 standing passengers bringing the total passenger capacity to 82. Gross load is calculated as 150 lbs x 82 = 12,300 lbs. At full capacity, the measured gross vehicle weight is 48,830 lbs. This value was used for all static tests. In order to avoid exceeding the GAWR (13,000 lbs) of the tag axle, ballast for 5 standing passengers was eliminated. This reduction from full capacity resulted in an adjusted measured gross vehicle weight of 48,090 lbs and was used for all dynamic testing.

VEHICLE DATA FORM

Bus Number: 0404	Arrival Date: 2-9-04
Bus Manufacturer: Blue Bird Corporation	Vehicle Identification Number (VIN): 1BAGRB2A45W100140
Model Number: Express 4500	Date: 2-9-04
Personnel: S.C. & T.S.	

WEIGHT: *Values in parentheses 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	5,450	5,430	7,940	7,490	5,030	5,525
SLW	6,950	6,880	9,380	8,970	6,125	6,600
GVW	8,000 (7,960)	8,020 (8,070)	9,880 (9,700)	9,530 (9,310)	6,500 (6,350)	6,900 (6,700)

Total Weight Details:

Weight (lb)	CW	SLW	GVW	GAWR
Front Axle	10,880	13,830	16,020 (16,030)	16,000
Middle Axle	15,430	18,350	19,410 (19,010)	23,000
Rear Axle	10,555	12,725	13,400 (13,050)	13,000
Total	36,865	44,905	48,830 (48,090)	GVWR: 52,000

Dimensions:

Length (ft/in)	44 / 4
Width (in)	100.5
Height (in)	120.5
Front Overhang (in)	81.0
Rear Overhang (in)	104.0
Wheel Base (in)	Front to rear: 297.0 Rear to tag: 50.0 Front to tag: 347.0
Wheel Track (in)	Front: 80.5
	Rear: 73.2 Tag: 86.6

Bus Number: 0404	Date: 2-9-04

CLEARANCES:

Lowest Point Outside Front Axle	Location: Frame	Clearance(in): 8.5
Lowest Point Outside Rear Axle	Location: Frame	Clearance(in): 8.7
Lowest Point between Axles	Location: Frame	Clearance(in): 11.0
Ground Clearance at the center (in)	11.0	
Front Approach Angle (deg)	7.6	
Rear Approach Angle (deg)	6.4	
Ramp Clearance Angle (deg)	4.2	
Aisle Width (in)	13.5	
Inside Standing Height at Center Aisle (in)	82.0	

BODY DETAILS:

Body Structural Type	Monocoque		
Frame Material	Steel		
Body Material	Aluminum & fiberglass		
Floor Material	Plywood		
Roof Material	Aluminum & fiberglass		
Windows Type	□ Fixed	■ Movable	
Window Mfg./Model No.	SPEC-TEMP / AS3 M8 3113G DOT 243		
Number of Doors	1 Front	1 Rear (handicap only)	
Mfr. / Model No.	Blue Bird Body Co. / na		
Dimension of Each Door (in)	Front - 27.7 x 94.0	Rear – 46.5 x 68.7	
Passenger Seat Type	□ Cantilever	■ Pedestal	□ Other (explain)
Mfr. / Model No.	American Seating / 2000		
Driver Seat Type	■ Air	□ Spring	□ Other (explain)
Mfr. / Model No.	Recaro / Ergo		
Number of Seats (including Driver)	54		

Bus Number: 0404	Date: 2-9-04

BODY DETAILS (Contd..)

Free Floor Space (ft^2)	42.7			
Height of Each Step at Normal Position (in)	Front 1. 16.0	2. 9.8	3. 9.9	4. 10.0
	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.	Caterpillar Inc. / C-12		
Location	□ Front	■ Rear	□ Other (explain)
Fuel Type	□ Gasoline	□ CNG	□ Methanol
	■ Diesel	□ LNG	□ Other (explain)
Fuel Tank Capacity (indicate units)	200 Gals		
Fuel Induction Type	■ Injected	□ Carburetion	
Fuel Injector Mfr. / Model No.	Caterpillar Inc. / C-12		
Carburetor Mfr. / Model No.	N/A		
Fuel Pump Mfr. / Model No.	Caterpillar Inc. / C-12		
Alternator (Generator) Mfr. / Model No.	Leece-Neville / VLF3278-002		
Maximum Rated Output (Volts / Amps)	28 / 280		
Air Compressor Mfr. / Model No.	Caterpillar TU-FLO / 550		
Maximum Capacity (ft^3 / min)	13.5		
Starter Type	■ Electrical	□ Pneumatic	□ Other (explain)
Starter Mfr. / Model No.	Caterpillar / 207-1557-24I		

Bus Number: 0404	Date: 2-9-04

TRANSMISSION

Transmission Type	□ Manual	■ Automatic	
Mfr. / Model No.	Allison Transmission / B500		
Control Type	□ Mechanical	■ Electrical	□ Other
Torque Convertor Mfr. / Model No.	Allison Transmission / B500		
Integral Retarder Mfr. / Model No.	Caterpillar Inc. / C-12		

SUSPENSION

Number of Axles	3		
Front Axle Type	■ Independent	□ Beam Axle	
Mfr. / Model No.	Meritor / RIS16EF18C1001		
Axle Ratio (if driven)	N/A		
Suspension Type	■ Air	□ Spring	□ Other (explain)
No. of Shock Absorbers	2		
Mfr. / Model No.	Gabriel / T21009BA		
Drive Axle Type	□ Independent	■ Beam Axle	
Mfr. / Model No.	Meritor / RC23161NFCF		
Axle Ratio (if driven)	4.89		
Suspension Type	■ Air	□ Spring	□ Other (explain)
No. of Shock Absorbers	4		
Mfr. / Model No.	Meritor / T20328EB		
Tag Axle Type	□ Independent	■ Beam Axle	
Mfr. / Model No.	Meritor / MC113003NSNC		
Axle Ratio (if driven)	N/A		
Suspension Type	□ Air	□ Spring	□ Other (explain)
No. of Shock Absorbers	2		
Mfr. / Model No.	Gabriel / T20327PB		

Bus Number: 0404	Date: 2-9-04

WHEELS & TIRES

Front	Wheel Mfr./ Model No.	Alcoa / 22.5 x 9.00
	Tire Mfr./ Model No.	Michelin Pilot XZA / 315/80R 22.5
Rear	Wheel Mfr./ Model No.	Alcoa / 22.5 x 9.00
	Tire Mfr./ Model No.	Michelin Pilot XZA / 315/80R 22.5
Tag	Wheel Mfr./ Model No.	Alcoa / 22.5 x 9.00
	Tire Mfr./ Model No.	Michelin Pilot XZA / 315/80R 22.5

BRAKES

Front Axle Brakes Type	□ Cam	■ Disc	□ Other (explain)
Mfr. / Model No.	Meritor / DX225		
Middle Axle Brakes Type	□ Cam	■ Disc	□ Other (explain)
Mfr. / Model No.	Meritor / DX225		
Rear Axle Brakes Type	□ Cam	■ Disc	□ Other (explain)
Mfr. / Model No.	Meritor / DX225		
Retarder Type	Engine brake		
Mfr. / Model No.	Caterpillar Inc. / C-12		

HVAC

Heating System Type	■ Air	□ Water	□ Other
Capacity (Btu/hr)	137,000		
Mfr. / Model No.	Carrier / 68RF353		
Air Conditioner	■ Yes	□ No	
Location	Exterior roof		
Capacity (Btu/hr)	110,000		
A/C Compressor Mfr. / Model No.	Carrier / 05GC 141810		

Bus Number: 0404	Date: 2-9-04

STEERING

Steering Gear Box Type	Hydraulic gear
Mfr. / Model No.	TRW / THP-90605
Steering Wheel Diameter	20.0
Number of turns (lock to lock)	5

OTHERS

Wheel Chair Ramps	Location: N/A	Type: N/A
Wheel Chair Lifts	Location: N/A	Type: N/A
Mfr. / Model No.	N/A	
Emergency Exit	Location: Window Door	Number: 17 2

CAPACITIES

Fuel Tank Capacity (gals)	200
Engine Crankcase Capacity (gallons)	9.0
Transmission Capacity (gallons)	12.0
Differential Capacity (gallons)	6.0
Cooling System Capacity (quarts)	18.0 (engine only)
Power Steering Fluid Capacity (gallons)	7.0

VEHICLE DATA FORM

Bus Number: 0404	Date: 2-5-04

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

Part Number	Description	Qty.
na	Operators manual	1
R90-BB-02	Fuel Filters	3
G2A-D1-888	Dinex module	1
VF4-15H11	24 volt relay	2
na	7.5 amp fuse (mini)	13
na	7.5 amp fuse	1
na	5 amp fuse	4
na	15 amp fuse	1
na	10 amp fuse (mini)	1
na	15 amp fuse (mini)	3
1R-0749	Fuel filter	2
1W-8845	Oil filter	1
1R-0716	Oil filter	2
Sikaflex-255 FC	Adhesive sealant	2
na	Windshield	3
na	Windshield weather strip	1
Michelin XZA-1	Tires	8
Michelin XZA-1/Alcoa 315/80 R22.5	Mounted tires	2

COMPONENT/SUBSYSTEM INSPECTION FORM

Bus Number: 0404	Date: 2-5-04

Subsystem	Checked	Comments
Air Conditioning Heating and Ventilation	√	
Body and Sheet Metal	√	
Frame	√	
Steering	√	
Suspension	√	
Interior/Seating	√	
Axles	√	
Brakes	√	
Tires/Wheels	√	
Exhaust	√	
Fuel System	√	Diesel
Power Plant	√	
Accessories	√	
Lift System	√	No handicap device installed. Simulated Installed to bus.
Interior Fasteners	√	
Batteries	√	

CHECK - IN

BLUE BIRD CORPORATION'S
MODEL EXPRESS 4500

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: 0404	Date: 10-7-04

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	N/A	
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: 0404	Date: 10-7-04

Component	Checked	Comments
HVAC :		
A/C Compressor	√	
Filters	√	
Fans	√	
ELECTRICAL SYSTEM :		
Fuses	√	
Batteries	√	
Voltage regulator	√	
Voltage Convertors	√	
Lighting	√	
MISCELLANEOUS :		
Brakes	√	
Handicap Lifts/Ramps	N/A	Simulated weight installed.
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

Blue Bird #0404

DATE	TEST MILES	SERVICE	ACTIVITY	DOWN TIME	HOURS
04-01-04	1,005	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
04-12-04	1,885	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
04-21-04	2,481	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
04-30-04	3,820	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
05-07-04	4,882	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
05-14-04	5,706	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
05-21-04	6,250	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00

SCHEDULED MAINTENANCE

Blue Bird #0404

DATE	TEST MILES	SERVICE	ACTIVITY	DOWN TIME	HOURS
05-27-04	7,021	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
06-02-04	7,799	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
06-14-04	8,021	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
07-08-04	8,978	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
08-11-04	10,634	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
08-17-04	11,502	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00

SCHEDULED MAINTENANCE

Blue Bird #0404

DATE	TEST MILES	SERVICE	ACTIVITY	DOWN TIME	HOURS
08-23-04	12,391	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
09-08-04	13,366	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
09-22-04	14,439	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
09-29-04	Complete	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
Both rear leveling valve arms.	1.00
Both fuel tanks.	8.50
Left front shock.	0.50
B1 module & weather pack.	1.50
Left front air bag.	2.00
All 4 radiator isolators.	1.00
Left front ABS sensor	0.50
Mode, temp and fan switches for defrost.	0.50
Both windshields.	3.00

At the end of the test, the remaining items on the list were removed and replaced. The transmission assembly took 11.00 man-hours (two men 5.50 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	11.00 man hours
Wiper Motor	0.50 man hours
Starter	0.50 man hours
Alternator	0.50 man hours
Batteries	0.50 man hours

1.3 REPLACEMENT AND/OR REPAIR OF SELECTED SUBSYSTEMS

TRANSMISSION REMOVAL AND REPLACEMENT (11.00 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 (0.50 MAN HOURS)

ALTERNATOR REMOVAL AND REPLACEMENT (0.50 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 enroute 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 32 Class 3 failures, nine involved the suspension system, five occurred with the windshield, four each to the body frame, electrical and main frame, three to the engine/transmission, two to the brakes and one with the fuel system. These, and the remaining 25 Class 4 failures are available for review in the Unscheduled Maintenance List located in Section 5.7 Structural Durability.

RELIABILITY DATA FORMS

Bus Number: 0404	Date: 9/28/04
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	157				1.00	8.00
		1,809			0.50	4.00
		2,309			0.50	4.00
		2,309			0.50	4.00
		2,368			2.00	8.00
	2,481				1.00	8.00
		3,988			0.50	4.00
	4,933				0.25	.025
		5,600			2.00	4.00
	5,600				2.00	2.00
		6,379			1.00	12.00
		7,021			1.00	10.00
	7,799				1.00	1.00
	8,591				0.50	8.00
Body/Doors/Body Frame		12,898			1.00	8.00
	954				1.00	4.00
	2,481				1.00	1.00
	4,933				1.50	1.50
	6,250				2.00	2.00

RELIABILITY DATA FORMS

Bus Number: 0404	Date: 9/28/04
Personnel: Robert 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/Doors/Body Frame (continued)	6,569				1.00	1.00
	9,607				2.00	16.00
	11,004				0.50	8.00
		13,366			10.00	20.00
		13,366			8.00	21.00
		13,366			4.00	21.00
		13,366			1.00	21.00
Electrical	264				1.00	8.00
		954/1,056			1.50	5.00
	2,175				1.00	1.00
	2,481				1.50	1.50
		9,128			2.00	2.00
	9,431				0.50	.050
		13,947			1.00	14.00
		14,439			0.50	0.50
Engine / Transmission		4,933			0.25	8.00
	8,106				1.00	1.00
		11,763			0.50	0.50
	12,898				1.00	1.00
		13,211			1.00	1.00

RELIABILITY DATA FORMS

Bus Number: 0404	Date: 9/28/04
Personnel: Robert Reifsteck	

Subsystems	Failure Type: Class 4 Bad Order Mileage	Class 3 Bus Change Mileage	Class 2 Road Call Mileage	Class 1 Physical Safety Mileage	Man Hours	Down Time
Windshield		6,022			4.00	48.00
		9,431			5.00	32.00
		12,969			3.00	32.00
		13,309			3.00	86.00
		14,439			3.00	20.00
Frame		1,809			1.00	4.00
		4,933			4.00	4.00
		8,106			18.50	232.00
		8,978			16.00	296.00
Tires	2,921				0.50	8.00
	3,550				0.50	0.50
	4,933				1.00	1.00
	10,633				2.00	2.00
Brakes	3,988				1.00	4.00
		9,128			0.50	20.00
		10,633			0.50	.050
Fuel System		440			8.50	48.00
Steering	6,569				1.00	1.00

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: 0404	Date: 6-15-04
Personnel: D.W., T.S. & S.C.	

Temperature (°F): 75	Humidity (%): 78
Wind Direction: Calm	Wind Speed (mph): Calm
Barometric Pressure (in.Hg): 30.06	

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 26.86 seconds.

PERFORMANCE DATA FORM

Bus Number: 0404	Date: 6-15-04
Personnel: D.W., T.S. & S.C.	

Temperature (°F): 75	Humidity (%): 78
Wind Direction: Calm	Wind Speed (mph): Calm
Barometric Pressure (in.Hg): 30.06	

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	3.27	3.30	3.49
20 mph	6.43	6.71	6.96
30 mph	10.93	11.11	11.18
40 mph	17.68	17.55	18.21
Top Test Speed(mph) 50	28.80	27.46	28.08

Clockwise Recorded Interval Times

Speed	Run 1	Run 2	Run 3
10 mph	2.43	3.52	3.46
20 mph	5.58	7.18	6.43
30 mph	9.55	11.96	10.58
40 mph	16.05	18.93	17.27
Top Test Speed(mph) 50	23.43	28.33	25.08

0404.ACC

PERFORMANCE SUMMARY SHEET

BUS MANUFACTURER :Blue Bird
BUS MODEL :Express 4500
BUS NUMBER :0404
TEST DATE :6-15-04

TEST CONDITIONS :

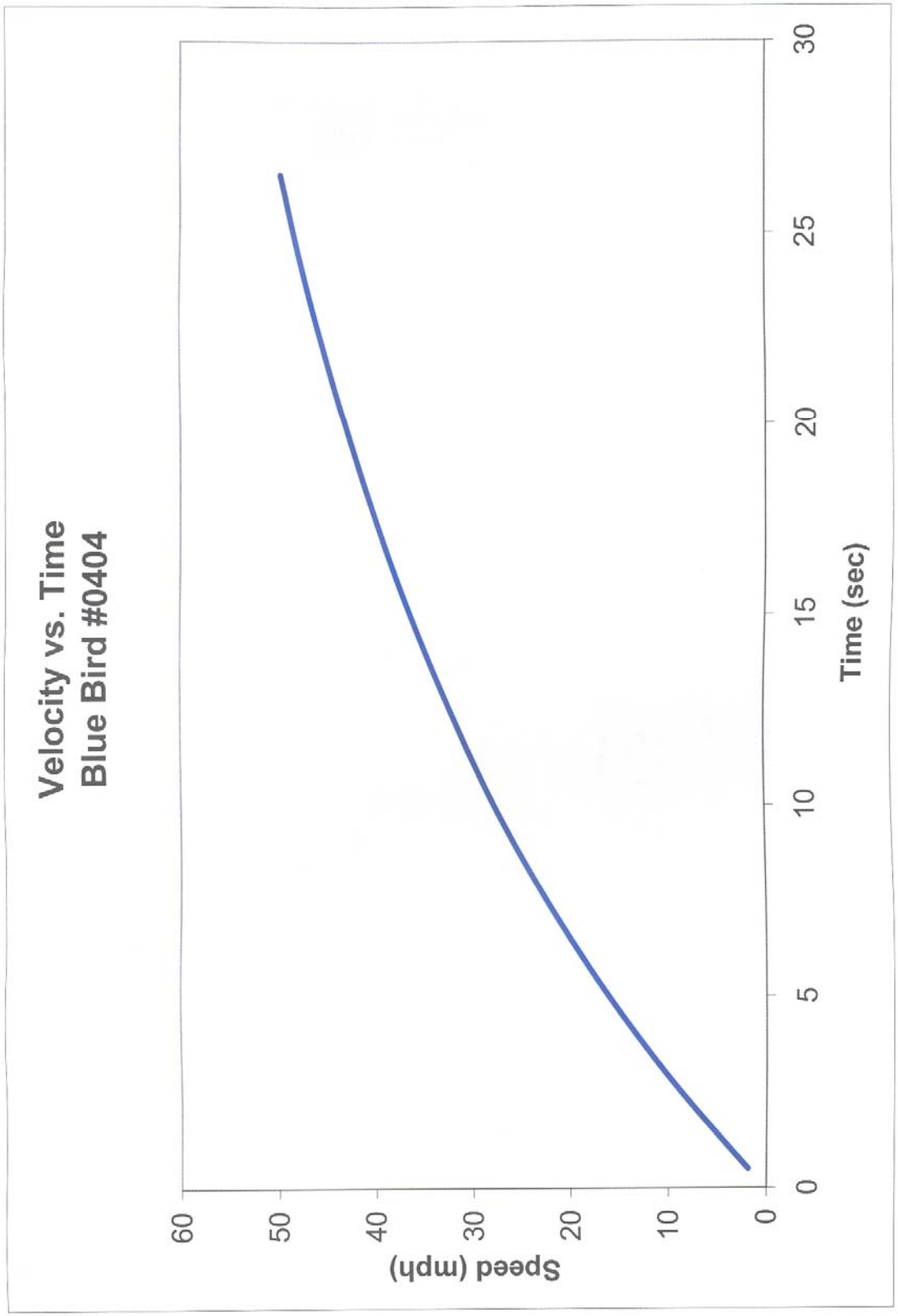
TEMPERATURE (DEG F)	: 75.0
WIND DIRECTION	: calm
WIND SPEED (MPH)	: .0
HUMIDITY (%)	: 78
BAROMETRIC PRESSURE (IN. HG)	: 30.1

VEHICLE SPEED	AVERAGE TIME (SEC)		
(MPH)	CCW DIRECTION	CW DIRECTION	TOTAL
10.0	3.35	3.14	3.25
20.0	6.70	6.40	6.55
30.0	11.07	10.70	10.89
40.0	17.81	17.42	17.62
50.0	28.11	25.61	26.86

TEST SUMMARY :

VEHICLE SPEED (MPH)	TIME (SEC)	ACCELERATION (FT/SEC^2)	MAX. GRADE (%)
1.0	.27	5.4	17.2
5.0	1.38	5.1	15.9
10.0	2.91	4.6	14.3
15.0	4.61	4.1	12.8
20.0	6.53	3.6	11.3
25.0	8.70	3.2	9.8
30.0	11.20	2.7	8.5
35.0	14.11	2.3	7.2
40.0	17.55	2.0	6.1
45.0	21.70	1.6	5.0
50.0	26.81	1.3	4.0

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
Blue Bird #0404
Speed (mph)
0
10
20
30
40
50
60
Time (sec)
0
5
10
15
20
25
30

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 82 people including the driver. The resulting test load is (82 x 375 lb) = 30,750 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 0.125 inches at reference point 9. The maximum permanent deflection after the final loading sequence ranged from -0.003 inches at reference point 1 to 0. 003 inches at reference points 4, 5 and 11.

STRUCTURAL SHAKEDOWN DATA FORM

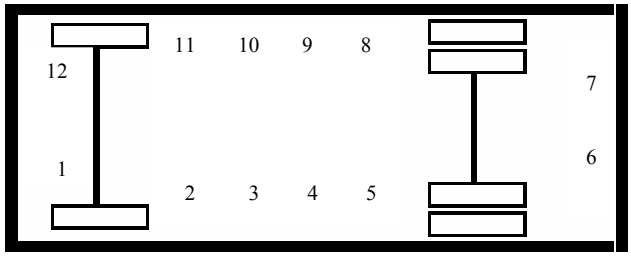
Bus Number: 0404	Date: 3-1-04
Personnel: D.L., E.D. & E.L.	Temperature (°F): 62
Loading Sequence: ■ 1 □ 2 □ 3 (check one) Test Load (lbs): 30,750	

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	-.001	-.001	.026	.026
2	0	.075	.075	.012	.012
3	0	.115	.115	.013	.013
4	0	.111	.111	.012	.012
5	0	.069	.069	.052	.052
6	0	.129	.129	.061	.061
7	0	.136	.136	.061	.061
8	0	.079	.079	.021	.021
9	0	.144	.144	.027	.027
10	0	.136	.136	.095	.095
11	0	.167	.167	.105	.105
12	0	.000	.000	.004	.004

STRUCTURAL SHAKEDOWN DATA FORM

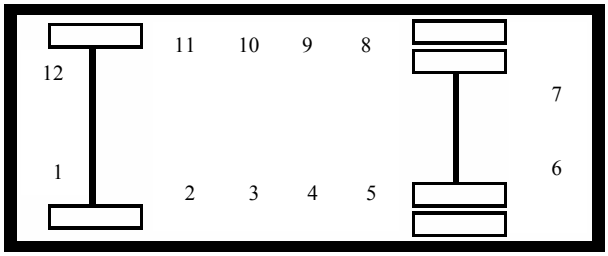
Bus Number: 0404	Date: 3-2-04
Personnel: D.L., S.C., T.S. E.D. & E.L.	Temperature (°F): 60
Loading Sequence: □ 1 ■ 2 □ 3 (check one) Test Load (lbs): 30,750	

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	.026	-.005	.031	.023	-.003
2	.012	.082	.070	.012	.000
3	.013	.125	.112	.015	.002
4	.012	.114	.102	.015	.003
5	.052	.062	.010	.055	.003
6	.061	.135	.074	.061	.000
7	.061	.140	.079	.062	.001
8	.021	.076	.055	.021	.000
9	.027	.152	.125	.026	-.001
10	.095	.150	.055	.095	.000
11	.105	.173	.068	.108	.003
12	.004	-.029	-.033	.003	-.001

5.1 STRUCTURAL SHAKEDOWN TEST

BUS LOADED TO 2.5 TIMES GVL
(30,750 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 fourteen times. The first and last test is with all wheels level. The other twelve tests are with each wheel 6 inches higher and 6 inches lower than the other three wheels.

All doors, windows, escape mechanisms, engine and steering 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: 0404	Date: 3-4-04
Personnel: T.S., D.L., E.D., E.L. & S.C.	Temperature(°F): 68

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	N/A
□ 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: 0404	Date: 3-4-04
Personnel: T.S., D.L., E.D., E.L. & S.C.	Temperature(°F): 68

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	N/A
□ 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: 0404	Date: 3-4-04
Personnel: T.S., D.L., E.D., E.L. & S.C.	Temperature(°F): 68

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	N/A
□ 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: 0404	Date: 3-4-04
Personnel: T.S., D.L., E.D., E.L. & S.C.	Temperature(°F): 68

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	N/A
□ 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: 0404	Date: 3-4-04
Personnel: T.S., D.L., E.D., E.L. & S.C.	Temperature(°F): 68

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	N/A
□ 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: 0404	Date: 3-4-04
Personnel: T.S., D.L., E.D., E.L. & S.C.	Temperature(°F): 68

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	N/A
□ 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: 0404	Date: 3-4-04
Personnel: T.S., D.L., E.D., E.L. & S.C.	Temperature(°F): 68

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	N/A
□ 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: 0404	Date: 3-4-04
Personnel: T.S., D.L., E.D., E.L. & S.C.	Temperature(°F): 68

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	N/A
□ 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: 0404	Date: 3-4-04
Personnel: T.S., D.L., E.D., E.L. & S.C.	Temperature(°F): 68

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	N/A
□ 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: 0404	Date: 3-4-04
Personnel: T.S., D.L., E.D., E.L. & S.C.	Temperature(°F): 68

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	N/A
□ 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: 0404	Date: 3-4-04
Personnel: T.S., D.L., E.D., E.L. & S.C.	Temperature(°F): 68

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	N/A
□ 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: 0404	Date: 3-4-04
Personnel: T.S., D.L., E.D., E.L. & S.C.	Temperature(°F): 68

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	N/A
□ 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: 0404	Date: 3-4-04
Personnel: T.S., D.L., E.D., E.L. & S.C.	Temperature(°F): 68

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	N/A
□ 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: 0404	Date: 3-4-04
Personnel: T.S., D.L., E.D., E.L. & S.C.	Temperature(°F): 68

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	N/A
□ 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 LOWER

RIGHT TAG 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 load-distributing yoke was incorporated as the interface between the Static Tow apparatus and the test bus tow hook/eyes. The test was performed to the full target test weight of 44,238 lbs (1.2 x 38,865 lbs CW). No damage or deformation was observed during all four pulls of the test. The manufacturer requested that no test be performed on the rear.

STATIC TOWING TEST DATA FORM

Bus Number: 0404	Date: 10-7-04
Personnel: E.D., E.L., T.S. & S.C.	Temperature (°F):

Inspect right front tow eye and adjoining structure.
Comments: No damage or deformation observed.
Check the torque of all bolts attaching tow eye and surrounding structure.
Comments: Welds confirmed.
Inspect left tow eye and adjoining structure.
Comments: No damage or deformation observed.
Check the torque of all bolts attaching tow eye and surrounding structure.
Comments: Welds confirmed.
Inspect right rear tow eye and adjoining structure.
Comments: N/A
Check the torque of all bolts attaching tow eye and surrounding structure.
Comments: N/A
Inspect left rear tow eye and adjoining structure.
Comments: N/A
Check the torque of all bolts attaching tow eye and surrounding structure.
Comments: N/A
General comments of any other structure deformation or failure: All four front pulls were completed to the full target test load of 44,238 lbs with no damage or deformation observed. Manufacturer requested no rear test be performed.

5.3 STATIC TOWING TEST

FRONT 20° UPWARD PULL

FRONT 20° DOWN PULL

5.3 STATIC TOWING TEST CONT.

FRONT 20° LEFT PULL

FRONT 20° RIGHT PULL

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: 0404	Date: 8-19-04
Personnel: S.C., & T.S.	

Temperature (°F): 73	Humidity (%): 83
Wind Direction: WSW	Wind Speed (mph): 8
Barometric Pressure (in.Hg): 30.00	

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 incorporating a hydraulic under lift wrecker. No problems were encountered with the towing interface.
Description and location of any structural damage: No noted.
General Comments: None

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 jack 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 5.6 inches to 12.6 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	10.3”
Rear axle – one tire flat	9.7”
Rear axle – two tires flat	8.0”

JACKING TEST DATA FORM

Bus Number: 0404	Date: 2-25-04
Personnel: T.S. & S.C.	Temperature (°F): 68

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 10.5 " D	9.7 " I 5.7 " D	
Left front	11.7 " I 10.3 " D	9.7 " I 5.6 " D	
Right rear—outside	9.8 " I 9.8 " D	12.4 " I 12.4 " D	
Right rear—both	9.8 " I 8.1 " D	12.4 " I 10.5 " D	
Left rear—outside	9.7 " I 9.7 " D	12.3 " I 12.3 " D	
Left rear—both	9.7 " I 8.0 " D	12.3 " I 10.4 " D	
Right tag	9.8" I 9.3" I	15.3" I 12.6" D	
Right middle or tag—both	NA	NA	
Left tag	9.7" I 9.2" D	15.3" I 12.6" D	
Left middle or tag—both	NA	NA	

Additional comments of any deformation or difficulty during jacking:
None

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: 0404	Date: 2-26-04
Personnel: T.S. & E.D.	Temperature (°F): 60

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 15,000 miles; approximately 12,500 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 6,250 miles with the bus operated at GVW. The second segment will consist of approximately 2,500 miles with the bus operated at SLW. The remainder of the test, approximately 6,250 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 March 8, 2004 and was conducted until September 28, 2004. The first 6,250 miles were performed at a GVW of 48,090 lbs. The number of standing passengers was reduced from 28 to 23. The ballast for five standing passengers was eliminated. This reduction in passenger weight was necessary to avoid exceeding the GAWR (13,000 lbs) of the tag axle. The GVW segment was completed on May 21, 2004. The next 2,500 mile SLW segment was performed at 44,905 lbs and completed on July 26, 2004, and the final 6,250 mile segment was performed at a CW of 36,865 lbs and completed on September 28, 2004.

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.

BLUE BIRD - TEST BUS #0404

MILEAGE DRIVEN/RECORDED FROM DRIVERS' LOGS

DATE	TOTAL DURABILITY TRACK	TOTAL OTHER MILES	TOTAL
03/08/04 TO 03/14/04	203.00	61.00	264.00
03/15/04 TO 03/21/04	113.00	107.00	220.00
03/22/04 TO 03/28/04	311.00	16.00	327.00
03/29/04 TO 04/04/04	136.00	109.00	245.00
04/05/04 TO 04/11/04	720.00	33.00	753.00
04/12/04 TO 04/18/04	279.00	221.00	500.00
04/19/04 TO 04/25/04	488.00	124.00	612.00
04/26/04 TO 05/02/04	1019.00	48.00	1067.00
05/03/04 TO 05/09/04	855.00	90.00	945.00
05/10/04 TO 05/16/04	721.00	187.00	908.00
05/17/04 TO 05/23/04	419.00	119.00	538.00
05/24/04 TO 05/30/04	914.00	144.00	1058.00
05/31/04 TO 06/06/04	319.00	164.00	483.00
06/07/04 TO 06/13/04	0.00	51.00	51.00
06/14/04 TO 06/20/04	0.00	135.00	135.00
06/21/04 TO 06/27/04	0.00	0.00	0.00
06/28/04 TO 07/04/04	415.00	70.00	485.00

DATE	TOTAL DURABILITY TRACK	TOTAL OTHER MILES	TOTAL
07/05/04 TO 07/11/04	321.00	66.00	387.00
07/12/04 TO 07/18/04	0.00	0.00	0.00
07/19/04 TO 07/25/04	0.00	0.00	0.00
07/26/04 TO 08/01/04	337.00	116.00	453.00
08/02/04 TO 08/08/04	405.00	171.00	576.00
08/09/04 TO 08/15/04	958.00	146.00	1104.00
08/16/04 TO 08/22/04	997.00	198.00	1195.00
08/23/04 TO 08/29/04	586.00	77.00	663.00
08/30/04 TO 09/05/04	325.00	15.00	340.00
09/06/04 TO 09/12/04	5.00	52.00	57.00
09/13/04 TO 09/19/04	581.00	0.00	581.00
09/20/04 TO 09/26/04	785.00	0.00	785.00
09/27/04 TO 10/03/04	288.00	0.00	288.00
TOTAL	12500.00	2520.00	15020.00

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

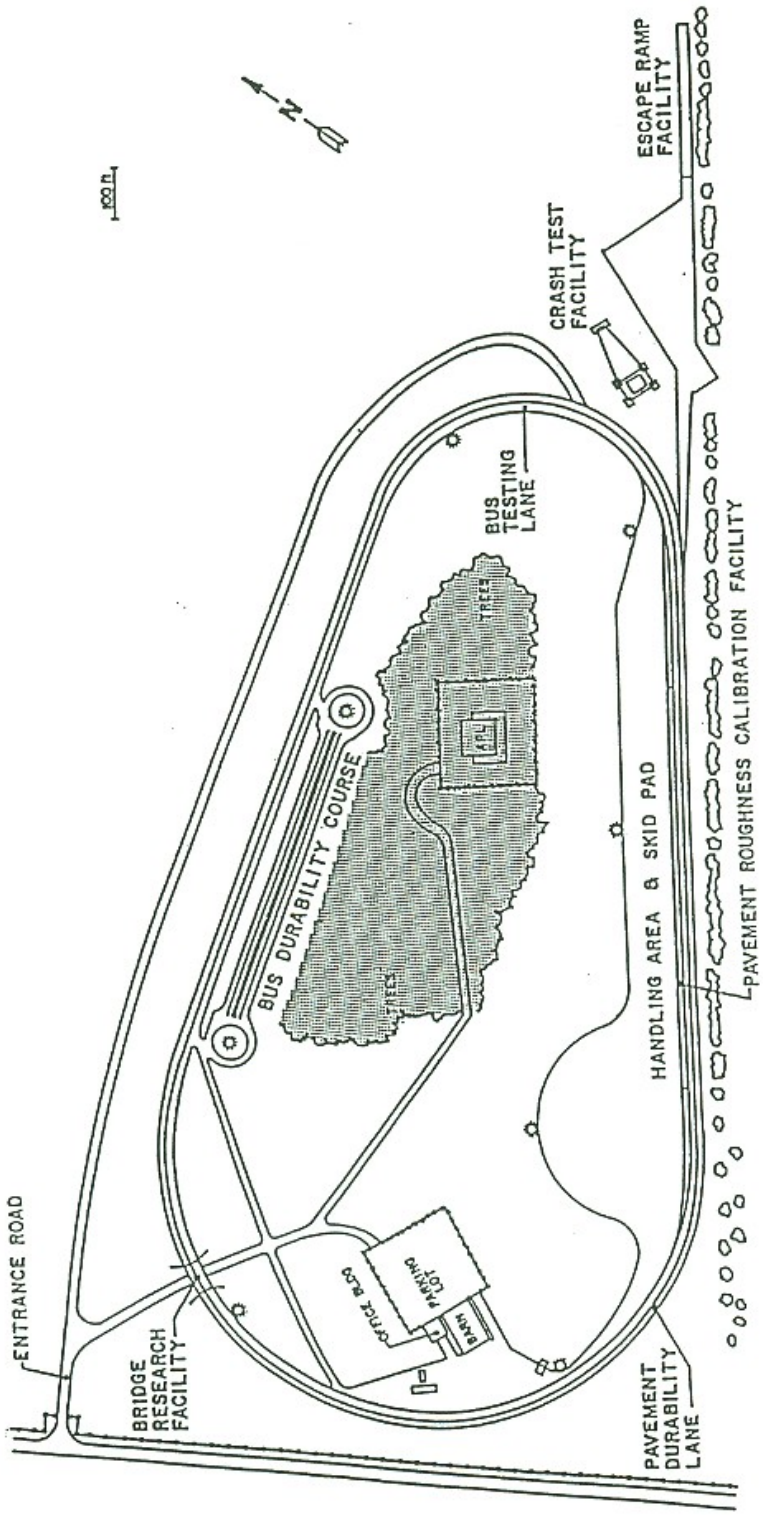
STANDARD OPERATING SCHEDULE

Monday through Friday

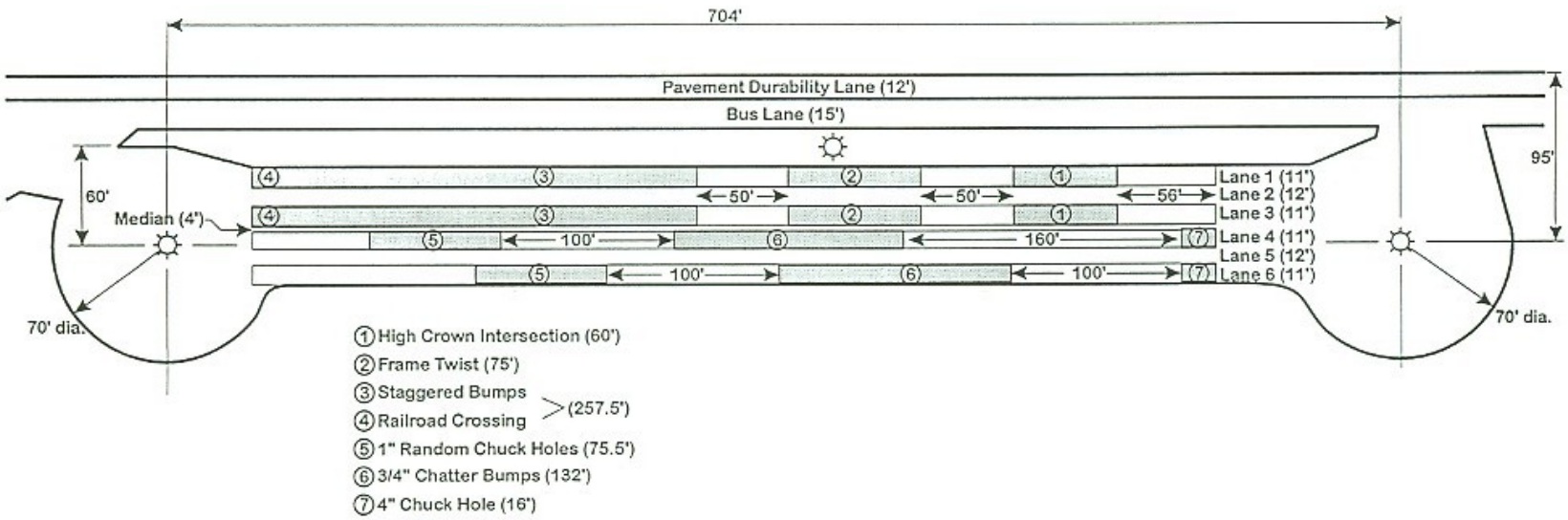
	HOUR	ACTION
Shift 1	midnight	D
	1:40 am	C
	1:50 am	B
	2:00 am	D
	3:35 am	C
	3:45 am	B
	4:05 am	D
	5:40 am	C
	5:50 am	B
	6:00 am	D
	7:40 am	C
	7:50 am	F
Shift 2	8:00 am	D
	9:40 am	C
	9:50 am	B
	10:00 am	D
	11:35 am	C
	11:45 am	B
	12:05 pm	D
	1:40 pm	C
	1:50 pm	B
	2:00 pm	D
	3:40 pm	C
	3:50 pm	F
Shift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



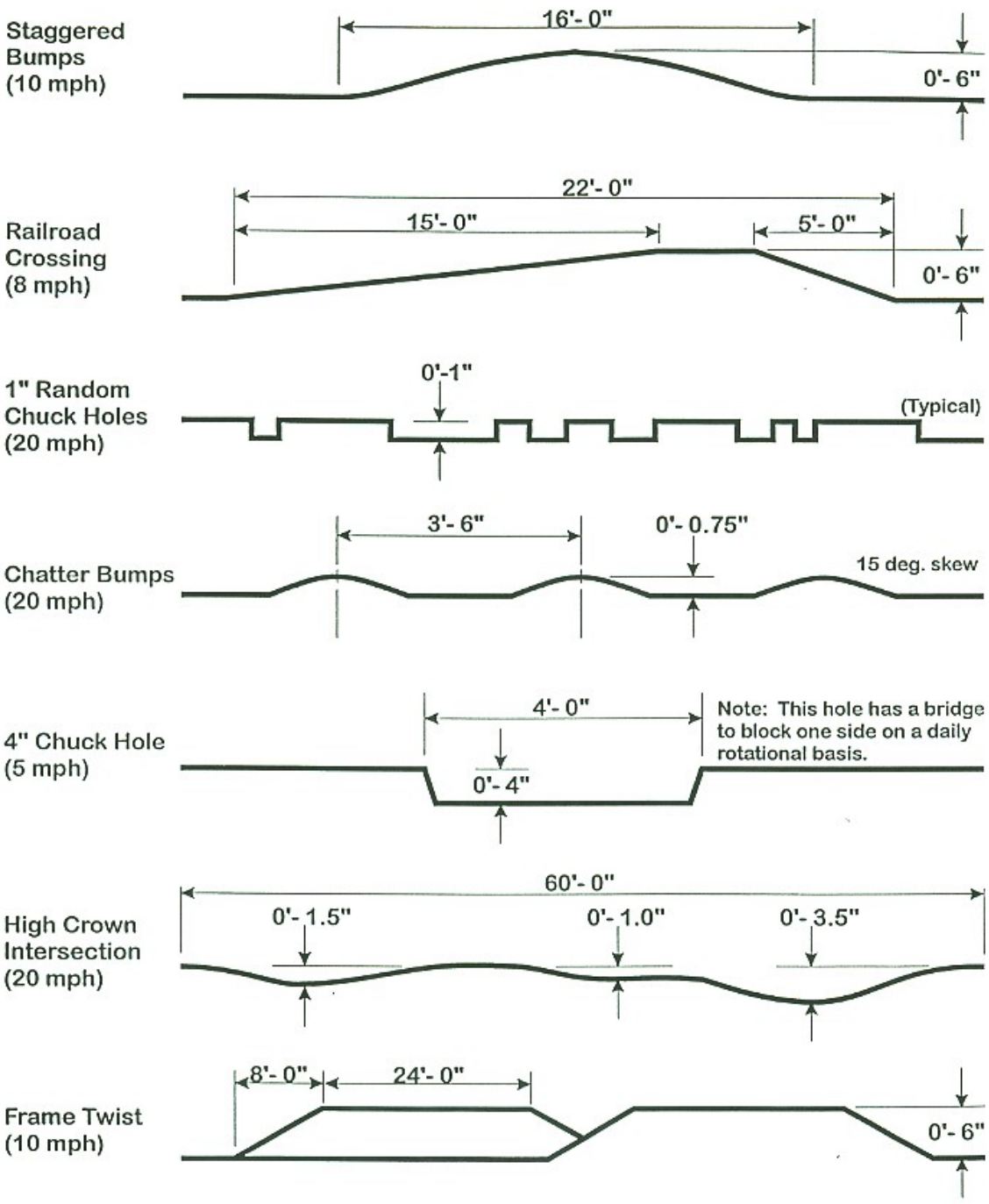
BUS TESTING AND RESEARCH TEST TRACK
UNIVERSITY PARK, PA



Plan View

Vehicle Durability Test Track

The Pennsylvania Transportation Institute
Penn State



Durability Element Profiles

The Pennsylvania Transportation Institute
Penn State

UNSCHEDULED MAINTENANCE

Blue Bird 0404

DATE	TEST MILES	SERVICE	ACTIVITY	DOWN TIME	HOURS
03-12-04	157	As per manufacturer's request.	Both rear leveling valve arms replaced. New holes drilled ¾" from existing holes. Arm connected and ride height raised.	8.00	1.00
03-15-04	264	The daytime running lights and low beams are inoperative.	Tightened loose connection at the Dinex located at the left of the entrance step well.	8.00	1.00
03-18-04	440	Fuel is leaking from the left side fuel tank.	Both fuel tanks removed and inspected. Left fuel tank has a cracked weld near the bottom. Right fuel tank reinstalled. New left fuel tank installed.	48.00	8.50
04-01-04	954	The adhesive bond is broken on the left front outer body panel above the electrical compartment door.	Cleaned and prepped area, applied urethane adhesive and reinstalled body panel with screws.	4.00	1.00
04-01-04	954	The right side battery is leaking around the positive post and the negative post and terminal are worn.	Battery replaced and new cable with terminal ordered.	4.00	0.50
04-05-04	1,056	Cable with terminal ordered on 4/1/04 arrived.	Cable installed.	1.00	1.00
04-12-04	1,809	The left side frame work is cracked where the lower radius arm attaches at the tag axle.	Crack welded/repaired.	4.00	1.00

UNSCHEDULED MAINTENANCE

Blue Bird 0404

DATE	TEST MILES	SERVICE	ACTIVITY	DOWN TIME	HOURS
04-12-04	1,809	The upper radius arm bolts are loose at the drive axle.	Bolts torqued.	4.00	0.50
04-15-04	2,175	The low beams will not operate.	Troubleshooting: B1 module replaced.	1.00	1.00
04-19-04	2,309	The right rear leveling valve link is broken.	Right rear leveling vavle link replaced.	4.00	0.50
04-19-04	2,309	The left shock is broken. The piston pulled out.	Left front shock replaced.	4.00	0.50
04-20-04	2,368	The bolts are out of the upper radius V-rod at the drive axle end.	Axle realigned and bolts installed.	8.00	2.00
04-21-04	2,481	The low beams will not operate. Module B1 shorted out and melted weather pack.	B1 module replaced and new weather pack spliced in.	1.50	1.50
04-21-04	2,481	The bolts are loose at the upper radius v-rod at the drive axle end.	Bolts replaced and torqued to 450 ft. lbs.	8.00	1.00
04-21-04	2,481	The handicap door frame screws are coming out.	Screws replaced with self tapping screws.	1.00	1.00
04-26-04	2,921	The left rear tag axle tire is flat.	Left rear tag axle tire replaced.	8.00	0.50
04-29-04	3,550	The right rear tag axle tire is worn.	Right rear tag axle replaced.	0.50	0.50

UNSCHEDULED MAINTENANCE

Blue Bird 0404

DATE	TEST MILES	SERVICE	ACTIVITY	DOWN TIME	HOURS
05-03-04	3,988	The left front shock has pulled apart.	Left front shock replaced.	4.00	0.50
05-03-04	3,988	Air is leaking from the front brake valve and the valve at the drive axle.	Loose fittings replaced.	4.00	1.00
05-10-04	4,933	The left tag axle tire is worn.	Front tires rotated to the tag axle. New tires installed on the tag axle.	1.00	1.00
05-10-04	4,933	The upper radiator hose is leaking coolant.	Both upper radiator hose clamps tightened.	8.00	0.25
05-10-04	4,933	The bolt for the rear suspension, lower radius rod is worn and the washer is broken.	Bolt washer and nut replaced.	0.25	0.25
05-10-04	4,933	The rivets are broken in the left, rear lower body panel.	Rivets replaced in the left, rear, lower body panel.	1.50	1.50
05-10-04	4,933	The frame weld is cracked where the “A” arm bolts to the frame.	Crack welded/repaired.	4.00	4.00
05-13-04	5,600	The left front air bag has blown out.	Left front air bag replaced.	4.00	2.00
05-13-04	5,600	The front upper radius rod mounting bolts are loose.	Front upper radius rod mounting bolts torqued.	2.00	2.00

UNSCHEDULED MAINTENANCE

Blue Bird 0404

DATE	TEST MILES	SERVICE	ACTIVITY	DOWN TIME	HOURS
05-20-04	6,022	The right side windshield fell out.	Right side windshield replaced.	48.00	4.00
05-21-04	6,250	25 rivets are missing from the side door.	All missing rivets replaced in the side door.	2.00	2.00
05-24-04	6,379	The left front shock has pulled apart.	Left front shock replaced.	12.00	1.00
05-25-04	6,569	The steering column will not tilt and the turn signal switch is falling off.	Metal burr cleaned from the locking teeth on the tilt column and missing screws replaced in the turn signal switch.	1.00	1.00
05-25-04	6,569	The engine compartment door will not open.	Lock linkage adjusted and mechanism lubricated.	1.00	1.00
05-27-04	7,021	Both radius rod brackets are loose at the tag axle.	All radius rod mounting bolts torqued.	10.00	1.00
06-02-04	7,799	The bolts are worn on the lower rear radius arm front mounting brackets.	Mounting bolts replaced on the lower rear radius arm mounting bracket.	1.00	1.00
06-30-04	8,106	All four radiator isolators are worn.	All four radiator isolators replaced.	1.00	1.00

UNSCHEDULED MAINTENANCE

Blue Bird 0404

DATE	TEST MILES	SERVICE	ACTIVITY	DOWN TIME	HOURS
06-30-04	8,106	Several cracks were found at the horizontal/vertical wall tube junctures on both sides of the bus. The mounting structure near the fuel tanks for the torque rod mounting castings is cracked.	The following rework was completed by Blue Bird representatives. Twenty gussets repaired by cutting apart, turning the "T" 180° and welding together. Manufacture (6) 2" x 2" "T" gussets. Installed 12 gussets on the right side and 14 gussets on the left side to the top and bottom of the window posts. Welded longitudinal and vertical tubes at the luggage by front wheel wells and rear wheel wells (27 locations). Both fuel tanks removed. Welded two gussets at the left and right tank area. Welded cracks in the mounting structure for the torque rod mounting castings and the lower right, left and center pan area. Both torque rod castings replaced.	232.00	18.50
07-06-04	8,591	The bolts are loose on the left side torque rod casting at the drive axle.	Bolts replaced and torqued to 44 ft lbs.	8.00	0.50
07-26-04	8,978	Manufacturer requested frame work be added to the radius arm mounts at the rear axle, left and right lower mounts.	Stainless steel tubing added to reinforce lower radius arms. (Fuel tank removed for installation).	296.00	16.00

UNSCHEDULED MAINTENANCE

Blue Bird 0404

DATE	TEST MILES	SERVICE	ACTIVITY	DOWN TIME	HOURS
07-28-04	9,128	Engine will not crank. Transmission pad will not power up.	Troubleshooting: replaced failed 10 amp fuse to the ATEC and starter key switch.	2.00	2.00
07-28-04	9,128	The “ABS” light is on.	The left front ABS sensor wire is broken. Left front ABS sensor replaced.	20.00	0.50
08-02-04	9,431	The right side windshield is cracked. The windshield frame at the bottom left and right is cracked.	Cracks welded/repaired. Right side windshield replaced.	32.00	5.00
08-02-04	9,431	The defrost control switch is broken.	Replaced mode switch, temp switch and fan switch for defrost controls.	0.50	0.50
08-04-04	9,607	The dash pad is loose, all bolts are missing.	5 nut-serts installed at the front of the dash. Replaced missing screws at the inside rear of the pad. New instrument panel light dimmer and intermittent wiper switch.	16.00	2.00
08-11-04	10,633	The drive axle and steering axle tires are worn.	All six tires replaced.	2.00	2.00
08-11-04	10,633	The left front ABS sensor wire is broken.	Left front ABS sensor replaced.	0.50	0.50

UNSCHEDULED MAINTENANCE

Blue Bird 0404

DATE	TEST MILES	SERVICE	ACTIVITY	DOWN TIME	HOURS
08-13-04	11,004	The air line from the PRX module under the dash is broken.	Air line replaced.	8.00	0.50
08-18-04	11,763	The left upper radiator isolator is broken.	Left upper radiator isolator replaced.	0.50	0.50
08-27-04	12,898	The right rear leveling valve arm is broken.	Right rear leveling valve arm replaced.	8.00	1.00
08-27-04	12,898	The top rear radiator isolator is missing a nut.	Nut installed on top rear radiator isolator.	1.00	1.00
08-31-04	12,969	The left side windshield is cracked at the upper right corner.	Both windshields removed. New windshield gasket installed, right side windshield installed, and new windshield installed on left side.	32.00	3.00
09-02-04	13,211	The forward lower and middle lower radiator isolators are broken.	The forward lower and middle lower radiator isolators replaced. Frame bracket tightened on the middle lower isolator. Three missing rivets replaced on the radiator door hinge. Four missing rivets replaced on the metal work around the radiator.	1.00	1.00
09-08-04	13,309	Both windshields are coming out of the gasket.	Removed both windshields and gaskets, cleaned surface on the windshield frame, installed new gasket and windshields with sealer provided by manufacturer.	86.00	3.00

UNSCHEDULED MAINTENANCE

Blue Bird 0404

DATE	TEST MILES	SERVICE	ACTIVITY	DOWN TIME	HOURS
09-14-04	13,366	The window frame welds are cracked at the upper and lower window body structure. Right side: 6 on top and 3 on bottom. Left side: 10 on top and 4 on bottom.	Overhead luggage racks removed. All cracks ground and cleaned. Cracks welded/repaired.	20.00	10.00
09-14-04	13,366	Welds are cracked in the driver's window body structure, entrance door and windshield frame.	Overhead interior panels removed. All cracks ground and cleaned. Cracks welded/repaired in the door frame upper front corner, both upper corners of the driver's window, and both lower corners of the windshield with gussets added.	21.00	8.00
09-14-04	13,366	Welds are cracked in the upper corners of the luggage compartments (body to floor frame). Eight on the left side and seven on the right side.	Rear lower body panels removed. Cracks ground and cleaned. Cracks welded/repaired.	21.00	4.00
09-14-04	13,366	The floor frame is cracked through on the side rear of the fuel tanks.	Panels rear of the fuel tank removed. Cracks ground and cleaned. Cracks welded/repaired. Steel angel plate added for support.	21.00	1.00
09-20-04	13,947	The engine will not crank. The battery posts are pitted. The right side battery is leaking at the positive post. Two cable ends are broken.	Both batteries, two cable ends and the +24v battery cable replaced.	14.00	1.00

UNSCHEDULED MAINTENANCE

Blue Bird 0404

DATE	TEST MILES	SERVICE	ACTIVITY	DOWN TIME	HOURS
09-23-04	14,439	Three fuse holders in the battery compartment are broken.	Three fuse holders replaced in the battery compartment.	0.50	0.50
09-23-04	14,439	Both windshields are working out.	Replaced windshield with new gasket.	20.00	3.00

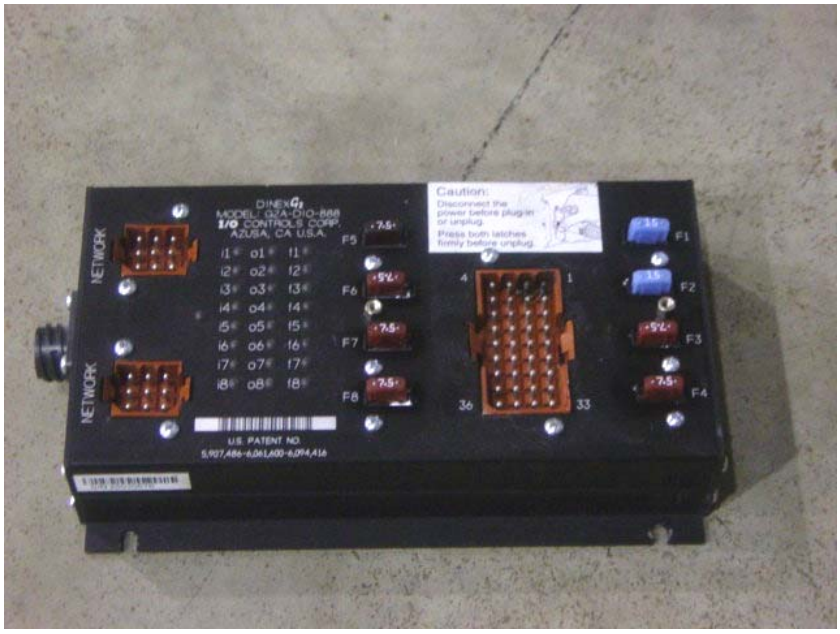
UNSCHEDULED MAINTENANCE

FUEL LEAKING FROM LEFT SIDE FUEL TANK (440 TEST MILES)

LEFT SIDE FUEL TANK LEAKING NEAR WELD AT THE BOTTOM (440 TEST MILES)

UNSCHEDULED MAINTENANCE CONT.

CRACKED FRAME WORK AT LOWER RADIUS ROD ATTACHMENT (1,809 TEST MILES)



FAILED B1 MODULE (2,175 TEST MILES)

UNSCHEDULED MAINTENANCE CONT.

LEFT FRONT SHOCK PULLED APART
(2,309 TEST MILES)

RIGHT SIDE WINDSHIELD FELL OUT
(6,022 TEST MILES)

UNSCHEDULED MAINTENANCE CONT.

25 RIVETS MISSING FROM THE SIDE DOOR (6,250 TEST MILES)

GUSSET ADDED NEAR BOTH FUEL TANKS DUE TO CRACKING (8,106 TEST MILES)

UNSCHEDU LED MAINTENANCE CONT.

**“T” GUSSETS ADDED AT
THE TOP OF WINDOW JUNCTURES
(8,106 TEST MILES)**

**FRAME WORK ADDED NEAR RADIUS ROD MOUNTS
(8,978 TEST MILES)**

UNSCHEDU LED MAINTENANCE CONT.

CRACKS REPAIRED IN WINDSHIELD FRAME
(9,431 TEST MILES)

FAILED DEFROST CONTROLS
(9,431 TEST MILES)

UNSCHEDU LED MAINTENANCE CONT.

FAILED FUSE HOLDERS
(14,439 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 $\pm$ 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 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 flow meter 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), liquified 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 60°F (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 60°F. 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

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

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

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

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.

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

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 20,214.0 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 – 2.04 mpg, ART – 2.67 mpg, and COM – 5.40 mpg. Average fuel consumption at idle was 8.04 lb/hr (1.28 gph).

FUEL ECONOMY PRE-TEST MAINTENANCE FORM

Bus Number: 0404	Date: 6-10-04	SLW (lbs): 44,905
Personnel: T.S. & S.C.		

FUEL SYSTEM	OK	Date	Initials
Install fuel measurement system	√	6-10-04	S.C.
Replace fuel filter	√	6-10-04	S.C.
Check for fuel leaks	√	6-10-04	S.C.
Specify fuel type (refer to fuel analysis)	Diesel		
Remarks: None			
BRAKES/TIRES	OK	Date	Initials
Inspect hoses	√	6-10-04	T.S.
Inspect brakes	√	6-10-04	T.S.
Relube wheel bearings	√	6-10-04	T.S.
Check tire inflation pressures (mfg. specs.)	√	6-10-04	T.S.
Remarks: None			
COOLING SYSTEM	OK	Date	Initials
Check hoses and connections	√	6-10-04	S.C.
Check system for coolant leaks	√	6-10-04	S.C.
Remarks: None			

FUEL ECONOMY PRE-TEST MAINTENANCE FORM (page 2)

Bus Number: 0404	Date: 6-10-04
Personnel: T.S. & S.C.	

ELECTRICAL SYSTEMS	OK	Date	Initials
Check battery	√	6-10-04	S.C.
Inspect wiring	√	6-10-04	S.C.
Inspect terminals	√	6-10-04	S.C.
Check lighting	√	6-10-04	S.C.
Remarks:			

DRIVE SYSTEM	OK	Date	Initials
Drain transmission fluid	√	6-10-04	T.S.
Replace filter/gasket	√	6-10-04	T.S.
Check hoses and connections	√	6-10-04	T.S.
Replace transmission fluid	√	6-10-04	T.S.
Check for fluid leaks	√	6-10-04	T.S.
Remarks:			

LUBRICATION	OK	Date	Initials
Drain crankcase oil	√	6-10-04	T.S.
Replace filters	√	6-10-04	T.S.
Replace crankcase oil	√	6-10-04	T.S.
Check for oil leaks	√	6-10-04	T.S.
Check oil level	√	6-10-04	T.S.
Lube all chassis grease fittings	√	6-10-04	T.S.
Lube universal joints	√	6-10-04	T.S.
Replace differential lube including axles	√	6-10-04	T.S.
Remarks:			

FUEL ECONOMY PRE-TEST MAINTENANCE FORM (page 3)

Bus Number: 0404	Date: 6-10-04
Personnel: T.S. & S.C.	

EXHAUST/EMISSION SYSTEM	OK	Date	Initials
Check for exhaust leaks	√	6-10-04	S.C.
Remarks: None			
ENGINE	**OK**	**Date**	**Initials**
Replace air filter	√	6-10-04	T.S.
Inspect air compressor and air system	√	6-10-04	T.S.
Inspect vacuum system, if applicable	N/A	6-10-04	T.S.
Check and adjust all drive belts	√	6-10-04	T.S.
Check cold start assist, if applicable	√	6-10-04	T.S.
Remarks: None			
STEERING SYSTEM	**OK**	**Date**	**Initials**
Check power steering hoses and connectors	√	6-10-04	S.C.
Service fluid level	√	6-10-04	S.C.
Check power steering operation	√	6-10-04	S.C.
Remarks: None			
	OK	**Date**	**Initials**
Ballast bus to seated load weight	√	6-10-04	S.C.
TEST DRIVE	**OK**	**Date**	**Initials**
Check brake operation	√	6-10-04	S.C.
Check transmission operation	√	6-10-04	S.C.
Remarks: None			

FUEL ECONOMY PRE-TEST INSPECTION FORM

Bus Number: 0404	Date: 6-14-04
Personnel: S.C.	

PRE WARM-UP	If OK, Initial
Fuel Economy Pre-Test Maintenance Form is complete	S.C.
Cold tire pressure (psi): Front 120 Middle N/A Rear 120	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 124 Middle N/A Rear 126	S.C.
Environmental conditions Average wind speed <12 mph and maximum gusts <15 mph Ambient temperature between 30°(-1°) 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: 0404	Manufacturer: Blue Bird	Date: 6-14-04
Run Number: 1	Personnel: R.C., T.S. & S.C.	
Test Direction: □CW or ■CCW	Temperature (°F): 66	Humidity (%): 94
SLW (lbs): 44,905	Wind Speed (mph) & Direction: 5 / SSW	Barometric Pressure (in.Hg): 30.03

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	8:20	8:20	30.5	0	5.77	5.77
ART #1	0	3:48	3:48	30.0	0	4.55	4.55
CBD #2	0	8:19	8:19	30.0	0	5.67	5.67
ART #2	0	5:53	5:53	32.0	0	4.57	4.57
CBD #3	0	8:22	8:22	31.0	0	5.80	5.80
COMMUTER	0	5:42	8:42	31.5	0	4.44	4.44
							Total Fuel = 30.80 lbs

20 minute idle : Total Fuel Used = 2.80 lbs

Heating Value = 20,214.0 BTU/LB

Comments: None

FUEL ECONOMY DATA FORM (Liquid Fuels)

Bus Number: 0404	Manufacturer: Blue Bird	Date: 6-14-04
Run Number: 2	Personnel: R.C., T.S. & S.C.	
Test Direction: ■CW or □CCW	Temperature (°F): 70	Humidity (%): 90
SLW (lbs): 44,905	Wind Speed (mph) & Direction: Calm	Barometric Pressure (in.Hg): 30.03

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	8:26	8:26	31.5	0	5.98	5.98
ART #1	0	3:49	3:49	32.0	0	4.41	4.41
CBD #2	0	8:23	8:23	33.0	0	5.84	5.84
ART #2	0	3:50	3:50	33.0	0	4.46	4.46
CBD #3	0	8:22	8:22	35.0	0	5.72	5.72
COMMUTER	0	5:43	5:43	34.5	0	4.40	4.40
							Total Fuel = 30.81 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: 0404	Manufacturer: Blue Bird	Date: 6-14-04
Run Number: 3	Personnel: R.C., T.S. & S.C.	
Test Direction: □CW or ■CCW	Temperature (°F): 73	Humidity (%): 83
SLW (lbs): 44,905	Wind Speed (mph) & Direction: 8 / SSW	Barometric Pressure (in.Hg): 30.03

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	35.0	0	5.95	5.95
ART #1	0	3:54	3:54	35.0	0	4.54	4.54
CBD #2	0	8:28	8:28	35.0	0	5.88	5.88
ART #2	0	3:52	3:52	35.5	0	4.48	4.48
CBD #3	0	8:26	8:26	35.0	0	5.95	5.95
COMMUTER	0	5:45	5:45	35.0	0	4.44	4.44
							Total Fuel = 31.24 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: 0404	Manufacturer: Blue Bird	Date: 6-14-04
Run Number: 4	Personnel: R.C., T.S. & S.C.	
Test Direction: ■CW or □CCW	Temperature (°F): 76	Humidity (%): 83
SLW (lbs): 44,905	Wind Speed (mph) & Direction: 8 / SSW	Barometric Pressure (in.Hg): 30.03

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	8:20	8:20	35.5	0	5.94	5.94
ART #1	0	3:48	3:48	35.0	0	4.43	4.43
CBD #2	0	8:22	8:22	35.0	0	5.95	5.95
ART #2	0	3:54	3:54	35.5	0	4.48	4.48
CBD #3	0	8:22	8:22	36.5	0	5.90	5.90
COMMUTER	0	5:43	5:43	36.0	0	4.45	4.45
							Total Fuel = 31.15 lbs

20 minute idle : Total Fuel Used = 2.56 lbs

Heating Value = 20,214.0 BTU/LB

Comments: None

0404.FUL
FUEL ECONOMY SUMMARY SHEET

BUS MANUFACTURER :Blue Bird
BUS MODEL :Express 4500
BUS NUMBER :0404
TEST DATE :6-14-04

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	17.24	5.73	.33	2.08
ART	9.12	3.82	.42	2.63
COM	4.44	3.82	.86	5.39
TOTAL	30.80	13.37	.43	2.72
Run # :2, CW				
CBD	17.54	5.73	.33	2.05
ART	8.87	3.82	.43	2.70
COM	4.40	3.82	.87	5.44
TOTAL	30.81	13.37	.43	2.72
Run # :3, CCW				
CBD	17.78	5.73	.32	2.02
ART	9.02	3.82	.42	2.65
COM	4.44	3.82	.86	5.39
TOTAL	31.24	13.37	.43	2.68
Run # :4, CW				
CBD	17.79	5.73	.32	2.02
ART	8.91	3.82	.43	2.69
COM	4.45	3.82	.86	5.38
TOTAL	31.15	13.37	.43	2.69

IDLE CONSUMPTION

First 20 Minutes Data : 2.80 Lb Last 20 Minutes Data : 2.56 Lb
Average Idle Consumption : 8.04 Lb/Hr

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

Run 1 : .6 Run 2 : .6 Run 3 : -.8 Run 4 : -.5

SUMMARY

Average Idle Consumption : 1.28 G/Hr
Average CBD Phase Consumption : 2.04 MPG
Average Arterial Phase Consumption : 2.67 MPG
Average Commuter Phase Consumption : 5.40 MPG
Overall Average Fuel Consumption : 2.70 MPG
Overall Average Fuel Consumption : 19.82 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 40.5 dB(A); ranging from 38.1 dB(A) at the rear passenger seats to 44.1 dB(A) at the driver's seat. 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 68.5 dB(A) at the front passenger seats to 79.6 dB(A) at the rear passenger seats. The overall average was 72.8 dB(A). The interior ambient noise level for this test was 34.0 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: 0404	Date: 2-10-04
Personnel: S.C.	
Temperature (°F): 36	Humidity (%): 64
Wind Speed (mph): Calm	Wind Direction: Calm
Barometric Pressure (in.Hg): 30.12	
Initial Sound Level Meter Calibration: checked by S.C.	
Interior Ambient Noise Level dB(A): 34.0	Exterior Ambient Noise Level dB(A): 43.6
Microphone Height During Testing (in): 48.0	

Measurement Location	Measured Sound Level dB(A)
Driver's Seat	44.1
Front Passenger Seats	40.5
In Line with Front Speaker	40.0
In Line with Middle Speaker	40.7
In Line with Rear Speaker	39.5
Rear Passenger Seats	38.1

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: 0404	Date: 6-15-04
Personnel: D.W., T.S. & S.C.	
Temperature (°F): 77	Humidity (%): 71
Wind Speed (mph): Calm	Wind Direction: Calm
Barometric Pressure (in.Hg): 30.06	
Initial Sound Level Meter Calibration: ■ checked by: S.C.	
Interior Ambient Noise Level dB(A): 34.0	Exterior Ambient Noise Level dB(A): 38.7
Microphone Height During Testing (in): 48	

Measurement Location	Measured Sound Level dB(A)
Driver's Seat	68.6
Front Passenger Seats	68.5
Middle Passenger Seats	74.6
Rear Passenger Seats	79.6

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

Comments: All readings taken in the center aisle.

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

Bus Number: 0404	Date: 6-15-04
Personnel: D.W., T.S. & S.C.	
Temperature (°F): 77	Humidity (%): 71
Wind Speed (mph): Calm	Wind Direction: Calm
Barometric Pressure (in.Hg): 30.06	

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 upshift.
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 37.3 dB(A), the average test result obtained while accelerating from a constant speed was 85.8 dB(A) on the right side and 92.6 dB(A) on the left side.

When accelerating from a standstill with an exterior ambient noise level of 38.4 dB(A), the average of the results obtained were 85.1 dB(A) on the right side and 91.8 dB(A) on the left side.

With the vehicle stationary and the engine, accessories, and air conditioning on, the measurements averaged 70.7 dB(A) at low idle, 84.3 dB(A) at high idle, and 86.2 dB(A) at wide open throttle. With the accessories and air conditioning off, the readings averaged 0.1 dB(A) lower at low idle, 0.6 dB(A) higher at high idle, and 0.8 dB(A) higher at wide open throttle. The exterior ambient noise level measured during this test was 38.2 dB(A).

EXTERIOR NOISE TEST DATA FORM
Accelerating from Constant Speed

Bus Number: 0404	Date: 6-15-04
Personnel: D.W., T.S. & S.C.	
Temperature (°F): 78	Humidity (%): 70
Wind Speed (mph): Calm	Wind Direction: Calm
Barometric Pressure (in.Hg): 30.06	

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): 37.3

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	84.6	1	92.5
2	84.7	2	92.0
3	85.9	3	90.9
4	85.0	4	92.6
5	85.7	5	91.7
Average of two highest actual noise levels = 85.8 dB(A)		Average of two highest actual noise levels = 92.6 dB(A)	

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

Comments: None

EXTERIOR NOISE TEST DATA FORM
Accelerating from Standstill

Bus Number: 0404	Date: 6-15-04
Personnel: D.W., T.S. & S.C.	
Temperature (°F): 78	Humidity (%): 70
Wind Speed (mph): Calm	Wind Direction: Calm
Barometric Pressure (in.Hg): 30.06	
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): 38.4	

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	85.3	1	91.9
2	84.5	2	90.7
3	84.8	3	89.7
4	84.4	4	91.1
5	84.4	5	91.7
Average of two highest actual noise levels = 85.1 dB(A)		Average of two highest actual noise levels = 91.8 dB(A)	

Final Sound Level Meter Calibration Check: ⊠ checked by: S.C.
Comments: None

EXTERIOR NOISE TEST DATA FORM
Stationary

Bus Number: 0404	Date: 6-15-04
Personnel: D.W., T.S. & S.C.	
Temperature (°F): 78	Humidity (%): 70
Wind Speed (mph): Calm	Wind Direction: Calm
Barometric Pressure (in.Hg): 30.06	

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): 38.2

Accessories and Air Conditioning ON

Throttle Position	Engine RPM	Curb (Right) Side dB(A)	Street (Left) Side db(A)
		Measured	Measured
Low Idle	720	68.7	72.7
High Idle	1,295	80.7	87.8
Wide Open Throttle	2,105	83.3	89.1

Accessories and Air Conditioning OFF

Throttle Position	Engine RPM	Curb (Right) Side dB(A)	Street (Left) Side db(A)
		Measured	Measured
Low Idle	725	68.6	72.6
High Idle	1,300	80.5	89.2
Wide Open Throttle	2,100	83.7	90.2

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

Comments: None

7.1 EXTERIOR NOISE TEST

TEST BUS UNDERGOING
EXTERIOR NOISE TESTING