DIESEL MECHANIC

MINING QUALIFICATIONS AUTHORITY

CODE: PN - 6

CONTROL THE SPEED OF A DOUBLE ACTING CYLINDER

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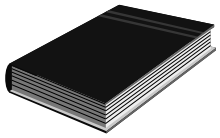


SOURCE REFERENCES

Demonstration by a competent person, e.g. a Training Officer.

FESTO – Pneumatics Basic Level Textbook

OBJECTIVE

You will be learning towards the outcome “Control the speed of a double acting cylinder”. Whilst learning towards the outcome you will be required to achieve the following:

- Know the application of supply air throttling.
- Know the application of exhaust air throttling.
- Know how to construct a circuit and set the flow control valve so that the piston will travel at the speed indicated by your Training Officer.

On completion of this module, the learner must be able to:

- State the application of supply air throttling.
- State the application of exhaust air throttling.
- Construct a circuit and set the flow control valve so that the piston will travel at the speed indicated by your Training Officer.

During this process you must adhere to certain specified requirements as listed in the Module.

ASSESSMENT AND EVALUATION CRITERIA

You will be assessed, when you are confident that you may achieve the outcomes as listed, to determine your competence as measured against the required criteria. This assessment will be in line with accepted best practices regarding assessment.

- Theoretical and practical assessments will be set during the module and must be completed without using reference.
- The learner will be required to answer all the questions without any reference.

HAZARD IDENTIFICATION AND CONTROL (HIAC) FORM

PN - 6

CONTROL THE SPEED OF A DOUBLE ACTING CYLINDER.

STEPS IN OPERATION / PROCESS	POTENTIAL ACCIDENT / INCIDENT	CONTROLS (BY RESPONSIBLE PERSON)
1. Construct a pneumatic circuit.	• Improper or careless handling of pneumatic components and pipes can lead to damage of equipment.	• Always handle components and pipes correctly, and with great care. • Wipe components and panel clean after use and store components.
2. Use of compressed air in a pressurised circuit.	• Circuit under pressure.	• Ensure circuit is depressurised before removing components or pipes
3. Insure work area is safe.	• Dirt particles in eyes and laceration of skin.	• Wear correct PPE.

NOTE: Before doing the practical work contained in this module, the learner must study the content of the above HIAC form again and then sign the statement below.

The above risks, which will be encountered in this module, are fully understood and will be controlled during the practical work.

Signature of learner: _____

Signature of Training Officer: _____

Date: _____

1. DOUBLE ACTING CYLINDERS

ITEM / TASK: Components of a double acting cylinder.

DESCRIPTION:

A. The construction principle of a double acting cylinder is similar to that of the single acting cylinder. However, there is no return spring, and the two ports are used alternatively as supply and exhaust ports. The double acting cylinder has the advantage that the cylinder is able to carry out work in both directions of motion. Thus, installation possibilities are universal. The force transferred by the piston rod is somewhat greater for the forward stroke than for the return stroke as the effective piston surface is reduced on the piston rod side by the cross-sectional area of the piston rod.

B. The double acting cylinder consist of the following components: (Fig 1)
   a. Cylinder barrel
   b. End cap
   c. Bearing cap
   d. Piston seal
   e. Guide bush
   f. Seal and scraper ring
   g. Seals
   h. Piston rod
   i. Piston

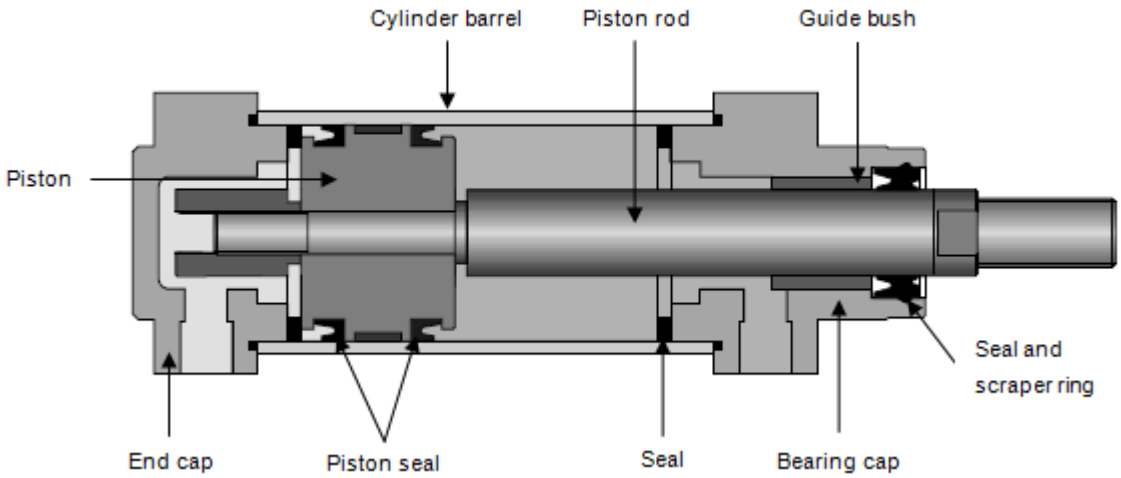


FIG 1.

C. Cylinder construction:

The cylinder barrel is usually made of seamless drawn steel tube. To increase the life of the sealing components, the bearing surfaces of the cylinder barrel are precision-machined. For special applications, the cylinder barrel can be made of aluminium, brass or steel tube with hard chromed bearing surface. These special designs are used where operation is infrequent or where there are corrosive influences.

The end cap and the bearing cap are, for the most part, made of cast material (aluminium or malleable cast iron). The two caps can be fastened to the cylinder barrel by tie rods, threads or flanges.

The piston rod is preferably made from heat-treated steel. A certain percentage of chrome in the steel protects against rusting. Generally the threads are rolled to reduce the danger of fracture.

A sealing ring is fitted in the bearing cap to seal the piston rod. The bearing bush guides the piston rod and may be made of sintered bronze or plastic-coated metal.

In front of this bearing bush is a scraper ring. It prevents dust and dirt particles from entering the cylinder space. Bellows are therefore not normally required.

D. The symbol for a double acting cylinder is shown in Fig 2.

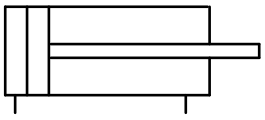


FIG 2.

ITEM / TASK: Function of a double acting cylinder.

DESCRIPTION:

A. A double acting cylinder can exert a force in any desired direction of movement.

ITEM / TASK: Operation of a double acting cylinder.

DESCRIPTION:

A. During the outward movement of the cylinder, the air enters port 2 (A). A pressure is built up which exerts a force at the back of the piston. The piston and the piston rod move outwards. The air on the opposite side of the piston will escape through port 4 (B). During the return movement, the flow of air is reversed by the control valve. The air enters the cylinder at port 4 (B). Thus, the outward and return movement may be used as working strokes. (See Fig 3)

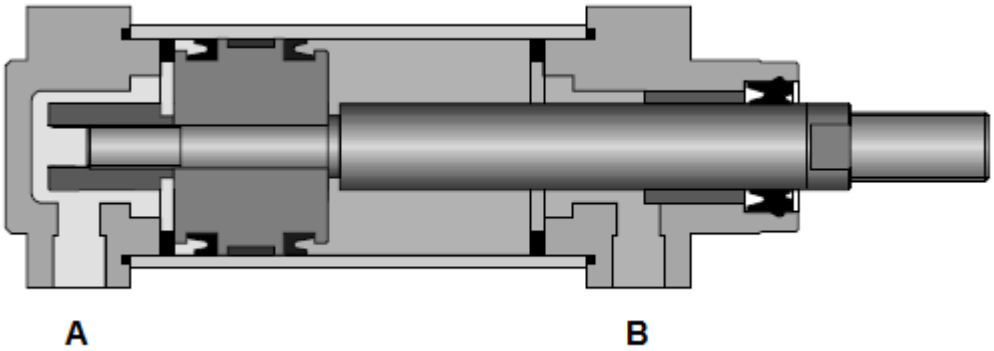


FIG 3.

ITEM / TASK: Cylinders with end position cushioning.

DESCRIPTION:

A. If large masses are moved by a cylinder, cushioning is used in the end positions to prevent sudden damaging impacts. Before reaching the end position, a cushioning piston interrupts the direct flow path of the air to the outside. Instead a very small and often adjustable exhaust aperture is open. For the last part of the stroke the cylinder speed is progressively reduced. If the passage adjustment is too small, the cylinder may not reach the end position due to the blockage of air.

B. The use of cushioning to reduce loads on the end caps and mountings during deceleration of the piston is important for long-life and smooth operation. The cushioning piston is shown on the exhaust air side of the piston. The arrow indicates adjustable cushioning and not the direction of cushioned motion. (Fig 4)

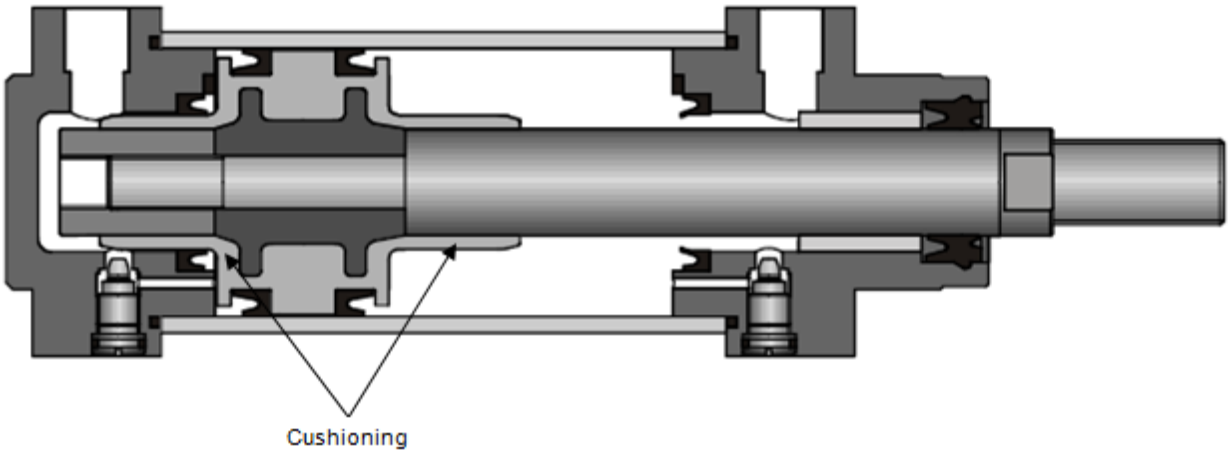


FIG 4.

C. The symbol for a double acting cylinder with end position cushioning is shown in Fig 5.

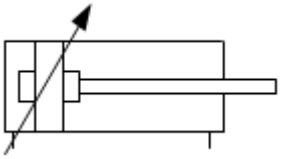


FIG 5.

DO THE SELF TEST AND PRACTICE ON THE NEXT PAGES BEFORE CONTINUING WITH THE REST OF THE MODULE.

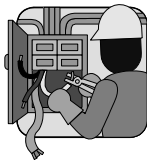
SELF TEST 1

1. What is the function of a double acting cylinder?

Refer to your notes to check your answers.

Ask your Training Officer to check your work and if it is correct, to sign below.

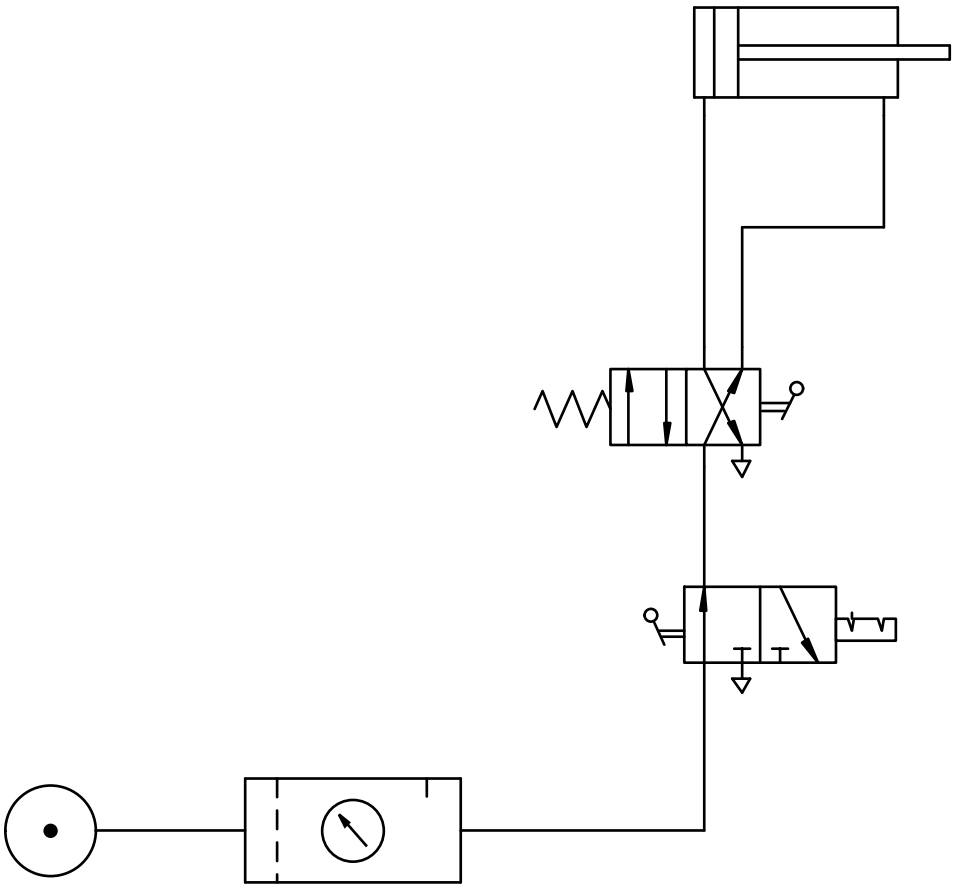
LEARNER	TRAINING OFFICER
DATE :	DATE :
SIGNATURE :	SIGNATURE :



PRACTICE

1. Practice drawing the symbol for a double acting cylinder.

2. Identify the double acting cylinder from the training panel / equipment.
3. Construct the circuit below on the training panel. Check the circuit by operating the 4/2 way directional control valve.



4. Indicate the flow of air for each position of the directional control valves on the above schematic drawing.

Ask your Training Officer to check your work and if it is correct, to sign below.

LEARNER	TRAINING OFFICER
DATE :	DATE :
SIGNATURE :	SIGNATURE :

2. SPEED CONTROL

ITEM / TASK: Introduction.

A. The speed of a double acting cylinder may be controlled by a one-way flow control valve described in module PN-4.
B. Fundamentally, there are two types of throttling circuits for double acting cylinders:
   a. Supply air throttling.
   b. Exhaust air throttling.

ITEM / TASK: Supply air throttling.

A. For supply air throttling, one-way flow control valves are installed so that the air entering the cylinder is throttled. The exhaust air can escape freely through the check / non return valve, of the throttle valve on the outlet side of the cylinder.
B. When the 4/2-way directional control valve is in its stationary position, the piston rod will be in its returned position and the working pressure (Pe1) will be shown on the pressure gauge. (Fig 6)

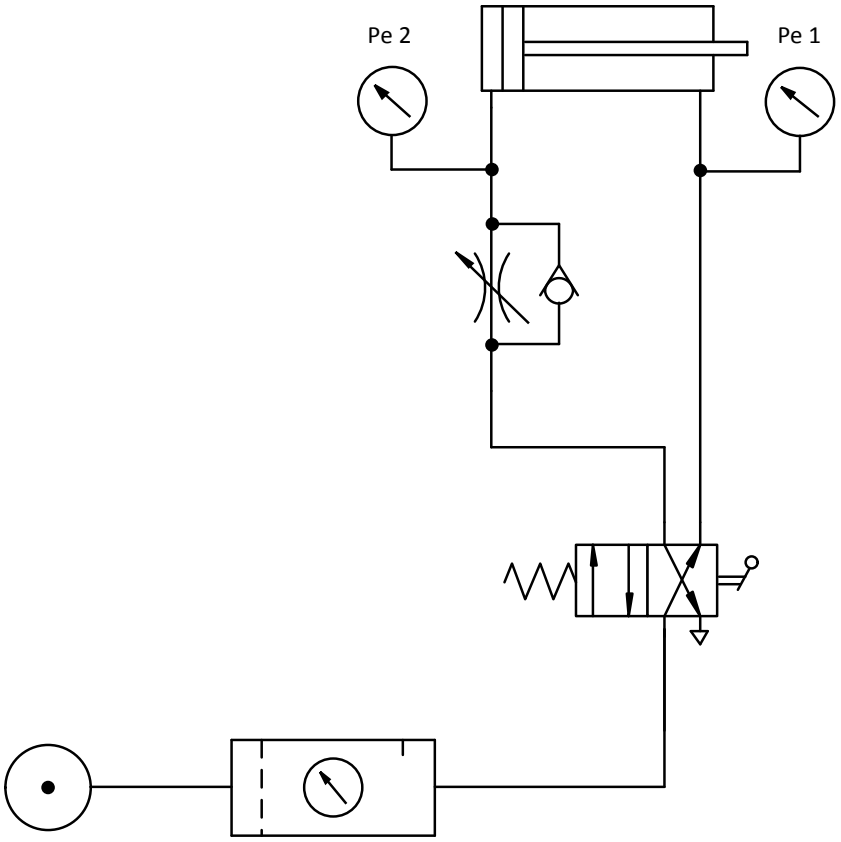


FIG 6.

C. When the 4/2-way directional control valve is operated, the supply air flowing to the cylinder is throttled by the one-way flow control valve. (Fig 7)

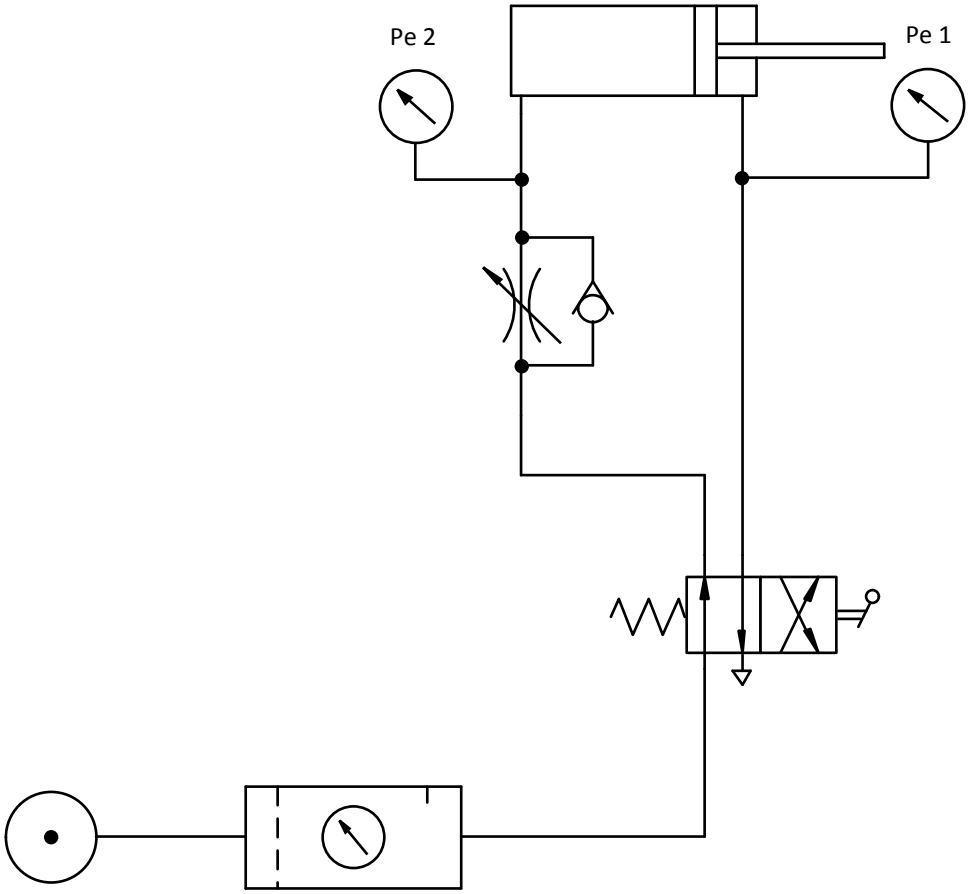


FIG 7.

D. The return air is forced out of the cylinder by the piston and flows to the atmosphere through port 3 (R). When the control valve is in selected position, the piston will move outwards.

E. The pressure indicated by the gauge (Pe2) will be low because of the fact that only the friction of the piston and the piston rod has to be exceeded.

F. Pressure Pe1 will be zero because the line is vented to atmosphere through port 3 (R).

G. The speed of the cylinder, when moving out can be controlled by adjusting the one-way flow control valve.

H. When the directional control valve is released to its stationary position, the supply air will flow through port 4 (B) to the cylinder. The return air will flow to atmosphere through the check / non return valve inside the one-way flow control valve. (Fig 8)

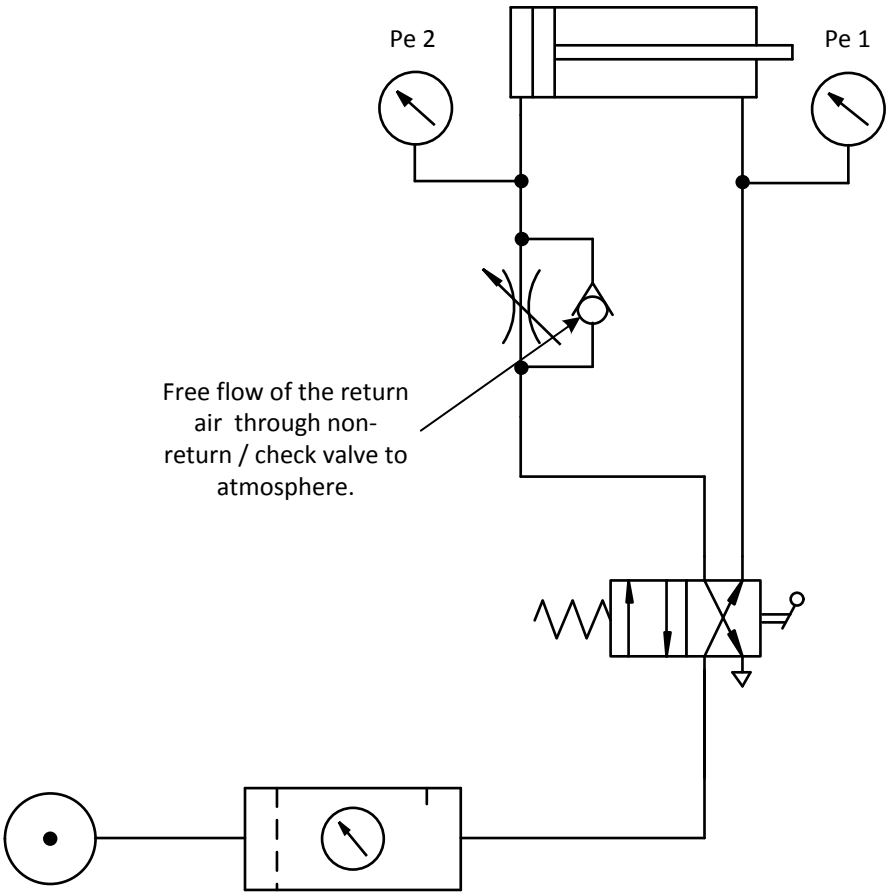


FIG 8.

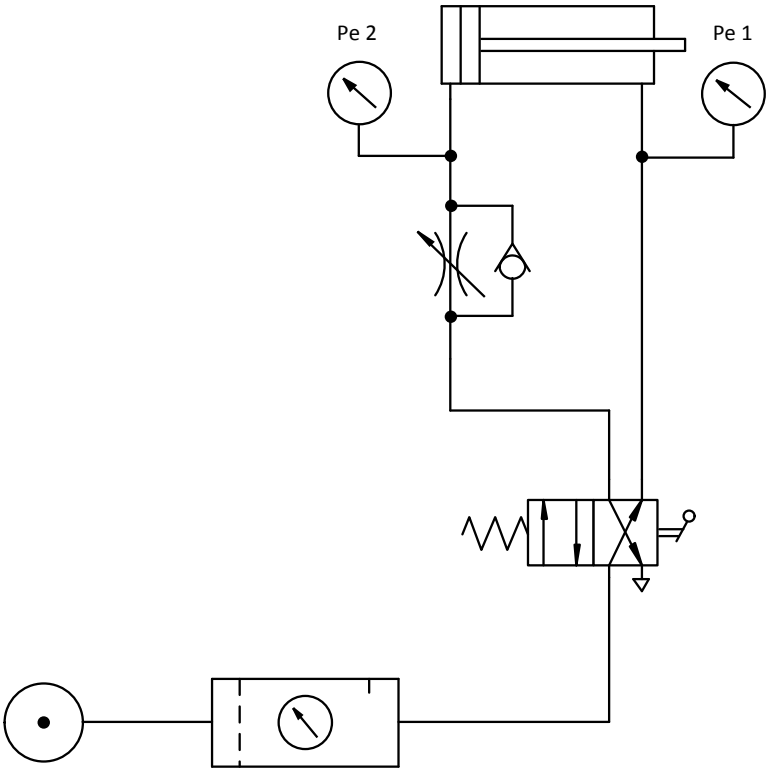
I. When the control valve is in the stationary position, the piston will move back.

DO THE PRACTICE ON THE NEXT PAGES

BEFORE CONTINUING WITH THE REST OF THE MODULE.

PRACTICE

1. Construct the circuit below on the training panel.



2. Adjust the one-way flow control valve for different cylinder speeds.
3. Indicate the flow of air for each position of the directional control valves on the above schematic drawing.

NB:

If high pressure readings are experienced when the cylinder moves inwards, check that the check / non return valve in the flow control valve is facing in the right direction.

Ask your Training Officer to check your work and if it is correct, to sign below.

LEARNER	TRAINING OFFICER
DATE :	DATE :
SIGNATURE :	SIGNATURE :

ITEM / TASK: Exhaust air throttling.

A. With exhaust air throttling, the supply air flows freely to the cylinder, and the exhaust air is throttled. In this case, the piston is loaded between two cushions of air. The first cushion effect is the supply pressure to the cylinder and the second cushion is the exhausting air being restricted at the one-way flow control valve orifice.

B. When the 4/2-way directional control valve is in its stationary position, the piston rod will be in its returned position and the working pressure (Pe1) will be shown on the pressure gauge. (Fig 9)

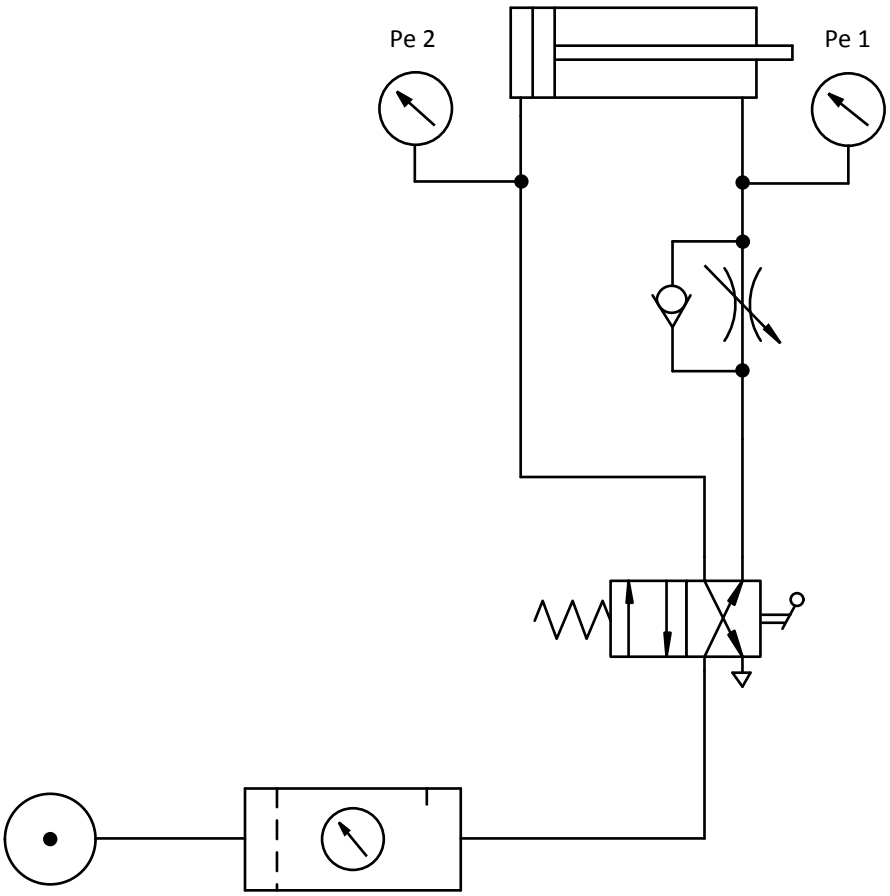


FIG 9.

C. When the directional control valve is operated, the supply air flows through port 2 (A) of the directional control valve into the cylinder. (Fig 10)

D. The return air is forced out of the cylinder by the piston and accumulates in front of the flow control valve which throttles the return air. (Fig 10)

E. Pressure builds up in the piston rod chamber and is shown on the pressure gauge (Pe1). (Fig 10)

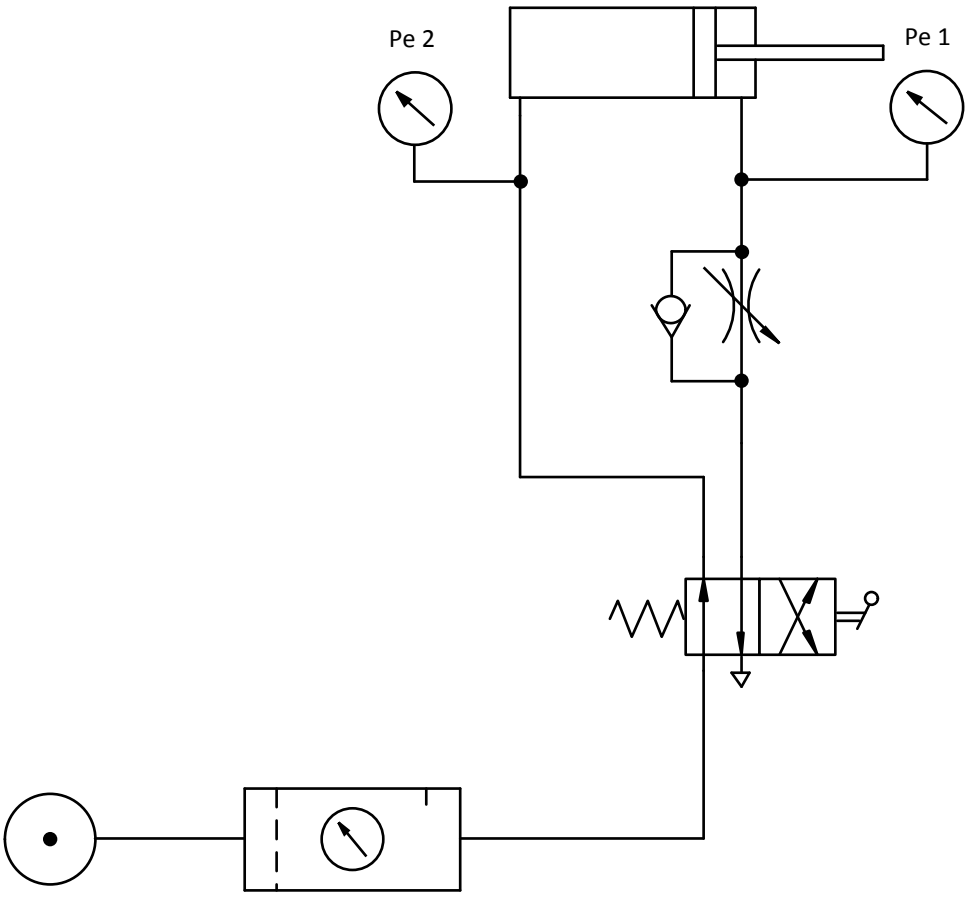


FIG 10.

F. On the other side of the piston, pressure of almost identical magnitude (the difference is due to the different surface areas of the piston) has built up and this causes the piston to travel out. During the outward stroke the piston is held between two cushions of air.

G. When the control valve is released to its stationary position, the supply air will flow through port 4 (B) of the directional control valve and the check / non return valve located in the flow control valve to the cylinder. The return air will flow to atmosphere through port 3 (R) in the directional control valve. With the directional control valve in selected position, the piston will move inwards. (Fig 11)

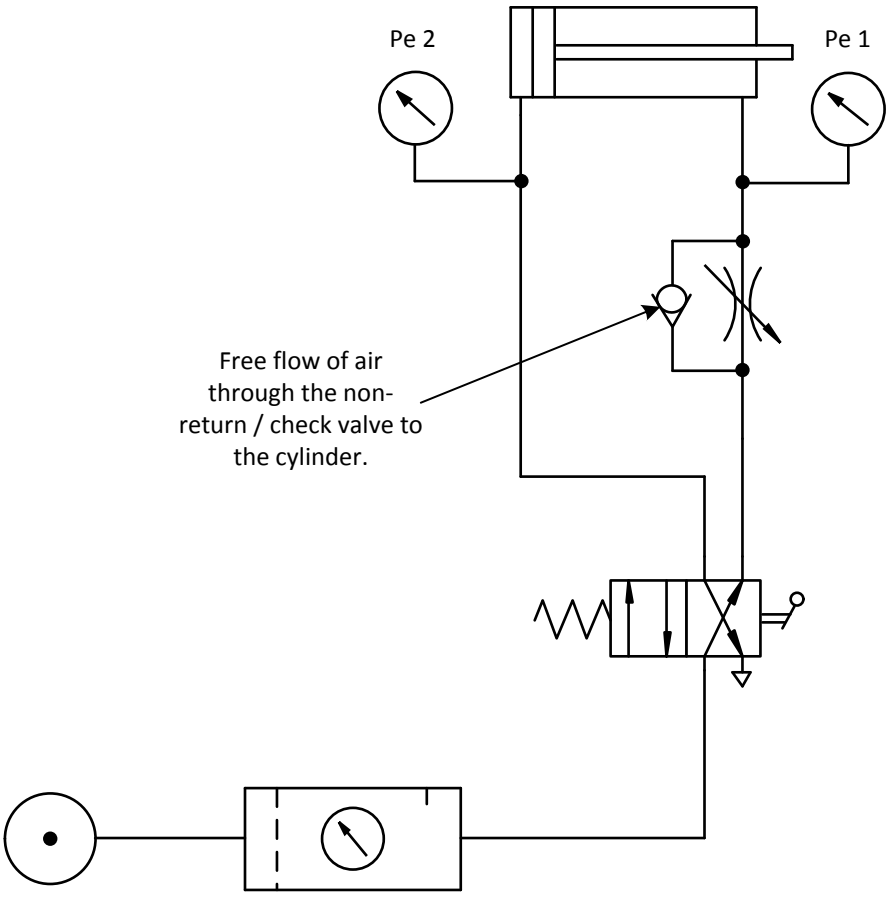


FIG 11.

H. Exhaust air throttling permits a smoother outward movement than supply air throttling because the piston is held between two cushions of air. Supply air throttling is used mainly with constant load acting against the direction of stroke, and with single acting cylinders. Exhaust air throttling is used mainly where the magnitude and the direction of the load varies.

DO THE SELF TEST AND PRACTICE ON THE NEXT PAGES BEFORE ATTEMPTING THE ASSESSMENT.

SELF TEST 2

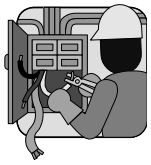
1. What is the function of supply air throttling?

2. What is the function of exhaust air throttling?

Refer to your notes to check your answers.

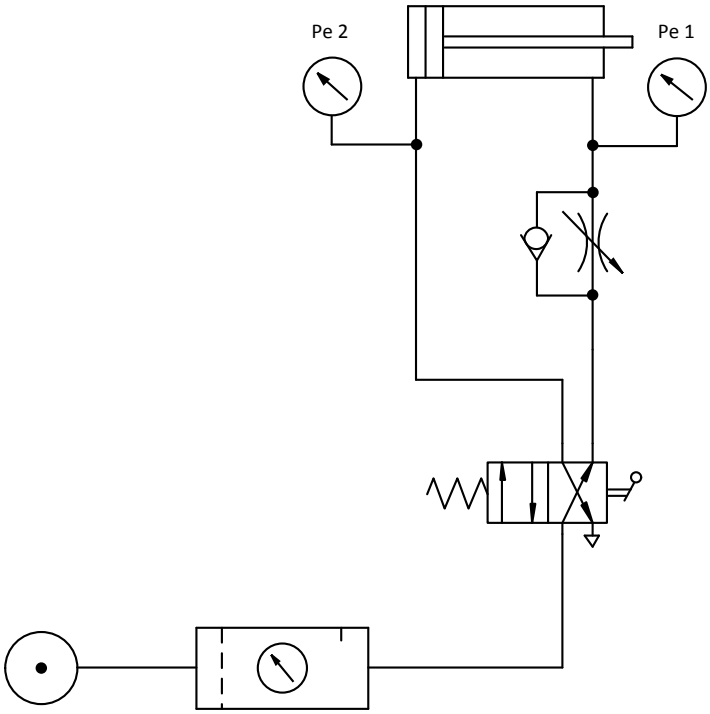
Ask your Training Officer to check your work and if it is correct, to sign below.

LEARNER	TRAINING OFFICER
DATE :	DATE :
SIGNATURE :	SIGNATURE :



PRACTICE

1. Construct the circuit below on the training panel.



2. Adjust the one-way flow control valve for different cylinder speeds.
3. Indicate the flow of air for each position of the directional control valves on the above schematic drawing.

Ask your Training Officer to check your work and if it is correct, to sign below.

LEARNER	TRAINING OFFICER
DATE :	DATE :
SIGNATURE :	SIGNATURE :

REMEMBER ALWAYS WORK SAFE

Once you have passed the entire practices, you are now at liberty to request a Formative Assessment from your Assessor.