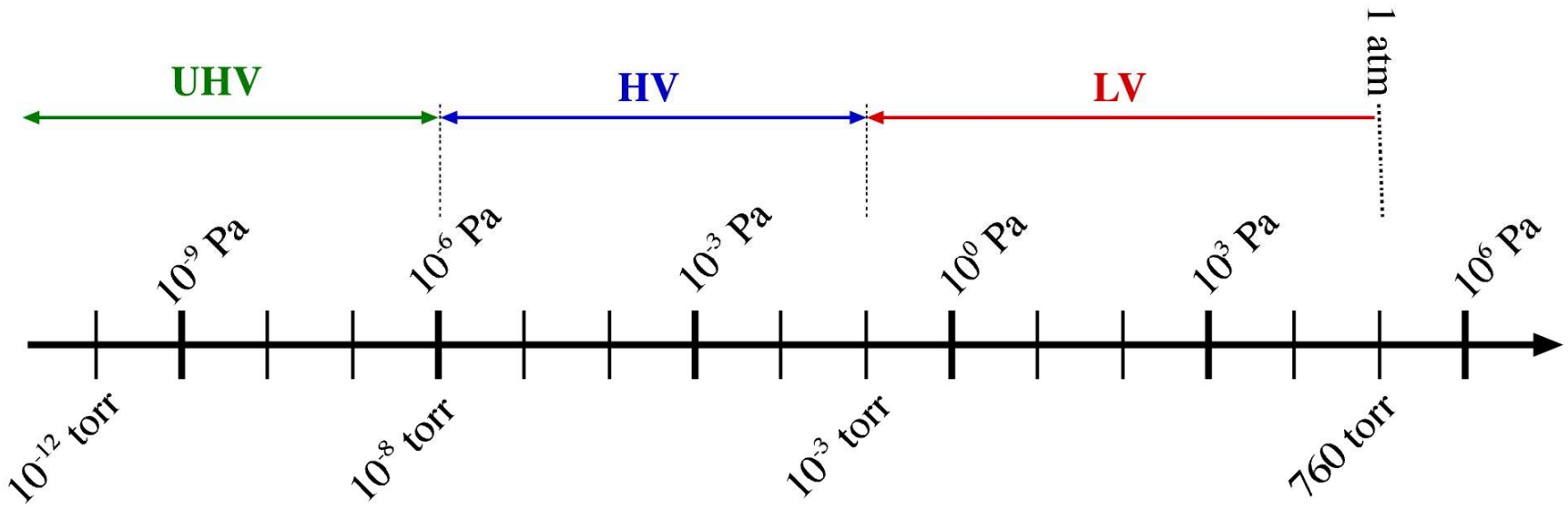
Vacuum terminology



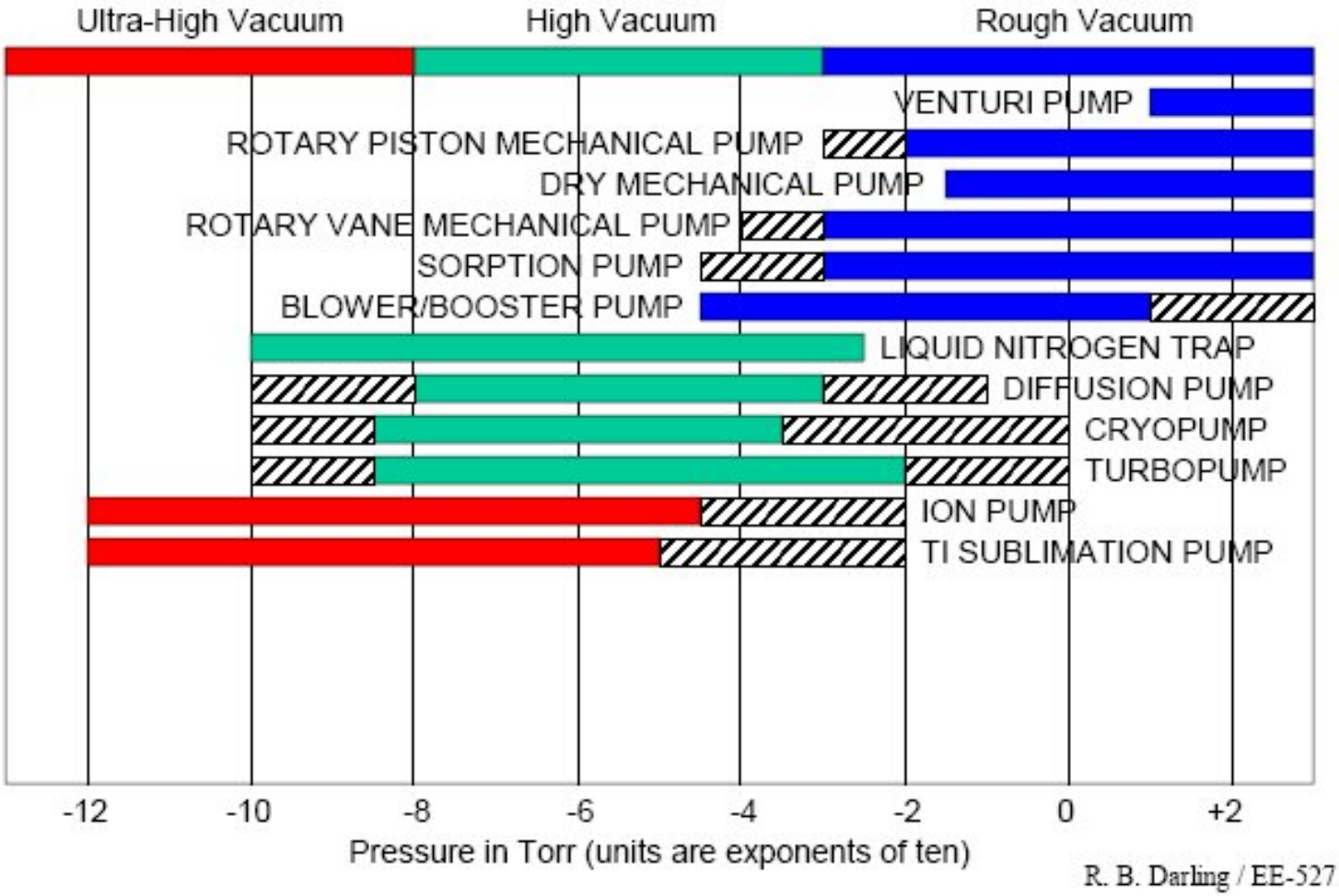
LV: Low/Rough Vacuum
HV: High Vacuum
UHV: Ultra-High Vacuum

$1\ \text{Pa} = 1\ \text{N/m}^2 = 10^{-5}\ \text{bar}$

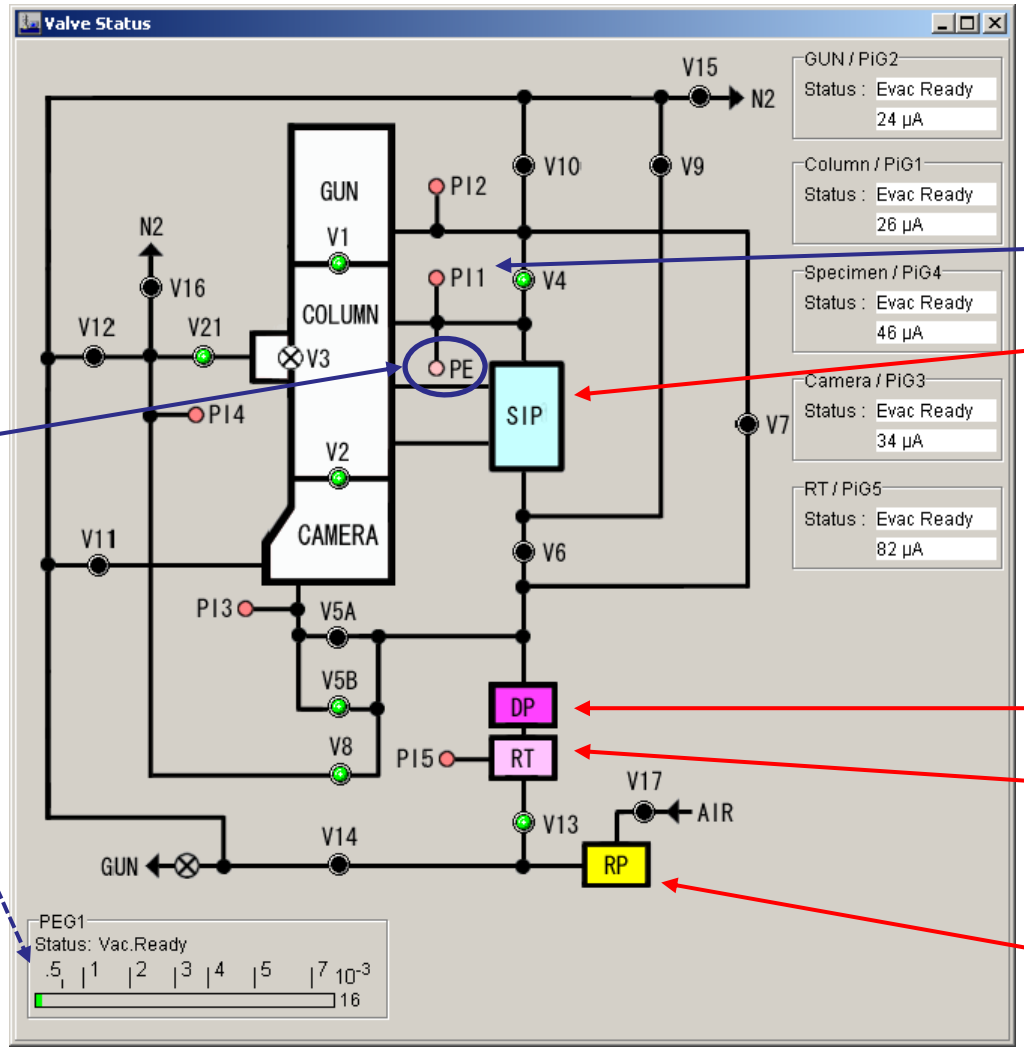
$1\ \text{atm} = 760\ \text{torr} = 1.01 \times 10^5\ \text{Pa} = 1.01\ \text{bar}$

$1\ \text{torr} = 133\ \text{Pa} = 1\ \text{mm} \cdot \text{Hg}$

Ranges for different pumps



Multiple pumps in a system



Pirani gauge

Ion pump

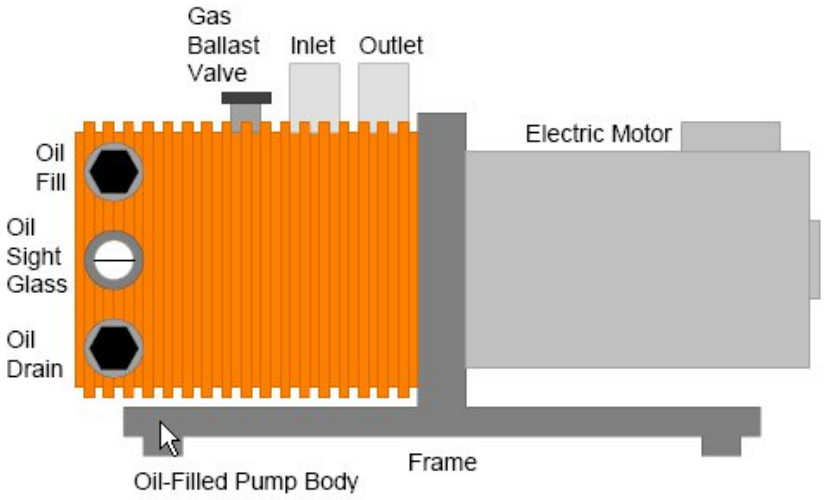
Penning gauge

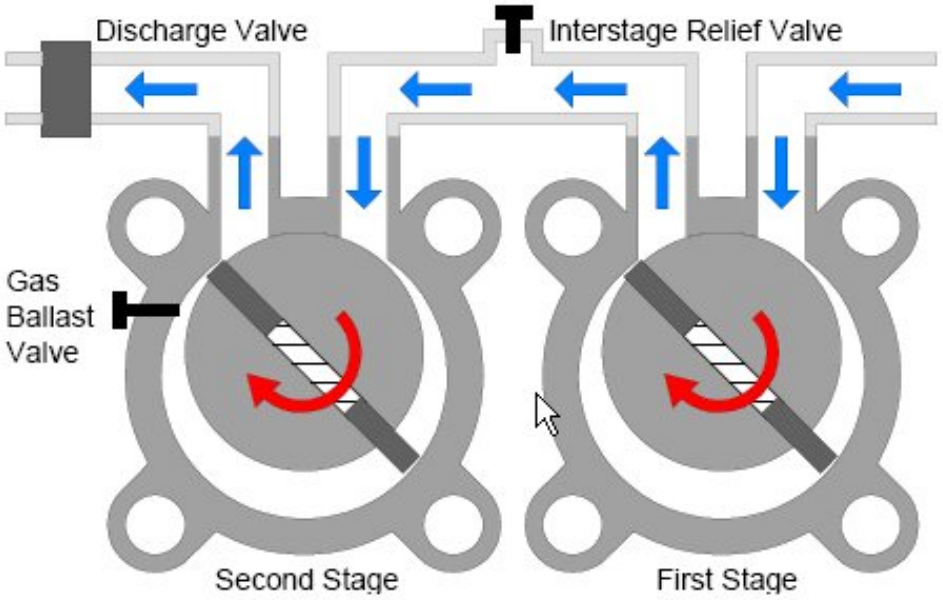
Diffusion pump

Reservoir tank

Roughing pump

Rotary, mechanical, roughing pump



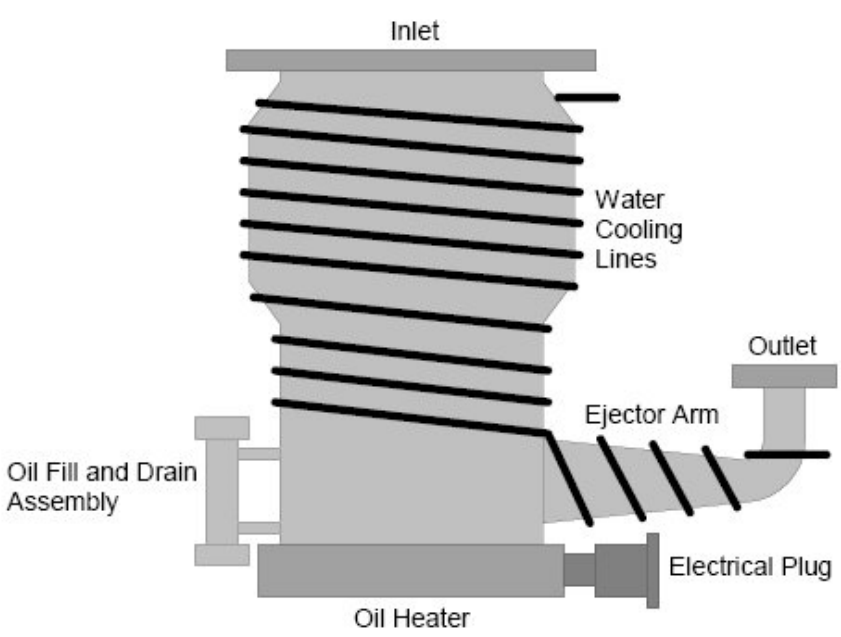


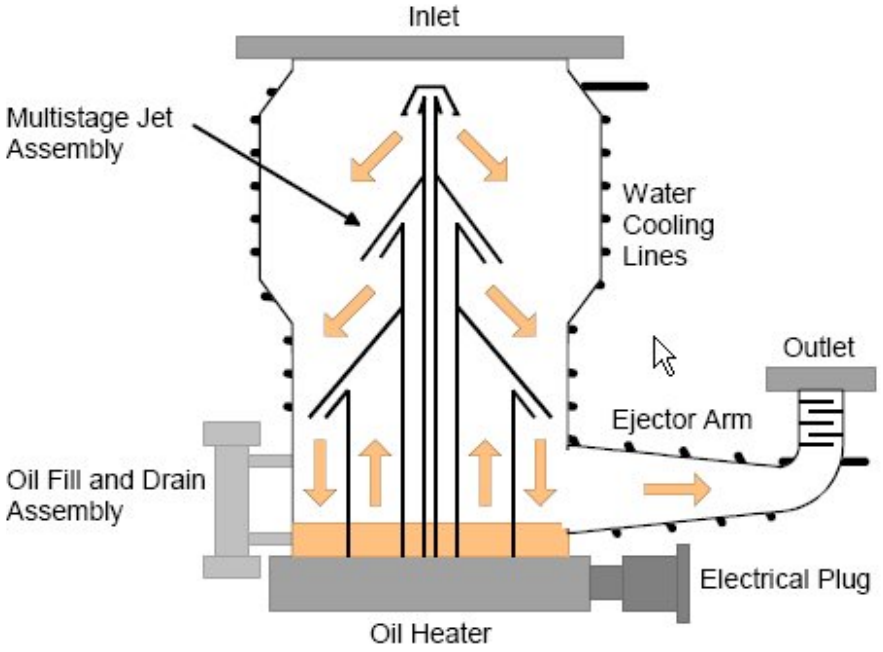
•Compress gas and force out

•Vanes immersed in oil to
-cool
-lubricate
-seal

•Oil backstreaming a problem
•Ballast used to release vaporize condensed contaminants

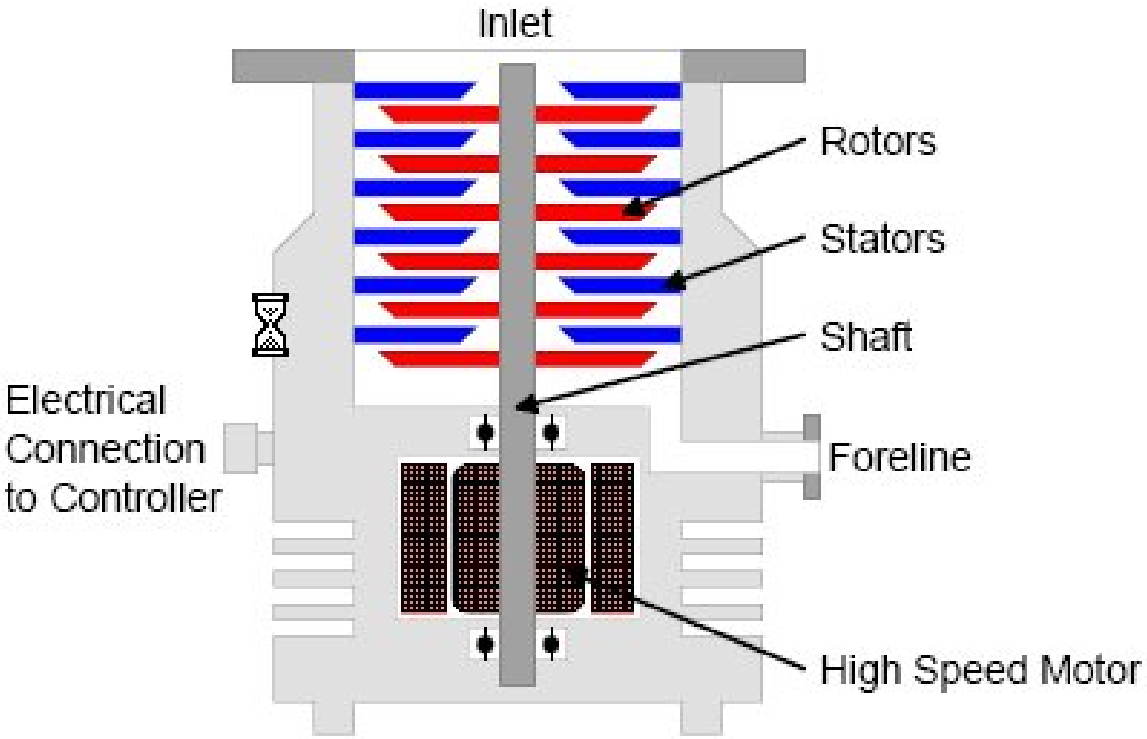
Oil diffusion pump





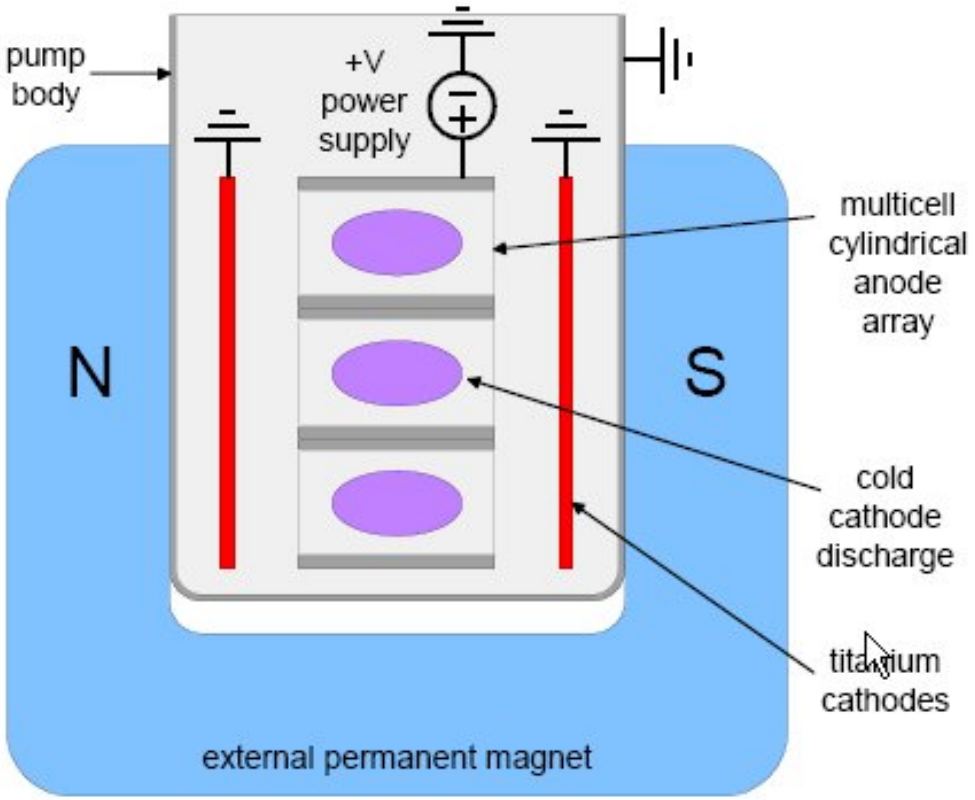
- Oil vapor flows upward and projects out of jets at high speeds.
- Vapor traps gases and condenses on cooled sides of pump
- Gases are released when oil returns to heater; extracted by roughing pump
- Do not provide a very “clean” vacuum.

Turbomolecular pump



- Rapidly spinning blades eject gas molcules
- Very clean vacuum
- Potential damage if rapidly vented

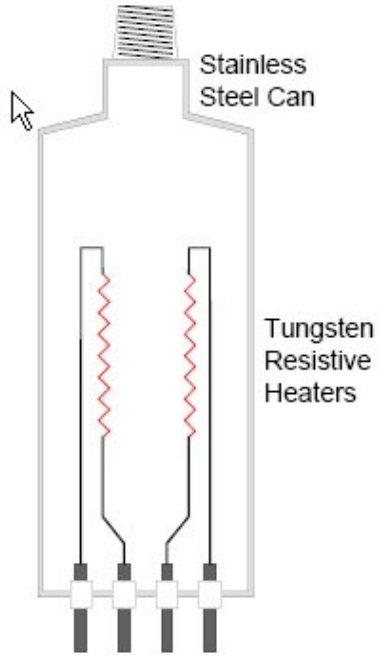
Ion getter pump



- E-field ionizes gases
- B-field increases path length
- Cascade effect produces more ions
- Gas ions implanted into cathode
- Similar to a vacuum gauge

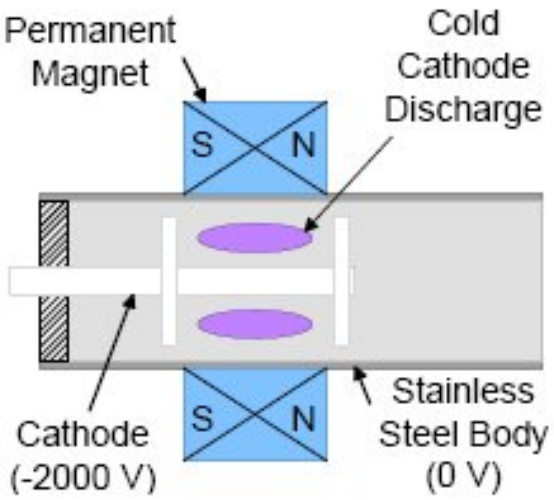
Vacuum gauges

Pirani Gauge



- Filament resistance depends on pressure and type of gas
- Low-vacuum gauge

Penning Gauge

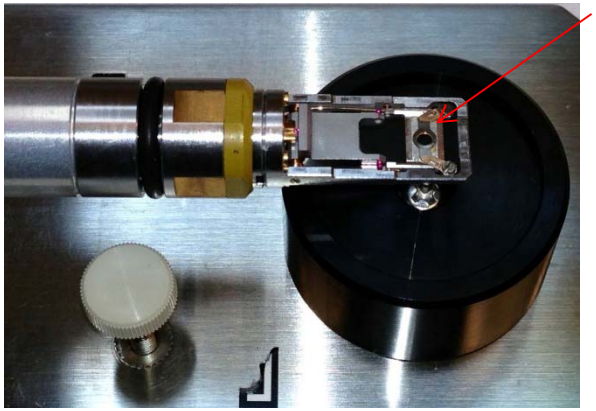


- Ionization current depends on pressure
- High-vacuum gauge

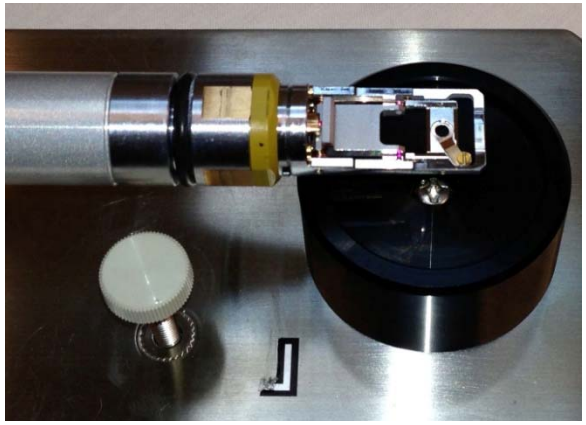
TEM Specimen Holders

Low-background, double-tilt

Be clip

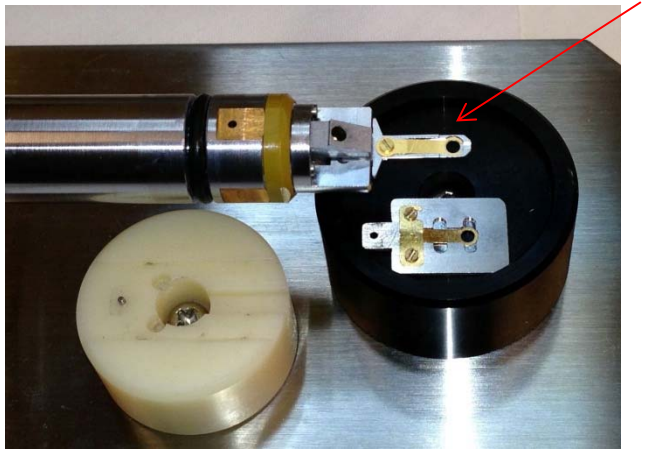


Standard double-tilt



Single-tilt/high-tilt

retainers



Heating