

SUPERIOR  GRAPHITE

# FormulaFX™

*Friction Modifiers*



**Why is graphite the choice modifier for friction applications?**

Graphite possesses unique properties of lubricity, resiliency, inertness, and thermal conductivity. Adding an incremental amount of graphite will stabilize the friction and manage thermal dispersion allowing the friction lining to reach the fullest potential.

**Why is Superior Graphite the choice supplier for graphite?**

Superior Graphite understands friction customers have specific requirements to produce a high performance product for the end-user, which is why global engineers worked tirelessly using advanced technological processes to develop **Formula FX™**.

**Formula FX™** is a family of graphite and carbonaceous materials used as a modifier in friction materials, such as brake linings, brake pads, and clutch facings, providing equilibrium between cohesive and adhesive frictional forces. Formula FX™ offers consistency in particle sizing and material purity, the key elements to meeting your need for quality, performance, and durability.

**Why Choose Formula FX™?**

**FormulaFX™**

**Technology**

**Superior Graphite thermally treats carbon materials.**

Electro-thermal purification technology is applied to select Formula FX™ carbon materials to transform powders at temperatures up to 2800°C. Volatiles are reduced or eliminated creating products with increased resiliency, lubrication, and purity.

**Quality**

**Superior Graphite manufactures high quality synthetic graphite.**

Formula FX™ is primarily produced from internally generated materials in the U.S. assuring consistency throughout. All materials undergo extensive quality control processes to ensure uniform properties.

**Customer Service**

**Superior Graphite provides unmatched customer support.**

Since 1917, Superior Graphite has focused on partner relationships to exceed expectations and promote mutual growth. Market Specialists take the extra step to make sure you are satisfied with the product from start to finish assuring excellent service.

**Customization**

**Superior Graphite provides customization you will not find with any other graphite supplier.**

Superior Graphite offers custom Formula FX™ carbon grades by screening materials and processing them through a comprehensive line of mechanical and fluid energy mills to produce uniquely-sized materials with the correct morphology to meet customer requirements.

**Variety**

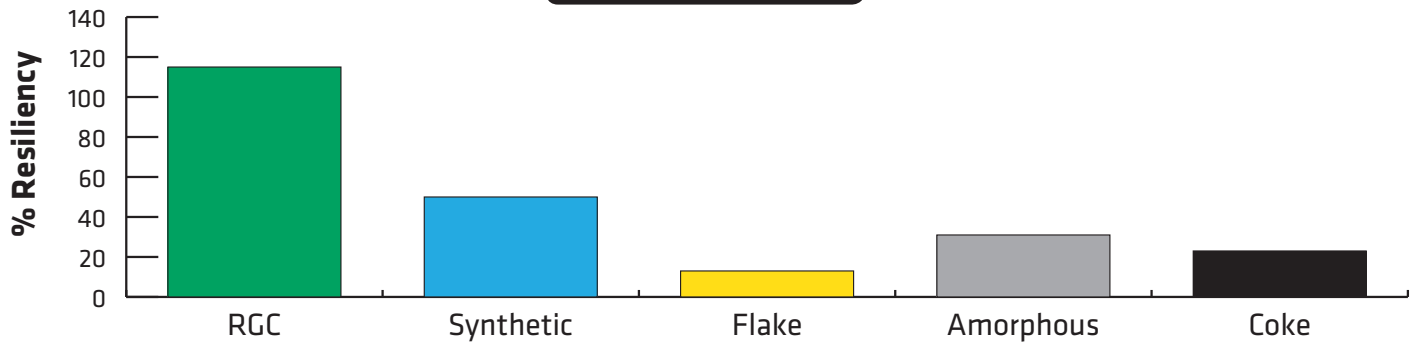
**You can choose from a variety of graphites or cokes.**

Find the Formula FX™ material that is the best fit for your friction requirements. Superior Graphite offers a full range of materials including natural flake, amorphous, and vein graphites, as well as synthetic graphites, thermally purified products, delaminated flakes, and a variety of cokes.



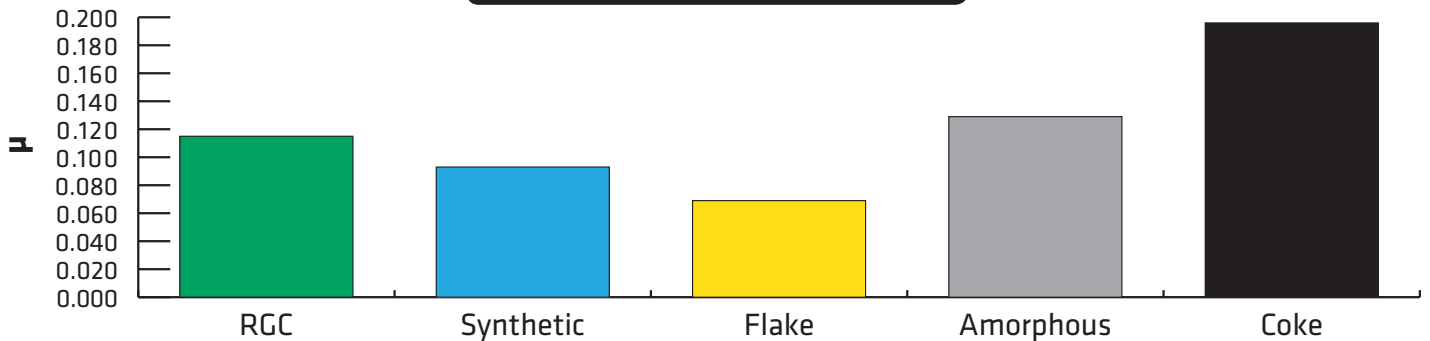
# Important Properties of Graphite/Carbon Materials

## Resiliency



- Resiliency directly impacts the compressibility in the finished brake lining.
- The use of highly resilient carbons has been shown to reduce noise and vibration.

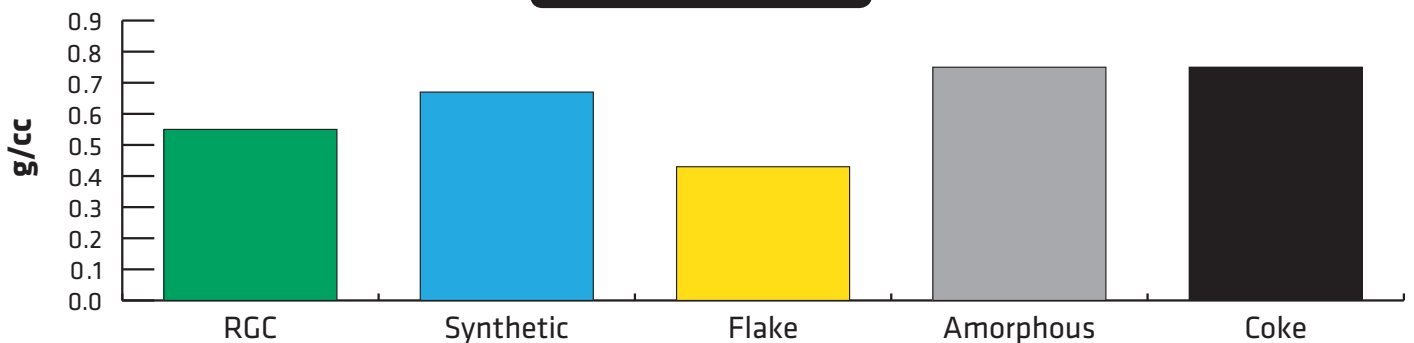
## Coefficient of Friction\*



- Coefficient of friction is essential to optimize stopping performance.
- Proper coefficient of friction levels in the final product can reduce temperature when braking and extend rotor life.

\* The Coefficient of Friction was tested steel on steel by using a dry powder, at room temperature on proprietary equipment.

## Bulk Density



- Bulk density becomes increasingly important when using volume additions.
- Choose the desired bulk density level to contribute to production of a lightweight brake pad while maintaining performance and durability.

## Formula FX™ Benefits

- Enhance performance durability
- Reduce noise
- Dissipate heat
- Improve pad compressibility
- Enhance strength properties to retain friction curve and reach desired coefficient range
- Optimize stopping performance and pedal feel
- Minimize wear and tear on brake lining, disc and rotors

## UNIQUE

RGC materials are the most unique and consistent graphitic carbons on the market today. Produced using the Superior Graphite's proprietary high temperature purification technology, RGC products are value-added graphitic powders possessing **extreme purity and highly resilient properties**. The resiliency alone separates RGC's from all other carbonaceous materials used in friction.

## ADVANCED PERFORMANCE

RGC is ideal for high performance products due to its **thermally conductive characteristics**. Regardless of operating temperatures, the compressibility of pads can be controlled and adjusted by adding roughly 1 - 5 % of coarse RGC material into NAO, Semi-Metallic or Low Steel formulations. RGC's properties contribute to the lubrication and energy dissipation in friction applications. Additionally, RGC strongly **contributes to noise reduction and reduces vibration** development.

## CONSISTENT QUALITY

RGC Materials can be **developed for critical specifications** with respect to particle size distribution (PSD). Resiliency, as well as other parameters are **strictly controlled** starting from the raw material to end product ensuring **optimal consistency**.



Grade	RGC14A	RGC18A
Average Size	Centered around 250 um (60 mesh)	Centered around 425 um (40 mesh)
PSD mm	Max 0.3 % > 1.8 mm Max 0.5 % > 1 mm 15-40%; 0.5-1 mm 45-65%; 0.25-0.5 mm 5-25%; 0.125-0.25 mm Max 5% < 0.125 mm	Max 5 % > 0.85 40-65%; 0.425-0.85 mm 30-50%; 0.18-0.425 mm Max 5% < 0.18 mm
PSD mesh	Max 0.3 % > 11 mesh Max 0.5 % > 18 mesh 15-40%; 35-18 mesh 45-65%; 60-35 mesh 5-25%; 120-60 mesh Max 5% < 120 mesh	Max 5 % > 20 mesh 40-65%; 40-20 mesh 30-50%; 80-40 mesh Max 5% < 80 mesh
Resiliency	100-150 %	100-150 %



**Superior Graphite offers a full portfolio of materials from FUNCTIONAL ..... to HIGH PERFORMANCE products to meet the most sensitive customer requirements.**

Type	Carbon % (LOI)	Size Range	Description	Benefits	SEM - 1000x
<b>Amorphous Graphite</b>	60 - 80%	20 - 800 microns	Amorphous graphite is microcrystalline in structure. Normally found as massive lumps with flat fracture cleavage. Formed by thermal metamorphism of coal seams.	<ul style="list-style-type: none"> <li>• Friction modifier</li> <li>• Soft</li> <li>• Lubricious</li> <li>• Microcrystalline</li> </ul>	
<b>Calcined Petroleum Coke</b>	99% min	75 - 800 microns	Calcined petroleum coke is formed from the by-product of crude oil distillation. These materials have a dark, flat sheen and are high in carbon.	<ul style="list-style-type: none"> <li>• Friction modifier</li> <li>• Low wear</li> <li>• Hard</li> <li>• High strength</li> </ul>	
<b>Synthetic Graphite</b>	98 - 99.7%	4 - 800 microns	Synthetic graphite is a by-product of graphite electrode manufacturing and is processed from calcined petroleum cokes, and graphitized at temperatures above 2700°C.	<ul style="list-style-type: none"> <li>• In-house production</li> <li>• High purity</li> <li>• Conductive properties</li> <li>• Lubricious</li> <li>• High strength</li> </ul>	
<b>Flake Graphite</b>	80 - 99%	4 - 800 microns	Flake graphite is fossil remnants which have been graphitized over time under extreme pressure and temperature. Found in metamorphic rock, these plate-like structures are liberated from ore through a flotation process.	<ul style="list-style-type: none"> <li>• Friction modifier</li> <li>• Lubricious</li> <li>• Conductive properties</li> <li>• Highly-ordered crystalline</li> </ul>	
<b>Purified Synthetic Graphite</b>	99.7 - 99.9%	4 - 800 microns	Synthetic graphite is transformed through a high temperature electro-thermal purification process that reduces impurities and hard particulates, such as silicon carbide and iron carbide.	<ul style="list-style-type: none"> <li>• Increased purity</li> <li>• Increased conductivity</li> <li>• Highly lubricious</li> <li>• High strength</li> </ul>	
<b>Purified Flake Graphite</b>	99.7 - 99.9%	4 - 800 microns	Flake graphite is purified through a high temperature electro-thermal purification technology. Impurities, such as quartz and iron, are reduced to create a highly-ordered crystalline structure.	<ul style="list-style-type: none"> <li>• Thermal and electrical conductivity</li> <li>• Enhanced lubrication properties</li> <li>• High purity</li> <li>• Highly-ordered crystalline</li> </ul>	
<b>Resilient Graphitic Carbon (RGC)</b>	99.7 - 99.9%	125 - 2000 microns	Raw materials selected for quality, consistency, and morphology are processed by a high temperature electro-thermal purification resulting in high purity and resiliency.	<ul style="list-style-type: none"> <li>• Highly resilient</li> <li>• Extremely pure</li> <li>• Increased crystallinity</li> <li>• Increased porosity</li> <li>• Properties aid noise reduction</li> </ul>	



### OUR MISSION:

We create value for our customers by providing SUPERIOR SOLUTIONS  
– utilizing our unique technologies, processes and talents –  
while contributing to the company's long-term success.

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