Industrial Graphite

Materials and post processes

OVERVIEW

Entegris' POCO Materials are ideal for a multitude of highly technical industrial applications. The defining characteristic of our graphite is the uniform microstructure inherent in the graphite materials. These graphites have a proven cost of ownership advantage in many applications, due to the properties that result from the material's uniform, isotropic microstructure. All of which is a result of a unique manufacturing process.

Our grades of graphite are segmented by grain sizes, which include one, five, 10, and 14 micron. They are further segmented by application, and they are sold in bulk form, or as custom machined components for specific applications. The properties of graphite make them ideal for use as a replacement for structural, tribological, thermal, even electrical components. In many applications, graphite has a lower cost of ownership and improved performance compared to many other material choices.

In addition to engineering specific properties into the graphite, we have a variety of post-processing options to further modify the material to fit specific industrial applications.

POST PROCESSES

Purification (-1)

Unpurified graphites have typical impurity levels over 1000 ppm, of which, the major constituents are metals. Our purification process reduces impurities to 5 ppm (99.9995%) or less as determined by ash analysis.

Densification (BG)

The process of manufacturing bulk synthetic graphite yields tiny voids (pores), which may link to the surface (open porosity) or be isolated (closed porosity). Densification partially fills the open pores with pure carbon, reducing the average pore size and open porosity. The open porosity is reduced by 80% through the BG process, resulting in graphite with reduced permeability.

Oxidation Inhibition (E2)

Graphite is subject to oxidation at high temperatures, typically above 450°C (842°F). Service temperature can be raised to 600°C (1112°F) by impregnating the graphite pore structure with zinc phosphate. The oxidation threshold increases an additional 50°C (122°F) if the graphite is purified.

Resin Impregnation (CFS)

The resin impregnation completely blocks the pore structure. This is applied to keep fluids from penetrating the graphite pore structure. The CFS process must be applied to bulk materials with a maximum cross section of 0.600". The maximum service temperature for the CFS impregnated material is approximately 150°C (302°F).

Acrylic Impregnation (R)

The acrylic impregnation keeps fluids and air from penetrating the graphite pore structure and prevents cross talk between pores, much like the CFS impregnation. The "R" process, however, yields a less abrasive material, increasing machinability and reducing the total cost of finished components. The process may be applied to bulk materials with a maximum cross section of 1". The recommended maximum service temperature for the impregnated material is approximately 150°C (302°F), with short-term excursions up to 200°C (392°F).

Pyrolytic Carbon Treatment (PYC)

Parts go through a unique, proprietary CVI process that provides a nonporous surface with an amorphous carbon coating. The treatment completely seals the surface of one and five micron grade graphites and reduces particle generation in abrasive environments. The treatment must be performed on finished components.

Silicon Carbide Conversion (SUPERSiC®)

Our unique conversion process produces the highest quality silicon carbide products available on the market today. This process starts with graphite material specially designed and manufactured for use as the precursor in the conversion process. Near net shaped parts are machined in graphite, purified, and subjected to a proprietary conversion process that substitutes pure silicon atoms for carbon atoms. The conversion to SUPERSiC silicon carbide results in significantly increased strength, electrical resistivity, and an oxidation threshold above 800°C (1472°F).

TYPICAL MATERIAL PROPERTIES

PROPERTIES	ZXF-5Q	ACF-10Q	AXF-5Q	AXM-5Q	AXZ-5Q
Particle size	1 µm (40 µin)	5 µm (200 µin)	5 µm (200 µin)	5 µm (200 µin)	5 µm (200 µin)
Pore size	0.3 µm (12 µin)	0.8 µm (32 µin)	0.8 µm (32 µin)	0.8 µm (32 µin)	0.7 µm (28 µin)
Total porosity: % volume	20%	21%	20%	23%	26%
Open porosity: % of total	80%	75%	80%	85%	90%
Apparent density	1.78 g/cm³ (0.0641 lb/in³)	1.77 g/cm³ (0.0637 lb/in³)	1.78 g/cm³ (0.0641 lb/in³)	1.73 g/cm³ (0.0623 lb/in³)	1.66 g/cm³ (0.0598 lb/in³)
Compressive strength	175 MPa (25,500 psi)	186 MPa (27,000 psi)	138 MPa (20,000 psi)	124 MPa (18,000 psi)	103 MPa (15,000 psi)
Flexural strength[1]	112 MPa (16,200 psi)	97 MPa (14,000 psi)	86 MPa (12,500 psi)	69 MPa (10,000 psi)	52 MPa (7500 psi)
Tensile strength[2]	79 MPa (11,500 psi)	69 MPa (10,000 psi)	62 MPa (9000 psi)	48 MPa (7000 psi)	34 MPa (5000 psi)
Modulus of elasticity	14,500 N/mm² (2.1 10^6 psi)	11,000 N/mm² (1.6 10^6 psi)	11,000 N/mm² (1.6 10^6 psi)	10,500 N/mm² (1.5 10^6 psi)	9000 N/mm² (1.3 10^6 psi)
Tensile strain to failure	0.78%	0.62%	0.95%	0.99%	n/a
Shore hardness	86	95	74	72	69
Electrical resistivity	1950 µΩ-cm (770 µΩ-in)	2460 µΩ-cm (970 µΩ-in)	1470 µΩ-cm (580 µΩ-in)	1650 µΩ-cm (650 µΩ-in)	2030 µΩ-cm (800 µΩ-in)

TYPICAL MATERIAL PROPERTIES (CONTINUED)

PROPERTIES	ZXF-5Q	ACF-10Q	AXF-5Q	AXM-5Q	AXZ-5Q
Coefficient of thermal expansion	8.1 µm/m°C (4.5 µin/in°F)	8.5 µm/m°C (4.6 µin/in°F)	7.9 µm/m°C (4.4 µin/in°F)	7.8 µm/m°C (4.3 µin/in°F)	7.6 µm/m°C (4.2 µin/in°F)
Thermal conductivity W/(cm·K) (BTU-ft/hr/ft²°F)	70 (40)	60 (35)	95 (55)	88 (50)	70 (40)
Oxidation threshold[3]	450°C (840°F)	470°C (880°F)	450°C (840°F)	460°C (860°F)	440°C (820°F)

[1] *Measured using four-point bend method.*

[2] *Estimated at 70% of flexural strength.*

[3] *Temperature that results in 1% weight loss in 24 hours. Oxidation threshold increases by approximately 100°C if graphite is purified. Test sample size equals 0.5" x 0.5" x 1.0".*

FOR MORE INFORMATION

Please call our Customer Service Center today to learn what our premium graphite and silicon carbide solutions can do for you. Visit poco.entegris.com/contact-us for the location nearest you.

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