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SAE J47 JUN86

Maximum Sound Level Potential for Motorcycles

SAE Recommended Practice
Completely Revised June 1986

Submitted for Recognition as an American National Standard

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SAE The Engineering Resource For Advancing Mobility®

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SPECIALIZED VEHICLE PRACTICE

Submitted for recognition as an American National Standard

SAE J47

Issued May 1975
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Supersedes J47 MAR85

Ø MAXIMUM SOUND LEVEL POTENTIAL FOR MOTORCYCLES

1. SCOPE: This SAE Recommended Practice establishes the test procedure, environment, and instrumentation for determining the maximum sound level potential for motorcycles under wide open throttle acceleration and closed throttle deceleration.

2. DEFINITIONS:

2.1 Rated Engine Speed: The speed in revolutions per minute at which the engine delivers maximum net brake power output as defined in SAE J1349 JUN85, as determined by the manufacturer.

2.2 Manual Clutch: A clutch which must be disengaged by the operator to prevent engine stalling when the vehicle's forward motion is stopped.

2.3 Longitudinal Plane of Symmetry: As defined in SAE J213a.

3. INSTRUMENTATION:

3.1 The following instrumentation shall be used where applicable:

3.1.1 A sound level meter which meets the Type 1 or Type S1A requirements of American National Standard Specification for Sound Level Meters, S1.4-1983. 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 equipment, provided that the system meets the requirements of SAE J184 MAR85, Qualifying a Sound Data Acquisition System.

3.1.2 An acoustic calibrator with accuracy of ±0.5 dB. (See para. 7.6.4.)

3.1.3 An engine speed tachometer, or other means of determining engine speed, with steady-state accuracy of ±3% at 60% and 100% of rated engine speed.

3.1.4 A speedometer with steady-state accuracy of ±3% at a vehicle speed of 100 km/h (62 mph).

3.1.5 An anemometer with steady-state accuracy of ±10% at a wind speed of 5.5 m/sec (12 mph).

3.1.6 An acceptable wind screen may be used with the microphone. To be acceptable, the screen shall not affect the microphone response more than ±1 dB for frequencies of 4000 - 10,000 Hz, taking into account the orientation of the microphone.

4. TEST SITE:

4.1 The test site (Fig. 1) shall be a flat open space accommodating a straight vehicle path and the following points:

On the vehicle path -

A) Microphone target point
B) Acceleration point - a point at least 7.5 m (24 ft 7 in) prior to the microphone target point established by the method described in paras. 5.2 and 5.3.
C) End point - a point 7.5 m (24 ft 7 in) beyond the microphone target point.
D) A point 15 m (49 ft 2 in) before the microphone target point.
E) A point 15 m (49 ft 2 in) beyond the microphone target point.

Off the vehicle path -

F) Microphone point - a point 15 m (49 ft 2 in) from the centerline of the vehicle path on the perpendicular line which passes through the microphone target point.

4.2 The measurement area within the test site shall be a triangular area defined by the microphone point (F) and the points D and E. The surface of the ground within at least this area shall be portland cement or bituminous asphalt concrete, dry and free from snow, soil, or other extraneous material.

4.3 The test site shall be free of large sound reflecting surfaces (other than the ground) such as parked vehicles, signboards, buildings, or hillsides, located within 30 m (98 ft) of the measurement area.

4.4 The vehicle path shall be relatively smooth portland cement or bituminous asphalt concrete, dry and free of extraneous material such as gravel, snow, or ice and of sufficient length for acceleration, deceleration, and stopping of the vehicle.

4.5 The microphone of the sound measurement system shall be located above the microphone point. The microphone shall be positioned 1.2 m ± 0.02 m (3 ft 11 1/4 in + 3/4 in) above the ground plane. The microphone's reference axis shall be perpendicular to the vehicle path. (See para. 7.6.1.)

4.6 The test site layout in Fig. 1, for purposes of clarity, illustrates an approach from left to right. Sound level measurements are to be made on both sides of the vehicle; therefore, it will be necessary to establish either a second microphone location on the opposite side of the vehicle path with a corresponding clear area, or use approaches from both directions with corresponding acceleration points and end points.

5. PROCEDURE:

5.1 Overview: The intention of this test is to have the vehicle under test reach the end point under its maximum noise conditions - at wide open throttle and at rated engine speed, or as close to rated engine speed as the powertrain and conditions permit. Vehicles with a manual clutch approach the acceleration point at a steady engine speed. All other vehicles begin accelerating from the acceleration point using a standing start procedure. Each vehicle uses a different acceleration point in the test. The acceleration point for each vehicle is established by, basically, running the test procedure in the reverse direction in order to determine how to run the test in the normal direction.

5.2 To establish the acceleration point for vehicles with a manual clutch - the end point shall be approached in first gear from the direction opposite to the direction of the test run at a constant speed corresponding to 60% of rated engine speed. When the front of the vehicle reaches the end point, the throttle shall be rapidly and fully opened to accelerate the motorcycle past the microphone target point under wide open throttle. By trial, the lowest transmission gear shall be selected that will result in the vehicle traveling the shortest distance from the end point to the place where rated engine speed is reached, but which is not less than 7.5 m (24 ft 7 in) past the microphone target point. The location of the front of the vehicle on the vehicle path when rated engine speed is attained shall be the acceleration point for test runs to be made in the opposite direction.

5.2.1 When the procedure described in para. 5.1 results in an unusual operating condition such as wheel spin, or front wheel lifting which endangers the rider, the next higher gear shall be selected for the test, and the procedure rerun to establish the new acceleration point. In any event, the procedure shall result in the vehicle being at the end point when rated engine speed is attained.

5.3 Vehicles without a manual clutch shall use a standing start acceleration, starting from the end point, to establish the acceleration point. With the front of the vehicle at the end point and with the transmission in the lowest selectable range, the throttle shall be rapidly and fully opened to accelerate the motorcycle past the microphone target point under wide open throttle.

5.3.1 For vehicles that allow for operator selection of transmission gear ratio, the lowest transmission gear shall be selected, by trial, that will result in the vehicle traveling the shortest distance from the end point to the place where rated engine speed is reached, but which is not less than 7.5 m (24 ft 7 in) past the microphone target point. The location of the front of the vehicle on the vehicle path when rated engine speed is attained shall be the acceleration point for test runs to be made in the opposite direction.

5.3.2 For vehicles that do not allow for operator selection of transmission gear ratio, the location of the front of the vehicle on the vehicle path immediately before the place where the first transmission upshift occurs which is not less than 7.5 m (24 ft 7 in) past the microphone target point shall be the acceleration point for the test runs to be made in the opposite direction.

5.3.2.1 For vehicles with continuously variable transmissions, the location of the front of the vehicle on the vehicle path where the vehicle speed reaches its maximum or 100 km/h (62 mph), whichever is lower, shall be the acceleration point for test runs to be made in the opposite direction.

5.3.3 If the speed at the acceleration point established in para. 5.3.1 or para. 5.3.2 is over 100 km/h (62 mph), then the procedure to establish the acceleration point shall be rerun and the location of the front of the vehicle on the vehicle path where the vehicle speed reaches 100 km/h (62 mph) shall be the acceleration point for test runs to be made in the opposite direction.

5.4 For the test under acceleration, the same basic procedure shall be used as was used in establishing the acceleration point, except that test runs shall be made in the opposite direction. The rider shall rapidly and fully open the throttle when the front of the vehicle reaches the acceleration point to accelerate the motorcycle past the microphone target point under wide open throttle. Full acceleration shall continue until the applicable ending conditions determined according to paras. 5.2 or 5.3 are achieved, which should be the end point, at which time the throttle shall be rapidly and fully closed.

5.5 Sufficient preliminary runs shall be made before measurements begin to familiarize the rider with the motorcycle under test and to establish the engine operating conditions. The engine temperature shall be within the normal operating range prior to each run.

5.6 The longitudinal plane of symmetry of the test vehicle shall be on the vehicle path for all test runs.

5.7 Unless it is apparent that maximum noise occurs under acceleration, the following test shall be performed to establish maximum sound levels under deceleration.

5.7.1 For the test under deceleration for vehicles tested under para. 5.2, the vehicle shall approach the end point from the reverse direction at rated engine speed in the gear selected for the test under acceleration. At the end point, the throttle shall be rapidly and fully closed and the vehicle shall be allowed to decelerate to an engine speed of one half of rated engine speed.

5.7.2 For the test under deceleration for vehicles tested under para. 5.3, a standing start procedure shall be used. The starting point shall be a point on the vehicle path which is the same distance from the end point as the acceleration point, only the opposite direction. With the front of the vehicle at this point, the throttle shall be rapidly and fully opened to accelerate the motorcycle to the end point under wide open throttle. When the front of the vehicle reaches the end point, the throttle shall be rapidly and fully closed and the vehicle shall be allowed to decelerate to a vehicle speed which is one-half that achieved at the end point.

6. MEASUREMENTS:

6.1 The sound level meter shall be set for fast response and for the A-weighting network.

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

6.3 Measurements shall be made only when the wind speed is below 5.5 m/sec (12 mph).

6.4 The following measurements shall be made for both the acceleration and, if conducted, deceleration test modes:

6.4.1 Measurements shall be taken for both sides of the vehicle.

6.4.2 The meter shall be observed during each test as the vehicle is accelerating or decelerating. The highest sound level observed for each side during each test run shall be recorded.

6.4.3 Sufficient test runs shall be made until at least four recorded measurements for each test mode and each side of the vehicle are within a 2 dB range. The sound level for that side and test mode shall be the arithmetic average of the first four measurements within a 2 dB range.

6.5 The sound level reported for the vehicle shall be the sound level of the side and test mode with the highest average sound level.

7. GENERAL COMMENTS:

7.1 Technically competent personnel should select equipment, and the test should be conducted only by trained and experienced persons familiar with the current techniques of sound measurement.

7.2 While making sound level measurements, not more than one person other than the rider and the observer reading the meter shall be within 15 m (49 ft 2 in) of the vehicle or microphone. The additional person shall be directly behind the meter observer on a line through the microphone and the observer.

7.3 The test rider should be fully conversant with and qualified to ride the machine under test, and be familiar with the test procedure.

7.4 It should be noted that error in the engine speed indicator as well as error due to operator response time may result in sound level measurement error.

7.5 Tachometers having steady-state accuracy within 3% of actual engine speed at 60% and 100% of the rated engine speed are commercially available and are included on some motorcycles as original equipment. This class of tachometers is regarded as being sufficiently accurate for general sound level measurements. In circumstances where very accurate sound level measurements are necessary, accurate engine speed determination is essential, and consideration must be given to the accuracy and response time of the engine speed measurement system. Special care must be taken not to exceed rated engine speed. Exact engine speed measurement must be based on the time interval for not less than one complete engine cycle; i.e., two crankshaft revolutions for a four-stroke engine.

7.6 Proper use of all test instrumentation is essential in obtaining 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. Specific items to be considered are:

7.6.1 The type of microphone, its directional response characteristics, and its orientation relative to the ground plane and source of noise.

7.6.2 The effects of ambient weather conditions (i.e., temperature, humidity, and barometric pressure) on the performance of all instruments.

7.6.3 Proper signal levels, terminating impedances, and cable lengths on multi-instrument measurement systems.

7.6.4 Proper acoustical calibration procedures, including the influence of extension cables, etc., shall be followed. Field calibration shall be made immediately before and after each test sequence. Internal calibration is acceptable for field use, provided that external calibration is accomplished immediately before or after field use.

7.7 This procedure, SAE J47, was developed primarily as a tool to determine the maximum sound level potential for motorcycles, and in no way intends to represent the way in which a motorcycle is driven on the public highways. The procedure SAE J331 was developed to yield noise from a new motorcycle under operating conditions more similar to motorcycles accelerating rapidly up to cruising speed on an expressway on-ramp.

8. REFERENCES:

8.1 American National Standard Specification for Sound Level Meters, ANSI S1.4-1983.

8.2 SAE Recommended Practice J184 MAR85, Qualifying a Sound Data Acquisition System.

8.3 SAE Recommended Practice J213a, Definitions - Motorcycles.

8.4 SAE Recommended Practice J331 MAR85, Sound Levels for Motorcycles.

8.5 SAE Standard J1349 JUN85, Engine Power Test Code - Spark Ignition and Diesel.

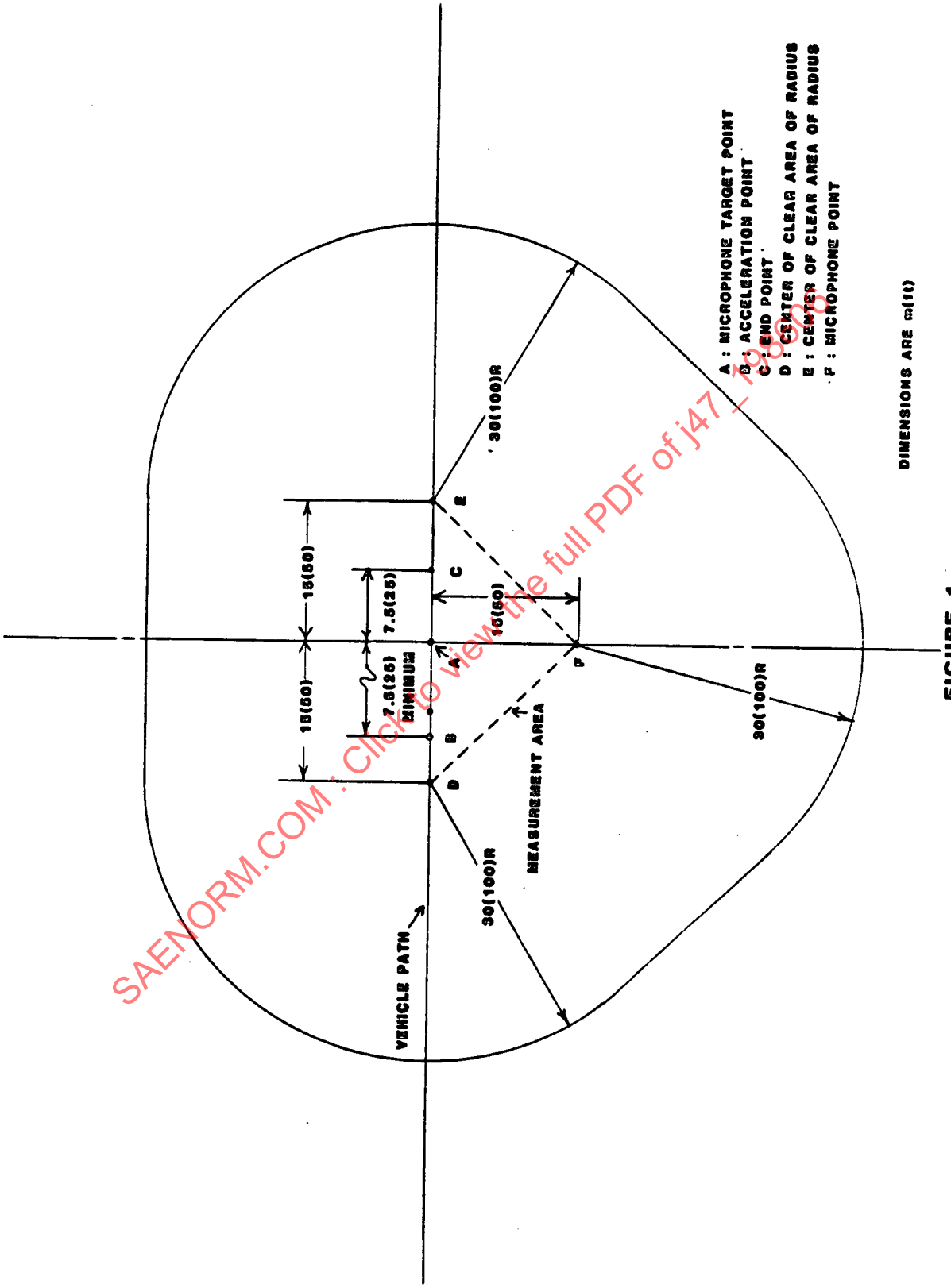

FIGURE 1

RATIONALE:

The proposed amendments to this procedure include both substantive and stylistic changes. The most noteworthy substantive changes are those made to Section 5, the PROCEDURE section.

The new procedure provides for testing of vehicles which are not equipped with a manual clutch. This category of vehicles includes motorcycles with automatic transmissions, continuously variable transmission, and operator selectable gear ratio transmissions with automatic clutches. These non-manual clutch motorcycles are tested using a standing start procedure, since this appears to be the most efficient way to reach maximum sound level conditions with minimum test site size requirements.

The division of motorcycles into two groups is somewhat different from the method proposed in the draft revision to SAE J331 MAR85. The reason is that this procedure, SAE J47, evaluates maximum sound level potential, and the division was made to ease testing and test site requirements. J331 MAR85 evaluates a less atypical mode of wide open throttle acceleration, and consistency with previous test data is required. For this reason, different vehicle groupings result under the different procedures.

Another change made limits maximum vehicle speed to 100 km/h. This maximum is intended to avoid unnecessarily large test sites; any motorcycle should reach its maximum sound level potential at a speed of 100 km/h or less.

A final major change is the addition of a deceleration test to Section 5. This test is required unless it is apparent that maximum noise occurs during the acceleration test.

The following describes the detail changes made in each section:

Section 2

Definitions for rated engine speed and longitudinal plane of symmetry have been added for clarity. A definition of manual clutch has been added.

Section 3

Several changes have been made to this section to make the instrumentation requirements of this Recommended Practice consistent with those incorporated in the proposed revisions to SAE J331 MAR85.

Speedometer accuracy specifications have been added since speedometer use is required for some vehicles.

Section 4

Many of the subsections under TEST SITE have been combined and rearranged in a more logical order. All of the information previously contained in the TEST SITE section remains. The location of the microphone is specified with given tolerances; other test site points are to be established in conformance with good engineering practice. Stylistic changes are consistent with the proposed revisions to SAE J331 MAR85.

RATIONALE (Cont'd.):

Section 5

The PROCEDURE section has been rewritten to include a procedure for testing motorcycles without a manual clutch. This new procedure is based on the premise that maximum sound level under acceleration occurs when the vehicle reaches rated engine speed, or maximum achievable engine speed, in the lowest transmission gear (highest numerical gear ratio). Since the numerical gear ratio for vehicles equipped with continuously variable transmission cannot be controlled, the ending condition for these vehicles is specified as a vehicle speed not to exceed 100 km/h. A standing start procedure is specified for vehicles not equipped with a manual clutch as the presumed best means of ensuring that repeatable results can be obtained.

As in the proposed revisions to SAE J331 MAR85, the wording in this section has been changed so that a test under deceleration is not required if it is apparent that maximum noise occurs under acceleration. The procedure for the deceleration test is such that the vehicle attains the same ending conditions at the end point as for the acceleration test, while traveling in the opposite direction.

The sound level for each side and mode has been changed and clarified as the first four readings for the side and mode within a 2 dB range.

Section 6, Section 7

Several of the proposed changes to SAE J331 MAR85 have been incorporated in these two sections.

RELATIONSHIP OF SAE STANDARD TO ISO STANDARD:

Not applicable.

REFERENCE SECTION:

SAE J184 MAR85, Qualifying a Sound Data Acquisition System

SAE J213a, Definitions-Motorcycles

SAE J331 MAR85, Sound Levels for Motorcycles

SAE J1349 JUN85, Engine Power Test Code-Spark Ignition and Diesel

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

APPLICATION:

This document establishes the test procedure, environment, and instrumentation for determining the maximum sound level potential for motorcycles under wide open throttle acceleration and closed throttle deceleration.