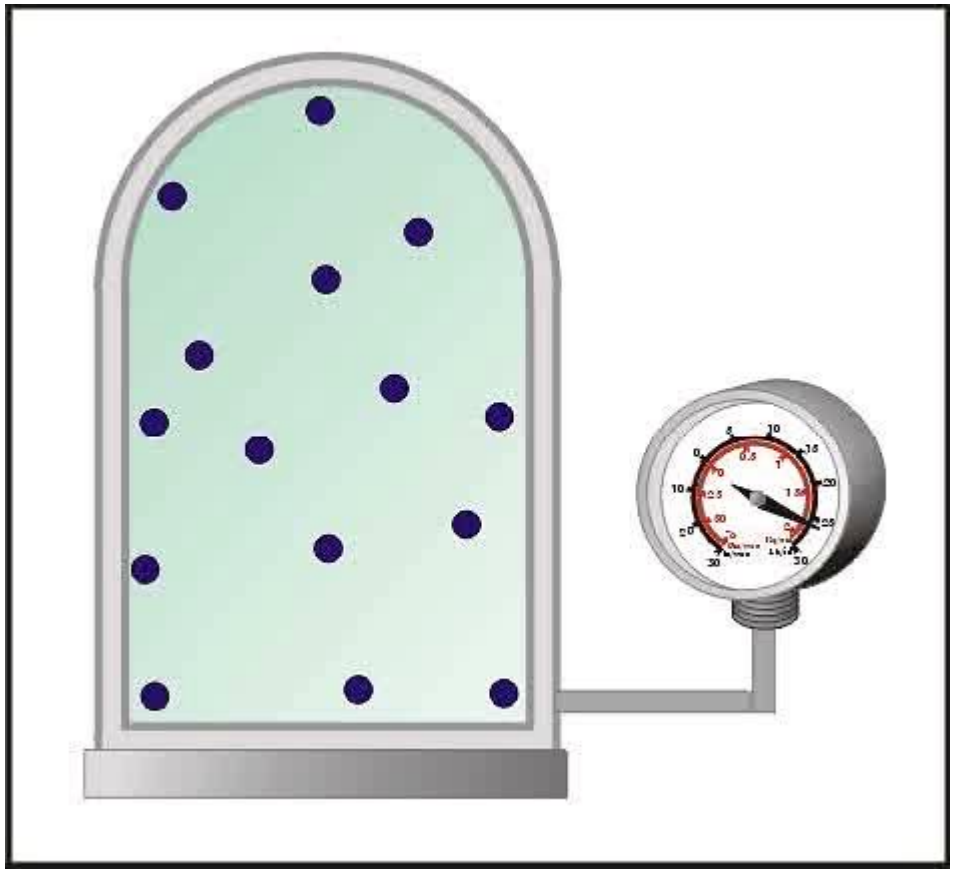
Vacuum Technology Basics

Vacuum is:

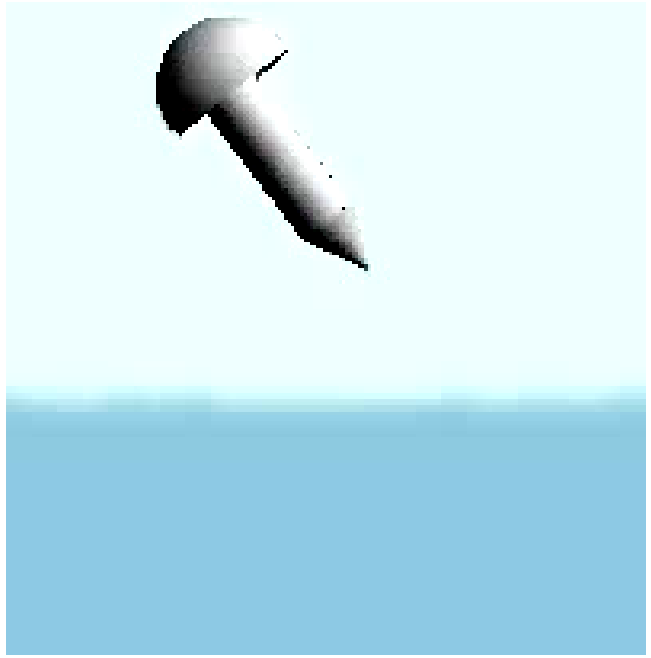
- Enclosed space that is partially emptied of gas
- Less gas inside chamber than outside atmosphere
- Produced by removing gas from chamber using Vacuum Pumps

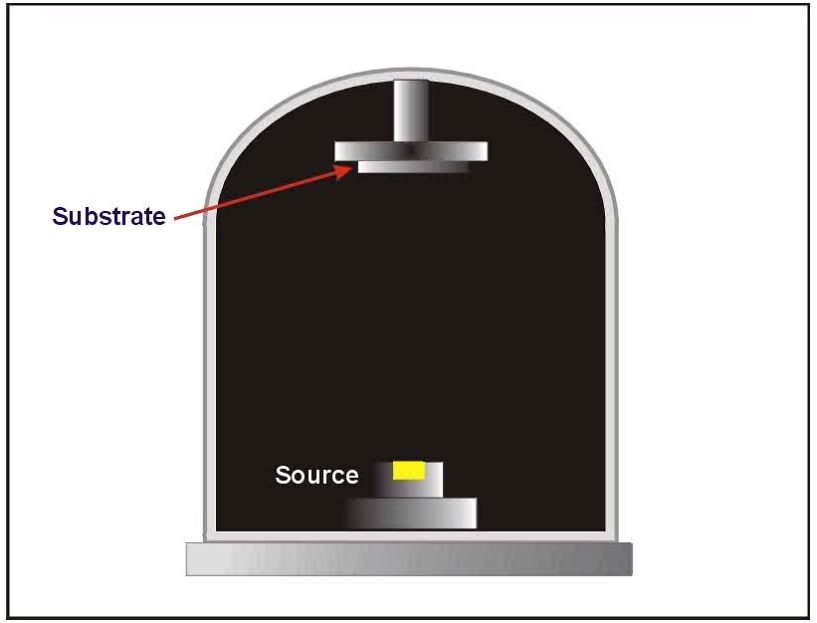


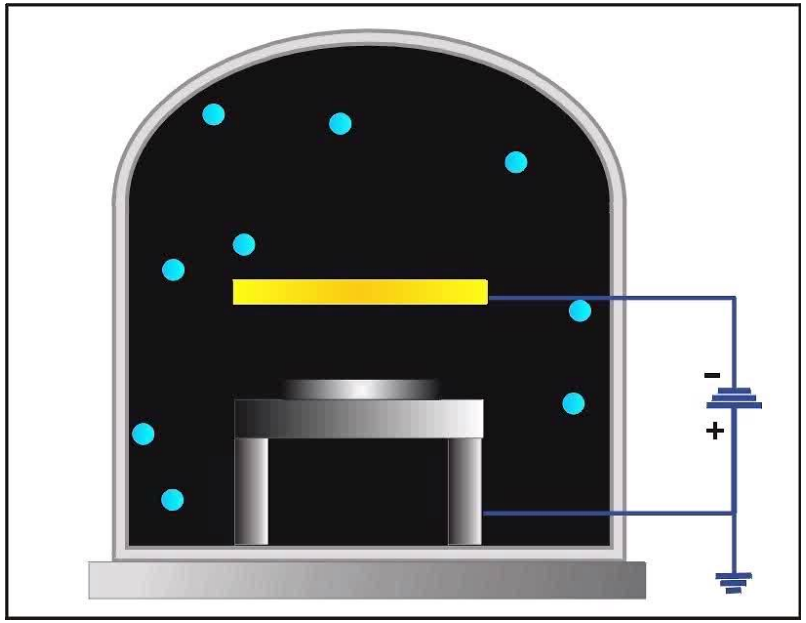
Vacuum Technology Basics

Why do we need vacuum?

- To be free from contamination and unwanted reaction for example oxidation.
- To have unobstructed path: Evaporation process.
- To facilitate ionization: Plasma etching & Sputtering process.



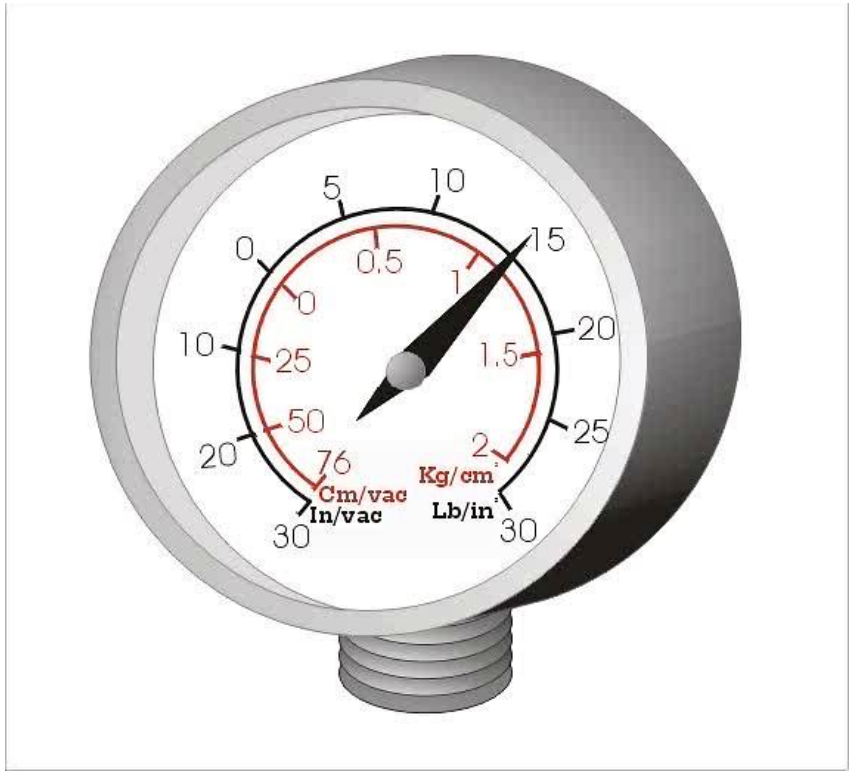




Vacuum Technology Basics

How is vacuum measure?

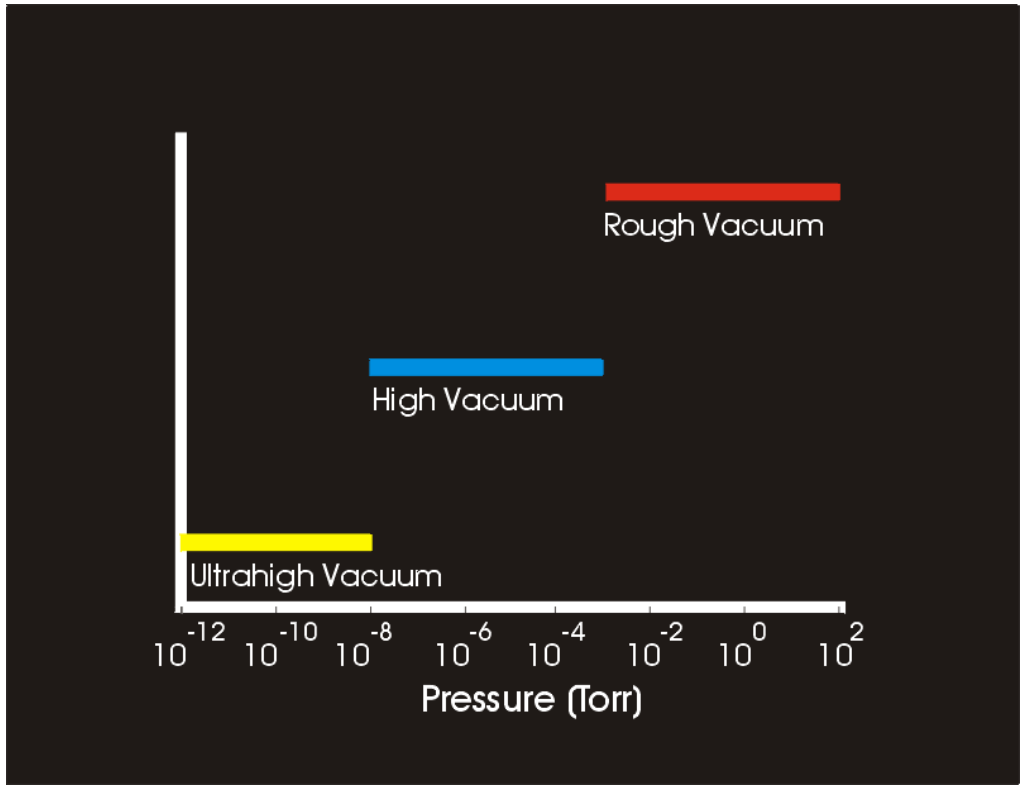
- Vacuum is measured by Pressure.
- The lower the quantity of gas molecules the lower the pressure.
- The lower the pressure the higher the vacuum.
- Typical Pressure Units are Torr, Pascal and Bar.



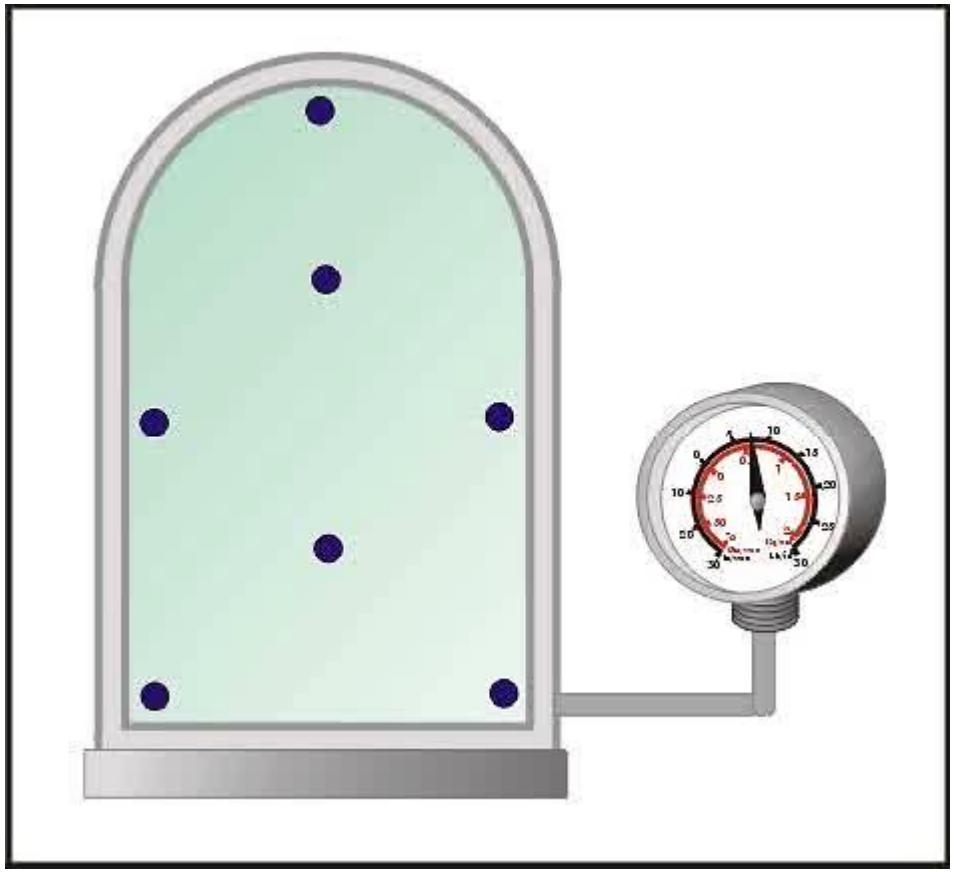
Vacuum Technology Basics

What are the levels of vacuum?

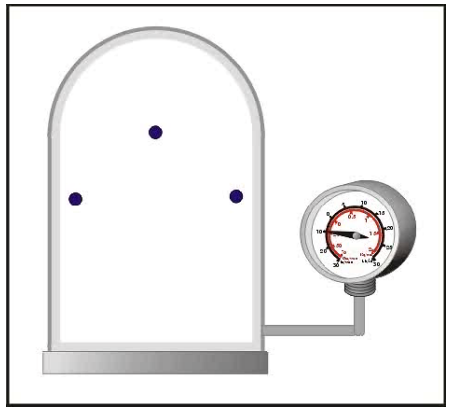
- Rough Vacuum from Atmospheric Pressure (760 Torr) down to 10^{-3} Torr.
- High Vacuum from 10^{-3} Torr down to 10^{-8} Torr.
- Ultrahigh Vacuum is less than 10^{-8} Torr.



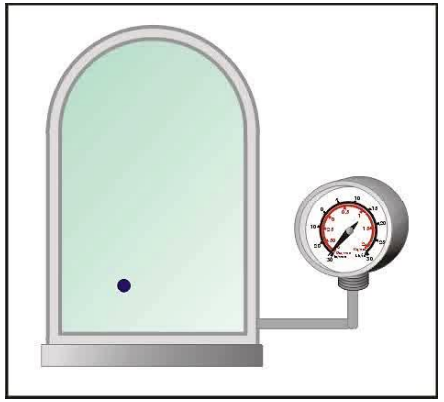
Vacuum Technology Basics



Rough Vacuum



Hign Vacuum



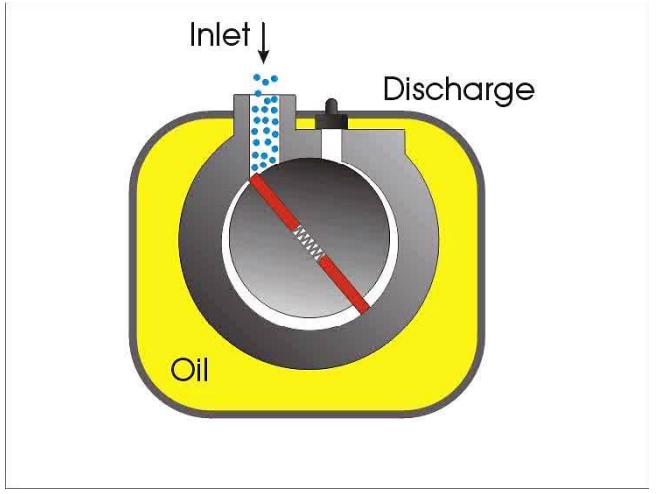
Ultra High Vacuum

Vacuum Technology Basics

Gas flow in roughing process is viscous in nature:

- The Rotary Vane Pump removes gases from chamber by mechanically pushing and exhausting them out. Gas expands into empty space created and is being pushed out to the exhaust subsequently.
- The Cryosorption Pump removes gases from chamber by trapping and lowering their temperature, thereby changing their form from gas state to solid state.

In the Rotary Vane Pump, gases from chamber expand into one side of the vane to be swept, compressed and expelled through a discharge valve to atmosphere in continual rotational cycles.



Vacuum Technology Basics

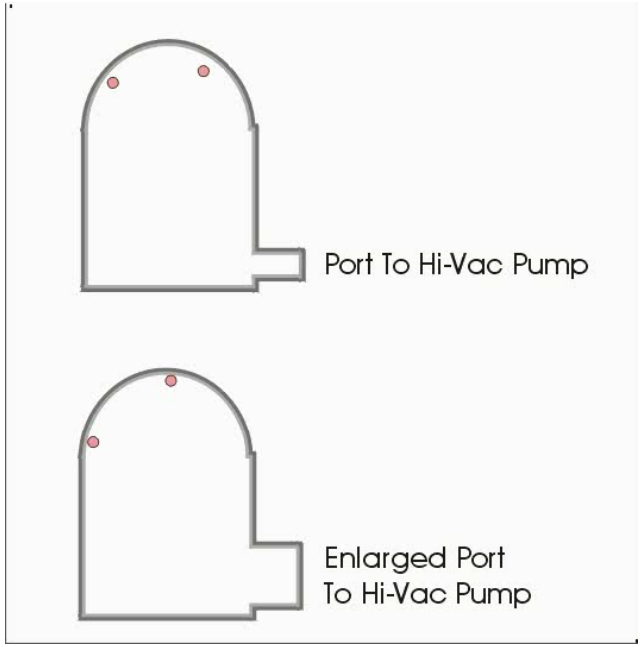
Nature of High Vacuum:

After roughing, gas flow at High Vacuum becomes molecular in nature, that is, gas particles are much further apart and therefore have no influence on each other (non-viscous). Gas particle movement are entirely probabilistic in nature

The connection port of the chamber to the High Vacuum pump is therefore intentionally made large to increase the probability of the gas particles flowing from the chamber to the pump.

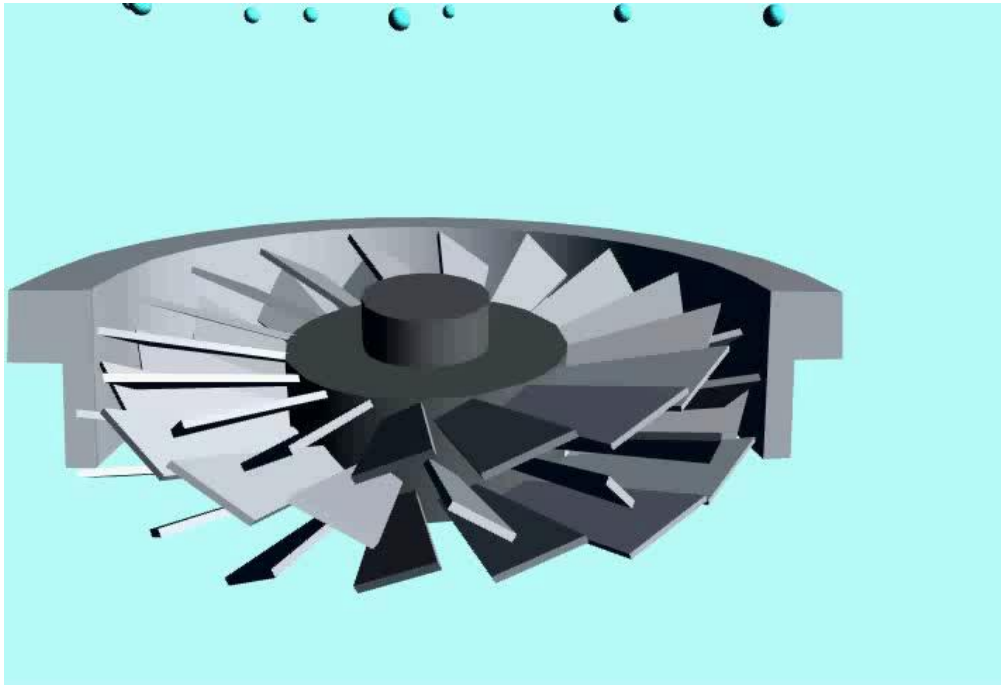
High Vacuum Pumps work by:

- Momentum Transfer: Turbomolecular and Diffusion pump
- Capture: Cryogenic pump



Vacuum Technology Basics

In momentum transfer of a Turbomolecular Pump, gas particles, which enter the pump, are given a push by the metal fins towards the desired direction. The pump is designed in a manner that once the gas particles are pushed away and out of the chamber, it is difficult for them to find its way back to the chamber.



Turbomolecular Pump

Vacuum Technology Basics

Complete Pumping Sequence:

- High Vac and Fore Valve closed.
- Roughing Valve opens for roughing.
- Roughing completed.
- Roughing Valve closed.
- High Vac and Fore Valve opens.
- High vacuum pumping takes place.