Dealing With a Cabin Fire  

*Speed is Life*

The statistics are clear: If you don’t put a cabin fire out in eight minutes or less, it will probably become uncontrollable. If you have an uncontrollable cabin fire and don’t land in fifteen minutes or less, you may lose the airplane and all on board. The key to surviving a cabin fire is speed: point the airplane to a landable surface, fight the fire if you can, and put the airplane on the ground. You can improve your odds if you know how to cut the electrons and any engine bleed air to the fire. If that fails, you should know how to fly your airplane’s fastest possible approach and landing.

The old school cabin fire philosophy in commercial aviation used to be, “fight the fire, and land if you have to.” In 1983 the captain of an Air Canada DC-9 delayed the decision to land for six minutes while his crew fought a lavatory fire. They were airborne for nearly 20 minutes before he managed to get the aircraft on the ground. After the exits were opened the aircraft burst into flames, killing 23 passengers as the remaining 18 passengers and 5 crewmembers made it out.

Fifteen years later, the crew of Swissair 111, en route from Boston to Geneva, detected what they thought was air conditioning smoke and elected almost immediately to return to Boston, less than four minutes after first detecting the odor. A minute later they opted for the closest airport, Halifax. In the next fifteen minutes, however, they declined direct routing to allow time to run checklists, prepare for the landing, and to allow for fuel dumping. After multiple aircraft systems began to fail the crew declared an emergency and requested an immediate landing. They impacted the water six minutes later, nearly 21 minutes after first detecting the odor, which turned out to be an electrical fire. All 243 on board perished.
Over the years we’ve armchair quarterbacked far too many cabin fires to think we have the problem solved. While many aircraft manufacturers are shying away from “immediate action” checklists, a cabin fire calls for immediate action protocols. We as pilots need to practice these in the simulator until proficient. If the first time you face a cabin fire is in the airplane, your chances of success are slim.

The firefighting effort should not delay an emergency landing, however. Even if you think you can successfully put out the fire, you cannot be sure the fire is fully extinguished or rule out a recurrence. Your primary focus should be: point the airplane to a landable surface and fly there as fast as you can.

**Cockpit Immediate Actions**

Studies have shown that a flight crew may have as few as 15 to 20 minutes to get an aircraft on the ground if a fire progresses without intervention or becomes uncontrollable. If you cannot be absolutely sure the fire will be contained, your first focus needs to be landing the aircraft as soon as possible. If you have spare crewmembers to fight the fire, they need to do so aggressively and immediately. (More on that later.) You, the pilot, have some work to do.

Typical corporate and airline aircraft interiors can make detecting the exact origin of a fire difficult. What you may think is air conditioning smoke may actually be an electrical fire. Smoke from behind an electrical panel door could be ventilation air from the engines. No matter the source, it may be prudent to have an immediate action plan on how to remove all possible threats while leaving the airplane still flyable and capable of shooting an instrument approach to a landing. Most aircraft manufacturers provide detailed checklists that are exhaustive in scope, but too time consuming to complete. Post accident simulator tests following the Swissair 111 crash revealed most crews required 20 to 30 minutes to complete the MD-11 Smoke/Fumes of Unknown Origin checklist. The fire became uncontrollable in half that time and the aircraft impacted the water 21 minutes after the fire was first detected.

If your smoke and fumes checklist, or checklists, can’t be completed in just a few minutes, you should devise an immediate action plan in a flight simulator to remove as many likely suspects as possible, while still leaving the airplane capable of navigating to a runway and shooting an ILS approach.
In a Gulfstream 450 or 550, for example, you can remove all electrical power from the airplane except the standby electrical system and still be able to communicate, navigate, and land. You can also remove half of the engine bleed air without fear of depressurization. An immediate action flow can be completed in 30 seconds:

1) Don pilot oxygen masks
2) Deploy passenger oxygen masks.
3) Turn off all cabin and auxiliary master switches.
4) Open the fuel crossflow valve and ensure main boost pumps are on.
5) Close the bleed air isolation valve and turn off the left engine bleed switch.
6) Activate the standby electrical system
7) Isolate the main AC buses, and turn off both engine driven AC generators.

If the smoke continues you can open the left bleed switch and close the right bleed switch. Once the aircraft reaches a lower altitude, you can shut both bleed switches. This immediate action flow duplicates six pages of very well written checklist procedure into 30 seconds and gives you your best chance of starving a fire before it becomes uncontrollable. While you are waiting for signs the fire is extinguished or will become uncontrollable, you must focus on getting the airplane on terra firma.

An oxygen mask and smoke goggles are a start, but having an Emergency Vision Assurance System (EVAS) can make the difference between attempting a risky “IFR inside the cockpit” landing and a relatively routine landing and successful evacuation. But using EVAS isn’t intuitive, you need to practice deploying it under duress and shooting an approach to a landing. Training vendors, such as FlightSafety International, offer aircraft-specific EVAS training in realistic, stressful conditions.
While you are in the simulator learning how to run your manufacturer’s smoke and fumes checklists more quickly, you should also explore the best techniques for getting the airplane from altitude to landing in minimum time. Flying at $V_{MO}$, throwing out the speed brakes, chopping the throttles, and configuring as speed permits is the obvious procedure. But in what order do you configure and how late can you begin your deceleration? You should practice a few profiles in the simulator until you have the right answer. Much of this involves technique above and beyond the checklist. FlightSafety instructors are old hands at helping you develop your techniques.

In the Gulfstream 550, for example, you can aim for an ILS final around 4,000 feet on glideslope, flying clean and at the airplane’s limiting speed. At 12 nautical miles, no wind, you can bring the power levers to idle and extend the speed brakes. At 250 knots you would extend the first notch of flaps. At 225 knots you would retract the speed brakes and extend the landing gear. The remaining flap settings come at 220 and 170 knots. Simulator tests show this brings the airplane to 50 feet above the runway at $V_{REF} + 5$, ready to land.

Your aircraft’s configuration rules may be different and you might be able to get away with over-speeding the gear and flaps, but you won’t know until you practice in the simulator. The G550, for example, is equipped with force limiters that stop flap extension if air loads are too high. Knowing the latest configuration distance can save you five or ten minutes should you configure too early, or having to circle at the last minute if you configure too late.
You should practice these “speed runs” while wearing an oxygen mask, smoke goggles, and using EVAS if you have it. With or without EVAS, you should assume you will be in a cockpit filled with smoke. We can all operate the speed brakes, extend the landing gear, and operate the flaps by feel alone. But can you tune an ILS frequency and program your flight director without sight of the switches and screens? If you have a choice, find an ILS with a long runway, tune the ILS immediately and plan on capturing the ILS as soon as possible. If your autopilot is working, use it. At that point, even if you do lose sight of everything inside, the aircraft will end up on the runway and all you have to do is brake to a stop. You might break something when auto-landing an airplane without auto-land capability, but you are more likely to safely evacuate a broken airplane than a crashed one.

**Firefighting**

If you have an extra crewmember or if you are far enough from landing that you can spare a pilot, fight the fire. You need to do this aggressively. Over the years we’ve come to realize that if you don’t put a cabin fire out in as little as eight minutes or less, it will become uncontrollable.

There are several areas in the cabin that are more likely than others to be the source of a fire:
- The galley, most notably a convection oven, a microwave oven, and trash bins.
- Other trash bins, such as in the lavatory.
- Any baggage compartments.
- Electrical equipment racks.
- Air conditioning ducts.

Know where any protective gear is and how to use it. Personal Breathing Devices are of little use if buried behind hundreds of pounds of baggage, especially if one of those bags is the source of the fire.

You should look for the exact location of the fire before applying any extinguishing agent, if possible. Discharging the extinguisher into the lavatory without first gaining access to the trash bin, for example, would not put out a fire in the trash bin. Look for smoke and use the back of your hand to feel for hot spots on panels and doors. The back of your hand is more sensitive to heat than your palms or your fingertips and using the back of the hand minimizes the risk of immobilizing your hands in case of burns.

Venting the smoke off the airplane can save lives and extend your firefighting time, but the process is less than intuitive. Turning off all air conditioning packs, if they are the source of the smoke, might be the right answer. But that action will probably also slam any outflow valves closed, trapping the smoke inside the cabin. Even with a good air conditioning pack you need to consider pressurization actions carefully. Raising the cabin altitude to increase airflow is usually a good bet. Many modern corporate aircraft completely exchange cabin air in two minutes or less. Larger aircraft can take five minutes or more. Increasing cabin altitude can speed the exchange of air.
If the day ever comes

The more you practice getting the airplane on the ground as soon as possible, the better prepared you will be if that day ever comes. There are other things you can do to stack the odds in your favor.

Declare an emergency and let ATC know what you are doing; let them adjust to your needs. You can ask them for a vector to the nearest runway, about the weather, and approach availability. And then let them know you want a single frequency, preferably the tower’s frequency, because changing frequencies may become impossible. If your aircraft has a radio that is available down to the last bit of electrons on the aircraft, use it. (VHF #1 on a Gulfstream 550.)

Get the ILS tuned and the autopilot in control as soon as possible. Once the autopilot has the ILS beam in its electronic grasp, you can have it land the airplane even if you don’t have an auto-land system. If you lose sight of the instruments, let the autopilot do its thing and once you feel runway below you, apply the brakes.

If you have a chance, discuss post-landing duties with the other pilot and other available crewmembers. Decide which exit is best, where to funnel passengers — upwind on the grass is best — and who will secure the aircraft. Let tower know where you plan on sending passengers so fire rescue doesn’t run anyone over.

If all goes well, you will have a war story to tell and a planeload of passengers wanting to buy you a beer. But you will need to think the process through, devise your own immediate action flow, and practice in the simulator. Remember: if you don’t extinguish the fire in eight minutes or less you probably won’t, and if the fire becomes uncontrollable, you need to get the airplane on the ground in fifteen minutes or less to be able to successfully evacuate all on board.