Unit 24: Applications of Pneumatics and Hydraulics

Unit code: J/601/1496

QCF level: 4

Credit value: 15

Aim

This unit aims to extend learners' understanding of pneumatic and hydraulic fluid power systems and their modern industrial applications and enable them to design fluid power circuits.

Unit abstract

Pneumatics and hydraulic systems involve the transmission of force and motion through a fluid. With pneumatic systems, the fluid is very often compressed air, although inert gases are also used in some applications. With hydraulic systems, the fluid is generally specially formulated oil, but water might also be used in some applications.

Pneumatic and hydraulic systems are to be found in transport, manufacturing, mechanical handling and process control. They each have their advantages and disadvantages. Gases have a low density and are compressible whilst liquids have a much higher density and are almost incompressible. As a result, hydraulic systems generally operate at higher pressures and can deliver very large positive forces such as those required in hydraulic presses, lifts and earth moving equipment. Pneumatic systems have a softer action and are not able to deliver such large forces. Compressed air is however readily available as a service in many industrial installations. It can be supplied over relatively long distances and is widely used in actuation and control systems and in robots.

This unit aims to extend the learner's knowledge and understanding of fluid power systems in modern industry. Learners will study pneumatic and hydraulic circuit symbols and diagrams and consider circuit designs. They will also examine the characteristics and selection of components and equipment and evaluate relevant industrial applications of pneumatics and hydraulics.

Learning outcomes

On successful completion of this unit a learner will:

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

2 Understand the construction, function and operation of pneumatic and hydraulic components, equipment and plant

3 Be able to design pneumatic and hydraulic circuits

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

Unit content

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

Pneumatic and hydraulic symbols: read and interpret eg energy conversion, valve, energy transmission, control and miscellaneous symbols; use of appropriate British and International Standards eg 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 eg use of ISO 1219-2 Part 2, component lists, component data sheets, displacement-step diagrams, operating instructions, installation and maintenance manuals; applications eg logic, memory and multi-actuator sequential circuit operation, cascading techniques, linear and rotary actuation circuits

2 **Understand the construction, function and operation of pneumatic and hydraulic components, equipment and plant**

Pneumatic equipment: types, construction, function and operation eg air compressors, coolers, dryers, receivers, distribution equipment, fluid plumbing and fittings, drain traps, FRL air service units, valves, actuators, seals

Hydraulic equipment: types, construction, function and operation eg fluids, pumps, motors, actuators, reservoirs, accumulators, fluid plumbing and fittings, valves, filters, seals, gauges

Performance characteristics: air compressors eg volumetric efficiency, compression ratio, isothermal efficiency; hydraulic pumps eg operating efficiency, losses, flow rate, operating pressure, shaft speed, torque and power

3 **Be able to design pneumatic and hydraulic circuits**

Pneumatic circuits: eg directional control, piloted control, reciprocating control, logic, memory, multi-actuator circuits with sequential operation, cascading techniques, stepper circuits, pulsed signals, latching circuits, direction and speed control of rotary actuators and air motors

Hydraulic circuits: eg sequential operation of multi-actuator circuits, regenerative circuits, counterbalance circuits, 'meter-in' and 'meter-out' circuits, bleed-off circuits, direction and speed control of hydraulic motors

Electro-pneumatic and electro-hydraulic circuits: use of electronic logic devices and systems and their interface with fluid power circuits; solenoid valve arrangements

Emergency 'fail safe' circuits: use of emergency stop circuits to give predictable 'parking' positions for linear actuators, emergency stopping circuits for rotary actuators and motors, thermal and pressure relief circuits, 'fail safe' circuit arrangements

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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 eg 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: eg 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 eg Health and Safety at Work Act 1974, Pressure Systems and Transportable Gas Containers Regulations 1989, Pressure System Safety Regulations 2000, SI 2000 No 128

Learning outcomes and assessment criteria

Learning outcomes On successful completion of this unit a learner will:	Assessment criteria for pass The learner can:
LO1 Be able to read and interpret pneumatic and hydraulic fluid power diagrams	1.1 recognise and describe given fluid power symbols that conform to the latest ISO 1219 standards or their national/international equivalent 1.2 from a given system diagram, read, interpret and explain the operation of either a pneumatic or hydraulic multi-actuator sequential system that uses a minimum of four actuators 1.3 produce a suitable circuit design drawing for either a pneumatic or hydraulic reversible rotary actuation system that includes speed control in both directions
LO2 Understand the construction, function and operation of pneumatic and hydraulic components, equipment and plant	2.1 identify the features, describe the function and explain the operation of given items of pneumatic and hydraulic equipment 2.2 analyse, compare and contrast the performance characteristics for two given items of pneumatic and two given items of hydraulic equipment
LO3 Be able to design pneumatic and hydraulic circuits	3.1 design and produce a circuit design diagram for either a pneumatic or hydraulic multi-actuator sequential operation circuit, that includes emergency stop functions 3.2 design and produce a circuit design diagram for either a pneumatic or hydraulic rotary actuation system that includes speed control in both directions 3.3 design and produce a circuit design diagram for either an electro-pneumatic or electro-hydraulic system arrangement 3.4 design and produce a circuit design for either a pneumatic or hydraulic 'fail-safe' circuit application
LO4 Be able to evaluate and justify industrial applications of pneumatics and hydraulics	4.1 evaluate and justify the use of either pneumatic or hydraulic fluid power technology for a given industrial application 4.2 evaluate and discuss the technical requirements and commercial considerations for the given industrial application 4.3 identify and discuss the appropriate health and safety requirements for the design, installation, maintenance and use of the given industrial application.

Guidance

Links

This unit has links with *Unit 22: Programmable Logic Controllers* and *Unit 41: Fluid Mechanics*.

Essential requirements

Centres must be equipped with, or have access to, industrial standard pneumatic and hydraulic equipment and test assemblies/facilities. In addition, relevant British and International Standards and British Fluid Power Association publications need to be available.

Employer engagement and vocational contexts

Liaison with employers would prove of benefit to centres, especially if they are able to offer help with the provision of suitable industrial hydraulic and/or pneumatic equipment and test facilities.