Unit 24: Applications of Pneumatics and Hydraulics

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

OUTCOME 4

TUTORIAL 1 – INDUSTRIAL APPLICATIONS

This tutorial completes the module. The outcome can be widely interpreted and if taken in detail it would require much more time than can be reasonably allocated to a single module. None of the outcomes can be reasonably studied in isolation and much of the material needed is embedded in the previous tutorials for outcomes 1 to 3. You will also need to complete the assignments in order to complete the outcome.

4 Be able to evaluate and justify industrial applications of pneumatics and hydraulics

Industrial applications: measurements of process and/or machine parameters in selected applications e.g. manufacturing, processing, transportation, utilities, operation of plant machinery, equipment, controlling processes and plant.

Technical requirements: design and selection of equipment, materials and components; installation; test and commissioning procedures

Commercial aspects: e.g. capital costs, running costs, maintenance, flexibility of proposed system, future expansion and/or changes to installation

Health and safety: requirements of safety legislation and relevant regulations e.g. Health and safety at Work Act 1974, Pressure Systems and Transportable Gas Containers Regulations 1989, Pressure System Safety Regulations 2000, SI 2000 No 128

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

- List the main industrial sectors using fluid power.
- Give valid reasons for deciding on the technical specification of a fluid power system.
- Explain the main factors involved in costing a fluid power system.
- Explain the safety regulations and implication in the design and running of a fluid power system.
- Explain the factors involved in deciding whether to use pneumatics and hydraulics.

1. INDUSTRIAL SECTORS

This section is concerned with the selection of fluid power equipment that is most suited for the specified application.

The following is a list of the main industrial sectors that use fluid power with some examples.

- Manufacturing.
  - Manufacturing processes
    - Robots
    - Press/forming tools
    - Extrusion
    - Machine tools
    - Conveyors
    - Rolling
    - Forging
    - Automated work cells
- Processing.
  - Refining
    - Iron and steel
    - Aluminium
    - Plastics
    - Glass
    - Oil products
    - Detergents
  - Food
    - Sugar refining
    - Salt refining
    - Slaughterhouses
    - Brewing
    - Dairy
    - Packaging
    - Pharmaceuticals
- Transportation.
  - Road/Rail
    - Loaders
    - Power steering/brakes
    - Winches
    - Car lifts
  - Aeroplanes
    - Undercarriage
    - Flaps/rudder
    - Shipping
    - Winches/cranes
    - Stabilisers
- Utilities/services.
  - Refuse collection.
  - Road cleaning
  - Fire appliances
- Plant operation.
  - Dockyard cranes
  - Straddle carriers
  - Earth moving (JCB)
  - Road construction

2. FLUID POWER TECHNICAL SPECIFICATION

The technical specification of the range of equipment listed varies from small to large, crude to precise, weak to powerful. Generally speaking the following applies.

- Hydraulics are used for power and precision.
- Pneumatics are used for light weight and speedy applications.

The materials used in the construction of the components (Actuators, valves and so on) are chosen to meet these specifications. For example:

- Hydraulic components are mainly made from steel.
- Pneumatic components are made from plastic and non-ferrous materials.

The environmental conditions are also important and regardless of whether it is hydraulic or pneumatic, the materials used in the system may have to withstand some of the following.

- Heat
- Cold
- Mechanical damage
- Dust
- Damp
- Chemical attack

3. COST

When specifying a fluid power system, the costing should include the following.

- Capital cost
- Installation cost
- Commissioning cost
- Running cost
- Maintenance
- Flexibility of the proposed system
- Future expansion and changes

When either pneumatic or hydraulic systems are equally suitable for an application the following should be considered.

- Hydraulics generally calls for a greater capital outlay.
- Hydraulic power is generally cheaper on an energy basis.
- Installation of hydraulic equipment generally calls for greater skills and hence costs more.
- Hydraulics with multiple machines generally requires a power pack for each machine.
- Pneumatic machinery can be plugged into a ring main.

4. HEALTH AND SAFETY

Safety is a matter of sound design and this is helped by close liaison with installation personnel to both learn from experience and to inform them.

There are many health and safety requirements that affect the installation and operation of fluid power systems. Some of the main points are as follows.

- Chemicals/environmental considerations.
- Guarding of machinery
- Operator safety
- Noise.
- Dangers associated with high pressures.

Legislation in force includes the following.

- Health and Safety at Work Act 1974
- Pressure systems and Transportable Gas Containers Regulations 1989
- Noise at Work regulations 1989
- The Food safety Act 1990
- The Control of Substances Hazardous to Health Regulations.

5. COMPARISON TABLE

	HYDRAULIC	PNEUMATIC
ENERGY SOURCE	Electric motor Int. combustion engine	Electric motor Int. combustion engine
ENERGY STORAGE	Accumulator	Air receiver
DISTRIBUTION SYSTEM	Very localised	Ring main
FLEXIBILITY	Not easy to expand	Easy to modify and change
CAPITAL COST	High	Lower
ENERGY COST	Medium	Higher
ROTARY ACTUATORS	Low speed Good control	High speed Control difficult
LINNEAR ACTUATORS	High forces	Medium forces
CONTROLLABLE FORCE	High degree of control and precision with high forces.	Control difficult with high forces.
MAINTENANCE	Replacement/repair expensive Fluid replacement/top up	Replacement/repair cheaper No fluid replacement
SAFETY	Oil may leak Fire hazard Chemical/environmental Problems possible.	Explosive failure Noisy