

ABOUT MORGAN ADVANCED MATERIALS



Morgan Advanced Materials is a global engineering company offering world-leading competencies in materials science, specialist manufacturing and applications engineering.

We focus our resources on the delivery of products that help our customers to solve technically challenging Problems, enabling them to address global trends such as energy demand, advances in healthcare and environmental sustainability.

What differentiates us?

Advanced material science and processing capabilities. Extensive applications engineering experience.
A strong history of innovation and reinvention. Consistent and reliable performance.
A truly global footprint. We find and invest in the best people.

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Advanced Electrical Materials For Wind Power



ABOUT US

Morgan Advanced Materials is a leader in its chosen markets with a global reputation for leading edge materials science and proven engineering solutions. We maintain consistently high standards of operational excellence through the outstanding technical capability of our people and a culture of continuous improvement. The group has significant operational presence in all the world's major regions, serving customers in more than 100 countries. Our headquarters is in the UK and the company is listed on the London Stock Exchange.

WHAT DIFFERENTIATES US?

- Advanced material science and processing capabilities
- Extensive applications engineering experience
- A strong history of innovation and reinvention
- Consistent and reliable performance
- A truly global footprint
- We employ and invest in the best people



A GLOBAL NETWORK OF 'MINDS' THINKING 'WHAT IF?'

We work collaboratively to develop materials, components and sub-assemblies to address specific customer needs. The parts that we make are often required to play a critical role in our customers' products and systems, helping them to perform more efficiently, more reliably and longer, sometimes in the most demanding environments.

Perfect Solutions for Wind Power Products

**-40°C , Relative humidity (RH) of 90%, corrosion of sea salt;
50°C , Relative humidity (RH) of 5%, attack of unbearable heat**

They are the extreme conditions for human being, but the daily working environments of wind turbines.

By understanding the specific needs of the wind power industry, and the opportunities and challenges you are facing, Morgan is committed to providing innovative & value-added solutions, raising the capacity and running time of wind turbines to fully meet your needs. Relying on our high-quality engineering application and global service system, we provide customers with wind power products (including carbon brush, brush holder & assembly, slip ring and maintenance grindstone for specific applications) used in various harsh environments and application expertise based on our on-site application experience gained from numerous times of wind turbine operation.



Excellent Running Performance

In a specific extreme working environment, it is important to select a material formula that can form a high-quality patina film between the carbon brush and the slip ring, as the film can prolong the service life of the carbon brush, protect the slip ring surface and reduce wear. Morgan's carbon brush model is developed according to various working environments to deliver the best performance at both high and low loads. Our carbon brushes remain excellent technical performances even in environments of low humidity, which is commonly required by wind fields. Our slip rings for generators also boost optimal performance and playing a key role in wind turbines.

More Comprehensive Professional Support

At Morgan, our holistic support begins with our very first meeting with you, which is based on our teams and covers engineering, sales, customer service and training.

Engineering design: promote each design plan from experts' point of view, for continuous improvement, low development cost, and high protection for your investment.

On-site troubleshooting: send trained, qualified and experienced professionals to the field, finding out problems and working out solutions.

Professional training: provide experienced regional sales and application personnel to convey knowledge on products and materials in ongoing training programs.

Punctual delivery: our high-standard operational excellence and complete global network enable us to deliver the products you need on time.

With Morgan's professional engineering services and production bases all over the world, we can provide you with customized industrial carbon brush products and solutions at your request. We promise to deliver on time, wherever you are.



Carbon Brush for Wind Turbines

With more than 160 years of experience in scientific research of carbon and graphite materials, global operation network, world-class testing equipment and instruments, and abundant material knowledge and application experience, Morgan has made its brush products a model in the industry for their excellent performance.

Product features:

- Excellent performance thanks to unique formula
- Low wear with advanced filming process
- Applicable to varied environments through multiple post-treatment processes

Major advantages:

- More than 160 years of experience in manufacturing and application of carbon brushes
- Advanced R&D and design capability
- Independent and complete overall production process
- Technical and application support by professional teams worldwide
- Optional carbon brush grades for multiple complex environments
- Customized products according to customers' specific requirements

Benefits to customers:

- Better overall solutions
- Less wear between slip rings
- Lower maintenance rate of wind turbines



Choosing the correct brush material according to your application environment can reduce the loss of slip rings and reach the maximum service life of brushes, which is also the decisive factor for the operation performance of generators. Our application engineers can help you choose the right brush grade, and design products specially based on your needs. You may also refer to our selection charts, and choose the materials meeting your specific needs according to different application environments.



Guide Table for Brush Grades

Grade	Typical Physical Property				Content of Metal %	Contact Voltage Drop V	Friction Coefficient	Maximum Constant Linear Speed m/s	Recommended Current Density (Range) A/cm ²	Application
	Density g/cm ³	Rockwell Hardness HRI0/588	Bending Strength MPa	Resistivity μΩm						
MGI127	2.44	80	28	3.8	30	~2.5	~0.18	15	8 ~ 12	Low current density, grade for general application, used for less than 1MW wind turbines
MGI147	2.95	75	30	3.2	50	0.8 ~ 2.2	~0.25	35	14 ~ 18	For general environment facies
MGI157	2.96	72	24	3.3	50	0.9 ~ 2.4	~0.25	35	14 ~ 18	For plateau environment facies
MGI167	2.98	77	26	3.3	50	1.0 ~ 2.4	~0.25	35	14 ~ 18	For marine environment facies
MGI165	3.8	89	30	0.3	65	≤1.05	~0.20	30	≤20	Lightning protection brush
MGI190	6.5	63	65	0.06	95	≤0.10	~0.30	20	≤25	Lightning protection brush, capable for larger current than MGI165
MAI147	2.65	95/70	29	1.94	47(s)	0.7 ~ 2.2	~0.25	35	12 ~ 18	Grounding brush for general wind turbines
MAI157	2.7	93/70	28	1.8	47(s)	0.8 ~ 2.4	~0.25	35	12 ~ 18	Grounding brush for plateau wind turbines
MAI167	2.63	90/70	26	1.85	47(s)	0.8 ~ 2.2	~0.25	35	12 ~ 18	Grounding brush for marine wind turbines

Counterfeit

Counterfeit and shoddy products will not only bring direct economic losses to you and your enterprises, but also cause incalculable harm and hidden dangers to the machines and equipment! So, please choose Morgan trademarks and products, and regular sales channels. Beware of "too cheap" products, similar trademarks or grades, and beware of imitations!

Quality Assurance

Morgan is the first to pass the ISO9001:2008 Quality System Certification in China's electric carbon industry, and can ensure that the production process meets international quality and safety standards.

The technical parameters of products are subject to change without notice. For specific specifications of actual shipment, please ask your sales representative.

As the actual service conditions of products are beyond control of Morgan Advanced Materials (Shanghai) Co., Ltd., the users shall be solely responsible for the safe use of products.

This product manual is not legally effective and is not intended for any patent license or proposal without license. It shall be used for reference, research and verification only.

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Slip Ring for Wind Turbines

With more than 160 years of experience in scientific research of carbon and graphite materials, global operation network, world-class testing equipment and instruments, and abundant material knowledge and application experience, Morgan has made its slip ring products a model in the industry for their excellent performance. For varied application environments, three types of slip rings – general, plateau and coastal are available in Morgan.

Product features:

- Press-up or build-up technology
- Multiple material options
- Complete product grades to meet different capacity
- Consistent performance under high pressure, ultra-high speed, extreme temperature and other harsh conditions
- Tests available to adapt to different using environments

Major advantages:

- Rich experience in manufacturing and application of slip rings
- Cutting-edge lab for slip ring models
- Worldwide technical support and application platform
- Independent and complete production process
- Product reliability verified by years' actual operation

Benefits to customers:

- Better complete solutions
- Customization according to customers' specific requirements
- Reliable manufacturing quality of sliprings to reduce maintenance cost on generators for customers
- More timely pre-sale and after-sale services, higher ROI



More than selling products, we are also engaged in the designing stage with customers, offering a full set of solutions to slip rings, helping customers reduce costs and raising wind turbines' adaptability to environments.

Regardless of the piercing and cutting coldness in Mongolia, or the scorching desert in Western America, Morgan's products can always perfectly perform their functions. With deep insights into the various challenges you are facing in the operation of wind turbines, we timely present our perfect solutions to optimize your wind turbine performance.



Product Performance Table

Model	Capacity	RPM	Outer Diameter	Inner Bore Size for Mounting	Rated Current
DH240	850KW	1000-2000rpm	Φ240mm	Φ79/80mm	300A
DH280	1.5MW	1000-2000rpm	Φ280mm	Φ119/120mm	480A
DH300	1.5MW	1000-2000rpm	Φ300mm	Φ119/120mm	500A
DH320	1.5MW	1000-2000rpm	Φ320mm	Φ138/139mm	500A
DH320	1.65MW	700-2000rpm	Φ320mm	Φ119/120mm	500A
DH320	2MW	930-2070rpm	Φ320mm	Φ138/139mm	800A
DH350	2.5MW	612-1380rpm	Φ350mm	Φ149/150mm	1000A
DH350	3MW	665-1344rpm	Φ350mm	Φ159/160mm	1000A
DH450	6MW	1170rpm	Φ450mm	Φ188/190mm	1800A

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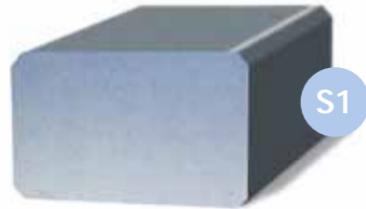
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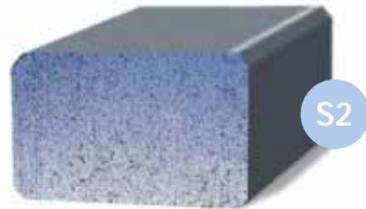
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SURFACE APPEARANCE OF BRUSHES



Smooth Polished Surface (S1)

This indicates good performance. However, if the polish is mirror-like (glazed), high frequency chatter due to low current may be the cause. Check the side-faces of the brush for signs of vibration.



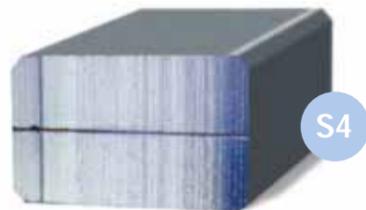
Open Textured Surface (S2)

This, again, indicates that brush performance is satisfactory. Actual appearance will depend on the type of grade.



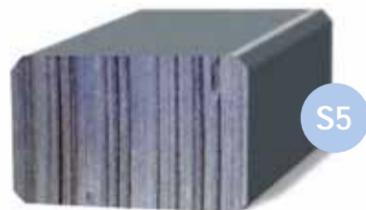
Finely Lined Surface (S3)

Another satisfactory condition. Fine lines indicate the presence of dust in the atmosphere. This may be overcome by the use of filters or ducting the machine's air supply from another area.



Finely Serrated Surface (S4)

This is a further development of (S3) above. The causes are normally atmospheric contamination or lack of load current.



Heavy Serrated Surface (S5)

As (4) above, but problem is more severe or has been allowed to continue longer.



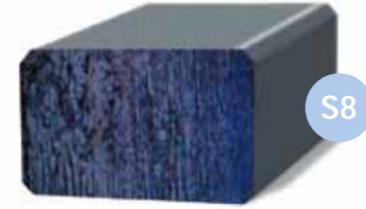
Ghost Marked Surface (S6)

This may be associated with difficult commutation and can arise from incorrect neutral position, interpole problems or other causes of poor commutation.



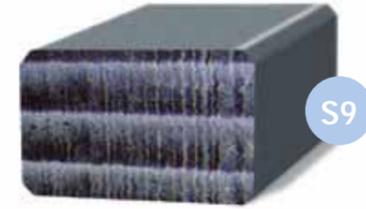
Burnt Edges (S7)

Normally occurs on the trailing edge of the brush. Caused by poor commutation and heavy sparking.



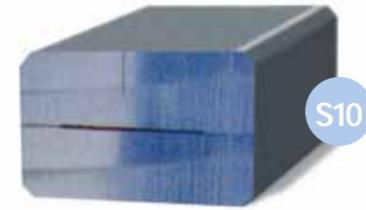
Pitted Surface (S8)

Indicates heavy under-brush sparking as a result of current overload or brush instability.



Laminated Surface (S9)

This is an unusual condition caused by an armature winding fault giving rise to poor commutation.



Double-bedded Surface (S10)

This occurs as a result of brush tilting on a reversing machine, i.e. the brush beds itself in both directions of rotation. In itself this does not give any cause for concern.



Copper Particles (S11)

Copper pick-up from commutator surface can result from copper drag problems or heavy peak loads. Can cause further commutator wear.



Chipped Edges (S12)

Normally occurs on the leading (entering) edge of the brush. breakage can result from poor commutator profile, high micas and severe brush instability.

PATINA



Light Film (P1)

Over the entire commutator surface is one of the many normal conditions often seen on a well-functioning machine. Film tone is dependent on the brush grade and current density.



Patina Dark (P2)

Good condition. Film can be light to dark in colour but the important feature is that it is uniform and even. Normally, a good film will have a slightly polished appearance.



Blotchy Film (P3)

This non-uniform filming condition is the most common appearance. The accumulated tolerances in the machine such as commutator roundness, brush contact pressure, unequal magnetic fields and chemical vapors all contribute to this type of film development.



Slot Bar Filming (P4)

Repeating light and dark filming patterns related to the number of armature coils per slot. This pattern is dependent on the machine design and usually not a function of the brush grade.



Streaking (P5)

Of only the film is not detrimental to the commutator. Brush and commutator life are not at risk in this condition. If metal transfer develops, this condition will progress into threading. This type of filming can be dependent on current density or brush grade.



Bright Spots (P6)

Bright spots in the film suggest poor contact or overloading. The resultant under-brush sparking tends to destroy the patina and will eventually erode the commutator.



Bar Burning (P7)

Is the erosion of the trailing edge of the commutator bar. Failed machine components, maladjusted electrical symmetry of the machine or a poor commutating brush can result in bar burning. If not corrected, this condition can cause severe commutator damage or a flashover.



Slot Bar Burning (P8)

Results in commutator erosion of every second, third, or fourth bar depending on the winding design of the armature. Improper brush material, brush design or electrical adjustment of the machine can cause this condition. This condition severely damages the commutator and reduces brush life.



Patina Streaked Without Collector Wear (P9)

A streaky film with no commutator wear, tracks can vary in width and colour. Caused by atmospheric conditions (humidity, oil vapour or other gases) or insufficient load.



Grooving (P10)

Is the uniform circumferential wear, the width of the brush, that is exhibited on the commutator. Excessive abrasive dust in the atmosphere or an abrasive brush can cause this condition. Extreme light spring pressure (below 1.5 psi) can also cause this condition. Proper brush applications and filtering the air on force ventilated motors can reduce the commutator wear.



Copper Drag (P11)

Occurs when high energy transfers copper in a molten state. These particles become coated by contaminants from the surrounding environment and do not oxidize properly to form the film on the commutator surface. These particles accumulate at the edge of the bar, eventually shorting across the insulating mica. This condition needs to be addressed immediately when discovered or serious damage may occur.

CHART OF COMMON DIFFICULTIES ON ROTATING ELECTRICAL MACHINES

Note: Collector means slip ring or commutator

SYMPTOMS														SYMPTOMS																																																																																
M	L	K	J	I	H	G	F	E	D	C	B	A	N	O	P	Q	R	S	T	U	V	W	X	Y	Z																																																																					
PROBABLE CAUSE OF TROUBLE														REMEDY																																																																																
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	Wear of slip ring on one polarity	Copper picking in brush face	Brush chatter	Collector surface streaky	Collector has unsymmetrical burn marks	Collector has symmetrical burn marks	Collector has wavy pattern	Ghost marks on steel slip rings	Glazed contact surface of brush	Pitted contact surface of brush	Chipping of brush edges or brush breakage	Failure to develop a protective skin	Insufficient voltage on self exciting machines	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41

Handwriting practice area with horizontal dashed lines and large light blue abstract shapes.