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SAE J1262 DEC85

Sound Measurement — Trenching Machines

SAE Standard
Revised December 1985

Submitted for Recognition as
an American National Standard

RATIONALE:

Editorial changes were made to bring the definitions and terminology into agreement with SAE J1382 MAY82, Classification, Nomenclature and Specification Definitions for Trenching Machines.

A separate sound measurement procedure has been written specifically for trenching machines because: (1) This machine class includes a large number of units having less than 15 kW (20 hp) of power and may include non-riding as well as riding type units. (2) Although this procedure closely parallels existing SAE Standards, more detailed machine operating conditions specific to trenching machines have been delineated to insure a common basis for sound level measurement. A more inclusive description of the four major side surface locations is provided as well.

No suitable SAE sound level measurement procedure exists for non-riding construction machines that could reasonably be applied to this type of trenching machine. Since they perform similar functions to trenching machines with a riding operator, both types have been included within this measurement procedure. The microphone height range specified for a standing or walking operator includes the ear height of the 50th percentile USA person (with shoes). This range has been restricted somewhat from J919 in an attempt to reduce measurement variability on small units which typically have the engine located well below ear level but close to the operator.

The recorded sound levels should be the highest reading observed for each test mode disregarding any short duration sound out of character with the test.

Draft No. 2	7-7-78	G. A. Stangle
Editorial Corrections	9-25-78	R. I. Myers
Editorial Corrections	8-23-84	G. A. Stangl

RELATIONSHIP OF SAE STANDARD TO ISO STANDARD:

Not applicable.

REFERENCE SECTION:

ANSI S1.1-1960 (R1971), Acoustical Terminology

ANSI S1.2-1962 (R1971), Physical Measurement of Sound

ANSI S1.4-1971 (R1976), Specifications for Sound Level Meters

SAE J88, Sound Measurement - Earthmoving Machinery - Exterior

SAE J184, Qualifying a Sound Data Acquisition System

REFERENCE SECTION: (Cont'd.)

SAE J245, Engine Rating Code - Spark Ignition

SAE J270, Engine Rating Code - Diesel

SAE J732, Specification Definitions--Loaders

SAE J833, USA Human Physical Dimensions

SAE J919, Sound Measurement - Earthmoving Machinery - Operstor-Singular Type

SAE J1166, Sound Measurement - Earthmoving Machinery - Operator Work Cycle

SAE J1382, Classification, Nomenclature and Specification Definitions for Trenching Machines

ANSI documents are available from the American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.

APPLICATION:

This Standard is intended for delineate test procedures for measurement of operator and exterior sound levels specifically for self-powered trenching machines.

All types of trenching machines regardless of engine size may be tested under this Standard. It is not intended to cover operation of safety devices such as backup alarms or accessories such as paving breakers. The sound levels obtained by using the test procedures set forth in this SAE Standard are repeatable and are representative of the higher range of sound levels generated by machines under actual field operating conditions, but do not necessarily represent the average sound level over a field use cycle. For measurement and calculation of the operator's sound exposure, the procedure should follow SAE J1166.

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OFF-HIGHWAY MACHINERY STANDARD

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SAE J1262

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SOUND MEASUREMENT--TRENCHING MACHINES

1. PURPOSE AND SCOPE:

1.1 Purpose: This Standard is intended to delineate test procedures for measurement of operator and exterior sound levels specifically for self-powered trenching machines.

1.2 Scope: All types of trenching machines regardless of engine size may be tested under this Standard. It is not intended to cover operation of safety devices such as backup alarms or accessories such as paving breakers. The sound levels obtained by using the test procedures set forth in this SAE Standard are repeatable and are representative of the higher range of sound levels generated by machines under actual field operating conditions, but do not necessarily represent the average sound level over a field use cycle. For measurement and calculation of the operator's sound exposure, the procedure should follow SAE J1166.

2. DEFINITIONS:

2.1 Trenching Machine: An off-highway machine used primarily to produce trench Ø in a continuous operation by means of a digging chain, wheel, disk, plow blade, or other functionally similar device (See SAE J1382).

2.2 Trench: A narrow excavation. In general, the depth is greater than the Ø width.

3. INSTRUMENTATION:

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

3.2 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 J184, Qualifying a Sound Data Acquisition System, for the frequency range that is of primary concern. The deviations in the magnetic tape recorder frequency response from flat response, especially at lower frequencies, must not affect the overall reading by more than ±0.5 dB(A).

3.3 An acoustical calibrator (accuracy within ±0.5 dB). (See paragraph 5.2.4.)

3.4 The use of a windscreen may be required under some test conditions (refer to paragraph 4.1.3), otherwise its use is optional, providing that it does not affect the A-weighted sound level of the source being measured by more than +0.5 dB(A), under zero windspeed conditions. (Also refer to paragraph 5.2.2.)

3.5 An anemometer or other device for measurement of ambient windspeed and direction. The accuracy is ±10% at the highest recommended windspeed. (See paragraph 5.2.2.)

3.6 A power source speed indicator (accuracy within ±2% of the indicated reading).

3.7 A thermometer for measurement of ambient temperature accuracy within ±1°C (1.8°F).

3.8 A barometer for measuring atmospheric pressure (accuracy within ±1.1 kPa (0.3 in Hg) of the indicated reading).

4. PROCEDURE:

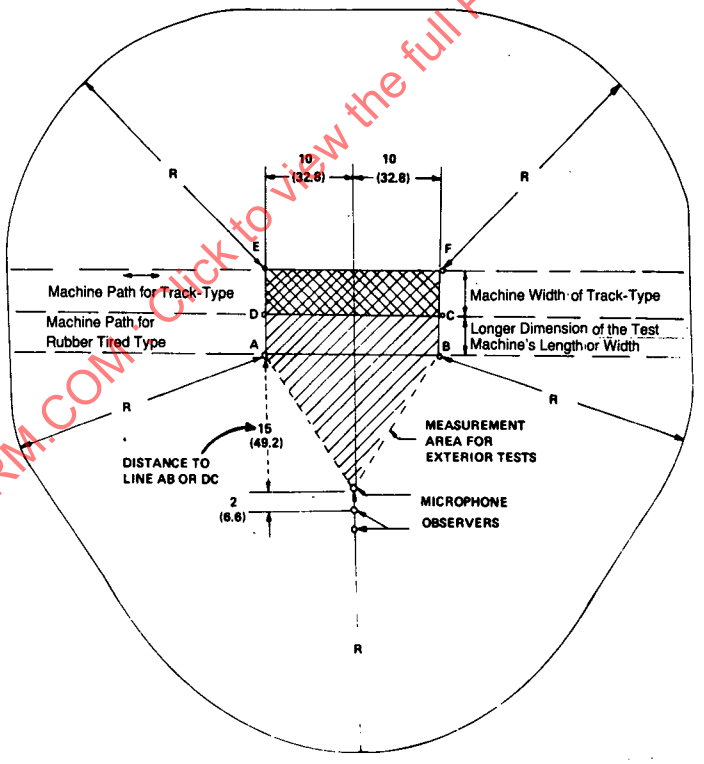
4.1 Test Site: The test area shall consist of a flat open space free of acoustically absorptive material such as snow, tall grass, and any large reflecting surfaces, such as a signboard, building, or hillside, located within 30 m (98.4 ft) of either the microphone or the machine being measured for exterior measurements or within 15 m (49.2 ft) of machine for operator station measurements. (See Fig. 1.)

4.1.1 The minimum measurement area (see Fig. 1) shall consist of the rectangle formed by points A, B, C, and D; in addition exterior measurements require the triangle formed by the microphone location and points A and B. Both designated areas shall be smooth concrete or smooth and sealed asphalt or a similar hard and smooth surface. The rectangle formed by points C, D, E, and F is for moving tests on crawler machines and shall consist of hard-packed earth or gravel. The moisture content should be low enough to prevent the material from sticking to the tracks. The planes between the exterior microphone location and line AB and planes encompassed by points A, B, C, F, E, and D shall form a continuous, uniform plane. It should not have over ±1% grade in the direction of travel. If a minimum measurement area test site is used, it will require reorientation of the

4.1.1 (Cont'd.)

machine for each major surface measuring during the stationary exterior tests, and the moving exterior tests 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 exterior tests and driving by in only one direction for the moving exterior tests.

4.1.2 Because bystanders may have an appreciable influence on the meter response when they are in the vicinity of the machine or microphone, not more than one person, other than the observer reading the meter, shall be within 17 m (55.8 ft) of the trenching machine for exterior measurements or within 2 m (6.6 ft) 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.) No person other than the operator shall be in the operator station area of the machine.



NOTE: R=30 (98.4) RADIUS MINIMUM FOR EXTERIOR MEASUREMENTS
R=15 (49.2) RADIUS MINIMUM FOR OPERATOR STATION MEASUREMENTS
DIMENSIONS ARE IN M(FT)

Ø FIG. 1 - TEST SITE CONFIGURATION

4.1.3 The ambient sound level due to sources other than the trenching machine being measured (including wind effects) shall be at least 10 dB(A) lower than the sound level of the machine being tested at that microphone location (See paragraph 4.6.3).

4.1.4 Stationary Tests: The machine shall be located on the hard surface area formed by points A, B, C, and D in Fig. 1.

4.1.5 Moving Tests:

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

4.1.5.2 For all track-type machines the path of travel shall be across the area defined by points C, D, E, and F in the directions shown in Fig. 1.

4.2 The machine shall be at a stabilized operating temperature during the test and must be operated in a manner such that the break-in procedure specified by the manufacturer is not violated.

4.3 Operator Station Measurements:

4.3.1 An operator shall be selected whose physical dimensions are as close as possible to a 50th percentile person (Ref. SAE J833):

(a) Standing height - bare feet 1600-1735 mm (62.9-68.3 in)
(b) Ear height - sitting 721-775 mm (28.4-30.5 in)
(c) Head width - 129-135 mm (5.1-5.3 in)

An operator with physical dimensions that fall outside the 5th percentile to the 95th percentile range (ear height - sitting 665-818 mm (26.2-32.3 in)) should not be permitted to operate the machine during this sound evaluation test (See also paragraph 4.3.3).

4.3.2 The microphone shall be located 80-160 mm (3.1-6.3 in) to the right of the operator's right ear unless the engine of the machine is located on the left side of the operator. For machines with the engine on the left side of the operator, the microphone should be located 80-160 mm (3.1-6.3 in) to the left of the left ear. The face of the microphone should be in line with the ear canal (See also paragraph 4.3.3). The face of the microphone should either point in the direction of the operator's vision (head mounted) or upwards (shoulder mounted). It is invisioned that for a head mounted or a shoulder mounted microphone, the microphone will be remote mounted via a cable. Microphones mounted on the machine should point in the forward travel direction.

NOTE: A 13 mm (0.5 in) nominal diameter microphone is recommended.

4.3.3 Non-riding units and units with standing operator shall have a more restrictive microphone position (height) for operator station measurements. The microphone shall be 1580 ± 80 mm (62.2 ± 3.1 in) above the ground at the normal operator position and orientation.

4.3.4 Ø When the test machine has a fully enclosed operator station, measurements are to be taken with windows, doors, and vents in a fully closed position and the appropriate climatizing accessories turned on. For air circulation fan(s) with two positions, the high speed shall be used. On fan(s) with three or more speed positions, intermediate speed shall be used. (Intermediate is defined as the third highest of a four or five speed position arrangement.) The test machine shall also be tested under a fully open configuration--all doors, windows, and vents open if they are designed to be open during machinery operation. Climatizing accessory fans shall be off for the latter test.

4.4 Exterior Measurements:

4.4.1 The microphone shall be located 1.2 m (3.9 ft) above the ground plane.

4.4.2 Ø For stationary tests, record the sound level obtained at a distance of 15 m (49.2 ft) normal to the centers of the four major surfaces of the machine at the microphone height. Generally, four major surfaces refer to front, rear, and sides of an imaginary box that would just enclose the prime mover (and auxiliary engine) including such items as the outside surfaces of tires or tracks, cross conveyor (as it affects machine length only) but excluding such items as the backfill blade (if so equipped), digging boom (or wheel) protrusion beyond its center of rotation, plow, backhoe boom, loader bucket, broom, and reel carrier, if they protrude beyond the imaginary box defined above. These attachments should not be removed for the tests, but are not considered in defining major surfaces (See SAE J1382).

4.4.3 For moving tests, take measurements at a distance of 15 m (49.2 ft) measured in a direction normal to both major side surfaces which are parallel to the machine path, as shown in Fig. 1. Operate the machine in a manner specified in paragraph 4.5.2.

4.5 Machine Operating Conditions:

NOTE: Machines with an auxiliary engine shall have the main engine and auxiliary engine run separately during tests in paragraphs 4.5.1.1, 4.5.1.2, and 4.5.1.3 with the other engine shut down. During the test in paragraph 4.5.1.4 only the auxiliary engine shall be run, and only the main propulsion engine run during the test prescribed in paragraph 4.5.2.

4.5.1 Stationary Tests With Ground Propulsion Transmission Shift Selector In Neutral Position:

4.5.1.1 Operate engine at no load with all component drive systems in neutral position and maximum governed speed (high idle at no load) at a stabilized condition.

4.5.1.2 Operate engine at no load and rated speed with all component drive systems in neutral position. Rated speed is defined per SAE J245 or J270.

4.5.1.3 It is recommended that care be taken to ensure stabilized combustion chamber surface temperatures prior to this test sequence. For on some types of engines, such as engines with precombustion chambers, repeatability of sound levels may be affected. A cool down period of 5 min is recommended. Operate engine at no load with all major component drive systems in neutral position through the cycle low idle-maximum governed speed (high idle)-low idle as rapidly as possible, but allowing the engine to stabilize for at least 10 s at the maximum governed speed (high idle) before it is permitted to return to low idle.

4.5.1.4 With the engine at the maximum governed speed (high idle) or manufacturer's recommended engine operating speed 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 extend and/or maximum height position and then back to original position. Components that may be cycled are: digging boom, wheel or plow lift, backhoe swing, loader or backfill blade lift, or steering,[1] as appropriate. The component cycled must have controls at the operator station. This cycling should be done as fast as practical, taking into consideration all the pertinent safety factors, and be accomplished without blowing relief valves.

For short cycle hydraulic operation, the system may be feathered. For units such as non-riding trenching machines without power steering or hydraulic controls, this section shall be omitted. In no case shall the digging chain (wheel) or vibratory plow drives be engaged for this test or other tests in this Standard.

4.5.2 Constant Speed Moving Test: Self-propelled trenching machines shall be operated in a forward intermediate gear ratio at no load at a location as specified in paragraphs 4.1.5.1 or 4.1.5.2. The power source shall be operated at maximum governed speed (high idle). 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 the test, one gear lower or higher may be used to eliminate the problem. Machines with hydrostatic or electric drives will be operated at approximately one-half its maximum ground speed with the governor control set in its maximum (high idle)

[1] For safety reasons and undesirability of change of location of major noise source in relation to other major components of the machine, steering which moves a major noise source relative to the operator station shall not be used in this test.

4.5.2 (Cont'd.)

position at no load. If this operating condition cannot be attained because of the interaction of engine and drive controls, then the ground speed may be increased or decreased so as to still permit the engine governor control to be set in the maximum position.

4.5.3 Ø Trenching machines having a major attachment that is normally used for the main operating function shall be equipped with this attachment. Examples of this are backfill blade, digging boom (wheel), direct burial plow and backhoe, as appropriate. For all tests these attachments shall be in their transport position, for example, backfill blade fully raised; plow, boom, or wheel fully raised and restrained (if appropriate). Units with loaders shall use carry position as specified by SAE J732, Specification Definitions--Loaders.

4.6 Measurements:

4.6.1 The microphone shall be located as stated in paragraphs 4.3.2 or 4.3.3 and 4.4 for all operating conditions.

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

4.6.3 The ambient temperature, atmospheric pressure, and A-weighted sound level shall be measured and recorded at the operator station and at one exterior measurement location with the machine shut down. If the machine has a fully enclosed operator station, these measurements shall be taken in the same enclosure configuration as operator tests are run. The ambient wind speed and direction shall be measured for all tests except those operator tests which only have a closed configuration--doors and/or windows not designed to be open during machine operation.

4.6.4 The stabilized maximum governed engine speed (high idle) at no load shall be measured and recorded.

4.6.5 The rated engine speed shall be monitored during the rated speed test per paragraph 4.5.1.2.

4.6.6 The gear ratio and approximate ground speed used during the moving test shall be recorded.

4.6.7 The sound level meter needle movement, digital readout, or graphic level recorded trace shall be observed during each test sequence at the specified microphone location. The highest value observed for all tests, disregarding sounds of short duration that are out of character with the test on the machine, shall be recorded for each test sequence. For a digital type readout, the meter must be frequently reset so that the out-of-character sound levels for the test sequence are not included if the max hold mode is being used. For the stabilized test condition of maximum governed speed (nigh idle) or rated engine speed, a single reading shall be recorded. For engine cycling, component cycling, and constant

4.6.7 (Cont'd.)

speed moving test conditions (paragraphs 4.5.1.3, 4.5.1.4, and 4.5.2) a minimum of three valid readings shall be taken for each measuring point. If for each specific test mode none of the 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 those 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 report shall include a sound level reading for each of the five test modes and cab configuration(s) in the format as shown in Appendix A. Reported sound levels shall be the arithmetical average of the recorded sound levels from the exterior tests and the recorded sound levels for each test mode and cab configuration from the operator tests.

5. GENERAL COMMENTS:

5.1 It is recommended that persons technically trained and experienced in the current techniques of sound measurements select the instrumentation and conduct the tests. Dedicated attention to detail and a thorough understanding of the machine and test instrumentation operational requirements shall be prerequisite of all personnel attached to the evaluation program.

5.2 Proper use of all test instrumentation 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.

5.2.1 The effects of ambient weather conditions on the performance of all instruments (for example: temperature, humidity, barometric pressure, and stray magnetic fields) should be known. Instrumentation can be influenced by low temperature, or significant changes in temperature, and caution should be exercised.

5.2.2 It is recommended that the wind speed of the air over the microphone not exceed 20 km/h (12.4 mph). (Caution should be used in making measurements with higher wind speeds.)

5.2.3 Proper signal levels, terminating impedances, and cable lengths on multi-instrument systems should be known.

5.2.4 Proper acoustical calibration procedure, to include the influence of extension cables, etc. should be performed. Field acoustical calibration shall be made immediately before and after the testing of each trenching machine or at least every 4 h. The calibration before and after shall not vary by more than ±0.5 dB for the tests to be valid.

5.2.5 The overall effect due to an alternate test environment on the sound level measurement shall not exceed ±1.0 dB(A) from the sound level measurement made at the test site described in paragraph 4.1.1.