FLUID POWER

FLUID POWER EQUIPMENT

TUTORIAL – ACCUMULATORS

This work covers part of outcome 2 of the Edexcel standard module:

UNIT 21746P APPLIED PNEUMATICS AND HYDRAULICS

The material needed for outcome 2 is very extensive so the tutorial is presented as a series.

OUTCOME 2 Investigate the construction and operation of pneumatic and hydraulic components, equipment and plant.	• Identify and describe the features of pneumatic and hydraulic equipment. • Analyse the performance characteristics of pneumatic and hydraulic equipment.

The series of tutorials provides an extensive overview of fluid power for students at all levels seeking a good knowledge of fluid power equipment.

On completion of this tutorial you should be able to do the following.

- Explain the principles and symbols of accumulators.
- Explain reasons for using accumulators.
- Explain the purpose of back up gas bottles.
- Explain the safety aspects involved with accumulators.
- Describe the construction of different types of accumulators.

ACCUMULATORS

1. INTRODUCTION

A hydraulic accumulator is a pressure vessel used for storing fluid. Accumulators are incorporated into a hydraulic system for one or more of the following reasons:

a) to meet peak demands of power

b) to smooth out pressure surges

c) to provide emergency power sources.

a) To meet peak demands of power

In some systems a pump may be required to deliver a supply of fluid to affect a certain cycle. However during this cycle the maximum demand might be required for 20% of the time so if a pump is a fixed-displacement type the relief valve will be discharging most of the fluid for 80% of the time. This represents a considerable loss of power if the pump is working continuously.

A smaller pump is used, so that during the slack period some of the fluid is used to charge an accumulator. The charge is then used to meet the peak demands and substantial savings are made.

b) To smooth out pressure surges

Pressure surges are caused in a hydraulic system when fluid flow is suddenly changed.

The high inertia of the moving fluid sets up shock waves in the pipes causing 'hammer' and vibration.

Accumulators will absorb the energy and dampen out these surges thus reducing vibrations and shock.

c) To provide emergency power source

The fluid energy stored in an accumulator may be sufficient to give an emergency supply in the case of a major electrical failure causing the pumps to stop.

2. TYPES OF ACCUMULATORS

2.1 Piston Type

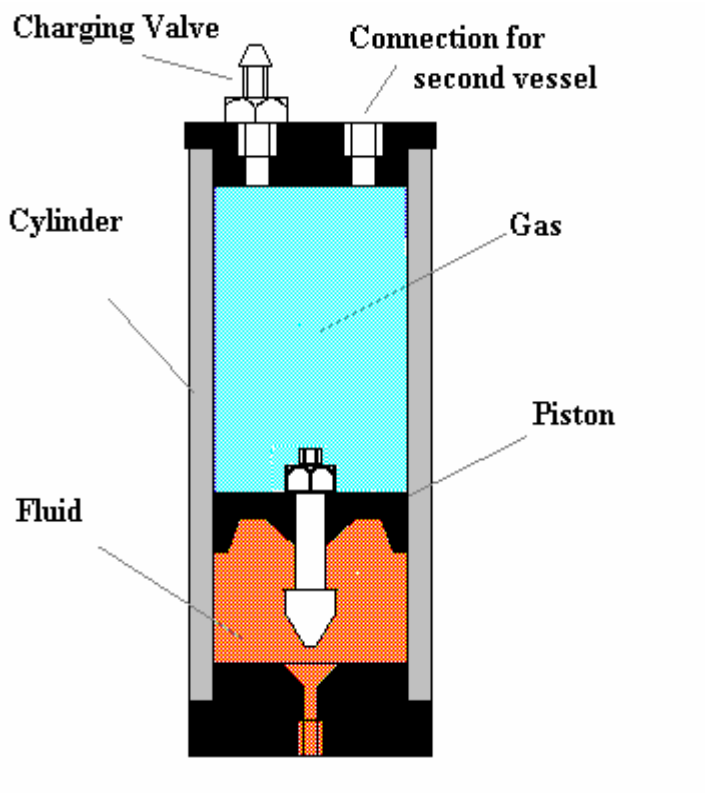


Figure 1

The body is constructed of seamless steel tubing with honed, polished and chromium plated bore. End covers are fixed directly to the ends of the body. Safety interlocks prevent dismantling of end plate until all the gas pressure is released. The piston is accurately machined and fitted with seals to prevent leakage.

The accumulator is first pre-charged with gas (Nitrogen) to a pressure of 75 - 80% of relief valve pressure setting. As soon as the hydraulic system pressure rises above the pre-charge pressure, oil enters and causes the piston to move away from the oil port. This reduces the gas volume and increases its pressure. The oil and gas are under virtually equal pressure. When the system pressure fails the oil is discharged.

Charging - Ensure that there is no oil pressure and feed in a small quantity of oil on the gas side of the piston. Disconnect the gas supply and replace screw cap on the charging valve.

The pre-charge pressure should be checked at regular periods. Generally speaking a pressure increase indicates a leakage of oil into the gas side and a decrease indicates a leakage of gas into the oil-side or to the atmosphere. An unduly large variation from correct pressure would indicate the need for a new seal.

N.B.When installing, the accumulator should be mounted vertically with the charging valve at the top.

2.2 Bag Type

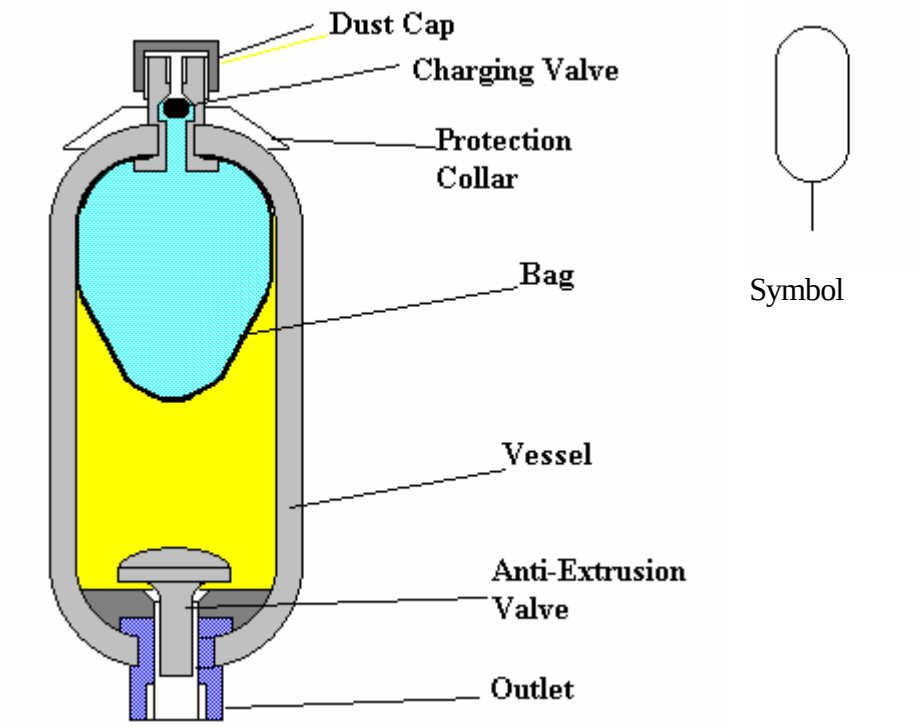


Figure 2

This type is made up of a steel sheet, a synthetic rubber bag incorporating an integrally moulded high pressure gas valve and an oil port assembly.

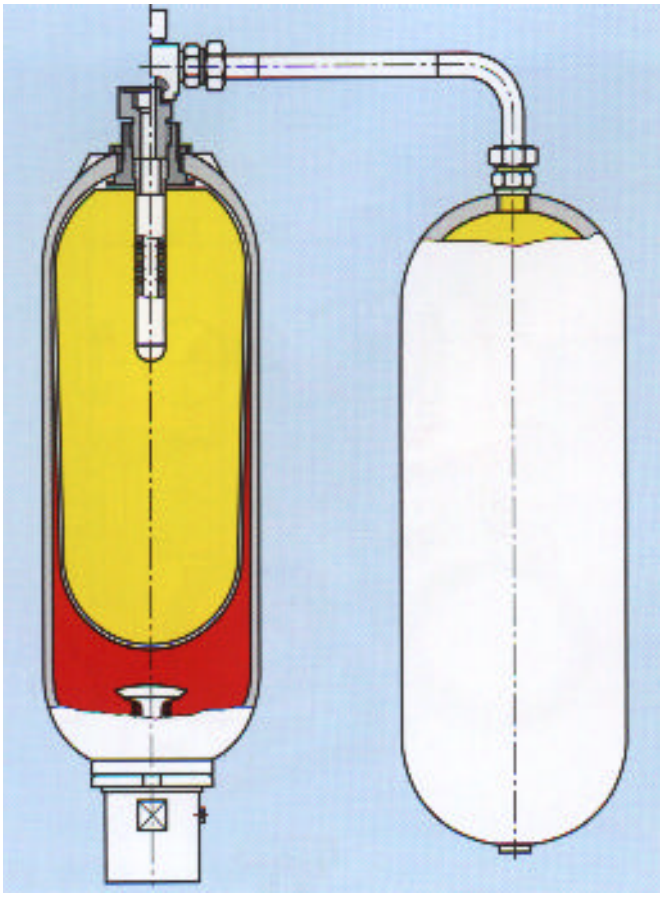
The steel shell is made from a single piece of special tubing without seams, welds and joints. The rubber bag fits inside the steel shell and keeps the gas and liquid separate.

The separator bag is pre-charged with NITROGEN to a pressure of 75 - 80% to the relief valve setting.

When the system pressure rises above the pre-charge pressure the anti-extrusion valve lifts off its seat and allows liquid to enter the shell. As the liquid fills the shell the gas in the bag is compressed so that the pressure inside the bag is the same as it is on the outside.

More liquid is discharged from the shell when the system pressure falls below the shell pressure. As long as the shell pressure and the system pressure remain equal the anti-extrusion poppet will stay open. When the expanding bag reaches the poppet it forces down onto its seat and prevents the extrusion of the bag through the fluid ports.

2.3 Back-up Bottles



Back-up bottles provide additional gas volume for an accumulator. This allows a large draw off with only a small drop in pressure.

A back-up bottle is simply a gas cylinder connected to the accumulator charging valve assembly. The accumulator functions as before but because of the greater gas volume the expansion is greater thus the liquid flows back into the system faster.

Figure 3

3. IMPORTANT SAFETY NOTE

DO NOT ATTEMPT MAINTENANCE on a system with an accumulator **until the accumulator is isolated or drained.**

DO NOT OPERATE any valve or solenoid **until the machinery is clear** of personnel.

The energy stored in the accumulator will activate the actuators.

PARK THE MACHINE in the position for maintenance (if possible) **before releasing accumulator pressure.**

ISOLATE THE ACCUMULATOR from the system before working on it.

DRAIN THE ACCUMULATOR to tank before working on it.

Circuits should contain an isolating valve and drain valve so that the accumulator can be disconnected from the system and the oil let out to tank in a controlled manner.

4. CONNECTION TO THE SYSTEM

The picture shows a safety and isolating block (1), cartridge pressure relief valve (2), main shut off valve (3), manually operated safety valve (4) and in addition to the system port (5) it also has pressure gauge ports.

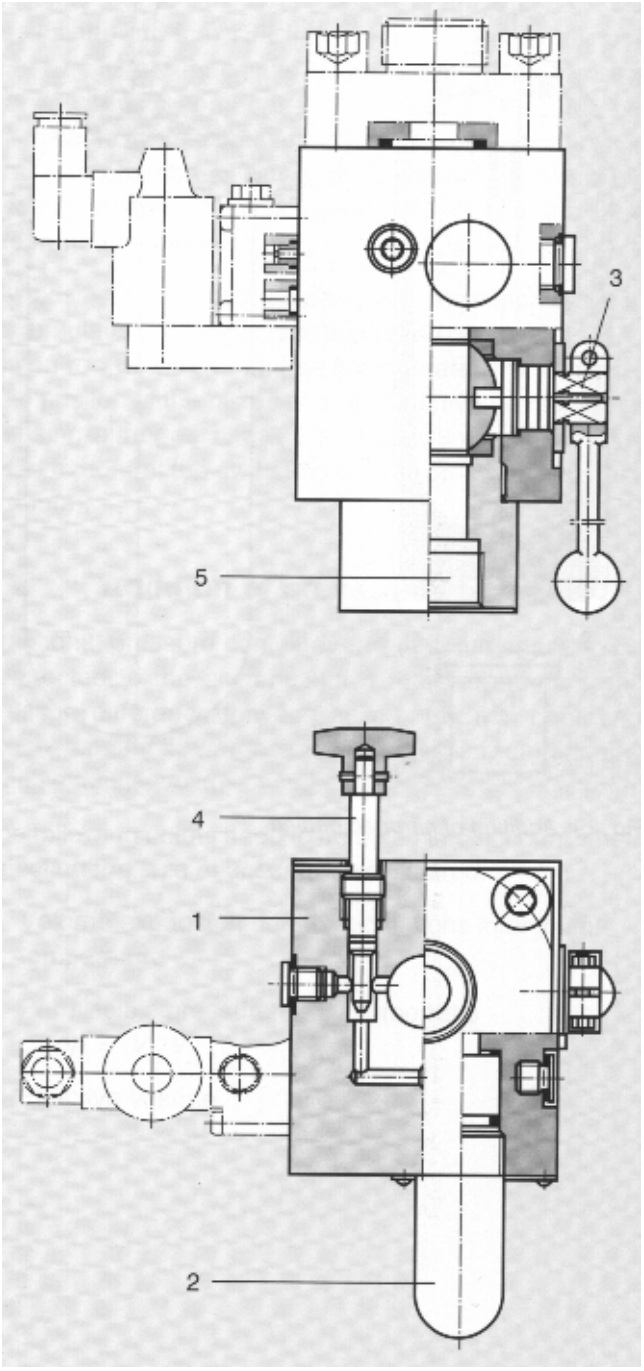
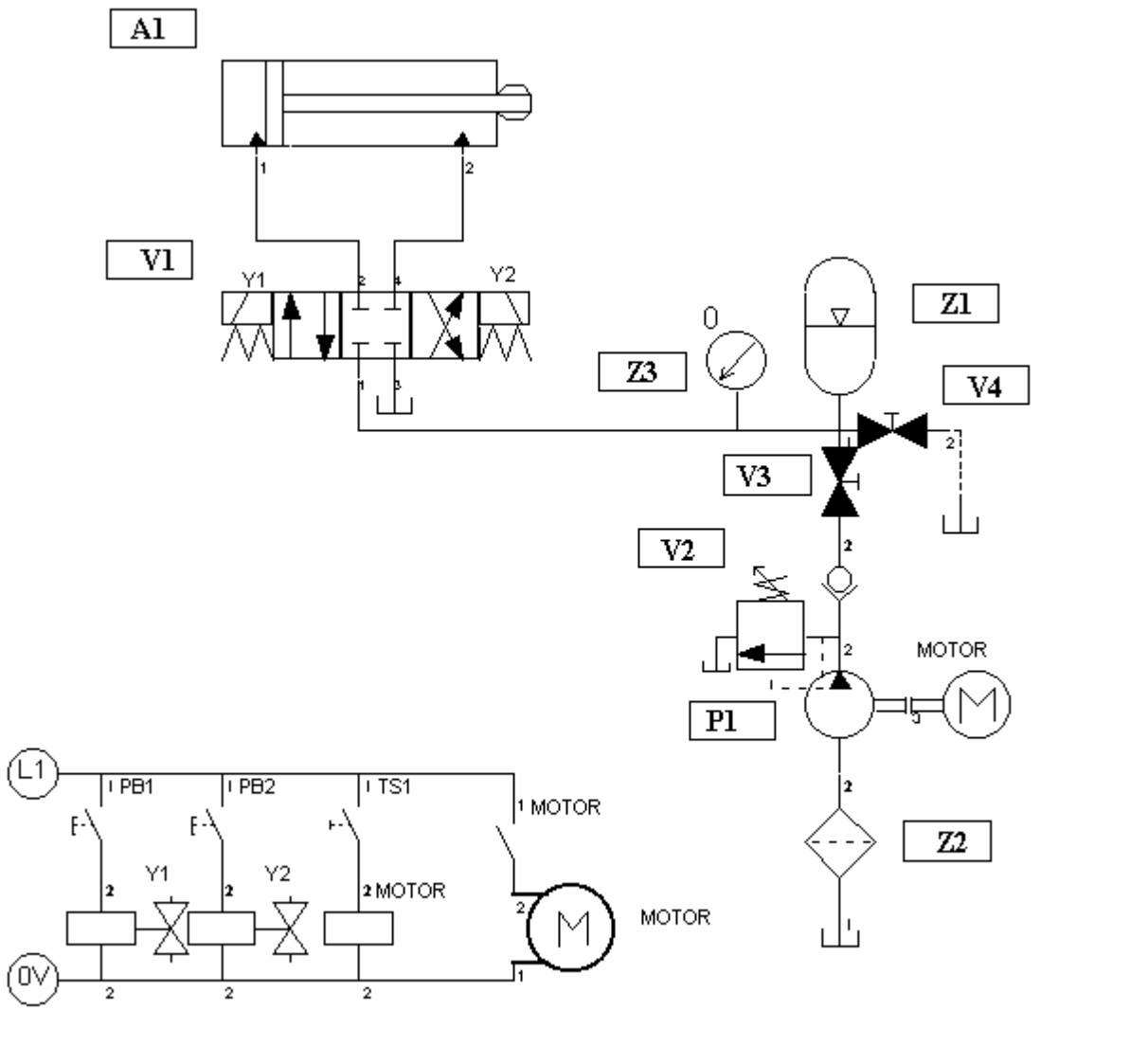


Figure 4

SELF ASSESSMENT EXERCISE

Study the circuit diagram of a hydraulic system below along with the electric wiring diagram. If you have access to the software Pneusim Pro™ you might construct it and test it on your computer.



The relief valve V2 is set to 100 bar. Switch TS1 starts the pump motor. The system pressure is monitored with the pressure gauge Z3. The actuator is controlled by solenoids and switches PB1 and PB2 are used to switch the solenoids Y1 and Y2 on or off.

1. To what pressure should the accumulator be initially charged? _____

2. If the hand valve V4 is opened, what happens to the pressure? _____

3. If PB1 is pressed, what happens to the actuator A1?

_____

4. State the gas that is normally used in accumulators? _____

5. Identify and explain the purpose of component V3 and V4._____

_____

6. Why is it important that V1 has a closed centre? _____

_____

7. State two reasons for using an accumulator in a system.

_____

_____

ANSWERS

1. 75 BAR (75% of the relief setting)
2. System pressure is lost as the system is vented to tank.
3. If PB1 is pressed, solenoid Y1 is energised and the DCV moves sending oil to the actuator to make it extend.
4. Nitrogen.
5. V3 isolates the system from the pump and V4 allows the system to be drained.
6. If the DCV V1 had an open centre, the accumulator would drain away to tank when the DCV is in the middle position.
7. Accumulators are used to smooth out pressure shocks, to provide an emergency source of fluid if the pump fails and to optimise the size of the pump in cyclic operations.