

Wind-Lab

The wind energy laboratory enables hands-on, premium training for students and professionals in the wind energy sector. The understanding of wind technology is gained through experiments with a real wind turbine in a tabletop wind tunnel.

Our mission at *mint-lab* is to get students excited of what they learn. With our tools, we ease quality education.



① Blower type **wind tunnel** driven by an axial fan. Open test section with movable cover. Diffusor, flow rectifier and nozzle to remove swirl and generate low turbulence wind flow up to 12 m/s.

② **Wind turbine** with 5W rated power. 280 mm rotor diameter, direct drive, 3-phase generator, torque control, variable pitch, exchangeable rotor blades (3D-printed).

③ Power supply 300W, globally compatible (90-264 V, 47-63 Hz, any plug)

④ Microcontroller, data acquisition, electrical load and server for web-app.

⑤ **Web app** to control the *Wind-Lab*, do experiments and post process the data.

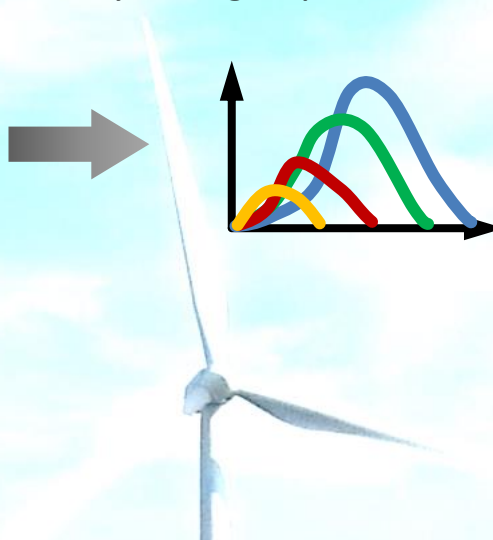
⑥ Flight case for safe transportation and easy storage. Measures: 60 x 60 x 100 cm, total weight < 30 kg.



Specifications may be subject to change



Concept of the Wind-Lab:
Understanding a wind turbine
by doing experiments



youtu.be/AN14TTTW14k

Watch to see how the Wind-Lab is used in a master class at the Technical University of Berlin.

Top 10 Experiments	Learning objective
Cut-in wind speed	Understanding how the pitch controller is used to start-up the wind turbine at low wind speed.
Generator torque	Understanding the influence of an electrical load on the speed of rotation, current and voltage.
Electrical Power Curve	Understanding the need to adjust the electrical load to track best efficiency of the wind turbine
Speed Up Test	Understand the aerodynamic behavior and identify operation points. Measure the c_p - λ curve.
Best Pitch Angle	Understand the influence of the blade's pitch angle on the power output and power limitation.
Spinning Down Test	Differentiate between electrical, mechanical and aerodynamic efficiency and quantify losses.
Converter Monitoring	Observe the 3-phase voltage, the AC-DC rectification and the smoothing of the DC-output.
Wind Turbine Control	Control the wind turbine by pitch and torque control to operate it at changing wind speeds.
Tower Dynamics	Understand the dynamic behavior of wind turbine components and create a Campbell Diagram.
Rotor Blade Design	Design a rotor blade and calculate the power curves. 3D-print the rotor blades and measure the power curves.