SPECIAL STUDY OF FATAL, WEATHER - INVOLVED, GENERAL AVIATION ACCIDENTS

ADOPTED: AUGUST 28, 1974

NATIONAL TRANSPORTATION SAFETY BOARD
Washington, D.C. 20591

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16.Abstract

Weather is the most frequently cited causal factor in fatal, general aviation accidents. This study examines, in detail, circumstances surrounding those accidents over a 9-year period. Observations are made and conclusions drawn about: Pilot time, time-in-type, time last 90 days, pilot certificate held, geographical location, pilot age, actual and simulated instrument time. Also examined are: Weather phenomena as a cause or factor, accuracy of weather forecasts, source and adequacy of weather briefings, time of day, type of flight plan, and time of year.

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SPECIAL STUDY OF FATAL WEATHER-INVOLVED GENERAL AVIATION ACCIDENTS

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INTRODUCTION

The National Transportation Safety Board is concerned about the large number of fatal, general aviation accidents which are weather-involved.[1] This study is based on those 2,026 accidents which occurred from 1964 through 1972.

In this special study, the Safety Board examines the latest accident data and the circumstances surrounding the accidents, delineates those areas which require special attention, and recommends action to reduce the number of weather-involved, fatal, general aviation accidents.

OVERVIEW OF THE DATA

Weather is the most frequently cited causal factor in fatal, general aviation accidents and has been for several decades. From 1964 through 1972, 2,026 fatal, weather-involved accidents killed 4,714 persons. These fatal, weather-involved accidents represent 36.6 percent of the total fatal, general aviation accidents for the period studied. These accidents occurred with disturbing regularity despite improvements in aircraft, instrumentation, training, training facilities, the air traffic control system, weather facilities, weather services, and navigational aids. (See Table 1 and Figure 1.)

The statistics also show that of the 9-year total of 45,321 general aviation accidents, 8,471, or 18.7 percent, were weather-involved and of the total 8,471 weather-involved accidents, 2,026, or 23.9 percent, were fatal

[1] For purposes of this study, a weather-involved accident was considered to be one for which the Safety Board had determined that weather had been a cause or contributing factor.

TABLE 1

GENERAL AVIATION ACCIDENTS 1964-1972

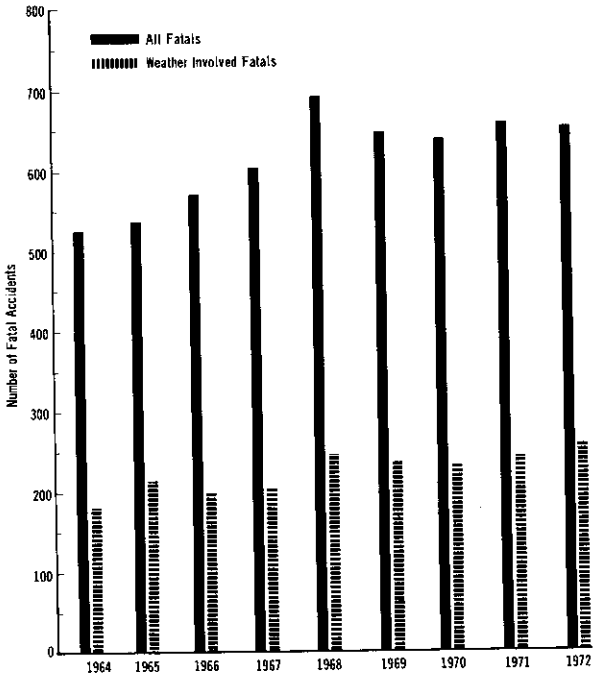
ALL ACCIDENTS			
YEAR	TOTAL	TOTAL FATAL	FATALITIES
1964	5,069	526	1,083
1965	5,196	538	1,029
1966	5,712	573	1,149
1967	6,115	603	1,333
1968*	4,968*	692	1,399
1969	4,767	647	1,495
1970	4,718	641	1,310
1971	4,640	660	1,401
1972	4,136	655	1,302
TOTAL	45,321	5,535	11,501

WEATHER INVOLVED ACCIDENTS			
YEAR	TOTAL	TOTAL FATAL	FATALITIES
1964	798	182	389
1965	669	215	489
1966	909	200	463
1967	1,112	202	441
1968	1,067	247	556
1969	986	237	616
1970	1,014	237	574
1971	947	246	580
1972	969	260	606
TOTAL	8,471	2,026	4,714

*The decrease in the total number of accidents was caused by a change in the definition of "substantial damage" included in the definition of an accident. The change was effective on January 1, 1968.

Figure 1

FATAL GENERAL AVIATION ACCIDENTS



accidents. On the average, more than 2 persons were killed in each accident.

Since 1967, the trend of fatal, weather-involved, general aviation accidents has been increasing steadily, while the trend of the accident rate per 100,000 aircraft-hours flown (all fatal accidents) has been downward generally. (See Figure 2.)

Nearly 60 percent of the fatal, weather-involved accidents have occurred during pleasure flying, and more than 20 percent have occurred during noncommercial business flights. By contrast, the remaining accidents occurred during more than 35 other kinds of flying. (See Table 2.)

About 60 percent of the accidents examined in this study occurred during daylight hours and 36 percent occurred at night. (See Table 3.)

TABLE 2

KIND OF FLYING BEING CONDUCTED FATAL WEATHER INVOLVED ACCIDENTS U.S. GENERAL AVIATION 1964-1972

KIND OF FLYING	NUMBER OF ACCIDENTS	PER CENT OF TOTAL
PLEASURE	1,189	58.64
BUSINESS (NON-COMMERCIAL)	415	20.43
AIR TAXI (PSGR. OPTNS.)	98	4.83
CORPORATE/ EXECUTIVE	49	2.41
FERRY	35	1.72
DUAL-INSTRUCTIONAL	30	1.48
PRACTICE	27	1.33
AIR TAXI (CARGO OPTNS.)	25	1.23
TOTAL	1,868	92.07

NOTE: The foregoing represent the Kind of Flying being conducted in most of the accidents. The remaining 158 accidents occurred during more than 30 other kinds of flying.

Figure 2

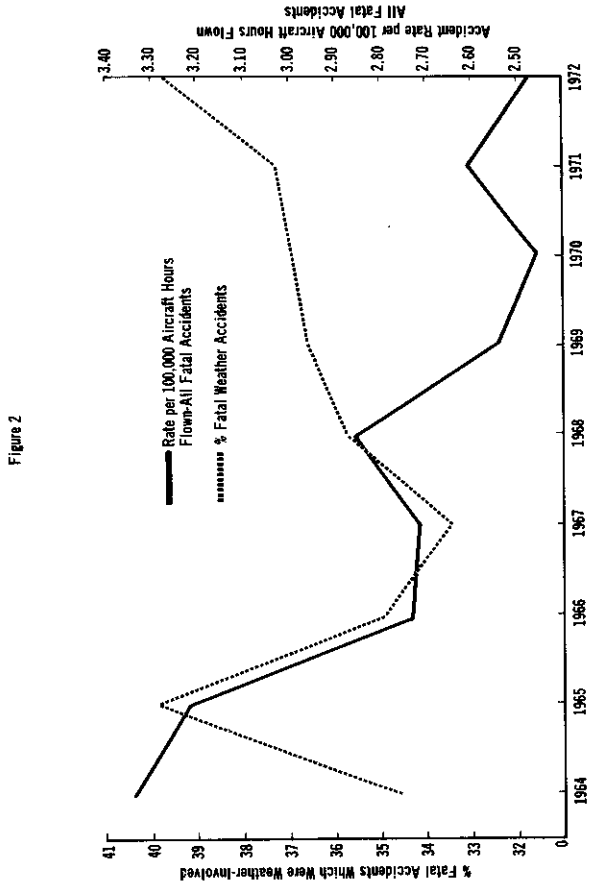


TABLE 3

CONDITIONS OF LIGHT VS. TYPE OF WEATHER CONDITIONS (Accident Site) WEATHER INVOLVED FATAL ACCIDENTS U.S. GENERAL AVIATION 1964-1972

	VFR	IFR	Below Minima*	Un-Known	Acci-dents	Per Cent
DAWN	6	23	5	–	34	1.67
DAYLIGHT	537	598	28	20	1,178	58.28
DUSK (twilight)	26	40	2	3	71	3.50
NIGHT (dark)	240	428	40	21	729	35.91
NIGHT (moonlight-bright)	1	2	–	–	3	.15
UNKNOWN/NOT REPORTED	3	6	–	1	10	.49
ACCIDENTS	809	1,096	75	45	2,025	
PERCENT	40.0	54.0	3.7	2.2		

*Landing/Takeoff accidents only.

Figure 3

PILOT DATA

Pilot Time

Pilots with fewer flight hours were more frequently involved in weather accidents, especially those pilots with more than 100, but less than 300, total flight-hours. (See Figure 3 and Table 4.) Perhaps the explanation for the peak is that by the time a pilot has accumulated 100 to 299 hours, he is confident of his flying ability even though his actual flying experience is low. His experience with flying in a variety of adverse weather conditions would, of course, be even lower. Therefore, these less experienced pilots might not be aware of the potential dangers involved with adverse weather.

In about 75 percent of the cases examined, the pilot with more time in type of aircraft was involved less frequently in a fatal accident. (See Table 5 and Figure 4.)

About 65 percent of the accidents surveyed involved pilots who had less than 50 flight-hours during the 90 days before the accidents. The curve dropped steeply thereafter. (See Table 6 and Figure 5.)

Pilot Certification

Most pilots involved in fatal, weather-involved accidents held private certificates. There have been more active private pilots than any other type each year since 1964. (See Tables 7 and 8.) In the 2,026 fatal, weather-involved accidents, 58.4 percent of the pilots held private pilot certificates while 41.4 percent of the total pilot population had private certificates during the period of 1964 through 1972. Although 27.8 percent of the active

Figure 4

TIME IN TYPE

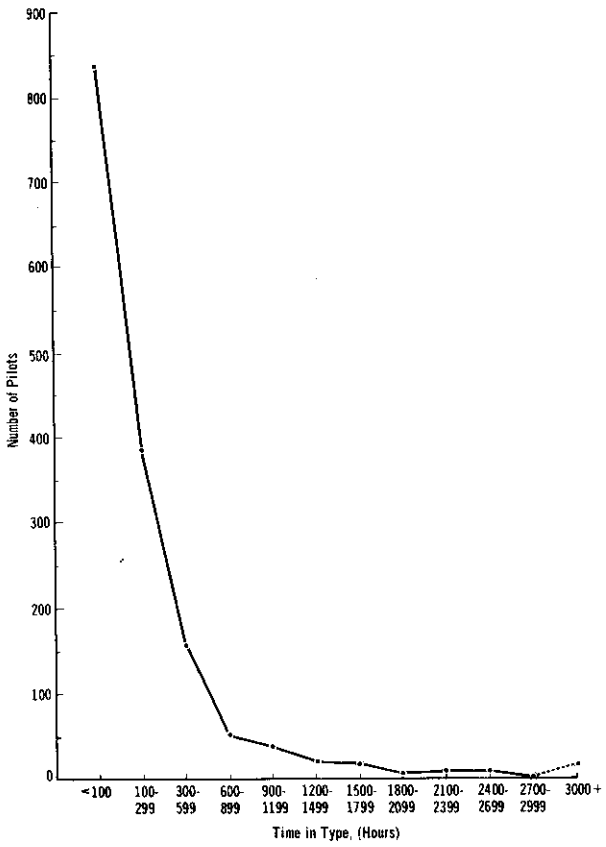


TABLE 4

TOTAL TIME ALL PILOTS

HOURS	Student	Private	Commercial	ATP	Comm. & F.I.	ATP & F.I.	Foreign	None/Exprd.*	TOTAL
<100	113	130	0	0	0	0	0	1	244
100-299	39	418	13	0	0	0	1	5	476
300-599	10	212	53	1	17	0	0	2	295
600-899	0	104	31	0	18	0	0	1	154
900-1199	3	53	29	0	21	0	1	2	109
1200-1499	0	40	12	0	12	1	0	0	65
1500-1799	1	35	19	0	13	1	0	0	69
1800-2099	0	29	11	1	13	0	0	0	54
2100-2399	0	13	12	1	9	4	0	0	39
2400-2699	0	19	12	1	5	3	1	0	41
2700-2999	0	9	4	0	4	0	0	0	17
3000+	0	51	124	34	103	34	0	1	347
TOTAL	166	1113	320	38	215	43	3	12	1910

*No certificate or expired certificate.

pilots held student certificates, only 8.8 percent of the pilots in fatal, weather-involved accidents were student pilots. This is a reflection, at least in part, of the care taken by flight instructors to conduct training activities during appropriate weather conditions.

Geographic Distribution of Accidents and Pilots Involved Compared with Total Active Pilots

Accident exposure to any one geographic area can be determined in two ways: (1) Compare the number of accidents in an area with the numbers of active aircraft in that area, or (2) compare the number of pilots in fatal accidents with the number of active pilots in specific areas. The latter comparison has been made by separating the accidents into FAA regions and comparing the number of accidents in each region with the number of active pilots in that particular region. (See Tables 9, 10, and 11 and Figures 6 and 7.) Even though the numbers of accidents in Alaska and in the New England region are comparable, the record in Alaska, because of the difference in the number of active pilots, is a particularly poor one; five times worse, in fact. Terrain and weather conditions, no doubt, contribute to the accidents. The Great Lakes Region, which has the largest number of active pilots, actually has the best record, and the Western Region, although it had the most accidents, did not fare too badly because it also has a large number of active pilots. Presumably, because of terrain and weather, the record is not particularly

TABLE 5

TIME IN TYPE-ALL PILOTS

HOURS	Student	Private	Commercial	ATP	Comm. & F.I.	ATP & F.I.	Foreign	None/Exprd.*	TOTAL
<100	128	525	73	8	74	15	2	4	829
100-299	20	249	57	11	36	10	0	3	386
300-599	1	87	40	3	22	4	0	0	157
600-899	1	27	11	1	10	2	0	0	52
900-1199	0	13	12	6	5	2	0	0	38
1200-1499	0	10	5	1	3	3	0	0	22
1500-1799	0	6	7	1	4	0	0	0	18
1800-2099	0	1	0	0	1	1	0	0	3
2100-2399	0	1	3	0	2	0	0	0	6
2400-2699	0	1	2	0	3	1	0	0	7
2700-2999	0	0	1	0	0	0	0	0	1
3000+	0	3	6	3	6	0	0	0	18
TOTAL	150	923	217	34	166	38	2	7	1537

*No certificate or expired certificate.

TABLE 6

ACTUAL PILOT TIME LAST 90 DAYS

HOURS	Student	Private	Commercial	ATP	Comm. & F.I.	ATP & F.I.	Foreign	None/Exprd.*	Total
<50	95	614	86	5	30	6	0	4	839
50-99	15	126	43	10	32	6	2	1	235
100-299	1	27	68	10	65	18	1	1	191
300-599	1	3	4	1	18	1	0	0	28
600-899	0	0	1	0	0	0	0	0	1
TOTAL	111	770	202	26	145	31	3	6	1294

*No certificate or expired certificate.

TABLE 7

TYPE OF PILOT CERTIFICATE FATAL WEATHER INVOLVED ACCIDENTS U.S. GENERAL AVIATION 1964-1972

TYPE OF CERTIFICATE	NUMBER	%
Student	179	8.8
Private	1,183	58.4
Commercial	336	16.6
ATP	38	1.9
Private/Flt. Instructor	0	0
Commercial/Flt. Instructor	216	10.7
ATP/Flt. Instructor	44	2.2
Other (Foreign)	3	
None (or expired)	24	
Unknown/Not Reported	3	
TOTAL	2,026	

Figure 5
TIME LAST 90 DAYS

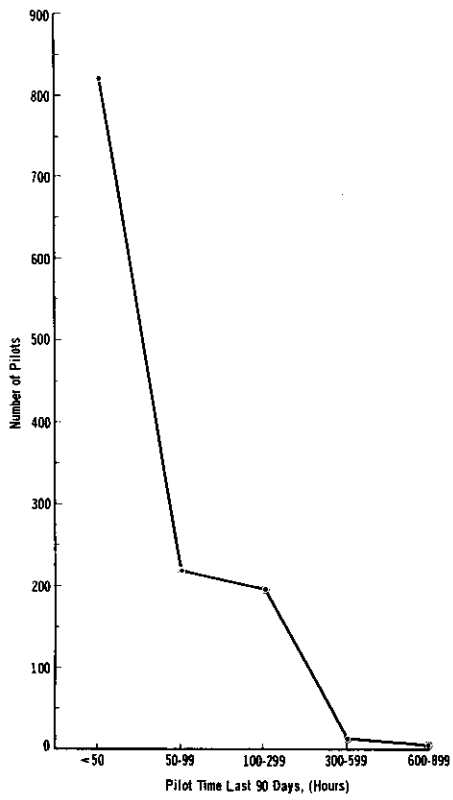


Figure 6

GEOGRAPHICAL DISTRIBUTION OF ACCIDENTS

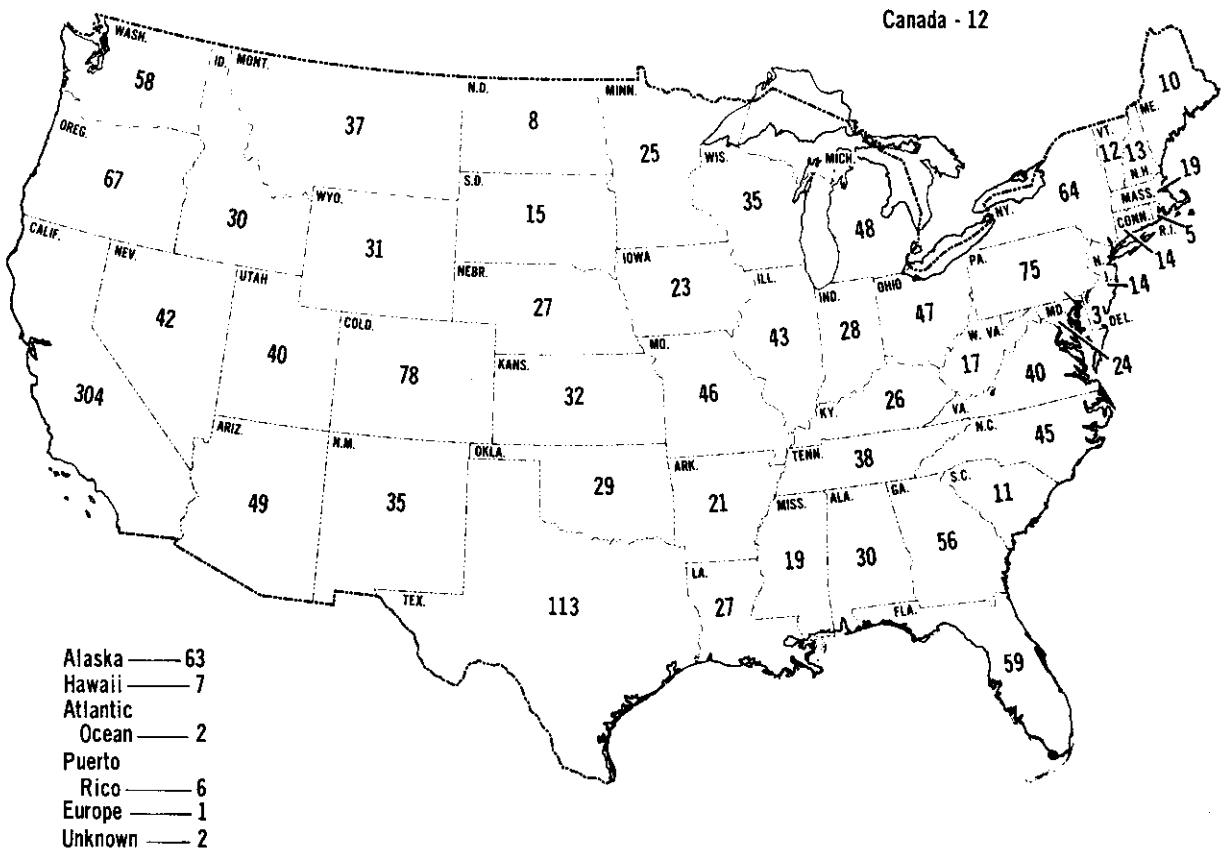


TABLE 8

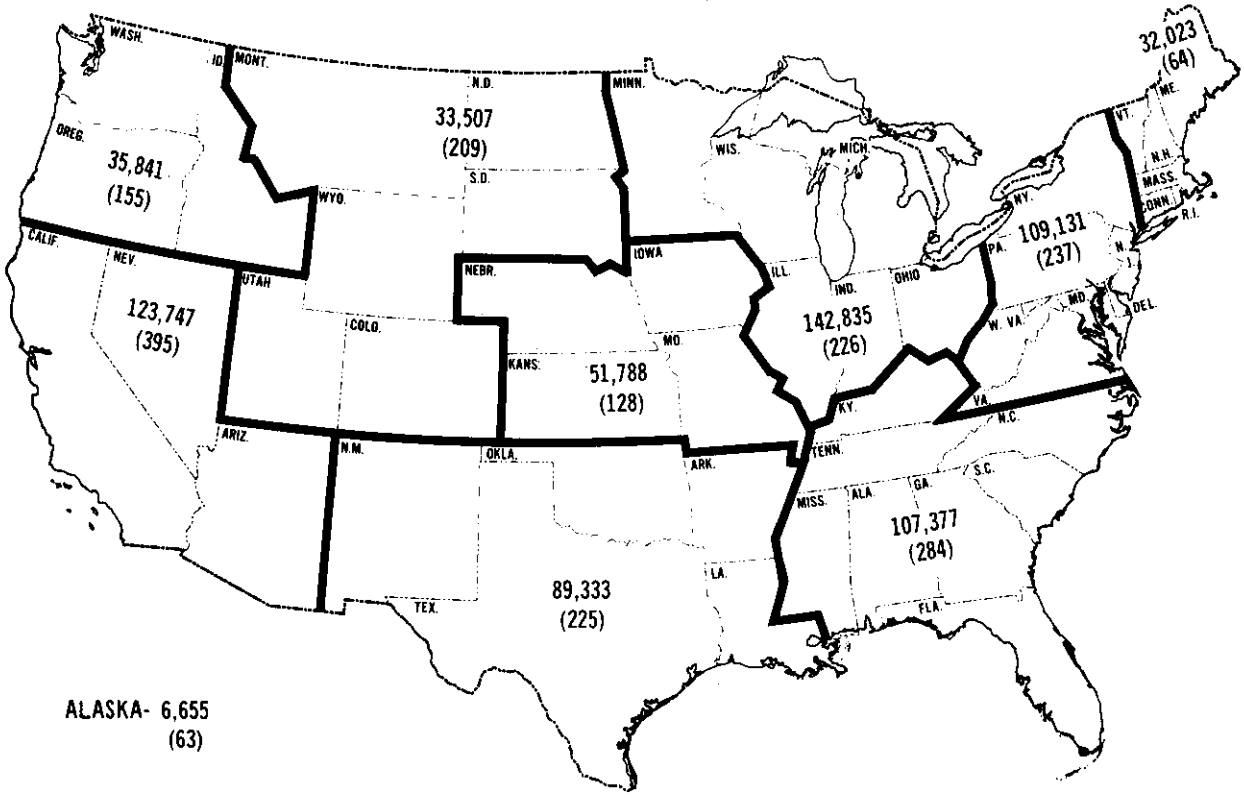
ACTIVE AIRMAN CERTIFICATES HELD: JAN. 1, 1964–DEC. 31, 1972

Category	1964	1965	1966	1967	1968	1969	1970	1971	1972	9 YEAR AVERAGE #	9 YEAR AVERAGE %
Pilot—Total . .	431,041	479,770	548,757	617,931	691,695	720,028	732,729	741,009	750,869	634,870	
Student . .	120,743	139,172	165,177	181,287	209,406	203,520	195,861	186,428	181,477	175,897	27.8
Private . .	175,574	196,393	222,427	253,312	281,728	299,491	303,779	312,656	321,418	262,975	41.4
Commercial	108,428	116,665	131,539	150,135	164,458	176,585	186,821	192,409	196,228	158,141	24.9
Airline transport	21,572	22,440	23,917	25,817	28,607	31,442	34,430	35,949	37,714	20,099	4.6

NOTE: These data derived from "FAA Statistical Handbook of Aviation, 1971-1972 Edition"

Figure 7

TOTAL ACTIVE PILOTS 1972 BY FAA REGION
(Numbers in parentheses are fatal weather involved accidents 1964-1972)



good in either the Rocky Mountain or the Northwest Regions.

Pilot Age Group

The age of those pilots in weather-involved accidents was tabulated by age groups. The peak group was 41-to 45 years. (See Table 12 and Figure 8.) Statistical data on pilot age were then solicited from the FAA's Office of Management Systems, Information and Statistics Division, in order to determine the age group to which most pilots belong. (See Table 13.) These statistics revealed that there are significantly more active pilots in the lower age groups than there are in the 41-45-year category. In 1968, 1970, and 1972 most pilots were in the 25-to 29-year group. Accordingly, the obvious question is: Why are the pilots in the 41-45-year age group so much more prone to be in fatal, weather-involved accidents than the younger pilots? Unfortunately, the question may be obvious, but the answer (or answers) would probably be forthcoming only after a detailed study by Human Factors Specialists. It is considered likely, however, that some of the many factors involved would include such subjects as: physical aspects, (i.e., light perception, reflexes, etc.), affluence, sophistication of equipment, present training requirements (including instrument flight) as opposed to training requirements when the older group was in the 25-to 29-year category, type of flying, and flying time.

Pilot Involvement as a Cause or Factor

Table 14 highlights the major types of pilot involvement which occurred during the 9 years studied. The most frequently cited cause was:

TABLE 9
LOCATION BY YEAR
WEATHER-INVOLVED FATAL ACCIDENTS
U.S. GENERAL AVIATION 1964-1972

LOCATION	64	65	66	67	68	69	70	71	72	Acci-dents	Per-cent
ALABAMA	3	4	5	5	2	1	2	1	7	30	1.48
ALASKA	4	8	6	5	8	11	6	8	7	63	3.10
ARIZONA	5	7	0	3	6	5	10	8	5	49	2.41
ARKANSAS	2	1	3	3	2	4	2	2	2	21	1.03
CALIFORNIA	41	31	24	38	31	37	43	32	28	304	15.02
COLORADO	11	4	7	7	10	13	6	11	9	78	3.84
CONNECTICUT	0	0	2	0	3	2	4	2	2	14	.74
DELAWARE	0	0	0	0	0	1	1	0	1	3	.15
FLORIDA	6	3	7	7	5	9	10	6	7	59	2.95
GEORGIA	4	2	6	5	8	6	4	9	12	56	2.76
HAWAII	0	2	2	0	0	1	0	1	1	7	.34
IDAHO	2	3	4	3	4	3	5	4	2	30	1.48
ILLINOIS	4	4	7	4	3	3	3	6	9	43	2.12
INDIANA	4	3	4	3	3	1	4	2	4	28	1.38
IOWA	0	3	3	2	2	3	4	3	3	23	1.13
KANSAS	2	4	4	0	6	3	2	7	4	32	1.58
KENTUCKY	1	3	2	3	2	2	3	5	5	26	1.28
LOUISIANA	1	1	4	3	3	4	2	6	3	27	1.33
MAINE	0	0	1	2	2	1	1	1	2	10	.49
MARYLAND	1	4	3	2	3	3	1	3	4	24	1.18
MASSACHUSETTS	1	2	0	4	4	2	3	2	1	19	.94
MICHIGAN	2	8	8	3	5	3	2	8	9	48	2.36
MINNESOTA	3	1	2	2	5	2	2	3	5	25	1.23
MISSISSIPPI	1	2	3	1	1	1	4	2	4	19	.94
MISSOURI	1	5	2	8	9	3	10	7	3	46	2.36
MONTANA	4	8	3	2	5	7	3	2	3	37	1.82
NEBRASKA	4	4	1	1	3	4	2	3	5	27	1.33
NEVADA	7	6	4	5	4	6	5	3	2	42	2.07
NEW HAMPSHIRE	1	0	3	0	1	2	1	3	2	13	.64
NEW JERSEY	1	0	0	2	3	1	2	3	2	14	.69
NEW MEXICO	4	4	1	6	2	6	2	3	7	35	1.72
NEW YORK	1	6	7	12	8	7	11	4	8	64	3.15
NORTH CAROLINA	3	3	7	5	6	6	3	6	6	45	2.22
NORTH DAKOTA	1	1	0	0	0	1	1	2	2	8	.39
OHIO	3	8	7	3	6	4	4	5	7	47	2.31
OKLAHOMA	1	4	4	6	3	2	5	1	3	29	1.43
OREGON	9	5	8	3	8	9	6	10	9	67	3.30
PENNSYLVANIA	5	7	9	6	15	6	5	12	10	75	3.69
RHODE ISLAND	0	0	0	0	2	0	1	2	0	5	.25
SOUTH CAROLINA	1	0	2	1	3	1	0	1	2	11	.54
SOUTH DAKOTA	1	3	1	1	4	1	2	2	0	15	.74
TENNESSEE	6	2	3	1	2	8	5	5	6	38	1.87
TEXAS	11	10	11	12	15	13	8	16	17	113	5.56
UTAH	4	9	4	4	3	6	2	3	5	40	1.97
VERMONT	0	3	0	2	2	1	0	1	3	12	.59
VIRGINIA	3	6	2	2	4	6	10	5	2	40	1.97
WASHINGTON	6	3	7	6	11	5	9	6	5	58	2.86
WEST VIRGINIA	0	2	1	1	3	3	3	0	4	17	.84
WISCONSIN	1	8	3	4	2	3	6	5	3	35	1.72
WYOMING	5	4	1	0	4	3	4	3	7	31	1.53
UNKNOWN/ NOT RPTD.	0	0	0	0	0	0	2	0	0	2	.10
PUERTO RICO	0	1	1	0	1	1	0	2	0	6	.30
VIRGIN ISLANDS	0	1	0	0	0	0	0	0	0	1	.05
CANADA	0	2	1	4	1	2	2	0	0	12	.59
EUROPE	0	0	0	1	0	0	0	0	0	1	.05
ATL. OCEAN N. LAT.	1	0	0	0	0	0	0	0	1	2	.10
ACCIDENTS	182	215	200	202	247	237	237	246	260	2026	

TABLE 10

TOTAL ACTIVE PILOTS AND FLIGHT INSTRUCTORS[1/] BY FAA REGION AND STATE: DECEMBER 31, 1972

FAA region and state	Total pilots
Total	[2/]750,869
United States—total	734,763
New England—total	32,023
Maine	3,417
New Hamshire	2,659
Rhode Island	1,721
Massachusetts	13,696
Connecticut	9,065
Vermont	1,465
Eastern—total	109,131
New York	36,467
Pennsylvania	25,007
Virginia	13,068
Maryland	9,848
West Virginia	3,052
Delaware	1,744
New Jersey	18,647
District of Columbia	1,298
Great Lakes—total	142,835
Illinois	34,827
Indiana	17,522
Minnesota	18,326
Michigan	26,585
Ohio	32,899
Wisconsin	12,676
Central—total	51,788
Kansas	14,409
Iowa	12,280
Missouri	17,227
Nebraska	7,872
Southern—total	107,377
North Carolina	13,225
South Carolina	6,152
Georgia	15,413
Florida	36,904
Mississippi	6,001
Alabama	11,967
Tennessee	11,093
Kentucky	6,622
Southwest—total	89,333
Louisiana	10,206
Oklahoma	14,537
Texas	52,291
New Mexico	5,892
Arkansas	6,407
Rocky Mountain—Total	33,507
Colorado	13,977
Wyoming	2,128
Utah	4,854
Montana	4,885
North Dakota	4,007
South Dakota	3,656
Western—Total	123,747
California	109,013
Arizona	11,132
Nevada	3,602
Northwest—total	35,841
Washington	20,185
Oregon	11,145
Idaho	4,511
Alaskan region—total	6,655
Pacific region—total	2,526
Outside U.S.—total	16,106

1/ Not included in total.
2/ Includes foreign.

TABLE 11

COMPARISON OF NUMBER OF PILOTS IN FATAL WEATHER-INVOLVED ACCIDENTS WITH NUMBER OF ACTIVE PILOTS (BY FAA REGION)

FAA REGION	PILOTS IN FATAL WX. INVOLVED ACCIDENTS (1964-1972)	RANK	ACTIVE PILOTS (1972)	RANK	PILOTS IN FATAL WX. INVOLVED ACCIDENTS / ACTIVE PILOTS (%)	RANK
New England	64	9	32,023	9	.19	8
Eastern	237	3	109,131	3	.22	7
Great Lakes	226	4	142,835	1	.16	9
Central	128	8	51,788	7	.25	6
Southern	284	2	107,377	4	.26	5
Southwest	225	5	89,333	5	.25	6
Rocky Mtn.	209	6	33,507	8	.62	2
Western	395	1	123,747	2	.32	4
Northwest	155	7	35,841	6	.43	3
Alaska	63	10	6,655	10	.95	1

Figure 8

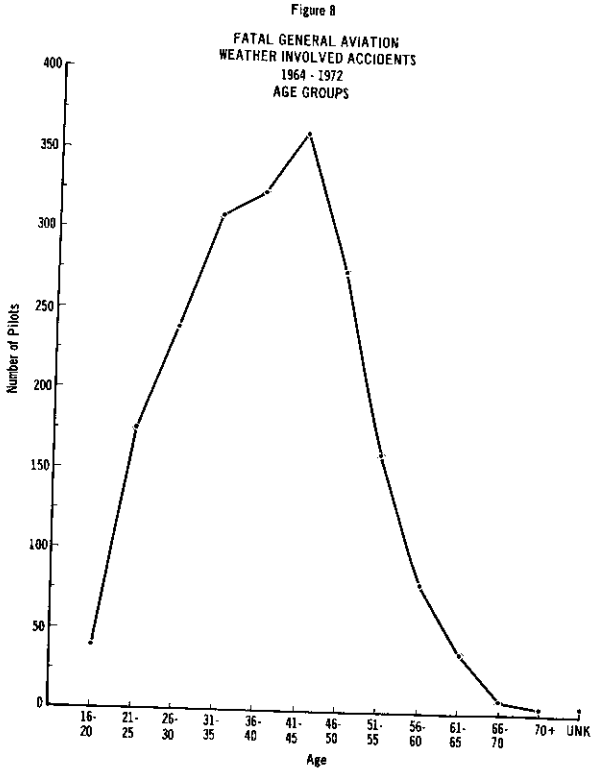


TABLE 12

PILOT AGE GROUP AND NUMBER OF ACCIDENTS FATAL WEATHER-INVOLVED ACCIDENTS U.S. GENERAL AVIATION 1964-1972

AGE GROUP	NUMBER OF ACCIDENTS
16-20	40
21-25	176
26-30	238
31-35	309
36-40	324
41-45	362
46-50	276
51-55	162
56-60	82
61-65	38
66-70	9
70+	4
UNKNOWN	6
TOTAL	2,026

TABLE 13

ACTIVE PILOT CERTIFICATES HELD, BY AGE GROUP OF HOLDER: 1968, 1970 and 1972*

AGE	1968 NUMBER	1968 PER-CENT	1970 NUMBER	1970 PER-CENT	1972 NUMBER	1972 PER-CENT
16-19	31,957	5	34,817	5	32,091	4
20-24	96,516	14	101,238	14	92,023	12
25-29	117,465	17	124,363	17	126,416	17
30-34	98,899	14	105,784	14	113,254	15
35-39	95,939	14	96,633	13	97,869	13
40-44	89,951	13	89,642	12	93,047	12
45-49	83,531	12	86,186	12	82,215	11
50-54	45,277	6	54,952	8	65,729	9
55-59	19,471	3	24,335	3	30,440	4
60 and over	12,689	2	14,779	2	17,785	3
TOTAL	691,695	100	732,729	100	750,869	100

*Source: FAA, Office of Management Systems, Information and Statistics Division

TABLE 14

CAUSE/FACTOR TABLE WEATHER-INVOLVED FATAL ACCIDENTS U.S. GENERAL AVIATION 1964-1972

Detailed Cause/Factor -Pilot in-Command-	Fatal Accidents Cause	Factor	Total
1. Continued VFR into adverse weather conditions	1,220	5	1,225
2. Spatial disorientation	580	9	589
3. Inadequate preflight preparation and/or planning	240	135	375
4. Attempted operation beyond experience/ capability level	197	10	207
5. Failed to obtain/ maintain flying speed	204	—	204

Continued VFR into adverse weather conditions. The next most frequently cited causes, by order of frequency, were: Inadequate preflight preparation and/or planning, attempted operation beyond experience/capability level, and failure to obtain/maintain flying speed.

Flight Plans

Almost 62 percent of the pilots did not file flight plans. (See Table 15.) Based on these statistics, it is possible that there may be a relationship between accident involvement and lack of a filed flight plan.

Instrument-Rated Pilots

In the 2,026 fatal, weather-involved accidents studied, 527 instrument-rated pilots were

TABLE 15

TYPE OF FLIGHT PLAN VS. TYPE OF WEATHER CONDITIONS WEATHER-INVOLVED FATAL ACCIDENTS U.S. GENERAL AVIATION 1964-1972

Type of Flight Plan \ Type of Weather*	VFR	IFR	Below Minima*	Un-Known	Acci-dents	Per Cent
None	568	630	34	24	1,252	61.90
VFR	179	233	6	17	435	21.44
IFR	46	174	27	4	251	12.37
Controlled VFR	—	7	3	—	10	.49
IFR (VFR on top)	—	4	2	—	6	.30
DVFR	—	3	—	—	3	.15
VFR flight following	11	10	—	—	21	1.03
Special VFR	4	30	2	—	36	1.77
Other	3	1	1	—	5	.25
Unknown/Not Rptd	2	4	—	—	6	.30
Accidents	809	1,095	75	45	2,024	
Per Cent	40.1	54.0	3.7	2.2		

*At accident site.
**Landing/Takeoff accidents only.

TABLE 16

INSTRUMENT RATED PILOTS VERSUS TYPE OF FLIGHT PLAN FILED TOTAL WEATHER ACCIDENTS 1964-1972

Type Flight Plan \ Category and Class Rating	Single Engine Land	Multi-Engine Land	Multi-Engine Sea	Multi-Engine Land/Sea	Single Engine Land/Sea	Single Multi-Engine Land	Single Multi-Engine Land/Sea	Rotor Craft	Accidents	Per Cent
None	47	1	1	1	4	128	21	3	205	39.09
VFR	17	2	–	–	1	46	6	–	72	13.66
IFR	41	3	–	–	–	158	26	1	229	43.45
IFR (VFR on top)	1	–	–	–	–	2	1	–	4	.76
DVFR	–	–	–	–	–	1	–	–	1	.19
VFR Flight following	1	–	–	–	–	1	–	–	2	.38
Special VFR	3	–	–	–	–	5	1	–	9	1.71
Other	1	–	–	–	–	2	–	–	3	.57
Unknown	–	–	–	–	–	1	–	–	1	.19
Accidents	111	6	1	1	5	344	55	4	525*	
Percent	21.1	1.1	.2	.2	.9	65.3	10.4	.8		

*Includes 2 collisions, therefore, 527 records.

TABLE 17

HOURS ACTUAL INSTRUMENT TIME

Hours	Student	Private	Commercial	ATP	Comm. & F.I.	ATP & F.I.	Foreign	None/Exprd.*	Total
0	65	248	22	0	4	0	0	2	341
1-19	12	92	22	0	16	0	1	1	144
20-49	0	10	14	1	21	0	0	0	46
50-99	0	9	11	0	13	3	0	0	36
100-299	0	16	14	3	24	9	0	0	66
300-599	0	1	15	7	6	7	0	0	36
600-899	0	2	6	0	4	1	0	0	13
900-1199	0	1	4	1	1	0	0	0	7
1200-1499	0	0	2	1	0	0	0	0	3
1500+	0	1	1	2	3	2	0	0	9
TOTAL	77	380	111	15	92	22	1	3	701

*No certificate or expired certificate.

involved, most of whom were rated in the single-multi-engine land category (65.3 percent). Although more than 43 percent of these instrument-rated pilots had filed IFR flight plans, almost 40 percent did not file a flight plan of any type. (See Table 16.)

Thirty-six fatal accidents involved special VFR flight plans, but only 9 involved instrument-rated pilots.

The statistics show that 233 instrument-rated pilots filed IFR flight plans, but a total of 257 IFR flight plans were filed by all pilots. In other words, even though they did not have instrument ratings, 24 pilots filed IFR flight plans.

Instrument Time–Actual and Simulated

Since the majority of weather-involved, fatal accidents occurred during IFR conditions, the amount of actual and simulated instrument time logged by the pilots involved was analyzed. Since these data were available in only 35 percent of the cases, it was assumed that they represented a cross-section of the total. Table 17 shows that almost half of the 701 pilots involved had no instrument time. With few exceptions, there were increasingly fewer accidents as instrument experience increased.

The relationship between accidents and simulated instrument time is similar to the relationship between accidents and actual instrument time. Four hundred sixteen of 730 pilots, or nearly 60 percent, had accumulated up to 19 hours of simulated instrument time.

TABLE 18

HOURS SIMULATED INSTRUMENT TIME

Hours	Student	Private	Commercial	ATP	Comm. & F.I.	ATP & F.I.	Foreign	None/Exprd.*	Total
0	32	46	3	0	0	0	0	2	83
1-19	42	346	19	1	7	0	0	1	416
20-49	0	37	22	0	23	2	0	0	84
50-99	0	22	25	2	35	6	0	0	90
100-299	0	0	17	4	16	7	0	0	44
300-599	0	0	6	1	1	3	0	0	11
600-899	0	0	0	0	0	0	0	0	0
900-1199	0	0	0	0	0	0	0	0	0
1200-1499	0	0	0	0	0	0	0	0	0
1500+	0	0	0	0	0	2	0	0	2
TOTAL	74	451	92	8	82	20	0	3	730

*No certificate or expired certificate.

TABLE 19

WEATHER PHENOMENA CONSIDERED AS A CAUSE/FACTOR IN FATAL, WEATHER-INVOLVED ACCIDENTS U.S. GENERAL AVIATION 1964-1972

Phenomenon	Cause	Factor	Total
Low Ceiling	129	1179	1308
Fog	89	723	812
Rain	44	485	529
Snow	29	212	241
Turbulence Associated with Clouds and/or Thunderstorms	46	145	191
Thunderstorm Activity	27	145	172
Icing Conditions (includes sleet, freezing rain, etc.)	38	111	149
Downdrafts, Updrafts	45	74	119

Note: The foregoing represent those weather phenomena most often considered as a cause/factor. Thirteen other categories are also coded by the Safety Board.

(See Table 18.) It would appear from the data that attempting to fly under instrument conditions with only limited simulated instrument experience does not provide an adequate level of proficiency to insure the safe conduct of the flight. Simulated instrument time is not to be discouraged, but pilots with little simulated time could become overconfident about their ability to handle an actual instrument situation when it is encountered.

WEATHER PHENOMENA AS A CAUSE/FACTOR

Low ceiling was the most frequently cited weather phenomenon in weather-involved, fatal, general aviation accidents. Fog and rain were the next two most frequently cited phenomena. Although such phenomena as turbulence, thunderstorm activity, and icing were involved in a significant number of cases, the numbers are small compared to those of low ceilings and fog. (See Table 19.)

WEATHER FORECASTS

In the cases studied, 74 percent of National Weather Service forecasts were considered to have been either substantially correct, or the weather was better than predicted. (See Table 20.) On the other hand, 11 percent were considered to have been worse than forecast. Of those, in only about 5.5 percent of the cases, the forecast was completely inaccurate, or the weather was considered to have been considerably worse than forecast.

If a pilot can assume that 3/4 of the forecasts he receives will be reasonably accurate, he cannot ignore the forecasts when planning a flight. Experienced pilots are aware that forecasts cannot be considered "gospel," but they also know that they cannot be ignored. Forecasts should be treated as the best professional advice available.

TABLE 20

ACCURACY OF WEATHER FORECAST VS. TYPE OF WEATHER CONDITIONS* WEATHER-INVOLVED FATAL ACCIDENTS U.S. GENERAL AVIATION 1964-1972

	VFR	IFR	Below Minima**	Un-Known	Acci-dents	Per Cent
Forecast substantially correct	490	816	61	24	1388	73.68
Weather slightly better than forecast	–	2	–	–	2	.11
Weather considerably better than forecast	1	–	–	–	1	.05
Weather slightly worse than forecast	30	72	3	1	106	5.61
Weather considerably worse than forecast	30	61	8	3	102	5.40
Forecast completely erroneous	–	2	–	1	3	.16
Unknown/Not Reported	157	110	3	13	282	14.99
Accidents	705	1,062	75	42	1,884	
Percent	37.5	56.3	4.0	2.2		

*At accident site.
**Landing/Takeoff accidents only.

WEATHER BRIEFINGS

Accurate forecasts issued by the National Weather Service are of little value unless they are included in an adequate preflight weather briefing. As a routine matter in the investigation of a weather-involved accident, Safety Board investigators attempt to determine if, in fact, a pilot did solicit a preflight weather briefing. If he did, an effort is made to identify the briefing source, so that at a later time, judgments can be made in regard to the adequacy of the briefing provided.

It has been the experience of Safety Board investigators that it is not generally difficult to determine the source of a preflight briefing, but the determination of adequacy can be a difficult, if not an impractical task, depending on available records or the memory or candor of the briefer who provided the postaccident statement.

TABLE 21

SOURCE OF WEATHER BRIEFING

Source	Accidents	Percent
Pilot, self-help	21	1.09
In-person, NWS*	55	2.85
Phone, NWS	66	3.43
In-person, FSS**	199	10.33
Phone, FSS	637	33.11
Radio, FSS	195	10.12
Recorded L/MF radio	3	.16
Partial in-person, NWS	5	.26
Partial, phone, NWS	3	.16
Partial in-person FSS	4	.21
Partial, phone, FSS	23	1.19
No brfng. received	546	28.33
Brfng. received, method unknown	37	1.92
Other	38	1.97
Unknown/not reported	94	4.88
Total Accidents	1923	

*National Weather Service personnel
**Flight Service Station personnel

Table 21 outlines the sources of preflight weather briefings provided to most of the pilots involved in the 1964 to 1972 fatal, weather-involved accidents. About one-third of the preflight weather briefings were by phone from the FAA's Flight Service Stations (FSS's). The FAA provided almost 55 percent of these briefings, while less than 7 percent were provided by the NWS. The FAA figure is larger because interagency agreements give primary responsibility for weather briefing to the FAA.

More than 28 percent of the pilots studied received no preflight weather briefings. Although it may not be easy to secure a weather briefing expeditiously in some areas, there are many ways in which preflight weather information can and should be solicited.

Twelve hundred eight-six of the pilots studied received a weather briefing of some type. Seven hundred nineteen of them filed flight plans. Of the 546 pilots who did not receive weather briefing, most did not file flight plans. There were 35 pilots who filed

flight plans, but did not receive a weather briefing.

In only 17 cases during 1964 to 1972, sufficient evidence existed to indicate that either inadequate preflight briefings or lack of advice of unsafe conditions were a cause or factor in the weather-involved fatal accidents. In 1968, the Safety Board recommended that audio recordings of preflight weather briefings be made, but budgetary considerations prevented implementation of this procedure by the FAA or NWS except on an experimental basis at several isolated FAA locations.

The audio recording of inflight weather briefings is one of the features of the FAA's En Route Flight Advisory Service (Flight Watch) which has been implemented on the west coast and is proposed to be a nationwide program by 1976. As planned, the program will include a network of 44 FSS's, specially equipped and manned to enable pilots in flight to get up-to-the-minute weather information on a discrete radio frequency. The new network is not a substitute for preflight weather briefing, but an added safety feature to enable pilots already en route to avoid unanticipated weather changes.

In 1972, four west coast stations were implemented and it was planned to implement 19 more stations in the Rocky Mountain area and along the east coast by mid-1974, but it appears unlikely that the latter goal will be met. There are also some doubts that the phased 4-year goal for nationwide implementation will be met.

Figure 9
FATAL GENERAL AVIATION WEATHER INVOLVED ACCIDENTS 1964 - 1972
MONTHS OF OCCURRENCE

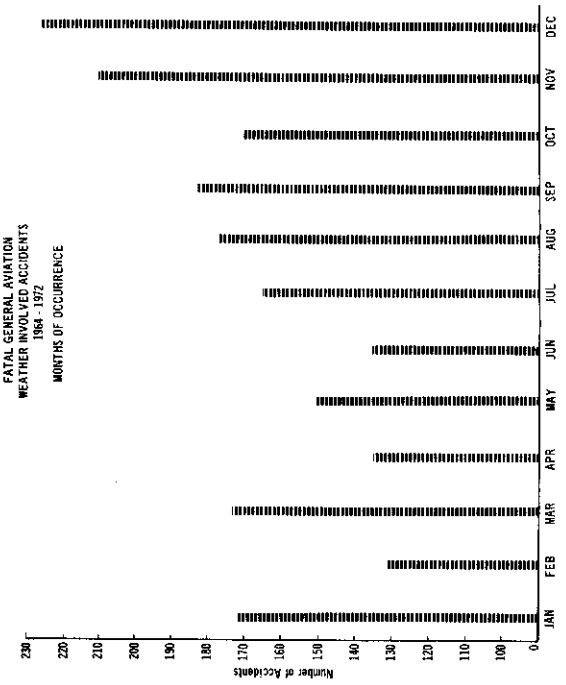


TABLE 22

MONTH OF OCCURRENCE BY YEAR

Month	64	65	66	67	68	69	70	71	72	Accidents	Per Cent
January	15	19	14	18	15	22	21	25	23	172	8.47
February	11	15	18	13	18	21	16	10	19	131	6.45
March	17	26	16	18	15	22	21	12	27	173	8.57
April	8	12	18	17	15	13	20	15	17	135	6.65
May	11	17	18	19	18	12	15	24	18	150	7.48
June	16	17	12	12	19	15	15	16	14	135	6.70
July	13	16	10	15	26	23	23	16	22	164	8.07
August	14	19	22	22	27	18	12	20	23	177	8.71
Sept.	15	17	23	19	18	21	28	25	17	183	9.01
October	11	17	17	17	20	20	19	32	17	170	8.37
Nov.	18	25	16	18	30	26	32	17	28	210	10.34
Dec.	33	25	16	15	27	25	16	35	35	226	11.18
Accidents	182	215	200	202	247	237	237	246	260	2,026	
Percent	9.0	10.6	9.8	10.0	12.2	11.7	11.7	12.2	12.8		

TIME OF YEAR

During November and December more fatal, weather-involved, general aviation accidents occurred than in other times of the year. Except for a slight peak in September and

a slight dip in October, there was a rising trend of accidents from June through December. Fewest accidents occurred during February, April,and June. The greatest drop in accidents occurred between December and January, while the greatest increase occurred between February and March (see Table 22 and Figure 9).

STATISTICAL SUMMARY

Based on the statistics presented, a pilot most likely to have been in a fatal, weather-involved, general aviation accident:

1. Received an adequate preflight weather briefing by telephone from a Flight Service Station which utilized Weather Service forecasts which were reasonably accurate.
2. Was proposing a pleasure flight.
3. Had between 100 and 299 flight hours.
4. Had less than 100 hours in the type of aircraft.
5. Had less than 50 hours in the 90 days before the accident.
6. Had a private pilot's certificate.
7. Did not have an instrument rating.
8. Had no actual instrument time, but did have between 1 and 19 hours of simulated instrument time.
9. Had not filed a flight plan.
10. Was between the ages of 41 and 45.
11. Crashed in IFR conditions, probably in fog or rain during daylight hours and
12. Was accompanied by at least one passenger.

ACTIONS BY GOVERNMENT AND INDUSTRY TO MINIMIZE WEATHER-INVOLVED, GENERAL AVIATION ACCIDENTS

National Weather Service (NWS)

Since the majority of pilots in weather-involved, fatal, general aviation accidents were provided reasonably accurate forecasts, the NWS decided that the presentation of its information should be improved because it was possible that pilots misinterpreted the presentation of the information. NWS computations indicate that the accident rate per 100,000 self-briefings is nearly 10 times the accident rate for pilots briefed by trained weather briefers.

Accordingly, the NWS launched several programs to improve and expand aviation weather services and products. It participated in a nationally televised aviation weather program; it developed Transcribed Weather Broadcast (TWEB) route forecasts; it expanded all terminal forecasts to cover a 24-hour period; it reduced forecast cycling; it established a combined NWS/FAA pilot weather briefing evaluation program; and it expanded the NWS forecast evaluation program.

The nationally televised aviation weather program is a cooperative effort by NWS, FAA, and AOPA, and provides pilots with a visual and oral weather briefing for flight planning purposes, and with local forecasts provided via voice inserts by more than 35 NWS forecast offices across the country.

Until 1973, the TWEB broadcasts used area-type forecasts. Now it provides route forecasts for more than 300 designated routes. These forecasts provide more specific information since a smaller area is covered. Additionally, the forecasts are available to pilot briefers who will no longer have to interpret for a given route by extracting and interpreting the information presented on the larger area-type forecasts.

The expansion of all terminal forecasts to 24-hour coverage also eliminated the necessity for the pilot briefer to interpret weather information from an area forecast for a location which had only 12-hour coverage.

Forecast cycling (refers to number of times a forecast is issued daily) was reduced so that the forecaster would have more time to monitor his forecasts and provide amendments if

required. During the extra time available, the forecaster monitors pilot reports, radar observations and surface weather observations, and is not forced to rush judgments in order to meet his next scheduled forecast time.

A joint evaluation program was set up between the NWS and the FAA to increase the monitoring of pilot weather briefings. The program provides for increased monitoring of FAA briefings by FAA personnel, which would free NWS personnel to monitor more NWS briefings. Formerly, the bulk of such work was done by the NWS. In addition to the increased cooperation with the FAA on pilot briefings, the NWS is expanding its evaluation staff to include a meteorologist responsible for evaluations in each State. These meteorologists are looking not only at the quality of pilot weather briefings, but at the quality of all other NWS aviation services and products. These meteorologists are close to the pilots who can point out aviation weather problems that could affect safety. They also receive feedback on problems and solutions from NWS headquarters and serve as the primary NWS representative at aviation weather seminars and clinics.

Other efforts include updating and republishing *Aviation Weather For Pilots and Flight Operations Personnel.* That 1965 document was a joint effort by the U.S. Weather Bureau (now NWS) and the FAA. It was intended for use not only by pilots, but also by personnel whose interest in meteorology was primarily in its application to flying.

Federal Aviation Administration (FAA)

While not specifically aimed at weather-involved accidents, the FAA's General Aviation Accident Prevention Program is working on the problem indirectly. Following a 2-year test in two FAA Regions, the program was expanded to all regions (except Europe) in 1971. The objectives of the program are to:

(1) Improve general aviation safety by applying effective accident prevention methods and techniques.
(2) Use FAA personnel and resources better.
(3) Motivate the entire aviation community to increased leadership and participation in safety activities and to increase the personal involvement of airmen.

An accident prevention specialist is assigned to each of 86 General Aviation and Flight Standards District Offices. There are 11 regional coordinators, and the national program is coordinated from FAA's Washington headquarters.

An effort to produce more proficient and therefore, safer pilots is the FAA's recent complete revision of 14 CFR 61, Certification: Pilots and Flight Instructors. The revision introduces a new "total operational training concept" to pilot training and testing. Instructors are responsible for training students to competence in the piloting operations specified, rather than just the performance of certain flight maneuvers. The oral and flight test for a pilot certificate will consist of an evaluation of the applicant's ability to conduct these operations safely, and will be based on the applicant's performance of procedures and maneuvers which are selected by the examiner from the appropriate flight test guide at the time of the test. In addition to the flight instructor's increased responsibility, the requirements for a flight instructor rating have been increased considerably. A flight instructor must have a commercial certificate and an instrument rating and is required to demonstrate ability in both ground and flight instruction.

Major changes, their effects, and the standards and procedures to be used in their implementation are outlined in FAA's Advisory Circular 61-65, issued on 9/5/73.

One new requirement (14 CFR 61.57) which will affect all pilots who intend to act as

pilot-in-command is a biennial flight review of flying skill and aeronautical knowledge. This review will be required beginning November 1, 1974. The only exceptions will be pilots working for an airline, or similar commercial operation, for which separate and periodic checks are already required.

The FAA has rewritten 14 CFR 141: Pilot Schools. The new regulations became effective on November 1, 1974, and are intended to revitalize the approved school program. Among other things, the new regulations should give certified schools a more important and more significant part in pilot training and testing to go along with the flight instructor's increased responsibilities under the new 14 CFR 61.

Minimum standards for instruction in meteorology for the private pilot certification course are contained in Appendix A to the new 14 CFR 141. The minimum number of classroom hours in ground training has been reduced to 35, and also includes such areas as: Regulations, use of the Airman's Information Manual and the FAA's Advisory Circular System, navigation, safe and efficient operation of aircraft, and radio communication.

Aircraft Owners and Pilots Association (AOPA)

AOPA's Air Safety Foundation is a separate, nonprofit organization which has grown into the largest nongovernmental general aviation safety organization in the world. Currently, it offers 18 training programs for airmen at many locations across the United States. Two of these programs deal specifically with the aviation weather problem.

One program was developed as a result of a survey conducted by the foundation after which it concluded that ". . . far too few pilots know far too little about Practical Aviation Weather—weather which if realistically understood, would enable every airman to make intelligent, knowledgeable, 'go or no-go' decisions. . . ." Accordingly, the foundation has developed a new, 2-day Practical Weather Course designed to "teach pilots of every rating to make intelligent appraisals of existing weather conditions and to govern their flying activities accordingly." The foundation indicates that the pilot will " . . . learn the causes of motion, about friction, inversions, shear zones and frontal zones . . . about vertical motions, how to effectively combat thunderstorms, squall lines, lightning, tornadoes, turbulence, cloud forms, fog and wind."

The second program is aimed specifically at the weather-involvement problem and is the nationally televised aviation weather program mentioned previously. It was an AOPA Foundation grant which made it possible for three Washington-Baltimore area educational TV stations to initiate the program with the cooperation of the NWS and the FAA. The program continues to be funded in part by the foundation and is produced by the Maryland Center for Public Broadcasting in Baltimore. The program is broadcast usually on Thursday and Friday evenings, and consists of a 15-minute segment of weather discussion and a 15-minute segment for pilot education. Information regarding rules and regulations, improved flying techniques, safe operation of aircraft, and the weather's relationship to aviation are discussed.

General Aviation Associations Council (GENAVAC)

The National Business Aircraft Association (NBAA) currently chairs the General Aviation Weather Requirements Committee of GENAVAC. The GENAVAC Council is comprised of the two senior elected officials of the following organizations: NBAA, AOPA, Aviation Distributors and Manufacturers Association (ADMA), General Aviation Manufacturers Association (GAMA), National Association of Flight Instructors (NAFI), National Pilots Association (NPA), and the National Air Transportation Associations (NATA). Because

of its concern with the quality of weather service, GENAVAC charged its Weather Requirements Committee with the responsibility of collating general aviation's aviation weather requirements for submission to the FAA and the National Oceanic and Atmospheric Administration—the parent organization of the National Weather Service. Those requirements have recently been proposed formally to those two agencies and are quoted below:

"1. With the steady and constant increase in pilot weather briefings we are approaching the point where individual weather briefings for pilots will no longer be economically feasible, or even physically possible. However, general aviation requires that individual pilot weather briefings continue until such time as mass and/or automated pilot weather briefings are available as the primary means of aviation weather briefings. In addition, a back up system must be accessible to pilots by telephone or aircraft radio in unusual situations, such as primary system failure, inaccessibility of the primary system or a requirement for additional weather data not available in the standard briefing.

"2. Restricted visibility is a significant hazard to general aviation, but it is very difficult or impossible to obtain realtime visibility information, especially at airports not regularly reporting aviation weather. Therefore, aviation surface weather observations for general aviation should be designed to provide additional and specific aviation weather data (when visibility is less than five miles) and aviation weather forecasts should be scheduled to provide maximum information between sunrise and sunset, normally the period of greatest general aviation activity.

"3. Valid aviation weather information reported by observers on the ground and in flight is delayed, trapped or lost within the aviation weather dissemination systems and is not available to general aviation pilots; therefore, all valid aviation weather information must be entered into the government weather dissemination system and be made available to general aviation pilots on a timely basis. A requirement exists for the collection and dissemination of all aviation weather reports, both surface and in-flight, made by private, commercial, military and other government observing and reporting sources. Interchange procedures should be established to insure that the general aviation pilot, regardless of the type of aircraft flown or pilot qualifications, be provided accurate aviation weather information from any and/or all of these sources.

"4. Many general aviation weather related incidents and accidents are directly traceable to unexpected encounters with unusual or hazardous weather phenomena. Accurate and timely information on the scope and timing of hazardous weather must be available to the General Aviation pilot; therefore, priority should be given to the observation and dissemination of unusual or hazardous weather information and this information should be available to communications services for expeditious relay to affected pilots.

"5. General aviation pilots are responsible for determining that aviation weather conditions are suitable to successfully complete their planned flights. Because of the limited means of aviation weather dissemination and/or lengthy delays incurred by pilots in attempting to contact authorized aviation weather facilities, adequate aviation weather data and/or weather briefings are frequently unavailable for flight planning; therefore methods of mass dissemination of preflight aviation weather data to general aviation pilots is a priority requirement. That access to the aviation weather dissemination system must be available to the general aviation pilot through simple communications means.

'6. Approximately 98% of all aircraft in the United States are in the general aviation category. Thus this fleet which normally conducts its entire flight operation below 10,000' AGL has the greatest potential for accidents. The record indicates that approximately 1/3 of the fatal accidents involving these aircraft are weather related. The difficulty in obtaining adequate weather information contributes to some percentage of these accidents. Therefore, a thorough aviation weather briefing including forecast and real-time weather must be readily available to all general aviation pilots for flight planning, enroute and terminal operations.

Information on rapidly changing weather situations must be immediately available to pilots in flight.

"7. Airman training programs should be designed to insure that general aviation pilots have an adequate understanding and working knowledge of aviation weather phenomena in order to be able to anticipate and cope with inflight weather situations.

"8. The technical language used by weather briefers and the complex symbology of written/teletype weather information is difficult to understand, and is susceptible to misinterpretation by pilots. Therefore, weather information must be presented in a sufficiently clear manner that all general aviation pilots can interpret and understand the weather data and can report inflight weather accurately."

Other Government/Industry Action

In 1961, the CLOUD NINE Committee which is an informal Government/Industry group was formed to study general aviation weather problems. The committee is used as a forum for the free exchange of views between interested Government agencies and the aviation industry concerning weather service to aviation (primarily general aviation). Membership is varied and consists primarily of the following: Aircraft Owners and Pilots Association, National Business Aircraft Association, General Aviation Manufacturers Association, National Air Transportation Associations, National Pilots Association, Experimental Aircraft Association, International Flying Farmers, Flying Physicians Association, Federal Aviation Administration, National Weather Service, and the National Transportation Safety Board.

CONCLUSIONS

In 1969, the Safety Board published a Weather Briefing Guide for the General Aviation Pilot in which it concluded that "Too many of the fatal, weather-involved, general aviation accidents were caused, in part at least, by the pilot's mistaken idea of his ability to cope with certain weather situations." Notwithstanding those efforts of Government and industry outlined above, the Board must conclude from this study that the situation has not improved. Similar conclusions have been reached by the FAA. In a recent issue of FAA WORLD commemorating the seventieth anniversary of flight, Mr. Alexander Butterfield, Administrator, touched on part of the problem in stating that, "The skies are more crowded today, but the real hazards to safe flight are precisely what Wilbur Wright warned against—'carelessness and overconfidence' on the part of some pilots, such as inadequate preflighting, risky weather decisions, and lack of visual alertness for other aircraft."

The Safety Board believes that the general aviation accident prevention efforts of Government and industry have been helpful and were it not for those programs mentioned, the record could probably be worse since general aviation activity has increased in the past 10 years. Greater efforts will be required to reverse the trend in weather-involved accidents, especially if the probable increase in exposure

predicted for general aviation for the next 5 to 10 years is accurate. Emphasis on weather awareness is required at all levels of pilot education, and Government/Industry accident prevention efforts must be continued, expanded,and accelerated.

RECOMMENDATIONS

The National Transportation Safety Board urges general aviation pilots to take full advantage of the various safety seminars, clinics, and courses of instruction sponsored both by Government and by industry. Visit the Weather Service or FAA facilities for familiarization and discussion of weather problems. The Board urges pilots to ask questions—keep updated on the latest procedures—make suggestions for improvements in service. Take advantage of instrument simulator training, as well as opportunities to gain actual instrument experience if they are instrument-rated, or when accompanied by a qualified flight instructor: Take advantage of the Aviation Weather show televised over the Public Broadcasting Service Broadcasting facilities for flight planning; never initiate a flight without a thorough preflight weather briefing and if there is any doubt, DON'T GO.

Based on the results of this study, the National Transportation Safety Board recommends that the:

Federal Aviation Administration:

1. Amend 14 CFR 141 to increase the required* minimum of 35 hours of classroom instruction given to private pilot trainees, and specify the number of hours of meteorological instruction required. (Recommendation A-74-67)
2. Require that written meteorology examinations be designed to measure an applicant's knowledge of the practical application in addition to technical aspects of meteorology. (Recommendation A-74-68)
3. Amend 14 CFR 61.57(b) to require a demonstration of the applicant's competence to procure and utilize weather information which will enable him to exercise safely the privileges of his pilot's certificate. (Recommendation A-74-69)
4. Amend 14 CFR 61.125 Aeronautical Knowledge (a) Airplanes, to require an applicant for a commercial pilot certificate to present evidence of meteorological knowledge in addition to the other areas of aeronautical knowledge now specified, similar to the requirements of 14 CFR 61.125 (b)(2), (c)(3), (d)(5), or (e)(3). (Recommendation A-74-70)
5. Increase the emphasis on aviation meteorology and weather limitations of pilots through its General Aviation Accident Prevention Program. (Recommendation A-74-71)
6. Take priority action in order to adhere to the proposed 4-year implementation plan for the En Route Flight Advisory Service (Flight Watch) program. (Recommendation A-74-72)
7. Implement, at least on an experimental basis at selected high general aviation activity locations, the audio recording of preflight weather briefings. (Recommendation A-74-73)

The National Oceanic and Atmospheric Administration/National Weather Service:

8. Accelerate efforts to update, publish, advertise, and disseminate the document entitled, *Aviation Weather for Pilots and Operations Personnel.* (Recommendation A-74-74)
9. Accelerate the expansion of the evaluation staff to its proposed complement of one evaluations meteorologist per State and include in his responsibilities the implementation of a quality control program for aviation weather observations. (Recommendation A-74-75)
10. Accelerate efforts to improve the presentation of aviation weather products. (Recommendation A-74-76)

*As of November 1, 1974.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JOHN H. REED
Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ LOUIS M. THAYER
Member

/s/ ISABEL A. BURGESS
Member

/s/ WILLIAM R. HALEY
Member

August 28, 1974

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