

LEVEL 4 ASSESSMENT SPECIFICATION

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Programme:	HNC/D MECHANICAL ENGINEERING HNC/D ELECTRICAL & ELECTRONIC ENGINEERING		
Module:	Engineering Applications & Study Skills		
Module code:	GOEN4000	Contribution to Overall Module Assessment (%):	60%
Lecturer:	C. Williams	Internal Verifier:	R. Kadhim
Assignment Title:	Designing and simulating pneumatic circuits for process control.	Word count (or equivalent):	1000
Submission deadline:	8/05/2025	Return date of provisional marks & written feedback:	22/05/2025
Submission method:	All written assessments, where practical and possible, must be submitted via Turnitin unless otherwise instructed by the Lecturer. (Please DO NOT put this assessment specification into Turnitin or it will match many similarities with other students' submissions.) Alternative submission method (if applicable): Late submission of the assessment will result in a late penalty mark. Penalties for late submission: Up to one-week late, maximum mark of 40%. Over one week late, 0%. Only the Extenuating Circumstances Panel may approve a change to submission dates.		
Academic honesty / referencing:	Academic honesty is required. In the main body of your submission you must give credit to authors on whose research and ideas your work is based. Append to your submission a reference list that indicates the books, articles, etc. that you have used, cited or quoted in order to complete this assessment.		

Task 1

Design Solution required

In a production setting, a double acting cylinder with stroke length of 250mm has to raise a load of 100kg up an inclined surface of 30 degrees. Tests at the production centre have measured that the coefficient of static friction is 0.19 and the coefficient of sliding friction is 0.13. The operating pressure of the production compressed air supply is a maximum of 0.7 Mpa. An operator uses a normally closed 3/2 push button switch to raise the load which they hold until the load is dispatched. The button is then released allowing the cylinder to retract.

Calculate the force required to move the load

Data

$$\alpha = 30^\circ, \quad m = 100kg$$

$$\mu_B = 0.19, \quad \mu_c = 0.13$$

$$P = 0.7\text{Mpa}, \quad \text{Length} = 250\text{mm}$$

Calculate Forces

$$F_B = \mu_B \cdot m \cdot g \cdot \cos x, \quad F_B = (0.19)(100)(9.8)(\cos(30)) = 161.25N$$

$$F_C = \mu_C \cdot m \cdot g \cdot \cos x, \quad F_C = (0.13)(100)(9.8)(\cos(30)) = 110.33N$$

$$F_w = m \cdot g \cdot \sin x, \quad F_w = (100)(9.8)(\sin(30)) = 490N$$

$$F_T = F_w + F_B, \quad F_T = 490N + 161N = 651N$$

$$P = \frac{F}{A} \quad A = \frac{F_T}{P_T} = \frac{651}{0.7} = 930\text{mm}^2$$

$$A_1 = d_p^2 \frac{\pi}{4},$$

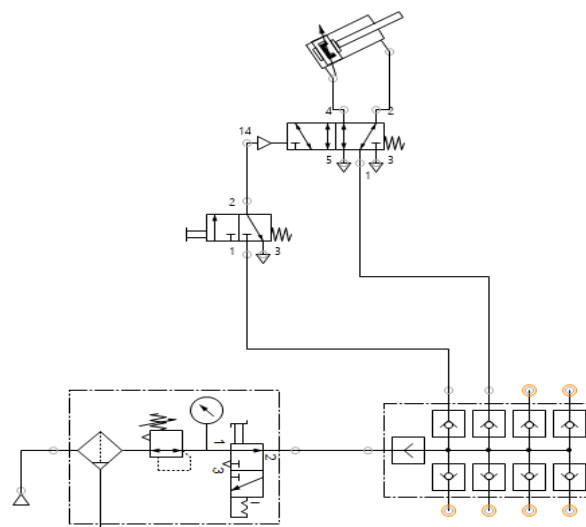
$$d_p = 2 \sqrt{\frac{A}{\pi}} = 2 \sqrt{\frac{930}{\pi}} = 34.41\text{mm}$$

Select a suitable cylinder that will meet the requirements

	Round cylinder CRHD-32- -PPV-A-MS-S6 195555 <table border="1"> <tr> <td>Mode of operation</td><td>Double-acting</td></tr> <tr> <td>Piston diameter</td><td>32 mm</td></tr> <tr> <td>Theoretical force at 0.6 MPa (6 bar, 87 psi), advance...</td><td>483 N</td></tr> <tr> <td>Stroke</td><td>10 mm - 500 mm</td></tr> <tr> <td>Cushioning</td><td>Pneumatic cushioning, adjustable at both ends</td></tr> </table>	Mode of operation	Double-acting	Piston diameter	32 mm	Theoretical force at 0.6 MPa (6 bar, 87 psi), advance...	483 N	Stroke	10 mm - 500 mm	Cushioning	Pneumatic cushioning, adjustable at both ends
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	Round cylinder CRHD-40- -PPV-A-MQ-S6 195544 <table border="1"> <tr> <td>Mode of operation</td><td>Double-acting</td></tr> <tr> <td>Piston diameter</td><td>40 mm</td></tr> <tr> <td>Theoretical force at 0.6 MPa (6 bar, 87 psi), advance...</td><td>754 N</td></tr> <tr> <td>Stroke</td><td>10 mm - 500 mm</td></tr> <tr> <td>Cushioning</td><td>Pneumatic cushioning, adjustable at both ends</td></tr> </table>	Mode of operation	Double-acting	Piston diameter	40 mm	Theoretical force at 0.6 MPa (6 bar, 87 psi), advance...	754 N	Stroke	10 mm - 500 mm	Cushioning	Pneumatic cushioning, adjustable at both ends
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Note: our calculated cylinder is not exactly of these sizes since for our body to be moved we need a cylinder that supports a greater mass and for the effect of operation we use a diameter of 38 mm and that is why we provide these two options since the first meets the direct requirements of the problem but the second does not provide the assurance that our system works properly.

Design the circuit and using Fluidsim check that it operates successfully.



Give a brief explanation of why you have selected each of the components in the circuit.

This following summary will deal with explanation and the use of each component as well as it has been used in the elaboration of our pneumatic system or circuit in general. Our system begins with the installation of a double-acting pneumatic cylinder, which in turn is inclined at an angle of 30 degrees, this cylinder controls a 5/2 valve which is directly connected to another 3/2 valve of the normally closed pushbutton type, which is responsible for activating our entire main system. Our system is powered by our system or maintenance unit which is responsible for regulating the pressure of our entire operating system.

COMPONENTS

Double-acting cylinder: it is responsible for moving the load that is on our surface.

5/2 valve: it is responsible for controlling our entire air system, that is, it controls the entry of air or the injection of air into our cylinder. This valve has 5 ways, it is the one that regulates the flow of air, it is the one that is responsible for contracting or expanding the cylinder.

Normally closed 3/2 valve we could say that it is like our star of the entire system since it is the part in charge of activating our entire operating system, considering that when the button is pushed and opened, it literally lets through the air that our system needs to work.

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Maintenance boxes: inside our maintenance boxes we have our non-return valves that only allow our air to flow in one direction, we also have our filters, pressure regulators, valve bank etc. The main purpose of our maintenance box is simply to ensure that there are no impurities or unstable pressures in our system as well as to provide assurance that everything is running stably and safely.

Task 2

The local production company is pleased with the results of your work and have another design issue they would like you to solve.

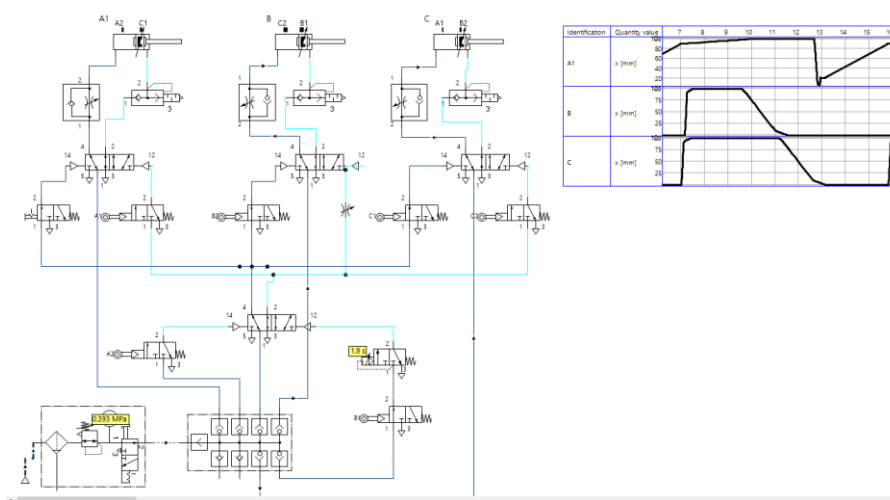
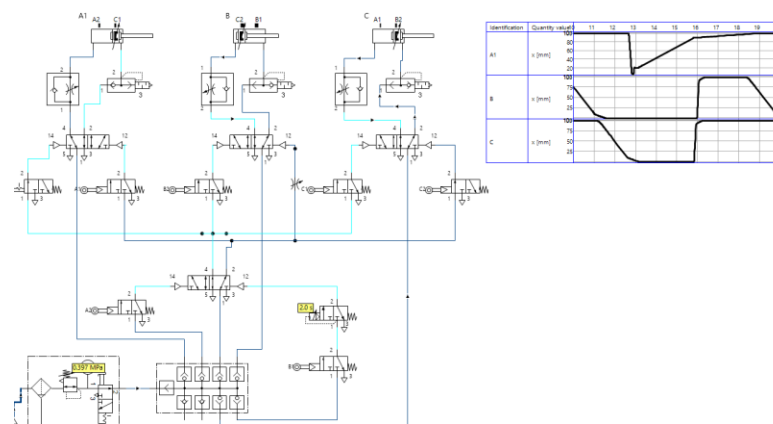
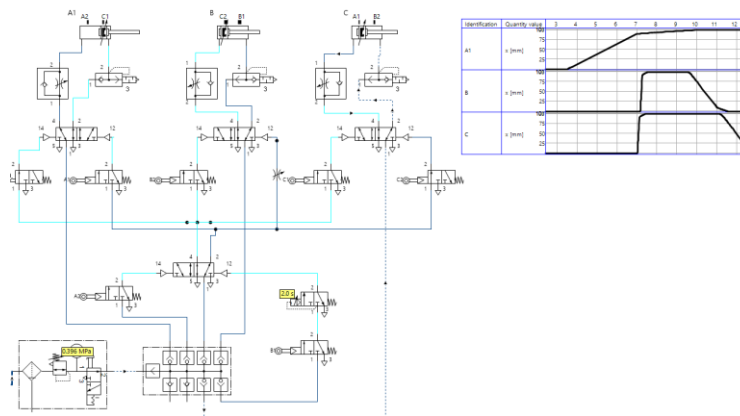
Design parameters

Three double acting cylinders have the following actuating sequence and operating requirements.

The control system must have a pneumatic solution to meet production requirements.

- Sequence A+ C+ B+ B- C- A-
- A time delay of 2 seconds after B+
- C & B are to extend rapidly and take between 1.5 to 2 seconds to retract
- A is to take between 3 to 3.5 seconds to extend and retract rapidly.
- The sequence is started using a latch switch and the system must run continuously until the latch is switched. Once the latch is switched back, the circuit must continue and finish its cycle and stop

Design the circuit and using Fluidsim check that it operates successfully.



Circuit Operation Explained

Our system begins with a simple but direct operation in terms of operation, that is, when we press our pneumatic switch the whole system begins to work in the required way, in the same way our cycle begins explicitly since the A+ cylinder extends in a controlled way and when it ends its travel it activates the extension of our C+ cylinder, then our cylinder B+ continuing its journey but this time acting with a timer of 2 seconds of time, once the cylinder B+ ends its cycle automatically our cylinder C contracts and finally our cylinder A returns quickly. However, when we turn off our circuit, it does not necessarily stop automatically, but until the complete cycle ends, that is, until our A- signal contracts and thus the cycle is prepared for its next activation. It is worth mentioning that in our process we comply with all the guidelines to give a correct response and a solution to the problem, especially in times both delayed and opened.

Explanation of the use of elements

Latch switch: it oversees making our entire system work or we could say in other words that it is our key which opens and closes or rather which activates and deactivates our system.

Double-acting cylinder: it is responsible for moving the load that is on our surface.

5/2 valve: it is responsible for controlling our entire air system, that is, it controls the entry of air or the injection of air into our cylinder. This valve has 5 ways, it is the one that regulates the flow of air, it is the one that is responsible for contracting or expanding the cylinder.

Pneumatic timers: as its name indicates, it is responsible for making or applying the times, either delay or activation, and how fast its components or airflow should act.

Maintenance boxes: inside our maintenance boxes we have our non-return valves that only allow our air to flow in one direction, we also have our filters, pressure regulators, valve bank etc. The main purpose of our maintenance box is simply to ensure that there are no impurities or unstable pressures in our system as well as to provide assurance that everything is running stably and safely.