

Pneumatic Systems

Air Generation & Distribution

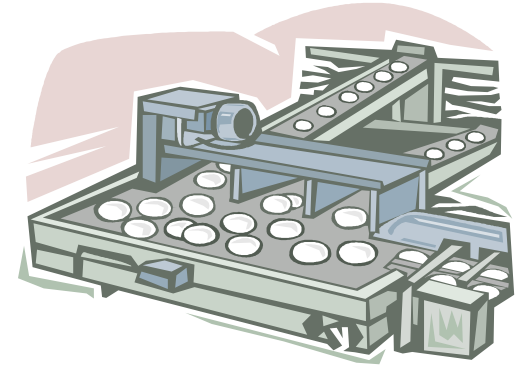
Source – Festo Textbook TP-101 Pneumatics Basic Level

Air Generation & Distribution

Air Preparation

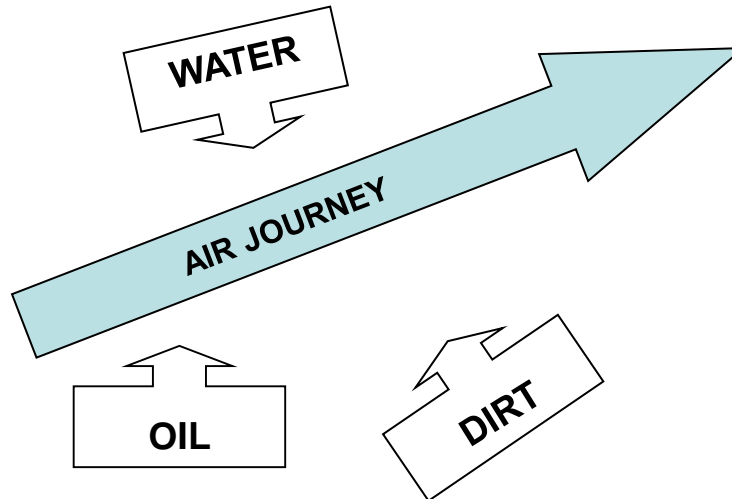
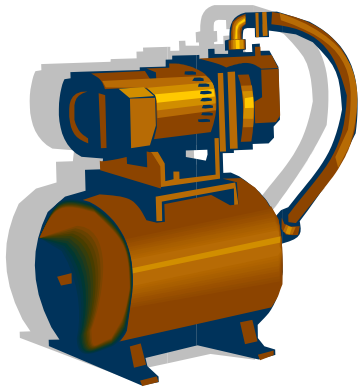
The 3 Musts!

1. Correct pressure
2. Dry air
3. Clean



Components

- Filters
- Compressors
- Dryers
- Filter c/w H2O separator
- Pressure regulators
- Lubricators
- Drainage points



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Air Preparation

Poorly Prepared Air Leads to:

- Rapid wear of seals & moving parts
- Oiled up valves
- Contaminated silencers
- Corrosion in pipes, valves, cylinders, etc
- Flushing out of lubrication of moving components

Leaked air may
contaminate product
like food!



Most pneumatic components work up to 8 – 10 Bar (116 – 145 PSI)

Most economical working pressure is 6 Bar (90 PSI)

Pressure losses typically 0.1 to 0.5 Bar (1.5 – 7 PSI)

Compressor should provide around 7 Bar (100 PSI)

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Air Compressors

The selection of an air compression is dependant upon:

- Quantity of air
- Pressure
- Quality & cleanliness
- Dryness

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Air Compressors

Compressor Types:

1. Reciprocating Piston Compressor
 1. Piston
 2. Diaphragm
2. Rotary Piston Compressor
 1. Sliding Vane
 2. Twin-shaft Screw
 3. Roots
3. Flow Compressor
 1. Radial Flow
 2. Axial Flow

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Air Compressors

Reciprocating Piston Compressor

Piston

A piston compresses the air drawn in via an inlet valve. The air is passed on via an outlet valve.

- Very common
- Wide range of pressures
- Can be multi-stage for > PSI
- Single stage → 4 bar
- Double stage → 15 bar
- Treble stage → > 15 bar

Diaphragm

Compressor chamber is separated from the piston by a diaphragm.

- Oil cannot get into the air flow
- Food
- Pharmaceutical
- chemical

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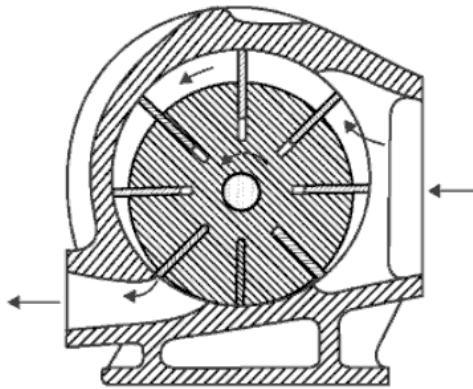
Air Compressors

Rotary Piston Compressor

Sliding Vane

A series of vanes that slide on a rotor.

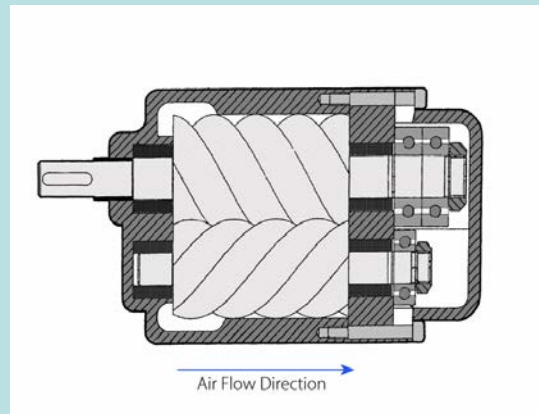
- Must use oil to cool & lubricate



Screw

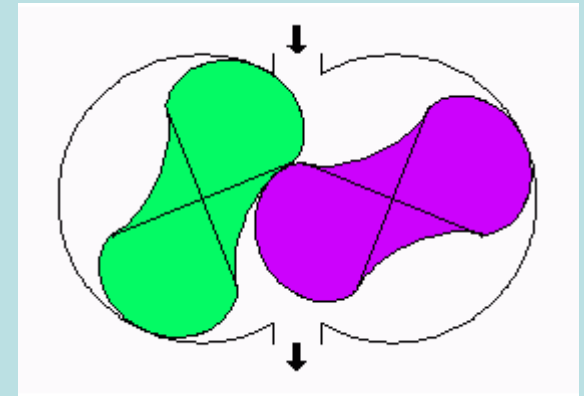
Two screws that are meshed together to compress air.

- Can be oil free
- Can be multi-stage
- Stable output pressure – no pulsating



Roots

Consists of two cycloidal wheels each with two cogs.



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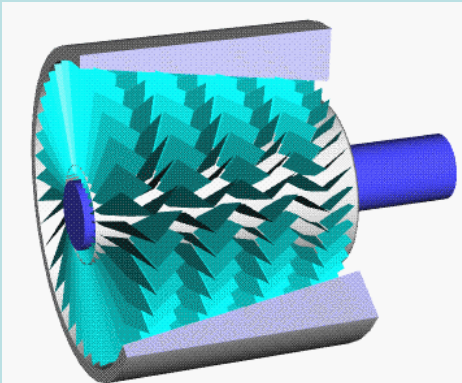
Air Compressors

Flow Compressor

Axial Flow

Air is made to flow by means of several turbine wheels.

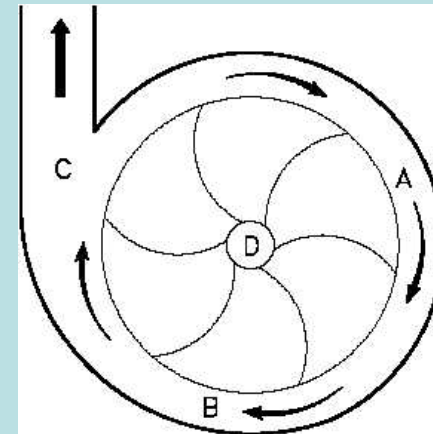
- Large air flow



Radial Flow

Air is made to flow by means of several turbine wheels.

- Large air flow





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Air Compressors

Regulation

It is necessary to regulate the compressor to meet the fluctuating demands of pneumatic systems.

Types of Regulation

Idling Regulation

Relief – operates against a relief valve.

Shut-off – suction side is shut off.

Claw – a claw holds the suction valve open

Part-load Regulation

Speed Adjust – speed of drive motor is adjusted based on pressure.

Suction Throttle Control
– a restrictor in the suction connection.

Intermittent Control

On – Off Control – based on min and max pressures.

Duty Cycle

Recommended around 75% - average & max air requirements should be calculated!

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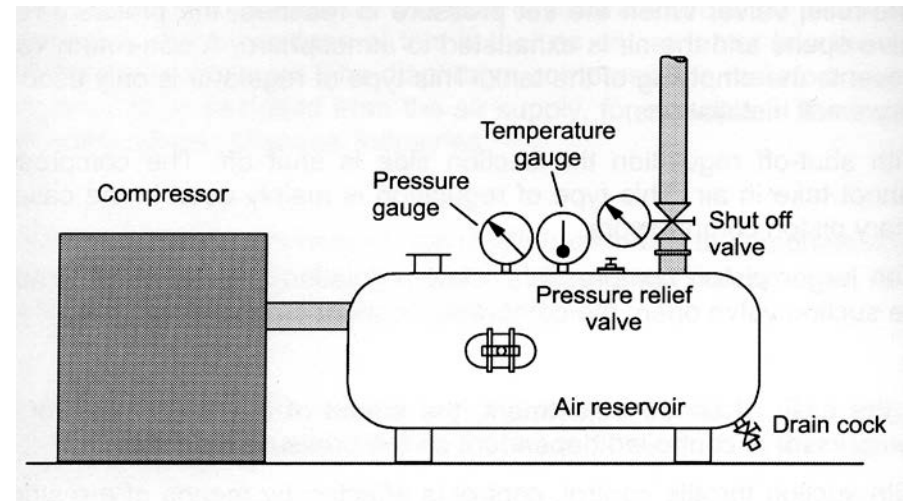
Reservoirs

A reservoir is placed downstream of the compressor. It's function is to:

- **Stabilize compressed air**
- It also has the effect of cooling hot air. Condensation must be removed periodically.

The size of a reservoir depends on the:

- Delivery volume of the compressor
- Air consumption
- Network size
- Permissible pressure drop in the supply network



Compressor does not have to run continuously.

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Air Dryers

Water enters the air system through the air intake of the compressor.

- Amount of water depends largely on relative air humidity
- Relative air humidity is dependent on the air temperature
- Dew point temperature is the temperature at which relative humidity is 100%
- The lower the Dew point the more the water will condense

The service life of pneumatic components is reduced when exposed to moisture.

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Air Dryers

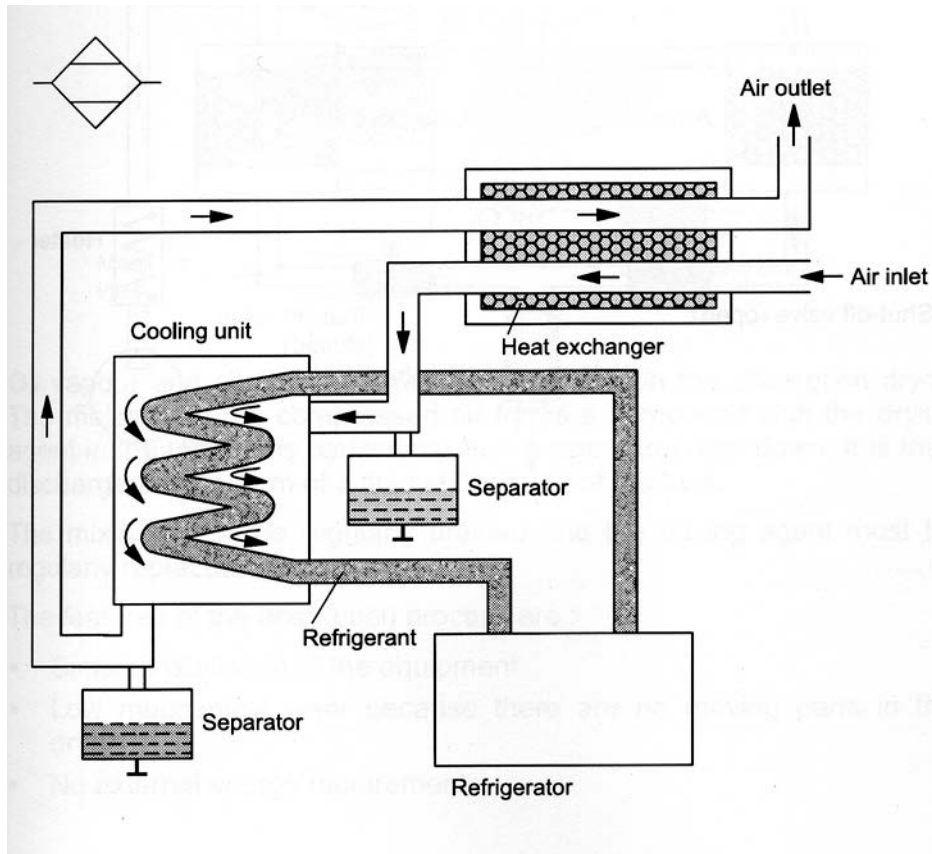
Three methods of reducing moisture:

1. Low temperature drying (most common)
2. Adsorption drying
3. Absorption drying

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Air Dryers

Low temperature drying.

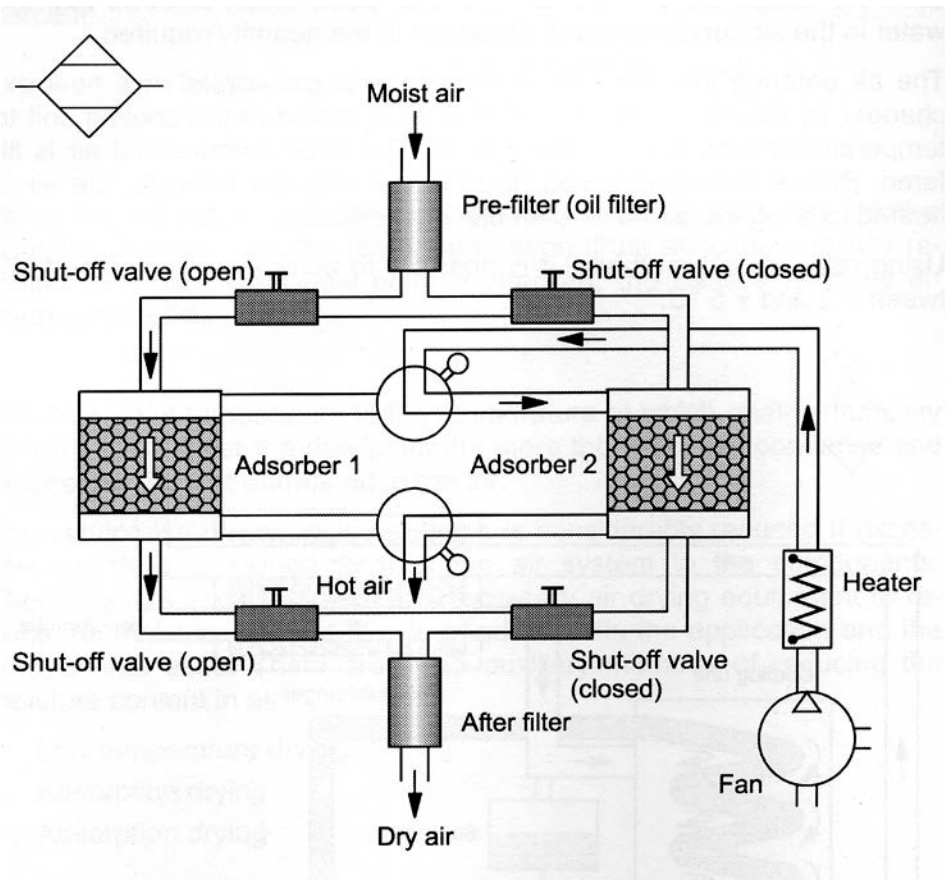


- Air is first passed through a heat exchanger
- Air continues to a cooling unit
- Air temperature is reduced to 2-5 degrees C
- Water is removed
- Return air must be warmed up before returning to network

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Air Dryers

Adsorption dryers

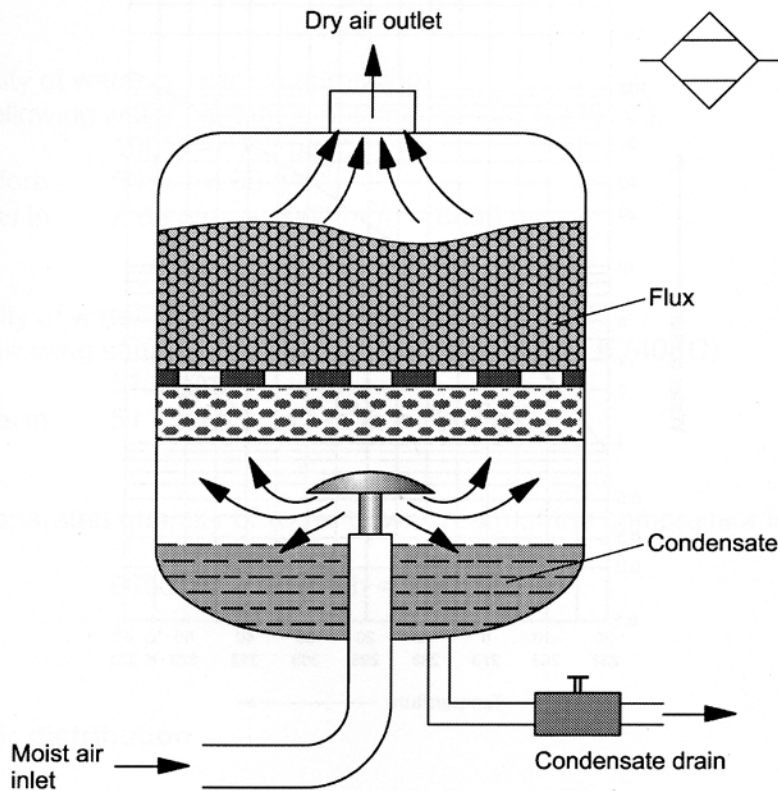


- Water is deposited on the surface of solids
- Drying agent is granular material (gel), almost entirely silicon dioxide
- Two tanks used, once one tank is saturated switch to other tank, first tank is regenerated by hot air drying

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Air Dryers

Absorption dryers



- A solid or liquid substance bonds a gaseous substance
- A purely chemical process
- Moisture in compressed air forms a compound with the drying agent which causes drying agent to break down
- Spent drying agent is discharged at bottom of tank
- High maintenance
- Simple, no moving parts
- No external energy required

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Air Distribution

Getting the air where it's needed.

Points to consider:

- Pipes – size, material, layout, maintenance
- Flow resistance – bends, branches, fittings
- Future requirements
- Condensation

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Service Unit

Combining filter, regulator & lubricator into one unit.

Things to consider:

- Total air throughput determines the size of the unit
- Working pressure may not exceed the value stated on the service unit
- Regular maintenance is required