Sound Level for Passenger Cars and Light Trucks –SAE J986 NOV81

SAE Standard
Completely Revised November 1981

THIS IS A PREPRINT WHICH IS SUBJECT TO REVISIONS AND CORRECTIONS. THE FINAL VERSION WILL APPEAR IN THE 1983 EDITION OF THE SAE HANDBOOK.

SAE The Engineering Resource For Advancing Mobility

PREPRINT

The ϕ symbol is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. If the symbol is next to the report title, it indicates a complete revision of the report.

ϕ SOUND LEVEL FOR PASSENGER CARS AND LIGHT TRUCKS—SAE J986 NOV81

SAE Standard

Report of the Vehicle Noise Committee, approved July 1967, completely revised by the Vehicle Sound Level Committee November 1981. Rationale statement included as appendix.

1. Introduction

1.1 Scope—This SAE Standard establishes the test procedure, environment, and instrumentation for determining the exterior sound level for passenger cars, multipurpose vehicles, and light trucks having a gross vehicle mass (weight) rating of 4540 kg (10 000 lb) or less.

The test procedure of this standard is characterized by having fixed initial conditions (specified initial vehicle speed and gear selection at a fixed start point on the test site) in contrast to the procedure of SAE Recommended Practice J1030, Maximum Sound Level for Passenger Cars and Light Trucks, which has fixed terminal conditions (attainment of rated engine speed at a fixed end point on the test site). Full-throttle acceleration and closed-throttle deceleration of the vehicle are included in both procedures.

Sound levels determined in accordance with this standard are dependent on the performance capability of the test vehicle, as influenced by power-to-mass ratio and overall power train gear ratio. Thus, this standard is particularly applicable for emphasizing sound emission of vehicles with large power-to-mass ratio or high overall gear ratio within the overall light vehicle population.

1.2 Definitions

1.2.1 RATED ENGINE SPEED—the engine speed at which the engine delivers rated net power output as defined in SAE Standard J1349 DEC80, Engine Power Test Code—Spark Ignition and Diesel, as determined by the manufacturer.

1.2.2 THROTTLE CONTROL—The driver-operated pedal (or other control) which connects through some mechanism to the engine fuel metering device (carburetor, fuel injectors, fuel distributor, or equivalent device) and thereby controls the engine power output.

NOTE: For the purpose of this standard, depression of the throttle control acts to increase engine speed and release of the throttle control acts to reduce engine speed.

2. Instrumentation

2.1 The instrumentation necessary to conduct this test shall meet the minimum performance requirements specified below.

2.2 The sound level meter shall meet the Type 1 or S1A requirements of the American National Standard Specification for Sound Level Meters, S1.4–1971 (R1976).

2.2.1 As an alternative to making direct measurements using a sound level meter, a microphone or sound level meter may be used with a magnetic tape recorder and/or a graphic level recorder or other indicating instrument providing the system is in conformance with SAE Recommended Practice J184a, Qualifying a Sound Data Acquisition System.

2.3 The sound level calibrator shall be accurate to ±0.5 dB. (See paragraph 6.3.4.)

2.4 The engine speed tachometer shall be accurate to ±2% of full scale, calibrated to read no less than actual speed over the upper third of the scale. The full scale of the instrument used for the measurement shall not be greater than 150% of rated engine speed. (See paragraph 6.4.)

2.5 The anemometer shall be accurate to ±10% at 19 km/h (12 mph) wind speed.

2.6 A microphone windscreen may be used, provided that it does not affect the microphone response more than ±1 dB for frequencies from 20–4000 Hz and ±1.5 dB for frequencies from 4000–10 000 Hz.

3. Test Site

3.1 The test site shall be a flat open space free of large reflecting surfaces such as parked vehicles, signboards, buildings, or hillsides located within 30 m (100 ft) of the measurement area, which is defined by the microphone location and the end points of the end zones for both directions of vehicle travel and includes the full width of the vehicle path. See paragraphs 3.4, 3.5, 6.6.1, and Fig. 1.

3.2 The surface of the measurement area shall be concrete or nonporous asphalt, dry and free from snow, soil, or other extraneous material.

3.3 The test site shall include a vehicle path of relatively smooth concrete or asphalt, dry and free of extraneous materials such as gravel and of sufficient length for acceleration, deceleration, and stopping of the vehicle.

3.4 The microphone shall be located 15 m (50 ft) from the center line of the vehicle path and 1.2 m (4 ft) above the ground plane. The reference axis of the microphone shall lie in the vertical plane containing the perpendicular to the vehicle path through the microphone location.

3.5 The following fixed points and zones shall be established on the vehicle path:

3.5.1 The start point, 7.5 m (25 ft) ahead of the perpendicular to the vehicle path through the microphone location;

3.5.2 The end zone, starting at 7.5 m (25 ft) beyond, and ending at 38 m (125 ft) beyond the perpendicular to the vehicle path through the microphone location.

3.6 If it is desired to measure the sound level for both sides of the vehicle during each test run, another microphone location, measurement area, and clear area shall be established laterally opposite, meeting the requirements of paragraphs 3.1, 3.2, and 3.4.

4. Vehicle Operation

4.1 Acceleration Test—The acceleration test is the primary test mode and must be conducted first to obtain information necessary to conduct the deceleration test.

4.1.1 For this test, the vehicle shall approach the measurement area along the vehicle path with the vehicle speed stabilized at 48 km/h (30 mph). The highest-numerical-ratio transmission gear shall be used that will result in the front of the vehicle reaching or passing the entry point of the end zone before rated engine speed is attained. It is recommended that the approach speed be held constant for a distance of at least 7.5 m (25 ft) prior to reaching the start point.

When the front of the vehicle reaches the start point, the throttle control shall be fully depressed as rapidly as possible and the vehicle allowed to accelerate until the engine speed reaches rated engine speed. The throttle control shall then be released sufficiently to maintain rated engine speed until the front of the vehicle reaches the end of the end zone, at which time the test run is terminated.

Should rated engine speed not be attained in the end zone, the test run is nonetheless terminated when the front of the vehicle reaches the end of the end zone. The maximum engine speed attained should be noted (see paragraph 4.1.3).

4.1.2 Vehicles equipped with an automatic transmission shall be tested without an automatic or forced downshift to a higher numerical gear ratio when full throttle control depression is established. If necessary, the downshift mechanism shall be disconnected or otherwise disabled so that the test is conducted using the gear ratio meeting the conditions given in paragraph 4.1.1.

4.1.3 The maximum engine speed attained in the acceleration test is to be used as the approach speed for the deceleration test (if conducted). This approach speed is rated engine speed, if attained in the acceleration test mode, or the average of the terminal engine speed values at the end of the zone as determined in paragraph 4.1.1.

4.2 Deceleration Test—The deceleration test shall also be conducted unless prior testing has established that the maximum sound level is produced in the acceleration test mode.

4.2.1 For this test, the vehicle shall approach the measurement area along the vehicle path in the same gear used for the acceleration test with the engine speed stabilized at the terminal speed determined in paragraph 4.1.3. It is recommended that the approach speed be held constant for a distance of at least 7.5 m (25 ft) prior to reaching the start point. When the front of the vehicle reaches the start point, the throttle control shall be completely released as rapidly as possible and the vehicle allowed to decelerate until the engine speed drops to one-half of the approach speed or the front of the vehicle reaches the end of the end zone.

4.3 The power train and exhaust system temperatures shall be within the normal operating range throughout each test run. A 1 min stabilizing period with the engine at idle speed and the transmission in neutral is required prior to each test run.

NOTE: Usually, a vehicle brought to normal engine coolant temperature through moderate driving operations is adequately conditioned for testing.

4.4 Preliminary runs to familiarize the driver and to establish the vehicle operating conditions should be made before sound level measurements are begun.

5. Measurements

5.1 The sound level meter shall be set for fast dynamic response and for the A-weighting network.

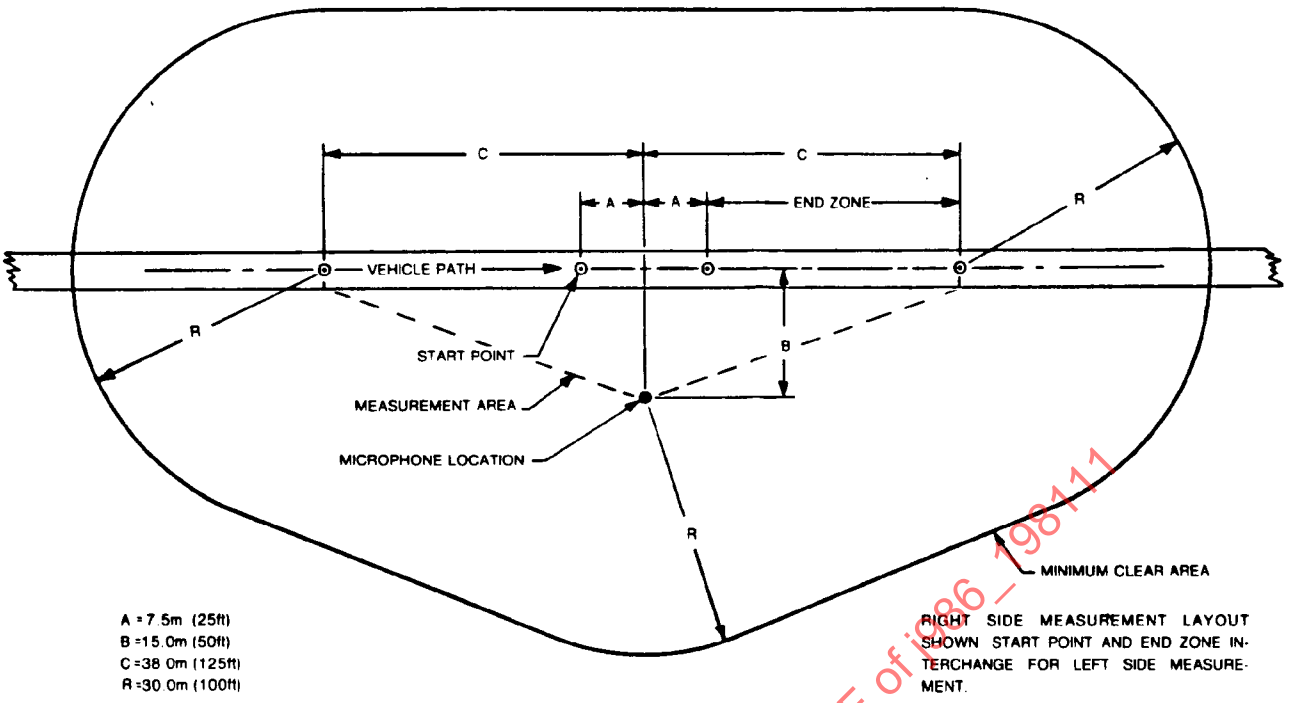

FIG. 1—MINIMUM TEST SITE

5.2 The ambient sound level at the test site due to sources other than the vehicle being measured, including wind effects, shall be at least 10 dB lower than the sound level produced by the vehicle under test.

5.3 Measurements shall be made only when the wind speed is below 19 km/h (12 mph).

5.4 The sound level meter or indicating instrument shall be observed during the constant-speed approach and acceleration or deceleration test phases specified in paragraphs 4.1 or 4.2. The highest sound level occurring during this observation period shall be recorded.

5.5 Four measurements shall be made for each side of the vehicle unless it has been established from prior testing that one side has the highest sound level, in which case only the side having the highest sound level need be measured. All values shall be recorded. The sound level for either side of the vehicle shall be the average of the two highest readings which are within 2 dB of each other.

If no two measurements in the initial set of four are within 2 dB, additional measurements shall be made until two measurements are within this range.

5.6 The reported sound level shall be that for the side of the vehicle having the highest sound level, from either the acceleration test mode or the deceleration test mode (if conducted).

6. General Comments

6.1 It is recommended that persons technically trained and experienced in current sound measurement techniques select the test instrumentation and conduct the tests.

6.2 When making sound level measurements, not more than one person other than the observer reading the meter shall be within 15 m (50 ft) of the vehicle or microphone, and that person shall be directly behind the observer reading the meter, on a line through the microphone and the observer.

6.3 Proper use of all test instrumentation is essential to obtain valid measurements. Operating manuals or other literature furnished by the instrument manufacturer should be referred to for both recommended operation of the instrument and precautions to be observed. Specific items to be considered are:

6.3.1 The type of microphone, its directional response characteristics, and its orientation relative to the ground plane and the sound source;

6.3.2 The effects of ambient weather conditions on the performance of all instruments (for example, temperature, relative humidity, and barometric pressure);

6.3.3 Proper signal levels, terminating impedances, and cable lengths on multi-instrument measurement systems;

6.3.4 Proper acoustical calibration procedures, to include the influence of extension cables, etc. Field calibration shall be made immediately before and after each test sequence. Internal calibration is acceptable for field use, provided that external calibration is accomplished immediately before and after field use.

6.4 Many tachometers in common use have an appreciable time lag in response during vehicle acceleration. The use of such a tachometer without suitable correction could result in the attainment of higher than intended engine speed and possible effects on measured sound levels.

6.5 Vehicles used for tests shall not be operated in a manner such that the break-in procedure specified by the manufacturer is violated.

6.6 It should be recognized that variations in measured sound levels may occur due to variations in test site, ambient weather differences (temperature, wind, and their gradients), test equipment differences, and inherent differences between nominally-identical vehicles.

6.6.1 A primary concern regarding the test site is flatness of the measurement area. It is recommended that the measurement area be flat within ±0.5 m (2 in), particularly in that portion of this area between the vehicle path center line and the microphone location and within a radius of 15 m (50 ft) from the intersection of the vehicle path center line and the perpendicular to it passing through the microphone location.

7. References

7.1 American National Standard Specification for Sound Level Meters, S1.4–1971 (R1976). (Available from the American National Standards Institute, 1430 Broadway, New York, NY 10018.)

7.2 SAE Recommended Practice J184 JUN78, Qualifying a Sound Data Acquisition System.

7.3 SAE Recommended Practice J1030, Maximum Sound Level for Passenger Cars and Light Trucks.

7.4 SAE Standard J1349 DEC80, Engine Power Test Code—Spark Ignition and Diesel.

APPENDIX
RATIONALE FOR SAE J986 NOV81

The SAE J986b Review Task Force was formed in early 1979 to consider revision of ANSI/SAE J986b-1976, "Sound Level for Passenger Cars and Light Trucks," prompted by a request to this effect made to the SAE Vehicle Sound Level Committee. Of primary concern was the approach speed for the deceleration test mode, which in some instances was felt to be inordinately high (above 65 to approaching 110 km/h, depending on the vehicle). Not only did this necessitate increased vehicle path length on the test site, but more critically, there was potential for unintended tire noise contribution to the measured sound level.

Test development work was conducted throughout the remainder of 1979 and much of 1980. The results of that effort produced and supported the proposed revisions reported herein. (Note: Prior history of this proce-