BLADE ADD-ONS FOR OEMS

Unlock the full potential of your blade designs.

WWW.POWERCURVE.DK
Today, the wind turbine industry is able to benefit from the aircraft industry by utilizing the well-known vortex generator technology to improve aerodynamic performance of wind turbines.

The use of vortex generators is not a new technology. Employed to increase the aerodynamic performance and stability of an air foil, vortex generators increase the efficiency of a wind turbine rotor.

**Postponing the Stall Point**

Each vortex generator consists of a triangular wing with a sharp leading edge. They are fabricated in multiple of pairs and integrated on a base plate, suitable for adhesive attachment on the blade surface. Each pair is symmetrically opposed in order to generate counter-rotating and interacting vortexes that energise the airflow to stay attached on the blade.

When correctly designed and positioned on the blade, vortex generators will make the wind flow stay attached on the blade surface for a longer time, thus reinstating lost lift due to age-related blade surface roughness. In short, the effect of the vortex generators is a reduced negative consequence of the blade surface degradation due to wear and tear.

**Design and Installation**

If the vortex generators are not designed or positioned correctly, the anticipated increase of the wind turbine power output may fail to appear. For that reason, it is important to always work closely with experts when pursuing the positive effect of vortex generators.

When developing new products for the wind energy industry, Power Curve teams up with the best there is. In Power Curve, experts join forces. When applying the Power Curve solution on original manufactured blades, the inevitable loss of aerodynamic efficiency as blade surfaces degrade is postponed. For that reason, an increasing number of OEMs choose to pre-install vortex generators on their blades before they leave the production site.

The partners behind Power Curve have worked individually within the wind turbine industry for many years, producing more than 5 million vortex generators in the past decade. In 2013, they merged into the company Power Curve where they form a team of experts and represent world-class competencies within:

- the application of passive blade enhancement devices for wind turbines
- scientific wind power aerodynamic research and engineering
- plastic injection moulding, shaping and installation
- lifting, handling and installation of complex components to the wind turbine industry

**DTU Risø**

The DTU Risø Department of Wind Energy is one of the world's leading applied research organizations of the vortex technology and is the engineer behind the Power Curve technology platform: A calculation tool which is able to analyse the effects of applied blade enhancing devices. This technology platform enables Power Curve to design and manufacture the optimal add-on devices and calculate their most advantageous positioning on the blade.

**Sander Tech**

Based on decades of experience in the OEM industry, Sander Tech has gained a unique and comprehensive insight into the driving parameters of developing, specifying and manufacturing injection moulded plastic devices for the harsh and demanding conditions in which wind turbines operate. Together with significant adhesive suppliers, Sander Tech has also developed high quality adhesion methods, processes and solutions.

**Liftra**

Liftra is specialized in lifting, transporting and handling of heavy components within the global wind industry. Liftra’s engineering team is renowned for their flexible and customised solutions, from equipment development and production to on-site installation and maintenance. Offering a deep knowledge of on-site logistics, handling and installation, Liftra manages the installation process in Power Curve.
The Production Process

Power Curve’s OEM solution includes a complete package of thoroughly developed solutions, from material to moulding: from small vortex generators for the outer part of the blade to large vortex generators which are applied closer to the rotor centre; from adhesion technology to logistics. However, should you prefer to use your own design, Power Curve also put our expertise and experience at your disposal in the design and production process.

Depending on which solution you choose, the total duration of production varies:

**Power Curve Recommended Solution:** Sourcing immediately

**Existing Technology Available:** Specifications and tool implementation

**New Solution to be Developed:** Development work required

### The Technology

**Injection Moulding**

In short the injection moulding technology is a series of processes where melted thermo plastic is forced under high pressure into a mould cavity defining the shape of the final object. Once the plastic has cooled, the object is released and then the process begins all over again.

There are three main parts in an injection moulded plastics machine: The mould, the clamping unit and the injection unit. The clamping unit holds the mould together during the plastic injection and the cooling process.

Plastic material in the form of small pellets are fed into the injection unit and then heated to a molten stage (transforming from a solid state to a liquid). After reaching the right temperature, the hot molten plastic is forced into the mould. Either a screw or a ram controls the pressure and speed of this phase of the injection process.
Excellence is a Promise

The Power Curve production is a process of defining, developing and refining special vortex generators that have been tailored for your next wind turbine project.

From start to finish, from raw material to complete product, not a single step in the production goes uninspected, and we are proud to provide our clients with the best quality assurance.

Product Inspection
- Measuring process: Weight, dimensions and strength testing
- The first 100 mouldings are discarded to ensure uniform high quality
- All items are visually inspected during production
- Produced items are selected for thorough QA control at fixed intervals

Material Assurance
- Component traceability is ensured by date and hour and operator initial registration on box labels
- All raw materials are supplied with data sheets, including relevant batch numbers

Adhesive Verification
- Adhesives selected according to the actual customer application, e.g. blade surface, installation environment and HSE requirements
- Data sheets and test results are provided as required
- Collaboration with world-leading adhesive suppliers

Workflow Integration
- Predefined work and installation instructions for workshop implementation to ensure a smooth workflow integration
- Specialist training for your production teams and site managers on all solutions
- Professional logistics partners are trained to transport your products from A to B

Quality Assurance

Adhesive Verification

Optimised to Cope With Real-Life Application

The rationale for applying the Power Curve solution on original manufactured blades is to postpone and in large to prevent the inevitable loss of power efficiency as the blade surface degrades. This has lead an increasing number of OEMs to preinstall vortex generators on their turbines so the end user can enjoy the effect of postponed expensive blade surface repair work. This is possible due to the power efficient prolonging effect of vortex generators which compensate for real-life blade surface wear and tear.

Customised for OEM Wind Turbines

The range of wind turbine blade designs is wide and so each Power Curve solution requires complex and carefully calculated fitting schemes and procedures. At Power Curve, we make sure that you receive a customised add-on solution, optimised for your wind turbines.

Designed For Client Workflow

Power Curve makes it straight-forward to enhance energy output performance for OEM wind turbines. The Power Curve team manufactures and delivers customised solutions for smooth implementation in the client production line. The add-ons are easily installed while the blade is still on the ground or at the production facility. Requirements to workflow, work instructions, QA and EHS are evaluated as an integrated part of the Power Curve solution.

Thorougly Validated and Low-Risk Solution

Designed to enhance aerodynamic performance, the effect of the vortex generator technology has been thoroughly validated by several independent researchers and institutions. As the Power Curve solution is applied to compensate for the gradual loss of aerodynamic performance, no structural risk is introduced as the application objective is to re-establish lost lift on the blades.

Based on the underlying physics of stall and pitch control principles, the Power Curve solutions are designed for pitch controlled turbines where the effects of vortex generators are predictable and controllable.

The principal AEP effect of vortex generators related to blade surface roughness

Low-Cost

High-Tech Solution

Your Benefits

The principal AEP effect of vortex generators related to blade surface roughness