Vacuum Technology Basics
-- or --
Mole Control

Outline:

$$Q = SP$$

Q is the Gas Load

- **Units: Torr-Liters-Second, Moles per Second, Molecules per Second**
- **Mole = The Molecular Weight of Any Gas in a 22.4 liter Volume at Atmospheric Pressure**
- **Mole – 6.023 X 10^{+23} Molecules of Any Gas**

S is the Pumping Speed of the Vacuum Pump

- **Units: Liters/ Second, Cubic Feet/ Minute, Cubic Furlongs/Millennium, etc..**

P is the Pressure in the Vacuum System

- **Units: Torr, Bar, Pascal, Atmosphere,**

Q: What are the sources of Gas?

Leaks

- **Pin hole, .01" diameter, 1/8 wall, 10^{-6} torr requires 500000 l/s pump.**

Materials

- **Vapor Pressure:**
- **Vapor Pressure of Mercury is 3 X 10^{-3} torr at room Temp.**
- **Vapor pressure of Titanium is less than 10^{-20} torr at room Temp**

Surface Out-Gassing: Can be many layers deep.

- **Mono-Layer of Water Vapor on Inside of Cube,**
- **if all was transferred from the surface to the volume:**
- **Would raise the pressure from Zero to 10 microns (10^{-2} torr)**

Processes

- **Water Vapor, Hydrogen, Light Hydrocarbons, Crud**

Our Mole

Cube with edges 11 inches long

Volume =	**22.4 liters** **~ 6 gallons**
Internal Surface Area	**726 sq. in.** **4750 sq. cm.**

Contains:

$6 \times 10^{+23}$ Molecules of Gas at ATM. (760 torr)
$8 \times 10^{+20}$ Molecules at 1 torr
$8 \times 10^{+17}$ Molecules at 1 micron
$8 \times 10^{+10}$ Molecules at 10^{-10} torr