

BCAS Factsheet 208-1

Vacuum Pressure Definitions



Vacuum ranges (Pressure in absolute values)

Rough (low) vacuum from 1013 to 0.5 mbar. kPa

- The gas flow would start as viscous and changes through turbulent to laminar flow (below 10 mbar) as the pressure drops
- These pressure conditions are where the terms rough pump or roughing out a chamber come from
- A primary pump is required in this pressure range

Medium vacuum from 1 to 10^{-3} mbar. kPa

- This is where we see a transition from viscous flow conditions to Knudsen flow where the average distance a molecule travels between collisions is approximately equal to the dimensions of the system pipework / hardware
- A primary pump is usually required for this area of operation

High vacuum from 10^{-3} to 10^{-7} mbar. kPa

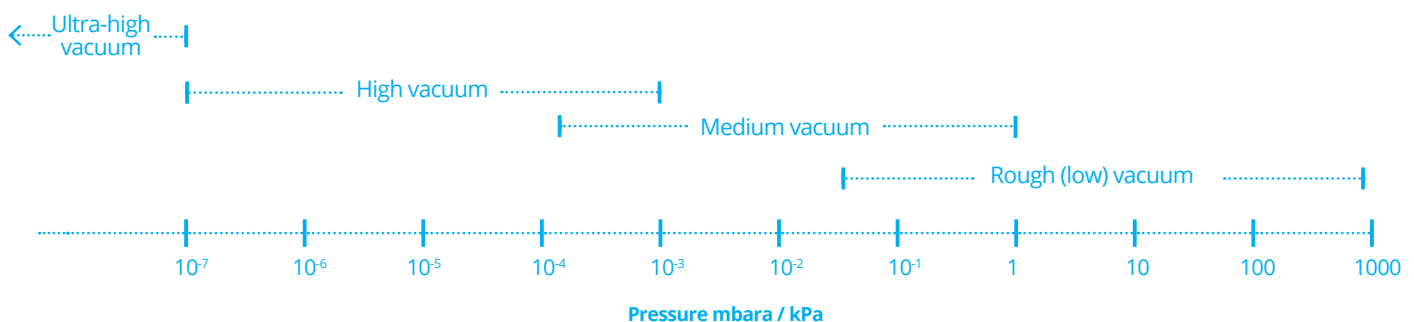
- This is known as the molecular flow regime. The molecules spend more time hitting the walls of the pipe than each other
- A secondary pump is required for this area of operation

Ultra-high vacuum from below 10^{-7} mbar kPa

- This would also be a molecular flow regime, but system cleanliness and leaks need to be extremely low
- **Note:** A vacuum is a space where the pressure is below the local atmospheric pressure

- The pressure regimes are typically listed as follows in technical publications:

1000-1mbar	—————→	Rough / low
1-10-3mbar	—————→	Medium
10-3mbar-10-7mbar	—————→	High vacuum
10-7mbar (and lower)	—————→	Ultra high vacuum



Vacuum pump glossary

Primary pumps (Roughing or backing pump)

- Used to evacuate a vacuum process or system from atmospheric pressure to the working pressure

- Usually single or two stage pumping mechanism
- Typically, mechanisms like oil-sealed rotary vane, claw, screw, or piston.
- **Single stage** - a pump with only one compression stage
- **Double stage** - a pump with two compression stages in series

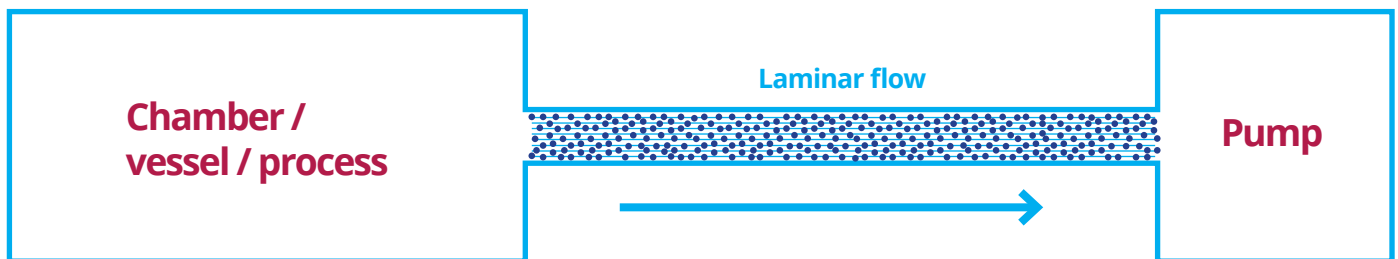
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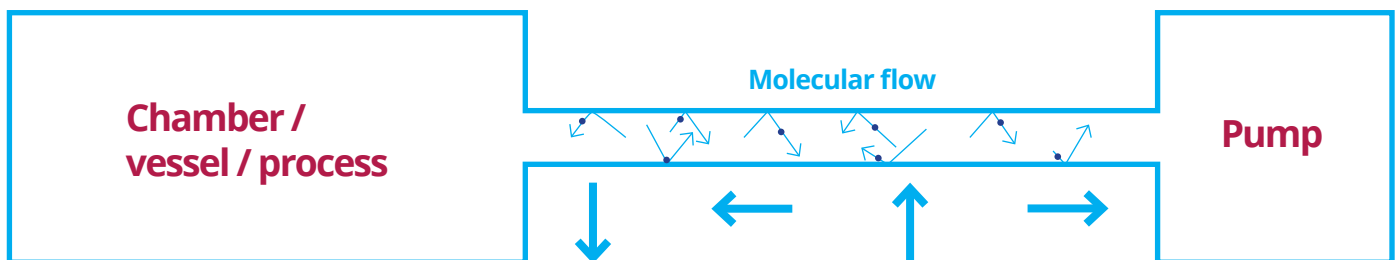


- **Secondary pumps** - Used to reduce the pressure further and would normally require a primary pump in series to help. Typically, mechanisms like roots, turbo-molecular, cryogenic or diffusion
- **Booster pump** - A type of secondary pump used to assist in moving high volumes of process gas. Typically, roots mechanism
- **Holding pump** - A simple primary pump used to maintain a vacuum while the main process is not running. Typically, oil-sealed rotary vane

Laminar flow occurs between 100 mbar and 10^{-1} mbar



Molecular flow occurs below 10^{-1} mbar



Turbulent flow occurs between 1000 mbar and 100 mbar

