

U.S. Air Carrier Accident Rate Lowered Significantly in 1989; Recently Released Report Compares Data to 1980-1988 Period

The data for calendar year 1989, which was published by the U.S. National Transportation Safety Board, is the NTSB's most recent annual review of data for aviation accidents involving revenue operations of U.S. air carriers. The data show a 17 percent reduction in the accident rate when compared to the previous nine years.

[Editor's Note: This article is adapted from the U.S. National Transportation Safety Board's (NTSB) Annual Review of Aircraft Accident Data, U.S. Air Carrier Operations, Calendar Year 1989, published May 1993. The report provides pilots and operators with essential information — causal factors behind accidents — and may aid in the prevention of future accidents.]

This report presents a statistical compilation and review of air carrier accidents that occurred in 1989 and involved U.S.-registered aircraft conducting operations under U.S. Title 14 of the Code of Federal Regulations (CFR) Parts 121, 125, 127 and 135. Briefly stated, Part 121 applies to air carriers, such as major airlines and cargo haulers, which fly large transport aircraft. Part 125 covers the operation of large, privately owned aircraft not held out for hire. Part 127 regulates the operation of helicopters used as scheduled air carriers. Part 135 applies to commercial air carriers commonly referred to as commuter airlines and air taxis. For a complete definition of

operations under each of these Parts, consult the applicable sections of the CFR.

The report is divided into three major sections: Part 121, 125 and 127 operations; scheduled Part 135 operations; and nonscheduled Part 135 operations. Each section begins with an overview of accidents and their consequences for 1989 and for the four preceding years. Several tables then present accident parameters for 1989 only. Each section concludes with tabulations that present comparative statistics for 1989 and for the five-year period 1984-1988.

Exposure data (flight hours, miles and departures) used to compute accident rates for operations under Parts 121, 125 and 127 and for scheduled operations under Part 135 were obtained from the Research and Special Programs Administration (RSPA) of the U.S. Department of Transportation (DOT). Flight hours for nonscheduled operations under Part 135 were estimated from data obtained by the U.S. Federal Aviation Administration (FAA) in its surveys

of general aviation activity. The U.S. National Transportation Safety Board (NTSB) Form 6120.4 (Appendix F) provides the factual data represented in this report.

In many of the tables presented in this report (such as Table 4, page 6), the number of accidents in a given category is small; in these tables, even a small change in the number of accidents would result in a significant change in the accident rate. Therefore, the reader should exercise caution in the use of these rates and in comparing numbers and percentages of accidents between two time periods when the number of accidents is small. The reader should avoid placing undue significance on a change that may be caused primarily by chance.

14 CFR 121, 125 and 127 OPERATIONS

In 1989, there were 28 accidents involving Part 121, 125 and 127 operations. The overall accident rate for 1989 was 0.248 per 100,000 hours flown, a slight decrease from the 1988 rate of 0.251. The 1989 rate was also 17.6 percent lower than the overall rate of 0.280 for the period from 1980-1988.

There were 11 fatal accidents in this category during 1989, involving 276 fatalities. This is the highest number of fatal accidents in the 10-year period reported in Table 14. The most serious of these accidents involved a Boeing 707 in Santa Maria, Portugal (144 fatalities), and a McDonnell Douglas DC-10 in Sioux City, Iowa (111 fatalities).

Table 1
Summary of Losses
14 CFR 121, 125 and 127 Operations
1985-1989

	1985	1986	1987	1988	1989
Accidents					
Fatal	7	3	5	3	11
Involved serious injury	8	15	12	16	5
Involved minor or no injury	<u>7</u>	<u>6</u>	<u>19</u>	<u>10</u>	<u>12</u>
Total	22	24	36	29	28
Fatalities					
Passenger	486	4	213	255	259
Crew	39	3	17	19	17
Other persons	<u>1</u>	<u>1</u>	<u>2</u>	<u>11</u>	<u>2</u>
Total	526	8	232	285	278
Aircraft Damage (14 CFR 121, 125 and 127)					
Destroyed	9	2	5	3	7
Substantial	8	8	18	12	11
Minor	0	4	4	0	0
None	<u>5</u>	<u>10</u>	<u>12</u>	<u>14</u>	<u>10</u>
Total	22	24	39	29	28

Source: U.S. National Transportation Safety Board

Table 2
Accident Rates
14 CFR 121, 125 and 127 Operations
1985-1989

	1985	1986	1987	1988	1989
Aircraft miles flown (thousands)	3,631,017	4,017,626	4,360,521	4,503,426	4,605,083
Aircraft hours flown	8,709,894	9,976,104	10,644,856	11,139,519	11,273,908
Departures flown	6,306,759	7,202,027	7,601,373	7,716,061	7,645,494
Accident Rates *					
Per million miles flown	0.0061	0.0057	0.0080	0.0062	0.0061
Per hundred thousand hours flown	0.253	0.231	0.329	0.251	0.248
Per hundred thousand departures flown	0.349	0.319	0.460	0.363	0.366
Fatal Accident Rates *					
Per million miles flown	0.0019	0.0005	0.0009	0.0004	0.0024
Per hundred thousand hours flown	0.080	0.020	0.038	0.018	0.098
Per hundred thousand departures flown	0.111	0.028	0.053	0.026	0.144

* The 12/21/88 sabotage involving a Pan American World Airways' (Pan Am) Boeing 747-100, the 12/7/87 suicide/sabotage involving a Pacific Southeast Airlines (PSA) BAe-146e and the 4/2/86 sabotage of a Trans World Airlines (TWA) B727-200 are excluded from accident rate computations.

Source: U.S. National Transportation Safety Board

Table 3
List of Accidents
14 CFR 121, 125 and 127 Operations
1989

Date M/D	Location	Type of Operation	Air Carrier	Aircraft Type	Aircraft Damage	Degree of Injury	First Occurrence
1/20	Buena Vista, CO	Sch Passenger	Aspen Airways	Convair 580	Substantial	Minor	Loss of power (total) — nonmechanical
1/20	Chicago, IL	Sch Passenger	Piedmont	Boeing 737-201	Substantial	None	Airframe/component/system failure/malfunction
2/08	Santa Maria, Portugal	Nonsch Passeng	Independent	Boeing 707	Destroyed	Fatal (144)	Not reported
2/09	Salt Lake City, UT	Sch Cargo	Evergreen	McDonnell-Douglas DC-9-32F	None	Fatal (1)	Miscellaneous/other
2/19	Puchong, Malaysia	Sch Cargo	Flying Tigers	Boeing 747-200	Destroyed	Fatal (4)	In-flight collision with terrain
2/24	Honolulu, HI	Sch Passenger	United	Boeing 747-122	Substantial	Fatal (9)	Airframe/component/system failure/malfunction
3/15	West Lafayette, IN	Nonsch Cargo	Mid Pacific	Nihon YS-IIA-600	Destroyed	Fatal (2)	Loss of control — in flight
3/17	Oakland, CA	Sch Passenger	Continental	Boeing 737-300	Substantial	None	Fire
3/18	Saginaw, TX	Sch Cargo	Evergreen	McDonnell-Douglas DC-9-33F	Destroyed	Fatal (2)	Airframe/component/system failure/malfunction
4/03	Los Angeles, CA	Sch Passenger	Piedmont	Boeing 767-201	None	Serious	Miscellaneous/other
5/10	San Diego, CA	Sch Passenger	Continental	Airbus A300-B4-203	None	Serious	In-flight encounter with weather
5/28	Denver, CO	Sch Passenger	Continental	McDonnell-Douglas MD-80	Substantial	Minor	Main gear collapsed
6/16	Jacks Creek, TN	Sch Passenger	Delta	Lockheed L-1011-38	None	Serious	In-flight encounter with weather
6/26	Atlanta, GA	Sch Passenger	Continental	Boeing 737-291	None	Serious	Propeller blast or jet exhaust/suction
Sch — Scheduled Nonsch — Nonscheduled							

Table 3 (Continued)
List of Accidents
14 CFR 121, 125 and 127 Operations
1989

Date M/D	Location	Type of Operation	Air Carrier	Aircraft Type	Aircraft Damage	Degree of Injury	First Occurrence
7/12	San Juan, PR	Sch Passenger	American	Airbus A300	None	Fatal (1)	On-ground collision with object
7/13	Vandalia, OH	Nonsch Cargo	Rosenbalm	McDonnell-Douglas DC-8-63F	Substantial	None	Airframe/component/system failure/malfunction
7/19	Sioux City, IA	Sch Passenger	United	McDonnell-Douglas DC-10-10	Destroyed	Fatal (111)	Airframe/component/system failure/malfunction
8/03	Atlanta, GA	Sch Cargo	Zantop	Convair 640	Substantial	None	Hard landing
8/19	Vero Beach, FL	Sch Passenger	USAir	Fokker F-28-4000	None	Serious	In-flight encounter with weather
9/12	Chicago, IL	Sch Passenger	American	McDonnell-Douglas MD-80	Substantial	Minor	Airframe/component/system failure/malfunction
9/20	Flushing, NY	Sch Passenger	USAir	Boeing 737-400	Destroyed	Fatal (2)	Loss of control — on ground
9/30	Bemidji, MN	Sch Passenger	Mesaba	Fokker F-27	Substantial	None	In-flight encounter with weather
10/07	Orlando, FL	Nonsch Passeng	USAir	McDonnell-Douglas DC-9-31	None	Fatal (1)	On-ground encounter with weather
10/14	Salt Lake City, UT	Sch Passenger	Delta	Boeing 727-232	Destroyed	Minor	Fire/explosion
11/06	Phoenix, AZ	Sch Passenger	America West	Boeing 757-200	None	None	Miscellaneous/other
12/21	Santa Ana, CA	Sch Passenger	American	Boeing 757-223	Substantial	None	In-flight collision with terrain
12/27	Miami, FL	Sch Passenger	Eastern	Boeing 727-225B	None	Fatal (1)	Miscellaneous/other
12/30	Tucson, AZ	Sch Passenger	America West	Boeing 737-204	Substantial	Minor	Fire

Sch — Scheduled
Nonsch — Nonscheduled

Source: U.S. National Transportation Safety Board

Table 4
Accidents and Rates by Type of Operation
14 CFR 121, 125 and 127 Operations
1989

	Type of Operation				
	Scheduled			All Non-Scheduled	All
	Passenger/ Cargo	All Cargo	All		
Accidents	20	4	24	4	28
Fatal accidents	5	3	8	3	11
Aircraft miles flown (thousands)	4,172,399	165,632	4,338,031	267,052	4,605,083
Aircraft hours flown	10,126,360	471,562	10,597,922	675,986	11,273,908
Departures flown	6,935,450	333,644	7,269,094	376,400	7,645,494
Accident Rates					
Per million miles flown	0.0048	0.0241	0.0055	0.0150	0.0061
Per hundred thousand hours flown	0.196	0.848	0.226	0.592	0.248
Per hundred thousand departures flown	0.288	1.199	0.330	1.063	0.366
Fatal Accident Rates					
Per million miles flown	0.0012	0.0181	0.0018	0.0112	0.0024
Per hundred thousand hours flown	0.049	0.636	0.075	0.444	0.098
Per hundred thousand departures flown	0.072	0.899	0.010	0.797	0.144

Source: U.S. National Transportation Safety Board

Table 5
Persons by Role and Degree of Injury
14 CFR 121, 125 and 127 Operations
1989

Role of Person	Degree of Injury				Total
	Fatal	Serious	Minor	None	
Pilot	5	0	2	21	28
Copilot	4	1	2	21	28
Check pilot	0	0	1	0	1
Flight engineer	2	0	3	4	9
Cabin attendants	5	10	18	77	110
Other crew	1	0	0	0	1
Passenger	<u>259</u>	<u>55</u>	<u>200</u>	<u>1,988</u>	<u>2,502</u>
Total aboard	276	66	226	2,111	2,679
Other ground	<u>2</u>	<u>2</u>	<u>3</u>	<u>0</u>	<u>7</u>
Grand total	278	68	229	2,111	2,686
Percent	10.3	2.5	8.5	78.6	

Source: U.S. National Transportation Safety Board

Table 6
Aircraft by Damage and Degree of Injury
14 CFR 121, 125 and 127 Operations
1989

Aircraft Damage	Degree of Injury				Aircraft	
	None	Minor	Serious	Fatal	No.	Percent
None	1	0	5	4	10	35.7
Substantial	6	4	0	1	11	39.3
Destroyed	0	1	0	6	7	25.0
Aircraft						
Total	7	5	5	11	28	
Percent	25.0	17.9	17.9	39.3		

Source: U.S. National Transportation Safety Board

Table 7
Aircraft by First Occurrence and Degree of Injury and by Damage
14 CFR 121, 125 and 127 Operations
1989

Type of First Occurrence	Degree of Injury				Aircraft Damage				Aircraft	
	None	Minor	Serious	Fatal	None	Minor	Substantial	Destroyed	No.	Percent
Airframe/component/system failure/malfunction	2	1	0	3	0	0	4	2	6	21.4
Fire/explosion	0	1	0	0	0	0	0	1	1	3.6
Fire	1	1	0	0	0	0	2	0	2	7.1
Main gear collapsed	0	1	0	0	0	0	1	0	1	3.6
Hard landing	1	0	0	0	0	0	1	0	1	3.6
In-flight collision with terrain	1	0	0	1	0	0	1	1	2	7.1
In-flight encounter with weather	1	0	3	0	3	0	1	0	4	14.3
Loss of control — in flight	0	0	0	1	0	0	0	1	1	3.6
Loss of control — on ground	0	0	0	1	0	0	0	1	1	3.6
On-ground collision with object	0	0	0	1	1	0	0	0	1	3.6
On-ground encounter with weather	0	0	0	1	1	0	0	0	1	3.6
Loss of power (total) — nonmechanical	0	1	0	0	0	0	1	0	1	3.6
Propeller blast or jet exhaust/suction	0	0	1	0	1	0	0	0	1	3.6
Miscellaneous/other	1	0	1	2	4	0	0	0	4	14.3
Not reported	0	0	0	1	0	0	0	1	1	3.6
Aircraft										
Number	7	5	5	11	10	0	11	7	28	
Percent	25.0	17.9	17.9	39.3	35.7	0	39.3	25.0		

Source: U.S. National Transportation Safety Board

Table 8
Aircraft by First Occurrence and Broad Phase of Operation
14 CFR 121, 125 and 127 Operations
1989

Type of First Occurrence	Phase of Operation									Aircraft	
	Standing	Taxi	Takeoff	Climb	Cruise	Descent	Approach	Landing	Not reported	No.	Percent
Airframe/component/system failure/malfunction	1	1	1	1	1	1	0	0	0	6	21.4
Fire/explosion	1	0	0	0	0	0	0	0	0	1	3.6
Fire	1	0	0	0	0	1	0	0	0	2	7.1
Main gear collapsed	0	0	0	0	0	0	0	1	0	1	3.6
Hard landing	0	0	0	0	0	0	0	1	0	1	3.6
In-flight collision with terrain	0	0	0	0	0	0	1	1	0	2	7.1
In-flight encounter with weather	0	0	0	0	1	2	0	1	0	4	14.3
Loss of control — in flight	0	0	0	0	0	0	1	0	0	1	3.6
Loss of control — on ground	0	0	1	0	0	0	0	0	0	1	3.6
On-ground collision with object	0	1	0	0	0	0	0	0	0	1	3.6
On-ground encounter with weather	0	1	0	0	0	0	0	0	0	1	3.6
Loss of power (total) — nonmechanical	0	0	0	0	1	0	0	0	0	1	3.6
Propeller blast or jet exhaust/suction	1	0	0	0	0	0	0	0	0	1	3.6
Miscellaneous/other	1	1	0	1	1	0	0	0	0	4	14.3
Not reported	0	0	0	0	0	0	0	0	1	1	3.6
Aircraft											
Number	5	4	2	2	4	4	2	4	1	28	
Percent	17.9	14.3	7.1	7.1	14.3	14.3	7.1	14.3	3.6		

Source: U.S. National Transportation Safety Board

Table 9
Aircraft by Phase of Operation and Degree of Injury and by Damage
14 CFR 121, 125 and 127 Operations
1989

Type of First Occurrence	Degree of Injury				Aircraft Damage				Aircraft	
	None	Minor	Serious	Fatal	None	Minor	Substantial	Destroyed	No.	Percent
Airframe/component/system	2	1	0	3	0	0	4	2	6	21.4
Standing	0	1	0	0	0	0	0	1	1	3.6
Standing — preflight	0	0	0	1	0	0	0	1	1	3.6
Standing — starting engine(s)	1	0	0	0	0	0	1	0	1	3.6
Standing — engine(s) operating	0	0	1	0	1	0	0	0	1	3.6
Standing — engine(s) not operating	0	0	1	0	1	0	0	0	1	3.6
Taxi — pushback/tow	1	0	0	2	3	0	0	0	3	10.7
Taxi — from landing	1	0	0	0	0	0	1	0	1	3.6
Takeoff — ground run	0	0	0	1	0	0	0	1	1	3.6
Takeoff — initial climb	1	0	0	0	0	0	1	0	1	3.6
Climb	0	0	0	1	1	0	0	0	1	3.6
Climb — to cruise	0	0	0	1	0	0	1	0	1	3.6
Cruise — normal	0	1	1	2	2	0	1	1	4	14.3
Descent — normal	0	2	2	0	2	0	2	0	4	14.3
Approach	0	0	0	1	0	0	0	1	1	3.6
Approach — visual flight rules pattern — final approach	0	0	0	1	0	0	0	1	1	3.6
Landing — flare/touchdown	3	0	0	0	0	0	3	0	3	10.7
Landing — roll	0	1	0	0	0	0	1	0	1	3.6
Not reported	0	0	0	1	0	0	0	1	1	3.6
Aircraft										
Number	7	5	5	11	10	0	11	7	28	
Percent	25.0	17.9	17.9	39.3	35.7	0	39.3	25.0		

Source: U.S. National Transportation Safety Board

Table 10
Aircraft by Condition of Light and Type of Weather
14 CFR 121, 125 and 127 Operations
1989

Condition of Light	Type of Weather			Aircraft	
	Visual Meteorological Conditions (VMC)	Instrument Meteorological Conditions (IMC)	Not reported	No.	Percent
Dawn	1	0	0	1	3.6
Daylight	13	0	1	14	50.0
Night (dark)	9	1	0	10	35.7
Dusk	1	0	1	2	7.1
Not reported	0	1	0	1	3.6
Aircraft					
Number	24	2	2	28	
Percent	85.7	7.1	7.1		

Source: U.S. National Transportation Safety Board

Table 11
Aircraft by Type of Operation and Degree of Injury
14 CFR 121, 125 and 127 Operations
1989

Type of Operation	Degree of Injury				Aircraft	
	None	Minor	Serious	Fatal	No.	Percent
Scheduled domestic passenger	5	4	5	2	16	57.1
Scheduled domestic cargo	1	0	0	2	3	10.7
Scheduled international pass.	0	1	0	3	4	14.3
Scheduled international cargo	0	0	0	1	1	3.6
Nonscheduled domestic pass.	0	0	0	1	1	3.6
Nonscheduled domestic cargo	1	0	0	1	2	7.1
Nonscheduled international pass.	0	0	0	1	1	3.6
Aircraft						
Number	7	5	5	11	28	
Percent	25.0	17.9	17.9	39.3		

Source: U.S. National Transportation Safety Board

Table 12
Aircraft by Occurrence of Fire, Degree of Injury and by Damage
14 CFR 121, 125 and 127 Operations
1989

Type of First Occurrence	Degree of Injury				Aircraft Damage				Aircraft	
	None	Minor	Serious	Fatal	None	Minor	Substantial	Destroyed	No.	Percent
Airframe/component/system	2	1	0	3	0	0	4	2	6	21.4
None	6	3	5	5	10	0	8	1	19	67.9
In flight	0	0	0	1	0	0	1	0	1	3.6
On ground	1	1	0	4	0	0	1	5	6	21.4
In flight and on ground	0	1	0	0	0	0	1	0	1	3.6
Other	0	0	0	1	0	0	0	1	1	3.6
Aircraft										
Number	7	5	5	11	10	0	11	7	28	
Percent	25.0	17.9	17.9	39.3	35.7	0	39.3	25.0		

Source: U.S. National Transportation Safety Board

Table 13
Broad Cause/Factor Assignments*
14 CFR 121, 125 and 127 Operations
1989

Cause/Factor dents	Cited as a Cause		Cited as a Factor		Cited as Either a Cause or a Factor (or Both)	
	Fatal Accidents	All Accidents	Fatal Accidents	All Accidents	Fatal Accidents	All Acci-
Aircraft #	3	7	2	2	5	8
Propulsion system and controls	1	2	0	1	1	3
Flight control system	1	0	0	0	1	0
Airframe	1	0	2	0	3	0
Landing gear	0	3	0	0	0	3
Systems/equipment/ instruments	1	4	1	1	2	4
Environment #	1	3	1	4	2	6
Weather	0	3	1	2	1	4
Object (trees, wires, etc.)	1	0	0	1	1	1
Terrain/runway condition	0	0	1	1	1	1
Personnel #	6	13	5	5	8	14
Pilot	3	6	2	1	3	6
Others (aboard)	0	2	0	0	0	2
Others (not aboard)	3	6	4	4	6	7
Number of aircraft					11	28
NTSB-determined probable cause					9	26

* Multiple causes and factors may be assigned in an accident.

This category is composed of the subcategories indented below it. The number of aircraft cited in a category may be less than or equal to the sum of the subcategory citations.

Source: U.S. National Transportation Safety Board

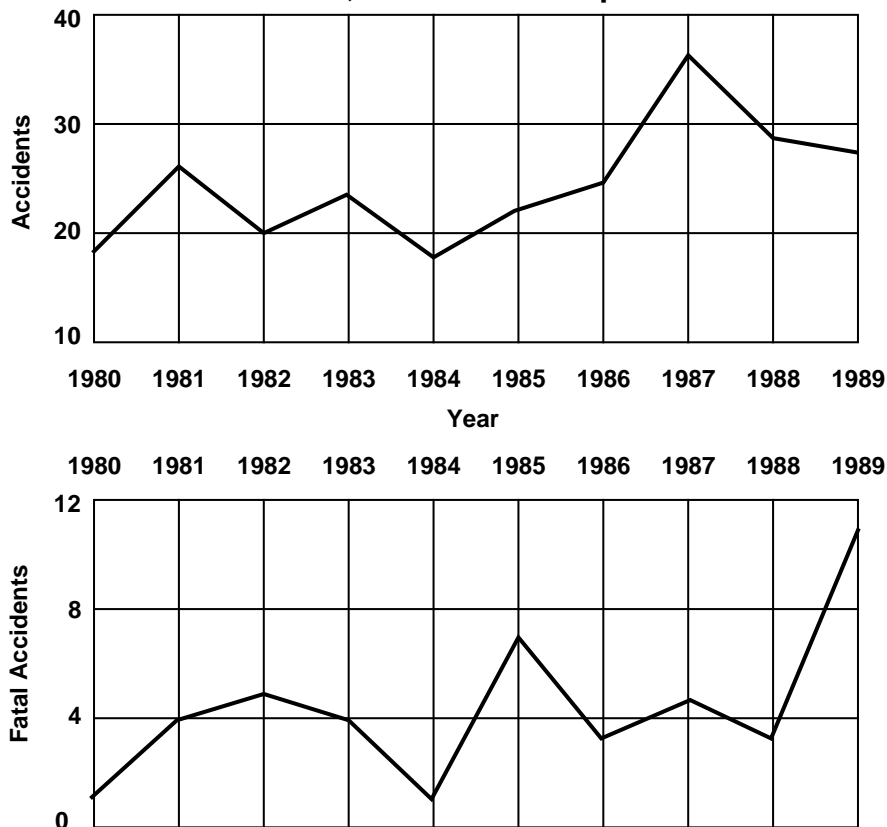
Table 14
Accidents, Fatal Accidents, Fatalities and Rates
All 14 CFR 121, 125 and 127 Operations
1980 - 1989

Year	Accidents	Fatal Accidents	Fatalities		Hours Flown	Accident Rate per 100,000* Aircraft Hours Flown	
			Total	Aboard Aircraft In this Category		Total	Fatal
1981	26	4	4	2	7,125,698	0.365	0.056
1982	20	5	235	223	7,040,325	0.270	0.057
1983	24	4	15	14	7,298,799	0.329	0.055
1984	17	1	4	4	8,165,124	0.208	0.012
1985	22	7	526	525	8,709,894	0.253	0.080
1986	24	3	8	7	9,976,104	0.231	0.020
1987	36	5	232	230	10,644,856	0.329	0.038
1988	29	3	285	274	11,139,519	0.251	0.018
1989	28	11	278	276	11,273,908	0.248	0.098

* Suicide and sabotage accidents excluded from rates as follows :
 Total — 1982 (1), 1986 (1), 1987 (1), 1988 (1)
 Fatal — 1982 (1), 1986 (1), 1987 (1), 1988 (1)

Source: U.S. National Transportation Safety Board

Accidents and Fatal Accidents
All 14 CFR 121, 125 and 127 Operations



Source: U.S. National Transportation Safety Board

Figure 1

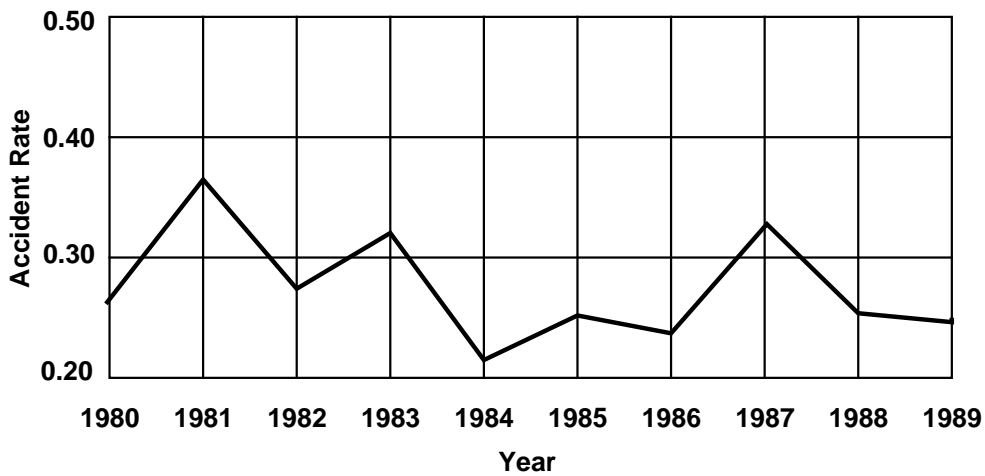
**Number of Fatalities
All 14 CFR 121, 125 and 127 Operations**



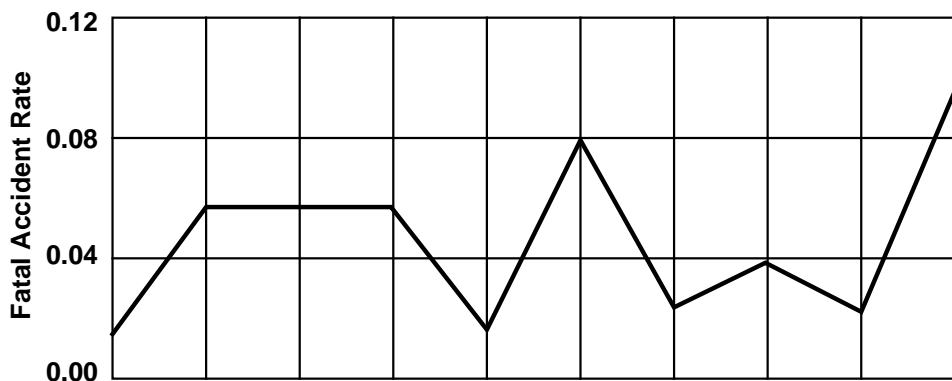
Source: U.S. National Transportation Safety Board

Figure 2

**Accidents per 100,000 Hours Flown
All 14 CFR 121, 125 and 127 Operations**



Source: U.S. National Transportation Safety Board



Source: U.S. National Transportation Safety Board

Figure 3

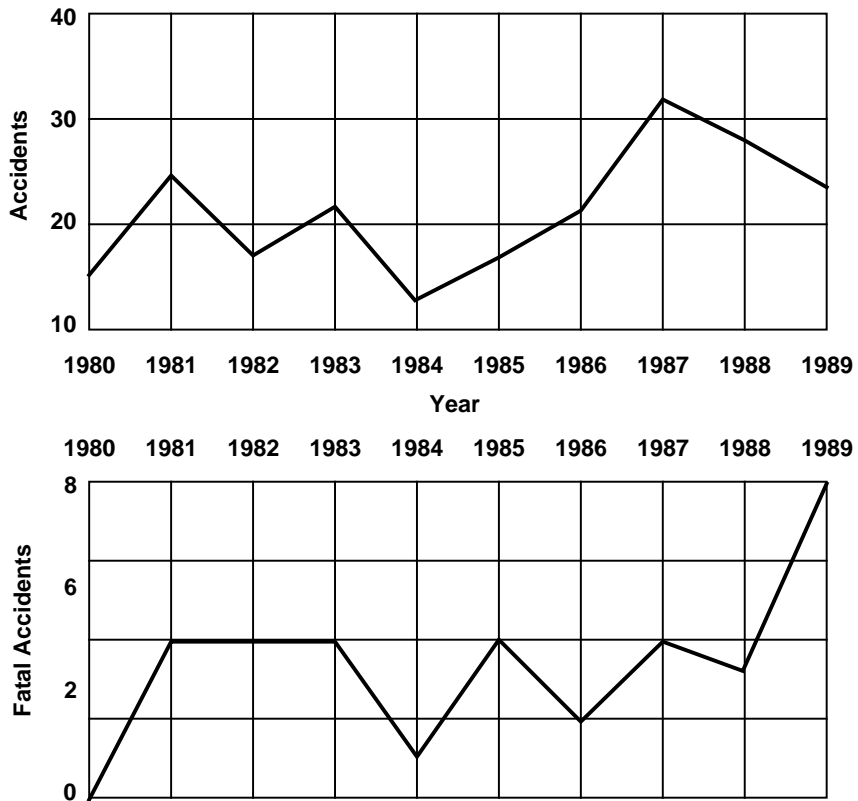
Table 15
Accidents, Fatal Accidents, Fatalities and Rates
Scheduled 14 CFR 121, 125 and 127 Operations
1980-1989

Year	Accidents	Fatal Accidents	Fatalities		Hours Flown	Accident Rate per 100,000* Aircraft Hours Flown	
			Total	Aboard Aircraft In this Category		Total	Fatal
1980	15	0	0	0	7,069,481	0.212	0.000
1981	25	4	4	2	6,834,140	0.366	0.059
1982	16	4	234	222	6,697,770	0.224	0.045
1983	22	4	15	14	6,914,969	0.318	0.058
1984	13	1	4	4	7,736,037	0.168	0.013
1985	17	4	197	196	8,265,332	0.206	0.048
1986	21	2	5	4	9,495,158	0.211	0.011
1987	32	4	231	229	10,115,653	0.306	0.030
1988	28	3	285	274	10,521,052	0.257	0.019
1989	24	8	131	130	10,597,922	0.226	0.075

* Suicide and sabotage accidents excluded from rates as follows :
 Total — 1982 (1), 1986 (1), 1987 (1), 1988 (1)
 Fatal — 1982 (1), 1986 (1), 1987 (1), 1988 (1)

Source: U.S. National Transportation Safety Board

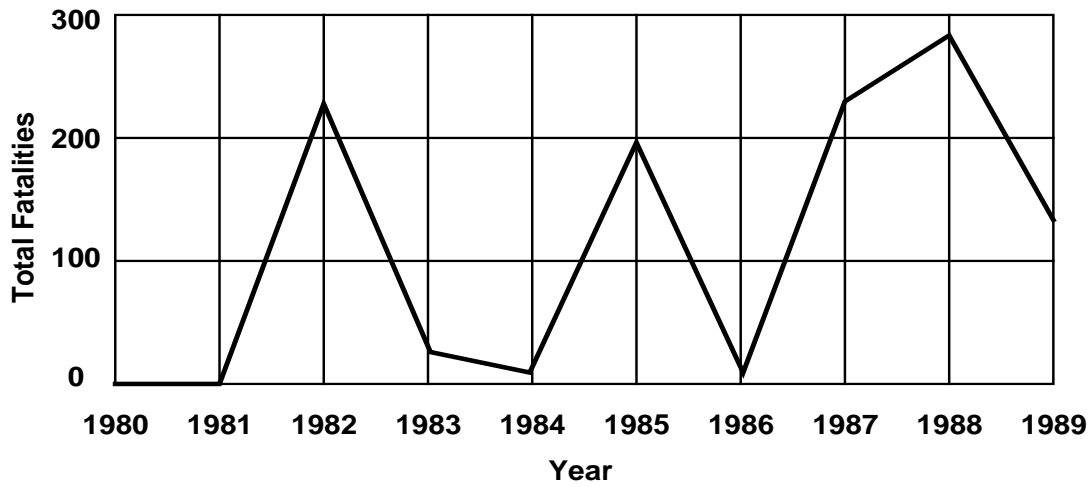
Accidents and Fatal Accidents
Scheduled 14 CFR 121, 125 and 127 Operations



Source: U.S. National Transportation Safety Board

Figure 4

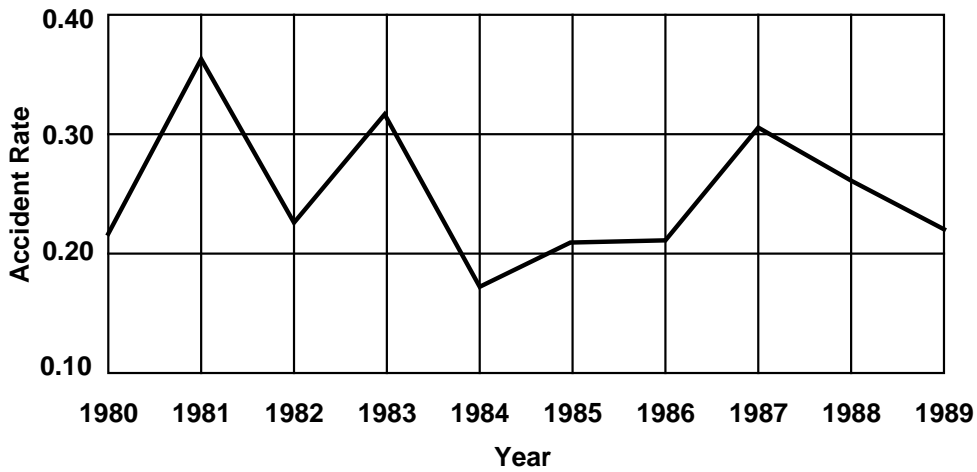
**Number of Fatalities
Scheduled 14 CFR 121,125 and 127 Operations**



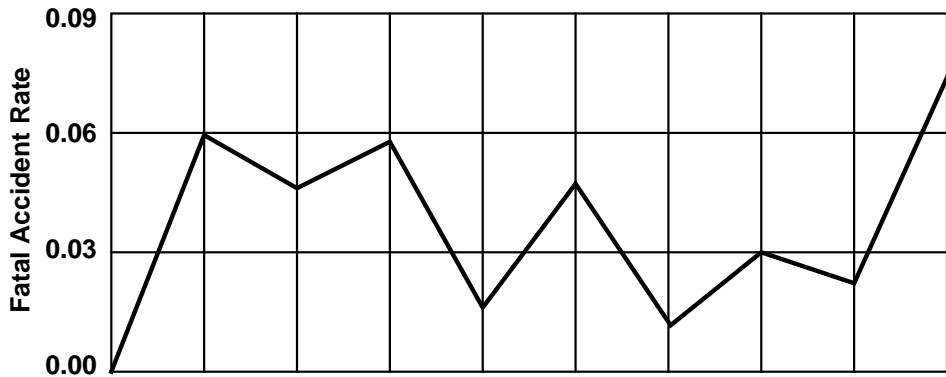
Source: U.S. National Transportation Safety Board

Figure 5

**Accidents per 100,000 Hours Flown
Scheduled CFR 121, 125 and 127 Operations**



1980 1981 1982 1983 1984 1985 1986 1987 1988 1989



Source: U.S. National Transportation Safety Board

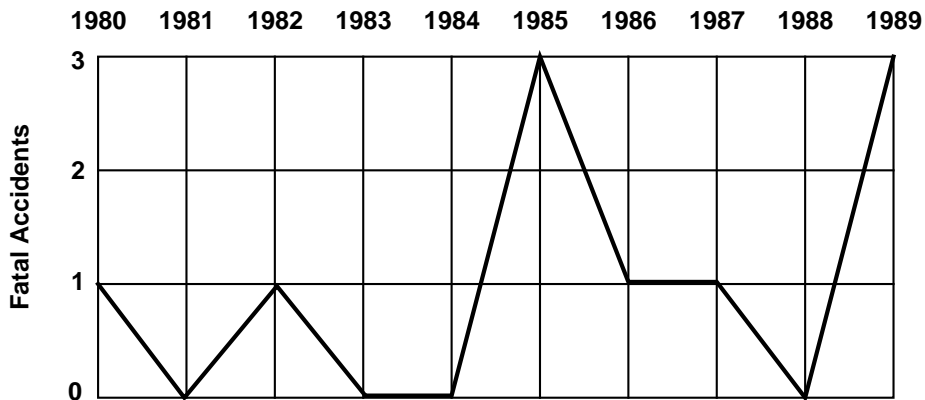
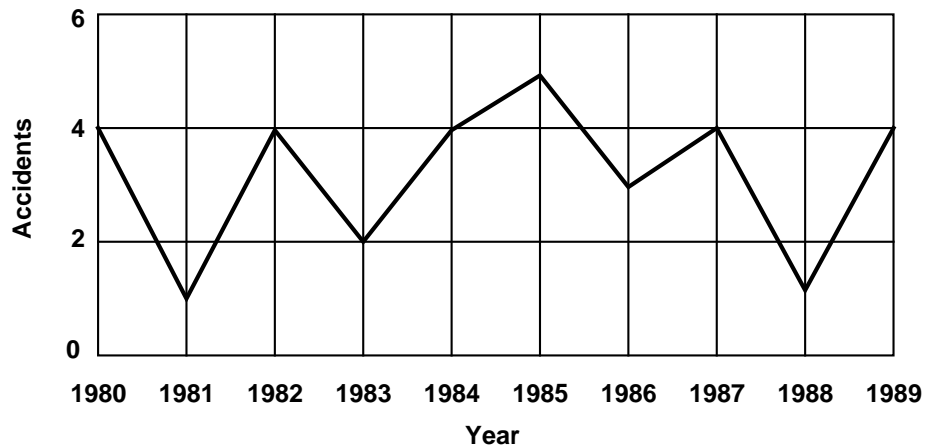
Figure 6

Table 16
Accidents, Fatal Accidents, Fatalities and Rates
Nonscheduled 14 CFR 121, 125 and 127 Operations
1980-1989

Year	Accidents	Fatal Accidents	Fatalities		Hours Flown	Accident Rate per 100,000* Aircraft Hours Flown	
			Aboard Aircraft			Total	Fatal
			Total	In this Category			
1980	4	1	1	0	310,100	1.290	0.322
1981	1	0	0	0	291,558	0.343	0.000
1982	4	1	1	1	342,555	1.168	0.292
1983	2	0	0	0	383,830	0.521	0.000
1984	4	0	0	0	429,087	0.932	0.000
1985	5	3	329	329	444,562	1.125	0.675
1986	3	1	3	3	480,946	0.624	0.208
1987	4	1	1	1	529,203	0.756	0.189
1988	1	0	0	0	618,467	0.162	0.000
1989	4	3	147	146	675,986	0.592	0.444

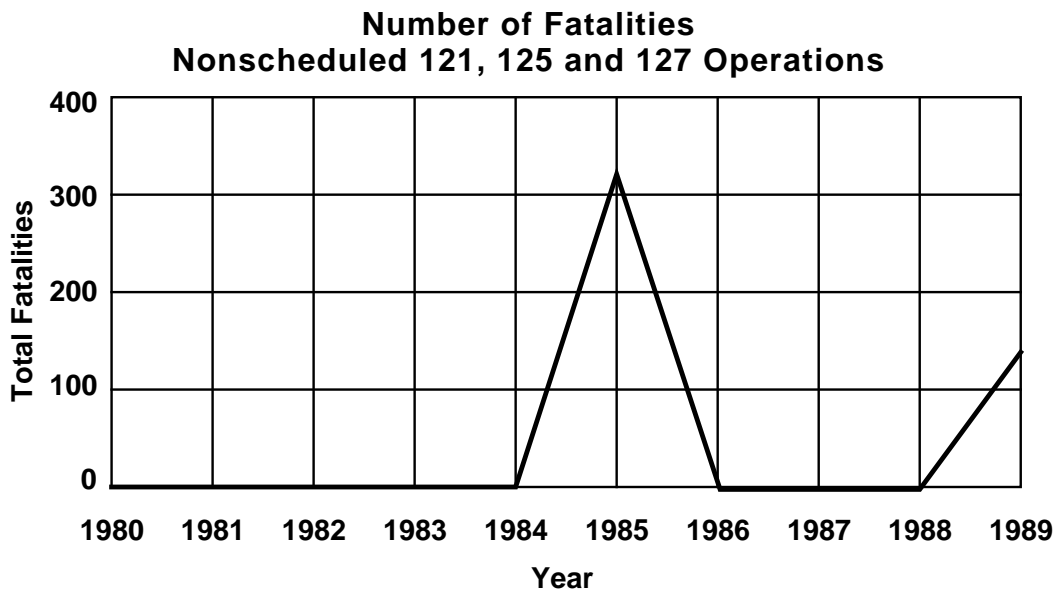
Source: U.S. National Transportation Safety Board

Accidents and Fatal Accidents
Nonscheduled 14 CFR 121, 125 and 127 Operations



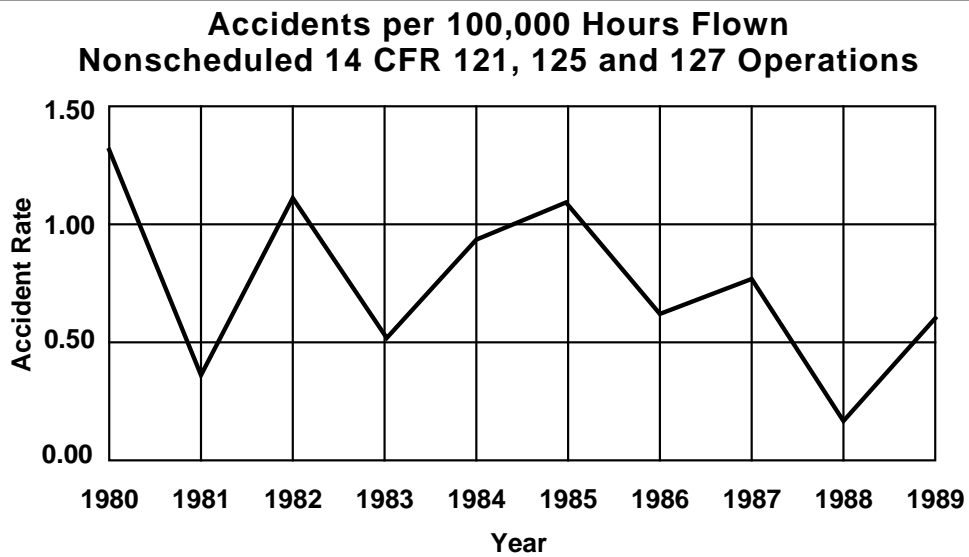
Source: U.S. National Transportation Safety Board

Figure 7

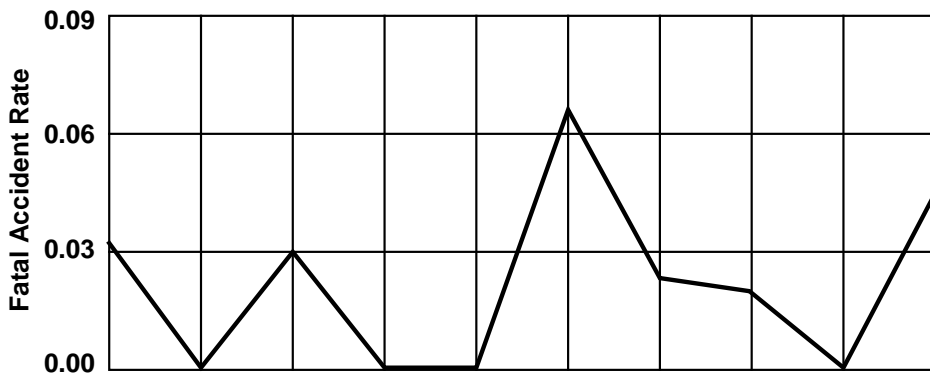


Source: U.S. National Transportation Safety Board

Figure 8



Source: U.S. National Transportation Safety Board



Source: U.S. National Transportation Safety Board

Figure 9

Table 17
First Occurrences in All Accidents and in Fatal Accidents
14 CFR 121, 125 and 127 Operations
1989 and 1984-1988

Type of Occurrence	All Accidents				Fatal Accidents			
	1989		1984-1988		1989		1984-1988	
	No.	Percent	Mean	Percent	No.	Percent	Mean	Percent
In-flight encounter with weather	4	14.3	6.6	25.4	0	.0	.2	5.6
Airframe/component/system fail/mal	6	21.4	4.0	15.4	3	27.3	.2	5.6
On-ground collision with object	1	3.6	2.8	10.8	1	9.1	.2	5.6
Miscellaneous/other	4	14.3	2.2	8.5	2	18.2	.2	5.6
Not reported	1	3.6	1.6	6.2	1	9.1	.4	11.1
Loss of control — in flight	1	3.6	1.4	5.4	1	9.1	1.2	33.3
In-flight collision with object	0	.0	1.0	3.8	0	.0	.2	5.6
Main gear collapsed	1	3.6	.6	2.3	0	.0	.0	.0
In-flight collision w/ terrain	2	7.1	.6	2.3	1	9.1	.4	11.1
Loss of engine power (total) — mech failure/malfunction	0	.0	.6	2.3	0	.0	.0	.0
Loss of engine power (partial) — mech failure/malfunction	0	.0	.6	2.3	0	.0	.2	5.6
Loss of engine power (total) — nonmechanical	1	3.6	.6	2.3	0	.0	.2	5.6
Nose gear collapsed	0	.0	.4	1.5	0	.0	.0	.0
Hard landing	1	3.6	.4	1.5	0	.0	.0	.0
Overrun	0	.0	.4	1.5	0	.0	.0	.0
Loss of engine power	0	.0	.4	1.5	0	.0	.0	.0
Altitude deviation, uncontrolled	0	.0	.2	.8	0	.0	.0	.0
Fire/explosion	1	3.6	.2	.8	0	.0	.0	.0
Explosion	0	.0	.2	.8	0	.0	.2	5.6
Loss of control — on ground	1	3.6	.2	.8	1	9.1	.0	.0
Near collision between aircraft	0	.0	.2	.8	0	.0	.0	.0
On-ground collision w/ terrain	0	.0	.2	.8	0	.0	.0	.0
On-ground encounter with weather	1	3.6	.2	.8	1	9.1	.0	.0
Propeller/rotor contact to person	0	.0	.2	.8	0	.0	.0	.0
Undershoot	0	.0	.2	.8	0	.0	.0	.0
Fire	2	7.1	.0	.0	0	.0	.0	.0
Propeller blast or jet exhaust/suction	1	3.6	.0	.0	0	.0	.0	.0
Total aircraft	28	100.0	26.0	100.0	11	100.0	3.6	100.0

Source: U.S. National Transportation Safety Board

Table 18
First Phases of Operation in All Accidents and in Fatal Accidents
14 CFR 121, 125 and 127 Operations
1989 and 1984-1988

Phase of Operation	All Accidents				Fatal Accidents			
	1989		1984-1988		1989		1984-1988	
	No.	Percent	Mean	Percent	No.	Percent	Mean	Percent
Cruise	4	14.3	6.0	23.1	2	18.2	.8	22.2
Takeoff	2	7.1	4.8	18.5	1	9.1	1.4	38.9
Landing	4	14.3	3.2	12.3	0	.0	.0	.0
Taxi	4	14.3	2.6	10.0	2	18.2	.2	5.6
Descent	4	14.3	2.6	10.0	0	.0	.2	5.6
Standing	5	17.9	1.8	6.9	1	9.1	.0	.0
Approach	2	7.1	1.8	6.9	2	18.2	.6	16.7
Climb	2	7.1	1.6	6.2	2	18.2	.0	.0
Not reported	1	3.6	1.6	6.2	1	9.1	.4	11.1
Maneuvering	0	.0	.0	.0	0	.0	.0	.0
Other	0	.0	.0	.0	0	.0	.0	.0
Total	28	100.0	26.0	100.0	11	100.0	3.6	100.0

Source: U.S. National Transportation Safety Board

Table 19
Broad Cause/Factor Assignments in All Accidents and in Fatal Accidents
14 CFR 121, 125 and 127 Operations
1989 and 1984-1988

Broad Cause/Factor	All Accidents				Fatal Accidents			
	1989		1984-1988		1989		1984-1988	
	No.	Percent	Mean	Percent	No.	Percent	Mean	Percent
Pilot	9	32.1	10.8	41.5	3	27.3	2.2	61.1
Other person (not aboard)	13	46.4	9.4	36.2	6	54.5	1.6	44.4
Weather	5	17.9	8.8	33.8	1	9.1	.6	16.7
Other person (aboard)	2	7.1	5.8	22.3	0	.0	.2	5.6
Systems/equipment/ instruments	6	21.4	4.6	17.7	2	18.2	1.0	27.8
Propulsion system and controls	4	14.3	2.8	10.8	1	9.1	.4	11.1
Landing gear	3	10.7	2.6	10.0	0	.0	.0	.0
Light conditions	0	.0	2.6	10.0	0	.0	.8	22.2
Object (tree, wires, etc.)	2	7.1	2.6	10.0	1	9.1	.4	11.1
Airframe	3	10.7	2.2	8.5	3	27.3	.4	11.1
Terrain/runway condition	2	7.1	2.0	7.7	0	.0	.0	.0
Flight control system	1	3.6	.8	3.1	1	9.1	.2	5.6
Airport/airways facilities, aids	0	.0	.6	2.3	0	.0	.0	.0
Total aircraft	28		26.0		11		3.6	
NTSB-determined probable cause	26		23.8		9		2.8	

Source: U.S. National Transportation Safety Board

14 CFR 135 Operations

There were 18 accidents involving scheduled 14 CFR 135 operations in 1989. The average number of accidents per year in this category for the years 1980-1988 is 24.5. The accident rate per 100,000 hours flown for 1989 is 0.803, compared with an overall rate of 1.527 for the period 1980-1988.

Of the 18 accidents in this category, five accidents were fatal, involving a total of 31 fatali-

ties. During the period 1980-1988, there were an average of 5.7 fatal accidents and 29.4 fatalities per year in scheduled 14 CFR 135 operations, with a fatal accident rate of 0.223 accidents per 100,000 hours flown.

One of the accidents reported in this section involved an on-ground collision between two scheduled 14 CFR 135 aircraft. Therefore, this section lists 18 accidents, involving 19 aircraft.

Table 20
Summary of Losses
Scheduled 14 CFR 135 Operations
1985-1989

	1985	1986	1987	1988	1989
<u>Accidents</u>					
Fatal	7	2	10	2	5
Involved serious injury	4	2	5	2	1
Involved minor or no injury	<u>10</u>	<u>11</u>	<u>17</u>	<u>15</u>	<u>12</u>
Total	21	15	32	19	18
<u>Fatalities</u>					
Passenger	28	3	42	17	25
Crew	8	1	15	4	6
Other persons	<u>1</u>	<u>0</u>	<u>2</u>	<u>0</u>	<u>0</u>
Total	37	4	59	21	31
<u>Aircraft Damage (Scheduled 14 CFR 135)</u>					
Destroyed	9	1	11	3	5
Substantial	12	13	18	15	13
Minor	0	1	2	1	0
None	<u>0</u>	<u>1</u>	<u>1</u>	<u>0</u>	<u>1</u>
Total	21	16	32	19	19

Source: U.S. National Transportation Safety Board

Table 21
Accident Rates
Scheduled 14 CFR 135 Operations

	1985	1986	1987	1988	1989
Aircraft miles flown (thousands)	300,817	307,393	350,879	380,237	393,619
Aircraft hours flown	1,737,106	1,724,586	1,946,349	2,092,689	2,240,555
Departures flown	2,561,463	2,798,811	2,809,918	2,909,005	2,818,520
<u>Accident Rates</u>					
Per million miles flown	0.070	0.049	0.091	0.050	0.046
Per hundred thousand hours flown	1.209	0.870	1.644	0.908	0.803
Per hundred thousand departures flown	0.820	0.536	1.139	0.653	0.639
<u>Fatal Accident Rates</u>					
Per million miles flown	0.023	0.007	0.028	0.005	0.013
Per hundred thousand hours flown	0.403	0.116	0.514	0.096	0.223
Per hundred thousand departures flown	0.273	0.071	0.356	0.069	0.177

Source: U.S. National Transportation Safety Board

Table 22
List of Accidents
Scheduled 14 CFR 135 Operations
1989

Date Location	Type of Operation	Aircraft Air Carrier	Aircraft Type	Degree of Damage	Injury	First Occurrence
1/03 Russian Mission, AK	Passenger	Ryan Air	Cessna 207A	Substantial	None	Loss of power (partial) — nonmechanical
1/16 Carolina, PR	Passenger	Vieques Air Link	Britten-Norman BN-2A	Substantial	None	Loss of power (total) — nonmechanical
1/17 Los Angeles, CA	Passenger	Skywest Airlines	Fairchild Swearingen SA-227AC		Substantial	Minor On-ground collision with object
1/30 Salt Lake City, UT	Passenger	Skywest Airlines	Fairchild Swearingen SA-227AC		Substantial	None On-ground collision
	Passenger	Skywest Airlines	Fairchild Swearingen SA-227AC		Substantial	None
3/09 Kasigluk, AK	Passenger	Seagull Air Service	Piper PA-32	Substantial	None	On-ground collision with terrain
3/31 Syracuse, NY	Passenger and Cargo	Brockway Air	Beech 1900C	Substantial	Minor	On-ground collision with object
4/19 Pelican, AK	Passenger and Cargo	Channel Flying	DeHavilland DHC-2	Destroyed	Fatal (2)	In-flight encounter with weather
5/18 Marion, IL	Passenger	Air Midwest	Fairchild Swearingen SA-226TC		Substantial	None Airframe/component/system failure/malfunction
7/26 Bullhead City, AZ	Passenger	American Int.	British Aerospace 3201	None	Serious	Miscellaneous/other
7/30 Haines, AK	Passenger	Skagway Air	Piper PA-32-301	Destroyed	Fatal (2)	In-flight encounter with weather
8/07 Nome, AK	Passenger and Cargo	Ryan Air	Cessna 402	Destroyed	Fatal (1)	In-flight encounter with weather
9/01 Boston, MA	Passenger and Cargo	Bar Harbor Airline	Beech 1900C	Substantial	None	On-ground collision with object
9/06 Los Angeles, CA	Passenger	Skywest Airlines	Fairchild Swearingen SA-227AC		Substantial	None On-ground collision with object
10/10 Philadelphia, PA	Passenger and Cargo	Pennsylvania Aviation	Britten-Norman BN-2A-MK3	Substantial	None	On-ground collision with object
10/28 Halawa, Molokai, HI	Passenger	Aloha Islandair	DeHavilland DHC-6-30D	Destroyed	Fatal (20)	In-flight encounter with weather
12/11 Kotzebue, AK	Passenger	Baker Aviation	Cessna 402	Substantial	Minor	On-ground collision with object
12/15 Staunton, VA	Passenger	USAir Express	British Aerospace 3101	Substantial	None	On-ground collision with terrain
12/26 Pasco, WA	Passenger	United Express	British Aerospace 3101	Destroyed	Fatal (6)	In-flight encounter with weather

Source: U.S. National Transportation Safety Board

Table 23
Persons by Role and Degree of Injury
Scheduled 14 CFR 135 Operations
1989

Role of Person	Degree of Injury				Total
	Fatal	Serious	Minor	None	
Pilot	4	1	1	13	19
Copilot	2	0	0	10	12
Passenger	25	3	3	100	131
Total aboard	31	4	4	123	162
Other aircraft*	0	0	1	1	2
Other ground	0	0	2	1	3
Grand total	31	4	7	125	167
Percent	18.6	2.4	4.2	74.9	

* Injuries carried opposite "Other aircraft" are injuries occurring in aircraft that are not part of this tabulation, but that were involved in collisions with aircraft that are a part of this tabulation.

Source: U.S. National Transportation Safety Board

Table 24
Aircraft by Damage and Degree of Injury
Scheduled 14 CFR 135 Operations
1989

Aircraft Damage	Degree of Injury				Aircraft	
	None	Minor	Serious	Fatal	No.	Percent
None	0	0	1	0	1	5.3
Substantial	10	3	0	0	13	68.4
Destroyed	0	0	0	5	5	26.3
Aircraft						
Number	10	3	1	5	19	
Percent	52.6	15.8	5.3	26.3		

Source: U.S. National Transportation Safety Board

Table 25
Aircraft by First Occurrence and Degree of Injury and by Damage
Scheduled 14 CFR 135 Operations
1989

Type of First Occurrence	Degree of Injury				Aircraft Damage				Aircraft	
	None	Minor	Ser	Fatal	None	Minor	Subs	Dest	No.	Percent
Airframe/component/system failure/malfunction	1	0	0	0	0	0	1	0	1	5.3
In-flight encounter w/weather	0	0	0	5	0	0	0	5	5	26.3
On-ground collision w/object	5	3	0	0	0	0	8	0	8	42.1
On-ground collision w/terrain	2	0	0	0	0	0	2	0	2	10.5
Loss of power (total) — nonmechanical	1	0	0	0	0	0	1	0	1	5.3
Loss of power (partial) — nonmechanical	1	0	0	0	0	0	1	0	1	5.3
Miscellaneous/other	0	0	1	0	1	0	0	0	1	5.3
Aircraft										
Number	10	3	1	5	1	0	13	5	19	
Percent	52.6	15.8	5.3	26.3	5.3	0.0	68.4	26.3		

Source: U.S. National Transportation Safety Board

Table 26
Aircraft by First Occurrence and Broad Phase of Operation
Scheduled 14 CFR 135 Operations
1989

Type of First Occurrence	Phase of Operation								Aircraft	
	Standing	Taxi	Takeoff	Cruise	Descent	Approach	Landing	Maneuver	No.	Percent
Airframe/component/system failure/malfunction	0	0	0	0	0	0	1	0	1	5.3
In-flight encounter with weather	0	0	0	3	0	1	0	1	5	26.3
On-ground collision with object	2	6	0	0	0	0	0	0	8	42.1
On-ground collision with terrain	0	1	1	0	0	0	0	0	2	10.5
Loss of power (total) — nonmechanical	0	0	0	0	1	0	0	0	1	5.3
Loss of power (partial) — nonmechanical	0	0	0	0	0	1	0	0	1	5.3
Miscellaneous/other	1	0	0	0	0	0	0	0	1	5.3
Aircraft										
Number	3	7	1	3	1	2	1	1	19	
Percent	15.8	36.8	5.3	15.8	5.3	10.5	5.3	5.3		

Source: U.S. National Transportation Safety Board

Table 27
Aircraft by Phase of Operation and Degree of Injury and by Damage
Scheduled 14 CFR 135 Operations
1989

Phase of Operation	Degree of Injury					Aircraft Damage			Aircraft	
	None	Minor	Serious	Fatal	None	Minor	Substantial	Destroyed	No.	Percent
Airframe/component/system	2	1	0	3	0	0	4	2	6	21.4
Standing — engine(s) operating	2	0	0	0	0	0	2	0	2	10.5
Standing — engine(s) not operating	0	0	1	0	1	0	0	0	1	5.3
Taxi — to takeoff	2	0	0	0	0	0	2	0	2	10.5
Taxi — from landing	2	3	0	0	0	0	5	0	5	26.3
Takeoff — ground run	1	0	0	0	0	0	1	0	1	5.3
Cruise	0	0	0	3	0	0	0	3	3	15.8
Descent — normal	1	0	0	0	0	0	1	0	1	5.3
Approach	0	0	0	1	0	0	0	1	1	5.3
Approach — VFR pattern — downwind	1	0	0	0	0	0	1	0	1	5.3
Landing — roll	1	0	0	0	0	0	1	0	1	5.3
Maneuvering	0	0	0	1	0	0	0	1	1	5.3
Aircraft										
Number	10	3	1	5	1	0	13	5	19	
Percent	52.6	15.8	5.3	26.3	5.3	.0	68.4	26.3		

Source: U.S. National Transportation Safety Board

Table 28
Aircraft by Condition of Light and Type of Weather
Scheduled 14 CFR 135 Operations
1989

Condition of Light	Type of Weather		Aircraft	
	Visual Meteorological Conditions (VMC)	Instrument Meteorological Conditions (IMC)	No.	Percent
Daylight	4	6	10	52.6
Night (dark)	3	2	5	26.3
Night (bright)	2	0	2	10.5
Dusk	2	0	2	10.5
Aircraft				
Number	11	8	19	
Percent	57.9	42.1		

Source: U.S. National Transportation Safety Board

Table 29
Aircraft by Type of Operation and Degree of Injury
Scheduled 14 CFR 135 Operations
1989

Type of Operation	Degree of Injury				Aircraft	
	None	Minor	Serious	Fatal	No.	Percent
Scheduled domestic passenger	8	2	1	3	14	73.7
Scheduled domestic passenger/cargo	2	1	0	2	5	26.3
Aircraft						
Number	10	3	1	5	19	
Percent	52.6	15.8	5.3	26.3		

Source: U.S. National Transportation Safety Board

Table 30
Aircraft by Proximity to Airport and Flight Plan
Scheduled 14 CFR 135 Operations
1989

Accident Location	Flight Plan			Aircraft	
	Visual Flight Rules (VFR)	Instrument Flight Rules (IFR)	Company VFR	No.	Percent
Off airport/airstrip	3	0	3	6	31.6
On airport	2	9	1	12	63.2
On airstrip	0	0	1	1	5.3
Aircraft					
Number	5	9	5	19	
Percent	26.3	47.4	26.3		

Source: U.S. National Transportation Safety Board

Table 31
Aircraft by Occurrence of Fire and Degree of Injury and by Damage
Scheduled 14 CFR 135 Operations
1989

Phase of Operation	Degree of Injury				Aircraft Damage				Aircraft	
	None	Minor	Serious	Fatal	None	Minor	Substantial	Destroyed	No.	Percent
None	10	3	1	1	1	0	13	1	15	78.9
On ground	0	0	0	4	0	0	0	4	4	21.1
Aircraft										
Number	10	3	1	5	1	0	13	5	19	
Percent	52.6	15.8	5.3	26.3	5.3	.0	68.4	26.3		

Source: U.S. National Transportation Safety Board

Table 32
Aircraft by Type of Aircraft and Degree of Injury and by Damage
Scheduled 14 CFR 135 Operations
1989

Type of Aircraft	Degree of Injury				Aircraft Damage				Aircraft	
	None	Minor	Serious	Fatal	None	Minor	Substantial	Destroyed	No.	Percent
Fixed-wing single reciprocating engine	2	0	0	2	0	0	2	2	4	21.1
Fixed-wing multiple reciprocating engines	2	1	0	1	0	0	3	1	4	21.1
Fixed-wing turboprop	6	2	1	2	1	0	8	2	11	57.9
Aircraft										
Number	10	3	1	5	1	0	13	5	19	
Percent	52.6	15.8	5.3	26.3	5.3	.0	68.4	26.3		

Source: U.S. National Transportation Safety Board

Table 33
Broad Cause/Factor Assignments*
Scheduled 14 CFR 135 Operations
1989

Cause/Factor causes	Cited as a Cause		Cited as a Factor		Cited as Either a Cause or a Factor (or Both)	
	Fatal Accidents	All Accidents	Fatal Accidents	All Accidents	Fatal Accidents	All Acci-
Aircraft #	0	2	1	0	1	2
Propulsion system and controls	0	1	0	0	0	1
Flight control system	0	0	1	0	1	0
Airframe	0	0	1	0	1	0
Landing gear	0	0	0	0	0	0
Systems/equipment/ instruments	0	1	0	0	0	1
Environment #	0	0	5	7	5	7
Weather	0	0	5	3	5	3
Light conditions	0	0	1	5	1	5
Object (trees, wires, etc.)	0	0	0	2	0	2
Airport/airways facilities, aids	0	0	0	1	0	1
Terrain/runway condition	0	0	4	2	4	2
Personnel #	5	13	2	10	5	14
Pilot	5	6	0	4	5	7
Others (aboard)	0	1	0	0	0	1
Others (not aboard)	0	6	2	8	2	11
Number of aircraft					5	19
NTSB-determined probable cause					5	19

* Multiple causes and factors may be assigned in an accident.

This category is composed of the subcategories indented below it. The number of aircraft cited in a category may be less than or equal to the sum of the subcategory citations.

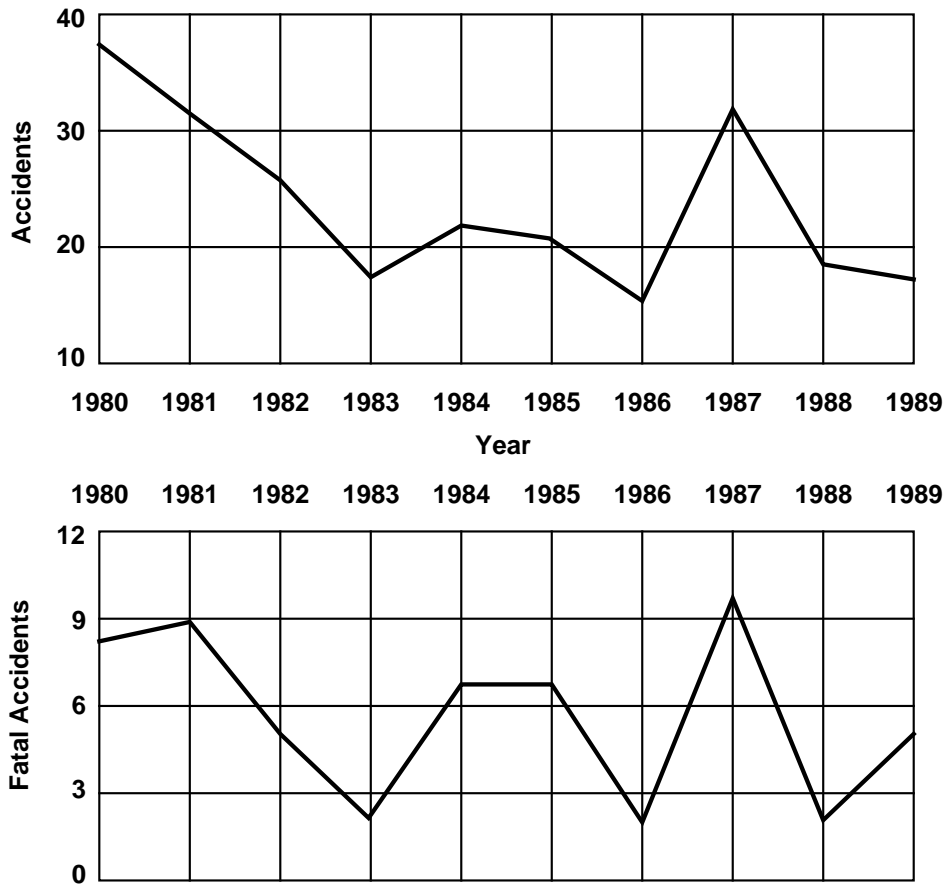
Source: U.S. National Transportation Safety Board

Table 34
Accidents, Fatal Accidents, Fatalities and Rates
Scheduled 14 CFR 135 Operations
1980-1989

Year	Accidents	Fatal Accidents	Fatalities		Hours Flown	Accident Rate per 100,000* Aircraft Hours Flown	
			Total	Aboard Aircraft In this Category		Total	Fatal
1980	38	8	37	37	1,175,588	3.232	0.681
1981	31	9	34	32	1,240,764	2.498	0.725
1982	26	5	14	14	1,299,748	2.000	0.385
1983	17	2	11	10	1,510,908	1.125	0.132
1984	22	7	48	46	1,745,762	1.260	0.401
1985	21	7	37	36	1,737,106	1.209	0.403
1986	15	2	4	4	1,724,586	0.870	0.116
1987	32	10	59	57	1,946,349	1.644	0.514
1988	19	2	21	21	2,092,689	0.908	0.096
1989	18	5	31	31	2,240,555	0.803	0.223

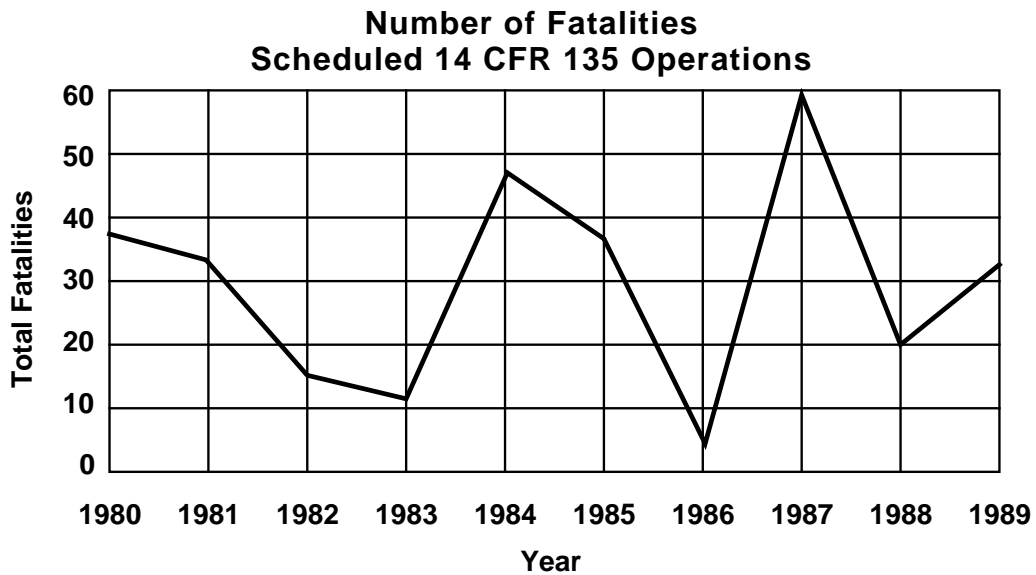
Source: U.S. National Transportation Safety Board

Accidents and Fatal Accidents
Scheduled 14 CFR 135 Operations



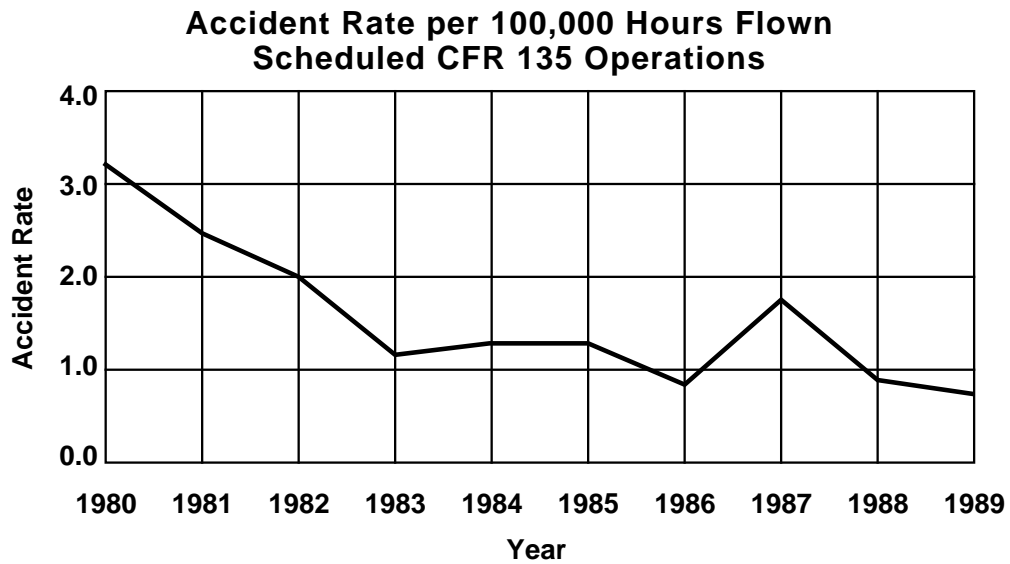
Source: U.S. National Transportation Safety Board

Figure 10

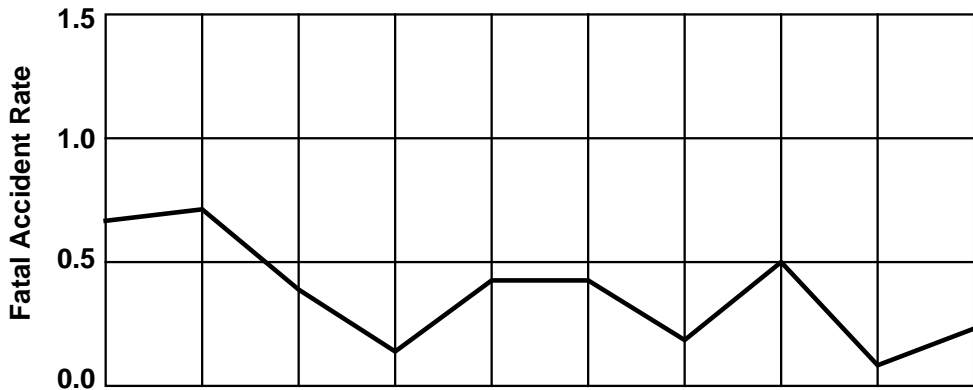


Source: U.S. National Transportation Safety Board

Figure 11



1980 1981 1982 1983 1984 1985 1986 1987 1988 1989



Source: U.S. National Transportation Safety Board

Figure 12

Table 35
First Occurrences in All Accidents and in Fatal Accidents
Scheduled 14 CFR 135 Operations
1989 and 1984-1988

Type of Occurrence	All Accidents				Fatal Accidents			
	1989		1984-1988		1989		1984-1988	
	No.	Percent	Mean	Percent	No.	Percent	Mean	Percent
Airframe/component/system failure/malfunction	1	5.3	3.2	14.5	0	.0	.8	14.3
Loss of engine power (total) — nonmechanical	1	5.3	2.0	9.1	0	.0	.6	10.7
Loss of control — in flight	0	.0	1.8	8.2	0	.0	1.0	17.9
In-flight encounter with weather	5	26.3	1.6	7.3	5	100.0	.6	10.7
In-flight collision with terrain	0	.0	1.4	6.4	0	.0	.6	10.7
Loss of control — on ground	0	.0	1.4	6.4	0	.0	.0	.0
On-ground collision with object	8	42.1	1.4	6.4	0	.0	.2	3.6
In-flight collision with object	0	.0	1.0	4.5	0	.0	.4	7.1
Loss of engine power (partial) nonmechanical	1	5.3	1.0	4.5	0	.0	.2	3.6
Hard landing	0	.0	.8	3.6	0	.0	.0	.0
Midair collision	0	.0	.8	3.6	0	.0	.4	7.1
Complete gear collapsed	0	.0	.6	2.7	0	.0	.0	.0
Loss of engine power	0	.0	.6	2.7	0	.0	.4	7.1
Gear collapsed	0	.0	.4	1.8	0	.0	.0	.0
Main gear collapsed	0	.0	.4	1.8	0	.0	.0	.0
Loss of engine power(total) — mechanical failure/malfunction	0	.0	.4	1.8	0	.0	.0	.0
Loss of engine power (partial) — mechanical failure/malfunction	0	.0	.4	1.8	0	.0	.2	3.6
Undershoot	0	.0	.4	1.8	0	.0	.0	.0
Vortex turbulence encountered	0	.0	.4	1.8	0	.0	.0	.0
Miscellaneous/other	1	5.3	.4	1.8	0	.0	.0	.0
Not reported	0	.0	.2	.9	0	.0	.2	3.6
Dragged wing, rotor, pod or float	0	.0	.2	.9	0	.0	.0	.0
Explosion	0	.0	.2	.9	0	.0	.0	.0
Nose gear collapsed	0	.0	.2	.9	0	.0	.0	.0
Gear not extended	0	.0	.2	.9	0	.0	.0	.0
Overrun	0	.0	.2	.9	0	.0	.0	.0
Propeller/rotor contact to person	0	.0	.2	.9	0	.0	.0	.0
Undetermined	0	.0	.2	.9	0	.0	.0	.0
On-ground collision with terrain	<u>2</u>	<u>10.5</u>	<u>.0</u>	<u>.0</u>	<u>0</u>	<u>.0</u>	<u>.0</u>	<u>.0</u>
Total	19	100.0	22.0	100.0	5	100.0	5.6	100.0

Source: U.S. National Transportation Safety Board

Table 36
First Phases of Operation in All Accidents and in Fatal Accidents
Scheduled 14 CFR 135 Operations
1989 and 1984-1988

Phase of Operation	All Accidents				Fatal Accidents			
	1989		1984-1988		1989		1984-1988	
	No.	Percent	Mean	Percent	No.	Percent	Mean	Percent
Approach	2	10.5	5.8	26.4	1	20.0	2.6	46.4
Landing	1	5.3	4.4	20.0	0	.0	.0	.0
Takeoff	1	5.3	3.0	13.6	0	.0	1.2	21.4
Taxi	7	36.8	2.8	12.7	0	.0	.2	3.6
Climb	0	.0	1.4	6.4	0	.0	.6	10.7
Cruise	3	15.8	1.4	6.4	3	60.0	.2	3.6
Descent	1	5.3	1.2	5.5	0	.0	.0	.0
Standing	3	15.8	.6	2.7	0	.0	.0	.0
Maneuvering	1	5.3	.6	2.7	1	20.0	.4	7.1
Other	0	.0	.6	2.7	0	.0	.2	3.6
Not reported	0	.0	.2	.9	0	.0	.2	3.6
Total aircraft	19	100.0	22.0	100.0	5	100.0	5.6	100.0

Source: U.S. National Transportation Safety Board

Table 37
Broad Cause/Factor Assignments in All Accidents and in Fatal Accidents
Scheduled 14 CFR 135 Operations
1989 and 1984-1988

Broad Cause/Factor	All Accidents				Fatal Accidents			
	1989		1984-1988		1989		1984-1988	
	No.	Percent	Mean	Percent	No.	Percent	Mean	Percent
Pilot	12	63.2	16.8	76.4	5	100.0	4.4	78.6
Other person (not aboard)	13	68.4	8.0	36.4	2	40.0	2.8	50.0
Weather	8	42.1	5.8	26.4	5	100.0	1.8	32.1
Terrain/runway condition	6	31.6	5.2	23.6	4	80.0	1.2	21.4
Propulsion system and controls	1	5.3	4.8	21.8	0	.0	1.4	25.0
Systems/equipment/ instruments	1	5.3	4.2	19.1	0	.0	1.4	25.0
Object (tree, wires, etc.)	2	10.5	3.0	13.6	0	.0	.6	10.7
Light conditions	6	31.6	2.6	11.8	1	20.0	.8	14.3
Landing gear	0	.0	2.4	10.9	0	.0	.0	.0
Airframe	1	5.3	1.4	6.4	1	20.0	.4	7.1
Airport/airways facilities, aids	1	5.3	1.0	4.5	0	.0	.4	7.1
Flight control system	1	5.3	0.6	2.7	1	20.0	.6	10.7
Other person (aboard)	1	5.3	.2	.9	0	.0	.2	3.6
Total aircraft	19		22.0		5		5.6	
NTSB-determined probable cause	19		21.6		5		5.4	

Source: U.S. National Transportation Safety Board

Nonscheduled 14 CFR 135 Operations

There were 111 accidents involving nonscheduled 14 CFR 135 aircraft in 1989. Twenty-five of them were fatal, involving a total of 83 fatalities. The average number of accidents per year in this category for the years 1980-1988 is 135.1.

The average accident rate for the period 1980-1988 was 4.82 accidents per 100,000 hours flown. The 1989 rate of 3.68 is 23.9 percent below this

average. The 1989 fatal accident rate of 0.83, the second lowest in the decade of the 1980s, is 27.8 percent below the nine-year average of 1.15.

One of the accidents reported in this section involved an on-ground collision between two nonscheduled 14 CFR 135 aircraft. Therefore, this section lists 111 accidents, involving 112 aircraft.

Table 38
Summary of Losses
Nonscheduled 14 CFR 135 Operations
1985-1989

	1985	1986	1987	1988	1989
Accidents					
Fatal	35	31	30	28	25
Involved serious injury	13	13	9	15	13
Involved minor or no injury	<u>106</u>	<u>73</u>	<u>58</u>	<u>58</u>	<u>73</u>
Total	154	117	97	101	111
Fatalities					
Passenger	39	26	31	22	46
Crew	36	35	32	33	35
Other persons	<u>1</u>	<u>4</u>	<u>2</u>	<u>4</u>	<u>2</u>
Total	76	65	65	59	83
Aircraft Damage (Nonscheduled 14 CFR 135)					
Destroyed	50	38	34	37	32
Substantial	104	77	62	62	80
Minor	2	1	4	1	0
None	<u>1</u>	<u>2</u>	<u>0</u>	<u>1</u>	<u>0</u>
Total	157	118	100	101	112

Source: U.S. National Transportation Safety Board

Table 39
Accident Rates
Nonscheduled 14 CFR 135 Operations

	1985	1986	1987	1988	1989
Aircraft Hours Flown	2,570,000	2,690,000	2,657,000	2,632,000	3,020,000
Accident Rates *					
All accidents	5.99	4.35	3.65	3.84	3.68
Fatal accidents	1.36	1.15	1.13	1.06	0.83

*Per hundred thousand hours flown

Source: U.S. National Transportation Safety Board

Table 40
List of Accidents
Nonscheduled 14 CFR 135 Operations
1989

Date	Location	Type of Operation	Aircraft Type	Aircraft Damage	Degree of Injury	First Occurrence
1/05	Aspen, CO	Cargo	Cessna 208B	Destroyed	Serious	In-flight encounter with weather
1/10	Juneau, AK	Passenger	Cessna 185F	Substantial	None	Nose over
1/11	Madison, NC	Cargo	Cessna 208B	Destroyed	Serious	In-flight collision with object
1/12	Bell Mountain, AK	Passenger	Hughes 500-D	Substantial	None	In-flight collision with terrain
1/15	Ketchikan, AK	Passenger	DeHavilland DHC-3	Destroyed	Fatal (2)	In-flight encounter with weather
1/15	Port Lions, AK	Passenger and Cargo	Piper PA-32-300	Substantial	None	Hard landing
1/17	Page, AZ	Cargo	Cessna T207A	Substantial	None	In-flight collision with object
1/17	Fort Myers, FL	Cargo	Piper PA-32-300	Substantial	Minor	Loss of power (total) — mechanical failure/malfunction
1/23	Kalskag, AK	Passenger	Cessna 207	Substantial	None	Loss of control — on ground
1/27	Durango, CO	Cargo	Cessna P210N	Substantial	None	In-flight collision with terrain
2/04	Hyannis, MA	Passenger and Cargo	Cessna 402B	Substantial	None	Miscellaneous/other
2/09	Fairbanks, AK	Cargo	Cessna U206G	Destroyed	Fatal (1)	Loss of power (total) — mechanical failure/malfunction
2/09	Cleveland, OH	Cargo	Cessna 310Q	Destroyed	Fatal (1)	In-flight collision with terrain
2/10	Fairbanks, AK	Cargo	DeHavilland DHC-3	Substantial	None	In-flight collision with terrain
2/13	Tyler, TX	Passenger	MBB BK-117-A1	Destroyed	Fatal (3)	In-flight encounter with weather
2/15	Binghamton, NY	Cargo	Falcon Fan Jet	Substantial	Serious	Overrun
2/17	Spokane, WA	Cargo	Mitsubishi MU-2B-35J	Substantial	None	On-ground collision with object
2/19	Corona, CA	Passenger	Cessna 402B	Destroyed	Fatal (10)	In-flight encounter with weather
3/01	Isla Verde, PR	Cargo	McDonnell-Douglas DC-3	Substantial	Minor	Loss of power
3/02	Norfolk, NE	Passenger	Cessna 310Q	Substantial	None	Loss of control — in flight
3/03	Anchorage, AK	Cargo	Cessna U206G	Substantial	None	Loss of control — on ground

Table 40
List of Accidents (Continued)
Nonscheduled 14 CFR 135 Operations
1989

Date	Location	Type of Operation	Aircraft Type	Aircraft Damage	Degree of Injury	First Occurrence
3/06	Puntilla Lake, AK	Passenger and Cargo	Cessna A-185-F	Substantial	Minor	Altitude deviation — uncontrolled
3/06	Johnstown, PA	Cargo	Beech TC-45J	Substantial	None	Nose gear collapsed
3/09	Covington, KY	Cargo	Beech BE-18	Destroyed	Fatal (1)	Loss of control — in flight
3/20	Kershaw, SC	Cargo	Piper PA-32-260	Substantial	Minor	Loss of power (total) — mechanical failure/malfuction
3/22	Jacksonville, FL	Cargo	Piper Aerostar	Destroyed	Fatal (1)	In-flight collision with object
3/24	Lake Arthur, LA	Passenger	Cessna A185F	Substantial	None	On-ground collision with object
3/30	Vallejo, CA	Cargo	Hughes 369D	Substantial	None	Loss of power (total) — mechanical failure/malfuction
3/31	Syracuse, NY	Cargo	Mitsubishi MU-2B-35	Substantial	Minor	On-ground collision with object
4/05	Park City, UT	Passenger	Bell 206B-III	Substantial	None	In-flight encounter with weather
4/05	Cheyenne, WY	Cargo	Piper PA-34-220T	Substantial	None	Hard landing
4/06	Utica, NY	Cargo	Piper Aerostar	Substantial	None	Airframe/component/system failure/malfuction
4/13	Siler City, NC	Cargo	Grumman AA-5B	Substantial	None	Loss of power (total) — mechanical failure/malfuction
4/14	Santa Ana, CA	Cargo	Sikorsky S-58ET	Substantial	Minor	Main gear collapsed
4/26	Jacksonville, FL	Cargo	Swearingen SA-226-AT	Substantial	None	Gear not retracted
4/26	Mt. Zion, IL	Cargo	Cessna 208A	Substantial	Minor	In-flight encounter with weather
4/28	Walker's Cay, Bahamas	Cargo	Britten-Norman BN-2A	Substantial	None	Not reported
5/06	Girdwood, AK	Passenger	Bell 412	Destroyed	Minor	Airframe/component/system failure/malfuction
5/07	Gulf of Mexico	Passenger and Cargo	MBB BO-105S	Destroyed	Fatal (1)	Loss of control — in flight
5/10	Tatitike, AK	Passenger and Cargo	Cessna C-402	Substantial	None	Loss of control — on ground
5/20	Waialeale Falls, HI	Passenger	Aerospatiale AS350D	Substantia	Minor	Loss of power (partial) — mechanical failure/malfuction
5/23	Green Island, AK	Passenger	Cessna 180	Substantia	Serious	Nose over

Table 40
List of Accidents (Continued)
Nonscheduled 14 CFR 135 Operations
1989

Date	Location	Type of Operation	Aircraft Type	Aircraft Damage	Degree of Injury		First Occurrence
					Injury	of	
1/05	Aspen, CO	Cargo	Cessna 208B	Destroyed	Serious		In-flight encounter with weather
5/29	Kahiltna Glac, AK	Passenger	Cessna 185F	Substantial	None		Loss of control — in flight
5/30	Lewiston, ID	Passenger	Bell 206B	Substantial	None		Loss of power (partial) — nonmechanical
5/31	Toksook Bay, AK	Passenger	Cessna 185F	Substantial	None		Gear not retracted
5/31	Tuba City, AZ	Passenger	Beech E-90	Substantial	None		On-ground collision with object
6/01	Big Timber, MT	Passenger	Bell 206L-3	Destroyed	Fatal (4)		Loss of control — in flight
6/07	Skagway, AK	Passenger	Piper PA-32-300	Substantial	None		Altitude deviation — uncontrolled
6/10	Moab, UT	Passenger	Cessna 182	Substantial	None		Loss of power (total) — nonmechanical
6/11	Waipio Valley, HI	Passenger	Beech H18	Destroyed	Fatal (11)		In-flight collision with terrain
6/14	Las Vegas, NV	Passenger	Cessna TU206G	Substantial	None		Loss of control — on ground
6/15	Puntilla Lake, AK	Passenger/Cargo	Aerospatiale AS350B	Destroyed	Fatal (1)		In-flight encounter with weather
6/16	Eek, AK	Passenger	Piper PA-32-300	Substantial	None		Main gear collapsed
6/23	Tuntutuliak, AK	Passenger	Piper PA-32-300	Substantial	None		Loss of power (total) — mechanical failure/ malfunction
6/26	Cleveland, TX	Cargo	Piper PA-601B	Substantial	Minor		Loss of power
7/06	Queens Cannery, AK	Passenger	Piper PA-32	Substantial	None		Undershoot
7/10	Fairbanks, AK	Cargo	Cessna 207	Substantial	None		Loss of power (total) — nonmechanical
7/11	Galveston, TX	Passenger/Cargo	Bell 206L-1	Destroyed	Fatal (2)		Midair collision
7/12	Fort Myers, FL	Cargo	Cessna 208B	Substantial	None		Hard landing
7/13	Kodiak, AK	Passenger	De Havilland DHC-2	Substantial	Serious		In-flight collision with terrain
7/14	Salt Lake City, UT	Cargo	Piper PA-34-200T	Substantial	None		Overrun
7/15	Quinhagak, AK	Passenger	Piper PA-32-300	Destroyed	None		Loss of power (total) — mechanical failure/ malfunction
7/18	Des Moines, IA	Cargo	Learjet 35	Substantial	Minor		Loss of control — on ground

Table 40
List of Accidents (Continued)
Nonscheduled 14 CFR 135 Operations
1989

Date	Location	Type of Operation	Aircraft Type	Aircraft Damage	Degree of Injury	First Occurrence
7/19	Glen Burnie, MD	Cargo	Beech E18S	Destroyed	Fatal (2)	Fire
7/27	Nappanee, IN	Cargo	Piper PA-32R-300	Substantial	None	Loss of power (partial) — mechanical failure/ malfunction
8/06	Boulder City, NV	Passenger	Bell 206B	Substantial	None	Loss of control — in flight
8/08	Georgetown, CO	Passenger	Bell 206B	Substantial	Serious	Loss of control — in flight
8/11	Tanana, AK	Passenger	Cessna 207-A	Substantial	Serious	In-flight collision with terrain
8/15	Greenwood, MS	Cargo	Beech 18	Substantial	None	In-flight collision with terrain
8/19	Volcano, HI	Pax and Cargo	Aerospatiale AS350D	Destroyed	Serious	Loss of power (total) — mechanical failure/ malfunction
8/19	Oak Grove, LA	Pax and Cargo	Bell 206B	Substantial	None	Hard landing
8/21	Carson City, NV	Passenger	Aerospatiale AS350D	Substantial	Serious	Loss of power (total) — mechanical failure/ malfunction
8/21	Gold Beach, OR	Passenger	Beech C90	Destroyed	Fatal (3)	Loss of control — in flight
8/27	Blanchard, ID	Passenger	Aerospatiale AS350D	Destroyed	Fatal (4)	Airframe/component/system failure/malfunction
8/28	Lynchburg, VA	Passenger	Piper PA-31-350	Destroyed	Fatal (5)	In-flight collision with object
8/30	Talkeetna, AK	Cargo	Piper PA-18	Substantial	None	Nose over
9/01	Sparrevohn, AK	Cargo	Cessna 172H	Substantial	None	On-ground collision with object
9/08	Petersburg, AK	Passenger	Hughes 369D	Substantial	None	In-flight collision with object
9/08	Monument Valley, UT	Passenger	Piper PA-31-350	Substantial	None	In-flight encounter with weather
9/11	Bentonville, AR	Cargo	Piper PA-32-300	Destroyed	Fatal (2)	Loss of power (total) — mechanical failure/ malfunction
9/15	Ontario, CA	Cargo	Piper PA-31-350	Destroyed	Fatal (1)	Airframe/component/system failure/malfunction
9/16	Molongo, OF	Passenger	Bell 206L-1	Substantial	None	In-flight collision with object
9/20	Zenia, CA	Passenger	Cessna 182	Substantial	None	On-ground collision with object
9/20	Hyannis, NE	Passenger	Cessna 172N	Substantial	Serious	In-flight collision with terrain

Table 40
List of Accidents (Continued)
Nonscheduled 14 CFR 135 Operations
1989

Date	Location	Type of Operation	Aircraft Type	Aircraft Damage	Degree of Injury	First Occurrence
9/21	Littlefork, MN	Cargo	Beech 80	Substantial	None	Airframe/component/system failure/ malfunction
9/25	Redoubt Bay, AK	Passenger and Cargo	Cessna 180	Substantial	None	Overrun
9/25	Tucson, AZ	Cargo	Cessna 177RG	Substantial	None	Loss of power (partial) — nonmechanical
9/27	Grand Canyon, AZ	Passenger	De Havilland DHC-6-300	Destroyed	Fatal (10)	Loss of control — in flight
10/01	King Salmon, AK	Passenger	Cessna 208	Substantial	None	In-flight collision with terrain
10/04	Nevis Island, OF	Passenger	Piper PA-23-250	Substantial	Minor	Not reported
10/05	Hoonah, AK	Passenger	Piper PA-32-300	Substantial	Serious	Loss of control — on ground
10/10	Grand Canyon, AZ	Passenger	Cessna T207A	Destroyed	Serious	Loss of power
10/10	High Island, Gulf of Mexico	Passenger	Bell 206B-III	Substantial	Minor	Roll over
10/10	Lacey Township, NJ	Passenger and Cargo	Agusta A109A-MKII	Destroyed	Fatal (5)	Airframe/component/system failure/ malfunction
10/10	Philadelphia, PA	Cargo	Beech 58	Substantial	None	On-ground collision with object
10/19	Dodgeville, WI	Cargo	Cessna 207	Substantial	None	Overrun
10/20	San Andros, OF	Passenger and Cargo	Beech G18S	Substantial	None	Not reported
10/24	San Antonio, TX	Cargo	Beech 58	Substantial	None	Fire/explosion
10/25	Ontario, CA	Cargo	Piper PA-31-350	Substantial	None	On-ground collision
		Cargo	Beech C-99	Substantial	None	
10/29	Little Rock, AR	Passenger and Cargo	Cessna 402B	Substantial	Fatal (1)	Fire
11/01	Fort Myers, FL	Passenger and Cargo	Piper Aerostar 601P	Destroyed	Fatal (1)	In-flight collision with terrain
11/02	Apopka, FL	Cargo	Piper Aerostar 600	Destroyed	Fatal (2)	In-flight collision with terrain
11/02	St. Paul, MN	Passenger	Bell 206L-3	Substantial	None	Loss of power (total) — nonmechanical
11/07	Quinhagak, AK	Passenger	Cessna 207	Substantial	None	Airframe/component/system failure/ malfunction

Table 40
List of Accidents (Continued)
Nonscheduled 14 CFR 135 Operations
1989

Date	Location	Type of Operation	Aircraft Type	Aircraft Damage	Degree of Injury	First Occurrence
11/13	Atlanta, GA	Cargo	Learjet 24	Substantial	None	On-ground collision with object
11/14	Morrisville, NC	Cargo	Piper PA-32R-300	Destroyed	Minor	Loss of power (total) — nonmechanical
11/25	EEK, AK	Passenger	Piper PA-32-260	Substantial	None	Loss of control — in flight
11/28	Block Island, RI	Passenger	Britten-Norman BN-2	Destroyed	Fatal (8)	In-flight collision with terrain
12/22	Beluga, AK	Passenger	Piper PA-31	Destroyed	Fatal (1)	In-flight collision with object
12/23	Brevig Mission, AK	Cargo	Beech 18	Substantial	None	Loss of power
12/27	S. Marsh Island, Gulf of Mexico	Passenger	Bell 206L-1	Destroyed	Serious	Loss of control — in flight

Source: U.S. National Transportation Safety Board

Table 41
Persons by Role and Degree of Injury
Nonscheduled 14 CFR 135 Operations
1989

Role of Person	Degree of Injury				Total
	Fatal	Serious	Minor	None	
Pilot	24	11	12	65	112
Co-pilot	4	1	2	2	9
Cabin attendants	1	0	0	0	1
Other crew	6	0	0	1	7
Passenger	46	19	35	112	212
Total aboard	81	31	49	180	341
Other aircraft*	1	0	4	6	11
Other ground	1	0	5	1	7
Grand total	83	31	58	187	359
Percent	23.1	8.6	16.2	52.1	

* Injuries carried opposite "Other aircraft" are injuries occurring in aircraft that are not part of this tabulation, but that were involved in collisions with aircraft that are a part of this tabulation.

Source: U.S. National Transportation Safety Board

Table 42
Aircraft by Damage and Degree of Injury
Nonscheduled 14 CFR 135 Operations
1989

Aircraft Damage	Degree of Injury				Aircraft	
	None	Minor	Serious	Fatal	No.	Percent
None	0	0	0	0	0	.0
Minor	0	0	0	0	0	0
Substantial	59	12	8	1	80	71.4
Destroyed	1	2	5	24	32	28.6
Aircraft						
Number	60	14	13	25	112	
Percent	53.6	12.5	11.6	22.3		

Source: U.S. National Transportation Safety Board

Table 43
Aircraft by First Occurrence and Degree of Injury and by Damage
Nonscheduled 14 CFR 135 Operations
1989

Type of First Occurrence	Degree of Injury				Aircraft Damage				Aircraft	
	None	Minor	Serious	Fatal	None	Minor	Substantial	Destroyed	No.	Percent
Altitude deviation uncontrolled	1	1	0	0	0	0	2	0	2	1.8
Airframe/component/system failure/malfunction	3	1	0	3	0	0	3	4	7	6.3
Fire/explosion	1	0	0	0	0	0	1	0	1	.9
Fire	0	0	0	2	0	0	1	1	2	1.8
Main gear collapsed	1	1	0	0	0	0	2	0	2	1.8
Nose gear collapsed	1	0	0	0	0	0	1	0	1	.9
Gear not extended	1	0	0	0	0	0	1	0	1	.9
Hard landing	4	0	0	0	0	0	4	0	4	3.6
In-flight collision with object	3	0	1	3	0	0	3	4	7	6.3
In-flight collision with terrain	5	0	3	5	0	0	8	5	13	11.6
In-flight encounter with weather	2	1	1	4	0	0	3	5	8	7.1
Loss of control — in flight	4	0	2	5	0	0	5	6	11	9.8
Loss of control — on ground	4	1	1	0	0	0	6	0	6	5.4
Midair collision	0	0	0	1	0	0	0	1	1	.9
Nose over	2	0	1	0	0	0	3	0	3	2.7
On-ground collision with object	8	1	0	0	0	0	9	0	9	8.0
Overrun	3	0	1	0	0	0	4	0	4	3.6
Loss of power	1	2	1	0	0	0	3	1	4	3.6
Loss of power (total) — mechanical failure/malfunction	4	2	2	2	0	0	6	4	10	8.9
Loss of power (partial) — mechanical failure/malfunction	1	1	0	0	0	0	2	0	2	1.8
Loss of power (total) — nonmechanical	3	1	0	0	0	0	3	1	4	3.6
Loss of power (partial) — nonmechanical	2	0	0	0	0	0	2	0	2	1.8
Roll over	0	1	0	0	0	0	1	0	1	.9
Undershoot	1	0	0	0	0	0	1	0	1	.9
Miscellaneous/other	2	0	0	0	0	0	2	0	2	1.8
Not reported	2	1	0	0	0	0	3	0	3	2.7
Other	1	0	0	0	0	0	1	0	1	.9
Aircraft										
Number	60	14	13	25	0	0	80	32	112	
Percent	53.6	12.5	11.6	22.3	.0	.0	71.4	28.6		

Source: U.S. National Transportation Safety Board

Table 44
Aircraft by First Occurrence and Broad Phase of Operation
Nonscheduled 14 CFR 135 Operations
1989

Type of First Occurrence	Phase of Operation										Aircraft	
	Standing	Taxi	Takeoff	Climb	Cruise	Descent	Approach	Landing	Maneuver	Other	No.	Percent
Altitude deviation — uncontrolled	0	0	1	0	0	0	0	0	1	0	2	1.8
Airframe/component/system failure/malfunction	0	0	1	0	5	0	0	1	0	0	7	6.3
Fire/explosion	0	0	1	0	0	0	0	0	0	0	1	.9
Fire	0	0	1	1	0	0	0	0	0	0	2	1.8
Main gear collapsed	0	1	0	0	0	0	0	1	0	0	2	1.8
Nose gear collapsed	0	0	0	0	0	0	0	1	0	0	1	1.8
Gear not extended	0	0	0	0	0	0	0	1	0	0	1	1.8
Hard landing	0	0	0	0	0	0	0	4	0	0	4	3.6
In-flight collision w/object	0	0	2	0	0	0	3	0	2	0	7	6.3
In-flight collision w/terrain	0	0	2	0	0	2	2	1	4	2	13	11.6
In-flight encounter w/weather	0	0	1	0	3	1	3	0	0	0	8	7.1
Loss of control — in flight	0	0	3	0	1	0	3	1	2	1	11	9.8
Loss of control — on ground	0	1	0	0	0	0	0	5	0	0	6	5.4
Midair collision	0	0	0	1	0	0	0	0	0	0	1	1.8
Nose over	0	0	0	0	0	0	0	3	0	0	3	2.7
On-ground collision w/object	0	4	1	0	0	0	0	4	0	0	9	8.0
Overrun	0	0	1	0	0	0	0	2	0	1	4	3.6
Loss of power	0	0	0	0	2	0	2	0	0	0	4	3.6
Loss of power (total) — mechanical failure/malfunction	0	0	0	2	6	1	1	0	0	0	10	8.9
Loss of power (partial) — mechanical failure/malfunction	0	0	1	0	0	0	0	0	1	0	2	1.8
Loss of power (total) — nonmechanical	0	0	0	0	2	0	2	0	0	0	4	3.6
Loss of power (partial) — nonmechanical	0	0	0	0	1	0	1	0	0	0	2	1.8
Roll over	0	0	1	0	0	0	0	0	0	0	1	.9
Undershoot	0	0	0	0	0	0	0	1	0	0	1	.9
Miscellaneous/other	2	0	0	0	0	0	0	0	0	0	2	1.8
Not reported	0	0	0	0	0	0	0	1	0	3	4	3.6
Aircraft												
Number	2	6	16	4	20	4	17	26	10	7	112	
Percent	1.8	5.4	14.3	3.6	17.9	3.6	15.2	23.2	8.9	6.3		

Source: U.S. National Transportation Safety Board

Table 45
Aircraft by Phase of Operation and Degree of Injury and by Damage
Nonscheduled 14 CFR 135 Operations
1989

Phase of Operation	Degree of Injury				Aircraft Damage				Aircraft	
	None	Minor	Serious	Fatal	None	Minor	Substantial	Destroyed	No.	Percent
Altitude deviation uncontrolled	1	1	0	0	0	0	2	0	2	1.8
Standing	1	0	0	0	0	0	1	0	1	.9
Standing — engine(s) operating	1	0	0	0	0	0	1	0	1	.9
Taxi	1	0	0	0	0	0	1	0	1	.9
Taxi — to takeoff	0	2	0	0	0	0	2	0	2	1.8
Taxi — from landing	3	0	0	0	0	0	3	0	3	2.7
Takeoff	3	1	0	1	0	0	4	1	5	4.5
Takeoff — ground run	3	0	0	0	0	0	3	0	3	2.7
Takeoff — initial climb	4	1	0	3	0	0	5	3	8	7.1
Climb	0	1	0	0	0	0	1	0	1	.9
Climb — to cruise	1	0	0	2	0	0	2	1	3	2.7
Cruise	2	0	0	4	0	0	2	4	6	5.4
Cruise — normal	6	3	2	3	0	0	8	6	14	12.5
Descent	0	0	1	1	0	0	1	1	2	1.8
Descent — normal	0	0	1	1	0	0	0	2	2	1.8
Approach	0	0	0	2	0	0	0	2	2	1.8
Approach — visual flight rules (VFR) pattern — base turn	0	1	0	0	0	0	1	0	1	.9
Approach — VFR pattern — final approach	4	0	0	1	0	0	4	1	5	4.5
Approach — go-around (VFR)	1	0	1	0	0	0	1	1	2	1.8
Approach — initial approach fix (IAF) to final approach fix (FAF)/outer marker instrument flight rules(IFR)	0	1	0	1	0	0	0	2	2	1.8
Approach — FAF/outer marker to threshold (IFR)	0	1	1	2	0	0	1	3	4	3.6
Approach — missed approach (IFR)	0	0	1	0	0	0	0	1	1	.9
Landing	5	0	0	0	0	0	5	0	5	4.5
Landing — flare/touchdown	7	0	1	0	0	0	8	0	8	7.1
Landing — roll	10	1	2	0	0	0	13	0	13	11.6
Maneuvering	3	1	3	2	0	0	7	2	9	8.0
Hover	1	0	0	0	0	0	1	0	1	.9
Other	4	1	0	2	0	0	5	2	7	6.3
Aircraft										
Number	60	14	13	25	0	0	80	32	112	
Percent	53.6	12.5	11.6	22.3	.0	.0	71.4	28.6		

Source: U.S. National Transportation Safety Board

Table 46
Aircraft by Condition of Light and Type of Weather
Nonscheduled 14 CFR 135 Operations
1989

Condition of Light	Type of Weather			Aircraft	
	Visual Meteorological Conditions (VMC)	Instrument Meteorological Conditions (IMC)	Not reported	No.	Percent
Dawn	3	3	0	6	5.4
Daylight	63	10	1	74	66.1
Night (dark)	16	12	0	28	25.0
Night (bright)	3	0	0	3	2.7
Not Reported	1	0	0	1	.9
Aircraft					
Number	86	25	1	112	
Percent	76.8	22.3	.9		

Source: U.S. National Transportation Safety Board

Table 47
Aircraft by Type of Operation and Degree of Injury
Nonscheduled 14 CFR 135 Operations
1989

Type of Operation	Degree of Injury				Aircraft	
	None	Minor	Serious	Fatal	No.	Percent
Domestic passenger	25	3	9	11	48	42.9
Domestic cargo	27	8	3	8	46	41.1
Domestic passenger/cargo	5	1	1	6	13	11.6
International passenger	1	1	0	0	2	1.8
International cargo	1	1	0	0	2	1.8
International passenger/cargo	1	0	0	0	1	.9
Aircraft						
Number	60	14	13	25	112	
Percent	53.6	12.5	11.6	22.3		

Source: U.S. National Transportation Safety Board

Table 48
Aircraft by Proximity to Airport and Flight Plan
Nonscheduled 14 CFR 135 Operations
1989

Accident Location	Flight Plan				Aircraft	
	None	Visual Flight Rules (VFR)	Instrument Flight Rules (IFR)	Company VFR	No.	Percent
Off airport/airstrip	11	7	14	31	63	56.3
On airport	3	6	17	13	39	34.8
On airstrip	1	1	1	3	6	5.4
Other	0	3	0	1	4	3.6
Aircraft						
Number	15	17	32	48	112	
Percent	13.4	15.2	28.6	42.9		

Source: U.S. National Transportation Safety Board

Table 49
Aircraft by Occurrence of Fire and Degree of Injury and by Damage
Nonscheduled 14 CFR 135 Operations
1989

Aircraft Fire	Degree of Injury				Aircraft Damage				Aircraft	
	None	Minor	Serious	Fatal	None	Minor	Substantial	Destroyed	No.	Percent
None	53	12	11	12	0	0	72	16	88	78.6
In flight	1	1	0	1	0	0	2	1	3	2.7
On ground	4	1	2	10	0	0	4	13	17	15.2
In flight and on ground	0	0	0	1	0	0	0	1	1	.9
Other	2	0	0	1	0	0	2	1	3	2.7
Aircraft										
Number	60	14	13	25	0	0	80	32	112	
Percent	53.6	12.5	11.6	22.3	.0	.0	71.4	28.6		

Source: U.S. National Transportation Safety Board

Table 50
Aircraft by Type of Aircraft and Degree of Injury and by Damage
Nonscheduled 14 CFR 135 Operations
1989

Type of Aircraft	Degree of Injury				Aircraft Damage				Aircraft	
	None	Minor	Serious	Fatal	None	Minor	Substantial	Destroyed	No.	Percent
All fixed wing *	51	10	9	18	0	0	66	22	88	78.6
Fixed-wing single reciprocating engine	28	4	6	3	0	0	35	6	41	36.6
Fixed-wing multiple reciprocating engines	15	3	0	11	0	0	19	10	29	25.9
Fixed-wing turboprop	7	2	2	4	0	0	9	6	15	13.4
Fixed-wing turbojet	1	1	1	0	0	0	3	0	3	2.7
All rotorcraft *	9	4	4	7	0	0	14	10	24	21.4
Rotorcraft turbine engine	9	4	4	7	0	0	14	10	24	21.4
Aircraft										
Number	60	14	13	25	0	0	80	32	112	
Percent	53.6	12.5	11.6	22.3	.0	.0	71.4	28.6		

* Not included in column totals

Source: U.S. National Transportation Safety Board

Table 51
Broad Cause/Factor Assignments*
Nonscheduled 14 CFR 135 Operations
1989

Cause/Factor dents	Cited as a Cause		Cited as a Factor		Cited as Either A Cause or a Factor (or Both)	
	Fatal Accidents	All Accidents	Fatal Accidents	All Accidents	Fatal Accidents	All Acci-
Aircraft #	9	25	2	6	9	31
Propulsion system and controls	5	13	1	1	5	14
Flight control system	2	2	0	1	2	3
Airframe	2	2	1	1	2	3
Landing gear	0	3	0	0	0	3
Systems/equipment/instruments	1	5	0	2	1	7
Environment #	0	4	13	61	13	62
Weather	0	4	8	31	8	34
Light conditions	0	0	4	11	4	11
Object (trees, wires, etc.)	0	1	4	14	4	15
Airport/airways facilities, aids	0	0	0	1	0	1
Terrain/runway condition	0	0	4	37	4	37
Personnel #	17	69	8	27	19	70
Pilot	16	60	6	22	17	60
Others (aboard)	0	0	0	0	0	0
Others (not aboard)	2	13	4	6	6	16
Number of aircraft					25	112
NTSB-determined probable cause					25	108

* Multiple causes and factors may be assigned in an accident.

This category is composed of subcategories indented below it. The number of aircraft cited in a category may be less than or equal to the sum of the subcategory citations.

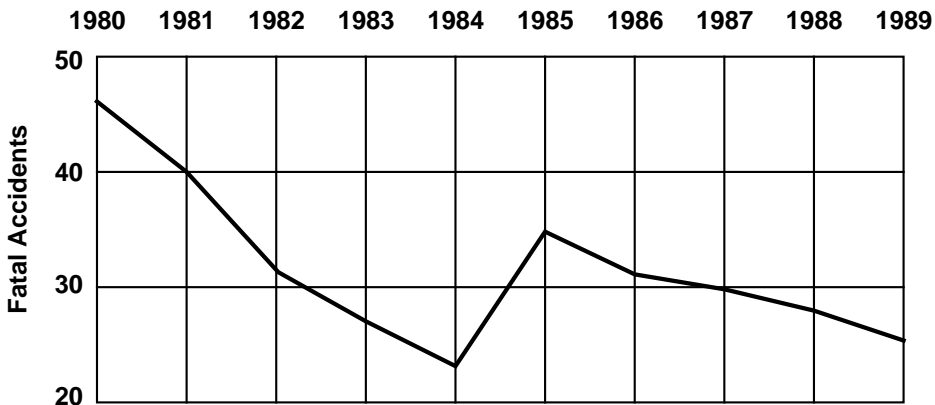
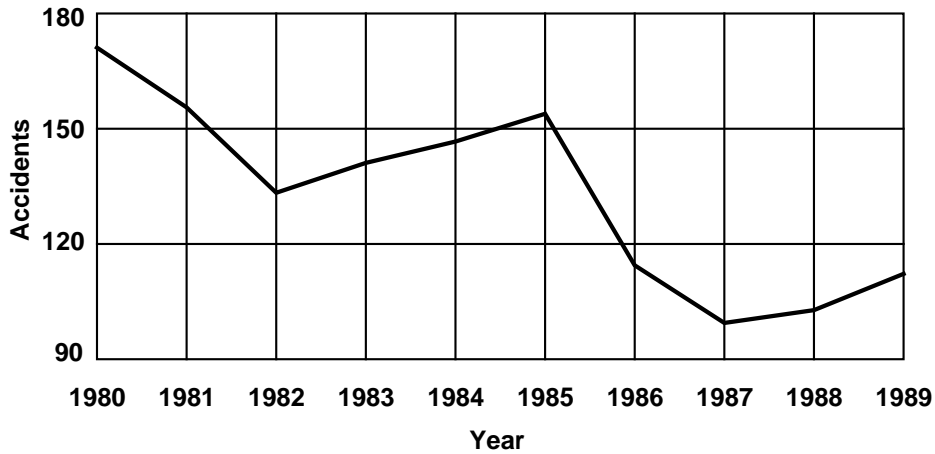
Source: U.S. National Transportation Safety Board

Table 52
Accidents, Fatal Accidents, Fatalities and Rates
Nonscheduled 14 CFR 135 Operations
1980-1989

Year	Accidents	Fatal Accidents	Fatalities		Hours Flown	Accident Rate per 100,000* Aircraft Hours Flown	
			Total	In This Category		Total	Fatal
1980	171	46	105	101	3,617,724	4.73	1.27
1981	157	40	94	92	2,895,827	5.42	1.38
1982	132	31	72	72	3,008,000	4.39	1.03
1983	141	27	62	57	2,378,000	5.93	1.14
1984	146	23	52	52	2,843,000	5.14	0.81
1985	154	35	76	75	2,570,000	5.99	1.36
1986	117	31	65	61	2,690,000	4.35	1.15
1987	97	30	65	63	2,657,000	3.65	1.13
1988	101	28	59	55	2,632,000	3.84	1.06
1989	111	25	83	81	3,020,000	3.68	0.83

Source: U.S. National Transportation Safety Board

Accidents and Fatal Accidents
Nonscheduled 14 CFR 135 Operations



Source: U.S. National Transportation Safety Board

Figure 13

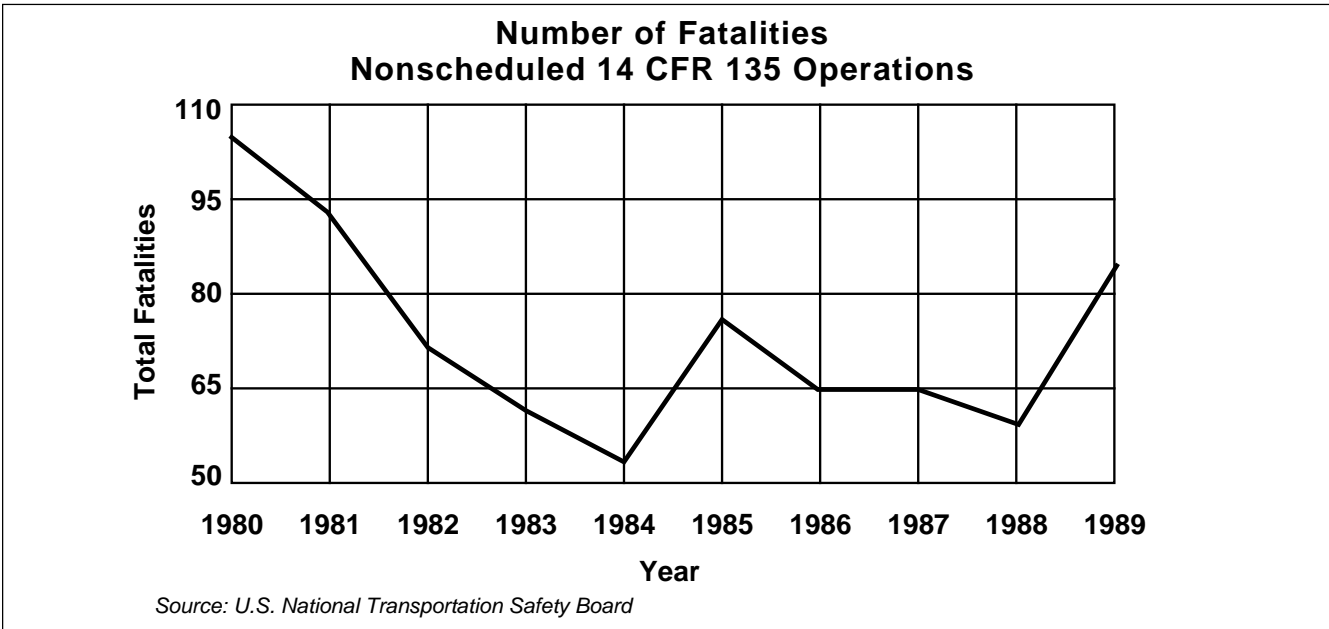


Figure 14

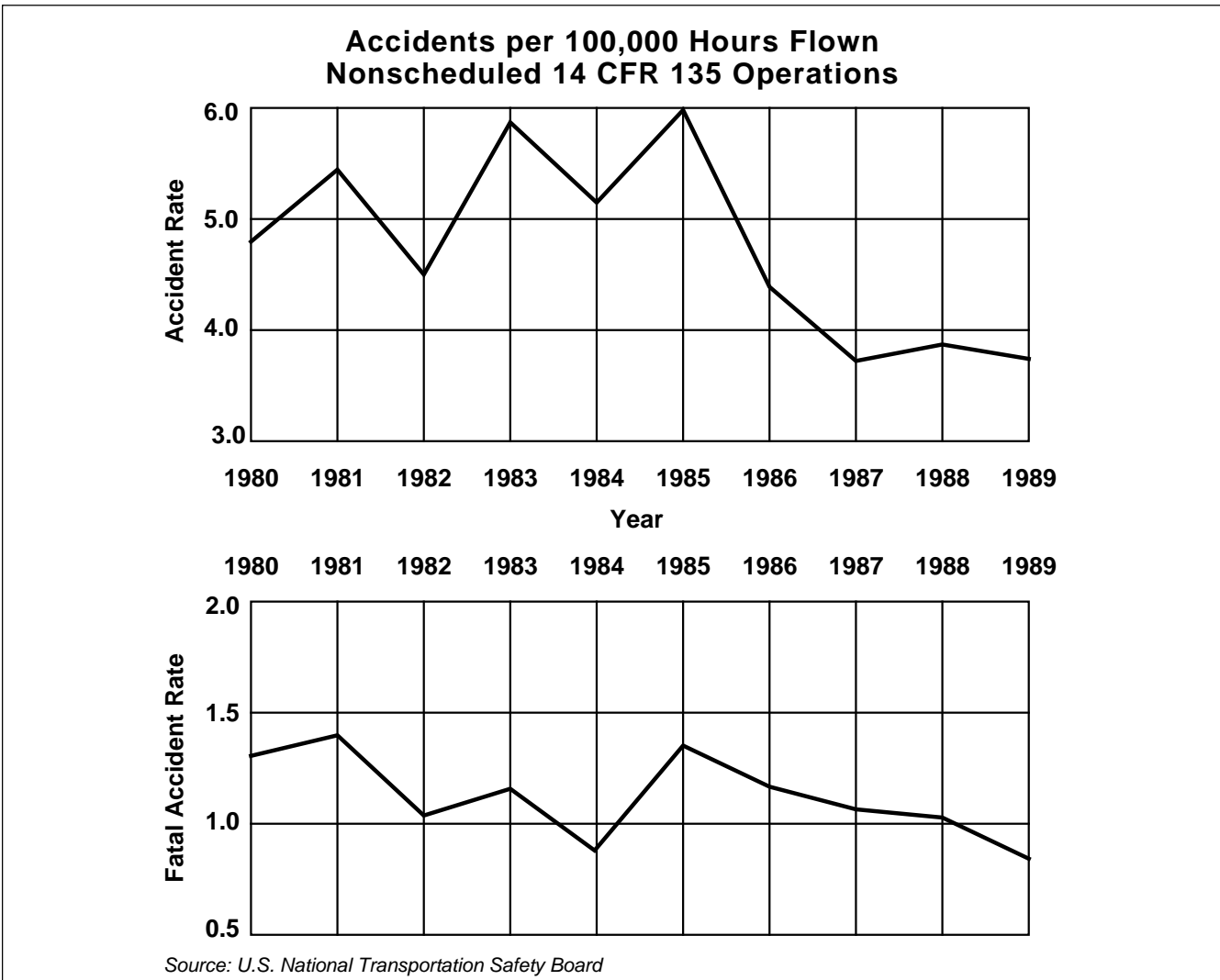


Figure 15

Table 53
First Occurrences in All Accidents and in Fatal Accidents
Nonscheduled 14 CFR 135 Operations
1989 and 1984-1988

Type of Occurrence Percent	All Accidents				Fatal Accidents			
	1989		1984-1988		1989		1984-1988	
	No.	Percent	Mean	Percent	No.	Percent	Mean	
Loss of control — in flight	11	9.8	14.2	11.4	5	20.0	6.8	23.0
Loss of control — on ground	6	5.4	10.8	8.7	0	.0	.4	1.4
In-flight encounter with weather	8	7.1	10.4	8.3	4	16.0	4.8	16.2
Loss of engine power (total) — nonmechanical	4	3.6	10.0	8.0	0	.0	.8	2.7
Airframe/component/system failure/malfunction	7	6.3	9.6	7.7	3	12.0	2.2	7.4
In-flight collision with object	7	6.3	9.6	7.7	3	12.0	2.6	8.8
In-flight collision w/terrain	13	11.6	9.4	7.5	5	20.0	4.6	15.5
Loss of engine power (total) — mechanical failure/malfunction	10	8.9	7.8	6.3	2	8.0	1.0	3.4
On-ground collision with object	9	8.0	6.6	5.3	0	.0	.6	2.0
Loss of engine power (partial) — mechanical failure/malfunction	2	1.8	4.0	3.2	0	.0	1.0	3.4
Overrun	4	3.6	3.6	2.9	0	.0	.0	.0
Loss of engine power	4	3.6	3.6	2.9	0	.0	1.2	4.1
Main gear collapsed	2	1.8	3.0	2.4	0	.0	.0	.0
On-ground collision w/terrain	0	.0	2.8	2.2	0	.0	.0	.0
Fire	2	1.8	2.4	1.9	2	8.0	.4	1.4
Undershoot	1	.9	2.0	1.6	0	.0	.2	.7
Loss of engine power (partial) — nonmechanical	2	1.8	1.8	1.4	0	.0	.0	.0
Midair collision	1	.9	1.6	1.3	1	4.0	.8	2.7
Hard landing	4	3.6	1.4	1.1	0	.0	.0	.0
Miscellaneous/other	2	1.8	1.2	1.0	0	.0	.2	.7
Nose gear collapsed	1	.9	1.0	.8	0	.0	.0	.0
Abrupt maneuver	0	.0	.8	.6	0	.0	.6	2.0
Explosion	0	.0	.8	.6	0	.0	.2	.7
Propeller/rotor contact to person	0	.0	.8	.6	0	.0	.0	.0
Not reported	3	2.7	.6	.5	0	.0	.0	.0
Altitude deviation, uncontrolled	2	1.8	.6	.5	0	.0	.2	.7
Gear not extended	1	.9	.6	.5	0	.0	.0	.0
Nose over	3	2.7	.6	.5	0	.0	.0	.0
Roll over	1	.9	.6	.5	0	.0	.2	.7
Fire/explosion	1	.9	.4	.3	0	.0	.0	.0
On-ground encounter with weather	0	.0	.4	.3	0	.0	.0	.0
Undetermined	0	.0	.4	.3	0	.0	.4	1.4
Missing aircraft	0	.0	.4	.3	0	.0	.4	1.4
Dragged wing, rotor, pod or float	0	.0	.2	.2	0	.0	.0	.0
Forced landing	0	.0	.2	.2	0	.0	.0	.0
Gear collapsed	0	.0	.2	.2	0	.0	.0	.0
Other gear collapsed	0	.0	.2	.2	0	.0	.0	.0
Gear not retracted	1	.9	.0	.0	0	.0	.0	.0
Total	112	100.0	124.6	100.0	25	100.0	29.6	100.0

Source: U.S. National Transportation Safety Board

Table 54
First Phases of Operation in All Accidents and in Fatal Accidents
Nonscheduled 14 CFR 135 Operations
1989 and 1984-1988

Phase of Operation	All Accidents				Fatal Accidents			
	1989		1984-1988		1989		1984-1988	
	No.	Percent	Mean	Percent	No.	Percent	Mean	Percent
Takeoff	18	16.1	26.6	21.3	4	16.0	4.4	14.9
Cruise	20	17.9	24.4	19.6	7	28.0	7.2	24.3
Landing	27	24.1	23.4	18.8	1	4.0	1.2	4.1
Approach	17	15.2	16.4	13.2	6	24.0	6.4	21.6
Maneuvering	10	8.9	9.6	7.7	2	8.0	4.4	14.9
Climb	4	3.6	6.4	5.1	2	8.0	2.2	7.4
Taxi	6	5.4	6.0	4.8	0	.0	.0	.0
Descent	4	3.6	4.8	3.9	2	8.0	1.8	6.1
Standing	2	1.8	3.8	3.0	0	.0	.6	2.0
Other	4	3.6	3.2	2.6	1	4.0	1.4	4.7
Total aircraft	112	100.0	124.6	100.0	25	100.0	29.6	100.0

Source: U.S. National Transportation Safety Board

Table 55
Broad Cause/Factor Assignments in All Accidents and in Fatal Accidents
Nonscheduled 14 CFR 135 Operations
1989 and 1984-1988

Broad Cause/Factor cent	All Accidents				Fatal Accidents			
	1989		1984-1988		1989		1984-1988	
	No.	Percent	Mean	Percent	No.	Percent	Mean	Per-
Pilot	77	68.8	96.0	77.0	17	68.0	25.4	85.8
Weather	42	37.5	37.2	29.9	8	32.0	13.2	44.6
Terrain/runway condition	41	36.6	37.0	29.7	4	16.0	9.0	30.4
Propulsion system and controls	19	17.0	28.4	22.8	5	20.0	4.4	14.9
Other person (not aboard)	22	19.6	21.4	17.2	6	24.0	7.8	26.4
Light conditions	15	13.4	21.2	17.0	4	16.0	8.6	29.1
Object (tree, wires, etc.)	19	17.0	19.4	15.6	4	16.0	5.4	18.2
Landing gear	3	2.7	12.0	9.6	0	.0	.4	1.4
Systems/equipment/ instruments	8	7.1	10.2	8.2	1	4.0	3.2	10.8
Airframe	5	4.5	6.0	4.8	2	8.0	1.8	6.1
Flight control system	5	4.5	2.6	2.1	2	8.0	1.4	4.7
Airport/airways facilities, aids	1	.9	2.2	1.8	0	.0	.4	1.4
Other person (aboard)	0	0	0.2	0	0	0	0	0
Total Aircraft	112		124.6		25		29.6	
NTSB-determined probable cause	108		123.6		25		29.6	

Source: U.S. National Transportation Safety Board

Appendix A

Midair Collision Accidents

U.S. Air Carrier Operations 1980-1989

Year	Accidents		Total Fatalities	Number of Accidents By Segments of Aviation Involved		
	Total	Fatal		S135 and GA	N135 and N135	N135 and GA
1980	3	3	3	0	1	2
1981	4	3	20	1	1	2
1982	3	1	3	1	1	1
1983	1	1	4	0	0	1
1984	1	1	17	1	0	0
1985	2	1	1	0	2	0
1986	0	0	0	0	0	0
1987	5	2	12	3	0	2
1988	2	1	4	0	0	2
1989	<u>1</u>	<u>1</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>1</u>
	22	14	66	6	5	11

Note: S135 = Scheduled 14 CFR 135 operation
 N135 = Nonscheduled 14 CFR 135 operation
 GA = General aviation

Appendix B

Explanatory Notes

Aircraft Accident: The accidents included herein are the occurrences incident to flight in which, as a result of the operation of an aircraft, any person (occupant or nonoccupant) receives fatal or serious injury or any aircraft receives substantial damage. The definition of substantial damage is:

- (1) Substantial damage means damage or failure that adversely affects the structural strength, performance or flight characteristics of the aircraft, and would normally require major repair or replacement of the affected component.
- (2) Engine failure, damage limited to an engine, bent fairings or cowling, dented skin, small punctured holes in the skin or fabric, ground damage to rotor or propeller blades, damage to landing gear, wheels, tires, flaps, engine accessories, brakes, or wingtips are not considered substantial damage.

Aircraft-Miles: The distance flown by aircraft in terms of great circle airport-to-airport distances measured in statute miles.

Causes and Related Factors: In determining probable cause(s) of an accident, all facts, conditions and circumstances are considered. The objective is to ascertain those cause and effect relationships in the accident sequence about which something can be done to prevent recurrence of the type of accident under consideration. Accordingly, for statistical purposes, where there are two or more causes of an accident, each is recorded and no attempt is made to establish a primary cause. Therefore, in the cause and related factor table, the figures shown in the columns dealing with cause will exceed the total number of accidents. The term factor is used, in general, to denote those elements of an accident that further explain or supplement the probable cause(s); this provides a means for collecting essential items of information that could not be readily categorized elsewhere in the system.

Collision Between Aircraft: Collisions between aircraft are so classified only when both aircraft are occupied. This includes collisions wherein both aircraft are airborne (midair); one is airborne, the other on the ground; and both are on the ground. A collision with a parked, unoccupied aircraft is classified under the broad category of collision with objects.

Fatal Injury: Any injury that results in death within 30 days of the accident.

Injury Index: Injury index refers to the highest degree of personal injury sustained as a result of the accident.

Nonscheduled Service: Revenue flights that are not operated in regular scheduled service, such as charter flights, and all nonrevenue flights incident to such flights.

Passenger Miles: One passenger transported one mile. Passenger miles are computed by the summation of the products of the aircraft-miles flown on each interairport flight multiplied by the number of passengers carried on the flight.

Personnel (Non-pilot): As defined for the broad cause/factor tables may include any of the following personnel:

Rules, regulations, standards personnel	Flight instructor on ground
Maintenance, servicing, inspection personnel	Operational supervisor personnel
Weather service personnel	Air traffic control personnel
Airport management	Airways facilities personnel
Production-design personnel	Pilot of another aircraft
Ground signalman	Ground crewman
Passenger	Spectator
Driver of vehicle	Third pilot
Flight engineer	Navigator
Radio operator	Flight attendant
Other flight personnel	Dispatching personnel

Phase of Operation: The phase of flight in which the first occurrence happened.

Revenue Passenger: A person receiving air transportation from an air carrier for which remuneration is received by the air carrier. Air carrier employees and others receiving air transportation for which a token service charge is levied are considered nonrevenue passengers.

Revenue Plane-miles: The total plane-miles flown in revenue service.

Rotorcraft (Broad Cause/Factor): When any part, assembly, or system that is unique to rotorcraft is cited as a cause or factor, then rotorcraft is considered a broad cause or factor in that accident.

Serious Injury: Any injury that 1) requires hospitalization for more than 48 hours, commencing within seven days from the date the injury was received; 2) results in a fracture of any bone (Except simple fractures of fingers, toes or nose); 3) involves lacerations that cause severe hemorrhages of nerve, muscle or tendon damage; 4) involves injury to any internal organ; or 5) involves second- or third-degree burns, or any burns affecting more than 5 percent of body surface.

Type of Occurrence: Occurrence is the highest level of an accident classification mechanism known as the sequence of events. This concept was introduced in 1982 accident investigations to describe the circumstances in an accident. To describe an accident, up to five occurrences may be used. Typically each occurrence is further defined by one or more findings which, when presented chronologically, depict the accident scenario from beginning to end in considerable detail. The findings are developed by NTSB analysts from a menu of words and phrases, and are the most detailed means of classifying an accident. The findings are also the vehicle used to describe the probable cause of, and related factors in, an accident. The example below illustrates the relationship between occurrences and findings.

Occurrence #1 LOSS OF POWER (PARTIAL) - MECHANICAL FAILURE / MALFUNCTION
Phase of Operation TAKEOFF - GROUND RUN

Finding(s)

1. COMPRESSOR ASSEMBLY - FATIGUE
2. COMPRESSOR ASSEMBLY - FAILURE, TOTAL
3. MATERIAL DEFECT (INADEQUATE QUALITY CONTROL) - MANUFACTURER

Types of Weather Conditions: The types of weather conditions visual meteorological conditions (VMC)/instrument meteorological conditions (IMC) are determined in accordance with the prescribed minima in Part 91 of the Federal Aviation Regulations. These minima pertain to the ceiling and visibility, in conjunction with the type of airspace, at the accident site. Type of weather conditions is based on surface weather as determined from officially recognized sources. Weather conditions encountered in flight are not necessarily representative of the flight plan classifications visual flight rules (VFR)/instrument flight rules (IFR) as carried under type of weather conditions.

Appendix C

Detailed Cause/Factor Assignments 14 CFR 121, 125 and 127 Operations

Cause/Factor Table 14 CFP 121, 125 and 127 Operations 1989

	Cause or Factor	Cause
Aircraft		
Air cond/heating/pressurization	1	1
Auxiliary power unit	1	1
Compressor assembly, forward fan	1	1
Door cargo	2	1
Door, inspection	1	0
Electrical system, electric wiring	1	1
Engine installation, mounting bolt	1	1
Fluid, hydraulic	1	1
Fuselage, cabin	1	0
Horizontal stabilizer surface	1	1
Hydraulic system	1	1
Hydraulic system, line	1	1
Hydraulic system, shutoff valve	1	0
Landing gear, emergency brake system	1	1
Landing gear, gear locking mechanism	1	1
Landing gear, main gear	1	1
Landing gear, normal brake system	2	2
Lubricating system	1	0
Oxygen system, passenger	1	1
Thrust reverser, accumulator	1	1
Facility		
Aircraft manuals, procedure information	1	0
Environment		
Aircraft parked	1	0
Downdraft	1	1
Icing conditions	1	0
Lightning strike	1	1
Terrain condition	2	0
Turbulence	2	1
Turbulence, clear air	2	1
Flight Crew		
Aborted landing	1	1
Aborted takeoff	1	1
Airspeed	1	0
Altitude	1	0
Anti-ice/deice system	1	0
Checklist	1	1
Compensation for wind conditions	1	1

	Cause or Factor	Cause
Flight Crew (continued)		
Crew/group coordination	1	0
Design stress limits of aircraft	1	1
Directional control	1	1
Emergency procedure	1	1
Equipment, other	1	1
Flare	2	2
Fuel supply	1	1
In-flight planning/decision	2	2
Incapacitation (anoxia/hypoxia)	1	1
Oxygen system	1	1
Powerplant controls	1	1
Procedures/directives	1	1
Proper descent rate	1	1
Remedial action	2	2
Touchdown	1	1
Trim setting	1	1
Other Person		
Acft/equip, inadequate standard/requirement	1	0
Aircraft/equipment inadequate	1	0
Aircraft/equipment, inadequate design	1	0
Airplane handling	1	1
Inadequate surveillance of operation	1	0
Insufficient standards/requirements — aircraft	2	0
Lack of total experience in type operation	1	0
Maintenance	1	0
Maintenance, inspection of aircraft	3	1
Maintenance, installation	1	1
Maintenance, overhaul	1	1
Maintenance, overhaul, major	1	1
Maintenance, replacement	1	1
Maintenance, service bulletins	1	0
Material defect	1	0
Material defect (inadequate quality control)	1	1
Overconfidence in personal ability	1	0
Procedures/directives	4	3
Seat belt	2	2
Supervision	1	1
Weather evaluation	1	1

Source: U.S. National Transportation Safety Board

Appendix D

Detailed Cause/Factor Assignments Scheduled 14 CFR 135 Operations

**Cause/Factor Table
Scheduled 14 CFR 135 Operations
1989**

	Cause or Factor	Cause
Aircraft		
Fluid fuel	1	1
Horizontal stabilizer surface	1	0
Powerplant	1	1
Wing	1	0
Facility		
Airport facilities, runway edge lights	1	0
Environment		
Aircraft moving on ground	1	0
Clouds	1	0
Dark night	4	0
Drizzle	2	0
Dusk	1	0
Fog	5	0
Icing conditions	1	0
Low ceiling	4	0
Night	1	0
Obscuration	1	0
Rain	3	0
Snow	1	0
Terrain condition	6	0
Unfavorable wind	1	0
Vehicle	1	0
Flight Crew		
Aircraft preflight	1	1
Airplane handling	1	1
Complacency	1	0
Crew/group coordination	1	0
Directional control	1	1
IFR procedure	1	1
In-flight planning/decision	5	4
Procedures/directives	1	1
Proper alignment	1	1
Remedial action	1	0
Stall	1	1
Supervision	1	1
VFR flight into IMC	4	4
Visual lookout	2	2
Visual/aural perception	1	0

Other Person

Air route traffic control center service	1	0
Aircraft/equipment inadequate visual restriction	1	0
Aircraft/equipment inadequate design	1	0
Airplane handling	1	1
Airport operations	1	1
Airport snow removal	1	0
Clearance	1	1
Complacency	1	1
Diverted attention	1	0
Improper initial training	1	0
Inadequate surveillance of operation	1	0
Inadequate training	1	0
Judgment	1	1
Maintenance modification	1	0
Physical impairment (alcohol)	1	1
Refueling	1	0
Supervision	1	0
Taxi speed	1	1
Traffic advisory	1	0
Visual lookout	4	3

Source: U.S. National Transportation Safety Board

Appendix E

Detailed Cause/Factor Assignments

Nonscheduled 14 CFR 135 Operations

Cause/Factor Table
Nonscheduled 14 CFR 135 Operations
1989

	Cause or Factor	Cause
Aircraft		
Aircraft performance climb capability	1	1
Aircraft performance hydroplaning condition	1	0
Electrical system	2	2
Engine assembly, crankshaft counterweights/vibration damper	1	1
Engine assembly, connecting rod	1	1
Engine assembly, connecting rod bolt	1	1
Engine assembly, crankshaft	3	3
Engine assembly, cylinder	1	0
Exterior lights	1	1
Flight control surfaces/attachments	1	1
Flight control flap attachment	1	0
Flight control rudder	1	1
Fluid, fuel	4	4
Fluid, oil	2	2
Fuel system	1	1
Fuel system, PC line	1	1
Fuel system fuel control	1	1
Fuel system nozzle	1	1
Fuel system, tank	1	1
Fuselage, crew compartment	2	2
Hydraulic system	1	1
Landing gear, main gear strut	1	1
Landing gear, main gear strut scissors	1	1
Landing gear, normal retraction/extension assembly	1	1
Landing light	1	0
Lubricating system, oil hose	1	1
Lubricating system, oil seal	1	1
Misc eqpt/furnishings, parachute/drag chute	1	0
Miscellaneous	1	1
Powerplant	2	2
Propeller system/accessories	1	0
Propeller system/accessories, hub	1	1
Rotor system, main rotor blade	1	1
Rotor system, main rotor blade spar	1	1
Rotorcraft flight control, cyclic control	1	1
Rotorcraft flight control, swashplate assembly	1	1
Turboshaft engine, gas generator turbine	1	1
Turboshaft engine, gas generator turbine shaft	1	1
Wing	3	2
Facility		
Airport facilities, aeronautical light beacon (obstacle)	1	0
Airport facilities, runway/landing area condition	6	0

	Cause or Factor	Cause
Environment		
Aircraft moving on ground	2	0
Aircraft parked	1	0
Animal(s)	1	0
Bird(s)	1	0
Clouds	1	0
Crosswind	6	1
Dark night	14	0
Dawn	1	0
Downdraft	6	0
Drizzle	2	0
Fence	2	0
Fog	11	1
Gusts	6	1
High density altitude	3	0
High wind	2	0
Icing conditions	1	0
Low ceiling	9	0
Obscuration	2	0
Other	1	1
Rain	6	0
Runway light	2	0
Snow	8	0
Tail wind	4	1
Terrain condition	39	0
Thunderstorm	1	0
Tree(s)	7	0
Turbulence	3	0
Turbulence in clouds	1	0
Turbulence (thunderstorms)	1	0
Unfavorable wind	3	0
Vehicle	2	0
Whiteout	1	0
Windshear	2	0
Wire, transmission	2	0
Flight Crew		
Aborted takeoff	1	1
Aircraft control	3	3
Aircraft preflight	2	2
Aircraft weight and balance	5	3
Airspeed	5	3
Airspeed (V_{LOF}) [liftoff speed]	1	1
Airspeed (V_{SO}) [stalling speed with flaps at landing setting]	1	1
Altitude	4	4
Autorotation	1	0
Brakes (normal)	2	1
Checklist	1	1
Clearance	5	5
Compensation for wind conditions	3	2
Complacency	1	0
Decision height	2	2
Descent	1	1

	Cause or Factor	Cause
Flight Crew (continued)		
Directional control	7	6
Distance	2	2
Emergency procedure	3	3
Flare	5	5
Flight into known adverse weather	4	2
Fuel consumption calculations	1	0
Fuel supply	3	2
Gear extension	1	1
Go-around	2	2
Hazardous weather advisory	1	1
IFR procedure	5	5
Ice/frost removal from aircraft	2	2
In-flight planning/decision	7	7
Lack of familiarity with geographic area	2	0
Lack of total experience in type of aircraft	2	0
Landing gear	1	1
Lowering of flaps	1	1
Maneuver	2	1
Minimum descent altitude	1	1
Missed approach	2	0
Operation with known deficiencies in equipment	1	0
Overconfidence in personal ability	1	0
Parking brakes	1	1
Planning-decision	7	7
Powerplant controls	1	1
Preflight planning/preparation	7	6
Procedures/directives	2	2
Propeller feathering	1	1
Proper alignment	6	5
Proper altitude	4	3
Proper assistance	1	1
Proper climb rate	1	1
Proper glidepath	1	1
Psychological condition	1	0
Recovery from bounced landing	2	2
Refueling	1	1
Remedial action	2	1
Reversers	1	0
Rotor rpm	1	1
Self-induced pressure	2	0
Spatial disorientation	1	1
Stall	1	1
Stall/mush	1	1
Taxi speed	1	1
Trim setting	1	1
Unsuitable terrain	1	1
VFR flight into IMC	5	4
Visual lookout	5	5
Visual/aural detection	1	0
Visual/aural perception	5	1
Weather evaluation	3	3
Wheels-down landing in water	1	1
Wheels-up landing	2	2

	Cause or Factor	Cause
Other Person		
Aircraft weight and balance	1	0
Airport operations	1	1
Brakes (normal)	1	1
Communications/information/air traffic control (ATC)	1	0
Company-induced pressure	1	1
Condition(s)/step(s) insufficiently defined	1	0
Condition(s)/step(s) not listed	1	0
Flight with inadequate en route/destination facilities	1	0
Hazardous weather advisory	1	1
Inadequate initial training	2	0
Inadequate surveillance of operation	1	0
Inadequate training (emergency procedure(s))	1	0
Insufficient standards/requirements - airman	1	0
Maintenance	1	1
Maintenance, 100-hour inspection	1	1
Maintenance, adjustment	1	1
Maintenance, compliance with airworthiness directive (AD)	1	1
Maintenance, inspection of aircraft	1	0
Maintenance, installation	2	1
Maintenance, overhaul, major	1	1
Maintenance, service bulletins	2	0
Material defect	1	1
Material defect (inadequate quality control)	1	1
Traffic advisory	1	0
Unsuitable terrain	1	1
Visual lookout	2	2

Source: U.S. National Transportation Safety Board

Appendix F

NTSB Form 6120.4

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Publications Received at FSF Jerry Lederer Aviation Safety Library

by
Editorial Staff

New Reference Materials

U.S. Federal Aviation Administration. Advisory Circular 21-34, *Shoulder Harness-Safety Belt Installations*. June 1993. 47 p.: ill.

This advisory circular (AC) provides information on the installation and use of shoulder harness and safety belt restraint systems. It focuses on basic design and installation principles of combined shoulder harness and safety belt restraint systems to satisfy requirements of Federal Aviation Regulations (FAR) Parts 23, 27, 29 and 91. [Purpose and Background]

U.S. Federal Aviation Administration. Advisory Circular 21-35, *Computer Generated/Stored Records*. June 1993. 9 p.

The purpose of this AC is to provide information and guidance concerning controls for managing information systems that generate and store records used in the manufacture of products and parts. This AC discusses control mechanisms that should be used when a production approval holder (PAH) uses an information system to generate and store records of products and parts manufactured to FAR requirements. [Purpose]

U.S. Federal Aviation Administration. Advisory Circular 23.1311-1, *Installation of Electronic Display Instrument Systems in Part 23 Airplanes*. June 1993. 20 p.

This AC shows how to comply with FARs applicable to the installation of electronic display instrument systems in Part 23 airplanes.

This AC lists the pertinent sections of the FAR, other ACs and Society of Automotive Engineers (SAE) documents that address aircraft instrumentation. Flight, powerplant, navigation instrumentation and airworthiness considerations are also addressed. [Modified purpose]

U.S. Federal Aviation Administration. Notice N 8110.48, *Airworthiness Approval of Navigation of Flight Management Systems Integrating Multiple Navigation Sensors*. April 1993. 42 p.

This notice provides an acceptable means of obtaining airworthiness approval of multisensor navigation of flight management systems integrating data from multiple navigation sensors for use as a navigation system for oceanic, domestic en route, terminal and nonprecision instrument approach (except localizer directional aid (LDA) and simplified directional facility (SDF)) operations. This document does not address global positioning system (GPS) equipment incorporating differential GPS capability. The guidelines provided in this notice supersede the criteria of AC 90-45A, *Approval of Area Navigation Systems for Use in the U.S. National Airspace System*. [Modified purpose]

Reports

Ames, S.A.; Purser, D.A.; Fardell, P.J.; Ellwood, J. *Cabin Water Sprays for Fire Suppression: An Experimental Evaluation*, U.K. Civil Aviation Authority (CAA), CAA Paper 92009. A special report prepared by the Fire Research Station of the Building Research Establishment,

Borehamwood, at the request of the CAA. March 1993. 135 p.: ill. Available through the CAA*.

Keywords

1. Airplanes — Fires and Fire Protection.
2. Aircraft Cabins — Fires and Fire Prevention.
3. Great Britain. Civil Aviation Authority.

Summary: This report describes results from experiments to investigate the effectiveness of on-board water spray systems in reducing the risk to passengers in an aircraft cabin exposed to external fire. Passenger exposure to the effects of external fires includes radiated and convected heat, toxic and irritant gases and particulates, and reduced visibility caused by smoke. The risks to passengers arise either directly from the effects of fire or indirectly by impeding escape from the aircraft.

Experiments were conducted to isolate and examine these potential risks using a Boeing 707 fuselage fitted with a water spray system and a severe fire source adjacent to an opening in the airplane's fuselage. The effects of fire were observed on the aircraft cabin, furnishings and fittings, and measurements were taken on the levels of cabin heat content and toxic fire byproducts.

According to the report, without the water spray activated, the survival time was less than 2.5 minutes. However, based on the observations of the fire development in the aircraft cabin, the water spray was found to reduce fire penetration into the cabin and to inhibit fire spread in the cabin. The water spray system was found to increase the time to incapacitation of standing passengers, with regard to cabin heat content, by 1.7 minutes and three minutes for crouching passengers. Moreover, the use of water sprays considerably reduced the amount of particulate matter and airborne

irritants, thereby reducing the risk of lung damage. The water spray system had little effect on visibility through smoke removal since the water spray pushed the rising smoke layer downward, thus reducing visibility at lower levels. The most effective arrangement of spray systems tested was found to be the zoned spray, with nozzles delivering water at the rate of 1 liter (.2642 gallon) per minute per square meter (10.764 square feet). The report includes references and tables and appendixes on Characteristics of Water Sprays, Gas and Particulate Sampling Methods, Temperature Measurements, Smoke Measurements and Thermal Radiation Measurements. [Modified summary]

Books

Curran, Jim. *Trends in Advanced Avionics*. Ames: Iowa State University Press, 1992. 189 p.: ill. Includes bibliographical references and index.

Keywords

1. Avionics.
2. Avionics — Equipment.

Summary: Recent advances in electronics have had an enormous impact on the core functions of aviation electronics (avionics): flight control, navigation, and communication. In Chapter One of *Trends in Advanced Avionics*, the author highlights major trends in avionics development and suggests where technical advances may govern future development. Chapter Two describes the complex framework of avionics development and delineates the major areas and concepts used in the framework. It also discusses technology factors, user acceptance, political and regulatory aspects and business concerns regarding avionics development. Chapter Three reviews previous and current advanced avionics programs ranging from the U. S. Air Force Aeronautical Systems

Updated Reference Materials (Advisory Circulars, U.S. FAA)

AC Number	Month/Year	Subject
120-40B	06/09/93	<i>Airplane Simulator Qualification, change 2 (updates Appendix 5, Windshear Qualification of AC 120-40B dated July 29, 1991).</i>

Division (ASD) and supercockpit programs to the advanced avionics concepts utilized in the Boeing 777. Chapter Four addresses system-level advances, focusing on system integration and automation. Chapter Five discusses advances in crew-system interfaces to increase situational awareness such as electronic cockpit displays, helmet-mounted dis-

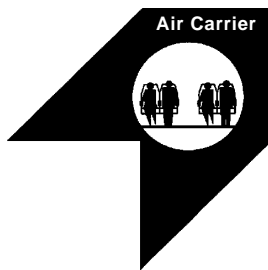
plays and speech recognition and synthesis. Subsequent chapters discuss advances in navigation, communication and flight control. The final chapter offers perspectives on the future of avionics development. A list of acronyms and abbreviations, references and index are also included. ♦

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Accident/Incident Briefs

by
Editorial Staff

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



Misplaced Flashlight Causes Gear-up Landing

Boeing 737. Substantial damage. No injuries.

The Boeing 737 was on approach when the flight crew determined that the right main landing gear would not extend. The aircraft subsequently landed with the gear leg retracted.

After landing, an emergency evacuation was conducted and there were no injuries to passengers or crew. The aircraft's No. 2 engine cowl and the bottom fuselage were damaged. There was no fire.

An investigation found a flashlight in the wheel well over the damaged up-lock actuator, which restricted operation of the hydraulic and manual gear extension systems. A manual gear extension was not attempted. Cabin floor placards that identify the landing gear view port locations were found to be obstructed by passenger carry-on luggage.

Hard Landing Ruptures Transport

McDonnell Douglas DC-9-30. Aircraft destroyed. Four serious injuries and 10 minor injuries.

The aircraft landed hard with an 11-knot tail wind in dry, daylight conditions. After the landing, all of the aircraft's tires blew out and the fuselage broke in two.

As the aircraft slid down the runway, the two fuselage parts separated before turning and coming to a stop. Of the 94 passengers and five crew members on board, four were injured seriously.



Hard-nosed Landing Puts Yak-40 into Slide

Yakovlev Yak-40. Substantial damage. No injuries.

After touchdown during the night landing, the first officer deployed the reversers. Because the runway was wet, he rapidly lowered the nose.

The nose gear collapsed rearward after the aircraft bounced three times. It slid 2,953 feet (900 meters) on its nose and came to a stop on the runway. There was no indication of a mechanical malfunction.

Auxiliary Power Unit Bashes Commuter

Fokker F-27. Substantial damage. No injuries.

Following engine start, the auxiliary power unit was being towed away from the twin-turboprop aircraft when it detached from the tug and struck the fuselage.

An inquiry determined that the pin used to attach the unit to the tug was too short to ensure a reliable connection. None of the 13 passengers or four crew members aboard was injured.

Wing Ice Stalls Commuter

Embraer 120 Brasilia. No damage. No injuries.

The aircraft was descending to 4,500 feet (1,372 meters) at night with the autopilot on. At about

200 feet (61 meters) above that altitude, the autopilot was disconnected.

The stick shaker activated and the aircraft stalled three times, losing about 1,000 feet (305 meters) of altitude.

The pilot regained control, applied full power and the aircraft climbed back to 4,500 feet; the first officer activated the wing deicer boots. The crew flew a holding pattern first, then executed an instrument landing system (ILS) approach and landed without incident. On the ground, the wing tips and the leading edge of the elevator were found covered with ice.



Mistrimmed Twin Refuses to Rotate

Cessna 421. Substantial damage. No injuries.

The pilot aborted the daylight takeoff because he could not rotate the aircraft. The twin-engine Cessna overran the runway and came to rest on soft ground.

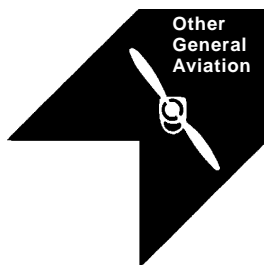
It was subsequently determined that the elevator trim wheel was in the full nose-down position.

Engine Failure Ends in Daylight Ditching

Cessna 402. Substantial damage. One serious and one minor injury.

During cruise at 6,500 feet (1,982 meters), the pilot heard a loud noise and saw that the right engine cowling had partially separated. A cylinder assembly was missing, and there was a fire in the engine compartment.

The pilot tried unsuccessfully to feather the propeller then descended to extinguish the fire. Although the fire was extinguished, the pilot could not maintain altitude and was forced to ditch.

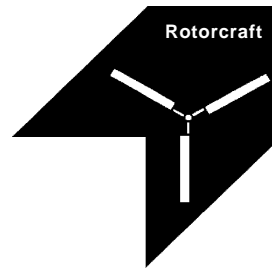


Exhaust Leak Disables Pilot

*Pitts Special. Substantial damage.
One serious injury.*

While in cruise, an exhaust pipe weld failed and the pipe detached from the engine mount.

The pilot radioed on approach that he suspected the detached pipe had damaged the left main landing gear. The left gear collapsed on touchdown. The pilot was found to be suffering from exhaust fume inhalation and was hospitalized.



Low Clouds Lead to Forced Landing

Robinson R-22B. Substantial damage. No injuries.

The helicopter was following a highway at about 350 feet (107 meters) above ground level when lower clouds forced the pilot to descend. The weather continued to deteriorate, and the pilot decided to reverse course.

During the turn, the low rpm light illuminated. The pilot lowered the collective and tried to regain airspeed, but because of low airspeed and tall trees he elected to land on the highway. The helicopter landed hard and rolled over. The pilot and passenger were not injured. At the time of the incident, the weather was reported as instrument meteorological conditions, 350 feet (107 meters) overcast and two miles (3 kilometers) visibility.

Wires Snare Helicopter During Hover

Bell 206B. Substantial damage. No injuries.

The pilot had just taken off from the parking ramp and was hover-taxiing to a hangar 300 feet (91 meters) from the ramp when the helicopter contacted electrical power lines 30 feet (9 meters) above the taxiway.

The aircraft descended uncontrolled, struck the taxiway and rolled over. The helicopter was on a ferry flight and had landed for fuel. The weather at the time was reported as visual meteorological conditions with clear skies, three miles visibility and winds of four knots. ♦