Sound Measurement–Construction Site–SAE J1075 APR85

SAE Recommended Practice
Completely Revised April 1985

φ SOUND MEASUREMENT—CONSTRUCTION SITE—
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Report of the Construction, Agricultural, and Off-Road Machinery Sound Level Technical Committee, approved April 1978, completely revised April 1985. Rationale statement available.

1. Introduction—The procedures set forth in this document may be used by construction site management for self regulation and construction site planning or by state and local officials for the enforcement of construction site noise regulations. Two measurement methods are provided to obtain the time-integrated equivalent sound level, L_{eq}, emitted by construction site activity. First, a sampling procedure is recommended for use with a sound level meter. Second, a measurement procedure using an integrating sound level meter is presented. The latter procedure is preferred. Use of this recommended practice provides sound level data representative of the complex time-varying sounds emitted by construction activities, which may be used to estimate community reaction to the construction activity.

2. Scope—This SAE Recommended Practice sets forth measurement procedures and instrumentation to be used for determining a "representative" sound level during a representative time period at selected measurement locations on a construction site boundary. The practice is not intended for use in determining occupational hearing damage risk. Determination of a representative time period is left to the judgement of the user.

3. Definitions

Construction Site—That area within the defined boundaries of the project. This includes defined boundary lines of the project itself, plus any staging area outside those defined boundary lines used expressly for construction or demolition.

Construction Site Boundaries—The outermost limit lines of the construction site.

Noise Sensitive Area—Property such as that used for public, commercial, religious, or educational purposes, or home dwellings, parks, and other special purpose areas in the vicinity of a construction site where the background ambient sound is less than the construction site sound level.

Background Ambient Sound—The overall sound typically associated with the environment in a given area, when the construction site is inactive, being composed of sounds from many sources far and near.

Representative Sound Level, L_A—The average of sound level samples obtained in accordance with the procedures.

Equivalent Sound Level, L_{eq}—The "energy average" sound level, a constant sound level consisting of the same amount of acoustic energy as the time varying sound over a given time period.

4. Instrumentation

4.1 Sound Level Measurement Instrument

4.1.1 If paragraph 6.1 is to be followed, a sound level meter meeting Type 1 requirements of ANSI S1.4–1983 or IEC 651–1979 specifications for sound level meters shall be used.

4.1.2 If paragraph 6.2 is to be followed, an integrating sound level that provides the equivalent sound level for a measurement period of at least 30 min shall be used. The integrating sound level meter should meet Type 1 requirements of the American National Standard Specifications for Integrating Sound Level Meters which is in preparation. The integrating sound level meter must have a "pause" or "standby" capability which inhibits data collection. The dynamic range of the instrument should be at least 80 dB, including crest factor.

4.1.3 As an alternative to making direct measurements with a sound level meter or integrating sound level meter, a microphone or sound level meter may be used with a magnetic tape recorder or graphic level recorder and data analysis instrumentation providing the system meets the requirements of SAE J184a.

4.2 An acoustic calibrator with an accuracy within ±0.5 dB.

4.3 A microphone windscreen recommended by the microphone manufacturer.

4.4 An anenometer or other device for use in measurement of wind speed and direction [accuracy within ±10% at 20 km/h (12.4 mph)].

5. Site Characterization

5.1 Obtain specific drawings, survey stake locations, or other pertinent information and sketch the boundaries of the construction site and noise sensitive areas; a facsimile of Fig. 1 may be used. Note the distance between the noise sensitive area(s) and the nearest boundaries.

5.2 Obtain information to determine location and activity pattern of equipment on the construction site during the planned measurement period.

5.3 Based on paragraphs 5.1 and 5.2, select the sound level measurement locations.

6. Measurements—Two sound level measurement procedures are presented. A manual sampling procedure using a sound level meter is given in paragraph 6.1, while paragraph 6.2 describes the procedure for an integrating sound level meter.

6.1 Manual Sampling with Sound Level Meter—Sound level measurements at construction site boundary adjacent to noise sensitive areas shall be taken with a sound level meter in the following manner for any *representative* 30 min period of construction activity:

6.1.1 Calibrate the sound level meter before and after each measurement period using an acoustic calibrator, per manufacturer's instructions. If calibration shifts by more than 0.5 dB, the measurements shall be repeated after correction of the shift problem.

6.1.2 Locate the microphone at the location selected in paragraph 5.3 at approximately 1.5 m (5 ft) above the ground and, if practical, at least 3 m (10 ft) from sound reflecting structures. If circumstances dictate, measurements may be made at other heights and closer to sound reflecting structures providing these facts are noted on a data sheet similar to Fig. 1.

6.1.3 Set the sound level meter to the A-weighting network and slow response. Observe the sound level meter during a 10 ± 2 s sampling

The φ symbol is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. If the symbol is next to the report title, it indicates a complete revision of the report.

CONSTRUCTION SITE SKETCH FORM

1. Measurer _____
2. Date _____ Temperature _____ Wind Velocity _____
3. Construction Site: Location _____
   Description _____
4. Sound Level Meter: Mfr. _____ Model _____ S/N _____
5. Remarks: _____
6. Site sketch showing site boundaries, noise sensitive areas, measurement locations, and major pieces of construction equipment in operation, with distances between the above items; also show wind direction:

FIG. 1—SAMPLE SITE SKETCH DATA SHEET

period at the *start* of each consecutive 30 s period. Record the maximum value observed during each sample period, L_A, on a data sheet such as shown in Fig. 2. Take 60 valid readings where a valid reading is one in which the measurements are not affected by intrusive noise sources external to the construction site, such as aircraft, emergency signals, and surface transportation; make a note on the data sheet for each invalid reading.

6.1.4 On/off highway vehicles, such as dump trucks, truck/mixers, etc., which occasionally enter, operate on, and leave the site, shall be considered as part of the construction activity while within the site boundaries. However, off-site pass-by of such vehicles in the area of the measurement location shall be considered as intrusions, and handled as outlined in paragraph 6.1.3. An alternative measurement system, per paragraph 4.1.2 or 4.1.3, is recommended when these off-site conditions occur to obtain a more valid measure of L_{eq}.

6.1.5 Determine the representative sound level, $\overline{L_A}$, using:

$$\overline{L_A} = \sum_{i=1}^{n} (L_A)_i / n$$

where: $\overline{L_A}$ = the arithmetic average of the $(L_A)_i$ values,

$(L_A)_i$ = those sound level samples that fall within a range from the maximum sampled level to 6 dB less than the maximum sampled level (e.g., if the maximum sampled level was 70 dB, all sound level samples from 64 dB to 70 dB would be $(L_A)_i$ values),

n = the number of $(L_A)_i$ values used for computing the arithmetic average.

6.1.6 Determine a correction to be applied to $\overline{L_A}$ to approximate L_{eq} for the measurement period: divide n by 60, read the corresponding value from Table 1, and subtract this value from $\overline{L_A}$:

$$L_{eq} = \overline{L_A} - \text{Correction}$$

6.2 Sampling with an Integrating Sound Level Meter—Equivalent sound level measurements at the construction site boundary adjacent to noise sensitive areas shall be taken with an integrating sound level meter in the following manner:

6.2.1 Calibrate the integrating sound level meter before and after each measurement period, using an acoustic calibrator. Equivalent sound level measurements at the construction site boundary adjacent to noise sensitive areas shall be taken with an integrating sound level meter in the following manner:

6.2.2 Locate the microphone at approximately 1.5 m (5 ft) above the ground and, if practical, at least 3 m (10 ft) from sound reflecting structures. When circumstances dictate, measurements may be made at other heights and closer to sound reflecting structures, providing these facts are noted on a data sheet similar to Fig. 1.

6.2.3 Set the integrating sound level meter to the A-weighting network and slow response (if no slow response switch is present, note that fact in the reporting described in paragraph 6.3.1). Estimate what the anticipated maximum and minimum levels will be during the measurements period and set the range of the meter to include these extremes (e.g., 40–120 dB is a typical range for construction site activity).

6.2.4 Start the integrating sound level meter and maintain it in a data collection state for 30 min, exclusive of periods deleted due to intrusions per paragraph 6.2.5.

6.2.5 If during the measurement period the levels are affected by intrusive noise sources external to the construction site, such as aircraft, emergency signals, and surface transportation, activate the pause or standby switch to inhibit data collection until the intrusion is over.

6.2.6 Record the L_{eq} value at the conclusion of the 30 min measurement period (exclusive of deleted time periods).

6.3 Information to be Reported

6.3.1 Name of measurer, date, time, construction site location, type of construction, wind velocity, ambient temperature, and sound level meter manufacturer, model, and serial number shall be reported.

6.3.2 A site sketch showing construction site boundaries, major pieces of construction equipment operating during measurement, noise sensitive

Measurer: _____ Date: _____ Time: _____
Construction Site: _____ Measurement Point: _____
Remarks: _____

Instructions:
1. Select A-weighting network and "slow" response on meter.
2. Calibrate meter using acoustic calibrator and install windscreen.
3. Observe for 10 ± 2 s at the start of each minute and each one-half minute for 30 min, and record maximum level for each observation period.

	L_A	Remarks		L_A	Remarks
1.			31.		
2.			32.		
3.			33.		
4.			34.		
5.			35.		
6.			36.		
7.			37.		
8.			38.		
9.			39.		
10.			40.		
11.			41.		
12.			42.		
13.			43.		
14.			44.		
15.			45.		
16.			46.		
17.			47.		
18.			48.		
19.			49.		
20.			50.		
21.			51.		
22.			52.		
23.			53.		
24.			54.		
25.			55.		
26.			56.		
27.			57.		
28.			58.		
29.			59.		
30.			60.		

4. Determine $\overline{L_A}$: Circle L_A values within 6 dB of maximum value.
$\overline{L_A}$ = number of circled values/sum of circled values = n/sum = ___/___ = ___
5. Determine L_{eq}:
n/60 = ___ Correction (Table 1) = ___ $L_{eq} = \overline{L_A}$ − Correction = ___

FIG. 2—MANUAL SAMPLING DATA SHEET

areas, measurement locations, and distances between these features shall be prepared.

6.3.3 The sound level samples, representative sound level, and equivalent sound level at each measurement location shall be reported. Ambient levels, if measured per paragraph 7.1, shall also be reported with the time of measurement and a description of background noise sources and events excluded from the sound level measurement.

7. General Comments

7.1 It is often desirable to obtain the background ambient sound level at the measurement locations when the construction site is inactive, such as before start-up, during the luncheon break, or after shut-down. The procedures in paragraph 6.1 or 6.2 should be used. Include all non-construction related noise sources, but exclude intrusive sources, such as emergency signals and aircraft or vehicles passing very close to the microphone, unless such occurrences are representative of typical ambient conditions at the measurement point.

7.2 Only persons technically trained and experienced in the current techniques of sound measurements should select the equipment and conduct the tests.

7.3 Proper usage 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 the recommended operation of the instrument and precautions to be observed. Specific items to be considered are:

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

7.3.2 The effects of ambient weather conditions on the performance of all instruments (for example, temperature, humidity, and barometric pressure). Instrumentation can be influenced by low temperature and high humidity, and caution should be exercised.

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

7.3.4 Proper acoustical calibration procedure, to include the influence of extension cables, etc. Internal calibration means is acceptable for field use, provided that external calibration is accomplished immediately before or after field use.

7.4 It is recommended that measurements be made only when wind velocity is below 20 km/h (12.4 mph). If the wind is gusting above 20 km/h, disregard those samples taken when the wind is above 20 km/h and take additional samples.

7.5 Measurements should not be made if significant changes occur in extraneous and non-construction related noise-making activities or patterns during the sampling period. Examples of changes in noise-making activities or patterns that may affect the data are:

1. Nearby noise sources, such as power mowers, pavement breakers, or power saws.
2. Changes in vehicular traffic flow, such as detouring of traffic of shift-change periods near industrial plants.

7.6 It is suggested that, if available, earphones with an impedance recommended by the meter manufacturer be used to ensure that the sound level values are not affected by electromagnetic interference, wind, or humidity.

TABLE 1—CORRECTIONS TO L_A TO OBTAIN L_{eq}

n/60[a]		Correction, dB[b]
Greater Than	Less Than or Equal To	
0.8	1.0	0
0.7	0.8	1
0.6	0.7	2
0.5	0.6	3
0.4	0.5	4
0.3	0.4	5
0.2	0.3	7
0	0.2	10

[a] n is the number of samples used in the calculation of L_A.
[b] Subtract from L_A to obtain L_{eq}.