

FIGURE 1. General aviation fatal accidents. Range of measured alcohol levels in the 56 positive cases

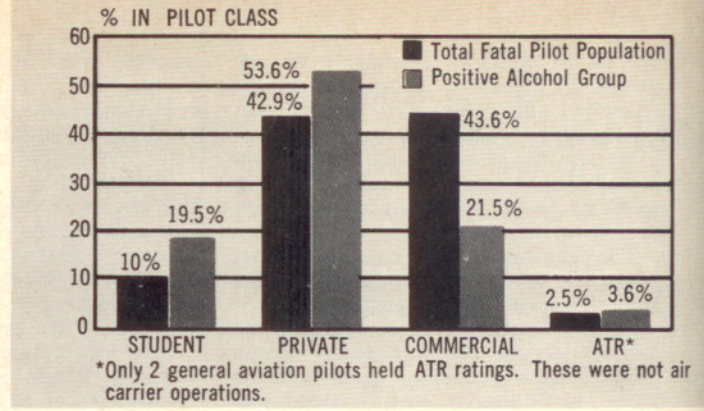


FIGURE 2. General aviation fatal accidents. Distribution by pilot classes

\*Only 2 general aviation pilots held ATR ratings. These were not air carrier operations.

by CHARLES R. HARPER, M.D.

# Alcohol And General Aviation

Little importance or attention has been given to the role of alcohol in civil general aviation accidents. Its significance has never been determined. This is evidenced, for example, by most recent authoritative accident statistical reports.<sup>2,3</sup> In these statistical reviews, covering 929 general aviation fatal accidents which occurred in the years 1960 and 1961, only eight cases were identified under the pilot causal factor heading, "operating under the influence of intoxicants," and only 31 cases were identified under the heading, "related factors." Thus, alcohol has been identified in only 4% of all the general aviation fatal accidents for this two-year period.

This paper represents a study of 158 general aviation fatal accidents in which toxicological examinations were performed on the pilots. These 158 cases were part of the total of 477 general aviation fatal accidents which killed 899 people in the year 1963. Thus, the study covers over one-third of the general aviation fatal accidents which occurred in 1963.

In this paper the term general aviation means civil, private, business, corporate, and commercial flying excluding all air carrier operations, both scheduled and nonscheduled, and ex-

*An FAA study reveals that 35.4% of pilots involved in 158 fatal accidents in 1963 tested positive for alcohol in toxicological examinations. Investigators urge further study of drinking problem*

cluding military aviation.

In each of these 158 cases, blood and/or tissue alcohol determinations were performed on the pilots. Reliable laboratories were utilized, including university medical school laboratories, state crime and police laboratories, the laboratories of the A.F.I.P., and private licensed medical laboratories. The laboratory results were carefully reviewed for the possibility of errors from contamination, putrefaction, and laboratory error.<sup>7,8,9</sup> Four doubtful cases were eliminated from the study. Ten cases in which alcoholism was strongly established by history, but not verified by laboratory determinations, were eliminated.

Of the 158 cases which received routine toxicological investigation, the unexpectedly high number of 56 were positive for blood and/or tissue alcohol. This represents 35.4% of the total general aviation fatal accidents studied! Extrapolation to the total of 477 gen-

eral aviation fatal accidents for the year 1963 indicated alcohol involvement in 169 cases. Cases in which the alcohol level was less than 15 milligrams per 100 milliliters blood were considered as negative for this study. In the positive alcohol group the average alcohol level was found to be 145 milligrams per 100 milliliters blood.

Throughout this paper, where comparisons are made between the positive alcohol 1963 study group and the overall general aviation fatal accident population, statistics covering the year 1926<sup>6</sup> are used since these are the latest statistics available for baseline comparison. Where such comparisons have been made in this study, the over-all general aviation fatal accident population did not have the positive alcohol population subtracted. Had it been possible to eliminate the positive alcohol group, the comparisons between the two groups would have shown a much larger contrast since the positive alcohol group comprises one-third of the over-all group.

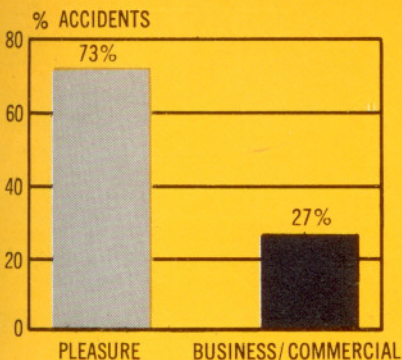
Figure 1 shows the range of alcohol levels in the 56 positive cases.

The positive-alcohol pilots were found to represent all classes of airmen and all pilot ratings. It is of interest to note that student pilots represented 19.5% of the fatal cases involving alcohol. This contrasts with the 11% incidence of student pilot involvement in all general aviation fatal accidents as reported in Civil Aeronautics Board Statistical Reviews.<sup>2,3</sup>

Figure 2 shows a detailed distribution of the pilots by classes included

**EDITOR'S NOTE:** This paper on the possible involvement of alcohol in fatal general aviation accidents, while somewhat technical in form, is published by *The PILOT* because of its significant findings in the field of alcohol and flying. It reemphasizes many of the points made in "Alcohol And Flying: Mortal Enemies," taken from Dr. Ross McFarland's "Human Factors In Air Transportation." The FAA researchers, Drs. Harper and Albers, admit that there is much to be done in this field of research. There are no

adequate figures for previous years with which to make comparisons, and the toxicological examinations were made on only about one-third of the pilots involved in fatal accidents. *The PILOT* expects to publish another article on this subject soon, explaining some of the points raised in the Harpers-Albers report. This article is published with the permission of the Aerospace Medical Association. It first appeared in the May 1964 issue of *Aerospace Medicine*, official magazine of the Association.



**FIGURE 3.** General aviation fatal accidents. Distribution by type of flying

and *WILLIAM R. ALBERS, M.D.*

# Accidents

in the 56 cases of positive alcohol. These are compared to the over-all fatal general aviation population.

All types of general aviation flying activities (non-air carrier) were represented in the alcohol positive group.

Figure 3 shows a comparison of the percentage of pleasure flying with the percentage of business and commercial flying involved.

Detailed flight histories of the alcohol positive group were reviewed. In 39 cases it was possible to determine the length of time of the flight from takeoff to crash. It was found that 48.7% crashed within 18 minutes or less. Of these, 18% crashed within 12 minutes or less!

These are unusually short flight durations. They are significant because a study of corresponding sample of fatal accidents in which alcohol involvement was definitely ruled out reveals only 26% crashing within 18 minutes after takeoff.

Figure 4 shows a comparison of these two groups.

An analysis of total pilot flight time in the positive alcohol group reveals a wide variation of experience ranging from low-time student pilots to pilots with almost 9,000 hours. It should be noted that only three pilots in the positive alcohol group held current instrument ratings.

Figure 5 gives the distribution of flight experience in the positive alcohol group and shows a comparison with the over-all general aviation fatal accident population. Of significance is the peaking of positive alcohol group accidents in the low total pilot time range around 300 hours.

Civil Aeronautics Board Statistical Reviews reveal that 9.3% of the total general aviation fatal accidents involved pilots with a total time of 100 hours or less. In the positive alcohol group we find that 16% of the fatal

% ACCIDENTS

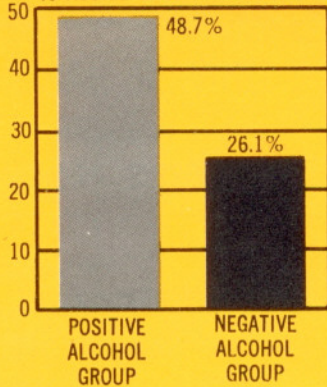


FIGURE 4. General aviation fatal accidents. Duration of flight from takeoff to accident (18 minutes or less)

% FREQUENCY OF ACCIDENTS

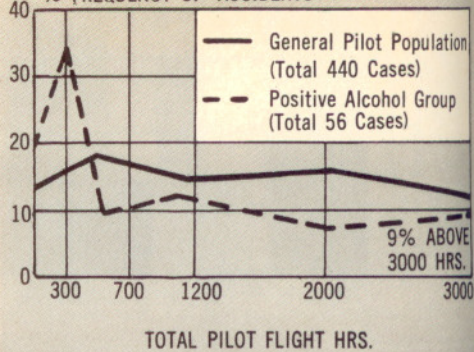


FIGURE 5. General aviation fatal accidents. Distribution based on pilot experience

accidents involved pilots with 100 hours or less. This is almost twice as many inexperienced pilots killed when alcohol is involved than are killed in the overall fatal accident population. This correlates with the unusually high per cent of student pilots involved as depicted in Figure 2.

The relationship of the positive alcohol group with weather factors and time of day is depicted in Figure 6.

This figure reveals that the positive alcohol group has a night accident rate twice that of the over all general aviation fatal accident group.<sup>5</sup>

It is of interest to note that, in the positive alcohol fatal group, Flight Standards Service accident reports reveal that 55% of the accidents involved basic loss of control. Also, while the incidence of stall-spin accidents in the over-all general aviation fatal accident population is 13%, in the positive alcohol fatal group under study the incidence of stall-spin accidents was found to be 33%, a 2½-fold increase. Twenty per cent of the positive-alcohol-fatal group involved "struck object" accidents.

### Discussion

This study reveals a much higher incidence of proven alcohol in pilots involved in fatal general aviation accidents than was previously known or reported.

Aksnes<sup>7</sup> has demonstrated that levels far below the commonly accepted legal limit of 150 milligrams per 100 milliliters of blood<sup>7,10</sup> have definite adverse effects upon flying skills. Comparison of his study with studies involving alcohol and driving skills<sup>4</sup> indicates that *flying skills are measurably decreased by only one-fourth the amount of alcohol necessary to produce measurable decrease in driving skills.* The present study adds support to Aksnes findings that low levels of alcohol adversely affect flying performance.

Student pilots and inexperienced pilots with positive alcohol have almost twice the fatality rate as the over-all general aviation group of the same category.

Pilot experience *per se* is no guaran-

tee against the adverse effects of alcohol, since high-time pilots are found in the positive-alcohol-fatal group. It appears, however, that alcohol involvement in the relatively inexperienced group, around the 300-hour-total-pilot-time range, is of much greater significance.

This study is but one example of the great need for medical and human factor studies in civil aircraft accident investigations. Civil aircraft today are well designed and constructed. Structural or mechanical failure is rare when airframe or engine limits are not exceeded. Human and medical factors represent a great unknown area in the man-machine-environment complex. The authors feel that this area holds the greatest promise for reducing the accident, injury, and fatality rates.

Too often accidents are pigeonholed under such factors as "weather," "inattention to pilot duties," "struck object," or "misjudged distance." Alcohol affects pilot judgment, attention (both inside and outside the cockpit), vision, and neuromuscular coordination.<sup>5, 8, 10, 11, 12</sup> It is not surprising, therefore, to find accidents involving poor flight planning, continuing into unfavorable weather, collision with objects, poor coordination, and stalls and spins.

This paper indicated a need for greater attention to alcohol in general aviation accidents from the investigative, research, and, most important of all, the pilot educational viewpoint.

While this study reveals that alcohol is involved in a very significant per cent of general aviation fatal accidents, it should not be inferred from this study that general aviation pilots are alcoholics. Extrapolating the per cent of alcohol involvement in this study to the total general aviation population reveals less than six-tenths of one per cent alcohol involvement in general aviation. The great majority of civil general aviation pilots are mature, dependable individuals who contribute to the high standards of excellence and safety of civil aviation today in the United States. It is clear that the alcohol-associated group is a very small group, but one which exerts an adverse

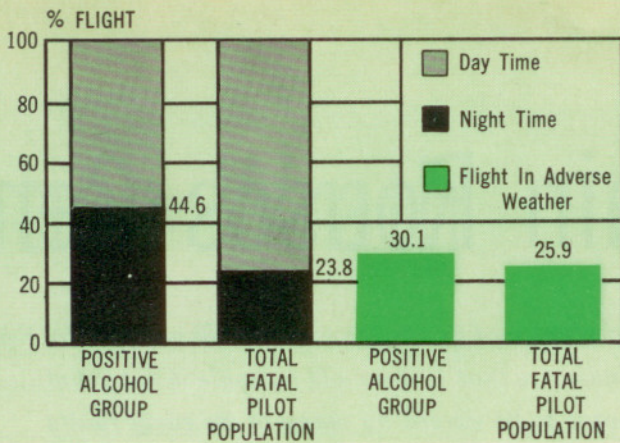


FIGURE 6. General aviation fatal accidents. Conditions of flight

© Aerospace Medical Association 1964

effect on the over-all image of civil aviation.

The authors wish to thank the many FAA Aviation Medical Examiners who volunteered to assist in this accident investigation program. These physicians served without remuneration and frequently at great personal and professional inconvenience in order to contribute to the improvement of aviation safety. Without their assistance there would be no factual data available, and studies such as this one would not be possible.

#### References

- AKSNES, E. G.: Effect of small doses of alcohol upon performance in a Link Trainer. *J. Avn. Med.*, 25:680-688, 1954.
- CIVIL AERONAUTICS BOARD: General Aviation Accidents, A Statistical Review, 1960.
- CIVIL AERONAUTICS BOARD: General Aviation Accidents, A Statistical Review, 1961.
- DREW, G. C., COLQUOUN, W. P., and LONG, H. A.: Effect of small doses of alcohol on a skill resembling driving. *Brit. Med. J.*, 2:993-999, 1958.
- ENZER, N., SIMONSON, E., and BAL-LARD, G.: The effect of small doses of alcohol on the central nervous system. *Am. J. Clin. Path.*, 14:333-341, 1944.
- FEDERAL AVIATION AGENCY: General Aviation Accident Data, 1961 and 1962.
- GONZALES, T. A., ET AL.: Ethyl Alcohol. *Legal Medicine, Pathology and Toxicology*. 2nd. ed., New York, N. Y., Appleton-Century-Crofts, 1954, pp. 1083-1122.
- KALANT, H.: The pharmacology of alcohol intoxication. *Quart. J. Stud. Alc., Supp.*, 1 Nov.
- LESTER, D.: Endogenous ethanol: A review. *Quart. J. Stud. Alc.*, 22:554-574, 1961.
- McFARLAND, R. A.: *Human Factors in Air Transportation*. 1st. ed. New York, N. Y., McGraw-Hill, 1953, pp. 135, 292-302.
- NEWMAN, H., and ABRAMSON, M.: Relation of alcohol concentration to intoxication. *Proc. Soc. Exp. Biol. and Med.*, 48:509-513, 1941.
- NEWMAN, H., and FLETCHER, E.: The effect of alcoholism on vision. *Am. J. Med. Sci.*, 202:723-730, 1941 ●

## ABSTRACT

This paper deals with the study of 158 general aviation fatal accidents in which routine toxicological examinations were performed on the pilots. This represents one-third of the total number of general aviation fatal accidents for the year 1963. It was found that 56 of the 158 cases were positive for blood and/or tissue alcohol, representing 35.4% of the total general aviation fatal accidents study.

All classes of airmen and all pilot ratings were found in the positive alcohol group. The incidence of student pilot involvement in this group was found to be almost twice that in the over-all fatal accident population. An interesting finding was that almost one-half of the alcohol positive group crashed within 18 minutes or less of takeoff. An analysis of total pilot flight time in the positive alcohol group re-

veals a high incidence of fatal accidents in the low total pilot time range around 300 hours. The positive alcohol group was found to have a night accident rate twice that of the over-all fatal accident group.

The paper reveals a much higher incidence of proven alcohol in pilots in fatal general aviation accidents than were previously known. The study adds support to Aksnes finding that relatively low levels of alcohol adversely affect flying performance. The study is an example of the great need for medical and human factors studies in civil aircraft accident investigations. Although the positive alcohol group contributed to over one-third of the general aviation fatal accidents, it is to be noted that this group comprised less than 0.6% of the total general aviation population.