



Unit III Class I

Pneumatics



Air Properties Definitions

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Air is a Gas. 78% Nitrogen, 21% Oxygen, traces H_2O , CO_2 , Ar, ..

Property	Dimensions	Value (SLS [*])	
		Metric	Imperial
Mass, Volume			
Density (ρ)	mass/volume	1.229 kg/m ³	.00237 slug/ft ³
Specific Volume (v)	volume/mass	.814 m ³ /kg	422 ft ³ /slug
Pressure (p)	force/area	101.3 kN/m ²	14.7 lb/in ²
Temperature (T)	degrees	15 °C	59 °F
Viscosity (μ)	force-time/area	1.73×10^{-5} N-s/m ²	3.62×10^{-7} lb-s/ft ²

* Sea Level Static (Standard Day)



The following is a list of the properties of air;

- Air has weight.
- Air is under pressure.
- Air has temperature.
- Air has a volume.
- Air usually contains some water vapour.
- Air usually has some velocity (speed).
- General Properties of Air.



Gas law

Boyle's law

As a mathematical equation, Boyle's law is

$$PV=C$$

Charles's law

$$V_1/T_1 = V_2/T_2$$

Lussac's law

$$P_1/T_1 = P_2/T_2$$



Components of pneumatic system

- Compressor
- Primary air treatment
- Receiver
- FRL
- Pneumatic valves
- Actuator



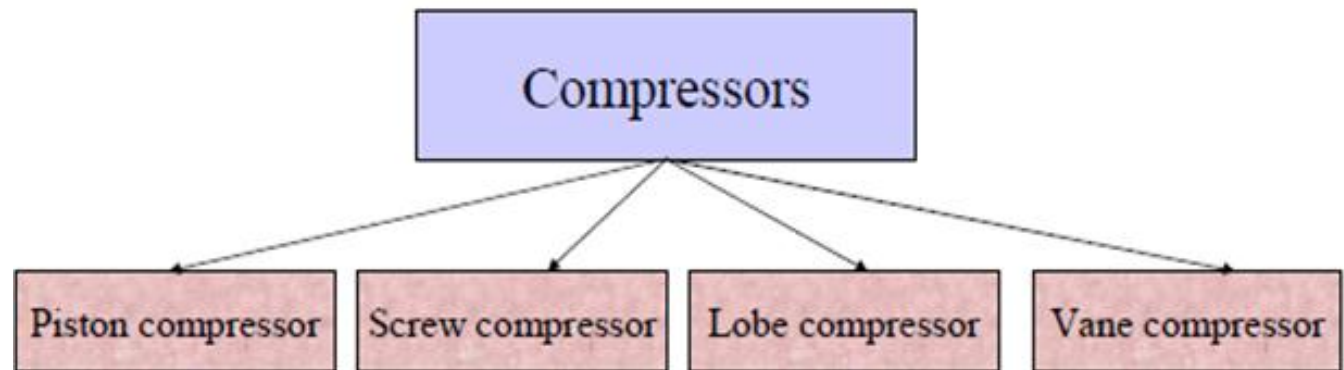


COMPRESSOR

A machine that extracts **air** from the atmosphere and compresses it into a holding chamber.

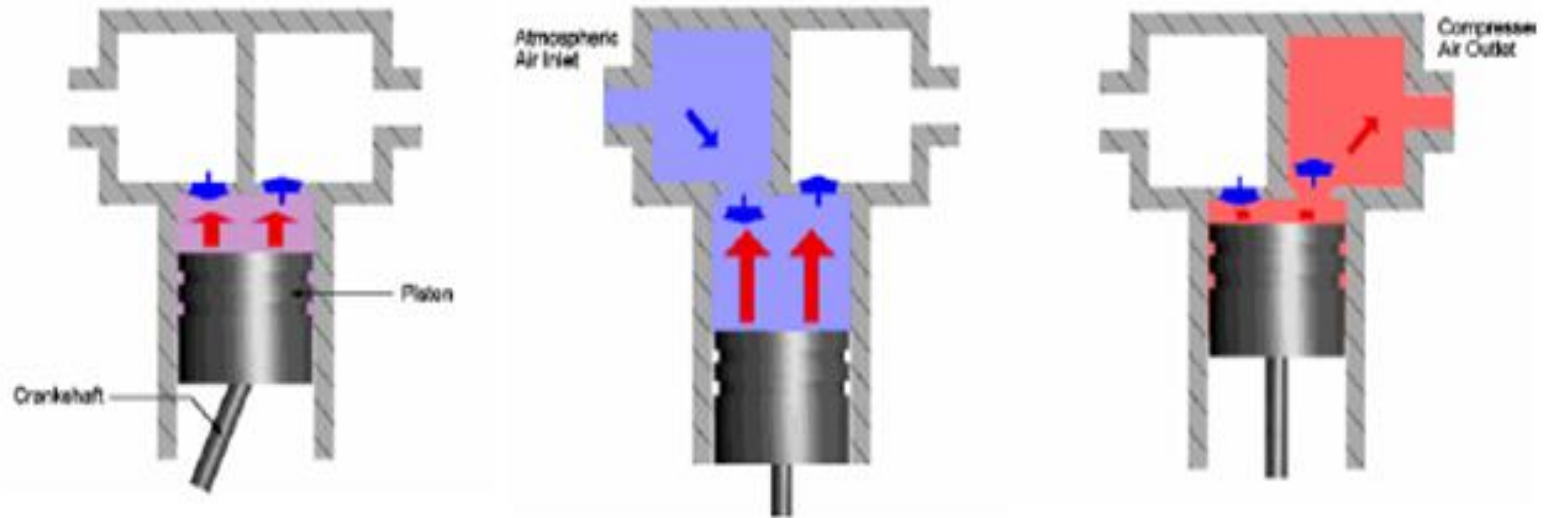
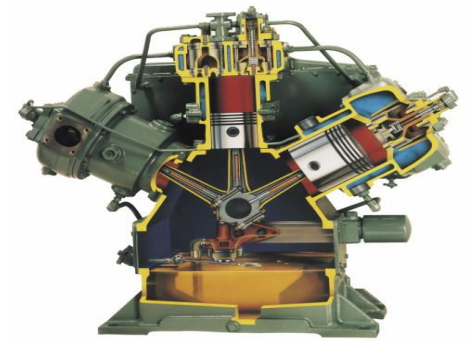
The most common use of compressed air is for the operation of pneumatic tools.

Air compressors are classified by the number of CFM (cubic feet per minute) compressed air they can produce.





Piston compressor



- Cooling is necessary
- Normally 10HP motor operates 145 to 175 psi

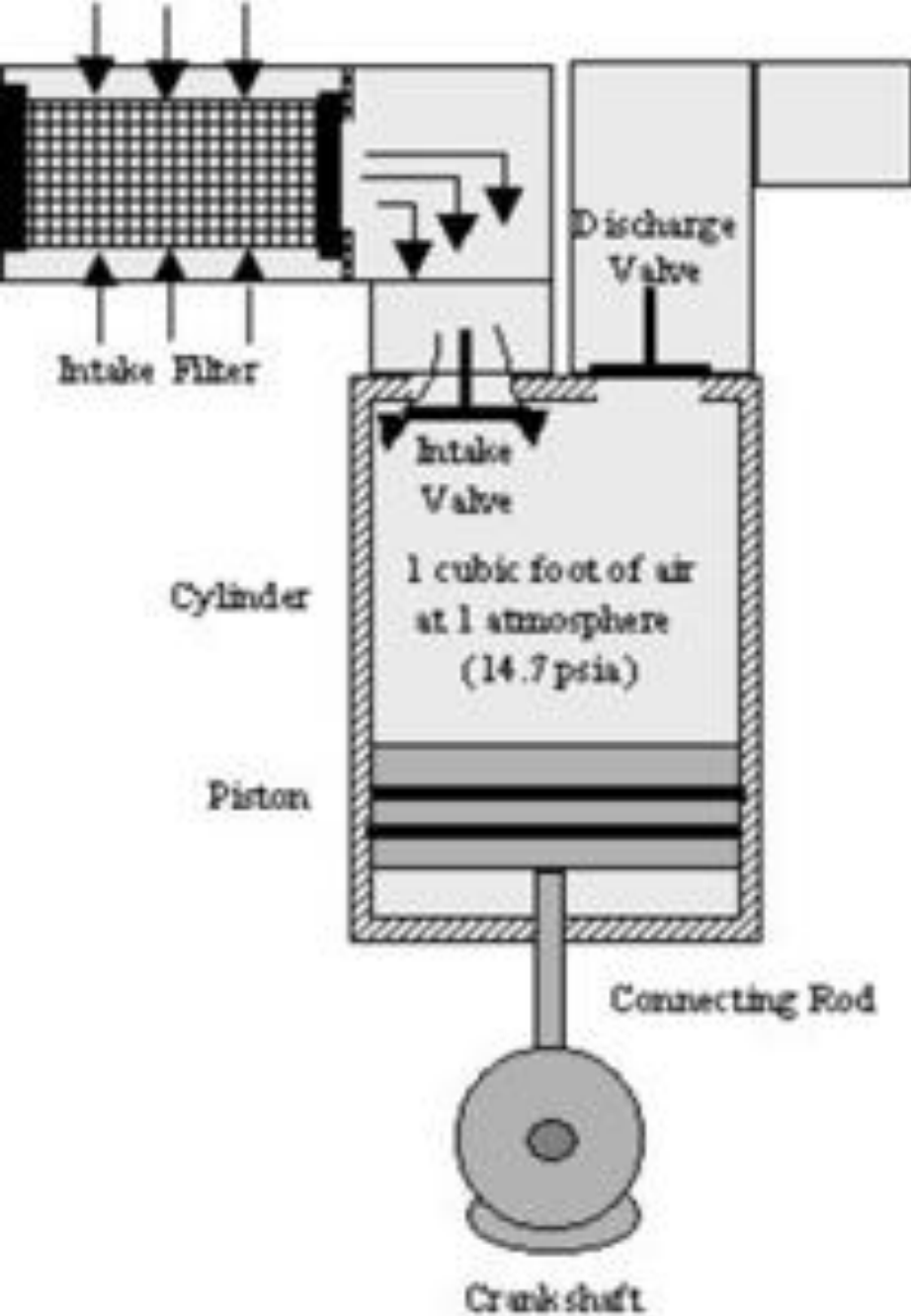


Fig. PD-1.1

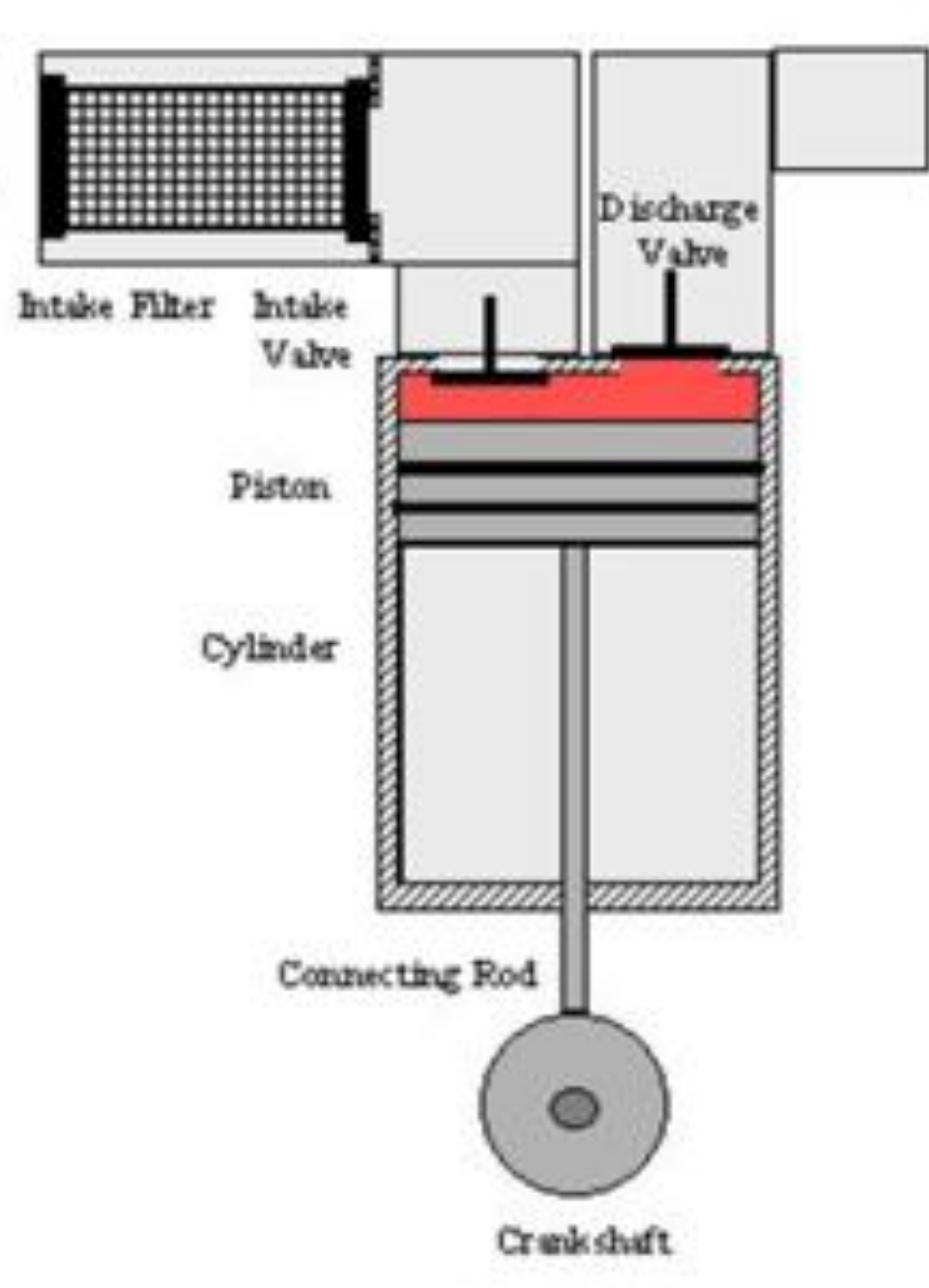
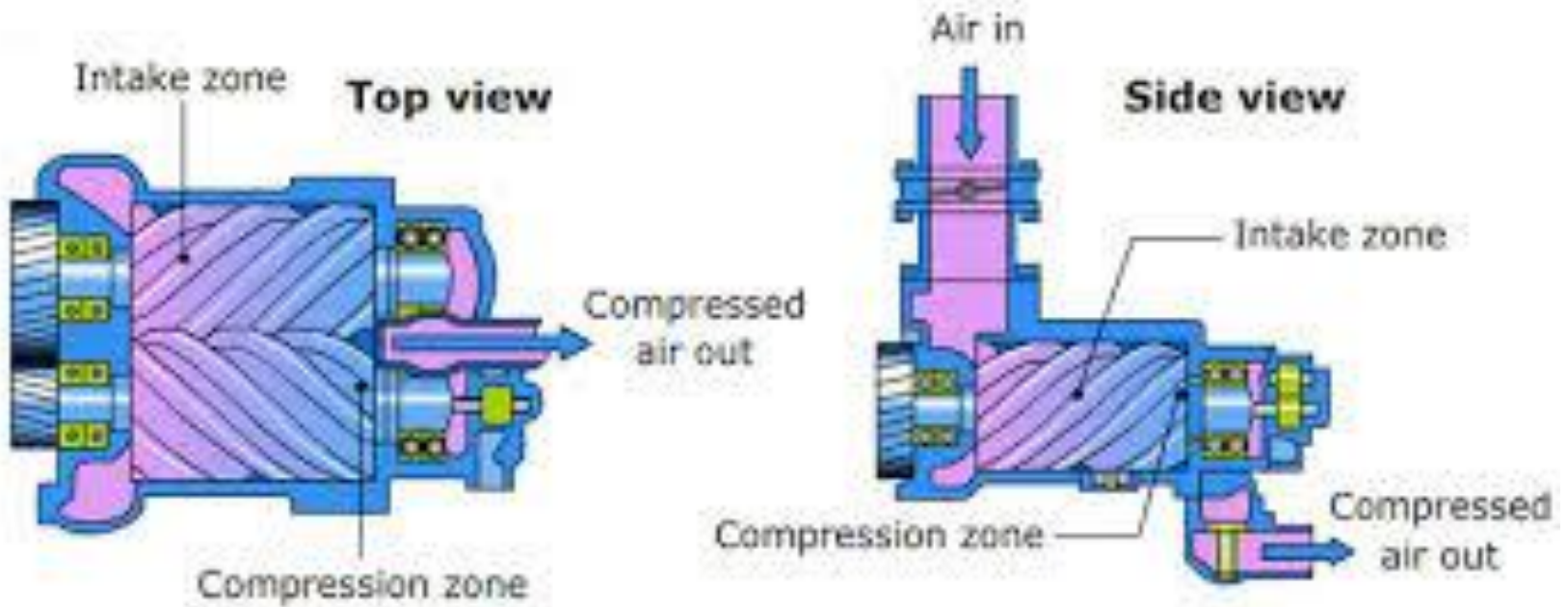


Fig. PD-1.2



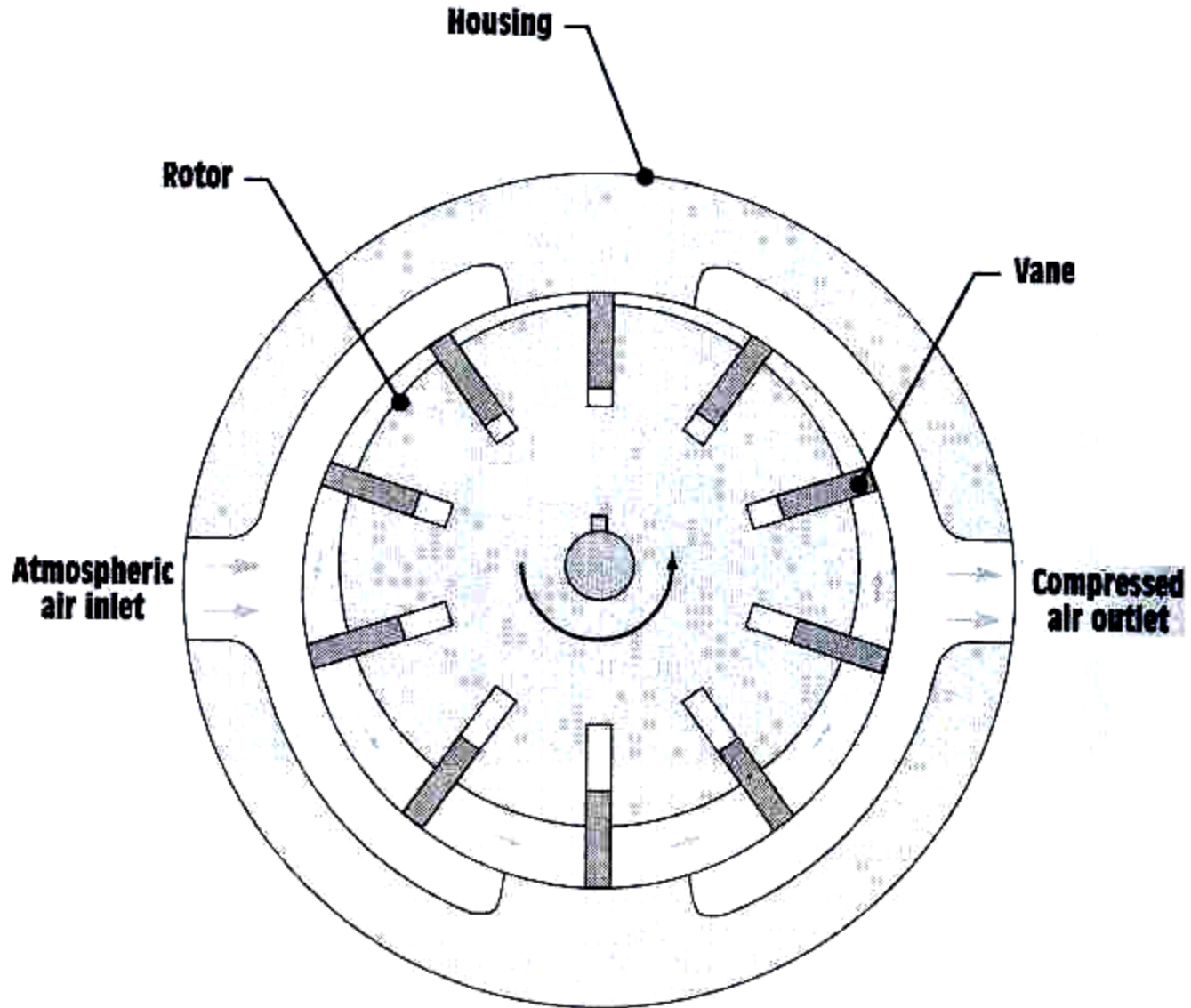
SCREW COMPRESSORS



Maximum upto 120 psi



VANE COMPRESSORS





Application of compressors

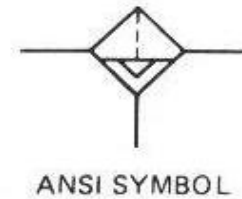
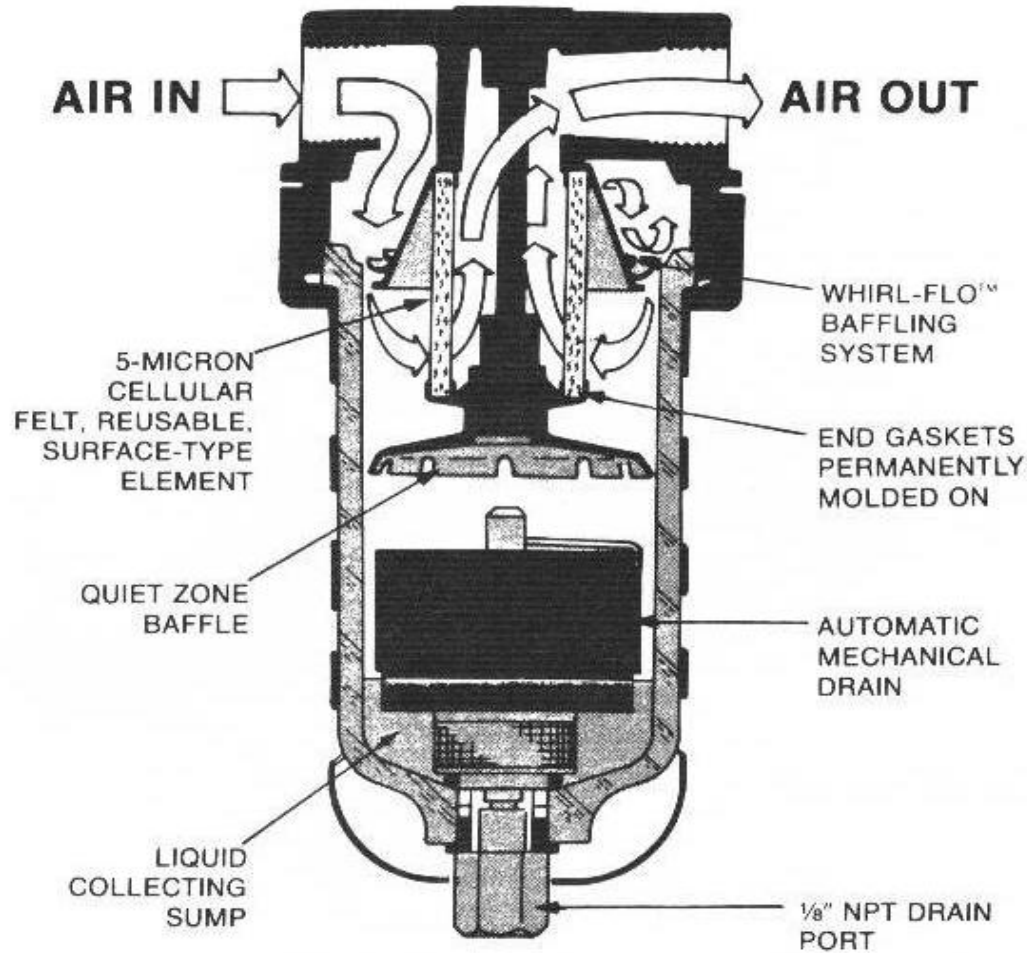


- P.E.T bottling industries, gas filling stations usually use reciprocating compressors.
- Processing equipment, Oxygen Generators Oil Atomization use compressors of required capacity.



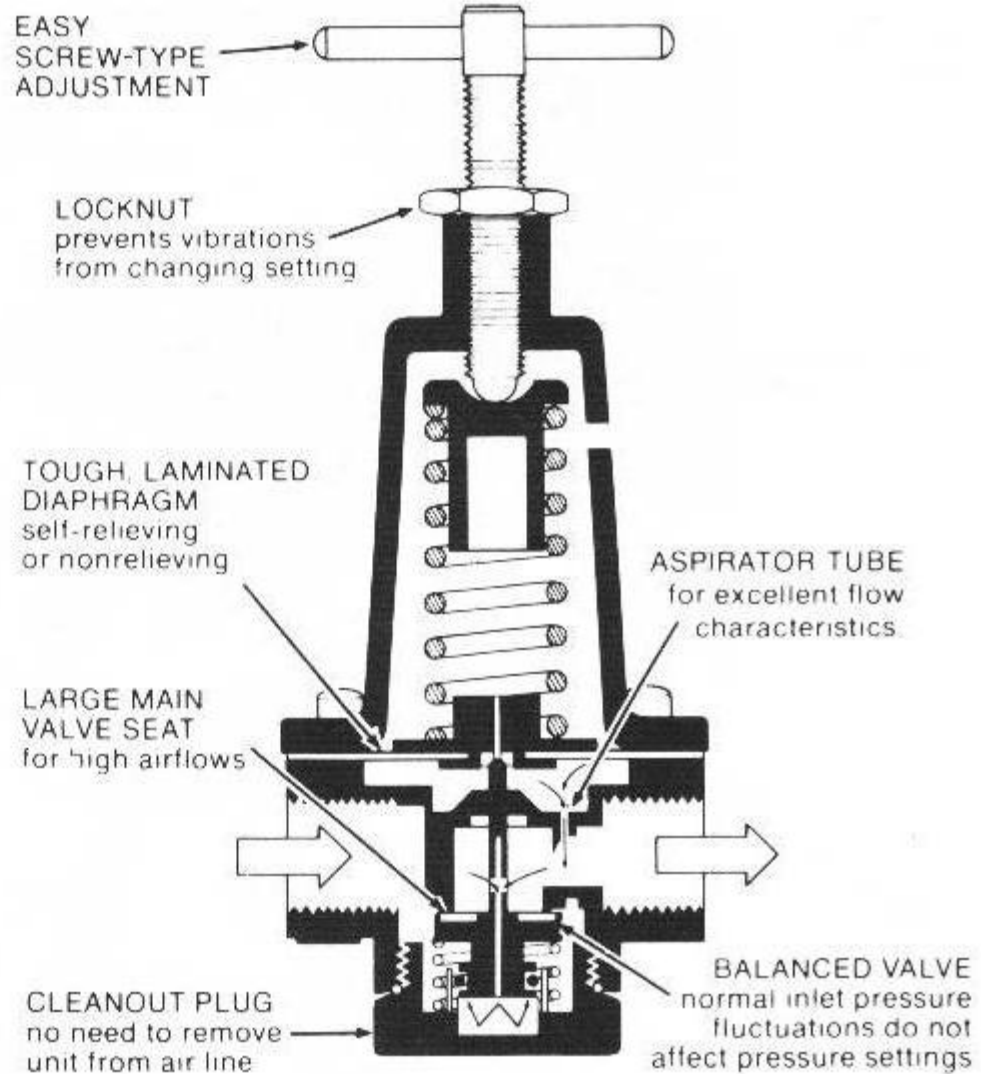
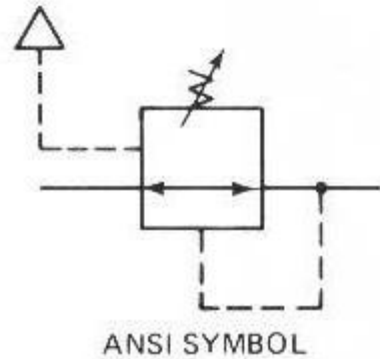


Air Filter



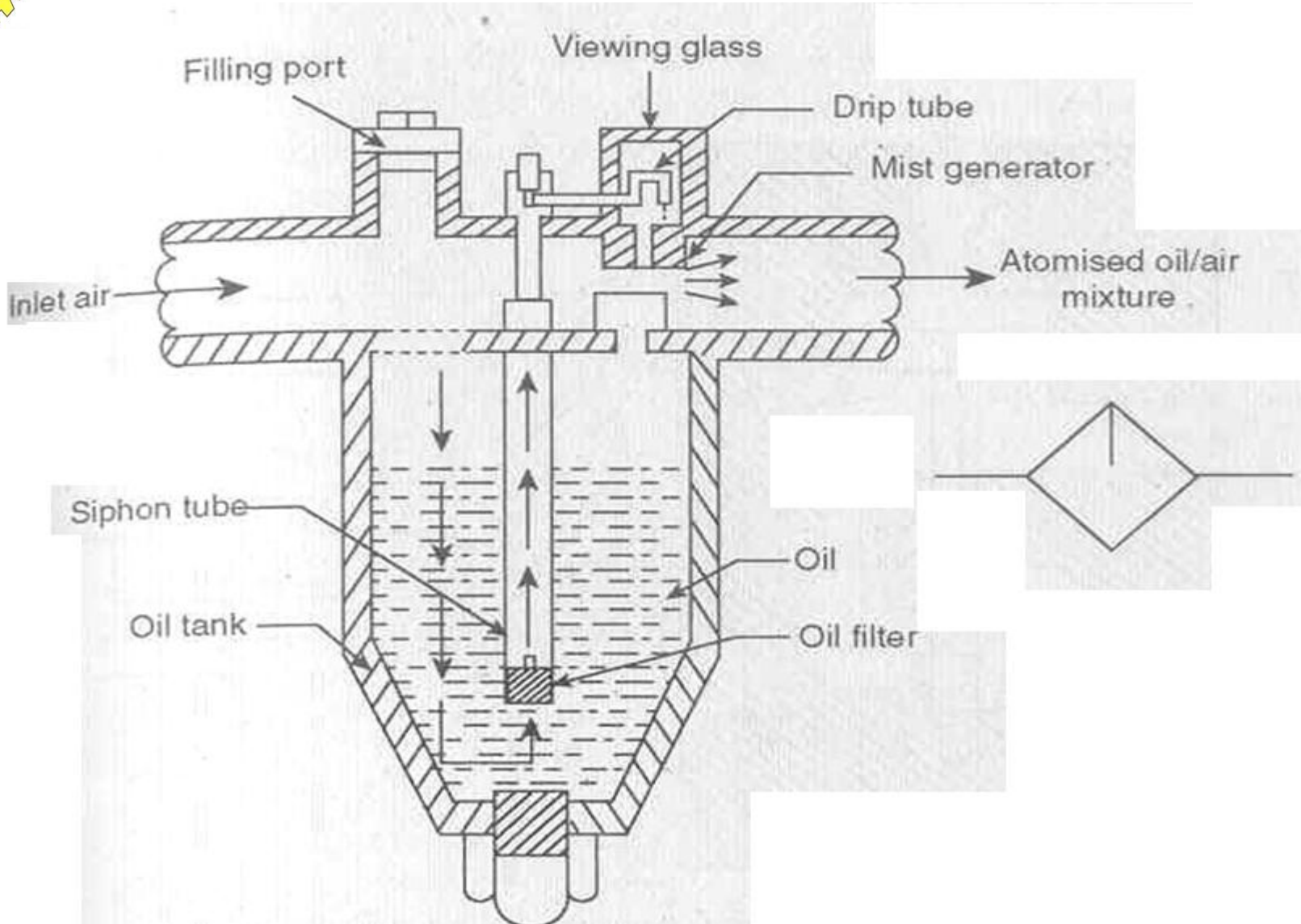


Air Pressure Regulator





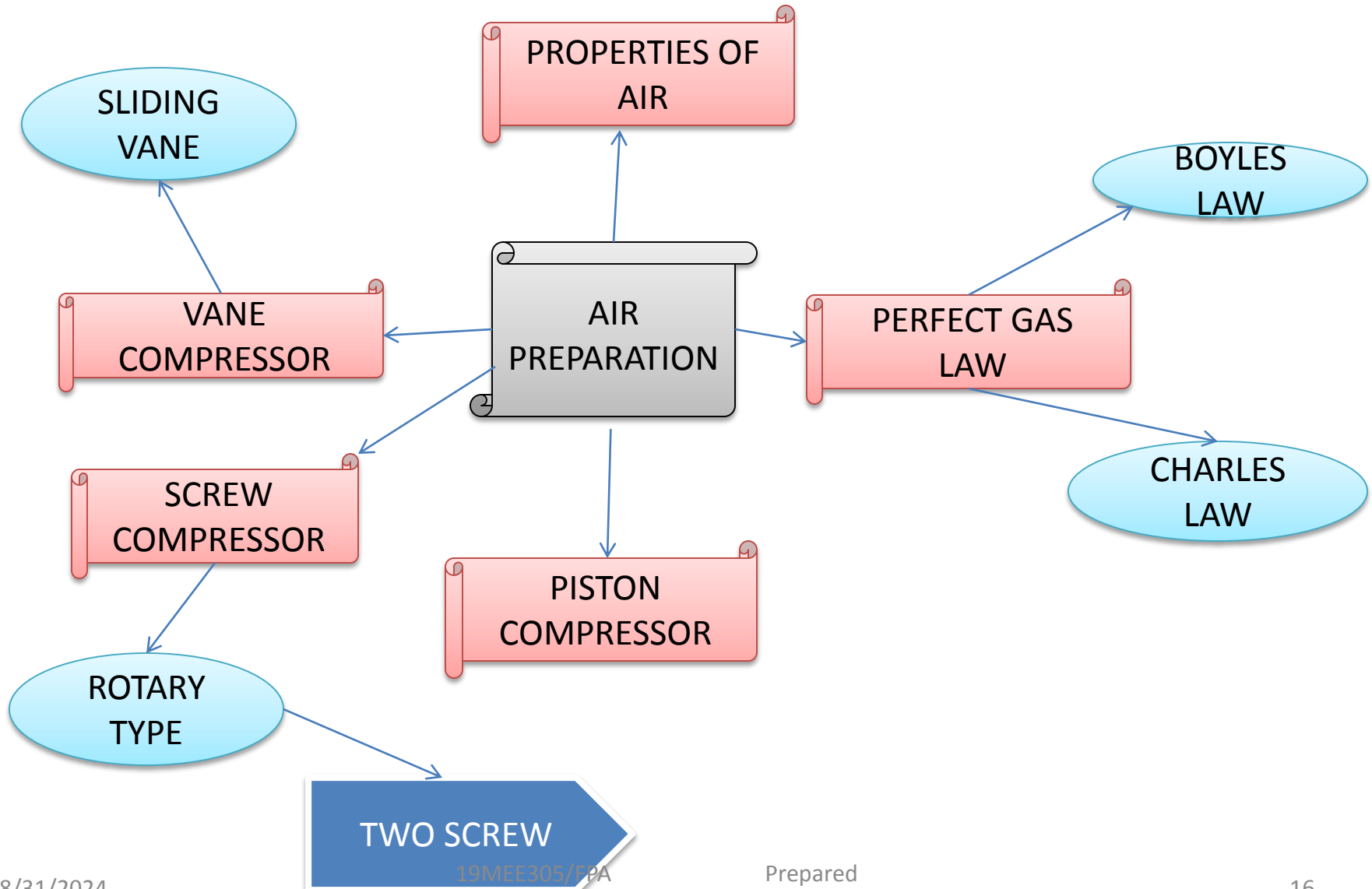
LUBRICATOR





Questions

1. What is the difference between free air and standard air?
2. What the standard air contains?
3. General gas law follows which law when temperature is constant?
4. General gas law follows which law when pressure is constant?
5. Which type of compressor is mostly used in industries? Why?





Summary

The composition of this 12 mile thick envelope.

- Due to the compressibility of air, increasing the pressure causes decrease in the volume of air.
- *Boyle's law*
 - Boyle discovered that the pressure and the volume of a particular quantity of gas was constant provided that the temperature did not vary.
- *Charles's law*
 - Charles found that the volume of a gas increased in equal amounts for equal increase increments of Temperature, if pressure is constant.



- *Lussac's law*
 - This law indicates that if the volume of a given gas is held constant, the pressure exerted by the gas is directly proportional to its absolute temperature.
- A compressor is a machine that compresses air or another type of gas from a low inlet pressure to a higher desired pressure level.
- Types
 - Piston compressor,
 - Screw compressor
 - Lobe compressor
 - Vane compressor



MCQ



- ge air compressors load and unload as pressure drops and builds, small air compressors:
- do the same.
 - never build enough pressure.
 - turn on at a minimum pressure and off at a maximum pressure.
2. Pneumatic system experiences lesser frictional pressure because _____
- Viscosity of air is high
 - Viscosity of air is low
 - Compressibility of air is high
 - Compressibility of air is low
3. Inertia effect of Pneumatic system is low because
- Weight density of gas is less
 - Weight density of gas is more
 - Density of gas is less
 - Density of gas is more
4. _____ compressors work on the principle of increasing the pressure of a definite volume of air by reducing volume in an closed chamber.
- Positive displacement compressors
 - Dynamic compressors
 - High pressure
 - Medium Pressure
5. _____ compressors are known as turbo compressors.
- Positive displacement compressors
 - Dynamic compressors
 - High pressure
 - Medium Pressure



Answer

1. Large air compressors load and unload as pressure drops and builds, small air compressors:

A. do the same.

B. never build enough pressure.

C. turn on at a minimum pressure and off at a maximum pressure.

2. Pneumatic system experiences lesser frictional pressure because _____

A. Viscosity of air is high

B. Viscosity of air is low

C. Compressibility of air is high

D. Compressibility of air is low

3. Inertia effect of Pneumatic system is low because

A. Weight density of gas is less

B. Weight density of gas is more

C. Density of gas is less

D. Density of gas is more

4. _____ compressors work on the principle of increasing the pressure of a definite volume of air by reducing volume in an closed chamber.

A. Positive displacement compressors B. Dynamic compressors C. High pressure D. Medium Pressure

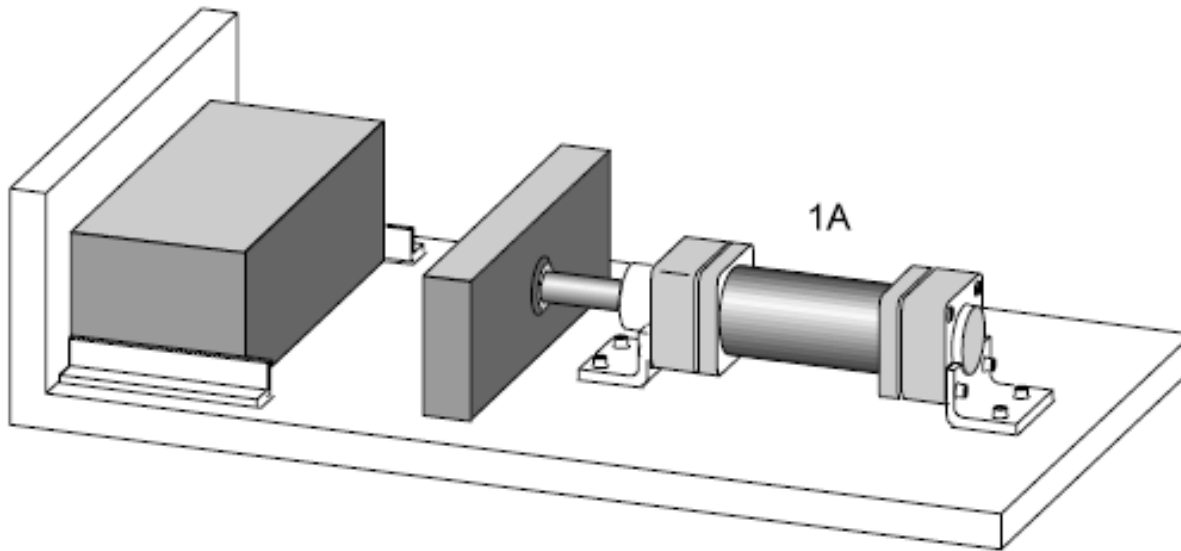
5. _____ compressors are known as turbo compressors.

A. Positive displacement compressors B. **Dynamic compressors** C. High pressure D. Medium Pressure



Higher Order Question

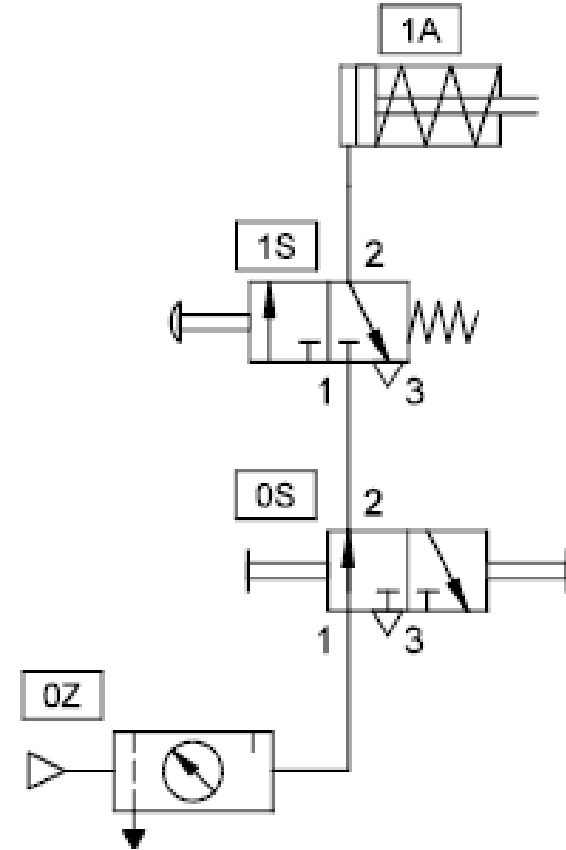
Study the following application and determine what are all the components required for developing the circuit.





Solution

- The control valve used for the single-acting cylinder is the 3/2-way valve.
- In this case, since the cylinder is of small capacity, the operation can be directly controlled by a push button 3/2-way directional control valve with spring return.
- On operating the push button the air passes through the valve from port 1 to 2 via the valve 1S into the piston chamber of the cylinder 1A.





- The pressure builds up and advances the piston rod against the force of the cylinder return spring.
- On release of the button, the valve spring returns the 3/2-way valve to its initial position and the cylinder retracts.
- The air returns from the cylinder via the exhaust port 3.
- Components which are the only one of their type are designated without 2 supplementary number Since the cylinder is the only working element in the circuit, it is designated 1A.