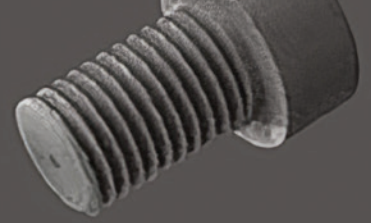


# REVOLUTIONIZING GRAPHITE & CARBON MATERIALS



OVER 100 YEARS OF CREATING,  
INNOVATING AND MANUFACTURING  
CRITICAL ADVANCED MATERIALS





# MEETING THE GLOBAL CHALLENGE FOR ADVANCED MATERIALS

Amsted Graphite Materials develops innovative carbon and graphite material solutions for customers worldwide. With a century-long legacy of creating, innovating and manufacturing science-based solutions, Amsted Graphite Materials has been continuously pushing the limits with ongoing testing, grade formulation and machining to meet our customers' most critical needs.

## BACKED BY THE FINANCIAL STRENGTH OF AMSTED INDUSTRIES

Amsted Graphite Materials is part of Amsted Industries, a diversified global manufacturer of industrial components serving primarily the rail, commercial vehicle, automotive and construction markets. Combining leading-edge manufacturing processes with a history of continuous innovation, Amsted Industries is proud to be a leader in each of the market segments it serves.







# GRAFSTAR™ ADVANCED GRAPHITE

GRAFSTAR™ Advanced Graphite is an ideal choice for customers across multiple industries with demanding applications requiring high strength, low thermal expansion and superior conductivity.

## HIGH STRENGTH

Unlike most materials, the mechanical strength of graphite increases with temperature. Graphite is twice as strong at 2500 °C as it is at room temperature.

## LOW THERMAL EXPANSION

Matching the coefficient of thermal expansion between materials is important for many applications. Graphite has an extremely low coefficient of thermal expansion and can be tailored to the application by carefully selecting the formulation.

## SUPERIOR CONDUCTIVITY

Graphite has a thermal conductivity of above 100 W/mK, very similar to many metals. Carbon material does not have the highly ordered crystalline structure of graphite and has a very low thermal conductivity.

## TYPICAL PROPERTIES\*

Grade	Units	Extruded**					Molded***			Isomolded**				
		AGSX	CBY	CS	CXP	SLX	PGW	PXP	PGX	ATR	ATJ	ATC	CGW	CGC
Bulk Density	g/cc	1.72	1.66	1.74	1.83	1.80	1.63	1.76	1.73	1.68	1.76	1.75	1.80	1.80
Max Particle Sizing	inches	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.001	0.001	0.001	0.001	0.001
Specific Resistance	μΩm	7.0	8.1	7.1	7.7	7.0	9.3	9.6	10.2	12.5	11.7	14.5	11.7	13.8
Flexural Strength	psi	3350	2400	3050	3200	3580	1960	2610	1600	3700	4500	4500	5000	5150
Modulus of Elasticity (Young's Modulus)	msi	1.9	1.32	1.59	1.42	1.59	1.00	1.34	1.00	1.16	1.40	1.65	1.55	1.65
Compressive Strength	psi	6500	5200	6600	7700	8300	4960	7610	4000	8000	9500	10000	11200	12500
C.T.E. (RT-to-100C)	x10 <sup>-6</sup> /°C	1.2	2.5	2.5	2.7	3.0	3.6	4.6	2.2	3.0	3.0	3.1	3.0	3.1
Thermal Conductivity	W/mK	170	145	160	160	170	130	120	125	100	120	95	120	100
Hardness	Rockwell "R" scale	60	70	83	90	95	32	80	45	45 "L" scale	65 "L" scale	85 "L" scale	90 "L" scale	100 "L" scale
Ash	ppm	1500	900	900	1200	1500	1200	600	700	900	900	1000	900	1000

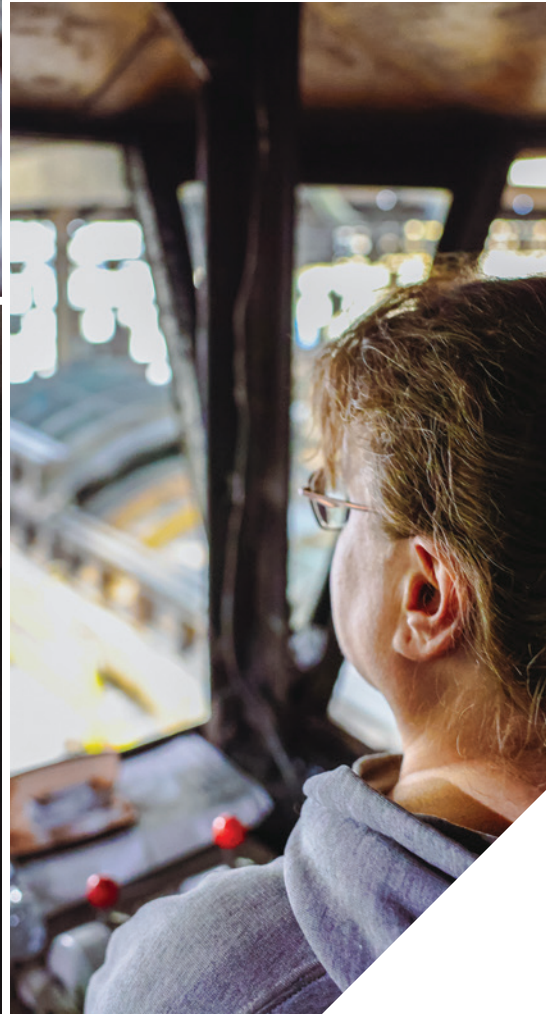
\* Reported properties are typical room temperature measured values and cannot be used as accept/reject specifications.

\*\* Typical extruded & isomolded graphite properties are with-grain values.

\*\*\* Typical molded graphite properties are against-grain properties.

# TECHNICAL EXPERTISE FROM AEROSPACE TO SEMICONDUCTOR APPLICATIONS

Our global team of applications engineers brings decades of experience and knowledge of high-temperature processes across diverse applications. From concept and prototyping to mass production, we offer technical answers to your most complex challenges with a fast response time.





## AEROSPACE & DEFENSE

Isomolded and extruded graphite with superior properties for low chemical and mechanical erosion and excellent performance

## ALUMINUM PROCESSING

T-114™ anti-oxidation treated graphite for superior resistance to oxidation above the melt line

## CHEMICAL PROCESSING

Materials inert to chemical attack, non-wetting by most chemicals and available in large diameter sizes for many applications

## CONTINUOUS CASTING

- ▶ Fine grain isomolded graphite specifically engineered with higher and lower thermal conductivities for success in continuous casting applications
- ▶ Grades CGW™ & CGC™ provide outstanding performance in copper and copper alloys

## NUCLEAR & ENERGY STORAGE

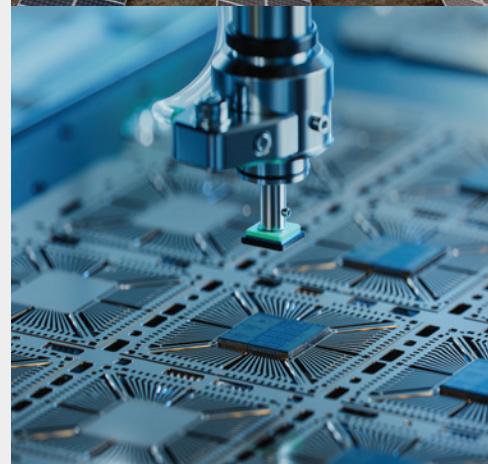
- ▶ Large format extruded and molded materials for energy storage applications such as thermal battery
- ▶ Grades PCEA™ and PCIB™ provide proven performance and qualification in graphite reactor core and shielding components

## OIL & GAS

Extruded graphite materials for matrix metal drill bit manufacturing

## SEMICONDUCTOR AND SOLAR TECHNOLOGY

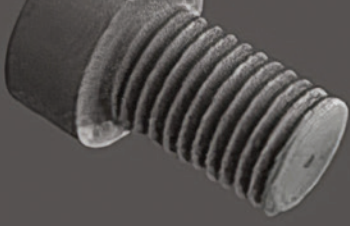
- ▶ Isomolded graphite materials supporting semiconductor and green energy with high-efficiency solutions for polysilicon and ingot processing
- ▶ Porous graphite for use in demanding single crystal silicon carbide wafer manufacture



# GRAPHITE APPLICATIONS

Application	Grades									
	Extruded			Molded			Isomolded			
	CBY	CS	CXP	PGW	PGX	PXP	ATR	ATJ	ATC	CGW
Ablative Materials			✓					✓	✓	✓
Aluminum Processing	✓	✓			✓					
Anodes/Cathodes for Chemical Processing										
Boats and Trays for Heat Treating	✓	✓			✓			✓		
Brazing Alloys	✓	✓								
Chemical Process Equipment	✓	✓			✓	✓				
Chill Plates	✓	✓								
Continuous Casting Dies								✓	✓	✓
Crucibles Metal Processing	✓	✓		✓	✓			✓		✓
Float Glass Linings		✓	✓							
Furnace Parts		✓			✓			✓		✓
Hot Glass Handling								✓	✓	✓
Impellers and Shafts	✓	✓								
Centrifugal Casting	✓	✓		✓	✓	✓				
Continuous Casting								✓	✓	✓
Direct Chill Casting		✓						✓		
Fused Refractories	✓	✓		✓			✓	✓		
Hot Pressing									✓	✓
Permanent Molds		✓						✓		
Pig Ingot Molds		✓								
PDC Bits for Oil and Gas	✓	✓	✓							
Powdered Metals	✓	✓		✓						
Pressure Casting				✓	✓	✓				
Slip Casting							✓			
Thermit Welding	✓	✓	✓							
Pipe Slides	✓	✓								
Plunging Bells and Sleeves	✓	✓								
Plunger Rams		✓					✓	✓		
Quartz Furnace Parts	✓	✓						✓		✓
Resistor Furnace Parts	✓	✓						✓	✓	✓
Resistor Heating Elements		✓						✓		
Riser Rods and Discs	✓									
Rocket Motors and Nozzles								✓		
Silicon and Silicon Compounds										
Single Crystal Growth								✓		✓
Polycrystalline Si			✓			✓		✓		✓
Metallurgical Si			✓			✓				
CZ Pullers			✓					✓		✓
DSS			✓					✓		✓
Semiconductor	✓	✓	✓		✓	✓		✓		✓
Susceptors for Induction Furnaces	✓	✓	✓	✓	✓	✓	✓			
Thermocouple Protection	✓	✓								✓
Tooling for Composites		✓		✓			✓	✓		✓





**AMSTED GRAPHITE MATERIALS SUPPLIES CUSTOMERS IN OVER 35 COUNTRIES WITH EXTRUDED, MOLDED, ISOMOLDED, POROUS CARBON, POROUS GRAPHITE, POWDER AND PARTICULATE CARBON AND GRAPHITE MATERIALS.**

Amsted Graphite Materials is part of the Amsted Industries family of companies, a diversified group of market-leading, global manufacturers serving the automotive, rail, commercial vehicle and construction markets that combine leading-edge manufacturing processes with a history of continuous innovation.

The Amsted Graphite Materials facility in Anmoore, West Virginia, is certified to AS 9100D.

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