

Evaporation Guide for the Elements*

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

H																		He															
Thermal Cracker, ECR or RF Plasma																																	
Li (mp 180)	Be (mp 1287)	Element to be Vaporized Recommended Effusion Cell or Evaporator System Recommended Crucibles vapor pressure vapor pressure vapor pressure																Cu (mp 1085° C)		mp = melting point in degrees Celsius BeO crucibles require care temperature of crucible temperature of crucible temperature of crucible		B (mp 2075)		C (mp 3550)		N		O		F		Ne	
Low Temp		PBN = pyrolytic Boron Nitride. Low Temp = low temperature effusion cell High Temp = high temperature effusion cell E-beam = electron beam. Elements evaporated by E-beam do not use a crucible. Valved = valved effusion cell used for As, P, S, Se, and Te 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.																Single Filament or High Temp				High Temp		Carbon Effusion		RF Plasma		ECR Plasma					
Al ₂ O ₃ , PBN, (BeO)		Explanation - Legend																Al ₂ O ₃ , Mo, Ta, (BeO)				C, VC		PGR		PBN		Al ₂ O ₃					
10 ⁻⁸	235	10 ⁻⁸	707																	10 ⁻⁸	1282	10 ⁻⁸	1657										
10 ⁻⁶	306	10 ⁻⁶	832																	10 ⁻⁶	1467	10 ⁻⁶	1867										
10 ⁻⁴	404	10 ⁻⁴	997																	10 ⁻⁴	1707	10 ⁻⁴	2136										
Na (mp 98)	Mg (mp 650)																	Al (mp 660)		Si (mp 1414)		P (mp 44)		S (mp 115)		Cl		Ar					
Low Temp																		Cold Lip		E-beam or High Temp		Valved Cracker		Valved Cracker or Valved		ECR Plasma		ECR Plasma					
PBN, Quartz																		PBN		Ta		Al ₂ O ₃ , PBN, Mo, Ta		PBN		Al ₂ O ₃		Al ₂ O ₃					
10 ⁻⁸	74	10 ⁻⁸	185																	10 ⁻⁸	685	10 ⁻⁸	992	10 ⁻⁸	54	10 ⁻⁸	-10						
10 ⁻⁶	123	10 ⁻⁶	246																	10 ⁻⁶	812	10 ⁻⁶	1147	10 ⁻⁶	88	10 ⁻⁶	17						
10 ⁻⁴	193	10 ⁻⁴	327																	10 ⁻⁴	972	10 ⁻⁴	1337	10 ⁻⁴	192	10 ⁻⁴	55						
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																
Low Temp		Low Temp		High Temp or Dual Filament		E-beam or High Temp		E-beam or High Temp		High Temp		Single Filament or High Temp		E-beam or High Temp		High Temp		High Temp		Single Filament or High Temp		Low Temp		Dual or Single Filament		Dual or Single Filament		Valved Cracker or Low Temp		Valved Cracker or Low Temp			
Al ₂ O ₃ , PBN, Quartz		Al ₂ O ₃ , PBN, Quartz		Al ₂ O ₃ , (BeO)		TiC		Mo, W		VC		Al ₂ O ₃ , (BeO)		Al ₂ O ₃		Al ₂ O ₃ , (BeO)		Al ₂ O ₃ , VC, (BeO)		Al ₂ O ₃ , Mo, Ta, (BeO)		Al ₂ O ₃ , PBN, Quartz		Al ₂ O ₃ , PBN, Quartz, (BeO)		Al ₂ O ₃ , PBN, Quartz		Al ₂ O ₃ , PBN, Quartz		PBN		PBN	
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																
Low Temp		Low Temp		High Temp		E-beam		E-beam		E-beam		E-beam		E-beam		High Temp		Single Filament or High Temp		Low Temp		Dual Filament		Dual or Single Filament		Valved Cracker or Low Temp		Valved Cracker					
Mo, VC		Al ₂ O ₃		---		---		---		Al ₂ O ₃ , (BeO)		Al ₂ O ₃ , Mo		Al ₂ O ₃ , Quartz, PBN		Al ₂ O ₃ , PBN		PBN		PBN		PBN		PBN		PBN		PBN					
		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	685	10 ⁻⁶	119	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	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																
Low Temp		Low Temp		High Temp		E-beam		E-beam		E-beam		E-beam		High Temp		High Temp or Single Filament		Near Ambient		Low Temp		Low Temp or Single Filament		Low Temp		Low Temp		Low Temp					
Quartz, PBN		Ta, Mo		Al ₂ O ₃		---		---		---		---		C, ThO ₂		Al ₂ O ₃ , PBN, VC		Al ₂ O ₃ , PBN, Quartz		Al ₂ O ₃ , Quartz		Al ₂ O ₃ , PBN, Quartz		Al ₂ O ₃ , Mo, PBN, Ta, W		Al ₂ O ₃ , VC, (BeO)		---					
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	Radioactive					
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			Radioactive			
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	

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)				
					Low Temp or Dual Filament				High Temp				Dual or Single Filament				
					Al ₂ O ₃ , VC, (BeO)				Ta				PBN, Ta, W				
10 ⁻⁸	970	Radioactive						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
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