The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
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SURFACE VEHICLE STANDARD

SAE J1169 | REV. MAR92

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Superseding J1169 FEB87

(R) MEASUREMENT OF LIGHT VEHICLE EXHAUST SOUND LEVEL UNDER STATIONARY CONDITIONS

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

   Measurements are taken under steady-state conditions. In this respect, this procedure differs from ISO 5130 which includes measurements under the dynamic conditions of an engine deceleration.

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

2. References

2.1 Applicable Documents—The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J184—Qualifying a Sound Data Acquisition System

2.1.2 ANSI PUBLICATIONS—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ANSI S1.4-1983—Specification for Sound Level Meters

ANSI S1.40-1984—Specification for Acoustical Calibrators

2.1.3 ISO PUBLICATIONS—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ISO 5130-1982-15—Acoustics—Measurement of noise emitted by stationary road vehicles—Survey method

3. Instrumentation

3.1 The instrumentation necessary to conduct this test shall meet the minimum performance requirements specified as follows.

3.2 A sound level meter meeting the Type 1, S1A, 2, or S2A requirements of ANSI S1.4-1983. (See 8.4.)

3.2.1 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, provided the system meets the requirements of SAE J184.

3.3 The calibration of the sound level meter shall be checked and adjusted according to the manufacturer's instructions using a calibrator meeting the requirements of ANSI S1.40-1984 at the start of measurements and rechecked and recorded at the end of them. (See 8.2.)

If the calibration readings of the sound level meter change by more than 1 dB during a series of measurements, the test shall be considered invalid.

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

3.5 Engine speed shall be measured with an instrument having an accuracy of ±3% or better at the speeds required for the measurements being performed.

4. Test Environment

4.1 A suitable test site shall be out-of-doors and consist of a level concrete, asphalt, or similar hard material flat surface, free from snow, grass, loose soil, ashes, or other sound absorbing material. It shall be 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.

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

4.2 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.

5. Microphone Orientation

5.1 The microphone shall be located at a distance of 0.5 m from the reference point on the exhaust gas outlet pipe (refer to Figure 1) and at an angle of 45 degrees (+0, -10 degrees) to the flow axis of the pipe termination (refer to Figure 2). The microphone shall be at the height of the reference point, but not less than 0.2 m 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 5.2, 5.3. and 8.6.)

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

5.1.2 If the flow axis of the outlet pipe is at 90 degrees to the vehicle longitudinal centerline, the microphone shall be located at the point, determined in accordance with 5.1, which is furthest from the engine.

5.2 For exhaust gas outlets located under the vehicle body, the microphone shall be located a minimum of 0.2 m from the nearest part of the vehicle, at a point closest to, but not less than 0.5 m from the reference point on the exhaust gas outlet, and at a height of 0.2 m above the ground surface, and not in line with exhaust gas flow. The angularity requirement of 5.1 may not be met in some cases. (Refer to Figure 2.)

5.3 If a vehicle has two or more exhaust gas outlets spaced less than 0.3 m 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 highest above the ground.

6. Procedure

6.1 The engine of the vehicle under test shall be at normal operating temperature during the test.

6.2 The engine hood or compartment cover shall be closed.

6.3 The vehicle air conditioner, if so equipped, shall be turned off.

6.4 With the vehicle transmission in the neutral or park position (and the parking brake applied for safety), the engine speed shall be slowly increased from idle to 3/4 of the engine speed at rated horsepower

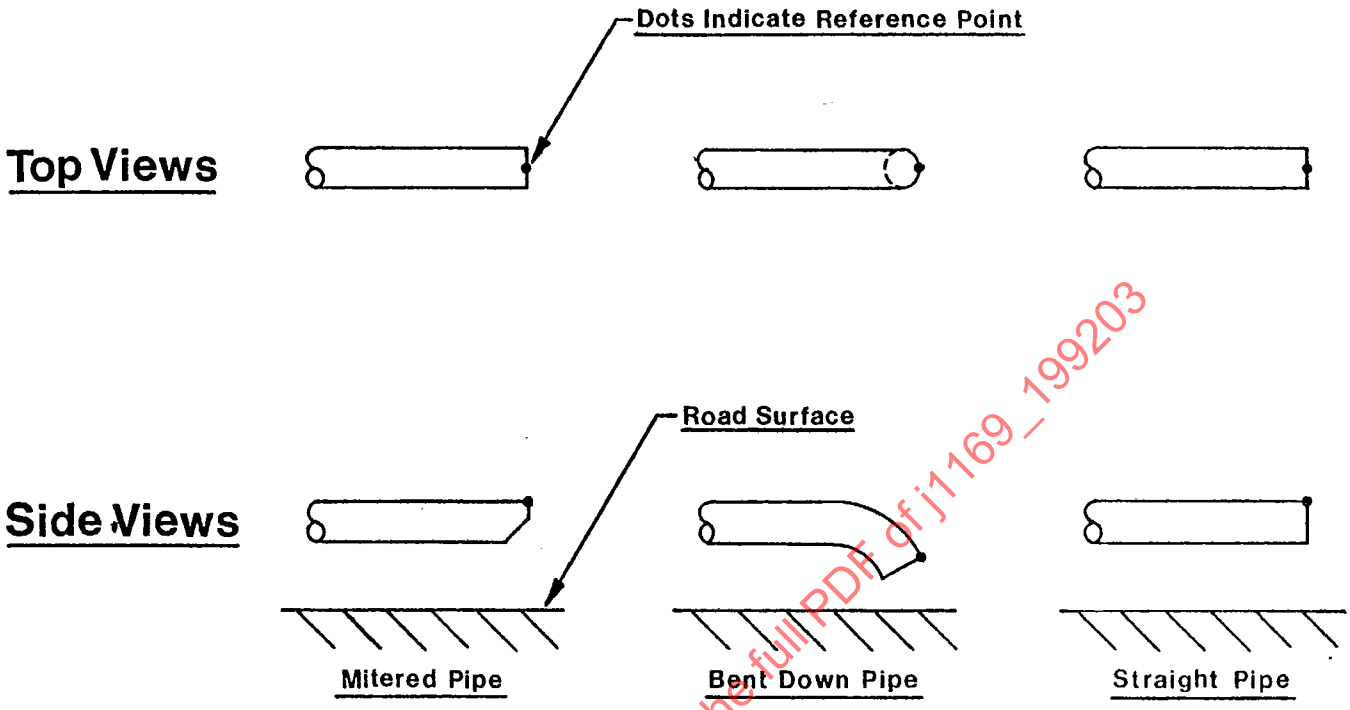

FIGURE 1—OUTLET PIPE DETAILS

as specified by the manufacturer, held constant at this speed for a sufficient time to obtain a sound level meter reading, and then slowly decreased to idle speed.

6.5 Vehicles equipped with a multi-mode exhaust system and a manual exhaust mode control switch shall be tested according to 6.4 for each position of the mode switch.

7. Measurements

7.1 The sound level meter shall be set for the slow exponential time-averaging characteristic and for the A-weighting network.

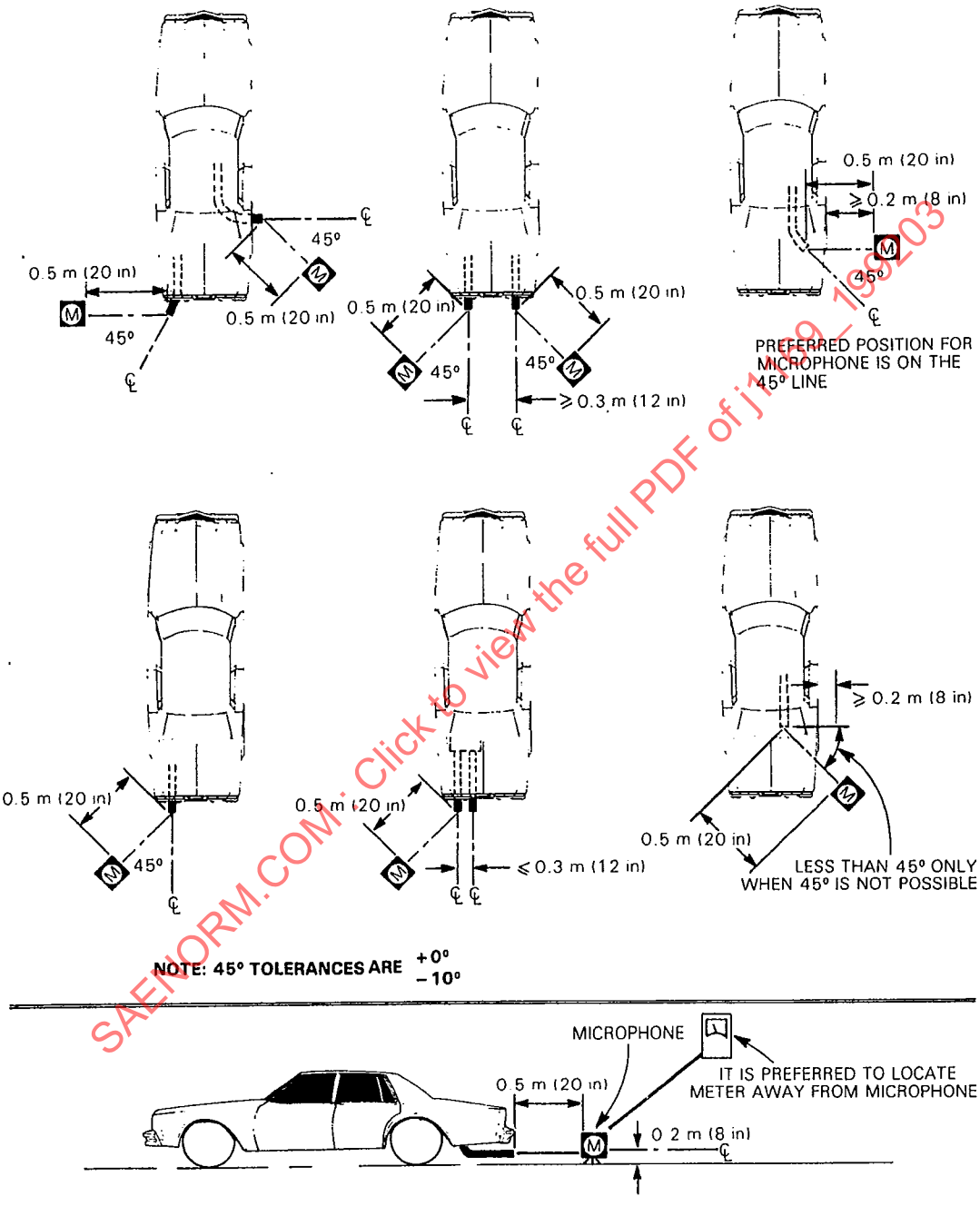

FIGURE 2—MICROPHONE LOCATION SKETCH

7.2 Measurements shall be made at each exhaust gas outlet, using the microphone location(s) described in Section 4.

7.3 The sound level meter shall be observed during the constant engine speed operation of the vehicle, as described in 6.4. The recorded reading shall be the highest sound level observed.

7.4 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.

7.4.1 For vehicles equipped with a multi-mode exhaust system and tested according to 6.5, the sound level reported shall be for the outlet and mode yielding the highest sound level.

8. General Comments

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

8.2 Instrument manufacturer's recommended calibration practice shall be followed. External acoustic calibration shall be performed immediately before and after each period of field use.

8.3 It should be recognized that variations in measured sound levels may occur due to variations in test sites, atmospheric conditions and test equipment.

8.4 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 measurement of exhaust noise.

8.5 Caution should be exercised when measuring rear- and mid-engine vehicles because engine and cooling fan noise may prevent accurate measurements of exhaust noise.

8.6 Instrument manufacturer's specifications for orientation of the microphone relative to the sound source and the location of the observer relative to the microphone shall be followed. The test may be performed with a hand-held sound level meter. However, it is recommended that the sound level meter or microphone be mounted on a stand or fixture for stability. When possible, it is preferable to use a microphone extension cable and to locate measurement or recording devices away from the microphone.

9. Notes

9.1 Marginal Indicia—The (R) 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.

PREPARED BY THE SAE VEHICLE SOUND LEVEL FORUM COMMITTEE AND
THE SAE LIGHT VEHICLE EXTERIOR SOUND LEVEL STANDARDS COMMITTEE

APPENDIX A

A.1 General—This appendix contains a discussion of the rationale for revision of SAE J1169 FEB87 and an explanation of the changes including revisions to existing sections. This revision permits evaluation of exhaust system sound level performance in accordance with existing regulatory requirements in the U.S. for light vehicle exhaust equipment. These requirements specify measurements at steady-state conditions which causes this SAE Standard to differ from ISO 5130 which requires measurements to be taken during an engine deceleration.

A.2 Rationale—This revision of SAE J1169 differs from the SAE J1169 FEB87 revision in that it provides for performing the stationary exhaust system sound level test at 3/4 of rated engine speed instead of the 3000 r/min specified in the FEB87 revision.

The test engine speed of 3/4 of rated engine speed is in accord with existing regulatory practices in the U.S. for stationary exhaust system sound level testing. In 1977, when SAE J1169 was initially approved, 3000 r/min provided a reasonable approximation of the light vehicle industry volume-weighted mean engine speed at rated power as specified by the manufacturer. This meant that personnel performing the stationary test did not need access to engine specifications data since one criterion was applied to all vehicles.

Subsequent automotive advancements have resulted in a proliferation of smaller displacement engines and higher speeds, some above 6000 r/min, at rated horsepower. Therefore, in order to establish uniform conditions for the stationary exhaust system sound level test the test criterion of 3/4 of the engine speed at rated horsepower is adopted in this document. This information is available from various sources for use by personnel performing the test.

A.3 Differences—The differences between this revision and SAE J1169-FEB87 are explained in general, citing only the reasons for additions, deletions, or changes to existing text.

In keeping with SAE metrication objectives, only metric measurements are specified throughout this document.

A.3.1 Section 1.1—This section is revised by adding a new second paragraph and editorial revisions to the third paragraph.

A.3.2 Section 2—This section was added as the Reference Section to comply with SAE Electronic Capture Guidelines.

A.3.3 Section 3.2.1—This section is revised only to update for the revision status of the reference SAE J184 document.

A.3.4 Section 3.3—This section is revised to incorporate the ANSI specification for acoustic calibrators.

A.3.5 Section 3.4—This section is revised to incorporate specific technical requirements for use of a microphone windscreen.

A.3.6 Section 3.5—This section is revised to specify changes to accuracy requirements for devices used to measure engine speed.

A.3.7 Section 4.1—This section is revised by adding the word 'suitable' as a test site descriptor.

A.3.8 Section 6.4—This Section is revised by changing the required engine speed for testing from a constant 3000 rpm to '3/4 of the engine speed at rated horsepower as specified by the manufacturer'.

A.3.9 Section 6.5—This section is new and is added to include requirements for testing of vehicles with dual-mode mufflers wherein engine or vehicle speed conditions, or, if provided, a manual override switch, determine if exhaust gases are expelled through one or two exhaust outlets.