Learning Center Library Contents

Flying in Flat Light and White Out Conditions
Author: FAA **Date:** 2001

Introduction

It is certain that such weather phenomena like flat light and white out have existed since the beginning of time. However, to date, no real in-depth studies into these weather conditions have been examined extensively as they relate to the aviation community. The Federal Aviation Administration continues to explore this unusual visual condition and in the interest of safety is committed to reporting any new findings.

Our senses do not deceive us. This is not because they always judge correctly, but because they do not judge at all.
Immanuel Kant

To help maintain high safety standards, the FAA has created this pamphlet and a video entitled, *"Flying in Flat Light & White Out Conditions."* This pamphlet is intended to provide a reference guide to supplement the video and any formal training you may receive. It is generic in nature and can be used with FAA Advisory

Circular 60-4A. 14 CFR Section 91.157 addresses special VFR weather minimums, indicating particular exceptions for helicopters, including how to equip the aircraft with proper operative equipment. There are multitudes of resources that can be accessed prior to flight when planning to travel into areas where flat light and white out are possibilities. Such resources include: local fixed-based operators; FAA Flight Service Stations; aviation associations, and pilots who are located in the area where you intend to travel.

Definitions

These definitions are not intended to be official scientific explanations, but merely to serve as operational definitions suitable to the aviation community for the purpose of this training. These terms should not be used interchangeably.

Flat Light

Flat light is an optical illusion, also known as "sector or partial white out." It is not as severe as "white out" but the condition causes pilots to lose their depth-of-field and contrast in vision. Flat light conditions are usually accompanied by overcast skies inhibiting any good visual clues. Such conditions can occur anywhere in the world, primarily in snow covered areas but can occur in dust, sand, mud flats, or on glassy water. Flat light can completely obscure features of the terrain, creating an inability to distinguish distances and closure rates. As a result of this reflected light, it can give pilots the illusion of ascending or descending when actually flying level. However, with good judgment and proper training and planning, it is possible to safely operate an aircraft in flat light conditions.

White Out

As defined in meteorological terms, white out is when a person becomes engulfed in a uniformly white glow. The glow is a result of being surrounded by blowing snow, dust, sand, mud or water. There are no shadows, no horizon or clouds and all depth-of-field and orientation are lost. A white out situation is severe in that there aren't any visual references. Flying is not recommended in any white out situation. Flat light conditions can lead to a white out environment quite rapidly, and both atmospheric conditions are insidious: they sneak up on you as your visual references slowly begin to disappear. White out has been the cause of several aviation accidents in snow-covered areas.

Self Induced White Out

This effect typically occurs when a helicopter takes off or lands on a snow-covered area. The rotor down wash picks up particles and re-circulates them through the rotor system. The effect can vary in intensity depending upon the amount of light on the surface. This phenomenon can happen on the sunniest, brightest day with good contrast everywhere. However, when it happens, there can be a complete loss of visual clues. If the pilot has not prepared for this immediate loss of visibility, the results can be disastrous.

From the NTSB Files

- **November, 1979** Air New Zealand DC-10 on a sightseeing flight from New Zealand to Antarctica crashes into a mountain during white out conditions, killing all 257 people on board.
- **June, 1999** A sightseeing flight in Alaska; 7 souls on board. The aircraft crashes into a mountain at 130 knots. There were no survivors. Probable cause: Flat light conditions and spatial disorientation.
- **September, 1999** Near Juneau, Alaska; Three helicopters crash within a 2-mile radius of one another. All rotorcraft sustain substantial damage. Flat light is listed as the major factor in all three accidents. Rescue operations were most difficult and delayed as a result of weather conditions.

- **Near Girdwood, Alaska on a photo flight mission** Weather is a good blue-sky day. The pilot traveled from the side to the shaded side of a mountain ridge. The change in light conditions created flat light. This lack of definition on the shaded side of the ridge caused the pilot to lose depth perception and scrape the ridge area. The pilot managed to land safely but with much damage to the helicopter.

Weather Does Change - Often!

Good planning does not prevent one from encountering flat light or white out conditions. Remember that:

"**P**roper **p**lanning **p**revents **p**oor **p**erformance."

Resources

To help pilots avoid becoming a statistic, the following are suggested "tools" or resources to utilize when planning a flight and potentially encountering unfavorable atmospheric conditions:

- Local Fixed Base Operator (FBO)
- Airmen Associations
- FAA Flight Service Station
- Pilots who frequently fly in the area you plan to travel and are familiar with the local conditions

Transport Canada serves as Canada's Aeronautical Commission; be sure to use their experience to your benefit.

Check All Available Weather Sources

- Study the weather trends regularly
- Understand the meanings of these weather trends in relation to your geographical area of travel
- Be aware of the effects of high thin overcast from approaching weather systems
- Good pilot reports (when given frequently) provide great reliability. Ask for and give them often.

Set (and Use) Personal Minimums

- In the event of adverse weather conditions, be aware, that the closer you are to your destination, the less likely you are to turn around and go back.

Never Take Off in a White Out Situation

Realize that in flat light conditions, it may be possible to depart but not to return to the departure area. During take-off, make sure you have a reference point; do not lose sight of it until you have a departure reference point in view. Be prepared to return to the take-off reference if the departure reference doesn't come into view.

Raising the Margin of Safety

When a pilot has degrading visual cues, the following equipment can assist in raising the margin of safety:

- Artificial horizon
- Vertical speed indicator
- Heading indicator
- Advanced instrumentation
- Radar altimeters
- Global positioning system (GPS)
- Pressure sensitive altimeter
- VHF omnirange (VOR) system
- Anything else that may be of assistance to you (i.e. colored glasses)

Flat light is common to snow skiers. One way to compensate for the lack of visual contrast and depth-of-field loss is by wearing amber tinted lenses (also known as blue blockers.) Special note of caution: Eyewear is not ideal for every pilot. Take into consideration personal factors: age, light sensitivity, and ambient lighting conditions.

So what should a pilot do when all visual references are lost?

- Trust the cockpit instruments
- Execute a 180-degree turnaround and start looking for outside references
- Above all, fly the aircraft

Landing in Low Light Conditions

When landing in a low light condition, use extreme caution. Look for intermediate reference points, in addition to checkpoints along each leg of the route for course confirmation and timing. The lower the ambient light becomes, the more reference points a pilot should use.

Airport Landings

Look for features around the airport or approach path that can be used in determining depth perception. Buildings, towers, vehicles or other aircraft serve well for this measurement. Use something that will provide you with a sense of height above the ground, in addition to orienting you to the runway.

Be cautious of snowdrifts and snow banks - anything that can distinguish the edge of the runway. Look for subtle changes in snow texture to identify ridges or changes in snow depth.

Off-Airport Landings

In the event of an off-airport landing, pilots have used a number of different objects to gain reference. Use whatever you must to create the contrast you need. Natural references seem to work best (trees, rocks, snow ribs, etc.)

- Overflight
- Use of markers
- Weighted flags
- Smoke bombs
- Red shop bags
- Dye markers
- Kool-aid
- Trees or tree branches

It is difficult to determine the depth of snow and what areas are level. Dropping items from the aircraft to use as reference points should be used as a visual aid only and not as a primary landing reference. Unless your marker is biodegradable, be sure to retrieve it after use.

Never put yourself in a position where no visual references exist.

Abort landing if blowing snow obscures your reference. Make your decisions early. Don't assume you can pick up a lost reference point when you get closer.

Exercise extreme caution when flying from sunlight into shade.

Pilot Inspired Techniques to Lower Flat Light Risks

- Always leave yourself an out.
- Don't fly until you only have one visual reference left.
- Try not to lose sight of your reference point at any time. Plan your approach so that your reference is always on your side when flying. Never turn away from your reference point.
- Fly with your head straight, looking forward; believe what your flight instruments are showing you.

Getting caught in a no visual reference situation can be fatal. Physical awareness may tell you that you are flying straight but you may actually be in a spiral dive with centrifugal force pressing against you. Having no visual references enhances this illusion.

Just because you have a good visual reference doesn't mean that it is safe to continue. There may be snow-covered terrain not visible in the direction that you are traveling.

Flying Around a Lake

When flying alongside lakeshores, use them as a reference point. Even if you can see the other side, realize that your depth perception may be poor and it is easy to fly into the surface. If you must cross the lake, check the altimeter frequently and maintain a safe altitude while you still have a good reference. Don't descend below that altitude.

The same rules apply to seemingly flat areas of snow. If you don't have good references, avoid going there.

Other Traffic

Be on the look out for other traffic in the area. Other aircraft may be using your same reference point. Chances are greater of colliding with someone traveling in the same direction as you, than someone flying in the opposite direction.

Ceilings

Low ceilings have caught many pilots off guard. Clouds do not always form parallel to the surface, or at the same altitude. Pilots may try to compensate for this by flying with a slight bank and thus creating a descending turn.

Glaciers

Be conscious of your altitude when flying over glaciers. The glaciers may be rising faster than you are climbing.

Summary

There are many factors that come into play when dealing with flat light and white out conditions. A pilot's instinctive responses must be immediate, and based on a well thought out plan. These unique visual conditions are insidious and can sneak upon you at any time. The environment can present challenging obstacles making the flight even more difficult. Completing a safe flight may mean choosing an alternate landing site, returning to the point of departure or simply choosing not to fly.

Pilots should establish individual personal minimums, setting strict parameters for landings and sticking by them. Continuing education especially with regard to instrument proficiency, talking to local flight operators, and gaining insight into the psychological, aeromedical, and physiological effects of flight are essential in keeping up with these unique atmospheric phenomena.

Other Sources of Information

Publications 14 CFR 91.157
(Special VFR Weather Minimums) 14 CFR, Chapter 1, Part 91.

Advisory Circular FAA AC-60-4A
02/09/83 *Pilot Spatial Disorientation*

Federal Aviation Administration
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FAA *(http://www.faa.gov/)*
(202) 267-7956

Contact your local FAA Flight Standards District Office's Safety Program Manager for more safety information.

U.S. Department of Transportation
Federal Aviation Administration
Washington DC

About This Series

The purpose of this series of Federal Aviation Administration (FAA) Aviation Safety Program publications is to provide the aviation community with safety information that is informative, handy and easy to review. Many of the publications in this series summarize material published in various audio-visual products produced by the FAA and used in its Aviation Safety Program.

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