

Measurement of Noise  
Emitted by Accelerating  
Highway Vehicles—  
SAE J1470 OCT84

SAE Recommended Practice  
Approved October 1984

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# MEASUREMENT OF NOISE EMITTED BY ACCELERATING HIGHWAY VEHICLES—SAE J1470 OCT84

## SAE Recommended Practice

Report of the Vehicle Sound Level Committee, Light Vehicle Exterior Sound Level Subcommittee, approved October 1984.

**1. Scope and Field of Application**—This SAE Recommended Practice is equivalent to ISO Standard 362–1981 except for the differences detailed in the Appendix, and includes the modifications adopted by WP29 in ECE R51.

This SAE Recommended Practice specifies an engineering method for measuring the noise emitted by accelerating highway vehicles of all types (except motorcycles) in intermediate gears with full utilization of the available engine power.

The method is designed to meet the requirements of simplicity and reproducibility of results under realistic vehicle operating conditions.

Measurements relate to operating conditions of the vehicle which give the highest noise level consistent with urban driving and which lead to reproducible noise emissions. Therefore, an acceleration test at full throttle from a stated engine or vehicle speed is specified.

The test method calls for an acoustical environment which can only be obtained in an extensive open space.

If measurements have to be carried out on the road in an acoustical environment which does not fulfill the requirements stated in this SAE Recommended Practice, it should be recognized that the results obtained may deviate appreciably from the results obtained using the specified conditions.

The results obtained by this method give an objective measure of the noise emitted under the prescribed conditions of test. However, it is necessary to consider the fact that the subjective appraisal of the annoyance of different classes of motor vehicles is not simply related to the indications of a sound level meter.

### 2. References and Related Documents

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

IEC Publication 651, Sound Level Meters.

ISO 362-1981, Acoustics—Measurement of Noise Emitted by Accelerating Road Vehicles—Engineering Method.

ISO 1585-1982, Road Vehicles—Engines Test Code—Net Power.

ISO 3833-1977, Road Vehicles—Types—Terms and Definitions.

ISO 1176-1974, Road Vehicles—Weights—Vocabulary.

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

SAE J184a, Qualifying a Sound Data Acquisition System.

**3. Definitions**—For the purpose of this SAE Recommended Practice, the following definitions apply.

**3.1 Automatic Downshift**—A gear change to a lower gear (higher numerical ratio) which occurs outside the control of the driver.

**3.2 Forced Downshift**—A gear change to a lower gear (higher numerical ratio) which can be initiated at the will of the driver. A forced downshift may be initiated, for example, by a change in the position of the throttle pedal, thereby activating an external switch which effects the downshift.

**3.3 Kickdown**—A forced downshift to the lowest possible gear (first or low gear).

**3.4 Rated Engine Speed**—The engine speed at which the engine delivers rated net power output as defined in SAE J1349 DEC80, Engine Power Test Code—Spark Ignition and Diesel, as specified by the manufacturer.

### 4. Instrumentation

**4.1 Instrumentation for Acoustical Measurements**—The sound level meter shall meet Type 1 or Type S1A requirements of ANSI S1.4-1983.

The sound level meter shall be set for the frequency weighting “A,” and the time weighting “F.”

The calibration of the sound level meter shall be checked and adjusted according to the manufacturer’s instructions or with a standard sound source (for example, a pistonphone) at the beginning of the measurements and rechecked and recorded at the end of them.

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

Compliance of the sound level meter with ANSI S1.4-1983, Type 1, shall be verified at intervals of not more than 2 years.

A microphone windscreen may be used, provided that it does not affect the microphone response more than  $\pm 1$  dB for frequencies from 20–4000 Hz and  $\pm 1.5$  dB for frequencies from 4000–10000 Hz.

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 J184a.

**4.2 Instrumentation for Speed Measurements**—Engine speed and vehicle speed shall be measured during the approach with instruments having an accuracy of 3% or better at the speeds required for the measurements being performed.

**4.3 Other Instrumentation**—Wind speed shall be measured with an anemometer that is accurate to  $\pm 10\%$  at 18 km/h.

### 5. Acoustical Environment, Meteorological Conditions, and Background Noise

**5.1 Test Site**—The test site shall be such that hemispherical divergence exists between the noise source and the microphone to within  $\pm 1$  dB.

This condition is deemed to be satisfied if the following requirements are met:

(a) Within a radius of 50 m around the center of the track, the space shall be free of large reflecting objects such as fences, rocks, bridges, or buildings. (See Fig. 1.)

(b) The entire test track and the surface of the site up to 10 m from the center “O” of the track shall consist of concrete, non-porous or sealed asphalt or similar hard material and be free from absorbing materials such as powdery snow, long grass, or ashes. (See Fig. 1.)

(c) In the vicinity of the microphone, there shall be no obstacle that could influence the acoustical field and no person shall be between the microphone and the noise source. The meter observer shall be positioned so as not to influence the meter reading.

A primary concern regarding the test site is flatness of the measurement area. It is recommended that the measurement area be flat within  $\pm 0.05$  m, particularly in that portion of this area between the vehicle path centerline and the microphone location and to a distance of 15 m before and after the intersection of the vehicle path and the perpendicular to it passing through the microphone location. (See Fig. 2.)

**5.2 Meteorological Conditions**—The measurements shall not be made in adverse weather conditions.

It is recommended that tests should not be carried out if the wind speed at microphone height exceeds 5 m/s (18 km/h).

**5.3 Background Noise**—The background noise (including any wind noise) shall be at least 10 dB below that produced by the vehicle under test.

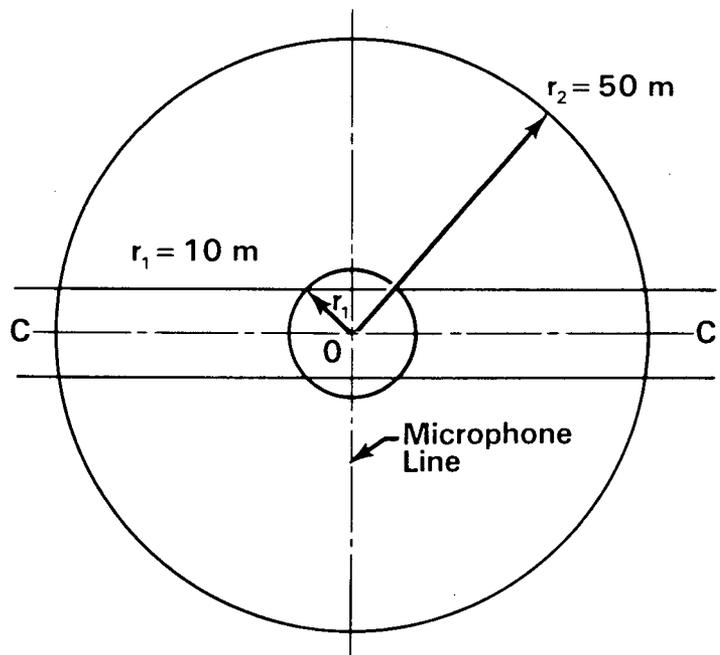


FIG. 1—TEST SITE

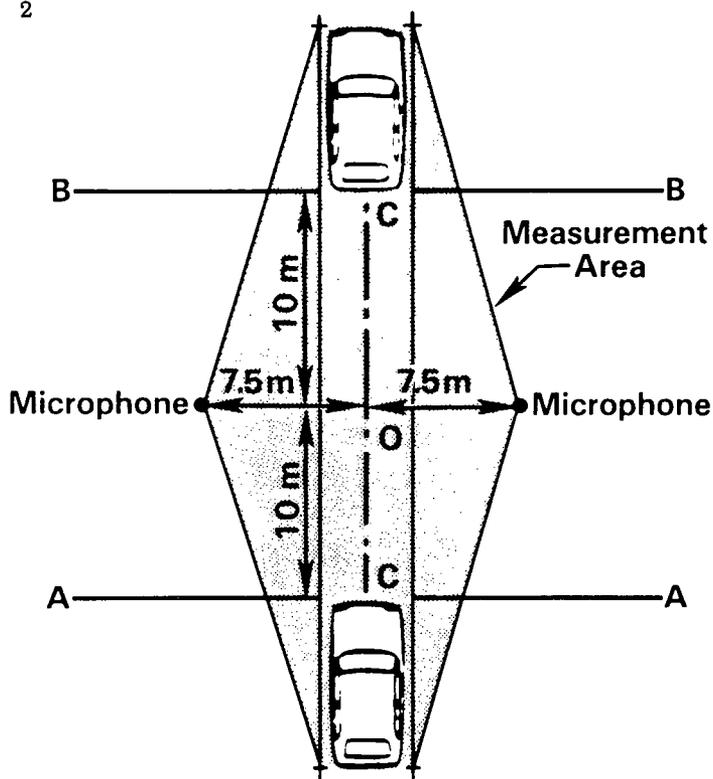


FIG. 2—MICROPHONE POSITIONS FOR MEASUREMENTS

## 6. Test Procedure

**6.1 Microphone Positions**—The distance from the microphone positions to the reference line CC (see Fig. 2) on the test track shall be 7.5 m.

The microphone shall be located 1.2 m above the ground level. Unless otherwise indicated by the manufacturer of the sound level meter, its reference axis for free field conditions (see ANSI S1.4-1983) shall be horizontal and directed perpendicularly towards the path of the vehicle (line CC) on the microphone line.

**6.2 Number of Measurements**—At least two measurements shall be made on each side of the vehicle.

**6.3 Readings to be Taken**—The maximum sound pressure level indicated during each passage of the vehicle when operated as specified in paragraph 6.5.1 shall be noted. If a sound peak obviously out of character with the general sound level is observed, the measurement shall be discarded.

The results shall be considered valid if the differences between two consecutive measurements made on the side of the vehicle which gives the higher sound pressure level do not exceed 2 dB.

The highest value given by these measurements shall constitute the result.

**6.4 Conditions of the Vehicle**—Measurements shall be made on vehicles unladen except for the driver and instrumentation and, except for the case of non-separable vehicles, without trailer or semi-trailer.

The tires of the vehicle shall be of the type normally fitted by the manufacturer to the vehicle and shall be inflated to the pressure(s) recommended by the manufacturer for the vehicle in its unladen condition.

The power train and exhaust system temperatures shall be within the normal operating range throughout each test run.

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

## 6.5 Operating Conditions

**6.5.1 GENERAL CONDITIONS**—The vehicle shall approach line AA with the path of its center line following as closely as possible line CC as specified in paragraphs 6.5.2.1 to 6.5.2.3 as appropriate.

When the front of the vehicle reaches line AA, the throttle shall, as rapidly as possible, be opened as fully as will ensure maximum acceleration without operating the kick-down, (if any) and held until the rear of the vehicle reaches line BB; the throttle shall then be closed as rapidly as possible.

Any trailer which is not readily separable from the towing vehicle shall be ignored when considering the crossing of line BB.

If the vehicle is fitted with more than two-wheel drive, it shall be tested in the drive which is intended for normal road use.

If the vehicle incorporates equipment which is not normally in operation on the road, such as a concrete mixer, a compressor, etc., this equipment shall not be in operation during the test.

**NOTE:** It is recommended that supplementary measurements be made with the equipment operating.

### 6.5.2 SPECIAL CONDITIONS

**6.5.2.1 Vehicles Without Transmission**—The vehicle shall approach line AA at a uniform vehicle speed corresponding to one of the following:

- (a) an engine rotational speed equal to  $\frac{3}{4}$  of the speed,  $n$ , which is the rated engine speed, or
- (b)  $\frac{3}{4}$  of the engine maximum rotational speed allowed by the governor at full load conditions of the engine, or
- (c) 50 km/h,

whichever is the lowest.

### 6.5.2.2 Manual Transmission Vehicle

#### (a) Approach speed

The vehicle shall approach line AA at a uniform vehicle speed corresponding to one of the following:

1. An engine rotational speed equal to  $\frac{3}{4}$  of the speed,  $n$ , which is the rated engine speed, or
2.  $\frac{3}{4}$  of the engine maximum rotational speed allowed by the governor at full load conditions of the engine, or
3. 50 km/h,

whichever is the lowest.

#### (b) Choice of the gear ratio

Vehicles having a manufacturer's gross vehicle mass rating of not more than 4540 kg and vehicles fitted with a transmission having four or fewer forward gears, shall be tested in second gear. Vehicles fitted with a transmission having more than four forward gears, shall be tested in both second and third gears. The average value of the sound levels recorded for these two conditions shall be calculated. This average is the reported level.

Vehicles having a manufacturer's gross vehicle mass rating of not more than 4540 kg and vehicles fitted with a transmission having more than four forward gears and equipped with engines having a maximum power higher than 140 kw and power/max-design mass ratio higher than 75 kw/t, shall be tested only in third gear provided that the speed at which the rear of the vehicle passes line BB in third gear exceeds 61 km/h.

Vehicles having a manufacturer's gross vehicle mass rating of more than 4540 kg and buses whose total number of forward gears is  $N$  (including those obtained by means of an auxiliary transmission or multi-gear axle), shall be tested successively with the gear selection equal to or higher than  $N/2$ . Only the condition giving the highest sound pressure level shall be reported.

### 6.5.2.3 Automatic Transmission Vehicle

Three cases may occur:

(a) Vehicles without a manual selector shall be tested at various uniform approach speeds of 30, 40, and 50 km/h or at  $\frac{3}{4}$  of the on-road maximum speed if this value is lower. The condition with the highest sound pressure level shall be reported.

(b) Vehicles equipped with a manual selector shall have the test performed in the selector position used for normal urban driving. The approach speed shall be determined by one of the following:

1. An engine rotational speed equal to  $\frac{3}{4}$  of the speed,  $n$ , which is the rated engine speed, or
2.  $\frac{3}{4}$  of the engine maximum rotational speed allowed by the governor at full load conditions of the engine, or
3. 50 km/h,

whichever is the lowest.

Forced downshift (for example by kick-down) as well as down shifting to the first ratio for transmissions having more than two discrete ratios shall be prohibited.

However, if during the test, in the case of vehicles having more than two separate gears, there is a down shift to first gear, the test procedure may be either of the following as selected by the manufacturer:

4. The speed of the vehicle can be increased to a maximum of 60 km/h in order to avoid such down shift, or
5. The vehicle speed shall remain 50 km/h, with the fuel supply to the engine limited to 95% of the supply necessary for full load.<sup>1</sup>

<sup>1</sup> This condition shall be satisfied in the case of a spark-ignition engine when the angle of the butterfly valve is 90% of full travel, and in the case of a compression-ignition engine when the movement of the feed rack of the injection pump is limited to 90% of its stroke.