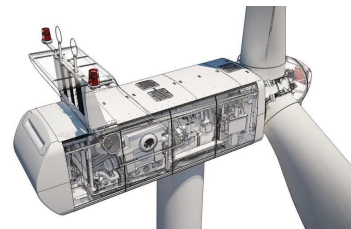


VESTAS V110-2.0 2000 110.0 !O!

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Company VESTAS IEC IIIA (95 m), IEC IIIA (125 m).
 Type/Version V110-2.0
 Rated power 2 000,0 kW
 Secondary generator 0,0 kW
 Rotor diameter 110,0 m
 Tower Tubular
 Grid connection 50/60 Hz

Origin country DK
 Blade type Vestas
 Generator type Variable
 Rpm, rated power 0,0 rpm
 Rpm, initial 0,0 rpm
 Hub height(s) 95,0; 125,0 m
 Maximum blade width 3,60 m
 Blade width for 90% radius 0,85 m
 Valid Yes
 Creator EMD
 Created 2014-06-11 14:27
 Edited 2014-06-11 14:27



Power curve: Level 0 - - Mode 0 - 12-2013

Source Manufacturer

| Source date | Creator | Created | Edited | Default | Stop windSpeed [m/s] | Air density [kg/m3] | Tip angle [°] | Power control | CT curve type |
|------------------|---------|------------------|------------------|---------|-------------------------|------------------------|------------------|---------------|---------------|
| 2013-12-06 00:00 | EMD | 2013-08-19 13:39 | 2014-06-11 14:32 | Yes | 20,0 | 1,225 | 0,0 | Pitch | User defined |

Based on Document no.: 0035-9278 V04.

Power curve

| Wind speed [m/s] | 3,00 | 3,50 | 4,00 | 4,50 | 5,00 | 5,50 | 6,00 | 6,50 | 7,00 | 7,50 | 8,00 | 8,50 | 9,00 | 9,50 | 10,00 | 10,50 | 11,00 |
|------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Power [kW] | 33 | 84 | 149 | 228 | 321 | 433 | 554 | 719 | 909 | 1 122 | 1 354 | 1 591 | 1 788 | 1 916 | 1 973 | 1 991 | 1 998 |
| Ce | 0,210 | 0,337 | 0,400 | 0,430 | 0,441 | 0,447 | 0,441 | 0,450 | 0,455 | 0,457 | 0,454 | 0,445 | 0,421 | 0,384 | 0,339 | 0,295 | 0,258 |

| Wind speed [m/s] | 11,50 | 12,00 | 12,50 | 13,00 | 13,50 | 14,00 | 14,50 | 15,00 | 15,50 | 16,00 | 16,50 | 17,00 | 17,50 | 18,00 | 18,50 | 19,00 | 19,50 |
|------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Power [kW] | 2 000 | 2 000 | 2 000 | 2 000 | 2 000 | 2 000 | 2 000 | 2 000 | 2 000 | 2 000 | 2 000 | 2 000 | 2 000 | 2 000 | 2 000 | 2 000 | 2 000 |
| Ce | 0,226 | 0,199 | 0,176 | 0,156 | 0,140 | 0,125 | 0,113 | 0,102 | 0,092 | 0,084 | 0,076 | 0,070 | 0,064 | 0,059 | 0,054 | 0,050 | 0,046 |

| Wind speed [m/s] | 20,00 |
|------------------|-------|
| Power [kW] | 2 000 |
| Ce | 0,043 |

Ct curve

| Wind speed [m/s] | 3,00 | 3,50 | 4,00 | 4,50 | 5,00 | 5,50 | 6,00 | 6,50 | 7,00 | 7,50 | 8,00 | 8,50 | 9,00 | 9,50 | 10,00 | 10,50 | 11,00 |
|------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Ct | 1,004 | 0,980 | 0,951 | 0,918 | 0,901 | 0,890 | 0,897 | 0,880 | 0,868 | 0,850 | 0,813 | 0,757 | 0,677 | 0,582 | 0,490 | 0,412 | 0,350 |

| Wind speed [m/s] | 11,50 | 12,00 | 12,50 | 13,00 | 13,50 | 14,00 | 14,50 | 15,00 | 15,50 | 16,00 | 16,50 | 17,00 | 17,50 | 18,00 | 18,50 | 19,00 | 19,50 |
|------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Ct | 0,301 | 0,262 | 0,229 | 0,203 | 0,181 | 0,162 | 0,145 | 0,131 | 0,119 | 0,108 | 0,099 | 0,091 | 0,084 | 0,077 | 0,072 | 0,067 | 0,062 |

| Wind speed [m/s] | 20,00 |
|------------------|-------|
| Ct | 0,058 |

Power curve: Level 1 - - Mode 1 - 12-2013

Source Manufacturer

| Source date | Creator | Created | Edited | Default | Stop windSpeed [m/s] | Air density [kg/m3] | Tip angle [°] | Power control | CT curve type |
|------------------|---------|------------------|------------------|---------|-------------------------|------------------------|------------------|---------------|---------------|
| 2013-12-06 00:00 | EMD | 2013-08-19 13:39 | 2014-06-11 14:33 | No | 20,0 | 1,225 | 0,0 | Pitch | User defined |

Based on Document no.: 0035-9278 V04.

Power curve

| Wind speed [m/s] | 3,00 | 3,50 | 4,00 | 4,50 | 5,00 | 5,50 | 6,00 | 6,50 | 7,00 | 7,50 | 8,00 | 8,50 | 9,00 | 9,50 | 10,00 | 10,50 | 11,00 |
|------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Power [kW] | 34 | 84 | 148 | 226 | 318 | 429 | 560 | 722 | 905 | 1 095 | 1 276 | 1 438 | 1 579 | 1 686 | 1 761 | 1 809 | 1 836 |
| Ce | 0,216 | 0,337 | 0,397 | 0,426 | 0,437 | 0,443 | 0,445 | 0,452 | 0,453 | 0,446 | 0,428 | 0,402 | 0,372 | 0,338 | 0,303 | 0,268 | 0,237 |

| Wind speed [m/s] | 11,50 | 12,00 | 12,50 | 13,00 | 13,50 | 14,00 | 14,50 | 15,00 | 15,50 | 16,00 | 16,50 | 17,00 | 17,50 | 18,00 | 18,50 | 19,00 | 19,50 |
|------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Power [kW] | 1 858 | 1 874 | 1 885 | 1 893 | 1 898 | 1 901 | 1 903 | 1 904 | 1 904 | 1 904 | 1 905 | 1 905 | 1 905 | 1 905 | 1 905 | 1 905 | 1 905 |
| Ce | 0,210 | 0,186 | 0,166 | 0,148 | 0,133 | 0,119 | 0,107 | 0,097 | 0,088 | 0,080 | 0,073 | 0,067 | 0,061 | 0,056 | 0,052 | 0,048 | 0,044 |

VESTAS V110-2.0 2000 110.0 !O!

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Wind speed [m/s] 20,00
Power [kW] 1 905
Ce 0,041

Ct curve

| Wind speed [m/s] | 3,00 | 3,50 | 4,00 | 4,50 | 5,00 | 5,50 | 6,00 | 6,50 | 7,00 | 7,50 | 8,00 | 8,50 | 9,00 | 9,50 | 10,00 | 10,50 | 11,00 |
|------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Ct | 1,004 | 0,980 | 0,951 | 0,918 | 0,901 | 0,888 | 0,887 | 0,843 | 0,798 | 0,744 | 0,679 | 0,607 | 0,539 | 0,473 | 0,413 | 0,360 | 0,312 |

| Wind speed [m/s] | 11,50 | 12,00 | 12,50 | 13,00 | 13,50 | 14,00 | 14,50 | 15,00 | 15,50 | 16,00 | 16,50 | 17,00 | 17,50 | 18,00 | 18,50 | 19,00 | 19,50 |
|------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Ct | 0,274 | 0,241 | 0,213 | 0,190 | 0,170 | 0,152 | 0,137 | 0,124 | 0,112 | 0,102 | 0,094 | 0,086 | 0,079 | 0,073 | 0,068 | 0,063 | 0,059 |

Wind speed [m/s] 20,00
Ct 0,055

HP curve comparison

| Vmean [m/s] | 5 | 6 | 7 | 8 | 9 | 10 |
|----------------|-------|-------|-------|-------|--------|--------|
| HP value [MWh] | 4 449 | 6 404 | 8 152 | 9 621 | 10 807 | 11 720 |

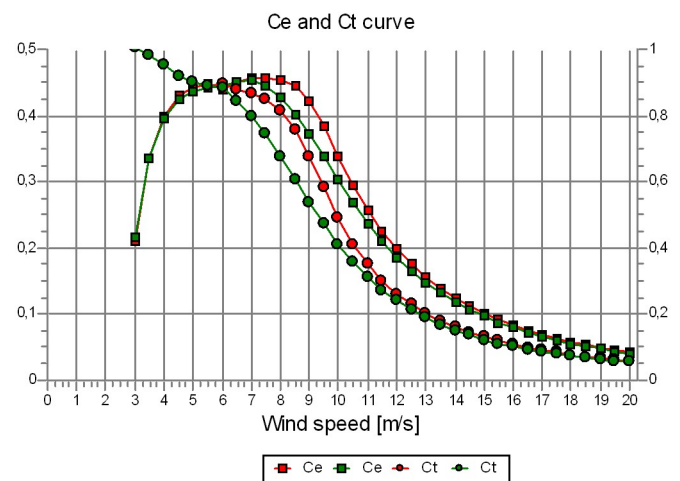
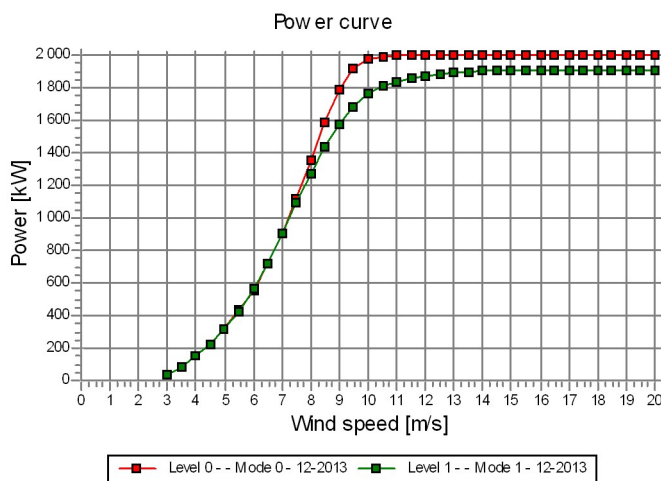
| Level 0 - - Mode 0 - 12-2013 [MWh] | 4 491 | 6 461 | 8 194 | 9 570 | 10 547 | 11 134 |
|------------------------------------|-------|-------|-------|-------|--------|--------|
| Check value [%] | -1 | -1 | -1 | 1 | 2 | 5 |
| Level 1 - - Mode 1 - 12-2013 [MWh] | 4 266 | 6 075 | 7 673 | 8 954 | 9 871 | 10 429 |
| Check value [%] | 4 | 5 | 6 | 7 | 9 | 12 |

The table shows comparison between annual energy production calculated on basis of simplified "HP-curves" which assume that all WTGs performs quite similar - only specific power loading (kW/m^2) and single/dual speed or stall/pitch decides the calculated values. Productions are without wake losses.

For further details, ask at the Danish Energy Agency for project report J.nr. 51171/00-0016 or see WindPRO manual chapter 3.5.2.

The method is refined in EMD report "20 Detailed Case Studies comparing Project Design Calculations and actual Energy Productions for Wind Energy Projects worldwide", jan 2003. Use the table to evaluate if the given power curve is reasonable - if the check value are lower than -5%, the power curve probably is too optimistic due to uncertainty in power curve measurement.

Updated in WindPRO 2.8, Feb. 2012, see details in manual!



Noise: Level 0 - - Mode 0 - 12-2013

Source Manufacturer

| Source date | Creator | Created | Edited | Default |
|------------------|---------|------------------|------------------|---------|
| 2013-12-06 00:00 | EMD | 2013-08-19 13:41 | 2014-06-11 14:38 | Yes |

| Hub height [m] | Wind speed [m/s] | Lwa,ref [dB(A)] | Wind speed dependency [dB(A)/m/s] | Pure tones |
|----------------|------------------|-----------------|-----------------------------------|------------|
| 95,0 | 3,0 | 96,6 | 1,0 | No |
| | 4,0 | 100,3 | 1,0 | No |
| | 5,0 | 104,4 | 1,0 | No |
| | 6,0 | 107,1 | 1,0 | No |
| | 7,0 | 107,3 | 1,0 | No |
| | 8,0 | 107,5 | 1,0 | No |
| | 9,0 | 107,5 | 1,0 | No |
| | 10,0 | 107,5 | 1,0 | No |
| | 11,0 | 107,5 | 1,0 | No |
| | 12,0 | 107,5 | 1,0 | No |
| 125,0 | 13,0 | 107,5 | 1,0 | No |
| | 3,0 | 96,8 | 1,0 | No |
| | 4,0 | 101,9 | 1,0 | No |
| | 5,0 | 105,1 | 1,0 | No |
| | 6,0 | 107,4 | 1,0 | No |
| | 7,0 | 107,5 | 1,0 | No |
| 8,0 | 107,5 | 1,0 | No | |

To be continued on next page...

VESTAS V110-2.0 2000 110.0 !O!

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...continued from previous page

| Hub height [m] | Wind speed [m/s] | Lwa,ref [dB(A)] | Wind speed dependency [dB(A)/m/s] | Pure tones |
|-------------------|---------------------|--------------------|--------------------------------------|------------|
| | 9,0 | 107,5 | | 1,0 No |
| | 10,0 | 107,5 | | 1,0 No |
| | 11,0 | 107,5 | | 1,0 No |
| | 12,0 | 107,5 | | 1,0 No |
| | 13,0 | 107,5 | | 1,0 No |

Based on Document no.: 0035-9278 V04.

Noise: Level 1 - - Mode 1 - 12-2013

Source Manufacturer

| Source date | Creator | Created | Edited | Default |
|------------------|---------|------------------|------------------|---------|
| 2013-12-06 00:00 | EMD | 2013-08-19 13:41 | 2014-06-11 14:39 | No |

| Hub height [m] | Wind speed [m/s] | Lwa,ref [dB(A)] | Wind speed dependency [dB(A)/m/s] | Pure tones |
|-------------------|---------------------|--------------------|--------------------------------------|------------|
| 95,0 | 3,0 | 96,3 | | 1,0 No |
| | 4,0 | 100,1 | | 1,0 No |
| | 5,0 | 103,7 | | 1,0 No |
| | 6,0 | 103,9 | | 1,0 No |
| | 7,0 | 105,0 | | 1,0 No |
| | 8,0 | 105,0 | | 1,0 No |
| | 9,0 | 105,0 | | 1,0 No |
| | 10,0 | 105,0 | | 1,0 No |
| | 11,0 | 105,0 | | 1,0 No |
| | 12,0 | 105,0 | | 1,0 No |
| | 13,0 | 105,0 | | 1,0 No |
| 125,0 | 3,0 | 96,6 | | 1,0 No |
| | 4,0 | 101,7 | | 1,0 No |
| | 5,0 | 104,2 | | 1,0 No |
| | 6,0 | 104,9 | | 1,0 No |
| | 7,0 | 105,0 | | 1,0 No |
| | 8,0 | 105,0 | | 1,0 No |
| | 9,0 | 105,0 | | 1,0 No |
| | 10,0 | 105,0 | | 1,0 No |
| | 11,0 | 105,0 | | 1,0 No |
| | 12,0 | 105,0 | | 1,0 No |
| | 13,0 | 105,0 | | 1,0 No |

Based on Document no.: 0035-9278 V04.

Visual dataName V110 visual
Source Manufacturer

| Hub height [m] | Source date | Creator | Created | Edited | Default |
|-------------------|------------------|---------|------------------|------------------|---------|
| 95,000 | 2013-12-06 00:00 | EMD | 2010-07-02 15:03 | 2014-06-12 13:52 | Yes |

Tower

| Height [m] | Bottom diameter [m] | Top diameter [m] |
|---------------|------------------------|---------------------|
| 30,0 | 3,9 | 2,3 |
| 24,4 | 3,9 | 3,9 |
| 23,0 | 3,9 | 3,9 |
| 15,8 | 4,2 | 3,9 |

Cabin

Distance cabin front (rotor) to tower center: 20 %

| Shape | Height front [m] | Height back [m] | Width front [m] | Width back [m] | Length bottom [m] | Length top [m] | Front offset [m] | Rear offset [m] |
|-------|---------------------|--------------------|--------------------|-------------------|----------------------|-------------------|---------------------|--------------------|
| Box | 4,00 | 0,60 | 3,90 | 3,90 | 0,90 | 0,90 | 0,00 | 0,00 |
| Box | 4,00 | 4,00 | 3,90 | 3,90 | 0,89 | 0,89 | 0,00 | 0,00 |
| Box | 6,77 | 6,77 | 3,90 | 3,90 | 1,95 | 1,95 | 1,40 | 1,40 |
| Box | 4,00 | 6,77 | 3,90 | 3,90 | 2,00 | 2,00 | 0,00 | 1,40 |
| Box | 4,00 | 4,00 | 3,90 | 3,90 | 5,18 | 5,18 | 0,00 | 0,00 |
| Box | 4,11 | 4,00 | 3,90 | 3,90 | 1,22 | 0,83 | 0,05 | 0,00 |

VESTAS V110-2.0 2000 110.0 !O!

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Rotor and hub

Distance cabin front (rotor) to tower center: 20 %

Number of blades

Blade position (center to cabin)

Chord max

Rotor position relative to tower

Hub length (cabin to spinner tip)

Spinner length (0 = no spinner)

Hub diameter (2xradius from hub center to blade root)

Spinner max diameter

Shaft radius

Hub tilt angle

Blade cone angle

| |
|---------|
| 3 |
| 1,70 m |
| 3,60 m |
| Up wind |
| 5,00 m |
| 3,30 m |
| 3,30 m |
| 4,80 m |
| 4,50 m |
| 6,0 ° |
| -2,0 ° |

