Exterior Sound Level Measurement Procedure For Powered Mobile Construction Equipment — SAE J88a

SAE RECOMMENDED PRACTICE

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EXTERIOR SOUND LEVEL MEASUREMENT PROCEDURE FOR POWERED MOBILE CONSTRUCTION EQUIPMENT - SAE J88a SAE Recommended Practice

Report of Vehicle Sound Level Committee approved November 1972 and last revised June 1975.

1. SCOPE-This SAE Recommended Practice sets forth the instrumentation and procedure to be used in measuring exterior sound levels for powered mobile construction equipment of 20 rated bhp and over. It is not intended to cover operation of safety devices (such as backup alarms) air compressors, jack hammers, and machinery designed primarily for operation on highways or ily for operation on highways or within factories, aircraft, or recreational vehicles such as snowmobiles and boats. The sound levels obtained by using the test procedures set forth in this SAE Recommended Practice are repeatable and are representative of the higher range of sound levels generated by the machinery under actual field operating conditions, but do not necessarily represent the average sound level over a field use cycle.

2. INSTRUMENTATION

2.1 A sound level meter which meets the Type 1 or S1A requirements of the American National Standard Specification for Sound Level Meters, S1.4-1971.

2.2 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 graphic level recorder or indicating instrument, providing the system meets the requirements of SAE Recommended Practice J184 QUALIFYING A SOUND DATA ACQUISITION SYSTEM.

2.3 An acoustical calibrator (see paragraph 4.2.4 — accuracy within ± 0.5dB).

2.4 A microphone windscreen shall be used that does not permit the effect on the microphone and frequency response to exceed ± 0.5 dB to 5kHz and ± 2.0dB to 12 kHz.

2.5 An anemometer or other device for measurement of ambient wind speed and direction (accuracy within ± 10%).

2.6 A power source rpm indicator (accuracy within ± 2%).

2.7 A thermometer for measurement of ambient temperature (accuracy within ± 1°).

2.8 A barometer for measuring atmospheric pressure (accuracy within ± 1%).

3.1 Test Site — The test area shall consist of a flat open space free of any large reflecting surfaces, such as a signboard, building or hillside, located within 30m (100ft) of either the microphone or the machinery being measured (see Fig.1). It is recommended that measurements be made only when the wind speed is below 19 km/h (12 mph).

3.1.1 The minimum measurement area (see Fig. 1) shall consist of the triangle formed by the microphone location, points A & B, and the rectangle formed by points A, B, C & D. Both designated areas shall be smooth concrete or smooth and sealed sphalt or a similar hard and smooth surface. The rectangle formed by points C, D, E & F shall consist of hard-packed earth. The planes between the microphone location and line AB and planes encompassed by points A, B, C, F, E & D shall form a continuous, uniform plane. If a minimum measurement area test site is used, it will require reorientation of the machine for each major surface measurement during the stationary tests, and the moving test will have to be run in two opposite directions. The other option is to have a larger measurement area test site and relocate the microphone for the series of prescribed test conditions with the machine in one position for stationary tests and driving by in only one direction for the moving tests.

3.1.2 Because bystanders have an appreciable influence on the meter response when they are in the vicinity of the construction machinery or

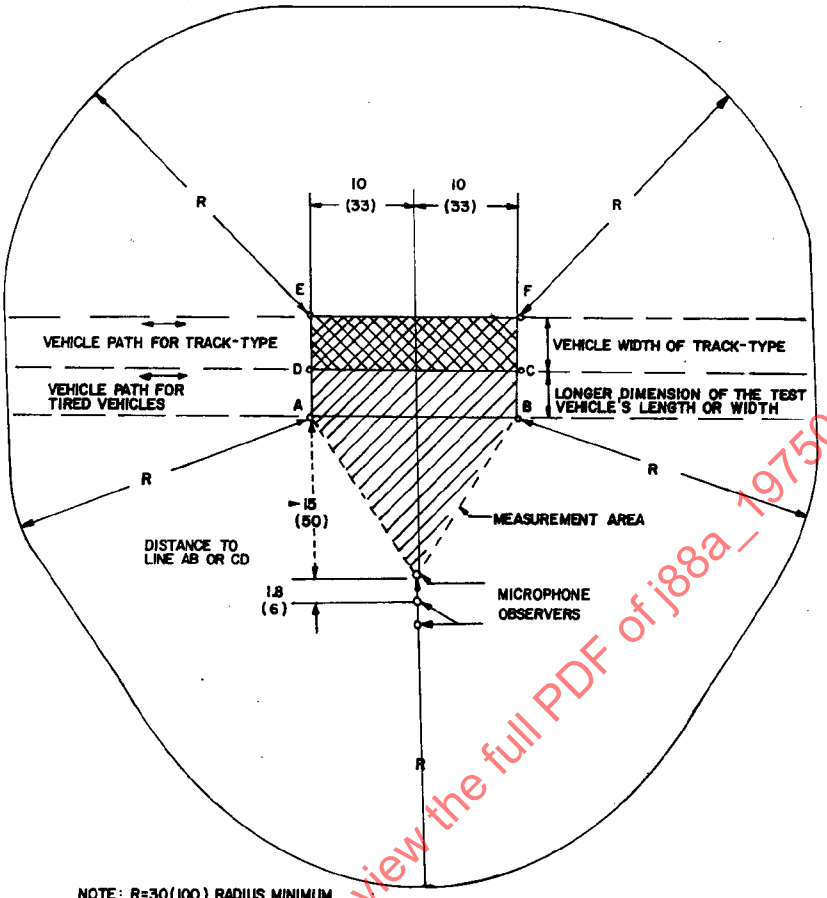

FIG. 1 - TEST SIT CONFIGURATION

microphone, not more than one person, other than the observer reading the meter, shall be within 17m (56 ft) of the construction machinery and 1.8m (6ft) of the measuring microphone, and that person shall be directly behind the observer who is reading the meter, on a line through the microphone and the observer (see Fig. 1).

3.1.3 The ambient sound level due to sources other than the construction machinery being measured (including wind effects) shall be at least 10 dB lower than the sound level of the machinery being measured. (see paragraph 3.3.3).

3.1.4 The surface between and under the construction machinery and microphone shall be smooth and free of acoustically absorptive material, such as snow or grass.

3.1.5 For all stationary tests the machinery shall be located on the hard surface area formed by points A,B,C&D in Fig 1.

3.1.6 Moving Tests

3.1.6.1 For moving tests of all rubber tired machines, the path of travel shall be across the area defined by points A, B, C & D in the directions shown in Fig. 1.

3.1.6.2 For moving tests of all steel wheel, steel drum or track-type of machines the path of travel shall be across the area defined by C, D, E & F in the direction shown in Fig. 1.

3.2 Tests Required

(a) For mobile construction machinery that is used primarily in a stationary mode, test per paragraphs 3.2.1.1, 3.2.1.2, and if applicable 3.2.1.3.

(b) For self-propelled construction machinery that is used primarily in a mobile mode, test per paragraphs 3.2.1.1, 3.2.1.2, 3.2.1.3, and 3.2.2. For construction machines which have an auxiliary power source, such as a truck mounted crane, the main engine and auxiliary engine shall be run separately during tests 3.2.1.1 and 3.2.1.2 with the other engine shut down. During test 3.2.1.3 only the auxiliary engine shall be run and only the main propulsion engine run during the test prescribed in 3.2.2. For combined construction machinery (such as small loader with backhoe) test per paragraphs 3.2.1.1, 3.2.1.2, 3.2.1.3 and 3.2.2.

3.2.1 Stationary Tests with Ground Propulsion Transmission Shift Selector in Neutral Position.

3.2.1.1 Operate all mobile construction machinery engines at no load with all component drive systems in neutral position and maximum governed speed (high idle at no load) at a stabilized condition.

3.2.1.2 Operate all mobile construction machinery engines at no load with all component drive systems in neutral position through the cycle "low idle-maximum governed speed (high idle at no load) low idle" as rapidly as possible, but allowing the engine to stabilize for at least 10 sec at maximum governed/ speed (high idle at no load) before it is permitted to return to low idle.

3.2.1.3 With the engine at the maximum governed speed (high idle at no load) in a stabilized condition, activate the appropriate hydraulic circuits, mechanical, electrical, hydrostatic, or torque converter drive systems to cycle the major components or component from the most retracted and/or lowered position to fully extended and/or maximum height position and then back to orginal position. This cycling should be done as fast as practical, taking into consideration all the pertinent safety factors/that can be accomplished without blowing relief valves. For safety reasons and undesirability of change of location of major noise source in relation to microphone, a major portion of the mobile machine, such as the tractor of a scraper unit, drum of a compactor, or the upper rotational structure of an excavator, shall not be moved or placed in a vibratory mode of operation during this stationary machine test.

3.2.2 *Constant speed moving Test* — Self-propelled construction machinery shall be operated in a forward intermediate gear ratio at no load at a location as specified in paragraphs 3.1.6.1 or 3.1.6.2. The power source shall be operated at full governor control setting. Intermediate is intended to mean second gear ratio for machines with three or four gear ratios, third gear ratio for machines with five or six gear ratios. fourth gear ratio for machines with seven or eight gear ratios, etc. (Gear ratio refers to overall gear reductions.) If there is a problem with the transmission shifting up or down in this phase of this test, one gear lower or higher may be used to eliminate the problem. Hydrostatic or electric drive machinery will be operated as near as possible to one-half its maximum ground speed. Machinery that has major noise-generating components which could be used at the above ground speed, such as on an elevating scraper or on a vibrating compactor, shall have these major components in operation during this moving test.

3.2.3 Construction machinery that has a major attachment that is normally used for the main operating function shall be equipped with this attachment. Examples of this are buckets on loaders and dozers on either wheel or track-type tractors. For all tests these attachments shall be in a minimum transport position of 0.15m (6 in) to 0.3 m (12 in) for dozers, scrapers, etc., and for loaders use carry position as specified by SAE Standard J732 SPECIFICATIONS DEFINITIONS-FRONT END LOADER.

3.3 MEASUREMENTS

3.3.1 The microphone shall be located at a height of 1.2m (4 ft) above the ground plane.

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

3.3.3 The ambient wind speed and direction, ambient temperature, atmospheric pressure, and ambient A-weighted sound level shall be measured and recorded at the height of 1.2m (4 ft) and within at least 3m (10 ft) of the one specified location of the microphone as shown in Fig. 1.

3.3.4 The stabilized maximum governed engine speed shall be measured and recorded.

3.3.5 The sound level meter needle movement shall be observed during each test sequence at the specified microphone location. The highest value observed, disregarding sounds of short duration that are out of character with the test on the machine, (example) impact sound such as bucket rack against stops, shall be recorded for each test sequence. For stabilized test conditions (3.2.1.1) a single reading shall be recorded for each measurement point. For cycling and moving test conditions (3.2.1.2, 3.2.1.3 and 3.2.2) a minimum of three readings shall be taken for each measuring point. If none of these readings are within 2 dB of each other, then additional readings shall be taken until there are two that are within 2 dB of each other. The reported value shall be the average of these two values that are within 2 dB of each other. If there are two pairs of readings that are within 2 dB of each other, report the average of the higher pair. The final reported result for each test mode shall be the highest reading for stabilized test conditions and the highest average for the cyclic or moving tests and must include the location of the microphone.

3.3.6 For stationary tests, record the sound level obtained at a distance of 15m (50 ft) normal to the centers of the four major surfaces of the equipment at the microphone height. Generally, four major surfaces refer to front, rear, and sides of an imaginary box that would just fit over the machine but does not include attachment items such as buckets, dozers, and booms (see Fig. 2). In the case of a crane or an ex-

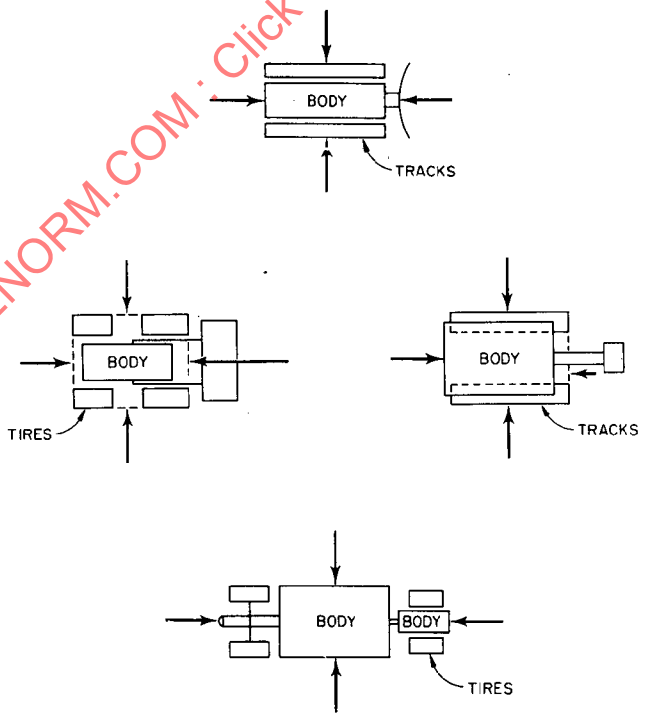

FIG. 2 - MAJOR SURFACE OUTLINES