

Evaporation Guide for the Elements*

Vacuum Level, Crucible Temperature, Crucible Type, Effusion Cell Type, E-beam & Plasma Choices

| H <small>Thermal Cracker, ECR or RF Plasma</small> | | | | | | | | | | | | | | | | | | He |
|---|---|---|------------------------------------|------------------------------------|--------------------------|---|--|---|---|---|---|--|--|---|---|-------------|-------------|----|
| Li (mp 180) | Be (mp 1287) | <p>Element to be Vaporized</p> <p>Recommended Effusion Cell or Evaporator System</p> <p>Recommended Crucibles</p> <p>vapor pressure vapor pressure vapor pressure</p> | | | | | | | | | | | | | | | | |
| <small>Low Temp</small> | <small>Single Filament or High Temp</small> | <p>Cu (mp 1085° C)</p> <p><small>Single Filament or High Temp</small></p> <p>Al₂O₃, Mo, Ta, (BeO)</p> <p>10⁻⁸ torr 722° C</p> <p>10⁻⁶ torr 852° C</p> <p>10⁻⁴ torr 1027° C</p> <p>Explanation - Legend</p> | | | | | | | | | | | | | | | | |
| <small>Al₂O₃, PBN, (BeO)</small> | <small>VC, (BeO)</small> | <p>mp = melting point in degrees Celsius</p> <p>BeO crucibles require care</p> <p>temperature of crucible</p> <p>temperature of crucible</p> <p>temperature of crucible</p> | | | | | | | | | | | | | | | | |
| 10 ⁻⁸ 235 | 10 ⁻⁸ 707 | <p>PBN = pyrolytic Boron Nitride.</p> <p>Low Temp = low temperature effusion cell</p> <p>High Temp = high temperature effusion cell</p> <p>E-beam = electron beam. Elements evaporated by E-beam do not use a crucible.</p> <p>Valved = valved effusion cell used for As, P, S, Se, and Te</p> <p>Gaseous elements, such as H, N, O, Cl and Ar are ionized using either an RF or ECR plasma. There are no settings for these materials.</p> | | | | | | | | | | | | | | | | |
| 10 ⁻⁶ 306 | 10 ⁻⁶ 832 | | | | | | | | | | | | | | | | | |
| 10 ⁻⁴ 404 | 10 ⁻⁴ 997 | | | | | | | | | | | | | | | | | |
| Na (mp 98) | Mg (mp 650) | | | | | | | | | | | | | | | | | |
| <small>Low Temp</small> | <small>Low Temp</small> | | | | | | | | | | | | | | | | | |
| <small>PBN, Quartz</small> | <small>Al₂O₃, PBN, VC</small> | | | | | | | | | | | | | | | | | |
| 10 ⁻⁸ 74 | 10 ⁻⁸ 185 | | | | | | | | | | | | | | | | | |
| 10 ⁻⁶ 123 | 10 ⁻⁶ 246 | | | | | | | | | | | | | | | | | |
| 10 ⁻⁴ 193 | 10 ⁻⁴ 327 | | | | | | | | | | | | | | | | | |
| K (mp 64) | Ca (mp 842) | Sc (mp 1541) | Ti (mp 1660) | V (mp 1910) | Cr (mp 1907) | Mn (mp 1246) | Fe (mp 1538) | Co (mp 1495) | Ni (mp 1455) | Cu (mp 1085) | Zn (mp 420) | Ga (mp 30) | Ge (mp 938) | As (mp 817) | Se (mp 221) | Br | Kr | |
| <small>Low Temp</small> | <small>Low Temp</small> | <small>High Temp or Dual Filament</small> | <small>E-beam or High Temp</small> | <small>E-beam or High Temp</small> | <small>High Temp</small> | <small>Single Filament or High Temp</small> | <small>E-beam or High Temp</small> | <small>High Temp</small> | <small>High Temp</small> | <small>Single Filament or High Temp</small> | <small>Low Temp</small> | <small>Dual or Single Filament</small> | <small>Dual or Single Filament</small> | <small>Valved Cracker or Low Temp</small> | <small>Valved Cracker or Low Temp</small> | | | |
| <small>Al₂O₃, PBN, Quartz</small> | <small>Al₂O₃, PBN, Quartz</small> | <small>Al₂O₃, (BeO)</small> | <small>TiC</small> | <small>Mo, W</small> | <small>VC</small> | <small>Al₂O₃, (BeO)</small> | <small>Al₂O₃</small> | <small>Al₂O₃, (BeO)</small> | <small>Al₂O₃, VC, (BeO)</small> | <small>Al₂O₃, Mo, Ta, (BeO)</small> | <small>Al₂O₃, PBN, Quartz</small> | <small>Al₂O₃, PBN, Quartz, (BeO)</small> | <small>Al₂O₃, PBN, Quartz</small> | <small>PBN</small> | <small>PBN</small> | | | |
| 10 ⁻⁸ 21 | 10 ⁻⁸ 282 | 10 ⁻⁸ 772 | 10 ⁻⁸ 1067 | 10 ⁻⁸ 1162 | 10 ⁻⁸ 837 | 10 ⁻⁸ 505 | 10 ⁻⁸ 858 | 10 ⁻⁸ 922 | 10 ⁻⁸ 927 | 10 ⁻⁸ 722 | 10 ⁻⁸ 123 | 10 ⁻⁸ 619 | 10 ⁻⁸ 812 | 10 ⁻⁸ 104 | 10 ⁻⁸ 63 | | | |
| 10 ⁻⁶ 65 | 10 ⁻⁶ 357 | 10 ⁻⁶ 917 | 10 ⁻⁶ 1235 | 10 ⁻⁶ 1332 | 10 ⁻⁶ 977 | 10 ⁻⁶ 611 | 10 ⁻⁶ 998 | 10 ⁻⁶ 1067 | 10 ⁻⁶ 1072 | 10 ⁻⁶ 852 | 10 ⁻⁶ 177 | 10 ⁻⁶ 742 | 10 ⁻⁶ 947 | 10 ⁻⁶ 150 | 10 ⁻⁶ 107 | | | |
| 10 ⁻⁴ 123 | 10 ⁻⁴ 459 | 10 ⁻⁴ 1107 | 10 ⁻⁴ 1453 | 10 ⁻⁴ 1547 | 10 ⁻⁴ 1157 | 10 ⁻⁴ 747 | 10 ⁻⁴ 1180 | 10 ⁻⁴ 1257 | 10 ⁻⁴ 1262 | 10 ⁻⁴ 1027 | 10 ⁻⁴ 247 | 10 ⁻⁴ 907 | 10 ⁻⁴ 1137 | 10 ⁻⁴ 210 | 10 ⁻⁴ 164 | | | |
| Rb (mp 38) | Sr (mp 777) | Y (mp 1526) | Zr (mp 1852) | Nb (mp 2468) | Mo (mp 2610) | Tc | Ru (mp 2310) | Rh (mp 1966) | Pd (mp 1555) | Ag (mp 962) | Cd (mp 321) | In (mp 157) | Sn (mp 232) | Sb (mp 631) | Te (mp 450) | I | Xe | |
| <small>Low Temp</small> | <small>Low Temp</small> | <small>High Temp</small> | <small>E-beam</small> | <small>E-beam</small> | <small>E-beam</small> | | <small>E-beam</small> | <small>E-beam</small> | <small>High Temp</small> | <small>Single Filament or High Temp</small> | <small>Low Temp</small> | <small>Dual Filament</small> | <small>Dual or Single Filament</small> | <small>Valved Cracker or Low Temp</small> | <small>Valved Cracker</small> | | | |
| | <small>Mo, VC</small> | <small>Al₂O₃</small> | --- | --- | --- | | --- | --- | <small>Al₂O₃, (BeO)</small> | <small>Al₂O₃, Mo</small> | <small>Al₂O₃, Quartz, PBN</small> | <small>Al₂O₃, PBN</small> | <small>PBN</small> | <small>PBN</small> | <small>PBN</small> | | | |
| | 10 ⁻⁸ 241 | 10 ⁻⁸ 957 | 10 ⁻⁸ 1477 | 10 ⁻⁸ 927 | 10 ⁻⁸ 1592 | Radioactive | 10 ⁻⁸ 1780 | 10 ⁻⁸ 1277 | 10 ⁻⁸ 842 | 10 ⁻⁸ 574 | 10 ⁻⁸ 74 | 10 ⁻⁸ 488 | 10 ⁻⁸ 682 | 10 ⁻⁸ 279 | 10 ⁻⁸ 155 | | | |
| | 10 ⁻⁶ 309 | 10 ⁻⁶ 1117 | 10 ⁻⁶ 1702 | 10 ⁻⁶ 1072 | 10 ⁻⁶ 1822 | | 10 ⁻⁶ 1990 | 10 ⁻⁶ 1472 | 10 ⁻⁶ 992 | 10 ⁻⁶ 685 | 10 ⁻⁶ 119 | 10 ⁻⁶ 597 | 10 ⁻⁶ 807 | 10 ⁻⁶ 345 | 10 ⁻⁶ 209 | | | |
| | 10 ⁻⁴ 404 | 10 ⁻⁴ 1332 | 10 ⁻⁴ 1987 | 10 ⁻⁴ 1262 | 10 ⁻⁴ 2117 | | 10 ⁻⁴ 2260 | 10 ⁻⁴ 1707 | 10 ⁻⁴ 1192 | 10 ⁻⁴ 832 | 10 ⁻⁴ 177 | 10 ⁻⁴ 742 | 10 ⁻⁴ 997 | 10 ⁻⁴ 425 | 10 ⁻⁴ 280 | | | |
| Cs (mp 29) | Ba (mp 727) | La (mp 920) | Hf (mp 2227) | Ta (mp 2996) | W (mp 3410) | Re (mp 3180) | Os | Ir (mp 2410) | Pt (mp 1768) | Au (mp 1064) | Hg (mp -39) | Tl (mp 304) | Pb (mp 328) | Bi (mp 271) | Po | At | Rn | |
| <small>Low Temp</small> | <small>Low Temp</small> | <small>High Temp</small> | <small>E-beam</small> | <small>E-beam</small> | <small>E-beam</small> | <small>E-beam</small> | | <small>E-beam</small> | <small>High Temp</small> | <small>High Temp or Single Filament</small> | <small>Near Ambient</small> | <small>Low Temp</small> | <small>Low Temp or Single Filament</small> | <small>Low Temp</small> | | | | |
| <small>Quartz, PBN</small> | <small>Ta, Mo</small> | <small>Al₂O₃</small> | --- | --- | --- | --- | | --- | <small>C, ThO₂</small> | <small>Al₂O₃, PBN, VC</small> | <small>Al₂O₃, PBN, Quartz</small> | <small>Al₂O₃, Quartz</small> | <small>Al₂O₃, Mo, PBN, Ta, W</small> | <small>Al₂O₃, VC, (BeO)</small> | | | | |
| 10 ⁻⁸ -16 | 10 ⁻⁸ 272 | 10 ⁻⁸ 990 | 10 ⁻⁸ 2160 | 10 ⁻⁸ 1960 | 10 ⁻⁸ 2117 | 10 ⁻⁸ 1928 | | 10 ⁻⁸ 1850 | 10 ⁻⁸ 1292 | 10 ⁻⁸ 807 | 10 ⁻⁸ -72 | 10 ⁻⁸ 280 | 10 ⁻⁸ 342 | 10 ⁻⁸ 329 | | | | |
| 10 ⁻⁶ 22 | 10 ⁻⁶ 354 | 10 ⁻⁶ 1212 | 10 ⁻⁶ 2250 | 10 ⁻⁶ 2240 | 10 ⁻⁶ 2407 | 10 ⁻⁶ 2207 | | 10 ⁻⁶ 2080 | 10 ⁻⁶ 1492 | 10 ⁻⁶ 947 | 10 ⁻⁶ -44 | 10 ⁻⁶ 360 | 10 ⁻⁶ 427 | 10 ⁻⁶ 409 | | | | |
| 10 ⁻⁴ 80 | 10 ⁻⁴ 462 | 10 ⁻⁴ 1388 | 10 ⁻⁴ 3090 | 10 ⁻⁴ 2590 | 10 ⁻⁴ 2757 | 10 ⁻⁴ 2570 | | 10 ⁻⁴ 2380 | 10 ⁻⁴ 1747 | 10 ⁻⁴ 1132 | 10 ⁻⁴ 7 | 10 ⁻⁴ 470 | 10 ⁻⁴ 497 | 10 ⁻⁴ 517 | Radioactive | Radioactive | Radioactive | |

| Others | Source | Crucible |
|-------------------|-----------------|---|
| Methane | ECR Plasma | ---- |
| Bio-Materials | Single Filament | Al ₂ O ₃ , Mo, Ta |
| Polymers | Near Ambient | Al ₂ O ₃ , PBN |
| Thorium (mp 1845) | E-beam | Al ₂ O ₃ , PBN |

| Ce (mp 795) | Pr | Nd | Pm | Sm | Eu (mp 822) | Gd | Tb | Dy (mp 1412) | Ho | Er (mp 1529) | Tm | Yb (mp 824) | Lu (mp 1663) |
|---|----|----|-------------|----|---|----|----|--------------------------|----|--|----|-------------------------|--|
| <small>High Temp</small> | | | | | <small>Low Temp or Dual Filament</small> | | | <small>High Temp</small> | | <small>Dual or Single Filament</small> | | <small>Low Temp</small> | <small>High Temp</small> |
| <small>Al₂O₃, VC, (BeO)</small> | | | | | <small>Al₂O₃, Mo, PBN, Ta</small> | | | <small>Ta</small> | | <small>PBN, Ta, W</small> | | <small>Ta</small> | <small>Al₂O₃</small> |
| 10 ⁻⁸ 970 | | | Radioactive | | 10 ⁻⁸ 283 | | | 10 ⁻⁸ 625 | | 10 ⁻⁸ 649 | | 10 ⁻⁸ 247 | 10 ⁻⁸ 870 |
| 10 ⁻⁶ 1150 | | | | | 10 ⁻⁶ 361 | | | 10 ⁻⁶ 750 | | 10 ⁻⁶ 777 | | 10 ⁻⁶ 317 | 10 ⁻⁶ 1228 |
| 10 ⁻⁴ 1380 | | | | | 10 ⁻⁴ 466 | | | 10 ⁻⁴ 900 | | 10 ⁻⁴ 897 | | 10 ⁻⁴ 417 | 10 ⁻⁴ 1376 |

* All values are based on the work of Edward Graper of the Lebow Corporation, Albrecht Fischer of VTS-CreaTec GmbH, Christian Bradley of Oxford Scientific and Dietrich von Diemar of Specs Scientific. © B. Vincent Crist, 2008

Some materials and their compounds are extremely toxic and must be handled with great care. Manufacturers safety, MSDS guidelines and handling instructions must be strictly followed each and every time it is used!

None of the companies accept responsibility for any misuse of materials or their evaporation and deposition.