SURFACE VEHICLE RECOMMENDED PRACTICE

J1492™ NOV2023

Issued 1992-03
Revised 2023-11

Superseding J1492 OCT2021

Measurement of Light Vehicle Stationary Exhaust System Sound Level Engine Speed Sweep Method

RATIONALE

SAE J1492 is updated to include testing of all modes and to clarify procedure applies to all propulsion technologies.

This SAE Recommended Practice is designed to check vehicle exhaust noise or simulated exhaust noise against a reference value. However, it has been used by some jurisdictions to support checking against a fixed limit value. This version of SAE J1492 incorporates provisions where the standard may be used by authorities to check against a fixed limit. This recommended practice also incorporates provisions for additional exhaust system configurations and the use of vehicles with driver selectable modes.

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 or simulated 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 or simulated exhaust sound level over a range of engine speeds or simulated engine speeds.

This document applies only to road vehicles equipped with an internal combustion engine or with an external sound system.

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

For more information on this standard, visit
https://www.sae.org/standards/content/J1492_202311/

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

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.

SAE J2805 provides methods to assess vehicle noise emission consistent with in-use vehicle noise emissions at realistic vehicle loads and speeds.

This document incorporates certain provisions of ISO 5130:2019 for measuring the sound level of exhaust systems (see Appendix A).

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, 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 +1 724-776-4970 (outside USA), www.sae.org.

SAE J184 Qualifying a Sound Data Acquisition System

SAE J1169 Measurement of Light-Vehicle Exhaust Sound Level Under Stationary Conditions (Cancelled Jul 2007)

SAE J1349 Engine Power Test Code - Spark Ignition and Compression Ignition - As Installed Net Power Rating

2.1.2 ANSI Accredited Publications

Copies of these documents are available online at https://webstore.ansi.org/.

ANSI S1.4-1983 Specification for Sound Level Meters

ANSI S1.40-1984 Specification for Acoustical Calibrators

2.1.3 ISO Publications

Copies of these documents are available online at https://webstore.ansi.org/.

ISO 5130:2019 Acoustics - Measurement of sound pressure levels emitted by stationary road vehicles

ISO 26101:2017 Acoustics – Test methods for the qualification of free-field environments

2.1.4 IEC Publications

Available from IEC Central Office, 3, rue de Varembe, P.O. Box 131, CH-1211 Geneva 20, Switzerland, Tel: +41 22 919 02 11, 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 this SAE Recommended Practice.

3.3 TARGET ENGINE SPEED RANGE

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

3.4 TARGET ACCELERATION CONTROL UNIT TRAVEL

Acceleration control unit travel for testing defined in the Recommended Practice.

3.5 TARGET ACCELERATION CONTROL UNIT TRAVEL RANGE

Allowable range of acceleration control unit travel based on target acceleration control unit travel 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).

4.3.1 Conformance of the sound pressure level measuring instrument, including microphone, the filters, and the sound calibrator with the relevant requirements of IEC 61672-1, IEC 61260-1, and IEC 60942, respectively, shall be verified by the existence of a valid certificate of conformance from the manufacturer. Conformance testing in accordance with IEC 61672-3, IEC 61260-3, and IEC 60942:2017, Annex B, respectively, is required for verification. If applicable, random incidence response of the microphone shall be verified by a procedure from IEC 61183.

All conformance testing shall be conducted by a laboratory, meeting the requirements of ISO/IEC 17025 and the maximum-permitted uncertainty defined in IEC 61672-1, IEC 61260-1, and IEC 60942.

The sound calibrator should be calibrated at intervals not exceeding one year, the conformance of the instrumentation system with the requirements of IEC 61672-1 should be verified at intervals not exceeding two years, and the conformance of analog filters, with the requirements of IEC 61260-1, should be verified at intervals not exceeding two years.

NOTE: Testing in accordance with IEC 61672-3 does not fully verify conformance with the requirements of IEC 61672-1, unless it has been pattern approved in accordance with IEC 61672-2.

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 ±1 dB for frequencies from 20 to 4000 Hz and ±1.5 dB from 4000 to 10000 Hz.

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

4.6 Acceleration control unit travel shall be measured with an instrument having an accuracy of ±2% or better at the conditions required for the measurements being performed.

5. TEST ENVIRONMENT

5.1 Test Site

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 fulfill 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.

For a source located at the projection of the reference point on the reflecting plane, the broadband qualification criteria given in ISO 26101:2017, Annex A shall be met within a volume, having a radius of at least 3 m.

In addition, the radius of the qualified volume and the height of the hemi-anechoic chamber shall be at least two times the height of the measurement reference point.

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 m ± 0.01 m from the reference point of the exhaust pipe, defined in Figure 1, and at an angle of 45 degrees (±5 degrees) 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 degrees 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 m ± 0.01 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.

For vehicles equipped with external sound generation systems, the location of the sound generation device(s) shall be treated as if it was an exhaust pipe.

In case the distance from the exhaust outlet to the outer side of the vehicle is larger than 0.2 m (Figures 2B and 2C), the following distances of d1 or d2 shall be chosen (see Figure 2C):

- Case 1:
  - d_1 shall be equal to 0.5 m, and the distance from the side (outer border of the vehicle) shall be at least 0.2 m.
  - d_2 shall be equal to 0.5 m, and the distance from the side (outer border of the vehicle) shall be at least 0.2 m.
- Case 2 (if Case 1 is not fulfilled):
  - d_1 shall be at least 0.5 m, and the distance from the side (outer border of the vehicle) shall be equal to 0.2 m.
  - d_2 shall be at least 0.5 m, and the distance from the side (outer border of the vehicle) shall be equal to 0.2 m.

When several positions are possible, as shown in Figure 2D, the microphone position giving the lowest value of d1 or d2 shall be used.

Figures 2A through 2D 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

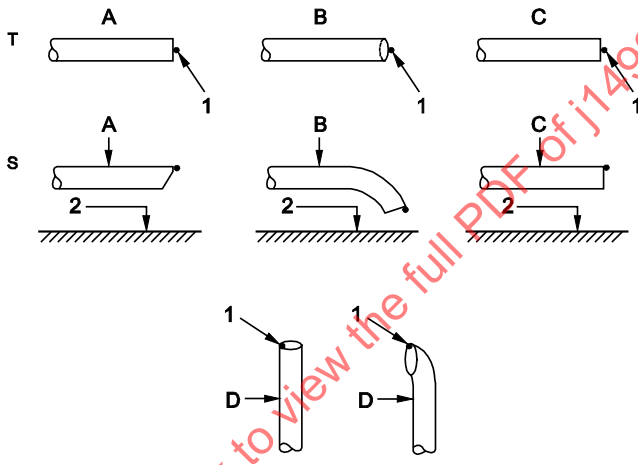
The vehicle transmission shall be in neutral position and the clutch engaged, or in parking or neutral position for automatic transmission, and the parking brake applied for safety.

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
A = Mitered pipe
C = Straight pipe
1 = Reference point
S = Side view
B = Bent down pipe
D = Vertical pipe
2 = Road surface

Figure 1 - Outlet pipe details

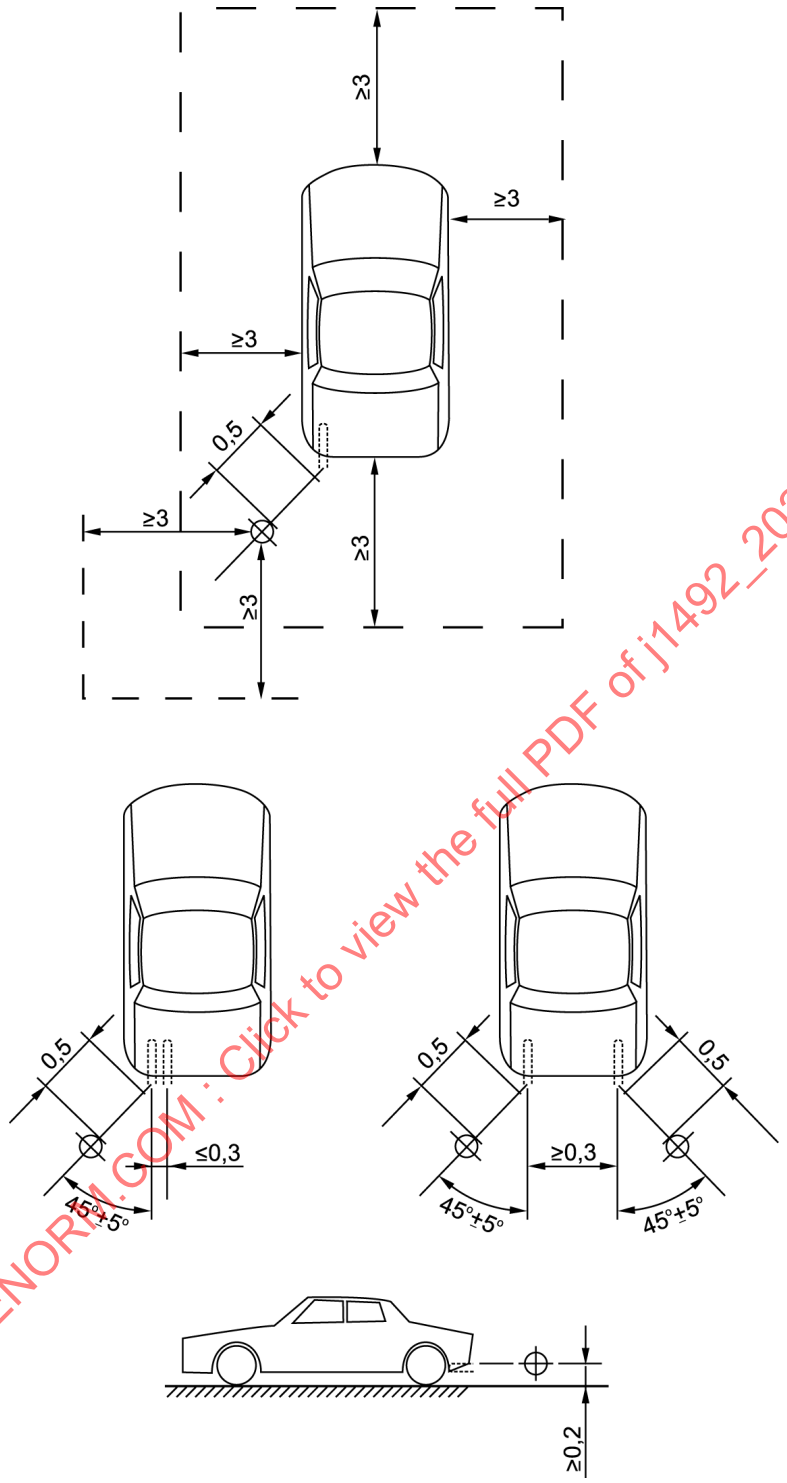


Figure 2A - Examples of microphone positions for various exhaust locations: rear accessible exhaust outlet

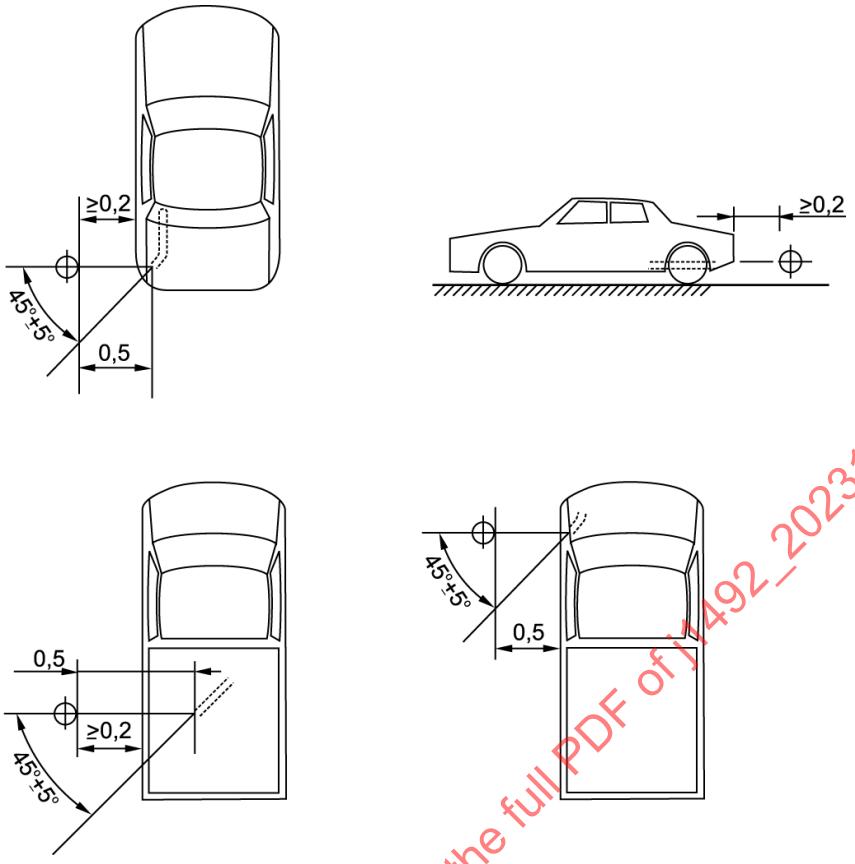


Figure 2B - Examples of microphone positions for various exhaust locations: angled side outlet and underbody angled outlet

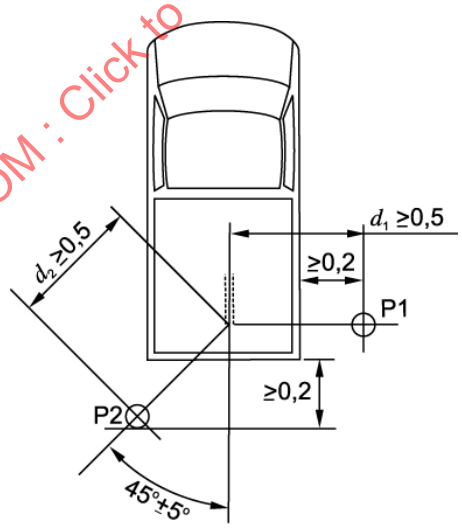
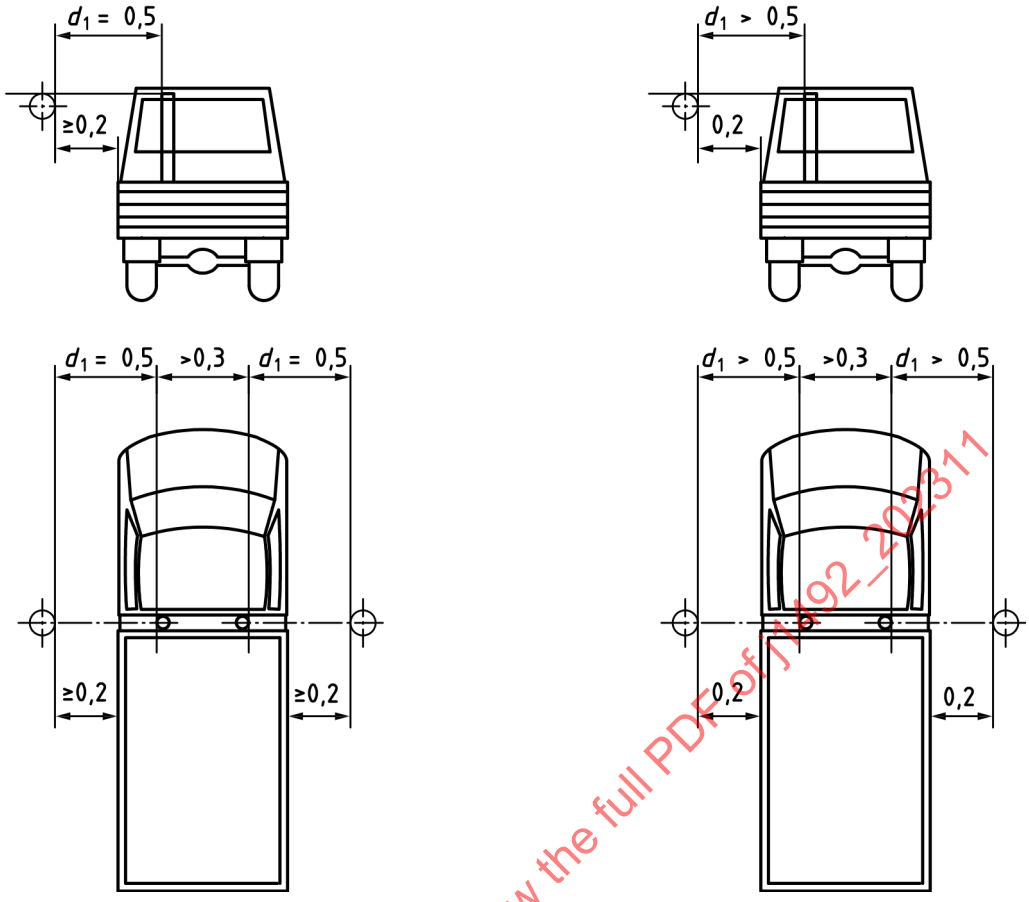


Figure 2C - Examples of microphone positions for various exhaust locations: underbody rear outlet



P1, P2 microphone positions 1 and 2, respectively
d_1, d_2 distances from the exhaust pipe to P1 and P2, respectively

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 ≤ 5000 minutes^{-1};
- 3750 minutes^{-1} for vehicles with a rated engine speed 5000 < S < 7500 minutes^{-1};
- 50% of the rated engine speed (S) for vehicles with S ≥ 7500 minutes^{-1};

with a tolerance of ±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.

For vehicles with an external sound system, the target shall be 100% of acceleration control unit travel with a tolerance of ±5%.