*Wind*Lab™

Wind Turbine Power System

A complete wind turbine electrical generation system, housed in a wind flow tunnel, featuring a three-phase generator and programmable wind speed source.

Product Summary

- Programmable, Variable Speed Wind Source
- Modern, Real World Blade Design
- Hub Accepts Custom Blades for Performance Comparison Testing
- All Alloy, Commercial Grade Planetary Gear Box
- Purpose-Built Three-Phase Generator with DC Excited Eight Pole Rotor and Stator
- Adjustable Resistive Load for Each Phase
- On Board Sensors and National Instruments™ Data Acquisition System
- LabVIEW™ Generated and User Configurable Virtual Instrument Panel
- Complete, Turn-Key System - Ready to Start Teaching Upon Delivery
- Industry Leading Warranty with Unsurpassed Customer Support
- Designed and Manufactured in the USA

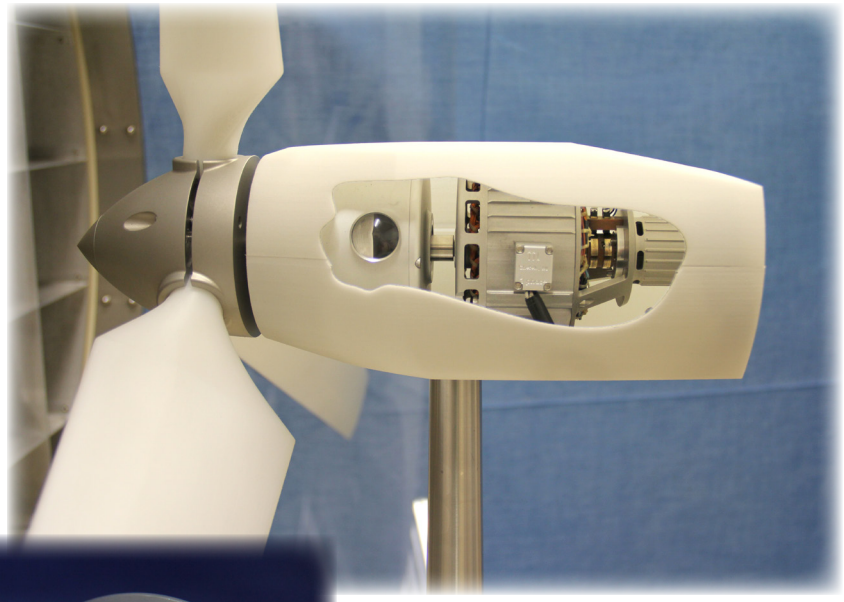
*Wind*Lab™ Wind Turbine Power System

Description

A complete, portable, self-contained three phase wind turbine electrical generation power system designed for engineering education and research. All major components of a full-scale wind turbine power system are replicated for hands on study.

Although miniature in scale, students are able to experience the full scope of real world wind turbine three phase electrical power generation principles. The system features a programmable speed wind fan and wind tunnel enclosure. The wind is ducted through a straightener vane to remove fan induced air rotation, providing a more real world wind flow pattern. Wind speed is measured by a wind anemometer. The scale, one meter wind turbine features an industry standard three bladed configuration, with manual pitch adjustment. Blades can be interchanged with alternate air-foil spec blades for performance investigation purposes.

The turbine rotor shaft drives a commercial grade all-alloy planetary gear box, which increases turbine rotor shaft RPM by 3.99 times to drive the generator at a higher RPM. The purpose built three phase generator features a DC excited, eight pole rotor and an eight pole, three phase stator. The wind turbine generator gondola nacelle features a built in “cutaway” section to allow the generator to be viewed during operation. Three operator-controlled rheostats allow independent resistive load adjustment for each phase of the three phase system. Rheostats can be collectively set with even resistance values to provide balanced load across all phases, or unevenly set to demonstrate uneven loading characteristics on an electrical generation system.



Industrial grade sensors measure and send system parameters to an integrated National Instruments™ digital data acquisition system. This system provides proper signals directly to control panel meters and through a USB connection for real time display on the provided laptop computer. The virtual instrument, created with LabVIEW™, offers real time display and interactive operator control features. Run data can be recorded for playback or follow-on analysis. The data acquisition software is user configurable and all source code is open.

Disassembled All-Alloy Planetary Gear Box

All components are pre-mounted on a portable rolling chassis allowing the entire system to be conveniently moved for use and storage. Metal surfaces are stainless steel, anodized or powder coated for durability and ease of maintenance. Controls are in plain view and intuitively arranged for ease of use. A comprehensive Operator’s Manual details all aspects of system operation. Complete technical and service information allows students, educators and technicians to gain a thorough understanding of system design, operation and construction. Summary operating checklists allow rapid mastery of system operation. Safety instructions address all operating conditions.

*Wind*Lab™ Wind Turbine Power System

Experimental / Demonstrational Opportunities

*Wind*Lab™ enables students and researchers to readily conduct in-depth experimentation and analysis of wind turbine electric power generation.

The existing rotor airfoil blades can be easily removed, allowing alternative airfoil rotor blades to be designed and installed for performance comparison testing. **Aeronautical** and **structural engineering students** will find this *Wind*Lab™ aspect alone to be challenging and highly educational.

Control engineering students will gain valuable knowledge and hands-on experience beyond the classroom with the programmable variable speed wind fan that can be operated manually or programmed to automate specific wind profiles. Various wind scenarios can be programmed and actually run to demonstrate/ determine wind turbine power generation performance. The programmable wind speed capabilities can even be used to run actual wind data profiles from proposed full-scale wind turbine sites to help determine site potential.

Electrical engineering students will especially appreciate the purpose-built three-phase electric generator on *Wind*Lab™. With adjustable resistive loading on each phase, users can experiment with the affects of unbalanced loading at various generation speeds, while experiencing the hands-on operation of a true three-phase electric power generation system.

Mechanical engineering students will gain knowledge and experience with the on-board rotor to generator speed amplification gear box.

The integrated data acquisition system records and displays data in real time for enhanced experimentation and analysis of all aspects of the *Wind*Lab™ System.

The very capable, open-ended design of *Wind*Lab™ allows for a multitude of educational and research possibilities including;

- Basic understanding of wind turbine power generation system operation
- Aerodynamic performance studies of wind turbine blade airfoils
- Gearbox design and operation analysis
- Three phase electrical generator operation and analysis
- Electrical power production in steady state wind conditions
- Unsteady wind/gusting conditions affect on power production
- Balanced/unbalanced loading affects on wind turbine performance
- Programmable wind profiles for performance studies
- Frequency control considerations
- Experimental and data acquisition technique
- Discussion topic: Considerations for stand-alone energy storage systems
- Discussion topic: Considerations for power grid integration
- Discussion topic: Considerations for wind farm coordination
- Discussion topic: Considerations for wind turbine maintenance
- Discussion topic: Power factor for an inductive load

Airfoil built with rapid prototype technology for comparative testing

*Wind*Lab™ Wind Turbine Power System

Details

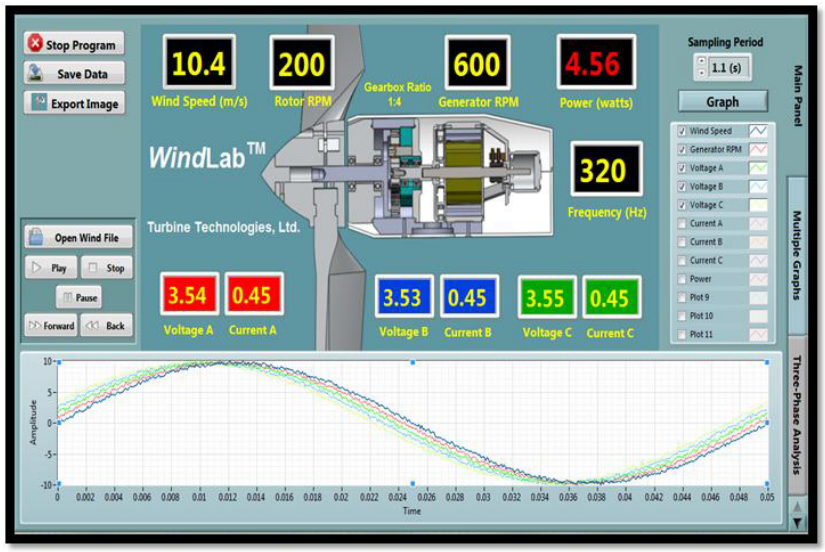
Dimensions
*Wind*Lab™: 67 w x 45 d x 76 h inches (170 w x 114 d x 193 h cm)
As Shipped: 70 w x 48 d x 82 h inches (178 w x 122 d x 208 h cm)

Weight
*Wind*Lab™: 712 lbs (323 kg)
As Shipped: 792 lbs (359 kg)

Instrumentation
Data Acquisition System:
National Instruments™ Hardware
32 Analog IN - 16 Digital IN/OUT - 2 Frequency/Counter Channels
Windows Laptop Computer - all Software Loaded and Pre-calibrated
Single Cable USB to PC Connection
Custom Virtual Instrument Display with Configurable Data Output
Installed Data Acquisition Sensors / Channels
Wind Speed
Wind Turbine Rotor RPM
Generator RPM
Generator Frequency
Generator Voltage for Each Phase
Current Draw for Each Phase
Total Power Output
Control Panel Mounted Displays/Controls:
Wind Speed
Turbine RPM
Voltage (3 total, one for each phase)
Current (3 total, one for each phase)
Load Rheostats (3 total, one for each phase)

Operating Conditions / Limitations
Wind Fan: Limited to 8.2 Amp Electrical Current Draw (fuse protected)
Generator: 7.5 Volts, 0.25 Amp, 3.25 Watts (Limited for Safety)

Operating Requirements
Typical Laboratory or Classroom Setting
Power: 208V single-phase 50/60Hz fused at 15 amp



Screen Shot of Included Virtual Instrument Panel

Purchase Specifications

- A wind turbine electric power plant designed for engineering education and research.
- A programmable wind fan and scale wind turbine mounted in a rigid, mobile wind tunnel cabinet.
- Wind fan to be driven by on-board, variable frequency drive with panel mounted speed controller.
- Wind turbine to be industry-standard three blade horizontal axis configuration with adjustable/replaceable blades.
- Wind turbine to drive planetary gear configuration step-up gear box.
- Generator to consist of a three phase, DC excited 8 pole rotor, eight pole three phase stator, with alternating current output.
- Unit to include operator panel-mounted generator voltage and current meters for each power phase.
- Load to be supplied by three operator panel-mounted rheostats, adjusted equally for balanced load, or unequally for unbalanced load scenarios.
- To be supplied with a USB based digital data acquisition system complete with computer and user configurable data acquisition software capable of measuring, recording and displaying analog, digital and frequency signals, including: Wind Speed, Turbine Rotor Speed, Generator RPM, Voltage, Current, Power and Frequency.
- Equipped with calibrated transducers capable of measuring all elements required for data acquisition system.
- All metal surfaces to be stainless steel, anodized or powder coated to promote durability and wear resistance.
- Provided with a comprehensive Operator's Manual with design, operation and construction information.
- Provided with summary operating checklists and safety instructions for all operating conditions.
- To be covered by a free two year warranty.

CREATING EDUCATIONAL LABORATORY EQUIPMENT FOR TOMORROW'S ENGINEER

Turbine Technologies, LTD.