

Design data testing



**Small Wind Turbine
Testing Workshop**

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Topics

- Objective
- Standards
- Instrumentation
- Database
- Results

Objective

“To determine the data required for the simplified load analysis or verify the aero elastic model.”

- Design power P_{design}
- Design rotation speed n_{design}
- Design shaft torque, Q_{design} (calculated from power and rpm)
- Maximum rotational speed, n_{max}

Intended to happen early in the design process. Test can be done by manufacturer.

Standard

IEC 61400-2 section 9.2

AWEA standard does not specifically call for design data testing.

Instrumentation

- Power
- Rotor speed
- Wind speed

- 1 minute statistics based on 0.5 Hz or better sample rate

Database for P_{design} and n_{design}

0.5 m/s wind speed bins between $(V_{in}-1)$ up to $2*V_{ave}$ shall contain 30 minutes of data

Table 1 – Basic parameters for SWT classes

SWT Class		I	II	III	IV	S
V_{ref}	(m/s)	50	42,5	37,5	30	Values to be specified
V_{ave}	(m/s)	10	8,5	7,5	6	
I_{15}	(-)	0,18	0,18	0,18	0,18	by the designer
a	(-)	2	2	2	2	

where

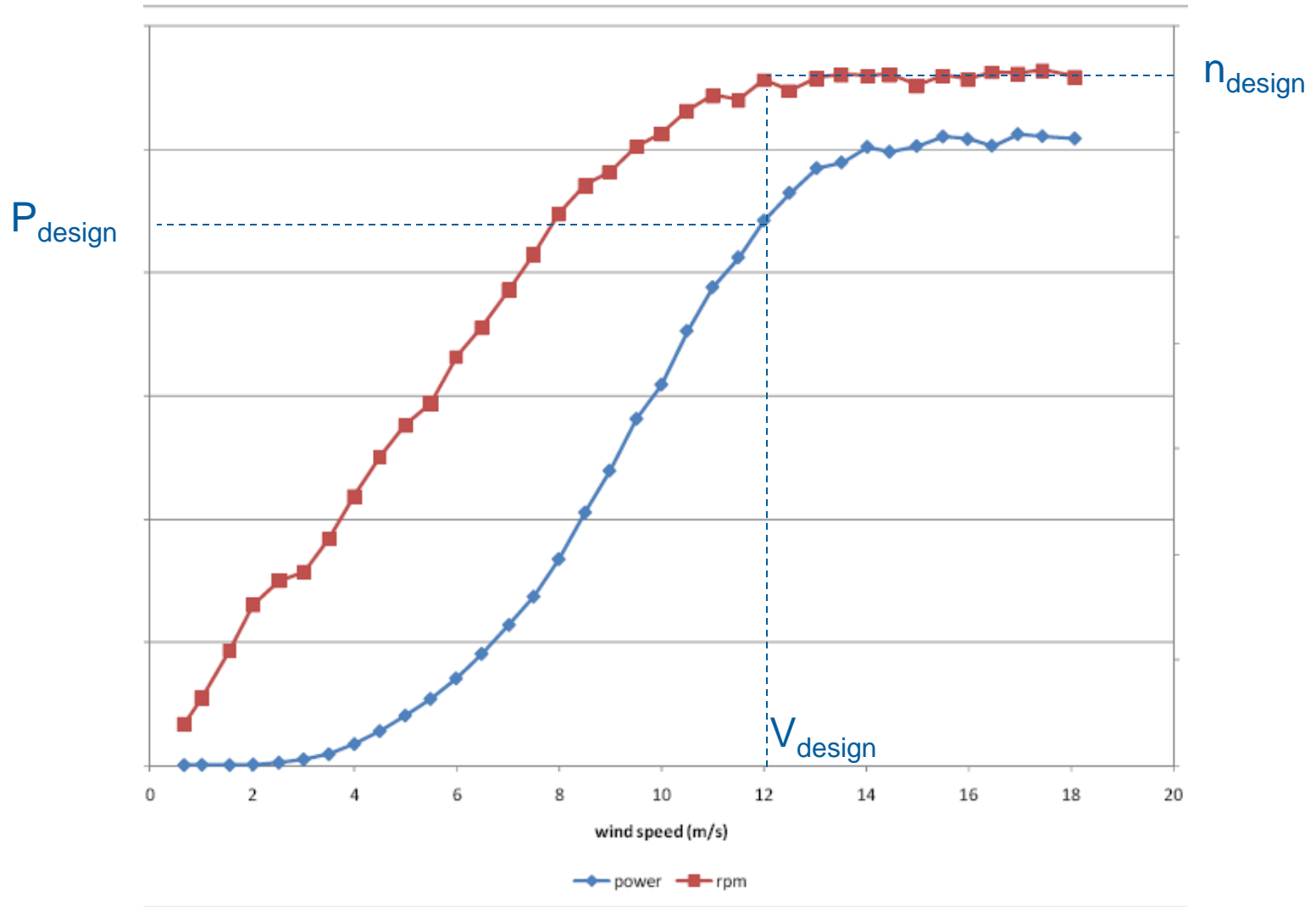
- the values apply at hub height, and
- I_{15} is the dimensionless characteristic value of the turbulence intensity at 15 m/s,
- a is the dimensionless slope parameter to be used in equation (7).

Source: IEC 61400-2 Ed.2

For class II turbine with V_{in} of 4 m/s this means: $3 < V < 17 \text{ m/s}$ (14.5hrs)

V_{design} defined as $1.4V_{ave}$ or 11.9m/s for class II

Example Results



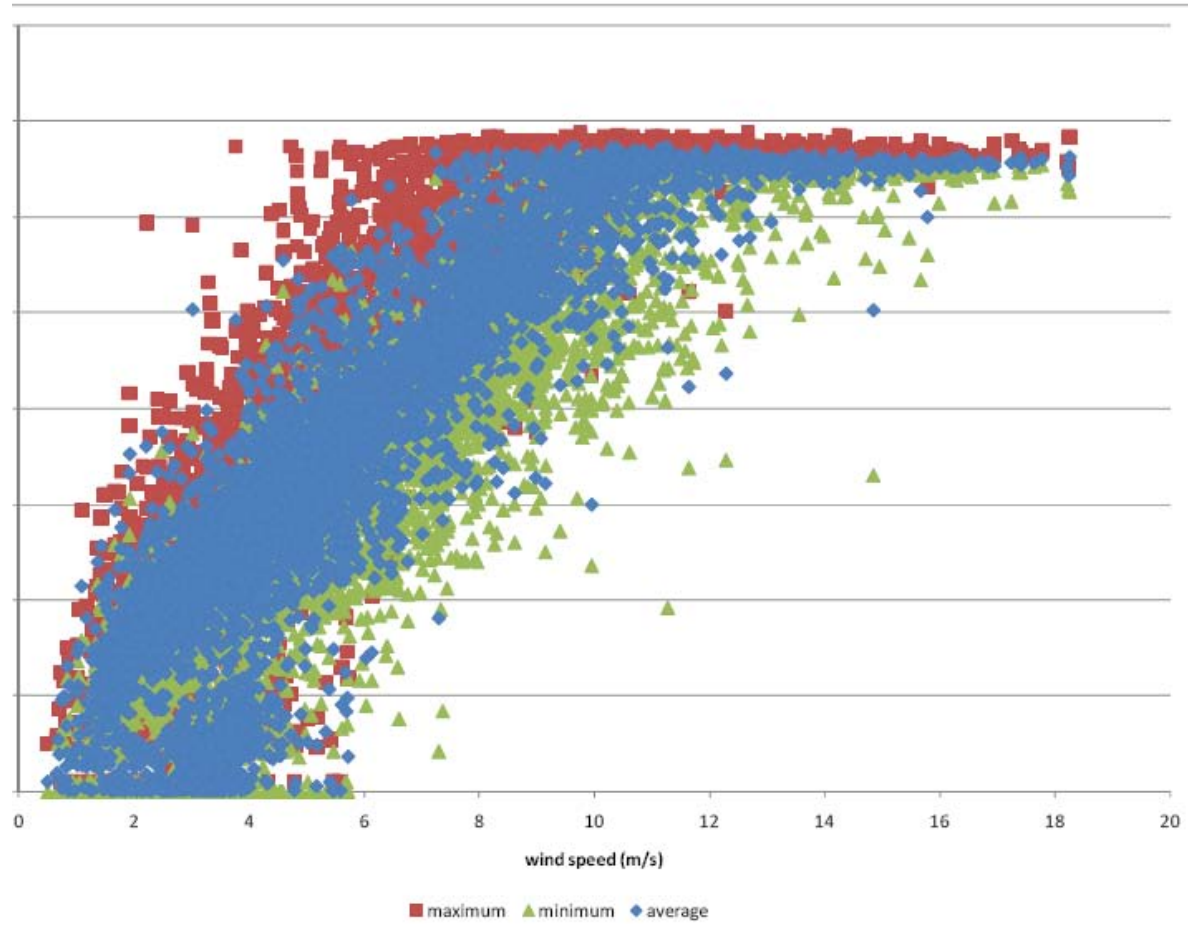
Data required for n_{\max}

Measure under turbine condition giving the highest rpm,
(such as unloaded)

Two hours of data, between 10 and 20 m/s. (30 minutes
below 15 m/s and 30 minutes above 15 m/s)

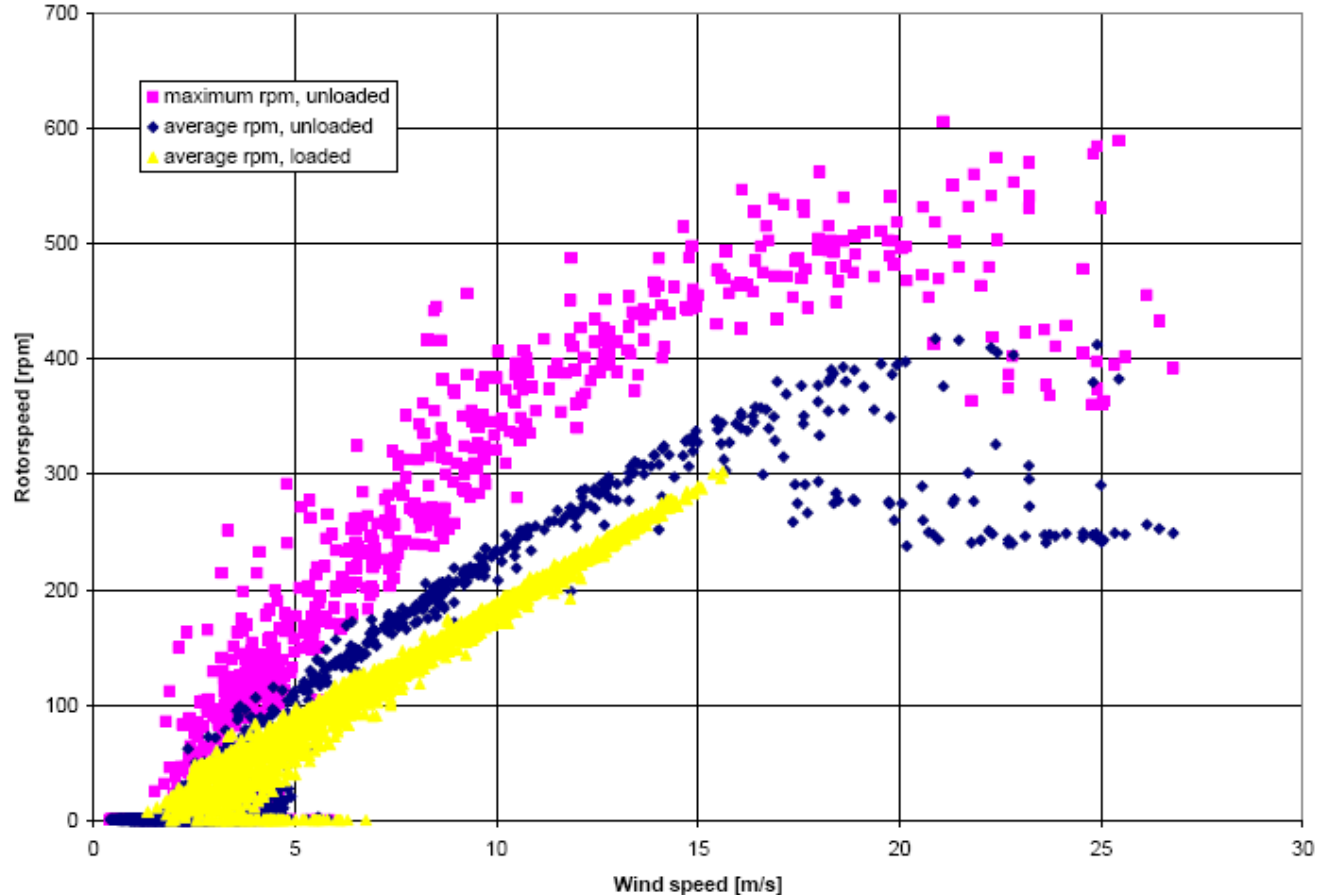
Extrapolate or interpolate any trend to V_{ref}

Example Results



No trend, active rpm control

Example Results



Unloaded condition gives high rpm,
trend