Accident and Incident Investigation In Soviet Practice

A two-pronged safety effort combines the investigation of both accidents and incidents to spread the data base and increase the potential for preventing future accidents.

Note: This article was prepared for FSF by the State Supervisory Commission for Flight Safety, Council of Ministers, U.S.S.R., (GOSAVIANADZOR) prior to changes that instituted commonwealth status for Russia and other Soviet republics.

One of the benefits that resulted from perestroika and glasnost was a relaxation of the government-imposed secrecy that had shrouded details of domestic U.S.S.R. aviation information and inhibited the benefits of shared safety data. The State Supervisory Commission for Flight Safety, Council of Ministers, U.S.S.R. (GOSAVIANADZOR) and Flight Safety Foundation-U.S.S.R. (FSF-USSR) were formed under the new open atmosphere and are sharing the benefits of two-way communication of aviation safety data with other nations.

The new information exchange has been reflected by the Flight Safety Foundation through publication in the Flight Safety Digest of: "U.S.S.R. Safety Information," (Statistics - March 1991); "Use of Flight Data Recorders to Prevent Accidents in the U.S.S.R.," (April 1991); and "U.S.S.R. Civil Aviation Flight Safety Analysis for 1990" (Statistics — July 1991). The following article highlights how preventive information is acquired not only from accidents, but from incidents as well.

Accident Investigation in Civil Aviation

The State Supervisory Commission for Flight Safety under the Council of Ministers of the U.S.S.R. (GOSAVIANADZOR) was established by the Council of Ministers in 1987. This independent government agency is charged with promoting aviation safety and preventing aviation accidents in the U.S.S.R.

GOSAVIANADZOR is authorized to supervise, on the governmental level, strict adherence by all ministries and other bodies, agencies and organizations of the U.S.S.R.:

- to standards of flying, air traffic control (ATC) operation and maintenance, airport operations, personnel training, accident and incident investigation; and,
- to airworthiness and airport worthiness requirements.

GOSAVIANADZOR can also supervise the process of developing and implementing preventive measures by ministries, other government bodies, agencies and organizations.

The commission investigates accidents in the U.S.S.R. involving Soviet airplanes with maximum takeoff weight of more than 30 metric tons (66,000 lb.) and helicopters that weigh more than 10 metric tons (22,000 lb.), plus all foreign aircraft that are involved in accidents in the U.S.S.R. GOSAVIANADZOR participates, in compliance with Annex 13 of the Chicago Convention, in the investigation of accidents involving Soviet aircraft in the territories of foreign states[1]. It also supervises, on the governmental level, the creation and implementation of technical aspects of search and rescue of aircraft, their passengers and crews.

The commission also can issue airworthiness type certificates and operational certificates for airports to meet the operational weather minimums for International Civil Aviation Organization (ICAO) Categories I, II and III landings.

In order to carry out its functions, GOSAVIANADZOR has three structural divisions.

The first division is the State Aviation Register of the U.S.S.R., which issues airworthiness certificates for aircraft, aerodromes and their equipment. It also supervises determination of airworthiness of aircraft and operational acceptability of airports.

Airworthiness standards development in the U.S.S.R. has a history of more than 60 years. Current documentation includes the third edition of airworthiness standards for civil fixed-wing aircraft and the second edition of airworthiness standards for helicopters. Standards have also been established for airports and their equipment.

The Soviet standards fully correspond to ICAO requirements and in some cases exceed their minimum standards and those of U.S. Federal Aviation Regulations (FARs) and Joint Airworthiness Regulations (JARs).

The U.S.S.R. standards specify:

- classification of hazards;
- quantitative characteristics for assessing the probability of such hazards; and,
- requirements for expected operational conditions.

Standard methods of assessing compliance with regulations are set forth for all sections of the airworthiness regulations.

The second division of GOSAVIANADZOR incorporates State Aviation Inspection, a function that supervises strict adherence to flight and operational procedures and to ATC and flight support standards by all the ministries and other governmental bodies that operate civil aircraft.

The Soviet standards fully correspond to ICAO requirements and in some cases exceed their minimum standards ... .

Functions of investigation of civil aircraft accidents rest with a third division, the Department of Accident Investigation and Prevention, and a scientific research laboratory that has the means and methods to investigate accidents.

The laboratory participates in accident investigations, carries out independent research and tests, and submits its final results to the commission. Using flight data recorder (FDR) and cockpit voice recorder (CVR) data, the laboratory models the flight characteristics of aircraft, analyzes crews' actions in emergency situations, and works out and implements new methods of flight dynamics analysis and corresponding mathematical models.

Accident and incident investigation is regulated by the *Aircraft Accident Investigation Manual*, mandatory for every level of investigation. The latest edition of the manual was adopted in 1989.

This manual includes:

- general issues, classification and definitions;
- order and organization of accident investigation;

- order and organization of incident investigation; and,

- order of implementing recommendations and measures based on the results of accident investigation.

The principle goal of accident investigation is prevention of similar accidents in the future. The standard establishes that accident investigation should not exceed 30 days. When there is a need for special time-consuming research or tests, this period may be extended by the highest officials of GOSAVIANADZOR.

The principle goal of accident investigation is prevention of similar accidents in the future.

When an accident occurs, a commission is assigned to investigate it, and consists of its chairman who is the investigator-in-charge (IIC), his deputy and members. If the investigation commission considers it necessary, experts may also be invited to participate. Commissions investigating accidents with light airplanes and helicopters on behalf of ministries and other governmental bodies, include experts possessing special knowledge in these areas. They also must have experience in the field of accident investigation and have no direct involvement with these accidents.

The standard determines the procedure of reporting aircraft accidents, as well as the initial actions of aviation officials before the investigation commission arrives on the accident scene. After the investigation commission arrives, subcommissions in the main directions of the work are usually formed — flight, engineering and administrative. If the IIC considers it necessary, he may form other subcommissions. The subcommissions usually are comprised of working groups.

The list of members of the subcommission and working groups and plans of their work are approved by the chairmen of the subcommissions. The major methodological and organizational decisions on the investigation are made by the IIC with the advice of the members of the commission. After their work is complete, the working groups make reports that are reviewed and discussed at the meetings of subcommissions. These reports are used as a basis for the subcommissions' reports which are then reviewed at the meetings of the commission.

Based on the results of the investigation, the commission prepares a formal accident report (the act) plus a special report for computerized recording, the form of which is based upon the ICAO Aircraft Accident/Incident Reporting System (ADREP) system. The date of the act approval, by senior officials of GOSAVIANADZOR or of ministries of other governmental bodies which assigned a commission to investigate an accident with a light airplane or a helicopter, is considered the date of the investigation termination.

The standard determines the rights and duties of the IIC, his deputy, members of the commission and experts. According to the standard, subcommissions carry out the following:

- The flight subcommission establishes the correlation between the accident and the professionalism of the crew members, the quality of operation procedures, ATC and flight support. It takes into consideration the influence of the aircraft structure, environmental and human factors. It also assesses the actions taken by the crew members and authorities during the emergency.

- The engineering subcommission examines the condition of the aircraft, the nature of its operation and the quality of maintenance. It identifies possible structural and production deficiencies and, if necessary, organizes special tests in order to find the correlation between the accident and the condition of the aircraft.

- The administrative subcommission evaluates the search and rescue operations, determines the aircraft payload, its distribution and attachment, identifies deviations from weight and balance standards, renders help to the injured persons and their relatives and meets their claims, clears the accident site and evaluates losses.

The methodological basis for accident investigation in the U.S.S.R. includes the following publications: *Methodological Guide for Accident Investigation*, adopted in 1977; *Medical Aircraft Investigation Manual* of 1986; and *Methodological Guide for Analysis of Deviation in Aviation System During Accident and Incident Investigation* of 1987. In addition, *Principles of Modelling and Evaluation of Flight Dynamics During Accident Investigation* and *Principles of Studying Human Factors in Accident Investigation* are also used.

Introduction of new aircraft, new airport equipment, improved and broader use of data recorders and greater emphasis on human factors considerations during accident investigations resulted in the need to update the *Methodological Guide for Accident Investigation*. Some principal changes also were made to the *Aircraft Accident Investigation Manual*, that became effective in 1989.

The definition of aircraft accidents was brought close to that of the ICAO definition.

The main distinctions of the new edition of the *Aircraft Accident Investigation Manual* compared to the previous (1988) edition include a change in the classification of aircraft accidents. The definition of aircraft accidents was brought close to that of the ICAO definition. In the new edition, practically all the cases previously classified as emergency events, are now considered accidents. This reduces the possibility of misunderstanding. The borderline between accidents and incidents has been more clearly defined.

The latest edition of the manual includes a new approach to classification and analysis of the occurrences not classified as accidents. Accident investigation procedures have been changed in the following way:

- The IIC's rights have been broadened.

- A more democratic approach to considering the options of the parties participating in the investigation is guaranteed.

- More flexible organizational methods of investigation have been established in everything concerning the membership in the investigation commission.

The procedures for developing new measures based upon the results of accident investigation as one of the main preventive methods have become more thorough. Terms and responsibilities for developing such measures are outlined in the new manual. Records of recommendations and monitoring the development of measures will be computerized.

For the first time, a new inter-agency system of incident investigation and analysis was established for the purpose of developing and implementing preventive measures. Operators and manufacturers will consider the results of all incident investigations.

One of the major tasks of the manual is the standardization with ICAO requirements of classification, methods of accidents investigation and prevention. However, some national features remain.

ICAO Annex 13 and the manual have different areas of application. Annex 13 determines the procedures of investigation of an accident involving an aircraft of one member state in the territory of another member state. It establishes the order of cooperation between these states as well as between the state of manufacture and the state whose interests may be undermined by this accident. The manual is a purely intrastate document and considers only investigations of accidents with Soviet civil aircraft in the U.S.S.R.. The manual deals only with the problems of cooperation with the state of manufacture.

Nevertheless, considering the Annex 13 recommendation concerning possible standardization of national and international investigation procedures, reviewing differences between them is justified. The essence of these differences can be summarized in three categories.

First, according to Annex 13, the criterion of an accident is the presence on board the aircraft of crew members or passengers. According to the manual, the criterion of the accident is the presence on board the aircraft of any person intending to make a flight, regardless of his being a member of the crew or a passenger or some other person. Such a distinction is justified by the notion that "passenger" and "crew member" in the U.S.S.R. has a clear legal definition; it is either a person with a ticket or one who is included in a special passenger list (passenger), or a person authorized to carry out the flight (a crew member). In this regard, all those on board the aircraft who have no necessary permission, are not considered either passengers, or crew members. At the same time, in terms of consequences of an accident, such persons are treated equally with passengers and crew members. The definition used in the manual allows classification of an aviation accident, the case of aircraft capture, hijacking and unwarranted takeoff resulting in serious consequences. This is impossible under the ICAO definition.

... the criterion of the accident is the presence on board the aircraft of any person intending to make a flight ... .

Second, Annex 13 regards as a criterion of an accident serious injuries of persons outside the aircraft. The manual disregards such cases unless they result in substantial consequences for the aircraft and the people on board. This approach is justified by the fact that these people, having nothing to do with the given flight, should not be considered as a threat to flight safety and, accordingly, the occurrence of their injuries should not be classified as an aircraft accident. Such cases, if they are of no danger to the safe operation of the aircraft, should be considered an unhappy event rather than an aircraft accident. Currently, however, this item of the manual is being revised and is expected to be brought into full compliance with the ICAO standards.

Third, Annex 13 also regards serious injuries as a criterion of an aviation accident. The manual classifies an occurrence as an accident only in case of fatal injuries. This approach is determined by the occurrences with serious injuries to people on board the aircraft without heavy consequences for the aircraft itself. As a rule, these cases are connected with the carelessness of the injured person himself.

The training of civil aviation accident investigators is accomplished at the Leningrad Civil Aviation Academy. The instructors are teachers and professors of the Academy and specialists of GOSAVIANADZOR, as well as of scientific and research organization of ministries and other governmental bodies. In the course of training, students learn practical skills in accident investigation and in decoding and analyzing data recorder information. They are also taught to organize and use a flying laboratory that is based aboard an An-12 airplane, work out recommendations and prepare the necessary documentation.

Incident Investigation in Civil Aviation

Accident prevention through identifying and eliminating deficiencies in the aviation system is the cornerstone of flight safety in the U.S.S.R. This premise, which has been realized by aviation organizations worldwide, is fully recognized by the Soviet civil aviation authorities, including GOSAVIANADZOR. In addition, the experience gained by

GOSAVIANADZOR and other civil aviation authorities of the U.S.S.R. has brought to the forefront that primary emphasis on accident investigation in the search to identify deficiencies is an expensive learning process in terms of the grave social and material consequences of these accidents.

While analyzing the factors of accidents, the U.S.S.R. has recognized that great human and material losses are the result of a combination of factors, although each one looked at separately may seem innocuous from the point of view of potential consequences. This is precisely why the concept of accident prevention based on early identification and detection of deficiencies through the investigation of incidents has gained broad recognition.

The term "incident" has been used in Soviet civil aviation for a long time. However, it sometimes has entailed interpretations that were at variance with the description accepted by ICAO. Today, though, the U.S.S.R. interpretation of an incident is in line with that adopted by ICAO. An incident denotes a deviation from the proper functioning of the aircraft, crew, ATC or maintenance service which has not caused an accident, but at the same time posed a potential threat to flight safety. Under a different set of circumstances, it could result in an accident.

Incident investigation in the U.S.S.R. is mandatory.

Incident investigation in the U.S.S.R. is mandatory. In order to avoid misunderstanding in the classification of incidents, and bearing in mind that there is some ambiguity in the interpretation of what should be classified as an incident, a list has been prepared that indicates 30 specific incidents that are to be investigated. A concept is employed in which as many incidents as possible are registered and investigated. This provides the operator and the manufacturer with the maximum amount of information available on the identified deficiencies.

However, the U.S.S.R. is aware that not all the deviations have the same impact on safety and, therefore, must be treated differently according to the degree of danger they pose. If a detected deficiency belongs to a high-risk area and could lead to an accident, it receives immediate attention and widespread corrective action. But if it proves to be less of a danger and poses no direct threat to flight safety, such as an unretracted gear after takeoff, decisions on the time and procedures required to eliminate this deficiency and the necessity to take action on it would be made based upon economic expediency.

All of the work on incidents can be divided into two stages. The first stage is the investigation proper. According to the Soviet system, incidents are usually investigated by the operators — by the civil aviation units that are directly involved. Such an order, an obvious departure from the principle of impartiality, is necessary because the corresponding government authorities are physically unable to investigate all the incidents. On a yearly basis, the number of incidents covered under the accepted official investigation list alone runs into several thousand a year. This high number of investigated incidents stems from the principle that stresses "more information for accident prevention."

In order to neutralize any possible partiality of the operator in the investigation of technical malfunctions, the rules require a mandatory participation by the manufacturer or a team from the repair or maintenance facility. The investigations are supervised by GOSAVIANADZOR and central bodies of the Ministry of Civil Aviation.

Incidents generally are investigated with the same principles and in the same order as accidents except for some simplification of the procedures. Another difference is that the incident investigation report, prepared by the investigation team, is not final and is subject to approval by the General Inspectorate on Flight Safety of the U.S.S.R. Ministry of Civil Aviation with consent from GOSAVIANADZOR.

The principle goal of the first stage is to gather factual information that would be used during the second stage — analysis and implementation of preventive measures. The second stage categorizes the data, screens out deficiencies and produces general recommendations to direct the preventive measures.

The main problem at this stage is to provide an adequate assessment of the incident's degree of danger. To solve this problem, a situational approach is employed that singles out four levels of danger of any given situation:

- adverse flight condition;
- hazardous situation;
- emergency situation; or,
- catastrophic situation.

The main problem ... is to provide an adequate assessment of the incident's degree of danger.

Incidents characterized by situations from hazardous down the list to catastrophic are considered serious. These categories of incidents receive priority in planning the preventive steps.

Incidents are analyzed by a special group of experts, mostly representing scientific and research bodies of the operator and manufacturer. Any decision on the necessity and the nature of preventive actions is made by the operator and the manufacturer within their competence.

Implementation of this system has been complicated by a few facts which were basically associated with two problems. The first problem is maintenance of a high quality of investigation by the operator. In general, incident investigation is a function that is not typical for an operator, at least on the level of regional units. First, because it is rather specific and requires the participation of well-trained experts who may not be available, and second, because incidents are so unpredictable and frequent, their investigation distracts the operator from his direct duties.

In this respect, it is not easy to convince the operator of the need to investigate as many incidents as possible. It is even more difficult to convince the operator to launch a comprehensive and objective investigation. Since the U.S.S.R. firmly believes in the necessity of thorough incident investigation, one of the primary solutions of this problem is the creation of special regional bodies for incident investigations. These bodies would act independently of the operator.

The second problem is purely methodological and involves complex issues such as providing adequate evaluation of the level of danger of the given incident and determining the effectiveness of the elimination of identified deficiencies. Complexity of the problem is based on the absence of common formal methods of conducting analysis. Today, it is being solved to a certain extent subjectively, using the method of expert evaluation. This problem might be solved by working out scientifically substantiated methods of conducting situational analysis. This is what the U.S.S.R. is doing now, and the results that have been achieved signal that in the near future the problem will be solved.

These are, in general terms, the basic concepts adopted in the U.S.S.R. on the use of incident-related information for accident prevention. It is hoped that their broad implementation will produce a higher level of early accident prevention and make it easier to optimize the measures aimed at the elimination of the identified deficiencies. ♦

Reference

1. "Statute of the State Supervisory Commission for Flight Safety Under the Council of Ministers of the U.S.S.R.," State Supervisory Commission for Flight Safety Under the Council of Ministers (GOSAVIANADZOR). Photocopies of this nine-page statute are available by request from the Flight Safety Foundation.

Aviation Statistics

Safety Performance of General Aviation Fixed-wing vs. Rotorcraft 1972-1990

by
Shung C. Huang
Statistical Consultant

Accident Rates Decline

General aviation aircraft safety data and analysis of fixed-wing aircraft as well as rotorcraft published by the U.S. National Transportation Safety Board (NTSB) generally indicate that the chance of rotorcraft being involved in accidents in terms of aircraft hours flown is greater than that of fixed-wing aircraft. Figures 1 and 2 show the accident rate distribution and trends for total accidents and fatal accidents per 100,000 aircraft hours for fixed-wing aircraft as compared to rotorcraft for the past 19 years.

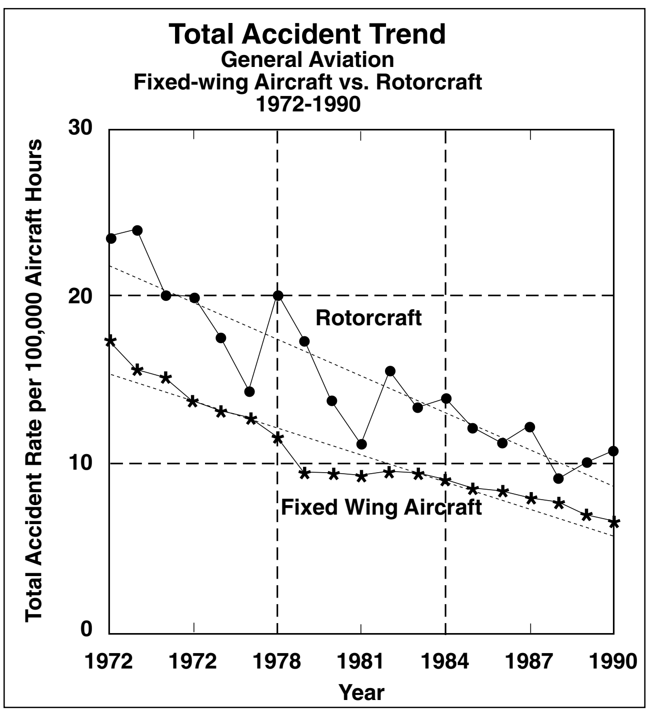

Figure 1

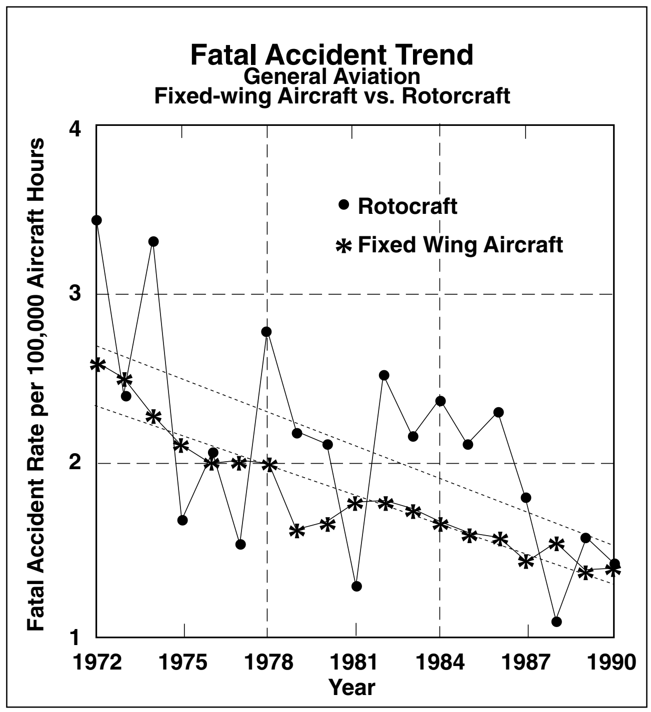

Figure 2

The straight lines in the figures showing the slope of changes are the result of smoothing to illustrate the accident trends. The linear expression shows that, through the years, the total accident rates and fatal accident rates for both fixed-wing and rotorcraft declined. The rates of total accidents and fatal accidents for both fixed-wing and rotorcraft are very similar. A difference is that the annual distribution of fatal accident rates for rotorcraft fluctuated significantly. In 15 of the 19 years, the annual fatal accident rates of rotorcraft were generally higher than those for fixed-wing aircraft; but in four of the 19 years, the rotorcraft rates were lower.

A review of the annual frequency of fatal accidents reveals that the fluctuation of the accident rates for rotorcraft was primarily due to significant changes in the number of annual fatal accidents in different years. However, the general trend is that rotorcraft accident rates are higher than those of fixed-wing aircraft.

Data Accuracy Depends Upon Reporting Accuracy

Such a finding is inconclusive, because rotorcraft operational data, particular the accuracy of flight time used to measure safety performance, was disputed. Some helicopter pilots and safety engineers have claimed that actual rotorcraft safety is better than perceived[6], and that the accident rates are actually lower than published because rotorcraft flight time could be much higher than that reported in annual surveys. [Prior to 1977, the active aircraft and flight times estimated by the U.S. Federal Aviation Administration (FAA) were based upon an annual FAA aircraft owner census. However, since 1977, the FAA has sampled a small percent of registered aircraft activity by means of an operational survey from which it makes estimates.]

The critics of the estimates pointed out that the rotorcraft flight hours collected during the sample survey fluctuated widely; in particular, the flight hour estimates for a few rotorcraft makes/models were significantly different each year. They concluded that the sample survey results since 1977 were insufficient for accurate estimates; consequently, the rotorcraft flight time could be well underestimated. The accident rates for rotorcraft could be much lower if their flight times could be shown to be significantly higher.

Current Data Collection Questioned

The possibility of inaccuracies in the estimates of rotorcraft flight hours by the FAA is perceivable because the sample survey estimates are subject to possible errors in many variables. In general, if the number of active aircraft for any rotorcraft make/model is very small, and the survey response rate for that particular make/model was relatively low, the standard error of the estimate could be very high. This is true for an estimate involving any aircraft makes/models.

On the contrary, if sample size is larger and the response rate of the survey is higher, the standard errors of survey estimates would be smaller. This is true for any estimate for rotorcraft as a whole. In other words, the estimate of flight time for all rotorcraft as a whole is definitely much more accurate than the estimates of active aircraft as well as flight time for any particular rotorcraft make/model if that make/model is a subset of the survey estimates.

In the results of the FAA's annual General Aviation Activity and Avionics Survey, the agency appears to acknowledge the discrepancy of survey estimates. To improve the accuracy of estimates for rotorcraft, the FAA first increased the sample size for rotorcraft in its annual general aviation aircraft survey and later in 1989 it conducted a special census of more than 10,000 registered rotorcraft. Table 1 provides summaries of aircraft hours flown and active aircraft estimated by the FAA based on the results of annual sample survey and rotorcraft census programs conducted prior to 1977 as well as the special rotorcraft census conducted in 1989.

Prior to 1977, the FAA annually sent a survey questionnaire to owners of all registered aircraft requesting them to report registration and activity related information. At that time, the response rate was higher than 85 percent. The accuracy of flight time estimates based upon the 1972-1976 census of registered aircraft as shown in Table 1 should be considered highly acceptable. Note that in Figure 1, the total accident rates of rotorcraft in 1972-1976 were higher than those for the fixed-wing aircraft, but the rotorcraft fatal accident rate was higher than the fixed-wing rate in one year and lower in another year. This wide fluctuation appears to be caused by the significant difference in the number of fatal accidents each year; the flight time had no significant effect upon the up and down variances at all because it did not fluctuate greatly.

Before 1977, the civil aircraft annual census showed that the ratio of active aircraft between fixed-wing and rotorcraft shifted from 50-to-one in 1972 to about 40-to-one in 1976. Further analysis of the data in Table 1 reveals that rotorcraft were more active than the fixed-wing aircraft because the average flight time per year per rotorcraft was more than double that of fixed-wing aircraft. From 1977 to 1988, the estimates based on the annual sample survey that included approximately 10 percent of registered fixed-wing aircraft and 30 percent to 40 percent of rotorcraft the population showed a similar pattern, with the ratio of active aircraft and flight time remaining in a similar proportion.

Table 1
Estimates of Active Aircraft and Flight Hours
Fixed-wing (1) vs. Rotorcraft
1972 - 1990 (2)

Year	Active Fixed-wing	Active Rotorcraft	Rotorcraft/ Fixed-wing*	Hours (000) Fixed-wing	Hours (000) Rotorcraft	Rotorcraft/ Fixed-wing*
1972	140,295	2,787	2.00%	26,656	1,037	3.89%
1973	148,416	3,143	2.11	28,697	1,158	4.03
1974	155,350	3,610	2.32	28,516	1,414	4.95
1975	161,570	4,073	2.52	32,365	1,547	4.78
1976	170,625	4,505	2.64	34,082	1,762	5.18
1977	170,077	3,765	2.21	33,162	1,868	5.63
1978	182,732	4,100	2.24	33,162	1,397	4.21
1979	192,667	4,506	2.34	36,760	1,522	4.14
1980	192,286	5,215	2.71	34,145	1,891	5.53
1981	193,654	6,246	3.22	34,113	2.303	6.75
1982	193,483	4,942	2.55	30,007	1,628	5.42
1983	193,660	5,385	2.78	28,917	1,709	5.91
1984	200,574	5,585	2.78	29,555	1,599	5.41
1985	191,493	5,546	2.90	28,471	1,766	6.20
1986	200,176	5,465	2.73	27,234	1,689	6.20
1987	200,153	5,005	3.10	27,067	1,388	5.12
1988	190,588	5,331	2.80	27,067	1,954	6.22
1989	197,731	5,946	3.00	27,998	1,813	6.47
1990	191,825	6,139	3.10	28,823	1,705	5.92

(1) Excludes gliders
(2) Prior to 1977, all data was based on annual registered aircraft census. Data estimates after 1977 (excluding 1989) were based upon annual sample surveys. Rotorcraft data for 1989 was estimated based upon a special rotorcraft census.
(*) Indicates rotorcraft as a percent of total fixed-wing.

In 1989, the data for fixed-wing aircraft was based upon sample surveys, while the data for rotorcraft was based upon the special rotorcraft census; the results showed that fixed-wing and rotorcraft maintain a similar relationship. Although, over the 10-year period, active general aviation fixed-wing aircraft showed little change, the hours flown shrank from 37 million hours in 1979 to 27 million hours in 1988. On the other hand, active rotorcraft showed a slight increase; the annual hours flown increased from 1.4 million in 1978 to almost 2 million hours in 1988.

An analysis in terms of ratio between fixed-wing and rotorcraft — both the number of rotorcraft as a percent of total fixed-wing aircraft and rotorcraft flight time as a percent of total fixed-wing flight time (Table 1) — showed a gradual increase over the period. This is an indication that the rotorcraft category continues to be more dynamic than the fixed-wing category in terms of numbers of active aircraft and flight time. Rotorcraft flight time increased while fixed-wing flight time did not; the overall trend of general aviation activity was slowing down between 1982 and 1987.

The statistics also show that the active aircraft and flight time of fixed-wing aircraft and rotorcraft compiled by annual sample surveys in the period between 1977 and 1988 are compatible with the data compiled by the special 1989 rotorcraft census as well as the surveys prior to 1977. Although the estimated numbers of active rotorcraft, total flight time and average flight time per rotorcraft based on the special 1989 rotorcraft census are slightly greater, a comparison of the estimates based on 1988 and 1990 general aviation sample surveys to those estimates based on census, reveals no significant difference.

Therefore, it appears acceptable to infer that survey estimates of active aircraft and flight time for rotorcraft based upon the annual sample survey could be slightly higher in some years and slightly lower in some other years, but the differentials appear insignificant. Therefore, it is difficult to conclude that the active aircraft and flight time for rotorcraft over the years had been underestimated beyond an acceptable level.

Even if the special 1989 rotorcraft census recorded slightly more active rotorcraft and flight hours, the accident rate for rotorcraft in 1989 as shown in Figures 1 and 2 was not substantially lower than that of previous years and succeeding years because the frequency of ac-

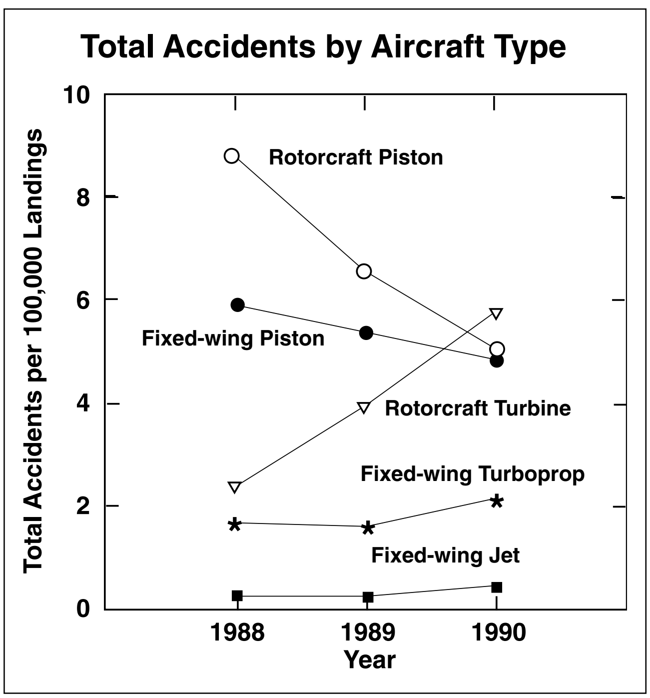

Figure 3

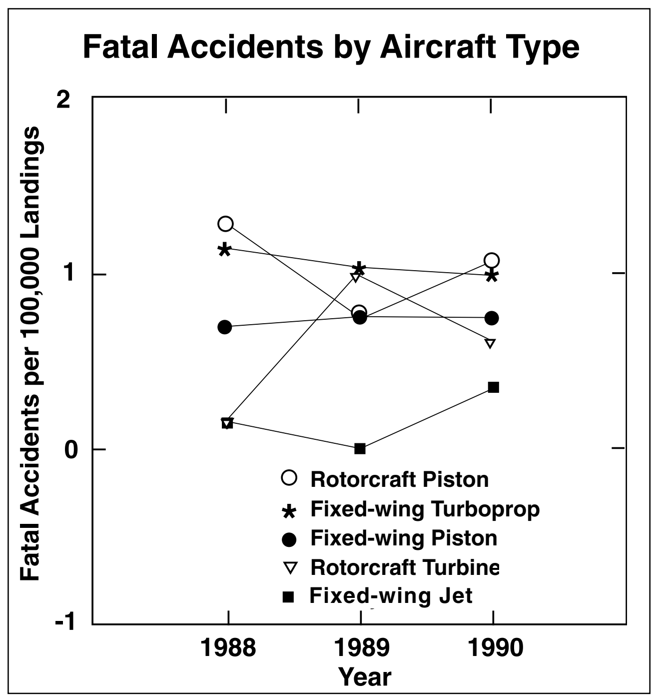

Figure 4

cident involvement in rotorcraft in 1989 was relatively higher.

Safety by Operations Measured

The operation, as well as the function of rotorcraft, differs greatly from fixed-wing aircraft. Generally, rotorcraft perform landings and takeoffs more often than fixed-wing aircraft. If the frequency of landing was used as a measurement of safety, the outcome of rotorcraft safety performance could be greatly different. Although the number of total operations (takeoffs and landings) of general aviation aircraft — excluding aircraft used for air taxi and commuter operation — is not readily available, the 1988 and 1990 annual FAA General Aviation Activity and Avionics Survey reported that fixed-wing aircraft on an average perform about 200 landings per year while a rotorcraft performs 500 landings in the same period.

In addition, the 1990 general aviation aircraft activity survey conducted at 250 airports by the Civil Air Patrol for the FAA reported that, in combined operations of local flight and cross-country flight, the fixed-wing, piston-engine aircraft performs 1.4 landings per hour; fixed-wing turboprop aircraft, approximately 1.1 landings per hour; fixed-wing turbojet, 0.8 landings per hour; piston-engine rotorcraft, 2.4 landings; and, turbine-engine rotorcraft 1.8 landing per hour. Overall, rotorcraft performed approximately twice as many landings as fixed-wing aircraft did. Based upon the estimates, the accident rate in terms of total accidents and fatal accidents per 100,000 landings for 1988 through 1990 are presented in Figures 3 and 4. ♦

Reference

1. "Annual Review of Aircraft Accident Data, U.S. General Aviation," U.S. National Transportation Safety Board. Calendar years 1977-1987.
2. "NTSB Brief of Accidents Involving Rotorcraft," U.S. National Transportation Safety Board. Annual Publication.
3. "General Aviation Activity and Avionics Survey, Annual Report," U.S. Federal Aviation Administration. Calendar years 1977 to 1989.
4. "Rotorcraft Activity Survey," U.S. Federal Aviation Administration. 1989.
5. "General Aviation Pilot and Aircraft Activity Survey," U.S. Federal Aviation Administration. 1990.
6. Roy G. Fox, "Reporting Helicopter Flight Hours," *Rotorbreeze*, Vol. 34, No. 3.

Reports Received at FSF Jerry Lederer Aviation Safety Library

Reports

Aviation Occurrence Report-Hydra Management Ltd. Aerospatiale 332C Super Puma C-GQRL, Quatam River, British Columbia, 03 October 1987. — Ottawa : Transportation Safety Board of Canada, 1991. Report Number 87-P70096. 40 p. in various pagings. [Communique TSB #13/91 to be released on 8 July 1991.]

Key Words
1. Aeronautics — Accidents — 1987.
2. Aeronautics — Accidents — Helicopters — Fatigue.

Summary: The helicopter had lifted a log and had begun to move forward when the main gearbox flexible mounting plate failed. This caused the Bendix drive shafts to fail, interrupting the transmission of engine power to the rotor system. The pilot jettisoned the log, but was unable to enter autorotation. The helicopter fell to the mountainside and was destroyed by impact and fire; the pilot and copilot were fatally injured. The Transportation Safety Board of Canada determined that the flexible mounting plate failed in fatigue because the true number of high-load cycles applied to the plate during heli-logging operations were not taken into account in the manufacturer's (Aerospatiale) determination of the service life of the plate. The operator did not detect cracks in the flexible mounting plate during inspections the night before and morning of the accident. [Synopsis] Recommendations A91-14 (Analysis of probability of failure of the newly designed mounting plate) and A91-15 (Location and visual inspection of the mounting plate) were issued as a result of this accident.

Aviation Occurrence Report-Risk of Collision Between: Lockheed L-1011-50 G-Beam and McDonnell Douglas DC-8-62 N1805 and Boeing 747-100 EI-BED, North Atlantic, 09 July 1989. — Ottawa : Transportation Safety Board of Canada, 1991. Report Number 89A0163. 21 p. [Communique TSB #15/91 to be released on 16 August 1991.] [FSF also has French edition]

Key Words
1. Aeronautics — Accidents — 1989.
2. Aeronautics — Accidents — Navigation Errors.
3. Air Traffic Control.
4. Airplanes — Near Midair Collisions.
5. Airplanes — Collision Avoidance.

Title page: "14 May 1991."

Summary: British Airways Flight 094 was eastbound over the North Atlantic when it began deviating south of its assigned track at 50 degrees west longitude. While off course, BA Flight 094 had three risks of collision with two aircraft and had losses of separation with two other aircraft at flight level 350. The Transportation Safety Board of Canada determined that a two-degree input error had been made during programming of the flight management system/inertial navigation system (FMS/INS) for the North Atlantic crossing. This error caused the aircraft to begin deviating off course at 50 degrees west longitude. INS cross-checks were not conducted at 50 degrees west, and the error went undetected, resulting in a 120-nautical mile deviation south of the assigned North Atlantic track. A weakness in the British Airways L-1011 fleet's system of cross-checking contributed to the seriousness of this occurrence. [Synopsis]

Aviation Noise: Costs of Phasing Out Noisy Aircraft. Report to Congressional Requesters/United States. General Accounting Office. — Washington, D.C. : U.S. General Accounting Office*, 1991. Report GAO/RCED-91-128, B-239410. 56 p. ; charts.

Key Words
1. Airport Noise — Control — Costs — United States.
2. Jet Transports — Noise — Law and Legislation — United States.
3. Noise Control — Costs.

Summary: In November 1990, the Airport Noise and Capacity Act of 1990 (ANCA) was enacted. This act phases out the noisiest jets currently in use (called "Stage 2" jets) by the year 2000 and limits the discretion of airports to adopt their own noise restrictions. In response to congressional request, this report describes the likely effects of ANCA on the costs of aviation noise restrictions to the airline industry . GAO estimates that, in the absence of any additional airport restrictions, phasing out Stage 2 aircraft by the year 2000 will cost about $2 billion, if each airline adopts the lowest cost method of meeting the required Stage 3 standards. This cost would rise to almost $5 billion if all Stage 2 aircraft were replaced rather than retrofitted with hushkits or new engines. If the U.S. Secretary of Transportation grants waivers allowed in the ANCA, allowing phaseout until the end of 2003 for up to 15 percent of each airline's fleet, GAO estimates that costs to the airline industry will be reduced by as much as $100 million because airlines will not have to make expenditures to replace or retrofit aircraft as soon as they otherwise would. The burden of aircraft noise borne by those living near airports, on the other hand, would of course be reduced more slowly. [Results in brief]

Air Ambulance Helicopter Operational Analysis. Final Report/Robert Newman (Systems Control Technology Inc.). — Washington, D.C. : Federal Aviation Administration, Research and Development Service ; Springfield, Virginia, U.S. : Available through NTIS*, [1991]. Report DOT/FAA/RD-91/7. 167 p. in various pagings : ill. ; 28 cm.

Key Words
1. Helicopters.
2. Airplane Ambulances — Piloting.
3. Airplane Ambulances — Weather.
4. Air Traffic Control.
5. Aeronautics in Meteorology.

Summary: This study of visual flight rules (VFR) weather minimums and operations areas for helicopter emergency medical service operators is based on operator responses to a questionnaire. The national average VFR operations weather minimums for all respondents was determined. Also, an estimate of the percentage of time that each respondent cannot fly because of ceiling and/or visibility below their VFR operating minimums was determined, as was the average percentage of time all respondents cannot fly. Analysis of the data indicated that on the average the operators have voluntarily adopted stricter minimums than recommended in the current FAA Advisory Circular 135-14. Furthermore, the analysis indicated that on the average the operators have more restrictive daylight minimums than those in the proposed change to AC 135-14 and less restrictive night minimums than those in the proposed change.

The FAA is in the process of determining if there is an economic justification for the improvement of low altitude communication, navigation and surveillance services. The results of this study provides data which will support further analysis of the benefits of air ambulance helicopters in an IFR environment. [Modified author abstract]

Air Traffic Control: *FAA Can Better Forecast and Prevent Equipment Failures.* Report to the Chairman, Subcommittee on Transportation and Related Agencies, Committee on Appropriations, House of Representatives/U.S. General Accounting Office*. — Washington, D.C. : U.S. General Accounting Office, [1991]. Report GAO/RCED 91-179. 14 p. ; 28 cm.

Key Words
1. United States — Federal Aviation Administration.
2. Air Traffic Control — Automation — United States.
3. Air Traffic Control — Equipment and Supplies — United States.

Summary: FAA has not performed a comprehensive assessment of the reliability of its ATC equipment at en route centers. Consequently, FAA managers do not have the complete picture they need to adequately assess the gravity of problems that maintenance personnel and controllers are experiencing with ATC system equipment. Current indications of problems with antiquated ATC equipment may be a precursor to failures in critical systems. If FAA improves the quality of the data it contains, the Maintenance Management System Corrective Maintenance data base holds the most promise for enabling FAA to take a more proactive approach to managing systems maintenance. [Conclusions]

Annual Report 1990/Transportation Safety Board of Canada. — Ottawa : Minister of Supply and Services Canada, 1991. 111 p.; charts, ill. Bilingual: English and French. ISBN: ISBN: 0-662-58243-8.

Key Words
1. Aeronautics — Accidents — Canada.
2. Aeronautics — Statistics — Canada.
3. Aeronautics — Safety Measures — Canada.

Contents: Members of the Board — Chairperson's Message — Introduction — Statistical Overview (Marine, Commodity Pipelines, Rail, Air) — Activities: Overview, Occurrence Classification and Response, Investigation Operations, Safety Studies, Technology in Transportation Accident Investigations (Derailment, Fire and Explosion, Remote Sensing, Flight Data and

Cockpit Voice Recorders), Human Factors, Confidential Aviation Safety Reporting Program, Communications, Occupational Health and Safety — Findings — Safety Action (including Safety Recommendations) — Appendices: Transportation Occurrence Statistics 1981-1990.

Summary: By an act proclaimed on 29 March 1990, the Transportation Safety Board of Canada, a new independent multi-modal agency, was established. The new Board replaces the Canadian Aviation Safety Board. This is the first annual report of the TSB.

Civil Aviation Statistics of the World 1990. Sixteenth Edition-1991. — Montreal : International Civil Aviation Organization, [1991]. 171 p. in various pagings; tables, graphs.

Key Words
1. Aeronautics — Accidents — Statistics — Periodicals.
2. Aeronautics, Commercial — Statistics — Periodicals.
3. Airlines — Statistics — Periodicals.
4. Aircraft — Statistics — Periodicals.
5. Air Pilots — Statistics — Periodicals.
6. Airports — Statistics — Periodicals.
7. Private Flying.

Contents: Map of ICAO Statistical Regions — ICAO World Statistics: Aircraft, Pilots, Safety, Fleets, Traffic, Finance — Statistics by Region and State: Aircraft, Pilots, Traffic, General Aviation — Statistics for Commercial Air Carriers by State: International Scheduled Airlines, Domestic Scheduled Airlines, Non-Scheduled Operators — Airports — Appendices.

Summary: Includes summaries of statistical information which is being reported regularly to ICAO but not presently published in other ICAO statistical digests, i.e., civil aviation safety, general aviation, and civilian pilot licenses. Chiefly tables. [Preface]

Civilian Training in High-altitude Flight Physiology. Final Report/John W. Turner (EG&G Dynatrend), M. Stephen Huntley Jr. (U.S. Department of Transportation), and John A. Volpe (U.S. National Transportation Systems Center).— Washington, D.C. : U.S. Federal Aviation Administration, Office of Aviation Medicine ; Springfield, Virginia, U.S. : Available through NTIS*, [1991]. Report DOT/FAA/AM-91/13. viii, 19, [24] p. ; 28 cm.

Key Words
1. Flight Training.
2. Atmosphere, Upper — Physiological Effect.
3. Aeronautics, Commercial — Employees — Training — United States.
4. Air Pilots — Training — United States.

Summary: A survey was conducted to determine if training in high-altitude physiology should be required for civilian pilots; what the current status of such training was; and, if required, what should be included in an ideal curriculum. The survey included a review of Aviation Safety Reporting System (ASRS) and U.S. National Transportation Safety Board (NTSB) accident/incidents, current U.S. Federal Aviation Regulations (FARs), the *Airman's Information Manual*, and military training courses. Interviews were conducted with various representatives of the industry. The survey determined that there is a need for such training. It was also found that current training practices are not uniform and sometimes do not even address those subjects required by FARs. The report contains recommendations for subjects to be included in a core curriculum. [Author abstract]

Exchange Ideology as a Moderator of the Procedural Justice-satisfaction Relationship. Final Report/L. Alan Witt, Dana Broach (Civil Aeromedical Institute). — Washington, D.C. : U.S. Federal Aviation Administration, Office of Aviation Medicine; Springfield, Virginia, U.S. : Available through NTIS*, [1991]. Report DOT/FAA/AM-91/11. 6 p. ; 28 cm.

Key Words
1. United States — Officials and Employees — Salaries, etc.
2. Job Satisfaction.

Summary: The study of 91 civilian U.S. government employees in a two-month, full-time training program tested the hypothesis that exchange ideology would moderate the relationship between procedural justice perceptions and satisfaction with the training experience. Exchange ideology refers to the relationship between what the individual receives and gives in an exchange relationship. Employee effort based on organization reinforcements is a strong exchange ideology. When employees put forth effort without regard to what they receive from the organization, it is a weak exchange ideology. The data indicated that perceptions of procedural justice accounted for greater variance in satisfaction among trainees with a strong exchange ideology than among those with a weak exchange ideology. These results suggest that the effect of fairness on satisfaction with a training experience appears to be dependent on the individual's exchange ideology. [Author abstract]

Selection Criteria for Alcohol Detection Methods. Final Report/Garnet A. McLean, Bruce W. Wilcox, Dennis V. Canfield (Civil Aeromedical Institute). —Washington, D.C. : U.S. Federal Aviation Administration, Office of Aviation Medicine ; Springfield, Virginia, U.S. : Available through NTIS*, [1991]. Report DOT/FAA/AM-91/12. 6, A-1, B-1, C-4 p. ; 28 cm.

Key Words
1. Drinking and Airplane Accidents.
2. Breath Tests.
3. Blood Alcohol — Analysis.
4. Alcohol.

Summary: The potential need for testing in the aviation industry for job-related alcohol abuse requires the development of a testing strategy based, in part, on selection of alcohol test instruments appropriate to the specific goals of the U.S. Federal Aviation Administration. The extensive availability of test instruments with varying capabilities and limitations makes selection of alcohol test instruments difficult technologically, with a considerable potential for choosing test instruments of inappropriate character. The considerations outlined herein are intended to assist in the selection process. [Author abstract]

Two Studies on Participation in Decision-making and Equity Among FAA Personnel. Final Report/ L. Alan Witt, Jennifer G. Myers (Civil Aeromedical Institute). — Washington, D.C. : U.S. Federal Aviation Administration, Office of Aviation Medicine ; Springfield, Virginia, U.S. : Available through NTIS*, [1991]. Report DOT/ FAA/AM-91/10. 14 p. ; 28 cm.

Key Words
1. United States — Federal Aviation Administration — Officials and Employees.
2. Decision-Making.
3. Job Satisfaction.

Contents: The Moderating Effect of Equity on the Relationship Between Participation in Decision-making and Job Satisfaction/L. Alan Witt — Perceived Environmental Uncertainty and Participation in Decision-making in the Prediction of Perceptions of Fairness of Personnel Decisions/L. Alan Witt and Jennifer G. Myers.

Summary: Study 1: Moderated multiple regression analyses on data collected from 2,177 FAA air traffic controller specialists indicated that equity perceptions moderated the relations between participation in decision-making and level of job satisfaction. Study 2: Data collected from 357 FAA personnel indicated that perceptions of participation in decision-making and environmental uncertainty accounted for unique variance in perceptions of levels of fairness in personnel decisions. [Author abstract]

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

*U.S. General Accounting Office (GAO)
Post Office Box 6012
Gaithersburg, MD 20877 U.S.
Telephone: (202) 275-6241

Accident/Incident Briefs

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

Air Carrier

Pitch-up Leads to Triple Stall

Airbus A310: No damage. No injuries.

The aircraft was being flown on an autopilot-coupled approach. A missed approach was initiated at a height of 1,500 feet and the autopilot pitched the nose up. The pilot tried to counteract the pitch-up by pushing forward on the control column. This action normally disengages the autopilot; however, the automatic disconnect is inhibited during the go-around mode.

Because of the pilot's control input, the still-engaged autopilot trimmed the stabilizer to minus 12 degrees in an attempt to raise the nose and maintain the programmed profile for the go-around. The nose-down control column input from the pilot, meanwhile, deflected the elevator 14 degrees nose down. However, his nose-down input was overpowered by the combined nose-up forces of the stabilizer trim and the thrust increase and flap retraction that were occurring as part of the go-around procedure.

The autopilot captured its preselected missed approach altitude after the aircraft had climbed approximately 600 feet and, having reached the end of its go-around mode, the autopilot disconnected automatically because of the pilot's nose-down control column input. Grossly mistrimmed, the airplane pitched up steeply to 88 degrees and the computed airspeed dropped to less than 30 knots. The stall warning was actuated for approximately four seconds and then stopped because the airspeed dropped below usable computed values and the autothrottle system disengaged. The airplane stalled at 4,300 feet and pitched down to minus 42 degrees during which time the pilot-induced control inputs showed full up elevator.

The airspeed increased as the aircraft descended rapidly, reaching 245 knots as the aircraft leveled off at 1,500 feet. Still trimmed excessively nose-up, the aircraft began to climb rapidly.

The second nose-up cycle produced a 70-degree pitch-up and another stall 50 seconds after the first one. The nose then dropped to minus 32 degrees and the airspeed built up to 290 knots by the time the aircraft leveled off at 1,800 feet. During this descent, pitch trim one and yaw dampers one and two disconnected and flight directors one and two dropped off line. During both stall cycles, the pilots attempted unsuccessfully to regain control of the aircraft by means of the autopilot but neither of the two systems would engage.

Another pitch-up followed, during which the aircraft nosed up to 74 degrees and climbed to 7,000 feet before stalling, 60 seconds after the second stall, and pitching down to minus 32 degrees. The aircraft leveled off briefly at 3,600 feet and 300 knots before beginning another pitch-up.

The nose went up to 74 degrees and the aircraft reached 9,000 feet. However, this time the pilots' use of thrust and elevator control inputs, and probably retrimming the elevator, prevented a stall and the aircraft leveled off at

130 knots. The speed increased and a milder pitch-up placed the aircraft at 11,500 feet. Control was regained by the pilots and the aircraft was landed with no further incident.

The manufacturer reviewed the incident and reported that the aircraft systems all functioned properly. The company recommended that pilots who want to change the direction of the aircraft in such a situation should either disconnect the autopilot first or engage an autopilot mode other than go-around.

"I Don't Remember Saying That"

Boeing 737: Moderate damage. No injuries.

After a rest period of almost 14 hours, the crew of two reported for the third consecutive night of flying. Duty time for a series of cargo flights had begun at 2355 hours and the aircraft was being prepared for the final flight that was to depart at 0640.

When the dispatcher noted at 0600 that the aircraft would be ready earlier than expected, he obtained the crew's agreement to request an earlier slot time for departure which was granted, and the departure time was moved to 0625. The crew was notified of the change at 0615.

While the first officer secured the forward service door, the captain obtained engine start and pushback clearance and indicated to the ground crew by interphone that the aircraft was ready to be pushed back. By then, the first officer had returned to the cockpit and began reading off the before start checklist items to which the captain responded.

The tug began to exert pressure through the tow bar on the nose gear to push the airplane back; however, the aircraft's parking brake had not been released and the nose gear leg collapsed rearward. The underside of the fuselage was damaged and the aircraft was taken out of service for repairs. There were no injuries.

The pilots reported that they did not recall informing the ground crew that the parking brake was released and that the pushback should be started. However, a replay of the cockpit voice recorder (CVR) revealed that the ground crew had been told that the aircraft was cleared for the pushback and that the parking brake was released.

Last-minute Command Changes

Vickers Vanguard 953C: Minor damage. No injuries.

The four-engine turboprop aircraft was on final approach and on glidepath according to both the visual approach slope indicator (VASI) and instrument landing system (ILS) glideslope indicators. The first officer was at the controls and was making a visual approach. At, or shortly before the landing flare, the captain took the controls from the first officer because he became concerned with the way the final approach had developed.

The captain carried out the landing. After touchdown, as the nosewheel was lowered to the runway, the captain gave the controls back to the first officer. The captain then selected ground idle on the power levers. At this time, severe vibration was experienced which was initially attributed to nosewheel shimmy. When the aircraft stopped in a right-wing-low attitude, the captain realized that the right-hand main gear tires had burst. After this was confirmed by air traffic control (ATC), the engines were shut down and the aircraft was evacuated on the runway.

There were no injuries, but the aircraft sustained damage to a landing gear door and the number three engine nacelle when the tires burst. The captain reported that the bursting of the tires had probably been caused by brake application.

Weight and Balance Review, Anyone?

Cessna 402: Substantial damage. No injuries.

The air taxi flight was due to take off in midday during daylight conditions. Nine passengers had been boarded without the pilot having obtained accurate weight information from them. The baggage was placed in the aft baggage compartment, and as the pilot entered the cabin on his way forward to the cockpit, the aircraft's tail fell to the ramp. The pilot raised the tail and decided to continue with the flight.

During the climbout at 200-400 feet above ground level (agl) the stall horn sounded, and the pilot requested that the passengers move forward. The passengers did so and remained forward until the aircraft landed. A stringer, rear bulkhead, elevator control tube and the housing for the tail navigation light were damaged. There were no injuries.

The aircraft's center of gravity (CG), according to the accident report, was beyond the aft limit of the loading envelope. There was no ballast in the forward baggage compartment.

The pilot was cited for inadequate preflight planning and for exceeding the center of gravity limits.

Low-airspeed Takeoff Leads to Trouble

Beechcraft B58 Baron: Substantial damage. No injuries.

The aircraft was departing from a snow-covered runway with a pilot and two passengers on board. The runway surface was covered with approximately three inches of crusted snow, with the center 15-20 feet packed down by aircraft operations.

The aircraft was slow to accelerate and began to pull to the left later in the takeoff roll. The pilot attributed this to a loss of power in the left engine but, instead of aborting the takeoff, he tried to take off. Because the airspeed was low, the aircraft climbed only a few feet before it settled back to the runway. This cycle was repeated several times, after which the aircraft struck a snowbank along the side of the runway in a nose-high attitude. The impact tore off the main landing gear and the nose gear collapsed when the aircraft spun around and came to rest in deep snow to the side of the runway. The aircraft sustained heavy damage but the pilot and his two passengers evacuated the aircraft without injury.

The engines were checked and run up to takeoff power; no discrepancies were found. A check of the tire marks on the runway revealed that the left main gear had been breaking a trail through the crusted snow while the nose gear and right main gear were rolling along the packed center portion of the runway near the beginning of the takeoff run.

It was concluded that the slow acceleration and left yaw had been caused by asymmetrical drag from the left main gear rolling through the crusted snow rather than a loss of engine power, and that the pilot attempted to lift off without sufficient airspeed even though directional control was lost. The accident was attributed to the pilot's failure to abort the takeoff when directional control was lost.

Just a Little Lower And We Should Be Visual ...

Piper PA-31 Navajo: Substantial damage. No injuries.

The aircraft was taken on a local test flight at night. It had been out of service the previous six weeks for repairs.

The pilot executed a few turns and returned to the airport to fly a few traffic patterns. While it was on the downwind leg, the aircraft entered a fog bank. The pilot conducted a full non-directional beacon/distance measuring equipment (NDB/DME) approach. The aircraft crossed the 5.5-mile DME fix inbound at the published altitude of 2,100 feet asl (above sea level); field elevation was 117 feet asl. According to the published approach procedure, the pilot was to descend until crossing the 2.5-mile DME fix at 950 feet asl.

However, the pilot anticipated that he would shortly encounter visual conditions, so he continued the descent to cross the 2.5-mile fix at approximately 750 feet asl. The aircraft contacted the ground seconds later at 500 feet asl. The landing gear was torn off and the aircraft slid to a stop. The four occupants were able to exit the aircraft without serious injury.

Other General Aviation

No Horn — No Joy

Piper PA-23-250 Aztec: Substantial damage. No injuries.

The flight was planned to transport a number of passengers to another town. However, some of the passengers failed to arrive at the designated meeting time, so the pilot prepared to depart without them.

Just after the aircraft became airborne, the pilot saw the missing passengers arrive at the airport. He decided to remain in the traffic pattern and land to pick them up. He reported later that, since he had just taken off, he thought that he had not yet raised the landing gear and did not bother to select gear down for the landing. Subsequently, he landed gear up. Not one of the four persons aboard was injured, but the damage to the propellers, engines and underside of the aircraft was extensive enough for the airplane to be considered beyond economical repair.

The pilot had not heard a gear-up warning horn prior to landing and did not remember having checked the gear position indicator lights. The gear lever was in the down position when the pilot returned to the cabin after the evacuation had been completed, but he considered that it could have been knocked to that position during the evacuation. A maintenance inspection revealed that the gear warning horn operated only intermittently.

Late Go-around Ruins Cow's Day

Cessna 182: Substantial damage. No injuries.

The aircraft was returning from a flight with a pilot and three passengers on board. The concrete runway was 792 meters (2,600 feet) long and 30 meters (100 feet) wide and was wet. The wind was almost directly across the nose at 5 knots (6 mph).

Crossing the runway threshold with flaps down, the pilot closed the throttle. The aircraft settled rapidly and the pilot flared too high. He then lowered the nose but overcorrected and the aircraft hit the ground hard and bounced twice. Prior to another bounce, the pilot tried to initiate a go-around, but the aircraft was slow to respond and the end of the runway was reached before the aircraft had reached a safe height. The pilot avoided hitting a fence post but the landing gear went through an area of trees and bushes that pulled the aircraft down and to the right, whereupon the right main wheel struck a cow.

Because of repeated ground strikes, the propeller was damaged and the aircraft came to rest approximately 1,000 feet beyond the end of the runway. There were no injuries to the occupants but the aircraft sustained major damage to the propeller, landing gear, fuselage and minor damage to the wings and tailplane. The cow had to be destroyed by a veterinarian.

The pilot stated that he was too high and fast on the landing approach and did not initiate the go-around soon enough.

Rotorcraft

Hidden Wires Snag Helicopter

Enstrom F-28: Substantial damage. No injuries.

The pilot was carrying a passenger to a shooting center operated by a sporting club. Inspecting the site from a height of 1,000 feet prior to the landing approach, he observed wire cables that were situated beyond the landing site he had chosen viewed from the direction of final approach. The inspection altitude was higher than the pilot normally used, but the site owner had requested that the helicopter not be flown lower because it would frighten thousands of pheasants in pens nearby.

The mid-morning sun was at the pilot's left and a five-knot wind from his 2 o'clock position and reduced speed to a hover taxi as he approached the touchdown spot. Suddenly, the main rotor mast encountered a power cable that the pilot had not seen during his pre-landing inspection. The wire broke and became wound around the rotating rotor mast, causing the aircraft to land heavily on its skids. The aircraft was extensively damaged but the two occupants were able to evacuate it without injury.

The wire that was struck had been suspended from poles spaced 100 yards apart and the poles either side of the helicopter's approach path were embedded in hedgerow trees. The pilot was unable to see the wire until just prior to impact because it did not contrast with the trees in the background.

Downwind Turn In Gusty Air

Enstrom F-28: Extensive damage. No injuries.

The pilot's mission was to fly with a photographer over and around the dam at a reservoir. The wind was estimated to be 15-20 knots, and the rotorcraft was operating in the lee of high ground that rose 150 feet above the level of the reservoir water. Reportedly, there were pockets of localized turbulence and downdrafts affecting the area.

The pilot picked up the photographer in mid-morning. The helicopter was hovered into the wind at approximately 60 feet above one end of the dam for about 45 seconds, and then moved across the water for more photographs. After that task was completed, the pilot turned the aircraft from its heading into the wind to a downwind direction and attempted to accelerate downwind. An immediate loss of height occurred, and the pilot increased power to 36 inches manifold pressure and pushed the cyclic control forward to increase the airspeed.

The helicopter continued to descend rapidly and the indicated airspeed read between 10 and 15 mph. Although the engine rpm was at the top of the green sector, the main rotor rpm was decaying rapidly, so the pilot elected to ditch the helicopter in the reservoir. The water landing was successful and the two occupants evacuated the sinking aircraft without injury.

The helicopter was recovered from the water the same day and, although extensively damaged, there was no evidence of mechanical failure prior to the ditching. ♦

1991 FSF Publications Index

LEGEND: AP-Accident Prevention • AO-Airport Operations • AMB-Aviation Mechanics Bulletin • CCS-Cabin Crew Safety • FSD-Flight Safety Digest • HFAM-Human Factors & Aviation Medicine • HSB-Helicopter Safety Bulletin • FSFN- Flight Safety Foundation News

Code	Subject	Title	Bulletin	Date
		Trees Block Flat Climb	AMB	July
	Control Loss			
		Be Prepared for Clear Air Turbulence	FSD	June
		Heavy Weather Weighs Down Aircraft	FSD	January
		Low on Experience, Low on Prudence — High on Risk	FSD	July
	Crew Associated			
		Demonstration Flight Got Carried Away	FSD	June
		Moving the Wrong Lever Can Give the Wrong Result	FSD	July
		Sleeping at the Controls Can Lead to a Rude Awakening	FSD	April
		Too Little Sleep Kills	FSD	November
		Under the Clouds and into a Tree	FSD	February
		When Things Go Wrong, Other Things Go Wrong	FSD	April
	Distraction			
		A Dangerous Case of Mistaken Identity and False Assumptions	FSD	June
		But the Gear Lever Was in the Down Position	FSD	July
		Flaps-up Speed Exceeded Because of Distraction	FSD	March
		Game of Musical Chairs Has Off-key Finale	FSD	March
		Overshot Altitude While Looking for Traffic	FSD	August
		Too Busy Talking to Passenger	FSD	August
	Engine(s)			
		Ground Checked OK, Flight Check NG	FSD	June
		Turbocharged Engines Like to Stay Warm	FSD	April
	Fuel Exhaustion			
		A Case for the Visual Fuel Check	FSD	May
		Almost Made It	FSD	March
		Fuel Shortage Shortens Trip	FSD	June
		Off You Go, But Keep It Short	FSD	April
		Out of Fuel and Practice	FSD	November
		Out of Fuel Leads to Out of Control	FSD	December
		Took Off on Empty Tank	FSD	June
		Where Did the Fuel Go?	FSD	June
	Ground Obstacles			
		Helicopter Took in the Wash	FSD	June
		Jet Blast, Unbraked Cart Result in Dented Aircraft	FSD	May
		Parking Problem Plucks Pitots	FSD	June
	Incorrect Procedure			
		Check Ride Trick Backfires	FSD	November
		Configuration Warning Saves the Day	FSD	January
		Descended Below Clearance Altitude	FSD	December
		Empty Aircraft Left on Runway	FSD	April
		Forced Landing Practice Taught Another Lesson	FSD	August
		Frequency Confusion Leads to Collision with Mountain	FSD	December
		Fuel Flows Downhill and Grounds Aircraft	FSD	February
		Inflight Stall Training Taught a Hard Lesson	FSD	April
		Instructor Confuses Lesson Instructions	FSD	January
		It Started Off by Being Late	FSD	January
		Lack of Practice Leads to Repairs	FSD	December
		Landed without Clearance	FSD	November
		Long Sideslip Leaves Engines without Fuel	FSD	July
		Murphy Is My Copilot	FSD	March
		Not Sure of Door? A Good Thump Is No Cure	FSD	February
		Off-target Toss Tumbles Helicopter	FSD	July
		Out of Altitude, on Final and into the Game	FSD	October
		Rapid Rotation Scrapes Tail	FSD	January
		Sent Helicopter on First Solo	FSD	February
		Set-up for Disaster	FSD	March
		The Aircraft That Moved by Itself	FSD	January
		The Pilot Who Thought He Could	FSD	October
	Inspection			
		Hurried Departure Goes Nowhere	FSD	December
		Pre-takeoff Control Checks Can Prevent Catastrophe	FSD	April
		Strange Noise at Night Makes Flight Interesting	FSD	August

Code	Subject	Title	Bulletin	Date
		Who Left the Door Open?	FSD	August
	Landing			
		Aircraft Went Astray in Dark of the Night	FSD	April
		Buggy Airspeeds Bring Bumpy Landing	FSD	June
		It Was a Dark and Snowy Night	FSD	July
		It's an Ill Wind That Crosses the Runway	FSD	June
		Landed Long at Wrong Airport	FSD	January
		Loose Tarpaulin Becomes Wet Blanket	FSD	March
		Low Speed During Approach	FSD	March
		Misjudging Height Leads to Early Touchdown	FSD	April
		Practice Autorotation Proves Costly	FSD	July
		The Long and Short of It	FSD	January
		Third Autorotation Was Not a Charm	FSD	August
		Too High and Fast Became too Low and Slow	FSD	April
	Mechanical			
		Disconnected Cyclic Leads to Loss of Control	FSD	June
		Engine Problem at Low Altitude	FSD	June
		Simulated Shutdown Became Realistic	FSD	January
		Two Warnings Were Not Enough	FSD	February
	Midair/Near Midair			
		Fatal Set-up		FSDJanuary
		Formation Flying Blind	FSD	December
	Rotor Strike			
		Loose Tarpaulin Becomes Wet Blanket	FSD	December
		Protruding Pipe Puts Helicopter Down	FSD	December
	Runway/Taxi Excursions			
		Downwind Taxiing Puts Aircraft in Ditch	FSD	July
	Pre-takeoff Collision			
		A Close Encounter of the Wrong Kind	FSD	April
		Touchdown Encounter	FSD	October
	Takeoff/Overrotation			
		Heavy Airplane Balks at Flight	FSD	June
		Pilot Feels Frosty Hand on the Clouds	FSD	March
	Undetermined			
		Engine Failure Demonstration Takes an Unexpected Turn	FSD	February
		Mystery Break	FSD	April
	Weather			
		Be Prepared for Clear Air Turbulence	FSD	May
		Ground Reference Lost in Whiteout	FSD	November
		Incomplete Training Leads to Fatal Encounter	FSD	December
		Landed into Fog	FSD	March
		Lost Way in Snow	FSD	June
		Low on Altitude and Night Experience	FSD	October
		Low Visibility Deceives Pilot	FSD	April
		Medical Flight Got too Low	FSD	December
		Morning Rain Mires Aircraft	FSD	March
		One Engine Out in Ice But No Emergency	FSD	August
		Power Lines in the Fog	FSD	November
		Powerlines Get in the Way	FSD	November
		Runway Incursions in Fog	FSD	January
		Severe Icing Is a Severe Threat	FSD	August
		The Final Cause: Continued VFR Flight into…	FSD	May
		The Windshear Gremlin Gives No Second Chances	FSD	April
		Weather, Powerlines and Helicopters Do Not Mix	FSD	October
		Whiteout, Blackout — Same Result During Landing	FSD	April
	Wire Strike			
		Tripped by Unseen Wires	FSD	October
1.75	**Maintenance Alerts**			

Code	Subject	Title	Bulletin	Date
		Airworthiness Directives Issued for Boeing 747s and 767s	AMB	Jan/Feb
		Bad Vibes End Flight	AMB	Mar/Apr
		Corrosion a Concern in Older Cessnas	AMB	Jan/Feb
		Crash Investigation Focuses on Missing Screws	AMB	Nov/Dec
		Don't Believe All Those Advertisements	AMB	Mar/Apr
		Door Trouble Defies Crew	AMB	May/June
		Elevator Hinge Pin Suspected as Cause of Inflight Breakup	AMB	Jan/Feb
		Exhaust Pipe Failures Result in Inflight Fires	AMB	Jan/Feb
		Faulty Maintenance Causes Fuel Farm Fire	AMB	Nov/Dec
		FOD Jams Landing Gear	AMB	Sept/Oct
		Human Factors Cited in Engine Failure Accident of DC-10	AMB	May/June
		Loose Actuator Fitting Jams Landing Gear	AMB	Jan/Feb
		Lost Wrench Means Trouble	AMB	Sept/Oct
		Maintenance Error Is Preventable	AMB	Sept/Oct
		Maintenance of Emergency Equipment Cited as Safety Factor	AMB	May/June
		Missing Bolt Results in Gear Up Landing	AMB	Sept/Oct
		Multiple Problems Ground Mooney	AMB	May/June
		Oil Leak + Dirty Compressor = Fatal Loss of Power	AMB	Mar/Apr
		Safety Pins Installed — Almost	AMB	Mar/Apr
		Scored Skin Results in Pressure Bulkhead Failure	AMB	Nov/Dec
		Smoke and Flames In the Cockpit	AMB	Nov/Dec
		Tail Rotor Shaft Bearing Failure Cause of Helicopter Accident	AMB	May/June
		Take Care with Those Cabin Windows	AMB	Jan/Feb
		Winter Temperatures Could Increase "Blue Ice" Problems	AMB	Nov/Dec
2.00	**Airports**			
		Airport X-ray Screening Technology Becomes a Viable Explosives Detector	AO	July/Aug
		Anatomy of a Runway Collision	AP	October
		The Rapid Runway Entry	AO	May/June
		U.S. Airport Access Control Moves Slowly	AO	Nov/Dec
		Updating Airport Emergency Capabilities	AO	Sept/Oct
2.50	**Approach and Landing**			
		Aftermath of a Tragedy	AP	August
		Early Descent Leads to Grief	AP	March
		Main Causes of Hard Landings	AP	February
3.00	**Aviation Medicine**			
		The HIV Positive Crew Member	HF&AM	Jan/Feb
		Upper Respiratory Infections and the Civil Aviation Crew Member	HF&AM	May/June
3.50	**Awards**			
		Awards Reflect Recognition	FSFN	Jan/Feb
		Barbour Award Board Meets	FSFN	June/July/Aug
		De Florez Award Goes to Three Boeing Employees	FSFN	Jan/Feb
		Editor Receives Distinguished Service Award	FSFN	Jan/Feb
		Soviet Pilot Chosen for Heroism Award	FSFN	Jan/Feb
		Thai Airways' Publication Receives Brownlow Award	FSFN	Jan/Feb
		United Pilot Receives Barbour Award	FSFN	Jan/Feb
12.00	**Communications**			
		The Cockpit-to-Shop Communications Link	HSB	Mar/Apr
17.00	**De-icing**			
		De-icing and Anti-icing Are Major Safety Factors in Winter Operations	AMB	Nov/Dec
17.75	**Design/Development**			
		Advanced Cockpit Technology in the Real World	AP	July
		Night Vision Goggles May Be in Your Future	HSB	Jan/Feb
19.00	**Education & Training**			

Code	Subject / Title	Bulletin	Date
	Accident Reports Offer Hidden Values and Buried Treasures	AP	April
	Effective Cabin Crew Training	CCS	May/June
	Learning From the Experience of Others	FSD	June
	Preventing Accidents Through Awareness and Training	HSB	Nov/Dec
	Regional Airline Command Training	FSD	June
	Special Use Airspace and Military Training Routes	AP	November
20.00	**Emergency Procedures**		
	United 232: Coping With the "One-in-a-Billion" Loss of All Flight Controls	AP	June
24.00	**Flight Operations**		
	Checklist — Guideposts Often Ignored	AP	May
	Stall Considerations for Transport Aircraft	AP	September
	When A Rejected Takeoff Goes Bad	FSD	January
24.50	**Foreign Object Damage**		
	Blue Ice Is a Continuing Threat to Safety	AP	December
25.00	**Fuels & Fuel Systems**		
	New Do's and Don'ts about Aircraft Fueling	AO	Mar/Apr
27.75	**Rotorcraft**		
	International Helicopter Guidelines Become Effective	AO	Jan/Feb
	Measuring Safety in Single- and Twin-engine Helicopters	FSD	August
	Set-up for Disaster	HSB	Sept/Oct
	The Philosophy and Realities of Autorotations	HSB	July/Aug
	Too Fast and too Low	HSB	May/June
28.00	**Human Factors**		
	Aircraft Accidents Aren't — Part Two	AP	January
	Carpal Tunnel Syndrome: A Menace to Health	CCS	Nov/Dec
	Dealing with Stress in the Aircraft Cabin	CCS	July/Aug
	Eating Habits During Layover Affect Flight Performance	HF&AM	Nov/Dec
	Flying and Diving — A Unique Health Concern	HF&AM	Sept/Oct
	Policy and Oversight in Fitness for Duty	HF&AM	Mar/Apr
	Retired Pilot Mortality Rate Appears Higher Than General Population	FSFN	Jan/Feb
	SIS — The Ultimate Realism in Simulators	HF&AM	July/Aug
	Snoring — Danger Signal in the Sky	HF&AM	Mar/Apr
	Understanding and Defusing the Sources of Stress	FSD	June
30.75	**Cabin Safety**		
	Flight Attendants: Aviation's Under-recognized Safety Resource	CCS	Mar/Apr
	Occupational Stress in the Aircraft Cabin	CCS	Sept/Oct
	Safety in the Air — What More Can Be Done?	CCS	May/June
	The Case for Effective Child Restraint	CCS	Jan/Feb
	The Effect of Passenger Motivation on Aircraft Evacuations	FSD	June
31.25	**Investigation**		
	Investigating the Management Factors in an Airline Accident	FSD	May
35.00	**Maintenance**		
	AMTECH 91 Moves to Orlando	AMB	Jan/Feb
	Aviation EXPO to Be Held in March 1992	AMB	Nov/Dec
	Call for NDT Papers	AMB	Mar/Apr
	Call for Nominations for the Joe Chase Award	AMB	Sept/Oct
	Computerized Accident Investigation Data Source Being Developed at ERAU	AMB	May/June
	Corrosion Prevention Program Affects Nearly 3,000 Aircraft	AMB	Jan/Feb
	Education Group Offers NDT Training Curriculum	AMB	Mar/Apr
	Electrostatic Circuit Board Damage Reduced	AMB	Nov/Dec
	Employers Expanding Use of Computers in Technician Training	AMB	May/June
	Expected Results of the F27 and F28 Aging Aircraft Programs	FSD	June

Code	Subject Title	Bulletin	Date
	FAA Issues Directives on Aircraft Corrosion Prevention	AMB	Mar/Apr
	Go-ahead Given for Boeing 777	AMB	Jan/Feb
	How to Work Safely with Composite Materials	AMB	Jan/Feb
	Minnesota Holds Technicians Conference	AMB	Jan/Feb
	NDI Courses Offered	AMB	Nov/Dec
	New AMB Editorial Coordinator Appointed	AMB	Jan/Feb
	Safe Disposal of Toxic Waste Created by Maintenance Activities	AMB	Sept/Oct
	Sandia to Manage Aging Aircraft Research Center	AMB	Sept/Oct
	Scholarship Program Offered to Youth	AMB	Mar/Apr
	Standards Revised for Grounding/Bonding During Aircraft Fueling Operations	AMB	May/June
	The First U.S. Licensed Mechanic	AMB	Sept/Oct
	The Mechanic and Metal Fatigue	AMB	Mar/Apr
	Tire Manufacturers Release Warning on Static Electricity	AMB	Nov/Dec
	Trust Is a Key Word In the Aviation Community	AMB	Sept/Oct
	Wheel Well Fire Warning May Be Difficult to Trace	AMB	Sept/Oct
35.50	**Maintenance Equipment/Services**		
	Air Purifying		
	Respirator Is Lightweight and Self-powered	AMB	Mar/Apr
	Combination Socket Fist Square and Hex Fasteners	AMB	Jan/Feb
	Compact Disc Maintenance Data May Be the Wave of the Future	AMB	Nov/Dec
	Exam Books Updated	AMB	Mar/Apr
	Get the Goo Out of the Ground Safely	AMB	Sept/Oct
	Hot Hands Offer Safety Warning	AMB	Mar/Apr
	Magnetic Sweepers Reduce Litter and Extend Tire Life	AMB	May/June
	No More Working in the Dark	AMB	Mar/Apr
	On Board Corrosion Diagnostic System	AMB	Sept/Oct
	Paving Blocks Keep Floors Clean and Safe	AMB	Nov/Dec
	Puller Set Improves Work Safety	AMB	Sept/Oct
	Reference Book For Composites	AMB	Jan/Feb
	Regulatory Compliance Audits Are Available	AMB	Sept/Oct
	Safety Cable — An Alternative to Lockwire	AMB	May/June
	Special Packaging of Lubricants Eliminates Contamination	AMB	Nov/Dec
	Spiral Wrap Protects Wiring	AMB	Jan/Feb
	Telescoping Towbar for Safer Operation	AMB	Jan/Feb
	Temperature Monitoring Decals Detect Overheats	AMB	Jan/Feb
	Video Analyzer Enhances Remote Visual Inspections	AMB	May/June
	Walk Safely and Protect the Environment, Too	AMB	Nov/Dec
	Waterjet System Removes Coatings More Safely	AMB	Sept/Oct
37.00	**Meetings**		
	Cessna CEO Praises "Best Ever" Corporate Aviation Safety Record	FSFN	Mar/Apr/May
	FSF Addresses Aircraft Operator's Meeting in Brazil	FSFN	Jan/Feb
	FSF Meets with Soviet Group in Rome	FSFN	Jan/Feb
	Italian Civil Aviation Director Emphasized Safety; FSF Vice Chairman Support Broadened Foundation Support	FSFN	Jan/Feb
	Participants Have Their Say	FSFN	Mar/Apr/May
	Participants Have Their Say	FSFN	Jan/Feb
	Putting the Pieces Together	FSFN	Jan/Feb
	Record Attendance of Governors	FSFN	Jan/Feb
	Retired Texaco Manager of Aviation Services Honored for Aviation Achievements	FSFN	Mar/Apr/May
	Rome Meeting Hailed Success	FSFN	Jan/Feb
	Special Thanks Goes to Alitalia	FSFN	Jan/Feb
	Wake Vortex Symposium Announced	FSFN	Jan/Feb
39.00	**Midair Collisions**		
	Midair Collision Avoidance	AP	December
45.00	**Pilot Proficiency**		
	The Three Critical Success Factors	AP	August
49.00	**Regulations**		
	FSF Endorses "Kinder, Gentler" FAA	FSFN	Jan/Feb

Code	Subject	Title	Bulletin	Date
51.50	**Sabotage/Security/Terrorism**			
	Terrorism — Dark Times Ahead?		FSD	June
	Terrorism — Dark Times Ahead?		FSD	March
53.00	**Statistics**			
	1990 Accident Statistics for Worldwide Scheduled Air Carrier and Commuter Airline Fleet		FSD	April
	An Annual Update of Worldwide Jet Transport Aircraft Fatal Accident and Hull Losses Calendar Year 1990		FSD	May
	An Annual Update of Worldwide Jet Transport Aircraft Fatal Accident and Hull Losses Calendar Year 1990		FSD	June
	An Update of Two Safety Rules Relating to Age and Alcohol		FSD	January
	Australian Civil Aviation		FSD	December
	Near Midair Collisions, Operational Errors and Pilot Deviations		FSD	August
	Reviewing Worldwide Airline Fatal Accidents and Jet Transport Aircraft Hull Losses		FSD	January
	Safety Changes in Canada, 1990		FSD	October
	Safety Trends in Worldwide General Aviation Operations		FSD	June
	Trends of Worldwide Bird Strikes Calendar Years 1984-1989		FSD	November
	U.S. Air Carrier Safety Performance Accident Statistics and Trends 1980-1990		FSD	March
	U.S. Civil Aviation Safety Records January-April, Calendar Year 1991		FSD	July
	U.S. Commuter Air Carrier and Air Taxi Accident Statistics and Trends Calendar Year 1990		FSD	April
	U.S. Transportation Fatalities Calendar Year 1990		FSD	October
	U.S.S.R. Civil Aviation Flight Safety Analysis for 1990		FSD	July
	U.S.S.R. Safety Information		FSD	March
	Was 1990 a "Good" Year?		FSD	October
59.75	**Weather**			
	Lightning Literacy for Ramp Personnel		AMB	May/June
	The Case for Better Microburst Detection		FSD	November