Simple Automatic Fire Suppression

by Joe Manchor

In-flight fire can be disastrous, especially if occurring in a large open space, such as the main cabin area of a rotorcraft. To combat fire, most aircraft are equipped with hand-held extinguishers. But fires may occur in inaccessible areas that may not be reached with the hand-held extinguisher. Additionally, flammable fluid fires, such as those that may occur after enemy encounters, can be particularly difficult to extinguish. For such fires, it is often important to extinguish as quickly as possible to prevent the spread of burning fuel to the point that the fire becomes unmanageable.

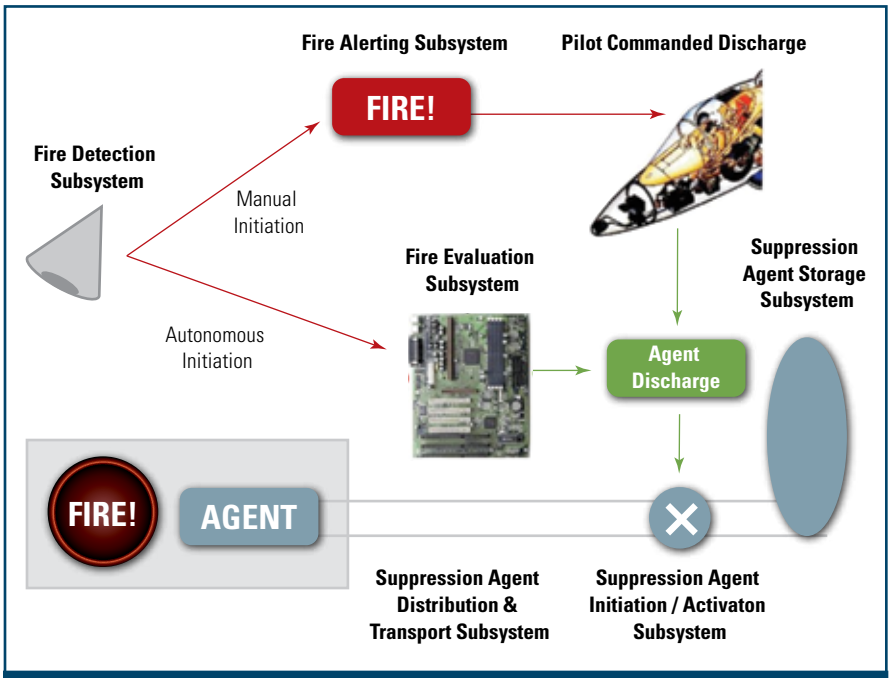

Figure 1 Automatic Suppression System

Protecting against ballistically induced fire is preferably achieved via passive means. Fuel containment technologies, such as self-healing fuel bladders or fuel line suction feed systems, are usually the first line of defense. Should passive technologies prove inadequate, it may sometimes become necessary to consider fire suppression systems.

An automatic system would be desired because it could quickly react to improve the chances of extinguishing the fire. Automatic systems can be costly and complex, with numerous subsystems. As seen in Figure 1, an automatic system can include fire detection, evaluation, alerting, and activation, along with suppression agent storage and distribution subsystems. Some of these subsystems may require interface with aircraft systems, such as the electrical system, further aggravating the complexity of the suppression system.

As system complexity increases, so does the potential for false alarms and/or failure. The system can also become unacceptably costly and heavy. As a result, some aircraft programs have been forced to forego needed fire protection, and accept some of the vulnerabilities imposed by their flammable fluid systems.

In 2003, the Joint Aircraft Survivability Program (JASP) sponsored a small project that evaluated the potential for simplification of aircraft fire suppression systems. The objectives of the Simple Passive Extinguisher (SPEX), JASP Project V-3-02, were to minimize the cost and weight impact of automatic fire suppression systems, while enhancing retrofit potential, allowing for possible kit installation on the battlefield, if needed.

The SPEX concept focuses on simplifying or eliminating as much as possible of the subsystems normally associated with active suppression systems. The characteristics of a fire alone, such as heat, would serve as the mechanism to initiate automatic activation of the system. An extremely simplified example of the SPEX concept may be thought of as a balloon filled with a fire suppression agent. Such a balloon would be placed in a fire vulnerable area. Heat from a fire would burst the balloon, releasing the agent to extinguish the fire.

While the above example is overly simplified, under this project several "Contractor Off-The-Shelf" (COTS) automatic suppression systems were identified that actually emulated this concept. These systems were mature enough to have potential for military

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aircraft applications. They were subsequently demonstrated in full-scale aircraft testing to evaluate their potential to automatically detect and extinguish ballistically induced fuel fire. The results of these tests were very encouraging, with one system in particular showing promise.

The Firetrace Aerospace automatic suppression system was shown effective in automatically detecting, activating, and extinguishing fires within a reasonable time. It should be noted that this system requires no electrical power or interface with any of the aircraft systems. For testing, it was merely mounted within the void space that it was to protect, highlighting its potential for retrofit and rapid fielding. Figure 2 shows the results of one of these tests.

As a result of the JASP SPEX project tests, both the P-8A Poseidon and V-22 Osprey programs conducted trade studies to evaluate the Firetrace system for their aircraft. Both programs found that it did meet their needs for ballistic fire suppression. As such, both aircraft have selected this technology to be included as part of their ballistic vulnerability reduction design.

The Firetrace system has also been evaluated for several other rotorcraft platforms and various applications under JASP and Joint Live Fire (JLF) sponsorship. These tests have varied from providing fire protection for small inaccessible aircraft voids, to suppressing large conflagrations in rotorcraft main cabin areas. Figure 3 shows a main cabin test, and illustrates that the system is very capable of detecting and extinguishing large fires in open, well-ventilated areas.

Figure 3 JLF Firetrace Testing for Rotorcraft Main Cabin Fire Protection

In August 2009, JASP provided recommendations for rotorcraft survivability improvement technologies for potential Director of Defense Research and Engineering sponsorship under the Secretary of Defense' Task Force on Helicopter Survivability. These technologies were required to be mature enough for rapid fielding. The Firetrace system was proposed as one of several vulnerability reduction technologies that would provide significant improvement to rotorcraft survivability.

Since the 2003 SPEX testing, automatic suppression systems have been developed and marketed by other vendors that also emulate the SPEX concept of minimized subsystems. Similarly, some of these do not require interface with aircraft systems, and promise even more rapid detection and suppression than the Firetrace system. It is hoped that future JASP and JLF efforts will provide the opportunity to evaluate these technologies to allow added competitive solutions to be identified for aircraft fire vulnerabilities. ■

Figure 2 JASP SPEX Project Testing of the Firetrace System