

3M™ Wind Vortex Generators



Aerodynamic Performance Upgrade

www.3M.com/wind

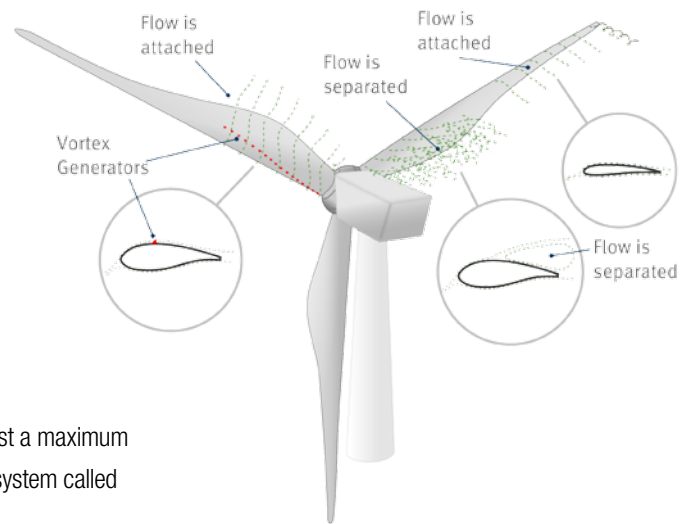
3M

Enhancing Efficiency at Every Turn with 3M™ Wind Vortex Generators

The Challenge

Due to shape and operation limitations the blades of large pitch-regulated wind turbines often have suboptimal aerodynamic properties at the root. This frequently leads to undesired airflow separation – known as aerodynamic stall – and has a significant impact on wind turbine efficiency. Surface roughness and leading edge erosion even amplify the issue.

The ideal structural twist and chord length of the blades that would be required for avoiding this effect is hard to realize and therefore the design compromise taken by blade OEMs generally offers the potential for aerodynamic improvement of blade performance.



The Solution

3M has joined forces with Smart Blade and UpWind to develop and field-test a maximum performing, highly reliable and quick-to-install aerodynamic enhancement system called 3M Wind Vortex Generators.

SMART BLADE

Maximum Performance

Vortex Generator physics were designed and tested in the wind tunnel by Smart Blade, a German engineering company with expertise in wind turbine aerodynamics

UPWIND SOLUTIONS

Quick and Accurate Installation

The installation process was verified and optimized by UpWind, a US wind turbine service provider offering a full range of O&M and performance services

3M

High Reliability

The product design and supply are ensured by 3M, a global technologies company with key competencies in material science, bonding technologies and long term outdoor weathering experience



3M Wind Vortex Generator

Several of these are attached to the root section of a wind turbine blade on defined spots that are determined in a diligent and proprietary analysis process

3M Wind Vortex Generators are tailored to each specific blade type and improve the blade performance by energizing the flow around the surface. This reduces flow separation and increases the performance of the entire turbine in terms of power, loads and service life.



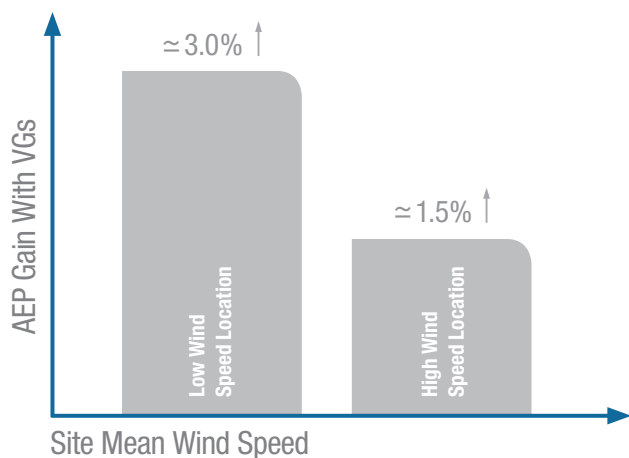
Superior Customer Value Through 3M Bonding Technology and Materials Expertise

As reliability is the key to achieve a long-term profitable investment, the material selection and evaluation is based on 3M's extensive knowledge about polymers, bonding technologies and weathering. 3M Wind Vortex Generators are made of a highly durable thermoplastic with dimensional stability and strength which has a proven track record of superior weathering resistance. Furthermore, our VGs are equipped with 3M™ Acrylic Foam Tape die-cuts that provide excellent long-term durability and holding power while treating the blade surface with care.

Your Benefits

Address aerodynamic blade issues caused by limited twist and chord length at blade root

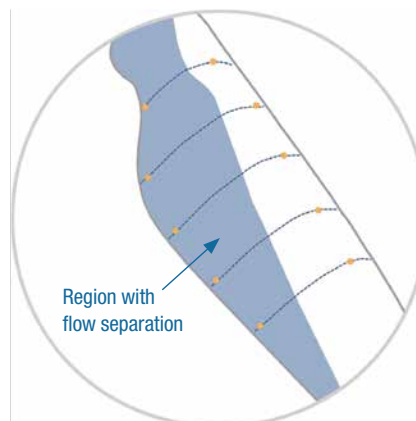
- Increased AEP of 2 to 3% has been confirmed in different case studies
- Stabilized aerodynamics which balance load effects of unsteady wind conditions
- Reduced noise due to less stall



The optimized assets achieve a significantly higher energy yield and higher profitability. The increase is depending on the turbine site, the turbine type and the turbine condition. As our long term field tests show, an increase in annual energy production of 2.0% or more can be expected.

Profit from an economically viable upgrade opportunity that gives you peace of mind

- Designed for highest reliability and fast roll-out to wind parks
- Relying on joint competency of 3M (material knowledge), Smart Blade (aerodynamic expertise) and UpWind (O&M expertise) as well as a global network of O&M companies for installation
- Adaptable to different blade types independent of turbine OEM
- Proven in hundreds of existing installations and backed up with case studies about actual performance improvement
- Payback time of approximately 1 to 2 years including installation, materials and downtime



Example of a flow separation region for a specific blade type. Its border corresponds with the 3M Wind Vortex Generator installation line.

3M Renewable Energy Division: Unmatched Capabilities

3M's commitment to the renewable energy industry includes a global organization of research and development, sales, marketing, manufacturing, and technical service – all dedicated to developing reliable materials that reduce costs and improve performance.

Expertise

Founded in 1902, 3M has extensive experience developing durable materials for outdoor applications in transportation, commercial graphics and optics. This includes world-class facilities for simulated and real-time weathering exposure and testing.

Innovation

At 3M, the innovation is never-ending. Whether the free-flow of ideas and solutions is occurring among our people, our technologies, our industries or the geographies where we operate, the human and technological connections within 3M enable infinite combinations and applications of expertise as ideas multiply and solutions expand.



● Laboratories	● Manufacturing	● Sales and Marketing	
USA	USA	USA	Singapore
Japan	Poland	Canada	China
Germany	Germany	Mexico	South Korea
South Korea	South Korea	Germany	Korea
Singapore	Singapore	Denmark	Japan
China	Japan	Spain	Taiwan
	Taiwan	UK	Malaysia
	China	France	India
		Italy	Brazil

For more information on our wind energy product line, contact 3M Renewable Energy at 800-755-2654 or visit us at www.3M.com/wind.

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This Renewable Energy Division product was manufactured under a 3M quality system registered to ISO 9001:2000 standards.



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