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Measurement of Noise Emitted by Accelerating Highway Vehicles

RATIONALE

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1. **Scope**—This SAE Standard is equivalent to ISO Standard 362 - 1997 except for the differences detailed in Appendix A, and includes the modifications adopted by WP 29 in ECE R51 Revision 1 and EEC 92/97 and EEC 96/20.

This document 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. Such conditions can usually be provided for:

- a. Measurements at the manufacturing stage
- b. Measurements at official testing stations

Measurements must be carried out in an acoustical environment which fulfill the requirements stated in this document. It should be noted that spot checking of vehicles chosen at random can rarely be made in an ideal acoustical environment. If measurements have to be carried out on the road in an acoustical environment which does not fulfill the requirements stated in this document, 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 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. The motorcycles are covered in other SAE documents that prescribe an operating mode that is more representative of actual use.

2. References

2.1 Applicable Publications—The following publications form a part of this specification to the extent specified herein. Unless other indicated, 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

SAE J1349—Engine Power Test—Spark Ignition and Diesel

SAE 951361—Paper from the SAE Noise & Vibration Conference Report, P-291, Volume 2, SAE and ISO Noise Test Site Variability

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

ANSI S1.4-1983 and S1.4A-1985—Specification for Sound Level Meters

ANSI S1.40-1984—Specification for Acoustical Calibrators

2.1.3 ECE PUBLICATIONS—Available from United Nations Economic Commission for Europe, Palais Des Nations, CH-1211, Geneva 10, Switzerland.

ECE R51—Uniform Provisions Concerning the Approval of Motor Vehicles Having at Least Four Wheels with Regard to Their Noise Emission

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

IEC Publication 60651: 1979—Sound Level Meters

IEC Publication 60942: 1988—Sound Calibrators

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

ISO 362-1981—Acoustics—Measurement of noise emitted by accelerating road vehicles—Engineering method

ISO 1176-1974—Road vehicles—Masses—Vocabulary and Codes

ISO 1585-1982—Road vehicles—Engine test code—Net power

ISO 3833-1977—Road vehicles—Types—Terms and definitions

ISO 10844:1994—Acoustics—Specification of test tracks for purpose of measuring noise emitted by road vehicles

2.1.6 EUROPEAN ECONOMIC COMMUNITY - EEC REFERENCE—Available from European Commission, Rue de la Loi 200, B-1049 Brussel, Belgium.

EC- 92/97/EEC—Council Directive of 10 November 1992 from the Official Journal of the European Communities

EC- 96/20/EEC—Council Directive of 27 March 1996 from the Official Journal of the European Communities

3. Definitions—For the purpose of this document, 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.

NOTE—An automatic downshift may be initiated, for example, by a change of pressure on or position of the accelerator control, thereby activating a special program which effects downshifts to gears which are lower than those normally used in urban driving.

- 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 affects the downshift.
- 3.3 Kickdown**—A forced downshift to the lowest possible gear (first or low gear).
- 3.4 Intermediate Result**—The value calculated from the test series measurements and used to determine the reported value.
- 3.5 Curb Mass**—Complete shipping mass of a vehicle fitted with all equipment necessary for normal operation plus the mass of the following elements:
- a. Lubricants, coolant (if needed), washer fluid,
 - b. Fuel (tank filled to at least 90% of the capacity specified by the manufacturer),
 - c. Optional equipment if included as standard parts for the vehicle such as:
spare wheel(s), wheel chocks, fire extinguisher(s), spare parts, and tool-kit.

NOTE—The definition of curb mass may vary from country to country, but in this document, it refers to the definition contained in ISO 1176. The mass values listed are US equivalent to the metric requirement:
1 Metric Tonne = 1.1 tons.

- 3.6 Rated Engine Speed, S**—That engine speed at which the engine develops its rated maximum net power as stated by the manufacturer.

NOTE—The test engine speed for governed engines is typically the maximum full load governed speed which is up to 500 rpm higher than the engine speed at maximum net power. The use of net rated power speed or maximum governed speed may vary from one regulatory group to another.

3.7 Vehicle Categories

- 3.7.1 Category M**—Motor vehicles with at least four wheels used for the carriage of passengers:

- M1—Vehicles used for the carriage of passengers and comprising no more than eight seats in addition to the driver's seat.
- M2—Vehicles used for the carriage of passengers and comprising more than eight seats in addition to the driver's seat, and having a maximum mass not exceeding 5.5 tons.
- M3—Vehicles used for the carriage of passengers and comprising more than eight seats in addition to the driver's seat, and having a maximum mass that exceeds 5.5 tons.

- 3.7.2 Category N**—Motor vehicles with at least four wheels used for the carriage of goods:

- N1—Vehicles used for the carriage of goods and having a maximum authorized total mass not exceeding 3.85 tons.
- N2—Vehicles used for the carriage of goods and having a maximum authorized total mass exceeding 3.85 tons but not exceeding 13.2 tons.
- N3—Vehicles used for the carriage of goods and having a maximum authorized total mass exceeding 13.2 tons.

4. Instrumentation

- 4.1 Instrumentation for Acoustical Measurements**—The sound level meter system including the windscreen recommended by the manufacturer shall meet Type 1 or Type S1A requirements of ANSI S1.4-1983. A microphone windscreen may be used, provided that it does not affect the microphone response by more than ± 1 dB for frequencies from 20 to 4000 Hz and ± 1.5 dB for frequencies from 4000 to 10 000 Hz.

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 using a sound level meter calibrator meeting the requirements of ANSI S1.40-1984 (for example, a pistonphone) at the beginning of the measurements and rechecked and recorded at the end of them. (See 7.3.4)

If the readings of the sound level meter obtained from these calibrations change by more than 0.5 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. The compliance of the sound calibration device with the requirements of ANSI S1.40-1984 shall be verified once a year. These compliance verification evaluations shall be performed by a laboratory which is authorized to perform calibrations traceable to the appropriate standards.

As an alternative to making direct sound level measurements using a sound level meter, a microphone or sound level meter may be used with a magnetic tape recorder, or other indicating instrument providing the system is in conformance with SAE J184. When using a system that includes a periodic monitoring of the A-weighted sound level, a reading should be made at a time interval not greater than 30 ms.

- 4.2 Instrumentation for Speed Measurements**—Engine speed and vehicle speed shall be measured during the approach with instruments having an accuracy of 2% or better at the speeds required for the measurements being performed.
- 4.3 Other Instrumentation**—The meteorological instrumentation used to monitor the environmental conditions shall include the following:
- A temperature measuring device which shall be accurate within ± 1 °C.
 - A wind speed measuring device which shall be accurate within ± 1.0 m/s.

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 ± 1 dB.

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

- 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 Figure 1.)
- The entire test track and the surface of the site up to 10 m from the center "0" of the track shall consist of concrete, non-porous or sealed asphalt, or similar hard material and be free of absorbing materials such as powdery snow, or ashes. (See Figure 1.)
- When this procedure is used for compliance and type approval of vehicle sold in non-US markets, the surface must be constructed according to the requirements given in ISO 10844. The surface shall also meet the performance criteria contained in ISO 10844.