Taking Wind Energy to New Heights
Innovative carbon solutions for onshore and offshore use

www.schunk-carbontechnology.com
Schunk Carbon Technology
A worldwide success. Always at your side.

Schunk Carbon Technology is a worldwide leader in the development, production and application of carbon and ceramic solutions. Like no other company, Schunk Carbon Technology combines innovation and technological expertise with exceptional service orientation into a service portfolio that is unique on the market.

Schunk Carbon Technology is a partner who offers you all the technological possibilities of a globally operating company and pragmatically puts your ideas into practice. And always precisely tailored to meet your requirements—for industrial volume markets as well as for highly specialized niche markets. Our technology portfolio, including mechanical carbon, electrical carbon, high temperature applications and technical ceramics, offers you perfect solutions for a diversity of industrial applications.

After all, this is our commitment:
Ahead in Carbon Technology. Closer to your Business.

A division of the Schunk Group.
Pioneering, full of ideas, based on partnership—this is how the Schunk Group has made a name for itself as a global technology group since 1913. Pioneering, because we build bridges for our customers to enable them to use innovative technologies to develop better products and conquer new markets. Full of ideas, because innovations are an essential part of our corporate culture. And based on partnership, because customer orientation is practiced on a daily basis by each and every Schunk Group employee.

With approximately 8,100 employees in 29 countries, the Schunk Group develops customized high-tech products and systems in a wide variety of areas on this basis: We are active in carbon technology, ceramics, environmental simulation, air conditioning technology as well as sintered metal and ultrasonic welding. And this is the case for many key industries: from automotive, train, aircraft and ship technology to solar and wind energy through to medical and electrical engineering as well as in the semiconductor industry. Our customers benefit from this extensive expertise.

PAVE—Our Core Competencies for Your Success

Sometimes at the beginning it is only a vague idea about materials substitution. Or the need to push back the performance limits. Or finding new answers to complex challenges for current-transmitting, mechanical or thermal applications. The motives of our customers for joining forces with Schunk Carbon Technology as a development partners are diverse. What they all have in common is trust in us to discover potential, to focus on the customer with our work and to develop customized solutions all the way up to the serial-production stage.

Fulfilling times-to-market that are growing shorter and shorter while still providing a high degree of process and system reliability require rethinking development strategies and collaboration with the customer. So Schunk Carbon Technology has combined its four core competencies in an interdisciplinary manner:

1. Solid materials competence in carbon, ceramics and quartz;
2. Material property engineering for the precise design of material properties;
3. The most modern of shaping technologies;
4. A comprehensive spectrum of surface treatments.

Just like with a toolbox, we can quickly and precisely transform our experience in these four competence areas into new developments and customer-specific solutions and when doing so we can exactly tune each parameter to its specific engineering problem. On this basis we can often integrate existing technologies into the development process so as to accelerate it. In any case, you obtain technological and economical added value in this way, from the first idea all the way to the market launch. The result is Process Added Value Engineering (PAVE), which makes us a pioneering development partner for your requirements.
Know-how is the Driving Force

Schunk Carbon Technology is one of the most advanced technology providers in the field of current transmission. Our no-compromise commitment to quality management and our highly efficient development and manufacturing processes are the common denominators behind high performance, economic efficiency, and reliability.

We have been producing cutting-edge products in the fields of actuators and contacting for more than 100 years. Our carbon-based materials provide the perfect technological foundation for high-efficiency current transmission solutions, even under the most extreme conditions. Our carbon brushes, contact strips, grounding systems, mounting systems, conductor lines as well as other products keep millions of electric motors, industrial, and railway applications running around the world. Our development efforts focus on ensuring a high degree of robustness, functional safety, and cost efficiency during operation.

In the wind industry, our optimal current transmission solutions ensure that everything runs smoothly. Anytime, anywhere. Thanks to our unique expertise of materials, we can develop tailor-made solutions in very short order and cover the entire breadth of customer-specific requirements, both for offshore and onshore installations as well as high-altitude plants.

Tailwind for Efficiency and Profitability

As a long-standing development partner of the wind power industry, we are setting technological benchmarks worldwide. Our carbon brushes and brush holder systems for generators and pitch installations, our reliable lightning protection and grounding systems as well as our newly developed solutions for low-noise and abrasion-resistant azimuth brake pads, help manufacturers and constructors of installations and generators achieve their goals.

Modern wind power plants are highly efficient power generators in terms of output and efficiency. In order to continuously optimize energy yield and profitability, energy losses and maintenance efforts must be minimized, the reliability of systems increased, and new locations in urban areas as well as under difficult climatic conditions need to be developed.

Schunk Carbon Technology offers customer-specific solutions to satisfy all of these requirements today. We also plan for tomorrow: Our experts monitor industry trends very carefully and derive development processes from this. For example, for the new performance classes up to 8 megawatt or to comply with more stringent noise emission regulations.
The generator is the core element of every wind power installation. You have to be able to absolutely rely on the quality, performance and reliability of the components used. Our carbon-based solutions provide efficient current transmission and the safe dissipation of interfering currents.

Higher Performance with Outstanding Reliability

The materials of our carbon brushes are adapted precisely to the on-site conditions. This perfects the transmission of power, guarantees a high thermal and electrical load capacity as well as low-wear operating behavior and long maintenance intervals.

**Carbon brushes**
for the most demanding requirements

High-frequency interference currents can severely damage transmission components and bearings. Our grounding brushes reliably conduct capacitive currents away from the shaft, thus minimizing repair costs and downtime of the wind turbine.

**Grounding brushes**
for reliable protection

Perfectly matched materials set standards in terms of reliability and efficiency, even under the toughest conditions. Our slip rings are used up to an electrical output of 6 MW, for amperages of up to 2,500 A and speeds of up to 3,000 rpm.

**Grounding brush holders**
for exact orientation

Our brush rockers form a perfect unit with our slip rings and can be individually matched to your generator type. Whether fully or partially assembled, our brush rockers reduce your installation effort significantly.

**Slip rings**
for smooth operation

Our brush rockers ensure exact positioning of the carbon brush on the slip ring at all times and thus make the transmission of power highly efficient. The integrated wear indicator also ensures increased efficiency in terms of maintenance and replacement.

**Brush rockers**
for minimal effort

These brush holders are the perfect supplement for our grounding brushes. They are custom designed for the grounding brushes you require, always position these correctly, and allow for capacitive interference currents to be reliably deflected even under extreme conditions.

**Grounding brush holders**
for exact orientation

Brush holders ensure standard positioning.

**Brush holders**
for perfect positioning

Carbon brushes for the most demanding requirements
Lightning protection systems certified, secure, and high performance

Our lightning protection systems meet the highest lightning protection class and the most stringent standards in use today. Confirmed by independent institutes. This excellent lightning protection solution minimizes damage, repair expenses, and downtimes of your wind turbines.

Maximizing Safety and Energy Yield

Wind turbines are often subjected to extreme weather conditions. Storms and lightning strikes can inflict heavy damage on your installations. Our technologically advanced components provide adequate protection under such conditions. Under normal weather conditions, they ensure that your installations deliver maximum yield through precisely pitched rotor blades.

In pitch systems, our carbon brushes impress with excellent data transmission properties, high resistance to wear, and high efficiency. Perfectly matched materials in accordance with the desired output and climatic conditions ensure a high degree of operational safety.

The grounding roller we have developed is a tried and tested alternative to our grounding brushes. The system can be used both as lightning protection and as shaft grounding and is particularly useful when abrasive dust is to be avoided.

Carbon brushes

customer-specific, efficient, and reliable

Grounding rollers

abrasion-free, flexible, and proven

Lightning protection systems

certified, secure, and high performance
The ambitions to expand wind power are running high. Don’t get slowed down by criticism and regulations concerning noise emissions, particularly in the vicinity of inhabited areas. Our quiet and almost abrasion-free azimuth braking pads provide a convincing solution that will keep you moving ahead.

Inorganic brake pads
Immediate noise reduction, lasting increase in efficiency

Our carbon-based brake pads differ from conventional organic pads by their extremely quiet operation. Carbon-based pads cannot glaze, which means that squeaking noises during braking are effectively prevented. Additionally, Schunk brake pads produce virtually no stick-slip effects, which can lead to destructive vibrations.

Our brake pads work nearly abrasion-free, which keeps the inside of the nacelle clean and ensures that important components are not contaminated by dust. Thanks to this wear resistance, maintenance intervals can be significantly optimized, which can lead to considerable cost savings, particularly in the offshore sector.

Noise Level—Brake Pads

You can rely on:

- Low-noise operation—less vitrification of the brake pads
- Reduction in the stick-slip effect—approximately the same static and dynamic friction coefficient
- Wear resistance—less abrasion, less pollution
- Resistance to lubricants
- Universal application—for both onshore and offshore
- Longer service intervals—reduced downtime, positive cost-benefit analysis

[^1] Inorganic brake pads by Schunk reduce brake noise significantly, which means that wind turbines can now be installed in previously inhospitable locations and be more readily accepted by the public.
The Most Reliable Way to Get Bearing Damage under Control

Our newly developed carbon-fiber shaft grounding system is already successfully used in many industrial areas. Now, technical innovation is also getting a foothold in wind turbines, in order to deflect stray currents safely from the shaft and adequately protect bearings, generators, and transmission components.

Universal and reliable bearing protection

Stray currents can cause devastating damage to ball bearings as well as generators and transmission components. This frequently leads to extensive repairs, which are time-consuming and expensive when working offshore. To improve safety and efficiency, we have developed a ground contact made of carbon fiber, which is capable of effectively deflecting high-frequency interfering currents from the shaft. Our system is composed of strands made up of approximately 200,000 tiny conductive fibers. These strands are subjected to thermal treatment and are thus rendered more conductive and less susceptible to abrasion. This means that bearing surfaces do not have to be coated, which saves a lot in costs. The fibers can also reach difficult to access areas inside the actuator systems. Our innovative grounding system can be used for both direct current and alternating current applications.

MATERIALS

Grade Recommendations

**Wind generators**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Metal content %</th>
<th>Opt. perm. current density A/m²</th>
<th>Opt. perm. current density A/cm²</th>
<th>Max. permanent speed ft/s</th>
<th>Max. permanent speed m/s</th>
<th>Remarks</th>
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<tbody>
<tr>
<td>C72</td>
<td>28</td>
<td>92</td>
<td>14</td>
<td>131</td>
<td>40</td>
<td>For low electrical loads</td>
</tr>
<tr>
<td>A41X</td>
<td>37</td>
<td>118</td>
<td>18</td>
<td>131</td>
<td>40</td>
<td>For low humidity</td>
</tr>
<tr>
<td>C80X</td>
<td>50</td>
<td>131</td>
<td>20</td>
<td>115</td>
<td>35</td>
<td>Standard grade suitable for brass, bronze and steel rings</td>
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<tr>
<td>C80Y3</td>
<td>50</td>
<td>131</td>
<td>20</td>
<td>115</td>
<td>35</td>
<td>Modification for high humidity</td>
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<td>C80Z2</td>
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<tr>
<td>C40Z3</td>
<td>75</td>
<td>144</td>
<td>22</td>
<td>115</td>
<td>35</td>
<td>Low electrical losses, less heat creation</td>
</tr>
<tr>
<td>S13</td>
<td>60</td>
<td>144</td>
<td>22</td>
<td>115</td>
<td>35</td>
<td>Lowest electrical losses</td>
</tr>
<tr>
<td>S13/2K</td>
<td>60</td>
<td>144</td>
<td>22</td>
<td>115</td>
<td>35</td>
<td>Cost effective solution</td>
</tr>
<tr>
<td>S20</td>
<td>60</td>
<td>144</td>
<td>22</td>
<td>115</td>
<td>35</td>
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</tr>
<tr>
<td>S20/2K</td>
<td>60</td>
<td>144</td>
<td>22</td>
<td>115</td>
<td>35</td>
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**Shaft grounding**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Metal content %</th>
<th>Opt. perm. current density A/m²</th>
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<th>Max. permanent speed m/s</th>
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<tr>
<td>A15</td>
<td>40</td>
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<td>131</td>
<td>40</td>
<td>Excellent film control</td>
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<tr>
<td>C60</td>
<td>92</td>
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<td>-</td>
<td>115</td>
<td>35</td>
<td>Lowest voltage drop, for difficult ambient conditions</td>
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<tr>
<td>C70</td>
<td>67</td>
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<td>115</td>
<td>35</td>
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<td>S13/F19</td>
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<td>-</td>
<td>230</td>
<td>70</td>
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<tr>
<td>S12K</td>
<td>5</td>
<td>-</td>
<td>-</td>
<td>131</td>
<td>40</td>
<td>Safe grounding at high frequencies</td>
</tr>
</tbody>
</table>

**Lightning protection**—our designs are approved up to 150 kA (10/350) μs—with special spark gap bracket up to 200 kA

<table>
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<th>Opt. perm. current density A/cm²</th>
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<th>Remarks</th>
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<td>E106</td>
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<td>78</td>
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<td>50</td>
<td>Improved commutation</td>
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<tr>
<td>S13</td>
<td>60</td>
<td>-</td>
<td>-</td>
<td>115</td>
<td>35</td>
<td>Slip ring units, signal transfer</td>
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**Pitch control**

<table>
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<td>-</td>
<td>78</td>
<td>12</td>
<td>164</td>
<td>50</td>
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<tr>
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<td>50</td>
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<td>60</td>
<td>-</td>
<td>-</td>
<td>115</td>
<td>35</td>
<td>Slip ring units, signal transfer</td>
</tr>
</tbody>
</table>

* On helically grooved rings only