# MEC-E5003 Fluid Power Basics

## Research Assignment: Pneumatics
## Study Year 2018–2019

**ASSIGNMENT**
**CARRIED OUT IN GROUPS, CONSISTS OF A LABORATORY EXERCISE**

# A. Laboratory exercise

Of the circuits build in laboratory exercise, first two are purely pneumatic and the latter two electro-pneumatic. The tasks are selected from the Festo Didactic -exercise material (540671), but their manner of representation has been slightly modified for this course.

### A.1 Stopping the movement of bottle crates on a process line

Bottle crates moving on a process line are to be provided with labels. For this the crates should be stopped for a moment in front of a labeling unit. Stopping is activated with a mechanical slide operated by a pneumatic cylinder. This in turn is controlled with the operating panel of the unit.

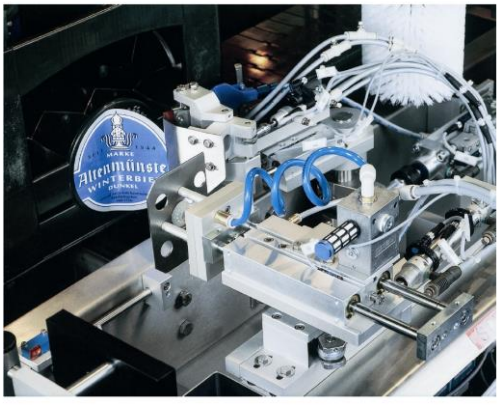

**Fig. A.1/1.** *Stopping the crates for labeling.*

Learning outcomes

1. You can describe the principle of indirect control and also build one.
2. You can explain the structure and function of pneumatically controlled 5/2-directional control valve.
3. You can explain the difference between signal and control elements/components.

Required functions

1. When the selector switch in the operating panel is turned, the cylinder makes positive (plus) movement and pushes the mechanical slide forward thus stopping the movement of the bottle crates.
2. When the selector switch is returned to its initial position, the cylinder makes negative (minus) movement and releases the bottle crates.
3. Cylinder remains in this position until the selector switch is turned again.

Tasks

1. Define the requirements set for the circuit considering activating and control elements.
2. Complete the pneumatic circuit diagram of bottle crate stopping unit shown below.
3. Build the circuit.
   - NB: the manifold and the maintenance unit (consisting of shut-off valve and pressure reducing valve) which both are needed in the circuit are not displayed in the figure A.1/2 below.
   - **Safety instruction:** Limit the maximum pressure of the maintenance unit to a value of 350 kPa (3,5 bar).
4. Check the coupling of the circuit and verify its correct operation.

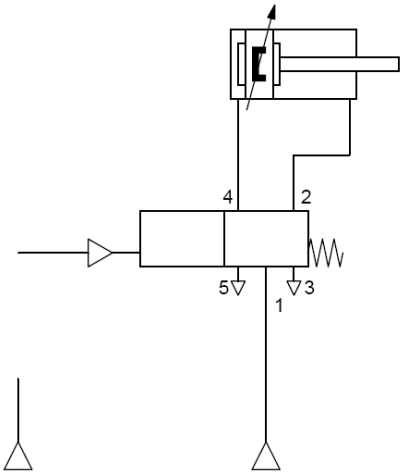


**Fig. A.1/2.** *Pneumatic circuit diagram of crate stopping unit.*

## A.2 Control of a sliding door

Pneumatically operated sliding door should be able to open and close from both sides of the door with a push button. In order to avoid possible operating errors in a case of emergency only one push button is allowed on both sides of the door.

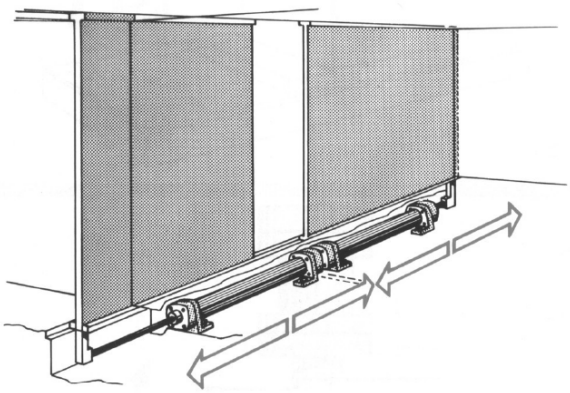

**Fig. A.2/1.** *Operation of sliding door.*

Learning outcomes

1. You can explain and realize logical functions AND/OR/NOT.
2. You can combine logic elements to produce versatile controls.
3. You can explain the structure and function of magnetic proximity switch.
4. You can identify 5/2-directional control valves and select the most suitable valve for a circuit based on the stated requirements and apply the valve in practice.

Required functions

1. When the sliding door is at its either end position it can be shifted to the other end position by pressing the push button. Thus the door can be closed and opened by the push button.
2. When the door is not at its either end positions then the opening/closing action cannot be started.

Tasks

1. Complete the pneumatic circuit diagram of the sliding door operating system shown below.
2. Build the circuit.
   - NB: the manifold and the maintenance unit (consisting of shut-off valve and pressure reducing valve) which both are needed in the circuit are not displayed in the figure A.2/2 below.
   - **Safety instruction:** Limit the maximum pressure of the maintenance unit to a value of 300 kPa (3 bar).
3. Check the coupling of the circuit and verify its correct operation.

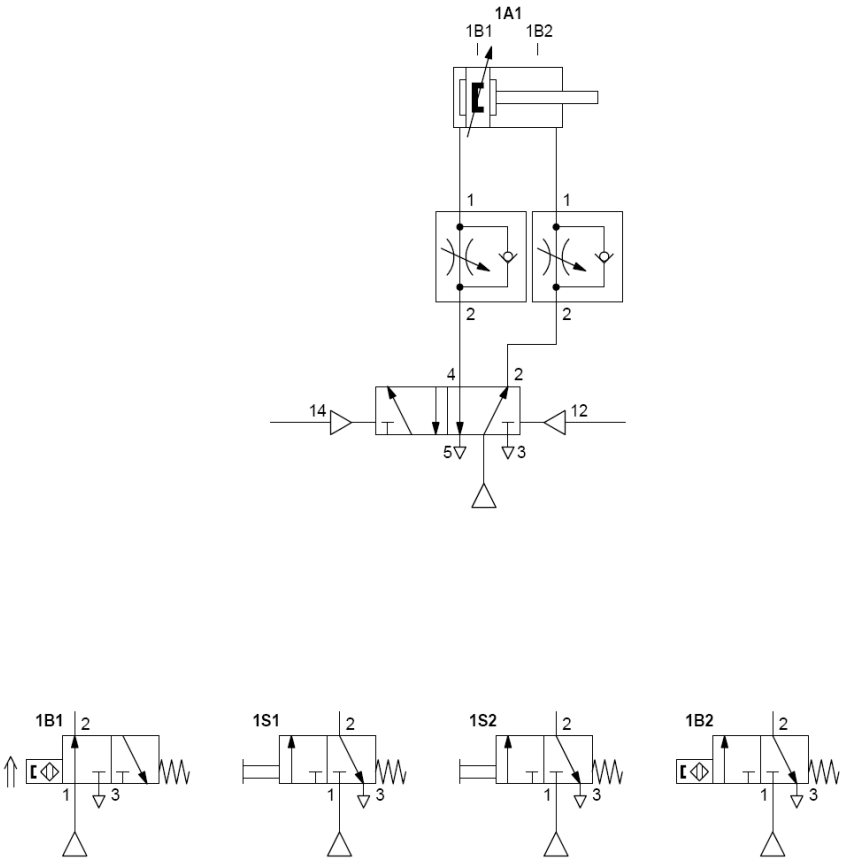


**Fig. A.2/2.** *Pneumatic circuit diagram of the sliding door operating system.*

Extra tasks

1. What kind of errors are possible to occur when building the system?
2. How do these errors affect to the system?
3. What happens if the pressure supply is interrupted or lost during the opening or closing of the sliding door?
4. Referring to preceding, what should be done in order to reintroduce the control of the door?

## A.3 Bottle sorting device

Sample bottles that enter the sorting unit should be sorted according to their size.

**Fig A.3/1.** *Sorting the sample bottles.*

Learning outcomes

1. You can describe the structure and operation of single acting cylinder.
2. You can describe the structure and operation of 3/2 magnet operated valve.
3. You can identify the operating types of directional control valves and draw corresponding symbols.
4. You can explain the principle of direct control and also build one.

Required functions

1. When the electric switch of the control system is pressed the single acting cylinder pushes the sample bottles aside from the conveyor.
2. When the switch is released the piston rod retracts to its initial position (i.e. negative aka minus position).
3. If the energy supply is interrupted the cylinder has to retract to its initial position.

Tasks

1. Complete the pneumatic and electric circuit diagrams of the bottle sorting unit shown below.
2. Simulate the electro-pneumatic diagram and verify that it operates as required.
3. Build the circuit (pneumatic and electric connections).
   - NB: the manifold and the maintenance unit (consisting of shut-off valve and pressure reducing valve) which both are needed in the circuit are not displayed in the figure A.3/2 below.
4. Check the coupling of the circuit and verify its correct operation.

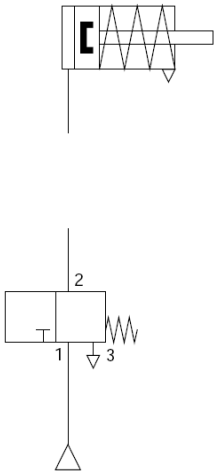


**Fig. A.3/2.** *Pneumatic circuit diagram of bottle sorting unit.*

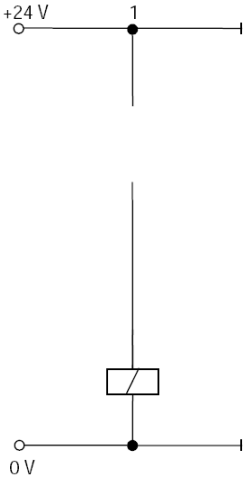


**Fig. A.3/3.** *Electric circuit diagram of the control of bottle sorting unit.*

## A.4 Emptying unit for vertical magazine

Wood panels stored in a vertical magazine are to be unloaded one by one.

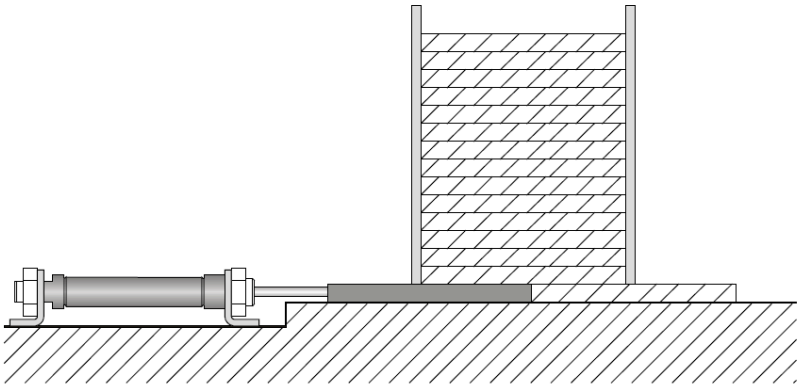

**Fig. A.4/1.** *Emptying unit for vertical magazine.*

Learning outcomes

1. You can apply double acting cylinder in pneumatic systems.
2. You can describe the structure and operation of electric/electric-controlled magnet operated valve (impulse valve).
3. You can describe one way to recognize whether the cylinder is at its end position.

Required functions

1. When the electric push switch of the control system is pressed the double acting cylinder pushes one wood panel out of the vertical magazine.
2. System has to recognize the cylinder reaching its positive (plus) position.
3. When the cylinder has reached its positive (plus) position it retracts to negative (minus) position.

Tasks

1. Complete the pneumatic and electric circuit diagrams of the vertical magazine emptying unit shown below.
2. Simulate the electro-pneumatic diagram and verify that it operates as required.
3. Build the circuit (pneumatic and electric connections).
   - NB: the manifold and the maintenance unit (consisting of shut-off valve and pressure reducing valve) which both are needed in the circuit are not displayed in the figure A.4/2 below.
4. Check the coupling of the circuit and verify its correct operation.

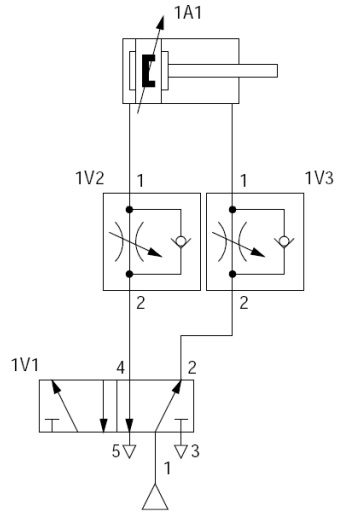


**Fig. A.4/2.** *Pneumatic circuit diagram of emptying unit for vertical magazine.*

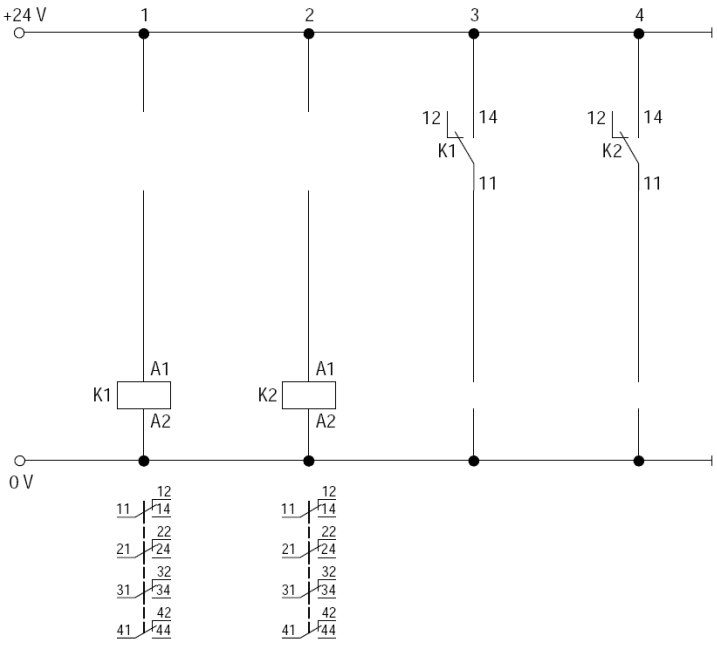


**Fig. A.4/3.** *Electric circuit diagram of the emptying unit for vertical magazine.*