



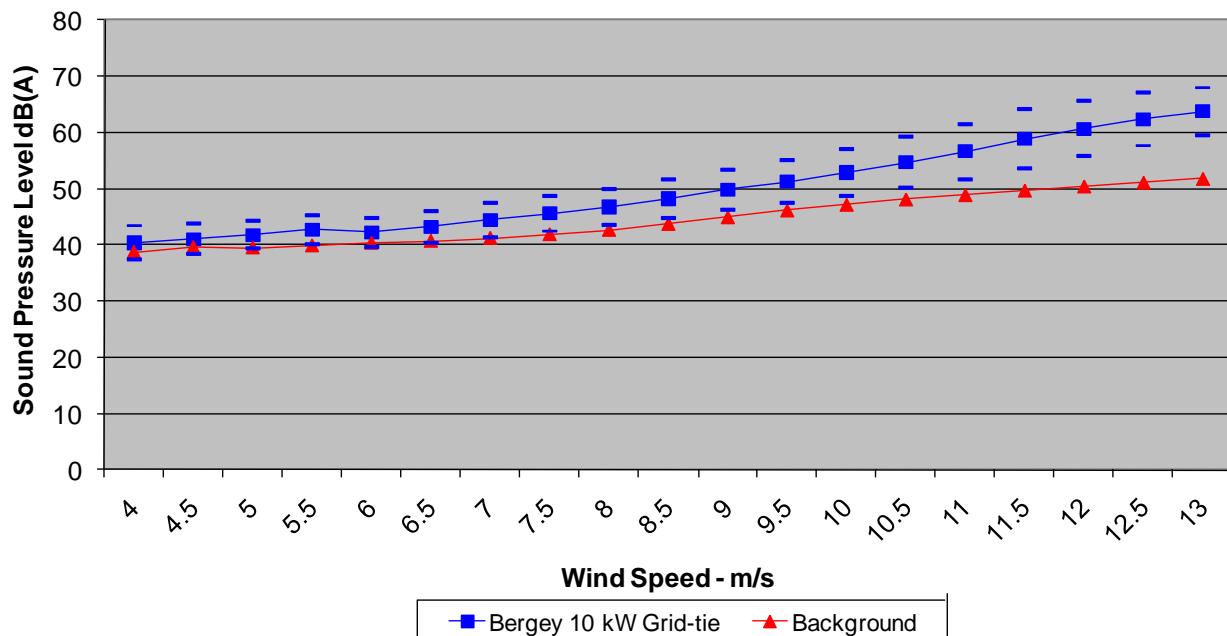
July 14, 2010

Acoustic Characteristics of the Bergey Excel-S 10 kW Wind Turbine

The following noise level data were taken by the USDA Agricultural Research Service in Bushland, Texas. USDA-Bushland is a contractor to the U.S. Department of Energy and has been field testing small wind turbines since the 1970's. This acoustics testing was conducted in support of certification of the BWC Excel-S to AWEA 9.1-2009. Per the AWEA standard, the tests were conducted in accordance with IEC 61400-11, "Wind Turbine Generator Systems, Part 11 - Acoustic Noise Measurement Techniques".

The sampling microphone was a calibrated Larson Davis Model 824, which was placed 34.2m (112 ft) from the base of the 30m (100 ft) wind turbine tower. The slant distance was 46m (151 ft). Wind speed was taken at a height of 10 m (33 ft)

Noise Data Collected on Bergey 10 kW Grid-tie, 30.5 m tower
USDA-ARS Lab near Bushland, TX (June 2010)



The data range provided is 4 m/s – 13 m/s because the calculation of the turbine component of the total sound pressure was calculated using background sound data at the same site from an earlier test on another brand of wind turbine and that test range was 4 – 13 m/s. Background sound levels must be taken with the wind turbine shutdown and that is more difficult to achieve on the Bergey Excel than the other brand previously tested. New background sound data over a wider range is currently being gathered. We do not believe there will be any significant differences in the results when this newer background data is available.

The calculation of the wind turbine contribution to total sound levels follows the guidelines in IEC 61400-11.

For a typical 5 m/s (11.2 mph) average wind speed site the wind speed will be below 11 m/s (25 mph) over 95% of the time. In this range the Excel-S wind turbine will add just 1 – 6 dBA to the background. As a general rule it takes 3 dBA added before a person will perceive a separate noise source.

AWEA Rated Sound Level: 52.1 dBA

The Rated Sound Level is the sound level at 60 m (197 ft) that the wind turbine will not exceed 95% of the time in a 5 m/s (11 mph) average wind speed site. The previous version of the BWC Excel-S had an AWEA Rated Sound Level of 54.7 dBA. The new version is quieter because the more powerful neodymium alternator has reduced the rated rotor speed from 300 RPM to 240 RPM.

The Sound Power Level is the total noise right at the source – the top of the tower. For the BWC Excel-S turbine the Sound Power Level corresponding to the AWEA Rated Sound Level is 91.0 dBA. Sound diminishes with distance. The Sound Pressure Level is the sound a listener would hear at the distance given, in this case 60m (197 ft)

The binned sound pressure and sound power level data is provided on the following page.

2010 Excel-S Acoustics Test Data
Bushland, 46 m Slant Distance

	Recorded		Backgrd	Turbine	Turbine
	Sound		Sound	Sound	Sound
Wind	Pressure		Pressure	Pressure	Power
Bin	Level		Level*	Level	Level
(m/s)	(dBA)	Std Dev	(dBA)	(dBA)	(dBA)
1	37.08	0.35			
1.5	36.14	0.55			
2	36.70	1.68			
2.5	38.57	3.05			
3	39.18	3.03			
3.5	39.94	3.27			
4	40.39	3.04	38.7	40.39	78.5
4.5	41.06	2.75	39.55	41.06	79.2
5	41.76	2.47	39.48	41.76	79.9
5.5	42.71	2.66	39.84	42.71	80.9
6	43.51	2.66	40.31	42.21	80.4
6.5	44.56	2.81	40.67	43.26	81.4
7	45.75	3.01	41.2	44.45	82.6
7.5	46.87	3.10	41.87	45.57	83.7
8	48.08	3.24	42.65	46.78	84.9
8.5	49.55	3.41	43.72	48.25	86.4
9	51.04	3.60	44.91	49.83	88.0
9.5	52.40	3.78	46.14	51.23	89.4
10	53.92	4.17	47.17	52.89	91.0
10.5	55.53	4.53	48.13	54.66	92.8
11	57.31	4.92	48.91	56.63	94.8
11.5	59.35	5.22	49.73	58.85	97.0
12	61.07	4.88	50.48	60.67	98.8
12.5	62.69	4.71	51.17	62.37	100.5
13	64.02	4.24	51.85	63.75	101.9
13.5	65.44	3.79			
14	66.60	3.29			
14.5	67.39	3.12			
15	68.10	3.04			
15.5	68.92	3.40			
16	69.60	3.18			
16.5	70.02	2.63			
17	71.42	1.82			
17.5	71.79	1.71			
18	71.53	3.22			
18.5	72.14	2.30			
19	73.00	1.13			
19.5	70.10	4.93			
20	62.00	0.00			
			* - From 2006 test on another turbine		

Sound Levels at a Distance from the Turbine

Sound Power Level is defined as the sound level at a distance of 1 meter (3.3 ft) from the source, which we take as the center of the rotor or, in other words, hub height. As a person gets farther and farther away from the wind turbine, the intensity of the sound they will hear reduces as the square of the distance. The following table provides the AWEA Rated Sound Levels at different distances from the base of the turbine, assuming a 30m (100 ft) tower. These levels do not include a contribution from background noise levels.

Distance from Turbine (meters)	Distance (feet)	Slant Distance (m)	Sound Press. Level (dBA)
30	98.42	42.4	53.5
60	196.85	67.1	49.5
90	295.27	94.9	46.5
120	393.70	123.7	44.2
150	492.12	153.0	42.4
180	590.55	182.5	40.8
210	688.97	212.1	39.5
240	787.40	241.9	38.4
270	885.82	271.7	37.4
300	984.25	301.5	36.5
330	1,082.67	331.4	35.6
360	1,181.10	361.2	34.9
390	1,279.52	391.2	34.2