Mechanical
Drives Training System

FESTO

Industrial Trades

User Guide

Festo Didactic
en
594994

Industrial Maintenance

Mechanical Drives Training System

Safety Instructions and Commissioning

594994

Order no.: 594994 (Printed version) 595746 (Electronic version)
First Edition
Revision level: 06/2020

By the staff of Festo Didactic

© Festo Didactic Ltée/Ltd, Quebec, Canada 2017
Internet: www.festo-didactic.com
e-mail: services.didactic@festo.com

Printed in Canada
All rights reserved
ISBN 978-2-89747-903-9 (Printed version)
ISBN 978-2-89747-904-6 (Electronic version)
Legal Deposit – Bibliothèque et Archives nationales du Québec, 2017
Legal Deposit – Library and Archives Canada, 2017

The purchaser shall receive a single right of use which is non-exclusive, non-time-limited and limited geographically to use at the purchaser's site/location as follows.

The purchaser shall be entitled to use the work to train his/her staff at the purchaser’s site/location and shall also be entitled to use parts of the copyright material as the basis for the production of his/her own training documentation for the training of his/her staff at the purchaser’s site/location with acknowledgement of source and to make copies for this purpose. In the case of schools/technical colleges, training centers, and universities, the right of use shall also include use by school and college students and trainees at the purchaser’s site/location for teaching purposes.

The right of use shall in all cases exclude the right to publish the copyright material or to make this available for use on intranet, Internet, and LMS platforms and databases such as Moodle, which allow access by a wide variety of users, including those outside of the purchaser’s site/location.

Entitlement to other rights relating to reproductions, copies, adaptations, translations, microfilming, and transfer to and storage and processing in electronic systems, no matter whether in whole or in part, shall require the prior consent of Festo Didactic.

Information in this document is subject to change without notice and does not represent a commitment on the part of Festo Didactic. The Festo materials described in this document are furnished under a license agreement or a nondisclosure agreement.

Festo Didactic recognizes product names as trademarks or registered trademarks of their respective holders.

All other trademarks are the property of their respective owners. Other trademarks and trade names may be used in this document to refer to either the entity claiming the marks and names or their products. Festo Didactic disclaims any proprietary interest in trademarks and trade names other than its own.

The following table lists the safety and common symbols that may be used in this course and on the equipment. Before performing manipulations with the equipment, you should read all sections regarding safety in the Safety Instructions and Commissioning manual accompanying the equipment.

If applicable, following subsections give general procedures related to the tasks you will be asked to perform in this course. Additional safety procedures are given before any task requiring specific safety precautions.

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.
	Static sensitive contents. Observe precautions for handling electrostatic discharge sensitive devices.
	Notice, non-ionizing radiation.
	Consult the relevant user documentation.
	Radio Equipment Directive (RED) geographical restrictions – consult the relevant user documentation.
	Direct current.
	Alternating current.
	Both direct and alternating current.

© Festo Didactic

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.

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

Read this guide carefully before using and operating the system. The guide contains essential instructions concerning the proper installation, use, maintenance, and commissioning of the equipment. Hence, you must keep the guide for the whole life of the product and make it available at all times to the users.

If, during the lifetime of the product, part(s) of the documentation is (are) damaged or missing, please contact your representative to replace the missing document(s).

Table of Contents

© Festo Didactic

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 document includes important instructions for safe use of the equipment.

1.2 Laboratory/classroom setup

- Residual current devices (RCDs) must protect the test area. Use type B residual current circuit breakers with a residual current rating inferior or equal to 30 mA.
- A supervisor must oversee the test area. A supervisor is a qualified electrician or a person who has the appropriate instruction, has knowledge of the respective safety requirements and safety regulations, and whose training has been accordingly documented.
- No damaged or defective devices may be used. Lockout damaged devices to prevent further use and remove them from the test area.

1.3 General requirements

General requirements for safe operation of electrical equipment:

- Do not lay cables over hot surfaces. A warning symbol identifies hot surfaces.
- Do not exceed the maximum permissible current loads for cables and devices unless otherwise specified. Always compare the current ratings of the device, the cable, and the fuse.
- Use only Festo equipment and accessories. Do not connect equipment or accessories from other manufacturers unless otherwise specified.
- Make sure the equipment is properly earthed (grounded).

1.4 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.

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 documents, and observe the safety instructions and precautions in the present document.

© Festo Didactic

1.5 Obligations of the operating company

The operating company undertakes to allow only those persons to work with the equipment who:

- Are familiar with the basic regulations regarding work safety and accident prevention and have been instructed in the use of the equipment.
- Have read and understood the section concerning safety, as well as the safety precautions.

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

1.6 Obligations of the trainees

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

- Read the section(s) concerning safety, as well as the safety precautions in this document.
- Familiarize themselves with basic regulations regarding work safety and accident prevention.

1.7 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.

⚠ CAUTION

Immediately eliminate any fault that may impair safety.

1.8 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

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.

© Festo Didactic

2 Introduction

2.1 Overview

The workstation of the Mechanical Drives Training System (see Figure 1) is designed for training and vocational education.

The workstation 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 workstation before using it.

Figure 1: The workstation of the Mechanical Drives Training System.

2.2 Workstation controls

The controls of the workstation are shown in Figure 2.

Figure 2: Controls of the workstation.

Located below the safety guard, on the left side of the control panel, are two connectors that are used to connect the motor and the clutch/brake, as shown in Figure 3.

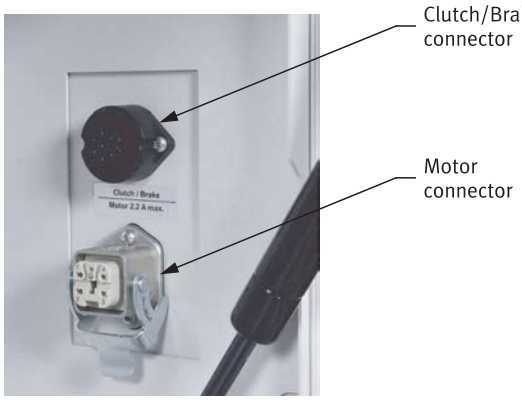

Figure 3: Connectors inside the workstation.

NOTICE

Use only the three-phase variable-frequency induction motor and clutch/brake provided with the training system. This motor and clutch/brake have specific characteristics that may not be met by other manufacturers.

At the back of the control panel, there is a Circuit Breaker that protects the system from short circuits and overcurrents. When starting the system, the Circuit Breaker switch must be set to the upper position, so that current is provided to the system (see Figure 4). In the case of a short circuit or overcurrent, the Circuit Breaker turns the system off. At the back of the control panel, there is also a connector for the main power cord, as shown in Figure 5.

© Festo Didactic

Figure 4: Circuit Breaker switch set to the upper position.

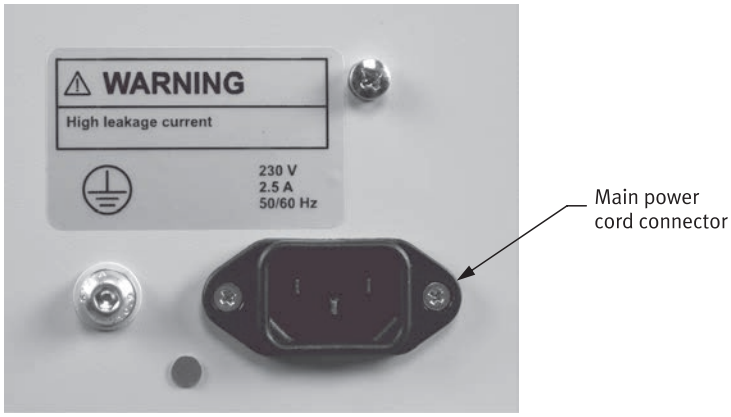

Figure 5: Main power cord connector.

Hint

The rating of the main power cord is different for the 120 V, 60 Hz ac power network. Refer to the Technical Data section.

2.3 Variable-frequency drive

NOTICE
If a factory reset is performed on the variable frequency drive (VFD), all parameters will be deleted, which may lead to equipment damage.

The motor of your training system has four poles. Since the number of poles of the motor remains constant, the speed directly varies with the frequency.

The variable frequency drive has five buttons and a display screen, as shown in the following figure. The panel layout of the variable-frequency drive is described in the remainder of this subsection.

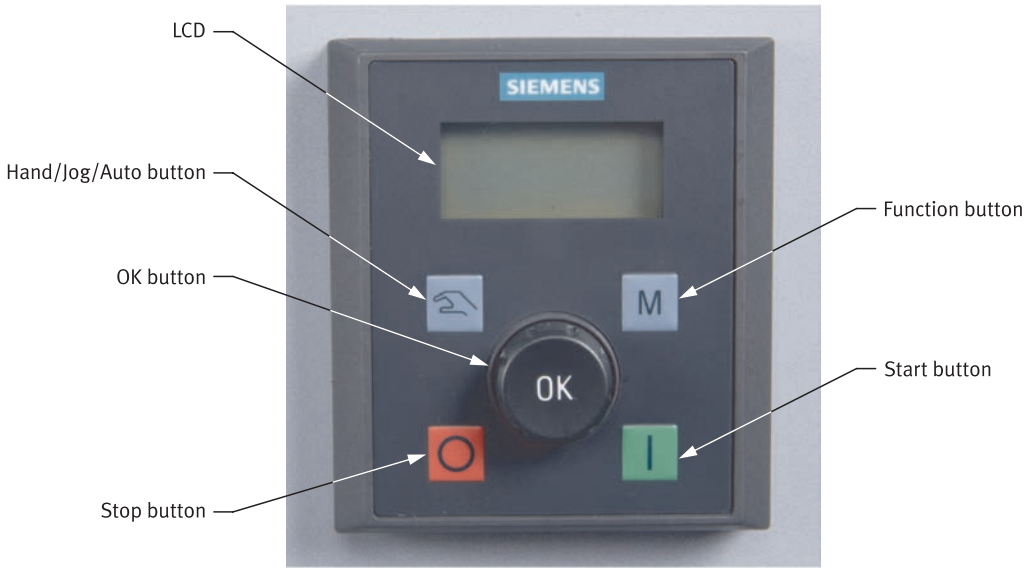

Figure 6: Variable-frequency drive panel layout.

The **Stop** button stops the drive.

The **Start** button starts the drive. The drive is configured to start the motor rotation clockwise at 15 Hz.

The **Hand/Jog/Auto** button sets the drive to Hand, Jog, or Auto mode. If the Hand icon is flashing on the display screen, the drive is in Jog mode. If the Hand icon is continuously on, the drive is in Hand mode.

- In the **Hand** mode, the frequency of the drive can be modified while the motor runs, which modifies the speed of the motor. The Hand mode also permits reversing the direction.
- In the **Jog** mode, the drive works continuously, at a fixed speed and direction, independently from the system's settings. It is equivalent to an override switch in some systems. To properly use the Jog mode, the button must be pressed continuously.
- In the **Auto** mode, the frequency of the drive is controlled by an external automation system.

The **OK** button can be turned clockwise or counter-clockwise to increase the frequency in the clockwise or counter-clockwise direction. Pressing this button alows to cycle through the information the drive can display. The available information are: drive output frequency (Hz), output voltage (V), output current (A), and dc voltage (V).

The **Function** button is a multi-function button that permits selecting a function and that can modify the digits of an item or access the setup menu.

© Festo Didactic

The **Display** shows the units and status of the drive. The units are either in volts (V), amperes (A), or hertz (Hz). The status of the drive is indicated by status icons. Table 1 shows the status icons with their meanings.

Table 1: Status icons with their descriptions.

Icon	Description
	The drive has at least one pending alarm.
	The drive has at least one pending fault.
	The drive is running. When the icon is flashing, the drive may be energized unexpectedly.
	The motor rotates in the reversed direction.
	Indicates if the drive is in the Hand, Jog, or Auto mode.
	The drive is in the commissioning mode.

The workstations come with different motors. The SI unit version of the system has an IEC frame motor with a shaft diameter of 14 mm. The U.S. customary unit version of the system has a NEMA frame motor with a shaft diameter of 5/8 in.

The motor parameters and other parameters of the variable-frequency drive are already set for the motor that comes with your workstation. For example, when you start the motor, it will always rotate clockwise with the drive set to 15 Hz. However, if you have an IEC motor and a NEMA motor and you switch between the two on the same workstation, you may have to change the drive parameters to take into account the difference in the electrical specifications and adjust the safety mechanisms.

The parameter P0820 allows to switch between the two default configurations.

Hint

Your workstation may not have this feature if it is an SI unit version produced before June 2020. For more information, see the note below Table 2.

1. Press M on the drive keyboard to enter the parameter editing mode.
2. Turn the OK button until you reach parameter P0820.
3. Press OK to access the parameter value.
4. Turn the OK button to set the parameter to 0 for a NEMA motor or to 1 for an IEC motor.
5. Press OK to confirm.
6. Press M for more than 2 seconds to exit the parameter editing mode.

Aside from parameter P0820, other parameters are visible in the parameter editing mode.

Table 2: List of visible parameters.

Parameter	Function	Description
P0003	User access level	Displays the user access level.
P0010	Commissioning parameter	This parameter must be set to 0, otherwise the motor will not start.
P0012	reserved	For commissioning only.
r0031	Actual filtered torque	Displays the electrical torque in Nm.
r0035	Actual motor temperature	Displays the calculated motor temperature. An algorithm calculates the temperature. It takes into account various parameters such as the torque and how long the motor has been running.
P0820		Allows to switch between two configurations: 0 for the NEMA motor and 1 for the IEC motor.

Hint
The SI unit versions of the system produced before June 2020 may have more visible parameters. In such versions, the parameter P0820 does not allow to switch between the two motors.

Besides the regular protection offered on a drive, the drive on your workstation has been configured to protect your motor and workstation via three features:

Hint
Your drive may not have the first and second features if the workstation is an SI unit version produced before June 2020. Furthermore, it will have the same maximal temperature as for the NEMA motor. For more information, see the note below Table 2.

- The drive will stop the motor if the current flowing through the motor is above the configured maximum for more that 5 seconds. The maximum currents are:
  - NEMA motor: 1.6 A
  - IEC: 1.25 A
- The drive stops the motor automatically after a continuous run of 5 minutes. This prevents overheating.
- An algorithm estimates the motor temperature and shuts down the motor if the computer temperature is above the pre-configured threshold. The maximum temperatures are:
  - NEMA motor: 155°C
  - IEC: 180°C

© Festo Didactic

The motor does not stop automatically when the estimated temperature reaches the threshold value. Instead, the drive displays a warning (A511). If the estimated temperature continues to rise 10% more (e.g., 180 + 18 = 198°C for the IEC motor), the motor stops and the drive goes into fault mode (F11).

If the drive displays an overheating fault (F11), turning off the drive will not clear the fault since the estimated temperature is saved in the drive (you can see the estimated temperature via parameter r0035). To reset the overheating fault you must let the drive on, with the motor stopped. This lets the motor cool down and allows the algorithm to decrease the calculated temperature. If you turn the drive off, the algorithm would not be able to calculate the cooling time and will consider the temperature of the motor is still high. It takes a couple of hour of cooling for the estimated temperature to go down to an acceptable level.

The variable frequency drive displays codes when specific faults and alarms occur. Table 3 shows the most common fault codes and Table 4 shows the most common alarm codes.

Hint
All fault codes are listed in the manufacturer documentation of the variable frequency drive.

Table 3: Common fault codes.

Fault	Description
F1	Indicates an overcurrent.
F2	Indicates an overvoltage.
F3	Indicates an undervoltage.
F4	Indicates an inverter overtemperature.
F11	Indicates a motor overtemperature.
F41	Indicates a motor data identification failure.
F85	Indicates an external fault.
F101	Indicates a stack overflow.
F452	Indicates a belt failure.

Table 4: Common alarm codes.

Alarm	Description
A501	Indicates a current limit.
A502	Indicates an overvoltage limit.
A503	Indicates an undervoltage limit.
A504	Indicates an inverter overtemperature.
A511	Indicates a motor overtemperature.
A535	Indicates a braking resistor overload.
A922	Indicates no load is applied to the inverter.
A952	Indicates a belt failure.

The main difference between faults and alarms is that faults can be cleared without correcting the issue. An alarm cannot be cleared as long as the issue has not been rectified.

Hint
All alarm codes are listed in the manufacturer documentation of the variable frequency drive.

© Festo Didactic

3 Safety Precautions

3.1 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.

⚠ CAUTION

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

NOTICE

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.

3.2 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.

⚠ WARNING

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

⚠ WARNING

There is a risk of personal injury, for example, intervertebral disk injury when trying to lift the workstation. Ask for assistance or lay the workstation in the work environment.

⚠ WARNING

The prony brake can become very hot when used for a long period of time. To prevent burn injuries, let it cool down before handling it.

⚠ WARNING

High leakage current! Be sure to establish an earth connection before connecting the equipment. The device may only be operated with an additional protective conductor. A terminal is available at the back of the device. 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

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

⚠ CAUTION

The rotating machines must stay firmly isolated and secured below the safety guard whenever the machines are powered on and/or their rotating parts have not completely stopped to avoid risks of injuries.

NOTICE

This is an EMC Class A (CISPR 11:2009) product. In a domestic environment, this product may cause radio interference, in which case the user may be required to take adequate measures to reduce interference.

3.3 Securing the equipment

This section gives general lockout/tagout instructions and specific procedures to shut down, and lockout the training system for maintenance or inspection, and to restart the system. The system must be locked and tagged anytime maintenance must be performed or whenever the user works on the system with the safety guard opened.

© Festo Didactic

3.4 General description of a lockout/tagout procedure

The lockout device consists of a hasp and a padlock and is used to install a locking mechanism at the Main switch. The hasp can be locked with one or more padlocks. The objective of the lockout device is to prevent an unexpected startup of machinery during installation and maintenance operations.

The tagout device is a tag that warns that a mechanism has been locked. The tag indicates that no one should attempt to operate the equipment. It also indicates the name of the person(s) who can remove the lockout device.

The workstation is supplied with lockout and tagout devices as shown in Figure 7. Each lockout and tagout device should be locked using a padlock.

Figure 7: Lockout/tagout hasp, lock, and tag

Once the maintenance and installation jobs are completed, the safety guard must be closed and lockout devices should be inserted at the padlock eyes near the safety guard's door handle.

3.5 General description of a lockout/tagout procedure

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.

Hint
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 closed.
- 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.

3.6 System shutdown procedure

1. Make sure that the safety guard is closed.
2. Turn the equipment off.
3. Install the lockout hasp in the Main switch. Next, install the padlocks and tags in the hasp (see Figure 8).

Figure 8: Installation of a lockout hasp, padlock and tag.

4. Try to turn on the main switch to verify that the system is electrically isolated. Press the safety reset button to test whether the system can be energized.

Hint
At this point, the system can be considered secure.

3.7 Re-energizing procedure

1. Make sure everything is secure inside and around the workstation and close the safety guard.
2. Notify all the people working around the equipment that the system is about to be energized.

© Festo Didactic

3. Ask everyone to remove his or her individual padlock and tag. Next, remove the hasp from the main switch.
4. Ask a authorized person for permission to power on the workstation. Turn the power on by setting the Main switch to the I (on) position.

3.8 Indication(s) of conformity – Electrical

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

- Low Voltage Directive (LVD) 2014/35/EU
  - EN 61010-1:2010 - Safety requirements for electrical equipment for measurement, control, and laboratory use - 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/EU
  - EN 50581:2012-09 - Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances
- EN 50581:2012-09
  - Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

3.9 Indication(s) of conformity – 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: European standard – Safety requirements for electrical equipment for measurement, control, and laboratory use

3.10 Degrees of ingress protection (IP)

The equipment is rated IP20.

NOTICE
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.

3.11 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, jewellery, or loose clothes
- Tie back long hair
- Clean the working area; it must be free of oil and water

3.12 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.

© Festo Didactic

4 Technical Data

4.1 Specifications

Table 5: System specifications.

Parameter	Value (230 V, 50 Hz ac power network)	Value (120 V, 60 Hz ac power network)
Nominal Voltage	230 V ac	120 V ac
Current	2.5 A	4.5 A
Frequency	50 Hz	60 Hz
Service Installation	Standard, single-phase outlet	
Physical Characteristics		
Intended Location	On a table top	
Net Weight	59.9 kg (132 lb)	
Dimensions (H x W x D)	44.5 x 73.1 x 120.1 cm (17.5 x 28.8 x 47.3 in), including the control panel	

Table 6: Motor specifications.

Parameter	SI unit version		U.S. customary unit version	
	Value (230 V, 50 Hz ac power network)	Value (120 V, 60 Hz ac power network)	Value (230 V, 50 Hz ac power network)	Value (120 V, 60 Hz ac power network)
Frequency	50 Hz	60 Hz	50 Hz	60 Hz
Nominal Speed	1330 r/min	1595 r/min	1438 r/min	1725 r/min
Power	0.25 kW (0.34 hp)		0.25 kW (0.34 hp)	
cosφ	0.740		0.619	
Maximum ambient temperature	40°C (104°F)		40°C (104°F)	
Weight	11.2 kg (24.7 lb)		10 kg (22.0 lb)	
Mounting base dimensions (H x W x D)	28 x 15.6 x 6.2 cm (11 x 6.14 x 2.44 in)		28 x 15.6 x 6.2 cm (11 x 6.14 x 2.44 in)	

Table 7: Prony brake specifications.

Parameter	Value
Torque Range	0 N·m-6 N·m (0 lbf·in-53.1 lbf·in)
Dimensions (H x W x D)	280 x 305 x 100 mm (11 x 12 x 3.94 in)
Net Weight	1.8 kg (3.97 lb)

© Festo Didactic

5 Unpacking, Transport, Disposal

5.1 Unpacking

Large equipment, such as the workstation, 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 packaging lists is present.

5.2 Transport

The workstation is intended to remain on a flat surface, such as a table top. When transporting the system is required, safety must be ensured.

⚠ WARNING

There is a risk of personal injury, for example, intervertebral disk injury when transporting the workstation. Ask for assistance when lifting the workstation is required, and use the grips on the sides of the system.

⚠ WARNING

Before transporting the panels, make a visual inspection to make sure that no component is about to fall. Furthermore, always transport the panels using the handles. Finally, the location of the panels should respect the horizontal and vertical distance ranges provided below. Failure to do so may result in serious injuries.

When transporting the panels, safety must be ensured to avoid injuries. The panels must must be kept at a horizontal distance less than 35 cm from the user's body. Furthermore, the vertical distance between the panels' center and the ground will vary between 30 cm and 125 cm.

The optional workbench has swivel casters, which makes it easy to move the system around. However, to prevent accidents, lock the casters when you do not move the system, as shown in Figure 9.

⚠ CAUTION

Always lock the casters when using the optional workbench.

Figure 9: Lock the swivel casters of the optional workbench.

NOTICE
The system is heavy with the optional workbench; use it and move it only on a flat floor.

5.3 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.

© Festo Didactic

6 Installation and Maintenance

6.1 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 ft)
- a temperature between 5°C and 40°C (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 overvoltages up to the levels of overvoltage category II
- temporary overvoltage occurring on the mains supply: 1500 V for 120 V mains and 2500 V for 230 V mains
- a pollution degree of 2 in accordance with IEC 60664-1

Hint
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.

6.2 Installation

The workstation is intended to remain on a flat surface, or a table top. When installing the workstation on a table top, take great care to prevent potential injuries.

⚠ WARNING

There is a risk of personal injury, for example, intervertebral disk injury when installing the workstation to the work environment. Ask for assistance when lifting the workstation is required, and use the grips on the sides of the system.

An earth connection must be established once the equipment is installed. The installation must be carried out by a qualified person only.

⚠ WARNING

High leakage current! Be sure to establish an earth connection before connecting the equipment. The device may only be operated with an additional protective conductor. A terminal is available at the back of the device. 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.

There is an optional wall support on which the panels can be hung. This wall support should be installed in an environment where circulation is limited. The components are hung on long screws and injuries may occur in the presence of high circulation.

⚠ CAUTION

Install the wall support and the panels in an environment where circulation is limited.

The Workstation must be installed in a table (or a workbench) that is able to support the weight of the workstation. If your work environment does not meet the given capacity, use the optional workbench provided by Festo Didactic.

NOTICE

The workstation must be installed in a table (or workbench) that supports up to 250 kg (550 lb) of weight.

6.3 Maintenance

The workstation of the Mechanical Drives Training System requires periodical maintenance. Students will perform some of this maintenance as part of their training. Qualified personnel must periodically perform other maintenance tasks.

Defective or missing components must be replaced immediately. Contact Festo Didactic service department to order replacement parts and for specific instructions to replace those parts.

⚠ WARNING

Do not operate the equipment with missing or damaged parts.

It is of the utmost importance to remove the power supply from the equipment before performing any of the maintenance tasks described in this section.

© Festo Didactic

DANGER

Turn the workstation power off before performing maintenance. Failing to do so greatly increases the risk of electrocution or finger pitching.

6.4 Main power cord

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

WARNING

Never use the equipment with a damaged power cord.

6.5 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 packaging lists if necessary.

6.6 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 workstation. Therefore, before each use, a technician or the instructor should inspect the workstation. The workstation should also be inspected after trainees have used it.

6.7 Cleaning and decontamination

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

NOTICE

Do not use abrasive substances or solvents to clean the safety guard’s plexiglass.

7 Commissioning

7.1 Quick start

1. Make sure the power light on the control panel is turned off. If not, set the Main switch to the O (off) position.
2. Install the lockout and tagout devices in the Main switch and lock them with a padlock. Then, open the safety guard.

	⚠ CAUTION
	Open the safety guard so that it blocks to its highest position to protect your (and your colleagues') head.

7.2 Fixation of T-slotted extrusion bars

1. Make sure there are four extrusion bars fixed at the back of the workstation.
2. Position and fix two extrusion bars to the position shown in Figure 10 (in SI units) or Figure 11 (in U.S. customary units). Use the rulers at each side of the workstation to measure the positions.
3. Tighten the extrusion bar bolts using a 6 mm hexagonal T-handle key.

> **Hint**
> Do not overtighten or under tighten the screws.

4. Make sure all screws are tightened.

Figure 10: Workstation setup.

© Festo Didactic

Figure 11: Workstation setup.

7.3 Motor installation

1. Position the three-phase variable-frequency induction motor on the extrusion bars as shown in Figure 12 (in SI units) or Figure 13 (in U.S. customary units). Use the rulers at each side of the workstation to measure the positions.
2. Fix the motor using the M8-1.25 x 20 mm screws and M8-1.25 T-nuts. Tighten the motor screws with a 6 mm hexagonal T-handle key, using a crisscross pattern.
3. Connect the motor to the variable-frequency drive. To do so, clip the metal end of the motor connector to its corresponding input at the back right below the safety guard.

NOTICE
When connecting the motor to the variable-frequency drive, make sure to lay the cable in a safe environment, so that it doesn't get damaged. Tuck the cable far from the rotating parts so that it doesn't move and roll around the rotating parts once the system will start.

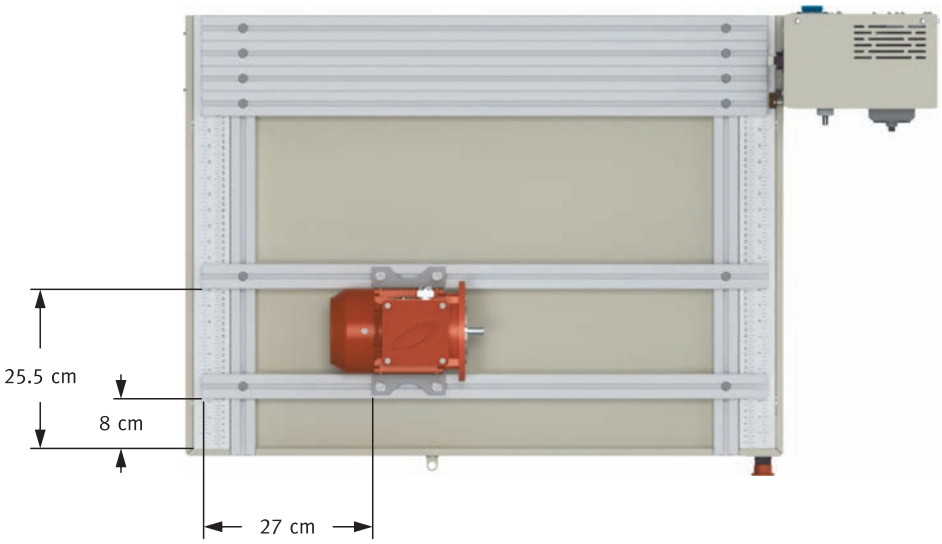

Figure 12: Workstation setup.

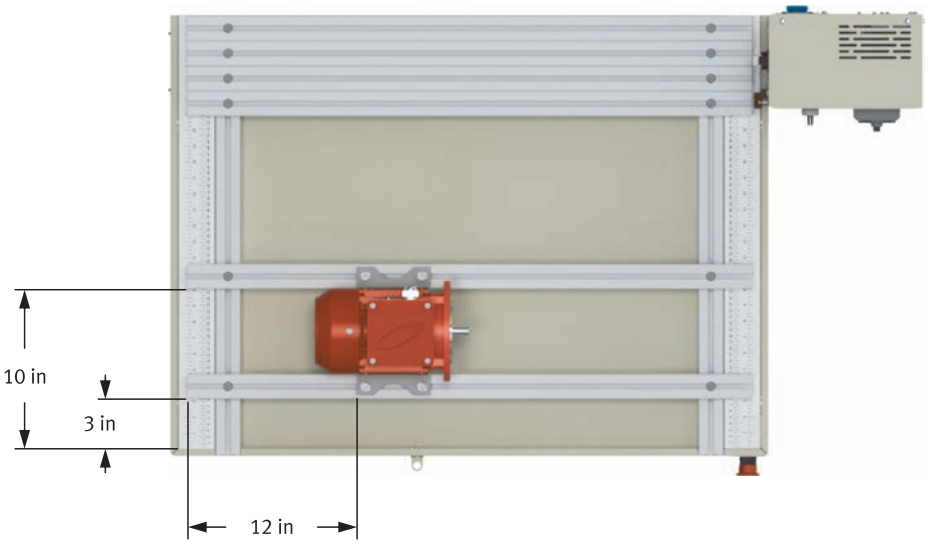

Figure 13: Workstation setup.

7.4 Running the system

1. Make sure that there are no loose objects present in the workstation and close the safety guard.
2. Remove the lockout and tagout devices from the Main switch. Then, install a hasp and a padlock at the padlock eyes near the safety guard's door handle.
3. Turn the power on by setting the Main switch to the I (on) position. Make sure the Power light on the control panel is turned on.

> **Hint**
> If the Power light does not turn on, make sure that the Circuit Breaker switch at the back of the control panel is set to the upper (on) position and that the workstation is connected to an ac wall outlet.

© Festo Didactic

4. Set the Clutch/Brake selector to Neutral.
5. Press the Safety Reset button.

NOTICE
Make sure no key is inserted into the motor shaft.

6. Start the motor by pressing the Start button (green button) on the variable-frequency drive.
7. Slowly rotate the OK button in the clockwise direction until the motor runs at a high speed.
8. Let the motor run for approximately 10 seconds.
9. Stop the motor by pressing the Stop button (red button) on the variable-frequency drive. Observe the time taken by the motor to completely stop running.
10. Turn off the system by setting the Main switch to the O (off) position.
11. Remove the lockout devices from the safety guard.

	⚠ CAUTION
	Wait for the motor to completely stop before removing the lockout device and opening the safety guard.

12. Disassemble the setup and return the components to the storage location.

8 Risks for Service Personnel

The following subsections list the risks to which service personnel is more likely to be exposed when using or servicing the equipment. It also gives recommendations to reduce those risks.

8.1 Risks of pinching

The workstation of the Mechanical Drives Training System involves rotating machines. Once the safety guard is opened, keep your hands away from these components to reduce risks of pinching injuries.

⚠ CAUTION

- Always close the safety guard before operating the system. Watch your (and your colleagues') hands and fingers when closing the safety guard.
- Always lock the safety guard before starting the system or when you do not need access to the rotating parts. Keep your (and your colleagues') hands and fingers away from rotating parts, such as the motor, couplings, gears, sprockets and pulleys.

8.2 Risks of cuts and bruises

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

⚠ CAUTION

- Manipulate the screws and fasteners with care to avoid cuts and other injuries.
- Some components, such as the straightedge, the combination square, the measuring tape, and the shaft keys have sharp edges. Manipulate them with care in other to prevent cuts and other injuries.
- Watch out for your colleagues when manipulating the shafts.
- Make sure to have a good grip when manipulating the components.
- Before installation and maintenance, open the safety guard so that it blocks to its highest position to protect your (and your colleagues') head.

8.3 Hot surfaces

⚠ CAUTION

The prony brake may get hot. Avoid touching it before it cools down. To avoid damaging the equipment, use water to cool down the brake drum.

© Festo Didactic

8.4 Risks of lifting hazard

⚠ CAUTION

- When manipulating the motor, make sure to have a good grip to avoid crushing your feet or someone else's feet.
- Manipulate the workstation and the panels with care to avoid injuries. Ask for assistance, use the handles, and respect the safe distances.

FESTO

CE Importer:
Festo Didactic SE
Rechbergstr. 3
73770 Denkendorf
Germany
Tel.: +49 711 3467-0
did@festo.com

US Importer:
Festo Didactic Inc.
607 Industrial Way West
Eatontown, NJ 07724
United States
Tel.: +1 732 938-2000
Toll Free: +1-800-522-8658
services.didactic@festo.com

CA Manufacturer:
Festo Didactic Ltée/Ltd
675, rue du Carbone
Québec (Québec) G2N 2K7
Canada
Tel.: +1 418 849-1000
Toll Free: +1-800-522-8658
services.didactic@festo.com

UK Importer:
Festo Ltd
Applied Automation Centre
Brackmills
Northampton, NN4 7PY
United Kingdom
T +44 800 626 422
info_gb@festo.com

www.festo-didactic.com

User Guide

Mechanical Drives Training System

0000594994000000000100