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Strobe Lights And Collision Avoidance

Although strobe lights are used as a deterrent to mid-air aircraft collisions, the author notes there are particular instances when pilots should not use them.

by

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Most pilots and aircraft operators regard the use of high intensity strobe lights as a definite deterrent to mid-air aircraft collisions. The strobe's brightly flashing lights stand out at night, and their million-candlepower brilliance combined with their flash frequency of one-to-two times per second provide a highly visible aircraft marking during daylight hours.

An increasing number of corporate and personal aircraft are being equipped with strobes, and more pilots are becoming familiar with their use. There are times, however, when they should not be used. One of these is when the aircraft is in clouds because of the possible effect on the pilot of the repetitious reflection of the flashing lights into the cockpit.

The U.S. Federal Aviation Administration (FAA) conducted an experiment to determine the effects the sustained reflection of the bright flickering of the strobe lights might have upon a person. No serious problems were detected, but some of the side effects noted were sufficient to raise caution flags against the use of the lights in cloud.

Test groups of both pilots and non-pilots were used in the experiment, whose findings included:

- Physical Effects — Both pilot and non-pilot test groups reported vague feelings of nausea when exposed to flashing strobe lights in an enclosed space, although none of the test subjects actually became ill. Both test groups also reported feeling increasingly drowsy as the experiment progressed. This effect was strong enough that a few of the test subjects felt they could not have remained awake had the exposure to the strobe lights continued.

- Pilot Adaptation — During the test, both pilots and non-pilots were tested for differences in reaction to strobe light exposure. The pilots, perhaps because of their instrument flight experience, tended to offset the strobe effects by focusing their vision on specific objects inside the cockpit rather than the light reflections, including imaginary instrument panels. As a result of such defensive behavior, pilot physiological responses to strobe exposure were less than those for the non-pilots.

Pilot observations included the comment that the flashing of the strobes in cloud — and the resultant illumination of the surrounding clouds — is similar to the distracting effect encountered when landing lights are turned on while in cloud.

Experiment researchers also cautioned that the glare from the flashing strobe lights appears to condition the eye to bright light, which could become a problem when a pilot reverts to an instrument scan after looking outside. The instrument panel, if dimly lighted, would be much darker in contrast to the bright outside lighting, and momentary interference with instrument readings could be expected.♦

Electronic CRTs Will Replace Electromechanical Gyros

Vertical and horizontal reference in new-generation transport aircraft will be provided by cathode ray tube (CRT) representations of aircraft attitude, heading, course, etc. The prime reason for the change from electromechanical gyros to electronic CRTs is to achieve greater reliability. Many pilots have also said that the presentation of information is clearer on a CRT.

While such electronic cockpit improvements are on the way, most pilots still will have to co-exist with the older electromechanical gyros for several more years. It is important to recognize their limitations, particularly those of the vertical gyro, which also is known as the artificial horizon or attitude direction indicator (ADI).

A Gyro is Similar to a Spinning Top

The principle of the vertical gyro in an ADI is the same as that of a child's spinning top. The mass of the top is concentrated in the plane of rotation, which is perpendicular to the vertical axis. As long as sufficient speed is maintained, the top will assume a natural balance, and any attempt to displace it from the vertical spin axis results in a resistance to the displacement and a return to the vertical spinning mode. As the spinning speed decreases, the top displays increasing instability and eventually "tumbles."

When a gyroscope is placed in a three-gimbal mounting so that its motion is essentially free in space, it can maintain its natural balance irrespective of the attitude of where it is placed — in this case, an aircraft. The gyro spinning plane, which is perpendicular to the earth, is utilized to represent a reference "horizon." As the aircraft changes attitude (pitch or bank), a displacement is created between the free spinning gyro and the attitude of the aircraft. This displacement is registered on an indicator face as the amount of pitch or bank from the artificially created horizon.

As with the child's top, if the spin velocity necessary for the gyro's natural balance is insufficient, the gyro becomes unstable and eventually "tumbles."

Mounting a second gyro with its spin axis horizontally oriented will result in it maintaining a position in azimuth. Displacements from this pre-selected value provides a convenient indication of aircraft deviation from course.

When the gyro is not in an erect and useable position, warning flags in the face of the instrument indicate that it cannot be used. Aside from simple mechanical failure, the chief problem encountered with an ADI is the interruption of electrical power. When power fails, the gyro spin rate begins to slow, permitting the gyro to "tumble."

As a matter of convenience, vertical gyros are designed to erect themselves quickly when power is reapplied. This "fast erect" feature typically erects the gyro at 35 degrees per minute until ± one degree of vertical is achieved or until 75 percent of design gyro speed is attained. After that point, normal erection occurs at a speed of two and a half degrees per minute for pitch and six degrees for roll.

'Tumble' Reaction Times

J.J. Packer, of McDonnell Douglas Corp., points out that power interruption to the gyro for more than 90 seconds may cause it to "tumble" and, consequently, take longer than normal to re-erect once power is restored. Should the gyro "tumble" but regain power prior to eight minutes of power loss, it may not have slowed to less than 75 percent rpm. If this is the case, the gyro will erect at the normal, rather than "fast" rate.

On the ground, this will require a wait of several minutes on a taxiway or at the gate. Should it occur during instrument flight, it would entail several undesirable minutes of flying using some reference other than the ADI. Ironically, a pilot may be able to regain useable attitude information faster by leaving power off the ADI for 10 or more minutes than by restoring power immediately once the 90-second period has been exceeded. By leaving power off for more than 10 minutes, the gyro is allowed to drop to a speed that demands "fast erect." In this way, it regains vertical orientation at a rate of 35 degrees per minute. Patience can be a virtue with a fallen gyro. ♦

Effects of the Crash Diet

One of the benefits of advancing civilization is the improved availability of food. A non-benefit is the tendency towards obesity among some segments of the population in countries where generous food supplies are available. Active pilots generally are not obese, but some do tend to be overweight and sometimes subscribe to counterproductive diet regimens.

The U.S. Federal Aviation Administration, concerned with the possible consequences of dieting programs adopted by overweight crewmembers, or by those who suspected that they might be, initiated a study of the so-called 24-hour crash diet, in which food is foresworn, except for low-caloric liquids.

During the course of the study, during which 10 years of data were analyzed, the findings indicated that, between 1969 and 1979, the "average weight-to-height ratio for male pilots increased." Conversely, the study found that the weight-to-height ratio of female pilots decreased during the period, although, on the average, they also remained somewhat overweight. The findings showed that:

- The average U.S. male pilot was 22.7 pounds heavier than his acceptable weight.

- The average U.S. female pilot was 9.1 pounds over her acceptable weight.

In FAA's study of the effects of the 24-hour "crash diet," the study researchers conducted a variety of tests and tasks designed to document body chemistry changes and task performance efficiency. The tests were given to a group of experimental subjects twice, once during a day of normal eating and once during a day of fasting.

Surprisingly, no major physiological effects were detected, even when the subjects were placed at a simulated elevation of 12,500 feet. Body temperatures were lower under crash diet conditions, but other physiological effects were minor. Task performance proved to be a more puzzling area.

Dieting Affects Task Performance

Although several studies have been made demonstrating decreased task accomplishment capability under conditions of fasting, the FAA study results failed to verify its findings. Task performance in this case was found to be better when the test group was on a 24-hour diet regimen than when it was eating "normally." The subsequent FAA report was careful to point out that the tasks did not combine physical and mental stresses as effectively as those experienced while flying and that heavier demands on the test subjects might have resulted in decreased performance.

As a result of the tests, the research team pointed out that subsequent research should attempt to establish the effects of specialized diets such as high carbohydrate or high protein have upon pilot physiology and task performance. To date, these types of tests have produced conflicting results.

One final effect found among the FAA study test subjects should be noted. The subjects were asked to rate their level of "fatigue" at regular intervals during both the normal and fasting phases of the test. A comparison was then made between the two phases.

No significant difference was perceived between the levels of fatigue in conditions of fasting and those of normal eating. However, the test group did show an increased level of fatigue at the end of the first day of both testing conditions.

The latter finding is interesting in another respect. The test subjects were fatigued at the end of their first day but were less so on the second. This may be similar to the fatigue pilots often encounter at the end of the first day of a multi-day trip.

During hangar talk, flight crews have noted that they were fatigued on the first night of a trip but were not overly tired on the subsequent nights when they had adjusted to the routine. Certainly, circadian rhythm disruptions affect pilots, but perhaps the sporadic nature of the job also may be a factor.

What is the effect, in terms of fatigue, when a pilot flies a continually disrupted schedule that, in effect, consists entirely of "first days?" ♦

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