

LIGHTNING
DIVERSION
SYSTEMS



ShockTape

**LIGHTNING PROTECTION
for Wind Turbine Blades**



POWERED BY
WICHITA STATE UNIVERSITY



Superior Lightning Protection | Easy and Fast Installation | Integrates with All OEM LPS Configurations

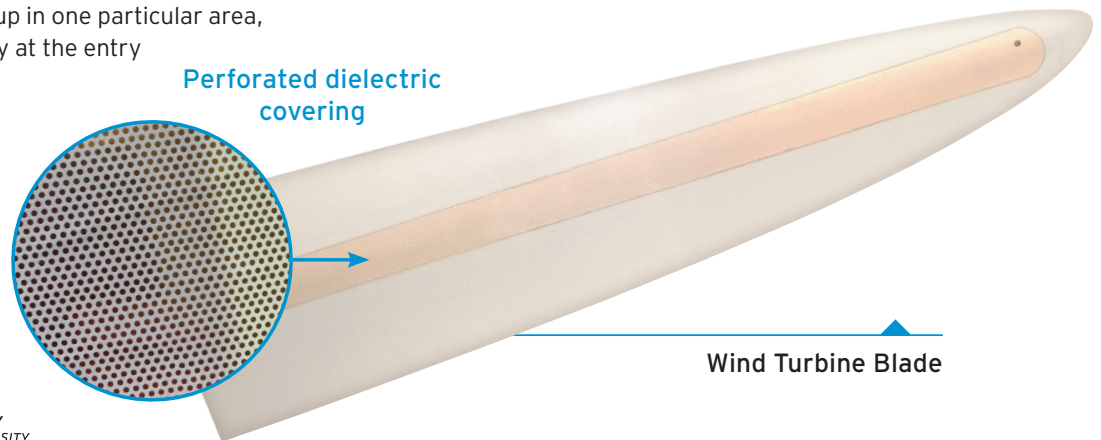


Why Lightning Protection Systems Fail

Current Lightning Protection System (LPS) designs have several areas of weakness, including small arrestor footprints, poor arc root dispersion, and potential for puncture to conductive blade components. In addition, down cable conductors must carry high levels of current in a short time, and improper routing can lead to internal arcing or flash over, especially in carbon components. Lightning strikes may also attach to unintended locations along the down cable which can also lead to flashover damage.

WHAT IS SHOCKTAPE?

- The ShockTape™ System (“ShockTape”) is a peel and stick retrofit solution that easily integrates to all OEM LPS configurations without requiring any electrical or mechanical connection.
- ShockTape is bonded to the surface of a wind turbine blade to expand the footprint associated with a blade’s existing LPS, dramatically improving its effectiveness and performance.
- The use of a proprietary perforated erosion film on the outer layer of ShockTape works to increase arc root dispersion, spreads out current density across the surface, prevents electric charge build-up in one particular area, and reduces the current density at the entry to the existing LPS arrestor.
- ShockTape allows for large current flows with minimum impedance, therefore minimizing damage not only to the ShockTape itself, but also to the existing LPS.
- By handling the initial high current energy density on the outside of the blade via ShockTape the rise time component of the lightning strike is reduced before entry into the existing LPS which reduces the chances of arcing or flashover.
- ShockTape has been shown to handle multiple lightning strikes with minimal damage to the covering. Even if damage to the ShockTape does occur after multiple strikes, the turbine blade continues to be protected as the system is a multi-layer laminate.





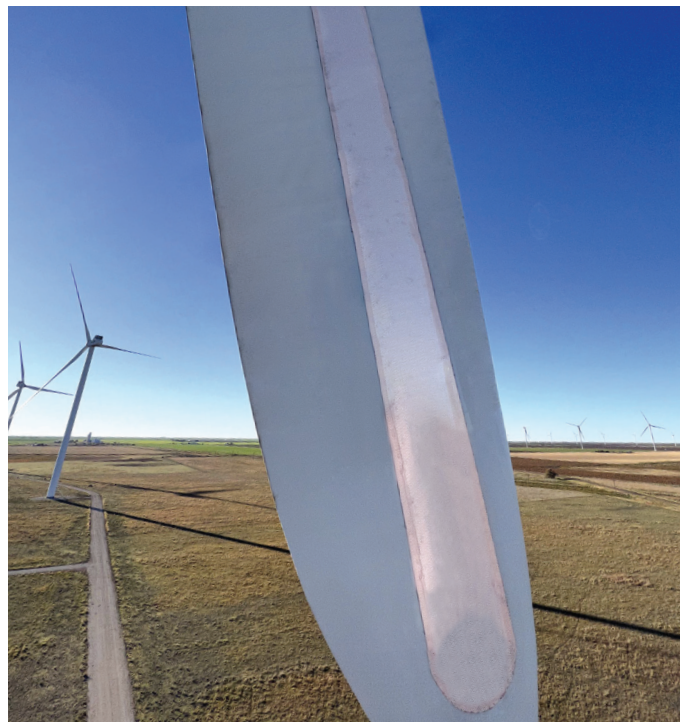
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How ShockTape Works

ShockTape™ works with the built-in LPS to provide a more reliable method of ensuring current transfer through the blades LPS both externally and internally. ShockTape integrates with the blades existing LPS system, increasing the LPS footprint and directing lighting to the tip receptor. Its perforated layer increases arc root dispersion, spreading current density across the surface, preventing build-up in one particular area, and decreasing the overall current density at the entry to the existing LPS arrestor. Given the much larger size of ShockTape compared to existing arrestors, it allows for large current flows with minimum impedance (resistance and inductance), minimizing damage not only to ShockTape but also to the existing LPS. By handling the initial high current energy density on the outside of the blade via ShockTape, the rise time component of the lightning strike is reduced before entry into the existing LPS, and down cable impedance concerns reduce significantly.

FEATURES & BENEFITS

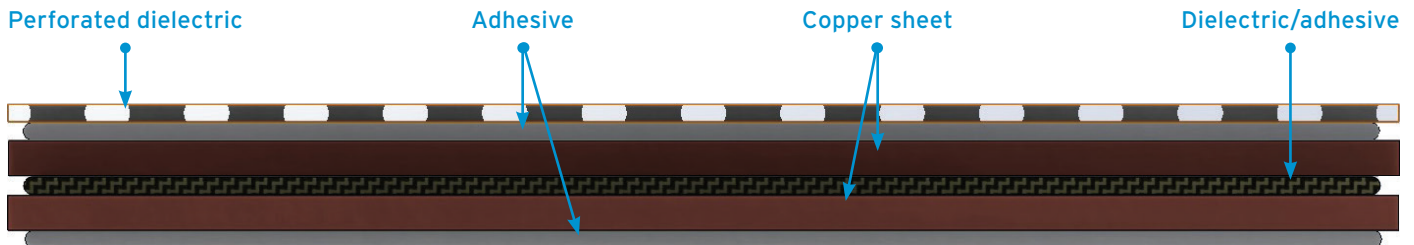
- Easy one day installation per turbine (3 blades).
- Cost-effective.
- Adaptable to various blade manufactures and configurations.
- Easy peel and stick installation. No special tools required.
- Non-obtrusive, no electrical connection to the LPS is required.
- Patent pending laminate covering that captures and directs a lightning strike to a wind turbine blade's built-in LPS.
- Proven in a test environment to withstand the toughest of lightning strikes.
- Ongoing field trials continue to validate results from lab tests.



ShockTape Design

CROSS-SECTIONAL VIEW OF SHOCKTAPE

ShockTape™ offers a multi-layer covering that captures lightning and directs it to a wind turbine's built-in lightning protection system.



PERFORATED DIELECTRIC: The first and outer layer is a proprietary perforated erosion film. This layer provides environmental protection to the copper and structural strength protection from the elements. It also performs the critical electrical function of spreading out the streamers, i.e., the streamers only come out of the holes, thereby increasing what is known as the "ARC Root Dispersion." When lightning attaches to ShockTape, the current spreads throughout the copper layer, minimizing damage to the surface, due to reduced current density, and provides protection for multiple lightning events.

ADHESIVE: The adhesive is a double-sided material providing structural strength, with the added dielectric strength directing current to either the "open area" of perforation; or the copper layers depending on which adhesive layer is referenced.

FIRST COPPER LAYER: This is the primary current conductor which carries the lightning current to the existing LPS arrester plug. The size of the copper allows for significant current flow with minimum impedance (resistance and inductance) to minimize damage.

SECOND COPPER LAYER: This layer performs multiple functions. The first is that it prevents punctures due to streamers from a conductive material, such as the LPS cable, carbon fiber spars, or oil/grease from reaching the surface and making a lightning attachment. In the unlikely event that the top layer of copper is damaged, the second layer is also capable of carrying the lightning current to the existing LPS.

ABOUT LIGHTNING DIVERSION SYSTEMS:

Lightning Diversion Systems (LDS) is a global leader in the design, development and production of segmented lightning diverter strips, devices and products for the military, aerospace and wind energy sectors. LDS has signed an exclusive licensing agreement with Wichita State University, allowing LDS to further develop and commercialize advanced lightning protection technology to offer wind turbine operators and OEMs better, more cost-effective protection against lightning strikes.

ABOUT BILLY MARTIN: Billy Martin has designed and patented ShockTape in conjunction with Wichita State University (WSU). His extensive background in aircraft lightning includes a combined 39 years of experience between Wichita State University's NIAR, Cessna Aircraft Company, and the Boeing Military Aircraft Company. Billy holds eight patents and has authored numerous white papers relating to aircraft lightning protection. He continues to support the development of ShockTape in collaboration with Wichita State University and LDS.



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