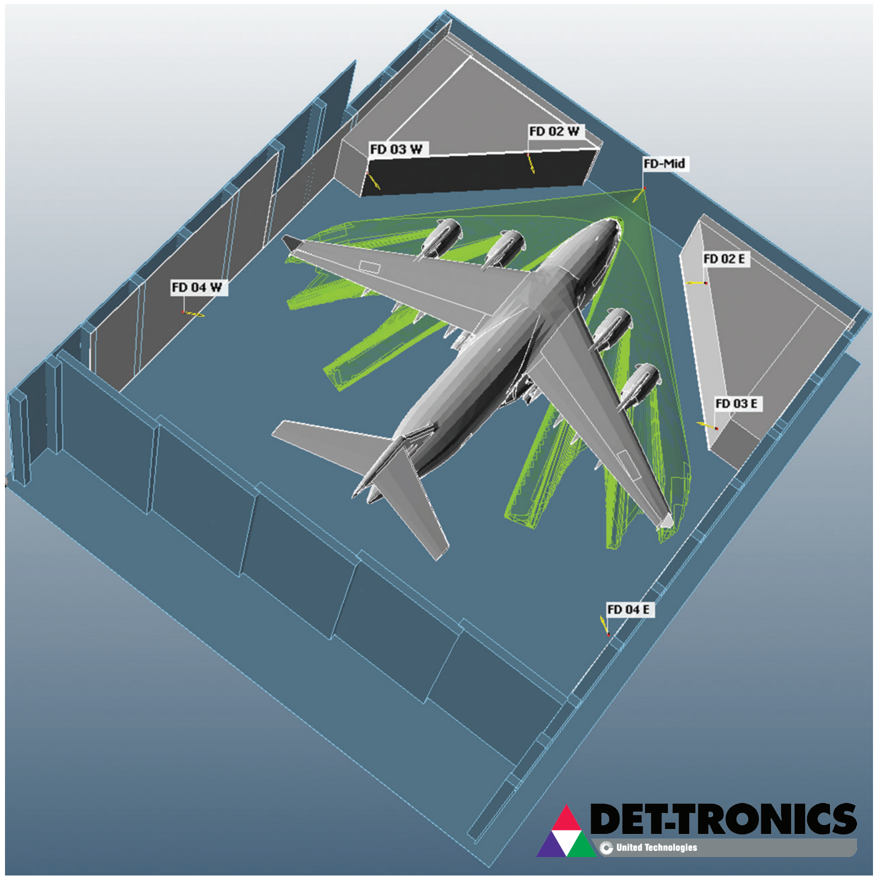
Fire Protection in Army Aircraft Hangars: Is Yours Up to Date?

By Michael J. Hosch and John Jarvis

Ensuring aircraft are mission-ready is job number one for aircraft maintenance and ground crews – and hangars provide the venue for this important job. So it is essential that hangars be protected from the dangers of fire. Hangar fire detection systems must evolve along with the aircraft and operations they protect. That's why today's military aircraft hangars require high-performance systems to detect fires and actuate supplemental suppression systems.

The National Fire Protection Association (NFPA) 409 "Standard on Aircraft Hangars" is the most common standard. It contains provisions for fire safety construction practices as well as fire detection and suppression systems. A second NFPA standard is specific to Aircraft Maintenance (NFPA 410). In addition, military branches supplement NFPA guidelines with standards applicable to their unique environments. U.S. Army facilities follow the protection criteria outlined in United Facilities Criteria (UFC) 3-600-01 "Fire Protection Engineering for Facilities" as supplemented by Engineering Construction Bulletin (ECB) 2015-17 "Changes to Reduce False Activations of High Expansion Foam Systems in Army Hangars."

ECB 2015-17 specifies the use of multispectrum infrared (IR) optical flame detectors for Army aircraft hangars because of several performance characteristics of this detection technology including its ability to detect flame at long, hangar-relevant distances through a potentially heavily smoke-laden environment. Below is an overview of the performance requirements of the supplemental ECB and the product attributes that support the ECB's specification of optical flame detectors.



3D GRAPHIC COURTESY OF DET-TRONICS

Certified fire protection engineers and other hangar experts use 3D flame mapping software to assist in determining detector placement so that the area of coverage is maximized and meets project specifications; the example above shows the FOV of a single detector positioned at the front of the plane and highlights the shadowing effect of the aircraft engines. In practice, this coverage would be augmented by additional detectors positioned strategically around the periphery of the hangar.

Rejecting False Alarms

The ability to reject false alarms and prevent the unwanted release of fire suppression foam is critical for uninterrupted hangar operations, and a high level of false alarm rejection is a key requirement of ECB 2015-17. A flame detector may never experience a real fire during its expected 20-plus year service life, but it is likely exposed to thousands of potential false alarm sources every day—such as welding, strobe lights, bright modulated sunlight, aircraft tug hot engine exhaust, and an occasional errant in-hangar auxiliary power unit firing.

Military hangars are also subject to a unique false alarm source, electromagnetic interference (EMI) from sophisticated and powerful onboard avionics and EW systems. Though these systems are rarely intentionally activated within the hangar itself, signals from aircraft operating in the immediate hangar vicinity can radiate through walls and open hangar doors. The signals can present a significant EMI rejection challenge for a flame detector so ECB 2015-17 specifies optical detectors with EMI immunity.

"Friendly flames" just outside the hangar, such as those from aircraft engine afterburners and/or auxiliary power units, can also lead to false alarms. To prevent a detector's field of view (FOV) from extending onto the hangar apron, ECB 2015-17 requires that the field of view of flame detectors be limited via "blinds."

Another practice that helps protect

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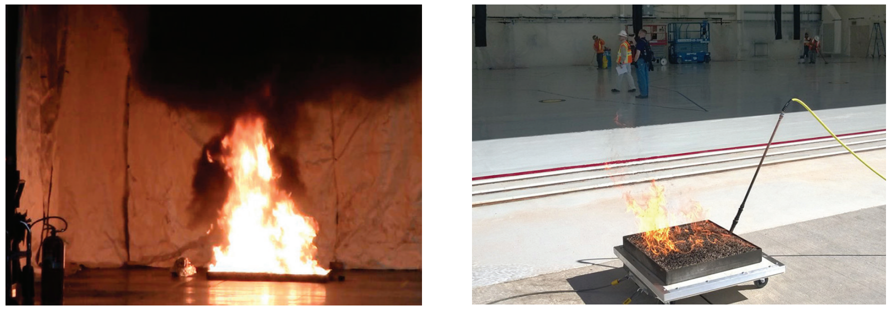
The U.S. Army's ECB 2015-17 specifies that infrared optical flame detectors used in hangar construction be provided with blinds to ensure detector fields of view do not extend beyond the spaces to be protected.



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Taken at Ladd Army Airfield, Ft. Wainwright, AK, the left image shows the soot and smoke generated by traditional pan fire testing; right image depicts a new proof-testing methodology using a patent-pending Jet Fuel Flame Simulator developed by Det-Tronics.

against an unnecessary but consequential false foam release event is the use of a voted detection system. ECB 2015-17 requires that at least three flame detectors have a clear view of any point of the hangar floor. Typically, when one detector signals a fire alarm, only an alarm notification is issued. If a second detector also signals a simultaneous fire alarm, the system automatically activates the suppression system. This belt-and-suspenders approach vastly reduces the potential for a suppression agent release due to a false alarm event.

Covering All the Angles

A primary objective of a fire protection system is to establish complete flame detection coverage for all of the assets and potential hazards within a structure. Optical flame detectors require a clear line of sight to the flame hazard, which is often a pool fire from aircraft fuel that has leaked from a tank and ignited on the hangar floor.

ECB 2015-17's requirement—that any position on the hangar floor is viewed by at least three flame detectors—is a system design challenge in hangars where optical flame detectors must have a clear view of the underwing portion of fixed wing aircraft. It is important to install the optical flame detectors low enough to obtain a clear underwing view of the entire aircraft but high enough so that tool cribs and equipment racks placed along the side wall do not form optical obstructions. The task is more difficult with helicopter airframes, the fuselage underbelly of which can be just a few feet off the ground.

Planning for Fire Detection and Suppression

Due to ECB 2015-17's triple-detection coverage requirement and the fact that hangars are filled with potential obstructions, analyzing and configuring a flame detection system requires a rigorous approach. A specialized 3D CAD mapping tool optimized for flame detector layout tasks can help discover and rectify poorly covered or blind spot areas and otherwise optimize detector placement coverage.

The output of the CAD tool is a coverage map that precisely details the coverage that each detector provides and allows flame detector positions to be quickly changed and assessed for coverage improvements. The speed of a planned detection system is critical for fire system performance. Significant damage to an airframe can be expected within 45 seconds of exposure to a jet fuel fire so systems are usually designed to act within 30 seconds (timed from actuation of the suppression system to discharge of HiEx foam through the most remote nozzle). As a consequence, the detection system must receive and analyze data from multiple flame detectors, make error-free decisions and dispatch suppression activation and alarm messages in no more than 15 seconds. Optical flame detectors such as the Det-Tronics X3301 multispectrum infrared flame detector meet this criterion with detection times in the sub-ten second range.

Commissioning a Hangar Fire Protection System

A typical requirement in the hangar commissioning process is proof-testing the system for specification compliance. Historically, fire proof-testing has been performed using pan fires of jet fuel placed at various positions inside the hangar to prove that the triple detection coverage requirements have been met. Using actual jet fuel pan fires for testing presents multiple operational issues including safety and health risks, fuel leaks and spills, possible hangar damage, and significant post-test cleanup needs. There is also a hazardous waste disposal issue related to the partially burned jet fuel.

Det-Tronics has developed a new proof-testing alternative that is gaining traction in the aircraft hangar fire protection industry. The patent-pending jet fuel fire simulator uses LP (propane) to accurately replicate the radiant spectral and flicker characteristics of an equivalent jet fuel pan fire as detected by the Det-Tronics X3301. This enables flame detector performance testing without the potential dangers and damages of pan fires.

Conclusion

Military hangars perform key mission-readiness functions. The fire protection and suppression systems that keep them safe and operational must be carefully engineered and implemented to address the unique requirements. Working with a fire detection expert such as Det-Tronics can help insure proper system planning and the latest technologies to protect military aircraft assets.

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