

DIESEL MECHANIC



MINING QUALIFICATIONS AUTHORITY

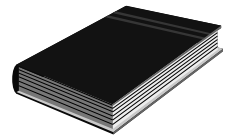
CODE: HYD - 3

FIT AND SET A PRESSURE RELIEF VALVE

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SOURCE REFERENCES

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

FESTO – Basic Level Textbook

OBJECTIVE

You will be learning towards the outcome “Fit and set a pressure relief valve”. Whilst learning towards the outcome you will be required to achieve the following:

- Know the purpose of a pressure relief valve.
- Indicate the direction of flow when operating different valves.
- Know the position where a pressure relief valve be fitted in a circuit.

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

- Indicate flow when operating different valves.
- State the purpose of a pressure relief valve.
- State where a pressure relief valve must be fitted in a circuit.

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 - 3****FIT AND SET A PRESSURE RELIEF VALVE**

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. INTRODUCTION

ITEM / TASK: Pressure relief valve.

DESCRIPTION:

The previous module showed that a pump can only withstand a certain pressure before it is damaged. The same rule applies to the other equipment in the circuit, e.g. the pipes, valves and cylinders. To protect the system against excessive pressure, a pressure relief valve is fitted.

Pressure relief valves have the task of controlling and regulating the pressure in a hydraulic system and in parts of the system. The pressure in a system is set and restricted by these valves. The control pressure is sensed at the input (P) of the valve.

2. PRESSURE RELIEF VALVE

ITEM / TASK: Construction and operation.

DESCRIPTION:

A. Pressure relief valves are designed in the form of poppet or slide valves. In the normal position,

- a compression spring presses a sealing element onto the input port, (Fig 1) or
- a slide is pushed over the opening to the tank connection.

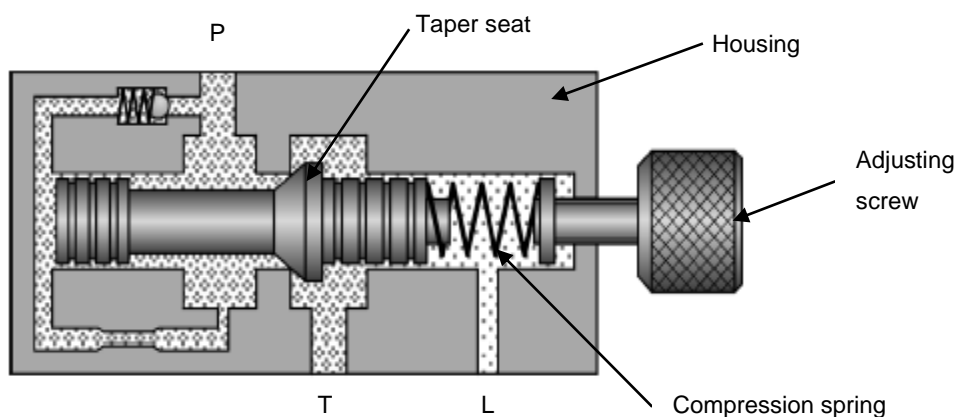


FIG 1.

B. Pressure relief valves operate according to the following principle:

- The input pressure (p) acts on the surface of the sealing element and generates a force.

- The spring force with which the sealing element is pressed onto the seat is adjusted by means of an adjusting screw and compression spring.
- If the force generated by the input pressure exceeds the spring force, the valve starts to open. This causes a partial flow of fluid to the tank. If the input pressure continues to increase, the valve opens until the complete pump delivery flow to the tank.

C. The symbol for a pressure relief valve is shown in Fig 2.

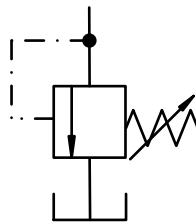


FIG 2.

D. The relief valve must always be fitted in the pressure line between the pump and the first control valve. See figure 3.

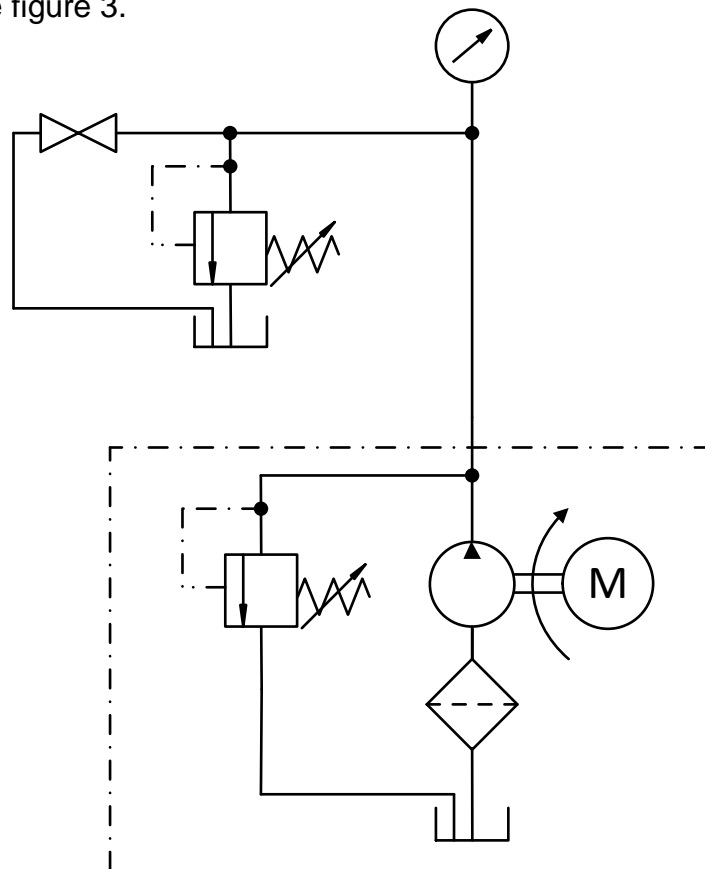


FIG 3.

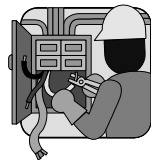
E. Pressure relief valves can be used as:

- **Safety valve**

A pressure relief valve is termed a safety valve when it is attached to the pump, for example, to protect it from overload. The valve setting is fixed at the maximum pump pressure. It only opens in case of emergency.

- **Sequence valves**

These open the connection to other consuming devices when the set pressure is exceeded. (Sequence valves will be dealt with later)



ITEM / TASK: Adjusting the pressure relief valve.

DESCRIPTION:

Refer to figure 3.

- Determine the pressure rating of the given circuit by looking up the specifications.
- Fit a pressure gauge in the pressure line.
- Fully open the shut-off valve.
- Undo the lock-nut on the relief valve and unscrew the adjusting screw to release all tension in the spring.



NB:

The above safety precaution must always be taken before the pump is started.

- Close the shut-off valve slowly while checking the pressure on the pressure gauge.



NB:

Remember under no circumstances must the pressure in the system exceed the rated pressure.

- Slowly screw in the adjusting screw on the relief valve while checking the pressure on the pressure gauge.
- When the rated pressure is reached, lock the adjusting screw with the lock-nut.
- Open the shut-off 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 pressure relief valve?

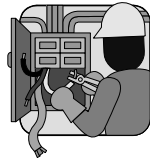
2. Where must a pressure relief valve be fitted in a circuit?

3. Why must the pressure relief valve be fitted in the position as described in question 2?

Refer to your notes to check your answers.

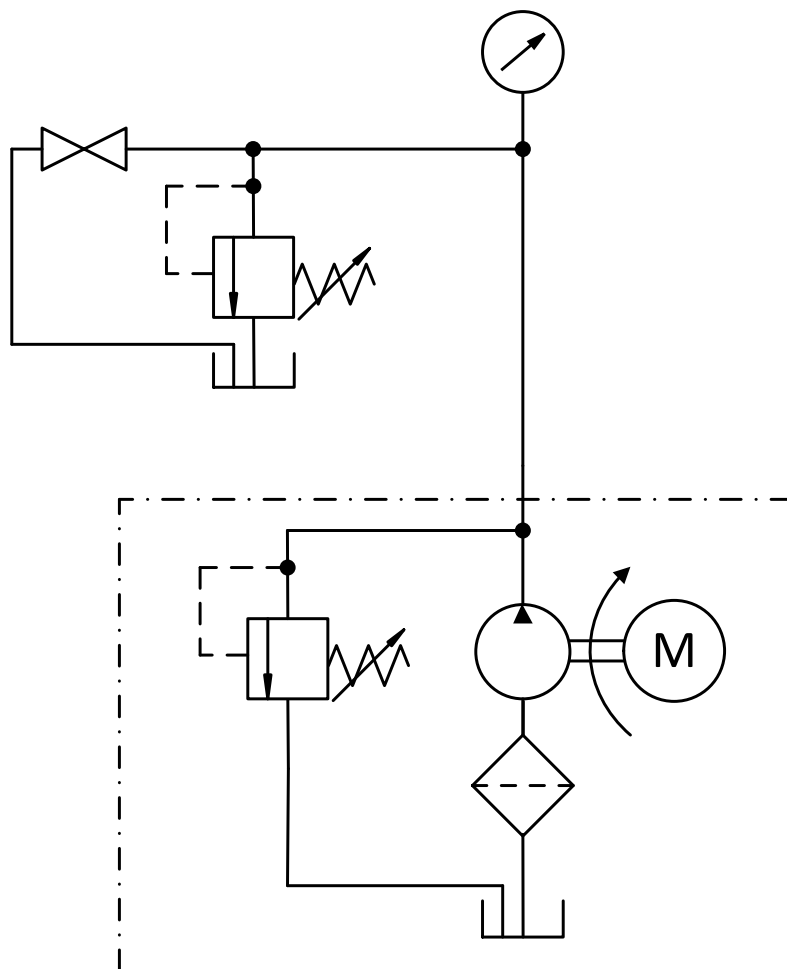
Ask your Training Officer to check your work and if it is correct, to sign below.

LEARNER	TRAINING OFFICER
DATE :	DATE :
SIGNATURE :	SIGNATURE :



PRACTICE

1. Practice drawing the symbol for a pressure relief valve.
2. Identify a pressure relief valve from the training equipment.
3. Construct the circuit as shown below onto the training panel.



4. Adjust the relief valve to open at 1 500 kPa and 2 500 kPa within ± 100 kPa respectively.
5. Use different colour highlighters and indicate (on the drawing above) the flow when:
 - The shut-off valve is open,
 - The shut-off valve is closed.

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. PILOT OPERATED PRESSURE RELIEF VALVE

ITEM / TASK: Construction and operation.

DESCRIPTION:

A. If a spring-loaded relief valve is used in a system which has a large volume flow, the taper seat will vibrate. The pressure in the system increases until the seat opens, then the pressure drops and the spool closes again. This cycle is repeated very rapidly and will eventually damage the seat. To overcome this problem a pilot operated valve is used.

i. **Unrestricted flow**

Before proceeding it is important to understand what happens when oil flows through a restriction.

Fig 4 shows the oil flowing freely through the pipe. The gauges indicate the same pressure because there is no restriction in the end of the pipe or between the gauges.

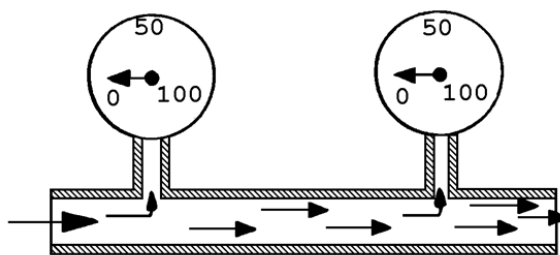


FIG 4.

ii. **Restricted flow**

When the end of the pipe is plugged there will be no flow. The gauges will indicate the same pressure because the pressure in the confined fluid is transmitted equally in all directions and acts with equal force on equal areas. Even if the restrictor is placed between the gauges, they will still read the same because the fluid is confined and is not flowing. This is shown in Fig 5 and Fig 6.

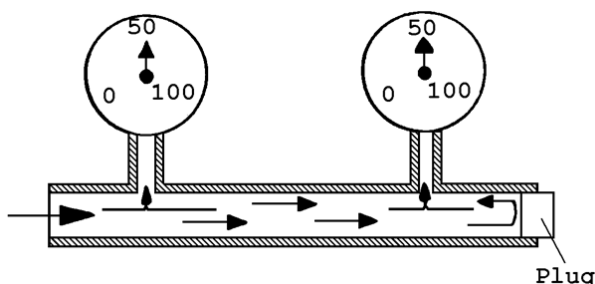


FIG 5.

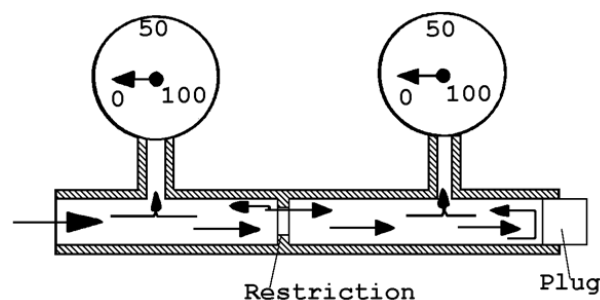


FIG 6.

When the plug is removed and the oil flows through the restriction between the gauges, they will indicate different pressures. The difference in pressure is the pressure drop caused by the restriction. Refer to Fig 7.

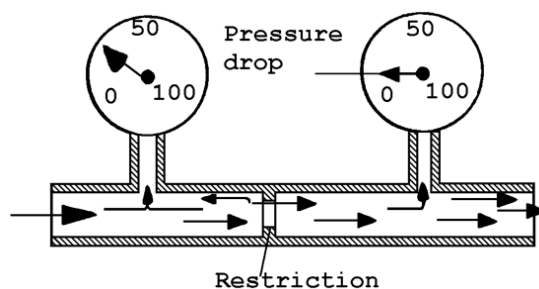


FIG 7.

- B. The pilot valve is held closed by a spring. The tension of the spring can be altered by means of the adjusting screw. Another spring holds the spool on its seat. The spool has a small hole through its centre. When the pressure in the system is below the set pressure of the valve, the oil will flow through the valve to the load. The pressure acts against the bottom of the spool and moves through its centre. See fig 8.

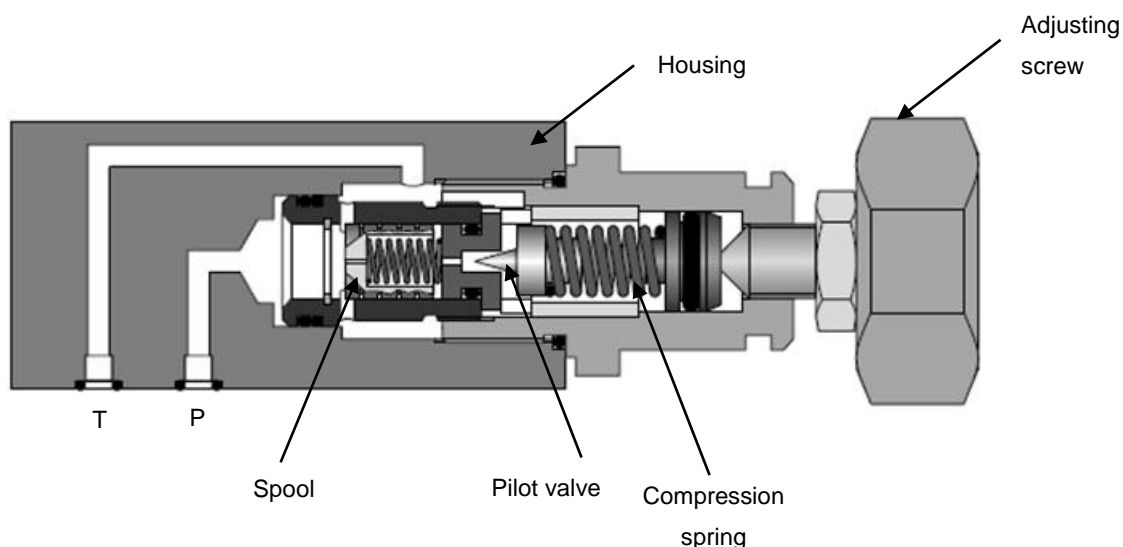


FIG 8.

It then acts against the top of the spool and against the bottom of the pilot valve. The spool will remain closed because the pressures acting on the top and on the bottom of it are equal. Only the tension of the light spring will hold the spool in a closed position. When the pressure in the system reaches the set pressure of the valve, the pilot valve will open and the oil on the top of the spool will flow to the reservoir.

When the pilot valve is open the oil will flow through the centre of the spool. The hole in the spool acts as a restriction and causes a pressure drop. The pressure at the bottom of the spool is then greater than the pressure at the top. This will cause the spool to move upwards and the excess oil is dumped into the reservoir.

C. The symbol for the pilot operated relief valve is shown in Fig 9.

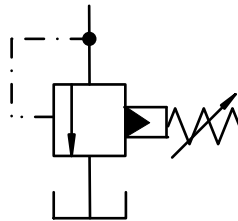
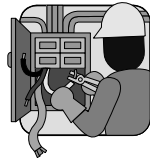


FIG 9.



PRACTICE

1. Practice drawing the symbol for a pilot operated pressure relief valve.

2. Identify a pilot operated pressure relief 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 :

4. ADJUSTING TWO PRESSURE RELIEF VALVES FOR DIFFERENT PRESSURES

ITEM / TASK: Setting different pressures.

DESCRIPTION:

It often happens that in certain applications, two pressure relief valves with different pressure settings are required in a circuit. Refer to Fig 10.

It is obvious that the pressure relief valve with the highest pressure setting must be adjusted prior to the pressure relief valve with the lowest pressure setting. Thus, of the two pressure relief valves shown in Fig 10, the 2 500 kPa pressure relief valve must be set first.

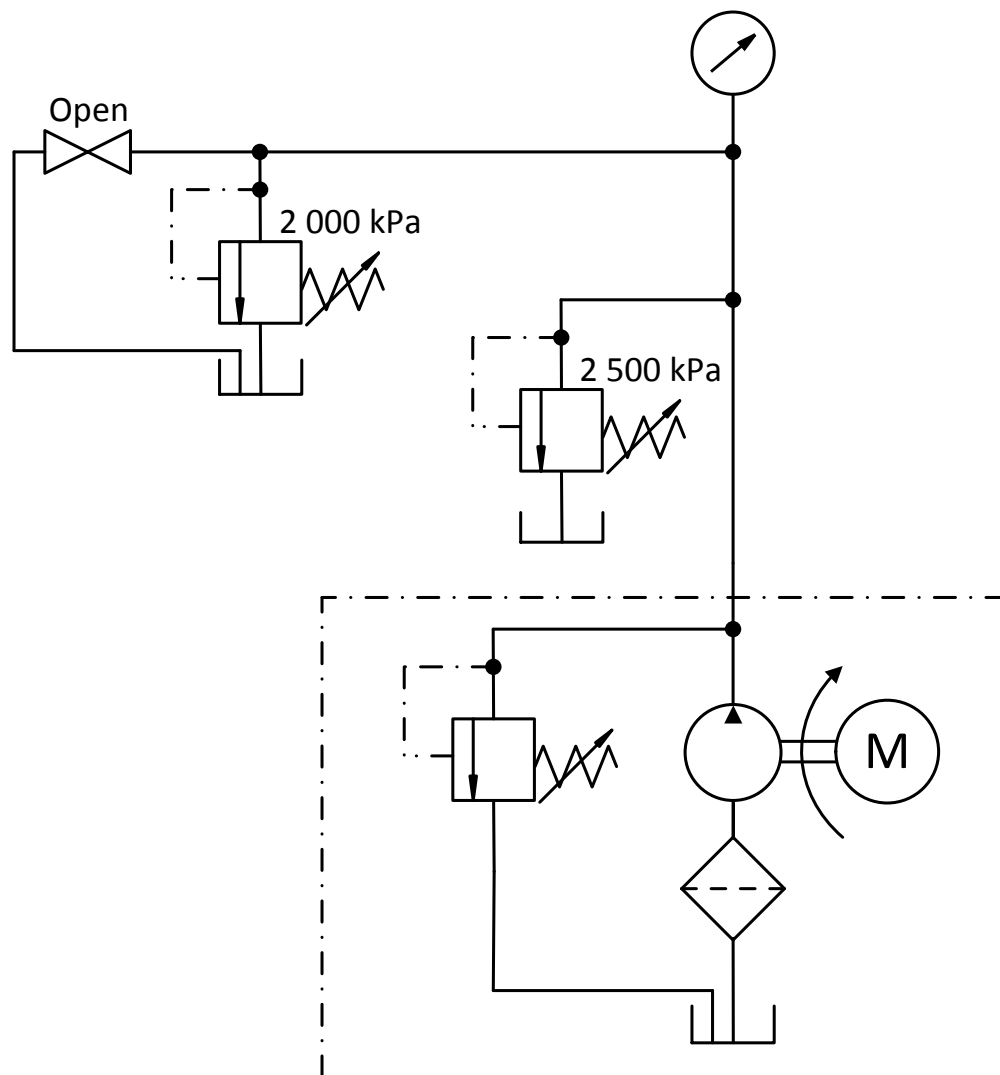
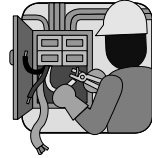


FIG 10.



ITEM / TASK: Adjusting the pressure relief valve.

DESCRIPTION:

Refer to Fig 10.

- Fit a pressure gauge in the pressure line.
- Fully open the shut-off valve.
- Undo the lock-nuts on both the pressure relief valves.
- Unscrew the adjusting screw on the 2 000 kPa pressure relief valve to prevent the oil from flowing through this valve when the circuit is loaded.



NB:

To protect the pump you must always fully unscrew the adjusting screw of the valve to be set, before you start the pump.

- Start the pump.
- Slowly close the shut-off valve, whilst checking the pressure indicated by the gauge.
- Screw in the adjusting screw on the 2 500 kPa pressure relief valve.
- When the gauge indicates the specified pressure (2 500 kPa in this case), lock the adjusting screw with the lock-nut.
- Now, slowly screw in the adjusting screw on the 2 000 kPa pressure relief valve.
- When the gauge indicates the specified pressure (2 000 kPa in this case), lock the adjusting screw with the lock-nut.
- Open the shut-off valve.

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



SELF TEST 2

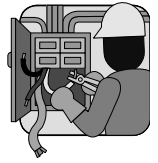
1. In what type of circuit will a pilot operated relief valve be used?

2. What will the pressure gauge reading be after setting both pressure relief valves with the shut-off valve closed?

Refer to your notes to check your answers.

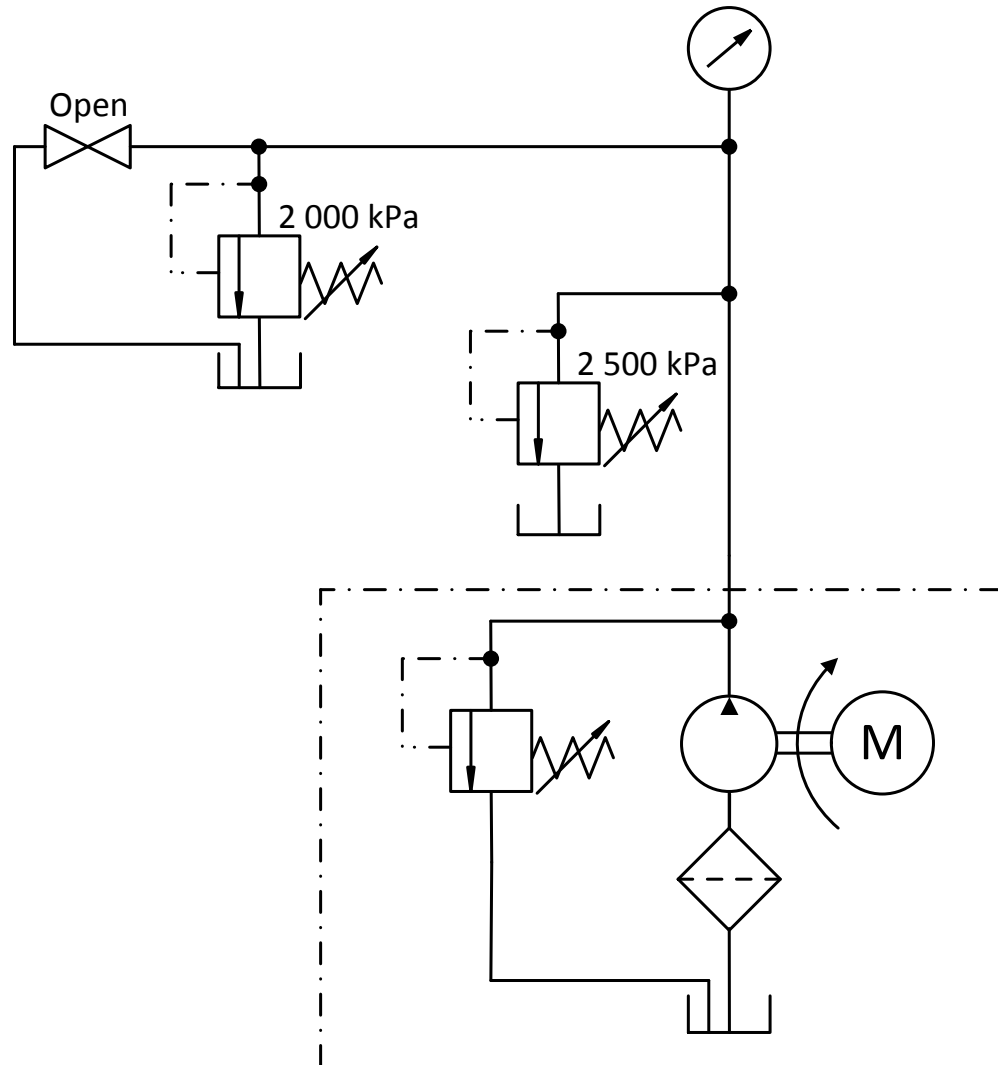
Ask your Training Officer to check your work and if it is correct, to sign below.

LEARNER	TRAINING OFFICER
DATE :	DATE :
SIGNATURE :	SIGNATURE :



PRACTICE

1. Construct the circuit as shown below on the training panel.



2. Adjust the relief valves to open at 2 000 kPa and 2 500 kPa ± 100 kPa respectively.
3. Use different colour highlighters and indicate (on the drawing above) the flow when:
 - The shut-off valve is open,
 - The shut-off valve is closed.

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.