Lakeshore Technical College

10-620-103 Fluid Power I

Course Outcome Summary

Course Information

Description ...prepares the learner to identify hydraulic and pneumatic component symbols; adjust a pressure relief valve; analyze the operation of a pilot operated relief valve; analyze Pascal's law; evaluate flow, velocity, work and power in industrial hydraulic and pneumatic circuits; analyze meter-in, meter-out, and bypass flow control circuits; identify basic hydraulic and pneumatic control valves; and assemble hydraulic circuits.

Total Credits 2

Total Hours 48

Pre/Corequisites

Corequisite Intermediate Algebra with Applications

Textbooks

Eaton – *Industrial Hydraulics Manual* – ISBN: - 13: 978-0-9788022-0-2 Copyright 2010. This text is used in both Fluid Power I and Fluid Power II courses.

Lab-Volt. *Hydraulic Fundamentals - Fluid Power - Student Manual* 30794-00. ISBN: 2-89289-349-6 Required. Comments: This text is used in both Fluid Power I and Fluid Power II courses.

Lab-Volt. *Pneumatic Fundamentals - Fluid Power - Student Manual* 31290-00. ISBN: 2-89289-383-6 Required. Comments: This text is used in both Fluid Power I and Fluid Power II courses.

Learner Supplies

Calculator

Safety Glasses

Course Competencies

1. Use hydraulic and Pneumatic trainer components to safely operate the trainer.

Linked Core Abilities

Apply learning
Communicate effectively
Demonstrate responsible and professional workplace behaviors
Respect and appreciate diversity
Work cooperatively

Assessment Strategies

1.1. Performance
1.2. Written Objective Test

Criteria

1.1. Able to identify components of the Fluid Power Trainer

Learning Objectives

1.a. Review safety rules to follow when using the Lab-Volt Hydraulics Trainer
1.b. Identify the various system components on the trainer
1.c. Identify the power unit components on the trainer
1.d. Measure the pressure setting of the power unit relief valve

2. Identify hydraulic and pneumatic components and symbols.

Linked Core Abilities

Apply learning
Demonstrate responsible and professional workplace behaviors

Learning Objectives

2.a. Identify industry standardized colors to correct function
2.b. Identify components on trainer from a graphic diagram.
2.c. Draw individual Hydraulic and Pneumatic component symbols from a word description
2.d. Construct an operating hydraulic and Pneumatic system from a graphic diagram of the circuit
2.e. Define terms associated with pneumatic pressure, such as: absolute pressure scale, bourdon tube, plunger gage, gage pressure scale, Hg. manometer, PSI, PSIA, PSIG, and vacuum
2.f. Define terms associated with fluid power, such as: critical velocity, free air, intensifier, relative humidity, SCFM, work, power, pressure, area and force

3. Adjust pressure relief valve to specified pressure

Linked Core Abilities

Apply learning
Communicate effectively
Demonstrate responsible and professional workplace behaviors
Respect and appreciate diversity
Work cooperatively

Learning Objectives

3.a. Explain the operation of a pressure relief valve
3.b. Establish the flow path in a circuit using a pressure relief valve
3.c. Construct and operate a circuit using a pressure relief valve or regulator
3.d. Explain how pressure is measured
3.e. Identify the various units of pressure measurement

4. Analyze the operation of a pilot operated relief valve

Linked Core Abilities

Apply learning
Communicate effectively
Demonstrate responsible and professional workplace behaviors
Respect and appreciate diversity
Work cooperatively

Learning Objectives

4.a. Advise the flow through a pilot operated relief valve during different modes of operation
4.b. Identify the three ports on a relief valve
4.c. Add the structure and operation of a simple relief valve
4.d. Describe the structure and operation of a pilot-operated relief valve

5. Analyze the characteristics associated with Pascal's law

Linked Core Abilities

Apply learning
Demonstrate critical thinking

Use mathematics effectively

Learning Objectives

5.a. Calculate pressure, force, and area for various conditions
5.b. Calculate the maximum load a cylinder can move during extension and retraction
5.c. Verifiy the formula F = P x A using a cylinder and a load spring
5.d. Discover what happens to a cylinder when equal pressure is applied to each side of its piston
5.e. Explain the concept of pressure distribution in a cylinder in equilibrium of forces
5.f. Determine the weight of the power unit given the pressure required to lift it

6. Evaluate Flow rate, Velocity, work and power in industrial fluid power circuits

Linked Core Abilities

Apply learning
Demonstrate critical thinking
Use mathematics effectively

Learning Objectives

6.a. Evaluate what causes flow in a hydraulic system
6.b. Calculate the flow rate need for various specified cylinder velocities
6.c. Calculate the velocity of a cylinder at various specified flow rates
6.d. Establish the relationship between flow rate and velocity

7. Analyze the following flow control circuits: meter-in, meter-out, and bypass

Linked Core Abilities

Apply learning
Communicate effectively
Demonstrate critical thinking
Demonstrate responsible and professional workplace behaviors
Respect and appreciate diversity
Use mathematics effectively
Work cooperatively

Learning Objectives

7.a. Identify three basic flow control circuits
7.b. Identify characteristics associated with a particular basic flow control circuit
7.c. List factors that affect flow through an orifice

8. Evaluate the general characteristics, terms, etc., of pressure drop verse flow relationship

Linked Core Abilities

Apply learning
Communicate effectively
Demonstrate critical thinking
Demonstrate responsible and professional workplace behaviors
Respect and appreciate diversity
Use mathematics effectively
Work cooperatively

Learning Objectives

8.a. List four characteristics of poppet valves
8.b. Explain the primary function of a flow control valve
8.c. Distinguish between fixed and variable orifices
8.d. Analyze the function of flow control valves in simple circuits containing cylinders, and directional control valves
8.e. Explain the need for quick exhaust valves
8.f. sketch a circuit diagram of a quick exhaust valve and explain its operation
8.g. Explain the purpose of pneumatic silencer

9. Evaluate the general characteristics, terms, etc., of vacuum generation

Linked Core Abilities

Apply learning
Demonstrate critical thinking

Use mathematics effectively

Learning Objectives

9.a. Explain linear air bearing theory of operation
9.b. Identify applications that use linear air bearings
9.c. Draw the symbol for a linear air bearing
9.d. State Bernoulli's Law
9.e. Explain Bernoulli's Law as it pertains to specific practical applications
9.f. Define terms associated with Bernoulli's Law, such as: uniform flow, venturi tube, and pressure

10. Evaluate the general characteristics, terms, etc. of hydraulic pumps

Linked Core Abilities

Apply learning
Communicate effectively
Demonstrate critical thinking
Demonstrate responsible and professional workplace behaviors
Respect and appreciate diversity
Use mathematics effectively
Work cooperatively

Learning Objectives

10.a. Explain the difference between positive and non-positive displacement pumps
10.b. Describe how pumps are rated
10.c. Explain two methods of vane loading used in hydraulic pumps
10.d. Use the terms, increasing volume and decreasing volume, to explain the operation of a hydraulic pump
10.e. Identify factors that cause pump slippage to increase
10.f. Describe how operating pressure and temperature effect volumetric efficiency
10.g. Describe the following terms as they relate to hydraulic pumps: cavitation, slippage, case drain, ane pump, gear pump, piston pump, variable volume pump, balanced vane pump, and vane loading

10.h. Use manufacturer pump specifications to test a pump in a hydraulic system

11. Evaluate the general characteristics, terms, etc. of hydraulic motors.

Linked Core Abilities

Apply learning
Communicate effectively
Demonstrate critical thinking
Demonstrate responsible and professional workplace behaviors
Respect and appreciate diversity
Use mathematics effectively
Work cooperatively

Learning Objectives

11.a. Explain the advantages of a hydraulic motor over an electric motor
11.b. Describe the design and operation of a hydraulic motor
11.c. Identify the common types of hydraulic motors used in industrial hydraulic systemsi
11.d. List performance factors of hydraulic motors
11.e. Calculate the torque and speed of a hydraulic motor
11.f. Determine the effect a change in flow rate or pressure has on motor operation
11.g. Describe the following terms as they relate to hydraulic motors, cavitation hydrostatic drive, open loop, closed loop, breakaway torque, starting torque and running torque

12. Evaluate the general characteristics, terms, etc., of pneumatic motors

Linked Core Abilities

Apply learning
Communicate effectively
Demonstrate critical thinking
Demonstrate responsible and professional workplace behaviors
Respect and appreciate diversity

Use mathematics effectively
Work cooperatively

Learning Objectives

12.a. Describe the design and operation of a pneumatic motor
12.b. Explain the methods of vane loading used on vane type pneumatic motors
12.c. Explain the term, torque
12.d. Calculate torque for an air motor at a rated horsepower and speed

13. Troubleshoot pneumatic motor applications

Linked Core Abilities

Apply learning
Communicate effectively
Demonstrate critical thinking
Demonstrate responsible and professional workplace behaviors
Respect and appreciate diversity
Use mathematics effectively
Work cooperatively

Learning Objectives

13.a. Interpret manufacture's data sheets
13.b. Determine the power, torque and flow rate of a pneumatic motor using the data sheets
13.c. Use a tachometer to measure the rotational speed of a pneumatic motor

14. Evaluate the general characteristics, terms, etc. of directional control valves

Linked Core Abilities

Apply learning
Communicate effectively
Demonstrate critical thinking

Learning Objectives

14.a. Explain various center position configurations that are used in DCV's
14.b. Identify ways that directional control valves are operated
14.c. Identify the flow paths through a four-way valve in any of its three operating positions
14.d. Define the following terms as they relate to directional control valves; open center, closed center, tandem center, manual override, pilot, spool, land, crossover conditions and piggy-back valve

15. Identify three basic kinds of control valves used in hydraulic circuits

Linked Core Abilities

Apply learning

Learning Objectives

15.a. Identify how to control the direction, force and speed of a cylinder
15.b. Describe the effect a change in system pressure or flow rate has on the force exerted by a cylinder
15.c. Trace the fluid flow through various valves during particular modes of operation
15.d. Identify the three basic kinds of control valves.

16. Evaluate characteristics of directional control valves

Linked Core Abilities

Apply learning
Communicate effectively
Demonstrate critical thinking
Demonstrate responsible and professional workplace behaviors
Respect and appreciate diversity
Use mathematics effectively
Work cooperatively

Learning Objectives

16.a. Explain the primary purpose for directional control valves
16.b. Describe the operation of normally passing and normally non-passing directional control valves
16.c. Explain how directional control valves are classified

16.d. Define terms associated with directional control valves, such as: valve body, bias spring, ports, spring offset, spools, detent, lapped spool, packed spool, and rotary bore
16.e. Explain what is meant by varnishing when referred to directional control valves.
16.f. Sketch a circuit diagram of a quick exhaust valve and explain its operation

17. Identify directional control valve function in various pneumatic circuits

Linked Core Abilities

Apply learning

Learning Objectives

17.a. Sketch and explain a use of exhaust center, pressure center, and blocked center directional control valves.
17.b. Sketch the symbols used to denote mechanical, electrical, and pneumatic actuation of directional control valves

18. Evaluate and determine the type and size of compressors required for a specific application

Linked Core Abilities

Apply learning
Demonstrate critical thinking
Use mathematics effectively

Learning Objectives

18.a. Describe the types of compressors available for industrial compressed air supply
18.b. Identify methods of cooling the air after compressing
18.c. Describe the difference between displacement and dynamic air compressors
18.d. List the types of dynamic compressors and displacement compressors

19. Evaluate both displacement and dynamic air compressors

Linked Core Abilities

Apply learning
Demonstrate critical thinking
Use mathematics effectively

Learning Objectives

19.a. Describe how a reciprocating piston compressor works
19.b. Describe how a helical compressor works
19.c. Evaluate the different types of helical compressors
19.d. Evaluate the benefits of a two stage compressor

20. Evaluate compressor performance and unloading methods

Learning Objectives

20.a. Describe compressor unloading and its benefits
20.b. Evaluate different methods of compressor unloading
20.c. Describe the effects of altitude on compressor performance
20.d. Explain what artificial demand is