Dangerous Goods and Air Safety

The list of dangerous goods that may be carried by air is growing at a rate that makes it difficult for shipper and carrier alike to keep abreast of safe methods of storage and handling.

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by
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The safety of civil aircraft is threatened by substances carried on board in passengers' baggage (whether in the hold or cabin), cargo, airmail, packages, aircraft stores and equipment, and explosives placed on board by saboteurs or hijackers. A serious threat is the increased number of hazardous materials produced for use by all manner of legitimate businesses and offered for shipment by air. Although a list of "dangerous goods" that may be carried by air is regularly revised, it is a challenge for even the most careful shippers and carriers to keep up-to-date on dangerous goods and the safest methods of handling and storing them.

The Regulatory Scene

For many years, the International Air Transport Association (IATA) had prime responsibility for determining how hazardous materials were packaged and what restrictions were to be placed on their transport. Its list of "restricted articles" was accepted by most countries and used by almost all shippers and cargo-carrying airlines whether they were members of IATA or not.

In 1983 the International Civil Aviation Organization (ICAO) published its own regulations on dangerous goods, in addition to IATA's "Restricted Articles Regulations," and this was achieved through the publication of two documents:

- Annex 18 to the Convention of International Civil Aviation — The safe Transport of Dangerous Goods by Air; and

- The Technical Instruction for the Safe Transport of Dangerous Goods by Air (Doc. 9284).

Annex 18 and the Technical Instructions both became applicable on January 1, 1984 and these documents are now used throughout the world by the 162 Member States of ICAO for international flights and, in most countries, for domestic flights. ICAO assumed this responsibility because of the need to harmonize the transport of dangerous goods by air with other modes of transport, to achieve compatibility with international regulations published by the United Nations and the International Atomic Energy Agency, and to give the regulations a higher international legal status.

The use of different terms in civil air transport for what are basically the same materials is undesirable, and "dangerous goods" used by ICAO is replacing IATA's "restricted articles." A third term, "hazardous materials," is still used in the United States but means essentially the same as "dangerous goods." The terms are used to identify substances or materials that may pose an unreasonable risk to health, safety and property when transported by any mode of transport. They are defined by ICAO as explosives, gases, corrosive materials, flammable liquids, flammable solids, organic peroxides, oxidizing materials, poisons, infectious substances, radioactive materials and other miscellaneous dangerous goods (in the United States referred to as other restricted materials-ORM).

Familiar items are affected, including matches, some cigarette lighters, hair dryers, medical supplies, fireworks, wheelchairs with wet-cell batteries, breathing apparatus with compressed air, paint thinners, ammunition and pyrotechnics. Radioactive materials constitute a particular hazard because they emit particles, rays or gases, which may be hazardous and cannot be detected except by special instruments. Most radioactive materials offered for transport on passenger aircraft are intended for use in, or incident to, research or medical diagnosis or treatment.

Some dangerous goods, or certain amounts thereof, are restricted to carriage in cargo aircraft only and these materials have to be stowed so as to be accessible to crew members while in flight. A logical but necessarily complex system has been developed for labeling and describing dangerous goods; it uses colors, shapes and symbols to contend with problems created by lack of education or foreign languages. The United States has its own national regulations, but the ICAO system may also be used domestically. The ICAO system must be used for all shipments transferred from a U.S. domestic route to an international one.

The ICAO system classifies dangerous goods into nine classes, with three packaging groups:

Packaging Group 1 = great danger.

Packaging Group 2 = medium danger.

Packaging Group 3 = minor danger.

Dangerous goods complicate aircraft emergency procedures especially if rescue and firefighting operations must deal with hazardous materials such as corrosive liquids and radioactive substances as well as dealing with occupants and fires. Proposals to add an item to the transmitted flight plan of the aircraft that indicate dangerous goods are aboard have not yet been adopted. The responsibility to notify the appropriate authorities during an emergency is left with the aircraft commander — who may have more urgent duties in these circumstances. In the event of an in-flight emergency, the captain is required to inform the appropriate agency of the class of dangerous goods on board so that emergency services may be alerted.

Airlines have to ensure that all personnel involved in the acceptance, documentation, handling and transportation of dangerous goods are trained to appropriate standards. They must ensure that dangerous goods accepted for air transport meet government regulations and that the pilot is informed of the presence of any such materials. Airlines are also required to display in a prominent place, visible to boarding passengers, notices concerning the requirements and penalties associated with the carriage of hazardous materials in baggage or as checked baggage. A current problem is that pilots are sometimes given a list of the dangerous goods immediately before the doors are closed and engines started, preventing them from checking the loading and labeling.

Pilots are expected to ensure that regulations for dangerous goods are observed. They have authority to delay flights to ensure the proper stowage and documentation of shipments, and to refuse carriage of any dangerous goods that are not in compliance with the regulations.

Shippers, packers and forwarders are required to properly package, identify and document all dangerous goods, and in a perfect world these precautions and the use of properly designed and equipped aircraft would come close to guaranteeing safe transport. Unfortunately, in the real world serous accidents occur.

Dangerous Goods Accidents

In December 1973 a Pan American World Airways Boeing 707 cargo aircraft crashed minutes short of a landing at Boston's Logan International Airport and the three crew members died when acrid smoke impaired their vision and ability to function. Investigations showed that more that half the chemicals on board were improperly packaged and almost all of the packages were improperly marked. Included in the shipment was nitric acid, an oxidizing material which reacts with many other materials causing intense heat and large amounts of smoke.

U.S. regulations require that nitric acid be packaged with suitable noncombustible cushioning material, but the boxes used for the outer packaging of the shipment were not manufactured to U.S. Department of Transportation standards — bottles were not packed in metal containers, and the cushioning material was combustible sawdust. Some of the chemicals were carried in portable "igloo" type containers and labelled "electrical appliances."

This evasion of the regulations was not an isolated incident. A similar shipment of nitric acid was loaded aboard another passenger aircraft (and again labelled as "electrical appliances"). Six months after the Pan American accident, a potential tragedy for 75 passengers aboard an Aeromexico DC-9 was narrowly averted when its crew discovered a shipment of nitric acid had spilled in the cargo compartment. An earlier U.S. interagency study had revealed that 175 of 300 packages inspected violated U.S. Federal Aviation Administration (FAA) regulations with 85 having incorrect or missing labels, 72 having radiation levels exceeding the amount stated on the package, 10 packages having radioactive levels exceeding the amount authorized per package and nine packages having nonapproved or improperly marked containers.

The U.S. Air Line Pilots Association (ALPA), studied these breaches of the regulations and in 1975 launched a 10-year campaign called the STOP (Safe Transport Of Passengers) program to reduce the risks associate with dangerous goods. The particular incident that caused ALPA to initiate its campaign was a spill of radioactive material in the cargo compartment of a Delta Air Lines passenger aircraft that exposed more than 900 persons in eleven cities to unnecessary radiation.

The action at first was almost a total embargo of all hazardous materials in cargo or passenger aircraft. During the early period of the ALPA campaign, the following materials were removed, at the demand of pilots, from passenger flights:

- 150 pounds of flammable liquids
- 40 pounds of sodium bisulphate and hydrochloric acid
- containers of xylene, a chemical with a low flash point
- 60 pounds of compressed gas

By the middle 1980s, detected violations of U.S. regulations had fallen to 600-800 per year and ALPA suspended its STOP campaign in October 1984. However, a January 1989 U.S. National Transportation Safety Board (NTSB) report of a serious occurrence aboard an American Airlines MD-80 aircraft in February 1988 showed that serious safety problems continued. An illegal, mislabelled shipment was responsible for the emergency landing and evacuation of the airliner at Nashville, Tennessee. Leakage of hydrogen peroxide and sodium hydroxide caused extensive damage to the floor and sub-floor of the passenger cabin. The way in which heat developed and damaged the inside of the cargo hold threatened the lives of 125 passengers and crew. After investigating this incident involving undeclared, or hidden, dangerous goods, the NTSB called for major changes in regulations, procedures and equipment to ensure safer air travel.

Passengers' Baggage

The following list is a selection of occurrences in the United Kingdom over a 12-month period in 1983-1984:

- During a customs check a suitcase was found to contain three bottles of nitric acid and one bottle of hydrochloric acid.

- A kerosene lamp was stolen by a rugby player on his way to the airport and smuggled onto the aircraft.

- Smoke emanated from a suitcase while the aircraft was being unloaded; it was found to contain two burned books of matches.

- A passenger was found in possession of a tear gas device.

- Two passengers were found to have 960 disposable lighters in their hand baggage and 163 more in their suitcases.

- During the crew's preflight inspection a can of flammable liquid was found in the luggage rack.

- During flight, fumes were seen emanating from paint carried in a passenger's bag.

- A passenger undergoing a security check was found with 144 quarter-litre bottles of hydrochloric acid in his baggage. Four members of the security team were hospitalized for four days after being exposed to the fumes.

- School children informed the cabin crew that they had fireworks in their pockets and in their luggage. There were six more similar incidents in the next two months, including one where 12 large and 2,500 small pieces of fireworks were discovered.

In February 1986, a British Airways passenger aircraft landed at London's Heathrow Airport, although it was scheduled to land at Manchester. The diversion was made because several passengers were suffering from exposure to fumes from two containers of ethyl chlorinate carried aboard by a passenger. He was charged with recklessly endangering the aircraft and all those aboard and was heavily fined.

In one case, a rocket engineer traveling as a passenger carried aboard a rocket motor that contained explosives. In another incident, a passenger caused $12,000 of damage to the carpet in a terminal building while carrying a leaking jar of corrosive substance from one check-in counter to another.

Although airlines display notices informing passengers about prohibited items, difficulties continue to be experienced — perhaps because the notices are unseen before the bags have been packed and passengers are reluctant to leave behind any item. Prohibited hazardous materials are frequently found in the possession of passengers when baggage is inspected at airport security screening.

Airmail Packages

Millions of packages are airmailed each year by a general public that is largely ignorant of regulations applicable to dangerous goods. A typical incident showing the risks posed by the mailing of dangerous goods happened at Brisbane, Australia. One of three parcels consigned from Taiwan to a "sporting arms dealer" exploded, causing serious injuries and damage. The investigation showed that after being exempted from inspection by customs, the parcels were being slid along a counter, and one of them fell four inches to a second counter and detonated. The packages bore no hazard warning labels, although each contained 44,000 starting pistol caps. The UN number (a serial number assigned to the article or substance under the United Nations classification system) used on the packages was not one recognized by postal or customs officers. The consignee claimed that it was a duplication of an earlier order but denied knowledge of the mode of consignment used on any other occasion.

FAA Cargo and Baggage Hold Categories

Class A — Compartments where fire would be easily discovered by a crew member and be easily accessible in flight, such as coat closets or overhead compartments in the passenger cabin.

Class B — Typically much larger than Class A with sufficient access in flight to enable a crew member to reach any part of the compartment with a hand-held fire extinguisher; incorporates smoke or fire detection to give warning at pilot or flight engineer station; requires liner meeting flame penetration standards; and access should be possible without smoke or fumes entering the passenger or flight deck areas. (The upper or main deck cargo compartments of "combi" aircraft, those which carry both passengers and cargo on the same deck separated by temporary or movable bulkheads, are normally Class B.)

Class C — Compartment that does not meet the accessibility requirements for Classes A and B, but which has built-in fire extinguishing and fire detection systems. These compartments are usually below the floor and can be large in volume.

Class D — A compartment in which fire would be completely contained without endangering the safety of the aircraft and its occupants, it is designed to contain a fire by restricting the supply of oxygen. (Some hazardous materials, however, are themselves oxygen producers.)

Class E — Main deck compartment used only for all-cargo flights; means must be provided to shut off ventilating air flow to or within a Class E compartment; a fire resistant liner must be capable of resisting the flame penetration; and the compartment is accessible to the crew and may be very large in volume. It must incorporate fire and smoke detection and must not block crew member evacuation routes.

"Combi" Aircraft

It is forecast that air transport of dangerous goods will increase at the rate of 20 percent per year. This prediction and the use of combi aircraft raise serious safety problems. In the latter, the main-deck cargo compartments are fully ventilated and nearby flight control cables could be exposed to very high temperatures in the event of fire. Because dangerous goods carried in these upper or main deck compartments are permitted on passenger aircraft, there is a requirement that they be accessible to the crew in flight (Class B).

Pilots are concerned by the absence of automatic extinguisher systems in Class B compartments, difficulty of access to these compartments with hand-held fire extinguishers and by doubts about performance and availability of fire and smoke detectors. They believe that the amount of ventilation provided in upper-and main-deck cargo compartments and the huge volume of oxygen available would sustain any fire that breaks out and perhaps permit it to become uncontrollable.

A 1987 conference of the International Federation of Air Line Pilots Associations (IFALPA) stated that the Federation would prefer that carriage of dangerous goods be limited to all-cargo aircraft but accepted that early implementation of that position is unlikely. Another policy stated that the Federation opposes the carriage of dangerous goods on the upper and main decks of combi aircraft because of the possible hazards of smoke, fumes or radiation entering into the passenger cabin and flight deck. The rationale for the policy was that tests show that the greater differential pressure required in a passenger compartment to prevent fumes and smoke from entering from a cargo compartment is not effective.

Another policy objective is to limit the carriage of dangerous goods to Class C compartments that are sealed and equipped with fire detection and extinguishing systems. IFALPA campaigns vigorously for improved cargo and baggage compartments with an objective being to limit the size of Class D compartments that rely on lack of ventilation as the principle means of suppressing fires.

A Combi Aircraft Accident

The prophetic concerns expressed by IFALPA in 1987 received unwanted substantiation when a South African Airways Boeing 747-200B combi aircraft crashed into the Indian Ocean 134 miles northeast of Mauritius with the loss of all 160 persons on board. The accident happened on November 28, 1987, but the voice recorder was not recovered until January 6, 1989; the wreckage was at a depth of more than 14,000 feet. Enough wreckage was recovered for the official inquiry to conclude that fire broke out in the aft upper deck cargo area and temperatures reached 1,000 degrees C. Investigation showed that there was a pressure build-up in the cargo area which burst through to the galley. Some passenger bodies showed abnormally high carbon monoxide concentrations, indicating that smoke penetrated the passenger cabin.

The only fire fighting equipment available to the crew was a single 16-pound rated Halon extinguisher with a stream duration of 12 seconds. In this situation, a flight attendant would have had to enter through a partition door, put on asbestos gloves, unfasten the 9-G cargo restraint net, rig the extinguisher, locate the fire in a particular pallet in conditions of thick smoke, and direct the extinguisher's contents onto the fire.

After this accident the airline converted its remaining Boeing 747 combi aircraft to all-passenger configurations.

There were media reports that some shippers of cargo on the ill-fated combi aircraft did not file claims for their losses, leading to unconfirmed speculation that illegal shipments were on board. Another suspicion was that the fire was "pyrotechnic" in origin.

Regulatory Response To the Accident

In September 1989 the FAA published an Airworthiness Directive (AD) that affects all Class B cargo compartments in combi aircraft where passengers and cargo are accommodated on the same deck, and will be implemented in two stages over a three-year period. The compartments have to be modified to Class C standard or have flame-resistant cargo containers equipped with smoke detectors and fire extinguishing systems. The AD also calls for implementation of numerous measures involving upper- or main-deck cargo compartments of combi aircraft within three years, some of which are:

- Smoke or fire detection systems with aural or visual warning at the station assigned to the person trained to fight fires.
- Fire extinguishing system to "knock down" a fire and suppress it so that the crew can find and put out the fire.
- Provision for a ventilation shut-off operable from the flight deck.
- Designated individuals trained to fight cargo fires.
- Provision of a cargo compartment liner that is flame and smoke resistant.
- Two-way communication between the flight deck, the fire fighter's duty station and cargo compartment.
- Cargo loading envelope limitations to provide access to all cargo to fight fires.
- Provision of a cargo compartment temperature indication system to both the flight deck and firefighter's station.

The FAA states that the firefighter must be a person trained to its standards and be additional to crew members required by current operational rules. The firefighter must search the cargo compartment before takeoff and every 30 minutes in flight unless an approved temperature-monitoring system is installed. Additional portable fire extinguishers are also required as is improved protection for cockpit voice and flight data recorders, windows, safety devices and flight control systems.

The AD provoked criticism from airlines because modification costs for Boeing 747 aircraft could be as high as $2.2 million per aircraft. British Airways has stated that it has improved its combi aircraft by covering pallets with fire-resistant blankets, installing fire curtains in cargo containers; increasing the number of fire extinguishers; and providing a cargo area viewing window, fire suits and additional training in fire fighting. Other airlines have responded in similar fashion, but some sought to extend the period allowed for compliance with the AD or to reduce the requirements. This was accommodated in the final ruling dated May 3, 1990 that allowed approximately six months of additional time for compliance.

Current Trends

A tendency to reduce the strictness of the original ICAO Technical Instructions for the Safe Transport of Dangerous Goods by Air, and to except from the regulations some small shipments of dangerous goods seems likely to increase levels of risk. These excepted shipments will not carry normal labels and thus the pilot-in-command will *not* be aware of their presence and their being mixed in with non-dangerous and identified dangerous goods. There will, therefore, be a greater risk requiring an increased awareness by all persons concerned if that risk is to be kept to an acceptable level.

Some experts believe that there is a need to provide better training to shippers, packers, forwarders and airline personnel; to educate the public about risks posed by dangerous goods; and to license cargo shippers and forwarders. An industry investment in improved technology could detect and deter both innocent and deliberate evasion of the regulations by installing equipment capable of detecting very small quantities of hazardous materials by means of "super sniffing" techniques, albeit at very high cost. Cargo or baggage loaded in containers or igloos is passed through the installed equipment at a rate of up to 20 containers per hour and it is claimed that the equipment can detect minute quantities of any material which it has been designed and programed to detect. Air samples gathered from the containers are passed through a test section containing a special disposable cartridge. Detection is based on the different molecular weights of the aromatic components of the target material and it is claimed that even if explosives or drugs are tightly enclosed in film wrap, sufficient odors will be detected to raise the alarm.

Because each installation costs more than $3 million they are unlikely to be widely used. It is possible that the cost of later versions of the equipment will be less and they will then be used at airports and the premises of freight forwarders. In October 1987 it was announced that the Japanese Customs Bureau had purchased four of the units and two systems are already in use in an unidentified Middle Eastern country where they are combined with X-ray equipment. It is not known if the super sniffer equipment can be used to detect all dangerous goods but it does raise hopes of equipment being developed in the future.

Until such detection equipment is widely available, ICAO regulations are enforced with increased emphasis on undeclared and hidden dangerous goods and the FAA's AD regarding Class B compartments is implemented worldwide, it is probable that many of the dangers posed by air carriage of hazardous materials will continue. ♦

About the Author

Laurie Taylor flew with the British Royal Air Force in World War II and later with British Overseas Airways Corp. (BOAC) and its successor, British Airways.

Taylor was chairman of the British Air Line Pilots Association (BALPA) and served as principal vice president, and later executive secretary of the International Federation of Air Line Pilots Associations. He has sat on the council of the U.K. Air Registration Board and was a member of the Airworthiness Committee of the International Civil Aviation Organization (ICAO) and of the Flight Time Limitations Committee of the U.K. Civil Aviation Authority (CAA).

He was awarded the Order of the British Empire (OBE), is a member of the Association of British Aviation Consultants and is a fellow of the Royal Aeronautical Society.

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Hazardous Waste and Aviation

Many substances commonly used in aviation become hazardous waste the moment they are spilled or are disposed of — that is when stringent environmental laws must be meticulously adhered to.

by
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"Corporation Executive Indicted for Toxic Waste Violation." Has a headline like this caught your eyes? Well, a toxic waste violation can happen in any industry, even in such a highly safety conscious business as a commercial airline.

Toxic or hazardous chemicals are used in many operations in the airline industry. Jet fuel is considered an ignitable hazardous waste. Grease solvents used in equipment maintenance are considered to be toxic waste by the U.S. Environmental Protection Agency (EPA). Hydraulic fluids and lubricating oils are classified as hazardous waste by several states (New Jersey, Massachusetts and Connecticut, among others). Cleaning compounds that are used in airplane cabins, airframes, electronics, cargo bays and control systems may contain toxic or corrosive chemicals. Worse yet, items shipped as cargo could become hazardous waste if spilled or damaged.

If any of these toxic chemicals are improperly disposed of, the law may place the blame on management, even if a manager or operator has only a very indirect responsibility for their use or misuse, and even if misuse took place years ago. Managers have even been found liable for improper actions of independent contractors. The law assigns responsibility for proper waste disposal primarily to the "generator" (the company that first produces the waste material) of the waste regardless of how many other companies handle the material afterward. The fines and jail terms handed out to corporate management, as well as considerations of safety and health of workers and the public, mean that managers should be aware and knowledgeable about toxic waste laws and the way that their companies deal with such materials.

A hazardous *material* is a substance that is regulated when it is in transportation. In the United States, hazardous material transportation is regulated and controlled by the U.S. Department of Transportation (DOT). Hazardous *waste* is a substance that is being disposed of that may pose a danger to human health and the environment. Hazardous waste is regulated by the EPA and various state agencies.

Learn the Acronyms

Hazardous chemical law has grown to be as complex and obscure as tax law. Most of these laws are usually known by their acronyms:

TOSCA (Toxic Substances Control Act), CERCLA (Comprehensive Environmental Response Compensation and Liability Act), ECRA (The Environmental Cleanup Responsibility Act), FIFRA (Federal Insecticide, Fungicide and Rodenticide Act), SARA (Superfund Authorization and Recovery Act), but there are also The Clean Air Act and The Clean Water Act. As usual, ignorance of the law is no excuse in court. The law that affects almost every large corporation is known as the Resource Conservation and Recovery Act (RCRA). RCRA governs the storage, treatment and disposal of hazardous waste. RCRA is enforced by the U.S. EPA as well as similar agencies at the state level. RCRA mandates "cradle to grave" recordkeeping for all hazardous waste activity.

Cradle to grave means that proper records must be kept from the moment waste is produced, while it is being stored or transported, and after it is disposed of. Most hazardous waste violations stem from improper or incomplete recordkeeping. To begin, any company that produces more than a certain minimum of waste must file a "Notification of Hazardous Waste Activity" form with the EPA and the appropriate state agency. In return, the company is given a control number known as the "EPA identification number" which must be present on all reports, records and shipping papers. RCRA requires that annual reports of all hazardous waste activity must be filed. Some states require quarterly reports as well.

Because of past improper treatment and disposal, current hazardous waste regulation and enforcement is both complicated and strict. Most large generators of hazardous waste are only allowed to store their waste for ninety days after it has been produced. After this period, the generator is liable to suffer fines and legal actions. The storage time limit on waste has a purpose; some of the biggest toxic waste sites began with improperly stored waste. Long-term storage results in many problems. Containers may begin to leak onto the ground. Containers left outside may rust or decompose and labels of contents of waste containers may fall off or become obscured with the passage of time. Congress put the storage time limit into law in order to correct problems like these. The less waste that is stored, the fewer problems will result. Because waste disposal is expensive, many companies might otherwise choose to delay this chore — in the past the delays have often been for years. Many toxic waste sites arose when a company went out of business leaving behind a large quantity of stored toxic waste and no funds to pay for its disposal. Of course, the 90-day time limit only applies to regulated hazardous waste, not to nonregulated waste, so it is important to keep the two distinct.

'Start Date' Is Important

To enforce storage limitations, RCRA requires that all hazardous waste containers be identified with a specific label that states the generator's name, address, EPA identification number, and the "start date" (the date that the waste was produced). The EPA also requires that detailed inventory records be kept on all waste. When waste is shipped offsite, special manifests are required, copies of which must be sent to state agencies where they become a matter of public record.

Even after the waste is shipped for disposal, liabilities remain. RCRA makes the original generator of the waste ultimately responsible for what happens to it even after it leaves his hands. Generators have been prosecuted for improper actions of contractors, i.e., haulers and disposal sites. For this reason it is very important for a waste generator to hire only responsible licensed hauling and disposal firms. Check your waste hauler thoroughly. Some companies are hiring their own environmental specialists. Like the tax laws, the waste laws are complicated and technical. A specialist can save a company money and legal fees.

"What exactly is hazardous waste and how do I know if my company produces any?" Most hazardous waste consists of common industrial chemicals used every day in a wide variety of operations. They become hazardous waste only when they are spilled or disposed. Waste types are identified by category and number in the U.S. Code, Title 40, beginning with Part 261.

The first category is called Characteristic Waste. Characteristic Waste is waste that exhibits a characteristic of ignitability, corrosivity or reactivity, or contains certain heavy metals or pesticides. Jet fuel that has become dirty or contaminated and has to be disposed is a good example of an ignitable waste. Inline fuel filters may also be considered ignitable waste. Many paints and paint thinners also fall into this category. Some cleaning compounds may be considered to be corrosive waste when they are disposed of. Air bag inflation devices that contain sodium azide may be reactive waste. Many common industrial waste materials, containing certain heavy metals such as lead or chromium, are called "Hazardous Waste from Nonspecific Sources." This category includes organic solvents and waste from metal plating operations. The grease solvents used in aircraft machine shops and maintenance operations fit into this category. Several states consider waste hydraulic fluid and lubricating oils hazardous waste. In addition, there are many other waste categories and specific waste types.

Hazardous Chemicals Are Airborne

Many hazardous chemicals are shipped by air each day. Hazardous waste as such is not shipped by air, but many other non-waste chemicals travel as air freight on both passenger and cargo aircraft. For safety reasons, extremely hazardous chemicals are forbidden from transport on passenger aircraft except in very small quantities that are well packaged. Such extremely hazardous chemicals are marked "cargo aircraft only." The U.S. DOT has strict rules about the packaging and labeling of all hazardous materials for air transport. Bulk chemicals are seldom shipped by air because the freight charge would be too high. Nevertheless, hazardous materials are probably present on most flights. Samples of chemical products, lab chemicals and samples for analysis travel through the mail and the air every day. Some materials that would not normally be thought of as dangerous can be damaging to aircraft. Switches and electrical equipment can contain metallic mercury, which, if it escapes from its container, can damage aluminum airframes. Common household drain cleaner can damage airframes as well. For this reason, such materials are allowed on aircraft only when securely packaged in leak-proof containers. In addition, despite the warning signs about hazardous material posted at all commercial air terminals, passengers unknowingly often carry hazardous materials in their luggage.

What happens to hazardous waste after it leaves the site where it was produced? In the past, most waste went to landfills or was injected into underground rock formations. Because of numerous incidents of leaking landfills and polluted groundwater, the U.S. Congress, when it reauthorized RCRA in 1984, mandated a phase-out of all forms of land disposal over a five-year period starting in 1986. Known by various terms, this "landban" is making dramatic changes in the ways that hazardous waste is treated and disposed of.

Today, incineration and treatment are becoming the rule. Incineration in high-temperature state-of-the-art incinerators is a popular, but expensive, method of waste disposal. The landban provides strict standards for the extent to which materials have to be treated. Waste water treatment is the preferred method for many other types of waste. Acids and alkalies are neutralized in this process and heavy metals are precipitated out of the waste, rendering it nonhazardous. The waste water goes to the public sewer and the solid residue goes to secure landfills. Of course, even when the waste is treated to the maximum extent required by law, a residue remains. This residue, which may consist of incinerator ash or treatment sludge, goes to modern landfills that are a far cry from their sometimes primitive predecessors.

The modern, licensed, secure landfill uses several different strategies to ensure that waste that is deposited there remains at the site. Current landfills contain at least four separate high density polyethylene liners along with additional layers of impermeable compacted clay that forms a chemical-proof barrier to any outward migration of the waste. In addition to these barriers, the modern landfill contains leachate collection systems to remove any liquid that may collect in the landfill. One ultimate goal of the landban is to make sure that only waste that has been treated to the maximum extent required by law goes into the ground.

Recycling — A Viable Option

Recycling of waste materials is among the best and most economical methods of treatment available. Certain organic materials such as grease solvents lend themselves to recycling. Congress requires waste minimization efforts from all producers of waste. The goal is to minimize the amount of waste that is produced, either through recycling, or redesign of processes and procedures in order to produce less waste in the first place. The landban has dramatically increased the cost of waste collection, treatment and disposal. This increased cost, in addition to waste taxes that are levied by many states, has created a strong incentive towards waste minimization. Some companies have switched to nonhazardous and nontoxic grease solvents. Others no longer use paints that require hazardous thinners. Switching to products that are not hazardous, or those that are easier to treat, can actually save companies money even if the initial outlay for the products is greater. Waste disposal costs, as well as waste taxes and environmental consulting fees, should be taken into account before purchasing new products.

Recent regulations such as the Superfund Reauthorization Act and Occupational Safety and Health Administration (OSHA) laws have increased the reporting burden on companies. Companies must have data on file on all the hazardous chemicals they use in their operations. This data usually takes the form of a Material Safety Data Sheet (MSDS). An MSDS is an OSHA-mandated form that lists the hazardous ingredients of a product and it should contain necessary safety and health information. OSHA requires that MSDS information be made available to all employees and that they be informed about any possible occupational exposure to hazardous chemicals.

Public concern about chemical exposure has resulted in "right to know" laws which mandate that not only workers, but also the public must be informed about any hazardous chemicals that companies use. This new regulation, part of the Superfund Reauthorization Act, requires that companies send chemical inventories and MSDS information to state agencies as well as local governments and fire departments. This information remains on file and available for public inspection. Companies also must report all spills of hazardous chemicals to these same agencies and this information is also freely available to the public. Information on spills and releases often finds its way into news articles, which can result in embarrassing explanations and poor public relations.

Another important new law is ECRA, now on the books in New Jersey and some other states and which may become federal law. ECRA mandates that before commercial property can be sold, it must pass an environmental audit, requiring that the site be certified to be clean of any hazardous chemical contamination from past activities. Past improper disposal practices are resulting in many expensive cleanup operations. The ECRA laws evolved because in the past, companies often sold contaminated sites to unsuspecting new owners.

One of the largest sources of hazardous waste results from spills and leaks during normal operations. Almost any kind of routine maintenance is bound to produce spillage of some sort. Oil and grease spills often accompany engine work. Small fuel leaks frequently occur during refueling and filter changes. Hydraulic fluid may escape during inspections and servicing. Many companies still follow the same procedures with this spill material that they have been following for years; namely, cover the spill with an absorbent, sweep it up, and throw it away with the trash. This method of waste handling is not good practice. Spilled material must be identified, correctly cleaned and put into proper containers. The containers should then be properly stored according to the hazardous waste regulations. Keeping hazardous trash and spill materials separate from nonhazardous debris is essential, in order to keep costs down and stay in legal compliance. If hazardous trash is mixed with non-hazardous refuse, the entire mixture is considered to be hazardous. Oil or grease spills, though not considered hazardous by federal law, are strictly regulated waste in several states. Failure to clean spills properly can result in the materials washing into soil and streams with consequent widespread pollution. In addition, fines and other legal penalties are always a possibility for companies that do not correctly clean or properly report spills.

Where to Go for Help

Suppose you are responsible for a site that may have environmental problems or you just need advice on these matters. Who should you ask for information? What kind of company should you hire?

Much will depend on what kind of company with which you are associated and what kind of site is being used. The first and most important resource is your own company's environmental and safety compliance department. Most large firms have such a department. Unfortunately, many of these departments have their hands full with other problems, and you may be operating at a site which has never come to their attention. The first step is to determine what your operation is currently doing with its hazardous chemicals and what its spill procedures are. Because waste is not a producing part of business, and had little glamor or advancement potential associated with it in the past, your operation may still be handling its waste materials the same way it handles ordinary trash. Nontechnical cleanup and maintenance people are probably not aware of what is necessary to be in legal compliance with today's complicated regulations.

Products	Possible Hazardous Constituents
Adhesives	Organic solvents
Antifoaming agents	Phthalate esters
Batteries:	
Lead acid	Lead, sulfuric acid
Nickel cadmium	Nickel, cadmium, caustic alkalies
Nickel iron	Nickel, caustic alkalies
Mercury	Mercury
Belt dressings	Lead, organic solvents
Brake fluids	Glycol ethers
Brake System Flushing Fluid	Methyl alcohol, other alcohols
Caulking compounds	Solvents, lead
Cleaning compounds	Corrosives, solvents, glycol ethers
Corrosion inhibitors	Chromates, nitrites, nitrites, amines, hydrazine
Cutting oils	Nitrites, chromates, glycol ethers
Degreasing compounds	Chlorinated solvents, cresol, phenol, caustic alkalies
Fiber glass repair chemicals	Organic peroxides, solvents
Fire extinguishers:	
Foam	Glycol ethers
Halon	Chlorinated solvents
Frost removers	Alcohols, glycols
Fuel driers	Alcohols
Gear oils	Lead, organic phosphates, barium
Greases	Lead, barium, chrome, glycol ethers, chlorinated solvents
Hydraulic fluids	Organic phosphates
Paints	Lead, zinc, chrome, solvents
Radiator flushes	Caustics, acids, solvents
Refrigerants	Chlorofluorocarbons
Tire cleaners	Caustics, alcohols, glycol ethers
Tire repair compounds	Solvents
Transmission fluids	Organic phosphates
Welding fluxes	Acids

Figure 1

Many environmental information firms are in existence and can provide extensive information on proper procedures. If you suspect that you are operating at a contaminated site, or that problems might exist, you may wish to hire a technical consulting firm in order to determine the extent of the problem. If you know that your site produces waste, and you need someone to package, transport and dispose of it, then you should hire the services of a full service waste management company. Waste disposal companies, waste transporters, consulting services and environmental laboratories can be found listed, by state, in *Industrial and Hazardous Waste Management Firms*, published annually by Environmental Information, Ltd., 7400 Metro Blvd., Suite 400, Minneapolis, MN 55435, U.S. Its telephone number is (612) 831-2473.

If you are hiring a waste management agency, you should make sure that you are dealing with a reputable firm. Good sources to check are the state EPAs. These agencies cannot recommend anyone, but they can inform you about any legal compliance problems a company might have had.

Many companies that do business outside the United States would do well to become informed on other countries' environmental regulations. These can be quite strict, particularly in Western Europe and Japan. In order to find out more information, the appropriate agencies should be contacted for each individual country. Some of these agencies are listed below. ♦

About the Author

John H. (Jack) Kehoe works as the senior materials routing supervisor for Laidlaw Environmental Service, Inc. at its Laurel, Md., transfer station. For the past five years, Kehoe has been responsible for overseeing the disposal of waste materials that the company handles on a contract basis. Previously he worked as a chemist in the company's field operations unit.

International Hazardous Materials Information

Belgium
Marcel Lambert
Cellule Environnement
Ministèré de la Santé Publique et de l'enviornnement
Quartier Vésale
Cité administrative de l'Etat
1010 Bruxelles

Canada
Pierre Beaudein
Waste Control Divsion
Environment Canada
W. Mary Blvd.
Ottowa, Ontario K1A OH3

Denmark
Waste Management Division
National Agency of Environmental Protection
Strandégade, 29
1401 Copenhagen K

Finland
Ministry of Environment
Environmental Protection Department
Waste Management Division
P.O. Box 399
SF-00121 Helsinki

France
Jean Louis Dutaret
Service des Déchets
Ministère de l'Environnement
14, Blvd du Général Leclere
92524 Neuilly s/Seine Cedex

Germany
Brudesministerium für Umwelt
Naturschutz und Reaktorsicherheit
Postfach 12 06 29
5300 Bonn 1

Greece
Ministère de l'Environnement de l'Urbanisme des Travaux Publics
Direction des Activités Internationales et des Sujets CEE
Patission 147
11251 Athènes

Italy
ENEA
125 Viale Regina Margherita
00198 Rome

Netherlands
Ministry of Public Housing
Physical Planning and Environmental Protection
Department of Waste and Clean Technologies
P.O. Box 450
2260 MB Leidschendam

Norway
State Pollution Control Authority
B.P. 8100 Dep.
0032 Oslo 1

Spain
D.G.M.A.
Ministerio de Obras Publicas y Urbanismo
Castellana 67
28071 Madrid

Division Environnement
Ministerio de Obras Publicas y Urbanismo
Castellana 67
28071 Madrid

Sweden
National Environmental Protection Board
Box 1302
17125 Solna

Switzerland
Office Fédéral pour la Protection de l'Environnement
3003 Berne

Turkey
Conseiller Juridique
Ministère des Affaires Etrangères
Mesrutiyet Caddesi 27
Yenisehir
06650 Ankara

United Kingdom
Jack Bently
Department of Environment
Room B5.48
Romney House
43, Marsham Street
London SW1 3PY

United States
Wendy Grieder
Office of International Activities
U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, DC 20460 U.S.

John Atcheson
Pollution Prevention Division
OPPE
U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, DC 20460 U.S.

Matthew Straus
U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, DC 20460 U.S.

Aviation Statistics

U.S. Transportation Fatalities and Trends In the Eighties

During 1989, transportation fatalities in the United States totaled 48,234 — a drop of three percent from 49,904 in 1988, according to the U.S. National Transportation Safety Board (NTSB). A breakdown of fatalities by transportation modes for calendar years 1988 and 1989 is shown in Table 1.

NTSB statistics show that general aviation fatalities were down from 796 in 1988 to 763, the lowest ever recorded annually in U.S. general aviation history. Air carrier accidents claimed the lives of another 277, down from 285 in 1988. However, the fatalities involving commuter air carrier and on-demand air taxi operations rose between 1988 and 1989, from 21 to 32 for commuters and 58 to 86 for air taxis.

Table 1 - U.S. Transportation Fatalities By Transportation Modes 1988 - 1989

Modes	1988	1989
Highway	47,087	45,454
Grade Crossing	689	791
Rail	563	601
Aviation		
Airline	285	277
Commuter	21	32
Air Taxi	58	86
General Aviation	781	763
Marine		
Commercial	128	95
Recreational	946	896
Pipeline	20	39
Total	50,578	48,243

As a comparison with surface transportation statistics, grade crossing accidents involving trains and highway vehicles resulted in 791 fatalities in 1989, up approximately 15 percent from 689 deaths in 1988. This is the highest number grade crossing fatalities since the beginning of the decade when 833 persons were fatally injured. The NTSB also reported that rail fatalities were up from 563 in 1988 to 601 in 1989. Of the 601 rail fatalities, more than 90 percent were non-passengers, six percent were rail employees and only about three percent were rail passengers.

In highway fatalities, which account for about 95 percent of total transportation, fatalities dropped more than three percent in 1989 from 47,087 in 1988 to 45,454. "While the decline in highway fatalities in heartening," the NTSB report noted, "the number of people killed in alcohol- and drug-related accidents is totally unacceptable. Alcohol and drug abuse continued to be one of greatest threats to transportation safety facing the nation." Although the NTSB did not release the most recent alcohol/drug-related transportation fatality statistics, the U.S. National Highway Traffic Safety Administration (NHTSA) 1987 statistics as shown in Table 2 reveal that of all motor vehicle drivers involved in highway fatal accidents, including motorcycle operators, eight percent had a .01-.09 percent blood-alcohol concentration (BAC) level and 25 percent had a .10 percent or higher BAC level.

In aviation, the U.S. Federal Aviation Regula-

Table 2 - Motor Vehicle Drivers, Pedestrians and Cyclists Involved in Highway Fatal Accidents Calendar Year 1987

Persons involved	Number	Blood Alcohol Concentration Level		
		None	Less than .10%	More than .9%
Vehicle Drivers	60,486	67%	8%	25%
Male	46,882	63%	9%	28%
Female	13,604	79%	6%	15%
Pedestrians and Bicyclists	7,751	64%	7%	29%
Motorcycle Operators	3,848	49%	13%	38%

tions (FAR) prohibit the use of alcohol by crew members within eight hours of flight time and also prohibit anyone from acting as a flight crew member while under the influence of alcohol. In a recent alcohol-related incident involving airline pilots, it was reported that the FAA in March this year revoked the licenses of three airline crew members who were charged with flying a jetliner from Fargo, North Dakota, to Minneapolis, Minnesota, while under the influence of alcohol. The NTSB has not released any more recent alcohol-related accident statistics to substantiate its concern about alcohol/drug abuse in aviation.

In a safety study, published in April 1984, the NTSB reported that during the years 1975-1981, more than 10 percent of the toxicological tests on all deceased pilots were positive for alcohol, but no deceased airline pilots were found to have positive alcohol tests in the same period. Toxicological tests were positive for alcohol in 6.4 percent of the tests made on fatally injured commuter air carrier pilots and in 7.4 percent of fatally injured air taxi pilots. In general aviation, 10.5 percent of toxicological tests on fatally injured pilots were positive for alcohol. The extent to which alcohol is involved in non-fatal accidents was not known because there is no federal authority to test surviving pilots for alcohol.

A graphical presentation of the annual fatality distribution over the past decade by transportation modes is show in Figure 1. Note that over the 10-year period, the annual fatalities of general aviation and recreational boating showed a very steady trend of improvement. Airline fatalities were up one year and down the next, with a low of one fatality in 1980 and four fatalities in 1981, 1984 and 1986, and a high of 526 fatalities in 1985; there was obviously not a trend in this category. Of all other transportation modes, including highway, rail, grade crossing, commuter, air carrier and air taxi, the annual fatalities show a decline in the early 1980s, but the trends for these categories turned upward since 1985-1986. ♦

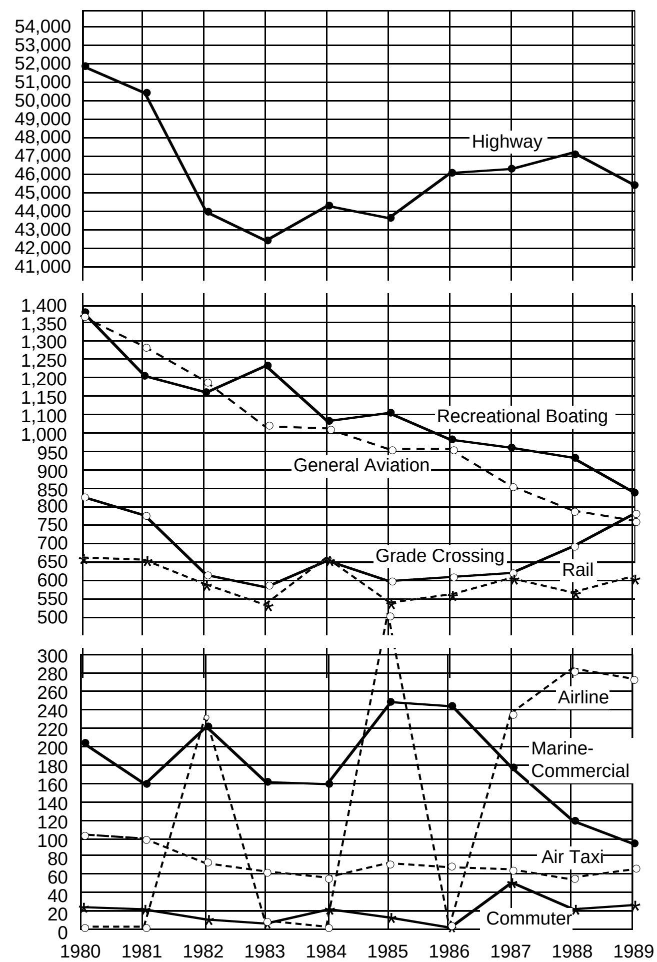


Figure 1

Reports Received at FSF Jerry Lederer Aviation Library

Reports

Human Factors of Flight-Deck Checklists: The Normal Checklist / Asaf Degani (NASA Ames Research Center) and Earl L. Wiener (University of Miami). — Washington, D.C. : National Aeronautics and Space Administration; Springfield, Va. : Available through NTIS*; May, 1990. Report NASA-CR-177549; Contract NCC2-377. 72p.

Key Words
1. Airplanes — Piloting — Checklists.
2. Airplanes — Piloting — Human Factors.
3. Air Pilots — Errors.
4. Air Pilots — Workload.
5. Airlines — Operational Procedures.

Summary: Although the aircraft checklist has long been regarded as the foundation of pilot standardization and cockpit safety, it has escaped the scrutiny of the human factors profession. The improper use, or the non-use, of the normal checklist by flight crews is often cited as the probable cause or at least a contributing factor to aircraft accidents. In this report, the authors attempt to analyze the normal checklist, its functions, format, design, length, usage, and the limitations of the humans who must interact with it. The manufacturers, government, airlines, and pilots all influence the ultimate design and usage of the checklist. The effects of airline mergers and acquisitions on checklist usage and design are noted. The interaction between production pressures ("making schedules") and checklist usage and checklist management are addressed. A list of design guidelines for normal checklists is provided. [author]

The Practice of Aviation Safety: Observations from Flight Safety Foundation Safety Audits / Capt. E.R. Arbon (Flight Safety Foundation), Capt. L. Homer Mouden (L. H. Mouden Associates), Robert A. Feeler (Robert A. Feeler Associates). — Arlington, Va.: Flight Safety Foundation, June 1990. Report FSF/CP-90/12. 45p. Available: FSF, $25.00 (U.S.)(member), $35.00 (U.S.)(nonmember).

Key Words
1. Aeronautics — Safety Measures — Auditing.
2. Airlines — Operational Procedures — Auditing.
3. Corporate Flying — Operational Procedures — Auditing.
4. Airports — Safety Measures — Auditing.
5. Air Pilots — Performance — Auditing.
6. Airplanes — Piloting — Auditing.
7. Safety Audits.

Table of Contents: Safety Audits and Operator Goals — A Typical Aviation Safety Audit — Lessons Learned from Safety Audits — Organizational Characteristics:

Policies and Procedures; Communication; Morale Issues; Organizing Safety Activities; Training; Flight Operations; Cabin Services; Maintenance and Engineering; Inspection Quality Assurance; Ramp Activities and Ground Operations; Aircraft, Equipment and Facilities; Corporate Aircraft Standards; Summary — Appendix [Bibliography].

Summary: This publication "shares, in a nonattributive manner, some of the Foundation's accumulated audit experience acquired from 60 audits conducted worldwide during the past decade, from small corporate aviation operations to large international air carriers. The dimensions of both internal self-audits and external independent audits, including general guidelines for conducting them, are also addressed. ... It is the aim of this document to provide operators with a perspective on how safety is or is not achieved; the recommendations and observations may be useful in self-examination of their own operations." [Foreword]

Report of the Board of Inquiry into the Loss of

South African Airways Boeing 747 - 244B Combi Aircraft "Helderberg" in the Indian Ocean on November 28th 1987 / Republic of South Africa. — Pretoria, South Africa; Government Printer, May 14, 1990. 264p [Two volumes bound together as one volume.]

Key Words
1 Aeronautics — Accidents — 1987.
2. Aeronautics — Accidents — Cargo Area.
3. Aeronautics — Accidents — Fire — Cargo Area.
4. Aeronautics — Accidents — Smoke Detectors.
5. Airplanes — Airworthiness.
6. Airplanes — Design and Construction.
7. Boeing 747 (Jet Transports) — Accidents.
8. Operation Resolve.
9. South African Airways — Accidents — 1987.

Letter to The Honorable Minister of Transport and of Public Works and Land Affairs submitting the final Report of Board of Inquiry, C.S. Margo, Chairman.

Summary: South African Airways Flight 295, B747-244B "Combi," Taipei to Plaisance, 5 flight crew, 14 cabin crew, 140 passengers on aboard. Some 46 minutes before the estimated time of arrival at Plaisance Airport, Mauritius, the flight deck informed the approach control at Plaisance that there was a smoke problem in the airplane and that an emergency descent to flight level 140 had been initiated. Eighteen minutes later, at about 04:07 local time, the airplane crashed into the Indian Ocean 134 nautical miles North-East of Plaisance Airport. There were no survivors. The wreckage, consisting of thousands of fragments, sank to the ocean at depths of the order of 15,000 feet, although many of the lighter materials floated away on the currents. "...sufficient evidence has been recovered to enable the Board to determine that the fire broke out in the forward pallet on the right side, the circumstances being such that a similar fire could occur again in another aircraft; that the fire got out of control, and generated consequences, either by way of damage to the aircraft, or by way of loss of control of the aircraft, or by way of incapacity (which term includes distraction) of the crew, which caused the aircraft to crash into the sea. On these firm bases, the Board is able to make recommendations of a practical nature which are aimed at ensuring that such a situation will not happen again." (p. 146). The NTSB, Boeing, U.S. FAA participated in the accident investigation. The NTSB issued recommendations A-88-61 through A-88-63 recommending that the FAA require cargo be carried in fire resistant containers; conduct research on fire detection and suppression methods; establish fire resistant requirements for the ceiling and sidewall liners.

Aircraft Accident Report: Evergreen International Airlines McDonnell Douglas DC-9-33F, N931F Saginaw, Texas, March 18, 1989. — Washington, D.C. : National Transportation Safety Board; Springfield, Va. : Available through NTIS*, April 23, 1990. Report NTSB/AAR-90/02, PB90-910402. 85p.

Key Words
1. Aeronautics — Accidents — 1989.
2. Aeronautics — Accidents — Cargo Doors.
3. Evergreen International Airlines — Accidents — 1989.

Summary: This crash occurred during the turn to final approach as the pilot was attempting to return to Carswell AFB, Fort Worth, TX, after a cargo door opened. This cargo flight was on an IFR flight plan. Night visual meteorological conditions existed at the time of accident. The captain & first officer, the only persons onboard, were killed. NTSB determines that the probable cause of this accident was the loss of control of the airplane for undetermined reasons following the inflight opening of the improperly latched cargo door. Contributing to the accident were inadequate procedures used by Evergreen Airlines and approved by the FAA for preflight verification of cargo door security, Evergreen's failure to mark properly the airplane's external cargo door lock pin manual control handle, and the failure of McDonnell Douglas to provide flightcrew guidance and emergency procedures for an inflight opening of the cargo door. Also contributing to the accident was the failure of the FAA to mandate modification to the door-open warning system for DC-9 cargo-configured airplanes, given the previously known occurrences of inflight door openings. NTSB issued Safety Recommendations A-90-86 and A-90-87, requiring flight manual amendments on the cargo doors for the DC-9. [Executive summary]

Proceedings of the Flight Safety Foundation Digital Flight Data Recording Workshop. — Arlington, Va.: Flight Safety Foundation, 1990. Report FSF/CP-90/11. 79p.

Key Words
1. Aeronautics — Safety Measures.
2. Airlines — Operational Procedures.
3. Airlines — Employees — Training of.
4. Flight Recorders.
5. Flight Crews — Performance — Analysis.
6. Flight Operations — Monitoring.

Table of Contents: Operational Flight Data Recording in the United Kingdom Civil Aviation Authority — Special Event Monitoring: An Engineering Perspective — Special Events Search and Master Analysis (SESMA) — The BALPA Involvement in DFDR Monitoring — Flight Data Recorder Replay and Analysis System — Prevention-Protection — The Scandinavian Airlines System Flight Analysis and Aircraft Monitoring System — Viewpoints on the Use of DFDR Data in an Operational Trend Analysis Program — Flight Data Evaluation in Swissair — DFDR Programs and Their Use at Swissair: The AEROPERS View — Legal Issues — Information Security: The Critical Element in DFDR Monitoring — ALPA Perspective — Training Implications — Workshop Summary.

Summary: Digital Flight Data Recorders provide the means to automatically and systematically obtain comprehensive data on flight operations which can be analyzed and provide information to prevent accidents. These proceedings include papers from airlines who are using DFDR procedures and pilot union representatives who discuss their experiences with DFDR. According to FSF, DFDR ... "now makes possible the timely identification of specific exceedances resulting from crew decisions as well as shortcomings in crew training, ATC procedures, airport design and aircraft design. And of course, being able to specify a problem is the first step toward positive corrective action." ♦

*U.S. Department of Commerce
National Technical Information Service (NTIS)
Springfield, VA 22161 U.S.
Telephone: (703) 487-4780

Accident/Incident Briefs

This information on accidents and incidents is intended to provide an awareness of problem areas through which such occurrences may be prevented in the future. Accident/incident briefs are based upon preliminary information from government agencies, aviation organizations, press information and other sources. The information may not be accurate.

Air Carrier

Excessive Expediting Leads to Embarrassment

Lockheed L-1011 TriStar: No damage. No injuries.

Maintenance personnel were taxiing the widebody aircraft from a hangar to another location on the airport to run up engine number 1 and perform vibration tests on it. The aircraft was being moved using engines 2 and 3.

After stopping at a holding point, the crew was cleared to cross a runway and was instructed to expedite clearing the runway. After the brakes were released and power was applied, the aircraft swerved to the left and the nose and left main landing gear left the paved surface, rolling onto the grass. The aircraft was stopped partially on the runway at a 90-degree angle to the centerline. Emergency services responded but there was no evidence of malfunction or damage, and the aircraft's brakes and nosewheel steering responded normally.

With clearance from the control tower, the aircraft was taxied back onto and across the runway to the runup area where the engine test was carried out without further incident.

The incident was attributed to the use of excessive assymetric thrust when the operator attempted to expedite the crossing of the runway. The three maintenance personnel involved were counseled on taxiing procedures which include a stipulation both in the training syllabus and taxi checklist to never exceed 35 percent N1 for ground operations. The carrier also prohibited further taxiing with an engine out.

Check That Loadsheet To Prevent Surprises

Lockheed L-1011 TriStar: No damage. No injuries.

The aircraft had been flown to Athens without passengers and with only 330 pounds of catering aboard for the crew. At Athens, 6,600 pounds of catering was loaded for a passenger flight to London. The load control agent assumed that the new catering data was automatically entered into the departure control system.

After the aircraft arrived at London, a number of discrepancies were noted in the loading and on the load sheet. These included: the catering weight indicated 330 pounds — the actual weight was 6,600 pounds; the paperwork indicated cargo compartment 1 was empty — the actual load included a spares pack weighing 1,500 pounds; and bags of a total weight of 1,500 pounds were recorded as being in cargo compartment 5, but the spares pack with the same indicated weight that was found in compartment 1 was not entered. Compartment 5 was empty.

The responsible loading staff member was suspended pending further training and flight crews were reminded to check loadsheet entries, especially for non-scheduled or unusual flight operations.

Commuter

Continued Approach After Windshear

British Aerospace BA 31 Jetstream: Substantial damage. Various injuries.

The aircraft was approaching to land in the early afternoon in daylight conditions in a winter day. There were six passengers and a crew of one aboard.

The aircraft encountered low-level windshear on final approach but the pilot continued the landing attempt. The aircraft landed hard and bounced. It then dove onto the runway, the landing gear collapsed and control was lost. It subsequently impacted a snow bank. The aircraft was destroyed and serious injuries were sustained by the pilot and one passenger, with minor injuries to the other five passengers.

Causal factors included the presence of the windshear, the failure to go around, inadequate wind compensation and improper recovery.

Unneeded Training Realism Gives Hard Lesson

Fairchild (Swearingen) SA-227 III: Aircraft destroyed. Various injuries to three.

The pilot was receiving a currency check ride. It was a half hour before midnight on a fall evening.

The instructor simulated an engine failure during takeoff. The aircraft did not climb as expected and struck the instrument landing system (ILS) antenna. A wingtip separated and the aircraft impacted the ground and was destroyed. Of the three crew members aboard, one was injured seriously and the other two sustained minor injuries.

Factors that contributed to the accident included the fact that the flaps were extended more than 50 percent during takeoff (a reflection on improper use of the checklist); inadequate supervision by the check pilot; and inadequate preflight planning and preparation.

Go-Around Attempt After No-gear Touchdown

Beechcraft B-55 Baron: Aircraft destroyed. Fatal injuries to one.

During an arrival early in the morning, the pilot initiated a go-around during the landing roll. He retracted the landing gear and made another approach.

On roundout during the second landing attempt, the propellers struck the runway. The pilot added power and lowered the gear but the aircraft rolled inverted and crashed. The Baron was destroyed by post-crash fire and the pilot sustained fatal injuries.

Among factors involved were failure to lower the gear, improper crew decisions and a failure of a propeller control.

Twas a Dark and Rainy Night

Beechcraft B-58 Baron: Substantial damage. No injuries.

The aircraft was approaching its destination after a cross-country flight. The pilot was the only occupant.

It was evening and dark, and the runway was wet. The pilot made an ILS approach but, because of excessive airspeed, landed long. With the wet runway and high speed, the aircraft hydroplaned and the pilot was unable to brake it to a stop before it ran off the end of the runway. The aircraft skidded 300 feet and collided with a rock pile. The aircraft was damaged substantially but the pilot exited unharmed.

Factors in this accident included excessive airspeed, failure to go around and hydroplaning conditions.

Continued VFR Flight into...

Piper PA-25-235 Pawnee: Aircraft destroyed. Fatal injuries to one.

The pilot of the aerial application aircraft had taken off at 0600 hours in the mid-summer day on a crop-spraying mission. Weather conditions were good but numerous fairly large patches of fog had been reported in the area, but these were expected to burn off later in the morning. About an hour and a quarter after the aircraft took off, witnesses reported an aircraft at a low altitude struck a power line after which it continued about 500 feet and out of control when it impacted the ground. The aircraft exploded and burned and the pilot sustained fatal injuries.

The witnesses also reported that there had been no fog when the aircraft began spraying but that fog quickly enveloped the area, restricting visibility to a half mile or less. Most of them stated also that it was difficult to follow the aircraft and to see the power line because of the fog.

Investigators surmised that the pilot attempted to use the power line as a guide to the landing strip but that he lost visual contact because of the fog. When he attempted to re-establish visual contact, the reduced visibility prevented him from seeing the cable in time to avoid hitting it. The finding was the classic "... attempted to continue the visual flight rules flight in unfavorable weather conditions."

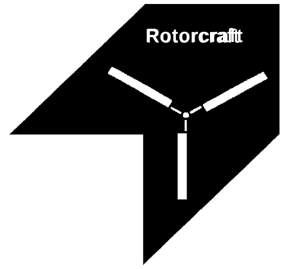
Low Reversal After Takeoff

Cessna 206: Aircraft Destroyed. Fatal injuries to two.

The aircraft was departing in mid-afternoon on a summer day. It had just taken off and was climbing through 500 feet during the initial climb when the engine lost power.

The pilot turned back toward the runway. The aircraft stalled and struck the ground to the side of the runway in a nose-down attitude at a high rate of descent. The aircraft was destroyed and both occupants sustained fatal injuries.

Examination of the engine revealed that a cylinder had failed because of thermal stresses and service life, resulting in the loss of power. Investigators reported that a suitable forced landing field was ahead of the aircraft when the power failed. When the pilot attempted to return to the takeoff point, the tight turn he made caused the airspeed to decay until the aircraft stalled. There was no opportunity to recover from the stall because of the low altitude and lack of engine power.



Late Change of Mind Has Unwelcome Result

Bell 206B: Substantial damage. No injuries.

The air taxi helicopter lost power while climbing through 6,000 feet. The pilot was not able to restart the engine and selected a forced landing spot near the shoreline of a lake.

Just prior to the touchdown, the pilot changed his intended landing site because of uneven terrain in the original location he had chosen. The maneuvering to get the helicopter to the new site caused excessive rotor energy to be expended and a hard landing resulted. The helicopter was damaged substantially but the pilot and three passengers were able to exit without injury.

Untimely Gust Encounter Upsets Rotorcraft

Bell 47: Substantial damage. No injuries.

During the downwind approach to a swath run, the aerial application rotorcraft experienced a sudden gust. The result was a retreating blade stall.

The helicopter struck the ground and rolled over. The pilot was able to evacuate without injury but the aircraft sustained substantial damage. ♦