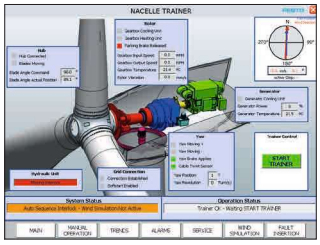
Nacelle – Wind Turbine Learning System

Operation and Maintenance of Wind Turbines

→ Video







From wind to electrical power

The Nacelle – Wind Turbine Learning System is a complete scaled-down version of commercial wind turbine nacelles, making it an excellent substitute for expensive actual equipment.

The learning system consists of a complete drive train that 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 61 cm (24 in) 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 and is located in an electrical enclosure together with all the other electrical components.

Simulating reality

A wind vane and an anemometer are located in a transparent enclosure on top of the training system to monitor wind speed and wind direction. Although they are not measuring actual wind, the control system managed by the user simulates the process, causing the weather sensors to react and send signals to the control system which take the simulated parameters into account.

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.

Grid-tied power generator

The generator allows the induction generator of the learning system to be connected to the grid and to return power proportional to the wind simulation in the system. It includes a soft starter, an overload, switchable compensation capacitors, and a power meter that allows the user to monitor several parameters of the power returned to the grid (VAR, W, VA, power factor, etc.).

Nacelle – Wind Turbine Learning System

120 V	**610873**
220 – 240 V	**610874**

Necessary accessory:

Isolation Transformer *	8064358

* This device is only required for specific systems: order no. 610874.

Nacelle – Wind Turbine Learning System with Power Generator

208 V, three-phase current	**610875**
400 V, three-phase current	**610876**

Expansion options for all Nacelle – Wind Turbine Learning Systems

Electrical Pitch Hub (next page)
Hydraulic Pitch Hub (next page)

Learning goals
- Wind Aerodynamics, Safety
- Hub and Low-Speed Shaft, Gearbox, Coupling, and Alignment
- Basic Hydraulic Circuit, Hydraulic Brakes
- Electrical Circuits and Control Systems
- Troubleshooting

Your advantages
- Demonstrates how a wind turbine nacelle, an electrical hub, and a hydraulic hub operate
- Helps practice maintenance and troubleshooting skills in a safe environment
- Faultable through the HMI
- Cost-effective, Full hands-on training with rugged equipment
- Comprehensive curriculum and lab exercises



Isolation Transformer 230V, 50 Hz
Device that eliminates high leakage currents and prevents undesired tripping of residual current devices (RCDs). A fuse protects this device and a thermal protection prevents overheating.

Recommended Learning Material

Workbooks



Campus license:

en	8166512
es	8233966

Note: The campus license includes the student and instructor PDF versions of the following workbooks: “Nacelle Operation and Maintenance” and “Grid-Tied Nacelle”. Printed workbooks available upon request.

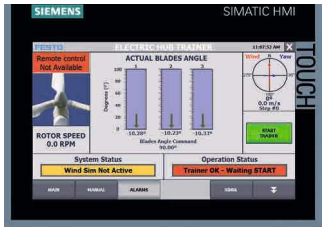
Courses on Festo LX
- → Nacelle Operation and Maintenance
- → Grid-Tied Nacelle

Pitch Hubs – Wind Turbine Learning System

Electrical and Hydraulic Control of Blade Pitch Angle







Blade-angle optimization for harnessing wind power

Housed in the hub that supports the blades, the pitch system is a combination of components that monitor and manipulate blade angles to control rotation speed, as well as the area exposed to the wind.

Pitch control is an important element of the overall wind turbine system that improves turbine efficiency by optimizing wind utilization. Pitch systems also stabilize rotational speed for uniform power generation and synchronization with the power grid. They protect the system by preventing turbine overspeed and reducing forces on the rotor during system idle or servicing.

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

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.

Electrical Pitch Hub – Wind Turbine Learning System
This system addresses blade pitch control and emergency back-up systems using technologies typically found in electrical pitch control systems, such as servo motor and gearbox.

120 V	**8091728**
220 – 240 V	**8091729**

Hydraulic Pitch Hub – Wind Turbine Learning System
The system addresses blade pitch control and emergency back-up systems using technologies typically found in hydraulic pitch control systems, such as cylinder, proportional valve and position sensor.

120 V	**8095227**
220 – 240 V	**8095228**

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

Your advantages
- 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

Recommended Learning Material

Workbooks



Campus licenses:

Electrical pitch hub, en	8098181
Hydraulic pitch hub, en	8098185

Printed workbooks available upon request.

Courses on Festo LX
→ Electrical Pitch Control
→ Hydraulic Pitch Control



