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PART 4 : SECTION 1

CHAPTER 1

FIRE IN THE AIR

Fire Risk

1. Precautions against fire are design requirements for all aircraft. This fact, together with the development of safety devices and extinguisher systems, has reduced the risk of fire in modern aircraft. Fires, other than those caused by enemy action, usually originate in the engine bay after mechanical failure of the engine or ancillary components. Defects in the induction, compressor, turbine exhaust, fuel, oil, or hydraulic systems, also constitute fire hazards.

2. A fire elsewhere in the aircraft seldom occurs, unless caused by short-circuiting of the wiring, mishandling of pyrotechnics, leakage of the fuel system, or unauthorized smoking by passengers or crew. Pilots should familiarize themselves with :—

- (a) Fire warning and extinguisher systems.
- (b) Action to be taken in the event of fire.
- (c) Layout of fuel system.
- (d) Main structural details of the aircraft.

Fire Warning

3. **Fuselage Fires.** Normally, adequate fire warning is given by the presence of smoke, a little of which will quickly fill the fuselage. Prompt action by the crew will successfully combat this type of fire. Opening cockpit windows may fill the cockpit with smoke and fumes owing to the induced forward draught, and windows should therefore be kept closed until the fire is out, when they may be opened to remove toxic fumes. *The extinguisher fluid used in pressure-cabin aircraft, a water-glycol mixture, does not produce toxic fumes* but it should not be used to combat fires involving burning liquids or electrical equipment.

4. **Engine-Bay Fires.** Visual indication of engine fires may not be immediate owing to the position of the engine, and pilots are assisted by red fire-warning lights in the cockpit, operated by flame switches in the engine bays. Fire-warning lights show a steady red in the event of fire, and are usually fitted close to, or recessed in, the feathering push-button of the respective engine in multi-engine piston aircraft. On some aircraft the warning lights are in the centre of the fire extinguisher push-button.

5. Fuel Tank-Bay Fires.

(a) On some aircraft a separate fire warning and extinguisher system is fitted for each of the tank bays. These systems, which are independent of the engine fire-extinguishing systems, are usually fully automatic, though manual controls may be fitted.

(b) Should a fire occur in a tank bay fitted with an automatic system, the flame switches will operate, the system will function, and a warning light, if fitted, will come on in the cockpit.

(c) In manually-operated systems the pilot will have to operate the appropriate fire extinguisher push-button when the fire warning lamp comes on. Both systems are operated automatically by inertia switches in the event of a crash landing ; however, the push-button, if fitted, should always be pressed as an additional precaution after a crash landing.

(d) Tank-bay fire-extinguishing systems are intended to cope with fires outside the tanks caused by leaks, etc., but afford no protection against explosions within the tanks. Nitrogen systems are also installed in some aircraft to afford protection against fires and explosions within the tanks.

Special Considerations

6. The following special considerations should be noted :—

(a) Some fighter aircraft have no provision for extinguishing tank-bay fires, but a warning light in the cockpit warns the pilot that he must prepare to leave the aircraft. The flame switches in this system are provided with test switches for checking purposes.

(b) In some aircraft the suppression of a fire in the tank bay exhausts all extinguisher bottles, with the result that a subsequent engine fire cannot be extinguished by the fire-extinguishing system.

(c) If the indication of fire has been given *only* by the glowing of a warning light, the pilot should throttle back and reduce speed as quickly as possible and take the action stated in para. 7 ; at the same time he must endeavour to ensure that a fire has, in fact, occurred. This is to cover the possibility of a faulty

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warning device. If the light continues to glow but no other indication of a fire is given, the flight should be continued at reduced power and a landing made as soon as practicable. Pilot's Notes give additional information when this consideration applies particularly to certain aircraft.

Preparation to Abandon Aircraft

7. On suspecting a fire, the captain should warn the crew to prepare to abandon the aircraft or, if height precludes any form of abandoning the aircraft, to prepare for a crash landing.

8. Should the fire show no signs of abating after action has been taken to extinguish it, or if there is a risk of explosion or structural failure, the captain should give orders to abandon aircraft if height permits. If there is sufficient height, pilots should not hesitate to abandon the aircraft rather than attempt a crash landing. Landing with the aircraft on fire is seldom justified and very dangerous; there is little chance of saving the aircraft after landing, and there is a great risk that the fire may increase or cause structural failure at an altitude where it would be unsafe to abandon the aircraft.

9. If the aircraft is too low to be abandoned a crash landing will be necessary. Fuel should not be jettisoned as the proximity of the fuel vapour to the fire may cause an explosion. Drop-tanks, whether containing fuel or not, should be dropped at the pilot's discretion. Tanks in the fuselage bomb bays, drop tanks, and ventral tanks, should always be jettisoned in the event of a fuselage fire and before a crash landing.

Action to Extinguish Fire (Piston Engines)

10. An engine fire is most probably a fuel or oil fire. The supply of fuel should be shut off and the engine throttled back and stopped if possible.

11. Although the fire may be checked by operating the fire extinguisher, as soon as the brief action of the extinguisher is finished the fire is liable to recur if the engine is still running. To obviate the presence of unburnt gases the ignition should not be switched off until the engine has stopped or nearly stopped; the fire extinguisher should then be operated.

12. If the propeller can be feathered, the following actions must be taken :—

(a) Close the throttle.

(b) Feather the propeller.

(c) Turn off the fuel to engine.

(d) When the engine has stopped, switch off the ignition and operate the fire extinguisher.

(e) Set main oxygen regulator to emergency.

(f) Turn off any cockpit hot air supply from the engine bay, to prevent the entry of fumes.

13. If the propeller will not feather, the following actions must be taken :—

(a) Close the throttle.

(b) Move the r.p.m. control-lever to the minimum r.p.m. position.

(c) Turn off the fuel to the affected engine.

(d) When the propeller has slowed to minimum r.p.m., switch off the ignition and operate the fire extinguisher.

(e) Set main oxygen regulator to emergency.

(f) Turn off any cockpit hot air supply from the engine bay to prevent the entry of fumes.

Action to Extinguish Fire (Turbo-Jet Engines)

14. The principles applied to piston engines are also applicable to turbo-jet engines, the sequence being :—

(a) Turn off the fuel (L.P. and H.P. cocks, in that order).

(b) Close the throttle.

(c) Reduce speed as quickly as possible.

(d) Operate the fire extinguisher.

(e) Set main oxygen regulator to emergency.

(f) Turn off the supply of cockpit air from the engine concerned.

For further information pilots should refer to Pilot's Notes for the type.

Note. The L.P. cock is shut off first to cut off the fuel supply at its source.

Action of Fire Extinguisher Systems

15. On most installations, all the fire extinguishers fitted in an engine bay discharge simultaneously when the fire extinguisher push-button is pressed. On some semi-automatic installations the fire extinguishers operate in stages, with a time interval between each stage.

16. On piston-engine aircraft, the sequence is started automatically by the flame switches which operate relays when the feathering push-button is pressed. The fire extinguisher push-button should always be pressed as the *last action* of the drill as a precaution against failure of the flame switches.

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FIRE IN THE AIR

17. **Flame Switches.** There are two types of flame switches in use :—

(a) *Fusible Flame Switches.* When fire breaks out the metal switch melts or fuses, and by so doing completes the circuit which switches on the fire-warning light. *When the fire is extinguished the warning light continues to glow.*

(b) *Resetting Flame Switches.* This type of flame switch completes the circuit and switches on the fire-warning light when a certain temperature is reached. The switch is made to function whenever the temperature exceeds the set figure and not necessarily by fire alone. In many aircraft this type of switch is fitted in the engine bay or at certain positions near the jet pipe and will function when a failure, such as a split combustion chamber or damaged jet pipe, admits very hot air into the engine bay. When the light comes on, the engine must be throttled back and speed reduced as quickly as possible ; if the light then goes out the initial indication was caused by a failure of the type described above and the flight can be continued at reduced power and a landing made as soon as possible. If the light remains on the probability of a fire exists but the pilot should always endeavour to confirm this before completing the fire drill. On aircraft where this consideration is particularly applicable Pilot's Notes gives additional guidance.

Refer to Pilot's Notes for the type of flame switch fitted to particular aircraft.

Engine Not to be Restarted

18. No attempt must be made to restart an engine after an engine-bay fire has been success-

fully extinguished. The fire is liable to recur if the engine is restarted, and the fire extinguisher system will not act again until replenished on the ground.

Accidental Operation of Fire Extinguisher Systems

19. If the fire extinguishers have been accidentally discharged the following action should be taken :—

(a) *Piston Engines.* Continue the flight with the throttle not less than two-thirds open, and after two or three minutes return to normal flight conditions. This minimizes the corroding effect of the extinguisher fluid and fouling of the sparking plugs, as it ensures rapid dispersal of the methyl bromide, which vaporizes rapidly at temperatures of +4° C. and above.

(b) *Turbo-Jet Engines.* Flight should be continued for two or three minutes at not less than two-thirds maximum permitted r.p.m. before returning to normal flight conditions.

(c) *Accidental Operation of Hand Extinguishers.* If an extinguisher using methyl bromide, or any other chemical having a toxic nature, is discharged inside the aircraft, all available ventilation should be opened immediately. The hand extinguisher chemical provided in pressure-cabin aircraft does not give off toxic fumes.

20. Operation of the fire extinguisher system, accidental or deliberate, must be reported after landing so that the necessary action can be taken to minimize corrosion and fouling and to replenish the extinguisher system.

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