

## **Titanium Sublimation Pumps Lifetime/Capacity**

Titanium Sublimation Pumps operate by heating a filament containing titanium to a temperature where the metal “sublimates” from the filament to the nearby walls of the vacuum system. (Sublimation is what happens to snow in Denver - it goes directly from the solid phase to the vapor phase without going through the intermediate liquid phase.)

Anyway, the titanium film on the vacuum system walls combines with the active gases as the gas molecules strike the wall. This provides a clean, high speed, simple auxiliary type of pump for many high vacuum applications. The more rapidly the gas molecules strike the wall (the higher the pressure) the more rapidly the titanium film gets saturated. Active gasses include hydrogen, nitrogen, oxygen, carbon monoxide, carbon dioxide and water vapor.

TSP's are generally used below  $10^{-4}$  torr. At this pressure, the filament would be operated continuously since it rapidly saturates. The lifetime of a continuously operating TSP filament is 10-20 hours; there are 3-4 filaments per cartridge, depending on the brand. At lower pressures, the operation can go to intermittent sublimation, since the fresh titanium film saturates more slowly. Some control units can be set to cycle automatically. If one could use all the titanium and dispense it with 100% efficiency, filament lifetime would be:

$10^{-5}$ torr range	days
$10^{-6}$ torr range	weeks
$10^{-7}$ torr range	months
$10^{-8}$ torr range	years

Of course, everything depends, on factors such as system temperature (low is better, like in golf), system gas access/conductance (high is better, like in basketball), gas species (noble gasses such as argon and helium require another pumping mechanism; methane also requires some other pump), system area/geometry, etc.