

W9x						
Power, cp & ct curves W90						
Doc. No. Dok. Nr.	Power, cp & ct curves W90					
Date Datum	27.5.2004	Rev. Überarbtg.	5			

General:

This document contains **power and thrust specific data** for the WTG configuration:

W90 LM43.8

Additional information:

The power data presented in this document are based on simulation data. That is, the power data are calculated using model information of the WTG. Thus, the presented data are best-knowledge predictions. They can not replace power performance testing. Moreover, the predictions are based on a set of calculation conditions (see page "Calculation conditions"). These conditions emulate the required test site conditions for power performance testing according to IEC 61400-12. The conditions in which the physical WTG is placed may differ from the calculation conditions.

References:

/1/ W0402-G01-TEDE-304-W2E-001-1-G; Allgemeine Beschreibung W90

/2/ W0402-G01-TEDE-304-W2E-001-1-E; General Description W90

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Calculation / prediction conditions

1. Wind turbine generator system

1.1 Rotor diameter	90	m
1.2 Rotor blade	LM43.8	
1.3 Nominal rotor speed	15.9	rpm
1.4 Controller	W2EC 1.0_1.0.2	
1.5 Losses	acc. to: W0402-N06-TENO-304-W2E-001-02-E	

2. Atmosphere

2.1 Air density	1.225	kg/m3
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3. Simulation site

3.1 Topographical variations	-5	deg (slope)
3.2 Turbulence intensity	10	% (constant vs. wind speed)
3.3 Wind gradient	0.16	-

4. Simulation procedure

4.1 Wind simulation	4 x 600s	(each wind simulation based on different seed)
	2 x 600s	(each wind simulation based on different seed)
4.2 Simulation intervall	4 - 14 m/s - power	(1 m/s bins)
	4 - 25 m/s - thrust	(1 m/s bins)

5. Derived results

5.1. Determination of the calculated power curve: IEC 61400-12 p.17, eq. (6) (7)

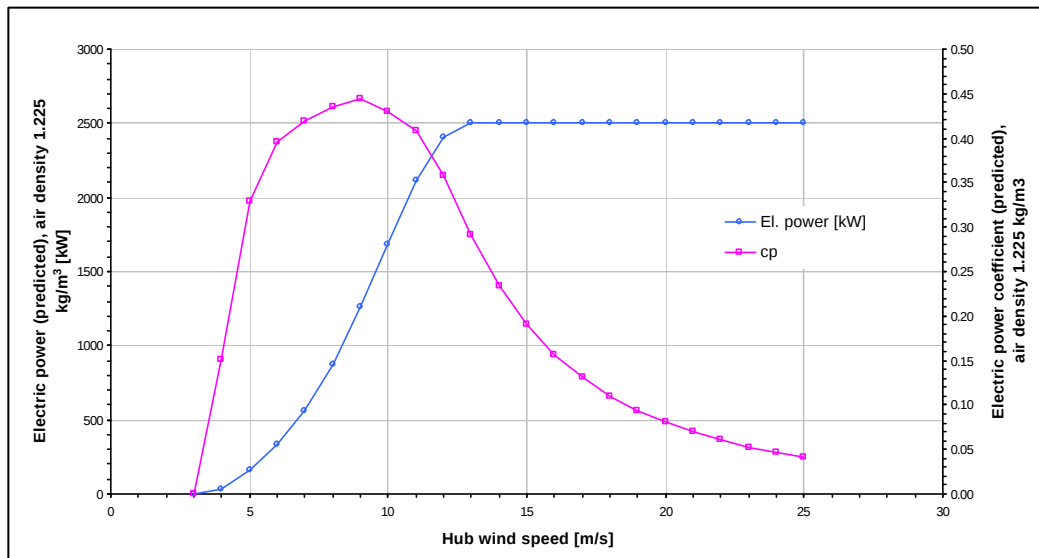
6. Simulation tool Flex5

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Power curve & Power coefficient W90
calculation utilizing Flex5 W2EC 1.0_1.0.2

v_{wind} [m/s]	El. power [kW]	cp
3	0.0	0.000
4	37.6	0.151
5	160.4	0.329
6	333.3	0.396
7	559.2	0.418
8	869.4	0.436
9	1260.0	0.444
10	1678.3	0.431
11	2113.8	0.408
12	2411.8	0.358
13	2500.0	0.292
14	2500.0	0.234
15	2500.0	0.190
16	2500.0	0.157
17	2500.0	0.131
18	2500.0	0.110
19	2500.0	0.094
20	2500.0	0.080
21	2500.0	0.069
22	2500.0	0.060
23	2500.0	0.053
24	2500.0	0.046
25	2500.0	0.041

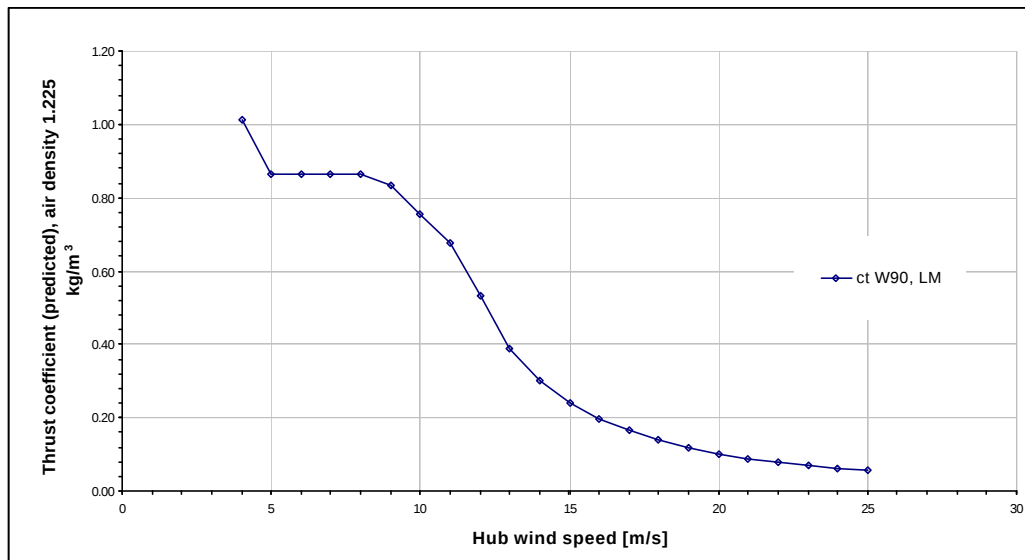


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Thrust coefficient W90, prediction LM Glasfiber, 19.05.03

v_{wind} [m/s]	ct W90, LM
4	1.011
5	0.865
6	0.865
7	0.865
8	0.865
9	0.834
10	0.754
11	0.678
12	0.534
13	0.389
14	0.301
15	0.241
16	0.197
17	0.164
18	0.139
19	0.119
20	0.102
21	0.089
22	0.079
23	0.070
24	0.062
25	0.056



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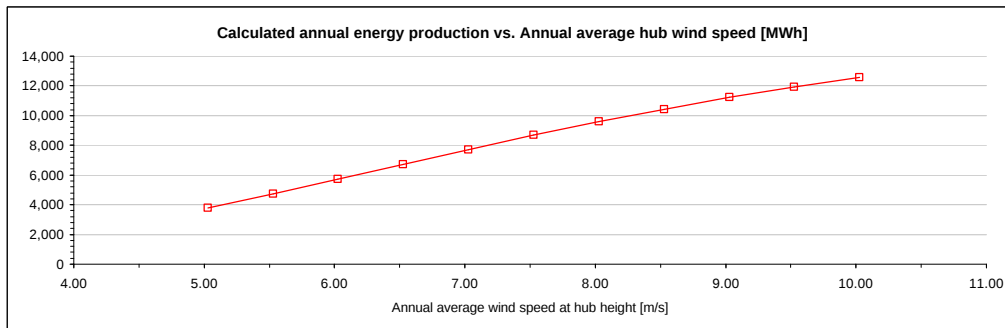
Annual energy production (AEP) (IEC 61400-12, 1998)

Table 1: AEP at selected annual average wind speeds at hub height

Hub wind speed	Calculated annual energy production *
[m/s]	[MWh]
5.00	3,150
5.50	4,093
6.00	5,083
6.50	6,088
7.00	7,081
7.50	8,039
8.00	8,950
8.50	9,800
9.00	10,581
9.50	11,289
10.00	11,918

Specific energy production
[kWh/m ² /yr]
495
643
799
957
1,113
1,264
1,407
1,540
1,663
1,774
1,873

* Standard conditions according to IEC 61400-12



EEG-Referenzertrag

Tabelle 2: Berechneter jährlicher Jahresenergieertrag auf Basis des EEG-Referenzerstandorts ** (Referenzertrag / 5)

Nabenhöhe	Referenzertrag / 5
[m]	[MWh]
60.00	5422
65.00	5577
70.00	5721
75.00	5855
80.00	5980
85.00	6097
90.00	6207
95.00	6312
100.00	6410
105.00	6504
117.00	6711
141.00	7066
160.00	7303

** EEG-Referenzstandort: 5.5m/s Jahresmittel in 30m, 1.225 kg/m³ Luftdichte, 0.1 m Rauigkeitslänge, Rayleigh-Verteilung (k=2)

