BOOZE, BOTTLES & THROTTLES

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It's an unhealthy combination even in the smallest quantities, as this research on actual in-flight pilot performance demonstrates

■■ The majority of U.S. pilots are more than reasonable, but among any group of people numbering some 800,000, there are bound to be a few bad apples. That is, there will be a few who insist on drinking before mounting their trusty aeronautical steeds and flying away. In earlier days, the horse frequently knew the way home and could negotiate this with no help from his rider. Not so our present-day conveyances.

About a decade ago, two FAA physicians, Drs. Harper and Albers, published a paper in which they stated that 37% of all fatal aircraft accidents involved pilots who had been drinking. At the same time, the Bureau of Safety of the Civil Aeronautics Board (the predecessor of our current National Transportation Safety Board) published figures which indicated that about 8% of the fatal aircraft accidents in the same period were caused by alcohol. Why the discrepancy?

To begin with, only one-third of all fatal accidents a decade ago had any sort of medical detective work associated with the primary accident investigation. The figure now is somewhat better, but by no means has the National Transportation Safety Board been able to medically cover all fatal accidents. In any case where alcohol is suspected, the investigators look for it, while they may ignore it as a factor in other accidents. It is possible, therefore, that the majority of alcohol accidents are investigated already. Applying this figure to the total number of accidents on a percentage basis yields an incorrectly high figure for the overall occurrence.

A second factor involves the occurrence of alcohol itself following a fatal aircraft accident. The Harper-Albers study used data from more than 200 different laboratories. While the majority of these laboratories are presumed to be accurate, it would be surprising indeed if at least a few of them did not make honest mistakes. Further, alcohol can be generated within tissues and blood by certain bacteria. If the victims of an accident are not recovered and examined immediately, these bacteria produce alcohol that will be reported when the investigation is performed. There are techniques to correct for this error, but few laboratories outside the FAA lab at Oklahoma City go to the trouble and effort to eliminate this error.

Lastly, there is a difference in the wording of the two studies. The FAA reported alcohol when found, even in extremely small amounts. The CAB, however, only reported alcohol in fairly large quantities in which it was felt to be the major cause of the accident. To better understand this, it is necessary to understand the method used to report alcohol levels.

The most common report concerning alcohol deals with the alcohol concentration in the blood. Other means can be used, but this is simple, since blood samples can be easily obtained, and alcohol is carried to the brain in the blood stream. A normal level is zero, and most state motor vehicle codes list values for what is called *prima facie* evidence of intoxication. An individual with a blood alcohol level above the *prima facie* percentage is legally drunk, with no further questions asked or proof needed. In some states, this value is set at 0.15%, while in a majority, the value is 0.10%. In two states, it is even lower, at 0.08%.

Some of the discrepancy between the Harper-Albers study and the CAB study can now be explained. Harper and Albers listed all alcohol accidents in which a blood level of 0.015% could be demonstrated. In other words, they used a level, as significant for alcohol, that was just one-tenth of that required as evidence of intoxication in some states. But just how significant are levels well below those required to be legally drunk? Everyone agrees that one should not fly when drunk, but what about very low levels?

This was the question posed to my colleague, Dr. Charles Billings, and me in 1968 by the Office of Aviation Medicine within the FAA. The Federal Air Surgeon, Dr. P. V. Siegel, wanted to know what effect moderate blood alcohol levels would have on pilot performance. In other words, following a fatal accident in which the pilot had a blood alcohol level of, say, 0.06%, what part did alcohol play ?

To answer this question, we decided to carry out actual in-flight studies rather than limit ourselves to sterile and possibly inappropriate laboratory work. Our first job was to obtain an

airplane, and for this work we chose a 1959-model Cessna 172. If there is a successor to the legendary J-3 Cub, the 172 is it. It is a very common, popular, garden-variety airplane. It is easy to fly, and almost every private pilot has flown one at some time or other.

We then equipped the airplane with a good radio, including a localizer and glideslope receiver as well as a marker beacon receiver. But then the modifications really began, for we also installed a very exotic series of sensors, control pickoffs, special recorders, and various other assorted "black boxes."

We were careful to leave the instrument panel untouched, and from the subject pilots' point of view, the airplane still looks and flies like a standard airplane. The equipment installed, however, requires that the airplane be flown as an experimental craft, and, in fact, the hardware, computers, and computer programs associated with the airplane are worth perhaps 10 times what the airplane itself originally cost.

While in flight, the equipment enables us to record the control movements of the rudder, ailerons, elevator, and throttle. We also can record airspeed, all radio communications, discrete events as we wish, and—most important—our position on a localizer and glideslope, as well as marker beacon passage. Lastly, we can record pilot heart rates or other physiological measurements.

The equipment takes considerable space, so one rear seat has been removed. The subject pilot occupies the normal left front seat, and I fly in the right seat to ensure that we don't make any headlines. A technician, usually a resident physician, flies in the right rear seat to operate the electronics and otherwise assist, as we shall see.

Sixteen pilots volunteered their services as subjects for this project. Eight were extremely experienced professional pilots from the Columbus, Ohio, area. Included in this group were four who held airline transport ratings and two more who were pilot examiners. They averaged 9,000 hours of flying time, and none had less than 4,000 hours. The remaining eight were "low-time" private and commercial pilots who averaged about 450 hours. None had more than 1,000 hours, although all had instrument ratings.

Each pilot was brought up to a desired alcohol level, based on his individual tolerance for vodka, and asked to fly four ILS approaches at night to the Port Columbus airport. To ensure that the pilot stayed at the desired alcohol level, we carried a Stephenson Breathalyzer ® in the Cessna and checked our subjects at regular intervals. As the alcohol level began to drop, our rear-seat technician poured small maintenance doses of our prime-quality "screwdrivers" to keep the subject at the desired level. The airlines have nothing on us!

Our target alcohol levels were 0, 0.04, 0.08, and 0.12%. Each pilot was compared with himself when sober, and not with any other pilot in the study. Incidentally, the FAA issued an exemption from the regulations to allow these pilots to fly while under the influence of alcohol. This is the only such exemption ever issued, and our pilots constitute the only group who have legally flown while under the influence of booze. While it may seem like fun to the uninitiated, our pilots all agreed that at the higher alcohol levels particularly, it was painful—at times nauseating—and they frequently suffered major hangovers the next day. It wasn't quite the bowl of cherries one might expect.

We had planned to use 0.15% as our peak level at first, and we set up a dress

rehearsal prior to beginning our actual data flights. An Eastern Airlines captain volunteered for this chore. At that time, he was flying a DC-9 on the shuttle service between LaGuardia and Washington National, so he had had ample recent ILS experience. In fact, probably no pilot for any airline makes any more ILS approaches per flying hour than does a shuttle pilot. Our airline pilot was quite experienced in light aircraft as well.

We were unable to calibrate his tolerance for alcohol, since he arrived in Columbus the morning of the test flight. Consequently, we overshot slightly and managed an alcohol level of 0.16%. However, this level in this experienced pilot caused such a degradation of his pilot skill that we knew that lower levels would be more than satisfactory for the rest of our data flights. It required no computer to tell us that 0.15% was incompatible with safe flight.

For example, we used the code call sign "Buckeye One" for our aircraft while in flight. This alerted Columbus controllers that the pilot might or might not be entirely in control of himself. More important, it alerted them that we needed to complete a full ILS for data purposes. Our pilot of that evening, however, couldn't remember our call sign and kept giving Eastern flight numbers in a somewhat slurred voice. We owe Eastern Airlines an apology, for we didn't win any friends for them that night.

During the course of one ILS approach, we were almost a mile south of the localizer between the two markers, an unthinkable error for this experienced pilot otherwise. At the termination of that approach, however, we passed the middle marker, and at the instant of passing, were exactly centered on the localizer and glideslope. There was just one problem. We were headed at 90 degrees to the runway! This directed us to a black field, and in other circumstances would have resulted in a fatal accident.

We held one other dress rehearsal, this time with Dr. Billings as the subject pilot. During this flight, the glideslope failed. I pointed this out, with a remark about the red flag showing. I further suggested that we fly to minimums anyway, since we always flew under VFR conditions. Nevertheless, Dr. Billings totally ignored the failed glideslope, followed the needle, and tried to fly the airplane into the ground about two miles short of the runway. Once again we had more than ample evidence that 0.15% was far too high a level of alcohol and would very likely result in a fatal accident.

In addition to the computer-recorded data, I made a simple log sheet of obvious pilot errors that required no value judgment on my part. For example, although many pilot-rating forms evaluate hard landings and so on, these still require subjective judgment on the part of the check pilot. This is a potential source of error. However, our pilots occasionally forgot to turn on the nav lights at night, shut down the aircraft and left the master switch or mag switch on, took off with full flaps or full carb heat, or made other obvious gross errors. These all found their way into my little black notebook.

Some 2½ years, 200-plus flying hours, and 512 ILS approaches later, we had all our data collected. What did it tell us?

In brief, alcohol and aviation don't mix in any quantity. The FAA, in response to a petition by AOPA, in 1970 passed a regulation which says that no one may fly any airplane within eight hours after drinking any alcoholic beverage. This means that even a beer with lunch will disqualify any pilot from flying for the next eight hours. In a few cases, where one really "ties one on," eight hours may not be enough, but for the average social drinker the rule is fairly reasonable.

The average person will burn up about an ounce of pure alcohol in an hour. Stated another way, blood alcohol levels will drop by about 0.015% per hour, although there are a number of things that influence both these numbers. The last figure means that for someone who is just on the border of intoxication in our most lenient states—that is, someone whose blood alcohol is 0.15%—a 10-hour period will be required before the blood alcohol level is back to zero. A hangover is difficult to define medically, and we made no attempt to work in this area, since our primary interest was in the positive blood alcohol field.

While a general statement about drinking and flying is easy to make, how bad is pilot performance at low alcohol levels?

If we look only at performance on the glideslope and localizer—the primary tracking task—it isn't too bad. In fact, all our pilots were able to take off and land in a passable manner. At 0.04%, there is no statistical difference between that value and the pilots' performance when completely sober. At 0.08%, things begin to go sour, and at 0.12% they are really quite bad, although with a 172 there was no problem in maneuvering to the runway for a landing. Given a bigger and faster airplane, though, it might well have been a different story.

There was surprisingly little difference between the experienced pilots and the "low-time" group. Performance on the glideslope was slightly better for the experienced group; they appeared to relax more and let the natural stability of the airplane work for them. The low-time group tended to chase the glideslope with less success and smoothness than our high-time pilots. The glide-slope chasing became more pronounced with increasing alcohol levels.

The real problem lies with the so-called secondary tasks that are essential to safe flight. As blood alcohol levels rise, attention spans narrow, and the pilot spends more of his available effort and concentration just on his central problems. For example, we can consider the localizer and the glideslope as the primary tracking tasks, but what of all the other things that occupy one's attention as well?

Our pilots, at the higher alcohol levels, had their hands full just flying the airplane. They failed to notice calls from the radar controllers. They forgot to turn on the nav lights, or to turn off the landing light. In a large number of cases, they forgot to use the carburetor heat, and on one occasion a 7,000-hour pilot examiner allowed the engine to ice almost to the point of complete failure. Even a student pilot would have been expected to recognize carburetor ice after a 400-rpm drop with considerable coughing and roughness. This was an unthinkable error for this pilot examiner when completely sober. But these secondary errors began to increase appreciably even at the very lowest alcohol levels used.

Taxi speed was another area of concern. Our pilots normally taxied slowly and carefully. However, under the influence of alcohol at any level, they began to taxi far too fast and were apparently unaware of their speed. In any case, we were taxiing down an unfamiliar taxiway when it took a rather sudden dogleg turn. We ran off the paving, and to ease the load on the nosewheel, I vigorously pulled back on the yoke. The airplane promptly ballooned into the air. We had been taxiing with more than flying speed!

Only one pilot actually lost control in the air. He became temporarily disoriented, and we began what might have been Cessna's version of an outside loop before I took control. On two other flights, pilots misread altimeters and glideslopes to the extent that we were below treetops in large fields two miles from the runway. All in all, a dozen or more fatal accidents were represented by incidents in our study.

Remember that we were using a Cessna 172. Had we had a complex aircraft with many other systems to use, we doubtless would have come close to a number of gear-up landings, failures to switch fuel to full tanks, misuse of constant-speed props, failure to use boost pumps and so on.

There are pilots of the "old school" who tell tales of boozing and flying, and who are around today. Most haven't kept up the bad habit, for it tends to be a self-limiting problem for those who do. Those who have gotten away with it, however, will admit that the flights in question were simple and uncomplicated. It's a good thing, too, for their spare mental capacity to deal with any unusual situation or any emergency was severely handicapped. Nor can one evaluate how well even a simple flight was managed. As one of our subjects said, "I'm flying all right—I think. But I don't really care."

The old saw that one can fly better after a beer or two doesn't hold up under the hard light of scientific scrutiny. Bottles and throttles just don't mix. □