

Pneumatic & Hydraulic Systems

Fluid Power: Power generated by an effective pumped or compressed fluids to provide force and motion to mechanisms. This force may be in the form of pushing, pulling, lifting or cutting. Fluid power includes hydraulics, which involves liquids, and pneumatics which uses air.

Advantages of Fluid Power

Hydraulics and pneumatics systems have a number of favorable characteristics:

- Very high power to weight ratio.
- Self-lubricating and cooling
- Low Initial cost, especially Pneumatic System
- Motion can be transmitted via fluid without the need for complicated systems of gears, cams, and levers
- The forces generated are transmitted over large distances with small loss
- It can provide smooth, flexible and uniform action without vibration
- It provides variable motions in both rotary and straight-line
- Fluid power systems are economical to operate

Disadvantages of Fluid Power

- Leaks must be prevented. This is a serious problem with the high pressure obtained in many fluid power installations
- Movement of the fluid within the lines and components can cause friction against the containing surfaces which can lead to serious losses in efficiency
- Fluid must be kept clean, clogging can cause series damages

Pneumatic or Hydraulic?

- In general, when the application requires a low amount of power and only fairly accurate control, a pneumatic system may be used.
- If the application requires a great amount of pressure and/or extremely accurate control, a hydraulic system should be used.

Pneumatic	Hydraulic
Power to weight ratio is lower than the Hydraulic System	Very High Power to weight ratio
Relatively cheap	More expensive than pneumatic
Can exhaust to atmosphere	Mess from oil leaks
Temperature has less effect	Oil property changes with temperatures
Safe in potentially explosive environment	Danger from oil leaks

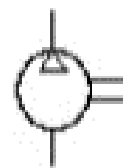
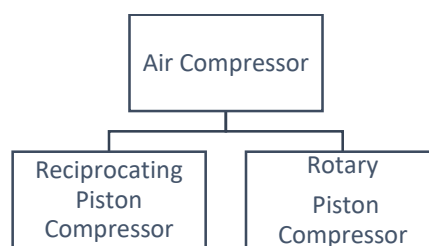
Pneumatic systems components

The Pneumatic system consists of

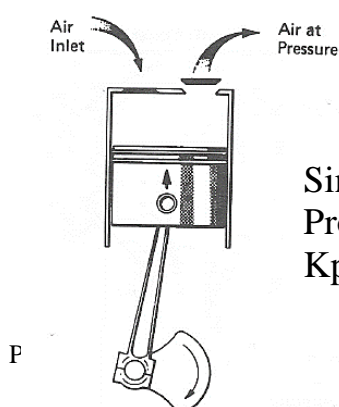
- Air compressors
- Air filter, dryer and separator
- Air reservoir (tanks)
- Regulator, relief, check and control valves
- Actuation cylinders

Air compressors

Rises the air pressure from atmospheric value to the desired level. Pneumatic components are designed for a maximum operating pressure of 800 to 1000 Kpa (8-10 bar).

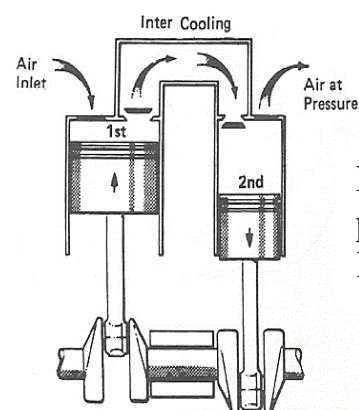


Reciprocating piston compressors



Single acting piston
Produces up to 400
Kpa (4 bar)

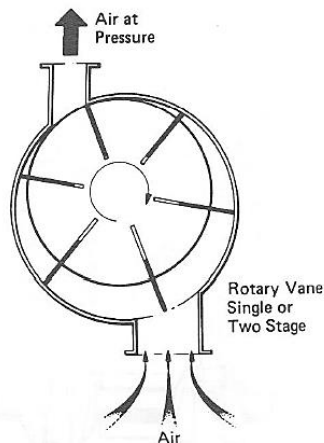
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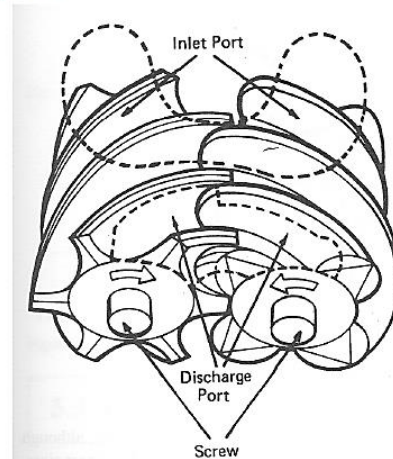
Double acting piston
produces up to 800
Kpa (8 bar)

Rotary compressors: It uses rotating elements to compress and increase the pressure of the air.

Rotary Vane compressors:

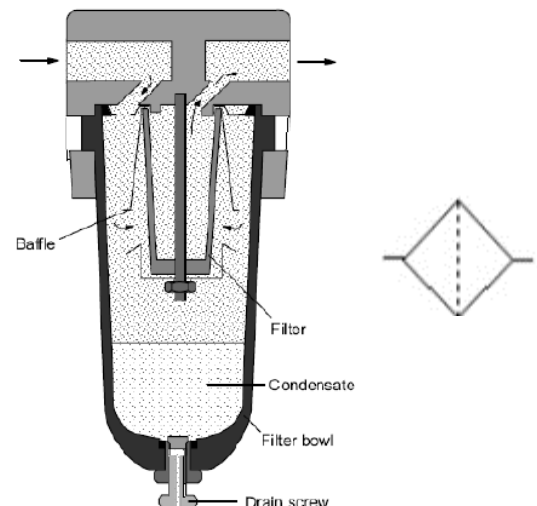


Screw compressor:

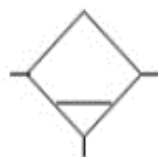


Air preparation: involves the following

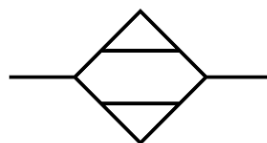
1. A pneumatic filter is a device which removes contaminants from a compressed airstream. One characteristic of compressed-air filters is the size. The size of the filter element indicates the minimum particle size which can be filtered out of the compressed air. Typical 5 microns.



2. Water separators separate out the mist of water droplets which are sometimes suspended in air by centrifugal means.



3. Pneumatic Dryer: An extra stage to dry out the compressed water using silica gel.

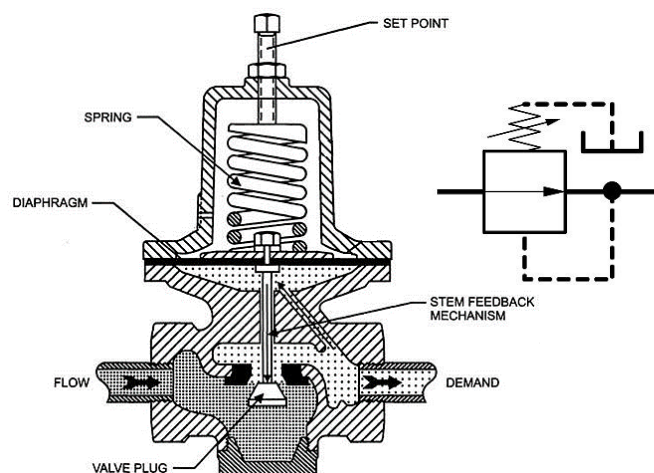


Reservoirs: store the compressed air from the compressor.

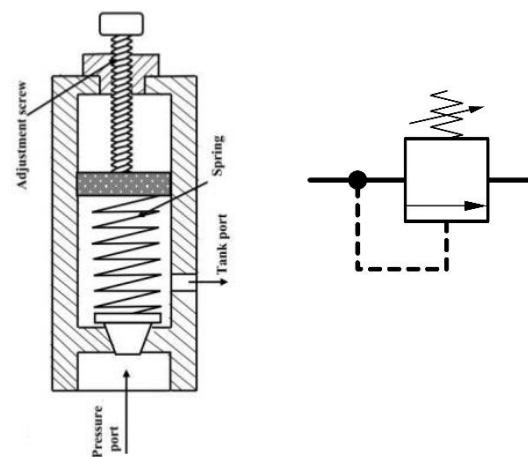


Pneumatic Valves

Pressure regulator valve: is a control valve that **reduces** the input pressure of a fluid to a desired value at its output keeping the operating pressure constant, regardless of pressure fluctuations or air consumption in the system **as long as** the input pressure at the pressure regulator is higher than the output pressure.



Pressure relief valve: When the set maximum pressure is reached, the pressure-relief valve opens and the air is exhausted to atmosphere.



Pressure check valve: on-return valve or one-way valve is a valve that normally allows fluid (liquid or gas) to flow through it in **only one** direction.

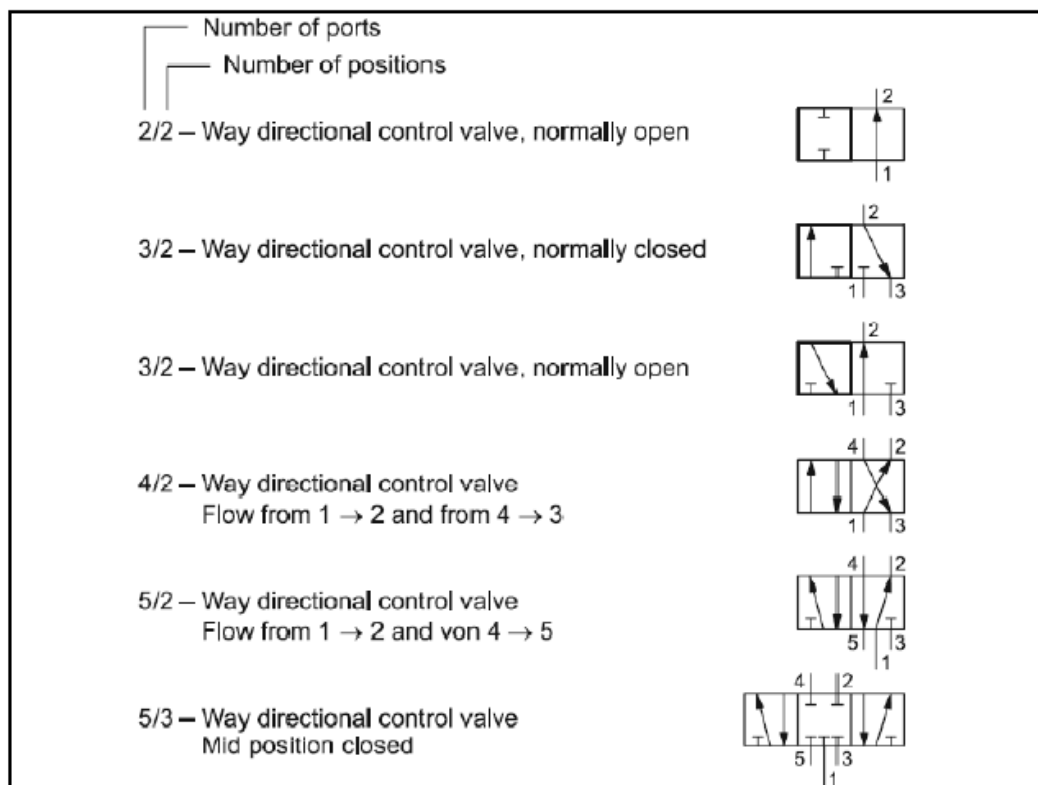


Directional control valves

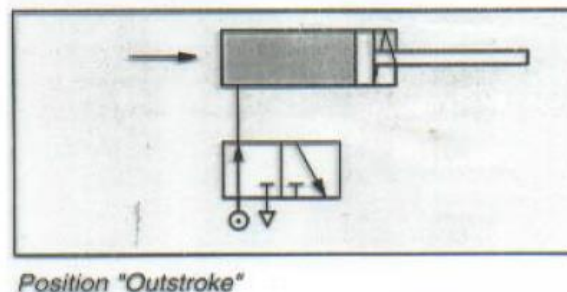
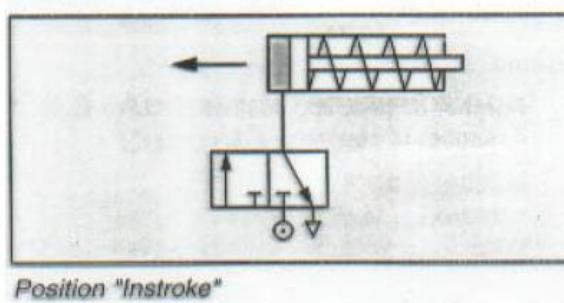
Devices that ***influence the control taken by an air*** by opening the passage of air and directing it to particular air lines or canceling it by blocking their passage or relieving the air to atmosphere via an exhaust port.

The directional control valve is characterized according to:

- Number of switching positions & Ports (2-way, 3-way, etc.)
- Method of actuation (Manual, mechanical, electrical)

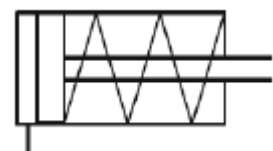


Ex) 3/2 – Way directional valve, normally closed



Pneumatic actuator: is an output device that converts the supplied fluid energy into a useful work (linear or rotary motion).

Single-acting cylinders: air is applied on **only** one side of the piston face. The other side is open to atmosphere and The return movement of the piston is produced by a built-in spring.



Double-acting cylinder: air is applied on **both** sides of the piston face. So that motion is controller in both directions.

