

LAKE COUNTY SOUND LEVEL MEASUREMENT WORKSHEET

Wind Energy Facilities

The **Wind Energy Facilities Sound Measurement Worksheet** is intended to determine the average sound level (i.e. **Source Sound Level**) from operating wind energy facilities by correcting for the ambient sound levels. This measurement will determine whether the sound exceeds the limits stipulated in Section 6.3 for large wind facilities and Section 6.4 for small wind facilities.

Sound Level Meters (SLM) must meet the Type 2 grade or better per the latest revision of ANSI S1.4 *American National Standard Specification for Sound Level Meters* and must have an integrating feature that meets ANSI S1.43 *American National Standard Specifications for Integrating Averaging Sound Level Meters*.

The **procedures** outlined here are based in essence on applicable portions of ANSI S12.9 *American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound* and Part 910 of Title 35: Environmental Protection, Subtitle H: Noise, Chapter 1: Illinois Pollution Control Board.

Frequency Measurement

- The A-weighted scale is most often utilized for the measurement of tonal or audible sound levels. These are sounds that range from 20 to 20,000 Hz. and that the human ear can typically hear.
- The C-weighted scale is utilized especially for measurement of low frequency sound, i.e. more bass tones or infrasound, which may or may not be audible to the human ear. Low frequency sounds can travel farther and may be enhanced in different locations such as in buildings.

Instrumentation Set-Up:

- Ensure the battery is in good condition.
- Ensure that the Sound Level Meter is calibrated according to manufacturer's instructions.
- Measurements may be taken at any location on a nonparticipating property, provided the location is not within:
 - 5 feet of small surfaces (e.g., trees, posts, etc),
 - 25 feet of a large reflective surface (e.g., shed, building, etc), or
 - 50 feet of a large reflective surface if the sound is tonal in nature.
- A tripod for the microphone or SLM is required if the sound is high-pitched. If the sound is low frequency in nature, a hand-held meter is acceptable as long as the arm is extended.
- The microphone on the SLM must be aimed toward the noise source and oriented at an angle recommended by the manufacturer (usually 45-70° off the ground).

Sound Level Limit Regulations for Wind Energy Facilities:

- The average sound level from wind facilities shall not exceed fifty-five (55) dB(A) during daytime hours or forty-five(45) dB(A) during nighttime hours at any point within neighboring, residentially zoned or used property. The different limits for daytime and nighttime sound levels are consistent with standards established by the Illinois Pollution Control Board. These sound level limits on residential properties are stricter than those established by the Illinois Pollution Control Board, because of the typical tonal, modulating and/or bass sounds experienced with wind facilities. The average sound level from wind facilities shall not exceed sixty-five (65) dB(A) on neighboring industrial properties and sixty (60) dB(A) on other neighboring nonresidential properties, at any time of the day.

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- No wind facility shall operate with an average sound level that is more than 5 dB(A) above the non-operational ambient level, as measured within 100 ft. of any residential dwelling on a neighboring property.
- To limit the level of low-frequency sound, the average C-weighted sound level during wind facility operation shall not exceed the A-weighted ambient sound level by more than twenty (20) dB.

Large Wind Facilities

The Applicant shall provide Financial Assurance (i.e. letter of credit or performance bond) satisfactory to the Lake County State's Attorney, secured by the owner for the purpose of contracting a professional sound level measurement, as deemed necessary, during the first two years of operation.

INSTRUCTIONS

Source and Receiver Location:

Identify the types of property from which the sound is coming (Source) and on which the sound is being measured (Receiver).

Nature of Sound:

Identify what is the Source of the sound being measured.

Weather Conditions:

- Measurements should not be made when ground level winds exceed 10 mph.
- Use an anemometer and compass to measure **wind speed** and **direction** and identify them on the Worksheet.
- Use a thermometer to determine **temperature** and a hygrometer to measure **relative humidity** to identify any adverse conditions. All instruments must be used in accordance with the manufacturer's recommended procedures.
- As an alternative, weather conditions can be obtained from an airport or weather station reporting local conditions through an internet site.

Equipment:

Identify the type of sound level meter being used and whether measurements will be using the A-weighted scale to measure tonal or audible sound (20 to 20,000 Hz) or the C-weighted scale to measure low frequency sound (Below 200 Hz).

Calibration Check:

Follow manufacturer's instructions to ensure that the Sound Level Meter is properly calibrated. Place the calibrator on the SLM microphone and adjust the meter as necessary so that it displays the rated output of the calibrator (usually 94.0 dB). This must be repeated before and after each series of measurements to ensure SLM stability.

Measured Sound Levels:

1. **Total Sound Level:** Collect a 1-2 minute sample of the sound with the wind energy facilities operating. Wait at least one minute collect a second sample. If the samples are within 2 dB, there is repeatability and the two levels can be averaged for a total sound level. If there is more than a 2 dB difference, repeated samples should be taken to determine which levels are most in common and can be averaged. This is repeated for the C scale if low frequency sound is a concern.

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- 2. Ambient Sound Level:** Ambient Sound represents the background sound level observed when the source is not operating. Collect a 10-15 second sample of the Ambient Sound during a period when there are no nearby distinct or prominent sounds, such as dogs barking, a plane flying over, or a car passing by. Wait over one minute to collect a second sample. If the samples are within 2 dB, there is repeatability and the two levels can be averaged. This is repeated for the C scale if low frequency sound is a concern.
- 3. Correction:** This figure calculates how to correct the Total Sound Level measurement for Ambient Sound.

 - a. Enter the difference between the Total and Ambient Sound Levels [Line 1 – Line 2]
 - b. If the Ambient sound is not at least 2 dB lower than the Total Level on 3a, a determination of violation cannot be made. If the difference is 2 dB enter a “4”; for a difference of 3, enter a “3”; for a difference of 4-5, enter a “2”; for a difference of 6-9, enter a “1”; and for a difference of 10 or more, enter a “0.”
- 4. Source Sound Level:** The average sound level from the operating Wind Energy System (Source) is the Total Sound Level minus the Correction factor. [Line 4 = Line 1 – Line 3b]
- 5. Increase above Ambient Sound:** An A-weighted sound level from a sound source that is more than 5 dB above the ambient level represents a significant increase in noise and is an objective indicator of annoyance. This is the difference between Line 4 and Line 2 and is used to assess compliance with the noise ordinance on residential properties. This measurement is intended for use on neighboring properties and should only be taken within 100 feet of a residential dwelling.
- 6. Low Frequency Measurement (if indicated):** Low frequency sound can impact neighbors over a longer distance than more tonal sounds and is possibly perceived indoors. A C-weighted sound level with the turbine(s) operating that is more than 20 dB above the A-weighted ambient sound level is an objective indicator of annoyance due to a significant increase in low frequency noise. If the difference between the C-weighted level of Line 4 and the A-weighted level of Line 2 is less than 20 then Wind Energy System is considered to be in compliance with the noise ordinance.

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Source Property: _____

___ Residential	___ Nonresidential	___ Industrial
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Receiving Property: _____

___ Residential	___ Nonresidential	___ Industrial
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Nature of Sound: _____

Location of instruments: _____

Wind Speed and Direction: _____

Equipment: _____

Date:
Time:
Examiner:

Calibration Check:

Sound level with calibrator in place:

Before	Cal. Level	After
_____ dB	94.0 dB	_____ dB

Measured Sound Levels:

1 **Total Sound Level** (*source on*):

Sample 1	Sample 2	Average
dB(A)	dB(A)	dB(A)
dB(C)	dB(C)	dB(C)

2 **Ambient Sound Level** (*quiescent level with source off*):

dB(A)	dB(A)	dB(A)
dB(C)	dB(C)	dB(C)

3 **Correction** for the ambient background sound

3a. Enter the difference between lines 1 and 2:

dB(C)	dB(A)
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If Line 3a = 0 or 1 dB the source level cannot be determined

3b. If Line 3a = 2 dB → enter 4 dB; 3 dB → enter 3 dB
 = 4-5 dB → enter 2 dB; 6-9 dB → enter 1 dB
 = 10 dB or more → enter 0 dB

dB(C)	dB(A)
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4 **Source Sound Level** (*line 1 minus line 3b*):

dB(C)	dB(A)
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5 **Increase Above Ambient Sound** (*A-wtd level in line 4 minus A-wtd level in line 2*):
 Measured within 100 ft of residential dwelling

dB(A)

6 **Low Frequency** = $C_{source} - A_{ambient}$ (*C-wtd level of line 4 minus A-wtd level of line 2*):

dB

Sound Limits (dB) on Receiving Properties:	Industrial	Nonresidential	Residential Day / Night
Source Sound Level (A-wtd) - Line 4	65	60	55 / 45
Increase Above Ambient Sound (A-wtd) - Line 5			5
Low Frequency, $C_{source} - A_{ambient}$ - Line 6	20	20	20