U.S. Department
of Transportation
**Federal Aviation
Administration**

Advisory Circular

Subject: IN-FLIGHT FIRES **Date:** 1/8/04 **AC No:** 120-80
Initiated by: AFS-210

1. WHAT IS THE PURPOSE OF THIS ADVISORY CIRCULAR (AC)?

a. General. The National Transportation Safety Board (NTSB) conducted a review of commercial aviation accidents involving in-flight fires. The scope of the review was limited to transport category airplanes operated by U.S. and foreign air carriers during the period 1983 to 2000. That review prompted the NTSB to issue a number of safety recommendations to the FAA, including A-01-83 through A-01-87 (see Appendix 1). The NTSB recommended that an Advisory Circular (AC) be developed and issued by the FAA to address a number of issues linked to in-flight fires. The FAA agrees with the safety intent of those recommendations and has developed the guidance material that follows. Specifically, this AC:

- Discusses the dangers of in-flight fires, with particular emphasis on hidden fires that may not be visible or easily accessed by the crew. It discusses the importance of recognizing and quickly assessing the conditions that may be associated with hidden fires and the importance of taking immediate action to gain access to fires that are located behind interior panels.

- Provides guidance on how to deal with in-flight fires, emphasizing the importance of crewmembers taking immediate and aggressive action in response to signs of an in-flight fire while stressing the effectiveness of Halon extinguishing agents.

- Discusses the importance of appropriate crewmember training in dealing with hidden fires, the effective application of fire extinguishing agents behind interior panels, and the urgency of the crew's action in dealing with such fires.

- Complements guidance previously developed for crewmembers concerning the proper use of cabin fire extinguishers (AC 20-42C, Hand Fire Extinguishers for Use in Aircraft, and National Fire Protection Association (NFPA) 408, Standard for Aircraft Hand Portable Fire Extinguishers) and the most effective means of extinguishing fires that are readily accessible.

- Includes information from research conducted by the FAA's Technical Center. As additional information becomes available, it will be published in future revisions to this AC.

b. Who should read this AC? Crewmembers operating transport category airplanes under 14 CFR part 121; also, crewmembers of passenger-carrying airplanes operating under other parts, including parts 125, 135, and 91. In particular, directors of safety, directors of operations, chief pilots, and training managers should read this AC.

c. Using this AC. When tailored to a specific aircraft and operators' procedures, the suggested guidelines presented in this AC provide a good framework for defense against in-flight fires. However, approved manufacturer's procedures and company procedures take precedence over the information presented in this AC. The importance of crewmembers taking immediate and aggressive action to locate the source, gain access, and effectively apply extinguishing agents to hidden fires cannot be overstressed. This task is complicated by the multitude of cabin configurations that are currently in use throughout the industry. For this reason there is no single formula for fighting/extinguishing in-flight fires.

2. DEFINITIONS.

a. Aggressively Pursue. Aggressively pursuing a fire means taking immediate action to determine the source of hot spots, smoke and/or flames. The crew should quickly evaluate the situation; gain access to the fire and attack the fire using all available resources, which may include deadheading crewmembers or able-bodied passengers (ABP).

b. Cheek Area. This term describes the area just below the floor, outboard of the cargo compartment areas. In narrow and widebody aircraft this area houses wire bundles, hydraulic lines, and other electrical components. (See Appendix 2.)

c. Circuit Breaker. CBs are designed to open an electrical circuit automatically at a predetermined overload of current.

d. Halon. Halon is a liquefied gas that extinguishes fires by chemically interrupting a fire's combustion chain reaction, rather than physically smothering it. This characteristic is one of the main reasons that Halon extinguishers are effective when the exact source of the fire cannot be positively determined. Halon fire extinguishing agents that have been approved for use in aircraft include Halon 1211, Halon 1301, and a combination of the two (Halon 1211/1301) Both are typified as "clean agents," leaving no agent residue after discharge.

(1) Halon 1211. The chemical name is bromochlorodifluoromethane. Halon 1211 is a multipurpose, Class A, B, and C rated agent that is effective against fires fueled by flammable liquids. Halon 1211 fire extinguishers discharge in an 85 percent liquid stream, giving the agent a range of 9-to-15 feet, which offers a significant advantage in fighting fires in large aircraft cabins.

(2) Halon 1301. The chemical name is bromotrifluomethane. Halon 1301 has Class A, B, and C capability in total flooding systems; however, Halon 1301 has limited Class A capability when used in portable fire extinguishers. The useable range of a Halon 1301 extinguisher is slightly less than that of a 1201 extinguisher.

e. Hidden Fires. Fires that are "hidden" are not readily accessible, may be difficult to locate and are more challenging to extinguish. Some examples of hidden fires would be fires behind sidewall paneling or in overhead areas.

f. Overhead Area. Area within the aircraft fuselage located above the ceiling panels. This area ranges in volume, depending on the aircraft type. In a narrowbody transport, this area may be only several inches high running the length of the fuselage. In widebody aircraft, however, this volume is much larger, and may range in height from 2 to 4 feet or more. A typical overhead area contains components of the aircraft's entertainment system, numerous wiring bundles, control surface cables, portions of the air conditioning system, passenger emergency oxygen system and other systems. (See Appendix 2.)

g. Return Air Grills. These are vents located along the baseboard area of each sidewall of the passenger cabin. Most transport category aircraft have air conditioning systems that supply conditioned air near the cabin ceiling. This air flows in a top-to-bottom direction, exiting through the return grills, and eventually out the fuselage via the outflow valve(s).

h. Recirculation Fan. These units are typically located in the overhead area, and are used to recirculate air in this space, to prevent elevated temperatures, and to remove stagnant air.

i. Smoldering Fire. A smoldering fire is characterized by combustion without a visible flame and a slow combustion rate. A smoldering fire left unattended or a fire that has not been completely extinguished can ignite and grow into a larger uncontrollable fire in a short time.

j. Suppressed Fire. A fire that has been partially extinguished which may or may not have visible flames. A suppressed fire if not extinguished, may re-establish itself and grow into a larger, uncontrollable fire in a short period of time.

3. WHAT ARE SOME OF THE MORE SUBTLE CAUSES OF IN-FLIGHT FIRES?

a. Wiring Failures. A majority of hidden in-flight fires are the result of electrical arcs along wire bundles. In most cases, the electrical arc acts as the initiating event, igniting other surrounding materials. The surface of insulation materials is often a conveyer of these initiating events, as contamination from spillage, accumulated dirt/dust, lubrication or corrosion inhibitors on these surfaces can promote flame spread (uncontaminated insulation materials are generally very fire resistant). In other instances, the re-setting of a tripped circuit breaker can overheat wiring, ultimately leading to failure and arcing, causing the same chain of events.

b. Electrical Component Failures. Electrical motors can overheat, bind, and fail, and possibly ignite surrounding materials. The spread of fire in these instances is exacerbated by an accumulation of contaminants in the immediate area.

c. Lightning Strikes. Although very infrequent, there have been instances in which a lightning strike has initiated a fire. In these instances faulty or contaminated insulation material contributed to the fire.

d. Bleed Air Leaks. Aircraft with systems that use air from the engine (bleed air) depend on a series of pneumatic lines to deliver the air supply. A failure of any of these supply lines, if left unchecked, can cause high temperatures in the surrounding area and damage to the aircraft's equipment, wiring, and associated components. High temperature bleed air leaks have been known to cause in-flight fires and structural damage.

e. Faulty Circuit Protection. A malfunctioning CB that does not open (trip) when an abnormally high current draw is detected may cause the affected unit or associated wiring to overheat and ignite.

4. WHAT ARE SOME OF THE INDICATIONS OF HIDDEN FIRES?

a. Abnormal Operation or Disassociated Component Failures. Failure or un-commanded operation of an aircraft component may indicate a developing fire. Electrical connections and the components themselves may have been damaged by a fire in the area of the component or at any point along its power supply line. For this reason cabin crewmembers should report all failures of electrical items to the flightcrew in accordance with company policy.

b. Circuit Breakers. Circuit Breaker(s) tripping, especially multiple breakers such as entertainment systems, coffee makers, etc., may be an indication of damage occurring in a hidden area common to the affected components.

c. Hot Spots. Hot spots on the floor, sidewall, ceiling or other panels should be immediately investigated.

d. Odor. This may be one of your first indications of an impending fire. Never ignore a strange odor; you need to identify its source as soon as possible.

e. Visual Sighting – Smoke. Smoke coming from vents or seams between interior panels, especially from the ceiling area, is a sure sign of a problem, and you should take immediate action to determine the source.

5. WHAT ARE SOME OF THE RESOURCES AVAILABLE FOR FIGHTING IN-FLIGHT FIRES?

a. The answer depends on the aircraft's specific cabin configuration, which may vary within types. Therefore, crewmembers should include this subject in crew briefings as suggested in AC 120-48, Communication and Coordination Between Flight Crewmembers and Flight Attendants.

b. In addition to the aircraft's required emergency equipment, crewmembers should also consider those items that are not normally thought of as fire fighting aids. For example, non-alcoholic beverages such as coffee, soda, juice, or water may be poured onto a fire. A carbonated beverage may be used as a fire extinguisher by shaking up the can or bottle, opening the top, and spraying the contents at the base of the fire. Additionally, wet blankets or pillows may be used as smothering devices to help extinguish a fire and prevent re-ignition. Any of

these suggestions may prove to be effective as possible fire fighting methods. These examples are not meant to be all-inclusive, and crewmembers should consider what other items might be useful.

c. Crewmembers should consider deadheading crewmembers and able-bodied passengers (ABP) as additional resources when combating a fire. The ability to enlist the help of qualified individuals, especially on a single flight attendant operation, might be very valuable in combating a fire and communicating with the flight deck crewmembers. Regardless of the type of operation, crewmembers should consider and use all available resources when faced with an in-flight fire.

6. FIRE EXTINGUISHERS.

a. Which type of fire extinguisher should I use? Immediate and aggressive action when confronted with a potential fire is much more important than delaying while you attempt to classify a particular fire. As a general rule Halon fire extinguishers are your best choice since Halon is classified as a multipurpose (Class A, B, & C fires) agent. Halon extinguishes fires by chemically interrupting a fire's combustion chain reaction, rather than by physically smothering the fire. Approved Halon-type extinguishers are three times as effective as Carbon Dioxide (CO_2) extinguishers with the same weight of extinguishing agent.

b. When a fire is discovered, the initial focus should be on extinguishing the fire and then following-up with the appropriate class of fire extinguisher. Generally, you should consider using the first available extinguisher rather than delaying your fire fighting efforts while you locate the most appropriate extinguisher. After you have initially suppressed the fire or exhausted the first fire extinguisher, you should use the preferred extinguishing agent for the class of fire to maintain control or extinguish the fire. (See Appendix 4.)

c. There are a few exceptions to this general guidance. A water fire extinguisher (H_2O) should not be discharged directly into a CB panel or an electrical outlet. Nor should water be used to combat a liquid fire (e.g., grease or fuel) that is pooled or has collected on a non-porous surface. The use of an H_2O extinguisher on a fire fueled by flammable liquids is acceptable if the surface has absorbed the liquid, such as gasoline poured on a seat or other absorbent material.

d. Why is it important to keep hand-held fire extinguishers upright? Hand-held fire extinguishers are designed to be used in the upright position. Most extinguishers have been designed with a center siphon tube that extends to the bottom of the canister. Placing a fire extinguisher on its side or upside down prevents the agent from flowing through the tubing, which has been designed to collect the agent from the bottom of the canister. Laying the extinguisher on its side or turning it upside down to aim at the ceiling may limit the amount of extinguishing agent that is available to be discharged, thereby reducing the extinguisher's fire fighting capacity. Consequently, fire extinguishers equipped with flexible discharge hoses and nozzles are better suited to handle fires that may require discharging the agent in an upward direction or in any other situation requiring flexibility. The installation and use of fire extinguishers with flexible hoses is highly desirable for these reasons.

7. CAN HALON CAUSE HARM TO PASSENGERS AND CREW?

a. Generally speaking, no. Various publications, including AC 20-42C, caution against exposure to "high levels" of Halon in confined spaces, citing the possibility of dizziness, impaired coordination, and reduced mental sharpness. AC 20-42C also provides guidelines that describe what is meant by the term "high level" and further states that these levels should not be exceeded in ventilated or non-ventilated passenger compartments on aircraft. However, studies have shown that discharging all of the hand-held Halon extinguishers required by regulation in the passenger cabin of an air carrier aircraft will not exceed the maximum concentration levels of Halon vapor specified in AC 20-42C or by NFPA 408 guidelines.

b. NTSB investigations of in-flight fires indicate that crewmembers have been hesitant to use Halon extinguishers during flight because of mistaken ideas about adverse effects of Halon. In one instance, a flight attendant went to the flight deck to inform the flightcrew of a fire and asked the captain whether to spray Halon into a vent where she suspected a fire. The captain instructed her not to use the Halon extinguisher, indicating he was concerned about spraying Halon in the cabin. In another instance, an off-duty company pilot considered using a Halon fire extinguisher, but decided against doing so because he was concerned that the Halon "would take away more oxygen." In each instance, the crewmembers lost critical time and delayed the aggressive pursuit of the fire.

c. The NTSB has expressed concern that risks of exceeding the maximum recommended levels of Halon gas outlined in AC 20-42C have been overemphasized in crewmember training programs, especially when compared to the risks of an in-flight fire. The NTSB emphasizes "…that the potential harmful effects on passengers and crew [of Halon] are negligible compared to the safety benefits achieved by fighting in-flight fires aggressively." The toxic effects of a typical aircraft seat fire, for example, far outweigh the potential toxic effects of discharging a Halon fire extinguisher.

8. QUESTIONS FOR CREWMEMBERS TO CONSIDER.

a. How critical are small in-flight fires? In-flight fires left unattended, particularly those that are not readily accessible, may lead to catastrophic failure and have resulted in the complete loss of airplanes. Fire tests conducted by various regulatory authorities have shown that fires allowed to spread into the aircraft's overhead area may become uncontrollable in as few as 8-10 minutes.

Studies have also shown that a flightcrew may have as few as 15-20 minutes to get an aircraft on the ground if the crew allows a hidden fire to progress without any intervention. Appendix 3 provides various illustrations of the time from the first indication to the crew of the presence of a hidden fire until it becomes catastrophically uncontrollable. These studies and other experience indicate that flight crewmembers should begin planning for an emergency landing as soon as possible after the first indication of fire. Delaying the aircraft's descent by only a couple of minutes might make the difference between a successful landing and evacuation and complete loss of an aircraft and its occupants.

b. As a crewmember, what should I do if I suspect a hidden fire? In accordance with company policies and procedures, coordinate with other crewmembers as applicable and take immediate and aggressive action to locate and extinguish the fire.

c. Is it necessary that I locate the exact source of a fire before applying extinguishing agent? If possible, yes. For example, a fire located behind a panel or within a cupboard area in the lavatory probably would not be successfully extinguished by discharging a fire extinguisher into the lavatory without first opening the cupboard or gaining access to the area behind the panel where the fire is located. An additional example would be a fire in the overhead area above a ceiling. Depending on the volume of the overhead area, discharging a fire extinguisher randomly without attacking the base of the flames or smoldering material probably would have no effect on the fire. It is unlikely that a fire in this area would be extinguished unless extinguishing agents were applied directly to the base or source of the fire.

d. Should I consider cutting or punching a hole in an aircraft cabin wall, ceiling, or floor panel in order to gain access to a fire? If this is the only way to gain access to the fire, yes. In this situation, the risk of damaging equipment behind the paneling and the possibility of creating a bigger problem must be weighed against the catastrophic potential of in-flight fires left unattended.

e. What resources can I use to access hidden fires? You should consider all available resources to access a hidden fire. Items found in carry-on baggage might be useful non-traditional resources, such as a shoehorn, knitting or crocheting needles, walking canes, and fairly rigid items that could pry apart paneling.

One of the best defenses is to be familiar with the interior configuration of the specific aircraft. This familiarity provides clues as to what tools would be most effective when trying to gain access to hidden areas of the aircraft. For example:

- Some aircraft are equipped with a manual release tool that is designed to open the oxygen compartments. This device may be used to separate or pull apart sidewall panels to permit access to a hidden fire.

- Some B-747-200s have cabin ceiling speaker covers that can be removed by simply snapping them out of their fixture. The removal of theses covers provides access to the overhead in the immediate area of the speaker fixture.

- Equipment located in raft survival kits that are not an integral part of a survival raft may be useful for gaining access to hidden fires.

- Galley equipment such as casserole or ice tongs, metal cutlery, or similar items may be useful in separating interior panels.

One of the most important elements in successfully combating an in-flight fire is an individual's own resourcefulness and determination in accessing hidden areas within the aircraft.

f. What is the best way to locate hot spots on a door or interior panel before attempting to open or remove it? While there is no single best method, we suggest using the back of your hand instead of your fingers or palm. The skin on the back of your hand is more sensitive to temperature variations than your palm or fingertips. Using the back of your hand allows you to be more aware of temperature fluctuations as you run your hand along a panel making it easier to locate hot spots on the panel. Also, using the back of the hand protects your palm and fingers from being immobilized in case the object is so hot that it could burn your hand. For example, if you were to grasp a hot door handle (e.g., lavatory door) using the palm of your hand, there is the possibility of burning your hand. A burned hand would make your fire fighting activities more difficult and could cause a delay in extinguishing the fire and conducting an evacuation of passengers.

g. As a crewmember, if I suspect a fire in a lavatory, what action should I take?

(1) If you suspect a fire in a lavatory you should immediately notify another crewmember, get the closest fire extinguisher and check the door for heat.

(2) Cautiously and slowly open the lavatory door. Try to locate the source of the fire and discharge the fire extinguisher at the base of the fire. If you cannot clearly identify the source of the fire aggressively attempt to locate the cause of the smoke and extinguish the fire. If the base of the flames or the source of the fire cannot be readily identified, do not discharge the agent with the intent of suffocating the smoke. This is not an effective way to fight a fire and would only waste valuable extinguishing agent when the source or base of the fire is not accessible. Remember, it is critically important that you protect yourself from the effects of smoke and fumes while attempting to fight a fire. Do not enter an enclosed area or begin to battle a fire that is generating heavy smoke without first donning your protective breathing equipment (PBE). A small fire can quickly grow to be large and uncontrollable. Time is critical when combating an in-flight fire and every available resource must be used to locate and extinguish it. Research has shown that a fire left uncontained can destroy an aircraft in as few as 20 minutes and a smoke filled cabin can be completely consumed by fire in as few as 6 to 10 minutes.

9. WHEN NOTIFIED OF A CABIN FIRE WHAT ACTIONS SHOULD THE FLIGHTCREW TAKE?

a. Technical evaluations and actual experience indicate that flight deck crewmembers should immediately follow company approved emergency procedures, notify ATC, and begin planning for an emergency landing as soon as possible. Delaying decent by only a couple of minutes may make the difference between a successful landing and evacuation and complete loss of the aircraft. If there is a fire in the flight deck compartment, pilots should notify the flight attendant(s) to prepare the cabin occupants for an emergency landing and evacuation in accordance with company procedures and, if appropriate, assist in fighting the fire.

b. Flight crewmembers must don smoke goggles and oxygen masks at the first indication of smoke or fumes and before accomplishing any abnormal or emergency procedures associated with smoke or fume elimination in accordance with your company's approved procedures and/or

the manufacturer's recommendations. Any delay might result in a crewmembers' inability to breathe and/or see.

c. Smoke and fume elimination procedures are designed primarily to evacuate the cabin of foreign pollutants. These procedures are not designed to eliminate the cause of the pollutant but rather to increase the aircraft's airflow to evacuate the pollutant. If the cause of the pollutant is a fire and the fire has not been extinguished, it is possible to worsen the situation by increasing airflow through the area where the fire or smoldering condition exists. For this reason, it is important to extinguish the fire first. If the original source of the fire cannot be determined, exercise caution when attempting to eliminate smoke and fumes from the aircraft. Your best defense as a flight crewmember is to have a good understanding of your aircraft's ventilation and/or pressurization systems and the location of major components within the fuselage. You must not delay taking corrective action in accordance with company-approved procedures for any reason.

d. The flightcrew's best defense against smoke and fumes is the quick donning of oxygen masks and associated smoke goggles. If you are required to leave the flight deck to assist in fighting a cabin fire, the FAA recommends that you don a PBE before leaving the flight deck. If you are to assist in an evacuation, you should don a PBE if you suspect that there is smoke or fumes in the cabin.

e. Recommended Procedures.

- Immediately don protective equipment
- Plan for an immediate descent and landing at the nearest suitable airport
- Do not use smoke/fume elimination procedures to treat a fire
- Do not reset CBs, unless required for safe flight

10. IF FLIGHT ATTENDANTS ARE ONBOARD, WHAT CAN THEY DO?

a. Company procedures should specify how a fire emergency should be handled, especially if there are multiple flight attendants onboard. However, one method that may be beneficial is to consider using a team approach to combat a fire. The team approach consists of using multiple flight attendants to assist in combating the fire.

The following Team example assumes a crew of five with three flight attendants and two pilots. Although the example assumes there are three flight attendants the team approach can be modified to fit any number of participants greater than one.

The crewmember (typically a flight attendant) who finds the fire is usually the person who is the firefighter. The firefighter aggressively attempts to locate the source of the fire, fights the fire, and actively tries to extinguish the fire. A second crewmember may serve as a communicator. The communicator relays factual information to the flight deck including the location, source,

and severity (e.g., is the fire under control, spreading, contained, extinguished) of the fire, the number of fire extinguishers used, smoke conditions, and what is being done to extinguish the fire (prying apart paneling, discharging an extinguishing agent into the sidewall or overhead). The communicator also makes announcements to inform and calm the passengers. Another crewmember, a runner, can assist by:

- Obtaining additional firefighting supplies
- Relocating passengers
- Distributing towels for passengers' use to cover their noses or mouths to filter out smoke
- Ensuring aircraft and or therapeutic oxygen bottles are moved out of the immediate area
- Generally assisting with firefighting support activities as may be required

b. In a single flight attendant operation, when a fire is suspected, immediate communication and coordination with the flight deck is critical. Be sure to follow established company procedures. The flight attendant performs a variety of tasks with the most important being aggressively pursuing and extinguishing the fire.

c. Recommended Procedures.

- Be aggressive; if flames are visible, fight the fire immediately
- Someone must immediately notify the flightcrew
- If flames are not visible, find the base or source of the fire
- Do not reset CBs, unless required for safe flight
- Relocate passengers as necessary
- Locate hot spots using the back of your hand
- Don PBE
- When searching for the source of a fire, open storage compartments or doors very carefully

11. WHAT IS THE FAA'S POLICY ABOUT RESETTING TRIPPED (POPPED) CIRCUIT BREAKERS (CB) IN-FLIGHT?

a. Resetting Circuit Breakers In Flight. The FAA reiterates its concern about resetting CBs during flight. Crewmembers may create a potentially hazardous situation if they reset a CB without knowing what caused it to trip. A tripped CB should not be reset in flight unless doing

so is consistent with explicit procedures specified in the approved operating manual used by the flightcrew or unless, in the judgment of the captain, resetting the CB is necessary for the safe completion of the flight. A detailed entry in the aircraft's maintenance log is a proven safety practice for tracking purposes, and may provide maintenance personnel with key information to enable prompt trouble-shooting and effective corrective action on the ground.

Air Carrier manuals and training programs should contain company policies and explicit procedures regarding resetting tripped CBs, both during flight and on the ground. The procedures shown in the manuals used by the air carrier's crewmembers, maintenance personnel and airplane ground servicing personnel should be consistent with the airplane manufacturer's guidance. Crewmembers should be reminded that a CB should not be used as a switch to perform procedural functions unless doing so is specified in approved company procedures or manufacturer's operating procedures.

b. What are the potential hazards associated with tripped circuit breakers? The FAA has published guidance material that states that circuit breakers are slow acting devices and may not offer sufficient disconnect protection during events such as arc tracking or insulation flashover. Arc tracking is a phenomenon in which a conductive carbon path is formed across an insulating surface. The carbon path provides a short circuit path through which current can flow (e.g., electrical arcing.) The effects of electrical faults can include:

- Component overheating
- Toxic fumes
- Smoke
- Fire
- Damage to wires, wire bundles, or parts
- Melting of holes in sheet metal parts by faulted, high current feeder cables
- Melting and burning of titanium bleed air ducts by a chaffed, high current feeder cable
- Electromagnetic interference (EMI) with equipment
- The simultaneous and unreasonable loss of both engine driven generators in a two-engine airplane

Additional information may be found in AC 25-16, Electrical Fault and Fire Prevention and Protection.

c. May crewmembers use a CB as an on/off switch? Since CBs are designed to open an electrical circuit automatically at a predetermined overload of current, they should not be used

for day-to-day operational functions because they would not be performing their intended function, which is protection against overloads. Circuit breakers, even those suitable for frequent operation, should not be used as a switch to turn protected items on or off. Exceptions to this procedure should be published and included in an air carrier's approved maintenance programs and flight operations manuals.

12. RECOMMENDED TRAINING.

a. Training Programs. Certificate holders' crewmember training programs should stress the importance of crewmembers taking immediate and aggressive action when confronted with in-flight fires. It should also emphasize accessing and fighting hidden fires.

b. Training. Operators should include the following knowledge and skill objectives in their crewmember training programs:

(1) Knowledge-based Objectives.

(a) In the event of a known or suspected in-flight fire, crewmembers must know how to take immediate and aggressive action to locate the source of fires.

(b) To assist crewmembers in locating the source of fires, they must know the various aircraft cabin configurations (e.g., overhead, sidewall, cheek, and tunnel areas) that they are required to operate.

(c) Crewmembers must understand the proper methods and/or techniques to gain access to areas that may supports hidden fires and the location of any cabin panels that can be removed without special tools.

(d) Each fight crewmember must understand the aircraft ventilation systems, including normal and abnormal procedures, with emphasis on the potential effects of airflow on hidden fires.

(e) To enable crewmembers to locate critical equipment components within the fuselage area, operators' manuals should contain a cross section of the aircraft's fuselage showing the location of electrical, fuel, and hydraulic lines.

(f) Potential indications of hidden fires and the importance of not arbitrarily resetting CBs.

(2) Skill-based Objectives.

(a) Cabin crewmembers should practice the procedures and/or techniques associated with:

- Aggressively locating the source of the fire

- Selecting the appropriate extinguishing agent
- Relocating passengers as necessary
- Opening storage compartments or doors
- Notifying the flightcrew under non-normal circumstances
- Locating hot spots on interior panels

(b) Flight crewmembers should practice the procedures and/or techniques associated with:

- Planning for an immediate descent and landing at the nearest suitable airport
- Aggressively locating the source of a fire
- Notifying the cabin crew under non-normal circumstances
- Operating the aircraft with the use of protective breathing equipment and smoke goggles
- Alternate means of dispersing smoke and fumes when the source of a fire is unknown

13. RELATED REGULATIONS (Title 14 of the Code of Federal Regulations (14 CFR)).

- Part 25, section 25.851
- Part 91, section 91.513
- Part 121, sections 121.119, 121.215, 121.221, 121.273, 121.275, 121.308, 121.309, 121.337, 121.417, and 121.703
- Part 135, sections 135.170, 135.331, and 135.415

14. RELATED ADVISORY CIRCULARS.

- AC 20-42C, Hand Fire Extinguishers for Use in Aircraft
- AC 25-9A, Smoke Detection, Penetration, and Evacuation Tests and Related Flight Manual Emergency Procedures
- AC 25-16, Electrical Fault and Fire Prevention and Protection

- AC 120-48, Communication and Coordination Between Flight Crewmembers and Flight Attendants

15. RELATED RESEARCH MATERIAL. You can obtain the following documents from various public sources such as the world wide web, public and university libraries, and the government entities or associations who published them.

- A Benefit Analysis for Enhanced Protection from Fires in Hidden Areas on Transport Aircraft, DOT/FAA/AR-02/50, CAA Paper 2002/01, Report prepared by R G W Cherry and Associates

- In-Flight Aircraft Seat Fire Extinguishing Tests (Cabin Hazard Measurements), DOT/FAA/CT-82/111, Hill, R.G., and Speitel, L., December 1982

- Effectiveness of Flight Attendants Attempting to Extinguish Fires in an Accessible Cargo Compartment, DOT/FAA/AR-TN99/29, Blake, D.R., April 1999

- Halon Extinguishment of Small Aircraft Instrument Panel Fires, DOT/FAA/CT-86/26, Slusher, G.R., Wright, J.A., and Speitel, L.C., December 1986

- NFPA 408, Standard for Aircraft Hand Portable Fire Extinguishers, 1999 Edition

- NFPA 12B Standard on Halon 1211 Fire Extinguishing Systems, 1990 Edition

- Halon 1211-Exposure Hazards, Ansul Technical Bulletin Number 47, 1980

- Chapters and sections of FAA Order 8400.10, Air Transportation Operations Inspector's Handbook, that address cabin safety issues and emergency procedures

16. HOW CAN I OBTAIN FAA PUBLICATIONS?

a. For copies of free FAA Handbooks/Orders, the AC checklist, or ACs for which there is not a charge, send a written request to:

U.S. Department of Transportation,
Subsequent Distribution Office, SVC-121.23
Ardmore East Business Center
3341Q 75th Avenue
Landover, MD 20785
FAX (301) 386-5394 (They accept mail and FAX request only.)

You may obtain FAA Handbooks and Orders on line at:
http://www.faa.gov/avr/afs/

You may also obtain Advisory Circulars on line at:
http://www.faa.gov/Regulatory_and_Guidance_Library/rgAdvisoryCircular.nsf/MainFrame?OpenFrameSet

b. To purchase copies of Title 14 of the Code of Federal Regulations (14 CFR), FAA Handbooks/Orders, and ACs, send all requests to:

Superintendent of Documents
P.O. Box 371954
Pittsburgh, PA 15250-7954
(202) 512-1800 – Order Desk

You may also obtain 14 CFR on line at:
http://www.faa.gov/ or
http://www.access.gpo.gov/nara/cfr/cfrhtml_00/Title_14/14tab_00.html

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Director, Flight Standards Service

NOTES ON APPENDICES

The following appendices contain information about the dangers associated with in-flight fires. This information may also be used to develop training programs in support of the recommendations contained in this AC. The information does not represent a rigid FAA view of best practices, which may vary among fleets and among certificate holders, and may change over time. Some of the examples may be readily adapted to a certificate holder's training and operating manuals for various airplane fleets. Others may apply to a certain airplane fleet and may not be adaptable apart from that fleet.

APPENDIX 1. NTSB ACCIDENT REVIEWS

This AC was issued in part based on the following NTSB investigations of recent in-flight fires:

- On September 17, 1999, a McDonnell Douglas MD-88 operated by Delta Air Lines experienced an in-flight fire and made an emergency landing at Cincinnati and Northern Kentucky International Airport, Covington, Kentucky. The airplane sustained minor damage. There were no injuries to the 2 flight crewmembers, 3 flight attendants, 3 off-duty flight attendants, and 113 passengers during the evacuation.

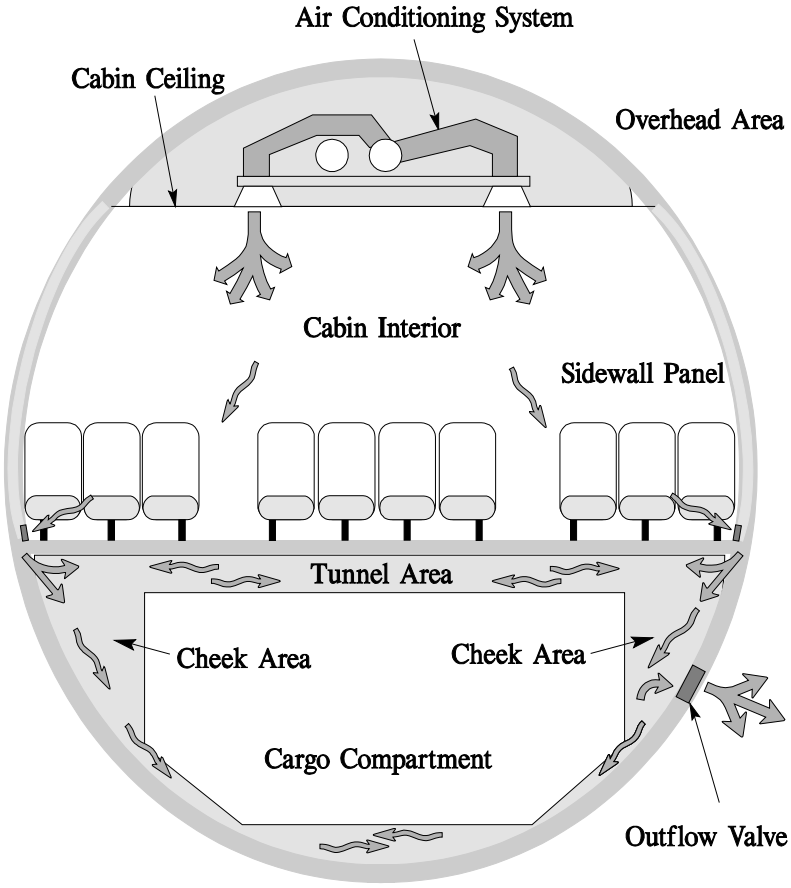
- On August 8, 2000, a McDonnell Douglas DC-9-32 operated by Air Tran Airways as flight 913, experienced an in-flight fire and made an emergency landing at Greensboro Piedmont-Triad International Airport, Greensboro, North Carolina. The airplane was substantially damaged from the effects of fire, heat, and smoke. Of the 57 passengers and 5 crewmembers on board, 3 crewmembers and 2 passengers received minor injuries from smoke inhalation, and 8 other passengers received minor injuries during the evacuation.

- On November 29, 2000, a McDonnell Douglas DC-9-82 operated by American Airlines as flight 1683, was struck by lightning and experienced an in-flight fire that began shortly after takeoff from Reagan National Airport, Washington, DC. The flightcrew made an emergency landing at Dulles International Airport and ordered an evacuation. The airplane sustained minor damage. There were no injuries to the 2 pilots, 3 flight attendants, and 61 passengers during the evacuation.

- On June 2, 1983, a McDonnell Douglas DC-9 operated by Air Canada as flight 797 experienced an in-flight fire and made an emergency landing at Cincinnati and Northern Kentucky International Airport, Covington, Kentucky. The fire was initially detected when a passenger noticed a strange smell and a flight attendant saw smoke in one of the lavatories. Another flight attendant saw that the smoke was coming from the seams between the walls and ceiling in the lavatory. During the descent, the smoke increased and moved forward in the cabin. After the airplane landed, flight attendants initiated an emergency evacuation. Of the 41 passengers and 5 crewmembers on board, 23 passengers were unable to evacuate and died in the fire. The airplane was destroyed.

APPENDIX 2. TYPICAL WIDE BODY CROSS SECTION

Although the following diagram represents a typical wide body aircraft, many narrow body aircraft have the same general layout and ventilation air flow. Other than the cabin height and width the main difference between wide body and narrow body aircraft is the volume of free space in the overhead area. This free space can range from a few feet to more than 4 feet in wide body aircraft and to a little as a few inches in small regional jets. Crewmembers must understand the volume of overhead space in a particular aircraft to effectively combat hidden fires in this area.



APPENDIX 3. TIME TO BECOMING NONSURVIVABLE [1]

The following chart depicts the time that various crews had from the first indication of the presence of a hidden fire, to the time that fire became catastrophically uncontrollable.

DATE	LOCATION	AIRCRAFT TYPE	TIME TO BECOME NON-SURVIVABLE (MINUTES)
07-26-1969	BISKRA, ALGERIA	CARAVELLE	26
07-11-1973	PARIS, FRANCE	B-707	7
11-03-1973	BOSTON, USA	B-707	35
11-26-1979	JEDDAH, SAUDIA ARABIA	B-707	17
06-02-1983	CINCINATTI, USA	DC-9	19
11-28-1987	MAURITIUS, INDIAN OCEAN	B-747	19
09-02-1998	NOVA SCOTIA, CANADA	MD-11	16

For aircraft with hidden fires, an approximate assessment is that only one third will reach an airfield before the fire becomes uncontrollable. [2]

[1] CAA PAPER 2002/02, (FAA Reference DOT/FAA/AR-02/50), "A Benefit Analysis for Enhanced Protection from Fires in Hidden Areas on Transport Aircraft, p." 6

[2] CAA PAPER 2002/02, (FAA Reference DOT/FAA/AR-02/50), "A Benefit Analysis for Enhanced Protection from Fires in Hidden Areas on Transport Aircraft," p. 20

APPENDIX 4. INFORMATION ON USING HAND FIRE EXTINGUISHERS

The following information has been extracted from AC 20-42C, Hand Fire Extinguishers for Use in Aircraft, and presented here for your review and ease of reference. The information presented below is current as of the date of this AC. However, this Appendix will not necessarily be updated. To ensure you have current information relating to hand fire extinguishers for use in the aircraft you should refer to AC 20-42.

a. Types of Fires. To select an appropriate extinguisher for use in an aircraft, consider the following classes of fires (as defined in the National Fire Protection Association (NFPA) Standard 10) that are likely to occur:

(1) Class A. Fires in ordinary combustible materials, such as wood, cloth, paper, rubber, and plastics for which the quenching and cooling effects of quantities of water, or of solutions containing a large percentage of water, are of prime importance.

(2) Class B. Fires in flammable liquids, oils, greases, tars, oil base paints, lacquers, and flammable gases for which extinguishing agents having a blanket effect are essential.

(3) Class C. Fires involving energized electrical equipment and where the electrical nonconductivity of the extinguishing agent is important.

(4) Class D. Fires, involving combustible metals such as magnesium, titanium, zirconium, sodium, lithium, and potassium, and require extinguishing agents of the dry powder types. The recommendations of the manufacturer for use of those extinguishers should he followed because of the possible chemical reaction between the burning metal and the extinguishing agent.

b. Extinguishing Agents Appropriate for Types of Fires. The following extinguishing agents are recommended, as appropriate, for use on the types of fires specified below and as defined in paragraph 7a of AC 20-42C:

(1) Carbon Dioxide - Class B or C.

(2) Water - Class A.

(3) Dry Chemicals - Class A, B, or C.

(4) Halogenated Hydrocarbons (Halon) - Class A, B, or C.

(5) Specialized Dry Powder - Class D.

NOTE: Only "all purpose" or A, B, C dry chemical powder extinguishers containing monoammonium phosphate have a UL Class A, B, C rating: all other powders have a Class B, C rating only.

APPENDIX 4. INFORMATION ON USING HAND FIRE EXTINGUISHERS (Continued)

c. Numeral Ratings. Numerals are used with the identifying letters for extinguishers labeled for Class A and Class B fires. The numeral indicates the relative extinguishing effectiveness of the device on a given size fire, which is dependent on the agent, the capacity of the device, discharge times, and design features. For example, an extinguisher rated as 4A should extinguish about twice as much Class A fire as a 2A rated extinguisher. A 2 1/2-gallon water extinguisher is rated 2A. On an extinguisher rated for Class B fires, the numeral rating precedes the letter "B". Numeral ratings are not used for extinguishers labeled for Class C or D fires. Extinguishers that are effective on more than one class of fires have multiple numeral-letter and letter classifications and ratings: for example, 5B:C.

d. Helpful Hints in Extinguishing Fires.

(1) Best results in fire fighting are generally obtained by attacking the base of the fire at the near edge of the fire and progressing toward the back of the fire by moving the fire extinguisher nozzle rapidly with a side-to-side sweeping motion.

(2) The effective discharge time of most hand-held fire extinguishers ranges from 8-to-25 seconds depending on the capacity and type of the extinguisher. Because of this relatively short effective time span, the proper selection and use of the fire extinguisher must be made without delay.

(3) Care must be taken not to direct the initial discharge at the burning surface at close range (less than 5-to-8 feet) because the high velocity stream may cause splashing and/or scattering of the burning material.

(4) Ventilate the compartment promptly after successfully extinguishing the fire to reduce the gaseous combustion and gases produced by thermal decomposition.