FLIGHT SAFETY FOUNDATION

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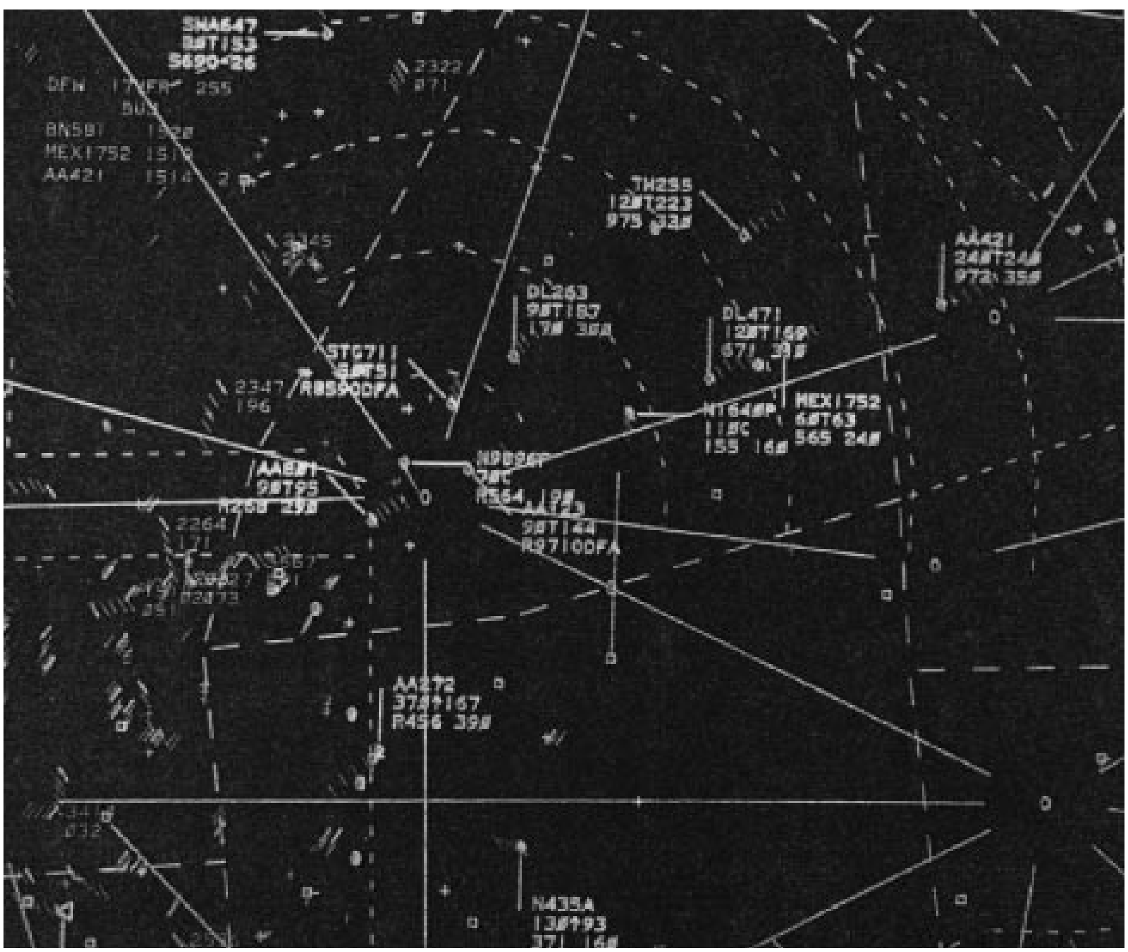
FLIGHT SAFETY
D I G E S T

New Pressures on Aviation Safety Challenge Safety Management Systems



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Flight Safety Foundation is an international membership organization dedicated to improving aviation safety. Nonprofit and independent, the Foundation was launched in 1945 in response to the aviation industry's need for a neutral clearinghouse to disseminate objective safety information, and for a credible and knowledgeable body that would identify threats to safety, analyze the problems and recommend practical solutions to them. Since its beginning, the Foundation has acted in the public interest to produce a positive influence on aviation safety. Today, the Foundation provides leadership to nearly 650 member organizations in 76 countries.

New Pressures on Aviation Safety Challenge Safety Management Systems

Competitive cost-reduction efforts, capacity bottlenecks and rapidly evolving technology all put a strain on safety margins. Far-reaching management initiatives will have to meet new challenges.

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Civil aviation is a global business that demands and achieves very high standards. The safety standards to which the world air transport industry works today have a solid foundation in the Annexes to the International Civil Aviation Organization (ICAO) Convention. The work of ICAO in setting up the Future Air Navigation Systems (FANS) Special Committee and developing the communications, navigation and surveillance/air traffic management (CNS/ATM) concept bears witness to the continuing importance of ICAO in developing new standards to match new technologies.

Nevertheless, setting standards is only one part of ensuring high levels of safety integrity in an air transport system that is becoming increasingly global and exposed to an increasing variety of pressures. In some aspects of the global air transport system, new approaches to ensuring safety integrity must be taken, both by the aviation industry and by its safety regulators.

One hardly needs to be reminded about the degree of change in the air transport industry over the past 15 years.

Since the U.S. domestic airlines were deregulated in 1978, shortly followed by liberalization in Europe, competitive policies in aviation have been adopted by governments throughout the world. Competition has been spurred by the privatization of national carriers and by economic recessions. Above all, these changes have put pressure on costs. The airline passenger has benefited from low fares, but the cost-reduction drive has created other pressures.

In contrast to the recession in the United States and Europe, some parts of the world, such as the Pacific Rim, have had healthy economies and significant air transport growth. At the same time, political change, as in the former Soviet Union states, has led to dramatic structural upheaval in some civil aviation industries. Emerging states continue to place a high priority on air transport development, but often with limited funds to support it.

Environmental concerns, media interest and competition in the application of new technologies increase pressures on the global air transport system.

Some of the results of pressures are very familiar:

- Runway capacity problems of many major hub airports;
- Airspace capacity bottlenecks;
- Flow control and the competition for slot times; and,
- Pressure on turnaround times.

Pressures to reduce costs can lead to demands for flight crews and air traffic controllers to work longer hours, within the regulatory limits, and to minimize maintenance down time.

Increased volumes in a constrained infrastructure produce their own pressures, such as the continual drive for improved efficiency by revised procedures and demands for the early introduction of new technologies.

All these pressures have safety implications.

Safety Margins Devolve Toward Regulated Minimums

It can be argued that a significant consequence of the combined pressures facing the aviation industry today is to reduce safety margins. When an airline or aviation system is under pressure to improve efficiency, there is a natural tendency to reduce operating criteria closer to the minimum standards permitted by the safety regulator. For example, in operations at congested airports there can be seen:

- Pressure to reduce approach separation distances;
- Identification of predetermined fast turn-off runway exits;
- Reduction of separation distances between taxiways and runways to provide more apron space; and,
- Tightening of apron maneuvering areas at the same time pressure is increasing for faster turnarounds.

Traffic-growth pressures contribute to reducing safety margins in a variety of ways. For example, some states have had to respond to air traffic growth by increasing rapidly the number of air traffic controllers in training. An inevitable consequence of this is a change in the ratio of experienced controllers to recently qualified controllers. This constrains rostering flexibility and adds to the high work load on experienced controllers, particularly if they are also supervising trainee controllers.

Pressure Increasing to Maximize Runway Capacity

One area that needs close monitoring by safety regulators is the increasing pressure to intensify runway operations. The drive to maximize runway capacity pressures air traffic control (ATC) providers and airlines to use techniques that will reduce the runway occupancy times of landing and departing aircraft.

Such pressures to save time at airports require high standards of professionalism and awareness by the pilots and air traffic controllers. ATC increasingly requires a pilot to delay reduction to final approach speed until a late stage in the approach to minimize separation time so that the aircraft crosses the threshold just as the preceding landing aircraft clears the runway. Speed must then be adjusted in order to exit the runway rapidly at a predetermined exit.

Pressures to reduce costs can lead to demands for flight crews and air traffic controllers to work longer hours, within the regulatory limits, and to minimize maintenance down time.

The same philosophy applied to departing aircraft encourages a higher proportion of aircraft to line up and take off "on the roll." A recent study of a major hub airport highlighted the potential capacity gain from this. Analysis showed that aircraft that lined up and stopped on the runway prior to takeoff had an average reaction time of 11 seconds from takeoff clearance to start-of-roll. The study suggested that if departing aircraft could decrease the time to seven seconds (which was equivalent to a 35 percent to 75 percent reduction), this could provide two extra departures per hour — not an unreasonable objective.

Of course, as a safeguard all such techniques and procedures must comply with the airline's Flight Operations Manual, which must satisfy the minimum safety regulatory standards. Such practices are also totally consistent with professional airmanship, professional flight operations and professional awareness of any risks involved. Nevertheless, this example of time saving, which reflects a logical attempt by airports and ATC to target maximum runway occupancy times for specific aircraft types, is reducing margins where there is a higher vulnerability to human-factor failure.

If this time saving is added to the pressures of minimizing stand allocation times and of maintaining slot times on congested routes, there is clearly a build-up of pressure on the flight crew. If, for one of the many possible operational reasons, flight start-up is delayed, a flight crew has little flexibility to complete predeparture checks and maintain a commercially sensitive slot time. Thus, safety margins have been further reduced.

Traffic volume and environmental pressures have an influence on the air traffic procedures in busy terminal areas, and ultimately on the work loads of both flight crews and controllers. Complicated departure routings and climb profiles add to the pressures, both on the ground and in the air. In such circumstances ATC instructions can be misheard by pilots and the subsequent incorrect readbacks missed by the controllers, possibly leading to deviations. Modern technology will help to minimize some of these risks but, as occurrence data bases confirm, even modern flight management system software sometimes fails, or a system can provide information that confuses the pilot at times of high work load. Such systems can also add to work load during a period of high pressure; for example, the need to update the system to accommodate an unexpected change of departure routing.

The net effect, so far, of reducing margins is not inherently unsafe when assessed against current minimum safety standards and current knowledge; otherwise air safety regulators would have taken action. The current air transport system has evolved with wide margins built into it. But each incremental reduction reduces those margins.

Nevertheless, an important unknown is what the accumulated effect on safety would be if the erosion of margins closely approached the safety regulatory minima on a wide scale. Knowledge of the big picture and how it all fits together is limited. Many of the safety regulatory requirements in use today have their foundation in analyses and decisions made decades ago. In some cases, the underlying rationale and statistical justification is not available or is not clear. Caution is necessary, therefore, in any process used to justify a further reduction in safety margins. More important, the right checks and balances must be put in place to maintain system safety integrity through operational change and new technological developments. The designers of tomorrow's aircraft and air traffic management (ATM) systems must be aware of these issues, just as much as today's airline, ATC and airport managers.

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Multidisciplinary Approach Is Needed

To maintain the safety integrity of the air transport system as margins are further reduced and new technologies are introduced, four main areas must be targeted:

- Technological development of new systems;
- Improved safety management of operations;
- A new emphasis to safety regulation; and,
- A review of safety objectives and criteria.

In each of these areas there needs to be an effective multidisciplinary approach and close liaison between industry and regulators. As accuracies increase and tolerances decrease, each professional discipline must better understand how its part of the total system will interact in routine operation with other parts of that system. Most importantly, the industry must comprehend the vulnerabilities to which the total system may become exposed when margins are reduced at the points of high pressure in operational service.

Such potential vulnerabilities must be identified and dealt with when systems are designed and procedures are defined, rather than in reaction to accidents and incidents.

Technological development can also contribute to maintaining and improving the safety integrity of the total system. At the heart of the total system are the man/machine and pilot/controller interfaces. The exposure to human-factor error must be reduced so that these critical interfaces of the system do not suffer unnecessary pressures. Collision avoidance, data-link and other technologies will aid in reducing pressures.

Operational Safety Management May Have Greatest Potential

One of the most important areas on which to concentrate, and arguably the most profitable in terms of potential for safety improvement, is the safety management of operations. When the total system fails under pressure, the cause frequently can be linked to failures or weaknesses in organizations' safety management systems.

It is well known that accident causes are usually complex, and that accidents are generally multicausal rather than the result of a single failure or error. It is readily accepted that a high proportion of aviation accidents and incidents are caused by human-factor errors. Nevertheless, it is far less widely recognized that many accident causes, which a few years ago would have been attributed to human error at the operational level, are often rooted in organizational issues and the role of management.

Action could yield significant benefits in three aspects of safety management — the formalization of safety management, the quality of training and the maintenance of a high standard of professional disciplines.

In the air transport industry, safety has a high priority. Its importance is implicit in almost everything that the industry does. Although the industry has a very good safety record, it is not always evident that operational companies (airlines, airport operators or ATC providers) have a coherent and formalized approach to safety management through all levels of their organizations.

In the air transport industry one often hears: “Safety is our highest priority!” An organization may have a good safety management system. But just because an airline has not had a major accident does not mean that the airline is safe. During recent years in the United Kingdom, several major nonaviation accidents have occured in which there were many fatalities. In each accident, the public inquiry found failings in the responsible organization and its management of safety.[1]

The management of safety must be systematic. It must be structured from the top of the organization, with clear accountabilities for safety at all levels. The safety culture in the organization should reflect this formal approach rather than just a generalized ethos of safety.

The essence of a good safety management system is that it explicitly demonstrates how safety is managed in the organization. This includes clarifying the processes used for identifying and evaluating potential hazards, for following-up incidents and for communicating safety-related matters, such as the lessons learned from incidents.

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Leading operating companies in the U.K. aviation sector are now developing more formal safety management disciplines. After a major review, during which important lessons were learned about the organization’s management of safety, the National Air Traffic Services (NATS) introduced a formal safety management system throughout its organization.

Also, the U.K. Civil Aviation Authority (CAA) is working closely with the U.K. Airport Operators Association to encourage the adoption of formal safety management disciplines at U.K. airports and to produce appropriate guidance material.

An important principle of formalization of safety management is that changes to standards and procedures should be subject to formal analysis of their safety significance. This principle should be applied to all proposals that reduce operational margins.

Standard Operating Procedures Still Need Emphasis

Professional disciplines must also be maintained. Violations of procedures and defined standards still surface in accident and incident reports. The failure of a flight crew to brief themselves properly and to listen to the Automatic Terminal Information Service (ATIS) broadcast prior to landing was the major contributory factor to an incident last year that resulted in an aircraft landing on a taxiway. The same incident revealed other basic failures of the flight crew and an inadequacy in the ATC procedures that had been overlooked by the ATC provider, the airport authority and their regulator. The lessons have been learned.

The use of poor radio transmission (RT) phraseology by flight crews and controllers has led too frequently to altitude deviations, airmisses and the mishandling of emergencies. There are many other reports of poor RT phraseology where safety was not put at risk, but where it might have been had the margin for error been less.

In a recent accident involving a U.K.-registered aircraft, the controllers demonstrated a lack of competence in handling an emergency. Following the accident, which involved a cockpit windscreen failure of a British Airways BAC One-Eleven on June 10, 1990, the CAA required increased attention to the handling of emergencies to be included in the basic and the recurrent training of controllers.

In a recent case of an aircraft with engine trouble, it appears that the flight crew of a four-engine turboprop Viscount freighter initially failed to use the appropriate emergency calls and the handling controllers were not made aware of the seriousness of the situation. By the time an emergency had been declared by the flight crew, there was no safety margin and the aircraft crashed. The pilot was killed in the crash and the first officer was seriously injured.

Globalization of Air Transportation Also Brings Safety Challenges

The introduction of new technologies and systems, the increasing globalization of air transportation and the many other pressures on the total system, not surprisingly, combine to place increased pressure for change on civil aviation safety regulators.

The introduction of formal safety management systems by ATC and airport operators must be accompanied by a change of approach by the safety regulator. Checklist-based inspections at the operational level are being replaced by audit techniques. These probe, on a structured basis, the adherence of the regulated organization to its own levels of safety. A much greater emphasis is placed on the organization and the management of safety, at all levels in the organization. The audit is likely to tell the regulator more about the underlying safety integrity of the organization than an inspection-based process. It also contributes more to a proactive dialogue on safety between the regulator and the regulated.

Incident investigation and analysis are vital tools for the regulator. The United Kingdom maintains an extensive mandatory occurrence reporting system. In addition to the government's Air Accidents Investigation Branch, the U.K. system includes industry-based committees that assess U.K. airmiss reports and reports by controllers of separation losses. The safety regulatory body also has a section dealing specifically with ATC incident investigations.

Globalization Requires Joint-authority Standards

The increasing globalization of air transportation and many other factors are leading to a more multilateral approach to safety regulation. In Europe, the Joint Aviation Authorities (JAA) already have established processes for conforming airworthiness requirements and the joint certification of aircraft. Joint maintenance organization approval standards were introduced recently. Joint requirements for flight operations, flight-time limitations, flight-crew licensing and aircraft mechanics are under development. To ensure that the joint standards are applied and adhered to, teams will monitor certain safety regulatory arrangements in member states and a sample of the organizations they regulate.

The increasing globalization of air transportation and many other factors are leading to a more multilateral approach to safety regulation.

Nevertheless, even in Europe, there is a wide variation in the researching and capability of the safety regulatory authorities. Some states may have to build up their regulatory teams. Some will have to introduce safety monitoring procedures where there were previously none.

There is a noticeable absence of formal international safety regulation in the oversight of air traffic services (ATS). In the United Kingdom, the safety regulation of air traffic services is the responsibility of the Safety Regulation Group of the CAA, the safety regulatory functions having been transferred from the National Air Traffic Services in 1988 and then developed more significantly.

Other states are beginning to follow the U.K. model. But the JAA, although recognizing the growing importance and safety significance of integrated airborne and ground systems, has not so far placed the harmonization of ATS safety regulations high on its agenda.

Meanwhile, interest is growing in how states will ensure the safety integrity of satellite-based communications and navigation systems. For most states, the global navigation satellite system (GNSS) will be provided by third parties from other states, and therefore outside their direct regulatory control. This raises two questions: What institutional arrangements are necessary and appropriate to ensure safety integrity? And what methods should be used?

ICAO has recognized that if airborne avionics systems require safety certification, then so do ground-based systems. The logic extends to satellite-based systems too. Because of the global nature of GNSS, it seems inevitable that ICAO must play a central role in establishing the framework on which safety regulation of GNSS will be based.

A three-tier model can be envisaged. ICAO would establish the underpinning safety regulatory standards for GNSS and act as a focal point for the creation of a global framework for safety regulation.

The practical safety regulatory oversight of GNSS might be organized regionally with, for example, the JAA being the focal point in Europe. The regional group would formulate regional policy and appoint audit teams drawn from member states. Individual states would thus participate in the oversight process at two levels — regional and national.

An increasing area of safety concern to regulatory authorities is the apparently low safety standards of some international carriers. This is also of particular concern to major airports that have high-intensity runway operations or whose approaches are over densely populated areas. The United States has already taken action on this front and the issue is being reviewed on a multilateral basis within Europe by the European Civil Aviation Conference and the JAA. One recent proposal is that international standards teams, working within a regional framework created under the auspices of ICAO, should oversee the regulatory authorities and airlines of states with less-developed aviation industries to ensure that the ICAO minimum standards are met.

Safety Objectives Demand Continual Reassessment

Regulators will need to devote more resources to the systematic review of safety objectives and criteria. Safety regulators on both sides of the Atlantic are attempting to reassess their safety goals, in objective and quantitative terms.

A major question is, by what measure should the safety of the air transport system and the performance of operators and safety regulators be judged? Should the measure be, for example, the number of fatalities, the fatal accident rate or some other measure?

Another issue is where best to focus the resources available for proactive safety analysis, research and development.

Human-factors research and analysis must be a high priority. Training, continued competence and adherence to professional disciplines are clearly also important.

At the more practical level in the short term, incident analysis should indicate where more immediate gains in safety can be made: whether, for example, to mandate (as the United States does) the installation of ground-proximity warning systems (GPWSs). The United States has already mandated the use of traffic-alert and collision avoidance systems (TCAS) but, in Europe, the results of further analysis of the use of TCAS II are awaited before such a commitment can be made.

Regulators must make greater use of safety and cost-benefit analysis techniques as evaluation tools to help decide at an early stage where available safety resources will have the most impact.

Another major issue is whether it is practicable to develop statistical targets for the safety performance of the air transport system as a whole. If this were possible, safety targets for the various components of the system could then be set more coherently.

The total system approach is not an easy task, and not all regulators are enthusiastic for the concept. However, the U.K. CAA is currently exploring how best to tackle such a challenging project. Even without a coherent quantitative result, the process should help identify the more significant elements in the total system so that the regulators can monitor more closely safety performance, prioritize where action is most needed, and, if necessary, define new standards.♦

Editorial Note: This article is adapted from a paper presented at a joint meeting of Flight Safety Foundation and the French National Academy of Air and Space, in Toulouse, France, November 1994. The views expressed in this article are those of the author and not necessarily those of the U.K. Civil Aviation Authority.

Reference

1. One example was the tragedy on March 6, 1987, when a British passenger ferry capsized near the port of Zeebrugge, Belgium. The accident, which resulted in nearly 200 fatalities, occurred because the bow loading doors had not been closed before the vessel put to sea. At the official inquiry, a representative of the U.K. Secretary of State for Transport said: “It seems to us that the nature of the fault for which management could probably be criticized is of a corporate nature. It involves many people over many years. … The fault of the management is a fault which could be found all the way from the junior superintendents in the marine department through to the board of directors.”

About the Author

Michael Overall is head of the U.K. CAA’s Licensing Standards Division, Safety Regulation Group. In 1984, Overall joined the CAA’s Safety Regulation Group, where he headed the group’s Support Services Division before transferring in 1988 to the U.K. National Air Traffic Services as director general of strategic planning.

Overall returned to the CAA’s Safety Regulation Group in 1990. As head of the Licensing Standards Division, Overall is responsible for the CAA’s personnel and airport licensing and air traffic services safety regulation.

Prior to his association with the Safety Regulation Group, Overall was head of the CAA’s Airports Policy Section, Economic Regulation Group, where he helped develop the CAA’s airline competition policies and was involved in associated international negotiations.

Overall began his career in aviation as an apprentice with Westland Helicopters, where he later worked on advanced helicopter designs and hovercraft sales. He has an engineering degree from City University, London.

U.S. Air Carrier Fatal Accident Rate Rose for Major Scheduled Airlines, Fell for Commuter Airlines in 1994

U.S. charter airlines completed fifth consecutive year with no fatal accidents.

Editorial Staff

Preliminary statistics released by the U.S. National Transportation Safety Board (NTSB) show that in 1994, the fatal accident rate rose for major scheduled air carriers, general aviation and air taxis. But although 1994 witnessed headline-making controversy about the safety of commuter airlines, the fatal accident rate for commuters declined.

The NTSB's preliminary figures showed 1,032 fatalities in U.S. civil aviation accidents in 1994, compared with 804 in 1993. Of the 1,032 fatalities, 239 involved the major carriers operating under U.S. Federal Aviation Regulations (FARs) Part 121; 89 involved commuter air carriers and air taxis operating under FARs Part 135; and 706 involved general aviation. (The subtotals add up to 1,034 because a runway collision between a DC-9 and a Cessna 441 included aircraft in two categories.)

Scheduled U.S. airlines operating in 1994 under Part 121 had 20 accidents, of which four involved fatalities. The number of accidents declined from 22 in 1993, but because several of the 1994 accidents were disastrous the 239 resulting deaths were much higher than the equivalent figure of one for 1993.

The 1994 scheduled U.S. major airline fatal accident rates vs. those of 1993 rose from 0.0002 to 0.0008 per million miles flown, and from 0.013 to 0.049 per 100,000 aircraft departures.

General aviation and air taxi data showed fewer fatalities in 1994 than in the previous year, although the fatality rate per 100,000 aircraft hours flown rose for both (from 1.78 to 1.87 for general aviation and from 0.90 to 1.35 for air taxis).

Scheduled commuter airline fatalities were about the same in 1994 as in 1993 (25 and 24, respectively). The number of accidents declined from 16 to 10, and the number of fatal accidents from four to three. The fatal accident rate per million miles flown dropped slightly, and the rate per 100,000 departures fell to 0.097 from 0.125 the year before.

The Oct. 31, 1994, crash of an American Eagle ATR-72 in Roselawn, Indiana, U.S., provoked much of the furor about commuter airline safety. But because the flight was operating under Part 121 rather than Part 135, which governs most commuter airlines, that accident was counted among those for large scheduled airlines rather than as a commuter accident.

General aviation accidents declined in both number and fatalities from 1993 to 1994. But the accident rate per 100,000 hours flown was higher in 1994 (9.47, up from 9.09), as was the fatality rate per 100,000 hours flown (1.87, a rise from 1.78).

Charter airlines' record remained a bright spot in 1994, the fifth consecutive year with no charter fatal accidents. Nevertheless, the accident rates per million miles flown and per 100,000 departures rose.

The NTSB defines an accident as an event resulting in substantial damage to an aircraft or serious injury to a person.

Table 1
Accidents, Fatalities and Rates, 1994 Preliminary Data — U.S. Air Carriers and General Aviation

	Accidents		Fatalities				Accident Rates Per 100,000 Aircraft Hours		Accident Rates Per 100,000 Departures	
	Total	Fatal	Total	Aboard	Aircraft Hours Flown	Departures	Total	Fatal	Total	Fatal
Air Carriers Operating Under Part 121										
Scheduled #	20	4	239	237	12,550,000	8,100,000	0.151	0.032	0.235	0.049
Nonscheduled	2	0	0	0	670,000	351,000	0.299	0	0.570	0
Air Carriers Operating Under Part 135										
Scheduled	10	3	25	25	2,330,000	3,100,000	0.429	0.129	0.323	0.097
Nonscheduled	84	27	64	63	2,000,000	n/a	4.20	1.35	n/a	n/a
General Aviation +	1,989	392	706	698	21,000,000	n/a	9.47	1.87	n/a	n/a
U.S. Civil Aviation *	2,106	426	1,032	1,023						
Foreign-registered Aircraft Accidents in the U.S.	18	4	16	16						
Unregistered Aircraft Accidents in the U.S.	13	6	6	6						
Military Aircraft that Collided with Civil Aircraft in the U.S.	1	1	1	0						

Exposure data estimate source: U.S. Federal Aviation Administration (FAA).

\# A 4/07/94 nonfatal accident that involved criminal activity is included in "Accidents" but not in "Accident Rates."

\+ Accidents involving U.S.-registered civil aircraft not operated under U.S. Federal Aviation Regulations Part 121 or Part 135.

* Accidents and fatalities in the categories do not necessarily sum to the figures in "U.S. Civil Aviation." Differences are because of collisions involving aircraft in different categories.

n/a Data not available.

Source: U.S. National Transportation Safety Board

Table 2
Accidents, Fatalities and Rates, 1982–1994 — U.S. Air Carriers Operating Under Part 121, Scheduled and Nonscheduled Service (Airlines*)

	Accidents		Fatalities					Accident Rates@					
								Per Million Aircraft Miles		Per 100,000 Aircraft Hours		Per 100,000 Departures	
Year	Total	Fatal	Total	Aboard	Aircraft Miles Flown#	Aircraft Hours Flown#	Departures#	Total	Fatal	Total	Fatal	Total	Fatal
1982	20	5	235	223	2,938,513,000	7,040,325	5,351,133	0.0065	0.0014	0.270	0.057	0.355	0.075
1983	24	4	15	14	3,069,318,000	7,298,799	5,444,374	0.0078	0.0013	0.329	0.055	0.441	0.073
1984	17	1	4	4	3,428,063,000	8,165,124	5,898,852	0.0050	0.0003	0.208	0.012	0.288	0.017
1985	22	7	526	525	3,631,017,000	8,709,894	6,306,759	0.0061	0.0019	0.253	0.080	0.349	0.111
1986	24	3	8	7	4,017,626,000	9,976,104	7,202,027	0.0057	0.0005	0.231	0.020	0.319	0.028
1987	36	5	232	230	4,360,521,000	10,645,192	7,601,373	0.0080	0.0009	0.329	0.038	0.460	0.053
1988	29	3	285	274	4,503,426,000	11,140,548	7,716,061	0.0062	0.0004	0.251	0.018	0.363	0.026
1989	28	11	278	276	4,605,083,000	11,274,543	7,645,494	0.0061	0.0024	0.248	0.098	0.366	0.144
1990	24	6	33	12	4,970,087,000	12,150,116	8,224,902	0.0048	0.0012	0.198	0.049	0.292	0.073
1991	26	4	62+	49	4,850,850,000	11,900,023	7,985,630	0.0054	0.0008	0.218	0.034	0.326	0.050
1992	18	4	39	31	5,087,722,000	12,495,667	8,082,526	0.0035	0.0008	0.144	0.032	0.223	0.049
1993	23	1	1	0	5,290,104,000	12,911,024	8,335,532	0.0043	0.0002	0.178	0.008	0.276	0.012
1994P	22	4	239	237	5,407,000,000	13,220,000	8,451,000	0.0039	0.0007	0.159	0.030	0.248	0.047

P Preliminary data.

* Includes accidents involving deregulated all-cargo air carriers and commercial operators of large aircraft when those accidents occurred during operations under U.S. Federal Aviation Regulations Part 121.

Source of estimate: U.S. Federal Aviation Administration.

\+ The fatalities total includes the 12 persons killed aboard a Skywest commuter aircraft and the 22 persons killed aboard the USAir airliner when the two aircraft collided on a runway.

@ The following suicide/sabotage cases are included in “Accidents” and “Fatalities” but not in “Accident Rates”:

			Fatalities	
Date	Location	Operator	Total	Aboard
8/11/82	Honolulu, Hawaii	Pan American World Airways	1	1
4/02/86	Near Athens, Greece	Trans World Airlines	4	4
12/07/87	San Luis Obispo, California	Pacific Southwest Airlines	43	43
12/21/88	Lockerbie, Scotland	Pan American World Airways	270	259
4/07/94	Memphis, Tennessee	Federal Express	0	0

Source: U.S. National Transportation Safety Board

Table 3
Accidents, Fatalities and Rates, 1982–1994 — U.S. Air Carriers Operating Under Part 121, All Scheduled Service (Airlines*)

	Accidents		Fatalities					Accident Rates@					
								Per Million Aircraft Miles		Per 100,000 Aircraft Hours		Per 100,000 Departures	
Year	Total	Fatal	Total	Aboard	Aircraft Miles Flown#	Aircraft Hours Flown#	Departures#	Total	Fatal	Total	Fatal	Total	Fatal
1982	16	4	234	222	2,806,885,000	6,697,770	5,162,346	0.0053	0.0011	0.224	0.045	0.291	0.058
1983	22	4	15	14	2,920,909,000	6,914,969	5,235,262	0.0075	0.0014	0.318	0.058	0.420	0.076
1984	13	1	4	4	3,258,910,000	7,736,037	5,666,076	0.0040	0.0003	0.168	0.013	0.229	0.018
1985	17	4	197	196	3,452,753,000	8,265,332	6,068,893	0.0049	0.0012	0.206	0.048	0.280	0.066
1986	21	2	5	4	3,829,129,000	9,495,158	6,928,103	0.0052	0.0003	0.211	0.011	0.289	0.014
1987	32	4	231	229	4,125,874,000	10,115,407	7,293,025	0.0075	0.0007	0.306	0.030	0.425	0.041
1988	28	3	285	274	4,260,785,000	10,521,052	7,347,575	0.0063	0.0005	0.257	0.019	0.367	0.027
1989	24	8	131	130	4,337,234,000	10,597,922	7,267,341	0.0055	0.0018	0.226	0.075	0.330	0.110
1990	22	6	39	12	4,711,542,000	11,524,726	7,928,357	0.0047	0.0013	0.191	0.052	0.277	0.076
1991	25	4	62+	49	4,582,837,000	11,253,868	7,672,585	0.0055	0.0009	0.222	0.036	0.326	0.052
1992	16	4	33	31	4,814,953,000	11,866,213	7,716,243	0.0033	0.0008	0.135	0.034	0.207	0.052
1993	22	1	1	0	4,985,277,000	12,201,367	7,977,096	0.0044	0.0002	0.180	0.008	0.276	0.013
1994P	20	4	239	237	5,106,000,000	12,550,000	8,100,000	0.0037	0.0008	0.151	0.032	0.235	0.049

P Preliminary data.

* Includes accidents involving deregulated all-cargo air carriers and commercial operators of large aircraft when those accidents occurred during operations under U.S. Federal Aviation Regulations Part 121.

Source of estimate: U.S. Federal Aviation Administration.

+ The fatalities total includes the 12 persons killed aboard a Skywest commuter aircraft and the 22 persons killed aboard the USAir airliner when the two aircraft collided on a runway.

@ The following suicide/sabotage cases are included in “Accidents” and “Fatalities” but not in “Accident Rates”:

			Fatalities	
Date	Location	Operator	Total	Aboard
8/11/82	Honolulu, Hawaii	Pan American World Airways	1	1
4/02/86	Near Athens, Greece	Trans World Airlines	4	4
12/07/87	San Luis Obispo, California	Pacific Southwest Airlines	43	43
12/21/88	Lockerbie, Scotland	Pan American World Airways	270	259
4/07/94	Memphis, Tennessee	Federal Express	0	0

Source: U.S. National Transportation Safety Board

Table 4
Accidents, Fatalities and Rates, 1982–1994 — U.S. Air Carriers Operating Under Part 121, All Nonscheduled Service (Airlines*)

	Accidents		Fatalities					Accident Rates@					
								Per Million Aircraft Miles		Per 100,000 Aircraft Hours		Per 100,000 Departures	
Year	Total	Fatal	Total	Aboard	Aircraft Miles Flown#	Aircraft Hours Flown#	Departures#	Total	Fatal	Total	Fatal	Total	Fatal
1982	4	1	1	1	131,628,000	342,555	188,787	0.0304	0.0076	1.168	0.292	2.119	0.530
1983	2	0	0	0	148,409,000	383,830	209,112	0.0135	0.0000	0.521	0.000	0.956	0.000
1984	4	0	0	0	169,153,000	429,087	232,776	0.0236	0.0000	0.932	0.000	1.718	0.000
1985	5	3	329	329	178,264,000	444,562	237,866	0.0280	0.0168	1.125	0.675	2.102	1.261
1986	3	1	3	3	188,497,000	480,946	273,924	0.0159	0.0053	0.624	0.208	1.095	0.365
1987	4	1	1	1	234,647,000	529,785	308,348	0.0170	0.0043	0.755	0.189	1.297	0.324
1988	1	0	0	0	242,641,000	619,496	368,486	0.0041	0.0000	0.161	0.000	0.271	0.000
1989	4	3	147	146	267,849,000	676,621	378,153	0.0149	0.0112	0.591	0.443	1.058	0.793
1990	2	0	0	0	258,545,000	625,390	296,545	0.0077	0.0000	0.320	0.000	0.674	0.000
1991	1	0	0	0	268,013,000	646,155	313,045	0.0037	0.0000	0.155	0.000	0.319	0.000
1992	2	0	0	0	272,769,000	629,454	366,283	0.0073	0.0000	0.318	0.000	0.546	0.000
1993	1	0	0	0	304,827,000	709,657	358,436	0.0033	0.0000	0.141	0.000	0.279	0.000
1994P	2	0	0	0	301,000,000	670,000	351,000	0.0066	0.0000	0.299	0.000	0.570	0.000

P Preliminary data.

* Includes accidents involving deregulated all-cargo air carriers and commercial operators of large aircraft when those accidents occurred during operations under U.S. Federal Aviation Regulations Part 121.

Source of estimate: U.S. Federal Aviation Administration.

Source: U.S. National Transportation Safety Board

Table 5
Accidents, Fatalities and Rates, 1982–1994 — U.S. Air Carriers Operating Under Part 135, All Scheduled Service (Commuter Air Carriers*)

	Accidents		Fatalities					Accident Rates@					
								Per Million Aircraft Miles		Per 100,000 Aircraft Hours		Per 100,000 Departures	
Year	Total	Fatal	Total	Aboard	Aircraft Miles Flown#	Aircraft Hours Flown#	Departures#	Total	Fatal	Total	Fatal	Total	Fatal
1982	26	5	14	14	222,355,000	1,299,748	2,026,691	0.117	0.022	2.000	0.335	1.283	0.247
1983	17	2	11	10	253,572,000	1,510,908	2,328,430	0.067	0.008	1.125	0.132	0.730	0.086
1984	2	7	48	46	291,460,000	1,745,762	2,676,590	0.075	0.024	1.260	0.401	0.822	0.262
1985	21	7	37	36	300,817,000	1,737,106	2,561,463	0.070	0.023	1.209	0.403	0.820	0.273
1986	15	2	4	4	307,393,000	1,724,586	2,798,811	0.049	0.007	0.870	0.116	0.536	0.071
1987	32	10	59	57	350,879,000	1,946,349	2,809,918	0.091	0.028	1.644	0.514	1.139	0.356
1988	19	2	21	21	380,237,000	2,092,689	2,909,005	0.050	0.005	0.908	0.096	0.653	0.069
1989	18	5	31	31	393,619,000	2,240,555	2,818,520	0.046	0.013	0.803	0.223	0.639	0.177
1990	15	3	6	4	450,067,000	2,336,952	3,159,763	0.033	0.007	0.642	0.128	0.475	0.095
1991	22	8	99+	77	331,464,000	2,171,067	2,647,876	0.058	0.021	1.013	0.368	0.831	0.302
1992	23	7	21	21	442,107,000	2,182,369	2,911,168	0.050	0.016	1.008	0.321	0.756	0.240
1993	16	4	24	23	505,481,000	2,422,554	3,198,384	0.032	0.008	0.660	0.165	0.500	0.125
1994P	10	3	25	25	499,000,000	2,330,000	3,100,000	0.020	0.006	0.429	0.129	0.323	0.097

P Preliminary data.

* Includes accidents involving all-cargo air carriers when those accidents occurred during scheduled operations under U.S. Federal Aviation Regulations Part 135. All-cargo air carriers no longer meet the U.S. Department of Transportation, Research and Special Programs Administration (RSPA) definition for "commuters."

Source of estimate: U.S. Federal Aviation Administration.

\+ The fatalities total includes the 12 persons killed aboard a Skywest commuter aircraft and the 2 persons killed aboard the USAir airliner when the two collided on a runway.

@ Rates are based on all accidents including some involving operators not reporting traffic data to U.S. Department of Transportation, Research and Special Programs Administration (RSPA).

The following (attempted) suicide case is included in "Accidents" but not in "Accident Rates":

			Fatalities	
Date	Location	Operator	Total	Aboard
4/17/92	Lexington, Kentucky	Mesaba Airlines	0	0

Source: U.S. National Transportation Safety Board

Table 6
Accidents, Fatalities and Rates, 1982–1994 — U.S. Air Carriers Operating Under Part 135, Nonscheduled Operations (On-demand Air Taxis*)

	Accidents		Fatalities			Accident Rates Per 100,000 Aircraft Hours	
Year	Total	Fatal	Total	Aboard	Aircraft Hours Flown#	Total	Fatal
1982	132	31	72	72	3,008,000	4.39	1.03
1983	141	27	62	57	2,378,000	5.93	1.14
1984	146	23	52	52	2,843,000	5.14	0.81
1985	154	35	76	75	2,570,000	5.99	1.36
1986	117	31	65	61	2,690,000	4.35	1.15
1987	97	30	65	63	2,657,000	3.65	1.13
1988	101	28	59	55	2,632,000	3.84	1.06
1989	111	25	83	81	3,020,000	3.68	0.83
1990	106	28	50	48	2,249,000	4.71	1.24
1991	87	27	70	66	2,241,000	3.88	1.20
1992	76	24	70	67	2,009,000	3.78	1.19
1993	69	19	42	42	2,100,000	3.29	0.90
1994P	84	27	64	63	2,000,000	4.20	1.35

* U.S. Federal Aviation Regulations Part 135.

P Preliminary data.

\# Source of estimate: U.S. Federal Aviation Administration

Source: U.S. National Transportation Safety Board

Table 7
Accidents, Fatalities and Rates, 1982–1994 — U.S. General Aviation

	Accidents		Fatalities			Accident Rates Per 100,000 Aircraft Hours@	
Year	Total	Fatal	Total	Aboard	Aircraft Hours Flown#	Total	Fatal
1982	3,233	591	1187	1170	29,640,000	10.90	1.99
1983	3,078	556	1069	1062	28,673,000	10.73	1.94
1984	3,017	545	1042	1021	29,099,000	10.36	1.87
1985	2,739	498	955	944	23,322,000	9.66	1.75
1986	2,582	474	967	878	27,073,000	9.54	1.75
1987	2,496	447	838	823	26,972,000	9.25	1.65
1988	2,386	460	800	792	27,446,000	8.69	1.68
1989	2,232	431	768	765	27,920,000	7.98	1.53
1990	2,216	442	766	761	28,510,000	7.77	1.55
1991	2,177	432	785	771	27,226,000	7.99	1.58
1992	2,075	448	860	858	23,792,000	8.72	1.88
1993	2,042	399	737	732	22,476,000	9.09	1.78
1994P	1,989	392	706	698	21,000,000	9.47	1.87

P Preliminary data.

\# Source of estimate: U.S. Federal Aviation Administration.

* U.S.-registered civil aircraft not operated under U.S. Federal Aviation Regulations Part 121 or Part 135.

@ Suicide and sabotage accidents excluded from rates as follows:

Total — 1982 (3); 1983 (1); 1984 (3, 2 fatal); 1985 (3, 2 fatal); 1987 (1, 1 fatal); 1988 (1); 1989 (5, 4 fatal); 1990 (1); 1991 (3, 2 fatal); 1992 (1, 1 fatal).

Source: U.S. National Transportation Safety Board

Table 8
Fatal Accidents, 1994 Preliminary Data — U.S. Air Carriers Operating Under Part 121, All Scheduled Service (Airlines*)

					Fatalities					
Date	Location	Operator	Service	Aircraft	Psgr.	Crew	Other	Total	Total Aboard	Reported Type of Accident
July 2	Charlotte, North Carolina	USAir	Psgr.	DC-9-30	37	0	0	37	62	Struck the ground during a missed approach.
Sep. 8	Aliquippa, Pennsylvania	USAir	Psgr.	B-737-300	127	5	0	132	132	In-flight loss of control
Oct. 31	Roselawn, Indiana	Simmons Airlines, dba American Eagle	Psgr.	ATR-72	64	4	0	68	68	In-flight loss of control.
Nov. 22	Bridgeton, Missouri	TWA	Psgr.	DC-9-82	0	0	2	2	140	Collided with a Cessna 441 on the runway.

* U.S. Federal Aviation Regulations Part 121.

Source: U.S. National Transportation Safety Board

Table 9
Fatal Accidents, 1994 Preliminary Data — U.S. Air Carriers Operating Under Part 135, All Scheduled Service (Commuter Air Carriers)

					Fatalities					
Date	Location	Operator	Service	Aircraft	Pgsr.	Crew	Other	Total	Total Aboard	Reported Type of Accident
Jan. 7	Columbus, Ohio	Atlantic Coast Airlines, dba United Express	Psgr.	Jetstream J-4101	2	3	0	5	8	Crashed 1.2 miles from the airport during an instrument approach.
Dec. 10	Elim, Alaska	Ryan Air Service	Psgr.	Cessna 402	4	1	0	5	20	Crashed into a mountain in instrument meteorological conditions.
Dec. 13	Morrisville, North Carolina	Flagship Airlines, dba American Eagle	Psgr.	BAe-3201	2	13	0	15	20	Crashed 4 miles from the airport during an instrument approach.

* U.S. Federal Aviation Regulations Part 135.

Source: U.S. National Transportation Safety Board

Publications Received at FSF
Jerry Lederer Aviation Safety Library

U.S. FAA Advisory Circular Outlines Certification Maintenance Requirements

New book argues the importance of stress and fatigue in aviation psychology.

Editorial Staff

Advisory Circulars (ACs)

Certification Maintenance Requirements. U.S. Federal Aviation Administration (FAA). Advisory Circular (AC) No. 25-19. November 1994. 12 p.

Summary: This AC provides one acceptable means for selecting, documenting and managing certification maintenance requirements (CMRs). CMRs are tasks designed to find and to limit exposure to otherwise-hidden failures. They do not have a preventative maintenance function. These required, periodic tasks are established during the design certification of the airplane as an operating limitation of the type certificate.

The AC says that the decision to create a CMR should include balancing the cost, weight or complexity of providing an alerting mechanism, or a device that will expose the latent failure, against the requirement for an operator to conduct a maintenance or inspection task at fixed intervals.

Ground Deicing and Anti-icing Training and Checking. U.S. Federal Aviation Administration (FAA). Advisory Circular No. 135-16. December 1994. 18 p.

Summary: This AC provides a means for U.S. Federal Aviation Regulations (FARs) Part 135 operators to comply with the Part 135 ground deicing rule. The AC provides guidance for training requirements that should be incorporated; certain air carriers' approved training programs; ground deicing and anti-icing guidance for air carriers that are not required to have an approved training program; and guidance for the pretakeoff contamination check required of most Part 135 air carriers.

Takeoff Safety Training Aid Announcement of Availability. U.S. Federal Aviation Administration (FAA). Advisory Circular (AC) No. 120-62. September 1994. 10 p.

Summary: This AC announces the availability of a joint FAA/Industry Takeoff Safety Training Aid. The goal of the Takeoff Safety Training Aid is to minimize the probability of rejected takeoff (RTO)–related accidents and incidents by improving pilots' ability to maximize takeoff performance margins; improving pilots' ability to make appropriate go/no-go decisions; and improving crews' ability to effectively accomplish RTO-related procedures.

The training aid is organized under four sections: Takeoff Safety — Overview for Management; Pilot Guide to Takeoff Safety; Example Takeoff Safety Training Program; Takeoff Safety — Background Data.

Helicopter Simulator Qualification. U.S. Federal Aviation Administration (FAA). Advisory Circular (AC) No. 120-63. October 1994. 58 p.; appendices.

Summary: This AC provides one acceptable means to qualify helicopter simulators for use in training programs or for airmen checking under various parts of the U.S. Federal Aviation Regulations (FARs). The guidelines in the AC are not mandatory.

The FAA has been involved in flight-simulator evaluation and approval since the mid-1950s, when air carriers were permitted to perform limited proficiency check maneuvers in airplane simulators. Since that time, however, simulators have reduced flight training costs for operators and made flight training safer. Although the FARs have been developed to permit the increased use of airplane simulators for flight training, they have not addressed the training and checking of crew members in helicopter simulators.

The AC says that helicopter simulators in use today have been approved on a case-by-case basis, but that it is expected that their use will expand rapidly and that applicable regulations will be amended to extend formal credit to the use of helicopter simulators in approved training programs.

Primary Category Aircraft. U.S. Federal Aviation Administration (FAA). Advisory Circular (AC) No. 21-37. 13 p.

Summary: This AC provides guidance for complying with the Code of Federal Regulations (CFR) certification procedures for products and parts (Part 21, Subchapter C, Chapter 1, Title 14 by explaining one acceptable means to ensure compliance with Federal Aviation Regulations (FARs) Part 121 §21.24 ("Issuance of Type Certificate: Primary Category Aircraft"). The AC discusses type, production, airworthiness certification, maintenance procedures and operating limitations, but does not discuss other general certification requirements common to aircraft and applicable to primary category aircraft.

Pilot Guide: Small Aircraft Ground Deicing. U.S. Federal Aviation Administration (FAA). Advisory Circular (AC) No. 135-17. December 1994. 50 p.; figures; appendix.

Summary: This AC, which is intended to be a quick-reference guide for pilots of commuter, air taxi and general aviation aircraft, provides pilots, flight crew members, maintenance and servicing personnel and other aviation professionals with information and recommendations for ground operations during weather conditions conducive to aircraft icing. The AC does not change or authorize deviation from the Federal Aviation Regulations (FARs). Topics covered include practices for pilots about frozen contaminants and their causes; effects of contamination; cold weather preflight procedures; and post-deicing/anti-icing checks.

Reports

Bibliography of Lewis Research Center Technical Publications Announced in 1993. U.S. National Aeronautics and Space Administration (NASA) Technical Memorandum No. 106666. November 1994. 470 p.

<u>Keywords:</u>

1. Bibliographies
2. Abstracts
3. Documentation
4. Indexes (Documentation)

Summary: This compilation of abstracts indexes and describes 733 technical publications and 283 additional contractor-authored research reports published by NASA's Lewis Research Center in 1993. All reports were first announced in the 1993 issues of *Scientific and Technical Reports* (STAR) and/or *International Aerospace Abstracts* (IAA).

Blinks, Saccades and Fixation Pauses During Vigilance Task Performance: I. Time on Task. Stern, John A.; Boyer, Donna; et al. A special report prepared for the U.S. Federal Aviation Administration (FAA) Office of Aviation Medicine. Report No. DOT/FAA/AM-94/26. December 1994. 45 p.; figures; tables; references. Available through the U.S. National Technical Information Service (NTIS).*

<u>Keywords:</u>

1. Fatigue
2. Eye Movements
3. Time-on-task
4. Blinks
5. Vigilance

Summary: This report is the result of a collaborative research project developed through the U.S.-U.S.S.R. Aviation Medicine and Human Factors Working Group. The working group was initiated under the U.S.-U.S.S.R. Agreement on Cooperation in Transportation Science and Technology.

Faced with the probability that in the future operators of complex equipment will spend more time monitoring computer-controlled devices than having hands-on control of the equipment, the researchers sought to answer the question, "Can gaze control measures be used to reflect, and hopefully to predict, periods of impaired vigilance?"

The study's results demonstrated that there are significant time-on-task effects, as shown by many aspects of eye movements and eye blinks, and the authors say that additional research is necessary to develop unobtrusive techniques to determine if equipment operators are functioning at reduced alertness levels.

FAA Vertical Flight Bibliography, 1962–1994. Smith, Robert D. Report No. DOT/FAA/RD-94/17. A special report prepared for the U.S. Federal Aviation Administration (FAA) Research and Development Service. August 1994. 292 p.; appendices.

<u>Keywords:</u>

1. Bibliography
2. Helicopter
3. Heliport

4. Powered-lift Vehicles
5. Rotorcraft
6. Tiltrotor
7. Vertiport

Summary: During the past three decades, the Federal Aviation Administration (FAA) has published about 350 technical reports about helicopters, heliports and other vertical flight issues. This report was compiled to provide a bibliography of those reports to persons interested in research, engineering and development of vertical flight aircraft.

Toward A New National Weather Service — Weather for Those Who Fly. Contract No. 50-DGNW-0-00041. U.S. National Research Council, National Weather Service Modernization Committee of the Commission on Engineering and Technical Systems. A special report prepared for the U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA). 1994. 100 p.; ill.; appendices. Available from the Transition Program Office of the U.S. National Weather Service (NWS), NOAA, 1325 East West Highway, Silver Spring, MD 20910 U.S. (301) 713-0454.

Keywords:
1. Weather Forecasting — United States
2. Meteorology — Research — United States

Summary: The United States has launched a program to modernize its NWS, which is part of the National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce. In 1989, at the request of NOAA, the National Research Council formed the NWS Modernization Committee to advise NOAA during the modernization. The committee's report is an overview of how new observations, atmospheric models and presentation techniques can lead to dramatic improvements in weather services for civil aviation, and it describes the need for improved weather-related education for pilots. The report concludes that the modernization of the NWS can lead to safer and more efficient flight and can increase the capacity of the airways.

Aviation Safety: Data Problems Threaten FAA Strides on Safety Analysis System. U.S. General Accounting Office (GAO). Report No. GAP/AIMD-95-27. February 1995. 30 p.; appendices. Available through GAO.**

Keywords:
1. Aeronautic — United States — Safety Measures
2. Aircraft Accidents — United States

Summary: The U.S. Federal Aviation Administration (FAA) is acquiring the Safety Performance Analysis System (SPAS), which is intended to aid the FAA in focusing its inspection and certification resources. The GAO has reviewed SPAS to determine if the FAA is effectively managing its acquisition of the system and to determine if the FAA is effectively addressing known data quality problems.

SPAS relies on data from many data bases, including those that make up the FAA's Aviation Safety Analysis System (ASAS). The report says that the GAO and the FAA, among others, have complained that the ASAS data bases contain data that are incomplete, inconsistent and inaccurate. The report says that if the quality of the data that SPAS uses does not improve, its inputs to safety-related decisions will be unreliable.

The report also says that the GAO found the FAA's work in analyzing and defining SPAS' requirements credible, but that the FAA's cost estimates for SPAS software were subjective and not supported by verifiable analysis.

The Role of Flight Progress Strips in En Route Air Traffic Control: A Time-series Analysis. Edwards, Mark B.; Fuller, Dana K.; et al. A special report prepared for the U.S. Federal Aviation Administration (FAA) Office of Aviation Medicine. Report No. DOT/FAA/AM-95/4. January 1995. 12 p.; appendix. Available through National Technical Information Service (NTIS).*

Keywords:
1. Air Traffic Control
2. Flight Progress Strips
3. ATC Automation
4. Human Factors
5. Training

Summary: Air traffic controllers in the United States use paper flight progress strips (FPSs) to document flight information; this process will eventually be replaced by electronic flight data entries. This report documents an observationalstudy of control actions, communication events and computer interactions of teams of air traffic controllers and individual air traffic controllers. The report says that the data gathered indicated that FPS activities were similar for individuals and for the data-side controllers in the team; and that flight strip activity for teams was predictable from the radar-side controller's actions, but not the data-side controller's actions.

Report on Proceedings — Aviation Accident Investigation Symposium, March 29–31, 1994, Tysons Corner, Virginia, Volume I: Industry Recommendations and Safety Board Responses. National Transportation Safety Board (NTSB). Report No. NTSB/RP-94/01. Adopted October 1994. Available through National Technical Information Service (NTIS).*

Report on Proceedings — Aviation Accident Investigation Symposium, March 29–31, 1994, Tysons Corner, Virginia, Volume II: Participant Presentations. U.S. National Transportation Safety Board (NTSB). Report No. NTSB/RP-94/01. Adopted

October 1994. Available through National Technical Information Service (NTIS).*

Keywords:

1. Aeronautics — Accidents — Congresses
2. Aeronautics — Safety Measures — Congresses

Summary: More than 490 people attended the Aviation Accident Investigation Symposium held in March 1994 by the U.S. National Transportation Safety Board (NTSB). The NTSB's purpose in holding the symposium was to get input on how NTSB programs, practices and procedures used in aviation accident investigations could be improved. Participants represented airframe and engine manufacturers, airlines, aviation associations and unions, government officials and non-U.S. investigative authorities.

Volume I presents the recommendations of working groups, which met on the last morning of the symposium, and the NTSB's responses to them. Volume II contains participants' presentations.

A Review of Civil Aviation Fatal Accidents in Which "Lost/Disoriented" Was a Cause/Factor: 1981–1990. Collins, William E. A special report prepared for the U.S. Federal Aviation Administration Office of Aviation Medicine. January 1995. 7 p. Available through National Technical Information Service (NTIS).*

Keywords:

1. Fatal Accidents
2. Lost/Disoriented
3. Spatial Disorientation

Summary: "Lost/disoriented" is one accident causation category used by the U.S. National Transportation Safety Board (NTSB) and refers to a loss of geographic awareness and the resulting confusion rather than "spatial disorientation." This study's purpose was to provide information surrounding the circumstances of "lost/disoriented" reports and to identify demographic and behavioral characteristics of pilots in those situations. A ten-year period was studied; 120 accidents, resulting in 169 fatalities, were found for the period. The frequency peaked in 1985, when there were 22 fatal "lost/disoriented" accidents. The report says that 75 percent of the pilots had no instrument rating and that 64 percent of the accidents were associated with adverse weather. Slightly more than half occurred at night.

Air Pollution: FAA's Reliance on Manufacturers for Jet Engine Emission Testing. U.S. General Accounting Office (GAO). Report No. GAO/RCED-94-99. A report to the Chairman, Subcommittee on Oversight and Investigations, Committee on Energy and Commerce, U.S. House of Representatives. July 1994. 12 p. Available through GAO.**

Keywords:

1. Jet Transports — United States — Testing
2. Airplanes — Jet Propulsion — Testing
3. Air — Pollution — Standards — United States

The U.S. Federal Aviation Administration (FAA) is responsible for enforcing emission standards set for jet aircraft engines by the U.S. Environmental Protection Agency (EPA). The FAA relies on manufacturers to design and conduct emissions tests, and designates engineers, who are manufacturers' employees, to represent the FAA throughout the testing process. This report was written in response to concerns, voiced by the U.S. House of Representatives, about how the FAA ensures compliance with standards and how the FAA and manufacturers have addressed the potential conflict of interest.

Books

ATP–FAR 135: Airline Transport Pilot, third edition. Boyd, K.T. Ames, Iowa, United States: Iowa State University Press, 1994. 204 p.; ill.; index; appendices.

Keywords:

1. Aeronautics — Examinations, questions, etc.
2. Airplanes — Piloting
3. Air pilots — Licenses — United States

Summary: This book is aimed at corporate, commuter and cargo carrier pilots with 1,500 hours aviation experience who want to prepare for the Airline Transport Pilot (ATP) Certificate covering jet and piston aircraft less than 12,500 pounds (5,670 kilograms). The author discusses performance charts, weight and balance problems associated with corporate aircraft and high- and low-altitude weather. The author also covers computer functions, charts and approach plates and flight procedures. In the preface, the author says that the text is not intended for primary, commercial or instrument instruction. A practice Federal Aviation Administration (FAA) examination is included.

Loving's Love: A Black American's Experience in Aviation. Loving, Neal V. Washington, D.C., U.S.: Smithsonian Institution Press, 1994. 278 p.; ill.; appendices.

Keywords:

1. Airpilots — United States — Biography
2. Afro-Americans in Aeronautics

Summary: Neal V. Loving was the first African American and the first double amputee to be qualified as a racing pilot by the National Aeronautic Association and the Professional Racing Pilots Association.

The title of this autobiography comes from the author's midget one-seater racing plane, the WR-1 "Loving's Love." Neal Loving completed and first flew the plane in 1950 — only six years after losing both his legs in the crash of his first production prototype, the S-1 glider, and 15 years after building his first full-size flying machine as a young high school graduate in Detroit, Michigan.

Describing his early days as a fledgling designer and his years as the owner of a flying school, Loving often refers to his personal creed, "no success without enthusiasm." At age 40, he enrolled as a full-time engineering student, going on to a long and distinguished career as an aerospace research engineer.

Flight Stress: Stress, Fatigue, and Performance in Aviation. Stokes, Alan; Kite, Kirsten. Brookfield, Vermont, United States: Ashgate Publishing Co., 1994. 427 p.; indices; figures.

Summary: The authors say that more attention should be paid to stress and fatigue in aviation psychology, although these issues have traditionally been considered peripheral factors. It is the authors' view that energetic factors are integral elements of human information processing. Chapter titles include: "Concepts of Stress," "Stress and Arousal," "Pilot Performance and Stress," "Decision Making and Communication," "Life Stress," "Stress and Pilot Personality," "Fear and Stress Extremes," "Fatigue in Flight Operations," "Trans-meridian Flight," "Stress in Air Traffic Control," "Organizations, Stress and Accidents," and "Automation and Boredom."

Proceedings of the Twenty-fifth International Seminar of the International Society of Air Safety Investigators. Sterling, Virginia, U.S.: International Society of Air Safety Investigators (ISASI), 1994. Published in *forum* Volume 27 (December 1994). 223 p.; figures; references. Available through ISASI, Technology Trading Park, Five Export Drive, Sterling, VA, 20164-4421 U.S. (703) 430-9668.

Summary: ISASI's 25th international seminar, "Detecting and Eliminating the Hazard," was held in Paris, France, in October 1994; the conference proceedings are published in *forum*, the group's quarterly publication. At the conference, the 1994 Jerome F. Lederer Award was given to the U.K. Aircraft Accident Investigation Branch for its work in investigating the bombing of a Pan Am 747-100 in Lockerbie, Scotland, in 1988. [Lederer is president *emeritus* of Flight Safety Foundation.]

Topics include icing, pro-active air safety investigation, controlled flight into terrain and the use of flight data for accident investigation and prevention. Thirty-two presentations were made during the five-day conference.

Accident Facts: 1994 Edition. National Safety Council. Itasca, Illinois, U.S.: National Safety Council, 1994. 122 p.; ill; index. Available from National Safety Council, 1121 Spring Lake Drive, Itasca, IL, 60143 U.S. (708) 285-1121.

Summary: The National Safety Council was chartered by an act of the U.S. Congress and is a nongovernmental, nonprofit public service organization. Its mission is to educate and influence society to adopt safety, health and environmental procedures, policies and practices to prevent suffering and loss resulting from preventable causes. *Accident Facts* is published annually by the National Safety Council, and is a statistical report on unintentional deaths, injuries and costs.

Causes and Deterrents of Transportation Accidents: An Analysis by Mode. Loeb, Peter D.; Talley, Wayne K.; Zlatoper, Thomas J. Westport, Connecticut, U.S.: Quorum Books, 1994. 240 p.; ill.; index.

<u>Keywords:</u>

1. Transportation Accidents — United States
2. Transportation — Safety Regulations — United States

Summary: The authors say that public policy to deter accidents or to improve transportation safety must be based on the knowledge of what causes and deters. Thus, their book focuses on the causes and deterrents of transportation accidents. They examine the "major" modes of transportation in the United States (automobiles, trucks, aircraft, recreational boats, commercial vessels and railroads) individually, but they also look across modes. They conclude that the primary cause of accidents in one mode of transportation may not be that in another, and that policy makers should be cautious if applying public policy for safety in one mode of transportation to another mode.♦

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Updated U.S. Federal Aviation Administration (FAA) Reference Materials

U.S. Federal Aviation Regulators (FARs)

Part	Date	Subject
Part 121	11/18/94	Certification and Operations: Domestic, Flag and Supplemental Air Carriers and Commercial Operators of Large Aircraft (change 6, incorporating Amendment 121-240, *Antidrug Program of Personnel Engaged in Specified Aviation*, adopted August 12, 1994, and Amendment 121-241, *Flight Attendant Duty Period Limitations and Rest Requirements*, adopted August 15, 1994).
Part 135	11/18/94	Air Taxi Operators and Commercial Operators (change 4, incorporating Amendment 135-51, *Antidrug Program for Personnel Engaged in Specified Aviation Activities*, adopted August 12, 1994, and Amendment 135-52, *Flight Attendant Duty Period Limitations and Rest Requirements*, adopted August 15, 1994).
Part 135	10/26/94, 12/2/94	Air Taxi Operators and Commercial Operators (change 5, incorporating Special Federal Aviation Regulation No. 71, *Air Tour Operators in the State of Hawaii*, adopted September 22, 1994, and Amendment 135-53, *Protective Glove Requirement*, adopted September 26, 1994, which affects 135.177).
Part 121	12/7/94	Certification and Operations: Domestic, Flag and Supplemental Air Carriers and Commercial Operators of Large Aircraft (change 7, incorporating Amendments 121-242 and 121-243, *Protective Glove Requirement*, adopted September 26, and November 29, 1994, respectively. Amends 121.309(d) and Appendix A).

Advisory Circulars (ACs)

AC Number	Date	Subject
120-57	10/5/94	*Surface Movement Guidance and Control System* (change 1).
183.29.1CC	9/2194	*Designated Engineering Representatives* (cancels AC No. 183.29-1BB, *Designated Engineering Representatives*, dated 7/7/93).
150/5300-13	11/10/94	*Airport Design* (change 4).
120/46A	10/11/94	*Use of Airplane Flight Training Devices (Inflight Training and Checking for Airman Qualification and Certification)* (cancels AC 120-46, dated June 12, 1987).

U.S. Federal Aviation Administration (FAA) Orders

Order	Date	Subject
7110.65H	1/10/95	Change 5 to *Air Traffic Control.*
7110.10K	1/10/95	Change 5 to *Flight Services.*
7210.3K	1/10/95	Change 5 to *Facility Operation and Administration.*

Accident/Incident Briefs

Tupolev 154 Crashes After Crew Fails To Extinguish Engine Fire

Pressure loss in hydraulic systems causes loss of control.

Editorial Staff

The following information provides an awareness of problems through which such occurrences may be prevented in the future. Accident/incident briefs are based on preliminary information from government agencies, aviation organizations, press information and other sources. This information may not be entirely accurate.

Air Carrier

Engine Fire Brings Down Tupolev

Tupolev 154. Aircraft destroyed. One hundred and twenty-six fatalities.

The three-engine Tupolev 154 had just departed a Russian airport on a daylight domestic flight when a fire warning activated for the No. 2 engine and auxiliary power unit (APU).

The crew made three unsuccessful attempts to extinguish the fire and about eight minutes after takeoff pressure was lost in all hydraulic systems, which caused a loss of aircraft control. The aircraft crashed, killing 116 passengers, nine crew members and one person on the ground.

Investigators believe the engine fire may have been caused by a starter failure.

Inconvenient Switch Distracts Pilots, Aircraft Descends into Trees

McDonnell Douglas DC-3. Aircraft destroyed. Three fatalities. Fourteen injuries.

The aircraft was on a night passenger/cargo flight from an African airport. Shortly after takeoff, the aircraft drifted off the 2.1-mile (3.4-kilometer) long, 131-foot (40-meter) wide runway and the right wing struck trees. The impact severed the wing and aircraft control was lost.

An investigation determined that immediately after takeoff, the first officer (who was flying) asked for power reduction, gear retraction and the landing lights to be extinguished. The captain complied. Investigators found that there were few visual cues because of darkness and that the first officer was distracted trying to operate an inconveniently located intercom switch. The accident report concluded that the captain failed to notice that the first officer had allowed the aircraft to descend and drift off the runway heading. The aircraft was destroyed in a postcrash fire.

Poor Approach Ends on Mountain Top

Boeing 707-300. Aircraft destroyed. Seven fatalities.

The aircraft was on a daylight instrument landing system (ILS) approach when it deviated from the localizer and struck a mountain three nautical miles from the airport. The aircraft was destroyed by the impact and a postcrash fire.

An investigation determined that the captain did not comply with ILS approach procedures and attempted a visual approach.

Although the captain reported that the aircraft was established on the localizer, it was not on the localizer course. The accident report said that the captain waited too long to initiate a missed approach.

Severe Turbulence Injures Three Cabin Crew

Airbus A320-211. No damage. One serious and two minor injuries.

The aircraft was on a flight from London to Turin, Italy, with seven crew members and 46 passengers on board. Moderate turbulence had been forecast for the entire route, although the cruise portion of the flight was smooth.

During the descent, an outbound aircraft warned the Airbus crew to expect turbulence north of Turin. The captain switched on the "fasten seat belts" sign and told the senior flight attendant to stow all loose equipment as soon as possible.

About four minutes later, the aircraft encountered violent turbulence causing +2.33g to -0.05g accelerations as it was descending through 17,000 feet (5,181 meters). The aircraft was in instrument meteorological conditions (IMC) with winds at 90 knots. The captain reported that the "shaking was so bad he could not see the instruments," according to an incident report. The aircraft reached calmer conditions at 8,000 feet (2,438 meters).

One cabin crew member suffered a broken leg and two other cabin crew members suffered minor injuries. One crew member suffered a sprained ankle and another suffered a sprained neck.

Air Taxi
Commuter

Icing Linked to Commuter's Dual Flameout

Shorts 360. No damage. No injuries.

The twin-engine turboprop aircraft was in cruise at 7,000 feet (2,133 meters) when both engines failed. The crew was able to restart the No.1 engine and to land safely at a nearby airport. There were no injuries.

An investigation revealed evidence of water in the cowlings of both engines and no mechanical problems were found. At the time of the engine power loss, the aircraft had entered icing conditions. The investigation determined that the crew had selected Level 3 anti-ice, but not for the engine cowling veins or windshield.

Emergency Evacuation Follows Uncontained Turbine Failure

Saab 340. Minor damage. Three minor injuries.

After touchdown, there was a loud bang and thick smoke when reverse propeller thrust was selected. The left-engine fire-warning bell activated and the engine-fire checklist was carried out.

The aircraft was brought to a stop on a taxiway, but several passengers were injured during the emergency evacuation. The aircraft was not equipped with evacuation chutes.

An investigation found that there was an uncontained failure of the left-engine power turbine. A "B" nut on the stage-four compressor bleed-tube coupling was disconnected, causing a loss of cooling air to the power-turbine rotor cavity and overheating the stage-four turbine disk. There was also evidence of heavy blade-tip rubbing into the strator-tip shroud-backing material.

Corporate
Executive

Twin Stalls on Approach, Killing Two

Cessna 421. Aircraft destroyed. Two fatalities. Five injuries.

The aircraft was making a daylight visual approach in instrument meteorological conditions (IMC) when it crashed just short of the runway.

An investigation determined that the aircraft had stalled and collided with trees in an uncontrolled descent. The crash killed the pilot and a passenger and seriously injured three other passengers. Two passengers suffered minor injuries.

Dusk Approach Ends in Fatal Crash in Street

Cessna 310. Aircraft destroyed. Six fatalities.

The aircraft was descending for landing at dusk when both engines began to sputter. The aircraft entered a "left turn spin" and crashed in a street near the airport.

A postcrash investigation determined that the fuel tanks were empty. The pilot and all five passengers on board were killed.

Other General Aviation

Disorientation Blamed for Fatal Takeoff Crash

Beech 55 Baron. Aircraft destroyed. Four fatalities.

The twin-engine Baron had departed for a night flight when it impacted the ground in a steep nose-down attitude shortly after takeoff. The aircraft crashed on the edge of a pond about one-half mile (0.8 kilometers) south and one-quarter mile (0.4 kilometers) west of the end of the departure runway.

An investigation determined that the pilot, who was not instrument rated, likely experienced vertigo and disorientation and lost control after takeoff. Both engines were tested and found to be operational. Fuel selectors were found in the auxiliary tank position.

Pleasure Flight Ends in Trees

Cessna 150. Substantial damage. No injuries.

The aircraft was on a daylight pleasure flight near a lake in Canada when the engine began to run rough and power decreased. Unable to maintain altitude, the pilot elected to attempt an emergency landing on a logging road.

The approach was too high and fast and an attempted go-around resulted in a stall. The aircraft descended into 75-foot (23-meter) high trees. The pilot and a passenger were able to exit the aircraft uninjured and were rescued the next day. The pilot told investigators that he suspected carburetor icing may have been a factor.

Twin Collides with Upsloping Canyon Terrain

Beech 50 Bonanza. Aircraft destroyed. Four fatalities.

The twin-engine Bonanza was on a daylight pleasure flight when it struck snow-covered terrain in a canyon about one-quarter mile (0.4 kilometers) from a mountain at 11,800 feet (3,596 meters) mean sea level (MSL).

The aircraft struck 15-degree upsloping terrain about 1,000 feet (305 meters) below a ridge line. An investigation determined that at the time of the accident, surrounding peaks were obscured by clouds, with multiple layers below a 12,000-foot (3,657-meter) overcast. The elevation of the highest nearby peak was 13,114 feet (3,997 meters). The pilot and three passengers were killed.

Smoking Radio Distracts Pilot on Approach

Piper PA-23 Apache. Substantial damage. No injuries.

The pilot of the twin-engine Apache noticed smoke coming from one of the radios when he was preparing for an approach at a rural Canadian airport. The smoke stopped when he turned the radio off.

The pilot proceeded to the airport where he made a gear-up landing, causing extensive damage to the propeller and the underside of the aircraft. Neither the pilot nor a passenger were injured. The pilot reported that the smoke incident had distracted him and that he subsequently forgot to lower the landing gear.

The pilot said that the gear horn did not activate prior to touch down because the airspeed was 105 mph instead of the normal landing speed of 95 mph. The Apache pilot said he kept the airspeed higher than normal because of a gusting cross-wind.

Rotorcraft

Clouds Block Mountain Pass, End Sightseeing Flight

Aerospatiale AS350B. Substantial damage. One serious injury. One minor injury.

The helicopter with six passengers on board was flying through a mountain pass on a sightseeing flight when the pilot reported that clouds were quickly forming in the pass and that he was unable to proceed.

While maneuvering, the pilot lost control of the helicopter and it collided with terrain. The pilot and four passengers were not injured. One passenger was seriously injured and another received minor injuries. Instrument meteorological conditions (IMC) were reported at the accident site.

River Bank Proves To Be Poor Landing Site

Hiller FH1100. Substantial damage. No injuries.

Seconds after the pilot landed the helicopter on a river bank, the river bank collapsed and the aircraft rolled into the water. The pilot and three passengers were not injured. The helicopter suffered substantial damage.

Sightseeing Flight Ends on Ridge

Hughes 369HS. Aircraft destroyed. Two fatalities.

The helicopter was on a sightseeing tour along the coast of the Pacific Ocean in daylight at the time of the accident. A witness said he heard the sound of impact and saw parts of the helicopter falling from cliffs.

The pilot and a passenger were killed and their bodies were recovered by divers. Weather at the time of the accident was reported as visual meteorological conditions (VMC).

Hard Landing Follows Fuel Exhaustion

Hiller UH-12E. Substantial damage. No injuries.

The helicopter was in cruise flight when the engine stopped. The pilot entered autorotation, but the landing was hard.

The main rotor severed the tail boom. The pilot reported that he had not relied on the fuel gauge, but instead had calculated fuel consumption based on time flown since the tank was full. The pilot speculated that the carburetor-bowl drain cock may have stuck open after the bowl was drained during preflight, which may have caused fuel loss.

Vision Problems Linked to Water Crash

Bell 206B. Substantial damage. No injuries.

The helicopter was on a maintenance test flight when the pilot aborted a high and fast approach to a beach landing area.

The pilot reported that he then attempted an approach from the opposite direction, but that the aircraft struck the water. The pilot said that as the helicopter descended, he entered shadows cast by nearby mountains and that his eyes did not have time to adjust before impact with the water.

The pilot was not injured. Weather at the time of the accident was reported as visual meteorological conditions, visibility 10 miles (16.1 kilometers).

Fog Bank Cuts Flight Short

Schweizer 269C. Substantial damage. One serious injury.

The helicopter collided with trees and terrain shortly after takeoff. The pilot reported that weather permitted a visual flight rules (VFR) departure but that the flight encountered a fog bank shortly after takeoff.

The pilot said that he attempted a 180-degree turn away from the fog bank but the aircraft contacted trees and crashed. The pilot received serious injuries in the crash. Weather at the time of the crash was reported as instrument meteorological conditions (IMC) with partial obscuration and one mile (1.6 kilometers) visibility.

Wind Gust Results in Loss of Directional Control

Bell 206A. Aircraft destroyed. One minor injury.

The helicopter was on approach to a ridge-line landing zone when a gust of wind caused a loss of directional control. The pilot reported that he was at about 70 feet (21.3 meters) above ground level (AGL) when he encountered the gust.

The helicopter began to spin and the pilot was unable to regain control before the helicopter struck the ground. The aircraft was destroyed by impact forces and a postcrash fire. The pilot suffered minor injuries. A passenger was not injured. Weather at the time of the accident was reported as visual meteorological conditions (VMC) with clear skies and 30 miles (48.3 kilometers) visibility.♦

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