

Reference Material:

Mobil Hydraulics Manual. Can be ordered online from web.fluidpower.eaton.com/ssl/listproducts_manuals.asp

Fluid Power Designer Lightning Reference Handbook, 8th edition. Available at

web.fluidpower.eaton.com/ssl/listproducts_manuals.asp

Learning Objectives:

1. Hydraulic Theory, use and maintenance of hydraulic fluids

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| <p>A. Hydraulic Theory</p> <ol style="list-style-type: none"> 1. Pascal's Law 2. Fluid flow <ol style="list-style-type: none"> a. Effects of an orifice on flow b. Effects of changes in pressure on flow 3. Pressure and flow <ol style="list-style-type: none"> a. Measurement names b. PSIG vs PSIA c. Charge pressure 4. Definition of fluid flow 5. Effects on fluid by ambient pressure 6. Causes of cavitation and aeration 7. Horsepower ratings 8. Purpose of fluid 9. Laminar flow 10. Types of energy in hydraulic system 11. Calculating area and force of actuators | <p>B. Hydraulic fluid</p> <ol style="list-style-type: none"> 1. Viscosity 2. Filtration <ol style="list-style-type: none"> a. Types of elements b. Efficiency measurement c. Location in system 3. Additives <ol style="list-style-type: none"> a. ISO 4406-1999 b. Required Cleanliness Levels 4. Types <ol style="list-style-type: none"> a. Synthetic b. Hydrocarbon 5. Fluid Features <ol style="list-style-type: none"> a. Characteristics of fluid b. Weight of oil vs water 6. Contamination 7. Definition of liquid flow 8. Demulsibility |
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2. Understand Hydraulic system components and their functions

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| <p>A. PTO's and Drives</p> <ol style="list-style-type: none"> 1. Types of engagement 2. Horsepower requirements 3. Drive line requirements <p>B. Hydraulic Pumps</p> <ol style="list-style-type: none"> 1. Types of pumps <ol style="list-style-type: none"> a. Piston <ol style="list-style-type: none"> 1. Fixed displacement 2. Variable displacement 3. Pressure compensating 4. Flow compensating b. Axial <ol style="list-style-type: none"> 1. Inline 2. Bent axis c. Vane d. Balanced vane e. Gear 2. Pump Applications <p>C. Reservoir</p> <ol style="list-style-type: none"> 1. Capacity Requirements 2. Design 3. Location <p>D. Plumbing</p> <ol style="list-style-type: none"> 1. Hosing type, size & construction 2. Line & tube type size & construction 3. Fitting types 4. Proper Sealing Methods 5. Routing and installation 6. Restriction to flow | <p>E. Valves</p> <ol style="list-style-type: none"> 1. Directional Valve <ol style="list-style-type: none"> a. Type <ol style="list-style-type: none"> 1. Rotary 2. Spool 3. Pilot Operated 4. Servo 5. Types of Actuation 6. Deadband 2. Cartridge Valve <ol style="list-style-type: none"> a. Relief and pressure reducing valves b. Flow control valves <ol style="list-style-type: none"> 1. Non-Compensated 2. Compensated c. Counterbalance, sequencing and unloading valve d. Slip-in cartridge e. Manifold blocks 3. Causes of Hysteresis 4. Solenoid Valves <ol style="list-style-type: none"> a. Power demand b. Definition c. Pulse width modulation 5. Pressure control valves <ol style="list-style-type: none"> a. Relief valve b. Pressure Reducing Valve | <p>F. Actuators</p> <ol style="list-style-type: none"> 1. Types <ol style="list-style-type: none"> a. Linear (cylinder) <ol style="list-style-type: none"> 1. Single Acting 2. Double Acting 3. Telescoping 4. Components of cylinders 5. Double acting double rod b. Rotary (Motor) <ol style="list-style-type: none"> 1. Gear 2. Vane 3. Piston 4. Roller Vane 5. Electric / hydraulic torque motor 6. Electric / hydraulic force motor <p>G. Heat Exchangers</p> <p>H. Accumulators</p> <p>I. Gauges and Meters</p> <ol style="list-style-type: none"> 1. Pressure Transmitter 2. Pressure Transducer |
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3. Understand and identify hydraulic circuits

A. Types

1. Parallel
2. Series
3. Regenerative
4. Unloading
5. Reciprocating
6. Hydrostatic
7. Open Center
8. Closed Center

B. Schematics & Symbols

1. Variable Motor
2. Accumulator
3. Fixed motor
4. Variable pump
5. Fixed pump
6. Filter
7. Cooler
8. Types of Cylinder

C. Control

1. Digital
2. Analog
3. Electro-Hydraulic

4. Troubleshooting, Tools and Equipment

A. Troubleshooting

1. Circuits
2. Components
 - a. Pumps
 - b. Valves
 - c. Actuators
 - (1) Cylinders
 - (2) Motors
 - d. Tubes, Hoses, and Fittings

B. Tools and Equipment

1. Flow meters
2. Pressure gauge sets
3. Tube fabrication
 - a. Tube benders
 - b. Flaring tools