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What is a **Fluid**?



A **fluid** is a substance that flows and takes the shape of its container. It includes liquids and gases, characterized by their ability to deform under applied stress.

Fluids exhibit properties like viscosity, density, and compressibility. In liquids, particles have fixed volume but not shape, while gases lack a fixed volume or shape.

Fluid dynamics studies their behavior, essential in fields like physics, engineering, and environmental science. Understanding fluid mechanics is crucial for designing efficient systems, from pipelines to aircraft, and addressing various natural phenomena like ocean currents and atmospheric flows.



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**Any substance that flows
is a fluid**

Types of Fluids

- **Ideal Fluid**
- **Real Fluid**
- **Newtonian Fluid**
- **Non-Newtonian Fluids**



Mechanicaljungle.com

Introduction to Fluid Power

Fluid power is a **1** of engineering that deals with the generation, control, and **2** of power using fluids—either **3** or gases. It plays a crucial role in various industrial and mechanical **4**, offering advantages such as high force-to-weight ratios and precise control.

applications

liquids

transmission

branch

Introduction to Fluid Power

Fluid power is a branch of engineering that deals with the generation, control, and transmission of power using fluids—either liquids or gases. It plays a crucial role in various industrial and mechanical applications, offering advantages such as high force-to-weight ratios and precise control.

Key Concepts in Fluid Power



1. Fluid Power Basics:

* Hydraulic Systems: Utilize **1** (usually **2**) to transmit power. Hydraulic systems are known for their high power density and are commonly used in **3**, aircraft, and automotive systems.

* Pneumatic Systems: Use compressed **4** or **5** to transmit power. Pneumatic systems are often employed in automation, tools, and equipment where **6** and speed are critical.

air oil gases liquids
heavy machinery cleanliness

1. Fluid Power Basics:

* **Hydraulic Systems:** Utilize liquids (usually oil) to transmit power. Hydraulic systems are known for their high power density and are commonly used in heavy machinery, aircraft, and automotive systems.

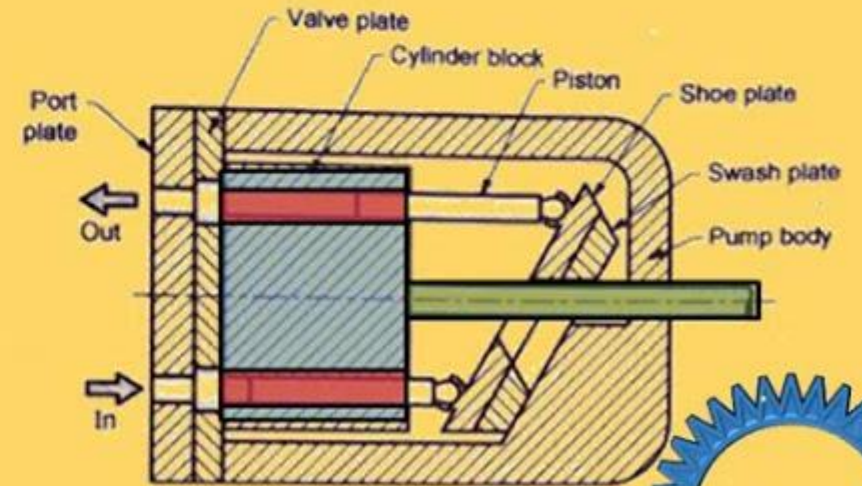
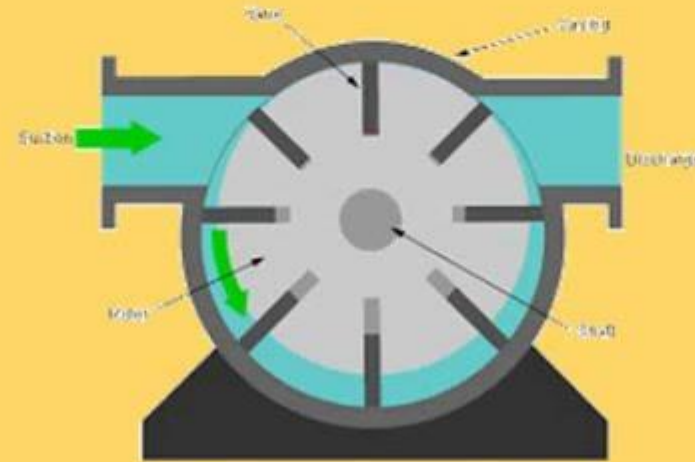
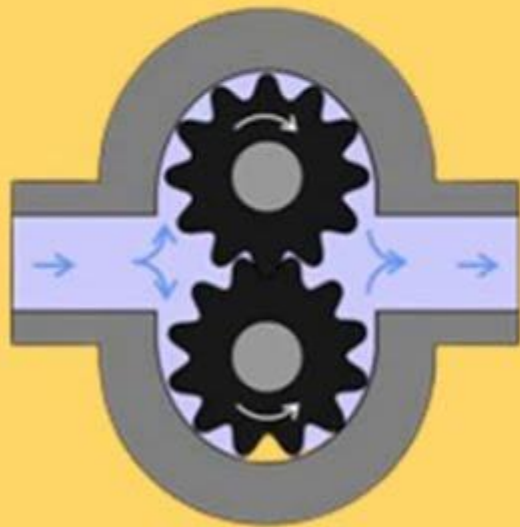
* **Pneumatic Systems:** Use compressed air or gases to transmit power. Pneumatic systems are often employed in automation, tools, and equipment where cleanliness and speed are critical.

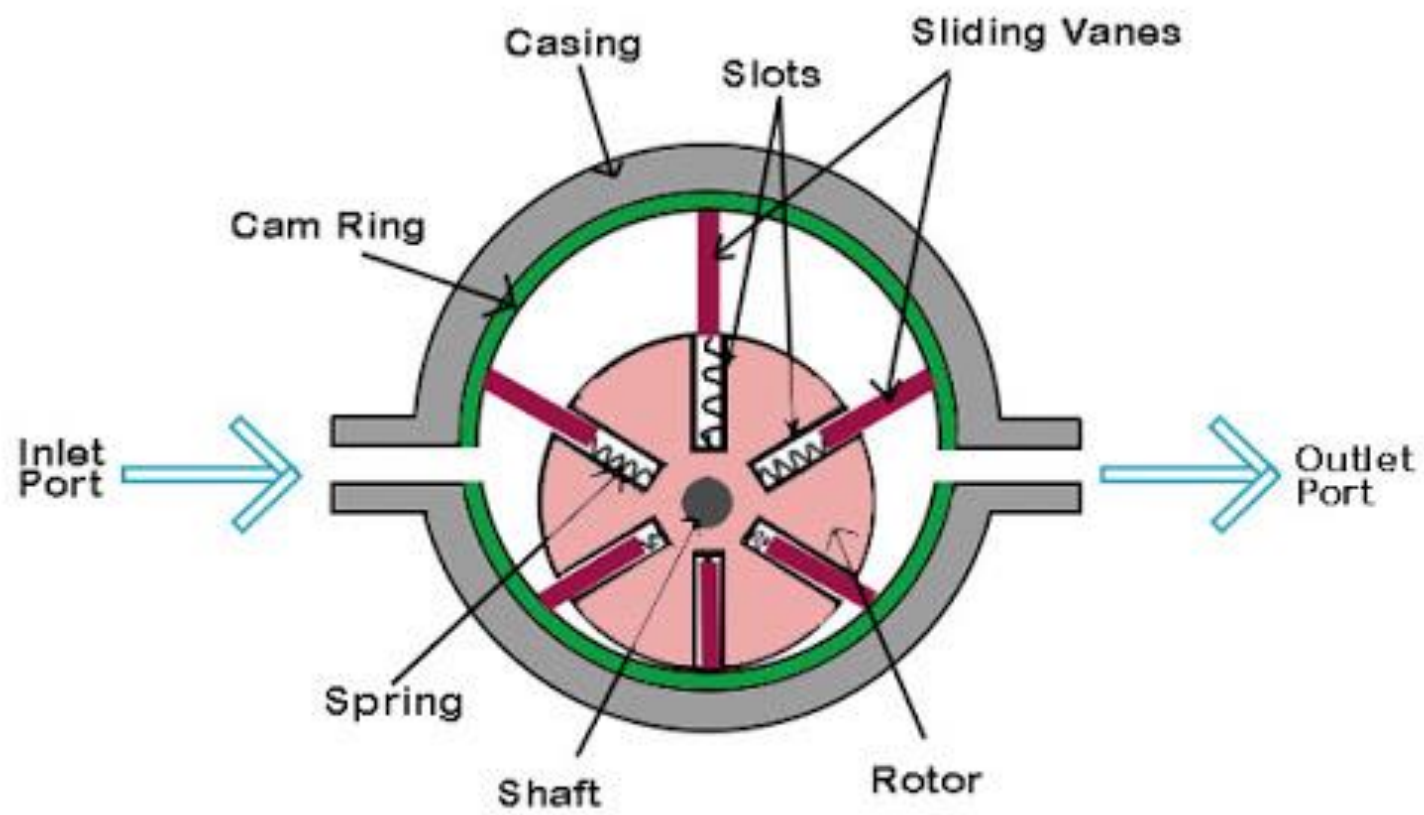
2-Components:

- **Pumps:** 1 _____ mechanical energy into 2 _____ energy by moving fluid through the system. Common types include gear pumps, vane pumps, and piston pumps.
- **Actuators:** 3 _____ that convert fluid power into 4 _____ motion. 5 _____ cylinders and pneumatic actuators are typical examples.
- **Valves:** Control the direction, pressure, and flow of the fluid. They regulate the operation of the system by 6 _____ fluid to various parts of the circuit.
- **Reservoirs:** 7 _____ the fluid and provide a means to maintain fluid levels and ensure smooth operation of the system

store control devices mechanical
convert hydraulic directing

Comparison Between Gear Pumps, Vane Pump And Piston Pump





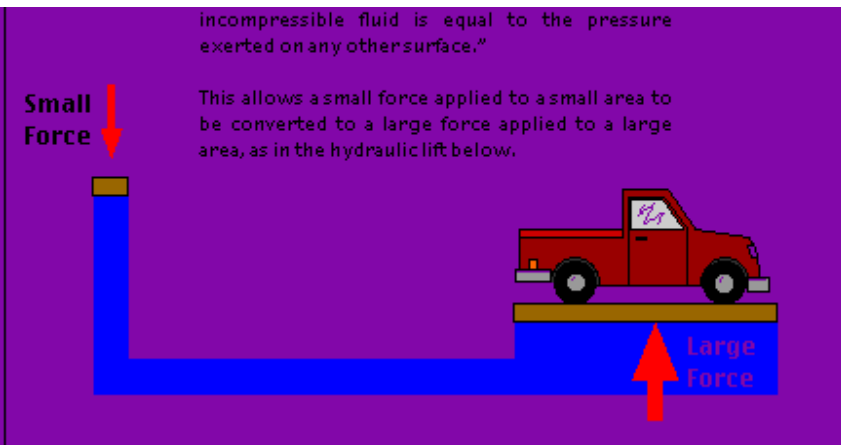
Vane Pump

2-Components:

- **Pumps:** Convert mechanical energy into hydraulic energy by moving fluid through the system. Common types include gear pumps, vane pumps, and piston pumps.
- **Actuators:** Devices that convert fluid power into mechanical motion. Hydraulic cylinders and pneumatic actuators are typical examples.
- **Valves:** Control the direction, pressure, and flow of the fluid. They regulate the operation of the system by directing fluid to various parts of the circuit.
- **Reservoirs:** Store the fluid and provide a means to maintain fluid levels and ensure smooth operation of the system

3-Principles of Operation:

- Pascal's Principle: States that a in pressure applied to an enclosed fluid is transmitted undiminished to all portions of the fluid and to the walls of its container. This principle is fundamental in hydraulic systems.
- Bernoulli's Equation: Describes the of energy in a flowing fluid, which is essential in understanding pressure and flow characteristics in pneumatic systems.



conservation
changes
change

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4-Applications and Advantages:

- Fluid power systems are integral in manufacturing automation, construction machinery, aircraft systems, and automotive engineering.
- Advantages include the ability to transmit high forces with compact equipment, smooth and precise control, and the capability to operate in hazardous environments

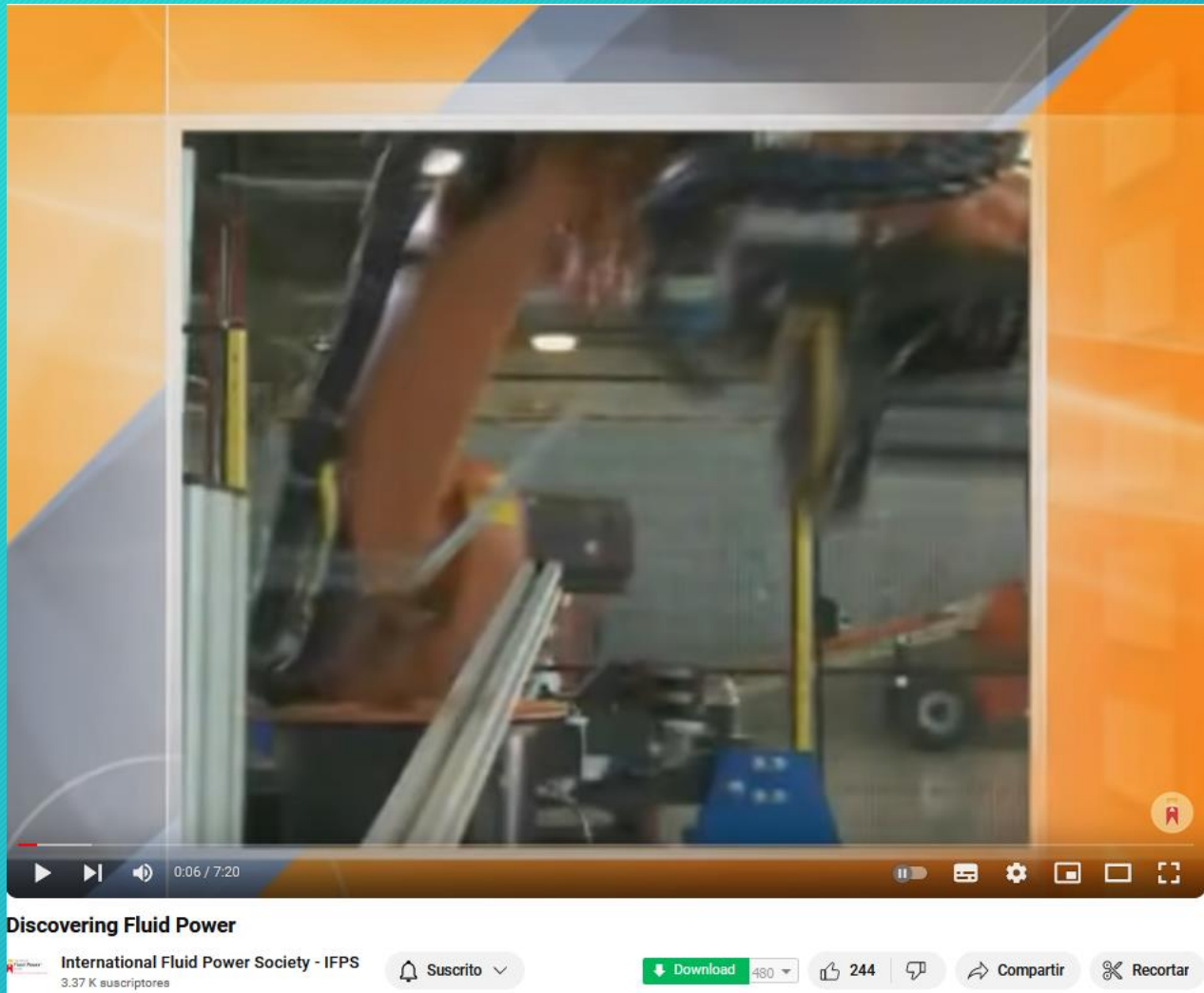
5-Safety and Maintenance:

- Ensuring the integrity of fluid power systems involves regular maintenance, such as 1 [] for leaks, 2 [] proper fluid levels, and 3 [] system pressure.
- Safety 4 [] must be observed to 5 [] accidents, especially given the high pressures and forces involved in these systems.

prevent precautions checking
monitoring ensuring

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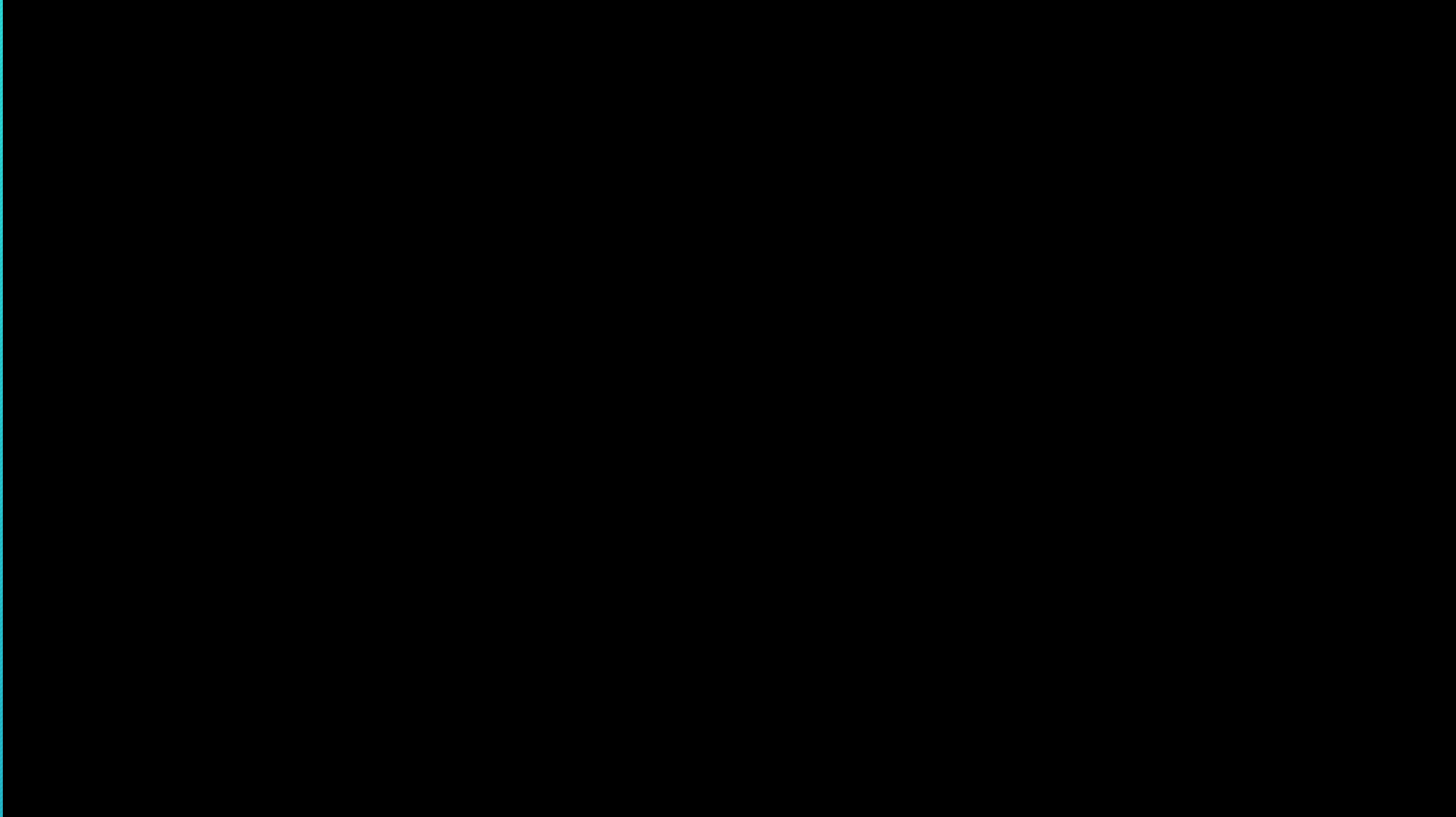
What is fluid power?
Watch the video and take down notes, please.

Discovering fluid power



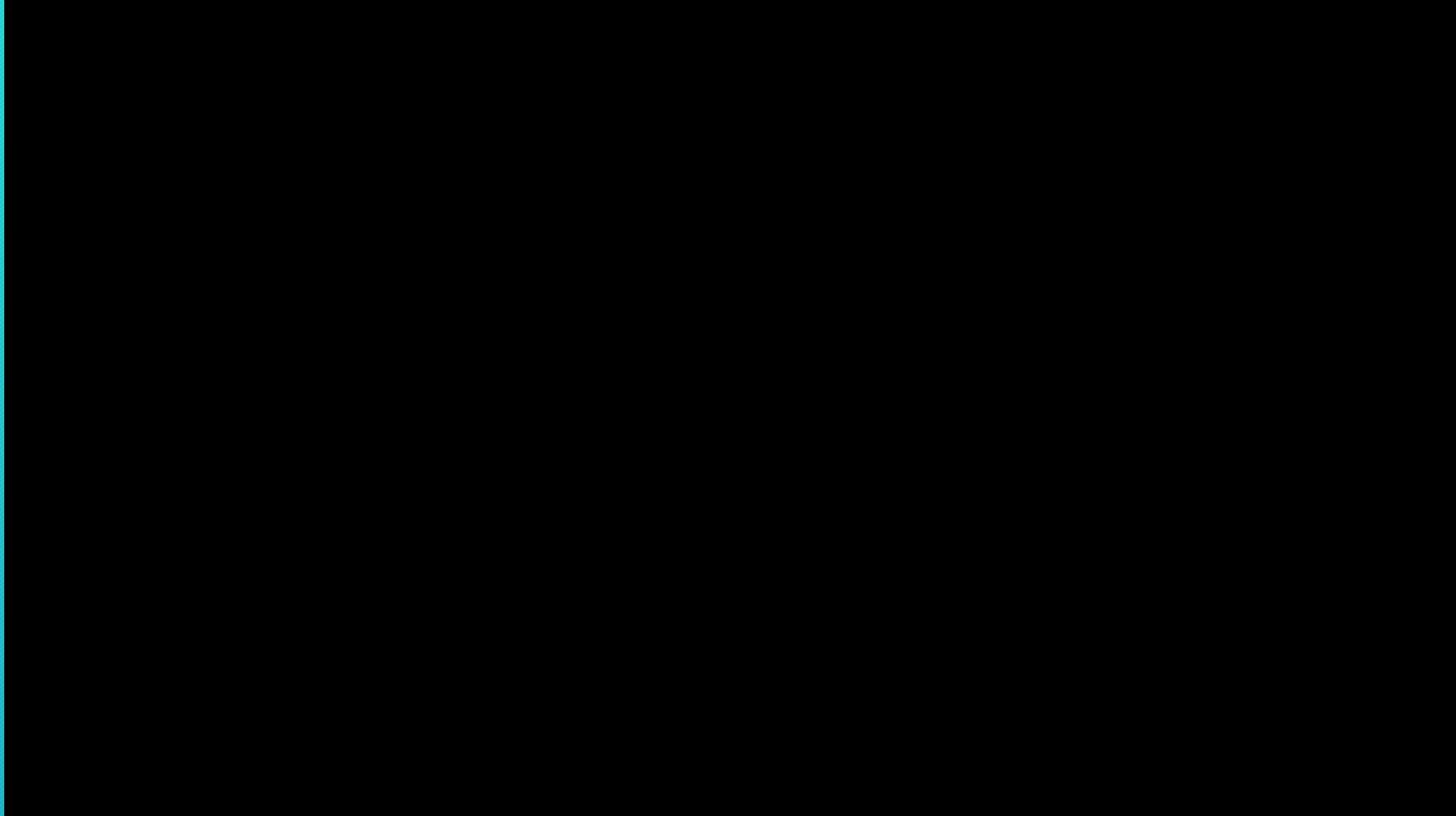


Hydraulics and pneumatics for teachers





Pneumatic and Hydraulic Systems - An Introduction



https://www.youtube.com/watch?v=xsGxOfwWm_E



0:00
in industrial processes there is a
0:02
requirement for objects or substances to
0:04
be moved from place to place in order to
0:06
do this industrial processes use devices
0:09
called Prime Movers Prime movers
0:11
transfer energy into physical movement
0:14
electricity can be used to power Prime
0:16
Movers
0:17
think of a motor that could be used for
0:20
a rotary movement such as driving a
0:22
wheel on a track or a pulley system if
0:25
linear movements are required using an
0:26
electric motor then screw jacks or rack
0:29
and pinion gearing may be used to
0:30
convert a rotary movement into a desired
0:33
linear movement
0:35
electromagnetic forces can be used for
0:37
Prime movers usually in the form of a
0:39
solenoid where electricity is applied to
0:42
an electric magnet that moves a shaft a
0:44
small distance against the spring
0:46
however there are alternatives to
0:48
electricity when it comes to Prime
0:49

Movers
0:50
pressurized fluid and gas systems can be
0:52
used to move energy from location to
0:54
location and also act in linear or
0:57
rotary fashion
0:58
these systems are called pneumatics for
1:00
gas field systems and hydraulics for
1:03
liquid filled systems in this video
1:05
series we are going to explore how these
1:07
pneumatic and hydraulic systems work
1:10
from the fundamental principles that
1:11
govern the systems including
1:13
calculations you might need to
1:14
understand two practical explanations of
1:17
the different parts of these systems
1:19
including pressure regulation hydraulic
1:22
pumps air compressors and air treatment
1:24
actuators and control valves as well as
1:27
the accessories to these systems
1:30
we also look at sequencing applications
1:32
that can be produced using Hydraulics
1:34
and pneumatics in industry
1:36
to finish the series I'll go through
1:37
some basic fault finding and maintenance

Pneumatics for beginners

pneumatics

noun, plural in form but singular in construction

definition: a branch of mechanics that deals with the mechanical properties of gases

pneumatic

adjective

Definition of *pneumatic*:

of, relating to, or using gas (as air): as

a : moved or worked by air pressure

b : adapted for holding or inflated with compressed air

What is a PNEUMATIC system?

Uses gasses to do their work

*The gasses **ARE** compressible*

The systems can be open systems

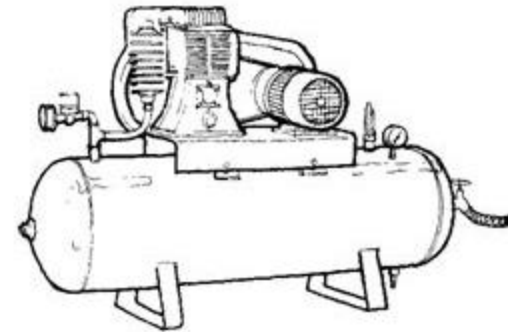
What is a HYDRAULIC system?

Uses Liquids to do their work

*The Liquids are **NOT** compressible*

The systems are always closed systems

*Remember the
definition of
WORK... “to
exert a FORCE
over a DISTANCE”*

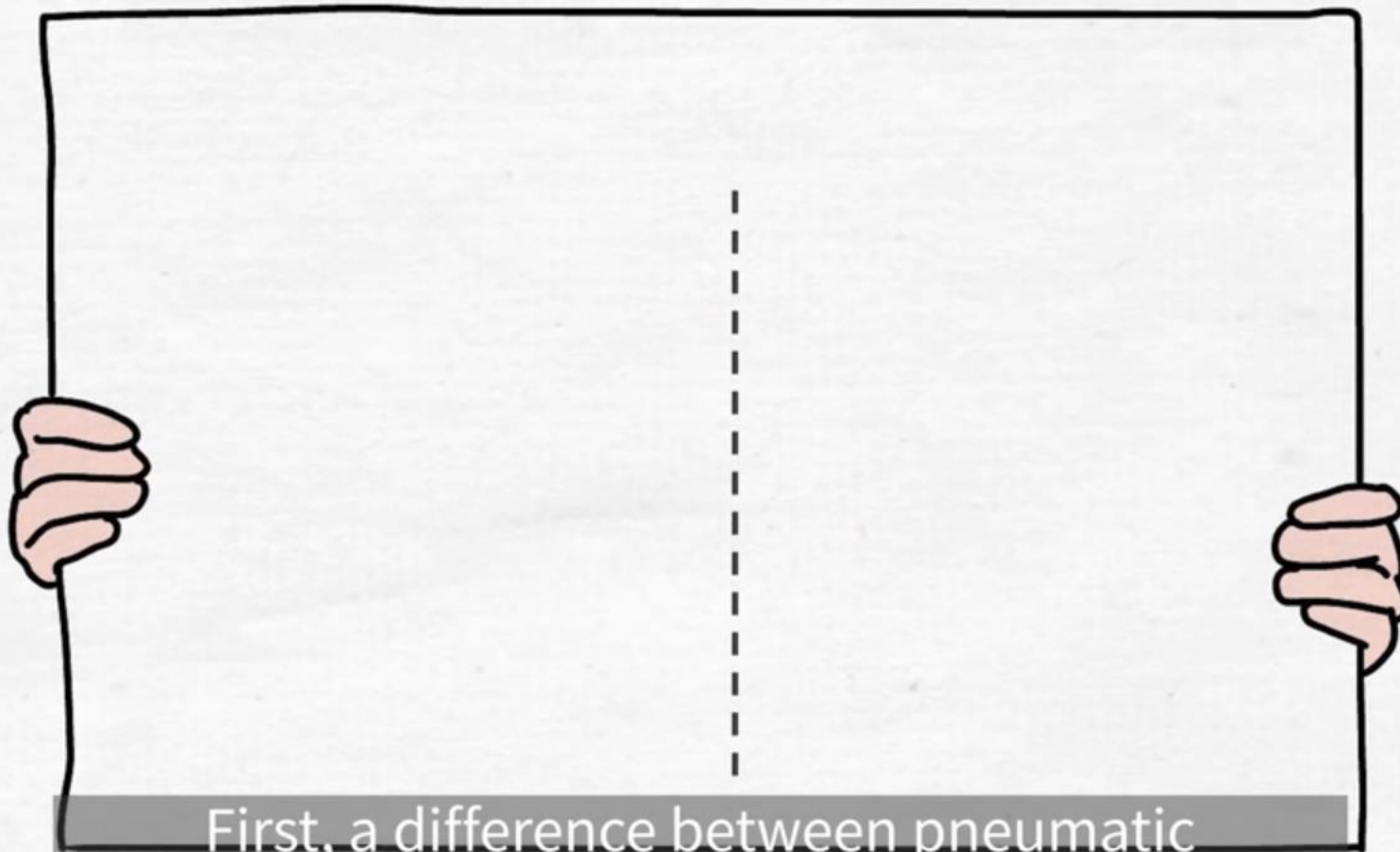


Six differences between pneumatics and hydraulics



Six differences between pneumatics and hydraulics

Pneumatic VS Hydraulic



First, a difference between pneumatic and hydraulic systems lies in the energy source

Six differences between pneumatics and hydraulics



Hello, Ms. Pneumatic here~!



Summary

Pneumatic Hydraulic

Energy Source	Air	Hydraulic oil
Speed of Response	Fast	Not bad
Degree of Precision	Bad	Good
Force	Low	High
Complexity of Piping system	Simple	Complex
Operating Environment	Clean & Safety	Fire risk

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Fluid Power Industry

Fact Sheet



In 2021, approximately **772 companies** in the United States employed more than **61,000 people** in the manufacture of fluid power components, representing an annual payroll of more than

\$4.4 Billion

Fluid power significantly impacts the US economy with thousands of companies and over **935,000 employees**, totaling a payroll of

\$75 Billion

In 2022, U.S. #fluidpower products were sold in 193 countries around the world with exports valued at \$8.3 billion

40% increase from 10 years earlier

In 2022, shipments of #pneumatic products in the United States totaled **\$6.1 billion**, or **24%** of the fluid power total. In 2022, shipments of #hydraulic products in the United States totaled **\$19.6 billion**, or **76%** of the fluid power total



■ Hydraulics
■ Pneumatics



#FluidPower-dependent employers reside in nearly all **50 U.S. states**. **California, Michigan, Ohio, Indiana, and Illinois** employ the highest number of people



In 2022, the manufacture of fluid power components was a **\$25.6 billion** industry in the United States. It was also competitive worldwide, with 2022 exports valued at **\$8.8 Billion**

#FluidPower employers reside in **36 of the 50 U.S. states**. The top 5 states with the highest number of employees are **Michigan, Ohio, California, Illinois, and New York**



The **top five pneumatic markets**, which represented **49%** of all pneumatic product sales in 2022, are **automotive** (including light truck and utility vehicle), **semiconductor machinery**, **packaging machinery**, **medical equipment**, and **metalworking/machine tools**

The **top five hydraulic markets**, which represented **52%** of all hydraulic product sales in 2022, are **construction machinery**, **agricultural machinery**, **material handling** (including conveying, heavy duty truck (class 4-8), and **automotive** (including light truck and utility vehicle)