

FLUID POWER

[HYDRAULICS AND PNEUMATICS]



FLUID POWER

- ▶ It is the technology that deals with the generation, control, and transmission of power using pressurized fluids.

- ❖ **HYDRAULICS**-when fluid is liquid.

Ex: petroleum oils, synthetic oils and water.

- ❖ **PNEUMATICS**-when fluid is gas.

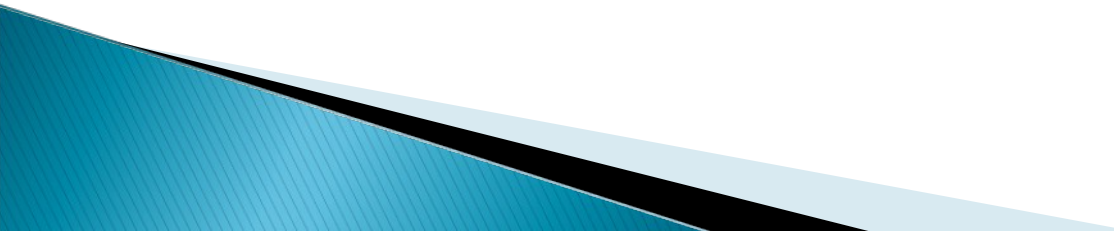
Ex: air.



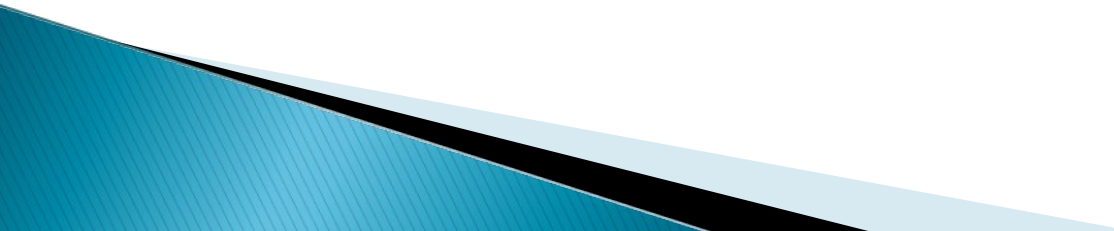
Basics methods of transmitting power

- ▶ Electrical
- ▶ Mechanical
- ▶ Fluid power

Advantages :

1. Ease and accuracy of control
 2. Multiplication of force
 3. Constant force or torque
 4. Simplicity, safety, economy.
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Drawbacks

- ▶ Hydraulic oils are messy.
 - ▶ Leakage is impossible to eliminate.
 - ▶ Possibility of fire accidents.
 - ▶ System slows down when leakage occurs.
 - ▶ Heavier in weight.
 - ▶ Valve operations are difficult.
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Classification

- ▶ Based on the control system

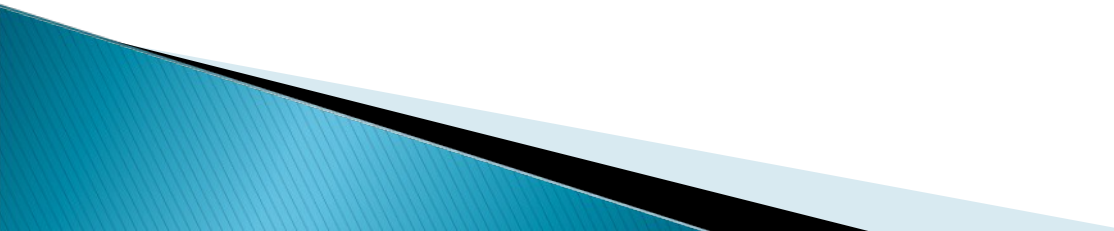
Open loop system

Closed loop system

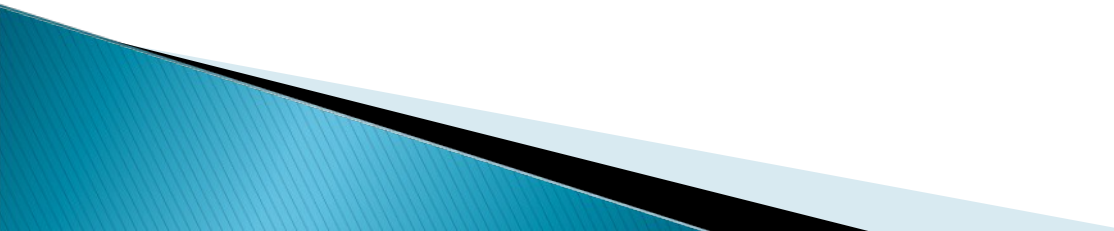
- ▶ Based on the type of control

1. Fluid logic control- using logic gates
2. Electrical control- electrical devices
3. Electronic control- micro electronic device

Basic Components

- ▶ Actuator-fluid power to mechanical power
 - ▶ Pump-to pump fluid from reservoir
 - ▶ Valves- control the direction
 - ▶ Power supply- motor to drive the pump
 - ▶ Reservoir- to store fluid
 - ▶ Piping- to carry fluid
 - ▶ Filters- remove dust and foreign particles
 - ▶ Pressure regulator- to maintain pressure
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Physical properties

- ▶ Good lubricity
 - ▶ Ideal viscosity
 - ▶ Chemical stability
 - ▶ High degree of incompressibility
 - ▶ Fire resistance
 - ▶ Good heat transfer capability
 - ▶ Low density
 - ▶ Foam resistance
 - ▶ Non toxicity
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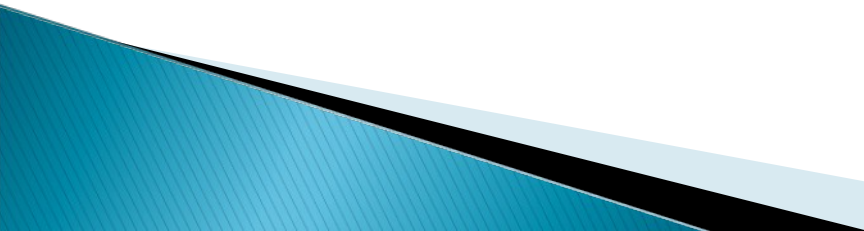
Fluids: liquids + gases

Fluid refers to both gases and liquids.

Fluids

- ▶ A liquid is fluid that for a given mass it will take the shape of its container.
- ▶ Liquids are incompressible.

Gases

- ▶ Air is the only commonly used gas in fluid systems because its inexpensive and readily available.
 - ▶ Its compressible
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Energy in hydraulic systems

- ▶ It's the ability to perform work.

Pascal's law: pressure applied to a confined fluid is transmitted equally in all directions throughout the fluid and acts perpendicular to the surfaces in contact with the fluid.

$$P_x = P_y = P_z$$

Applications:

Hydraulic Jack, press etc...

Continuity Equation

- ▶ It states that for steady flow in a pipe line the fluid flow rate is same for all locations of the pipe.

$$Q = a_1 v_1 = a_2 v_2$$

Bernoulli's Equation

- By conservation of energy, the total energy possessed by the fluid at point 1 is equal to the energy possessed by fluid at point 2.
- $Z_1 + P_1/\gamma + V_1^2/2g = C$

Frictional Losses in pipelines

- ▶ Losses in pipe valves and fittings.

Laminar and turbulent flow:

fluid flowing in smooth layers or laminae is laminar flow and fluid flowing in random and fluctuated is known as turbulent.

Reynold's Number [N_R]

If N_R less than 2000 its laminar.

If N_R greater than 2000 its turbulent.

DARCY 'S EQUATION

- ▶ $H_L = fLv^2/2gd$