Exhibit F

Georgetown University Campus Plan 2011-2020
Zoning Commission Case No. 10-32

Exhibit Prepared By:
Conrad J. DeWitte, Jr., Esq.
Foxhall Village Resident and Property Owner

June 2, 2011

Analysis of Noise from Buses Along Proposed Park Bus Road

Currently, there is no bus traffic along the eastern ridge of Glover-Archbold Park. It is undeniable that the diesel-powered bus traffic will produce noise and exhaust on the eastern edge of the park where currently there is none. As indicated by the presentation of parties opposed to the university's campus plan, there is concern that the increase in noise and exhaust from bus traffic will likely become objectionable to neighboring properties including the park and private property along the western ridge of the park.

Georgetown University operates buses manufactured by Blue Bird Corporation. These buses appear to be the All American Rear Engine model. Appendix A provides a specification for the latest model of the Blue Bird All American Rear Engine bus. Pennsylvania State University performed a STURAA Test[1] on the All American in 2003. *See* Appendix B. This report, prepared under contact for the U.S. Government provides relevant data regarding noise generated by the university's GUTS buses. *See* Appendix B, at 96-101. This report also provides relevant data regarding exhaust generated by the university's GUTS buses. *See* Appendix B, at 75-89.

The Exterior Noise Test portion of the All American STURAA Test measured the noise levels generated when the bus was (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; and (3) stationary, with the engine at low idle, high idle, and wide open throttle. Appendix B, at 96. The test procedures were in accordance with SAE Standards SAE J366b, Exterior Sound Level for Heavy Trucks and Buses, including the placement of the microphone at 50 feet from the vehicle being measured. *See* Appendix B, at 96; Appendix C, at 7.2-5.

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[1] The Surface Transportation and Uniform Relocation Assistance Act of 1987 (STURAA) states that no new bus model may be acquired under the Federal Transit Administration Act of 1964 unless a bus of such model has been tested at a bus testing facility. The bus testing facility shall be capable of testing a bus for maintainability, reliability, safety, performance, structural integrity, fuel economy, and noise. *See* 49 U.S.C. § 5318 (2009).

These measurements were taken in decibels, dB(A), which is a logarithmic scale. Generally, a 10 dB(A) increase in noise is equivalent to a doubling of the sound as perceived by a human.[2] The following chart summarizes the data presented in the All American STURAA report:

Tested Condition	Ambient Noise Level dB(A)	Notations	STURAA Test Average Measured Noise Level dB(A)
accelerating from a constant speed	43.8	right side of bus	72.9
accelerating from a constant speed	43.8	left side of bus	74.8
accelerating from a standstill	44.1	right side of bus	72.8
accelerating from a standstill	44.1	left side of bus	74.8
low idle, vehicle stationary	43.0	**ON**: accessories and air conditioning	56.6
wide open throttle, vehicle stationary	43.0	**ON**: accessories and air conditioning	71.8
low idle, vehicle stationary	43.0	**OFF**: accessories and air conditioning	57.8
wide open throttle, vehicle stationary	43.0	**OFF**: accessories and air conditioning	72.0
fast idle	n/a	test bus not equipped	n/a

See Appendix B, at 96-100.

From these measurements taken at a known distance (50 feet), we can calculate the noise in dB(A) that the buses will make at any distance from their source. A point source S sends out sound waves uniformly in all directions. Sound pressure at a distance r from the source decreases as 1/r. The relationship between a noise level L_1 measured in decibels at a distance r_1 and a noise level L_2 measured decibels at a distance r_2 can be expressed by the following formula[3]:

$$r_1 = r_2 \cdot 10^{(L_1 - L_2)/20}$$

Taking L_1 to be the data measured at r_1=50 feet during the All American STURAA test, we can solve for the sound level in decibels (L_2) to be heard at the center of Glover-Archbold Park. We can also solve for the sound level in decibels (L_2) to be heard at the back doors of the homes that are located on the western side of Glover-Archbold Park. Thus, solving for L_2 in the formula above gives:

$$L_2 = L_1 - \left(20 \cdot \log\frac{r_1}{r_2}\right)$$

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[2] *See* Decibel Table---Loudness Comparison Chart <http://www.sengpielaudio.com/calculator-levelchange.htm>.

[3] *See* Damping of sound level with distance, available at <http://www.sengpielaudio.com/calculator-distance.htm>.

The average distance from the proposed loop road to the center of Glover-Archbold Park ($r_{2G\text{-}AP}$) is about 160 feet. *See* Appendix D. The average distance from the proposed loop road to the back of the homes on the western side of Glover-Archbold Park ($r_{2FOXHALL}$) is 320 feet. *See* Appendix D. Using these distances, the STURAA noise test data measured at r_1=50 feet (*see* Appendix C, at 7.2-5), and the formula above, we can calculate the sound level of the buses at the center of the park and at back of the homes at the western edge of the park, as follows:

Tested Condition	**Notations**	**STURAA Test Average Measured Noise Level dB(A)**	**Calculated Noise Level Center of Park Average (r_2=160 feet) dB(A)**	**Calculated Noise Level Western Edge of Park (r_2=320 feet) dB(A)**
accelerating from a constant speed	right side of bus	72.9	62.8	56.8
accelerating from a constant speed	left side of bus	74.8	64.7	58.7
accelerating from a standstill	right side of bus	72.8	62.7	56.7
accelerating from a standstill	left side of bus	74.8	64.7	58.7
low idle, vehicle stationary	**ON**: accessories and air conditioning	56.6	46.5	40.5
wide open throttle, vehicle stationary	**ON**: accessories and air conditioning	71.8	61.7	55.7
low idle, vehicle stationary	**OFF**: accessories and air conditioning	57.8	47.7	41.7
wide open throttle, vehicle stationary	**OFF**: accessories and air conditioning	72.0	61.9	55.9
fast idle	test bus not equipped	n/a	n/a	n/a

All of the three main test conditions discussed above are relevant to the university's proposed bus road. As proposed, GUTS buses will travel north of Kehoe Field west toward Glover-Archbold Park. *See* Appendix D (showing the proposed park loop road in red). Buses will then make a left turn onto the park-side loop road. The eastern ridge of Glover-Archbold Park is not a constant grade. This portion of the road would start out flat, and then descend, and then become flat again, and then descend again. Thus, upon entering the park portion of the loop road, the bus will need to accelerate. After accelerating out of the turn the bus will again need to accelerate as the road levels out behind the Yates Field House. Presumably, these portions of the GUTS bus travel are equivalent to "accelerating at full throttle from a constant speed at or below 35 mph." Next, the GUTS bus will travel north along the eastern ridge of Glover-Archbold Park. Presumably this portion of the GUTS bus travel is equivalent to "stationary, with engine at low idle, high idle, and wide open throttle." Finally, depending on the conditions on the park-side loop road, the GUTS buses will occasionally have to stop to allow for wildlife or other vehicle traffic and then accelerate. This portion of GUTS bus travel is equivalent to "accelerating at full throttle from standstill." Thus, the noise measurement at each test condition shown in the chart

above is relevant to whether the proposed bus loop road will likely becoming objectionable to neighboring property because of noise and traffic.

As noted above, the sound from the bus engine varies depending on the side the engine is placed; the right side of the bus is quieter. Note, however, that the Penn State Test measurements were taken at a location with no reflecting surfaces nearby. Appendix B, at 112. The bus loop road along the Glover-Archbold Park, however, has a continuous reflective surface along its' eastern side, composed of earth at the most northern and southern portions, and concrete---in the form of the back of the Yates Field House in the middle. These surfaces will reflect the sound from the left (noisier) side of the buses into the park, increasing the overall calculated noise in the park from the buses. Also, the noise from the buses will echo throughout Glover-Archbold Park valley.

Finally, while some of this noise may be dampened by the leaf canopy in the summer months, in the Fall, Winter, and Spring, when all the trees have no leaves, the noise will not be dampened. The Zoning commission should give great weight to the overall noise levels in the winter months, when school is in session and there are no leaves on the trees. This will be the time when maximum noise from the buses.

To put the calculated numbers in perspective, in the center of Glover-Archbold Park and at the western edge of Glover-Archbold Park, the sound of the buses while moving will fall into the range of normal conversation (i.e. 45-60 dB(A)). *See* Appendix E, at 3; Appendix F. This noise is incompatible with a National Park, which right now is only filled with the noise from rustling leaves (15 to 20 dB(A)), the occasional bird call (44dB(A)), rainfall (50 dB(A)), and thunder (120 dB(A)). Thus, these calculations provide substantial evidence that the proposed bus loop road will likely becoming objectionable to neighboring property because of noise and traffic.

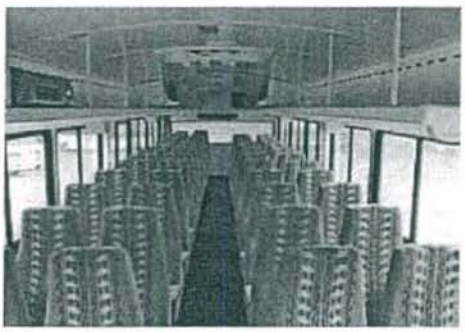
Appendix A

ALL AMERICAN® REAR ENGINE

The All American's ergonomic driver's area includes a high-back seat to maximize comfort.

Features:

- Seating for up to 56 adult passengers or 84 student passengers
- Complete entrance visibility
- Roomy underfloor luggage bays in a variety of sizes and locations for safe and convenient storage
- Excellent driver ergonomics with a wraparound dash console and high-back seat
- Convenient service access
- Various seat types and seat plans available
- Unrivaled strength, safety, and durability from Blue Bird's renowned unitized body construction
- Diesel and natural gas engines



The All American features optional overhead parcel racks for convenient storage as well as optional types of seating.

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BLUE BIRD

ALL AMERICAN® REAR ENGINE SPECIFICATIONS

Chassis

- 50,000 psi steel frame rails 9 5/8" high x 3" flanges x 1/4" thick
- Cummins® ISB-10, 200-300 horsepower
- Allison® automatic transmission, 2500 PTS
- Synthetic transmission fluid
- 60-gal. fuel tank between frame rails
- 240-amp alternator
- 11R22.5 (G) tires
- Large, easy to read gauges
- 13,200 lb. front axle with 13,200 lb. 2-leaf parabolic spring suspension
- 21,000 lb. rear axle with a two-stage, rear suspension system (rating varies by wheelbase)
- Black rubber coolant hoses
- Air brake system
- Anti-lock brakes
- 12" steel front bumper
- Tilting/telescoping steering wheel
- Group-31 batteries
- "Huck Spin" fasteners on all permanent frame fixtures

Durability

- All parts are pre-primed or thoroughly rust-proofed after fabrication and before assembly
- Entire underbody (body skirt and floor) is undercoated before mounting on chassis
- Exterior surfaces are painted with heat-cured polyurethane
- Interior surfaces are painted with high-quality, hot-sprayed, baked-on enamel
- 1/8" Smooth black rubber flooring, 3/16" ribbed rubber aisle
- Black rubber cooling hoses
- Synthetic transmission fluid
- 11R22.5 (G) tires
- Spicer "lubed for life" driveline
- Rubber molded wheelhouse
- 13,200 lb. front axle with 13,200 lb. 2 leaf parabolic spring suspension
- 21,000 lb. rear axle with a two-stage, rear suspension system (rating varies by wheelbase)
- Rear exit exhaust
- "Huck Spin" frame fasteners

Safety

- 4-wheel anti-lock brakes
- Single halogen headlights, combination high/low beam
- Driver's three-point seat belt with adjustable 7 1/2" pillar loop
- "Full view" outward-opening electric entrance door with square-inch tempered safety glass
- Unencumbered stepwell area
- Flat and convex rearview mirrors
- Electric horn with high and low note
- Blue Bird's unitized construction of the passenger compartment
- 12" steel front bumper, 12" steel rear bumper
- Rear exit exhaust
- 8.25 x 22.5 Disc, hub-piloted steel wheels
- 11R22.5 (G) tires

Strength

- 14-gauge steel, hat shaped posts and roof bows
- Rigid 16-gauge steel roof longitudinal internal structural members
- 16-gauge, channeled interior steel window headers
- A massive 16-gauge continuous belt of interior steel armor above and below floor line
- Riveted and welded construction
- Four full-length, 16 gauge exterior side rub rails
- 20-gauge exterior side panels
- 22-gauge interior galvalume side panels
- 14-gauge steel floor panels
- 50,000 psi steel chassis frame with permanent fixtures and attached with "Huck Spin" fasteners

Serviceability

- Engine Compartment: Pantograph opening, fiberglass door with gas assist cylinders; 80" wide x 34"high for easy access; remote engine start switch, starter button, compartment light switch, and oil pressure gauge
- Body wiring terminal is easily accessible through exterior electrical compartment
- Wiring is color coded and continuously numbered for easy identification
- Fused circuit protection
- Tempered glass, split-sash windows
- Easy-opening, outward opening electric entrance door; features long-lasting, oil-impregnated, bronze pivotal bearings
- Body wiring is encased in "easy to access" PVC molding above passenger windows
- Rear exit exhaust

Comfort & Convenience

- 78" headroom at aisle, front to rear
- 12" split-sash, tempered windows
- Tinted windshield
- 90,000 btu front heater and defroster
- 5/8" plywood for insulation of the floor
- Unencumbered stepwell area
- Full "panoramic" cockpit view
- Full body insulation
- Acoustic headlining (Driver's section)

Driver Ergonomics

- Power steering with tilting/telescoping column
- Large, easy to read gauges
- Backlit, easy to reach switch panel with rocker switches
- Electric, intermittent single switch windshield wipers
- Wrap around dash with power door control and other convenient switches
- Electric outward opening door
- 3-point seat belt with 7 1/2" vertical adjustment
- Fully adjustable driver's seat
- Cruise control

Optional Features

- Cummins® ISL-G CNG engine 250 & 280 hp
- Cummins® ISC-10 diesel engine 285-300 hp
- Allison® 3000 PTS Transmission
- Front and rear air ride suspension
- Electric, remote control and heated mirrors
- Laminated glass
- Transit style windows
- Dedicated door and wheelchair lifts, along with recessed wheelchair securements for special-needs passengers
- Underfloor luggage compartments with locking doors
- Tinted glass
- Mud flaps
- Vandal locks
- AM/FM/CD Radio with deluxe speakers
- 100-gallon fuel tank

Dimensions

Headroom	78"
Width Exterior	96"
Width Interior	90 3/4"
Skirt Length	19 3/4"
Overall Length	406" - 490"
Overall Height	124" excluding options

Wheelbase/Passenger Capacity	Student	Adult
189" =	66	44
217" =	72	48
245" =	78	52
259" =	84	56
273" =	84	56

BLUE BIRD

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Appendix B

STURAA TEST

10 YEAR

350,000 MILE BUS

from

BLUE BIRD CORPORATION

MODEL ALL AMERICAN

DECEMBER 2003

PTI-BT-R0317

PENNSTATE

The Pennsylvania Transportation Institute

201 Research Office Building (814) 865-1891
The Pennsylvania State University
University Park, PA 16802

Bus Testing and Research Center

2237 Old Route 220 North (814) 695-3404
Duncansville, PA 16635

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Blue Bird Corporation submitted a model All American, diesel-powered 34 seat (including the driver) 35-foot bus, for a 10 yr/350,000 mile STURAA test. The odometer reading at the time of delivery was 1,483.0 miles. Testing started on July 29, 2003 and was completed on November 28, 2003. 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 August 5, 2003 and was completed on November 17, 2003.

The interior of the bus is configured with seating for 34 passengers including the driver. Free floor space will accommodate 15 standing passengers resulting in a potential load of 49 persons. At 150 lbs per person, this load results in a measured gross vehicle weight of 28,920 lbs. The first segment of the Structural Durability Test was performed with the bus loaded to a GVW of 28,920 lbs. The middle segment was performed at a seated load weight of 26,800 lbs and the final segment was performed at a curb weight of 20,750 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), with the exception of the alternator, were found to be readily accessible and no restrictions were noted. The alternator along with the accessories belt had limited access.

The Reliability section compiles failures that occurred during Structural Durability Testing. Breakdowns are classified according to subsystems. The data in this section are arranged so that those subsystems with more frequent problems are apparent. The problems are also listed by class as defined in Section 2. The test bus encountered no Class 1 or Class 2 failures. Of the 29 reported failures, seven were Class 3 and 22 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 28.87 seconds.

The Shakedown Test produced a maximum final loaded deflection of 0.160 inches with a permanent set ranging between 0.001 to 0.006 inches under a distributed static load of 19,575 lbs. The Distortion Test was completed with all subsystems, doors and escape mechanisms operating properly. Water leakage was observed during the test at the 6th window on the left and leakage was also found around the frame on the right rear emergency windows.

The test bus was not equipped with any type of tow eyes or tow hooks, therefore, the Static Towing Test was not performed. The Dynamic Towing Test was performed by means of a front-lift tow. The towing interface was accomplished using a hydraulic under-lift wrecker. The bus was towed without incident and no damage resulted from the test. The manufacturer does not recommend towing the bus from the rear, therefore, a rear test was not performed. The Jacking and Hoisting Tests were also performed without incident. The bus was found to be stable on the jack stands, and the minimum jacking clearance observed with a tire deflated was 6.8 inches.

A Fuel Economy Test was run on simulated central business district, arterial, and commuter courses. The results were 4.67 mpg, 4.97 mpg, and 9.53 mpg respectively; with an overall average of 5.58 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 All American. The bus has a front door, forward of the front axle, and a rear, dedicated handicap antrance equipped with a Braun Corporation model L919F1B handicap lift. Power is provided by a diesel-fueled, Caterpillar Inc. model 3126/7.2 L engine coupled to an Allison model MD3060 transmission.

The measured curb weight is 9,900 lbs for the front axle and 10,850 lbs for the rear axle. These combined weights provide a total measured curb weight of 20,750 lbs. There are 34 seats including the driver and room for 15 standing passengers bringing the total passenger capacity to 49. Gross load is 150 lb x 49 = 7,350 lbs. At full capacity, the measured gross vehicle weight is 28,920 lbs.

VEHICLE DATA FORM

Bus Number: 0317	Arrival Date: 7-29-03
Bus Manufacturer: Blue Bird Corporation	Vehicle Identification Number (VIN): 1BABEC0A24F214920
Model Number: All American	Date: 7-29-03
Personnel: S.C. & E.D.	

WEIGHT:

Individual Wheel Reactions:

Weights (lb)	Front Axle		Middle Axle		Rear Axle	
	Right	Left	Right	Left	Right	Left
CW	4,980	4,920	N/A	N/A	5,210	5,640
SLW	5,500	5,790	N/A	N/A	7,470	8,040
GVW	5,630	5,460	N/A	N/A	8,620	9,210

Total Weight Details:

Weight (lb)	CW	SLW	GVW	GAWR
Front Axle	9,900	11,290	11,090	11,020
Middle Axle	N/A	N/A	N/A	N/A
Rear Axle	10,850	15,510	17,830	20,280
Total	20,750	26,800	28,920	GVWR: 31,300

Dimensions:

Length (ft/in)	35 / 5
Width (in)	96.40
Height (in)	122.00
Front Overhang (in)	89.25
Rear Overhang (in)	145.00
Wheel Base (in)	190.75
Wheel Track (in)	Front: 80.0
	Rear: 72.0

Bus Number: 0317	Date: 7-29-03

CLEARANCES:

Lowest Point Outside Front Axle	Location: Fuse box	Clearance(in): 13.4
Lowest Point Outside Rear Axle	Location: Fuel tank support	Clearance(in): 16.8
Lowest Point between Axles	Location: Muffler	Clearance(in): 15.7
Ground Clearance at the center (in)	16.8	
Front Approach Angle (deg)	10.3	
Rear Approach Angle (deg)	8.7	
Ramp Clearance Angle (deg)	10.0	
Aisle Width (in)	13.2	
Inside Standing Height at Center Aisle (in)	75.8	

BODY DETAILS:

Body Structural Type	Integral		
Frame Material	Steel rail		
Body Material	Steel		
Floor Material	Plywood		
Roof Material	Steel		
Windows Type	□ Fixed	■ Movable	
Window Mfg./Model No.	Atwood / AS3 MI5B DOT 573		
Number of Doors	1 Front	1 Rear	
Mfr. / Model No.	Blue Bird Corp. / Outward opening entry door (feature 30977-02)		
Dimension of Each Door (in)	Front-30.3 x 78.1	Rear – 37.8 x 51.4 Handicap – 42.8 x 69.5	
Passenger Seat Type	□ Cantilever	■ Pedestal	□ Other (explain)
Mfr. / Model No.	Blue Bird Corp./ Feature 02785		
Driver Seat Type	□ Air	□ Spring	■ Other (explain)
Mfr. / Model No.	Bostrom Seating, Inc. / Routemaster		
Number of Seats (including Driver)	34 + 2 wheelchair positions		

Bus Number: 0317	Date: 7-29-03

BODY DETAILS (Contd..)

Free Floor Space (ft^2)	22.6			
Height of Each Step at Normal Position (in)	Front 1. 15.5	2. 8.3	3. 8.3	4. 9.0
	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.	Caterpiler Inc. / 3126/7.2L		
Location	■ Front	□ Rear	□ Other (explain)
Fuel Type	□ Gasoline	□ CNG	□ Methanol
	■Diesel	□ LNG	□ Other (explain)
Fuel Tank Capacity (indicate units)	60 gals		
Fuel Induction Type	■Injected	□ Carburetion	
Fuel Injector Mfr. / Model No.	Caterpiler Inc. / 3126/7.2L		
Carburetor Mfr. / Model No.	N/A		
Fuel Pump Mfr. / Model No.	Caterpiler Inc. / 3126/7.2L		
Alternator (Generator) Mfr. / Model No.	Leece-Nevilee / A0014830LC		
Maximum Rated Output (Volts / Amps)	14 / 175		
Air Compressor Mfr. / Model No.	Bendix / Tu-Flo 550		
Maximum Capacity (ft^3 / min)	13.2		
Starter Type	■Electrical	□ Pneumatic	□ Other (explain)
Starter Mfr. / Model No.	Denso / 22800-5851		

Bus Number: 0317	Date: 7-29-03

TRANSMISSION

Transmission Type	□ Manual	■ Automatic	
Mfr. / Model No.	Allison Transmission / MD 3060		
Control Type	□ Mechanical	■ Electrical	□ Other
Torque Convertor Mfr. / Model No.	Allison Transmission / MD 3060		
Integral Retarder Mfr. / Model No.	N/A		

SUSPENSION

Number of Axles	2		
Front Axle Type	□ Independent	■Beam Axle	
Mfr. / Model No.	Meritor / FF967LX116		
Axle Ratio (if driven)	N/A		
Suspension Type	■ Air	□ Spring	□ Other (explain)
No. of Shock Absorbers	2		
Mfr. / Model No.	Hendrickson / 60998-002		
Middle Axle Type	□ Independent	□ Beam Axle	
Mfr. / Model No.	N/A		
Axle Ratio (if driven)	N/A		
Suspension Type	□ Air	□ Spring	□ Other (explain)
No. of Shock Absorbers	N/A		
Mfr. / Model No.	N/A		
Rear Axle Type	□ Independent	■ Beam Axle	
Mfr. / Model No.	Meritor / RS21145NFLF903		
Axle Ratio (if driven)	4.88		
Suspension Type	■ Air	□ Spring	□ Other (explain)
No. of Shock Absorbers	2		
Mfr. / Model No.	Henderickson / 31602		

Bus Number: 0317	Date: 7-29-03

WHEELS & TIRES

Front	Wheel Mfr./ Model No.	Accuride / Na
	Tire Mfr./ Model No.	Michelin XZE / 255/70R 22.5
Rear	Wheel Mfr./ Model No.	Accuride / Na
	Tire Mfr./ Model No.	Michelin XZE / 255/70R 22.5

BRAKES

Front Axle Brakes Type	■ Cam	□ Disc	□ Other (explain)
Mfr. / Model No.	Meritor / Q-Plus		
Middle Axle Brakes Type	□ Cam	□ Disc	□ Other (explain)
Mfr. / Model No.	N/A		
Rear Axle Brakes Type	■ Cam	□ Disc	□ Other (explain)
Mfr. / Model No.	Meritor / Q-Plus		
Retarder Type	N/A		
Mfr. / Model No.	N/A		

HVAC

Heating System Type	□ Air	■ Water	□ Other
Capacity (Btu/hr)	Front – 90,000 Center – 50,000 Rear – 80,000		
Mfr. / Model No.	Bergstrom & Hurri Hot		
Air Conditioner	■ Yes	□ No	
Location	Rear interior ceiling		
Capacity (Btu/hr)	80,000		
A/C Compressor Mfr. / Model No.	Carrier TM-16		

STEERING

Steering Gear Box Type	Hydraulic gear
Mfr. / Model No.	Ross / TRW
Steering Wheel Diameter	18.0
Number of turns (lock to lock)	4.5

Bus Number: 0317	Date: 7-29-03

OTHERS

Wheel Chair Ramps	Location: N/A	Type: N/A
Wheel Chair Lifts	Location: Right rear	Type: Hydraulic platform
Mfr. / Model No.	The Braun Corp. / L919F1B	
Emergency Exit	Location: Window Door Hatch	Number: 9 1 2

CAPACITIES

Fuel Tank Capacity (units)	60 gals
Engine Crankcase Capacity (gallons)	7.50
Transmission Capacity (gallons)	7.25
Differential Capacity (gallons)	4.5
Cooling System Capacity (quarts)	6.80
Power Steering Fluid Capacity (gallons)	0.75

VEHICLE DATA FORM

Bus Number: 0317	Date: 7-29-03

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

Part Number	Description	Qty.
NA	Manuals	2

COMPONENT/SUBSYSTEM INSPECTION FORM

Bus Number: 0317	Date: 7-29-03

Subsystem	Checked	Comments
Air Conditioning Heating and Ventilation	✓	
Body and Sheet Metal	✓	
Frame	✓	
Steering	✓	
Suspension	✓	
Interior/Seating	✓	
Axles	✓	
Brakes	✓	
Tires/Wheels	✓	
Exhaust	✓	
Fuel System	✓	
Power Plant	✓	
Accessories	✓	
Lift System	✓	
Interior Fasteners	✓	
Batteries	✓	

CHECK - IN

BLUE BIRD CORPORATION'
MODEL
ALL AMERICAN

CHECK - IN CONT.

BLUE BIRD CORPORATON'S
MODEL
ALL AMERICAN
EQUIPPED WITH A
BRAUN MODEL L919F1B HANDICAP LIFT

1. MAINTAINABILITY

1.1 ACCESSIBILITY OF COMPONENTS AND SUBSYSTEMS

1.1-I. TEST OBJECTIVE

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

1.1-II. TEST DESCRIPTION

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

1.1-III. DISCUSSION

Accessibility, in general, was adequate. Components covered in Section 1.3 (repair and/or replacement of selected subsystems), with the exception of the alternator, were found to be readily accessible and no restrictions were noted. The alternator along with the accessories belt had limited access.

ACCESSIBILITY DATA FORM

Bus Number: 0317	Date: 11-24-03

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

ACCESSIBILITY DATA FORM

Bus Number: 0317	Date: 11-24-03

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

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

1.2-I. TEST OBJECTIVE

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

1.2.-II. TEST DESCRIPTION

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

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

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

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

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

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

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

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

1.2-III. DISCUSSION

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

(Page 1 of 2)
SCHEDULED MAINTENANCE
Blue Bird 0317

DATE	TEST MILES	SERVICE	ACTIVITY	DOWN TIME	HOURS
08-15-03	1,328	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
08-25-03	2,056	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
09-02-03	2,795	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
09-22-03	3,652	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
09-30-03	4,712	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
10-13-03	5,826	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
10-20-03	6,364	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00

(Page 2 of 2)
SCHEDULED MAINTENANCE
Blue Bird 0317

DATE	TEST MILES	SERVICE	ACTIVITY	DOWN TIME	HOURS
10-23-03	8,170	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
10-31-03	9,089	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
11-08-03	10,089	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
11-11-03	11,050	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
11-18-03	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.

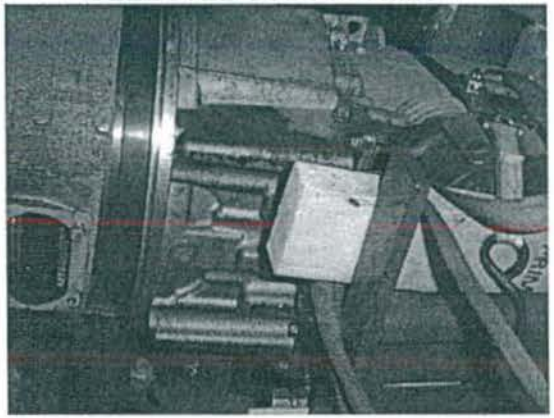
	MAN HOURS
Rear axle locating shims	1.00
Front sway bar bushings	1.00
Carrier bearing	2.00
Left rear leaf spring	2.00
Air brake mounting bracket/slack adjuster	3.00
Ignition relay	3.00
Right front air bag	2.00

At the end of the test, the remaining items on the list were removed and replaced. The transmission assembly took 10.00 man-hours (two men 5.00 hrs) to remove and replace. The time required for repair/replacement of the four remaining components is given on the following Repair and/or Replacement Form.

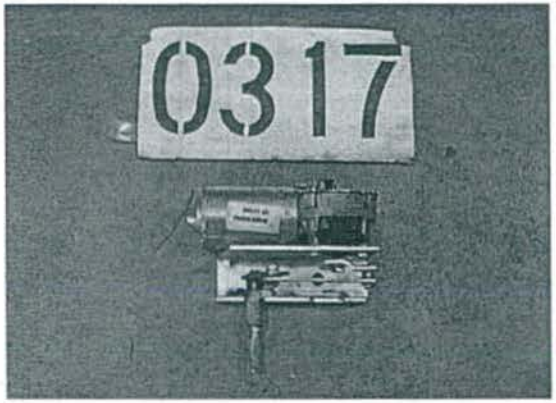
REPLACEMENT AND/OR REPAIR FORM

Subsystem	Replacement Time
Transmission	10.00 man hours
Wiper Motor	0.50 man hours
Starter	0.75 man hours
Alternator	2.00 man hours
Batteries	0.50 man hours

1.3 REPLACEMENT AND/OR REPAIR OF SELECTED SUBSYSTEMS



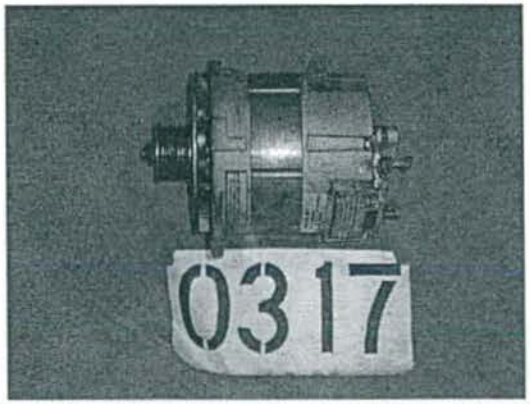
TRANSMISSION REMOVAL AND REPLACEMENT
(10.00 MAN HOURS)



WIPER MOTOR REMOVAL AND REPLACEMENT
(0.50 MAN HOURS)

1.3 REPLACEMENT AND/OR REPAIR OF SELECTED SUBSYSTEMS CONT.

STARTER REMOVAL AND REPLACEMENT
(0.75 MAN HOURS)



ALTERNATOR REMOVAL AND REPLACEMENT
(1.00 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 seven Class 3 failures, two involved the engine/transmission and suspension systems and one each with the axles, brakes and tires. These, and the remaining 22 Class 4 failures are available for review in the Unscheduled Maintenance List, located in Section 5.7 Structural Durability.

RELIABILITY DATA FORMS

Bus Number: 0317	Date: 11-19-03
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	671				1.00	1.00
	1,277				2.00	2.00
	2,795				0.50	0.50
	3,652				1.00	1.00
	5,659				1.00	1.00
	5,876				1.00	1.00
		5,915			2.00	2.00
	6,364				0.50	0.50
	9,139				1.00	1.00
		11,252			2.00	2.00
Frame/Body	671				1.00	1.00
	2,056				2.00	2.00
	5,876				1.00	1.00
	6,364				0.50	0.50
	6,364				0.25	0.25
	8,170				0.50	0.50
	9,139				1.00	1.00
	9,690				0.50	0.50
	9,690				0.50	0.50
Engine/Transmission		671			1.00	1.00
	2,056				2.00	2.00
		4,217			1.00	1.00

RELIABILITY DATA FORMS

Bus Number: 0317	Date: 11-19-03
Personnel: Bob Reifsteck	

	Failure Type					
	Class 4 Bad Order	Class 3 Bus Change	Class 2 Road Call	Class 1 Physical Safety		
Subsystems	Mileage	Mileage	Mileage	Mileage	Man Hours	Down Time
Engine/Transmission (continued)	8,669				3.00	3.00
	8,669				1.00	1.00
Air Conditioning	523				0.50	0.50
	11,252				1.00	1.00
Axles		227			1.00	1.00
Brakes		6,059			3.00	3.00
Wheels/Tires		1,827			0.50	0.50

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: 0317	Date: 11-18-03
Personnel: R.C. & S.C.	

Temperature (°F): 46	Humidity (%): 87
Wind Direction: SSE	Wind Speed (mph): 5
Barometric Pressure (in.Hg): 30.24	

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 28.87 seconds.

PERFORMANCE DATA FORM

Bus Number: 0317	Date: 11-18-03
Personnel: R.C., T.S. & S.C.	
Temperature (°F): 46	Humidity (%): 87
Wind Direction: SSE	Wind Speed (mph): 5
Barometric Pressure (in.Hg): 30.24	
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	4.80	3.62	3.68
20 mph	8.43	6.99	6.74
30 mph	12.37	11.46	11.27
40 mph	20.24	19.40	19.21
Top Test Speed(mph) 50	31.43	30.30	30.08

Clockwise Recorded Interval Times

Speed	Run 1	Run 2	Run 3
10 mph	3.39	3.05	3.24
20 mph	6.36	5.93	6.21
30 mph	10.08	9.74	10.15
40 mph	17.17	17.18	17.52
Top Test Speed(mph) 50	27.02	26.86	27.55

0317.ACC

PERFORMANCE SUMMARY SHEET

BUS MANUFACTURER :Blue Bird
BUS MODEL :All American
BUS NUMBER :0317
TEST DATE :11/18/03

TEST CONDITIONS :

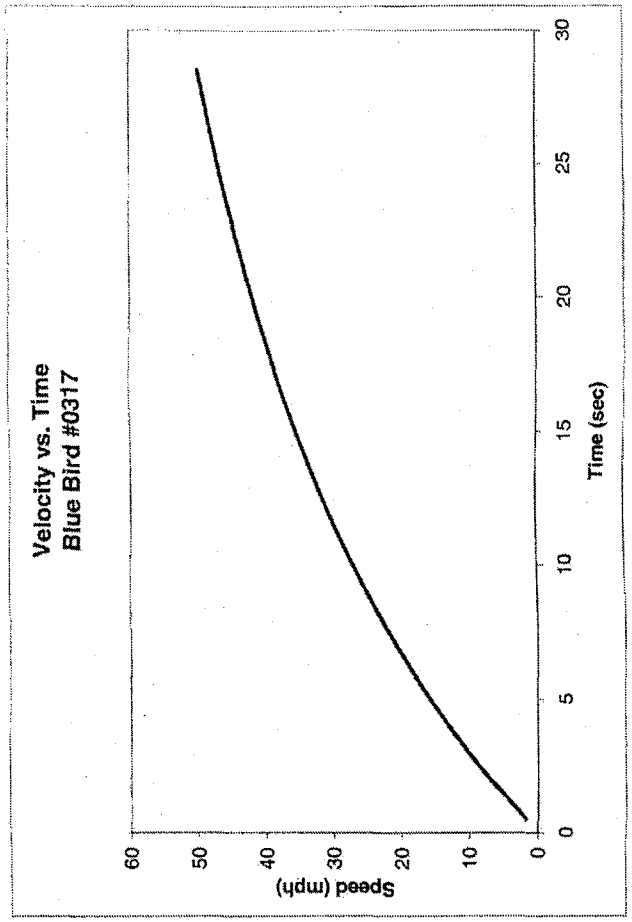
TEMPERATURE (DEG F) : 46.0
WIND DIRECTION : SSE
WIND SPEED (MPH) : 5.0
HUMIDITY (%) : 87
BAROMETRIC PRESSURE (IN. HG) : 30.2

VEHICLE SPEED	AVERAGE TIME (SEC)		
(MPH)	CCW DIRECTION	CW DIRECTION	TOTAL
10.0	4.03	3.23	3.63
20.0	7.39	6.17	6.78
30.0	11.70	9.99	10.85
40.0	19.62	17.29	18.45
50.0	30.60	27.14	28.87

TEST SUMMARY :

VEHICLE SPEED (MPH)	TIME (SEC)	ACCELERATION (FT/SEC^2)	MAX. GRADE (%)
1.0	.27	5.4	17.0
5.0	1.40	5.0	15.6
10.0	2.96	4.5	14.0
15.0	4.70	4.0	12.4
20.0	6.68	3.5	10.9
25.0	8.94	3.0	9.4
30.0	11.57	2.6	8.0
35.0	14.67	2.2	6.8
40.0	18.39	1.8	5.6
45.0	22.95	1.4	4.5
50.0	28.72	1.1	3.5

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.



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 49 people including the driver. The resulting test load is (49 x 375 lb) = 18,375 + 1,200 lbs (2 wheelchair positions = 19,575 lbs. The load is distributed evenly over the passenger space. Deflection data before and after each loading and unloading sequence is provided on the Structural Shakedown Data Form.

The unloaded height after each test becomes the original height for the next test. Some initial settling is expected due to undercoat compression, etc. After each loading cycle, the deflection of each reference point is determined. The bus is then unloaded and the residual (permanent) deflection is recorded. On the final test, the maximum loaded deflection was 0.160 inches at reference point 6. The maximum permanent deflection after the final loading sequence ranged from 0.001 inches at reference points 2, 4, 8, and 10 to 0. 006 inches at reference point 6.

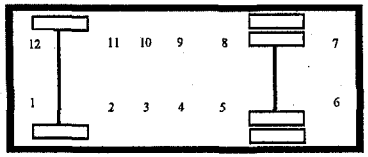
STRUCTURAL SHAKEDOWN DATA FORM

Bus Number: 0317	Date: 8-1-03
Personnel: T.S., D.L., M.H. & S.C.	Temperature (°F): 74
Loading Sequence: ■ 1 □ 2 □ 3 (check one) Test Load (lbs): 13,950	

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	.060	.060	.051	.051
2	0	.029	.029	.007	.007
3	0	.048	.048	.018	.018
4	0	.045	.045	.011	.011
5	0	.038	.038	.012	.012
6	0	.160	.160	.014	.014
7	0	.098	.098	.051	.051
8	0	.030	.030	.005	.005
9	0	.038	.038	.002	.002
10	0	.035	.035	.004	.004
11	0	.023	.023	.004	.004
12	0	.094	.094	.039	.039

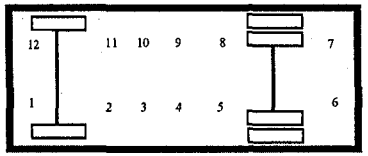
STRUCTURAL SHAKEDOWN DATA FORM

Bus Number: 0317	Date: 8-2-03
Personnel: T.S., D.L., M.H. & S.C.	Temperature (°F): 76
Loading Sequence: □ 1 ■ 2 □ 3 (check one) Test Load (lbs): 13,950	

Indicate Approximate Location of Each Reference Point

Right

Front of Bus

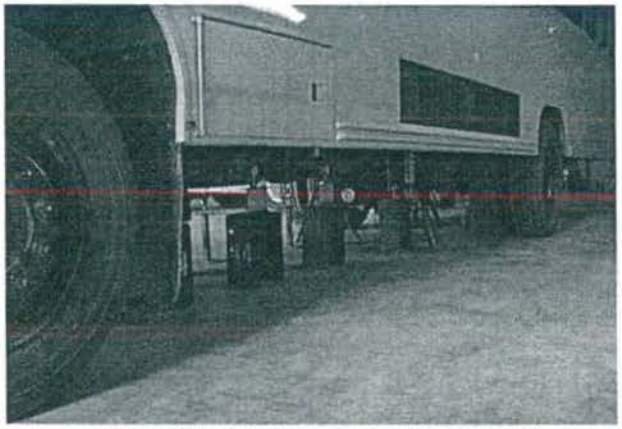


Left

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	.051	.061	.010	.056	.005
2	.007	.026	.019	.008	.001
3	.018	.048	.030	.020	.002
4	.011	.042	.031	.012	.001
5	.012	.037	.025	.015	.003
6	.014	.174	.160	.020	.006
7	.051	.114	.063	.056	.005
8	.005	.029	.024	.006	.001
9	.002	.036	.034	.005	.003
10	.004	.034	.030	.005	.001
11	.004	.023	.019	.006	.002
12	.039	.105	.066	.042	.003

5.1 STRUCTURAL SHAKEDOWN TEST



DIAL INDICATORS IN POSITION

BUS LOADED TO 2.5 TIMES GVL
(19,575 LBS)

5.2 STRUCTURAL STRENGTH AND DISTORTION TESTS - STRUCTURAL DISTORTION

5.2-I. TEST OBJECTIVE

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

5.2-II. TEST DESCRIPTION

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

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

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

5.2-III. DISCUSSION

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

All doors, windows, escape mechanisms, engine, steering and handicapped devices operated normally throughout the test. The undercarriage and body indicated no deficiencies. Water leakage was observed during the test at the 6th window on the left and the right rear emergency windows are leaking around the frame. 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: 0317	Date: 8-5-03
Personnel: S.C., T.S., E.D., E.L. & M.H.	Temperature(°F): 75

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

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

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

Bus Number: 0317	Date: 8-5-03
Personnel: S.C., T.S., E.D., E.L. & M.H.	Temperature(°F): 75

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

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

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

Bus Number: 0317	Date: 8-5-03
Personnel: S.C., T.S., E.D., E.L. & M.H.	Temperature(°F): 75

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

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

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

Bus Number: 0317	Date: 8-5-03
Personnel: S.C., T.S., E.D., E.L. & M.H.	Temperature(°F): 75

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

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

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

Bus Number: 0317	Date: 8-5-03
Personnel: S.C., T.S., E.D., E.L. & M.H.	Temperature(°F): 75

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	Right rear emergency window is leaking around the frame.
⊠ Front Doors	No deficiencies.
⊠ Rear Doors	No deficiencies.
⊠ Escape Mechanisms/ Roof Vents	No deficiencies.
⊠ Engine	No deficiencies.
⊠ Handicapped Device/ Special Seating	No deficiencies.
⊠ Undercarriage	No deficiencies.
⊠ Service Doors	No deficiencies.
⊠ Body	No deficiencies.
⊠ Windows/ Body Leakage	No deficiencies.
⊠ Steering Mechanism	No deficiencies.

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

Bus Number: 0317	Date: 8-5-03
Personnel: S.C., T.S., E.D., E.L. & M.H.	Temperature(°F): 75

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	6th window on the left & the right rear emergency windows are leaking around the frame.
⊠ Front Doors	No deficiencies.
⊠ Rear Doors	No deficiencies.
⊠ Escape Mechanisms/ Roof Vents	No deficiencies.
⊠ Engine	No deficiencies.
⊠ Handicapped Device/ Special Seating	No deficiencies.
⊠ Undercarriage	No deficiencies.
⊠ Service Doors	No deficiencies.
⊠ Body	No deficiencies.
⊠ Windows/ Body Leakage	No deficiencies.
⊠ Steering Mechanism	No deficiencies.

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

Bus Number: 0317	Date: 8-5-03
Personnel: S.C., T.S., E.D., E.L. & M.H.	Temperature(°F): 75

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	6th window on the left & the right rear emergency windows are leaking around the frame.
⊠ Front Doors	No deficiencies.
⊠ Rear Doors	No deficiencies.
⊠ Escape Mechanisms/ Roof Vents	No deficiencies.
⊠ Engine	No deficiencies.
⊠ Handicapped Device/ Special Seating	No deficiencies.
⊠ Undercarriage	No deficiencies.
⊠ Service Doors	No deficiencies.
⊠ Body	No deficiencies.
⊠ Windows/ Body Leakage	No deficiencies.
⊠ Steering Mechanism	No deficiencies.

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

Bus Number: 0317	Date: 8-5-03
Personnel: S.C., T.S., E.D., E.L. & M.H.	Temperature(°F): 75

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	6th window on the left & the right rear emergency windows are leaking around the frame.
⊠ Front Doors	No deficiencies.
⊠ Rear Doors	No deficiencies.
⊠ Escape Mechanisms/ Roof Vents	No deficiencies.
⊠ Engine	No deficiencies.
⊠ Handicapped Device/ Special Seating	No deficiencies.
⊠ Undercarriage	No deficiencies.
⊠ Service Doors	No deficiencies.
⊠ Body	No deficiencies.
⊠ Windows/ Body Leakage	No deficiencies.
⊠ Steering Mechanism	No deficiencies.

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

Bus Number: 0317	Date: 8-5-03
Personnel: S.C., T.S., E.D., E.L. & M.H.	Temperature(°F): 75

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	6th window on the left & the right rear emergency windows are leaking around the frame.
⊠ Front Doors	No deficiencies.
⊠ Rear Doors	No deficiencies.
⊠ Escape Mechanisms/ Roof Vents	No deficiencies.
⊠ Engine	No deficiencies.
⊠ Handicapped Device/ Special Seating	No deficiencies.
⊠ Undercarriage	No deficiencies.
⊠ Service Doors	No deficiencies.
⊠ Body	No deficiencies.
⊠ Windows/ Body Leakage	No deficiencies.
⊠ Steering Mechanism	No deficiencies.

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

Bus Number: 0317	Date: 8-5-03
Personnel: S.C., T.S., E.D., E.L. & M.H.	Temperature(°F): 75

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	6th window on the left & the right rear emergency windows are leaking around the frame.
⊠ Front Doors	No deficiencies.
⊠ Rear Doors	No deficiencies.
⊠ Escape Mechanisms/ Roof Vents	No deficiencies.
⊠ Engine	No deficiencies.
⊠ Handicapped Device/ Special Seating	No deficiencies.
⊠ Undercarriage	No deficiencies
⊠ Service Doors	No deficiencies.
⊠ Body	No deficiencies.
⊠ Windows/ Body Leakage	No deficiencies.
⊠ Steering Mechanism	No deficiencies.

5.2 STRUCTURAL DISTORTION TEST

RIGHT FRONT WHEEL SIX INCHES HIGHER

RIGHT REAR WHEEL SIX INCHES LOWER

5.3 STRUCTURAL STRENGTH AND DISTORTION TESTS - STATIC TOWING TEST

5.3-I. TEST OBJECTIVE

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

5.3-II. TEST DESCRIPTION

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

5.3-III. DISCUSSION

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

5.4 STRUCTURAL STRENGTH AND DISTORTION TESTS - DYNAMIC TOWING TEST

5.4-I. TEST OBJECTIVE

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

5.4-II. TEST DESCRIPTION

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

5.4-III. DISCUSSION

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

DYNAMIC TOWING TEST DATA FORM

Bus Number: 0317	Date: 11-25-03
Personnel: E.D. & D.L.	

Temperature (°F): 58	Humidity (%): 10
Wind Direction: SW	Wind Speed (mph): 5
Barometric Pressure (in.Hg): 30.25	

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.
Description and location of any structural damage: None noted.
General Comments: None

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 6.8 inches to 23.7 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	16.8"
Rear axle – one tire flat	23.5"
Rear axle – two tires flat	21.9"

JACKING TEST DATA FORM

Bus Number: 0317	Date: 7-30-03
Personnel: E.D & M.H.	Temperature: 75

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

Deflated Tire	Jacking Pad Clearance Body/Frame (in)	Jacking Pad Clearance Axle/Suspension (in)	Comments
Right front	19.3 " I 16.8 " D	8.8 " I 6.8 " D	
Left front	19.2 " I 16.9 " D	8.7 " I 6.8 " D	
Right rear—outside	24.1 " I 23.7 " D	15.0 " I 14.7 " D	
Right rear—both	24.1 " I 22.0 " D	15.0 " I 13.1 " D	
Left rear—outside	24.0 " I 23.5 " D	15.0 " I 14.7 " D	
Left rear—both	24.0 " I 21.9 " D	15.0 " I 13.0 " D	
Right middle or tag—outside	NA	NA	
Right middle or tag—both	NA	NA	
Left middle or tag—outside	NA	NA	
Left middle or tag—both	NA	NA	
Additional comments of any deformation or difficulty during jacking:			
None			

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.

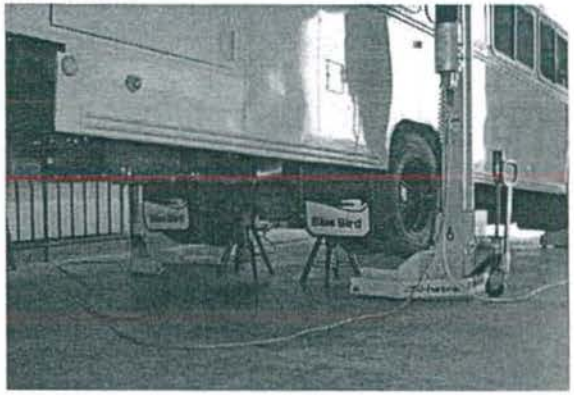
The bus easily accommodated the placement of the vehicle lifts and jack stands and the procedure was performed without any instability noted.

HOISTING TEST DATA FORM

Bus Number: 0317	Date: 7-30-03
Personnel: S.C. & E.D.	Temperature (°F): 73

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

5.6 HOISTING TEST



TEST BUS STABLE ON JACK STANDS

5.7 STRUCTURAL DURABILITY TEST

5.7-I. TEST OBJECTIVE

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

5.7-II. TEST DESCRIPTION

The test vehicle is driven a total of 11,250 miles; approximately 8,750 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 4,625 miles with the bus operated at GVW. The second segment will consist of approximately 2,000 miles with the bus operated at SLW. The remainder of the test, approximately 4,625 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 August 5, 2003 and was conducted until November 17, 2003. The first 4,625 miles were performed at a GVW of 28,920 lbs. and completed on September 25, 2003. The next 2,000 mile SLW segment was performed at 26,800 lbs and completed on September 25, 2003, and the final 4,625 mile segment was performed at a CW of 20,750 lbs and completed on November 17, 2003.

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 #0317
MILEAGE DRIVEN/RECORDED FROM DRIVERS' LOGS

DATE	TOTAL DURABILITY TRACK	TOTAL OTHER MILES	TOTAL
08/04/03 T0 08/10/03	594.00	77.00	671.00
08/11/03 TO 08/17/03	662.00	139.00	801.00
08/18/03 TO 08/24/03	509.00	75.00	584.00
08/25/03 TO 08/31/03	658.00	81.00	739.00
09/01/03 TO 09/07/03	364.00	248.00	612.00
09/08/03 TO 09/14/03	339.00	119.00	458.00
09/15/03 TO 09/21/03	553.00	27.00	580.00
09/22/03 TO 09/28/03	1071.00	50.00	1121.00
09/29/03 TO 10/05/03	413.00	70.00	483.00
10/06/03 TO 10/12/03	252.00	13.00	265.00
10/13/03 TO 10/19/03	898.00	145.00	1043.00
10/20/03 TO 10/26/03	933.00	141.00	1074.00
10/27/03 TO 11/02/03	710.00	139.00	849.00
11/03/03 TO 11/09/03	794.00	466.00	1260.00
11/10/03 TO 11/16/03	0.00	613.00	613.00
11/17/03 TO 11/23/03	0.00	99.00	99.00
TOTAL	8750.00	2502.00	11252.00

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

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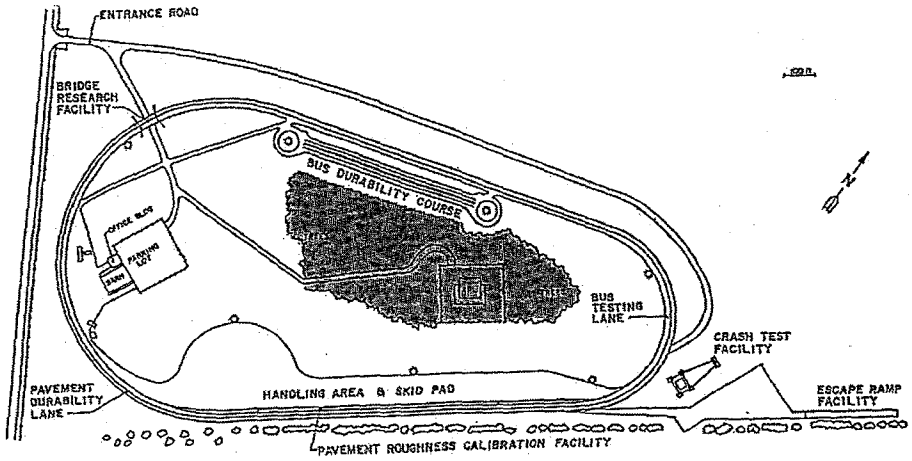

BUS TESTING AND RESEARCH TEST TRACK
UNIVERSITY PARK, PA

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

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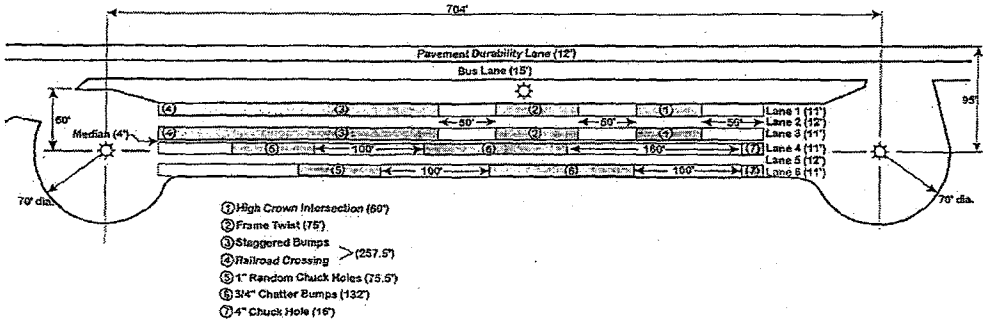
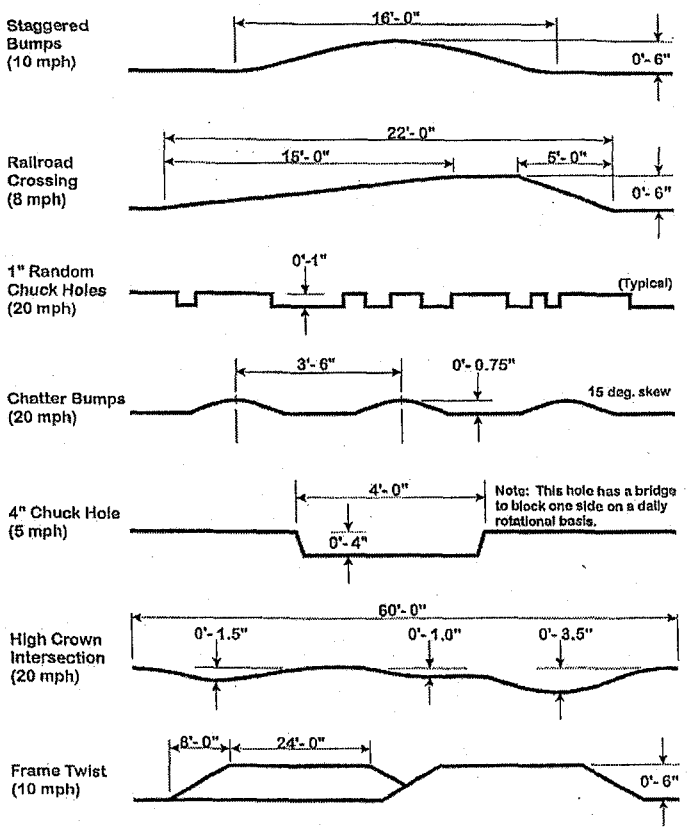


Plan View
Vehicle Durability Test Track
The Pennsylvania Transportation Institute
Penn State



Durability Element Profiles

The Pennsylvania Transportation Institute
Penn State

UNSCHEDULED MAINTENANCE
Blue Bird 0317

DATE	TEST MILES	SERVICE	ACTIVITY	DOWN TIME	HOURS
08-06-03	227	The locating shims have fallen out at the lateral bar on the rear axle and the axle has shifted to the left.	Locating shims replaced and rear axle aligned.	1.00	1.00
08-08-03	523	The A/C will not function.	Loose +12 volt tightened at the evaporator unit.	0.50	0.50
08-11-03	671	Rear lateral bar shims are loose.	Retorque rear lateral bar shims.	1.00	1.00
08-11-03	671	The left side engine mount is loose.	Both engine mounts torqued.	1.00	1.00
08-11-03	671	Eight frame-to-body mounts are loose, 4 each side.	All frame to body mounts torqued.	1.00	1.00
08-14-03	1,277	The front sway bar bushings are worn.	Front sway bar bushings replaced.	2.00	2.00
08-20-03	1,827	The right front tire is flat.	Tire plugged/repaired.	0.50	0.50
08-25-03	2,056	The second carrier bearing from the front on the driveshaft is worn.	Carrier bearing replaced.	2.00	2.00
08-25-03	2,056	Six frame-to-body bushings are worn.	Six frame-to-body bushings replaced.	2.00	2.00
09-02-03	2,795	Manufacturer confirmed the initial front sway bar is the incorrect size.	Front sway bar replaced with proper size.	0.50	0.50
09-10-03	3,652	The front sway bar bushings are worn.	Front sway bar bushings replaced.	1.00	1.00

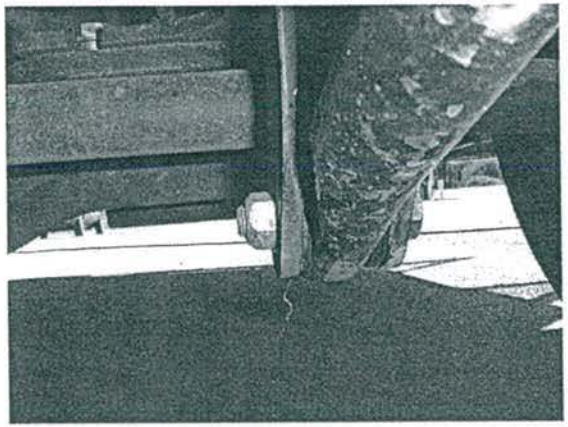
(Page 2 of 3)
UNSCHEDULED MAINTENANCE
Blue Bird 0317

DATE	TEST MILES	SERVICE	ACTIVITY	DOWN TIME	HOURS
09-18-03	4,217	The engine will not crank.	Check charging system, cleaned battery terminals tightened loose +12 volt terminal at the starter.	1.00	1.00
09-18-03	4,217	The left side, front sway bar bushing is worn.	All four front sway bar bushings replaced.	1.00	1.00
09-29-03	5,659	All front sway bar bushings are worn.	All front sway bar bushings replaced.	1.00	1.00
09-30-03	5,876	The left and right front sway bar bushings are worn.	Left and right front sway bar bushings replaced.	1.00	1.00
09-30-03	5,876	Seven frame-to-body bushings are worn.	Seven frame-to-body bushings replaced.	1.00	1.00
10-02-03	5,915	The top ply is broken on the left rear leaf spring.	Left rear leaf spring replaced.	2.00	2.00
10-09-03	6,059	The left rear, air brake mounting bracket on the "S" cam is broken.	New bracket and slack adjuster installed.	3.00	3.00
10-13-03	6,364	The two upper sway bar bushings on the front sway bar are worn.	Bushings replaced.	0.50	0.50
10-13-03	6,364	Three frame-to-body bushings are worn.	Three frame-to-body bushings replaced.	0.50	0.50
10-13-03	6,364	Four body rivets are missing at the wheel chair door.	Rivets replaced.	0.25	0.25

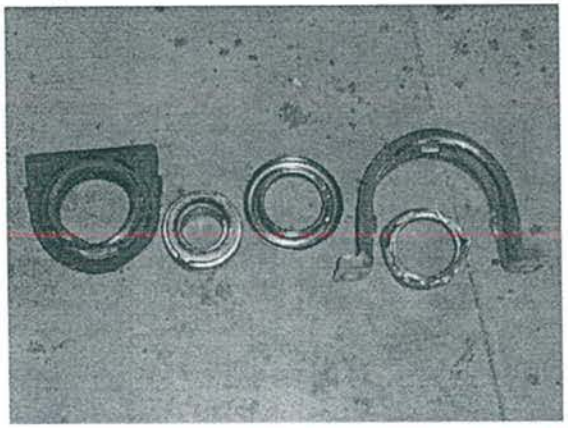
(Page 3 of 3)
UNSCHEDULED MAINTENANCE
Blue Bird 0317

DATE	TEST MILES	SERVICE	ACTIVITY	DOWN TIME	HOURS
10-23-03	8,170	The handicap door will not latch.	Reattached down rod to latch.	0.50	0.50
10-28-03	8,669	The ignition relay has fallen out.	Ignition relay replaced.	3.00	3.00
10-28-03	8,669	The battery hold downs are loose.	Battery hold downs tightened.	1.00	1.00
10-31-03	9,139	Eight frame-to-body bushings are worn.	Eight frame-to-body bushings replaced.	1.00	1.00
10-31-03	9,139	All four front sway bar bushings are worn.	All four front sway bar bushings replaced.	1.00	1.00
11-05-03	9,690	The handicap door will not latch.	Reattached down rod to latch.	0.50	0.50
11-05-03	9,690	Numerous body rivets are missing at the wheel chair door.	Rivets replaced.	0.50	0.50
11-19-03	11,252	The right front air bag is leaking.	Right front air bag replaced.	2.00	2.00
11-19-03	11,252	Heater blower; the vent controller broke off and fell into the blower.	Blower repaired.	1.00	1.00

UNSCHEDULED MAINTENANCE

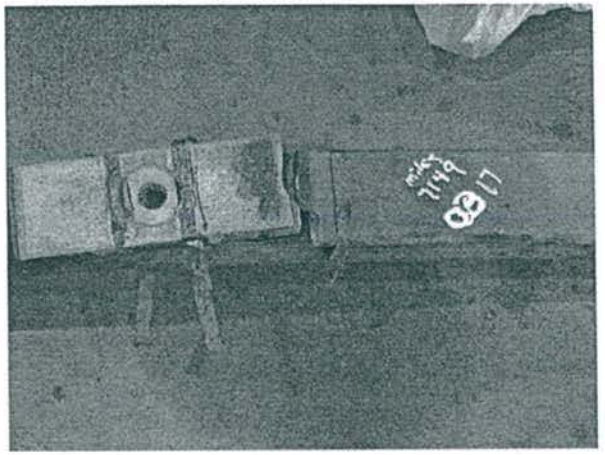


FRONT SWAY BAR BUSHINGS ARE WORN
(1,277 TEST MILES)



WORN DRIVE SHAFT CARRIER BEARING
(2,056 TEST MILES)

UNSCHEDULED MAINTENANCE CONT.



BROKEN TOP PLY OF THE LEFT REAR LEAF SPRING
(5,915 TEST MILES)

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

2. Section 2.1 applies to compressed natural gas (CNG), 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

$FEo_{mi/lb}$ = 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

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

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.

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

where

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

Combining steps 1-3 yields

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

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

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

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

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

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

These combine to give a fuel economy in miles per lb. The energy equivalent (mile/BTUx10^6) will also be provided so that the results can be compared to buses that use other fuels.

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

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

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

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

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

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

where Gm = Density of test fuel at standard conditions

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

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

where

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

6-III. DISCUSSION

This is a comparative test of fuel economy using 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 – 4.67 mpg, ART – 4.97 mpg, and COM – 9.53 mpg. Average fuel consumption at idle was 5.58 lb/hr (0.55 gph).

FUEL ECONOMY PRE-TEST MAINTENANCE FORM

Bus Number: 0317	Date: 11-13-03	SLW (lbs): 26,800
Personnel: S.C., T.S. & E.D.		

FUEL SYSTEM	OK	Date	Initials
Install fuel measurement system	✓	11/13/03	S.C.
Replace fuel filter	✓	11/13/03	T.S.
Check for fuel leaks	✓	11/13/03	S.C.
Specify fuel type (refer to fuel analysis)	Diesel		
Remarks: None			
BRAKES/TIRES	OK	Date	Initials
Inspect hoses	✓	11/13/03	S.C.
Inspect brakes	✓	11/13/03	S.C.
Relube wheel bearings	✓	11/13/03	S.C.
Check tire inflation pressures (mfg. specs.)	✓	11/13/03	S.C.
Remarks: None			
COOLING SYSTEM	OK	Date	Initials
Check hoses and connections	✓	11/13/03	S.C.
Check system for coolant leaks	✓	11/13/03	S.C.
Remarks: None			

FUEL ECONOMY PRE-TEST MAINTENANCE FORM (page 2)

Bus Number: 0317	Date: 11-13-03
Personnel: S.C., T.S. & E.D.	

ELECTRICAL SYSTEMS	OK	Date	Initials
Check battery	✓	11/13/03	S.C.
Inspect wiring	✓	11/13/03	S.C.
Inspect terminals	✓	11/13/03	S.C.
Check lighting	✓	11/13/03	S.C.
Remarks: None			
DRIVE SYSTEM	OK	Date	Initials
Drain transmission fluid	✓	11/13/03	T.S.
Replace filter/gasket	✓	11/13/03	T.S.
Check hoses and connections	✓	11/13/03	T.S.
Replace transmission fluid	✓	11/13/03	T.S.
Check for fluid leaks	✓	11/13/03	T.S.
Remarks: None			
LUBRICATION	OK	Date	Initials
Drain crankcase oil	✓	11/13/03	E.D.
Replace filters	✓	11/13/03	E.D.
Replace crankcase oil	✓	11/13/03	E.D.
Check for oil leaks	✓	11/13/03	T.S.
Check oil level	✓	11/13/03	T.S.
Lube all chassis grease fittings	✓	11/13/03	T.S.
Lube universal joints	✓	11/13/03	T.S.
Replace differential lube including axles	✓	11/13/03	T.S.
Remarks: None			

FUEL ECONOMY PRE-TEST MAINTENANCE FORM (page 3)

Bus Number: 0317	Date: 11-13-03		
Personnel: S.C., T.S. & E.D.			
EXHAUST/EMISSION SYSTEM	OK	Date	Initials
Check for exhaust leaks	✓	11/13/03	S.C.
Remarks: None			
ENGINE	OK	Date	Initials
Replace air filter	✓	11/13/03	T.S.
Inspect air compressor and air system	✓	11/13/03	T.S.
Inspect vacuum system, if applicable	✓	11/13/03	T.S.
Check and adjust all drive belts	✓	11/13/03	T.S.
Check cold start assist, if applicable	✓	11/13/03	T.S.
Remarks: None			
STEERING SYSTEM	OK	Date	Initials
Check power steering hoses and connectors	✓	11/13/03	S.C.
Service fluid level	✓	11/13/03	S.C.
Check power steering operation	✓	11/13/03	S.C.
Remarks: None			
	OK	Date	Initials
Ballast bus to seated load weight	✓	11/13/03	S.C.
TEST DRIVE	OK	Date	Initials
Check brake operation	✓	11/13/03	S.C.
Check transmission operation	✓	11/13/03	S.C.
Remarks: None			

FUEL ECONOMY PRE-TEST INSPECTION FORM

Bus Number: 0317	Date: 11/18/03
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 120 Middle N/A Rear 122	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: 0317	Manufacturer: Blue Bird	Date: 11-18-03
Run Number: 1	Personnel: R.C., T.S. & S.C.	
Test Direction: □CW or ■CCW	Temperature (°F): 49	Humidity (%): 58
SLW (lbs): 26,800	Wind Speed (mph) & Direction: 5 / W	Barometric Pressure (in.Hg): 30.24

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	8:17	8:17	13	0	2.57	2.57
ART #1	0	4:01	4:01	19	0	2.45	2.45
CBD #2	0	8:24	8:24	23	0	2.61	2.61
ART #2	0	3:55	3:55	23	0	2.39	2.39
CBD #3	0	8:21	8:21	26	0	2.59	2.59
COMMUTER	0	5:52	5:52	24	0	2.66	2.66
							Total Fuel = 15.27 lbs

20 minute idle : Total Fuel Used = 1.16 lbs
Heating Value = 20,214.0 BTU/LB
Comments: None

FUEL ECONOMY DATA FORM (Liquid Fuels)

Bus Number: 0317	Manufacturer: Blue Bird	Date: 11-18-03
Run Number: 2	Personnel: R.C., T.S. & S.C.	
Test Direction: ■CW or □CCW	Temperature (°F): 54	Humidity (%): 58
SLW (lbs): 26,800	Wind Speed (mph) & Direction: 5 / W	Barometric Pressure (in.Hg): 30.24

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	8:30	8:30	22	0	2.62	2.62
ART #1	0	3:55	3:55	25	0	2.43	2.43
CBD #2	0	8:26	8:26	26	0	2.59	2.59
ART #2	0	3:57	3:57	27	0	2.43	2.43
CBD #3	0	8:22	8:22	25	0	2.57	2.57
COMMUTER	0	5:53	5:53	27	0	2.49	2.49
							Total Fuel = 15.13 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: 0317	Manufacturer: Blue Bird	Date: 11-18-03
Run Number: 3	Personnel: R.C., T.S. & S.C.	
Test Direction: □CW or ■CCW	Temperature (°F): 55	Humidity (%): 51
SLW (lbs): 26,800	Wind Speed (mph) & Direction: 8 / W	Barometric Pressure (in.Hg): 30.20

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	8:25	8:25	26	0	2.48	2.48
ART #1	0	3:52	3:52	24	0	2.43	2.43
CBD #2	0	8:22	8:22	25	0	2.51	2.51
ART #2	0	3:52	3:52	26	0	2.39	2.39
CBD #3	0	8:18	8:18	25	0	2.55	2.55
COMMUTER	0	5:51	5:51	24	0	2.50	2.50
						Total Fuel =	14.86 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: 0317	Manufacturer: Blue Bird	Date: 11-18-03
Run Number: 4	Personnel: R.C., T.S. & S.C.	
Test Direction: ■CW or □CCW	Temperature (°F): 45	Humidity (%): 87
SLW (lbs): 26,800	Wind Speed (mph) & Direction: Calm	Barometric Pressure (in.Hg): 30.24

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	8:21	8:21	17	0	2.55	2.55
ART #1	0	3:52	3:52	18	0	2.38	2.38
CBD #2	0	8:15	8:15	19	0	2.66	2.66
ART #2	0	3:52	3:52	21	0	2.38	2.38
CBD #3	0	8:21	8:21	22	0	2.48	2.48
COMMUTER	0	5:52	5:52	21	0	2.41	2.41
						Total Fuel =	14.86 lbs

20 minute idle : Total Fuel Used = 1.14 lbs
Heating Value = 20,214.0 BTU/LB
Comments: None

0317.FUL
FUEL ECONOMY SUMMARY SHEET

BUS MANUFACTURER :Blue Bird BUS NUMBER :0317
BUS MODEL :All American TEST DATE :11/18/03

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	7.77	5.73	.74	4.62
ART	4.84	3.82	.79	4.95
COM	2.66	3.82	1.44	9.00
TOTAL	15.27	13.37	.88	5.49
Run # :2, CW				
CBD	7.78	5.73	.74	4.62
ART	4.86	3.82	.79	4.93
COM	2.49	3.82	1.53	9.62
TOTAL	15.13	13.37	.88	5.54
Run # :3, CCW				
CBD	7.54	5.73	.76	4.76
ART	4.82	3.82	.79	4.97
COM	2.50	3.82	1.53	9.58
TOTAL	14.86	13.37	.90	5.64
Run # :4, CW				
CBD	7.69	5.73	.75	4.67
ART	4.76	3.82	.80	5.03
COM	2.41	3.82	1.59	9.94
TOTAL	14.86	13.37	.90	5.64

IDLE CONSUMPTION

First 20 Minutes Data : 1.16 Lb Last 20 Minutes Data : 1.14 Lb
Average Idle Consumption : 3.45 Lb/Hr

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

Run 1 : -1.6 Run 2 : -.7 Run 3 : 1.1 Run 4 : 1.1

SUMMARY

Average Idle Consumption : .55 G/Hr
Average CBD Phase Consumption : 4.67 MPG
Average Arterial Phase Consumption : 4.97 MPG
Average Commuter Phase Consumption : 9.53 MPG
Overall Average Fuel Consumption : 5.58 MPG
Overall Average Fuel Consumption : 40.88 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 46.5 dB(A); ranging from 44.6 dB(A) at the rear passenger seats to 50.7 dB(A) in line with the middle speaker. The interior ambient noise level for this test was 34.0 dB(A).

The second test measures interior noise during acceleration from 0 to 35 mph. This noise level ranged from 70.2 dB(A) at the front passenger seats to 76.5 dB(A) at the driver's seat. The overall average was 72.1 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: 0317	Date: 7-29-03
Personnel: E.D. & S.C.	
Temperature (°F): 82	Humidity (%): 75
Wind Speed (mph): Calm	Wind Direction: Calm
Barometric Pressure (in.Hg): 30.10	
Initial Sound Level Meter Calibration: ⊠ checked by: S.C.	
Interior Ambient Noise Level dB(A): 34.0	Exterior Ambient Noise Level dB(A): 46.4
Microphone Height During Testing (in): 48.0	

Measurement Location	Measured Sound Level dB(A)
Driver's Seat	45.2
Front Passenger Seats	45.4
In Line with Front Speaker	47.4
In Line with Middle Speaker	50.7
In Line with Rear Speaker	45.6
Rear Passenger Seats	44.6

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

Comments: All readings taken in the center aisle.

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

Bus Number: 0317	Date: 2-29-03
Personnel: E.D. & S.C.	
Temperature (°F): 82	Humidity (%): 75
Wind Speed (mph): Calm	Wind Direction: Calm
Barometric Pressure (in.Hg): 30.10	
Initial Sound Level Meter Calibration: ⊠ checked by: S.C.	
Interior Ambient Noise Level dB(A): 34.0	Exterior Ambient Noise Level dB(A): 46.4
Microphone Height During Testing (in): 48	

Measurement Location	Measured Sound Level dB(A)
Driver's Seat	76.5
Front Passenger Seats	70.2
Middle Passenger Seats	70.6
Rear Passenger Seats	71.2

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

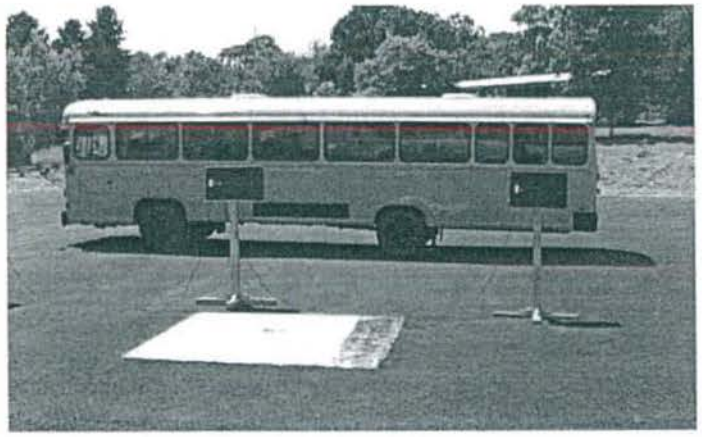
Bus Number: 0317	Date: 11-18-03
Personnel: R.C., T.S. & S.C.	
Temperature (°F): 46	Humidity (%): 87
Wind Speed (mph): 5	Wind Direction: SSE
Barometric Pressure (in.Hg): 30.24	

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:

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 43.8 dB(A), the average test result obtained while accelerating from a constant speed was 72.9 dB(A) on the right side and 74.8 dB(A) on the left side.

When accelerating from a standstill with an exterior ambient noise level of 44.1 dB(A), the average of the results obtained were 72.8 dB(A) on the right side and 74.8 dB(A) on the left side.

With the vehicle stationary and the engine, accessories, and air conditioning on, the measurements averaged 56.6 dB(A) at low idle and 71.8 dB(A) at wide open throttle. With the accessories and air conditioning off, the readings averaged 1.2 dB(A) higher at low idle and 0.2 dB(A) higher at wide open throttle. The exterior ambient noise level measured during this test was 43.0 dB(A). Note; the test bus was not equipped with a fast idle mode, therefore, data for that condition is not available.

EXTERIOR NOISE TEST DATA FORM
Accelerating from Constant Speed

Bus Number: 0317	Date: 11-18-03
Personnel: R.C., T.S. & S.C.	
Temperature (°F): 48	Humidity (%): 81
Wind Speed (mph): 5	Wind Direction: SE
Barometric Pressure (in.Hg): 30.24	
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): 43.8	

Accelerating from Constant Speed Curb (Right) Side		Accelerating from Constant Speed Street (Left) Side	
Run #	Measured Noise Level dB(A)	Run #	Measured Noise Level dB(A)
1	71.8	1	73.0
2	72.5	2	74.3
3	72.5	3	74.9
4	72.9	4	74.7
5	72.9	5	74.6
Average of two highest actual noise levels = 72.9 dB(A)		Average of two highest actual noise levels = 74.8 dB(A)	

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

EXTERIOR NOISE TEST DATA FORM
Accelerating from Standstill

Bus Number: 0317	Date: 11-18-03
Personnel: R.C., T.S. & S.C.	
Temperature (°F): 48	Humidity (%): 81
Wind Speed (mph): 5	Wind Direction: SE
Barometric Pressure (in.Hg): 30.24	
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): 44.1	

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	72.7	1	74.8
2	72.7	2	74.4
3	72.8	3	74.6
4	72.4	4	74.8
5	72.6	5	74.4
Average of two highest actual noise levels = 72.8 dB(A)		Average of two highest actual noise levels = 74.8 dB(A)	

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

EXTERIOR NOISE TEST DATA FORM
Stationary

Bus Number: 0317	Date: 11-18-03
Personnel: R.C., T.S. & S.C.	
Temperature (°F): 48	Humidity (%): 81
Wind Speed (mph): 5	Wind Direction: SE
Barometric Pressure (in.Hg): 30.24	
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): 43.0	

Accessories and Air Conditioning ON			
Throttle Position	Engine RPM	Curb (Right) Side dB(A)	Street (Left) Side db(A)
		Measured	Measured
Low Idle	780	56.5	56.7
High Idle	N/A	N/A	N/A
Wide Open Throttle	2,600	71.5	72.0

Accessories and Air Conditioning OFF			
Throttle Position	Engine RPM	Curb (Right) Side dB(A)	Street (Left) Side db(A)
		Measured	Measured
Low Idle	775	56.8	58.8
High Idle	N/A	N/A	N/A
Wide Open Throttle	2,600	71.5	72.4

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

7.2 EXTERIOR NOISE TESTS

Appendix C

HEAVY-DUTY ARTICULATED 500,000-MILE BUS WITH A MINIMUM SERVICE LIFE OF 12 YEARS

7. NOISE

7.2 EXTERIOR NOISE TESTS

April 2006

ABBREVIATIONS

ABTC	- Altoona Bus Test Center
A/C	- air conditioner
ADB	- advance design bus
CBD	- central business district
CI	- compression ignition
CNG	- compressed natural gas
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)
FTA	- Federal Transit Administration
GAWR	- gross axle weight rating
GL	- gross 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
hr	- hour
LNG	- liquefied natural gas
mpg	- miles per gallon
mph	- miles per hour
NBM	- new bus models
PSBRTF	- Penn State Bus Research and Testing Facility
PTI	- Pennsylvania Transportation Institute
rpm	- revolutions per minute
SAE	- Society of Automotive Engineers
SCF	- standard cubic feet
SCFM	- standard cubic feet per minute
SCH	- test scheduler
SEC	- secretary
SI	- spark ignition
SLW	- seated load weight (curb weight plus 150 lb for every designed passenger seating position and for the driver)
TD	- test driver
TM	- track manager
TP	- test personnel

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 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. TEST ARTICLE

The test article is a heavy-duty articulated transit bus with a minimum service life of 12 years or 500,000 mi.

7.2-IV. TEST EQUIPMENT/FACILITIES/PERSONNEL

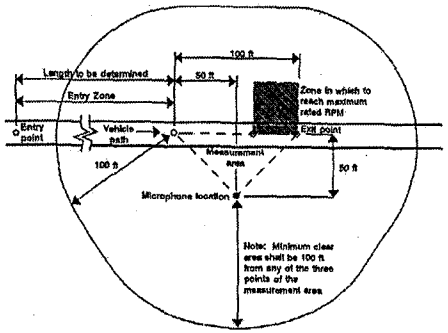
1. Test Equipment
   a. Tape measure (100 ft) or a wheeled distance meter
   b. Road markers (e.g., chalk and highway cones)
   c. Portable engine speed tachometer.
   d. Sound level meter - meeting Type 1 or S1A requirements of American National Standard Specification for sound level meters, S1.4-1971 (includes microphone and manual). The sound meter shall be set for fast response and the A-weighting network.
   e. Sound level calibrator.
   f. A windscreen that does not affect the microphone response more than ±1 dB(A) for frequencies of 20-4000 Hz or ± 1 1/2 dB(A) for frequencies of 4,000 - 10,000 Hz.
   g. Sound level meter tripod that is capable of holding the microphone and meter at 4 ft above ground level.
   h. Clipboard for data recording
   i. Speed measurement system.
2. Test Facility - Test site is at the PSBRTF using the skid pad area.
   a. The measurement area shall be free of tall grass, bystanders, snow or other sound-absorbing materials.
   b. The ambient sound level (including wind effects) at the test site shall be at least 10 dB(A) below the level of the test vehicle operated in accordance with the test procedures.
   c. The wind speed in the measurement area shall be less than 12 mph.
3. Test Personnel - The personnel consist of the following:
   a. Bus driver (DR)
   b. Test personnel (TP)

7.2-V. TEST DATA

The test data consist of the test procedure and data where requested. On completion of the test, test data shall be forwarded to the ABTC manager.

7.2-VI. TEST PREPARATION AND PROCEDURES

The detailed test preparation and procedures are listed in procedure 7.2-1, 7.2-2, and 7.2-3. This section includes figure 7.2-1 and Exterior Noise Test Data Forms - 7.2-1, 7.2-2, and 7.2-3.

DETAILED TEST PROCEDURES		TITLE: 7. Noise
Procedure 7.2-1		NOMENCLATURE: 7.2 Exterior Noise Tests - Accelerating from Constant Speed
OPER STEP	ACTION BY	TEST PREPARATION
		 Figure 7.2-1. Test Site - Configured unidirectional for left to right acceleration from constant speed.

DETAILED TEST PROCEDURES		TITLE: 7. Noise
Procedure 7.2-1		NOMENCLATURE: 7.2 Exterior Noise Tests-- Accelerating from Constant Speed
OPER STEP	ACTION BY	TEST PREPARATION
1	TP	Retrieve work order form for this test.
2	TP	Verify that all test prerequisites defined by 7.2 III, Equipment/Facilities/Personnel are satisfied. **NOTE:** The following steps will define the layout of the test area. (Refer to figure 7.2-1)
3	TP	*Establish an acceleration point by placing a cone at a point along the vehicle path.*
4	TP	Establish an end point along the vehicle path by placing a second cone 100 ft from the acceleration point.
5	TP	Establish the microphone location midway between the acceleration point and the end point at a distance of 50 ft to the right from the center line of the vehicle path. Position the height of the microphone 4 ft above the ground plane, pointing horizontally toward the midpoint.
6	TP	Select a transmission ration and entry speed such that at wide-open throttle, the vehicle will accelerate from the acceleration point with the following considerations. a) The entry speed is such that the starting engine speed is no more than two-thirds (66%) of maximum rated or governed engine speed. b) *The vehicle reaches maximum rated or governed engine speed before the* end point or just prior to transmission upshift. c) The vehicle does not exceed 35 mph before reaching end point. **NOTE:** Should the maximum rated or governed rpm not be attained until beyond the end point, select lower gear until maximum rpm or transmission upshift is attained before the end point.
7	TP	Select the rear bumper as the vehicle reference point.
8	TP	Turn lights and all accessories on.
9	TP	Operate the engine until the coolant temperature is in the normal operating range.

DETAILED TEST PROCEDURES		TITLE: 7. Noise
Procedure 7.2-1		NOMENCLATURE: 7.2 Test Procedure - Exterior Noise Tests— Accelerating from Constant Speed
OPER STEP	ACTION BY	TEST PROCEDURE
1	TP	Verify that all test preparations have been completed.
2	TP	Record the bus number, date, temperature, relative humidity, wind speed and direction, and barometric pressure on the Exterior Noise Test Data Form 7.2-1.
3	TP	Set the sound level meter for fast response and the A-weighting network and the "auto" position.
4	TP	Check the calibration of the sound level meter.
5	TP	Measure the ambient sound level and record it on the Exterior Noise Test Data Form 7.2-1. **NOTE: When taking sound level measurements, position the sound level meter at least 1 meter or arm's length away from the body.**
6	TD	Position the test bus 150 ft from the entry point. Turn on all accessories.
7	TP	Verify that the wind speed is less than 12 mph and the ambient temperature is between 30° F and 90° F.
8	TD	Approach the acceleration point using the entry speed and gear ratio selected in step 6 of the Test Preparation 7.2-1. When the vehicle reference point reaches the acceleration point, apply full throttle and hold until the bus shifts to the next highest gear. Decelerate in a safe manner and return to the starting point.
9	TP	Observe the meter during the period the bus is accelerating. The applicable reading shall be the highest sound level indicated during the run (between the 100 ft span). Record the highest observation on the Exterior Noise Test Data Form. **NOTE: *The test personnel* is cautioned to rerun the test if unrelated peaks occur due to extraneous ambient noises.**
10	TP	Repeat steps 7 thru 9 until the three highest readings are within +-2 db(A) of each other or 10 readings are made. Record the average of the two highest observations on the Exterior Noise Test Data Form.
DETAILED TEST PROCEDURES		TITLE: 7. Noise

Procedure 7.2-1		NOMENCLATURE: 7.2 Exterior Noise Accelerating from Constant Speed (continued)
OPER STEP	ACTION BY	TEST PREPARATION AND PROCEDURE
11	TD	Switch the acceleration and end points and position the bus 150 ft from the acceleration point, facing the opposite direction from previous runs. **NOTE: Switching the entry points changes the test site of figure 7.2-1 to its mirror image. That is, the acceleration point is on the right and the test zone is on the left. The test site is now ready for *right to left motion.***
12	TP	Repeat step 10 traveling in the opposite direction. The sound level will be measured for the left side of the bus.
13	TP	Recheck sound level meter calibration. **NOTE: If meter calibration has changed by more than ±0.5 dB(A), recalibrate the meter and repeat test procedure.**

EXTERIOR NOISE TEST DATA FORM
Accelerating from Constant Speed

Bus Number:	Date:
Personnel:	
Temperature (EF):	Humidity (%):
Wind Speed (mph):	Wind Direction:
Barometric Pressure (in.Hg):	
Verify that microphone height is 4 feet, wind speed is less than 12 mph and ambient temperature is between 30EF and 90EF: Gchecked by	
Initial Sound Level Meter Calibration: Gchecked by	
Exterior Ambient Noise Level dB(A):	

Accelerating from Constant Speed Curb (Right) Side			Accelerating from Constant Speed Street (Left) Side		
Run #	Measured Noise Level dB(A)	Actual Noise Level dB(A)	Run #	Measured Noise Level dB(A)	Actual Noise Level dB(A)
1			1		
2			2		
3			3		
4			4		
5			5		
6			6		
7			7		
8			8		
9			9		
10			10		
Average of two highest actual noise levels = dB(A)			Average of two highest actual noise levels = dB(A)		
Final Sound Level Meter Calibration Check: Gchecked by					
Comments:					
NOTE: Actual noise level is corrected for exterior ambient noise level.					

DETAILED TEST PROCEDURES		TITLE: 7. Noise
Procedure 7.2-2		NOMENCLATURE: 7.2 Exterior Noise Tests - Accelerating from Standstill
OPER STEP	ACTION BY	TEST PREPARATION
1	TP	Retrieve work order form for this test.
2	TP	Verify that all test prerequisites defined by 7.2-III, Equipment/Facilities/personnel are satisfied. **NOTE: The following step will define the layout of the test area. (Refer to figure 7.2-2)**
3	TP	Establish a starting point and exit point by placing two highway cones 80 ft apart, beside the vehicle path.
4	TP	At the point along the center line of the vehicle path, midway between the start and exit points, measure a distance 50 ft perpendicular to the vehicle path and mark the location for the sound level meter.
5	TP	Position the sound level meter at this point, 4 ft above the ground using the sound level meter tripod. Point the microphone toward the midpoint on the vehicle path.
6	TD	Operate the engine until the coolant temperature is in the normal operating range. Turn lights and all accessories on.
7	TP	Select the rear bumper as the vehicle reference point. ***NOTE: On vehicles equipped with radiator shutters, the shutter position causing maximum sound level should be determined, and the test conducted with the shutters in such position.***

DETAILED TEST PROCEDURES		TITLE: 7. Noise
Procedure 7.2-2		NOMENCLATURE: 7.2 Exterior Noise Tests - Accelerating from Standstill (Continued)
OPER STEP	ACTION BY	TEST PREPARATION

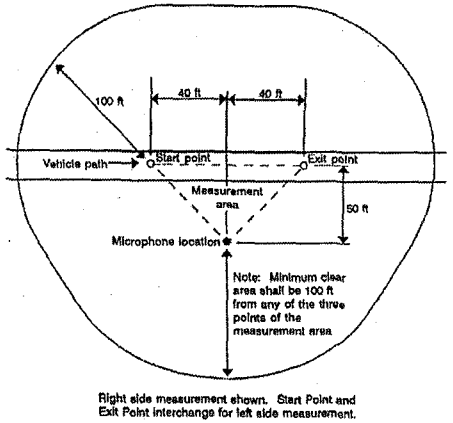


Figure 7.2-2. Test Site - configured for acceleration from standstill.

DETAILED TEST PROCEDURES		TITLE: 7. Noise
Procedure 7.2-2		NOMENCLATURE: 7.2 Exterior Noise Accelerating from Standstill
OPER STEP	ACTION BY	TEST PREPARATION AND PROCEDURE
1	TP	Record the bus number, date, temperature, relative humidity, wind speed and direction, and barometric pressure on the Exterior Noise Test Data Form 7.2-2.
2	TP	Set the sound level meter for fast response and the A-weighting network in the "auto" position. NOTE: Because bystanders have an appreciable influence on meter response, position all persons out of the measurement area, behind the sound level meter.
3	TP	Check the calibration of the sound level meter.
4	TP	Measure the ambient sound level and record it on the Exterior Noise Test Data Form 7.2-2.
5	TP	Verify that the wind speed is less than 12 mph and the ambient temperature is between 30° F and 90° F.
6	TD	Position the test bus so that is centered in the vehicle path, with the left side of the rear bumper next to the starting cone.
7	TD	Turn all accessories on.
8	TD	With the transmission in "Drive," rapidly establish full throttle. When the rear bumper has passed the exit cone, decelerate and return to the starting point.
9	TP	The sound level meter shall be observed during the period when the bus is accelerating. The applicable reading shall be the highest sound level obtained for the run (between the 80 ft span). **NOTE: The test personnel is cautioned to rerun the test if unrelated peaks occur due to extraneous ambient noises.**
10	TD	Repeat steps 6 thru 9 until the two highest readings are within 2 dB(A) of each other or 10 readings are made. Record all observations and the average of the two highest on the Exterior Noise Test Data Form.

DETAILED TEST PROCEDURES		TITLE: 7. Noise
Procedure 7.2-2		**NOMENCLATURE: 7.2 Exterior Noise Accelerating from Standstill (continued)**
OPER STEP	**ACTION BY**	**TEST PROCEDURE**
11	TP	Switch the starting and exit points. The test bus will now run in the opposite direction, and noise levels will be recorded for the left side of the bus.
12	TP	Position the test bus so that it is centered in the vehicle path, with the right side of the rear bumper next to the starting cone.
13	TP	Repeat steps 7 thru 9 until the two highest readings are with +- 2 dB(A) of each other or 10 readings are made. Record all observations and the average of the two highest on the Exterior Noise Test Data Form.
14	TP	Recheck sound level meter calibration. **NOTE: If meter calibration has changed by more than ±0.5 dB(A), recalibrate the meter and repeat the test procedure.**

EXTERIOR NOISE TEST DATA FORM
Accelerating from Standstill

Bus Number:	Date:
Personnel:	
Temperature (EF):	Humidity (%):
Wind Speed (mph):	Wind Direction:
Barometric Pressure (in.Hg):	
Verify that microphone height is 4 feet, wind speed is less than 12 mph and ambient temperature is between 30EF and 90EF: gchecked by	
Initial Sound Level Meter Calibration: gchecked by	
Exterior Ambient Noise Level dB(A):	

Accelerating from Standstill Curb (Right) Side			Accelerating from Standstill Street (Left) Side		
Run #	Measured Noise Level dB(A)	Actual Noise Level dB(A)	Run #	Measured Noise Level dB(A)	Actual Noise Level dB(A)
1			1		
2			2		
3			3		
4			4		
5			5		
6			6		
7			7		
8			8		
9			9		
10			10		
Average of two highest actual noise levels = dB(A)			Average of two highest actual noise levels = dB(A)		

Final Sound Level Meter Calibration Check: gchecked by
Comments:
NOTE: Actual noise level is corrected for exterior ambient noise level.

DETAILED TEST PROCEDURES		TITLE: 7. Noise
Procedure 7.2-3		NOMENCLATURE: 7.2 Exterior Noise Tests – Stationary
OPER STEP	ACTION BY	TEST PROCEDURE
1	TP	Record the bus number, date, temperature, relative humidity, wind speed and direction, and barometric pressure on the Exterior Noise Test Data Form 7.2-3.
2	TP	Set the sound level meter for fast response and the A-weighting network and switch to the "auto" mode. **NOTE: Because bystanders have an appreciable influence on meter response, position all persons out of the measurement area, behind the sound level meter.**
3	TP	Check the calibration of the sound level meter.
4	TP	Measure the ambient sound level and record it on the Exterior Noise Test Data Form 7.2-3.
5	TD	Verify that the wind speed is less than 12 mph and the ambient temperature is between 30° F and 90° F.
6	TP	Install the engine tachometer (tape) and verify correct operation. **NOTE: Make sure the light reflecting tape is installed on the crankshaft pulley.**
7	TD	Turn on all lights, accessories and air conditioning.
8	TD	Set the bus engine to low idle.
9	TP	Measure the engine rpm. With the engine compartment closed, measure the noise level at the specified rpm and record the values on the EXTERIOR NOISE TEST DATA FORM. **NOTE: Unrelated peaks due to extraneous ambient noise should be ignored.**
10	TD	Set the bus engine to high idle (if obtainable).
11	TP	Repeat Step 9.
12	TD	Establish and hold wide open throttle.
13	TP	Repeat step 9.

DETAILED TEST PROCEDURES		TITLE: 7. Noise
Procedure 7.2-3		NOMENCLATURE: 7.2 Exterior Noise Stationary (continued)
OPER STEP	ACTION BY	TEST PREPARATION AND PROCEDURE
14	TD	Reverse the position of the test bus, such that the bus is centered in the vehicle path with the right side of the rear or front bumper (wherever applicable) next to the center cone. **NOTE: Noise measurements will now be made from the left side of the bus.**
15	TP	Repeat steps 7 thru 13.
16	TD	Turn off all lights, accessories, and air conditioning.
17	TP	Repeat steps 8 thru 13 to obtain left side measurement with accessories off.
18	TD	Place the test bus so that it is centered in the vehicle path with the left side of the rear bumper or front bumper (wherever applicable) next to the center cone.
19	TP	Repeat steps 8 thru 13 to obtain right side measurement with accessories off.
20	TP	Recheck calibration of sound level meter. **NOTE: If meter calibration has changed by more than ±0.5 dB(A), recalibrate the meter and repeat the test procedure.**
21	TP	Return all test equipment to proper location.

EXTERIOR NOISE TEST DATA FORM
Stationary

Bus Number:	Date:
Personnel:	
Temperature (EF):	Humidity (%):
Wind Speed (mph):	Wind Direction:
Barometric Pressure (in.Hg):	
Verify that microphone height is 4 feet, wind speed is less than 12 mph and ambient temperature is between 30EF and 90EF: Gchecked by	
Initial Sound Level Meter Calibration: Gchecked by	
Exterior Ambient Noise Level dB(A):	

Accessories and Air Conditioning ON					
Throttle Position	Engine RPM	Curb (Right) Side dB(A)		Street (Left) Side dB(A)	
		Measured	Actual	Measured	Actual
Low Idle					
High Idle					
Wide Open Throttle					

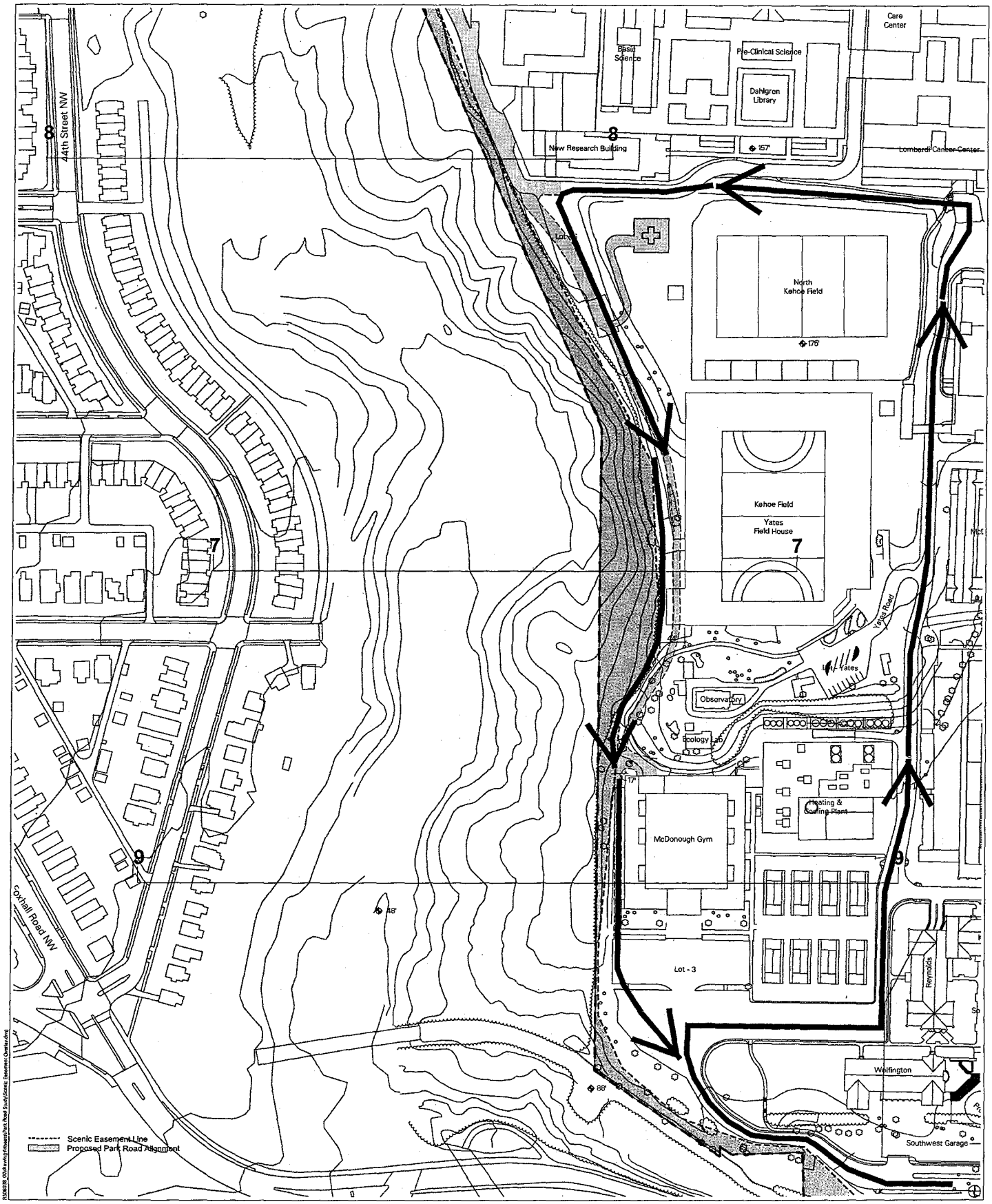
Accessories and Air Conditioning OFF					
Throttle Position	Engine RPM	Curb (Right) Side dB(A)		Street (Left) Side dB(A)	
		Measured	Actual	Measured	Actual
Low Idle					
High Idle					
Wide Open Throttle					
Final Sound Level Meter Calibration Check: Gchecked by					
Comments:					
Note: The actual sound level is corrected for the ambient noise level.					

REVISIONS

All revisions to this test procedure must be identified on this page. Briefly describe each revision in the space provided below.

Revision	Description	Date	Approval

Appendix D



Georgetown University

Cooper, Robertson & Partners

July 7, 2010

08038.01

Campus Plan 2010 - 2020

Scenic Easement Overlay

Appendix E

THE OHIO STATE UNIVERSITY EXTENSION

FACT SHEET

Community Development

CDFS-190-08

The Invisible Environment Fact Sheet Series

Noise

Jackie LaMuth
Leader, Resource Development and Management
Ohio State University Extension

Noise is defined as unwanted sound. Noise is an inescapable part of everyday life—the television, a plane flying overhead, a faulty muffler on a passing car, dogs barking, children laughing. Mild noise can be annoying; excessive noise can destroy a person's hearing. People do not easily become accustomed to noise. The slightest unwanted sound can become very annoying if it continues for any length of time. While the continuous hum of a busy freeway may be ignored by some nearby residents, others will never be able to ignore it and increasingly will find it irritating.

How Humans Hear

The visible part of the ears are sound-gathering scoops that guide sound waves along a one-inch canal, which acts as a resonating chamber. When they reach the eardrum, they become vibrations. These vibrations are picked up in the middle ear by three tiny, linked ear bones and are mechanically passed deeper to the inner ear where hair cells translate them into electrochemical impulses. The auditory part of the brain interprets this stimulus and decides how far away it is, where it is, and what it is.

What the Ears Hear

Sound occurs when waves of compressed atmospheric particles travel through the air. The waves are created when atmospheric particles alternately are squeezed closer together than normal, then pulled farther apart than normal (see Figure 1). Sound waves move outward from the vibrating source and weaken as they travel. They may be reflected or bent by obstacles so the sound that reaches the ear may be different from the sound that was originally generated.

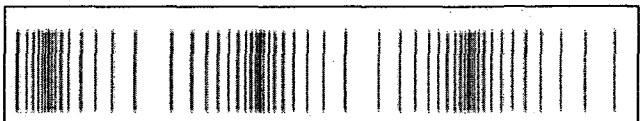


Figure 1. Waves are created when atmospheric particles alternately are squeezed closer together than normal, then pulled farther apart than normal.

Measuring Sound

The frequency and intensity of sound are measured. Sound-producing vibrations are repetitive or cyclical and are measured in Hertz (Hz), which notes the number of cycles that occur per second (cps). The greater the frequency, the higher the pitch. Children's ears respond to frequencies as high as 40,000 Hz, while the range for adult ears narrows considerably, mostly by loss in the high-frequency range.

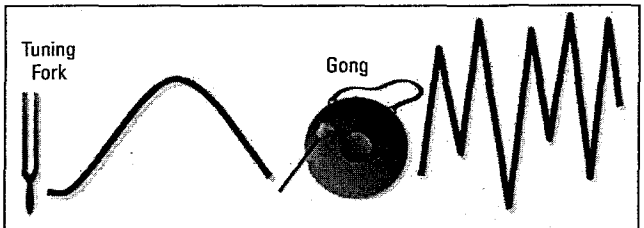


Figure 2.

The intensity or force of a sound determines its loudness and is measured in decibels (dB). The greater the force, the louder the sound. Each increase of three decibels doubles the loudness. The difference between 100 dB of a garbage truck and 110 dB of a race car represents an increase of more than 300 percent.

Safe Range	Sound in Decibels (dB)	Injury Range	Sound in Decibels (dB)
Stream flow, rustling leaves	15	Race car, loud thunder, rock band (sustained)	120/130
Watch ticking, soft whisper	20–30	Jack hammer from 3 feet	100
Quiet street noises	40	Jet airplane takeoff from 120 feet	120
Normal conversation	45–60	Pain threshold (close)	130
Normal city or freeway traffic	70	Rocket launch from 150 feet	180
Vacuum cleaner	75		
Hair dryer	85		
Lawn mower, heavy equipment	90		
Garbage truck	100		
Screaming baby	115		

an accelerated heartbeat and high blood pressure, gastric-intestinal problems, a decrease in alertness and ability to memorize, nervousness, pupil dilation, and a decrease in the visual field. Effects that may be longer lasting include insomnia, nervousness, bulimia, chronically high blood pressure, anxiety, depression, and sexual dysfunction.

A Health Problem or a Social Irritation

Noise generates conflicts between the participating and nonparticipating groups. People generally tolerate noise more easily if they are causing it, if they feel it is necessary, and/or if they know its source.

Every exposure to loud noise destroys some hair cells. Continuous exposure to noise at a level no louder than people shouting, over a period of years for 8 hours a day, 5 days a week can cause some degree of hearing loss. This type of hearing loss is permanent.

Noise in the Workplace

"This office is so noisy, I can't think!" When noise levels in a workplace are loud enough to require people to raise their voices in order to talk, the sounds are above 85 decibels. If people are exposed to such noise levels for eight hours a day, the Occupational Safety and Health Act (OSHA) requires the workplace to develop a formal hearing conservation program. This can include measuring noise, engineering controls to reduce noise, hearing examinations for exposed employees, and personal protective equipment. Sound below 85 decibels is not regulated. Noise levels above 58 dB can interfere with voice communications and affect thought processes for some people.

Employees may sense noise in two ways. They most often hear it as it travels through the air from its source. Less frequently, employees may "feel" the noise as the noise source vibrates and sends vibrations through the building structure.

According to OSHA's permissible noise exposures table, the higher the decibel level, the shorter the acceptable duration of exposure per day. For example, the operator of a jack hammer (100 dB) may spend no more than two hours per day exposed to that noise level. Airport employees who work around jet airplanes as they rev up their engines (120 dB) may spend no more than 15 minutes per eight-hour day exposed.

A Growing Concern

Noise pollution is an increasing problem in developing countries with road traffic noises being the major contributor. Two percent of the U.S. population considers aircraft to be a major noise nuisance. Among the sources of neighborhood noise problems and countless complaints and court cases are stereo systems, household appliances, and barking dogs. Many U.S. towns and cities have noise ordinances that prohibit or restrict certain noises at certain times, including animal noise, outdoor entertainment, construction, and other equipment and machinery.

Possible Solutions

Effective solutions to noise will vary depending on the nature of the problem. When complaints are made about noise, try to identify which specific characteristic of the noise is offensive so control measures can be explored. Is the noise too loud, too unpredictable, or too high pitched? Having neglected equipment and systems serviced, or enclosing noisy machines in a separate room may be the answer. When noise sources are diffused, isolating people with dividers may offer some relief if the dividers are at least 5 feet high and are placed as close to the floor as possible.

A separate conference room is needed for confidential conversations. Noise can penetrate drop ceilings and travel

THE OHIO STATE UNIVERSITY EXTENSION

FACT SHEET

Community Development

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The Invisible Environment Fact Sheet Series

Noise

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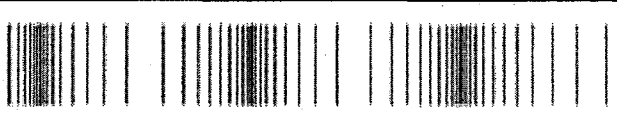
Noise is defined as unwanted sound. Noise is an inescapable part of everyday life—the television, a plane flying overhead, a faulty muffler on a passing car, dogs barking, children laughing. Mild noise can be annoying; excessive noise can destroy a person's hearing. People do not easily become accustomed to noise. The slightest unwanted sound can become very annoying if it continues for any length of time. While the continuous hum of a busy freeway may be ignored by some nearby residents, others will never be able to ignore it and increasingly will find it irritating.

How Humans Hear

The visible part of the ears are sound-gathering scoops that guide sound waves along a one-inch canal, which acts as a resonating chamber. When they reach the eardrum, they become vibrations. These vibrations are picked up in the middle ear by three tiny, linked ear bones and are mechanically passed deeper to the inner ear where hair cells translate them into electrochemical impulses. The auditory part of the brain interprets this stimulus and decides how far away it is, where it is, and what it is.

What the Ears Hear

Sound occurs when waves of compressed atmospheric particles travel through the air. The waves are created when atmospheric particles alternately are squeezed closer together than normal, then pulled farther apart than normal (see Figure 1). Sound waves move outward from the vibrating source and weaken as they travel. They may be reflected or bent by obstacles so the sound that reaches the ear may be different from the sound that was originally generated.



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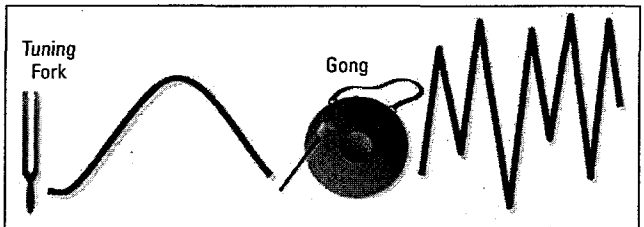

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The Difference Between Sound and Noise

Not all people are affected the same way by the same sounds. We often take for granted the sounds we hear every day. On different occasions and in varying situations, however, common everyday sounds can interfere with our routine task. When this happens, sounds become noise.

What may be a disturbing noise for one person may be a pleasant sound for someone else. For example: A couple lives in a small town and every morning a nearby rooster crows at daybreak. The wife finds it a pleasant way to awaken each day; the husband can't stand it. He awakens before the rooster crows and waits for it to begin. When it does, he flies into a rage. Train whistles, children playing, someone coughing during a symphony, and people talking in a movie are examples of sounds that can evoke extreme reactions.

Sounds that are generally considered to be pleasant create variations in pressure with a regular pattern. Sound waves commonly translated as noise often have irregular patterns (see Figure 2). The patterns created by human voices have both irregular and regular sound pulses. An adult with good hearing can hear frequencies between 20 and 20,000 hertz (Hz). Frequencies between 2000 Hz and 8000 Hz are considered most annoying; those below 500 Hz or above 10,000 Hz are considered less annoying.

Noise as an Irritant

It is not so much the pitch or loudness of a sound that makes it unbearable as it is its repetitive nature, the distraction it causes, and the lack of control over it. A voice in normal conversation is generally around 60 dB. Normal city or freeway traffic registers 70 dB. Some cities have incorporated the use of rubber asphalt made from recycled tires in an attempt to reduce the level of traffic noise.

Noise as a Psychological Fact

Research on noise indicates that there is a psychological element to the level of sound that one considers to be "noise." Introverted people seem to be more bothered by noise than extroverted people. Individuals prone to depression, hypochondria, and anxiety or who are going through a difficult emotional experience such as divorce or unemployment tend to be more sensitive to extraneous sounds and consider them noise.

How Noise Damages the Ear

Normal hearing depends on the health of the three components of the human ear: the inner, middle, and outer ear. There are three kinds of hearing loss: conductive, neural, and sensory. Conductive hearing loss occurs

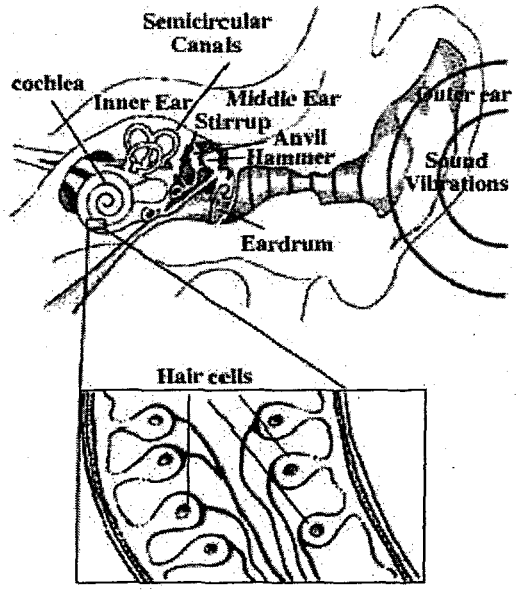

Figure 3.

when something happens to the outer or middle ear, such as excessive ear wax, a damaged ear drum, or fluid in the middle ear. Neural hearing loss is caused by damage to auditory nerves. Sensory hearing loss is caused by damage to the inner ear (cochlea) and is the most common form associated with noise.

The cochlea contains thousands of tiny hair cells that transmit sound impulses to the auditory nerve. An explosion of 140 dB can cause permanent deafness, for it destroys certain cells in the inner ear that do not regenerate. The middle ear has a reflex action that reduces the transmission of sound and helps prevent damage. It is too slow, however, to protect against sudden bursts of sounds such as gunshots. Extended exposure to excessive noise levels can flatten or disfigure hair cells or cause them to fuse together; this can reduce the ability of the hair cells to transmit sound. Sensory hearing loss is generally irreversible, but further loss can be prevented by using protective equipment or by reducing the amount of noise in the workplace. The most common causes of conductive hearing loss in the workplace would be damage to the eardrum due to a blow to the head or an explosion. Examples of safe levels and injury range levels of sound are shown in the table on the next page.

Noise Damages More Than the Ears

In addition to contributing to hearing loss, too much noise can affect health in other ways, too. There are immediate effects that may be temporary or may become longer lasting. These include cardiovascular problems with

Appendix F

Common Sounds

This decibel (dB) table compares some common sounds and shows how they rank in potential harm to hearing.

Sound	Noise Level (dB)	Effect
Boom Cars	145	
Jet Engines (near)	140	
Shotgun Firing	130	
Jet Takeoff (100–200 ft.)		
Rock Concerts (varies)	110–140	Threshold of pain begins around 125 dB
Oxygen Torch	121	
Discotheque/Boom Box	120	Threshold of sensation begins around 120 dB
Thunderclap (near)		
Stereos (over 100 watts)	110–125	
Symphony Orchestra		Regular exposure to sound over 100 dB of more than one minute risks permanent hearing loss
Power Saw (chainsaw)	110	
Pneumatic Drill/Jackhammer		
Snowmobile	105	
Jet Flyover (1000 ft.)	103	
Electric Furnace Area		No more than 15 minutes of unprotected exposure recommended for sounds between 90–100 dB
Garbage Truck/Cement Mixer	100	
Farm Tractor	98	
Newspaper Press	97	
Subway, Motorcycle (25 ft.)	88	Very annoying
Lawnmower, Food Blender	85–90	85 dB is the level at which hearing damage (8 hrs.) begins
Recreational Vehicles, TV	70–90	
Diesel Truck (40 mph, 50 ft.)	84	
Average City Traffic	80	Annoying; interferes with conversation; constant exposure may cause damage
Garbage Disposal		
Washing Machine	78	
Dishwasher	75	
Vacuum Cleaner, Hair Dryer	70	Intrusive; interferes with telephone conversation
Normal Conversation	50–65	
Quiet Office	50–60	Comfortable hearing levels are under 60 dB
Refrigerator Humming	40	
Whisper	30	Very quiet
Broadcasting Studio	30	
Rustling Leaves	20	Just audible
Normal Breathing	10	
		The threshold of normal hearing starts at about 1000 to 4000kHz.