

Unit 24: Applications of Pneumatics and Hydraulics

Unit code: J/601/1496 QCF level: 4 Credit value: 15

OUTCOME 1 SYMBOLS AND STANDARDS

1 Be able to read and interpret pneumatic and hydraulic fluid power diagrams

Pneumatic and hydraulic symbols: read and interpret e.g. energy conversion, valve, energy transmission, control and miscellaneous symbols; use of appropriate British and International Standards e.g. BS 2917, ISO 1219-2 (2009), ISO 9461 (Hydraulics), CETOP, RP68P, ISO 5599 (Pneumatics)

Fluid power diagrams: read and interpret system-layout and circuit diagrams e.g. use of ISO 1219-2 Part 2, component lists, component data sheets, displacement-step diagrams, operating instructions, installation and maintenance manuals; applications e.g. logic, memory and multi-actuator sequential circuit operation, cascading techniques, linear and rotary actuation circuits

Outcome one is somewhat general and difficult to cover without studying the other outcomes at the same time. The model assignments should be attempted only when a fuller understanding of fluid power has been achieved by studying the rest of the tutorials. This tutorial is quite short in content but provides an introduction to more complex circuits in the other outcomes.

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

- Explain the general purpose of fluid power.
- Explain the importance of standards.
- Find and use the appropriate standards.
- Explain the correct layout and identification of fluid power circuit diagrams.

1. INTRODUCTION

Fluid power is widely used throughout industry and throughout the world. Here are some examples.

- Earth moving machines such as excavators. (Hydraulics)
- Winches on cranes and boats. (Hydraulics)
- Rams for extrusion presses. (Hydraulics)
- Automated production lines. (Pneumatic and Hydraulic)
- Aeroplane controls. (Hydraulic).
- Automated assembly units. (Pneumatic and Hydraulic)
- Robots. (Pneumatic and Hydraulic)
- Machine tools (Hydraulic)

Hydraulic power is usually used for precise control of large forces (e.g. rudder control on an aeroplane).

Pneumatic power is used for rapid but light forces (e.g. rapid assembly of electrical components in a switch box).

2. STANDARDS

STANDARDS ARE IMPORTANT FOR THE FOLLOWING REASONS.

- Components must be interchangeable and must perform to known standards. This includes actuators, valves and pipe fittings.
- Symbols must be interpreted the same way by any competent person so that they can follow a circuit diagram and install them correctly.
- Drawings layouts and drawing symbols must be interpreted the same way by any competent person and this involves both circuit and layout drawings.
- There are many other standards concerning things such as health and safety, hydraulic fluids and filters.

There are various organisations devoted to producing standards in the field of fluid power. The standards organisations in this field are

- BS (British Standards).
- ISO (International Standards Organisation).
- CETOP (Comite Des Transmissions Oleohydrauliques et Pneumatiques or European Hydraulic and Pneumatics Committee).

Unfortunately you can only obtain the standards by purchasing them but you will find them published at various web sites such as:

You find a comprehensive set of free downloads for symbols at
<http://www.gobookee.org/iso-1219-symbols/>

Pneumatic Symbols download

<http://blog.utp.edu.co/ricosta/files/2011/08/SIMBOLOGIA-NEUMATICA-ISO-1219-1.pdf>

Hydraulic Symbols chart download

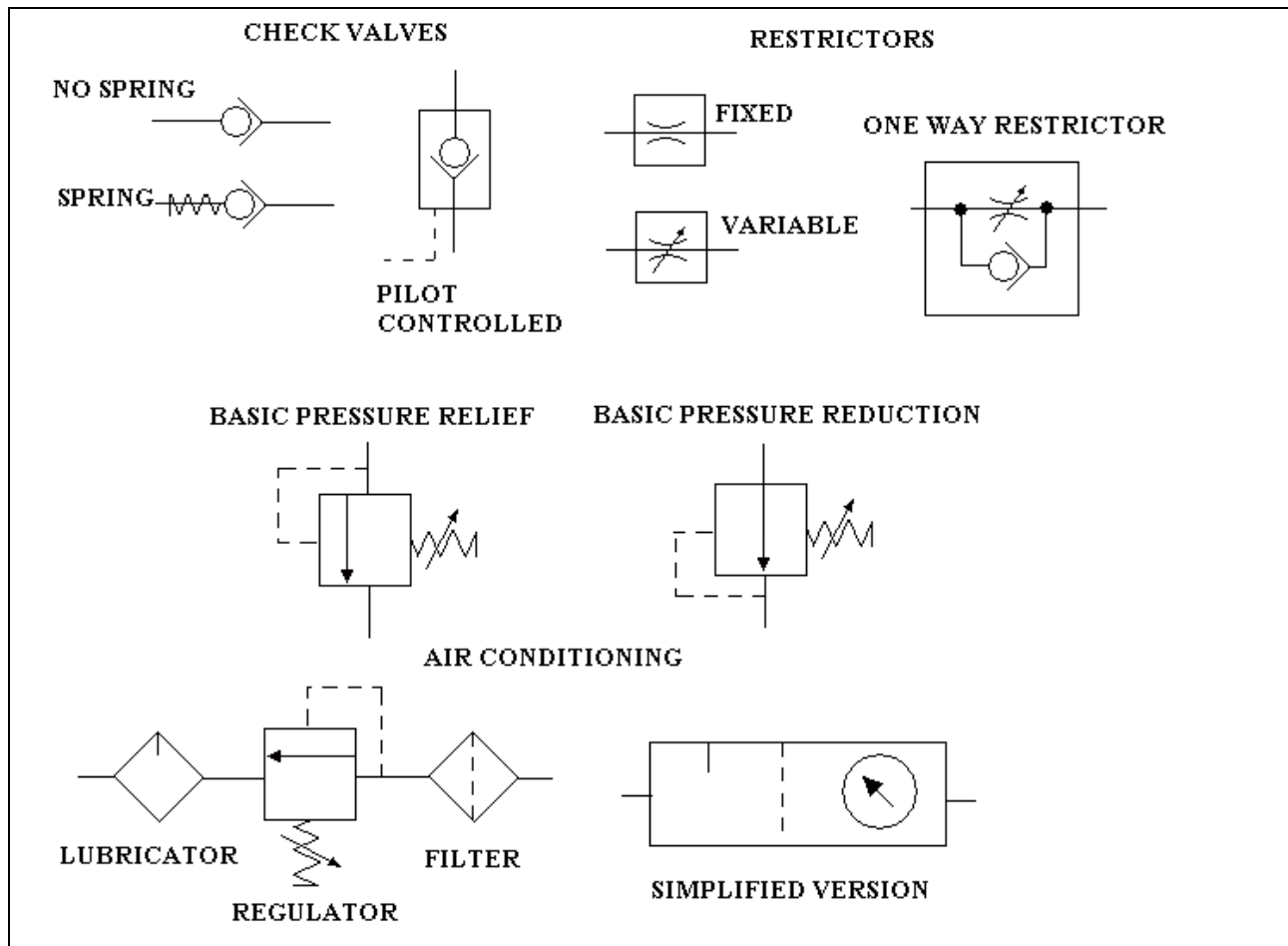
<http://www.hydraulicsonline.co.uk/pdf/Hydraulic%20Symbols.pdf>

Pneumatic Symbols chart download

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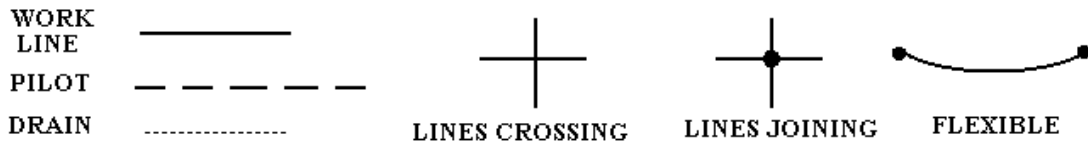
Hydraulic symbols are free at this link http://www.swtc.edu/ag_power/hydraulics/symbols/symbols.htm

You will learn more about symbols in the other outcomes where they are explained in full. Next is a set of basic symbols.

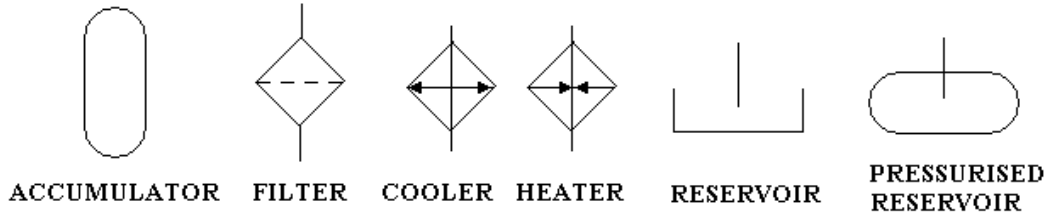


BASIC FLUID POWER SYMBOLS - NOT DRAWN TO SCALE

LINES



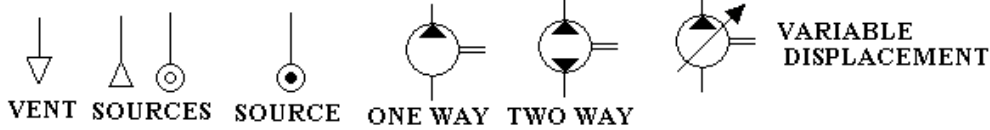
FLUID CONDITIONING/STORAGE



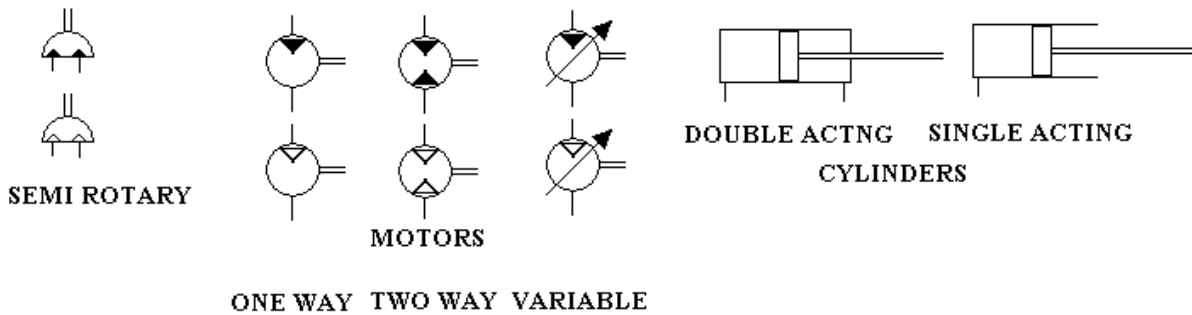
PNEUMATIC

HYDRAULIC

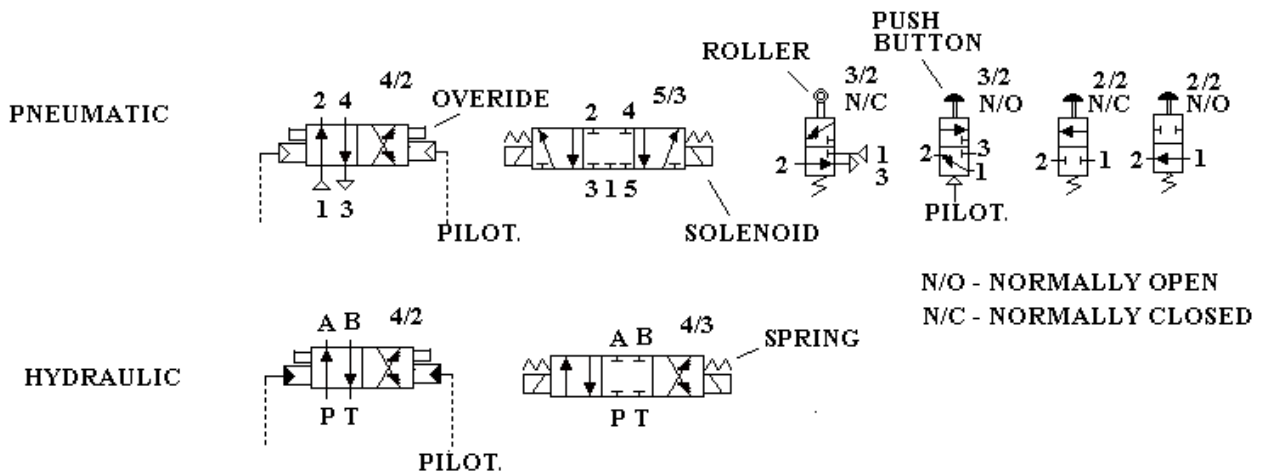
PUMPS



ACTUATORS



DIRECTIONAL CONTROL VALVES



3. DRAWING CIRCUIT DIAGRAMS

The main standards for circuit drawings are as follows.

Symbols must be created to standards BS2917/ISO 1219-1. You should use these throughout your studies.

The layout of the drawing should conform to ISO 1219 – 2

The standards for connections to the hardware are covered by ISO 9461:1992 for hydraulics.

The standards for connections to the hardware are covered by ISO 5599 for pneumatics:--

ISO 5599-1:2001 - Pneumatic fluid power - Five-port directional control valves - Mounting interface surfaces without electrical connector

ISO 5599-2:2001 - Pneumatic fluid power - Five-port directional control valves - Mounting interface surfaces with optional electrical connector

ISO 5599-3:1990 - Pneumatic fluid power; five-port directional control valves - code system for communication of valve functions

NUMBERING SYSTEM

Each component on the circuit diagram should be numbered and annotated with essential data such as pressure settings and capacity.

The number should consist of four parts. Consider the identification tag 2 – 3V5

The first number is the installation number. If there is only one, it may be omitted.

The second number is the circuit number and again if there is only one, it may be omitted. The number 0 is used for the drawing of the power pack and accessories.

The letter identifies the type of component as follows.

P	Pump
A	Actuator
M	Prime Mover
S	Sensor
V	Valve

Z or any other appropriate letter is used for any other component.

The last number is the sequence number of the component so V5 means valve number 5.

PIPES

Pipes are identified on drawings with the following letters.

P	Pressure lines
T	Tank or return lines
L	Leakage or drainage lines

Each should be numbered starting with 1 and a different number used for pipes at different operating pressures.

The hydraulic and pneumatic examples attached show these features.

The use of Computer Aided Design packages such as “PneSim pro”™ automatically produce drawings to the correct standards.

STANDARD PAPER SIZES

The ISO standards for drawing paper sizes are as follows.

Size	Width mm	Length
A0	841	1189
A1	594	841
A2	420	594
A3	297	420
A4	210	297

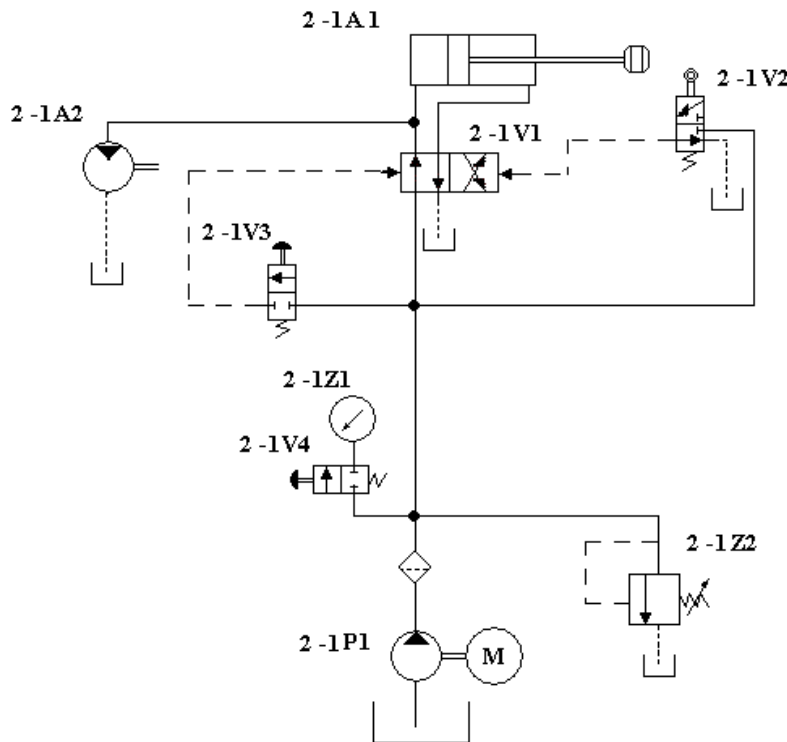
GROUPED SYMBOLS

If a group of symbols need to be grouped to indicate for example that they are built as a single assembly a box is drawn around them using long and short chain dotted line as follows. _ _ _ _ _

EXAMPLE OF A CIRCUIT DRAWING

LIST OF PARTS

ITEM	DESCRIPTION	QTY	ID.	SPECIFICATION
1	Double acting cylinder	1	A1	Rex C23-760D
2	Hydraulic motor	1	A2	VK-6-56-P3
3	4/2 DCV Pilot/Pilot	1	V1	NG-7124/3/8
4	3/2 DCV Roller/spring	1	V2	NG-7125/3/8
5	2/2 DCV Button/Spring NC	2	V3 V4	NG-7128/3/8
6	Pressure gauge	1	Z1	BD 713 0-200
7	Full Flow filter	1	Z2	FF-71309/8
8	Pump	1	P1	DWT 7-1/2



ACTUATORS AT TOP

DCV NEXT LEVEL

ANCILLIARY EQUIPMENT

TITLE BLOCK

ACE HYDRAULICS PLC		
DRG No.	902-05-02	Signature
Drawn	A.N.Other	
Chkd	J.Doe	
Scale		
Installation	2	

This is a good point to complete Worksheet No.1

WORKSHEET 1 INTRODUCTION TO BASIC CIRCUITS

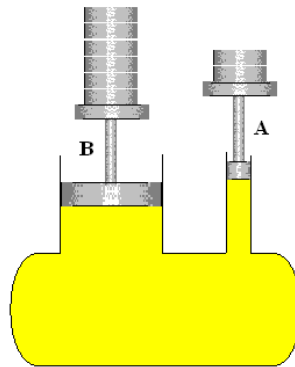
PART 1 – SIMPLE JACK

A good starting point in understanding hydraulic circuits is the simple jack similar to that used to lift cars off the ground.

Examine the diagram of a simple hydraulic jack. Piston A is pushed down by a weight and piston B is pushed up raising another weight.

1.a. Which moves the most A or B? _____

1.b. Which is the heaviest weight A or B? _____



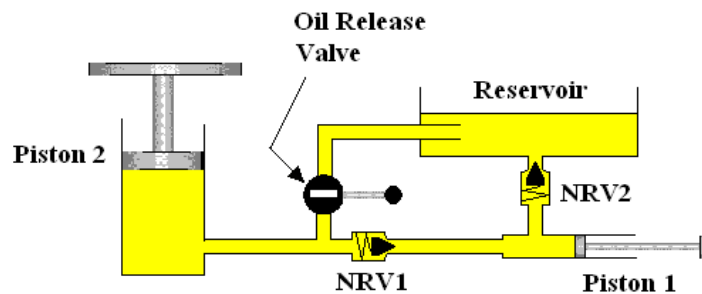
2. The next diagram shows a simple jack. Write down what happens to NRV1 , NRV 2 and piston 2 when piston 1 is pushed in (the answer is either open or shut in each case).

NRV 1 _____ NRV 2 _____ Piston 2 _____

Write down what happens when piston 1 is pulled out.

NRV 1 _____ NRV 2 _____ Piston 2 _____

What is the purpose of the oil release valve ?



PART 2 BASIC HYDRAULIC CIRCUIT.

Study the simple hydraulic system shown below and fill in the answers to the questions.

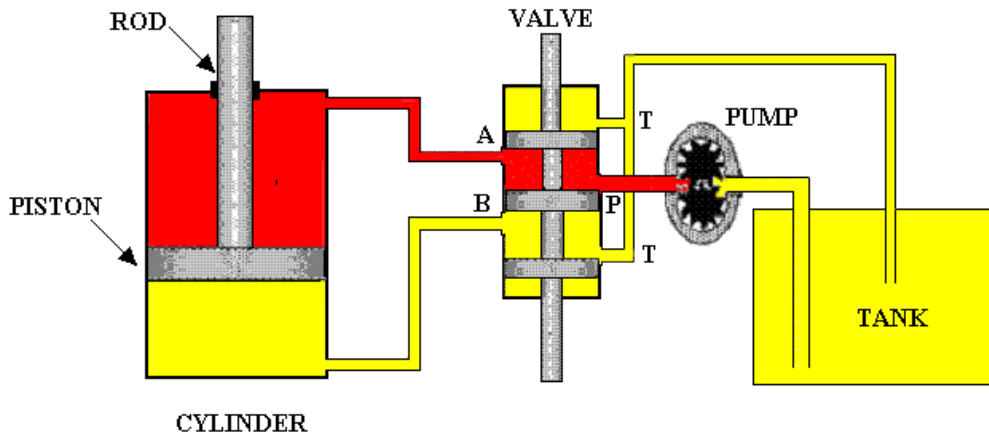


Figure 3

3. With the valve in the position shown, which way is the cylinder piston moving, UP or DOWN?

4. Which way must the valve be moved in order to reverse the motion of the load cylinder, UP or down?

5. What will happen to the pressure on the outlet of the pump when the load piston reaches the end of the travel? Will it INCREASE or DECREASE?

6. The simple hydraulic circuit shown represents the system in figure 3. The circuit diagram should be drawn using symbols from British Standard 2917 and these are laid out below. Using solid pencil lines draw in the pipe line connections to complete the circuit.

