D40 Hot Air Balloon Fires, Power Lines, Product Liability

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After attending this presentation, attendees will understand the mechanism of failure, accident prevention, and outcomes of hot air balloon power line strikes. Product liability issues relating to an actual case and potential design changes to prevent short circuits will assist the legal and forensic engineering community.

This presentation will impact the forensic science community by providing attendees with an understanding of the mechanisms, causes, and product liability issues of hot air balloon power line strikes.

Hot-air ballooning can be an enjoyable recreation. Pilots fall under Federal Aviation Administration (FAA) jurisdiction with a "lighter-than-free-air balloon" rating. Per Federal Regulation Sec 61.68, commercial balloon operators are required to maintain an FAA mandated pilot's license, type-specified for the apparatus. Pilots are trained in collision avoidance under 14 CFR and a ground crew is required to assist with takeoff, flying, and landing. What is not often mentioned, or mediated upon, is that 34 hot air balloon accidents occur per 10,000 flight hours in the United States. Of these, 12% are due to balloon convergence with power lines/utility poles and 80% of all combined fatalities are the result of an accidental power line strike.

One of the most recent accidents occurred on May 9, 2014, in Ruther Glen, VA, with an event originating outside of Doswell, VA. There were three fatalities and a debris path 1.75 miles long. The National Transportation Safety Board (NTSB) reports that between 1983 and 2007 there were nine power line contacts involving balloons resulting in 17 fatalities.

Most power line strikes occur at takeoff and landing sites, close to populated areas with distribution power lines ranging in voltage from 4,160 to 13,200 to as high as 34,500 volts phase-to-phase. The distance between phases ranges from about two to six feet depending on the type of construction. Sub-transmission lines ranging from 44,000 to 69,000 volts, or transmission lines ranging from 115,000 to 735,000 volts with 10- to 30-foot spacing between phases, may be nearby. The National Electrical Safety Code (NESC) sets out phase-to-phase spacing and phase-to-ground spacing for power lines.

Power lines are rarely insulated but are bare copper or aluminum conductors. While contact with one phase may occur without incident to a balloon, contact between phases is much more dangerous. Incidents where a bird's wingspan shorted two phases, electrocuting the bird, igniting its feathers, and starting a fire have been investigated. Balloons, given their much greater size and potential conductivity of metallic components, can likewise make phase-to-phase contact or get tangled up and cause a short circuit.

Given the foreseeable dangerous risk of contact, product liability can become a major issue, especially regarding the construction and design of the balloon basket. Those who design, manufacture, sell, or furnish products that are unsafely defective may be liable — even strictly liable for defects that make a product unreasonably dangerous. Yet despite the foreseeability of such accidents, basket design has not changed significantly.

The construction of a balloon assembly falls under the jurisdiction of the NTSB. The balloon envelope is made of nylon, which is an insulating material and would not short circuit a power line. The problem is the metallic parts of the balloon, which are not insulated. The wicker basket usually contains an aluminum frame and four propane fuel tanks which are either stainless steel or aluminum. Thus, when a basket with its frame and tanks comes in contact with a power line a phase-to-phase short circuit may occur. The KWc quantity of energy in the ensuing arcing is usually sufficient to melt and vaporize the aluminum or stainless steel and perforate the propane tank wall, releasing and igniting the propane and the wicker basket before any power line fuse or relay operates to clear the fault. The hot gas also rises, enters, and heats up the balloon causing an uncontrolled rate of climb. The occupants and pilot have only one choice…jump!

Similar accidents have been investigated and an insulation system has developed and tested in the laboratory to prevent the short circuits occurring in most instances. This insulation concept has been presented in successful product liability litigation involving balloons. This presentation includes the details of one such hot air balloon fire/power line strike, fatality, injury, and associated litigation outcome.

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