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DISORIENTATION

MEDICAL Stuff

Whose Gyros Can You Trust?

If you have ever experienced the effects of disorientation while flying, you know how dangerous this condition can become. It can cause motion sickness, vertigo, and loss of control. This article describes the physical causes of disorientation and how to avoid it.

The Inner Ear

Most problems related to disorientation can be traced to the inner ear, a sensory organ about the size of an eraser on a pencil. It may well be the most well-protected organ in the human body and for good reason. It's the key to our ability to balance in the dark and maintain visual tracking when on the ground. [Note: People without inner ears do not have balance problems until the lights go out. The vestibular system allows us, on the ground, to move our bodies and heads and still maintain a stable visual image.]

The inner ear is similar to a six-axis gyro system. It detects movement in the roll, pitch, and yaw axes that pilots know so well. When the sensory outputs of the inner ear are integrated with appropriate visual references and other orientation cues from our bodies, there is little chance to experience spatial disorientation.

Vision and the Inner Ear

The problem occurs when the outside visual input is obscured leaving seat-of-the-pants and inner ear to provide balance. Then, you're down to relying on the output from the inner ear—and that's when trouble can start.

Fluid in the inner ear reacts only to acceleration (rate of change), not a constant velocity. For example, when you initiate a banking left turn, your inner ear will detect the roll into the turn, but if you hold the turn constant, your inner ear will signal no further roll change and sense that it has returned to level flight.

As a result, when you finally level the wings by rolling right that new roll change will be detected by your inner ear. Since you felt level (wrongly) before rolling right, you will believe you're banking to the right. This illusion is the crux of the problem you have when flying without instruments in low visibility weather. Inner feelings of balance by the pilot do not reflect velocity. Even the best pilots will quickly become disoriented if they attempt to fly without instruments when there are no outside visual references. That's because vision provides the dominant and coordinating sense we rely upon for stability.

Perhaps the most treacherous thing under such conditions is that the signals the inner ear produces—incorrect though they may be—become very powerful, difficult to ignore, and feel correct!

These sensory illusions occur because flight is an unnatural environment for the inner ear—our senses are not capable of providing reliable signals that we can interpret and relate to our position in three dimensions—without visual reference.

"Seat of the Pants" Flying

Does "seat of the pants" flying work in IFR weather? Judge for yourself: Anyone sitting in an airplane that is making a coordinated turn, no matter how steep, will have little or no sensation of being tilted in the air—unless the horizon is visible. Similarly, it is possible to climb or descend gradually without a noticeable change in pressure against the seat. It is even possible to end up upside down, but, by still pulling on the yoke and pulling "+" G's, all feels well. That's because a gradual change in any direction of movement, even a two degree/second roll for many people, may not be strong enough to activate the inner ear organs, so you may not realize that the aircraft is accelerating, decelerating, or banking.

Instrument Flying

The obvious method to prevent disorientation is to get instrument time towards an instrument rating. But, that rating alone is no automatic guarantee because there is no such thing as "perpetually knowing how to fly on instruments." All flying skills, but particularly instrument flying skills, do you no good without continual practice. You must continue to practice your skills. You are either formally trained and current—or you're unqualified.

For the unqualified pilot, the sudden loss of visual reference is similar to a sudden loss of eyesight. Emotional pressures surge, and you can lose your orientation in less than 20 seconds. You could be starting the infamous maneuver known as the "graveyard spiral" and not even know it.

All pilots should check the weather conditions and use good judgement in flight planning. The VFR pilot should avoid low visibility conditions, such as night flying, fog, clouds, and haze.

And, if you're instrument-rated and current, you should always trust your instruments and your training. Those gyros are much more reliable than the ones inside your head, but must be cross-checked with all performance instruments to detect an occasional mechanical failure.

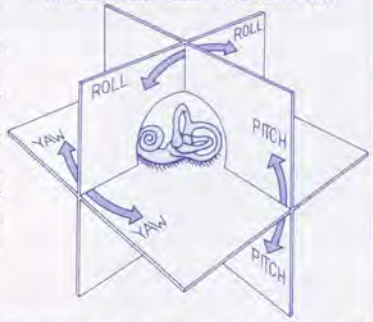
One way to experience how insidious disorientation can be, contact the Safety Program Manager at your local FAA Flight Standards District Office for a ride in the Barany Chair or check with CAMI at the address below for the next demonstration of their Vertigon.

This article is adapted from a pamphlet of the same name in the series "Medical Facts for Pilots," developed by FAA's Civil Aeromedical Institute. If you want additional copies or more information on pilot vision, contact CAMI's Aeromedical Education Division, AAM-400, P.O. Box 25082, Oklahoma City, OK 73125. Ask for publication AM-400-90/1. Also see the article on page 4 for CAMI's latest, high-tech approach to educating pilots on vertigo.

SOME ADDITIONAL THOUGHTS ON DISORIENTATION

- No pilot can fly in IFR conditions without instruments.
- The inner ear can give false positional information unless there is also a visual reference.
- You can literally fly upside down and not know it!
- You can lose orientation in less than 20 seconds if you are in clouds and are not on the instruments.

The semicircular canals of the inner ear:



The inner ear is like a gyro, detecting movement in the roll, pitch and yaw axes.

But What About the Dog?

Technology is Great, but Some Things Never Change

by Robert R. McMeekin, Jr., M.D., J.D.

At a recent pilot meeting, several pilots vehemently proclaimed that they had never experienced vertigo, even though their average accumulated flight time was more than 15,000 hours. How spoiled we've become!

I had nostalgic reflections of earlier days in aviation and wonderment at the remarkable recent advances throughout the aviation industry. Radar, good communications radios, auto pilots that do everything...the list keeps growing. Everyone has GPS; never lost anymore. Weather reporting and forecasting have improved greatly; no more jokes about the weatherman. Everywhere you look you find improvements that make crewmembers' jobs easier and passengers' rides smoother and safer.

All these improvements renew arguments about whether new generations of aircraft need two pilots or three. But future aircraft will have automatic everything, programmed from the gate for automatic takeoff, en route, and landing; and the new glass, fly-by wire, auto-land cockpits will have only one pilot...and a dog. That's right, a dog. Cockpit resource management? Well, the pilot is there to feed the dog. And the dog is there to bite the pilot if he tries to touch any of the controls.

Even before I became a flight surgeon, I probably knew more about aviation physiology than the average pilot. But translating knowledge into practice can be an entirely different matter. I recall, about 30 years ago, making an instrument approach in a single engine aircraft to my home airport when the forecast had been for good visual conditions. The weather at the commercial airport 25 miles away was ceiling of 800 feet and visibility of three miles, but I had no way of knowing that the local airport ceiling was in the trees.

At minimum descent altitude, I was still between layers of cloud; but just as I initiated the missed approach procedure, I saw a brief glimpse of the runway and a few aircraft parked on the ground. Now, here I was, having transitioned from instrument scan to watching that small patch of runway pass beneath the wing, applying power for the missed approach, increasing pitch attitude for climb-out and banking left to return to the radio beacon, and suddenly experiencing an irresistible urge to pitch the nose of the aircraft downward to avoid a perceived dangerously high noseup attitude. Although I could see from the instrument scan that the aircraft pitch was nosedown, airspeed was increasing and altitude was decreasing, I still had an irresistible urge to push the nose further down. Had my attitude gyro failed? Panic! "Not good," I thought. Thinking quickly, I decided to go with the altitude and airspeed cues. Good choices. Level the wings, nose up, climb straight ahead.

It probably took less than 30 seconds for the whole episode, and I was on my way to an uneventful approach to my alternate airport. Coriolis effect and acceleration—VERTIGO! I knew about that...but now I knew it.

The new gadgets certainly do make flying easier. Less frequently crewmembers get into the predicaments that were once serious problems. But the underlying problems remain, and when the gadgetry stops working, the crewmember is suddenly on his own, separated from the earliest pilots by only the lack of leather helmet, goggles, and silk scarf—a true emergency.

When crewmembers once had few instruments upon which to rely, and those few instruments stopped working reliably with great frequency, the crewmembers were prepared in anticipation that something would go wrong. They trained for the eventuality that essential instruments would fail. I remember my instructor check ride: The inspector covered the instruments one-at-a-time until I was left with only engine tachometer, vertical speed indicator, turn-and-slip indicator, clock, and VOR receiver with OBS indicator stuck on 90-270. The objective was to fly to the nearest instrument airport and land. Naturally, the simulated weather was instrument approach minimums, and the instructor had control of the (simulated) inoperative communication radios.

Tough challenge...but doable. We had trained for it.

Is flying less of a challenge today? Faster aircraft means that things happen more quickly, and information workload factors are worrisome. How can we ensure that crewmembers know, rather than just know about, limitations their own physiology places on the success of their flight as well as they know their aircraft and its systems?

Recent regulatory proposals included an extensive physiology training curriculum, but the final regulation incorporates less sweeping changes. The training curriculum is already full, and flight hours in aircraft or simulators are expensive. Nevertheless, the challenge is to find a way to pass on to new crewmembers (and probably some old ones, too) the experience of the past while we are, at the same time, providing new devices that isolate them from those very problems.

Rather than simply adding more to the training curriculum, the time has come for a thorough review of the physiology training elements essential to crewmember safety and to incorporate them in a manner that ensures the crewmembers know, rather than simply know about, aviation physiology.

Now, about that dog...

Dr. Robert McMeekin is the president of the Aerospace Medical Association, and this article was published in the July 1997 issue of the Association's journal, Aviation, Space, and Environmental Medicine. *He recently retired from the U.S. Army Medical Department after more than 30 years of service. Dr. McMeekin was the Federal Aviation Administration's Federal Air Surgeon from September 1987 to January 1991. The article is reprinted with permission of the author and* Aviation, Space, and Environmental Medicine.

VIRTUAL VERTIGO

Virtual Reality is coming soon to the FAA's Civil Aeromedical Institute (CAMI). CAMI's Aeromedical Education Division will begin demonstrating its new, first-of-its-kind Virtual Reality Spatial Disorientation Demonstrator (VRSDD) to pilots. This high-tech device is designed to provide a more realistic demonstration of the effect of inflight vestibular illusions, otherwise known as vertigo.

Since aviation's beginnings, vertigo has been a constant threat to pilots. Classes and demonstrations have made many pilots aware of this problem. While telling pilots of the conditions and situations that may possibly lead to vertigo takes a significant step in assuring that they know it can happen, pilots must know what these illusions feel like. To accomplish this, most instructors use a device called a barany chair. A barany chair is simply a chair mounted on a rotating axis. A blindfolded pilot is slowly turned on the rotating platform and then stopped to experience the sensation of mild disorientation. Though the barany chair has been an effective tool, it lacks the realism of the actual flight environment.

With the ever-improving technology in real-time 3D virtual reality, it seemed only logical to pursue this avenue as a possible solution to the barany chair's shortcomings. Real-time 3D virtual reality uses a sophisticated computer, a magnetic head-tracking device, and a head-mounted display (HMD) to create a realistic cockpit environment. Putting on the HMD, the pilot becomes immersed within a virtual flying world.

The computer and a head tracker provide the pilot with real-time flight cues. When the pilot looks in any direction, it's very similar to being in the real thing, an actual cockpit. This, of course, makes an infinitely more realistic demonstration over that of simply putting on a blindfold and then spinning in a chair. Once the pilot puts on the HMD, the "virtual pilot" will be "inside" a real-time, 3D flight environment.

The VRSDD will demonstrate two common forms of vertigo: somatogyral, or spinning in the opposite direction, and coriolis, or false sensation of violently tumbling. The demonstration begins with the pilot flying at 7,000 feet in clear weather. An air traffic controller's voice on the intercom instructs the pilot to turn to a new heading. As the pilot initiates the turn, it cues the chair to turn in a corresponding direction. When the pilot has attained the new heading, another instruction from the controller says to roll out to straight and level flight. Then, another turn. About half-way through this turn, zero visibility conditions are introduced to further enhance the illusion. This, coupled with a partial instrument panel failure on roll-out, brings about the ideal environment for vertigo to occur.

The FAA's first VRSDD was delivered in mid-February. After it has been thoroughly tested, the simulator will be available for demonstration in conjunction with physiological training classes and at some of the country's major air shows this season. If you are interested in taking a demonstration "flight" or have questions concerning the new device, please contact either J. R. Brown at (405) 954-6211 or Larry Boshers at (405) 954-7767. Both work in CAMI's Airman Education Programs in the Aeromedical Education Division in Oklahoma City, OK.

This article was reprinted from the Winter 1997 edition of CAMI's Federal Air Surgeon's Medical Bulletin.

TIPS AND PEARLS
by Dr. Glenn Stoutt

Motrin and Advil: Great for fever, aches, and pains. Buy the generic ibuprofen—you can get 500 ibuprofen tables at discount stores for $10, or about 2¢ a tablet.

Stay away from aspirin unless you are taking it to prevent heart attacks. Aspirin does a number on your stomach. It can also cause bleeding, even post-operative bleeding that can require a return to the operating room. Nose bleeds can occur after routinely taking one adult aspirin (325 mg) a day. One baby aspirin (81 mg) is probably enough to take of lessening your chances of a heart attack, but do what your physician recommends.

One carrot supplies your entire day's requirement of vitamin A and beta carotene.

Dry skin? Nothing better than Crisco. No perfume, and the price is right.

Your heart is about the size of your fist, yet it pumps bloods through more than 60,000 miles of blood vessels—long enough to circle the Earth more than twice. It beats about 3 billion non-stop (you hope!) times in your lifetime. The dinosaur brachiosaurus had a heart the size of a Volkswagen, needed to pump blood to its brain 30 feet away.

The absolutely worst emotion a person can have? The most likely to give you a killer heart attack? ANGER. It's bad for just about everything: blood pressure, digestion, sex, athletics, thinking—you name it. So, heed the Chinese proverb, "Keep a green tree in your heart and perhaps a singing bird will come."

Relax, and enjoy the greatest people in the world—your friends who love flying.

The views and recommendations expressed here are those of the author and not necessarily those of the FAA.

FATIGUE CAN PUT YOU TO REST

by Melchor J. Antuñano, MD

Fatigue, a normal physiological response of the human body to sleep loss and circadian rhythm disruption, is characterized by decreased physical and mental efficiency.

Common signs and symptoms of fatigue include sleepiness, overall discomfort, irritability, depression, apathy, physical and emotional isolation from others, loss of appetite, slurred speech, visual fixation and impaired visual perception, decreased alertness and attention, channelized thinking, difficulty concentrating, slowed reaction time, need for increased sensory stimulation to react, impaired short-term memory, poor judgement, loss of accuracy and control smoothness, unawareness of error accumulation, errors on sequential tasks, neglect of secondary tasks, and responses that become increasingly more dependent on previously acquired habits (good or bad).

These manifestations can be aggravated by individual exposure to other stressors, including low barometric pressure, noise, vibration, linear and angular accelerative (G) forces, high ambient temperature, and low humidity. Furthermore, self-imposed stressors, such as poor physical fitness, inadequate diet or nutrition, inadequate hydration, excessive body weight, drug and alcohol use or abuse, use of medications (non-prescription and prescription), excessive caffeine consumption, and tobacco use can predispose you to becoming fatigued. They also can aggravate fatigue.

Sleep is a period of rest for the body and mind, during which bodily functions are partially suspended and consciousness is temporarily interrupted. Sleep is as necessary as food and water for the well-being of an individual. The average healthy adult is accustomed to a single, prolonged sleep period of approximately eight hours. During a typical 24-hour day, there are two normal periods of sleepiness: between the hours of 3-5 a.m. and 3-5 p.m. Sleeping less than eight hours per day can result in sleep loss, which can become cumulative (sleep debt).

After sleep loss, the most notable feature of recovery sleep is its increased depth, rather than its duration. This means that following sleep loss, you do not have to sleep the same number of hours that you lost. Sleep loss can be caused by circadian

rhythm disruptions, sleep disorders (sleep apnea, nocturnal myoclonus [nighttime muscle spasms]), stress, alcohol and drugs use or abuse, excessive caffeine consumption, bad sleep habits, uncomfortable sleeping environment, use of sleeping pills, etc. In addition, with increased age sleep become less deep and more disrupted, and total nocturnal sleep decreases. The main physiological effect of sleep loss is an increase in sleepiness, which causes fatigue.

Circadian rhythm defines a biological cycle of approximately 25 hours that determines the physiological behavior (activity levels) of all body functions. Circadian rhythms are influenced by the succession of day and night, changes in ambient illumination, and the timing of food consumption, physical activity, and social activities. Circadian rhythms can be affected by a sudden change in individual work-rest schedules (shift work), sudden relocation to a different time zone (transmeridian flights), use of medications to sleep and to stay awake, alcohol and drug use or abuse, etc. The alteration of a circadian rhythm is commonly known as circadian desynchronization or desynchronosis; however, if it is caused by a transmeridian flight, it can be called transmeridian desynchronization, jet lag syndrome, or simply, jet lag.

Various factors affect your ability to adapt to a new circadian rhythm:

1) Adaptation takes longer with increasing age.
2) Different body functions adapt at different rates.
3) Extroverted individuals adapt faster than introverted.
4) The greater the time difference between the time of origin and the local time, the longer it takes to adapt.
5) Adaptation to a backward schedule (longer daytime-westbound flights) is faster than adaptation to a forward schedule (shorter daytime-eastbound flights).

Manifestations of circadian desynchronization, or incomplete adaptation to a new circadian rhythm, include difficulty falling asleep, difficulty remaining asleep, daytime sleepiness, decreased physical and mental performance, gastrointestinal problems, and other signs and symptoms associated with fatigue. ✣

This article originally appeared in the Federal Air Surgeon's newsletter "Medical Bulletin." The author manages the Aeromedical Education Division at FAA's Civil Aeromedical Institute (CAMI) located in Oklahoma City, OK.

You can prevent fatigue by taking the following actions:

1) Develop and practice an appropriate sleep routine that includes at least eight hours of high quality sleep in a quiet, dark environment in a comfortable bed.
2) Try to get at least as much sleep per 24 hours during a trip as you would in a normal 24-hour period at home.
3) Use physical or mental relaxation techniques to fall asleep, when necessary.
4) Develop and practice a regular physical exercise routine, but not before going to bed.
5) Do not eat a heavy meal or drink large amounts of liquids before going to bed.
6) Eat a balanced diet to prevent in-flight hypoglycemia.
7) Do not consume any alcohol or caffeine before going to bed.
8) Get up and try an activity that helps you fall asleep, if you cannot go to sleep after 15-30 minutes in bed; for example, read, listen to soft music, or watch a relaxing television program.
9) Avoid using sleeping pills to promote sleep and stimulants to promote wakefulness unless they are prescribed by a flight surgeon. The same advice applies to the use of melatonin.
10) Take a nap of no longer than 40 minutes—immediately before your scheduled flight—if your sleep period on the night before a flight was inadequate. A nap can acutely improve alertness because it decreases the length of continuous wakefulness before a duty period.
11) Follow the NASA Fatigue Countermeasures Program, which recommends the use of strategic naps in three-person non-augmented long-haul flights (transmeridian or intrameridian). Crewmembers can alternate (one at a time) taking a 40-minute nap (not longer) during the low workload portion of cruise.
12) Stretch in the seat and move about the cabin when possible during flight.

Common Misconceptions About Fatigue

1) Eight hours of rest are as beneficial as eight hours of sleep.
2) I know exactly how tired I am.
3) I have lost sleep before, and I did just fine.
4) I'm motivated enough to just push through it.
5) I am a highly experienced and capable pilot (have the "right stuff") and can still fly an aircraft even if I am tired.
6) I don't need more than three or four hours of sleep every night.
7) If I'm tired, all I need is a cup of coffee to feel better.
8) There is a quick and easy fix for fatigue.
9) One cure will work for everyone.

HYPOXIA

MEDICAL Stuff

The Higher You Fly...or You May Feel Great Until It's Too Late

Breathing is one of the most automatic things we do—over 20,000 times a day. Each breath does two things for our body. It expels carbon dioxide when we exhale and takes in oxygen when we inhale. It's a delicate balance.

Exercise or stress increases the production of carbon dioxide so we breathe faster to eliminate it and take in more oxygen at a greater rate.

Because of the effects of gravity, the amount of air containing oxygen is greater at sea level. For example, the pressure at sea level is twice that found at 18,000 feet MSL (mean sea level). [Gravity is a constant, but a drop in atmospheric pressure results in all atmospheric gases expanding—gaining more space between molecules—thus less oxygen per given breath.]

Although the percentage of oxygen contained in air at 18,000 feet is identical to that at sea level (a little over 20%), the amount of air our lungs take in with each breath contains half the oxygen found at sea level. Breathing faster or more deeply doesn't help. In fact, because you're consciously overriding a system that is normally automatic, you'll be compounding the problem by exhaling too much carbon dioxide.

Supplemental Oxygen

The solution is simple, familiar to most pilots, and required by FAR § 91.211: supplemental oxygen. The regulation specifies a 30-minute limit before oxygen is required on flights between 12,500 and 14,000 feet MSL and immediately upon exposure to cabin pressures above 14,000 feet MSL. For best protection, you are encouraged to use supplemental oxygen above 10,000 feet MSL. At night because vision is particularly sensitive to diminished oxygen, a prudent rule is to use supplemental oxygen when flying above 5,000 feet MSL.

So, when you fly at high altitudes, supplemental oxygen is the only solution. That's because supplemental oxygen satisfies the twin demands of having enough oxygen to meet your body's demands and a breathing rate that excretes the right amount of carbon dioxide.

Hypoxia

Unfortunately your body doesn't give us reliable signals at the onset of hypoxia—oxygen starvation—unless we have received special training to recognize the symptoms. In fact, it's quite the contrary. The brain is the first part of the body to reflect a diminished oxygen supply, and the evidence of that is usually a loss of judgement.

Hypoxia Tests

Altitude chamber tests, in which high altitude flight conditions are duplicated, have shown that some people in an oxygen deficient environment actually experience a sense of euphoria—a feeling of increased well-being. These subjects can't write their name intelligibly or even sort a deck of cards by suits; yet, they think they're doing just fine!

Such is the insidious nature of oxygen deprivation. It sneaks up on the unwary and steals the first line of sensory protection—the sense that something is wrong, dreadfully wrong.

The Higher You Go

Bear in mind, the progressive reduction of oxygen per breath will continue the higher you go. Flying above a layer of clouds that doesn't look too high, or flying in the mountains on a clear day, are the very environments that have caused many good "flatland" pilots to get into trouble.

Symptoms

Everyone's response to hypoxia varies. Unless, as we've stated, you've had special training to recognize its symptoms, hypoxia doesn't give you much warning. It steals up on you, giving your body subtle clues.

The order of symptoms varies among individuals: increased breathing rate, headache, lightheadedness, dizziness, tingling or warm sensations, sweating, poor coordination, impaired judgement, tunnel vision, and euphoria. Unless detected early and dealt with, hypoxia can be a real killer.

So, don't decide you'll try to fly over that range of mountains, thinking you'll turn back if you start to feel badly. You may feel great—until it's too late. Use supplemental oxygen.

Smoking and Altitude

A western state pilot lived to tell about this one. Cruising at 13,500 feet MSL over mountainous terrain in his light single, he took a deep drag on his cigarette and next remembered being in a screaming dive with just enough altitude left in which to pull out. That deep drag replaced precious oxygen in his brain with carbon monoxide, and he passed out.

Physiological Training for Pilots

The effects of hypoxia can be safely

experienced under professional supervision at the FAA's Civil Aeromedical Institute's (CAMI) altitude chamber Oklahoma City and at 17 cooperating military installations throughout the U.S. If you would like to attends a one-day physiological training course, contact your local FAA Flight Standards District Office and ask the Safety Program Manager for AC Form 3150-7.

You'll learn to recognize your symptoms of hypoxia. It could mean the difference between life and death.

This article is adapted from a pamphlet of the same name developed by FAA's Civil Aeromedical Institute. If you want additional copies or more information on hypoxia, contact CAMI's Aeromedical Education Division, AAM-400, P.O. Box 25082, Oklahoma City, OK 73125. Ask for publication AM-400-91/1.

SOME HYPOXIA POINTS TO REMEMBER

- When you breathe, you inhale oxygen and exhale carbon dioxide.
- With each normal breath, you inhale about one-half liter of air, 20% of which is oxygen.
- At 18,000 feet MSL, you have half the sea level air pressure; hence, only half the oxygen.
- We all react differently to the effects of hypoxia. Only physiological training can safely "break the code" for you.
- Oxygen starvation first affects the brain; judgement is impaired, so you may not know you are in trouble.

I Won't Do That Again

Because this is a first person account, we have left the author's language intact. There are one or two words used which some may find offensive. -Editor

I have recently converted to a Mooney, and I must say I am in love. My wife says I would probably take it to bed with me if I could. After 20 hours flying I had noticed that one of the air ducts was not delivering fresh air as it should and also felt that the heater was still delivering warmth although it was closed off. My engineer [mechanic] was going to fix it when he could.

On an evening test flight, after adjusting engine tick-over, we were just flying along when suddenly we began to feel much greater heat than before with a smell of engine. I turned to return to Shobdon at once, realizing we had a problem, but even before sighting the field I began to have serious difficulties. My wife was also clearly in trouble.

I have read of the effects of carbon monoxide poisoning, but to experience them first hand when flying is another matter. Being a psychologist by trade, once I had recovered sufficiently, I jotted down the mental process as I experienced it.

Firstly, I felt distant to operations and nauseous and began to have doubts whether I was really in the plane or was only dreaming. Part of me just wanted to sleep more than anything else in the world, but at the same time a little voice inside told me we were dying of CO poisoning but I could not quite remember why.

All I wanted to do was sleep and carry on dreaming. I began to try to determine whether it really was a dream or was this real and frankly got more and more confused and I became obsessed with this problem. Somehow, if I could find the bedroom light switch I was dreaming but where the hell was it in the cockpit? I gave up on this and decided that I would carry on with the scenario whether it was real or not...nothing worried me by then, my thoughts came from a long way off. I reduced airspeed and opened the door, getting my wife to hold it, just to reduce the rising temperature which was becoming oppressive. Thoughts about fresh air had gone by now and I was much more worried about being sick on the new interior.

Shobdon was in sight, so I tried the radio but it was after closing and somehow I prepared for a direct join on long final. Here routine took over and the right things got done without thinking which was now almost impossible.

There was a 15 knot crosswind and somehow I knew things did not look right...without thinking I went around, did a circuit on automatic, fighting extreme nausea, and this time made a good touchdown. I do not remember the taxi back and can only pick up the thread when we were fully stopped, neatly parked at engineering. My wife could not stand and looked awful and I was unable to exit the plane for some time. We recovered enough to get home three hours later.

With 20/20 hindsight, I feel there were a number of lessons here:

- Carbon monoxide combines with hemoglobin avidly and is not easily released. Thus, recovery from whatever semi-conscious state we find ourselves in takes a lot of time.
- Its effect removes urgency, and one just is unable to assimilate reality. One experiences what could be described as an altered state of conscious awareness rapidly moving to coma.
- Provided the difficulty is identified soon enough, well rehearsed routines remain in effect longest, and it is this that got us back to the ground. Original thinking and problem solving is impossible.
- So we all read about human performance, but words in books cannot ever have the impact of experience. This is a problem that can happen to most aircraft at any time. I guess that quite a few unexplained accidents could be put down to this. Be prepared.

I know there are far more experienced people who could comment here, but I figure that we should consider the following:

- Do not defer any problems you may encounter with vent and heating controls. Ensure that flapper valves and cables are in order. Get your heat exchanger checked more often. I know it is yet another job, but believe me it is worth it.
- For God's sake fit a CO detector. These can be as simple as a pill, or more sophisticated systems are available.
- By the detector, place a checklist of procedures should this deadly gas be detected. If you are overcome, you will not be able to remember what to do. Checks should include shutting heating ducts, opening all fresh air vents. Do you know at what speed you can safely open your door or canopy? Do you have oxygen? Use it if you do.
- We were lucky; Shobdon was dead close. If you are cross-country, consider a precautionary landing. If you leave it any longer, I doubt that you will make it.

Remember, winter will be here soon enough and those heaters will be going on...

This article is from the General Aviation Safety Information Leaflet (GASIL) and the CAA comment stated that subsequent investigation showed that the CO came from two cracks in the exhaust which were not visible to the naked eye. The weld line looked as though it was satisfactory.

FAA Discretionary Issuances Permit Medical Certification of Many Pilots Despite Disabilities

Improved diagnosis and treatment have made it possible for many pilots to receive special medical certification despite conditions—including heart disease, Hodgkin's disease, lymphoma, and leukemia—that once would have precluded them from obtaining approval.

by Stanley R. Mohler, M.D.

The policy of the U.S. Federal Aviation Administration (FAA) is that "airmen with a history or clinical diagnosis of any medical condition [may] be granted discretionary medical certification through...special issuance provisions if it [is] determined that, notwithstanding the person's failure to meet the applicable medical standard, pilot duties [can] be performed, with appropriate limitations on conditions, without endangering public safety." In its 1994 proposal to revise the medical certification procedures and standards for pilots, the FAA said, "Overall, the safety record of pilots who were granted exemption has been at least as good as that of the general population of airmen who hold medical certificates issued under the medical standards."

The revised medical standards that went into effect in September 1996 eliminated some outdated requirements for vision and hearing to obtain certification, and a separate policy change issued in December 1996 ended the absolute ban on pilots with insulin-treated diabetes mellitus (applies to third-class medical certification applicants only). But regulatory changes aside, improved understanding, diagnosis and treatment of medical disorders has enabled the FAA to expand the scope of discretionary issuances of medical certification to pilots who have poten-

tially disqualifying conditions.

U.S. Federal Aviation Regulations (FAR) Parts 61 and 67 establish three classes of medical certification (first class, airline transport pilot certificate; second class, commercial pilot certificate; and third class, private pilot, student pilot and recreational certificate). The term of validity and the physical requirements for the medical certificates vary. The first-class certificate has the most stringent physical requirements and must be renewed every six months. The second-class certificate has less stringent physical requirements and is renewed annually. The third-class certificate has the lowest physical requirements and is issued for three years if the individual is under age 40; otherwise, for two years.

If an applicant initially fails to obtain medical certification in one of these categories, it may still be possible for him or her to obtain medical certification. A medical clearance given to a pilot with disabilities who cannot otherwise qualify for medical certification is referred to broadly as a discretionary issuance (commonly known as a waiver). Discretionary issuances include special issuances and Statements of Demonstrated Ability (SODA).

"To be granted a special issuance, a pilot has had to demonstrate by operational experience, flight testing, special practical evaluation, or a special medical evaluation that he or she can carry out the appropriate pilot duties without endangering public safety during the prescribed time period of the medical certificate," says the FAA. An authorization for special issuances may be granted by the U.S. Federal Air Surgeon. The Federal Air Surgeon has also delegated the authority to "authorize" a special issuance to the manager of the Aeromedical Certification Division at the Civil Aeromedical Institute (CAMI) and, in limited cases, to the Regional Flight Surgeons (RFS). In a small number of cases, the U.S. National Transportation Safety Board (NTSB) may order an issuance.

A special issuance covers progressive diseases such as coronary heart disease; a SODA concerns a medical condition that is static and nonprogressive, such as an amputated limb. A major distinction between the two discretionary issuances is that a special issuance is for a specific period. After it expires, the pilot must reapply for another special issuance. A SODA, by contrast, generally has no expiration date.

"Through special-issuance provisions," the FAA said, "many airmen have returned to productive aviation careers and others to private flying after recovery and rehabilitation from serious medical conditions without adverse impact on public safety."

The data in Tables one through seven relate to some of the more common medical conditions of pilots. The data were compiled from records of pilots active on January 1, 1997, and include discretionary issuances granted to pilots as of that date.

Vision. As shown in Table 1, pilots who have lost one or both lenses of their eyes, usually through cataract surgery, can be certified if suitable corrective lenses, either spectacles or contacts, are obtained. Pilots whose natural lenses have been replaced with artificial lenses may also be certified if they meet certain criteria.

With modern treatment for glaucoma, which may include surgery, pilots may be returned to medical certification status if they retain sufficient visual fields and experience no adverse side effects to any medication prescribed.

Under the new standards, monocular pilots may also be certified, as they have been in the past. Monocular means either the absence of one eye or total or legal blindness in one eye. From the FAA's perspective, a person is considered monocular if one eye only is within the medical standard limits, even with correction.

Hearing. Table 2 lists certain conditions related to hearing. Persons with functioning hearing aids can be certified in all three medical certificate classes because the use of a functional hearing aid is equivalent in principle to vision aided by corrective lenses. Totally deaf persons have been certified to operate in non-radio control environments.

M`ènière's disease—a combination of vertigo (dizziness), tinnitus (ringing in the ears), and deafness—does not necessarily result in loss of medical certification, if appropriate treatment has been received and the symptoms have been brought under control.

Persons with a history of vertigo alone can be considered for certification if:

Table 1
Discretionary Issuances: Vision

Code	Condition	Certification		
		First-class	Second-class	Third-class
134	Aphakia	141	359	1,024
139	Glaucoma	246	551	1,407
160	Artificial Lens	363	953	2,491
162	Monocular	184	638	2,169

Table 2
Discretionary Issuances: Hearing/Ear Pathology

Code	Condition	Certification		
		First-class	Second-class	Third-class
220	Hearing Aids, Deafness	790	1,322	1,247
238	Ménière's Disease	17	25	72
239	Ear Pathology, Vertigo, Other Ear Pathology	515	447	815

Source: U.S. Federal Aviation Administration (FAA) Aeromedical Institute (CAMI). The table shows the number of U.S. pilots active Jan. 1, 1997, who were granted discretionary issuances for specific pathologies. The codes in the table refer to the U.S. FAA's pathological-code numbers.

- The symptoms are controlled with medication that does not have side effects adverse to safe flying (only during training with CFI);
- The symptoms have subsided for a substantial time and are deemed unlikely to recur;
- The symptoms are rare and can be disregarded by the individual under conditions of flight; or,
- A specific cause of the symptoms is located and eradicated by surgery or other means.

Persons who have been successfully treated for otosclerosis (a formation of spongy bone in the middle ear leading to deafness) by surgery have been returned to flight status. Acoustic-nerve neuroma (a sensory-nerve tumor in the inner ear that can lead to deafness), treated by surgery or radiation, will not preclude the return to medical certification status in many cases.

Cardiovascular conditions. Table 3 lists several cardiovascular conditions that at one time would have precluded medical certification for many pilots. With advances in basic and clinical scientific research programs, pilots with a wide variety of conditions affecting the heart and blood vessels can be certified on a case-by-case basis. The clinical methodologies for diagnosis, treatment, and follow-up evaluation of individuals in the categories listed in Table 3 are sufficiently developed to enable the certification for first, second, or third class.

Pilots with transplanted hearts are not being certified, although in the past, a few were initially given third-class certification. (Tissue rejection subsequently led to loss of medical certification.) As scientific research on the rejection and disease process advances, it is possible that pilots with transplanted hearts may again be considered in the future for medical certification.]

Genitourinary conditions. Pilots with colitis (inflammation of the intestines) and regional ileitis (inflammation of the ileum, part of the small intestine) (see Table 4) have in the past had certification problems. As a result of advances in surgical and medical treatment, pilots who suffer from these conditions are achieving certification in all three classes.

As organ transplants become increasingly common, those with kidney transplants are achieving certification in all three classes, while pilots with transplanted livers have achieved certification in second and third classes.

In the past, persons with a history of kidney stones were generally not medically certified. It was felt that the excruciating pain of renal colic, which could be experienced at unpredictable times, could cause incapacitation and perhaps lead to an aircraft accident. Today, modern diagnostic and thera-

Table 3
Discretionary Issuances: Cardiovascular Conditions

Code	Condition	Certification		
		First-class	Second-class	Third-class
420	Transplant: Heart	–	–	–
431	Myocardial Infarction	178	187	1,917
439	Angioplasty	178	147	1,466
440	Coronary Bypass	158	178	2,172
445	Cardiac Pacemaker	3	8	78
456	Mitral Valve Prolapse, Barlow's Syndrome	550	574	1,234
457	Mechanical Heart Valve	6	19	79
458	Tissue Heart Valve	4	8	43
485	Hypertension with Medication	3,042	5,865	18,223

Table 4
Discretionary Issuances: Genitourinary Conditions

Code	Condition	Certification		
		First-class	Second-class	Third-class
551	Colitis, Regional Ileitis	468	547	1,247
565	Liver Transplant	–	3	15
570	Kidney Transplant	12	15	64
573	Kidney Stones	3,514	4,722	9,368
574	Male Genital System, Prostatic and Testicular Cancer	2,292	3,062	6,101

Source: U.S. Federal Aviation Administration (FAA) Aeromedical Institute (CAMI). The table shows the number of U.S. pilots active Jan. 1, 1997, who were granted discretionary issuances for specific pathologies. The codes in the table refer to the U.S. FAA's pathological-code numbers.

peutic techniques can remove kidney stones by surgical or nonsurgical means and can provide preventive measures that minimize the possibility of future stone formation. In addition, periodic diagnostic tests can detect kidney stones at an early stage, thus decreasing the chances of subsequent renal colic by treating the developing stone condition.

Cancers of the prostate and testes are increasingly being diagnosed at an early stage through screening programs. The prostatic-specific antigen (PSA) test is an example of a relatively recent procedure that identifies many prostatic cancers at an early stage. Pilots in all three classes of medical certification have been diagnosed with medical conditions in this category. With respect to female cancers, including those of the cervix, ovaries, and breasts, there will be increasing numbers of female pilots applying for medical certification with these conditions in the future.

Neuropsychiatric conditions. One area that has benefited from significant advances of current technologies and diagnostic methods comprises cerebral, vascular, neurological, and psychiatric conditions. As shown in Table 5, such evaluations have resulted in a number of medical certifications of persons with conditions in each of the cited categories. Flight operations require a degree of alertness that is incompatible with the unpredictable onset of sleep, so a diagnosis of narcolepsy almost always precludes medical certification.

Individuals who have experienced strokes (caused by some type of blood-vessel spasm, aneurysm [thinning, stretching, or bulging of an artery wall] rupture or blood clot) can, following recovery, be considered for a discretionary issuance if certain criteria are met. These criteria include the reduction of important risk factors such as hypertension, tobacco use and obesity; the reduction of atherogenesis factors (that is, factors which increase the risk for angina [chest pain], stroke or heart attack); and the adoption of other measures to control risk factors. If an aneurysm is successfully treated by surgery, a person may be certified if the remaining signs and symptoms are deemed not to impair performance.

Mental functioning and neurological status require assessment in each case. In addition, medical evaluators must consider the likelihood of a recurrence of the process that led to the initial stroke.

Various types of seizures are considered for a discretionary issuance on an individual basis if the cause of the seizure is defined, if medical or surgical steps have brought the conditions under control, and if, following sufficient time (which may be as much as several years), the special-issuance reviewers conclude that a recurrence is highly unlikely

Pilots with multiple sclerosis in remission have been returned to medical certification. Persons with certain degenerative nerve diseases that are exceedingly slow in progression have also been returned to medical certification status, as have those diagnosed with certain chronic brain-syndrome conditions that, following evaluation, are deemed not to impair brain functions important to safe flight operations.

In its early stages, Parkinson's disease can be the foundation, on a case-by-case basis, for a discretionary issuance. The ability of the affected person to intentionally override an involuntary trernor is a major factor in the decision to issue a discretionary issuance.

Discretionary issuances for migraine headache history are not uncommon. Major considerations with this condition include the frequency of the headaches, the nature of the warning aura, and the ability of the individual to prevent further progression if onset—accompanied by the potential loss of the visual fields—occurs during flight.

A generalized collection of neuroses, anxiety, hypochondria, and phobic conditions may, depending on the circumstances, cause problems for medical certification. The individual's response to therapy is considered, along with the degree to which the individual can mitigate the symptoms of the condition while accomplishing flight duties.

Other conditions listed in Table 5 include major affective disorder, and depression plus mania. Advanced psychiatric clinical practice and medical research make possible individual assessments of those with such conditions. Among the considerations are the remission status of the condition, the level of awareness that the affected individual has with respect to the condition, the nature of the treatment used (if any), and the response. Specialists assess the likelihood of a recurrence of symptoms and the extent to which an affected person can recognize the onset of a relapse. Pilots have been certified by discretionary issuance in all three classes.

For many years, pilots with alcohol-dependence and -abuse problems had to hide their problem or face permanent medical disqualification. Because the vast majority of such dependent individuals at some point encounter severe personal problems that lead to disclosure of their alcoholism, a large number of pilots were medically disqualified in the 1970's and early 1980's.

Following a major FAA-commissioned report from the American Medical Association (AMA), the FAA adopted a standard of two years as the minimum period of abstinence from alcohol for those with this condition who seek certification. The FAA has given discretionary issuances reducing this period, but only when the applicant has met a number of stringent criteria, including:

- A full commitment and partnership of the aviation employer and employee to ensure the employee's continued sobriety through monitoring;
- "Full commitment and partnership of the recovering employee with a fellow employee to ensure continued sobriety through monitoring; [and,]
- Frequent evaluations, testing and attendance at professional aftercare treatment."

The treatment of alcoholism is recognized by the FAA, the Air Line Pilots Association, International (ALPA), the Allied Pilots Association (APA), and the National Institute of Alcohol and Drug Abuse as a highly desirable step that, under certain circumstances, could lead to a return to flight status by an alcohol-dependent person. Since the program began, several thousand pilots in all three classes have been returned to medical certification by discretionary issuances.

Nevertheless, FAR § 67.107 states that a medical certificate will not be issued—or if issued, will be rescinded—if there has been substance abuse within the preceding two years. Substance abuse is defined as "use of a substance in a situation in which the use was physically hazardous, if there has been at any other time an instance of the use of a substance also in a situation in which that use was hazardous.

Included in the definition are a conviction or administrative warning for driving under the influence of alcohol or the cancellation, suspension or revocation of a driver's license "while intoxicated by alcohol or a drug, while impaired by alcohol or a drug, or while under the influence of alcohol or a drug." Furthermore, under FAR § 61.15, a pilot holding a medical certificate is obliged to provide "a written report of each motor vehicle action to the FAA ... no later than 60 days after the motor vehicle action."

Dr. W. Keith Martin, ALPA's associate aeromedical advisor, said, "The [U.S. Federal Air Surgeon] has instructed all [aviation medical examiners] to defer the issuance of a pilot medical certificate when a pilot reports a second offense on an FAA application. The deferral generally results in a request from the FAA Medical Certification Division...for a drug and alcohol abuse evaluation. If the evaluation results in no diagnosis of drug or alcohol abuse/dependence, the FAA will issue the pilot medical certificate. This process [however] can be time-consuming (six to 10 weeks), during which time a pilot will be without a medical certificate."

Martin also said, "Simple failure to report an incident, no matter how insignificant, is often the primary cause for FAA action. The FAA's main concern is that of 'alcohol or drug misuse, abuse, or dependence.' A one-time incident, if properly reported, seldom results in FAA action."

Limb deformities and amputations. An entirely different kind of condition involves various limb deformities or amputations (see Table 6). From the beginning of manned flight, there have been aviators who have managed to pilot aircraft despite certain physical deformities. The determining consideration is the ability of the individual to safely operate specific aircraft. These conditions are considered static, and once a determination has been made to issue medical certification, possibly through a medical flight test, the individual can attain or retain this status.

Metabolic and endocrine disorders. Disturbed carbohydrate metabolism, diet-controlled diabetes, and Type II diabetes controlled by oral medication have all been the basis for discretionary issuances (see Table 7). Medical research and scientific understanding allow examiners to individually assess applicants with histories of

Table 5
Discretionary Issuances: Neuropsychiatric Conditions

Code	Condition	Certification		
		First-class	Second-class	Third-class
602	Stroke	139	181	543
605	Epilepsy, Grand, Petit, Convulsive Reaction	20	34	101
607	Narcolepsy	–	2	9
620	Multiple Sclerosis, Chronic Brain Syndrome, Degenerative Nerve Disease	23	28	71
621	Parkinson's Disease	15	22	48
628	Migraine	380	662	1,927
661	Neuroses, Anxiety, Hypochondria, Phobic Conditions	1,106	1,449	4,036
662	Schizophrenia	5	14	22
663	Major Affective Disorder, Depression Plus Mania	6	7	27
683	Alcoholism—Not Special Issuance	128	105	248
683	Alcoholism—Special Issuance	751	113	70

Source: U.S. Federal Aviation Administration (FAA) Aeromedical Institute (CAMI). The table shows the number of U.S. pilots active Jan. 1, 1997, who were granted discretionary issuances for specific pathologies. The codes in the table refer to the U.S. FAA's pathological-code numbers.

any of these conditions.

Diabetes insipidus is an endocrinological condition related to insufficient antidiuretic hormone from the pituitary gland. If left untreated, this condition results in frequent urination. By taking the hormone under prescription, normal urine flow can be restored.

Hyper- and hypo-thyroid illness is readily treated by appropriate thyroid extracts or by synthetic thyroid hormones. Cushing's disease, which is a complex condition related to the pituitary and the adrenal glands (excesses of certain hormones from one or the other, or both), and Addison's disease, which is a deficiency of one or both of these hormones, can be treated so the affected person can maintain a normal lifestyle.

Clearly, many diseases and conditions that only 10 years ago disqualified many pilots from medical certification—including Hodgkin's disease, lymphoma, leukemia, blood dyscrasia, and other conditions—have, through advances in clinical research and treatment, been brought under sufficient control to enable medical certification in a large number of cases.

As in the past, the Federal Air Surgeon's central concern whether the pilot can, despite certain medical conditions, safely operate an aircraft without causing harm to him/herself or other persons, or damage to the aircraft or other property. For the vast majority of those who enjoy relatively good health and want to fly, medical certification is possible.

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Mohler, an airline transport pilot and certified flight instructor, was director of the U.S. Federal Aviation Administration's Civil Aviation Medicine Research Institute (now the Civil Aeromedical Institute) for five years and chief of the Aeromedical Applications Division for 13 years.

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Table 6
Discretionary Issuances: Limb Deformities and Amputations

Code	Condition	Certification: First-class	Second-class	Third-class
761	Deformity of Finger and Amputations	60	118	249
766	Deformity of Hand and Wrist	63	100	208
771	Deformity of Arm Above Elbow	21	67	154
772	Deformity of Arm Below Elbow	17	33	80
	Deformity of Lower Extremities:			
781	Toe	18	22	48
785	Ankle	61	111	183
790	Above Knee	23	75	153
791	Below Knee	64	141	282

Table 7
Discretionary Issuances: Metabolic and Endocrine Disorders

Code	Condition	Certification: First-class	Second-class	Third-class
931	Disturbed Carbohydrate Metabolism	124	203	373
932	Thyroid—Hyper	183	221	399
933	Thyroid—Hypo	775	1,111	2,546
935	Diabetes, Diet-controlled	177	368	930
937	Diabetes, Oral Medication	107	184	607
938	Diabetes, Insipidus	3	7	13
939	Cushing's, Addison's Disease	134	108	267
964	Hodgkin's Disease	72	82	192
968	Lymphoma/ Leukemia, Dyscrasia	277	274	614

Source: U.S. Federal Aviation Administration (FAA) Aeromedical Institute (CAMI). The table shows the number of U.S. pilots active Jan. 1, 1997, who were granted discretionary issuances for specific pathologies. The codes in the table refer to the U.S. FAA's pathological-code numbers.

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DIABETIC PILOT "OVERJOYED" TO FLY AGAIN

by Mike Wayda

He has the distinction of being described as "the happiest man in Oklahoma" in a local newspaper story reporting on his return to flying after a 13-year hiatus forced by the onset of diabetes mellitus.

Michael Bilcik, from Yukon, OK, says he is indeed happy to be medically qualified to solo because of a policy implemented in December 1996 that permits diabetics to apply for third-class medical certification.

He is the first Oklahoma pilot to be certified and one of 16 nationwide who have reclaimed their pilot-in-command status as of last summer.

After learning the great news that FAA approval of the new diabetic pilot rule was imminent, Bilcik dusted off his flying skills with a flight instructor. Needing only 10 hours of flight instruction to check out in a Cessna 172, he now has a cross-country flight to Austin, TX, in his logbook. "The flying part was simple," he said. "It was the new airspace requirements that gave me the most trouble," he added, referring to the airspace reclassifications enacted in 1993.

Bilcik says he has no trouble monitoring his blood glucose levels (he uses a Profile One-Touch™ meter) and that he has not encountered any difficulty complying with the new rules. Because he uses an external insulin pump and takes from eight to 10 blood glucose sticks daily, his glucose level normally is at 80 mg/dl. The rules require that his glucose level be at least 100 mg/dl to be able to fly, so he says that he must adjust his insulin use accordingly. "That has been the only 'problem' encountered thus far, in terms of complying with the rules," he said.

"The pump is not for everyone," he warns, "because it requires strict monitoring." That is the reason for his eight to 10 blood glucose samples per day. He uses Humalog (insulin lispro rDNA, manufactured by Ely Lilly), a rapid-acting human insulin produced using recominant DNA technology.

Bilcik jogs regularly and enjoys an occasional round of golf. "Bottoming out" or being ketotic on his insulin pump has not been a problem because of his physical conditioning, regular monitoring, and motivation to achieve complete control of his blood glucose level.

He plans to upgrade his pilot skills by taking flight lessons in a Cessna 210 (with retractable landing gear and variable-pitch prop). After becoming proficient in this and gaining the neces-

sary flight time to upgrade further, Bilcik feels that the sky is the limit.

By last summer, the Civil Aeromedical Institute's (CAMI) Aeromedical Certification Division, had received 87 applications for diabetic certification, 16 of which have been approved to receive 12-month certificates; 57 cases are pending (additional information has been requested from applicants); and 14 were denied for various reasons. All three regular review staff physician are involved in the certification process.

Several media outlets asked for interviews with the newly certified private pilot. Why the interest in diabetics who would like to fly? "It's got to be the greatest gift to someone who has lost the right to pilot an airplane," Bilcik stated. "There are many, many diabetics, former pilots, who would do almost anything to be able to get back into their airplanes and take off," adding with a smile, "I really love to fly—who wouldn't be overjoyed to get their wings back?"

And who wouldn't be interested in learning about such success stories?

How an Insulin Pump Works

An insulin pump consists of a pump reservoir filled with insulin, a small battery-operated pump, and computer chips that allow the user to control exactly how much insulin the pump delivers. It is all contained in a plastic case about the size of a pager.

The pump reservoir delivers insulin to the body by a thin plastic tube called an infusion set. Infusion sets come in various lengths and have a needle or soft cannula at the end, through which the insulin passes. The needle or cannula is inserted under the skin, usually on the abdomen. The process of putting the infusion set in place is called insertion, and is very much like giving a standard insulin injection. The infusion set is changed every two or three days. The pump is intended to be used continuously and delivers insulin 24 hours a day according to a programmed plan unique to each pump wearer. A small amount of insulin is given continually (the basal rate). This insulin keeps blood glucose in the desired range between meals and overnight. When food is eaten, the user programs the pump to deliver a bolus dose of insulin matched to the amount of food that will be consumed.

The pump, which fits in the palm of the hand, regulates the flow of insulin to the diabetic's insertion point—usually the abdomen. The pump is not automatic. The user must decide how much insulin will be given. Using the results of frequent blood glucose monitoring, the experienced pump user can utilize the device to obtain excellent blood glucose control while living a normal lifestyle.

Continuous subcutaneous insulin infusion with an infusion pump is an alternative to multiple-daily-injection therapy for achieving near-normal levels of blood glucose in diabetics.

Medical Certification of Insulin-Treated Diabetic Applicants

The FAA has established a policy that permits the special issuance medical certification of insulin-treated applicants for third-class medical certification. Consideration will be given only to those individuals who have been clinically stable on their current treatment regimen for a period of six months or more. Consideration is not being given for first- of second-class certification.

Individuals certificated under this policy will be required to provide substantial documentation regarding their history of treatment, accidents related to their disease, and current medical status. If certificated, they will be required to adhere to stringent monitoring requirements and are prohibited from operating aircraft outside the U.S. The following is a summary of the evaluation protocol and an outline of the conditions that the FAA will apply:

Initial Certification

1. The applicant must have had no recurrent (two or more) episodes of hypoglycemia in the past five years and none in the preceding one year resulting in loss of consciousness, seizure, impaired cognitive function or requiring intervention by another party, or occurring without warning (hypoglycemia unawareness).
2. The applicant will be required to provide copies of all medical records, as well as accident and incident records pertinent to their history of diabetes.
3. A report of a complete medical examination, preferably by a physician who specializes in the treatment of diabetes, will be required. The report must include as a minimum:
   - —Two measurements of glycated hemoglobin (total A1 or A1C concentration and the laboratory reference range), the first at least 90 days before the current measurement.
   - —Specific reference to the applicant's insulin dosages and diet.
   - —Specific reference to the presence or absence of cerebrovascular, cardiovascular, or peripheral vascular disease or neuropathy.
   - —Confirmation by an eye specialist of the absence of clinically significant eye disease.
   - —Verification that the applicant has been educated in diabetes and its control and understands the actions that should be taken if complications, especially hypoglycemia, should arise. The examining physician must verify that the applicant has the ability and willingness to monitor properly and manage his or her diabetes.
   - —If the applicant is age 40 or older, a report, with ECG tracings, of a maximal graded exercise stress test.
   - —The applicant shall submit a statement from his or her treating physician, aviation medical examiner, or other knowledgeable person attesting to the applicant's dexterity and ability to determine blood glucose levels using a recording glucometer.

This article originally appeared in the Federal Air Surgeon's "Medical Bulletin," published by the FAA Civil Aeromedical Institute. The author is the bulletin's editor.

Medical Certification of Airmen With Diabetes Controlled by Diet or Oral Medications

The following guidelines will be used for individuals with diabetes mellitus controlled by diet or oral hypoglycemic medications:

1. Individuals with a diagnosis of diabetes mellitus controlled by diet alone are considered eligible for all classes of medical certificates under the medical standards provided they have no evidence of cardiovascular, neurological, renal, or ophthalmological disease. Special examinations need not be performed unless indicated by history or clinical findings. The Aviation Medical Examiner (Examiner) may issue [a certificate] if the applicant is otherwise qualified.
2. Individuals with a diagnosis of diabetes mellitus controlled by use of an oral hypoglycemic medication may be considered for the special issuance of any class medical certificate under the following conditions:
   a. Initial certification decisions shall not be made by the Examiner. These cases will be deferred to the Aeromedical Certification Division (AMCD). Examiners may be delegated authority to make subsequent certification decisions, subject to further AMCD review and consideration.
   b. Following initiation of treatment with oral hypoglycemic medication, a 60-day period must elapse prior to certification to assure adequate control, stabilization, and the absence of side effects or complications from the medication.
   c. The initial determination of eligibility may be made on the basis of a report from the treating physician. For favorable consid-

eration, the report must contain a statement regarding the medication used, dosage, the presence or absence of side effects and clinically significant hypoglycemic episodes, and an indication of satisfactory control of the diabetes. The results of a glycated hemoglobin (Hb Alc) determination within the past 30 days must be included. Note must be made also of the presence or absence of cardiovascular, neurological, renal, and ophthalmological disease. Certification decisions in the presence of one or more of these associated diseases shall be based on consideration of the aggregate risk.

d. Recertification decisions will be made on the basis of reports from the treating physician. The contents of the report must contain the same information required for initial certification and specifically reference the presence or absence of satisfactory control, any change in the dosage or type of oral hypoglycemic drug, and the presence or absence of complications or side effects from the medication. In the event of an adverse change in the applicant's diabetic status (poor control, complications, and/or side effects from the medication) or the appearance of an associated systemic disease, an Examiner who has been given the authority to issue a certificate (pending further review and consideration by the AMCD) shall defer certification to the AMCD. If, upon further review, it is decided that recertification is appropriate, the Examiner may be given authority again to issue certificates (subject to AMCD review and consideration) based on data provided by the treating physician, including such information as may be required to assess the associated medical condition(s).

e. As a minimum, follow-up evaluations by the treating physician of the applicant's diabetic status shall be required every six months for first-class certification and annually for second- and third-class certification.

f. Airmen who are diabetics should be counseled by Examiners regarding the significance of their disease and its possible complications. They should be informed of the potential for hypoglycemic reactions and cautioned to remain under close medical surveillance by their treating physicians. They should be advised also that should their medications be changed or dosages modified, they should not perform airman duties until the treating physician has concluded that their conditions are under control and present no hazard to aviation safety.

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This guidance material is found in the Guide for Aviation Medical Examiners, September 1996, pages 74 and 75.

STRESS and the Pilot

by Melchor J. Antuñano, M.D.

Stress is a term commonly used by people without necessarily knowing exactly what it means. Different people have different definitions of stress; for some, stress defines the factors that cause the body to respond, while for others it defines the human responses to the insult. A more accurate and comprehensive definition of stress involves the biological responses of the human body to any physical, physiological, and psychological demands (known as stressors). In other words, stress defines the alteration of the normal state of biological equilibrium of the human body due to physical, physiological, and psychological stressors, and the resulting compensatory responses of the body to restore such an equilibrium.

Physical stressors in aviation are associated with the flight environment: low barometric pressure (leading to hypoxia, expansion of body trapped gases, decompression sickness); noise and vibration (leading to fatigue and impaired visual and psychomotor performance); unfamiliar motion and inadequate orientational cues (leading to airsickness and spatial disorientation); linear and angular accelerative (G) forces (leading to sensory illusions, redout, greyout, blackout, G-induced loss of consciousness); sudden decelerative forces (leading to injuries); extreme temperature and humidity (leading to thermal stress and impaired performance); breathing-air quality (leading to illnesses and/or diseases); and solar/cosmic radiation.

Physiological stressors include: fatigue, sleep loss/deprivation, illnesses and diseases (acute and chronic), poor physical fitness, inadequate diet/nutrition, inadequate hydration, excessive body weight, drug and alcohol use/abuse, use of medications (nonprescription and prescription), excessive caffeine consumption, and tobacco use.

Psychological stressors involve human mental (cognitive and psychomotor) and emotional responses to socio-cultural, family, and job-related factors. Person-person, person-machine, and person-environment interactions can be sources of psychological stress. Personal life changes known to produce significant stress include: death of spouse, divorce, marital separation, detention in jail or other institution, death of a close family member, major personal injury or illness, marriage, being fired from work, marital reconciliation, retirement from work, major change in health or behavior of family members, and pregnancy.

In addition, pilots can experience stress when confronted with emergencies, unexpected situations, or unfamiliar events during the operation of an aircraft. Flying in bad weather, at night, or over open water, flying alone, performing an instrument approach to minimums, experiencing lengthy delays (due to traffic, weather, equipment, scheduling, etc.), flying in a high-density traffic area, flying into unfamiliar airports, becoming temporarily lost in flight or approaching/landing at the wrong airport (geographical disorientation), experiencing a near midair collision, having equipment malfunctions, having conflicts with other crewmembers or ATC personnel, being subject to flight checks, exceeding individual piloting skills, and transitioning to a more complex aircraft, are some examples of events that can be the direct cause of stress and/or aggravate pre-existing stress. In general, any activities characterized by high workload such as takeoffs, approaches, and landings involve varying levels of stress. Highly automated cockpits (glass cockpits) can be an additional source of stress for pilots, especially for those transitioning from older aircraft with limited automation to newer aircraft.

Everyone's life is characterized by constant changes that can cause stress, and cannot be easily avoided or eliminated. Stress, per se, is not bad; some degree of stress is necessary to stay healthy, motivated, and alert and to avoid boredom and complacency. On the other hand, excessive stress can be unhealthy, it can impair performance, lead to errors, and cause incidents or accidents. Individual tolerance and susceptibility to stress varies from one person to another, as do the individual mechanisms to cope with stress. Stress tends to be cumulative, and, if it is excessive, it can overload a pilot's ability to safely operate an aircraft. Knowledge, understanding, and experience are important factors that can improve a pilot's ability to deal with stress. However, overconfidence on these same factors can also lead to failure to recognize (or denial of) a stressful condition. Even the best pilots in the world are, at one time or another, subject to significant pre-flight stress (problems involving family, job, finances, health, etc.), and do not have sufficient reserves left to cope with the demands (inflight stressors) of flying an aircraft.

Stress can be manifested by any of the following signs and symptoms: anxiety, irritability, excitability, impulsiveness, aggressiveness, emotional overreaction, insomnia, depression, crying for no reason, emotional or physical isolation from others, problems concentrating, confusion, difficulty remembering important information, increased self-doubt, nightmares, fatigue, trembling, weakness, diarrhea, indigestion, frequent need to urinate, migraine headaches, grinding of the teeth, cold sweating, increased smoking or overeating, loss of appetite, alcohol and drug use/abuse.

An effective approach to deal with stress includes:

- Defining the source of stress
- Evaluating available resources for problem-solving (including professional advice from a psychiatrist or a psychologist)
- Exploring possible solutions (including relaxation therapies)
- Selecting the best solution
- Taking action
- Evaluating the outcome
- Making corrections or changes (if needed) and trying again

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The best decision a pilot can make when experiencing a significant level of stress is not to fly.

This article originally appeared in the Federal Air Surgeon's Medical Bulletin, *Fall 1997.*

PILOT VISION

Most pilots are familiar with the optics of the eye. Before we start flying we know whether we have normal uncorrected vision, whether we are farsighted or nearsighted, or have other vision problems.

And most of us who have prescription lenses—contacts or eyeglasses—have learned to carry an extra set of glasses with us when we fly, just as a backup.

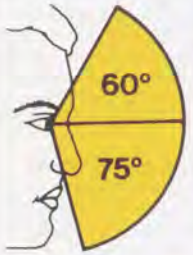
But, vision in flight is more than a lesson in optics. Seeing combines the images that are received on the retina of the eye, and the signals that are transmitted to the brain.

The Fovea

The fovea, the central part of the retina, is where our vision is most sharp. Few pilots realize how small this foveal field of vision is. It is a conical field of view of only about one degree.

To fully appreciate how small a one degree field is, and to demonstrate foveal

field, take a quarter from your pocket and tape it to a flat piece of glass, such as a window. Now back off four and a half feet from the mounted quarter and close one eye. The area of your field of view covered by the quarter is a one degree field, similar to your foveal vision.



Normal Vertical Vision Field:

Most can see a 135 degree field –60° up and 75° down. The sharpest visiion, about 1°, is within the foveal field.

Now we know that you can see a lot more than just that one-degree cone. The normal field of vision of each eye is about 135° vertically and about 160° horizontally. But, do you know how little detail you see outside of that foveal cone? Your visual acuity drops off rather rapidly. For example, outside of a 10° cone, concentric to the foveal one-degree cone, you see only about one-tenth of what you can see within the foveal field. In terms of an on-coming aircraft, if you are capable of seeing an aircraft within your foveal field at 5,000 feet away with peripheral vision you would detect it at 500 feet.

That's why when you were learning to fly, your instructor always told you to "put your head on a swivel"—to keep your eyes scanning the wide expanse of space around your aircraft.

Normal Horizontal Vision Field:

The normal field varies according to the individual's bone structure...some noses interfere more with vision than others. The foveal field is the central 1-degree field.

Focus and Distant Vision

We all know how important it is to be able to focus. Yet distance focus, without a specific object to look at, tends to diminish rather quickly.

If you fly over water or under hazy conditions with the horizon obscured or between cloud layers at night, your distance focus relaxes after about 60 to 80 seconds. There is nothing specific on which to focus; so, your eyes revert to an intermediate focal distance that's only a short distance in front of the aircraft.

The answer to this obviously limiting phenomenon is to condition your eyes for distant vision. Focus on the most distant object that you can see, even if it's just a wing tip. Do this before you begin scanning the sky in front of you. As you scan, make sure you repeat this refocusing exercise often.

Where to Scan

What you look for in your scan is also important. Most of us are instinctively alert for potential head-on encounters with another aircraft. Actually a study of 50 mid-air collisions revealed that only eight percent were head-on. However, 42% were collisions between aircraft heading in the same direction. So, compared with opposite-direction traffic your chances of having a mid-air are over five times greater with an aircraft you are overtaking or one that is overtaking you.

Visual Anomalies

As a pilot, you are responsible to make sure your vision is equal to the task of flying—that you have good near, intermediate, and distant visual acuity because—

- Distant vision is required for VFR operations including takeoff, attitude control, navigation, and landing
- Distant vision is especially important in avoiding mid-air collisions
- Near vision is required for checking charts, maps, frequency settings, etc.
- Near and intermediate vision are required for checking aircraft instruments

Learn about your own visual strengths and weaknesses. Changes in vision may occur imperceptibly or very rapidly. Periodically self-check your range of visual acuity by trying to see details at near, intermediate, and distant points. If you notice any change in your visual capabilities, bring it to the attention of your Aviation Medical Examiner

And, if you use corrective glasses or contacts, carry an extra pair with you when you fly. Always remember: Vision is a pilot's most important sense. ✣

This article is adapted from a pamphlet of the same name in the series "Medical Facts for Pilots," developed by FAA's Civil Aeromedical Institute. If you want additional copies or more information on pilot vision, contact CAMI's Aeromedical Education Division, AAM-400, P.O. Box 25082, Oklahoma City, OK 73125. Ask for publication AM-400-90/2.

MEDICAL Stuff

SPECIAL OPHTHALMIC NEEDS OF AVIATORS

by Van B. Nakagawara, OD,FAAO
Kathryn J. Wood, Opt. TR
Ronald W. Montgomery, BS

Civil aviation is a major commercial and technological industry in the U.S. Approximately 1.45 million people rely daily on scheduled air carriers for business and personal travel, while general aviation contributes more than $45 billion annually to the national economy and provides more than 540,000 jobs.

Over the past two decades, the demographics of the civil airman population have changed. The percentage of airman who are ≥40 years of age has increased from 39% in 1976 to more than 59% in 1996. The average age of civil airmen in 1996 was 43 years. A common consequence of aging is an increased prevalence of vision problems. There has been a nearly 30% increase in restrictions associated with visual conditions in civil airmen from 1976 to 1996.

SOME POINTERS ON SHARP VISION

The sharpest distant focus is only within a one-degree cone.

Outside of a 10° cone, visual acuity drops 90%.

Scan entire horizon, not just the sky in front of your aircraft.

You are five times more likely to have a mid-air with an aircraft flying in the same direction than one flying in the opposite direction.

When an eye doctor examines and prescribes for a patient, it is customary to ask the individual about occupational and recreational activities that might influence the use of any ophthalmic correcting devices. In general, a single correcting device is not functional for all activities. For civil airmen, the types of ophthalmic devices recommended are often determined by the flight activities being performed. For example:

Airmen who do aerobatic flying may be advised to wear soft contact lenses, since they are not as easily dislodged as rigid lenses.

Agricultural aircraft operators (crop dusters) may be exposed to harmful pesticides. Soft contact lenses, which can absorb chemicals into their matrix, may be contraindicated. Adequate eye protection should be recommended to these pilots.

Eye protection devices should be recommended for all monocular aviators, since they can receive ocular trauma from flying objects in the cockpit during turbulence or aerobatic maneuvers. Additionally, bird strikes have shattered aircraft windscreens.

Monovision contact lens wear is not recommended for flying, since it reduces stereopsis and distance visual acuity. Presbyopic airmen who wear contact lenses should be fitted with lenses for distant vision and prescribed eyeglasses to correct for near vision.

Opaque or translucent colored contact lenses may affect peripheral vision of the pilot, especially at dusk and at night, and should be discouraged.

The pilot is exposed to many glare sources in aviation and proper eye protection from glare should be recommended. Since color vision is important to the airman, dark tints (i.e., less than 8% transmittance) and tints that distort color vision (e.g., blue-blocking lenses) should be avoided.

Polarizing spectacles reveal striations in plastic or tempered glass windscreens that can produce visual fatigue and distortion.

A thick spectacle frame temple may break the seal of an oxygen mask and interfere with communication headsets. A thick eyewire frame may affect the peripheral field of vision.

Seating position (reclining, head forward, or normal) has a major influence on bifocal segment heights. It is recommended that the bifocal segment be set at a height that will enable the pilot see the instrument panel in front without interfering with distant viewing. To determine correct segment position, the pilot should mark the height on the lens with a grease pencil while seated in the cockpit. Presbyopic pilots who fly multiple aircraft may require different sets of spectacles for each aircraft.

Smaller segment bifocals (e.g., ST-25) allow for distant peripheral vision around the bifocal segment. However, for more sophisticated aircraft with wide instrument arrays, a wide reading area (e.g., executive bifocal) may be preferred. (See Figure 1, next page.)

For presbyopic pilots who view instruments above the line of sight, an occupational or task-specific lens may be recommended, such as the Varilux "Overview" or a double "D" segment lens. The double "D" segment with a standards separation (13mm) between

the segments may reduce the visual field of an aviator. However, special lenses with a wider separation (20mm) may provide a practical solution. (See Figure 2,)

Trifocal users may find the normal intermediate segment width (7mm) too narrow for viewing the complete instrument panel without moving their heads. A lens with a modified intermediate segment (14mm) may resolve the problem (e.g., X-Cel's CRT lens—see Figure 2).

Many pilots advance their seats forward on takeoff and landing to improve their external visibility. In flight, aviators often move their seats back to provide more comfort to their legs and back. Therefore, pilots may be 30+ inches from the instrument panel and 20 to 36 inches from navigational charts. Lenses for near and intermediate distances should be considered when prescribing for pilots.

Charges in lens types (single vision to bifocal, bifocal to trifocal or progressive addition) can affect peripheral vision and depth perception. The airman should be advised that new lenses can distort vision and alter visual cues (visual scene appears to slant, objects appear larger or smaller than actual size) while performing flight maneuvers.

Red light in the cockpit should be avoided since it reduces accommodating ability and contributes to making aviation maps and charts unreadable.

Aviation medical examiners can contribute to aviation safety by ensuring that pilots are wearing ophthalmic devices that best serve their particular needs. Knowledge of the unique occupational, recreational, and environmental requirements of the civil airman can assist the aviation medical examiner in suggesting alternate vision corrective devices that are better suited for a particular aviation activity. ✣

Dr. Nakagawara, Ms. Wood, and Mr. Montgomery are members of the Aeromedical Research Division's Vision Research Team at FAA's CAMI. This article was reprinted from the Winter 1997 edition of CAMI's Federal Air Surgeon's Medical Bulletin.

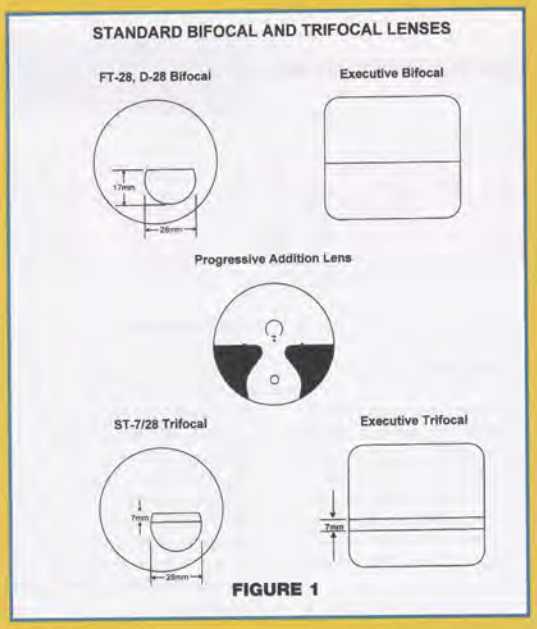


FIGURE 1

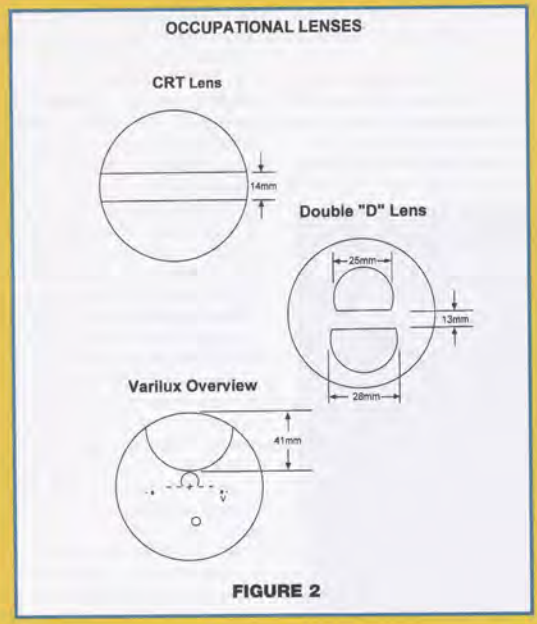


FIGURE 2

SMOKE!

by Arvind K. Chaturvedi, Ph.D.

Fire is an integral part of our everyday life, and smoke is one of its products. There have always been efforts to control fire and use it for constructive purposes, but, even then, accidental fires do occur, and fire continues to cause loss of lives and property.

Uncontrolled fires threaten homes, factories, and transportation systems. The specter of fire in the air is a pilot's recurrent nightmare, carried over from the early days of fabric covered aircraft, when the time between ignition and loss of the aircraft could be measured in relatively few minutes.

Smoke Toxicity

Modern [transport category] aircraft benefit from flame retardant materials and improved fire extinguishing systems to such an extent that in-flight fires are rare occurrences. However, survivable crashes followed by fire happen, primarily from fuel spills around the downed aircraft. In the confined environment of an aircraft cabin, the presence of smoke automatically indicates the existence of an emergency situation. Extinguishment of fires obviously has first priority, but smoke inhalation should be recognized as a very real danger while this is being accomplished.

Inhalation of toxic gasses in smoke is the primary cause of fatalities in most fires—this is true whether the fire is in a high-rise building, a residential bedroom, or an aircraft cabin. Smoke gasses do not need to reach lethal levels to impair pilot performance seriously. [Less than] lethal exposures can cause even experienced pilots to make potentially fatal mistakes.

In view of the seriousness of any aircraft fire, let us examine the various aspects of fire and smoke.

Fire

Fire is a complex, dynamic, physicochemical event and is the result of a rapid chemical reaction generating smoke, heat, flame, and light. Each fire is different. Smoke composition and heat generated in a fire depend on types of burning materials and environmental conditions.

Smoke

Smoke is a complex of particulate matter, as well as a variety of invisible combustion gasses and vapors suspended in the fire atmosphere. Smoke may diminish light and obscure vision, and its gasses could be toxic.

Smoke Gasses

Carbon monoxide and hydrogen cyanide are the two principal toxic combustion gasses. Most [aircraft] cabin furnishings contain carbon and will generate both carbon monoxide and carbon dioxide when burned; carbon monoxide can also be released from faulty cabin heaters. Burning wool, silk, and many nitrogen-containing synthetics will produce the more toxic hydrogen cyanide gas. Irritant gasses, such as hydrogen chloride and acrolein, are generated from burning wiring insulation and some other cabin materials. Generally, carbon dioxide levels increase and oxygen concentrations decrease during fires.

Smoke Effects

Visual smoke can delay escape from a fire, while the irritant gasses can induce tears, pain, and disorientation. The visual obstruction is obvious, but the subtle effects of carbon monoxide and hydrogen cyanide inhalation, although less readily detected, can cause physical incapacitation and subsequent death.

Toxicologically, carbon monoxide combines with the hemoglobin in blood and interferes with the oxygen supply to tissues, while hydrogen cyanide inhibits oxygen utilization at the cellular level. Carbon dioxide, a relatively innocuous fire gas, increases the respiration rate causing an increase in the intake of the other combustion gasses.

The decreased oxygen level found in most fire scenarios further enhances the problem of getting enough oxygen to the biological sites to maintain normal function. Continued inhalation of these gasses can result in severe hypoxia. At high altitude where oxygen levels are lower, the effects of carbon monoxide and hydrogen cyanide are greatly enhanced.

Signs and Symptoms

Carbon monoxide poisoning produces headache, weakness, nausea, dizziness, confusion, dimness of vision, disturbance of judgement, and unconsciousness followed by coma and death. Although carbon monoxide causes deleterious effects on the central nervous system, death usually occurs from cardiotoxicity. Not all symptoms will necessarily be experienced by every individual exposed to this gas. Some have succumbed from inhaling low carbon monoxide levels, while others have survived breathing higher concentrations.

Hydrogen cyanide poisoning signs and symptoms are weakness, dizziness, headache, nausea, vomiting, coma, convulsions, and death. Death results from respiratory arrest. Hydrogen cyanide gas acts very rapidly—symptoms and death can both occur quickly.

Survival

There is no universal best procedure to follow in the event of an aircraft fire because no two fires are likely to be the same. Extinguishing the fire, if possible, is the immediate priority. An equally obvious second priority is to breathe as little smoke for as short a duration as possible.

Some larger aircraft are supplied with portable, self-contained breathing masks for the crew, but small, private aircraft are not so equipped unless they regularly fly at the altitudes where supplemental oxygen is required by regulation.

Cloth held over the nose and mouth will provide protection from smoke particulates; if the cloth is wet, it will also absorb most of the water-soluble gasses; i.e., hydrogen cyanide and hydrogen chloride. Cabin venting will reduce the concentrations of combustible gasses but is not usually a viable option while actually fighting the fire.

Knowledge of the less obvious hazards and a few simple preparations can increase one's chances for survival in an aircraft fire. A small, hand-held fire extinguisher can be used to put out small onboard fires. Careful inspection and maintenance of cabin heaters will minimize the chance of carbon monoxide leakage into the cabin air system. A carbon monoxide detector could also be installed in the cockpit to detect the presence of this colorless, odorless gas.

As always planning your probable actions before an emergency arises will increase your chances for acting quickly and correctly.

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This article is adapted from a pamphlet of the same name in the series "Medical Facts for Pilots," developed by FAA's Civil Aeromedical Institute. If you want additional copies or more information on smoke, contact CAMI's Aeromedical Education Division, AAM-400, P.O. Box 25082, Oklahoma City, OK 73125. Ask for publication AM-400-95/1.

REMEMBER...

Fires are the main hazard for the occupants of a survivable crash.

A fire generates smoke, heat, flame, and light.

Inhalation of toxic gasses in smoke is the primary cause of death in most fires.

Carbon monoxide and hydrogen cyanide are the main toxic gasses in smoke.

Exposure to carbon monoxide can also be the result of faulty heaters.

A wet cloth held over the nose and mouth provides some protection from smoke inhalation.

A small, hand-held fire extinguisher should always be carried aboard general aviation aircraft.

Install a carbon monoxide detector in the cockpit.

ON DIETING

by Glenn R. Stoutt Jr., MD

After the end of year holidays is when we all resolve to lose the excess pounds gained from Thanksgiving until the New Year. However, the aim should not be to lose weight but to lose fat. In desperation, we often look at the magazines at the supermarket checkout lines that promise a breakthrough (a "loophole" in the laws of thermodynamics) with a new magic diet. But sadly, there is absolutely no way to lose a pound without burning 3,500 calories.

You can, of course, lose seven or eight pounds of water in just a few days. But the fat remains. We will still be fat, just somewhat dehydrated.

Fat Factoids

Cellulite is just another name for fat, dreamed up years ago by some health writer.

Fat is relatively water-free, so when you lose fat you are losing pure, lardy, ugly fat—and not water.

Overnight weight gains or losses on your scales are from water shifts.

Muscle weighs more than fat, so it is possible to work out and build up muscle tissue, lose fat, and then have the scales deceptively tell you that you are gaining.

The body uses practically no energy to metabolize fat in your diet, whereas it uses about 20-25% of the calories in carbohydrates and protein for metabolizing them. In other words, when you eat 200 calories of meat or pasta your body actually gets only about 150 calories. Fat in your diet, on the other hand, goes lickety-split to wherever it can find some room to be stored.

Spot reducing is a myth. Fat comes off in the same sequence it was stored. Depending on your genes, it may be stored as love handles, jodhpur thighs, jowls, butt, or pot-belly.

A combination of diet and exercise is absolutely necessary to lose weight. Neither alone is the answer, and there are no shortcuts.

Dr. Stoutt has been an active aviation medical examiner for 37 years.

This article was reprinted from the Winter 1997 edition of the CAMI's Federal Air Surgeon's Medical Bulletin.

Weight and Balance-Diet Pills and Flying

Aside from serious concerns over "Fen/Phen's" safety, are diet pills okay for pilots to use?

by Donato J. Borrillo, M.D., J.D. and David Lozano, M.D.

One in three, or 58 million American adults, aged 20 through 74, are estimated to be overweight; an increase from 25 to 33 percent between 1980 and 1991.

The number of obese pilots, per se, is not known; however, the recent glut of diet pills on the market, both prescribed and over-the counter, should be taken into account by the Aviation Medical Examiner. Left untreated, obesity increases a pilot's susceptibility to decompression sickness, decreases mobility within the cockpit, and increases the risk of sudden incapacitating events. Obesity is a known risk factor for diabetes, heart disease, high blood pressure, gallbladder disease, arthritis, breathing problems, and some forms of cancer.

This article does not necessarily promote diet pills for the obese, but rather, focuses on the side-effects of diet pills on pilots.

The best results for weight loss have been obtained under medically supervised programs and with long-term programs that emphasize exercise. The medical benefit of abrupt weight loss from using pulsed diet pills, lasting weeks or months, is negligible.

The "New Diet Pills"

The most recent pharmacological approach to the treatment of obesity has been a combination of two drugs, Phentermine (Adipex) and Fenfluramine (Pondimin). Phentermine prevents the body from absorbing dopamine and norepinephrine. This gives a feeling of energy and reduces the craving for sugar. Many patients are able to lose weight taking Phentermine alone; however, most are prescribed a combination of the two drugs, commonly referred to as "Fen/Phen."

Fenfluramine was originally developed as an antidepressant and was later reclassified as an anorectic drug when the side-effect of weight loss was evident. Fenfluramine inhibits serotonin absorption and gives a sense of "well being." It reduces cravings for complex carbohydrates and curbs the appetite.

Dexfenfluramine (Redux) is chemically similar to Fenfluramine. Dexfenfluramine contains only the active right-handed Dexfenfluramine isomer, whereas Fenfluramine contains both the "Dex" and "Levo" inactive left-handed Fenfluramine isomers. Because Dexfenfluramine contains only the "active" ingredient, 15 mg of Dexfenfluramine is equal to 30 mg of Fenfluramine.

Two other diet pills will be out on the market this year, Sibutramine (Meridia) and Orlistat (Xenical). Similar to Fen/Phen, Meridia is an "all-in-one" time-release pill with less risk of pulmonary hypertension than Fenfluramine. Orlistat inhibits the absorption of fat in the intestinal tract, and lacks serious side-effects. Orlistat does inhibit absorption of fat-based vitamins (A, D, E, and K) and is related to Olestra, a fat substitute. Both Olestra and Orlistat may cause gas and cramping.

Diet Pills and Their Effects on the Pilot

Although the International Primary Pulmonary Hypertension (IPPH) Study in 1997 drew most attention to Fenfluramine, primary pulmonary hypertension is a rare consequence. It may occur in one to two individuals per mil-

"DE-PHEN-ITIONS"

- **Fenfluramine** (Pondimin): sympathomimetic amine with CNS depression
- **Phentermine** (Adipex): sympathomimetic amine similar to amphetamine
- **Fenfluramine** and **Phentermine** (Fen/Phen): commonly used in synergistic combination
- **Dexfenfluramine** (Redux): "right-handed" active isomer of fenfluramine
- **Sibutramine** (Meridia): "all-in-one" time released Phen/Fen pill
- **Orlistat** (Xenical): inhibits intestinal fat absorption, similar to Olestra a "fat substitute"
- **Phentermine** and **Phendimetrazine** (Phen/ Phendi): two sympathomimetic amines

lion in the general population; Fenfluramine use increases a patient's risk of PPH by 23 times, or 23 to 46 per million. Of greater concern, however, are the more common disqualifying side-effects of diet pills.

Phentermine may cause overstimulation of both the cardiovascular and central nervous system. Palpitations, tachycardia, hypertension, restlessness, and gastrointestinal disturbances may result. Moreover, Phentermine should not be used with monoamine oxidase inhibitors, decongestants, or Tagamet.

Fenfluramine may cause drowsiness, diarrhea, and dry mouth; in addition, it is contraindicated in patients taking selective serotonin reuptake inhibitors, Zoloft and Prozac (usually not seen in aviators). Dextromethorphan (cough syrup) must also be avoided. Some doctors, concerned about the liability of prescribing Fenfluramine, prescribe Phentermine and Phendimetrazine (phen/phendi) instead. Phendimetrazine is not a replacement for Fenfluramine; rather, it is another central nervous system stimulant.

Pursuant to the Guide for Aviation Medical Examiners, when item 17 (MEDICATIONS) is checked YES:

> 17. Do You Currently Use Any Medication (Prescription or Non-prescription)?
> ❑ Yes ❑ No
>
> If yes, give name, purpose dosage, and frequency

If the applicant checks YES, the name, dosage, frequency, and purpose of each medication should be reported. This includes both prescription and nonprescription medication.

For example, any airman who is undergoing continuous treatment with anticoagulants, antiviral agents, anxiolytics, barbiturates, chemotheraputic agents, experimental hypoglycemic, investigational, *mood-ameliorating* [emphasis ours], motion sickness, narcotic, sedating antihistaminic, sedative, steroid drugs, or tranquilizers must be deferred certification unless the treatment has previously been cleared by FAA medical authority.

During periods in which the foregoing medications are being used for treatment of acute illnesses, the airman is under obligation not to perform the duties of an airman unless cleared by the FAA.

Disposition

In general, diet pills are sympathomimetic amines and should be treated as prescribed stimulants. Mood-altering medication warrants deferral of certification for FAA clearance. The recent increase in diet pill use for weight reduction should be kept in mind by the Aviation Medical Examiner, since these medications are not simply used to correct "Weight and Balance."

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This article originally appeared in the Federal Air Surgeon's Medical Bulletin, Fall 1997.

The Aeromedical Certification Division reiterates the FAA's position on diet medications and flying:

"The article by Drs. Borrillo and Lozano accurately reflects the thoughts of the Aeromedical Certification Division. We do not feel that the use of any 'psychotropic' medication (including diet pills) on a continuing basis is compatible with the safe performance of pilot duties. Once an individual has achieved his or her desired weight and has been off the medications long enough to no longer experience withdrawal symptoms, then flying may be resumed."

Editor's note: On September 15, the FDA, acting on evidence of "significant side-effects" associated with Dexfenfluramine (Redux) and Fenfluramine (Pondimin), requested the manufacturers of these products to voluntarily withdraw them for the treatment of obesity. The companies involved agreed take them off the market. The FDA has not requested the withdrawal of Phentermine (Adipex), another widely-used medication for obesity.

CALENDAR OF EVENTS

May 1-3 - Brainerd, MN. 19th Annual Minnesota Seaplane Pilots Association Safety Seminar, Ruttgers Resort. Contact Mike Schmitt at (612) 477-4538.

May 2 - 3 - Ft. Lauderdale, FL. The 1998 Shell Air and Sea Show will be held along the beach at Ft. Lauderdale and will feature military and civilian aerobatics. All five branches of the U.S. military will be participating, including the Blue Angels. The event is free to the public. Contact (954) 527-5600, ext. 88, for further information.

May 13-16 - Greenwood, MS. The 27th annual formation flying clinic for any type Warbird will be open to any member of any Warbird organization and for any type of aircraft. Contact Vernon Ricks at (601) 453-5646.

May 16 - Waterville, ME. 4th Annual Maine Seaplane Pilots Association Safety Seminar. Contact Don Lagace (207) 622-7332.

June 6 - Frederick, MD. AOPA Fly-In. Call (800) 942-4269.

• Centerline Thrust

Why did the FAA change the rule on centerline thrust aircraft in FAR Part 61?

Name withheld

When the new FAR Part 61 became effective on August 4, 1997, one of its changes required that a pilot provide an aircraft for a practical test that could meet all of the practical test requirements for a particular pilot or flight instructor certificate. For multiengine pilot applicants this meant they had to now provide a multiengine aircraft that had a published minimum control speed for the test. In the past, pilots that used an aircraft for a multiengine practical test that didn't have a published minimum control speed such as a Cessna 337 model would receive an operating limitation on their pilot certificate upon successful completion of their practical test that restricted them to operating only similar centerline thrust aircraft. The same was true of military pilots applying for a civil certificate based upon their military training in aircraft with no published minimum control speed. They too would receive a centerline thrust limitation. These limitations would remain in effect until the pilot passed a certification test in a multiengine aircraft with a published minimum control speed.

FAA has now changed its policy for such applicants back to its old policy. The new FAR §61.45(b) reinstates the policy of allowing pilots to take a multiengine practical test in an aircraft without a published minimum control speed. Pilots will now receive an operating limitation on their certificate upon successful completion of the practical test that limits the applicant to operating aircraft ("limited center thrust"). The limitation will remain in effect until the pilot takes and successfully passes a practical test in a multiengine aircraft with a published minimum control speed.

A similar policy will also apply to other aircraft with operating limitations that don't meet all of the test requirements of the appropriate practical test standards. Pilots taking practical tests in such aircraft will receive an appropriate operating limitation on their certificates until they take and pass the appropriate practical test in an aircraft without the operating limitation.

FAA AVIATION NEWS welcomes comments. We may edit letters for style and/or length. If we have more than one letter on the same topic, we will select one representative letter to publish. Because of our publishing schedules, responses may not appear for several issues. We do not print anonymous letters, but we do withhold names or send personal replies upon request. Readers are reminded that questions dealing with immediate FAA operational issues should be referred to their local Flight Standards District Office or Air Traffic facility. Send letters to FORUM Editor, FAA AVIATION NEWS, AFS-805, 800 Independence Ave., SW, Washington, DC 20591, or FAX them to (202) 267-9463;. e-mail address: Dean.Chamberlain@faa.dot.gov

• Is It Time To Ground Alcohol?

Thanks for another good article! It made me wonder again about something that seems taken for granted on airlines: serving alcohol. It seems to me from a standpoint of flight safety that it's at least odd for airlines to be contributing to a major safety problem by serving passengers alcohol. As I understand it, regulations prohibit boarding intoxicated passengers. But the effort to gain a competitive edge by serving free liquor can quickly turn a marginal passenger into a drunken one.

It may be heretical, but what about banning liquor on all flights? At one time it was considered almost an inalienable right to smoke on airline flights. Now almost all flights are smoke free—at considerable savings in wear and tear on the planes and flight crew, too. Perhaps in the same way airlines could get out of the business of making flight attendants into cocktail waitresses. It would immediately enhance flight safety.

And I expect the dollar savings for not having to have a fully stocked bar on every flight would be considerable. I know I'd be glad not to have to worry about some lunkhead behind me who'd had too much to drink bashing my seatback from recline to upright with no warning, as happened to me on one flight!

Perhaps there's an airline brave enough to test liquor and smoke free flights. I'd sign up!

Thanks again for all you're doing. I do look forward to the FAN!

Deborah L. Scheetz
Dracut, MA

Thanks for your comments. Readers, what do you think?

• ADF—Not Dead Yet

Just finished the January/February issue. Great as usual!

A note of caution for GPS users that intend to remove their ADF's when installing an IFR approved GPS.

A lot of ILS procedures are having a note "ADF REQUIRED" added on the approach plate. See for example the Hyannis, MA, ILS RWY 24 and ILS 15 procedures. The note means that if you don't have an ADF installed and operational, you can't fly the ILS approach.

Having qualified my aircraft and myself to shoot GPS approaches under FAR Part 135, I find it difficult to believe that the GPS cannot be ready on a missed approach to take me immediately to the hold point with better accuracy. (You don't use the GPS on an ILS.)

Don Byrne
EAL Retired
Via Internet

Thanks for the tip.

AvNEWS

FAA AND NOS ANNOUNCE REVISIONS TO TWO HELICOPTER ROUTE CHARTS

Effective with the revised Houston Class B airspace will be the 3rd edition of the Houston Helicopter Route Chart. The new chart was effective on March 26. The chart has been reformatted resulting in a smaller plastic-based chart. Houston Intercontinental is on one side and Hobby on the other. The Boston chart has also been reformatted resulting in a smaller plastic-based chart with a new downtown inset and latitude/longitude listings of heliports, airports, medical facilities and turning points of routes. The Boston chart is effective April 23.

Charts may be purchased from local FBO's as well as directly from NOS Distribution by calling (800) 638-8972 within the U.S. or (301) 436-8301 from outside the U.S. Because helicopter route charts have life cycles of several years or more, they are printed on a plastic material for greater durability. Should you have any questions about the helicopter route chart program, you can call Allen Feldman at the FAA, ATA-130. His telephone number is (202) 267-9302.

1998 FAA AMT AWARDS CONTEST

Of 5,000 AMT Awards issued in 1997, just over 50% entered the FAA/NASCAR Contest, a mark that Winston-Salem, NC Airworthiness Safety Program Manager Phil Randall wants to increase for 1998. To enhance participation in the awards program—which is a voluntary way for mechanics to enhance their professional skills, get recognition for the effort from the FAA, and win some great sponsor-donated prizes—the 1998 prizes have been designed to appeal to more than NASCAR racing fans.

The Grand Prize does include attendance at the July 3, 1999 Daytona IRW Race, but also awards day passes to Disney World/Epcot/MGM Studios. First Place prize is a trip for two to the 1999 Reno Air Races, and Second Place awards a trip for two to the 1999 Sun 'n Fun Fly-In. The Third Place winner will attend a two-day, 16-hour "Maintenance Resource Management" training course given by FlightSafety International, and the Fourth Place prize is two $500.00 gift certificates for tools. One hundred Fifth Place winners will receive a golf shirt with the FAA AMT Awards logo. Winners are chosen by drawing.

Anyone who holds an airframe, powerplant, airframe and powerplant, or repairman certificate or who is employed full time by a FAR Part 121/135 air carrier or FAR Part 145 repair station or who is a full time student at a FAR part 147 school is eligible to enter the contest if they participate in the FAA AMT Awards Program.

For information on the FAA AMT Awards Program or the contest contact FAA Airworthiness Safety Program Manager Phil Randall in Winston-Salem at (336) 631-5147, ext. 57; FAX: (336) 631-5014; Internet e-mail: phil.randall@faa.dot.gov .

NEW IFR CHART DATA

New information has been added to some select IFR Enroute Low Altitude charts. The new information consists of Computer Navigation Fixes (CNF's) which are intended to provide pilots relying on GPS or other database utilizing navigation systems the information necessary to identify required positions using only that equipment. Initially CNF's will be added to Mileage Breakdown points (turns) on airways, which are currently charted with just a small "x." Pilots using non-database navigation systems (e.g., VOR, DME, NDB, etc.) will continue to identify airway turns in the same manner that they do now (e.g., intercepting next radial, etc.).

CNF's are for database utilizing navigation systems only, and do not have any Air Traffic Control (ATC) functions. ATC will not have aircraft hold at, or report passing, a CNF. Likewise, pilots should not request routing to, or via, a CNF, and pilots should not reference CNF's in communications with ATC.

The first CNF's appeared on the Alaska IFR Low Altitude charts effective January 1, 1998. The remaining CNF's will be phased-in on all Government IFR Low Altitude charts over a period of three or four cycles.

DEDICATED AIR AND SPACE CHANNEL

On April 2, Wingspan: Air and Space Channel will go into effect in major cable television and satellite markets across the U.S. and internationally. The new channel is exclusively dedicated to aviation and space topics and will provide news, entertainment, documentaries, and educational programs.

Wingspan is the producer of the Wings series for the Discovery Channel, and Wingspan programs are currently broadcast in 39 countries and in 11 languages. It also produces programming for A&E, The History Channel, PBS, Speedvision, and several foreign channel. For the past 18 months Wingspan has produced a weekly aviation news program for the channel Speedvision and will continue all its previous programming in addition to the new Air and Space Channel. Wingspan possesses the world's largest archive of aviation-related video and film.

For more information on Wingspan: Air and Space Channel, contact Wingspan at (301) 718-0700. To get Wingspan in your area, contact your local cable or satellite provider.

ASRS ON LINE

The Aviation Safety Reporting System (ASRS), the FAA sponsored, NASA program for airmen to report aviation safety information is now on the Internet. The web site includes 20 ASRS databases. The Internet address is <http://olias.arc.nasa.gov /asrs/repset.htm>.

Editor's Runway

from the pen of Phyllis-Anne Duncan

FIRST DO NO HARM

The title of this issue's Editor's Runway comes from the Hippocratic Oath that doctors take, but I think as pilots and mechanics we can apply that oath to ourselves. First, do no harm to ourselves so that we are not unsafe users of the airspace system; second, keep ourselves in good health so that our flying harms no one else.

With all of today's pressures and warp-speed lifestyles, paying attention to the machine that is one's body sometimes falls low on the list of priorities. That is why we devoted this issue of FAA Aviation News primarily to aviation medicine topics—just as a reminder that the airplane can be in tip-top physical condition; but, if the person who flies it or the person who maintains it is not, there can be a problem. As I selected the various articles and noted their subjects, I realized that at some point in the past year, I had been fatigued, stressed, and sleep-deprived (articles on pages 5 and 18). I developed "over 40" eyes and now have to use reading glasses over my contacts—but I hadn't pointed out to the optician that I was a pilot and those glasses might need special construction (page 21). And diet (page 24)—well, let's not go there. (The good news is I'm not the only one; I'm not even the only pilot.) Consequently, it was probably best that I had more hours at the desk than at the controls rather than pose a possible danger to myself or others.

As I edited the articles, I also recalled there was a spate of fatal accidents late last winter where pilots were overcome by CO in the cockpit (pages 7 and 8), and spatial disorientation continues to be a major accident cause (article on pages 1, 3, and 4). So, what we've tried to give you here is a mixed bag of aviation medical information which you can read and think about and hopefully discuss with your personal aviation medical examiner (AME). Some of the information may be disappointing to some of us; namely, there is no way to lose weight except by burning 3,500 calories somehow—i.e., exercise and a good diet not "miracle" cures (page 25). Yet, some of the most optimistic information herein is on how airmen can be restored to flying status by medical recertification (page 17), and how now diabetic pilots can be pilots in command again (pages 15 and 16). Aviation and medicine, both separately and together, offer so many opportunities for advancements in the upcoming years that I believe it likely that FAA will re-evaluate many more previously disqualifying, treatable conditions and will restore more medically disqualified pilots to flying status. There are plenty of examples of the FAA "system" working. Back in the early 1980's I had a medical condition which was corrected by surgery but whose aftermath kept me from flying for nearly two years. Sometimes I despaired of ever getting back in the air other than with a flight instructor for the rest of my life. Persistence and carefully following the AME's advice won out, and I got my medical back—five pretty exciting words.

But that experience showed me that the temptation to fly "business as usual" after losing one's medical is strong. If we are so tempted, we need to consider that if the unthinkable should happen while we're in the air, we are not the only ones affected. Thus, maintaining good health and adhering to regulatory requirements are not only important to our continuing ability to fly but to our passengers and persons and property on the ground as well. Every year, there are a couple of stories that make the national news about a pilot who becomes incapacitated with a non-pilot passenger. These situations have 100% happy endings only in the movies or TV. You have to be prepared for any flying eventuality by keeping yourself trained and proficient; by keeping yourself in good physical and mental health; and by encouraging your most frequent passenger to either get his or her own pilot certificate or at least take a Pinchhitters course. Your continued good health is important to your family and friends and the public whether you're in the living room or the cockpit.

All of us over 40 face the inevitable march of age, but by knowing the kinds of medical issues that can affect our privilege to fly, by taking care of our minds and bodies, and by working within the system to become recertified where it is feasible, we can extend our flying "lives" to our benefit and no one's detriment. I'm looking forward to joining that exclusive club of over-90 aviators who still fly. I'll see you there.

'Til next time...

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