IND220: Lab 4.1: AS Double-Acting Cylinder with Electric Controls

Upon completion of this lab procedure, the student should be able to:

1. Explain how a double-acting cylinder operates
2. Explain how a solenoid actuated, spring return, 5/2 valve operates
3. Identify a proximity switch on a pneumatic and electrical print
4. Explain the flow path of air in a pneumatic circuit with a flow control valve
5. Interpret the operation of the electrical circuit that controls the pneumatic valve
6. Predict what could be wrong if the circuit does not operate properly

This lab should be performed on the student's virtual machine. Automation Studio is a simulation software that will allow the users to build pneumatic and electrical circuits, then simulate the circuits running.

Part 1: Go into the Virtual Machine to access Sakai.
*Log into the Virtual Machine, then open Sakai, then navigate to the IND220 course (sites).
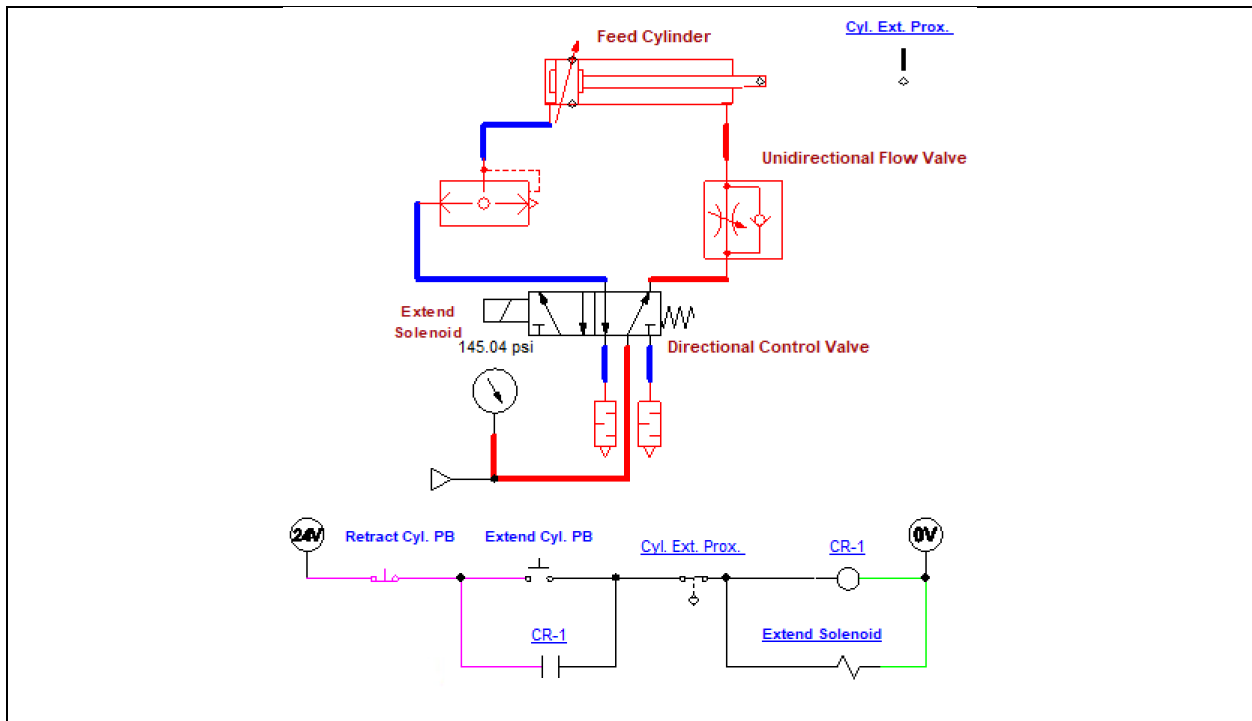*Go to Module 4 within Course Content. Click on the .PRX file: IND220 Lab 4.1 Circuit 1

Figure 1. The pneumatic and electrical circuit in circuit 1 of this lab.

1. The circuit shown in Figure 1 will be the circuit that will be run/simulated in Automation Studio.

2. The next step is to start the simulation.   Click on the Start Simulation (Green) button in the top left corner of the Automation Studio screen to start the simulation.

3. Click on the Extend Cyl. PB to initiate the circuit:

    a. Does the cylinder rod extend immediately? _____

    b. When does the cylinder rod retract? _____

    c. What is the purpose of the CR-1 relay in this circuit? _____

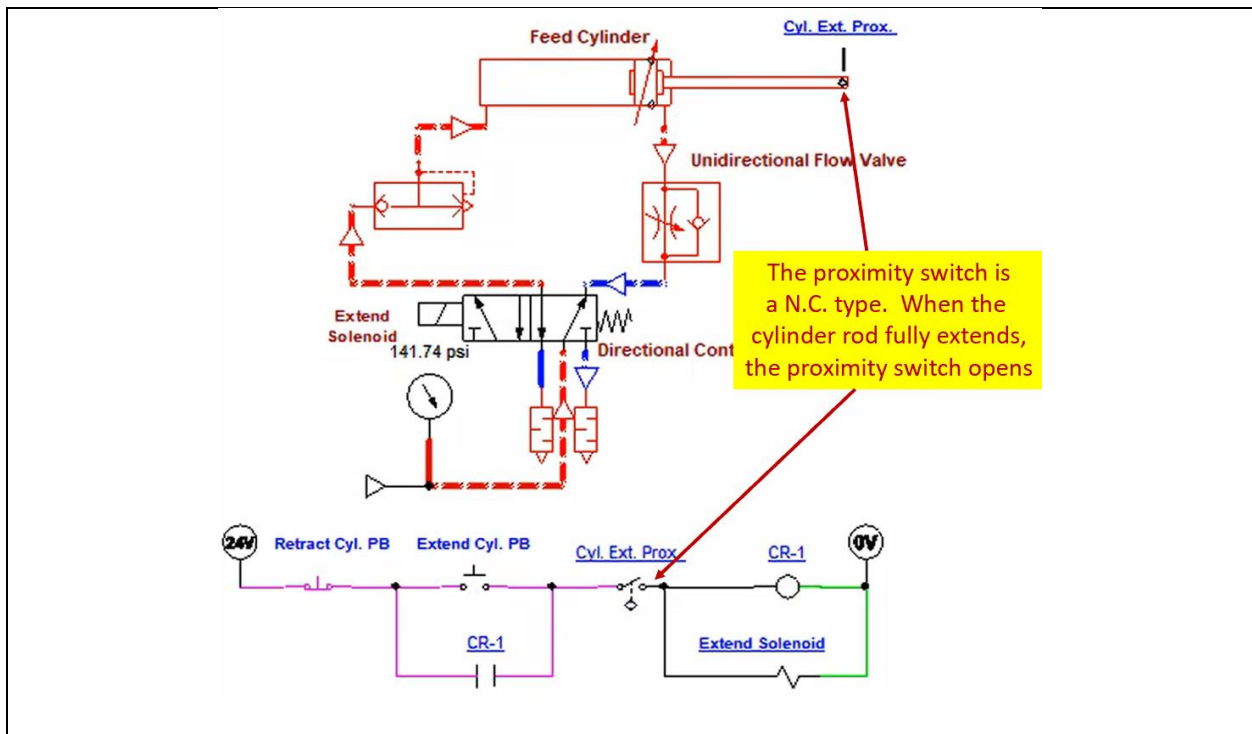   d. Is the proximity switch a N.O. or N.C. type of contact? _____

Figure 2. The proximity switch of Circuit 1.

4. Notice in Figure 2, that when the cylinder rod is fully extended, the proximity switch is actuated, which the opens proximity switch in the electrical circuit which deenergizes the Extend Solenoid.

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5. An important aspect about the pneumatic circuit is that the flow control valve controls the speed of the cylinder rod while it is extending. The adjustment is the internal diameter of the valve, which the user can adjust by clicking on the valve during the simulation. Figure 3 shows that the internal diameter of the needle valve is 0.7 mm.
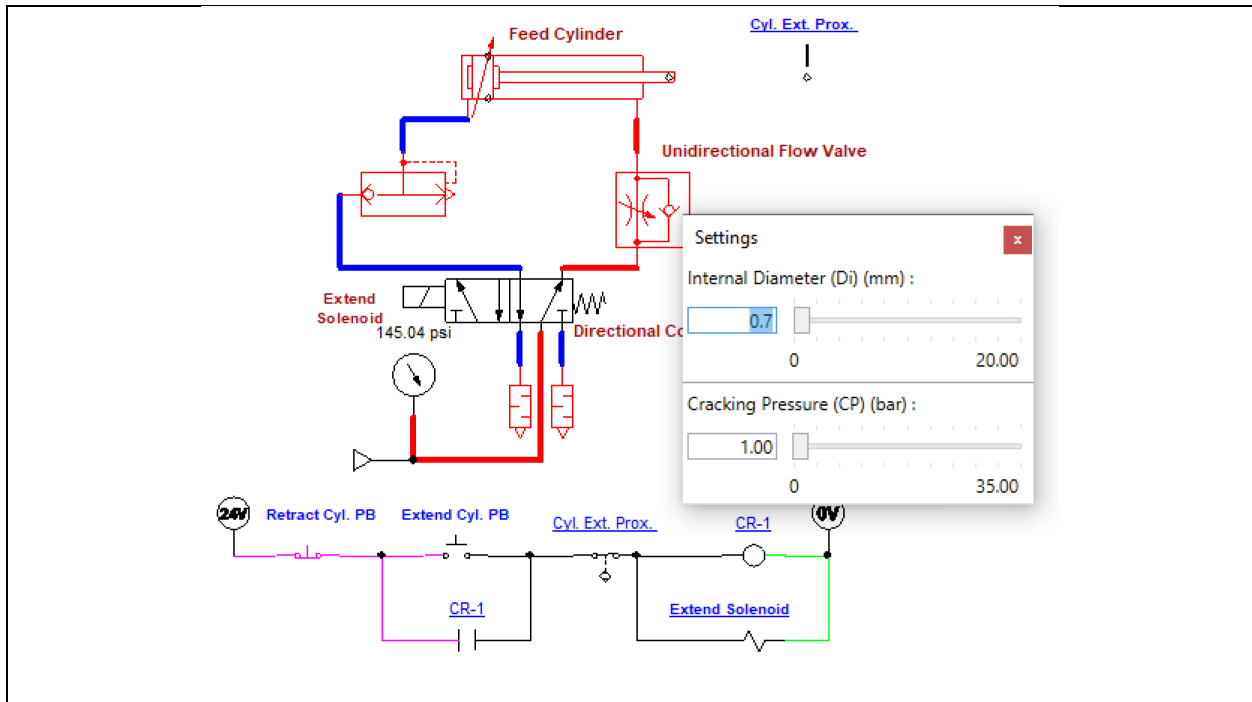

Figure 3. The flow control valve of Circuit 1.

6. Change the internal diameter to 1 mm, by clicking on the flow valve and entering 0.7, then press the Enter key. Close the Settings dialog box.

    a. Click on the Start Pushbutton to start the circuit.

    b. Does the cylinder rod speed up, or slow down when extending? _____

7. Change the internal diameter to 0.5 mm, by clicking on the flow valve and entering 0.5, then press the Enter key. Close the Settings dialog box.

    a. Click on the Start Pushbutton to start the circuit.

    b. Does the cylinder rod speed up, or slow down when extending? _____

8. Stop the simulation.

Part 2: Controlling the Solenoid with an On-delay timer.
*Log into the Virtual Machine, then open Sakai, then navigate to the IND220 course (sites).
*Go to Module 4 within Course Content
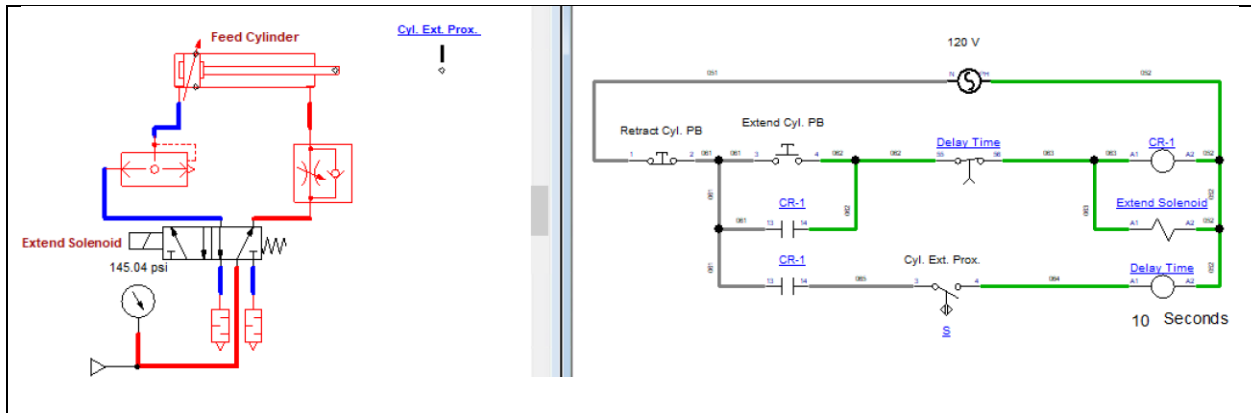*Click on the .PRX file named IND220 Lab 4.1 Circuit 2

Figure 4. Circuit 2 an electric circuit controlling the Extend Solenoid.

9. Figure 4 shows circuit 2 of this lab. Notice that in this simulation that the electrical circuit is on a separate document (sometimes called a sheet) than the pneumatic circuit. To be specific, the pneumatic circuit is on a standard document, and the electrical circuit is on an Electrotechnical document. The advantage of this setup is that the user can use the clamp on ammeter and the multimeter to test the electrical circuit.

10. This electrical control circuit operates different from circuit 1. This circuit has the cylinder rod stay extended for 10 seconds after the proximity switch senses it is fully extended. After the time delay, the cylinder retracts.

11. Click the Start PB.
    a. Does the cylinder rod extend immediately? _____

    b. Is the timer an on-delay, or off-delay type? _____
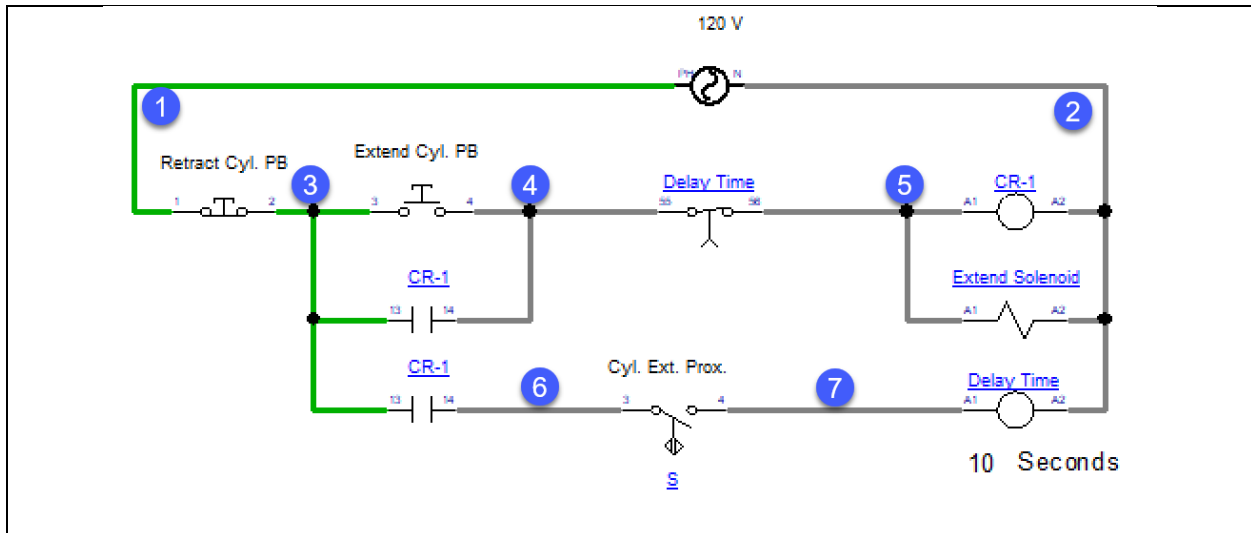
    c. When does the time cycle start? _____

Figure 5. The electrical control circuit of circuit 2.

12. Figure 5 shows just the electrical control circuit for circuit 2. Click the **Extend Cy. PB** switch to start the cycle.

    a. If the cylinder rod is fully extended, what is the voltage from 5 to 2? _____

    b. If the cylinder rod is fully extended, what is the voltage from 7 to 2? _____

    c. When the cylinder rod is retracting, what is the voltage from 5 to 2? _____

    d. When the cylinder rod is retracting, what is the voltage from 7 to 2? _____

Questions:

1. How will the cylinder be effected during the run cycle of the circuit in Figure 1, if the internal diameter of the flow valve is increased?
   a. The cylinder rod will speed up during extension
   b. The cylinder rod will slow down during extension
   c. The cylinder rod will speed up during retraction
   d. The cylinder rod will slow down during retraction

2. What could be the problem if when the cylinder rod is extending in Figure 1, then half way through the extension it retracts?
   a. Proximity switch is faulty
   b. Cylinder is faulty
   c. The stop button is pressed
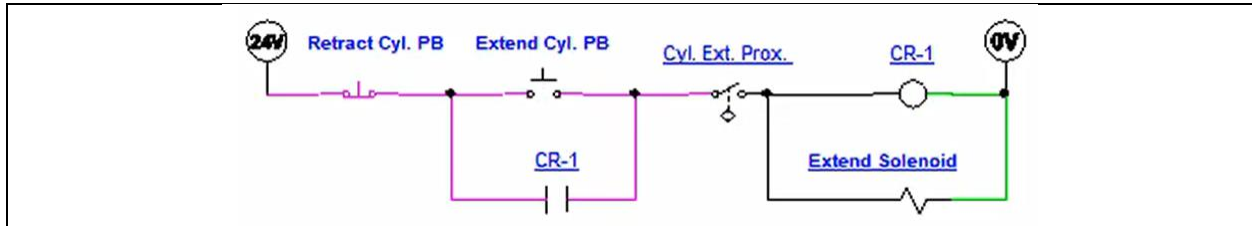   d. The 5/2 valve is stuck in the default position

Figure 6. The electrical circuit from circuit 1.

3. In the state of this electrical circuit simulation, what is the state of the cylinder rod?
   a. Cylinder rod is fully retracted
   b. Cylinder rod is fully extended
   c. Cylinder rod is extended half way
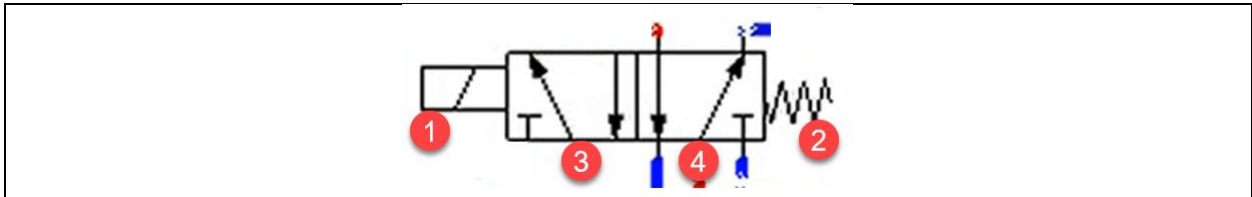   d. Cannot determine the cylinder rod position from this circuit

Figure 7. The directional control valve of circuit 1.

4. Which is the default position of the valve in Figure 7?
   a. 1
   b. 2
   c. 3
   d. 4

5. Which device in Figure 7 moves the valve into the actuated position?
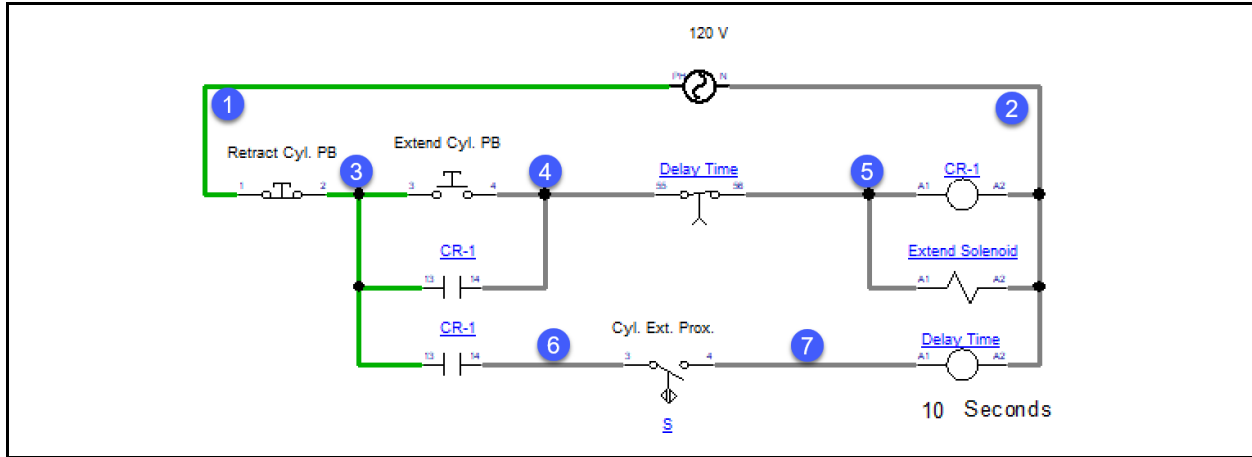   a. 1
   b. 2
   c. 3
   d. 4

Figure 8. Control circuit for circuit 2.

6. In Figure 8, if the Retract Cyl. PB is actuated and release, what would be the measured voltage?
   a. Between wires 3 and 2? _____

   b. Between wires 4 and 2? _____

   c. Between wires 5 and 2? _____

7. In Figure 8, if the Extend Cyl. PB is actuated and release, what would be the measured voltage?
   a) Between wires 4 and 2? _____

   b) Between wires 5 and 2? _____

   c) Between wires 6 and 2? _____

8. What could be wrong in the circuit in Figure 8, if the Extend Cyl. PB is actuated and released, then CR-1 comes on but not the Extend Solenoid?
   a. The Extend Cyl. PB is faulty
   b. CR-1 coil is faulty
   c. The Extend Solenoid coil is faulty
   d. Nothing is wrong, the Extend Solenoid should not come on until after the time delay