

# Premium Carbon Materials

## *For the Aerospace Industry*

The grades of graphite manufactured by POCO are segmented by grain size. These include one, five, ten, and fourteen micron, and then are further segmented by application.

The defining characteristic of POCO graphites 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.

POCO grades of graphite are sold in bulk form, or as custom machined components for specific applications. The properties of our graphite make it an ideal material to be used as a replacement for structural, tribological, thermal, even electrical components. In many applications, POCO graphite has a lower cost of ownership and improved performance compared to other material choices.

In addition to engineering specific properties into the graphite, POCO has a variety of post processing options to further modify the material to fit the needs of aerospace applications.

### **HIGH-PERFORMANCE SOLUTIONS**

Performing in extreme environments and adhering to stringent Aerospace and Aviation safety regulations demand components and materials that are both reliable and resilient. Our solutions benefit from over 50 years of experience with materials and design innovation. We rely on the knowledge we've gained through that experience to optimize the performance of applications, even under the most extreme conditions. POCO solutions have served the civil, commercial, and military aerospace sector for many years. Our tightly controlled manufacturing and quality processes, along with superior customer service remain the hallmarks of POCO's Products.



### **Leading Manufacturer of Aerospace Products**

POCO is a worldwide supplier of high-performance materials and products. Our proven materials help to improve a number of aerospace systems. POCO's solutions are supplied to several leading aircraft manufacturers, jet engine OEM's, rotatable manufacturers, MRO suppliers, and subcontractors in the aerospace sector.

### **Energy Performance**

By reducing weight, increasing reliability and durability, POCO's material solutions have contributed to the improvement of the efficiency of our customers' systems and applications.

### **Engineering, Technology Development — Teaming**

POCO's Engineering and Technology Development will work as a team with our customer base to develop innovative solutions in order to improve the performance of our customers' applications.

### **Quality and the Environment**

POCO's production site, located in the Dallas/Fort Worth metroplex area, is an ISO®-certified facility. This means that our customers receive products that are built to meet the strictest quality criteria, and in accordance with applicable environmental standards for the aerospace sector.

## POST PROCESSES

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### Purification (-1)

Unpurified POCO graphites have typical impurity levels over 1000 ppm. The major constituents are metals; POCO's purification process reduces impurities to 5 ppm (99.9995%) or less as determined by ash analysis. By removing metallic impurities, the oxidation threshold for POCO's materials is increased by up to 50°C (122°F).

### 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 and AP)

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 pore structure of the graphite. The oxidation threshold increases an additional 50°C (122°F) if the graphite is purified.

### Silicon Carbide Conversion (SUPERSiC®)

POCO's 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 which 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

MATERIAL	AXF-5Q	AXF-5QC*	ACF-10Q	ACF-10QE2	ACF-10QE2.1*	ACF-10Q1AP*	SUPERSiC
Particle size	5 μm (200 μin)	5 μm (200 μin)	5 μm (200 μin)	5 μm (200 μin)	5 μm (200 μin)	5 μm (200 μin)	N/A
Pore size	0.8 μm (32 μin)	0.8 μm (32 μin)	0.8 μm (32 μin)	0.8 μm (32 μin)	0.8 μm (32 μin)	0.8 μm (32 μin)	N/A
Total porosity (% volume)	20%	17%	21%	18%	18%	19%	20%
Open porosity (% of total porosity)	80%	60%	75%	60%	50%	63%	19%
Apparent density	1.78 g/cm <sup>3</sup>	3.00 g/cm <sup>3</sup>	1.77 g/cm <sup>3</sup>	1.85 g/cm <sup>3</sup>	1.85 g/cm <sup>3</sup>	1.85 g/cm <sup>3</sup>	2.53 g/cm <sup>3</sup>
Compressive strength	138 MPa (20,000 psi)	170 MPa (24,650 psi)	186 MPa (27,000 psi)	201 MPa (29,200 psi)	205 MPa (29,700 psi)	187 MPa (27,200 psi)	N/A
Flexural strength <sup>1</sup>	86 MPa (12,500 psi)	107 MPa (15,500 psi)	97 MPa (14,000 psi)	103 MPa (15,000 psi)	110 MPa (16,000 psi)	105 MPa (15,200 psi)	155 MPa (22,400 psi)
Tensile strength <sup>2</sup>	62 MPa (9,000 psi)	72 MPa (22,500 psi)	69 MPa (10,000 psi)	72 MPa (10,500 psi)	77 MPa (11,200 psi)	73 MPa (10,650 psi)	6129 MPa (18,700 psi)
Modulus of elasticity	11,000 N/mm <sup>2</sup> (1.69 10 <sup>6</sup> psi)	21,000 N/mm <sup>2</sup> (2.9 10 <sup>6</sup> psi)	11,000 N/mm <sup>2</sup> (1.6 10 <sup>6</sup> psi)	14,320 N/mm <sup>2</sup> (1.7 10 <sup>6</sup> psi)	13,470 N/mm <sup>2</sup> (1.9 10 <sup>6</sup> psi)	13,040 N/mm <sup>2</sup> (1.8 10 <sup>6</sup> psi)	217 GPa (31 10 <sup>6</sup> psi)
Tensile strain to failure	0.95%	0.95%	0.62%	0.62%	0.62%	0.62%	N/A
Shore hardness	74	75	95	95	97	96	N/A
Electrical resistivity	1470 μΩ-cm (580 μΩ-in)	175 μΩ-cm (69 μΩ-in)	2460 μΩ-cm (970 μΩ-in)	2460 μΩ-cm (970 μΩ-in)	2460 μΩ-cm (970 μΩ-in)	2460 μΩ-cm (970 μΩ-in)	N/A
Coefficient of thermal expansion	7.9 μm/m°C (4.4 μin/in°F)	8.7 μm/m°C (4.8 μin/in°F)	7.6 μm/m°C (4.2 μin/in°F)	7.6 μm/m°C (4.2 μin/in°F)	7.6 μm/m°C (4.2 μin/in°F)	7.6 μm/m°C (4.2 μin/in°F)	4.2 μm/m°C (2.4 μin/in°F)
Thermal conductivity – W/m-K (Btu-ft/ hr/ft <sup>2</sup> °F) <sup>3</sup>	95 (55)	175 (101)	60 (35)	46.1 (27)	44.6 (26)	65.5 (38)	151 (86)
Oxidation threshold <sup>4</sup>	450°C (840°F)	495°C (923°F)	470°C (880°F)	N/A	N/A	N/A	N/A
Oxidation resistance <sup>5</sup>	N/A	N/A	N/A	0.94%	1.21%	1.71%	N/A
Total impurity level	–	–	–	–	–	–	<10 ppm
Specific stiffness	–	–	–	–	–	–	86 kN.m/g
Poisson's ratio	–	–	–	–	–	–	0.17
Dynamic shear modulus	–	–	–	–	–	–	97 GPa (14 10 <sup>6</sup> psi)
Fracture toughness	–	–	–	–	–	–	2.44 MPa.m <sup>0.5</sup>
Hardness knoop	–	–	–	–	–	–	1992 kg/mm <sup>2</sup>
Thermal diffusivity	–	–	–	–	–	–	92 × 10 <sup>-6</sup> m <sup>2</sup> /s
Instantaneous CTE at RT	–	–	–	–	–	–	2.4 10 <sup>-6</sup> /K (1.3 10 <sup>-6</sup> /°F)

\* Impregnated Graphite

<sup>1</sup> Measured using 4-point bend method; <sup>2</sup> Estimated at 70% of flexural strength; <sup>3</sup> Estimated value; <sup>4</sup> Temperature that results in 1% weight loss in 24 hours in air. Oxidation threshold increases by approximately 100° if graphite is purified. Test sample size equals (surface area to volume = 10); <sup>5</sup> Percent weight loss of a sample with 10:1 surface area: volume ratio for 24 hours @ 607°C (1125°F) in air.

#### FOR MORE INFORMATION

Please call your Regional Customer Service Center today to learn what POCO can do for you. Visit [poco.com](http://poco.com) and select the [Contacts](#) link for the location nearest you.

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