

	<b>SURFACE VEHICLE RECOMMENDED PRACTICE</b>	<b>SAE</b>	<b>J1492 OCT2008</b>
		Issued 1992-03 Revised 2008-10	
		Superseding J1492 MAY1998	
(R) Measurement of Light Vehicle Stationary Exhaust System Sound Level Engine Speed Sweep Method			

## RATIONALE

Prior SAE Standards assumed vehicles could be operated at  $\frac{1}{4}$  rated engine speed for the purpose of stationary sound pressure level testing. Technical development of vehicles and engines have changed the operation of many engines and vehicles under stationary conditions. This standard incorporates the changes in exhaust system configuration and the use of engine management and fuel cut-off systems during stationary conditions.

## INTRODUCTION

This sound pressure level measurement procedure has been developed for use in engineering evaluation of the sound pressure level performance of road vehicle in the vicinity of the exhaust systems. The method is intended to check vehicles in use and also to determine variations in the exhaust sound pressure level, which can result from:

- the wear, maladjustment, or modification of particular components when the defect does not appear by visual inspection;
- the partial or complete removal of devices reducing the emission of certain sound pressure levels.

It is possible to determine some of these variations by comparing the measurements with reference measurements made under similar conditions using the same method. Other variations can only be detected when the engine is operated at realistic load.

### 1. SCOPE

This SAE Recommended Practice establishes the test procedure, environment, and instrumentation to be used for measuring the exterior exhaust sound level for passenger cars, multipurpose vehicles, and light trucks under stationary conditions providing a continuous measure of exhaust system sound level over a range of engine speeds.

This document applies only to road vehicles equipped with an internal combustion engine.

The method is designed to meet the requirements of simplicity as far as they are consistent with reproducibility of results under the operating conditions of the vehicle.

It is within the scope of this document to measure the stationary A-weighted sound pressure level during:

- measurements at the manufacturing stage
- measurements at official testing stations
- measurements at roadside testing

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It does neither specify a method to check the exhaust sound pressure level when the engine is operated at realistic load nor a method to check the exhaust sound pressure levels against a general noise limit for categories of road vehicles. It provides the means for detecting exhaust system resonances with the potential to affect both exterior and interior sound quality.

This document incorporates certain provisions of ISO 5130:2007 for measuring the sound level of exhaust systems. (See Appendix A.)

## 2. REFERENCES

### 2.1 Applicable Publications

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 International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), [www.sae.org](http://www.sae.org).

SAE J184      Qualifying a Sound Data Acquisition System

SAE J1349      Engine Power Test Code—Spark Ignition and Compression Ignition—Net Power Rating

#### 2.1.2 ANSI Publications

Available from ANSI, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, [www.ansi.org](http://www.ansi.org).

ANSI S1.4-1983      Specification for Sound Level Meters

ANSI S1.40-1984      Specification for Acoustical Calibrators

#### 2.1.3 ISO Publication

Available from ANSI, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, [www.ansi.org](http://www.ansi.org).

ISO 5130:2007      Acoustics—Measurement of noise emitted by stationary road vehicles—Survey method

#### 2.1.4 IEC Publications

Available from International Electrotechnical Commission, 3, rue de Verambe, P.O. Box 131, 1211 Geneva 20, Switzerland, Tel: +41-22-919-02-11, [www.iec.ch](http://www.iec.ch).

IEC 60942      Electroacoustics—Sound calibrators

IEC 61672-1      Electroacoustics—Sound level meters—Part 1: Specifications

## 3. DEFINITIONS

### 3.1 Rated Engine Speed, S

Engine speed at which the engine develops its rated maximum net power as defined in SAE J1349.

### 3.2 Target Engine Speed

Engine speed for testing defined in the Recommended Practice.

### 3.3 Target Engine Speed Range

Allowable range of engine speed for valid test based on target engine speed and 5% tolerance.

## 4. INSTRUMENTATION

4.1 The instrumentation necessary to conduct this test shall meet minimum performance requirements as specified herein.

4.2 A sound level meter meeting the Type and S1A requirements of ANSI S1.4-1983 or IEC 61672-1.

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

4.3 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 or IEC 60942 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 0.5 dB during a series of measurements, the test shall be considered invalid.

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

4.5 Engine speed shall be measured with an instrument having an accuracy of  $\pm 2\%$  or better at the speeds required for the measurements being performed.

## 5. TEST ENVIRONMENT

5.1 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 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 radius from the microphone location and any point on the vehicle.

As an alternative to outside testing, a large hemi-anechoic chamber may be used. The hemi-anechoic chamber shall fulfil the acoustical requirements given above. These requirements shall be met if the testing facility meets the 3 m distance criteria above and has a cut-off frequency below the lower of:

- One-third-octave band below the lowest fundamental frequency of the engine during test conditions;
- 100 Hz.

NOTE: Indoor testing facilities noise performance is specified in terms of the cut-off frequency (Hz). This is the frequency above which the room can be assumed to act as a semi-anechoic space.

### 5.2 Background Noise

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.

### 5.3 Meteorological Conditions

The tests shall not be carried out if the wind speed, including gusts, exceeds 5 m/s, during the sound measurement interval.

## 6. MICROPHONE ORIENTATION

The microphone shall be located at a distance of  $0.5 \text{ m} \pm 0.01 \text{ m}$  from the reference point of the exhaust pipe defined in Figure 1 and at an angle of  $45^\circ (\pm 5^\circ)$  to the vertical plane containing the flow axis of the pipe termination. 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 towards the reference point on the exhaust outlet.

If two microphone positions are possible, the location farthest laterally from the vehicle longitudinal centerline shall be used.

If the flow axis of the exhaust outlet pipe is at  $90^\circ$  to the vehicle longitudinal centerline, the microphone shall be located at the point, which is furthest from the engine.

If a vehicle has two or more exhaust 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 farthest from the vehicle longitudinal centerline, or when such outlet does not exist, to the outlet, which is highest above the ground.

For vehicles having an exhaust provided with outlets spaced more than 0.3 m apart, one measurement is made for each outlet as if it were the only outlet and the highest sound pressure level shall be noted.

For vehicles with a vertical exhaust (e.g. commercial vehicles) the microphone shall be placed at the height of the exhaust outlet. Its axis shall be vertical and oriented upwards. It shall be placed at a distance of  $0.5 \text{ m} \pm 0.01 \text{ m}$  from the exhaust pipe reference point as defined in Figure 1, but never less than 0.2 m from the side of the vehicle nearest to the exhaust.

For vehicles, where the reference point of the exhaust pipe is not accessible, or located under the vehicle body, as shown in Figures 2b and 2c, because of the presence of obstacles which form part of the vehicle (e.g. spare wheel, fuel tank, battery compartment), the microphone shall be located at least 0.2 m from the nearest obstacle, including the vehicle body, and its axis of maximum sensitivity shall face the exhaust outlet from the position least concealed by the above mentioned obstacles.

When several positions are possible, as shown in Figure 2c, the microphone position giving the lowest value of  $d_1$  or  $d_2$  shall be used.

Figures 2a - d show examples of the position of the microphone, depending on the location of the exhaust pipe.

NOTE: For the purpose of roadside checking, the reference point may be moved to the outer surface of the vehicle body.

## 7. PREPARATION OF THE VEHICLE

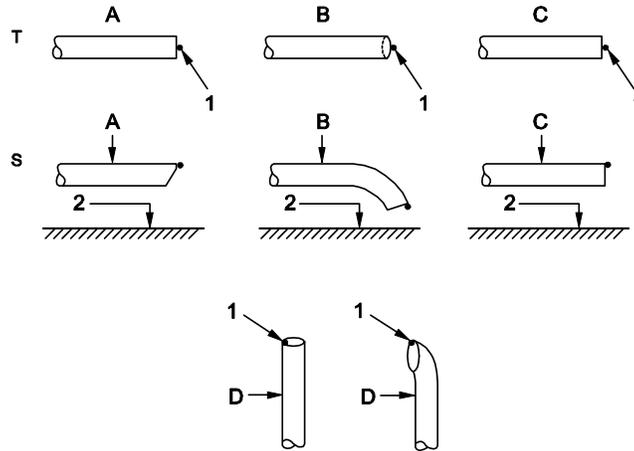
The vehicle transmission shall be in neutral position and the clutch engaged, or in parking position for automatic transmission, and the parking brake applied for safety.

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

If the vehicle is fitted with fan(s) having an automatic actuating mechanism, this system shall not be interfered with during the sound pressure level measurements.

The engine hood or compartment cover shall be closed.

Before each series of measurements, the engine shall be brought to its normal operating temperature, as specified by the manufacturer.



T = Top view

S = Side view

A = Mitered pipe

B = Bent down pipe

C = Straight pipe

D = Vertical pipe

1 = Reference point

2 = Road surface

FIGURE 1 - OUTLET PIPE DETAILS

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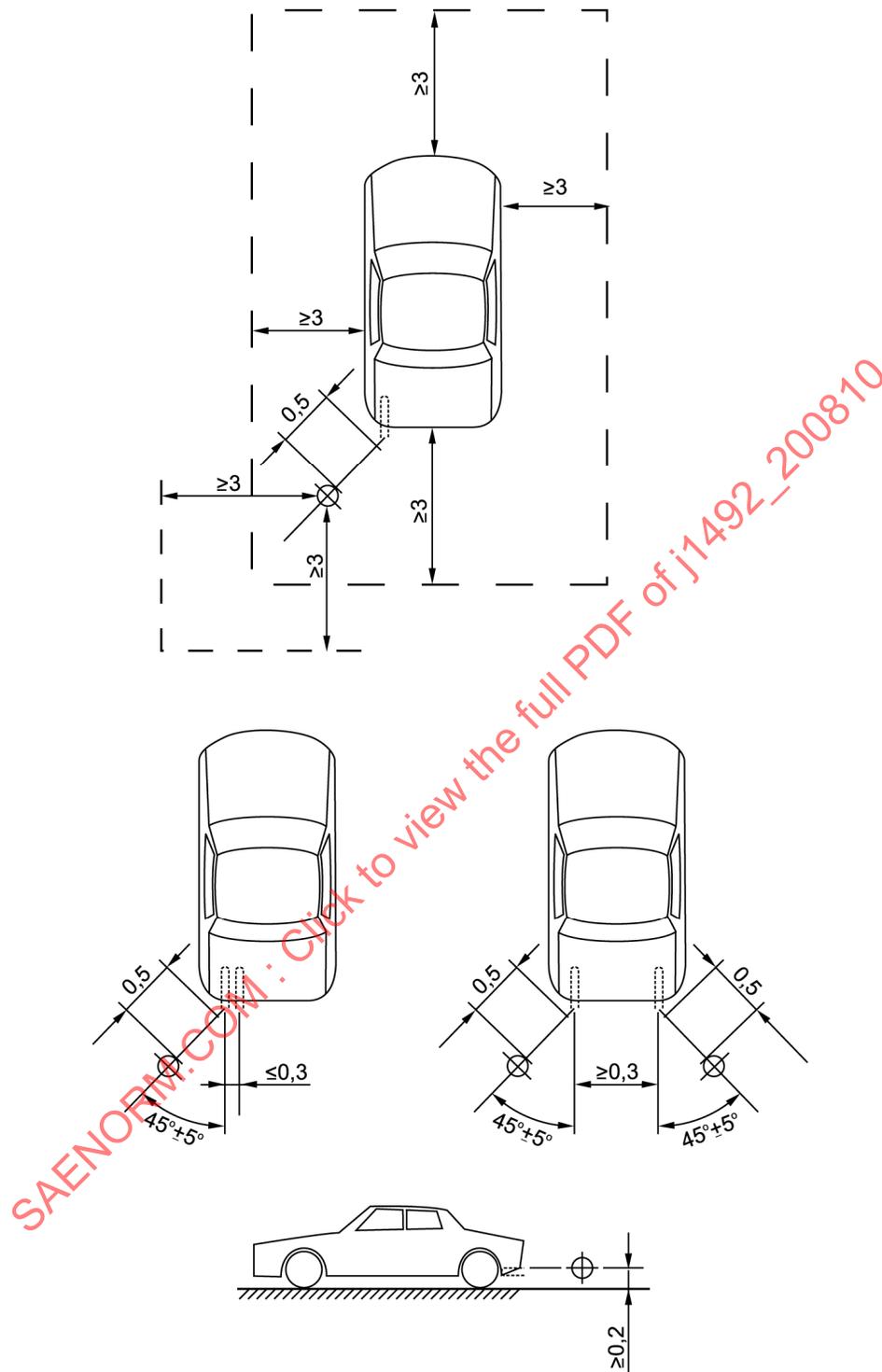


FIGURE 2A - EXAMPLES OF MICROPHONE POSITIONS FOR VARIOUS EXHAUST LOCATIONS:  
REAR ACCESSABLE EXHAUST OUTLET

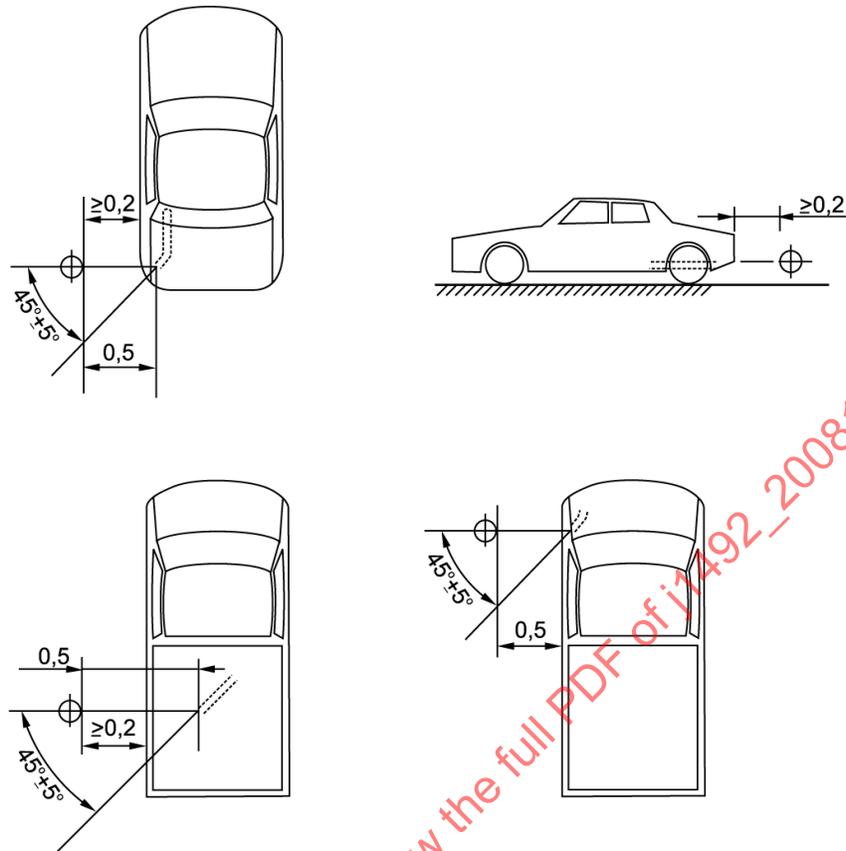


FIGURE 2B - EXAMPLES OF MICROPHONE POSITIONS FOR VARIOUS EXHAUST LOCATIONS:  
ANGLED SIDE OUTLET AND UNDERBODY ANGLED OUTLET

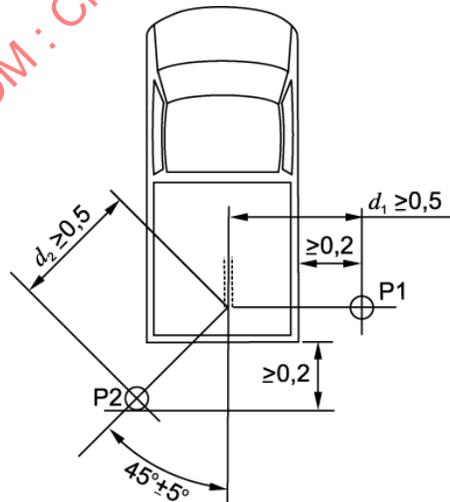


FIGURE 2C - EXAMPLES OF MICROPHONE POSITIONS FOR VARIOUS EXHAUST LOCATIONS:  
UNDERBODY REAR OUTLET

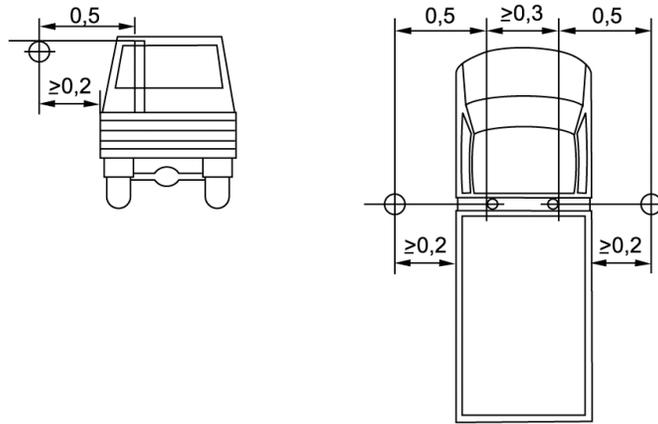


FIGURE 2D - EXAMPLES OF MICROPHONE POSITIONS FOR VARIOUS EXHAUST LOCATIONS:  
VERTICAL OUTLET

## 7.1 Test Operation

### 7.1.1 General

The sound level meter shall be set for the fast exponential time-averaging characteristic.

### 7.1.2 Target Engine Speed

The target engine speed shall be:

- 75% of the rated engine speed  $S$  for vehicles with  $S \leq 5000 \text{ min}^{-1}$ ;
- $3750 \text{ min}^{-1}$  for vehicles with a rated engine speed  $5000 < S < 7500 \text{ min}^{-1}$ ;
- 50% of the rated engine speed  $S$  for vehicles with  $S \geq 7500 \text{ min}^{-1}$ ;

with a tolerance of  $\pm 5\%$ .

If the vehicle cannot reach the target engine speed as specified above, the target engine speed shall be 5% below the maximum possible engine speed for the stationary test.

### 7.1.3 Engine Operation Conditions

The engine speed shall be gradually increased from idle to the target engine speed, not exceeding the tolerance band as given in 6.4.2 and or 6.4.3 and held constant for at least 1 second. Then the throttle control shall be rapidly released and the engine speed shall be returned to idle. The sound pressure level shall be measured during this entire cycle. The maximum sound level meter reading shall be taken as the test value.

The measurement shall be regarded as valid if the test engine speed is held at the target engine speed range for at least 1 second.

NOTE: The change from idle up to target engine speed should occur over a 10 to 15 second interval. Some engines exhibit sensitivity to the rate of increase. The longer time interval tends to reduce run-to-run variability.

7.1.4 Vehicles equipped with a multi-mode exhaust system and a manual exhaust mode control switch shall be tested according to 6.5.2 with the mode switch in all positions.