

Basic Hydraulics

Course 307: Basic Hydraulics

Covers hydraulic principles, types of hydraulic fluids and their characteristics. Describes components of the hydraulic system and their functions, including filters and strainers, reservoirs and accumulators, pumps, piping, tubing and hoses, control valves, relief valves, and actuating devices. Covers a variety of cylinders and hydraulic motors.

TPC Training is accredited by IACET to offer **1.0 CEU** for this program.



Lesson 1: Principles of Hydraulics

Topics

Fluid Power and Hydraulics; Force, Weight, and Mass; Pressure; Work, Power, and Energy; Incompressibility and Nondiffusion; Hydrostatic Pressure; Pascal's Law; Transmission of Fluid Power; Fluid Flow in Pipes; Bernoulli's Principle; The Effect of Heat on Liquids; Hydraulic Power Systems

Objectives

- Explain the difference between absolute and gauge pressure.
- Demonstrate how power is calculated.
- Explain Pascal's Law.
- Describe the difference between laminar and turbulent flow.
- Name the main components of a hydraulic system.

Lesson 2: Hydraulic Fluids

Topics

Functions of Hydraulic Fluids; Physical Properties; Viscosity; Viscosity Index; Viscosity and Pressure; Pour Point; Fluid Selection; Component Protection; Chemical Properties; System Contamination; Water; Dissolved Air; Foaming; Corrosion and Rusting; Types of Hydraulic Fluids

Objectives

- List the most important properties of hydraulic fluids.
- Explain how viscosity is measured.
- Explain the meaning of the viscosity index.
- Describe the effect of fluid temperature on viscosity.
- Name the causes of corrosion and fluid oxidation.
- Identify various types of hydraulic fluids.

Lesson 3: Strainers and Filters

Topics

Hydraulic System Requirements; Settling; Degree of Filtration; Performance Characteristics; Performance of Different Media; Strainers; Reservoir Strainers; In-Line Strainers; Filters; Fiber Media; Nonfibrous Surface Media; Magnetic Media; Filter and Strainer Installations

Objectives

- Name contaminants found in hydraulic systems.
- Explain the difference between a strainer and a filter, and describe the main function of each.
- Describe the two basic types of filter/strainer media.
- Draw graphic symbols for strainers and filters.

Lesson 4: Reservoirs and Accumulators

Topics

System Demands; Fluid Reservoir Requirements; Baffles; Air Separation; Reservoir Cooling; Reservoir Accessories; Accumulators

Objectives

- Explain the functions of fluid reservoirs.
- Explain the purpose of reservoir baffles.
- Describe various methods of counteracting high operating temperatures.
- Identify important accessories used with reservoirs.
- Demonstrate pressure ratio calculation for a differential-piston accumulator.

Lesson 5: Hydraulic Pumps

Topics

Pump Classification; Rating and Selecting Factors; Capacity; Pressure; Energy Consumption; Drive Speed; Efficiency; Reliability; Fluid Characteristics; Size and Weight; Control Adaptability; Service Life; Installation and Maintenance Costs; Types of Pumps; Gear Pumps; External Gear Pumps; Internal Gear Pumps; Axial-Flow (Screw) Pumps; Cycloidal Pumps; Vane Pumps; Piston Pumps

Objectives

- Name the main classification of hydraulic pumps.
- List factors affecting pump selection and pump performance.
- Define volumetric efficiency and overall efficiency.
- Identify the most common types of positive-displacement pumps, and describe their operation.

Lesson 6: Piping, Tubing, and Fittings

Topics

Hydraulic Piping; Flow and Velocity; Hydraulic Pressure; Pressure Loss; Losses in a Line; Steel Pipe; Pipe Fittings; Pipe Installation; Tubing; Tube Bending; Tube Fittings; Hoses; Hose-End Fittings; Quick-Connect/Disconnect Couplings; Hose Installations

Objectives

- Discuss the chief considerations in hydraulic line selection.
- Demonstrate how flow velocity and pressure loss are calculated.
- Explain pipe size schedules.
- Describe various types of fittings used in hydraulic systems.
- Explain the reason for using steel pipe.
- List the main advantages of tubing.

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Lesson 7: Directional Control Valves

Topics

Directional-Control Valves; Manually Operated Valves; Automatic Two-Way Valves; Check Valves; Pilot-Operated Check Valves; Spool Valves; Two-Way Spool Valves; Hydraulic-Motor Control; Normally Open and Closed Valves; Holding Valves; Four-Way and Five-Way Valves; Rotary Valves; Valve Actuators; Flow Ratings; Accessories

Objectives

- Explain the classification of directional control valves.
- Describe how manually operated valves work.
- Explain the difference between direct-acting and pilot-operated valves.
- Describe the operation of a check valve, a spool valve, a three-way valve, a four-way valve, and a rotary valve.
- Explain the difference between normally closed and normally open valves.

Lesson 8: Pressure-Control Valves

Topics

Pressure-Control Valves; Pressure-Relief Valves; Poppet Valves; Spool Valves; Sequence Valves; Counterbalance Valves; Holding Valves; Unloading Valves; Pressure-Reducing Valves; Shock Suppressors; Flow-Control Valves; Pressure and Temperature Compensation

Objectives

- Explain the functions of a pressure-control valve, a pressure-relief valve, and a pressure-reducing valve.
- Describe the operation of a spool valve, a poppet valve, and a sequence valve.
- Explain the purpose of holding valves, unloading valves, and counterbalance valves.
- Name the operations performed by flow-control valves.
- Describe how pressure compensation and temperature compensation work.

Lesson 9: Cylinders

Topics

Description of Cylinders; Double-Acting Cylinders; Single-Acting Cylinders; Two-Piston Cylinders; Positional Cylinders; Cylinder Construction; Piston Rings and Seals; Rod Packings; Cylinder Mounting; Selecting a Cylinder; Flow Capacity; Cushioning; Piston Rod Strength; Cylinder Applications

Objectives

- Describe the purpose of a hydraulic cylinder, and explain how a double-acting cylinder works.
- Explain the difference between “pull-type” and “push-type” single-acting cylinders.
- Describe the construction of a hydraulic cylinder.
- Explain the various methods of mounting cylinders.
- Demonstrate how to calculate the flow capacity of a hydraulic cylinder.

Lesson 10: Hydraulic Motors

Topics

Motor Classification; Rating and Selection Factors; Hydraulic-Motor Construction; Gear, Vane, and Piston Motors; Rotary Actuators

Objectives

- Explain the classification of hydraulic motors.
- Demonstrate how the torque of a hydraulic motor is calculated.
- Calculate the horsepower output of a hydraulic motor.
- Discuss cost factors and other considerations affecting motor selection.
- Describe the construction of a hydraulic motor.
- Explain the operating principles of a gear motor, a vane motor, and a piston motor.