FEDERAL TRANSIT BUS TEST

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

Altoona Bus Testing and Research Center
Test Bus Procedure

7.2 EXTERIOR NOISE TESTS

Pass/Fail
October 2016

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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
LTI	Larson Transportation Institute
mpg	Miles per gallon
mph	Miles per hour
NBM	New bus models
PSTT	Penn State Test Track
rpm	Revolutions per minute
SAE	Society of Automotive Engineers
SCF	Standard cubic feet
SCFM	Standard cubic feet per minute
SCH	Test scheduler
SA	Staff Assistant
SI	Spark ignition
SLW	Seated load weight (curb weight plus 150 lb. for every designated 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 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 PSTT 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 transit but with a minimum service life of 4, 5, 7, 10 or 12 years.

7.2-IV. TEST EQUIPMENT/FACILITIES/PERSONNEL

Test Equipment

1. Calibrated Tape measure (100 ft.) or a wheeled distance meter
2. Road markers (e.g., chalk and highway cones)
3. Calibrated 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.
4. Calibrated sound level calibrator.
5. Camera
6. Calibrated weather instrument
7. A windscreen that does not affect the microphone response more than+1 dB(A) for frequencies of 20-4000 Hz or +1 ½ dB(A) for frequencies of 4,000-10,000 Hz.

8. Calibrated sound level meter tripod that is capable of holding the microphone and meter at 4 ft. above ground level.
9. Clipboard for data recording.
10. Non-calibrated anemometer pen (for reference only).

Test Facility – Test site is at the PSTT using the skid pad area.

1. The measurement area shall be free of tall grass, bystanders, snow or other sound-absorbing materials.
2. 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.
3. The wind speed in the measurement area shall not gust more than 12 mph and the ambient temperature is between 30°F and 90°F.

Test Personnel – The personnel consist of the following:

1. Bus driver (DR)
2. Test Personnel (TP)

7.2-V. TEST DATA

The test data consists of the test procedure and data where requested. All forms to be filled out with pen. 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.

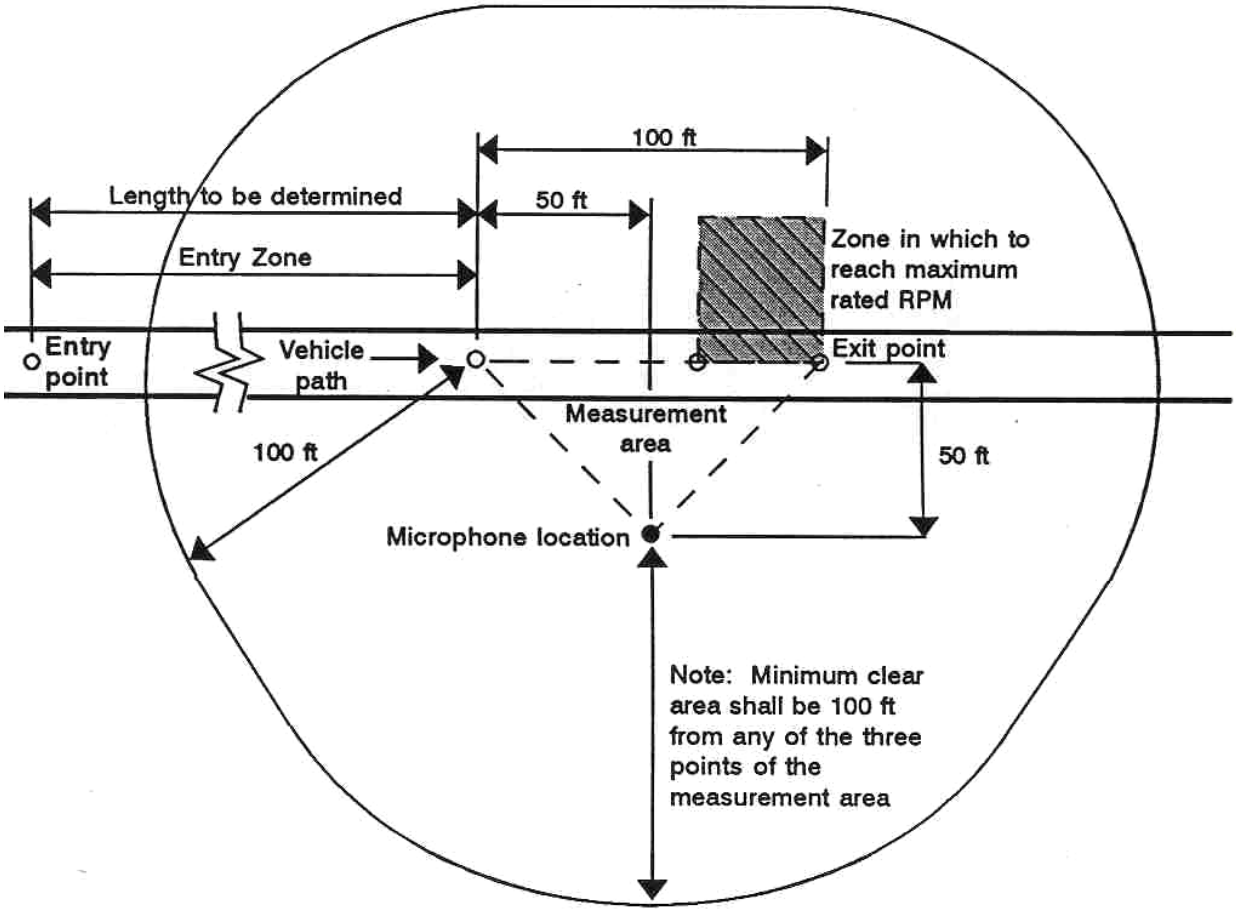

Figure 7.2-1. Test Site - Configured unidirectional for left to right acceleration from constant speed.

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	Record bus number, manufacturer and date on data form.
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 approximately100 ft. from the acceleration point.
5	TP	Establish the microphone location midway between the acceleration point and the end point at a distance of approximately 50 ft. to the right from the center line of the vehicle path. Position the height of the microphone approximately 4 ft. above the ground plane, pointing horizontally toward the midpoint.
6	TP	Select a transmission ratio and entry speed such that at wide-open throttle, the vehicle will accelerate from the acceleration point with the following consideration. a. The entry speed is such that the starting engine speed is no more than approximately 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 up-shift. 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 up-shift 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 Exterior Noise Tests** **Accelerating from Constant Speed**	
OPER STEP	**ACTION BY**	**TEST PROCEDURE**
1	TD	Confirm approximately using a non-calibrated anemometer pen that the wind speed/gusts are less than 12 mph. Using the calibrated weather instrument, verify the ambient temperature is between 30°F and 90°F.
2	TP	Verify that all test preparations have been completed.
3	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.
4	TP	Set the sound level meter for “fast response” and the “A-weighting” network and the “auto” position.
5	TP	Check the calibration of the sound level meter. Record reading of Exterior Noise Test Data Form.
6	TP	Measure the ambient sound level and record it on the Exterior Noise Test Data From 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.
7	TD	Position the test bus approximately 150 ft. from the entry point. Turn on all accessories.
8	TD	Approach the acceleration point using the entry speed and gear ratio selected in steps 6 of the Test Preparation 7.2-1. Whet net 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 approximately 100 ft. span). Record the highest observation on the Exterior Noise Test Data Form. NOTE: The test personnel must 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 Tests** **Accelerating from Constant Speed (continued)**	
OPER STEP	**ACTION BY**	**TEST PROCEDURE**
11	TD	Switch the acceleration and end points and position the bus approximately150 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.