


SMALL WIND TURBINE TESTING AND CERTIFICATION


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WIND GENERATOR CLASSIFICATIONS



Rated power (kW)	Rotor swept area (m ²)	Sub-category
$P_{\text{rated}} < 1 \text{ kW}$	$A < 4 \text{ m}^2$ (1.25m Dia)	Pico wind turbine
$1 \text{ kW} < P_{\text{rated}} < 7 \text{ kW}$	$A < 40 \text{ m}^2$ (3.6m Dia)	Micro wind turbine
$7 \text{ kW} < P_{\text{rated}} < 50 \text{ kW}$	$A < 200 \text{ m}^2$ (7.9m dia)	Mini wind turbine or
$50 \text{ kW} < P_{\text{rated}} < 100 \text{ kW}$	$A < 300 \text{ m}^2$ (9.6m Dia)	No clear ^{SWT} definition yet adopted



CLASSIFICATION OF SWT



SWT Class	I	II	III	IV	S
V_{ref} (m/s)	50	42,5	37.5	30	Values to be specified by the designer
V_{ave} (m/s)	10	8.5	7.5	6	
I_{15} (-)	0.18	0.18	0.18	0.18	
a (-)	2	2	2	2	

Where

- the values apply at hub height and
- I_{15} is the dimensionless characteristic value of the turbulence intensity at 15 m/s
- a is the dimensionless slope parameter to be used in equation



CLASSIFICATION OF SMALL WIND TURBINE BASED ON APPLICATION



Small wind turbines (SWTs) are used in two main areas

- **'Autonomous' electrical systems (also called 'stand-alone', 'grid-isolated' or 'off-grid'), < 10 kW**
not connected to any larger electrical system and are therefore solely responsible for the control of voltage and frequency;
- **'Distributed generation', or on grid or grid-connected'**
systems with small generators connected to a larger public distribution network, where there is a network operator responsible for overall control
 - a) Isolated grid electricity generation 10 kW to 200 kW
 - b) Central grid electricity generation > 200 kW



INTERESTS and Proposals on SWTs



Small wind turbines (SWTs)

- **NASA test certified magnus wind turbine – from Japan**
- **Vertical Axis wind turbines 200-250 watts- for captive-Kolkatta**
- **Small domestic wind turbine 2 kW in Coorg-district-Karnataka**
- **Multi-rotor SWT – a draft patent filed for CWET's comment-Karnataka**
- **Vertical axis SWT in hybrid used for Hoarding-illumination-US-JV Punjab**
- **Scheme for empanelment of SWTs (Wind, wind-solar, wind-solar-diesel)**



HURDLES FOR SMALL WIND TURBINE



- Small wind turbine performance specifications are **not standardized**; potential for black eyes to thwart market growth
- Consumers **need greater assurance** of safety, functionality, and durability to justify investments
- Agencies **providing financial assistance** are asking for performance assurance to increase support for Incentives
- Consumers do **not have user friendly** tools to compare turbine or accurately estimate energy *performance*
- **Lack of Adequate design details** with Manufacturers/suppliers of SWT



SMALL WIND TURBINE CERTIFICATION



- Energy yields Overstated by some manufacturers/ suppliers
- No idea of performance (safety, noise, energy yield)
- In order to boost the quality of the wind turbines
- Essential for industry credibility and leveraging incentive fund



WISHES OF STAKEHOLDERS

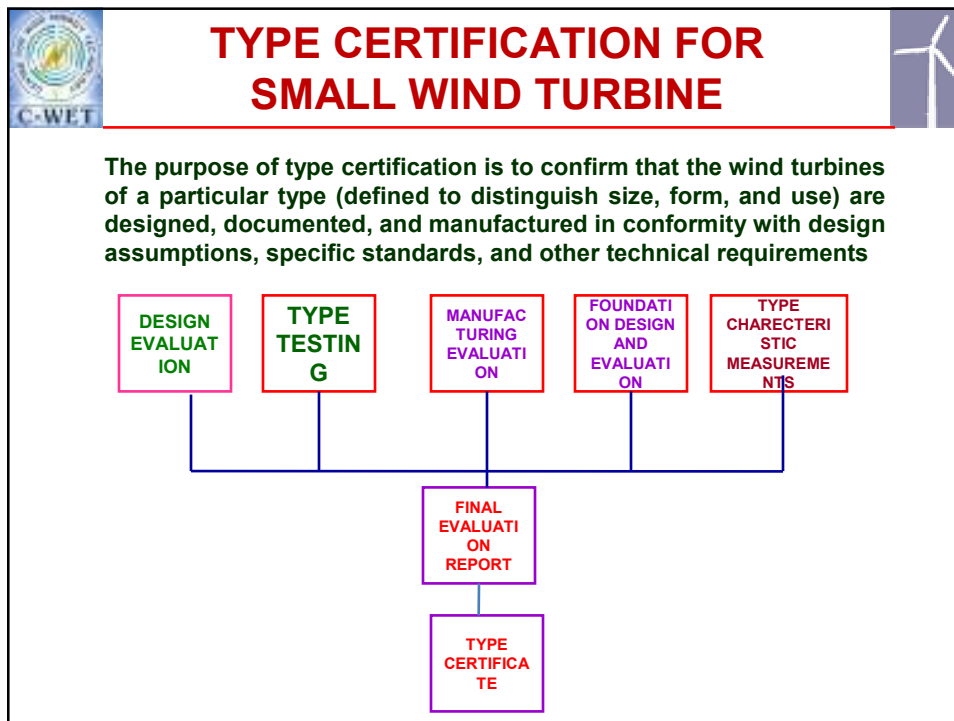
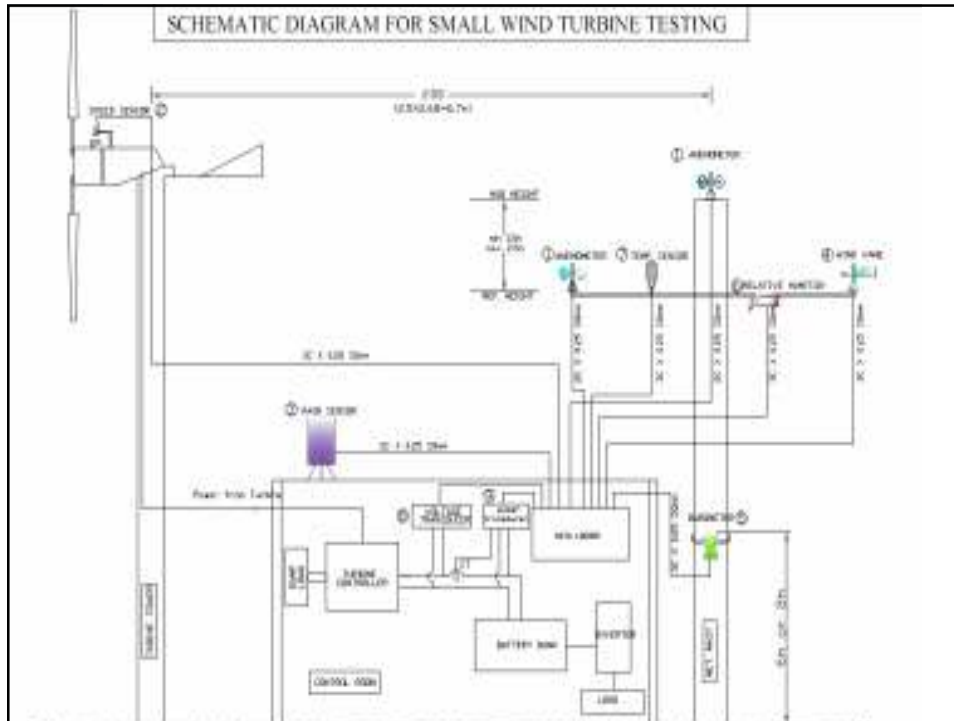


Manufacturers/suppliers:

- Low costs
- Should fit international standards
- Bigger market

Potential buyers:

- Trustful information on performance
- Energy yield prediction
- Safety
- Nuisance (Noise, shadow, reflections)
- Should fit international standards

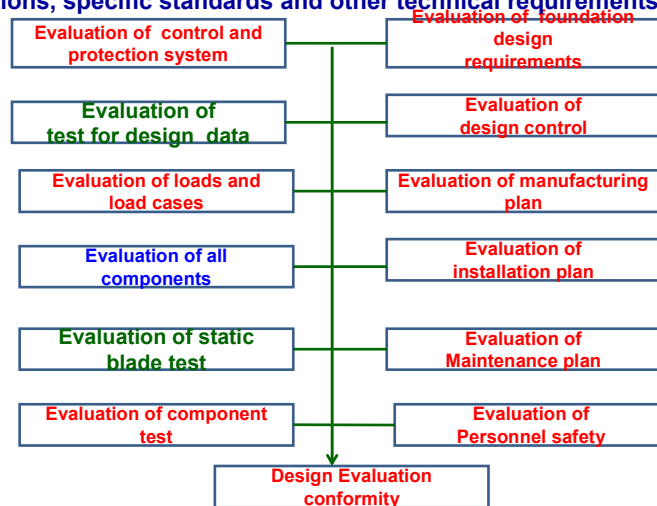




DESIGN EVALUATION



The objective of the design evaluation is to examine whether the wind turbine type is designed and documented in conformity with the design assumptions, specific standards and other technical requirements



DESIGN FEATURES TO BE EVALUATED FOR SWT



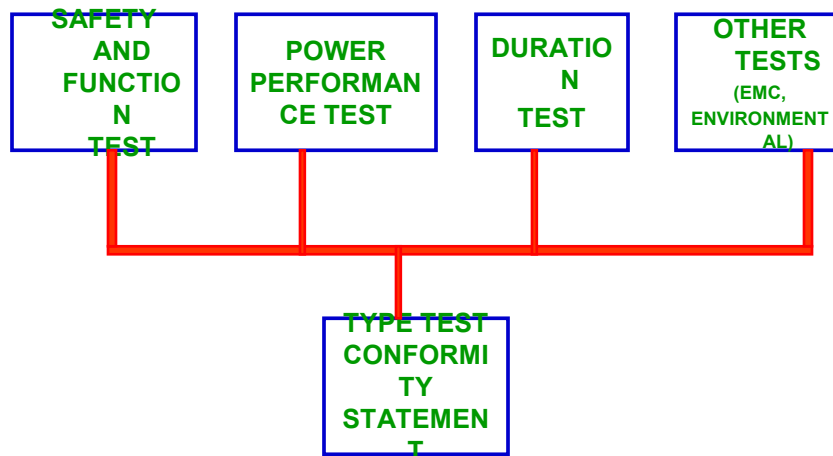
- CONTROL AND PROTECTION SYSTEM
- LOADS AND LOAD CASES
- STRUCTURAL COMPONENTS
- MECHANICAL AND ELECTRICAL COMPONENTS



TYPE TESTING



The objective of the type test is to provide data needed to verify aspects which are vital to safety and therefore need additional experimental verification, and aspects which cannot be reliably evaluated by analysis.



TESTS TO BE CARRIED OUT



Based on IEC Standards

- Power performance measurement
- Annual Energy Production
- Sound Pressure Levels (55 db DAY, 45db NGT)
- Strength and Safety Test (Pass/Fail)
- Duration Test (Pass/Fail)



SAFETY AND FUNCTION TEST (1/2)



The purpose of safety and function testing is to verify that the wind turbine under test displays the behavior predicted in the design and that provisions relating to personnel safety are properly implemented.

The safety and function tests shall include the critical function of the control and protection system that require test verification. These are

- power and speed control;
- yaw system control (wind alignment);
- loss of load;
- over speed protection at design wind speed or above; and
- start-up and shut down above design wind speed.



SAFETY AND FUNCTION TEST (2/2)



Other items that might be applicable are:

- excessive vibration protection;
- battery over- and under-voltage protection;
- emergency shutdown under normal operation;
- cable twist; and
- anti-islanding (for grid connections)



DURATION TEST



The purpose of the duration test is to investigate:

- structural integrity and material degradation (corrosion, cracks, deformations, wear);
- quality of environmental protection of the wind turbine; and
- the dynamic behaviour of the turbine.



DURATION TEST



The wind turbine will have passed the duration test when it has achieved:

- **reliable operation during the test period;**
- **at least 6 months of operation;**
- **at least 2 500 h of power production in winds of any velocity;**
- **at least 250 h of power production in winds of $1.2 V_{ave}$ and above; and**
- **at least 25 h of power production in winds of $1.8 V_{ave}$ and above**



POWER PERFORMANCE TEST



The Power Performance test will be carried in accordance to the IEC standard, Wind Turbine Generator Systems, Part 12: Power performance Measurement Techniques, IEC 61400-12-1 the evaluation and performance testing of small wind turbines

- Power curves - validation of the manufacturer's performance claims over a range of wind speeds, aggregated over time.
- Energy yield - determination of the amount of energy likely to be generated per annum, for a specific average wind speed.
- Acoustic noise level - measurement of the noise footprint using internationally agreed techniques.



RELIABLE OPERATION



Reliable operation means:

- operational time fraction of at least 90 %;
- no major failure of the turbine or components in the turbine system;
- no significant wear, corrosion, or damage to turbine components; and
- no significant degradation of produced power at comparable wind speeds.



EMPANELMENT PROCEDURE



- 1) **Registration Certificate or a equivalent document showing legal identity of the company;**
 - ❖ *Adequate manufacturing facility and quality system adhering to ISO 9001 requirements / proof of having applied for ISO*
 - ❖ Detailed technical specification of the turbine.
 - ❖ Product manual covering details of installation, maintenance, routine inspection and personnel safety. **Minimum simplified design document. (Format to be provided by C-WET)**
 - ❖ Electrical circuit diagrams.
 - ❖ **Number of Installations and its performance.(Format by C-WET)**
 - ❖ Name plate prominently indicating wind turbine manufacturer and country, model and serial no., revision no., production date, maximum voltage and current at turbine terminals, frequency for turbine connected to the grid.
 - ❖ Enter into the agreement for Testing with C-WET with the above details
 - ❖ **Based on above the particular model of the manufacturer will be empanelled.**
- 2) **Models having valid test report will be empanelled subject to evaluation of**



GUIDELINES FOR EMPANELMENT



- [Guidelines](#) prepared by the **C-WET**

