



IGNITION SOURCE VIABILITY: A FIREWORK STORY

ESi conducted a “ladder-sequence” of multiple tests, instead of one test with a variety of variables, resulting in a systematic, repeatable method to demonstrate the BC401 bottle rocket was a viable ignition source of rooftop debris and roofing material. The case settled in favor of ESi’s client, the insurer of the property.

SITUATION

On December 30, 2016, ESi was hired to determine the viability of a potential ignition source for a fire that occurred on July 4, 2012 at a residence. Fire department and police personnel were dispatched to the scene, extinguished the fire, and investigated the area, which included interviewing witnesses. Multiple neighbors identified the origin of the fire to have been on the western side of the rooftop. Fireworks were heard earlier in the day by multiple neighbors and bottle rocket stick remains were found around the property. A neighbor came forward and informed the police that fireworks were discharged that day from their property and provided an exemplar bottle rocket. A subsequent fire origin and cause investigation was conducted by the property owner’s insurer. This investigation confirmed the area of origin to be on the roof and eliminated all potential ignition sources within the attic and rooftop area except fireworks.

ESi was tasked to determine if the specific firework provided to police officers matched the firework remains within the property, assess the characteristics of the firework including sale, make, trajectory, distance, and report (a report is another name for bang), and to ultimately determine the viability of the firework as a potential ignition source specific to the fire scenario.

Practice: Fires & Explosions

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Services Utilized

- Origin and Cause Finding
- Scenario Replication and Testing
- Laser Scanning

About ESi

For over 30 years, ESi has leveraged its multidisciplinary team of engineers, scientists, and professional technical staff to investigate many major accidents and disasters. Our technical expertise, hands-on experience and state-of-the-art facilities, combined with diagnostic, analytical and physical testing capabilities create an ideal environment for quickly identifying and interpreting the facts of a case.

Contact ESi

For more information visit our website or call us toll free at 866.596.3994

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SOLUTION

ESi conducted an initial background review of the file material provided which included fire and police reports, witness statements, depositions, and photographs. Simultaneously, a three-dimensional (3D) laser scan of the residence, property and neighborhood was conducted to generate an accurate rendering of the incident area. Utilizing the data available, the goal was then to create a “ladder-sequence” of multiple tests to demonstrate whether the firework was a viable ignition source. This approach allowed each “step” in the testing to be evaluated independently.

The subject property and adjacent properties were scanned to determine distances and heights from the reported launch site. After completing the analysis of the 3D laser scan and determining the distance, angle, and trajectory of the neighbor’s property to the fire origin property, ESi needed to secure exemplar bottle-rockets for field and laboratory testing. The firework was identified as a Black Cat BC401, which is illegal in most States based on its small diameter size. The BC401 is a hand-rolled 50mg report-powdered bottle rocket with a red stick (stabilizer). Due to the illegality of small diameter fireworks within the States, acquiring the firework was difficult, but successful. Field testing was conducted on the exemplar fireworks to determine length of travel from ignition to report (bang) at various launch angles. The data was compared to the 3D rendering to verify if the exemplars could travel from the neighbor’s property to the subject property and roof (it was).

After the field testing on the firework was completed, an analysis of the rooftop condition was required. During the fire origin and cause investigation, conducted by the insurer, rooftop debris and roofing materials were collected as artifacts. ESi received the artifacts for laboratory testing. The exemplar fireworks were then used to test for ignition viability of the rooftop artifacts.

RESULTS

Due to the inherent variability of the BC401 firework’s manufacturing process, the firework field testing resulted in a wide range of results. The testing verified that the BC401 had the ability to fly at varying angles regardless of initial orientation and position, travel a range of over 300', travel over 75' before report, as well as exhibit signs of “sputtering” or to discharge visible sparks before the report or bang. Additionally, it was noted that some fireworks “sputtered” without a report in addition to some fireworks post-report exhibited flaming combustion of paper wrapping debris.

The roof debris, including leaves and pine needles, and the cedar shake shingle roofing materials were provided to ESi for analysis and testing. The post-report ignition of the BC401 paper wrapping was a critical data point related to the laboratory testing for the roof debris. The testing determined the burning paper wrapping was a sufficient heat source to ignite the pine needles and rooftop debris into a smoldering fire. Next, the transition between a smoldering fire of debris to the rooftop material had to be verified. The rooftop debris was tested and confirmed as a sufficient heat source to ignite roofing material. The debris was positioned on top of multiple cedar shake shingles and ignited to a smoldering fire. The smoldering fire ignited the shingles and over time continued flame propagation.

The estimated time lapse of firework ignition, to flight, to smoldering ignition of debris, and flaming ignition of roofing material was evaluated and computed. It was then compared to the statements and timeline of events on the date of loss. The testing and comparison demonstrated that the BC401 bottle rocket was a viable ignition source from firework discharge, to secondary unintended fuel package ignition, and finally to visible roofing material ignition.



Controlled testing of debris to shingle.



Firework to debris ignition.

WHY ESi.

Our fire and explosion experts work with clients to gather evidence related to fires and explosions, reconstruct, and analyze accidents in detail, to uncover the component failures, human errors, and other factors that caused them. Our consultants possess strong backgrounds in:

- Origin & Cause Finding
- Fuel Gases
- Fire Protection Systems
- Codes & Regulations
- Scenario Replication & Testing
- Gas Dispersion Modeling
- Fire Spread Analysis
- 3D Laser Scanning



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