

# Aviation Human Factors

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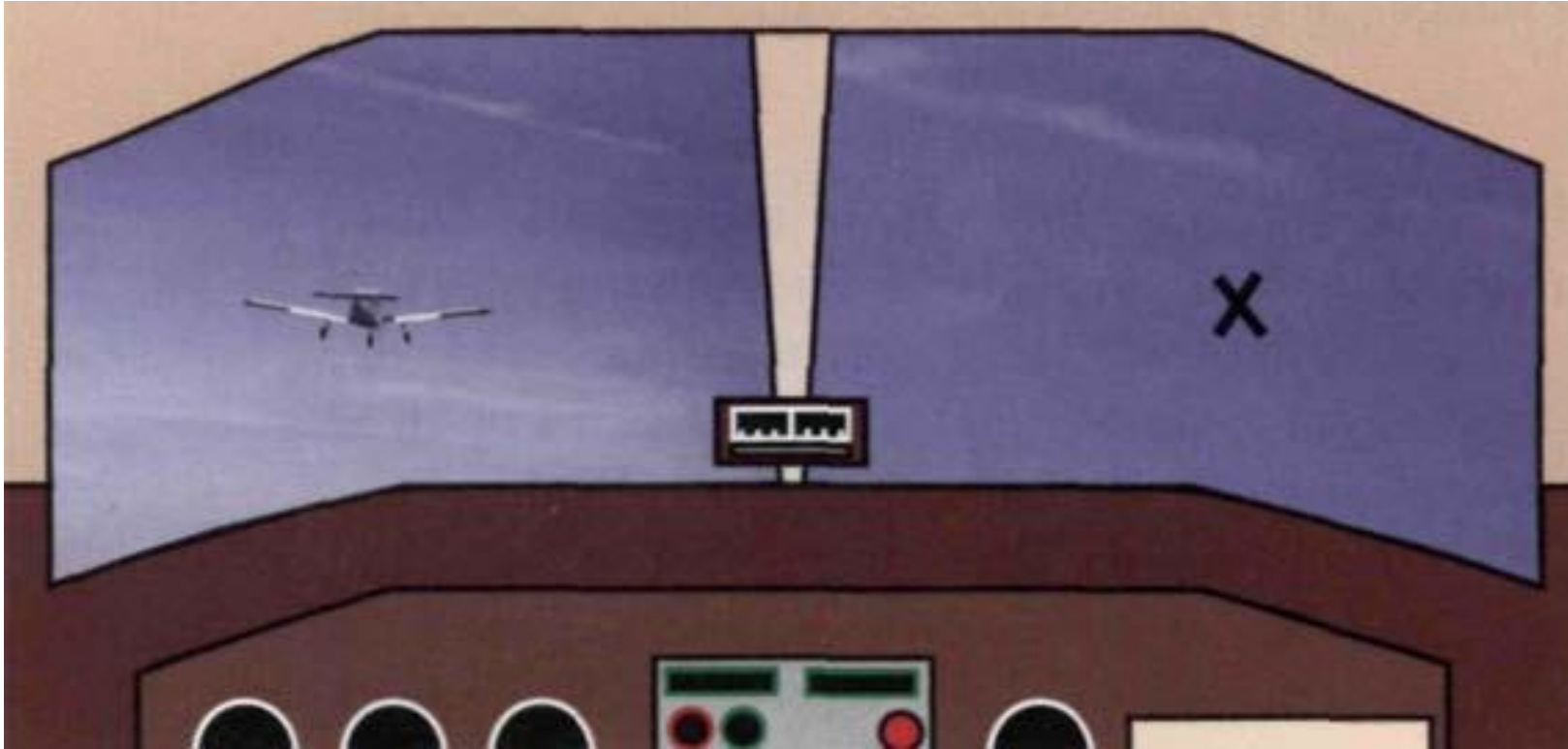
## **Aviation Physiology**

- Vision in Flight
- Night Vision
- Visual Illusions
- Hypoxia
- Supplemental Oxygen
- Hyperventilation

## **Aeronautical Decision-Making**

- Applying the Decision-Making Process
  - Pilot-In-Command Responsibility
  - Hazardous Attitudes
  - Communication
  - Resource Use
  - Workload Management
  - Situational Awareness
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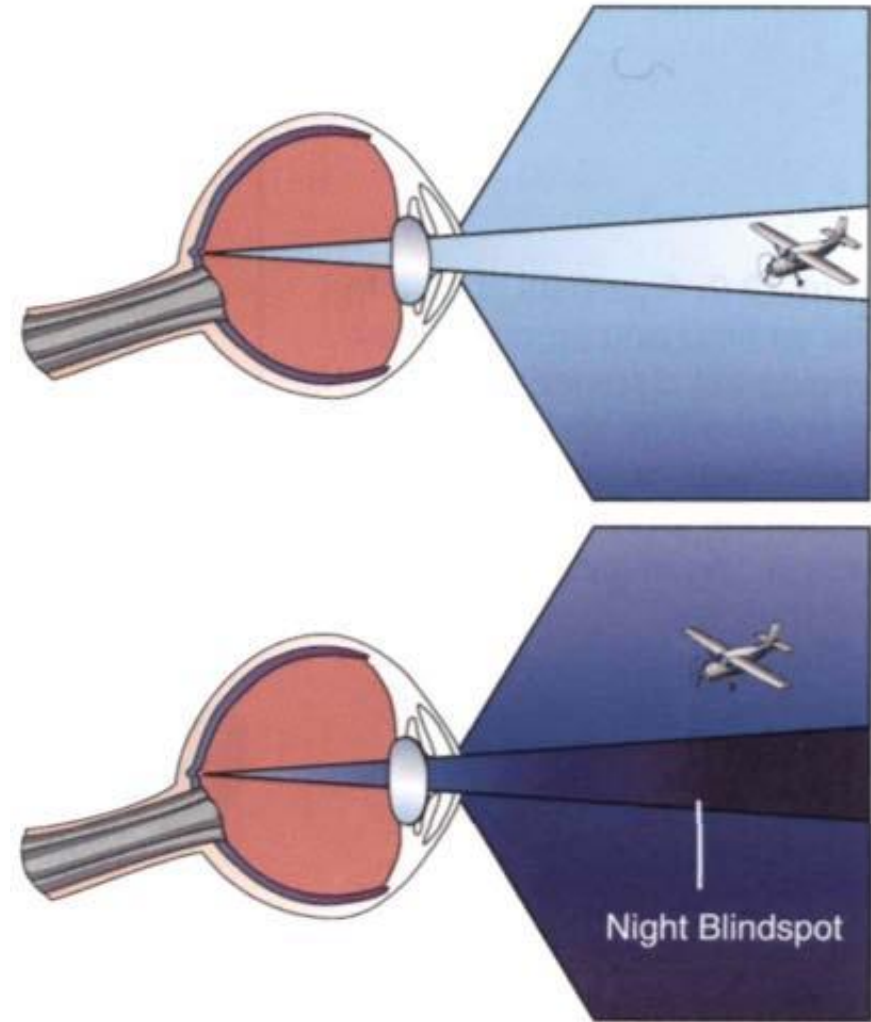
# Blind Spots



This illustration provides a dramatic example of the eye's blind spot. Cover your right eye and hold this page at arm's length. Focus your left eye on the X in the right side of the windshield and notice what happens to the aircraft as you slowly bring the page closer to your eye.

# Night Vision

When you look directly at an object, the image is focused mainly on the fovea. At night, your ability to see an object in the center of the visual field is reduced as the cones lose much of their visual acuity and the rods become more receptive. You also lose much of your depth perception and your judgment of size.



If you see a steady green and flashing red light, an aircraft is passing from left to right.

A steady red and flashing red light indicate an aircraft is crossing to your left.



A steady white light combined with a flashing red light identify an aircraft flying away from you.

If you see a red position light to the right of a green light, an aircraft is flying toward you.

If you see a steady green and flashing red light, an aircraft is passing from left to right.

A steady red and flashing red light indicate an aircraft is crossing to your left.



A steady white light combined with a flashing red light identify an aircraft flying away from you.

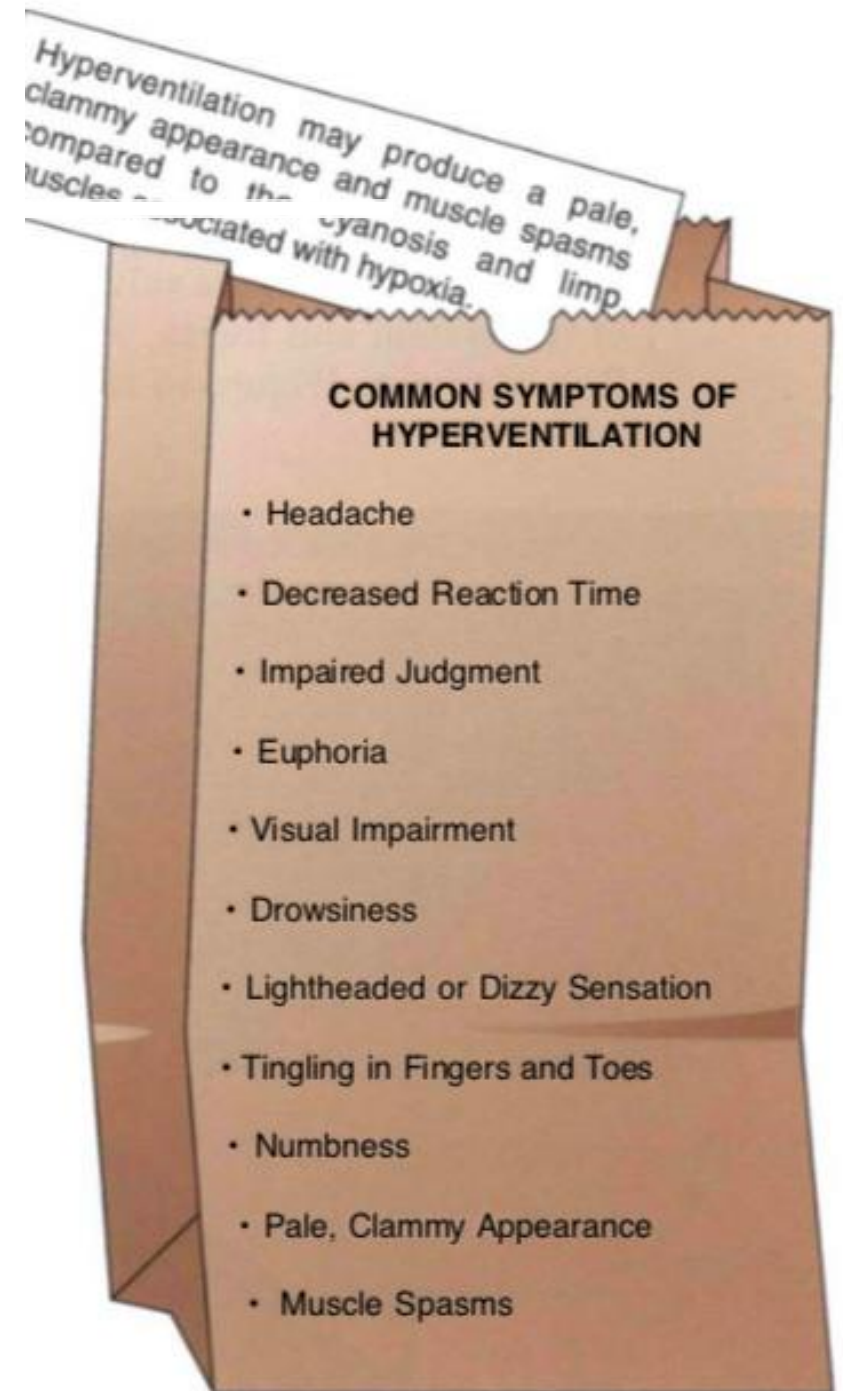
Your Airplane

# Aeromedical Factors

- Hypoxia
- Hyperventilation
- Spatial Disorientation
- Optical Illusions
- Motion Sickness
- Carbon Monoxide Poisoning
- Fatigue
- Exposure to Chemicals
- Dehydration and Heat Stroke
- Altitude-Induced Decompression Sickness

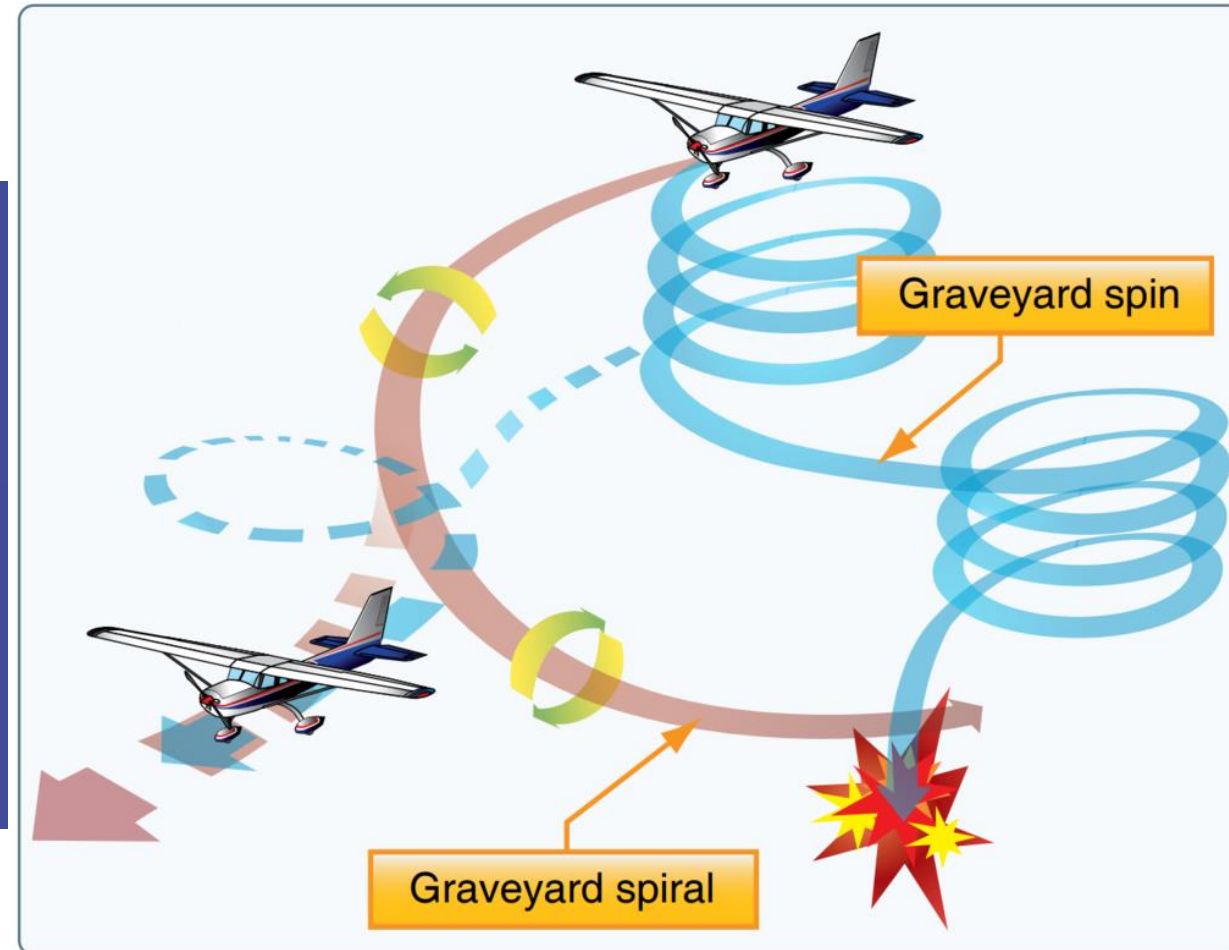
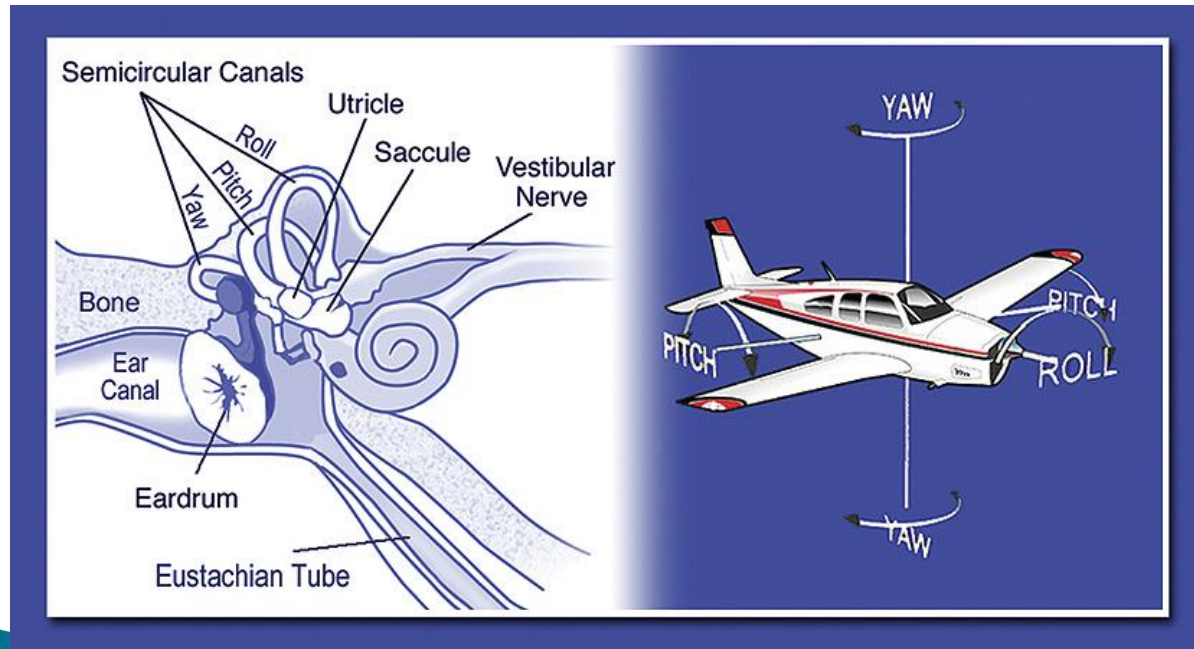
# Hyperventilation

Hyperventilation is rapid or deep breathing which can be caused by emotional tension, anxiety, or fear. Hyperventilation can occur while breathing supplemental oxygen.



# Spatial Disorientation

Spatial disorientation is defined as **the inability of a pilot to correctly interpret aircraft attitude, altitude or airspeed in relation to the Earth or other points of reference.**



# CARBON MONOXIDE

The most common form of hypemic hypoxia is carbon monoxide poisoning.

Since it attaches itself to the hemoglobin about 200 times more easily than does oxygen, carbon monoxide (CO) prevents the hemoglobin from carrying oxygen to the cells. It can take up to 48 hours for the body to dispose of carbon monoxide. If the poisoning is severe enough, it can result in death.

Carbon monoxide poisoning can result from a faulty aircraft heater.

## Monoxide Exposure

Turn the cabin heat fully off. Increase the rate of cabin fresh air ventilation to the maximum. Open windows if the flight profile and aircraft's operating manual permit such an action. If available (provided it does not represent a safety or fire hazard), consider using supplemental oxygen.



# MOTION SICKNESS

Motion sickness occurs in a fairly high number of persons who travel by air, land, and sea.

"Car sickness," "sea sickness," "air sickness," and "space motion sickness (yes, as many as 50% of astronauts experience nausea during space travel) all refer to the same types of symptoms that include increased breathing rate (hyperventilation), cold sweats, dizziness, increased salivation, headache, fatigue, and general discomfort.

The more severe symptoms that make motion sickness particularly offensive in an airplane are nausea and vomiting.

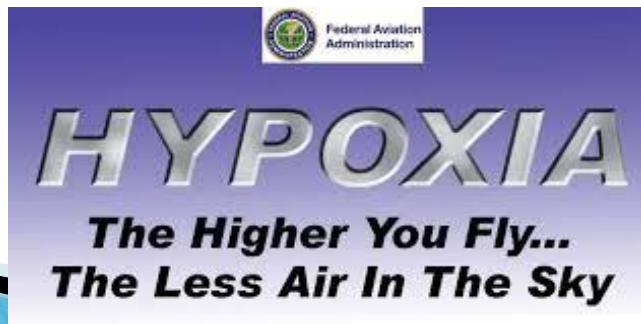
Minimize the effects of motion sickness both before and during the flight.

- Before the flight, eat just a light meal a few hours prior to takeoff.
  - Don't smoke. (Don't ever smoke!)
  - If it's a training flight, know what maneuvers are planned for the lesson so you won't be surprised by "unusual attitude" training. If it's an aerobatics lesson, it's even more important to know the plan.
  - During the flight, stay focused on the tasks, especially that of maintaining a straight and level attitude.
  - Keep the vents open to fresh, cool outside air.
  - Use supplemental oxygen if you have it available.
- 

# High Altitude Flying

## Hypoxia

- Pilots also know something about the dangers of hypoxia (insufficient oxygen) at altitude.
- Specifically, as the blood's oxygen saturation drops with altitude, a series of symptoms — all of them dangerous — can set in.



| Hypoxia: Time Of Useful Consciousness |                        |
|---------------------------------------|------------------------|
| 45,000 Feet                           | 9-15 seconds           |
| 35,000 Feet                           | 30-60 seconds          |
| 25,000 Feet                           | 3-5 minutes            |
| 10,000 Feet                           | Hypoxia Symptoms Begin |

# High Altitude Flying

- The air we breathe at the surface is roughly 79 percent nitrogen and other gases, and 21 percent oxygen.
  - Lots of bad things happen when the blood's oxygen saturation drops.
  - Night vision goes first, as retinal function begins to deteriorate at altitudes as low as 5,000 feet.
  - Nausea, apprehension, tunnel vision, headaches, fatigue, dizziness, blurred vision, tingling sensations, numbness, and mental confusion are some of the other symptoms, and they can vary from individual to individual.
- 

# High Altitude Flying

- The common symptoms of hypoxia include increased breathing rate, dizziness, headache, sweating, reduced peripheral vision, and fatigue, but the most insidious symptom is a feeling of euphoria. Pilots suffering from hypoxia often experience a false sense of security rather than a sense of the danger inherent to this condition.
  - For pilots, hypoxia's adverse effects are described in terms of time of useful consciousness (TUC) and effective performance time (EPT).
  - TUC is a measure of your ability to function in a meaningful way. In other words, it's a kind of threshold on the pathway to becoming, first, something like a drooling fool, and second, unconscious and then certifiably out of it.
  - EPT is defined as the time from the loss of significant oxygen to the time when you are no longer able to perform tasks in a safe and efficient manner. This is a dangerous condition, because hypoxia's onset is subtle.
- 

# FAR: Supplemental Oxygen

## § 91.211 Supplemental oxygen

- (a) *General.* No person may operate a civil aircraft of U.S. registry:
    - (1) At cabin pressure altitudes above 12,500 feet (MSL) up to and including 14,000 feet (MSL) unless the required minimum flight crew is provided with and uses supplemental oxygen for that part of the flight at those altitudes that is of more than 30 minutes duration;
    - (2) At cabin pressure altitudes above 14,000 feet (MSL) unless the required minimum flight crew is provided with and uses supplemental oxygen during the entire flight time at those altitudes; and
    - (3) At cabin pressure altitudes above 15,000 feet (MSL) unless each occupant of the aircraft is provided with supplemental oxygen.
- 

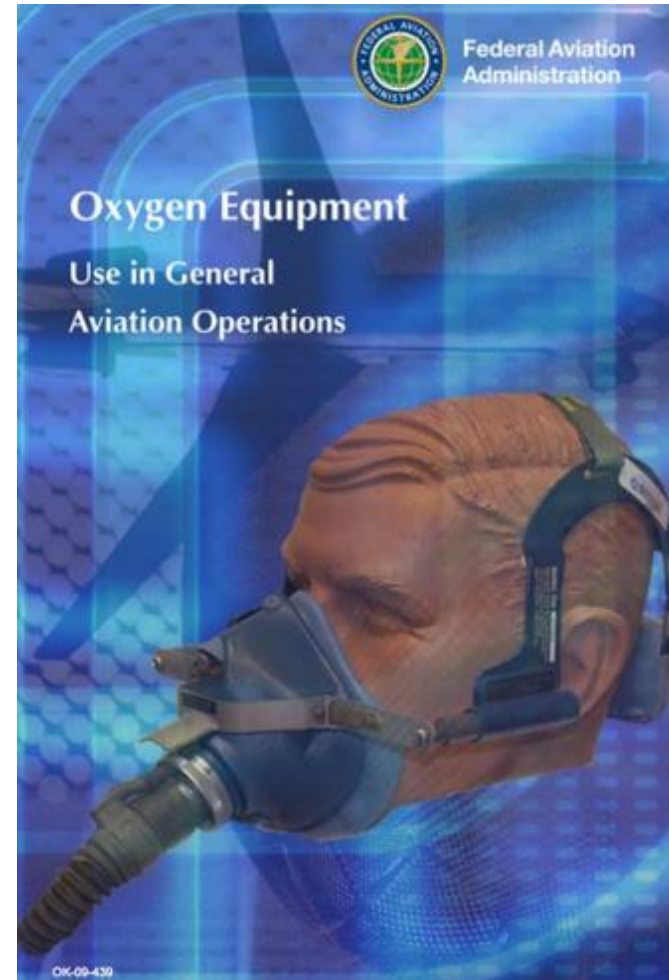
# FAR: Supplemental Oxygen

## § 91.211 Supplemental Oxygen Recap!

- So from 12,500 to 14,000 ft, if you're there for more than 30 minutes, you have be on oxygen. Okay?
- 14,000 feet, required crew is required to be on supplemental oxygen.
- 15,000... you must offer to your passengers, however, they don't have to accept it



# Use of Oxygen





## I'M SAFE CHECKLIST

**I**llness—Do I have any symptoms?

**M**edication—Have I been taking prescription or over-the-counter drugs?

**S**tress—Am I under psychological pressure from the job? Worried about financial matters, health problems, or family discord?

**A**lcohol—Have I been drinking within 8 hours?  
Within 24 hours?

**F**atigue—Am I tired and not adequately rested?

**E**motion—Am I emotionally upset?



# Medication

## DO NOT FLY

|                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ALLERGY MEDICATIONS<br/>(1<sup>st</sup> GENERATION)</b> | <p>Sedating Antihistamines:</p> <ul style="list-style-type: none"> <li>• Found in many over-the counter (OTC) allergy and other types of medications, as single agent or in any combination product.</li> <li>• Applies to nasal, ophthalmic, AND oral formulations.               <ul style="list-style-type: none"> <li>◦ diphenhydramine (Benadryl)</li> <li>◦ chlorpheniramine (Coricidin; ChlorTrimeton)</li> </ul> </li> </ul> <p>See pharmaceutical, <a href="#">Allergy – Antihistamine &amp; Immunotherapy Medication</a></p>                                                                                                    |
| <b>ANTI-ANXIETY</b>                                        | <ul style="list-style-type: none"> <li>• Including but not limited to:               <ul style="list-style-type: none"> <li>◦ alprazolam (Xanax)</li> <li>◦ lorazepam (Ativan)</li> <li>◦ temazepam (Restoril)</li> <li>◦ triazolam (Halcion)</li> </ul> </li> </ul>                                                                                                                                                                                                                                                                                                                                                                      |
| <b>MUSCLE RELAXANTS</b>                                    | <ul style="list-style-type: none"> <li>• Including but not limited to:               <ul style="list-style-type: none"> <li>◦ carisoprodol (Soma)</li> <li>◦ cyclobenzaprine (Flexeril)</li> </ul> </li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>OTC ACTIVE DIETARY SUPPLEMENTS</b>                      | <ul style="list-style-type: none"> <li>• Including but not limited to:               <ul style="list-style-type: none"> <li>◦ Kava-Kava</li> <li>◦ Kratom</li> <li>◦ Valerian</li> </ul> </li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>PAIN MEDICATION</b>                                     | <ul style="list-style-type: none"> <li>• May be used occasionally for time-limited conditions that are either single episode or recurrent episodes with resolution.</li> <li>• Annotate Block 60 if use is temporary for a medical procedure or for a medical condition and the medication has been discontinued.</li> <li>• Annotate the start and stop dates and reason for use.</li> <li>• Narcotic pain relievers including but not limited to morphine, codeine, oxycodone (Percodan, Oxycontin), and hydrocodone (Lortab, Vicodin, etc.).</li> <li>• Non-narcotic pain relievers (e.g., tramadol [Ultram]).</li> </ul>              |
| <b>PRE-MEDICATION OR PRE-PROCEDURE DRUGS</b>               | All medications used as an aid to outpatient surgical or dental procedures.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>SEDATIVES/SLEEP AIDS</b>                                | <ul style="list-style-type: none"> <li>• All currently available sleep aids, both prescription and OTC, can cause impairment of mental processes and reaction times, even when the individual feels fully awake. See <a href="#">Sleep Aid and wait times</a> for currently available prescription sleep aids.</li> <li>• Diphenhydramine (Benadryl) - Many OTC sleep aids contain diphenhydramine as the active ingredient (see sedating antihistamines above).               <ul style="list-style-type: none"> <li>◦ The wait time after diphenhydramine is 60 hours (based on maximum pharmacologic half-life)</li> </ul> </li> </ul> |

[FAA]

# Medication Wait Time

## GENERAL NO FLY WAIT TIMES

(Updated 06/28/2023)

For Aviation safety, pilots should **not fly following the last dose of any medications** until a period of time has elapsed equal to:

- A. 5-times the maximum pharmacologic half-life of the medication (preferred); or
- B. 5-times the maximum hour dose interval if pharmacologic half-life information is not available. For example, there is a 30-hour wait time for a medication that is taken every 4 to 6 hours. If there is a range, calculate by using the higher number (e.g., 6 hours x 5 = 30 hours No Fly wait time).

### LABEL WARNINGS:

Do not fly or perform safety-related duties while using any medication (prescription or OTC) that carries a label precaution or warning that **it may cause drowsiness or advises the user to “be careful when driving a motor vehicle or operating machinery.”** This applies even if label states, “until you know how the medication affects you” and even if the medication has been used before with no apparent adverse effect. Such medications can cause impairment even when the individual feels alert and unimpaired (see “unaware of impair” above).

For more information, see Pharmaceuticals, [Over-the-Counter Medications](#).

# Effects of Alcohol

- Brain effects include impaired reaction time, reasoning, judgment, and memory.
  - Alcohol decreases the ability of the brain to make use of oxygen
  - Effect magnified by simultaneous exposure to altitude – less oxygen
- Visual symptoms include eye muscle imbalance, which leads to double vision and difficulty focusing.
- Inner ear effects include dizziness, and decreased hearing perception.
- Other variables: sleep deprivation, fatigue, medication use, altitude hypoxia, or flying at night or in bad weather.

Ref: <https://www.faa.gov/pilots/safety/pilotsafetybrochures/media/alcohol.pdf>

# Eight hours, bottle to throttle

## Alcohol or drugs.

- (a) No person may act or attempt to act as a crewmember of a civil aircraft—
  - (1) Within 8 hours after the consumption of any alcoholic beverage;
  - (2) While under the influence of alcohol;
  - (3) While using any drug that affects the person's faculties in any way contrary to safety; or
  - (4) While having an alcohol concentration of 0.04 or greater in a blood or breath specimen. Alcohol concentration means grams of alcohol per deciliter of blood or grams of alcohol per 210 liters of breath.
- (b) Except in an emergency, no pilot of a civil aircraft may allow a person who appears to be intoxicated or who demonstrates by manner or physical indications that the individual is under the influence of drugs (except a medical patient under proper care) to be carried in that aircraft.

- 14 CFR § 91.17

# Other Considerations

1. A more conservative approach is to wait 24 hours from the last use of alcohol before flying.
  - Especially true if intoxication occurred or if you plan to fly IFR.
  - Cold showers, drinking black coffee, or breathing 100% oxygen **cannot** speed up the elimination of alcohol from the body.
2. Consider the effects of a hangover. Eight hours from “bottle to throttle” does not mean you are in the best physical condition to fly, or that your blood alcohol concentration is below the legal limits.
3. Recognize the hazards of combining alcohol consumption and flying.
4. Use good judgment. Your life and the lives of your passengers are at risk if you drink and fly. Keep in mind that regulations alone are no guarantee that problems won't occur.

**20. You attended a party last night and you consumed several glasses of wine. You are planning to fly your aircraft home and have been careful to make sure 8 hours have passed since your last alcoholic drink. You can make the flight now only if you are not under the influence of alcohol and your blood alcohol level is**

-  **A. below .04%.**
- B. below .08%.**
- C. 0.0%.**

[FAA Sample Airman Knowledge Test Questions – Private Pilot Airplane]

**6.16. Duty Day Restrictions.** Maximum aero club duty day is 12 hours for a single pilot or 16 hours for two qualified pilots in an aircraft with dual flight controls. Flight duty day begins when the pilot(s) reports to the aero club for the first flight, or to the duty location (place of employment) for the first duty (work) of the day, whichever occurs first. Minimum crew rest between duty days is 10 hours after 8 hours or less of duty time, 12 hours for more than 8 hours duty time.

[\[AFMAN 34-152\]](#)

# Hazardous Attitudes

| The Five Hazardous Attitudes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Antidote                                          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|
| <b>Anti-authority:</b> “Don’t tell me.”<br>This attitude is found in people who do not like anyone telling them what to do. In a sense, they are saying, “No one can tell me what to do.” They may be resentful of having someone tell them what to do or may regard rules, regulations, and procedures as silly or unnecessary. However, it is always your prerogative to question authority if you feel it is in error.                                                                                             | <b>Follow the rules. They are usually right.</b>  |
| <b>Impulsivity:</b> “Do it quickly.”<br>This is the attitude of people who frequently feel the need to do something, anything, immediately. They do not stop to think about what they are about to do, they do not select the best alternative, and they do the first thing that comes to mind.                                                                                                                                                                                                                       | <b>Not so fast. Think first.</b>                  |
| <b>Invulnerability:</b> “It won’t happen to me.”<br>Many people falsely believe that accidents happen to others, but never to them. They know accidents can happen, and they know that anyone can be affected. However, they never really feel or believe that they will be personally involved. Pilots who think this way are more likely to take chances and increase risk.                                                                                                                                         | <b>It could happen to me.</b>                     |
| <b>Macho:</b> “I can do it.”<br>Pilots who are always trying to prove that they are better than anyone else think, “I can do it—I’ll show them.” Pilots with this type of attitude will try to prove themselves by taking risks in order to impress others. While this pattern is thought to be a male characteristic, women are equally susceptible.                                                                                                                                                                 | <b>Taking chances is foolish.</b>                 |
| <b>Resignation:</b> “What’s the use?”<br>Pilots who think, “What’s the use?” do not see themselves as being able to make a great deal of difference in what happens to them. When things go well, the pilot is apt to think that it is good luck. When things go badly, the pilot may feel that someone is out to get them or attribute it to bad luck. The pilot will leave the action to others, for better or worse. Sometimes, such pilots will even go along with unreasonable requests just to be a “nice guy.” | <b>I’m not helpless. I can make a difference.</b> |

U.S. >

## OceanGate CEO Stockton Rush said in 2021 he'd "broken some rules" in design of Titan sub that imploded

BY LI COHEN

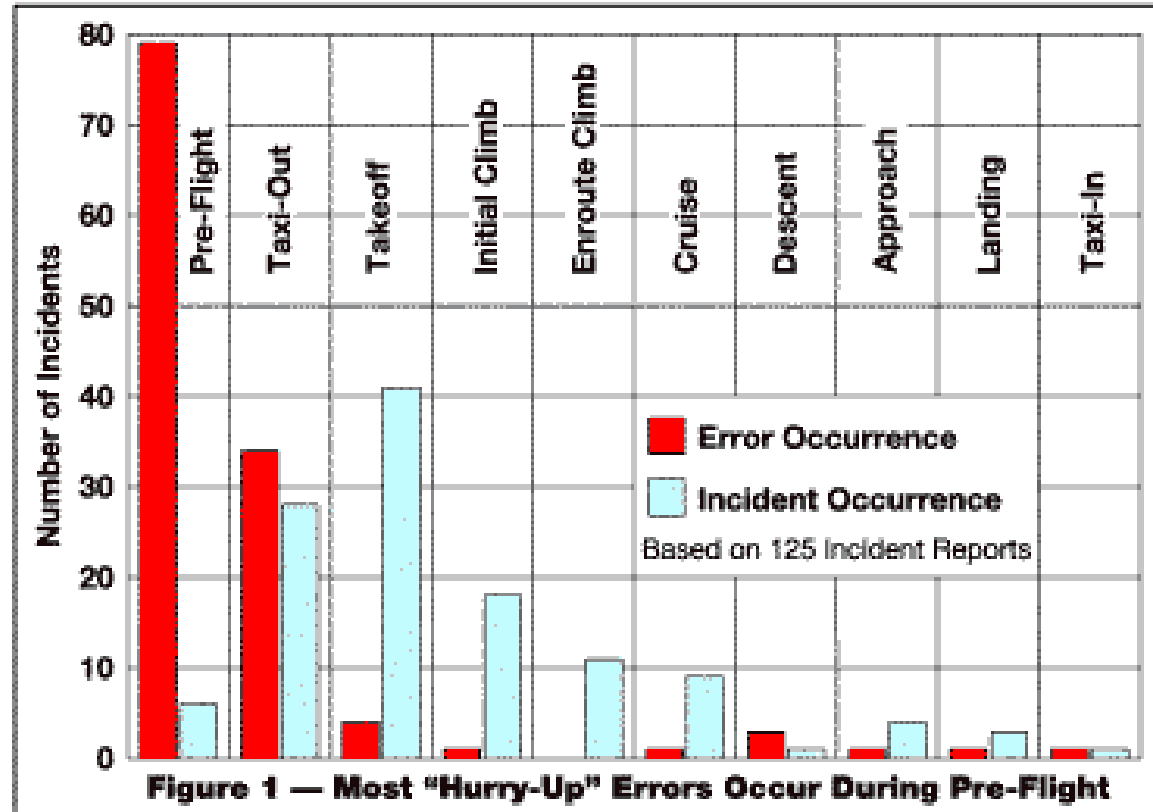
UPDATED ON: JUNE 23, 2023 / 2:06 PM / CBS NEWS



Speaking to Estrada, Rush specifically discussed the vessel's design, which many have been questioning as news of its fate came to light.

"The carbon fiber and titanium - there's a rule you don't do that," Rush said, speaking of the materials used to construct the sub. "Well, I did. It's picking the rules that you break that are the ones that will add value to others and add value to society, and that really to me is about innovation."

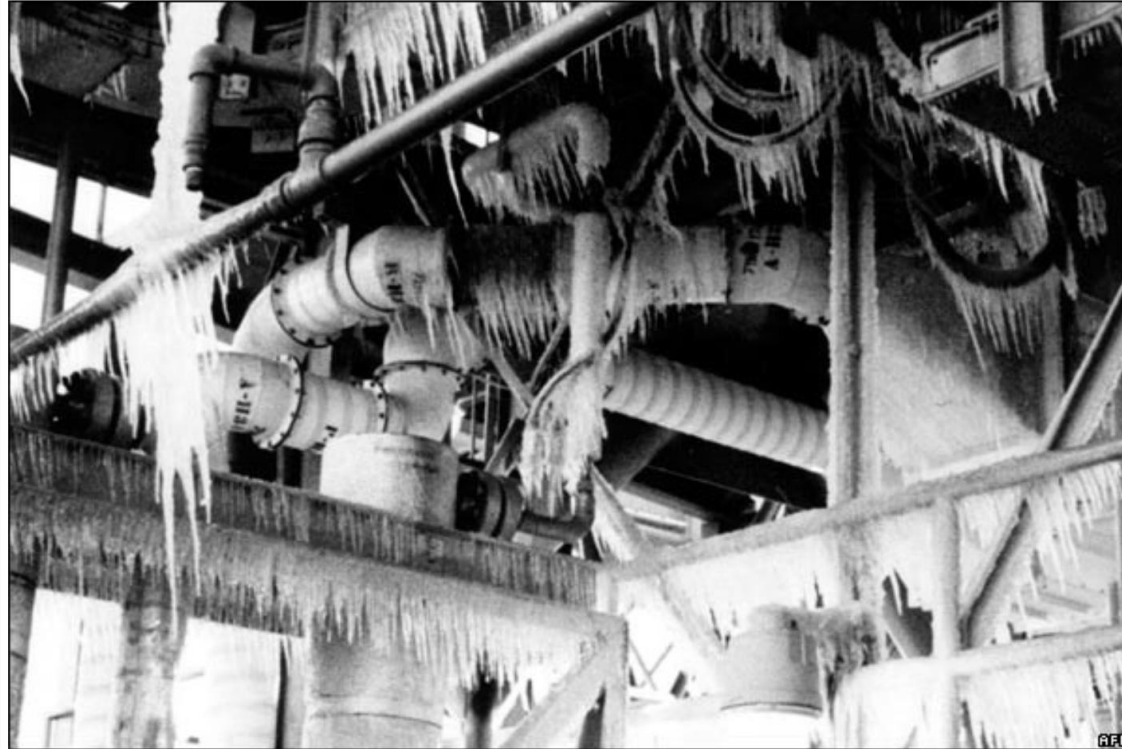
# Hurry-up Syndrome



[NASA]

On Jan. 28, 1986, the STS-51-L Space Shuttle Program mission with the orbiter *Challenger* prepared for liftoff. The forecast was a bitter 26 degrees Fahrenheit in Florida that morning. Water leaks formed icicles on the launch pad.

"Based on that visual, would you have wanted to launch a rocket?" Hale asked. Wide eyes and shaking heads in the audience answered his question.



*Icicles forming at the base of Challenger. Image Credit: NBC*

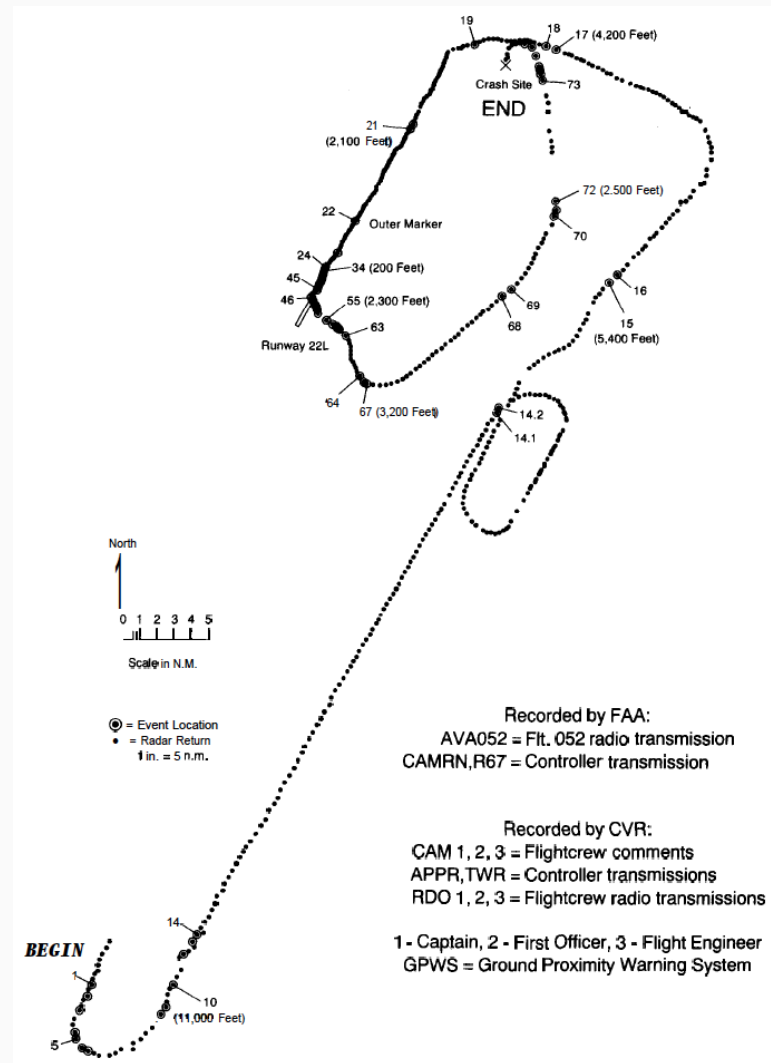
The pressure was strong to get this mission on the road. They had scrubbed launching the day before, and there were already 13 other instances of flight delays in the previous months.

[[NASA JSC](#)]

# Macho & Invulnerability



# Resignation



[NTSB]

*The accurate perception and understanding of all the factors and conditions within the four fundamental risk elements (pilot, aircraft, environment, and type of operation) that affect safety before, during, and after the flight.*

– FAA Risk Management Handbook

# Internal Resources

- Avionics – automation management; memory aids
- Checklist discipline – do the same thing the same way
- Verbal communication – have a plan; brief yourself
- What else?



# Crew Resource Management



## Passenger briefing: SAFETY

- S    Seat belts fastened for taxi, takeoff, landing  
      Shoulder harness fastened for takeoff, landing  
      Seat position adjusted and locked in place
- A    Air vents (location and operation)  
      All environmental controls (discussed)  
      Action in case of any passenger discomfort
- F    Fire extinguisher (location and operation)
- E    Exit doors (how to secure; how to open; build muscle memory)  
      Emergency evacuation plan  
      Emergency/survival kit (location and contents)
- T    Traffic (scanning, spotting, notifying pilot)  
      Talking, (“sterile flight deck” expectations)
- Y    Your questions? (Speak up!)





# Special Emphasis Areas for Pilots and Aircrew



# Special Emphasis Areas

- Positive aircraft control
- Procedures for positive exchange of flight controls (who is flying the airplane)
- Stall/Spin awareness
- Collision avoidance
- Wake turbulence avoidance
- Land and hold short operations (LAHSO)



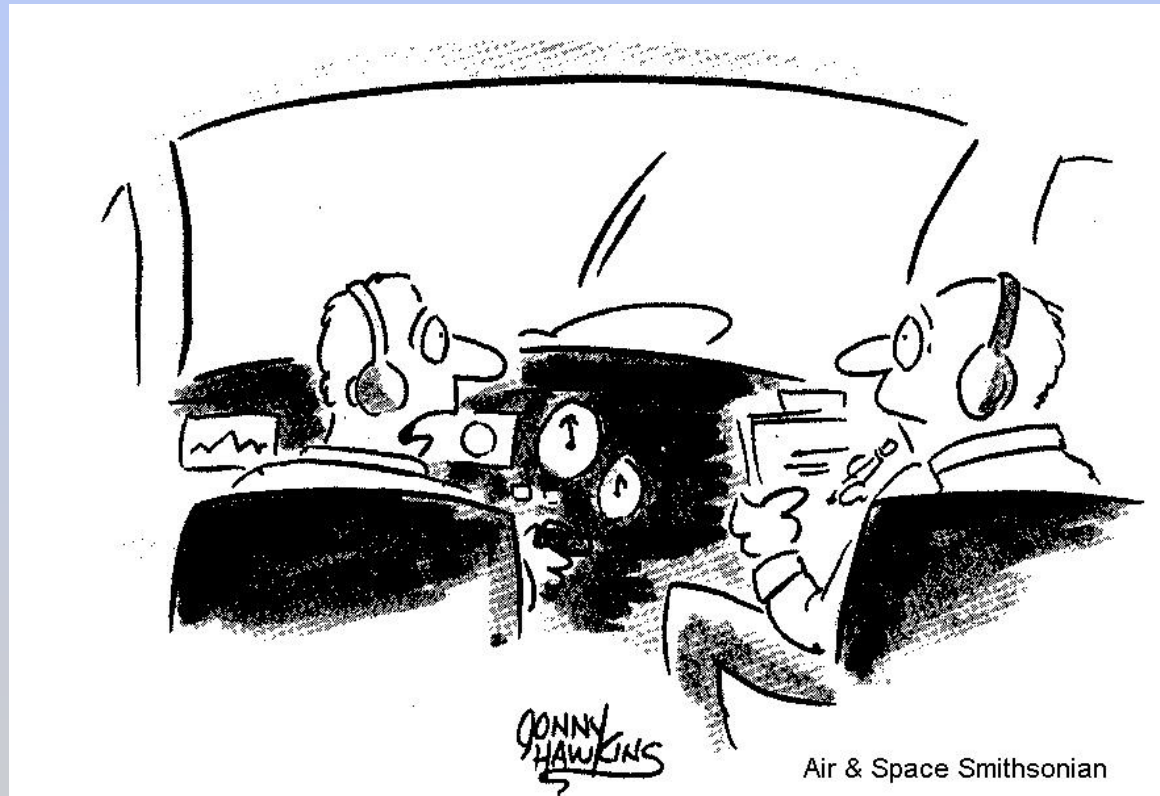
# Special Emphasis Areas

- Runway incursion avoidance
  - Hot spots
- Controlled flight into terrain (CFIT)
- Aeronautical decision making (ADM)
- Checklist usage
- Single pilot resource management (SRM)
- Icing condition operational hazards, anti-icing and deicing equipment, differences, and approved use and operations

# During the flight check



## The Newest Statement During a Flight Exam



**“I am NOT the weakest link.”**

# Engine Out: Boldface Memory Actions



- ☒ **Airspeed – Best Glide**
- ☒ **(Air)Field – Nearest landing place**
- ☒ **Fuel Selectors - Fuel Pump ON**
- ☒ **Mixture – Rich**
- ☒ **Carb Heat – ON**
- ☒ **Confirm with Checklist**

**We still see simulated engine failures inflight a problem area**

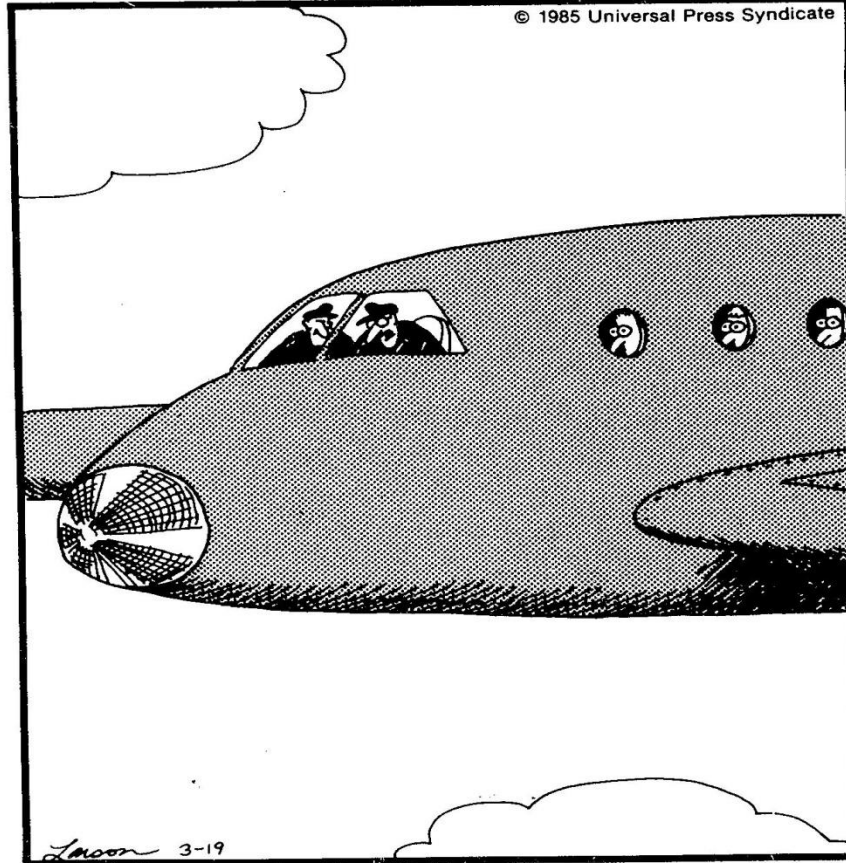
# Be Prepared for Emergencies!



## THE FAR SIDE

By GARY LARSON

© 1985 Universal Press Syndicate



"The fuel light's on, Frank! We're all going to die! ...  
Wait, wait. ... Oh, my mistake—that's the  
intercom light."

# Electronic Flight Bag (EFB)

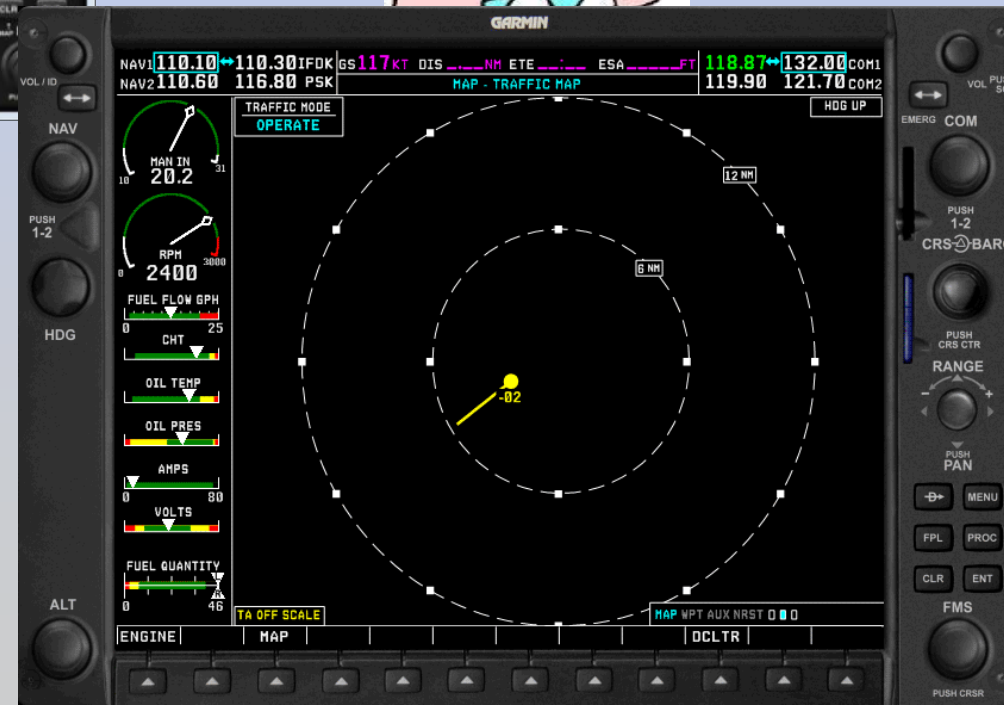
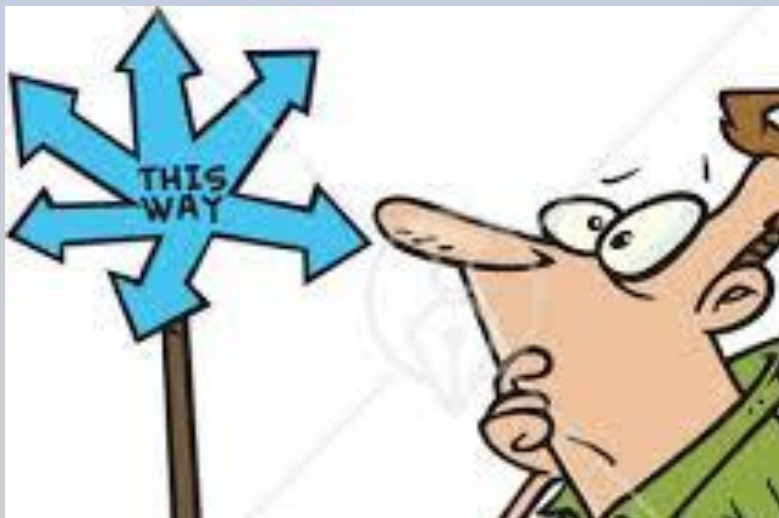


**Check pilots shall inquire into the applicant's use of EFBs/ECDs during CAP operations and include their use, as appropriate, during annual and abbreviated check ride flights.**

**Ground and flight evaluations shall be based on meeting the established FAA Areas of Operation using the EFB/ECD tools and methods the pilot uses during normal CAP operations.**



# 6 Minutes, 38 Seconds!!



# Collision Avoidance: 80/20 Rule



- **Collision Avoidance continues to be a concern**

## Use the 80/20 Rule

80% of the time scanning for traffic

20% of the time scanning cockpit

## CAP Aircraft have Pulse Lights

Always use lights in vicinity of an airport and high-traffic areas



# Please don't text and fly!



# Night Approach!



# Don't Let Accidents Happen!



# Don't Let Accidents Happen!

