

# **AWEA Small Wind Turbine Performance and Safety Standard**



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## AMERICAN WIND ENERGY ASSOCIATION STANDARDS

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# AWEA Small Wind Turbine Performance and Safety Standard

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separate performance tests if both versions were to be certified, but would not need a separate safety evaluation in most cases.

- 1.3.5 Except as noted in Sections, 4.2, 4.5, 5.2.3, 5.2.4, 5.2.5 and 6.1.8, towers and foundations are not part of the scope of this standard because it is assumed that conformance of the tower structure to the International Building Code, Uniform Building Code or their local equivalent will be required for a building permit.

## **1.4 Compliance**

- 1.4.1 Certification to this standard shall be done by an independent certifying agency such as the Small Wind Certification Council (SWCC) or a Nationally Recognized Testing Laboratory (NRTL). Self-certification is not allowed.
- 1.4.2 It is the intent of this standard to allow test data from manufacturers, subject to review by the certifying agency.
- 1.4.3 Compliance with this standard for the purposes of advertising or program qualification, or any other purpose, is the responsibility of the manufacturer.

## **1.5 Definitions**

- 1.5.1 Definitions contained in IEC 6140







## 4 Strength and Safety

- 4.1 Except as noted below, mechanical strength of the turbine system shall be assessed using either the simple equations in Section 7.4 of IEC 61400-2 ed.2 in combination with the safety factors in Section 7.8, or the aeroelastic modeling methods in the IEC standard. Evaluation of, as a minimum, the blade root, main shaft and the yaw axis (for horizontal axis wind turbines) shall be performed using the outcome of these analyses. A quick check of the rest of the structure for obvious flaws or hazards shall be done and if judged needed, additional analysis may be required.
- 4.2 Variable speed wind turbines are generally known to avoid harmful dynamic interactions with towers. Single/dual speed wind turbines are generally known to have potentially harmful dynamic interactions with their towers. Therefore, in the case of single/dual speed wind turbines, such as those using either one or two induction generators, the wind turbine and tower(s) must be shown to avoid potentially harmful dynamic interactions. A variable speed wind turbine with dynamic interactions, arising for example from control functions, must also show that potentially harmful interactions are likewise avoided.
- 4.3 Other safety aspects of the turbine system shall be evaluated including:
  - 4.3.1 procedures to be used to operate the turbine;
  - 4.3.2 provisions to prevent dangerous operation in high wind;
  - 4.3.3 methods available to slow or stop the turbine in an emergency or for maintenance;
  - 4.3.4 adequacy of maintenance and component replacement provisions; and
  - 4.3.5 susceptibility to harmful reduction of control function at the lowest claimed operating ambient temperature.
- 4.4 A Safety and Function Test shall be performed in accordance with Section 9.6 of IEC 61400-2 ed.2.
- 4.5 The manufacturer shall submit design requirements for towers including:
  - 4.5.1 mechanical and electrical connections;
  - 4.5.2 minimum blade/tower clearance;
  - 4.5.3 maximum tower top loads; and
  - 4.5.4 maximum allowable tower top deflection.

## 5 Duration Test

- 5.1 To establish a minimum threshold of reliability, a duration test shall be performed in accordance with the IEC 61400-2 ed.2 Section 9.4.
- 5.2 Changes and additional clarifications to this standard include:
  - 5.2.1 The test must include at least 25 hours in wind speeds of 15 m/s (33.6 mph) and above.
  - 5.2.2 Minor repairs are allowed, but must be reported.
  - 5.2.3 If any major component such as blades, main shaft, generator, tower, controller, or inverter is replaced during the test, the test must be restarted.
  - 5.2.4 The turbine and tower shall be observed for any tower dynamics problems during the duration test and the test r

## 7 Labeling

- 7.1 The AWEA Rated Annual Energy (AWEA RAE) shall be stated in any label, product literature or advertising in which product specifications are provided.
  - 7.1.1 The AWEA RAE shall be rounded to no more than 3 significant figures.
- 7.2 The manufacturer shall state the AWEA Rated Power if a rated power is specified.
- 7.3 The manufacturer shall state the AWEA Estimated Sound Level if a sound level is specified.
- 7.4 Other performance data recommended to be stated in specifications about the turbine are:
  - 7.4.1 Cut-in Wind Speed
  - 7.4.2 Cut-out Wind Speed
  - 7.4.3 Maximum Power
  - 7.4.4 Maximum Voltage
  - 7.4.5 Maximum Current(s)
  - 7.4.6 Overspeed Control
  - 7.4.7 Power Form

## 8 Changes to Certified Products

- 8.1 It is anticipated that certified wind turbines will occasionally be changed to provide one form of improvement or another. In some cases such changes will require review by the certifying agency and possible changes to the certified product parameters. The following guidance is provided concerning when product changes will require certifying agency review:
- 8.1.1 Any changes to a certified wind turbine that will have the cumulative effect of reducing AWEA Rated Power or AWEA Rated Annual Energy by more than 10%, or that will raise the AWEA Rated Sound Level by more than 1 dBA will require retesting and recertification by the certifying agency. Only those characteristics of the wind turbine affected by the design change(s) would be reviewed again.
  - 8.1.2 Any changes to a certified wind turbine that could reduce the strength and safety factors by 10%, or increase operating voltages or currents by 10%, will require resubmission of the Wind Turbine Strength and Safety Report and recertification by the certifying agency.
  - 8.1.3 Any changes to a certified wind turbine that could materially affect the results of the Duration Test will require retesting, submission of a new Duration Test Report, and recertification by the certifying agency.
- 8.2 The manufacturer is required to notify the certifying agency of all changes to the product, including hardware and software, for the life of the turbine certification. The certifying agency will determine whether the need for retesting and additional review under the guidelines provided in Section 8.1.
- 8.3 The use of Engineering Change Orders or their equivalent is recommended.

## 9 References and Appendices

### 9.1 References

- 9.1.1 Evaluation Protocol for Small Wind Systems, Rev. 3. NREL internal document
- 9.1.2 IEC 61400-12-1 ed.1, Wind Turbines – Part 12-1: Power performance measurements of electricity producing wind turbines
- 9.1.3 IEC 61400-11 ed.2, Wind turbine generator systems - Part 11: Acoustic noise measurement techniques
- 9.1.4 IEC 61400-2, ed.2, Wind Turbines – Part 2: Design requirements of small wind turbines

## Appendix A

### Sound Levels for Different Observer Locations and Background Sound Levels

The AWEA Rated Sound Level is calculated at a distance of 60 meters from the rotor hub and excludes any contribution of background sound. As the distance from the turbine increases, the background sound becomes more dominant in determining the overall sound level (turbine plus background).

Background sound levels depend greatly on the location and presence of roads, trees, and other sound sources. Typical background sound levels range from 35 dBA (quiet) to 50 dBA (urban setting)

Equation 1 can be used to calculate the contribution of the turbine to the overall sound level using the AWEA Rated Sound Level. Equation 2 can be used to add the turbine sound level to the background sound level to obtain the overall sound level.

$$\text{turbine sound level } L_{AWEA} = 10\log(4 \cdot 60^2) + 10\log 4 R^2 \quad (1)$$

Where:

$L_{AWEA}$  is the AWEA Rated Sound Level [dBA].

R is the observer distance from the turbine rotor center [m]

$$\text{overall sound level} = 10\log\left(10^{\frac{\text{turbine level}}{10}} + 10^{\frac{\text{background level}}{10}}\right) \quad (2)$$

**Table 1 Overall Sound Levels at Different Locations for an AWEA Rated Sound Level of 40 dBA**

Distance from rotor center [m]	$L_{AWEA}$ : 40 dBA				
	background noise level (dBA):				
	30	35	40	45	50
10	55.6	55.6	55.7	55.9	56.6
20	49.6	49.7	50.0	50.9	52.8
30	46.1	46.4	47.0	48.6	51.5
40	43.7	44.1	45.1	47.3	50.9
50	41.9	42.4	43.9	46.6	50.6
60	40.4	41.2	43.0	46.2	50.4
70	39.2	40.2	42.4	45.9	50.3
80	38.2	39.4	41.9	45.7	50.2
100	36.6	38.3	41.3	45.5	50.2
150	34.1	36.8	40.6	45.2	50.1
200	32.8	36.1	40.4	45.1	50.0

**Table 2 Overall Sound Levels at Different Locations for an AWEA Rated Sound Level of 45 dBA**

Distance from rotor center [m]	L <sub>AWEA</sub> : 45 dBA				
	background noise level (dBA):				
	30	35	40	45	50





