

Wind Turbine Learning Solutions

Practical Training for Wind Turbine Technicians

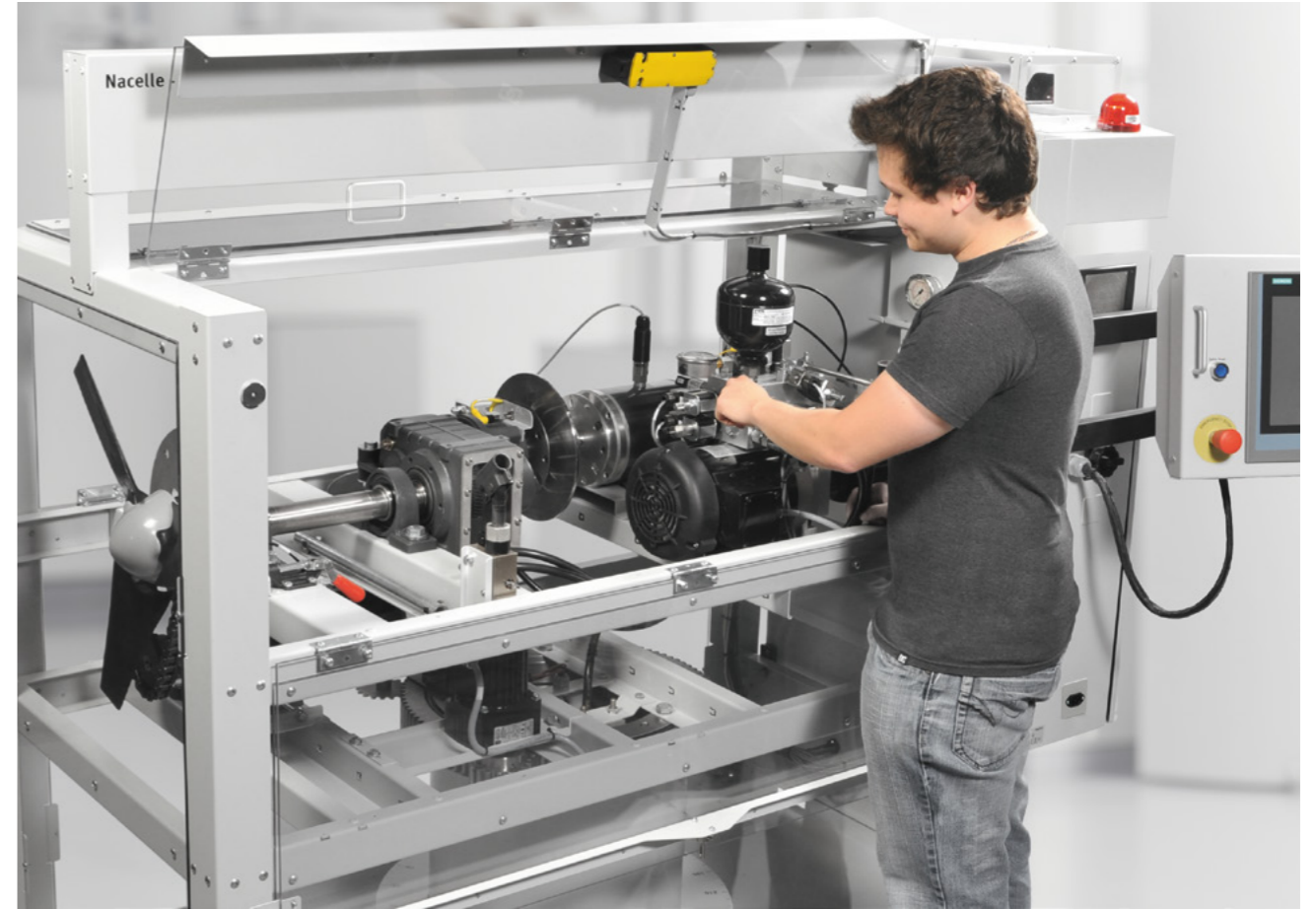
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Discover the following learning systems and courses:

- Nacelle – Wind Turbine Learning System
- Power Generator for the Nacelle – Wind Turbine Learning System
- Electrical Pitch Hub – Wind Turbine Learning System
- Hydraulic Pitch Hub – Wind Turbine Learning System

Maximize employability of students in the wind power industry



Training the people who will make the world more sustainable

To increase the share of renewables in the global energy mix, many governments, as well as industrial and electricity companies, turn to wind power and invest in offshore or onshore wind farms.

Technical schools and colleges contribute to the long-term success of such investments by training a skilled workforce. A key job profile in this field is the wind turbine technician who installs, commissions, maintains, inspects, troubleshoots, repairs, and operates wind power installations.

Employment for wind power technicians is projected to grow faster than average among all occupations over the coming decades. Schools must get ready to train more people and expand training facilities to meet the growing demand for wind turbine technicians.

Turnkey solutions for comprehensive training

Powering a real wind turbine in the classroom is impossible, mainly because of safety and space issues. Yet future wind turbine technicians and operators need practical experience to build their expertise.

Our didactic wind turbine nacelle and pitch hubs prepare students for real-world operation, troubleshooting, and maintenance situations in a practical and safe environment.

Courses target core competencies for wind power technicians: general knowledge about wind energy technology, logic of operation, electrical and mechanical safety, and electric power and electronics, as well as mechanics and hydraulics.

“ Hands-on course material matches real-world skill requirements. ”

Benoît Maisonneuve, Prof. Engineer and Product Manager,
Renewable Energy Learning Solutions



Certification in the wind power industry

BZEE develops best-practice vocational training standards for the wind industry and turnkey solutions for training providers, delivering training through a global network of licensed partners.

Vocational and technical schools that offer wind turbine technician training programs and meet BZEE requirements can become members of the BZEE Network as certified training providers. This ensures that their training is aligned to acknowledged world-wide standards. Students can then apply for the title of BZEE Wind Turbine Service Technician.

For more info:
→ www.bzee-network.com

Festo Didactic is a BZEE-recommended provider of technical education equipment.

A scaled-down, fully-operational wind turbine



High realism, high didactic value

The Nacelle – Wind Turbine Learning System is a complete replica of the nacelle of a commercial wind turbine that demonstrates how wind energy is captured and converted into electrical power. Space-efficient and affordable, the learning system is fully interactive, enhancing the user experience.

The learning system consists of a complete and exposed drive train that allows students to observe and extensively manipulate the various components.

The system includes the main shaft, a gearbox with a transparent side cover, speed sensors, a hydraulic brake, and an asynchronous generator. The yaw system is fully operational and features a slewing bearing, a gear motor, a drive, a position sensor, and fail-safe hydraulic brakes.

A manual hydraulic pump and an accumulator, as found in real-world wind turbines, are also included. A PLC controls the different functions of the nacelle. Complementary equipment allows instructors to further delve into pitch control and connection to the electrical grid.

An industrial electrical panel

The lockable electrical panel contains all the electrical supply, distribution, and control functionality for the learning system: contactors, variable-frequency drives, breakers, fuses, power supplies, and remote inputs/outputs for the PLC.



Watch a video presentation:
bit.ly/WindTurbineNacelle

Learning content

- Nacelle familiarization, safety, and control system
- User interface and wind simulation
- Gearbox, coupling, and alignment
- Basic hydraulic circuit
- Hydraulic brakes
- Electrical circuit and panel
- Troubleshooting

Main features

- Complete representation of the nacelle of a horizontal-axis wind turbine for realistic training
- Focus on maintenance and troubleshooting skills
- Safe working environment
- Rugged industrial equipment
- Faults can be inserted through the HMI
- Turnkey, comprehensive course material

01 An electric gear motor turns the rotor shaft to simulate wind-derived rotation.

02 Verifying the torque of a bolt.

03 Opening the pressure breather valve in preparation for a gearbox oil change.

04 When the electric motor is not running, the hand pump increases pressure in the hydraulic circuit.

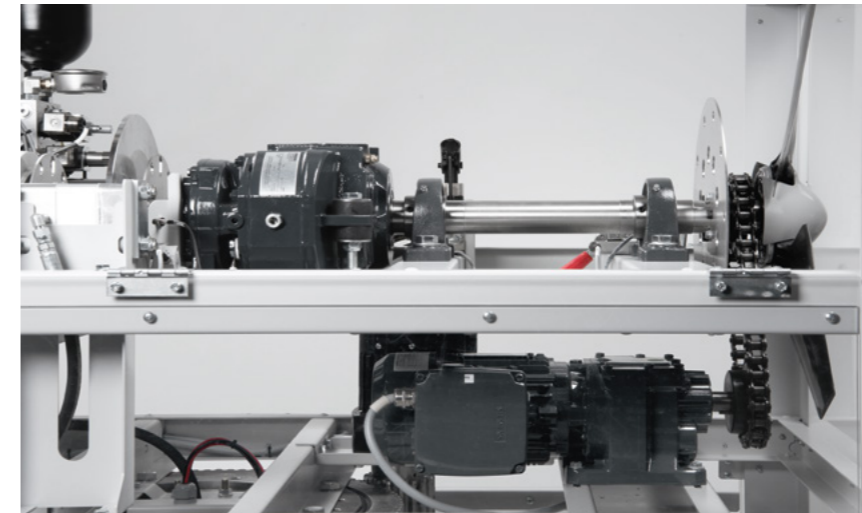
05 Pillow blocks support the rotor shaft and allow it to turn as freely as possible using bearings.

06 The yaw system rotates to simulate rotation of a wind turbine nacelle into and out of the wind.

07 Releasing the parking brake manually in preparation for an alignment procedure.

01

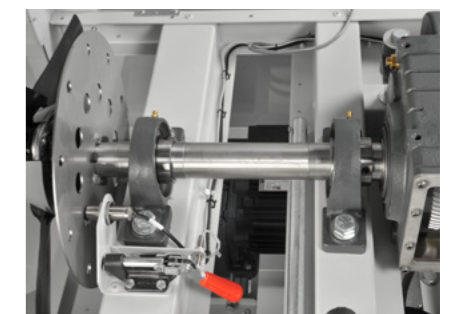
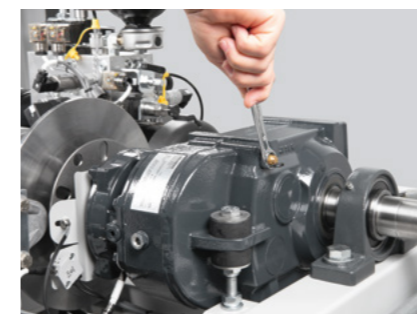
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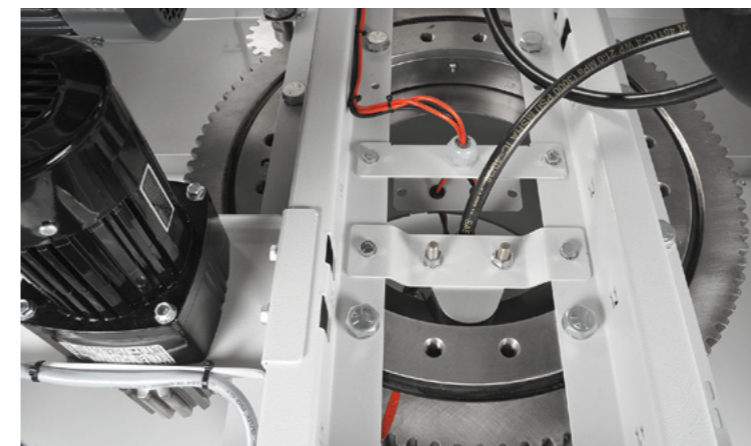
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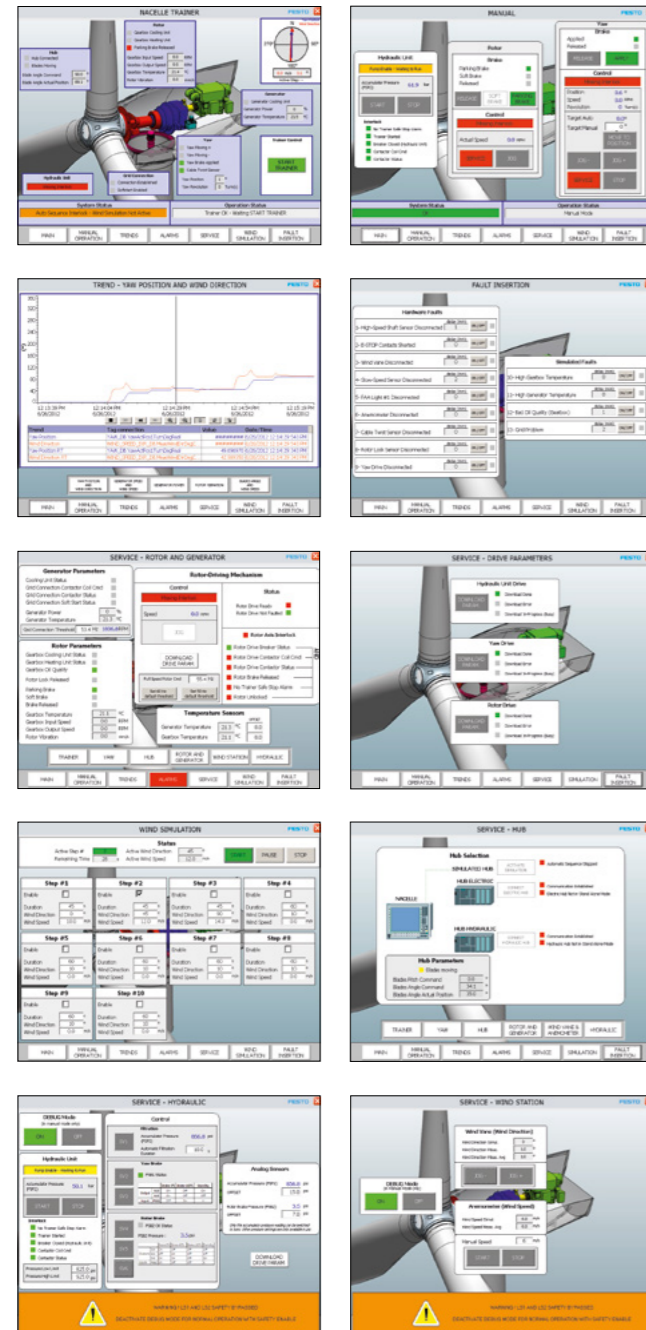


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Realistic wind simulation and grid connection



An accurate representation of reality

A wind vane and an anemometer, located in a transparent enclosure on top of the training system, monitor wind speed and wind direction.

Students use the HMI to program wind simulations for a thorough understanding of how wind conditions impact the production of electricity. Small motors actuate the weather sensors, sending signals to the control system, which then uses the parameters to produce authentic data.

Generate real electrical power

Wind turbines are rarely used in autonomous setups; they are usually connected to an electrical network. To create a grid connection, the optional Power Generator can be installed on top of the electrical panel of the Nacelle – Wind Turbine Learning System.

The Power Generator enables the nacelle's three-phase induction generator to produce real power that is returned to the system proportionate to the wind simulation running on the wind turbine.

Students can study the electrical circuit that connects a wind turbine generator to the electrical grid, and monitor and analyze several actual – not simulated – electrical parameters, such as VAR, W, VA, power factor, etc.

The learning system features industrial components, such as a soft starter, an overload, switchable compensation capacitors, and a SENTRON PAC3200 power meter from Siemens.

01 The optional power generator module is installed above the electrical panel.

02 The induction generator converts the rotation of the rotor into three-phase electrical power.

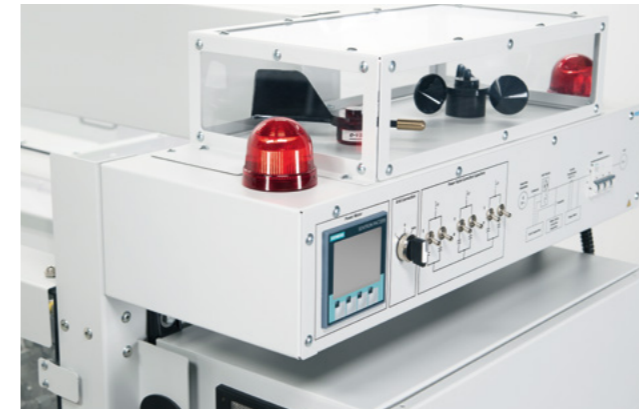
03 The electrical panel is safely grounded and contains devices commonly found in the industry.

04 During a troubleshooting exercise, a student checks the electrical continuity of a contactor.

05 The course material covers all necessary safety procedures.

06 An included vibration sensor can be secured on most metallic components to perform vibration analysis.

01



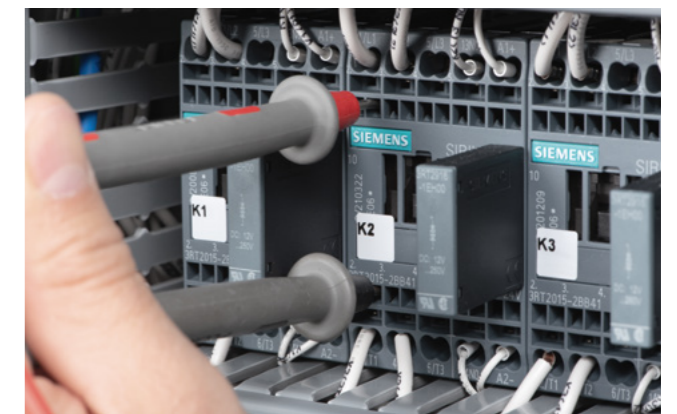
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Control of blade pitch angle



Demonstrate realistic pitch adjustment

In the Nacelle – Wind Turbine Learning System, the rotor blades turn but cannot be pitched. Instead, the pitch angle is simulated and displayed on the main screen of the HMI.

To comprehensively demonstrate the pitch adjustment with wind conditions, a pitch hub can be connected to the Nacelle – Wind Turbine Learning System using a fiber-optic connector. Pitch hubs can also be operated independently.

Electrical or hydraulic, same as found in the industry

Two pitch hub learning systems are available: electrical and hydraulic. Both include all components of a typical commercial pitch hub and a representation of the wind turbine blade. The system reacts to simulated wind conditions, corresponding to the typical behavior of a real wind turbine.

Each hub addresses blade pitch control and emergency backup systems using the appropriate technologies typical of their respective electrical or hydraulic pitch control systems. The HMI controls and monitors the blade movement and the training system. It runs a SCADA interface that communicates directly with a Siemens PLC inside the electrical panel.

01 The servomotor rotates the slewing bearing via an integrated planetary gearbox and an external pinion gear.

02 Screen captures of the HMI that operates and monitors the system.

03 Pumping a small amount of grease inside the automatic lubricator.

04 Plugging the battery pack to the connector inside the lubricator's unit.

05 Unscrewing the oil filter for the hydraulic unit oil and filter change.

06 The pitch control system rotates the blade in response to changing wind speed to reach an optimal angle of attack.

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02



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Learning content

- Introduction to energy production with wind power
- Machine safety
- Introduction to SCADA
- Rotor
- Hydraulic or electric pitch control
- Electrical system and back-up power
- Troubleshooting

Main features

- Fully-operational, single-blade positioning systems
- Blade movement actuated by a servo motor and a gearbox or by a hydraulic cylinder
- Industrial components
- Faults can be inserted through the HMI
- Emergency pushbutton and protective guard
- Turnkey, comprehensive course material

Guided learning paths for hands-on experimentation

Below: Screen captures from the eLab course “Nacelle Operation and Maintenance” on Festo LX.

A comprehensive learning approach

Training on the didactic equipment is supported by turnkey courses with pedagogical objectives carefully established to consolidate learning and maximize the employability of students in the wind power industry.

Illustrated courseware conveys theory in a straightforward manner and accompanies students step-by-step through practical experiments for enhanced autonomy. Questions help review and assess knowledge.

Modular course content can be easily integrated into your lesson plans. Teaching hints and the answers to all questions are provided. This speeds up course preparation and simplifies evaluations of student progress.

Four courses are available as eLab courses on Festo LX, or in print or PDF version:

Nacelle – Operation and Maintenance

This course covers the production of electrical energy from wind power with a focus on operation, troubleshooting, and maintenance of the Nacelle – Wind Turbine Learning System.

Grid-Tied Nacelle

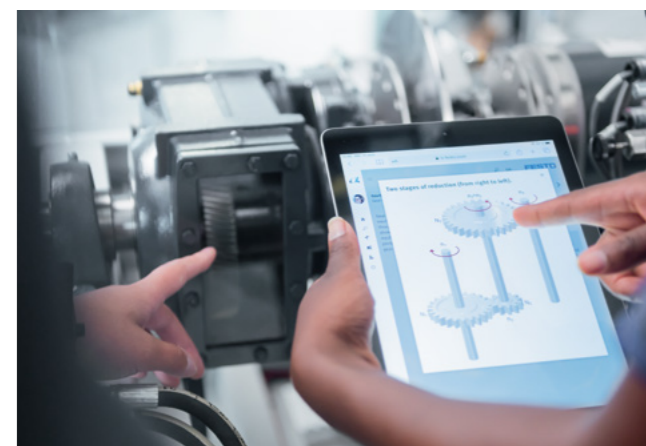
This course is an add-on to the “Nacelle – Operation and Maintenance” course and focuses on the optional Power Generator.

Electrical Pitch Hub

This course covers the fundamentals of electrical pitch control systems, with emphasis on the operation and control equipment, as well as troubleshooting.

Hydraulic Pitch Hub

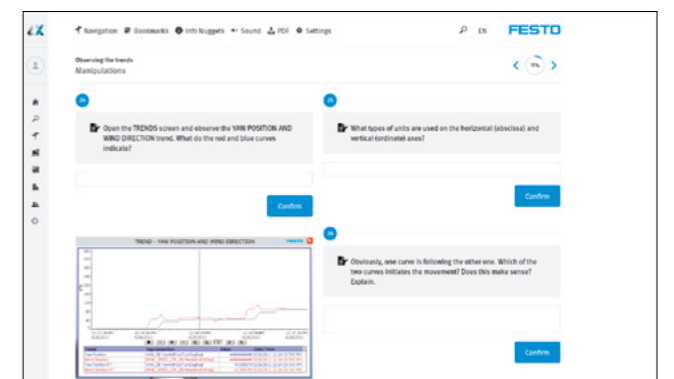
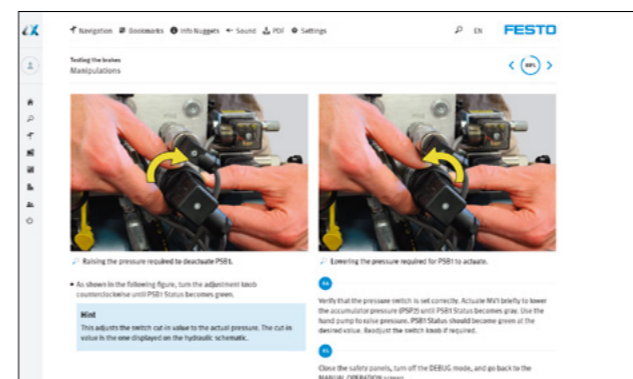
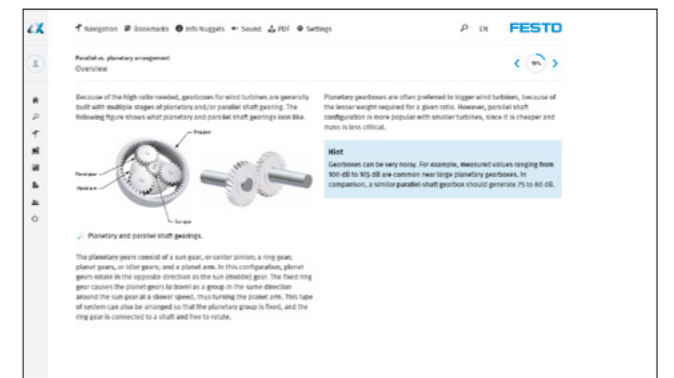
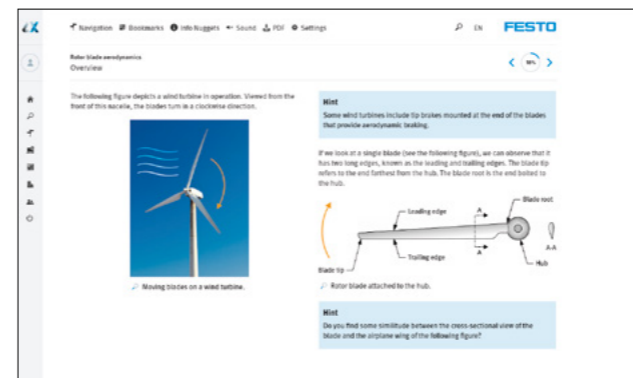
This course covers the fundamentals of hydraulic pitch control systems, with emphasis on the operation and control equipment, as well as troubleshooting.



Discover Festo Learning Experience

Festo LX is a digital portal that offers learning content (hardware-oriented courses for our learning systems, eLearning courses, videos, evaluations, and more) for many technical areas. It is based on multimedia learning nuggets that can easily be adapted and combined to form individual learning paths.

Create your free account and browse the content:
lx.festo.com



Configure a learning environment adapted to your goals.



Find inspiration in our wind power training room.

Enter our virtual showroom and draw from a wide portfolio of learning solutions to select and combine training equipment that fits your exact requirements.

Experience an interactive overview of learning systems that build knowledge and competencies in wind power mechanics, hydraulics, electricity and electronics, and electric power technology.



Tour the virtual showroom:

→ bit.ly/Wind-Power-Training-Demo-Room

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