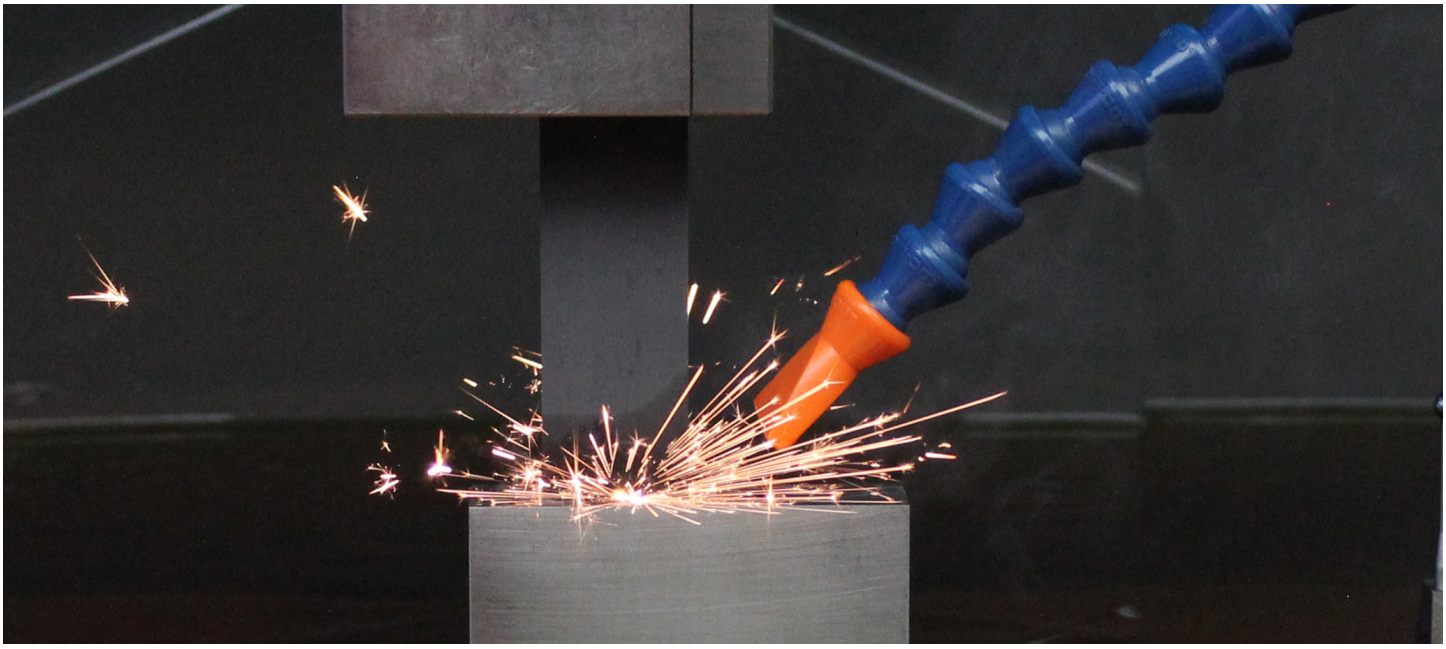
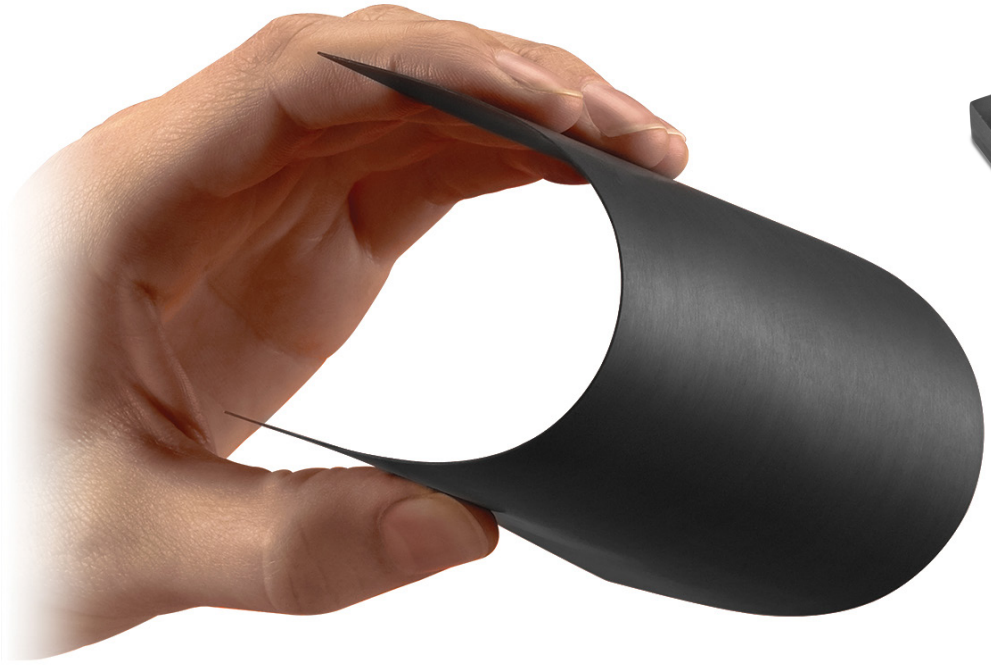
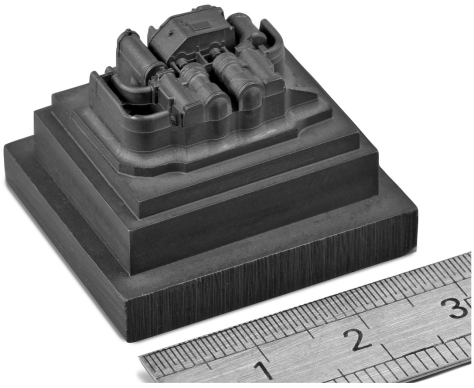
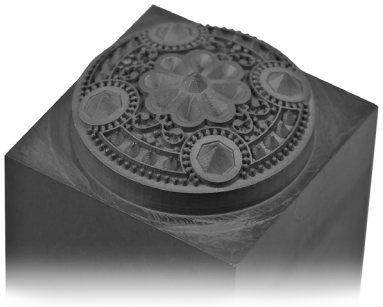
EDM Graphite

Selection guide



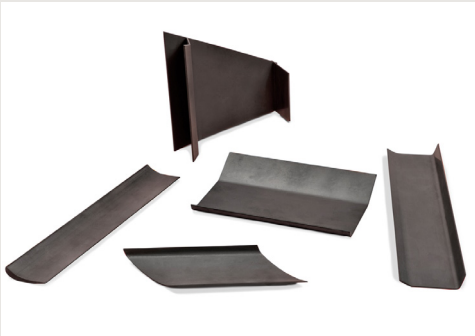






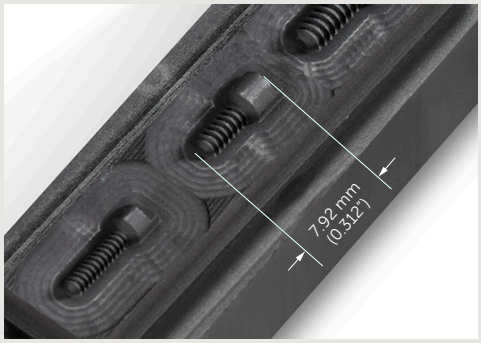
APPLICATIONS

Our EDM electrode materials offer the best balance of metal removal rates, low electrode wear, and excellent total cost of ownership. Each EDM graphite grade provides consistent performance from block to block, year to year, and has been tailored for a specific range of electrode applications with benchmarked performance characteristics.



Aerospace Applications

- Blades
- Vanes
- Seal Slots



Medical Applications

- Surgical Fasteners
- Dental Implants
- Orthopedic Joints

Consumer Applications

- Caps and Closures
- Plastic Injection
- Electrical Connectors

Automotive Applications

- Speakers
- Lenses
- Power Distribution

KEY FACTORS OF ELECTRODE SELECTION

EDM has taken its place as a proven, precision technology, chosen for what it can do, rather than what conventional machining cannot do. EDM machine technology has spawned a world of new applications wherein increased importance is placed on the graphite electrode material utilized.

While there are many methods used to determine the right material for a job, we believe there are five factors that mean the difference between success and failure, profit and loss.

Metal Removal Rate (MRR)

Metal removal rate is usually expressed as cubic millimeters per hour (mm^3/hr) or cubic inches per hour (in^3/hr), but in fact could just as realistically be expressed as $/hr. Achieving an efficient MRR is not simply a matter of the right machine settings. It also involves direct energy dissipated in the EDM process. Graphite is generally much more efficient than metallic electrodes, however metal removal rates vary widely between graphite types. With the proper electrode material/work metal/application combination, MRR can be maximized.

Wear Resistance (WR)

There are four types of wear: volumetric, corner, end, and side. Of the four, we believe that corner wear is the most important since the contours of the final cut are determined by the electrode's ability to resist the erosion of its corners and edges. It follows that if an electrode can successfully resist erosion at its most vulnerable points, then overall wear will be minimized, and maximum electrode life achieved. Electrode erosion cannot be prevented, but it can be minimized by choosing the proper electrode material/work metal combination and machining at the optimum settings.

The ability of an electrode to produce and maintain detail is directly related to its resistance to wear and its machinability. Minimizing corner wear requires choosing an electrode material that combines high strength with high temperature resistance.

Surface Finish (SF)

Fine surface finish is obtained by a combination of the proper electrode material, good flushing conditions, and the proper power supply settings. High frequency, low power, and orbiting produce the best finish, as these conditions produce smaller, less defined craters in the work metal. The final surface finish will be a mirror image of the electrode's surface, so Angstrofine and Ultrafine particle, high strength graphites are the best choices for finishing electrodes.

Machinability

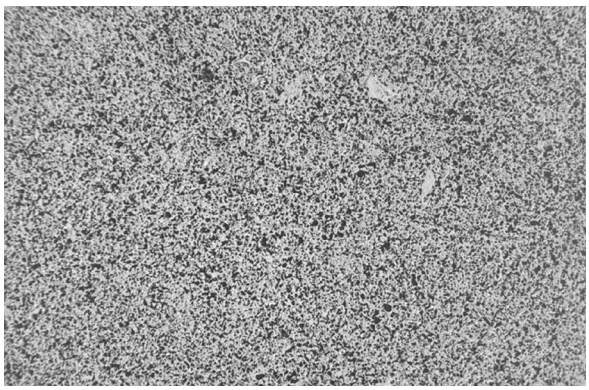
Any machinist who has ever machined graphite is aware that graphite cuts very easily. Simply being easy to machine does not necessarily make a material the best choice for an electrode. It must also be strong to resist damage from handling and from the EDM process itself. Strength and small particle size are important so that minimum radii and close tolerances may be achieved. Material hardness is also a factor in graphite machinability. Harder electrode materials will be more prone to chipping during the machining process.

Material Cost

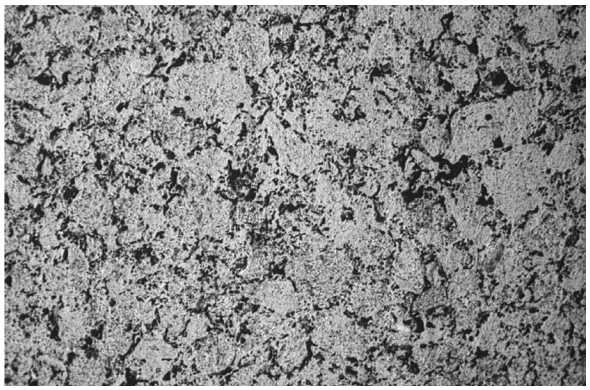
Electrode material cost generally represents only a small part of the total EDM job cost. What is too often overlooked, however, is that electrode material cost considered outside the total job cost is completely meaningless.

Fabrication time, cutting time, labor, and electrode wear all depend on the electrode material more than on any other factor. Thus it is critical that you know the properties and performance characteristics of the available electrode materials as they affect the work metals you are machining. Only with this data is it possible to make a cost/performance analysis to determine the true cost of an EDM job.

GRAPHITE GRADES



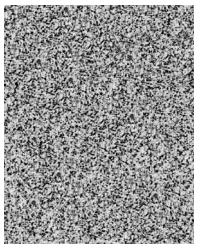
Our 5 micron EDM material



Competitor's 5 micron material

Angstrofine Graphite

EDM-AF5® graphite



EDM-AF5 is the premier graphite electrode material available on the market today with an average particle size of less than one micron. This particle structure has superior strength, provides for fine surface finish (7 µinR_a), and gives excellent metal removal rate and high resistance to wear.

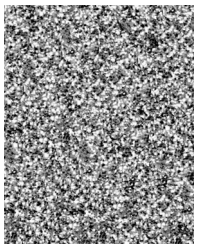
Typical Value	
Average particle size:	<1 µm
Flexural strength:	1,019 kg/cm² (14,500 psi)
Compressive strength:	1,554 kg/cm² (22,100 psi)
Hardness:	83 Shore
Electrical resistivity:	21.6 µΩm (850 µΩin)

Applications

- Fine detailed electrodes for engraving
- Hard to machine detail
- Delicate and fragile electrodes
- Various type threading electrodes
- Jobs requiring fine surface finishes
- Intricate molds and dies

Copper Ultrafine

EDM-C3® graphite



EDM-C3 is a high-quality graphite infiltrated with copper, recommended where speed, wear, and surface finish are important. Unequalled for fragile electrodes, many EDMers choose this grade to compensate for operator inexperience or where poor flushing conditions exists.

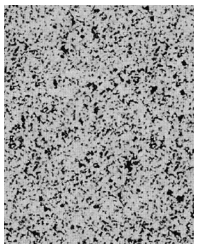
Typical Value	
Average particle size:	<5 µm
Flexural strength:	1,427 kg/cm² (20,300 psi)
Compressive strength:	1,993 kg/cm² (28,350 psi)
Hardness:	66 Shore
Electrical resistivity:	3.2 µΩm (127 µΩin)

Applications

- Fine detailed electrodes where strength is critical
- Threading electrodes
- Aerospace applications
- Plastic injection molds
- Machining of carbide
- Small hole drilling

Ultrafine Graphite

EDM-4® graphite



EDM-4 is the premier offering in the Ultrafine grain classification. This highly isotropic grade combines extraordinary strength with moderate hardness, yielding superior electrode fabrication characteristics. EDM-4 has superior EDM performance characteristics for metal removal rates, wear and surface finish.

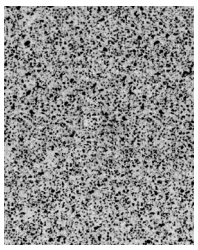
Typical Value	
Average particle size:	<4 µm
Flexural strength:	1,230 kg/cm² (17,500 psi)
Compressive strength:	1,511 kg/cm² (21,500 psi)
Hardness:	76 Shore
Electrical resistivity:	12.7 µΩm (500 µΩin)

Applications

- EDMing of fine detailed electrodes requiring excellent surface finishes
- Wire cut electrodes
- Plastic injection molds

Ultrafine Graphite

EDM-3® graphite



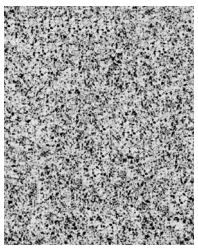
EDM-3 is an isotropic Ultrafine grain graphite that offers high strength with outstanding wear and fine surface finish characteristics easily machined to thicknesses of 0.1 mm or less.

Typical Value	
Average particle size:	<5 µm
Flexural strength:	935 kg/cm² (13,300 psi)
Compressive strength:	1,273 kg/cm² (18,100 psi)
Hardness:	73 Shore
Electrical resistivity:	15.6 µΩm (615 µΩin)

Applications

- EDMing of fine detailed electrodes
- Punch and die sets
- Plastic injection molds
- Threading electrodes
- Use in aerospace metal cutting

EDM-2® graphite



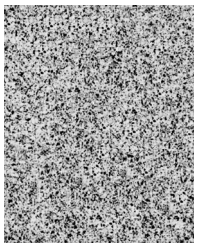
EDM-2 is an isotropic Ultrafine grain graphite with high strength and good wear characteristics. Recommended for use on detailed electrodes, where speed, fine finish, and resistance to wear are desired.

Typical Value	
Average particle size:	<5 microns
Flexural strength:	787 kg/cm² (11,200 psi)
Compressive strength:	1,188 kg/cm² (16,900 psi)
Hardness:	71 Shore
Electrical resistivity:	16.0 µΩm (620 µΩin)

Applications

- IC Molds
- Aerospace applications
- Fine-detailed electrodes
- Minimum-taper-cavities
- Blind cavity work

EDM-1® graphite



EDM-1 graphite is our lowest priced Ultrafine grain graphite. In addition to providing good wear resistance, speed, and finish, lower electrode fabrication costs are possible when larger electrodes are required.

Typical Value

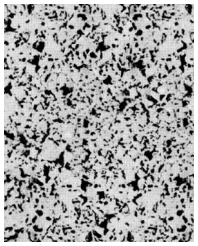
Average particle size:	<5 µm
Flexural strength:	682 kg/cm² (9,700 psi)
Compressive strength:	988 kg/cm² (14,200 psi)
Hardness:	69 Shore
Electrical resistivity:	19.3 µΩm (760 µΩin)

Applications

- Fabricating electrodes with good detail
- Low wear electrodes
- High detail roughing electrodes
- Molds and dies

Superfine Graphite

EDM-200® graphite



EDM-200 is an isotropic Superfine particle graphite providing good strength, surface finish, and wear resistance. Moderately priced, EDM-200 graphite provides excellent repeat-ability from electrode to electrode and from job to job.

Typical Value

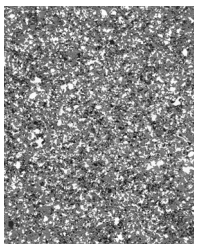
Average particle size:	10 µm
Flexural strength:	635 kg/cm² (9,000 psi)
Compressive strength:	1,075 kg/cm² (15,500 psi)
Hardness:	68 Shore
Electrical resistivity:	14.7 µΩm (580 µΩin)

Applications

- Structural ribs
- Roughing or finishing electrodes
- Large featured mold
- High strength large electrodes

Copper Superfine

EDM-C200® graphite



EDM-C200 is a Superfine graphite infiltrated with copper that offers excellent metal removal rates and good wear resistance. EDM-C200 graphite improves cutting stability in poor flushing conditions, and is an excellent material for cutting aerospace alloys.

Typical Value

Average particle size:	10 µm
Flexural strength:	851 kg/cm² (12,100 psi)
Compressive strength:	1,631 kg/cm² (23,200 psi)
Hardness:	62 Shore
Electrical resistivity:	2.9 µΩm (114 µΩin)

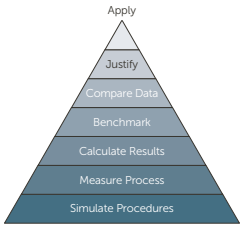
Applications

- EDMing of fine detailed electrodes requiring excellent surface finishes
- Wire cut electrodes
- Plastic injection molds

TECHNICAL ARTICLES

All articles can be accessed by scanning the QR code or visiting us at poco.com.

Total Cost of Ownership



The Total Cost of Ownership (TCO) model and analysis are commonly used to make decisions when purchasing new equipment, but can also be applied to the major elements associated with the operation of the sinker EDM equipment, such as graphite electrode materials. When TCO principals are applied to these major elements, the value proposition and productivity of these elements start to impact profitability of owning and operating the equipment.

This article provides insight into the key aspects of applying the Total Cost of Ownership Model to your electrode material selection process, and using this method to maximize the efficiency of your EDM process.

Dealing with Graphite Dust

Dust, a common household word that can be defined as a finely powdered substance of various matters often suspended in the air. This article reviews the characteristics of graphite dust and answers often-asked questions in dealing with it.

Making EDM Profitable

This article reviews the factors to consider when working with an exotic work metal application, and a real-world example of how electrode material selection and EDM parameters can impact the bottom line.

Electrode Effect on Quality EDM Finish

This article discusses the economic impact the electrode material has on producing fine surface finishes even with the newer EDM generator technology. To access more information about how the quality of your electrode material can impact your work piece finish, scan the QR code to access the full article.

EDM Effect on Surface Integrity

Learn about the altered metal layers created during the EDM process, and how the EDM process parameters can impact the work piece finish and surface integrity.

Sometimes Graphite Isn't Enough

An explanation of how the correct machine parameters can improve your EDM process when dealing with non-standard materials, such as beryllium copper, titanium, and tungsten carbide.

Graphite vs. Copper

View a true cost comparison of time and material between copper and graphite electrodes, and examine the differences between each of the EDM key performance indicators. Scan the QR code to read the full article and to learn more about copper versus graphite.

EDM Graphite Buyer's Guide

Unless you have money to burn, time to spare, and a great mold repair team, never buy EDM graphite described as "equivalent to" or "as good as." Learn tips on how to assure you are getting what you need when it comes to sourcing graphite.

TECHNICAL ASSISTANCE

If you have a question concerning electrode materials (ours or anyone elses), call the EDM experts. Our EDM technical service personnel have many years of practical EDM experience and can help you with design, machining, operating parameters, or practically any situation involving electrode management techniques.

- Grade verification
- Production problems
- Applications specialists

EDM TECHNICAL MANUAL

Our *EDM Technical Manual* is now available online at www.edmtechman.com or as an app for your iOS or Android device.

iOS Device

Android Device

INDUSTRY-LEADING EDM TRAINING

We offer an EDM technical training program to help EDMers improve their performance. This is a no-charge, three-day training session that includes classroom and laboratory activities, and provides a better understanding of how to control the EDM process to achieve predictable results. This is practical information that the attendee can put to use on the shop floor.

- EDM basics
- EDM sinker technology
- Properties and characteristics of graphite

FOR MORE INFORMATION

Please call your local distributor to learn what our premium graphite solutions can do for you. Visit poco.entegris.com/distributors for the location nearest you.

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