AIRCRAFT HULL PROTECTION

INTRODUCTION

These guidelines apply to facilities producing, housing, modifying or repairing large or high valued aircraft. Present guidelines, such as NFPA 409, do not address protection for the interior of such aircraft undergoing maintenance, construction, or modification. There are also no specific guidelines for the protection of aircraft mock-ups. Existing guidelines are generally based on the protection of the structures housing the aircraft or mock-ups.

With the value of a modern jet aircraft in the upper multi-million dollars, the need for interior fire detection or automatic fire protection during production, housing and maintenance is evident. A plane in a hanger or assembly building is comparable, in size and volume, to a building in a building. For example, a Boeing 747 can hold 500 or more passengers. The Boeing 777-300 has a wing span of 200 ft (61 m), an overall length of 242 ft (73.8 m) and a 19 ft (5.8 m) interior width.

POSITION

During manufacturing, provide interior fire detection or protection as soon as the hull sections are joined and combustibles are introduced. Combustibles include wiring, insulation, paneling, upholstery, carpeting, avionics, and compartments containing hydraulic systems. In many cases it is not practical to provide interior detection/protection until temporary flooring is installed. Electrical equipment is the most frequent cause of fires.

Provide temporary automatic fire protection or fire detection in the interior as soon as a plane is placed in a hanger for prolonged maintenance. If the plane is not electrically energized, the doors are kept shut and no personnel are allowed inside, detection or protection may not be needed.

There is no standard method of providing interior fire detection or protection for all aircraft. Detection and protection is highly customized and designed for specific applications using specifications set by the insured in conjunction with AXA XL Risk Consulting. The decision to provide detection or automatic interior fire extinguishing systems is based on the availability and response time of an on-site fire brigade/fire department, occupant attendance, the implementation of loss prevention programs meeting AXA XL Risk Consulting's *OVERVIEW*, and risk analysis.

In construction or major modification of large commercial aircraft, the trend has moved away from automatic interior protection of aircraft, to early detection with manual suppression by a plant fire brigade. As a minimum, the fire brigade should meet the requirements for Advanced Exterior And Interior Structural Fire Brigades as defined in NFPA 600. Use air sampling - type smoke detection systems.

Because of the recognized potential for stratospheric ozone depletion associated with Halochlorofluorocarbons (HCFC), do not install any new halon systems. Use of Halon substitutes is the desirable method for situations needing automatic fire protection.

CO_2 protection is rarely utilized due to the inherent personnel hazards associated with total flood CO_2 in the protected space.

Temporary interior sprinkler protection has been used in the past for some military aircraft projects. Due to the high potential for accidental sprinkler discharge and subsequent contamination of the aircraft, this protection scheme has lost favor.

Use impairment procedures found in *OVERVIEW* (PRC.1.1.0) when protection equipment is taken out of service during movement of the plane between assembly positions.

Provide protection or detection in all interior areas including cargo areas, passenger compartments, cockpits, avionics compartments, and areas containing hydraulics.

Provide full Central Station or Proprietary supervision of protection systems, including trouble signals and fire alarms. In addition, provide interlocks between the detection or extinguishing system and electric power service to the aircraft to shut down power upon detection or extinguishing system actuation.

Provide portable extinguishers throughout. As a minimum, extinguishers may be placed at the entrances to the hull.

Airplane mock-ups are best protected by a traditional sprinkler system. Extend automatic sprinkler protection to the area beneath the mock-up if there is a possibility that combustibles may be placed there.

DISCUSSION

Three uniquely different situations are encountered where interior protection of an aircraft hull is needed. These are commercial and other closed aircraft, cargo planes with large, open doors; and mock-ups.

Closed Aircraft

Closed aircraft are considered to be aircraft without any large, cargo door openings. Openings typically consist of the personnel aircraft doors and baggage or small cargo hatches.

Because of the high potential for water damage and contamination, space limitations and need to move the aircraft from one assembly position to another, sprinkler protection is rarely used in closed aircraft. Contamination from accidental sprinkler discharge could cause an aircraft purchaser to reject the plane, and would also involve FAA inspections of the aircraft. Because of this, a clean agent extinguishing system is the preferred choice of protection.

If sprinkler protection is the chosen method of protection, use quick disconnect piping to facilitate installation and removal. Hoses can be used to connect to appropriate fixed piping outside of the aircraft. Piping can be supported by stanchions located to minimize interference of individuals working in the aircraft. When the plane is moved from station to station during assembly, the hose connection can be removed and connected to the hose at the next station. Provide a separate indicating control valve in the sprinkler supply to the airplane.

Base the sprinkler protection on a density of 0.20 gpm/ft² (8.15 L/min/m²) over the entire area, in accordance with NFPA 13 and PRC.12.1.1.0. Sprinkler systems may be either wet or pre-action systems. To avoid accidental discharge of sprinklers, pre-action systems may be installed using smoke detection to actuate the valve. Charging the piping with nitrogen, and monitoring the nitrogen pressure can insure piping and sprinkler head integrity. Another advantage of having a pre-action system is the detection system that can give an early alarm when smoke in the cabin is first detected.

CO_2 is not generally used because of the safety hazard to personnel working inside. However, if used, proper training and interlocks are essential. The installation should be in accordance with NFPA 12 and PRC.13.3.1.

In the 1990s the industry generally moved away from Halon systems with reliance on early smoke detection by air sampling - type smoke detectors with rapid response and manual suppression by on-site fire fighters. Where air sampling - type smoke detection systems are utilized, the installation should be in accordance with NFPA 72, with the exception that sampling piping cannot be permanently fixed in place. Also, maximum air sample transport time from the farthest sampling point should not exceed 90 s. Typically, the air sampling ports are mounted on stanchions inside the plane or in window mounting units or plugs, and are connected to the detection unit via hard rubber hoses.

Acceptance tests are critical for each aircraft position and configuration, utilizing a smoke generator in various locations of the aircraft to verify detector response time. Testing should simulate actual aircraft assembly arrangements that include fans in the doorways normally provided for worker comfort. Testing of the high sampling air flow switch is also critical to ensure that the failure to connect a sampling hose to any one of the aircraft sampling ports will result in a trouble alarm.

Supervisory and alarm signals from the air sampling - type smoke detection systems should be monitored by a UL listed Central Station, a Proprietary Supervising Station, or a combination of both. The installation, servicing and testing should be in conformance with NFPA 72. Annunciation of trouble and fire alarms at the Central Station or Proprietary Supervising Station should clearly identify the aircraft assembly position where the signal originated.

Mock-ups

Full size mock-ups are rarely used. The use of three dimensional computer design programs is now the standard. These programs have eliminated the need to physically check for fit and interference between parts during the design phase.

If a mock-up is encountered, they are stationary and are seldom moved to another location. This allows the use of fixed automatic sprinkler protection. Piping is placed on the outside of the mock-up airplane and sprinkler heads are stubbed into the interior. Provide sprinkler protection based on a density of 0.20 gpm/ft² (8.15 L/min/m²) over the entire area, in accordance with NFPA and PRC.12.1.1.0. Flush style concealed heads are typically used to be as unobtrusive as possible. A separate indicating - type control valve should be provided in the sprinkler feed main for each mock-up.

Cargo Planes

Cargo planes provide a unique challenge because of the large cargo doors, which would allow gaseous agents to rapidly escape. Fixed pipe sprinkler systems are difficult to use since the aircraft is moved from assembly position to assembly position. Also, fixed sprinkler piping is not possible since these will be functional aircraft.

The solution is to temporarily hang sprinkler piping inside all cargo, personnel and flight decks. Temporarily clamp piping into position and connect it to an outside manifold using ½ in. (12.7 mm) diameter armored hoses routed through openings in the aircraft.

In conclusion, the protection and detection schemes previously described were designed and chosen for specific applications. A modification, mix or combination of these methods can be utilized. Whatever is chosen must be a compromise between the need for minimal impact on the aircraft assembly work and the need for protection of the planes. The choice and design of the protection system should be through consultation between the AXA XL Risk Consulting account team and the insured’s management, augmented by contractors knowledgeable in special extinguishing systems.