

Calculation of sound levels from land-based wind turbines

Distance up to 1000 m

According to Swedish Environmental Protection Agency, Energy Agency, National Board of Housing, Building and Planning

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Date:

Site

.....

 Made by:

Calculation point

	Wind turbine number				
	1	2	3	4	5
<i>For more than 5 wind turbines, see Info sheet</i>					

Source data

Sound Power Level, Lw, dB(A) re 1 pW	100	0	0	0	0
Wind speed, m/s	8				
Hub height, m	60	0	0	0	0

Site corrections

Ground roughness	0,05	0,05	0,05	0,05	0,05
Lw variation with wind speed, k, dB(A)/m/s	1	1	2	1	1
Corrected Sound Power Level, dB(A)	100,0	0,0	0,0	0,0	0,0

Calculation point

Heights are stated as heights above ground at the calculation point

Height of tower base, m	0	0	0	0	0
Height of calculation point, m:	1,5				
Distance, calculation point - tower base, m	500	0	0	0	0
Distance: Hub - calculation point	503,4	0,0	0,0	0,0	0,0

Results. Calculated Sound Pressure Levels

	Wind turbine number				
	1	2	3	4	5
Attenuation by air absorption, dB(A)	-2,5	0,0	0,0	0,0	0,0
Att. by geometric wave divergence, dB(A)	-54,0	0,0	0,0	0,0	0,0
Sound Pressure Level from individual turbines, dB(A)	35,4	0,0	0,0	0,0	0,0

Total Sound Pressure Level, dB(A) **35,4**

Comments:

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Calculation point

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For several wind turbines, see Info sheet

Ljuddata	LwA,corr	Octave band, centre frequency, Hz						
		63	125	250	500	1000	2000	4000
Source data								
Sound Power Level, Lw, dB(A) re 1 pW	100	10	2	2	0	0	-5	-10
Wind speed, m/s	8							
Hub height, m	60							

Site corrections

Ground roughness	0,05
Lw variation with wind speed, k, dB(A)/m/s	1
Corrected Sound Power Level, dB(A)	100,0

Calculation point

Heights are stated as heights above ground at the calculation point

Height of tower base, m

Height of calculation point, m:

Distance, calculation point - tower base, m

Distance: Hub - calculation point

Attenuation by air absorption

	Octave band, centre frequency, Hz						
	63	125	250	500	1000	2000	4000
Attenuation, dB	0,1	0,4	0,7	1,7	3,8	9,5	26,4

Results. Calculated Sound Pressure Levels

Attenuation by air absorption, dB(A)

Att. by geometric wave divergence, dB(A)

Total Sound Pressure Level, dB(A) **24,9**

Comments:

Determination of current Sound Power Level. Corrections

Starting point is the measured wind turbine Sound Power Level L_{wA} (apparent sound power level according to IEC 61400-11). This value shall be corrected depending on:

1. **The condition of the ground at the location of the wind turbine.**
2. **Sound Power Level variation with wind speed, k , dB(A)/m/s. Supplier data.**

1. The condition of the ground at the location of the wind turbine.

The terrain is characterised by its roughness length z_0 , which may be assessed from the table below:

Type of terrain	Roughness length, z_0 in m	
Suburban houses, provincial towns		
Forest, forest belts	0,3	
Many trees and/or bigger bushes		
<i>Agricultural areas with few houses, trees, etc.</i>	0,05	Most common / Default
<i>Airports with trees and buildings</i>		
Airport landing strip		
Cut grass. Bare earth		
Even snow surfaces	0,01	
Even sand surfaces		
Water surfaces (lakes, bays, open sea)		

Suitable ground roughness length according to the above table is to be entered on the calculation sheet.

2. Sound Power Level variation with wind speed, k , dB(A)/m/s. Supplier data.

Fixed speed wind turbines	$k = 0.5 - 1$ dB(A)/m/s	Default 1 dB(A)/m/s
Variable speed wind turbines	k is considerable bigger	

The constant k is obtained from the wind turbine supplier and is to be entered on the calculation sheet.

Help program for calculation of simultaneous noise immission from many turbines

Addition of sound pressure levels

Source No.	dB
1	0
2	0
3	0
4	0
5	0
6	0
7	0
8	0
9	0
10	0
11	0
12	0
13	0
14	0
15	0
16	0
17	0
18	0
19	0
20	0

Total Level **0,0**

Addition of equal levels

Level	0	dB
Number	0	No.
Total Level	0,0	dB



Calculation of sound levels from land-based wind turbines

Instructions

Input data

Input

Light blue field with red text is used as input data for calculation.

NB These areas must be filled in correctly.

In light green fields with black text you can fill in appropriate information about the site and the calculation.

Comments

Other fields cannot be altered.

Calculation

Is done automatically as soon as data is altered. (If not, change default of Excel.)

Print out

Use print out routines in Excel. Should normally fit on to one page. If not, click on Preview and alter the margins. Alt. Preview, Format and adapt to one page.

Comment, hints

When the pointer is placed over a cell with a red corner, comments will show up →

There are calculation programmes for two situations:

Short distance, up to 1000 m

Calculation is done directly in dB(A) for up to five wind turbines simultaneously.

Long distance, over 1000 m

Assessment is done in octave bands. Assessment can be done for one wind turbine at a time.

Calculation of simultaneous noise emission from several wind turbines

For larger wind farms, use the help program sheet Addition of Levels.

You choose the type of calculation with Excel tabs at the bottom of the Excel window.

If the sheet tabs are not visible at the bottom of your screen, change *Tools, Alternative, View*

The calculation model is described in "Ljud från vindkraftverk

Sound from wind turbines]", ISBN 620-6241-7. (In Swedish)

Published by Swedish Environmental Protection Agency, Energy Agency,
National Board of Housing, Building and Planning.

The report can be downloaded at www.acuvib.com

NB The calculations are valid for downwind conditions, i.e. when the wind blows from the wind farm towards the calculation point. In upwind conditions, the sound pressure level may be less, especially when the distance to the farm is large.

Attenuation by air absorption

Model for short distance

dB(A)/m
0,005

Model for long distance

Frequency, Hz	dB/m
63	0,0001
125	0,0003
250	0,0006
500	0,0014
1000	0,0032
2000	0,0079
4000	0,022

End of Info Sheet
