

**TRANSACTIONS OF SOCIETY OF ACTUARIES
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**REPORT OF THE AVIATION
AND HAZARDOUS SPORTS EXPERIENCE COMMITTEE**

AVIATION STATISTICS

This report covers statistics obtained from United States and Canadian governmental sources, both civilian and military, supplemented by publications of the aviation industry. The emphasis in the report is primarily on the 1985 and 1986 data that have become available. Data from earlier periods (where included) are for comparison and for indication of trends.

UNITED STATES CIVIL AVIATION

United States Civil Aviation can be divided into two types: Commercial Air Carriers and General Aviation. Commercial Air Carriers can be divided into Certificated Route Air Carriers, Air Taxi, Commuter Air Carriers, Supplemental Air Carriers, Commercial Operators, Commercial Operators of Large Aircraft, and Air Travel Clubs. Definitions of what constitutes a particular aviation type or activity are formulated by the Civil Aeronautics Board or the Federal Aviation Administration. This report covers the mortality experience of Certificated Route Air Carriers and General Aviation.

Pilots engaged in air carrier flying may not, under government regulations, fly more than 100 hours per month or more than 1,000 hours per year in domestic operations. Pilots in international operations are generally limited to 120 hours per month or 300 hours every 90 days depending upon the size of the flight crew. Certificated Route Air Carrier pilots, in particular, under a union-negotiated contractual obligation, are allowed to fly a maximum of 700 to 800 hours per year. Some air carriers have no such union obligation and generally require pilots to fly the maximum annual number of regulation hours.

Certificated Route Air Carriers (Passenger/Cargo)

Certificated Route Air Carriers hold certificates of public convenience and necessity issued by the Civil Aeronautics Board authorizing the performance of service over specified routes and a limited amount of nonscheduled service. They are divided into two groups: passenger/cargo and all cargo.

As defined by the Civil Aeronautics Board, "domestic" operations are, in general, within the 50 states of the United States, including intra-Alaska and intra-Hawaii operations. "International" (technically, "international and territorial") operations are, in general, outside the territory of the United

States and include the operations between the United States and foreign countries and the United States and its territories and possessions.

Table 1 shows the recent aviation fatality rates of the United States Certificated Route Air Carriers for scheduled service for passengers, first pilots, all pilots and copilots, and other crew members in domestic and international flying. Lives exposed as "All Pilots and Copilots" and "Other Crew Members" include persons who may do the less-than-normal amounts of flying because of supervisory duties or other reasons. Helicopter airlines that are also Certificated Route Air Carriers are excluded from the experience in Table 1.

TABLE 1
UNITED STATES CERTIFICATED ROUTE AIR CARRIERS
(PASSENGER/CARGO) AVIATION DEATH RATES*

Years	Passenger Rate per 1,000 Scheduled Passenger-Hours†	First-Pilot Rate per 1,000 Scheduled Airplane-Hours†	All Pilot and Copilot Rate per 1,000 Life-Years‡	Other Crew Member Rate per 1,000 Life-Years‡
Domestic Operations				
1977-1981 ..	0.0001 (9)	0.0002 (5)§	Not Available	Not Available
1982-1986 ..	0.0001 (10)	0.0002 (8)		
1985	0.0002 (2)	0.0003 (2)§		
1986	0.0000 (1)§	0.0001 (1)§		
International Operations				
1977-1981 ..	0.0001 (1)	0.0003 (1)§	Not Available	Not Available
1982-1986 ..	0.0000 (2)	0.0002 (1)§		
1985	0.0002 (1)	0.0012 (1)§		
1986	0.0000 (0)§	0.0000 (0)§		
Domestic and International Operations				
1977-1981 ..	0.0001 (10)	0.0002 (6)	0.0842 (7)	0.1391 (5)
1982-1986 ..	0.0001 (12)	0.0002 (9)	0.1178 (9)	0.0794 (9)
1985	0.0002 (3)	0.0004 (3)§	0.1907 (3)	0.2029 (3)
1986	0.0000 (1)	0.0001 (1)§	0.0571 (1)§	0.0136 (1)§

*Number of fatal accidents is shown in parenthesis.

†Based on scheduled operations only; experience of helicopter carriers is excluded.

‡Based on all operations, scheduled and nonscheduled; experience of helicopter carriers is excluded.

§Based on five or fewer fatalities.

In some prior studies, mortality rates of crew members have been given separately for domestic and international operations. A review of the exposure information revealed that the split into domestic and international has not always been accurate. Therefore, the rates for this study are given for combined domestic and international operations.

The exposure figures in Table 1 are taken from the *FAA Statistical Handbook of Aviation* (Tables 6.3, 6.4, 6.7, and 6.8 in the 1986 edition) and the annual report of the Air Transport Association of America. The numbers for accidents and fatalities are taken from Safety Information Bulletins published annually by the National Transportation Safety Board.

Certificated Route Air Carriers (All-Cargo)

Carriers in this class hold temporary certificates of public convenience and necessity issued by the Civil Aeronautics Board authorizing the operation of scheduled air freight express and mail transportation over specified routes as well as nonscheduled flights that may include passengers.

Prior studies showed that there had been no pilot fatalities in scheduled service in the period 1973–1982. There was one fatal accident in each of 1983, 1984, 1985, and 1986. The 1983 and 1986 accidents each had three fatalities—the entire crew of the airplanes. The 1984 accident involved the death of four people: the entire crew and one passenger. The 1985 accident claimed the lives of the crew of two.

Unfortunately, all-cargo exposure is no longer available, so it is not possible to calculate fatality rates.

AIR CARRIERS OF COUNTRIES OTHER THAN THE UNITED STATES

The general conditions in aviation technology unique to any country influence the hazards of flying in that country. Each country has its own aviation regulations and methods of enforcement. These regulations may differ for domestic and international operations, the latter being affected by international agreements relating to the crossing of international boundaries.

World Air Transport Statistics, a publication of the International Air Transport Association (IATA), reports on the operations of association members. IATA member airlines numbered 160 on December 31, 1986. Of the 160 members, 127 reported data to the IATA. The reporting IATA members carried 57 percent of the world's passenger air traffic in 1986 and 1985. United States membership has fluctuated in recent years and stood at 11 passenger/cargo air carrier members in 1986 and 10 in 1985. Of the 1986 members, however, three did not report statistics to IATA.

Table 2 gives passenger fatality rates per 1,000 scheduled passenger hours. The results for the 1977–81 and 1982–86 periods show that the safety record of airlines in countries other than the United States is similar to that in the 1975–1984 period but continues to be less favorable than that of the United States scheduled airlines.

In 1986, 38 percent of the scheduled passenger hours reported to IATA were flown by the United States members. This is an increase from 35 percent in 1984 and 28 percent in 1982. United States IATA members also accounted for 64 percent of the scheduled airlines passenger hours flown by all United States Certificated Route Air Carriers in 1986. This is about the same as 66 percent in 1984 and an increase from 49 percent in 1982. The combined international and domestic schedules experience of all United States Certificated Route Air Carriers (passenger/cargo) is included in Table 2 for comparison. The information required for Table 2 was taken from *World Air Transport Statistics* and Table 1.

TABLE 2
 SCHEDULED AIR CARRIERS (PASSENGERS/CARGO)
 OF UNITED STATES AND OTHER COUNTRIES
 PASSENGER DEATH RATES PER 1,000 SCHEDULED PASSENGER-HOURS*

Years	Members Reporting to IATA		All United States Air Carriers	
	Countries Other Than the United States	United States		
1977-1981	0.0005 (1,674)	0.0002 (329)	0.0001 (402)	
1982-1986	0.0004 (1,676)	0.0001 (152)	0.0001 (393)	
1985	0.0008 (724)	0.0000 (21)	0.0002 (174)	
1986	0.0002 (227)	0.0000 (0)	0.0000 (0)	

*Number of fatalities is shown in parentheses.

UNITED STATES GENERAL AVIATION

General Aviation is divided into 11 use categories: Aerial Application, Aerial Observation, Commuter Air Carrier, Demand Air Taxi, Business Transportation, Executive Corporate Transportation, Instructional Flying, Personal Flying, Rental Aircraft, Other Work Use, and Other. The flying time in General Aviation during 1986 was 3.76 times that of the Certificated Route Air Carriers (passenger/cargo) domestic flights. This is a decline from the figures of 6.14 in 1982 and 5.24 in 1984. The decrease in this ratio reflects the increase in hours flown by Certificated Route Air Carriers and a decrease in hours reported for General Aviation.

Prior to 1977, the FAA collected statistics on General Aviation by sending a registration to all General Aviation aircraft owners each January requesting such information as the number of hours flown and the primary use of each aircraft. Beginning in 1977, a sample of approximately 14 percent of all

registered General Aviation aircraft was selected as a basis for determining how many hours were flown by all aircraft according to primary use.

Death rates for General Aviation in Table 3 are expressed per 1,000 aircraft hours. Some distortion in death rates by type of flying may occur because the methods used for assigning deaths are not entirely consistent with those used for assigning aircraft hours. Although it might be helpful to relate deaths to average hours flown in a year by pilots in each category of General Aviation, such data cannot be estimated reliably from information supplied by the National Transportation Safety Board and the FAA. Only fixed-wing aircraft are included.

TABLE 3
GENERAL AVIATION FLYING BY KIND
PILOT AVIATION DEATH RATES PER 1,000 AIRCRAFT HOURS*

Years	Pleasure	Instruction	Business	Corporate	Aerial Application	Air Taxi
1977-1981 ..	0.029 (1,828)	0.007 (206)	0.007 (293)	0.004 (97)	0.010 (109)	0.011 (220)
1982-1986 ..	0.033 (1,760)	0.005 (115)	0.009 (293)	0.001 (28)	0.008 (75)	0.010 (125)
1985	0.029 (310)	0.005 (20)	0.008 (52)	0.003 (10)	0.005 (9)	0.012 (24)
1986	0.030 (289)	0.004 (18)	0.010 (56)	0.001 (3)	0.010 (17)	0.011 (24)

*Number of fatalities is shown in parentheses.

The six categories of Pleasure, Instruction, Business, Corporate, Aerial Application, and Air Taxi made up 91 percent of the total General Aviation flying hours during the period 1982-86.

In the five-year period 1982-86, Pleasure flying accounted for about 31 percent of pilots' flying time in General Aviation. Death rates in this category are probably overstated because there is a tendency for pilots to understate the amount of time they spend Pleasure flying and overreport the amount of time they spend on other flying. In Table 3, Rental hours are included in Pleasure hours on the assumption that most pilots renting planes do so for pleasure purposes.

Instruction flying in the 1982-86 period represents about 13 percent of the total hours in General Aviation. The experience under flight training of civilians included the death of either the instructor or the student, depending on who was acting as pilot when the accident occurred. Practice flying not under the supervision of an instructor, either in the air or on the ground, is not included in the Instruction category.

The combined Business and Corporate categories account for approximately 33 percent of the total General Aviation hours in the 1982–86 period. Business flying is done by nonprofessional pilots flying for business reasons. Corporate flying is done by professional pilots receiving a direct salary or compensation for piloting an aircraft (not for public hire) operated by a corporation or business firm for the transportation of personnel and/or cargo and furtherance of the company's business.

Air Taxi flying accounted for approximately 8 percent of the total General Aviation hours in 1982–86. This type of flying included scheduled and nonscheduled passenger and cargo flying by professional pilots other than Corporate that is not done by Certificated Route Air Carriers, Charter Air Carriers, or Commercial Operators. Table 3 includes both scheduled and nonscheduled Air Taxi flying.

Aerial Application, which accounted for approximately 6 percent of General Aviation flying during 1982–86, includes firefighting operations and the distribution of chemicals or seeds in agricultural, reforestation, and insect control. Pilot fatality rates in this category have traditionally been higher than those in other commercial activities, but in the years after 1975 have shown improvement. For example, the pilot death rate for the years 1971–74 was 0.018.

The exposure data in Table 3 were taken from the *FAA Statistical Handbook of Aviation* (Table 8.3 in the 1986 edition). The number of fatalities was supplied by the National Transportation Safety Board in response to a special request.

CANADIAN CIVIL FLYING

Canadian airlines aviation fatality rates are not available for the publication of this report. Statistics Canada has discontinued the publication that was used in the past to complete this table, and the committee has not been able to locate an appropriate source of data for passenger-hours and airplane-hours.

The fatality rates among Canadian civil pilots, by class of license, are shown in Table 4 for 1975–79, 1980–84, 1985, and 1986, based on figures furnished by Transport Canada. Note that many pilots holding licenses may be inactive and that pilots holding airline transport licenses are not necessarily flying for scheduled airlines, because they may engage in other types of flying.

TABLE 4
CANADIAN CIVIL PILOTS BY CLASS OF LICENSES
1975-1986 AVIATION FATALITY RATES

Class of License	Period	Life-Years of Exposure	Aviation Fatalities	Rate per 1000 Life-Years of Exposure
Glider	1975-79	13,117	6	0.46
	1980-84	21,020	0	0.00
	1985	4,621	1	0.22
	1986	4,727	0	0.00
Private (excluding students) ...	1975-79	176,237	182	1.03
	1980-84	201,612	136	0.67
	1985	37,790	14	0.37
	1986	35,845	24	0.67
Commercial	1975-79	37,122	124	3.34
	1980-84	41,563	73	1.76
	1985	7,967	7	0.88
	1986	7,053	11	1.56
Senior Commercial	1975-79	4,779	17	3.56
	1980-84	6,443	10	1.55
	1985	1,212	1	0.83
	1986	1,164	0	0.00
Airline Transport	1975-79	20,621	39	1.89
	1980-84	29,897	32	1.07
	1985	6,472	0	0.00
	1986	6,649	4	0.60

Source: Superintendent, Statistics Analysis, Canadian Aviation, Safety Board, Ottawa, Ontario K1G 3T8.

UNITED STATES MILITARY

The data for this portion of the study are not available at this time. Because of cutbacks and other changes, source data have not been located that can be utilized. In the next report, data will be brought up-to-date where feasible.

CANADIAN MILITARY

Aviation fatality rates among Canadian regular military forces, excluding reserves, are shown in Table 5 by age, rank, and functional classification.

TABLE 5
CANADIAN REGULAR FORCES
1985-1986 AVIATION FATALITY RATES PER 1,000 LIFE-YEARS OF EXPOSURE*

	1985		1986	
	Pilots	Crew	Pilots	Crew
Age Group				
Under 25	0.0 (0)	0.7 (1)	0.0 (0)	0.0 (0)
25-29	0.4 (2)	0.5 (2)	0.2 (1)	0.0 (0)
30-34	0.9 (3)	0.0 (0)	0.0 (0)	0.0 (0)
35-39	0.8 (2)	0.3 (1)	0.5 (1)	0.3 (1)
40 and over	0.3 (1)	0.3 (1)	0.3 (1)	0.0 (0)
All	0.4 (8)	0.3 (5)	0.2 (3)	0.1 (1)
Rank				
Lieutenant and lower rank	0.3 (1)	0.4 (4)	0.0 (0)	0.1 (1)
Captain	0.5 (5)	0.3 (1)	0.3 (3)	0.0 (0)
Major	0.6 (2)	0.0 (0)	0.0 (0)	0.0 (0)
Lieutenant and higher rank	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
All	0.4 (8)	0.3 (5)	0.2 (3)	0.1 (1)
Functional Classification†				
Fighter	0.0 (0)	0.0 (0)	0.3 (1)	0.0 (0)
Training	0.1 (1)	0.0 (0)	0.0 (0)	0.0 (0)
Transport	1.3 (6)	0.5 (4)	0.5 (2)	0.1 (1)
Maritime	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
Helicopter	0.2 (1)	0.2 (1)	0.0 (0)	0.0 (0)
Others	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
All	0.3 (8)	0.3 (5)	0.1 (34)	0.1 (1)

*The number of fatalities is shown in parentheses.

†The fatality rates by functional classification are understated because some pilots and crew members fly more than one type of aircraft. The extent of understatements in total can be determined by comparing the fatality rates of the "All" categories.

Note: The 1974-78 and 1980-84 data are available in prior reports. Care should be taken in comparing data and in developing trends.

Source: Director, Personnel Information Services, National Defense, National Defense Headquarters, Ottawa, Canada K1A 0K2.

The average number of flying hours for all pilots combined has remained steady over the five-year period at approximately 280 hours per year and shows little variation by age group. Crew members average about 337 hours per year. There is some variation by functional classification, but this cannot be determined accurately because of duplicate counting in different functions. Pilots and crew members flying more than one type of aircraft are counted in each function in which flying is done.

The extent of overstatement by type of aircraft is unknown. The adjusted average annual flying time for pilots and crew in the transport and maritime categories is considerably higher than for that in the categories of fighter,

training, and helicopter over five years. The former group averages 335 hours per year and the latter approximately 159 hours per year.

INTERCOMPANY EXPERIENCE

No intercompany experience was collected for the period 1985–86 because of the lack of company participation in providing meaningful data. However, efforts are being made to rejuvenate this portion of the report by collecting the exposure and deaths through the annual contributions to the Individual Life Insurance Experience Studies. As those data are collected, they will be reported.

HAZARDOUS SPORTS

As indicated in the previous report, the intercompany experience on hazardous sports has been discontinued because of a lack of exposure data. Here again, this portion of the report is being rejuvenated through the collection of data through the annual contributions to the Individual Life Insurance Experience Studies.

Also, efforts are being made to locate and obtain, from governmental and association sources, data that could be used to report the mortality for various hazardous sports.

Although some organizations do have accurate data on deaths, the reported exposures may be suspect.

