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 54.7 dB(A); ranging from 54.1 dB(A) at the front passenger seats to 55.9 dB(A) at the rear passenger seats. 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 73.6 dB(A) at the front passenger seats to 74.6 dB(A) at the middle passenger seats. The overall average was 74.3 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: 0706	Date: 5-10-07
Personnel: S.C. & T.S.	
Temperature (°F): 76	Humidity (%): 65
Wind Speed (mph): Calm	Wind Direction: Calm
Barometric Pressure (in.Hg): 30.11	
Initial Sound Level Meter Calibration: _ checked by: S.C.	
Interior Ambient Noise Level dB(A): < 34.0	Exterior Ambient Noise Level dB(A): 44.6
Microphone Height During Testing (in): 48.0	

Measurement Location	Measured Sound Level dB(A)
Driver's Seat	54.5
Front Passenger Seats	54.1
In Line with Front Speaker	55.0
In Line with Middle Speaker	54.4
In Line with Rear Speaker	54.3
Rear Passenger Seats	55.9

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: 0706	Date: 8-29-07
Personnel: B.S., T.S. & S.C.	
Temperature (°F): 70	Humidity (%): 85
Wind Speed (mph): Calm	Wind Direction: Calm
Barometric Pressure (in.Hg): 30.15	
Initial Sound Level Meter Calibration: _ checked by: S.C.	
Interior Ambient Noise Level dB(A): < 34.0	Exterior Ambient Noise Level dB(A): 41.1
Microphone Height During Testing (in): 48.0	

Measurement Location	Measured Sound Level dB(A)
Driver's Seat	74.4
Front Passenger Seats	73.6
Middle Passenger Seats	74.6
Rear Passenger Seats	74.5

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

Comments: All readings taken in the center aisle.

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

Bus Number: 0706	Date: 8-29-07
Personnel: B.S., T.S. & S.C.	
Temperature (°F): 70	Humidity (%): 85
Wind Speed (mph): Clam	Wind Direction: Calm
Barometric Pressure (in.Hg): 30.15	

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

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

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

7.1 INTERIOR NOISE TEST

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

7.2 EXTERIOR NOISE TESTS

7.2-I. TEST OBJECTIVE

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

7.2-II. TEST DESCRIPTION

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

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

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

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

During the test, special attention should be paid to:

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

7.2-III. DISCUSSION

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

With an exterior ambient noise level of 40.9 dB(A), the average test result obtained while accelerating from a constant speed was 70.9 dB(A) on the right side and 76.3 dB(A) on the left side.

When accelerating from a standstill with an exterior ambient noise level of 40.2 dB(A), the average of the results obtained were 68.8 dB(A) on the right side and 71.0 dB(A) on the left side.

With the vehicle stationary and the engine, accessories, and air conditioning on, the measurements averaged 57.0 dB(A) at low idle, 61.7 dB(A) at high idle, and 71.7 dB(A) at wide open throttle. With the accessories and air conditioning off, the readings averaged 0.3 dB(A) lower at low idle and 0.4 dB(A) lower at wide open throttle. The exterior ambient noise level measured during this test was 40.6 dB(A). Note; The air conditioning must be on to activated the high idle mode.

EXTERIOR NOISE TEST DATA FORM
Accelerating from Constant Speed

Bus Number: 0706	Date: 8-29-07
Personnel: B.S., T.S. & S.C.	
Temperature (°F): 72	Humidity (%): 85
Wind Speed (mph): Calm	Wind Direction: Calm
Barometric Pressure (in.Hg): 30.15	
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): 40.9	

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	71.0	1	75.4
2	70.9	2	75.8
3	70.8	3	76.8
4	70.8	4	75.2
5	70.7	5	75.7
Average of two highest actual noise levels = 70.9 dB(A)		Average of two highest actual noise levels = 76.3 dB(A)	

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

Comments: None noted.

EXTERIOR NOISE TEST DATA FORM
Accelerating from Standstill

Bus Number: 0706	Date: 8-29-07
Personnel: B.S., T.S. & S.C.	
Temperature (°F): 72	Humidity (%): 85
Wind Speed (mph): Calm	Wind Direction: Calm
Barometric Pressure (in.Hg): 30.15	
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): 40.2	

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	67.8	1	70.7
2	68.8	2	71.2
3	67.5	3	70.1
4	68.8	4	69.5
5	67.5	5	69.9
Average of two highest actual noise levels = 68.8 dB(A)		Average of two highest actual noise levels = 71.0 dB(A)	

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

Comments: None noted.

EXTERIOR NOISE TEST DATA FORM
Stationary

Bus Number: 0706	Date: 8-29-07
Personnel: B.S., T.S. & S.C.	
Temperature (°F): 72	Humidity (%): 85
Wind Speed (mph): Calm	Wind Direction: Calm
Barometric Pressure (in.Hg): 30.15	
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): 40.6	

Accessories and Air Conditioning ON

Throttle Position	Engine RPM	Curb (Right) Side dB(A)	Street (Left) Side db(A)
		Measured	Measured
Low Idle	705	57.5	56.5
High Idle	1,159	60.3	63.0
Wide Open Throttle	3,995	70.7	72.6

Accessories and Air Conditioning OFF

Throttle Position	Engine RPM	Curb (Right) Side dB(A)	Street (Left) Side db(A)
		Measured	Measured
Low Idle	703	56.9	56.4
High Idle	N/A	N/A	N/A
Wide Open Throttle	3,995	71.1	73.0

Final Sound Level Meter Calibration Check: _ checked by: S.C.
Comments: A/C must be activated for high idle to run.

7.2 EXTERIOR NOISE TESTS

TEST BUS UNDERGOING EXTERIOR NOISE TESTING