



ICC-SWCC™ SUMMARY REPORT SWCC-16-02



Small Wind Turbine Certification Program

Manufacturer: Bestwatt B.V.
Wind Turbine Model: Bestwind 30
(480 VAC, 3-phase, 60 Hz)
Certification Number: SWCC-16-02

www.smallwindcertification.org
(888) 422-7233

3060 Saturn St., Suite 100, Brea, CA 92821 USA

A Program of the ICC Evaluation Service (ICC-ES)

The above-identified Small Wind Turbine is certified by the Small Wind Certification Council (ICC-SWCC) - Small Wind Certification Program to be in conformance with the AWEA *Small Wind Turbine Performance and Safety Standard* (AWEA Standard 9.1 – 2009). For the current ICC-SWCC Certificate visit: www.smallwindcertification.org

This report summarizes the results of testing and certification of the Bestwatt B.V. Bestwind 30 in accordance with AWEA Standard 9.1-2009. The Bestwind 30 is a 3-blade, upwind, stall regulated, horizontal axis wind turbine with a rotor diameter of 13.1 m and swept area of 135.1 m². All testing was performed on a turbine system utilizing a 26.5 m (87') lattice tower at a test site in Ihrhove, Westoverledingen near Papenburg, Germany. Power Performance testing was performed from 09 January 2015 through 01 April 2015 by Ingenieurbüro Dr. Ing. Dieter Frey. Duration testing was performed from 01 October 2014 through 01 April 2015 by Ingenieurbüro Dr. Ing. Dieter Frey. Safety and Function testing was performed from 23 January 2015 to 19 November 2015 by GL Garrad Hassan Deutschland GmbH. Acoustic testing was performed from 08 February 2015 to 09 February 2015 by GL Garrad Hassan Deutschland GmbH.

1. Turbine Ratings

The Bestwind 30 performance testing was conducted in accordance with Section 2 of AWEA Standard 9.1-2009. The resulting turbine ratings, tabulated graphical Annual Energy Production (AEP), and graphical and tabulated power curve are given below.

AWEA Rated Annual Energy @ 5 m/s	48,800 kWh
AWEA Rated Sound Level	49.8 dB(A)
AWEA Rated Power @ 11 m/s	27.2 kW
Peak Power @ 16 m/s	34.2 kW

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2. Tabulated Annual Energy Production (AEP)

Corrected to a sea level air density of 1.225 kg/m³. Please note that the table lists AEP from 3 m/s to 10 m/s instead of the typical 4 m/s to 11 m/s

Hub Height Annual Average Wind Speed (m/s)	AEP Measured (kWh)	Standard Uncertainty in AEP (kWh)	Standard Uncertainty in AEP	AEP Extrapolated (kWh)
3	6,958	1,417	20%	6,958
4	24,502	2,555	10%	24,502
5	48,842	3,589	7%	48,847
6	75,719	4,292	6%	75,877
7	101,247	4,667	5%	102,396
8	122,450	4,797	4%	126,540
9	137,738	4,758	4%	147,302
10	146,964	4,612	3%	164,120

3. Annual Energy Production Curve

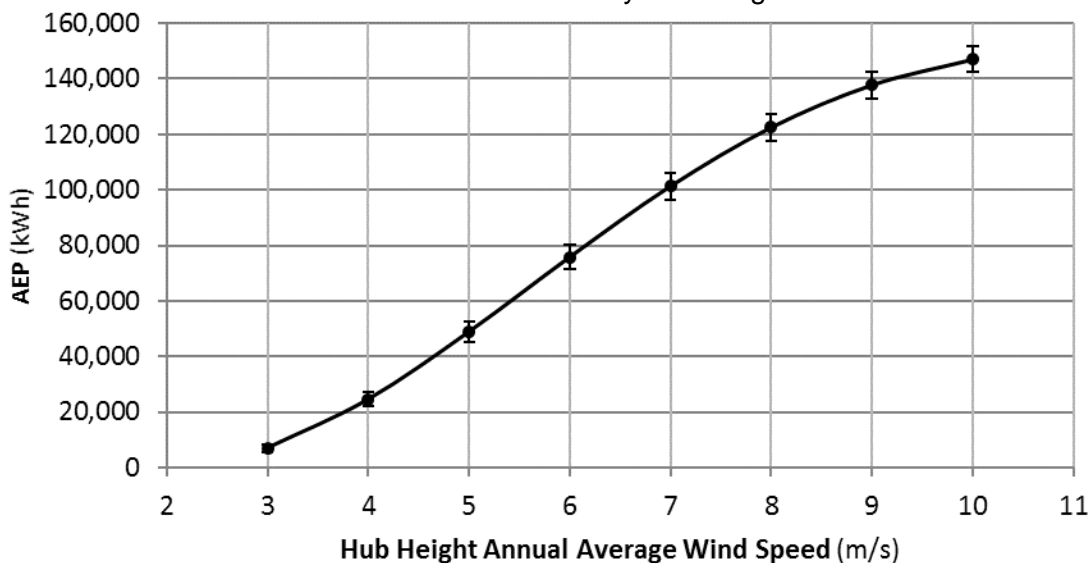
Estimated Annual Energy Production

(AEP-measured)

with Standard Uncertainty

Bestwatt B.V. Bestwind 30

Reference air density: 1.225 kg/m³



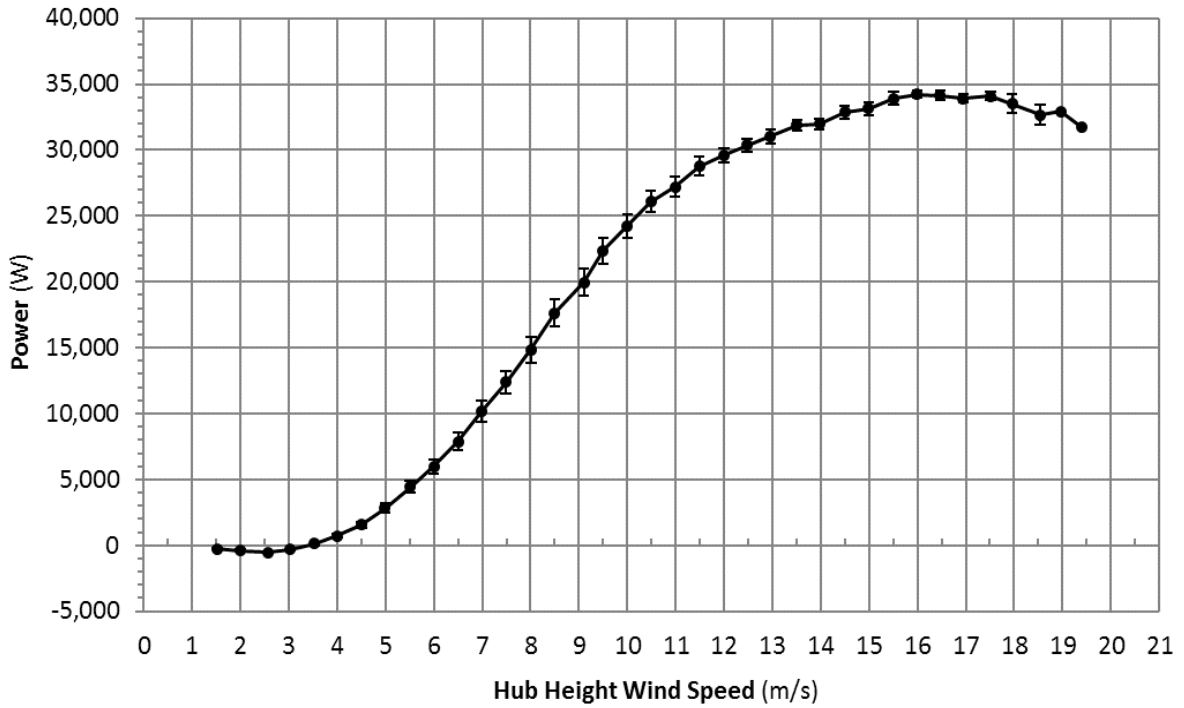
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4. Power Curve

Power Curve
with Combined Standard Uncertainty
Bestwatt B.V. Bestwatt 30
Reference air density: 1.225 kg/m³



5. Tabulated Power Curve

Corrected to a sea level air density of 1.225 kg/m ³					Category A	Category B	Combined
Bin No.	Hub Height Wind Speed	Power Output	Cp	1-minute samples	Standard Uncertainty, Si	Standard Uncertainty, Ui	Standard Uncertainty, Ci
	<i>m/s</i>	<i>Watts</i>			<i>Watts</i>	<i>Watts</i>	<i>Watts</i>
1	1.52	-263	-0.86	71	25	55	61
2	2.00	-385	-0.56	91	27	56	62
3	2.56	-541	-0.38	169	13	53	55
4	3.02	-327	-0.14	332	10	78	79
5	3.53	113	0.03	449	14	115	116
6	4.00	732	0.13	545	18	165	165
7	4.50	1,560	0.20	430	26	247	249
8	4.99	2,821	0.26	500	29	361	362
9	5.51	4,441	0.31	537	40	430	432
10	6.00	5,976	0.32	586	43	513	515
11	6.50	7,880	0.33	506	60	673	676
12	6.99	10,190	0.35	473	73	773	776
13	7.49	12,390	0.34	403	97	824	830
14	8.01	14,840	0.33	383	117	989	996
15	8.50	17,640	0.33	358	130	1041	1049
16	9.10	19,960	0.32	417	126	1020	1028
17	9.50	22,360	0.30	349	121	978	985
18	10.00	24,240	0.28	274	135	881	891
19	10.49	26,100	0.26	236	147	762	776
20	10.99	27,210	0.24	155	180	736	758
21	11.49	28,770	0.22	116	177	670	693
22	12.00	29,620	0.20	121	174	500	529
23	12.48	30,360	0.18	97	189	485	521
24	12.96	31,040	0.17	107	177	506	536
25	13.51	31,900	0.15	113	184	375	417
26	13.97	31,990	0.14	100	143	396	421
27	14.50	32,880	0.12	85	141	451	473
28	14.99	33,140	0.11	80	157	434	462
29	15.51	33,930	0.11	73	170	464	494
30	15.99	34,230	0.10	80	129	263	293
31	16.47	34,150	0.09	64	156	282	322
32	16.95	33,900	0.08	45	205	247	321
33	17.51	34,110	0.07	42	193	289	348
34	17.96	33,530	0.07	20	398	628	744
35	18.54	32,670	0.06	15	306	679	745
36	18.96	32,920	0.06	9	0	0	0
37	19.40	31,720	0.05	8	0	0	0

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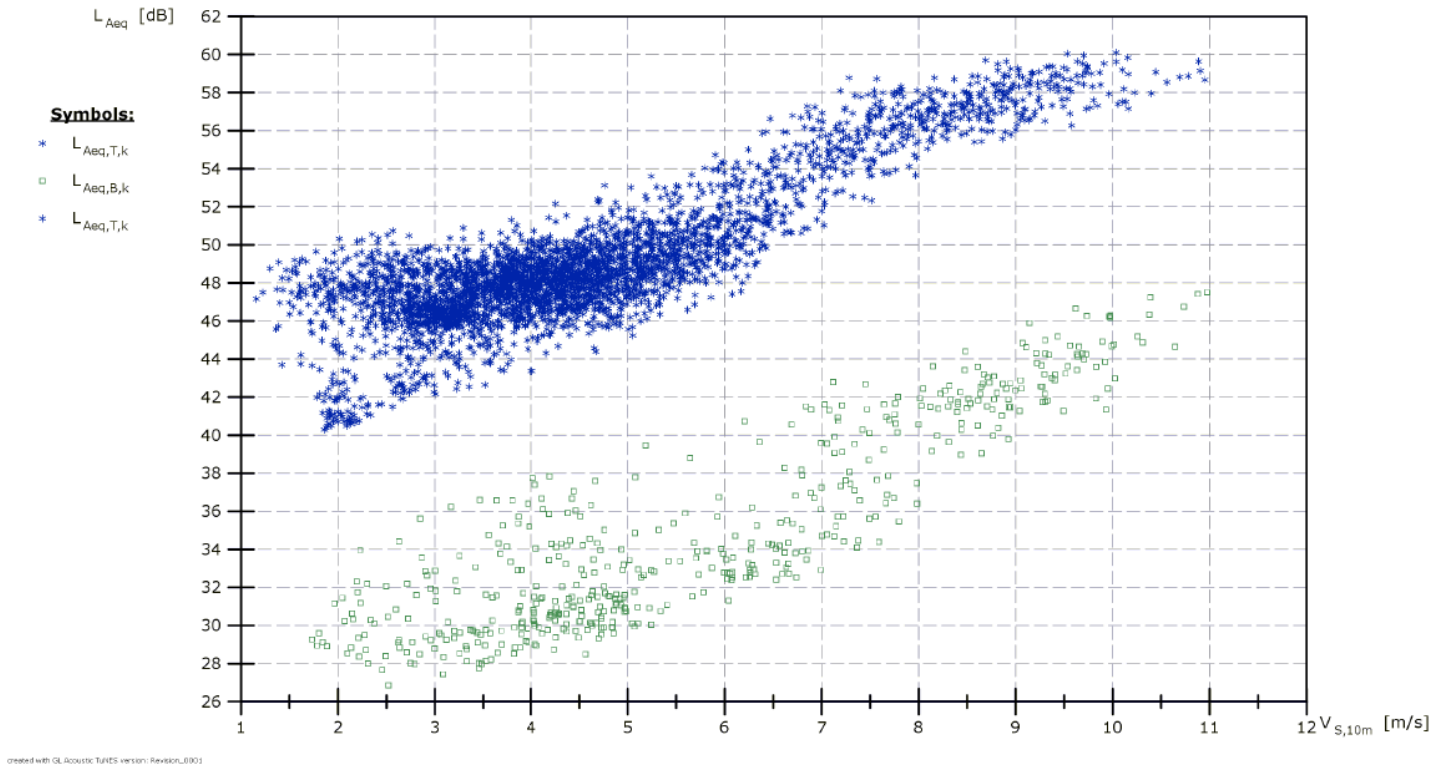
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6. Tabulated Acoustic Data

The Bestwind 30 was tested in accordance with Section 3 of AWEA Standard 9.1-2009. The tabulated Sound Power Level is provided for specific wind speed bins.

Wind Speed at 10m Height m/s	Measured Turbine Sound Level dB(A)	Measured Background Sound Level dB(A)	Background Corrected Sound Level dB(A)	Apparent Sound Power Level dB(A)	Combined Uncertainty dB(A)
6	51.3	34.3	51.2	89.2	2.3
7	54.2	37.9	54.1	92.1	1.7
8	55.8	40.7	55.7	93.7	1.4
9	57.9	42.7	57.8	95.8	1.1
10	58.7	45.0	58.5	96.5	1.1

7. Graphical Acoustic Data (from GLGH report GLGH-4286 14 12454 293-A-0004-A)



8. Duration Testing

The Bestwind 30 successfully completed a Duration Test for an IEC Class II Small Wind Turbine with an Operational Time Fraction of 99.8%. The highest instantaneous wind speed recorded during the test was 27.5 m/s (61.5 mph). The average turbulence intensity at 15 m/s was 10.4 %.

9. Mechanical Strength Analysis

The mechanical strength analysis was found to be in conformance with IEC 61400-2 as modified by section 4 of AWEA Standard 9.1 – 2009 for an IEC Class II Small Wind Turbine.

10. Safety and Function testing

Safety and Function testing was found to be in conformance with sections 4.3 and 4.4 of AWEA Standard 9.1 – 2009.

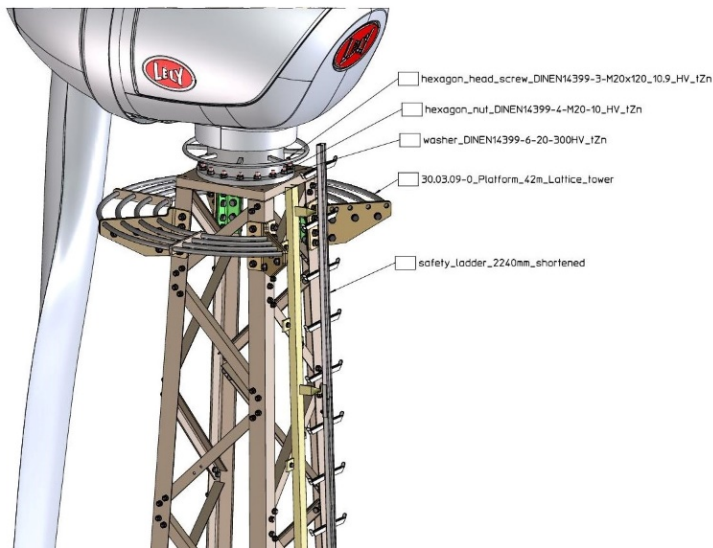
11. Manufacturer Tower Design Requirements (SRCC is not responsible for any errors in the document below, which is provided by the manufacturer).

Basic tower design requirements	
Turbine Model	Bestwind 30
Power rating	29.8kW
Tower top mass	2544 kg
Rotor diameter	13.12m
Number of blades	3
Rotor swept area	135.1m ²
Extreme wind speed Ve1 (one-year occurrence)	47.6 m/s
Extreme wind speed Ve50 (fifty-year occurrence)	59.5 m/s
Lateral thrust at Ve50 (parked rotor)	30.9 kN
Distance mounting flange face to rotor axis	0.814 m
Distance tower center to center of gravity nacelle	0.443 m
Distance from tower center to rotor center	0.95 m
Thrust offset from tower centre axis	0 m
Turbine mass offset from tower centre	0 m
Maximum shaft braking torque	11.20 kNm
Rotor speed at rated power	65 rpm
Rotor speed maximum	80 rpm
Maximum tower top deflection at Ve50 as a percentage of height	0.5 %
Natural frequency range	1.2 – 5.8 Hz
Rotor tilt angle	5.0 deg
Minimum blade/tower clearance (at blade tip)	0.79 m
Rotorblade	
1. flap wise natural frequency, dynamic	3.24 – 3.29 Hz
2. flap wise natural frequency, dynamic	12.93 - 13.12 Hz
1. edge wise natural frequency, dynamic	6.06 – 6.15 Hz
2. edge wise natural frequency, dynamic	26.73 – 27.13 Hz
Tower	
1. mode longitudinal/transverse, dynamic	1.20 Hz
2. mode longitudinal/transverse, dynamic	5.51 Hz
Torsion, dynamic	3.78 Hz
Nacelle, yaw, dynamic	9.42 Hz

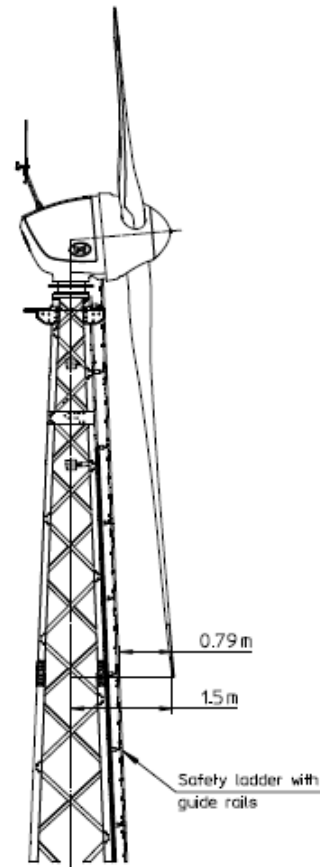
Mechanical and Electrical Connections

Please refer to the installation manual chapter 5 for the mechanical installation, and chapter 6 for the electrical installation of the Bestwatt B.V. Bestwind 30 (Document No. IM01 REV.:03.181115) which is available from Bestwatt.

Mechanical connection, nacelle to tower



Minimum Blade/Tower Clearance



Please note: The above Tower Design Requirements information is provided for reference only. Please obtain the Tower Design Specifications document from Bestwatt. Bestwatt has a policy of allowing the Bestwind 30 turbine to be installed only on towers approved by Bestwatt B.V.

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