Training
Basic Hydraulics
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The Best Power to Weight Ratio of All Energy Conversion Systems

**Hydraulic motor:**
- displacement: 5 cm³/r (0.30 in³/r)
- continuous speed 8500 rpm
- continuous power 13kW (17.5 hp)
- length 134mm (5.28 in)
- weight 5 kg (11 lb)

**Electric motor:**
- speed 2900 rpm
- power 11kW (15 hp)
- length 320mm (12.6 in)
- weight 65 kg (145 lb)
Simple Hydraulic System

Remote control valve
Operating handle
Open center directional control valve (hydraulically operated)

Control (pilot) pressure

Reservoir ("tank")

'Low' pressure

'High' pressure

Hydraulic cylinder
Pressure control valve (max pressure limiter)
Fixed displacement pump (vane type)
Filter

Load
Hydraulic Schematic Symbols

Accumulator

Cylinder
Double acting

Directional Control Valve
(manually operated)
Dump Pumps
Hydraulic System Components: Gear Pump

Hydraulic Pump Symbol
Hydraulic System Components: Accumulator

Accumulator symbol
Hydraulic System Components: Directional Control Valve

- Electrohydraulic solenoid
- Spool
- Housing

Diagram showing the components and flow paths labeled as A, B, P, and T.
Hydraulic System Components: Double Acting Cylinder

- Cylinder barrel
- Front end bearing
- Piston rod
- Piston
- Rear end bearing
- Cylinder symbol
Hydraulic System Components: Fixed Displacement Motor

- LSHT Motor
- Gear Motor
Hydraulic System Components: Pilot Control Valves

VP04 Pneumatic Controls

PCL04 Hydraulic Controls
Hydraulic System Components: Electronic Controls
Hydraulic Oil How Much

- General Rule – $1 \frac{1}{2} \times$ the Rated Flow of the Pump at 1200 rpm’s
- Example P51 Pump with 6.38 Cubic Inches of Displacement
- $[6.38 \text{ cid} \times 1200 \text{ rpm} / 231] \times 1.5 = 50 \text{ Gallons}$
HYDRAULIC OIL WHAT KIND

Grade AW22 – Very Cold Temperature (Northern Canada)
Grade AW32 - Good All Temperature (Most Common)
Grade AW68 - Extremely High Temperatures (Florida- New Mexico- Arizona- Texas- Southern California)

Make Sure To Use Non-Foaming Hydraulic Oil
HYDRAULIC OIL HOW TO CHECK

- Take a Sample from the middle of the Hydraulic Tank
- Does the Fluid Look Milky?
- Does the Fluid have foam or air bubbles?
- Is the Fluid Black or Burnt Looking?
- Does the Fluid Smell Like Something the Cat Brought In?
- Is their Presence of Metal Particles in the Fluid?
HYDRAULIC OIL – WHEN TO REPLACE

- When these gauges are in the red it is time to replace the filter element.
- If you have no gauge on the filter make it a point to go and purchase one from your nearest distributor.
HYDRAULIC TANKS - WHAT SIZE

- If the cylinder requires 50 gallons or more to extend you will need a 70 to 75 gallon tank, or the bed will not fully extend.
- General rule works most of the time, but make sure you do not run out of fluid when operating the equipment.
HYDRAULIC TANKS – WHAT SHOULD BE INCLUDED

Sight and Temperature Gage

Breather / Filler Cap

Suction and Return Line Ports
HYDRAULIC HOSES – WHAT KIND

- Since we are using hydraulic oil we need a hydraulic hose
- Suction Hose – 100R4
- Medium Pressure Hose up to 3000 PSI 100R17
- All Hoses Listed are for Standard Dump Truck/Trailer
HYDRAULIC PUMPS - WHAT DETERMINES THE TYPE OF PUMP

- Flow Required
- RPM’s the Pump will operate
- Hydraulic System Pressure Requirement
- Type of Hydraulic Valve [Open or Closed]
- Budget / Hours of Operation
- When full flow is not required, variable volume piston pumps are more attractive
HYDRAULIC PUMPS USED WITH OPEN CENTER VALVES

- Gear Pump
- Vane Pumps
- Fixed Displacement Piston
HYDRAULIC PUMPS USED WITH CLOSED CENTER VALVES

- Variable Volume Pressure Compensated Piston Pump
- Variable Volume Load Sense Controls
HYDRAULIC VALVES- WHAT KIND OF VALVE

- System Flow Requirement
- System Pressure Requirement
- Amount of Operator Control Required
- HP Efficiency – Heat Issues
# HYDRAULIC VALVES SIZE & SYSTEM PRESSURE

<table>
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<tr>
<th>Valve</th>
<th>Type</th>
<th>Flow</th>
<th>Max PSI</th>
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<tr>
<td>V040</td>
<td>Open</td>
<td>10.6 GPM</td>
<td>4350 PSI</td>
</tr>
<tr>
<td>V20</td>
<td>Open</td>
<td>25.0 GPM</td>
<td>3500 PSI</td>
</tr>
<tr>
<td>V20LS</td>
<td>Closed/LS</td>
<td>25.0 GPM</td>
<td>3500 PSI</td>
</tr>
<tr>
<td>DVA20</td>
<td>Open</td>
<td>40.0 GPM</td>
<td>2500 PSI</td>
</tr>
<tr>
<td>DVG20</td>
<td>Open</td>
<td>40.0 GPM</td>
<td>3500 PSI</td>
</tr>
<tr>
<td>DVA35</td>
<td>Open</td>
<td>70.0 GPM</td>
<td>2500 PSI</td>
</tr>
<tr>
<td>DVG35</td>
<td>Open</td>
<td>70.0 GPM</td>
<td>3500 PSI</td>
</tr>
<tr>
<td>VP170</td>
<td>Closed/LS</td>
<td>60.0 GPM</td>
<td>5000 PSI</td>
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HYDRAULIC VALVE – SINGLE ACTING / DOUBLE ACTING

- Single acting valves only have one work port [Generally the B Port]
- Double acting valves have two work ports [A Port and B Port]
HYDRAULIC MID INLETS

• Types
  • Combined Flow - Mid Inlet (Inlet 1 + Inlet 2)
  • Split Flow - Mid Inlet (Inlet 1 separate Inlet 2)
HYDRAULIC VALVE – POWER BEYOND

- **Purpose**
  - Allow for multiple valve sections to be run from a single section pump

Power Beyond Port to additional valve

Return Line Port
Open Center Schematic
Closed Center LS Schematic
Horse Power Consumption

\[
HP = \frac{\text{GPM} \times \text{PSI}}{1714}
\]

Rule of Thumb

- Gear Pumps are ideal when full pump flow is being used
- LS Pumps are ideal when full pump flow is not used
HYDRAULIC CYLINDERS - Rod and Telescopic

- Rod - Single Ram
- Telescopic - Multiple Stages
MOBILE CYLINDERS – SINGLE ACTING DOUBLE ACTING

- **Single Acting Cylinders**
  - Power Up
  - Gravity Down
  - Single Hose Connection
  - 3 Way Valve Work Section

- **Double Acting Cylinders**
  - Power Up
  - Power Down
  - Two Hose Connection
  - 4 Way Valve Work Section
CYLINDERS – BLEEDING AIR FROM THE CYLINDER

A messy job but has to be done

- Reasons telescopic cylinders require bleeding air
  - To avoid spongy action
  - To avoid cylinders raising in the wrong sequence
  - To avoid costly repairs
- How to bleed a telescopic cylinder (Single Acting)
  - Raise the cylinder almost to the top
  - Lower the bed to about 2 feet from the bottom
  - Turn the adjustment screw CCW and then close
  - Repeat if necessary
Hydraulic Motors - Types

- LSHT Motors
- Gear Motors
HYDRAULIC MOTORS – HOW MOTORS WORK

- Hydraulic Motors provide rotary motion
- Pressurized oil drives the rotating group for desired rotary motion
- This is not a pump
HYDRAULIC FILTRATION
SPIN ON & CANISTER

- Spin on filtration [generally low pressure return line filters]
- Canister filtration [medium to high pressure inline filtration located between the hydraulic pump and the hydraulic valve]
HYDRAULIC FILTRATION
HOW FILTERS ARE SELECTED

- Flow and Pressure
- Microns – Degree of Filtration
- Absolute versus Nominal
PTO’S TYPES

- **Manual PTO’s**
  - Used with manual transmissions
    - Six or Eight Bolt Opening
    - Pneumatic Actuator or Cable
      - Truck Clutch must be disengaged
    - Hot Shifts for manual transmission are available in pneumatically engage clutch packs
      - Truck Clutch does not need to be disengaged
- **Hot Shift PTO’s**
  - Used with automatic transmissions
    - Six or Ten Bolt openings
    - Recommended Engagement less than 1000 rpm’s
PTO – MANUAL MOST POPULAR

• Six Bolt 442 - Eight Bolt 489
• Rugged Cast Iron construction versus aluminum
• Grease able Flanges Available without pump removal
• Note: PTO Torque ratings must meet application
  • Pump, Compressors, Blowers, Water Pumps, Propane Pumps, etc.
• Note: 489 Must have pump support bracket for pumps in excess of 40 lbs.
PTO’S for Automatic Transmissions

- **270/271**
  - Six Bolt
  - Aisin, Allison, Dodge, GM, Mitsubishi
- **277/278**
  - 10 Bolt
  - Wet Spine extending Shaft life by a factor of 10
  - Allison World Transmission, Caterpillar Automatic
  - Popular with large fleets, maintenance issues with manual transmissions
- **246**
  - Ford
DUMP TRUCK - Three Line System

Air Lines

Suction Hose

Return Line Hose

High Pressure Hose

Highly Recommended
Best Service Life
Dump Trailer – Three Line System
One Line to the Trailer

Air Lines

Suction Hose

Return Line Hose

High Pressure Hose

Highly Recommended
Best Service Life
QDB Manual Spreader Valve with Power Beyond

QDB CAN BE REPLACED WITH PSM ELECTRONIC SPREADER
- Reduce In Cab Noise
- Take Hydraulic’s Out of Cab
PSM 1000 Spreader Valve
No In Cab Hydraulics

Note:
Spreader can have all hydraulic flow shut down from inside the cab.
PSM1000 Spreader Valve with LS

Note: Minimum of 3 work sections / Plow Up-Down / Plow Left-Right / Hoist / PSM 1000
Questions