

Reference Material:

Mobil Hydraulics Manual by Vickers. Can be ordered online from <http://www.hydraulicsliteraturestore.com/mohyma.html>

Learning Objectives:

1. Hydraulic Theory, use and maintenance of hydraulic fluids

A. Hydraulic Theory

1. Pascal's Law
2. Fluid flow
 - a. Effects of an orifice on flow
 - b. Effects of changes in pressure on flow
3. Pressure and flow
 - a. Measurement names
 1. Bar
 - b. PSIG vs PSIA
 - c. Charge pressure
 - d. Metric conversion
 - e. Hydrodynamics
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
12. Measuring force

B. Hydraulic fluid

1. Viscosity
2. Filtration
 - a. Types of elements
 - b. Efficiency measurement
 - c. Location in system
 - d. Demulsibility
 - e. Coalescing filters
3. Additives
4. Types
 - a. Synthetic
 - b. Hydrocarbon
 - c. ATF
5. Fluid Features
 - a. Characteristics of fluid
 - b. Weight of oil vs water
6. Contamination
 - a. ISO 4406-1999
 - b. Required Cleanliness Levels
 - c. Oxidation catalysts
 - d. New fluids
7. Definition of liquid flow

2. Understand Hydraulic system components and their functions

A. PTO's and Drives

1. Types of engagement
2. Horsepower requirements
3. Drive line requirements

B. Hydraulic Pumps

1. Types of pumps
 - a. Piston
 1. Fixed displacement
 2. Variable displacement
 - (i) Inline
 - (ii) Bent axis
 - (iii) Compensator
 3. Pressure compensating
 4. Flow compensating
 - b. Axial
 - c. Vane
 - d. Balanced vane
 - e. Gear
2. Pump Applications

C. Reservoir

1. Capacity Requirements
2. Design
3. Location
4. Function

D. Plumbing

1. Hosing type, size & construction
2. Line & tube type size & construction
 - a. How hydraulic steel tubing size is measured
3. Fitting types
4. Proper Sealing Methods
5. Routing and installation
6. Restriction to flow

E. Valves

1. Directional Valve
 - a. Type
 1. Rotary
 2. Spool
 - (i) Deadband
 3. Pilot Operated
 4. Servo
 5. Types of Valve Actuators
 - (i) Forced motor
 - (ii) Torque motor
 6. Shuttle
2. Cartridge Valve
 - a. Relief and pressure reducing valves
 - b. Flow control valves
 1. Non-Compensated
 2. Compensated
 - c. Counterbalance, sequencing and unloading valve
 - d. Slip-in and screw-in cartridges
 - e. Manifold blocks
3. Causes of Hysteresis
4. Solenoid Valves
 - a. Power demand
 - b. Pulse width modulation
5. Pressure control valves
 - a. Relief valve
 - b. Pressure Reducing Valve
 - c. Balance piston relief valve
 1. Vent connection

F. Actuators

1. Types
 - a. Linear (cylinder)
 1. Single Acting
 2. Double Acting
 3. Telescoping
 4. Components of cylinders
 - (i) Seal construction
 5. Double acting double rod
 - b. Rotary (Motor)
 1. Gear
 2. Vane
 3. Piston
 4. Roller Vane
 5. Electric / hydraulic torque motor
 6. Electric / hydraulic force motor
2. Torque

G. Heat Exchangers

H. Accumulators

1. Maintaining pressure

I. Gauges and Meters

1. Pressure Transmitter
2. Pressure Transducer

3. Understand and identify hydraulic circuits & symbols

- A. Types
 1. Parallel
 2. Series
 3. Regenerative
 4. Open Circuit
 5. Closed Circuit
 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, Strainer
 7. Cooler
 8. Types of Cylinder
 9. Heater
 10. Temperature Controller
- 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
 - (i) Pressure intensification
 2. Motors
 - d. Tubes, hoses, fittings
- B. Tools and Equipment
 1. Flow meters
 2. Pressure gauge sets
 3. Tube fabrication
 - a. Tube benders
 - b. Flaring tools

5. Definitions

- A. Unload
- B. Closed Circuit
- C. Reciprocation
- D. Circuit
- E. Demulsibility
- F. Bar
- G. Deadband
- H. Wiper ring
- I. Thermocouple
- J. Solenoid
- K. Hysteresis