

Stacking magazine station

Solution to exercise 1: Learning about components and their function

■ Learning objective

Upon completing this exercise, you should

- be familiar with the most important components used in the stacking magazine station

■ Problem description

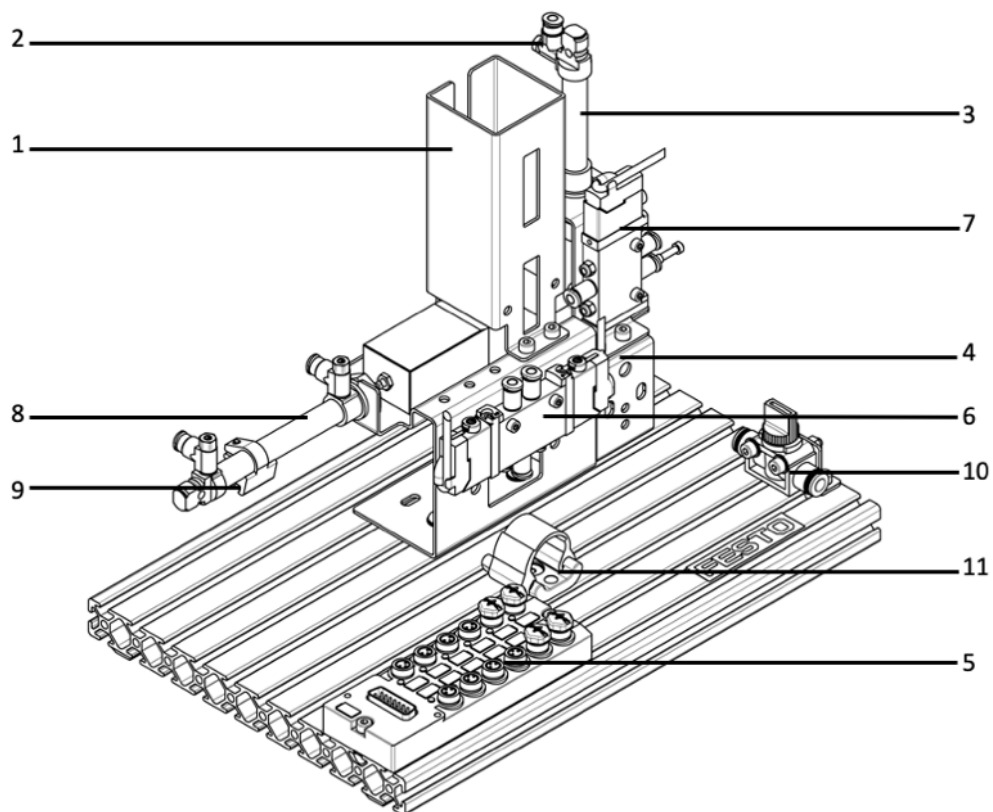
All automated systems use a range of components such as sensors, valves, motors, etc. It is important to be familiar with the function of the components in a system.

■ Task

1. Match the components with their correct designation and describe their purpose within the station.

■ Aids

- Theory book
- FluidSIM® online help
- Data sheets



Name:

Class:

Date:

1. Match the components with their correct designation and describe their purpose within the station.

No.	Designation	Function within the station
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		

Stacking magazine station

Solution to exercise 2: Learning about components, symbols and designations

■ Learning objective

Upon completing this exercise, you should

- be familiar with the symbols and designations of key pneumatic components

■ Problem description

All automated systems use a range of components such as sensors, valves, motors, etc. It is important to describe the function of the system clearly and simply to all involved. This is done using, among other things, electrical, pneumatic and hydraulic circuit diagrams.

To understand these circuit diagrams, you must be familiar with the symbols used.

■ Task

1. Match the components with the correct symbols and designations. Do this by entering the number assigned to the component in the correct fields in the “Symbol” and “Designation” columns.

■ Aids




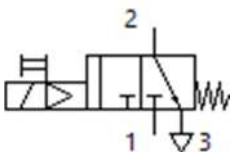

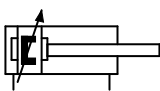

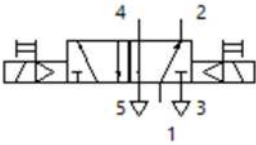

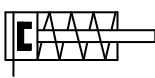

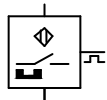
- Theory book
- FluidSIM® online help
- Data sheets

Name:

Class:

Date:

1. Match the components with the correct symbols and designations. Do this by entering the number assigned to the component in the correct fields in the "Symbol" and "Designation" columns.

Component	Symbol	Designation
1 	<input type="text"/> 	<input type="text"/> One-way flow control valve
2 	<input type="text"/> 	<input type="text"/> Double-acting cylinder
3 	<input type="text"/> 	<input type="text"/> 3/2-way single solenoid valve
4 	<input type="text"/> 	<input type="text"/> Single-acting cylinder
5 	<input type="text"/> 	<input type="text"/> Magnetic proximity sensor
6 	<input type="text"/> 	<input type="text"/> 5/2-way double solenoid valve

Stacking magazine station

Exercise 1: Learning about components and their function

■ Learning objective

Upon completing this exercise, you should

- be familiar with the most important components used in the stacking magazine station

■ Problem description

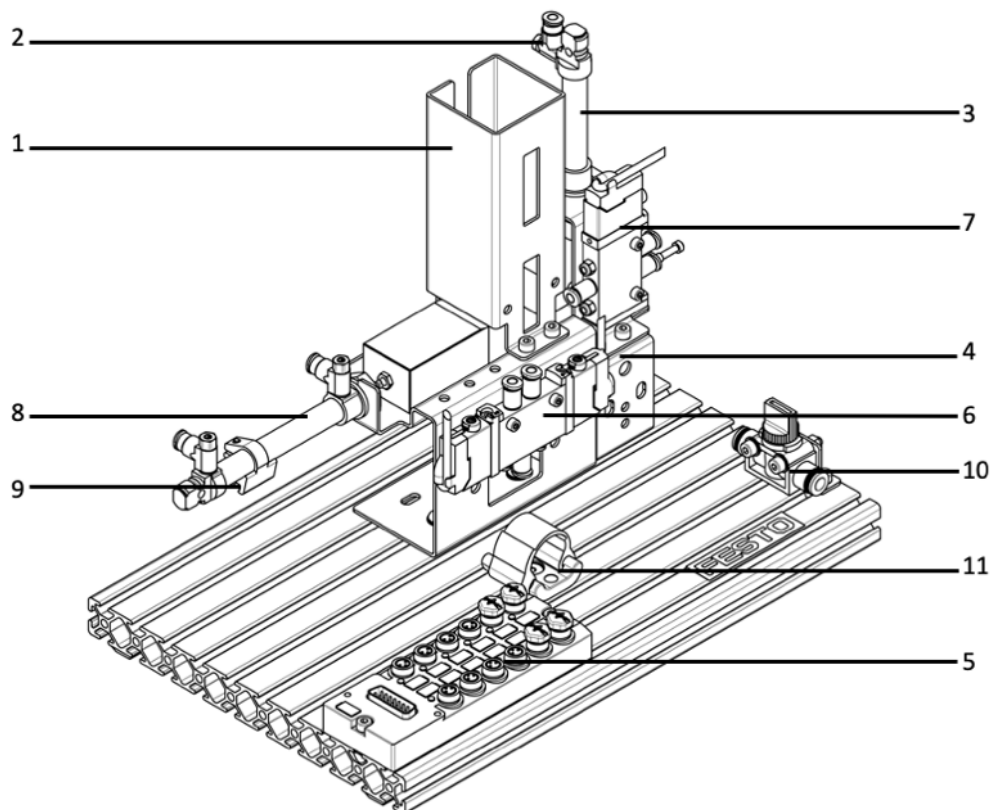
All automated systems use a range of components such as sensors, valves, motors, etc. It is important to be familiar with the function of the components in a system.

■ Task

1. Match the components with their correct designation and describe their purpose within the station.

■ Aids

- Theory book
- FluidSIM® online help
- Data sheets



Name:

Class:

Date:

1. Match the components with their correct designation and describe their purpose within the station.

No.	Designation	Function within the station
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		

Stacking magazine station

Exercise 2: Learning about components, symbols and designations

■ Learning objective

Upon completing this exercise, you should

- be familiar with the symbols and designations of key pneumatic components

■ Problem description

All automated systems use a range of components such as sensors, valves, motors, etc. It is important to describe the function of the system clearly and simply to all involved. This is done using, among other things, electrical, pneumatic and hydraulic circuit diagrams.

To understand these circuit diagrams, you must be familiar with the symbols used.

■ Task

1. Match the components with the correct symbols and designations. Do this by entering the number assigned to the component in the correct fields in the "Symbol" and "Designation" columns.

■ Aids


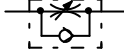

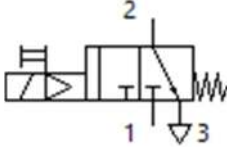

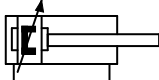

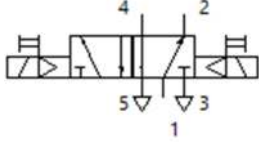
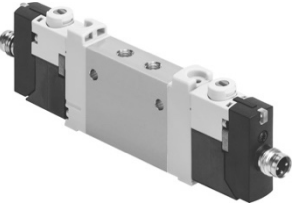
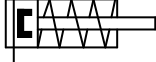

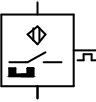
- Theory book
- FluidSIM® online help
- Data sheets

Name:

Class:

Date:

1. Match the components with the correct symbols and designations. Do this by entering the number assigned to the component in the correct fields in the "Symbol" and "Designation" columns.

Component	Symbol	Designation
1 	<input type="text"/> 	<input type="text"/> One-way flow control valve
2 	<input type="text"/> 	<input type="text"/> Double-acting cylinder
3 	<input type="text"/> 	<input type="text"/> 4/2-way single solenoid valve
4 	<input type="text"/> 	<input type="text"/> Single-acting cylinder
5 	<input type="text"/> 	<input type="text"/> Magnetic proximity sensor
6 	<input type="text"/> 	<input type="text"/> 4/2-way double solenoid valve

Stacking magazine station

Exercise 3: Learning about the function of components

■ Learning objective

Upon completing this exercise, you should

- be familiar with the function, use and classification of key components used in the stacking magazine station

■ Problem description

All automated systems use a range of components such as sensors, valves, motors, etc. It is important to be familiar with the function of these components.

■ Task

1. Complete the table.
2. Decide whether the component is a sensor or actuator, control component or mechanical component.
3. Describe this component's function within the stacking magazine station. Are you familiar with similar examples from your own environment?

■ Aids

- Theory book
- FluidSIM® online help
- Data sheets

Stacking magazine station

Exercise 4: Creating schematic and circuit diagrams

■ Learning objectives

Upon completing this exercise, you should

- be able to create schematic diagrams, pneumatic circuit diagrams and allocation lists

■ Problem description

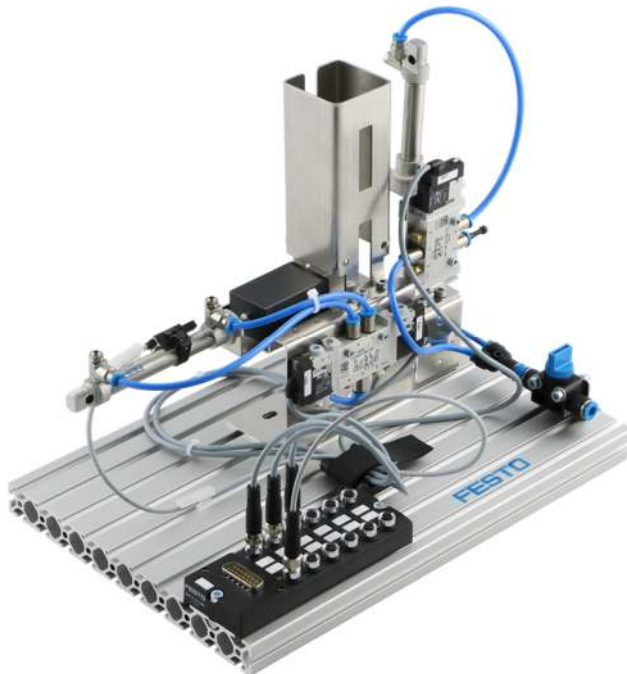
Engineers use schematic diagrams, technical drawings, part lists or circuit diagrams to describe machines. These tools can be used to describe machines or machine parts efficiently and clearly.

■ Tasks

1. Create a schematic diagram for the stacking magazine pictured showing the function and position of the important components.
2. Create an allocation list that specifies which sensor or actuator is plugged into which slot on the multi-pin plug distributor.
3. Create a pneumatic circuit diagram of the station using FluidSIM®.

■ Aids

- Theory book
- FluidSIM® sample circuit diagrams
- Stacking magazine station



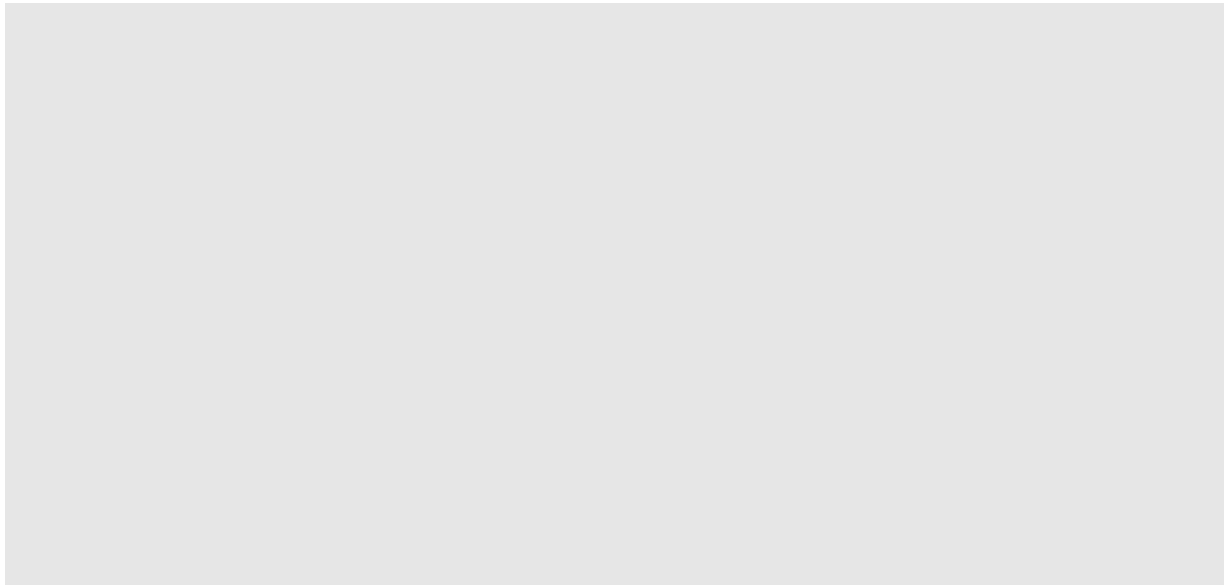
Picture of the station

Name:

Class:

Date:

1. Create a schematic diagram for the stacking magazine pictured showing the function and position of the key components.



Schematic diagram

2. Create an allocation list that specifies which sensor or actuator is plugged into which slot on the multi-pin plug distributor.

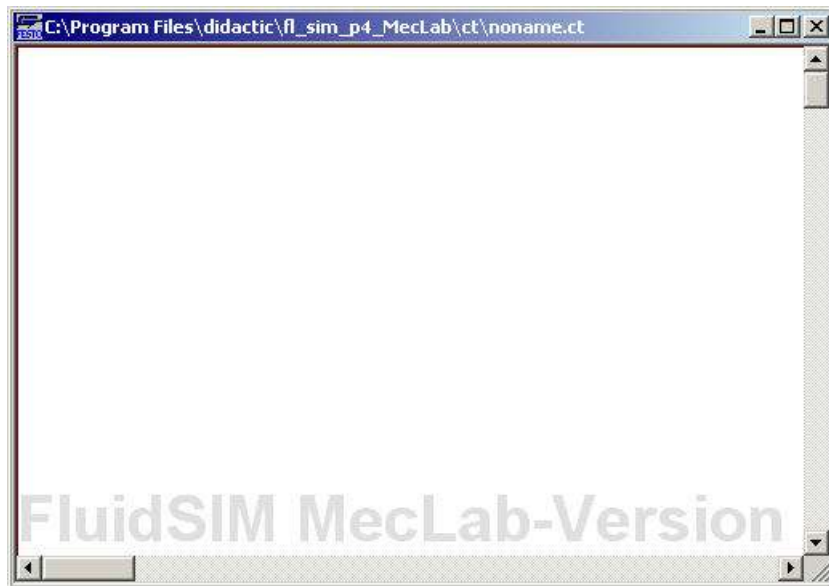
Slot	Designation	Description

Name:

Class:

Date:

3. Create a pneumatic circuit diagram of the station using FluidSIM®.



Stacking magazine station

Exercise 5: Controlling a single-acting cylinder

■ Learning objectives

Upon completing this exercise, you should

- be able to select the components of an electropneumatic circuit
- be able to design electropneumatic circuits
- be able to control a single-acting cylinder using FluidSIM®

■ Problem description

An important function of the stacking magazine station is pressing together containers and lids. A controller is to be designed for this purpose.

A vertically arranged pneumatic cylinder which is supplied with air by a solenoid valve and is actuated via a PC is to be used for pressing in. The cylinder should advance when a pushbutton is actuated and remain advanced for as long as the pushbutton remains actuated. An important parameter is that for safety reasons, the cylinder must also return to the upper end position in the event of a power failure.

■ Tasks

1. Select a suitable cylinder from the two available.
Explain the reasons for your selection.
2. Select a suitable valve from the four available.
Explain the reasons for your selection.
3. Design a pneumatic circuit diagram for the components you selected.
Carry out a functional test via simulation.
4. Complete the electrical circuit diagram by including a suitable actuating component.
5. Transfer the solution to FluidSIM®. Carry out a functional test via simulation.
6. Extend the circuit so that the cylinder in the stacking magazine station can be actuated.
Test its operability.

■ Aids

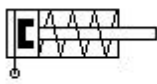
- Theory book
- FluidSIM®

Name:

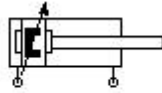
Class:

Date:

1. Select a suitable cylinder from the two available.
Explain the reasons for your selection.



a

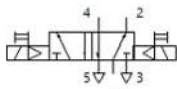


b

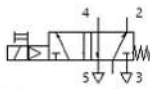
a) single-acting cylinder; b) double-acting cylinder

Reasons

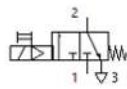
2. Select a suitable valve from the four available.
Explain the reasons for your selection.



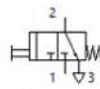
a



b



c



d

- a) 5/2-way double solenoid valve
- b) 5/2-way single solenoid valve
- c) 3/2-way normally closed solenoid valve
- d) 3/2-way normally closed valve, manually-actuated

Reasons

Name:

Class:

Date:

3. Design a pneumatic circuit diagram for the components you selected and carry out a functional test via simulation using FluidSIM®. The components required are the single-acting cylinder, the 3/2-way solenoid valve and a compressed air supply. Test the circuit in simulation mode by clicking on the valve's manual override with the mouse.

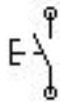


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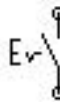
Class:

Date:

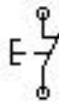
4. Complete the electrical circuit diagram by selecting a suitable actuating component. The actuating components available are:



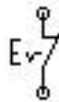
a



b

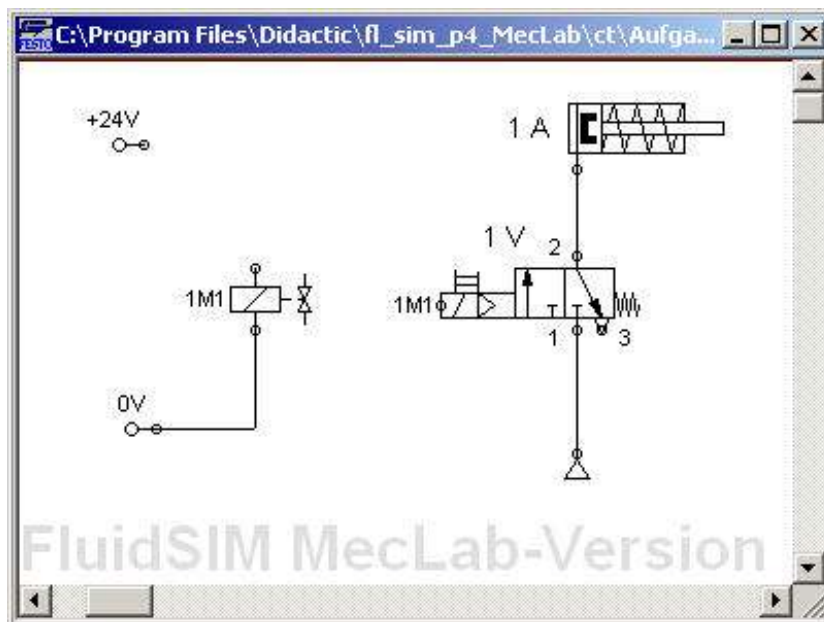


c



d

a) pushbutton (N/O contact), b) detenting pushbutton (N/O contact), c) pushbutton (N/C contact), d) detenting pushbutton (N/C contact)

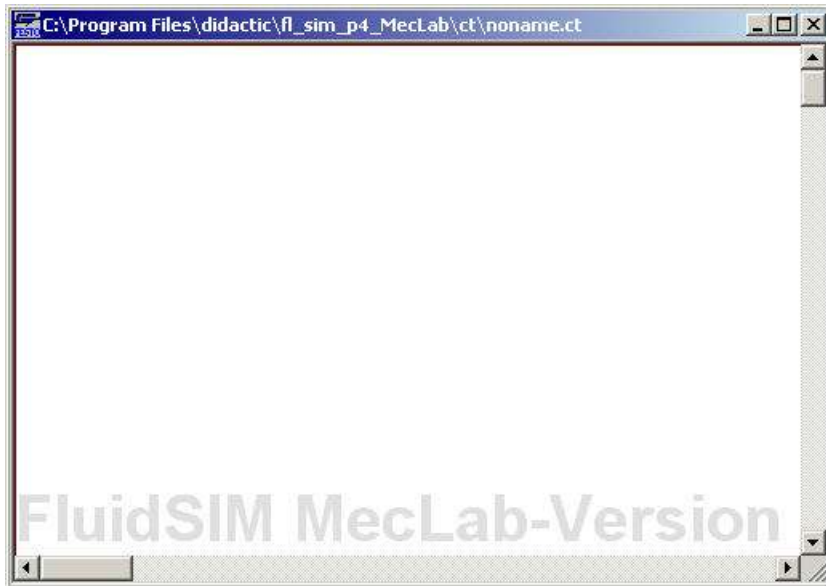


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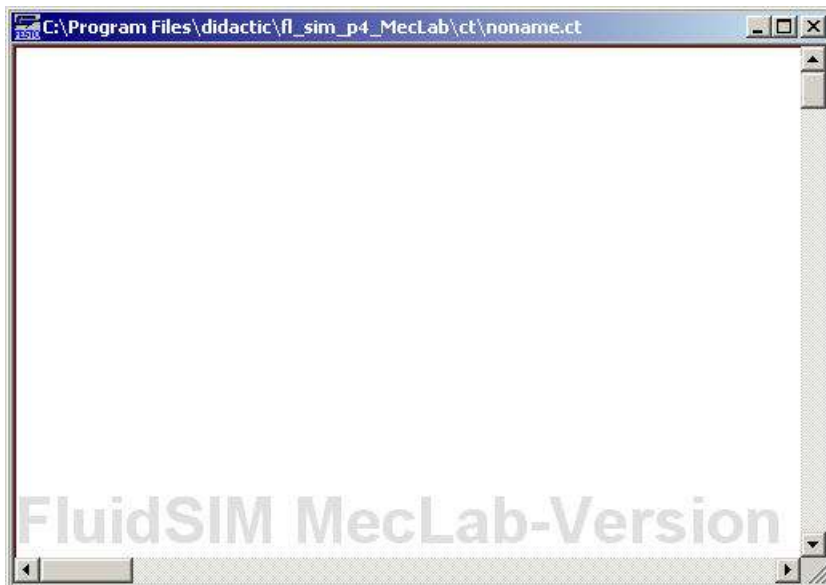
Class:

Date:

5. Transfer the solution to FluidSIM® and carry out a functional test via simulation.



6. Extend the circuit so that the cylinder in the stacking magazine station can be actuated.
Test its operability.
Do this by extending your circuit diagram to include the multi-pin plug symbol and allocating the designation for the solenoid coil to the slot where the solenoid coil is actually plugged in.



Stacking magazine station

Exercise 6: Controlling a double-acting cylinder

■ Learning objectives

Upon completing this exercise, you should

- be able to interpret schematic diagrams, allocation lists and circuit diagrams
- be able to create electropneumatic circuits and simulate them using FluidSIM®
- be able to control a double-acting cylinder using FluidSIM®

■ Problem description

The function of the stacking magazine is to store workpieces and dispense them individually. A double-acting pneumatic cylinder is used to push out the workpieces. A control system is to be developed for this purpose.

■ Tasks

1. Compare the stacking magazine station with the schematic diagram, circuit diagram and allocation list shown below and construct the station accordingly.
2. Connect the station to the compressed air supply, open the stop cock and actuate the valve manual override. What do you observe? What happens if you adjust the one-way flow control valves using a screwdriver? How can the resulting effect be utilised?
3. Create the full electropneumatic circuit in FluidSIM® and test it via simulation.
To do this, launch FluidSIM® and create the pneumatic circuit diagram shown above. Then create an electrical circuit with the following function:
 - the cylinder 1A advances after a pushbutton is actuated,
 - the cylinder retracts again after a further pushbutton is actuated.Use the components pushbutton, voltage supply and valve solenoid for this.
Test your circuit in simulation mode. Also change the setting of the one-way flow control valves and observe what happens.
4. Actuate the double-acting cylinder of the stacking magazine station using FluidSIM®.

■ Aids

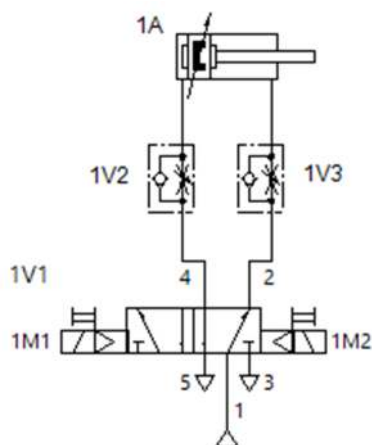
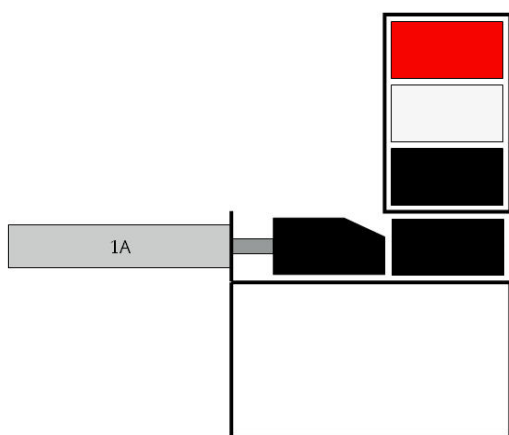
- Theory book
- FluidSIM®
- Stacking magazine station

Name:

Class:

Date:

1. Compare the stacking magazine station with the schematic diagram, circuit diagram and allocation lists shown below. Check whether the arrangement of all the components corresponds to the schematic diagram, the tubing corresponds to the circuit diagram and the pin allocation corresponds to the allocation list. If not, structure the station in accordance with these sources of information.



Schematic diagram and electropneumatic circuit diagram

Slot	Designation	Description
1	1M1	Valve solenoid 1 of valve 1 (advance cylinder 1A)
3	1M2	Valve solenoid 2 of valve 1 (retract cylinder 1A)

2. Connect the station to the compressed air supply and open the stop cock. Actuate the valve manual override. What do you observe? What happens if you adjust the one-way flow control valves using a screwdriver? How can the resulting effect be utilised?

Name:

Class:

Date:

3. Create the full electropneumatic circuit in FluidSIM® and test it via simulation.

To do this, launch FluidSIM® and create the pneumatic circuit diagram shown above. Then create an electrical circuit with the following function:

- the cylinder 1A advances after a pushbutton is actuated,
- the cylinder retracts again after a further pushbutton is actuated.

Use the components pushbutton, voltage supply and valve solenoid for this.

Test your circuit in simulation mode.

Also change the setting of the one-way flow control valves and observe what happens.

Name:

Class:

Date:

4. Control the double-acting cylinder of the stacking magazine station using FluidSIM®. Do this by extending the circuit from Exercise 3 to include the multi-pin plug symbol and set the necessary labels. Then connect the station to your PC using the EasyPort and start the simulation (this is now the same as actuating the cylinder).



Stacking magazine station

Exercise 7: Controlling using relays

■ Learning objectives

Upon completing this exercise, you should

- be familiar with the mode of operation and fields of application of relays
- be able to create simple control systems using relays
- be able to realise logic operations using relays
- be able to realise circuits using time relays

■ Problem description

Relays are one of the most important components in modern control systems, even and particularly in the age of microelectronic controllers.

■ Tasks

1. Read up about the structure and mode of operation of relays.
What types of relay are you familiar with?
2. In FluidSIM®, create an actuator for a solenoid coil using a pushbutton and a relay.
3. Two-hand start devices are often used for safety reasons. This means that a machine can only start if two pushbuttons are actuated simultaneously. The purpose of this device is to prevent the machine operator from sticking a hand into the machine while it is running. Create a circuit for a two-handed start device of a single-acting cylinder. Test the circuit in the FluidSIM® simulation mode. Could this function also be realised using switches?
4. Many processes are time-controlled. The press-in unit of the stacking magazine station should press together the container and lid for exactly 10 s to allow an adhesive to cure. Develop a control system for this on the basis of the circuit from Exercise 1. Test your circuit via simulation and using the stacking magazine station.

■ Aids

- Theory book
- FluidSIM®

Name:

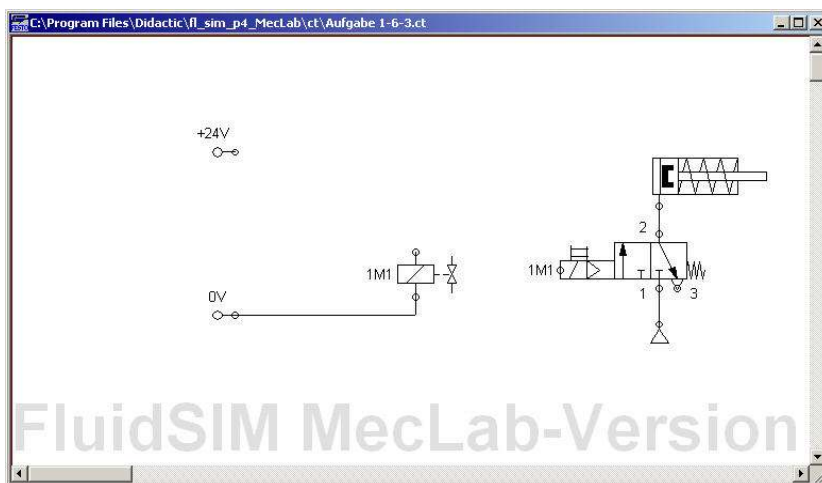
Class:

Date:

1. Read up about the structure and mode of operation of relays.

What types of relay are you familiar with?

2. In FluidSIM®, create an actuating circuit for a solenoid coil using a pushbutton and a relay.
Do this by adding to the circuit diagram shown below.

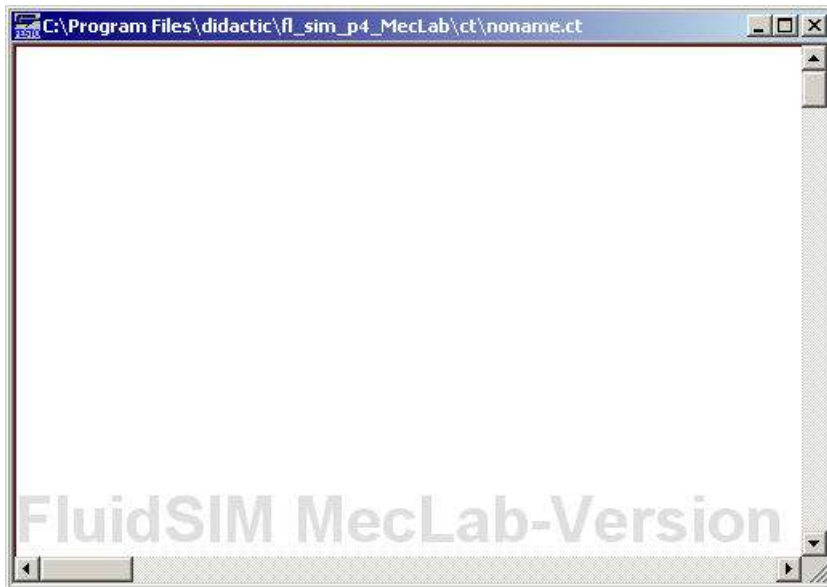


Name:

Class:

Date:

3. Two-hand start devices are often used for safety reasons. This means that a machine can only start if two pushbuttons are actuated simultaneously. The purpose of this is to prevent the machine operator from sticking a hand into the machine while it is running. Create a circuit for a two-handed start device of a single-acting cylinder. Test the circuit in the FluidSIM® simulation mode. Could this function also be realised using switches?

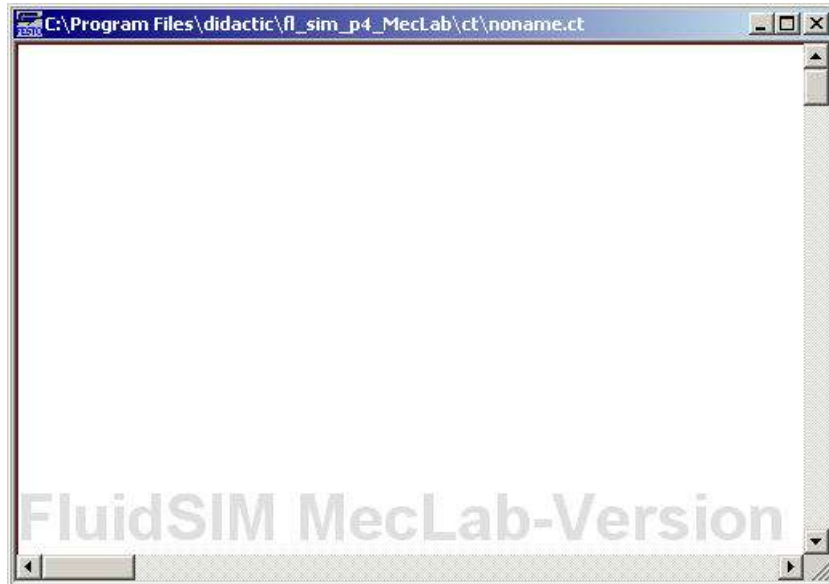


Name:

Class:

Date:

4. Many processes are time-controlled. The press-in unit of the stacking magazine station should press together the container and lid for exactly 10 s to allow an adhesive to cure. Develop a control system for this on the basis of the circuit from Exercise 1. Test your circuit via simulation and using the stacking magazine station.



Stacking magazine station

Exercise 8: Using proximity sensors

■ Learning objectives

Upon completing this exercise, you should

- be familiar with the function of magnetic proximity sensors
- be able to realise control circuits using sensors
- be able to create simple sequencers

■ Problem description

Sensors are an important part of all automated systems. The stacking magazine station features a magnetic proximity sensor that detects the position of a cylinder piston.

A control system is to be developed for the stacking magazine with the following characteristics:

- The operator places a container in the assembly device and pushes the Start button.
- The double-acting cylinder pushes a lid out of the storage tower (onto the container) and then returns to its normal position.
- The single-acting cylinder presses together the container and the lid for exactly 10 s.
- The operator removes the finished workpiece (container plus lid).
- The colour of the container and lid should be immaterial.

■ Tasks

1. How can you ensure that the single-acting cylinder only advances when the double-acting cylinder is fully advanced? What component is required?
2. Create a schematic diagram of the setup.
3. Create an electropneumatic circuit in FluidSIM® and test it via simulation. Create an allocation list for the inputs and outputs of the multi-pin plug distributor.
4. Set up the station as per the schematic diagram, install tubing between all pneumatic components and connect the electrical components to the multi-pin plug distributor. Test the function of the control system using the station.

■ Aids

- Theory book
- FluidSIM®

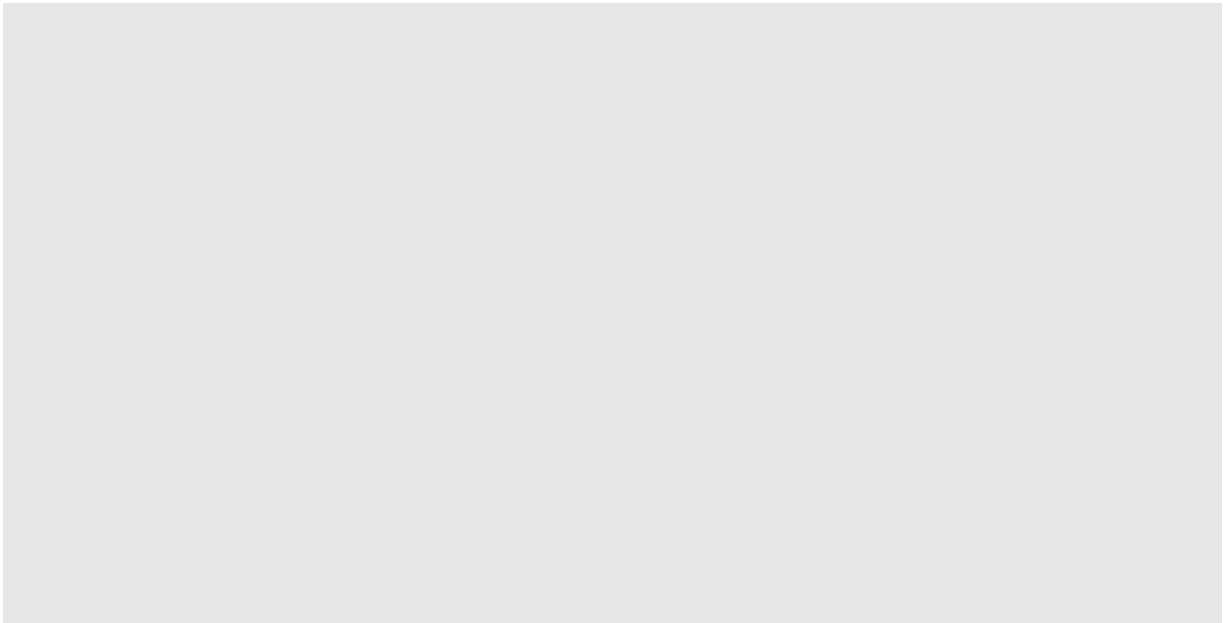
Name:

Class:

Date:

1. How can you ensure that the single-acting cylinder only advances when the double-acting cylinder is fully advanced? What component is required?

2. Create a schematic diagram of the setup.



Schematic diagram

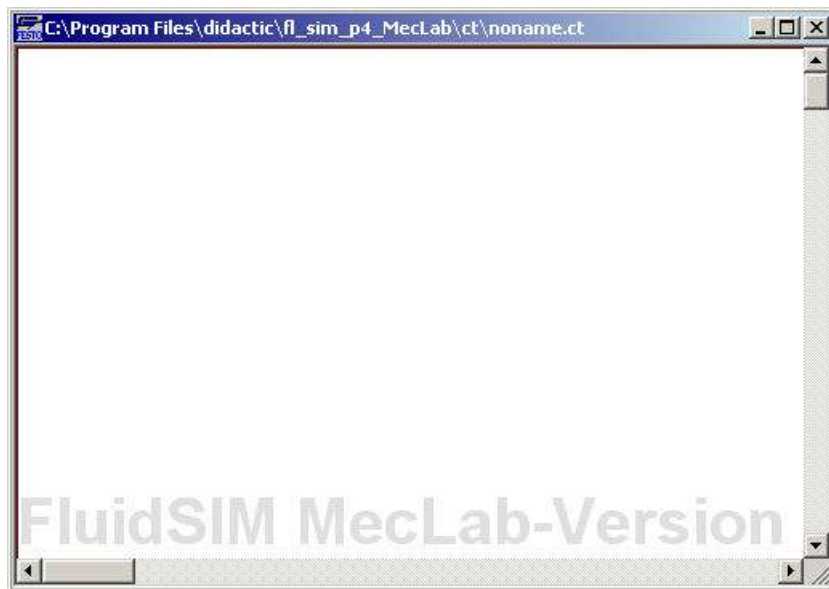
Name:

Class:

Date:

3. Create an electropneumatic circuit in FluidSIM® and test it via simulation. Create an allocation list for the inputs and outputs of the multi-pin plug distributor.

Slot	Assignment	Function
0		
1		
3		
5		



4. Set up the station as per the schematic diagram, install tubing between all pneumatic components and connect the electrical components to the multi-pin plug distributor. Test the function of the control system using the station.

