

A Product of the
Cooperative Engineering Program

SAE J1169 FEB87

**Measurement of Light
Vehicle Exhaust
Sound Level Under
Stationary
Conditions**

**SAE Standard
Reaffirmed February 1987**

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**Submitted for Recognition as
an American National Standard**

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MEASUREMENT OF LIGHT VEHICLE EXHAUST SOUND LEVEL UNDER STATIONARY CONDITIONS

1. INTRODUCTION:

- 1.1 Scope: This SAE Standard establishes the test procedure, environment, and instrumentation to be used for measuring the exhaust sound level of passenger cars, multipurpose vehicles, and light trucks under stationary conditions.

This sound level measurement procedure has been developed as a guide for governmental agencies establishing in-service sound level limitations and enforcement measurement procedures. It is directed at the assessment of vehicle exhaust noise and is not intended to determine maximum vehicle sound levels.

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, S1A, 2, or S2A requirements of American National Standard Specification for Sound Level Meters, S1.4-1983. (See paragraph 7.4.)
- 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 indicating instrument, providing that the system is in conformance with SAE Recommended Practice J184 FEB87, Qualifying a Sound Data Acquisition System.
- 2.3 The sound level calibrator shall be accurate to ± 0.5 dB.
- 2.4 A microphone windscreen may be used, and shall be of a type recommended by the sound level meter manufacturer.
- 2.5 The engine speed measuring device shall be accurate to ± 100 rpm at 3000 rpm.

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3. TEST ENVIRONMENT:

3.1 The test site shall be out-of-doors and shall consist of a flat surface of concrete, asphalt, or similar hard material, free of snow, grass, loose soil, ashes, or other sound absorbing material. It shall be in an open space free from large reflecting surfaces, such as parked vehicles, buildings, billboards, trees, shrubbery, parallel walls, people, etc., within a 3 m (10 ft) radius from the microphone location and any point on the vehicle.

3.1.1 As an alternative to outside testing, a large hemi-anechoic chamber may be used.

3.2 The ambient sound level (including wind effects) from sources other than the vehicle being tested, shall be at least 10 dB below that produced by the test vehicle.

4. MICROPHONE LOCATION:

4.1 The microphone of the sound level meter shall be located at a distance of 0.5 m (20 in) from the reference point on the exhaust gas outlet pipe (refer to Fig. 1) and at an angle of 45 deg (+0, -10 deg) to the flow axis of the pipe termination (refer to Fig. 2). The microphone shall be at the height of the reference point, but not less than 0.2 m (8 in) from the ground surface. The reference axis of the microphone shall lie in a plane parallel to the ground surface and shall be directed toward the reference point on the exhaust gas outlet. (See also paragraphs 4.2, 4.3, and 7.6)

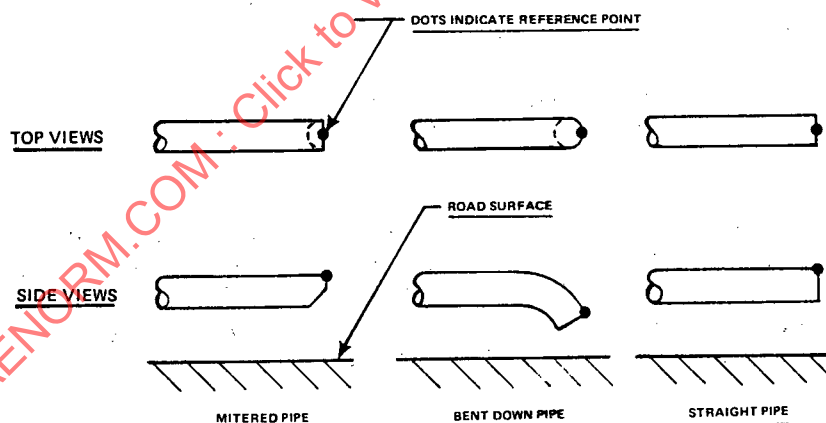


FIG. 1 - OUTLET PIPE DETAILS

4.1.1 If two microphone locations are possible, the location furthest laterally from the vehicle longitudinal centerline shall be used.

4.1.2 If the flow axis of the exhaust gas outlet pipe is at 90 deg to the vehicle longitudinal centerline, the microphone shall be located at the point, determined in accordance with paragraph 4.1, which is furthest from the engine.

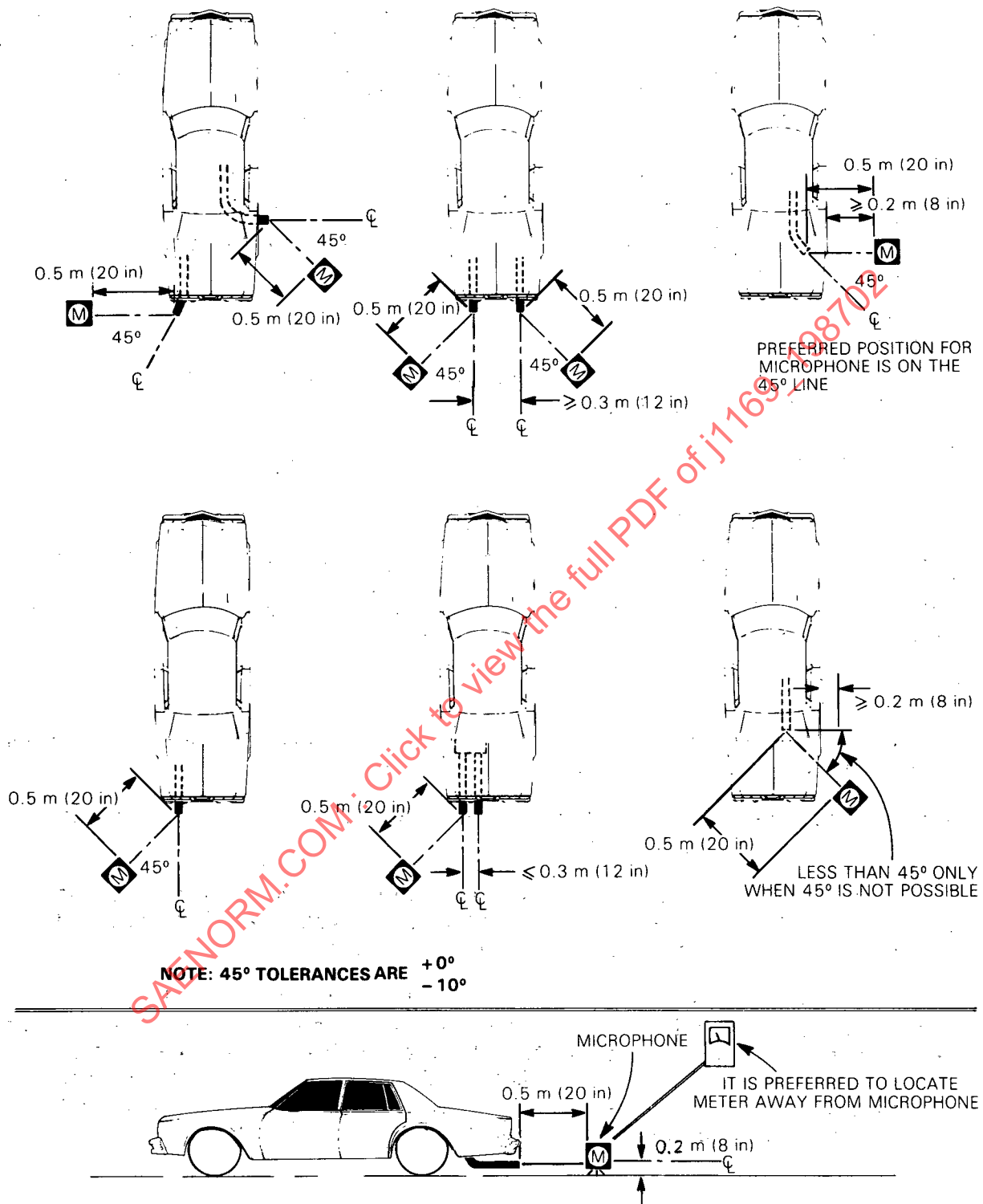


FIG. 2 - MICROPHONE LOCATION SKETCH

- 4.2 For exhaust gas outlets located under the vehicle body, the microphone shall be located a minimum of 0.2 m (8 in) from the nearest part of the vehicle, at a point closest to, but not less than 0.5 m (20 in) from the reference point on the exhaust gas outlet, and at a height of 0.2 m (8 in) above the ground surface, and not in line with exhaust gas flow. The angularity requirement of paragraph 4.1 may not be met in some cases (refer to Fig. 2).
- 4.3 If a vehicle has two or more exhaust gas outlets spaced less than 0.3 m (12 in) apart and connected to a single silencer, only one measurement shall be made. The microphone shall be located relative to the outlet furthest from the vehicle longitudinal centerline, or, when such outlet does not exist, to the outlet which is the highest above the ground.

5. PROCEDURE:

- 5.1 The engine of the vehicle under test shall be at normal operating temperature during the test.
- 5.2 The engine hood or compartment cover shall be closed.
- 5.3 The vehicle air conditioner, if so equipped, shall be turned off.
- 5.4 With the vehicle transmission in neutral or park position (and the parking brake applied for safety), the engine speed shall be slowly increased from idle speed to 3000 rpm, held constant at this speed for a sufficient time to obtain a sound level meter reading, and then slowly decreased to idle speed.

6. MEASUREMENTS:

- 6.1 The sound level meter shall be set for the slow exponential time-averaging characteristic and for the A-weighting network.
- 6.2 Measurements shall be made at each exhaust outlet, using the microphone location(s) described in Section 4.
- 6.3 The sound level meter shall be observed during the constant engine speed operation of the vehicle, as described in paragraph 5.4. The recorded reading shall be the highest sound level observed.
- 6.4 The tests shall be repeated at each exhaust gas outlet until two measurements are obtained which are within 2 dB of each other. The reported sound level for a given outlet shall be the arithmetic average of the two highest measurements which are within 2 dB of each other. For vehicles equipped with multiple exhaust gas outlets, the sound level reported shall be for the outlet having the highest average sound level.

7. GENERAL COMMENTS:

- 7.1 It is recommended that persons technically trained and experienced in current sound measurement techniques select the test instrumentation and conduct the tests.
- 7.2 Instrument manufacturer's recommended calibration practice shall be followed. External acoustic calibration shall be performed immediately before and after each period of field use, and at intervals during use not exceeding 1 h.
- 7.3 It should be recognized that variations in measured sound levels may occur due to variations in test sites, atmospheric conditions, test equipment, and operator skill. These variations should not exceed 2 dB.
- 7.4 Although either Type 1 or Type 2 sound level meters may be used with this procedure, it is suggested that a Type 1 instrument be considered, to incorporate superior crest factor capability and lesser overall tolerance which should result in more accurate measurements.
- 7.5 Caution should be exercised when measuring rear-engine vehicles because engine and cooling fan noise may prevent accurate measurement of exhaust noise.
- 7.6 Instrument manufacturer's specification for orientation of the microphone relative to the source of sound and the location of the observer relative to the microphone shall be followed. The sound level meter or microphone should be mounted on a stand for stable location. If possible, it is preferable to use a microphone extension cable and to locate the meter away from the microphone.

8. REFERENCES:

- 8.1 American National Standard Specification for Sound Level Meters, S1.4-1983. (Available from American National Standards Institute, 1430 Broadway, New York, NY 10018.)
- 8.2 SAE Recommended Practice J1184a, Qualifying a Sound Data Acquisition System (June 1978).