Aviation Security In An Age Of Terrorism

The author emphasizes that there are no quick or cheap security solutions to the terrorism threat, and urges the whole airport/airline community to consider security as important an element of their corporate standing as their flight safety record, reputation for service and aspirations to excel.

by

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There are many factors which contribute to or detract from aviation safety and the topic "Aviation Security in an Age of Terrorism" is but a small element of the whole.

In the following discussion, I intend to touch on the following topics:

- The Nature of the Terrorist Threat.
- The Techniques of Terrorism.
- The Development of Countermeasures.
- Counter Terrorist Techniques.
- Counter Terrorist Equipment.
- The Coordinated Response.
- Future Directions.

The Measure of the Terrorist Threat

It is interesting that, despite many United Nations resolutions on Terrorism, they have not yet produced an agreed definition. With the diversity of views the phrase "one man's Terrorist is another's freedom fighter" is alive and well and was illustrated by the U.N. moving a session to Geneva to hear words of wisdom from Yasser Arafat — a freedom fighter to most but the leader of a terrorist organization to the United States and Israel.

Terrorism involves the use of violence; it is intended to provoke fear and it has a political aim. It is the last element which distinguishes it from the activities of the drug barons and the gangs — perhaps increasingly less, as they grow sufficiently powerful to exert significant political influence. The acts themselves are crimes — murder, arson, extortion, blackmail, manslaughter, etc. There is no crime of "terrorism." Terrorism is the motivation for criminal acts, and it is the political element and the provocation of fear in a much wider constituency than those directly affected by the crime which distinguishes terrorism from ODC — ordinary "decent" crime.

A great many observers, analysts, writers and governments have attempted to classify terrorists under various headings usually according to motivation. They include:

- **Nationalistic, Separatist or Ethnic.** These groups usually have clearly stated, overt objectives although rather like the mouse that cornered the elephant — now what? They include for example, the Euzkadi Ta Azkatusuna (ETA) — independence for the Basque, Many Palestinian Organizations — the destruction of the state of Israel and return of its territory to the Palestinians, the Irish Republican Army (IRA) — withdrawal of the British from Ireland and establishment of a United Socialist Republic, Sikhs, Tamils, etc.

- **Ideology of the Left or Right, Anarchist, Nihilist.** Organizations embracing left-or-right wing principles in an extreme form or with the objective of destroying "the establishment." Examples include Tupamaros of Uruguay, Baader/Meinhof/Red Army Faction, Action Directe, Celles Com-France, Federal Republic of Germany, the United States (the Weathermen), UK, (the UVF UDA), and, more anarchist than revolutionary, the Japanese Red Army.

- **State Sponsors.** Operations researched, funded and directed by States such as Libya, Iran, Iraq, Syria, North Korea, Yemen, etc. Seen as an opportunity for the militarily weak to pull feathers

from the eagle's tail or annoy the lion while staying out of reach of its claws. They are particularly dangerous, as they make available to terrorist groups the resources of a state, intelligence organizations to research targets, relatively modern weapons and explosives readily available in the Arms bazaars around the world as the major nations re-equip and dispose of weapons of an earlier generation, (SA7, RPG7, varieties of small arms, explosives, mines, grenades, etc.). They often target "dissidents" and opposing regimes.

• **Fanatics.** Religious — the Shiite fundamentalist, Hezbullah, Amal, Zionists, etc., often perpetrating horrific acts of violence in the name of their god — Spanish Inquisition.

• **Mercenary.** Increasingly, the products of 20 years of terrorism become addicted to their trade probably the most famous was Carlos, the Jackal, who kidnapped the OPEC delegates in Vienna in 1975. These groups, with loose and variable connections to state sponsors, such as Abu Nidal, tout their services to the highest bidder and have set up commercial terrorist schools, produced videos to demonstrate their talents and record "successes" as promotional material for future clients. The enormous sums of money involved in the drug trade have attracted mutual attention between the drug barons and the terrorist groups and have given birth to a relatively new form of mercenary terrorism — narcoterrorism.

The Techniques of Terrorism

While terrorism has been a feature of contemporary life since the Assassins of the 10th and 11th centuries, the modern form born in the 1960s has adopted significantly new techniques. While a range of techniques utilizing the bomb and the bullet are still employed, there have been marked improvements in the planning and execution of terrorist acts. The techniques include:

• **Bombings (Sabotage).** As Brian Jenkins of the Rand Corporation observed, "Terrorism is Theater." One of its major goals is publicity through the world's media ever avid for spectacularly nasty acts. The bomb is tailor made to meet this requirement, pictures of death and destruction. Examples include the destruction of three aircraft at Dawsons Field in 1970 following the Leila Khaled hijack attempt, the Pan Am 747 mid air explosion which killed a young Japanese National after descent to Honolulu had commenced on August 11, 1982.

A similar bomb was recovered from a Pan Am Boeing 747 in Rio on August 25, 1982. The January 17, 1984, explosion in the hold of the Air France 747 ex Karachi, the 329 lives lost on Air India 747 in June 1985, the 165 on the Korean Airlines 747 in 1987, the attempt by Hindawi to smuggle a very clever device aboard an ElAl 747 using his duped, pregnant Irish girlfriend in 1987 — the list goes on. In addition to attacks on aircraft, there are the attacks on airports and airline offices. Bombs at Narita and Frankfurt caused considerable loss of life, loss of confidence and, temporarily, heightened security.

• **Hijacking.** The most spectacular form of terrorist "theater" and one of particular interest to those concerned with aviation safety. Most hijackings have involved the odd, lone "loony tune" but anyone who followed the Kuwait Airways Flight 422 hijacking from Bangkok through Tehran to Algiers could not but be impressed by the degree of planning, the sophistication of the weaponry and the way in which the hijackers controlled negotiations choosing time, place and interlocutor.

Equally impressive was the performance of Captain Yousef who dealt with nine fanatical terrorists for 16 days. While the media assessed the outcome as a draw, there is no doubt that terrorist organizations regarded it as a major success. Even the benighted Ali Ahmed who hijacked Captain Gary Gleeson and his Air New Zealand Boeing 747 in Nadi in 1987 gained a vast amount of media exposure. The recent Russian hijack from South Russia to Israel in December 1988 shows that the Eastern Block is not immune — and that its handling arrangements are much as ours.

• **Armed Attacks.** Of these, the simultaneous attacks at Rome and Vienna on December 27, 1985, are the classic example — four dead and 45 were injured in Vienna with 18 dead and 65 wounded at Rome.

• **Selective Assassination.** Kill one — frighten 10,000 — the philosophy of Bakunin, a Russian terrorist of the last century. With the importance of the airlines as multi-national companies and of their senior executives to their successful operation, such people are just as much targets for terrorist groups as the executives of Siemens or Renault. Failure to pay "protection" money, acts seen as counter productive to the aspirations of some group, even as innocent as flying refugees or politicians, may attract terrorist attention. Again it is of little use protecting the chief executive at enormous cost. The assassins will merely move down the corporate pecking order a notch or so.

• **Nuclear, Biological and Chemical.** Brian Jenkins argues that while we must not discount terrorist use of — and there is no doubt about terrorist access to these weapons — the scale is too great to be attractive to terrorists basically seeking publicity and wishing to develop or to continue to appeal to some political constituency. No real use of chemical agents is recorded but the increasingly wide use in the Iran-Iraq war, for example, will doubtless inspire

some 'loony tune' seeking the "Oxygen of publicity" to find a place for chemical warfare agents in the terrorist armory.

• **Guided and Rocket Weapons.** The SAM-7 and RPG-7, both of Eastern Block manufacturers, have been used and encountered in terrorist hands. The target presented by a Boeing 747 on approach or takeoff is the stuff of a missile designer's dreams. As the weapons of modern warfare are replaced by "front line" nations, more of the earlier generations become available in the arms bazaars.

The techniques are diverse and imaginative. The technology available to terrorist groups is of a high quality, and the planning and preparation is improving all the time. The groups also study the media action replays and refine their techniques and tactics.

The Development of Counter Measures

Following the events of the early 1970s and, in particular the "Munich Massacre" of Israeli athletes, most nations, west and east, looked at the means of combatting terrorism. As is often the case when dealing with a sudden problem, the major efforts were devoted to countering the symptoms rather than looking at the causes of the disease and seeking a cure. The 1970s saw the birth of special Counter Terrorist forces, GSG9, British and Australian SAS, French GIGN, FBI Hostage Rescue Team and the allocation of special counter-terrorist roles to existing special forces, the Royal Netherlands Marines, the Egyptian Commando's, New Zealand SAS, U.S. Delta and SEAL teams, Indonesian Special Forces, Russian Spetznatz, etc.

In parallel, the intelligence world started accumulating information on the movers and shakers within terrorist movements and special groups studying terrorist profiles and modus operandi appeared. Dr. Thomas Strentz, of the FBI, who has produced many texts on terrorist profiles, motivation, etc., identifies three basic terrorist types:

• **Leaders** — either sex, educated, middle class, urban sophisticated, multi-lingual, articulate, dedicated, strong personalities and politically active prior to involvement;

• **Opportunistic or Criminals** — usually male, limited education, 20 to 30 age group, lower class, streetwise, good verbal skills, learned criminal skills, selfish, strong personalities, criminal background, politics peripheral; and

• **Followers** — either sex, well educated, 20 to 25 age group, middle class, urban sophisticates, multilingual, articulate, well trained, weak personalities, politically active prior to involvement.

This sort of information is now widely published and discussed and has no doubt resulted in a much better degree of cooperation between counter-terrorist forces. Following the TWA hijacks in 1985, great emphasis was placed on intelligence sharing, joint training and a similar hard-line attitude to terrorist demands. The cooperative efforts of western nations have led to the apprehension of a number of western terrorist and much stiffer treatment and sentencing of those apprehended, often in countries other than those in which the attacks occurred.

To quote again from Strentz, "Terrorism is different today than it was yesterday, and it will, like any dynamic organization, change again by tomorrow." Terrorists have new tactics and adapt and adjust to counter measures developed by governments or airlines, or they die and are replaced by more dynamic individuals. A review of the development of counter measures and terrorist responses to those counter measurers underlines the truth of that statement.

Counter Terrorist Techniques

The main elements of counter terrorism are:

- Prevention;
- Protection;
- Incident management; and
- Response.

Prevention. The key here is intelligence. Timely, accurate, reliable and comprehensive intelligence is the key ingredient in the prevention of terrorism. The intelligence services of the Western Nations and those of the Eastern Block traditionally devote much energy to keeping their secrets — from each other. Western Leaders at the Tokyo Summit in 1986, the OEC virtually annually, and many other conferences of world leaders have emphasized the need to cooperate in ending the disease of terrorism. There are signs that this is happening and that the Eastern Block with its increasing problem with politically motivated violence is also prepared to join the world community in its war on terrorism.

Protection. Vulnerable parts of our modern and complex society can be protected. The cost of protection is enormous and will never satisfy those seeking protection nor cease to annoy those who prefer comfort to protection. At airports, restriction of access to airports, vehicle search in pre-parking sterile areas, luggage and person searches, isolation of non-searched cargo and strict control of access to key points on both land and airside have all been instituted to greater or lesser degrees worldwide.

Certainly the influence of the airlines is rightly enormous and the threat of bans on flights to airports with unsatisfactory arrangements is usually adequate to cause remedial action. The covert presence of sky-marshalls at airports is certainly a deterrent — terrorists rarely want to die — but their presence on aircraft is a hotly debated issue, where I personally believe that they probably add to the risk of fatalities rather than diminish it. If a flight is considered

sufficiently sensitive to warrant the presence of sky-marshalls, one presumes that the preflight security is the best available; hence, it should be impossible to smuggle arms or explosives aboard — hence sky-marshalls are unnecessary!

Incident Management. The key ingredient to successful incident management is firm political direction. Where the interests of many countries are involved, as is frequently the case with an aircraft hijacking, all governments must agree to the principles on which negotiation and resolution of the incident are to be based.

There is a tendency for every department of State in each of the governments involved to "fight its corner" and seek to dominate the so-called "policy formulation. Quite honestly, if your policy is not formulated, clear and unambiguous prior to an incident, then you are too late. Policy making on the run is a recipe for disaster. In a major incident involving an aircraft a great many interests are involved — the governments of the nations owning the incident venue, or venues of the aircraft and whose citizens are involved directly or indirectly. It will not work efficiently unless it is well-planned, rehearsed and understood by all involved.

The hijacking of an aircraft in Southern Russia and its flight to Israel is almost a classic. The prime aim was to preserve the lives of the 30 or so school children aboard — to the extent that an aircraft, three million dollars and safe conduct to Tel Aviv were provided. On arrival, the hijackers were arrested and promptly returned to Russia. No lasting concessions were made to the terrorists, and the risk to hostages was minimized.

Response. We are all familiar with the special forces mentioned earlier that are trained and equipped to terminate a terrorist hijack, kidnap or armed assault by force of arms. This is the spectacular last act in the "Theater of Terrorism" but, like nuclear weapons, is hopefully mainly a deterrent. The committal of such forces is generally an admission of failure of all the other responses available to governments. These responses include:

- **Intelligence** — a full identification of the terrorists, their arms equipment, plans and sponsors;

- **Political pressure** — terrorists have political aims and hence, political associates. The role of Nabih Berri in negotiating the release of the remaining hostages from the TWA aircraft on June 14, 1985 in Beirut was crucial. The potential pressure points must be known, recorded and kept functional;

- **Negotiation** — Negotiation is a specialized task and is ideally undertaken by specialists. Anyone — and this includes flight crew — who is likely to have a face to face role with terrorists needs some understanding of the methods and techniques of negotiation;

- **Political direction.** The direction of an incident must be firm, unambiguous and understood by all, terrorists and responding governments alike. Preservation of the lives of hostages is the aim, no significant concessions to terrorists is the only policy which will ultimately persuade its advocates that the game is not worth the [gamble];

- **Scene management.** The management of a terrorist incident scene is enormously difficult and complex, made the more so by the media that will almost certainly rapidly outnumber terrorists, responding forces, hostages and members of the public. To coordinate the activities of all the specialists involved is a task which requires training, experience and frequent practice of a well developed anti-terrorist plan.

You cannot handle a hijacked Boeing 747 with a gathering of people who would never meet in the normal course of events and who have an imperfect understanding of their own and the roles of others involved in incident management and resolution.

Counter Terrorist Equipment

The firms which market radiographic, metal detecting and personnel searching equipment are naturally reluctant to admit any deficiencies in its performance. Most security equipment in common use is commercially developed and marketed and studied as assiduously — more assiduously — by terrorists as it is by its legitimate users. To ensure that the capabilities of equipment used in countering terrorism is the best available for its task requires a number of monitors:

- An independent research and development organization or facility to properly evaluate equipment against the known techniques and tactics adopted by terrorist groups.

- A comprehensive training package to ensure that the 10 cent labor employing the fruits of the efforts of million dollar designers make optimal use of the equipment.

- A sound counter terrorist plan which incorporates equipment in the security loop to optimize the overall performance of the man/machine combination.

- An audit arrangement to monitor the efficiency of servicing, maintenance and operating arrangements for equipment and systems in use.

- A think tank where those likely to be affected by terrorist acts can gather, consider and discuss the effectiveness of their organization's contribution to curing the disease of terrorism.

The Coordinated Response

The last year for which I have figures indicates that in the United States in 1985 some $14 billion was spent on official security and law enforcement organizations — and $21 bil-

lion by commercial organizations in the same field. The commercial sector was growing at over three times the rate of the official sector.

Security is an enormous business, and in no industry more so than aviation. If we are not to be either faced with unacceptably low levels of security or unacceptably high costs, coordination of effort is required at all levels including individual firms, industries, nations and international communities. Groups such as this can and do exert enormous pressures on their employer's and their governments to enhance security but the pressure has not always led to coordinated and cost effective responses. Terrorism is not going to go away. Let us better plan and coordinate our company, industry, national and international response to the variable but ever present threat.

Future Directions

As the world becomes a smaller and more crowded place, so the march of technology makes solving complex and difficult problems easier but costly and complex. The potential damage, which can be inflicted by small and determined groups of terrorists on complex, modern systems, becomes an ever greater threat.

While terrorism can point to few outright political victories, the opportunity to make a major political or financial/political gain through the expenditure of relatively limited resources will continue to be attractive. They study in detail the equipment and operation of airlines and will identify weaknesses which can be exploited. We must all be aware of the threat and continually review and revise our contribution to countering terrorism.

The aviation industry is in the front line of the war against terrorism, and we must promote increased cooperation between individuals, companies and nations in fighting the war we cannot win — but dare not lose.

Terrorism Q & A

A question-and-answer session can expand upon a prepared presentation by eliciting information that adds to the value of the meeting. The following are responses by Birg. MacKenzie-Orr to questions put to him after his talk on terrorism during a recent Flight Safety Foundation Air Safety Seminar in Australia.

Q. *The cost of security arrangements at airports is enormous. Are they really effective?*

A. Ben Gurion (Tel Aviv) security costs exceed 25 percent of its gross budget. They have not had a serious incident since May 1972. Security arrangements vary considerably from airport to airport. Immediately following an incident, everyone lifts their game then they gradually fall off to a lower effective level. Like pilot training, maintenance and servicing nothing is 100 percent effective but, most of the time something less than 100 percent is enough.

A professional terrorist will study his target, note its weakness, plan his operation to maximize his chance of success; even so, many terrorist plans are aborted because they fear detection. Some security is better than none at all — it will deter most potential terrorists and loonies — good security not only deters, it is flexible and can increase the level of protection in direct response to the threat revealed by good intelligence. El Al security prevented Hindawi from getting an almost undetectable bomb aboard at Heathrow by utilizing competent, trained security officials and good equipment.

I would like to see aircraft security the responsibility of someone who is going to fly with the aircraft — the captain, the flight director. Nothing motivates anyone to check that security is good more than having to suffer the consequences of failure. If you want to motivate security checkers, make them fly with aircraft whose passengers and cargo they have just checked.

Q. *Which airports because of their physical layout or design are more prone to terrorist acts? Besides Tel Aviv Airport are there any airports that come to mind where security is excellent?*

A. Most airports were designed and built in an age when passenger handling was the only consideration; security did not rate. Pressures are such that additions are stuck on ad-hoc to meet commercial pressures; security still does not rate. The newer airports do have an increasing security input into design and those airports at high risk — Ben Gurion (Tel Aviv), Aldergrove (Belfast) — have had good security built in at great cost. The problem is that terrorists will study all airports on routes in which they are interested and pick the weakest link in the chain to attack.

The U.S. FAA is trying to enforce international standards on ports used by American carriers, and IATA is doing likewise. Since the hijacking of Kuwait flight 422, Bangkok security had become a lot tighter — for how long? Frankfurt, Rome, Athens — all have tightened up — for how long?

Q. *What is your opinion of the personnel who staff passenger screening checkpoints at major airports? Please cite any personal experiences at some major airports (your view of the competence of the staff and any loopholes you may have observed?)*

A. The $100,000 a year person in the left hand seat relies on a $10,000 a year person with minimal training, little motivation, who goes home to watch TV after an eight-hour day — to ensure that nothing gets aboard his aircraft that could cause problems (like a potential $250 million loss of equipment and a $1 billion lawsuit). Despite this, I think most security checkers try hard and most security managers do their best to motivate them.

At an airport in Europe, I had a tour of security precautions with the police chief. The place was awash with uniformed policeman carrying Uzi's, every checkpoint had two or three

policemen, armored cars were parked around the terminal, watch towers were manned and the perimeter was constantly patrolled by police vehicles.

I went back to the airport at 2 a.m. along for a flight scheduled to leave at 4 a.m. It and several others were delayed. The only four policemen to be found were playing cards in the restaurant. The lounges, outside areas, sterile areas were covered with hundreds of passengers, sleeping, and reading.

The check points were manned by the second team, half asleep and not bothering to recheck people who left the sterile area to get a drink and then went back. When flights restarted, hundreds of people were trying to embark at the same time. Airline staffs were herding passengers like sheep to get them away. The security checking system could not handle the load and gave up.

Where motivation is poor, commercial pressures are great and facilities inadequate, it does not need too determined a terrorist to get through. Again, I believe that just as the captain has ultimate responsibility for the serviceability and technical checking of the aircraft which he is going to fly, he should also have responsibility for the security checking of everything and every person who goes aboard his aircraft.

Q. *How do we prevent access to the airside of an airport by terrorists working with airport or airline employees — any new security methods that can be used?*

A. An airport has to have a comprehensive and integrated security plan to which all elements contribute and for which the airport manager is responsible. Elements of the plan should include:

- Identification of the areas of security significance;
- A pass system which restricts access of personnel and vehicles to only those areas essential to the performance of their duties;
- A venting system for personnel with access to the highest security areas;
- Appropriate physical barriers between areas of different security significance;
- A monitored system of enforcement of security regulations;
- A regular system of checking electrical/electronic/mechanical security equipment.
- A system for random checking of security arrangements;
- A regular review of the security plan and special reviews when any constructional or operational changes are contemplated or when intelligence of a raised level of threat is received.
- A preplanned system for upgrading security when warranted by intelligence;
- A briefing, indoctrination (new employees) and continuation training plan audited by periodic exercises designed to test sub systems and the whole plan; and,
- International audits of security arrangements.

There are no cut-price or quick-fix security solutions. The whole airport/airline community has to feel that security is as important an element of their corporate standing as is their flight safety record, reputation for service and aspirations to be the "best".

Q. *Do you think it is acceptable for authorities to allow a hijacked aircraft to take off? As with Kuwait flight422 at Cyprus and the recent Russian hijacking going to Israel?*

A. The "authorities" managing the incident have a single aim — to minimize the risk of death or injury to the passengers and cabin crew — and — the western nations have all agreed that their policy should be to make "no significant political concessions to terrorists." Keeping the aim and the policy in mind, the managers had to decide if allowing the aircraft to take off from Cyprus or Southern Russia would:

- Reduce the risk of having a hostage killed or injured
- Be a political concession to the terrorists.

In my opinion, with nine well armed and equipped, fanatical terrorists aboard Kuwait flight 422 in Cyprus the chance of having more hostages killed (two had been killed) was great. The hijacker's demand to fly to Algiers was made early enough for some accommodation to be reached with Algiers on how the incident would be managed there. It was not a significant political concession (the ultimate release of the terrorists of course was a significant concession).

As the United States and Israel have shown, the temporary freeing of terrorists after an incident does not guarantee that they will not be subsequently pursued relentlessly and tirelessly. The major concession sought was the release of 17 Arab terrorists held in Kuwait jails. This was not granted. I would be surprised if the nine terrorists have not been thoroughly identified and documented, if any ever reappear in a western democracy on a terrorist mission, and if any survive to old age outside a prison. Allowing the aircraft to leave Cyprus did not conflict with either aim or policy.

Again, in the case of the Russian hijacking, the cooperation with Israel and the "temporary" provision of three million dollars and an aircraft allowed the release of all hostages unharmed and made no significant political concession. The Russian hijackers will certainly not survive to old age outside a prison!

In the management of a terrorist incident, the unchangeables are the aim — free the hostages — and the policy — no significant political concessions. The detailed management then depends upon the judgment of (hopefully) experienced counter terrorists based upon the intelligence they glean from every possible source, and the resources they can command to resolve the incident. The assault option will hopefully only ever be needed as a sort of ultimate deterrent; it will inevitably lead to loss of life in most circumstances and if used prematurely could well preserve the policy but totally defeat the aim.

Hijacking — A First-Hand View

Captain Subhi Yousef was flying Kuwait Airways Flight 422 from Bankok to Kuwait on April 5, 1988 when the airplane was taken over by terrorists. The following account of subsequent events reflects an interview of Captain Yousef by Brig. MacKenzie-Orr.

Capt. Yousef believed that seven terrorists boarded the aircraft in Bangkok and that they had a minimum of three revolvers. After Teheran there were nine terrorists, all of whom had weapons, including "some" sub machine guns, many grenades and explosive and "electrical components" which they fitted around doors and emergency exits.

For the 10 days before they reached Algiers, the terrorists were very trigger happy and argued among themselves a great deal. There was no clear leader and all nine gave instructions to Capt. Yousef from time to time. All were involved in negotiations and frequently had heated debates with much gun waving when responding to inquiries from "on shore." They would only negotiate in Arabic and only with people of their choosing and did a lot of communicating through Capt. Yousef.

There was always at least one terrorist on the flight deck with a revolver and a grenade and at times up to three all similarly armed. Capt. Yousef was questioned two to four times an hour on average by one or another of the terrorists. They questioned every technical and operational decision and had a very sketchy idea of how the aircraft communications and other systems worked.

Capt. Yousef had to explain every technical or operational requirement to two or three people and was frequently threatened with death or injury should he not do exactly as he was told. He used every excuse to plead for the release of hostages and made all decisions and actions slow and deliberate.

The terrorists were fanatical, illogical and very dangerous. The passengers were terrified and believed that anyone could be killed at anytime. The terrorists were particularly excited in Cyprus when they believed that an attempt might be made to storm the plane by the British. Capt. Yousef did his best to dissuade authorities from considering an assault option as he believed it would have led to many deaths.

When they arrived in Algiers, there was a noticeable reduction in tension and the flight crew was able to get some rest.

Capt. Yousef had no training in hijack procedures — Kuwaiti captains have often discussed hijacking but no formal training in negotiating techniques is indicated. Capt. Yousef's handling of the terrorists was excellent. He established a special position as the technical and operationally competent handler of the aircraft and was able to calm down excited terrorists and influence their response to the requests for the release of hostages.

He was prepared to fly the aircraft back to Kuwait after the terrorists left. Capt. Yousef returned to Kuwait after the terrorists left. He returned to Kuwait and after a medical check did an operational check-out and was back as a line pilot some 15 days after the incident was terminated.

The lessons Capt. Yousef learned were:

- Keep calm;
- Concentrate on professional duties, insist on completion of full checks and operational routines — be firm in technical matters;
- Do not flinch when hijackers scream and rant, try to maintain as normal an atmosphere and routine as possible;
- Retain as much authority for passengers and cabin crew as possible; and,
- Keep in mind that fanatics are very difficult to deal with.

Capt. Yousef believed that some formal training in counter terrorism, including the terrorist tactics, techniques and capabilities and negotiating skills would be very valuable.♦

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Aircraft Crashworthiness. Saczalski, Kenneth, Ed. University Press of Virginia. 1975. 698p. ISBN 0-8139-0634-2.

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Human Error Avoidance Techniques — Conference Proceedings. (Human Error Avoidance Techniques Conference, Washington, D.C., December 1-3, 1987.) 1988. Society of Automotive Engineers, Inc. SAE P-204. 91p.

Table of Contents: The Necessary Systems Approach, Management of Human Error by Design, Human Factors and the U.S. Air Force Aircraft Mishap Prevention Program, U.S. Army Human-Error-Related Data Bases, Human Error Mishap Causation in Naval Aviation, Data Bases of Aviation Incidents Resulting from Human Error, Analyzing Controller Tasks to Define Air Traffic Control System Automation Requirement, Total Scope of Hazard Analyses, Modelling System Design Components of Pilot Error, A "Newcomer's" Perspective on System Error Prevention in Operational Test and Evaluation, Software Systems Safety and Human Error Avoidance, Advanced Technology Cockpit Design and the Management of Human Error, Managing Human Performance-INPO's Human Performance Evaluation System, Human Performance in a Technical Society-The Army Approach.

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Worldwide Airline Safety Records Calendar Year 1988

Worldwide airlines operating large aircraft in calendar year 1988 recorded 25 fatal accidents and 17 jet transport aircraft hull-losses resulting in 1,171 fatalities. The following is a listing of the fatal accidents and hull-losses. Note that the injury index of two reported fatal accidents which occurred inside USSR are not available.

In 1988, worldwide aviation community was frightened deeply by the following unusual events:

1. An Iranian Airbus A-300 was shot down over Persian Gulf on July 3, by military actions, killing all 286 passengers and crew members aboard the aircraft;

2. The security failure in Bangkok, Thailand, led to a Kuwait airliner that was hijacked on April 5. The event lasted more than two weeks. Two passengers were killed by hijackers who were set free by final negotiating nation for exchange of passenger safety and freedom;

3. Also as a result of security failure, a Boeing 747 jumbo jet that crashed on December 21 at Lockerbie, Scotland, resulted in 259 passenger and crew fatalities and 11 persons killed on the ground. The preliminary investigation finding indicated that the jetliner was brought down by the explosion of a bomb which was sneaked into the baggage compartment by terrorists;

4. A Boeing 737 jetliner lost a top portion of its fuselage on April 28 at high altitude causing the death of a flight attendant. Fortunately, the aircraft was brought down to a safe landing.

During the past several years, worldwide airlines, airport and civil aviation authorities in a cooperative effort have done a lot to improve air travel security, and the system is considered to be efficient. The terrorists, however, still can find their way to sneak firearms as well as explosives into the aircraft. Flight safety goes hand-in-hand with flight security. It is apparent that much more has to be done to strengthen the system. Although the Boeing 737 jetliner that lost a portion of its top fuselage at high altitude only claimed the life of a flight attendant, it can probably be considered a miracle. After the occurrence, the public was worried it could happen again to other older aircraft. The structure failure of the Boeing 737 brought up the question of airworthiness of those jetliners entered into service in the 1960s. As a matter of fact, cracks on the fuselage and over the wing under paint had been discovered before in some older aircraft through routine inspection.

Although worldwide aviation authorities and industries already have programs in place to provide for continued airworthiness of older transport aircraft, the U.S. Federal Aviation Administration (FAA), looking for new ideas in the area of design, maintenance, inspection and research and development that will ensure flight safety, sponsored a meeting on older aircraft in June last year. The meeting called worldwide specialists together to discuss the common problems and focused on exchange of information on airframe, engines, inspections and human factors associated with inspection.

According to FAA, there were several incidents during the past year in which large cracks developed on older jetliners. Last October, the FAA, therefore, issued an order urging U.S. Boeing 737 operators to replace rivets on older Boeing 737 as a result of increasing concern about cracking fuselage skin on the older aircraft. Again in last November, the FAA directed the airline to conduct repetitive electronic "Eddy Current" Inspection of all DC-9s that have had more than 55,000 landings. The agency later in a proposed directive urged all U.S. air carriers operating Boeing 727 jetliners to replace from 3,300 to 4,150 rivets on each aircraft, depending on the model.

One final note is that the information provided in the listing is still preliminary subject to further verification. However, it may be relied upon for statistical comparison and serve as a record for reference.

Worldwide Airline Fatal Accidents and Jet Transport Aircraft Hull-Losses

Calendar Year 1988

Date	Location	Aircraft	Damage	Fatal-ities	Phase	Remarks
1/4	Izmir, Turkey	Boeing 737	D	16	En route	An unscheduled flight
1/18	Chongqing, China	IL-18	D	108	Approach	Engine failure/loss of control. A/C hit high ground and burned.
1/18	Krasnovodsk, USSR	Tu-154	D	11	Landing	Missed runway and landed on soft ground and broke in two.
1/24	USSR	YAK 40	D	unknown		Details not reported.
2/27	Surgat, USSR	Tu-134	D	unknown	Landing	Crashed on landing. Fire after impact.
2/29	Araphoy, Cyprus	Boeing 727	D	15	Approach	Crashed into high ground.
3/4	Pamfou, France	FH-227	D	23	Approach	Hit a powerline in severe weather conditions.
3/17	Cucuta, Colombia	Boeing 727	D	137	Climbout	Crashed into high ground in low visibility.
3/31	Cairo, Egypt	DC-8	D	4	Takeoff	Aborted takeoff, overran and burned.
4/5	Bangkok-Kuwait flight	Boeing 747	N	2	En route	Hijacking - two passengers were killed by hijackers.
4/28	Maui, Hawaii	Boeing 737	S	1	En route	Decompression. Upper cabin forward fuselage separated.
5/24	San Jose, Costa Rica	Boeing 727	D	0	Takeoff	Stalled on takeoff climb.
5/26	Nicaragua	DC-6	D	6	En route	Crashed en route from Panama to Nicaragua.
6/12	Argentina	MD-81	D	22	Approach	Undershot in thick fog.
6/16	Putao, Burma	F-27	D	4	Approach	Crashed on landing approach.
6/26	Paris, France	A-320	S	3	Go-around	Hit tree in an Air show.

Date	Location	Aircraft	Damage	Fatal-ities	Phase	Remarks
7/3	Persian Gulf	A-300	D	256	En route	Shot down by Military force.
7/21	Matogun, Lagos	Boeing 707	D	6	Approach	A cargo flight.
8/2	Varna, Yugoslavia	YAK-40	D	27	Takeoff	Crashed in aborted takeoff due to engine failure.
8/31	Dallas, TX	Boeing 727	D	15	Takeoff	Crashed and burned.
8/31	Hong Kong	Trident	D	7	Landing	Skidded off the end of runway into Kowloon Bay in heavy rain.
10/7	Shanxi, China	IL-14	D	43	Takeoff	Crashed shortly after takeoff.
10/17	Rome, Italy	Boeing 707	D	31	Landing	Crashed in thick fog.
10/19	Ahmadabad, India	Boeing 737	D	130	Approach	Crashed in heavy fog and burst.
10/19	Gauhati, India	F-27	D	34	En route	Crashed into mountain en route from Siechar to Gauhati.
12/21	Lockerbie, Scotland	Boeing 747	D	270	En route	Crashed into a gas station after inflight explosion.

Index of aircraft damage:

N = No Damage
S = Substantial
D = Destroyed

Accident/Incident Briefs

Could Have Been Worse

United States - February

DC-9: Fire damage to midcargo compartment. Minor smoke-inhalation injuries reported by nine passengers and five ground personnel.

According to the final Hazardous Materials Incident Report from the National Transportation Safety Board (NTSB), the regularly scheduled DC-9 had departed Dallas/Fort Worth International Airport bound for Nashville Metropolitan Airport. There were 120 passengers, four flight attendants and two flight crew members aboard.

In addition to passenger luggage, the airplane carried 6,365 pounds of air freight, including two packages of hazardous materials — a 20-pound cylinder of oxygen and a 104-pound fiber drum of textile treatment chemicals. The captain had been advised of the presence of the oxygen, but the fiber drum had not been identified as containing hazardous materials. The captain was unaware that it was on board (further, the drum had no orientation markings and had been stored in the airplane on its side, allowing leakage). Materials inside the fiber drum included five gallons of a strong hydrogen peroxide solution and 25 pounds of a sodium orthosilicate-based mixture.

En route, a flight attendant and a deadheading first officer noticed some smoke in the cabin and advised the cockpit crew. The captain, who was aware of a previous problem with the auxiliary power unit that had produced fumes during an earlier flight, was skeptical about the flight attendant's report of smoke and did not declare an emergency. The deadheading first officer helped the flight attendant find the source of the smoke and contacted the flight's first officer with the information that the floor was hot and getting soft, urging the flight crew "to land this thing in a hurry."

The captain's reactions indicated he was still dealing with fumes, not fire-produced smoke, as noted by his comment when the airplane was at 1,000 feet on final approach: "We don't have a problem yet, just a few fumes."

After landing, the deadheading first officer again called the cockpit and told them "You've got a big problem back here ... the heat is coming up through the floor." He told them he saw smoke and said, "We better get outta here." When the flight's first officer passed this on to him, the captain decided to call the fire equipment and evacuate the airplane.

Fire was discovered in the midcargo compartment and CRF personnel extinguished it.

The NTSB determined that the probable cause of the in-flight fire was a chemical reaction from the hydrogen peroxide (in a concentration prohibited for air transportation) that leaked and combined with the sodium orthosilicate-based mixture from an undeclared and improperly prepared container. Cited also were the shipper's lack of knowledge about the requirements regarding shipping of hazardous materials and inadequate detection procedures. Contributing factors to the delay in detecting the fire and the captain's reluctance to declare an emergency were the lack of fire-smoke detection equipment in the cargo compartment and insufficient crew communication. Other contributing factors, according to the NTSB, were the lack of fire extinguishing capability in the cargo compartment and inadequate design of the compartment ceiling.

Costly Abort

United Kingdom - October

Boeing 757: Damage to nose and nose gear. No reported injuries.

The pilot aborted the takeoff and was unable to stop on the runway. The airplane ran off the end of the runway and the nose gear collapsed.

Overrun Surprise

Argentina - September

Boeing 737: Damage unreported. No injuries to 56.

The airliner was arriving at Ushuaia Airport at the end of a domestic flight when it ran into one of those first-one-thing-then-another situations. It ran off the end of the runway and then plunged into the waters of the Beagle Channel. Luckily, it also experienced one of those all's-well-that-ends-well situations.

Accident/incident briefs are based upon preliminary information from government agencies, aviation organizations, press information and other sources. The information may not be accurate.

Fine Feathered Friend

United Kingdom - September

Boeing 737: Engine damage. No injuries.

The air carrier was taking off from Lulsgate Airport (Bristol) carrying 130 vacationers bound for Tenerife when a bird was ingested into one of the airplane's two engines. The captain shut down the engine and flew to London's Gatwick Airport where he made a safe emergency landing. The passengers continued the flight on another aircraft.

Some Blowout

Costa Rica - September

Boeing 757: Damage to tire. Minor injuries to nine.

The airliner with 122 passengers and seven crew members was taking off from San Jose Airport for Miami when a tire blew out and the takeoff had to be aborted.

Sightseeing Tragedy

China - October

Ilyushin 1I-14: Aircraft destroyed. Fatal injuries to 38 of 42 passengers and four crew members. Numerous injuries to persons on the ground.

The domestic airliner had been giving 15-minute air tours for residents of the area around Linfen, a city in northern China.

A minute after one takeoff, carrying 38 passengers, including 33 employees of a local factory, the airplane descended toward the city, hit the roof of a hotel and crashed into the ground. Four occupants managed to escape the wreckage before it exploded and burned, killing the other 38 on board, including the crew. A number of persons on the ground were also injured.

Sticking One's Nose In

Thailand - October

Boeing 747: Damage to fuselage nose. Minor injuries to three.

The airliner with 293 passengers and 19 crew members aboard had arrived at Bangkok International Airport after a flight from Jakarta. While parking, the airplane struck the the terminal and imbedded its nose six feet into the building.

Two passengers and one member of the crew were slightly injured in the incident. The airplane was damaged enough for the passengers to be given alternate transportation.

Parking Problem

United States - October

Boeing 747: Unspecified damage to engine nacelle. No injuries.

The jet airliner arrived at Los Angeles International Airport from Tahiti with 297 on board. As it was taxiing to its gate at the terminal, one of its engines struck a fire vehicle parked nearby.

There were no injuries and the 277 passengers and 20 crew members departed the aircraft without incident.

Fatal Ditching

Sierra Leone - September

PZL Mi-2: Aircraft sunk. Two missing, presumed drowned. Five rescued.

The helicopter was on a routine shuttle flight between Lungi Airport at Freetown and Aberdeen at about 8 a.m. At the mouth of the Sierra Leone River the aircraft ditched in the sea and sank. No cause was given for the ditching.

Crash on Landing

Philippines - October

Rockwell Commander 560: Aircraft substantially damaged. Fatal injuries to one. Unspecifiedinjuries to four.

The light twin was ferrying base personnel to Clark Air Force Base, 50 miles north of Manila. It crashed while attempting to land.

Wet Crash Landing

Philippines - October

Beech Queen Air: Damage unspecified. No injuries to 11.

The airplane had taken off from the Manila airport en route for Palawan Province when both engines reportedly "died."

The Queen Air made a forced landing in a rice paddy in Cavite Province, south of Manila. The two crew members and nine passengers evacuated the airplane without injuries.

For Want of a Bolt

United Kingdom - July

Rockwell Commander 114: Right main gear components andunderside of wing damaged. No injuries to four.

After a business flight from Manchester to Norwich, the aircraft was cleared for a visual approach and a normal landing was made. Near the end of the landing rollout, however, the right main gear collapsed and the airplane ground-looped to the right. It veered off the runway and came to rest in the grass.

Upon later examination, it was found that the main pivot shaft at the top of the landing gear leg had moved forward and had disengaged from its aft fitting assembly, allowing the gear to fold. The reason it moved was that a retaining bolt was missing.

The airplane had had its last certificate of airworthiness inspection in April 1986 and two annual inspections had been carried out since then.

Mystery at Sea

Italy - October

Piper: Aircraft sunk. Three dead.

Three persons were in the lightplane that was rented from the Palermo Aero Club. They had taken off from Boccadifalco Airport on a pleasure flight. The last contact from the pilot at 11 a.m. reported that the airplane was flying at about 6,000 feet over the sea near Trabia, approximately 20 miles south-east of Palermo; the airplane was due to land 15 minutes later.

The Piper did not arrive at the airport, and a police helicopter was dispatched to search for it. A patch of fuel was sighted on the water off Casteldaccia, midway between Trabia and Palermo. The airplane was found by divers under 22 feet of water with the bodies of the three men inside.

Island Overnighter

Greece - October

Piper PA-28 Archer: Aircraft sunk. No reported injuries.

The aero club airplane with two aboard was flying over the sea off Marathon, near Athens, when the pilot reported to air traffic controllers that the engine had failed. Minutes after the 6 p.m. report, he radioed that he was about to ditch the airplane off Marathon.

Three airplanes and a helicopter were dispatched to search for the downed aircraft, but gave up at nightfall. After the search was resumed the next morning, a Navy helicopter spotted the two men on an uninhabited island some 20 miles northeast of Athens about 12 hours after they had ditched. The survivors had swam to the island after their powerless airplane failed to glide to a mainland airport.

Deadly Descent

United Kingdom - September

Wassmer D.120A: Aircraft destroyed. Fatal injuries to two.

The lightplane was en route from Shoreham to a fly-in at Slinfold in the company of two other aircraft. It was within a half mile of the destination when it was observed nose-diving,

possibly because of engine failure, 50 yards from some cottages near Sussex.

The airplane crashed into woods near a country lane. Firemen rushed to the scene to rescue the occupants, but they were already dead. Cause of the accident was not established.

Airplane-Auto Confrontation

United Kingdom - October

de Havilland Tiger Moth: Substantial damage. No injuries.

The lightplane had completed a local flight and was approaching to land at Redhill Airfield.

On low final prior to reaching the runway threshold, the aircraft struck an automobile crossing the approach path on a perimeter road.

Slippery Grass

United Kingdom - July

Cessna 150: Minor damage. No injuries.

The lightplane with two aboard was making an approach to a 1,000-foot-long grass strip with a 10- to 15-knot crosswind from the left. Smoke from a straw fire was blowing across the approach path.

The airplane touched down about halfway along the runway, and the 78-hour pilot applied brakes. He found that the braking effectiveness on the grass, that was wet with dew, was insufficient to stop the airplane on the runway, and there was not enough runway left to initiate a go-around.

The pilot veered to the right into an area of long grass trying for better deceleration, but lost control of the airplane. Pilot, passenger and plane finally came to rest in a patch of scrub on the bank of the nearby River Thames.

A Murphy Invitation

United Kingdom - May

Piper PA-28 Arrow: Damage to fuselage underside, propeller, engine and engine mounts. No injuries to two.

The pilot later stated that during takeoff from the grass strip where he based his airplane, he had, as he usually did, selected the "override" position on the landing gear emergency extension lever. However, the gear retracted and the airplane settled to the runway, sliding off the side to end up on an adjacent taxiway.

The emergency extension lever is a part of the automatic gear lowering system built into this airplane. Selecting "override" merely cancels the automatic system — it does not affect the normal operation of the retractable gear that is controlled by the gear selector handle and the main gear "squat" switch.

After the accident, the aircraft was recovered. The gear was cycled and found to operate normally, indicating to investigators that the landing gear selector handle may have been placed in the Up position during the takeoff run. During a takeoff run with the gear lever in the Up position, the gear would remain down and locked only so long as the gear strut was compressed by the airplane's weight sufficiently to engage the squat switch. Once the airplane lifts off and the strut extends, the squat switch no longer is engaged and the gear-raising mechanism is "cleared" to operate whenever the gear selector is in the Up position. During a takeoff run along a bumpy grass runway, the struts may extend even momentarily before the airplane reaches flying speed and the gear will retract if the selector calls for it.

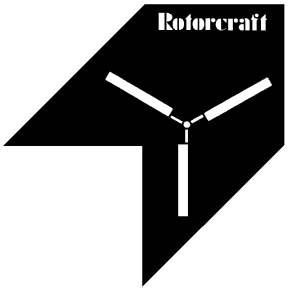
Nose Dive

Ireland - September

Cessna 152: Aircraft destroyed. Fatal injuries to two.

An instructor and a student were on a training flight over north County Hublin when the airplane crashed in a field. The two occupants were killed instantly and the wreckage of the airplane was said to be spread over a wide area.

The Cessna was seen to "nose dive" and skim trees at the edge of the field before crashing near a road about four miles west of Dublin Airport shortly after 4 p.m.



No Time to Twist

United Kingdom - September

Robinson R22: Aircraft destroyed. No injuries to one.

A student pilot was departing on a local flight at Thruxton shortly before noon. As he reported later, during lift-off the rotorcraft "twisted" and ended up as a write-off.

Dynamic Roll Over

New Zealand - March

Bell 206L: Aircraft destroyed. No report of injuries.

The rotorcraft pilot had landed on a grassy area to let off five passengers. On takeoff, as he began to lift the helicopter into a hover, the right-hand fiberglass bear paw (a flat plate attached to the bottom of the skid to keep it from sinking into snow) became snagged in the turf when the helicopter moved slightly to the right. As the pilot continued to add power, the rotorcraft rolled and crashed inverted, after which it caught fire and burned out.

The investigation considered a number of factors. The rotorcraft had been sitting in a nose-down attitude on the site where the passengers deplaned. According to investigators, the proper technique for takeoff would have been to apply cyclic control to place the main rotor disc level with the actual horizon and then to increase the collective pitch slowly to bring the aircraft to a level attitude. The cyclic should be used to keep the rotor disc level and to prevent any side-to-side or fore-and-aft displacement of the aircraft. After the helicopter has been leveled, the collective should be increased slowly to lift it clear of the ground. The pilot of the accident aircraft had allowed the machine to move to the right before finishing the liftoff, causing the skid to catch in the turf and the helicopter to enter dynamic roll over when power was applied to complete the takeoff.

The investigation also determined that the helicopter's center of gravity had been near the aft limit. In combination with the sloping ground, this situation could have made the takeoff more difficult because the rear bear claws would remain in contact with the ground longer.

Tripped Down

United Kingdom - July

Robinson R22: Main rotor blades, gearbox and tail boom damaged. No injuries to two.

The two-seat rotorcraft landed facing uphill on a grass-covered slope. When the pilot attempted to take off again, the helicopter moved forward and, it was thought later, the long grass became entangled between the skids and the metal skid shoes. The pilot applied full aft cyclic control and attempted to continue the liftoff. However, the helicopter tipped forward and the main rotor hit the ground. The rotorcraft then rolled on its side and the main rotor blades, now bent, struck the tail boom.

The aircraft sustained damage to the tail boom, gearbox and the main blades.

Close Quarters, Close Call

United Kingdom - July

SA341 Gazelle: Tips of main rotor blades damaged. No injuries.

The rotorcraft was being used for pleasure flying at a sports event. Considering the prevailing wind direction and the desire to avoid overflights of the spectators and automobile parking areas, the pilot had selected a takeoff path that passed behind a tree at the edge of the parking area before turning back into the wind.

Shortly after he took off on one flight, the pilot was distracted for a moment and, when he turned his head forward again he had to make a violent evasive maneuver to avoid several large birds. He felt a slight impact and returned the helicopter to the landing area to inspect it.

Although he had felt no difference in the helicopter's handling qualities, the pilot discovered damage to all three rotor blade tips. Careful inspection revealed a one half- to one-inch dent in the leading edge of each blade tip, along with small pieces of wood — no feathers, though. He apparently had missed the birds, but the alternative almost was worse.

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	Visual Fatigue Reduces Pilot Performance	HFAM	May/June
3.50	**Awards**		
	Canadian Aviation Safety Award	AMB	Jan/Feb
	Cecil Brownlow Memorial Fund for Publications Grows	FSFN	August
	Deadline Nears for De Florez Award Nominations	FSFN	June
	Foundation to Join Distinguished Roster of Wings Club Award Recipients	FSFN	July
	Heroism Award Nominations Sought	FSFN	January
	Soviets Award Medal to Flight Safety Foundation's Lederer	FSFN	Nov/Dec
	Wings Club Presents Highest Award to Foundation	FSFN	Nov/Dec

Code	Subject	Bulletin	Date
5.00	**Birds**		
	Coping With The Bird-Strike Menace	AO	July/Aug
12.00	**Communications**		
	Communication and Coordination Between Flight Crewmembers and Flight Attendants	ATC	Sep/Oct
	Do You Work Smart?	AMB	Mar/April
	Order in the Cockpit	AP	April
17.75	**Design/Development**		
	An In-Line Air Flow Meter	AMB	May/June
	Assessing Gasket Sealability	AMB	Jan/Feb
	Beam Seal Fitting	AMB	Jan/Feb
	Cleaning Components In Tight Clearances	AMB	Jan/Feb
	De-Icing System Shows Promise	FSFN	June
	Four-Bladed Conversion	AMB	Jan/Feb
	New Corrosion Treatment Developed	AMB	Nov/Dec
	Simple, Highly Accurate Method For Predictive Maintenance/ Troubleshooting	AMB	Mar/April
19.00	**Education & Training**		
	Additions To The Aviation Technician's Vocabulary	AMB	Nov/Dec
	Aircraft Mechanics Specifications Handbook Available	AMB	May/June
	Airport Inspection Videotape Available — A Comprehensive Guide To Aircraft Maintenance Tools	AMB	Jan/Feb
	Commuter Airline Pilot Training	AMB	Nov/Dec
	FAA Announces New Series of Written Tests for A&P Mechanics	AP	November
	FARs For Aviation Mechanics Under One Cover	AMB	Nov/Dec
	Foundation Aids Development of FAA Safety Indicators Program	AMB	Nov/Dec
	Foundation Publication Supplements College Course	FSFN	July
	Group Formed to Steer Direction of Safety Indicators Program	FSFN	August
	Helicopter Training Must Move Into The Future	FSFN	August
	Model Airline Safety Program	HS	May/June
	Portuguese Aviation Safety Center Offers Courses	FSD	November
	Referring To The Manual Could Drive You To Ruin	FSFN	June
	Reflections On Air Carrier Safety	AMB	May/June
		FSD	June

Code	Subject	Bulletin	Date
19.00	**Education & Training (continued)**		
	Spartan School Names New President	FSFN	February
	Taking Responsibility For Safety Training	HS	March/April
	The Sky's The Limit For Teenage Aviation Buffs	FSFN	February
	Tools To Fly By	AMB	Sept/Oct
	Where Can I Purchase NDT Equipment?	AMB	Nov/Dec
19.50	**Electrical & Electrical Systems & Equipment**		
	Battery Safety	AMB	July/Aug
	DC-10/A-300 Generator Lubrication	AMB	Sept/Oct
	Electric Heat Guns Should Be Used With Care	AMB	Nov/Dec
	Seeing Is Believing	AMB	July/Aug
	The Ten Commandments of Electrical Safety	AMB	Nov/Dec
	To Measure Is To Know	AMB	Sept/Oct
20.00	**Emergency Procedures**		
	Emergency – Pre-Accident Plans	FSD	May
	Inflight CPR – Are You Capable?	CCS	Sept/Oct
	Positions Brace Passengers for Impact To Reduce Injuries and Fatalities	CCS	Jan/Feb
24.00	**Flight Operations**		
	How To Deal With Induced Turbulence	HS	Sept/Oct
	Rejected Takeoffs – A Refresher	AP	November
	Strobe Light and Collision Advoidance	AP	February
25.00	**Fuels & Fuel Systems**		
	Anti-Icing Additives – Take Care When Adding	AMB	Sept/Oct
27.00	**Government Policy**		
	The FAA's Mechanical Reliability Reporting/ Service Difficulty Reports	AMB	Sept/Oct
	The United States National Airspace System Plan Part One	FSD	February
	The United States National Airspace System Plan Part Two	FSD	March
	U.S. Government Says Airlines Can Improve Pilot Hiring Practices	ATC	July/Aug
27.50	**Ground Safety**		
	Motivating Ground Crew Safety	AO	May/June
27.75	**Helicopters**		
	Helicopter EMS Accidents Demand Additional Scrutiny	HS	Jan/Feb

Code	Subject	Bulletin	Date
27.50	**Helicopters (continued)**		
	Tiltrotor Offers A Choice	HS	Nov/Dec
27.85	**Hijacking & Terrorism**		
	Civil Aviation Remains Vulnerable To Terrorism	FSD	April
	How To Survive In A Hijacking And Hostage Situation	CCS	July/Aug
28.00	**Human Factors**		
	Assessing Pilot Fitness by Modern Techniques	HFAM	Sept/Oct
	Coming To Grips With Panic	CCS	March/April
	Fear of Flying....What Is It? Who Has It? What Can Be Done About It?	CCS	May/June
	Hands and Feet	AMB	July/Aug
	Hazard of Burns From Aircraft Cleaning Compounds	AMB	Nov/Dec
	How To Assist The Unaccompanied Child	CCS	Nov/Dec
	Keep Alcohol Out of the Corporate Cockpit	PSE	Jan/Feb
	Pilots Must Be As Airworthy As Their Aircraft	HFAM	Jan/Feb
	Sleep, Sleep, Sleep	PSE	March/April
	The Effects of Facial Hair On The Efficiency of Oxygen Masks	AMB	Sept/Oct
31.25	**Investigation**		
	An Accident That Should Never Have Happened	ATC	May/June
	The Practice of Aircraft Accident Investigation	AP	May
33.00	**Legal Matters**		
	Bogus Parts Now Face Label Problems	AMB	Nov/Dec
	Liability Insurance: An American Crisis	AMB	July/Aug
35.00	**Maintenance**		
	Another Version of FOD	AMB	Sept/Oct
	A Sodering Iron Safe For Sensitive Components	AMB	July/Aug
	B-727 Fire Bottle Gauge Visibility	AMB	Sept/Oct
	Coating Thickness Gauge – An Anodizer's Dream Come True	AMB	May/June
	Composite Delamination – A Definition	AMB	Sept/Oct
	Composite Repair Requires A Thorough Knowledge	AMB	March/April
	Corrosion In Crevices	AMB	Sept/Oct
	DC-9 Whole Bearing Seals	AMB	Sept/Oct
	Delaying Brake Changes Is False Economy	AMB	July/Aug
	Dye Penetrant Inspection Goes Fluorescent	AMB	May/June
	Engine Oil vs. Hydraulic Oil – Don't Confuse Them	AMB	Sept/Oct

Code	Subject	Bulletin	Date
35.00	**Maintenance (continued)**		
	Heat Shrinking Tubing And Environmental Splicing	AMB	March/April
	Impact Tools Are As Welcome As Adjustable Wrenches	AMB	March/April
	Lightweight High Speed Buffer	AMB	Nov/Dec
	Manual Troubleshooting	AMB	Nov/Dec
	Mobile Robots To Aviation Technicians?	AMB	March/April
	Much Danger In Storing Oxidizers Near Flammables	AMB	May/June
	Portable Video Analyzer For Internal Borescope Inspections	AMB	Nov/Dec
	Preflight Check – Ground Locks	AMB	May/June
	Self-Locking Powerplant Nuts With A "Catch"	AMB	May/June
	Sloppy Maintenance Causes FOD	AMB	July/Aug
	Sophisticated Flight Line Instrument Calibration	AMB	Sept/Oct
	Special Lubes For Special Purposes	AMB	May/June
	The Aviation Technician Goes High Tech.	AMB	Sept/Oct
	Tri-Wing Fasteners – An Evolution	AMB	July/Aug
	Unreported Minor Damage Can Cause Big Trouble	AMB	July/Aug
	Use & Care of Micro-Matic Torque Wrenches	AMB	Nov/Dec
	Wrap Up That Hydraulic Leak	AMB	July/Aug
36.00	**Management**		
	Decisions, Motivation, Mind Set	FSD	October
	In Defense of Company Procedure	AP	September
	Manuals, Management and Coordination	FSD	September
	Taking Responsibility for Safety Training	HS	March/April
	The Decision To Fly	AP	December
	Who Is Flying The Aircraft?	FSD	August
37.00	**Meetings**		
	Agenda Set For Spring Seminar	FSFN	January
	Airline and Government Officials Meet with Enders in Iceland	FSFN	August
	Aviation Maintenance Professionals To Visit China	FSFN	February
	Cooke Addresses French Aviation in Cannes	FSFN	August
	Corporate Advisory Committee Hears Virtues of Latest U.S. FAA Reorganization	FSFN	July
	Enders Addresses International Conference On Aircraft Collision Avoidance	FSFN	January
	Enders Meets with Airworthiness Federation	FSFN	Sept/Oct
	European Corporate Seminar Set For '89	FSFN	Sept/Oct
	Forecasting Future Aviation	FSFN	Sept/Oct
	Foundation Sets Workshop For China	FSFN	Sept/Oct

Code	Subject	Bulletin	Date
37.00	**Meetings**		
	Hazards Tackled by Corporate Seminar	FSFN	June
	International Air Safety Seminar Goes Down Under	FSFN	June
	Maintenance of Aircraft Highlighted At Upcoming Hannover Air Show	AMB	March/April
	November Cabin Safety Conference Rescheduled	FSFN	June
	U.S. Presidential Candidates' Aviation Positions Presented	FSFN	Sept/Oct
	Viasa Sponsors International Pilot Seminar in Venezuela	FSFN	Sept/Oct
49.00	**Regulations**		
	Airline Deregulation Economic Boom Or Bust?	FSD	January
	The Effects of Economics on Aviation Safety	FSD	March
51.50	**Sabotage/Security**		
	Aviation Security In An Age Of Terroism	FSD	December
53.00	**Statistics**		
	Civil Aviation and Flight Safety In Canada	FSD	September
	Effectiveness of Worldwide Civil Aviation Security Program and Flight Safety	FSD	April
	General Aviation Statistics	FSD	August
	Flight Safety – 10 Years After Airline Deregulation: A statistical review of airline performance and safety indicators	FSD	October
	Near Midair Collison Indicents and Midair Collision Accidents	FSD	November
	United States Transportation Fatalities Calendar Year 1987	FSD	March
	U.S. Civil Aviation Accident Trends	FSD	November
	U.S. Commuter Air Carrier and On-Demand Air Taxi	FSD	June
	Worldwide Airline Jet Transportation Aircraft Fatal Accidents and Hull Losses Calendar Year 1987	FSD	May
	Worldwide Airline Record Calendar Year 1987	FSD	February
	Worldwide Airline Safety Records Calender Year 1988	FSD	December
59.75	**Weather**		
	Coping With Hydroplaning	AP	August
	From the President: Danger - Thin Ice	FSFN	June
	Frost Costs	AMB	Jan/Feb
	Here Comes The Iceman	AP	January
	Insidious Rotor Ice	HS	Nov/Dec
	Nature Creates Visibility Restrictions	ATC	Jan/Feb

Code	Subject	Bulletin	Date
59.75	**Weather (continued)**		
	Next Generation Weather Radars To Increase Flight Safety	AO	March/April
	Summer Hazards	AP	July
	Winter Flying: Sharing Experience	AP	October
00.00	**General**		
	American Helicopter Society Publishes Enders	FSFN	August
	Briefly . . . Staff Activity . . .	FSFN	June
		FSFN	July
	Controlling The Deer-Strike Hazard	AOS	Nov/Dec
	Five New Governors Elected To Board	FSFN	February
	Flight Safety Foundation Names New Chairman	FSFN	Nov/Dec
	Foundation Governor To Be Honored	FSFN	February
	Governors Reaffirm Foundation's Intellectual Freedom	FSFN	June
	Headquarters Relocated	FSFN	Nov/Dec
	Jerry Lederer Wings Club Remarks	FSFN	Nov/Dec
	Librarian Joins Foundation to Head Library Project	FSFN	August
	Nelson Highlighted in Safety Publication	FSFN	Sept/Oct
	New Controller Joins Foundation Staff	FSFN	Sept/Oct
	New Editor Signs Aboard	FSFN	June
	News From The Lederer Library	FSFN	February
	Officials at Iberian Airline Briefed on Foundation Activities	FSFN	August
	Ralph Nelson Takes New V.P. Position	FSFN	June
	Reports Received at FSF	FSD	April
		FSD	August
		FSD	December
		FSD	February
		FSD	July
		FSD	June
		FSD	March
		FSD	May
		FSD	November
		FSD	October
		FSD	September
	Selecting A Business Aircraft	AP	June
	The Most Sold Airliner in The World– The Boeing 737	AMB	Nov/Dec
	Tokyo Proceedings to Be Best – Order Extras Now	FSFN	June
	What Is A Cockpit?	AMB	July/Aug
	Wings Club Remarks by Enders	FSFN	Nov/Dec
00.05	**Obituaries**		
	Aviation Pioneer and Former Flight Safety Foundation Chairman Dead at 92	FSFN	August
	Cecil Brownlow, Aviation Journalist, Dead at 61	FSFN	February
	John P. Doswell 1923-1987	FSFN	January

Symbols are used in this index to designate the publication listed. The symbols represent the initial letters of the titles of the publications. The code numbers preceding each heading are intended to serve as basis for coding or filing the items.

AP – Accident Prevention
AO – Airport Operations
ATC – Air Taxi/Commuter (Publication ended with the Sept/Oct issue.)
AMB – Aviation Mechanics Bulletin
CCS – Cabin Crew Safety
FSD – Flight Safety Digest
HFAM – Human Factors & Aviation Medicine
HS – Helicopter Safety
FSFN – Flight Safety Foundation News
PSE – Pilots Safety Exchange (Publication ended with the March/April issue.)