

Wildfires pose an increasing risk to electrical transmission infrastructure, particularly in regions where dry and windy conditions contribute to fire ignition and spread. One of the key vulnerabilities of conventional steel-core conductors is their susceptibility to excessive sag under high temperatures and heavy loads, which increases the likelihood of contact with vegetation and potential ignition. Composite core conductors manufactured by Epsilon Cable offer a technically superior alternative that mitigate wildfire risks while enhancing grid resilience.

Key wildfire prevention benefits of composite core conductors

Reduced conductor sag and vegetation contact

A major advantage of composite core conductors is their significantly lower thermal expansion coefficient compared to steel-core alternatives. Traditional aluminum conductor steel-reinforced (ACSR) and aluminum conductor steel-supported (ACSS) conductors exhibit increased sag as temperatures rise, which can lead to violations of minimum clearance requirements and an increased likelihood of contact with vegetation. Composite core conductors, by contrast, maintain superior tensile strength and minimal elongation under thermal stress, reducing the

risk of vegetation ignition and compliance violations with industry clearance standards.

Lower operating temperature and reduced ignition risk

Another critical advantage of composite core conductors is their lower operating temperature when subjected to the same current load as conventional conductors. ACSS conductors, for example, can reach temperatures of 250°C (482°F) at full capacity, which is close to the auto-ignition temperature of dry vegetation. Composite core conductors, by contrast, operate at cooler temperatures -below 180°C (356°F), significantly lowering the probability of fire ignition in the event of a line failure.

Enhancing grid resilience during wildfires

Beyond wildfire prevention, composite core conductors also play a crucial role in maintaining grid stability during fire-related disruptions.
Their ability to carry more current without excessive thermal sag allow them to accommodate increased loads without violating ground clearance requirements. This enables utilities to reroute power efficiently, reducing service outages during a crisis.

Maintaining transmission integrity under fire conditions

In high-temperature environments, the aluminum strands in conventional ACSR conductors suffer strength degradation due to the softening of aluminum and corrosion of the galvanic barrier protecting the steel core.
Composite core conductors, in contrast, retain their structural properties at high temperatures, reducing the likelihood of conductor replacement following exposure to wildfires. This translates to lower maintenance costs and faster service restoration times for utilities operating in fire-prone regions.
This is especially true as steel-reinforced conductors will sag further into the flames due to thermal expansion, whereas composite core conductors remain at a greater distance from the fire source. This point can be confirmed by a study conducted by the National Bureau of Standards evaluating the temperature above a fire at different height levels (https://nvlpubs.nist.gov/nistpubs/Legacy/IR/nbsir79-1910.pdf)

Improved load-sharing capabilities in contingency scenarios

In the event of a fire-induced outage, composite core conductors act as a «shock absorber» within the grid by accommodating power flow redirections without excessive sag or ground clearance violations. Their ability to handle emergency loading conditions ensures that power can be transmitted through alternative pathways without the risk of cascading failures or

prolonged service interruptions. This capability aligns with reliability standards set forth by NERC and supports modern grid resiliency initiatives.

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Advanced monitoring with smart conductors

The next frontier in wildfire prevention and grid resilience lies in the integration of smart conductors, which not only carry electricity safely and efficiently but also act as sensors, providing real-time data to grid operators. By embedding monitoring technologies, transmission lines can actively contribute to wildfire risk reduction and grid stability.

Early defect detection and dynamic line monitoring

Smart conductors can detect and report anomalies before they escalate into failures or fire-inducing events. These capabilities include:

— Identifying hot spots along the conductor caused by defects, wildfires, vegetation contact, or external factors like bird nests, before they start a fire
— Monitoring conductor sag in real time to prevent clearance violations
— Measuring energy flow to optimize grid efficiency and detect irregularities
— Detecting high wind conditions to anticipate and mitigate risks of galloping

Acting as fire alarms

By continuously monitoring ambient conditions and conductor performance, smart conductors can also function as early-warning fire detection systems. The ability to detect localized

temperature spikes and abnormal behaviors enables faster response times, helping utilities mitigate wildfire risks before they escalate.

The Smart Cable consortium

Epsilon Cable initiated the Smart Cable collaborative research program several years ago to advance innovations in this field. By partnering with universities, utilities, and leading transmission professionals, the initiative aims to develop and implement cutting-edge sensor technologies to make power grids safer and more reliable.

The growing frequency and severity of wildfires underscore the urgent need for utilities to adopt fire-resistant and high-performance transmission solutions. Composite core conductors represent a proven technology that not only reduces wildfire ignition risks through superior sag performance and lower operating temperatures but also enhances grid resilience by maintaining integrity during fire events. As utilities and policymakers seek to modernize the transmission infrastructure in fire-prone regions, composite core conductors provide a technically sound and cost-effective solution that supports both wildfire mitigation and long-term grid reliability.



***About the Author*, Alexandre LULL**
Alexandre is Managing Director of Epsilon Composite. After studying composite materials, aerospace engineering and business management, he began his career in the Airbus group, before joining Epsilon Composite. He is closely involved in the activities of Epsilon Cable to

support the modernisation of electrical infrastructures. As a leader, Alexandre is focused on developing the company’s global performance, integrating extra-financial criteria and sustainable development into its strategy.