DIESEL MECHANIC

MINING QUALIFICATIONS AUTHORITY

CODE: HYD - 4

CONSTRUCT A CIRCUIT WITH A SINGLE ACTING CYLINDER

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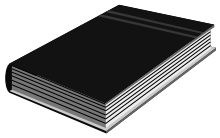
TRG 9

INDEX

The following elements are contained in this learning guide:



SOURCE REFERENCES

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

FESTO – Basic Level Textbook

OBJECTIVE

You will be learning towards the outcome “Construct a circuit with a single acting cylinder”.
Whilst learning towards the outcome you will be required to achieve the following:

- Construct a circuit with the relevant valves.
- Know the purpose of a cylinder.
- Know the purpose of a directional control valve.

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

- Indicate flow when operating different valves.
- State the purpose of a cylinder.
- State the purpose of a directional control valve.

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.
- There must not be any damage to any equipment.

HAZARD IDENTIFICATION AND CONTROL (HIAC) FORM

HYD - 4

CONSTRUCT A CIRCUIT WITH A SINGLE ACTING CYLINDER

STEPS IN OPERATION / PROCESS	POTENTIAL ACCIDENT / INCIDENT	CONTROLS (BY RESPONSIBLE PERSON)
1. Construct a hydraulic circuit.	• Improper or careless handling of hydraulic 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 hydraulic oil in a pressurised circuit.	• Circuit under pressure.	• Ensure circuit is depressurised before removing components or pipes
3. Insure work area is safe	• Oil in eyes and laceration of skin. • Slip and fall.	• Wear correct PPE. • Ensure working area is clean and safe. • Wear correct safety boots.

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. INTRODUCTION

ITEM / TASK: Control valves.

DESCRIPTION:

Another important component in the hydraulic system is the control valve.

The system shown in Fig 1 has a tank, a pump, a cylinder and a number of valves. Five valves will be required to control the movement of the cylinder.

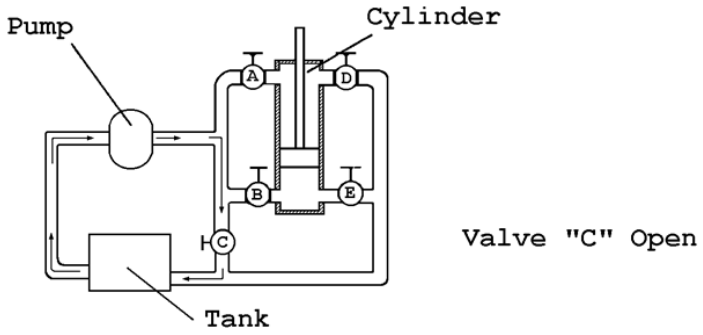


FIG 1.

When the cylinder is at rest, all the valves will be closed except the one marked "C".

To raise the cylinder, valves "B" and "D" must be opened and "C" must be closed. The opening and closing of the valves must occur simultaneously. It would obviously require a highly trained double jointed operator to achieve this. See Fig 2 below.

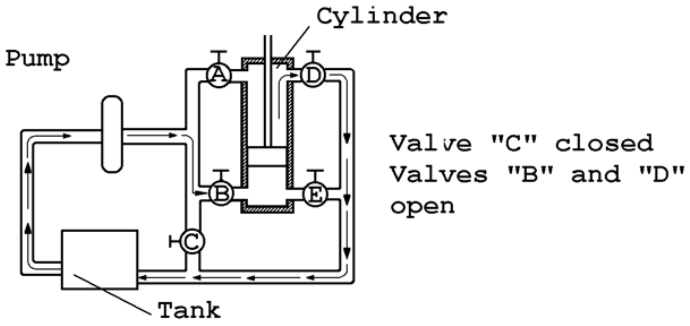


FIG 2.

To overcome this problem a directional-control valve is used. Refer to Fig 3 **on the next page.** The valve consists of a spool which fits into a housing with ports in it. The metal to metal contact between the spool and the housing forms a seal. The narrow portions of the spool allow the fluid to pass through the valve. The thick portion of the spool blocks the flow.

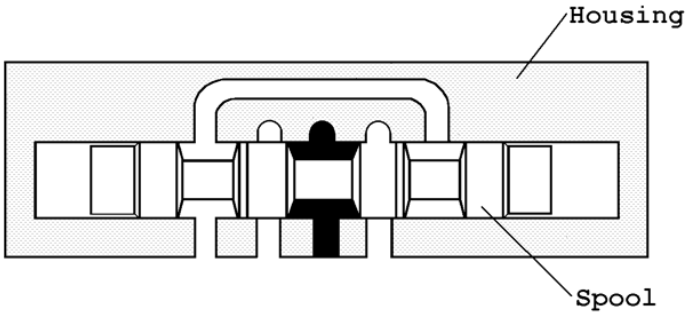


FIG 3.

These valves control the direction of flow of the hydraulic fluid and, thus, the direction of motion and the positioning of the working components. Directional control valves may be actuated manually, mechanically, electrically, pneumatically or hydraulically. They convert and amplify signals (manual, electric or pneumatic) forming an interface between the power control section and the signal control section.

Directional control valves are shown by means of several connected squares.

- The number of squares indicates the number of switching positions possible for a valve.
- Arrows within the squares indicate the flow direction.
- Lines indicate how the ports are interconnected in the various switching positions.

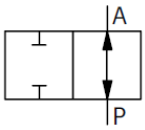
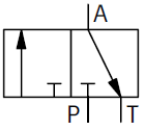
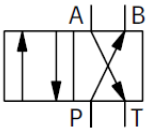
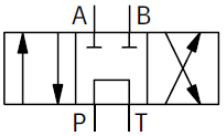
There are two possible methods of port designation. One method is to use the letters P, T, A, B and L, the other is to label ports alphabetically A, B, C, D, etc. The first method is generally preferred. ***Ports should always be labelled with the valve in the neutral position.*** Where there is no neutral position, they are allocated to the switching position assumed by the valve when the system is in its initial position.

The neutral position is defined as the position automatically assumed by the valve on removal of the actuating force.

When labelling directional control valves, it is first necessary to specify the ***number of ports*** followed by the ***number of switching positions***. Directional control valves have at least two switching positions and at least two ports. In such an instance, the valve would be designated a 2/2-way valve. The following diagrams show other directional control valves and their circuit symbols.

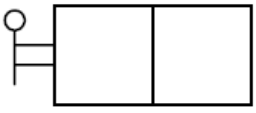
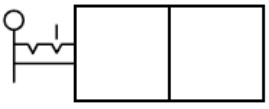
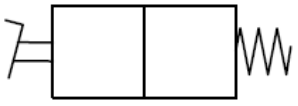
No of ports

No of switching positions

					Symbol	***Port designations***		
2	/	2	-	way valve		P	=	Pressure port
3	/	2	-	way valve		T	=	Return port
4	/	2	-	way valve		A / B	=	Power ports
4	/	3	-	way valve		L	=	Leakage oil

The switching position of a directional control valve can be changed by various actuation methods. The symbol for the valve is elaborated by the addition of the symbol indicating the actuation method.

In the case of some of the actuation methods shown, such as push button, pedal, lever with detent, **a spring is always necessary for resetting**. Resetting may also be achieved by switching the valve a second time, e.g. in the case of a valve with hand lever and detent setting. Listed below are the symbols for the most important actuation methods.

by push button with spring return	
by lever	
by lever with detent setting	
by pedal and spring return	

2. 3/3 WAY DIRECTIONAL CONTROL VALVE

ITEM / TASK: Construction and operation.

DESCRIPTION:

A. The spool of a 3/3-way directional control valve (detent) permits flow from port "P" to port "T" in the neutral position. Port "A" is blocked in this position. (Fig 4)

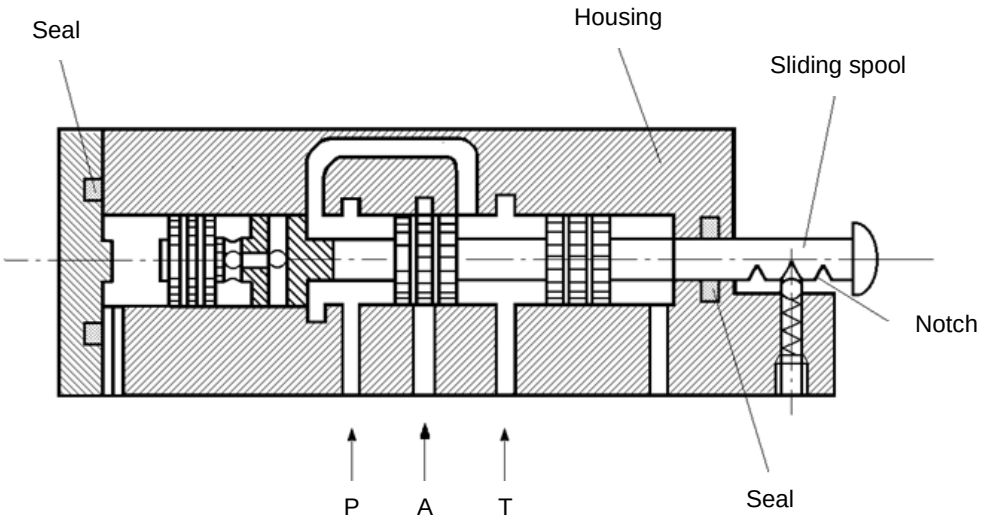


FIG 4.

B. In the position shown in Fig 5, the oil will flow freely from port "P" to port "A". Port "T" is blocked in this position.

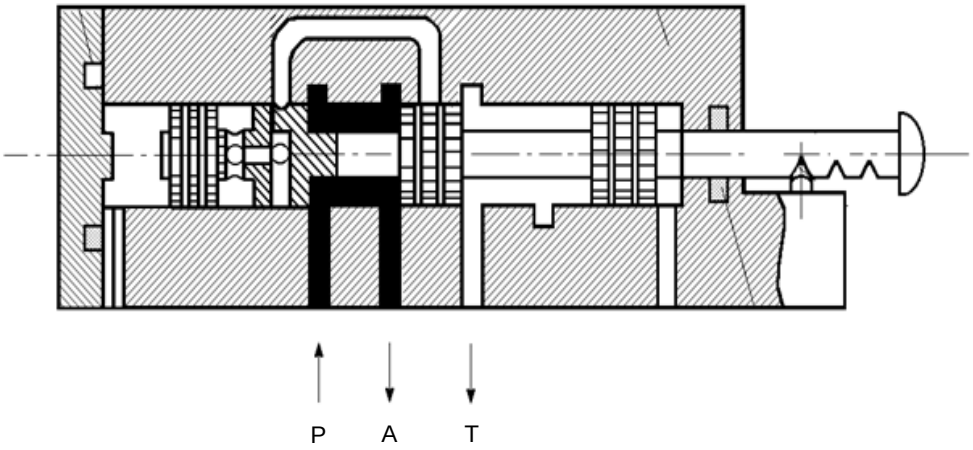


FIG 5.

C. In the position shown in Fig 6, the oil will flow freely from port "P" to port "T" and from port "A" to port "T".

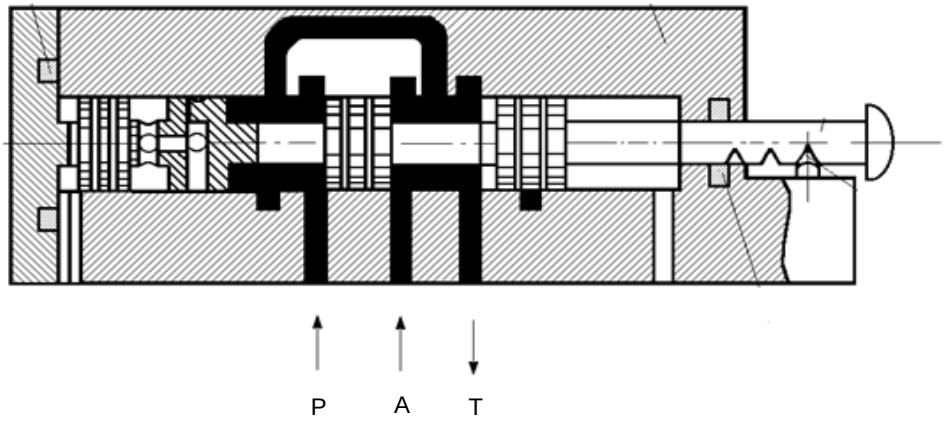


FIG 6.

D. The symbol for a 3/3 way directional control valve is shown in Fig 7.

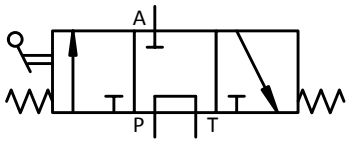


FIG 7.

NOTE:

A 4/3 way directional control valve with a blocked port b will function the same as a 3/3 way directional control valve.

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

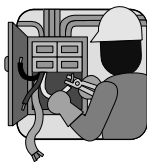
SELF TEST 1

1. What is the function of a directional control valve in a hydraulic circuit?

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 3/3 way directional control valve.

2. Identify a 3/3 way directional control valve from the training equipment.

Ask your Training Officer to check your work and if it is correct, to sign below and then go on to the next section.

LEARNER	TRAINING OFFICER
DATE :	DATE :
SIGNATURE :	SIGNATURE :

3. SINGLE-ACTING CYLINDERS

ITEM / TASK: Types.

DESCRIPTION:

A. The hydraulic cylinder converts hydraulic energy into mechanical energy. It generates linear movements. For this reason, it is also referred to as a “linear motor”.

There are two types of cylinders.

a. single-acting cylinder, and
b. double-acting cylinder. (Will be described in detail in module HYD - 5)

a. **Single-acting cylinders**

In single-acting cylinders, only the piston side is supplied with hydraulic fluid. Consequently, the cylinder is only able to carry out work in one direction. These cylinders operate according to the following principle:

- The hydraulic fluid flows into the piston area. Owing to the counter force (weight/load), pressure builds up at the piston. Once this counter force has been overcome, the piston travels into the forward end position.
- During the return stroke, the piston area is connected to the reservoir via the line and the directional control valve whilst the pressure line is closed off by the directional control valve. The return stroke is affected either by a spring or by a weight load. In the process, these forces (load forces) overcome the frictional forces in the cylinder and in the lines and valves and displace the hydraulic fluid into the return line.

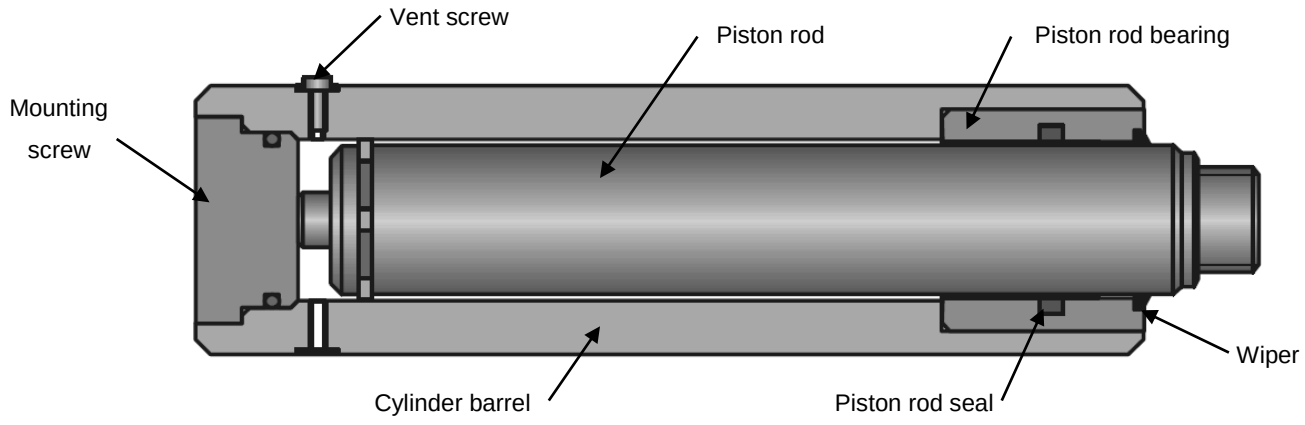


FIG 8.

B. Single-acting cylinders are used wherever hydraulic power is required for only one direction of motion.

Examples:

- ✓ for lifting, clamping and lowering workpieces,
- ✓ in hydraulic lifts,
- ✓ scissor lifting tables
- ✓ and lifting platforms.

Single-acting cylinders can be mounted as follows:

- ∗ Vertical mounting: when the return movement of the piston is brought about by external forces (special instance: scissor lifting table);
- ∗ horizontal mounting: for single-acting cylinders with spring-return.

C. The symbol for a single-acting cylinder returned by external force is shown in Fig 9.

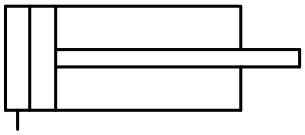


FIG 9.

D. The symbol for a single-acting cylinder returned by spring force is shown in Fig 10.

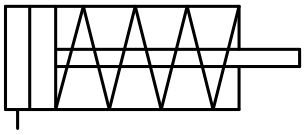


FIG 10.

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

SELF TEST 2

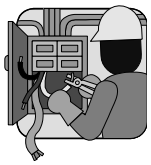
1. What is the function of a cylinder in a hydraulic circuit?

2. What causes the single-acting cylinder to retract?

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 :



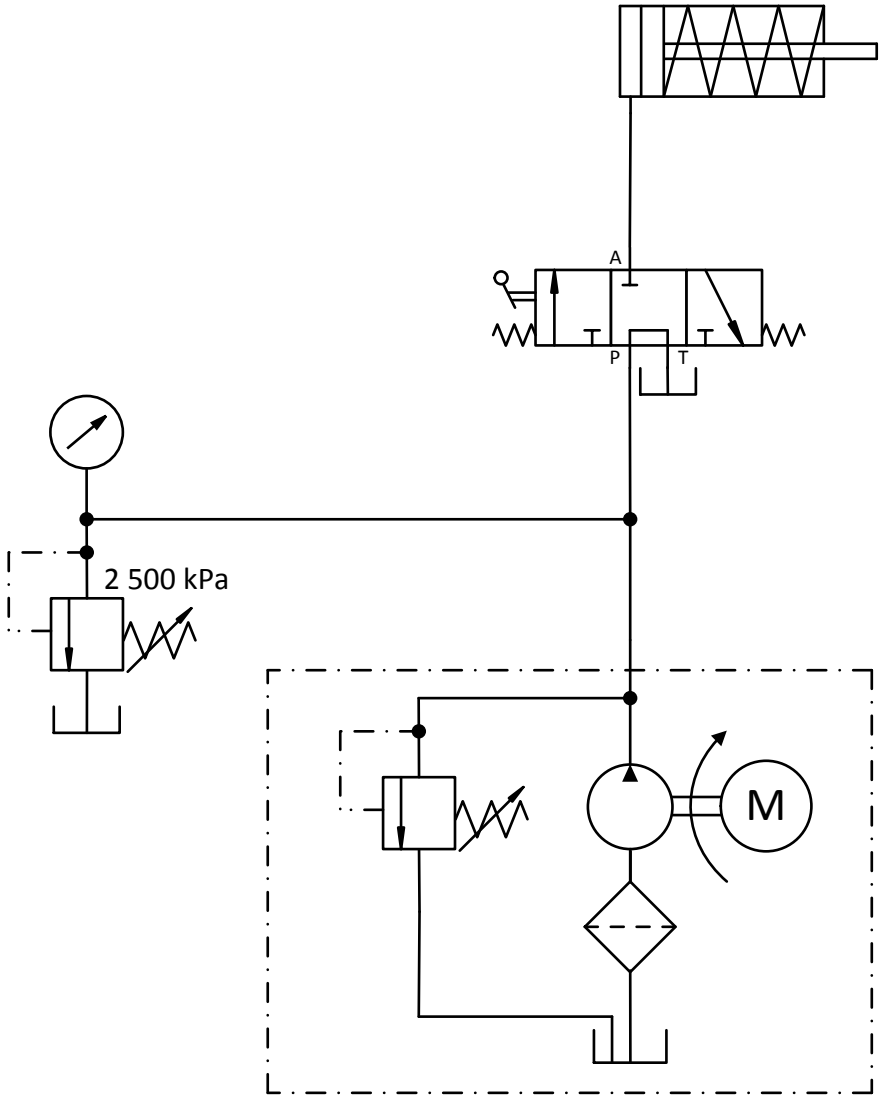
PRACTICE

1. Practice drawing the symbol for a single acting cylinder returned by an external force.

2. Practice drawing the symbol for a single acting cylinder returned by a spring.

3. Identify the single acting cylinder from the training equipment.
4. Construct the circuit as shown in the diagram on the next page on the training panel and adjust the relief valve to open at 2500 kPa.

NOTE:
A 4/3 way directional control valve with a blocked port b will function the same as a 3/3 way directional control valve.



5. Use different colour highlighters and indicate (on the drawing above) the flow when:
    - the 3/3 way directional control valve is in position “a”
    - the 3/3 way directional control valve is in position “o” (Neutral)
    - the 3/3 way directional control valve is in position “b”

NB:

To load the circuit so that the relief valve can be adjusted, you must activate the control valve in position "a" or “b”.

After the cylinder reaches the fully extended position, with the control valve still in position "a", the cylinder forms a restriction to flow. It therefore performs the same function as the shut-off valve described in the previous duty.

In this condition the circuit will be loaded to develop a maximum pressure and you will be able to adjust the relief valve to protect the circuit.

Ask your Training Officer to check your work and if it is correct, to sign below and then go on to the next section.

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.