SAE International™

SURFACE VEHICLE RECOMMENDED PRACTICE

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Measurement of Exhaust Sound Pressure Levels of Stationary On-Highway Motorcycles

RATIONALE

Not applicable.

FOREWORD

This recommended practice establishes an alternative to SAE J1287 for measuring exhaust sound pressure levels of stationary motorcycles. Users of SAE J1287 for roadside enforcement of sound pressure levels for on-highway motorcycles have reported difficulties with its implementation and this document seeks to address those concerns by simplifying the test procedures and conditions. Both an Idle Test and a Set RPM Test are defined. The Idle Test can be used independently to identify some vehicles with excessively loud exhaust systems. However, the Set RPM Test will be more effective and should be used instead of the Idle Test when the objective is maximizing the identification of vehicles that substantially exceed Federal EPA standards. A non-constant, Swept RPM Test Method is also included as an alternative to the Set RPM Test for motorcycles that will not hold constant rpm under a no-load condition.

The test procedures described in Section 7 and the exhaust sound pressure level (dBA) limits specified in Section 9 are based on a comprehensive study of a wide variety of on-highway motorcycles tested with both original equipment and aftermarket exhaust systems. The specified limits were determined through an extensive investigation of correlation between measurement results obtained using the Federal EPA passby procedure (Appendix I to Subparts D and E of the Motorcycle Noise Emission Test Procedures in Title 40, Code of Federal Regulations [CFR], Part 205) with results obtained using the stationary procedures described in this document, and have been set so as not to fail vehicles that comply with the Federal EPA requirements specified in 40 CFR Part 205. To avoid false failures of vehicles certified to meet the Federal EPA standards, any standards set based on this procedure shall not be numerically lower than the exhaust sound pressure level (dBA) limits specified in Section 9.

Care must be taken not to confuse stationary sound pressure levels with total motorcycle sound pressure levels. The procedures of this document do not evaluate total motorcycle sound during operation. For that purpose, SAE J331 or SAE J47 is recommended.

1. SCOPE

This SAE Recommended Practice establishes test procedures, test conditions, environment, and instrumentation for determining the exhaust sound pressure levels of stationary motorcycles. These are based on a comprehensive study of a wide variety of on-highway motorcycles, and therefore are intended to be applied to on-highway motorcycles. For off-highway motorcycles, SAE J1287 continues to be the recommended practice.

1.1 Purpose

This document is intended to provide a basis for roadside monitoring or screening of stationary on-highway motorcycle exhaust sound pressure levels where use of a more comprehensive procedure for measuring total motorcycle sound during operation, such as SAE J331 or SAE J47, is not practical.

2. REFERENCES

2.1 Applicable Publications

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 724-776-4970 (outside USA), www.sae.org.

SAE J47 Maximum Sound Level Potential for Motorcycles

SAE J184 Qualifying a Sound Data Acquisition System

SAE J213 Motorcycle Classifications

SAE J331 Sound Levels for Motorcycles

SAE J1287 Measurement of Exhaust Sound Pressure Levels of Stationary Motorcycles

SAE TSB 002 Preparation of SAE Technical Reports

2.1.2 ANSI Publications

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

ANSI S1.4-1983 (R 2006) with Amd.S1.4A-1985 American National Standard Specification for Sound Level Meters

ANSI S1.40-2006 American National Standard Specifications and Verification Procedures for Sound Calibrators

2.1.3 Code of Federal Regulations

Available from U.S. Government Printing Office, 732 North Capitol Street, NW, Washington, DC 20401, Tel: 202-512-0000, http://www.gpoaccess.gov/cfr/index.html.

Title 40, Part 205 Transportation Equipment Noise Emission Controls

2.1.4 IEC Publications

Available from International Electrotechnical Commission Regional Center for North America (IEC-ReCNA), 446 Main Street, 16th Floor, Worchester, MA. 01608, or from ANSI (see 2.1.2), www.iec.ch.

IEC 60942 Electroacoustics—Sound Calibrators

3. DEFINITIONS

3.1 Field Calibration

Calibration of the sound level meter using an external sound level calibrator for the purpose of ensuring the accuracy of sound level meter readings.

3.2 Longitudinal Plane of Symmetry

As defined in SAE J213.

3.3 Maximum Engine Speed

The engine speed in revolutions per minute, sometimes referred to as the “redline” speed, which is specified by the manufacturer as not to be exceeded.

3.4 Test Session

A group of sound level tests made at a single location on a single day.

4. INSTRUMENTATION

The following instrumentation shall be used:

4.1 A sound level meter meeting the Type 1, Type S1A, Type 2, or Type S2A requirements of ANSI S1.4-1983 (R2006).

4.1.1 As an alternative to making direct measurements using a sound level meter, a microphone or sound level meter may be used with a recorder or other indicating instrument, provided the system meets the requirements of SAE J184.

4.2 A sound level calibrator with an accuracy of ±0.5 dB conforming to IEC 60942 (R2003) Class 1 and/or ANSI S1.40-2006.

4.3 A windscreen which does not affect microphone response more than ±1 dB for frequencies of 63 to 4000 Hz and ±1.5 dB for frequencies of 4000 to 10 000 Hz.

4.4 An original equipment engine speed tachometer. Alternatively other means of determining engine speed with a steady-state accuracy of ±3% at the test speed may be used,

4.5 An anemometer with steady-state accuracy of ±10% at 9 m/s (20 mph).

5. TEST SITE

5.1 The test site shall be an open area free of large sound-reflecting surfaces (other than the ground) such as parked vehicles, signboards, or buildings located within 2.5 m (8 ft) of the motorcycle being tested.

5.2 The surface of the ground within the area described in 5.1 shall be paved or hard-packed earth, level within the typical slope of a paved street or parking lot with no curbs closer than 0.25 m (10 in) of the exhaust outlet being measured.

6. TEST CONDITIONS

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

6.2 The transmission of the motorcycle under test shall be in neutral. If no neutral is provided, testing should be limited to the Idle Test specified in 6.3.1.

6.3 Test rpm

The allowable limits for exhaust sound pressure level (dBA) specified in Section 9 are directly related to the following test speeds:

6.3.1 Idle Test

The engine shall be run at idle speed. (See 7.2.2) If the engine will not idle without stalling, the throttle shall be opened the minimum amount required to keep the engine running. Determine the minimum amount of throttle opening required by trial and error and then hold the throttle open the minimum amount required to keep the engine running.

6.3.2 Engine Speed for Set RPM and Swept RPM Tests

TABLE 1 - ENGINE SPEED FOR SET RPM AND SWEPT RPM TESTS AS A FUNCTION OF ENGINE CONFIGURATION

Engine Configuration	Engine Speed
Less than 3 cylinders or more than 4	2000 rpm (±200 rpm), or 75% of maximum engine speed, whichever is less
Engines with 3 or 4 cylinders	5000 rpm (±200 rpm), or 75% of maximum engine speed, whichever is less

6.4 The ambient sound pressure level (including wind effects) at the test site due to sources other than the motorcycle being measured shall be at least 10 dB lower than the sound pressure level produced by the motorcycle under test.

6.5 Wind speed at the test site during the test shall be less than 9 m/s (20 mph).

6.6 While making sound pressure level measurements, not more than one person other than the rider, the measurer, and an assistant (if necessary) to operate the throttle shall be within 2.5 m (8 ft) of the motorcycle under test or the microphone, and that person shall be directly behind the measurer on a line through the microphone and the measurer.

7. PROCEDURE

7.1 Operation of the Motorcycle

A motorcycle operator shall sit astride the motorcycle in normal riding position with one or both feet on the ground. Either or both brakes may be applied to keep the motorcycle from moving. Alternatively, the motorcycle may be placed on its center stand or the front wheel of the motorcycle may be placed in a restraint and the motorcycle may be held in the vertical position with or without the rider sitting astride the motorcycle. *For the Idle Test only, the motorcycle may be placed on its side or center stand without the rider sitting astride the motorcycle.*

7.2 Test Procedures

7.2.1 Choice of Test Procedure

The Idle Test specified in 7.2.2 should be used where a relatively simple test is needed to identify some vehicles with excessively loud exhaust systems. The Set RPM Test specified in 7.2.3 should be used instead of the Idle Test when the objective is maximizing the identification of vehicles that substantially exceed Federal EPA standards. Some motorcycles may not be able to maintain the test speed specified in 6.3.2 for 2 seconds under the no load conditions of the Set RPM Test method. Under those circumstances, the Swept RPM Test Procedure specified in 7.2.4 shall be used as an alternative to the Set RPM Test.

7.2.2 Idle Test Procedure

The engine shall be run at idle speed for at least 5 seconds. If the engine will not idle without stalling, the throttle shall be opened the minimum amount required to keep the engine running. Determine the minimum amount of throttle opening required by trial and error and then hold the throttle open the minimum amount required to keep the engine running.

7.2.3 Set RPM Test Procedure

The motorcycle operator shall run the engine at the test speed specified in 6.3.2 for at least 2 seconds.

7.2.4 Swept RPM Test Procedure

The engine shall be slowly accelerated to the test rpm specified in 6.3.2. When the specified engine speed is reached, the throttle shall be returned rapidly to the closed position. The test cycle begins when the engine speed is increased above idle and continues until the engine speed reaches the test speed. Ideally, the engine should be accelerated at a uniform rate from idle to the target speed during a period of at least 2 seconds. This may require some trial and error to determine how to manipulate the throttle to achieve a steady increase in speed without causing the maximum engine speed to exceed the target speed by more than 200 rpm.

8. MEASUREMENTS

8.1 For the Idle Test and Set RPM Test the sound level meter shall be set for A-weighting and for slow dynamic response. For the Swept RPM Test procedure specified in 7.2.4 the sound level meter shall be set for A-weighting and fast dynamic response. For the Swept RPM Test a maximum hold setting should be used. (See Appendix A, Section A.3)

8.2 Field Calibration of the Sound Level Meter

8.2.1 Field calibration of the sound level meter using the sound level calibrator (see 4.2) shall be made:

a. immediately before the first test of each test session

b. immediately after the last test of each test session

c. whenever the sound level meter has been dropped or transported from one location to another in a vehicle.

8.2.2 Field calibration of the sound level meter using the sound level calibrator (see 4.2) should be made at intervals of no more than 1 hour.

8.2.3 Tests conducted since the previous calibration shall be considered valid if the calibration at the end of each test session requires an adjustment of not more than 0.5 dB.

8.3 The microphone shall be located:

- behind the exhaust outlet,
- 0.5 m ± 0.01 m (20 in ± 1/2 in) from the exhaust outlet,
- within 0.01 m (1/2 in) of the same height as the exhaust outlet, but at least .2 m above the ground, and
- at a 45 degrees ± 10 degrees angle to the normal line of travel of the motorcycle.

8.3.1 The longitudinal axis of the microphone shall be in a plane parallel to the ground plane. The axis of the microphone shall be oriented as specified by the instrument manufacturer (see Figure 1).

8.3.2 If there is more than one exhaust outlet per side refer to Figure 2 to determine the exhaust outlet for microphone placement.

8.4 No wire or other rigid means of distance measurement shall be attached to the sound measuring system.

8.5 To determine the maximum exhaust sound pressure level, tests shall be made on each side of a motorcycle with an exhaust outlet. If the results of a test conducted on one side exceed the limits specified in Section 9, testing on the other sides is unnecessary to determine non-compliance.

8.6 The following data shall be recorded for each test:

8.6.1 The measured exhaust sound pressure level. The sound pressure level recorded shall be that measured on the loudest side of the motorcycle during the test cycle described in Sections 7. (if outlet located on both sides — see 8.5)

8.6.2 Any adjustment to the measured exhaust sound pressure level made pursuant to 9.2.

8.6.3 The measurement method used, i.e. Idle Test (7.2.2), Set RPM Test (7.2.3) or Swept RPM Test (7.2.4).

8.6.4 For Set RPM Test (7.2.3) or Swept RPM Test (7.2.4), the test speed, in rpm, corresponding to the sound pressure level measurement of 8.6.1

8.6.5 Wind speed at the test site during the measurement

8.6.6 Ambient sound pressure level at the test site during the measurement.

8.6.7 Whether the end of test session calibration adjustment was within 0.5 dB (yes or no)

9. LIMITS

9.1 Any standards set based on this procedure shall not be numerically lower than the following exhaust sound pressure limits, which are specified in direct relation to the test speeds specified in 6.3:

TABLE 2 - SOUND PRESSURE LIMITS FOR EACH TEST PROCEDURE

Engine Configuration	Test Procedure	Limit (dBA)
All	Idle Test (7.2.2)	92
Less than 3 cylinders or more than 4	Set RPM Test (7.2.3) or Swept RPM Test (7.2.4)	96
Engines with 3 or 4 cylinders	Set RPM Test (7.2.3) or Swept RPM Test (7.2.4)	100

9.2 Before comparing measured values to the limits in 9.1, subtract 2 dBA from the measurement for any motorcycle equipped with an exhaust system labeled in accordance with 40CFR205.169(e)(1) as meeting the Federal EPA noise emission requirements. This adjustment shall not apply to labeled systems that have obviously been modified or tampered with.

10. GENERAL COMMENTS

10.1 It is essential that persons conducting the test be knowledgeable of the test procedure and use of the instrumentation.

10.2 Proper use of all test instruments is essential to obtain valid measurements. Operating manuals or other literature furnished by the instrument manufacturer should be referred to, for both recommended operation of the instrument and precautions to be observed.

10.3 Specific Items for Consideration

10.3.1 The type of microphone, its directional response characteristics, and its orientation relative to the source of sound.

10.3.2 The effects of ambient weather conditions on the performance of all instruments (for instance, temperature, humidity, and barometric pressure).

10.3.3 Proper acoustical calibration procedure to include the influence of extension cables, etc.

10.4 Although either Type 1 or Type 2 sound level meters may be used with this procedure, because of its better precision, Type 1 meters are strongly recommended for critical measurements, such as when legal enforcement is to be carried out.

10.5 The use of the word "shall" in the procedure is to be understood as obligatory. The use of the word "should" is to be understood as advisory. The use of the word "may" is to be understood as permissive.

11. NOTES

11.1 Marginal Indicia

A change bar (I) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.

PREPARED BY THE SAE MOTORCYCLE TECHNICAL STEERING COMMITTEE

APPENDIX A

As provided in TSB 002, this Appendix adds supplementary engineering reference data and educational material and is not an integral part of the basic technical report.

This procedure is intended for enforcement of in-use motorcycle standards for on-highway motorcycles.

If tests are made using variations of test parameters specified in this standard, a description of any variations from this standard shall be reported along with test results obtained. Such results shall not be reported as having been obtained according to the standard conditions of this document, and shall not state “tested according to SAE J2825”.

A.1 INSTRUMENT SELECTION

Type 1 instrumentation, which generally can provide the most accurate and repeatable measurements, and are strongly recommended when the need for accuracy is great, such as enforcement action which may result in some form of penalty. Type 2 instrumentation may be appropriate for other applications such as preliminary screening tests, or for general data gathering. Experience with instruments not meeting ANSI Type 1 or Type 2 specifications has shown that such meters do not possess operating characteristics of sufficient accuracy or consistency.

If slow response is not available for the meter used, a ½ second Leq is an acceptable alternative to slow response.

A.2 SAFETY

Engine and exhaust system parts become very hot and remain hot for some time after the engine is run. Wear protective gloves while working near a hot exhaust system or engine.

Use adequate eye and hearing protection while making measurements.

Avoid operating an engine in an enclosed area. Exhaust contains poisonous carbon monoxide gas which can collect rapidly in an enclosed area and cause illness, loss of consciousness or death.

A.3 SOUND LEVEL METER SETTINGS

Use of fast response with a digital meter may cause reading difficulty and associated degradation of measurement accuracy and repeatability, unless a means is available to hold a particular reading, e.g. maximum level, level at a specified rpm etc. Note that different meter manufacturers may describe this capability differently and the manual for the device in use should be consulted.