

## The use of double-acting cylinders in electro-hydraulic circuit

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**Abstract.** The paper presents aspects related use of double-acting cylinder. Besides, in the article are presented three hydraulic schemes that double acting cylinder. Meaning, two hydraulic circuits and one electro-hydraulic circuits. First hydraulic schemes has the following devices: fixed displacement pump, air filter, 4/3 way hand lever valve, tanks reservoir, filter and double acting cylinder (Cyli 1-1). However, second hydraulic scheme has the following devices: fixed displacement pump, 4/3 way hand lever valve, check valves, valve office and two double acting cylinders (Cyli 2-1 and Cyli 2-2). Forward, the electro-hydraulic circuit has the following devices: tanks, throttle check valves, 5/2 way hand lever valve, fixed displacement pump, lamp, relays, relay with switch-on delay, valve solenoid and double acting cylinder (Cyli 3-1). The design and simulation of the all three circuits from this article is done FluidSim software from Festo.

**Keywords.** hydraulic, cylinder, scheme, FluidSim, relay, rod.

### 1. Introduction

The double-acting cylinder is a modern hydraulic pneumatic actuator. In fact, there are many types of double-acting cylinders.

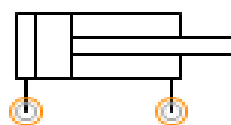
This hydraulic actuator is used in many fields of activity: robotics, excavations, lifting equipment, [1]. The main features of the double acting cylinder are: size, stroke, cushioning, mounting position, feed speed, reset force, product weight, mode of operation, etc.

In this paper we use only classic double-acting cylinders, Figure 1.



**Figure 1.** Double acting cylinder

In specialized hydraulic circuits, the double-acting cylinders have a specific symbol, Figure 2.

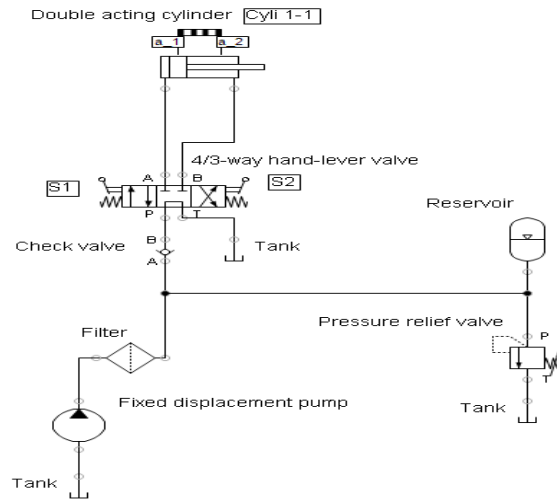


**Figure 2.** Symbol of double-acting cylinder

## 2. The analysis of hydraulic circuits

All hydraulic circuits with the actuators are supplied with oil from the tank. The oil reaches the valve and actuators with the help of fixed displacement pump, [2].

First hydraulic circuit uses only one double-acting cylinder, Figure 3.



**Figure 3.** First hydraulic circuit using double-acting cylinder

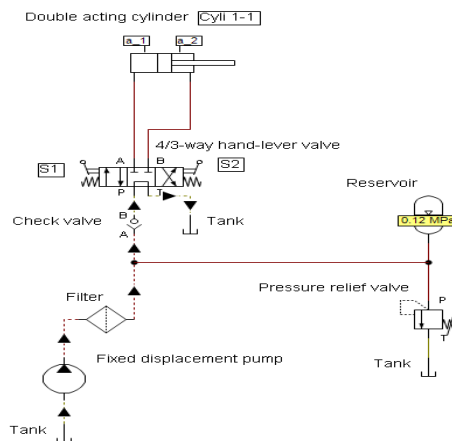
In the table below there are given the component devices used in the first hydraulic scheme.

**Table 1:** The devices of the first hydraulic scheme

Description	Number of components
Tank	3
Fixed displacement pump	1
Check valve	1
4/3 way hand lever valve	1
Check valve	1
Reservoir	1
Pressure relief valve	1
Double acting cylinder (Cyl 1-1)	1

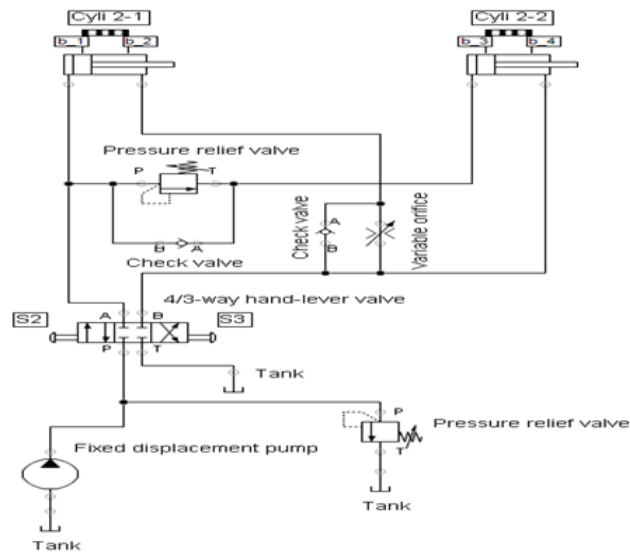
In the first hydraulic circuit, the S1 level belongs to the 4/3 way hand level valve. When the operator presses the S1 lever, the piston rod moves from point a<sub>1</sub> to point a<sub>2</sub>, [3].

After that, the operator presses the S2 lever, the piston rod return from point a<sub>2</sub> to point a<sub>1</sub>, because the 4/3 way valve is equipped with two springs, Figure 4.



**Figure 4.** First hydraulic circuit using double acting cylinder. Simulation.

Second hydraulic circuit has two actuators (Cyli 2-1 and Cyli 2-2), Figure 5.



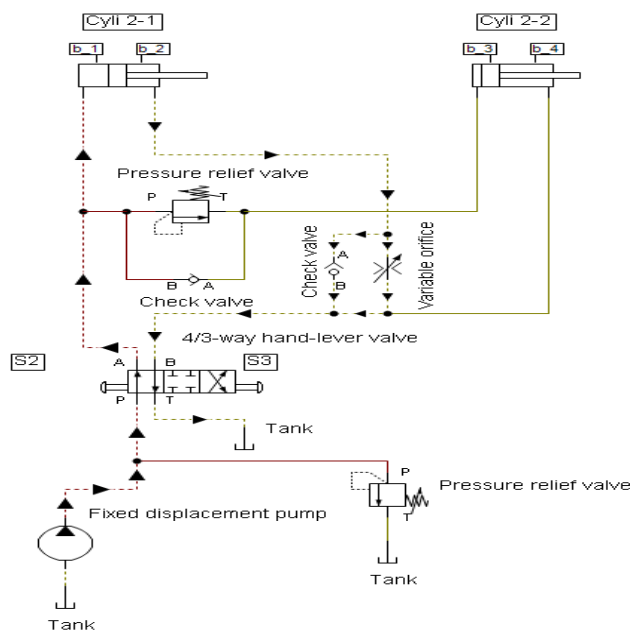
**Figure 5.** Second hydraulic circuit

In the table below there are given the component devices used in the first hydraulic scheme, [4].

**Table 2:** The devices of the first hydraulic scheme

Description	Number of components
Tank	3
Valve office	1
Check valve	2
4/3 way hand lever valve	1
Fixed displacement pump	1
Pressure relief valve	1
Double acting cilynders (Cyli 2-1 and Cyli 2-2)	2

If operator presses S3 button, piston rod of Cyli 2-1 move from point b<sub>1</sub> to point b<sub>2</sub> and afterwards piston rod of Cyli 2-2 move b<sub>3</sub> to point b<sub>4</sub>, Figure 6.



**Figure 6.** Second hydraulic circuit. Simulation I.

Afterwards, the operator presses S3 button. In this case, piston rod of Cyli 2-2 move from point b<sub>4</sub> to point b<sub>3</sub> and piston rod of Cyli 2-1 move from point b<sub>2</sub> to point b<sub>1</sub>, Figure 7.

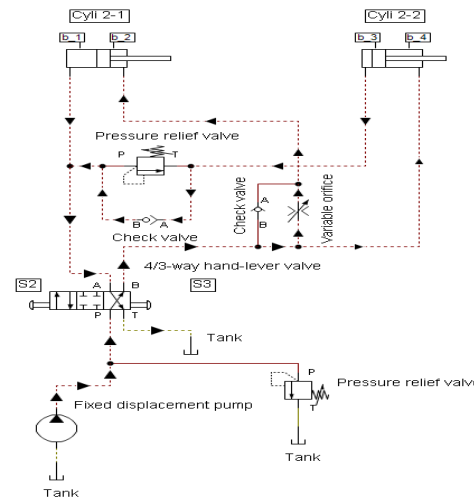


Figure 7. Second hydraulic circuit. Simulation II.

### 3. The analysis of electro-hydraulic circuit

In practice there are many types of electro-hydraulics circuits. But in this manuscript only the electro-hydraulic circuit with a double-acting cylinder is studied (Cyli 3-1), [5].

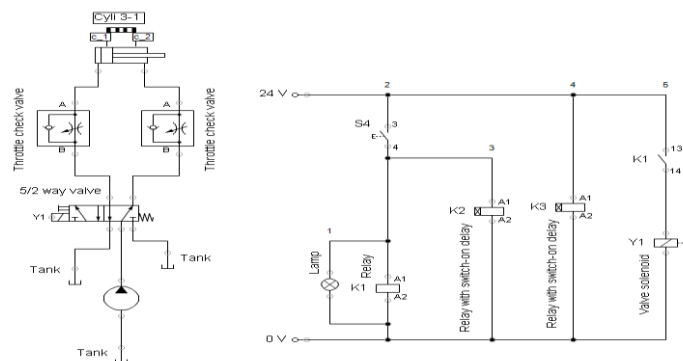


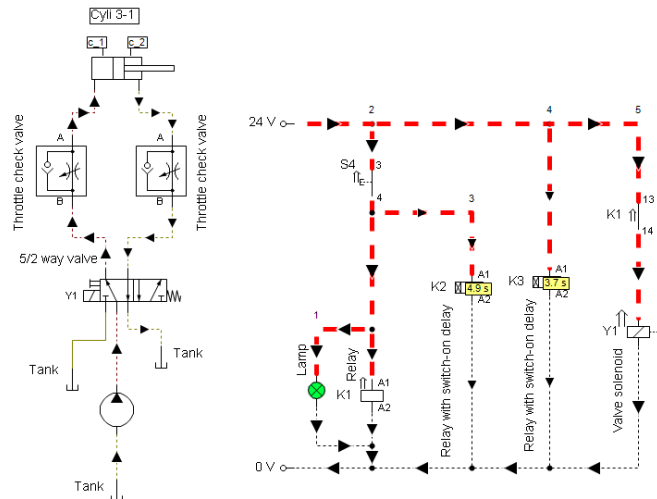
Figure 8. Electro-hydraulic circuit. Simulation II

In the table below there are given the component devices used in the first hydraulic scheme, [6].

Table 3: The devices of electro-hydraulic scheme

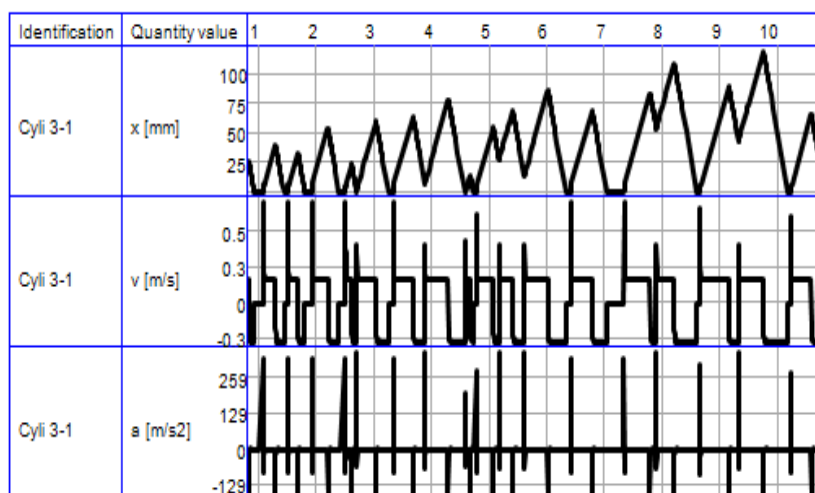
Description	Number of components
Tank	3
Trottle check valve	2
5/2 way hand lever valve	1
Fixed displacement pump	1
Double acting cilynder (Cyli 3-1)	2
Lamp	1
Relay	1
Relay with switch – on delay	2
Valve solenoid	1

Finally, the operator presses S4 button, piston rod of double acting cylinder (Cyli 3-1) moves from point c<sub>1</sub> to point c<sub>2</sub>. Afterwards, this piston rod returns from point c<sub>2</sub> to point c<sub>1</sub>, because the spring of the 5/2 way valve and lamp shows green signal, Figure 9.



**Figure 9.** Electro-hydraulic circuit. Simulation

The diagrams given show variation of the following functional parameters of double-acting cylinder (Cyl 3-1), Figure 10.



**Figure 10.** Diagrams of electro-hydraulic circuit

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#### 5. Conclusion

The advantages of electro-hydraulics in the article are:

- Increased safety;
- Easier to control;
- More environmental friendly.

The piston rod has a reduced downtime caused by hazardous oil leaks.

An installation can be made with the help of the electro-hydraulic schemes. This electro-hydraulic installation for university students.

In the future, we want to make electro-hydraulics schemes that contain the double-acting cylinder with Graftec or logic module.

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