



Flight crews worldwide now have a single integrated checklist that can be used for all non-alerted events.

# Flight Crew Response to In-Flight Smoke, Fire, or Fumes

Smoke, fire, or fume (SFF) events can occur suddenly in commercial airplanes. Yet information about the source of the event may be vague, incomplete, inaccurate, or contradictory. Additionally, there is a wide range of possible sources and situations.

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Historically, airlines have provided flight crews with checklists to help them identify and deal with smoke, fire, and fumes. Until recently, manufacturer and airline checklists varied in format and content. In response to this situation, Boeing worked together with airlines, pilots, and other manufacturers to develop a philosophy and a checklist template to standardize and optimize flight crew responses to non-alerted SFF events (i.e., events not announced to the flight crew by onboard detection systems).

These efforts have produced a set of new, industry standard procedures that:

- Define a common approach for manufacturers and airlines to take when developing checklists.

- Define a common set of actions for pilots to expect across multiple models.
- Create an SFF checklist template that addresses key issues that were widely divergent in the industry.

## PROVIDING THE BEST POSSIBLE CREW GUIDANCE

The objective of the checklist template is to provide the best possible crew guidance for managing in-flight SFF events while acknowledging that every SFF situation is different.

As a result, flight crews worldwide now have a single integrated checklist that can be used across all non-alerted SFF events

(see fig. 1). The guidance provided by the new template addresses:

- SFF source identification.
- Actions to perform regardless of source.
- Crew communication.
- Timing for diversion and landing initiation.
- Smoke or fumes removal.
- Additional actions to perform if smoke persists.
- Loss of capability and operational consequences.

**Figure 1: Smoke, fire, or fumes (SFF) checklist template**

Boeing used this template to develop new SFF checklists for all passenger models of the 737, 747, 757, 767, and 777 airplanes and is in the process of developing and evaluating similar checklists for the MD-80, MD-90, 717, MD-10, and MD-11 airplanes. The template is designed to be used by all manufacturers and operators to standardize and optimize flight crew responses to non-alerted SFF events.

| STEP   | ACTION  | RESPONSE   |
|--|---|------------|
| 1  | Diversion may be required.  |            |
| 2  | Oxygen masks (if required)  | On, 100%   |
| 3  | Smoke goggles (if required)   | On         |
| 4  | Crew and cabin communications   | Establish  |
| 5  | Manufacturer's initial steps  | Accomplish |
| <b>Anytime smoke or fumes become the greatest threat, accomplish separate <i>Smoke or Fumes Removal Checklist</i>.</b> |   |            |
| 6  | Source is immediately obvious and can be extinguished quickly:<br>If YES → go to Step 7.<br>If NO → go to Step 9.                                     |            |
| 7  | Extinguish the source.<br>If possible, remove power from affected equipment by switch or circuit breaker on the flight deck or in the cabin.          |            |
| 8  | Source is visually confirmed to be extinguished:<br>If YES → consider reversing manufacturer's initial steps. Go to Step 17.<br>If NO → go to Step 9. |            |
| 9  | Remaining minimal essential manufacturer's action steps<br>[These are steps that do not meet the "initial steps" criteria but are probable sources.]  | Accomplish |
| 10   | Initiate a diversion to the nearest suitable airport while continuing the checklist.  |            |
| <b>Warning: If the smoke/fire/fumes situation becomes unmanageable, consider an immediate landing.</b>                 |   |            |
| 11   | Landing is imminent:<br>If YES → go to Step 16.<br>If NO → go to Step 12.   |            |
| 12   | "X" system actions<br>[These are further actions to control/extinguish source.] If dissipating, go to Step 16.  | Accomplish |
| 13   | "Y" system actions<br>[These are further actions to control/extinguish source.] If dissipating, go to Step 16.  | Accomplish |
| 14   | "Z" system actions<br>[These are further actions to control/extinguish source.] If dissipating, go to Step 16.  | Accomplish |
| 15   | SFF continues after all system-related steps are accomplished:<br>Consider landing immediately.<br>Go to Step 16.                                     |            |
| 16   | Review Operational Considerations.  |            |
| 17   | Accomplish <i>Smoke or Fumes Removal Checklist</i> , if required.   |            |
| 18   | Checklist complete.   |            |

## INDUSTRY CONSENSUS REGARDING SFF EVENTS

The Flight Safety Foundation sponsored this international industry initiative to improve checklist procedures for airline pilots confronting smoke, fire, or fumes. It also published the *Smoke/Fire/Fumes Philosophy and Definitions*, which was used to construct the SFF checklist template. Here are the key components of this philosophy.

### General

- The entire crew must be part of the solution.
- For any smoke event, time is critical.
- The SFF checklist template:
  - Does not replace alerted checklists (e.g., cargo smoke) or address multiple events.
  - Includes considerations to support decisions for immediate landing (e.g., overweight landing, tailwind landing, ditching, forced off-airport landing).
  - Systematically identifies and eliminates an unknown SFF source.
- At the beginning of an SFF event, the crew should consider all of the following:
  - Protecting themselves (e.g., oxygen masks, smoke goggles).
  - Communication (e.g., crew, air traffic control).
  - Diversion.
  - Assessing the SFF situation and available resources.

### Source elimination

- It should be assumed pilots may not always be able to accurately identify the smoke source due to ambiguous cues.
- It should be assumed alerted-smoke-event checklists have been accomplished but the smoke's source may not have been eliminated.
- Rapid extinguishing or elimination of the source is the key to preventing escalation of the event.

- Manufacturer's initial steps that remove the most probable smoke or fume sources and reduce risk must be immediately available to the crew. These steps are developed by the manufacturer and typically have the pilot turn off components or systems having the highest probability of addressing a smoke/fire/fume source. These steps should be determined by model-specific historical data or analysis.
- Initial steps for source elimination:
  - Should be quick, simple, and reversible.
  - Will not make the situation worse or inhibit further assessment of the situation.
  - Do not require analysis by the crew.

### Timing for diversion/landing

- Crews should anticipate diversion as soon as an SFF event occurs and should be reminded in the checklist to consider a diversion.
- After the initial steps, the checklist should direct diversion unless the SFF source is positively identified, confirmed to be extinguished, and smoke or fumes are dissipating.
- The crew should consider an immediate landing anytime the situation cannot be controlled.

### Smoke or fumes removal

- The decision to remove smoke or fumes must be made based upon the threat being presented to the passengers or crew.
- Crews should accomplish procedures in the *Smoke or Fumes Removal Checklist* only after the fire has been extinguished or if the smoke or fumes present the greatest threat.
- The crew should be directed to return to the *Smoke/Fire/Fumes Checklist* after smoke/fumes removal if the *Smoke/Fire/Fumes Checklist* was not completed.

### Additional steps for source elimination

- Additional steps aimed at source identification and elimination:
  - Are subsequent to the manufacturer's initial steps and the diversion decision.
  - Are accomplished as time and conditions permit, and should not delay landing.
  - Are based on model-specific historical data or analysis.

## CHECKLISTS FOR BOEING AIRPLANES

Boeing has used this new template to develop a combined checklist that addresses electrical smoke, air-conditioning smoke, cabin smoke, and fumes.

In 2007, Boeing published new Airplane Flight Manual and Quick Reference Handbook checklists for all passenger models of the 737, 747, 757, 767, and 777. Boeing is in the process of developing and evaluating similar checklists for the MD-80, MD-90, 717, MD-10, and MD-11 airplanes.

## SUMMARY

By working through a logical checklist, flight crews can better isolate the cause of SFF events and take appropriate action.

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