

International Electrotechnical Commission Standard IEC 61400-11 and Other Procedures

Acoustic Noise Measurement Techniques

Arlinda Huskey

National Renewable Energy Laboratory

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Standards and Other Procedures

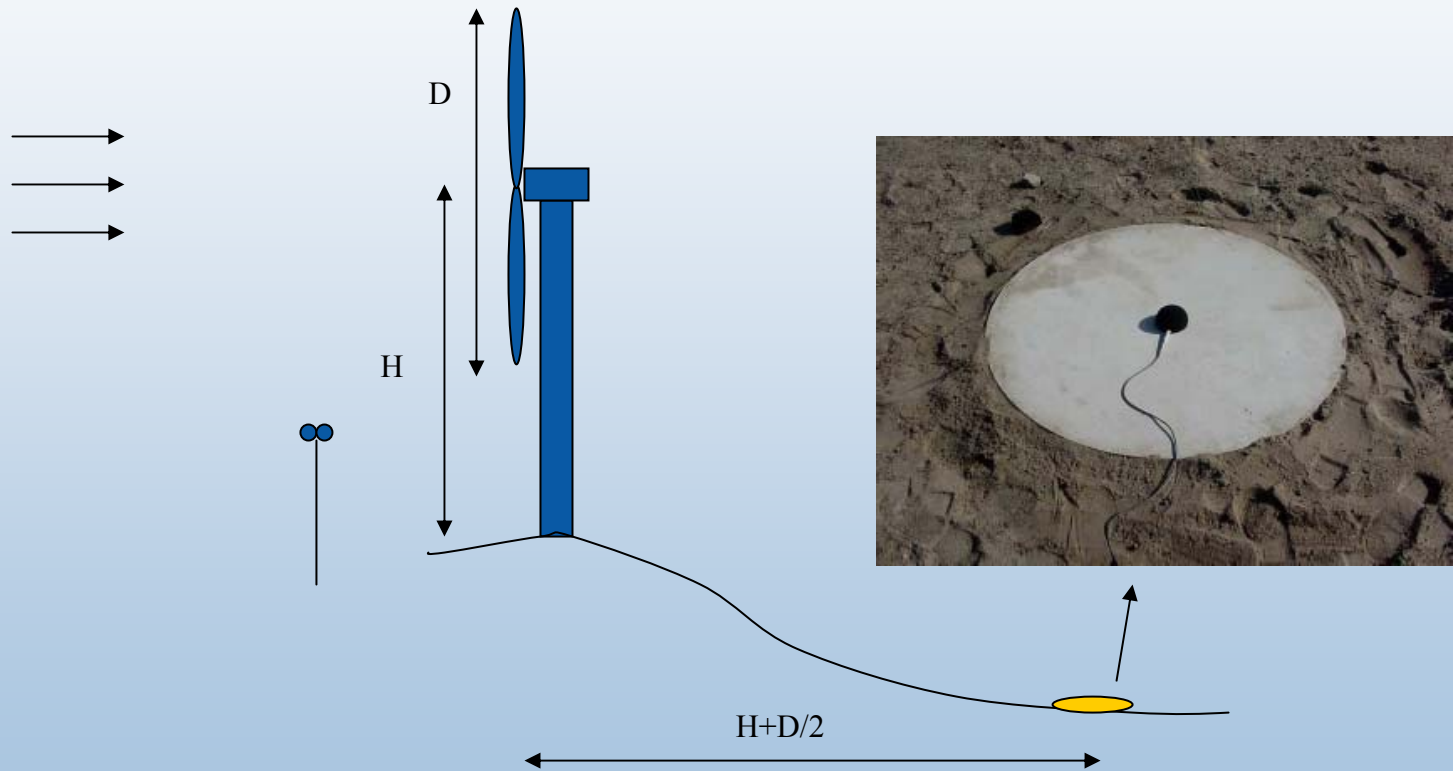
- IEC 61400-11 Second Edition 2002 Acoustic Noise Measurement Techniques
 - Amendment approved in 2005
- MEASNET, Version 2, January 2005
- AWEA small wind turbine performance and safety standard

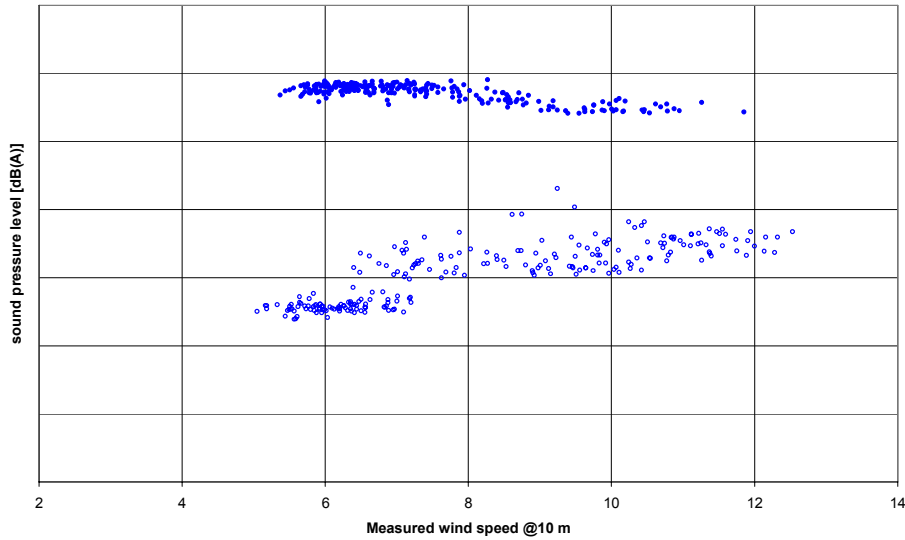


IEC 61400-11 2002

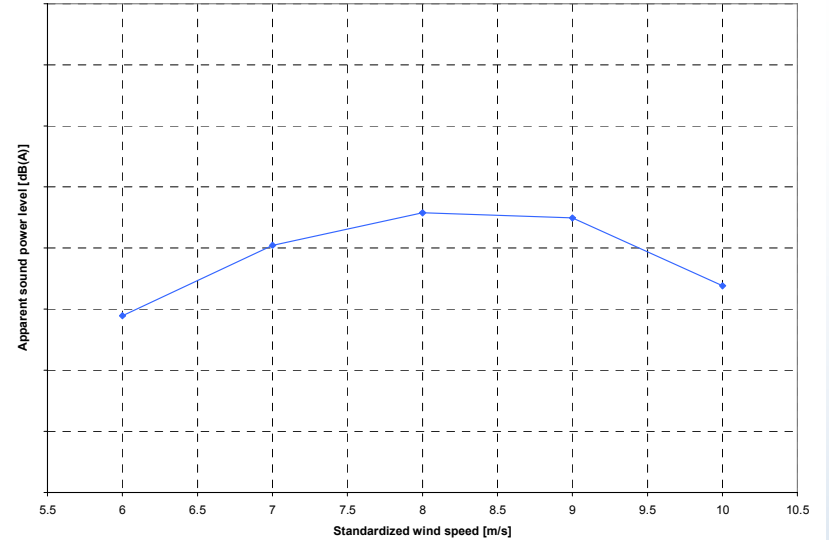
- Used by
 - Manufacturers to declare acoustic emission performance
 - Purchasers to verify declared values
 - Wind turbine operators to verify declared values
 - Wind turbine planner or regulator to meet regulations or permit requirements
- Reporting
 - Sound power level at 6, 7, 8, 9, and 10 m/s
 - 1/3 octave levels at 6, 7, 8, 9, and 10 m/s
 - Tonality at 6, 7, 8, 9, and 10 m/s
 - Uncertainty for all above values

IEC 61400-11 Method

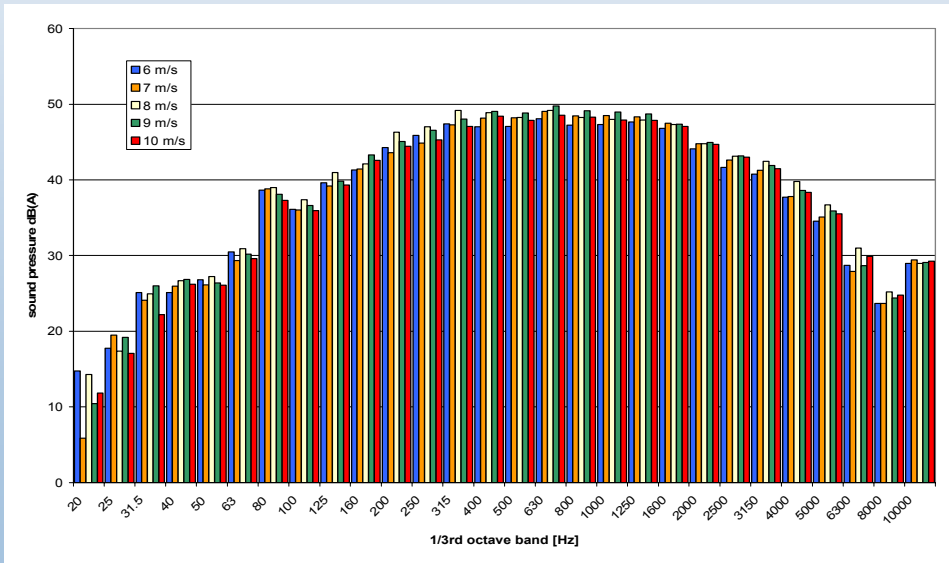




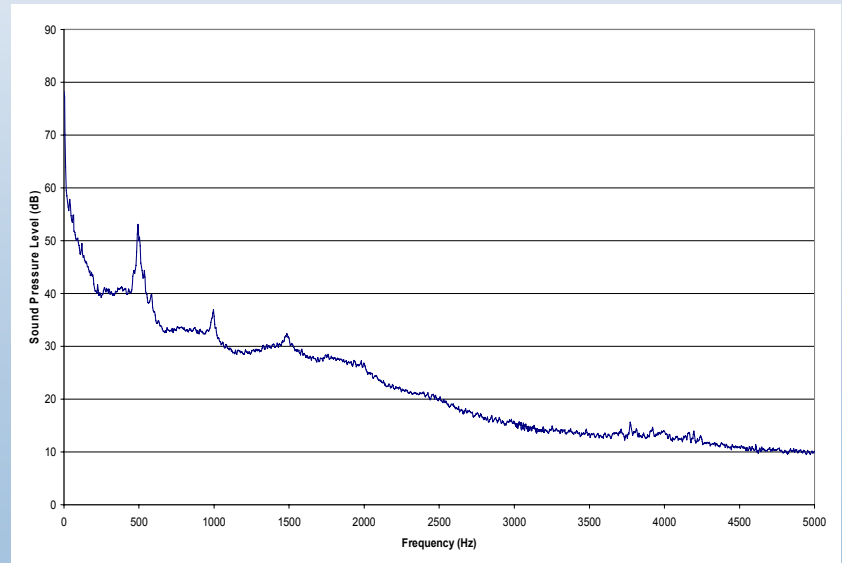
Measured sound levels



Sound Power Levels



1/3rd octave levels



Tonality

IEC 61400-11 Changes from 1st Edition

- Tonality
 - Improvement for pitch controlled and stall controlled turbines
 - Analysis on shorter time periods to better characterize tones
 - Improvement on procedure to identify tones
 - Optional audibility criterion added for reportable tones
- Sound power levels, 1/3 octave, and tonality reported for 6, 7, 8, 9, and 10 m/s
 - Previously reported for only 8 m/s

IEC 61400-11 Changes from 1st Edition

- Derived wind speed from power above 95% of rated power
 - No previous method but needed for turbines reaching rated power before 10 m/s
 - A ratio of measured and derived wind speed before 95% rated power used to derive wind speed from power after 95% rated power
 - “Questionable”
- More work and complicated but more information reported, better repeatability

Amendment to IEC 61400-11

- Nacelle anemometer method preferred to using ratio for wind speed determination above 95% of rated power
- Reporting of rotor speed and pitch angle recommended
- In determining the sound pressure levels, a higher order regression will be used. Another option is linear regression within bins

IEC 61400-11 Revision for 3rd Edition

- New revision started May 2006
- Methods for other wind turbines will be considered (small, low wind speed, offshore)
- Anemometer height (currently 10 meters up to hub height)
- Averaging period (currently 1-minute)
- Improvements in 1/3 octave procedure for modeling purposes
- Improvements in the uncertainty analysis
- Wind farm verification
- Possibly including infrasound, impulsive, and low frequency noise

MEASNET

- International MEASuring NETwork of wind energy institutes
- MEASNET objectives:
 - High quality measurements
 - Uniform interpretation of standards
 - Interchangeability of results (round robin comparisons)
- Expert groups for acoustic noise, power performance, power quality, and anemometer calibration
- NREL is MEASNET member approved for power quality and acoustic noise
- Procedures based on IEC with modifications
- Faster process of approval than IEC



AWEA Small Wind Turbine Performance and Safety Standard

- Procedure for evaluating the safety, reliability, performance, and acoustic characteristics of a small wind turbine
- Uses terms very close to the IEC standard but suited to help the consumer understand better
- Uses the general methodology of the IEC standard for quality measurements but has some changes to better characterize dynamic small wind turbines such as overspeed control
- Overall reporting “number” is the Small Wind Certification Corporation (SWCC) rated sound level

Conclusions

- Standards need revision:
 - “State-of-the-art” knowledge changes
 - Wind turbines change
- The best methods differ based on the type and size of wind turbine
- All standards and procedures are to ensure quality and repeatable measurements
- Terminology can be confusing, make sure you understand what number is used