Graphite Materials and Systems

Specialty Graphites for Electrical Discharge Machining

- Advanced material, equipment, and process solutions
- Engineered for customers from more than 35 industries
- Tailor-made from the most comprehensive product portfolio
- In-depth production and material knowledge
- Consistent high quality, performance, and service
- Attractive total cost of ownership

Broad Base. Best Solutions.
Advanced solutions enable our customers to get ahead.

SGL Group offers advanced solutions – even for challenging applications. We understand the specific requirements of our customers and combine in-depth production, material, and engineering knowledge with the most comprehensive specialty graphite portfolio. This makes us the partner of choice to leading companies in many different industries.

Exceptional resistance to heat and corrosion, high purity and mechanical strength are just a few of the outstanding properties which our materials offer. Specialty graphite products from SGL Group achieve optimal results where other materials fail. No matter what your specific requirements might be, we will identify the best solution from the most comprehensive range of specialty graphites.

- Fine grain graphite: isostatic, vibration-molded, die-molded, extruded
- Expanded natural graphite
- Carbon fiber-reinforced carbon (C/C)
- Soft and rigid graphite felts
- Silicon carbide-coated graphite materials

Additionally we use other materials like PTFE, silicon carbide, and specialty metals.

With our portfolio and technical know-how spanning more than 35 different industries, we engineer tailor-made solutions in close partnership with our customers.

SGL Group covers the entire value chain of specialty graphite production, including raw material processing, semi-finished product manufacture, precision machining, purification, and coating. When it comes to engineering of equipment and process solutions our service range makes the difference: We offer mechanical and process design, production, assembly, commissioning, and service – all from a one-stop shop. This is how we control and ensure the consistent high quality, reliability, and performance of our products – and enable our customers to become more competitive. Challenge us. We are there for you worldwide.

Specialty graphite solutions for electrical discharge machining (EDM)

Specialty graphite electrodes are becoming increasingly important in EDM when very high precision and advanced design are required. Our innovative products and material solutions make us the partner of choice.
Specialty graphites for electrical discharge machining.

Graphite is now widely used for electrical discharge machining in production and moldmaking because it offers key advantages:

- Time and cost saving due to low wear
- Less complex milling tools and easier machining
- Exceptionally suitable for fine detailed geometries and high-quality surface finishes (micromachining)
- Low thermal influence of the electrode and component to the effect of heat
Specialty graphites for EDM electrodes

Our isostatically pressed fine-grain graphites are appreciated for their outstanding properties in EDM processes. They permit high material removal rates with low electrode wear and have high flexural strength at elevated temperatures.

By selecting the most suitable material, even the highest surface finish requirements can be easily fulfilled. We have long-standing EDM expertise and know what is important. With our wide range of materials and technical support, we can help OEMs and end users achieve the best results.

Achievable surface roughness depths with our SIGRAFINE® fine-grain graphites

<table>
<thead>
<tr>
<th>Ra max (µm)</th>
<th>0.4</th>
<th>0.56</th>
<th>0.80</th>
<th>1.12</th>
<th>1.6</th>
<th>2.24</th>
<th>3.15</th>
<th>4.5</th>
<th>6.30</th>
<th>9.00</th>
<th>12.5</th>
<th>18.0</th>
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<tbody>
<tr>
<td>VDI</td>
<td>12</td>
<td>15</td>
<td>18</td>
<td>21</td>
<td>24</td>
<td>27</td>
<td>30</td>
<td>33</td>
<td>36</td>
<td>39</td>
<td>42</td>
<td>45</td>
</tr>
</tbody>
</table>

![Graphite electrode for the production of aircraft turbine blades](image)

The achievable surface finish depends on generator technology as well.
To ensure consistent quality, every stage of our production process is strictly monitored. Every block is tested and documented. The measures range from accurate incoming goods checks and raw material tests to continuous monitoring of process parameters taken from each individual block leaving the production process. In addition, clear identification marks make every product fully traceable back through every stage of the production process.

+ All test laboratory work, such as comparative measurement, is offered to our customers as an independent service.

+ Video: Isostatic graphite, a key product for the high-tech industry.

SIGRAFINE® isostatic graphites for EDM electrodes

<table>
<thead>
<tr>
<th>Applications</th>
<th>R8340</th>
<th>R8500X</th>
<th>R8500</th>
<th>R8510</th>
<th>R8650</th>
<th>R8710</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block/rod/mass electrodes</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Standard electrodes</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Ready-to-run electrodes</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
</tbody>
</table>
Material partner for micro-machining in the EDM sector.

Increasingly high precision requirements are placing more exacting demands on EDM materials. To meet this challenge, in collaboration with our customers, we have developed a new material R8710 especially for micromachining.

The key advantage of the new material lies in its high strength. This permits easy replication of even very fine details and high contour sharpness with minimal tolerances.

This is just one example of an application-specific optimized solution from the SGL Group.
SIGRAFINE® fine-grain graphites for moldmakers

*Versatile, reliable, efficient.*

Our comprehensive range of fine-grain graphites covers all EDM requirements, right through to high-performance milling (HPM). The speed at which graphite can be machined is limited only by the performance of the computer and the machining system, but not by the material itself. Besides very high cutting speeds, feed rates of more than 10 m/min can be achieved, depending on the electrode geometry. These parameters are comparable with those for aluminum and plastics.

Working with our graphites does not require any special knowledge. Modern EDM machines are already designed for the specific quality and properties of our various graphite grades. To give our customers added security, we assist them every step of the way in individual projects, from material selection to on-site technical support.

**SIGRAFINE® is the new brand name** for our fine-grain graphites, previously known under the names RINGSDORFF®, SIGRAFORM®, SIGRAMENT® and CRYSTA-SIL®.

Standard dimensions of our SIGRAFINE® isostatic graphite grades for EDM

<table>
<thead>
<tr>
<th>SIGRAFINE R8340</th>
<th>SIGRAFINE R8500X</th>
<th>SIGRAFINE R8510</th>
<th>SIGRAFINE R8650</th>
<th>SIGRAFINE R8710</th>
</tr>
</thead>
<tbody>
<tr>
<td>1550 x 410 x 200 mm</td>
<td>1230 x 500 x 400 mm</td>
<td>1230 x 1020 x 330 mm</td>
<td>1230 x 480 x 260 mm</td>
<td>610 x 390 x 190 mm</td>
</tr>
<tr>
<td>1230 x 500 x 400 mm</td>
<td>610 x 500 x 400 mm</td>
<td>1230 x 500 x 400 mm</td>
<td>610 x 500 x 400 mm</td>
<td></td>
</tr>
<tr>
<td>610 x 500 x 400 mm</td>
<td></td>
<td>610 x 500 x 400 mm</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ø 150 x 1230 mm
ø 180 x 1230 mm
ø 200 x 1230 mm
ø 225 x 1230 mm
ø 250 x 1230 mm
ø 280 x 1230 mm
ø 320 x 1230 mm
ø 350 x 1230 mm
ø 380 x 1230 mm
ø 420 x 1230 mm

Please ask for the list of dimensions of our standard ready-to-run electrodes.

The dimensions are minimum sizes.
We continue to further develop our materials in compliance with industry-specific standards. Our customers benefit from ongoing material optimization, no matter in which industry they operate: e.g. automotive, aerospace, medical technology or micromachining, where material performance plays a key role.

Material data for our SIGRAFINE® electrode graphites

<table>
<thead>
<tr>
<th>Typical properties</th>
<th>Unit</th>
<th>R8340</th>
<th>R8500X</th>
<th>R8500</th>
<th>R8510</th>
<th>R8650</th>
<th>R8710</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulk density</td>
<td>g/cm³</td>
<td>1.72</td>
<td>1.75</td>
<td>1.77</td>
<td>1.83</td>
<td>1.84</td>
<td>1.88</td>
</tr>
<tr>
<td>Open porosity</td>
<td>Vol. %</td>
<td>15</td>
<td>14</td>
<td>14</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Average grain size</td>
<td>µm</td>
<td>15</td>
<td>12</td>
<td>10</td>
<td>10</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Medium pore entrance diameter</td>
<td>µm</td>
<td>2.2</td>
<td>2.0</td>
<td>1.8</td>
<td>1.8</td>
<td>1.1</td>
<td>0.6</td>
</tr>
<tr>
<td>Coefficient of permeability</td>
<td>10⁻² cm²/s</td>
<td>25</td>
<td>15</td>
<td>25</td>
<td>6</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Rockwell hardness</td>
<td>HR₁₀₀/₁₀₀</td>
<td>80</td>
<td>70</td>
<td>70</td>
<td>90</td>
<td>95</td>
<td>105</td>
</tr>
<tr>
<td>Flexural strength</td>
<td>MPa</td>
<td>45</td>
<td>45</td>
<td>50</td>
<td>60</td>
<td>65</td>
<td>85</td>
</tr>
<tr>
<td>Dynamic modulus of elasticity</td>
<td>GPa</td>
<td>11</td>
<td>10.5</td>
<td>10.5</td>
<td>11.5</td>
<td>12.5</td>
<td>13.5</td>
</tr>
<tr>
<td>Resistivity</td>
<td>µΩm</td>
<td>12</td>
<td>15</td>
<td>14</td>
<td>13</td>
<td>14</td>
<td>13</td>
</tr>
<tr>
<td>Thermal conductivity (20 °C)</td>
<td>Wm⁻¹ K⁻¹</td>
<td>105</td>
<td>80</td>
<td>90</td>
<td>105</td>
<td>95</td>
<td>105</td>
</tr>
<tr>
<td>Thermal expansion (20 – 200 °C)</td>
<td>10⁻⁴ K⁻¹</td>
<td>3.2</td>
<td>4.2</td>
<td>4.2</td>
<td>4.2</td>
<td>4.1</td>
<td>4.7</td>
</tr>
<tr>
<td>Ash content</td>
<td>max. %</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
</tr>
</tbody>
</table>

These are average values.
We will find the best solution – in partnership with you.

The fascinating potential of carbon as a material excites us and inspires us to develop optimum solutions in partnership with our customers.

With our comprehensive material portfolio and valuable specialist know-how, we can manufacture tailored products – even for the most challenging applications.

Consistently high quality, a global presence, innovative strength, and the extensive experience of our employees make us a reliable partner to our customers.

Whatever challenges you face, together we will find the best solution.

- Unique product portfolio
- Innovative technologies and solutions
- Production sites close to sales markets
- Technology & Innovation Center in Germany with international networks

We have wide-ranging expertise in raw materials, advanced manufacturing processes, and long-standing application and engineering know-how. We have a comprehensive portfolio of carbon, graphite, and carbon fiber products and our integrated value chain covers everything from carbon fiber to composites. With a global sales and distribution network and modern production sites in Europe, North America, and Asia, we are close to our customers throughout the world.

We use this broad base to offer our customers the best solutions possible. That’s how we live up to our claim: Broad Base. Best Solutions. This claim is also upheld by our corporate SGL Excellence philosophy of continuous improvement.

More information can be found by visiting: www.sglgroup.com  
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