Hydraulic Pitch Hub

Wind Turbine Learning System

Electric Power Technology

User Guide

Festo Didactic
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Electricity and New Energy

Hydraulic Pitch Hub
Wind Turbine Learning System

Safety Instructions and Commissioning
8098168

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Safety and Common Symbols

The following safety and common symbols may be used in this course and on the equipment:

Symbol	Description
DANGER	**DANGER** indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.
WARNING	**WARNING** indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.
CAUTION	**CAUTION** indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.
CAUTION	**CAUTION** used without the *Caution, risk of danger* sign ⚠, indicates a hazard with a potentially hazardous situation which, if not avoided, may result in property damage.
	Caution, risk of danger. Consult the relevant user documentation.
	Caution, risk of electric shock
	Caution, lifting hazard
	Caution, hot surface
	Caution, risk of fire
	Caution, risk of explosion
	Caution, belt drive entanglement hazard
	Caution, chain drive entanglement hazard
	Caution, gear entanglement hazard
	Caution, hand crushing hazard
	Notice, non-ionizing radiation
	Consult the relevant user documentation.
	Direct current
	Alternating current
	Both direct and alternating current

Symbol	Description
	Three-phase alternating current
	Earth (ground) terminal
	Protective conductor terminal
	Frame or chassis terminal
	Equipotentiality
	On (supply)
	Off (supply)
	Equipment protected throughout by double insulation or reinforced insulation
	In position of a bi-stable push control
	Out position of a bi-stable push control

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About This Document

Safety considerations
The Safety Symbols table at the beginning of the manual lists safety symbols that may be present in this manual or on the equipment.

Make sure that you are wearing appropriate protective equipment when using the system. You should never use the equipment if you have any reason to think that a manipulation could be dangerous.

Important
The operator should familiarize himself/herself with the contents of this manual before installing and operating the equipment.

The Safety Symbols table at the beginning of this manual lists safety symbols that may be present in this manual or on the equipment.

This manual is freely available for download from the Festo Didactic website.

Upon request, printed copies of this manual are freely available. Contact your Festo Didactic sales representative.

> In this document, “the equipment”, “the system” and/or “the learning system” specifically refers to the Hydraulic Pitch Hub Learning System.

1 General Requirements for Operating the Equipment

1.1 Important general note

Safety precautions and regulations are not disruptive, but rather prevent disturbances and enhance safety during use of the system. For this reason, everyone who works with the system must be familiar with safety precautions and regulations and adhere to them. This applies to rules and regulations regarding accident prevention at the location of use, as well. Knowledge of these rules, regulations, and precautions are fundamental prerequisites for safe use and trouble-free operation of the equipment.

This manual includes important instructions for safe use of the equipment.

1.2 General requirements for operating the equipment

General requirements for safe operation of electrical equipment:

- National regulations for operating electrical systems and equipment must be observed in commercial facilities.

- The laboratory or classroom must be overseen by a supervisor.
  - A supervisor is a qualified electrician or a person who has been trained in electrical engineering, knows the respective safety requirements and regulations, and whose training has been documented accordingly.

- Installation and commissioning of the equipment must be performed as directed in the accompanying documentation before any person can use the equipment for its intended purpose.

- Damaged or defective equipment must never be used.
  - Damaged devices must be barred from further use and removed from the laboratory or classroom.
  - Damaged connection cables and leads, pneumatic tubing, and hydraulic hoses represent a safety risk and must be removed from the laboratory or classroom.

Regulation in certain countries requires that the laboratory or classroom is equipped with the following devices:

- The ac power outlets in the laboratory or classroom must be protected by residual current devices (RCDs).
  - Electrical equipment (e.g., power supply units, compressors, hydraulic power units, etc.) may only be operated in training rooms which are equipped with residual current devices (RCDs).
  - Type A or type B residual current circuit breakers with a residual current set in accordance with the local regulation (generally ≤ 30 mA) must be used to protect the ac power outlets in the laboratory or classroom.

- The ac power outlets in the laboratory or classroom must be protected by overcurrent protection devices.
  - Circuit breakers or fuses.

For additional safety, the laboratory or classroom can also be equipped with the following devices:

- One or several energy-off devices can be provided.
  - An emergency-off device can be provided to turn electric power off for the whole laboratory or classroom.
  - An emergency-off device can be provided at each workstation to turn electric power off at the workstation only.

- The laboratory or classroom can be secured so that operating voltage and compressed air supply cannot be activated by unauthorized persons, for example by means of:
  - Lockable power-on switches.
  - Lockable on-off valves.

1.3 Use for intended purpose

The equipment may only be used:

- For its intended purpose in teaching and training applications.
- When its safety functions are in flawless condition.

The components of the equipment are designed in accordance with the latest technology and recognized safety rules. However, life and limb of the user and third parties may be endangered and the equipment may be impaired if it is used improperly.

The learning program from Festo Didactic has been developed and produced exclusively for basic and advanced training in the field of wind power generation. To ensure the safety of the trainees during their training, the training company and/or supervisors must make sure that all trainees use the equipment as directed in the accompanying Festo Didactic training manuals, and observe the safety instructions and precautions in the present manual.

1.4 Dangers associated with the equipment

The equipment is designed in accordance with the state-of-the-art and recognized safety rules. Nevertheless, life and limb of the user and third parties may be endangered, and the respective machine or other property may be damaged during its use.

⚠ WARNING

Immediately eliminate any fault that may impair safety.

2 Guarantee and Liability

Our “general terms and conditions of sale and delivery” are always applicable. These are made available to the operating company no later than on conclusion of the sales contract. Guarantee and liability claims resulting from personal injury and/or property damage are excluded if they can be traced back to one or more of the following causes:

- Use of the equipment for anything other than its intended purpose.
- Improper commissioning and/or operation of the equipment.
- Use of the equipment with defective safety equipment, or with improperly attached or non-functional safety and protective equipment.
- Non-compliance with instructions included in the core documentation with regard to commissioning and operation.
- Unauthorized modifications to the equipment.
- Improperly executed repairs.
- Disasters resulting from the influence of foreign bodies and acts of nature.

Festo Didactic hereby excludes any and all liability for damages suffered by trainees, the training company, and/or any third parties, which occur during use of the equipment in situations which serve any purpose other than training and/or vocational education, unless such damages have been caused by Festo Didactic due to malicious intent or gross negligence.

3 For your Safety

3.1 Important information

Fundamental prerequisites for safe use and trouble-free operation of the equipment include knowledge of basic safety precautions and safety regulations. This manual includes important instructions for safe use of the equipment.

In particular, the safety precautions must be adhered to by all persons who work with the equipment. In addition, all pertinent accident prevention rules and regulations, which are applicable at the respective place of use, must be adhered to.

3.2 Obligations of the operating company

The operating company only permits those who meet the following qualification to work with the equipment:

- Persons that are familiar with the basic regulations regarding work safety and accident prevention, and have been trained in the use of the equipment.
- Persons that have read and understood the chapter concerning safety and the warnings in this manual.

Personnel should be tested at regular intervals for safety-conscious work habits.

3.3 Obligations of the trainees

All persons who have been entrusted to work with the equipment must complete the following steps before beginning work.

- Read the chapter concerning safety and the warnings in this manual.
- Familiarize themselves with the basic regulation regarding work safety and accident prevention.

4 Work and Safety Instructions

4.1 General

⚠ WARNING

Presence of dangerous voltage!

- The equipment conducts dangerous voltage which may be dangerous. Disregard of the warnings and/or non-observance of the safety instructions in this manual may result in life-threatening danger, severe injury, or major damage to property.

⚠ CAUTION

- Trainees should only work with the equipment under the supervision of a qualified supervisor.
- Always use the equipment as directed in the accompanying Festo Didactic training manuals.
- Observe the specifications included in the technical data for the individual components, and in particular, all safety instructions.
- Set the equipment up so that activation of switches and disconnectors is not made difficult.
- Any equipment malfunction which may impair safety must be eliminated immediately.
- Wear personal safety equipment (safety glasses, safety shoes, etc.) when working with the equipment.

4.2 Electrical system

⚠ WARNING

- **Risk of death in case of missing or interrupted protective earthing conductor!**
  - Equipment with protective earthing terminals must always be earthed.
  - Protective earthing connections must always be established first (i.e., before establishment of connections to voltage sources) and removed last (i.e., after removal of all connections to voltage sources).
  - The protective earthing conductors (yellow-green) must not be interrupted, either inside or outside of any device.
  - The insulation of the protective conductors must never be damaged or removed.
  - Equipment with a high leakage current must be additionally earthed with a separate protective earthing conductor. Such equipment is generally provided with an additional protective earthing terminal dedicated to this purpose.

- **Risk of death due to electric shocks!**
  - Contact voltages greater than 25 V ac or 60 V cc are not permissible.
  - Coming into contact with voltages greater than 33 V ac or 70 V cc may be fatal.
  - Always follow appropriate safety procedures when taking measurements inside the electrical panel. Keep the electrical panel closed at all other times.

⚠ CAUTION

- Parts (e.g., large capacitors) in electrical equipment may remain charged at dangerous voltage levels for a certain time after the equipment has been disconnected from all sources of electrical power. Such parts become accessible when opening the equipment housing, thereby resulting in a risk of electric shock. Wait a few minutes after disconnection of the power sources before working on any piece of equipment.
- Hazard-free operation of the equipment is no longer possible in the case of visible damage, malfunction, incorrect storage, or incorrect transport. In any of these situations, turn electric power off immediately and protect the equipment against inadvertent use.

CAUTION

- Ventilation slots on the equipment must never be covered. The equipment must be installed in such a way that air can flow through the slots unhindered. The equipment is cooled primarily by convection.
- The equipment may generate high-frequency interference in residential areas, which may make it necessary to implement interference suppression measures.

4.3 Hydraulic system

⚠ CAUTION

Hydraulic lines have the potential to cause high-pressure injection injuries. If someone is injected with a high-pressure fluid, take the injured person to the nearest medical unit immediately. Failure to do so may result in amputation of the injured body part.

⚠ WARNING

Do not touch the hydraulic cylinder while the system is running. Hydraulic cylinders apply a force that can easily crush hands.

⚠ WARNING

Unrestrained hoses that fail in hydraulic systems can move rapidly back and forth, causing concussions, lacerations, and broken bones. Do not approach whipping hoses.

⚠ CAUTION

The operating pressure of the system should not exceed 66.2 bar (960 psi).

⚠ CAUTION

The hydraulic fluid temperature should not exceed 50 °C, as it could cause burns or scalding in case of leakage. If the fluid temperature increases above this level, shut down the hydraulic power unit and wait for the fluid temperature to decrease.

⚠ CAUTION

The solenoids actuating the valves connected to the hydraulic unit can get hot.

4.4 Handling and installation

- The system is heavy and intended to remain on a flat surface. Use it and move it only on a flat floor.
- Before moving the system, make sure there are no obstacles in the way, and the floor is not bumpy or slippery.
- Do not attempt to lift the system by yourself. Trying to do so may cause fatal accidents and damage to the equipment.
- Whenever it is necessary to move the system, use the supplied swivel casters. In all other situations, they should always be locked.
- Always close and lock the electrical panel door before moving the system.
- When moving the system, place the HMI close to the frame of the system by collapsing the HMI mount as much as possible. Be careful to avoid surrounding obstacles.

⚠ WARNING

High leakage current! Be sure to establish an earth connection before connecting the equipment. The system should only be operated with an additional protective conductor. A terminal is available next to the bottom-left side of the electrical cabinet. The cross section of the copper wiring used to this end must be at least 4 mm^2. The electrical installation must be carried out by a qualified person, who must make sure to respect the regional and national standards applicable.

CAUTION

The system must be installed on a floor that supports a minimum weight of 226 kg.

4.5 Connecting equipment to ac power outlets

The learning system should be connected to an earthed ac power wall outlet.

⚠ WARNING

Failure to comply with the above requirement may increase the severity of electric shocks resulting from the leakage current of the equipment.

Furthermore, regulation in certain countries requires electric equipment in laboratory classrooms to be connected to ac power outlets that are provided with overcurrent protection (fuses or circuit breakers) and residual current protection (residual current devices of type A or type B). Make sure that the ac power outlets in your laboratory classroom are protected according to the local regulation in your country before using the system.

5 Safety Precautions

5.1 Preliminary warning

Even though the equipment has been carefully designed to ensure trainees' safety, there are residual risks that cannot be reduced via technical solutions without impairing the learning process. The first and foremost safety measure that must be enforced at all times is the proper supervision of the trainees.

Nothing can replace the supervision and guidance of a qualified instructor. Trainees have an incomplete mastery of the subject. They can make mistakes and most certainly will. That is an essential part of the learning process.

The role of the instructor is to let trainees make mistakes that have no consequences on their safety, while protecting them from mistakes that can have unfortunate consequences.

Nothing can replace the supervision and guidance of a qualified instructor.

CAUTION

The equipment is designated as EMC Class A (CISPR 11:2009). In a domestic environment, it can cause radio interference, in which case the user may be required to take adequate measures.

5.2 General warnings

The warning symbols indicating potential hazards are listed in the Safety and Common Symbols section at the beginning of this manual. Whenever you encounter one of these symbols on the equipment, specific actions may be required to ensure your safety and prevent damage to the equipment.

⚠ CAUTION

The system should be operated under supervision at all times. Never let the system operate unattended.

⚠ WARNING

Do not attempt to lift the system by yourself.

⚠ CAUTION

Some components have sharp edges. To prevent cuts and injuries, manipulate them with care.

⚠ CAUTION

Make sure the power cord's insulation is not damaged before energizing the system.

⚠ CAUTION

Make sure the equipment is turned off before making or modifying any connection.

⚠ CAUTION

Wear personal safety equipment when working on electrical circuits. Refer to the Personal protective equipment (PPE) section.

CAUTION

- Oil may leak from the hydraulic power unit. Always inspect the system for leaks before operating it.
- Make sure the floor around the working area is dry and clean before approaching the system.
- Turn the system off when a leak is detected. Do not operate the equipment until the source of the leak has been repaired.
- Leaks can cause floors to become wet. Any leakage of liquid on the floor must be thoroughly cleaned.

5.3 Indication of conformity

5.3.1 Electrical

The equipment is in conformity with the following directives and standards:

- Machinery Directive 2006/42/EC
  - EN 60204-1:2006-06: Safety of machinery - Electrical equipment of machines - Part 1: General requirements
- Electromagnetic Compatibility Directive (EMC) 2014/30/EU
  - IEC 61326-1:2012: Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements
  - EN 55011:2009 (Class A): Industrial, scientific, and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement, modified
- Restriction of the use of certain Hazardous Substances Directives (RoHS) 2011/65/EC
  - EN 50581:2012-09: Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

5.3.2 Mechanical

The equipment is in conformity with the following directives and standards:

- Directive 2006/95/EC of the European parliament and of the council of 12 December 2006 (LVD)
  - EN 61010-1:2010-10: European standard – Safety requirements for electrical equipment for measurement, control, and laboratory use

5.4 Degrees of ingress protection (IP)

The equipment is rated IP20.

CAUTION

The equipment is not protected against liquid infiltration or immersion. Keep it away from all types of liquids. Failure to do so could damage the equipment.

5.5 Personal protective equipment (PPE)

Even with all the safety features implemented on the equipment, there are still residual risks due to misuse or defective part(s). To further reduce the risks of injury, always follow the rules below when using the equipment:

- Wear safety glasses
- Wear safety shoes
- Do not wear anything that might get caught such as a tie, jewelry, or loose clothes
- Tie back long hair
- Clean the working area; it must be free of oil and water

5.6 Equipment modification

Do not modify the equipment without prior written permission of Festo Didactic. The equipment uses complex industrial components and modifications could have undesired consequences on product integrity and safety.

6 Introduction

6.1 Overview

The Hydraulic Pitch Hub Learning System, shown in Figure 1, is designed for training and vocational education, and allows pitch control of a wind turbine blade. The system provides the necessary components of a wind turbine hub assembly that uses hydraulic blade pitch control to capture and control wind energy.

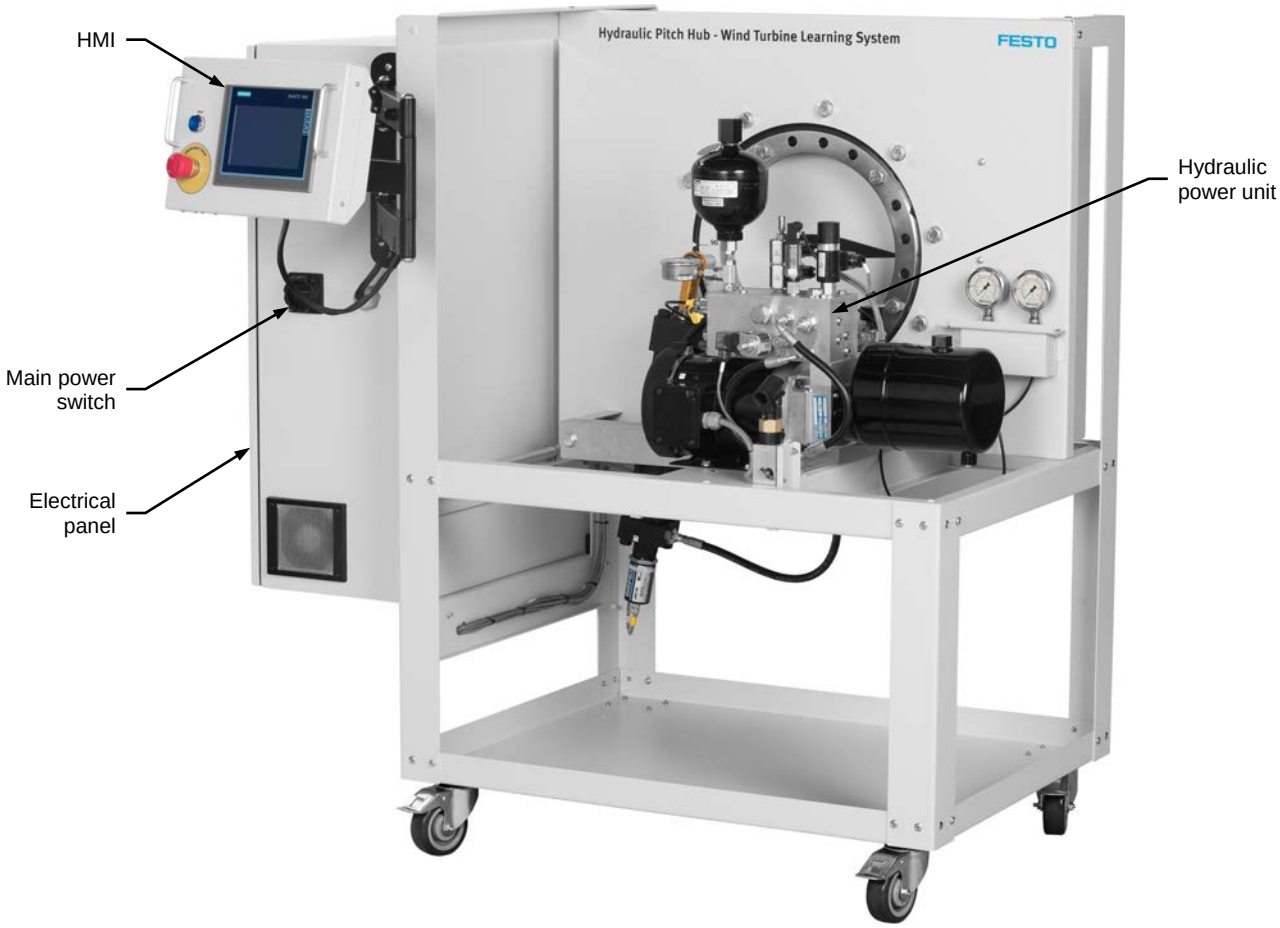

Figure 1. Hydraulic Pitch Hub Learning System.

The learning system uses industrial-grade components to provide an experience as close as possible to field training. The complexity and inherent risks associated with industrial components may be present when using the system. Hence, trainees and instructors must understand the principle of operation of the system before using it.

6.1.1 Pitch hub assembly

The components of the pitch hub assembly are shown and identified in Figure 2.

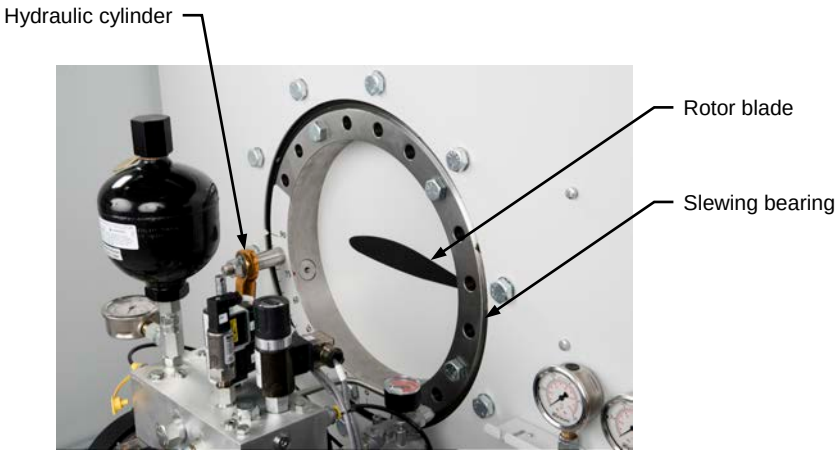

Figure 2. Pitch hub assembly.

6.1.2 Hydraulic power unit

The hydraulic power unit generates the power to drive the hydraulic cylinder and pitch the rotor blade. The unit comprises a motor, an accumulator, a reservoir, solenoids, and other components. The main components are identified in Figure 3.

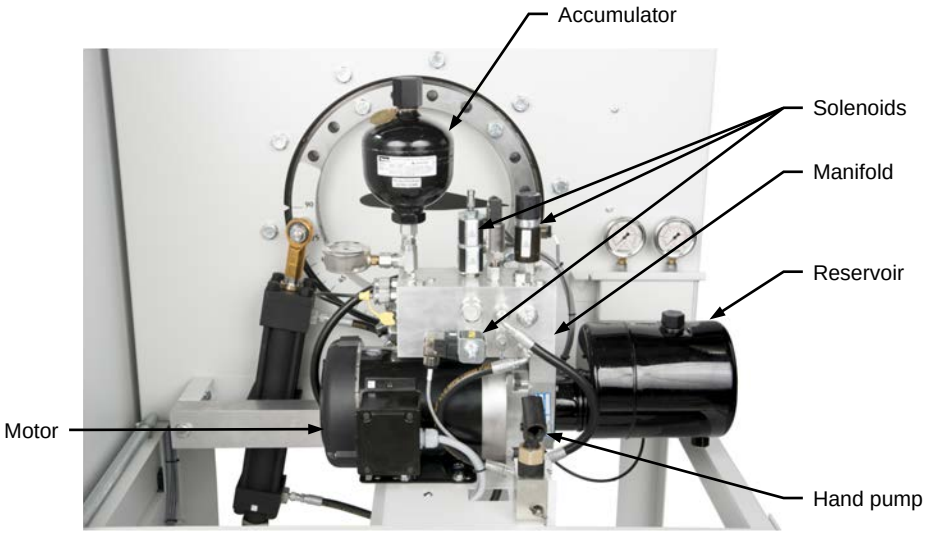

Figure 3. Hydraulic power unit.

6.1.3 Electrical panel

The electrical panel is in a grounded metallic enclosure. This enclosure is locked and should not be opened by the users without the approval and supervision of a qualified instructor. Its main components are shown in Figure 4.

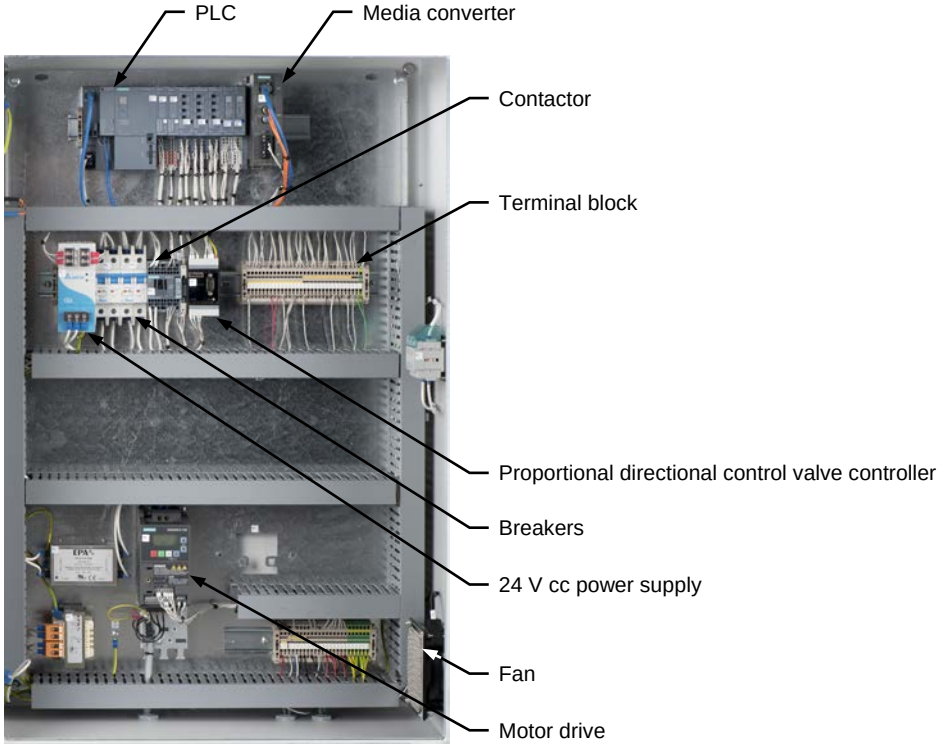

Figure 4. Electrical panel.

The connector for the main power cord is located next to the bottom-left side of the control panel, as shown in Figure 5.

Figure 5. Main power cord connector.

The main power switch is located on the mid-right side of the panel, as shown in Figure 6. This switch powers the system on or off.

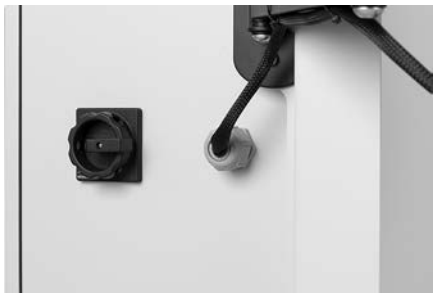

Figure 6. Main power switch.

The electrical panel features a key lock to prevent unauthorized access, as shown in Figure 7.

⚠ DANGER

Devices in the electrical panel carry potentially lethal currents. It should only be opened by a qualified technician or under the supervision of an instructor.

Figure 7. Locking the electrical panel door to prevent unauthorized access.

Great care must be taken when the electric panel is open; the following recommendations must be followed always.

Working safely inside the electrical cabinet requires you to be alert for potential electric shock hazards and to follow some basic safe operating guidelines. Equipment manufacturers normally supply manuals (or other documentation) with recommendations that should be followed to ensure safe operation. Likewise, local and national building, fire, and electrical codes provide important safety guidelines.

Wearing appropriate clothing and protective equipment and using the proper tools is essential to limit the risk of injury. However, it is important to bear in mind that equipment alone is not a substitute for safe work habits and a safe work environment.

Always follow lockout/tagout procedures as required, use electrically insulated hand tools, and ensure that proper electrical grounding techniques are implemented. Grounding will ensure that exposed metal parts are never electrically charged, either by electrostatic build-up or by a shorted power cable, causing potential hazard to the technician. If there is ever a short circuit (e.g., the electrical insulation of a cable fails, and the copper wire touches a metal bracket), the path to the earth will make the circuit protection trip.

6.1.4 Human machine interface (HMI)

The HMI, shown in Figure 8, is a touch screen that operates and monitors the system. The HMI provides control and data monitoring via a supervisory control and data acquisition system (SCADA).

Figure 8. Human machine interface (HMI).

6.1.5 Emergency button and reset button

The learning system features an emergency button and a reset button, as shown in Figure 8. The emergency button (red) allows users to turn off all equipment in case of emergency. The reset (blue) button allows users to reset the system and resume operation when the emergency is cleared.

6.1.6 Pressure gauge guard

The hoses connected to the two hydraulic pressure gauges are not equipped with check valves. Therefore, unscrewing these hoses could cause a serious hydraulic oil leak. To prevent hoses from being unscrewed from the pressure gauges, a permanent steel guard prevents access to the hose connectors, as shown in Figure 9. This guard is riveted to the frame of the system and must not be removed.

CAUTION

Do not unscrew the hoses from the pressure gauges. Unscrewing these hoses could cause a serious hydraulic oil leak.

Figure 9. Pressure gauge guard.

6.2 Securing the equipment

This section gives general lockout/tagout instructions and specific procedures to shut down, lockout the learning system for maintenance or inspection, and restart it. The system must be locked and tagged anytime maintenance must be performed.

6.2.1 General description of a lockout/tagout procedure

Lockout/tagout procedures are safety measures taken to ensure that machines or equipment on which personnel are performing service or maintenance are safe and cannot be powered unless every employee is prepared.

The lockout procedure is the installation of a locking mechanism to isolate the main power switch and any other source of energy on a piece of equipment. The objective of the lockout is to physically prevent any unexpected start of machinery. Each person involved in the job must install a padlock to the lockout/tagout device (Figure 10).

Figure 10. Lockout/tagout hasp, lock, and tag.

The tagout procedure is the installation of a tag to warn that a mechanism was locked. It indicates that no one should attempt to operate the equipment. The tag also indicates the name of the person(s) who can remove the lockout/tagout device.

Prior to any operation of a machine or equipment, tasks that may expose workers to the inadvertent release of hazardous energy must be identified and proper training must be provided to personnel. Sources of hazardous energy may be electrical, mechanical, hydraulic, pneumatic, chemical, thermal, gravitational, or others. To make a machine or equipment safe:

- Notify all affected employees that a procedure is going to be performed on a machine or equipment.
- De-energize the machine or equipment.
- Isolate and block all forms of hazardous energy using locks and/or tags. In general, lockout devices are preferred over tags. If more than one person is assigned to a task, all workers must use a personal and identifiable lock and/or tag at each energy-isolating device. A group lockout/tagout is also possible, providing that all workers are properly protected. The last hole of a locking hasp is usually reserved to accommodate an additional hasp.
- Verify that no one is near the machine or equipment and test if it is possible to start the equipment.

Special additional procedures may be required in cases where dangerous products like chemicals are involved.

When energizing a machine:

- Check that the machine or equipment is ready to operate, that the area is clear and secure, and that the safety guard is in place.
- Notify all affected employees that the machine or equipment is about to be energized, and check that no worker is within reach of the machine or equipment.
- Remove your own lock and tag and ask the other workers to do the same thing. The machine or equipment must not be energized if a lock has not been removed by its owner.
- Start the equipment and make sure that it is working properly.

6.2.2 System shutdown procedure

1. Turn the equipment off.
2. Install the lockout hasp in the main switch. Next, install the padlock and tag in the hasp (Figure 11).

Figure 11. Installation of a lockout hasp, padlock, and tag.

3. Try to turn on the main switch to verify that the system is electrically isolated. Press the reset button to test whether the system can be energized.
4. Depressurize the accumulator of the hydraulic system by lifting the lever shown in Figure 12. Return the lever to its original position once the accumulator is depressurized (i.e., after approximately ten seconds).

Figure 12. Depressurizing the hydraulic accumulator.

⚠ DANGER

Never unscrew the accumulator. Unscrewing the accumulator when it is pressurized may transform it into a life-threatening projectile.

Only qualified personnel can perform maintenance on the accumulator.

⚠ CAUTION

Be sure to depressurize the hydraulic accumulator. The hydraulic cylinder can move inadvertently if the accumulator is still pressurized.

6.2.3 Re-energizing procedure

1. Make sure everything is secure inside and around the system.
2. Notify all the people working around the equipment that the system is about to be energized.
3. Ask everyone to remove his or her individual padlock and tag. Next, remove the hasp from the main switch.
4. Ask an authorized person for permission to power on the system. Turn the power on by setting the main power switch to the ON position.
5. Wait for the HMI to boot. The HMI should start automatically. The MAIN screen should open with some (flashing red) visual alarms.

The PLC may take a minute or two to boot after the HMI starts.

7 Technical Data

7.1 Specifications

Parameter	Value
Power Requirements	
Nominal Voltage	230 V ac
Frequency	50 Hz/60 Hz
Current	2.2 A
Service Installation	Standard single-phase outlet
Hydraulic Unit	
Operating Pressure	600 to 960 psi
Reservoir	4 L (1 gal)
Oil Type	ISO32 or AW32
Physical Characteristics	
Intended Location	On the floor (stands on casters)
Dimensions (H x W x D)	1372 x 1524 x 750 mm (54 x 60 x 29.5 in)
Net weight	226 kg

Table 1. Technical specifications.

8 Unpacking, Transport, Disposal

8.1 Unpacking

Large equipment such as the learning system is shipped in wooden crates built on a wooden pallet. Only heat-treated wood is used in the packaging according to IPPC standards. Therefore, wooden packaging can be disposed of, or reused without risk of pest proliferation. Paper and cardboard packaging should be recycled in accordance with local regulation.

Upon unpacking your equipment, check that every item showed in the packing lists is present.

8.2 Transport

The system is intended to remain on a flat floor. When transporting the system is required, safety must be ensured.

The swivel casters help to move the system around. However, to prevent accidents, lock the casters when you do not move the system, as shown in Figure 13.

⚠ CAUTION

Always lock the casters when using the learning system.

Figure 13. Locking the swivel casters of the Hydraulic Pitch Hub.

8.3 Disposal

Do not discard the equipment with normal waste: it contains electrical and electronic components. A specialist must dismantle the product. Each component must be recycled or disposed of according to your local legislation.

It is the owner's responsibility to make provisions for the equipment recycling and safe disposal.

Before dismantling the equipment, a technician must purge the nitrogen from the accumulator and must drain the oil from the hydraulic power unit. Make sure to dispose the oil according to local regulation.

9 Maintenance

9.1.1 Main power cord

Before each usage, check if the main power cord is damaged. If the cord is damaged, it must be replaced with an appropriate power cord. Select the type of power line according to your local electrical requirements.

9.1.2 Hydraulic unit oil and filter change

1. If the pressure reading in the accumulator pressure gauge is not zero, actuate valve MV1 for about 10 seconds to completely discharge the accumulator. The accumulator pressure gauge and valve MV1 are shown in Figure 14.

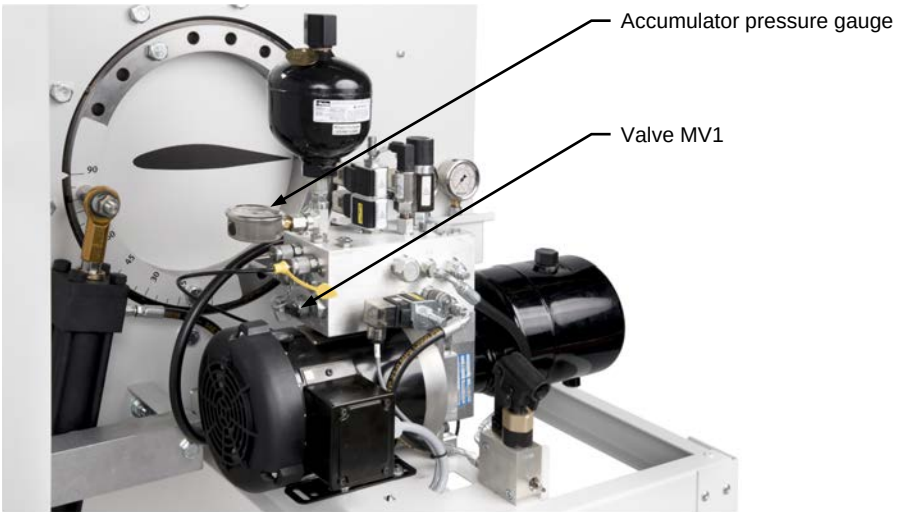

Figure 14. Accumulator pressure gauge and valve HM1.

If the accumulator is not discharged, some oil will not be drained.

2. De-actuate valve MV1.
3. Position a plastic pan under the drain plug at the bottom of the system.

Use a clean pan if you plan to reuse the oil.

4. Remove the plug on top of the oil reservoir.
5. Unscrew the drain plug using a 1/4-inch hex key. Let the oil drain completely.
6. Make sure the seal of the drain plug is in good condition.
7. Once the oil reservoir is completely drained, screw the drain plug back in place.
8. Carefully move the pan over the bottom surface of the system until it is under the oil filter.
9. Use the filter wrench to unscrew the oil filter, and then pour the oil from the filter into the pan.

The oil filter may contain some oil. Be careful while unscrewing the filter to prevent it from spilling oil over the system or the surrounding area.

10. Clean up any oil that may have spilled on the system.
11. Apply a thin oil coat on the filter seal you are about to use. Oil helps with screwing the filter smoothly and preserves its leak tightness. If you reuse the same filter, make sure it is still in good condition (seal and body). If filter replacement is required, refer to Table 2 for filter specifications.

Recommended product	Stauff SF6310-18
Filtering paper	10 µm
Diameter	77.5 mm (3.05 in)
Length	87 mm (3.43 in)
Element thread	¾ - 16 UNF
Beta ratio	β10 ≥ 2
Dirt holding capacity	6 g (0.35 oz)
Filtration area	825.2 cm^2 (127.9 in^2)
By-pass setting	124 kPa (18 psi)
Maximum working pressure	1400 kPa (200 psi)

Table 2. Hydraulic oil filter specifications.

12. Screw the oil filter in place using only your hands.
13. Put the plastic funnel on top of the reservoir. If oil replacement is required, refer to Table 3 for oil specifications.

Recommended product	Shell Hydraulic S1 M32 or equivalent
ISO fluid type	HM
ISO viscosity grade	32
Technology	Mineral, zinc-based
Kinematic viscosity @ 40 °C	32 cSt
Viscosity index	96
Density @ 15 °C	0.869 kg/l

Table 3. Hydraulic oil specifications.

14. Fill the reservoir with about four liters (one gallon) of oil.
15. Put the plug back on top of the oil reservoir.
16. Clean the area.

9.1.3 Consumables and other replacement parts

It is possible to replace consumable pieces or damaged equipment. Use only Festo Didactic accessories to ensure compatibility and sustainability of the equipment. Refer to the packing lists if necessary.

9.1.4 Frequency of inspection

This equipment is meant to be used by trainees. They may not yet have the experience or background required to detect problems with the learning system. Therefore, before each use, a technician or the instructor should inspect the system. The system should also be inspected after trainees have used it.

9.1.5 Cleaning and decontamination

To clean the system, the power must be turned off. An all-purpose cleaner and a soft cloth can be used on most of the components.

10 Commissioning

10.1 Environmental requirements

The equipment is designed to be installed indoors and must be operated in the following environmental conditions to ensure user safety:

- an altitude up to 2000 m (6560 feet)
- a temperature between 5°C and 40°C (between 41°F and 104°F)
- a maximum relative humidity of 80% for temperatures up to 31°C (88°F), decreasing linearly to 50% relative humidity at 40°C (104°F)
- mains supply voltage fluctuations which do not exceed ±10% of the nominal voltage
- transient overvoltage up to the levels of overvoltage category II
- temporary overvoltage occurring on the mains supply: 2500 V
- a pollution degree of 2 in accordance with IEC 60664-1

> The word pollution used above refers to any addition of foreign matter, solid, liquid, or gaseous (ionized gases), that may produce a reduction of dielectric strength or surface resistivity.

Make sure that the location where you want to install the equipment meets the environmental requirements listed above, and then follow the directives given in the next sections to safely install and use the equipment.

Trainees must have basic electrical knowledge before using the equipment and a qualified instructor must supervise the training sessions.

10.2 Quick start

10.2.1 System preparation

1. Remove all wrapping material.
2. Install the protective earth conductor (green-yellow).

⚠ WARNING

The installation of the protective earth conductor, as well as any other electrical installation, must be carried out by a qualified person, who must make sure to respect the regional and national standards applicable.

3. Add approximately 4 L of ISO 32 hydraulic oil to the system (follow the procedure in section 9.1.2).

10.2.2 Starting the system

1. Make sure the main switch is off and everything is secure inside and around the system.
2. Notify everyone that the system is about to be energized.
3. Connect the main power cord connector.
4. Open the electrical panel and make sure the breakers are on.
5. Close the electrical panel.
6. Make sure the emergency stop button is not actuated. If it is actuated, rotate it counterclockwise until it pops out.
7. Turn on the main power switch.
8. Wait for the HMI to boot. The HMI should start automatically.
9. Press the reset button.

10.2.3 Changing the HMI language

The HMI is available in four languages: English, French, Spanish, and German. To change the language of the HMI:

1. In the HMI MAIN screen, press the double arrowhead in the bottom-right corner of the screen.
2. Select the SERVICE screen.
3. Press the arrowhead in the middle right of the screen.
4. A languages drop-down list on the bottom of the window allows changing the HMI language.
5. This drop-down list is password protected. At the prompt, enter the default user: “admin” and the password: “festo”.
6. Select the desired language from the drop-down list.

10.2.4 Using the automatic mode

1. Press Start Trainer in the HMI MAIN screen.
2. If the ALARMS button is flashing red, press it. In the ALARMS screen, acknowledge each current alarm. Next, press RESET ALARMS, if necessary.
3. Press SIMUL in the HMI MAIN screen.
4. In the WIND SIMULATION screen, press START.
5. Press START AUTO in the MAIN screen to change Operation Status to Automatic.
6. Stop the simulation by pressing the STOP button in the MAIN screen.

10.2.5 Starting the system in manual mode

1. Press Start Trainer in the HMI MAIN screen.
2. If the ALARMS button is flashing red at this point, press it. In the ALARMS screen, acknowledge each current alarm. Next, press RESET ALARMS, if necessary.
3. Then, press MANUAL to change Operation Status to Manual Mode.
4. You can manipulate the learning system from the MANUAL screen.

10.2.6 Activating the emergency stop and resuming the system

1. Press the emergency stop button (red).
2. Observe the HMI screen to verify the system has been stopped.
3. Rotate the emergency stop button counterclockwise until it pops out.
4. Press the reset button (blue).
5. Press START TRAINER in the HMI screen.

10.3 Fault insertion

Instructors can insert faults in the system to help students practice troubleshooting. To insert one or several faults into the system:

1. Press FAULT INSERTION at the bottom of the screen.
2. At the prompt, enter the default user: “admin” and the password: “festo”.
3. Press FAULT INSERTION a second time to access the corresponding screen.
4. From this screen, you can enable or disable the fault using the on/off button. You can also set a delay before the fault turns on.

10.4 Risks for service personnel

This section lists the risks to which service personnel are likely to be exposed when using or servicing the equipment. It also gives recommendations to reduce those risks.

10.4.1 Risk of injection

Hydraulic systems, such as the hydraulic power unit of the learning system, comprise hoses that may burst if damaged. This may lead to a high-pressure injection injury, as pointed out in section 4.3.

⚠ WARNING

Do not try to detect leaks by touching hydraulic lines or fittings while the system is running or pressurized.

⚠ WARNING

Avoid touching damaged or defective hoses while the system is running or pressurized.

⚠ CAUTION

Defective hoses may burst under pressure. Make sure the hoses are in flawless condition before using the equipment.

10.4.2 Risk of whiplash when working with hydraulic lines

The hydraulic energy contained in hydraulic hoses, if released improperly or by accident, may cause injuries and damage to the equipment, as pointed out in section 4.3.

⚠ WARNING

Stay away from whipping hoses. If a hydraulic line in the system breaks, never try to grab it. Instead, step away from the area and try to shut the system off.

⚠ WARNING

During operation, avoid touching or approaching a hose if the fittings are damaged or the hose is corroded.

⚠ CAUTION

Before servicing and starting the system, inspect the hoses, looking for indications of corrosion, defective fittings, or soft spots.

10.4.3 Risks of cuts and bruises

Be careful not to hurt yourself or someone else when using the equipment components.

⚠ CAUTION

- Always close and lock the electrical panel door before moving the system or when it is not necessary to access the electrical components.
- Place the HMI close to the frame of the system by collapsing the HMI mount as much as possible when moving the equipment.
- The electrical cabinet has sharp edges and components. To reduce the risks of cuts, do not slide your hands or fingers on the cabinet door or enclosure.
- To reduce the risks of foot injuries when moving the equipment, always wear safety shoes.

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