

E230 Aircraft Systems

The Amazing Fluid Power

6th Presentation

School Of
Engineering



What is fluid power?

- Fluid power is the technology of exploiting the properties of fluids to generate, control, and transmit power as a result of the pressurization of fluids.
- As the term fluid refers either to gases or to liquids, fluid power is also subdivided into the categories of hydraulics and pneumatics.

Control surfaces

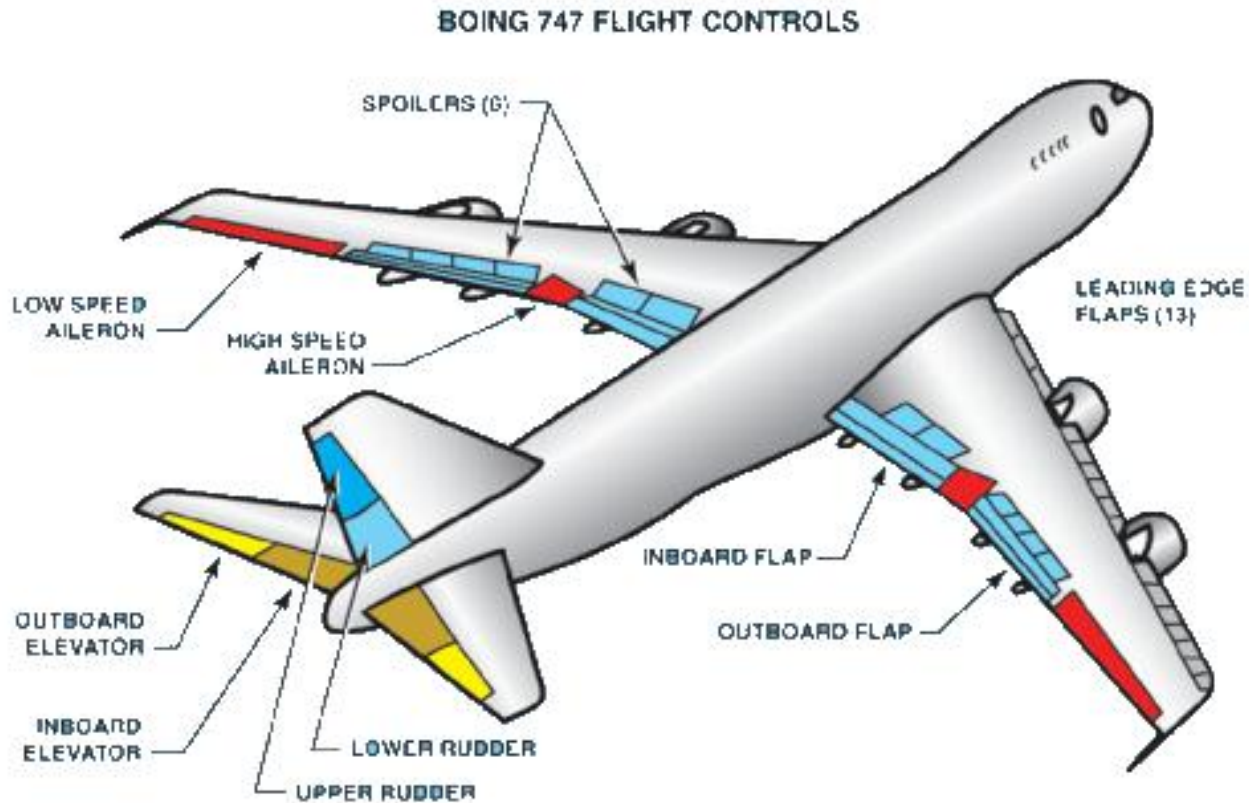


FIG 01-63

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Aircraft system with fluid power

- Primary and Secondary Flight Control surfaces
- Landing Gear System
- Wing and Engine Anti-Ice system
- Engine Start System
- Thrust Reversers



Basic Difference between Hydraulics and Pneumatics

	Hydraulics	Pneumatics
1	Uses compressed liquid (oil) for power generation	Uses compressed air for power generation
2	Produces large amount of force due to high pressure (in the range of up to 600 bar)	Produces limited force due to low pressure (in the range of 6 to 8 bar)
3	High power to weight ratio	Low power to weight ratio
4	Hydraulic systems are more precise as the medium (liquid) is incompressible.	Pneumatic systems are not so precise as the medium (air) is compressible
5	The use of oil as working fluid provides self lubrication function	No self lubrication possible as the working medium is air

Continued...

6	Easier to achieve linear motion, but with limited speed	Easier to achieve linear motion, but with relatively higher speed
7	Hydraulic motors with lower speed but highly efficient	Pneumatic motors with high speed but highly inefficient
8	Sensitive to temperature fluctuation	Insensitive to temperature change
9	Oil leak makes the system unfit for applications where hygiene is a requirement	Relatively clean and suitable for food and pharmaceutical application

Hydraulic System Structure

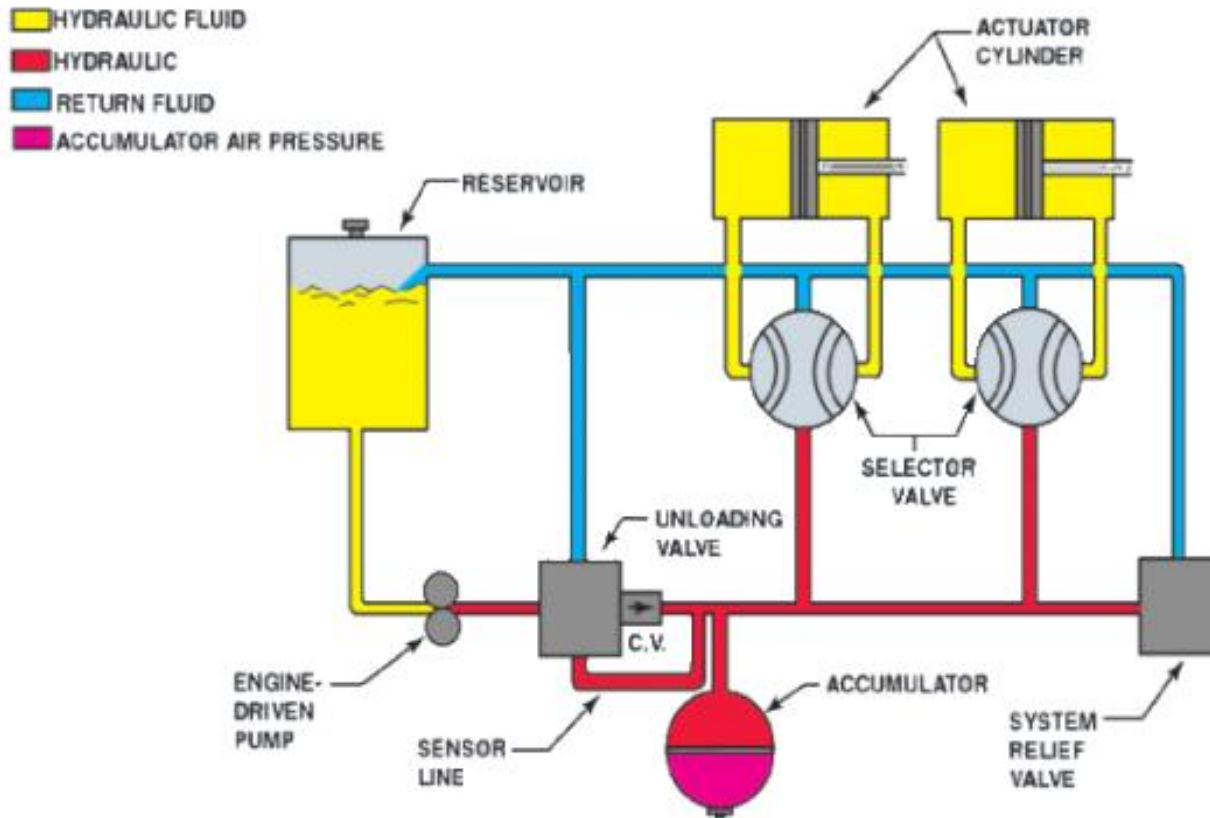
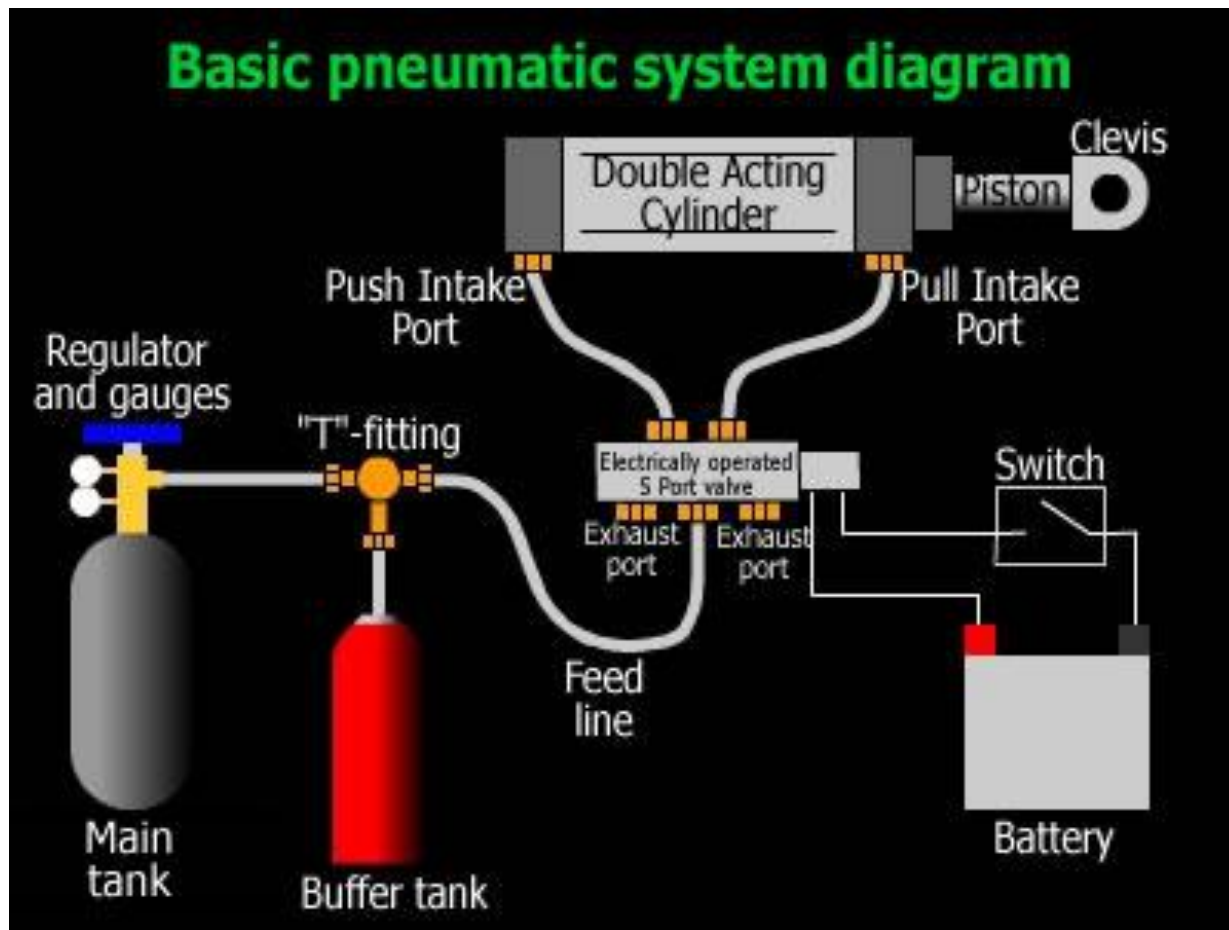
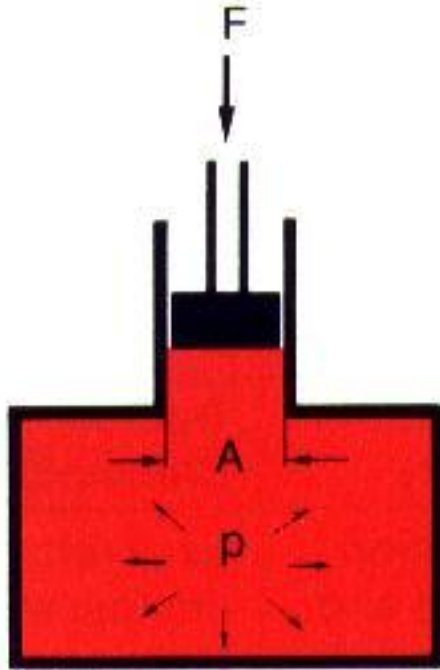


FIG 08-14
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Pneumatic System Structure

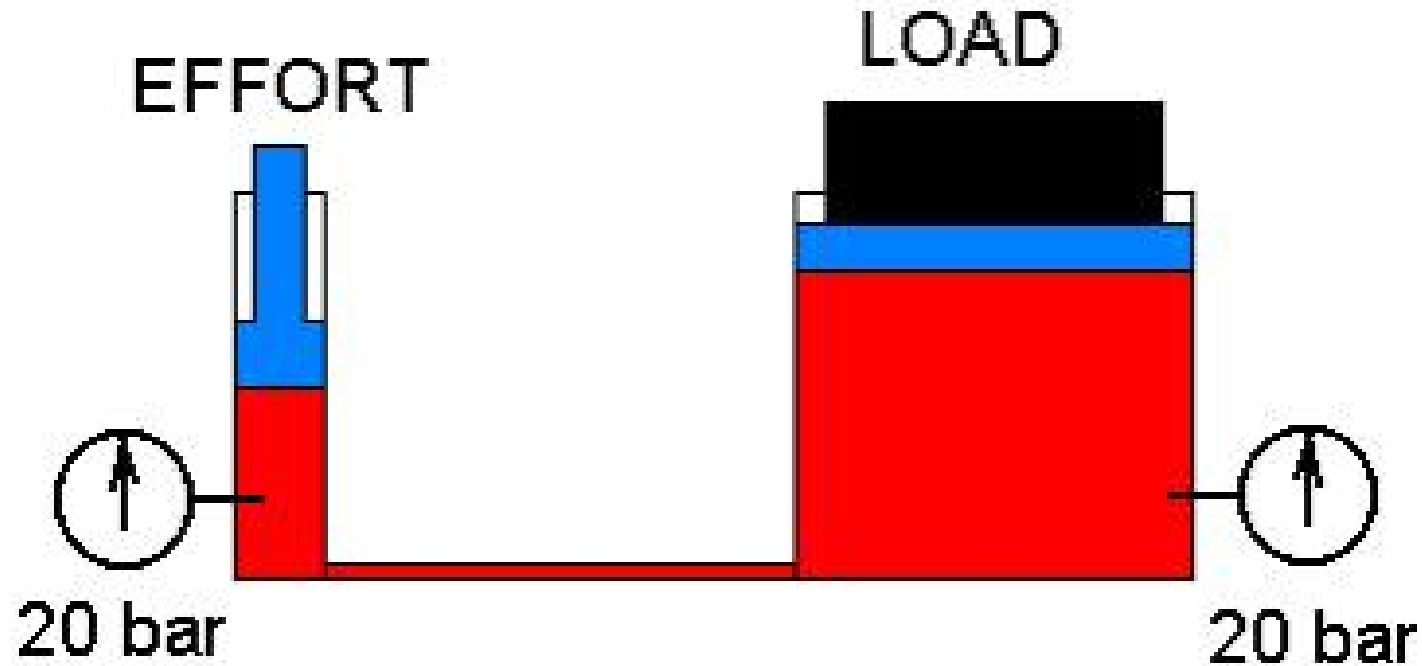


Pascal's Law

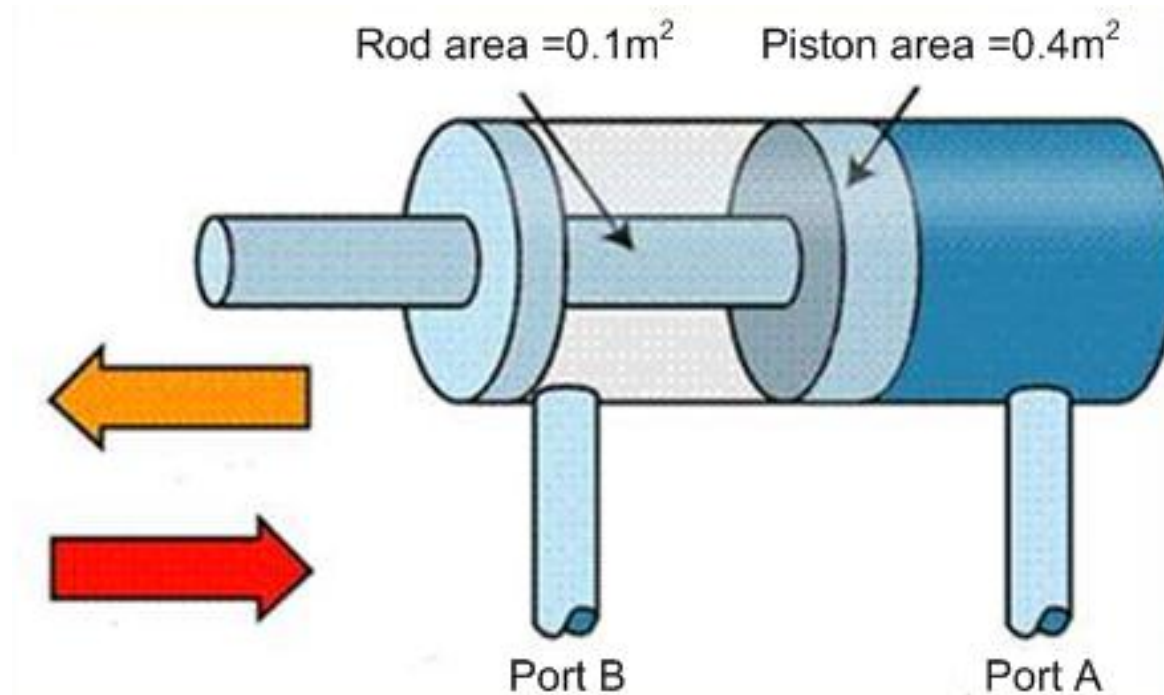


Pascal's Law states that:
"pressure exerted anywhere in a confined liquid is transmitted equally and undiminished in all directions throughout the liquid."

Amplification of Hydraulic force



Force Produced in a Hydraulic Cylinder



Hydraulic Applications in Aircrafts

□ Primary Flight Controls:

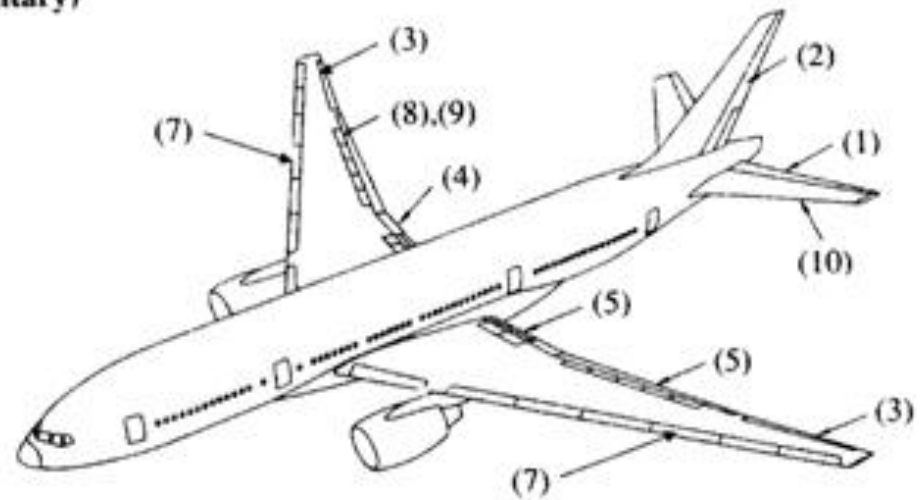
- -Elevators – (1)
- -All-moving tail surfaces (military)
- -Rudders – (2)
- -Ailerons – (3)
- -Flaperons – (4)
- -Canards

□ Secondary Flight Controls

- -Flaps – (5)
- -Slats – (7)
- -Spoilers – (8)
- -Airbrakes – (9)
- -Stabilizer trim – (10)

□ Utilities

- -Landing gear
- -Brakes
- -Gear steering
- -Aerial refueling probes (military)
- -Cargo doors
- -Loading ramp (military)
- -Passenger stairs



Pneumatic System in Aircrafts

The main source of pneumatic power in aircrafts is the bleed air system. Bleed air is extracted from the engine compressor and after cooling and pressure reduction it is used for variety of functions:

- High pressure bleed air is used as motive power for many of the valves
- Medium-pressure bleed air is used to start the engine
- Bleed air is also used to provide anti-ice protection
- It is used as the motive power for the engine thrust reversers.
- Bleed air tapped from the engine is used to provide air to pressurize the cabin and cabin conditioning environmental system.

Learning Objectives

- Basics of Hydraulics
- Basics of Pneumatics
- Hydraulic systems in aircraft
- Pneumatic systems in aircraft
Bleed Air System