

FEDERAL TRANSIT BUS TEST

Performed for the Federal Transit Administration U.S. DOT
In accordance with CFR 49, Volume 7, Part 665

Manufacturer: Blue Bird Body Company
Model: Gasoline Vision

Submitted for Testing in Service-Life Category
10Year /350,000 Miles

July 2017

Report Number: LTI-BT-R1701-P

PENNS^TATE



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FEDERAL TRANSIT BUS TEST

Performed for the Federal Transit Administration U.S. DOT
1200 New Jersey Avenue, SE
Washington, DC 20590

In accordance with CFR 49, Volume 7, Part 665

Manufacturer: Blue Bird Body Company

Manufacturer's address:

402 Blue Bird Blvd.
Fort Valley, GA 31030-0937

Model: Gasline Vision

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Quality Authorization

Director, Bus Research
and Testing Center
Title

7/17/17
Date

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EXECUTIVE SUMMARY

Blue Bird Body Company submitted a model Gasoline Vision, gasoline-powered 72 seat (including the driver) 39-foot bus, for a partial STURAA test in the 10 yr/350,000 mile category. The Federal Transit Administration determined that the following tests would be performed; 4.1 Performance Test, 6. Fuel Economy Test, 7.1 Interior Noise Test (Conditions 2 & 3), 7.2 Exterior Noise Test (Conditions 1 & 2) and 8. Emissions. The odometer reading at the time of delivery was 9,704 miles. Testing started on March 6, 2017 and was completed on May 18, 2017. The Check-In section of the report provides a description of the bus and specifies its major components.

The interior of the bus is configured with seating for 72 passengers including the driver. This test bus is not designed to accommodate standing passengers. At 150 lbs per person, this load results in a measured gross vehicle weight of 28,220 lbs.

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 27.0 seconds. Top speed obtained on the dynamometer was 59.6 mph. The maximum gradeability at 10 mph and 40 mph were 14.6% and 5.9% respectively.

A Fuel Economy Test was run on simulated transit test cycles: Manhattan cycle, Orange County Bus cycle and the Heavy-Duty Urban Dynamometer Driving Schedule (HD-UDDS). central business district, arterial, and commuter courses. The results were 2.79 mpg, 3.78 mpg, and 5.55 mpg respectively; with an overall average of 4.04 mpg.

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

The Emissions Test was performed. These results are available in Section 8 of this report.

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
PSTT	- Penn State Test Track
PTI	- Pennsylvania Transportation Institute
rpm	- revolutions per minute
SAE	- Society of Automotive Engineers
SCH	- test scheduler
SA	- staff assistant
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 Body Company, model Gasoline Vision. The bus has a front door, rear of the front axle. The rear of the bus is equipped with an emergency exit. Power is provided by a gasoline-fueled, Ford Motor Co. model 6.8L V10 engine coupled to a Ford Motor Co. model 6R140-6 speed automatic transmission.

The measured curb weight is 6,100 lbs for the front axle and 11,290 lbs for the rear axle. These combined weights provide a total measured curb weight of 17,390 lbs. There are 72 seats including the driver. This test bus is not designed to accommodate standing passengers. Gross load is $150 \text{ lb} \times 72 = 10,800 \text{ lbs}$. At full capacity, the measured gross vehicle weight is 28,220 lbs.

VEHICLE DATA FORM

Page 1 of 7

Bus Number: 1701-P	Date: 03-06-17
Bus Manufacturer: Blue Bird Body Company	Vehicle Identification Number (VIN): 1BAKGCBA4GF319060
Model Number: Gasoline Vision	Chassis Mfr./Mod.#: Blue Bird / N/A
Personnel: T.S. & S.R.	Starting Odometer Reading: 9,704

WEIGHT:

Individual Wheel Reactions:

Weights (lb)	Front Axle		Middle Axle		Rear Axle	
	Curb	Street	Curb	Street	Curb	Street
CW	2,920	3,180	N/A	N/A	5,550	5,740
SLW	3,480	3,720	N/A	N/A	10,410	10,610
GVW	3,480	3,720	N/A	N/A	10,410	10,610

Total Weight Details:

Weight (lb)	CW	SLW	GVW	GAWR
Front Axle	6,100	7,200	7,200	8,500
Middle Axle	N/A	N/A	N/A	N/A
Rear Axle	11,290	21,020	21,020	21,000
Total	17,390	28,220	28,220	GVWR: 29,500

Dimensions:

Length (ft/in)	39 /1.75
Width (in)	96.0
Height (in)	119.0
Front Overhang (in)	43.75
Rear Overhang (in)	152.25
Wheel Base (in)	273.75
Wheel Track (in)	Front: 80.6
	Middle: N/A
	Rear: 72.6

VEHICLE DATA FORM

Page 2 of 7

Bus Number: 1701-P	Date: 03-06-17
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CLEARANCES:

Lowest Point Outside Front Axle	Location: Bumper	Clearance(in): 15.1
Lowest Point Outside Rear Axle	Location: Hitch	Clearance(in): 16.4
Lowest Point between Axles	Location: Body panel next to door	Clearance(in): 9.3
Ground Clearance at the center (in)	12.0	
Front Approach Angle (deg)	19.04	
Rear Approach Angle (deg)	6.1	
Ramp Clearance Angle (deg)	5.0	
Aisle Width (in)	13.6	
Inside Standing Height at Center Aisle (in)	76.0	

BODY DETAILS:

Body Structural Type	Integral		
Frame Material	Steel		
Body Material	Steel		
Floor Material	Steel		
Roof Material	Steel		
Windows Type	<input checked="" type="checkbox"/> Fixed	<input checked="" type="checkbox"/> Movable	
Window Mfg./Model No.	LCI 228 Tempered DOT 620 AS2		
Number of Doors	_1_ Front	_1_ Rear	
Mfr. / Model No.	Blue Bird / N/A		
Dimension of Each Door (in)	Front- 24.1 W x 80.9 H	Rear- 38 W x 53 H	
Passenger Seat Type	<input type="checkbox"/> Cantilever	<input checked="" type="checkbox"/> Pedestal	<input type="checkbox"/> Other (explain)
Driver Seat Type	<input checked="" type="checkbox"/> Air	<input type="checkbox"/> Spring	<input type="checkbox"/> Other (explain)
Mfr. / Model No.	National Seating / NS2000		
Number of Seats (including Driver)	72		

VEHICLE DATA FORM

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Bus Number: 1701-P	Date: 03-06-17
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BODY DETAILS (Contd..)

Free Floor Space (ft ²)	32.39 ft ²
Height of Each Step at Normal Position (in)	Front 1. <u>11.8</u> 2. <u>9.1</u> 3. <u>9.1</u> 4. <u>9.7</u>
	Middle 1. <u>N/A</u> 2. <u>N/A</u> 3. <u>N/A</u> 4. <u>N/A</u>
	Rear 1. <u>N/A</u> 2. <u>N/A</u> 3. <u>N/A</u> 4. <u>N/A</u>
Step Elevation Change - Kneeling (in)	N/A

ENGINE

Type	<input type="checkbox"/> C.I.	<input type="checkbox"/> Alternate Fuel	
	<input checked="" type="checkbox"/> S.I.	<input type="checkbox"/> Other (explain)	
Mfr. / Model No.	Ford Motor Company/ 6.8 L V10		
Location	<input checked="" type="checkbox"/> Front	<input type="checkbox"/> Rear	<input type="checkbox"/> Other (explain)
Fuel Type	<input checked="" type="checkbox"/> Gasoline	<input type="checkbox"/> CNG	<input type="checkbox"/> Methanol
	<input type="checkbox"/> Diesel	<input type="checkbox"/> LNG	<input type="checkbox"/> Other (explain)
Fuel Induction Type	<input checked="" type="checkbox"/> Injected	<input type="checkbox"/> Carburetion	
Alternator (Generator) Mfr. / Model No.	Leece-Neville / AV1160P2003		
Maximum Rated Output (Volts / Amps)	12 / 240		
Air Compressor Mfr. / Model No.	Bendix / TU-FLO 550		
Maximum Capacity (ft ³ / min)	13.2		
Starter Type	<input checked="" type="checkbox"/> Electrical	<input type="checkbox"/> Pneumatic	<input type="checkbox"/> Other (explain)
Starter Mfr. / Model No.	Denso / N/A		

VEHICLE DATA FORM

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Bus Number: 1701-P	Date: 03-06-17
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TRANSMISSION

Transmission Type	<input type="checkbox"/> Manual	<input checked="" type="checkbox"/> Automatic	<input type="checkbox"/> Load Sensing Adaptive
Mfr. / Model No.	Ford Motor Company/ 6R140- 6 Speed Automatic		
Control Type	<input checked="" type="checkbox"/> Mechanical	<input type="checkbox"/> Electrical	<input type="checkbox"/> Other
Integral Retarder	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	

SUSPENSION

Number of Axles	2		
Front Axle Type	<input type="checkbox"/> Independent	<input checked="" type="checkbox"/> Beam Axle	
Mfr. / Model No.	Hendrickson/ Steertek NXT		
Axle Ratio (if driven)	N/A		
Suspension Type	<input type="checkbox"/> Air	<input checked="" type="checkbox"/> Spring	<input type="checkbox"/> Other (explain)
No. of Shock Absorbers	2		
Mfr. / Model No.	SACHS / 471700000456		
Middle Axle Type	<input type="checkbox"/> Independent	<input type="checkbox"/> Beam Axle	
Mfr. / Model No.	N/A		
Axle Ratio (if driven)	N/A		
Suspension Type	<input type="checkbox"/> Air	<input type="checkbox"/> Spring	<input type="checkbox"/> Other (explain)
No. of Shock Absorbers	N/A		
Mfr. / Model No.	N/A		
Rear Axle Type	<input type="checkbox"/> Independent	<input checked="" type="checkbox"/> Beam Axle	
Mfr. / Model No.	SPICER / 230609H		
Axle Ratio (if driven)	6.17		
Suspension Type	<input type="checkbox"/> Air	<input checked="" type="checkbox"/> Spring	<input type="checkbox"/> Other (explain)
No. of Shock Absorbers	2		
Mfr. / Model No.	SACHS / 471700000464		

VEHICLE DATA FORM

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Bus Number: 1701-P	Date: 03-06-17
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WHEELS & TIRES

Front	Wheel Mfr./ Model No.	SRW / 10023346A2
	Tire Mfr./ Model No.	Michelin / XZE 255 70R/22.5
Rear	Wheel Mfr./ Model No.	SRW / 10023346A2
	Tire Mfr./ Model No.	Michelin / XZE 255 70R/22.5

BRAKES

Front Axle Brakes Type	<input checked="" type="checkbox"/> Cam	<input type="checkbox"/> Disc	<input type="checkbox"/> Other (explain)
Mfr. / Model No.	Meritor/ Q+		
Middle Axle Brakes Type	<input type="checkbox"/> Cam	<input type="checkbox"/> Disc	<input type="checkbox"/> Other (explain)
Mfr. / Model No.	N/A		
Rear Axle Brakes Type	<input checked="" type="checkbox"/> Cam	<input type="checkbox"/> Disc	<input type="checkbox"/> Other (explain)
Mfr. / Model No.	Meritor/ Q+		

HVAC

Heating System Type	<input type="checkbox"/> Air	<input checked="" type="checkbox"/> Water	<input type="checkbox"/> Other
Capacity (Btu/hr)	90,000		
Mfr. / Model No.	Bergstrom Climate Systems / BNU030671		
Air Conditioner	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	
Location	N/A		
Capacity (Btu/hr)	N/A		
A/C Compressor Mfr. / Model No.	N/A		

STEERING

Steering Gear Box Type	Hydraulic Gear		
Mfr. / Model No.	TRW/ THP60		
Steering Wheel Diameter	18.0"		
Number of turns (lock to lock)	4.25		
Control Type	<input type="checkbox"/> Electric	<input checked="" type="checkbox"/> Hydraulic	<input type="checkbox"/> Other (explain)

VEHICLE DATA FORM

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Bus Number: 1701-P	Date: 03-06-17
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OTHERS

Wheel Chair Ramps	N/A	Location:	Type:
Wheel Chair Lifts	N/A	Location:	Type:
Mfr. / Model No.	N/A		
Emergency Exit	Location:		Number:
	Windows		4
	Front & Rear Doors		2
	Roof Hatch		1

CAPACITIES

Fuel Tank Capacity (gallons)	60
Engine Crankcase Capacity (gallons)	2
Transmission Capacity (gallons)	3.5
Differential Capacity (gallons)	5
Cooling System Capacity (gallons)	12
Power Steering Fluid Capacity (quarts)	4

COMPONENT/SUBSYSTEM INSPECTION FORM

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Bus Number: 1701-P	Date: 03-06-17
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Subsystem	Checked	Initials	Comments
Air Conditioning Heating and Ventilation	✓	S.R.	None noted.
Body and Sheet Metal	✓	S.R.	Approximately 12" scrape on body panel at curbside rear
Frame	✓	S.R.	None noted.
Steering	✓	S.R.	None noted.
Suspension	✓	S.R.	None noted.
Interior/Seating	✓	S.R.	None noted.
Axles	✓	S.R.	None noted.
Brakes	✓	S.R.	None noted.
Tires/Wheels	✓	S.R.	None noted.
Exhaust	✓	S.R.	None noted.
Fuel System	✓	S.R.	None noted.
Power Plant	✓	S.R.	None noted.
Accessories	✓	S.R.	None noted.
Lift System	N/A	S.R.	None noted.
Interior Fasteners	✓	S.R.	None noted.
Batteries	✓	S.R.	None noted.

CHECK - IN



**BLUE BIRD BODY COMPANY
MODEL: GASOLINE VISION**



VIN TAG

CHECK - IN CONT.



OPERATOR'S AREA



ENGINE COMPARTMENT

CHECK - IN CONT.



INTERIOR FROM FRONT

4.0 PERFORMANCE

4.1 PERFORMANCE - AN ACCELERATION, GRADEABILITY, AND TOP SPEED TEST

4.1-I. TEST OBJECTIVE

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

4.1-II. TEST DESCRIPTION

In this test, the bus will be operated at SLW on a chasis dynamometer. The bus will be accelerated at full throttle from a standstill to a maximum “geared,” maximum “governed,” or maximum “safe” speed not exceeding 80 mph. The maximum “geared” speed is defined as the limited output capabilities of the test vehicle’s engine and drivetrain. The maximum “governed” speed, if applicable, is the top speed as limited by the engine control system. The maximum “safe” speed is defined as the maximum speed that the dynamometer is limited to. The test vehicle speed will be measured using a speed encoder built in the chasis dynamometer. The time intervals between 10 mph increments will be recorded using a Data Acquisitions System. Time-speed data and the top speed attained will be recorded on the Performance Data Form. The recorded data will be used to generate a percent grade versus speed table and a speed versus time curve.

4.1-III. DISCUSSION

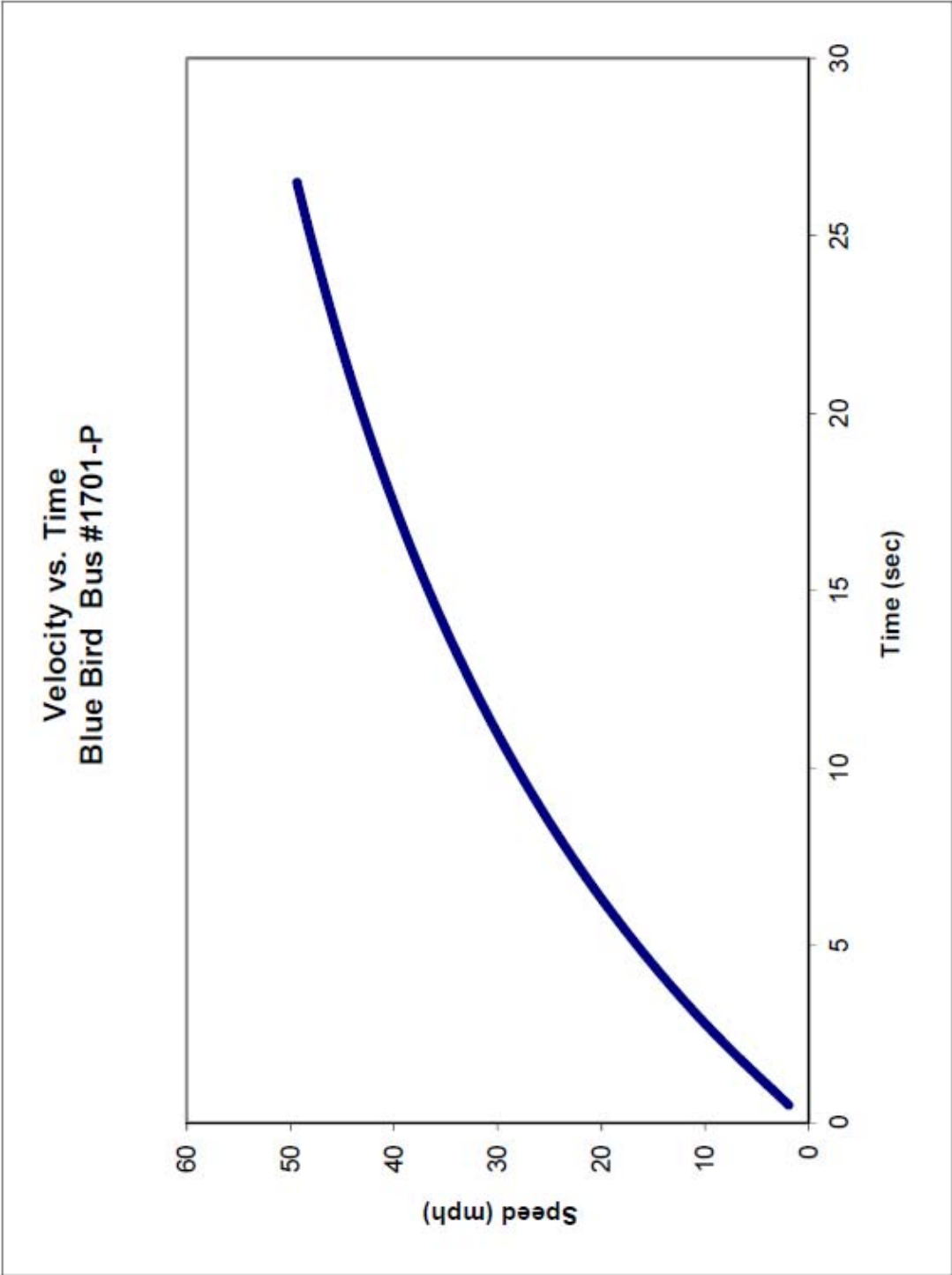
This test consists of three runs from standstill to full throttle on the chassis dynamometer. Speed versus time data is obtained for each run and results are averaged to minimize test variability. The test was performed up to a maximum speed of 59.6 mph. The fitted curve of velocity vs. time is attached, followed by the calculated gradeability results.

PERFORMANCE DATA FORM

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Bus Number: 1701-P		Date: 04-20-17	
Personnel:			
Temperature (°F): 90		Humidity (%): 63	
Barometric Pressure (in.Hg): 28.7			
		INITIALS:	
Air Conditioning - OFF	✓Checked	J.S.	
Ventilation fans - ON HIGH	✓Checked	J.S.	
Heater pump motor - OFF	✓Checked	J.S.	
Defroster - OFF	✓ Checked	J.S.	
Exterior and interior lights - ON	✓ Checked	J.S.	
Windows and doors - CLOSED	✓ Checked	J.S.	
ACCELERATION, GRADEABILITY, TOP SPEED			
Counter Clockwise Recorded Interval Times			
Speed	Run 1	Run 2	Run 3
10 mph	3.0	2.8	3.0
20 mph	6.1	6.0	6.2
30 mph	11.0	11.0	11.0
40 mph	18.0	17.9	18.2
50 mph	26.8	26.8	27.3
60 mph	N/A	N/A	N/A
70 mph	N/A	N/A	N/A

Maximum Speed (mph): 59.6



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

6-I. TEST OBJECTIVE

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

6-II. TEST DESCRIPTION

This test is performed in the emissions bay of the LTI Vehicle Testing Laboratory. The Laboratory is equipped with a Schenk Pegasus 300 HP, large-roll (72 inch diameter) chassis dynamometer suitable for heavy-vehicle emissions testing. The dynamometer is located in the end test bay and is adjacent to the control room and emissions analysis area. The driving cycles are the Manhattan cycle, a low average speed, highly transient urban cycle (Figure 1), the Orange County Bus Cycle which consists of urban and highway driving segments (Figure 2), and the EPA HD-UDDS Cycle (Figure 3).). A fuel economy test will comprise of two runs for the three different driving cycles, and the average value will be reported.

1. For liquid fuels, this test procedure uses a calibrated flowmeter system and/or a calibrated fuel weighing scale. The flowmeter system utilizes a precise four-piston positive displacement flow meter. The weighing scale system includes heat exchangers to maintain temperature in diesel and common-rail injection systems.
2. For gaseous fuels, like compressed natural gas (CNG), liquefied natural gas (LNG), cryogenic fuels, and other fuels in the vapor state, a calibrated gaseous 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 test will be recorded on the Fuel Economy Data Form.

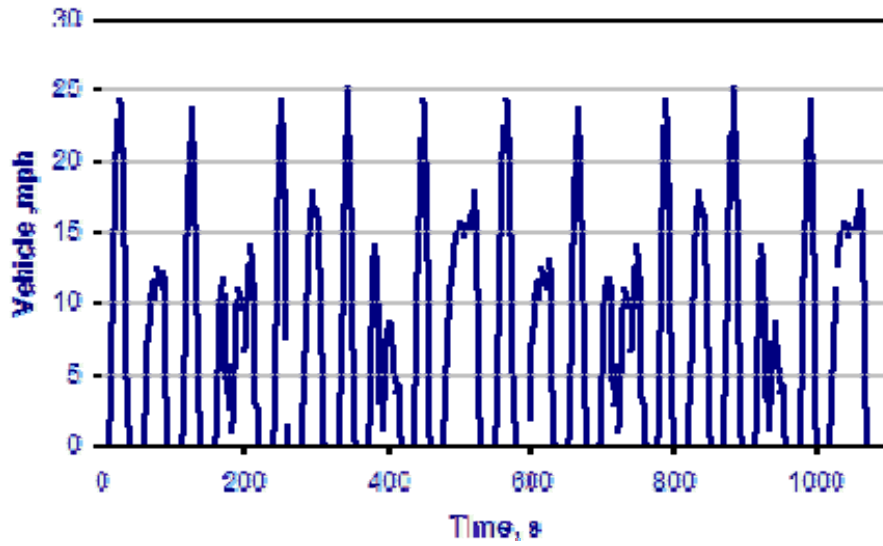


Figure 1. Manhattan Driving Cycle (duration 1089 sec, Maximum speed 25.4 mph, average speed 6.8 mph)

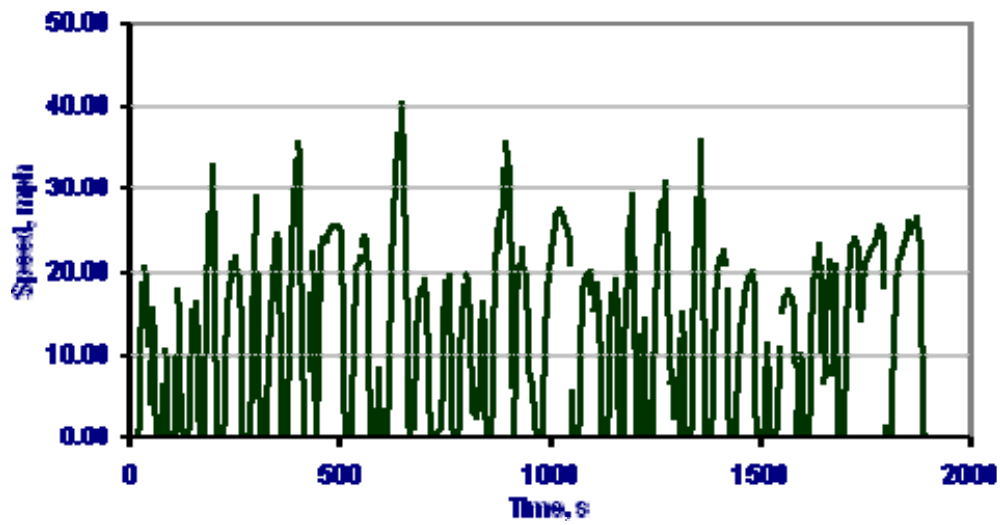


Figure 2. Orange County Bus Cycle (Duration 1909 Sec, Maximum Speed 41 mph, Average Speed 12 mph).

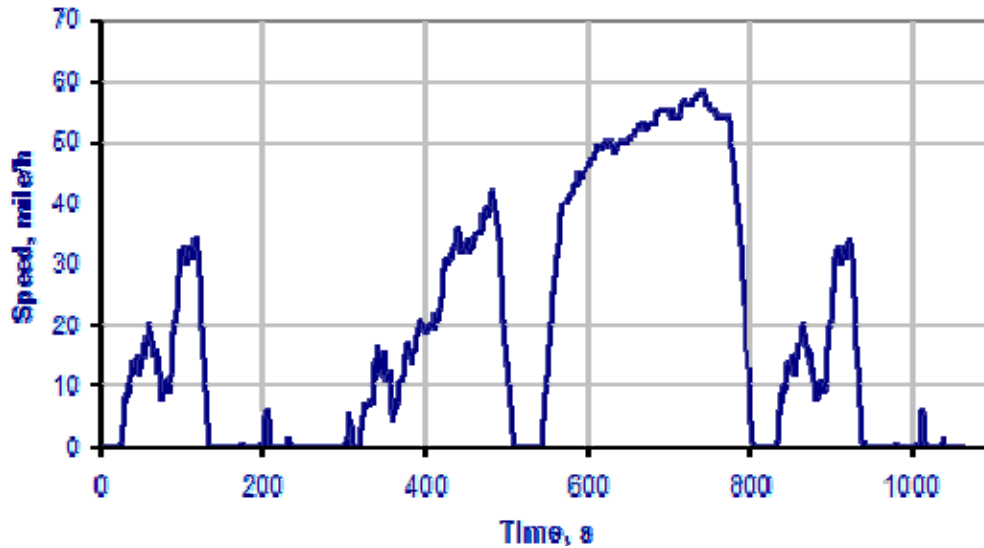


Figure 3. HD-UDDS Cycle (duration 1060 seconds, Maximum Speed 58 mph, Average Speed 18.86 mph).

6-III. DISCUSSION

The driving cycle consists of three simulated transit driving cycles: Manhattan, Orange County Bus Cycle and the HD-UDDS, as described in 6-II. The fuel consumption for each driving cycle and idle is measured.

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 Form. Finally, the summary sheet provides the average fuel consumption for the three test cycles and for 20 minute idle. The average fuel consumption for the Manhattan, OCBC and the HD-UDDS were 2.79 mpg, 3.78 mpg and 5.55 mpg respectively. For idle, the fuel consumption was 0.62 gal/hr.

FUEL ECONOMY PRE-TEST MAINTENANCE FORM

Page 1 of 3

Bus Number: 1701-P	Date: 04-07-17	SLW (lbs):
Personnel: T.S., E.L. & S.R.		

FUEL SYSTEM	OK
Install fuel measurement system	✓
Replace fuel filter	N/A
Check for fuel leaks	✓
Specify fuel type (refer to fuel analysis)	Gasoline
Remarks: fuel filter in tank	
BRAKES/TIRES	OK
Inspect hoses	✓
Inspect brakes	✓
Relube wheel bearings	✓
Check tire inflation pressures (mfg. specs.)	✓
Check tire wear (less than 50%)	✓
Remarks: None noted	
COOLING SYSTEM	OK
Check hoses and connections	✓
Check system for coolant leaks	✓
Remarks: None noted	

FUEL ECONOMY PRE-TEST MAINTENANCE FORM

Page 2 of 3

Bus Number: 1701-P	Date: 04-07-17
Personnel: T.S., E.L. & S.R.	
ELECTRICAL SYSTEMS	OK
Check battery	✓
Inspect wiring	✓
Inspect terminals	✓
Check lighting	✓
Remarks: None noted	
DRIVE SYSTEM	OK
Drain transmission fluid	✓
Replace filter/gasket	✓
Check hoses and connections	✓
Replace transmission fluid	✓
Check for fluid leaks	✓
Remarks: None noted	
LUBRICATION	OK
Drain crankcase oil	✓
Replace filters	✓
Replace crankcase oil	✓
Check for oil leaks	✓
Check oil level	✓
Lube all chassis grease fittings	✓
Lube universal joints	✓
Replace differential lube including axles	✓
Remarks: None noted	

FUEL ECONOMY PRE-TEST MAINTENANCE FORM

Page 3 of 3

Bus Number: 1701-P	Date: 04-07-17
Personnel: T.S., E.L. & S.R.	
EXHAUST/EMISSION SYSTEM	OK
Check for exhaust leaks	✓
Remarks: None noted	
ENGINE	OK
Replace air filter	✓
Inspect air compressor and air system	✓
Inspect vacuum system, if applicable	✓
Check and adjust all drive belts	✓
Check cold start assist, if applicable	✓
Remarks: None noted	
STEERING SYSTEM	OK
Check power steering hoses and connectors	✓
Service fluid level	✓
Check power steering operation	✓
Remarks: None noted	
	OK
Ballast bus to seated load weight	✓
TEST DRIVE	OK
Check brake operation	✓
Check transmission operation	✓
Remarks: None noted	

FUEL ECONOMY PRE-TEST INSPECTION FORM

Page 1 of 1

Bus Number: 1701-P	Date: 04-18-17
Personnel: T.S., E.L. & S.R.	
PRE WARM-UP	If OK, Initial
Cold tire pressure (psi): Front <u>105</u> Middle <u>N/A</u> Rear <u>105</u>	✓
Engine oil level	✓
Engine coolant level	✓
Interior and exterior lights on, evaporator fan on	✓
Fuel economy Pre-Test Maintenance Form is complete	✓
Fuel economy instrumentation installed and working properly.	✓
Fuel line -- no leaks or kinks	✓
Bus is loaded to SLW	✓
WARM-UP	If OK, Initial
Bus driven for at least 20 min on dynamometer	✓

FUEL ECONOMY SUMMARY FORM (Gaseous and Liquid fuels)

Page 1 of 1

Bus Number: 1701-P	Manufacturer: Blue Bird	Date: 05-18-17
Fuel Type: Gasoline	Personnel: J.S. & S.J.	
Average Ambient Temp (°F): 86.3	Humidity (%): 64	Barometric Pressure (in.Hg): 28.7
SLW (lbs): 28,220		

Run/Cycle	Manhattan	Orange County	UDDS	20 Min Idle
Fuel Consumption mpg.	2.79	3.78	5.55	0.62 gal/hr.
Fuel Consumption scf/mile	N/A	N/A	N/A	N/A

Comments: None noted.

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:

Note: This bus was only tested under Condition #2 and Condition #3.

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 bus was tested for conditions #2 and #3 only, as noted in section 7.1-II.

The second test measures interior noise during acceleration from 0 to 35 mph. This noise level ranged from 72.9 dB(A) at the driver's seat to 72.4 dB(A) at the rear passenger seats. The overall average was 71.4 dB(A). The interior ambient noise level for this test was less than 30.0 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 2: 0 to 35 mph Acceleration Test

Page 1 of 2

Bus Number: 1701-P	Date: 04-11-17
Personnel: S.R. & C.S.	
Temperature (°F): 78	Humidity (%): 32
Wind Speed (mph): 4	Wind Direction: SW
Barometric Pressure (in.Hg): 30.10	
Initial Sound Level Meter Calibration: 93.6 dB(A)	
Interior Ambient Noise Level dB(A): Less than 30	Exterior Ambient Noise Level dB(A): 41.2
Microphone Height During Testing (in): 46.0	
Initial Reading at Speaker: 93.6 dB(A)	Final Reading at Speaker: 94.0 dB(A)

Reading Location	Measured Sound Level dB(A)
Driver's Seat	72.9
Front Passenger Seats	70.8
Middle Passenger Seats	69.6
Rear Passenger Seats	72.4

Final Sound Level Meter Calibration: 94.0 dB(A)

Comments: None Noted.

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

Page 2 of 2

Bus Number: 1701-P	Date: 04-11-17
Personnel: S.R. & C.S.	
Temperature (°F): 81	

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

Source of Noise	Location	Description of Noise
Engine and Accessories	N/A	N/A
Windows and Doors	N/A	N/A
Seats and Wheel Chair lifts	N/A	N/A
Other	N/A	N/A

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

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:

Note: This bus was only tested under Condition #1 and Condition #2.

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

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

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

During the test, special attention should be paid to:

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

7.2-III. DISCUSSION

The Exterior Noise Test determines the noise level generated by the vehicle under different driving conditions and at stationary low and high idle, with and without air conditioning and accessories operating. The test site is a large, level, bituminous paved area with no reflecting surfaces nearby. As noted in section 7.2-II, only conditions #1 and #2 were tested.

With an exterior ambient noise level of 42.1 dB(A), the average test result obtained while accelerating from a constant speed was 73.1 dB(A) on the right side and 74.1 dB(A) on the left side.

When accelerating from a standstill with an exterior ambient noise level of 42.8 dB(A), the average of the results obtained were 72.0 dB(A) on the right side and 73.5 dB(A) on the left side.

EXTERIOR NOISE TEST DATA FORM

Accelerating from Constant Speed

Page 1 of 2

Bus Number: 1701-P		Date: 04-11-17	
Personnel: S.R. & C.S.			
Temperature (°F): 79		Humidity (%): 30	
Wind Speed (mph): 6		Wind Direction: SW	
Barometric Pressure (in.Hg): 30.10			
Verify that microphone height is 4 feet, wind speed is less than 12 mph and ambient temperature is between 30°F and 90°F: ■			
Initial Sound Level Meter Calibration: 93.6 dB(A)			
Exterior Ambient Noise Level: 42.1 dB(A)			
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	72.4	1	73.8
2	72.7	2	73.7
3	72.3	3	73.7
4	73.4	4	74.0
5	72.1	5	74.2
6	N/A	6	N/A
7	N/A	7	N/A
8	N/A	8	N/A
9	N/A	9	N/A
10	N/A	10	N/A
Average of two highest actual noise levels = 73.1 dB(A)		Average of two highest actual noise levels = 74.1 dB(A)	
Final Sound Level Meter Calibration Check: 94.0 dB(A)			
Comments: None noted.			

EXTERIOR NOISE TEST DATA FORM

Accelerating from Standstill

Page 2 of 2

Bus Number: 1701-P		Date: 04-11-17	
Personnel: S.R. & C.S.			
Temperature (°F): 80		Humidity (%): 29	
Wind Speed (mph): 7		Wind Direction: SW	
Barometric Pressure (in.Hg): 30.10			
Verify that microphone height is 4 feet, wind speed is less than 12 mph and ambient temperature is between 30°F and 90°F: ■			
Initial Sound Level Meter Calibration: 93.6 dB(A)			
Exterior Ambient Noise Level: 42.8 dB(A)			
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	71.8	1	72.9
2	71.5	2	73.5
3	70.9	3	73.4
4	72.1	4	73.2
5	71.4	5	72.6
6	N/A	6	N/A
7	N/A	7	N/A
8	N/A	8	N/A
9	N/A	9	N/A
10	N/A	10	N/A
Average of two highest actual noise levels = 72.0 dB(A)		Average of two highest actual noise levels = 73.5 dB(A)	
Final Sound Level Meter Calibration Check: 94.0 dB(A)			
Comments: None noted.			

7.2 EXTERIOR NOISE TESTS



TEST BUS UNDER GOING EXTERIOR NOISE TESTING

8. EMISSIONS TEST – DYNAMOMETER-BASED EMISSIONS TEST USING TRANSIT DRIVING CYCLES

8-I. TEST OBJECTIVE

The objective of this test is to provide comparable emissions data on transit buses produced by different manufacturers. This chassis-based emissions test bears no relation to engine certification testing performed for compliance with the Environmental Protection Agency (EPA) regulation. EPA's certification tests are performed using an engine dynamometer operating under the Federal Test Protocol. This emissions test is a measurement of the gaseous engine emissions CO, CO₂, NO_x, HC and particulates (diesel vehicles) produced by a vehicle operating on a large-roll chassis dynamometer. The test is performed for three differed driving cycles intended to simulate a range of transit operating environments. The cycles consist of Manhattan Cycle, the Orange County Bus driving cycle, and the Urban Dynamometer Driving Cycle (UDDS). The test is performed under laboratory conditions in compliance with EPA 1065 and SAE J2711. The results of this test may not represent actual in-service vehicle emissions but will provide data that can be used by recipients to compare buses tested under different operating conditions.

8-II. TEST DESCRIPTION

This test is performed in the emissions bay of the LTI Vehicle Testing Laboratory. The Laboratory is equipped with a Schenk Pegasus 300 HP, large-roll (72 inch diameter) chassis dynamometer suitable for heavy-vehicle emissions testing. The dynamometer is located in the end test bay and is adjacent to the control room and emissions analysis area. The emissions laboratory provides capability for testing heavy-duty diesel and alternative-fueled buses for a variety of tailpipe emissions including particulate matter, oxides of nitrogen, carbon monoxide, carbon dioxide, and hydrocarbons. It is equipped with a Horiba full-scale CVS dilution tunnel and emissions sampling system. The system includes Horiba Mexa 7400 Series gas analyzers and a Horiba HF47 Particulate Sampling System. Test operation is automated using Horiba CDTCS software. The computer controlled dynamometer is capable of simulating over-the-road operation for a variety of vehicles and driving cycles.

The emissions test will be performed as soon as permissible after the completion of the GVW portion of the structural durability test. The driving cycles are the Manhattan cycle, a low average speed, highly transient urban cycle (Figure 1), the Orange County Bus Cycle which consists of urban and highway driving segments (Figure 2), and the EPA UDDS Cycle (Figure 3). An emissions test will comprise of two runs for the three different driving cycles, and the

average value will be reported. Test results reported will include the average grams per mile value for each of the gaseous emissions for gasoline buses, for all the three driving cycles. In addition, the particulate matter emissions are included for diesel buses, and non-methane hydrocarbon emissions (NMHC) are included for CNG buses. Testing is performed in accordance with EPA CFR49, Part 1065 and SAE J2711 as practically determined by the FTA Emissions Testing Protocol developed by West Virginia University and Penn State University.

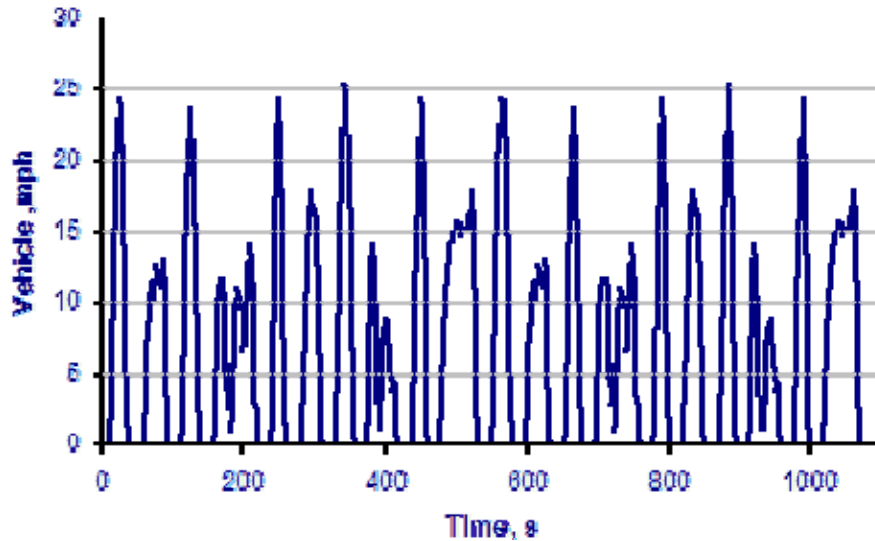


Figure 1. Manhattan Driving Cycle (duration 1089 sec, Maximum speed 25.4mph, average speed 6.8mph)

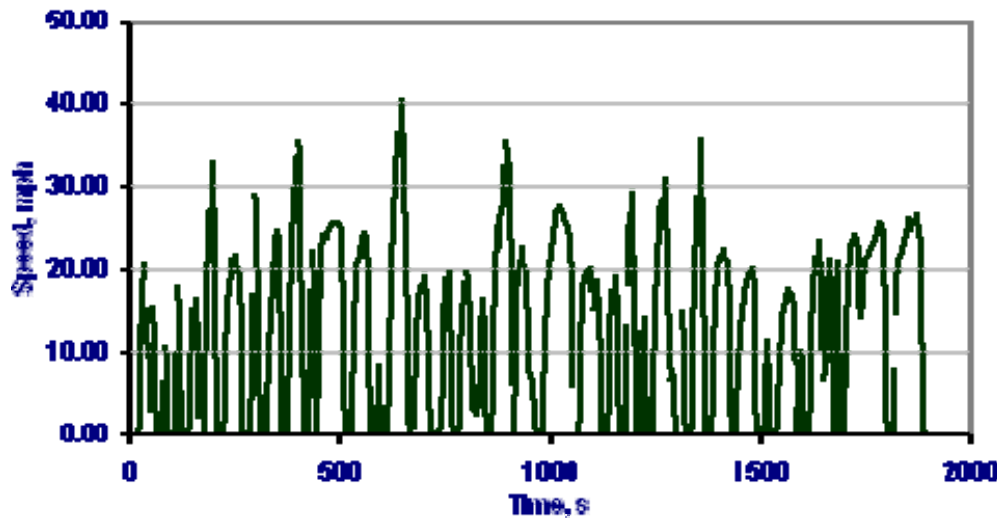


Figure 2. Orange County Bus Cycle (Duration 1909 Sec, Maximum Speed 41mph, Average Speed 12mph)

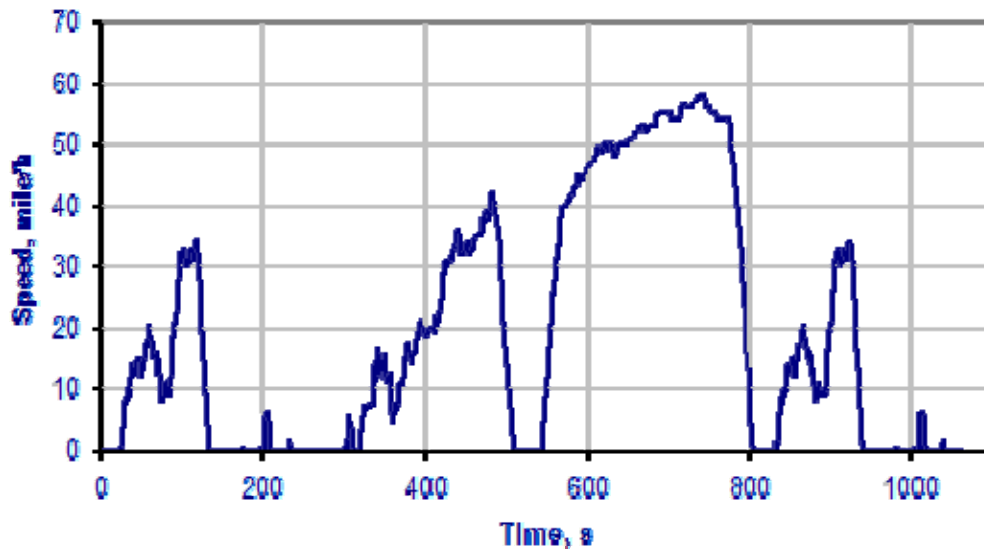


Figure 3. HD-UDDS Cycle (duration 1060seconds, Maximum Speed 58mph, Average Speed 18.86mph)

8-III. TEST ARTICLE

The test article is a Blue Bird Body Company model Gasoline Vision transit bus equipped with gasoline fueled Ford Motor Company, 6.8L V10.

8-IV. TEST EQUIPMENT

Testing is performed in the LTI Vehicle Testing Laboratory emissions testing bay. The test bay is equipped with a Schenk Pegasus 72-inch, large-roll chassis dynamometer. The dynamometer is electronically controlled to account for vehicle road-load characteristics and for simulating the inertia characteristics of the vehicle. Power to the roller is supplied and absorbed through an electronically controlled 3-phase ac motor. Absorbed power is dumped back onto the electrical grid.

Vehicle exhaust is collected by a Horiba CVS, full-flow dilution tunnel. The system has separate tunnels for diesel and gasoline/natural gas fueled vehicles. In the case of diesel vehicles, particulate emissions are measured gravimetrically using 47mm Teflon filters. These filters are housed in a Horiba HF47 particulate sampler, per EPA 1065 test procedures.. Heated gaseous emissions of hydrocarbons and NOx are sampled by Horiba heated oven analyzers. Gaseous

emissions for CO, CO₂ and cold NO_x are measured using a Horiba Mexa 7400 series gas analyzer. System operation, including the operation of the chassis dynamometer, and all calculations are controlled by a Dell workstation running Horiba CDCTS test control software. Particulate Filters are weighed in a glove box using a Sartorius microbalance accurate to 1 microgram.

8-V. TEST PREPARATION AND PROCEDURES

All vehicles are prepared for emissions testing in accordance with the Fuel Economy Pre-Test Maintenance Form. (In the event that fuel economy test was performed immediately prior to emissions testing this step does not have to be repeated) This is done to ensure that the bus is tested in optimum operating condition. The manufacturer-specified preventive maintenance shall be performed before this test. The ABS system and when applicable, the regenerative braking system are disabled for operation on the chassis dynamometer. Any manufacturer-recommended changes to the pre-test maintenance procedure must be noted on the revision sheet. The Fuel Economy Pre-Test Inspection Form will also be completed before performing. Both the Fuel Economy Pre-Test Maintenance Form and the Fuel Economy Pre-Test Inspection Form are found on the following pages.

Prior to performing the emissions test, each bus is evaluated to determine its road-load characteristics using coast-down techniques in accordance with SAE J1263. This data is used to program the chassis dynamometer to accurately simulate over-the-road operation of the bus.

Warm-up consists of driving the bus for 20 minutes at approximately 40 mph on the chassis dynamometer. The test driver follows the prescribed driving cycle watching the speed trace and instructions on the Horiba Drivers-Aid monitor which is placed in front of the windshield. The CDCTS computer monitors driver performance and reports any errors that could potentially invalidate the test.

All buses are tested at full seated load weight. The base line emissions data are obtained at the following conditions:

1. Air conditioning off
2. Evaporator fan or ventilation fan on
3. One Half Seated load weight
4. Appropriate test fuel with energy content (BTU/LB) noted in CDTCS software
5. Exterior and interior lights on
6. Heater Pump Motor off
7. Defroster off
8. Windows and Doors closed

The test tanks or the bus fuel tank(s) will be filled prior to the fuel economy test with the appropriate grade of test fuel.

8-VI DISCUSSION

The following Table 1 provides the emissions testing results on a grams per mile basis for each of the exhaust constituents measured and for each driving cycle performed.

TABLE 1 Emissions Test Results

Test Completed at Full SLW: 28,220 lbs.			
Driving Cycle	Manhattan	Orange County Bus	UDDS
CO₂, gm/mi	3,207	2,270	1,474
CO, gm/mi	5.7	5.6	5.4
THC, gm/mi	0.06	0.07	0.10
NMHC, gm/mi	0.05	0.05	0.07
NO_x, gm/mi	0.02	0.02	0.02
Particulates. gm/mi	N/A	N/A	N/A
Fuel consumption mpg	2.79	3.78	5.55