



Generic Checklists Focus Response to In-flight Dangerous-goods Incidents

Public education and airline procedures reduce the likelihood of passengers carrying prohibited items that could cause harm by spilling, leaking, igniting a fire or releasing fumes in the cabin. Emergency-response guidance helps airlines to update training, procedures and tactics for flight attendants facing these situations.

FSF Editorial Staff

If all airline passengers knew and complied with restrictions on checking or carrying dangerous goods, flight attendants would have one less issue requiring in-flight vigilance and emergency preparation. In reality, the cabin crew must be prepared for accidents/incidents¹ in which prohibited items brought into the cabin create risks of injury or damage that could compromise the safety of a flight.

The *Emergency Response Guidance for Aircraft Incidents Involving Dangerous Goods* by the International Civil Aviation Organization (ICAO) was designed for civil aviation authorities and airlines to use as a basis for updating related cabin crew training, checklists and procedures to handle in-flight situations involving accessible dangerous goods.²

ICAO defines dangerous goods as “articles or substances which are capable of posing a risk to health, safety, property or the environment and which are shown in the list of dangerous goods in the [ICAO *Technical Instructions for the Safe Transport of Dangerous Goods by Air*] or which are classified according to those instructions.”³ The *Technical Instructions* are used by airlines to control the air transport of dangerous goods (also called “hazardous material [hazmat]”⁴ in some countries) as cargo in cargo aircraft and/or passenger aircraft and in checked/carry-on baggage.

“The first indication of a potential [dangerous-goods] incident could be a passenger becoming concerned about an item in their cabin baggage which is leaking or giving off fumes (this can happen because of the reduced pressure); or a passenger seen



using an item which is not permitted in the cabin,” the U.K. Civil Aviation Authority (CAA) said in 2004 advisory material for airlines.⁵ “Also, there have been incidents caused by items which passengers can legitimately take on aircraft but which developed faults during flight. If it appears that the item is not likely to cause a problem, it might be better for the passenger to be allowed to keep it; although a watch should be kept for any sign of leakage or fuming.”

Known or suspected dangerous goods typically involve the cabin crew either in enforcing prohibitions/restrictions on specific items or in responding to breakage, spillage or leakage of liquids, powders or gases that could cause injury or damage. *Emergency Response Guidance* includes two lists of more than 2,500 dangerous goods (articles or substances sorted alphabetically by proper shipping name in one list and sorted by United Nations [UN] number on another list). The guidance also contains a table of 11 emergency-response drills and 14 “additional-risk” drill variations for use after the flight crew conducts aircraft-specific emergency checklists and considers landing as soon as practical. A generic checklist for cabin crews handling dangerous-goods incidents also is part of the guidance (see “Basic Principles Apply to Dangerous-goods Response,” page 2).

Conducting actions on the generic checklist requires an initial decision: either to leave undisturbed the affected area of the cabin (i.e., not apply fire-extinguishing agent or water) then to keep it isolated and covered with polyethylene bags and blankets until ground personnel can respond after landing, or to remove

Basic Principles Apply to Dangerous-goods Response

The International Civil Aviation Organization has recommended the following guiding principles for a cabin crew responding to a suspected in-flight dangerous-goods incident:¹

- Notify the captain, coordinate actions with the flight crew and keep the flight crew informed about cabin crew intentions and results of actions taken;
- Identify the specific dangerous-goods item involved and ensure that the captain has complete and accurate facts;
- Fight any fire that occurs using standard procedures;
- Assess potential consequences, such as a hazardous chemical reaction, before applying water to a spilled dangerous-goods item or if fumes are present;
- Relocate passengers away from the affected area;
- If the airline policy normally allows smoking in the cabin, require all passengers to stop smoking whenever fumes or vapors from hazardous goods are present;
- Obtain the dangerous-goods emergency-response kit (if equipped) for response to spillage/leakage situations;
- Obtain useful items (such as required aircraft emergency equipment, eye protection, overalls and galley equipment/supplies) that safely could be adapted to spillage/leakage situations;
- Don portable breathing equipment when fumes are present and protect the face with a smoke hood or gas-tight smoke mask;
- Cover the hands with rubber gloves if possible and/or with fire-resistant gloves/oven mitts (covered by a polyethylene bag if the gloves/mitts otherwise would absorb liquid);
- Provide wet towels or cloths to passengers with instructions on how to cover the nose and mouth to breathe filtered air;
- Do not provide therapeutic oxygen or activate drop-down oxygen-mask systems because contaminated air would be breathed with the low flow of oxygen;
- If appropriate under the circumstances, place the dangerous-goods item in polyethylene bags and securely stow the polyethylene bags in a location selected for safety (such as the farthest lavatory from the flight deck);
- Handle seat cushions and seat covers that have been in contact with the dangerous-goods substance with the same precautions as when handling the dangerous goods;
- Use polyethylene bags, other plastic bags and blankets to cover the carpet/floor where a dangerous-goods substance leaked or spilled;
- Before landing, check regularly the status of the stowed dangerous-goods item and aircraft furnishings that were contaminated;
- After landing, notify responding ground personnel about the dangerous-goods item, all known facts about the item and where the item was stowed; and,
- Ensure that details about the dangerous-goods incident are entered in the aircraft-maintenance log to prompt replacement of the emergency-response kit and any other aircraft maintenance required because of the dangerous-goods incident.♦

— FSF Editorial Staff

Note

1. ICAO. Doc 9481 AN/928, *Emergency Response Guidance for Aircraft Incidents Involving Dangerous Goods*, 2005–2006 Edition. November 2004.

the substance with absorbent materials, stow the contaminated materials in polyethylene bags and then cover the affected area with polyethylene bags and blankets until after landing. (If these are not available, alternative covers include airsickness bags opened with the plastic-covered side down, and plastic-covered passenger-briefing cards.) Known or suspected dangerous goods in powder form may suggest the first choice, ICAO said.

“If it is absolutely certain that the [dangerous-goods] item will not create a problem, the decision may be made not to move it,” ICAO said. “In most circumstances, however, it will be better to move the item [by the recommended methods].” (See “Techniques for Using Polyethylene Bags, Gloves Protect Hands,” page 3.)

U.K. CAA said, “The decision to try to remove the residue of a spillage, or leave it in [place] and cover, may depend on the extent of that spillage and the effect it is having on passengers and crew.”

The *Emergency Response Guidance* was designed for in-flight dangerous-goods accidents/incidents — not those that occur while the aircraft is on the ground — on the assumption that aircraft rescue and fire fighting personnel and/or other hazmat specialists typically would respond on the ground.

Civil aviation authorities worldwide typically provide regulations and guidance for preventing dangerous-goods accidents/incidents in the cabin. For example, the U.K. CAA

said that prevention of dangerous-goods incidents requires continual education and reminders for airline passengers.

Investigation of a U.S. dangerous-goods incident in 1998 found that a passenger had checked an ice chest that held plastic bottles containing 2.0 gallons (7.6 liters) of a 35-percent hydrogen-peroxide solution — an oxidizer with corrosive properties that can cause chemical reaction and fire. The bottles split, and the solution leaked into checked baggage and mail sacks inside a cargo compartment while the passenger aircraft was en route.⁶

“One of the biggest problems faced by operators is passengers who take, or try to take, on an aircraft items of dangerous goods to which they are not entitled,” U.K. CAA said. “In these circumstances, there is the potential for an incident to occur in flight, with disastrous results; and there have been such events in the past. ... The primary consideration in any [dangerous-goods] incident should be to preserve the ability of the crew to fly the aircraft. The other considerations are: to safeguard all other persons on board from the effects of any fumes or liquid from leaking packages of dangerous goods; to

protect the aircraft structure as far as possible from damage; and to control the potential for the dangerous goods to cause any further harmful effect.”

In the United States, the Federal Aviation Administration (FAA) has published information for airline passengers about prohibited items and exceptions to U.S. hazmat regulations.⁷

“Many common items used every day in the home or workplace may seem harmless; however, when transported by [aircraft], they can be very dangerous,” FAA said. “In flight, variations in temperature and pressure can cause items to leak, generate toxic fumes or start a fire. ... Do not pack in luggage or carry on board fireworks (signal flares, sparklers or other explosives);⁸ flammable solids or liquids (fuel, paints, lighter refills, matches); household items (drain cleaners and solvents); pressure containers (spray cans, butane fuel, scuba tanks, propane tanks, carbon-dioxide cartridges, self-inflating rafts); weapons (firearms, ammunition, gunpowder, Mace, tear gas or pepper spray [Title 49, U.S. Code of Federal Regulations, contains specific restrictions that allow one small ‘self-defense

Techniques for Using Polyethylene Bags, Gloves Protect Hands

If the cabin crew has access to a dangerous-goods emergency-response kit during flight, and the decision has been taken to remove a spilled/leaked substance, the International Civil Aviation Organization said that the following method of double-bagging dangerous goods may be appropriate:¹

- “Prepare two [polyethylene] bags by rolling up the sides and placing [the bags] on the floor;
- “Place the item [and contaminated furnishings such as seat covers and sections of carpet] inside the first bag with the closure of the item, or the point from which it is leaking from its container, at the top;
- “Take off the rubber gloves while avoiding skin contact with any [contaminant] on them;
- “Place the rubber gloves in the second bag;
- “Close the first bag while [expelling] the excess air;
- “Twist the open end of the first bag and use a bag tie to tie it sufficiently tight to be secure, but not so tight that pressure-equalization cannot take place; [and,]
- “Place the first bag (containing the item) in the second bag, which already contains the rubber gloves, and secure the open end in the same manner as that used for the first bag.”

If the aircraft is not equipped with a dangerous-goods emergency-response kit, flight attendants can improvise in the following manner, ICAO said:

- “[Obtain portable breathing equipment, eye protection and supplies including] oven gloves or fire-resistant gloves [from the galley], if available; at least two large polyethylene waste-bin bags; and, at least three smaller polyethylene bags, such as those used for duty-free [sales] or bar sales or, if none [are] available, airsickness bags;
- “Pick up the item [with gloves covered by small polyethylene bags] and place it in a polyethylene bag. Ensure [that] the receptacle containing the dangerous goods is kept upright or the area of leakage is at the top;
- “Using paper towels, newspaper, etc., [as appropriate for the substance to] mop up the spillage Place the soiled towels, etc. in another polyethylene bag;
- “Place the gloves and bags used to protect the hands either in a separate small polyethylene bag or with the soiled [paper] towels;
- “If extra bags are not available, place the [paper] towels, gloves, etc. in the same bag as the [dangerous-goods] item; [and,]
- “Expel excess air from the bags and close [them] tightly so as to be secure but not so tight that pressure equalization cannot take place.”♦

Note

1. ICAO. Doc 9481 AN/928, *Emergency Response Guidance for Aircraft Incidents Involving Dangerous Goods*, 2005–2006 Edition. November 2004.

spray' in checked luggage only]; [or] other hazardous materials (dry ice, gasoline-powered tools, wet-cell batteries, camping equipment with fuel, radioactive materials [except limited quantities], poisons, infectious substances)."

Although U.S. hazmat regulations prohibit general types of dangerous goods in checked baggage or carry-on baggage, exceptions allow passengers/crewmembers to carry specific items in the cabin subject to approval by individual airlines, restrictions on quantities and compliance with requirements.

"Personal-care items [nonradioactive medicinal/toilet articles] containing hazardous materials (e.g., flammable perfume [including duty-free perfume and cologne], aerosols [such as hair spray and shaving cream]) totaling no more than 70 ounces [two kilograms] may be carried on board," FAA said. "Contents of each container may not exceed 16 fluid ounces [470 milliliters]. Matches and lighters may only be carried on your person. However, 'strike-anywhere matches,' lighters with flammable-liquid reservoirs and lighter fluid [and lighter refills] are forbidden. ... Dry ice (4.0 pounds [1.8 kilograms] or less) for packing perishables may be carried [aboard] an aircraft provided [that] the package is vented." Carbon-dioxide cylinders for the operation of mechanical limbs and spare cylinders of similar size required for the duration of travel also can be carried in the cabin.⁹

Some regulated items — such as battery-powered heat-producing tools (from which the energy source or heat-producing component is removed),¹⁰ a mercury thermometer or barometer carried by a government official (subject to specific provisions for packaging and notification of the airline and pilot-in-command) — only can be transported in carry-on baggage in compliance with the applicable U.S. hazmat regulations.

Some regulated items — such as non-toiletry aerosols that contain nonflammable–nontoxic gas, small-arms ammunition for personal use, battery-powered wheelchairs/mobility aids (subject to specific provisions for nonspillable batteries and spillable batteries) — only can be transported in checked baggage in compliance with the applicable U.S. hazmat regulations.

Other regulated items — such as nonradioactive medicinal/toilet articles; up to 5.0 liters (1.3 gallons) of alcoholic beverages containing more than 24 percent alcohol but not more than 70 percent alcohol by volume in retail packaging; one small medical/clinical thermometer in a protective case for passenger/crewmember use; and a maximum of two nonflammable-gas inflation cartridges fitted into a self-inflating life jacket and two spare cartridges — can be carried in checked baggage or as carry-on baggage by each passenger/crewmember in compliance with applicable U.S. hazmat regulations. (Alcoholic beverages containing not more than 24 percent alcohol by volume are not subject to these regulations.)

Prohibited items include some non-toiletry aerosol products (e.g., spray paints, aerosol laundry starch and spray insecticides); corrosive drain cleaners; oxygen-generating equipment;¹¹ oxygen

cylinders/canisters; unapproved lighters for use or sale by the airline; gas refills (spare butane cartridges) for hair curlers; and alcoholic beverages with more than 70 percent alcohol (140 proof) including 95-percent grain alcohol and 150-proof rum.

The generic cabin crew checklist in *Emergency Response Guidance* is intended to be adapted for use by airlines "in association with existing emergency procedures established in the aircraft flight manual," ICAO said.

"The document may also be used in the required dangerous-goods training program for crewmembers," ICAO said. "Some operators provide dangerous-goods emergency-response kits¹² for use aboard aircraft and also provide training to crewmembers regarding the use of the kit in dangerous-goods incidents."

Identifying an unknown dangerous-goods item and any specific risk may be possible by asking the passenger who brought the item aboard the aircraft. A well-informed passenger also may know appropriate methods of handling the dangerous-goods situation. A passenger may be able to assist, for example, in translating label information into the language of the crew.

Alternatively, finding a shipping name, UN number or other label information on the container may be possible. Knowing the shipping name or UN number may enable the flight crew and/or ground personnel to identify the dangerous-goods item in the *Emergency Response Guidance* or a national database and to determine which ICAO-recommended drill to use.

"If the passenger can identify the item, refer to ... the appropriate emergency-response drill," ICAO said. "On aircraft with only one cabin crewmember, consult with the pilot-in-command as to whether the aid of a passenger should be sought in dealing with the incident."

Frequent communication between the cabin and flight deck will be required. With adequate information, the flight crew may decide to select settings on the environmental control system to maximize cabin ventilation and to vent all cabin air outside the aircraft (rather than recirculating cabin air). This is appropriate in some scenarios to prevent recirculation of contaminated air and to reduce the concentration of airborne particles, fumes or other contaminants from dangerous goods, ICAO said.

The cabin crew cannot assume that normal methods of removing spills and leaks — such as wetting, wiping, blotting and/or brushing — will be safe or effective for dangerous goods. Significant differences include the appropriateness of applying water to an unknown spilled/leaked substance and the appropriateness of using products made of organic materials such as paper or cloth to absorb the substance. Water may cause the spillage/leakage to spread, initiate a severe chemical reaction or increase the rate of generation of fumes in some situations.¹³

Normal methods of absorbing liquids during cleanup also could be hazardous if they cause a chemical reaction.

“Care should always be taken when mopping up any spillage or leakage to ensure there will be no reaction between what is to be used for mopping up and the dangerous goods,” ICAO said. The alternative in this situation is to cover the substance with no attempt to mop up the substance.

After the dangerous-goods item has been double-bagged, one stowage option is to use a catering box or a bar box — placed on the floor so that the door opens upward — like a closed chest to hold the bags for the remainder of the flight. A rear galley or lavatory may be the best location to store the box and/or loose bags because it is farthest from the flight deck.

Monitoring the situation for the remainder of the flight calls for attention to the position of the stowed bags. Otherwise, aircraft maneuvering could cause a container of dangerous goods inside a bag to again tip over, spill, leak or release fumes.

“Wherever the box or bag(s) have been located, wedge them firmly in place to prevent them from moving and to keep the item upright,” ICAO said. “Ensure that the position of the box or bags will not impede disembarkation from the aircraft. ... If a galley is used, the box or bag(s) can be stowed in an empty waste-bin container. If a [lavatory] is used, the box can be placed on the floor or the bag(s) [can be] stowed in an empty waste container. The [lavatory] door should be locked from the outside. In a pressurized aircraft, if a [lavatory] is used, any fumes will be vented away from passengers. However, if the aircraft is unpressurized, there may not be positive pressure in a [lavatory] to prevent fumes from entering the passenger cabin.

“If the [contaminated] carpet cannot be removed [and rolled up inside in a polyethylene bag], it should remain covered by a large bin bag or polyethylene bags, etc. and additional bags should be used to reduce the fumes.”

U.K. CAA has amplified the ICAO recommendations on cabin crew response to dangerous-goods incidents to include the following:

- “If dangerous goods can be identified by [shipping] name or UN number, it may be possible to obtain information about them from the flight crew if a copy of the [ICAO] *Emergency Response Guidance* document is carried [on the flight deck];
- “Cabin equipment made from polyethylene or a similar plastic material can be utilized to pick up and contain any spillage, if this is needed; [and,]
- “The spillage of a flammable liquid onto fabric may increase the release of a flammable vapor, making the possibility of a fire more likely if an ignition source (e.g. a lighted cigarette) is present.”

In summary, flight attendants are most likely to bring an in-flight dangerous-goods incident to a safe conclusion by following

established procedures and training rather than relying on their “instinctive reaction to a situation,” U.K. CAA said.♦

Notes

1. International Civil Aviation Organization (ICAO). *Annex 18, The Safe Transport of Dangerous Goods by Air*. Third edition, July 2001. Annex 18 defines a *dangerous-goods accident* as “an occurrence associated with and related to the transport of dangerous goods by air which results in fatal or serious injury to a person or major property damage.” A *dangerous-goods incident* is defined as: “An occurrence, other than a dangerous-goods accident, associated with and related to the transport of dangerous goods by air, not necessarily occurring on board an aircraft, which results in injury to a person, property damage, fire, breakage, spillage, leakage of fluid or radiation or other evidence that the integrity of the packaging has not been maintained. Any occurrence relating to the transport of dangerous goods which seriously jeopardizes the aircraft or its occupants is also deemed to constitute a dangerous-goods incident.”
2. ICAO. Doc 9481 AN/928, *Emergency Response Guidance for Aircraft Incidents Involving Dangerous Goods*, 2005–2006 Edition. November 2004.
3. ICAO. Annex 18.
4. U.S. hazardous-materials regulations (49 Code of Federal Regulations Parts 100–185) are written, issued and officially interpreted by the Office of Hazardous Materials Safety, Research and Special Programs Administration, U.S. Department of Transportation. They are enforced in air transportation by the U.S. Federal Aviation Administration (FAA).
5. Safety Regulation Group, U.K. Civil Aviation Authority (CAA). Civil Aviation Publication 668, *Transport by Air of Dangerous Goods, Munitions of War, Sporting Weapons and Animals: Guidance Material on the Operator’s Responsibilities*. September 2004.
6. FAA Civil Aviation Security. “Transportation of Hydrogen Peroxide (H₂O₂).” *Dangerous Goods Advisory Bulletin* no. DGAB-01-01, Nov. 28, 2001. This document provides one example of a dangerous-goods item that, if spilled in the cabin, would require personal protective measures and counterintuitive actions. FAA said that airline personnel should be aware that “special care must be taken when leakage of baggage or cargo is discovered, even when the liquid is clear, colorless and odorless. Do not assume it is water. If you encounter hydrogen peroxide, special care should be taken. ... Due to its water-like appearance, it is difficult to distinguish hydrogen peroxide from water by sight and/or smell [and use of hydrogen-peroxide-test strips may be required]. ... Residual hydrogen peroxide that is allowed to dry (evaporation of water causes hydrogen-peroxide solution to concentrate) on organic materials such as paper, fabric, cotton, leather, wood or other combustible materials can cause the material to ignite. Hydrogen peroxide may cause irreversible tissue damage to the eyes, including blindness. Hydrogen-peroxide solutions are corrosive to eyes, nose, throat, lungs and skin. Also, hydrogen-peroxide vapors are corrosive to eyes, throat and lungs.”
7. Office of Security and Hazardous Materials, FAA. *These Fly ... These May Not*. Dec. 21, 2004.
8. FAA. *Fireworks: Dangerous Cargo*. Dec. 21, 2004.
9. Office of Security and Hazardous Materials, FAA. *Hazardous Materials Carried by Passengers and Crewmembers*. March 2004. <ash.faa.gov>

10. FAA. *Don't Pack Light for Your Next Flight: Torch Flames on Airplanes Don't Fly*. Dec. 21, 2004. Various small devices known as torches/micro torches, utility lighters and gas-powered soldering tools — typically powered by flammable gas and ignited by an electronic starter — create a hazard if packed in baggage by an airline passenger. “The FAA has investigated several incidents recently where these micro torches either caught fire or exploded during loading aboard passenger aircraft,” FAA said. “In two recent incidents involving a fire, these cylinders were packed or shipped with the torch head attached, and the electronic igniter switch was found in the ON position. . . . One passenger checked a toolbox containing a micro torch. The toolbox exploded during loading and injured two airline employees. The passenger claimed he had emptied the torch by [operating] it on [the HIGH setting] for four hours. . . . Do not pack any flammable-gas torches in any checked [baggage] or carry-on baggage.”
11. FAA Civil Aviation Security. “Passenger Personal Liquid Oxygen Canister.” *Dangerous Goods Advisory Bulletin* no. DGAB-00-01, Aug. 31, 2000. The document said, “[FAA] recently received information from an air carrier concerning a passenger who attempted to carry a personal oxygen canister containing oxygen, refrigerated liquid (commonly described as liquid oxygen) on board the aircraft as a spare oxygen source. . . . The passenger was using a compressed-oxygen cylinder supplied by the airline Another passenger heard a hissing sound [while the aircraft crew was preparing for departure] and notified the flight attendant, who then notified the captain. The captain informed the passenger that she could not fly with the spare liquid-oxygen canister, which was stowed in an improper orientation in an overhead bin. . . . Liquid oxygen may explode on contact with heat or oxidizing materials and is strictly forbidden on both passenger [aircraft] and cargo aircraft.”
12. ICAO said that its recommendations assume that a typical dangerous-goods emergency-response kit contains “large, good-quality polyethylene bags; bag ties; and long rubber gloves.” U.K. CAA said that airlines should consider adding to this kit small packages of sand, which typically does not react chemically with dangerous-goods items, and sodium bicarbonate, which will neutralize many acids and only should be applied to acid spills. Paper towels and other paper products intentionally have been omitted from recommended kits because of the risk of a reaction with some dangerous-goods substances. “It should be noted that polyethylene is reasonably resistant to all dangerous goods, at least for a short while,” U.K. CAA said. “Sand is inert and can be used safely, except when there are products containing hydrofluoric acid; these are identified [in the ICAO *Emergency Response Guidance*] by UN numbers UN 1786 and [UN] 1790. Sodium bicarbonate can be used safely with all acids, but there may be some bubbling and carbon dioxide may be given off. . . . Despite passenger reaction, it might be preferable not to attempt to remove the residue but leave it covered by sand or sodium bicarbonate.”
13. U.K. CAA said that some dangerous goods react severely with water. “Usually, where there is a severe reaction, the classification assigned to the goods is that of having either a primary hazard or subsidiary risk of being water-reactive,” U.K. CAA said. “However, there are other dangerous goods which react with water, but this is not immediately apparent from the classification.” U.K. CAA guidance material lists UN numbers for dangerous goods that either have been designated as water-reactive substances in ICAO *Emergency Response Guidance* or otherwise are known to be water-reactive substances.

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