AIRCRAFT HANGARS
MAINTENANCE AND OVERHAUL FACILITIES

INTRODUCTION

Aircraft require routine service and aircraft serving the public also are required by Federal Aviation Administration (FAA) to have scheduled inspection, certification and overhaul as preventive safety measures. Commercial airlines, fleet aircraft operators and aircraft manufacturers maintain hangar, shop and storage space for indoor maintenance and repair of aircraft. Facilities must be available for performing tasks of equipment replacement and test on the aircraft. Facilities for bench repair and test of electrical, mechanical, hydraulic or air operated devices and instruments, air frame or sheet metal parts, machining, painting, and seating fabric repair also are required.

PROCESS AND HAZARDS

Line Maintenance

Line maintenance occurs to aircraft when a plane lands at an airport and has need of minor repairs or equipment changes. The aircraft may need a tire changed, a leak repaired immediately, or similar repair. The aircraft may be pulled into the hangar with fuel and possibly with tanks “topped off.” This means that the fuel tanks are filled to the top until there is no vapor space in the tank. This will also eliminate the potential for condensation of water in the fuel system. The plane may be in the hangar a few minutes, several hours or could be days if special parts are not immediately available. These facilities do not have the required manpower, tools or supplies for major repairs. Rarely are major repairs done in such a hangar. In the event major work is required, necessary personnel and supplies are flown or trucked to the craft. This would be needed for example, if an aircraft were taken out of service due to an engine failure. The necessary replacement is made and the plane is ferried to a major overhaul base for final repairs and inspection.

During maintenance, the aviation fuel in the aircraft and the many plastics involved in the interior seating and passenger compartment finishing offer severe loss potentials. If ignited, serious damage to the aircraft and serious property damage potential exists. Common ignition sources are hot work associated with maintenance and repair work, cutting, welding and electrical arcing. The aircraft may be supplied with ground power making on board electrical systems hot and also potential sources of ignition.

Overhaul Facilities

The overhaul facility generally has a hangar larger than the line maintenance hangar and capable of providing services for several aircraft simultaneously. Most scheduled maintenance and aircraft

overhaul tasks are performed here. Due to the nature and scope of work performed sizable shop and stores areas are required.

Hangars

The amount of fuel remaining in the fuel system (tanks and lines) when the aircraft is brought into the hangar will vary with the type of maintenance. The system may contain fuel or may be “drained” or “drained and purged.” Draining requires complete draining of fuel from the aircraft. Tanks, filters, pumps and lines to the end point injection system are drained. Purging requires the entire system to be purged with inert gas such as nitrogen. Often open cell foam blocks are installed to adsorb vapors and liquid residues.

Aircraft disassembly attendant with overhaul will depend on the type of maintenance and the condition of the aircraft. They also will do required inspections and certification procedures.

Generally, the aviation fuel has been drained or fuel system drained and purged, however, flammable and combustible liquids are used in parts cleaning, painting and paint stripping. Necessary grounding and ground power supply source represent unusual electrical hazards. Aircraft interiors contain large amounts of plastics. Cranes, hoists, mobile handling equipment and work platforms are used extensively.

Fuel

Fueling of aircraft is usually done at runway facilities but these tanks may be located in the vicinity of overhaul operations. Normal operations for fueling on the runway will have the onsite fire department in attendance (if they have one).

Any fire involving flammable and/or combustible liquids can lead to serious damage. Sites with Jet-A fuel tanks should be Pre-planned accordingly.

There are several types of jet fuels with varying degree of flash points and uses. See Table 1 for flash points of the fuels.

TABLE 1
Flash Point of Fuels

Name of Fuel	Flash Point °F
Jet A-1	> 100
Jet A (typical commercial fuel)	120
Jet B	< close to JP-4 for colder climates
JP-4	0
JP-5	140
JP-8	100

SI Units: °C = °(F-32)

Jet fuels are a kerosene based product with varying additives to lower the flash point and to lower the freezing point, especially for military grade fuels. Jet A has virtually the same flash point as Jet A-1 but a much higher freeze temperature.

JP-4 is typically considered military grade fuel. It is a blend of gasoline, kerosene and light distillates for corrosion inhibitors and low freezing points. The additive of gasoline drastically reduces the flash point. JP-5 is also a military grade fuel with a much higher flash point than JP-4.

Jet B is a blend of gasoline/naphtha and kerosene to lower the freezing point and is rarely used except for colder climates. The addition of the gasoline reduces the flash point as well. JP-8 is the military equivalent of Jet A-1 with additives for corrosion and de-icing.

Shops

The various maintenance shops include avionics, machine, frame and sheet metal, plating, paint and fabric which may be utilized to facilitate major repairs. Shops may be located in cut off areas of the

hangar structure or in detached buildings. Each shop area has occupancy features common within the industry.

Typical loss exposure from flammable and combustible liquid usage in paint shops and for cleaning operation can be found in most shops. There will be hydraulics involved in the machine shops which can become involved in a hot fire. Corrosion is a serious loss exposure should there be a fire in the plating area. Cleaning tank liners are subject to heater overheating due to low liquid levels. See PRC.9.5.1 and PRC.2.3.2.

Stores

This is the storage area for spare parts and supplies. Parts may be packaged in cardboard boxes and plastic in KD cartons, wooden crates or unpackaged. Storage may be in various rack and bin storage systems, palletized or wired basket bulk floor storage configurations. Whatever method lends it to storing and handling goods will be found. Typically, high piled storage configurations will not be encountered because of the limited number of common items. Automated computer controlled storage and retrieval (AS/RS) may be in use. Values in these areas are normally high.

Parts and sub-assemblies which are frequently needed are stocked and stored in the stores area. These usually contain a variety parts including rubber tires, plastic and other rubber parts, assembled seats, fabrics, electrical equipment, metal castings, sheet metal, sub-assemblies, and assorted small parts and on occasion replacement engines. Classification of commodities range from Class I to Class IV, Group A plastic and rubber tires to completely non-combustible parts.

Heavy combustible loading is present in the storage areas. Any fire here would spread rapidly and has the potential of a very large loss due to high values. Spare parts are FAA certified and if involved in a loss incident would either be scrapped or sent back to the manufacturer for recertification. Salvage is unlikely for parts as a whole for use and may be scrapped entirely.

LOSS PREVENTION AND CONTROL

The protection guidelines are not all inclusive. Where hazards or construction features are unusual to the occupancy covered, the protection for that hazard or construction is discussed. Care should be taken in applying the protection guidelines given since they are written with an “average” hazard level in mind. Increased levels would warrant increased protection. The protection standards contained in the Reference section should be consulted.

Construction

Provide cut-offs between the hangar and shops or stores in accordance with NFPA 409. Design the buildings for wind loads in accordance with ASCE 7 or equivalent (see PRC.2.0.1.1). Windstorm is of particular importance as the overall construction of the buildings is very large and often relatively light weight (metal panel on steel columns). The wall and roofs are large areas and mechanical fastening need to follow proper methods and meet regional wind burst levels. Some facilities will use Mobile Transport Bays (MTB) that extend beyond the hangar if additional space is needed. These need to meet the same wind design as the rest of the structure. If they can’t, then plans to be put in place for the removal of these before expected windstorms.

Interior Protection

Hangar Areas

- Use NFPA 409 to determine the Class of hangar (I – IV). Protect Group I hangars with an overhead deluge foam system with detection by rate-of-rise, fixed temperature, or rate compensation type system. The discharge rate for systems using protein, flouroprotein or AFFF solutions should be in accordance with NFPA 409. When using AFFF use a density of 0.16 gpm/ft² (6.51 L/min/m²)/area for non-air aspirating or 0.20 gpm/ft² (8.14 L/min/m²)/area for air aspirating heads.

- Provide under wing foam protection where aircraft wing area is more than 3000 ft² (279 m²). Fire detection for system actuation should be provided by UV/IR type system. One method of under wing application is Viking Corporation's Grate Nozzles but other methods are available.
- Where the aircraft interior is exposed provide interior hull protection.
- Install hand hose systems in every hangar to provide manual fire control. Arrange the hose stations to permit application of water/foam on each side and into the interior of aircraft. Design it so at least two hose lines will operate simultaneously.

Shops

Protect the shops in accordance with NFPA 13 based on the following:

- Metal Work Shops: Ordinary Hazard Group 2.
- Paint Shops: Extra Hazard Group 1.
- Plating Shops: Ordinary Hazard Group 2. For additional guidelines for plastic tank protection see PRC.9.5.1 and PRC.2.3.2.
- Stores: Based the density on the commodity, storage height and arrangement. See PRC.12.1.1.0 for additional protection guidelines.

Unusual installation, critical equipment or usage may require improvements.

Special Hazards

Protect paint booths and cleaning booths with sprinklers in the booth, behind the filters and in the exhaust duct all controlled by a separate control valve. Use Class I, Group D, Division I electrics within the booth and beyond as outlined in NFPA 33 and PRC.9.2.3.1. Interlock the ventilation with the spray gun.

Maintenance and Overhaul Facilities

Paint and other flammable and combustible liquid storage should be kept to a one day supply in the process area. Keep bulk storage in approved cabinets or in a 2-h cut-off room depending upon the amount stored. If a cut-off room is needed, protect it with sprinklers, listed electrical equipment, containment, and ventilation per NFPA 30 and PRC.8.1.0.

Design and protect plastic tanks and ductwork in plating areas in accordance with PRC.9.5.1 and PRC.2.3.2.

Exterior Protection

Design the water supply to be capable of furnishing water for the largest number of systems that may be expected to operate simultaneously. This will include deluge systems, hand hose lines and underwing protection, if provided. The total pumping capacity should be such that the maximum demand can be met with the largest pump out of service.

Install an underground loop around the buildings with adequate section control valves and hydrants outlets that match the responding fire departments. Depending upon flow requirements, the loop may need to be as large as 24 in. (610 mm). Due to the height and width of roof areas, roof hydrants and hose should be provided as well as fixed ladder access.

Due to large volume of water used for fire protection devices in aircraft hangars, provide 6-in. (152-mm), 3-way fire department connections.

MANAGEMENT PROGRAMS

Management program administrators should report to top management through the minimum number of steps. They should also institute adequate loss prevention inspection and audit programs to communicate program effectiveness to top management. This management feedback is a key feature

of PRC.1.0.1. In developing a program, pay particular attention to the following important areas that can be unique to this industry:

Employee Training

Due to the varying applications of maintenance operations, training for personnel is key to understand the issues at hand. Often floor areas have vertical wall separations for various reasons which isolate portions of the hull, wings, etc. This can give a false sense of security relating to the small area where the worker is located. This complacency can introduce flames, dangerous work, etc. in areas that should not have it.

Typically there is a certification level for people/contractors working in the industry. This often is handled via a specific client or an off site training operation that is recognized in the industry. Frequently this is for regional areas that have several corporations doing similar work. Written programs with follow up refreshers are needed. See PRC.1.4 for further information.

Pre-Emergency Planning

There are not that many structures that can accommodate full size airplanes, therefore structures are limited. Understanding the relationship ahead of a major incident helps to address current concerns now and supports the need for local protection at the property. See PRC.1.7 for further information.

Hazard Evaluation

Written programs need to clearly define the existing hazards including fuel, flammable/combustible liquids, painting operations, etc. There also needs to be a clear responsibility chart of personnel with defined roles for new hazards brought on site. This includes safety, engineering, facilities, management, etc. personnel to sign off on new equipment/methodologies when brought on site. See PRC.1.13 for further information.

Outside Contractors

Aircraft maintenance and overhaul is very complicated and requires many personnel for completion. This often involves bringing in contractors to complete specific tasks needed. All contractors should have on site training, records maintained, refresher/preferred contractor status, etc. and should follow all expected guidelines of any onsite employee. See PRC.1.0.4 for further information.

OTHER REFERENCES

Many other sources of information can be found in the list below including other PRC.17.17.2 and PRC.17.17.3.