

DIESEL MECHANIC



MINING QUALIFICATIONS AUTHORITY

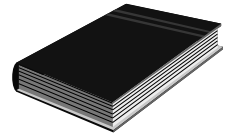
CODE: HYD - 5

CONSTRUCT A CIRCUIT WITH A DOUBLE ACTING CYLINDER

INDEX

The following elements are contained in this learning guide:

TOPIC	PAGE NUMBER
Index	2
Source reference	3
Objective	4
Hazard Identification and Control (HIAC) form	5
Double acting cylinders	6 – 7
Self Test 1	8
Practice	9
4/3 way directional control valve (Tandem centre / re-circulating)	10 – 12
Practice	13 – 14
4/3 way directional control valve (Mid position closed / closed centre)	15 – 17
Self Test 2	18
Practice	19 - 21



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 double acting cylinder”.

Whilst learning towards the outcome you will be required to achieve the following:

- Construct a tandem centre circuit with the relevant valves.
- Construct a closed centre circuit with the relevant valves.
- Know the difference between a single acting cylinder and a double acting cylinder.
- Know the purpose of a double acting cylinder.
- Know the purpose of a 4/3 way directional control valve.

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

- Indicate flow when both control valves are in neutral.
- State the purpose of a double acting cylinder.
- State the purpose of a 4/3 way 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 - 5****CONSTRUCT A CIRCUIT WITH A
DOUBLE ACTING CYLINDER**

STEPS IN OPERATION / PROCESS	POTENTIAL ACCIDENT / INCIDENT	CONTROLS (BY RESPONSIBLE PERSON)
1. Construct a hydraulic circuit.	<ul style="list-style-type: none"> Improper or careless handling of hydraulic components and pipes can lead to damage of equipment. 	<ul style="list-style-type: none"> Always handle components and pipes correctly, and with great care.
2. Use of hydraulic oil in a pressurised circuit.	<ul style="list-style-type: none"> Circuit under pressure. 	<ul style="list-style-type: none"> Wipe components and panel clean after use and store components. Ensure circuit is depressurised before removing components or pipes
3. Insure work area is safe	<ul style="list-style-type: none"> Oil in eyes and laceration of skin. Slip and fall. 	<ul style="list-style-type: none"> 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. DOUBLE ACTING CYLINDERS

ITEM / TASK: Double acting cylinder construction and operation.

DESCRIPTION:

A. In the case of double-acting cylinders, both piston surfaces can be pressurized. Therefore, it is possible to perform work in both directions.

These double acting cylinders operate according to the following principle:

- The hydraulic fluid flows into the piston area and pressurises the piston surface. Internal and external resistances cause the pressure to rise. Consequently, the resistances can be overcome and the piston rod extends. This is possible owing to the conversion of hydraulic energy into mechanical energy which is made available to a consuming device.

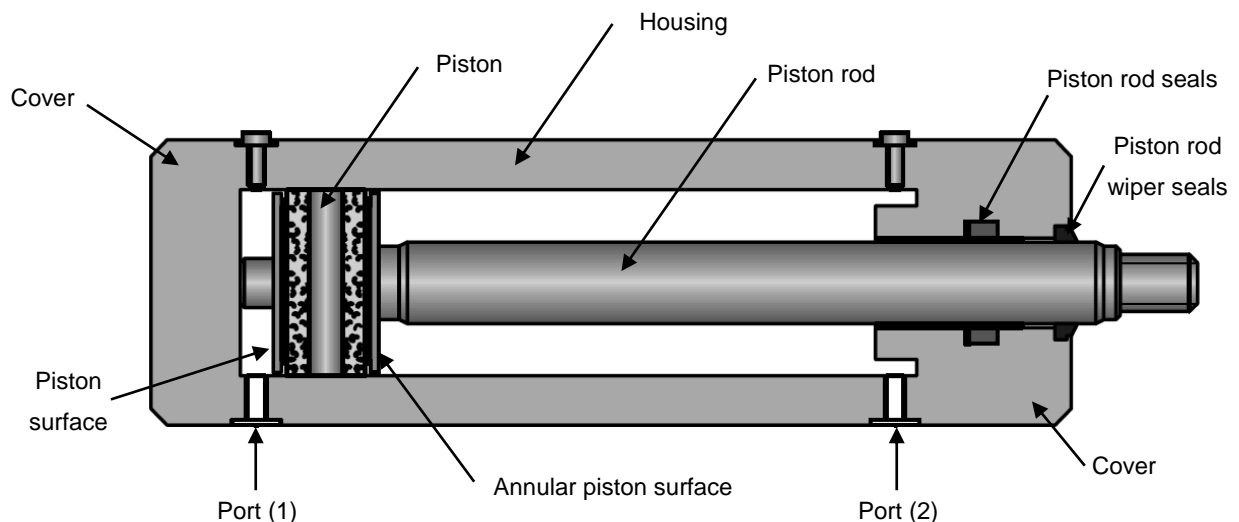


FIG 1.

- Keep in mind that when the piston extends the oil on the piston rod side must be displaced via port (2) to the reservoir. During the return stroke, the hydraulic fluid flows into the (annular) piston rod area. The piston retracts and the oil quantity is displaced from the piston area by the piston through port (1) to the reservoir.

B. The movements generated by hydraulic cylinders are used for:

- ✓ Machine tools
 - Feed movements for tools and workpieces
 - Clamping devices
 - Cutting movements on planing machines, shock-testing machines and broaching machines
 - Movements on presses, etc.
- ✓ Handling devices and hoists
 - Tilting, lifting and swivel movements on tippers, fork-lift trucks, etc.
- ✓ Mobile equipment
 - Excavators
 - Power loaders
 - Tractors
 - Fork-lift trucks
 - Tipper vehicles
- ✓ Aircraft
 - Lifting, tilting and turning movements on landing gear, wing flaps, etc.
- ✓ Ships
 - Rudder movements, adjustment of propellers.

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

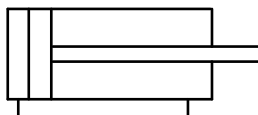


FIG 2.

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



SELF TEST 1

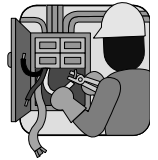
1. What are the differences between a single acting and double acting cylinder?

2. State 4 functions of a double acting cylinder used as machine tools?

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 a double acting cylinder from the training panel.

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 :

2. 4/3 WAY DIRECTIONAL CONTROL VALVE (TANDEM CENTRE / RE-CIRCULATING)

ITEM / TASK: Construction and operation.

DESCRIPTION:

A. In a tandem-centre system, the oil from the pump is allowed to flow through the centre of the valve (from port p to port t) and back into the reservoir when the valve is in a neutral position. (Fig 3).

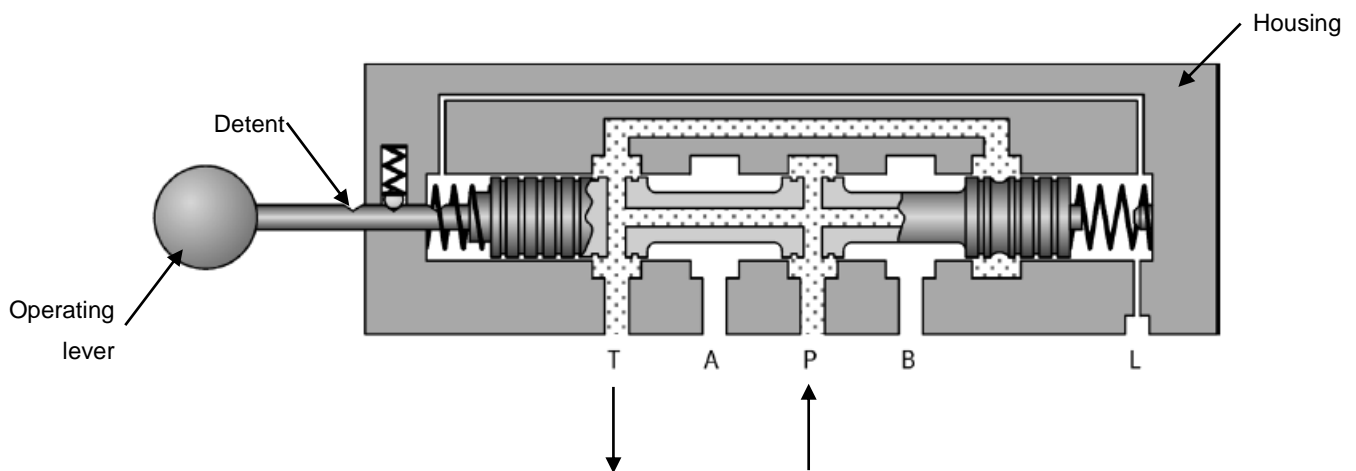


FIG 3.

B. When the spool is moved into position “a” of the valve, the oil is directed from port p to port a of the directional control valve (into the cylinder), causing the cylinder rod to extend. As the rod extends the oil in the annular side of the cylinder returns through the control valve to the reservoir. This is shown in Fig 4 and Fig 5 on the next page.

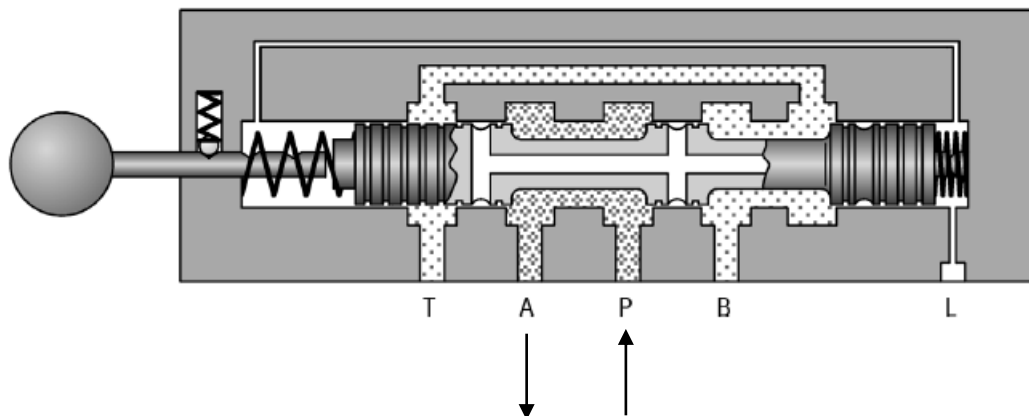


FIG 4.

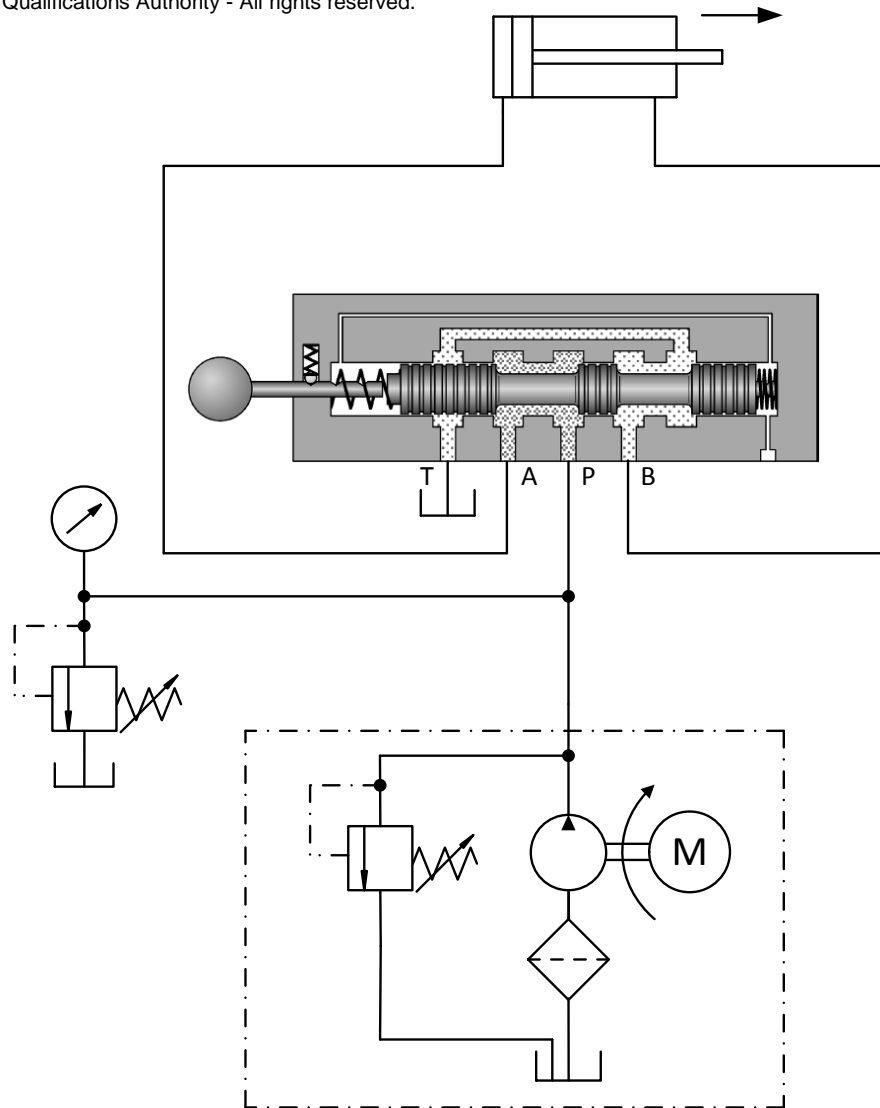


FIG 5.

- C. When the spool is moved into position b, the oil from the pump is directed from port p to port b causing the rod to retract. As the rod retract, the oil in the piston side of the cylinder returns through the control valve to the reservoir. See Fig 6 and Fig 7 on the next page.

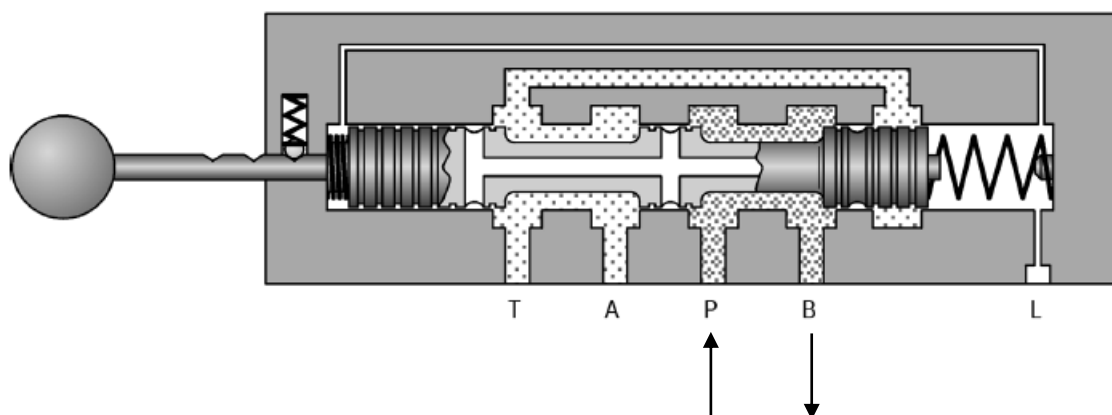


FIG 6.

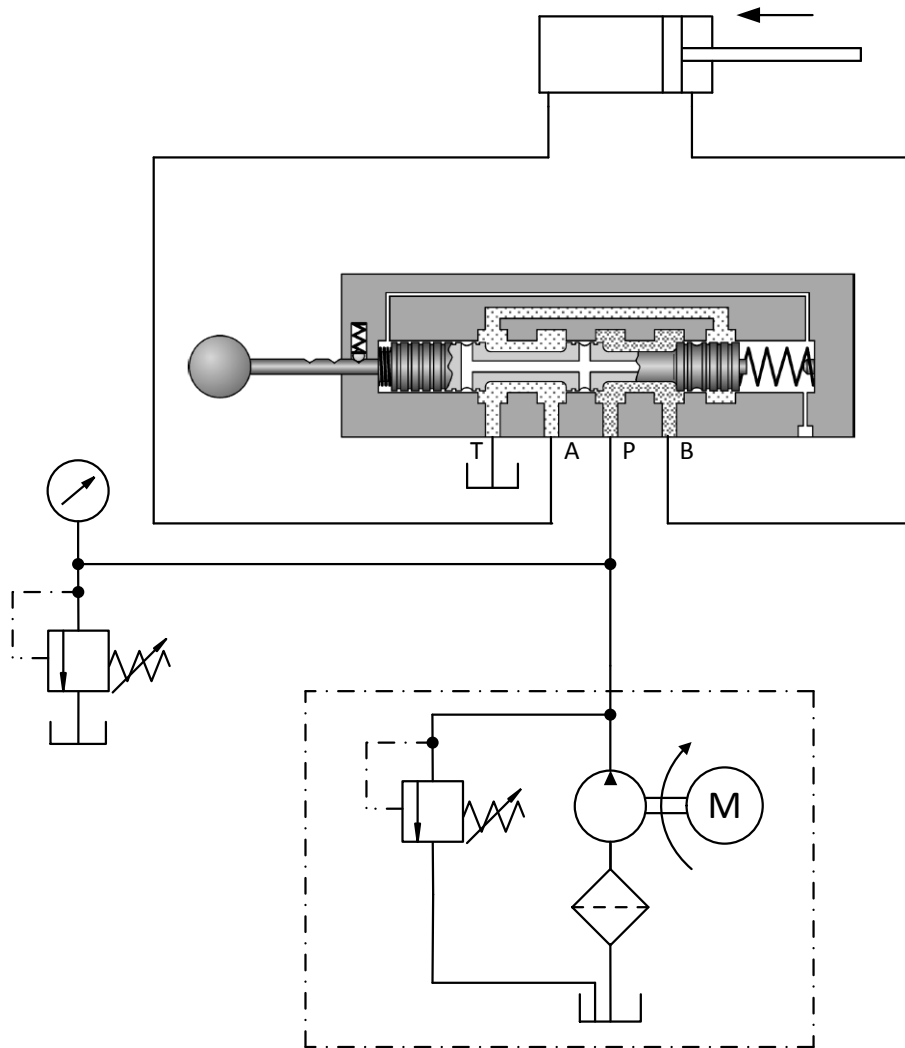


FIG 7.

- D. One of the main applications of 4/3-way directional control valves involves the triggering of double acting cylinders or motors (stop, clockwise rotation, anticlockwise rotation).
- E. The symbol for a 4/3 way directional control valve (tandem centre / re-circulating) is shown in Fig 8.

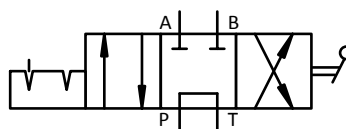
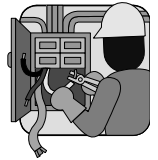


FIG8.

**DO THE PRACTICE ON THE NEXT PAGE
BEFORE CONTINUING WITH THE REST OF THE MODULE.**



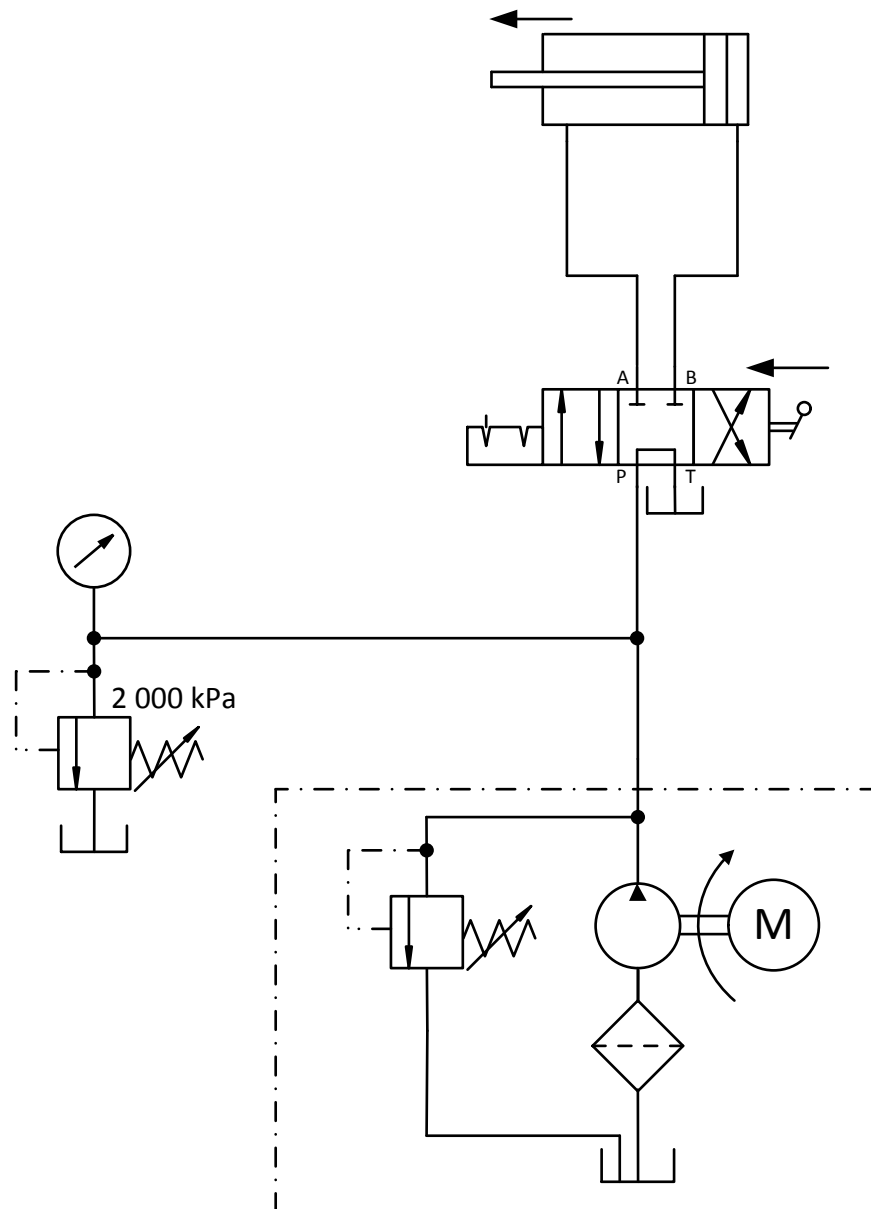
PRACTICE

1. Practice drawing the symbol for a 4/3 way directional control valve, tandem centre / re-circulating.
2. Identify a 4/3 way directional control valve, tandem centre / re-circulating from the training equipment.
3. Construct the circuit as shown in the diagram below on the training panel and adjust the relief valve to open at 2000 kPa.
4. Use different colour highlighters and indicate (on the drawing) the flow when:
 - the 4/3 way directional control valve is in position “a”
 - the 4/3 way directional control valve is in position “o” (Neutral)
 - the 4/3 way directional control valve is in position “b”



NB:

When the cylinder is shown in a horizontal position in a schematic diagram, it must always be shown to move in the same direction as the control valve is activated, i.e. from right to left.



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. 4/3 WAY DIRECTIONAL CONTROL VALVE (MID POSITION CLOSED / CLOSED CENTRE)

ITEM / TASK: Construction and operation.

DESCRIPTION:

A. In a closed-centre circuit, the oil from the pump is blocked at the entrance of the valve when it is in a neutral position. (Fig 9)

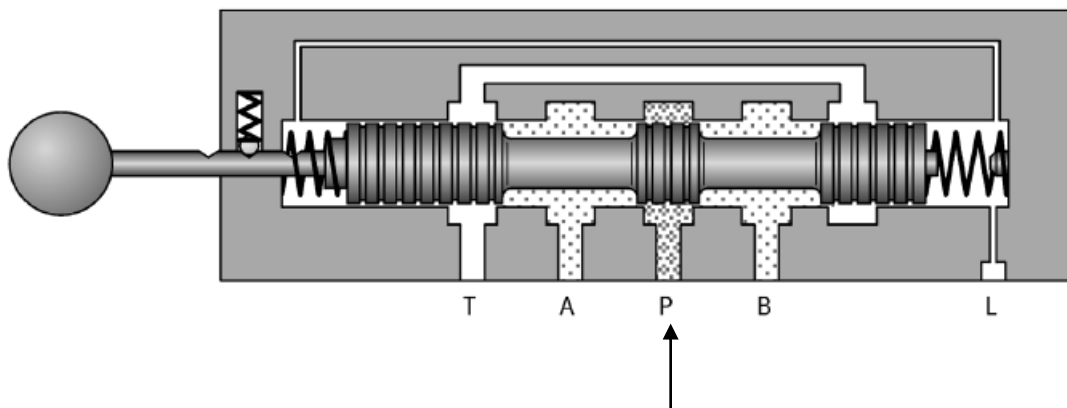


FIG 9.

B. If the spool is moved into position “a”, the oil is directed to extend the piston rod of the cylinder. (Fig 10 and Fig 11 on the next page)

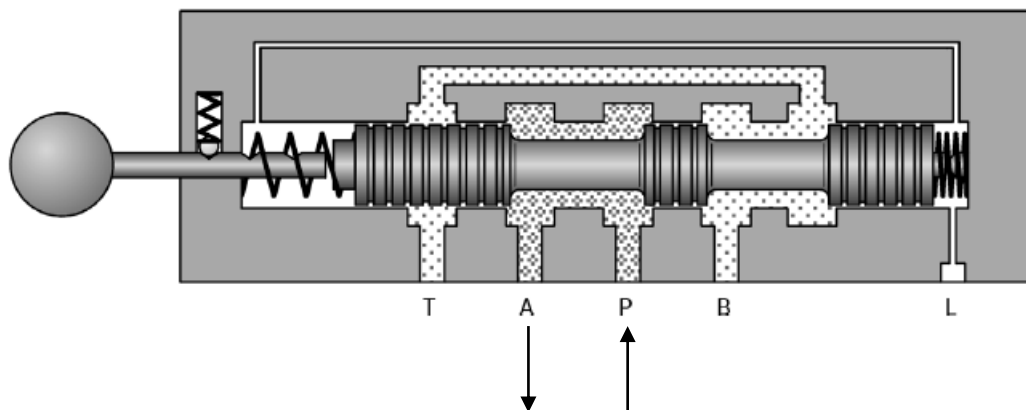


FIG 10.

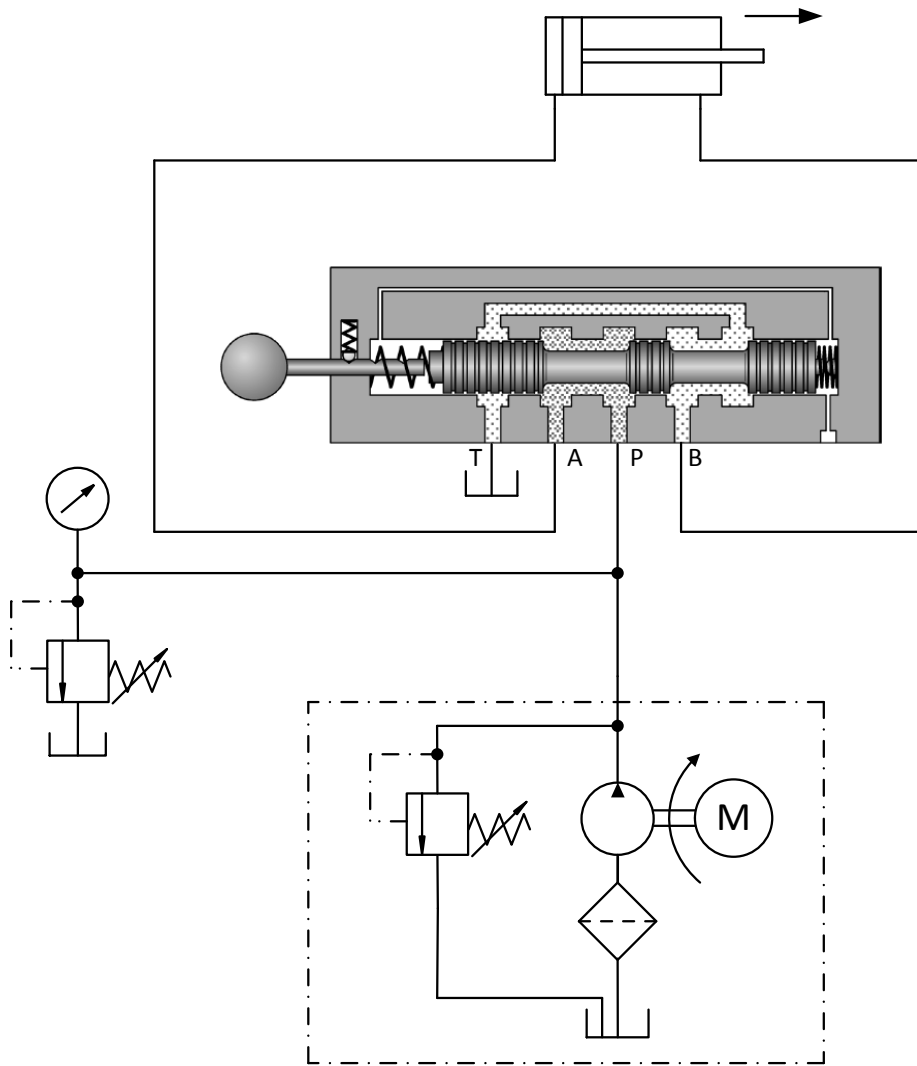


FIG 11.

C. If the spool is moved into position “b”, the oil is directed to retract the piston rod of the cylinder. (Fig 12 and Fig 13 on the next page).

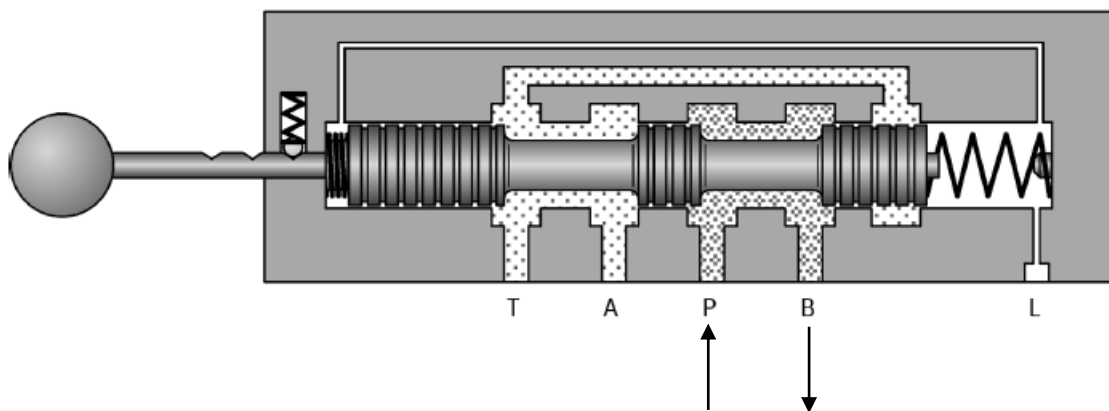


FIG 12.

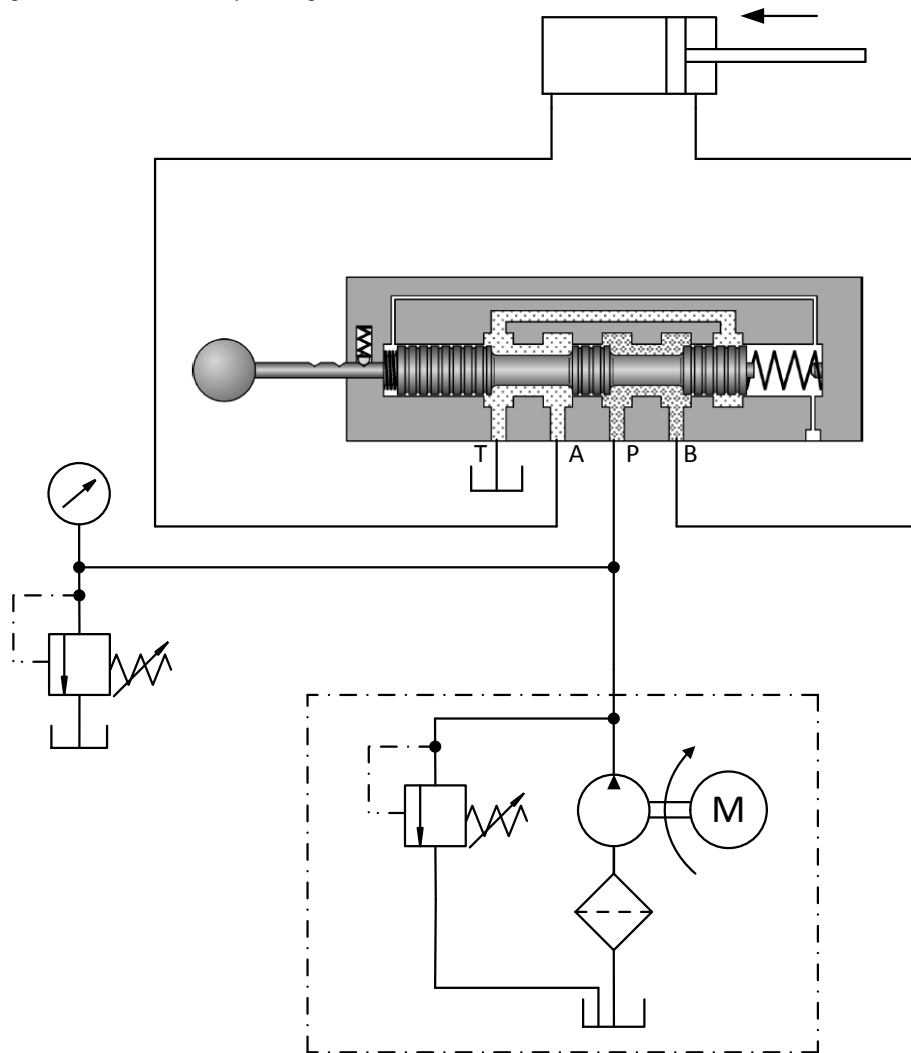


FIG 13.

D. The symbol for a 4/3 way directional control valve, mid position closed / closed centre is shown in Fig 14.

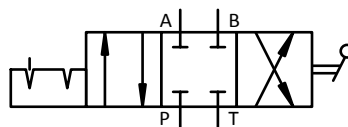


FIG 14.

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



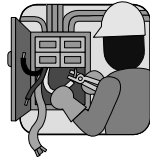
SELF TEST 2

1. What is the function of a 4/3 way directional control valve tandem centre (re-circulating) or mid position closed (closed centre) 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 :



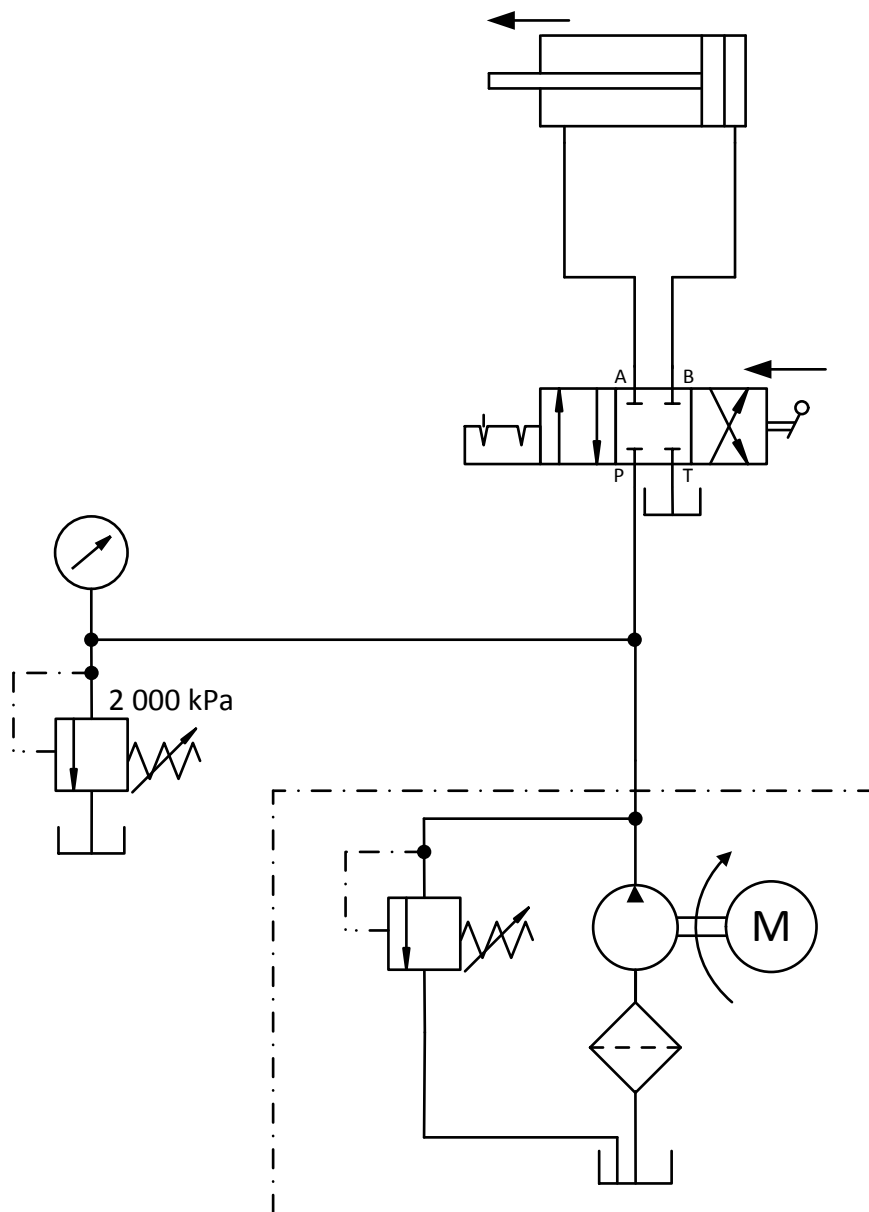
PRACTICE

1. Practice drawing the symbol for a 4/3 way directional control valve, mid position closed / closed centre.
2. Identify a 4/3 way directional control valve, mid position closed / closed centre from the training equipment.
3. Construct the circuit as shown in the diagram (below) on the training panel and adjust the relief valve to open at 2000 kPa.
4. Use different colour highlighters and indicate (on the drawing) the flow when:
 - the 4/3 way directional control valve is in position “a”
 - the 4/3 way directional control valve is in position “o” (Neutral)
 - the 4/3 way directional control valve is in position “b”



NB:

When the cylinder is shown in a horizontal position in a schematic diagram, it must always be shown to move in the same direction as the control valve is activated, i.e. from right to left.



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.