

E-Beam Crucibles

Materials and recommendations

The Entegris graphite electron beam evaporation crucibles are designed to offer E-Beam users improved evaporation performance over that obtainable in bare hearth mode. Our graphite crucible acts as an "energy efficient" thermal barrier between the molten evaporant and the water cooled copper hearth.

This will allow an increased deposition rate of up to 400% with the same power, or the same deposition using only 25% of the power, when compared to evaporation from a bare hearth. In some applications, the high power required to achieve an economical deposition rate can emit a form of radiation that can damage the devices on the wafers.

Entegris crucibles allow for a much lower power setting while maintaining an acceptable deposition rate.

Graphite Material

Entegris' POCO® facility manufactures graphite, which is utilized in the production of E-Beam evaporation crucibles. The defining characteristics of Entegris graphite are its inherent uniform microstructure, providing consistent performance due to its high strength and purity, its ability to withstand wide temperature regimes, and its small pore size. These properties result in longer life, compatibility with a variety of melts and high-yield depositions. In combination, Entegris' POCO crucibles provide the best cost of ownership.

FABMATE®-BG E-Beam Crucibles

FABMATE-BG crucibles offer the user cleaner handling with reduced particle content in the melt. Additional benefits are reduced wetting and longer crucible life.

DFP-1 graphite is densified, machined, and purified and then given an amorphous carbon treatment. This treatment is unique because it does more than coat the surface. It also infiltrates and locks onto the graphite. This treatment provides a harder surface, with the porosity sealed to reduce wetting and eliminate particles.



TYPICAL PURITY ANALYSIS

Elements detected via GDMS	ppm range
Iron (Fe)	ND to trace
Silicon (Si)	ND to trace
Aluminum (Al)	ND to trace
Magnesium (Mg)	ND to trace
Vanadium (V)	ND to trace
Nickel (Ni)	ND to trace
Chromium (Cr)	ND to trace
Titanium (Ti)	ND to trace
Copper (Cu)	ND to trace
Boron (B)	ND to trace
Manganese (Mn)	ND to trace
Lithium (Li)	ND to trace
Cadmium (Cd)	ND to trace
Molybdenum (Mo)	ND to trace
Lead (Pb)	ND to trace
Silver (Ag)	ND to trace
Zinc (Zn)	ND to trace
Calcium (Ca)	ND to trace
Potassium (K)	ND to trace
Sodium (Na)	ND to trace

Note: Total ash range 5 ppm or less
ND = Not detected

SPECIFICATIONS

DFP-3-2 part number	FABMATE BG part number	Description	Top OD (A)	Height (B)	Wall (C)	Angle (D)
DE-11429	DE-11606	EB-1	19.05 mm (0.750")	4.11 mm (0.162")	1.02 mm (0.040")	30°
DE-11430	DE-11607	EB-2	35.15 mm (1.384")	15.06 mm (0.593")	2.36 mm (0.093")	15°
DE-11431	DE-11608	EB-3	21.97 mm (0.865")	14.30 mm (0.563")	2.36 mm (0.093")	15°
DE-11432	DE-11609	EB-4	29.64 mm (1.167")	14.30 mm (0.563")	2.36 mm (0.093")	15°
DE-11433	DE-11610	EB-5	23.77 mm (0.936")	15.06 mm (0.593")	2.36 mm (0.093")	15°
DE-11434	DE-11611	EB-6	51.56 mm (2.030")	25.91 mm (1.020")	2.36 mm (0.093")	15°
DE-11455	N/A	EB-6M	51.56 mm (2.030")	25.91 mm (1.020")	6.35 mm (0.250")	15°
DE-11435	DE-11612	EB-7	75.18 mm (2.960")	39.67 mm (1.562")	2.36 mm (0.093")	7° 30'
DE-11436	DE-11613	EB-8	50.80 mm (2.000")	26.97 mm (1.062")	2.36 mm (0.093")	15°
DE-11456	DE-11631	EB-8M	50.80 mm (2.000")	26.97 mm (1.062")	6.35 mm (0.250")	15°
DE-11437	DE-11614	EB-9	45.09 mm (1.775")	23.88 mm (0.940")	2.36 mm (0.093")	15°
DE-11457	DE-11632	EB-9M	45.09 mm (1.775")	23.88 mm (0.940")	6.35 mm (0.250")	15°
DE-11438	DE-11615	EB-10	***	11.10 mm (0.437")	1.58 mm (0.062")	14°
DE-11439	N/A	EB-11	25.40 mm (1.000")	19.05 mm (0.750")	3.18 mm (0.125")	0°
DE-11458	DE-11633	EB-12M*	82.55 mm (3.250")	38.86 mm (1.530")	6.35 mm (0.250")	15°
DE-11441	DE-11617	EB-13	37.59 mm (1.480")	17.02 mm (0.670")	3.18 mm (0.125")	15°
DE-11459	DE-11634	EB-13M	37.59 mm (1.480")	17.02 mm (0.670")	6.35 mm (0.250")	15°
DE-11460	DE-11635	EB-14M**	60.71 mm (2.390")	25.40 mm (1.000")	6.35 mm (0.250")	15°
DE-11442	DE-11618	EB-15	48.01 mm (1.890")	17.78 mm (0.700")	3.18 mm (0.125")	15°
DE-11443	DE-11619	EB-16	46.99 mm (1.850")	17.27 mm (0.680")	2.36 mm (0.093")	15°
DE-11444	DE-11620	EB-17	56.18 mm (2.212")	35.56 mm (1.400")	2.36 mm (0.093")	15°
DE-11445	DE-11621	EB-18	41.66 mm (1.640")	24.64 mm (0.970")	3.18 mm (0.125")	15°
DE-11446	DE-11622	EB-19	14.22 mm (0.560")	9.75 mm (0.384")	2.36 mm (0.093")	15°
DE-11447	DE-11623	EB-20	17.93 mm (0.706")	11.81 mm (0.465")	2.36 mm (0.093")	15°
DE-11448	DE-11624	EB-21	20.45 mm (0.805")	13.84 mm (0.545")	2.36 mm (0.093")	15°
DE-11449	DE-11625	EB-22	22.48 mm (0.885")	15.11 mm (0.595")	2.36 mm (0.093")	15°
DE-11450	DE-11626	EB-23	28.58 mm (1.125")	13.20 mm (0.520")	2.36 mm (0.093")	15°
DE-11451	DE-11627	EB-24	32.51 mm (1.280")	23.88 mm (0.940")	2.36 mm (0.093")	15°
DE-11452	DE-11628	EB-25	41.48 mm (1.633")	23.88 mm (0.940")	2.36 mm (0.093")	15°
DE-11453	DE-11629	EB-26	48.77 mm (1.920")	20.57 mm (0.810")	2.36 mm (0.093")	15°
DE-11454	DE-11630	EB-27	68.58 mm (2.700")	37.85 mm (1.490")	2.36 mm (0.093")	15°

Note: Typical outside bottom radius is 3.18 mm (0.125")

*Outside bottom radius is 6.60 mm (0.260")

**Outside bottom radius is 6.35 mm (0.250")

***EB-10 is a rectangular crucible; see image on page 4 for details.

MELT

Melt Level

The ideal melt level for most metals is between 30% to 80% of the crucible volume. Spill-over may occur if the melt level is greater than 80%. Crucible overheating or breakage due to the beam striking the crucible bottom may occur if the melt level is below 30%.

To aid in obtaining the ideal melt level, the capacity chart can be used to determine the maximum crucible cavity volume. Calculate 80% of the volume to determine the amount of material needed.

Aluminum is the most frequently evaporated metal. Since aluminum is known to “wet” graphite, the melt level needs to be reduced. Crucibles should only be filled to 70% of the crucible height rather than 80% of the total volume. Use the special column for aluminum in the capacity chart to determine the correct amount of material.

Recommended Melt Materials

The Entegris graphite E-Beam crucible is suitable for use with a large variety of materials including:

Ag	Be	Mo	SiO
Al	CdS	Na ₃ AlF ₆	SiO ₂
Al-Ge	CeO ₂	Ni _x Cr _x	Sn
Al-Si	Cr	Pb	Ta
As	Cu	Pd	Te
Au	Ga	Pt	Ti
B	Ge	Se	TiO

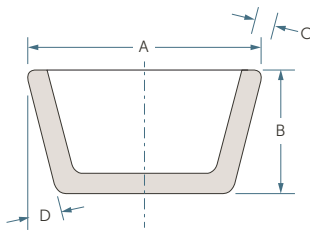
Crucible Capacity

Crucible style	TOTAL VOLUME	MAXIMUM WEIGHT OF ALUMINUM (GRAMS)	
	cc	in ³	70% of height
EB-1	0.24	0.01	0.30
EB-2	4.80	0.29	8.20
EB-3	1.80	0.11	3.00
EB-4	4.40	0.27	7.50
EB-5	2.40	0.15	4.00
EB-6	30.40	1.85	52.10
EB-6M	17.00	1.04	29.10
EB-7	126.00	7.69	84.20
EB-8	30.20	1.84	51.10
EB-8M	16.90	1.03	28.60
EB-9	20.20	1.23	34.30
EB-9M	10.30	0.63	17.40
EB-10	2.80	0.17	4.90
EB-11	2.30	0.14	4.30
EB-12M	94.70	5.78	163.30
EB-13	8.20	0.50	14.10
EB-13M	3.90	0.24	6.80
EB-14M	27.10	1.65	47.50
EB-15	16.20	0.99	28.80
EB-16	17.10	1.04	30.30
EB-17	47.60	2.90	78.50
EB-18	14.70	0.90	24.50
EB-19	0.32	0.02	0.51
EB-20	0.84	0.05	1.35
EB-21	1.44	0.09	2.32
EB-22	2.10	0.13	3.30
EB-23	3.70	0.23	6.40
EB-24	8.30	0.51	13.10
EB-25	16.30	0.99	27.30
EB-26	21.90	1.33	38.20
EB-27	82.70	5.05	139.70

DIMENSIONS

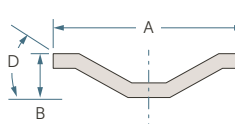
Crucible Measurements

Standard Round Crucibles

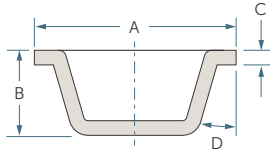


Special Shapes

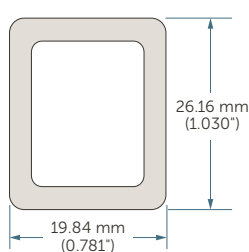
EB-1



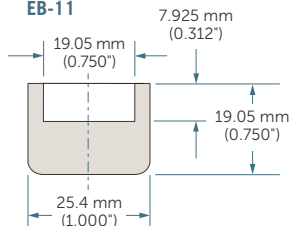
EB-2



EB-10 (Top View)



EB-11



OD dimensions	0.25 mm (+0.010") 0.00 mm (-0.000")
Other dimensions	±0.13 mm (±0.005")
Angles	+1°–0°
Typical inside radius	0.76 mm (0.03")
Typical outside bottom radius	3.18 mm (0.125")
Finish	3.2 × 10 ⁻³ mm (1.25 RMS)

Note: All sharp edges broken.

CRUCIBLE SELECTION

Crucibles physically protect the hearth, meaning less downtime for cleaning, less damage from destructive cleaning techniques, and less damage from accidents while handling.

Two of the most popular sizes are also inventoried in taller versions. EB-17 and EB-18 tall crucibles are designed to hold a larger charge of metal and fit in the same hearths as the EB-6, EB-8, and EB-13

crucibles. Although these crucibles are designed to have adequate top clearance, we recommend verifying clearance prior to placing an order.

Check our crucible source cross-reference table on page 5, as a guide to the selection of the correct crucible. Information in the table was supplied by gun manufacturers and customer experience. Due to variations in the pocket sizes, we recommend hearth dimensions be checked prior to ordering.

SOLUTIONS TO COMMON PROBLEMS

Melt Levels

The most common cause of crucible failures is overfilling. Overfilling can cause the melt to spill over the edge of the crucible. When a spillover occurs, a thermal short is created between the crucible and the hearth. The resultant thermal stress causes the crucible to crack. For this reason, a maximum melt level of 80% of the crucible capacity is recommended.

Crucible Contact

Another significant cause of crucible failures is cracking due to the improper seating of the crucible in the hearth. Out-of-round or chiseled hearths often create nonuniform mechanical stresses on the crucible walls. For the longest crucible life and for the most reproducible evaporation results, contact between the graphite crucible and the copper hearth should be restricted to the bottom of the hearth cavity. A circular graphite or copper shim is frequently used to achieve proper contact.

Handling

Improper crucible handling and storage also can be the source of crucible life problems. Crucibles should be handled with tongs, gloves, or finger cots; never with bare hands or fingers. Used crucibles available for reuse should be stored in a dry, oxygen-free environment.

Aluminum Melts

Aluminum carbide formation affects the life of crucibles used for aluminum evaporation. The aluminum carbide forms a transparent, yellowish film on the surface of the aluminum. When the film covers the entire surface of the aluminum, the evaporation rate is reduced to near zero. The presence of this phenomenon is indicative of excessive crucible temperature. The beam power should be reduced to minimize the formation of aluminum carbide.

SOURCE CROSS-REFERENCE TABLE

Crucible number	Equipment manufacturer	Power	Hearth pockets	Source model number	Hearth volume	Comments
EB-1	Varian®	2 KW	1	980-0001		
	Varian	2 KW	3	980-0003		
	Varian	2 KW	5	980-0005		
EB-2	Temescal®	8 KW	4	TIH-270		
	Temescal			FIH-270 (1½)		Same dimensions as EB-4, lip on top
	Temescal			FIH-180		
	Varian	6 KW	1 or 4	980-1105		
	Davis & Wilder		3 or 4	5613		
EB-3	Temescal					Very near dimensions of EB-5; this model may fit better in rotary multipocket source
	Sloan					
EB-4	Balzers		4	ESQ-110	7 cc	
	Temescal			FIH-180	7 cc	
	Temescal			FIH-270	7 cc	
	Temescal	8 KW		TIH-270	7 cc	
	Temescal	10 KW	1	SFIH-270-1	7 cc	
	Temescal	6–10 KW	4	STIH-270-1	7 cc	
	Temescal	10 KW	6	STIH-270-2M	7 cc	May use EB-13
	Temescal	10 KW	1	UHVC-270-1	7 cc	
	Temescal	6–10 KW	4	UHVM-270-1	7 cc	
	Varian	6 KW	1 or 4	980-1105	7 cc	
	Davis & Wilder	10 KW	3 or 4	5603		15° wall, not 30° wall model
	Davis & Wilder	16 KW	8	5714		4 cavity, takes 2 × 2½"
	Telemark	8 KW	6	271-5		
	Telemark	8 KW	6	271-6		
EB-5	Temescal			TIH-180		
	Temescal			TFE-180		
	Temescal			LTFH-180		
	Temescal					
	Davis & Wilder	8 KW	1	5600		
	Davis & Wilder	8 KW	1	5613		
	Davis & Wilder	8 KW	1	5614		

SOURCE CROSS-REFERENCE TABLE (CONTINUED)

Crucible number	Equipment manufacturer	Power	Hearth pockets	Source model number	Hearth volume	Comments	
EB-6	Temescal	14 KW	1	SFIH-27Q-2	40 cc	Due to slight variations among hearths, EB-6 or EB-8 could be used; check hearth dimensions; for taller crucible see EB-17	
	Temescal	14 KW	1	FIH-270-2	40 cc		
	Temescal	14 KW	1	UHVC-270-2	40 cc		
	Sloan			V-6	40 cc		
	Telemark		1	272-04	40 cc		
EB-7	Sloan			V-7			
EB-8	Temescal	14 KW	1	UHVC-270-2	40 cc	See comments on EB-6 and EB-17	
	Temescal	14 KW	1	SFIH-270-2	40 cc		
	Temescal	14 KW	1	FIH-270-2	40 cc		
	Davis & Wilder			5721	40 cc		
	Davis & Wilder			5724	40 cc		
	Sloan			V-8	40 cc		
EB-9	Leo Eng.		1	000195	30 cc	May use 2 EB-13 and 2 EB-9	
	Leo Eng.		4	000200	30 cc		
	Leo Eng.		4	000210	30 cc		
	Sloan		1	V-5	30 cc		
	Balzers		4	ESQ-113	30 cc		
	Telemark		4	271-09	30 cc		Without web
	Telemark		4	271-10	30 cc		Without web
	Telemark		4	271-15	30 cc		Uses 3 EB-13 and 1 EB-9
	Telemark		4	271-16	30 cc		Uses 3 EB-13 and 1 EB-9
EB-10	Sloan		1	V-10			
EB-11	Veeco®						
EB-12	Balzers		1	ESQ-110*	156 cc	Hearth #BK-204-890-T (*3¼" diameter only)	
	Temescal	20 KW	1	SFIH-270-3	156 cc		
	Temescal		1	FIH-270*	156 cc		
	Temescal	14 KW		UHVC-270-3	156 cc		
	Davis & Wilder		1	5731	156 cc		

SOURCE CROSS-REFERENCE TABLE (CONTINUED)

Crucible number	Equipment manufacturer	Power	Hearth pockets	Source model number	Hearth volume	Comments
EB-13	Leo Eng.		1	000295	15 cc	
	Leo Eng.		4	000210	15 cc	May use 2 EB-9 and 2 EB-13
	Temescal			STIH-270-2	15 cc	
	Temescal	10 KW	4	STIH-270-2M	15 cc	May use EB-4
	Temescal	10 KW	2	Gemini	15 cc	
	Temescal	10 KW	3	Trigon	15 cc	
	Telemark	8 KW	4	271-01	15 cc	
	Telemark	8 KW	4	271-02	15 cc	
	Telemark	8 KW	4	271-03	15 cc	Uses 3 EB-13 and 1 EB-16
	Telemark	8 KW	4	271-04	15 cc	Uses 3 EB-13 and 1 EB-16
	Telemark		1	211-15	15 cc	
	Telemark		4	261 -01	15 cc	
	Telemark		4	261-02	15 cc	
	Telemark		6	271-11	15 cc	
	Telemark		6	271-12	15 cc	
	Telemark		4	271-15	15 cc	Uses 3 EB-13 and 1 EB-9
	Telemark		4	271-16	15 cc	Uses 3 EB-13 and 1 EB-9
	Telemark		6	271-32	15 cc	Uses 3 EB-23 and 3 EB-13
	Telemark		6	271-33	15 cc	Uses 3 EB-23 and 3 EB-13
	Telemark		4	271-36	15 cc	Uses 2 EB-13 and 2 EB-16
	Telemark		4	271-37	15 cc	Uses 2 EB-13 and 2 EB-16
	Telemark		6	271-38	15 cc	Uses 3 EB-13 and 3 EB-25
	Telemark		6	271-39	15 cc	Uses 3 EB-13 and 3 EB-25
Telemark		6	271-40	15 cc	Uses 4 EB-13 and 2 EB-25	
Telemark		6	271-41	15 cc	Uses 4 EB-13 and 2 EB-25	
Telemark		6	271-42	15 cc	Uses 2 EB-13 and 4 EB-25	
Telemark		6	271-43	15 cc	Uses 2 EB-13 and 4 EB-25	
Telemark		1	272-02	15 cc		
EB-14	ET Equipments	15 KW	1	ET-15	15 cc	

SOURCE CROSS-REFERENCE TABLE (CONTINUED)

Crucible number	Equipment manufacturer	Power	Hearth pockets	Source model number	Hearth volume	Comments
EB-16	Telemark	8 KW	4	271-07	25 cc	
	Telemark	8 KW	4	271-08	25 cc	
	Telemark		1	272-03	25 cc	
	Telemark		4	271-03	25 cc	Uses 3 EB-13 and 1 B-16
	Telemark		4	271-04	25 cc	Uses 3 EB-13 and 1 B-16
	Telemark		4	271-36	25 cc	Uses 2 EB-13 and 2 B-16
	Telemark		4	271-37	25 cc	Uses 2 EB-13 and 2 B-16
	Temescal		1	STIH-270-3	25 cc	
	Temescal		1	STIH-270-4	25 cc	
EB-17	See EB-68				40 cc	Tall crucible designed to be used in the same hearth as an EB-6 or EB-8
EB-18	See EB-13				15 cc	Tall crucible designed to be used in the same hearth as an EB-13; will work with 4-pocket rotary hearths
EB-19	Telemark		1	211-01	1 cc	
EB-20	Telemark		1	211-02	2 cc	
EB-21	Telemark		1	211-03	3 cc	
EB-22	Telemark		1	211-04	4 cc	
	Telemark		4	261-44	4 cc	
	Telemark		4	261-14	4 cc	
EB-23	Telemark		1	211-07	7 cc	
	Telemark		1	272-01	7 cc	
	Telemark		4	261-28	7 cc	
	Telemark		4	261-47	7 cc	
	Telemark		4	271-28	7 cc	
	Telemark		4	271-29	7 cc	
	Telemark		6	271-05	7 cc	
	Telemark		6	271-06	7 cc	
	Telemark		6	271-32	7 cc	Uses 3 EB-23 and 3 EB-13
	Telemark		6	271-33	7 cc	Uses 3 EB-23 and 3 EB-13
	Telemark		8	271-13	7 cc	
	Telemark		8	271-14	7 cc	

SOURCE CROSS-REFERENCE TABLE (CONTINUED)

Crucible number	Equipment manufacturer	Power	Hearth pockets	Source model number	Hearth volume	Comments
EB-24	Telemark		1	211-12	12 cc	
	Telemark		1	272-12	12 cc	
	Telemark		4	261-34	12 cc	
	Telemark		4	261-41	12 cc	
	Telemark		8	271-34	12 cc	
	Telemark		8	271-35	12 cc	
EB-25	Telemark		6	271-18	25 cc	
	Telemark		6	271-27	25 cc	
	Telemark		6	271-38	25 cc	Uses 3 EB-13 and 3 EB 25
	Telemark		6	271-39	25 cc	Uses 3 EB-13 and 3 EB-25
	Telemark		6	271-40	25 cc	Uses 4 EB-13 and 2 EB-25
	Telemark		6	271-41	25 cc	Uses 4 EB-13 and 2 EB-25
	Telemark		6	271-42	25 cc	Uses 2 EB-13 and 4 EB-25
	Telemark		6	271-43	25 cc	Uses 2 EB-13 and 4 EB-25
EB-26	Telemark		1	272-30	30 cc	
	Telemark		4	271-19	30 cc	
	Telemark		4	271-20	30 cc	
EB-27	Telemark		1	272-05	100 cc	

FOR MORE INFORMATION

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