

Lightning Strike Protection

LS-1000

Enhanced Blade Protection

For wind turbine OEMs or their service providers - whose installations are subject to lightning strikes - Integument's LS-1000 provides enhanced blade protection. Unlike embedded protection, ours is a sacrificial and serviceable outer skin.



Damage from lightning strikes to wind turbine blades can range from immediate catastrophic failure to difficult to detect stress weakening and cracks, which then lead to eventual failures. Preventing damage can save money and time from being spent on field repairs.



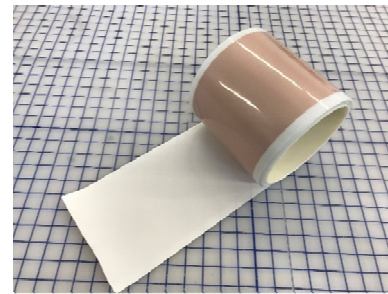
LS-1000

LS-1000 combines a conducting foil mesh with a thin, durable, fluoropolymer barrier film (ECTFE), bonded together by a long-lasting, acrylic pressure sensitive adhesive. This results in an easy-to-apply, peel-and-stick lightning strike protection film.

Integument uses fluoropolymer films in its products for superior performance compared to other polymer films. Fluoropolymers combine mechanical strength with unmatched chemical and temperature resistance. In LS-1000, ECTFE provides environmental protection to both the metallic conducting layer and corrosion protection to the underlying turbine blade skin.

The same excellent barrier properties of fluoropolymers inhibit bonding to other materials, including adhesives, without a specialized surface treatment. Compared to other surface treatments, Integument's FluoroGrip® process lasts longer, provides superior adhesion strength, and is UV stable.

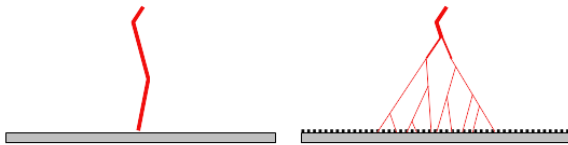
LS-1000 comes standard as 7 inch wide rolls, with custom configurations available. In the image below the white material is the fluoropolymer layer. The metallic conducting layer (copper) is visible through a clear release liner, which is removed during installation.



Installation on a clean and dry surface is simple and quick: peel off the release liner as the film is pressed into place. A significant advantage of pressure sensitive adhesives is that there are no hazardous fumes or volatiles, therefore no environmental controls or specialized personal protective equipment are required. LS-1000 is ready to use immediately upon installation, with adhesion strength improving over 72 hours. In the event of lightning strike, LS-1000 acts as a sacrificial layer and is readily replaced, reducing down time and cost for repairs.

Technology

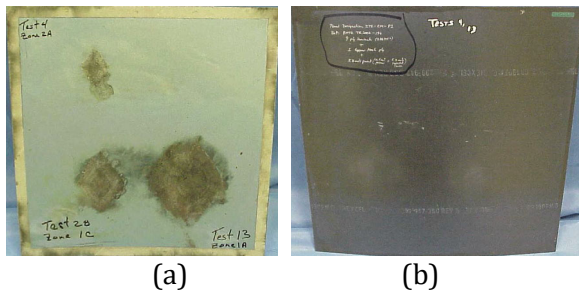
Combining the conducting mesh with the thin barrier film promotes arc root dispersion, which spreads the impact of electrical and thermal shock of a lightning strike. LS-1000 will absorb the brunt of the effects as a sacrificial layer, mitigating or eliminating potential damage to the underlying blade structure. Placed over point receptors, LS-1000 helps to funnel the current to the blade's internal down conductors.



The normal situation: Current is concentrated and damage is intense at the single strike point. If the surface is painted the damage is even more intense. Paint concentrates the arc root and compresses shock wave effects.

Arc Root Dispersion: Multiple arc roots are encouraged by an electronically "rough" surface. LS-1000 promotes arc root dispersion, helping to mitigate damage to the underlying surface.

LS-1000 was developed in part through research sponsored by the US Navy. The pictures below show the direct effects of simulated lightning strike on the front (a) and back (b) sides of a CFC panel under test. The front was protected by Integument's lightning strike protection film, and as designed, is burned. The CFC panel remains intact, and there are no punctures or cracks to the back side.



(a)

(b)

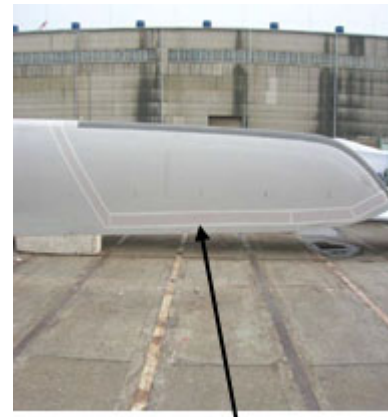
Zones	Current Component	Amplitude (kA)	Action Integral (A ² s)	Charge Transfer (A.s, C)
1A	A	200 to 215	1.5x10 ⁶ to 2.0x10 ⁶	N/A
	B	3.1	N/A	11.0
	C	0.23 to 0.27	N/A	10.0 to 11.0
1B	A	210 to 215	1.8x10 ⁶ to 2.0x10 ⁶	N/A
	B	3.1 to 3.2	N/A	11.0 to 12.0
	C	0.20 to 0.30	N/A	17.0 to 215.0
	D	105	0.25x10 ⁶ to 0.29x10 ⁶	N/A
1C	A	145 to 155	0.81x10 ⁶ to 0.91x10 ⁶	N/A
	B	3.1 to 3.2	N/A	11.0 to 12.0
	C	0.24 to 0.34	N/A	3.0 to 11.0
2A	B	3.1 to 3.2	N/A	11.0
	C	0.21 to 0.30	N/A	10.0 to 13.0
	D	100 to 105	0.25x10 ⁶ to 0.28x10 ⁶	N/A

Applications

LS-1000 can be installed near the blade tips, where most strike attachments occur, or along the full blade length for greater protection. The film should cover receptors to enable current flow to down conductors.



Point receptor – untreated.



LS-1000 treatment.

LS-1000 can be used for both new installations and for retrofit of existing turbines. It has been in commercial use on wind turbines since 2006.

Integument Technologies

Integument has been developing and offering a range of peel-and-stick, applique-style coatings for over 20 years, servicing markets and applications with extreme conditions where others can not – a skin above the rest.

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